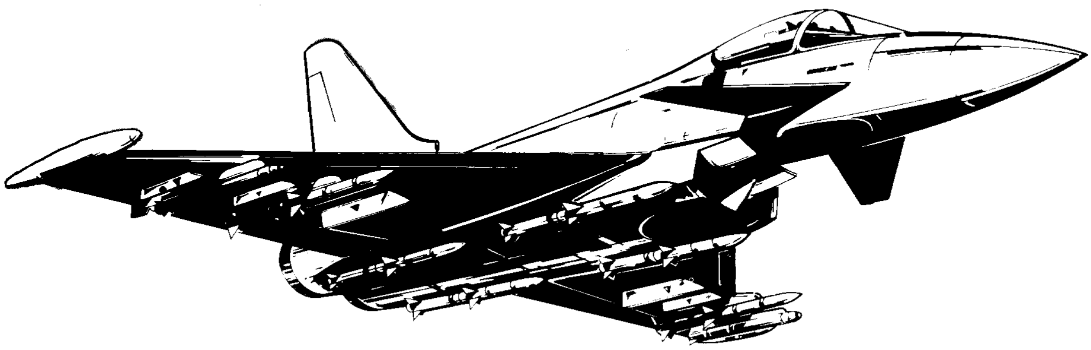
FLIGHT MANUAL

C.16

AIRCRAFT



AVIONICS SYSTEM

The technical content of this manual has been vetted through the Quality Assurance Procedures required by the Technical Publications Generating Plan PL-J-0-E-0076.

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NOTICE	THIS PUBLICATION SUPERSEDES THE 1B-B/FMASP-15

31 MARCH 2004
CHANGE 2 - 31 MARCH 2005

LIST OF EFFECTIVE PAGES

Dates for Issue for Original and Changed Pages are:

Original	0	31 March 2004
Change	1	3 January 2005
Change	2	31 March 2005

PAGE No.			*CHANGE/REV	PAGE No.			*CHANGE/REV
A (List of Effective Pages)			2	I-02-01	thru	I-02-68	0
B	thru	U	1	I-03-01	thru	I-03-160	2
				I-04-01	thru	I-04-48	1
				I-05-01	thru	I-05-12	1
TO-I-01	thru	TO-I-08	2	I-06-01	thru	I-06-22	0
I-01-01	thru	I-01-14	1	AI-01	thru	AI-04	0

* A zero in this column shows the first issue of the page

NOTES TO USERS

SCOPE

The Flight Manual contains the necessary information for safe operation of the EF2000 aircraft. The instructions provide you with a general knowledge of the aircraft stores, weapons, characteristics and specific normal and emergency operating procedures. Your experience is recognized, therefore basic flight principles are avoided.

PERMISSIBLE OPERATIONS

The Flight manual takes a "positive approach" and normally states only what you can do. Unusual operations or configurations are prohibited unless specifically covered herein. Clearance must be obtained before any questionable operation is attempted, which is not specifically permitted in this manual.

APPLICABILITY OF THIS MANUAL

Information contained in this manual is applicable to EF2000 production aircraft Batch 1 and Batch 2.

ASSOCIATED MANUALS

The following publications are complementary:

1C-16-1-1	Flight Manual - Description and Operation
1C-16-1-2	Flight Manual - Flight Characteristics and Procedures
1C-16-1-3	Flight Manual - Performance Data
1C-16-1-4	Flight Manual - Avionics System
1C-16-1-5	Flight Manual - Weapon Firing / Delivery
1C-16-1-6	Flight Manual - Confidential Data
1C-16-1CL-1	Flight Crew Checklist

MANUAL STRUCTURE

The manual is divided into SECTIONS. Each section is divided into CHAPTERS. The chapters contain the entire information relevant to a specific aircraft system, e.g. Hydraulic System, or to a specific Phase of Flight (PoF), e.g. Preparation for Flight.

Triplex page numbering is being introduced to identify each page, i.e. Section-Chapter-Page. Therefore, the first page of the first Chapter of Section I is annotated I-01-01, while the assumed last page of this Chapter reads I-01-08. Similarly the first and last page of the third Chapter of Section II would be annotated II-03-01, II-03-06 (assumed last page). Illustrations and tables are following the same rules, i.e. Section-Chapter-Figure or Section-Chapter-Table number.

This manual constitutes a compilation of aircrew relevant material which has been produced in modular form (Data Modules) on a workshare basis by the responsible SDR Tech Pubs department.

IN-LINE APPLICABILITY DEFINITIONS

The in-line applicability is used for specific text areas or figures. The following applicability entries are used within this manual to identify those EF2000 aircraft to which the information is applicable:

Single	Information is applicable for all single seat series production aircraft.
Twin	Information is applicable for all twin seat series production aircraft.
SS Version	Information is applicable for Spanish single seat series production aircraft only
ST Version	Information is applicable for Spanish twin seat series production aircraft only
PSC X.X	Information is applicable for aircraft fitted with the Production System Configurartion X.X (i.e. PSC 1.2, PSC 2.0 etc)
Premod	Information is applicable for aircraft with the indicated modification not fitted
Postmod	Information is applicable for aircraft with the indicated modification fitted

The end of the applicability is indicated by the "←" symbol.

UPDATING PROCEDURES

The manual will be updated/amended in form of Urgent Changes or Routine Changes.

URGENT CHANGES

The urgent update procedures will be used to provide a quick reaction to give important information in form of:

- Interim Operational Supplement (INTOS)
- Interim Safety Supplement (INTTS)
- Regular Operational Supplement (OS)
- Regular Safety Supplement (SS)

Generally, the holder of the aircraft decides whether an INTOS or an INTSS or a regular Operational/Safety Supplement has to be generated to inform the aircrew of an operational or safety relevant subject.

Urgent changes are issued by fax, secure fax if necessary, or through the relevant distribution channels, giving instructions for the change/amendment. An INTOS/INTSS or a SS/OS may be incorporated into the next Routine Change.

INTERIM SUPPLEMENTS

Interim Supplement will be filed in sequential order in front of the manual and their existence should be documented on the page RECORD OF AMENDMENTS.

REGULAR SUPPLEMENTS

Regular supplement will be filed in sequential order in front of the manual. Their existence should be documented on the page RECORD OF AMENDMENTS.

ROUTINE CHANGES

Routine Changes are issued at certain intervals or as necessary.

A Routine Change will consist of a change instruction page and amendment pages in form of complete Chapters. Changes/amendments to a Chapter will always completely replace the affected Chapter. The change instruction page will have the word CHANGE (including the sequential change number) and the change issue date.

A revised List of Effective Pages is issued with each change. The manual title page is reissued with each change and carries the sequential change number and change date (i.e. CHANGE 1-15 JUNE 2004) and the relevant basic issue date (i.e. 30 MARCH 2004) at the left lower bottom.

CHANGE SYMBOL

New or amended matter of technical importance in the data modules is shown with a vertical bar in the outer margin of the Page. Change symbols of a previous issue of the data modules are removed. Changes to illustrations are indicated by a note, located under the figure number/title, giving the reason for the change.

WARNINGS, CAUTIONS, NOTES

WARNING

Operating procedure, technique, etc., which could result in personal injury or loss of life if not carefully followed.

CAUTION

Operating procedure, technique, etc., which could result in damage to equipment if not carefully followed.

NOTE

An operating procedure, technique, etc., which is considered essential to emphasize.

"MUST", "SHALL", "WILL", "SHOULD", AND "MAY"

The words "must, "shall" or "will" shall be used to express a mandatory requirement. The word "should" shall be used to express non mandatory provisions. The word "may" shall be used to express permissiveness.

YOUR RESPONSIBILITY

Every effort is made to keep this manual up-to-date. However, we cannot correct an error unless we know about its existence. In this regard, it is essential that you do your part. Any questions, corrections or additions should be submitted.

CORRECTIONS AND RECOMMENDATIONS

Any comments and suggestions to correct or improve the information in this manual should be submitted to:

Oficial Coordinador de los Manuales Operativos/Tacticos del EF-2000.

RECORD OF AMENDMENTS

RECORD OF INCORPORATED OR DELETED SAFETY AND/OR OPERATION SUPPLEMENTS

The following table records supplements deleted or incorporated into this manual since the preceding revision or change.

Type and No. of Supplement	Date of Issue	Short Title	Remarks

RECORD OF SUPPLEMENTS NOT INCORPORATED

The following table records supplements not yet incorporated into this manual. Interim supplements are recorded here as well.

Type and No. of Supplement	Date of Issue	Short Title	Remarks

LIST OF ABBREVIATIONS

STANDARD EUROFIGHTER ABBREVIATIONS INDEX

A

A	Amperes
A&I	Attack and Identification
A-L	Approach and Landing
a.m.	above mentioned
A/A	Air to Air
A/B	Airborne
A/C	Aircraft
A/D	Analog / Digital or Analog to Digital
A/F	Airfield
A/F	Airframe
A/F	Across Flats
A/G	Air to Ground
A/R	As Required
A/S	Air to Surface
A/V	Air Vehicle
AA	Avionics & Armament
AAA	Anti Aircraft Artillery
AAAM	Advanced Air to Air Missile
AAIM	Aircraft Autonomous Integrity Monitoring
AAM	Air to Air Missile
AAM	Autopilot Attack Mode
AAMMU	Airborne Advanced Message Monitoring Unit
AAOR	Air to Air Override
AAR	Air to Air Refuelling
AAV	AMRAAM Air Vehicle
AAVI	AMRAAM Air Vehicle Instrumented
AAW	Air to Air Warfare
AB	Air Base
AB	Air Brake
AB	Afterburner
ABAS	Aircraft Body Axis System
ABCP	Afterburner Centrifugal Pump
ABFCU	Afterburner Fuel Control Unit
ABFMU	Afterburner Fuel Metering Unit
AC	Attack Computer
AC	Armament Carriage
AC	Alternating Current
AC-GCU	AC Generator Control Unit
ACA	Agile Combat Aircraft
ACAC	Air Cooled Air Cooler
ACC	Accumulator
ACC	Automatic Code Change
ACCIP	Advanced Continuously Computed Impact Point
ACCS	Air Command Control System
ACDD	Attitude Climb-Dive Display
ACE	Armament Control Element
ACES	Advanced Concept Ejection Seat
ACFAM	Attitude Coupled Fuselage Aiming Mode
ACFC	Air-Cooled Fuel Cooler
ACIS	Armament Carriage and Installation System
ACL	Anti-Collision Lights
ACM	Air Combat Mode
ACM	Acquisition Mode
ACM	Air Combat Maneuvers
ACMI	Air Combat Mission Instrumentation
ACMI	Air Combat Manoeuvring Instrumentation

ACNEDAS	Aircraft Carried Normal Earth Directed AxisSystem
ACO	Airspace Co-ordination Order
ACOC	Air-Cooled Oil Cooler
ACP	Allied Communication Procedure
ACQ	Acquire
ACR	Active Cockpit Rig
ACRW	Aircrew
ACS	ADA Compilation System
ACS	Armament Control System
ACT	Air Combat Training
ACU	Actuator Control Unit
ACUE	Autocue
ACVMS	Aircraft Crypto Variable Management System
ACVMU	Aircraft Crypto Variable Management Unit
AD	Air Defence
ADA	Airborne Data Acquisition
ADA	[High Order Language for Operational Software] / Product Name
ADAS	Airborne Data Acquisition System
ADASS	Advanced Data Acquisition Simulation System
ADB	Avionic Data Bus
ADC	Air Data Computer
ADCU	Air Data Conversion Unit
ADD	Airstream Direction Detectors
ADF	Automatic Direction Finding
ADGE	Air Defence Ground Environment
ADL	Automatic Data Link
ADP	Air Data Probes
ADR	Accident Data Recorder (see CSMU)
ADS	Air Data System
ADS	Aerodynamic Data Set
ADT	Air Data Transducer
ADU	Air Data Unit
ADU	Automatic Deployment Unit
ADV	Air Defence Variant
AEA	Aircrew Equipment Assembly
AFC	Automatic Frequency Control
AFCS	Air Flow Control System
AFCV	Air Flow Control Valve
AFD	Attack Flight Director
AFDS	Automatic Flight Director System
AFDS	Autonomous Freeflight Dispenser System
AFR	Air Fuel Ratio
AFV	Armoured Fighting Vehicle
AG	Attention Getter
AGC	Automatic Gain Control
AGL	Above Ground Level
AGM	Air to Ground Missile
AGR	Air to Ground Ranging
AGS	Anti-G Suit
AGTS	Armament Ground Test Switch
AGV	Anti G-Valve
Ah	Ampere hour
AHDERU	Advanced Heavy Duty Ejector Release Unit
AI	Attack and Ident
AI	Attitude Indicator
AIC	Air Intake Casing
AIC	Air Intake Control
AICA	Air Intake Control Actuator
AICS	Air Intake Control System
AIM	Air Intercept Missile
AIM-9L	Air Intercept Missile - 9L (Sidewinder)
AIPT	Air Intake Pressure Transducer
AIS	Armament Integration System
AISS	Attack and Identification Subsystem
AIU	Airborne Interface Unit
AIU	Aircraft Instrumentation Unit
AJ	Anti-Jamming
AL	Aluminium
AL-Li	Aluminium-Lithium
ALARM	Air-Launched Anti-Radiation Missile
ALDERU	Advanced Light Duty Ejector Release Unit
ALF	Ambient Lighting Facility
ALG	Algorithms

ALIU	Automatic Liferaft Inflation Unit
ALK	Alterable Legend Keys
ALPHA	Angle of Attack
ALT	Altimeter / Altitude / Alteration
AM	Amplitude Modulation
AMB	Ambient
AMC	Actuator Movement Checks
AMLCD	Active Matrix Liquid Crystal Display
AMMO	Ammunition
AMMU	Advanced Measurement Monitoring Unit
AMP	Ampere
AMPA	Advanced Mission Planning Aid
AMRAAM	Advanced Medium Range Air to Air Missile
AMSL	Above Mean Sea Level
AMSU	Aircraft Motion Sensor Unit
AMT	Automatic Mask Tensioning
AMT	Accelerated Mission Testing
AN	Activity Number
ANLG	Analog
ANMC	Actuator Non-Movement Checks
ANVIS	Advanced Night Vision Intensifier Spectacles
AoA	Angle of Attack
AoB	Angle of Bank
AOB	Auxiliary Oxygen Bottle
AoI	Area of Interest
AOTD	Active Optical Target Detector
AP	Autopilot
APPROX	Approximate
APSP	Avionic Production Software Package
APU	Auxiliary Power Unit
APUCU	APU Control Unit
APUSOV	APU Shut-Off Valve
AQ	Acquisition
ARHC	Automatic Reheat Cancellation
ARLA	Advanced Rail Launcher
ARM	Armament
ARM	Anti-Radiation Missile
ARM/S	Anti-Radiation Missile / System
ART	Auto Roll Trim
AS	Aircraft Standards
ASBC	Armament Safety Break Contactor
ASDA	Accelerate Stop Distance Available
ASE	Allowable Steering Error
ASGTS	Armament Safety Ground Test Switch
ASI	Air Speed Indicator
ASI	Aircraft / Store Interface
ASI	Aircraft Station Interface
ASL	Azimuth Steering Line
ASLR	Automatic Low Speed Recovery
ASM	Air Switch Master
ASM	Air System Master
ASM	Air to Surface Missile
ASO	Automatic Steering Override
ASODV	Afterburner Shut-Off and Dump Valve
ASP	Aircrew Services Package
ASR	Air to Surface Ranging
ASRAAM	Advanced Short Range Air to Air Missile
Assy	Assembly
ASTA	Aircrew Synthetic Training Aids
ASU	Aerial Switch Unit
ASU	Acceleration Sensing Unit
AT	Auto Throttle
ATC	Air Traffic Control
ATC	Air Turbine Control
ATF	Advanced Tactical Fighter
ATM	Air Turbine Motor
ATMCV	Air Turbine Motor Control Valve
ATS	Air Turbine Starter
ATS	Automatic Test System
ATS/M	Air Turbine Starter/Motor
ATSMCV	Air Turbine Starting Motor Control Valve
ATT	Attitude
ATTENSONS	Attention getting Sounds
ATU	Air Data Transducer Unit
AUTOCAP	Autonomous Combat Air Patrol
AUX	Auxiliary
AV	Avionics

AVOID	Aircraft Vertical Obstruction Information Data
AVR	Automatic Voltage Regulator
AVS	Avionics System
AVS	Avionic Software
AVSOV	Avionic Shut-Off Valve
AW	All Weather
AWACS	Airborne Early Warning and Control System
AWFL	Aircraft Airworthiness Flight Limitation
AWR	Approach Warning Receiver
AWS	Angle-While-Scan
AWS	Adaptive Waveform Scheduling
AWX	All Weather (Fighter)
AZ	Azimuth

B

B&C	Biological and Chemical
BAL	Balance
BAM	Boresight Acquisition Mode
BARO	Barometric
BATT	Battery
BC	Battery Contact
BC	Bus Control (Controller)
BC	Bacteriological and Chemical
BETA	Angle of Sideslip
BFCM	Basic Flight Control Mode
BFD	Basic Flight Design
BFL	Bomb Fall Line
BICU	Bus Interface Coder Unit
BIM	Bus Interface Module
BIN	Binary
BIT	Built-In Test
BITE	Built-In Test Equipment
BLISK	Bladed Disk
BME	Basic Mass Empty
BMS	Battery Master Switch
BNG	Bombs, non-guided
BOS	Bomb ON Station
BOSS	Bomb ON Station Switch
BP	Briefing Pack
BPD	Bypass Duct
BPR	Bypass Ratio
BRD	Broad (Band Width)
BRKT	Bracket
BRT	Bright(ness)
BS	Build Standard
BSCE	Brake & Skid Control Equipment
BSD	Bulk Storage Device
BSTACQ	Boresight Acquisition
BTC	Bus-Tie Contactor
BTRU	Barostatic Time-Release Unit
BVR	Beyond Visual Range
BVRAAM	Beyond Visual Range Air to Air Missile

C

C	Chaff
C	Chemical
°C	Celsius (Degree Centigrade)
C&D	Controls and Displays
C/E	Crew Escape
C/F	Chaff and Flares
C" Bore	Counterbore
C^2	Command and Control
C^2 & I	Command Control and Information
C^3	Command, Control, Communication
C^3 & I	Command, Control, Communication and Information
CAC	Close Air Combat
CALC	Calculated
CAMU	Communication and Audio Management Unit
CAP	Combat Air Patrol
CAS	Calibrated Airspeed
CAS	Command Augmentation System
CASIM	Close Air Support Interdiction Missile
CASOM	Conventionally Armed Stand-Off Missile
CAT	Category

CATM	Captive Air Training Missile
CAU	Cold Air Unit
CBIT	Continuous Built-In Test
CBLS	Carrier Bomb Light Store
CBT	Computer Based Training
cc	Cubic Centimetre
CCDL	Computer / Compiler Data Link
CCDU	Cockpit Control and Display Unit
CCIC	Combustion Chamber Inner Casing
CCIL	Continuously Computed Impact Line
CCIP	Continuously Computed Impact Point
CCIS	Command and Control Information System
CCL	Conventional Control Law
CCOC	Combustion Chamber Outer Casing
CCPG	Chest Counter Pressure Garment
CCRP	Continuously Computed Release Point
CCw	Counter Clockwise
Cd	Cadmium plated
CDA	Climb-Dive Attitude
CDD	Climb-Dive Display
CDE	Constraint Delay
CEP	Circular Error Probability
CES	Crew Escape System
CEUC	Canopy Emergency Unlock Cylinders
CF	Centre Fuselage
CFC	Carbon Fibre Composite
CFD	Chaff and Flares Dispenser
CFG	Constant Frequency Generator
CFH	Carefree Handling
CFIT	Controlled Flight Into Terrain
CFREE	Carefree
CFW	Catastrophic Failure Warning
CG	Center of Gravity
CH	Chord Line
CHAN	Channel
CHD	Change Destination
CIC	Close In Combat
CIU	Cockpit Interface Unit
CJDPU	Canopy Jack Disconnect Piston Unit
CJGFIU	Canopy Jettison Gas Fired Initiator Unit
CJIU	Canopy Jettison Initiator Unit
CJMIU	Canopy Jettison Manual Initiator Unit
CJRM	Canopy Jettison Rocket Motors
CJS	Canopy Jettison System
CL	Control Laws
CL	Centerline
CLASS	Classification
CLP	Centre Line Pylon
CLR	Clear
cm	Centimeter
CM	Counter Measures
CMHDD	Center Multifunction Head Down Display
CMS	Configuration Management System
CMS	Command Mode Selector
COMJAM	Communication Jamming
COMMS	Communications (System)
COMSEC	Communication Security
CON-DI	Convergent / Divergent
CONF	Configuration
CP	Center of Pressure
CPCV	Cockpit Pressure Control Value
CPT	Cockpit Procedure Trainer
CPU	Central Processing Unit
CR	Crash Recorder (see CSMU)
CRM	Canopy Rocket Motors
CRT	Cathode Ray Tube
CRYP SEL	Cryptovariable Selection
CSCP	C-Scope
CSD	Constant Speed Drive
CSDU	Constant Speed Drive Unit
CSG	Constant Speed Generator
CSG	Computer Symbol Generator
CSMU	Crash Survivable Memory Unit
CSU	Central Station Unit

CSU	Central Suppression Unit
CSV	Cabin Safety Valve
CT	Cockpit Trainer
CT/IPS-E	Cockpit Trainer / Interactive Pilot Station Enhanced
CT/IPS	Cockpit Trainer / Interactive Pilot Station
CTA	Current Transformer Assembly
CTC	Cabin Temperature Control
CTCV	Cabin Temperature Control Valve
CTL	Cutter Trace Line
CTR	Center
CTRL	Control
Cu	Copper
CU	Control Unit
CV	Control Valve
CVSD	Continuously Variable Slope Delta
Cw	Clockwise
CW	Continuous Wave
CW	Chemical Warfare
CWI	CW Illuminator
CWP	Center Wing Pylon
CWY	Clearway

D

D of A	Direction of Arrival (Vector)
D&C	Displays and Controls
D/A	Digital to Analog
DA	Defensive Aids
DAC	Defensive Aids Computer
DAC	Digital-to-Analog Converter
DAS	Displayed Airspeed
DASS	Defensive Aids Subsystem
dB	Decibel
DBF	De-Briefing Facility
DBGS	Data Base Generation System
DBHM	Data Bus Health Monitoring
DBMC	Data Bus Monitor and Controller
DBS	Doppler Beam Sharpening
DC	Direct Current
DCLT	De-clutter
DDL	Direct Data Link
DDM	Direct Drive Motor
DDV	Direct Drive Valve
DECU	Digital Engine Control Unit
Deg	Degrees
DEK	Digital Entry Keyboard
Del	Delete
DEP	Design Eye Position
Dest	Destination
DF	Direction Finding
DFLT	Default
DI	Drag Index
DI/O	Discrete Input / Output
DIS	Drag Index System
DME	Distance Measuring Equipment
DME-P	Distance Measuring Equipment-Precision
DMG	Digital Map Generator
DoA	Direction of Arrival
DP	Design Point
DRF	Disorientation Recovery Facility
DTL	Designated Target List
DTP	Detection Processor (Board - FLIR)
DU	Distribution Unit
DU	Duration
DVI/O	Direct Voice Input / Output
DVO	Direct Voice Output
DWP	Destination Waypoint
DWP	Dedicated Warning Panel
DYN	Dynamic

E

E	East
E/O	Electro / Optical
EAS	Equivalent Air Speed
ECS	Engine Control System
ECS	Engine Cowling System
ECS	Environmental Control System
ECU	Engine Control Unit
EDDI	Electronic Direct Digital Interface
EDV	Electrical Depressurization Valve

EED	Electro Explosive Device
EEPROM	Electrically Erasable Programmable Read Only Memory
EF	Eurofighter GmbH
EF 2000	Eurofighter 2000
EFA bus	Eurofighter Fiber Optic Data bus
EFH	Engine Flight Hours
e.g.	Exempli gratia (for example)
EGT	Exhaust Gas Temperature
EHSV	Electro Hydraulic Servo Valve
EJ	Emergency Jettison
EJ	Eurojet Turbo GmbH
EJB	Emergency Jettison Button
EL	Elevation
ELEC	Electrical
ELINT	Electronic Intelligence
EM	Electromagnetic
EMC	Electro-Magnetic Compatibility
EMCON	Emission Control
EMGY	Emergency
EMP	Electro Magnetic Pulse
EMU	Engine Monitoring Unit
ENG	Engine
ENSS	European Navigation Satellite System
ENT	Enter
EO	Emergency Oxygen
EOC	Enhanced Operational Capability
EOS	Emergency Oxygen Supply
EPG	Electrical Power Generation
EPGS	Electrical Power Generation System
EPM	Electronic Protection Measures
EPROM	Erasable Programmable Read Only Memory
ERA	Emergency Ram Air
ERAV	Emergency Ram Air Valve
ERHC	Emergency Reheat Cancellation
ERP	Eye Reference Point
ERU	Ejection Release Unit
ESJ	Escort Jammers
ESLW	External Store Light Weight
ESM	Electronic Support Measures
ESP	Electronic Stability Programme
ESS	Engineering Support System
Est	Estimated
ESV	Emergency Spool Value
ESV	Emergency Spill Valve
etc.	Et cetera (and others, and so forth)
ETC	Environmental Temperature Control
ETD	Electronic Transfer Device
ETI	Elapsed Time Indicator
ETR	Elapsed Time Recorder
ETTC	Estimated Time to Completion
EW	Early Warning
EW	Electronic Warfare
EXL	External Lighting
EXT	External

F

°F	Fahrenheit (Degrees)
F	Fuselage
F	Flare
F/..	Front
F/P	Foreplane
FA	Frequency Agility
FAM	Frequency Agility Mode(s)
FAR	Fuel Air Ratio
FBI	Frequency and Bias Input Facility
FBS	Full Back Stick
FCAGT	Full Coverage Anti-g Trousers
FCC	Flight Control Computer
FCC	Flight Crew Checklist
FCL	Flight Control Laws
FCN	Flight Clearance Note
FCOC	Fuel Cooled Oil Cooler
FCP	Flight Controls Pressure
FCS	Flight Control System
FCSHU	Flight Control System and Hydraulic Utility
FCSM	Flight Control System Mode
FCSU	Flight Control System Unit
FD	Flight Director

FF	Fuel Flow
FF	Front Fuselage
FFS	Full Forward Stick
FH	Flight Hour
FH	Frequency Hopping
FID	Flame Ionization Detector
FIG	Figure
FL	Flight Level
FLC	First Line Check
FLIR	Forward Looking Infra Red
FLT OPs	Flight Operations
FLT	Flight
FLT CONT	Flight Control
FM	Flight Manual
FM	Frequency Modulation
FMDZ	Forward Missile Deployment Zone
FMS	Fuel Management System
FMS	Full Mission Simulator
FMU	Fuel Metering Unit
FO	Fibre Optic
FOC	Final / Full Operational Clearance
FOD	Foreign Object Damage
FoM	Figure of Merit
FoV	Field of View
FP	Fuel Probe
FPD	Flat Panel Display
FPL	Foreplane
FPM	Feet per Minute
FPU	Filter Package Unit
FR	Flight Refuelling
FRC	Flight Reference Card(s) (Checklist)
FREQ	Frequency
FRP	Flight Refuelling Probe
FRS	Flight Resident Software
FS	Flight Safety
FSOV	Fuel Shut-Off Valve
FSP	First Stage Pump
FSU	Fuselage Station Unit
FT / ft	Feet / Foot
FTT	Fixed Target Track
Fwd	Forward

G

G	Gun
g	Gram
g	Acceleration of Gravity
G-LOC	G-induced Loss of Consciousness
G/A	Ground-Air
GBX	Gear Box
GB	Guided Bomb
GBU	Guided Bomb Unit
GC	Generator Contact
GCA	Ground Controlled Approach
GCCU	Ground Crew Connector Unit
GCI	Ground Controlled Intercept
GCJB	Gun Control Junction Box
GCR	Ground Crew
GCS	Guidance Control Section
GCU	Generator Control Unit
GDF	Ground Debriefing Facility
GEOREF	Geographic Reference
GEU	Gun Electronic Unit
GFE	Government Furnished Equipment
GHZ	Gigahertz
GIC	GPS Integrity Channel
GLU	Ground Loading Unit
GM	Ground Mapping
GMT	Greenwich Mean Time
GMTI	Ground Moving Target Identification (Indicator)
GMTT	Ground Moving Target Track
GND	Ground
GNSS	Global Navigation Satellite System
GNSSP	Global Navigation Satellite System Panel
GP	General Purpose
GPC	Ground Power Connector
GPS	Global Positioning System
GPSU	Global Position System Unit
GPU	Ground Power Unit

GPWS	Ground Proximity Warning System
GRD	Guard Receiver
GREF	Geographic Reference (System)
GS	Ground Speed
GSE	Ground Support Equipment
GSF	Ground Support Facility
GSI	Gun Safety Interlock
GSS	Ground Support System
GTE	Ground Test Equipment
GU	Guard UHF
GUH	Get-U-Home
GUI	Graphical User Interface
GV	Guard VHF
GW	Guided Weapon

H

h	hour
H	Height
H/W	Hardware
HACQ	HUD Acquisition
HAoA	High Angle of Attack
HARM	High Speed Anti-Radiation Missile
HAVQ	Have Quick
HB	High Band
HDD	Head Down Display
HDERU	Heavy Duty Ejection Release Unit
HDG	Heading
HDH	Head Down HUD
HDHUD	Head Down / Head Up Display
HDLG	Handling
HEA	Head Equipment Assembly
HEAPU	Head Equipment Assembly Processor Unit
HEIU	High Energy Ignition Unit
HERO	High Energy Radiation Output
HERO	Hazard of Electromagnetic Radiation
Hex	Hexagon
hex	hexadecimal
HF	High Frequency
HFD	Horizontal Fuselage Datum
HI	Heading Indicator
HI-LO-HI	High-Low-High
HiPPAG	High Pressure Pure Air Generator
HIRTAS	High Intensity Radio Transmitters
HISL	High Intensity Strobe Light
HL	High Level
HMD	Helmet Mounted Display
HMS	Helmet Mounted Sight
HMS/D	Helmet Mounted Sight / Designator
HMSS	Helmet Mounted Sight
HOTAS	Hands On Throttle and Stick
HP	High Pressure
HP	Hydraulic Pump
Hp	Barometric Altitude
HPC	High Pressure Compressor
HPGU	Hydraulic Pressure Generator Unit
HPRU	Harness Power Retraction Unit
HPS	Helmet Positioning System
HPT	High Pressure Turbine
HR	Hour
HR	High Resolution
HRM	High Resolution Map / Mapping
HSI	Horizontal Situation Indicator
HTC	High Pressure Turbine Casing
HUD	Head-Up Display
HUDCP	HUD Control Panel
HUDACQ	Head Up Display Acquisition
HUDLS	Head Up Display Light Sensors
HUDR	Head Up Display Repeater
HUP	Head Up Panel
HVPS	High Voltage Power Supply
HYD	Hydraulic
Hz	Hertz

I

I/O	Input / Output (GE)
IAS	Indicated Air Speed
iaw	in accordance with
IB	Inboard
IBIT	Initiated BIT

IC	Integrated Circuit
ICAO	International Civil Aviation Organization
ICO	Instinctive Cut-Out
ICU	Interface Control Unit
ID	Identification/Identity
IDENT	Identification
IDG	Integrated Drive Generator
IF	Instrument Flying
IFBIT	In-Flight BIT
IFF	Identification Friend / Foe
IFR	Instrument Flight Rules
IFRP	In-Flight Refuelling Probe
IFU	Interface Unit
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
IMRS	Integrated Monitoring and Recording System
IMU	Inertial Measuring Unit
IMV	Instrumented Measurement Vehicle
IN	Inertial Navigation
INFO	Information
INS	Inertial Navigation System
INT	Interrogator
INT	Internal
INTCP	Intercept
INTER	Intermediate
IntOS	Interim Operational Supplement
INTRG	Interrogate
INTSCT	Intersection
IntSS	Interim Safety Supplement
INU	Inertial Navigation Unit
IOC	Initial Operational Clearance
IOC	Initial Operational Capability
IOS	Instructor Operator Station
IP	Initial Point
IPU	Interface Processor Unit
IR	Infra Red
IRCM	Infra Red Counter Measure
IRCCM	Infra Red Counter-Counter Measure
IRS	Infra Red Signature
IRST	Infra Red Search and Track
IRU	Inertial Reference Unit
ISA	International Standard Atmosphere
ISO	International Standards Organization
ISOL	Isolation Valve
Iss	Issue
ISU	Inboard Station Unit
ITR	Instantaneous Turn Rate
ITSP	Integrated Tip Stub Pylon
ITSPL	Integrated Tip Stub Pylon Launcher
ITSU	Integrated Tip Station Unit
ITV	Integrated Test Vehicle
IWP	Inboard Wing Pylon
IWSSS	International Weapon System Support System

J

JAM	Jamming
JDAM	Joint Direct Attack Munition
JEM	Jet Engine Modulation
JETT	Jettison
JFS	Jet Fuel Starter
JP	Jet Pipe
JS	Jam to Signal
JTIDS	Joint Tactical Information Distribution System

K

K	Degrees Kelvin
KB	Kilobyte (1024 Bytes)
kbs	kilobits per second
KCAS	Knots Calibrated Air Speed
KDAS	Knots Display Air Speed
KEAS	Knots Equivalent Air Speed
KFT	Thousands of Feet
kg	Kilogram
Khz	Kilohertz
KIAS	Knots Indicated Air Speed

km	Kilometer
kN	Kilo Newton
KoD	Key of Day
KPa	Kilo Pascal
KR	Kinematic Ranging
kt	Knot(s)
kVA	Kilo Volt Ampere
KW	Kilo Watts
kWs	Kilo Watt second

L

LAAD	Landing Aid
LAB	Linked Ammunition Box
LAN	Local Area Network
LAS	Late Arm Switch
LAU	Launcher Air Unit
LB	Low Band
lbs	Pounds
LC	Lightning Controller
LCA	Launcher Carrying Adapter
LCD	Liquid Crystal Display
LCGS	Liquid Conditioning Generation System
LCN	Load Classification Number
LCS	Liquid Cooled Suit
LCS	Liquid Conditioning System
LCV	Liquid Cooling Vest
LCV	Liquid Conditioned Vest
LCWL	Left Air Intake COWL
LD	Lift Dump
LD	Lift & Drag
LDERU	Light Duty Ejection Release Unit
LDG	Landing Gear (System)
LDP	Laser Designator Pod
LE	Leading Edge
LEAS	Leading Edge Actuation System
LED	Light Emitting Diode
LEMP	Lightning Electro-Magnetic Pulse
LES	Leading Edge System
LFC	Left Fuel Computer
LFD	Longitudinal Fuselage Datum
LFK	Lenkflugkrper
LFS	Low Flying System
LG	Landing Gear
LGB	Laser Guided Bomb
LGC	Landing Gear Computer
LGS	Left Glare Shield
LH	Left Hand
LHGS	Left Hand Glare Shield
LINS	Laser Inertial Navigation System
LL	Low Level
L/L	Latitude / Longitude
LLAB	Linkless Ammunition Box
LMG	Left Main Gear
LMHDD	Left Multifunction Head Down Display
LN	Lane
LNCH	Launch
LO	Low
LoA	List of Abbreviations (NETMA)
LOC	Location
LORAN	Long Range Navigation
LoS	Loss of Sight
LoS	Line of Sight
LOX	Liquid Oxygen
LP	Low Pressure
LPC	Low Pressure Compressor
LPI	Low Probability of Intercept
LPT	Low Pressure Turbine
LPTR	Low Pressure Turbine Rotor
LRI	Line Replaceable Item
LROL	Left Read Out Line
LRSOM	Long Range Stand-Off Missile
LRSOW	Long Range Stand-Off Weapon
LRU	Line Replaceable Unit
LS	Low Speed
LS	Life Support
LS	Lightning Strike
LSP	Locality Specific Protection
LSZ	Launch Success Zone
Ltr	Liter
LVT	Low Volume Terminal
LW	Laser Warner

LWR	Laser Warner Receiver
LQP	Left Quarter Panel

M

m	Meter
M	Mach
M/S	Meters / Second
MAC	Mean Aerodynamic Chord
MASS	Master Armament Safety Switch
MAW	Missile Approach Warning
MAWR	Missile Approach Warning Receiver
max	Maximum
MB	Megabyte (1 MB = 1024 KB = 1048576 Byte)
MBF	Mission Briefing Facility
MBS	Maximum Brake-on Speed
MDC	Miniature Detonating Cord
MDE	Manual Data Entry
MDE	Mission Data Entry
MDEF	Manual Data Entry Facility
MDEK	Manual Data Entry Key
MDF	Mission Debriefing Facility
MDLR	Mission Data Loader and Recorder
MDP	Maintenance Data Panel
MEL	Missile Ejection Launcher
MET	Meteorological
MFMU	Main Fuel Metering Unit
MFoR	Maximum Field of Regard
MFR	Mass Flow Rate
MFRL	Multi Function Rail Launcher
MHDD	Multifunction Head Down Display
Mhz	Megahertz
MIDS	Multifunctional Information and Distribution System
MIJI	Meaconing, Intrusion, Jamming and Interference
MIL	Military
MIL-SPEC	Military Specification
MIL-STD	Military Standard
min	Minimum
min	Minutes
MISC	Miscellaneous
MISREP	Mission Report
MIU	MIDS Interface Unit
MJ	Mega Joule
MK	Moding Key
ML	Mach Limit
MLAW(R)	Missile Launch Approach Warning (Receiver)
MLG	Main Landing Gear
MLS	Microwave Landing System
MLW	Missile Launch Warning
mm	millimeters
MMI	Man Machine Interface
MMV	Main Metering Valve
MNV	Main Valve
MOB	Main Operating Base
MOD	Modification
MOD KIT	Modification Kit Set
MON	Monitor
MOS	Missile On Station
MP	Medium Pressure
MP	Mission Planning
MPa	Mega Pascal
MPCP	Multi Purpose Camera Pod
MPI	MASS Position Indicator
MRAAM	Medium Range Air to Air Missile
MRL	Modular Rail Launcher
ms	milliseconds
MSD	Minimum Safe Distance
MSL	Missile
MSL	Mean Sea Level
MSOC	Molecular Sieve Oxygen Concentrator
MSOGS	Molecular Sieve Oxygen Generator System
MSOW	Medium Range Stand-Off Weapon
MSS	Mission Support System
MTI	Moving Target Indicator
MTT	Multiple Target Track
MW	Micro Wave

MW	Missile Warning
MWSL	Main Wheel Static Load

N

N	North
N	Newton
N-LoS	Non-Line of Sight
N/A	Not Applicable
N/R	Not Required
NACISC	NATO Communication and Info System
NADGE	NATO Air Defence Ground Environment
Natfit	National Fit
NATO	North Atlantic Treaty Organisation
NAV	Navigation
NAVSTAR	Navigation System with Time and Ranging
NBC	Nuclear, Biological, Chemical
NC	NATO Confidential
NC	Navigation Computer
NCI	Non-Cooperative Identification
NDB	Non Directional Bacon
NELSZ	No Escape Launch Success Zone
NEMP	Nuclear Electro-Magnetic Pulse
Netident	Network Identification Name
NF	Notch Filter
NGV	Nozzle Guide Vane
NH	Nuclear Hardening
NH	Rotor Speed High Pressure
NIS	NATO Identification System
NL	Rotor Speed Low Pressure
NLG	Nose Landing Gear
NM	Nautical Mile
NO	Number
NORM	Normal
NPR	Nozzle Pressure Ratio
NR	NATO Restricted
NRV	Non Return Valve
NRW	Narrow Band Width
NS	NATO Secret
NSCAC	Non Safety Critical Armament Controller
NSCAS	Non Safety Critical Armament System
NTH	North
NU	NATO Unclassified
NV	Night Vision
NVE	Night Vision Enhancement
NVED	Night Vision Enhancement Device
NVG	Night Vision Goggles
NVM	Non Volatile Memory
NVRAM	Non Volatile Random Access Memory
NWP	Next Way Point
NWS	Nose Wheel Steering
NX	Longitudinal Acceleration
NY	Lateral Acceleration
NZ	Normal Acceleration
NZL	Nozzle Load

O

O/B	Outboard
OAT	Outside Air Temperature
OBOGS	On-Board Oxygen Generation System
OFP	Operational Flight Programme
OGV	Outlet Guide Vane
OH	Operating Hours
OME	Operating Mass Empty
OMS	Opto-Mechanical Subassembly
ORA	Optimum Release Altitude
OSU	Outboard Station Unit
OTF	On Top Fix
OU	Outboard Station Unit
OUTBD	Outboard
OVRD	Override
OVRTMP	Over temperature
OWFS	Over Water Flying Suit
OXG	Oxygen Generation
OXR	Oxygen Regulation
Oxy	Oxygen

P

P	Pressure
PA	Pilot Awareness
PACT	Primary Actuation
PAPFC	Primary Actuation Pre-Flight Checks
PAR	Precision Approach Radar
Para	Paragraph
PB	Push-Button
PBF	Pilot Briefing Facility
PBG	Pressure Breathing Garment
PBIT	Power-Up BIT
PDM	Performance Data Manual
PDME	Precision Distance Measuring Equipment
PDS	Portable Data Store
PDU	Pylon Decoder Unit
PDU	Pilot Display Unit
PEC	Personal Equipment Connector
PETL	Previously Engaged Target List
PEU	Pylon Ejector Unit
PFC	Pre-flight Check
PFD	Primary Flight Display
PFM	Pulse Frequency Modulation
PH	Phase
PI	Point Intercept
PIF	Pilot Information Files
PIO	Pilot Identity Override
PIO	Pilot-Induced Oscillation
PK	Probability of Kill
PLB	Personal Locator Beacon
PLT	Pilot
PMDS	Portable Maintenance Data Store
PoE	Point of Embodiment
PoF	Phase of Flight
PoI	Probability of Intercept
POL	Petroleum / Oil Lubricants
POSN	Position
POT	Power Off-Take (Shaft)
PP	Present Position
PPI	Plan Position Indicator
PPI	Present Position Indicator
ppm(v)	Parts per million by volume
PPSA	Pedal Position Sensor Assembly
PPSU	Pedal Positioning Sensor Unit
PRESS	Pressure
PRF	Pulse Repetition Frequency
PRI	Pulse Repetition Interval
PROM	Programmable Read-Only Memory
PRP	Propulsion System
PRSOV	Pressure Regulator Shut-Off Valve
PRV	Pressure Regulator Valve
PS	Priority Search
PSET	Preset
PSI	Pounds per Square Inch
PSI	Project Security Instruction
PSMK	Personal / Pilot Sensor Moding Key
PSP	Personal Survival Pack
PSP	Production Software Package
PSSA	Pilots Stick Sensor Assembly
PSU	Pedal Sensor Unit
PT	Point
PTA	Priority Target Accept
PTO	Power Take-Off
PTT	Push-To-Talk
PTT	Push-To-Transmit
PTY	Priority
PVU	Position Velocity Update
PWR	Power

Q

QR	Quick Release
QRA	Quick Reaction Alert / Aircraft
QRB	Quick Release Box
QTR	Quarter
QTY	Quantity

R

R	Right
RHFMU	Re-Heat Fuel Metering System
R MAX	Range Maximum

R MIN	Range Minimum
R, r, rad	Radius
R-INBD	Right Wing Inboard Store Station
R-OUTBD	Right Wing Outboard Store Station
R/..	Rear
R/F	Rear Fuselage
R/T	Radio Transmission
RACM	Radar Air Combat Mode(s)
RAD	Radar
RAD	Radio
rad	Radian
RAD ALT	Radar Altimeter
RADAR	Radio Detection And Ranging
RAM	Random Access Memory
RAM	RADAR Absorbing Material
RAP	Relative Aiming Point
RBGM	Real Beam Ground Mapping
RCR	Runway Condition Range
RCS	Radar Cross Section
RCWL	Right Air Intake COWL
RE	Role Equipment
REC	Recovery
RECCE	Reconnaissance
REF	Reference
REL	Release
REV	Reverse
RF	Radio Frequency
RFA	Request for Alteration
RFI	Request for Information
RFI	Radio Frequency Interference
RGS	Right Glare Shield
RGU	Rate Gyro Unit
RH	Right Hand
RHAW	Radar Homing and Warning
RHGS	Right Hand Glare Shield
RHOJ	Radar Home On Jam
RHWR	Radar Homing and Warning Receiver
RMG	Right Main Gear
RMHDD	Right Multifunction Head Down Display
RMS	Root Mean Square
RNAV	Radio Navigation
RNG	Range
ROL	Read Out Lines
ROM	Read-Only Memory
RPI	Remote Position Indicator
RPM	Revolutions Per Minute
RPPS	Rudder Pedal Position Sensor
RPU	Receiver Processing Unit
RR	Rolls Royce
RROL	Right Read Out Lines
RSD	Release to Service Document
RSPS	Right Secondary Power System Computer
RSU	Rate Gyro Sensing Unit
RT	Remote Terminal
RTB	Return to Base
RTC	Real Time Clock
RTO	Rejected Take-Off
RW	Radar Warning
RWR	Radar Warning Receiver
RWS	Range-While-Scan / Search
RX	Receiver

S

s	Seconds
S/A	Surface to Air
S/S	Single Seater
S/W	Software
SACQ	Slaved Acquisition
SAF	Safety, Arming and Firing Device
SAM	Surface to Air Missile
SAR	Search and Rescue
SBY	Standby
SCAC	Safety Critical Armament Controller
SD	Steering Dot
SD	Standard Deviation
SE	Single Engine
Sec	Second (Time)
SEC	Security (Measures)
SECOPS	Security Operation Procedures
SECR	Secure

Sect	Section
SEL JET	Selective Jettison
SEP	Specific Excess Power
SEQ	Sequence (r)
SFT	Supersonic Fuel Tank
SHM	Structural Health Monitoring
SID	Standard Instrument Departure
SIM	Simulation / Simulator
SIP	Service Instructor Pilot
SIPT	Service Instructor Pilot Training
SJ	Selective Jettison
SK	Soft Key
SL	Sea Level
SMD	Surface Mounted Device
SOJ	Stand-Off Jammers
SOV	Shut-Off Valve
SOW	Stand-Off Weapon
SP	Software Package
SPA	Series Production Aircraft
SPIF	Special Pilot Information Files
SPS	Secondary Power System
SPS	Software Package System
SPSCU	Secondary Power System Control Unit
SQ OVRD	Squelch Override
SRAAM	Short Range Air to Air Missile
SRJ	Store Release and Jettison
SRSOM	Short Range Stand-Off Missile
SS	Single Seat
SS	Sideslip
SS	Subsystem
SSA	Stick Sensor Assembly
SSCU	Sensor and Signal Conditioning Unit
SSICA	Stick Sensor and Interface Control Assembly
SSICU	Stick Sensor and Interface Control Unit
SSK	Subsystem Key
SSL	Static Sea Level
SSR	Secondary Surveillance Radar
STANAG	Standardization Agreement
STBY	Standby
STC	Stick Top Controller
STD	Standard
STD	State Transition Diagram
STOL	Short Take-Off / Landing
STOVL	Short Take-Off and Vertical Landing
STR	Sustained Turn Rate
STT	Single-Target-Track
SU	Station Unit
SUM	Start Up Mass
Supplans	Support Plans
SVM	Selector Valve Manifold
SW	Software
SWL	Single Wheel Load
SWP	Set Waypoint
SWY	Stopway

T

T/O	Take-Off
T/R	Transmitter / Receiver
T/S	Twin Seater
TA	Turn Around
TA	Terrain Avoidance
TAC AA	TACAN Air to Air
TAC AS	TACAN Air to Surface
TACAN	Tactical Air Navigation
TAP	Terminal Approach Procedures
TAR	Tactical Air Reconnaissance
TAS	True Airspeed
TBD	To Be Defined / Determined
TBT	Turbine Blade Temperature
TCRI	Track Cross Reference Index / Indicator
TCV	Temperature Control Valve
TD	Towed Decoy
TD	Target Designation
TEL	Time Early / Late
TEMP	Temperature
TEMPEST	Temporary Emissions of Spurious Transmissions
TET	Turbine Exhaust Temperature

TEU	Tank Ejector Unit
TFoV	Total Field of View
TGS	Track Group Symbology
TGT	Target
TGT	Turbine Gas Temperature
TMC	Twin Missile Carrier
TN	Track Number
TN	Time Now
ToA	Time of Arrival
ToD	Time of Day
TODA	Take-Off Distance Available
ToL	Top of Lines
TOO	Target of Opportunity
TOR	Terms of Reference
TORA	Take-Off Runway Available
TOT	Take-Off-Trim
TP	Technical Publication(s)
TRK	Track
TRT	Turn-Round Time
TRU	Transformer Rectifier Unit
TS	Twin Seat
TSC	Twin Store Carrier
TSP	Tip Stub Pylon
TSU	Tip Station Unit
TTC	Throttle Top Controller
TTG	Time to Go
TTU	Triplex Transducer Unit
TWS	Track-While-Scan
TWT	Travelling Wave Tube
TX	Transmitter

U

U/C	Undercarriage
U/F	Under Fuselage
U/W	Under Wing
UCS	Utilities Control System
UHF	Ultra High Frequency
UIV	Utility Isolation Valve
US	Utility System
USRM	Under Seat Rocket Motor
USS	Undercarriage Selector Switch
UTC	Universal Time Code
UTC	Universal Time Coordinated
UTIL	Utilities
UTIL PRESS	Utilities Pressure
UTM	Universal Transversal Mercator
UV	Ultra Violet
UVEPROM	Ultraviolet Electronically Programmable Read-Only Memory
UVPROM	Ultraviolet (light erasable) Programmable Read-Only Memory

V

V	Volt
V	Velocity
V/UHF	Very / Ultra High Frequency
VA	Volt-Ampere
VACQ	Visual Acquisition
VACQM	Visual Acquisition Mode
VC	Varycowl
Vc	Velocity Closure
Vd	Diving Velocity (Speed)
VDC	Volts Direct Current
VHF	Very High Frequency (30 MHz to 300 MHz)
VIB	Vibration
VIGV	Variable Inlet Guide Vane
VISIDENT	Visual Identification
VLF	Very Low Frequency
VLV	Valve(s)
VMC	Visual Meteorological Conditions
VOL	Volume
VOR	VHF Omnidirectional Radio Range
VPRSOV	Variable Pressure Regulator Shut-Off Valve
VR	Rotation Speed
vs	versus
VS	VelocitySearch
VSI	Vertical Speed Indicator
VTAS	Voice, Throttle and Stick
VV	Velocity Vector

VVR	Video Voice Recorder
VWS	Voice Warning System

W

W	Watt
W	Warning
W/M	Writing Marker
w/o	Without
WAN	Wide Area Network
WFG	Wave Form Generator
WFoV	Wide Field of View
WG	Wing
WoD	Word of Day
WOG	Weight on Ground
WOMW	Weight on Main Wheel
WONW	Weight on Nose Wheel
WOW	Weight-on-Wheels
WOW	Weight-off-Wheels
WP	Wing Pylon
WP	Warning Panel
WP	Waypoint
WPN	Weapon
WPSU	Wing Pylon Station Unit
WPT	Waypoint
wrt	with respect to
WS	Weapon System
WSP	Weapon System Package
WTP	Wing Tip Pod
WTSP	Wing Tip Stub Pylon
WUT	Wind-Up Turn
WVR	Within Visual Range

X

XFEED	Cross-feed
XFER	Transfer
XMIT	Transmitter
XPDR	Transponder

Y

Y	Yaw (Axis)

Z

Z	Zoom

SYMBOLS AND OTHERS

°C	Celcius (Degrees)
°F	Fahrenheit (Degrees)
3-D	Three Dimensional

AVIONICS SYSTEM

DESCRIPTION AND OPERATION

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AVIONICS SYSTEM INTEGRATION

AVIONICS SYSTEM INTEGRATION

The avionics systems are integrated using multiple, dual redundant databus networks which provide system integrity after system failures and/or battle damage. Data transfer between the systems is achieved using STANAG 3838 and STANAG 3910 databus networks, video and synchronization links, and dedicated data links.

AVIONIC SYSTEMS DATABUS OPERATIONS

Each databus comprise two independent channels A and B. There are two databus controllers; primary and secondary, with the exception of the defensive aids and radar bus. Both bus controllers monitor their own and each others operation. Should the primary bus controller fail then the secondary bus controller will automatically take over control. Table I-01-01 lists the primary and secondary bus controllers for the avionic systems. The system LRI are connected via remote terminals to buses A and B. The databus controlling software is stored within the bus controllers.

The STANAG 3838 (Mil-Std 1553B) is a low speed databus, transmitting data at 1.0 MHz. The STANAG 3910 is a dual speed databus, transferring control signals on a Mil-Std 1553B bus and data at 20 MHz on a fiber optic bus. The avionics system is interconnected via the following aircraft databuses:

- STANAG 3910
  - Avionic
  - Attack
- STANAG 3838
  - Cockpit
  - Weapons
  - Defensive aids
  - Radar.

Databus	Primary Bus Controller	Secondary Bus Controller
Avionic	Navigation computer	Attack computer
Attack	Attack computer	Navigation computer
Cockpit	Cockpit Interface Unit 1 (CIU1)	Cockpit Interface Unit 2 (CIU2)
Weapons	Primary channel of the Non Safety Critical Armament Controller (NSCAC)	Secondary channel of the Non Safety Critical Armament Controller (NSCAC)
Defensive Aids	Defensive Aids Computer (DAC)	None
Radar	Radar processor	None

Table I-01-01 Avionic Systems Primary and Secondary Bus Controllers

DATABUS START-UP/RESTART

On application of power the aircraft systems and each LRI perform their own PBIT. Failures for safety critical systems detected within a LRI are indicated on the Dedicated Warning Panel (DWP). All failures are reported on the Maintenance Data Panel (MDP) and are recorded in the Portable Maintenace Data Store (PMDS). Databus operations are initiated and both the primary and secondary bus controllers check the validity of each others operation. Successful completion of PBIT by all subsystems and LRI is indicated on the ACUE format.

If a databus controller failure occurs on the ground, it may automatically be reconfigured back into the system in its prime role. This will only occur if the fault subsequently clears and the bus controller passes CBIT. If a failure occurs with a bus controller whilst airborne, it will not be reconfigured back into the system even if the fault clears. If a total power failure occurs whilst airborne, then the first bus controller on line having passed PBIT will take control of both buses (where applicable) when power is restored.

The DWP will enter the reversionary mode of operation if both of the cockpit or avionic databuses fail. If both Cockpit Interface Units (CIU) or Computer Symbol Generators (CSG) fail, refer to Warning Equipment.

SECONDARY BUS CONTROLLER LIMITATIONS

With the current software version it is possible that the secondary bus controller may not take over all the responsibilities of the primary bus controller and some functions may be lost. The consequences of bus controller failure(s) are as follows.

NAVIGATION COMPUTER FAILURE

In the event of a navigation computer failure, navigation bus control is assumed by the attack computer, resulting in the consequences that follow:

- Climb/dive angle displayed has reduced integrity
- The low height warning is lost
- Navigation and steering displays extinguished
- LINS available for flight path displays only
- TACAN mode change not available.

ATTACK COMPUTER FAILURE

In the event of an attack computer failure (including loss of AC power), attack bus control is assumed by the navigation computer, resulting in the loss of functionality as follows:
- All radar
- IFF interrogator
- Steering and priming indications.

DOUBLE CIU FAILURE

For Single seat aircraft

The results of a double CIU failure are as follows:
- The cockpit databus is disabled
- The DWP switches to reversionary mode
- The MHDD soft keys and the HUD moding are inoperative
- STOR format information is not available
- The left glareshield is not lit
- The dedicated readout panel is not lit
- Switches and controls for systems that interface via the CIU are inoperative.

⇐

For Twin seat aircraft

The results of a double CIU failure are as follows:
- The cockpit databus is disabled
- The DWP switches to reversionary mode
- The MHDD soft keys and the HUD moding are inoperative
- STOR format information is not available
- The left glareshield is not lit (front and rear cockpits)
- The dedicated readout panel is not lit (front and rear cockpits)
- Switches and controls for systems that interface via the CIU are inoperative.

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ARMAMENT CONTROL SYSTEM FAILURES

In the event of an Armament Control System (ACS) failure, the following functionalities are lost:
- Selective Jettison (SJ)
- Stores configuration data to FCS
- Missile firing
- Gun.

DATABUS ARCHITECTURE

Figure I-01-01 gives an overview of the avionics databus architecture. The avionic system comprise the following subsystems:
- Communications (COMMS)
- Integrated Monitoring and Recording Subsystem (IMRS)
- Navigation (NAV)
- Display and Controls (D&C)
- Attack and Identification (A&I)
- Defensive Aids Subsystem (DASS)
- Armament Control Subsystem (ACS).

COMMUNICATIONS SUBSYSTEM

The communications subsystem comprise:
- The Communications and Audio Management Unit (CAMU)
- V/UHF transceiver 1
- V/UHF transceiver 2
- Combined fin tip antenna
- Lower antenna.

The CAMU, VHF1 and VHF2 are interconnected by dedicated links and to the avionic bus. The connection between each LRI and databus is shown in Figure I-01-02 .

INTEGRATED MONITORING AND RECORDING SUBSYSTEM

The IMRS comprise the following LRI:
- Interface Processing Unit (IPU)
- Crash Survivable Memory Unit (CSMU)
- Sensor and Signal Conditioning Units (SSCU)
- Video/Voice Recorder (VVR)
- Mission Data Loader and Recorder (MDLR), and the Portable Data Store (PDS)
- Bulk Storage Device (BSD).

The LRI are interconnected via the avionic bus, the attack bus, the utilities control bus and dedicated links. The connections between each LRI and the databuses is shown in Figure I-01-03 .

NAVIGATION SUBSYSTEM

The navigation subsystem comprise the following LRI:
- Navigation computer
- Laser Inertial Navigation Subsystem (LINS)
- Global Positioning Subsystem (GPS)
- Radar altimeter
- Tactical Airborne Navigation (TACAN).

The LRI are interconnected via the avionic bus and dedicated links. The connections between each LRI and databus is shown in Figure I-01-04 .

DISPLAYS AND CONTROLS SUBSYSTEM

For Single seat aircraft

The displays and controls subsystem comprise the following LRI:
- HUD
- Three MHDD
- Left glareshield

- Right glareshield, including the Get-U-Home (GUH) instruments
- Two CIU
- Two CSG
- Lighting controllers
- Dedicated Warning Panel (DWP)
- Digital Map Generator (DMG)
- Stick top controllers
- Throttle top controllers
- Reversionary instruments.

⇐

For Twin seat aircraft

The displays and controls subsystem comprise the following LRI:

- HUD
- HUD video camera
- HUDR (rear cockpit)
- Six MHDD
- Left glareshield (front and rear cockpit)
- Right glareshield, including the Get-U-Home (GUH) (front and rear cockpit)
- Four CIU
- Two CSG
- Lighting controllers
- Two Dedicated Warning Panels (DWP)
- Digital Map Generator (DMG)
- Stick top controller (front and rear cockpit)
- Throttle top controller (front and rear cockpit).
- Reversionary instruments (front and rear cockpit).

⇐

The LRI are interconnected via the cockpit bus, the avionic bus, the utility control bus, video and synchronization links and dedicated links. The connections between the LRI and databuses are shown in Figure I-01-05 .

ATTACK AND IDENTIFICATION SUBSYSTEM

The attack and identification subsystem comprise:

- Radar
- Attack computer
- IFF interrogator/transponder.

The attack and identification LRI are interconnected via the attack bus, the avionic bus and dedicated links, refer to Figure I-01-06 .

DEFENSIVE AIDS SUBSYSTEM

The defensive aids subsystem comprise:

- Defensive Aids Computer (DAC)
- Chaff dispensers
- Flare dispensers.

Interconnection of the LRI is via the defensive aids bus, the attack bus and dedicated links.

ARMAMENT CONTROL SUBSYSTEM

The ACS comprise the following LRI:

- Safety Critical Armament Controller (SCAC)
- Non Safety Critical Armament Controller (NSCAC)
- Distribution Unit (DU)
- Fuselage Station Unit (FSU)
- Wing Pylon Station Unit (WPSU), one per pylon fitted to aircraft
- Two Integrated Tip Station Units (ITSU)
- Master Armament Safety Switch (MASS)
- Two Armament Safety Break Contactor (ASBC).

The ACS LRI are interconnected by the weapons bus, attack bus and by dedicated links, refer to Figure I-01-07 . The weapons audio signals are routed to the CAMU.

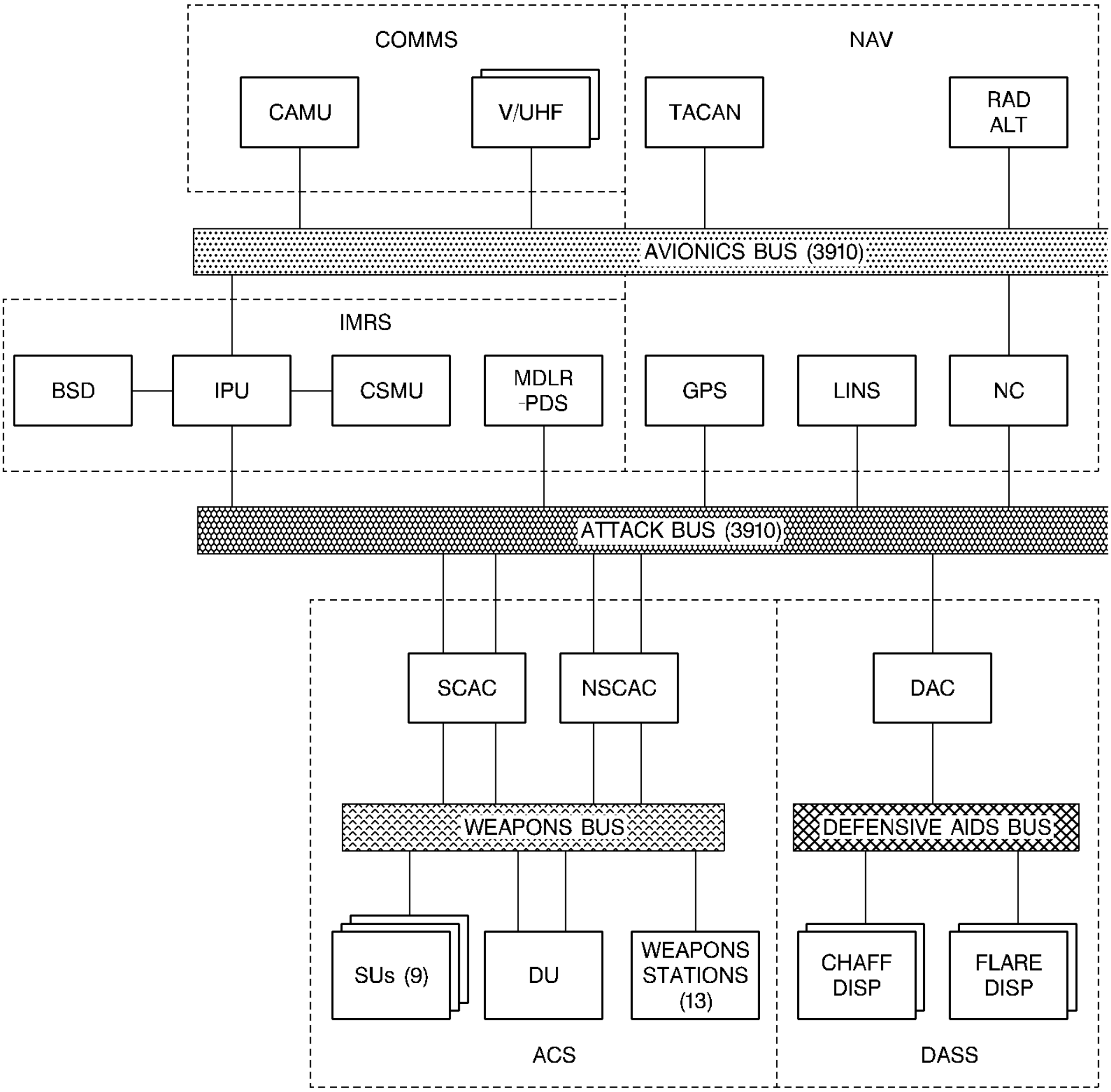

Figure I-01-01 Avionics Databus Architecture (1 of 2)

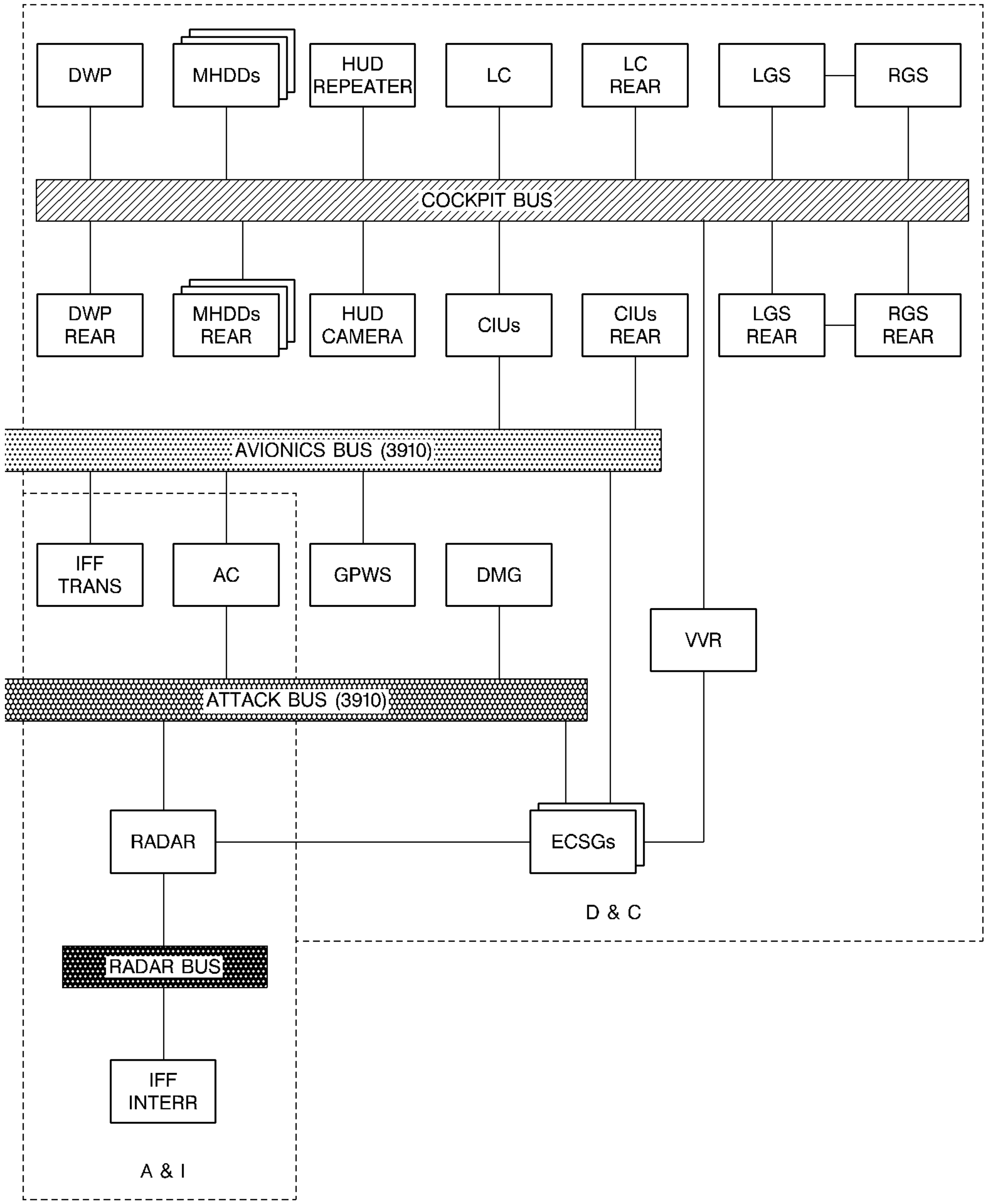

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Figure I-01-01 Avionics Databus Architecture (2 of 2)

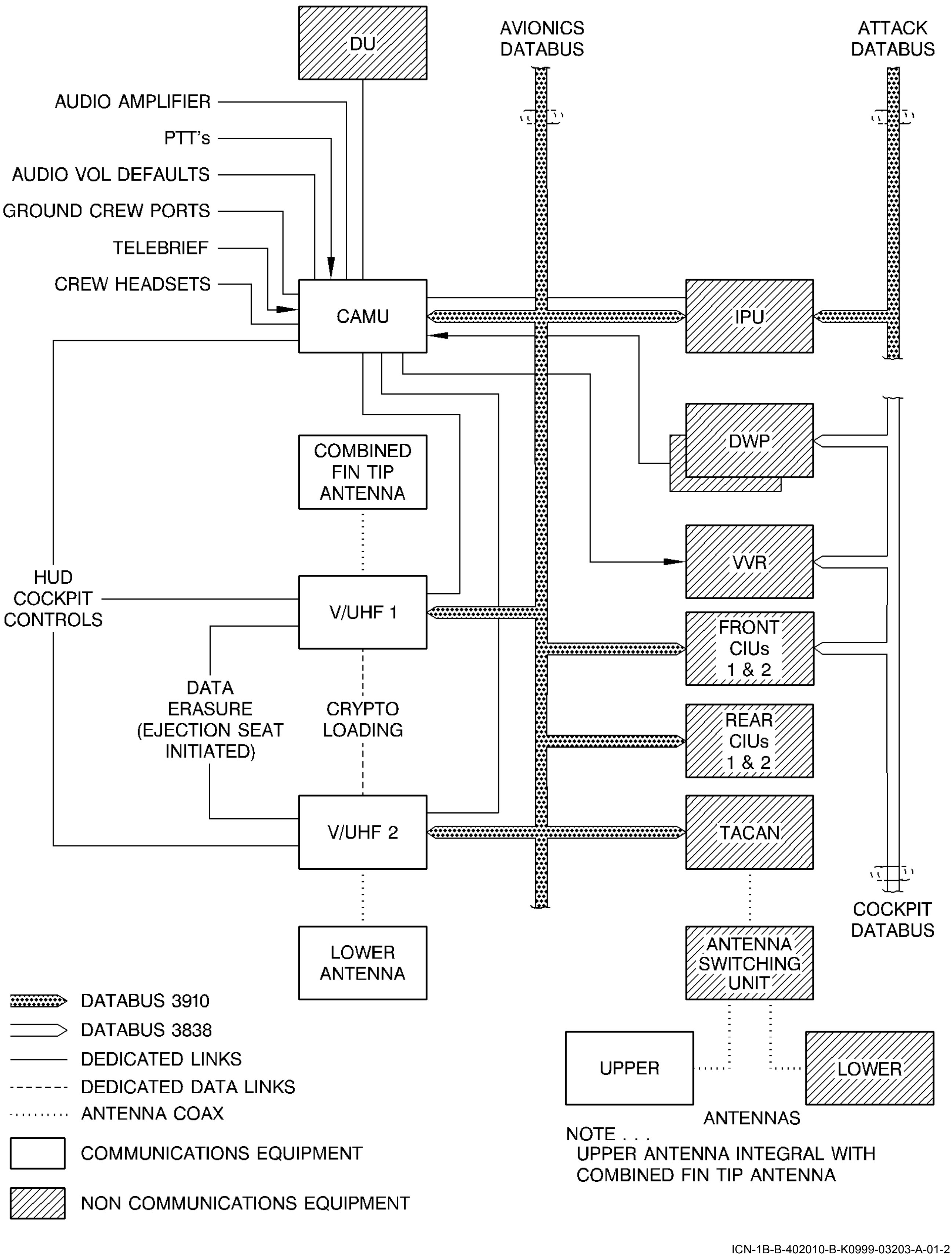

Figure I-01-02 Communications Subsystem Architecture

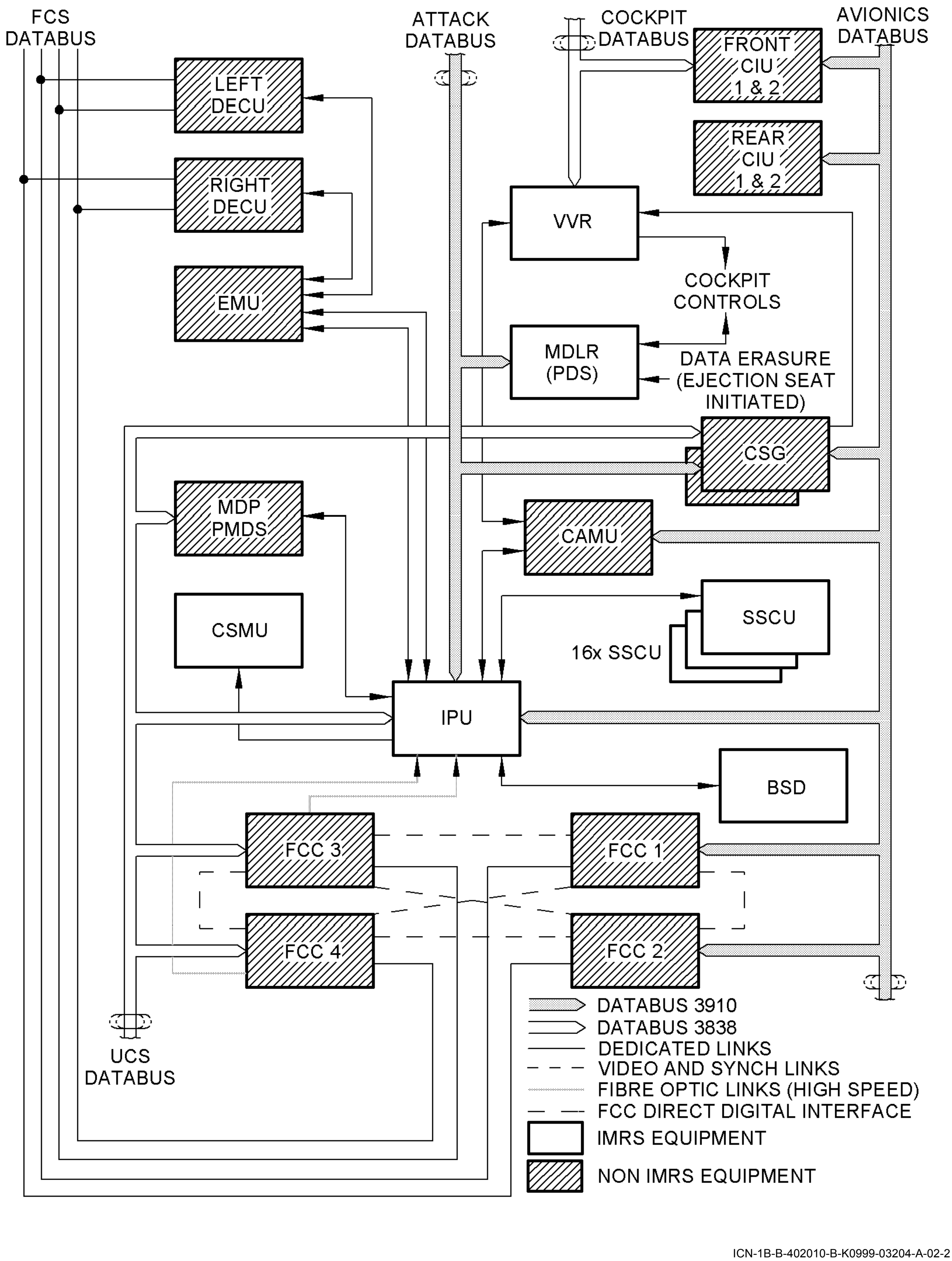

Figure I-01-03 Integrated Monitoring and Recording Subsystem Architecture

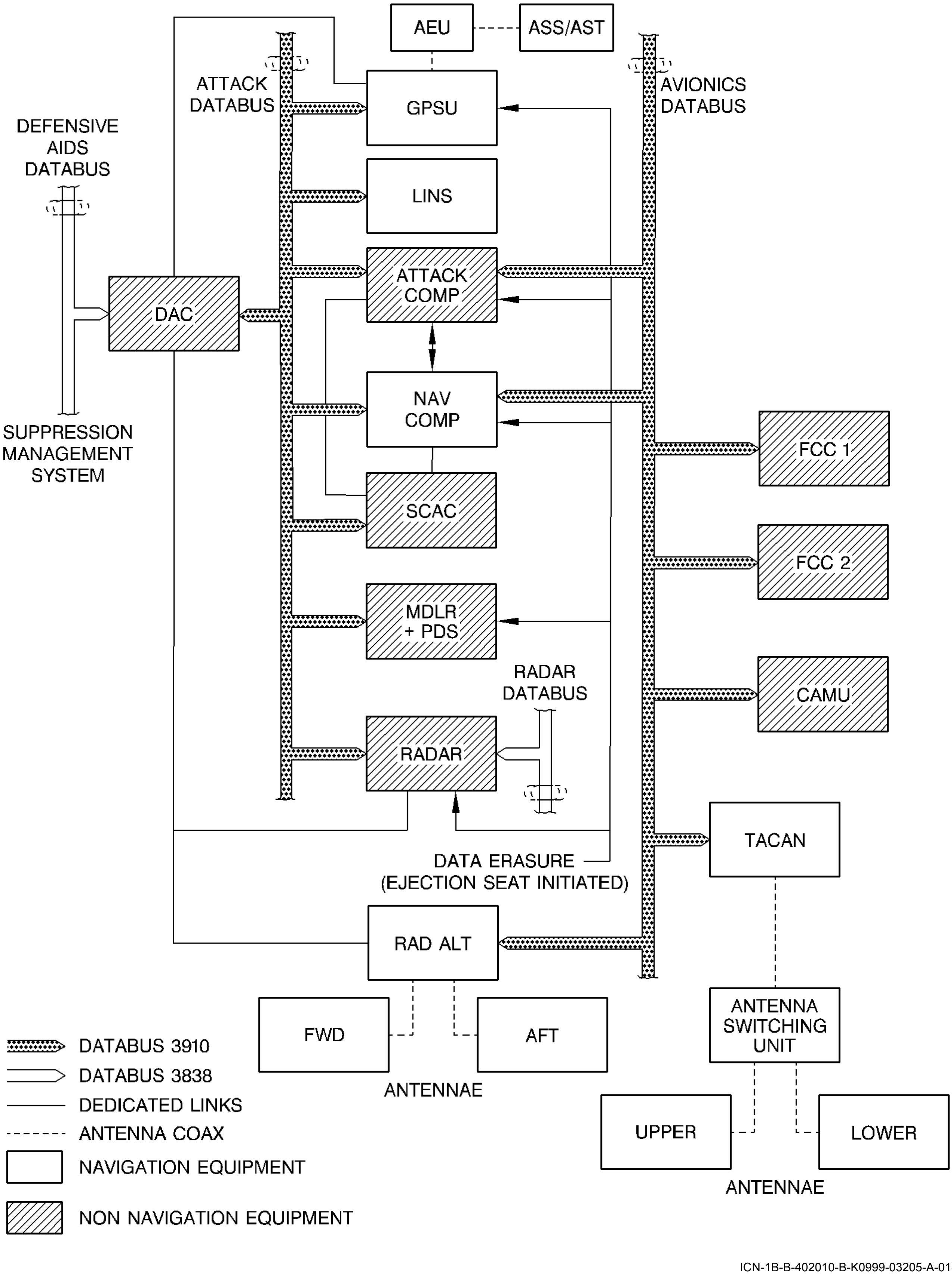

Figure I-01-04 Navigation Subsystem Architecture

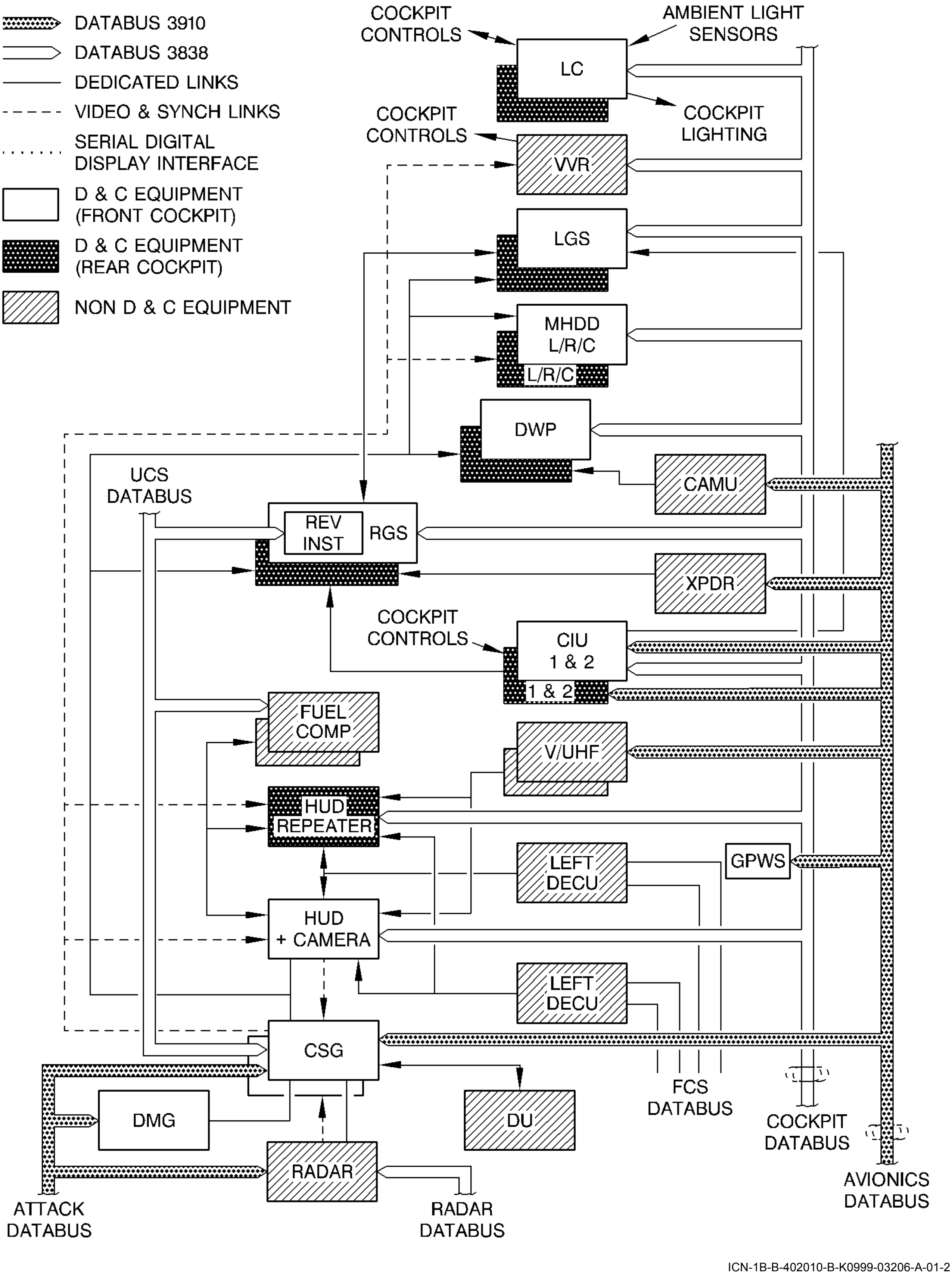

Figure I-01-05 Displays and Controls Subsystem Architecture

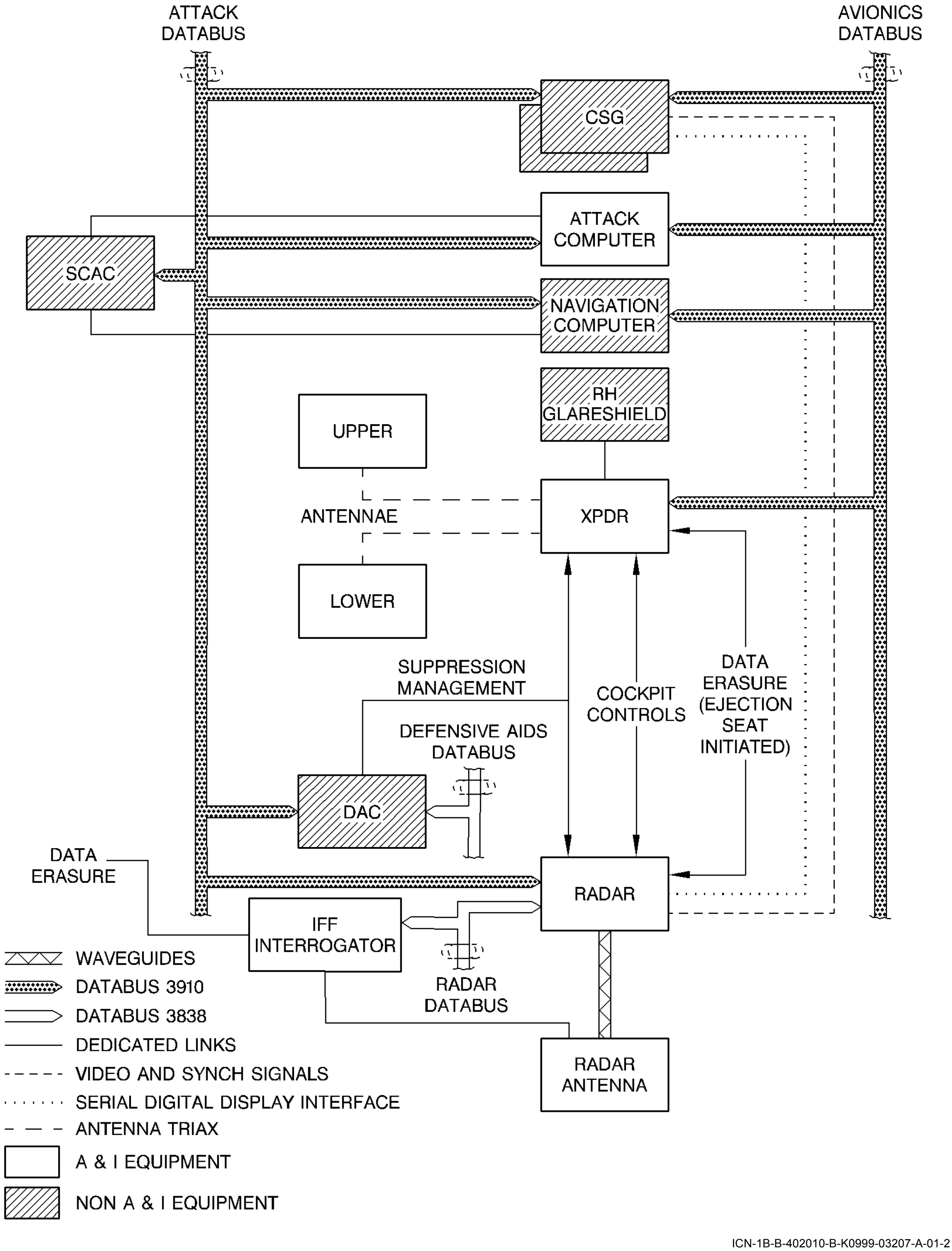

Figure I-01-06 Attack and Identification Subsystem Architecture

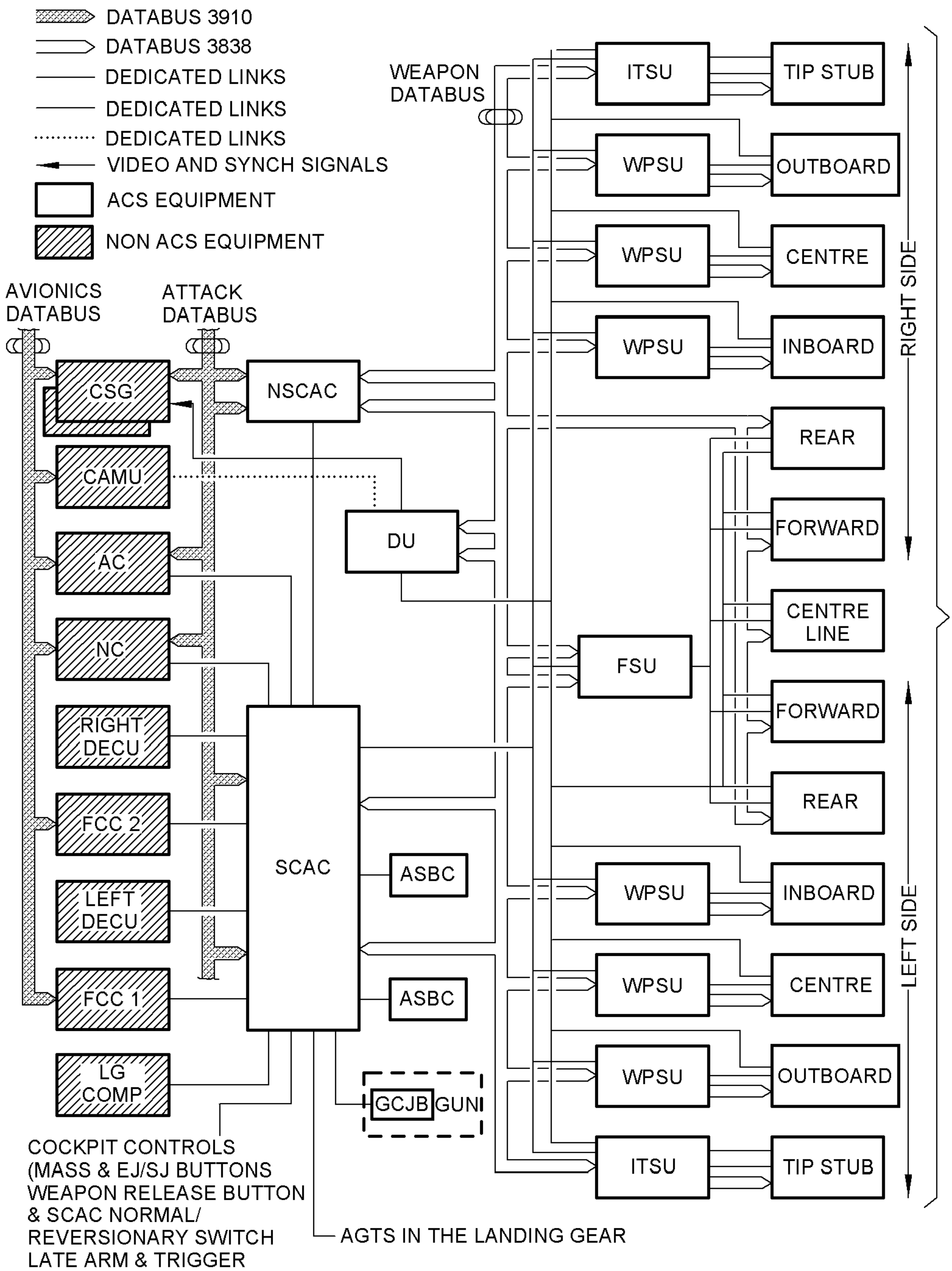

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Figure I-01-07 Armament Control Subsystem Architecture

SYSTEM SOFTWARE

Application software is loaded to the applicable Line Replaceable Item (LRI) from the Ground Loading Unit (GLU) through the Central Loading Port (CLP) and via the applicable databus.

SOFTWARE RISK CLASSES

The software risk classes are defined as Class 1, Class 2 and Class 3.

An asterisk attribute can be used with Class 2 and Class 3 software. The asterisk attribute is applied to software that would normally be of a higher classification. For example, if there is a mitigating independent function or additional factor provided for software implementing H1 or H2 functions, the software becomes Class 2 rather than the Class 1 otherwise required . The asterisk attribute does not denote a separate risk class.

CLASS 1 SOFTWARE

Class 1 software is rigorously developed and tested to provide the highest integrity. It is used for safety critical functions, i.e. those functions where a failure or fault within the software could cause a serious or even a catastrophic risk to the aircraft, pilot or to third parties.

Class 1 software is utilized for the following:
- Flight Control Computers (FCC)
- Air Data Transducer (ADT) system
- Inertial Measuring Unit (IMU)
- Stick Sensor Interface Control Assembly (SSICA)
- Safety Critical Armament Controller (SCAC)
- Emergency SCAC
- Fuselage Station Unit (FSU)
- Inboard wing pylon station unit LH
- Ejection seat controller
- Digital Engine Control Units (DECU)
- Part of the Computer Symbol Generator (CSG)
- Head-up Display (HUD)
- HUD Pilots Display Unit (PDU)
- Distance Measuring Equipment (DME)
- Microwave Landing System (MLS)
- Fuel computers
- Landing gear computer.

CLASS 2* SOFTWARE

Class 2* software is utilized for the following:
- Constant Frequency Generator (CFG) control unit
- Glareshields
- Part off the CSG
- Cockpit Interface Unit (CIU)
- Digital Map Generator (DMG)
- Multifunction Head Down Display (MHDD)
- Head Equipment Assembly (HEA) processing unit
- HEA interface unit
- Mission Data Loader and Recorder
- Interface Processor Unit (IPU)
- Enhanced Lighting Controller (ELC)
- Defensive Aids Computer (DAC)
- Auxiliary Power Unit (APU) control unit
- Laser Inertial Navigation System (LINS)
- Navigation computer
- Attack computer
- Forward Looking Infrared (FLIR)
- DC generator control unit
- Radar altimeter
- Maintenance Data Panel (MDP)
- Front Computer
- Secondary Power System (SPS) computers
- Flare dispenser
- Paramagnetic Oxygen Monitor (POM)
- Zirconia Oxygen Monitor (ZOM)
- Ice detector control unit
- Warnings panel electronic unit.

CLASS 2 SOFTWARE

Class 2 software is designed to a similar standard as Class 1 software but is tested to a less stringent standard. This software is used for functions where a failure would not result in a serious or catastrophic hazard. The only difference between the two software standards consists of some post system failure drills that are affected by the degree of safety assumed for the underlying operating software standard.

Class 2 software is utilized for the following:
- Non Safety Critical Armament Controller (NSCAC)
- Chaff dispenser
- Weapons system distribution unit
- Multi Function Rail Unit (MFRL) electronic unit
- Integrated tip station unit LH
- MIDS Interface Unit (MIU) (only a TACAN function is available through the MIU at PSP1)
- Nose Radar system
- HUD control panel
- Ground Proximity Warning System (GPWS)
- Video Voice Recorder (VVR)
- DMG processing modules/databus interface modules/mass memory module
- Communication and Audio Management Unit (CAMU)
- VHF/UHF transceiver
- Identification Friend or Foe (IFF) transponder
- Oil Debris Monitoring System (ODMS)
- Aircraft crypto-variable management unit
- Engine Monitoring Units (EMU)

CLASS 3* SOFTWARE

Class 3* software is utilized for the following:
- Portable Maintenance Data Store (PMDS).

CLASS 3 SOFTWARE

Class 3 software is used for functions where a failure would not significantly reduce the mission capability or the crew ability. Class 3 software is used mainly for maintenance applications.

Class 3 software is utilized for the following:
- DECU support software
- Crash Survivable Memory Unit (CSMU).

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COCKPIT INTERFACES

COMPUTER SYMBOL GENERATOR

The Computer Symbol Generator (CSG) is part of the Displays and Control (D&C) system and is located in the avionic bay. Its function is to produce the symbology displayed on the Head-up Display (HUD), Multifunction Head Down Display (MHDD), and provide the video output to the Video/Voice Recorder (VVR). The CSG is also the interface between aircraft systems and the D&C for video inputs and non-catastrophic failure warnings.

There are two CSG fitted, CSG1 and CSG2, each capable of driving the MHDD and HUD. With the two position CSG toggle switch, on the right forward console, in the NORM position, the system automatically selects the on-line CSG and sets the other CSG to standby when power is applied. The standby CSG will automatically take over operation if a fault is detected in the on-line CSG, or when the CSG switch is selected to the REV (reversionary) position.

OPERATION

CSG1 is powered from AC busbar XP1 and CSG2 from AC busbar XP2. An internal power supply module converts the AC supply to the DC voltages required for CSG operation.

The CSG has a direct video link to the VVR. It receives and transmits data to other aircraft systems using the avionic, attack and Utilities Control System (UCS) databus.

The CSG produces the outputs required for the HUD and MHDD operating in raster mode. The symbology and video is displayed in green monochrome for the HUD and up to sixteen colors for the MHDD.

Six video signals can be fed to the CSG but only three are currently used. The three video signals, in raster format, are from:

- The HUD camera (color)
- The map generator (color)
- The radar system (monochrome)

A monochrome outside world picture is taken by a video camera, which is mounted on the forward end of the HUD assembly. The video is mixed with HUD symbology in the CSG and recorded on the VVR.

For Twin seat aircraft

The combined image is also projected on the rear cockpit HUD.
⇐

The map generator video signal is one of the display options when using the Pilot Awareness (PA) format.

The radar outputs a Direct Data Link (DDL) video signal to the CSG when the radar system is in the ground mapping mode. This video signal is an optional display when in ATCK format.

The CSG provides the interface between aircraft systems and the warnings system (except catastrophic warnings, which are hard-wired direct to the DWP). When a failure is detected in a system, the CSG triggers the attention getters, the warning display on the DWP, where relevant, and the generation of attensons and voice warnings, via the Communication and Audio Management Unit (CAMU).

When the recording of display data is initiated, the CSG will multiplex the video signals from the MHDD, HUD and the HUD camera before sending them to the VVR.

HEAD UP DISPLAY

The HUD is a flight instrument which projects flight and weapons delivery information into the pilots FOV. The symbols are generated by one of two Computer Symbol Generators (CSG) and are focused at infinity. Provision is made for the selection or exclusion of certain symbology appropriate to the current flight mode.

NOTE

> The HUD and other onboard instruments should be cross-monitored at appropriate intervals.

Upon switch-on (but before normal operation begins) an internal start-up BIT is automatically initiated but no test patterns are generated. During operation, a continuous BIT monitors certain HUD functions.

If both CSG or the AC power supply fail, the HUD format will not be displayed but the DC driven controls and indicators on the Head up Panel (HUP) function as normal.

If the DC power supplies to the HUD fail, the battery supported displays and controls on the HUP will remain operable for a limited period.

In addition, if the HUP fails, radio 1 and 2 can be controlled via the left glareshield.

CONSTRUCTION

The HUD includes the following subassemblies:

- PDU
- HUP
- HUD video camera
- HUD mounting tray.

PILOT DISPLAY UNIT

The PDU comprises an optical assembly plus mechanical and electrical assemblies that combine to project information to the pilot. The PDU is positioned such that the combining glass is in the pilots LOS and is not obscured.

Two light sensors mounted on the top of the PDU monitor the ambient light conditions to maintain the contrast level of the display.

HEAD UP PANEL

The HUP is located immediately below the PDU and contains the controls and indicators associated with the HUD.

HUD VIDEO CAMERA

The HUD video camera enables the recording of the outside world, as seen through the combiner assembly. The output of the video camera is routed to the selected CSG, where the HUD symbology is added. The result is a view of the outside world with HUD symbology superimposed upon it.

HUD MOUNTING TRAY

The HUD mounting tray enables the ground crew to harmonize the PDU with the airframe by adjusting four mounting tray adjusting studs.

HUD SYMBOLOGY

HUD symbology consists of:
- Attitude/directional reference symbology
- Airdata symbology
- Autopilot symbology
- Navigation symbology
- Air to air attack symbology
- Miscellaneous symbology.

ATTITUDE/DIRECTIONAL REFERENCE SYMBOLOGY

Attitude/Directional Reference Symbology is shown in Figure I-02-01 and Figure I-02-03 .

The climb/dive symbol is a winged circle which provides aircraft directional reference whilst the system is operating in climb/dive mode. The symbol has two modes of operation; locked (LOCK) and Velocity Vector (VV). These modes are controlled by the LOCK/VV selector/indicator on the HUP. In LOCK, the aircraft symbol is locked to the vertical axis of the HUD (indicated by a radial flag at the 12 oclock position on the circle) and can be adjusted using the depression setting control on the HUP. When in VV, the symbol is referenced to the aircraft velocity vector in elevation between +5° and -15° with respect to the Longitudinal Fuselage Datum (LFD).

NOTE

The VV symbol does not move in azimuth.

A diamond indicates the aircrafts velocity vector. Full freedom of movement extends to the limit of the HUD FOV, where it parks and flashes at the FOV edge.

The attitude symbol replaces the climb dive symbol if airspeed falls below 48 kt to indicate aircraft pitch attitude instead of climb/dive angle.

Aircraft climb/dive angles and roll attitude, relative to the aircraft symbol are displayed by a horizon bar, climb/dive bars and zenith and nadir stars. Climb/dive is displayed in the form of a tapered ladder with incremental steps of 5°, from 0° up to 30°, and steps of 10°, from 30° to 80°. The climb/dive symbology is displayed at a ratio of 1:1 to the real world from 0 to 5°. Thereafter the ratio increases at a nonlinear rate reaching a maximum of 4.4:1 at 90°. In roll the display has 360° movement around the aircraft symbol.

The bank/roll pointer is an infilled triangular pointer which is rotated around a fixed bank scale to indicate current bank angle. The scale covers the range 0° to 60° with graduation marks at the 10°, 20°, 30° and 60° positions.

The Specific Excess Power (SEP) markers consist of two arrow heads, displayed at each side of the aircraft symbol. The displacement between these arrow heads and the aircraft symbol indicates the angle at which the aircraft should climb or dive to achieve a constant speed. When the aircraft symbol is bracketed by the SEP markers a constant speed is indicated. The markers provide an indication of climb performance, energy loss/available in turns and are useful for speed control in precision flying.

The pull up arrow warning is presented as a flashing arrow, which rotates about its center point, such that it always points away from the ground. The command PULL UP is shown boxed below the arrow.

MISCELLANEOUS SYMBOLOGY

Miscellaneous symbology is shown in Figure I-02-02 and Figure I-02-03 .

Stopwatch count up presents an increasing time interval in hours, minutes and seconds, whilst countdown presents a decreasing one . Upon reaching 0 the digits flash for 5 seconds. Split time for the count up or countdown stopwatch may be indicated. When the split time is displayed the stopwatch continues to run.

Undercarriage state is presented on the left of the display. One of three legends is displayed to indicate the state of each landing gear leg. Gear up and locked is indicated by UP, gear down and locked is indicated by D and gear in transit is indicated by X. The landing gear status is displayed whenever the gear is locked down or in a state of transition. Gear status is displayed for a further 10 seconds when the gear is declared up and locked.

An indication of depression angle is provided by a digital readout to a resolution of 0.1°; the angle is set by the rotary depression setting control on the HUP. The depression angle is the displacement of the aircraft symbol from the LFD during lock mode, The new value (0 to -15°) is displayed for 5 seconds following any change to the depression angle setting.

The airbrake indicator is shown against the aircraft symbol when the airbrake is in any position other than closed and locked.

LATE ARM SAFE is displayed to indicate that the late arm control is set to the safe condition.

GEAR is displayed to indicate that the undercarriage limiting speed of 290 kt has been exceeded.

XFER is displayed to indicate that manual fuel transfer is in progress.

AUTO RECOVERY is displayed to indicate that the automatic recovery mode is enabled.

AIRDATA SYMBOLOGY

The symbology associated with airdata is shown in Figure I-02-04 , Figure I-02-05 and Figure I-02-08 .

The barometric altitude display comprises an analogue and a digital display (up to five digits), surrounded by a circular scale of 10 dots and a rotating pointer. The pointer rotates once per 1000 ft. Display resolution is in 20 ft increments at, or below 5000 ft, increasing to 50 ft increments above 5000 ft.

Displayed airspeed is presented digitally on the left of the display to a resolution of 1.0 kt. Ground speed or Mach number can be selected via the GS/M selector/indicator, on the HUP. With weight off wheels, the Mach number is displayed automatically when Mach number exceeds M0.9.

NOTE

Between M1.0 and M1.2, KDAS is a combination of aircraft KCAS and KEAS. However, when the Mach number is less than M1.0, KDAS is sourced from KCAS only, and when it is greater than M1.2, KDAS is sourced from KEAS only.

AoA is indicated by a small scale which moves against the aircraft symbol to indicated pitch during the take-off and landing PoF. The scale has three horizontal markers: an upper marker representing 16°, a middle marker representing 14° and a lower marker representing 12°.

The vertical velocity scale on the right of the display is indicated in ft/min. The display comprises a triangular pointer that moves against a fixed scale with an elastic line connecting the pointer to the zero marker on the scale. The display covers the range -2000 ft/min to +2000 ft/min and is marked at ±500 ft/min, ±1000 ft/min and ±2000 ft/min. If the scale limits are exceeded the pointer rotates upwards or downwards.

Barometric pressure is set via the left glare shield. Following any change to this setting the new value is displayed on the HUD for 5 seconds as a four digit readout.

Normal g (Figure I-02-04) will be displayed alongside the energy cue (Figure I-02-05), unless in ground PoF, when the readout is no longer displayed. Normal g is displayed to a resolution of 0.1g.

The energy cue indicates AoA and speeds required for optimum aircraft performance. A speed scale provides a reference to relate the energy cue symbols against. The energy cue is available in the navigation, combat and air to surface PoF. The energy cue symbols provide the following:

- An indication of maximum and minimum speed, via the speed scale
- An indication of the AoA for the maximum Sustained Turn Rate (STR) at current speed
- An indication of current AoA (+30° to -5°). The caret symbol can be displayed -5° below the minimum marker on the speed scale
- An indication of the AoA required to achieve maximum acceleration
- An indication of the current speed, via a marker which moves between the maximum and minimum speed markers
- An indication of the speed trend, i.e. the predicated speed in 5 seconds time. The length is limited to a maximum of 30 kt/sec and grows either up or down from the current speed symbol
- An indication of the speed required for the maximum STR
- An indication of the lowest speed required at which the highest g is available, for the current aircraft configuration is indicated.

AUTOPILOT SYMBOLOGY

The symbology associated with the autopilot is shown in Figure I-02-06 and Figure I-02-08 .

The barometric altitude acquire value, set by the pilot, is presented digitally at the top of the display when the autopilot barometric altitude mode has been selected. The initial value of the display is the current barometric altitude of the aircraft with higher or lower values selectable (500 ft to 50 000 ft, in 100 ft increments) via HOTAS moding. The altitude acquire display is shown boxed when the autopilot is engaged and the aircraft is climbing or diving to the required altitude. Upon acquisition, the digits of the barometric altitude display are boxed to indicate that the demanded value is being held.

When the autopilot heading or track acquire mode is selected, the demanded value, set by the pilot, is presented digitally at the top of the display preceded by HDG or TRK as appropriate. The initial value displayed is the current heading or track with new values selectable (from 0 to 359° in 1° steps). The heading or track acquire value is shown boxed when the autopilot is engaged and the aircraft is turning onto the required track/heading. Upon acquisition the value is displayed as three boxed digits. If the heading is being held the digits will be presented within the heading ribbon and centered on the lubber line, however, if a track is being held the digits are presented above the track marker.

When the autothrottle DAS or Mach mode is selected, the demanded value, set by the pilot, is presented digitally at the top of the display, preceded by the letter M in the case of Mach mode. The initial value is the current aircraft airspeed or Mach number with new values selectable (M0.18 to M2.00 in M0.01 increments or 110 kt to 726 kt in 1.0 kt increments) via the HOTAS autothrottle switch. The value is shown boxed at the top of the display when the autothrottle is engaged and the speed is being acquired. Upon acquisition the digits of the displayed airspeed or Mach number are boxed to indicate that the demanded value is being held.

During operation in auto climb mode, A-CLIMB DAS or A-CLIMB M is presented at the top of the display dependent on the mode selected. Whilst in constant airspeed mode A-CLIMB DAS is displayed, and similarly when in constant Mach mode A-CLIMB M is displayed. The display is mutually exclusive with the Mach/DAS acquire mode described above.

NAVIGATION SYMBOLOGY

The symbology associated with the navigation is shown in Figure I-02-07 and Figure I-02-08 .

Initialization Symbology

The LINS alignment cross is a gapped cross that can be slewed within the HUD FOV. It indicates the bearing to a reference object when performing the HUD optical method of LINS alignment. The cross will remain on the HUD until the LINS mode is entered.

The LINS alignment level is a status indication to inform the pilot of LINS alignment error which is expressed in nautical miles per hour.

The Time To Go (TTG) to the completion of LINS alignment is presented in digital form. Upon completion of LINS alignment LINS RDY is displayed. The system is then ready to enter the navigation mode.

Steering Symbology

The heading ribbon comprises a five dot scale that moves against a fixed lubber line. Each dot represents a 5° increment with heading digits displayed every 10°. Three heading digits are displayed at all times, unless minimum declutter is selected, when only one digit is displayed. When true heading is displayed, the letter T is visible above the center of the scale.

Current track angle is indicated by the track marker, which is read against the heading ribbon. If the marker reaches the limit of the visible ribbon it will park and rotate sideways to indicate that the track error is in excess of the scale.

The steering bug symbol is used to indicate steering required to follow navigation demands. The symbol is read against the heading ribbon and will park and rotate sideways if the steering error is in excess of the visible ribbon.

Waypoint Symbology

An analogue indication of time early/late is presented if the current Destination Way Point (DWP) has been allocated a planned time. A pointer moves against a linear scale comprising three marks: the center mark represents 0 seconds; the left mark (annotated L) represents -60 seconds (late); the right mark (annotated E) represents +60 seconds (early). If the time, early or late, exceeds the limits of the scale the pointer parks and rotates sideways to point off the scale.

A digital readout showing the number of current DWP is displayed. A letter is displayed adjacent to the waypoint number to identify waypoint type: eg 199 C, where:

- C represents a combat air patrol point.
- M represents a mark point
- F represents a fuel point
- No letter represents a route point.

Waypoint bearing and range is provided in a digital readout below the DWP number and is expressed in degrees and nautical miles respectively.

TTG until the current DWP is reached is expressed digitally in minutes and seconds below the early/late display.

During close navigation (65 seconds to go) a waypoint countdown circle is presented to provide a 60 second countdown to the DWP. As the aircraft approaches the waypoint the circle winds down, however, if the aircraft starts to move away from the waypoint the circle will wind up again.

Also during close navigation the direction of turn (left or right) and the planned track to the next waypoint are indicated by a triangular pointer and a digital readout respectively. However, if the track to the next waypoint after the current DWP is the same, the symbology will not be displayed.

The route destination waypoint marker is a gapped diagonal cross and is used to indicate the expected LOS to the waypoint during the close navigation phase. If the aircraft is above 10 000 ft the symbol is not displayed. However, if the route DWP has no height associated with it, then the system assumes that the aircraft is at zero feet AMSL. In addition, if the aircraft is below 10 000 ft AMSL and starts to gain height, the symbol will not disappear until the aircraft goes higher than 11 000 ft AMSL.

Navigation Aids Symbology

The selected TACAN channel number is displayed as a digital readout. Range and bearing from the selected TACAN beacon are displayed digitally in degrees and nautical miles. The selected beacon is identified as an air to surface or an air to air beacon by the letters AS and AA respectively.

Miscellaneous Navigation Symbology

NO MONITOR is presented when the LINS/best navigation cross monitor is not available.

RAD ALT is presented digitally with up to four digits: 0 to 5000 ft in 10 ft increments. If RAD ALT only has been selected and the RAD ALT unlocks, or the aircraft exceeds 5000 ft, the RAD ALT digits are replaced by flashing barometric altitude figures. If BARO ALT/RAD ALT mode is selected and the RAD ALT data is invalid, unlocked or off, then the digits are replaced by dashes.

AIR TO AIR ATTACK SYMBOLOGY

The symbology associated with air to air attack is shown as follows:

- Radar track/target symbology (Figure I-02-16)
- Combat steering and air to air missile symbology (Figure I-02-35)
- Gun, visual ident and miscellaneous symbology (Figure I-02-11)
- An example of a HUD air to air attack format is shown in Figure I-02-12
- Examples of radar air combat mode formats are shown in Figure I-02-13 , Figure I-02-14 and Figure I-02-15 .

Radar Track/Target Symbology

A gapped square indicates the sight line to a track of unknown allegiance. The appearance of the symbol is changed if the track moves outside the current scan volume, to indicate that it is being tracked in memory only. If a Track Cross Reference Index (TCRI), a letter unique to that particular track, has been generated it will be displayed centrally above the track symbol. A pointer is displayed against the track symbol, which continually indicates horizontal aspect angle of the track. The symbol and aspect angle pointer are displayed in one of three sizes, dependent upon the current range to the track as follows:

- Small size for track range greater than 20 nm
- Medium size for track ranges 10 to 20 nm
- Large size for track ranges 0 to 10 nm.

A gapped circle with four dashes indicates the sight line to a friendly track. Memorized tracking, aspect angle and the relationship between symbol size and target range are the same as that described for an unknown track.

A gapped diamond indicates the sight line to a hostile track. Memorized tracking, TCRI, aspect angle and the relationship between symbol size and target range are the same as that described for unknown track position.

A square symbol indicates the sight line to up to seven secondary targets (targets 2 to 8 in the Designated Target List (DTL)) of unknown allegiance, along with their TCRI; known as an unknown target marker. Memorized tracking, TCRI, aspect angle and the relationship between symbol size and target range are the same as that described for unknown track position.

A circle indicates the sight line to up to seven friendly secondary targets (targets 2 to 8 in the DTL); known as a friendly target marker. Memorized tracking, aspect angle and the relationship between symbol size and target range are the same as that described for unknown track position.

A diamond indicates the sight line to up to seven hostile secondary targets (targets 2 to 8 in the DTL), with their TCRI; known as a hostile target marker. Memorized tracking, TCRI, aspect angle and the relationship between symbol size and target range are the same as that described for unknown track position.

A square with a square border indicates the sight line to a target of unknown allegiance, occupying the first position in the DTL, along with its TCRI; known as an unknown first target marker. Memorized tracking, TCRI, aspect angle and the relationship between symbol size and target range are the same as that described for unknown track position. In addition, if the target moves outside the HUD FOV the symbol will flash and move around the edge of the display, on a line between the target and the center of the display.

A circle with a circular border indicates the sight line to a friendly target, which is the first target in the DTL; known as a friendly first target marker. Memorized tracking, aspect angle, target movement outside the HUD FOV and the relationship between symbol size and target range are the same as that described for unknown first target marker.

A diamond with a diamond border indicates the sight line to a hostile target, which is the first target of the DTL; known as a hostile first target marker. Memorized tracking, TCRI, aspect angle, target movement outside the HUD FOV and the relationship between symbol size and target range are the same as that described for unknown first target marker.

A gapped diagonal cross is used to indicate that the radar is currently locked to an air to air target; known as radar lock on.

A small diamond is displayed against the first target in the DTL when a valid shoot condition exists; known as the shoot cue.

An analogue indication of the longest time the AMRAAM will take to acquire a target autonomously, if fired presently, is indicated by a marker which moves around the edge of the target symbol. The marker moves anticlockwise to indicate countdown and vice versa. Before countdown, when the marker is positioned at the top of the display, a time of 60 seconds or greater is indicated. Below 60 seconds the marker moves around the box, which is scaled such that 30 seconds is at the bottom and zero seconds is top center.

A cross that fills the inside of the target symbol indicates that the target has been fired at, i.e. missile in flight. If the time to the target exceeds the missiles flight time, such that it will never reach the target unless the target moves favourably, the cross symbol will flash. If the missile can never reach the target the cross symbol is no longer displayed.

A diagonal cross indicates that the minimum AMRAAM , SRAAM or gun range has been reached for the associated target; known as a minimum range cross. When AMRAAM is selected, the cross may be shown against any of the first six targets in the DTL. When SRAAM is selected the cross will be shown centered on the first target only. When the gun is selected the cross will be centered on the director gun sight. The cross is also shown centered on the aircraft symbol, to indicate minimum radar range plus 10 meters, when in visual identification (VISIDENT) mode.

Combat Steering

A circle and a dot are used to display the Allowable Steering Error (ASE) for an intercept course that will provide a valid firing solution against the current target. The circle varies in diameter to show current ASE and the dot shows actual azimuth and elevation error. To maintain the intercept course the aircraft must be maneuvered such that the steering dot remains within the ASE circle. The steering dot will begin to flash if the error exceeds a certain threshold.

WARNING

Do not rely solely on radar information for a required breakaway.

A large diagonal flashing cross centered on the aircraft symbol indicates that a breakaway is required to avoid collision with the target being attacked.

AMRAAM Symbology

A gapped circle of fixed diameter, having six dashes and centered on the LFD, indicates the area in which the AMRAAM will search when launched in visual mode (7.5° around the bore sight); known as the acquisition cone.

The weapons scale and marker is a vertical linear scale and marker, used to compare target range against the AMRAAM envelope. The system calculates the minimum and two maximum weapon ranges, which are marked on the scale as horizontal lines. The two maximum ranges differ as one range is based on the target remaining at 1g (R MAX 1), while the other assumes that the target will perform an escape maneuver during the AMRAAM fly out (R MAX 2). The shorter of the two ranges is the no escape limit. A target range marker is displayed, which moves from beyond R MAX 1 into the missile range scale as the aircraft closes on the target. As the range to the target decreases below 2 nm, sight line range to target is displayed in feet below 12 200 ft. Should the target range increase above 14 000 ft, the display changes back to nautical miles. In addition, the greater of the two R MAX figures is displayed at the top of the scale (nm). If the target range is less than R MIN the marker will park at the R MIN marker and rotate to point downwards. If the target range is greater than the HUD FOV limit, the marker will park and rotate to point up. The rate of closure is displayed in knots below the range scale and the target aspect angle is displayed directly below that.

A circle of fixed diameter, centered on the aircraft symbol, is used to indicate range to target when the sight line range is less than, or equal to 12 000 ft. It is known as the missile target range circle. The circle unwinds as the range decreases. If AMRAAM (or SRAAM) is selected, the minimum range is displayed as a dot on the range circle.

Missile time to release is indicated by digital readout; the earliest opportunity to release an AMRAAM inside R MAX 1 against the first target in the DTL.

A digital readout indicates the longest time the missile will take to acquire a target autonomously, if fired presently, against the first target in the DTL. It is known as missile time to go autonomous. The readout appears automatically when the target is within R MAX 1 of the missile envelope.

Adigital readout indicates the time to autonomous operation for the AMRAAM currently in flight with the longest flight time.

AMRAAM turn away limits are presented as a box of variable size and position, surrounded by inward pointing arrows. During the post launch phase of an AMRAAM attack, the system calculates the steering limits, in bothazimuth and elevation, that must be adhered to in order to keep the target within radar gimbal limits. The aircraft should be maneuvered so that the VV remains inside the box to adhere to the limits.

In the event of a multiple AMRAAM attack, with the missiles in flight, the system evaluates the turn away limits for each missile and then calculates their combined turn away limits. The combined limits are calculated such that all targets remain within the radar gimbal limits and that all missiles remain within the data link side lobes.

SRAAM Symbology

A gapped diamond is used to indicate current seeker head look angle, where the seeker has not yet acquired a target. If the seeker head moves outside the HUD FOV, the symbol will flash and move around the edge of the display, along a line between the seeker head position and the center of the display. The symbol is enlarged if SRAAM wide FOV (XFOV) is selected.

A hexagon is used to indicate the current seeker head look angle, where the seeker has acquired a target. If the seeker head moves outside the HUD FOV,he symbol will flash and move around the edge of the display along a line between the seeker head position and the center of the display.

The SRAAM target range circle is presented as a circle of fixed diameter, centered on the aircraft symbol, and indicates the range to the target when sight line range is ≤ 12 000 ft; the circle unwinds as the range decreases. If SRAAM is selected, SRAAM minimum range is displayed as a dot on the range circle.

The SRAAM weapons scale and marker are used to compare target range against the SRAAM envelope. Presentation is identical to the AMRAAM weapons scale and marker, .

Selection of SRAAM uncage preset is identified by the presence of a letter U below the SRAAM weapon scale symbology.

Gun Symbology

The director gunsight is displayed in the primary and mixed gun modes provided that the radar is in gun lock mode. The sight comprises an aiming pipper, a range to target circle and an indication of closing speed. The aiming pipper is a dot which is used to indicate future sight line to the target in one bullets time of flight. The range to target circle is a fixed diameter circle which is centered on the aiming pipper and is used to indicate sight line range to the target from 12 000 ft to 0 ft. The circle unwinds anticlockwise as the range to the target decreases. Two event markers are displayed against the circle representing minimum and maximum gun ranges. A digital readout of closing or opening speed is displayed in knots directly below the gunsight: a closing speed is indicated by (+) and an opening speed by (-). If the target moves outside the HUD FOV the symbol will flash and move around the edge of the display on a line between the target and the center of the display.

The gun boresight cross is presented as a fixed cross that reflects the angular difference between the gun datum and the LFD.

The historic gun tracer line is displayed in gun secondary mode and represents the flight path of the bullet stream over a 2 second period, against three range bars. The tracer line is 2 seconds in length and comprises a line of sixteen segments, each segment representing 0.125 seconds. Range bars corresponding to 1000 ft, 2000 ft and 3000 ft are shown with the tracer line and represent fixed target wing spans of 50 ft, 40 ft and 30 ft. Every 2 seconds the path of gun rounds, down the tracer line, is shown by a gap of two segments known as the dark bullet. The gap travels down the tracer line at bullet speed to provide an indication of timing.

The gun scale and marker are used to compare target range against the gun envelope. Presentation is similar to that for the air to air missiles (and), however, there is only one R MAX value.

Visual Identification Symbology

The steering position cue enables nomination of a steering position, in VISIDENT mode, on either a 30° or a 50° cone from behind the target, which will drive the steering dot, i.e. Single Target Track (STT) and target, less than max VISIDENT range. Each cone has twelve selectable positions represented by a circular pattern of twelve dots. The VISIDENT target altitude, track and airspeed are also displayed in digital format within the circular pattern.

When selected the X-Y marker appears on the default position (6 oclock position on the 30° cone) or the previously selected position, along with a circular marker. The X-Y marker can then be moved to any of the other positions to perform an X-Y insert to confirm the selection. A visual confirmation of the selection is provided by the circular marker which repositions itself on the newly selected position.

Target parameters, i.e. track, altitude and airspeed, are indicated in digital form within the VISIDENT steering position cue symbology.

The target range circle is presented as a circle of fixed diameter, centered on the aircraft symbol, and indicates the range to the target when sight line range is less than 2 nm. The circle unwinds as the range decreases, and goes out at 180 meters. An event marker is positioned on the circle to indicate the minimum VISIDENT range. An indication of closing (+) or opening (-) speed, in knots, is displayed directly beneath the range circle.

Closing or opening speed is indicated in both analogue and digital forms. The analogue display comprises a pointer, which moves against a fixed speed scale, covering the range +80 kt to -20 kt. The speed scale is presented as six evenly spaced dots, where the space between each dot represents 20 kt. An elastic line connects the pointer and the dot that represents 0 kt, to enable the display to be read quickly and easily. If the closing speed is beyond the limits of the display the pointer parks at the maximum value and rotates sideways. A digital readout of closing speed (in knots) is also provided adjacent to the analogue display, which is able to indicate closing (+) or opening (-) speeds beyond the limits of the analogue display.

Range to target is indicated in analogue and digital forms by the range scale. The analogue display comprises a pointer, which moves against a fixed vertical scale, on which maximum and minimum VISIDENT ranges, and minimum radar lock range are marked. As the aircraft is maneuvered towards the target, the marker moves down from the top of the HUD FOV, towards the range scale. Actual sight line range to the target in nautical miles is indicated by a digital read out adjacent to the pointer. As the range to the target decreases below 1.0 nm, sight line range to target is displayed in feet below 6080 ft. Should the target sight line range increase above 7000 ft, the display changes back to nautical miles.

Miscellaneous

An indication of weapon selection is provided by the air to air weapons display at the bottom right corner of the HUD.

If no weapons are currently selected the letters M, S and G are displayed representing AMRAAM , SRAAM and gun respectively. Each letter is suffixed by a number, denoting the quantity of stores/rounds remaining, or the letter X, denoting no stores/rounds remaining. When an air to air weapon is selected its associated letter is replaced by boxed text i.e. AMRAAM, SRAAM or GUN as appropriate. If SRAAM reject has occurred the number of rejected SRAAM is displayed in brackets adjacent to the SRAAM remaining display. SRAAM slaved and manual modes are also displayed as an S or M suffix respectively.

The text SHOOT is presented boxed, when a valid firing opportunity exists against the next target; known as the shoot cue.

