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U.S. Department of Transportation
Federal Aviation Administration
Specification

VOR/DME Equipment

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DOD-D-1000	Drawings, Engineering and Associated Lists
MIL-E-17555	Electronic and Electrical Equipment Accessories and Repair Parts; Packaging and Packing of

1-2.1.3 FAA standards.-

FAA-STD-012	Paint Systems for Equipment
FAA-STD-021	Configuration Management, Contractor Requirements
FAA-STD-024	Preparation of Test and Evaluation Documentation
FAA-STD-025	Preparation of Interface Control Documents
FAA-STD-028	Contract Training Program

1-2.1.4 Military standards.-

DOD-STD-100	Engineering Drawing Practices
DOD-STD-1686	Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment
DOD-STD-2167	Defense System Software Development
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-280	Definitions of Item Levels, Item Exchangeability, Models, and Related Terms
MIL-STD-415	Test Provisions for Electronic Systems and Associated Equipment, Design Criteria for
MIL-STD-454	Standard General Requirements for Electronic Equipment

MIL-C-24308	Connector, Electric, Rectangular, Miniature, Polarized, Shell, Rack and Panel, General Specification for
DOD-D-1000	Drawings, Engineering and Associated Lists
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FAA-STD-025	Preparation of Interface Control Documents
FAA-STD-028	Contract Training Program

1-2.1.4 Military standards.-

DOD-STD-100	Engineering Drawing Practices
DOD-STD-1686	Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment
DOD-STD-2167	Defense System Software Development
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-280	Definitions of Item Levels, Item Exchangeability, Models, and Related Terms
MIL-STD-415	Test Provisions for Electronic Systems and Associated Equipment, Design Criteria for
MIL-STD-454	Standard General Requirements for Electronic Equipment

MIL-C-24308	Connector, Electric, Rectangular, Miniature, Polarized, Shell, Rack and Panel, General Specification for
DOD-D-1000	Drawings, Engineering and Associated Lists
MIL-E-17555	Electronic and Electrical Equipment Accessories and Repair Parts; Packaging and Packing of

1-2.1.3 FAA standards.-

FAA-STD-012	Paint Systems for Equipment
FAA-STD-021	Configuration Management, Contractor Requirements
FAA-STD-024	Preparation of Test and Evaluation Documentation
FAA-STD-025	Preparation of Interface Control Documents
FAA-STD-028	Contract Training Program

1-2.1.4 Military standards.-

DOD-STD-100	Engineering Drawing Practices
DOD-STD-1686	Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment
DOD-STD-2167	Defense System Software Development
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-280	Definitions of Item Levels, Item Exchangeability, Models, and Related Terms
MIL-STD-415	Test Provisions for Electronic Systems and Associated Equipment, Design Criteria for
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1-3.1.10.2.3 Fault isolation.- Automatic isolation of an equipment fault to the lowest specified level of component replacement. (Note: fault isolation is not limited to faults producing a fault condition in the monitor; see paragraph 1-3.1.10.4.)

1-3.1.10.3 Executive monitor.- A device which continuously examines key parameters of the output signals of the facility/equipment, provides for shutdown of equipment when these signal characteristics are found to be outside of pre-established tolerances, and simultaneously initiates local and remote alarm indications. In normal unattended operation of the facility these actions are automatic.

1-3.1.10.4 Fault condition.- The condition where a monitor senses that one or more parameters of the output signals are outside of pre-established tolerances.

1-3.1.10.5 Alarm condition.- A condition which results when a fault (1-3.1.10.4) has existed for a pre-established period of time. Alarm results in the action described under 1-3.1.10.3.

1-3.1.10.6 Monitor "fail safe".- A principle which states that a failure in the executive monitor itself must result in an alarm (1-3.1.10.5).

1-3.1.10.7 Monitor "happy".- The condition where the executive monitor senses that the monitored signal parameters are within established tolerances and provides local and remote indication of normal operation.

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1-3.1.10.9 Monitor "bypass".- A feature which allows a technician to override the normal functions of the executive monitor to permit operation of an equipment for troubleshooting purposes.

1-3.1.11 Operating transmitter/transponder.- A transmitter/transponder which is energized and radiating signal(s) through the ground station antenna.

1-3.1.12 Module.- Two or more parts which form a portion of an assembly or a unit replaceable as a whole but having parts which are individually replaceable.

1-3.1.13 Shutdown.- The condition wherein neither transmitter/transponder is radiating signal(s).

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examination of essential voltages, signal amplitudes, waveforms and timing characteristics and to provide for the connection of test equipment for troubleshooting, adjustment and maintenance operations. Test points for all units employing microprocessors shall include all data, address and control signals. The VOR/DME shall have a central diagnostic function that shall initiate, log results and provide for the display of diagnostic results at the MPS or PMDT interface if a terminal is connected. The diagnostic routine shall be able to localize 85% of all failure occurences to a single faulty LRU (see paragraph 1-3.1.20) and 95 percent of all failure occurrences to no more than two candidate LRUs, one of which contains the faulty element. The diagnostic routine shall be automatically initiated when an alarm or alert occurs except when the condition is the result of an environmental sensor parameter of paragraph 3-3.3.2.10.1 through 3-3.3.2.10.5 herein. Additional manually initiated diagnostics shall be available from the PMDT in local mode or from the MPS to offer more detailed information to aid in the maintenance process. The results of the automatic diagnostic routine shall be stored in memory at the facility RMS until reset at the PMDT interface or from the MPS. When the diagnostic routine is automatically initiated due to an alarm or alert, the entire routine shall be run to ensure that all failures have been identified.

1-3.3.7.1 Location.- Test points on plug-in printed wiring boards shall be located on the outside edge of the board. Printed edge connectors may be used for test points.

1-3.3.7.2 Adapters.- If edge board connectors are used, a minimum of two connector test adapters shall be furnished with each system to facilitate connection of test probes to the printed edge connections. Storage shall be provided within the cabinets for all adapters and connectors.

1-3.3.8 Reset switch.- Each unit of the VOR/DME equipment that employs microprocessors shall have a front panel mounted, momentary contact switch labeled "RESET". Activation of the reset switch shall cause all program variables and all software/firmware controlled hardware to be initialized to a predefined condition from which normal program execution can continue.

1-3.3.9 Non-volatile memory.- There shall be non-volatile memory(s) provided. The executive/operating program shall be in read-only memory (ROM). The working/data storage program memory(s) shall have at least three months of non-volatility. There shall be storage in non-volatile memory(s) of current status data of all monitored transmitter and transponder parameters and the upper and lower monitor fault/threshold alarm limits, also last routine sample data, and post-fault (but prior

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1-3.3.13.2 Adjustment storage.- Electronically entered control settings must be stored in non-volatile memory either immediately upon entry or at the conclusion of an adjustment/maintenance operation. Storing of control settings shall be automatic and shall provide notification to the operator. It shall not be possible for equipment to be restored to normal operation without saving control settings. For this specification, non-volatile storage is considered to be at least 90 days.

1-3.3.13.3 Remote communications.- Remote communications shall be established by the use of Government furnished dedicated 4-wire telephone lines between the VOR/DME facility and the RSCE location and thence to the MPS via the RSCE to MPS interface (see paragraph 9-3.2.2.1). The telephone lines shall be private line, data voice-grade circuits that will be unity gain and will be furnished with OdB transmission level point (TLP) at the send and receive interface.

The capability for remote communications shall be such that any function which can be performed locally through the FCPU to PMDT interface with the PMDT in local mode, can also be performed remotely.

1-3.3.14 Frequency sources.- Each VOR equipment required to provide an RF output on an assigned frequency shall employ a crystal controlled frequency source whereby the required carrier frequency is derived from a single frequency determining component. A crystal oscillator where used (installed) in the VOR and a spare shall be provided. In lieu of a set of crystals, VOR frequency may be controlled by a crystal referenced frequency synthesizer adjustable over the full frequency range of 108.0 MHz to 118.0 MHz in steps of .05 MHz. The DME shall employ a frequency synthesizer whereby any required frequency (see Table 1) is derived from a single frequency determining component. Means shall be provided to prevent radiation of an RF output signal on other than the desired channel frequency due to malfunction of the frequency synthesizer circuits. Selection of the assigned DME channel and mode (x or y) shall be accomplished through the FCPU and shall display the DME channel and mode selected. Each unit of equipment shall be tuned and adjusted for operation on a channel (operating frequency) assigned by the Government. The contractor shall request the frequency

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1-3.8 Software.- All VOR/DME software shall be developed and documented in accordance with DOD-STD-2167. "Programs" written at levels that do not require assembly or cross-assembly can be adequately documented with logic diagrams and/or truth tables. The documentation specified in DOD-STD-2167 is not required to adequately support this low level of program. All formal software reviews and audits, including Reliability and Maintainability tests/audits, shall be conducted in accordance with MIL-STD-1521. A subset of the data item descriptions (DIDs) contained in DOD-STD-2167 will be specified in the contract and shall be delivered by the contractor. The contractor shall include the software design/development effort in the Configuration Management plan for the program and insure that the software meets CM requirements of DOD-STD-2167.

1-3.9 Documentation.- Level 3 engineering drawings shall be prepared in accordance with DOD-D-1000 and DOD-STD-100. Course materials shall be developed in accordance with FAA-STD-028. Parts lists in hard copy used for provisioning shall be formatted in accordance with FAA-G-1375 for spare parts-peculiar and MIL-STD-1561 for all other lists. Parts list for provisioning developed from LSA shall be formatted in accordance with MIL-STD-1388-2A and documented in an automated medium compatible with the FAA LSA automated database. Technical instruction books in accordance with Specification FAA-D-2494 shall be provided as specified in the contract schedule.

1-3.10 Logistics.- Logistics support for the VOR/DME equipment shall be in accordance with MIL-STD-1388-1A and MIL-STD-1388-2A.

1-3.10.1 Supply Support.- Spare parts-peculiar shall be indentified and acquired in accordance with FAA Specification FAA-G-1375. Repairable LRUs will be identified and spares requirements quantified from data generated by logistic support analysis (LSA) in accordance with MIL-STD-1388-1A. Provisioning lists will be developed from data generated by LSA and formatted in accordance with MIL-STD-1388-2A. Provisioning will be accomplished in accordance with MIL-STD-1561.

1-3.11 Training.- The contractor shall submit a training proposal for the VOR/DME equipment in accordance with the requirements of FAA-STD-028 and as further delineated in the contract schedule.

1-4 QUALITY ASSURANCE PROVISIONS

1-4.1 General.- The contractor shall establish and maintain a quality control program as specified in the contract schedule. The quality assurance provisions of Section 4 of Specification FAA-G-2100 shall also apply.

1-3.8 Software.- All VOR/DME software shall be developed and documented in accordance with DOD-STD-2167. "Programs" written at levels that do not require assembly or cross-assembly can be adequately documented with logic diagrams and/or truth tables. The documentation specified in DOD-STD-2167 is not required to adequately support this low level of program. All formal software reviews and audits, including Reliability and Maintainability tests/audits, shall be conducted in accordance with MIL-STD-1521. A subset of the data item descriptions (DIDs) contained in DOD-STD-2167 will be specified in the contract and shall be delivered by the contractor. The contractor shall include the software design/development effort in the Configuration Management plan for the program and insure that the software meets CM requirements of DOD-STD-2167.

1-3.9 Documentation.- Level 3 engineering drawings shall be prepared in accordance with DOD-D-1000 and DOD-STD-100. Course materials shall be developed in accordance with FAA-STD-028. Parts lists in hard copy used for provisioning shall be formatted in accordance with FAA-G-1375 for spare parts-peculiar and MIL-STD-1561 for all other lists. Parts list for provisioning developed from LSA shall be formatted in accordance with MIL-STD-1388-2A and documented in an automated medium compatible with the FAA LSA automated database. Technical instruction books in accordance with Specification FAA-D-2494 shall be provided as specified in the contract schedule.

1-3.10 Logistics.- Logistics support for the VOR/DME equipment shall be in accordance with MIL-STD-1388-1A and MIL-STD-1388-2A.

1-3.10.1 Supply Support.- Spare parts-peculiar shall be indentified and acquired in accordance with FAA Specification FAA-G-1375. Repairable LRUs will be identified and spares requirements quantified from data generated by logistic support analysis (LSA) in accordance with MIL-STD-1388-1A. Provisioning lists will be developed from data generated by LSA and formatted in accordance with MIL-STD-1388-2A. Provisioning will be accomplished in accordance with MIL-STD-1561.

1-3.11 Training.- The contractor shall submit a training proposal for the VOR/DME equipment in accordance with the requirements of FAA-STD-028 and as further delineated in the contract schedule.

1-4 QUALITY ASSURANCE PROVISIONS

1-4.1 General.- The contractor shall establish and maintain a quality control program as specified in the contract schedule. The quality assurance provisions of Section 4 of Specification FAA-G-2100 shall also apply.

1-3.8 Software.- All VOR/DME software shall be developed and documented in accordance with DOD-STD-2167. "Programs" written at levels that do not require assembly or cross-assembly can be adequately documented with logic diagrams and/or truth tables. The documentation specified in DOD-STD-2167 is not required to adequately support this low level of program. All formal software reviews and audits, including Reliability and Maintainability tests/audits, shall be conducted in accordance with MIL-STD-1521. A subset of the data item descriptions (DIDs) contained in DOD-STD-2167 will be specified in the contract and shall be delivered by the contractor. The contractor shall include the software design/development effort in the Configuration Management plan for the program and insure that the software meets CM requirements of DOD-STD-2167.

1-3.9 Documentation.- Level 3 engineering drawings shall be prepared in accordance with DOD-D-1000 and DOD-STD-100. Course materials shall be developed in accordance with FAA-STD-028. Parts lists in hard copy used for provisioning shall be formatted in accordance with FAA-G-1375 for spare parts-peculiar and MIL-STD-1561 for all other lists. Parts list for provisioning developed from LSA shall be formatted in accordance with MIL-STD-1388-2A and documented in an automated medium compatible with the FAA LSA automated database. Technical instruction books in accordance with Specification FAA-D-2494 shall be provided as specified in the contract schedule.

1-3.10 Logistics.- Logistics support for the VOR/DME equipment shall be in accordance with MIL-STD-1388-1A and MIL-STD-1388-2A.

1-3.10.1 Supply Support.- Spare parts-peculiar shall be indentified and acquired in accordance with FAA Specification FAA-G-1375. Repairable LRUs will be identified and spares requirements quantified from data generated by logistic support analysis (LSA) in accordance with MIL-STD-1388-1A. Provisioning lists will be developed from data generated by LSA and formatted in accordance with MIL-STD-1388-2A. Provisioning will be accomplished in accordance with MIL-STD-1561.

1-3.11 Training.- The contractor shall submit a training proposal for the VOR/DME equipment in accordance with the requirements of FAA-STD-028 and as further delineated in the contract schedule.

1-4 QUALITY ASSURANCE PROVISIONS

1-4.1 General.- The contractor shall establish and maintain a quality control program as specified in the contract schedule. The quality assurance provisions of Section 4 of Specification FAA-G-2100 shall also apply.

1-3.8 Software.- All VOR/DME software shall be developed and documented in accordance with DOD-STD-2167. "Programs" written at levels that do not require assembly or cross-assembly can be adequately documented with logic diagrams and/or truth tables. The documentation specified in DOD-STD-2167 is not required to adequately support this low level of program. All formal software reviews and audits, including Reliability and Maintainability tests/audits, shall be conducted in accordance with MIL-STD-1521. A subset of the data item descriptions (DIDs) contained in DOD-STD-2167 will be specified in the contract and shall be delivered by the contractor. The contractor shall include the software design/development effort in the Configuration Management plan for the program and insure that the software meets CM requirements of DOD-STD-2167.

1-3.9 Documentation.- Level 3 engineering drawings shall be prepared in accordance with DOD-D-1000 and DOD-STD-100. Course materials shall be developed in accordance with FAA-STD-028. Parts lists in hard copy used for provisioning shall be formatted in accordance with FAA-G-1375 for spare parts-peculiar and MIL-STD-1561 for all other lists. Parts list for provisioning developed from LSA shall be formatted in accordance with MIL-STD-1388-2A and documented in an automated medium compatible with the FAA LSA automated database. Technical instruction books in accordance with Specification FAA-D-2494 shall be provided as specified in the contract schedule.

1-3.10 Logistics.- Logistics support for the VOR/DME equipment shall be in accordance with MIL-STD-1388-1A and MIL-STD-1388-2A.

1-3.10.1 Supply Support.- Spare parts-peculiar shall be indentified and acquired in accordance with FAA Specification FAA-G-1375. Repairable LRUs will be identified and spares requirements quantified from data generated by logistic support analysis (LSA) in accordance with MIL-STD-1388-1A. Provisioning lists will be developed from data generated by LSA and formatted in accordance with MIL-STD-1388-2A. Provisioning will be accomplished in accordance with MIL-STD-1561.

1-3.11 Training.- The contractor shall submit a training proposal for the VOR/DME equipment in accordance with the requirements of FAA-STD-028 and as further delineated in the contract schedule.

1-4 QUALITY ASSURANCE PROVISIONS

1-4.1 General.- The contractor shall establish and maintain a quality control program as specified in the contract schedule. The quality assurance provisions of Section 4 of Specification FAA-G-2100 shall also apply.

TABLE 1

VOR-TACAN-DME CHANNEL FREQUENCIES AND PAIRING

VHF Chan. Freq. MHz	Chan. No.	DME-TACAN Inter. Freq. MHz	DME-TACAN Reply Freq. MHz	VHF Chan. Freq. MHz	DME-TACAN Inter. Chan. No.	DME-TACAN Inter. Freq. MHz	DME-TACAN Reply Freq. MHz
-	1X	1025	962	108.20 VOR	19X	1043	980
-	1Y	1025	1088	108.25 VOR	19Y	1043	1106
-	2X	1026	963	108.30 ILS	20X	1044	981
-	2Y	1026	1089	108.35 ILS	20Y	1044	1107
-	3X	1027	964	108.40 VOR	21X	1045	982
-	3Y	1027	1090	108.45 VOR	21Y	1045	1108
-	4X	1028	965	108.50 ILS	22X	1046	983
-	4Y	1028	1091	108.55 ILS	22Y	1046	1109
-	5X	1029	966	108.60 VOR	23X	1047	984
-	5Y	1029	1092	108.65 VOR	23Y	1047	1110
-	6X	1030	967	108.70 ILS	24X	1048	985
-	6Y	1030	1093	108.75 ILS	24Y	1048	1111
-	7X	1031	968	108.80 VOR	25X	1049	986
-	7Y	1031	1094	108.85 VOR	25Y	1049	1112
-	8X	1032	969	108.90 ILS	26X	1050	987
-	8Y	1032	1095	108.95 ILS	26Y	1050	1113
-	9X	1033	970	109.00 VOR	27X	1051	988
-	9Y	1033	1096	109.05 VOR	27Y	1051	1114
-	10X	1034	971	109.10 ILS	28X	1052	989
-	10Y	1034	1097	109.15 ILS	28Y	1052	1115
-	11X	1035	972	109.20 VOR	29X	1053	990
-	11Y	1035	1098	109.25 VOR	29Y	1053	1116
-	12X	1036	973	109.30 ILS	30X	1054	991
-	12Y	1036	1099	109.35 ILS	30Y	1054	1117
-	13X	1037	974	109.40 VOR	31X	1055	992
-	13Y	1037	1100	109.45 VOR	31Y	1055	1118
-	14X	1038	975	109.50 ILS	32X	1056	993
-	14Y	1038	1101	109.55 ILS	32Y	1056	1119
-	15X	1039	976	109.60 VOR	33X	1057	994
-	15Y	1039	1102	109.65 VOR	33Y	1057	1120
-	16X	1040	977	109.70 ILS	34X	1058	995
-	16Y	1040	1103	109.75 ILS	34Y	1058	1121
108.00*	17X	1041	978	109.80 VOR	35X	1059	996
108.05 VOR	17Y	1041	1104	109.85 VOR	35Y	1059	1122
108.10 ILS	18X	1042	979	109.90 ILS	36X	1060	997
108.15 ILS	18Y	1042	1105	109.95 ILS	36Y	1060	1123

*108.00 MHz is not scheduled for facilities. The frequencies of channel 17X are assigned to facilities for testing airborne system components.