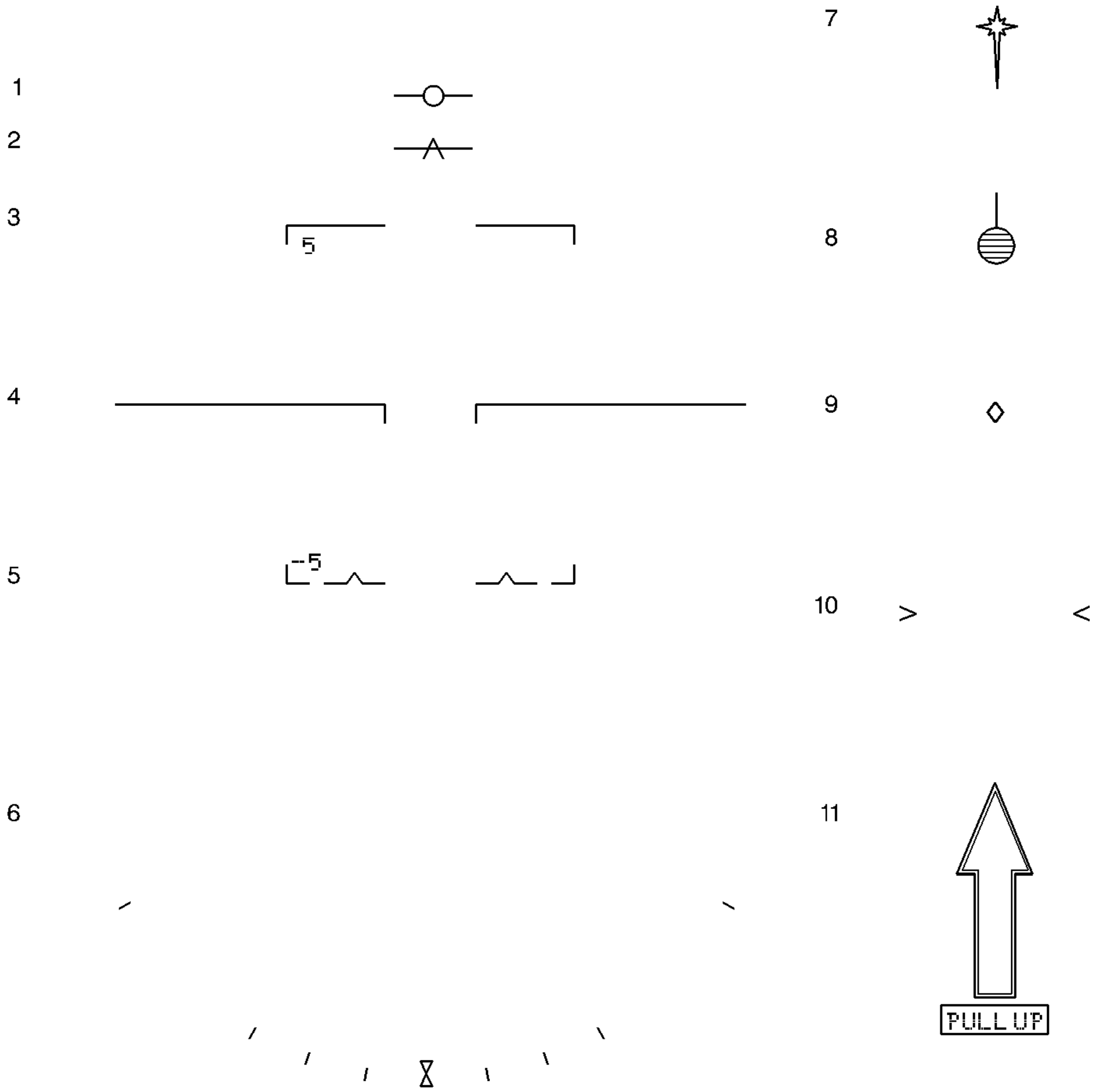
Target aspect angle is the angular difference between a targets track and own aircraft center line: the angle is expressed from 0 to 180° left or right. If the difference is less than 10° left or right (expressed as 1L or 1R) a letter T is displayed, denoting tail chase. If the difference is greater than 170° left or right (expressed 17L or 17R) the letter H is displayed, denoting head on.

Radar Air Combat Mode Symbology

The area of scan volume during HUD acquisition (HUDQ) mode is indicated by outlining the HUD FOV. The radar locks to the first detected plot in the scan volume.

The area of scan volume during vertical acquisition (VACQ) mode is displayed by outlining the vertical pattern on the HUD. The radar locks onto the first plot detected within the two bar vertical pattern.

The area of scan volume during radar slaved acquisition (SACQ) mode is indicated by a circle of fixed diameter. Upon selection of the mode the initial sight line is boresight, however, the sight line can be slewed anywhere within the HUD FOV using the X-Y controller. In this mode the radar will lock to the nearest plot.



1	CLIMB/DIVE SYMBOL	7	ZENITH STAR
2	ATTITUDE SYMBOL	8	NADIR
3	CLIMB BAR	9	VELOCITY VECTOR
4	HORIZON BAR	10	SPECIFIC EXCESS POWER MARKER
5	DIVE BAR	11	PULL UP ARROW
6	BANK/ROLL POINTER		

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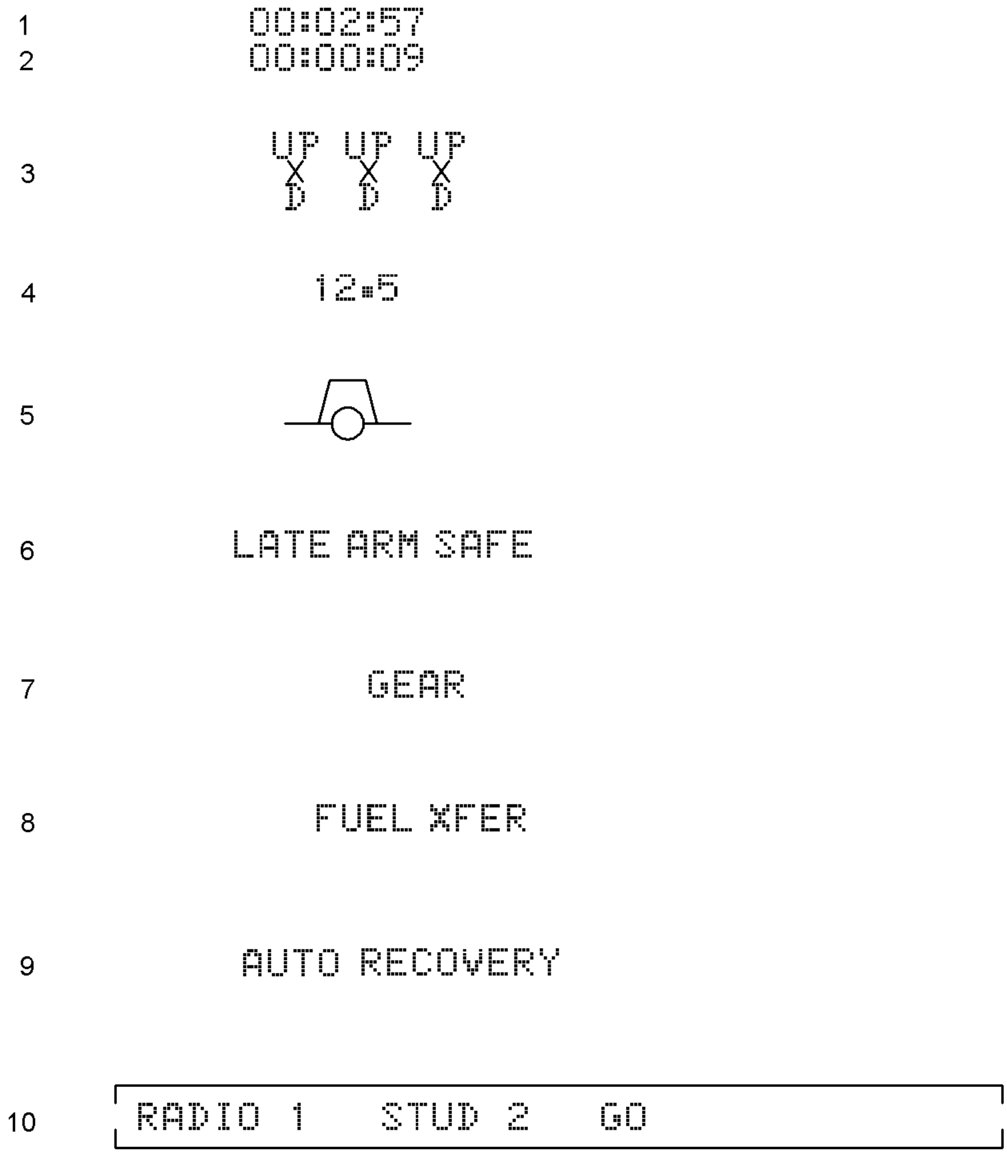
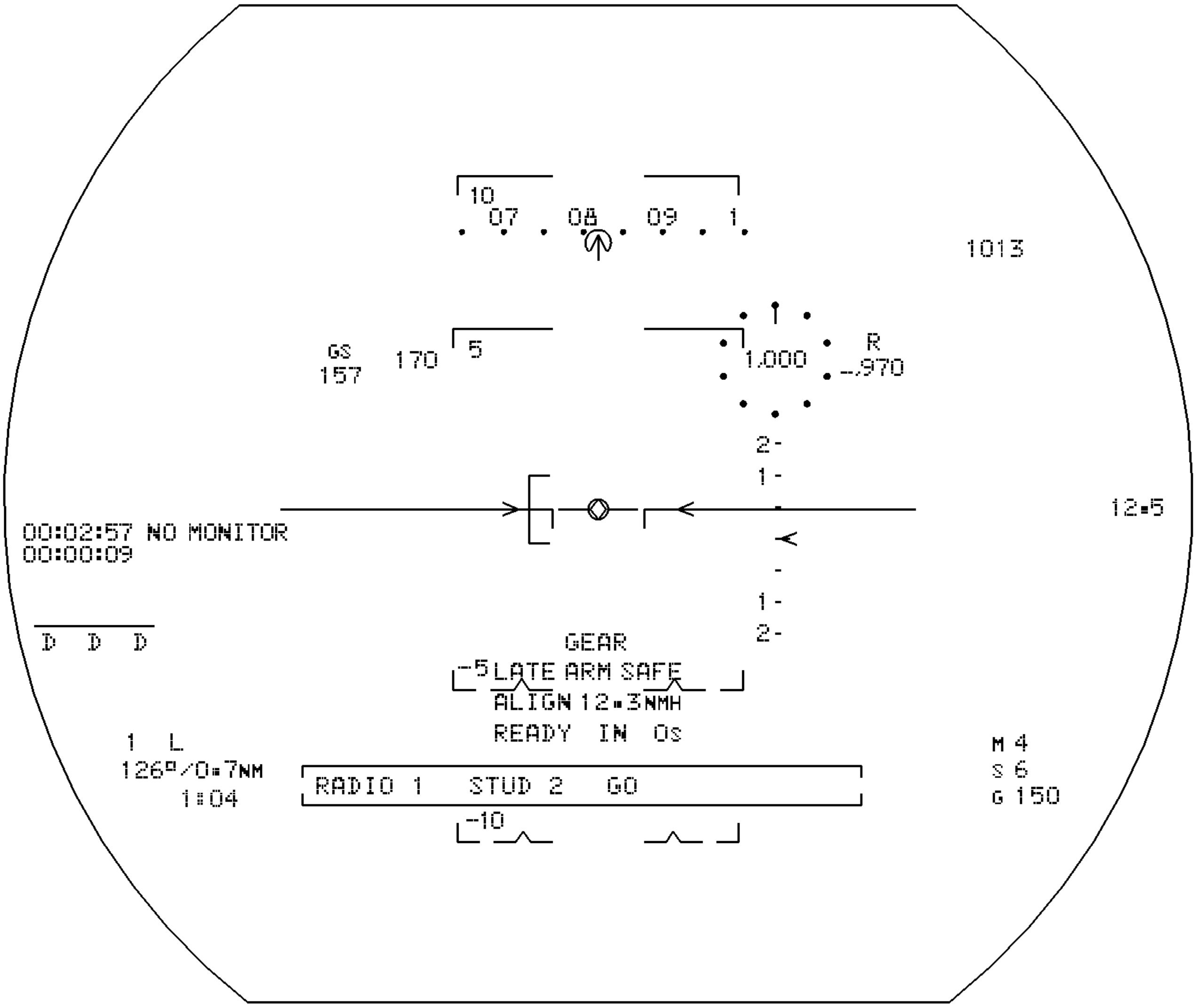
Figure I-02-01 Attitude/Directional Reference Symbology



1 STOPWATCH COUNT UP
2 STOPWATCH COUNTDOWN
3 UNDERCARRIAGE STATE
4 DEPRESSION ANGLE
5 AIRBRAKE INDICATOR
6 LATE ARM SAFE INDICATOR
7 GEAR LIMIT INDICATION
8 FUEL TRANSFER STATUS
9 AUTO RECOVERY
10 DIRECT VOICE INPUT

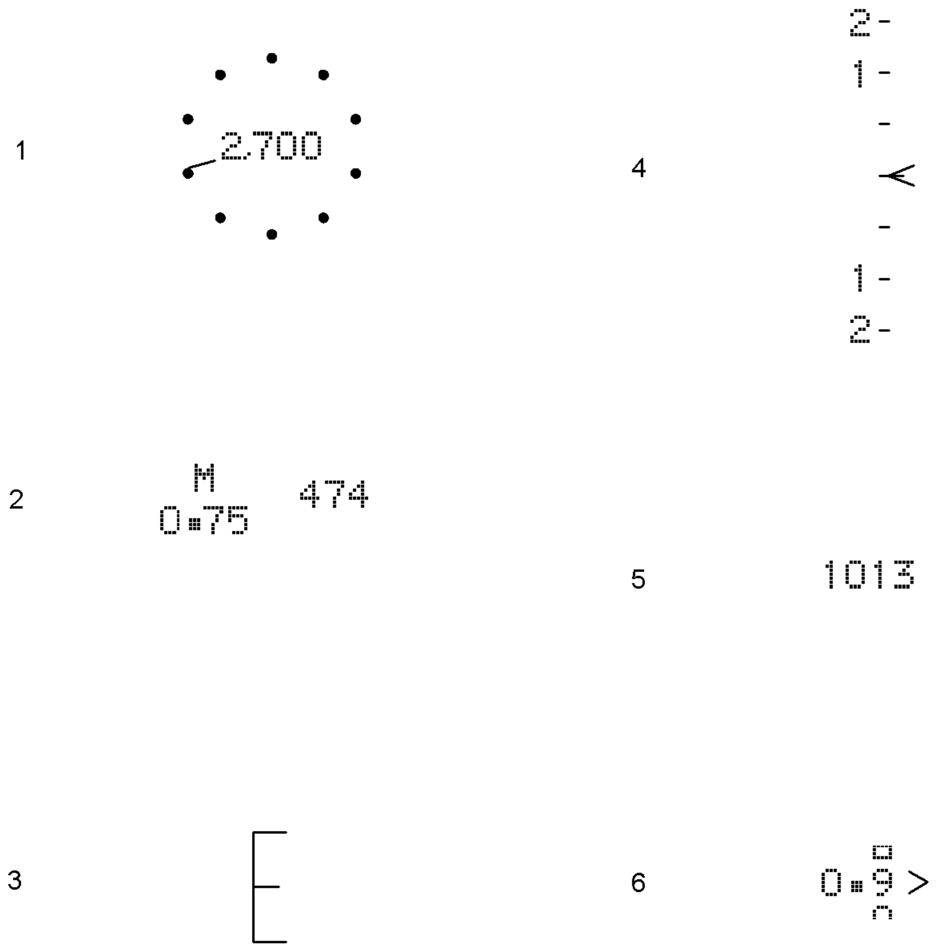
ICN-1B-B-311400-B-K0999-01491-A-02-2

Figure I-02-02 Miscellaneous Symbology



ICN-1B-B-311400-B-K0999-01492-A-01-2

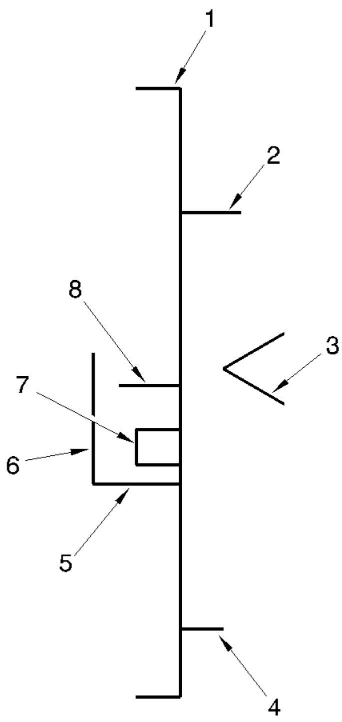
Figure I-02-03 Example HUD Format (Attitude, Directional and Miscellaneous Symbology)



1 BAROMETRIC ALTITUDE DISPLAY
2 DISPLAYED AIRSPEED/MACH NUMBER
3 ANGLE OF ATTACK SCALE
4 VERTICAL VELOCITY
5 BAROMETRIC PRESSURE SETTING
6 NORMAL G

ICN-1B-B-311400-B-K0999-01493-A-02-2

Figure I-02-04 Airdata Symbology



1 SPEED SCALE
2 AOA FOR MAXIMUM STR AT CURRENT SPEED
3 CURRENT AOA
4 ACCELLERATION AOA
5 CURRENT SPEED
6 SPEED TREND
7 SPEED FOR MAXIMUM STR
8 LOWEST SPEED FOR HIGHEST NZ (CORNER SPEED)

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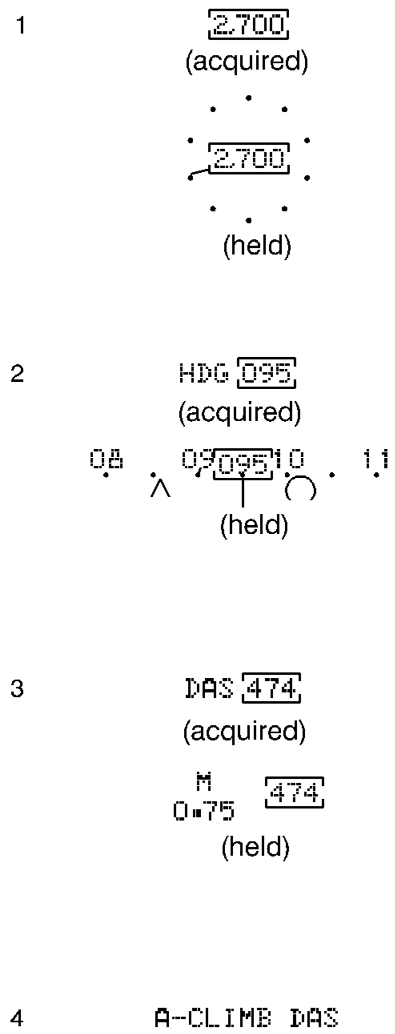
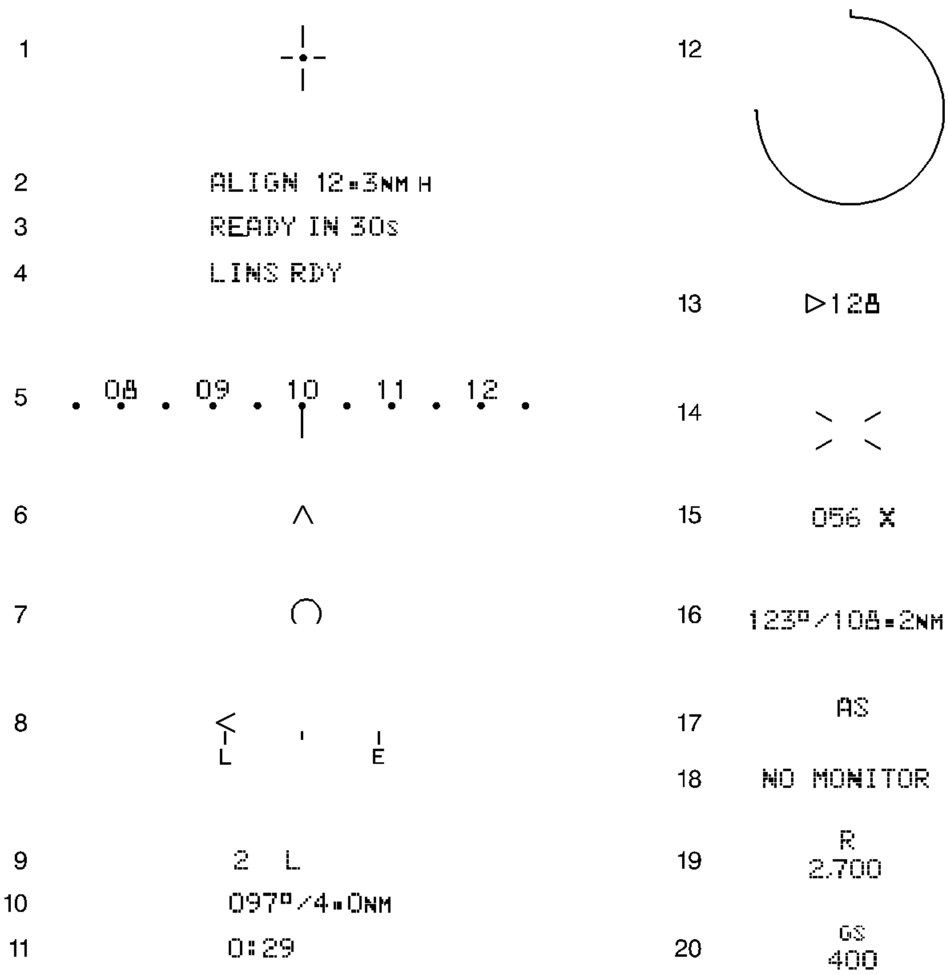
Figure I-02-05 Energy Cue Symbology



1 ALTITUDE ACQUIRE
2 HEADING/TRACK ACQUIRE
3 MACH/DAS ACQUIRE
4 AUTO CLIMB

ICN-1B-B-311400-B-K0999-01495-A-01-2

Figure I-02-06 Autopilot Symbology



1 LINS ALIGNMENT CROSS
2 LINS ALIGNMENT LEVEL
3 LINS ALIGNMENT TIME TO GO
4 LINS ALIGNMENT READY CAPTION
5 HEADING RIBBON
6 TRACK MARKER
7 STEERING BUG
8 TIME EARLY LATE
9 WAYPOINT NUMBER AND TYPE
10 WAYPOINT BEARING AND RANGE
11 TIME TO GO
12 WAYPOINT COUNTDOWN CIRCLE
13 DIRECTION OF TURN TO NEXT WAYPOINT
14 ROUTE DESTINATION WAYPOINT MARKER
15 TACAN CHANNEL
16 TACAN BEARING AND RANGE
17 TACAN AIR TO SURFACE/AIR TO AIR
18 NO MONITOR
19 RADAR ALTITUDE
20 GROUND SPEED

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Figure I-02-07 Navigation Symbology

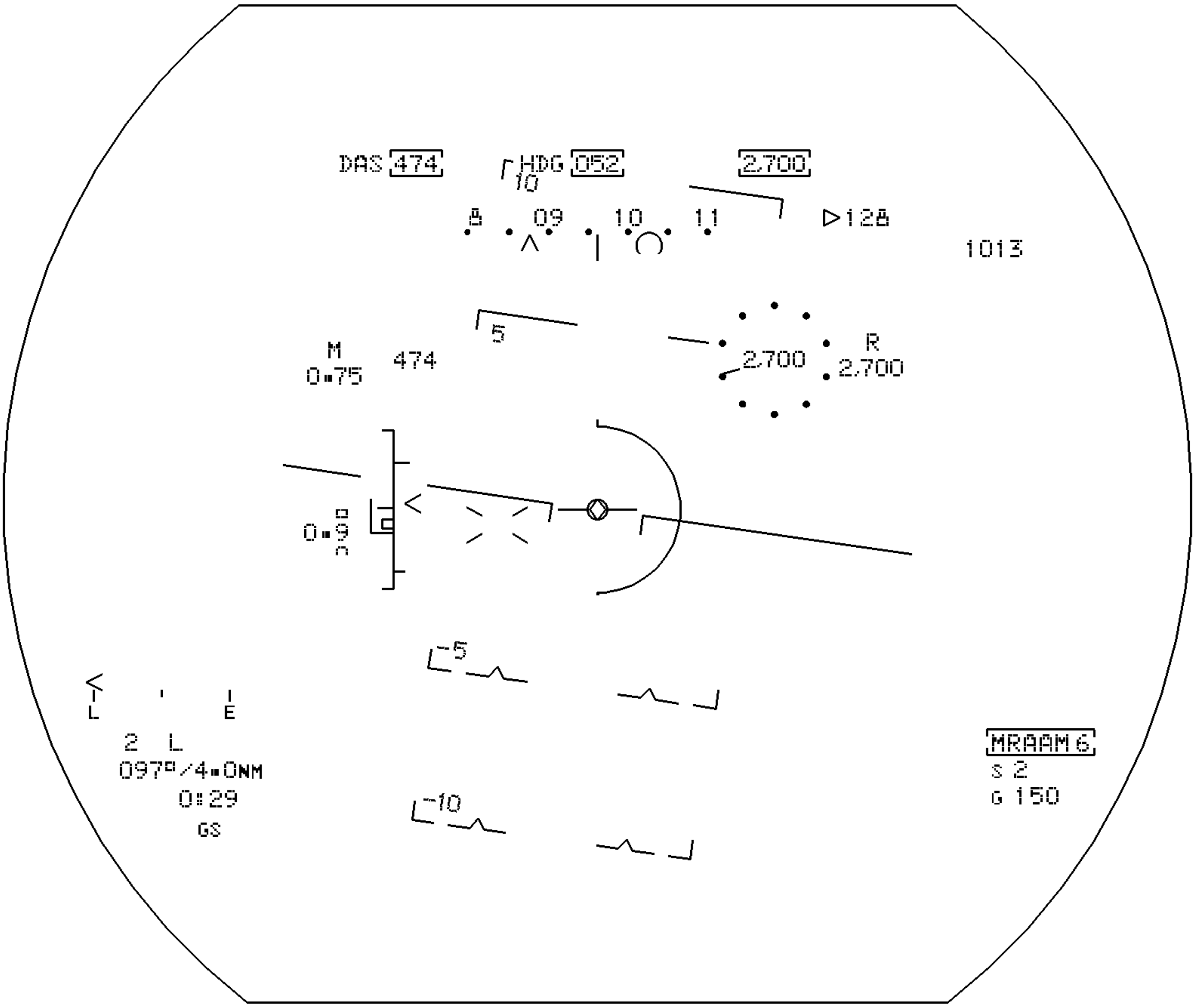

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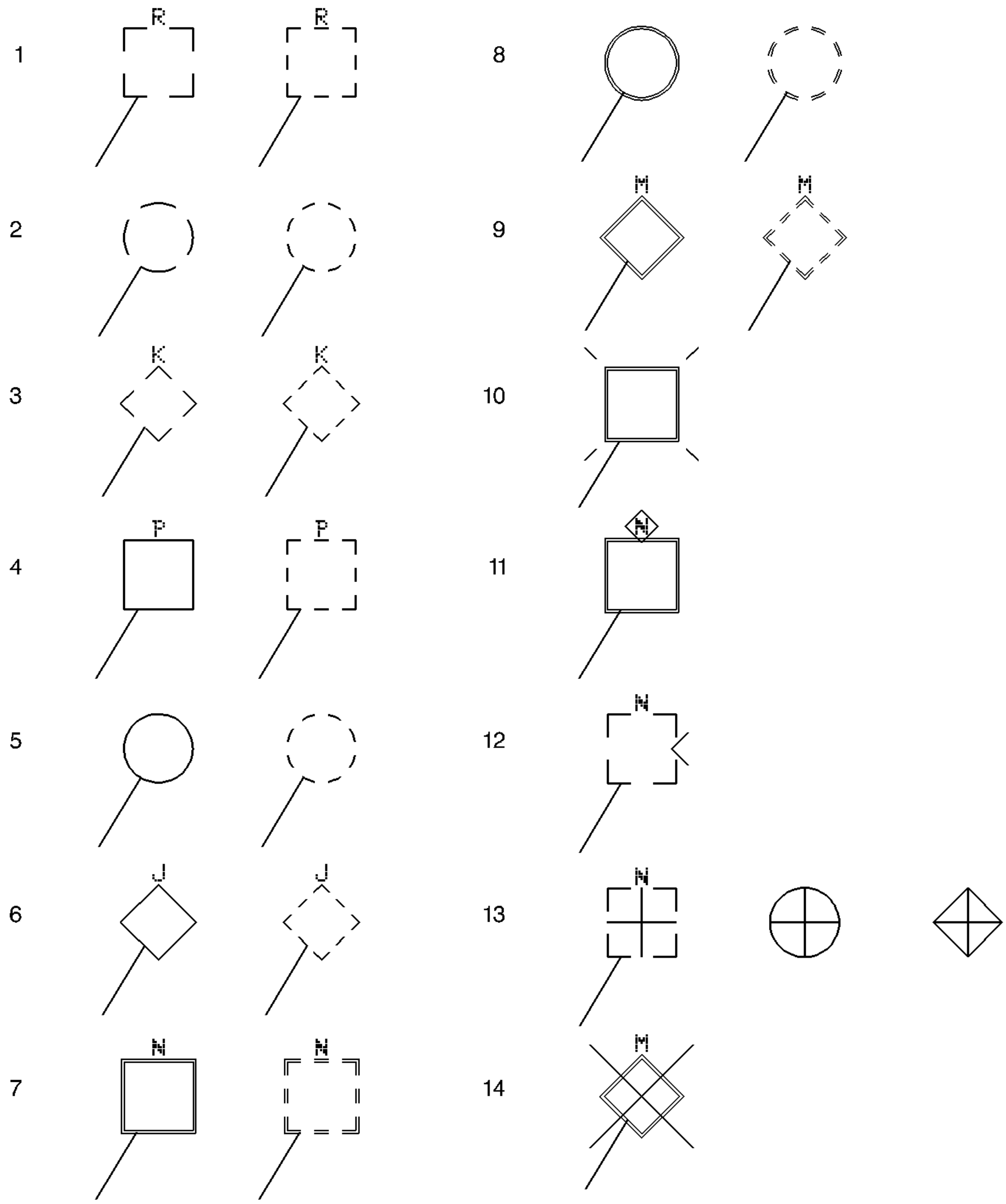
Figure I-02-08 Example HUD Format (Airdata, Autopilot and Navigation Symbology)



1 UNKNOWN TRACK POSITION
2 FRIENDLY TRACK POSITION
3 HOSTILE TRACK POSITION
4 UNKNOWN TARGET MARKER
5 FRIENDLY TARGET MARKER
6 HOSTILE TARGET MARKER
7 UNKNOWN FIRST TARGET MARKER
8 FRIENDLY FIRST TARGET MARKER
9 HOSTILE FIRST TARGET MARKER
10 RADAR LOCK ON
11 SHOOT CUE
12 AMRAAM LONGEST TIME TO AUTONOMOUS
13 MISSILE IN FLIGHT
14 MINIMUM RANGE CROSS

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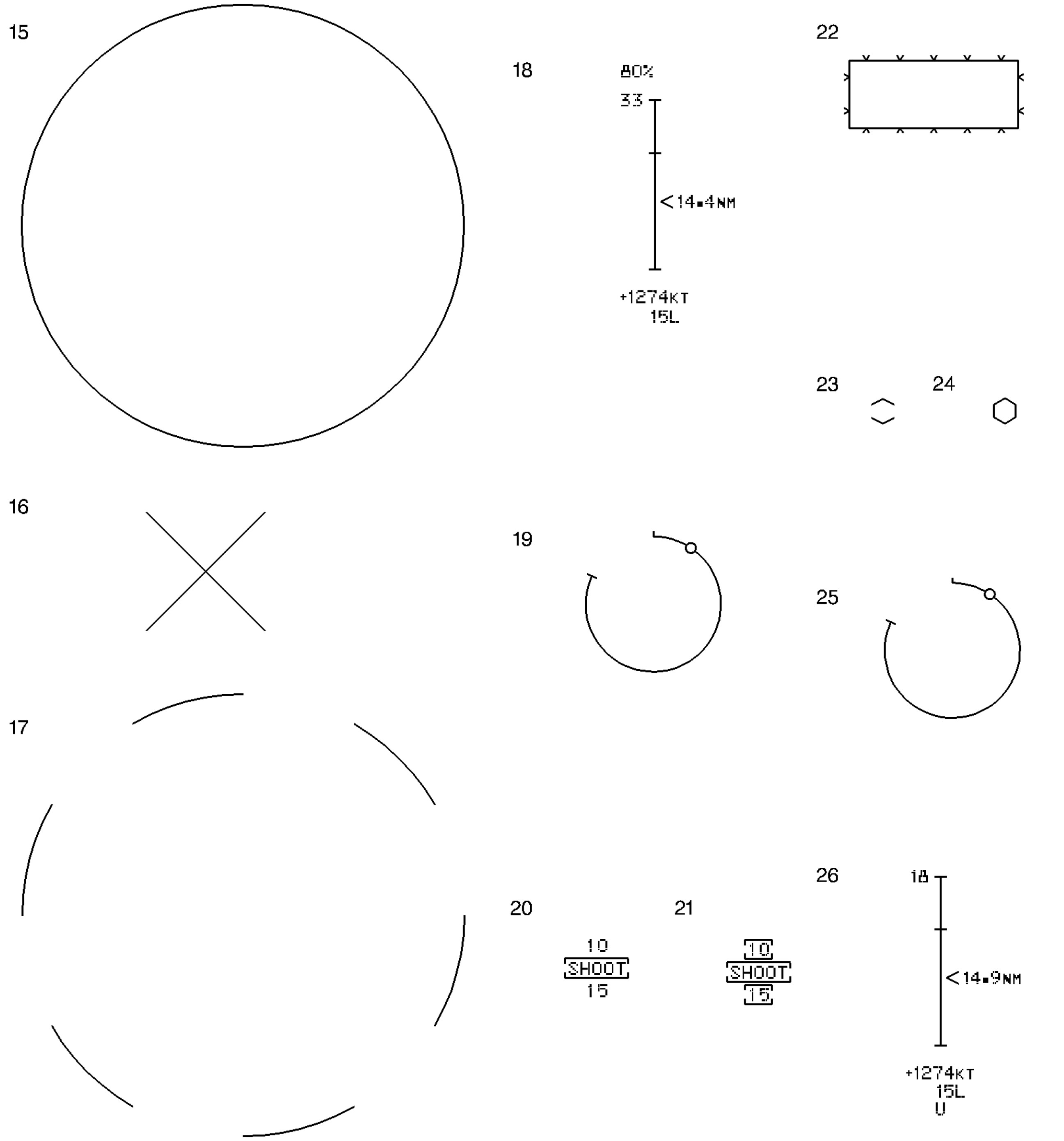
Figure I-02-09 Radar Track/Target Symbology



15 ALLOWABLE STEERING ERROR AND STEERING DOT
16 BREAK AWAY CROSS
17 ACQUISITION CONE
18 WEAPONS SCALE AND MARKER
19 MISSILE TARGET RANGE CIRCLE
20 MISSILE TIME TO RELEASE
21 MISSILE TIME TO GO AUTONOMOUS
21 MISSILE IN FLIGHT TIME TO AUTONOMOUS
22 TURN AWAY LIMITS
23 HEAD LOOK ANGLE-NOT ACQUIRED
24 HEAD LOOK ANGLE-ACQUIRED
25 SRAAM TARGET RANGE CIRCLE
26 SRAAM WEAPONS SCALE AND MARKER
26 SRAAM UNCAGE PRESET

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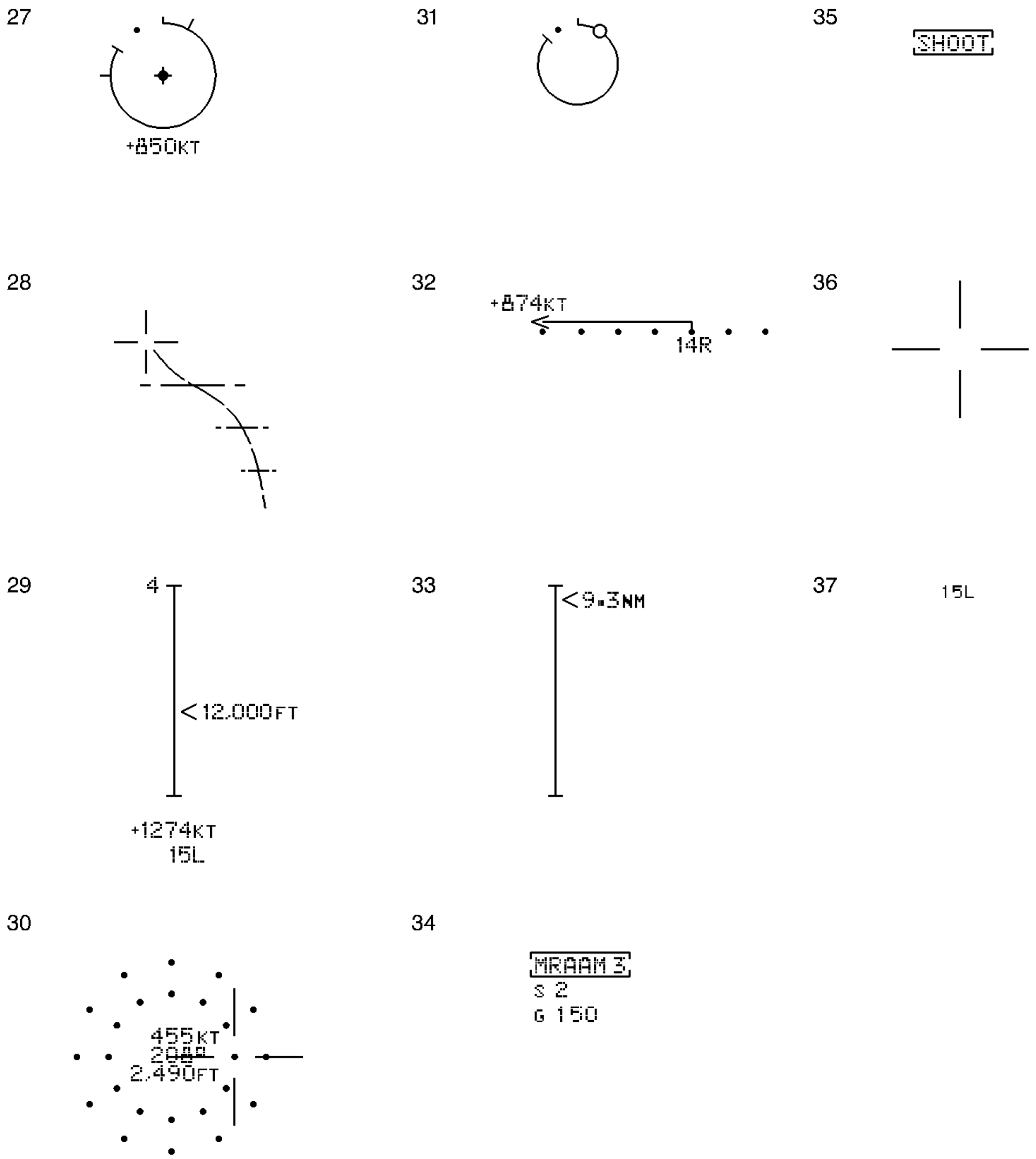
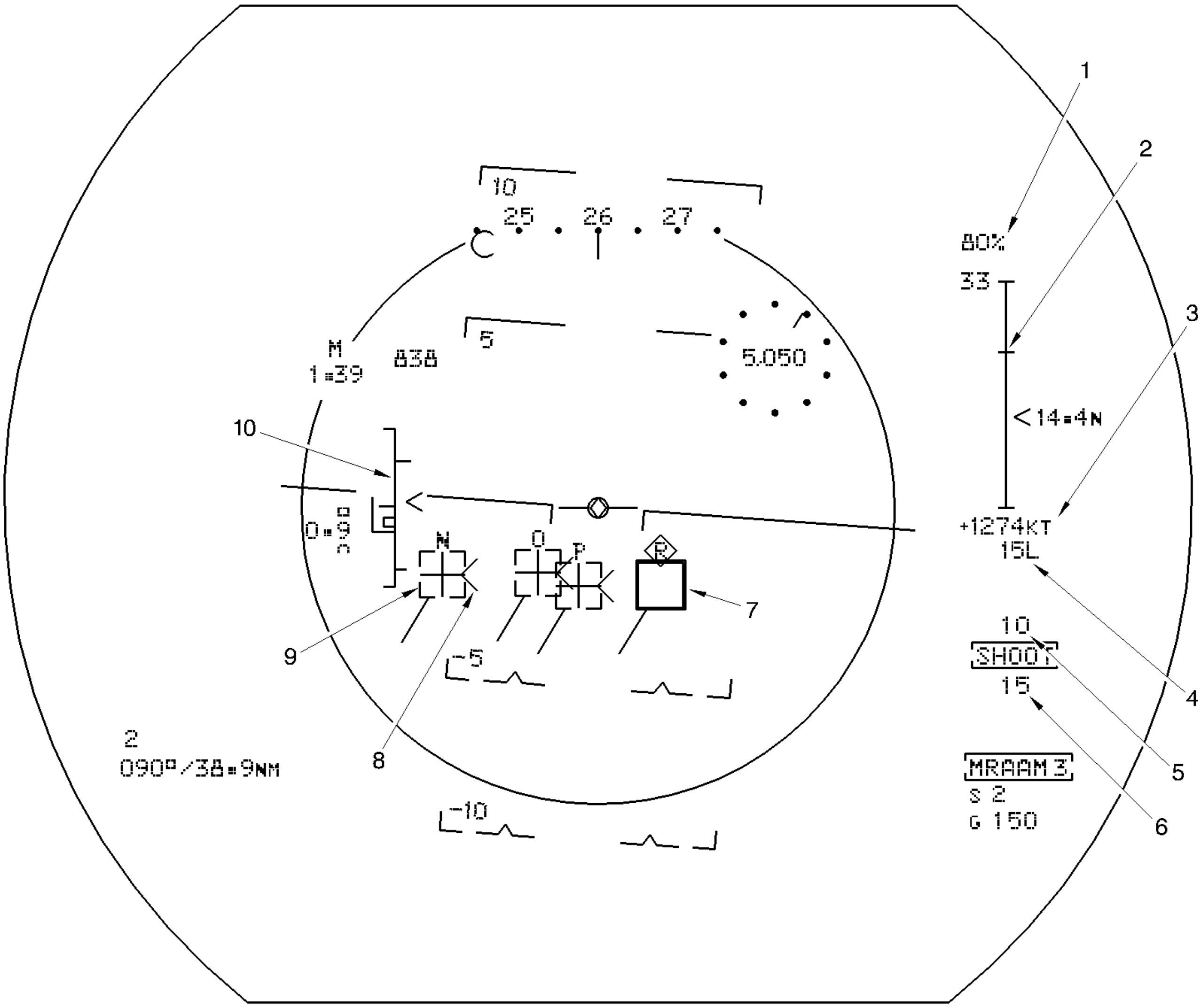
Figure I-02-10 Combat Steering and Air to Air Missile Symbology



27	DIRECTOR GUNSIGHT	32	CLOSING SPEED
28	GUN BORESIGHT CROSS	33	RANGE SCALE
28	HISTORIC GUN TRACER LINE	34	AIR TO AIR WEAPONS DISPLAY
29	GUN SCALE AND MARKER	35	SHOOT CUE
30	STEERING POSITION CUE	36	X-Y MARKER
30	TARGET PARAMETERS	37	TARGET ASPECT ANGLE
31	TARGET RANGE CIRCLE		

ICN-1B-B-311400-B-K0999-01500-A-01-2

Figure I-02-11 Gun and VISIDENT Symbology



1 AMRAAM PROBABILITY OF INTERCEPT
2 AMRAAM SCALE AND MARKER
3 RANGE RATE
4 ASPECT ANGLE
5 TIME TO AUTONOMOUS - IF FIRED NOW
6 LONGEST TIME TO AUTONOMOUS - MISSILES IN FLIGHT
7 No.1 TARGET TD BOX
8 TD LONGEST TIME TO AUTONOMOUS
9 TD BOX, MISSILE IN FLIGHT
10 ENERGY CUE

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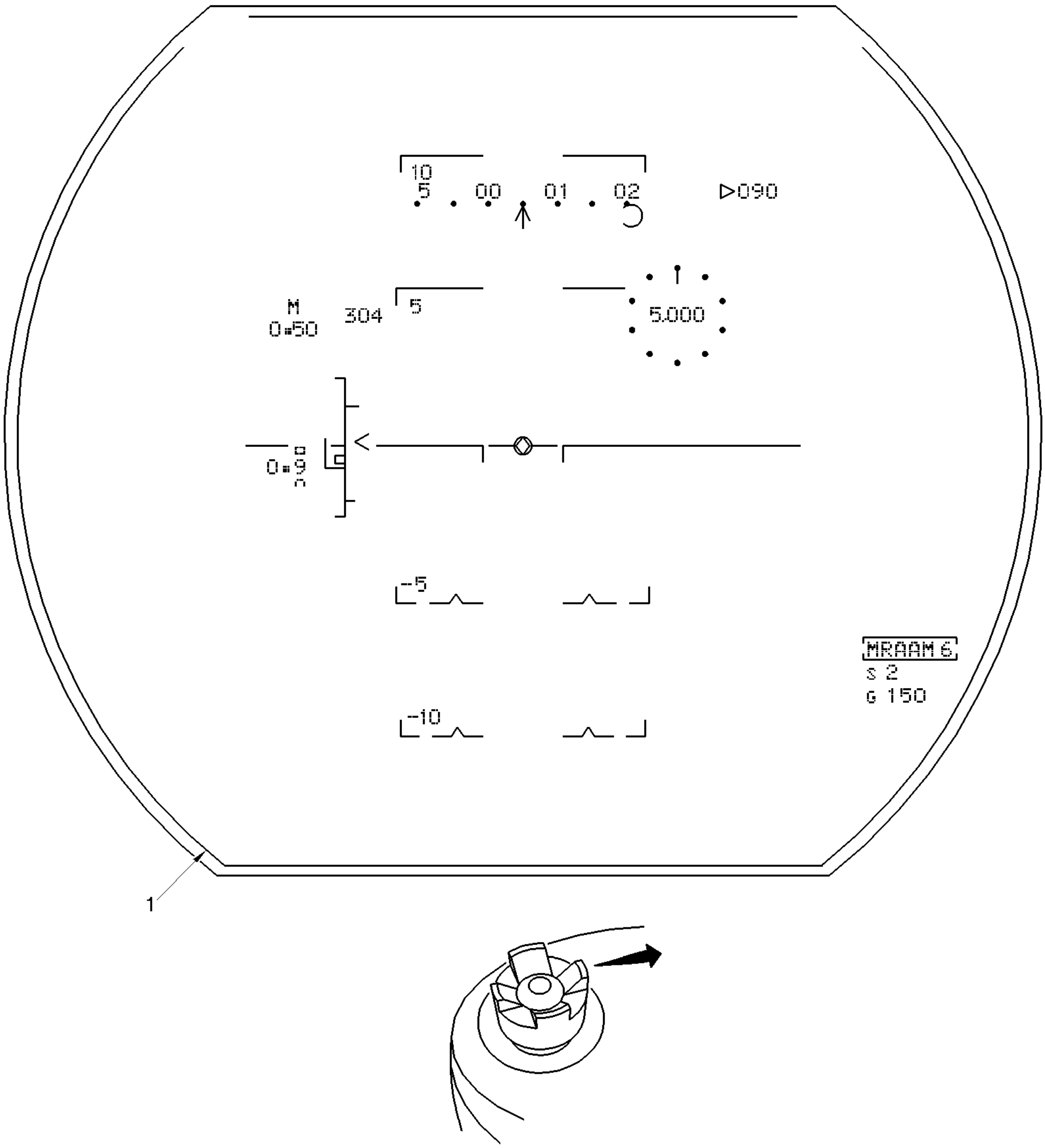
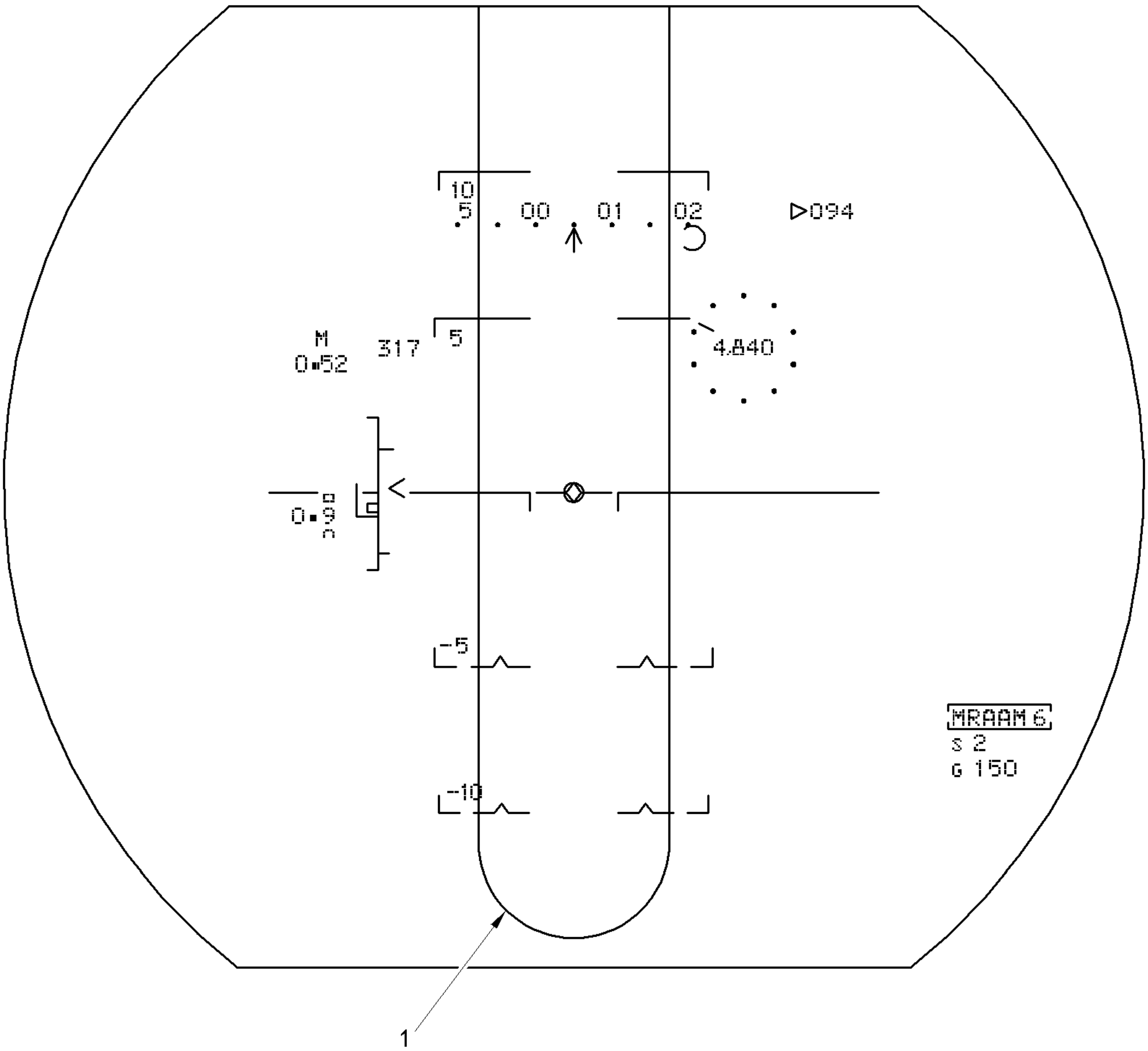
Figure I-02-12 Example HUD Format (Air to Air Attack Mode)

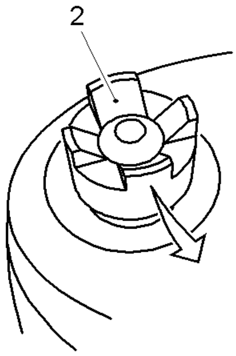


1 HUD ACQUISITION SEARCH BOUNDARY

ICN-1B-B-311400-B-K0999-01502-A-01-2

Figure I-02-13 HUD Acquisition

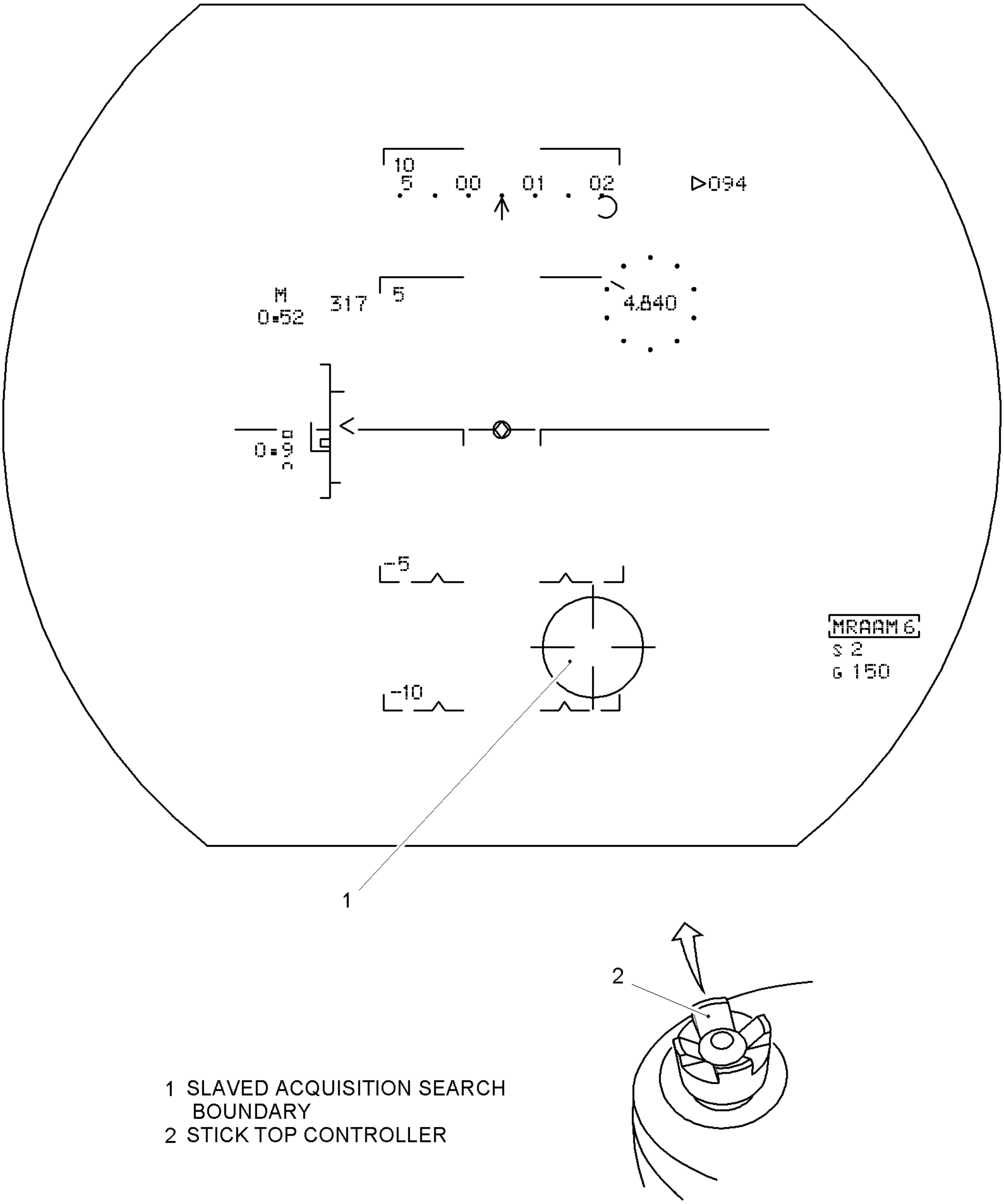




1 VERTICAL ACQUISITION SEARCH BOUNDARY
2 STICK TOP CONTROLLER

ICN-1B-B-311400-B-K0999-01472-A-02-2

Figure I-02-14 Vertical Acquisition



1 SLAVED ACQUISITION SEARCH BOUNDARY
2 STICK TOP CONTROLLER

ICN-1B-B-311400-B-K0999-01503-A-02-2

Figure I-02-15 Radar Slaved Acquisition

MULTIFUNCTION HEAD DOWN DISPLAY

The cockpit display suite has three Multifunction Head Down Displays (MHDD). Each MHDD comprises a 6 inch square flat panel Active Matrix Liquid Crystal Display (AMLCD) with 17 soft-keys surrounding the screen. The MHDD can present a variety of tactical and aircraft system information.

Formats are grouped to specific MHDD: the detailed groups are described in but the general principles are that the left MHDD carries tactical attack formats, the center carries the Pilot Awareness (PA) format, while the right carries further tactical displays as well as the bulk of the aircraft system formats. This does not mean that formats are lost if any one of the MHDD fail; the format groups can be displayed on any MHDD by use of the display swap keys located on the pedestal panel. Certain formats, refer to Table I-02-01 , are defined as default formats for particular PoF, and are automatically displayed upon entry into that PoF. In general any format can be selected at any time via the MHDD soft-keys appropriate for that MHDD format group.

The MHDD formats shown in Figure I-02-16 to Figure I-02-35 are to be considered as typical examples of the system information that can be displayed.

SYMBOL GENERATION

The MHDD formats are produced by the Computer Symbol Generator (CSG). There are two CSG, each capable of driving up to six MHDD and two HUD. Only one CSG is on-line at any one time; the other CSG is in standby mode just in case the on-line CSG fails. The CSG in standby can be chosen to be the on-line CSG by selecting the CSG toggle switch, located on the right forward console, to the REV (reversionary) position. The output of the selected CSG is transmitted to the MHDD via dedicated video links.

Soft-key legends are generated by the Cockpit Interface Unit (CIU). When a soft-key option is selected it is transmitted by the CIU to the relevant system via the cockpit and avionic databus.

FAILURE

In the event of a MHDD failure, it is possible to transfer the displays from the failed MHDD to the remaining operational MHDD using the display change selector/indicators on the pedestal panel.

FORMATS

The three MHDD provide the primary display for a number of systems and allow control selections for some systems to be made. The information is organized into the following formats:

- Attack (ATCK)
- Autocue (ACUE) (not available in the air)
- Checklist (CHKL)
- Defensive Aids Sub System (DASS)
- Digital Map Generator (DMG)
- Disorientation Recovery Format (DRF)
- Elevation (ELEV)
- Engines (ENG)
- Fuel (FUEL)
- Head Down HUD (HDHUD)
- Horizontal Situation Indicator (HSI)
- Hydraulics (HYD)
- Maintenance (MNTC)
- Pilot Awareness (PA)
- Radios (FREQ)
- Stores (STOR)
- Waypoint (WPT)
- Warnings (W) (only available while warnings are present) .

In each PoF the left and right MHDD formats are automatically selected for display by default. The formats for each PoF are given in Table I-02-01 . The soft-keys enable options associated with each format, or selection of other display formats.

Phase of Flight Selected	Formats Displayed Upon Entry Left MHDD	Formats Displayed Center MHDD	Formats Displayed Upon Entry Right MHDD
Ground	ACUE	PA	ENG/STOR
Take-off	ATCK	PA	ENG
Navigation	ATCK	PA	ELEV
Air to Air Combat	ATCK	PA	ELEV
Approach & Landing	ATCK	PA	ENG
Engine format initially, followed by stores format when the MASS is set to STBY or LIVE			

Table I-02-01 Default Format Displays

The MNTC format is used for ground maintenance and can only be selected from the ACUE format. The ACUE format is only available on the ground.

Formats are displayed on specific MHDD. Detailed information for each format/MHDD is given in the following Tables:

- Ground Procedures Formats - Table I-02-02
- Take-off Formats - Table I-02-03
- Navigation Formats - Table I-02-04
- Air to Air Combat Formats - Table I-02-05
- Approach and Landing Formats - Table I-02-06 .

Left MHDD	Center MHDD	Right MHDD
Autocue[9]	Pilot Awareness	Engines (initially), Stores (when MASS is set to standby or live)
Head Down HUD [7]	Disorientation Recovery [2]	Head Down HUD
Attack		Elevation
Maintenance [3]		DASS
Checklist [1]		Reversionary
Engines [10]		Checklist [8]
Fuel [1]		Engines [5]
Hydraulics [1]		Fuel
Stores [1]		Hydraulics
		Radios
		Waypoints

Default

[1] From the Warnings format on the right MHDD

[2] From the selection of Auto Recovery

[3] From the ACUE format

[4] Only when there is a warning

[5] When STOR is the default format

[6] When ENG is the default format

[7] From the ATCK format

[8] When there is not a warning

[9] Default if preflight. Only available when the undercarriage selection is not UP

[10] From the HDHUD format on the left MHDD or from the Warnings format on the right MHDD

Left MHDD	Center MHDD	Right MHDD
		Stores [6]
		Warnings [4]

Default

[1] From the Warnings format on the right MHDD

[2] From the selection of Auto Recovery

[3] From the ACUE format

[4] Only when there is a warning

[5] When STOR is the default format

[6] When ENG is the default format

[7] From the ATCK format

[8] When there is not a warning

[9] Default if preflight. Only available when the undercarriage selection is not UP

[10] From the HDHUD format on the left MHDD or from the Warnings format on the right MHDD

Table I-02-02 Ground Procedures Formats

Left MHDD	Center MHDD	Right MHDD
Attack	Pilot Awareness	Engines
Head Down HUD	Disorientation Recovery[2]	Head Down HUD
Autocue [6]		Elevation
Checklist [1]		DASS
Engines [5]		Reversionary
Fuel [1]		Checklist [4]
Hydraulics [1]		Fuel
Stores [1]		Hydraulics
		Radios

Default

[1] From the Warnings format on the right MHDD

[2] From the selection of Auto Recovery

[3] Only when there is a warning

[4] When there is not a warning

[5] From the HDHUD format on the left MHDD or from the Warnings format on the right MHDD

[6] Default if an ACUE CAUTION or NOGO and the undercarriage selection is not UP. Only available with Weight On Wheels

Left MHDD	Center MHDD	Right MHDD
		Waypoints
		Stores
		Warnings [3]

Default

[1] From the Warnings format on the right MHDD

[2] From the selection of Auto Recovery

[3] Only when there is a warning

[4] When there is not a warning

[5] From the HDHUD format on the left MHDD or from the Warnings format on the right MHDD

[6] Default if an ACUE CAUTION or NOGO and the undercarriage selection is not UP. Only available with Weight On Wheels

Table I-02-03 Take-off Formats

Left MHDD	Center MHDD	Right MHDD
Attack	Pilot Awareness	Elevation
Head Down HUD	Disorientation Recovery [2]	Head Down HUD
Autocue [6]		DASS
Checklist [1]		Reversionary
Engines [5]		Checklist [4]
Fuel [1]		Engines
Hydraulics [1]		Fuel
Stores [1]		Hydraulics
		Radios
		Waypoints

Default

[1] From the Warnings format on the right MHDD

[2] From the selection of Auto Recovery

[3] Only when there is a warning

[4] When there is not a warning

[5] From the HDHUD format on the left MHDD or from the Warnings format on the right MHDD

[6] Default if an ACUE CAUTION or NOGO and the undercarriage selection is not UP.

Left MHDD	Center MHDD	Right MHDD
		Stores
		Warnings [3]

Default

[1] From the Warnings format on the right MHDD

[2] From the selection of Auto Recovery

[3] Only when there is a warning

[4] When there is not a warning

[5] From the HDHUD format on the left MHDD or from the Warnings format on the right MHDD

[6] Default if an ACUE CAUTION or NOGO and the undercarriage selection is not UP.

Table I-02-04 Navigation Formats

Left MHDD	Center MHDD	Right MHDD
Attack	Pilot Awareness	Elevation
Head Down HUD	Disorientation Recovery [2]	Head Down HUD
Checklist [1]		DASS
Engines [5]		Reversionary
Fuel [1]		Checklist [4]
Hydraulics [1]		Engines
Stores [1]		Fuel
		Hydraulics
		Radios
		Waypoints

Default

[1] From the Warnings format on the right MHDD

[2] From the selection of Auto Recovery

[3] Only when there is a warning

[4] When there is not a warning

[5] From the HDHUD format on the left MHDD or from the Warnings format on the right MHDD

Left MHDD	Center MHDD	Right MHDD
		Stores
		Warnings [3]

Default

[1] From the Warnings format on the right MHDD

[2] From the selection of Auto Recovery

[3] Only when there is a warning

[4] When there is not a warning

[5] From the HDHUD format on the left MHDD or from the Warnings format on the right MHDD

Table I-02-05 Air to Air Attack Formats

Left MHDD	Center MHDD	Right MHDD
Attack	Pilot Awareness	Engines
Head Down HUD	Disorientation Recovery [2]	Head Down HUD
Autocue [6]		Elevation
Checklist [1]		DASS
Engines [5]		Reversionary
Fuel [1]		Checklist [4]
Hydraulics [1]		Fuel
		Hydraulics
		Radios
		Waypoints
		Stores
		Warnings [3]

Default

[1] From the Warnings format on the right MHDD

[2] From the selection of Auto Recovery

[3] Only when there is a warning

[4] When there is not a warning

[5] From the HDHUD format on the left MHDD or from the Warnings format on the right MHDD

[6] Only available when the undercarriage selection is not UP

Table I-02-06 Approach and Landing Formats

NOTE

The right MHDD provides an option to select either the CHKL, ENG, FUEL, HYD and STOR format for display on the left MHDD. When an option is selected, the displayed format on the left MHDD, replaces the current display until it is deselected or an alternative selection is made on the right MHDD.

GENERAL FORMAT SYMBOLOGY

In most cases, if information is presented in an analogue format (e.g. thermometer scales or counter pointers), a digital readout is also presented. Red is used to indicate warnings or failure conditions requiring immediate action, e.g. hostile track; amber indicates cautionry conditions, e.g. unknown track; and green or white indicates correct or satisfactory conditions, e.g. friendly track. Flashing symbology is used to alert the aircrew to:

- A change in priorities, e.g. a change in target/track order of threat priority
- An illegal action, e.g. an unacceptable stores jettison program
- An action can not be achieved, e.g. an AMRAAM that will not reach the target.

ATTACK FORMAT

The Attack (ATCK) format enables sensor contacts to be displayed, tracked, interrogated or nominated for attack using the following HOTAS controls:

- Radar Elevation Control and Radar A/S Gain (located on left throttle top)
- X-Y Controller (located on the right throttle top)
- DTL Rotate and Re-attack Switch (located on the right throttle top)
- Air-to-Air Weapons Selector (located on the stick top)
- Interrogator Switch (located on the stick top)
- Radar Air Combat Mode, Radar Lock/Break Lock Selector (located on the stick top).

During operation in Track While Scan (TWS) mode radar contacts are displayed against one of two selectable range/azimuth display formats. The default format is a B-scope grid type presentation, refer to Figure I-02-16 . Radar scan volume is indicated against the grid by three vertical lines, which together represent scan width and center.

Soft-key selection enables the display to be changed to a Plan Position Indication (PPI) type presentation if required, refer to Figure I-02-17 . When PPI is selected, radar contacts are displayed against a sector upon which range is indicated by arcs.

A Velocity Search (VS) mode is provided as an alternative to TWS and is accessed by soft-key selection, refer to Figure I-02-18 . When in VS mode, the radar plots are shown against a velocity azimuth type display.

AUTOCUE FORMAT

The Autocue (ACUE) format, refer to Figure I-02-19 , supports preflight activities by presenting the information necessary for safe preparation of the aircraft for its intended task. The following types of data are presented:

- Control prompts (switch settings)
- Flight control system status
- Navigation system status
- Caution indications
- Failure indications
- Store error indications
- Displays and controls error indications
- Portable Data Store (PDS) load indications
- Crypto variable indications
- Command eject indications
- Operational status indications.

The soft-keys associated with the ACUE format enable the required LINS alignment mode and LINS NAV mode to be selected.

CHECKLIST FORMAT

The Checklist (CHKL) format provides the aircrew with a list of standard and emergency checklists from which the required drill can be selected, refer to Figure I-02-32 .

Standard Checklist

The standard checklists provide the aircrew with the drills required to perform normal aircraft and systems checks, refer to Figure I-02-33 .

Emergency Checklist

The emergency checklists provide the aircrew with the emergency drills required to perform aircraft and system checks for abnormal operation. Similar in format to the standard checklist.

Warnings Procedures and Consequences

The warnings procedures and consequences provide the aircrew with the procedure/consequence associated with the warning displayed on the DWP, refer to Figure I-02-35 .

DASS FORMAT

The Defensive Aids Subsystem (DASS) format displays range rings and targets relayed from the ATCK format, and the remaining number of chaff packages and flares, at the present software standard. The only DASS function currently available is the discharge of chaff and flares via the chaff/flare release switch, located on the left throttle top.

ELEVATION FORMAT

The Elevation (ELEV) format format enables sensor contacts to be displayed, tracked, interrogated or nominated for attack using the following HOTAS controls:

- Radar Elevation Control and Radar A/S Gain (located on left throttle top)
- X-Y Controller (located on the right throttle top)
- DTL Rotate and Re-attack Switch (located on the right throttle top)
- Air-to-Air Weapons Selector (located on the stick top)
- Interrogator Switch (located on the stick top)
- Radar Air Combat Mode, Radar Lock/Break Lock Selector (located on the stick top).

The contacts are displayed against one of two selectable formats; an altitude/range grid presentation known as Profile, refer to Figure I-02-20 , or an altitude/azimuth grid presentation known as C-scope, refer to Figure I-02-21 .

With the profile format selected the X-axis represents plan range in front of the aircraft while the Y-axis represents altitude. Scanner elevation coverage is displayed by two diverging lines and the pattern can be steered in elevation via a rotary control on the throttles.

The C-scope presentation displays azimuth on the X-axis while the Y-axis is used to display relative altitude. Scanner volume is displayed in both azimuth and elevation.

ENGINE FORMAT

The Engine (ENG) format, refer to Figure I-02-22 , displays engine low pressure turbine speed (NL) with Turbine Blade Temperature (TBT) and nozzle area (Aj) represented by four circular displays (two for each engine). Important values are displayed by either digital or analogue readouts. Each display has an alphanumeric value corresponding to the analogue data presented, except for high pressure turbine speed which is represented by two separate rolling digit type displays. Intake positions are displayed (only if auto cowl operation fails) by digital readouts and by two triangular markers which move against a fixed linear scale. The fuel flow is indicated in digital form at the top of the display. Warning captions related to the engines are also shown on this format, when applicable.

The soft-keys associated with the ENG format enable DECU lane selections to be made and other formats to be accessed.

FUEL FORMAT

The FUEL format, refer to Figure I-02-23 , displays the internal and external fuel tank contents pictorially. Each tank has a digital readout corresponding to the fuel remaining. Fuel transfer and boost pumps within the internal fuel tanks are displayed. The status of the low pressure fuel cocks is indicated by two symbols, each comprising a bar within a circle.

Engine feed lines are shown between the boost pumps and the LP fuel cock symbols. Fuel feed temperatures are indicated in digital form adjacent to the LP cock symbology.

Other information displayed on the FUEL format includes a fuel total readout, CG warnings and a transfer selector prompt to show the recommended selection to restore fuel balance.

HEAD DOWN HUD FORMAT

The HDHUD format, refer to Figure I-02-24 , displays analogue and digital readouts as presented on the HUD. Symbology presented on the format is categorized as follows:

- Attitude and directional symbology
- Navigation symbology
- Air data symbology
- Attack symbology.

The main difference between the two displays is that the HDHUD format has a circular display in addition to the HUD climb/dive bars. The circular display is divided into two sectors, one colored blue and the other brown, indicating climb or dive respectively.

If the total velocities are <48 kt, the display will change to show the pitch attitude. This change is indicated by the aircraft climb/dive symbol changing to an attitude symbol. These symbols are fixed at the display center with the circular display moving around them.

HYDRAULICS FORMAT

The Hydraulics (HYD) format, refer to Figure I-02-25 , displays a diagrammatic representation of the left and right hydraulic systems. The display shows the status of the valves and reservoirs along with associated information e.g. pressures, levels and temperatures. The information is displayed in analogue and digital form.

Reservoir contents, flight control pressures and utilities pressures are displayed. If a system pressure or reservoir content within the hydraulic system falls below the safe level the associated box(es) are displayed in red and the digital readout(s) of actual contents will be displayed against a red infill.

The status of the utility isolation valves is indicated by two symbols, each comprising a bar within a circle. An AUTO or MAN caption is displayed adjacent to the symbols to indicate whether the valves are being controlled automatically (by the utilities control system) or manually (via soft-key selection).

PILOT AWARENESS FORMAT

The Pilot Awareness (PA) format, refer to Figure I-02-26 , displays navigational information in plan form. The symbology can be displayed against a digitally generated map and one of four selectable grids; range, lat/long, geographical reference or bull"s-eye. The PA format also presents track/target data and a limited amount of miscellaneous information to assist in the safe management of the aircraft. The display is active and therefore gives an up-to-date representation of aircraft positioning at all times.

RADIO FORMAT

The Radio (FREQ) format, refer to Figure I-02-27 , displays the V/UHF frequencies for the manual channel and the 24 preset channels for radios 1 and 2. The data is presented in the form of two mutually exclusive lists one covering radio 1 details and the other covering radio 2, however, the format always displays manual channel data for both radios.

STORES FORMAT

The Stores (STOR) format, refer to Figure I-02-28 , displays a diagrammatic representation of weapon system status and current stores configuration. Stores are represented by white outlined symbols at positions relative to their host store station. Stores are selected for jettison by performing an X-Y insert over the appropriate store symbol(s).

WARNINGS FORMAT

The Warnings (W) format displays the warnings which are applicable during flight and, by soft-key selection, the procedures and consequences for them.

When the warnings format is selected, the highest priority warning will be displayed. The priority of a warning is based on whether it has been acknowledged, its category and time of occurrence.

WAYPOINT FORMAT

The Waypoint (WPT) format, refer to Figure I-02-29 , displays information associated the master waypoint list, the automatic route, and the manual route in the form of three separate waypoint lists. The lists are mutually exclusive and can be accessed by selection of three soft-keys labelled WPT LIST, AUTO RTE and MAN RTE.

MAINTENANCE FORMAT

The Maintenance (MNTC) format provides, via the ACUE format, the facility to make IBIT selections for ground maintenance functions. This format is not available when the aircraft is in motion or the ejection seat(s) is armed.

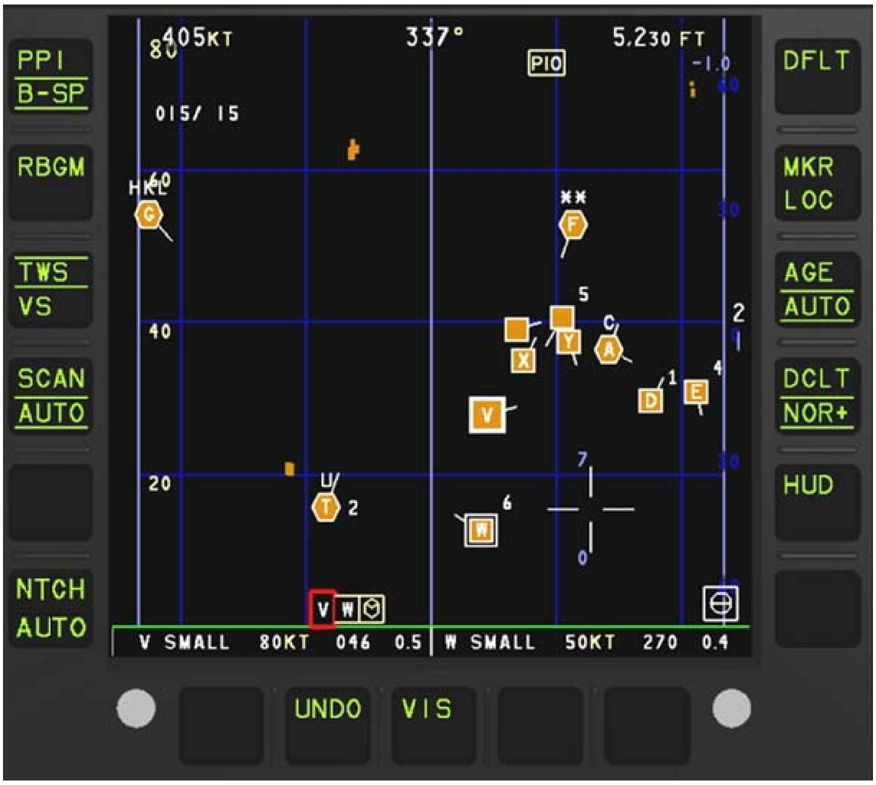
DISORIENTATION RECOVERY FUNCTION FORMAT

The Disorientation Recovery Function (DRF) format, refer to Figure I-02-30 , displays a decluttered HDHUD format on the center MHDD. When the aircraft achieves stable conditions, fulfilling the DRF requirements, the FCS will automatically engage the autopilot. The MHDD will then revert back to their previously selected formats prior to the selection of the DRF.

HORIZONTAL SITUATION INDICATOR FORMAT

The Horizontal Situation Indicator (HSI) format, refer to Figure I-02-31 , displays the following TACAN or navigation system derived data:

- Compass Rose
- Plan Range (Nav mode)
- Slant Range (TACAN mode)
- Bearing Pointer
- Course Readout
- Course Pointer
- Heading Marker
- Autopilot Demanded Heading
- Current Aircraft Track Pointer
- Lateral Deviation and Scale
- To/From Flag
- Current Destination Waypoint Number (Nav mode)
- TACAN Channel Number and Type (TACAN mode)
- TACAN Mode Indication (TACAN mode).

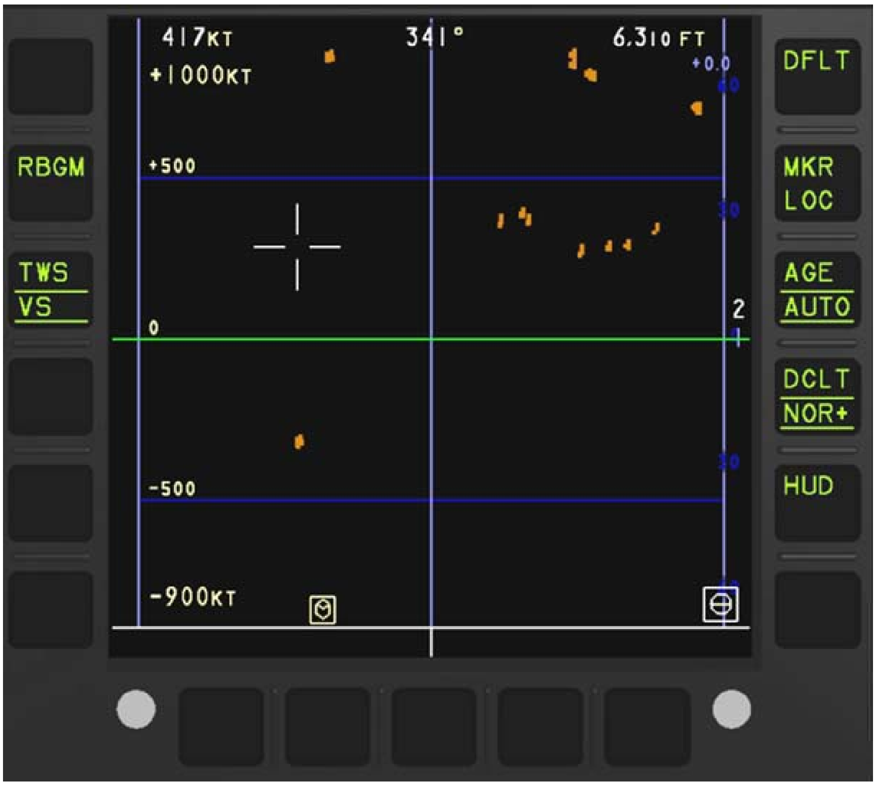


ICN-1B-B-311500-B-K0999-03564-A-02-2

Figure I-02-16 Typical Example of B-Scope ATCK Format

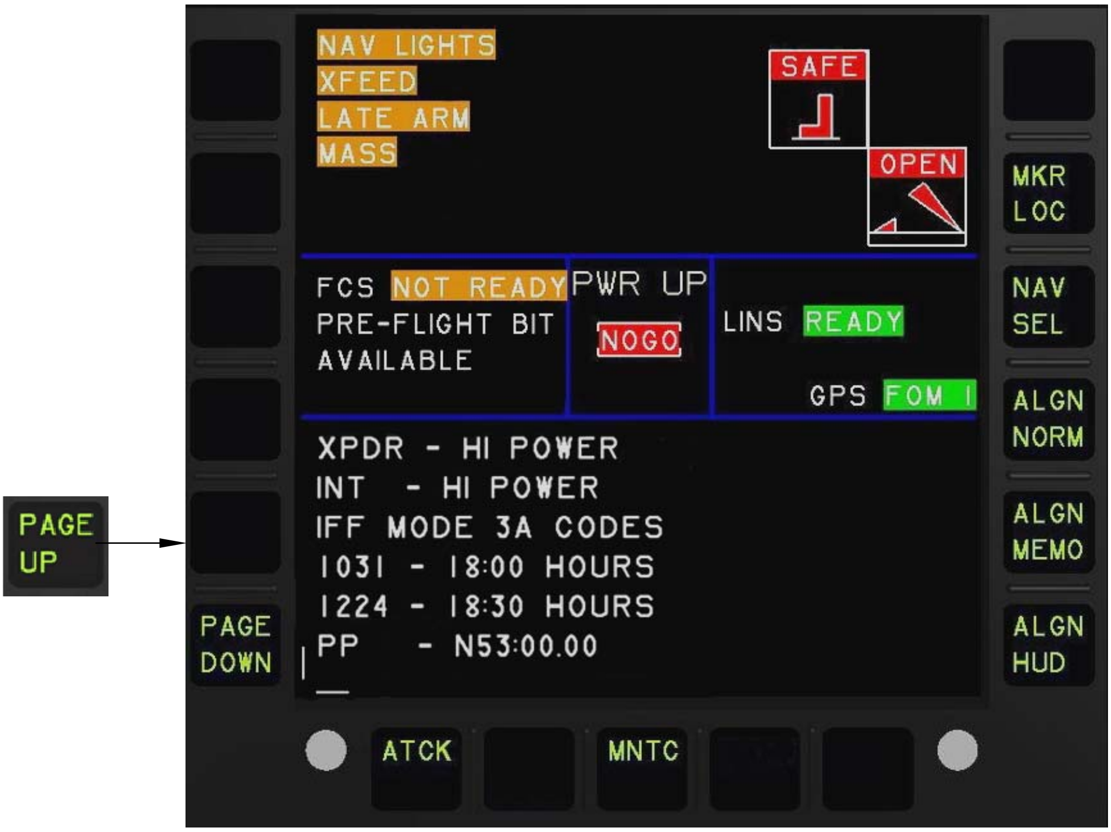
ICN-1B-B-311500-B-K0999-02187-A-02-2

Figure I-02-17 Typical Example of PPI ATCK Format



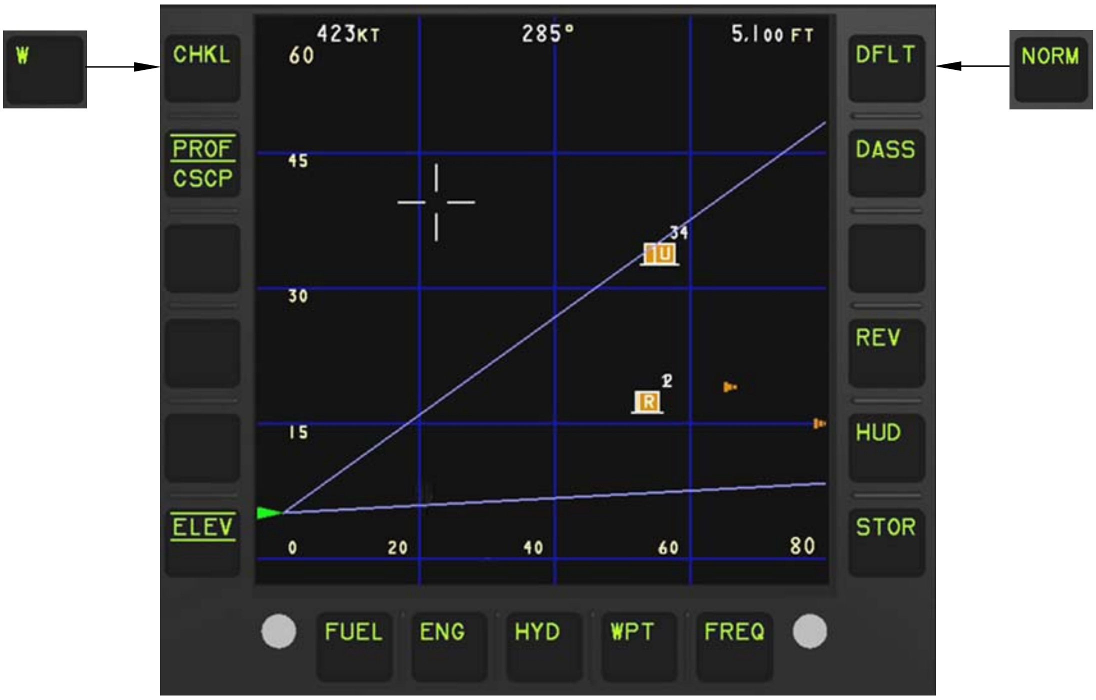
ICN-1B-B-311500-B-K0999-03565-A-01-2

Figure I-02-18 Typical Example of Velocity Search ATCK Format



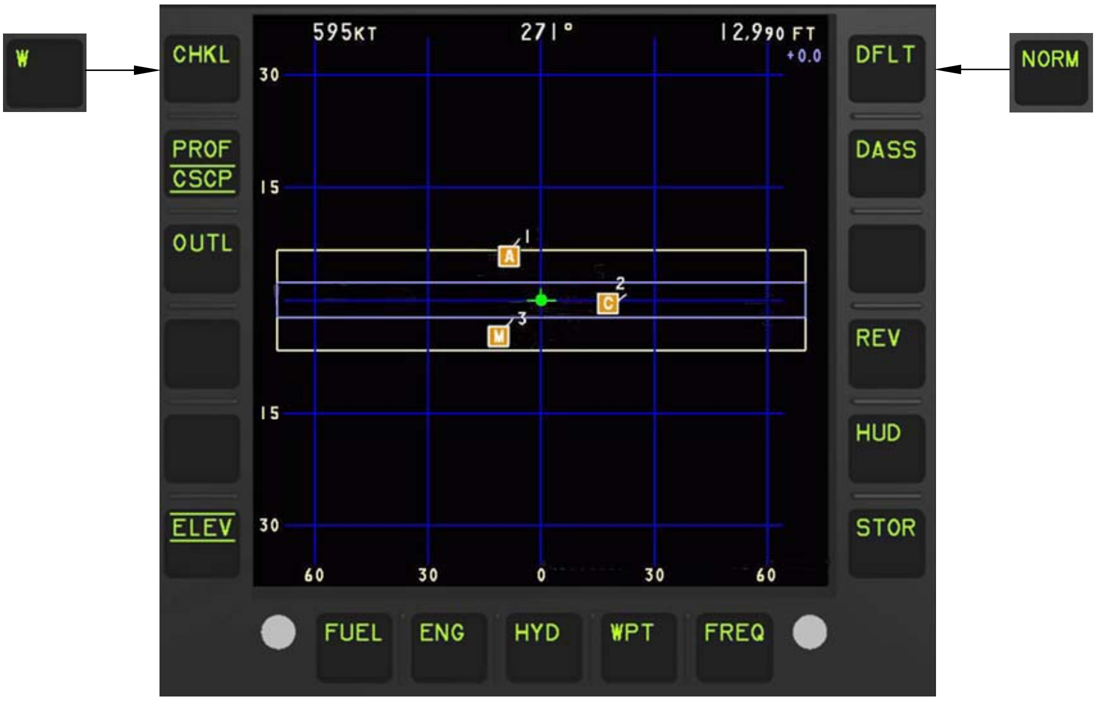
ICN-1B-B-311500-B-K0999-02188-A-01-2

Figure I-02-19 Typical Example of ACUE Format



ICN-1B-B-311500-B-K0999-03567-A-01-2

Figure I-02-20 Typical Example of Profile ELEV Format

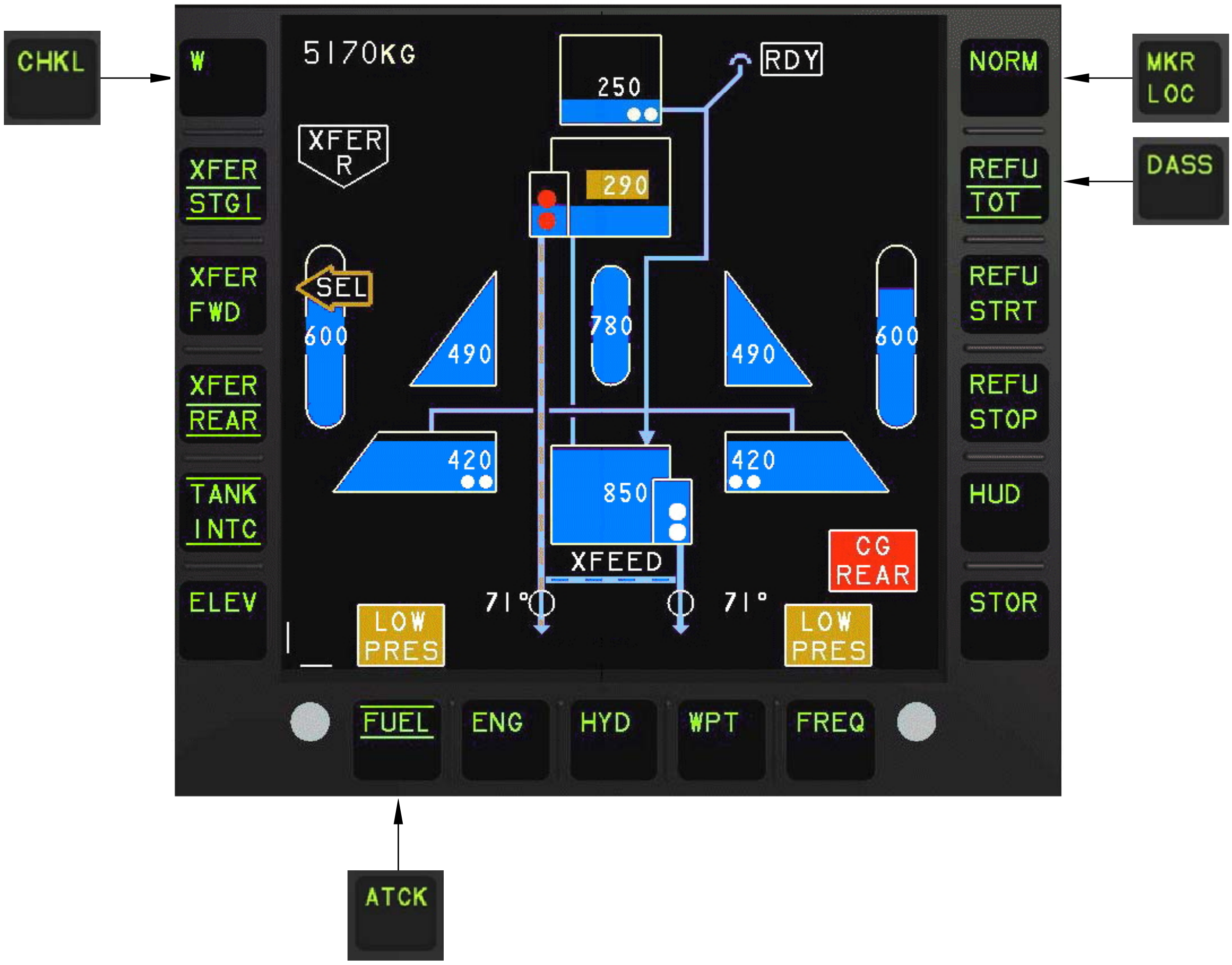


ICN-1B-B-311500-B-K0999-03566-A-01-2

Figure I-02-21 Typical Example of C-Scope ELEV Format

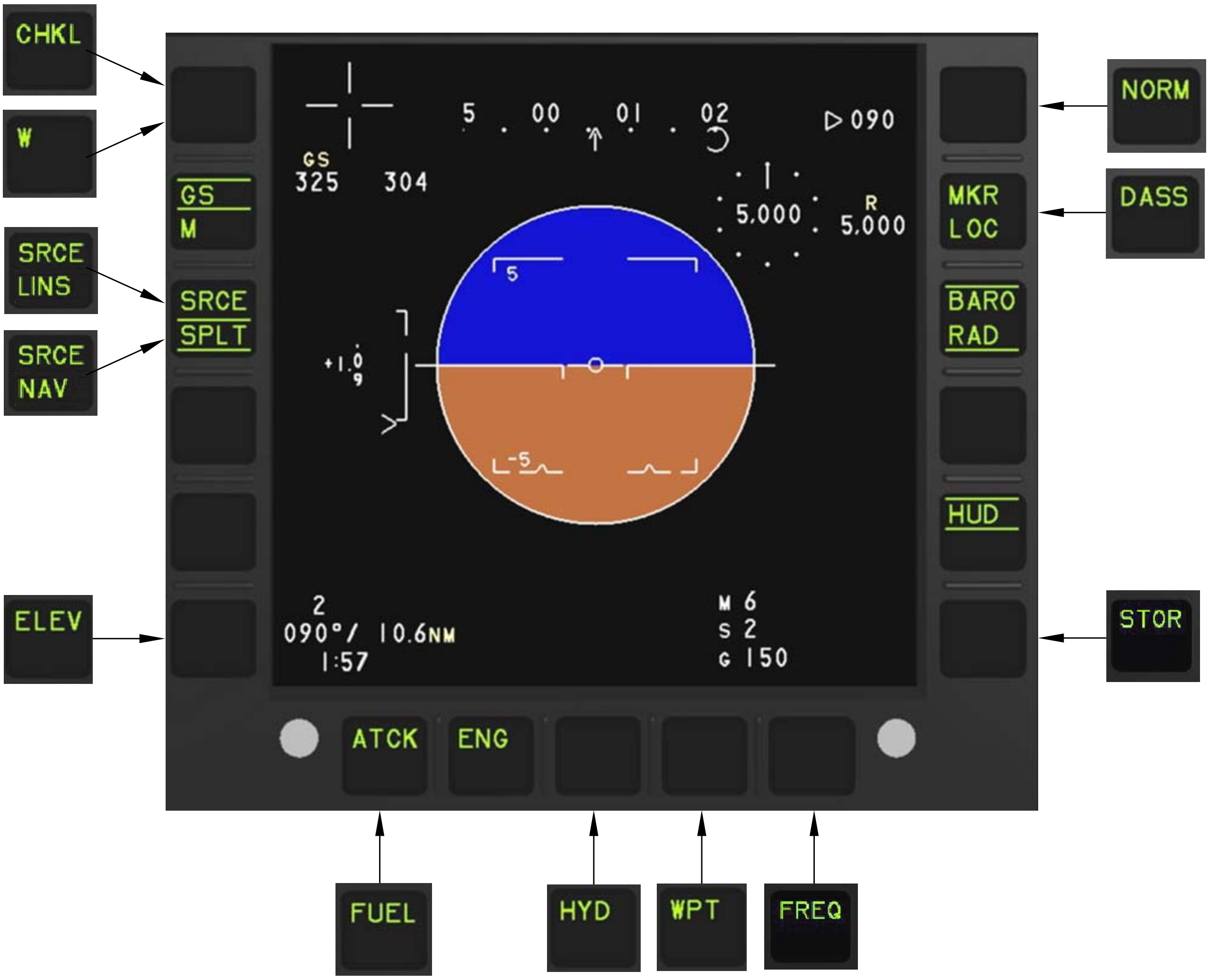
ICN-1B-B-311500-B-K0999-02190-A-01-2

Figure I-02-22 Typical Example of ENG Format



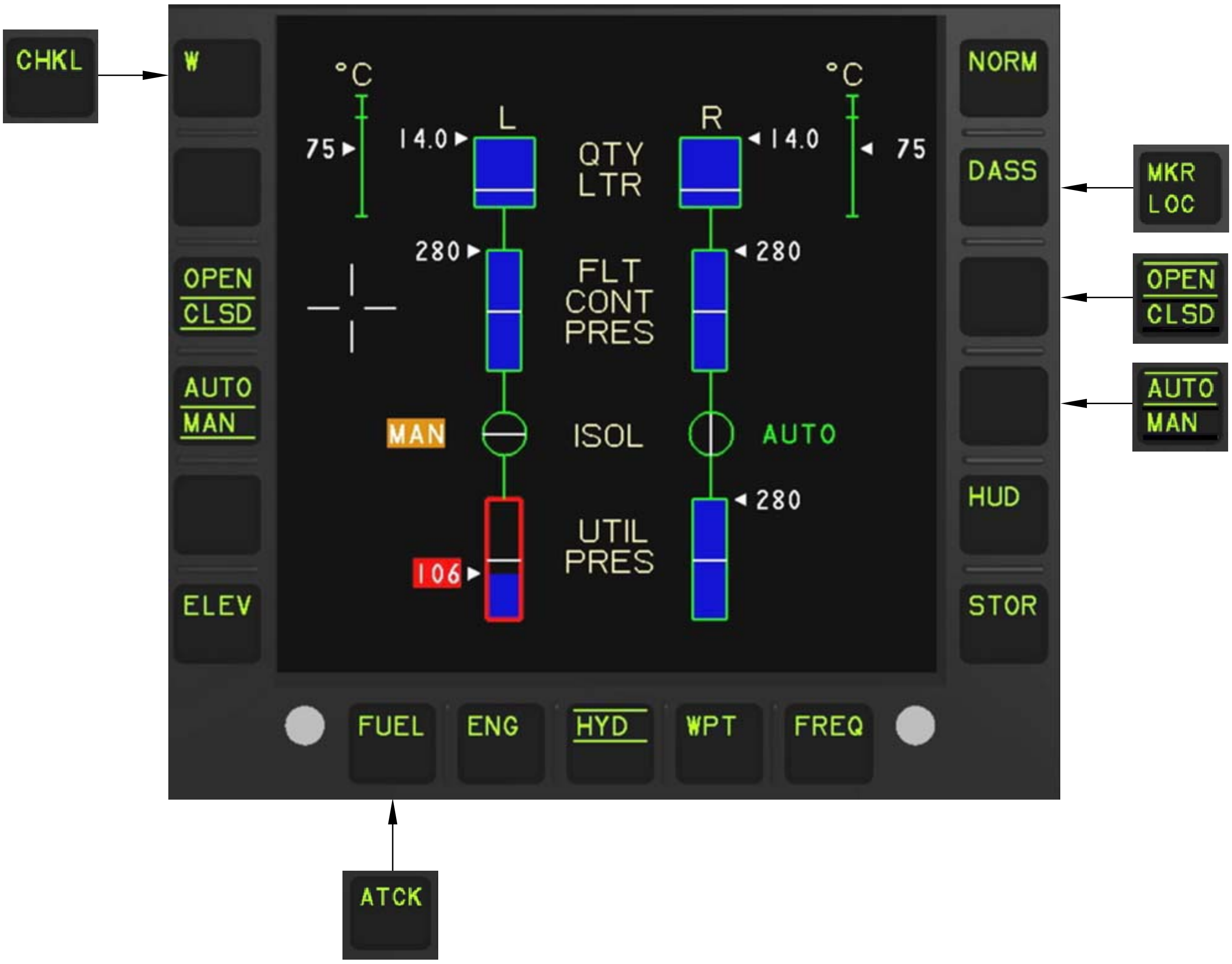
ICN-1B-B-311500-B-K0999-02191-A-01-2

Figure I-02-23 Typical Example of FUEL Format



ICN-1B-B-311500-B-K0999-02192-A-01-2

Figure I-02-24 Typical Example of HDHUD Format

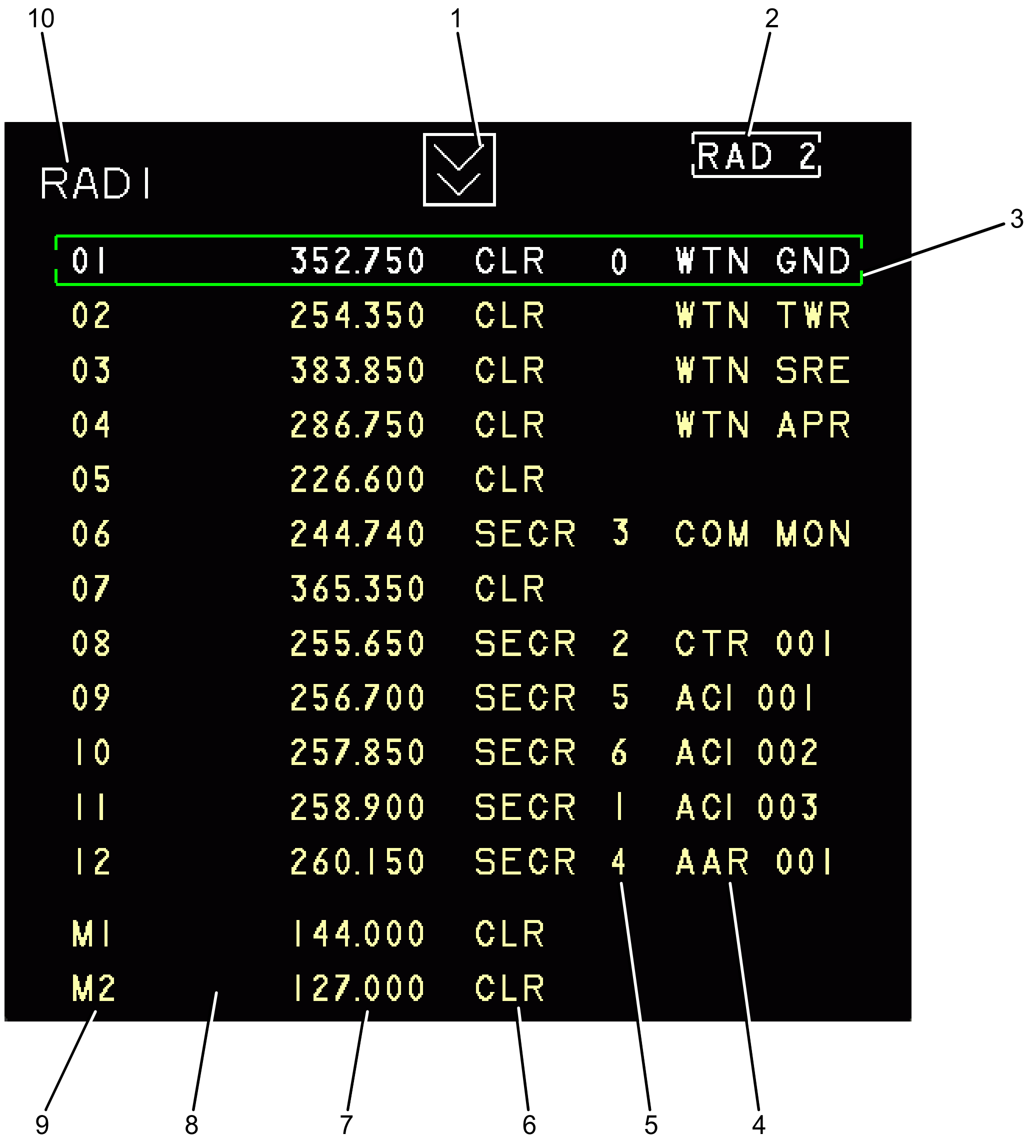


ICN-1B-B-311500-B-K0999-02193-A-01-2

Figure I-02-25 Typical Example of HYD Format

ICN-1B-B-311500-B-K0999-02194-A-01-2

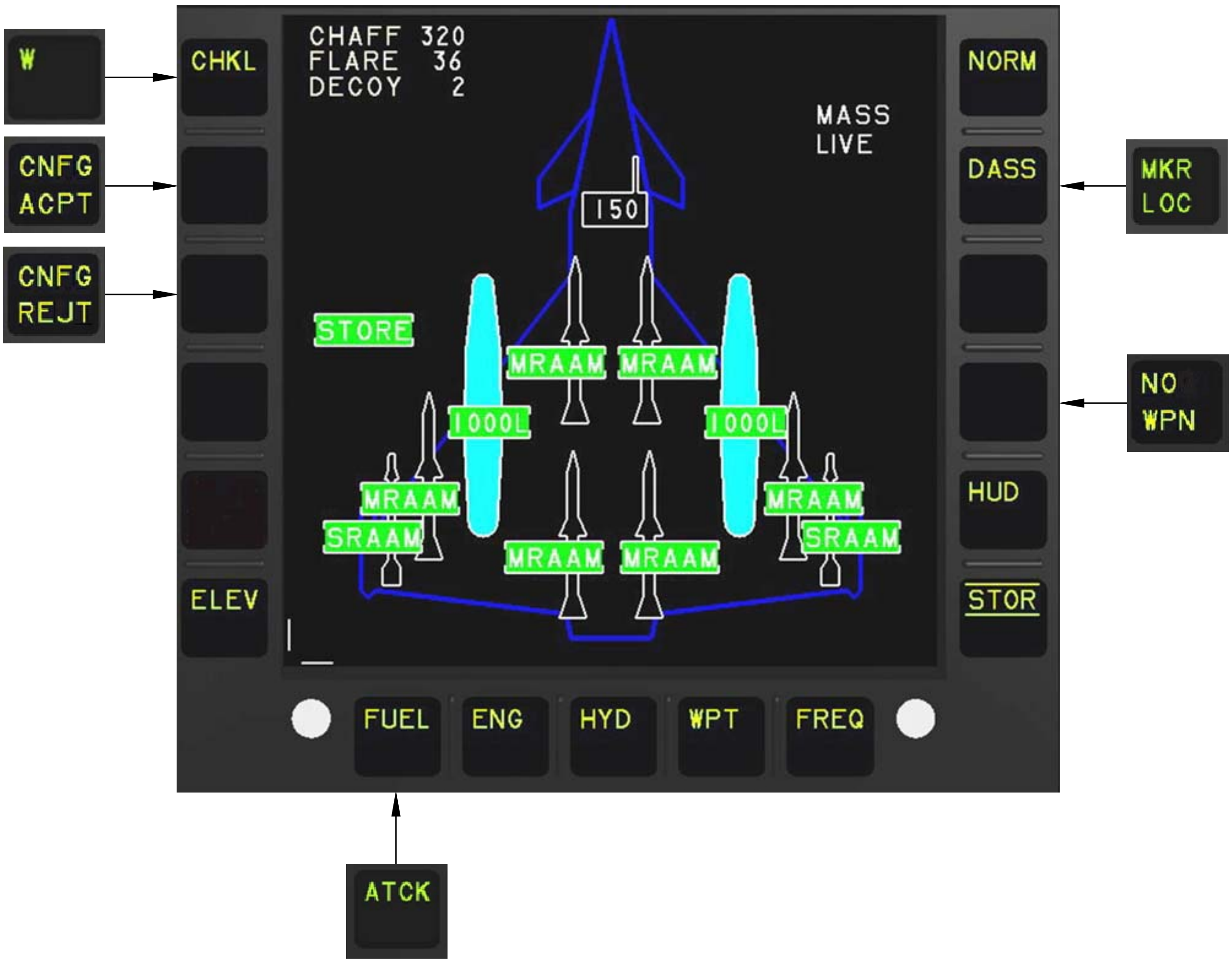
Figure I-02-26 Typical Example of PA Format



1 PAGE UP/DOWN ICON
2 RADIO SELECT ICON (EITHER RAD1 OR RAD2)
3 CURRENT CHANNEL IN USE (WITH ADDITIONAL INFORMATION)
4 CHANNEL IDENTIFIER
5 KEY OF DAY
6 CLEAR/SECURE STATUS
7 CHANNEL FREQUENCY
8 FREQUENCY HOPSET COLUMN (NATO OR NON-NATO)
9 CHANNEL NUMBER (M = MANUAL)
10 SELECTED RADIO (EITHER RAD1 OR RAD2)

ICN-1B-B-230000-B-K0999-01861-A-01-2

Figure I-02-27 Typical Example of FREQ Format

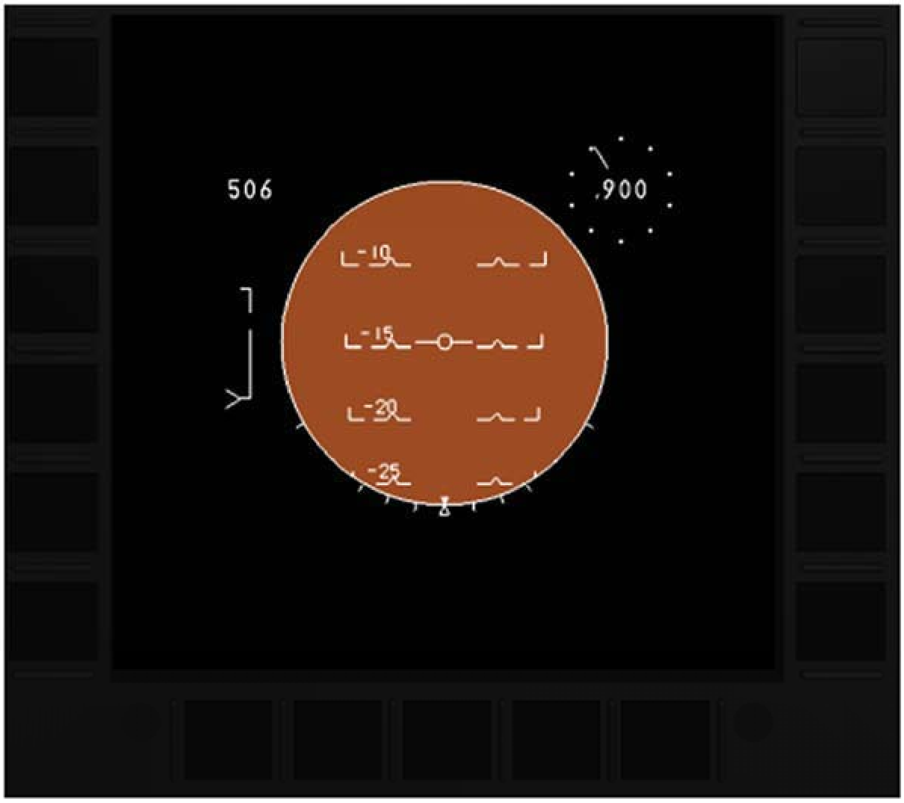


ICN-1B-B-311500-B-K0999-02197-A-01-2

Figure I-02-28 Typical Example of STOR Format

ICN-1B-B-311500-B-K0999-06554-A-01-2

Figure I-02-29 Typical Example of WPT Format



ICN-1B-B-311500-B-K0999-03623-A-01-2

Figure I-02-30 Typical Example of DRF Format

ICN-1B-B-311500-B-K0999-03617-A-01-2

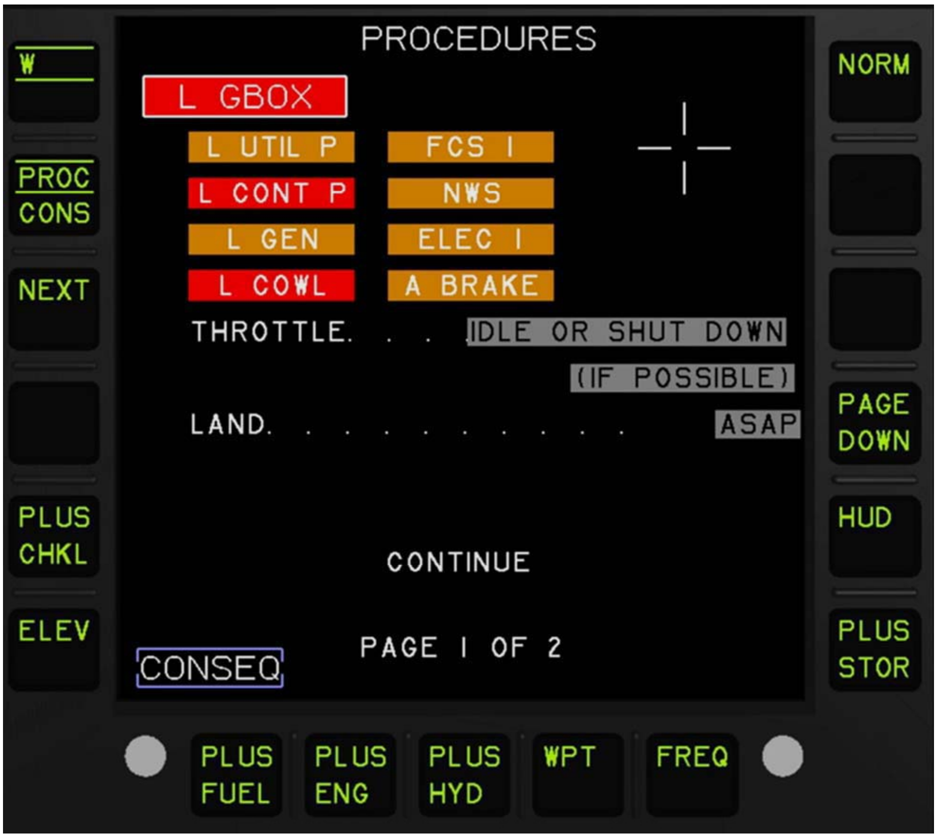
Figure I-02-31 Typical Example of HSI Format

ICN-1B-B-311500-B-K0999-04338-A-01-2

Figure I-02-32 Typical Example of CHKL Format

ICN-1B-B-311500-B-K0999-04506-A-01-2

Figure I-02-33 Typical Example of CHKL Format - Standard Checklist



ICN-1B-B-311500-B-K0999-04505-A-01-2

Figure I-02-34 Typical Example of CHKL Format - Warnings Procedures

ICN-1B-B-311500-B-K0999-04507-A-01-2

Figure I-02-35 Typical Example of CHKL Format - Consequences

MANUAL DATA ENTRY

The Manual Data Entry Facility (MDEF) is located on the left glareshield and is part of the Displays and Control (D&C) system. It is used for moding and data entry to several avionic systems, (Figure I-02-36). The MDEF consists of the following:

- Subsystem keys
- Moding keys
- Read Out Line (ROL)
- Writing marker switch
- Data Entry Keyboard (DEK)
- Destination waypoint (DWP) ROL
- Change destination (CHD) key.

SUBSYSTEM KEYS

There are thirteen subsystem keys, one of which is the set waypoint key (SWP) located separate to the other subsystem keys. The MIDS, A/S and NIS keys currently have no function. The subsystem keys allow moding and data entry to the following functional groups, called the MDEF subsystems.

- Navigation (NAV)
- Navigation aids (AIDS)
- IFF interrogator (INT)
- IFF transponder (XPDR)
- Radar transmitters (XMIT)
- Radio 1 (RAD1)
- Radio 2 (RAD2)
- Defensive aids (DAS)
- Miscellaneous (MISC)
- Set waypoint (SWP).

Selection of a subsystem is indicated by the illumination of bars above and below the legend of the key. Initially on applying power a subsystem will not be selected. When a subsystem is selected, the default displays and optional functions for that subsystem are displayed in the ROL, on the moding keys and the data entry keys. These remain illuminated until the subsystem is deselected by pressing the key again.

MODING KEYS

There are twelve moding keys, each key consists of two rows of four multifunction characters. The legend displayed on the key describes the function of that mode. The moding keys have three functions:

1. To indicate the current functional status of the selected subsystem
2. To enable the functional state to be changed
3. To allow subsystem data to be entered or edited via the DEK/ROL.

If two modes are presented on one moding key, e.g. TRK/DIR (Figure I-02-37), horizontal bars (boxing) will be displayed above and below the legend indicating which mode has been selected. The alternative mode can be selected by pressing the key; the bars above and below the legend will move to box the new selection. To return to the original mode the key must be pressed again.

If one mode is identified by two lines of text on a key, e.g. EDIT RTE (Figure I-02-37), a bar will be displayed above the upper legend and below the lower legend.

Some moding keys are used to indicate which data input mode is currently selected. When a data input mode is selected, either the current or default data is displayed in the ROL, and the DEK displays the relevant alphanumeric characters and symbols required for the data entry.

Selection of certain moding keys may present data on other aircraft displays and also allow data entries/changes by use of the X-Y controller.

READ OUT LINES

The ROL are displayed on a four row by 13 column display. When a moding key is selected, it displays either subsystem status information or the current/default data for the option selected, when applicable. The current data displayed in some cases can be overtyped. Where no system data exists dashes are displayed where data input is required/possible. The data for some moding key selections requires more than one page of ROL information; this is indicated by a page number on the right side of the bottom row.

A writing marker is automatically positioned in the ROL under the first character that can be changed (Figure I-02-37). The writing marker can be repositioned using the writing marker switch.

WRITING MARKER SWITCH

The writing marker switch, is a five-position switch, spring-loaded to the center position. It is used to position the writing marker under a variable in the ROL. This switch can also be used to move between pages of a multi-page display, by holding the switch in either the up or down position, so that the writing marker forces the page to scroll.

DATA ENTRY KEYBOARD

The DEK consists of eighteen multifunction keys and dedicated clear (CLR) and enter (ENT) keys. Each of the multifunction keys can display an alphanumeric character or symbol. The symbols that can be displayed are arrows; to indicate up, down, left and right, and a hash (#) symbol.

The characters on the keys, and the position of the writing marker in the ROL, are configured for the moding function selected, (Figure I-02-38). Consequently the characters displayed may change several times during data entry.

Only the valid alphanumeric characters for data entry at the writing marker position are displayed. A left or right arrow presented on keys indicates there is another available configuration for the data entry keyboard, e.g. entries requiring alpha characters. Pressing the key displaying a left or right arrow will scroll through the available options.

Up and down arrow keys perform the same function as selecting the writing marker switch to the up or down position, except in multi-page displays where they are used to select the next/previous page.

Some data inputs are independent of the writing marker position in the ROL. For example; if the N and E options are displayed in the ROL when entering lat/long coordinates, the keys will give the option to change to S and W options. Selection of such options have no effect on the position of the writing marker but will switch the displayed ROL to the alternative mode.

The # can be used to automatically enter leading zeroes into certain data fields. It is selected after the numerical entry and any columns prior to the number are set to zero, e.g. for a four column field; 5# would enter 0005 and 40# would enter 0040.

When entering radio frequencies, the last character will be entered automatically dependent on the number before, e.g. if the number before is 0 or 5, a 0 will be entered and if 2 or 7 is the number before, 5 will be entered. The writing marker will always position itself under the last entered character of the radio frequency so it can be overwritten if required.

The input data will only be supplied to the subsystem selected if it passes validation ( ) after the ENT key ( ), has been pressed.

If more than one page of ROL requires data entry for the input sequence, data can only be input to the subsequent page after either, pressing of the ENT key, or by paging through the ROL using the writing marker switch or the up/down arrow keys.

A time check facility is used to indicate that a data entry has been selected and is incomplete. As soon as a data entry option is selected, a timer is started. If a key has not been selected after approximately 7 seconds, the ROL data and writing marker will flash twice per second. Any selection of the writing marker switch, data entry key or X-Y controller, with the exception of ENT on the DEK, will stop the ROL flashing and reset the timer. Pressing the ENT key disables the time check facility.

ENTER KEY

The input of data has no effect on the selected subsystem until the ENT key is pressed. When the ENT key is pressed, validation is performed on the input data. If the data are valid, the ROL data, including the writing marker and fixed characters, will not be displayed for approximately 0.5 seconds. If no more data page entries are required, the ROL will display the page with the entered data, the writing marker (positioned under the first variable character), and dashes replaced by zeros for partially defined variables.

The multipage ROL configurations only occur for WP details and Mode 1 and 3A manual codes associated with the XPDR and INT subsystem.

When a page of data is entered for the IFF Mode 1 and 3A manual codes, pressing the ENT key will result in the bracketed IFF Mode 1 and 3A code being selected. Movement between pages is possible by using the up/down arrow keys, which will be presented when appropriate.

When a page of data is entered for the NAV or SWP subsystem, pressing the ENT key will result in the removal of the data from the initial ROL, and then its redisplay for approximately 1 second before the next page requiring data entry is displayed.

When the ROL are displaying the last page of data on a waypoint, pressing the ENT key will result in the first page of the next highest unpaired waypoint being displayed.

CLEAR KEY

The clear key (CLR) enables the quick reconfiguration of the ROL so that an input sequence can be restarted, either for a particular variable or the whole page.

A single press of the CLR key sets the variable above the writing marker position to a dash and repositions the writing marker under the first column for that variable. Two successive presses of the CLR key will set all the variables in the ROL to dashes and repositions the writing marker to the start of the first variable. Parameters that are changed independent of the writing marker, e.g. N, E, S and W variables, are reset to their default values.

DATA VALIDATION

There are four types of data validation:

1. The validity of parameters, which cause reconfiguration of other data in the ROL. These immediate validation checks are carried out when the last character of the variable has been input. This validation check is performed when entering preset channel numbers in the radio subsystems, and for waypoints in both the SWP and NEW WP options.

2. When the ENT key is pressed, all variables are checked to ensure that they are within their specified range.
3. Checks to ensure all the required variables have been defined.
4. The final validity check is to ensure the ring-back data is the same as that sent, i.e. the new data sent to the subsystem are returned and compared again with the data sent.

Failure of a validation check is indicated by the variable data and writing marker flashing for 2 to 3 seconds. The writing marker will then be positioned under the first variable that is in error and will continue to flash until the DEK becomes active. Pressing any data entry key will stop the ROL flashing.

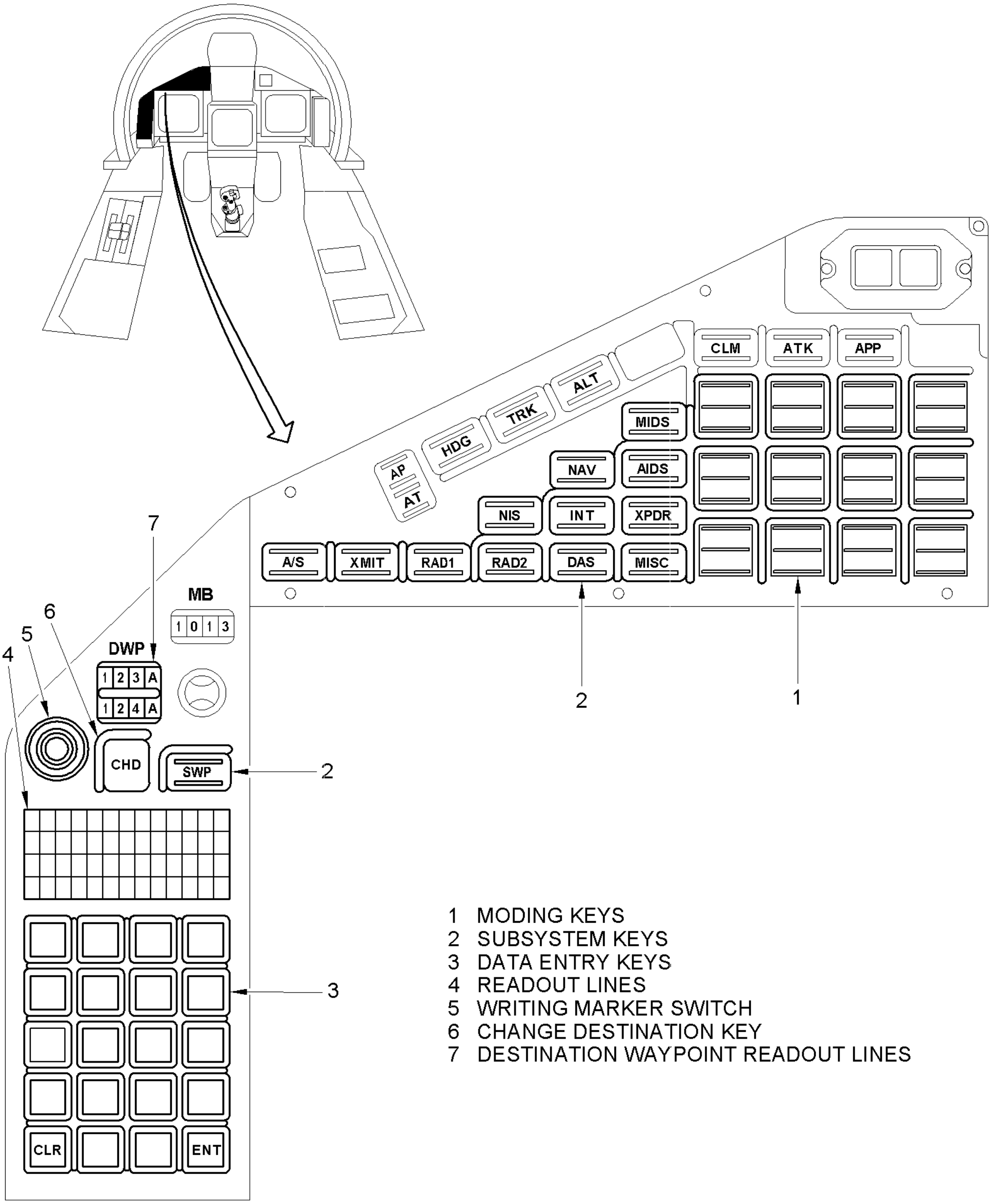
DESTINATION WAYPOINT READ OUT LINES

The DWP ROL, is a four column by two row display, which indicates the destination waypoint number on the upper row, and the subsequent destination waypoint number on the lower row. HOLD will be displayed on the upper row if there is no waypoint selected, and four dashes will be displayed on the lower row if there is no subsequent waypoint.

CHANGE DESTINATION MODING KEY

The change destination (CHD) moding key, can be used to select the next destination waypoint (DWP).

If the CHD is selected when HOLD is displayed on the upper row of the DWP ROL, steering will revert to the previous DWP prior to entering HOLD.