TABLE 1

VOR-TACAN-DME CHANNEL FREQUENCIES AND PAIRING

VHF Chan. Freq. MHz	Chan. No.	DME-TACAN Inter. Freq. MHz	DME-TACAN Reply Freq. MHz	VHF Chan. Freq. MHz	DME-TACAN Inter. Chan. No.	DME-TACAN Inter. Freq. MHz	DME-TACAN Reply Freq. MHz
-	1X	1025	962	108.20 VOR	19X	1043	980
-	1Y	1025	1088	108.25 VOR	19Y	1043	1106
-	2X	1026	963	108.30 ILS	20X	1044	981
-	2Y	1026	1089	108.35 ILS	20Y	1044	1107
-	3X	1027	964	108.40 VOR	21X	1045	982
-	3Y	1027	1090	108.45 VOR	21Y	1045	1108
-	4X	1028	965	108.50 ILS	22X	1046	983
-	4Y	1028	1091	108.55 ILS	22Y	1046	1109
-	5X	1029	966	108.60 VOR	23X	1047	984
-	5Y	1029	1092	108.65 VOR	23Y	1047	1110
-	6X	1030	967	108.70 ILS	24X	1048	985
-	6Y	1030	1093	108.75 ILS	24Y	1048	1111
-	7X	1031	968	108.80 VOR	25X	1049	986
-	7Y	1031	1094	108.85 VOR	25Y	1049	1112
-	8X	1032	969	108.90 ILS	26X	1050	987
-	8Y	1032	1095	108.95 ILS	26Y	1050	1113
-	9X	1033	970	109.00 VOR	27X	1051	988
-	9Y	1033	1096	109.05 VOR	27Y	1051	1114
-	10X	1034	971	109.10 ILS	28X	1052	989
-	10Y	1034	1097	109.15 ILS	28Y	1052	1115
-	11X	1035	972	109.20 VOR	29X	1053	990
-	11Y	1035	1098	109.25 VOR	29Y	1053	1116
-	12X	1036	973	109.30 ILS	30X	1054	991
-	12Y	1036	1099	109.35 ILS	30Y	1054	1117
-	13X	1037	974	109.40 VOR	31X	1055	992
-	13Y	1037	1100	109.45 VOR	31Y	1055	1118
-	14X	1038	975	109.50 ILS	32X	1056	993
-	14Y	1038	1101	109.55 ILS	32Y	1056	1119
-	15X	1039	976	109.60 VOR	33X	1057	994
-	15Y	1039	1102	109.65 VOR	33Y	1057	1120
-	16X	1040	977	109.70 ILS	34X	1058	995
-	16Y	1040	1103	109.75 ILS	34Y	1058	1121
108.00*	17X	1041	978	109.80 VOR	35X	1059	996
108.05 VOR	17Y	1041	1104	109.85 VOR	35Y	1059	1122
108.10 ILS	18X	1042	979	109.90 ILS	36X	1060	997
108.15 ILS	18Y	1042	1105	109.95 ILS	36Y	1060	1123

*108.00 MHz is not scheduled for facilities. The frequencies of channel 17X are assigned to facilities for testing airborne system components.

TABLE 1

VOR-TACAN-DME CHANNEL FREQUENCIES AND PAIRING

VHF Chan. Freq. MHz	Chan. No.	DME-TACAN Inter. Freq. MHz	DME-TACAN Reply Freq. MHz	VHF Chan. Freq. MHz	DME-TACAN Inter. Chan. No.	DME-TACAN Inter. Freq. MHz	DME-TACAN Reply Freq. MHz
-	1X	1025	962	108.20 VOR	19X	1043	980
-	1Y	1025	1088	108.25 VOR	19Y	1043	1106
-	2X	1026	963	108.30 ILS	20X	1044	981
-	2Y	1026	1089	108.35 ILS	20Y	1044	1107
-	3X	1027	964	108.40 VOR	21X	1045	982
-	3Y	1027	1090	108.45 VOR	21Y	1045	1108
-	4X	1028	965	108.50 ILS	22X	1046	983
-	4Y	1028	1091	108.55 ILS	22Y	1046	1109
-	5X	1029	966	108.60 VOR	23X	1047	984
-	5Y	1029	1092	108.65 VOR	23Y	1047	1110
-	6X	1030	967	108.70 ILS	24X	1048	985
-	6Y	1030	1093	108.75 ILS	24Y	1048	1111
-	7X	1031	968	108.80 VOR	25X	1049	986
-	7Y	1031	1094	108.85 VOR	25Y	1049	1112
-	8X	1032	969	108.90 ILS	26X	1050	987
-	8Y	1032	1095	108.95 ILS	26Y	1050	1113
-	9X	1033	970	109.00 VOR	27X	1051	988
-	9Y	1033	1096	109.05 VOR	27Y	1051	1114
-	10X	1034	971	109.10 ILS	28X	1052	989
-	10Y	1034	1097	109.15 ILS	28Y	1052	1115
-	11X	1035	972	109.20 VOR	29X	1053	990
-	11Y	1035	1098	109.25 VOR	29Y	1053	1116
-	12X	1036	973	109.30 ILS	30X	1054	991
-	12Y	1036	1099	109.35 ILS	30Y	1054	1117
-	13X	1037	974	109.40 VOR	31X	1055	992
-	13Y	1037	1100	109.45 VOR	31Y	1055	1118
-	14X	1038	975	109.50 ILS	32X	1056	993
-	14Y	1038	1101	109.55 ILS	32Y	1056	1119
-	15X	1039	976	109.60 VOR	33X	1057	994
-	15Y	1039	1102	109.65 VOR	33Y	1057	1120
-	16X	1040	977	109.70 ILS	34X	1058	995
-	16Y	1040	1103	109.75 ILS	34Y	1058	1121
108.00*	17X	1041	978	109.80 VOR	35X	1059	996
108.05 VOR	17Y	1041	1104	109.85 VOR	35Y	1059	1122
108.10 ILS	18X	1042	979	109.90 ILS	36X	1060	997
108.15 ILS	18Y	1042	1105	109.95 ILS	36Y	1060	1123

*108.00 MHz is not scheduled for facilities. The frequencies of channel 17X are assigned to facilities for testing airborne system components.

TABLE 1

VOR-TACAN-DME CHANNEL FREQUENCIES AND PAIRING

VHF Chan. Freq. MHz	Chan. No.	DME-TACAN Inter. Freq. MHz	DME-TACAN Reply Freq. MHz	VHF Chan. Freq. MHz	DME-TACAN Inter. Chan. No.	DME-TACAN Inter. Freq. MHz	DME-TACAN Reply Freq. MHz
-	1X	1025	962	108.20 VOR	19X	1043	980
-	1Y	1025	1088	108.25 VOR	19Y	1043	1106
-	2X	1026	963	108.30 ILS	20X	1044	981
-	2Y	1026	1089	108.35 ILS	20Y	1044	1107
-	3X	1027	964	108.40 VOR	21X	1045	982
-	3Y	1027	1090	108.45 VOR	21Y	1045	1108
-	4X	1028	965	108.50 ILS	22X	1046	983
-	4Y	1028	1091	108.55 ILS	22Y	1046	1109
-	5X	1029	966	108.60 VOR	23X	1047	984
-	5Y	1029	1092	108.65 VOR	23Y	1047	1110
-	6X	1030	967	108.70 ILS	24X	1048	985
-	6Y	1030	1093	108.75 ILS	24Y	1048	1111
-	7X	1031	968	108.80 VOR	25X	1049	986
-	7Y	1031	1094	108.85 VOR	25Y	1049	1112
-	8X	1032	969	108.90 ILS	26X	1050	987
-	8Y	1032	1095	108.95 ILS	26Y	1050	1113
-	9X	1033	970	109.00 VOR	27X	1051	988
-	9Y	1033	1096	109.05 VOR	27Y	1051	1114
-	10X	1034	971	109.10 ILS	28X	1052	989
-	10Y	1034	1097	109.15 ILS	28Y	1052	1115
-	11X	1035	972	109.20 VOR	29X	1053	990
-	11Y	1035	1098	109.25 VOR	29Y	1053	1116
-	12X	1036	973	109.30 ILS	30X	1054	991
-	12Y	1036	1099	109.35 ILS	30Y	1054	1117
-	13X	1037	974	109.40 VOR	31X	1055	992
-	13Y	1037	1100	109.45 VOR	31Y	1055	1118
-	14X	1038	975	109.50 ILS	32X	1056	993
-	14Y	1038	1101	109.55 ILS	32Y	1056	1119
-	15X	1039	976	109.60 VOR	33X	1057	994
-	15Y	1039	1102	109.65 VOR	33Y	1057	1120
-	16X	1040	977	109.70 ILS	34X	1058	995
-	16Y	1040	1103	109.75 ILS	34Y	1058	1121
108.00*	17X	1041	978	109.80 VOR	35X	1059	996
108.05 VOR	17Y	1041	1104	109.85 VOR	35Y	1059	1122
108.10 ILS	18X	1042	979	109.90 ILS	36X	1060	997
108.15 ILS	18Y	1042	1105	109.95 ILS	36Y	1060	1123

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TABLE 1

VOR-TACAN-DME CHANNEL FREQUENCIES AND PAIRING

VHF Chan. Freq. MHz	Chan. No.	DME-TACAN Inter. Freq. MHz	DME-TACAN Reply Freq. MHz	VHF Chan. Freq. MHz	DME-TACAN Inter. Chan. No.	DME-TACAN Inter. Freq. MHz	DME-TACAN Reply Freq. MHz
-	1X	1025	962	108.20 VOR	19X	1043	980
-	1Y	1025	1088	108.25 VOR	19Y	1043	1106
-	2X	1026	963	108.30 ILS	20X	1044	981
-	2Y	1026	1089	108.35 ILS	20Y	1044	1107
-	3X	1027	964	108.40 VOR	21X	1045	982
-	3Y	1027	1090	108.45 VOR	21Y	1045	1108
-	4X	1028	965	108.50 ILS	22X	1046	983
-	4Y	1028	1091	108.55 ILS	22Y	1046	1109
-	5X	1029	966	108.60 VOR	23X	1047	984
-	5Y	1029	1092	108.65 VOR	23Y	1047	1110
-	6X	1030	967	108.70 ILS	24X	1048	985
-	6Y	1030	1093	108.75 ILS	24Y	1048	1111
-	7X	1031	968	108.80 VOR	25X	1049	986
-	7Y	1031	1094	108.85 VOR	25Y	1049	1112
-	8X	1032	969	108.90 ILS	26X	1050	987
-	8Y	1032	1095	108.95 ILS	26Y	1050	1113
-	9X	1033	970	109.00 VOR	27X	1051	988
-	9Y	1033	1096	109.05 VOR	27Y	1051	1114
-	10X	1034	971	109.10 ILS	28X	1052	989
-	10Y	1034	1097	109.15 ILS	28Y	1052	1115
-	11X	1035	972	109.20 VOR	29X	1053	990
-	11Y	1035	1098	109.25 VOR	29Y	1053	1116
-	12X	1036	973	109.30 ILS	30X	1054	991
-	12Y	1036	1099	109.35 ILS	30Y	1054	1117
-	13X	1037	974	109.40 VOR	31X	1055	992
-	13Y	1037	1100	109.45 VOR	31Y	1055	1118
-	14X	1038	975	109.50 ILS	32X	1056	993
-	14Y	1038	1101	109.55 ILS	32Y	1056	1119
-	15X	1039	976	109.60 VOR	33X	1057	994
-	15Y	1039	1102	109.65 VOR	33Y	1057	1120
-	16X	1040	977	109.70 ILS	34X	1058	995
-	16Y	1040	1103	109.75 ILS	34Y	1058	1121
108.00*	17X	1041	978	109.80 VOR	35X	1059	996
108.05 VOR	17Y	1041	1104	109.85 VOR	35Y	1059	1122
108.10 ILS	18X	1042	979	109.90 ILS	36X	1060	997
108.15 ILS	18Y	1042	1105	109.95 ILS	36Y	1060	1123

*108.00 MHz is not scheduled for facilities. The frequencies of channel 17X are assigned to facilities for testing airborne system components.

TABLE 1

VOR-TACAN-DME CHANNEL FREQUENCIES AND PAIRING

VHF Chan. Freq. MHz	Chan. No.	DME-TACAN Inter. Freq. MHz	DME-TACAN Reply Freq. MHz	VHF Chan. Freq. MHz	DME-TACAN Inter. Chan. No.	DME-TACAN Inter. Freq. MHz	DME-TACAN Reply Freq. MHz
-	1X	1025	962	108.20 VOR	19X	1043	980
-	1Y	1025	1088	108.25 VOR	19Y	1043	1106
-	2X	1026	963	108.30 ILS	20X	1044	981
-	2Y	1026	1089	108.35 ILS	20Y	1044	1107
-	3X	1027	964	108.40 VOR	21X	1045	982
-	3Y	1027	1090	108.45 VOR	21Y	1045	1108
-	4X	1028	965	108.50 ILS	22X	1046	983
-	4Y	1028	1091	108.55 ILS	22Y	1046	1109
-	5X	1029	966	108.60 VOR	23X	1047	984
-	5Y	1029	1092	108.65 VOR	23Y	1047	1110
-	6X	1030	967	108.70 ILS	24X	1048	985
-	6Y	1030	1093	108.75 ILS	24Y	1048	1111
-	7X	1031	968	108.80 VOR	25X	1049	986
-	7Y	1031	1094	108.85 VOR	25Y	1049	1112
-	8X	1032	969	108.90 ILS	26X	1050	987
-	8Y	1032	1095	108.95 ILS	26Y	1050	1113
-	9X	1033	970	109.00 VOR	27X	1051	988
-	9Y	1033	1096	109.05 VOR	27Y	1051	1114
-	10X	1034	971	109.10 ILS	28X	1052	989
-	10Y	1034	1097	109.15 ILS	28Y	1052	1115
-	11X	1035	972	109.20 VOR	29X	1053	990
-	11Y	1035	1098	109.25 VOR	29Y	1053	1116
-	12X	1036	973	109.30 ILS	30X	1054	991
-	12Y	1036	1099	109.35 ILS	30Y	1054	1117
-	13X	1037	974	109.40 VOR	31X	1055	992
-	13Y	1037	1100	109.45 VOR	31Y	1055	1118
-	14X	1038	975	109.50 ILS	32X	1056	993
-	14Y	1038	1101	109.55 ILS	32Y	1056	1119
-	15X	1039	976	109.60 VOR	33X	1057	994
-	15Y	1039	1102	109.65 VOR	33Y	1057	1120
-	16X	1040	977	109.70 ILS	34X	1058	995
-	16Y	1040	1103	109.75 ILS	34Y	1058	1121
108.00*	17X	1041	978	109.80 VOR	35X	1059	996
108.05 VOR	17Y	1041	1104	109.85 VOR	35Y	1059	1122
108.10 ILS	18X	1042	979	109.90 ILS	36X	1060	997
108.15 ILS	18Y	1042	1105	109.95 ILS	36Y	1060	1123

*108.00 MHz is not scheduled for facilities. The frequencies of channel 17X are assigned to facilities for testing airborne system components.

TABLE 1

VOR-TACAN-DME CHANNEL FREQUENCIES AND PAIRING

VHF Chan. Freq. MHz	Chan. No.	DME-TACAN Inter. Freq. MHz	DME-TACAN Reply Freq. MHz	VHF Chan. Freq. MHz	DME-TACAN Inter. Chan. No.	DME-TACAN Inter. Freq. MHz	DME-TACAN Reply Freq. MHz
-	1X	1025	962	108.20 VOR	19X	1043	980
-	1Y	1025	1088	108.25 VOR	19Y	1043	1106
-	2X	1026	963	108.30 ILS	20X	1044	981
-	2Y	1026	1089	108.35 ILS	20Y	1044	1107
-	3X	1027	964	108.40 VOR	21X	1045	982
-	3Y	1027	1090	108.45 VOR	21Y	1045	1108
-	4X	1028	965	108.50 ILS	22X	1046	983
-	4Y	1028	1091	108.55 ILS	22Y	1046	1109
-	5X	1029	966	108.60 VOR	23X	1047	984
-	5Y	1029	1092	108.65 VOR	23Y	1047	1110
-	6X	1030	967	108.70 ILS	24X	1048	985
-	6Y	1030	1093	108.75 ILS	24Y	1048	1111
-	7X	1031	968	108.80 VOR	25X	1049	986
-	7Y	1031	1094	108.85 VOR	25Y	1049	1112
-	8X	1032	969	108.90 ILS	26X	1050	987
-	8Y	1032	1095	108.95 ILS	26Y	1050	1113
-	9X	1033	970	109.00 VOR	27X	1051	988
-	9Y	1033	1096	109.05 VOR	27Y	1051	1114
-	10X	1034	971	109.10 ILS	28X	1052	989
-	10Y	1034	1097	109.15 ILS	28Y	1052	1115
-	11X	1035	972	109.20 VOR	29X	1053	990
-	11Y	1035	1098	109.25 VOR	29Y	1053	1116
-	12X	1036	973	109.30 ILS	30X	1054	991
-	12Y	1036	1099	109.35 ILS	30Y	1054	1117
-	13X	1037	974	109.40 VOR	31X	1055	992
-	13Y	1037	1100	109.45 VOR	31Y	1055	1118
-	14X	1038	975	109.50 ILS	32X	1056	993
-	14Y	1038	1101	109.55 ILS	32Y	1056	1119
-	15X	1039	976	109.60 VOR	33X	1057	994
-	15Y	1039	1102	109.65 VOR	33Y	1057	1120
-	16X	1040	977	109.70 ILS	34X	1058	995
-	16Y	1040	1103	109.75 ILS	34Y	1058	1121
108.00*	17X	1041	978	109.80 VOR	35X	1059	996
108.05 VOR	17Y	1041	1104	109.85 VOR	35Y	1059	1122
108.10 ILS	18X	1042	979	109.90 ILS	36X	1060	997
108.15 ILS	18Y	1042	1105	109.95 ILS	36Y	1060	1123

*108.00 MHz is not scheduled for facilities. The frequencies of channel 17X are assigned to facilities for testing airborne system components.

TABLE 2

VOR/DME SYSTEM-VERIFICATION REQUIREMENT TRACEABILITY MATRIX

REQUIREMENTS		TEST LEVEL AND METHOD					TEST LOCATION		REMARKS
PARAGRAPH NUMBER	TITLE	FIRST ARTICLE DESIGN QUALIFICATION	TYPE TEST NORMAL CONDITIONS	TYPE TEST SERVICE CONDITIONS	PRODUCTION TESTS	OPERATIONAL SHAKEDOWN	FACTORY	ASM-150/ ACT	
3-3.3.2.3.3.2	30 Hz AM output adjustment	T	T				X		
3-3.3.2.3.5	Amplitude modulation of the FM signal	T	T				X		
3-3.3.2.3.6	Provisions for calibration	D					X		
3-3.3.2.3.7.1	30 Hz AM modulation	T	T				X		
3-3.3.2.3.7.2	9960 Hz modulation	T			T		X		
3-3.3.2.3.7.3	Phase	T			T		X		
3-3.3.2.4	VOR certification parameters	T				T	X	X	
3-3.3.2.5	DME certification parameters	T				T	X	X	
3-3.3.2.6	Additional tests and measurements	D					X		
3-3.3.2.7.1	Integrity test	D					X		
3-3.3.2.7.2	Ground check	D				D	X	X	
3-3.3.2.8	Environmental equipment interface	I,D					X		
3-3.3.2.9.1.1	Test oscillator output	T					X		
3-3.3.2.9.1.2	RCO receiver testing	D					X		
3.3.3.2.9.2	Engine generator testing	D				D	X	X	
3-3.3.2.9.3	External control relay	D				D	X	X	
3-3.3.2.10.1	Intrusion detector	D				D	X	X	
3-3.3.2.10.2	Smoke detector	D				D	X	X	
3-3.3.2.10.3	AC power	D				D	X	X	
3-3.3.2.10.4	Inside temperature	D				D	X	X	
3-3.3.2.10.5	Outside temperature	D				D	X	X	
3-3.3.2.11	FCPU monitor and control functions	D				D	X	X	
3-3.3.3.1	Communications with the RSCE site	I					X		

VERIFICATION METHOD: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D

TABLE 2

VOR/DME SYSTEM-VERIFICATION REQUIREMENT TRACEABILITY MATRIX

REQUIREMENTS		TEST LEVEL AND METHOD					TEST LOCATION		REMARKS
PARAGRAPH NUMBER	TITLE	FIRST ARTICLE DESIGN QUALIFICATION	TYPE TEST NORMAL CONDITIONS	TYPE TEST SERVICE CONDITIONS	PRODUCTION TESTS	OPERATIONAL SHAKEDOWN	FACTORY	ASM-150/ ACT	
3-3.3.2.3.3.2	30 Hz AM output adjustment	T	T				X		
3-3.3.2.3.5	Amplitude modulation of the FM signal	T	T				X		
3-3.3.2.3.6	Provisions for calibration	D					X		
3-3.3.2.3.7.1	30 Hz AM modulation	T	T				X		
3-3.3.2.3.7.2	9960 Hz modulation	T			T		X		
3-3.3.2.3.7.3	Phase	T			T		X		
3-3.3.2.4	VOR certification parameters	T				T	X	X	
3-3.3.2.5	DME certification parameters	T				T	X	X	
3-3.3.2.6	Additional tests and measurements	D					X		
3-3.3.2.7.1	Integrity test	D					X		
3-3.3.2.7.2	Ground check	D				D	X	X	
3-3.3.2.8	Environmental equipment interface	I,D					X		
3-3.3.2.9.1.1	Test oscillator output	T					X		
3-3.3.2.9.1.2	RCO receiver testing	D					X		
3.3.3.2.9.2	Engine generator testing	D				D	X	X	
3-3.3.2.9.3	External control relay	D				D	X	X	
3-3.3.2.10.1	Intrusion detector	D				D	X	X	
3-3.3.2.10.2	Smoke detector	D				D	X	X	
3-3.3.2.10.3	AC power	D				D	X	X	
3-3.3.2.10.4	Inside temperature	D				D	X	X	
3-3.3.2.10.5	Outside temperature	D				D	X	X	
3-3.3.2.11	FCPU monitor and control functions	D				D	X	X	
3-3.3.3.1	Communications with the RSCE site	I					X		

VERIFICATION METHOD: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D

TABLE 2

VOR/DME SYSTEM-VERIFICATION REQUIREMENT TRACEABILITY MATRIX

REQUIREMENTS		TEST LEVEL AND METHOD					TEST LOCATION		REMARKS
PARAGRAPH NUMBER	TITLE	FIRST ARTICLE DESIGN QUALIFICATION	TYPE TEST NORMAL CONDITIONS	TYPE TEST SERVICE CONDITIONS	PRODUCTION TESTS	OPERATIONAL SHAKEDOWN	FACTORY	ASM-150/ ACT	
3-3.3.2.3.3.2	30 Hz AM output adjustment	T	T				X		
3-3.3.2.3.5	Amplitude modulation of the FM signal	T	T				X		
3-3.3.2.3.6	Provisions for calibration	D					X		
3-3.3.2.3.7.1	30 Hz AM modulation	T	T				X		
3-3.3.2.3.7.2	9960 Hz modulation	T			T		X		
3-3.3.2.3.7.3	Phase	T			T		X		
3-3.3.2.4	VOR certification parameters	T				T	X	X	
3-3.3.2.5	DME certification parameters	T				T	X	X	
3-3.3.2.6	Additional tests and measurements	D					X		
3-3.3.2.7.1	Integrity test	D					X		
3-3.3.2.7.2	Ground check	D				D	X	X	
3-3.3.2.8	Environmental equipment interface	I,D					X		
3-3.3.2.9.1.1	Test oscillator output	T					X		
3-3.3.2.9.1.2	RCO receiver testing	D					X		
3.3.3.2.9.2	Engine generator testing	D				D	X	X	
3-3.3.2.9.3	External control relay	D				D	X	X	
3-3.3.2.10.1	Intrusion detector	D				D	X	X	
3-3.3.2.10.2	Smoke detector	D				D	X	X	
3-3.3.2.10.3	AC power	D				D	X	X	
3-3.3.2.10.4	Inside temperature	D				D	X	X	
3-3.3.2.10.5	Outside temperature	D				D	X	X	
3-3.3.2.11	FCPU monitor and control functions	D				D	X	X	
3-3.3.3.1	Communications with the RSCE site	I					X		

VERIFICATION METHOD: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D

TABLE 2

VOR/DME SYSTEM-VERIFICATION REQUIREMENT TRACEABILITY MATRIX

REQUIREMENTS		TEST LEVEL AND METHOD					TEST LOCATION		REMARKS
PARAGRAPH NUMBER	TITLE	FIRST ARTICLE DESIGN QUALIFICATION	TYPE TEST NORMAL CONDITIONS	TYPE TEST SERVICE CONDITIONS	PRODUCTION TESTS	OPERATIONAL SHAKEDOWN	FACTORY	ASM-150/ ACT	
3-3.3.2.3.3.2	30 Hz AM output adjustment	T	T				X		
3-3.3.2.3.5	Amplitude modulation of the FM signal	T	T				X		
3-3.3.2.3.6	Provisions for calibration	D					X		
3-3.3.2.3.7.1	30 Hz AM modulation	T	T				X		
3-3.3.2.3.7.2	9960 Hz modulation	T			T		X		
3-3.3.2.3.7.3	Phase	T			T		X		
3-3.3.2.4	VOR certification parameters	T				T	X	X	
3-3.3.2.5	DME certification parameters	T				T	X	X	
3-3.3.2.6	Additional tests and measurements	D					X		
3-3.3.2.7.1	Integrity test	D					X		
3-3.3.2.7.2	Ground check	D				D	X	X	
3-3.3.2.8	Environmental equipment interface	I,D					X		
3-3.3.2.9.1.1	Test oscillator output	T					X		
3-3.3.2.9.1.2	RCO receiver testing	D					X		
3.3.3.2.9.2	Engine generator testing	D				D	X	X	
3-3.3.2.9.3	External control relay	D				D	X	X	
3-3.3.2.10.1	Intrusion detector	D				D	X	X	
3-3.3.2.10.2	Smoke detector	D				D	X	X	
3-3.3.2.10.3	AC power	D				D	X	X	
3-3.3.2.10.4	Inside temperature	D				D	X	X	
3-3.3.2.10.5	Outside temperature	D				D	X	X	
3-3.3.2.11	FCPU monitor and control functions	D				D	X	X	
3-3.3.3.1	Communications with the RSCE site	I					X		

VERIFICATION METHOD: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D

TABLE 2

VOR/DME SYSTEM-VERIFICATION REQUIREMENT TRACEABILITY MATRIX

REQUIREMENTS		TEST LEVEL AND METHOD					TEST LOCATION		REMARKS
PARAGRAPH NUMBER	TITLE	FIRST ARTICLE DESIGN QUALIFICATION	TYPE TEST NORMAL CONDITIONS	TYPE TEST SERVICE CONDITIONS	PRODUCTION TESTS	OPERATIONAL SHAKEDOWN	FACTORY	ASM-150/ ACT	
3-3.3.2.3.3.2	30 Hz AM output adjustment	T	T				X		
3-3.3.2.3.5	Amplitude modulation of the FM signal	T	T				X		
3-3.3.2.3.6	Provisions for calibration	D					X		
3-3.3.2.3.7.1	30 Hz AM modulation	T	T				X		
3-3.3.2.3.7.2	9960 Hz modulation	T			T		X		
3-3.3.2.3.7.3	Phase	T			T		X		
3-3.3.2.4	VOR certification parameters	T				T	X	X	
3-3.3.2.5	DME certification parameters	T				T	X	X	
3-3.3.2.6	Additional tests and measurements	D					X		
3-3.3.2.7.1	Integrity test	D					X		
3-3.3.2.7.2	Ground check	D				D	X	X	
3-3.3.2.8	Environmental equipment interface	I,D					X		
3-3.3.2.9.1.1	Test oscillator output	T					X		
3-3.3.2.9.1.2	RCO receiver testing	D					X		
3.3.3.2.9.2	Engine generator testing	D				D	X	X	
3-3.3.2.9.3	External control relay	D				D	X	X	
3-3.3.2.10.1	Intrusion detector	D				D	X	X	
3-3.3.2.10.2	Smoke detector	D				D	X	X	
3-3.3.2.10.3	AC power	D				D	X	X	
3-3.3.2.10.4	Inside temperature	D				D	X	X	
3-3.3.2.10.5	Outside temperature	D				D	X	X	
3-3.3.2.11	FCPU monitor and control functions	D				D	X	X	
3-3.3.3.1	Communications with the RSCE site	I					X		

VERIFICATION METHOD: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D

TABLE 2

VOR/DME SYSTEM-VERIFICATION REQUIREMENT TRACEABILITY MATRIX

REQUIREMENTS		TEST LEVEL AND METHOD					TEST LOCATION		REMARKS
PARAGRAPH NUMBER	TITLE	FIRST ARTICLE DESIGN QUALIFICATION	TYPE TEST NORMAL CONDITIONS	TYPE TEST SERVICE CONDITIONS	PRODUCTION TESTS	OPERATIONAL SHAKEDOWN	FACTORY	ASM-150/ ACT	
5-3.3.8.9.7.2	Auxillary alarm input	D					X		
5-3.3.8.9.8	Remote readout	D					X		
5-3.3.8.9.9.1	Component failure	A,D,T					X		
5-3.3.8.9.10	Fault setting tolerances	T					X		
5-3.3.8.10	Keyer	D					X		
5-3.3.8.10.1	Identification code characteristics	T					X		
5-3.3.8.10.2	Sychronization for associated equipment	D					X		
6-3.3.2	Compatibility	D					X		
6-3.3.4	Stabilization of performance characteristics	T		T			X		
6-3.4.1	Operating channels	D					X		
6-3.4.1.2	RF tuning	T					X		See 1-3.3.14.1
6-3.4.1.3	Channel frequency accuracy and stability	T		T			X		
6-3.4.2	Duplexer	D					X		
6-3.4.3.1	Receiver bandwidth and stability	T		T	T		X		
6-3.4.3.2	Receiver decoder	D					X		
6-3.4.3.3	Receiver dead time	D					X		
6-3.4.3.4	Receiver recovery time	T					X		
6-3.4.3.5.1	Short distance echoes	T	T				X		
6-3.4.3.5.2	Long distance echoes	T	T				X		
6-3.4.3.6	Station DME traffic load monitoring	D					X		
6-3.4.3.7.1	On-channel sensitivity	T		T	T		X		
6-3.4.3.7.1.1	Variation with interrogation loading	T		T	T		X		
6-3.4.3.7.1.2	Triggering level at other pulse spacings	T		T	T		X		

VERIFICATION METHOD: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D

TABLE 2

VOR/DME SYSTEM-VERIFICATION REQUIREMENT TRACEABILITY MATRIX

REQUIREMENTS		TEST LEVEL AND METHOD					TEST LOCATION		REMARKS
PARAGRAPH NUMBER	TITLE	FIRST ARTICLE DESIGN QUALIFICATION	TYPE TEST NORMAL CONDITIONS	TYPE TEST SERVICE CONDITIONS	PRODUCTION TESTS	OPERATIONAL SHAKEDOWN	FACTORY	ASM-150/ ACT	
5-3.3.8.9.7.2	Auxillary alarm input	D					X		
5-3.3.8.9.8	Remote readout	D					X		
5-3.3.8.9.9.1	Component failure	A,D,T					X		
5-3.3.8.9.10	Fault setting tolerances	T					X		
5-3.3.8.10	Keyer	D					X		
5-3.3.8.10.1	Identification code characteristics	T					X		
5-3.3.8.10.2	Sychronization for associated equipment	D					X		
6-3.3.2	Compatibility	D					X		
6-3.3.4	Stabilization of performance characteristics	T		T			X		
6-3.4.1	Operating channels	D					X		
6-3.4.1.2	RF tuning	T					X		See 1-3.3.14.1
6-3.4.1.3	Channel frequency accuracy and stability	T		T			X		
6-3.4.2	Duplexer	D					X		
6-3.4.3.1	Receiver bandwidth and stability	T		T	T		X		
6-3.4.3.2	Receiver decoder	D					X		
6-3.4.3.3	Receiver dead time	D					X		
6-3.4.3.4	Receiver recovery time	T					X		
6-3.4.3.5.1	Short distance echoes	T	T				X		
6-3.4.3.5.2	Long distance echoes	T	T				X		
6-3.4.3.6	Station DME traffic load monitoring	D					X		
6-3.4.3.7.1	On-channel sensitivity	T		T	T		X		
6-3.4.3.7.1.1	Variation with interrogation loading	T		T	T		X		
6-3.4.3.7.1.2	Triggering level at other pulse spacings	T		T	T		X		

VERIFICATION METHOD: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D

TABLE 2

VOR/DME SYSTEM-VERIFICATION REQUIREMENT TRACEABILITY MATRIX

REQUIREMENTS		TEST LEVEL AND METHOD					TEST LOCATION		REMARKS
PARAGRAPH NUMBER	TITLE	FIRST ARTICLE DESIGN QUALIFICATION	TYPE TEST NORMAL CONDITIONS	TYPE TEST SERVICE CONDITIONS	PRODUCTION TESTS	OPERATIONAL SHAKEDOWN	FACTORY	ASM-150/ ACT	
5-3.3.8.9.7.2	Auxillary alarm input	D					X		
5-3.3.8.9.8	Remote readout	D					X		
5-3.3.8.9.9.1	Component failure	A,D,T					X		
5-3.3.8.9.10	Fault setting tolerances	T					X		
5-3.3.8.10	Keyer	D					X		
5-3.3.8.10.1	Identification code characteristics	T					X		
5-3.3.8.10.2	Sychronization for associated equipment	D					X		
6-3.3.2	Compatibility	D					X		
6-3.3.4	Stabilization of performance characteristics	T		T			X		
6-3.4.1	Operating channels	D					X		
6-3.4.1.2	RF tuning	T					X		See 1-3.3.14.1
6-3.4.1.3	Channel frequency accuracy and stability	T		T			X		
6-3.4.2	Duplexer	D					X		
6-3.4.3.1	Receiver bandwidth and stability	T		T	T		X		
6-3.4.3.2	Receiver decoder	D					X		
6-3.4.3.3	Receiver dead time	D					X		
6-3.4.3.4	Receiver recovery time	T					X		
6-3.4.3.5.1	Short distance echoes	T	T				X		
6-3.4.3.5.2	Long distance echoes	T	T				X		
6-3.4.3.6	Station DME traffic load monitoring	D					X		
6-3.4.3.7.1	On-channel sensitivity	T		T	T		X		
6-3.4.3.7.1.1	Variation with interrogation loading	T		T	T		X		
6-3.4.3.7.1.2	Triggering level at other pulse spacings	T		T	T		X		

VERIFICATION METHOD: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D

TABLE 2

VOR/DME SYSTEM-VERIFICATION REQUIREMENT TRACEABILITY MATRIX

REQUIREMENTS		TEST LEVEL AND METHOD					TEST LOCATION		REMARKS
PARAGRAPH NUMBER	TITLE	FIRST ARTICLE DESIGN QUALIFICATION	TYPE TEST NORMAL CONDITIONS	TYPE TEST SERVICE CONDITIONS	PRODUCTION TESTS	OPERATIONAL SHAKEDOWN	FACTORY	ASM-150/ ACT	
5-3.3.8.9.7.2	Auxillary alarm input	D					X		
5-3.3.8.9.8	Remote readout	D					X		
5-3.3.8.9.9.1	Component failure	A,D,T					X		
5-3.3.8.9.10	Fault setting tolerances	T					X		
5-3.3.8.10	Keyer	D					X		
5-3.3.8.10.1	Identification code characteristics	T					X		
5-3.3.8.10.2	Sychronization for associated equipment	D					X		
6-3.3.2	Compatibility	D					X		
6-3.3.4	Stabilization of performance characteristics	T		T			X		
6-3.4.1	Operating channels	D					X		
6-3.4.1.2	RF tuning	T					X		See 1-3.3.14.1
6-3.4.1.3	Channel frequency accuracy and stability	T		T			X		
6-3.4.2	Duplexer	D					X		
6-3.4.3.1	Receiver bandwidth and stability	T		T	T		X		
6-3.4.3.2	Receiver decoder	D					X		
6-3.4.3.3	Receiver dead time	D					X		
6-3.4.3.4	Receiver recovery time	T					X		
6-3.4.3.5.1	Short distance echoes	T	T				X		
6-3.4.3.5.2	Long distance echoes	T	T				X		
6-3.4.3.6	Station DME traffic load monitoring	D					X		
6-3.4.3.7.1	On-channel sensitivity	T		T	T		X		
6-3.4.3.7.1.1	Variation with interrogation loading	T		T	T		X		
6-3.4.3.7.1.2	Triggering level at other pulse spacings	T		T	T		X		

VERIFICATION METHOD: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D

TABLE 2

VOR/DME SYSTEM-VERIFICATION REQUIREMENT TRACEABILITY MATRIX

REQUIREMENTS		TEST LEVEL AND METHOD					TEST LOCATION		REMARKS
PARAGRAPH NUMBER	TITLE	FIRST ARTICLE DESIGN QUALIFICATION	TYPE TEST NORMAL CONDITIONS	TYPE TEST SERVICE CONDITIONS	PRODUCTION TESTS	OPERATIONAL SHAKEDOWN	FACTORY	ASM-150/ ACT	
5-3.3.8.9.7.2	Auxillary alarm input	D					X		
5-3.3.8.9.8	Remote readout	D					X		
5-3.3.8.9.9.1	Component failure	A,D,T					X		
5-3.3.8.9.10	Fault setting tolerances	T					X		
5-3.3.8.10	Keyer	D					X		
5-3.3.8.10.1	Identification code characteristics	T					X		
5-3.3.8.10.2	Sychronization for associated equipment	D					X		
6-3.3.2	Compatibility	D					X		
6-3.3.4	Stabilization of performance characteristics	T		T			X		
6-3.4.1	Operating channels	D					X		
6-3.4.1.2	RF tuning	T					X		See 1-3.3.14.1
6-3.4.1.3	Channel frequency accuracy and stability	T		T			X		
6-3.4.2	Duplexer	D					X		
6-3.4.3.1	Receiver bandwidth and stability	T		T	T		X		
6-3.4.3.2	Receiver decoder	D					X		
6-3.4.3.3	Receiver dead time	D					X		
6-3.4.3.4	Receiver recovery time	T					X		
6-3.4.3.5.1	Short distance echoes	T	T				X		
6-3.4.3.5.2	Long distance echoes	T	T				X		
6-3.4.3.6	Station DME traffic load monitoring	D					X		
6-3.4.3.7.1	On-channel sensitivity	T		T	T		X		
6-3.4.3.7.1.1	Variation with interrogation loading	T		T	T		X		
6-3.4.3.7.1.2	Triggering level at other pulse spacings	T		T	T		X		

VERIFICATION METHOD: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D

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PARAGRAPH NUMBER	TITLE	FIRST ARTICLE DESIGN QUALIFICATION	TYPE TEST NORMAL CONDITIONS	TYPE TEST SERVICE CONDITIONS	PRODUCTION TESTS	OPERATIONAL SHAKEDOWN	FACTORY	ASM-150/ ACT	
5-3.3.8.9.7.2	Auxillary alarm input	D					X		
5-3.3.8.9.8	Remote readout	D					X		
5-3.3.8.9.9.1	Component failure	A,D,T					X		
5-3.3.8.9.10	Fault setting tolerances	T					X		
5-3.3.8.10	Keyer	D					X		
5-3.3.8.10.1	Identification code characteristics	T					X		
5-3.3.8.10.2	Sychronization for associated equipment	D					X		
6-3.3.2	Compatibility	D					X		
6-3.3.4	Stabilization of performance characteristics	T		T			X		
6-3.4.1	Operating channels	D					X		
6-3.4.1.2	RF tuning	T					X		See 1-3.3.14.1
6-3.4.1.3	Channel frequency accuracy and stability	T		T			X		
6-3.4.2	Duplexer	D					X		
6-3.4.3.1	Receiver bandwidth and stability	T		T	T		X		
6-3.4.3.2	Receiver decoder	D					X		
6-3.4.3.3	Receiver dead time	D					X		
6-3.4.3.4	Receiver recovery time	T					X		
6-3.4.3.5.1	Short distance echoes	T	T				X		
6-3.4.3.5.2	Long distance echoes	T	T				X		
6-3.4.3.6	Station DME traffic load monitoring	D					X		
6-3.4.3.7.1	On-channel sensitivity	T		T	T		X		
6-3.4.3.7.1.1	Variation with interrogation loading	T		T	T		X		
6-3.4.3.7.1.2	Triggering level at other pulse spacings	T		T	T		X		

VERIFICATION METHOD: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D

NOTES

(1) Design Qualification Tests (DQT) shall include testing of all input and output ports of the FCPU, storage of data in memory, and display of data on the front panel. Simulated inputs may be used during DQT, Type, or Production tests.

(2) Design Qualification tests on VOR transmitter equipment shall be conducted at a minimum of three RF frequencies: 108 MHZ, 113 MHz, and 118 MHz.