1 MODING KEYS
2 SUBSYSTEM KEYS
3 DATA ENTRY KEYS
4 READOUT LINES
5 WRITING MARKER SWITCH
6 CHANGE DESTINATION KEY
7 DESTINATION WAYPOINT READOUT LINES

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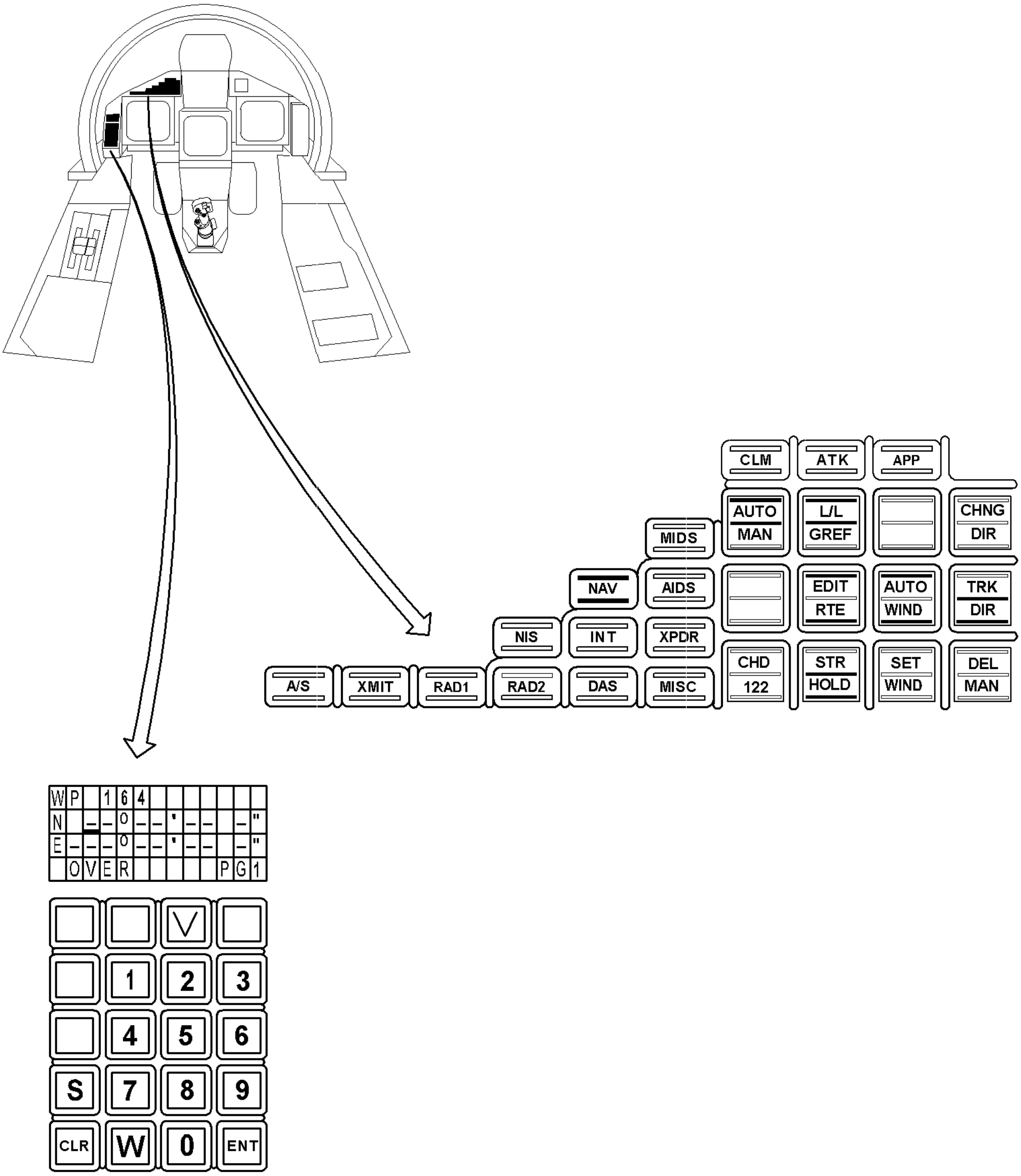
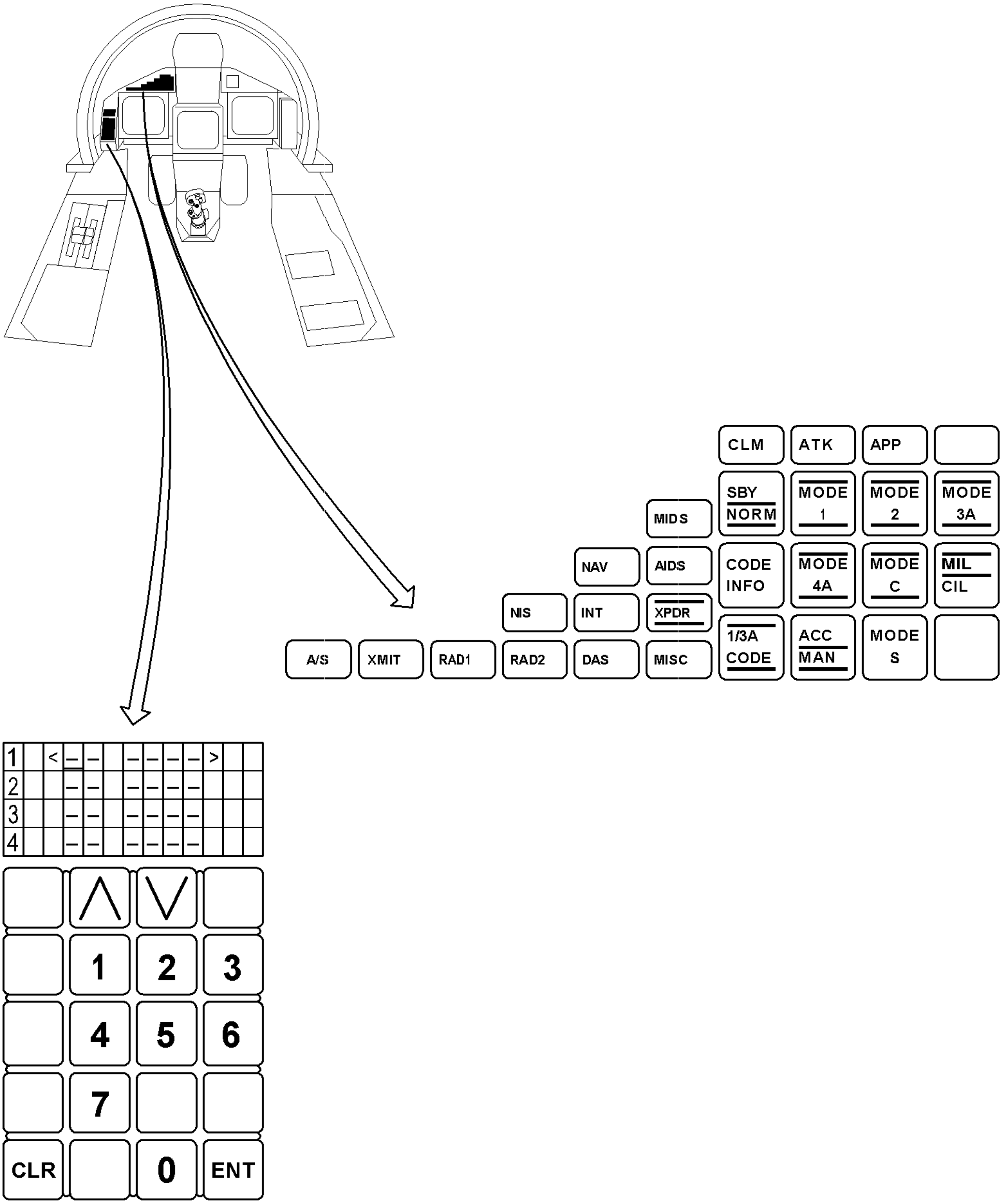
Figure I-02-36 MDEF - Controls and Indicators



ICN-1B-B-311100-B-K0999-01573-A-02-2

Figure I-02-37 ROL Configuration (Example)



ICN-1B-B-311100-B-K0999-01576-A-02-2

Figure I-02-38 Data Entry Key Configuration - Example for the Transponder Subsystem

MISCELLANEOUS MDE

The miscellaneous subsystem key, identified MISC (Figure I-02-39), is one of the controls of the Manual Data Entry Facility (MDEF) which is located on the left glareshield.

Initially on applying power, the miscellaneous subsystem will not be selected. Selection of the miscellaneous subsystem key is indicated by the illumination of bars above and below the MISC legend. When this key is pressed, the default displays and optional functions are displayed in the ROL, on the moding keys and on the data entry keys. These remain illuminated until the subsystem is deselected by pressing the key again.

The miscellaneous subsystem comprises the functions that follow:
- Stopwatch
- Bogus weapon configuration
- Lamps test
- Bingo fuel settings
- Automatic cryptovariable suppression
- Video Voice Recorder (VVR) status
- Simulated target generation
- Ground proximity warning.

On initial selection of the MISC subsystem key, the display stopwatch (DISP WTCH), Ground Proximity Warning System (GPWS), count up (CNTU) and bogus AMRAAM (BGUS AMR) moding keys are displayed as the default options, (Figure I-02-39). The stopwatch readouts on the ROL, HUD and HDHUD format display zero in count-up mode, and only CLR and ENT are displayed on the keyboard.

NOTE

> With the current software version there is no ROL or data entry keyboard moding associated with the BGUS AMR option; it will only be displayed if:
> - The function has been loaded via the Maintenance Data Panel (MDP)
> - No live weapons were fitted (missiles and/or gun) at the start of the mission.
>
> The BGUS AMR simulates the selection of an AMRAAM and the subsystem behaves as if the aircraft is armed.

STOPWATCH/COUNTUP

The stopwatch is started on the default display by pressing the STRT TIME key. When the STRT TIME key is pressed, the ROL, HUD and HDHUD display the elapsed time (Figure I-02-40), all the data entry keys are disabled and the moding keys reconfigure to give the STOP TIME and split time (SPLT TIME) options (Figure I-02-41). On selection, the split time is displayed below the stopwatch time on the ROL, HUD and HDHUD.

When STOP TIME is selected, the moding keys reconfigure to display the STRT TIME and timer reset (RSET TIME). The RSET TIME key is not displayed after selection.

The stopwatch ROL is not displayed if either MISC or DISP WTCH is deselected. However, the stopwatch will be displayed on the HUD and HDHUD when the stopwatch is active (running/split). Reselection of the subsystem or stopwatch will display the current stopwatch time.

STOPWATCH/COUNTDOWN

The countdown function is selected by pressing the CNTU/CNTD moding key. In countdown mode, the stopwatch readouts display dashes until a time is entered. Countdown selection is indicated by the illumination of status bars on the CNTD key legend. On initial selection the ROL displays dashes where data entry is required, and the data entry keyboard is configured for numerical entry (Figure I-02-42). The data entry CLR key sets the data entry field to dashes if a countdown time has previously been entered.

All leading zeroes must be entered, and when inputting the data, the ROL will blink and the moding keys will reconfigure to display STRT TIME.

When the STRT TIME key is pressed, countdown will commence in the ROL, HUD and HDHUD and the moding keys will reconfigure to display the SPLT TIME and STOP TIME options. Also, the data entry keys will not be displayed and the ENT and CLR keys will be disabled. The SPLT and STOP TIME options operate in the same way as that for the count up stopwatch selection.

Upon reaching zero, the ROL reconfigures to the initial countdown time set and STRT TIME is redisplayed on the moding keys. The countdown indication (00:00:00) on the HUD and HDHUD will flash for 5 seconds, after which it will not be displayed, unless the MISC DISP WTCH submode is selected or the stopwatch becomes active.

LAMPS TEST

The lamps test function (Figure I-02-43), is for ground maintenance purposes and is available with weight on wheels only.

BINGO FUEL SETTINGS

Four bingo fuel levels can be specified or modified by selecting the FUEL BNGO moding key. When FUEL BNGO is selected, the ROL displays the current bingo fuel settings and the data entry keyboard configures for numerical entry (Figure I-02-44).

On initial selection, the ROL display dashes where data entry is required, and the last digit of the fuel levels are fixed at zero. Fuel levels can be specified to an accuracy of 10 kg but they must not be within 100 kg of each other; BINGO 4 cannot be set to less than 200 kg. When the CLR key is pressed, it will set ROL 4 to 200 kg, (i.e. display −200KG).

The next fuel bingo level to be reached is indicated by angled brackets on the ROL. When a particular bingo level is reached, the relevant bingo warning is generated. The angled brackets then move to the ROL which contains the next bingo fuel level to be reached.

The writer marker will be positioned under the first digit of the lower bingo fuel setting if two entries are within the minimum 100 kg separation.

NOTE

> Ensure data entries are accurate; a validation check is not carried out between bingo entries and actual fuel contents when the ENT key is pressed.

All four data entry fields must be completed before the data is entered. The ROL will blink when the ENT key is pressed, then the data will be redisplayed. If the data entry fails validation, the writer marker will be positioned under the first character of the field in error.

AUTOMATIC CRYPTOVARIABLE WARNING SUPPRESSION

Cryptovariable codes are necessary for operation of the Electronic Counter Counter Measure (ECCM) modes and for secure speech encryption and decryption. The Key of Day (KOD) cryptovariables are used for voice encryption and decryption functions. The Word of Day (WOD) cryptovariables are used for ECCM functions.

When power is applied to the aircraft, the system defaults to the unsuppressed setting.

The CRYP SUPP moding key is used to suppress cryptovariable voice warnings, DWP warnings and the ACUE format warning captions whilst on the ground. Suppression is confirmed by the illumination of status bars on the moding key legend.

VIDEO VOICE RECORDER STATUS

When the VVR is selected, the ROL defaults to VVR on the first line and line two shows the status. When the VVR key is pressed again, the ROL indicates the elapsed tape time (Figure I-02-45).

The key legend can show four possible modes:
- VVR OFF
- VVR SBY (displayed when a cassette is installed and PBIT has successfully completed)
- VVR REC (displayed when in either auto or manual record)
- VVR FAIL (displayed when the unit has failed PBIT, CBIT or IBIT).

The default mode of the VVR is standby (SBY), in this mode the VVR is controlled automatically by the avionics system. When the aircraft has weight off wheels, the VVR will enter the record (REC) mode automatically when any of the conditions that follow exist:
- The late arm switch is selected to the armed position
- The trigger first detent is engaged
- A VISIDENT target is less than 1 NM.

In automatic control, the VVR will stop recording and enter SBY mode 15 seconds after any of the conditions listed above no longer exist. However, if another of the conditions listed above is initiated during this time, then the VVR will continue to record. The VVR will only enter STBY 15 seconds after the subsequent condition has been completed or exited.

SIMULATED TARGET GENERATION

When the SIM TGT key is selected, the subsystem generates a simulated target with a default speed, range, bearing and altitude.

GROUND PROXIMITY WARNING SYSTEM

The Ground Proximity Warning System (GPWS) is an integrated terrain/obstacle avoidance system, based on a terrain/map reference navigation capability. The MDEF is used to switch the GPWS between ON and OFF and to display and set the Minimum Separation Distance (MSD) height.

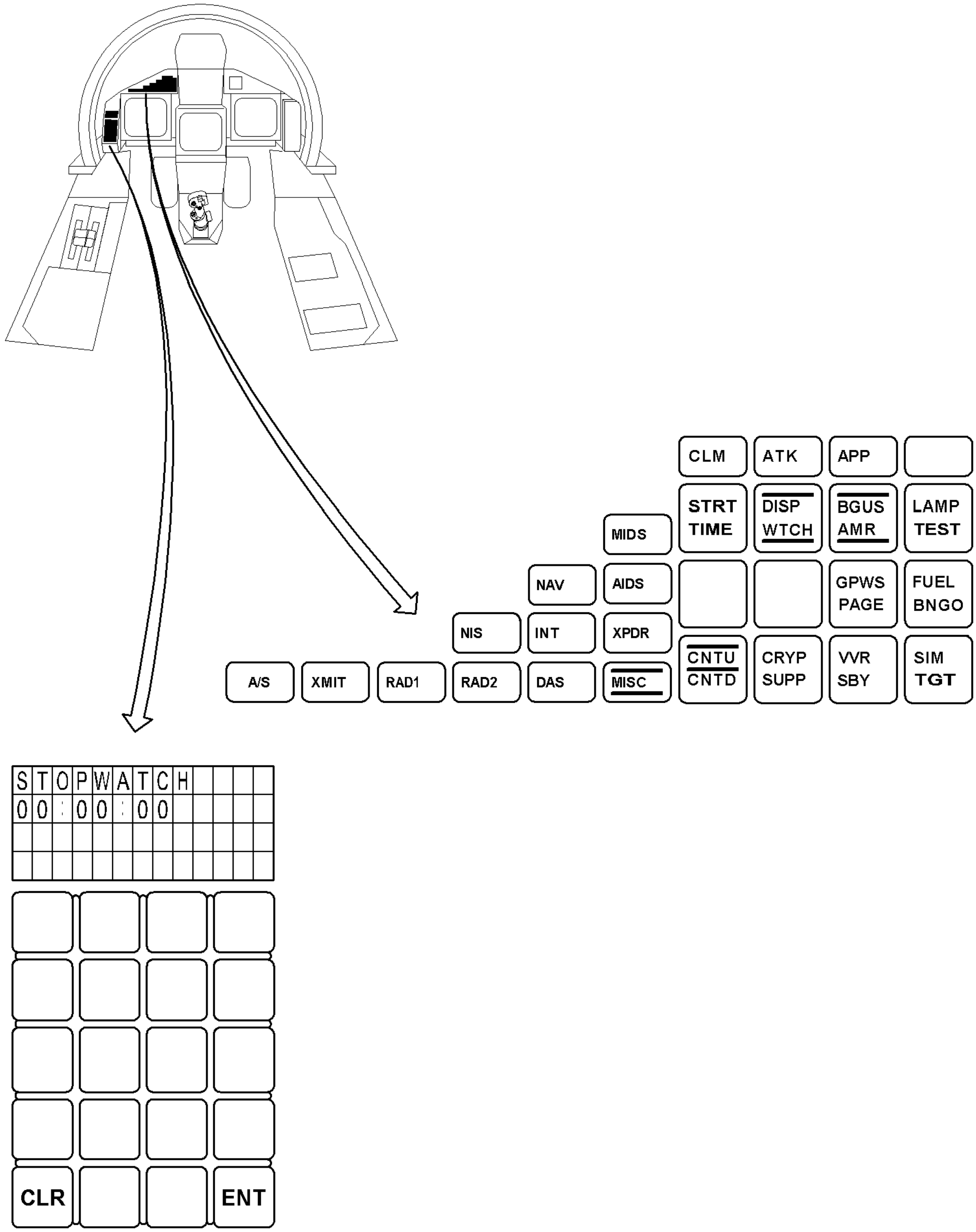


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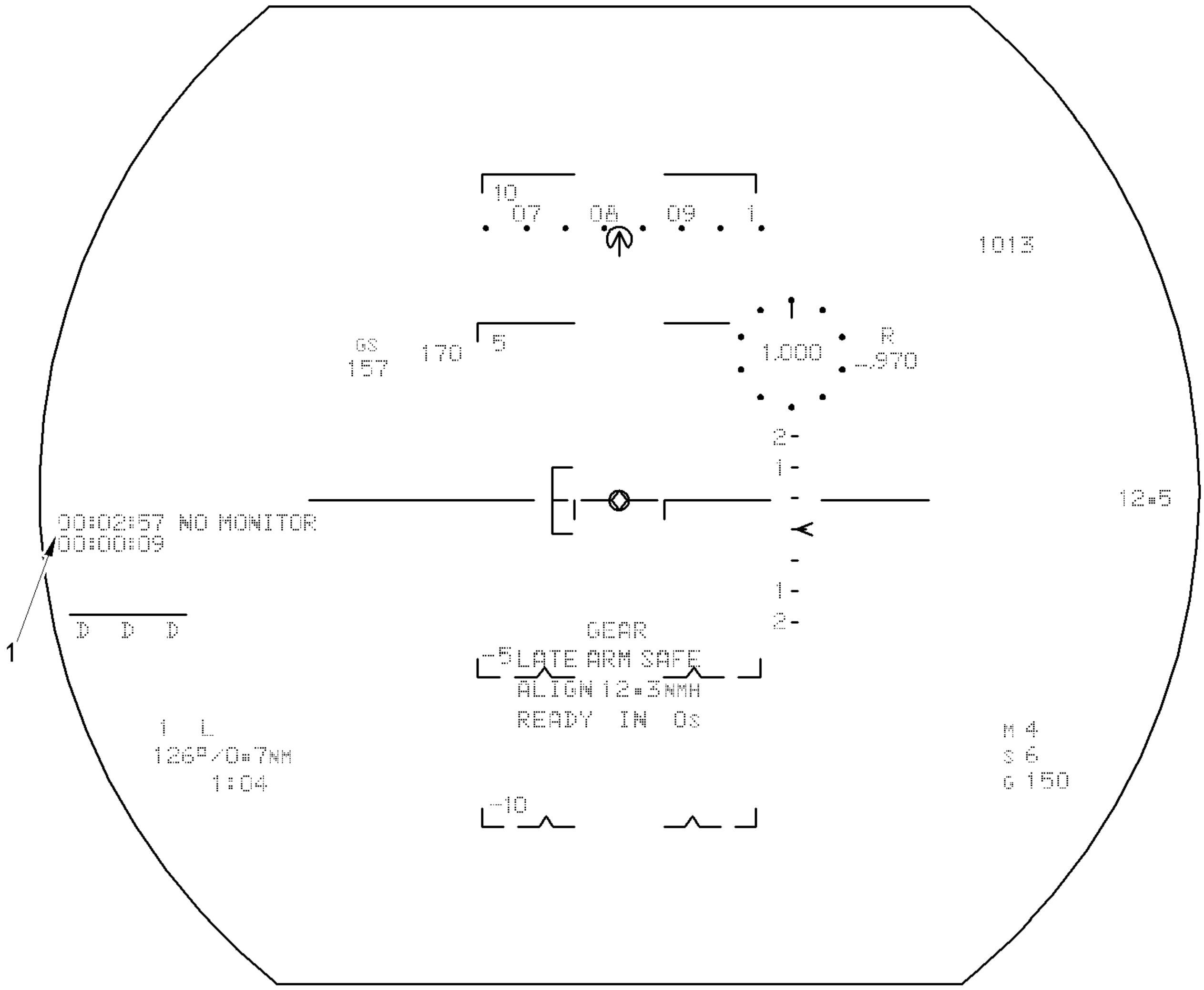
Figure I-02-39 Miscellaneous Subsystem Default Configuration



1 STOPWATCH

ICN-1B-B-311100-B-K0999-04558-A-02-2

Figure I-02-40 HUD - Stopwatch Symbology

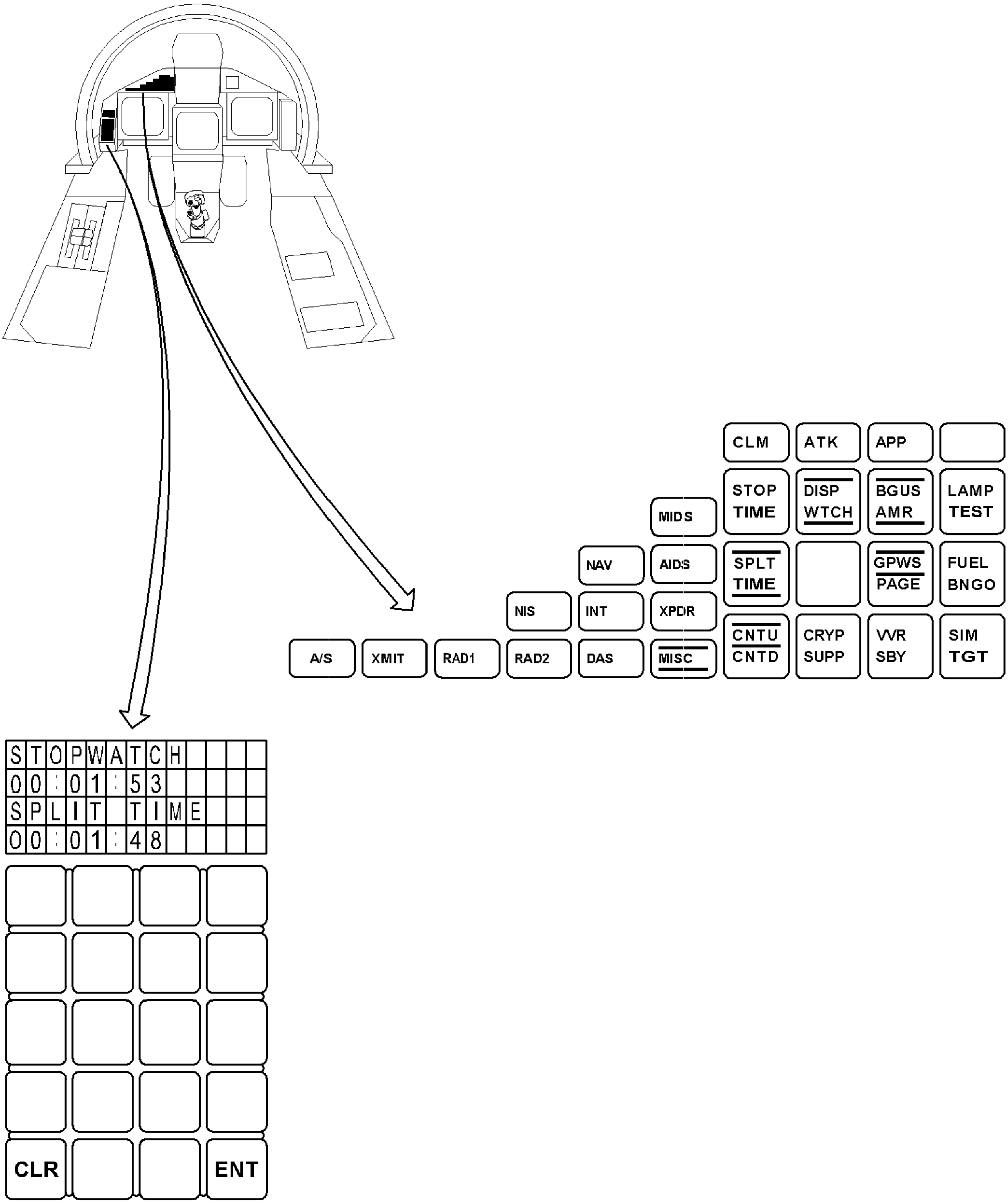


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Figure I-02-41 Stopwatch Count Up Configuration - Active

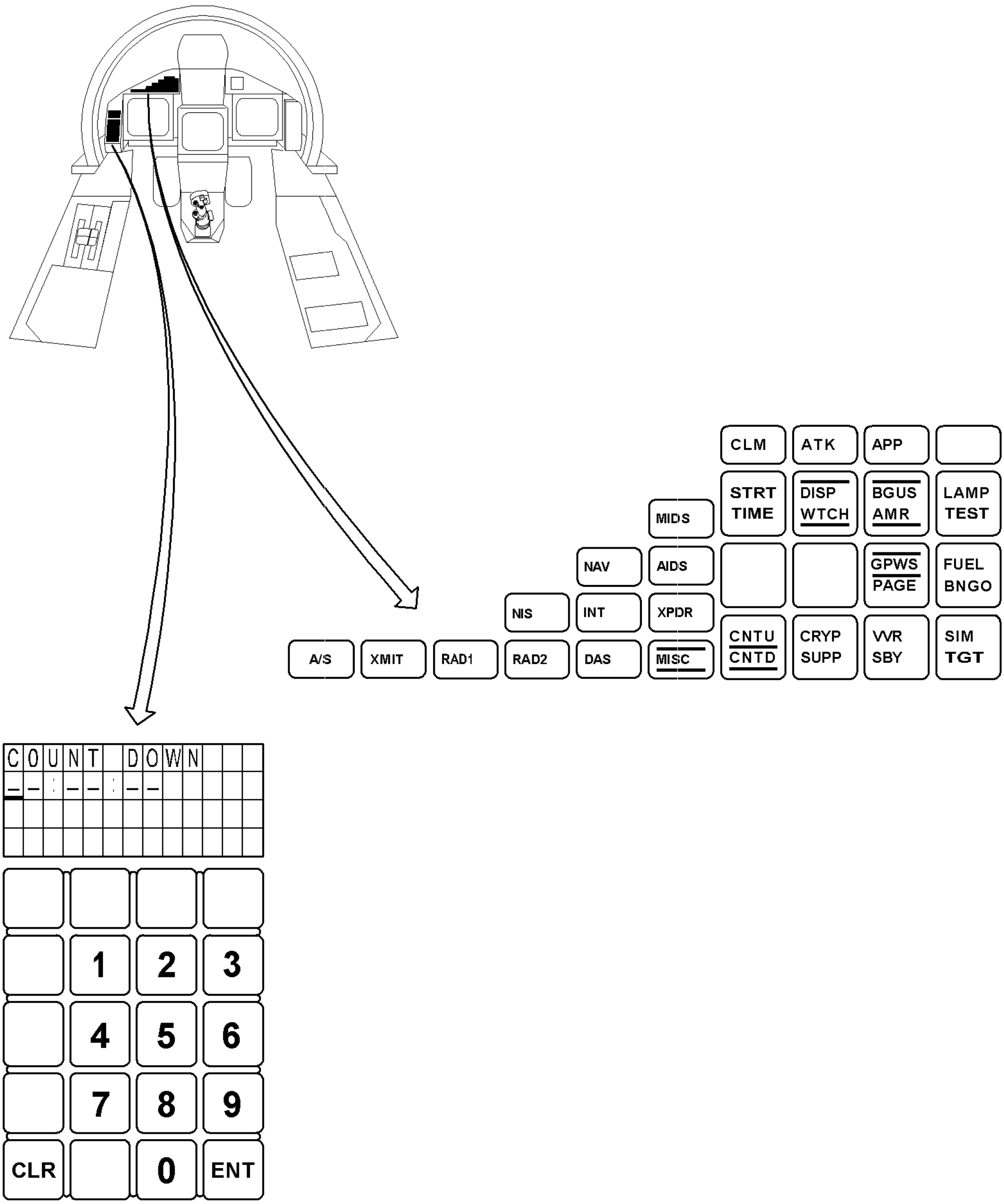

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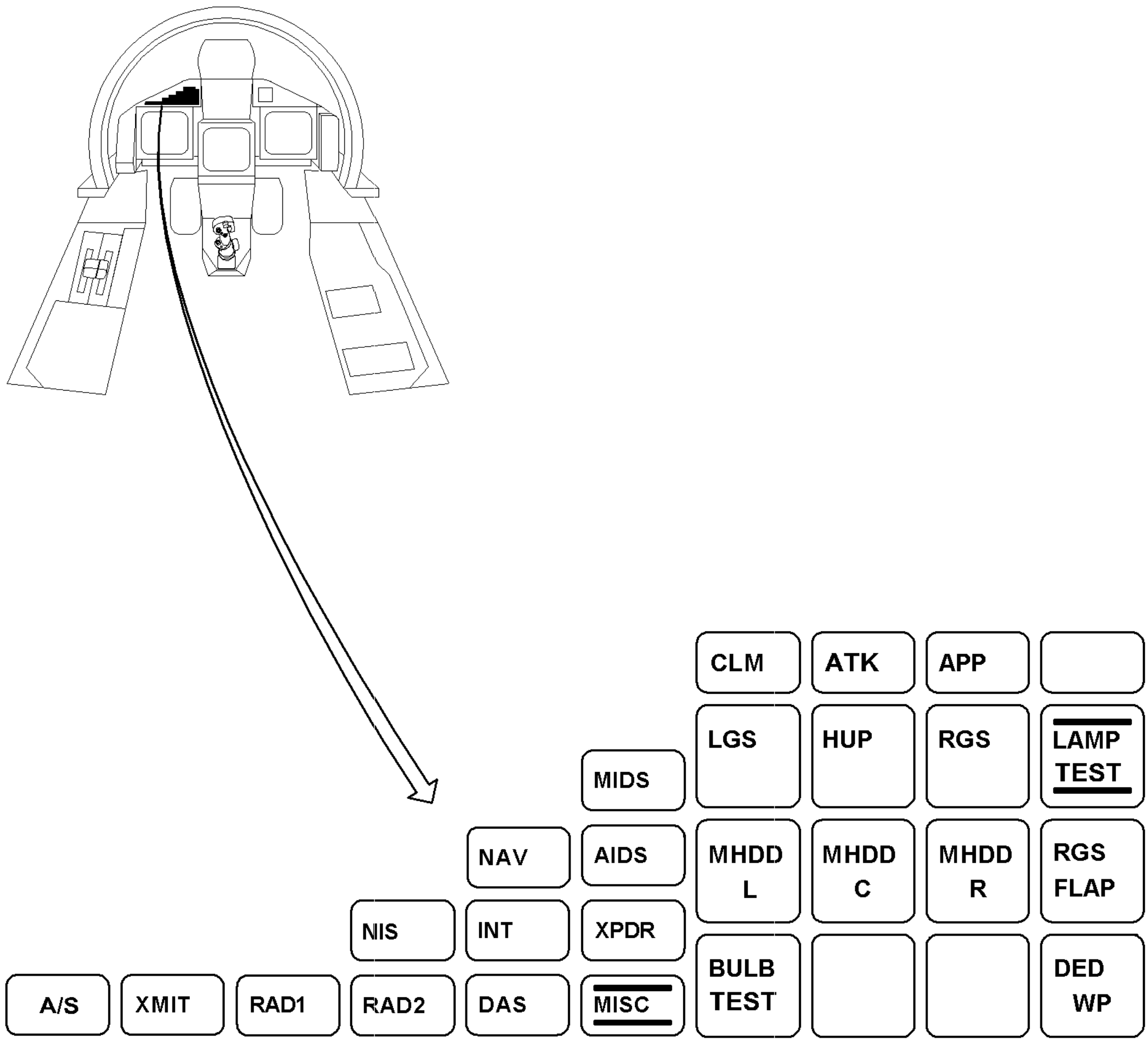
Figure I-02-42 Stopwatch Countdown Initial Configuration



ICN-1B-B-311100-B-K0999-01615-A-03-2

Figure I-02-43 Lamps Test Options - Weight on Wheels

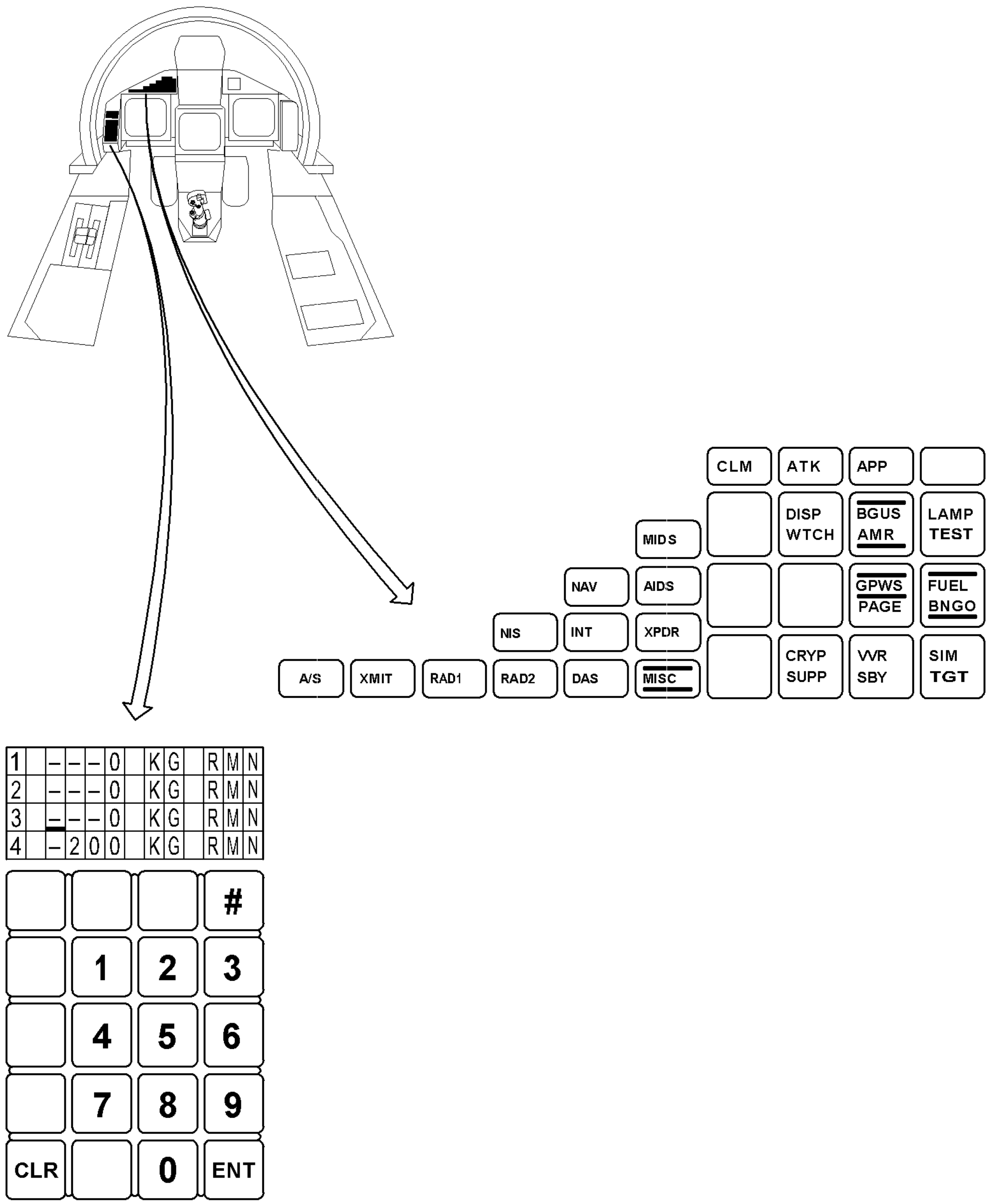


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Figure I-02-44 Bingo Fuel ROL

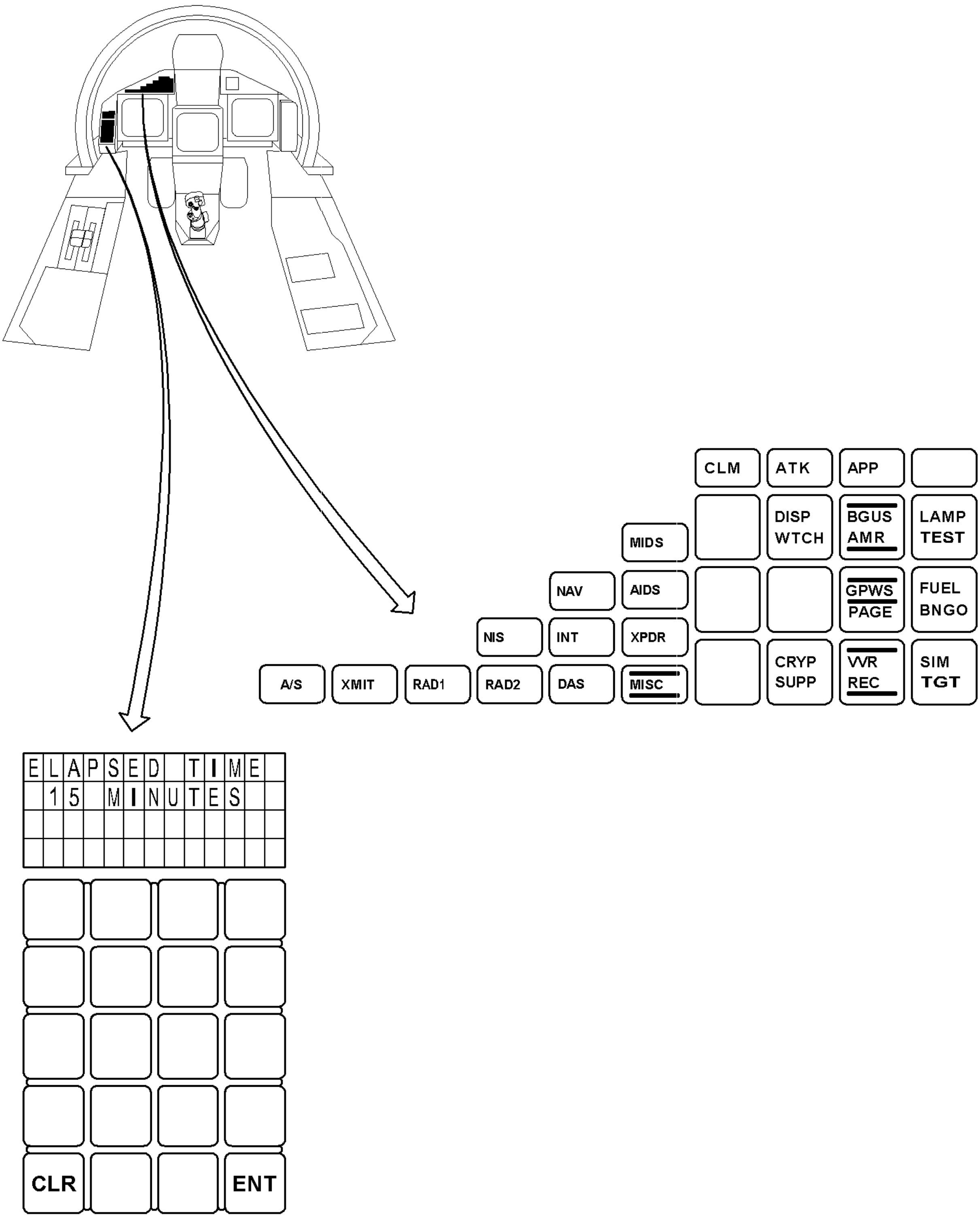

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Figure I-02-45 Video Voice Recorder ROL

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NAVIGATION SYSTEM

GENERAL

The Navigation System provides accurate navigational position and velocity vector data plus flight path control display. It derives the essential flight data (position, velocities, heading, height, attitudes) from on-board sensors and supplies these data to the Navigation Computer (NC).

The Navigation System consists of the following equipment:

- Laser Inertial Navigation System (LINS): this is the primary sensor for dead reckoning navigation. It provides Present Position (LAT, LONG), True Heading, Bank, Inclination, Climb/Dive Angle, Earth referenced velocities (East, North, Vertical), Earth referenced accelerations (East, North, Vertical), Body Linear and Angular Velocities and Accelerations plus Baro-IN Altitude
- Global Positioning System (GPS): this is the second main source for navigation data. It provides Present Position, Altitude, Earth Referenced Velocities (North, East, Vertical), UTC Time and Climb/Dive Angle
- Radar altimeter (RADALT): this provides precision height information up to 5000 ft above currently overflown surface
- Navigation Computer (NC): this dedicated computer uses data from the LINS and the other systems / sensors to compute Best Navigation Data, navigation steering and weapon aiming parameters. If the LINS is invalid, data from the Flight Control System (FCS) is used instead

The following items are not part of the Navigation Subsystem, but their data are used by the Navigation Subsystem to update the navigation data or for reversionary mode operation:

- Inertial Measurement Units (IMUs), part of the FCS
- Air Data System (ADS), part of the FCS
- Flight Control Computers (FCC), part of the FCS
- Attack Computer (AC), part of the Attack and Identification system
- Defensive aid computer (DAC), part of the DASS
-

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  Multiple Information and Distribution System (MIDS), part of the COMMS. This equipment also includes the TACAN.

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NAVIGATION FUNCTIONS

Navigation functions consist of:

- Primary and Secondary Dead Reckoning: Dead Reckoning means the determination of position without the use of external aids and is calculated from the record of the known starting point, the courses flown, the distance achieved (which can be estimated from velocity), and the known or estimated drift. The primary Dead Reckoning Navigation function uses LINS data. The Secondary Dead Reckoning Navigation function uses air data and attitudes provided by the FCS

- BC Initialization: after power up, the NC first performs its PBIT function then runs the Purchaser Provided Software (PPSW). The NC then initializes itself as primary Bus Controller (BC) on the AVS Bus and as a Remote Terminal (RT) on the Attack Bus
- Primary Bus Controller: as primary BC on the AVS Bus, the NC controls the input / output data and the management of the acyclic requests on the low and high speed data buses
- Reversionary Bus Controller on the Attack Bus: in the event of loss of AC, the NC takes over the control of both the AVS and the ATK buses
- Mission Data Loading via PDS or GLU: the NC allows dynamic loading of single or multi-mission data from the PDS or the GLU respectively
- Health Monitoring: the NC monitors the AVS RTs status in Normal Mode and AVS / ATK RTs status in Reversionary Mode to determine the GO / NOGO LRIs status and manages the transactions, by either disabling them when the RT is declared faulty or by activating them when an RT is recovered from a failure
- IBIT: the Navigation IBIT function is performed on ground only. During the IBIT the NC switches to RT state on both buses and, as consequence, the AC becomes the BC on both buses. When the IBIT is successfully completed, the Avionic BC hand-over is performed and the NC attempts to return into the normal mode of operation. In addition, when the NC operates as BC, performs the IBIT monitor function of all the databus LRIs. This function provides the monitoring of the LRIs IBIT sequence. The results are provided to the system (IMRS and D+C) in order to carry out the relevant actions in case of IBIT sequence failures detection
- Maintenance Data Generation: the NC generates the maintenance message following a LRI failure detection. The message is then sent to the IPU
-

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  MIDS TACAN Functionality: the NC manages the TAC AA and TAC AS modes; in the first case bearing and range are with respect to another aircraft equipped with a TACAN airborne beacon, in the second case they are referred to a ground TACAN station. In both modes the NC also manages the RX and RX / TX modes

  ⇐

- Navigation System Initialization: initialization of the navigation system is automatically performed once the required data has been loaded via the PDS and the GLU. The necessary data can also be manually loaded via the MDEF
-

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  LINS Alignment: the LINS can be aligned on the ground using three different alignment modes (Full Gyrocompass, Memorized Heading and Rapid Heading)

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  LINS Alignment: the LINS can be aligned on the ground using three different alignment modes (Full Gyrocompass, Memorized Heading and Rapid Heading) and in flight, using the In-Flight Alignment (IFA) technique

  ⇐
- Ground Static Harmonization: on ground the NC manages the LINS Harmonization data coming from an external source (IPU) in order to correct LINS installation errors
- Best Data generation: when LINS modes are available, the NC, aided by a Kalman Filter, produces the best navigation data by integrating the automatic navigation aids (GPS) or a manual fix (OTF) to refine the dead reckoning performance. In the event of LINS failure, best data are produced without Kalman Filter processing and the FCS is used as the reversionary for the LINS
- Navigation Moding: the NC automatically enters the NAV Mode based upon sensors availability. This can also be selected manually. The system automatically enters LINS GPS1 if both sensors are valid when LINS NAV is selected (via the MHDD NAV SEL moding key). All available modes are illuminated on the MDEF and the selected one is boxed. The following modes are available:
  - MODE 1: LINS + GPS + KF (LINS GPS1)
  - MODE 3: LINS + OTF + KF (LINS FIX1)
  - MODE 4: LINS + GPS (LINS GPS2)
  - MODE 5: LINS + last KF correction + OTF (LINS FIX2)
  - MODE 6: FCS + GPS (FCS GPS)
  - MODE 8: FCS + OTF (FCS FIX).
- Low Height Warning: a warning is generated by the NC during NAV and AA PoF if the best height, measured by the radar altimeter, decreases below the clearance height set on the RHGS "LOW HT" control. The attention getters and a voice warning "Low Height" give immediate warning of the danger. A pull-up indication is also displayed on the HUD and on the HDHUD format. This is a flashing arrow which rotates about its centre point such that it always points away from the ground. As soon as best height becomes greater than 3% of clearance height datum, the "Low Height" warning is cancelled by the NC. Generation of the "Low Height" warning is delayed by 15 seconds when a WOW transition from ON to OFF occurs and NAV or AA POF is engaged.
- Wind Calculation and Selection: wind data (speed and direction) are calculated when the LINS / FCS data are valid, otherwise Set Wind (if this has been entered using the MDEF or via the PDS / GLU) is used as Best Wind
- Steering (including steering bug): navigation steering is provided as display parameters of the three available steering types: Direct, Track and Hold. The steering azimuth commands to acquire and hold the planned track are displayed as a steering bug above the aircraft heading ribbon as displacement from the HUD azimuth centre line for manual steering
- Route Loading and Manipulation: two routes, each consisting of up to 50 waypoints, can be loaded via the PDS or manually using the MDEF. Waypoints and routes can be manually modified. Up to 200 waypoints can be stored in the Navigation Computer. The possible waypoint types are:
  - Overfly
  - Route
  - Landing
  - Mark
  -

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    CAP.

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- Mark Waypoints: up to 10 Mark waypoints can be stored into the NC during the flight for successive investigation on the ground
-

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  Emergency Airfield Data Calculation: the NC continuously provides the range and bearing of the nearest emergency airfield with respect to the aircraft present position. In case of NC failure, EA functionality is lost and the last calculated data are locked in red on the GUH

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  Emergency Airfield Skip/Freeze function: this function provides range and bearing of the nearest emergency airfield with respect to the aircraft present position. The NC provides the capability of skipping and hence to chose the Emergency Airfield by pressing the EA/SKIP moding-key. In particular, when Auto Mode is selected, the function determines the nearest Emergency Airfield; when Freeze Mode is selected, the function freezes

and provides continuous guidance to the current selected Emergency Airfield. In case of NC failure, EA functionality is lost and the last calculated data are locked in red on the GUH
⇐

- Navigation Fixing: navigation fixing can be performed automatically by means of the GPS or by manually performing an On Top Fix (OTF)
- Universal Time Co-ordinate (UTC) Management: in reversionary mode only, the NC manages the UTC time for the entire Avionics system. The UTC time manager determines where the best system time source information resides (between GPS and radios) and distributes the UTC time to all Avionics System LRIs
- LINS / GPS velocity monitor: the NC assesses the integrity of the LINS data by comparison of the LINS and GPS velocities. The MON TRIP warning is generated in the event of a difference in excess of a predetermined value.
- LINS / FCS attitude monitor: the NC assesses the Integrity of the LINS data by comparison of the LINS and FCS attitudes. The MON TRIP warning is generated in the event of a difference in excess of a predetermined value.
- GPS Present Position Integrity Monitor (Auto monitor): GPS PP Integrity is self-monitoring and compares the last received GPS position with a predicted position to determine its validity. If the difference exceeds a predefined threshold, the NC no longer uses the GPS as a navigation sensor. NAV modes 1, 4 and 6 plus velocity monitor are lost. The indication NO MONITOR is displayed on the HUD and HDHUD format.
- LINS / GPS Position Monitor: integrity of the LINS data is determined by comparison of the LINS and GPS positions performed within the NC (on the ground only). The MON TRIP warning is generated in the event of a difference in excess of a predetermined value.
-

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  LINS In-Flight Alignment (IFA): provided that the GPS is valid, it is used to aid the LINS to perform an In Flight Alignment. During IFA, steering guidance to the three specifically-generated waypoints is provided by the steering bug
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  CAP Steering : the NC provides steering cues to acquire and maintain position on a predefined CAP pattern. The waypoint data blocks on the HUD and the PA format show range and bearing to the CAP datum and the PA displays the CAP pattern, the CAP datum and the planned CAP speed in knots. When approaching a DWP that has been defined as a CAP, the following types of navigation steering become available: CAP Acquiring Steering, CAP Steering and Off CAP Steering
  ⇐

- Magnetic Heading Calculation: the magnetic variation is deduced from the Best Present Position, Best True Altitude, UTC Time then combined with the Best True Heading to generate the Best Magnetic Heading.

BUILT-IN TEST FUNCTION

LRIs that are part of the Navigation Subsystem incorporate three types of built in test facilities:

- Power-up Built-In-Test (PBIT). PBIT is a self-test, which is automatically initiated after the application of power to the electrical bus. PBIT constitutes the minimum pre-flight check for the equipment and also runs when power is restored following an interruption. The objective of PBIT is to perform the most thorough possible testing of individual equipment within the allocated time.

  All NAV Subsystem electronic LRIs perform their PBIT independently.

- Continuous Built-In-Test (CBIT). Continuous monitoring of the NAV Subsystem LRIs is undertaken by the CBIT. This self-test automatically starts once the PBIT has been successfully completed, providing that the loadable software (PPSW) is present.

  The CBIT operations are not intrusive: the equipment continues to correctly operate during the test. The CBIT functions are automatically performed as a background task under control of the equipment operational program; they are performed continuously at fixed rates.

- Initiated Built-In-Test (IBIT). Although not selectable from the cockpit, IBIT is the greatest depth self-test for each LRI. It can only be run from the maintenance data panel.

WARNINGS

The following Navigation system failure or abnormal condition warnings are displayed on the dedicated warning panel:

- **LINS** in all POF
- **NAV CPTR** in all POF
- **RAD ALT** in all POF

- **GPS** in all POF

- **MON TRIP** or **MON TRIP** (Amber in GND POF only)

NAVIGATION SYSTEM - CONTROLS AND INDICATORS

The Manual Data Entry Facility (MDEF) allows data to be manually entered and manipulated within the aircraft avionics subsystems. The selections available relevant to the Navigation subsystem are grouped in the following MDEF subsystems:

- Navigation aids (AIDS)
- Navigation (NAV)
- Set Waypoint (SWP)
- Miscellaneous (MISC)
- Transmitters (XMIT).

NOTE

At the end of each procedure, pressing the relevant SSK will occult all the MKs (i.e. no SSK boxed).

In some instances data may be entered and manipulated in combination with the X-Y controller.

The X-Y controller can be used in isolation to perform specific functions.

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Some of the functions detailed below may also be undertaken via the direct voice input (DVI) facility.

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NAVIGATION AIDS SUBSYSTEM

When selected the modes / data entry tasks of the Navigation Aids subsystem (AIDS SS) are displayed on the moding keys (Figure I-03-01 shows the default selections) and the following tasks can be performed:

- Input a new aircraft Present Position for LINS alignment (Figure I-03-02)
- Input Global Positioning System (GPS) initialization data (Figure I-03-03)
-

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  Selection of LINS In Flight Alignment (Figure I-03-04)

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- View / Selection of available navigation modes (Figure I-03-05)
- Select the TACAN between On and Standby and select between TACAN Air-to-Air mode and TACAN Air-to-Surface mode (Figure I-03-06)

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  The DVI command TACAN - AIR selects the TACAN to air-to-air mode. The DVI command TACAN - SURFACE selects the TACAN to air-to-surface mode

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- Select to use the previous TACAN channel (Figure I-03-07)
- Input a new TACAN channel (Figure I-03-08)

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  On recognition of the DVI command TACAN - CODE, the current TACAN channel is displayed in the HUD DVI ROL. A new TACAN channel may be specified by entering the required digits. The mode defaults to X, and may be changed to Y by the command YANKEE.

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- Select to use TACAN in transmit/receive mode or receive mode only (Figure I-03-09)

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  The DVI command TACAN - RECEIVE selects the TACAN to receive mode only. The DVI command TACAN - TRANSMIT selects the TACAN to transmit and receive mode.

  ⇐

NAVIGATION SUBSYSTEM

NOTE

The functions listed below are not to be used since they are not yet cleared:

- UTM positioning system
- Fuel and Target waypoint types
- Moving waypoint attributes.

When selected the modes / data entry tasks of the Navigation subsystem (NAV SS) are displayed on the moding keys (Figure I-03-10 shows the default selections) and the following functions can be performed:

- Select between the Automatic and Manual routes (Figure I-03-11)
- Create/edit the manual route:
  - Specify WP position (L/L) (Figure I-03-12)
  - Specify WP position (GREF) (Figure I-03-13)
  - Specify WP position (XY on PA) (Figure I-03-14)

Soft.Prog.Ed.: PSC 2.0 onwards

The DVI command ROUTE - 155 causes waypoint 155 to be entered as the NNWP in the current route.

⇐

- Specify WP Type (Figure I-03-15)
- Specify WP attributes (O, R, L PAG 2) (Figure I-03-16)
-

Soft.Prog.Ed.: PSC 2.0 onwards

Specify WP attributes (CAP PAG 2 and 3) (Figure I-03-17)

⇐

-

Soft.Prog.Ed.: PSC 2.0 onwards

Specify WP attributes (O, R, L PAG 3 or CAP PAG 4) (Figure I-03-18)

⇐

- No Unpaired WP (Figure I-03-19).

Note that this function is not to be used when the Manual Route is selected, due to current CSG problems.

- Maintain (Hold) current track (Figure I-03-20)
- Steering Type Selection (Figure I-03-21)
- New Track Moding (Figure I-03-22)
- Reverse the order of the route currently selected to be flown (Figure I-03-23)
- Input manual wind data and select between system derived wind data and manually input wind data (Figure I-03-24)
- Change destination so that the previous Destination Waypoint (DWP) becomes the current DWP (Figure I-03-25)

Soft.Prog.Ed.: PSC 2.0 onwards

The DVI command DEST - DOWN causes the previous DWP to become the new DWP. If the press-to-recognize control remains selected repeating the DOWN command allows the destination to be changed backwards to the start of the route. The DVI command DEST - UP causes the waypoint after the DWP (the NNWP) to become the DWP.

⇐

- Delete the Manual Route (Figure I-03-26)

SET WAYPOINT SUBSYSTEM

NOTE

The functions listed below are not to be used since they are not yet cleared:

- UTM positioning system
- Fuel and Target waypoint types
- Moving waypoint attributes

When selected the modes/data entry tasks of the Set Waypoint Subsystem (SWP SS) are displayed on the moding keys (Figure I-03-27 shows the default moding) and the following functions are able to be performed:

- Create new waypoints and edit existing waypoints (Figure I-03-28 , Figure I-03-29 and Figure I-03-30)
- Create a MARK waypoint at present position (Figure I-03-31)

Soft.Prog.Ed.: PSC 2.0 onwards

The DVI command PA - MARK causes a MARK waypoint to be created.

⇐

- Delete waypoints (Figure I-03-32)
- Draw a line from a waypoint on the PA format (Figure I-03-33)
- Define a new bullseye position (Figure I-03-34)
- Edit Fighter Area of Responsibility (FAOR) information (Figure I-03-35)
-

Soft.Prog.Ed.: PSC 2.0 onwards

Emergency Airfield Mode Selection (Figure I-03-36).

⇐

MISCELLANEOUS SUBSYSTEM

When selected the modes/data entry tasks of the Miscellaneous (MISC) subsystem are displayed on the moding keys. Setting of fuel reserves is allowed (Figure I-03-37).

TRANSMITTERS SUBSYSTEM

When selected the modes/data entry tasks of the Transmitters (XMIT) subsystem are displayed on the moding keys. It is allowed to Silence all the transmitters contemporarily or TACAN / RADALT separately (Figure I-03-38).

X-Y FUNCTIONALITY

NOTE

The functions listed below are not to be used since they are not yet cleared:

- Air to Surface Range fix (ASR)
- Range and Bearing fix (RBF)
- Precise Velocity Update fix (PVU)
- Select the UTM grid option
- Fuel, Orbit and Target waypoint types.

The following functions are available via the X-Y controller:

- LINS Rapid Alignment (Figure I-03-39)
-

  Soft.Prog.Ed.: PSC 1.1.X

  Page waypoints list (Figure I-03-40)

  ⇐

-

  Soft.Prog.Ed.: PSC 2.0 onwards

  Page waypoints list (Figure I-03-41)

  ⇐

- Display extra data on waypoints on the WPT List format (Figure I-03-42)
- Copy waypoints from the waypoint list into a route (Figure I-03-43)
- Move waypoints within a route or between routes (Figure I-03-44)
- Remove waypoints from the route ROL (Figure I-03-45)
- Scroll route ROL (Figure I-03-46)
- Reset route ROL (Figure I-03-47)
- Select window-on-the-world (Figure I-03-48)
- Change the range scale (Figure I-03-49)

  Soft.Prog.Ed.: PSC 2.0 onwards

  The DVI command PA - UP causes the displayed range scale of the PA format to increase. Provided the press-to-recognize control remains selected, repeating the command UP causes the displayed range scale to increase in steps until the maximum range scale is reached, upon which repeated commands have no effect.

  ⇐

  Soft.Prog.Ed.: PSC 2.0 onwards

  The DVI command PA - DOWN causes the displayed range scale of the PA format to decrease. Provided the press-to-recognize control remains selected, repeating the command DOWN causes the displayed range scale to decrease in steps until the minimum range scale is reached, upon which repeated commands have no effect.

  ⇐

  Soft.Prog.Ed.: PSC 2.0 onwards

  Once the PA command has been recognized, and provided the press-to-recognize control remains selected, a mixture of UP and DOWN commands may be used to change the scale as required. The DVI command PA - DEFAULT returns the PA format to its default settings as defined by PSMK.

  ⇐

- Display extra data on waypoints on the PA format (Figure I-03-50)
- Display the time early/late error (Figure I-03-51)
- Display the groundspeed indication (Figure I-03-52)
- Select between UTC time and Mission Time (Figure I-03-53)
-

  Soft.Prog.Ed.: PSC 1.1.X

  Perform an On-top fix (Figure I-03-54)

  ⇐

-

  Soft.Prog.Ed.: PSC 2.0 onwards

  Perform an On-top fix (Figure I-03-55)

  ⇐

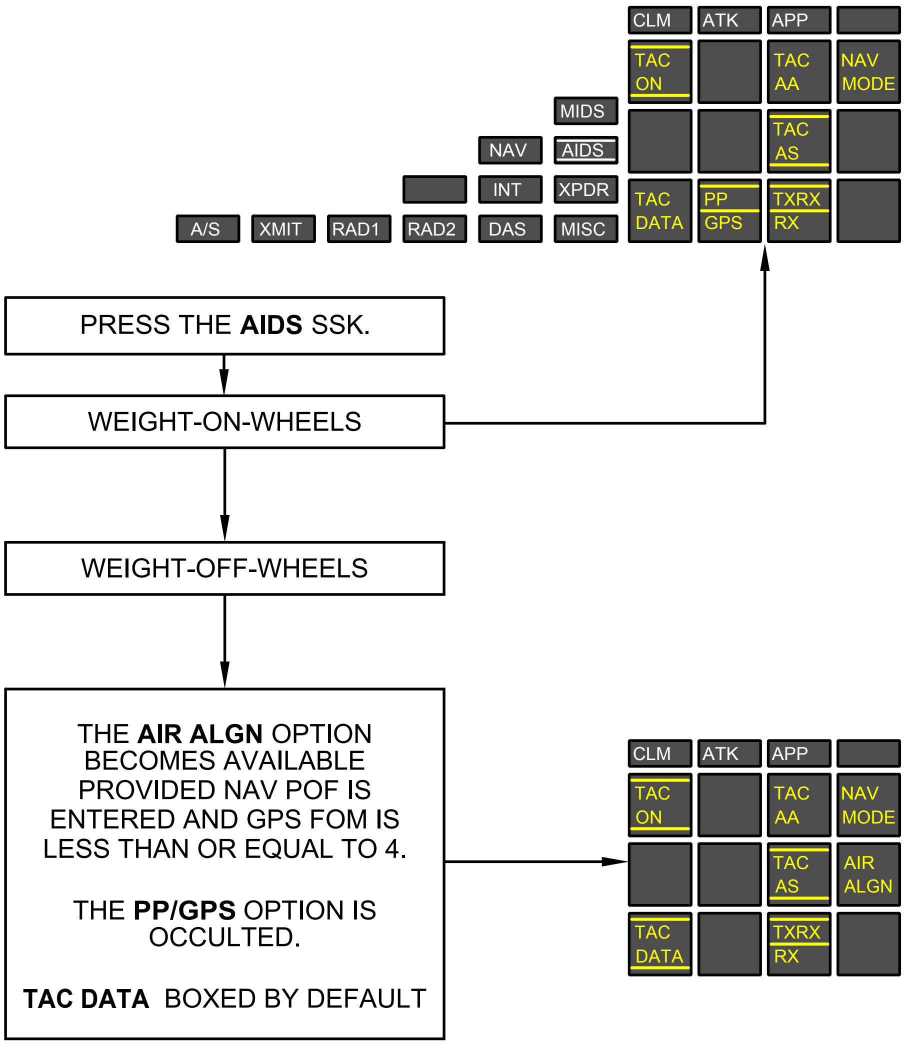
- Display extra data on present position (Figure I-03-56)
- Select the bullseye grid for display (Figure I-03-57)

  Soft.Prog.Ed.: PSC 2.0 onwards

  The DVI command PA - BULLSEYE is used to select the bullseye grid on the PA format between on and off.

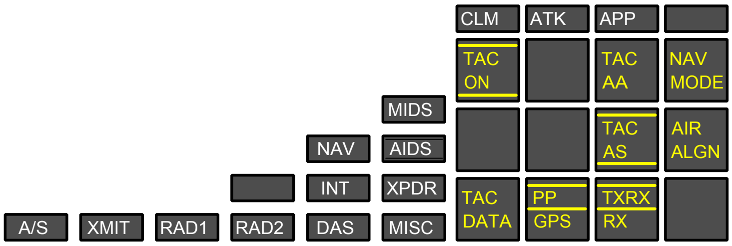
  ⇐

- Select between range, L/L, GEOREF and UTM grids and select between the two available DMG color palettes (Figure I-03-58)
- Display a zoom window (Figure I-03-59).



ICN-1B-B-340000-A-A0019-05543-A-02-2

Figure I-03-01 Navigation AIDS Subsystem Default Moding



PRESS THE **AIDS** SSK.

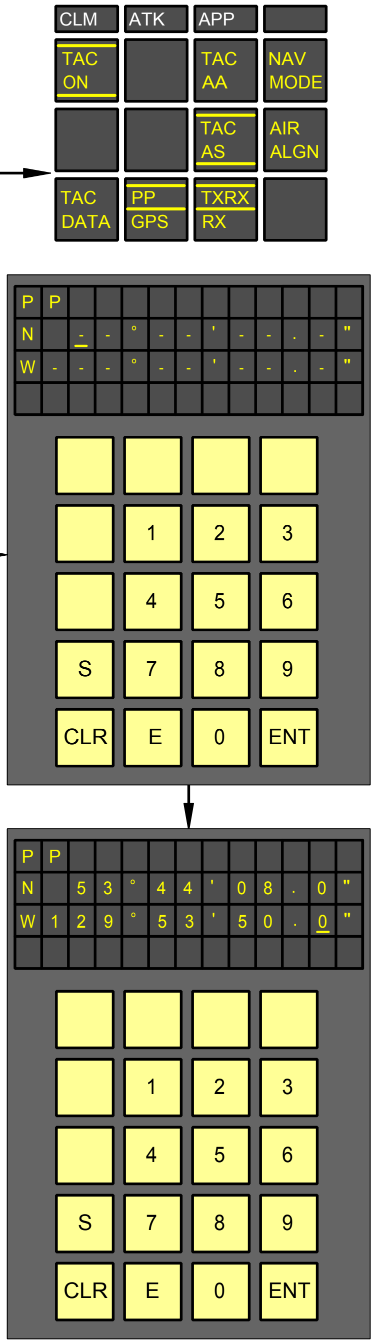
PP IS SELECTED BY DEFAULT DURING THE LINS ALIGNMENT PROCEDURE AND W-ON-W.

IF PP IS HELD IN NON VOLATILE MEMORY OR HAS BEEN LOADED VIA PDS, IT IS DISPLAYED IN THE ROL AND MAY BE EDITED VIA THE DEK.

IF NO PRESENT POSITION DATA EXISTS ROL CONFIGURE WITH DASHES. PP MAY BE ENTERED VIA THE DEK.

N,S,E AND W OPTIONS MAY BE CHANGED AT ANY TIME, IRRESPECTIVE OF WM POSITION.

PRESS **ENT** TO CONFIRM NEW PP DATA.



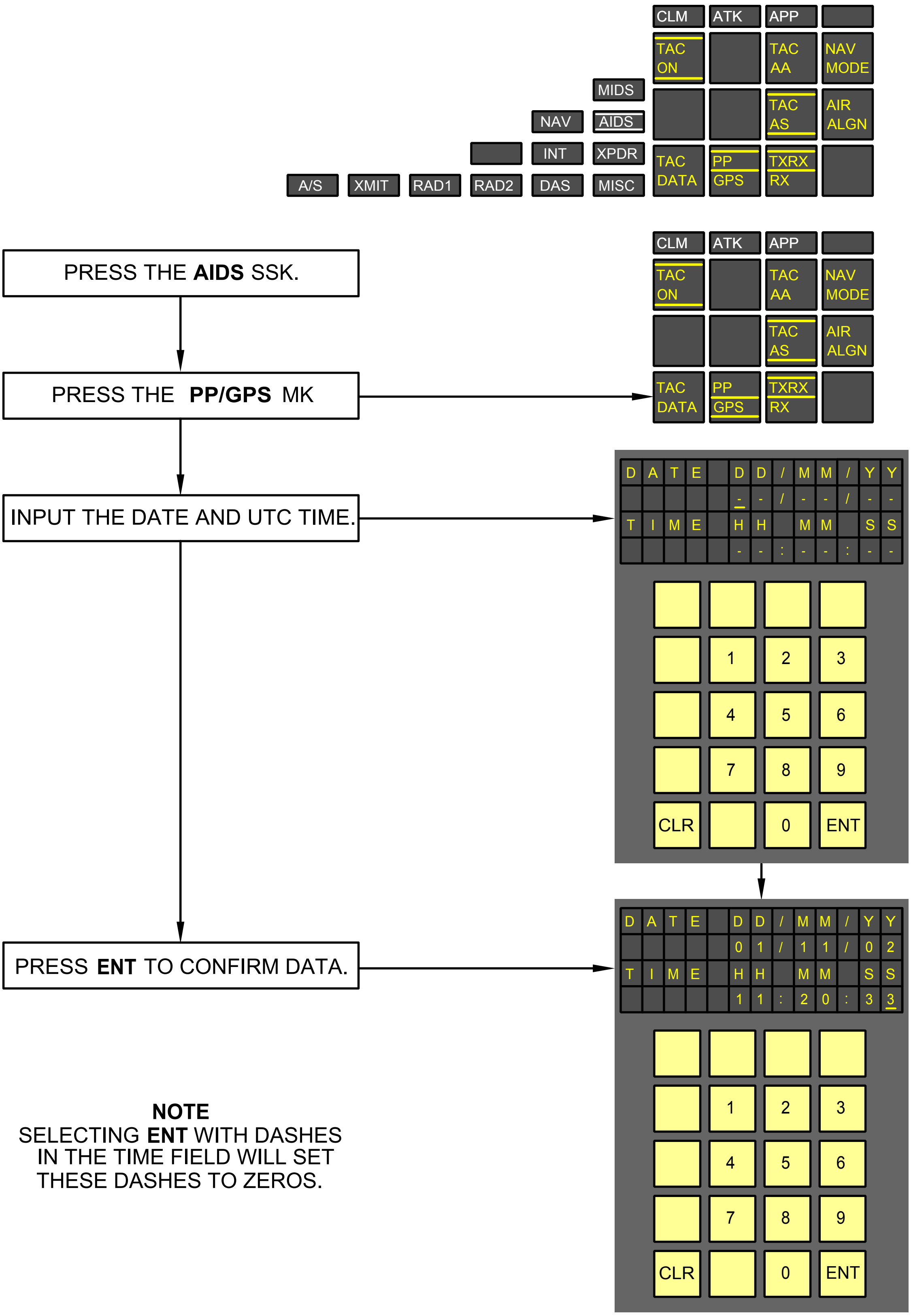
NOTE

THE **PP** MK IS ONLY AVAILABLE WHEN:

- WEIGHT-ON-WHEELS
- LINS IN ALIGNMENT MODE OR LINS DATA INVALID.

ICN-1B-B-340000-A-A0019-05544-A-02-2

Figure I-03-02 Present Position Insertion

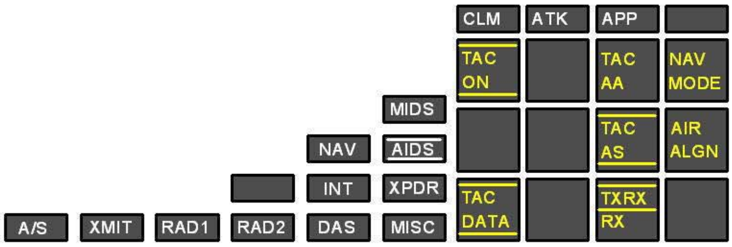


ICN-1B-B-340000-A-A0019-05545-A-02-2

Figure I-03-03 GPS Initialization

Soft.Prog.Ed.: PSC 2.0 onwards

NOTE
PRIOR TO SELECTING IFA ENSURE THAT THE AIRCRAFT SPEED AND ALTITUDES ARE STABLE.

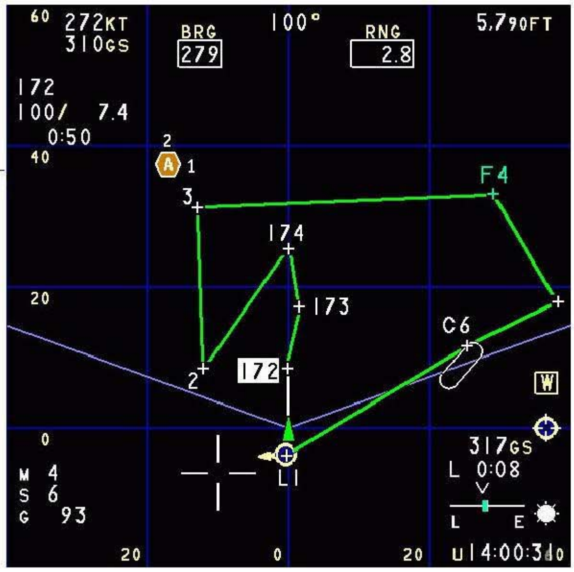


PRESS THE **AIDS** SSK.

PRESS THE **AIR ALGN** MK.

ON THE PA FORMAT AN IFA ROUTE CONSISTING OF 2 ROUTE WP (172, 173) AND ONE OVERFLY WP (174), IS ENTERED INTO THE CURRENT ROUTE PRIOR TO DWP.

AIR ALGN MK ONLY AVAILABLE WHEN WEIGHT OFF WHEELS, NAV POF AND GPS FOM ≤ 4.



FLY THE IFA ROUTE AS ACCURATELY AS POSSIBLE WHILST MAINTAINING A CONSTANT GROUND SPEED (THE SAME VALUE THAT EXISTED AT IFA SELECTION).

LINS ALIGNMENT TIME-TO-GO (IN SECS) AND LINS ALIGNMENT LEVEL (IN NM/H) ARE DISPLAYED IN HUD/HDHUD. REFER TO LINS DESCRIPTION

'NAV RDY' DISPLAYED IN HUD/HDHUD WHEN IFA COMPLETE. PILOT EXITS IFA MODE AND ENTERS NAV MODE BY DESELECTING **AIR ALGN** MK.

NOTE

1. ONLY THE ALTERNATIVE ROUTE MAY BE EDITED DURING IFA.
2. IT IS NOT COMPULSORY TO FLY THE DIVERSIONARY ROUTE, BUT IFA WILL TAKE LONGER TO COMPLETE.
3. IF **AIR ALGN** IS DESELECTED BEFORE IFA HAS BEEN COMPLETED THERE WILL BE A DEGRADATION IN SYSTEM PERFORMANCE
4. "**EDIT RTE**" MK WILL BE OCCULTED IN THE NAV SSK, IF THE **MAN** ROUTE IS BEING FLOWN.

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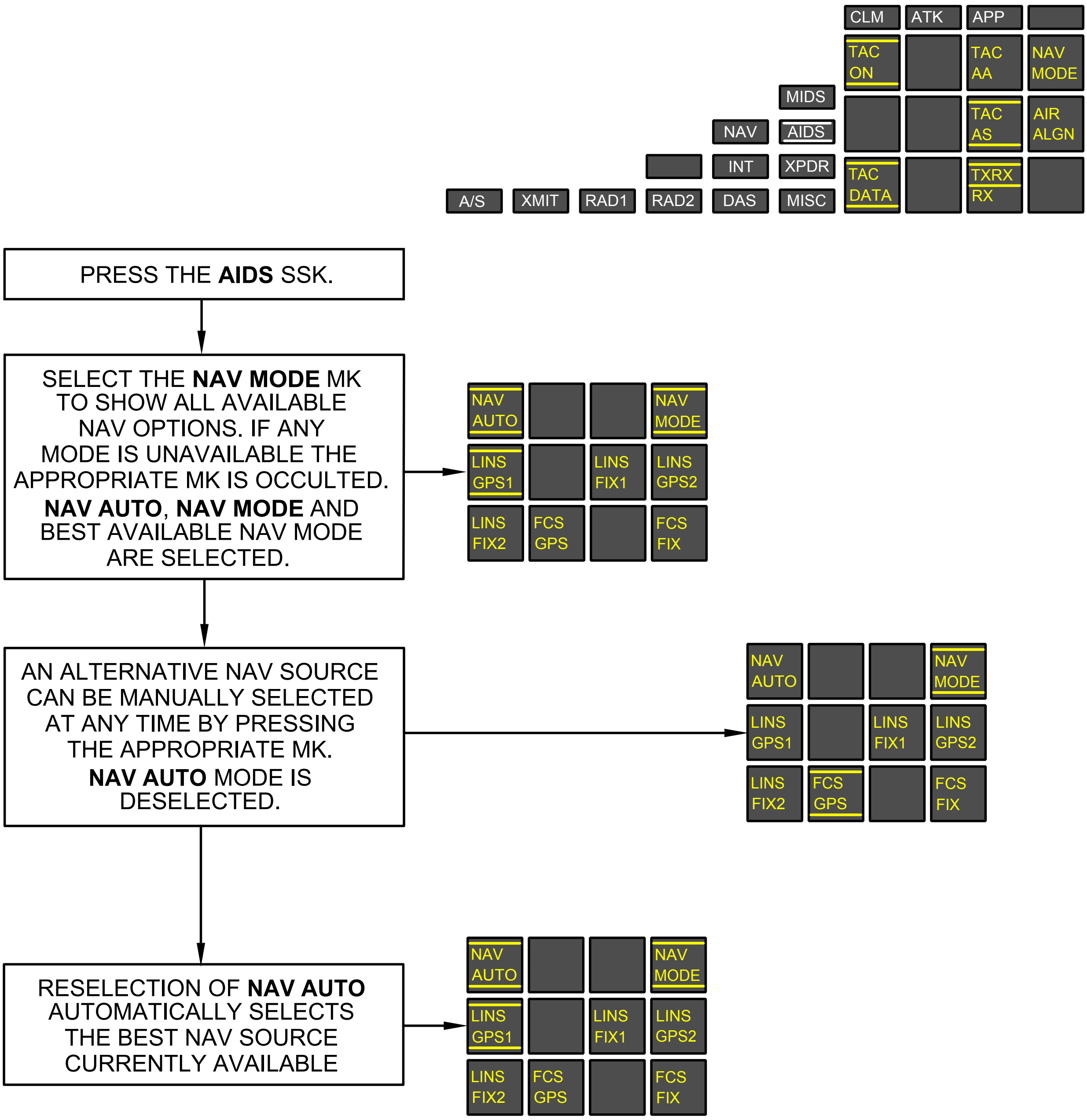
Figure I-03-04 LINS In Flight Alignment Mode

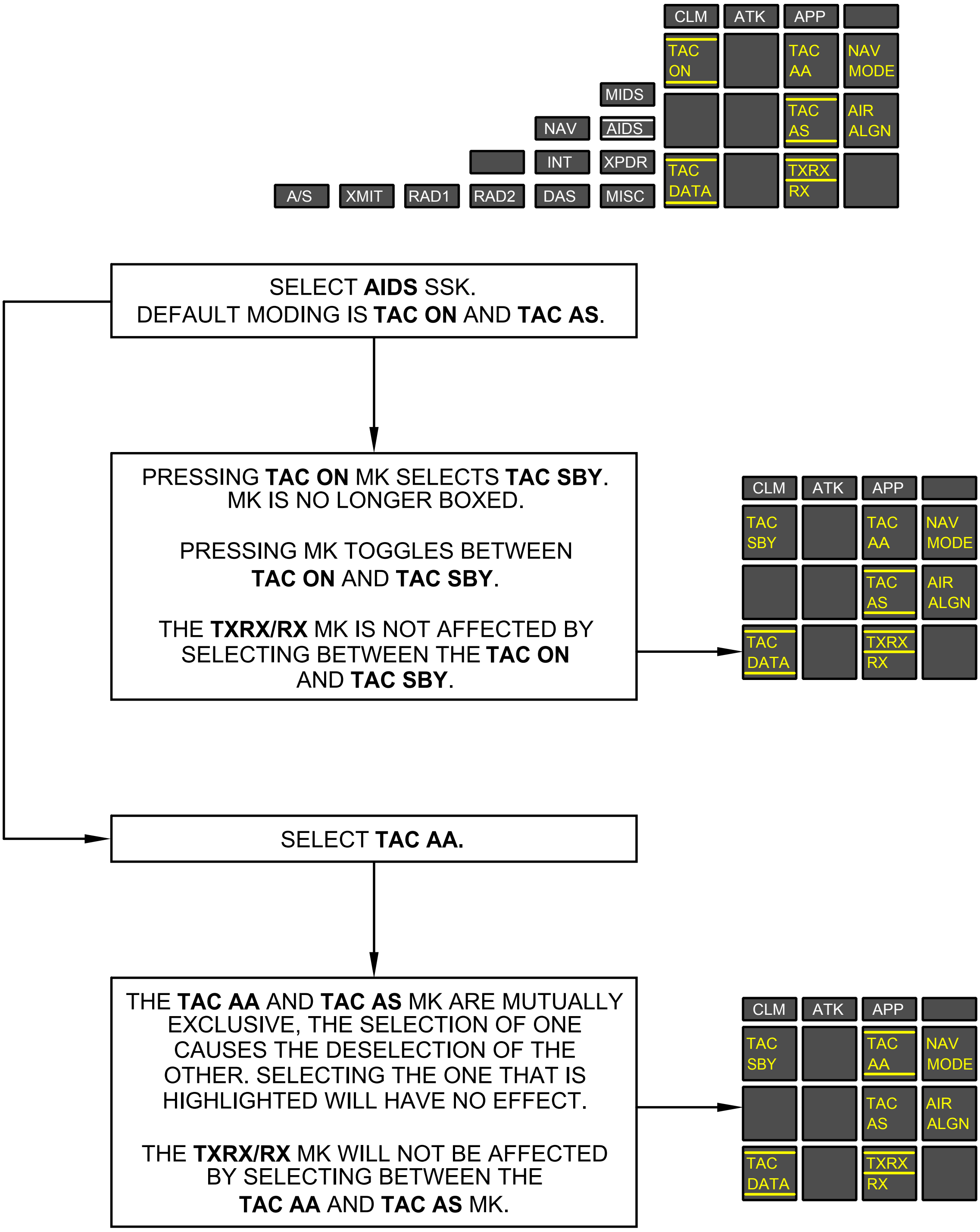
⇐



NOTE
IF A MANUALLY SELECTED NAV MODE BECOMES UNAVAILABLE, THE NAV AUTO MODE WILL BE AUTOMATICALLY RE-ENGAGED CAUSING THE BEST AVAILABLE NAV SOURCE TO BE USED.

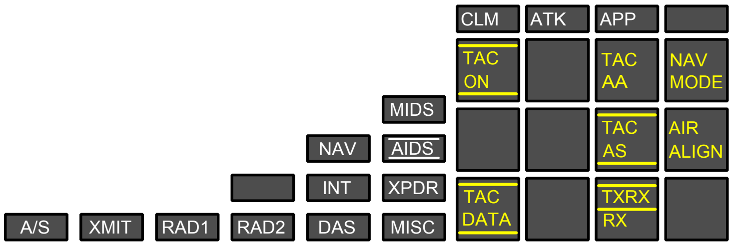
ICN-1B-B-340000-A-A0019-05548-A-02-2

Figure I-03-05 Automatic/Manual Selection of Navigation Modes



ICN-1B-B-340000-A-A0019-05549-A-02-2

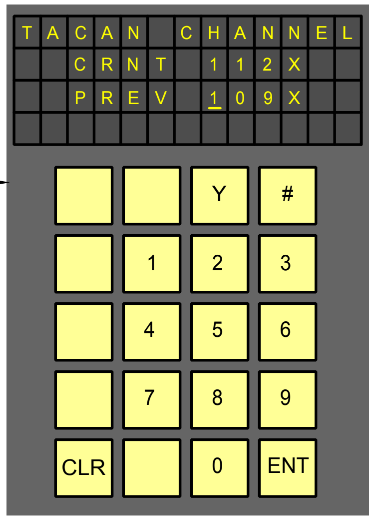
Figure I-03-06 Select Between TACAN ON and SBY and Between TAC AA and TAC AS



PRESS THE **AIDS** SSK.

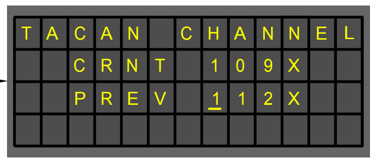
IN NAV POF AND W-OFF-W THE TAC DATA MK IS SELECTED BY DEFAULT.
TAC DATA CAN BE MANUALLY SELECTED IN ANY OTHER POF.

ROL RECONFIGURE TO DISPLAY THE CURRENT AND PREVIOUS TACAN CHANNELS. IF THERE IS NO PREVIOUS CHANNEL THEN ROL 3 WILL BE SET TO 'NEW - - - X'.



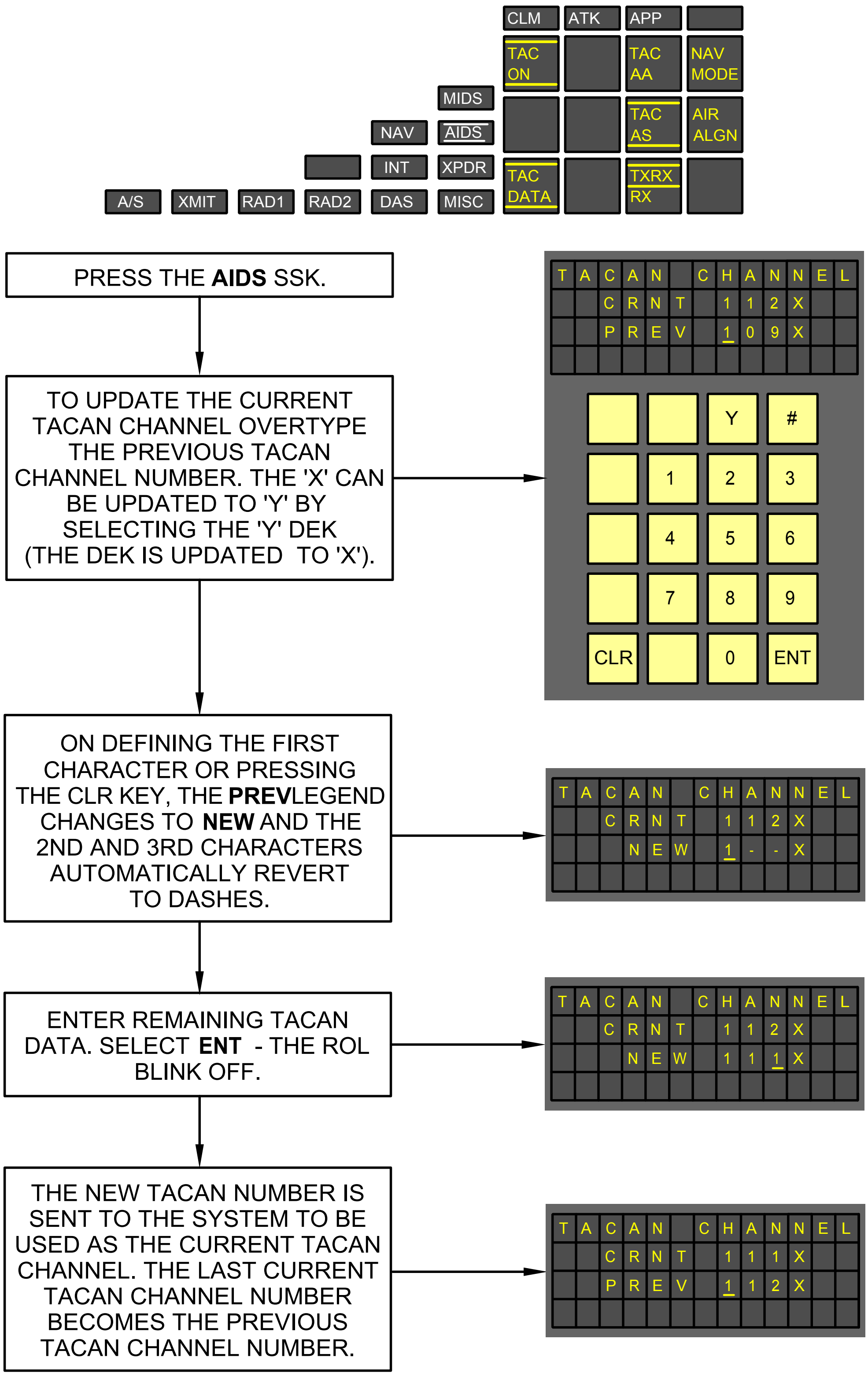
IN ORDER TO USE THE PREVIOUS TACAN CHANNEL SELECT ENT.

THE PREVIOUS TACAN CHANNEL IS SENT TO THE SYSTEM TO BE USED AS THE NEW TACAN CHANNEL AND THE INFORMATION ON ROL 2 AND 3 IS SWITCHED.



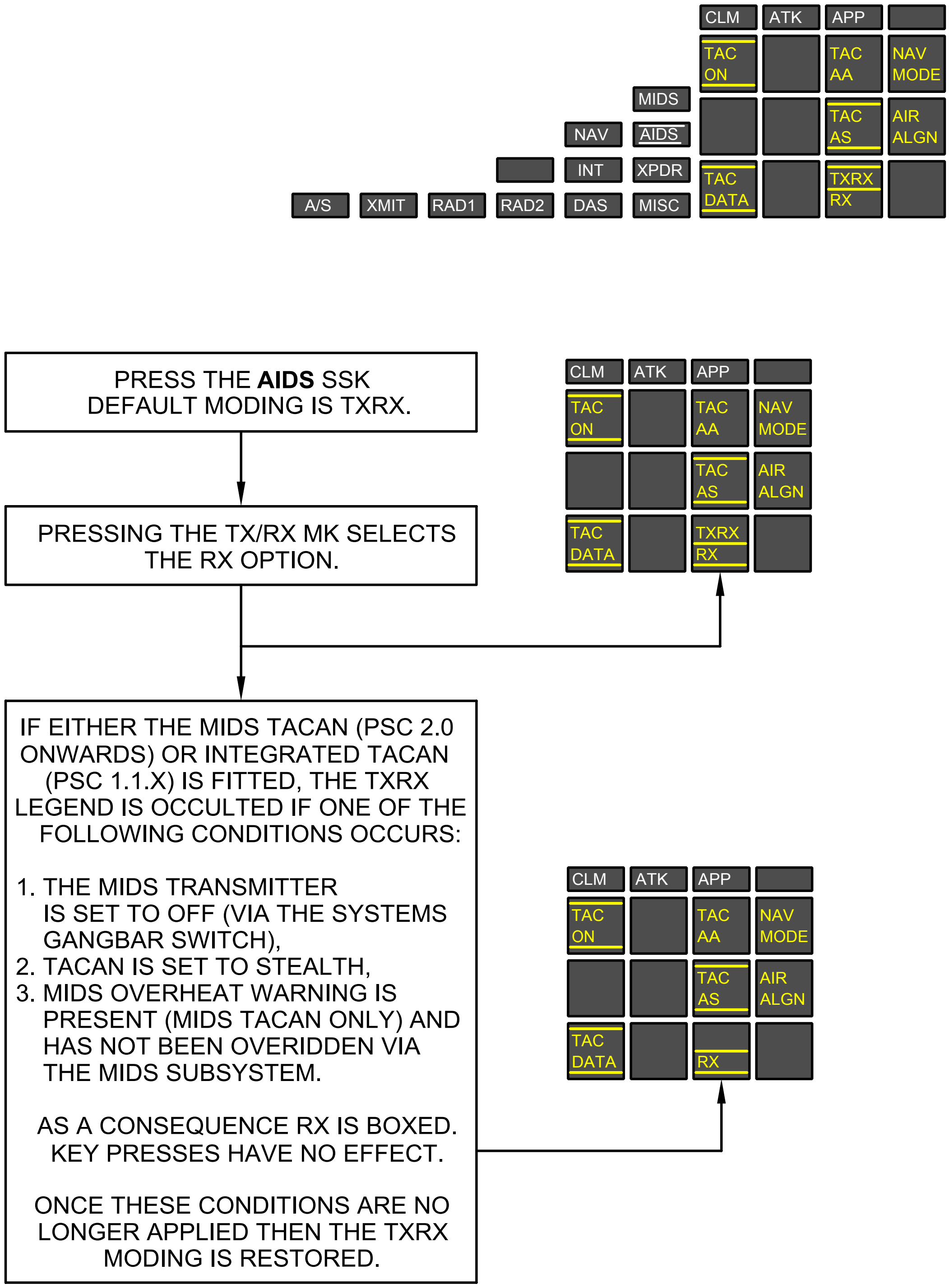
ICN-1B-B-340000-A-A0019-05550-A-02-2

Figure I-03-07 Edit TACAN Channel - Select Previous



ICN-1B-B-340000-A-A0019-05551-A-02-2

Figure I-03-08 Edit TACAN Channel - Input New Channel



NOTE
THE **TXRX/RX** MK IS UNAFFECTED BY SELECTING BETWEEN **TAC AA** AND **TAC AS**.

ICN-1B-B-340000-A-A0019-05552-A-02-2

Figure I-03-09 Select TACAN Between Transmit/Receive and Receive Only

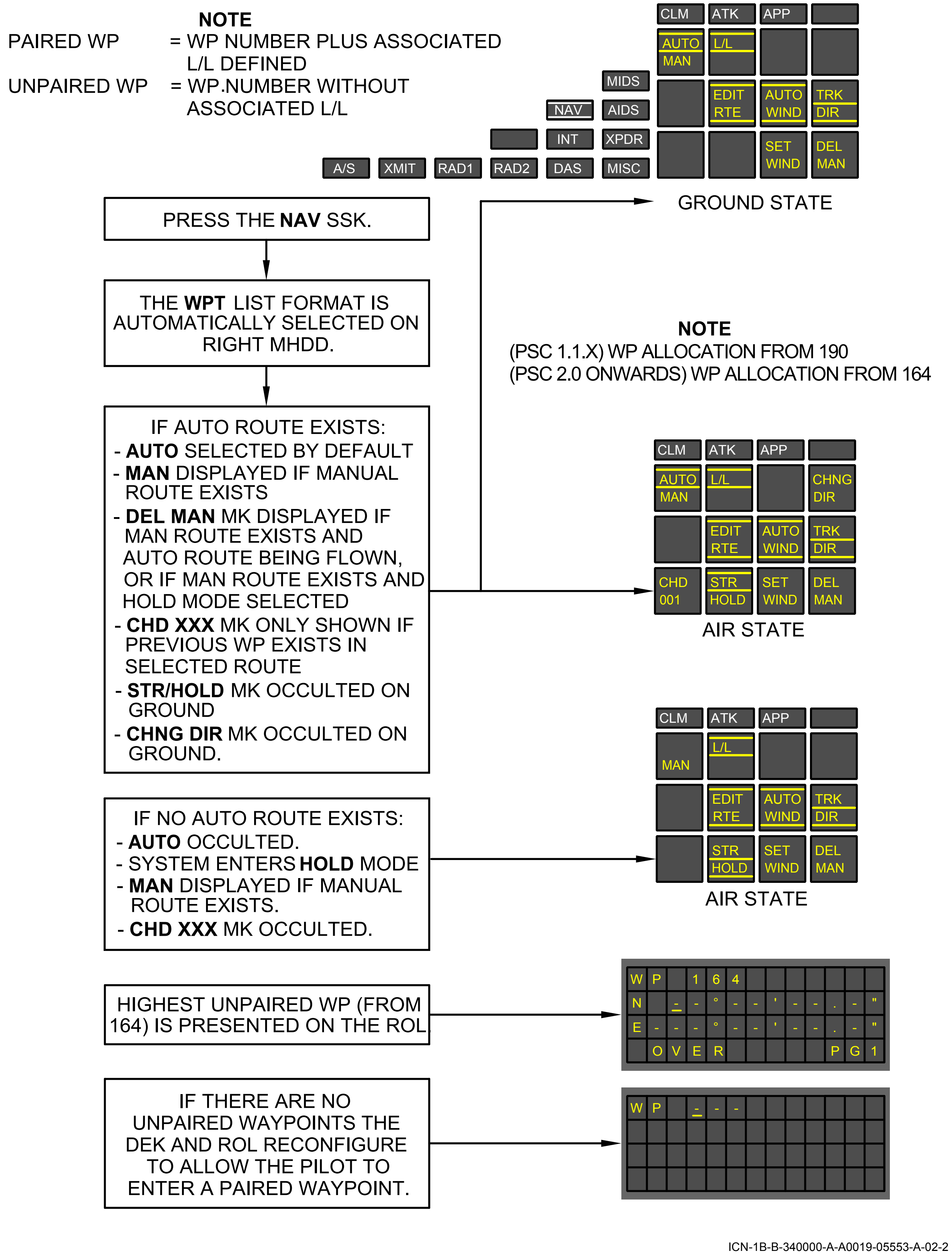
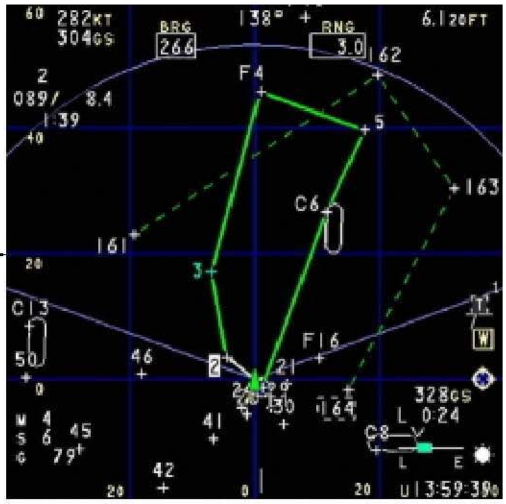


Figure I-03-10 Navigation Subsystem Default

PRESS THE **NAV** SSK.

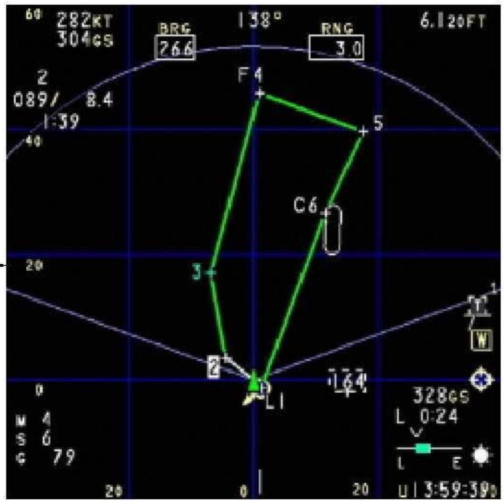
THE **WPT** LIST FORMAT IS AUTOMATICALLY SELECTED ON RIGHT MHDD. PAGE CONTAINING DWP IS SHOWN.

THE PA FORMAT SHOWS ALL WAYPOINTS LYING IN THE AREA OF COVERAGE. BOTH AUTO AND MANUAL ROUTES ARE SHOWN (IF THEY EXIST).



AUTO ROUTE (INDICATED BY SOLID LINE) IS SELECTED TO BE FLOWN BY DEFAULT ON INITIAL SELECTION OF NAV SSK. SYSTEM PROVIDES STEERING FOR AUTO ROUTE DWP (WP2 IN THIS EXAMPLE).

ON DESELECTION OF WPT FORMAT THE PA FORMAT DISPLAYS ONLY THE ROUTE SYMBOLOGY OF THE SELECTED ROUTE, THE JWP AND CAP RACETRACK ASSOCIATED WITH CAP WP (UP TO A MAX OF 5).



ON REACHING THE END OF THE AUTO ROUTE THE LAST WAYPOINT REMAINS ENGAGED AS DWP AND STEERING INFORMATION CONTINUES TO BE PROVIDED WITH RESPECT TO THIS WP.

CONTINUED ON SHEET 2

ICN-1B-B-340000-A-A0019-05555-A-03-2

Figure I-03-11 Automatic and Manual Route Selection (1 of 2)

PRESS THE **AUTO/MAN** MK TO SELECT MANUAL ROUTE.
IF THE JWP IS THE FIRST WP IN MAN RTE THEN **CHD XXX** AND **CHNG DIR** ARE OCCULTED.

MAN RTE IS ONLY DISPLAYED ON PA FORMAT. SYSTEM PROVIDES STEERING FOR MAN RTE DWP (164).

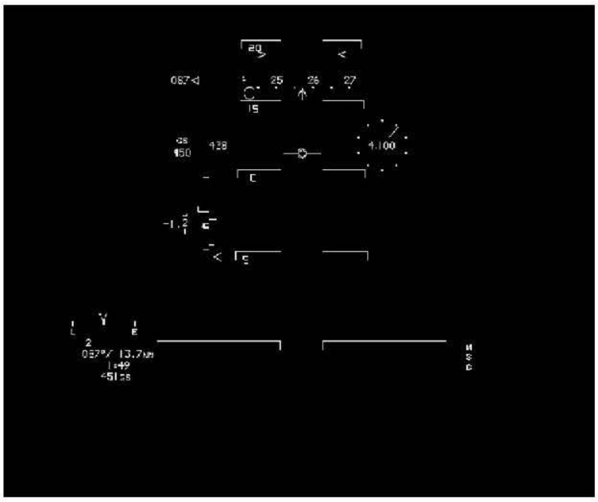
ON REACHING THE END OF THE MAN RTE:
- AUTO RTE IS SELECTED IF LAST WP IN MAN RTE ALSO EXISTS IN AUTO RTE AND STEERING IS PROVIDED FOR NEXT WP IN AUTO RTE (CALLED JWP)
- MAN RTE REMAINS SELECTED IF LAST WP IN MAN RTE IS NOT IN AUTO RTE, OR IF THE LAST WP IN MAN RTE IS ALSO THE LAST WP IN AUTO RTE (LAST WP REMAINS AS DWP).

ROUTE STEERING INFORMATION IS ALSO PROVIDED ON THE HSI FORMAT (A), HDHUD FORMAT (B) AND THE HUD (C).

A

B

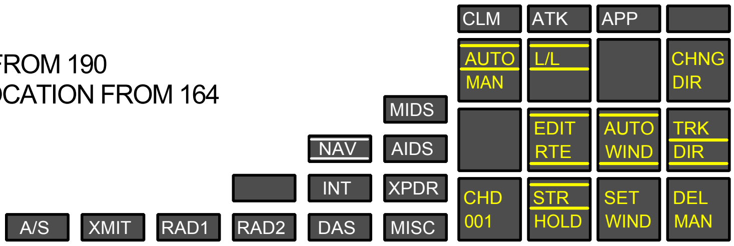
C



ICN-1B-B-340000-A-A0019-05556-A-03-2

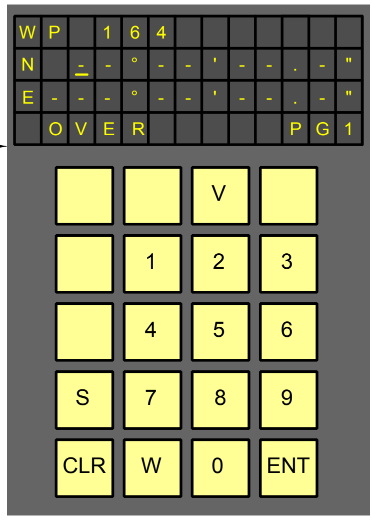
Figure I-03-11 Automatic and Manual Route Selection (2 of 2)

NOTE
(PSC 1.1.X) WP ALLOCATION FROM 190
(PSC 2.0 ONWARDS) WP ALLOCATION FROM 164



PRESS THE **NAV** SSK. **EDIT RTE** SELECTED BY DEFAULT.

UNPAIRED WAYPOINTS AVAILABLE.

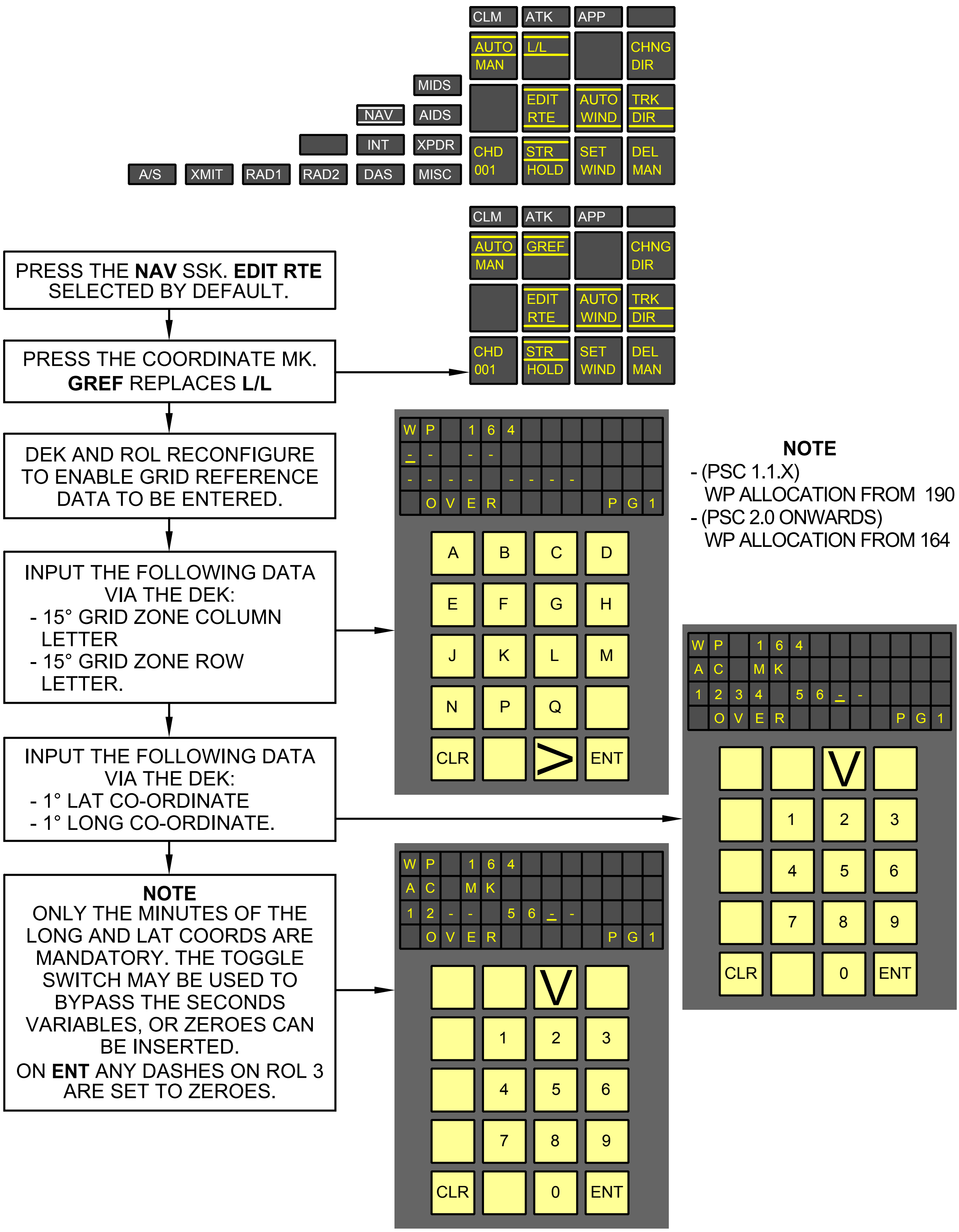


THE HIGHEST UNPAIRED WP NUMBER FROM 164 IS DISPLAYED.
DEK AND ROL CONFIGURE TO ALLOW WP ATTRIBUTES TO BE DEFINED.
L/L IS SELECTED BY DEFAULT, BUT GREF OR UTM MAY BE MANUALLY SELECTED.

INPUT LAT/LONG VIA DEK.

ICN-1B-B-340000-A-A0019-06738-A-01-2

Figure I-03-12 Route Creation via MDEF - Specify WP position (L/L)



ICN-1B-B-340000-A-A0019-05558-A-02-2

Figure I-03-13 Route Creation via MDEF - Specify WP position (GREF)

PRESS THE **NAV** SSK. X-Y MARKER ANNOTATED WITH 'RTE'.

UNPAIRED WP AVAILABLE

PERFORM AN X-Y INSERT ON THE **PA** FORMAT AT THE POSITION WHERE THE NEW WP IS REQUIRED.

X-Y HIGHLIGHTED AND L/L OF X-Y POSITION SHOWN.

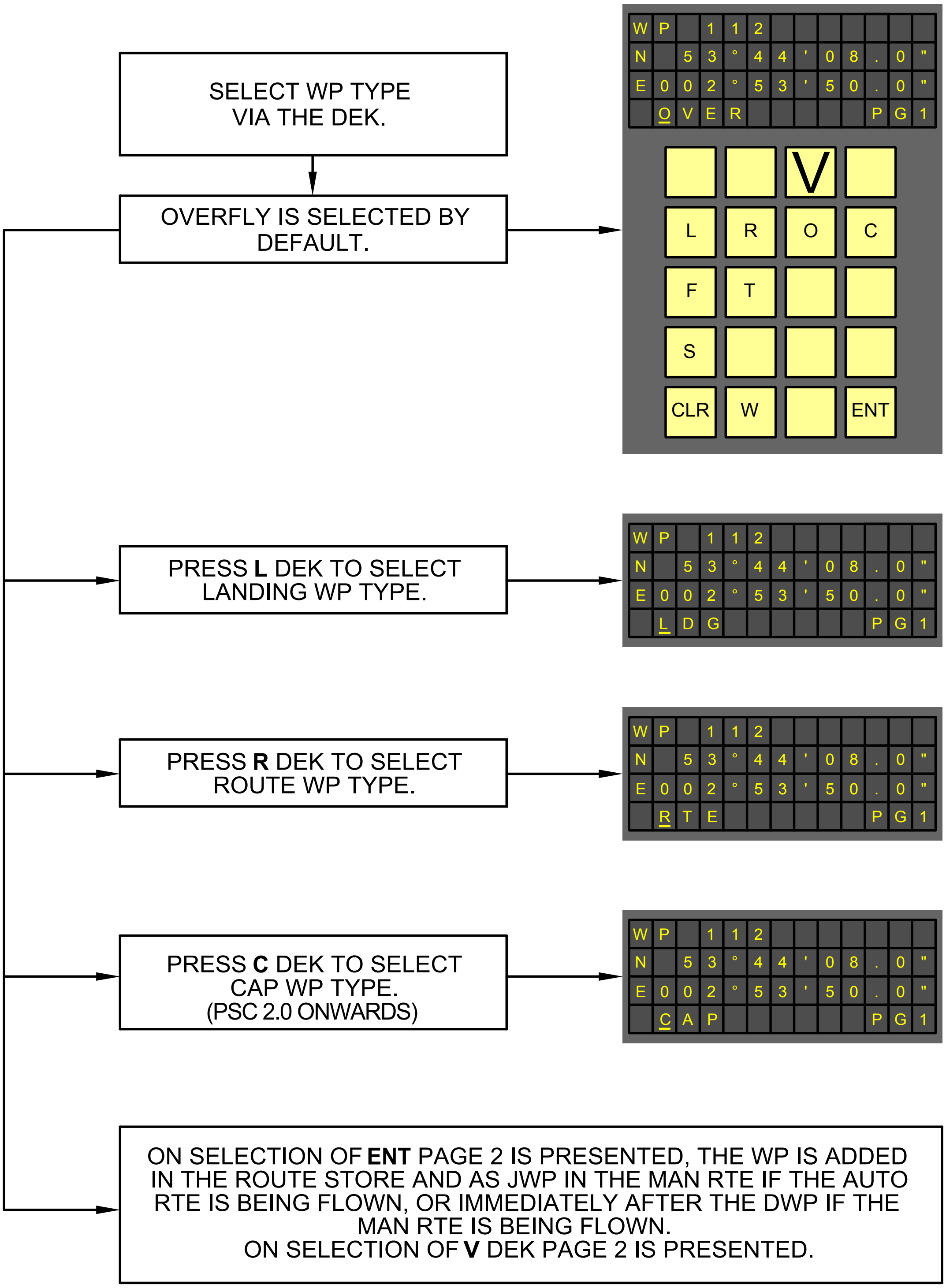
ROLS CONFIGURE TO SHOW THE LAT/LONG OF THE WP.

IF NO EDITING IS REQUIRED A SECOND CONSECUTIVE X-Y INSERT (OR **ENT**) SHOWS PAGE 2, THE WP IS ADDED TO THE WP TO THE ROUTE STORE AS JWP IN THE MAN RTE IF THE AUTO RTE IS BEING FLOWN, OR IMMEDIATELY AFTER THE DWP IF THE MAN RTE IS BEING FLOWN. ON SELECTION OF **V** DEK PAGE 2 IS PRESENTED.

NOTE
- ANY DEK SELECTION (EXCEPT WM) CANCELS X-Y INVOLVEMENT WITH THE PROCEDURE
- AT THE END OF THE OPERATIONS "ENTER" MUST BE PRESSED INSTEAD OF "X-Y INSERT"

ICN-1B-B-340000-A-A0019-05559-A-03-2

Figure I-03-14 Route Creation via MDEF - Specify WP position (XY on PA)



ICN-1B-B-340000-A-A0019-06742-A-01-2

Figure I-03-15 Route Creation via MDEF - Specify WP Type

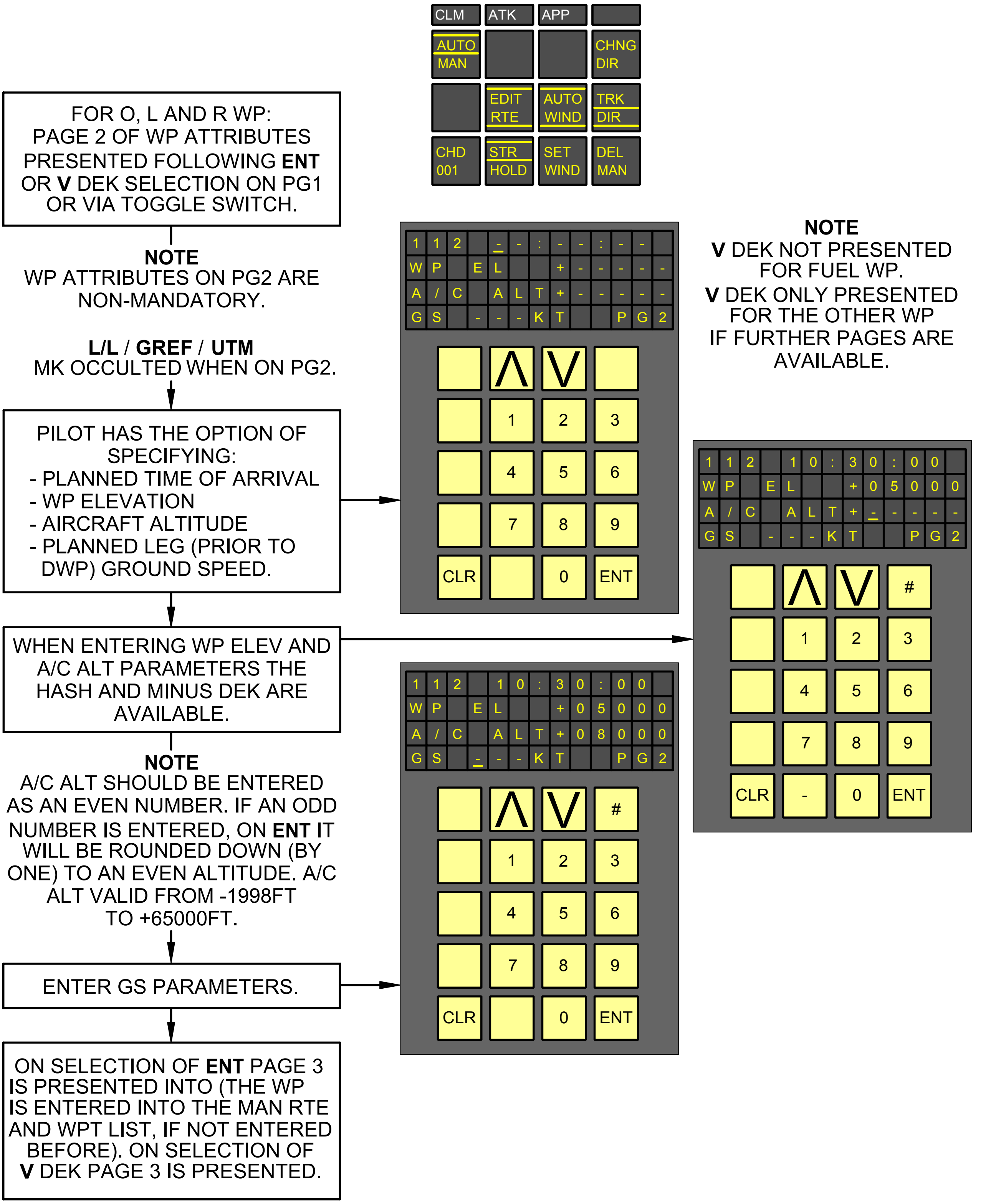
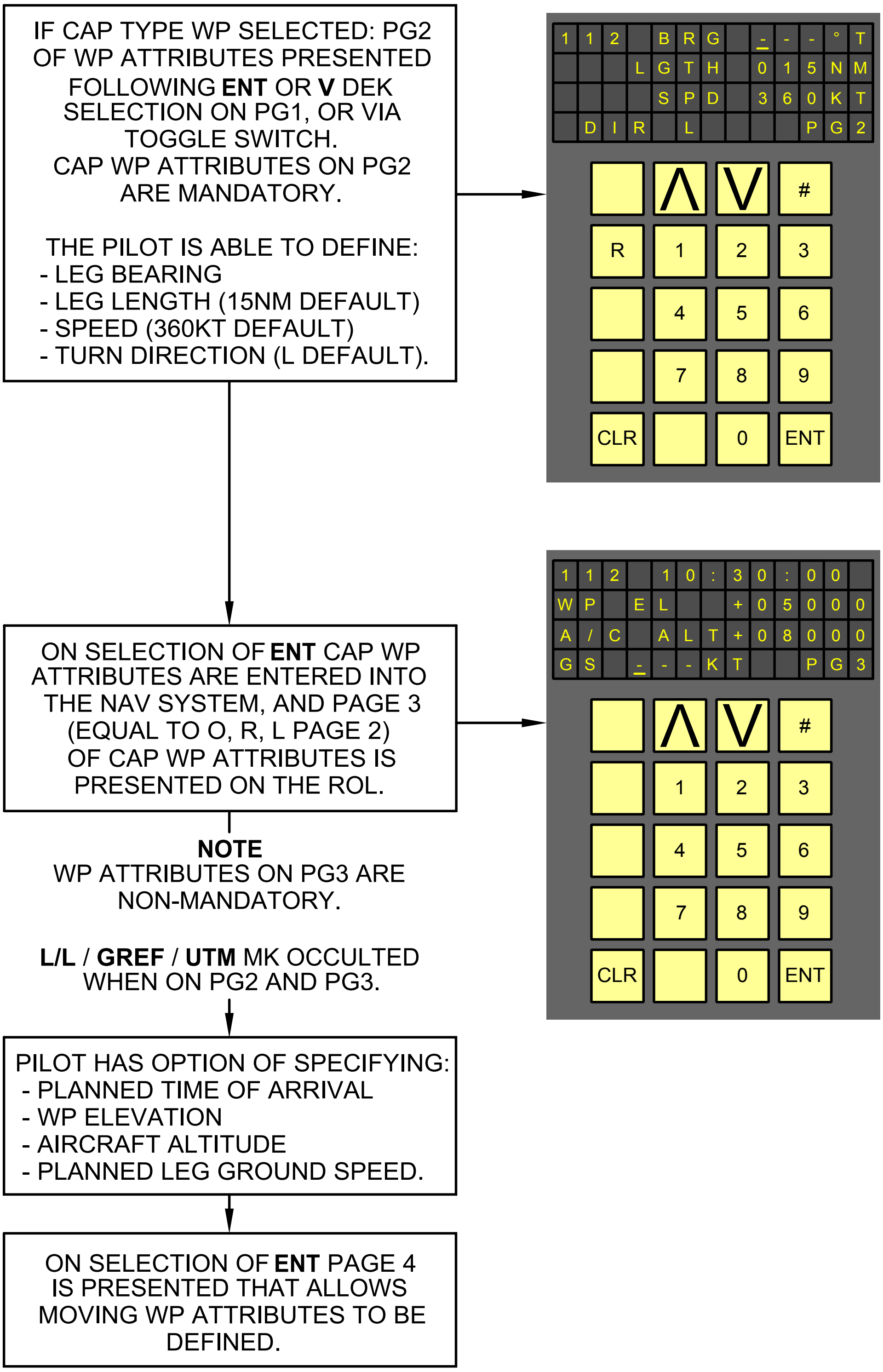


Figure I-03-16 Route Creation via MDEF - Specify WP attributes (O, R, L PAG 2)

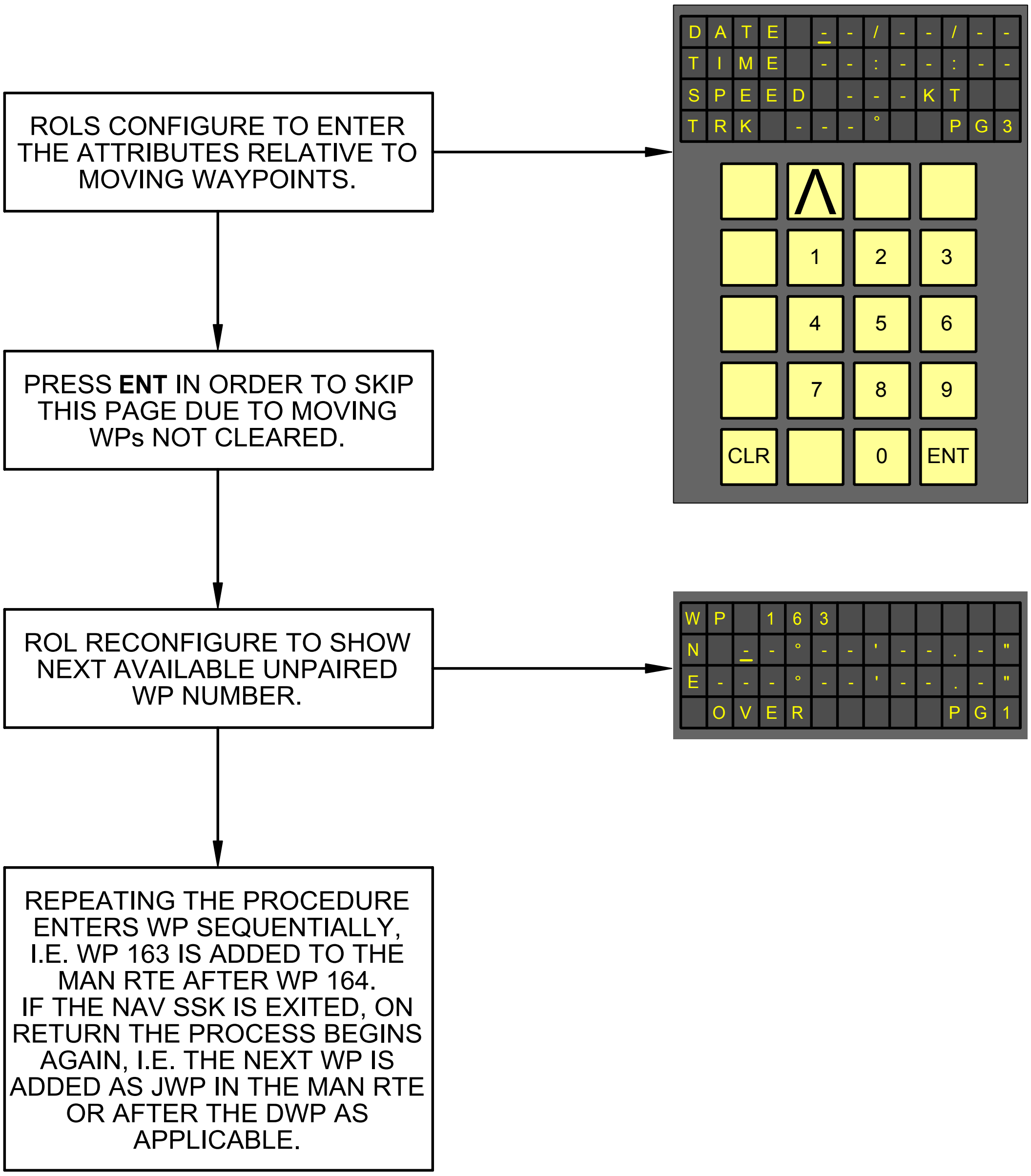
Soft.Prog.Ed.: PSC 2.0 onwards



ICN-1B-B-340000-A-A0019-06743-A-01-2

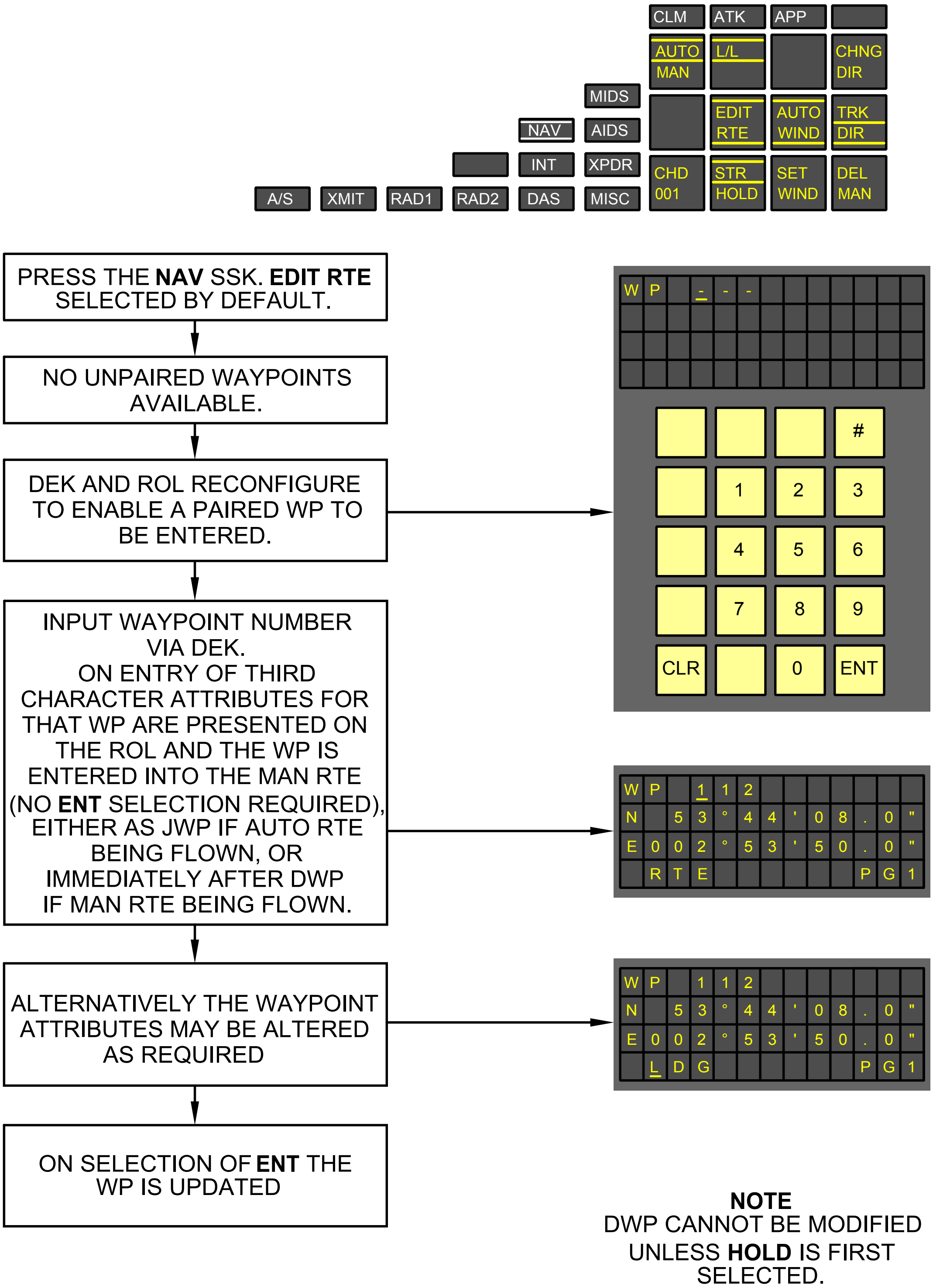
Figure I-03-17 Route Creation via MDEF - Specify WP attributes (CAP PAG 2 and 3)

⇐



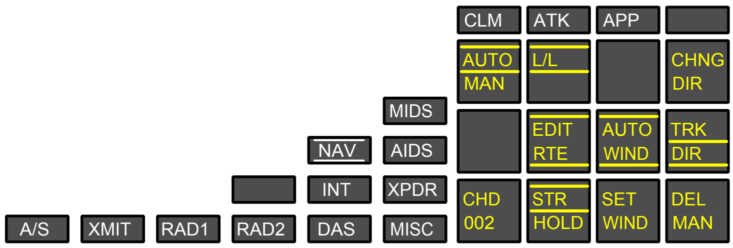
ICN-1B-B-340000-A-A0019-06740-A-01-2

Figure I-03-18 Route Creation via MDEF - Specify WP attributes (O, R, L PAG 3 or CAP PAG 4)



ICN-1B-B-340000-A-A0019-06739-A-01-2

Figure I-03-19 Route Creation via MDEF - No Unpaired WP



PRESS THE **NAV** SSK.

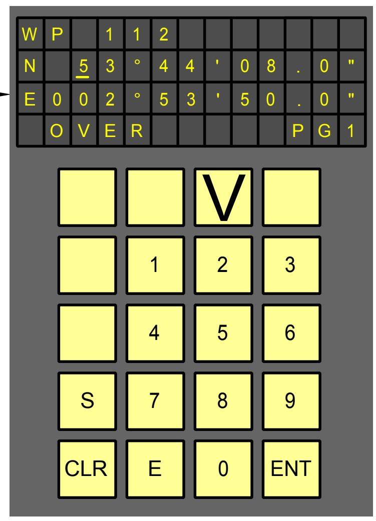
STR (STEER MODE) IS SELECTED BY DEFAULT ON INITIAL SELECTION OF THE NAV SUB SYSTEM.

PRESS **STR/HOLD** MK, STR IS DESELECTED AND **HOLD** MODE IS ENGAGED. STEERING INFORMATION IS PROVIDED TO MAINTAIN CURRENT TRACK. (**NEW TRK** MODE BECOMES UNAVAILABLE).

DEK AND ROL CONFIGURE TO ENABLE DWP TO BE MODIFIED IF REQUIRED.

TO DESELECT **HOLD**:
- RESELECT THE **STR/HOLD** MK OR **CHD** KEY (LGS). STEERING IS PROVIDED TO DWP.
- SELECT THE **CHD XXX** MK OR **CHNG DIR** MK. STEERING IS PROVIDED FOR PREVIOUS WP.
- SELECT THE **TRK/DIR** MK
- SELECT THE **AUTO/MAN** MK

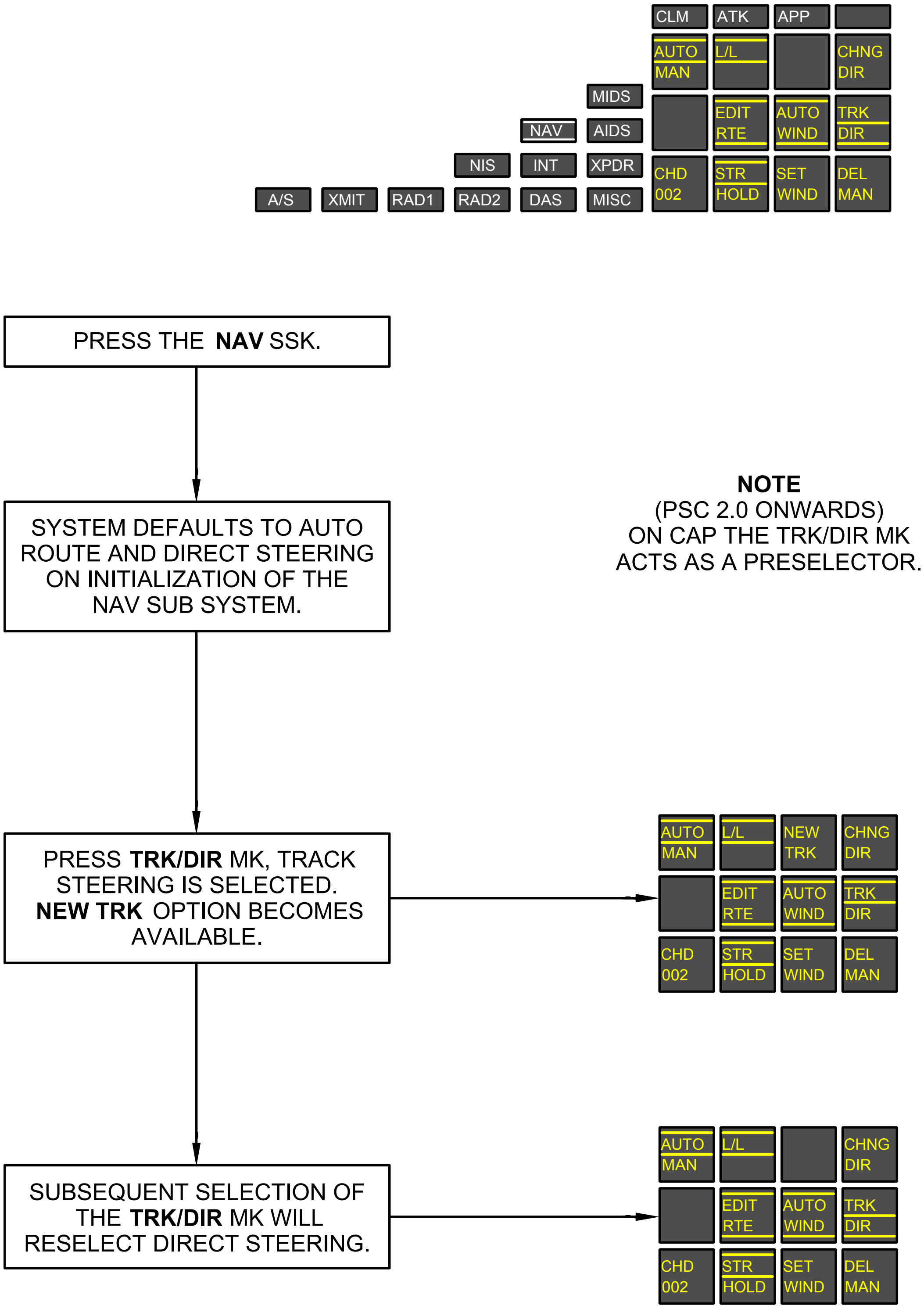
NOTE 1
THE **STR** / **HOLD** MK IS ONLY AVAILABLE IF THE FOLLOWING CONDITIONS EXIST:
- EXISTENCE OF A DWP
- WEIGHT-OFF-WHEELS.



NOTE 2
THIS IS THE ONLY METHOD OF MODIFYING THE DWP WHILST AIRBORNE.

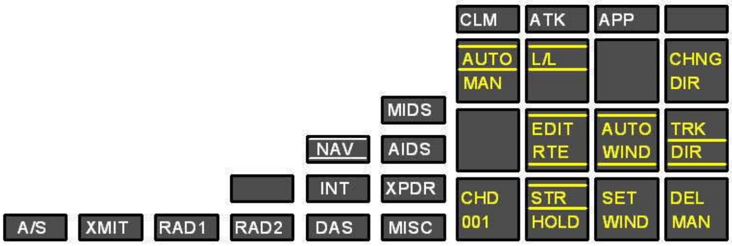
ICN-1B-B-340000-A-A0019-05565-A-02-2

Figure I-03-20 Hold Steering



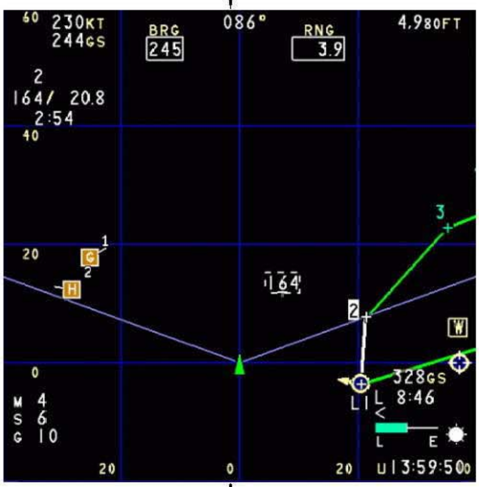
ICN-1B-B-340000-A-A0019-05564-A-02-2

Figure I-03-21 Steering Type Selection



PRESS THE **NAV** SSK.
DIR STEERING IS DEFAULT SELECTION.
IN DIRECT STEERING THE TRACK LINE FROM PP TO DWP IS CONTINUALLY UPDATED.

WITH **TRK** MANUALLY SELECTED THE DIRECT TRACK LINE IS OCCULTED AND REPLACED BY THE PLANNED TRACK FOR THE CURRENT LEG.

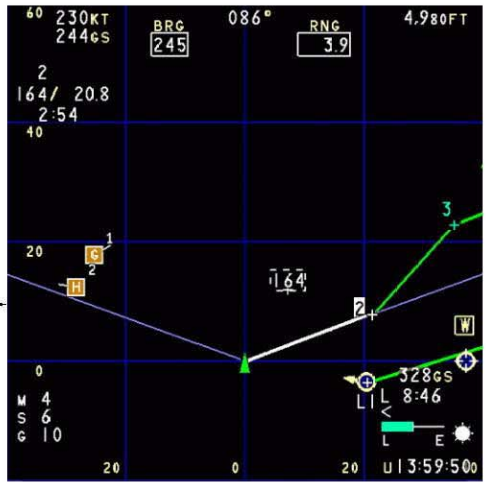


NOTE

- THE **NEW TRK** MK IS NOT BOXED WHEN SELECTED.
- SUBSEQUENT SELECTIONS OF THE **NEW TRK** MK WILL REPEAT THE FUNCTION AND WILL CANCEL THE PREVIOUS NEW TRACK LINE.
- THE **NEW TRK** MK IS OCCULTED WHEN IN HOLD STEERING OR WHEN THE A/C HAS WEIGHT-ON-WHEELS.

SELECT THE **NEW TRK** MK.

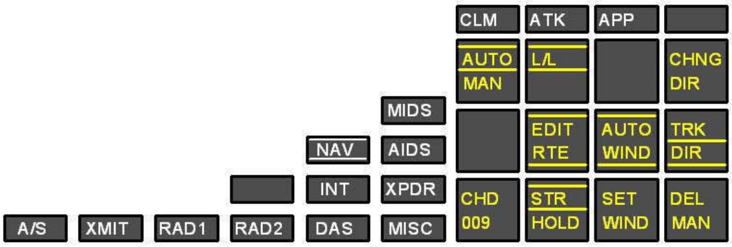
NAV SYSTEM CALCULATES A NEW TRACK FROM PRESENT POSITION (PP) TO DESTINATION WAYPOINT (DWP). A TRACK LINE IS DRAWN ON THE PA FORMAT FROM PP TO DWP.



A RESELECTION OF THE CONTROL WILL CAUSE THE FUNCTION BEING REPEATED (A NEW TRACK IS CALCULATED AND DISPLAYED).

ICN-1B-B-340000-A-A0019-05566-A-03-2

Figure I-03-22 New Track Moding



PRESS THE **NAV** SSK.

SELECT AUTO OR MANUAL ROUTE AS NECESSARY.

PRESS THE **CHNG DIR** MK. MK REMAINS UNBOXED.

CURRENTLY SELECTED ROUTE IS REVERSED. STEERING IS PROVIDED TO THE PREVIOUS WAYPOINT, **HOLD** MODE IS DESELECTED IF ENGAGED.

REVERSED SEQUENCE

9 8 7 6 5 4 3 2 1

(WAYPOINT 9 BECOMES DESTINATION).

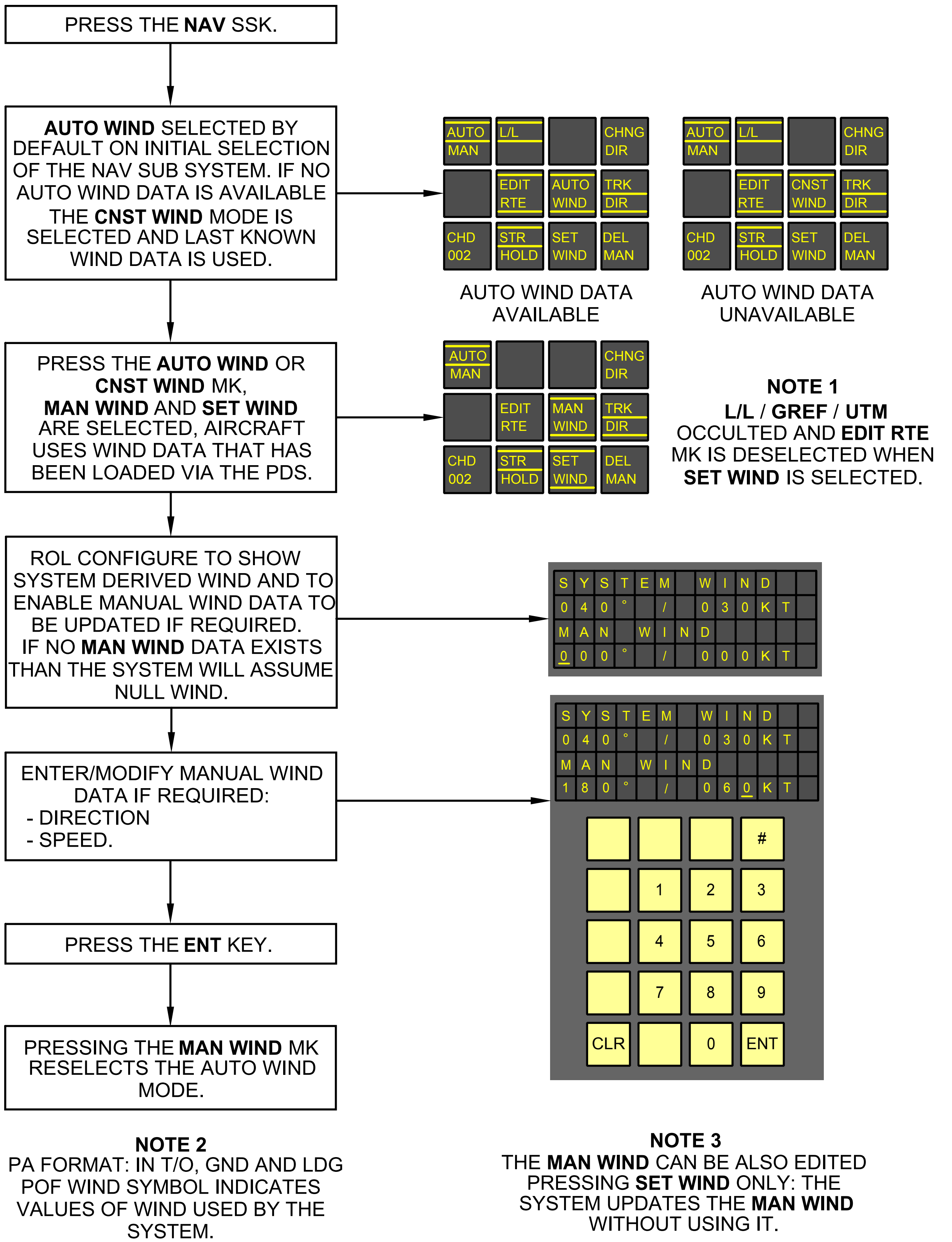
NOTE

THE **CHNG DIR** MK IS OCCULTED WHEN:

- W-ON-W
- NO PREVIOUS WP EXISTS.

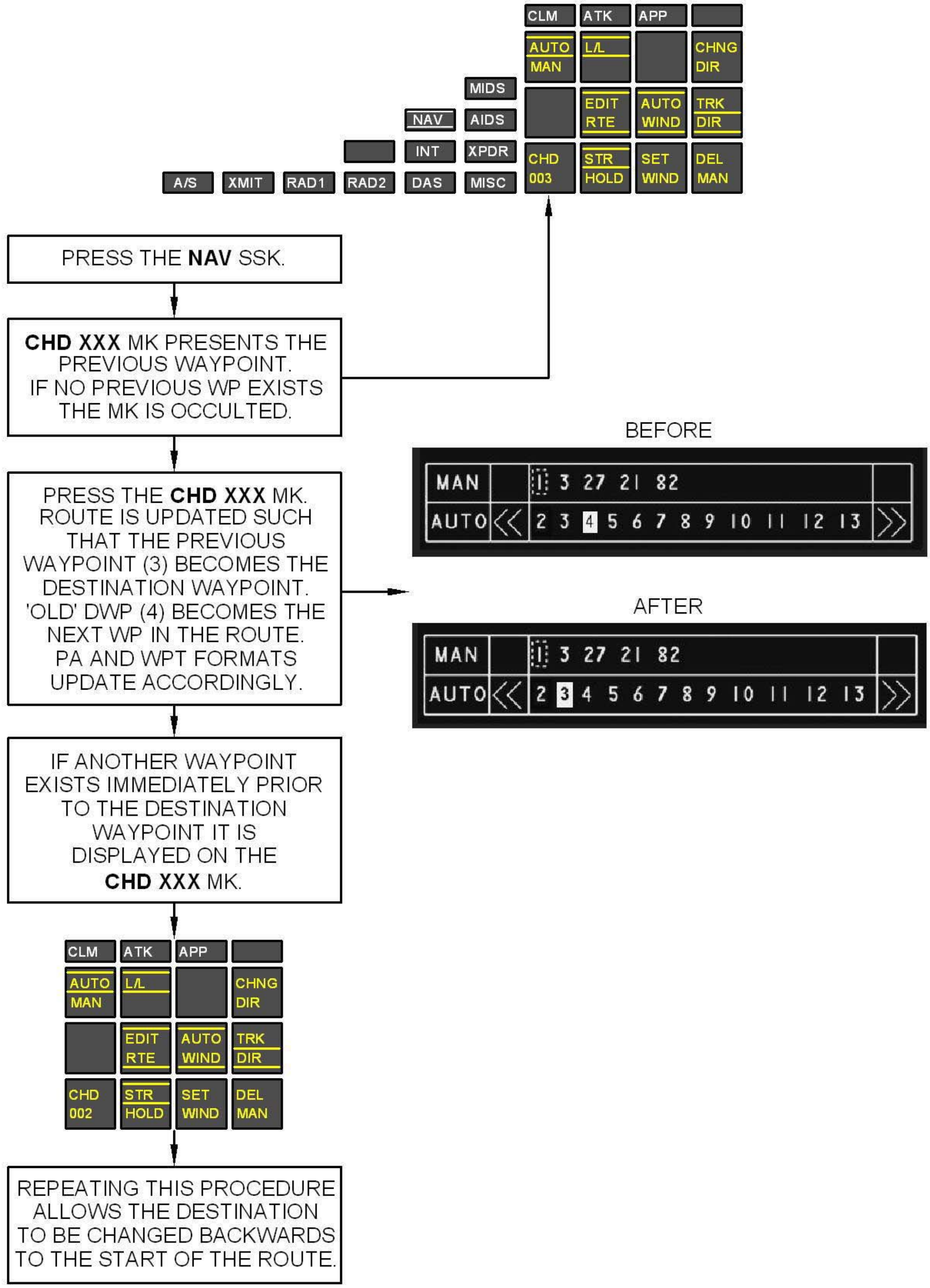
ICN-1B-B-340000-A-A0019-05562-A-03-2

Figure I-03-23 Reverse the Currently Selected Route



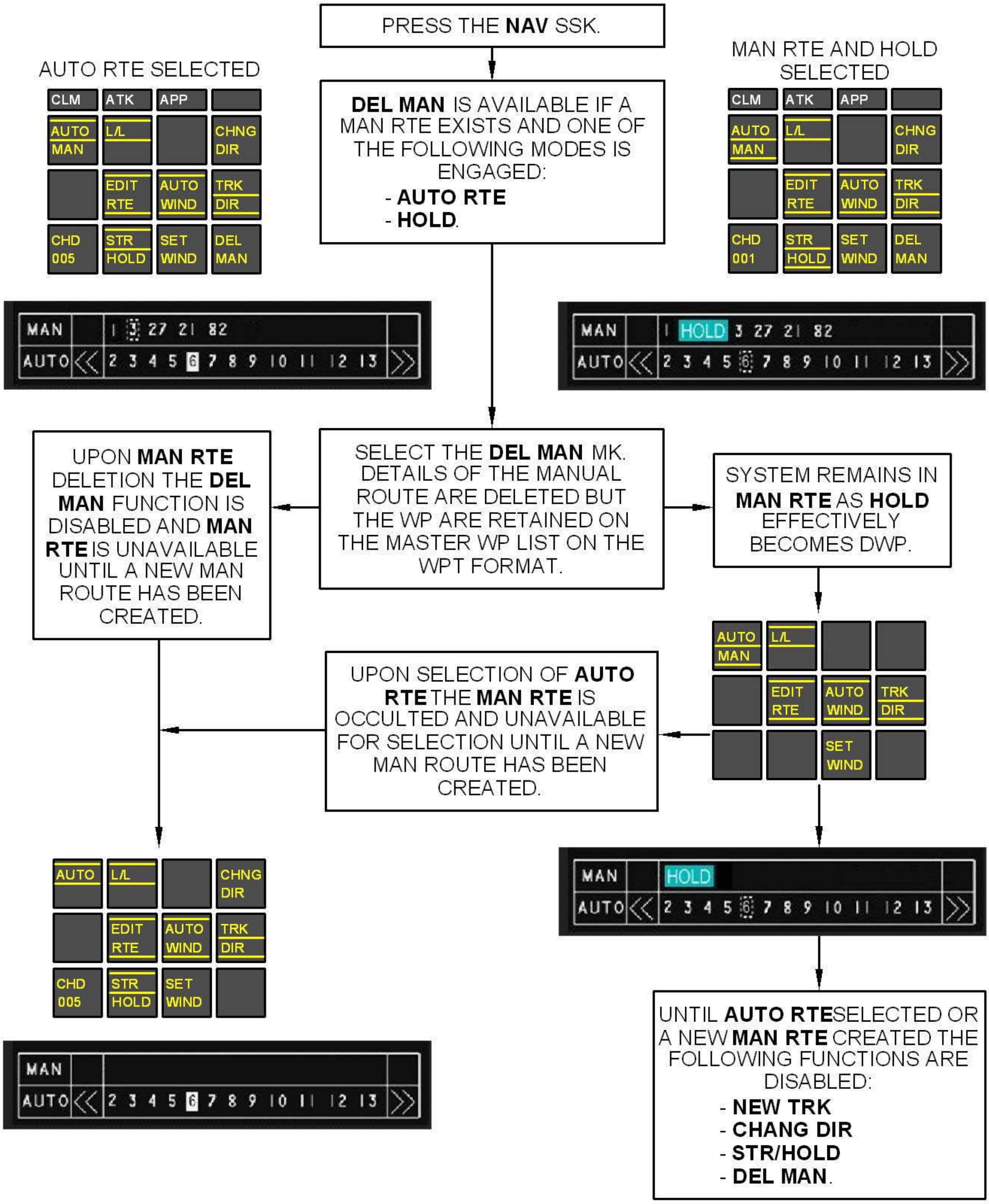
ICN-1B-B-340000-A-A0019-05554-A-02-2

Figure I-03-24 Selection of Wind Modes



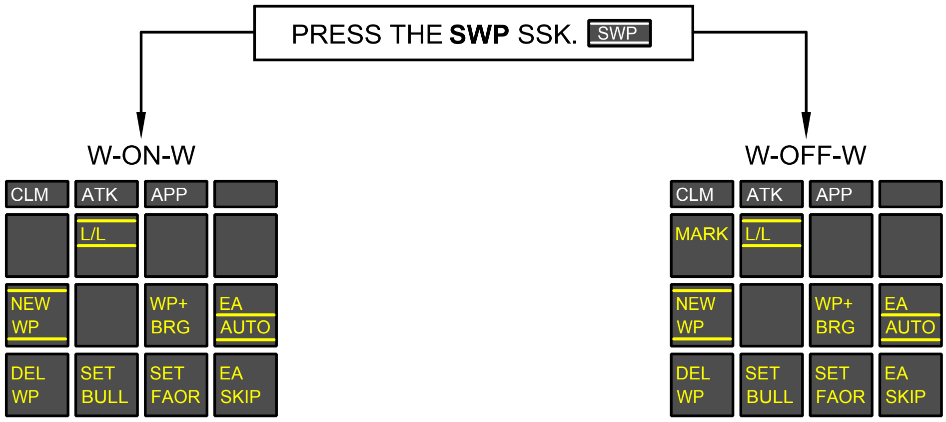
ICN-1B-B-340000-A-A0019-05563-A-03-2

Figure I-03-25 Select the Previous DWP as the New DWP

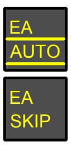


ICN-1B-B-340000-A-A0019-05561-A-03-2

Figure I-03-26 Manual Route Deletion



NOTE



(PSC 2.0 ONWARDS)
OCCULTED IF NO EMERGENCY AIRFIELDS ARE LOADED.

WITH W-OFF-W **MARK** MK OCCULTED IF ALL 10 MARK WP EXIST IN A RTE BUT REWRITABLE IF THEY ARE NOT PART OF A ROUTE.

X-Y MARKER ANNOTATED **NWP**

ICN-1B-B-340000-A-A0019-05567-A-02-2

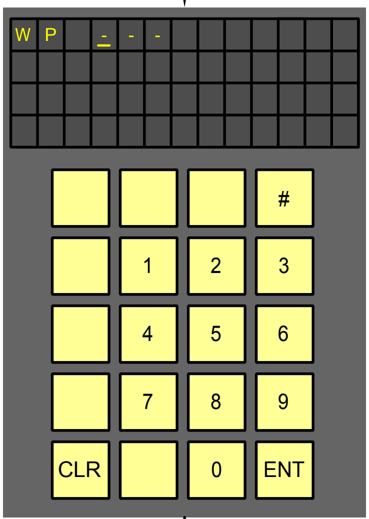
Figure I-03-27 Set Waypoint Subsystem Default Moding

PRESS THE **SWP** SSK. **NEW WP** AND **L/L** SELECTED BY DEFAULT.

NO UNPAIRED WP AVAILABLE.

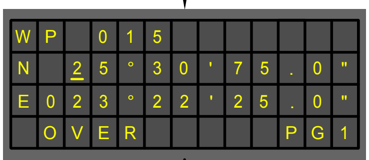
DEK AND ROLs CONFIGURE TO ALLOW A PAIRED WP NUMBER TO BE ENTERED (EITHER BY DEK OR X-Y INSERT OVER EXISTING WP).

NOTE 1
(PSC 1.1.X)
WP ALLOCATION FROM 190
(PSC 2.0 ONWARDS)
WP ALLOCATION FROM 164.



NOTE 2
WP ATTRIBUTES ON PAGES 2, 3 AND 4 ARE ENTERED IN THE SAME WAY AS FOR EDIT RTE MODING (NAV SSK).

AFTER WP ENTRY **L/L** / **GREF** / **UTM** MK, DEK AND ROL REMODE TO REFLECT THE POSITIONING SYSTEM THAT THE WP IS STORED IN.



MODIFY WAYPOINT ATTRIBUTES AS NECESSARY.

PRESSING **ENT**, PAG2 IS PRESENTED AND THE MODIFICATIONS ARE RECORDED IN THE ROUTE STORE. ON SELECTION OF **V** DEK, PAG2 IS PRESENTED.

AFTER FILLING IN THE LAST PAGE OF ATTRIBUTES, PRESSING ENT ROLs WILL CONFIGURE TO ALLOW CHANGE OF ANOTHER UNPAIRED WP

ICN-1B-B-340000-A-A0019-06744-A-01-2

Figure I-03-28 Define/Edit a Waypoint via DEK - No Unpaired WP available

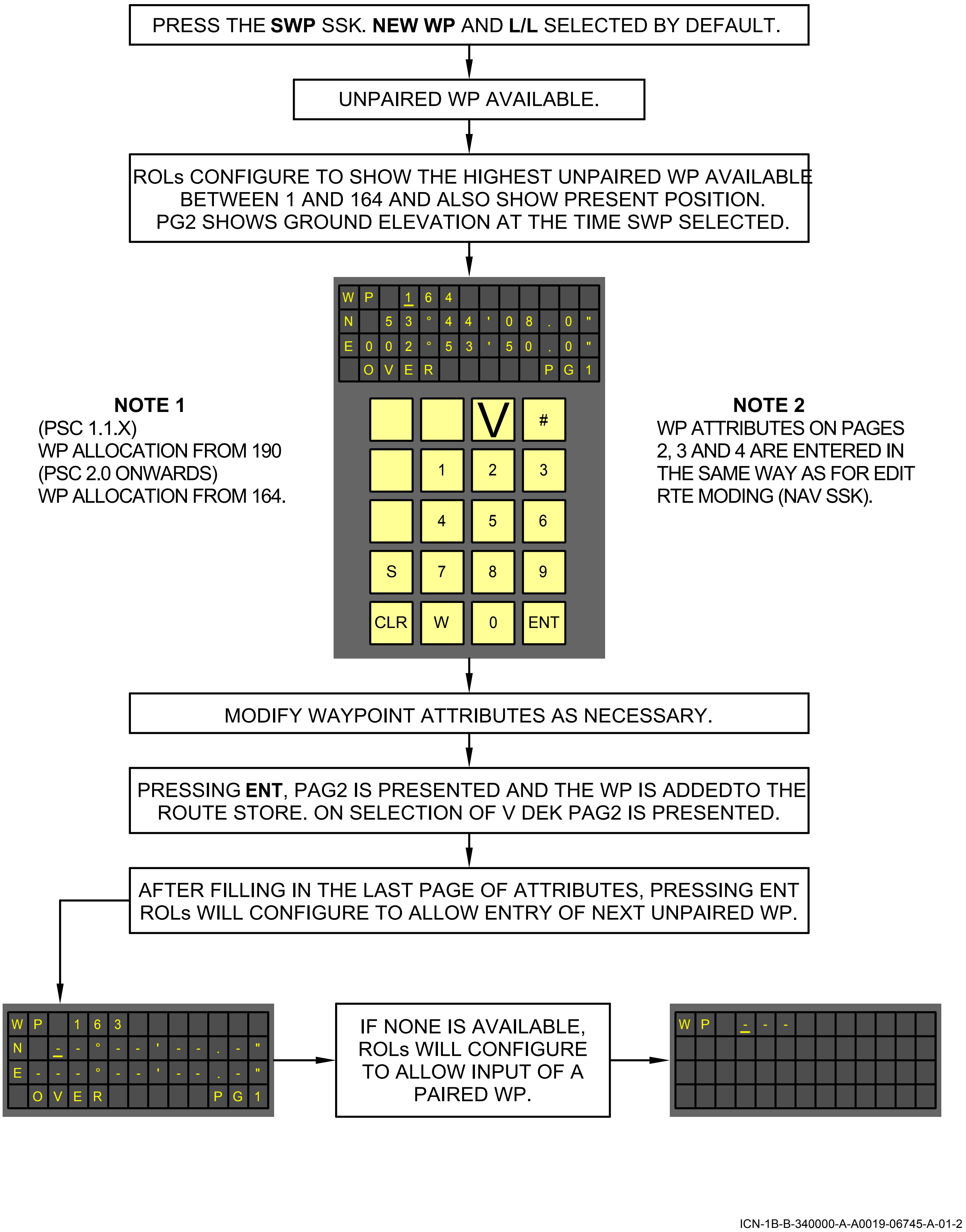
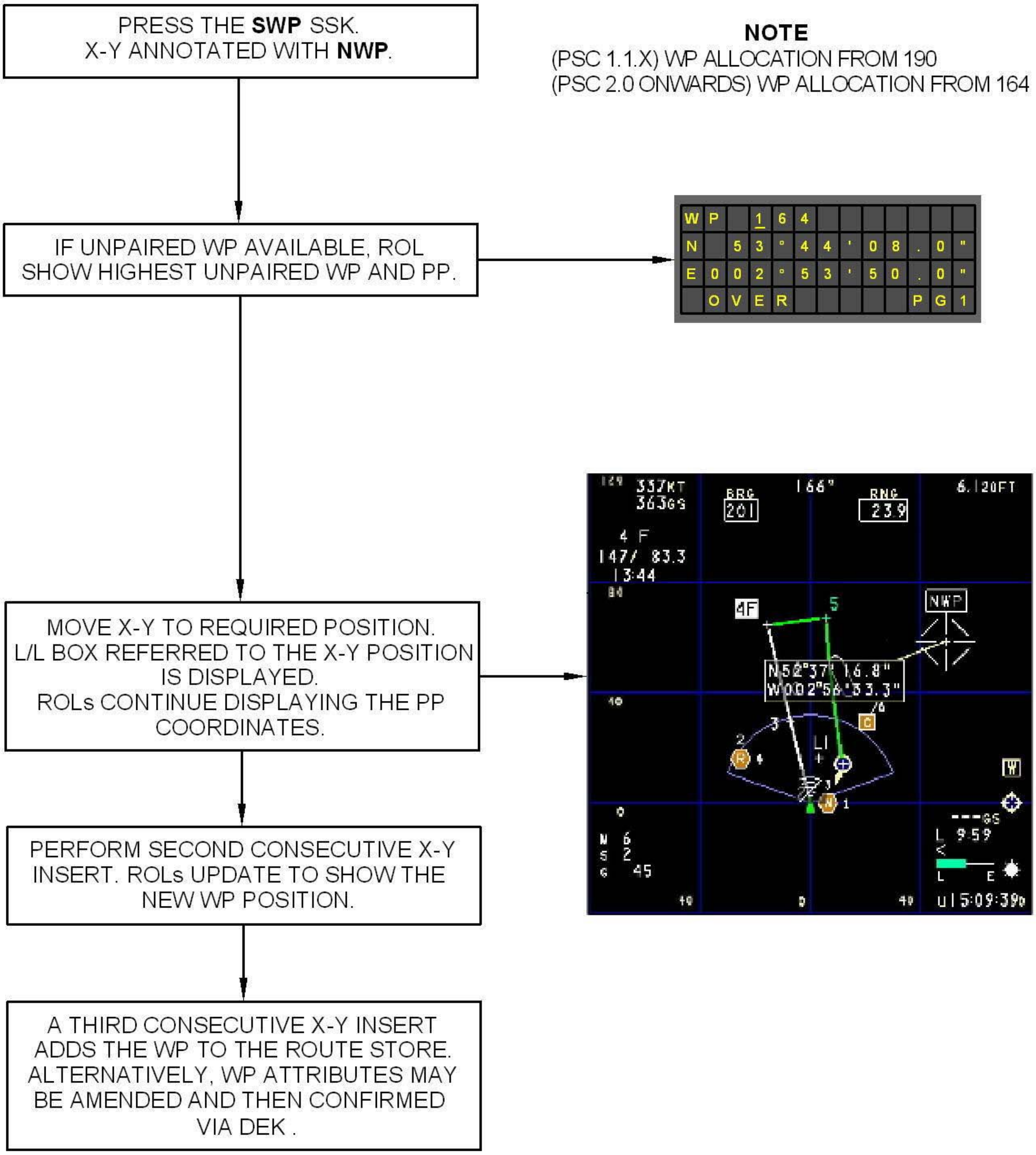


Figure I-03-29 Define/Edit a Waypoint via DEK - Unpaired WP available

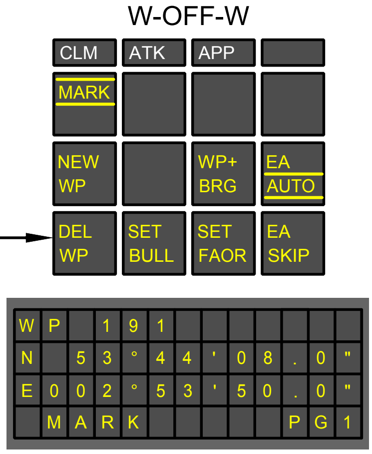


ICN-1B-B-340000-A-A0019-06746-A-02-2

Figure I-03-30 Define Waypoints coordinates via X-Y

PRESS THE **SWP** SSK.

SELECT **MARK** MK. A WP IS CREATED AT PP. DEK IS OCCULTED AND **CLR** AND **ENT** FUNCTIONS DISABLED. ROL SHOW POSITION OF MARK WP (L/L ONLY) FOR 5 SECONDS.
SYSTEM ALLOCATES LOWEST WP NUMBER FROM THE RANGE 191-200.



NOTE

- SELECTION OF **MARK** MK ALWAYS INTERRUPTS ANY OTHER MDE MODING.
- PA FORMAT: MARK WP ARE DISPLAYED AS 191 TO 200 WHEN IN A ROUTE BUT ARE DISPLAYED AS M1 TO M10 WHEN NOT IN A ROUTE.
- IF ALL 10 MARKS HAVE BEEN CREATED, EXISTING MARKS NOT IN A ROUTE ARE SUCCESSIVELY OVERWRITTEN.
- IF ALL 10 MARKS ARE IN EITHER ROUTE, **MARK** MK IS OCCULTED AND IS NOT AVAILABLE UNTIL A MARK WP IS REMOVED FROM A ROUTE.

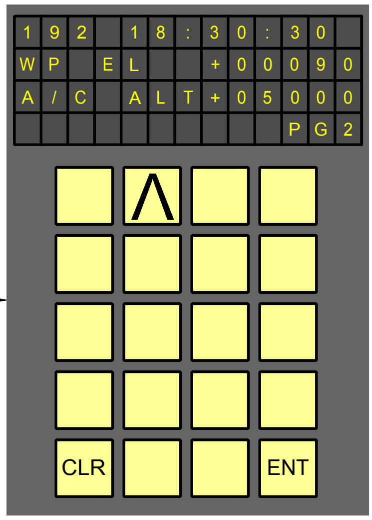
RESELECTION OF THE **MARK** WP, EVEN WHILE STILL SELECTED, CREATES A NEW MARK POINT.

5 SECONDS AFTER ITS SELECTION THE MARK MK IS DESELECTED AND THE SWP DEFAULT MODING IS SHOWN.

ON SUBSEQUENT SELECTION OF THE MARK WP NUMBER (VIA NEW WP ETC) PAGE 2 OF THE WP ATTRIBUTES CAN BE VIEWED, SHOWING:

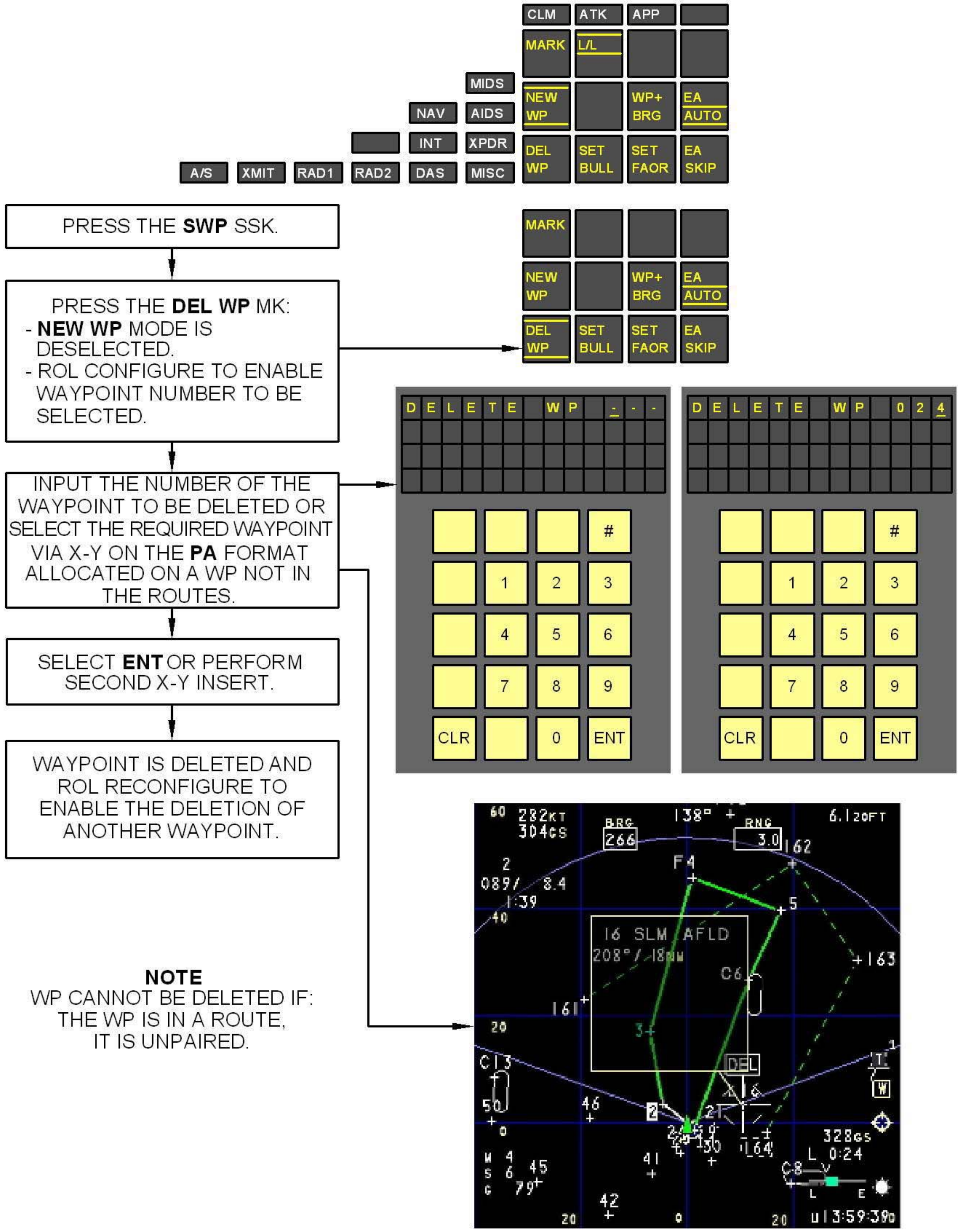
- TIME OF CREATION
- WP ELEVATION
- A/C ALTITUDE

MARK WP CAN NOT BE EDITED.



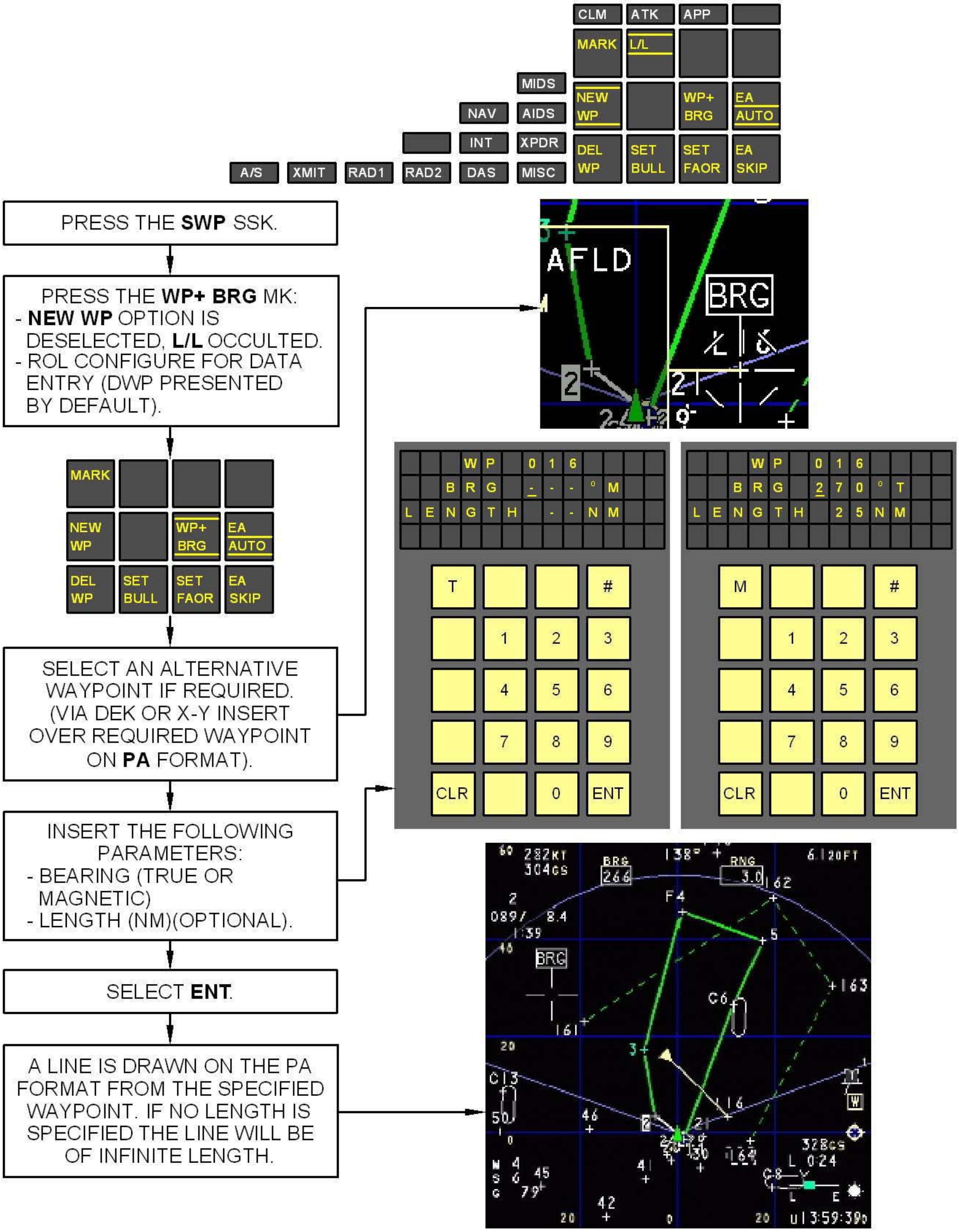
ICN-1B-B-340000-A-A0019-05570-A-02-2

Figure I-03-31 Create a Mark Waypoint at Present Position



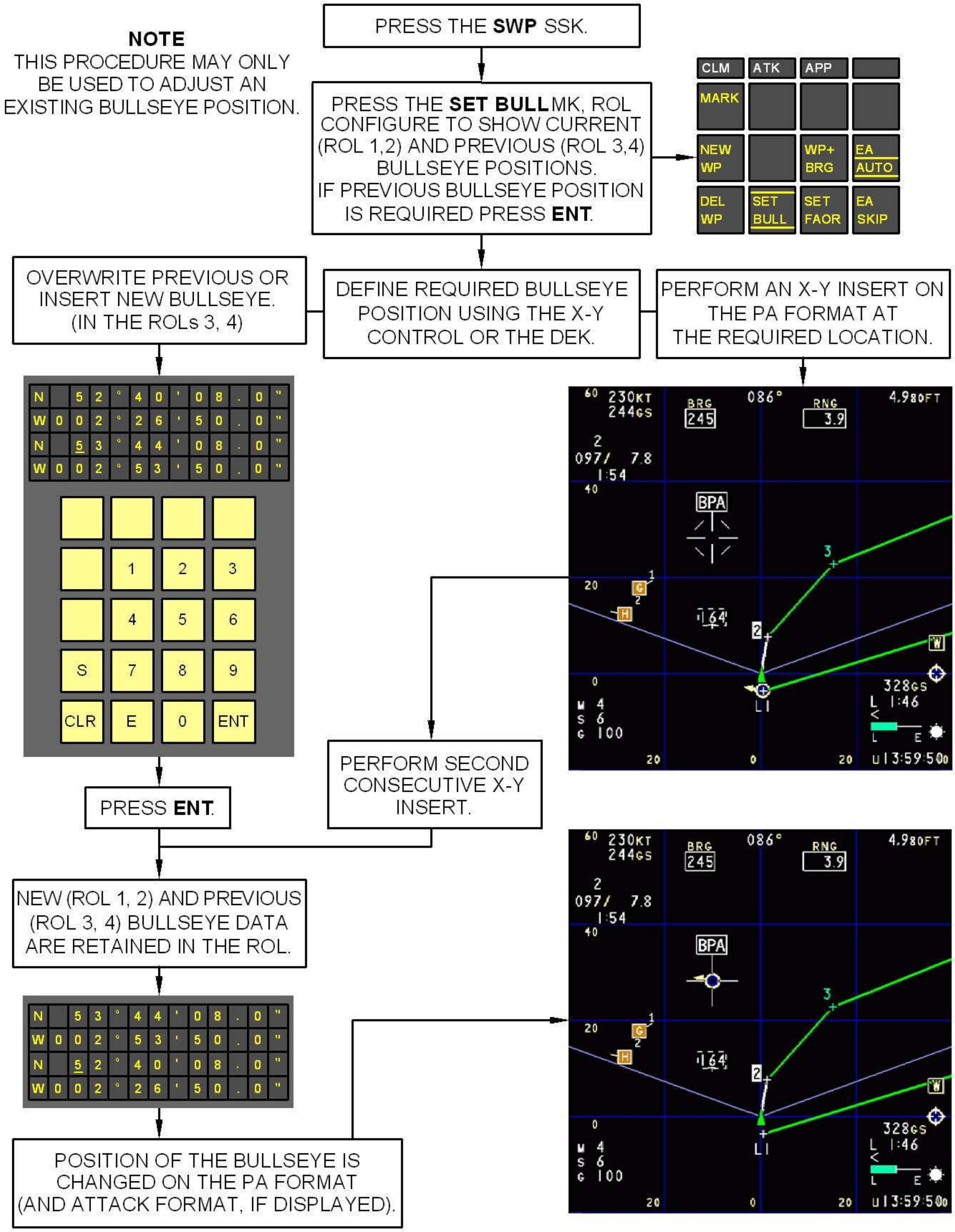
ICN-1B-B-340000-A-A0019-05569-A-03-2

Figure I-03-32 Delete a Waypoint



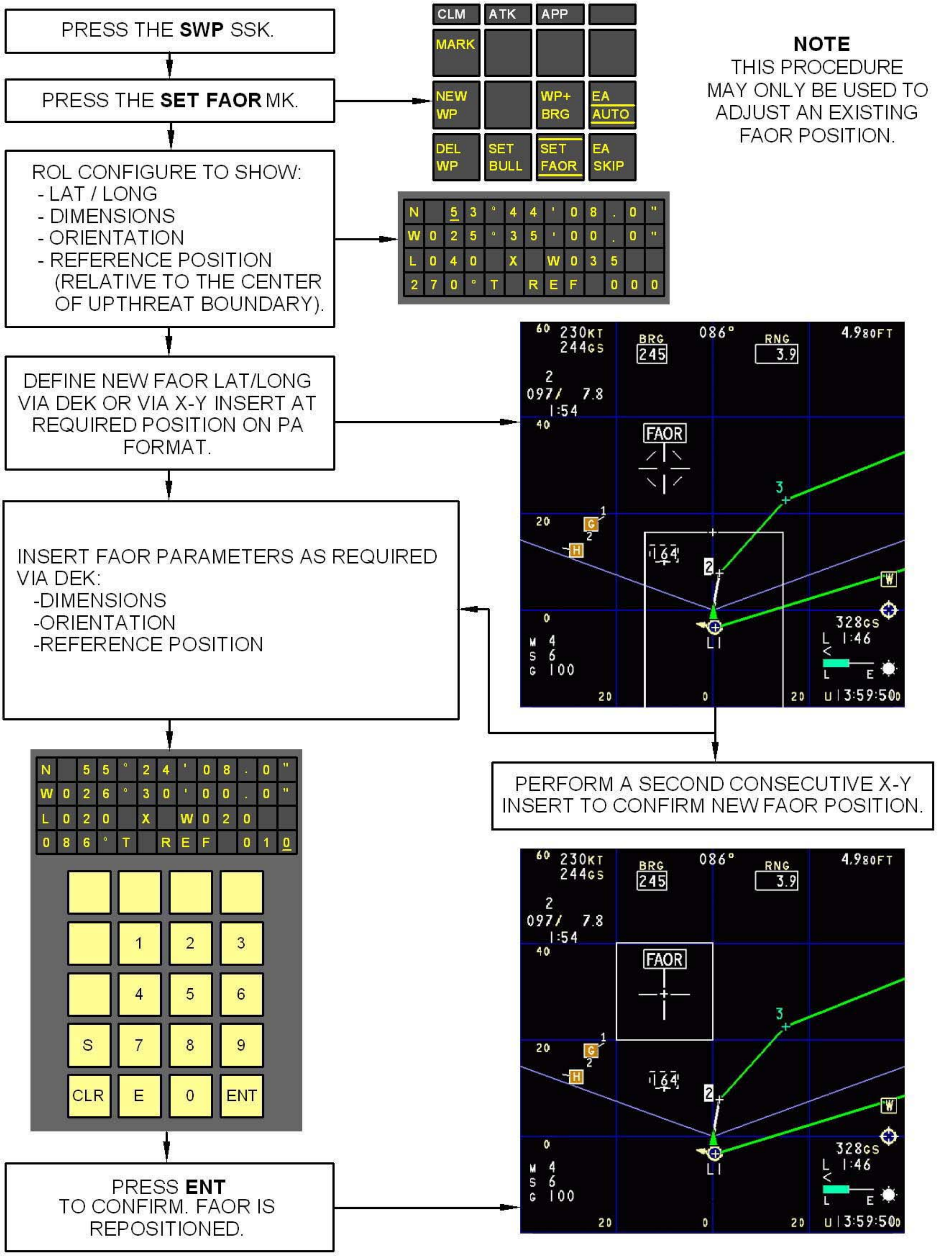
ICN-1B-B-340000-A-A0019-05571-A-03-2

Figure I-03-33 Draw a Line from a Paired Waypoint



ICN-1B-B-340000-A-A0019-05572-A-03-2

Figure I-03-34 Set Bullseye Position via DEK/X-Y



ICN-1B-B-340000-A-A0019-05573-A-03-2

Figure I-03-35 Set Fighter Area of Responsibility via DEK/X-Y

Soft.Prog.Ed.: PSC 2.0 onwards

PRESS THE **SWP** SSK.

NOTE
UP TO 8 EMERGENCY AIRFIELDS MAY BE LOADED VIA PDS.

EMERGENCY AIRFIELD AUTO MODE SELECTED. IN AUTO MODE THE NAV SYSTEM SELECTS THE NEAREST EMERGENCY AIRFIELD TO THE A/C PP AND DISPLAYS THE AIRFIELD ID, RANGE AND BEARING ON THE GUH SUITE ON THE RGS.

ON SELECTION OF THE **EA SKIP** MK, THE NEXT NEAREST EMERGENCY AIRFIELD IS DISPLAYED. REPEATING THIS PROCESS SKIPS THE AIRFIELDS IN SEQUENCE. ONCE ALL AIRFIELDS HAVE BEEN 'SKIPPED', THE SYSTEM RECONSIDERS ALL AIRFIELDS AGAIN AND DISPLAYS THE NEAREST TO PP.

PRESS THE **EA/AUTO** SSK.

EA/FRZE DISPLAYED, **EA SKIP** OCCULTED. WITH **FRZE** DISPLAYED THE CURRENTLY SELECTED EMERGENCY AIRFIELD IS DISPLAYED CONTINUOUSLY.

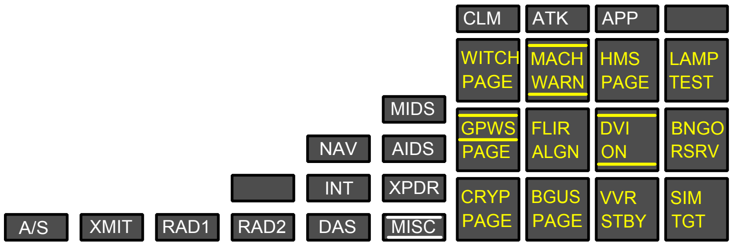
PRESS THE **EA/FRZE** SSK.

ICN-1B-B-340000-A-A0019-06748-A-01-2

Figure I-03-36 Emergency Airfield Mode Selection

⇐

PRESS THE **MISC** SSK.

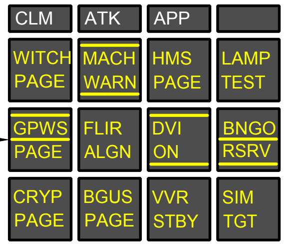


↓

THE MKs CONFIGURE TO SHOW THE DEFAULT MODING SELECTIONS OF THE **MISC** SSK.

↓

PRESS THE **BNGO**/**RSRV** MK TWICE, **RSRV** WILL BOX.

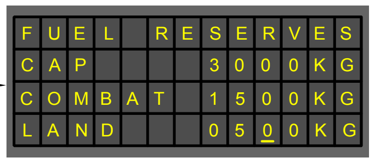


↓

THE ROLs CONFIGURE TO INPUT THE RESERVE LEVELS (TO AN ACCURACY OF 10 KG). LAND FIELD DEFAULTS TO THE MINIMUM VALUE OF 200 KG.

↓

WHEN THE LAST CHARACTER IS INPUT ON ROL4 THE WM WILL PARK.



↓

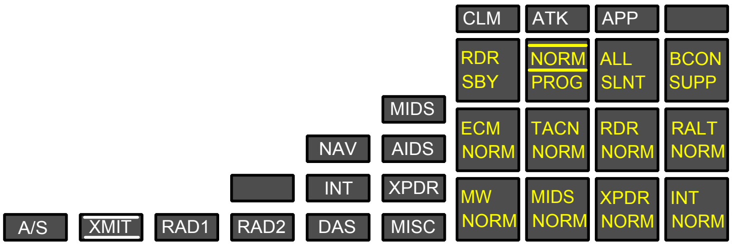
SELECT ENT. THE ROLs BLINK OFF AND RECONFIGURE WITH THE WM UNDER THE FIRST CHARACTER ON ROL2.

NOTE

RESERVES ARE USED IN THE DETERMINATION OF FUEL WARNINGS.

ICN-1B-B-340000-A-A0019-06741-A-01-2

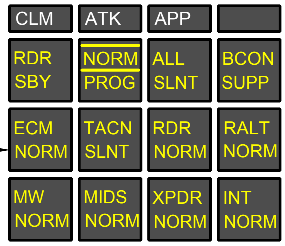
Figure I-03-37 Edit the Fuel Reserves



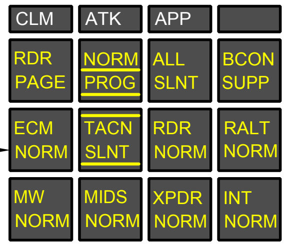
PRESS THE **XMIT** SSK.

THE MKs CONFIGURE AS SHOWN. **NORM** IS THE INITIAL DEFAULT.

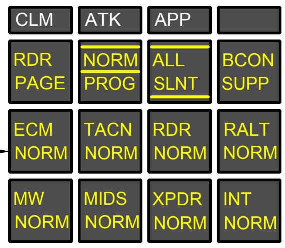
SELECT THE **TACN NORM** (**RALT NORM**) MK. TACAN (RADALT) SWITCHES TO **TACN SLNT** (**RALT SLNT**). WHILE PROG MK IS NOT SELECTED THESE CONTROLS ACT AS PRESELECTORS. THE TACAN (RADALT) IS NOT INHIBITED YET.



SELECT THE **PROG** MK. THIS SILENCES THE TACAN (RADALT). **TACN SLNT** (**RALT SLNT**) BECOMES BOXED.



SELECT THE **ALL SLNT** MK, THE LEGEND IS BOXED. ALL THE TRANSMITTERS ARE INHIBITED FROM TRANSMITTING. A RESELECTION OF THE CONTROL WILL NOT DESELECT THE **ALL SLNT** MK, AN ALTERNATIVE MUTUALLY EXCLUSIVE MK MUST BE SELECTED TO DESELECTED **ALL SLNT**.



ICN-1B-B-340000-A-A0019-06770-A-01-2

Figure I-03-38 Silence RADALT / TACAN / ALL Transmitters

POSITION THE AIRCRAFT SO THAT A LOCAL LANDMARK CAN BE SEEN WITHIN THE HUD FIELD OF VIEW.

A HEADING ALIGNMENT CROSS IS PRESENTED ON THE HUD.

USING THE X-Y CONTROLLER SLEW HEADING ALIGNMENT CROSS TO OVERLAY THE LANDMARK AND PERFORM A SINGLE X-Y INSERT.

AFTER X-Y INSERT, THE NORMAL ALIGNMENT STOPS AND THE RAPID (HUD) ALIGNMENT STARTS. THE RELEVANT PARAMETERS ON HUD AND AUTOCUE FORMAT RE-MODE AS APPROPRIATE.

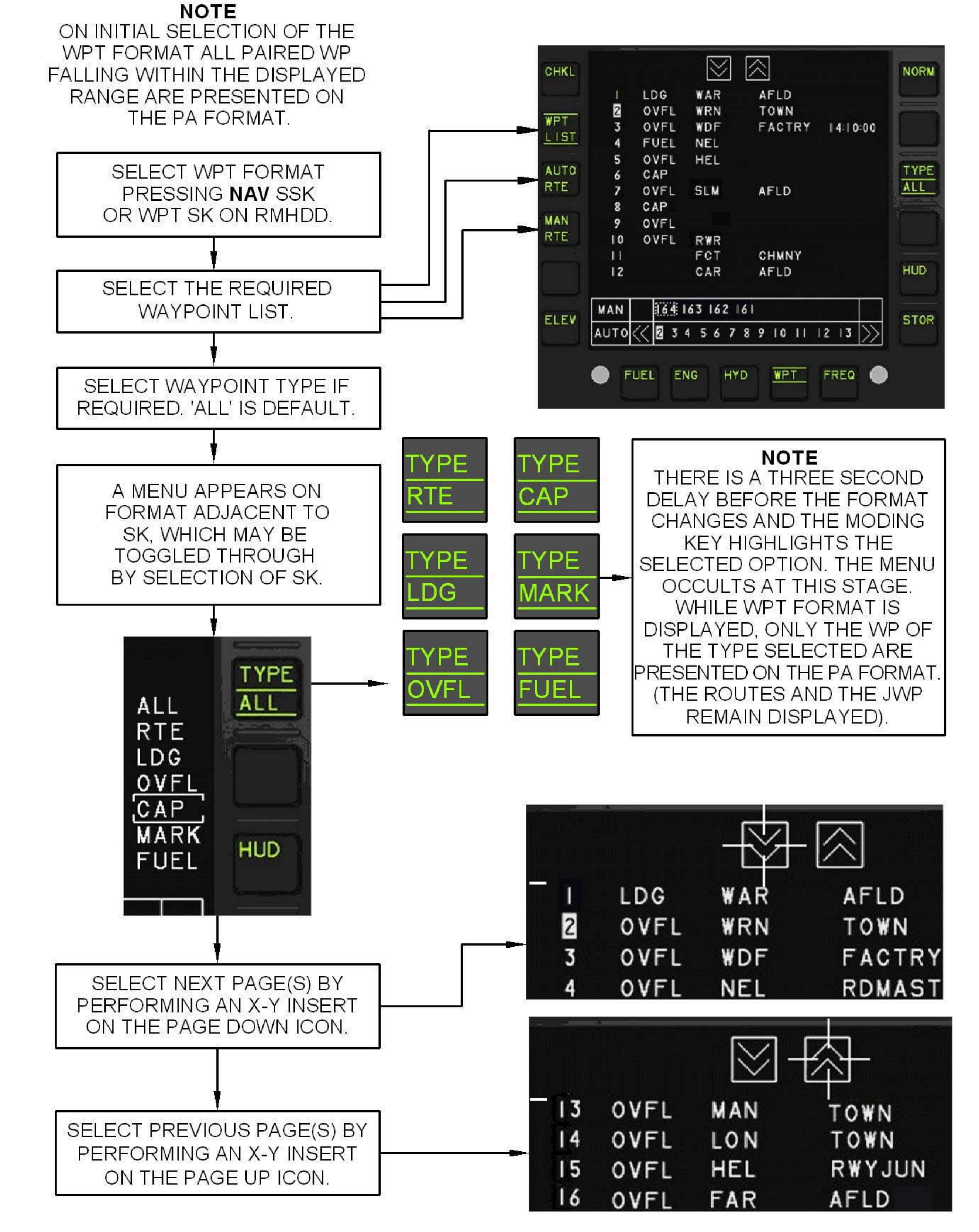
NOTE

THE HUD ALIGNMENT IS MADE AVAILABLE ONLY IF THE RELEVANT DATA (PP, COORDINATES OR BEARING OF THE LANDMARK) HAVE BEEN LOADES VIA PDS/GLU.

ICN-1B-B-340000-A-A0019-05546-A-03-2

Figure I-03-39 LINS Rapid Alignment

Soft.Prog.Ed.: PSC 1.1.X

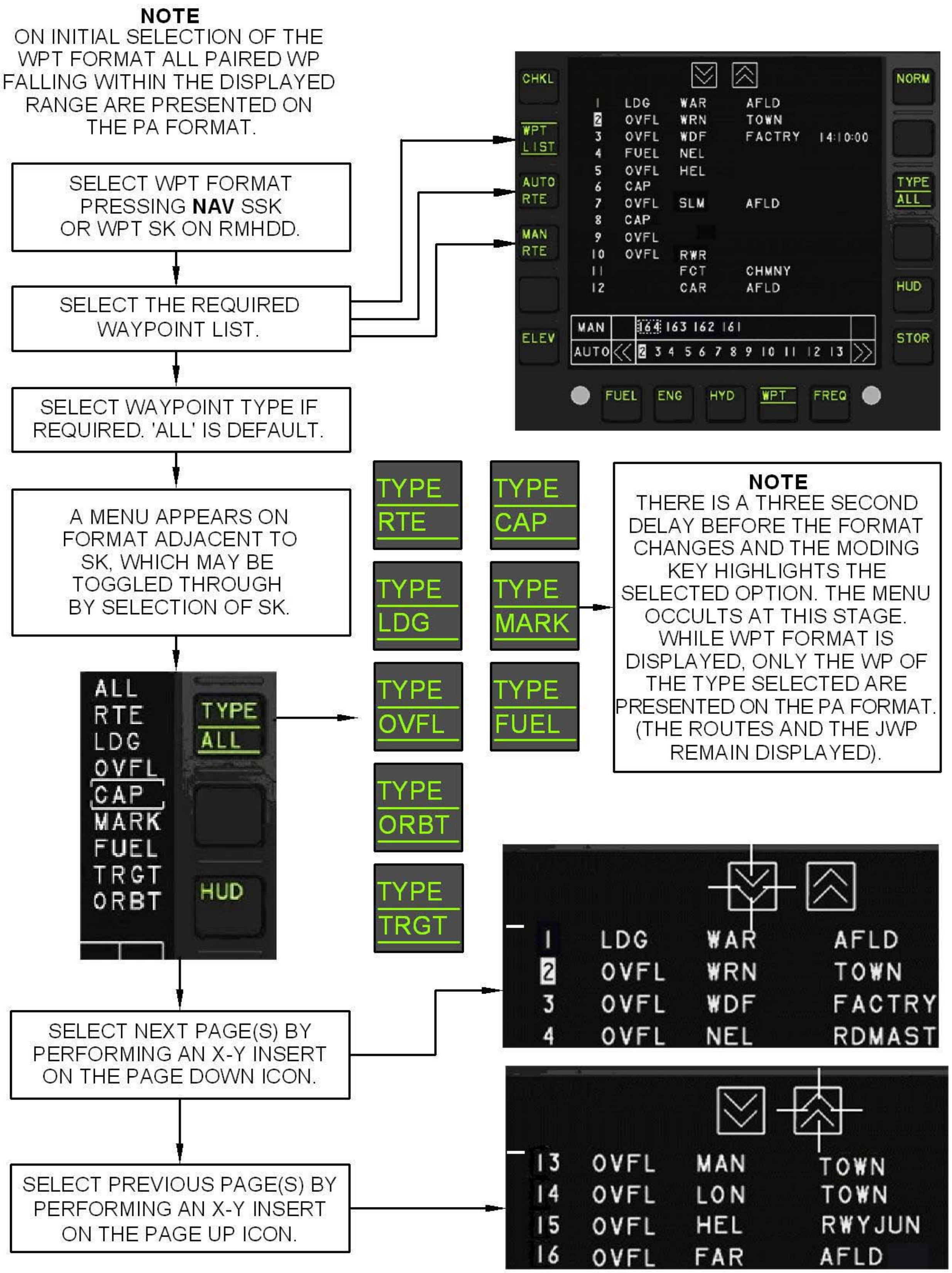


ICN-1B-B-340000-A-A0019-05574-A-03-2

Figure I-03-40 Select Waypoint Lists

⇐

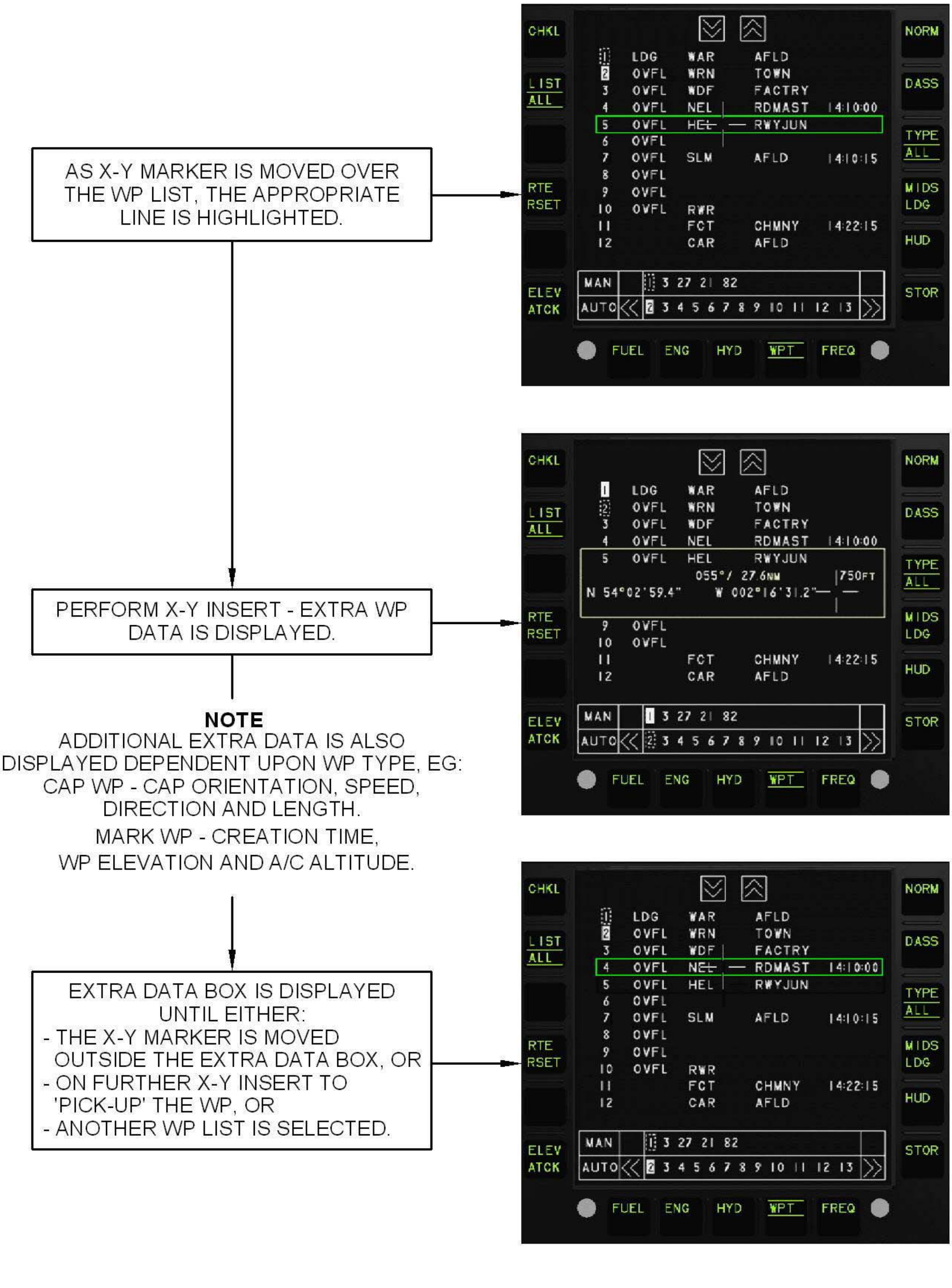
Soft.Prog.Ed.: PSC 2.0 onwards



ICN-1B-B-340000-A-A0019-06806-A-02-2

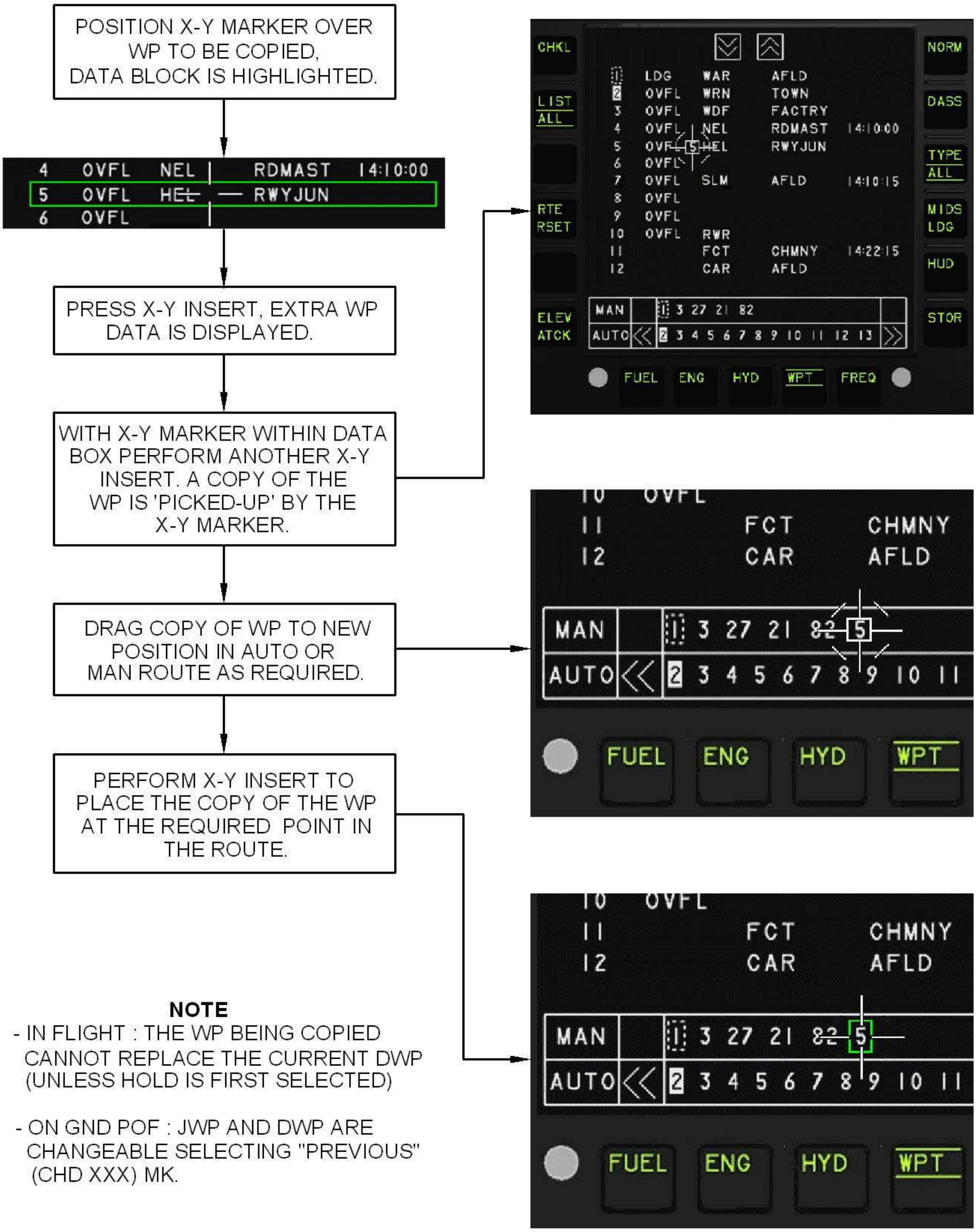
Figure I-03-41 Select Waypoint Lists

⇐



ICN-1B-B-340000-A-A0019-05575-A-03-2

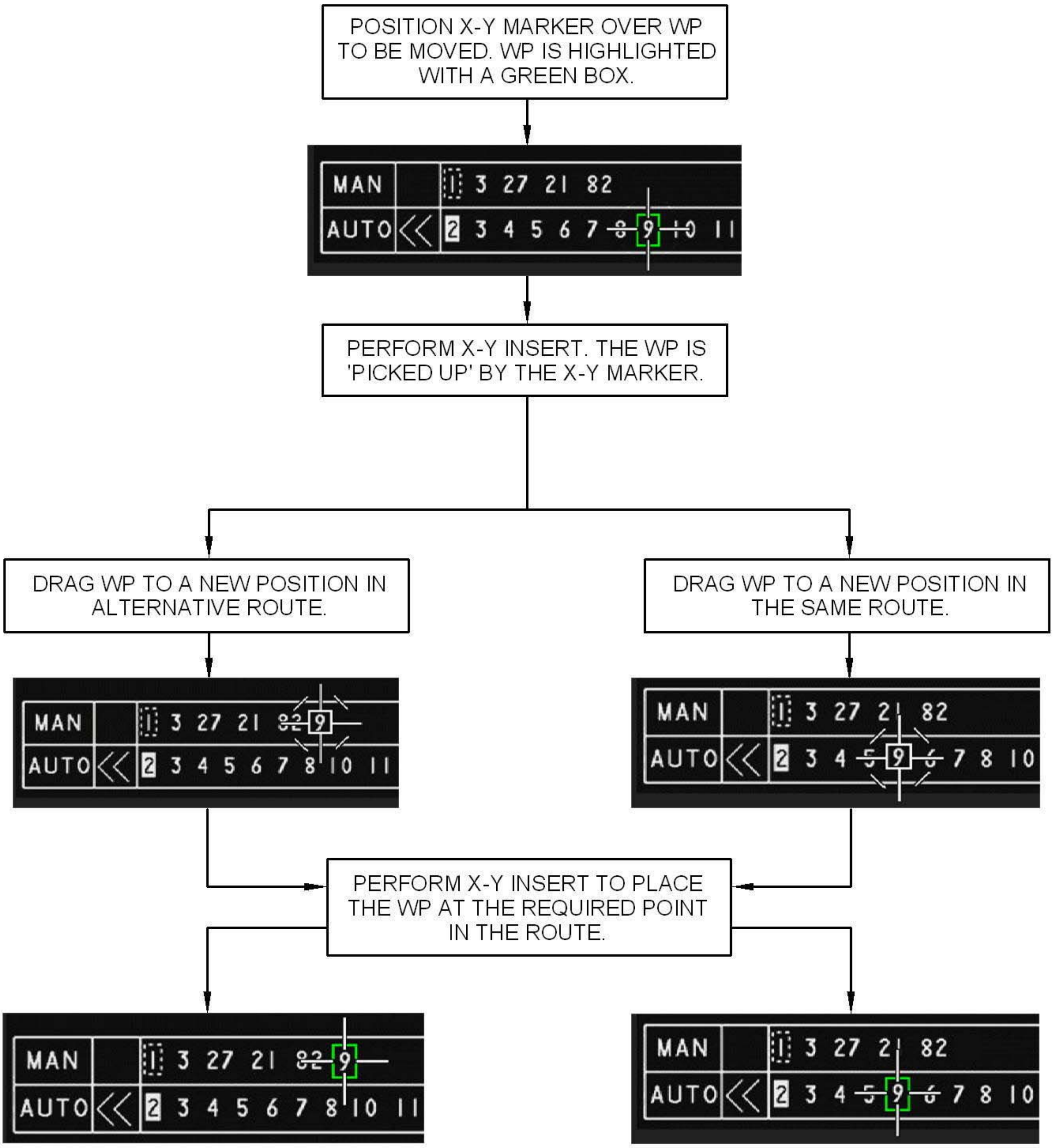
Figure I-03-42 Display Extra Data on Waypoints



NOTE
- IN FLIGHT : THE WP BEING COPIED CANNOT REPLACE THE CURRENT DWP (UNLESS HOLD IS FIRST SELECTED)
- ON GND POF : JWP AND DWP ARE CHANGEABLE SELECTING "PREVIOUS" (CHD XXX) MK.

ICN-1B-B-340000-A-A0019-05576-A-03-2

Figure I-03-43 Add Waypoints in the routes



NOTE

- IN FLIGHT : TO MOVE OR TO REPLACE THE CURRENT DWP. **HOLD** MUST FIRST BE SELECTED.
- ON GND POF : JWP AND DWP ARE CHANGEABLE SELECTING "PREVIOUS" (CHD XXX) MK.

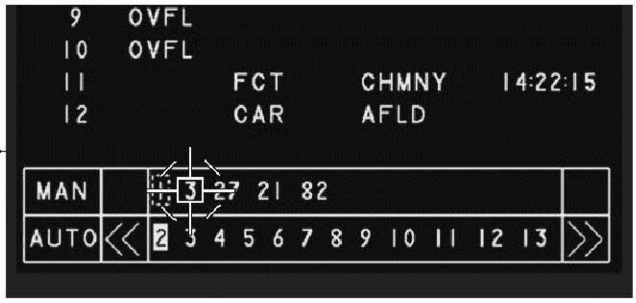
ICN-1B-B-340000-A-A0019-05577-A-03-2

Figure I-03-44 Move Waypoints in the routes

NOTE
THIS PROCEDURE ONLY REMOVES WP FROM THEIR RESPECTIVE ROUTES, THE WP ARE STILL RETAINED IN THE WP LIST.

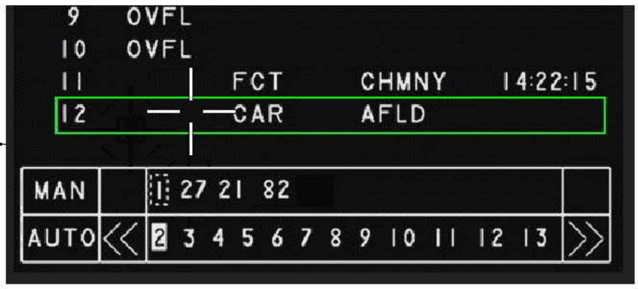
POSITION X-Y MARKER OVER WP TO BE REMOVED.

PERFORM X-Y INSERT. THE WP IS 'PICKED UP' BY THE X-Y MARKER.



DRAG WP OUT OF THE ROUTE ROLs.

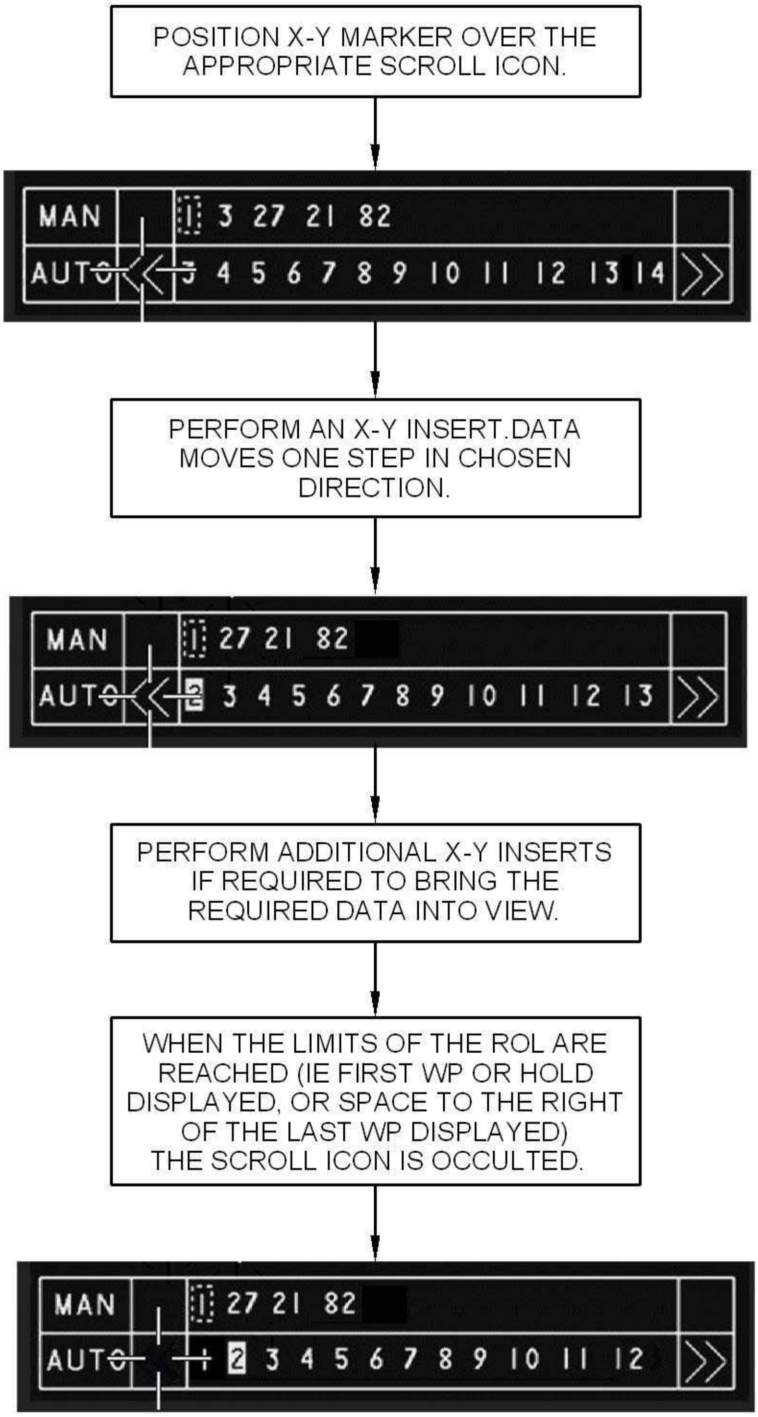
PRESS X-Y INSERT TO RELEASE THE WP.



NOTE
- IN FLIGHT : TO REMOVE THE CURRENT DWP **HOLD** MUST FIRST BE SELECTED.
- ON GND POF : JWP AND DWP ARE CHANGEABLE SELECTING "PREVIOUS" (CHD XXX) MK.

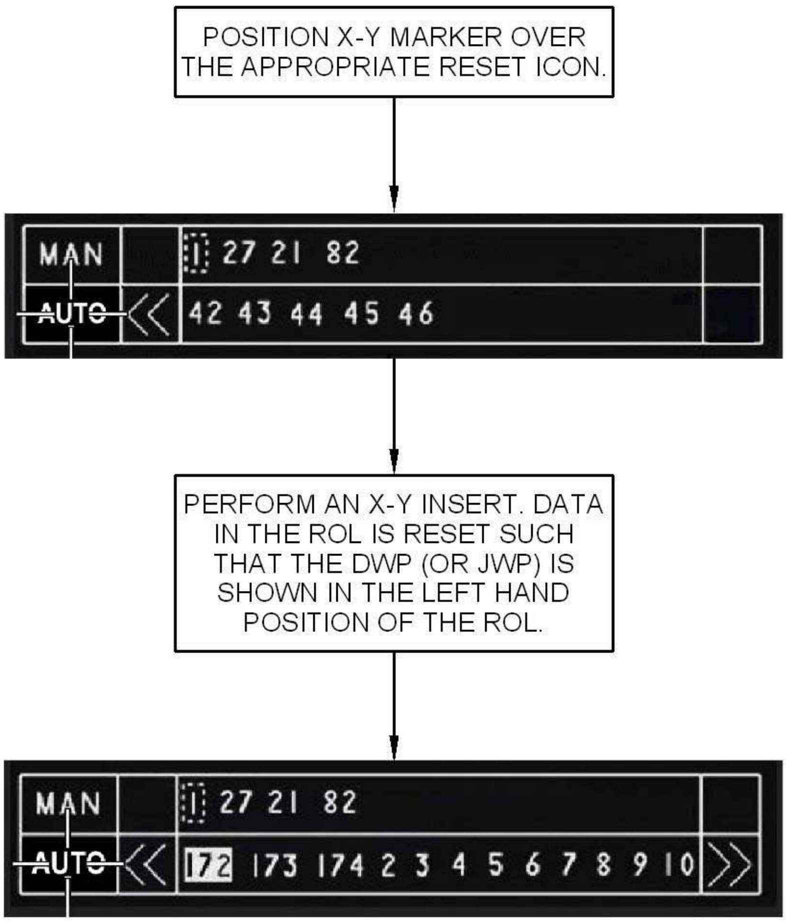
ICN-1B-B-340000-A-A0019-05578-A-03-2

Figure I-03-45 Remove Waypoints from their Respective Routes



ICN-1B-B-340000-A-A0019-05579-A-03-2

Figure I-03-46 Scroll the Route ROL



ICN-1B-B-340000-A-A0019-05580-A-03-2

Figure I-03-47 Reset the Route ROL

FROM PA FORMAT PERFORM X-Y INSERT OVER THE 'WINDOW 'ICON.

'WINDOW-ON-THE-WORLD' MODE IS ENGAGED.

THE X-Y MARKER:
- IS HIGHLIGHTED
- IS ANNOTATED WITH A 'W'
- JUMPS TO THE CENTER OF THE SCREEN.

THE **DFLT** SK REMODES TO EITHER **RTN PP SK** (IF A/C STABILIZED) OR **RTN DWP SK** (IF GND STABILIZED).

THE DISPLAY AREA IS NOW SLAVED TO THE X-Y CONTROLLER.

SLEW THE DISPLAY UNTIL THE REQUIRED AREA IS IN VIEW.

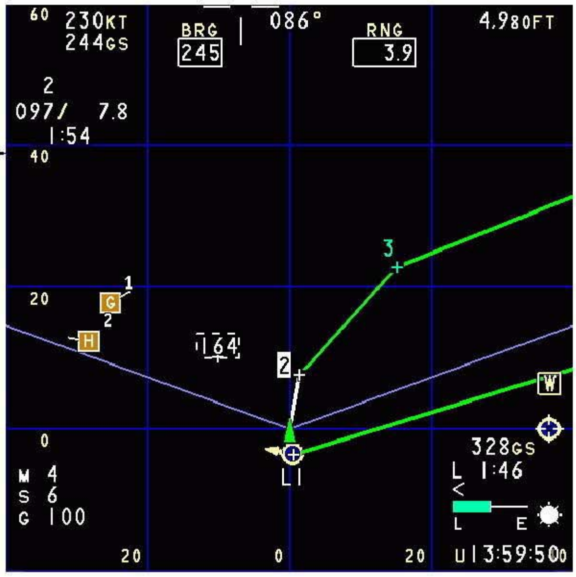
PERFORM A FURTHER X-Y INSERT TO RELEASE THE WINDOW IN THE REQUIRED LOCATION AND TO CANCEL WINDOW-ON-THE-WORLD MODE.

DISPLAY CAN BE RETURNED TO THE PREVIOUSLY SELECTED MAP MODE BY SELECTION OF THE **RTN PP** SK OR **RTN DWP** SK.

ICN-1B-B-340000-A-A0019-05581-A-03-2

Figure I-03-48 Select Window-on-the-World

INCREASE OR DECREASE THE RANGE SCALE AS REQUIRED BY DRIVING THE X-Y MARKER AGAINST THE UPPER OR LOWER EDGES OF THE PA FORMAT RESPECTIVELY.



RANGE SCALE CHANGES ONE STEP IN THE CHOSEN DIRECTION.

AVAILABLE GRID SCALES ARE:

- 3NM
- 5NM
- 10NM
- 20NM
- 40NM
- 80NM
- 120NM
- 200NM
- 320NM

IF THE X-Y DEMAND IS MAINTAINED THE RANGE SCALE WILL CHANGE AT A RATE OF TWO STEPS PER SECOND UNTIL MAX OR MIN RANGE IS SELECTED.

THE RANGE SCALE FUNCTION IS AVAILABLE WHEN ANY OF THE FOLLOWING MDEF MODES ARE SELECTED:

- EDIT ROUTE
- NEW WAYPOINT
- WAYPOINT PLUS BEARING
- DELETE WAYPOINT
- BULLSEYE POSITION ADJUST
- FIGHTER AREA OF RESPONSIBILITY

ICN-1B-B-340000-A-A0019-05582-A-03-2

Figure I-03-49 Adjust Range Scale

PERFORM SINGLE X-Y INSERT OVER WP. EXTRA INFORMATION IS DISPLAYED, DEPENDENT UPON WP TYPE. DATA IS ONLY DISPLAYED IF DEFINED VIA PDS.

OVERFLY, ROUTE AND LANDING WP:

- WP NUMBER
- IDENTIFIER
- DESCRIPTION
- WP ELEVATION
- ETA (IF WP HAS SCHEDULED TOA)
- PLANNED LEG GROUND SPEED
- TIME TO WP (ALONG ROUTE)
- PLANNED ARRIVAL TIME
- PLANNED A/C ALTITUDE OVER WP
- RANGE AND BEARING
- LEG GROUNDSPEED (PSC 2.0 ONWARDS).

MARK WP:

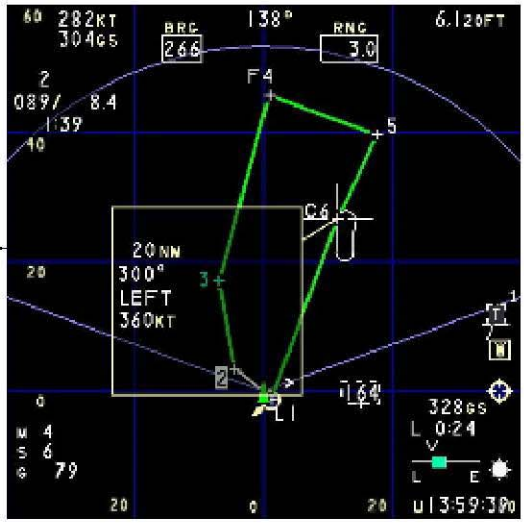
- WP NUMBER
- WP ELEVATION
- WP CREATION TIME
- PLANNED A/C ALTITUDE OVER WP
- RANGE AND BEARING

THIS INFORMATION IS ALSO PRESENTED ON PAGE 2 OF CAP WP, SEE BELOW.

(PSC 2.0 ONWARDS)
CAP WP:
EXTRA INFORMATION IS PRESENTED ON TWO PAGES. PAGE 1 DISPLAYS:

- LEG LENGTH
- ORIENTATION (OF OUTBOUND LEG)
- DIRECTION (LEFT OR RIGHT)
- SPEED
- '>' TO INDICATE 2ND PAGE AVAILABLE.

X-Y INSERT WITHIN BOX DISPLAYS 2ND PAGE OF INFORMATION, SEE ABOVE.

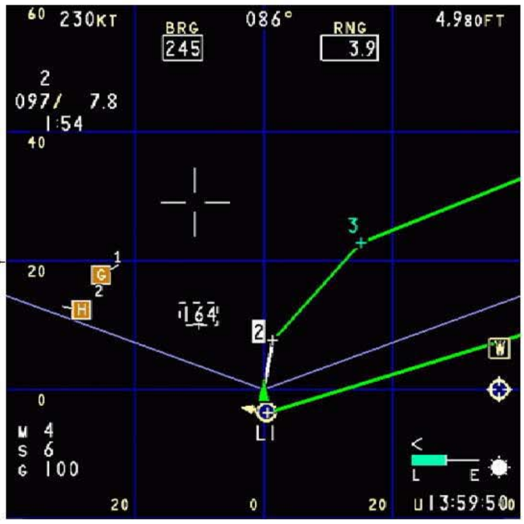


ICN-1B-B-340000-A-A0019-05583-A-03-2

Figure I-03-50 Display Extra Information on Waypoints (PA Format)

NOTE
(PSC 2.0 ONWARDS)
TIME EARLY/LATE INFORMATION IS OCCULTED WHILE ON CAP.

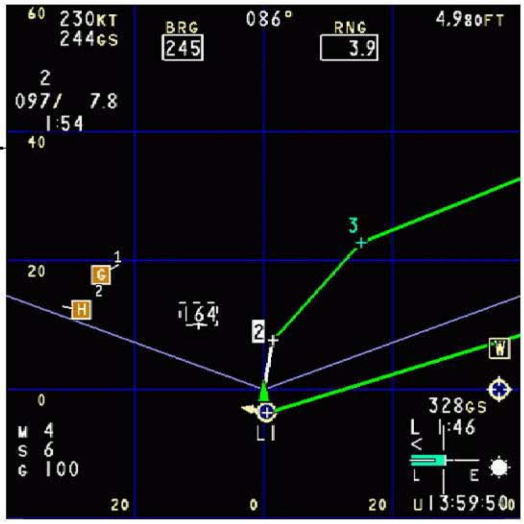
ON THE PA FORMAT THE TIME EARLY/LATE INDICATION IS SHOWN BY DEFAULT IF A WP FURTHER ALONG THE ROUTE HAS A PLANNED TIME OF ARRIVAL.



NOTE
TIME EARLY/LATE ERROR, GROUNDSPEED AND DEMANDED GROUNDSPEED ARE DISPLAYED BY DEFAULT IF A WP FURTHER ALONG THE ROUTE HAS A PLANNED TOA AND 'ON' IS DEFINED BY PSMK.

PERFORM X-Y INSERT OVER THE TIME EARLY/LATE INDICATION.

TIME EARLY/LATE ERROR, GROUNDSPEED AND DEMANDED GROUNDSPEED READOUTS ARE ADDED ON THE PA FORMAT.

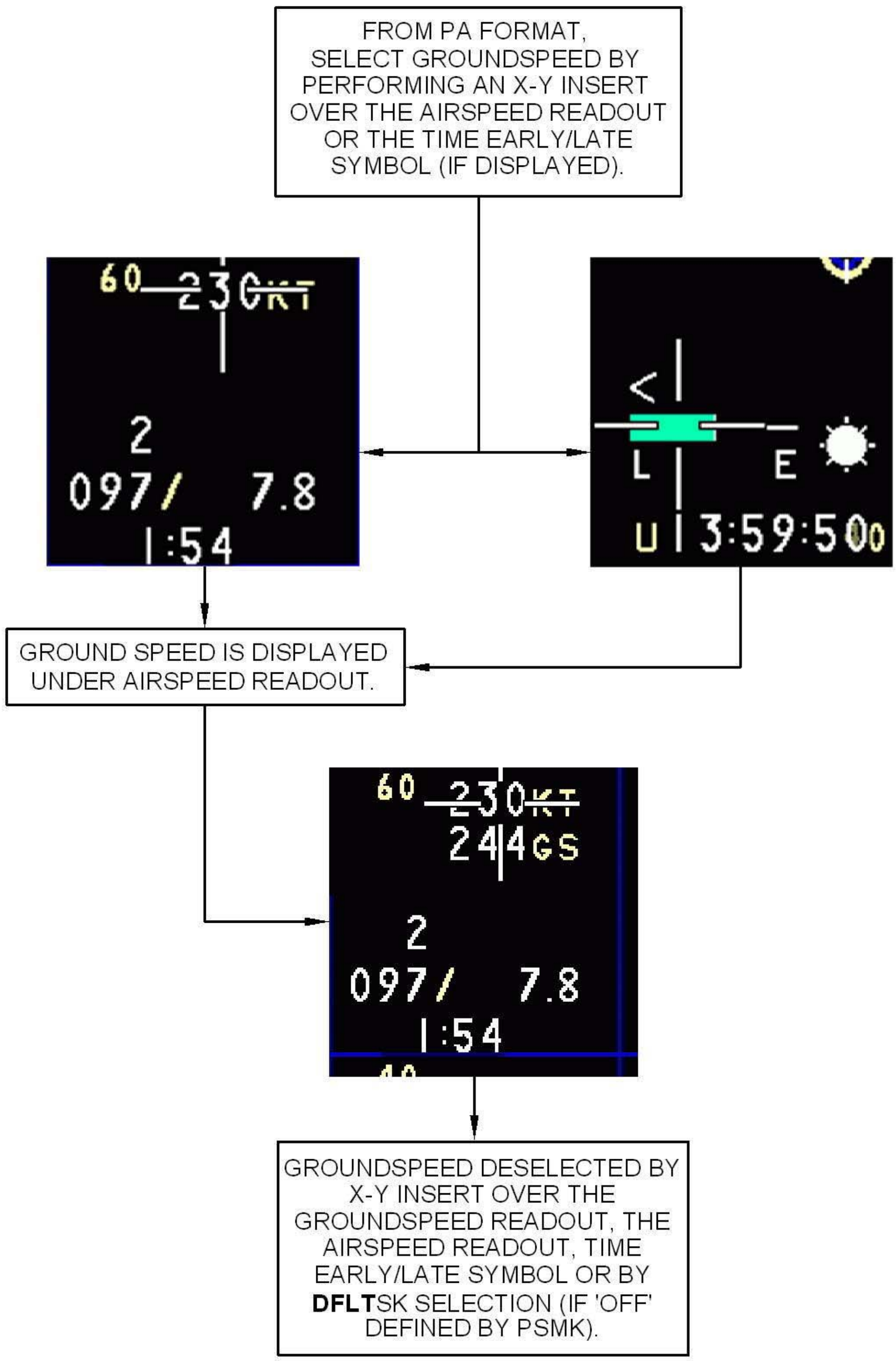


THE TIME EARLY/LATE ERROR, GROUNDSPEED AND DEMANDED GROUNDSPEED CAN BE REMOVED BY X-Y INSERT OVER AIRSPEED, GROUNDSPEED, TIME EARLY/LATE ERROR OR TIME EARLY/LATE INDICATION OR BY DFLT SK (IF 'OFF' DEFINED BY PSMK).

ICN-1B-B-340000-A-A0019-05585-A-03-2

Figure I-03-51 Select/Deselect Time Early/Late Information

NOTE
GROUNDSPEED IS NOT SHOWN
BY DEFAULT ON POWER UP
UNLESS 'ON' IS DEFINED BY PSMK.



ICN-1B-B-340000-A-A0019-05584-A-03-2

Figure I-03-52 Select/Deselect Groundspeed Indication

FROM PA FORMAT TIME OF DAY (UTC TIME) IS DISPLAYED BY DEFAULT ON POWER UP.

PERFORM A SINGLE X-Y INSERT OVER UTC TIME DISPLAY.
ALTERNATIVE (MISSION) TIME IS DISPLAYED.

NOTE
FIRST SELECTION ON GROUND STARTS/RESETS MISSION TIME. MISSION TIME, IF NOT MANUALLY STARTED BEFORE, WILL START AUTOMATICALLY WITH W-OFF-W.

TO RETURN TO UTC TIME, PERFORM ANOTHER X-Y INSERT OR SELECT THE **DFLT**SK.

ICN-1B-B-340000-A-A0019-05586-A-03-2

Figure I-03-53 Time Reference Selection

Soft.Prog.Ed.: PSC 1.X

OTF IS AVAILABLE IF POF = NAV, THE DWP IS OVERFLY OR LANDING AND THE NAV SYSTEM IS IN IS IN EITHER A LINS/FIX OR FCS/FIX MODE.

↓

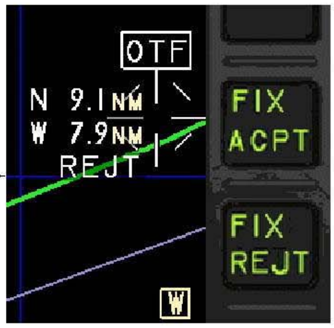
SELECT THE **FIX OTF** SK.

↓

X-Y IS ANNOTATED WITH OTF AND JUMPS TO PA FORMAT EDGE NEXT TO THE **FIX OTF** SK **OTF FIX** IS PRESENTED BOXED.

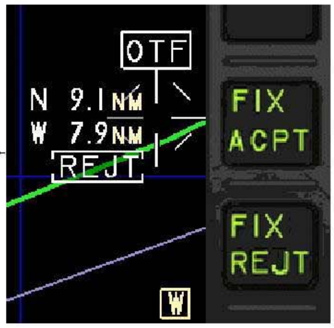
↓

PERFORM X-Y INSERT WHEN OVER THE DWP.
POSITION ERROR IS DISPLAYED.
FIX OTF SK REMODES TO **FIX ACPT**
FIX REJT SK APPEARS BELOW **FIX ACPT** SK
IF NAV MODE 3 IS SELECTED, A RECOMMENDATION TO ACCEPT OR REJECT THE FIX IS SHOWN.



↓

SELECT **FIX ACPT** SK OR **FIX REJT** SK.
NAV SYSTEM ESTIMATE OF POSITION IS UPDATED (IF ACCEPTED) OR NOT (IF REJECTED).
FIX ACPT SK AND **FIX REJT** SK OCCULT.



NOTE

OTF MODE IS DESELECTED BY:

- PRESSING THE **FIX ACPT** OR **FIX REJT** SK
- PRESSING THE **DFLT** SK
- PRESSING THE **MKR LOC** SK
- SELECTING SACQ, SRAAM SLAVED OR VISIDENT MODE
- SELECTING THE HSI FORMAT
- CHANGING THE DWP BY THE PILOT ACTION.

ICN-1B-B-340000-A-A0019-05587-A-03-2

Figure I-03-54 Perform On Top Fix

⇐

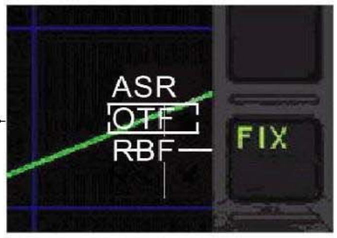
Soft.Prog.Ed.: PSC 2.0 onwards

OTF IS AVAILABLE IF POF = NAV, THE DWP IS OVERFLY OR LANDING AND THE NAV SYSTEM IS IN IS IN EITHER A LINS/FIX OR FCS/FIX MODE.

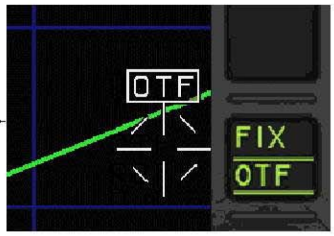
SELECT THE **FIX** SK.

A MENU APPEARS ON FORMAT ADJACENT TO SK, WHICH MAYBE TOGGLED TROUGH BY SELECTION OF SK.

SELECT THE **OTF** FROM MENU.

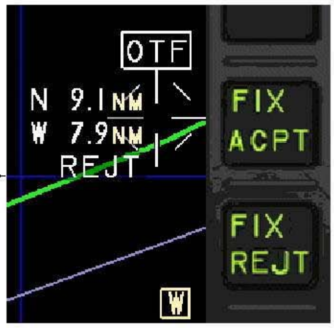


X-Y IS ANNOTATED WITH OTF AND JUMPS TO PA FORMAT EDGE NEXT TO THE **FIX OTF** SK
OTF FIX IS PRESENTED BOXED.

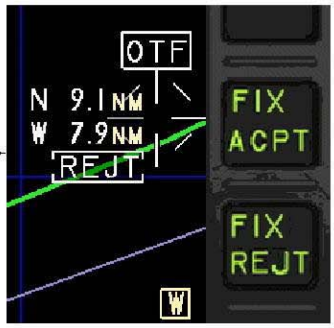


PERFORM X-Y INSERT WHEN OVER THE DWP.

POSITION ERROR IS DISPLAYED.
FIX OTF SK REMODES TO **FIX ACPT**
FIX REJT SK APPEARS BELOW **FIX ACPT** SK
IF NAV MODE 3 IS SELECTED, A RECOMMENDATION TO ACCEPT OR REJECT THE FIX IS SHOWN.



SELECT **FIX ACPT** SK OR **FIX REJT** SK.
NAV SYSTEM ESTIMATE OF POSITION IS UPDATED (IF ACCEPTED) OR NOT (IF REJECTED).
FIX ACPT SK AND **FIX REJT** SK OCCULT.



NOTE

OTF MODE IS DESELECTED BY:

- PRESSING THE **FIX ACPT** OR **FIX REJT** SK
- PRESSING THE **DFLT** SK
- PRESSING THE **MKR LOC** SK
- SELECTING SACQ, SRAAM SLAVED OR VISIDENT MODE
- SELECTING THE HSI FORMAT
- CHANGING THE DWP BY THE PILOT ACTION.

ICN-1B-B-340000-A-A0019-06771-A-02-2

Figure I-03-55 Perform On Top Fix

⇐

FROM PA FORMAT PERFORM AN X-Y INSERT OVER THE PP SYMBOL.

EXTRA DATA ASSOCIATED WITH PP IS DISPLAYED AS FOLLOWS:

- LATITUDE
- LONGITUDE
- GPWS HEIGHT AND POSITION FOM
- NAV MODE
- ESTIMATED POSITIONAL ERROR

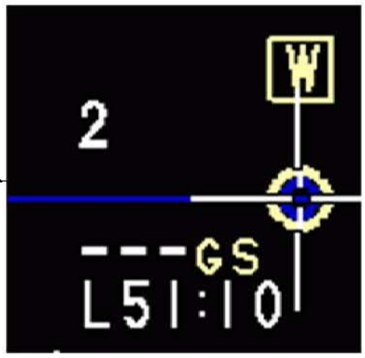
EXTRA DATA OCCULTS 3 SECONDS AFTER X-Y IS MOVED OFF THE PP SYMBOL, OR IMMEDIATELY ON SELECTION OF **DFLT**SK OR ON INSERT ON ANOTHER SYMBOL.

ICN-1B-B-340000-A-A0019-05588-A-03-2

Figure I-03-56 Display Extra Data on Present Position

NOTE
BULLSEYE ICON IS SHOWN BY DEFAULT IF SELECTED RECTANGULAR GRID SCALE IS 20NM OR GREATER AND A BULLSEYE HAS BEEN DEFINED.

PERFORM AN X-Y INSERT OVER THE BULLSEYE GRID ICON.



BULLSEYE GRID REPLACES RECTANGULAR GRID.

BULLSEYE GRID CENTERED ON BULLSEYE SYMBOL, ALLOWING PILOT TO REFER RANGES AND BEARINGS RELATIVE TO BULLSEYE.

(PSC 2.0 ONWARDS)
BEARING AND RANGE OF PP FROM BULLSEYE REPLACES WP DATA.

NORTH SOUTH LINE, TO AID ORIENTATION, REPLACES NORTH INDICATION ON BULLSEYE SYMBOL.

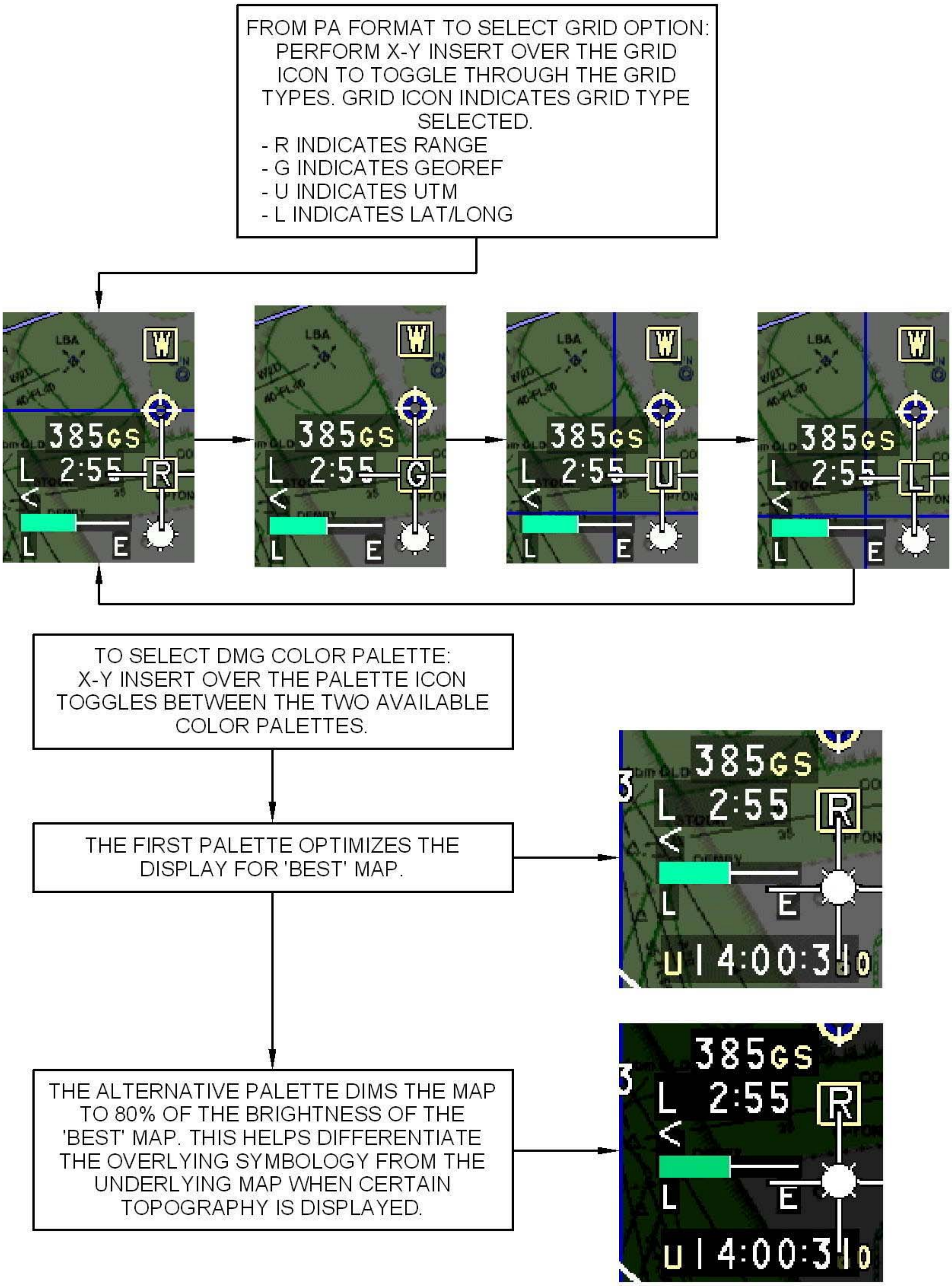
RANGES AVAILABLE ARE 320, 200, 120, 80, 40, AND 20NM. RANGE SCALE MAY BE ALTERED BY X-Y 'BUMPING'.

WHEN SELECTING BETWEEN THE BULLSEYE GRID AND THE RECTANGULAR GRID THE CURRENTLY SELECTED SCALE WILL BE CARRIED ACROSS FROM ONE GRID TO THE OTHER.

RESELECTION OF BULLSEYE GRID ICON OR SELECTION OF **DFLT**SK RETURNS DISPLAY TO RECTANGULAR RANGE GRID.

ICN-1B-B-340000-A-A0019-05589-A-03-2

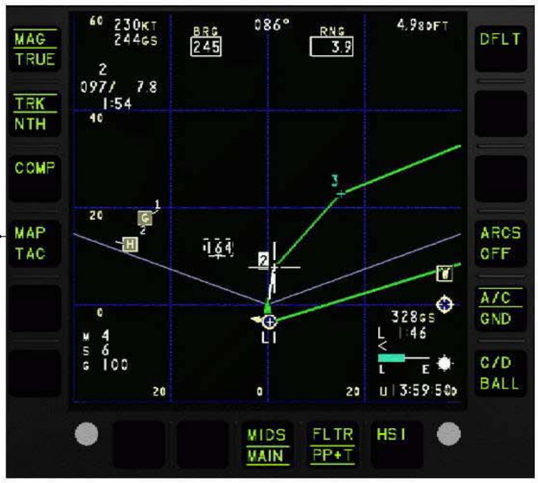
Figure I-03-57 Display Bullseye Grid



ICN-1B-B-340000-A-A0019-05590-A-03-2

Figure I-03-58 Select Between Grid Options and Selecting the DMG Color Palette

TO DISPLAY THE ZOOM PICTURE PERFORM A X-Y INSERT(FOR MORE THAN ONE SECOND) ON A TRACK/TARGET SYMBOL, THE PP SYMBOL OR BLANK AREA OF THE FORMAT.



THE ZOOM PICTURE IS GROUND STABILIZED IF THE INSERT IS PERFORMED OVER A WP OR BLANK AREA OF FORMAT (INDICATED BY THE 'GROUND' LEGEND BEING DISPLAYED).

THE ZOOM PICTURE IS TRACK STABILIZED IF THE INSERT WAS PERFORMED OVER A TRACK/TARGET SYMBOL OR THE PP SYMBOL (INDICATED BY THE 'TRACK' LEGEND BEING DISPLAYED).

WHILST ZOOM IS SELECTED:
- THE A/C AND GND STABILIZATION SK IS NOT AVAILABLE FOR SELECTION
- WINDOW ON THE WORLD AND RANGE CHANGING ARE NOT AVAILABLE.

ZOOM PICTURE MAY BE CANCELLED BY X-Y INSERT OVER ANY BLANK AREA INSIDE THE ZOOM PICTURE.

THE SCALE OF THE ZOOM WINDOW IS DICTATED BY THE PA SCALE WHEN ZOOM IS SELECTED AS FOLLOWS:

PA SCALE (NM)	ZOOM SCALE (NM)
3 - 5	3
10 - 20	5
40	10
80	20
200 - 120	40
320	80

ICN-1B-B-340000-A-A0019-05591-A-03-2

Figure I-03-59 Select the Zoom Window

NAVIGATION SYSTEM - DISPLAYS

Typical Multifunction Head Down Displays (MHDD) associated with the navigation system are shown in Figure I-03-60 to Figure I-03-83 .