Testing at service conditions (DQT and Type) shall be performed in accordance with paragraph 4.11 of Specification FAA-G-2100. Transmitter output power shall not be less than 140 watts.

Type and Production testing may be performed at any operational frequency.

(3) Design Qualification tests on VOR monitor equipment shall be conducted on three frequencies: 108 MHz, 113 MHz, and 118 MHz. Each test shall be conducted at the maximum and minimum RF input power levels to the equipment.

Type testing at Service conditions and Production tests shall be conducted with a 2 volt/meter RF input level at 113 MHz.

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DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

VOR/DME EQUIPMENT
PART 3 - FACILITY CENTRAL PROCESSING UNIT (FCPU)

3-1 SCOPE - FACILITY CENTRAL PROCESSING UNIT (FCPU)

3-1.1 Scope of Part 3.- This Part 3 is one of a group of specification documents under the basic heading "VOR/DME Equipment", each of which carries the basic number FAA-E-2678 together with an alpha revision letter and a slant line and number corresponding to the Part number. Part 3 of the specification covers the requirements for the facility central processing unit (FCPU) to be furnished as part of a set of equipment as defined in Part 1. The FCPU makes the determination of the status of all monitors (VOR and DME) through the initiation of automatic limit tests upon monitor discrepancies and periodically for certification verification (3-3.3.2.4 and 3-3.3.2.5). The FCPU stores and transmits all data available for use at a remote site (see FAA-E-2678b/9). The FCPU software stores all data (faults, alarms, and shutdowns) for future availability and historical record keeping.

3-1.2 Limitations of Part 3.- This Part 3 does not completely define the requirements for physical and electrical interface with other equipment elements covered under other parts of the specification, these being the responsibility of the contractor Additionally, certain requirements are defined only through references to other parts of the specification.

3-2 APPLICABLE DOCUMENTS.- (See Paragraph 1-2 of Part 1.)

3-3 REQUIREMENTS

3-3.1 Equipment to be furnished by the contractor.- Each VOR/DME system to be provided under this specification shall include a facility central processing unit (FCPU) complete and in accordance with all of the requirements of this specification.

3-3.2 Definitions.- The following definitions define non-standard technical terms and/or special terms that form a part of this specification.

3-3.2.1 Operating tolerance/limit.- The operating tolerance/limit is the maximum deviation or the range from the standard

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

VOR/DME EQUIPMENT
PART 3 - FACILITY CENTRAL PROCESSING UNIT (FCPU)

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DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

VOR/DME EQUIPMENT
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DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

VOR/DME EQUIPMENT
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3-3.2 Definitions.- The following definitions define non-standard technical terms and/or special terms that form a part of this specification.

3-3.2.1 Operating tolerance/limit.- The operating tolerance/limit is the maximum deviation or the range from the standard

(f) Provide a "pass-through" function which provides the capability to pass messages up to 4000 characters in length from the MPS. This capability shall supply any additional processing or formatting, or both, required to interface with the communications subsystem.

(g) Provide storage capabilities sufficient to store the current status of alarms and alerts, data values, alarm and alert thresholds, operator menus, and program instructions necessary to support interface functions on the MPS and test routines needed to meet the maintainability requirements of (d) above.

(h) Failure in the RMS shall not propagate, i.e., cause failures in, or in any way degrade the air traffic operational capabilities of the VOR/DME system.

(i) In addition to the Startup/Recovery Command of paragraph 3.7.2 of NAS-MD-790, the RMS shall respond to a Master Shutdown command issued from the MPS interface which will cause the VOR/DME systems to shut down without delay.

3-3.3.1.2 FCPU interfaces.- The FCPU provides a central point for communications between the VOR/DME equipment and the RSCE and thence to the MPS. It shall contain the interfaces listed in the following subparagraphs.

3-3.3.1.2.1 FCPU to RSCE interface.- The FCPU to RSCE interface shall be in accordance with EIA standard RS-232 wired as synchronous data terminal equipment (DTE). It shall interface through a contractor provided commercially available voice over data modem with the Government furnished 4 wire telephone line described in paragraph 1-3.3.13.1. The interface shall operate at a minimum rate of 1200 baud.

3-3.3.1.2.2 Portable maintenance data terminal (PMDT) interface.- (See paragraph 3-3.2.16.) The PMDT interface shall be in accordance with EIA Standard RS-232, wired as asynchronous, data communication equipment (DCE), full duplex, 25 pin, type D interface. The PMDT interface shall use eight bit, no parity and shall automatically adjust to baud rates of 2400, 4800, 9600. The interface shall be wired to a front panel mounted female MIL-C-24308 (MS-18275) connector. ASCII characters received via the PMDT interface shall also be transmitted via the PMDT interface, i.e., echoed as the characters are received. The PMDT interface protocol, to be approved by the Government, shall be commercially available.

3-3.3.1.3 PMDT interface commands.- With the PMDT in local mode commands shall be provided to support the man-machine interface

(f) Provide a "pass-through" function which provides the capability to pass messages up to 4000 characters in length from the MPS. This capability shall supply any additional processing or formatting, or both, required to interface with the communications subsystem.

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3-3.3.1.2.1 FCPU to RSCE interface.- The FCPU to RSCE interface shall be in accordance with EIA standard RS-232 wired as synchronous data terminal equipment (DTE). It shall interface through a contractor provided commercially available voice over data modem with the Government furnished 4 wire telephone line described in paragraph 1-3.3.13.1. The interface shall operate at a minimum rate of 1200 baud.

3-3.3.1.2.2 Portable maintenance data terminal (PMDT) interface.- (See paragraph 3-3.2.16.) The PMDT interface shall be in accordance with EIA Standard RS-232, wired as asynchronous, data communication equipment (DCE), full duplex, 25 pin, type D interface. The PMDT interface shall use eight bit, no parity and shall automatically adjust to baud rates of 2400, 4800, 9600. The interface shall be wired to a front panel mounted female MIL-C-24308 (MS-18275) connector. ASCII characters received via the PMDT interface shall also be transmitted via the PMDT interface, i.e., echoed as the characters are received. The PMDT interface protocol, to be approved by the Government, shall be commercially available.

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(g) Provide storage capabilities sufficient to store the current status of alarms and alerts, data values, alarm and alert thresholds, operator menus, and program instructions necessary to support interface functions on the MPS and test routines needed to meet the maintainability requirements of (d) above.

(h) Failure in the RMS shall not propagate, i.e., cause failures in, or in any way degrade the air traffic operational capabilities of the VOR/DME system.

(i) In addition to the Startup/Recovery Command of paragraph 3.7.2 of NAS-MD-790, the RMS shall respond to a Master Shutdown command issued from the MPS interface which will cause the VOR/DME systems to shut down without delay.

3-3.3.1.2 FCPU interfaces.- The FCPU provides a central point for communications between the VOR/DME equipment and the RSCE and thence to the MPS. It shall contain the interfaces listed in the following subparagraphs.

3-3.3.1.2.1 FCPU to RSCE interface.- The FCPU to RSCE interface shall be in accordance with EIA standard RS-232 wired as synchronous data terminal equipment (DTE). It shall interface through a contractor provided commercially available voice over data modem with the Government furnished 4 wire telephone line described in paragraph 1-3.3.13.1. The interface shall operate at a minimum rate of 1200 baud.

3-3.3.1.2.2 Portable maintenance data terminal (PMDT) interface.- (See paragraph 3-3.2.16.) The PMDT interface shall be in accordance with EIA Standard RS-232, wired as asynchronous, data communication equipment (DCE), full duplex, 25 pin, type D interface. The PMDT interface shall use eight bit, no parity and shall automatically adjust to baud rates of 2400, 4800, 9600. The interface shall be wired to a front panel mounted female MIL-C-24308 (MS-18275) connector. ASCII characters received via the PMDT interface shall also be transmitted via the PMDT interface, i.e., echoed as the characters are received. The PMDT interface protocol, to be approved by the Government, shall be commercially available.

3-3.3.1.3 PMDT interface commands.- With the PMDT in local mode commands shall be provided to support the man-machine interface

(f) Provide a "pass-through" function which provides the capability to pass messages up to 4000 characters in length from the MPS. This capability shall supply any additional processing or formatting, or both, required to interface with the communications subsystem.

(g) Provide storage capabilities sufficient to store the current status of alarms and alerts, data values, alarm and alert thresholds, operator menus, and program instructions necessary to support interface functions on the MPS and test routines needed to meet the maintainability requirements of (d) above.

(h) Failure in the RMS shall not propagate, i.e., cause failures in, or in any way degrade the air traffic operational capabilities of the VOR/DME system.

(i) In addition to the Startup/Recovery Command of paragraph 3.7.2 of NAS-MD-790, the RMS shall respond to a Master Shutdown command issued from the MPS interface which will cause the VOR/DME systems to shut down without delay.

3-3.3.1.2 FCPU interfaces.- The FCPU provides a central point for communications between the VOR/DME equipment and the RSCE and thence to the MPS. It shall contain the interfaces listed in the following subparagraphs.

3-3.3.1.2.1 FCPU to RSCE interface.- The FCPU to RSCE interface shall be in accordance with EIA standard RS-232 wired as synchronous data terminal equipment (DTE). It shall interface through a contractor provided commercially available voice over data modem with the Government furnished 4 wire telephone line described in paragraph 1-3.3.13.1. The interface shall operate at a minimum rate of 1200 baud.

3-3.3.1.2.2 Portable maintenance data terminal (PMDT) interface.- (See paragraph 3-3.2.16.) The PMDT interface shall be in accordance with EIA Standard RS-232, wired as asynchronous, data communication equipment (DCE), full duplex, 25 pin, type D interface. The PMDT interface shall use eight bit, no parity and shall automatically adjust to baud rates of 2400, 4800, 9600. The interface shall be wired to a front panel mounted female MIL-C-24308 (MS-18275) connector. ASCII characters received via the PMDT interface shall also be transmitted via the PMDT interface, i.e., echoed as the characters are received. The PMDT interface protocol, to be approved by the Government, shall be commercially available.

3-3.3.1.3 PMDT interface commands.- With the PMDT in local mode commands shall be provided to support the man-machine interface

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3-3.3.1.2.1 FCPU to RSCE interface.- The FCPU to RSCE interface shall be in accordance with EIA standard RS-232 wired as synchronous data terminal equipment (DTE). It shall interface through a contractor provided commercially available voice over data modem with the Government furnished 4 wire telephone line described in paragraph 1-3.3.13.1. The interface shall operate at a minimum rate of 1200 baud.

3-3.3.1.2.2 Portable maintenance data terminal (PMDT) interface.- (See paragraph 3-3.2.16.) The PMDT interface shall be in accordance with EIA Standard RS-232, wired as asynchronous, data communication equipment (DCE), full duplex, 25 pin, type D interface. The PMDT interface shall use eight bit, no parity and shall automatically adjust to baud rates of 2400, 4800, 9600. The interface shall be wired to a front panel mounted female MIL-C-24308 (MS-18275) connector. ASCII characters received via the PMDT interface shall also be transmitted via the PMDT interface, i.e., echoed as the characters are received. The PMDT interface protocol, to be approved by the Government, shall be commercially available.

3-3.3.1.3 PMDT interface commands.- With the PMDT in local mode commands shall be provided to support the man-machine interface

Hz AM signal or 9960 Hz FM signal to be available at the test input of the VOR monitor.

3-3.3.2.3.4 Output.- The test generator output shall be connected to the VOR monitor test input by means of a shielded cable.

3-3.3.2.3.5 Amplitude modulation of the FM signal.- There shall be less than 2.0 percent amplitude distortion of the 9960 Hz FM signal.

3-3.3.2.3.6 Provisions for calibration.- Provision shall be incorporated in the equipment for use in verifying phase calibration. Phase shift network controls, switch(es), meter(s), and test point(s) shall be conveniently located within the equipment for calibration purposes. Provision shall be incorporated within the equipment for use in correcting any phase displacement existing in the vertical amplifier of the oscilloscope.

3-3.3.2.3.7 VOR monitor integrity.- To test integrity of the VOR monitor the following subparagraphs shall apply.

3-3.3.2.3.7.1 30 Hz AM modulation.- The 30 Hz AM modulation fault detection function (paragraph 5-3.3.8.9.2) shall be confirmed by using the VOR test generator as a signal source to determine the 30 Hz AM modulation fault limits. The measured fault limits shall be compared with the commanded fault limits (paragraph 5-3.3.8.9.2). When the measured values equal or exceed the commanded values, a fault condition shall exist. The measurements and comparisons shall be performed automatically without interfering with normal operation.

3-3.3.2.3.7.2 9960 Hz modulation.- The 9960 Hz modulation fault detection function (paragraph 5-3.3.8.9.3) shall be confirmed by using the VOR test generator as a signal source to determine the 30 Hz modulation fault limits. The measured fault limits shall be compared with the commanded fault limits (paragraph 5-3.3.8.9.3). When the measured values equal or exceed the commanded values, a fault condition shall exist. The measurements and comparisons shall be performed automatically without interfering with normal operation.

3-3.3.2.3.7.3 Phase.- The phase fault detection function (paragraph 5-3.3.8.9.1) shall be confirmed by using the VOR test generator as a signal source to determine the phase fault limits. The measured fault limits shall be compared with the commanded fault limits (paragraph 5-3.3.8.9.1). When the measured values equal or exceed the commanded values, a fault condition shall exist. The measurements and comparisons shall be performed automatically without interfering with normal operation.

Hz AM signal or 9960 Hz FM signal to be available at the test input of the VOR monitor.

3-3.3.2.3.4 Output.- The test generator output shall be connected to the VOR monitor test input by means of a shielded cable.

3-3.3.2.3.5 Amplitude modulation of the FM signal.- There shall be less than 2.0 percent amplitude distortion of the 9960 Hz FM signal.

3-3.3.2.3.6 Provisions for calibration.- Provision shall be incorporated in the equipment for use in verifying phase calibration. Phase shift network controls, switch(es), meter(s), and test point(s) shall be conveniently located within the equipment for calibration purposes. Provision shall be incorporated within the equipment for use in correcting any phase displacement existing in the vertical amplifier of the oscilloscope.

3-3.3.2.3.7 VOR monitor integrity.- To test integrity of the VOR monitor the following subparagraphs shall apply.

3-3.3.2.3.7.1 30 Hz AM modulation.- The 30 Hz AM modulation fault detection function (paragraph 5-3.3.8.9.2) shall be confirmed by using the VOR test generator as a signal source to determine the 30 Hz AM modulation fault limits. The measured fault limits shall be compared with the commanded fault limits (paragraph 5-3.3.8.9.2). When the measured values equal or exceed the commanded values, a fault condition shall exist. The measurements and comparisons shall be performed automatically without interfering with normal operation.

3-3.3.2.3.7.2 9960 Hz modulation.- The 9960 Hz modulation fault detection function (paragraph 5-3.3.8.9.3) shall be confirmed by using the VOR test generator as a signal source to determine the 30 Hz modulation fault limits. The measured fault limits shall be compared with the commanded fault limits (paragraph 5-3.3.8.9.3). When the measured values equal or exceed the commanded values, a fault condition shall exist. The measurements and comparisons shall be performed automatically without interfering with normal operation.

3-3.3.2.3.7.3 Phase.- The phase fault detection function (paragraph 5-3.3.8.9.1) shall be confirmed by using the VOR test generator as a signal source to determine the phase fault limits. The measured fault limits shall be compared with the commanded fault limits (paragraph 5-3.3.8.9.1). When the measured values equal or exceed the commanded values, a fault condition shall exist. The measurements and comparisons shall be performed automatically without interfering with normal operation.

Hz AM signal or 9960 Hz FM signal to be available at the test input of the VOR monitor.

3-3.3.2.3.4 Output.- The test generator output shall be connected to the VOR monitor test input by means of a shielded cable.

3-3.3.2.3.5 Amplitude modulation of the FM signal.- There shall be less than 2.0 percent amplitude distortion of the 9960 Hz FM signal.

3-3.3.2.3.6 Provisions for calibration.- Provision shall be incorporated in the equipment for use in verifying phase calibration. Phase shift network controls, switch(es), meter(s), and test point(s) shall be conveniently located within the equipment for calibration purposes. Provision shall be incorporated within the equipment for use in correcting any phase displacement existing in the vertical amplifier of the oscilloscope.

3-3.3.2.3.7 VOR monitor integrity.- To test integrity of the VOR monitor the following subparagraphs shall apply.

3-3.3.2.3.7.1 30 Hz AM modulation.- The 30 Hz AM modulation fault detection function (paragraph 5-3.3.8.9.2) shall be confirmed by using the VOR test generator as a signal source to determine the 30 Hz AM modulation fault limits. The measured fault limits shall be compared with the commanded fault limits (paragraph 5-3.3.8.9.2). When the measured values equal or exceed the commanded values, a fault condition shall exist. The measurements and comparisons shall be performed automatically without interfering with normal operation.

3-3.3.2.3.7.2 9960 Hz modulation.- The 9960 Hz modulation fault detection function (paragraph 5-3.3.8.9.3) shall be confirmed by using the VOR test generator as a signal source to determine the 30 Hz modulation fault limits. The measured fault limits shall be compared with the commanded fault limits (paragraph 5-3.3.8.9.3). When the measured values equal or exceed the commanded values, a fault condition shall exist. The measurements and comparisons shall be performed automatically without interfering with normal operation.

3-3.3.2.3.7.3 Phase.- The phase fault detection function (paragraph 5-3.3.8.9.1) shall be confirmed by using the VOR test generator as a signal source to determine the phase fault limits. The measured fault limits shall be compared with the commanded fault limits (paragraph 5-3.3.8.9.1). When the measured values equal or exceed the commanded values, a fault condition shall exist. The measurements and comparisons shall be performed automatically without interfering with normal operation.

Hz AM signal or 9960 Hz FM signal to be available at the test input of the VOR monitor.

3-3.3.2.3.4 Output.- The test generator output shall be connected to the VOR monitor test input by means of a shielded cable.

3-3.3.2.3.5 Amplitude modulation of the FM signal.- There shall be less than 2.0 percent amplitude distortion of the 9960 Hz FM signal.

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3-3.3.2.3.7 VOR monitor integrity.- To test integrity of the VOR monitor the following subparagraphs shall apply.

3-3.3.2.3.7.1 30 Hz AM modulation.- The 30 Hz AM modulation fault detection function (paragraph 5-3.3.8.9.2) shall be confirmed by using the VOR test generator as a signal source to determine the 30 Hz AM modulation fault limits. The measured fault limits shall be compared with the commanded fault limits (paragraph 5-3.3.8.9.2). When the measured values equal or exceed the commanded values, a fault condition shall exist. The measurements and comparisons shall be performed automatically without interfering with normal operation.

3-3.3.2.3.7.2 9960 Hz modulation.- The 9960 Hz modulation fault detection function (paragraph 5-3.3.8.9.3) shall be confirmed by using the VOR test generator as a signal source to determine the 30 Hz modulation fault limits. The measured fault limits shall be compared with the commanded fault limits (paragraph 5-3.3.8.9.3). When the measured values equal or exceed the commanded values, a fault condition shall exist. The measurements and comparisons shall be performed automatically without interfering with normal operation.

3-3.3.2.3.7.3 Phase.- The phase fault detection function (paragraph 5-3.3.8.9.1) shall be confirmed by using the VOR test generator as a signal source to determine the phase fault limits. The measured fault limits shall be compared with the commanded fault limits (paragraph 5-3.3.8.9.1). When the measured values equal or exceed the commanded values, a fault condition shall exist. The measurements and comparisons shall be performed automatically without interfering with normal operation.

Hz AM signal or 9960 Hz FM signal to be available at the test input of the VOR monitor.

3-3.3.2.3.4 Output.- The test generator output shall be connected to the VOR monitor test input by means of a shielded cable.

3-3.3.2.3.5 Amplitude modulation of the FM signal.- There shall be less than 2.0 percent amplitude distortion of the 9960 Hz FM signal.

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3-3.3.2.3.7 VOR monitor integrity.- To test integrity of the VOR monitor the following subparagraphs shall apply.

3-3.3.2.3.7.1 30 Hz AM modulation.- The 30 Hz AM modulation fault detection function (paragraph 5-3.3.8.9.2) shall be confirmed by using the VOR test generator as a signal source to determine the 30 Hz AM modulation fault limits. The measured fault limits shall be compared with the commanded fault limits (paragraph 5-3.3.8.9.2). When the measured values equal or exceed the commanded values, a fault condition shall exist. The measurements and comparisons shall be performed automatically without interfering with normal operation.

3-3.3.2.3.7.2 9960 Hz modulation.- The 9960 Hz modulation fault detection function (paragraph 5-3.3.8.9.3) shall be confirmed by using the VOR test generator as a signal source to determine the 30 Hz modulation fault limits. The measured fault limits shall be compared with the commanded fault limits (paragraph 5-3.3.8.9.3). When the measured values equal or exceed the commanded values, a fault condition shall exist. The measurements and comparisons shall be performed automatically without interfering with normal operation.

3-3.3.2.3.7.3 Phase.- The phase fault detection function (paragraph 5-3.3.8.9.1) shall be confirmed by using the VOR test generator as a signal source to determine the phase fault limits. The measured fault limits shall be compared with the commanded fault limits (paragraph 5-3.3.8.9.1). When the measured values equal or exceed the commanded values, a fault condition shall exist. The measurements and comparisons shall be performed automatically without interfering with normal operation.

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3-3.3.2.3.7.2 9960 Hz modulation.- The 9960 Hz modulation fault detection function (paragraph 5-3.3.8.9.3) shall be confirmed by using the VOR test generator as a signal source to determine the 30 Hz modulation fault limits. The measured fault limits shall be compared with the commanded fault limits (paragraph 5-3.3.8.9.3). When the measured values equal or exceed the commanded values, a fault condition shall exist. The measurements and comparisons shall be performed automatically without interfering with normal operation.

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3-3.3.2.9.1.1 Test oscillator output.- The test oscillator, under PMDT or MPS interface control, shall have the capability to provide a continuously variable output signal from 0 to 100,000 microvolts. The oscillator shall be able to modulate the output signal with a 1000 Hz tone adjustable to any value between 20 and 40 percent. The root mean square (RMS) value of the total distortion of the 1000Hz test tone shall not exceed 3.0 percent.

3-3.3.2.9.1.2 RCO receiver testing.- The FCPU shall include the memory capability to control the remote testing of the following parameters of the main and standby RCO communications receivers.

(a) Status control (on-line or off-line)
(b) Voice frequency output (on-line receiver)
(c) Squelch/AGC (on-line receiver)
(d) Measurement of S+N/N (off-line receiver)

3-3.3.2.9.2 Engine generator testing.- The FCPU shall include the memory capability to provide for remote testing of the following performance checks of the facility engine generator (not to be supplied under this specification).

(a) Remote run exercise
(b) Remote stop exercise
(c) Engine oil pressure
(d) Engine coolant temperature
(e) Fuel storage tank level
(f) Generator output voltage (single phase)
(g) Generator output current
(h) Generator output frequency
(i) Battery charging rate (I)
(j) Battery cranking voltage (E)
(k) Engine starting time (normally less than 15 seconds)

3-3.3.2.9.3 External control relays.- For certain control functions, the actual switching will be accomplished by Government furnished 48 volt DC relays located within or near the equipment or device being controlled. Power for operation of these relays shall be provided by the BCPS (see Part 2). The FCPU shall provide the ground return path for the appropriate relay coil by means of a temporary software latch which shall persist for 180 ms ±20 ms. For design and test purposes, it may be assumed that the relay current will not exceed 40 ma under which conditions the voltage drop across the connecting terminals shall not exceed 4 volts. The FCPU shall have the capability to control at least ten external relays. Programming for this function shall be included in the software development specified in paragraph 1-3.8 herein.

3-3.3.2.10 Environmental parameters.- The following sensors together with all necessary cabling, connectors, terminal boards, enclosures, mounting hardware and installation instructions shall

3-3.3.2.9.1.1 Test oscillator output.- The test oscillator, under PMDT or MPS interface control, shall have the capability to provide a continuously variable output signal from 0 to 100,000 microvolts. The oscillator shall be able to modulate the output signal with a 1000 Hz tone adjustable to any value between 20 and 40 percent. The root mean square (RMS) value of the total distortion of the 1000Hz test tone shall not exceed 3.0 percent.

3-3.3.2.9.1.2 RCO receiver testing.- The FCPU shall include the memory capability to control the remote testing of the following parameters of the main and standby RCO communications receivers.

(a) Status control (on-line or off-line)
(b) Voice frequency output (on-line receiver)
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a minimum of 2 hours. Batteries may be used to provide the 2 hour nonvolatility.

3-3.3.4.8 Alternative Voice Input.- The equipment shall include provisions to accept an alternate voice input from Government furnished equipment that will be used to continuously modulate the voice channel of the VOR transmitter when it is not being modulated by voice on the dedicated telephone line. If the Government elects to use the alternate voice input, it shall be used in lieu of the voice identification of paragraph 3-3.3.4 and the voice identification shall be disabled with no adverse effects. The push to talk (PTT) signal of paragraph 9-3.2.1.2 shall remove the alternate voice input from the voice channel of the VOR transmitter and connect the dedicated line in its place. Application of the PTT signal shall additionally cause a 600 ohm load to be simultaneously placed across the input terminals of the alternate voice input line to preclude open circuit damage to the equipment connected to the line. The line shall be made available, by the Government, to a contractor furnished terminal board within the cabinets containing the FCPU.

3-3.4 Software

To perform the functions required by section 3-3.3 above, FCPU software components shall, as a minimum, be provided as follows.

(a) Remote Monitoring System (RMS) software (sections 3-3.4.1 through 3-3.4.4)
(b) Operating software (3-3.4.5)
(c) Fault diagnosis software (3-3.4.6)
(d) Installation and checkout software (3-3.4.7)
(e) Utility software (3-3.4.8)

The most detailed requirements presented to the contractor by the FAA are in the RMS software; for this reason the following sections discuss these RMS requirements in terms of functional requirements, required processing of message sequences, allowed message structure, FCPU/MPS communications interface requirements, and specific VOR/DME RMS requirements. Software requirements found elsewhere in the FCPU specification are then allocated to the remaining software components.

3-3.4.1 RMS software

The RMS software shall implement the required software for data collection, alarm detection, message processing, and the communications interface with the Maintenace Processing System (MPS), as described in NAS-MD-790, NAS-MD-793, and 3-3.2.13.

The RMS software shall provide the capability to perform data collection of all available data (see Parts 1 through 7 of the specification) from the VOR, DME, environmental, and

a minimum of 2 hours. Batteries may be used to provide the 2 hour nonvolatility.

3-3.3.4.8 Alternative Voice Input.- The equipment shall include provisions to accept an alternate voice input from Government furnished equipment that will be used to continuously modulate the voice channel of the VOR transmitter when it is not being modulated by voice on the dedicated telephone line. If the Government elects to use the alternate voice input, it shall be used in lieu of the voice identification of paragraph 3-3.3.4 and the voice identification shall be disabled with no adverse effects. The push to talk (PTT) signal of paragraph 9-3.2.1.2 shall remove the alternate voice input from the voice channel of the VOR transmitter and connect the dedicated line in its place. Application of the PTT signal shall additionally cause a 600 ohm load to be simultaneously placed across the input terminals of the alternate voice input line to preclude open circuit damage to the equipment connected to the line. The line shall be made available, by the Government, to a contractor furnished terminal board within the cabinets containing the FCPU.

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3-3.4.1 RMS software

The RMS software shall implement the required software for data collection, alarm detection, message processing, and the communications interface with the Maintenace Processing System (MPS), as described in NAS-MD-790, NAS-MD-793, and 3-3.2.13.

The RMS software shall provide the capability to perform data collection of all available data (see Parts 1 through 7 of the specification) from the VOR, DME, environmental, and

Change of state comparison shall be performed by the RMS as part of its data comparison activities. This comparison shall be performed to determine if the VOR/DME equipment, or one of its components, has changed to another state (for example, from an operational state to a failed state, or from a failed state to a normal state). The RMS shall be capable of maintaining a record of the state of each of the monitored parameters for at least three interrogation cycles. The retrieval and comparison of this state data shall be performed as part of each cycle in the parameter retrieval and comparison process.

3-3.4.1.1.2.2 Data storage, retrieval and updating.

(a) Data storage

The RMS shall have sufficient storage capacity to store, as a minimum, the following data:

1. Alarm Threshold Values.

Sufficient threshold data shall be stored at the RMS to determine two possible alarm conditions for each of the critical parameters being monitored: out of tolerance conditions (hard alarms) and conditions indicative of an impending failure (soft alarms). It shall be possible to change the RMS's threshold values from the MPS or from a PDMT in local mode.

2. Parameter State Values.

Storage capacity shall be provided for the storage of data that describes the state of each critical parameter, i.e., normal/operational or alarm.

3. Remote Control and Adjustment Command Codes.

The RMS shall be capable of storing the information needed to decode the remote control and adjustment commands it is required to respond to. Remote control and adjustment capabilities for the RMS, and their associated command codes shall be defined by the contractor and shall conform with the format presented in NAS-MD-790.

4. Initialization Tables.

The RMS shall be capable of storing the initialization information, needed to initialize the RMS, in changeable, non volatile memory. Local site changes to this information may be down-loaded from an MPS or PMDT (maximum 512 bytes) as described in NAS-MD-793.

5. Equipment and RMS Parameter Values.

Change of state comparison shall be performed by the RMS as part of its data comparison activities. This comparison shall be performed to determine if the VOR/DME equipment, or one of its components, has changed to another state (for example, from an operational state to a failed state, or from a failed state to a normal state). The RMS shall be capable of maintaining a record of the state of each of the monitored parameters for at least three interrogation cycles. The retrieval and comparison of this state data shall be performed as part of each cycle in the parameter retrieval and comparison process.

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5. Equipment and RMS Parameter Values.

3-3.4.1.1.2.4 Trend data storage

The VOR/DME RMS software shall have the capability of programming for automatic storage at 1 to 72 hour intervals (adjustable in 1/2 hour steps) of all parameter data selectable for trend analysis.

3-3.4.1.1.2.5 Command processing.- A primary function for the RMS shall be responding to commands from the MPS. This includes actions performed in response to a failure, as well as actions performed when no failure condition is declared. Examples of this capability include initializing the subsystem, and the adjusting of equipment control parameters as operational demands on the equipment change.

(a) Equipment remote control, adjustment, diagnostic and initialization requirements

Remote control, adjustment, diagnostic, and initialization capabilities and commands shall be defined by the contractor and shall be documented in the contractor-prepared ICD. The RMS must be capable of receiving and recognizing valid commands, controlling the execution of those commands, determining the equipment's state after the execution of the command, and generating the appropriate message for reporting the results to the user who issued the command.

(b) Command acceptance and verification

The RMS shall be designed to accept commands formatted in accordance with the command message format presented in NAS-MD-790.

Upon receiving a command message, the RMS shall verify that the command is a valid command. This shall be accomplished through the use of the command code transmitted as part of the command message. If the command is found to be an invalid command, the RMS shall generate the appropriate Command Reject Message to report that the command was not executed.

(c) Command execution

If a command received by the RMS is found to be a valid command, the RMS shall select and execute the appropriate process control algorithm or change the desired equipment parameter value. Execution of the command shall be accomplished without a need for secondary commands or human intervention. If the RMS is in the local control mode when a command comes from the MPS, the command shall not be executed and a Command Reject message shall be formatted for up-line transmission.

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3-3.4.2.1.2.2 Automatic monitoring.- The RMMS will provide for the retrieval of equipment data from RMSs without any human intervention, through the use of an automatic monitoring capability. Automatic monitoring will differ from demand monitoring in the way the process is initiated and in the way the retrieved data is disseminated. Data collection and processing requirements for the RMS will be the same under automatic monitoring as those required of the RMS under demand monitoring. Processing requirements for the MPS under automatic monitoring will be slightly different than those under demand monitoring.

Under automatic monitoring, continuous polls (low-level protocol polls as described in NAS-MD-790) for retrieving equipment performance data from a particular RMS will be generated automatically by the MPS. A schedule for retrieving data from equipment assigned to a particular MPS will be specified in site adaptable tables maintained in the MPS's data base. These tables will be scanned on a regular basis to determine if a Parameter Request message has to be generated in order to retrieve any equipment performance data. Parameter Request messages generated through this process will be routed to the target RMS in the same manner described previously. When the response to the Parameter Request message is received by the MPS, the data will be processed for storage in the MPS's data base.

3-3.4.2.2 Alarm function

3-3.4.2.2.1 Objective.- The primary objective behind implementing the alarm capability is to reduce the amount of time that passes between when an equipment failure, out of tolerance, or state change condition occurs, and when the appropriate personnel are notified. This capability will also provide personnel responsible for the equipment with an indication of what component or equipment subsystem caused the alarm, or of the severity of the problem, by providing values for the monitored parameter that triggered the alarm, state change notice, or return to normal message.

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changing equipment control parameter values stored in the equipment or RMS.

4. Determine Response To Command. After the command execution process has been completed, the RMS shall retrieve whatever equipment performance parameter data is required to determine the response to the command.

5. Format Response Notification. After the response to the command is determined, the RMS shall generate a response notification, for transmission back up-line to the MPS. The response notification shall be sent in the form of a Control Result message, unless the command was an Adjustment Command, in which case the RMS would format the appropriate Adjustment Result message for transmission up-line.

3-3.4.2.5 Remote diagnostics function.

3-3.4.2.5.1 Objective. - The objective of the diagnostics function is to provide a centralized capability for diagnosing remote facility equipment faults to the LRU level. This capability shall permit an authorized person to identify all failing or failed components or modules prior to visiting the site to make the necessary repairs. In addition, it shall enable the person to analyze the problem and to note the necessary replacement parts and test equipment while at the facility site with the RMS in the local control mode.

Diagnostics shall either provide fault information about a failing component, at the line replaceable unit (LRU) level, or about parameter values. In some cases, off-line tests may be required to acquire the fault information.

3-3.4.2.5.2 Process description. - The remote diagnostics function is the primary function used by the MPS to obtain fault information pertaining to VOR/DME equipment. The diagnosing of VOR/DME equipment is to be conducted on primarily a demand basis. Under the automatic diagnostics mode, once an alarm is detected, the RMS shall automatically perform diagnostic test(s) to obtain fault information on the failing or failed component. No human intervention shall be required under this mode. The result(s) of a diagnostics test shall be formatted for transmission up-line to the MPS.

Under the demand diagnostics mode, an authorized person shall enter a command to diagnose a specific piece of equipment through an MDT connected to an MPS, or a PMDT in the local mode. The RMS shall initiate the diagnostics test(s).

Other command and message processing activities required for the

changing equipment control parameter values stored in the equipment or RMS.

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3-3.4.2.5.1 Objective. - The objective of the diagnostics function is to provide a centralized capability for diagnosing remote facility equipment faults to the LRU level. This capability shall permit an authorized person to identify all failing or failed components or modules prior to visiting the site to make the necessary repairs. In addition, it shall enable the person to analyze the problem and to note the necessary replacement parts and test equipment while at the facility site with the RMS in the local control mode.

Diagnostics shall either provide fault information about a failing component, at the line replaceable unit (LRU) level, or about parameter values. In some cases, off-line tests may be required to acquire the fault information.

3-3.4.2.5.2 Process description. - The remote diagnostics function is the primary function used by the MPS to obtain fault information pertaining to VOR/DME equipment. The diagnosing of VOR/DME equipment is to be conducted on primarily a demand basis. Under the automatic diagnostics mode, once an alarm is detected, the RMS shall automatically perform diagnostic test(s) to obtain fault information on the failing or failed component. No human intervention shall be required under this mode. The result(s) of a diagnostics test shall be formatted for transmission up-line to the MPS.

Under the demand diagnostics mode, an authorized person shall enter a command to diagnose a specific piece of equipment through an MDT connected to an MPS, or a PMDT in the local mode. The RMS shall initiate the diagnostics test(s).

Other command and message processing activities required for the

changing equipment control parameter values stored in the equipment or RMS.

4. Determine Response To Command. After the command execution process has been completed, the RMS shall retrieve whatever equipment performance parameter data is required to determine the response to the command.

5. Format Response Notification. After the response to the command is determined, the RMS shall generate a response notification, for transmission back up-line to the MPS. The response notification shall be sent in the form of a Control Result message, unless the command was an Adjustment Command, in which case the RMS would format the appropriate Adjustment Result message for transmission up-line.

3-3.4.2.5 Remote diagnostics function.

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user password identifiers equate to various levels of security, each command entry shall be validated against the applicable security level list before execution. Each sign-on command entry shall be reported to the MPS. At least 24 unique six-character user password identifiers shall be provided. These passwords shall be maintained as an On-Site Security logical unit for remote administrative maintenance.

The first step shall consist of the operator entering his user identification. The second step shall consist of the operator entering his password. Neither the identifier characters nor the password characters shall be displayed. Invalid entries shall be flagged as errors, and shall cause the access procedure to halt and return to the idle (wait) sequence. A timer shall be provided to require a sign-on procedure to be repeated if the interface is idle for more than 15 minutes. Any valid messages transmitted over the interface shall reset this timer.

The first level password (highest) shall give access to all possible data and command executions, including MPS access during remote operation. The second level shall provide access to all data, and controls for changing alert limits, during local operation. The third level shall provide access to environmental data and status of VOR/DME equipment only.

These levels of security are intended to control stand-alone operation during installation, and maintenance at an installed VOR/DME site in the absence of MPS communications. The level of security established during entry shall not restrict operator access to MPS during remote control mode, or MPS security for change to local control mode.

3-3.4.2.7.1.2 Remote control mode security.

PMDT entry, at any level of on-site security, shall provide access to commands requesting MPS access as a standard Maintenance Data Terminal (MDT). The VOR/DME RMS must pass all communications through between PDMT and MPS without alteration during such access. The MPS security procedures shall apply to all PMDT access to RMM databases and commands, as follows; no RMS functions are necessary to implement the following procedures.

When logging on through the MPS logon screen and using information typed on that screen (facility ID, cost control center, MPS password), user authorization and equipment assignment records maintained in the MPS data base will be checked to determine whether or not the requester is authorized to access the specific VOR/DME site originating the request. If the results of this check indicate that the requester is not authorized, a message refusing the logon will be generated by the MPS and routed to the data requester's terminal for display.

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Performance), or in response to a request from an authorized system user (referred to herein as Demand System Performance).

3-3.4.2.9.2.1 Automatic system performance. - The RMS shall control and perform the retrieval of its system performance data. The actions performed by the RMS during the acquisition, storage, and transmission up-line of this data are described below.

1. System Performance Data Retrieval. The RMS shall be designed with a self-monitoring capability. This capability shall allow for the collection of the data needed to detect the failure or impending failure of RMS components, and to evaluate the performance, efficiency, and utilization of the VOR/DME RMS as opposed to the VOR/DME equipment.

Given that many of the capabilities of the RMS shall be provided through the use of software, instead of hardware, software monitors shall be used in conjunction with hardware monitors. Together, the hardware and software monitors shall collect the data needed to evaluate the utilization of the RMS's memory and CPU, track the effect of changes to the RMS's hardware and software, detect voltage fluctuations in the RMS equipment or the failure of a component of the RMS. The system performance monitors shall also provide the means for maintaining records on the RMS's transaction related activities. The retrieved RMS performance data shall be conditioned and scaled, when appropriate, and stored in such a manner that it shall be retrievable separate from the facility performance data also being retrieved and stored by the RMS.

2. Receive Specific Poll. All transmissions received by the RMS shall be examined upon receipt to determine if they are to be processed by the RMS or retransmitted to the PMDT. The RMS shall examine the address data included in the subject specific poll. The receipt of a specific poll for system performance data shall be established at this point. The response required of the RMS shall be to format the RMS's system performance data and transmit it up-line to the MPS.

3. Retrieve and Format Data. After establishing that it has to transmit its system performance data up-line, the RMS shall retrieve the required data from its data base and format the data for transmission. The data shall be transmitted in the form of a Parameter Response message. Formatting shall involve placing the data elements in their appropriate message fields and adding the necessary communication control characters to the actual message.

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3-3.4.3.2.1.1.4 Messages. - Messages are the third and highest organizational level in the allowed message structure. A message is here defined as a string of fields organized in such a way as to permit proper association of the fields with corresponding processing routines.

Standard message types are enumerated in Figure C. It is from this catalog of types that VOR/DME RMS messages shall be constructed.