Soft.Prog.Ed.: PSC 1.X

ICN-1B-B-311000-B-K0999-05941-A-01-2

Figure I-03-60 Waypoint Format

⇐

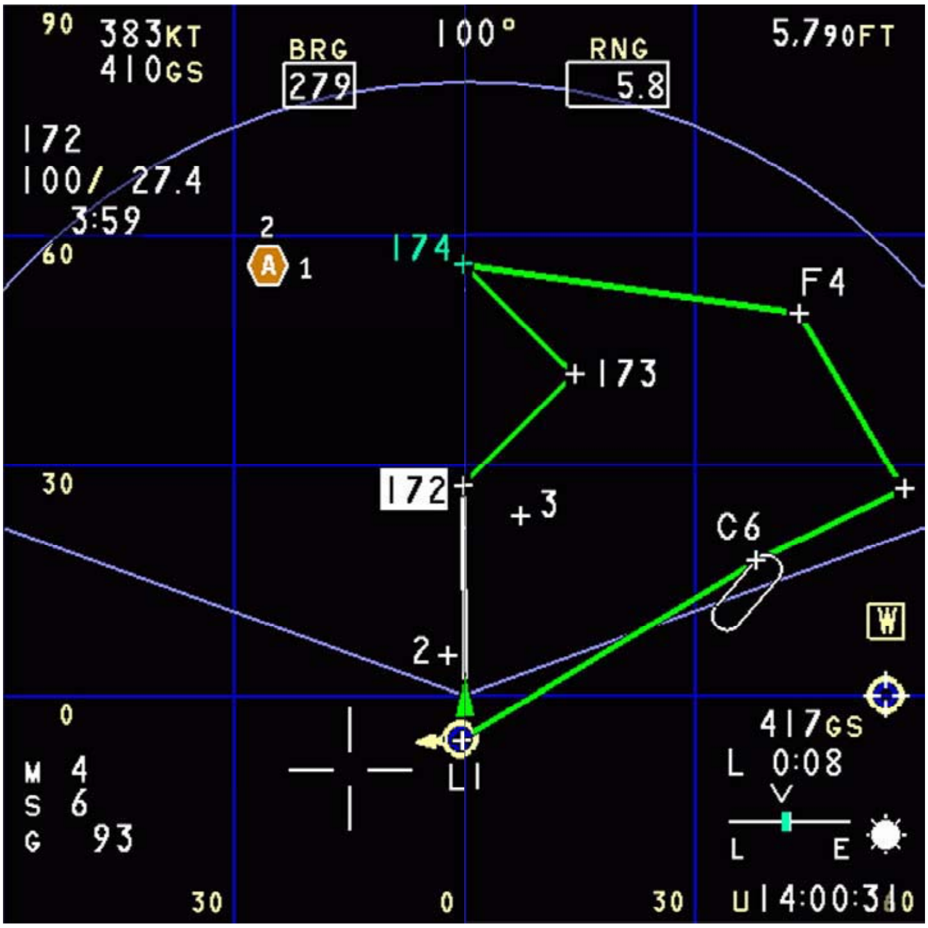
Soft.Prog.Ed.: PSC 2.0 onwards

ICN-1B-B-311000-B-K0999-05941-A-02-2

Figure I-03-61 Waypoint Format

⇐

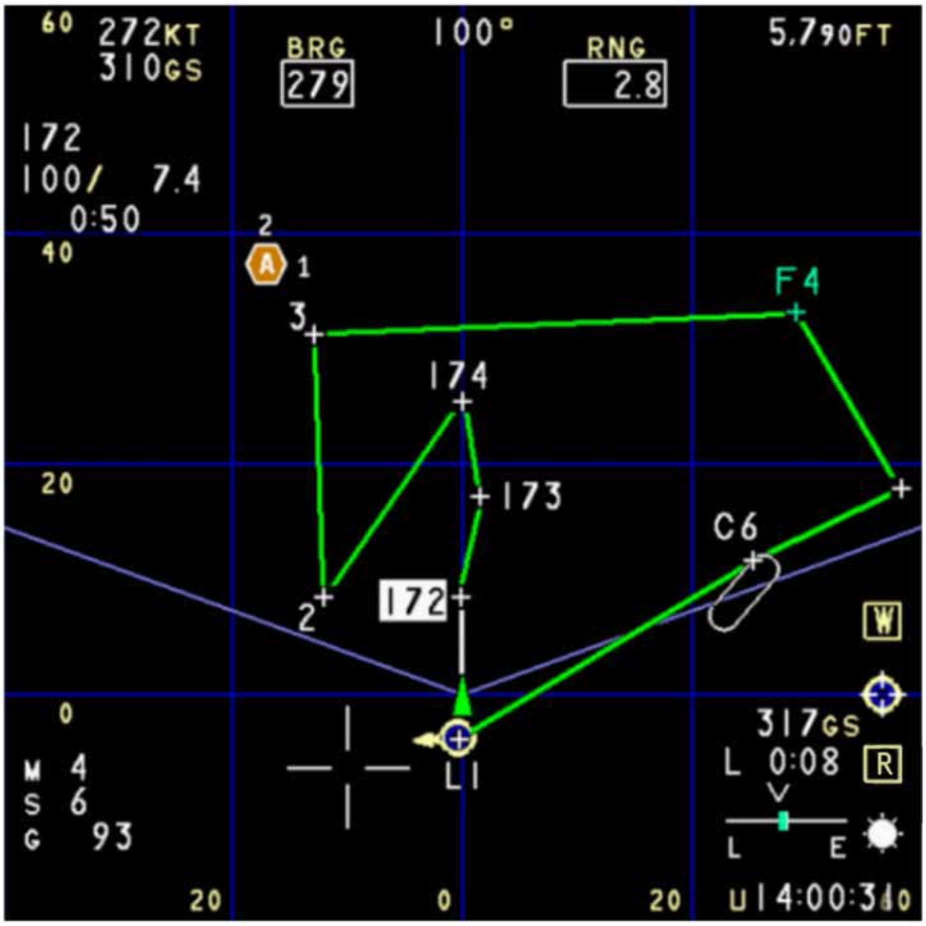
Soft.Prog.Ed.: PSC 1.X



ICN-1B-B-341000-B-K0999-04344-A-01-2

Figure I-03-62 LINS Airborne Alignment Mode

Soft.Prog.Ed.: PSC 2.0 onwards

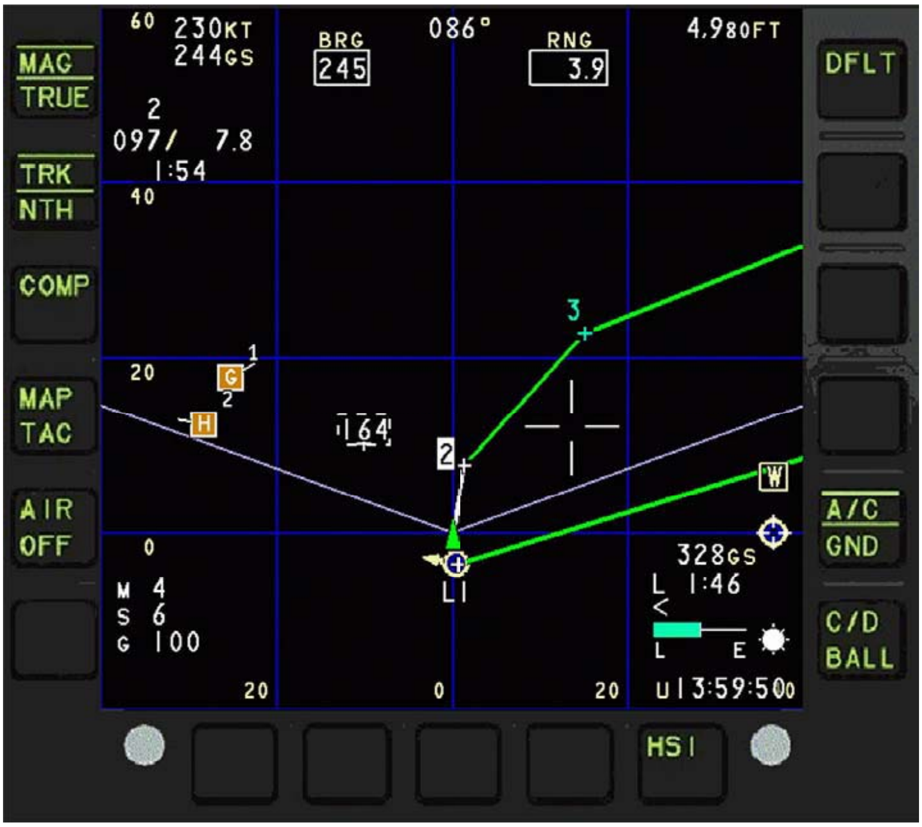


ICN-1B-B-341000-B-K0999-04344-A-02-2

Figure I-03-63 LINS Airborne Alignment Mode

⇐

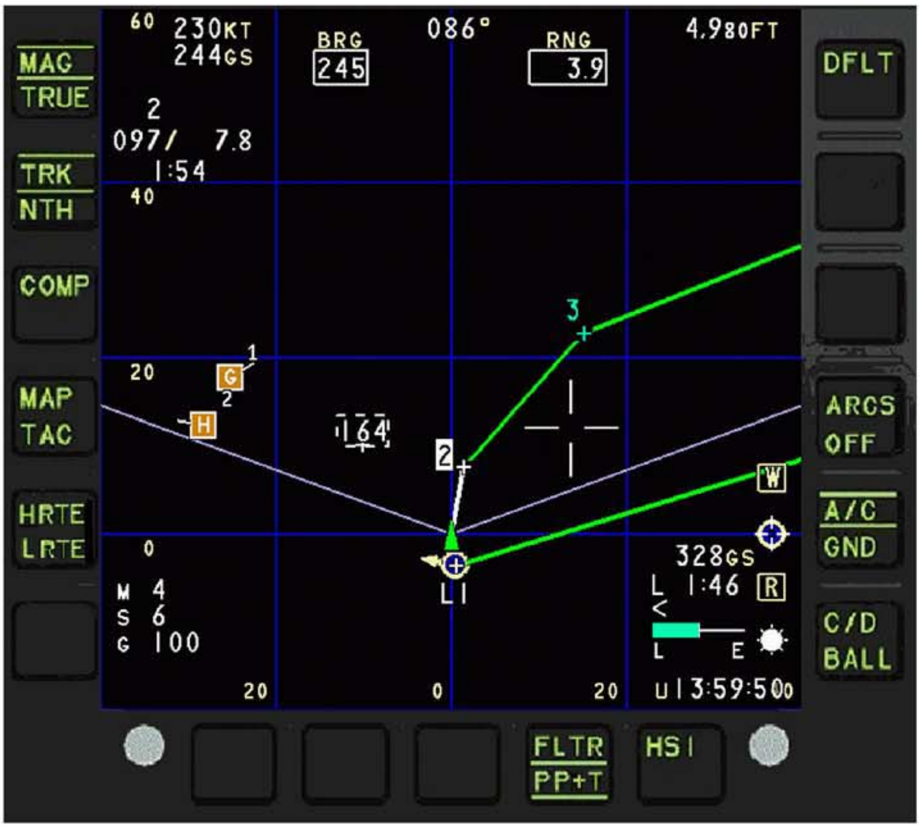
Soft.Prog.Ed.: PSC 1.X



ICN-1B-B-341000-B-K0999-04345-A-01-2

Figure I-03-64 Auto Route Selection

Soft.Prog.Ed.: PSC 2.0 onwards



ICN-1B-B-341000-B-K0999-04345-A-02-2

Figure I-03-65 Auto Route Selection

⇐

Soft.Prog.Ed.: PSC 1.X

ICN-1B-B-341000-B-K0999-04346-A-01-2

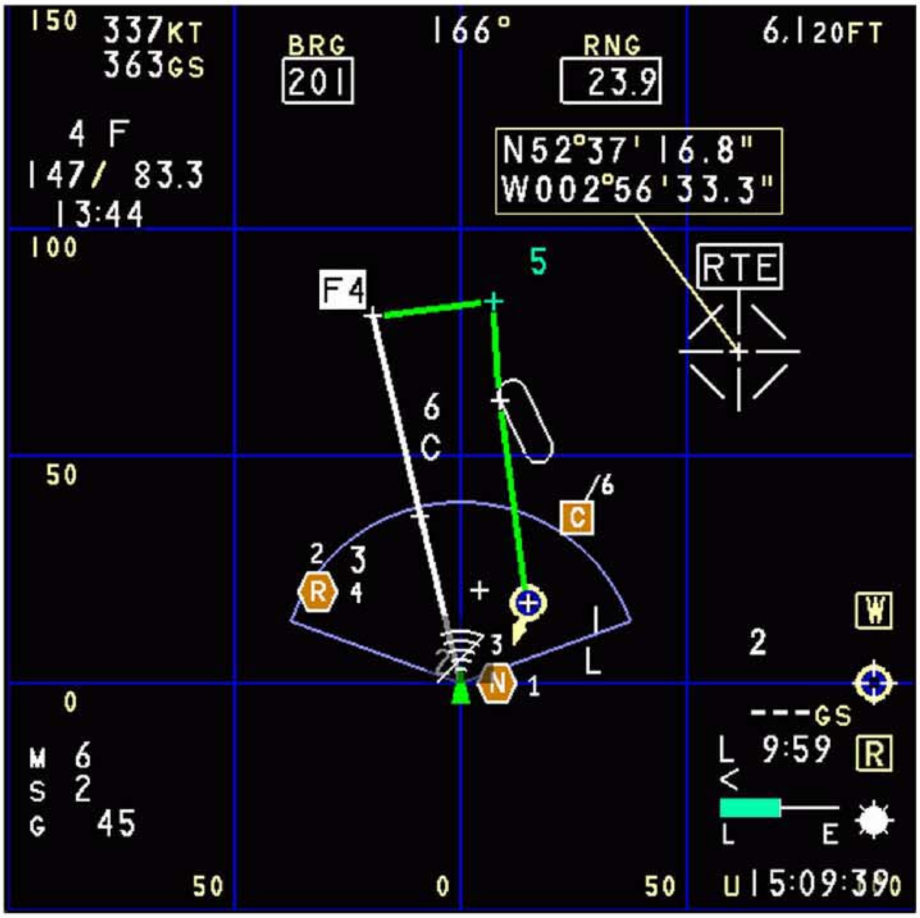
Figure I-03-66 Manual Route Selection

Soft.Prog.Ed.: PSC 2.0 onwards

ICN-1B-B-341000-B-K0999-04346-A-02-2

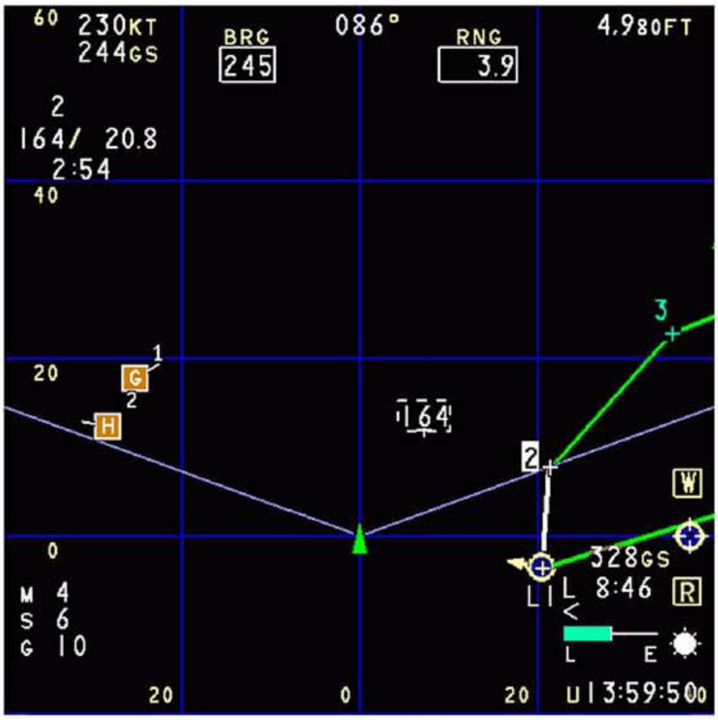
Figure I-03-67 Manual Route Selection

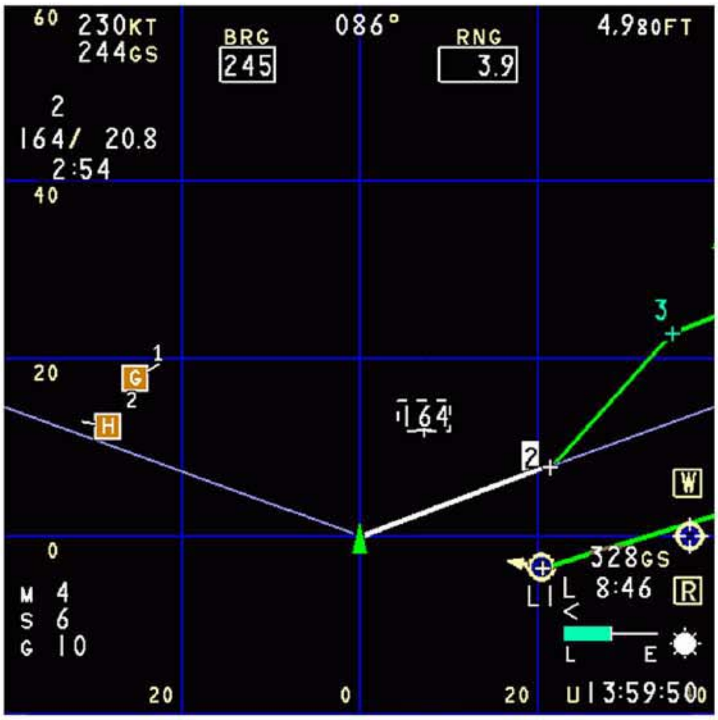
⇐



ICN-1B-B-341000-B-K0999-04347-A-02-2

Figure I-03-68 Manual Route Creation



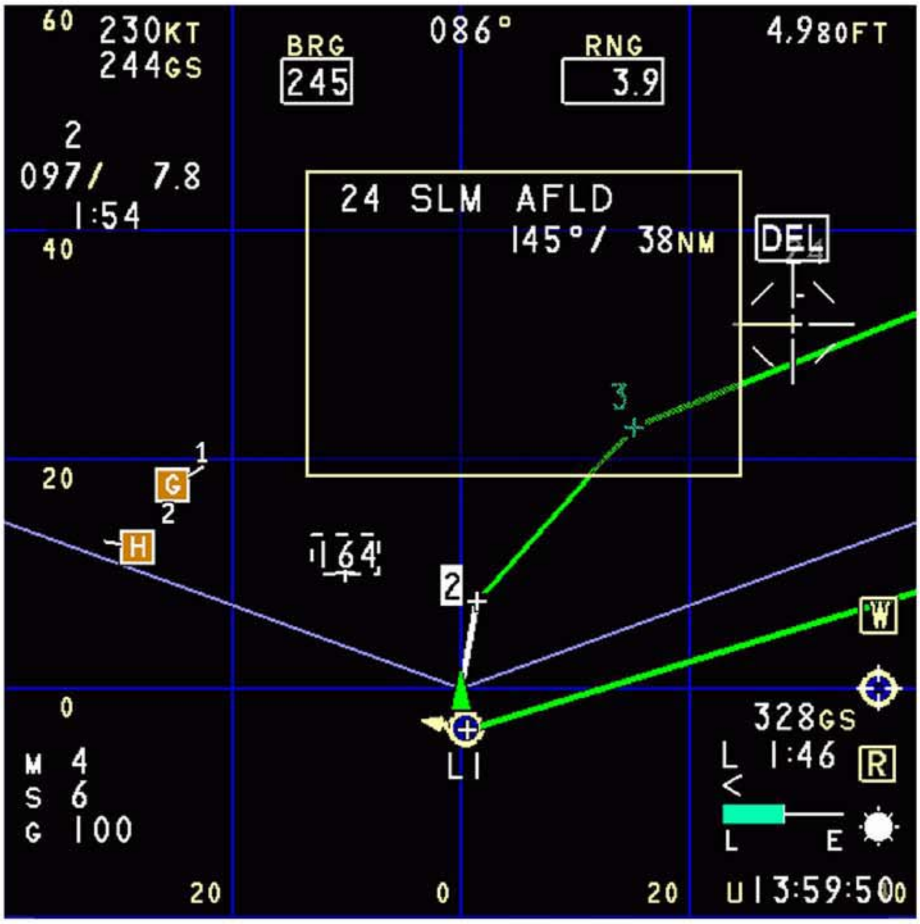


ICN-1B-B-341000-B-K0999-04348-A-02-2

Figure I-03-69 New Track Moding

ICN-1B-B-341000-B-K0999-04349-A-02-2

Figure I-03-70 Identify/Edit Paired Waypoint



ICN-1B-B-341000-B-K0999-04350-A-02-2

Figure I-03-71 Delete Waypoint Moding

Soft.Prog.Ed.: PSC 1.X

ICN-1B-B-341000-B-K0999-04351-A-01-2

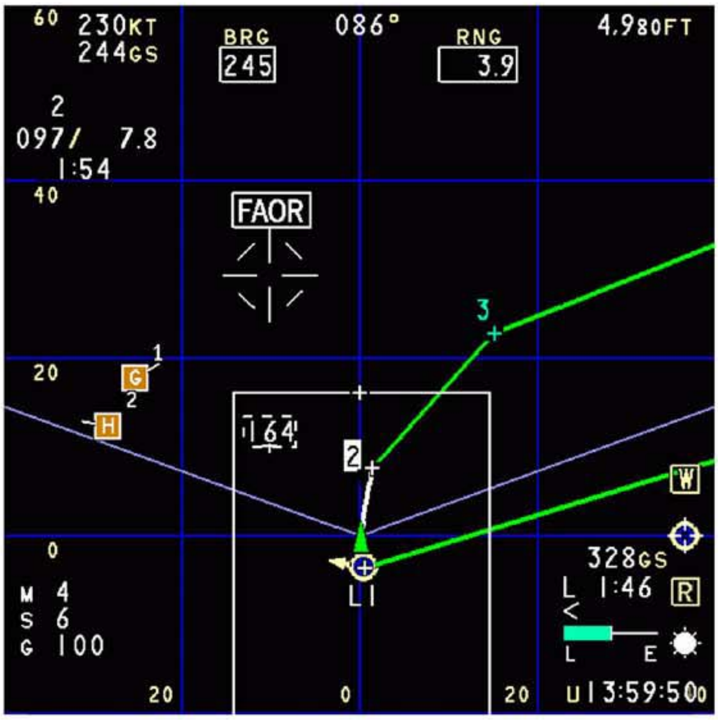
Figure I-03-72 Bullseye Grid Selection

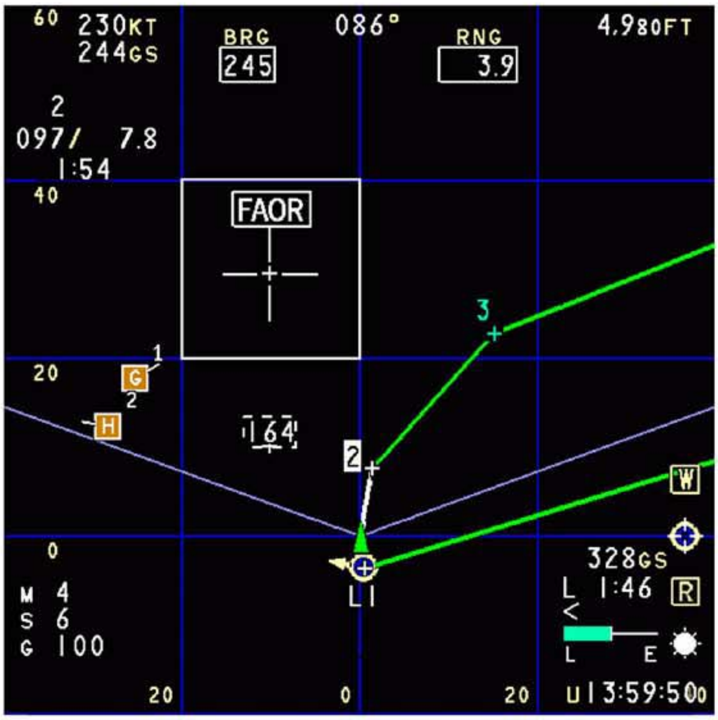
Soft.Prog.Ed.: PSC 2.0 onwards

ICN-1B-B-341000-B-K0999-04351-A-02-2

Figure I-03-73 Bullseye Grid Selection

⇐

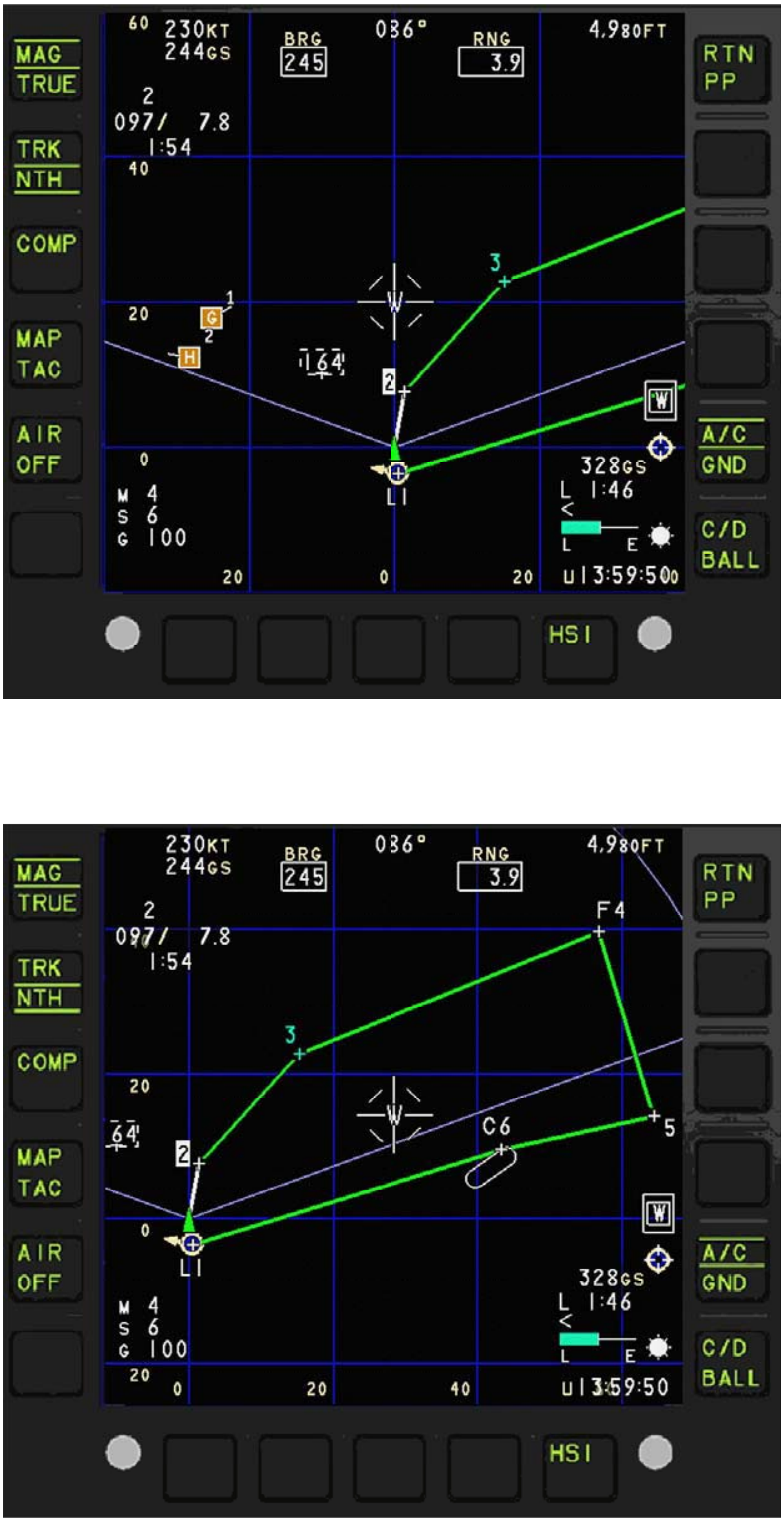




ICN-1B-B-341000-B-K0999-04352-A-02-2

Figure I-03-74 Set FAOR

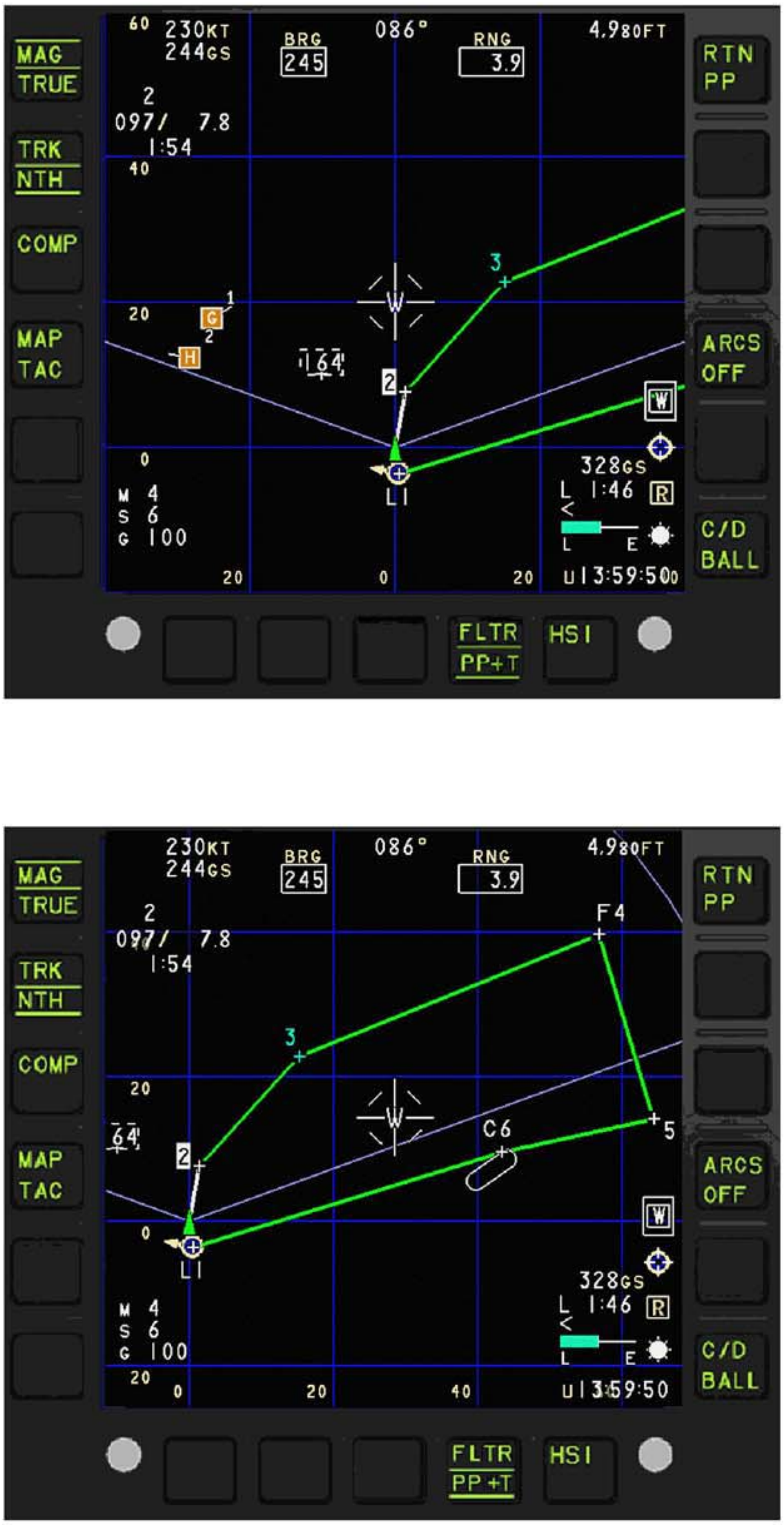
Soft.Prog.Ed.: PSC 1.X



ICN-1B-B-341000-B-K0999-04353-A-01-2

Figure I-03-75 Window-on-the-World Selection

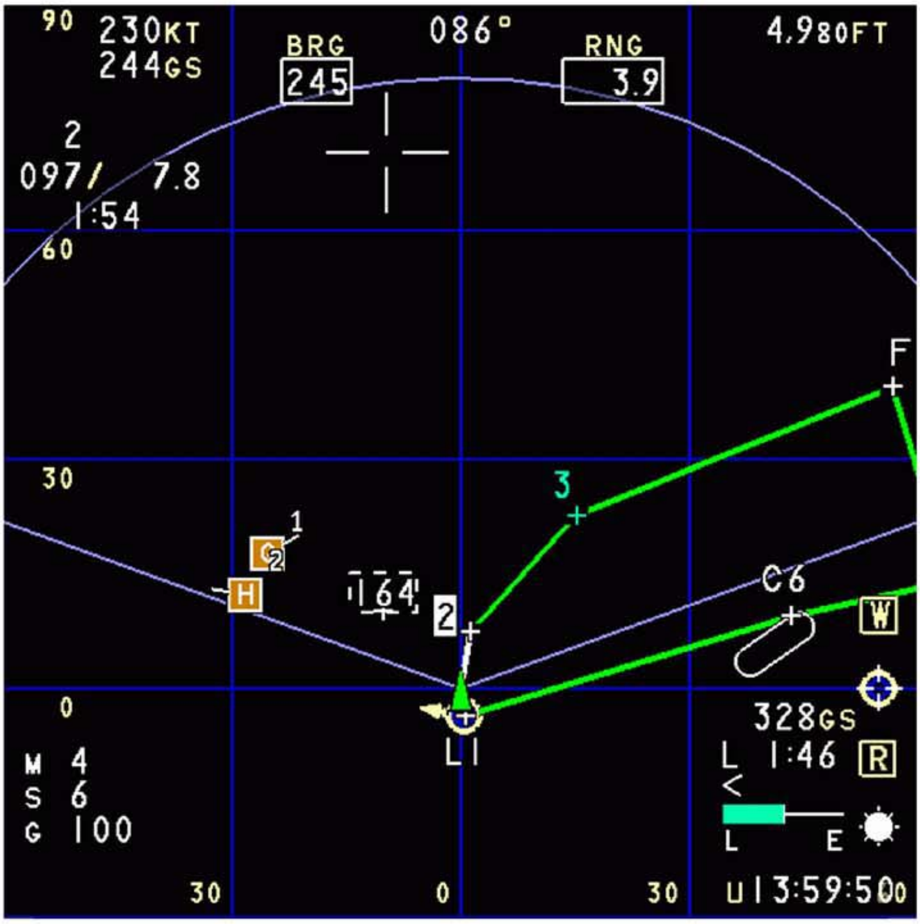
Soft.Prog.Ed.: PSC 2.0 onwards



ICN-1B-B-341000-B-K0999-04353-A-02-2

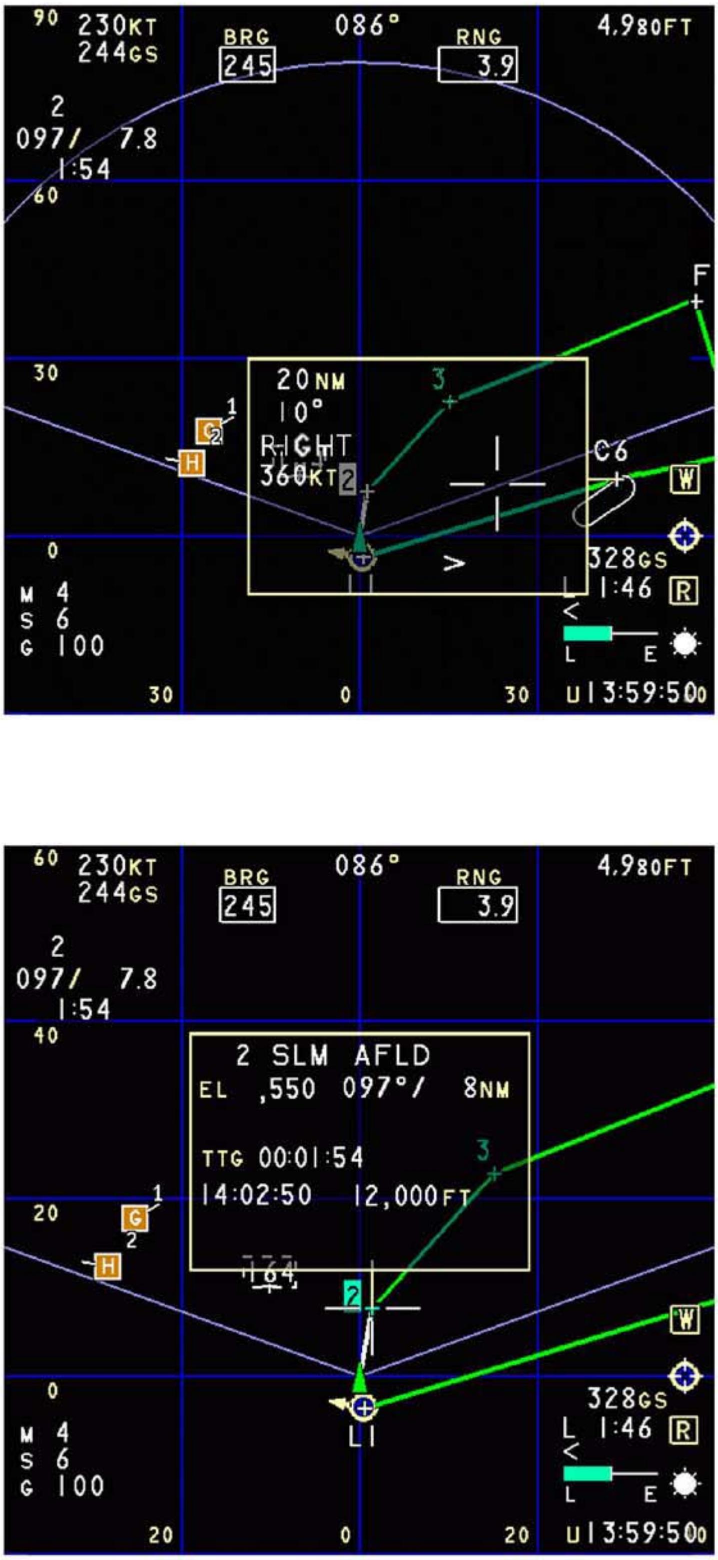
Figure I-03-76 Window-on-the-World Selection

⇐



ICN-1B-B-341000-B-K0999-04354-A-02-2

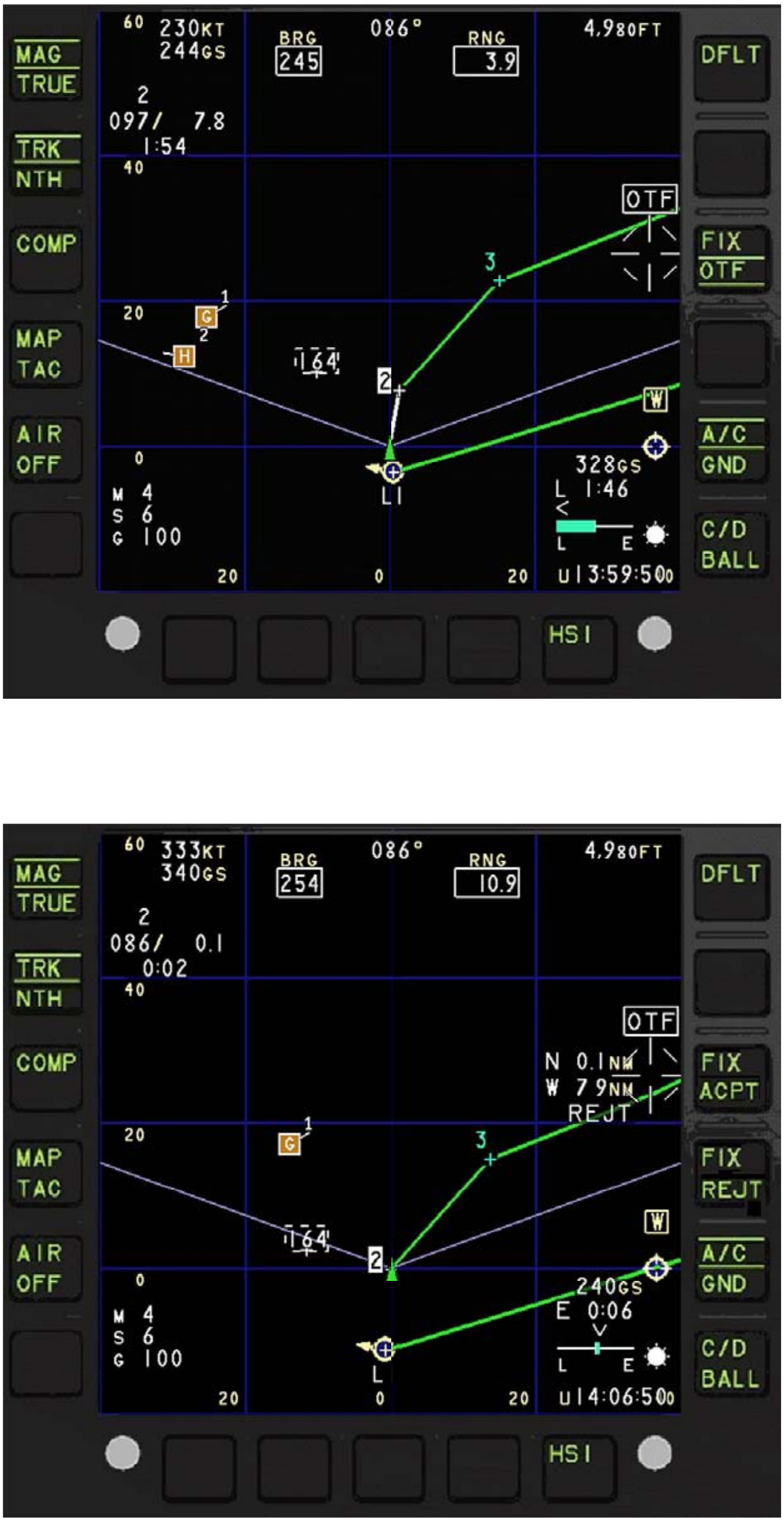
Figure I-03-77 Display Range Scale



ICN-1B-B-341000-B-K0999-04355-A-02-2

Figure I-03-78 Extra Data on Waypoint (PA Format)

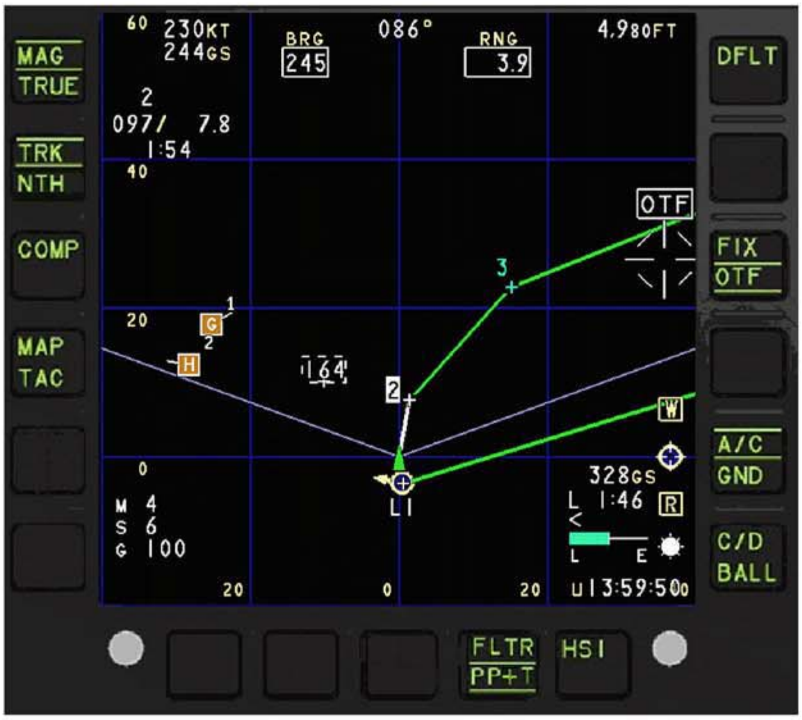
Soft.Prog.Ed.: PSC 1.X



ICN-1B-B-341000-B-K0999-04356-A-01-2

Figure I-03-79 On-Top-Fixing

Soft.Prog.Ed.: PSC 2.0 onwards

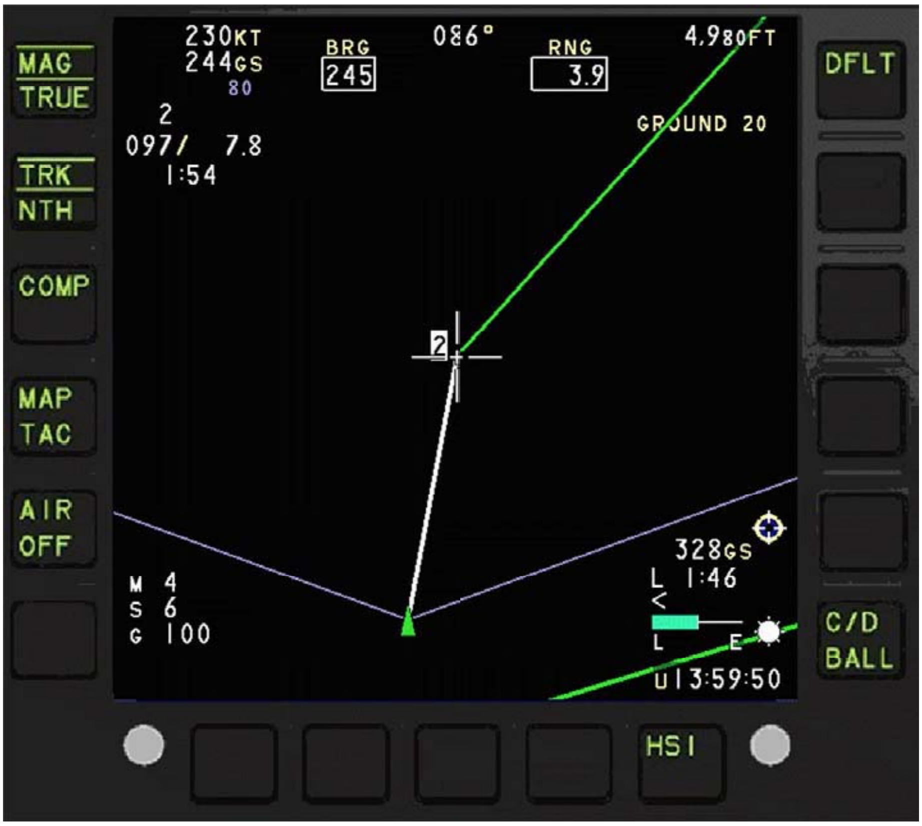


ICN-1B-B-341000-B-K0999-04356-A-02-2

Figure I-03-80 On-Top-Fixing

⇐

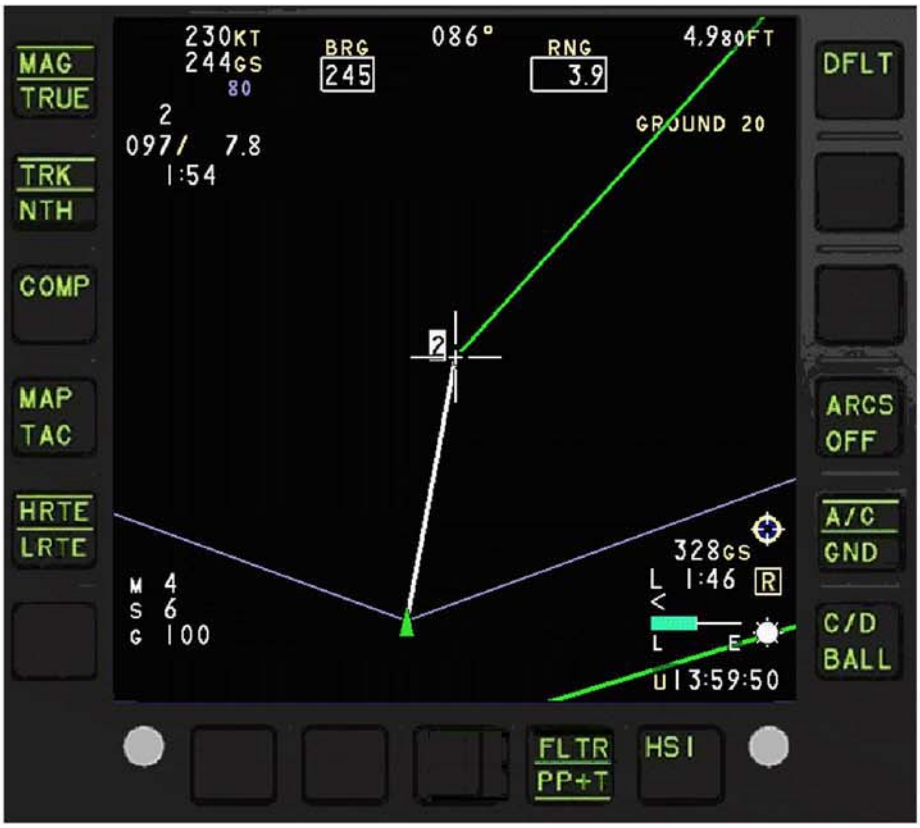
Soft.Prog.Ed.: PSC 1.X



ICN-1B-B-341000-B-K0999-04357-A-01-2

Figure I-03-81 Zoom Window

Soft.Prog.Ed.: PSC 2.0 onwards



ICN-1B-B-341000-B-K0999-04357-A-02-2

Figure I-03-82 Zoom Window

⇐

ICN-1B-B-341000-B-K0999-03471-A-02-2

Figure I-03-83 Autocue Format

NAVIGATION FIXING

Fixing is the procedure by which the Navigation System estimate of the aircraft present position is updated to maintain navigation accuracy by compensating for LINS and IMU (FCS modes) drift. Fixing can be carried out automatically using the GPS (if a NAV mode which uses the GPS is selected), which provides accurate present position and velocity information, or manually by an On Top Fixing (OTF).

ON TOP FIXING (OTF)

An OTF is performed to update the best present position and it is available when the navigation mode is 3, 5 or 8 and the destination waypoint (DWP) is landing or overfly.

Soft.Prog.Ed.: PSC 1.X

The OTF procedure is selected via the FIX OTF SK on the PA format (refer to Figure I-03-84). On selection, it becomes boxed and the XY marker is parked next to the FIX OTF SK (during the time of fixing).

⇐

Soft.Prog.Ed.: PSC 2.0 onwards

The OTF procedure is selected via the FIX SK on the PA format (refer to Figure I-03-84). On selection of this SK, a dedicated menu shows the available fixes. The presently possible fixes are:

- OTF
- RBF (Range and Bearing Fix)
- ASR (Air to Surface Ranging)
- PVU (Precision Velocity Update).

Range and Bearing Fix, Air to Surface Ranging and Precision Velocity Update are not to be used because not yet cleared. Each time the SK is pressed, a different fix is selected. Three seconds after OTF selection (time necessary for the request to be accepted), the FIX SK changes to FIX OTF (boxed), the FIX REJT SK appears and the XY marker is parked next to the FIX OTF SK (during the time of fixing).

⇐

Any XY positional demands will be ignored. When overflying the fix point, the XY controller must be pressed. An indication of fix error (in nautical miles, North or South, East or West) is displayed on the PA format. The fix can be accepted or rejected using the FIX ACPT (after XY insertion the FIX OTF SK renames as FIX ACPT) or FIX REJT SK.

If the current NAV mode is Mode 3, a recommendation for accepting or rejecting (ACTP or REJT) the fix is shown below the fix error figures. This is based on the estimated magnitudes of the errors as computed by the Kalman Filter. On acceptance, the error is cleared from the display (if present) and the system, using the measured delta, updates the best present position. On rejection, the error is cleared from the display (if present) but the present position is not updated.

NOTE

> When the OTF mode is engaged the automatic DWP change is suspended. Once disengaged (i.e. accepting or rejecting the fix), the automatic DWP change is restored.

The OTF procedure may be cancelled at any time before any fixing has occurred using the FIX REJT SK. Based on the current navigation mode, the OTF procedure should be performed at different rates:

NAV MODE 3 (LINS + FIX + KF, LINS FIX1 MK BOXED)

Following fix acceptance, the NC updates the best PP with the correction derived from the OTF PP in relation to the LINS-calculated PP corrected by the Kalman Filter.

NOTE

> According to the observed LINS drift, it is recommended to perform the first fix procedure around 30 minutes since the LINS Navigate Mode entered, and every 45 minutes for the remainder of the mission.

NAV MODE 5 (LINS + FIX, LINS FIX2 MK BOXED)

Following fix acceptance, the NC updates the best PP with the correction derived from the OTF PP in relation to the LINS-calculated PP, with last KF correction if an automatic (GPS in NAV Mode 1) or manual (OTF in NAV Mode 3) fix was previously performed.

NOTE

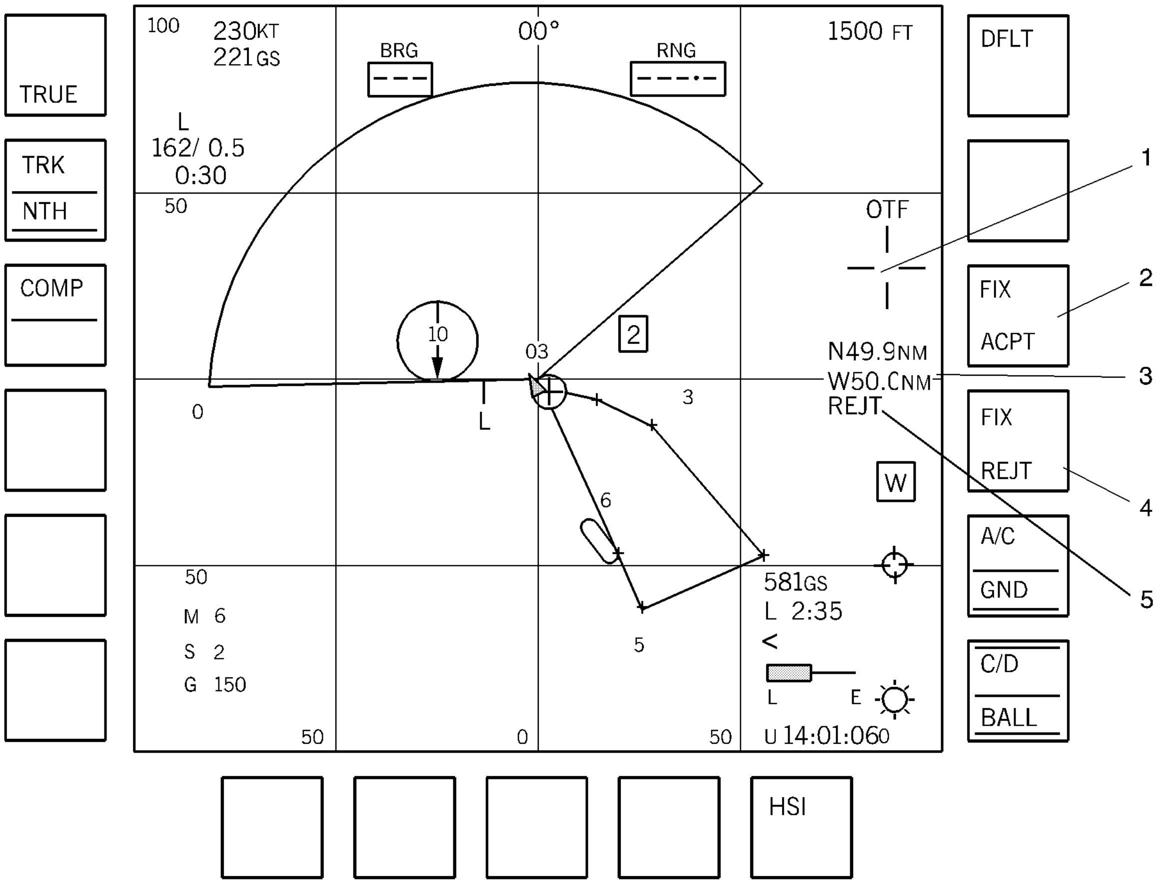
> According to the observed LINS drift, it is recommended to perform the first fix procedure around 30 minutes since the LINS Navigate Mode entered, and every 20 minutes for the remainder of the mission.

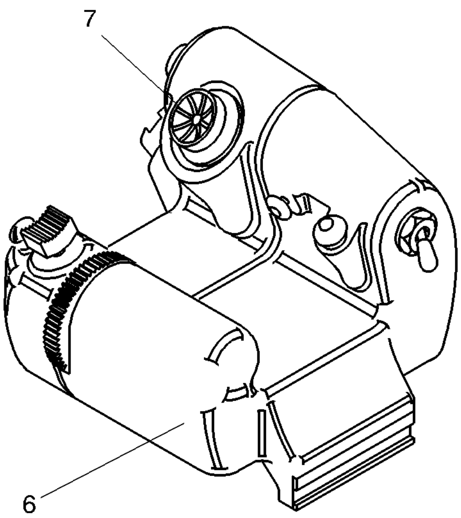
NAV MODE 8 (FCS + FIX, FCS FIX MK BOXED)

Following fix acceptance, NC updates the best PP with the correction derived from the OTF PP in relation to the PP derived from the FCS data (TAS, acceleration, altitude and heading) and the last calculated wind before LINS failure.

NOTE

Best data may be degraded due to wind speed/direction changes following the LINS failure, since the NC continues using the last valid wind calculated value from LINS prior to its failure until a manual wind is inserted by pilot. For this reason, the FCS OTF procedure should be used with a clear perception of its limitations. The OTF procedure should be frequently performed to minimize potential errors.





1 XY CURSOR
2 FIX ACPT SOFT KEY
3 KF EVALUATION
4 FIX REJT SOFT KEY
5 ACPT/REJT INDICATION (MODE 3 ONLY)
6 THROTTLE CONTROL TOP
7 XY CONTROLLER

ICN-1B-B-346100-A-A0019-01221-A-03-2

Figure I-03-84 Insert On Top Fix

NAVIGATION STEERING

Steering provides all the necessary information to fly the aircraft on a required flight pattern.

Steering calculations, performed by the NC, provide information to follow a route consisting of legs and waypoints (a leg is the segment between two consecutive waypoints in a route).

The widest possibility to control and change the flight pattern is provided.

Steering information is shown, on the PA, HSI formats; a steering bug, against a heading ribbon on the HUD and HDHUD format, provides to follow the desired track.

Steering can be performed with respect to either True or Magnetic North, as desired. A North-up or Track-up orientation of the PA format can be selected.

Steering is conducted following well-defined rules, dictated by steering types and modes.

The appropriate steering types and/or modes are selected either automatically or manually, dependent upon the waypoints availability. The NC uses three logically separate memory areas to store the necessary data:

- Waypoint General Store (commonly called Route Store)
- Auto Route
- Manual Route.

The Route Store is a data set of up to 200 entries, each of which can be provided with those attributes necessary to define the waypoint. The following three attributes are obligatory and represent the minimum requirement:

- Number (from 1 to 200 - assigned automatically)
-

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  Type (Route, Overfly, Mark, Landing)

  ⇐

-

  Soft.Prog.Ed.: PSC 2.0 onwards

  Type (Route, Overfly, Mark, CAP, Landing)

  ⇐

- Coordinates (Lat / Long, Georef).

Other attributes may be inserted as required:

- Waypoint altitude (referred to mean sea level)
- Planned A/C altitude (at waypoint)
- Identifier (3 alphanumeric chars)
- Description (6 alphanumeric chars)
- Scheduled time of arrival at waypoint
-

  Soft.Prog.Ed.: PSC 2.0 onwards

  CAP parameters (length, direction, speed, turn)

  ⇐

-

  Soft.Prog.Ed.: PSC 2.0 onwards

  Leg groundspeed.

  ⇐

For Mark waypoints the scheduled time of arrival at waypoint is substituted by the creation time.

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The attributes applicability with reference to the waypoint type are shown in Table I-03-01 .

ATTRIBUTE	OVERFLY	ROUTE	LANDING	MARK
Number	X	X	X	X
Position	X	X	X	X
Elevation	X	X	X	X
Planned A/C altitude at WP	X	X		X
Identifier	X	X	X	
Description	X	X	X	
Scheduled time	X	X	X	
Time of creation				X

Table I-03-01 Attributes Applicability

⇐

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The attributes applicability with reference to the waypoint type are shown in Table I-03-02 .

ATTRIBUTE	OVERFLY	ROUTE	LANDING	MARK	CAP
Number	X	X	X	X	X
Position	X	X	X	X	X
Elevation	X	X	X	X	X
Planned A/C altitude at WP	X	X		X	X
Identifier	X	X	X		X
Description	X	X	X		X

ATTRIBUTE	OVERFLY	ROUTE	LANDING	MARK	CAP
Scheduled time	X	X	X		X
Time of creation				X	
Pattern length					X
Pattern direction					X
Pattern speed					X
Pattern turn					X
Leg groundspeed	X	X	X	X	X

Table I-03-02 Attributes Applicability

⇐

Additional waypoint information is continuously calculated and displayed, based on the aircraft flight path and its spatial relationship to the waypoint. Such information consists of:

- Range
- Bearing
- Time-to-go to DWP.

On the PA and WPT list formats it is possible, at any time, to visualize the characteristics of a waypoint by positioning the XY marker over the desired waypoint and clicking once. The data appears within a box.

The waypoint additional information box on the PA format contains the following data:

- Number
- Identifier
- Description
- Elevation
- Bearing
- Range
- Time-to-go to Waypoint
- Planned time of arrival, or time of creation for Mark waypoints
- Planned aircraft altitude at waypoint.
-

Soft.Prog.Ed.: PSC 2.0 onwards

Leg groundspeed

⇐

- Estimated time of arrival.

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If the waypoint type is CAP, there are two pages of information: the first page shows the CAP parameters (pattern length, direction, speed and turn), whereas the second page (accessed by clicking anywhere within the first page box) shows the other information.

⇐

The waypoint additional information box on the WPT list format contains the following data:

- Number
- Type
- Lat / Long or Georef
- Bearing
- Range
- Elevation
- Planned aircraft altitude at waypoint (if defined)
- Identifier
- Description
- Planned time of arrival, or time of creation for Mark waypoints
-

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CAP parameters (pattern length, direction, speed and turn)

⇐

Soft.Prog.Ed.: PSC 1.X

The waypoints allocation within the NC Route Store is shown in Table I-03-03 :

FROM	TO	REMARKS
001	190	Generic waypoints (loadable via PDS).(1)
172	174	In Flight Alignment waypoints (managed by the NC). (2)
191	200	Mark waypoints
(1) Note that WP number 172, 173 and 174 are dedicated to IFA		
(2) Not available due to the fact that IFA functionality is not yet cleared		

Table I-03-03 Waypoints Allocation

⇐

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The waypoints allocation within the NC Route Store is shown in Table I-03-04 :

FROM	TO	REMARKS
001	164	Generic waypoints (loadable via PDS)
165	171	MIDS Mission Assignment waypoints (loadable via a MIDS message only) (1)
172	174	In Flight Alignment waypoints (managed by the NC)
175		MLS Transition waypoint (2)
176	190	MIDS Flight Path waypoints (loadable via a MIDS message only) (1)
191	200	Mark waypoints
(1) Not available due to the fact that MIDS functionality are not yet cleared		
(2) Not available due to the fact that MLS is not yet installed		

Table I-03-04 Waypoints Allocation

⇐

Waypoints attributes can be amended, at any time, using the MDEF.

ROUTES AND WAYPOINTS

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The navigation system can manage two different types of route: an Auto Route (planned) and a Manual Route (unplanned). Each route can contain up to 50 waypoints, three of which are reserved for the In-Flight Alignment (IFA). The waypoints sequence can be manually modified to suit flight requirements.

⇐

Soft.Prog.Ed.: PSC 2.0 onwards

The navigation system can manage two different types of route: an Auto Route (planned) and a Manual Route (unplanned). Each route can contain up to 50 waypoints, three of which are reserved for the In-Flight Alignment (IFA) and one for the MLS Transition waypoint. The waypoints sequence can be manually modified to suit flight requirements.

⇐

It is not possible to insert a WP before the DWP or JWP, both in the Auto Route and in the Manual Route (unless HOLD has been selected via the MDEF/NAV SSK).

It is possible to delete waypoints from the Route Store using the DEL WP MK on the MDEF, selectable by pressing the MDEF SWP SSK.

If a waypoint to be deleted is in a route, it must first be removed from that route.

Those parts of the routes within the format selected area of coverage can be viewed on the PA format; the leg just flown is removed from the display on acquiring the new leg (when the WPT list format is not selected).

AUTO ROUTE

The Auto Route is set as default for steering.

The Auto Route can be:
- created via the format using the XY controller
- loaded via the PDS/GLU
- manually reordered in the WPT list format, using the XY controller drag and drop” technique
- cancelled one waypoint at a time and via WPT list only.

The last saved Auto Route is maintained in the NC non-volatile memory for successive re-use. Loading a new route overwrites the previous one.

Manually changing the Auto Route saves any alterations as permanent changes to the route content in the non-volatile memory. The initial Auto Route can only be restored by further manual changes or by loading it again. The original Auto Route in the PDS is not modified in any way by manual changes effected in flight.

The Auto Route is displayed on the PA format as a solid green line except for the current leg which is shown in white.

MANUAL ROUTE

The Manual Route is never selected by default; it can be manually selected (if available) at any time. If the Auto Route does not exist, HOLD” is selected automatically with weight off wheels.

The Manual Route can be:
- created via the:
  - XY controller on the WPT list format
  - MDEF only, using the NAV SSK (not to be used when the Manual Route is selected)
  - XY controller on the PA format, using the NAV SSK (not to be used when the Manual Route is selected)
  - combination of actions via PA format and MDEF, using the NAV SSK (not to be used when the Manual Route is selected).
- loaded via the PDS/GLU
- manually reordered in the WPT list format, using the XY controller drag and drop” technique

- cancelled either waypoint by waypoint (via the XY controller on the WPT list format) or in a single step (using the DEL MAN MK, selectable via the MDEF NAV SSK).

The last saved Manual Route is not maintained in the NC non-volatile memory at aircraft shut-down.

The Manual Route is displayed on the PA format as a green dashed line, except for the current leg which is shown in white.

If the last waypoint in the Manual Route is included in the Auto Route, the aircraft automatically transfers to the Auto Route as soon as this waypoint (called Join waypoint) is reached.

NAVIGATION FUNCTIONS VIA MDEF

The following functions improve the flexibility of the navigation system. They are all selectable using the MDEF, after selecting the NAV SSK or the SWP SSK.

The following functions can be selected from the NAV SSK:

- CHNG DIR (Change Direction): this MK, selected by pressing the CHNG DIR MK, reverses the selected route direction and allows navigation back along the selected route. The route is completely reversed, i.e. the previous waypoint is selected as new DWP. The new waypoint order is shown on the WPT list format.
- CHD XXX (Previous Waypoint): on pressing the CHD XXX MK the route sequence steps back one waypoint, providing steering back to the previous waypoint but retaining the planned route sequence. Successive presses of this MK let the DWP change through the previous waypoints. This MK is available when there is a preceding waypoint in the route currently being flown that is available for selection and in Hold Steering.
- EDIT RTE (Edit Route): this MK allows new waypoints to be defined or existing waypoints edited. The system places the waypoints in the Route Store and in the Manual Route as follows:
  - If the Manual Route is being flown, the first waypoint inserted is placed after the DWP
  - If the Auto Route is being flown, the first waypoint inserted is placed as JWP
  - If Hold Steering is selected the first waypoint is placed at the beginning of the remainder of the Manual Route.

  In any case, successive waypoints are inserted after the last entered, sequentially. The logic which defines where a waypoint will be positioned is reset on every selection of the NAV SSK. This function is not to be used when the Manual Route is selected.

- AUTO/MAN RTE (Automatic/Manual Route Selection): this MK allows the pilot to choose between Auto or Manual Route to be flown. Steering with respect to each route will commence from PP when that route is engaged. The Auto and Manual routes are mutually exclusive. The Auto Route is the default choice.
- L/L and GREF (Coordinates system Selection): this MK allows waypoints to be defined in either the L/L or GREF positioning system via the DEK and ROLs. By default L/L is selected.
- AUTO WIND (Automatic/Manual Wind Selection): this MK shows the current source of wind data being used and allows the pilot to select between AUTO (system) wind data (speed and direction) and manually input or PDS loaded set wind data (mutually exclusive). The set wind data is used by the system when the pilot selects the MAN wind mode.

  If system data is not available then the last calculated value is used as a constant wind value and the legend (top line) changes from AUTO to CNST, to indicate constant value. When MAN wind is selected, SET WIND is automatically selected.

  The wind symbol is displayed in the PA format T/O and LDG POFs.

- SET WIND: this MK enables to view (on the ROLs) the current manually input or PDS loaded set wind data, which can be overtyped as required. The set wind data will be used by the system when MAN wind mode is selected.
- DEL MAN (Delete Manual Route): the DEL MAN MK on the MDEF allows a previously created Manual Route to be deleted. This is displayed only if either Auto Route or Hold Steering are currently selected. This MK is not presented if there are no waypoints in the Manual Route.

- TRK/DIR (Track/Direct Steering Type Selection): the TRK/DIR MK allows the selection between Track and Direct steering for the route currently selected to be flown. Direct steering is the default selection. Changing destination or route does not affect the TRK/DIR selection.
- NEW TRK (New Track): with Track Steering engaged, by selecting this MK, the system calculates steering information for a new track from PP at the time of control selection, to the DWP. A track line is drawn in white on the PA format from PP to the DWP. A reselection of the control will result in the function being repeated, i.e. a new track is calculated and displayed. The original new track is cancelled.

  This MK is not displayed if the DIR MK is selected.

- STR/HOLD (Steering/Hold Selection): the STR/HOLD MK enables to temporarily suspend the flying of the currently selected route, in order to maintain the actual track. Steering (STR) is the default selection. While HOLD is selected, it is possible to modify the attributes of the DWP and manipulate the route, including the DWP change.

The SWP SSK is used to perform the following functions:

- MARK (Definition of Mark Waypoints): the MARK MK records the aircraft PP, altitude and WP elevation in the L/L positioning system, and the time of the Mark point creation. WP numbers 191-200 inclusive are reserved for Mark waypoints. These waypoints once created can be inserted into the routes and they are stored into the PDS.
- L/L GREF (Coordinates System Selection): this MK allows waypoints to be defined in either the L/L, GREF positioning system via the DEK and ROLs. The system defaults to L/L. This MK is available in NAV SSK too.
- NEW WP (New Waypoint): the NEW WP MK (boxed by default) allows the entry of new waypoints and the editing of waypoints parameters in the L/L or Georef coordinates systems. If the SWP SSK is pressed and the NEW WP MK is boxed, it is possible to create or modify a waypoint using the MDEF or XY controller on the PA format. The sequence is closed by pressing the ENT key on the DEK or via XY insert on the PA format, but the enter procedure must be applied in case the MDE has been used.
- DEL WP (Delete Waypoint): the DEL WP MK allows the deletion of waypoints from the Route Store. Once the DEL WP MK is boxed, two different ways are available for the waypoint deletion:
  - MDEF ROLs, editing the waypoint number
  - PA format, using the XY controller
- WP+BRG (Bearing from a waypoint on the PA format): this MK draws a line from any existing waypoint on the PA format for a specified length along a specified bearing. If no distance is provided, the line will be drawn to infinity. While this mode is selected, the MDEF and the XY marker are configured to enable the selection of the waypoint from which the line will be drawn. The waypoint number typed on MDE or a single XY insert identify the waypoint, after which the bearing (magnetic or true) and length must be entered.
- SET BULL: this MK allows an existing bullseye to be viewed and its position to be changed (in L/L coordinates system only). The bullseye grid can be selected or cancelled using the XY controller marker on the PA format; the initial PDS latitude and longitude can be viewed and edited via the MDEF and the XY controller; it is not possible to steer to a bullseye.
- SET FAOR (Fighter Area of Responsibility): this MK allows the existing values of the FAOR settings to be viewed and/or changed (the position can be expressed in L/L coordinates system only). Initial FAOR values are defined via the PDS but it is possible to amend these after selecting the FAOR MK.
- *Soft.Prog.Ed.: PSC 2.0 onwards*

  EA AUTO/FRZE (Auto/Freeze Emergency Airfield Selection): this MK allows to select between AUTO and FREEZE modes for Emergency Airfield. AUTO is the default mode. There are up to eight emergency airfields, loaded via PDS. The AUTO mode allows the Navigation sub-system to select the nearest airfield to PP as current one. The airfield identifier, range and bearing information are displayed on the RGS.

  ⇐
- *Soft.Prog.Ed.: PSC 2.0 onwards*

  EA SKIP (Skip Emergency Airfield Selection): when AUTO mode is selected the SKIP function allows to skip through the emergency airfields. Skipping through all the emergency airfields then all the airfields will be reconsidered, and the one nearest to the current PP will be displayed.

  ⇐

A further navigation function is provided using the Change Destination key (CHD) on the MDEF: it allows to skip the DWP, selecting the waypoint after the DWP to become the new DWP.

ROUTE TRANSITION

AUTOMATIC ROUTE TRANSITION

The automatic transfer between the two routes can be performed only from the Manual Route to the Auto Route, if all the following conditions are met:

- The Destination Waypoint (DWP) is the last one in the Manual Route and it is common with one waypoint of the Auto Route (JWP)
- The common waypoint has not yet been overflown (when in Auto Route)
- The DWP does not coincide with the last waypoint of the Auto Route.

In the Figure I-03-85 the arrows show the track followed by the aircraft in an automatic route transition.

MANUAL ROUTE TRANSITION

The manual transfer between the two routes can be performed, at any time, by selecting the NAV SSK and then the AUTO/MAN MK on the Left Glareshield.

The Join waypoint (JWP) is the waypoint of the alternative route which is the first not flown and that will be engaged as DWP if the other route is selected.

The Join waypoint is shown, on the PA and WPT list formats, as a number surrounded by a dashed box. If the WPT list format is not selected, the PA format shows the route currently flown and the JWP, if it falls within the format coverage.

STEERING PARAMETERS

The following definitions of the steering parameters must be given:

- Planned Track: this parameter represents the local track direction, referenced to the True North, at aircraft Present Position on the planned route, with respect to which the Along and Across Track distances are determined
- Direct Track: this is the direction, referred to the True North, of the track from the aircraft Present Position to the DWP in the route
- Actual Track: it specifies the direction of aircraft travel with respect to the Earth in the horizontal plane. It coincides to direction of the aircraft groundspeed vector, referenced to the True North
- Track Angle Error: this datum is the angular difference between the track angle the aircraft is commanded to fly and the actual track angle. The datum is positive when the Command Track is greater than the Actual Track
- Command Track: this datum represents the direction, referred to the True North, of the required Groundspeed Vector. Depending on the Steering Mode and Steering Leg Section, the Command Track may coincide with the Planned Track, the Direct Track or, on entering Hold Mode, the Actual Track
- Direct Range: it is measured between the aircraft present position and the DWP in the selected route
- Planned Acquisition Angle: this datum represents the angle with which the aircraft is approaching the Planned track
- Distance To Roll In: this is the distance to go from the predicted start of the turn onto the next leg (Roll In Point) in the Route steering mode to the DWP
- Along Track Distance: this is distance along the Planned Track between the following points:
  - Intersection point of the perpendicular to the planned track from aircraft present position and the planned track
  - Next Waypoint.
- Across Track Distance: it defines the perpendicular distance the aircraft has deviated from the Planned Track in the horizontal plane. The data is positive when the displacement is on the right side of the Planned Track and negative otherwise
- Distance To Go: this parameter represents the distance the aircraft must travel to complete the current leg. According to the type and the mode of steering, it represents:
  - the value of the Along Track Distance from aircraft present position to the end of the leg in Point to Point steering mode
  - the value of the distance from aircraft present position to the Roll In Point (point at which the leg ends) in Route steering mode
  -

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    the direct range from aircraft present position to the CAP Datum waypoint in CAP steering mode

    ⇐
  - the direct range from aircraft present position to the DWP (if available) in Hold steering type
- Time To Go: this datum represents the estimated time required to reach the end of the current leg.

The Figure I-03-86 shows some of the above definitions.

STEERING TYPES

Four Steering types are available:

- DIRECT
- TRACK
- HOLD
- NO-STEER.

According to the steering type selected and the position of the aircraft, each leg of the route is flown following a path made of segments, ruled by three different laws: Straight, Direct and Overfly.

Straight Law: while flying this segment the aircraft is requested to acquire/reacquire the Planned Track (i.e. the Command Track is equal to the Planned Track), following three phases:

- Intercept phase: the aircraft is commanded to acquire and maintain an intercept angle with respect to the Planned Track, as a function of the Across Track Distance. The demanded intercept angle increases with the Across Track Distance (in nautical miles) according to Table I-03-05 .

ACROSS TRACK DISTANCE (NM)	DEMANDED INTERCEPT ANGLE (deg)
from 0 to 1.25	15
from 1.25 to 2.50	25
> 2.50	50

Table I-03-05 Intercepts Angles

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This phase is shown in red in Figure I-03-89 and ends when the aircraft starts running the portion of circle defined by R = 2.5 NM (point A).

⇐

Soft.Prog.Ed.: PSC 2.0 onwards

This phase is shown in red in Figure I-03-89 and ends when the aircraft starts running the portion of circle defined by R = 2.0 NM (point A).

⇐

-

Soft.Prog.Ed.: PSC 1.X

Acquire phase: this phase starts at the end of the Intercept phase (point A) and leads the aircraft to reach the Planned Track, turning with a fixed radius defined by R = 2.5 NM, if possible, otherwise the turning occurs with a fixed radius corresponding to the maximum bank angle (60°). The maximum bank demand depends on the Calibrated Air Speed (CAS) as shown in Table I-03-06 and Figure I-03-87 .

CURRENT POF	KCAS	BANK ANGLE LIMIT (deg)
LDG	-	30
Any other POF	≤ 200	30
	> 200 and ≤ 400	Increasing, from 30 to 60
	> 400	60

Table I-03-06 Maximum Bank Demand

⇐

Soft.Prog.Ed.: PSC 2.0 onwards

Acquire phase: this phase starts at the end of the Intercept phase (point A) and leads the aircraft to reach the Planned Track, turning with a fixed radius defined by R = 2 NM, if possible, otherwise the turning occurs with a fixed radius corresponding to the maximum bank angle (60°). The maximum bank demand depends on the Calibrated Air Speed (CAS) as shown in Figure I-03-88 .

⇐

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At any time the system calculates both the demanded bank angle to turn at a fixed radius defined by R = 2.5 NM and the bank angle limit as functions of the KCAS. If the demanded bank angle is less than or equal to the bank angle limit, the required bank angle to turn is set equal to the demanded bank angle, otherwise it is set equal to the bank angle limit.

⇐

Soft.Prog.Ed.: PSC 2.0 onwards

At any time the system calculates both the demanded bank angle to turn at a fixed radius defined by R = 2 NM and the bank angle limit as functions of the KCAS. If the demanded bank angle is less than or equal to the bank angle limit, the required bank angle to turn is set equal to the demanded bank angle, otherwise it is set equal to the bank angle limit.

⇐

Soft.Prog.Ed.: PSC 1.X

This approach is applicable up to 20 000 ft of altitude. Above 20 000 ft, the required bank angle to effect the turn always coincides to the bank angle limit and the turn occurs at a fixed radius which depends on the KCAS (i.e. the R = 2.5 NM turn radius is not mandatory).

⇐

Soft.Prog.Ed.: PSC 2.0 onwards

This approach is applicable up to 15 000 ft of altitude. Above 15 000 ft, the required bank angle to effect the turn always coincides to the bank angle limit and the turn occurs at a fixed radius which depends on the KCAS (i.e. the R = 2 NM turn radius is not mandatory).

⇐

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This phase is shown in green in Figure I-03-89 and ends when the aircraft finishes running the portion of circle defined by R = 2.5 NM (point B).

⇐

Soft.Prog.Ed.: PSC 2.0 onwards

This phase is shown in green in Figure I-03-89 and ends when the aircraft finishes running the portion of circle defined by R = 2 NM (point B).

⇐

- Capture phase: this phase starts on completion of the Acquire phase (i.e. when the aircraft is on the Planned Track, point B) and allows to maintain the aircraft on the Planned Track. This track is shown with a solid blue in Figure I-03-89 .

NOTE

According to the aircraft position, velocity and attitudes one of the above phases (or more) can be skipped.

Direct Law: while flying this segment the aircraft is requested to reach the DWP directly from the PP (i.e. the Command Track is equal to the Direct Track).

Overfly: while flying this segment the aircraft is requested to maintain the last calculated Direct Track, which will not be longer updated (i.e. the Command Track is equal to the last Direct Track).

DIRECT STEERING TYPE

Direct Steering is selected by default (if a DWP is available) when Weight off Wheels is detected. It can also be selected manually by pressing the NAV SSK and then the TRK DIR MK on the MDEF. In both cases the caption DIR becomes boxed.

In Direct Steering the aircraft is steered to reach directly the DWP, i.e. the Command Track is set equal to the Direct Track, from the PP to the DWP (refer to Figure I-03-90).

NOTE

The steering bug always represents a heading demand.

The direct track from the PP to the DWP is continuously updated while the leg is being flown (as shown in Figure I-03-90 with red dashed lines) and it is drawn in white on the PA format.

NOTE

Soft.Prog.Ed.: PSC 1.X

In Direct Steering the DWP is always considered an Overfly waypoint.⇐

NOTE

Soft.Prog.Ed.: PSC 2.0 onwards

In Direct Steering the DWP is always considered an Overfly waypoint, apart from the CAP waypoint which is treated as a Route waypoint at the first acquisition.⇐

The flight pattern is composed of two segments:

- Direct: this is the first segment of the leg (from PP to point A) and finishes when the Direct Range is equal to 2 NM (i.e. when the aircraft enters the circle of two nautical miles centred on the DWP).
- Overfly: it is initiated when the Direct Range is equal to 2 NM and finishes when the current leg is over (from point A to point B).

The current leg is over when the Direct Range is less or equal to 2 NM (i.e. the aircraft is inside the two-nautical-mile circle around the DWP) and increasing: i.e, once entered inside the circle, the change leg occurs when the Direct Track reaches the minimum value before increasing (abeam).

If the aircraft follows the Direct Track the change leg occurs when the aircraft reaches the DWP (point B coincides with the DWP); following a different trajectory, the change leg occurs when the aircraft is abeam with respect to the DWP (refer to Figure I-03-91 , point B).

In any case, the mandatory condition for the automatic change leg is to enter inside the two-nautical-mile circle, otherwise it never occurs unless the manual change is performed (using the CHD key on the LGS). In case of manual DWP change, a new track is calculated from the PP to the new DWP and the aircraft is steered to reach directly the new DWP.

NOTE

If a manual fix procedure (OTF) is in progress, the change leg is not provided: the steering information is still referred to the last DWP in order to allow the fix completion, as appropriate.

TRACK STEERING TYPE

Track Steering is selected manually by pressing the NAV SSK and then the TRK DIR MK on the MDEF. On selection, the caption TRK becomes boxed. In Track Steering the aircraft is steered to maintain/acquire the Planned Track, i.e. the Command Track is set equal to the Planned Track.

NOTE

The steering bug always represents a bank demand.

Soft.Prog.Ed.: PSC 1.X

Track Steering has two modes: Route and Point to Point.
⇐

Soft.Prog.Ed.: PSC 2.0 onwards

Track Steering has four modes: Route, Point to Point, CAP and CAP Acquire.
⇐

Soft.Prog.Ed.: PSC 1.X

Based on the DWP type, the steering mode is automatically determined according to Table I-03-07 .

WAYPOINT TYPE	STEERING MODE
Route	Route
Overfly	Point To Point
Landing	Point To Point
Mark	Point To Point

Table I-03-07 Steering Modes

⇐

Soft.Prog.Ed.: PSC 2.0 onwards

Based on the DWP type, the steering mode is automatically determined according to Table I-03-08 .

WAYPOINT TYPE	STEERING MODE
Route	Route
Overfly	Point To Point
Landing	Point To Point
Mark	Point To Point
CAP	Acquire or CAP (*)
(*) CAP Acquire mode at the first acquisition, CAP mode at the successive acquisitions.	

Table I-03-08 Steering Modes

⇐

Soft.Prog.Ed.: PSC 1.X

If the DWP is the last waypoint of the route the steering mode is set to Point To Point (the last WP is always considered as Overfly).

⇐

Soft.Prog.Ed.: PSC 2.0 onwards

If the DWP is the last waypoint of the route the steering mode is set to Point To Point (the last WP is always considered as Overfly) except for the CAP waypoint.

⇐

On selection of Track Steering, only the Planned Track is shown on the PA format, and the current leg is drawn in white.

The segment composition of the flight pattern is described, for each steering mode, in the following paragraphs.

Route Steering Mode

Route steering information is provided so that a smooth transition from the current leg to the next leg is achieved without overflying the DWP (see Figure I-03-92). The point at which the transition is performed is named the Roll In Point (RIP) and it is the point to which the Time To Go and Distance To Go are calculated.

Figure I-03-92 , Figure I-03-93 and Figure I-03-94 show the sequence of segments which compose the flight pattern to follow from the PP onwards.

Two cases must be distinguished, according to whether the PP lies inside or outside the cone of 100° around the Planned Track, with vertex coincident to the DWP.

Soft.Prog.Ed.: PSC 1.X

PP inside the cone: The flight pattern is composed of a single straight segment: the aircraft is steered to acquire the Planned Track following the relevant phases (intercept, acquire and capture), as shown in Figure I-03-92 . On reaching the Planned Track, the aircraft is steered towards the Roll In Point (RIP). The calculation of the RIP takes into account the position of the NNWP (i.e. the next Planned Track), the Actual Track (the RIP is always calculated on the Actual Track) and the fixed turn radius defined by R = 2.5 NM. The turn is performed following the same laws as for the acquire phase of the straight segment (taking into account the CAS, the altitude and the bank angle limit). Another condition to be respected regards the distance between the DWP and the calculated RIP, which must be in the range 1÷7 NM; if the above distance is outside this range, the RIP is placed as follows:

- If this distance is greater than 7 NM, it is set to 7 NM
- If this distance is lesser than 1 NM, it is set to 1 NM.

The current leg is over when the Direct Range is less than or equal to the Distance To Roll In, i.e. when the aircraft reaches the RIP. The calculated flight pattern to run is drawn in solid red in Figure I-03-92 . If the aircraft follows the planned track the change leg occurs when the aircraft reaches the theoretical RIP; following a different trajectory (i.e. the actual track is different from the planned track), the system calculates an alternative RIP and the change leg occurs when the aircraft reaches it (see Figure I-03-93).

⇐

Soft.Prog.Ed.: PSC 2.0 onwards

PP inside the cone: The flight pattern is composed of a single straight segment: the aircraft is steered to acquire the Planned Track following the relevant phases (intercept, acquire and capture), as shown in Figure I-03-92 . On reaching the Planned Track, the aircraft is steered towards the Roll In Point (RIP). The calculation of the RIP takes into account the position of the NNWP (i.e. the next Planned Track), the Actual Track (the RIP is always calculated on the Actual Track) and the fixed turn radius defined by R = 2 NM. The turn is performed following the same laws as for the acquire phase of the straight segment (taking into account the CAS, the altitude and the bank angle limit). Another condition to be respected regards the distance between the DWP and the calculated RIP, which must be in the range 1÷7 NM; if the above distance is outside this range, the RIP is placed as follows:

- If this distance is greater than 7 NM, it is set to 7 NM
- If this distance is lesser than 1 NM, it is set to 1 NM.

The current leg is over when the Direct Range is less than or equal to the Distance To Roll In, i.e. when the aircraft reaches the RIP. The calculated flight pattern to run is drawn in solid red in Figure I-03-92 . If the aircraft follows the planned track the change leg occurs when the aircraft reaches the theoretical RIP; following a different trajectory (i.e. the actual track is different from the planned track), the system calculates an alternative RIP and the change leg occurs when the aircraft reaches it (see Figure I-03-93).

⇐

PP outside the cone: The flight pattern is composed of a single direct segment: the aircraft is steered directly from the PP to the RIP, which is calculated on the Direct Track. The change leg follows the same moding of the previous case. The calculated flight pattern to run is drawn in red in Figure I-03-94 .

In both cases (PP inside and outside the cone), if a manual DWP change is performed using theCHD key on the LGS, the aircraft is steered to reach the next leg in the route, following the Track Steering laws.

Pointto Point Steering Mode

Steering information is provided so that the aircraft is steered to overfly the DWP (see Figure I-03-95).

Figure I-03-95 and Figure I-03-96 show the sequence of segments which compose the flight pattern from the PP onwards.

As for the Route Steering mode, two cases must be distinguished, according to whether the PP lies inside or outside the cone previously defined.

PP inside the cone: The flight pattern is composed of three segments:

- Straight: this is the first segment of the leg; the aircraft is steered to acquire the Planned Track following the relevant phases (intercept, acquire and capture), as shown in Figure I-03-95 . It ends when the Direct Range becomes equal to 5 NM
- Direct: this is the second segment of the leg and starts when the Direct Range is equal to 5 NM. The aircraft is steered to reach directly the DWP, as shown in Figure I-03-95 . It ends when the Direct Range becomes equal to 2 NM. In this case the steering bug always represents a bank demand even if the Direct segment is engaged because the steering bug demand depends on the steering type and not on the segment type
- Overfly: this is the last segment of the leg and starts when the Direct Range is equal to 2 NM. The aircraft is steered to maintain the last calculated Direct Track, which will not be longer updated, as shown in Figure I-03-95 . It ends when the change leg occurs.

The mandatory condition for the automatic change leg is to enter inside the two-nautical-mile-circle, otherwise it never occurs unless the manual change is performed (using the CHD key on the MDEF). In case of manual DWP change, a new track is calculated (and drawn in white on the PA format) from the PP to the new DWP and the aircraft is steered to reach directly the new DWP.

PP outside the cone: The flight pattern is composed of two segments:

- Direct: this is the first segment of the leg; the aircraft is steered directly from the PP to the DWP, as shown in Figure I-03-96 . It ends when the Direct Rane becomes equal to 2 NM
- Overfly: this is the last segment of the leg and starts when the Direct Range is equal to 2 NM. The aircraft is steered to maintain the last calculated Direct Track, which will not be longer updated, as shown in Figure I-03-96 . It ends when the change leg occurs.

The change leg law is the same as for the previous case (PP inside the cone). The calculated flight pattern to run is drawn in red in Figure I-03-96 .

NOTE

If a fix procedure is in progress, the change leg is not provided: the steering information is still referred to the last DWP in order to allow the fixing completion, as appropriate.

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Combat Air Patrol (CAP) Steering

The navigation system provides steering cues to acquire and maintain position on a pre-defined CAP pattern (see Figure I-03-97). At all times, the PA format waypoint data block shows range and bearing to CAP datum. The HUD shows range and bearing to CAP datum in CAP Acquire Mode; in CAP Mode only the CAP Datum number is shown. The PA format displays the CAP pattern, the CAP datum and the planned CAP speed in knots.

When approaching a DWP that has been defined as a CAP, the system provides two different phases of navigation steering: CAP Acquire and CAP.

CAP Acquire: a CAP waypoint is treated initially as a Route waypoint, therefore the navigation system uses the Route Steering rules: the CAP datum (refer to Figure I-03-97) is not overflown at the first acquisition. The system computes the RIP according to the Hot Leg orientation, the Actual Track (the RIP is always calculated on the Actual Track) and the fixed turn radius of 2 NM. After reaching the RIP, the system changes from CAP Acquire to CAP steering and the PA format shows the CAP pattern (enlarged to replace the whole route), sized as defined by CAP attributes. The Hot Leg is colored in bright white.

CAP: this provides steering cues to capture and maintain the planned CAP pattern, using capture laws similar to those used in Track steering. The Hot Leg is always fixed. At the end of it, the system will give a fly left or right command to carry out a left or right hand pattern as specified. To calculate the bank angle demand necessary to perform the In Turn, the system takes into account groundspeed and wind. To allow flexibility in the way the CAP pattern is flown, during the In Turn the navigation system continuously adjusts the size of the CAP in response to how the aircraft is manoeuvred. Once the

Reference Point (Figure I-03-97) has been reached, the original CAP is replaced (and redrawn on the PA format) by the corrected one. On In Turn completion the aircraft is led to fly the Cold Leg in the same manner as for the Hot Leg. After that, the Out Turn starts. On reaching the first half of the Out Turn the system verifies if it is possible to reach the CAP datum (and successively the Hot Leg) following the current curve. In case no overshoot is predicted, the system continues flying the calculated turn; differently, if the Out Turn has not been flown as it was calculated (due to pilot or environment changes), the system leads the aircraft to fly a Direct segment to the CAP datum (Figure I-03-98); also in this case the steering bug represents a bank demand. Note that the CAP pattern is not redrawn on the PA format (i.e. the Direct segment is not displayed). Each time the aircraft reaches the end of the Hot Leg, all the calculations restart.

Off CAP: the aircraft is defined to be Off CAP" when flying outside a rectangular area, sized 3 by 2 hot legs, as shown in Figure I-03-99. If a short Hot Leg (< CAP diameter) has been planned at altitudes over 35000 feet, this area is resized to 9 by 6 CAP diameters. If the aircraft is Off CAP, CAP Steering is disengaged and the system reverts to CAP Acquire Steering to re-position the aircraft back onto the Hot Leg. The re-acquisition of the Hot Leg occurs in the same manner as for the first CAP datum acquisition (see path 1 in Figure I-03-99). The only exception to this condition is when the aircraft lies within a narrow cone extending from the CAP datum symmetrically about the hot leg and wide two times the CAP acquisition angle (β) defined in Figure I-03-97 . Within this cone, direct steering to the CAP datum is provided. On approaching the CAP datum, the system will continue to steer to overhead the CAP datum and will then fly a teardrop turn back onto the Hot Leg (see path 2 in Figure I-03-99). If the aircraft moves from inside to outside the cone and vice versa, then the steering cues will change according to the appropriate law. To exit the CAP and fly the remaining of the route, the Change Destination key (CHD) on the LHGS must be pressed: the destination waypoint becomes the one after the CAP waypoint in the route currently flown.

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HOLD STEERING TYPE

In Hold Steering the aircraft maintains the actual track being followed at the point of engagement of the type.

Hold Steering is selected:
- Automatically at take-off (weight off wheels transition) if both the Auto and Manual routes do not contain any waypoint
- Manually at any time by selecting the MDEF STR/HOLD MK.

On the Left Glareshield, the DWP ROL shows HOLD and the NNWP ROL shows the DWP number. If there are no waypoints after the DWP, the NNWP ROL shows dashes.

If HOLD is deselected, the system reverts to the previously engaged steering type and Planned Track.

In Hold Steering the aircraft flies a straight pattern until:
- the HOLD MK is pressed again, or
- a different steering type is selected (via the TRK/DIR MK), or
- the DWP is changed (by pressing the CHD control on the MDEF), or
- another route is selected (via the AUTO/MAN MK), or
- the route is reversed (via the CHNG DIR MK), or
- the CHD XXX MK (previous WP) is pressed.

Note that selecting the HOLD steering type it is allowed to modify the DWP attributes and also to add waypoints before the DWP, which cannot be performed with the STR MK selected.

NO-STEER TYPE

When the aircraft is on ground the type is set to No-Steer: the steering calculations are not performed, but the information on the displays are not affected.

CLOSE NAVIGATION

The close navigation phase enters when the Time To Go to the DWP is equal to 65 seconds.

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The DWP type must not be CAP.

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The following information is displayed on the HUD and HDHUD format (refer to Figure I-03-101):
- Time To Go circle, centred on the aircraft symbol, displayed from 65 seconds and counting down from 60 seconds
- DWP marker, indicating the computed ground stabilized DWP position
- Indication of the next planned track and the direction to turn to achieve it, left or right of heading ribbon depending on whether the turn is left or right of the current Planned Track.

The close navigation symbology disappears when:
- the aircraft is further than 65 seconds from the DWP
- *Soft.Prog.Ed.: PSC 2.0 onwards*

  the aircraft is on CAP

  ⇐
- the aircraft climbs above 11 000 feet
- achieving the DWP
- Tacan mode is selected on the HSI format.

STEERING BUG

The steering commands to acquire and hold the track are calculated and displayed as a steering bug against the aircraft heading ribbon (refer to Figure I-03-100).

A lubber line indicates the current aircraft heading: it is fixed, whereas the heading ribbon (scale plus numbers) moves with respect to it (the displayed heading value is numbered by decades). The track marker (upside down v”) is moving and indicates the actual track, which can not coincide with the heading, due to the wind effect: in absence of wind the two symbols are superimposed, forming an upward arrow.

When the steering bug reaches the lubber line it means that the aircraft is on the Command Track; if it reaches the limits of the ribbon, it rotates 90 degrees (clockwise at the right hand corner, counter clockwise at the left one) pointing outside the ribbon.

The above indication are presented both on the HUD and on the HDHUD format.

CONTROLS AND INDICATORS

The navigation displays present the selected type of information necessary to steer the aircraft. The information is shown on the following displays:
- Head Up Display (HUD)
- Pilot Awareness format (PA)
- Horizontal Situation Indicator format (HSI)
- Waypoint format (WPT)
- Head Down Head Up Display format (HDHUD).

HEAD UP DISPLAY (HUD)

The Head Up Display, see Figure I-03-101 , provides the pilot with steering information.

At the centre of the screen, a climb/dive ladder indicates the current aircraft climb/dive angle and bank by tapered ladder with variable gearing.

A triangular pointer against a fixed scale provides an indication of the aircraft vertical velocity. (Only in GND, T/O and LDG PoF).

The barometric altitude is shown both in analogue and digital form, whereas the aircraft height above terrain is indicated in digital form, labelled with a letter R” above the string.

The steering bug, indicating the required steering to follow the navigation demands, is indicated by a horseshoe symbol against a heading ribbon scale; on the same scale also the track marker is represented, which shows the aircraft actual track.

A waypoint data block shows the information relative to the DWP, i.e. number, range, bearing and time to go. If the TACAN mode has been selected on the HSI format, the DWP data are replaced by the TACAN ones, i.e. TACAN channel number and type, TACAN mode (either A/A or A/S), bearing and range.

An indication of the time early or late to the next waypoint that has been assigned a time of arrival is also provided. The system calculates the demanded groundspeed necessary to recover (compensate) the delay (anticipation).

This display also provides a digital indication of the groundspeed, mutually exclusive with MACH number, the airspeed, the heading (either true or magnetic) and the barometric pressure setting (Shown by default in GND, T/O and LDG PoF and for 5 seconds, when value of setting changed in NAV AA and AS PoF).

In Close Navigation phase (i.e. when it takes 65 seconds to arrive at the DWP), the HDHUD formats shows in addition the following symbols:
- the countdown circle, which indicates the time remaining at the DWP reaching
- the direction of turn to next waypoint, indicating the direction of the next leg in the route
- the DWP marker, which gives the position of the DWP.

In case of Low Height warning generation, the display shows a flashing arrow, at the centre of the screen, which rotates in order to point always away from the ground. At the bottom of the arrow, a fix LOW HT legend is presented.

When the LINS / best NAV cross monitor function is not available anymore, the string NO MONITOR appears to warn the pilot.

Both during the LINS ground and in flight alignments, the display shows the relevant parameters, i.e.:
- the accuracy
- the remaining time at the end of the alignment
- the caption LINS RDY at the end of the alignment, replacing the two captions above.

Selecting the appropriate keys on the Head Up Panel (HUP) it is also possible to:
- select between the visualization of the Barometric altitude, the RADALT height or both, via the BARO/RAD key
- select between the visualization of the groundspeed or MACH number, via the GS/M key.

PILOT AWARENESS FORMAT (PA)

The Pilot Awareness (PA) format, see Figure I-03-102 , is presented by default on the centre MHDD.

The main information is about the routes. The route currently flown is normally presented: the current leg is colored in white, the remainder of the route in green. If the WPT list format has been selected on the right MHDD, the PA format shows both the auto and manual routes (provided that they have been loaded). All the waypoints (join waypoint included) and legs lying within the format coverage are presented.

Soft.Prog.Ed.: PSC 1.X

Each waypoint is represented as a number against a cross; for Mark and Landing waypoints the type is also shown (M" for Mark, L" for Landing). The DWP is highlighted through a contrast-inverted visualization. The JWP is indicated by a dashed box around its number.
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Soft.Prog.Ed.: PSC 2.0 onwards

Each waypoint is represented as a number against a cross; for CAP, Mark and Landing waypoints the type is also shown (C" for CAP, M" for Mark, L" for Landing). A CAP waypoint is shown as a cross plus a fixed sized CAP symbol. The DWP is highlighted through a contrast-inverted visualization. The JWP is indicated by a dashed box around its number.
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Dragging the XY marker on any waypoint and making an XY insert causes the waypoint extra data box to be visualized.

The aircraft symbol is indicated as a green triangle: its position on the screen depends upon the track-up or north-up selection made by the TRK NTH SK. Dragging the XY marker on the triangle and clicking once allows the visualization of the aircraft present position within a box.

A waypoint data block shows the information relative to the DWP, that is number, range, bearing and time to go.

The PA format shows in digital form the aircraft heading, which is magnetic as default or true on demand, using the MAG TRUE SK (in this case a letter T precedes the number), the CAS, the groundspeed (on demand, clicking on the CAS indication or selecting the demanded groundspeed to be visualized), the altitude and TACAN range and bearing (if available).

The UTC time is displayed as a digital string preceded by the letter U", to distinguish it from the mission time (preceded by the letter M"), which can be accessed clicking on the time string.

An indication of the time early or late to the next waypoint that has been assigned an arrival time is also provided: a legend describes the early/late portion, a marker and an infill describe the amount. The scale is ±60 seconds. Time in excess of ±60 seconds is indicated by marker rotation and park at the end of the scale. The system calculates the demanded groundspeed necessary to recover (compensate) the delay (anticipation) and displays the datum, on demand, clicking on the time early/late symbol.

In Ground, Take-off and Landing POFs an indication of the wind parameters is provided: digital readout for speed and arrow for direction.

Selecting the appropriate SK it is also possible to:

- superimpose the compass rose (120° or 360°), via the COMP SK
- superimpose the map or tactical symbology, via the MAP/TAC SK
- visualize the climb/dive ball, via the C/D BALL SK
- perform a fixing procedure, via the FIX SK.

HORIZONTAL SITUATION INDICATOR FORMAT (HSI)

The Horizontal Situation Indicator (HSI) format is selectable from the PA format using the HSI SK (see Figure I-03-103); it replaces the PA format.

Either Navigation or TACAN data can be shown, by pressing the NAV TAC SK (this SK is presented only if the HSI SK is boxed): the former refer to the route currently flown, the latter refer to the selected TACAN station.

A 360° compass card is displayed by default; the aircraft symbol is always shown at the centre of the display and the compass card rotates around it.

On the periphery of the compass card, the following symbols are shown:

- a lubber line, indicating the aircraft heading
- the track pointer, indicating the aircraft actual track
- the autopilot heading marker
- the bearing pointer, whose tail indicates the bearing of the DWP (or TACAN station).

Inside the compass card, the following symbols are presented:

- the course pointer, which is an arrow pointing at the manually course set
- the lateral deviation bar, indicating the angular deviation between the set course and the actual bearing
- the TO/FROM flag, which indicates whether the aircraft is flying towards or away from the DWP or TACAN station.

This display also provides a digital indication of:

- CAS
- altitude
- groundspeed, on demand, clicking on the CAS indication
- heading (only true" in TAC configuration)
- range, w.r.t. the DWP or TACAN station
- bearing, w.r.t. the DWP or TACAN station
- DWP number (in NAV configuration)

- TACAN mode (A/A, A/S) and channel (in TAC configuration)
- course, set via the right hand MHDD rotary control.

Selecting the appropriate SKs it is also possible to:
- visualize the climb/dive ball, via the C/D BALL SK
- go through the NAV and TAC configuration, via the NAV/TAC SK.

WAYPOINT LIST FORMAT

The Waypoint List format (refer to Figure I-03-104) is selected manually using the WPT SK or automatically whenever the NAV SSK is pressed.

Soft.Prog.Ed.: PSC 1.X

This format gives a list of the waypoints with details of number, type, identifier, description and, if defined, planned time of arrival. An XY insert anywhere on the waypoint data line opens an expanded information box with additional information of latitude and longitude, range and bearing, waypoint altitude, planned aircraft altitude (if defined).

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Soft.Prog.Ed.: PSC 2.0 onwards

This format gives a list of the waypoints with details of number, type, identifier, description and, if defined, planned time of arrival. An XY insert anywhere on the waypoint data line opens an expanded information box with additional information of latitude and longitude, range and bearing, waypoint altitude, planned aircraft altitude (if defined) and CAP parameters (pattern orientation, speed, direction, length) for CAP waypoints.

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The list can be scrolled up or down by clicking on the relevant symbols on the top of the display.

The Waypoint format also displays the waypoints in the Auto and Manual routes. These show the route waypoints in order.

Both in the list and within the routes ROLs, the JWP is highlighted with a dashed outline and the DWP is highlighted contrast inverted; the DWP is normally placed in the first position of the active route ROL. As the aircraft overflies a waypoint, the ROL list moves to the left, so that the DWP is always at the beginning of the line. If required, the waypoints out of view can be visualized using the XY marker on the scroll arrows.

Selecting the appropriate SK it is also possible to:
- visualize the whole waypoints list, or the Auto Route waypoints list, or the Manual Route waypoints list via the WPT LIST, AUTO RTE and MAN RTE SKs, respectively
- visualize the waypoints of a certain type only, via the TYPE ALL SK.

HEAD DOWN HEAD UP DISPLAY FORMAT (HDHUD)

The HDHUD format (see Figure I-03-105) provides a repetition of the steering information presented on the HUD. In addition to the HUD symbology, the HDHUD adds the climb/dive ball.

Selecting the appropriate SKs it is also possible to:
- select between the visualization of the Barometric altitude, the RADALT height or both, via the BARO/RAD SK
- select between the visualization of the groundspeed or MACH number, via the GS/M SK
- select the source (LINS or FCS) for the data to be visualized on the HUD and HDHUD format, in case of monitor trip, via the SRCE SPLT SK.

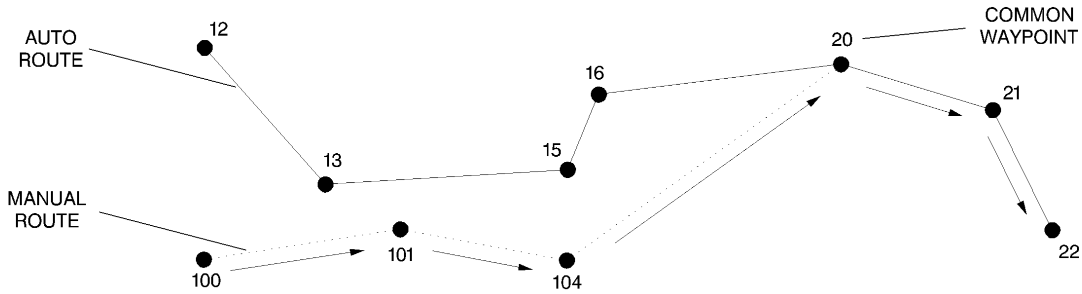

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Figure I-03-85 Automatic Route Transition

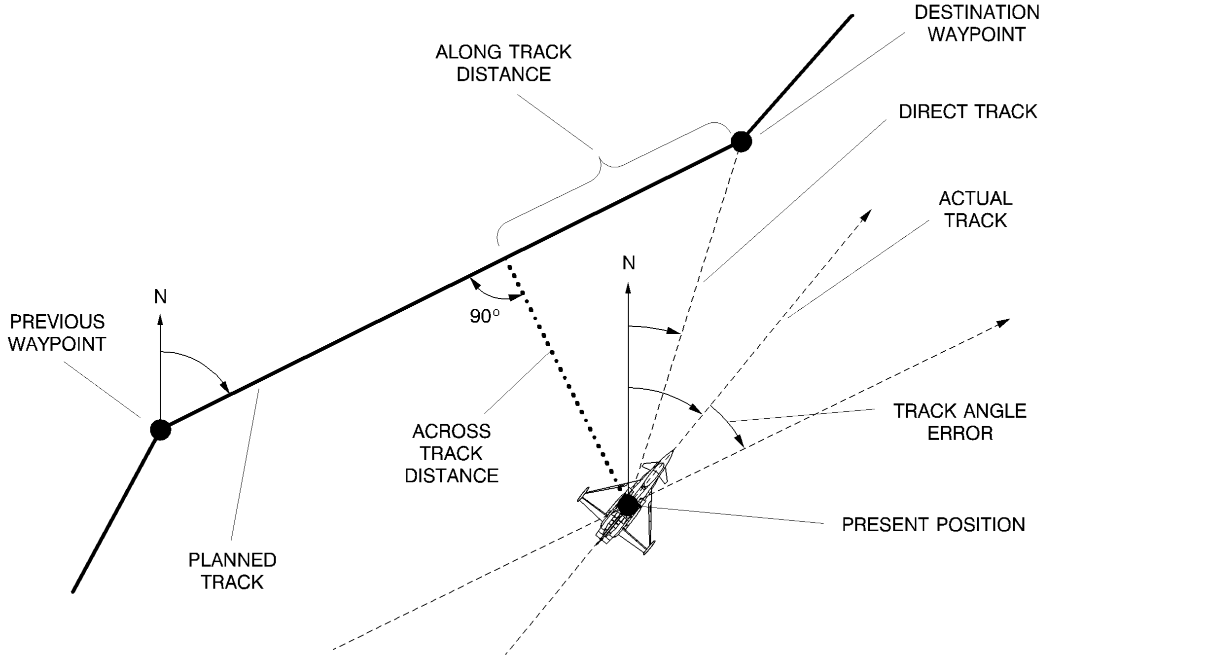
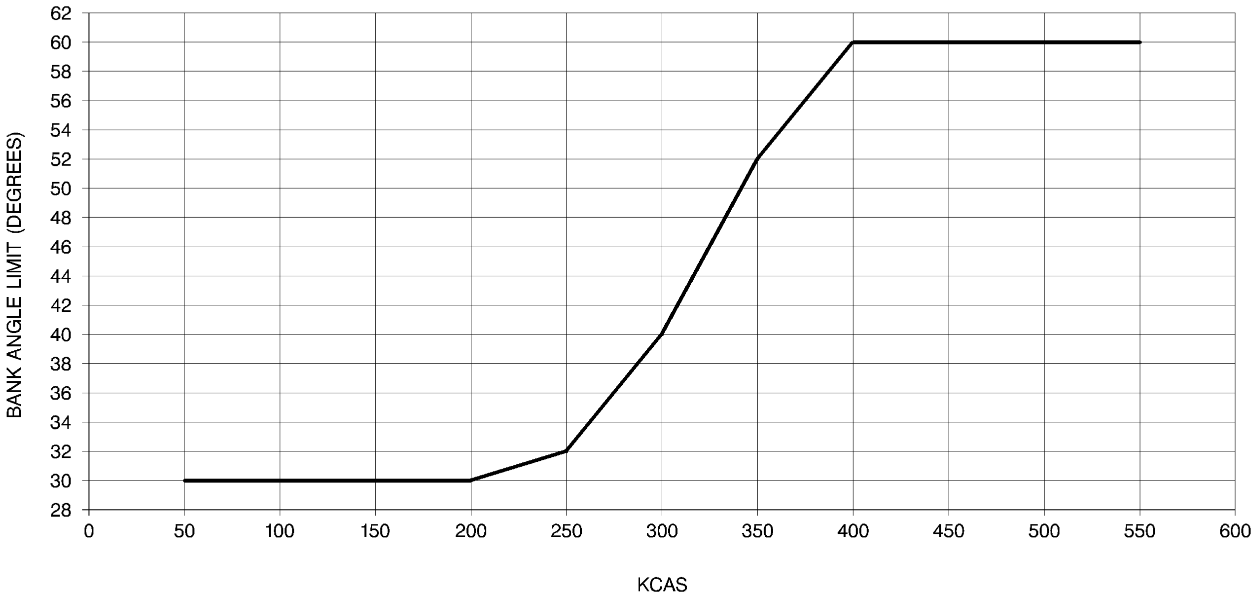


Figure I-03-86 Steering Parameters

Soft.Prog.Ed.: PSC 1.X



ICN-1B-B-346200-A-A0019-06725-A-01-2

Figure I-03-87 Bank Angle Limit

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Soft.Prog.Ed.: PSC 2.0 onwards

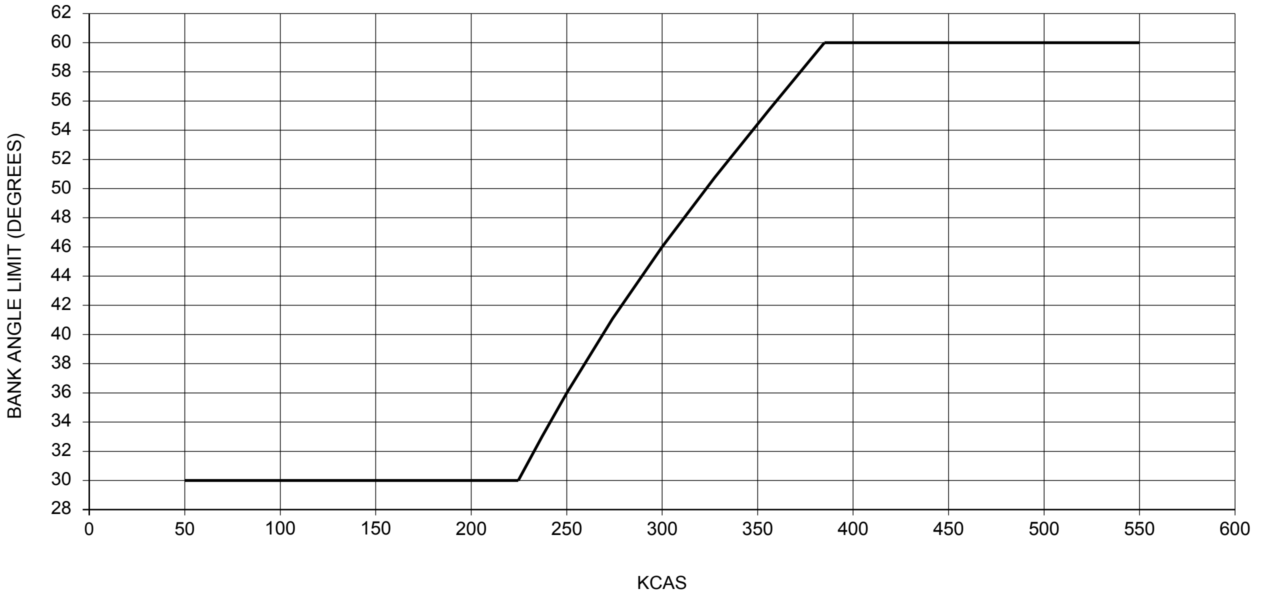
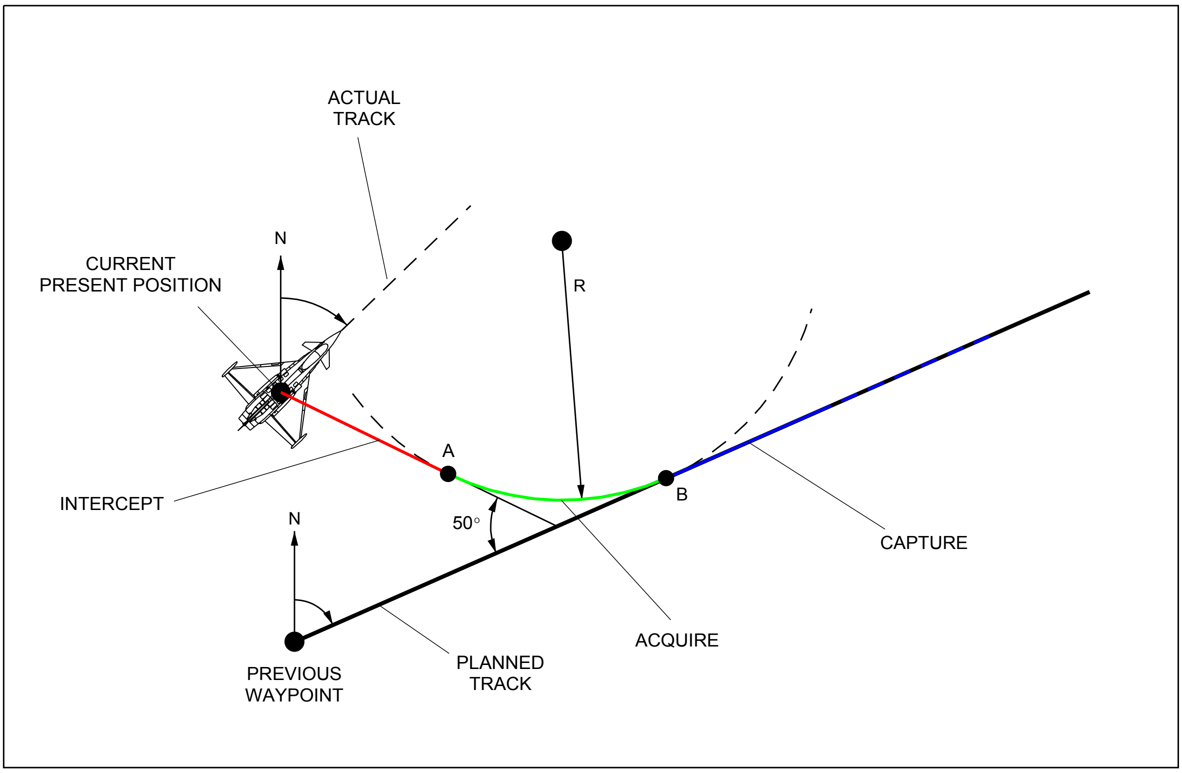


Figure I-03-88 Bank Angle Limit

⇐



ICN-1B-B-346200-A-A0019-06726-A-02-2

Figure I-03-89 Straight Law

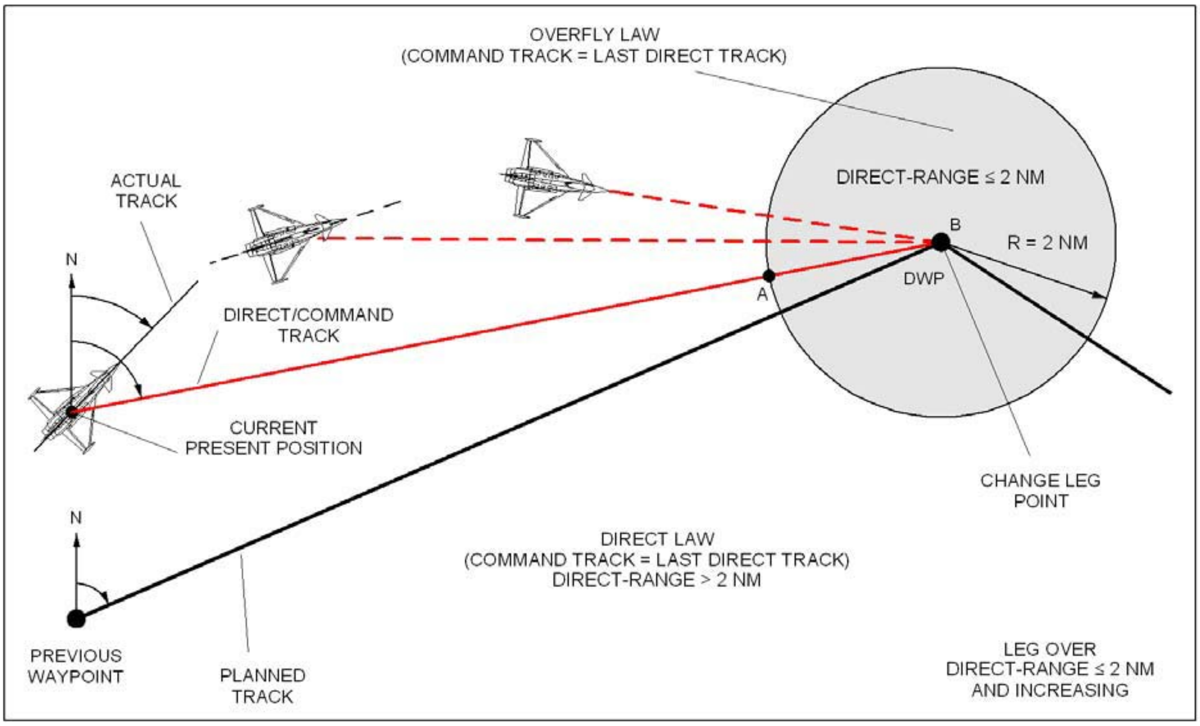


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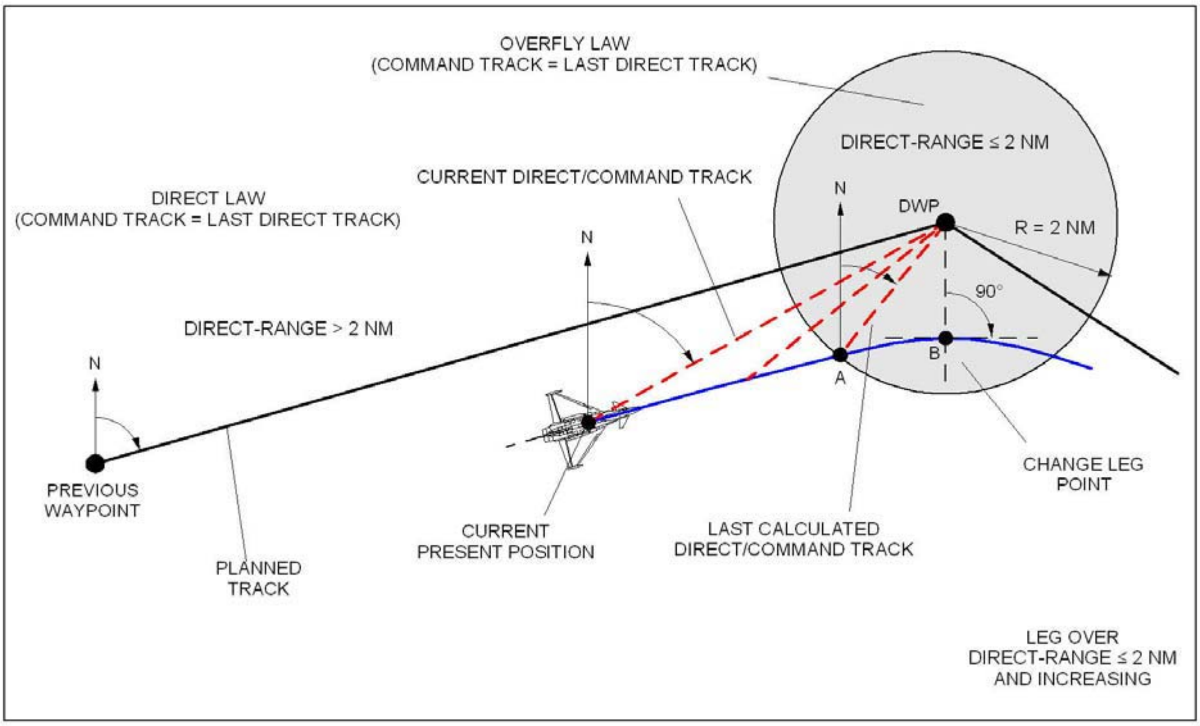
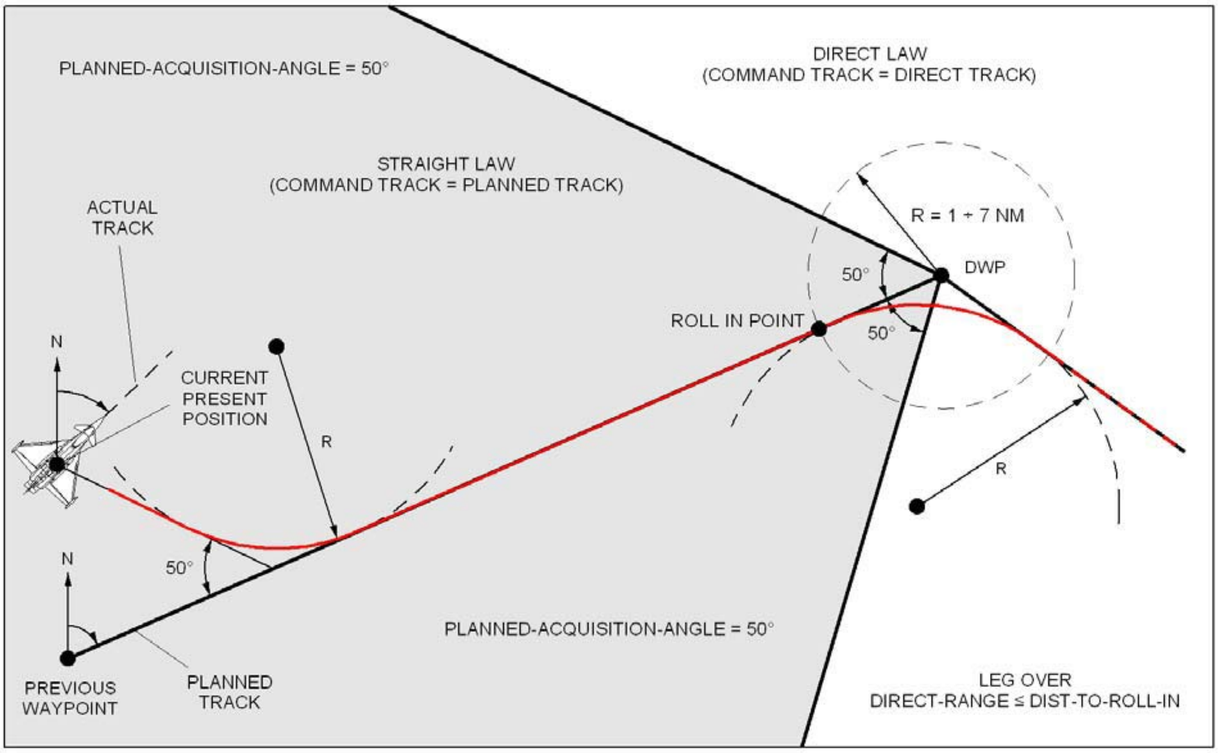
Figure I-03-90 Direct Steering (Overflying DWP)



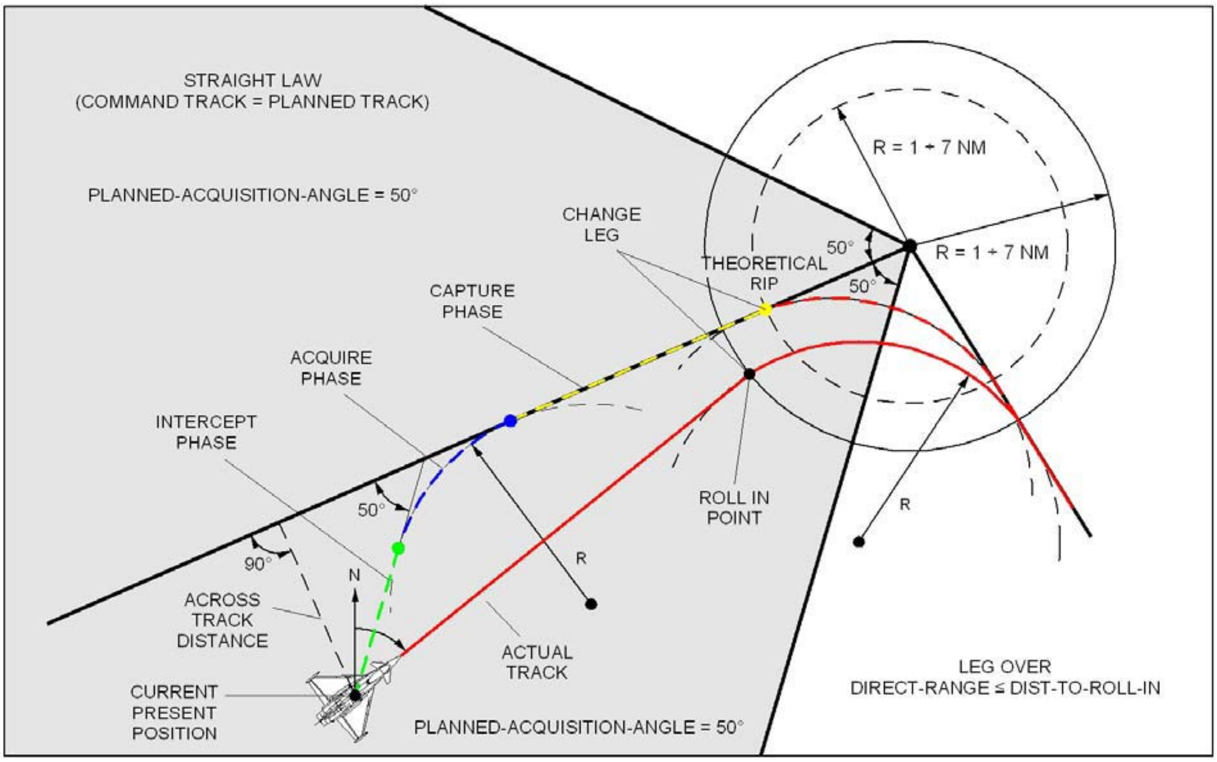
ICN-1B-B-346200-A-A0019-06728-A-02-2

Figure I-03-91 Direct Steering (Abeam DWP)



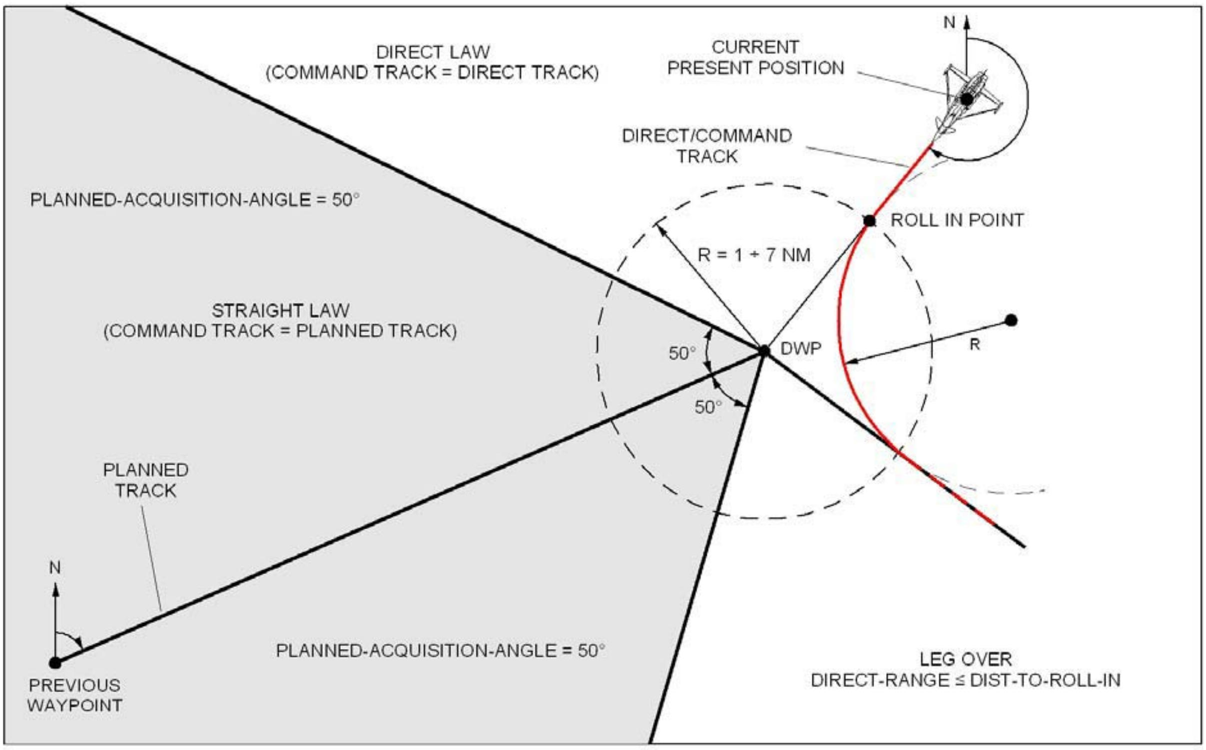
ICN-1B-B-346200-A-A0019-06729-A-02-2

Figure I-03-92 Route Steering on Planned Track (Inside Cone)