MESSAGE TYPE	PARAMETER
FIXED NO. OF FIELDS	NF: NUMBER OF FIELDS
REPEATING FIELD GROUP - VARIABLE	k2: NO. OF FIELDS IN REPEATING GROUP
REPEATING FIELD GROUP - FIXED	k2: NO. OF FIELDS IN REPEATING GROUP
	J: NO. OF REPEATING GROUPS
VARIABLE NO. OF REPEATING FIELD GROUPS OF VARIABLE REPETITIONS EACH	k2(i): NO. OF FIELDS IN $i^{t}h$ REPEATING GROUP
FIXED NO. OF REPEATING FIELD GROUPS OF VARIABLE REPITITIONS EACH	k2(i): NO. OF FIELDS IN $i^{t}h$ REPEATING GROUP
	J: NO. OF REPEATING GROUP STRUCTURES
VARIABLE NO. OF REPEATING FIELD GROUPS OF FIXED REPETITIONS EACH	k2(i): NO. OF FIELDS IN $i^{t}h$ REPEATING GROUP
	I: NO. OF REPEATING GROUPS IN $i^{t}h$ STRUCTURE OF REPEATING GROUPS
FIXED NO. OF REPEATING FIELD GROUPS OF FIXED REPETITIONS EACH	k2(i): NO. OF FIELDS IN $i^{t}h$ REPEATING GROUP
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FIGURE C: STANDARD MESSAGE TYPES

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FIXED NO. OF REPEATING FIELD GROUPS OF VARIABLE REPITITIONS EACH	k2(i): NO. OF FIELDS IN $i^{t}h$ REPEATING GROUP
	J: NO. OF REPEATING GROUP STRUCTURES
VARIABLE NO. OF REPEATING FIELD GROUPS OF FIXED REPETITIONS EACH	k2(i): NO. OF FIELDS IN $i^{t}h$ REPEATING GROUP
	I: NO. OF REPEATING GROUPS IN $i^{t}h$ STRUCTURE OF REPEATING GROUPS
FIXED NO. OF REPEATING FIELD GROUPS OF FIXED REPETITIONS EACH	k2(i): NO. OF FIELDS IN $i^{t}h$ REPEATING GROUP
	I(j): NO. OF REPEATING FIELD GROUPS IN $i^{t}h$ REPEATING GROUP
	J: NO. OF REPEATING GROUP STRUCTURES

FIGURE C: STANDARD MESSAGE TYPES

3-3.4.3.2.1.1.4 Messages. - Messages are the third and highest organizational level in the allowed message structure. A message is here defined as a string of fields organized in such a way as to permit proper association of the fields with corresponding processing routines.

Standard message types are enumerated in Figure C. It is from this catalog of types that VOR/DME RMS messages shall be constructed.

MESSAGE TYPE	PARAMETER
FIXED NO. OF FIELDS	NF: NUMBER OF FIELDS
REPEATING FIELD GROUP - VARIABLE	k2: NO. OF FIELDS IN REPEATING GROUP
REPEATING FIELD GROUP - FIXED	k2: NO. OF FIELDS IN REPEATING GROUP
	J: NO. OF REPEATING GROUPS
VARIABLE NO. OF REPEATING FIELD GROUPS OF VARIABLE REPETITIONS EACH	k2(i): NO. OF FIELDS IN $i^{t}h$ REPEATING GROUP
FIXED NO. OF REPEATING FIELD GROUPS OF VARIABLE REPITITIONS EACH	k2(i): NO. OF FIELDS IN $i^{t}h$ REPEATING GROUP
	J: NO. OF REPEATING GROUP STRUCTURES
VARIABLE NO. OF REPEATING FIELD GROUPS OF FIXED REPETITIONS EACH	k2(i): NO. OF FIELDS IN $i^{t}h$ REPEATING GROUP
	I: NO. OF REPEATING GROUPS IN $i^{t}h$ STRUCTURE OF REPEATING GROUPS
FIXED NO. OF REPEATING FIELD GROUPS OF FIXED REPETITIONS EACH	k2(i): NO. OF FIELDS IN $i^{t}h$ REPEATING GROUP
	I(j): NO. OF REPEATING FIELD GROUPS IN $i^{t}h$ REPEATING GROUP
	J: NO. OF REPEATING GROUP STRUCTURES

FIGURE C: STANDARD MESSAGE TYPES

LU, VOR Monitor Status LU, DME Monitor Status LU, BCPS Status LU, and FCPU Status LU. Parameters (data points) and setpoints shall be identified for each LU, and alerts/alarms designated, with explicit description of messages exchanged between the VOR/DME RMS and the MPS in processing each event.

3-3.4.4.11 Parameter sampling

The VOR/DME RMS software shall sample all parameters at least once every five seconds. (See paragraph 3-3.3.1.8 herein.)

3-3.4.4.12 Full remote control

Full remote control shall be provided over all functions available locally through the PMDT, as required in paragraph 1-3.3.13.3 herein.

3-3.4.5 Operating software

The following subparagraphs allocate functions required in the hardware portion of this specification (section 3-3.3 and following) to non-RMS software. Although all software must meet documentation requirements of MIL-STD-1521 and DOD-STD-2167A, the following software component designations are not intended to identify Computer Software Configuration Items (CSCIs) required in these standards; CSCIs are to be identified by the contractor.

a. Operational software -- all software required to support VOR/DME operation, and RMS monitoring and control, exclusive of fault diagnosis software, and software used specifically during installation.

b. Fault diagnosis software -- all software required to support automatic diagnostic functions.

c. Installation and checkout software -- all software required to support installation, testing, and standalone operation in the absence of an FAA RMMS environment.

d. Utility software -- other software (e.g. PMDT and RSCE software) used during operation, and software used offline or outside normal operation for problem analysis and resolution.

LU, VOR Monitor Status LU, DME Monitor Status LU, BCPS Status LU, and FCPU Status LU. Parameters (data points) and setpoints shall be identified for each LU, and alerts/alarms designated, with explicit description of messages exchanged between the VOR/DME RMS and the MPS in processing each event.

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DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

VOR/DME EQUIPMENT
PART 4 - VOR TRANSMITTER EQUIPMENT

4-1 SCOPE - VOR TRANSMITTER EQUIPMENT

4-1.1 Scope of Part 4.- This Part 4 is one of a group of specification documents under the basic heading "VOR/DME Equipment", each of which carries the basic number FAA-E-2678 together with an alpha revision letter and a slant line and number corresponding to the Part number. This Part 4 of the equipment specified herein consists of the necessary circuitry for generating the navigation signals of a VHF omnirange (VOR) station.

4-1.2 Limitations of Part 4.- This Part 4 does not completely define the requirements for physical and electrical interface with other equipment elements covered under the other parts of the specification, these being the responsibility of the contractor. Additionally, certain requirements are defined only through reference to other parts of the specification.

4-2 APPLICABLE DOCUMENTS.- (See paragraph 1-2 of Part 1.)

4-3 REQUIREMENTS

4-3.1 Equipment to be furnished by the contractor.- Each VOR transmitter furnished by the contractor shall be complete in accordance with all specification requirements.

4-3.2 Definitions.-

4-3.2.1 Goniometer.- The term "goniometer" refers to that unit which produces two RF pure double sidebands which are 30 Hz removed from the VOR carrier frequency. The two 30 Hz components are in audio phase quadrature. Additionally, the goniometer produces a 9960 Hz FM subcarrier signal for amplitude modulating the VOR carrier frequency.

4-3.2.2 Carrier power.- The term "carrier power" is defined as the unmodulated RF power supplied at the transmitter RF output jack during normal operation.

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VOR/DME EQUIPMENT
PART 4 - VOR TRANSMITTER EQUIPMENT

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FEDERAL AVIATION ADMINISTRATION

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requirements shall exist for keying of the DME in accordance with paragraph 4-3.3.3.11.4.2. Keying may be located within circuitry other than the VOR transmitter.

4-3.3.3.11.1 1020 Hz frequency stability.- The stability of 1020 Hz frequency shall be within ±0.5 percent over the range of service conditions.

4-3.3.3.11.2 Harmonic distortion.- The total harmonic distortion of the 1020 Hz audio signal (continuous tone output) shall not exceed 3.0 percent.

4-3.3.3.11.3 Output level and stability.- The oscillator/keyer shall provide adjustable levels sufficient to amplitude modulate the carrier output 8 percent with a stability which shall maintain the percentage of amplitude of the carrier output to within ±1 percent over the range of service conditions.

4-3.3.3.11.4 Keyer.- The keyer shall operate to key the 1020 Hz audio signal into the dot-dash characters of International Morse Code representing any three- or four-letter combination of the alphabet. The characters shall be readily programmable through the FCPU. The keyer shall be of solid state semiconductor digital design. Motor driven devices to create the keying impulses shall not be used.

4-3.3.3.11.4.1 Identification code characteristics.- The identification code characteristics shall conform to the following:

(a) The dots shall be of duration between 100 milliseconds and 125 milliseconds. The dashes shall be of a duration three times that of the dots.

(b) The spacing between the dots and dashes of a code letter shall be equal to the duration of one dot within ±5 percent.

(c) The spacing between consecutive letters of the three- or four-letter identification code group shall be equal to the duration of three dots within ±5 percent.

(d) The repetition rate for the three-or four-letter identification code group shall be eight times per minute (once in each 75-dot length interval), except as noted under paragraph 4-3.3.3.11.4.2.

4-3.3.3.11.4.2 Synchronization for associated equipment.- The keyer shall be programmed to operate in association with DME equipment such that every fourth identification cycle

requirements shall exist for keying of the DME in accordance with paragraph 4-3.3.3.11.4.2. Keying may be located within circuitry other than the VOR transmitter.

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(d) The repetition rate for the three-or four-letter identification code group shall be eight times per minute (once in each 75-dot length interval), except as noted under paragraph 4-3.3.3.11.4.2.

4-3.3.3.11.4.2 Synchronization for associated equipment.- The keyer shall be programmed to operate in association with DME equipment such that every fourth identification cycle

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(c) The spacing between consecutive letters of the three- or four-letter identification code group shall be equal to the duration of three dots within ±5 percent.

(d) The repetition rate for the three-or four-letter identification code group shall be eight times per minute (once in each 75-dot length interval), except as noted under paragraph 4-3.3.3.11.4.2.

4-3.3.3.11.4.2 Synchronization for associated equipment.- The keyer shall be programmed to operate in association with DME equipment such that every fourth identification cycle

requirements shall exist for keying of the DME in accordance with paragraph 4-3.3.3.11.4.2. Keying may be located within circuitry other than the VOR transmitter.

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4-3.3.3.11.3 Output level and stability.- The oscillator/keyer shall provide adjustable levels sufficient to amplitude modulate the carrier output 8 percent with a stability which shall maintain the percentage of amplitude of the carrier output to within ±1 percent over the range of service conditions.

4-3.3.3.11.4 Keyer.- The keyer shall operate to key the 1020 Hz audio signal into the dot-dash characters of International Morse Code representing any three- or four-letter combination of the alphabet. The characters shall be readily programmable through the FCPU. The keyer shall be of solid state semiconductor digital design. Motor driven devices to create the keying impulses shall not be used.

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4-3.3.3.11.4.2 Synchronization for associated equipment.- The keyer shall be programmed to operate in association with DME equipment such that every fourth identification cycle

±3 degrees and 180 ±3 degrees, referenced to the carrier reference input 4-3.3.4.2.

4-3.3.4.3.8 Deviation from the average maximum envelope amplitude.- For one complete period of the 30 Hz modulation signal, any individual maximum envelope amplitude, at both the outputs, shall not deviate by more than 0.5 percent from the average of all such maximums (averaged over a period of at least five complete cycles of 30 Hz).

4-3.3.4.3.9 Output circuit loading.- The goniometer output circuitry shall be designed to provide the specified performance when feeding a RG-214/U coaxial cable having any value of VSWR in the range of 1.0 to 2.0. The goniometer output shall not be required to operate within specification limits for greater values of VSWR, however, no part(s) of the goniometer shall be damaged as the result of any degree of mismatch, including open and short, at any point on the output transmission line(s). The two RF outputs specified shall be terminated at the rear of the equipment in an "N" type connector suitable for mating with a UG-185/U connector.

4-3.3.4.3.10 Power output during warm up.- The warm up requirements shall be the same as those specified in 4-3.3.3.1.2 for the VOR transmitter.

4-3.3.4.3.11 Power output measurement.- Directional couplers and detectors shall be incorporated at each sideband output for measurement of forward and reverse power and VSWR by the FCPU, see Part 3.

4-3.3.4.4 9960 Hz FM subcarrier generator.- The 9960 Hz FM subcarrier generator provides the "reference" 30 Hz signal for the conventional VOR system. This 30 Hz reference is contained as frequency modulation of the 9960 Hz signal. The following parameter tolerances shall apply to the 9960 Hz FM subcarrier. All requirements shall be met over the range of service conditions.

4-3.3.4.4.1 Mean frequency stability.- The mean frequency (see 4-3.2.6) of the 9960 Hz FM subcarrier signal shall be 9960 Hz ±0.1 percent.

4-3.3.4.4.2 Phase control and stability.- A phase shifter control shall be provided in the 30 Hz signal circuitry of the 9960 Hz FM subcarrier generator. This control shall provide a range of 0.00 to 359.99 degrees of phase shift to the 30 Hz signal. The phase shift shall be in increments of 0.01 degree or less (continuously variable). The phase stability of the 30 Hz component shall remain constant within ±0.1 degree (referenced to the 30 Hz zero crossover(s) of the RF sideband(s)).

±3 degrees and 180 ±3 degrees, referenced to the carrier reference input 4-3.3.4.2.

4-3.3.4.3.8 Deviation from the average maximum envelope amplitude.- For one complete period of the 30 Hz modulation signal, any individual maximum envelope amplitude, at both the outputs, shall not deviate by more than 0.5 percent from the average of all such maximums (averaged over a period of at least five complete cycles of 30 Hz).

4-3.3.4.3.9 Output circuit loading.- The goniometer output circuitry shall be designed to provide the specified performance when feeding a RG-214/U coaxial cable having any value of VSWR in the range of 1.0 to 2.0. The goniometer output shall not be required to operate within specification limits for greater values of VSWR, however, no part(s) of the goniometer shall be damaged as the result of any degree of mismatch, including open and short, at any point on the output transmission line(s). The two RF outputs specified shall be terminated at the rear of the equipment in an "N" type connector suitable for mating with a UG-185/U connector.

4-3.3.4.3.10 Power output during warm up.- The warm up requirements shall be the same as those specified in 4-3.3.3.1.2 for the VOR transmitter.

4-3.3.4.3.11 Power output measurement.- Directional couplers and detectors shall be incorporated at each sideband output for measurement of forward and reverse power and VSWR by the FCPU, see Part 3.

4-3.3.4.4 9960 Hz FM subcarrier generator.- The 9960 Hz FM subcarrier generator provides the "reference" 30 Hz signal for the conventional VOR system. This 30 Hz reference is contained as frequency modulation of the 9960 Hz signal. The following parameter tolerances shall apply to the 9960 Hz FM subcarrier. All requirements shall be met over the range of service conditions.

4-3.3.4.4.1 Mean frequency stability.- The mean frequency (see 4-3.2.6) of the 9960 Hz FM subcarrier signal shall be 9960 Hz ±0.1 percent.

4-3.3.4.4.2 Phase control and stability.- A phase shifter control shall be provided in the 30 Hz signal circuitry of the 9960 Hz FM subcarrier generator. This control shall provide a range of 0.00 to 359.99 degrees of phase shift to the 30 Hz signal. The phase shift shall be in increments of 0.01 degree or less (continuously variable). The phase stability of the 30 Hz component shall remain constant within ±0.1 degree (referenced to the 30 Hz zero crossover(s) of the RF sideband(s)).

±3 degrees and 180 ±3 degrees, referenced to the carrier reference input 4-3.3.4.2.

4-3.3.4.3.8 Deviation from the average maximum envelope amplitude.- For one complete period of the 30 Hz modulation signal, any individual maximum envelope amplitude, at both the outputs, shall not deviate by more than 0.5 percent from the average of all such maximums (averaged over a period of at least five complete cycles of 30 Hz).

4-3.3.4.3.9 Output circuit loading.- The goniometer output circuitry shall be designed to provide the specified performance when feeding a RG-214/U coaxial cable having any value of VSWR in the range of 1.0 to 2.0. The goniometer output shall not be required to operate within specification limits for greater values of VSWR, however, no part(s) of the goniometer shall be damaged as the result of any degree of mismatch, including open and short, at any point on the output transmission line(s). The two RF outputs specified shall be terminated at the rear of the equipment in an "N" type connector suitable for mating with a UG-185/U connector.

4-3.3.4.3.10 Power output during warm up.- The warm up requirements shall be the same as those specified in 4-3.3.3.1.2 for the VOR transmitter.

4-3.3.4.3.11 Power output measurement.- Directional couplers and detectors shall be incorporated at each sideband output for measurement of forward and reverse power and VSWR by the FCPU, see Part 3.

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4-3.3.4.4.1 Mean frequency stability.- The mean frequency (see 4-3.2.6) of the 9960 Hz FM subcarrier signal shall be 9960 Hz ±0.1 percent.

4-3.3.4.4.2 Phase control and stability.- A phase shifter control shall be provided in the 30 Hz signal circuitry of the 9960 Hz FM subcarrier generator. This control shall provide a range of 0.00 to 359.99 degrees of phase shift to the 30 Hz signal. The phase shift shall be in increments of 0.01 degree or less (continuously variable). The phase stability of the 30 Hz component shall remain constant within ±0.1 degree (referenced to the 30 Hz zero crossover(s) of the RF sideband(s)).

±3 degrees and 180 ±3 degrees, referenced to the carrier reference input 4-3.3.4.2.

4-3.3.4.3.8 Deviation from the average maximum envelope amplitude.- For one complete period of the 30 Hz modulation signal, any individual maximum envelope amplitude, at both the outputs, shall not deviate by more than 0.5 percent from the average of all such maximums (averaged over a period of at least five complete cycles of 30 Hz).

4-3.3.4.3.9 Output circuit loading.- The goniometer output circuitry shall be designed to provide the specified performance when feeding a RG-214/U coaxial cable having any value of VSWR in the range of 1.0 to 2.0. The goniometer output shall not be required to operate within specification limits for greater values of VSWR, however, no part(s) of the goniometer shall be damaged as the result of any degree of mismatch, including open and short, at any point on the output transmission line(s). The two RF outputs specified shall be terminated at the rear of the equipment in an "N" type connector suitable for mating with a UG-185/U connector.

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4-3.3.4.4.2 Phase control and stability.- A phase shifter control shall be provided in the 30 Hz signal circuitry of the 9960 Hz FM subcarrier generator. This control shall provide a range of 0.00 to 359.99 degrees of phase shift to the 30 Hz signal. The phase shift shall be in increments of 0.01 degree or less (continuously variable). The phase stability of the 30 Hz component shall remain constant within ±0.1 degree (referenced to the 30 Hz zero crossover(s) of the RF sideband(s)).

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4-3.3.4.3.8 Deviation from the average maximum envelope amplitude.- For one complete period of the 30 Hz modulation signal, any individual maximum envelope amplitude, at both the outputs, shall not deviate by more than 0.5 percent from the average of all such maximums (averaged over a period of at least five complete cycles of 30 Hz).

4-3.3.4.3.9 Output circuit loading.- The goniometer output circuitry shall be designed to provide the specified performance when feeding a RG-214/U coaxial cable having any value of VSWR in the range of 1.0 to 2.0. The goniometer output shall not be required to operate within specification limits for greater values of VSWR, however, no part(s) of the goniometer shall be damaged as the result of any degree of mismatch, including open and short, at any point on the output transmission line(s). The two RF outputs specified shall be terminated at the rear of the equipment in an "N" type connector suitable for mating with a UG-185/U connector.

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respective circuits to the extent that loading each test point with a 1 megohm resistance will not introduce a phase shift greater than 0.1 degree, nor change the value of modulation of the 30 Hz AM by more than 0.2 percent of modulation, nor change the value of 9960 Hz frequency deviation by more than 0.2 Hz.

5-3.3.5 Input signals.- Except as otherwise specified, the monitor equipment shall meet all performance requirements with the monitor antenna operated in a radio frequency signal field having characteristics and modulation components specified in the tabulation below.

Input Signals to Antenna

RF carrier frequency - 108 to 118 MHz
RF field intensity - 0.3 to 3 volts/meter
Polarization - horizontal

Signal Carrier Component	Frequency (Hz)	Percent
30 Hz AM	30 ± 1%	20 to 40
Station Identification	1020 ± 50	4 to 15
Voice	300 - 3000	15 to 40
FM subcarrier	9960 ± 480 ± 1%	20 to 40
*30 Hz FM	30 ± 1%	

* Derived from the FM subcarrier signal components within the monitor by discrimination (or equivalent).

5-3.3.5.1 Test signals.- In ground check operation (5-3.3.6) the test signal is the FM subcarrier signal (5-3.2.3) obtained directly from output of the operating goniometer. The test signal (5-3.2.11) consists of the composite 9960 Hz AM signal for periodic calibration verification, and is provided by the FCPU test generator.

5-3.3.6 Ground check system. - The contractor shall provide a 16 point automatic ground check system.

5-3.3.6.1 Ground check.- By utilizing the input signals from the ground check monitor antennas, the VOR monitor azimuth measuring circuits and the test signals (5-3.3.5.1), it shall be possible to measure the azimuth error of the radiated signal to the nearest 0.1 degree. It shall be possible to initiate the automatic ground check routine and to display the results thereof from the PMDT or the MPS.

5-3.3.6.2 Ground check results. - The FCPU shall provide the capability for manual storage of the reference ground check phase error readings (5-3.2.15) in non-volatile memory and to perform the calculations and display the algebraic difference

respective circuits to the extent that loading each test point with a 1 megohm resistance will not introduce a phase shift greater than 0.1 degree, nor change the value of modulation of the 30 Hz AM by more than 0.2 percent of modulation, nor change the value of 9960 Hz frequency deviation by more than 0.2 Hz.

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5-3.3.6.2 Ground check results. - The FCPU shall provide the capability for manual storage of the reference ground check phase error readings (5-3.2.15) in non-volatile memory and to perform the calculations and display the algebraic difference

300 to 3000	Within ±2.5 (referred to 1000 Hz)

5-3.3.8.3.5 Audio distortion.- The total harmonic distortion in the range of 300 Hz to 3000 Hz shall not exceed 4 percent at rated output.

5-3.3.8.3.6 Hum and noise.- The total hum and noise level shall not exceed -24 dBm at all settings of the level control.

5-3.3.8.3.7 Headphone output.- The audio signals from the aural output shall be applied to a 1/4 inch phone jack, which shall be provided on the front panel of the monitor, marked AUDIO, for use in checking station identification and voice signals with headphones, and shall meet the requirements of the following subparagraph. A mating plug shall be provided with the phone jack.

5-3.3.8.3.7.1 Output power.- The output power at the phone jack, when terminated in a 20,000 ohm ±5 percent resistive load, shall be at least +4 dBm. Also, connecting a 20,000 ohm ±5 percent resistive load across the phone jack shall not cause a change in aural output at 1000 Hz at the rear terminals greater than 0.5 dB.

5-3.3.8.4 Isolation from 30 Hz AM signal.- The level of the 30 Hz AM signal in the 30 Hz FM channel shall be at least 60 dB below the level of 30 Hz AM at the output of the AM detector.

5-3.3.8.5 Detector signal harmonics.- The level of harmonics of the detected 30 Hz FM signal, as measured at the input of the stage following the detector, shall be at least 60 dB below the fundamental.

5-3.3.8.6 Azimuth selection circuit.- The requirements of the following subparagraphs shall apply to the azimuth selection circuit.

5-3.3.8.6.1 Azimuth selection.- It shall be possible to select the azimuth reference between 000.0 and 359.9 degrees in 0.1 degree increments via the FCPU to PMDT interface or the FCPU to RSCE interface (paragraphs 3-3.3.1.2.1 and 3-3.3.3.1.2.2 herein, respectively). This reference will be set only at the highest data access security level (paragraph 3-3.3.1.12).

5-3.3.8.7 Zero adjustment.- The VOR monitor microprocessor shall automatically compensate for the inherent phase difference between the two 30 Hz channels. The phase

300 to 3000	Within ±2.5 (referred to 1000 Hz)

5-3.3.8.3.5 Audio distortion.- The total harmonic distortion in the range of 300 Hz to 3000 Hz shall not exceed 4 percent at rated output.

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5-3.3.8.3.7.1 Output power.- The output power at the phone jack, when terminated in a 20,000 ohm ±5 percent resistive load, shall be at least +4 dBm. Also, connecting a 20,000 ohm ±5 percent resistive load across the phone jack shall not cause a change in aural output at 1000 Hz at the rear terminals greater than 0.5 dB.

5-3.3.8.4 Isolation from 30 Hz AM signal.- The level of the 30 Hz AM signal in the 30 Hz FM channel shall be at least 60 dB below the level of 30 Hz AM at the output of the AM detector.

5-3.3.8.5 Detector signal harmonics.- The level of harmonics of the detected 30 Hz FM signal, as measured at the input of the stage following the detector, shall be at least 60 dB below the fundamental.

5-3.3.8.6 Azimuth selection circuit.- The requirements of the following subparagraphs shall apply to the azimuth selection circuit.

5-3.3.8.6.1 Azimuth selection.- It shall be possible to select the azimuth reference between 000.0 and 359.9 degrees in 0.1 degree increments via the FCPU to PMDT interface or the FCPU to RSCE interface (paragraphs 3-3.3.1.2.1 and 3-3.3.3.1.2.2 herein, respectively). This reference will be set only at the highest data access security level (paragraph 3-3.3.1.12).

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300 to 3000	Within ±2.5 (referred to 1000 Hz)

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5-3.3.8.4 Isolation from 30 Hz AM signal.- The level of the 30 Hz AM signal in the 30 Hz FM channel shall be at least 60 dB below the level of 30 Hz AM at the output of the AM detector.

5-3.3.8.5 Detector signal harmonics.- The level of harmonics of the detected 30 Hz FM signal, as measured at the input of the stage following the detector, shall be at least 60 dB below the fundamental.

5-3.3.8.6 Azimuth selection circuit.- The requirements of the following subparagraphs shall apply to the azimuth selection circuit.

5-3.3.8.6.1 Azimuth selection.- It shall be possible to select the azimuth reference between 000.0 and 359.9 degrees in 0.1 degree increments via the FCPU to PMDT interface or the FCPU to RSCE interface (paragraphs 3-3.3.1.2.1 and 3-3.3.3.1.2.2 herein, respectively). This reference will be set only at the highest data access security level (paragraph 3-3.3.1.12).

5-3.3.8.7 Zero adjustment.- The VOR monitor microprocessor shall automatically compensate for the inherent phase difference between the two 30 Hz channels. The phase

300 to 3000	Within ±2.5 (referred to 1000 Hz)

5-3.3.8.3.5 Audio distortion.- The total harmonic distortion in the range of 300 Hz to 3000 Hz shall not exceed 4 percent at rated output.

5-3.3.8.3.6 Hum and noise.- The total hum and noise level shall not exceed -24 dBm at all settings of the level control.

5-3.3.8.3.7 Headphone output.- The audio signals from the aural output shall be applied to a 1/4 inch phone jack, which shall be provided on the front panel of the monitor, marked AUDIO, for use in checking station identification and voice signals with headphones, and shall meet the requirements of the following subparagraph. A mating plug shall be provided with the phone jack.

5-3.3.8.3.7.1 Output power.- The output power at the phone jack, when terminated in a 20,000 ohm ±5 percent resistive load, shall be at least +4 dBm. Also, connecting a 20,000 ohm ±5 percent resistive load across the phone jack shall not cause a change in aural output at 1000 Hz at the rear terminals greater than 0.5 dB.

5-3.3.8.4 Isolation from 30 Hz AM signal.- The level of the 30 Hz AM signal in the 30 Hz FM channel shall be at least 60 dB below the level of 30 Hz AM at the output of the AM detector.

5-3.3.8.5 Detector signal harmonics.- The level of harmonics of the detected 30 Hz FM signal, as measured at the input of the stage following the detector, shall be at least 60 dB below the fundamental.

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5-3.3.8.3.7 Headphone output.- The audio signals from the aural output shall be applied to a 1/4 inch phone jack, which shall be provided on the front panel of the monitor, marked AUDIO, for use in checking station identification and voice signals with headphones, and shall meet the requirements of the following subparagraph. A mating plug shall be provided with the phone jack.

5-3.3.8.3.7.1 Output power.- The output power at the phone jack, when terminated in a 20,000 ohm ±5 percent resistive load, shall be at least +4 dBm. Also, connecting a 20,000 ohm ±5 percent resistive load across the phone jack shall not cause a change in aural output at 1000 Hz at the rear terminals greater than 0.5 dB.

5-3.3.8.4 Isolation from 30 Hz AM signal.- The level of the 30 Hz AM signal in the 30 Hz FM channel shall be at least 60 dB below the level of 30 Hz AM at the output of the AM detector.

5-3.3.8.5 Detector signal harmonics.- The level of harmonics of the detected 30 Hz FM signal, as measured at the input of the stage following the detector, shall be at least 60 dB below the fundamental.

5-3.3.8.6 Azimuth selection circuit.- The requirements of the following subparagraphs shall apply to the azimuth selection circuit.

5-3.3.8.6.1 Azimuth selection.- It shall be possible to select the azimuth reference between 000.0 and 359.9 degrees in 0.1 degree increments via the FCPU to PMDT interface or the FCPU to RSCE interface (paragraphs 3-3.3.1.2.1 and 3-3.3.3.1.2.2 herein, respectively). This reference will be set only at the highest data access security level (paragraph 3-3.3.1.12).

5-3.3.8.7 Zero adjustment.- The VOR monitor microprocessor shall automatically compensate for the inherent phase difference between the two 30 Hz channels. The phase

5-3.4 Reliability.- (See paragraph 1-3.4 of Part 1.)

5-4 QUALITY ASSURANCE.- (See paragraph 1-4 Part 1.)

5-5 PREPARATION FOR DELIVERY.- (See paragraph 1-5 Part 1.)

5-3.4 Reliability.- (See paragraph 1-3.4 of Part 1.)

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The following paragraphs identify requirements for the transponder equipment and associated circuitry.

6-3.4.1 Operating channels.- Transponders shall provide the specified performance on each of the channels and modes (X or Y) listed in Table I of Part 1 when the proper frequency channel is selected by means of the frequency synthesizer (paragraph 1-3.3.14 of Part 1). (Except as may be permitted in 6-3.4.1.1 and 6-3.4.1.2 below, no other action shall be required to change channels.)

6-3.4.1.1 Broadband operation.- One single design shall be utilized for each RF device to cover operation on any selected channel.

6-3.4.1.2 RF tuning.- Unless otherwise provided in the contract or request for proposal, each RF device shall be capable of operating on any channel assignment within its design range (6-3.4.1.1 above) without the need for retuning. A pre-selector (if used) shall be exempt from this requirement.

6-3.4.1.3 Channel frequency accuracy and stability.- (See paragraph 1-3.3.14.1 of Part 1.)

6-3.4.1.4 RF pulse parameters.- RF pulse parameters shall be based on linear detection of the RF envelope(s) of the pulses. Reply pulse spacing and shape shall be as measured at the output of the transmitter, and reply delay shall be measured as defined under 6-3.2.2. (While certain requirements on permitted variation and stability may be contained hereinafter under a specific functional heading most directly associated with the required performance, the stated requirement shall nevertheless apply to the transponder as a whole.)

6-3.4.2 Duplexer.- A duplexer shall be provided to permit simultaneous operation of the receiver and transmitter on a single antenna. The duplexer shall be of the passive type. No adjustment to the duplexer shall be required in order to achieve the performance required throughout the band of frequencies listed in Table I of Part 1.

6-3.4.3 Receiver and associated video circuitry.- All performance requirements specified hereinafter which involve interrogation signal(s) shall be met when the signals have any combination of characteristics defined under paragraphs 6-3.2.1 through 6-3.2.1.5 and, unless otherwise indicated, have any value from threshold triggering level to not less than -10 dBm as referenced to the transponder antenna transmission line connector.

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is the same as the assigned channel (X or Y) and which occur at rates up to 1000 pps shall not reduce the on-channel sensitivity by more than 1 dB from the value measured in 6-3.4.3.7.1. The requirement shall be met when the adjacent channel signals have levels up to -10 dBm.

6-3.4.3.7.1.4 Desensitization by CW.- The presence of CW interference signal on the assigned channel frequency or elsewhere within the receiver pass-band shall not reduce the on-channel sensitivity by more than 2 dB from the value measured in the absence of CW interference when the level of the interference is 10 dB below the on-channel sensitivity level measured in the absence of interference. (This requirement shall be met for all settings of the receiver squitter rate control (6-3.4.3.10) which result in receiver noise decodes at a rate of no greater than 10 per second.) Additionally, within the range of receiver desensitization provided by automatic gain reduction (6-3.4.3.12) the reply efficiency to a single aircraft interrogation shall not be reduced by more than 10 percent when the level of the interrogation signal is 6 dB and more above the level of the interfering CW signal.

6-3.4.3.7.1.5 Desensitization by high repetition rate/high duty cycle pulse signals.- In the presence of an input of 37,000
single pulses per second of 8 microseconds width (30 percent duty cycle) and having a peak level equal to the CW level specified in 6-3.4.3.7.1.4 above (i.e., 10 dB below the on-channel sensitivity level measured in the absence of interference), the maximum reduction in receiver sensitivity and reply efficiency shall not exceed 0.5 dB and 3 percent, respectively.

6-3.4.3.7.2 Sensitivity to adjacent channel interrogations.- The receiver shall not respond to interrogation signals at frequencies ±900 KHz removed from the on-channel interrogation frequency and which have spacings of the constituent pulses of a pair at the design center values for the frequency in use at any level up to -10 dBm.

6-3.4.3.7.3 Reply delay time variation.- (See 6-3.2.2.) Reply delay time variation shall not exceed the following:

(a) ±0.5 microsecond over the range of service conditions with an input signal level having any value between -94 dBm and -79 dBm with an interrogation pulse rise time of 2.5 (±0.5) microseconds.

(b) ±0.10 microsecond over the range of service conditions with an input signal level of -79 dBm to -10 dBm with

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function. Means shall be provided, however, for isolation of a DME identification fault when a malfunction of the VOR identification keyer or associated wiring and switching extend to the DME equipment. The keying characteristics (Morse code word and character length, and repetition rate) shall be the same as for the VOR identification keyer (Part 5) except that the DME keyer shall key at 30 (±1) second intervals.

6-3.4.6 Transmitter and associated circuitry.- Each DME transmitter and associated modulator and power supply circuit shall provide the following performance and output signal characteristics.

6-3.4.6.1 DME transmitter.-

6-3.4.6.1.1 Pulse shape.- The RF envelope of each pulse, as detected by a linear detector, shall have a smoothly rounded shape falling within the following limits.

6-3.4.6.1.1.1 Pulse rise time.- The rise time shall be 2.5 (+0.5, -1.0) microseconds.

6-3.4.6.1.1.2 Pulse top.- The instantaneous amplitude of the pulse shall not, at any instant between the point on the leading edge which is 95 percent of the maximum voltage amplitude, fall below a value which is 95 percent of the maximum voltage amplitude.

6-3.4.6.1.1.3 Pulse duration.- The pulse duration shall be 3.5 (±0.5) microseconds.

6-3.4.6.1.1.4 Pulse decay time.- The decay time shall be 2.5 (±1.0) microseconds.

6-3.4.6.1.2 Power output.- The power output at the peak of each pulse shall not be less than a level of 1000 watts as measured at the output of the equipment cabinet. The DME shall also meet all specification requirements when the power output, as measured at the output of the equipment cabinet, is setup for 100 watt operation.

6-3.4.6.1.3 Pulse power variation.- The difference in power level at the peak of constituent pulses of any pulse pair shall not exceed 1 dB. Additional amplitude modulation of the output pulse train shall not exceed 5 percent.

6-3.4.6.1.4 RF output control. - Means shall be provided to permit continuous adjustment of the RF output power in).25 dB steps from a preset level of 1000 watts or from a preset level of 100 watts over the range of 0 to -6 dB, respectively. It shall also be possible to enter the desired

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function. Means shall be provided, however, for isolation of a DME identification fault when a malfunction of the VOR identification keyer or associated wiring and switching extend to the DME equipment. The keying characteristics (Morse code word and character length, and repetition rate) shall be the same as for the VOR identification keyer (Part 5) except that the DME keyer shall key at 30 (±1) second intervals.

6-3.4.6 Transmitter and associated circuitry.- Each DME transmitter and associated modulator and power supply circuit shall provide the following performance and output signal characteristics.

6-3.4.6.1 DME transmitter.-

6-3.4.6.1.1 Pulse shape.- The RF envelope of each pulse, as detected by a linear detector, shall have a smoothly rounded shape falling within the following limits.

6-3.4.6.1.1.1 Pulse rise time.- The rise time shall be 2.5 (+0.5, -1.0) microseconds.

6-3.4.6.1.1.2 Pulse top.- The instantaneous amplitude of the pulse shall not, at any instant between the point on the leading edge which is 95 percent of the maximum voltage amplitude, fall below a value which is 95 percent of the maximum voltage amplitude.

6-3.4.6.1.1.3 Pulse duration.- The pulse duration shall be 3.5 (±0.5) microseconds.

6-3.4.6.1.1.4 Pulse decay time.- The decay time shall be 2.5 (±1.0) microseconds.

6-3.4.6.1.2 Power output.- The power output at the peak of each pulse shall not be less than a level of 1000 watts as measured at the output of the equipment cabinet. The DME shall also meet all specification requirements when the power output, as measured at the output of the equipment cabinet, is setup for 100 watt operation.

6-3.4.6.1.3 Pulse power variation.- The difference in power level at the peak of constituent pulses of any pulse pair shall not exceed 1 dB. Additional amplitude modulation of the output pulse train shall not exceed 5 percent.

6-3.4.6.1.4 RF output control. - Means shall be provided to permit continuous adjustment of the RF output power in).25 dB steps from a preset level of 1000 watts or from a preset level of 100 watts over the range of 0 to -6 dB, respectively. It shall also be possible to enter the desired

function. Means shall be provided, however, for isolation of a DME identification fault when a malfunction of the VOR identification keyer or associated wiring and switching extend to the DME equipment. The keying characteristics (Morse code word and character length, and repetition rate) shall be the same as for the VOR identification keyer (Part 5) except that the DME keyer shall key at 30 (±1) second intervals.

6-3.4.6 Transmitter and associated circuitry.- Each DME transmitter and associated modulator and power supply circuit shall provide the following performance and output signal characteristics.

6-3.4.6.1 DME transmitter.-

6-3.4.6.1.1 Pulse shape.- The RF envelope of each pulse, as detected by a linear detector, shall have a smoothly rounded shape falling within the following limits.

6-3.4.6.1.1.1 Pulse rise time.- The rise time shall be 2.5 (+0.5, -1.0) microseconds.

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6-3.4.6.1.1.3 Pulse duration.- The pulse duration shall be 3.5 (±0.5) microseconds.

6-3.4.6.1.1.4 Pulse decay time.- The decay time shall be 2.5 (±1.0) microseconds.

6-3.4.6.1.2 Power output.- The power output at the peak of each pulse shall not be less than a level of 1000 watts as measured at the output of the equipment cabinet. The DME shall also meet all specification requirements when the power output, as measured at the output of the equipment cabinet, is setup for 100 watt operation.

6-3.4.6.1.3 Pulse power variation.- The difference in power level at the peak of constituent pulses of any pulse pair shall not exceed 1 dB. Additional amplitude modulation of the output pulse train shall not exceed 5 percent.

6-3.4.6.1.4 RF output control. - Means shall be provided to permit continuous adjustment of the RF output power in).25 dB steps from a preset level of 1000 watts or from a preset level of 100 watts over the range of 0 to -6 dB, respectively. It shall also be possible to enter the desired

the DME antenna base (antennas not required to be furnished under this specification). Input RF connections shall be provided to connect to the DME coupling probes.

7-3.4.2.2.2.1 DME antenna coupling probes.- All performance requirements of the DME monitor shall be met when the RF input to the monitor has any initial level between +17 dBm and +33 dBm.

7-3.4.2.2.3 Directional couplers.- Directional couplers shall have a nominal coupling factor of 30 dB (including the attenuation of the connection cable to the monitor), and a directivity of not less than 20 dB. Couplers shall have an accuracy of ±0.50 dB under normal test conditions, over the frequency range of 960 through 1215 MHz. Coupling factor shall not vary by more than ±0.5 dB over the service conditions.

7-3.4.3 Key monitored signal parameters.- The following is a list of key signal parameters required to be monitored such that when any of these signal characteristics are found to be outside of preestablished tolerances, the monitor shall provide the specified fault and alarm indications and actions. (See specifically paragraphs 1-3.1.10.3 through 1-3.1.10.9, 1-3.1.14, and 1-3.3.19 of Part 1):

	Parameter	Reference	Note
(a)	Reply delay	6-3.2.2 (Part 6)	(1) (2)
(b)	Output pulse spacing	6-3.4.4.2 (Part 6)	(2)
(c)	Receiver sensitivity	6-3-4.3.7.1 (Part 6)	(1) (2)
(d)	Transponder output pulse rate	6-3.2.3 (Part 6)	(2) (6)
(e)	Transponder power output	6-3.4.7.1.2 or 6-3.4.7.2.1 (Part 6)	(2)
(f)	Identification	6-3.4.5 (Part 6)	(2)
(g)	Radiated power level		(3)

NOTE 1: (a) and (c) shall utilize only reply pulses which are synchronous with monitor interrogations.