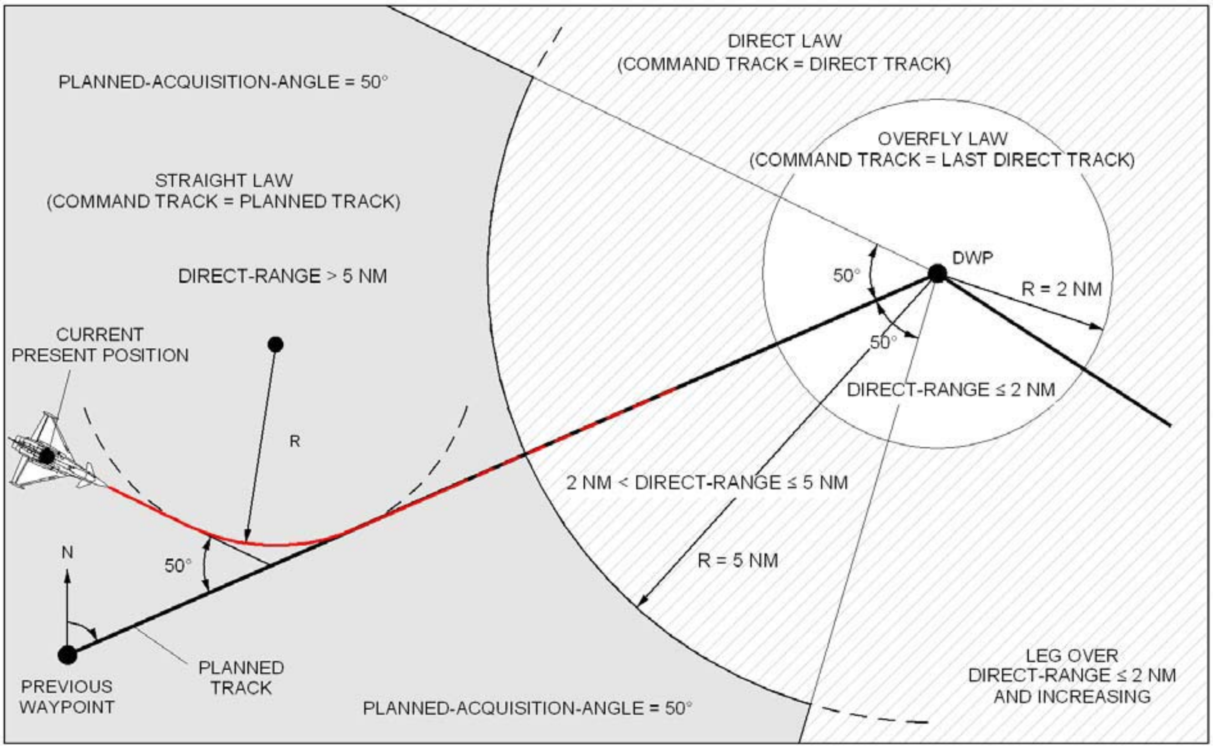
ICN-1B-B-346200-A-A0019-06730-A-02-2

Figure I-03-93 Route Steering off Planned Track (Inside Cone)



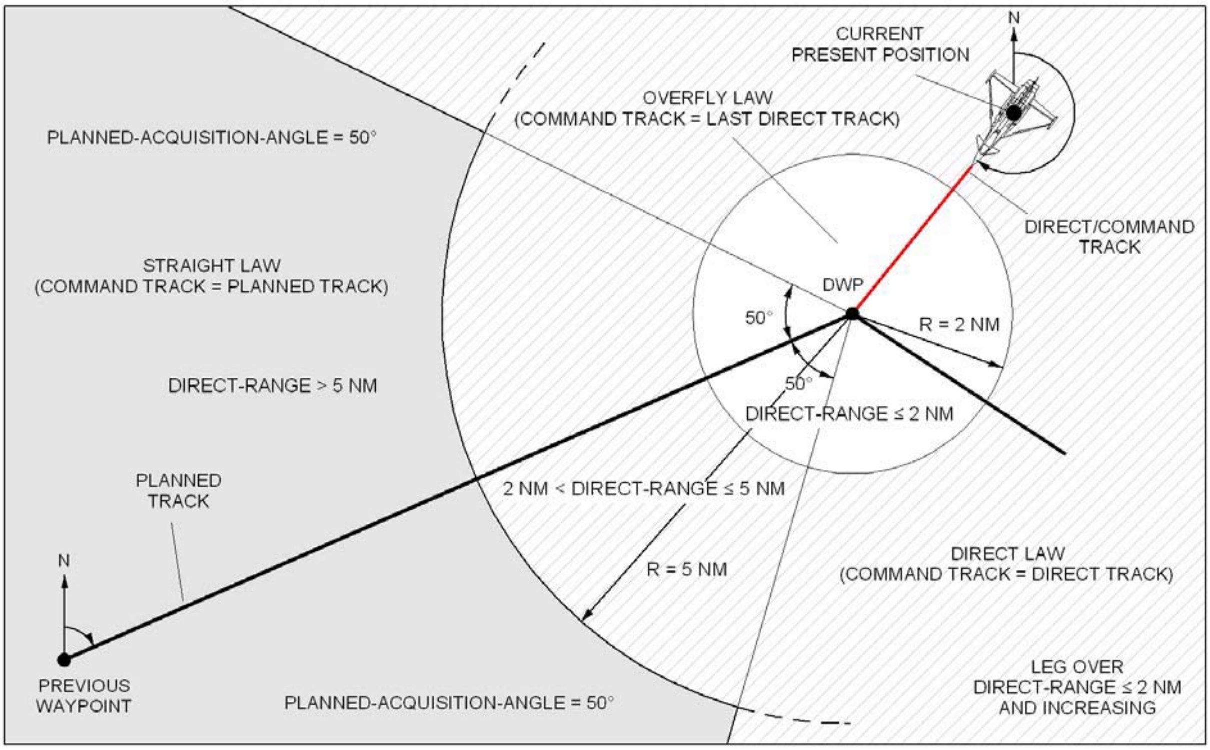
ICN-1B-B-346200-A-A0019-06731-A-02-2

Figure I-03-94 Route Steering (Outside Cone)



ICN-1B-B-346200-A-A0019-06732-A-02-2

Figure I-03-95 Point to Point Steering (Inside Cone)



ICN-1B-B-346200-A-A0019-06733-A-02-2

Figure I-03-96 Point to Point Steering (Outside Cone)

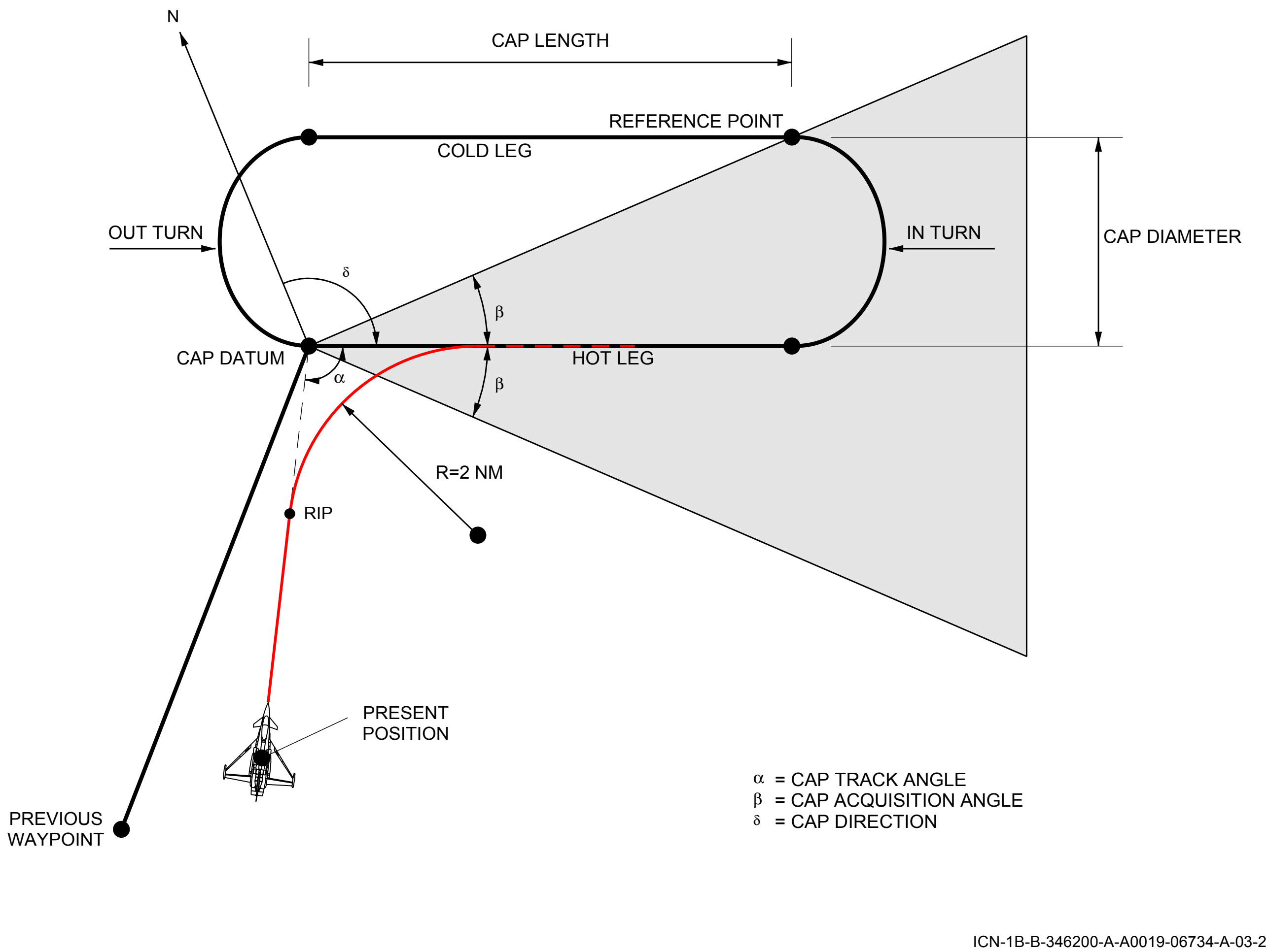


Figure I-03-97 CAP Steering

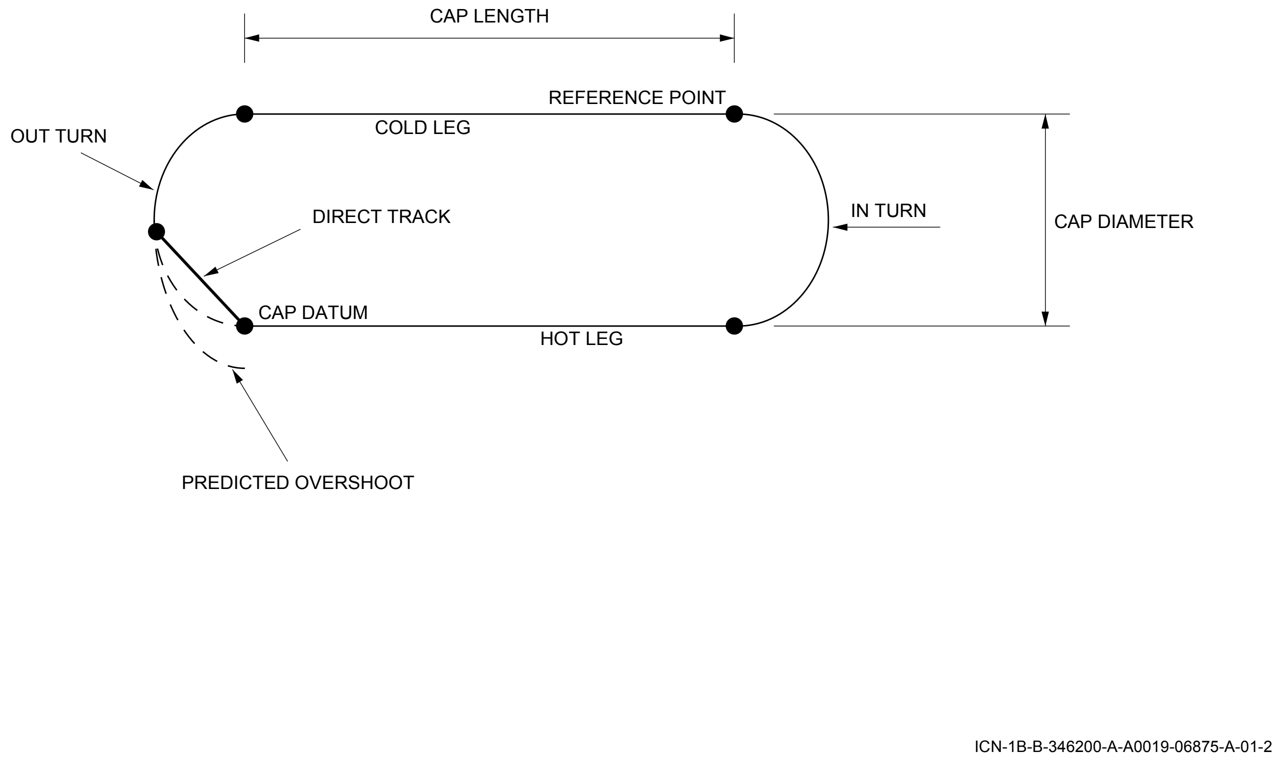


Figure I-03-98 Direct Leg CAP Recovery

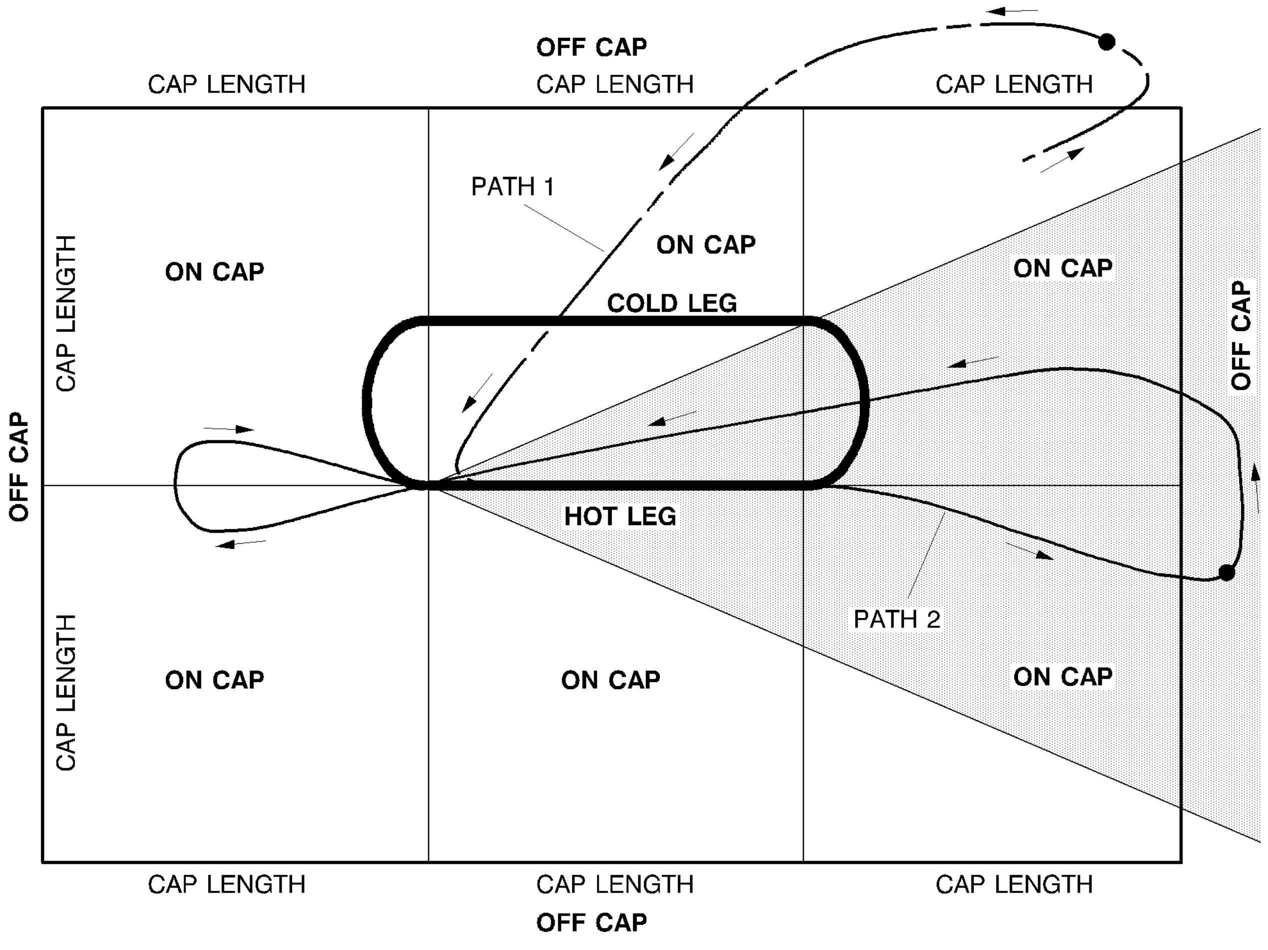


Figure I-03-99 OFF CAP Steering

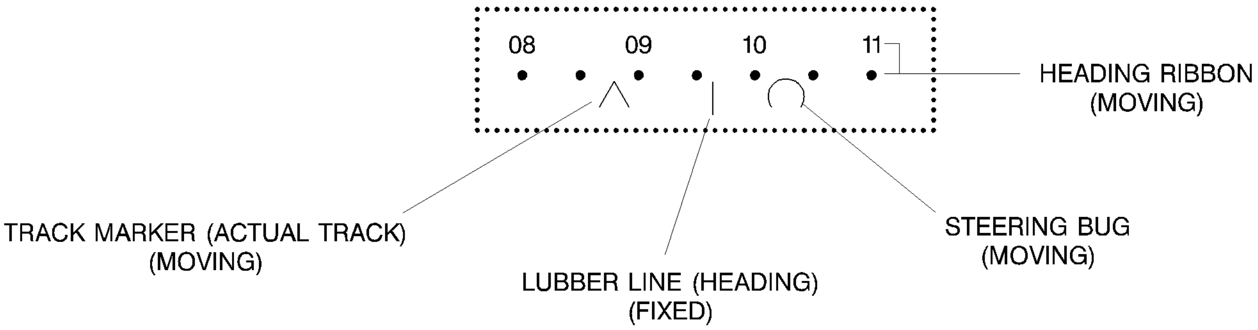
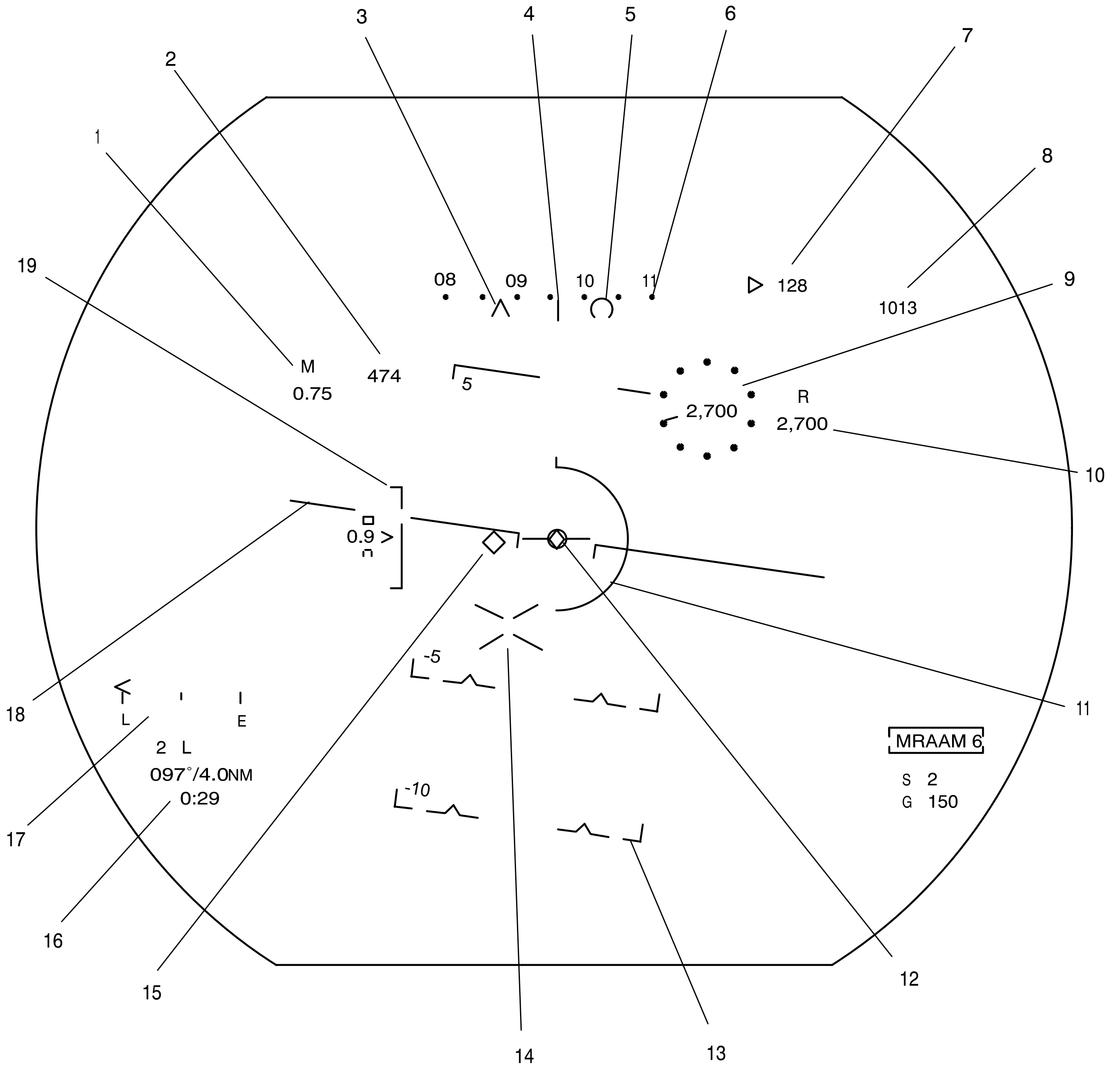


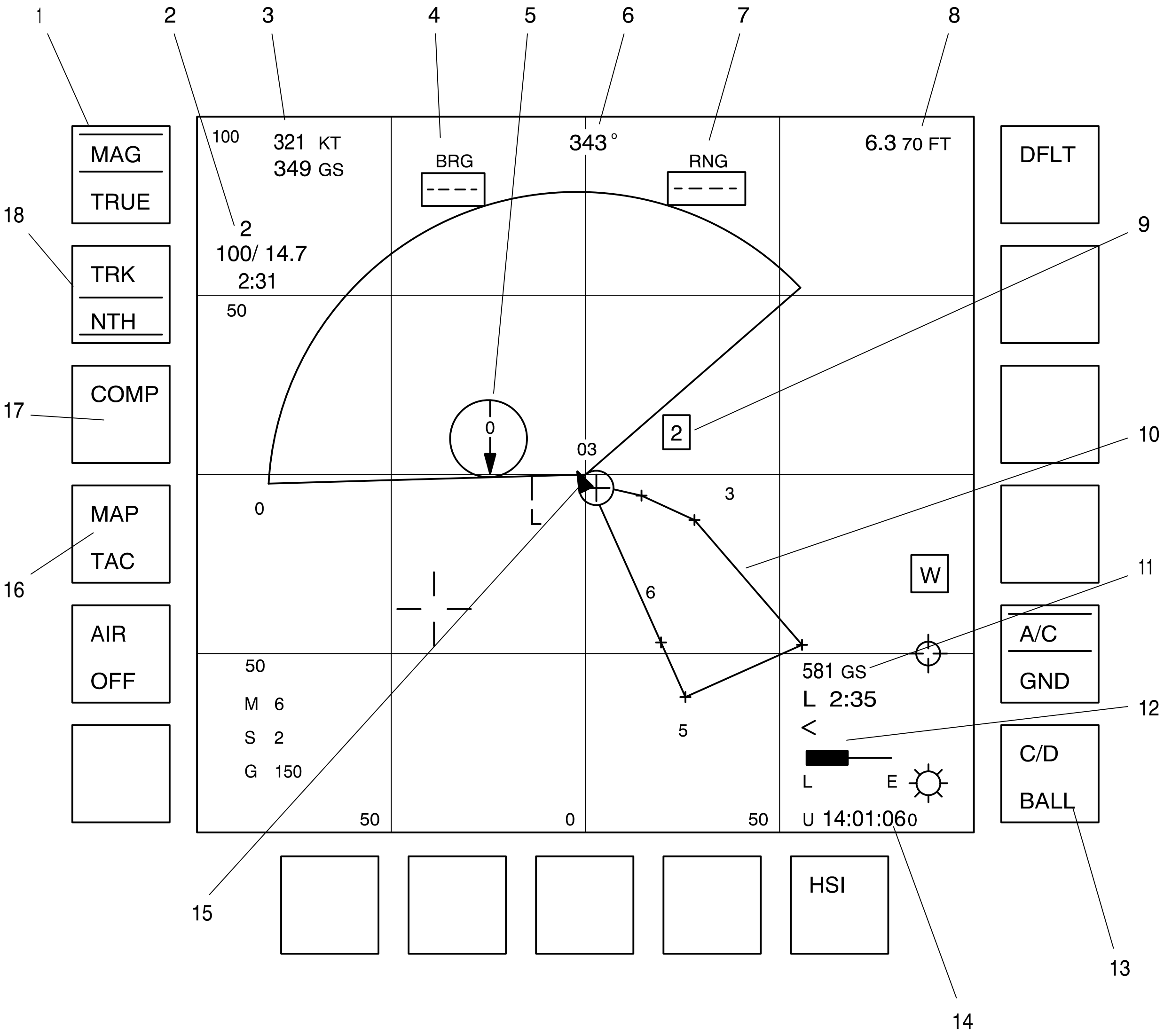
Figure I-03-100 Steering Bug



1 MACH OR GROUND SPEED DISPLAY
2 DAS
3 TRACK MARKER
4 LUBBER LINE
5 STEERING BUG
6 HEADING RIBBON
7 NEXT PLANNED TRACK AND DIRECTION OF TURN
8 BARO PRESSURE SETTING
9 BAROMETRIC ALTITUDE
10 RADALT ALTITUDE
11 TIME TO GO CIRCLE
12 AIRCRAFT SYMBOL
13 CLIMB/DIVE LADDER
14 DWP MARKER
15 VELOCITY VECTOR DIAMOND
16 WAYPOINT DATA BLOCK
17 TIME EARLY/LATE
18 ZERO DEGREE HORIZON BAR
19 CURRENT AOA (PSC 1.1.X) ENERGY CUE (PSC 2.0 ONWARDS)

ICN-1B-B-346200-A-A0019-06717-A-02-2

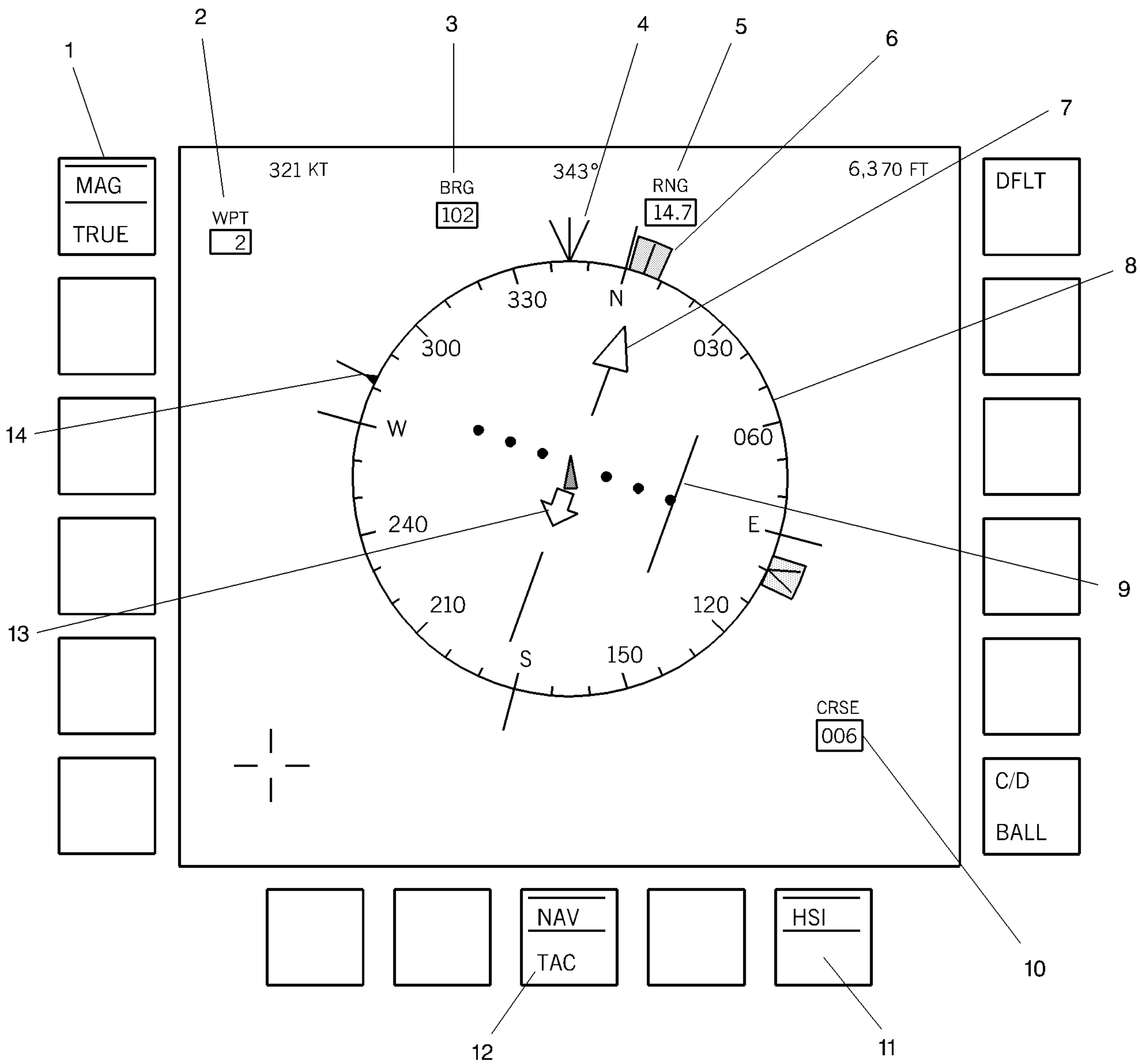
Figure I-03-101 HUD Navigation Format



ICN-1B-B-346200-A-A0019-06719-A-02-2

1	MAGNETIC TRUE SOFT KEY	10	AUTOROUTE
2	WAYPOINT DATA BLOCK	11	DEMANDED GROUND SPEED
3	CURRENT AIR SPEED/GROUND SPEED	12	TIME EARLY/LATE
4	BEARING TO TACAN STATION	13	CLIMB/DIVE BALL SOFT KEY
5	WIND SPEED AND DIRECTION	14	UTC TIME
6	HEADING	15	TRIANGLE TO INDICATE PP
7	RANGE TO TACAN STATION	16	MAP/TACTICAL SOFT KEY
8	ALTITUDE	17	COMPASS ROSE SOFT KEY
9	DESTINATION WAYPOINT	18	TRACK UP/NORTH UP SOFT KEY

Figure I-03-102 Pilot Awareness Format



1 MAGNETIC/TRUE SOFT KEY
2 DESTINATION WAYPOINT
3 BEARING TO DWP OR TACAN
4 LUBBER LINE WITH ACTUAL TRACK SYMBOL "V" SUPERIMPOSED
5 RANGE TO DWP OR TACAN
6 AUTOPILOT HEADING MARKER
7 COURSE POINTER
8 COMPASS CARD
9 LATERAL DEVIATION BAR
10 DIGITAL COURSE
11 HSI FORMAT SOFT KEY
12 NAV/TAC SOFT KEY
13 TO/FROM FLAG
14 BEARING POINTER

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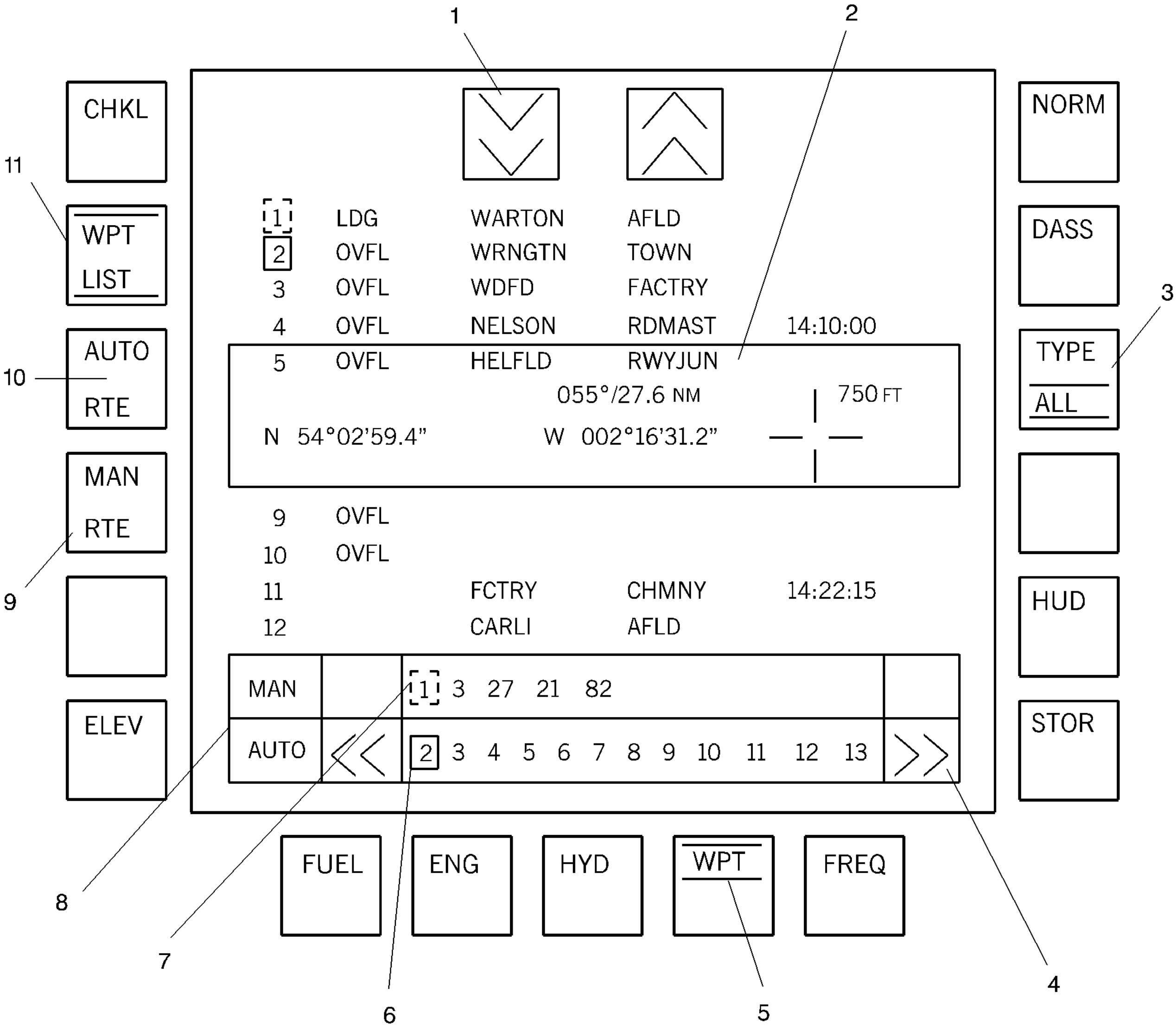
Figure I-03-103 HSI Format



1 WAYPOINT LIST SCROLL ARROW
2 WAYPOINT EXPANDED INFORMATION BOX
3 WAYPOINT TYPE SOFT KEY
4 ROUTE ROL SCROLL ARROW
5 WPT FORMAT SOFT KEY
6 DESTINATION WAYPOINT (DWP)
7 JOIN WAYPOINT (JWP)
8 AUTO AND MANUAL ROUTE ROLS
9 MANUAL ROUTE SOFT KEY
10 AUTOROUTE SOFT KEY
11 WPT LIST SOFT KEY

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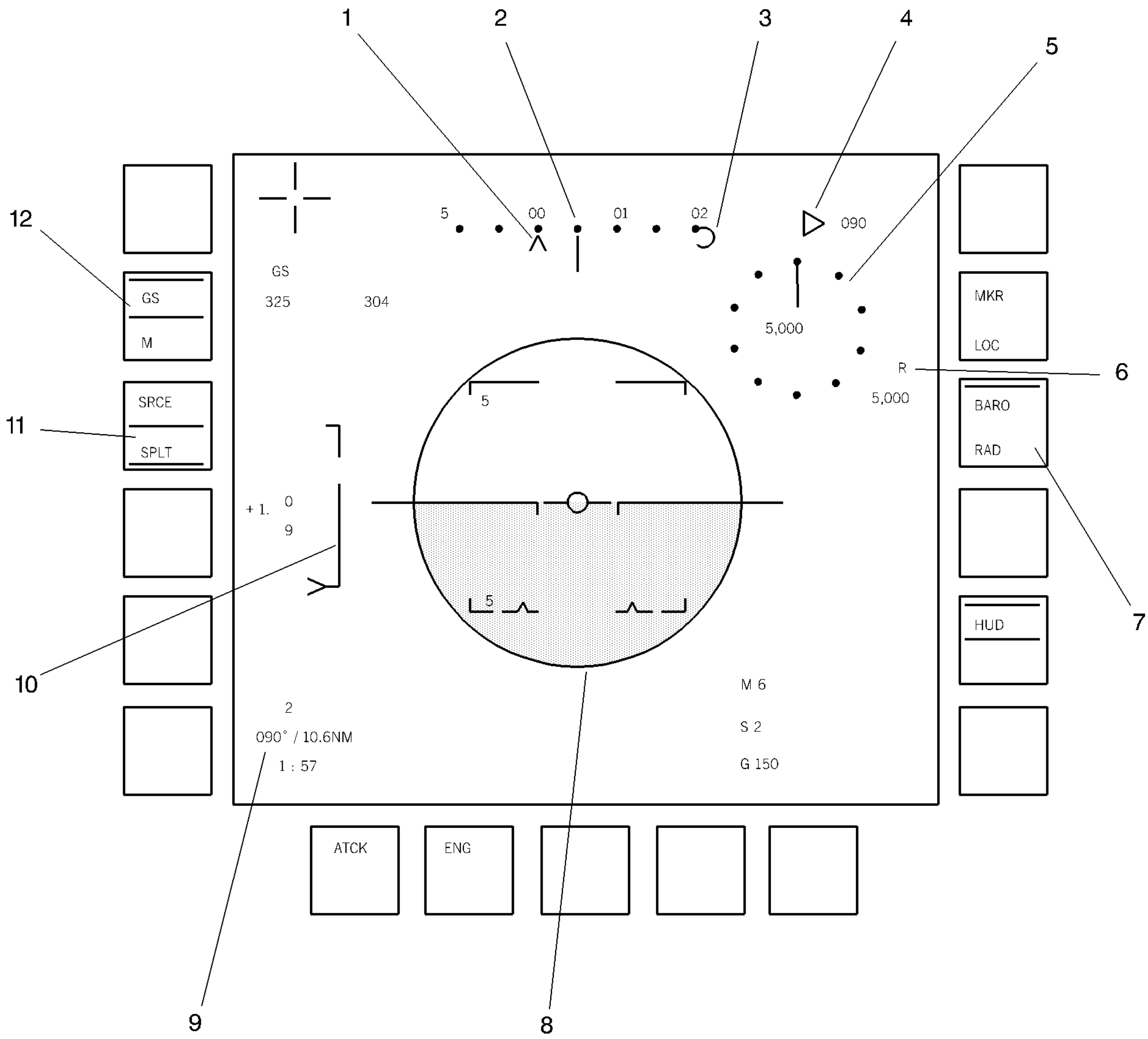
Figure I-03-104 Waypoint List Format (with Expanded Information selected)



1 ACTUAL TRACK
2 HEADING
3 STEERING BUG
4 NEXT PLANNED TRACK AND DIRECTION OF TURN
5 BAROMETRIC ALTITUDE
6 RADALT ALTITUDE
7 BARO/RAD SOFT KEY
8 CLIMB/DIVE LADDER AND BALL
9 WAYPOINT DATA BLOCK
10 VERTICAL VELOCITY
11 SOURCE SPLIT SOFT KEY
12 GROUND SPEED/MACH NUMBER SOFT KEY

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Figure I-03-105 HD HUD in NAV Selection

NAVIGATION MODES

The Navigation System automatically selects the best available navigation mode dependent upon the sensors availability. The automatic selection can be manually over-ridden. The NAV modes can be viewed using the NAV MODE MK, accessed via the AIDS SSK on the MDEF: the available ones are lit, whereas the selected one is lit and boxed.

NOTE

Mode 8 shall only be used in emergency case due to significant inaccuracies of up to 1 NM/min, caused by the unavailability of wind calculation.

Six navigation modes, which allow a graceful degradation in performance, are available as shown in Table I-03-09 .

NAV mode	Sensors	NAV mode cockpit indication
1	LINS + KF + GPS	LINS GPS1
3	LINS + KF + OTF	LINS FIX1
4	LINS + GPS	LINS GPS2
5	LINS + OTF + last KF correction	LINS FIX2
6	FCS + GPS	FCS GPS
8	FCS + OTF	FCS FIX

Table I-03-09 Navigation Modes

Modes 1, 3, 4 and 5 use the LINS, which is the primary dead reckoning navigation sensor. Modes 6 and 8 use the FCS (IMU and air data), which is the reversionary dead reckoning navigation system.

LINS and IMU are autonomous inertial sensors and are affected by drift, increasing with time. In order to reduce this error, it is necessary to perform a periodic correction: this can be either automatic, if the GPS is available, or manual, using the OTF technique.

Modes 1 and 3 use the Kalman Filter, which is an additional aid to further reduce the LINS error. This is a recursive algorithm that provides an efficient navigation solution, using data coming from the sensors involved in the current NAV mode. The filter generates an estimate of the LINS position error based on the past values.

The system can deselect the KF when:
- a malfunction is detected in the KF performance
- LINS data are declared invalid
- the current latitude is greater than 85°.

AUTOMATIC SELECTION

On ground, after LINS alignment procedure, the system automatically selects the NAV Mode 4 (NAV AUTO and LINS GPS2 MKs boxed) due to the fact that the KF is available only when the LINS enters the Navigate mode. Once NAV SEL SK becomes boxed, Mode 1 is engaged and the MKs change accordingly.

The flow chart (see Figure I-03-106) briefly shows the criterion the system uses to choose the best NAV mode.

NAV Mode 1 is maintained while LINS, GPS and KF are available. When one component is lost the system reverts to the next best NAV Mode available. For example, if LINS data become invalid, the system selects NAV Mode 6, which is the first NAV Mode without LINS.

The loss of LINS and KF causes the immediate NAV Mode change; differently, when the GPS signal is lost (data invalid), the system maintains the current NAV Mode using the following logic:
- if the current NAV Mode is 1, it is maintained up to 20 minutes until the KF estimate of the position error is less than the predefined threshold; the more the aircraft flies straight and level, the more NAV Mode 1 is retained
- if the current NAV Mode is 4 or 6, it is maintained up to 90 seconds to allow a possible GPS recovery.

In case of GPS failure, NAV Modes 1, 4 and 6 are immediately lost.

MANUAL SELECTION

Any navigation mode can be selected, at any time, provided the involved sensors support that mode. When a manual selection is performed, the chosen NAV mode MK becomes boxed and, at the same time, the NAV AUTO MK and the relative NAV mode MK (e.g. LINS GPS1, etc.) deselect (i.e. illuminated but not boxed).

A manual NAV mode selection does not imply the loss of the other NAV modes, including the deselected one.

At any time, it is possible to revert to the automatic NAV mode pressing the NAV AUTO MK.

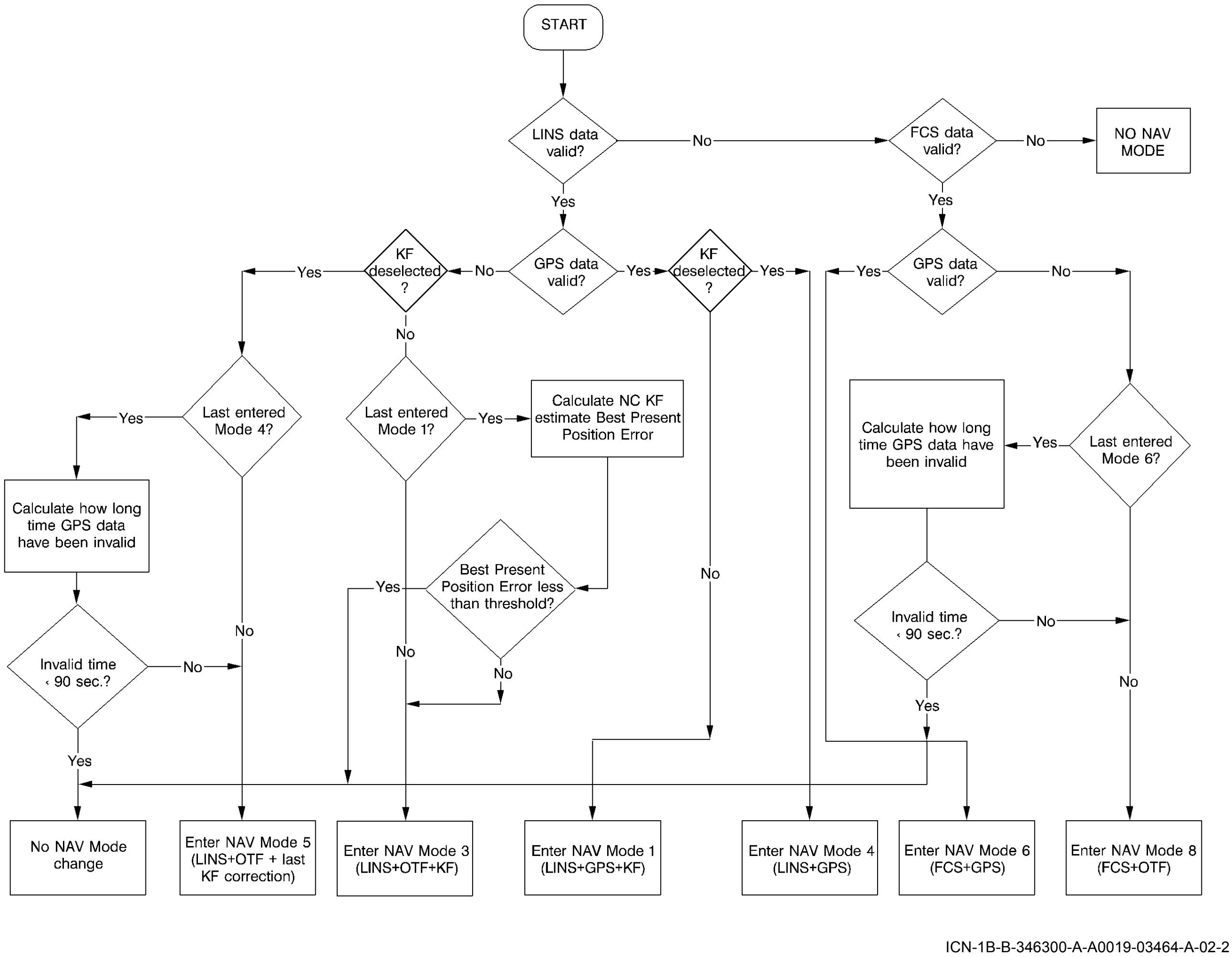

Figure I-03-106 Navigation Auto Mode Logic

LASER INERTIAL NAVIGATION SYSTEM

The main purpose of the Laser Inertial Navigation System (LINS) is to provide the aircraft with autonomous and continuous navigation data. It is the primary dead reckoning system and establishes the aircraft geometric zero reference point for all navigation calculations. It provides:

- Present Position (Latitude, Longitude)
- True Heading
- Bank
- Inclination
- Climb/Dive Angle
- Earth referenced velocities (East, North, Vertical)
- Earth referenced accelerations (East, North, Vertical)
- Body linear and angular velocities and accelerations
- Baro-IN Altitude.

The LINS consists of two LRIs:

- Laser Inertial Navigator
- Mounting Rack.

It acts as an RT on the ATK BUS via a dual-redundant digital databus.

MODES OF OPERATION

The LINS has the following main modes of operation:

- Initialization
- Alignment
- Navigate
- OFF.

In addition, a Ground Static Harmonization mode allows any discrepancies between the aircraft axes and the mounting axes to be nulled out, minimizing attitude errors.

INITIALIZATION

When the equipment is energized, it performs a Power-Up BIT. After successful completion of the Power-Up BIT, the LINS automatically enters the Normal Alignment mode.

The LINS requires accurate initial position data plus Standard Baro Altitude information (which it gets from the FCS) to stabilize its vertical channel. If the Standard Baro Altitude becomes invalid for more than 5 minutes, the LINS declares its vertical channel invalid, causing the loss of the LINS navigation modes.

When the Standard Baro Altitude becomes valid again, the LINS reacquires its vertical channel, although this can take up to 90 seconds.

ALIGNMENT

Three types of alignment are available in GND PoF:
- Full Gyrocompass
- Memorized Heading
- Rapid Heading.

Three additional features are provided to improve the alignment:
- Refinement
- Incremental
- Restart.

Soft.Prog.Ed.: PSC 2.0 onwards

An In-flight Alignment (IFA) can also be performed in flight. ⇐

Full Gyrocompass Alignment

The Full Gyrocompass Alignment, an automatic self-contained process which determines local vertical position and heading, is the normal type of alignment when reaction time is not critical. It lasts 240 seconds. It automatically starts when the PBIT ends and it is indicated, on the Autocue format (refer to Figure I-03-107) by:
- the ALGN NORM soft key boxed
- a READY IN caption decrementing from 240 seconds to 0, showing the time remaining to the end of the alignment
- an ALIGN caption decrementing from 64 NM/h to 0.8 NM/h, showing the alignment error
- a NORM caption, showing that a Normal Alignment is in progress.

The HUD shows the ALIGN and READY IN captions (refer to Figure I-03-108).

The PP insertion is mandatory, even if it is the same as the stored one. It can be achieved at any time, either automatically by the PDS/GLU or manually via the MDEF. It is displayed on the MDEF Read Out Lines.

Once entered, the LINS performs a check between the input latitude and the sensed one.

If the PP is entered within 45 seconds and has an accuracy better than 1 arcmin in latitude, the alignment continues, otherwise it restarts from 240 seconds and 64 NM/h. On the other hand, if the PP is entered after 45 seconds, in order to avoid the alignment restart, the required accuracy must be at least 0.1 arcmin in latitude. In case a great difference exists between the two latitude values, the LINS stops aligning to enter the Navigate Mode. In order to make the LINS available, the NAV SEL soft key must be pressed: the equipment returns to the Alignment Mode and the Restart procedure is automatically activated.

Soft.Prog.Ed.: PSC 1.X

Once the alignment is complete, the READY IN caption is substituted by a LINS READY caption on the Autocue format and a LINS RDY caption on the HUD. It remains displayed until the LINS enters the Navigate Mode. The ALIGN caption disappears.⇐

NOTE

Soft.Prog.Ed.: PSC 1.X

LINS READY only means that the alignment has been completed; in order to verify if the LINS outputs are valid, the Best NAV Mode (shown on the Autocue format) must be checked. Three cases must be distinguished, according to the captions displayed:

- LINS READY and NAV Mode = 1, 3, 4, 5 This means that the PP has been entered and the alignment has been successfully completed (LINS data valid).

- LINS READY" and NAV Mode = 6, 8 or none This means that the PP has not been entered: the LINS has used the stored PP and the alignment has been completed (LINS data invalid). If the PP used by the LINS is correct, in order to reach full performance it is sufficient to press the ENT" data entry key: the result is that a LINS NAV Mode is immediately selected. In case the PP is incorrect, the right one must be entered and the alignment restarts.

- No indications This means that the LINS tried to align using a wrong PP (either entered or taken from the LINS NVM): the difference between the used PP and the LINS sensed PP was outside the range of validity (dependent upon the current latitude). The LINS stops the alignment (within 90 seconds) and enters the Navigate Mode. The only way to reach full performance" is to re-engage the Alignment Mode, initiating a Restart procedure.

⇐

Soft.Prog.Ed.: PSC 2.0 onwards

Once the alignment is complete, the READY IN" caption is substituted by a LINS READY caption on the Autocue format and a LINS RDY caption on the HUD. The ALIGN caption remains displayed, together with LINS READY, until the LINS enters the Navigate Mode.⇐

NOTE

Soft.Prog.Ed.: PSC 2.0 onwards

LINS READY means that the alignment is complete but LINS data are not necessarily valid. Three cases must be distinguished, according to the captions displayed:

- LINS READY and ALIGN 0.8 NM/h This means that the PP has been entered and the alignment has been successfully completed (LINS data valid).

- LINS READY and ALIGN 4 NM/h This means that the PP has not been entered: the LINS has used the stored PP and the alignment has been completed (LINS data invalid). If the PP used by the LINS is correct, in order to reach full performance it is sufficient to press the ENT data entry key (ALIGN 4 NM/h changes to ALIGN 0.8 NM/h without initiating a new alignment procedure). In case the PP is incorrect, the right one must be entered and the alignment restarts.

- No indications This means that the LINS tried to align using a wrong PP (either entered or taken from the LINS NVM): the difference between the used PP and the LINS sensed PP was outside the range of validity (dependent upon the current latitude). The LINS stops the alignment (within 90 seconds) and enters the Navigate Mode. The only way to reach full performance is to re-engage the Alignment Mode, initiating a Restart procedure.

⇐

Memorized Heading Alignment

The Memorized Heading Alignment is used when rapid reaction time is essential. The last recorded values of present position and heading are used. A special shutdown technique is necessary at the end of the preceding flight to provide the required conditions for this type of alignment:

- do a Full Gyrocompass Alignment without entering the LINS Navigate Mode
- have AC power removed first, then not less than 40 seconds later, have DC power removed
- give instructions that the aircraft must not be moved.

As for the Full Gyrocompass Alignment, similar indications are provided: ALIGN decrements from 64 NM/h and READY IN from 30 seconds.

If the above conditions have been respected, the ALGN MEMO soft key on the Autocue format is presented when the aircraft is next powered up. The LINS normally starts a Full Gyrocompass Alignment: when the ALGN MEMO soft key is pressed, it becomes boxed, stops the alignment in progress and initiates a Memorized Heading Alignment, whose information replaces the previous one. The MHDD also changes the NORM caption to MEMO. This alignment can also be commanded as an automatic procedure via the PDS/GLU. Once the alignment is complete, the READY IN caption is substituted by a LINS READY caption on the MHDD and a LINS RDY caption on the HUD.

Rapid Heading Alignment (HUD)

The Rapid Heading Alignment (HUD) is used when the reaction time is critical. This requires:

- an accurate PP
- the bearing or co-ordinates of a reference optical object visible through the HUD.

This data must be provided by the PDS / GLU. This alignment is commanded as an automatic procedure via the PDS/GLU only.

As for the Memorized Heading Alignment, the same indications are provided: ALIGN decrements from 64 NM/h and READY IN from 30 seconds.

The LINS starts a Full Gyrocompass Alignment: as soon as the system acquires the PDS/GLU data, the ALGN HUD soft key becomes available and the HUD Alignment Cross appears on the centre of the HUD. Positioning the cross (using the XY Controller) over the reference object and inserting stops the current alignment and starts the HUD alignment, whose information replaces the previous one. The MHDD also changes the NORM caption to HUD. Once the alignment is complete, the READY IN caption is substituted by a LINS READY caption on the MHDD and a LINS RDY caption on the HUD. When the LINS enters the Navigate mode (manual selection or aircraft motion) the HUD Alignment Cross occults and the XY Marker is displayed at the marker locate.

Alignment Refinement

Alignment Refinement can take place after an alignment has been successfully completed (LINS error = 0.8 NM/h). It is used to recover the drift accumulated by the equipment, in Navigate Mode, since the selection of the NAV SEL soft key. If the aircraft has been moved, by stopping and steadily setting to ON the park brake the best possible alignment before take-off will be achieved.

No indications of time or accuracy are provided on the displays, except for the LINS READY caption appearing again on the Autocue format (LINS RDY on the HUD) when the procedure is complete (generally after few seconds).

The following conditions must be met otherwise the procedure cannot take place:

- the LINS mode of operation has changed from Alignment to Navigate
- taxi time has not exceeded 10 minutes (from first movement under power)
- the aircraft groundspeed has not exceeded 50 knots
- Weight-On-Wheels transition from OFF to ON has not been detected
- the park brake status has changed from OFF to ON.

If the above conditions are satisfied, the Alignment Refinement is automatically performed as soon as the park brake is set to ON: the NAV SEL soft key becomes deselected (i.e. the LINS enters the Alignment Mode), the NAV Mode degrades to NAV Mode 6 and the LINS refines the accuracy it reached at the end of the preceding alignment.

Incremental Alignment

If the LINS enters the Navigate Mode stopping the alignment with READY IN less than 150 seconds, it is possible to continue the alignment provided that the following conditions are all met:

- READY IN" shows less than 150 seconds
- the LINS mode of operation has changed from Alignment to Navigate
- taxi time has not exceeded 10 minutes (from first movement under power)
- the aircraft groundspeed has not exceeded 50 knots
- Weight-On-Wheels transition from OFF to ON has not been detected
- the park brake status has changed from OFF to ON.

If the above conditions are satisfied, the Incremental Alignment is automatically performed as soon as the park brake is set to ON: the NAV SEL soft key becomes deselected (i.e. the LINS exits the Navigate Mode) and the alignment procedure continues over the last present position (ALIGN and READY IN indications continue decreasing from the values they had when the alignment stopped).

The Incremental Alignment can be performed only if the alignment mode is Normal.

Alignment Restart

The Alignment Restart allows to revert to a Full Gyrocompass Alignment if the LINS has entered the Navigate Mode before the alignment completion. This functionality becomes available when:

- the aircraft moves or the NAV SEL soft key is pressed while the READY IN caption shows more than 150 seconds
- the aircraft moves or the NAV SEL soft key is pressed while the READY IN caption shows less than 150

seconds but the Incremental Alignment conditions are not met
- a Rapid / Memorized Heading alignment has been interrupted
- a great difference exists between the entered PP and the LINS sensed PP.

The procedure is activated by pressing the NAV SEL soft key (provided that the park brake is ON). After about 2 seconds the soft key disappears. Within 10 seconds the ALGN NORM soft key reappears and the LINS returns to the Alignment Mode. The alignment countdown restarts from 240 seconds and the accuracy from 64 NM/h. The insertion of an accurate PP is required within 45 seconds. If a new PP is not entered within this time, the LINS will use the GPS PP if valid, otherwise it will use the last best PP stored in the Navigation Computer. The alignment information given on the Autocue format and HUD is the same as for the Full Gyrocompass Alignment. This alignment is the only available after landing. It is used to prepare the system for next Memorized Heading Alignment.

NOTE

An alignment restart using PP from GPS or NC must only be used in the absence of a physically known PP, e.g. an away-from base landing where the true PP is unknown.

Soft.Prog.Ed.: PSC 2.0 onwards

In Flight Alignment (IFA)

This facility is provided to align the LINS in flight, using GPS data to provide correction vectors for the alignment. It can be activated in case:
- the LINS was partially aligned on ground (READY IN less than 210 seconds)
- the navigation time makes necessary to re-align the LINS to recover the drift accumulated.

The air alignment facility is only available in NAV POF and when the GPS FOM is ≤ 4; it is accessed pressing the AIDS subsystem key on the MDEF, then the AIR ALGN soft key.

Once the IFA has been selected, the LINS exits the Navigate Mode to enter the Alignment Mode and the Navigation System automatically switches to NAV MODE 6 (FCS + GPS).

In order to perform the IFA the pilot must fly the aircraft along a defined flight path, provided by the Navigation Computer after the IFA request, maintaining constant altitude and groundspeed. This path consists of three waypoints (numbered 172, 173 and 174 of the route store) calculated as a function of the current position, actual track and speed (see Figure I-03-109). The IFA flight path is inserted into the current route: the 172 waypoint becomes the DWP and the previous DWP is shifted after the 174 waypoint. The route on the PA format is updated.

The three IFA waypoints are positioned in the route currently flown as follows:
- the first one is placed along the actual track at a distance requiring 1 minute, from the PP at IFA selection, to be run
- the second one is placed along a track lying at 10 degrees right from the actual track: the relevant leg duration is 1 minute
- the last one is placed along the initial track, so that the third leg must be achieved turning 20 degrees left from the second leg; the relevant leg duration is 1 minute.

The first two IFA waypoints are treated as route waypoints, whereas the third one is treated as overfly. As soon as IFA is commanded, the Navigation System automatically selects the Track steering type to fly the IFA route (but the steering type indication on the MDEF does not change). During the alignment, the HUD displays READY IN (from 180 to 0 seconds) and ALIGN (from 64 to 0.8 NM/h) as for the other alignment types.

When the profile has been completed, satisfactory alignment of the LINS is indicated by the LINS RDY caption: the pilot must deselect AIR ALGN to terminate the alignment process. On IFA deselection, the LINS returns to Navigate Mode, the IFA waypoints are removed from the current route, and the aircraft is steered towards the waypoint which was the DWP before IFA selection.

After IFA completion, if the AIR ALGN soft key is not deselected, the LINS remains in Alignment mode (LINS data not available) and the Navigation System steers the aircraft, in Track steering type, along the remaining of the route.

In case of failed or interrupted alignment, all navigation modes based on the LINS will be lost.

⇐

NAVIGATE

This is the normal LINS operational mode. It can either be selected manually, by pressing the NAV SEL soft key on the Autocue format, or automatically, when the aircraft begins to move, on taxi-out. If any alignment has been successfully completed, the LINS provides all navigation data.

OFF

This is the normal shut-down procedure. During an Off Mode sequence, the LINS records the last computed present position and heading data for automatic use at the next power-up (Memorized Heading Alignment), then shuts itself down. The procedure consists in removing the AC power first and, after 40 seconds at least, the DC power.

It is also possible to shut-down the equipment removing the DC power within 4 seconds from the AC power removal. This implies the unavailability of the Memorized Heading alignment at next power-up.

GROUND STATIC HARMONIZATION

In order to minimize the LINS attitude errors due to discrepancies between the LINS mounting planes and the aircraft axes, the LINS is harmonized on the ground using a laser adaptor facility to determine pitch, roll and yaw errors. These data are loaded via the PMDS and sent to the LINS to make the necessary corrections; they are stored only into the LINS Non Volatile Memory (NVM).

The harmonization procedure must be performed in the following cases:

- initial aircraft build
- after excessive G or heavy landing
- after adjustment of aircraft datum mounting points
- after repair / replacement of the Mounting Rack
- when any alignment errors are suspected.

CONTROLS AND DISPLAYS

The LINS formats are illustrated in the ready states in Figure I-03-110 (ACUE) and Figure I-03-111 (HUD).

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Figure I-03-107 LINS Alignment Phase on ACUE Format

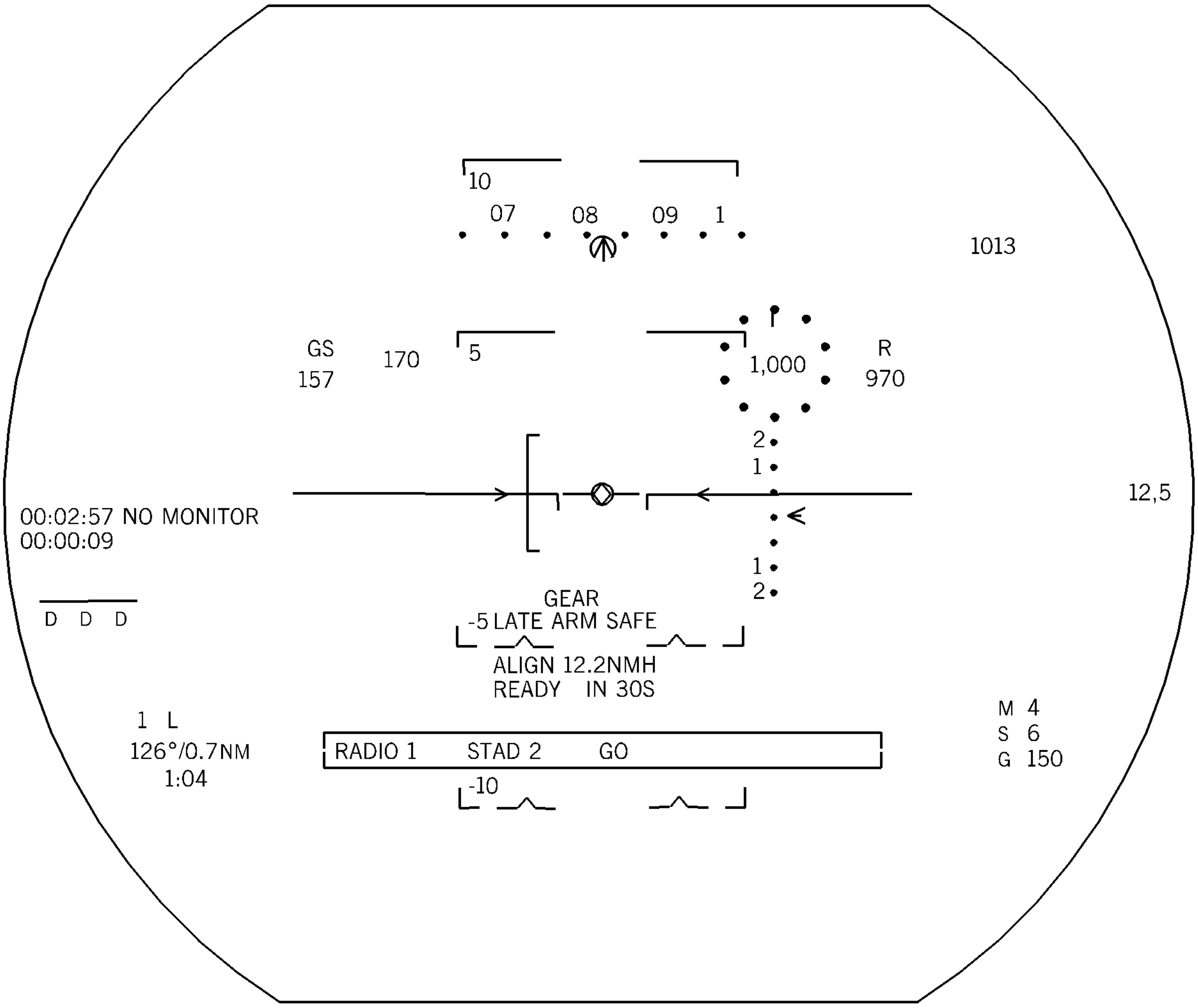

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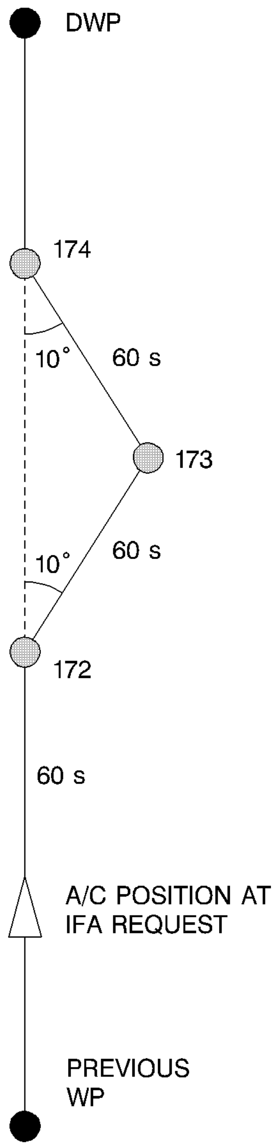
Figure I-03-108 LINS Alignment Phase on HUD



ICN-1B-B-344100-A-A0019-06716-A-01-2

Figure I-03-109 In Flight Alignment

ICN-1B-B-344100-A-A0019-05600-A-01-2

Figure I-03-110 LINS ready on ACUE

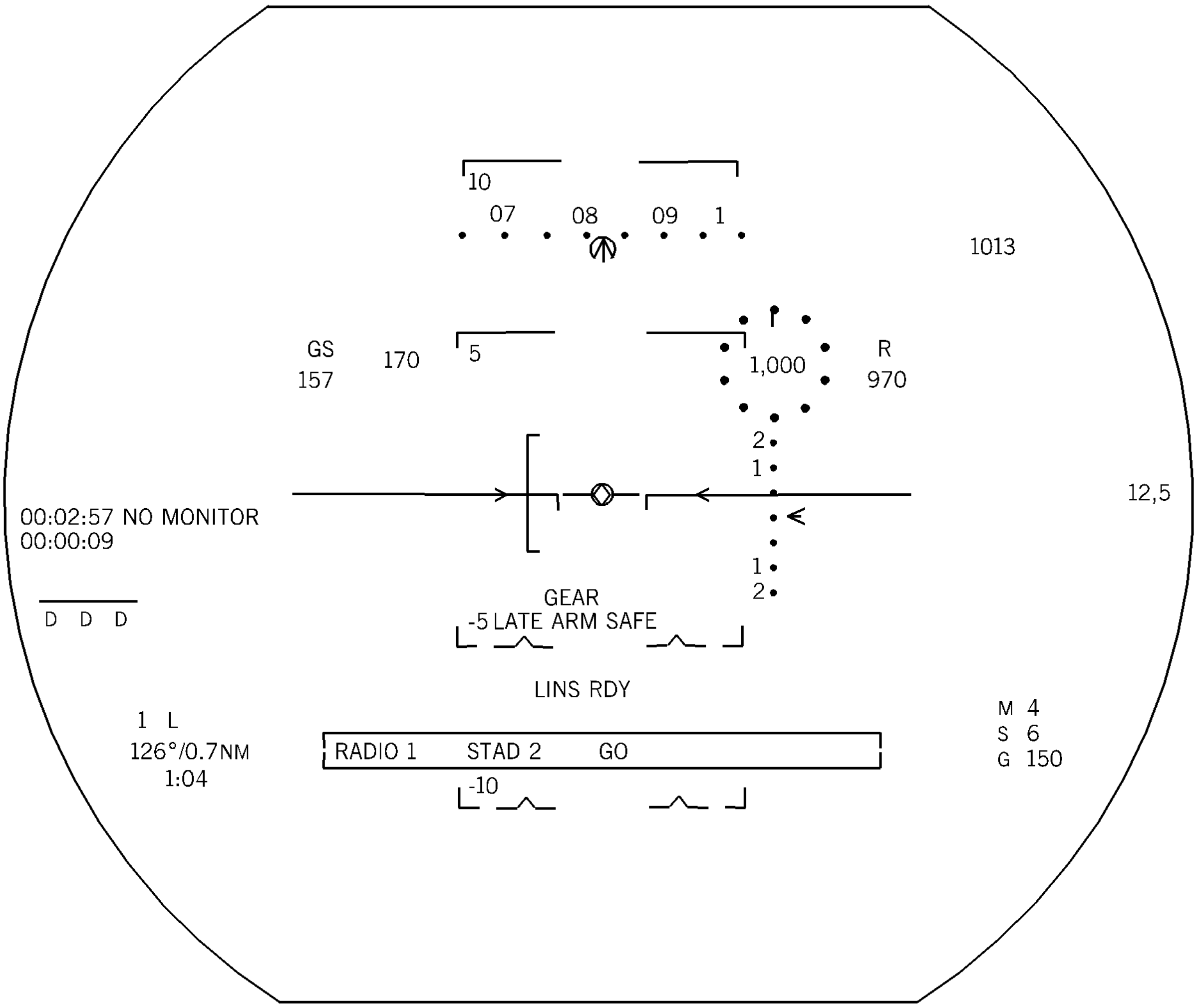


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Figure I-03-111 LINS Ready on HUD

NAVIGATION COMPUTER

The Navigation Computer (NC) determines the best navigation data for the selected navigation mode and computes the navigation steering parameters.

It also manages and controls the Avionic and Attack Serial Digital data buses (generally referred to as the EFABUS), acting as primary Bus Controller for the Avionic databus (AVS) and as reversionary Bus Controller for the Attack databus (ATK).

It contains two software packages: the Supplier Provided Software (SPSW) which controls the NC hardware and the Purchaser Provided Software (PPSW) which utilizes the SPSW to provide the following subsystem functionalities:

- Bus Initialization
- Primary Bus Controller on AVS Bus
- Reversionary Bus Controller on ATK Bus
- Single/Multi mission Data Loading via PDS/GLU
- Health Monitoring
- IBIT Monitoring
- Maintenance Data generation
- MDLR Recording
- NVM Retrieval
- NAV initialization
- Best Data Generation
- Nav Mode Auto / Manual Selection
- Main Navigation Mode 1 (LINS + GPS + KF)
- NAV Mode 3 (LINS + KF + OTF)
- NAV Mode 4 (LINS + GPS)
- NAV Mode 5 (LINS data corrected with last KF output + OTF)
- NAV Mode 6 (FCS + GPS)
- NAV Mode 8 (FCS + OTF)
- Radalt TX Inhibit
- Low Height Warning Generation
- Wind Calculation and Selection
- Steering Laws (including Steering Bug)
- Emergency Airfield Data Calculation
- *Soft.Prog.Ed.: PSC 2.0 onwards*

  Emergency Airfield Skip/Freeze function

  ⇐
- Universal Time Coordinate (UTC) Management
- LINS / GPS Velocity Monitor
- LINS / FCS Attitude Monitor
- LINS / GPS Position Monitor
- GPS Present Position Integrity Monitor
- *Soft.Prog.Ed.: PSC 2.0 onwards*

  LINS In-Flight Alignment (IFA)

  ⇐
- *Soft.Prog.Ed.: PSC 2.0 onwards*

  CAP Steering

  ⇐
- Lat/Long to/from GEOREF Conversion
- Route, Overfly, Landing, Mark waypoints
- *Soft.Prog.Ed.: PSC 2.0 onwards*

  CAP waypoints

  ⇐
- Magnetic Heading Calculation
- On Top Fix (OTF).

GLOBAL POSITIONING SYSTEM

The Global Positioning System (GPS) is a geo-stationary network of a nominal 24 navigation satellites (generally referred to as the NAVSTAR constellation) designed for US military use and controlled by the US Government. The orbital altitude is such that the satellites repeat the same track and configuration over any point approximately each 24 hours (4 minutes earlier each day). There are six orbital planes (with nominally four satellites in each), equally spaced at 60 degrees apart, and inclined at about fifty-five degrees with respect to the equatorial plane. Between five and eight satellites are simultaneously visible from any point on the earth. Navigation in three dimensions is the primary function of GPS.

Using self-contained atomic clocks as their reference, the satellites transmit time-controlled non-encrypted ”Coarse Acquisition” (C/A) ,also known as Standard Positioning Service (SPS) and Precise Position Service (PPS), generally shortened to P” codes on two frequencies called L1 (1575.42 MHz) and L2 (1227.60 MHz).

The L1 frequency carries the navigation message and the SPS code signals. The L2 frequency is used to measure the ionospheric delay by PPS equipped receivers. C/A-code is transmitted only on L1 and is available to all (including non-military) users of GPS. The P-Code (Precise) modulates both the L1 and L2 carrier phases.

The P-Code is a very long (seven days) 10 MHz PRN code. In the Anti-Spoofing (AS) mode of operation, the P-Code is encrypted into the Y-Code and requires a classified AS Module for each receiver channel. The P (Y)-Code is the basis for the PPS and includes the NAV Messages transmitted by the NAVSTAR” Constellation.

The Navigation Message (a 50 Hz signal consisting of data bits that describe the GPS satellite orbits, clock corrections, and other system parameters) also modulates the L1-C/A code signal.

The main components of the aircraft GPS are:
- Navigation System Unit (NSU)
- Antenna Electronic Unit (AEU)
- Antenna Set (AS)

and act to provide:
- Present Position
- Altitude
- Earth Referenced Velocities (north, east, vertical)
- UTC Time
- Climb / Dive Angle
- Erasure of crypto data under certain circumstances via a PPS Secure Module within the NSU.

MODES OF OPERATION

The main modes of operation are:
- Power on
- Initialisation (INIT)
- Navigate
- Crypto Erasure
- OFF.

POWER ON

When power is applied, the NSU and the AEU automatically enter a dedicated PBIT routine. Following successful completion, the GPS enters the INIT mode.

INITIALISATION (INIT)

The GPS is enabled to receive the following initialisation data, after which it passes to the Navigate mode:
- Position
- Velocity
- Time and Date
- Almanac
- GPS Antenna position (via the EFABUS interface).

NAVIGATE

This mode has two sub-phases:
- Initial acquisition
- Normal tracking.

Initial Acquisition

The NSU has five parallel independent channels, each able to acquire and use data from any of the satellites currently within its horizon. Acquisition of a satellite by any channel automatically excludes the same satellite from being acquired by another channel. A minimum of four satellites must be acquired to allow determination of the 4-dimensional spatial coordinates of the aircraft (Latitude, Longitude, height and time). Almanacs and ephemeris data allow the identification and tracking of GPS satellites.

Almanacs are approximate orbital data parameters for all satellites. Ten parameters describe satellite orbits over extended periods of time (useful for months in some cases) and a set for all satellites is periodically transmitted by each satellite. Signal acquisition time on receiver start-up is significantly aided by the availability of current almanacs. The approximate orbital data is used to preset the receiver with the approximate position and carrier Doppler frequency (the frequency shift caused by the rate of change in range to the moving satellite) of each satellite in the constellation.

Ephemeris data parameters describe short sections of the satellite orbits. Normally, a receiver gathers new ephemeris data each hour, but can use old data for up to four hours without this causing any significant position error. Ephemeris parameters are used with an algorithm that computes the satellite position for any time within the period of the orbit described by the ephemeris parameter set. Dependent upon the availability of the almanac and ephemeris data in the NSU, initial satellite acquisition is accomplished automatically by one of the following methods:
- Normal Start. This uses C/A code acquisition before handing over to P(Y) (if the cryptokeys have been loaded) and is initiated whenever the receiver has current almanac data resident in memory but there are initial uncertainties in Position, Velocity and Time Estimates (limits are: aircraft within 100 Km of last switch-off position and current ground speed up to approx 350 Kt). Time To First Fix (TTFF), defined as the elapsed time from the application of power to the GPS until the subsequent output of present position, velocity and time to the data bus, is normally less than five minutes.
- Hot Start (only with Time Loader). This uses direct P(Y) code acquisition and is initiated whenever the receiver has current ephemeris and almanac data plus cryptovariable codes and the initial Position, Velocity and Time (PVT) estimates are good (within 10 km of last switch-off position and aircraft speed is negligible). TTFF is normally less than 4 minutes.
- Cold Start. This is a worst case” situation and is initiated only if the receiver"s non-volatile memory has been cleared. Satellites are acquired by means of a fairly lengthy search-the-sky” technique. The GPS module automatically enters the Search-The-Sky (STS) mode when it does not contain current almanac data or ephemeris data or the internal clock is not available, but estimated PP is good within 10 km. It starts with C/A code acquisition before handing over to P(Y) (if the cryptokeys have been loaded). Whenever the GPS module enters the STS mode, the NSU provides it with the last stored present position. TTFF may take 20 minutes or more.

Normal Tracking

This is the normal operative mode, and starts when the inital acquistion is completed.

The GPS can lock onto up to five satellites, but it needs to be locked to at least four simultaneously to allow determination of the aircraft"s spatial coordinates. With less than four satellites locked, coordinate references are provided in a mixed context of GPS plus another sensor (e.g. in order, LINS or FCS) until the unit re-establishes lock on the minimum number of valid NAVSTAR satellites above its horizon.

When the GPS is aided” in this way, the NC does not use the GPS data.

Velocity is computed from change in position over time, or the satellite Doppler frequencies, or both.

CRYPTO ERASURE

The encrypted data contained in the Precise Position Service Secure Module of the NSU is erased when:
- ejection takes place
- erasure is selected (dedicated control on left console)
- mission time duration expires
- the NSU is removed from the avionic bay.

OFF

GPS has no power applied. It maintains essential information, e.g. almanac and ephemeris database, GPS keys and an estimate of time clock in a non-volatile memory sustained by an internal battery.

DISPLAYS AND CONTROLS

The MHDD / PA and ACUE formats provide an indication of GPS health through a Figure of Merit (FOM) value between 9 and 1 (lower is better). If loading of cryptovariables fails, an indication is provided on the ACUE format.

Aircraft time which appears on the MHDD / PA format is derived from the GPS (as UTC time).

RADAR ALTIMETER

The radar altimeter (RADALT) provides accurate height-above-terrain information for any type of surface currently being overflown, up to a maximum of 5000 ft. Its accuracy is ±2% of the measured height or ±2 ft (whichever is the greater). It consists of:
- a transmitter/receiver
- a transmitter antenna
- a receiver antenna.

Height information is displayed on the HUD and on the HDHUD format (see Figure I-03-112). A control switch on the RGS allows the desired clearance height (i.e. the do not fly below height) to be set. The low height datum is displayed beside the control switch. A low height audio/visual warning is generated when the clearance height is reached.

The radar altimeter acts as a Remote Terminal on the AVS bus and is connected to it by a dual redundant data bus.

RADAR ALTIMETER MODES OF OPERATION

STANDBY MODE

On ground, at aircraft power-up, the Radar Altimeter performs a Start up BIT (SBIT). During this phase the equipment does not transmit. A short subset of the SBIT is also performed whenever a transmit command is received. The transition from Standby to Transmit mode cannot be achieved until the SBIT is successfully completed.

In Standby Mode the Radar Altimeter emissions are inhibited. This condition can be met either automatically or manually; the automatic command is given by the NC, when bank/inclination > 60° and/or the aircraft attitude rates exceed ± 60°/s for more than 2 seconds; the manual command can be given by setting the RAD ALT transmission switch (on the right hand console) to off, or the XMIT subsystem key and the soft key dedicated to the RAD ALT (on the MDEF). The inhibition via the XMIT subsystem key is used for stealth purpose.

TRANSMIT MODE

Transmit is the normal Radar Altimeter operational mode and requires that the RADALT control switch is set to RAD ALT position. Transmit mode has the following sub-modes:
- Search
- Track
- Memory.

In the Search mode, the system establishes the initial lock, following which it switches to the Track mode to provide the height information. The height is permanently refreshed to a memory store: in the event of a temporary loss of lock, the RADALT enters the Memory Mode: it returns the last stored height for up to one second (this requirement may be less than one second if lock is restored sooner). Simultaneous with the loss of lock, the RADALT re-enters the Search mode in order to re-acquire the lock, and when re-established, returns to Track mode.

Radalt transmitter power varies as a function of the perceived height.

NOTE

Whenever the measured height becomes greater than 5000 ft, the RADALT remains in Transmit mode but the sub-mode goes to Search.

RADAR ALTIMETER CONTROLS AND DISPLAYS

RADAR ALTIMETER CLEARANCE HEIGHT SETTING CONTROL

The clearance height can be set by means of the LOW HT rotary control, located on the right glareshield. A clockwise rotation increases its value. The clearance height setting control has two levels of resolution:

- from 0 to 300 ft: 10 ft increments
- from 300 to 5000 ft: 50 ft increments.

Similarly, counterclockwise rotation will decrement the clearance height setting value of the appropriate steps. During NAV and AA PoF, when the aircraft is below the selected clearance height, the warning facility activates a CAT 1 audio/visual warning consisting of flashing attention getters accompanied by the Low Height audio voice message.

In addition a pull up indication is displayed on the HUD and on the HDHUD format by means of a flashing arrow which rotates about its center point, such that it always points away from the ground and the LOW HT caption below it.

As soon as best height becomes greater than 3% of clearance height datum, the Low Height warnings are cancelled by the Navigation Computer.

NOTE

Generation of the Low Height warnings is delayed by 15 seconds when a WOW transition from ON to OFF occurs and NAV or AA PoF is engaged.

RADAR ALTIMETER CLEARANCE HEIGHT SETTING DISPLAY

The selected clearance height is indicated on a four digit display adjacent to the clearance height setting control (see Figure I-03-112).

NOTE

The Radar Altimeter clearance height setting control and display are present in both cockpits, but the rotary control is active in the front cockpit only (i.e. it is possible to set the clearance height datum only from the front cockpit).

RADAR ALTIMETER TRANSMISSION CONTROL SWITCH

A two position gated toggle switch RAD ALT / OFF located on the right console systems gangbar of the front cockpit only, controls the Radar Altimeter transmission (see Figure I-03-112). In the RAD ALT position (forward) the equipment transmits, vice versa in the OFF position (afterward) it does not transmit. The switch is protected to prevent an inadvertent selection of the OFF position in flight: this cause the loss of the Low Height warning.

BARO / RAD SELECTOR

Two different controls select between display of barometric altitude only (default on power-up), RADALT height only or both. One is placed on the HUP (see Figure I-03-112), the other is a soft key of the HDHUD format. Both controls affect the visualization on the two displays.

HDHUD FORMAT AND HUD

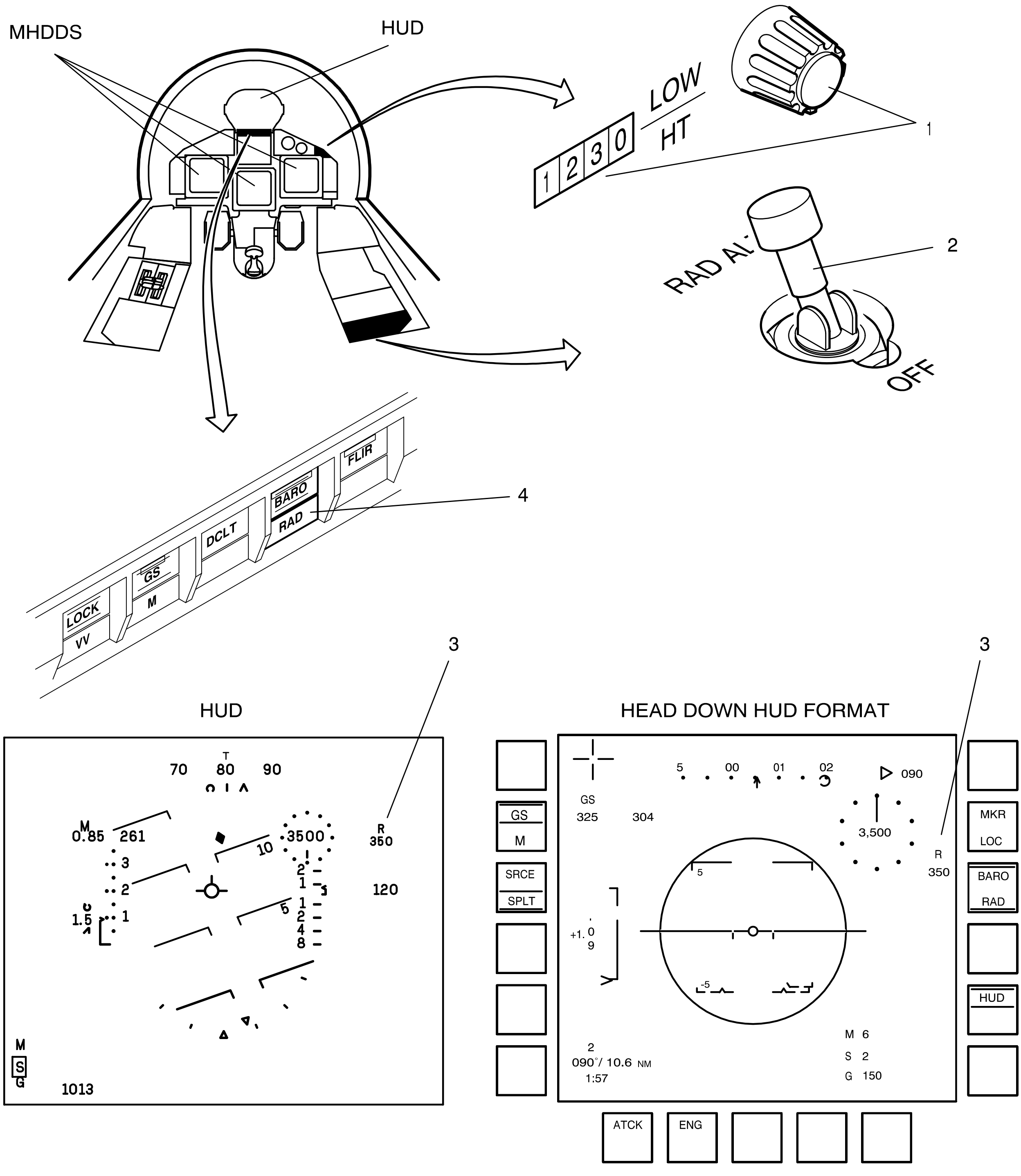
The RADALT height is displayed on the HDHUD format and in 10 ft increments. It is shown, together with the barometric altitude, refer to Table I-03-10 .

NOTE

If the RADALT is faulty or in Standby Mode, the visualization on both displays is the same as for the Switch in OFF position case.

BARO / RAD selector status	RAD ALT switch position	
	RAD ALT	OFF
RAD	RAD ALT height indication (.000 on ground)	Flashing Baro Altitude indication
BARO / RAD	Baro Altitude indication and RAD ALT height indication (.000 on ground)	Baro Altitude indication and RAD ALT indication showing dashes
BARO	Baro Altitude indication	Baro Altitude indication

Table I-03-10 Altitude/Height Indication



1 RADAR ALTIMETER CLEARANCE HEIGHT SETTING CONTROL AND DISPLAY
2 RADAR ALTIMETER TRANSMISSION CONTROL SWITCH
3 RADAR ALTIMETER HEIGHT INDICATION
4 BARO/RAD SELECTOR

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Figure I-03-112 Radar Altimeter Controls and Displays

GROUND PROXIMITY WARNING SYSTEM

The Ground Proximity Warning System (GPWS) is not safety or mission critical. The information provided is advisory and the pilot is responsible for performing the required pull-up maneuver to ensure safe flight.

The GPWS uses data from the following systems:
- Laser Inertial Navigation System (LINS)
- Global Positioning System (GPS)
- Radar Altimeter (RAD ALT)
- Flight Control System (FCS).

The GPWS is an integrated system that will accurately calculate the aircraft position relative to the ground from the data provided by the LINS, GPS, RAD ALT and FCS, together with the terrain and/or obstacle map data loaded to the system.

The FCS provides supplementary information to the GPWS with regard to the aircraft configuration and g limits. This data, along with that supplied by the LINS, GPS, RAD ALT and FCS is compared with an aircraft dynamic model and the Portable Data Store (PDS) defined Minimum Separation Distance (MSD). The system continuously computes the g required to clear the most critical terrain profile (ground and obstacle) within the flight path. Allowances are made for positional uncertainty, pilot reaction time and the time to roll the wings level.

If the GPWS predicts that a pull-up maneuver at or above the pre-defined g limit is required to prevent incursion below the MSD the GPWS warning will be activated, at the same time a pull-up arrow is displayed on the HUD to aid safe aircraft recovery.

INITIALIZATION

The GPWS initialization procedure is performed automatically by loading the MSD data via the PDS. The GPWS accepts MSD data over the range 0 ft to 5000 ft in 25 ft increments. Where no MSD value is loaded via the PDS, or a PDS download failure occurs, the MSD will default to a fixed value of 50 ft. There is no dedicated warning to indicate that the MSD has failed to load, although this would be indicated by means of the PDS ERROR - D+C DATA prompt on the ACUE format. The MSD value in use is displayed on the Manual Data Entry Facility (MDEF) and ACUE format.

NOTE

The PDS entered MSD value, or the GPWS default MSD value cannot be changed via the MDEF.

The GPWS terrain database and the obstacle database are loaded via the Ground Loading Unit (GLU). If the data fails to load, is corrupted or if the aircraft ground Present Position (PP) is outside the area of definition of the terrain and/or obstacle databases, the appropriate prompts are displayed on the ACUE format, refer to Table I-03-11 .

Prompt	Meaning
GLU ERROR - GPWS TERRAIN DATA	Terrain data not loaded or corrupted
GLU ERROR - GPWS OBSTACLE DATA	Obstacle data not loaded or corrupted
GPWS ERROR - TERRAIN AREA DATA	Present position outside terrain data area
GPWS ERROR - OBSTACLE AREA DATA	Present position outside obstacle data area
GPWS MSD - 1000	Current MSD setting for the GPWS
PDS ERROR - D+C DATA	Possible MSD has failed to load from the PDS

Table I-03-11 GPWS Autocue Format Indications

MODES OF OPERATION

The GPWS is operative in all PoF, with the following limitations. The GPWS pull-up warning and the related HUD and Head Down HUD (HDHUD) symbology, and the TERRAIN DATA, TERRAIN VALID, OBSTACLE DATA and OBSTACLE VALID warnings are inhibited when:
- When the aircraft has weight-on-wheels
- On transition of landing gear to up (with a prior transition of weigh-on-wheels to weight-off-wheels) for 15 seconds
- When the landing gear is selected down
- When the GPWS has failed.

There are four modes of operation:
- Primary mode
- Reversionary mode
- Acquisition mode
- Off.

The GPWS determines the mode of operation based upon the validity and availability of the input signal, the GPWS confidence level, height and map data validity and hardware status. This information is used to give an estimate of height and position uncertainty, refer to Figure I-03-113 . These uncertainties are given a Figure of Merit (FoM) and are indicated by a number between 1 and 5 inclusive; the greater the number the larger the uncertainty of aircraft height or position. Refer to Table I-03-12 and Table I-03-13 .

GPWS Position FoM	System Positional Uncertainty (ft)	System Positional Uncertainty (m)
1	0 - 158	0 - 48
2	170 - 250	52 - 76
3	262 - 328	80 - 100
4	342 - 472	104 - 144
5	> 485	> 148

Table I-03-12 GPWS Position FoM

GPWS Height FoM	System Terrain Clearance (ft)	System Terrain Clearance (m)
1	0 - 52	0 - 16
2	55 - 78	17 - 24
3	82 - 105	25 - 32
4	108 - 160	33 - 49
5	> 164	> 50

Table I-03-13 GPWS Height FoM

The system status can be viewed by performing an X-Y insert over the PP symbol on the PA format. An additional data box is displayed that shows the GPWS height FoM and position FoM.

PRIMARY MODE

The primary mode is the normal operating mode with all required inputs assessed as being valid and within the specified accuracy. When operating in this mode GPWS height FoM and position FoM are equal to 1.

If the GPWS suffers a temporary loss of one or more of its sensors, e.g. RAD ALT input data due to the attitude of the aircraft, then the GPWS is able to minimize the effects of this temporary loss or intermittent sensor operation without inhibiting GPWS functionality.

REVERSIONARY MODE

The GPWS enters reversionary (REV) mode when the height FoM and/or position FoM increase above 1, due to degraded information or error in the data supplied by the sensors.

As the FoM increase the larger the height and positional uncertainty of the aircraft, therefore a greater height is required for the aircraft to clear terrain and/or obstacles. When the FoM increase, the possibility of nuisance warnings also increases. There is no dedicated warning to indicate that the REV mode has been entered.

ACQUISITION MODE

If the GPWS FoM increase above a critical value as a consequence of a failure of the GPWS sensors or a prolonged period of time without GPS, terrain/obstacle or RAD ALT data input, the GPWS is automatically deselected and enters acquisition mode. In addition the Dedicated Warning Panel (DWP) GPWS warning and associated GPWS voice message are presented. The system will remain in acquisition mode until a position of sufficient accuracy is determined, whereupon the GPWS warning is reset and the system enters either the primary or REV mode of operation, depending upon height FoM and position FoM.

OFF MODE

The GPWS can be switched off via the moding keys located on the left glareshield. When selected OFF all of the GPWS warnings and symbology are inhibited, with the exception of the MSD value, displayed on the MDEF and the ACUE format, the GPWS failure warning, and the FoM on the PA format. The legend GPWS AVAIL is also presented on the PA format to show that the GPWS is available but has been selected to OFF.

MANUAL DATA ENTRY FACILITY

The GPWS moding key is available upon selection of the MISC subsystem key, refer to Figure I-03-115 . The GPWS defaults to ON, indicated by the GPWS legend being boxed on the GPWS/PAGE moding key following aircraft power-up, and valid navigation data becoming available.

The first ROL will display the current MSD as defined via the PDS. If the MSD is not defined then a default height of 50 ft is displayed.

Selecting the GPWS/PAGE moding key produces the GPWS sub-page, which show two active moding keys, one of which is used to switch the system between GPWS ON and GPWS OFF.

With the GPWS ON legend shown, on the sub-page, selection of the GPWS/PAGE moding key will return the system to the MISC subsystem default display.

If the system has been selected to GPWS OFF, the GPWS legend on the GPWS/PAGE moding key will be unboxed, and all GPWS warnings and symbology will be suppressed with the exception of:

- The GPWS fail warning and DWP caption
- The display of the MSD on the first ROL
- The GPWS AVAIL and FoM indications on the PA format.

If the system has been selected to GPWS OFF and the GPWS/PAGE moding key is selected, it will return the system to the MISC subsystem default display showing the GPWS/PAGE moding key unboxed.

HUD SYMBOLOGY

A pull-up arrow, with its outer line flashing at 4Hz, is displayed on the HUD and HDHUD , when triggered. The arrow is shown with its reference point centered on the aircraft symbol and is able to rotate around its reference point such that the arrow is always perpendicular to the horizon and points away from the ground, refer to Figure I-03-114 .

The arrow is accompanied by the breakaway cross on the MHDD formats (except the HDHUD, Maintenance and DRF) and by a PULL UP voice message.

DEDICATED WARNING PANEL

GPWS warnings are shown on the DWP with the associated voice warnings/messages given in Table I-03-14 .

NOTE

In all conditions except GPWS failure, the warning will be suppressed when the GPWS is selected OFF on the MDEF.

NOTE

In all conditions except GPWS failure, the warnings are suppressed until 15 seconds after entering the NAV PoF from T/O PoF (weight-off-wheels) and when undercarriage selected up in LDG PoF.

DWP Indication	Voice Warning/Message	Meaning
GPWS	GPWS	GPWS failure
TERRAIN	Terrain data (CAT 3 - NAV, AA and LDG phase of flight)	GPWS terrain and obstacle data has been lost and the aircraft is outside the terrain data defined area. The GPWS will not be able to provide warnings to clear terrain
TERRAIN (Goes out)	Terrain valid (CAT 4 - NAV, AA and LDG phase of flight)	GPWS terrain data has been restored, the aircraft has re-entered the defined area. This message requires the DWP TERRAIN warning previously set
OBSTACLE	Obstacle data (CAT 3 - NAV, AA and LDG phase of flight)	GPWS obstacle data has been lost as the aircraft is outside the area where obstacle has been defined. The system will continue to provide warnings to clear terrain
OBSTACLE (Goes out)	Obstacle valid (CAT 4 - NAV, AA and LDG phase of flight)	GPWS obstacle data has been restored. This warning requires the DWP OBSTACLE warning previously set
None	Pull up (CAT 1 - NAV, AA and LDG phase of flight)	This voice warning accompanies the pull-up arrow on the HUD when the warning is triggered

Table I-03-14 DWP Indications and Voice Warning/Messages

NORMAL OPERATION

TERRAIN AND OBSTACLE WARNING

If, within the current flight path, the GPWS predicts that a pull-up maneuver is required at or above a predefined g level, to prevent incursion below the total system clearance height above the terrain or obstacle, then the voice warning PULL UP is activated. The total system clearance height includes both the predefined MSD and an allowance for the GPWS height and position uncertainties. The warning is generated such that there is sufficient time to react, roll the wings level and to perform a pull-up maneuver at or above the predefined g level.

The flashing pull-up arrow is displayed on the HUD and HDHUD simultaneously. To improve awareness of the situation, the breakaway cross is also displayed on all the MHDD formats, except for the HDHUD, Maintenance and DRF formats.

NOTE

The GPWS pull-up HUD arrow takes precedence over the low height pull-up HUD arrow, although the precedence of the voice warning will depend on the warning category.

Continuous monitoring of aircraft response is carried out during the pull-up maneuver by comparing the required g with the achieved g. The GPWS warning will reset and the pull-up arrow will no longer be displayed, provided the aircraft has achieved the required trajectory that will allow it to clear the terrain or obstacle safely, and be outside of the total system clearance height.

OFF MAP

When the aircraft position or its predicted trajectory is outside the area where the GPWS terrain data is defined, the GPWS is not able to provide the pull-up warning to clear both the terrain and obstacles. Under these conditions the DWP will display the warning TERRAIN, accompanied by the voice warning Terrain data". When the aircraft re-enters the defined area for terrain data then the GPWS pull-up warning function, to clear both terrain and obstacles, becomes available again, the DWP warning TERRAIN goes out and the voice message TERRAIN VALID is given.

When the aircraft position or its predicted trajectory is outside the area where the GPWS obstacle data is defined, the GPWS is not able to provide the pull-up warning to clear obstacles, although it continues to provide the warning to clear the terrain. Under these conditions the DWP will display the warning OBSTACLE, accompanied by the voice warning OBSTACLE DATA. When the aircraft re-enters the defined area for obstacle data then the GPWS pull-up warning to clear obstacles becomes available again, the DWP warning goes out and the voice message OBSTACLE VALID is given.

The TERRAIN and OBSTACLE warnings are inhibited when the GPWS is selected OFF via the moding keys, located on the left glareshield, or if the GPWS failure (DWP captions and voice warning) is triggered.

NOTE
'GPWS AVAIL' INDICATES THAT GPWS IS AVAILABLE BUT NOT SELECTED ON AT THE MDEF.

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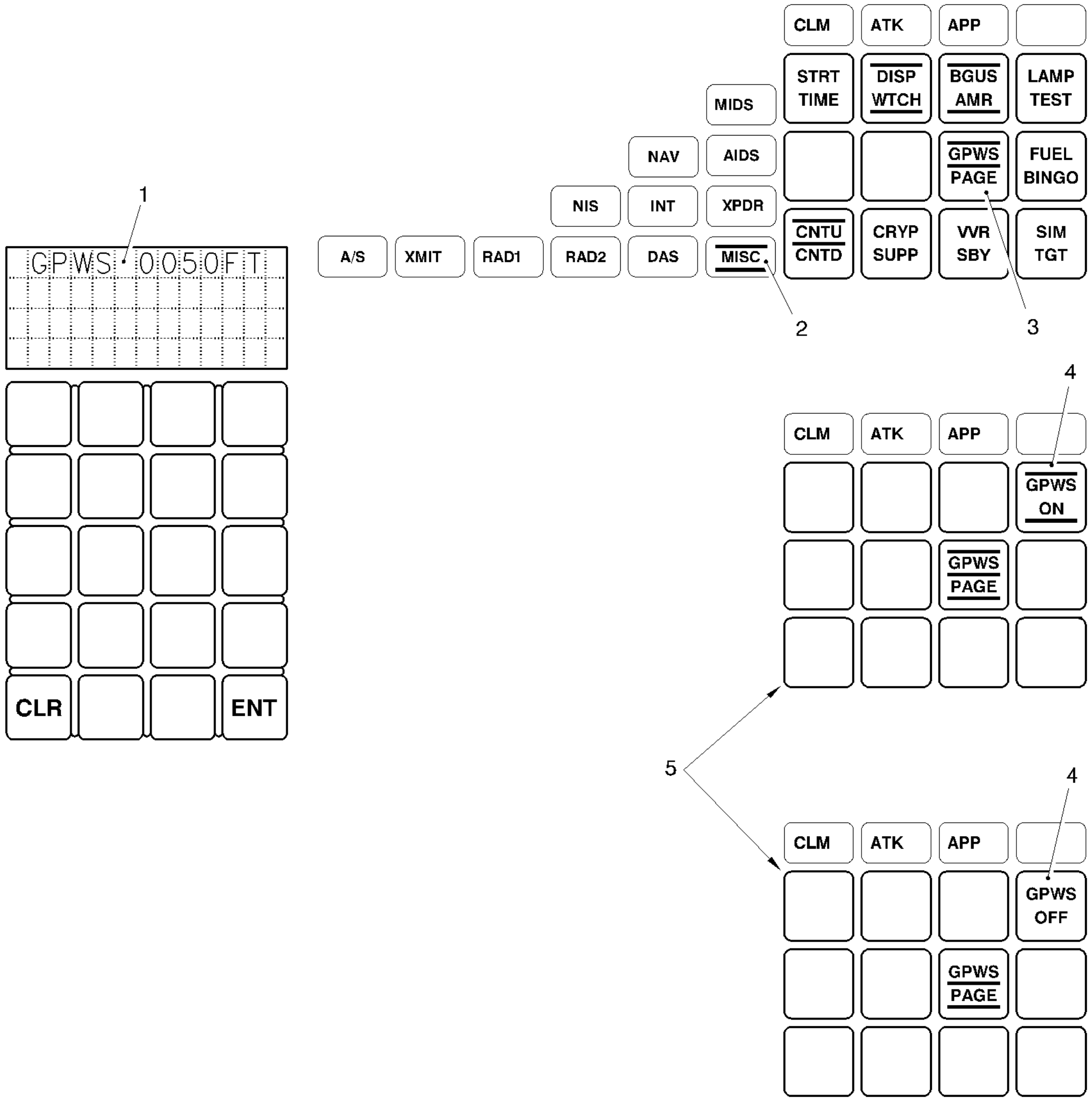
Figure I-03-113 PA Format (GPWS Indications)



1 ROL SHOWING CURRENT MSD
2 MISC SUBSYSTEM KEY
3 GPWS FUNCTION MODING KEY
4 GPWS ON/OFF MODING KEY
5 GPWS SUB-PAGE SHOWING GPWS ON/OFF

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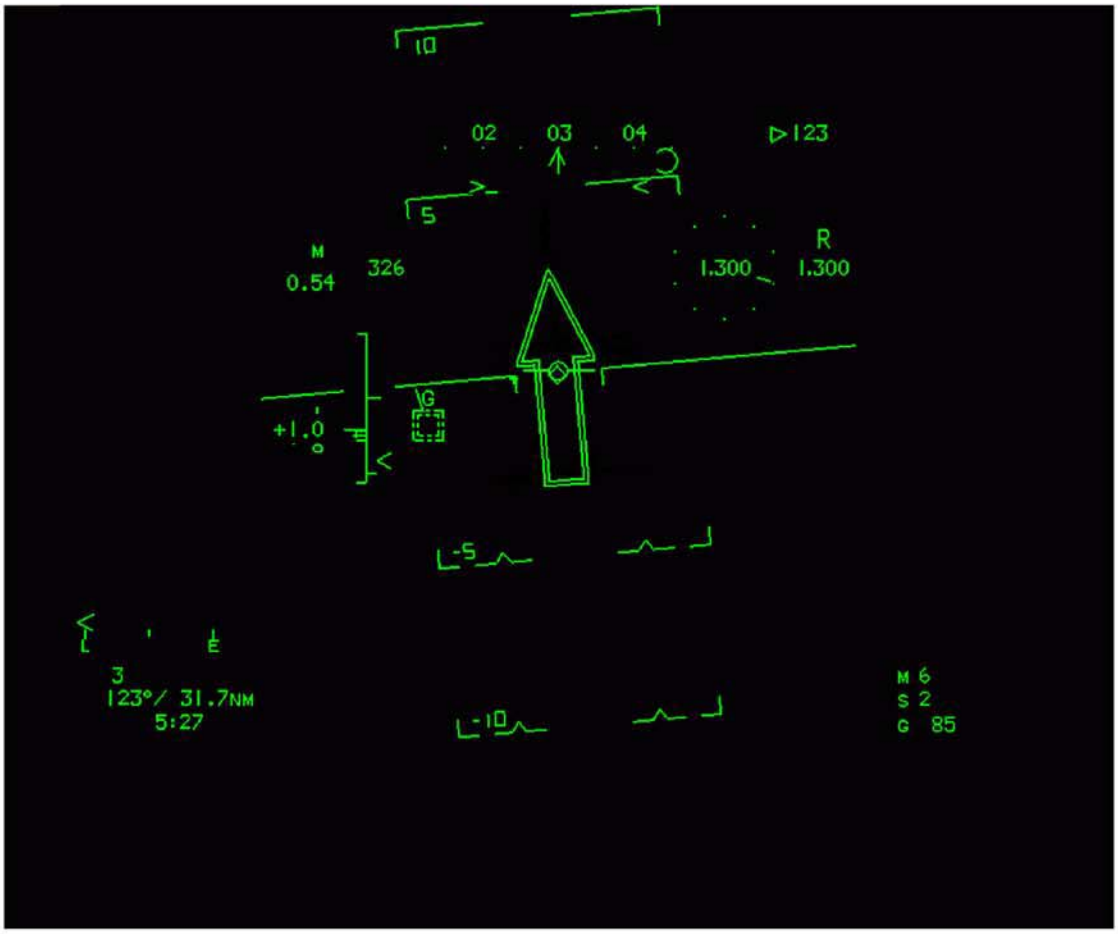
Figure I-03-114 GPWS Moding



NOTE
OUTER LINE OF ARROW FLASHES AT 4HZ.
ARROW ROTATES ABOUT ITS REFERENCE
POINT (AIRCRAFT SYMBOL) SUCH THAT
IT ALWAYS POINTS AWAY FROM
THE GROUND.

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Figure I-03-115 HUD GPWS (Pull-up Arrow)

TACAN

The TACAN system consists of two antennas, a transmitter/receiver unit and an antenna switching unit. It is controlled through the Manual Data Entry Facility (MDEF).

The TACAN equipment provides conventional Air to Surface (A/S) and Air to Air (A/A) modes of operation as follows:

- A/S receive mode - Magnetic Bearing
- A/S transmit/receive mode - Magnetic Bearing and Range
- A/A transmit/receive mode - Range

The antenna switching unit automatically selects the antenna receiving the strongest signal.

FUNCTION

The TACAN system defaults to on following power-up. The MIDS toggle switch on the right hand console located within the battery gangbar has two positions. When selected to MIDS, the TACAN operates in the transmit/receive mode. When selected to OFF, the TACAN operates in receive mode only.

When AS receive mode is selected, or when TACAN silent mode is selected through the MDE (XMIT subsystem key), the TACAN transmitter is inhibited. In this situation the TACAN will only provide magnetic bearing against a ground beacon, and no slant range.

A beacon confirms its identity through the Communications and Audio Management Unit (CAMU) with an audio tone in morse code. The volume of the audio tone is adjusted using a rotary control located on the left rear console.

NOTE

Soft.Prog.Ed.: PSC 2.0 onwards

In case of the EuroMIDS terminal is installed, the TACAN bearing INFORMATION is not valid; therefore the TACAN bearing cannot be used as NAV source information in any flight conditions.⇐

The range (RNG) and bearing (BRG) information is displayed digitally, in boxes on the PA format. Selecting the NAV/TAC soft key to TAC, on the HSI format, will display the range and bearing information and also the TACAN channel number, type and mode instead of the navigation waypoint data, refer to Figure I-03-116 . The readout of the TACAN channel, the bearing and the range data can also be displayed on the HUD. The TACAN channel number and type are also displayed on the Dedicated Read-out Panel (DRP), located on the right glareshield, refer to Figure I-03-117 .

The TACAN system is tested by PBIT, and is fully operational after a 3 minute warm-up period. It is at this stage that the CBIT is initiated. A failure of the system detected by CBIT is shown by the presence of the TACAN caption on the Dedicated Warning Panel (DWP) and the voice message TACAN. If the TACAN function fails (or is not present) the moding keys for TACAN are not lit.

AIR TO SURFACE RECEIVE MODE

In this mode the system only calculates the magnetic bearing to the selected TACAN ground beacon using a signal transmitted from that beacon only.

AIR TO SURFACE TRANSMIT/RECEIVE MODE

In this mode the system transmits interrogation pulse pairs to determine the slant range in nautical miles to a selected TACAN ground beacon, together with the magnetic bearing.

AIR TO AIR TRANSMIT/RECEIVE MODE

In this mode the system transmits interrogation pulse pairs to determine the slant range in nautical miles to selected AA TACAN.

OPERATION

This mode of operation and channel selection is through the Navigation AIDS subsystem soft key, moding keys and the MDEF on the left glareshield. Pressing the TAC ON moding key will set the system to TAC SBY, pressing the moding key again will return the system to TAC ON. The selection of TAC A/A will cause the deselection of TAC A/S and vice versa. The TXRX moding key will not be affected by selecting between the TAC A/A and TAC A/S moding keys, refer to Figure I-03-118 . Pressing the TXRX moding key toggles between receive mode and transmit mode. The default selections are shown in Figure I-03-118 .

NOTE

If the TACAN is under stealth control the upper TXRX legend of the moding key is not lit as this option is not available.

TO EDIT TACAN CHANNEL - INPUT NEW CHANNEL

To update the CRNT TACAN channel number, overtype the previous (PREV) TACAN channel number in ROL 3. The TACAN type can also be changed from X to Y by selecting the Y key on the Data Entry Keyboard (DEK), refer to Figure I-03-119 .

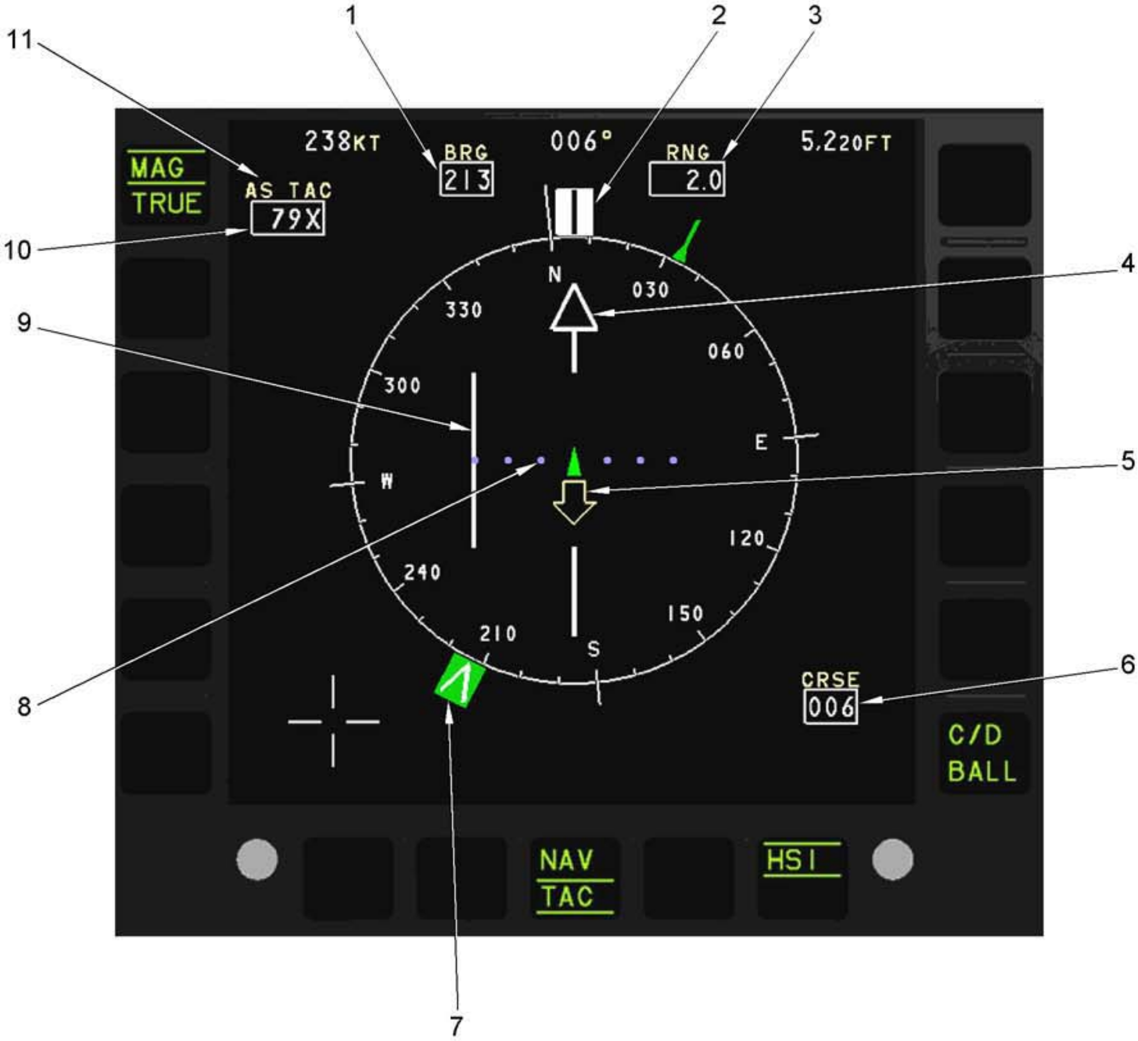
On defining the first character, the PREV legend will change to NEW and the second and third characters automatically revert to dashes, ready to receive the remaining TACAN data. On selection of the ENT key on the DEK, the ROL will go blank momentarily, then show the new channel number as CRNT and the previous CRNT channel number as PREV.

TO EDIT TACAN CHANNEL - SELECT/CLEAR PREVIOUS

In the NAV POF the TAC DATA moding key is selected as default; TAC DATA can be manually selected in any other PoF. The ROL will reconfigure to display the CRNT and PREV TACAN channel number. If there is no PREV channel number then ROL 3 will show NEW ---X, refer to Figure I-03-120 .

To select the PREV channel number, select the ENT key on the DEK. The PREV channel number is sent to the system to be used as the CRNT channel number and the information in ROL 2 and ROL 3 is switched.

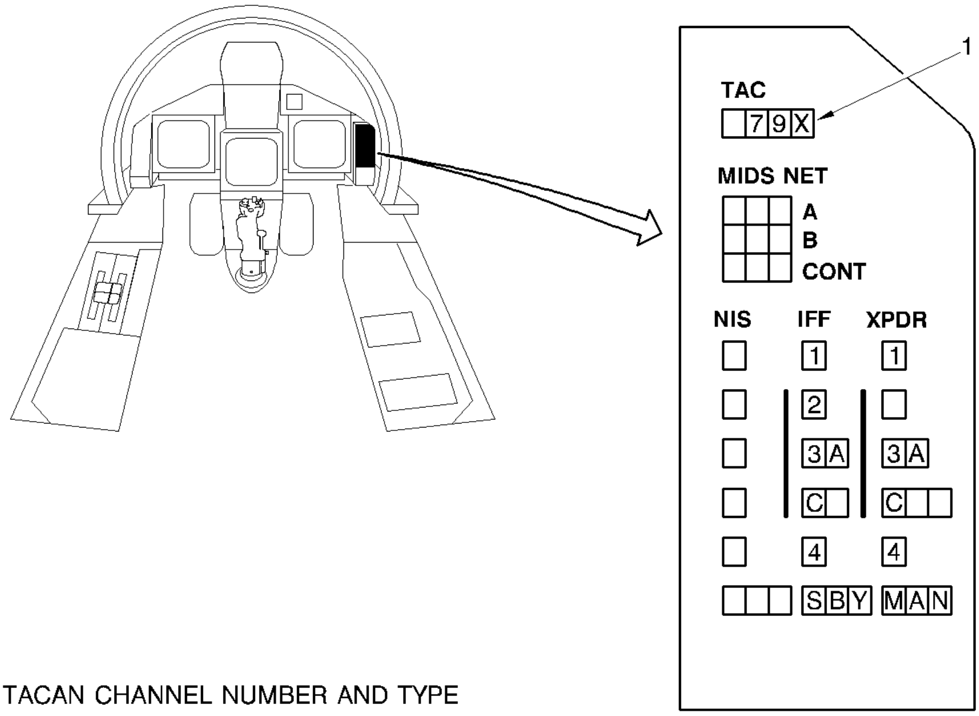
To clear the PREV channel number select the CLR key on the DEK; in ROL 3 the channel number will be set to dashes and the PREV legend will change to NEW; the channel type will default to X. The CRNT channel number will not change.



1 BEARING TO TACAN BEACON
2 HEADING MARKER
3 SLANT RANGE TO TACAN BEACON
4 COURSE POINTER
5 TO/FROM ARROW
6 COURSE SET INDICATION
7 BEARING POINTER (TO TACAN BEACON)
8 LATERAL DEVIATION SCALE
9 LATERAL DEVIATION BAR
10 TACAN CHANNEL NUMBER AND TYPE
11 TACAN IN AIR-TO-SURFACE MODE

ICN-1B-B-345200-B-K0999-04510-A-02-2

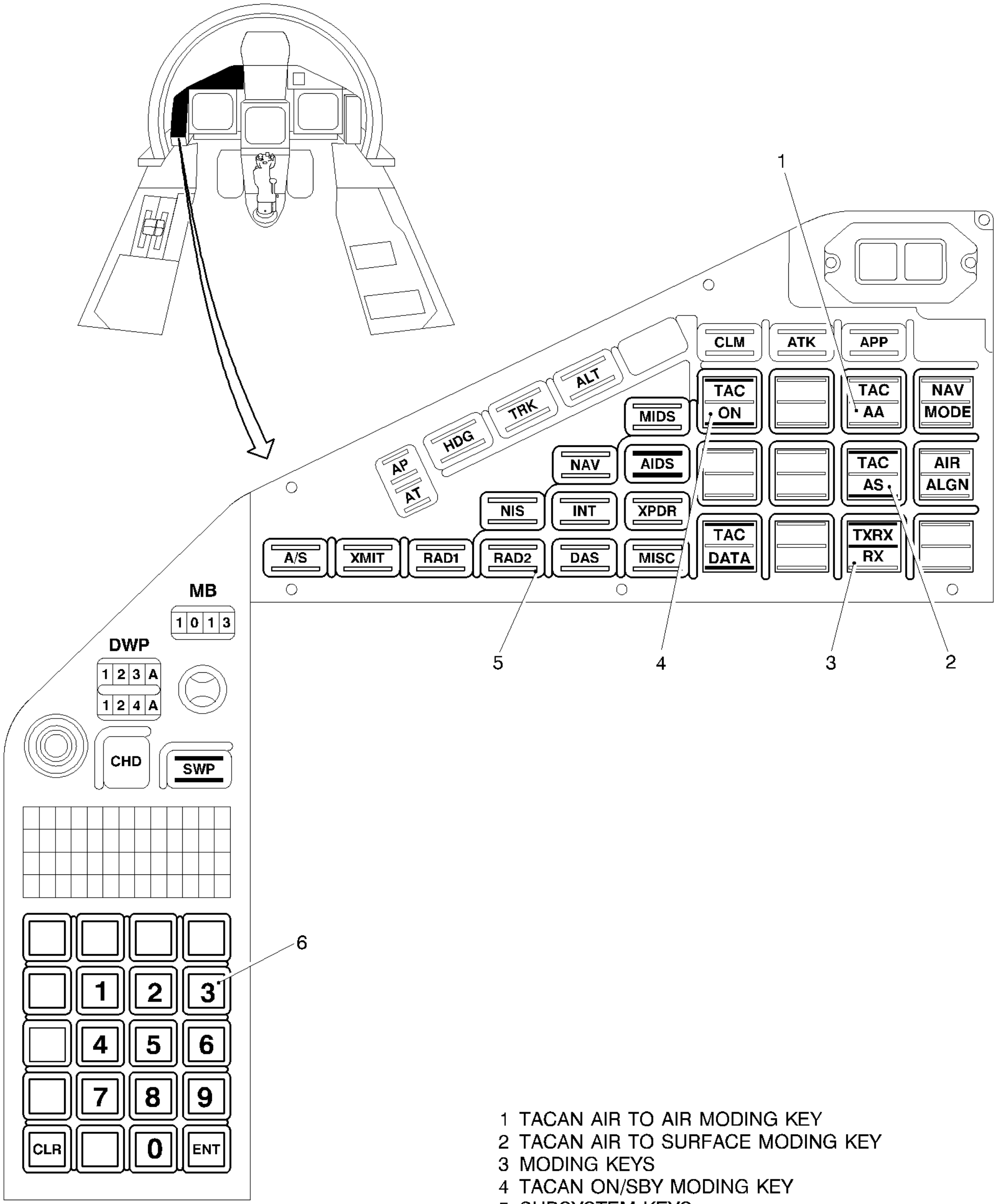
Figure I-03-116 TACAN Display (PA Format)



1 TACAN CHANNEL NUMBER AND TYPE

ICN-1B-B-345200-B-K0999-04511-A-01-2

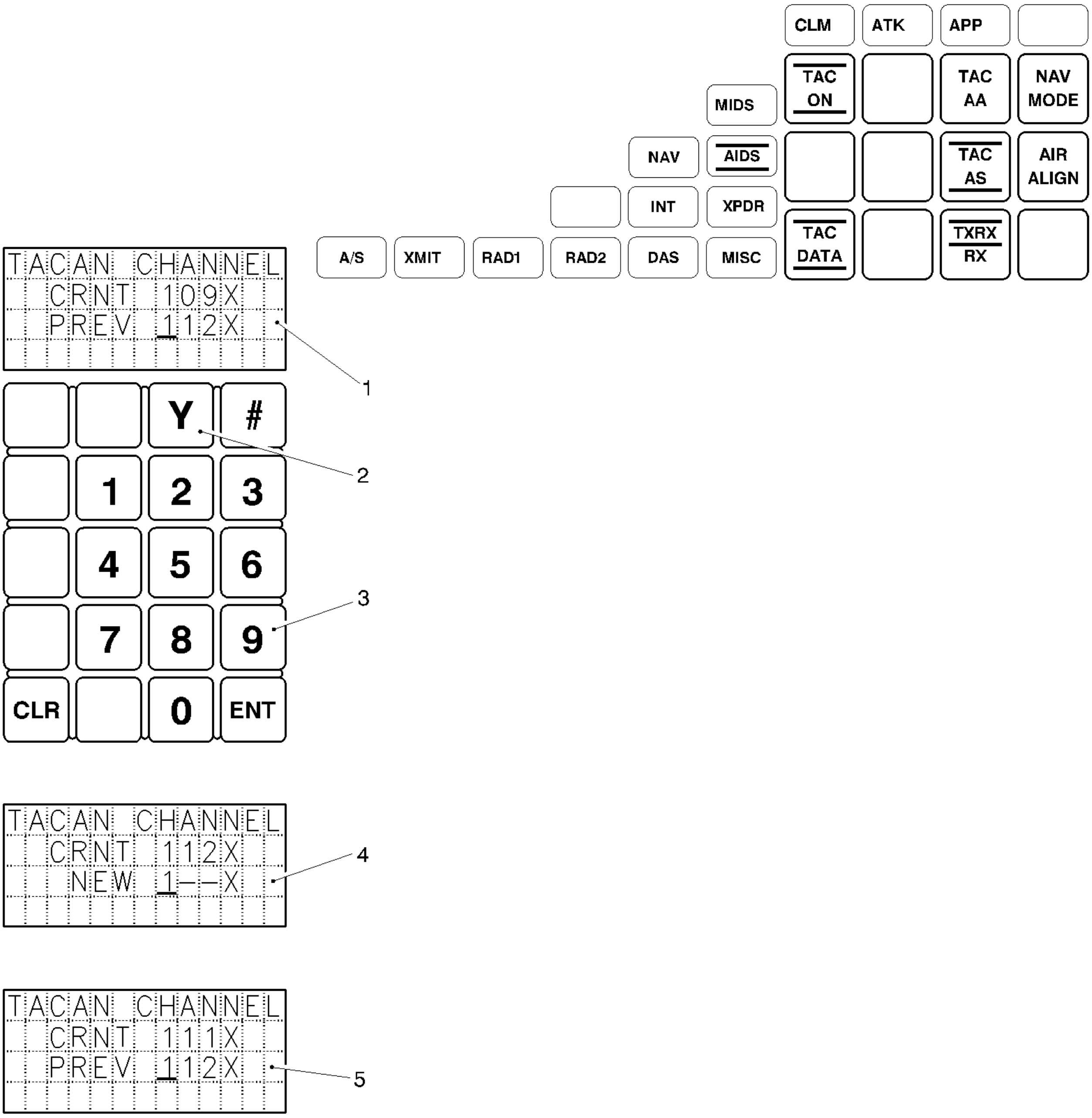
Figure I-03-117 Right Glareshield - Dedicated Read-out Panel - TACAN Channel Number and Type



1 TACAN AIR TO AIR MODING KEY
2 TACAN AIR TO SURFACE MODING KEY
3 MODING KEYS
4 TACAN ON/SBY MODING KEY
5 SUBSYSTEM KEYS
6 MANUAL DATA ENTRY FACILITY (MDEF)

ICN-1B-B-345200-B-K0999-04630-A-01-2

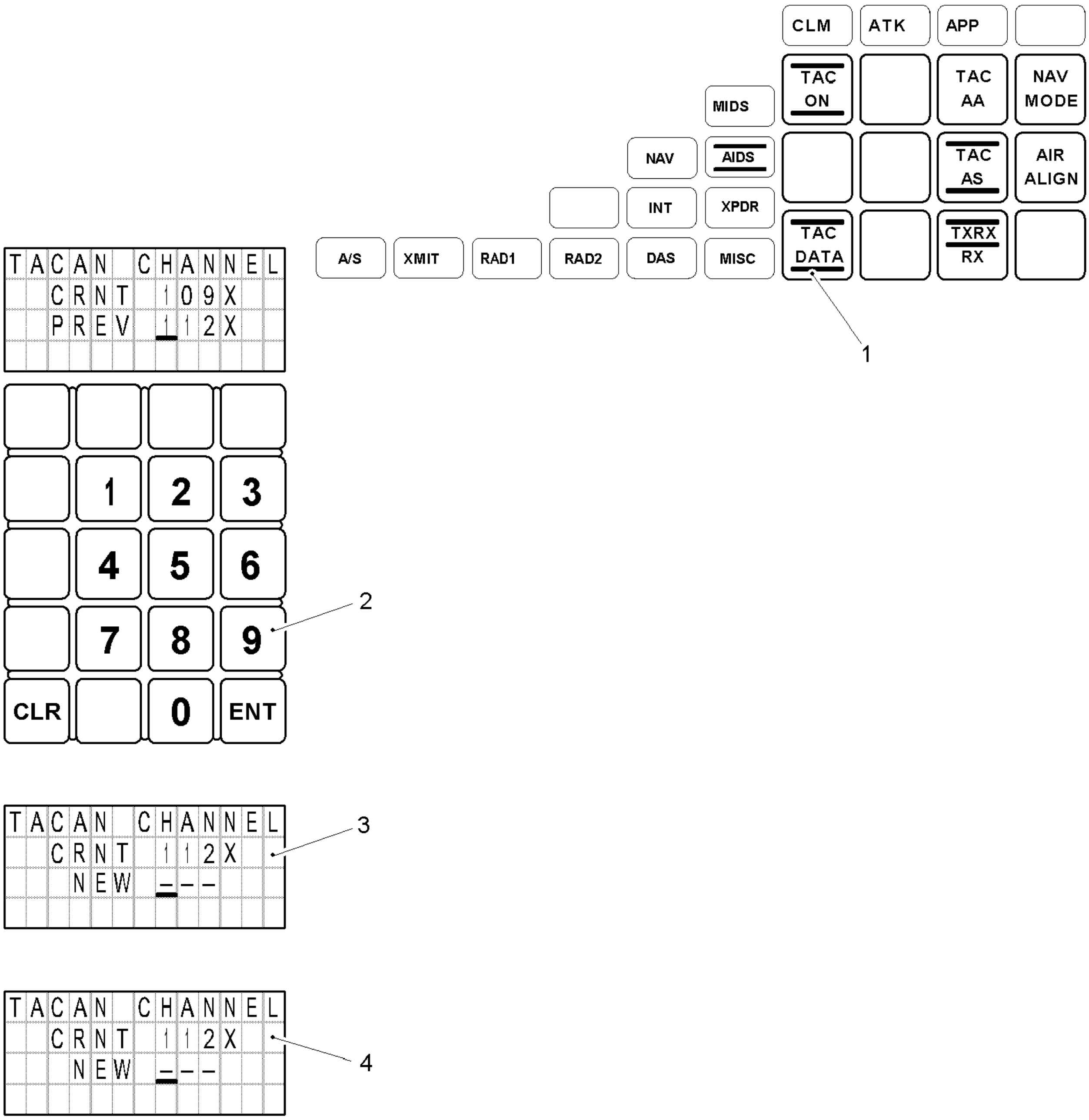
Figure I-03-118 TACAN Displays - Left Glareshield (Weight-off-Wheels)



1 ROL 3
2 X/Y DATA ENTRY KEY
3 DATA ENTRY KEYS
4 ROL 3 UPON INPUT OF FIRST CHARACTER
5 ROL 3 UPON PRESSING ENT KEY ON DEK

ICN-1B-B-345200-B-K0999-04594-A-01-2

Figure I-03-119 Edit TACAN Channel - Input New Channel



1 TAC DATA MODING KEY
2 DATA ENTRY KEYS
3 ROL 3 IF NO PREVIOUS TACAN CHANNEL NUMBER
4 ROL 3 UPON PRESSING CLR KEY ON DEK

ICN-1B-B-345200-B-K0999-04595-A-02-2

Figure I-03-120 Edit TACAN Channel - Select/Clear Previous

Intentionally left blank

COMMUNICATION EQUIPMENT

GENERAL

The communication system provides clear and secure air to air and air to ground communications and audio management. The system (refer to Figure I-04-01) consists of the Communications and Audio Management Unit (CAMU), two identical and independent VHF/UHF transceivers, the Multifunctional Information Distribution System (MIDS), the antennas, and their associated controls and indicators.

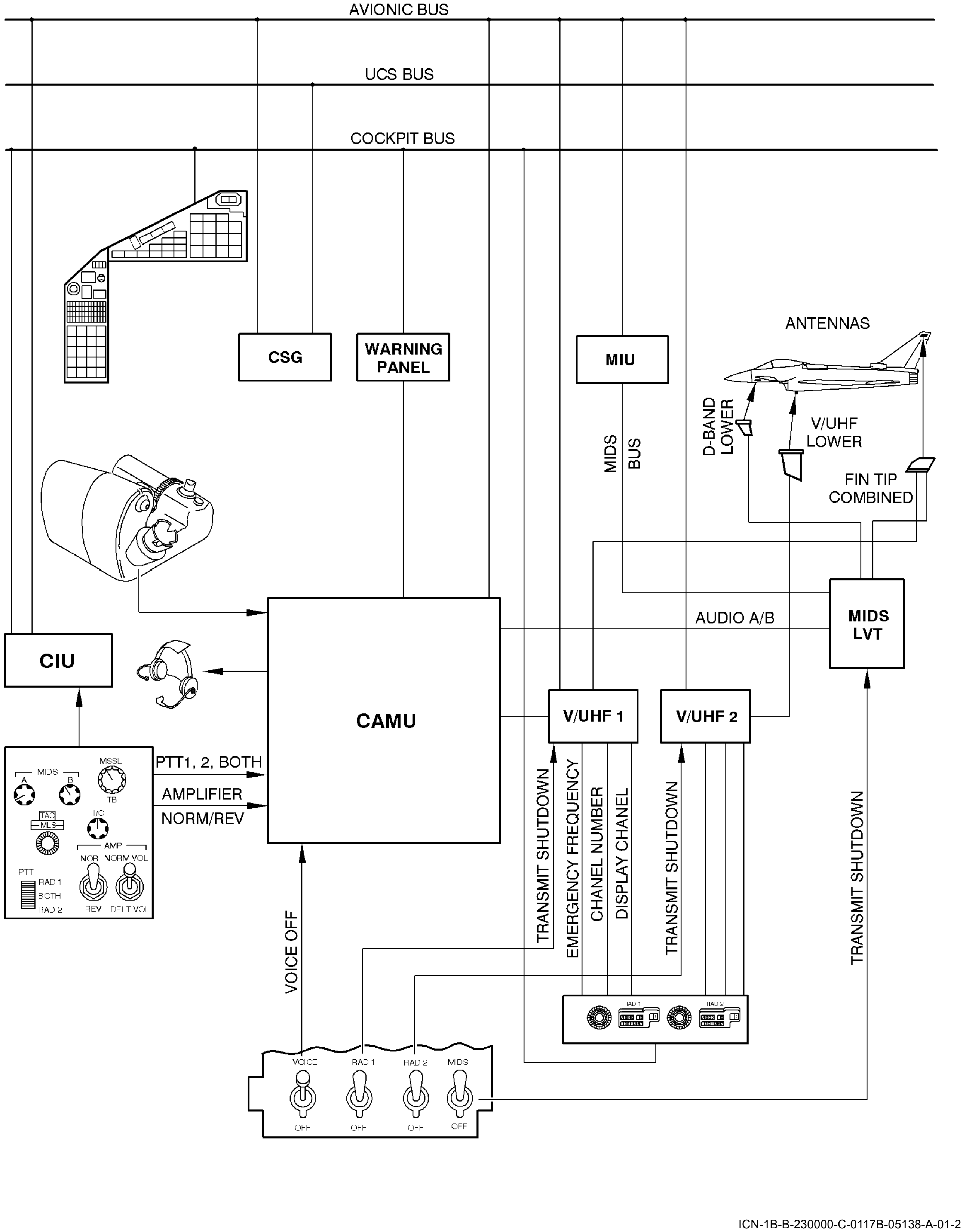


Figure I-04-01 Communication System

COMMUNICATION EQUIPMENT - CONTROLS AND INDICATORS

LEFT REAR CONSOLE

The left rear console (refer to Figure I-04-02) contains the duplicate PTT switch, the TACAN/MLS volume controls, the intercom volume control, the amplifier selector switch, the default volume selector switch, the missile audio/telebrief volume control and the MIDS A / B volume/transmission control.

DUPLICATE PTT SWITCH

The duplicate PTT switch is labeled RAD 1 - BOTH - RAD 2, has four positions and is spring-loaded centrally up. Pressing forward transmits on radio 1, backwards on radio 2. Pressing down in the center position transmits on both radio 1 and 2.

TACAN/MLS VOLUME CONTROLS

These coaxial controls vary audio volume for the TACAN (top rotary) and MLS (bottom rotary).

INTERCOM VOLUME CONTROL

A rotary knob labeled I/C, controls the intercom volume.

AMPLIFIER SELECTOR SWITCH

A two-position toggle switch labeled NORM and REV, provides manual selection of the reversionary amplifier.

DEFAULT VOLUME SELECTOR SWITCH

A gated two-position switch labeled NORM VOL and DFLT VOL, provides the manual selection of the default (fixed) audio volume setting. Also with the switch to DFLT VOL radio transmission is restricted to radio 1, reception is still available on both radios.

MISSILE AUDIO/TELEBRIEF VOLUME CONTROL

A rotary knob labeled MSSL and TB controls the SRAAM and telebrief audio levels. The knob is pushed in to transmit on telebrief.

MIDS VOICE CHANNEL A-B VOLUME AND TRANSMISSION CONTROLS

Two circular rotary controls, labeled MIDS A and MIDS B, control the audio volume of MIDS A and MIDS B voice channels. The control is pressed down to transmit on the relevant voice channel.

HOTAS

The communications switch on the right throttle (refer to Figure I-04-02) controls radio transmission, Direct Voice Input (DVI) and voice warning suspend. Pressing forward transmits on radio 1, pressing back on radio 2 and pressing in transmits on both radios simultaneously. Pressing up enables voice warning suspend. Pressing down enables DVI.

LEFT GLARESHIELD

The Manual Data Entry Facility (MDEF) provides the main controls for the radios, under separate RAD 1 and RAD 2 subsystem keys. The available modes and functioning of these subsystem keys are identical and the following description applies equally for both. The RAD 1 subsystem keys display is shown in Figure I-04-03 , and provides the following modes and functions:

TX TIME	Used as part of the HaveQuick and Saturn set up procedures, this facility allows the transmission of the Time of Day (ToD) to a receiving platform. Different times may be used for radio 1 and radio 2. When this function has been selected, the RX TIME function is not available and the moding key is occulted.
SQ ON/OFF	Deselects the automatic squelch facility, to assist in hearing weak signals at the expense of increased background noise. This facility is only available in clear speech modes, in secure modes the moding key is occulted.
NRW/BRD	This controls reception over a broad or narrow band around the selected frequency. This facility is only available in clear speech modes, in secure modes the moding key is occulted.
RX TIME	Used as part of the HaveQuick and Saturn set up procedures, this facility allows the reception of an operating time from another platform. When this function is selected, the TX TIME function is not available and the moding key is occulted.
NORM/LOW	Selects between full (NORM) and low transmitter power output, to reduce emission power and enhance stealth characteristics.
MAN/PSET	This allows the operating frequencies to be defined for both manual and preset channels. Additionally, HaveQuick and Saturn secure operating modes and their associated net identifiers can be selected in place of a standard frequency. It also allows the radio transmission to be pre-selected between clear and secure speech.
HAIL ON/OFF	Allows the selection of the Saturn Hail mode, through which a caller can attract the attention of the pilot that communication is required on a pre-defined frequency.

GRDU/GRDV Selects the guard receiver to either the military or civil guard frequency, or selects the guard receiver off.

DEFAULT SETTINGS

On initial power up, the following moding keys are selected as defaults:

MAN frequency - configures the Data Entry Keyboard (DEK) and Readout Lines (ROL) for manual frequency entry

NRW bandwidth

NORM power

GRDU military guard frequency on the guard receiver.

Each radio is set to the last channel or frequency in use on the previous shutdown.

HEAD UP PANEL

The HUP (refer to Figure I-04-03) contains rotary volume and channel select controls and readout displays for each radio. The outer (larger) rotary control controls radio audio volume. The inner (smaller) rotary control allows selection of any of up to 24 preset channels and the manually set frequency. The manual frequencies are defined by using the MDEF RAD1 or RAD 2 subsystem key sets; on entering the required manual frequency on the DEK, the system automatically selects the radio to manual frequency. However, the pilot may then select between that manual frequency and the presets by use of the HUP rotary controls. Pulling the channel selector knob out disables the channel selection function and sets the radio to 243.0 MHz (UHF guard).

There are displays to indicate the preset channel and the frequency in use. Displays also show whether the VHF or UHF guard frequency has been selected for monitoring (on the guard receiver), and whether the current frequency or channel is operating in Clear (CLR) or Secure (SECR) speech mode.

The HUP radio readout displays present the following information:

- The "number" of the channel selected (1-24 for a preset channel, M if a manual frequency or G for UHF guard).
- The "Frequency" of the selected channel (e.g. "297.725", "HQ1 074" for a HaveQuick 1 net, and "SAT 119 B" for a SATURN B net).
- If the guard receiver is set to VHF or UHF guard frequency (GU or GV) or guard receiver deselected (blank). When the radio is transmitting or receiving the display changes to (-U) or (-V) or (-) during and for 3 seconds after the transmission or reception.
- If the radio is operating in clear or secure mode (CLR or SECR).

RIGHT FORWARD CONSOLE

Transmitter switches for each radio, labeled RAD1 - OFF and RAD2 - OFF, are included in the battery gangbar on the right forward console (refer to Figure I-04-02). Power is permanently applied to the radios, each transmitter switch at OFF inhibits the transmission of that radio, reception remains active.

The voice warning switch, labeled VOICE and OFF, on the battery gangbar controls the voice warning system. With the switch at OFF all voice warnings, except for catastrophic, are inhibited.

COMMUNICATION WARNINGS

On the DWP, the following captions are presented:

VOICE	Indicates a failure of the voice output and audio warning system in the CAMU.
COMMS "COMMS"	Indicates: - a failure of any VHF/UHF transceivers, or - upon selection a radio channel, channel not available or illegal, or - crypto keys or time not properly loaded on any radio.

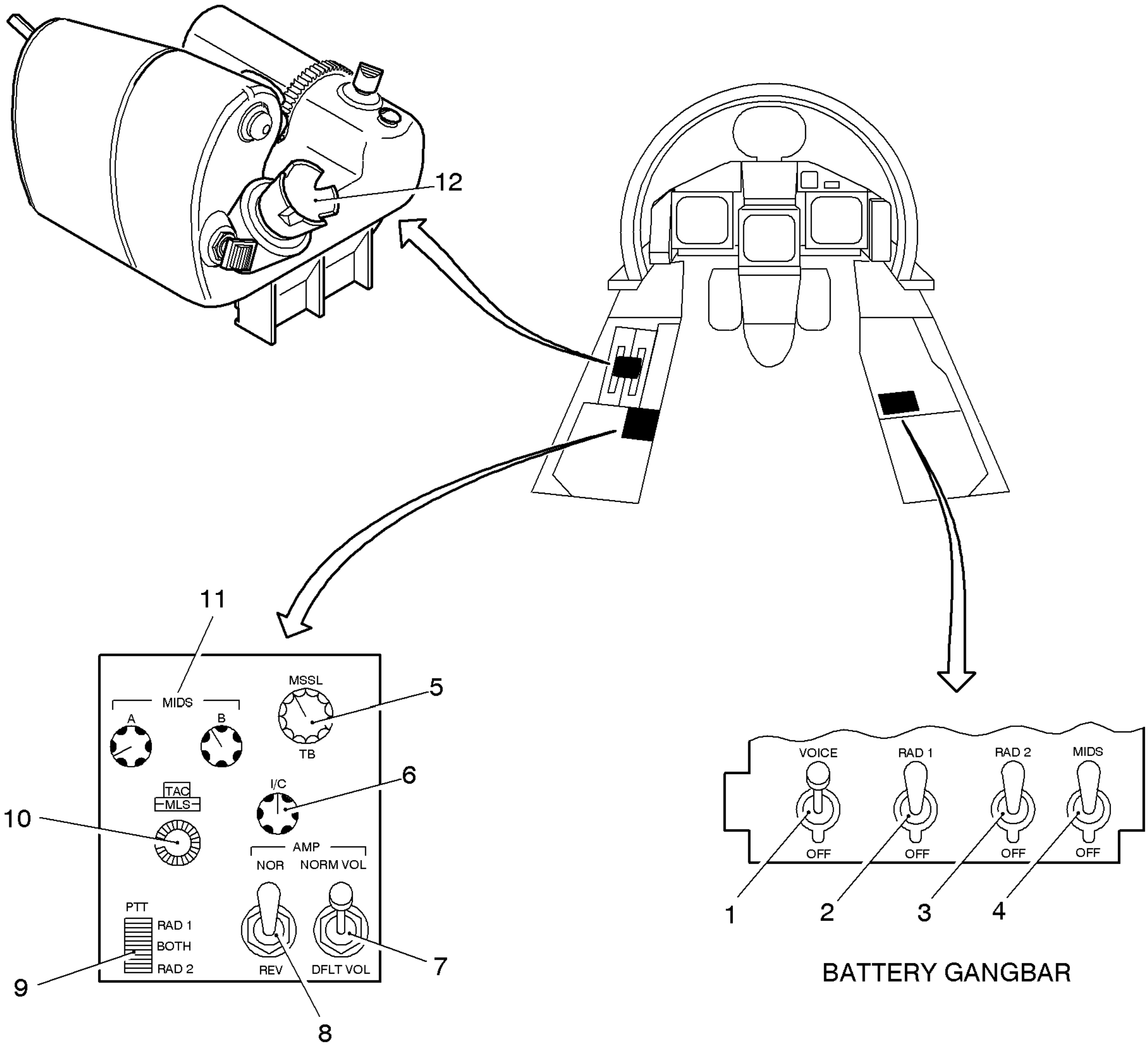
The following sound and voices are used for warning:

Beep	(CAT 4) Simultaneous clear/secure transmission. Any radio transmission in clear mode is attempted while another secure transmission through the other radio or MIDS (if operative) is taking place (or vice versa).
"FREQUENCY"	(CAT 4) Radios common tuning. Simultaneous channel selection on both radios using frequencies separated 50 kHz or less, or ECCM channels with the same parameters.
"HAIL RADIO 1" or "HAIL RADIO 2"	(CAT 4) A hail signal is detected on the hailing frequency while the relevant radio is operating in SATURN mode with HAIL enabled.

For Twin seat aircraft

TWO SEAT DIFFERENCES

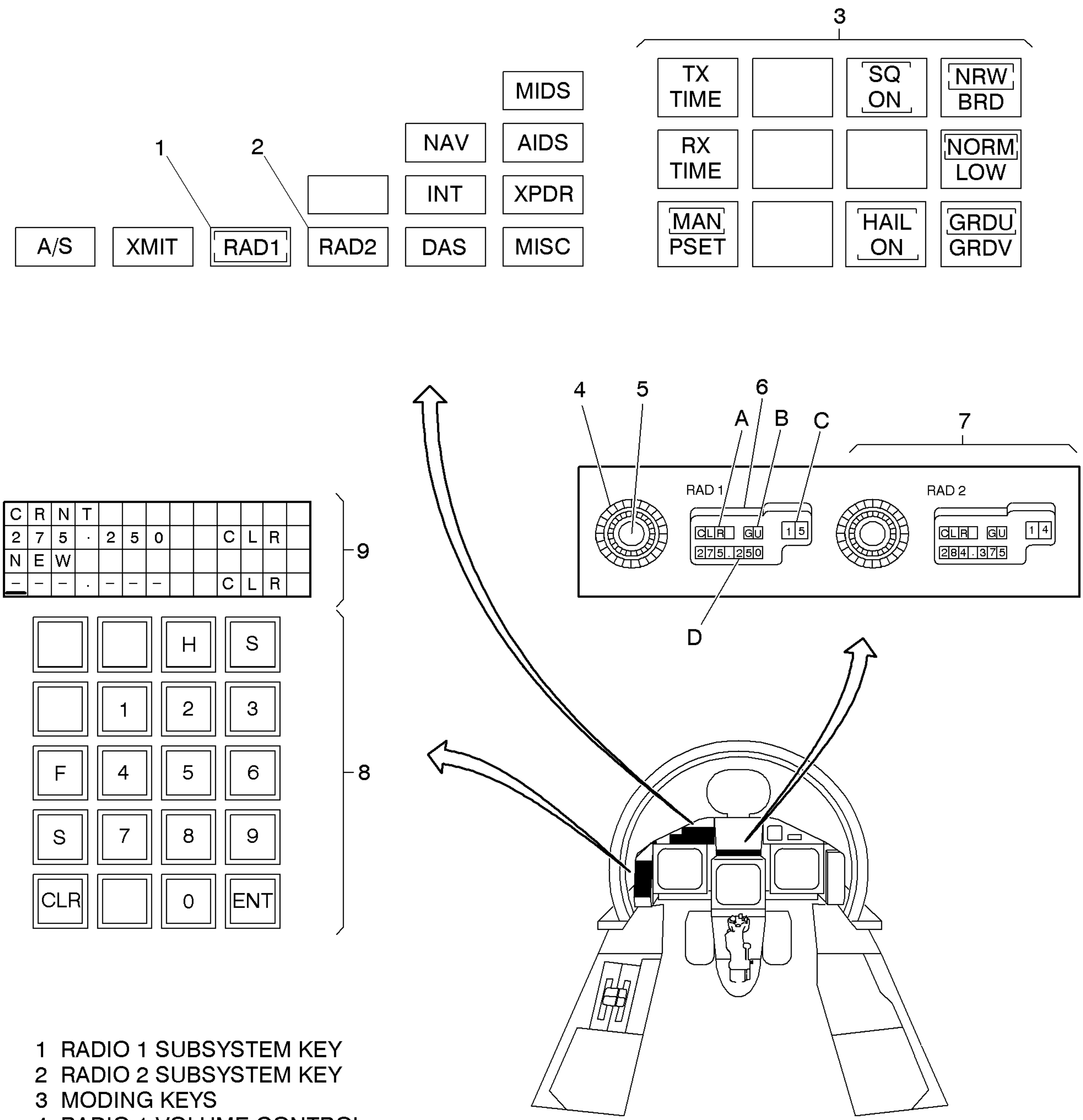
The rear cockpit communication controls are shown in Figure I-04-04 . The rear HUP and MDEF radio controls are identical to the front cockpit. The front and rear controls operate in parallel with no front or rear control priority; whichever control is operated last controls the system. The front and rear radio audios are routed through different CAMU audio modules, allowing each pilot to set volume at his desired level. Muting of all audios except cockpit intercom is achieved by pressing up the HOTAS communication switch in either cockpit. ⇐



1 VOICE WARNING CONTROL SWITCH
2 RADIO 1 TRANSMITTER SWITCH
3 RADIO 2 TRANSMITTER SWITCH
4 MIDS TRANSMITTER SWITCH
5 MISSILE AUDIO/TELEBRIEF VOLUME CONTROL
6 INTERCOM VOLUME CONTROL
7 DEFAULT VOLUME SELECTOR SWITCH
8 AMPLIFIER SELECTOR SWITCH
9 DUPLICATE PTT SWITCH
10 TACAN/MLS VOLUME CONTROLS
11 MIDS VOICE CHANNEL A/B VOLUME/TRANSMISSION CONTROLS
12 COMMUNICATION CONTROL SWITCH

ICN-1B-B-230000-C-0117B-01234-A-02-2

Figure I-04-02 Communication - Controls and Indications

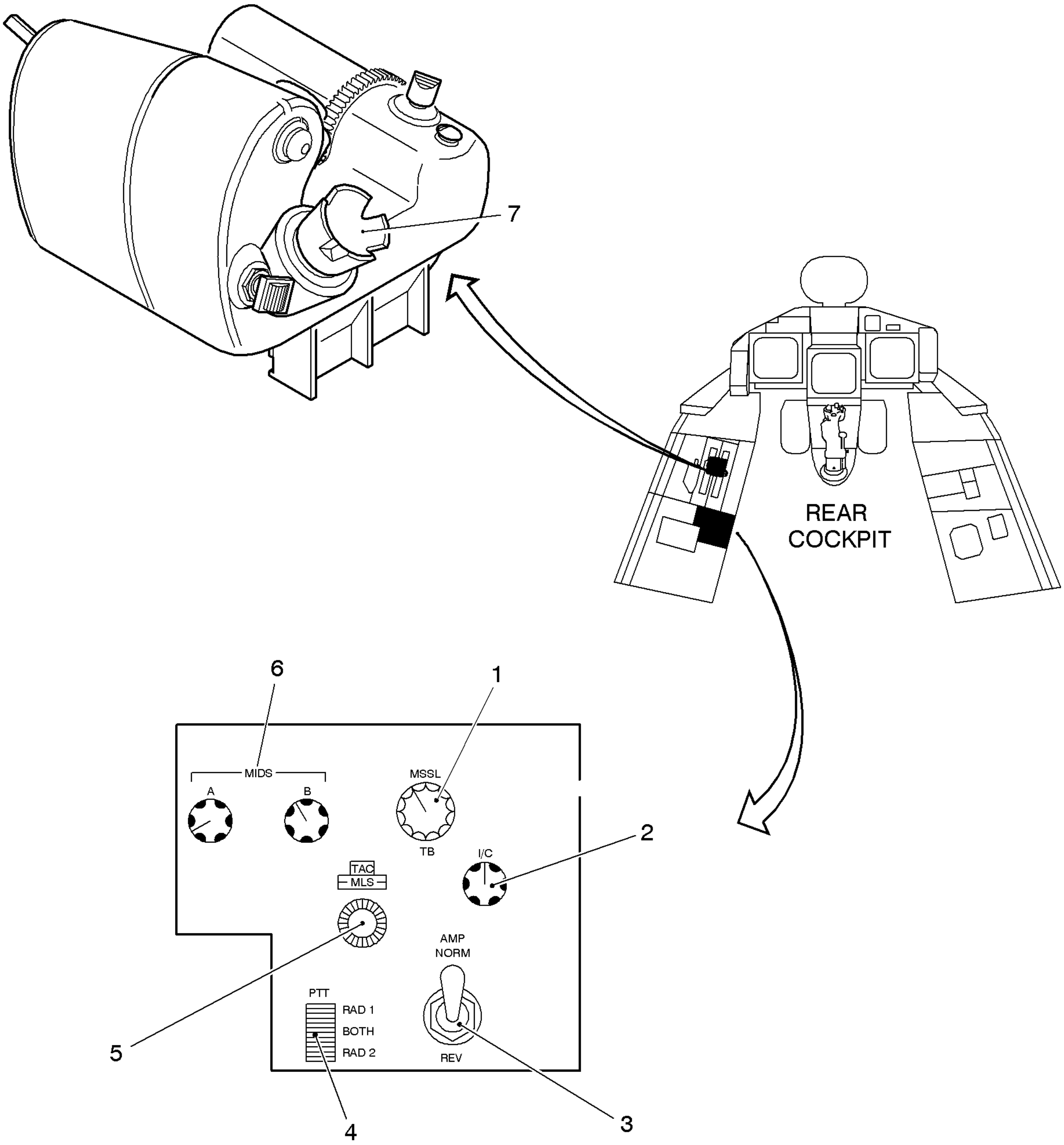


1 RADIO 1 SUBSYSTEM KEY
2 RADIO 2 SUBSYSTEM KEY
3 MODING KEYS
4 RADIO 1 VOLUME CONTROL
5 RADIO 1 CHANNEL SELECTOR KNOB
6 RADIO 1 READOUT DISPLAY
A. OPERATING MODE
B. ENABLED GUARD RECEIVER MODE & RADIO TRANSMIT/RECEIVE INDICATION
C. SELECTED CHANNEL DISPLAY
D. FREQUENCY ASSOCIATED TO THE SELECTED CHANNEL
7 SIMILAR TO ITEM 4 TO 6 FOR RADIO 2
8 DATA ENTRY KEYBOARD
9 READOUT LINES

ICN-1B-B-230000-C-0117B-01233-A-03-2

Figure I-04-03 Radios - Controls and Indications

For Twin seat aircraft



1 MISSILE AUDIO/TELEBRIEF VOLUME CONTROL
2 INTERCOM VOLUME CONTROL
3 AMPLIFIER SELECTOR SWITCH
4 DUPLICATE PTT SWITCH
5 TACAN/MLS VOLUME CONTROLS
6 MIDS VOICE CHANEL A/B VOLUME/TRANSMISSION CONTROLS
7 COMMUNICATIONS CONTROL SWITCH

ICN-1B-B-230000-C-0117B-01236-A-02-2

Figure I-04-04 Communication - Rear Cockpit Controls

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VHF/UHF RADIO

Two identical VHF/UHF radios are fitted, controlled through the MDEF, the HUP and HOTAS controls. Each radio provides the following coverage:

Receive only: 108.000 to 117.975 MHz

Transmit and receive (VHF): 118.000 to 155.975 MHz

Transmit and receive (UHF): 225.000 to 399.975 MHz

Each radio has 24 preset frequencies (channels), and any 12.5 kHz (in VHF) or 25 kHz (in UHF) spaced frequency can be manually selected. The pilot may select an additional receiver in each radio on which to monitor VHF or UHF Guard frequency. Secure speech facilities are available, dependant on the loading of suitable cryptovariables, and UHF HaveQuick and Saturn ECCM facilities are also available, depending on the loading of Time of Day (ToD) and Word of Day (WoD). Radio 1 is powered from essential DC bus bar PP7 and radio 2 from nonessential DC bus bar PP2. This means only radio 1 is available on the ground on battery power.

Radio 1 is connected to the fin tip combined antenna, while radio 2 is connected to the lower VHF/UHF antenna.

NORMAL RADIO OPERATION

POWER UP

Power is automatically applied to radio 1 when the battery is turned ON during the starting procedures. Both radios are powered when the APU generator is on line, an engine is running, or ground power is applied. The relevant transmitter is inhibited when the battery gangbar RAD 1 or RAD 2 switch is OFF, but reception is still enabled. The radios are set to the channel or manual frequency in use when the radio was last depowered.

PRESET FREQUENCY SELECTION

The preset channels are selected using the rotary channel control on the HUP, the selected channel and the frequency associated with that channel are displayed in the radio readout displays.

The frequencies associated with the preset channels may be amended by selecting the MAN/PSET moding key to PSET (refer to Figure I-04-05). The Readout Lines (ROL) configure to show the currently selected channel and associated frequency; if the radio is currently using a manual frequency, the ROL and writing marker are configured to allow the typing in the required channel number. The frequency associated with the channel is displayed in the third ROL, and may be amended using the Data Entry Keyboard (DEK). MDEF routines used to select a channel and to modify the frequency associated with that channel are:

RAD (1 or 2) - PSET - DEK type in channel number - DEK type in required frequency - ENT (Channel number and frequency can be selected and/or altered independently, changes are implemented on pressing the ENT key).

MANUAL FREQUENCY SELECTION

The currently selected manual frequency is displayed in the second ROL (refer to Figure I-04-06). The previously used manual frequency (if it exists) is shown in fourth ROL. The DEK may be used to amend the previous frequency if required, while the radio continues to use the current frequency. On pressing the ENT key, the previous and current frequencies are exchanged, the readout lines display the new frequency now in use in the second ROL, while the last used frequency is placed in the fourth ROL for editing if required. The frequency currently being used by the radio is also shown on the radio readout displays. The MDEF routine is:

RAD (1 or 2) - MAN - DEK type in new frequency - ENT.

Having selected the required frequency, the pilot selects between using manual or preset channel frequency by the frequency control on the HUP. With manual selected ("M" in the channel window), the current manual frequency is displayed in the frequency window of the radio readout displays.

SAME FREQUENCY TRANSMISSION

If both radios are set to the same frequency i.e. frequencies separated 50 kHz or less, or ECCM channels with the same parameters a Cat 4 warning "FREQUENCY" is triggered to warn of a potential mutual interference problems.

GUARD RECEIVER MODE SELECTION

The guard receiver of each radio can be set individually to receive on UHF or VHF guard frequencies (refer to Figure I-04-07). The power-up default setting is UHF guard frequency. Guard monitoring is available in both fixed frequency and ECCM modes. Manual selection between UHF, VHF and OFF is made via the GRDU/GRDV moding key and the selection is shown on the radio readout displays on the HUP.

TRANSMISSION/RECEPTION ON EMERGENCY FREQUENCIES

Rapid selection of a radio to UHF guard (243 MHz) is by pulling relevant HUP channel selector knob to the out position. The radio readout displays indicate selection of the channel and the frequency. When UHF guard is deselected, the radio reverts to the channel that was previously selected, provided that the channel selector has not been rotated during guard channel selection. To transmit on VHF guard (121.5 MHz), this frequency must be set manually.

BANDWIDTH

To aid coherent communication narrow or broad bandwidth can be selected via the MDEF using the NRW/BRD moding key, the default setting is narrow. Manual selection of bandwidth is only available in the fixed frequency, HaveQuick I and HaveQuick II clear voice modes. Broad bandwith is automatically selected when in HaveQuick I or HaveQuick II, Saturn or fixed frequency secure modes. In these secure modes the NRW/BRD moding key is unavailable for selection. When these secure modes are deselected the system sets the bandwidth to its previously selected state and the moding key is available for selection.

TRANSMITTER POWER

Manual selection of low transmitter power is provided via the MDEF using the NORM/LOW moding key. High power (NORM) is the default setting, it is used for long range communications. Low power is used for short range, stealth, or other operational reasons.

SQUELCH MODE

The squelch function rejects unwanted weak signals to improve message clarity, but can be turned off to keep weak signals audible, power up default is ON. Manual selection of the squelch function is only available in the fixed frequency, HaveQuick I and HaveQuick II clear voice modes. Squelch is automatically selected to OFF when in HaveQuick I or HaveQuick II, Saturn or fixed frequency secure modes. In these secure modes the SQ ON/OFF moding key is unavailable for selection. When these secure modes are deselected the system sets squelch to its previously selected state and the moding key is available for selection.

BROWSE RADIO LIST

The majority of the radio channel information is displayed on the FREQ format (refer to Figure I-04-08). The format is available in all PoF and is accessed by selection of the FREQ soft key on the MHDD. The format includes details of channel number, frequency or network identifier, station identifier, clear/secure status, current KoD number for that channel (if secure) and whether NATO or non-NATO hopsets are selected in HaveQuick II or Saturn modes. The currently selected channel is highlighted by a green box. On first selection of the FREQ format, the page showing the current radio 1 channel is displayed. The frequency channel lists for either radio 1 or radio 2 can be selected by XY insert on the relevant radio icon or by selecting the RAD1/RAD2 soft key. Successive pages of radio information can be selected by XY insert on the page up and down icons or using the PAGE UP or PAGE DOWN soft keys.

ECCM MODES OF OPERATION

To aid communications in the ECM jamming environment, HaveQuick I and HaveQuick II, and Saturn frequency hopping ECCM communications are available. HaveQuick II and Saturn are capable of using either NATO or non-NATO hopsets. These modes require an accurate UTC system time (ToD) and Word of Day (WoD). If ToD and WoD are not available, the ECCM modes are not available for selection. Selection of Saturn mode or HaveQuick I or HaveQuick II secure voice mode automatically selects broad bandwidth and switches the squelch filtering to OFF.

Soft.Prog.Ed.: PSC 2.0 onwards

Additional HaveQuick II and Saturn modes (FMT 1, 2, 3, 4 and SAT-T40) are available for training purposes.
⇐

Time Synchronization

To ensure satisfactory operation of the ECCM modes there are means to receive and transmit an accurate update of time (refer to Figure I-04-09). If the value of the system time supplied to the radios degrades to a level which jeopardizes the correct operation of the ECCM modes, or if the system time becomes unavailable, then a Cat 3 COMMS warning is generated to indicate a required time update. The MDEF routine for receiving the ToD is:

RAD (1 or 2) - RX TIME

The RX TIME moding key remains selected until a satisfactory ToD is received, even if the RAD subsystem key is deselected. The function can be deselected any time before receiving a valid ToD by manually de-selecting the RX TIME.

The MDEF routine to send Net ToD is:

RAD (1 or 2) - TX TIME

On selecting TX TIME, the radio transmits ToD for 5 seconds and then automatically de-selects. Transmission can be interrupted by manually de-selecting TX TIME.

Cryptovariables

Cryptovariable codes are necessary for operation of the ECCM modes and for secure speech encryption and decryption. KoD cryptovariables are used for voice encryption and decryption and WoD cryptovariables are used for the ECCM functions. All radio cryptovariables (six KoD, six WoD and one Key Encryption Key) are loaded using a fill gun. A KoD cryptovariable is stored for each channel and the initial allocation of a KoD number to individual channels is defined by the PDS channel information data.

ECCM Mode Selection

HaveQuick and Saturn modes are set using the data entry keyboard, accessed through the MAN or PSET moding keys. On selection of a RAD subsystem key; the default manual (MAN) frequency edit mode is automatically selected, and the readout lines and data entry keyboard configured accordingly. The data entry keyboard includes "H" and "S" keys (refer to Figure I-04-10). Selecting one of these keys re-configures the third ROL to read "NEW" and the fourth ROL to "HAVQ" for HaveQuick and "SAT" for Saturn, with blank spaces available for entering the appropriate HaveQuick or Saturn net number. The net numbers for each facility lie between 001 and 999. Saturn nets are additionally identified with "A" or "B", an "A" or "B" key is included in the data entry keyboard when Saturn has been selected. The readout lines either show the previously selected mode or default to "A" for new entries. The MDEF routines are as follows:

- To select Havequick: RAD (1 or 2) - DEK "H" - DEK type in net number - ENT
- To select Saturn: RAD (1 or 2) - DEK "S" - DEK type in net number - DEK type in "A" or "B" - ENT

This moding is identical for PSET channel frequencies.

Soft.Prog.Ed.: PSC 2.0 onwards

The training HaveQuick II net modes (FMT 1, 2, 3, 4) are identified with a "F" in the DEK, and the net numbers for the training modes (HQII and SAT) lie between 1000 and 1015.

⇐

Secure Speech

Clear and secure voice communications for both fixed frequency and frequency hopping ECCM modes of operation can be selected. Secure speech is possible on all frequencies, depending on valid KoD cryptovariables being loaded. If valid KoD cryptovariables are not loaded, secure speech is not available. The default status for secure communications is clear, but channels may be defined as secure either through PDS load or by manual selection via the MDEF. Selection of a secure channel automatically selects the broad bandwidth and switches the squelch filtering to ON.

Secure speech mode is selected by the "S" key in the DEK (refer to Figure I-04-11). On selection, the key changes to "C", to allow re-selection to Clear speech when required. The fourth ROL displays "CLR" or "SECR" to indicate Clear or Secure has been selected. The MDEF routines are:

- To select secure speech: RAD (1 or 2) - DEK "S" - ENT
- To select clear speech: RAD (1 or 2) - DEK "C" - ENT

On selecting "S" the ROL indicate the current KoD. If no KoD is loaded, the writing marker jumps to the blank KoD field on the third ROL, and the DEK are configured with the numbers 1 - 6. One of these numbers must be entered for the secure voice mode to be available. A separate KoD may be loaded for each channel or frequency, the KoD can be changed at any time using the DEK.

If one radio is set to clear speech and the other to secure and the pilot attempts to transmit simultaneously on both radios (or is transmitting on MIDS secure voice at the same time) a warning "beep" is triggered on the intercom to warn of the potential security compromise.

Saturn Hail

Selection of Saturn enables the monitoring of a Hail frequency, provided that a hailing frequency has been loaded, hailing frequencies can only be entered by PDS and cannot be altered. A different hailing frequency can be loaded for each radio. HAIL ON is the system default, but can be de-selected and re-selected via the HAIL ON/OFF moding key while in Saturn mode, or preselected prior to entering Saturn mode. If no hailing frequency has been loaded for either or both radios, the related HAIL ON/OFF moding key is not available. When a signal of more than 3 seconds is received on the Hail frequency, a Cat 4 warning ("HAIL RADIO 1" or "HAIL RADIO 2" as appropriate) is given.

For Twin seat aircraft

TWO SEAT DIFFERENCES

The front and rear cockpit HUP and MDEF radio controls are identical. There is no priority cockpit in controlling the radios through the HUP and MDEF; the last input made is used to set the required channel, frequency or operating mode.

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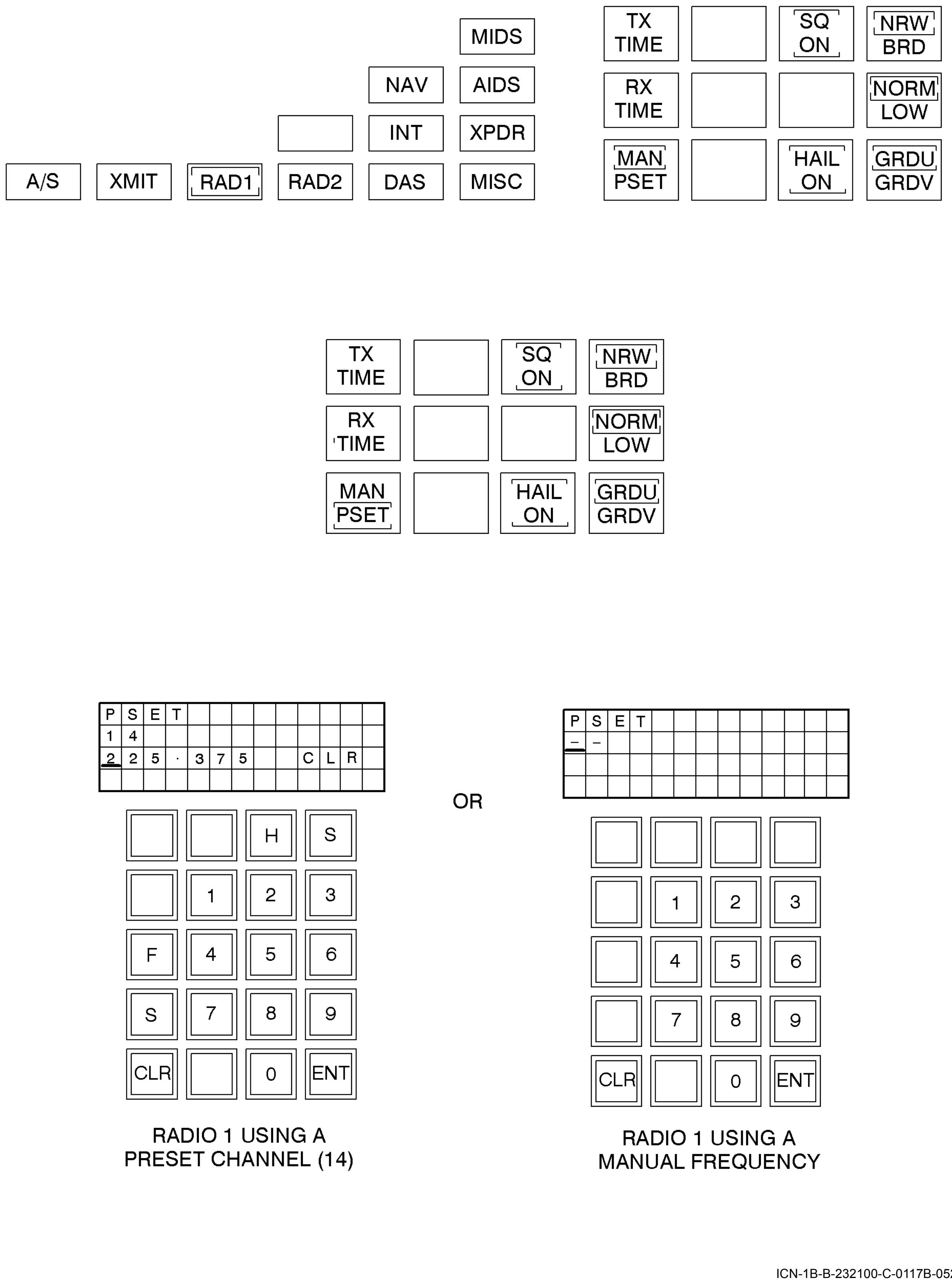


Figure I-04-05 Preset Frequency Selection

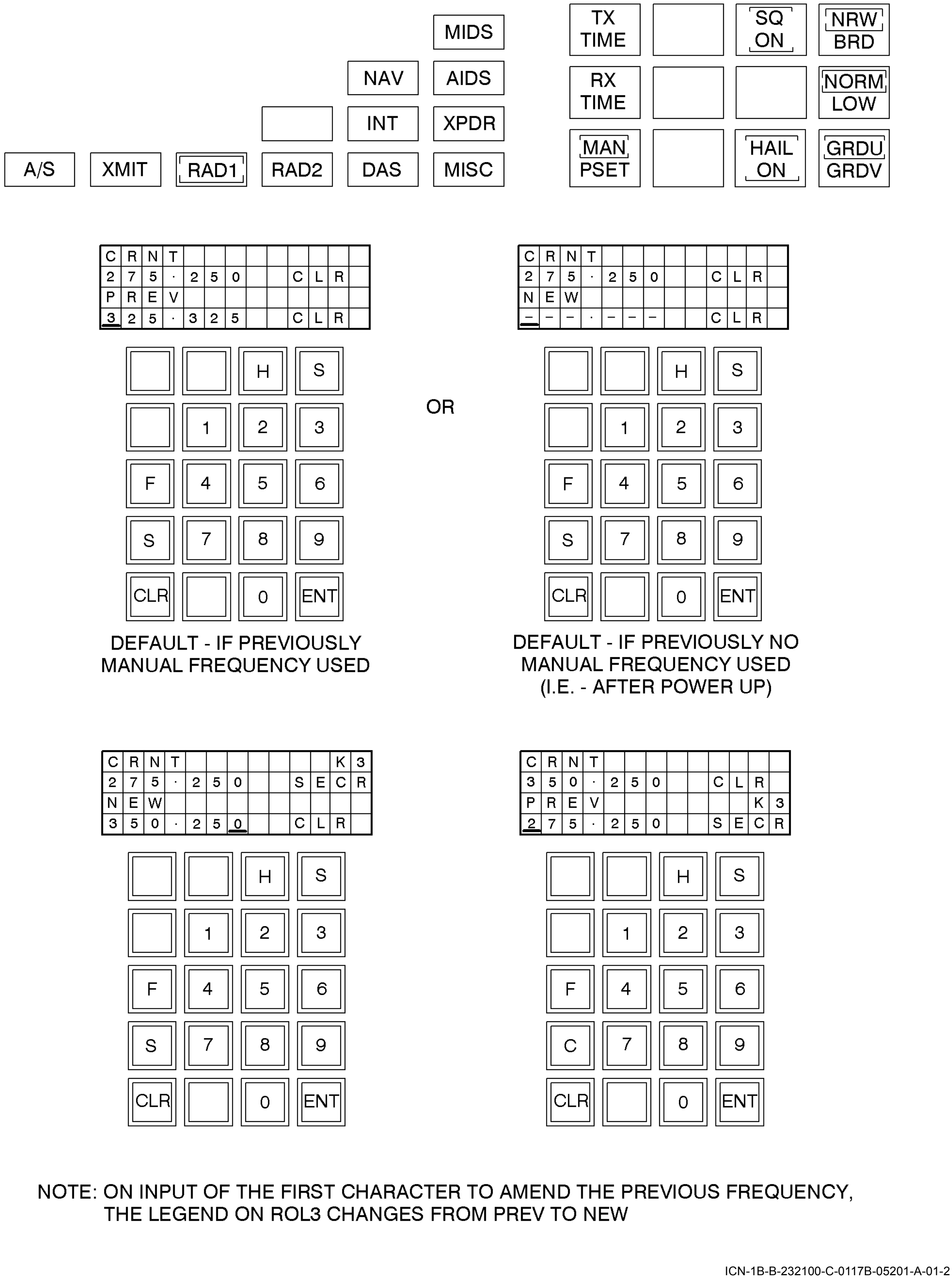
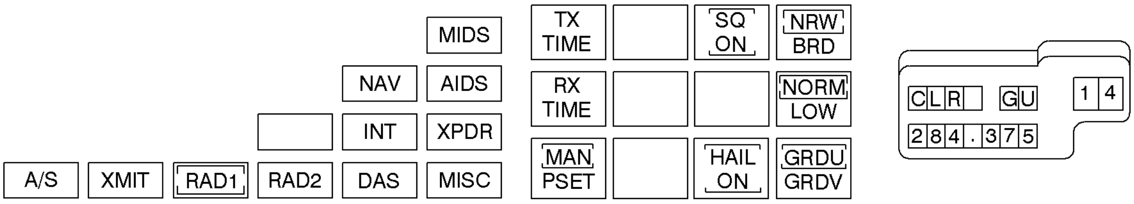
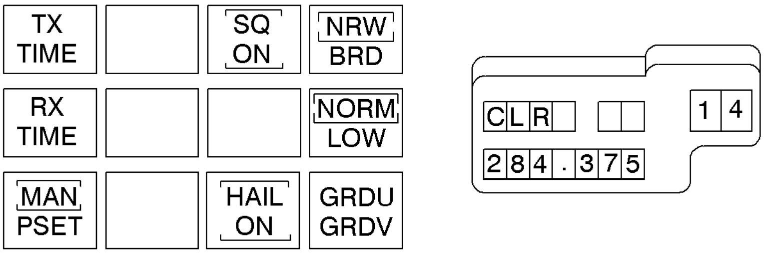


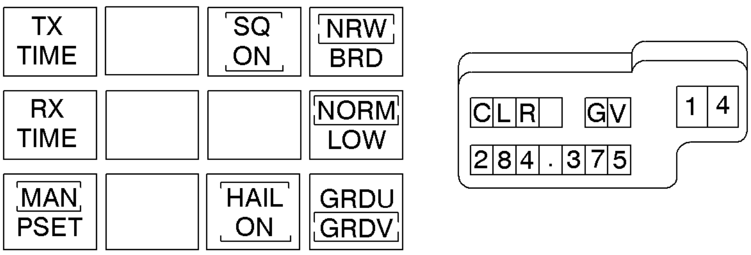
Figure I-04-06 Manual Frequency Selection



DEFAULT SETTING - UHF GUARD FREQUENCY SELECTED



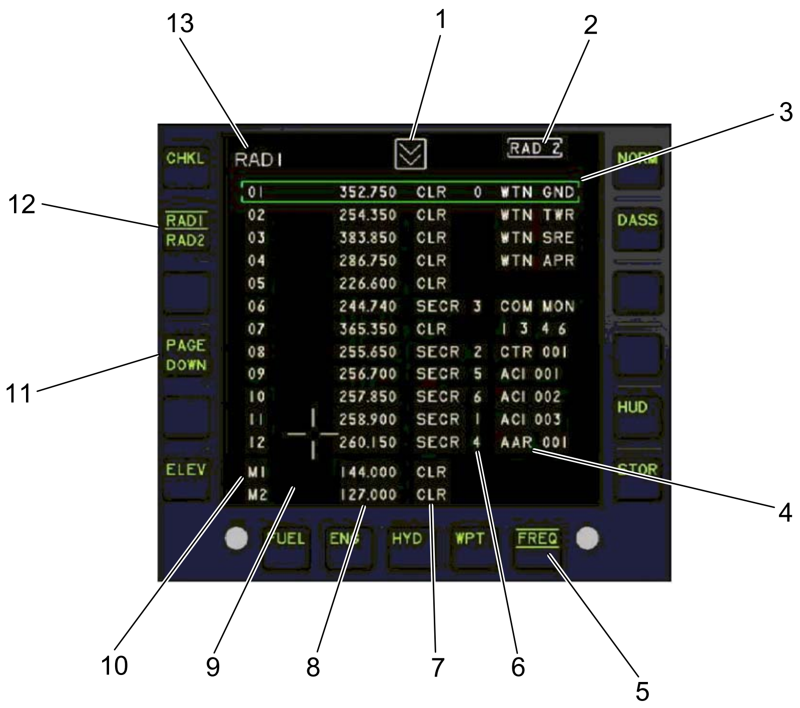
GUARD RECEIVER DESELECTED



VHF GUARD FREQUENCY SELECTED

ICN-1B-B-232100-C-0117B-05203-A-01-2

Figure I-04-07 Guard Receiver Mode Selection



1 PAGE UP/DOWN ICON
2 RADIO SELECT ICON (EITHER RAD1 OR RAD2)
3 CURRENT CHANNEL IN USE (WITH ADDITIONAL INFORMATION)
4 STATION IDENTIFIER
5 FREQ SOFTKEY
6 KEY OF DAY
7 CLEAR/SECURE STATUS
8 FREQUENCY
9 FREQUENCY HOPSET COLUMN (NATO OR NON-NATO)
10 CHANNEL NUMBER (M= MANUAL)
11 PAGE DOWN SOFTKEY
12 RAD1/RAD2 SOFTKEY
13 SELECTED RADIO (EITHER RAD1 OR RAD2)

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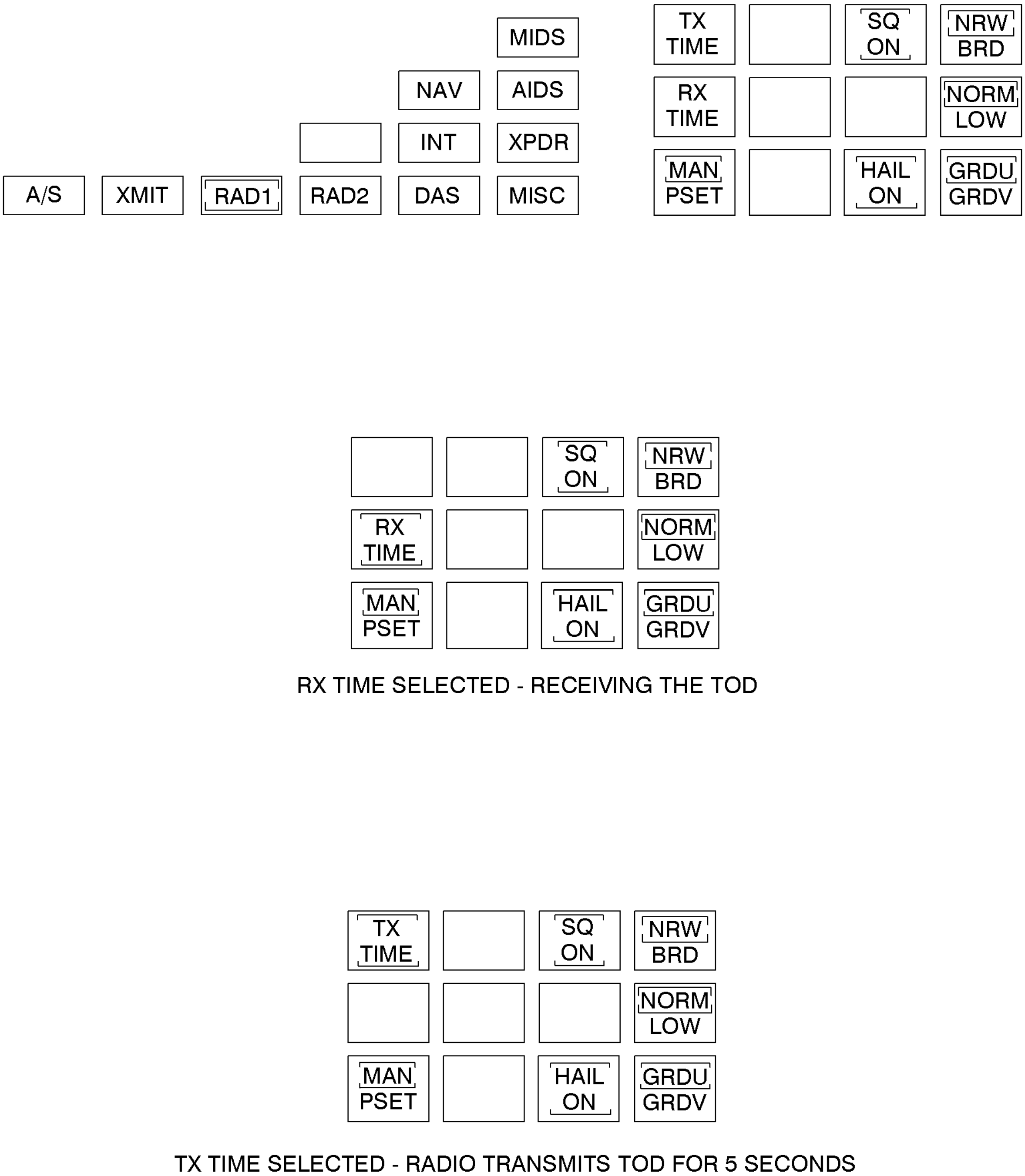
Figure I-04-08 MHDD - FREQ Format



ICN-1B-B-232100-C-0117B-05204-A-02-2

Figure I-04-09 Time Synchronization

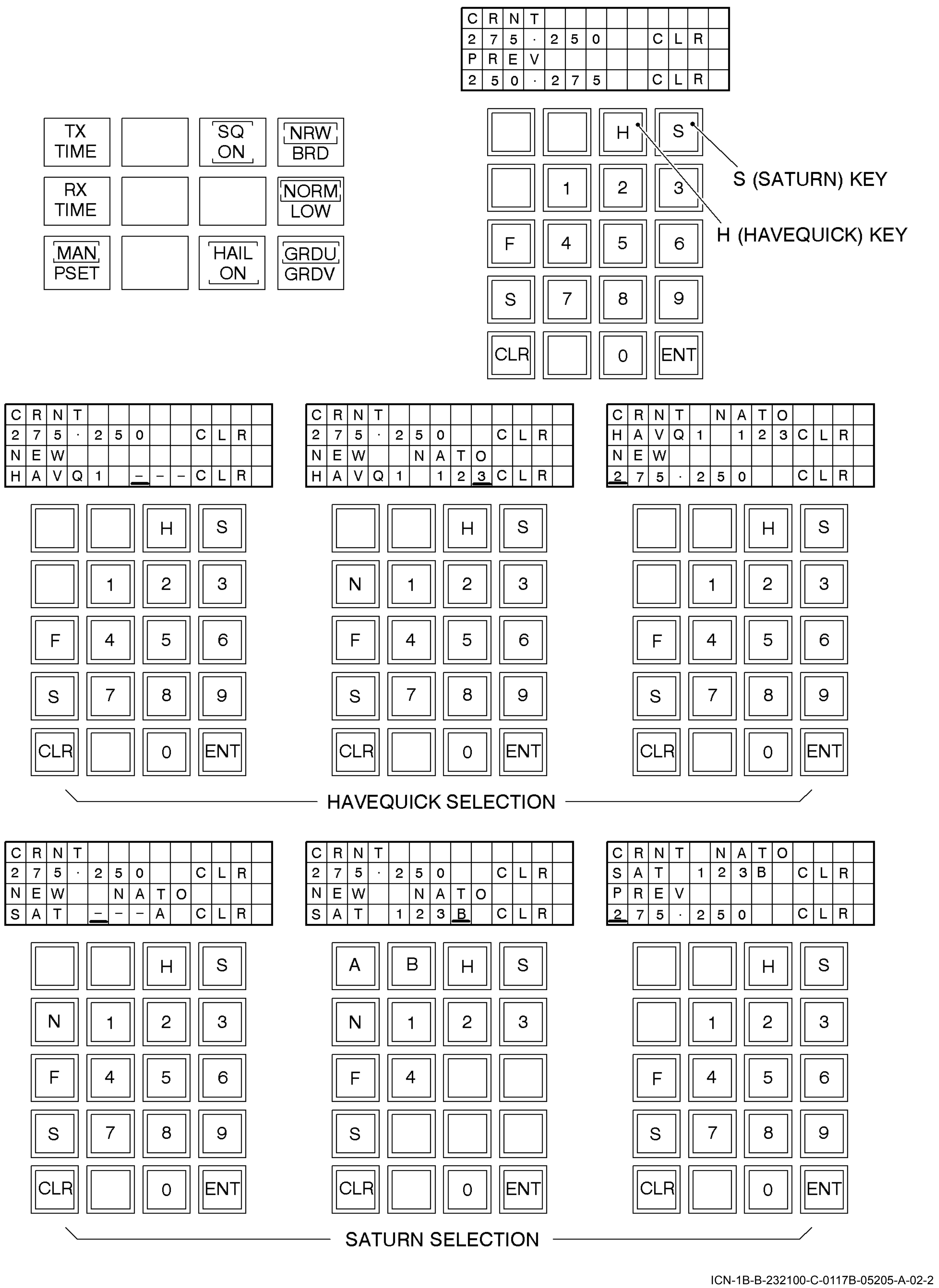
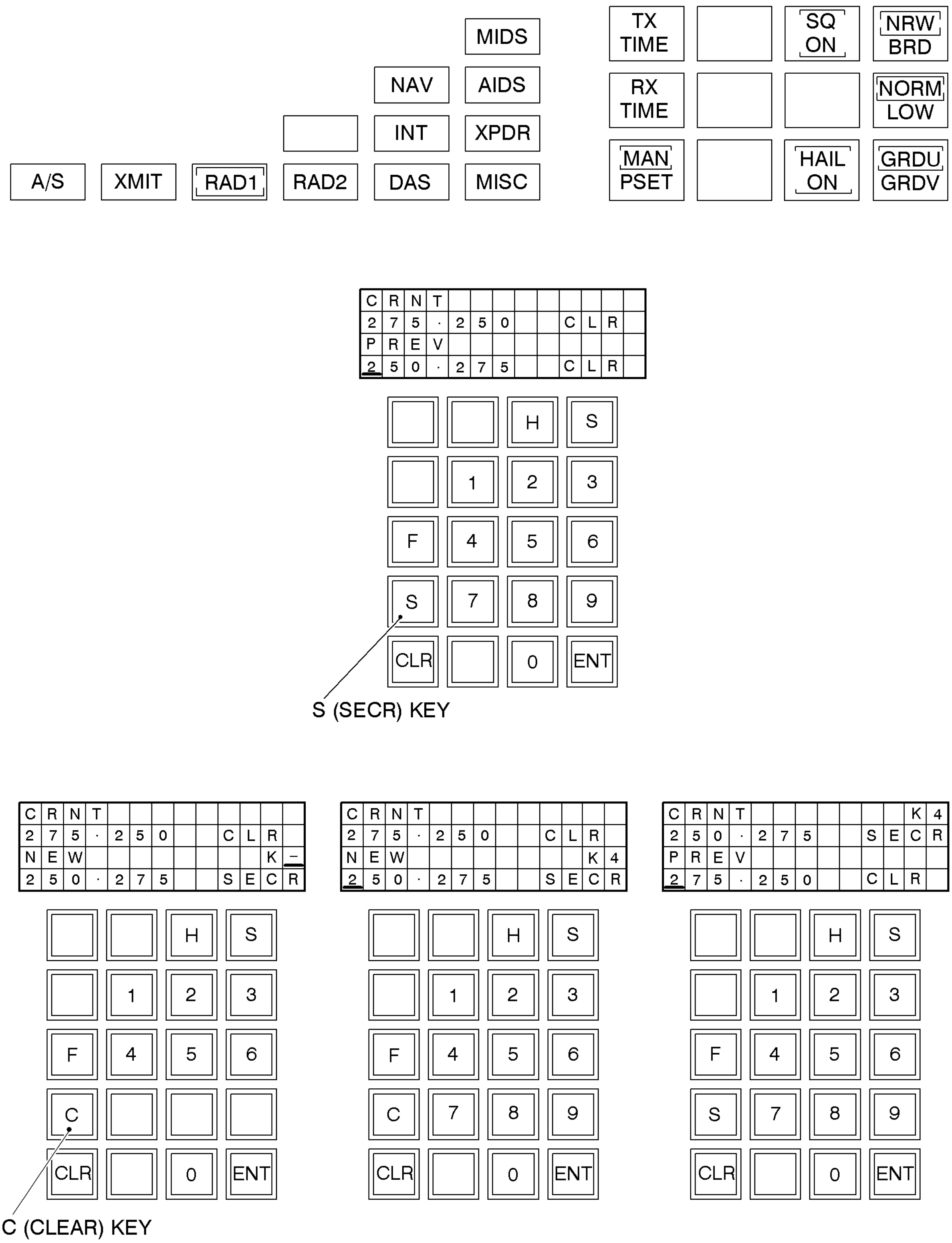


Figure I-04-10 ECCM Mode Selection



ICN-1B-B-232100-C-0117B-05206-A-02-2

Figure I-04-11 Secure Speech

COMMUNICATIONS AND AUDIO MANAGEMENT UNIT

The CAMU controls the aircraft communication system, managing all audio routing and control between the system components and the cockpit. The CAMU also generates warning audios and voice messages, and provides redundancy and automatic re-moding in event of component failure. The CAMU is powered through DC PP1 and PP7 DC busbars, allowing intercom and transmission/reception via radio 1 when on battery power.

The CAMU consists of a processor module, two audio communication modules, two warning generator modules, an audio filtering and switching module, a speech recognition module and an external data bus terminal module. Each audio communication module incorporates two amplifier boards, each with a normal and a reversionary amplifier, providing redundancy and continued operation in the event of module or amplifier failures.

OPERATION

START

Electrical power is applied automatically to the CAMU and related communications equipment during the normal startup process. The CAMU and radio 1 are powered from the battery, providing intercom and R/T through radio 1 on battery power if required, the remaining equipment becoming available either on provision of APU generator power or the connection of ground power. With the APU running, it is possible to communicate on both radios and also initialize and establish net communication through MIDS data link and voice (if operative).

AUDIO MANAGEMENT

The CAMU provides intercom whenever powered, controlled through the intercom volume control on the left console. Individual radio, MIDS voice channel (if operative), navaid, telebrief and missile audio volumes are also controlled through their individual volume controls.

FAILURES

A full or partial failure of the CAMU is indicated by full or partial loss of audio. The selection of amplifier selector switch to REV selects the alternate audio module within the CAMU and should recover normal operation. If this is unsuccessful, audio may be recovered by selecting the default volume selector switch to DFLT VOL, audio levels are then fixed at levels stored within the CAMU and the individual volume controls are inoperative. Also, radio transmission is restricted to radio 1 only, radio 2 reception is still possible (at fixed volume) but transmission is disabled.

For Twin seat aircraft

TWO SEAT DIFFERENCES

AMPLIFIER SELECTOR SWITCH

Cockpit audio control is via audio module 1 for the front cockpit and audio module 2 for the rear cockpit. This provides for independent volume control, using the individual controls in each cockpit. Selection of either cockpit amplifier selector switch to REV changes audio control to the other cockpit audio module. Also, following a CAMU audio module failure, independent volume control is lost. If audio module 1 fails, the front cockpit loses audio. On selecting the front cockpit amplifier selector switch to REV, audio is regained through audio module 2, but the volume levels in both cockpits are set by the rear cockpit volume controls. Similarly, if audio module 2 fails, rear cockpit audio is provided by audio module 1, with volume levels set by the front cockpit.

If the aircraft is flown solo (command eject switch to SOLO), failure moding is identical to the single seat, i.e. an audio module failure and selection of amplifier selector switch to REV, results in audio being provided by audio module 2, but the pilot retains audio level control through the front cockpit volume controls.

DEFAULT VOLUME SELECTOR SWITCH

There is no default volume selector switch in the rear cockpit, but putting the front cockpit switch to DFLT VOL restricts rear cockpit transmission to radio 2, while the front cockpit is restricted to transmission on radio 1. Reception is available on both radios in each cockpit. Also, with the front cockpit default volume selector to DFLT VOL, there is no cockpit intercom.

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DIRECT VOICE INPUT

A Direct Voice Input (DVI) system provides an additional method of managing the cockpit and systems. The DVI system replicates some existing control functions, which means the loss of DVI control for any reason (e.g. unserviceability or poor recognition because of environmental conditions) does not result in the loss of associated functions. DVI is used to support the cockpit management tasks:

- To replicate many functions that are also done by XY control, e.g. A/A target nomination, MHDD format range scale changing.

- To replicate many MHDD soft key functions, e.g. right MHDD format selection.

- To replicate many MDEF moding key and DEK functions, e.g. radio channel selection.

DVI is not used to replicate HOTAS functions, these are specifically designed to be done rapidly on dedicated controls, and the use of DVI would probably be slower. DVI is not used to control any safety critical functions e.g. selecting weapons or lowering the undercarriage, or to replicate functions controlled by hard-wired switches. The DVI system is contained in a module within the CAMU, and interfaces with the avionic system through the avionic bus.

CONTROLS AND INDICATORS

The controls and indicators are as follows:

DVI Enable	Pressing down the communication switch (on the throttle top unit) enables the DVI system.
HUD Feedback	For complex commands (see) a line of text is displayed in the bottom of the HUD so the recognition of the DVI command can be monitored. The line consists of an outline box surrounding the text showing the recognized DVI inputs. A horizontal line (the cursor) underlies the position in the text string that is being controlled by the DVI at that moment. The text line ceases to be shown as soon as the communication switch is released.
Audio Tone	A brief audio tone "beep" is output when the DVI recognizes certain commands, and provides a feedback that the DVI command has been recognized.
MDEF DVI	The DVI ON/OFF moding key provides a means of disabling the DVI. However, with OFF selected, some DVI commands still trigger a recognition beep and/or a voice output, although no other system responses occur.

DESCRIPTION

The DVI system comprises a sound recognizer (a module within the CAMU) that interfaces, through the avionic bus, with the cockpit displays and controls. The sound recognizer recognizes sounds, rather than words, and must be loaded with the pilot voice templates in order to achieve high recognition rates. The templates are loaded on system startup via PDS. The DVI is enabled when the throttle communication switch is pressed down, it is not permanently active or enabled. In this way, DVI commands are "transmitted" to the avionic system, analogous to radio transmission.

VOCABULARY AND SYNTAX

The vocabulary for the DVI module stores 112 words, however only 50 words are currently used Figure I-04-12 . The full set of 112 words must be still stored in the DVI template. The DVI vocabulary is split into 39 nodes to improve recognition rate and DVI response time; a node is a subset of the total vocabulary of words. This allows the DVI to sort through only the limited number of words in a node, recognize the command and then go to another node containing only those words relevant to the initial command.

The DVI responds to whatever "sound" the pilot makes for any particular command if he has trained and prepared his template correctly. It is therefore possible to adapt the word vocabulary to whatever words or language is required, providing the syntax that is fixed within the DVI moding is retained. Syntax is the way the words in the vocabulary are grouped into the nodes.

When DVI is initiated, the system is listening for one of 10 words in the top level node (refer to Figure I-04-12). In some cases, the single word may be the whole command, e.g. CLOSE (to close a TGS). More often, recognition of a top level word steps to a second node, with a similarly small subset of words for recognition. An example of this is when TARGET (first level node) is recognized, the DVI steps to the node containing the list of TCRI, to identify the relevant track (TARGET DELTA nominates track D as a target). In some functions, recognition of this second level node leads to a third node, and so on, up to a maximum of 11 levels for the most complex command. Action is not necessary to manage or assist this process, other than speaking the command at normal speaking speed.

COMMANDS

DVI is used for a wide variety of functions, with a variety of types of command. Each function can be considered as fitting in one of two groups of functions.

SIMPLE FUNCTIONS

These are short commands, consisting of one or more words. The feedback that the system has recognized and responded to the DVI command is given by the audio tone "beep" and by seeing the system response on the cockpit displays. For example, EXPAND GOLF opens the TGS whose highest priority track (i.e. the track alphanumeric in the centre of the TGS) is G. It is immediately obvious that the DVI has recognized and actioned the command when the attack or PA format change to the expanded TGS display.

COMPLEX FUNCTIONS

These are commands that require construction through several nodes or layers before the DVI system can output the complete command in a suitable form to the relevant sub-systems. Typically, they are DVI functions that replicate the more complicated XY or MDE button-pushing functions e.g. radio channel changing. The feedback is a combination of audio beep and HUD feedback, along with display response when the command has been validated. The command sequence of these commands match as closely as possible the corresponding XY or MDE function sequence. It is not possible to mix these two control processes, i.e. to start a command using XY or MDE and finish it using DVI.

SYSTEM FEEDBACKS

There are two feedbacks from the system available to indicate that the pilot command has been recognized and actioned.

AUDIO TONE

A short audio tone "beep" is given when the system recognizes a DVI word. If the command is spoken slowly, it "beeps" after each recognized word. However, in normal speech there is insufficient space between words for the beep to be played without intruding on the following word. This means that a string of DVI words, if spoken at normal speed, result in multiple beeps being issued as a feedback that the DVI has been recognized.

HUD FEEDBACK

In complex DVI commands a text line is displayed in the scratchpad area of the HUD, when the DVI recognizes a word that leads to one of these commands. The text line is a box, 34 characters long, with a short horizontal bar - the cursor - indicating the next position that is being listened for by the DVI. As the words of the command are recognize, the appropriate characters are added to the line and the cursor moves along the line in sequence. When the command is finished, the last word in the command - GO - is always an executive: the text line then blinks off momentarily to indicate that the final word has been recognized and the command delivered to the system.

The system checks "validates" that the command is in an acceptable form e.g. that the necessary command words have been recognized; and to indicate satisfactory completion of the command sequence the text line ceases to be shown. If the message does not validate correctly the HUD text line remains displayed for 7 seconds. In this case, the DVI switch should be released to cancel the DVI selection and remove the line, and then re-pressed to repeat the command.

VOICE OUTPUT

The DVI command CONTENTS results in a voice feedback of the requested data e.g. "Three Five Five Zero Kilos" as the current total fuel contents.

WARNINGS INTERACTION

If a warning occurs while the communication switch is pressed down during DVI, the warning audio (attensons and voice) are played immediately but do not inhibit the DVI message recognition. If this warning occurs, the DVI command can be completed without re-starting. If a warning audio is already playing when the communication switch is pressed down, to activate DVI, the warning audio is inhibited for as long as the switch is held; the DVI command can be entered normally.

Voice output in response to CONTENTS command is immediately cancelled if a warning audio occurs while the voice output is playing.

For Twin seat aircraft

TWO SEAT OPERATION

DVI functionality is only possible from the front seat, and selection of the rear seat DVI switch has no effect. However, the rear seat occupant hears the DVI commands and any resulting audio feedback or voice output, and the rear HUD displays the text line for complex commands.

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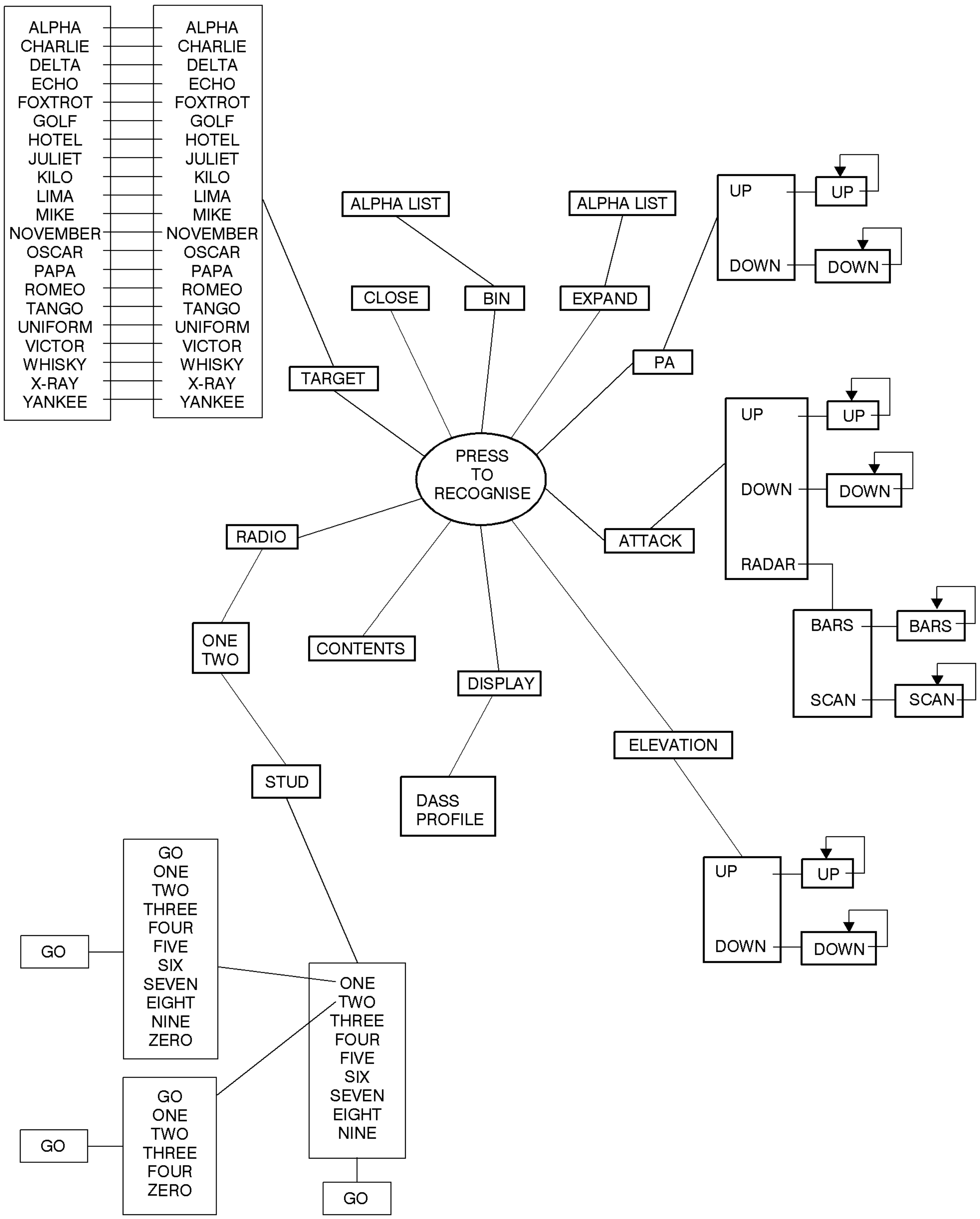

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Figure I-04-12 DVI Syntax

MULTIFUNCTIONAL INFORMATION DISTRIBUTION SYSTEM

The Multifunctional Information Distribution System (MIDS) is a high capacity digital information system which allows secure, flexible and jam-resistant real-time data exchange between all users within a network. All the units in this network exchange data regarding their position, status, tracks detected, engaged and attacked by them, etc. Each participant has its own Track Number (TN), identifying it within the network. The Net Time Reference (NTR) unit gives the time reference and all the units within the net are synchronised with it. Control Units (C2) direct forces under their control and provide them with a precise picture of the battle scenario. They assign unique TN to tracks detected by all the participants (to also identify them within the network) and transmit data regarding dangerous areas and other similar functions. They also order movement, engagement and other assignments to all units under their control and provide data on the current threat situation. The MIDS also performs the TACAN function (refer to 1B-B-34-52-00-00A-043A-A). The MIDS is integrated within the avionics system and the information received over the network is automatically available for display as required.

The equipment consists of a MIDS Low Volume Terminal (MIDS LVT), a MIDS Interface Unit (MIU), the D-band lower antenna, the fin tip combined antenna and their associated displays and controls. The MIDS LVT, the interface with the network, sends to MIU all the received messages and transmits to the net all the commanded data. It performs some automatic processes, including the relative navigation function and also holds the TACAN Hardware. The equipment automatically erases cryptovariables on seat ejection or physical removal of the MIDS LVT. The cryptovariables can be loaded before the mission through the crypto port located under the right wing. The MIU is the interface for the MIDS LVT and the rest of the aircraft equipment, performing as its bus controller and also as a remote terminal in the avionics bus. The MIU receives the PDS data, performs some validation and initializes the terminal with the mission data addressed to it. The MIU also commands the LVT transmissions to the network, sends the MIDS data to the avionics system and cockpit and receives the pilot inputs.

MIDS functions can be grouped as follows:

- **Network Participation.** Once initialized, the system is synchronised with the network. Net participation also provides relative navigation, determining aircraft present position by using time differences to calculate aircraft position relative to a known datum: this provides 2 additional navigation modes within the navigation sub-system whenever the aircraft is established on a net.
- **Track Management and Tactical Data Exchange.** Data on tracks (air, land or sea based) can be received from a variety of sources, e.g. C2 units, or other fighters on the net. Where possible, this data is fused within the weapons system with other data from the aircraft"s own sensors, to minimize ambiguities. At the same time, Eurofighter"s own fully ranged radar track data and ESM bearing data, as well as a variety of other tactical data, e.g. engagement status, fuel and weapons load, is automatically transmitted to the net.
- **Command and Control Management.** Various command and control messages can be received or sent, for example engagement or disengagement commands, or pointer messages.
- **Secure Voice.** MIDS provides secure voice transmit/receive facilities, providing an additional method of transferring information between net users.
- **Free Text Messaging.** Defining and sending Alpha Numeric Free Text (ANFT) messages.
- **TACAN.** The MIDS includes a conventional A/A and A/S TACAN (refer to Tacan).

MIDS - CONTROLS AND INDICATORS

MIDS TRANSMISSION CONTROL SWITCH

A switch on the right console, inside the battery gangbar, controls power to MIDS antenna. When OFF, MIDS and TACAN transmission are inhibited.

MIDS VOICE CHANNEL A-B VOLUME AND TRANSMISSION CONTROLS

Two circular rotary controls on the left console, labeled MIDS A and MIDS B, control the audio volume of MIDS A and MIDS B voice channels. The control is pressed down to transmit on the relevant voice channel.

MIDS CHANNELS INDICATOR

The right glareshield front flap displays the current MIDS voice and control channels.

HEAD UP PANEL

The HUP includes a monochrome MIDS display panel with six associated multifunction soft keys. It provides the main display surface for received MIDS text messages. Depending on message content, the multifunction soft keys allow the pilot to acknowledge action, review, delete and manipulate the display. The display also indicates any changes in net synchronization status. Figure I-04-13 shows a typical HUP format.

The HUP displays data on one of five formats:

- **Pending (PEND) format** : Stacks the received and pending response messages in priority order. Up to 12 messages can be stored within this format. If more than 12 messages are received and not actioned, messages are overwritten on a priority basis.
- **Miscellaneous (MISC) format** : Displays C2 requests, pointer message alerts and free text messages (stacked in this order of priority) received from other units. If

a second message is received while another is being displayed, the current is replaced by the new one. If a high priority pending message is received, the pending format is automatically selected.

- **Recall (RCAL) format** : Accepted pending messages are stored in this format in time accepted order. Up to 6 messages can be stored in this format. When it is full a new accepted message replaces the oldest.
- **ANFT format** : This format is automatically displayed on selecting the FREE TEXT moding key and contains the PDS-loaded list of free text messages that can be selected for editing and transmission.
- **Status format** : Displays MIDS system status and only appears when it is necessary to alert of a particular status event (e.g. automatic deselection of exercise mode). This format occults automatically on receipt of a new high priority message on the pending format. Until status messages are cancelled by pressing the CLR soft key, the status format will be re-displayed after the first HUP moding key selection.

Pending, recall, ANFT and miscellaneous format have a common structure (see Figure I-04-13) containing the following blocks of data:

- The current message block. Shows the type of message, source unit, object of message (identified by TN, STN or IN), position, speed, course, track and height. The asterisks at each corner show the top and bottom of the current message block.
- Format in use.
- Number of messages above and below the current message.
- Above message cues. Show the type of messages stacked above the current one. The ">" symbol on the left of the legend indicates that the message has not yet been displayed as the current message.
- Below message cues. Show the types messages stacked below the current one. The ">" symbol on the left of the legend indicates that the message has not yet been displayed as the current message.
- Upwards and downwards arrows at the right corners of the MIDS display show the direction where a new message is placed.

Each of the six associated multifunction soft keys is a momentary action, illuminated push-button, whose legend changes to indicate the function of the key. The available soft keys modes are as follows:

WILL	Indicates acceptance of the currently displayed MIDS command. The WILCO receipt/compliance response is transmitted to the C2 that originated the command.
CANT	Indicates rejection of the currently displayed MIDS command. The CANTCO receipt/compliance response is transmitted to the C2 that originated the command and the message is deleted.
KEEP	Indicates acknowledgement of the currently displayed MIDS command but no response is sent onto the network.
CLR	Rejects the currently displayed message or has seen it and wants to remove it from the display. The message is deleted and no response is sent onto the network.
SEL	Only available when the ANFT format is displayed, it allows selection and display on the MDEF ROLs of the required ANFT message from the list displayed.
UP	Scrolls up through the format message list.
DOWN	Scrolls down through the format message list.
PEND	Selects the pending message format.
MISC	Selects the miscellaneous message format.
RCAL	Selects the recalled message format.

The centre of the top line of the HUP format displays synchronization status, using the following captions:

NO TX/RX	The terminal has not achieved any synchronization status. There is no reception or transmission of MIDS messages.
RX ONLY	The MIDS is in coarse synchronization with the net and can receive, but not transmit messages.
TX/RX OK	The MIDS has achieved fine synchronization with the net and is capable of receiving and transmitting MIDS messages. The TX/RX legend disappears after 5 seconds to reduce display clutter.

Any change of synchronization status is indicated by a cat 4 "MIDS SYNC" warning.

MANUAL DATA ENTRY FACILITY

Many of the network participation functions are carried out on the MDEF, which is the primary means of inputting alphanumeric data into the MIDS. These facilities are available within the MIDS SSK, and the MDEF with MIDS selected is shown in Figure I-04-15 . Once initialized and established on the net, the MIDS SSK includes the following moding keys:

FREE TEXT	Displays the free text messages (up to 20 may be loaded through PDS mission data) on the HUP and configures the DEKs and ROLs for limited editing, addressing and sending of the selected text message.
PRMY TN	Allows the change of the aircraft Track Number (TN).
EXCS REAL	Allows selection of MIDS exercise mode.
MIDS NORM/OFF	Selecting OFF inhibits the transmission and reception of MIDS messages. Reselecting NORM resets the synchronization.
ALT TIME	Allows selection between the PDS-loaded primary and alternate time slot sets.
MIDS TEST	Selects the MIDS test message routine and configures the XY cursor for nominating an addressee.
NET PAGE	Selects the net page submode of the MIDS SSK. The following moding keys are available:

MAIN NET	Selects the MIDS main net filter. All the MIDS track data is displayed on the MHDDs .
FSUB NET	Selects the MIDS full sub-net filter. The MIDS track data, except the surveillance messages no correlated with the own sensor data, is displayed on the MHDDs .
RSUB NET	Selects the MIDS restricted sub-net filter. All the PPLI and all the MIDS track data from the cooperating aircraft is displayed on the MHDDs .
C2 CHNG	Allows either the request to change C2 (C2 RQST), or to change C2 directly (C2 DIR) by entering the C2 NTRN.
CHNG NETS	Enables the change of the control or voice channels being used. Channels between 1 and 126 are available, channel 127 selects "no channel".
TXFL OFF/PTLF/PPLI	Allows selection of transmitter filter. OFF filter deselected. PTLF: the system transmits Priority Tracks/Lock Follow and PPLI. PPLI: the system only transmits the PPLI message.

COOP A/C	Displays the TNs of all nominated co-operating aircraft on the net. The TNs can be amended or deleted by using the DEKs or by XY. A maximum of 8 co-operating aircraft may be nominated at any one time.
NTR	Enables the aircraft to become the Net Time Reference (NTR) for the MIDS network.

AFLD IDNT	Enables addressing and sending of a maintenance message, which is then sent automatically on entry into A/L PoF.

If there is any failure during MIDS initialization, a MIDS data load fail is displayed on the MHDD autocue format (see Figure I-04-24). On selecting the MIDS SSK, the top left moding key shows the problem detected or the function that has to be input or amended to continue initialization:

PDS OLD	PDS data is older than that already stored.
SET TN	Loaded TN is corrupted, unavailable or invalid if there is a failure.
INVD DATA	Invalid initialization data.
TOD OSET	Time Of day Offset not loaded or available.

MIDS stealth moding and transmission control are managed through the XMIT SSK, which includes the following MIDS-related keys:

MIDS SLNT	Inhibits all the MIDS data transmissions except the secure voice. With MIDS SLNT selected, the NTR, C2 CHNG, MIDS TEXT and FREE TEXT moding keys and functions are not available.
TACN SLNT	Inhibits TACAN transmissions, resulting in loss of TACAN range data.

MULTIFUNCTION HEAD DOWN DISPLAYS

Track data supplied by the MIDS net (known as "MIDS tracks") is displayed on the attack, PA and elevation formats. A full description of track symbology is given in the Weapons System (refer to OTE 1C-16-1-5). If a track is defined solely by MIDS, the track symbol has a solid outline with a dark grey infill. MIDS tracks may be nominated, denominated, and manipulated in the same way as radar tracks.

MHDD Highlights

A highlight symbol (a circle with a vertical cross inside) is used to highlight an object specified in a received MIDS message. If a threat message is received, both the track being threatened and the threatening track are highlighted. Threatening tracks highlighted in such messages are indicated with a red circle; all other tracks are highlighted with a white circle. A green circle is used to indicate the sending track (e.g. C2 or other joint user)

Left MHDD

In addition to the track symbology and highlight symbols shown on the attack format, the left MHDD autocue format displays initialization failures and MIDS-related PDS download failures. An example autocue display is shown in Figure I-04-24 , indicating example failures.

PA Format

The PA format provides the main display of the "Recognized Air/Surface Picture" (RASP) transmitted over the MIDS network. In addition to air and surface tracks, geographically related MIDS information e.g. MIDS reference points and new flight path messages of up to 15 waypoints and received pointer data are displayed on receipt of the relevant MIDS message, until the message is accepted (WILL) or rejected (CANT) on the HUP. The PA extra information boxes, accessed by XY insert on the track or waypoint of interest, contain additional information on navigational points or tracks provided by MIDS. The MIDS net can also provide or update tactical data - e.g. FEBA/FLOT, MEZ data, etc. - that is stored within the digimap and displayed on PA.

The PA format also contains icons that are used to construct pointer, heads up or mission tasking messages: an example PA format is shown in Figure I-04-27 .

The volume and type of MIDS data displayed can be filtered as a function of the data sources and nets used, by using the net filter moding keys (MAIN NET, FSUB NET or RSUB NET).

Waypoints Format

In addition to track symbology on the elevation format, the RMHDD waypoints format provides access to airfield data periodically updated through the MIDS (e.g. airfield states and associated weather), by selecting the MIDS LDG key: a typical format is shown in Figure I-04-25 . The waypoints format also displays a MIDS flight path message route, as a new MAN route, once the message has been accepted (WILL).

Frequency Format

Selection of the MIDS C2 soft key displays C2-related communications information. Figure I-04-26 shows a typical display.

MIDS WARNINGS

The following CAT 3 captions and associated voice warnings are available:

MIDS XMIT "MIDS TRANSMITTER"	Indicates a MIDS transmission failure or degraded transmission. MIDS XMIT is a consequential warning following a MIDS T or MIDS CRYP warning.

MIDS "MIDS"	Indicates a MIDS failure. During initialization or change of set, any erroneous data detected by the MIDS LVT also triggers this warning. MIDS is a consequential warning following a MIDS CRYP warning.
MIDS T "MIDS TEMP"	Indicates an overtemperature condition exits within the MIDS LVT and performance has totally or partially been lost.
MIDS CRYP "MIDS CRYPTO"	The MIDS LVT equipment has lost the crytovariables.

The following voice messages are used for warning or prompt:

MIDS THREAT	(CAT 1) A threat warning message has been received: the resulting data is shown on the HUP and MHDDs.
MIDS MESSAGE	(CAT 4) A MIDS message has been received and it is displayed on the HUP pending format. The voice warning is repeated every minute until the message is selected to be viewed.
MIDS SYNC	(CAT 4) The MIDS synchronization status has changed.
IPF BREACH	(CAT 4) The MIDS terminal interference protection features have been breached and MIDS transmissions are inhibited until an IPF reset is made (MDEF soft key).

MIDS OPERATION

GENERAL MODING PRINCIPLES

To minimize workload, the cockpit design provides simple intuitive moding and a high degree of MIDS automation. The following moding principles have been applied:

- No pilot action is required to display MIDS tracks on the prime weapons system displays (AF, PA, EF, and HUD). Additional data associated with MIDS tracks is automatically added to existing extra data displays (e.g. in the MHDD ROLs and the PA extra information boxes) as part of the track and identity fusion processes.
- Incoming messages are always available for display on the HUP: this is the prime display for command instructions, although some of the message content may also be displayed on the MHDDs (e.g. Highlight icons, track position and vector, MIDS flight path messages, etc.).
- If a MIDS instruction is accepted by pressing WILL, the WILL press also initiates other actions required to satisfy that message. For example, if a C2 engage assignment is received, pressing WILL automatically replies to C2 that the assignment has been accepted and also loads the object track into the DTL, ready for engagement.
- All high priority message construction (e.g. sending a mission assignment message to a wingman) is done through HOTAS and the MHDDs.
- Low priority message construction (e.g. free text message editing and sending) or MIDS management (e.g. MIDS test or changing C2) is done through the MDEF, using the MIDS SSK moding keys.
- No pilot action is required in transmitting track data or own aircraft status data (fuel, weapon load, engagement status, etc.).
- Once initialized on the net, no pilot action is required to maintain net communications, other than changes required by the tactical situation, e.g. change of C2 or change of net channel.

These principles mean that, if PDS data has been correctly downloaded, MIDS initialization and net entry occurs without pilot input. MIDS net data is automatically received and presented on the appropriate displays. Any dedicated messages (e.g. mission assignment messages or other command instructions) and initialization progress are displayed on the HUP. Voice prompts advise when new HUP messages are received: this means regular monitoring of the HUP is not required. Acceptance of messages will, where appropriate, automatically configure the weapons system to carry out the required actions. HOTAS or the MDEF are used to configure messages to be sent, but the transmission of the message is largely automated.

MIDS INITIALIZATION

Two independent sets of MIDS initialization, cryptovariable and other data are downloaded automatically after power-up and completion of BIT, and MIDS initialization commences automatically. To transmit data onto the net, the MIDS transmitter must be switched on (hard-wired switch on the battery gangbar) and the relevant MDE Stealth (XMIT SSK) and MIDS mode (MIDS SSK) moding keys must be in the transmit/NORM state. Initialization progress is indicated on the HUP display using the following messages:

NO TX/RX	The terminal has not achieved any synchronization status.
RX ONLY	The MIDS LVT is in coarse synchronization status. It is capable of receive messages, but the synchronization is not fine enough to allow transmission. At this stage, the MIDS LVT is refining its time.

TX/RX OK — The MIDS LVT has achieved fine synchronization status and is capable of receiving and transmitting MIDS messages. This legend disappears after 5 seconds. Every change of status is followed by a MIDS SYNC warning.

INITIALIZATION FAILURES

If initialization data is not properly loaded, the power up autocue format indicates failure by a "PDS" prompt plus an additional prompt indicating the specific load failure. Some failures cannot be recovered immediately through pilot action - e.g. failure to load non-pilot amendable cryptovariable data - in which case there is no further action the pilot can take without external assistance. Failures that can be recovered through pilot action are actioned through the MDEF MIDS SSK, where the top left Moding Key (MK) indicates the specific problem and the DEKs and ROLs are automatically configured to ENT the required data or select the required option for that problem. The top left MK options for pilot-corrected failures are:

PDS OLD — If the PDS-loaded data is older than that already stored from a previous mission, the required data set can be selected by reviewing the options on the ROLs (see Figure I-04-15) and selecting 1 or 2 and pressing ENT; the MIDS then initializes using the chosen data.

SET TN — After selection of PDS LOAD or PREV LOAD option or if the PDS time data check had been passed but the TN of either or both sets is invalid, the top left MK shows SET TN. The DEKs and ROLs display the primary TNs of the PDS and previous loads (see Figure I-04-15). The required TNs can be typed in and ENT pressed to set the required TNs.

INV DATA — If any loaded data fails the validation checks, a "MIDS" warning is generated and the top left MK shows INVD DATA. The ROLs display which set has failed and allow the pilot to select between two options (see Figure I-04-16). Selecting LOADED VAL replaces only the invalid values by default ones, while DEFAULT VAL replaces all values with default values. The required option is selected by typing 1 or 2 and pressing ENT. The DEKs are occulted but the ROLs remain unchanged until the initialization process is finished.

TOD OSET — When TOD OSET is displayed, the ROLs show current UTC time and the DEKs allow the typing in of a time offset for each data set. Offsets must be defined as whole hours between the range +12 to -12 hours. On pressing ENT the MIDS commences initialization using the entered data.

If after two minutes the PDS data has not been loaded the MIDS default values are used by the system. The PDS prompt is displayed on the MHDD autocue format (see Figure I-04-24). On selecting the MIDS SSK, the top left MK shows SET TN and the ROLs configure to define TNs for both sets. Once the primary TNs have been defined as described above the top left MK shows TOD OSET (see Figure I-04-16), allowing entry of time offset as described above.

HUP FORMATS

The primary display of dedicated messages, MIDS status, and MIDS management is the HUP. MIDS messages and other MIDS information are displayed on the HUP in one of 5 formats:

- **Pending (PEND) Format** : Tactical messages (e.g. mission assignments, vector messages, flight path messages) are displayed on the pending format (see Figure I-04-14). If the pending format is already selected, no unactioned pending messages are present, and a pending message is received, the message is displayed immediately in the centre 5 lines of the display - the current message area is marked by an asterisk at each corner. If a pending message is displayed but not actioned, additional pending messages are stored in the pending list, waiting to be selected for view and action. Such messages are stored in the list according to their priority: higher priority messages than the current message are stored above the current message, lower priority ones below. The UP and DOWN keys allow review of all the pending messages if required and a flashing arrow at the rightend of the top and/or bottom HUP ROL indicates that an unread message is stored above and/or below othe current message. The lines immediately above and below te current message area show the message type stored immediately above and below the current message, and a number at the right end of the same line indicates the number of messages above and below the current message. All unread messages are marked by a caret (>) next to the contracted message lines above and below the current message block. High priority messages (e.g. threat warning, break engage, priority kill) are always displayed immediately, automatically displacing any existing message or format. Arrival of any incoming message is indicated to the pilot by a Cat 4 "MIDS MESSAGE" voice prompt.

- **Miscellaneous (MISC) Format** : Lower priority messages, e.g. free text or net administration messages, are displayed on the miscellaneous format (see Figure I-04-14). This is configured and manipulated in the same way as the pending format. The MISC format can be selected using the MISC soft key. If a Pending message is received, the MISC format is automatically replaced by the pending format. If a MISC format message is received while the pending format is selected, the pending format remains selected and the MISC soft key flashes to prompt selection of the MISC format to view the message.
- **Recall (RCAL) Format** : Mission assignment messages that have been received and actioned (e.g. WILL pressed to accept message) are removed from the pending or miscellaneous formats and placed in the recall format (see Figure I-04-14). This is accessed via RCAL soft key: if no messages are stored in the format, the key legend is occulted.
- **ANFT Format** : Alpha Numeric Free Text (ANFT) messages can be prepared and loaded via PDS, and are displayed on the HUP whenever the MDEF MIDS ANFT moding key is selected. Limited editing (e.g. entry of numbers or N, S, E, or W for position) can be carried out using the DEKs.
- **Status Format** : This is automatically displayed following a change in system status, e.g. the cancellation of MIDS exercise mode. The format is deselected by selecting another format or by acknowledging the status message by pressing the CLR soft key.

TRACK DATA

MIDS track data is sent to the attack computer to create a system track file. Where possible, the data is combined with other sensor data on the same track to produce a fused track containing the best quality kinematic and identity data, which is then displayed on the HUD and MHDDs. Track symbology and system data fusion is described in the Weapons System (refer to OTE 1C-16-1-5). Note that there may be noticeable positional errors between the MIDS tracks and own sensor tracks from the same target. This is because of the relatively low update rate of the MIDS data and the time taken within the net for a track to be detected, transmitted to C2, processed into the recognized air picture, then re-transmitted, and finally received, processed and displayed within Eurofighter. The fusion process takes these delays into account, but it should be remembered that there may be a significant positional lag between the symbology and the real track when monitoring MIDS-only tracks on the HUD and MHDDs.

MIDS A/A Track Types

Each friendly aircraft on the net regularly transmits a PPLI and platform status messages, which in addition to positional data and weapon and fuel status includes identification attributes. This allows the weapons system to use specific symbology to differentiate between different track types, as follows:

- **Co-Operating Aircraft**

  Nomination of other MIDS users as cooperating aircraft allows the transmission of mission assignment commands to those aircraft, and the reception of weapon and fuel status information from them. Up to 4 co-operating aircraft can be defined in pre-mission planning and loaded via the PDS: the aircraft are identified by track number in the MDEF ROLs when the COOP A/C moding key is selected. A 4-character callsign is displayed in the PA extra information box as well as in the addressee icons in the PA format mission assignment and pointer message displays. Co-operating aircraft are displayed as enlarged friendly symbols with a dot in the centre.

  Up to 4 additional co-operating aircraft can be nominated at any time by selecting the MDEF - MIDS - COOP A/C. The ROLs show the TNs of the current nominated aircraft, with dashes in the vacant ROLs. Additional aircraft are nominated either by typing in their track numbers on the DEKs, or by XY and double insert on their track symbol on the PA format: the first insert identifies the required TN and shows it on the ROL, the second insert ENTs it into the Co-op list. Co-ops may be deleted either by typing in the TN and pressing CLeaR, or by 2 XY inserts on the track. Note, the ROLs will not re-order to fill in the space left by a cleared TN: if for example, a list of 4 co-ops is reduced by deleting the second track in the list, the second field on the ROL shows dashes, and the PA format addressee list (when displayed) will have a gap between lines one and three.

- **Mission Correlators**

  It is possible for a package of aircraft to be specifically grouped for a particular mission, e.g. an A-S attack force supported by escort fighters. The track symbols of the correlated aircraft are not changed but the mission correlator attributes (e.g. correlating fighter, bomber, etc.) are displayed in the PA extra information box for each correlated track. Note, mission correlator aircraft need not also be co-operating aircraft.

- **Command and Control (C2)**

  Any C2 units on the net are displayed as enlarged friendly symbols with a white diagonal cross in the centre.

HANDLING INCOMING MESSAGES

Messages may be sent by other net users (e.g. C2, fighter element leader), requiring own ship to take action. These messages will generally be one of three types:

- Mission Assignment Messages, e.g. engage or disengage a track, priority kill a track. Acknowledgement of the message is made by pressing WILL (to accept) or CANT (to reject). If an acknowledgement is not required, the HUP displays the KEEP and CLR keys, to allow storage or deletion of the message as required. Where appropriate, the object track of the message is highlighted on the MHDD tactical displays by a white circle, and the sending track is highlighted with a green circle.
- Command Messages, e.g. vector onto a specified heading, return to base, go to tanker, new navigation routing. On acceptance, or rejection, these messages will also be removed from the pending or miscellaneous formats and may or may not be stored, depending on the specific message type.
- Information Messages, e.g. changes in airfield operating state, or free text information messages. These are occulted on acknowledgement.

Mission Assignment Messages

The handling of incoming MIDS messages is similar for all message types. For simplicity, the complete message list is not described in this document, the handling of the most commonly used messages is as follows:

- A priority kill message commands an urgent, high priority interception. On WILL press, the highlight circle is occulted, and the track is automatically loaded into the first position in the DTL. The priority kill message is moved to the recall format. To re-read the message, pressing the RCAL soft key displays the message on the HUP, and displays the highlight circles around the related track symbols on the MHDDs.
- An engage message has less urgency but is indicated in the same way. However, on WILL press the object track is loaded into the next available space in the DTL rather than the first position: this may be manually adjusted to suit the prevailing tactical situation. Engage messages are also stored, and may be reviewed as described above. An Investigate message is treated the same as an Engagement message, i.e. on WILL the object track is loaded into the next available DTL space.
- A disengage message commands the pilot to break off a current engagement. On WILL press, the highlight circle is occulted but the track remains in the DTL and all previously accepted messages affecting this track are deleted from the recall format.

Flight Path Messages

The C2 unit may send a flight path message, defining a required navigation route of up to 15 waypoints. The message is received on the pending format: the HUP displays "NEW ROUTE". If the route is incomplete (e.g. loss of some waypoints during transmission) the HUP displays "INCOMPLETE ROUTE", the number of waypoints missing, and lists the sequence number (from 1 to the maximum number in the route, up to 15) of the missing point(s).

The requested route is displayed on the PA format in blue, allowing review of the route prior to acceptance. On pressing WILL to acknowledge acceptance, the route is occulted from the PA and replaces any existing MAN route. Steering commands are enabled and the route displayed by selecting NAV - MAN RTE.

Restricted Area Boundary

Similarly, C2 may send a message defining a restricted or otherwise significant geographic area. The message is received on the pending format, the HUP displaying "NEW RESTRICTION", and the area boundary is displayed on the PA format. Acceptance of the message results in the area being displayed on the PA as part of the digimap tactical data, the extra data can be opened using XY.

Tactical Data Updating

Some tactical data, loaded via PDS, can be updated during flight by the MIDS. No pilot action is required to enable this function, and no MIDS HUP messages are received and displayed during the process.

SENDING MESSAGES

Two generic types of messages - tactical messages and information messages - can be sent using a combination of HOTAS, HUP and MDEF controls

Mission Assignment

Mission assignment messages are created using the PA mission assignment icon and XY procedures. On completion of the command sequence, the system automatically configures the message and transmits it. The message is constructed in the order addressee - target - action required, with the XY cursor label indicating the current step of the following process:

- Select the assignment function, by XY insert on the mission assignment icon. The PA format changes to include the mission type icons, the co-operating aircraft list and 4-character idents shown at the top left of the track symbols of co-operating aircraft (see Figure I-04-23).
- Define the required addressee, by XY insert on the addressee"s track symbol, or by XY insert on the callsign in the address list.
- Define the tracks that are to be assigned. This is done by XY insert on each track symbol in turn - up to 6 tracks may be assigned. On each insert, a pointer is attached to the track, to show it has been selected.
- Define the action required. This may be Engage, Disengage, or Investigate, and is done by XY insert on the appropriate PA icon. This insert completes

message construction: the mission and addressee icons are occulted, the mission assignment icon is deselected, and the MIDS formats and sends the message.

Pointer Message

A pointer message can be transmitted to any available addressee, highlighting an object of interest. If positioned on a track, the pointer is tied to that track; if positioned off a track, the pointer is ground stabilized and can therefore be used to mark points of interest on the ground, as defined by the radar (A-S RBGM, GMTI or Interleaved modes) or on the digimap. The pointer message procedure is similar to sending a mission assignment, with the order point of interest - addressee. The process is initiated by XY insert on the pointer message icon (see Figure I-04-27): the XY cursor is replaced by the pointer arrow, the PA displays the permitted addressee list, and 4-character idents are displayed next to any of the co-operating aircraft track symbols within PA coverage. The pointer is placed over the point of interest and XY insert pressed: the pointer stabilizes on the track or ground position as described above and the XY cursor reappears, configured for defining the addressee. This can be defined by XY insert on the relevant track symbol, or on the callsign in the addressee list, or by insert on a collective addressee icon. The icons provide up to 4 addressee options: C2, all friendlies on the net, all co-operators on the net, and a "HEADS UP" broadcast address (see next paragraphs). On XY inserting on the addressee, the message is automatically transmitted, the pointer icon deselected, and normal XY functioning returned.

Heads Up Alert

This message is a subset of the pointer message, using the pointer to highlight an track of interest and a single icon to simultaneously identify the message and transmit it for C2 to take the appropriate controlling action.

Free Text Message

Free text messages are transmitted by selecting a message from a list stored in the MIDS, editing it if required, and then sending it. The facility is controlled via the MDEF MIDS SSK. On selecting MIDS - FREE TEXT, the HUP displays the available message list: the HUP scroll soft keys are used to scroll through the list. The required message is selected either by typing in the message number on the MDEF and pressing ENT, or by pressing the SEL key on the HUP. The ROLs and DEKs reconfigure to allow the pilot to edit the message: note that only limited editing is possible, restricted to the entry of numbers and N, S, E, and W, since a full alphanumeric keyboard is not available. The message is accepted by pressing ENT, and the ROLs and DEKs then reconfigure to allow the TN of the addressee to be typed in. On pressing ENT again, the message is transmitted. Alternatively, the message can be addressed and sent by putting the XY cursor over the addressee"s track symbol on an MHDD and pressing insert twice: the first insert loads the TN into the ROLs and the second transmits the message. When the message is sent, the MDEF automatically reverts to the MIDS SSK page with FREE TEXT deselected.

MAIN AND SUB NETS

The amount of MIDS track data displayed on the MHDDs can be reduced using a display filter. The facility is controlled via the net filter moding keys. On pressing the NET PAGE Moding Key (MK) the net page submode of the MIDS SSK is selected and the net filter moding keys are available. MAIN NET is selected by default: all the MIDS track data is displayed. On selecting FSUB NET the surveillance messages no correlated with the own sensor data, are deleted, the other MIDS track data is displayed. On RSUB NET selection, only the PPLI and MIDS track data from the co-operating aircraft is displayed.

The MIDS data transmitted by ownship can also be reduced using a transmission filter. This facility is controlled via the TXFL MK available when the net page submode is selected. The TXFL OFF is selected by default: all tracks are transmitted. Pressing TXFL OFF MK changes the key to TXFL PTLF: the system is only transmitting Priority Tracks/Lock Follow (PT/LF), PPLI, engagement status and any pilot initiated tracks. A second press changes the key to TXFL PPLI: only the PPLI message, egagement status and any pilot initiated tracks are transmitted.

ACCESSING OTHER MIDS DATA

As well as track positional and vector information, the MIDS can provide a range of additional information for display when required.

Track Extra Information

Extra Information on tracks is available by XY inserting on the object track on the PA format: this displays the extra information box, which for tracks supported by MIDS includes much additional data. Several pages of data may be available on MIDS-supported friendly tracks: successive pages are selected by XY inserting anywhere in the extra info box.

Airfield Extra Information

The MIDS provides additional data related to airfields (e.g. runway in use, color state, weather, airfield state) which can be displayed on the RMHDD waypoints format on selection of the MIDS LDG soft key. XY inserting on the required airfield data line causes the airfield expanded data box to be displayed. Figure I-04-25 shows a typical display.

NET MANAGEMENT FUNCTIONS

The following paragraphs describe the MDEF functions related to Eurofighter"s participation in the net. These are not usually required during the mission except when changes to net or C2 or other tactical considerations force a change.

Change C2

Tactical reasons may require a change of controlling unit, either on own request or on command from the current C2. If a change C2 command is received from the C2, pressing WILL automatically initiates the change. Alternatively, a C2 change can be done using the MDEF - MIDS - NET PAGE - C2 CHNG moding key (see Figure I-04-18). On selection, the key changes to C2 DIR: this allows direct entry into the new net, by typing in the C2 TN and pressing ENT, or by double XY insert on the C2 track symbol.

A second press of the C2 CHNG/DIR moding key changes the key to C2 RQST (see Figure I-04-19) and the DEKs and ROLs are configured for typing in the TN of the new C2: pressing ENT transmits the request. Alternatively, the new C2 can be addressed and the message sent by XY inserting twice on the new C2 track symbol on the PA format: the first insert identifies the required addressee, the second insert transmits the message. On message transmit, the C2 RQST moding key is deselected and the MDEF reverts to the MIDS SSK - NET PAGE submode.

The C2 response to the request is displayed on the HUP. If the C2 accepts the change, control is automatically transferred and the new C2 communications information is automatically updated: this can be viewed at any time by the RMHDD frequency format MIDS C2 soft key (see Figure I-04-26).

Time Slot Changing

Primary and alternate time slots are loaded via PDS as part of initialization data. Changing the time slot currently being used is via the ALT TIME moding key (see Figure I-04-20), on selection the DEK and ROLs configure to enter the time when the change is to occur. Type the time of change and press ENT to store the time. Pressing CLR sets all the fields to dashes. Pressing ENT with no time defined (i.e. all the time fields to dashes) generates an immediate change of time slot.

Voice and Control Channel Change

The control and voice channels may be changed by selecting the CHNG NETS MK of the net page submode. The ROLs display the current control and voice channels: the DEKs are configured for typing in different control channel numbers. Channels between 1 and 126 are available for use: setting channel 127 selects no channel (no receive or transmit). The current control and voice channels are also displayed on the RMHDD frequency format, by selecting the MIDS C2 soft key (see Figure I-04-26).

Net Time Reference (NTR)

The aircraft can be set as NTR for the net by selecting the NTR moding key (see Figure I-04-21). The ROLs configure to display the selection to be made and the option is confirmed by pressing ENT. The DEKs and ROLs then blank, and the NTR moding key shows the current NTR status - when boxed, the aircraft is acting as NTR.

Primary TN Change

Own aircraft TN can be changed by selecting the PRMY TN moding key (see Figure I-04-17). The ROLs show the current and previous TNs: the previous TN can be amended using the DEKs, pressing ENT changes the current TN.

MIDS Test

Once established on the net, a MIDS functional test is available. This sends a test request message to a nominated net user, which sends a test message in return. MIDS Test is only required if problems are experienced in normal operation. The test is carried out by selecting the MIDS TEST moding key: this configures the DEKs and ROLs for entering the other station"s TN, which can either be typed in, or defined by a double XY insert on the station"s track symbol. If no addressee unit is selected the MIDS LVT sends the test to the first TN in a connectivity list loaded as part of the PDS data. After a short delay for message transmission and reception, the test result is displayed on the HUP.

Maintenance Message

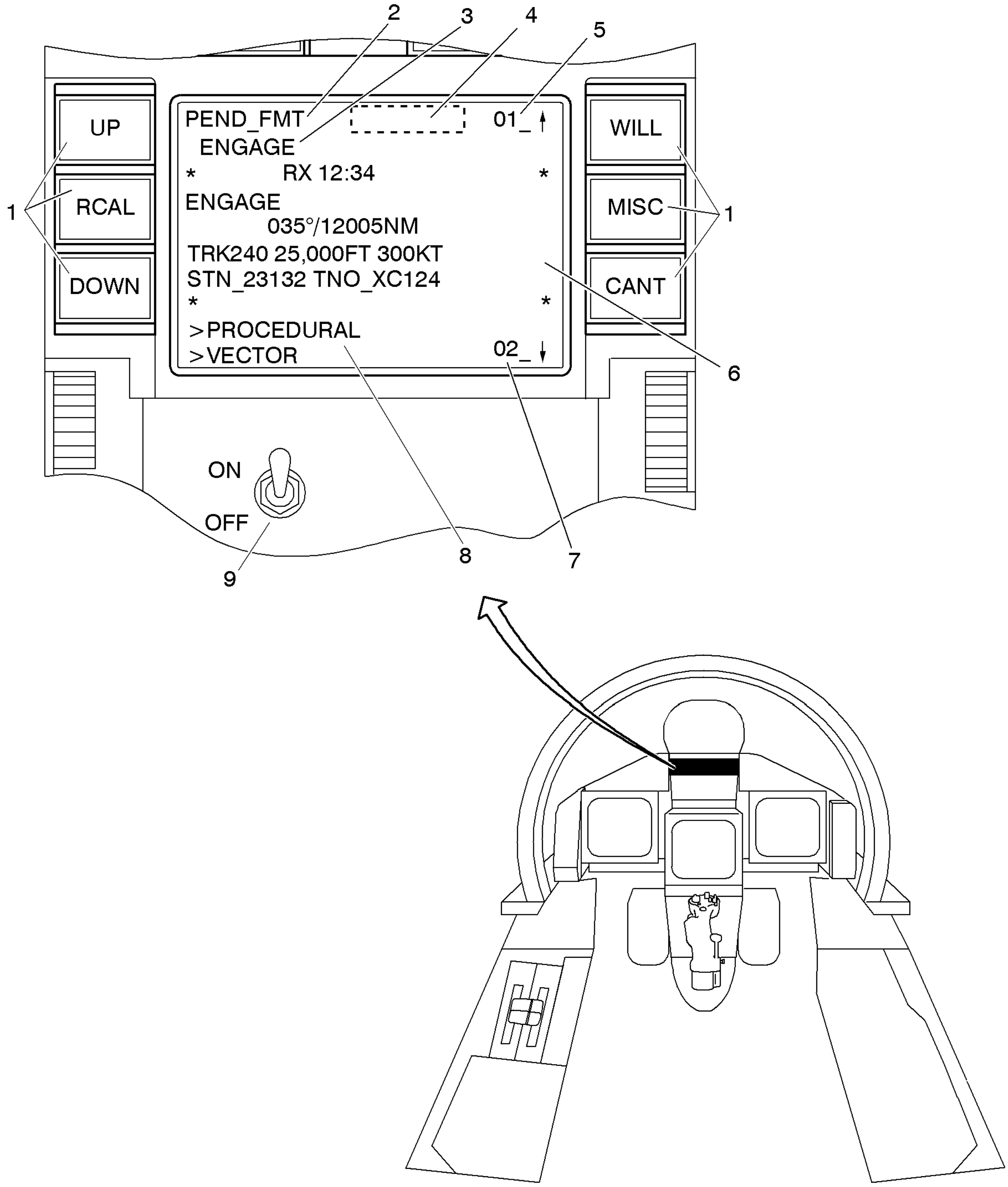
It is possible to automatically transmit a message containing serviceability and maintenance data on entry into landing PoF (i.e. on lowering the undercarriage). This function is enabled or disabled via PDS: if enabled, the AFLD IDNT moding key is available in the MIDS SSK. Selecting AFLD IDNT (see Figure I-04-22) configures the DEKs and ROLs for entry of the desired airfield TN (the last entered TN is displayed by default), either by typing in the TN on the DEKs or by XY insert on the airfield entry in the waypoint format). If no TN is entered (TN field dashes) no message will be transmitted.

IPF RESET

The MIDS LVT includes Interference Protection Features (IPF) that monitor MIDS transmissions for potential interference with radio navigation aids. If the IPF monitors are tripped, a Cat 4 "IPF BREACH" voice warning is given and MIDS transmissions are inhibited although reception is still enabled. All functions requiring transmission are lost, including NTR, C2 RQST, TEST MESSAGE and FREE TEXT. The monitors are reset by pressing the IPF RSET moding key, which is displayed in the MIDS SSK following an IPF breach.

STEALTH MODING

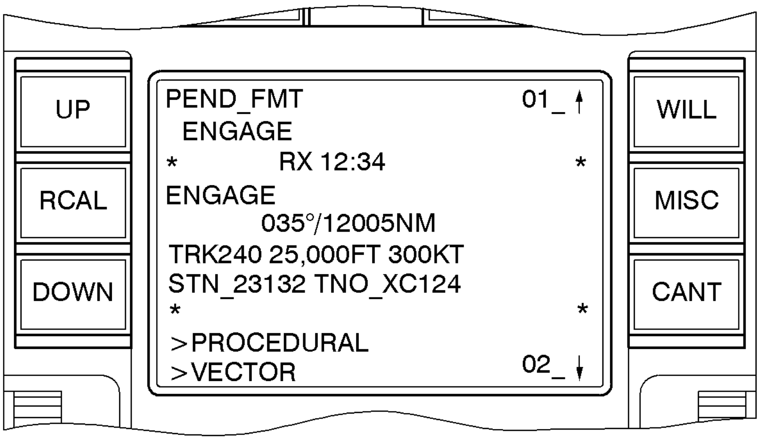
MIDS transmissions may be inhibited for tactical stealth reasons through the MDEF XMIT moding keys, either by selecting the ALL SLNT moding key or the PROG moding key with the MIDS moding key set to SLNT. When Silent, the MIDS will drop out of fine synchronization (voice message "MIDS SYNC") and any MIDS function requiring MIDS message transmission will be unavailable. Under these conditions, the moding keys or icons used for selecting that function are occulted. The MIDS will still receive transmissions when in SLNT, allowing continued monitoring of the RASP and messages from other, non-silent, units on the net.