NOTE 2: (a) through (f) shall utilize the outputs of antenna transmission line couplers (7-3.4.2.2.1).

the DME antenna base (antennas not required to be furnished under this specification). Input RF connections shall be provided to connect to the DME coupling probes.

7-3.4.2.2.2.1 DME antenna coupling probes.- All performance requirements of the DME monitor shall be met when the RF input to the monitor has any initial level between +17 dBm and +33 dBm.

7-3.4.2.2.3 Directional couplers.- Directional couplers shall have a nominal coupling factor of 30 dB (including the attenuation of the connection cable to the monitor), and a directivity of not less than 20 dB. Couplers shall have an accuracy of ±0.50 dB under normal test conditions, over the frequency range of 960 through 1215 MHz. Coupling factor shall not vary by more than ±0.5 dB over the service conditions.

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(a)	Reply delay	6-3.2.2 (Part 6)	(1) (2)
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(c)	Receiver sensitivity	6-3-4.3.7.1 (Part 6)	(1) (2)
(d)	Transponder output pulse rate	6-3.2.3 (Part 6)	(2) (6)
(e)	Transponder power output	6-3.4.7.1.2 or 6-3.4.7.2.1 (Part 6)	(2)
(f)	Identification	6-3.4.5 (Part 6)	(2)
(g)	Radiated power level		(3)

NOTE 1: (a) and (c) shall utilize only reply pulses which are synchronous with monitor interrogations.

NOTE 2: (a) through (f) shall utilize the outputs of antenna transmission line couplers (7-3.4.2.2.1).

the DME antenna base (antennas not required to be furnished under this specification). Input RF connections shall be provided to connect to the DME coupling probes.

7-3.4.2.2.2.1 DME antenna coupling probes.- All performance requirements of the DME monitor shall be met when the RF input to the monitor has any initial level between +17 dBm and +33 dBm.

7-3.4.2.2.3 Directional couplers.- Directional couplers shall have a nominal coupling factor of 30 dB (including the attenuation of the connection cable to the monitor), and a directivity of not less than 20 dB. Couplers shall have an accuracy of ±0.50 dB under normal test conditions, over the frequency range of 960 through 1215 MHz. Coupling factor shall not vary by more than ±0.5 dB over the service conditions.

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	Parameter	Reference	Note
(a)	Reply delay	6-3.2.2 (Part 6)	(1) (2)
(b)	Output pulse spacing	6-3.4.4.2 (Part 6)	(2)
(c)	Receiver sensitivity	6-3-4.3.7.1 (Part 6)	(1) (2)
(d)	Transponder output pulse rate	6-3.2.3 (Part 6)	(2) (6)
(e)	Transponder power output	6-3.4.7.1.2 or 6-3.4.7.2.1 (Part 6)	(2)
(f)	Identification	6-3.4.5 (Part 6)	(2)
(g)	Radiated power level		(3)

NOTE 1: (a) and (c) shall utilize only reply pulses which are synchronous with monitor interrogations.

NOTE 2: (a) through (f) shall utilize the outputs of antenna transmission line couplers (7-3.4.2.2.1).

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7-3.4.2.2.2.1 DME antenna coupling probes.- All performance requirements of the DME monitor shall be met when the RF input to the monitor has any initial level between +17 dBm and +33 dBm.

7-3.4.2.2.3 Directional couplers.- Directional couplers shall have a nominal coupling factor of 30 dB (including the attenuation of the connection cable to the monitor), and a directivity of not less than 20 dB. Couplers shall have an accuracy of ±0.50 dB under normal test conditions, over the frequency range of 960 through 1215 MHz. Coupling factor shall not vary by more than ±0.5 dB over the service conditions.

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	Parameter	Reference	Note
(a)	Reply delay	6-3.2.2 (Part 6)	(1) (2)
(b)	Output pulse spacing	6-3.4.4.2 (Part 6)	(2)
(c)	Receiver sensitivity	6-3-4.3.7.1 (Part 6)	(1) (2)
(d)	Transponder output pulse rate	6-3.2.3 (Part 6)	(2) (6)
(e)	Transponder power output	6-3.4.7.1.2 or 6-3.4.7.2.1 (Part 6)	(2)
(f)	Identification	6-3.4.5 (Part 6)	(2)
(g)	Radiated power level		(3)

NOTE 1: (a) and (c) shall utilize only reply pulses which are synchronous with monitor interrogations.

NOTE 2: (a) through (f) shall utilize the outputs of antenna transmission line couplers (7-3.4.2.2.1).

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	Parameter	Reference	Note
(a)	Reply delay	6-3.2.2 (Part 6)	(1) (2)
(b)	Output pulse spacing	6-3.4.4.2 (Part 6)	(2)
(c)	Receiver sensitivity	6-3-4.3.7.1 (Part 6)	(1) (2)
(d)	Transponder output pulse rate	6-3.2.3 (Part 6)	(2) (6)
(e)	Transponder power output	6-3.4.7.1.2 or 6-3.4.7.2.1 (Part 6)	(2)
(f)	Identification	6-3.4.5 (Part 6)	(2)
(g)	Radiated power level		(3)

NOTE 1: (a) and (c) shall utilize only reply pulses which are synchronous with monitor interrogations.

NOTE 2: (a) through (f) shall utilize the outputs of antenna transmission line couplers (7-3.4.2.2.1).

7-3.4.4.6.1 High output level.- The high output level shall be set at -30 dBm (-60 dBm at the transponder receiver input).

7-3.4.4.6.2 Low output level.- The low output level shall have a range of initial adjustment between -25 dBm and -80 dBm (-55 dBm and -110 dBm at the transponder input).

7-3.4.4.6.3 Test output levels.- During test operation the signal generator shall provide pulsed or CW outputs at the various levels required for the measurement of transponder receiver performance requirements of paragraphs 6-3.4.3.7.1, through 6-3.4.3.7.2 and 6-3.4.3.7.3 (b) and (d) of Part 6.

NOTE: During test operation the signal generator shall not be required to provide time shared outputs. Accomplishment of measurements corresponding to paragraphs 6-3.4.3.7.1.1, 6-3.4.3.7.1.3, and 6-3.4.3.7.1.4 presume the use of two signal generators and are therefore required in the dual monitor configuration.

7-3.4.4.7 Output PRF.- The output PRF in the normal monitor mode of operation shall not exceed 30 pps, of which up to 80 percent shall be permitted to be at the low output level (7-3.4.4.6.2) and as few as 20 percent shall be permitted to be at the high output level (7-3.4.4.6.1). In the test mode of operation for those measurements involving the percentage of replies to desired signals the number of interrogations shall not exceed 400 pps. For tests requiring the simulation of traffic loading or undesired off-channel pulses, the signal generator shall be capable of providing output pulse rates anywhere within the range of 10 through 10,000 pps. Output pulse pairs provided in this last mode of operation shall be random in occurrence (i.e., the pulse spacing distribution shall be approximately exponential).

7-3.4.5 Video pulse generator.- The video pulse generator shall provide simulated transponder output pulse pairs for alarm limit certification of the following monitored parameters:

(a) Reply delay (7-3.4.3.2.2).

(b) Reply pulse spacing (7-3.4.3.2.2).

(c) Receiver sensitivity (percent replies) (7-3.4.3.2.3).

(d) Output pulse rate (7-3.4.3.2.4).

7-3.4.4.6.1 High output level.- The high output level shall be set at -30 dBm (-60 dBm at the transponder receiver input).

7-3.4.4.6.2 Low output level.- The low output level shall have a range of initial adjustment between -25 dBm and -80 dBm (-55 dBm and -110 dBm at the transponder input).

7-3.4.4.6.3 Test output levels.- During test operation the signal generator shall provide pulsed or CW outputs at the various levels required for the measurement of transponder receiver performance requirements of paragraphs 6-3.4.3.7.1, through 6-3.4.3.7.2 and 6-3.4.3.7.3 (b) and (d) of Part 6.

NOTE: During test operation the signal generator shall not be required to provide time shared outputs. Accomplishment of measurements corresponding to paragraphs 6-3.4.3.7.1.1, 6-3.4.3.7.1.3, and 6-3.4.3.7.1.4 presume the use of two signal generators and are therefore required in the dual monitor configuration.

7-3.4.4.7 Output PRF.- The output PRF in the normal monitor mode of operation shall not exceed 30 pps, of which up to 80 percent shall be permitted to be at the low output level (7-3.4.4.6.2) and as few as 20 percent shall be permitted to be at the high output level (7-3.4.4.6.1). In the test mode of operation for those measurements involving the percentage of replies to desired signals the number of interrogations shall not exceed 400 pps. For tests requiring the simulation of traffic loading or undesired off-channel pulses, the signal generator shall be capable of providing output pulse rates anywhere within the range of 10 through 10,000 pps. Output pulse pairs provided in this last mode of operation shall be random in occurrence (i.e., the pulse spacing distribution shall be approximately exponential).

7-3.4.5 Video pulse generator.- The video pulse generator shall provide simulated transponder output pulse pairs for alarm limit certification of the following monitored parameters:

(a) Reply delay (7-3.4.3.2.2).

(b) Reply pulse spacing (7-3.4.3.2.2).

(c) Receiver sensitivity (percent replies) (7-3.4.3.2.3).

(d) Output pulse rate (7-3.4.3.2.4).

7-3.4.4.6.1 High output level.- The high output level shall be set at -30 dBm (-60 dBm at the transponder receiver input).

7-3.4.4.6.2 Low output level.- The low output level shall have a range of initial adjustment between -25 dBm and -80 dBm (-55 dBm and -110 dBm at the transponder input).

7-3.4.4.6.3 Test output levels.- During test operation the signal generator shall provide pulsed or CW outputs at the various levels required for the measurement of transponder receiver performance requirements of paragraphs 6-3.4.3.7.1, through 6-3.4.3.7.2 and 6-3.4.3.7.3 (b) and (d) of Part 6.

NOTE: During test operation the signal generator shall not be required to provide time shared outputs. Accomplishment of measurements corresponding to paragraphs 6-3.4.3.7.1.1, 6-3.4.3.7.1.3, and 6-3.4.3.7.1.4 presume the use of two signal generators and are therefore required in the dual monitor configuration.

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7-3.4.5 Video pulse generator.- The video pulse generator shall provide simulated transponder output pulse pairs for alarm limit certification of the following monitored parameters:

(a) Reply delay (7-3.4.3.2.2).

(b) Reply pulse spacing (7-3.4.3.2.2).

(c) Receiver sensitivity (percent replies) (7-3.4.3.2.3).

(d) Output pulse rate (7-3.4.3.2.4).

7-3.4.4.6.1 High output level.- The high output level shall be set at -30 dBm (-60 dBm at the transponder receiver input).

7-3.4.4.6.2 Low output level.- The low output level shall have a range of initial adjustment between -25 dBm and -80 dBm (-55 dBm and -110 dBm at the transponder input).

7-3.4.4.6.3 Test output levels.- During test operation the signal generator shall provide pulsed or CW outputs at the various levels required for the measurement of transponder receiver performance requirements of paragraphs 6-3.4.3.7.1, through 6-3.4.3.7.2 and 6-3.4.3.7.3 (b) and (d) of Part 6.

NOTE: During test operation the signal generator shall not be required to provide time shared outputs. Accomplishment of measurements corresponding to paragraphs 6-3.4.3.7.1.1, 6-3.4.3.7.1.3, and 6-3.4.3.7.1.4 presume the use of two signal generators and are therefore required in the dual monitor configuration.

7-3.4.4.7 Output PRF.- The output PRF in the normal monitor mode of operation shall not exceed 30 pps, of which up to 80 percent shall be permitted to be at the low output level (7-3.4.4.6.2) and as few as 20 percent shall be permitted to be at the high output level (7-3.4.4.6.1). In the test mode of operation for those measurements involving the percentage of replies to desired signals the number of interrogations shall not exceed 400 pps. For tests requiring the simulation of traffic loading or undesired off-channel pulses, the signal generator shall be capable of providing output pulse rates anywhere within the range of 10 through 10,000 pps. Output pulse pairs provided in this last mode of operation shall be random in occurrence (i.e., the pulse spacing distribution shall be approximately exponential).

7-3.4.5 Video pulse generator.- The video pulse generator shall provide simulated transponder output pulse pairs for alarm limit certification of the following monitored parameters:

(a) Reply delay (7-3.4.3.2.2).

(b) Reply pulse spacing (7-3.4.3.2.2).

(c) Receiver sensitivity (percent replies) (7-3.4.3.2.3).

(d) Output pulse rate (7-3.4.3.2.4).

7-3.4.4.6.1 High output level.- The high output level shall be set at -30 dBm (-60 dBm at the transponder receiver input).

7-3.4.4.6.2 Low output level.- The low output level shall have a range of initial adjustment between -25 dBm and -80 dBm (-55 dBm and -110 dBm at the transponder input).

7-3.4.4.6.3 Test output levels.- During test operation the signal generator shall provide pulsed or CW outputs at the various levels required for the measurement of transponder receiver performance requirements of paragraphs 6-3.4.3.7.1, through 6-3.4.3.7.2 and 6-3.4.3.7.3 (b) and (d) of Part 6.

NOTE: During test operation the signal generator shall not be required to provide time shared outputs. Accomplishment of measurements corresponding to paragraphs 6-3.4.3.7.1.1, 6-3.4.3.7.1.3, and 6-3.4.3.7.1.4 presume the use of two signal generators and are therefore required in the dual monitor configuration.

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(a) Reply delay (7-3.4.3.2.2).

(b) Reply pulse spacing (7-3.4.3.2.2).

(c) Receiver sensitivity (percent replies) (7-3.4.3.2.3).

(d) Output pulse rate (7-3.4.3.2.4).

8-3.3.2.3 Output phase.- The phase of each sideband output signal shall be maintained such that over the service conditions there is no more than 12 degrees difference between the phase of the 9960 Hz beat produced by mixture of the sideband signal with the carrier reference signal and the phase of the 9960 Hz reference signal.

8-3.3.2.4 Output frequency and phase response time.- The requirements of 8-3.3.2.2 and 8-3.3.2.3 shall apply within 9 seconds after initial application of power. (The procedure of paragraph 4.11 of Specification FAA-G-2100 is modified to delete reference to "15 minutes" in Step c.)

8-3.3.2.5 9960 Hz reference frequency.- The equipment design shall incorporate a 9960 Hz reference frequency generator. At the contractor's option, the reference generator may be either of the tunable frequency or fixed frequency type. The tunable device shall be capable of adjustment to within 1.0 Hz and shall have a stability of ± 10 Hz over the range of service conditions. If the contractor elects to provide a fixed frequency device, the precision and stability shall be such as to provide an output frequency of 9960 Hz ± 1.0 Hz over the range of service conditions.

8-3.3.2.6 Output signal spectrum.- Spurious radiation components within specified frequency bands on either side of the fundamental shall not exceed the following levels:

Frequency Band	Level Below Fundamental
15 KHz through 18 KHz	15 dB
18 KHz through 27 KHz	32 dB
27 KHz through 37 KHz	52 dB
Above 37 KHz	62 dB

8-3.3.2.7 Carrier to sideband isolation.- The level of the carrier reference frequency in the output of either sideband output signal shall be at least 34 dB below the level of the sideband output signal.

8-3.3.2.8 Cross channel isolation.- The level of the upper sideband signal (USB) present in the output of the lower sideband signal (LSB) shall be at least 40 dB below the output level of the USB signal and vice versa.

8-3.3.2.9 Stray radiation.- With the transmitter operating at maximum output power (8-3.3.2.1), stray radiation shall not exceed a level of 14.0 microwatts effective radiated power. This requirement shall be met with the equipment in or out of its enclosure.

8-3.3.2.3 Output phase.- The phase of each sideband output signal shall be maintained such that over the service conditions there is no more than 12 degrees difference between the phase of the 9960 Hz beat produced by mixture of the sideband signal with the carrier reference signal and the phase of the 9960 Hz reference signal.

8-3.3.2.4 Output frequency and phase response time.- The requirements of 8-3.3.2.2 and 8-3.3.2.3 shall apply within 9 seconds after initial application of power. (The procedure of paragraph 4.11 of Specification FAA-G-2100 is modified to delete reference to "15 minutes" in Step c.)

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8-3.3.2.9 Stray radiation.- With the transmitter operating at maximum output power (8-3.3.2.1), stray radiation shall not exceed a level of 14.0 microwatts effective radiated power. This requirement shall be met with the equipment in or out of its enclosure.

8-3.3.2.3 Output phase.- The phase of each sideband output signal shall be maintained such that over the service conditions there is no more than 12 degrees difference between the phase of the 9960 Hz beat produced by mixture of the sideband signal with the carrier reference signal and the phase of the 9960 Hz reference signal.

8-3.3.2.4 Output frequency and phase response time.- The requirements of 8-3.3.2.2 and 8-3.3.2.3 shall apply within 9 seconds after initial application of power. (The procedure of paragraph 4.11 of Specification FAA-G-2100 is modified to delete reference to "15 minutes" in Step c.)

8-3.3.2.5 9960 Hz reference frequency.- The equipment design shall incorporate a 9960 Hz reference frequency generator. At the contractor's option, the reference generator may be either of the tunable frequency or fixed frequency type. The tunable device shall be capable of adjustment to within 1.0 Hz and shall have a stability of ± 10 Hz over the range of service conditions. If the contractor elects to provide a fixed frequency device, the precision and stability shall be such as to provide an output frequency of 9960 Hz ± 1.0 Hz over the range of service conditions.

8-3.3.2.6 Output signal spectrum.- Spurious radiation components within specified frequency bands on either side of the fundamental shall not exceed the following levels:

Frequency Band	Level Below Fundamental
15 KHz through 18 KHz	15 dB
18 KHz through 27 KHz	32 dB
27 KHz through 37 KHz	52 dB
Above 37 KHz	62 dB

8-3.3.2.7 Carrier to sideband isolation.- The level of the carrier reference frequency in the output of either sideband output signal shall be at least 34 dB below the level of the sideband output signal.

8-3.3.2.8 Cross channel isolation.- The level of the upper sideband signal (USB) present in the output of the lower sideband signal (LSB) shall be at least 40 dB below the output level of the USB signal and vice versa.

8-3.3.2.9 Stray radiation.- With the transmitter operating at maximum output power (8-3.3.2.1), stray radiation shall not exceed a level of 14.0 microwatts effective radiated power. This requirement shall be met with the equipment in or out of its enclosure.

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DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

VOR/DME EQUIPMENT
PART 9 - REMOTE STATUS AND COMMUNICATIONS EQUIPMENT (RSCE)

9-1 SCOPE - REMOTE STATUS AND COMMUNICATIONS EQUIPMENT (RSCE)

9-1.1 Scope of Part 9.- This Part 9 is one of a group of specification documents under the basic heading VOR/DME equipment, each of which carries the basic number FAA-E-2678 together with an alpha revision letter and a slant line and number corresponding to the Part number. This Part 9 of the specification covers the requirements for the remote status and communication equipment (RSCE) to be furnished as part of a set of equipment as defined in Part 1 of this specification (FAA-E-2678c/1).

The RSCE will be located at a site remote from the facility and will provide VOR/DME operational status information and audio communications capability to operations personnel. It will provide an interface between the VOR/DME facility and the MPS.

9-1.2 Limitations of Part 9.- This Part 9 does not completely define the requirements for operation with other equipment elements covered under other parts of the specification, these being the responsibility of the designer of the complete system. Additionally, certain requirements are defined only through reference to other parts of the specification.

9-2 APPLICABLE DOCUMENTS.- (See paragraph 1-2 of Part 1.)

9-3 REQUIREMENTS

9-3.1 Equipment to be furnished by the contractor.-

9-3.1.1 Hardware.- The following items shall be furnished for each facility.

Unit	Quantity
Communications unit	1
RSCE processing unit	1
VOR/DME status unit	1

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VOR/DME EQUIPMENT
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The RSCE will be located at a site remote from the facility and will provide VOR/DME operational status information and audio communications capability to operations personnel. It will provide an interface between the VOR/DME facility and the MPS.

9-1.2 Limitations of Part 9.- This Part 9 does not completely define the requirements for operation with other equipment elements covered under other parts of the specification, these being the responsibility of the designer of the complete system. Additionally, certain requirements are defined only through reference to other parts of the specification.

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