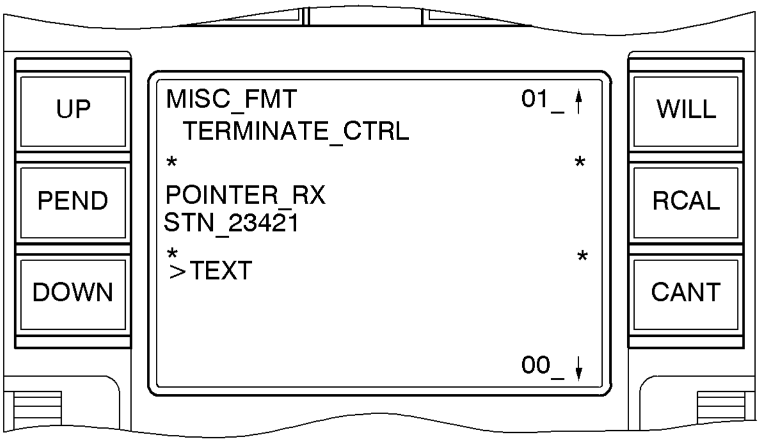
1. MULTIFUNCTION SOFT KEYS
2. FORMAT TYPE
3. MESSAGE TYPE OF NEXT MESSAGE ABOVE IN FORMAT
4. SYNCHRONISATION STATUS
5. NUMBER OF MESSAGES ABOVE CURRENT MESSAGE
6. CURRENT MESSAGE BLOCK
7. NUMBER OF MESSAGES BELOW CURRENT MESSAGE
8. NEXT MESSAGE TYPES
9. HUD POWER CONTROL

ICN-1B-B-232200-C-0117B-04673-A-02-2

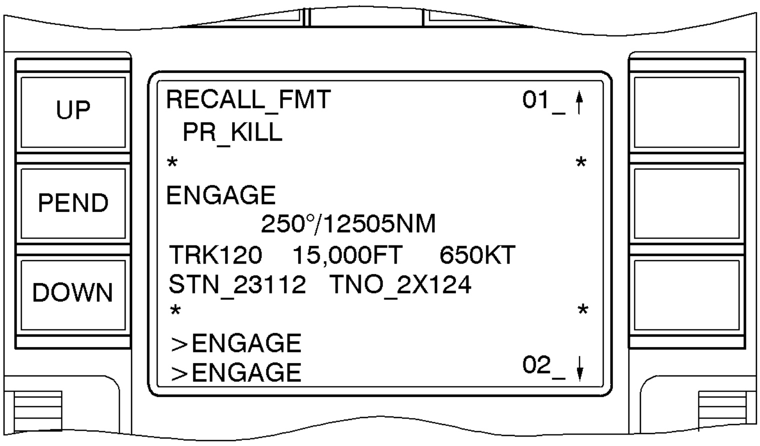
Figure I-04-13 MIDS Head Up Panel Display



PENDING FORMAT



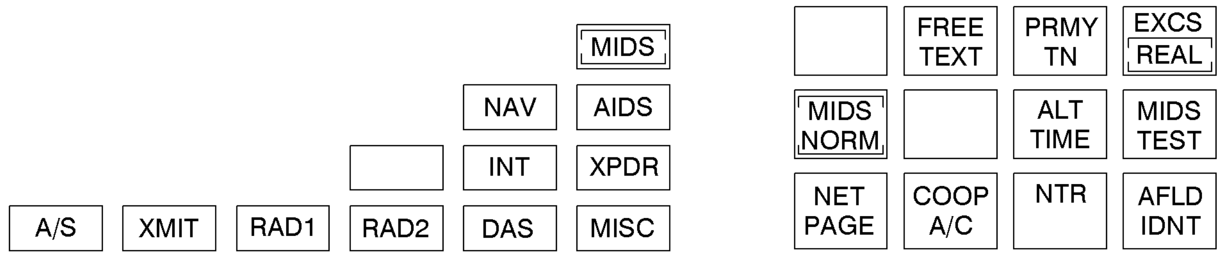
MISCELLANEOUS FORMAT



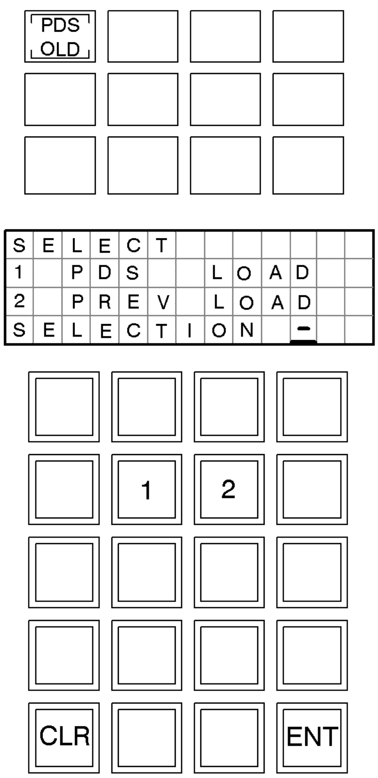
RECALL FORMAT

ICN-1B-B-232200-C-0117B-04964-A-01-2

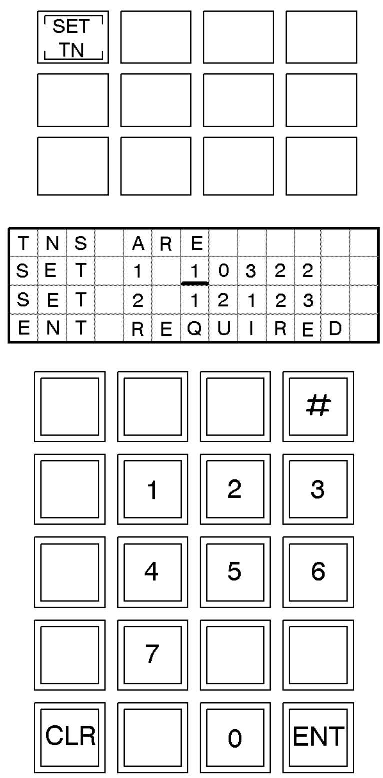
Figure I-04-14 Examples of HUP Format



DEFAULT MODING - NO FAILURE



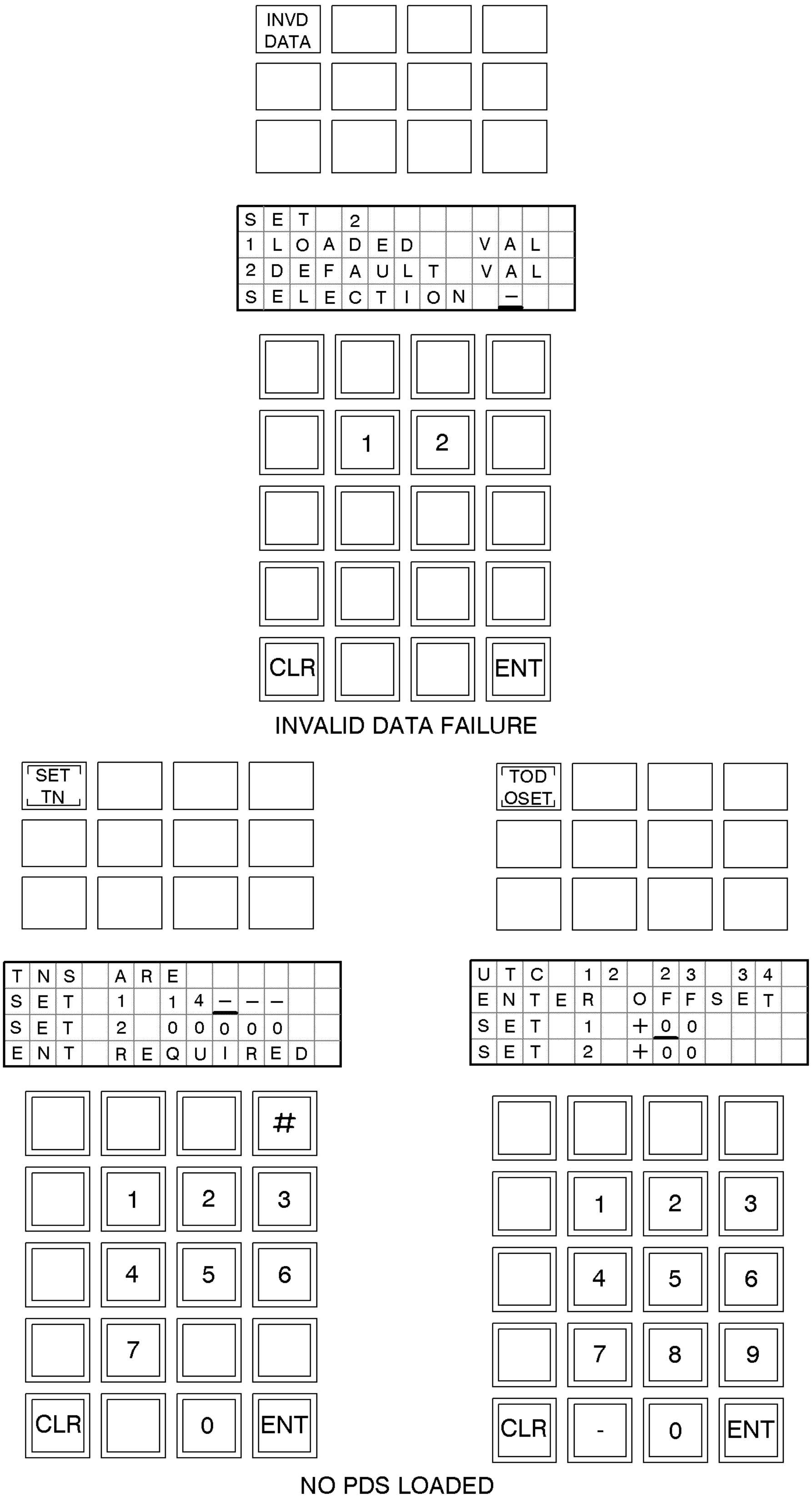
PDS OLD FAILURE



SET TN FAILURE

ICN-1B-B-232200-C-0117B-04688-A-02-2

Figure I-04-15 MIDS Initialization



ICN-1B-B-232200-C-0117B-04689-A-02-2

Figure I-04-16 MIDS Loaded Data Failures

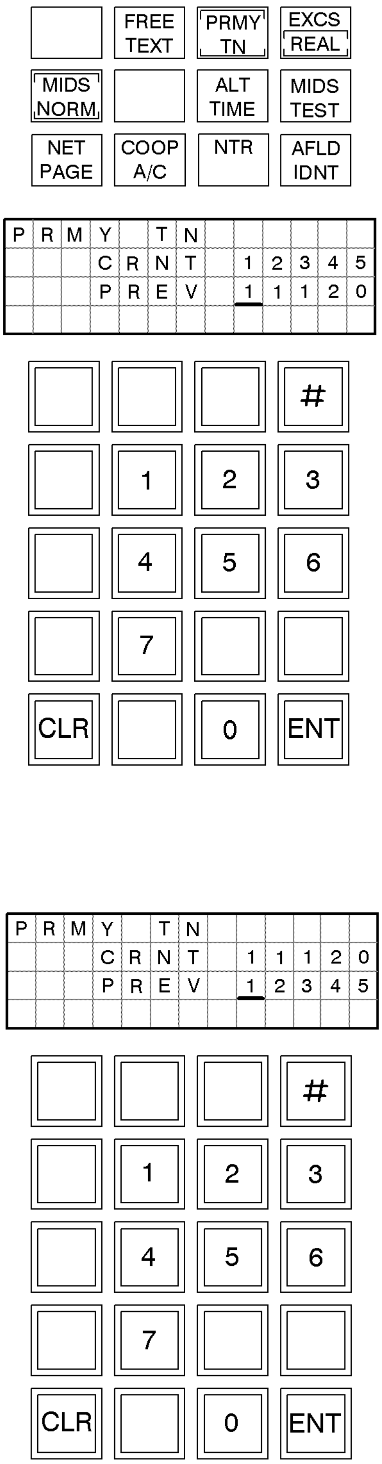
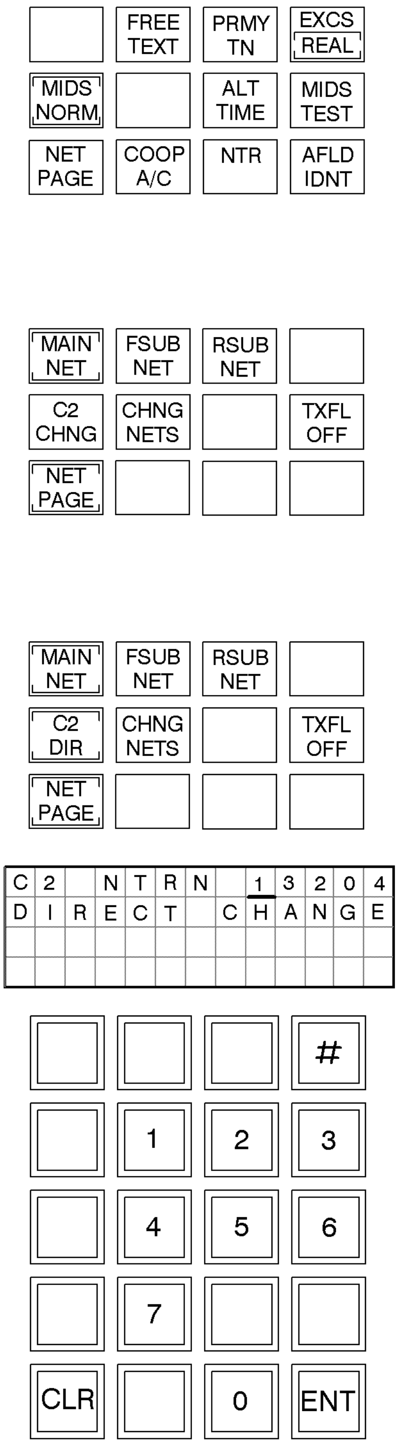


Figure I-04-17 Edit Primary TN



ICN-1B-B-232200-C-0117B-04693-A-02-2

Figure I-04-18 Direct Change of C2

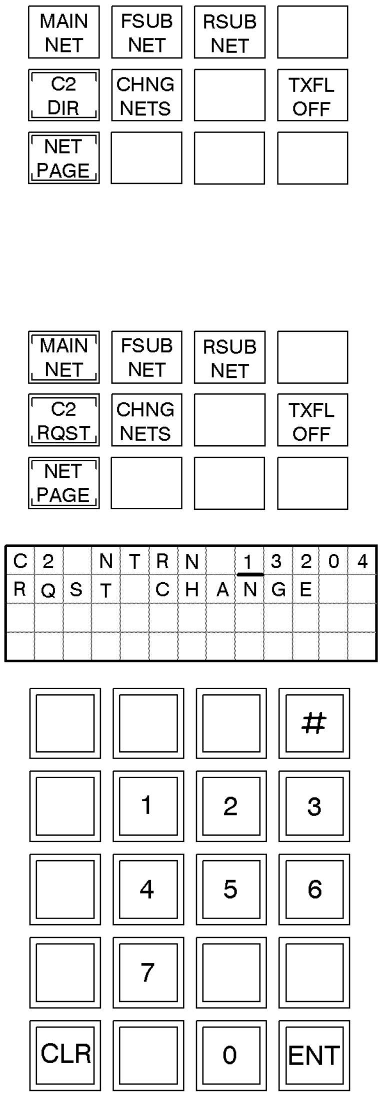


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Figure I-04-19 Request a Change of C2

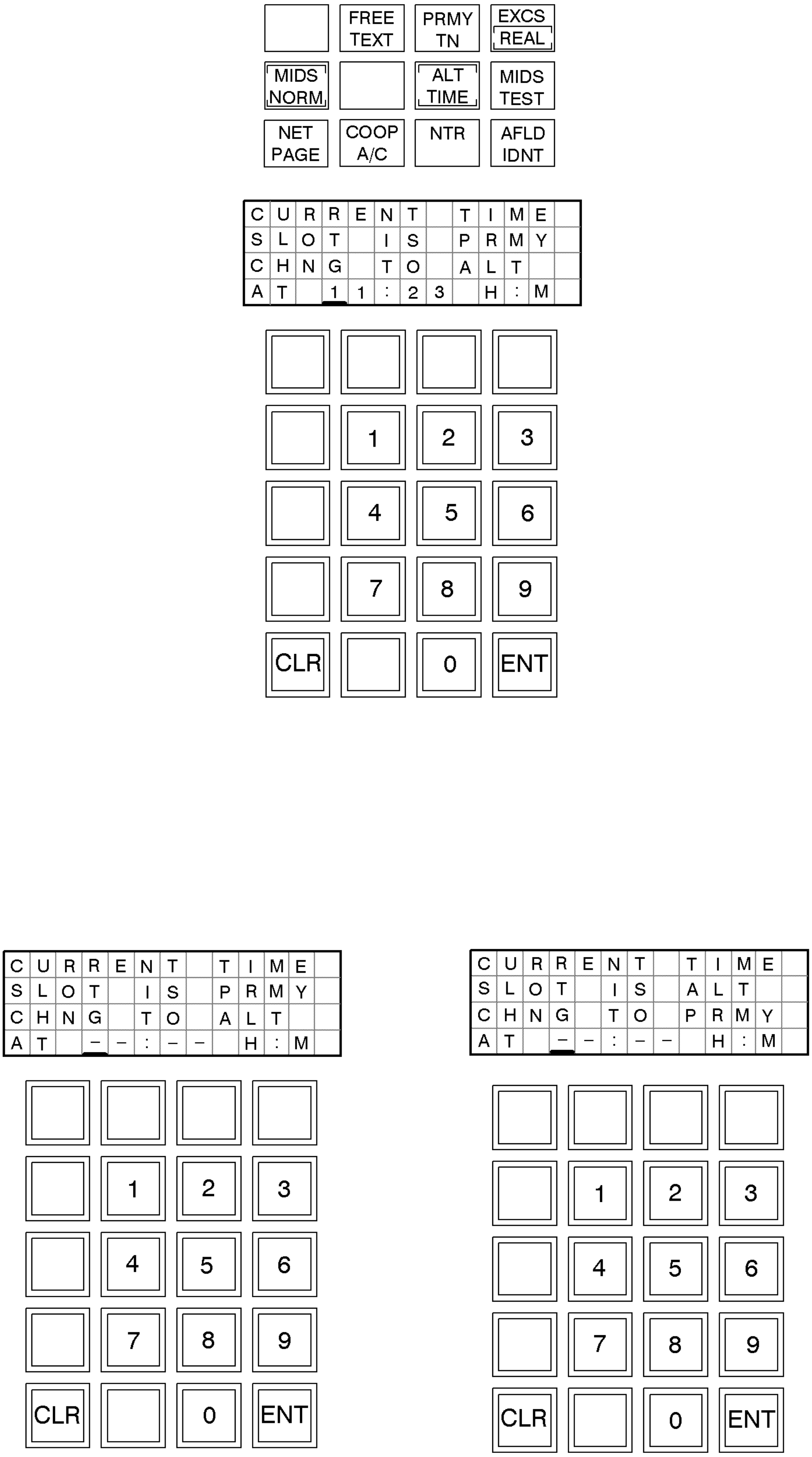

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Figure I-04-20 Select Alternative Time Slot

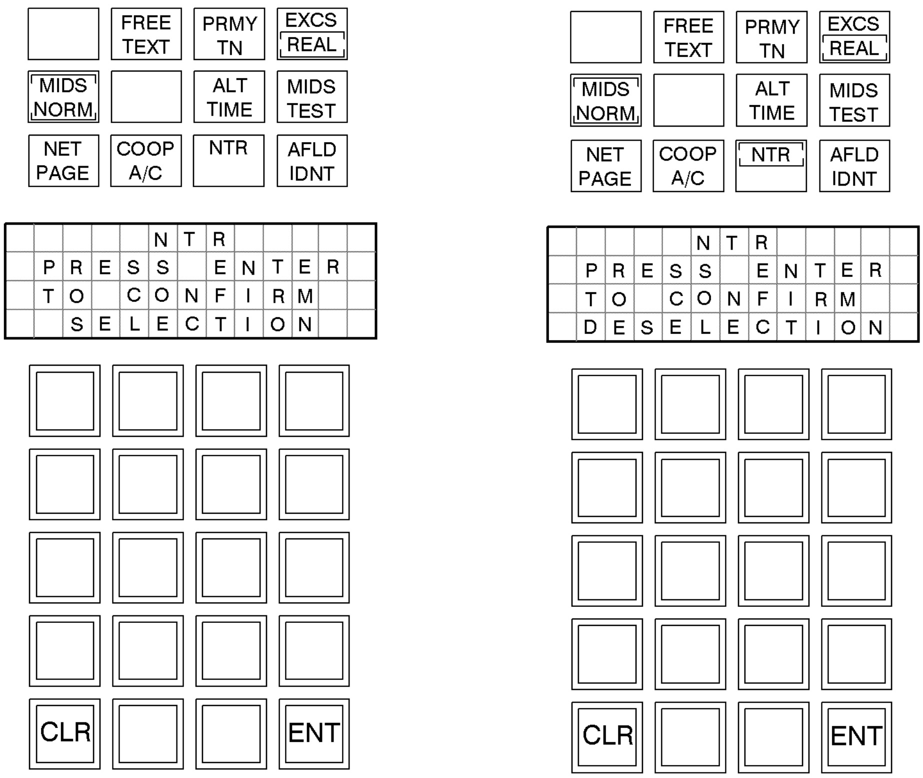

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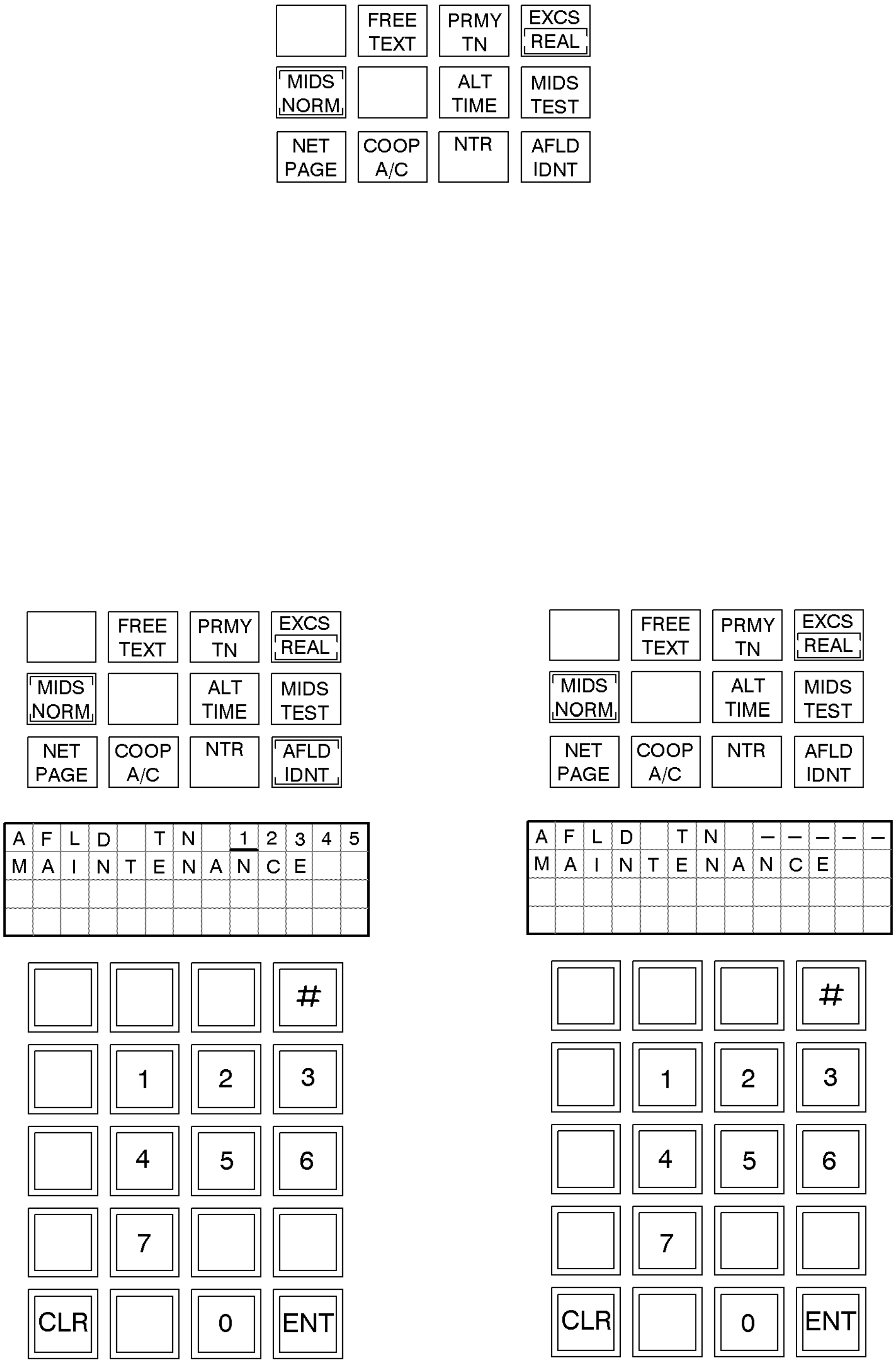
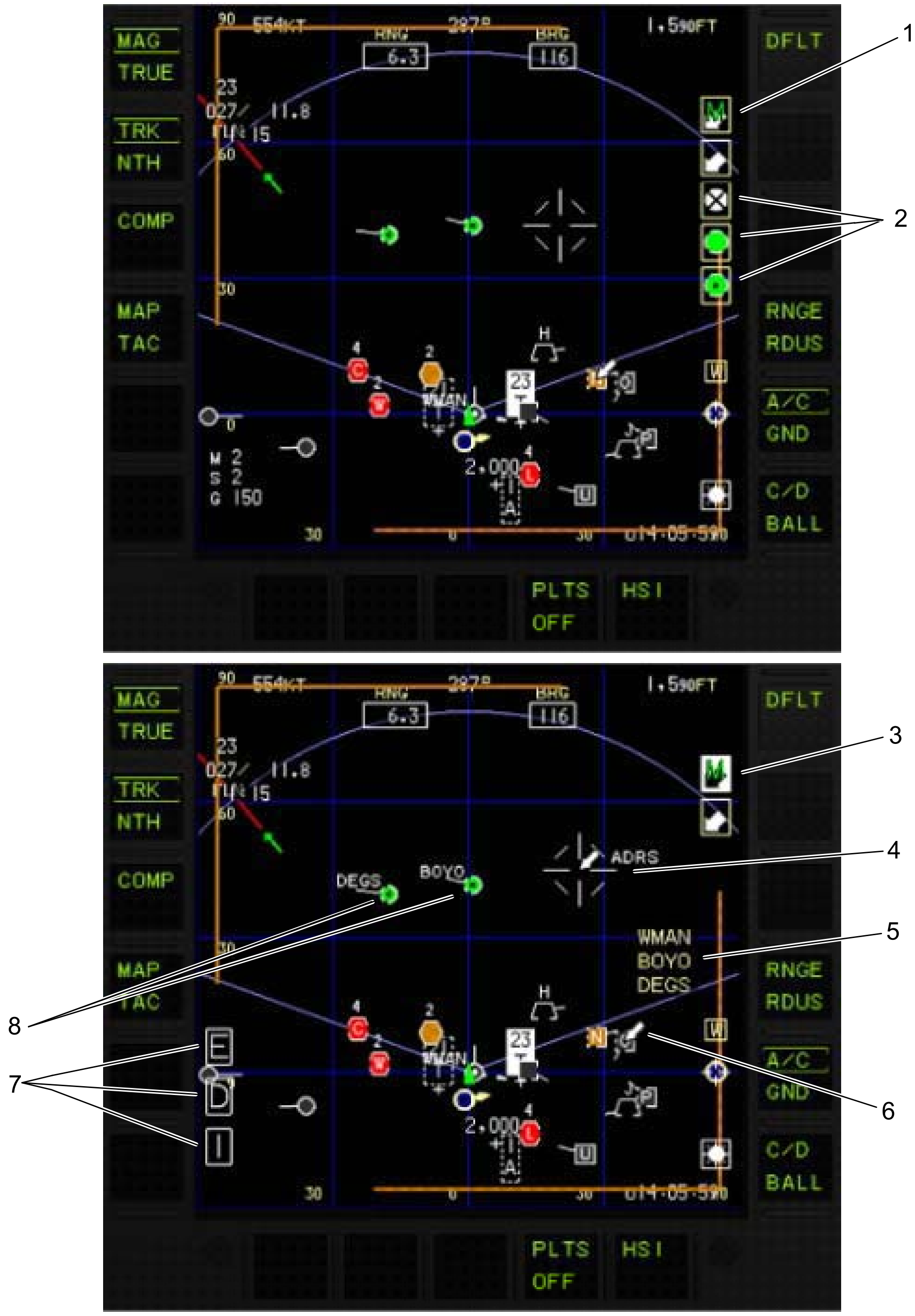
Figure I-04-21 Selection / Deselection of NET Time Reference Role



ICN-1B-B-232200-C-0117B-04699-A-02-2

Figure I-04-22 Specify an Airfield TN



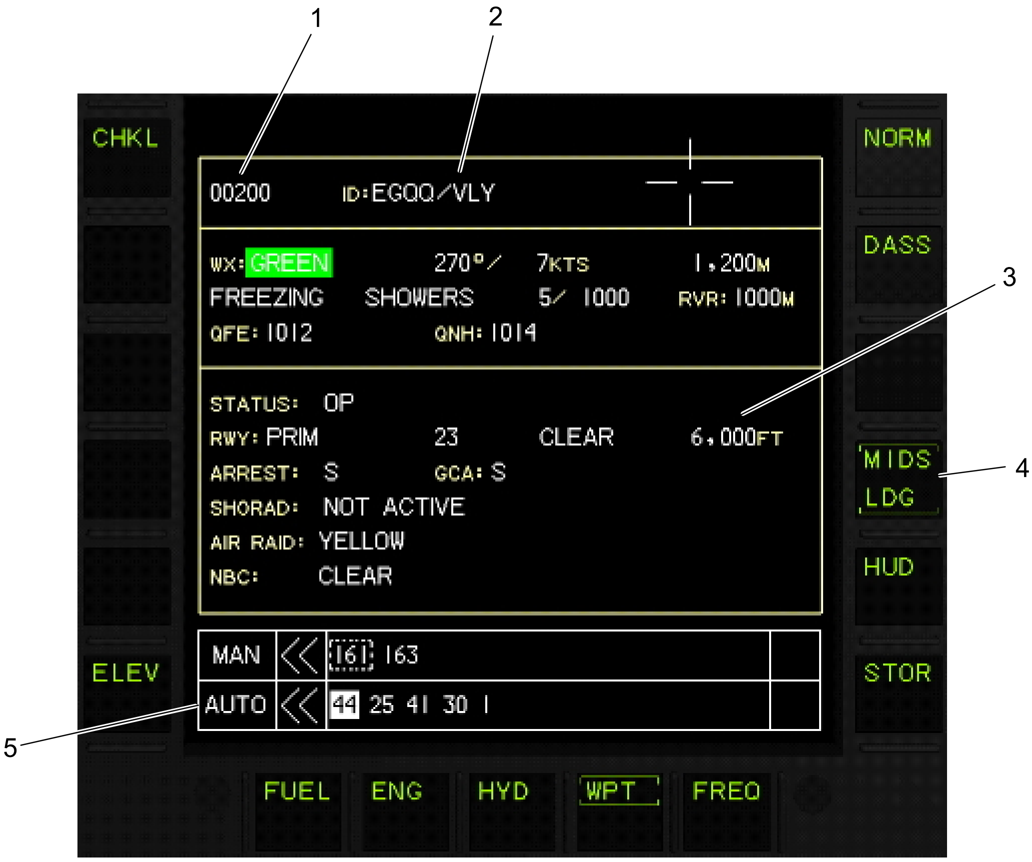
1 MISSION ASSIGNMENT ICON
2 POINTER ADDRESS ICONS (C2, COLLECTIVE, CO-OP)
3 MISSION ASSIGNMENT ICON SELECTED
4 MISSION ASSIGNMENT TIED TO THE XY CURSOR
5 CO-OPERATING AIRCRAFT CALLSINGS LIST
6 POINTER ARROW, TRACK STABILISED
7 MISSION TYPE ICONS
8 FRIENDLY CO-OP TRACKS, WITH CALLSINGS

ICN-1B-B-232200-C-0117B-04706-A-02-2

Figure I-04-23 MHDD - MIDS Mission Assignment

ICN-1B-B-232200-C-0117B-04707-A-01-2

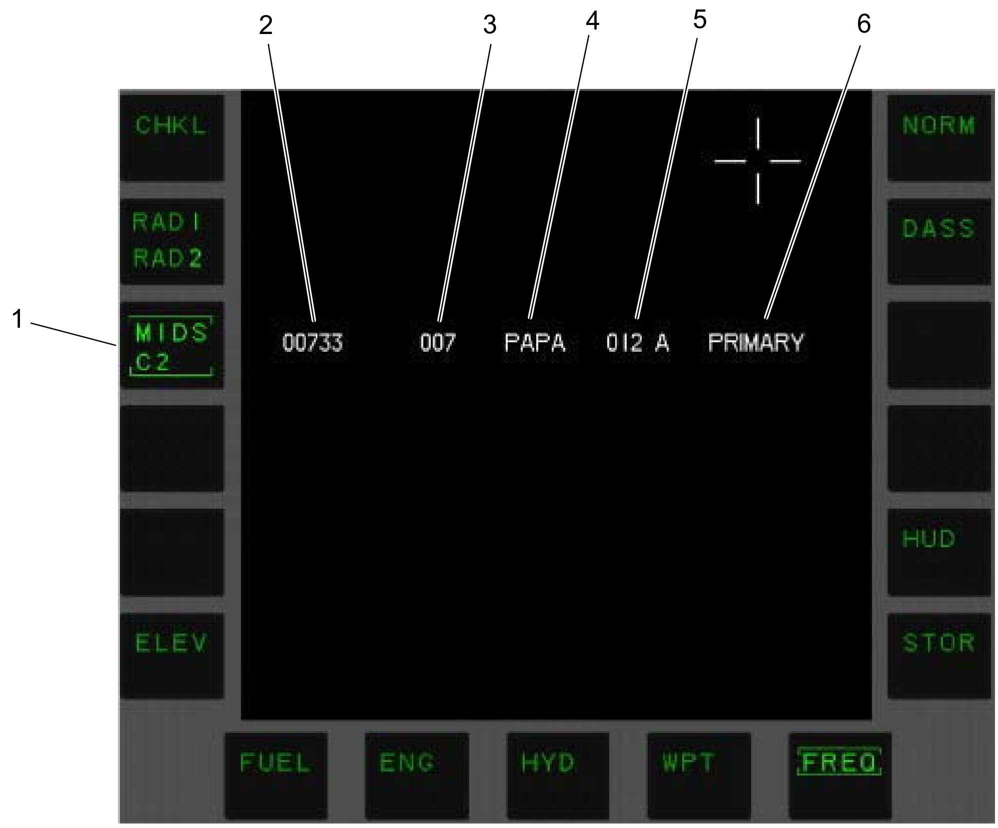
Figure I-04-24 MHDD Autocue Format with a MIDS Data Load Failure (no PDS loaded warning)



1 AIRFIELD TRACK NUMBER
2 AIRFIELD ICAO IDENTIFIER AND NAME
3 AIRFIELD DATA
4 MIDS LDG SOFT KEY
5 AUTO AND MANUAL ROUTE ROLS

ICN-1B-B-232200-C-0117B-04708-A-02-2

Figure I-04-25 MHDD Waipoint Format - MIDS Airfield Information



1 MIDS C2 SOFT KEY
2 C2 TN
3 CURRENT CONTROL CHANNEL
4 C2 VOICE CALLSIGN
5 C2 VOICE CHANNEL - USING VOICE MODE A
6 PRIMARY/SECONDARY CONTROL CHANNEL INDICATION

ICN-1B-B-232200-C-0117B-04709-A-02-2

Figure I-04-26 MHDD Frequency Format - C2 Unit Communications Data

1 MISSION ASSIGNMENT ICON
2 POINTER MESSAGE ICON (SELECTED)
3 UNKNOWN MOVING MIDS SURFACE TRACK
4 TACTICAL DATA - AAR TOWLINE
5 MIDS FRIENDLY CO-OPERATING AIRCRAFT TRACK
6 MIDS FRIENDLY JOINT USER TRACK
7 8 TRACK TGS
8 POINTER MESSAGE TIED TO THE XY CURSOR

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Figure I-04-27 MHDD PA Format with MIDS Information

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INTEGRATED MONITORING AND RECORDING SYSTEM

GENERAL

The Integrated Monitoring and Recording System (IMRS) collates and processes data obtained from various sensors and systems, in order to present information on the overall condition of the aircraft.

Most of the aircraft systems carry out BIT on start up and continuously thereafter, to monitor system performance and detect failures. The aircraft structure and engines are instrumented to support post-flight calculations for Structural Health Monitoring (SHM). The instrumentation provides data relating to fatigue consumption and health trend monitoring, as well as monitoring for limit exceedance during flight. In addition, the primary cockpit displays, the outside world video from the HUD camera and the cockpit intercom audio are recorded. All this data is collected centrally through the IMRS, processed then stored on one or more of the storage devices that follow, for post-flight replay, if required:
- Portable Maintenance Data Store (PMDS)
- Portable Data Store (PDS)
- Video Voice Recorder (VVR)
- Bulk Storage Device (BSD)
- Crash Survivable Memory Unit (CSMU).

INFORMATION INTERFACE

An Interface Processor Unit (IPU) automatically controls the IMRS by acquiring data from the sources that follow:
- Avionics, Attack and UCS buses
- No. 3 and No. 4 Flight Control Computers
- Engine Monitoring Unit (EMU)
- Communication and Audio Management Unit (CAMU)

After start up and data download from the PDS, via the Mission Data Loader and Recorder (MDLR), the IPU monitors and records system information. This data is then processed, formatted and compressed, where necessary, before being sent for storage on the Maintenance Data Panel (MDP) or MNTC format. The IPU is powered by the essential DC bus bar (PP3).

MISSION DATA LOADER RECORDER

The Mission Data Loader/Recorder (MDLR) provides the interface between the Portable Data Store (PDS) and aircraft systems via the attack data bus. The PDS is used to load/record data to/from the following aircraft systems:
- Armament Control System (ACS)
- Attack and Identification (AI) system
- Communication system
- Controls and displays system
- Defensive Aids Subsystem (DASS)
- Navigation system.

The MDLR is located on the right rear console (Figure I-05-01).

OPERATION

Power to the MDLR is supplied by the nonessential busbar PP2. If power is lost the system draws its power from the essential busbar PP3 for a maximum of 400 ms. If power does not return to PP2 during this time the MDLR enters the inhibit mode.

The MDLR has three normal modes of operation:
- Standby
- Mission data load
- Mission data record.

STANDBY MODE

Standby mode is entered when power is applied to the system and the PDS is not installed, the PDS cover on the MDLR is open, or after data erasure has been performed.

MISSION DATA LOAD

Mission data is automatically loaded to the aircraft avionics systems when the pilot inserts the PDS into the MDLR, the cover is closed, power is applied to the cockpit bus, and the PBIT has successfully been completed.

The bus controller receives a table specifying the amount of data to be loaded and to which systems. When the required data has been loaded the system enters the record mode.

RECORD MODE

In this mode of operation DASS emitters and radar Non-Cooperative Identification (NCI) data is stored in non-volatile memory within the PDS. The data recorded is stored in a specific area of the PDS and will not overwrite data that has been previously uploaded to the avionics system.

DATA ERASE

The data contained within the PDS is automatically erased upon ejection, or when the cover guarded secure data erase control push-button (Figure I-05-01) on the left rear console is depressed, assuming the PDS is inserted into the MDLR.

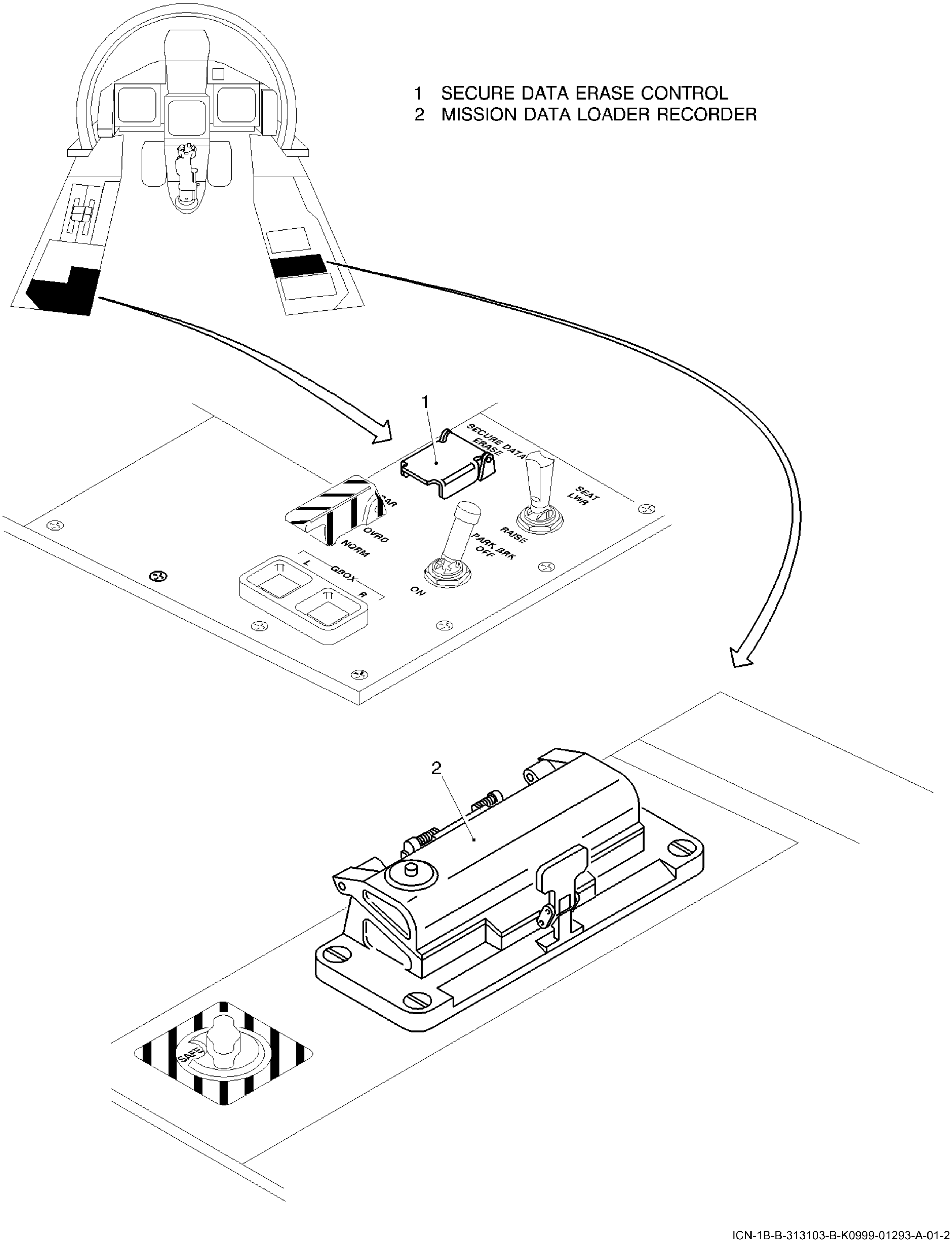


Figure I-05-01 Mission Data Loader Recorder and Secure Data Erase Control

VIDEO/VOICE RECORDER

The VVR uses a standard Hi 8, 8 mm magnetic video tape to record the MHDD and HUD displays and the cockpit audio. It also records pilot initiated event markers and other data for post flight analysis.

The VVR interfaces with:
- The two Computer Symbol Generators (CSG) (for multiplexed video)
- The CAMU (for audio)
- The Cockpit Interface Unit (CIU) (for event marking, time data, navigation data, multiplex selection and VVR mode control).

For Single seat aircraft

The VVR (Figure I-05-02) is mounted on the avionic bay roof.
⇐

For Twin seat aircraft

The VVR (Figure I-05-03) is mounted on the bulkhead on the right side of the front cockpit.
⇐

The VVR has an in-built thermostatically controlled heater to dispel moisture and the video cassette access door is also watertight to prevent moisture ingress. If the VVR detects moisture is present at power-on, the heaters will turn on automatically and operate until the moisture has evaporated or for a maximum of 16 minutes.

OPERATION

The VVR enters standby automatically after power-on and completion of PBIT. Once in standby, VVR STBY is displayed on the MISC VVR moding key and REC (unboxed) is displayed on the VVR push button, on the right console. Record mode can be selected manually by pressing the RECORD push button on the right console; REC is then boxed to indicate recording has started. The elapsed recording time can be checked at any time by selecting the MDEF/MISC and pressing the VVR SBY/REC key; elapsed time is then shown on the ROL. The VVR also begins recording automatically with weight-off-wheels and at least one of the following conditions are met:
- Air to surface (A/S) PoF is selected
- The late arm switch is enabled
- The radar is in VISident mode and the target range is less than 1 nm
- The trigger is pressed to the first detent.

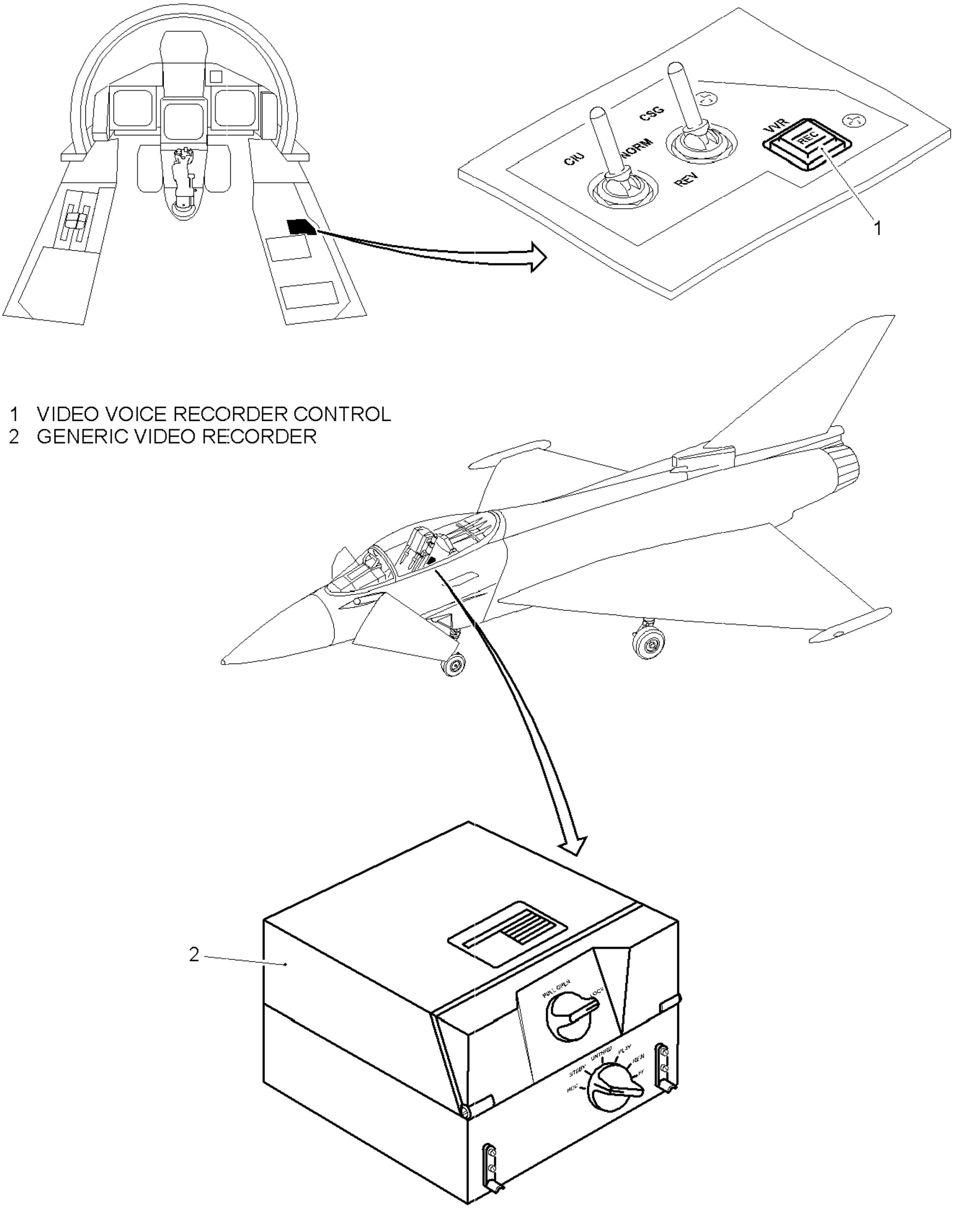
The following events are also recorded when they occur:
1. Selection and release of the first trigger detent
2. Selection and release of the second trigger detent
3. Weapon Release Button press and release
4. Weapon release pulses.

The VVR reverts to standby (SBY) automatically after 15 seconds, when each of these events is no longer apparent.

The VVR either remains in, or enters the OFF mode when:
- A tape cassette is not present, or is not inserted correctly
- Moisture is still present after the VVR heater has been on for 16 minutes
- The end of the tape has been reached.
- An end of mission signal has been received by the VVR.

If the VVR fails PBIT, CBIT or IBIT, the MISC VVR moding key shows VVR FAIL (boxed) and REC on the right console push button, goes out.

For Single seat aircraft



1 VIDEO VOICE RECORDER CONTROL
2 GENERIC VIDEO RECORDER

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Figure I-05-02 Video/Voice Recorder

⇐

For Twin seat aircraft

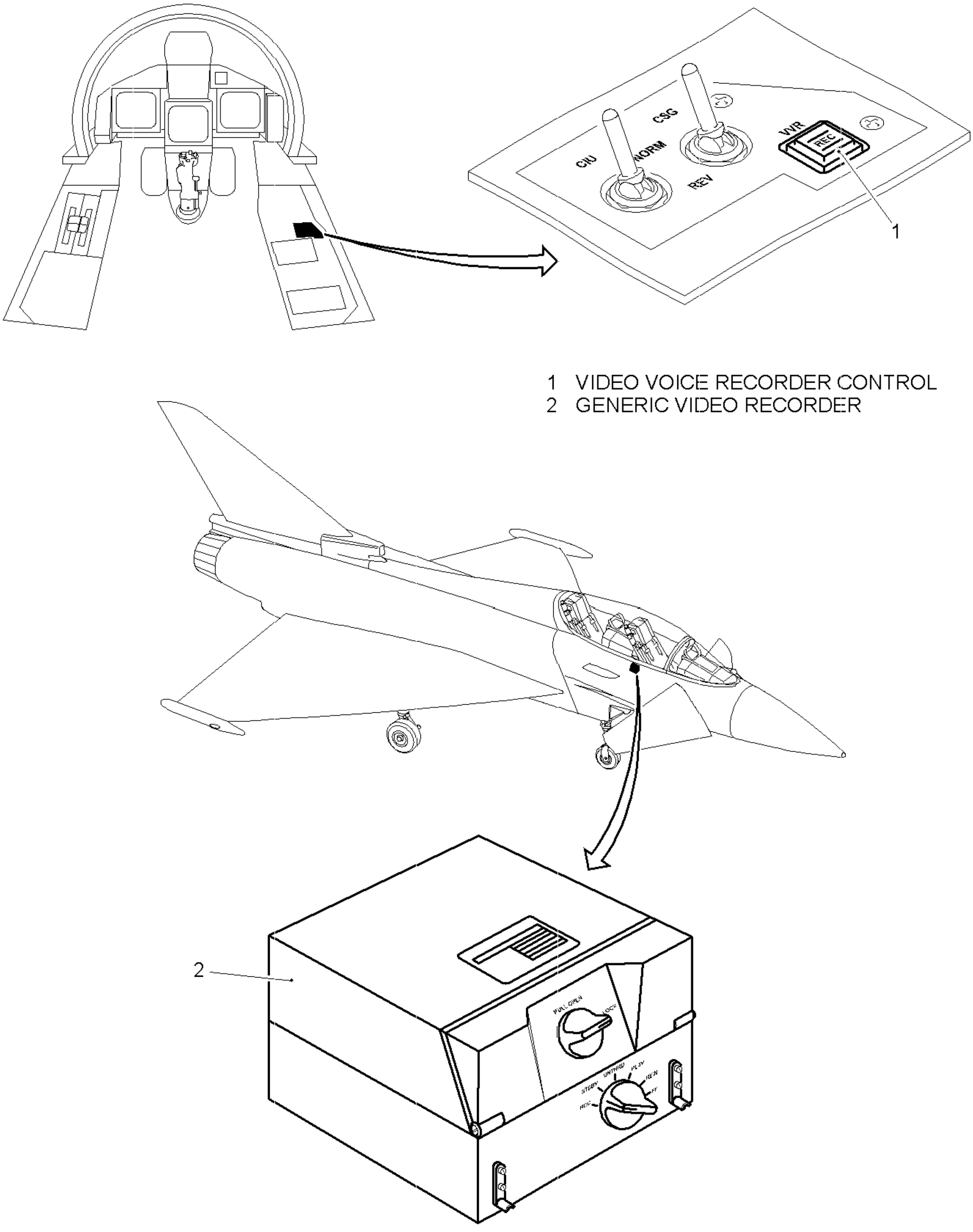

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Figure I-05-03 Video/Voice Recorder

⇐

BULK STORAGE DEVICE

The BSD is installed when required and is used for ‘special studies’ as defined by the operator; storing information for off-aircraft analysis. The data in compressed and uncompressed format, received from the IPU, is stored in non-volatile memory. Up to 15 Mbytes of data can be stored and when this limit is reached, recording ceases in order to prevent data being overwritten. The information transferred to the BSD can be:

- Engine health monitoring data
- Structural health monitoring data
- Secondary Power System (SPS) monitoring data
- Any other data received and used within the IPU.

CRASH SURVIVABLE MEMORY UNIT

The CSMU is a solid state, non-volatile flight data recorder that records data from the aircraft data buses, the CAMU and the FCS, to assist in incident and accident investigations. Data is passed to the CSMU via the IPU.

CSMU ACTIVATION

Soft.Prog.Ed.: PSC 1.1.x

When power is applied to the aircraft, the CSMU is activated and the previously stored data is erased automatically. However, if the CSMU write enable circuit breaker has been set open after the previous flight, data stored in the CSMU will not be erased when power to the aircraft is re-applied.

⇐

Soft.Prog.Ed.: PSC 1.2 onwards

When power is applied to the aircraft, the CSMU is activated and the write enable circuit breaker has to be closed to allow new data to be recorded.

⇐

The status of the write enable circuit breaker is displayed on the MDP.

RECORDED DATA

Soft.Prog.Ed.: PSC 1.1.x

The following information is recorded in digital format:

- Engine start data, FCS actuator check data and data 90 seconds before and after weight-off-wheels
- The last 90 minutes of flight data, stored in compressed format
- The last 30 seconds of flight data, stored uncompressed
- The last 30 minutes of all headset audio.

⇐

Soft.Prog.Ed.: PSC 1.2 onwards

The following information is recorded in digital format:

- Engine start data, FCS actuator check data and data from power-up to 90 seconds after weight-off-wheels
- Data for the entire flight, stored in compressed format
- Data for the entire flight, stored uncompressed
- All headset audio for the entire flight.

The recording duration of the CSMU is in excess of four hours.

⇐

DOWNLOADING OF RECORDED DATA

Data recorded on the CSMU can be downloaded off-aircraft using the Ground Support System (GSS), or whilst on-aircraft via the Ground Loading Unit (GLU).

OPERATION

A beacon unit attached to the CSMU contains a UHF radio locator beacon, underwater (sonar) locator beacon, batteries and an antenna. If the aircraft suffers an impact greater than 35.5 g in any direction, the UHF radio locator beacon is activated and transmits a signal on 243.5 MHz. This UHF emergency signal has an effective range of 50 nm. The sonar locator beacon activates immediately upon immersion in water and transmits a 37.5 kHz signal with an effective range of 1.5 nm.

CRYPTO VARIABLE MANAGEMENT SYSTEM

The Aircraft Cryptovariable Management System (ACVMS) provides the storage and management of cryptovariables required for operation of the following equipment:

- V/UHF1
- V/UHF2
- MIDS
- GPS
- IFF Transponder
- IFF Interrogator.

Encrypted key variables are required by the Multifunctional Information and Distribution System (MIDS), V/UHF1 and 2, whilst non-encrypted key variables are used by the GPS, IFF transponder and IFF interrogator.

NOTE

The ACVMS is currently at an interim standard which allows the loading of encrypted and non-encrypted variables by direct access. The system will be fully operational after installation of the ACVMU.

The ACVMS (fully operational installation) provides Universal Time Co-ordinated (UTC) time to the avionics system; this is sourced from the ACVMS UTC clock.

INTERIM INSTALLATION

The interim installation utilises a dummy ACVMU located in the avionics bay, and an extra back-up cable to enable loading of non-encrypted variables, refer to Figure I-05-04 . The ‘back-up" cable is connected between an additional non-encrypted fill port located in the right wing apex, and the dummy ACVMU.

The loading of encrypted key variables to the radios and MIDS is achieved using the bulk fill connector which is located in the right wing apex.

FULLY OPERATIONAL INSTALLATION

The ACVMU will accept, store and manage key variables loaded via the bulk fill port in the right wing apex, refer to Figure I-05-05 . The UTC clock supplies time signals to the avionic system via the ACVMU and the avionic data bus.

The ACVMU will distribute encrypted key variables to V/UHF1, V/UHF2 and the MIDS, and non-encrypted key variables to the GPS, IFF transponder and the IFF interrogator.

Cryptovariable data is erased automatically on ejection, or when the secure data erase button, located on the left console, is pressed, or when the ACVMU is physically removed from its mounting tray.

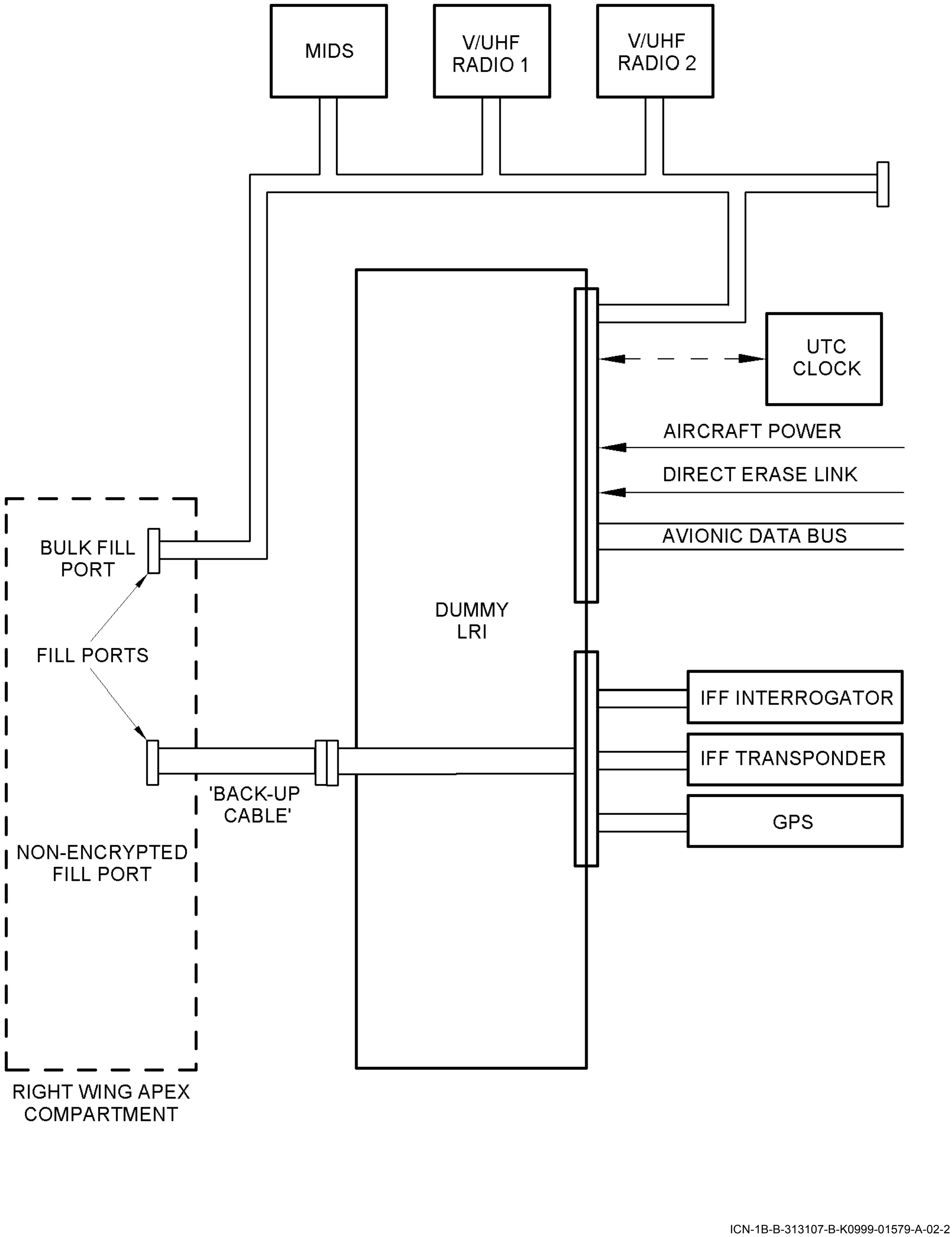


Figure I-05-04 Interim Installation

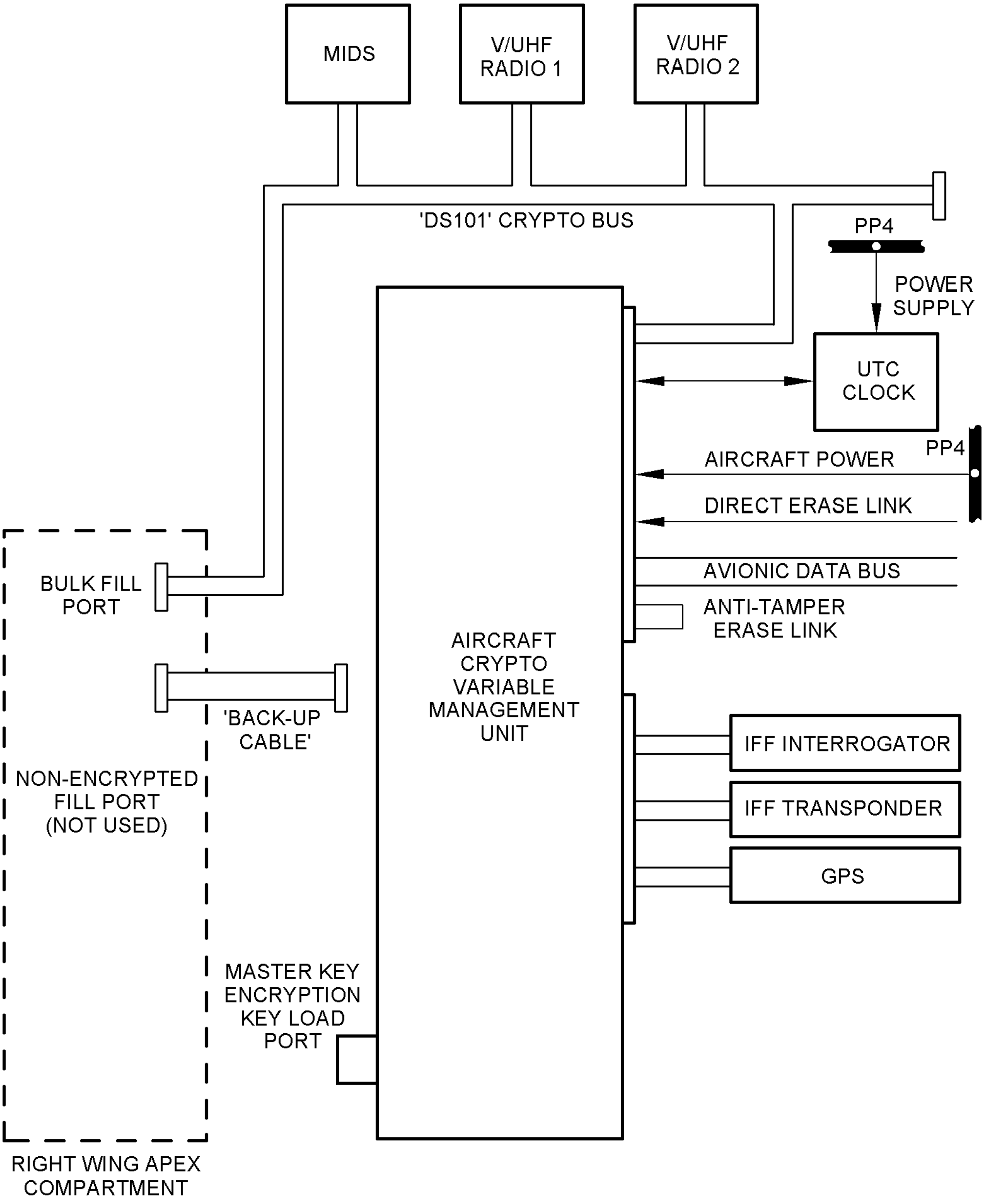


Figure I-05-05 Fully Operational Installation

MAINTENANCE DATA PANEL

The MDP is the central point of data input/output for maintenance actions on the aircraft. The MDP stores all significant aircraft data and allows recovery of such data either directly, via a text display or the PMDS. On the ground, the MDP gives rapid access to the aircraft maintenance data, providing a comprehensive history of significant events for maintenance purposes. The MDP can be interrogated via the text display on the panel, and/or via the PMDS which can be removed for analysis after flight. During flight, the MDP stores maintenance and servicing data transmitted by the aircraft systems and records them on the PMDS. The MDP is located in the aircraft fuselage (Figure I-05-06), near the left engine intake.

The MDP operates in two modes, ground and flight. Flight mode is used whenever the MDP access door is closed. In flight mode the display is inactive but the MDP continues to interact with the IMRS and UCS. On the ground with the panel door open, available MDP functionality depends on the available power source. When full power is available (ground power unit, APU or engine driven generators) the full range of menus and MDP functions are available. If battery power only is available and the MDP power switch is set to BATT, a reduced set of MDP menus and functions are available.

IMRS communication is not possible in BATT mode and the interface to the UCS requires positive activation of the UCS bus controller (fuel computer) and UCS subsystem computers. These occur on selection of specific maintenance actions by the operator. Ground mode of operation is terminated when the MDP access door is closed. This de-activates the display and physically sets the MDP power switch to NORM.

In normal ground mode, the MDP provides:
- On-screen display
- Maintenance recording
- Maintenance functions
- Data loading (upload and download)
- Built-in Test (BIT).

DISPLAY

The MDP screen is a monochrome touch-sensitive display using on-screen menus to give access to:
- System/LRI status and failure data (actual/last flight status)
- Limit exceedance data (actual/last flight status)
- Status of consumables (actual)
- Weapon system consumables (chaff, flare, decoy and gun rounds) (last flight status)
- Weapon/stores configuration data (last ground crew input or last flight status)
- Lifed items status.

RECORDING

The following information is downloaded to the PMDS:
- Aircraft identification
- PMDS identification
- System/LRI failure data (up to five flights)
- Exceedance data (last flight)
- Engine health monitoring data (last flight)
- SHM data (up to five flights)
- Secondary Power System (SPS) life monitoring data (up to five flights)
- Hydraulic trend data (up to five flights)
- Event marker data (up to five flights)
- Harmonization data.

MAINTENANCE FUNCTIONS

The MDP menus provide controls for the following maintenance actions:
- Aircraft inspections and turnaround, including consumables and pressures
- Refuelling/defuelling, including tank selection control
- BIT initialization for SPS, wheelbrakes, MSOC, ECS, fire detection system, UCS computers, navigation system, LINS, IMRS, EMU and engine igniters.

DATA LOADING

The following data can be loaded through the MDP screen:
- Manual input and uploading of the initial weapon/stores configuration data
- Initial data for SPS life monitoring
- BSD parameters.

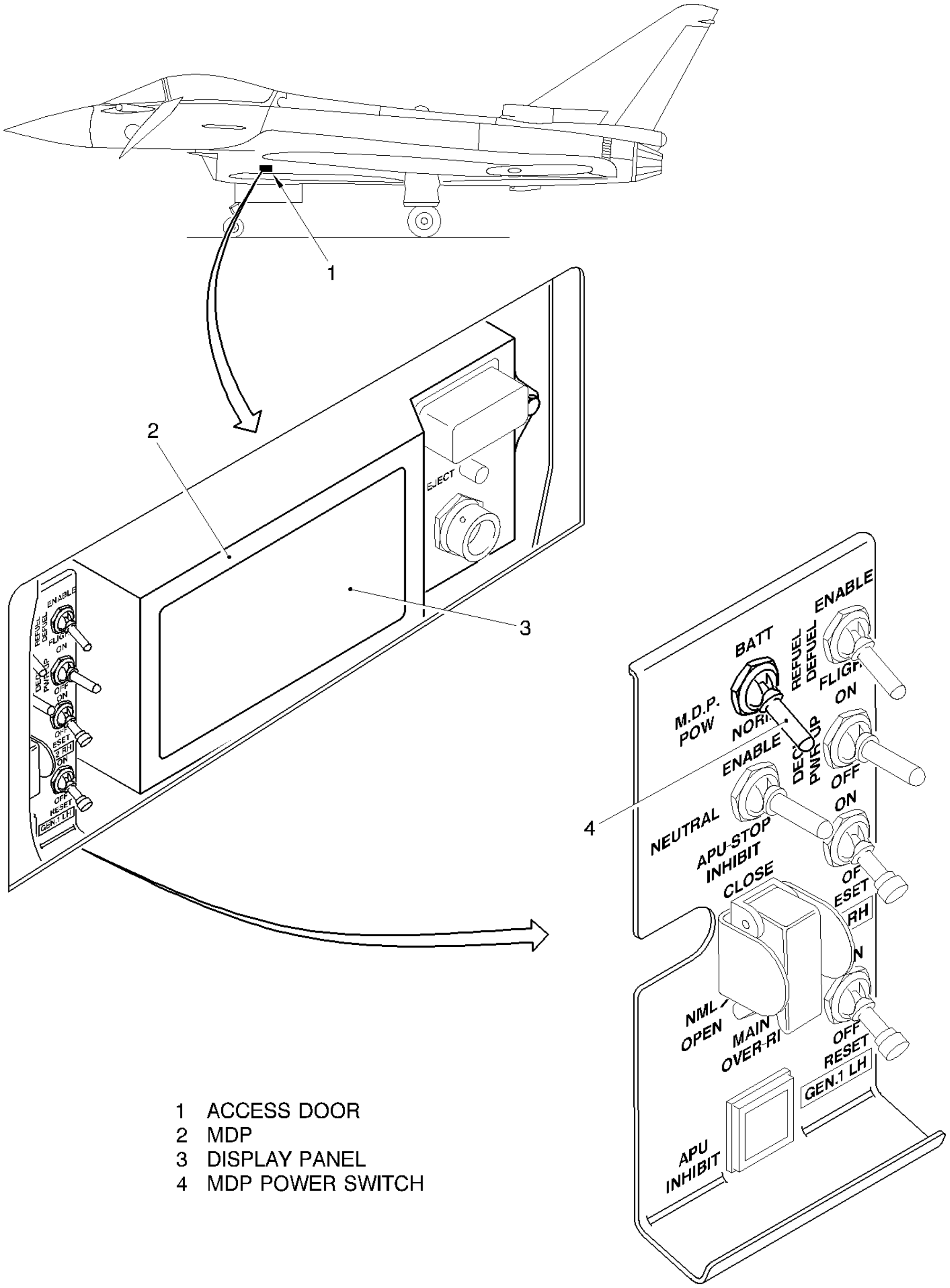
The following data can be loaded from the PMDS:
- Configuration data
- Initial data for structural health monitoring
- Initial data for engine health monitoring
- Initial data for SPS life monitoring
- Harmonization data
- Bulk storage device parameters
- FCS basic mass empty and centre of gravity data.

BUILT-IN TEST

BIT provides equipment monitoring during flight and testing on the ground. When an equipment failure is detected, relevant information is stored in a non-volatile memory for investigation after flight. There are three types of BIT:
- Power-up BIT (PBIT); on all related systems is initiated automatically on system power-up and is completed within 12 seconds
- Initiated BIT (IBIT); is performed on request for maintenance activities

- Continuous BIT (CBIT); is a continuous monitoring process of equipment functionality, executed automatically under control of system application software.

BIT detected failures are stored for display on the MDP and/or download through the PMDS for post flight analysis.



1 ACCESS DOOR
2 MDP
3 DISPLAY PANEL
4 MDP POWER SWITCH

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Figure I-05-06 Maintenance Data Panel

WARNING EQUIPMENT

AUDIO WARNING EQUIPMENT

The Communication and Audio Management Unit (CAMU) provides and controls the communications. If a failure occurs, the relevant system sends a warning to the master Computer Symbol Generator (CSG), where it is categorized and prioritized. The CSG outputs the warnings to the Dedicated Warning Panel (DWP) and triggers the attention getters. It also activates the CAMU to output the necessary attensons and voice warnings.

VOICE WARNING SYSTEM MUTE CONTROL

Voice warnings can be suspended by selecting the Voice Warning Suspend (VWS) position on the communications control, located on the right throttle top (Figure I-06-01). When the VWS position is selected and released, the voice warning and all voice warnings of equal or lower priority are suspended for a period of 15 seconds. However, if the VWS position is selected and held for > 15 seconds, all voice warnings are suspended for the duration of the switch press. During VWS, warnings of higher priority than the current warning are unaffected by VWS suspension.

For Twin seat aircraft

A voice warning audio-control (Figure I-06-01), located on the right console in the forward cockpit only, controls the transmission of voice warning messages. With the switch in the forward position, identified VOICE, voice warning messages are transmitted via the CAMU. With the switch in the aft position, identified OFF, voice warning messages are not transmitted. With the switch in this position, the other functions of the CAMU are not affected. Catastrophic warnings cannot be suspended or disabled.

⇐

PRESS-TO-TRANSMIT

There are two Press-to-Transmit (PTT) controls, one on the right throttle top and one on the left console (Figure I-06-01). If a warning message has started to play, selecting a PTT control will suspend the warning for the duration that the PTT is selected. The warning message will continue after the PTT control has been released. If a PTT is pressed and then a warning occurs, the warning will play immediately. Catastrophic warnings messages will be played regardless of the position of the PTT control.

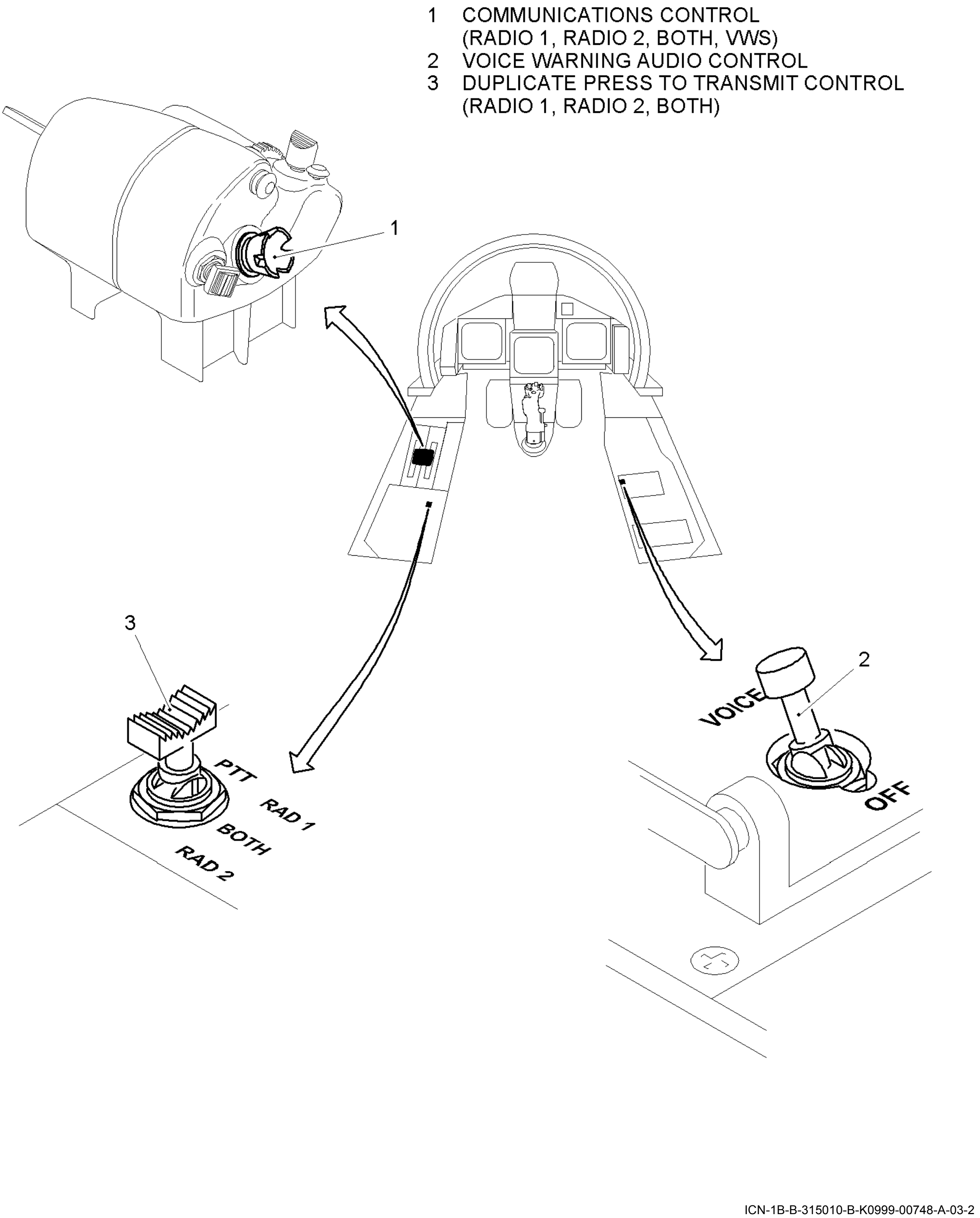


Figure I-06-01 Cockpit Audio Warning Controls

WARNINGS MANAGEMENT AND FAILURE ANALYSIS

Under normal operating conditions, all on-aircraft systems are automatically monitored for failures. Failures that directly affect aircraft operation or require pilot compensation or corrective action are presented to the pilot through the warning system. Failures that do not directly affect aircraft operation are not presented to the pilot, but are recorded through the Integrated Monitoring and Recording System (IMRS) for subsequent investigation and fault analysis.

The warnings system prioritizes all existing warnings and presents them in an organized and consistent manner. The warnings are presented by some, or all of the following devices: flashing attention getters, a caption on the Dedicated Warnings Panel (DWP), an attention getting sound (attenson) and a voice warning message. The aural components of the warning are generated by the Communications and Audio Management System (CAMU).

All warnings are either related to aircraft systems or are of a procedural nature and are assigned a category according to the POF, and are also prioritized within each category. The categories are Catastrophic, 1, 2, 3 and 4 in descending order of priority. Warnings occurring simultaneously will be presented sequentially according to their category and prioritization.

During start-up/shutdown, warnings are suppressed to prevent an array of warnings due to inactive equipment or systems.

Warnings generated as a consequence of a primary fault condition are referred to as secondary warnings and they are presented on the DWP but do not trigger any other part of the warnings system.

CATASTROPHIC WARNINGS

A catastrophic failure is an event which makes it impossible for the aircraft to continue safe flight and handling. Immediate pilot action is advised which, under some circumstances, may be immediate ejection.

CATEGORY 1 WARNINGS

A category 1 warning is of a procedural nature and warns of a hazardous situation that requires immediate action.

Upon receipt of a category 1 warning, the attention getters flash and the voice warning message is heard. Pressing one of the attention getters acknowledges the warning; the attention getters stop flashing and, if it is the first play of the voice message, the voice warning is allowed to play in full and then ceases. For subsequent plays, the message stops immediately , upon pressing the attention getter . Figure I-06-02 illustrates this sequence.

NOTE

> The voice warning message interrupts and mutes any incoming audio communications.

CATEGORY 2 WARNINGS

A category 2 warning is related to aircraft systems and warns of a primary failure that requires immediate action.

Upon receipt of a category 2 warning, the attention getters and the related DWP red caption flash, and an attenson is heard, which is followed by a voice warning message. By pressing one of the attention getters, the attention getters stop flashing and the flashing DWP caption becomes steady. If it is the first play of the voice message, it is allowed to play in full, and then ceases. For subsequent plays, it stops playing immediately , upon pressing the attention getter ; Figure I-06-03 illustrates this sequence.

NOTE

> The attenson interrupts and mutes any incoming audio communications, the voice warning message operates in parallel with any incoming communications.

CATEGORY 3 WARNINGS

A category 3 warning is also related to aircraft systems and warns of a primary failure that requires attention.

Upon receipt of a category 3 warning, the attention getters and the related DWP amber caption flash, and a voice warning message is heard. By pressing one of the attention getters, the attention getters stop flashing and the flashing DWP amber caption becomes steady. If it is the first play of the voice message, it is allowed to play in full, and then ceases. For subsequent plays, it stops immediately , upon pressing the attention getter . Figure I-06-04 illustrates this sequence.

NOTE

> The voice warning message operates in parallel with any incoming audio communications.

CATEGORY 4 WARNINGS

A category 4 warning is procedural only and provides advice or information of a procedural nature.

Upon receipt of a category 4 warning, a voice warning message is played twice and then stops. It can also be stopped by pressing one of the attention getters (even though they are not flashing and not active for this category of warning). If it is the first play of the voice message, it is allowed to play in full, and then ceases.

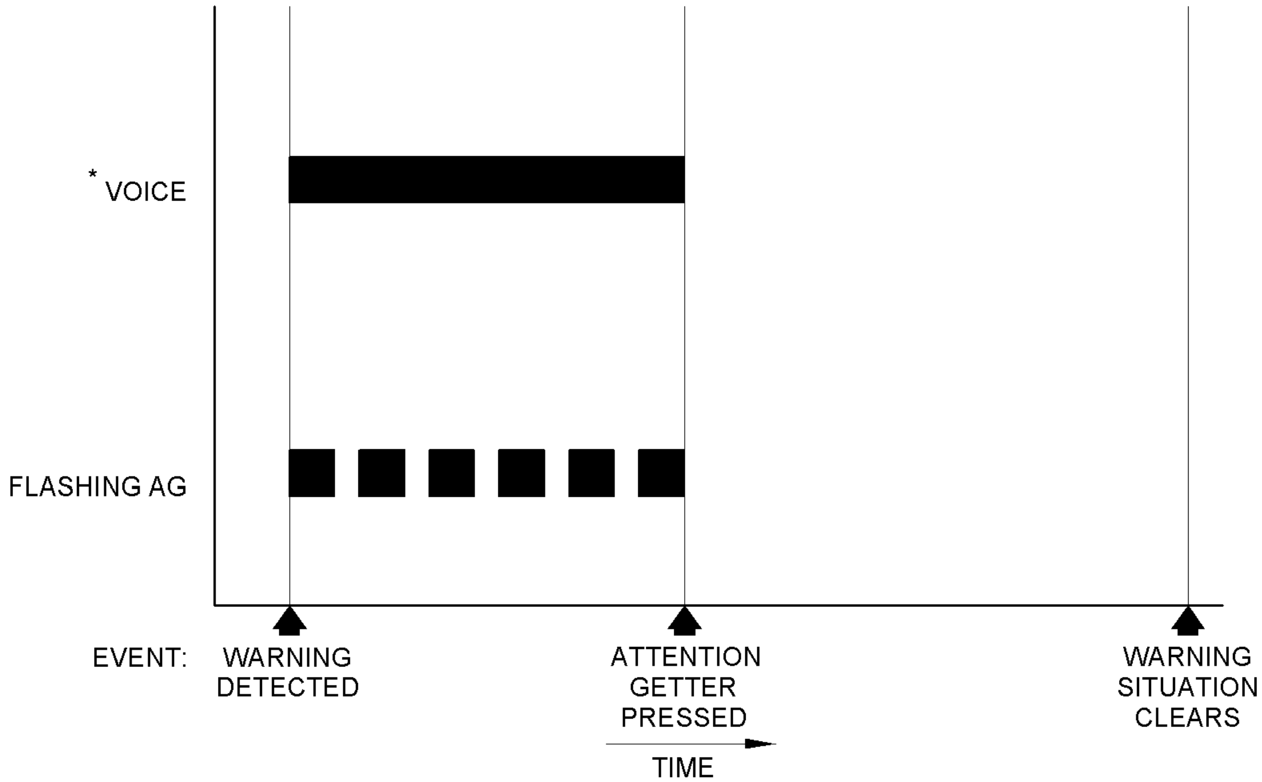
There are no DWP warning indications for a Category 4 warning.

NOTE

> The message operates in parallel with any incoming audio communications.

GET-U-HOME WARNINGS

The GUH warnings are all category 2, except for one (CPT DISP) which is category 3. They are presented to the pilot as described for other category 2 and 3 warnings.



* NOTE...
IF THE VOICE MESSAGE IS BEING PLAYED FOR THE FIRST TIME, IT WILL BE ALLOWED TO PLAY IN FULL EVEN IF THE ATTENTION GETTER IS PRESSED.

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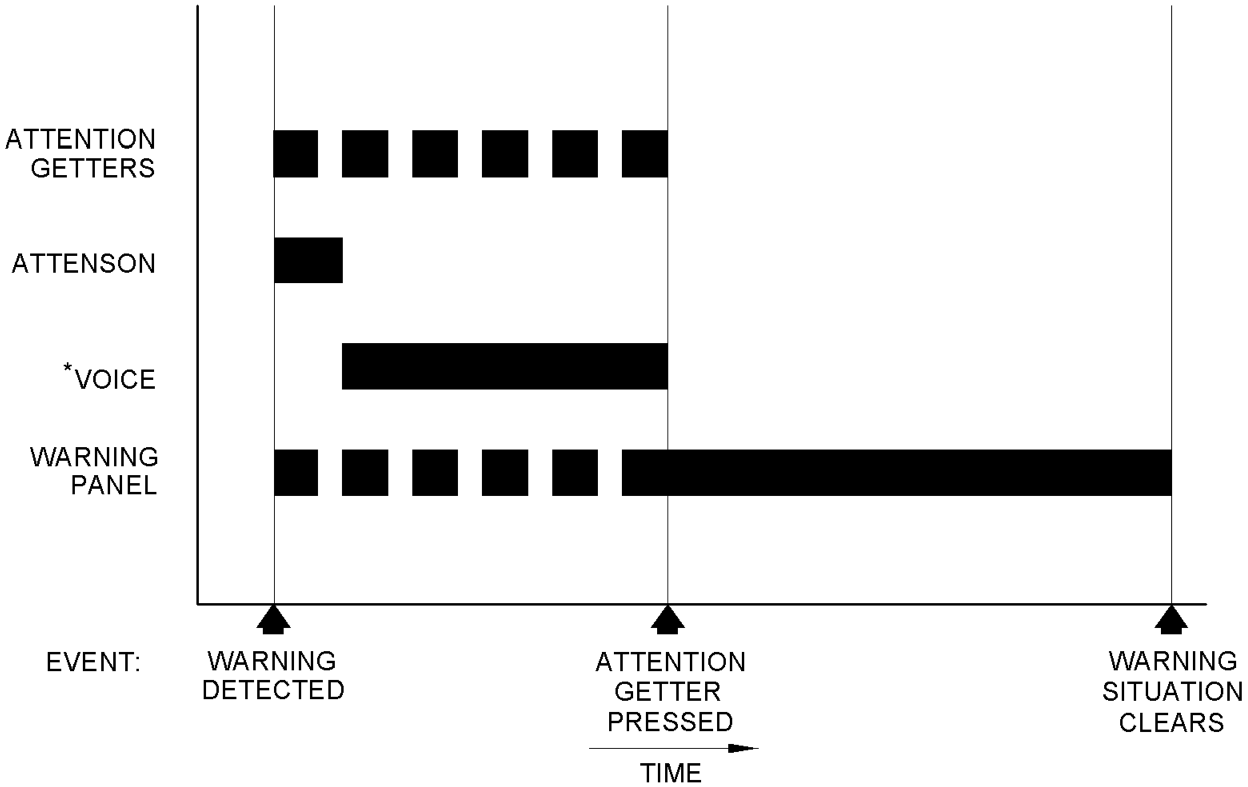
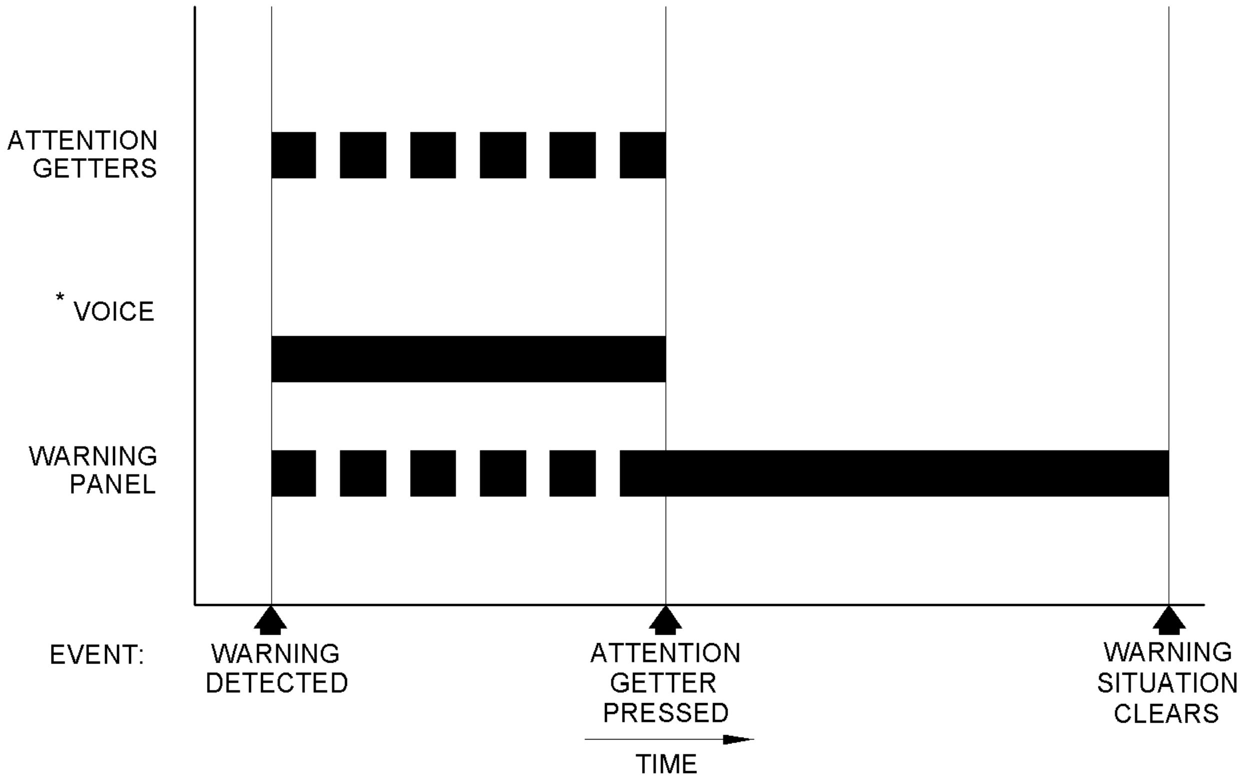
Figure I-06-02 Category 1 Warning Sequence



* NOTE...
IF THE VOICE MESSAGE IS BEING PLAYED FOR THE FIRST TIME, IT WILL BE ALLOWED TO PLAY IN FULL EVEN IF THE ATTENTION GETTER IS PRESSED.

ICN-1B-B-315020-B-K0999-00750-A-02-1

Figure I-06-03 Category 2 Warning Sequence



* NOTE...
IF THE VOICE MESSAGE IS BEING PLAYED FOR THE FIRST TIME, IT WILL BE ALLOWED TO PLAY IN FULL EVEN IF THE ATTENTION GETTER IS PRESSED.

ICN-1B-B-315020-B-K0999-03743-A-02-2

Figure I-06-04 Category 3 Warning Sequence

DEDICATED WARNING PANEL

The Dedicated Warnings Panel (DWP), Figure I-06-05 , is situated on the right quarter panel. It consists of a reconfigurable, dot matrix type display capable of presenting 27 captions simultaneously, in three columns of nine. The bottom row of three is reserved for captions related to catastrophic warnings; two are currently defined. Captions are presented either red or amber depending on the classification, category 2 or 3 respectively. A primary warning flashes until acknowledged by the pressing of one of the attention getters. Secondary warnings are a consequence of primary warnings, and do not flash. When a warning has been acknowledged, the caption remains visible until the warning situation clears.

The captions are presented in the order of priority, from the top to the bottom of the display. Captions associated with systems on the left of the aircraft are displayed on the left of the display; similarly on the right.

The captions are presented such that any red captions always appear at the top of the DWP, with any amber captions beneath them. A subsequent primary warning will appear above any primary warnings of the same category which are already present in a particular column.

Secondaries will appear beneath their applicable primary, if they are the same category and column. Otherwise they will appear at the top of their applicable column/category.

WARNING PANEL MODE PUSH-BUTTON/INDICATOR

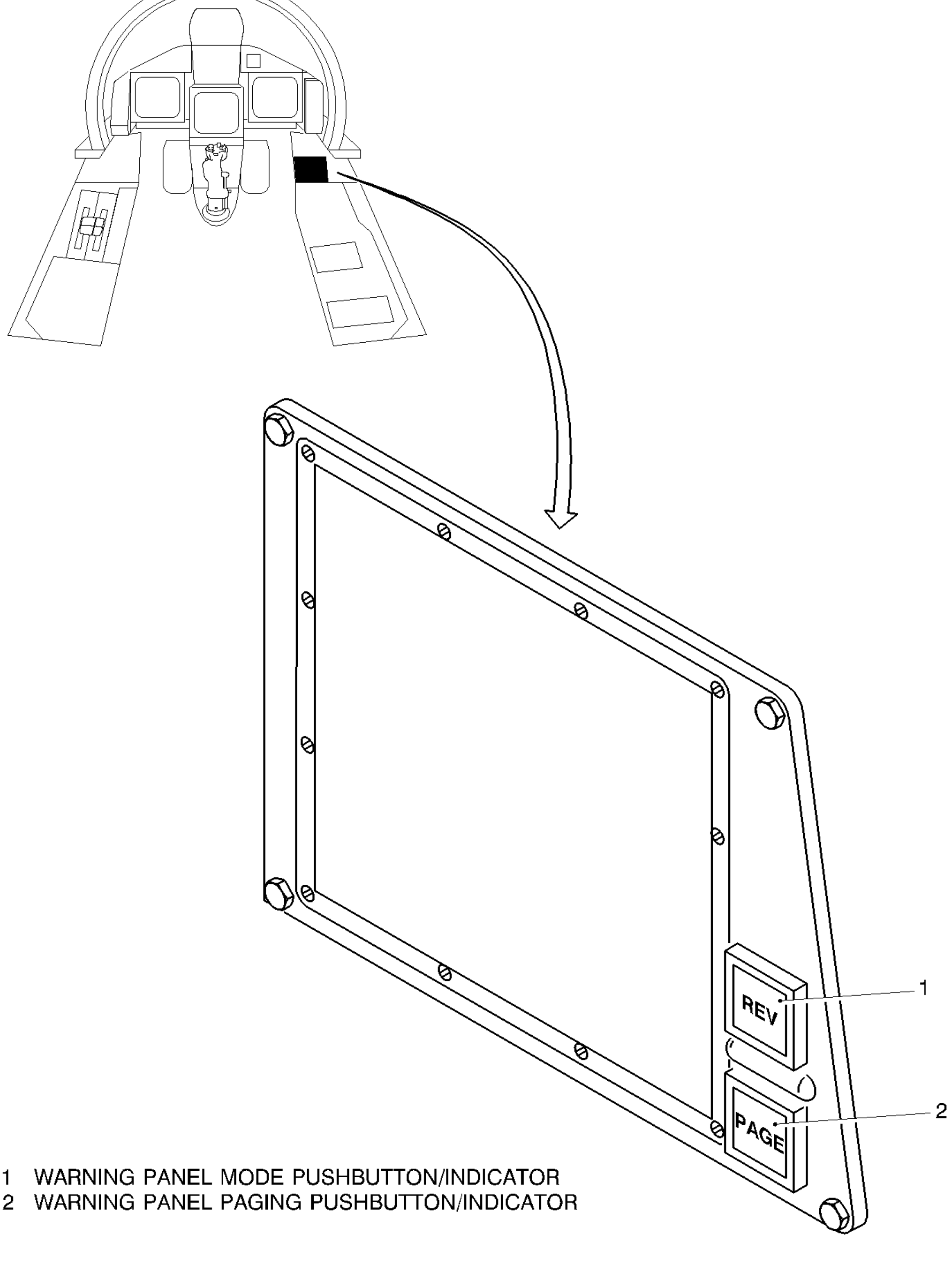
The warning panel mode push-button/indicator, Figure I-06-05 , is available for selection at all times under normal circumstances. Selection is indicated by illumination of the status bars on the REV push-button. Upon selection the DWP enters a reversionary "get-u-home" mode of operation. In addition to manual selection, reversionary mode is engaged automatically when the DWP loses one of its two power supplies, or the avionics data bus fails.

After a manual selection of the reversionary mode, further selection of the push-button causes the panel to revert back to the normal mode of operation. Upon successful deselection, the status bars go out. If a detected failure has caused the panel to enter the reversionary mode, selection of the push-button has no effect. The normal mode of operation is re-engaged by the system if the fault condition clears.

WARNING PANEL PAGING PUSH-BUTTON/INDICATOR

The warning panel paging push-button/indicator, Figure I-06-05 , enables the pilot to scroll through two pages of warnings (if a second is present). If the number of warnings generated reach two pages in length, further new warnings will cause the warnings at the bottom of page 2 to be obscured from sight. As warnings on page 1 or page 2 are cleared satisfactorily, obscured warnings will come back into view as space on page 2 becomes available.

When the first warning panel page becomes full, PAGE is lit on the push-button. Upon selection of the push-button, the status bars are lit and page 2 of the warnings is displayed. Selection of the push-button will display page 1 again, and the status bars will go out.



1 WARNING PANEL MODE PUSHBUTTON/INDICATOR
2 WARNING PANEL PAGING PUSHBUTTON/INDICATOR

ICN-1B-B-315030-B-K0999-00742-A-01-1

Figure I-06-05 Dedicated Warning Panel

VISUAL/AUDIO WARNINGS

The aircraft warning system provides both visual and audio warnings. The visual warnings are presented via the attention getters and the Dedicated Warnings Panel (DWP). The audio warnings are presented using attention getting sounds (attenson) and voice warning messages.

VISUAL WARNINGS

Two flashing red attention getters, located on the left and right glareshields, inform the pilot of a warning situation. By pressing one of the attention getters, the warning is acknowledged and the flashing stops.

The DWP presents a visual indication of all category 2 and 3 warnings, and the catastrophic warnings. Upon receipt of a warning, the DWP caption will flash until acknowledged, when it will remain steady. A warning which is the result of an indirect system failure will not flash.

AUDIO WARNINGS

Category 1 and 4 warnings generate a voice warning message, but not an attenson. Category 2 warnings carry an attenson and a voice warning message. The voice warning message sounds until the warning is acknowledged. Category 4 warnings are sounded twice and then stop automatically.

CATASTROPHIC WARNINGS

This category of warning has the highest priority and is indicated by flashing attention getters, a dedicated caption on the DWP and a voice message that plays immediately, interrupting any other audio message. Two catastrophic warnings are defined; a double hydraulics failure and a high integrity warning. The causes, voice messages and captions are shown in Table I-06-01 .

Cause	Voice Message	Caption
Double hydraulic system failure	Double hyd fail	HYD TOT
Any one of a small number of FCS related problems which would degrade handling	Reversionary envelope	REV ENV

Table I-06-01 Catastrophic Warning

REVERSIONARY WARNINGS

In the reversionary mode the DWP shows a limited number of warnings. The captions are in the same positions on the DWP each time they are shown. The causes, voice messages and captions are shown in Table I-06-02 .

Cause	Voice Message	Caption
Left engine fire	Left engine fire	L FIRE
Left control circuit hydraulic pressure	Left control pressure	L CONT P
Essential DC failure	Essential DC	ESS DC
Double AC generator failure	Double AC	AC
Double CIU/CSG failure	Cockpit display	CPT DISP
Oxygen	Oxygen	OXY
APU fire	APU fire	APU FIRE
Right engine fire	Right engine fire	R FIRE
Right control circuit low hydraulic pressure	Right control pressure	R CONT P

Table I-06-02 Reversionary Warnings

CATEGORY 1 WARNINGS

Category 1 warnings are the next highest priority of warning and are indicated by the attention getters and a voice warning message. The message informs the pilot of the condition or the immediate action to be taken, and continues until the warning is acknowledged or the warning condition clears. The causes and voice warning messages are shown in Table I-06-03 .

Cause	Voice Message
MASS not live*	Mass not live
GPWS pull up/Manual pull-up	Pull up
Gear down limit speed	Gear limit
Landing gear not lowered and: - airspeed < 180kts - altitude < 300ft - throttle levers < 75% max dry	Landing gear
Radar altimeter low height	Low height
Low speed	Speed low recover
Park brake**	Park brake
* Takeoff phase of flight Category 4 in certain phases or combinations of warnings ** Takeoff and approach and landing phases only	

Table I-06-03 Category 1 Warnings

CATEGORY 2 WARNINGS

Category 2 warnings are the next highest priority and are indicated by an attenson, attention getters, a voice message and a red DWP caption. The voice warning message follows the attenson and informs the pilot of the condition. The voice message continues until the acknowledged by pressing the attention getter. The causes, voice messages and captions are shown in Table I-06-04 thru Table I-06-15 .

Cause	Voice Message	Caption
No cooling to avionic LRI	ECS fan	FAN
Left uncontrolled hot gas leak	Left ECS leak	L ECS LK
Right uncontrolled hot gas leak	Right ECS leak	R ECS LK

Table I-06-04 Air Conditioning System

Cause	Voice Message	Caption
DC generation failure level 2	Electrical second fail	ELEC 2
Essential DC failure*	Essential DC	ESS DC
Double AC generator failure*	Double AC	AC
* Reversionary mode warnings		

Table I-06-05 Electrical Power System

Cause	Voice Message	Caption
FCS second failure	FCS second fail	FCS 2
Brakes loss of function*	Brakes	BRK FAIL
Auto-throttle failure*	Auto-throttle fail	A THROT
*Category 3 in certain phases of flight or combinations of warnings.		

Cause	Voice Message	Caption
Left intake cowl failure	Left intake cowl	L COWL
Right intake cowl failure	Right intake cowl	R COWL
Slat system freeze	Slats fail	SLATS
Nose wheel steering failure	Nose wheel steering	NWS
Airbrake failure	Airbrake fail	A BRAKE
Autopilot failure	Autopilot	A/PILOT
Probe heating second failure	Probe second fail	PROBE 2
Hazardous CG position	CG one	CG1
Critical CG impingement*	CG two	CG2
Loss of fuel mass or stores	FCS mass	FCS MASS
System failures which would result in degraded handling	FCS reversionary	FCS REV
Air data failure	Air data	AIR DATA
*Category 3 in certain phases of flight or combinations of warnings.		

Table I-06-06 Flight Control System

Cause	Voice Message	Caption
Left fuel over-temperature*	Left fuel temp	L FUEL T
Right fuel over-temperature*	Right fuel temp	R FUEL T
Left fuel low pressure	Left fuel pressure	L FUEL P
Right fuel low pressure	Right fuel pressure	R FUEL P
*Category 3 in certain phases of flight or combinations of warnings.		

Table I-06-07 Fuel System

Cause	Voice Message	Caption
Low pressure in left utilities	Left UTIL	L UTIL P
Low pressure in right utilities	Right UTIL	R UTIL P
Catastrophic warning system failure*	Catastrophic warning system fail	CFW FAIL
Left control circuit low hydraulic pressure	Left control pressure	L CONT P
Right control circuit low hydraulic pressure	Right control pressure	R CONT P
* Ground phase of flight only		

Table I-06-08 Hydraulic System

Cause	Voice Message	Caption
Brakes loss of function	Brakes	BRK FAIL
Category 3 in certain phases of flight or combinations of warnings.		

Cause	Voice Message	Caption
Anti-skid loss of function	Anti skid	A/SKID
Hook down without command	Hook down	HOOK DWN
Category 3 in certain phases of flight or combinations of warnings.		

Table I-06-09 Landing Gear System

Cause	Voice Message	Caption
Navigation disparity monitor trip	Monitor trip	MON TRIP
Category 3 in certain phases of flight or combinations of warnings.		

Table I-06-10 Navigation System

Cause	Voice Message	Caption
Oxygen	Oxygen	OXY
Category 3 in certain phases of flight or combinations of warnings.		

Table I-06-11 Oxygen System

Cause	Voice Message	Caption
APU fire	APU fire	APU FIRE
The canopy warning horn sounds intermittently with the APU fire warning.		

Table I-06-12 Airborne Auxiliary Power

Cause	Voice Message	Caption
Canopy not locked	Canopy not locked	CANOPY
Ladder not stowed and locked	Ladder not stowed	LADDER

Table I-06-13 Windshield and Canopy

Cause	Voice Message	Caption
Left engine oil low pressure	Left oil pressure	L OIL P
Right engine oil low pressure	Right oil pressure	R OIL P
Left engine fire	Left engine fire	L FIRE
Right engine fire	Right engine fire	R FIRE
Left engine performance	Left engine performance	L ENG P
Right engine performance	Right engine performance	R ENG P
Left reheat failure	Left reheat	L RHEAT
Right reheat failure	Right reheat	R RHEAT
Category 3 in certain phases of flight or combinations of warnings.		

Cause	Voice Message	Caption
Left engine flameout	Left engine flameout	L FLAME
Right engine flameout	Right engine flameout	R FLAME
Category 3 in certain phases of flight or combinations of warnings.		

Table I-06-14 EJ200 Engine Turbofan

Cause	Voice Message	Caption
air leak	SPS leak	SPS LEAK
Left gearbox failure	Left gearbox	L GBOX
Right gearbox failure	Right gearbox	R GBOX
Left gearbox lubrication over-temperature	Left gearbox temp	L GBOX T
Right gearbox lubrication over-temperature	Right gearbox temp	R GBOX T
Left air turbine starter motor over speed	Left air turbine	L ATSM
Right air turbine starter motor over speed	Right air turbine	R ATSM

Table I-06-15 Accessory Gear Boxes and Drive System

CATEGORY 3 WARNINGS

Category 3 warnings are the next highest priority of warning. The warning starts with attention getters, a voice message and an amber caption. The voice message continues until an attention getter is pushed. The causes, voice messages and captions are shown in Table I-06-16 thru Table I-06-31 .

Cause	Voice Message	Caption
Environmental control system failure	ECS	ECS
Cabin low pressure	Cabin low pressure	CABIN LP
Cabin high pressure	Cabin high pressure	CABIN HP

Table I-06-16 Air Conditioning System

Cause	Voice Message	Caption
Communications failure	Comms	COMMS
Voice message failure	(none)	VOICE

Table I-06-17 Communication System

Cause	Voice Message	Caption
Right AC generator failure	Right generator	R GEN
Left AC generator failure	Left generator	L GEN
Right AC generator over temperature	Right generator temp	R GEN T
Left AC generator over temperature	Left generator temp	L GEN T

Cause	Voice Message	Caption
DC generation failure level 1	Electrical first fail	ELEC 1
Battery overheat	Battery overheat	BATT T

Table I-06-18 Electrical Power System

Cause	Voice Message	Caption
FCS first failure	FCS first fail	FCS 1
Left intake cowl failure	Left intake cowl	L COWL
Right intake cowl failure	Right intake cowl	R COWL
Slat system freeze	Slats fail	SLATS
Nose wheel steering failure	Nose wheel steering	NWS
Airbrake failure	Airbrake fail	A BRAKE
Autopilot failure	Autopilot	A PILOT
Probe heating second failure	Probe second fail	PROBE 2
Pitch/roll/yaw trim failure	Trim	TRIM
Barometric pressure setting failure	Baro pressure	BARO-SET
Hazardous C.G. position	CG one	CG1
Critical CG impingement*	CG two	CG2
FCS reset	FCS reset	FCS RSET
Throttle follow-up failure	Follow-up throttle	THROT LK
*Category 2 in certain phases of flight or combinations of warnings.		

Table I-06-19 Flight Control System

Cause	Voice Message	Caption
Left fuel computer failure	Left fuel computer	L FUEL C
Right fuel computer failure	Right fuel computer	R FUEL C
Left fuel over-temperature*	Left fuel temp	L FUEL T
Right fuel over-temperature*	Right fuel temp	R FUEL T
Vent pressure/temperature	Fuel vent	VENT
Fuel low level	Fuel low	FUEL LOW
IFR probe lock failed	IFR probe	IFR
Fuel transfer	Fuel transfer	XFER
Flight refuel system failure	Fuel valve	FUEL VLV
*Category 2 in certain phases of flight or combinations of warnings.		

Table I-06-20 Fuel System

Cause	Voice Message	Caption
UCS computer failure	UCS computer	UCS CPTR
Air in left hydraulics	Left HYD air	L HYD A
Air in right hydraulics	Right HYD air	R HYD A

Cause	Voice Message	Caption
Left hydraulics over temperature	Left HYD temp	L HYD T
Right hydraulics over temperature	Right HYD temp	R HYD T

Table I-06-21 Hydraulic System

Cause	Voice Message	Caption
Ice detected	Icing	ICE
Windscreen heating system failure	Windscreen heater fail	WINDSCRN

Table I-06-22 Ice and Rain Protection

Cause	Voice Message	Caption
Double CIU failure rear cockpit (T/S A/C only)	Rear CIU	REAR CIU
Map not available	Map	MAP
GPWS failure	GPWS	GPWS
Terrain data unavailable	Terrain data	TERRAIN
Obstacle data unavailable	Obstacle data	OBSTACLE
Double CIU/CSG failure*	Cockpit display	CPT DISP
CIU single failure	CIU fail	CIU
CSG single failure	CSG fail	CSG
Barometric pressure setting failure	Baro set	BARO-SET
* Reversionary mode warnings		

Table I-06-23 Indicating, Recording System, Computing

Cause	Voice Message	Caption
Hook down without command*	Hook down	HOOK DWN
Hook loss of function	Hook fail	HOOK
Parachute loss of function	Chute fail	CHUTE
Brakes loss of function*	Brakes	BRK FAIL
Anti-skid loss of function*	Anti skid	A/SKID
* Category 2 in certain phases of flight or combinations of warnings.		

Table I-06-24 Landing Gear System

Cause	Voice Message	Caption
Global positioning system failure	GPS	GPS
Laser inertial navigator failure	LINS	LINS
Radar altimeter failure	RAD ALT	RAD ALT
Navigation computer failure	NAV computer	NAV CPTR
Category 2 in certain phases of flight or combinations of warnings.		

Cause	Voice Message	Caption
Tactical air navigation failure	TACAN	TACAN
Navigation disparity monitor trip	Monitor trip	MON TRIP
Category 2 in certain phases of flight or combinations of warnings.		

Table I-06-25 Navigation System

Cause	Voice Message	Caption
Oxygen*	Oxygen	OXY
MSOC not in use	MSOC off	MSOC
*Category 2 in certain phases of flight or combinations of warnings.		

Table I-06-26 Oxygen System

Cause	Voice Message	Caption
Left engine oil over-temperature	Left oil temp	L OIL T
Right engine oil over-temperature	Right oil temp	R OIL T
Left engine vibration	Left engine vibration	L VIBR
Right engine vibration	Right engine vibration	R VIBR
Left DECU failure	Left DECU	L DECU
Right DECU failure	Right DECU	R DECU
Left reheat	Left reheat	L RHEAT
Right reheat	Right reheat	R RHEAT
Category 2 in certain phases of flight or combinations of warnings.		

Table I-06-27 EJ200 Engine Turbofan

Cause	Voice Message	Caption
SPS pipe over pressure	SPS over pressure	SPS P
Left SPS computer failure	Left SPS computer	L SPS C
Right SPS computer failure	Right SPS computer	R SPS C
APU door has failed to open	APU door	APU DOOR
Left power take-off shaft failure	Left power off take	L POT
Right power take-off shaft failure	Right power off take	R POT

Table I-06-28 Accessory Gear Boxes and Drive System

Cause	Voice Message	Caption
Radar shutdown failure	Radar shutdown	RADAR SD
Radar total failure	Radar	RADAR
IFF interrogator failure	Interrogator	IFF INT
IFF interrogator/ tramsmitter cryptovariable failure	IFF crypto	IFF CRYP
IFF interrogator overtemperature	Interrogator temp	INT T

Cause	Voice Message	Caption
Attack computer failure	Attack computer	ATK CPTR
Transponder failure	Transponder	XPDR

Table I-06-29 Surveillance/Attack and Identification

Cause	Voice Message	Caption
NSCAC failure	NSCAC fail	NSCAC
Weapon hang-up	Hang up	HANG-UP
Gun failure	Gun fail	GUN FAIL
Distribution unit failure	DU fail	DU FAIL
ACS failure	ACS fail	ACS FAIL
Selective jettison failure	Selective jettison fail	SJ FAIL
Emergency jettison failure	Emergency jettison fail	EJ FAIL
Gun scoop failure	Gun scoop	GN SCOOP
SCAC channel failure	SCAC	SCAC

Table I-06-30 Weapon System

Cause	Voice Message	Caption
Defensive aids computer failure	DASS computer	DAS CPTR
Flare dispenser disabled	Flare dispenser	FLARE
Chaff dispenser failed	Chaff dispenser	CHAFF

Table I-06-31 Tactical Electronic Warfare

CATEGORY 4 WARNINGS

Category 4 warnings have the lowest priority and have a voice message only. The message provides the nature of the warning and is played twice. The causes and the voice messages are shown in Table I-06-32 .

Cause	Voice Message	Caption
Radar altimeter low height*	Low height	None
Throttle override	Auto-throttle	None
Auto-pilot override/auto-pilot out of limits	Auto-pilot	None
Auto-recover selected	Auto-recover	None
Auto-pull-up	Auto-pull-up	None
FCS override	FCS override	None
Passing 5000ft check height	Five thousand feet	None
Disengagement of baro alt auto-pilot mode	Altitude mode drop-out	None
Supersonic advance warning	Transonic	None
Bingo 1	Bingo 1	None
* In approach and landing phase of flight ** Category 1 in takeoff phase of flight		

Cause	Voice Message	Caption
Bingo 2	Bingo 2	None
Bingo 3	Bingo 3	None
Bingo 4	Bingo 4	None
Autocue failure	Autocue	None
DWP failure	DWP fail	None
Rear DWP failure	Rear DWP fail	None
VVR failure	VVR fail	None
VVR run time check	Check VVR	None
VVR tape end	VVR tape end	None
Terrain valid for GPWS	Terrain valid	None
Obstacle is valid for GPWS	Obstacle valid	None
Mode 4 incorrect own response	Mode 4 response	None
IFF transponder ACC available	Transponder ACC available	None
IFF interrogator ACC available	Interrogator ACC available	None
Simultaneous clear/secure transmit	(beep tone)	None
Gear travel speed	Gear travel	None
MASS not live**	Mass not live	None
Airframe temperature	Airframe temp	None
Maximum speed exceeded	Max speed	None
Auto-throttle reheat required	Select reheat	None
Chaff empty	Chaff empty	None
Flares empty	Flares empty	None
Wing tanks empty	Wing tanks empty	None
Center line tank empty	Center tank empty	None
Hail radio 1	Hail radio 1	None
Hail radio 2	Hail radio 2	None
Radios common tuning	Frequency	None
* In approach and landing phase of flight		
** Category 1 in takeoff phase of flight		

Table I-06-32 Category 4 Warnings

FIRE WARNING SYSTEM

Engine bay fires are detected by firewire detectors located in each engine bay. When a fire is detected a category 2 warning is initiated.

The engine fire is indicated by flashing attention getters, a DWP caption (L FIRE and/or R FIRE) and a voice warning message ("Left engine fire" and/or "Right engine fire"). The ENG format also displays the caption L FIRE and/or R FIRE.

In addition, an engine bay fire/overheat is indicated on two indicators, one for the left engine and one for the right engine. The indicators are located on either side of the HUD Control Panel (HUDCP). If a fire is detected, the caption F is illuminated on the respective indicator.

Warning of an APU fire/overheat, category 2, is indicated by flashing attention getters, the caption APU FIRE on the DWP and a voice warning message ("APU fire").

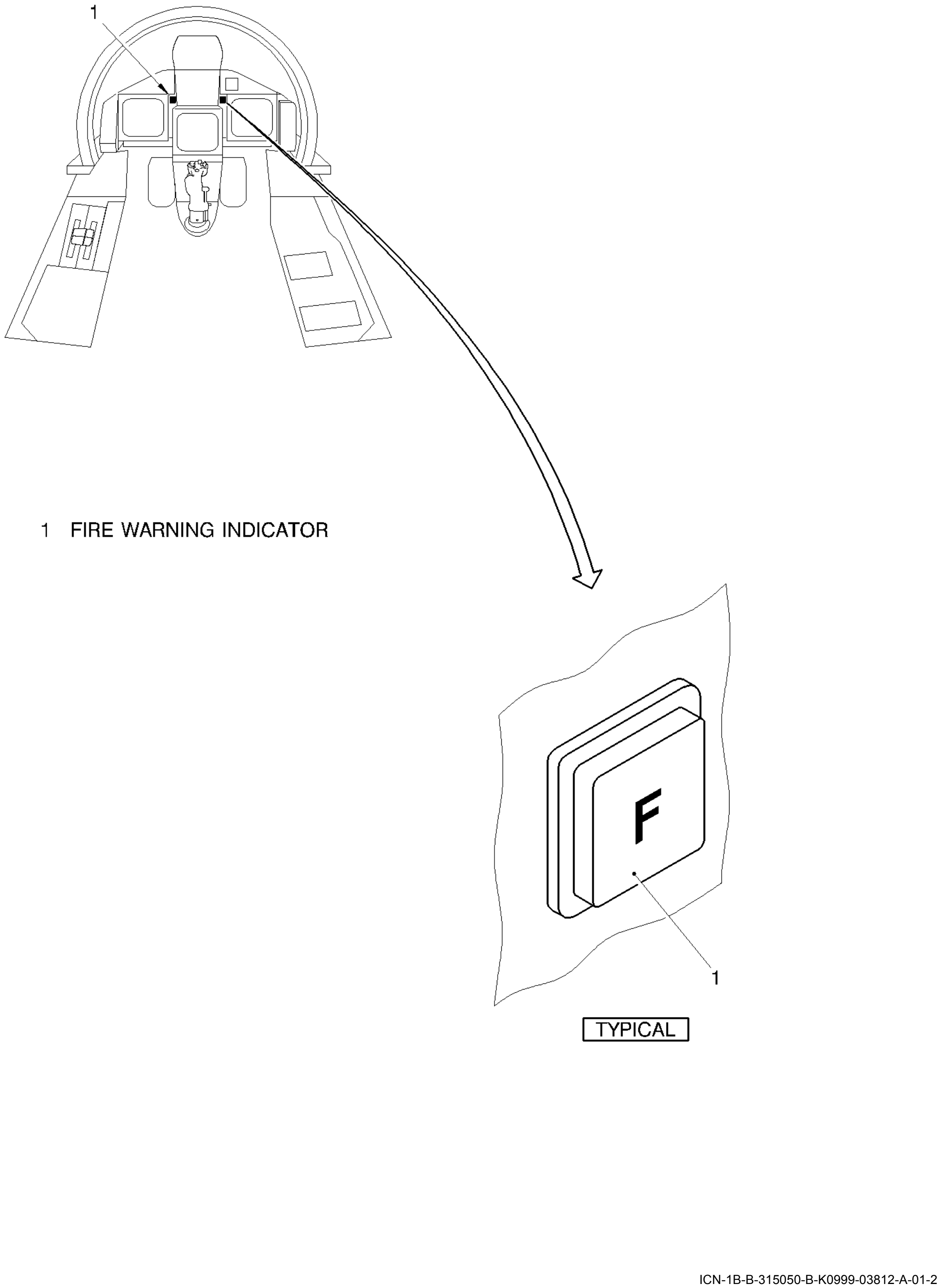


Figure I-06-06 Fire Warning Indicators

DWP REVERSIONARY WARNINGS

In the event of a failure of the displays and/or warning systems associated data bus, or a loss of one of its two power supplies, the Dedicated Warnings Panel (DWP) enters a reversionary GUH mode. This mode is also selected when a fault is detected within; the DWP, the link between the DWP and Computer Symbol Generator (CSG), or if data from the CSG is in error. The reversionary mode can also be selected manually via the REV push-button indicator next to the DWP.

The single page of GUH warnings displays eight category 2 warnings, in fixed positions, driven by dedicated inputs. One category 3 GUH warning may also be displayed which is generated internally by the DWP when it detects loss of valid data bus inputs. In addition, the DWP also displays any catastrophic warnings. These warnings are hardwired and can also be displayed in the event of a total loss of power to the DWP. The GUH warnings (Figure I-06-07) are listed, with captions, as follows:

- Left engine fire (L FIRE)
- Essential DC failure (ESS DC)
- Right engine fire (R FIRE)
- Double AC failure (AC)
- Low hydraulic pressure in left control circuit (L CONT P)
- Loss of oxygen system (OXY)
- Low hydraulic pressure in right control circuit (R CONT P)
- APU fire (APU FIRE)
- Double hydraulic system failure (HYD TOT) - (catastrophic warning)
- Any one of a small number of FCS related problems which could degrade handling (REV ENV) - (catastrophic warning)
- Double CSG/CIU failure (CPT DISP) - (Category 3).

All GUH warnings and the associated audio messages are identical to those in normal operation.

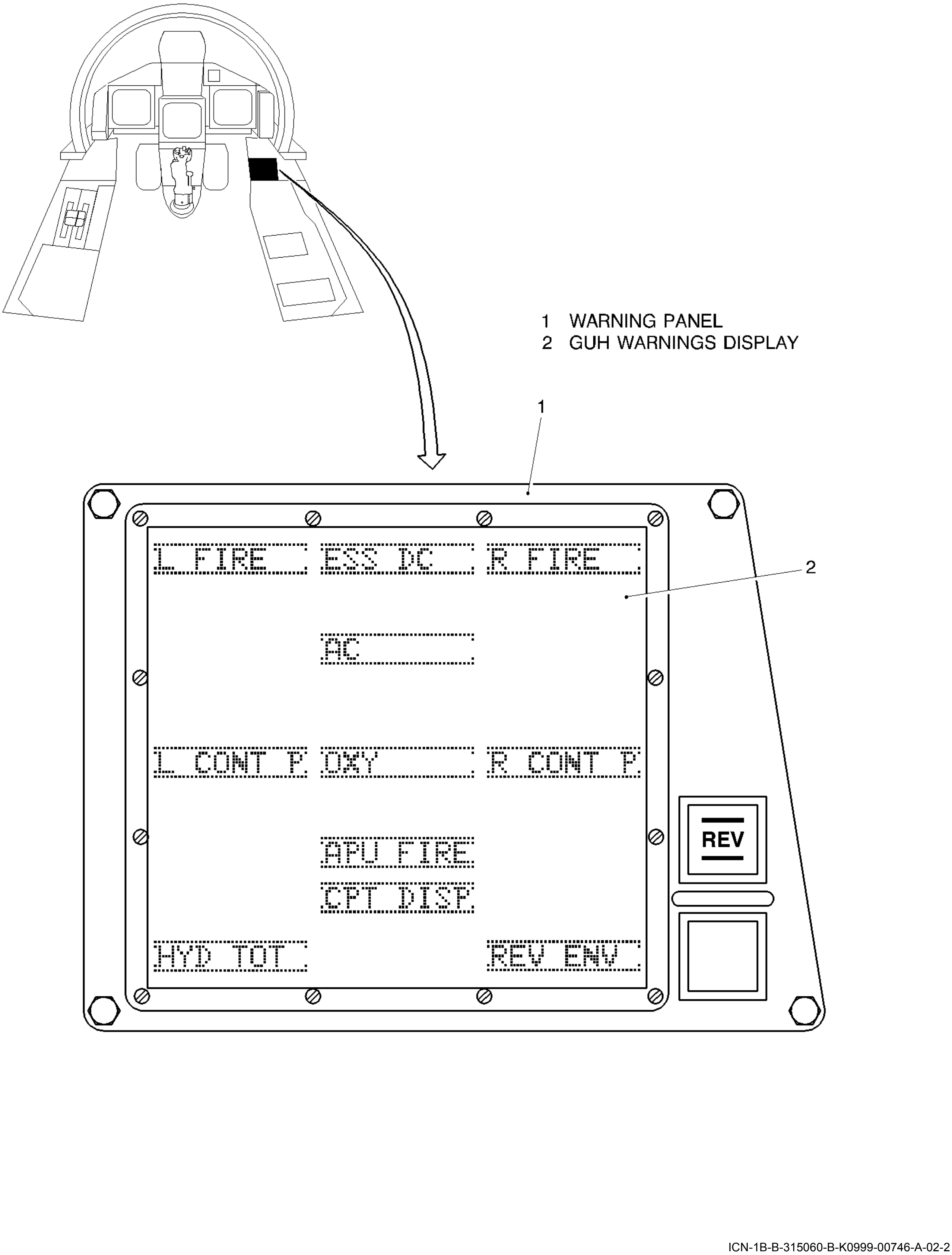


Figure I-06-07 GUH Warnings Display

ALPHABETICAL INDEX

ALPHABETICAL INDEX

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ALPHABETICAL INDEX