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Analog C-Band Video Transmitter Requirements Document

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Analog C-Band Video Transmitter Requirements Document

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1 SCOPE

This document covers the requirements for C-Band Video transmitters which are utilized for NASA DFRC chase aircraft video relay. These transmitters are utilized on research aircraft which include; manned and unmanned fixed and rotary wing vehicles. The transmitters are operated in adverse environments and are used for applications critical to mission safety therefore they must be highly reliable.

2 APPLICABLE DOCUMENTS

2.1 Government Documents

- RCC 106-07, Range Commanders Council (RCC) Telemetry Standard
- MIL-STD-704F, Aircraft Electrical Power Characteristics
- DCP-O-018, Environmental Acceptance Testing, Electromagnetic and Electromechanical Equipment
- MIL-STD-461F, Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment
- MIL-STD-810F, Environmental Test Methods and Engineering Guidelines
- RCC 118-06, Test Methods for Telemetry Systems and Subsystems, Volume I: Test Methods for Telemetry Systems and Subsystems
- RCC 118-02, Test Methods for Telemetry Systems and Subsystems, Volume II: Test Methods for Telemetry RF Subsystems
- RCC 452-86, Video Standards and Formats
- RCC 453-77, Test Methods for Television Systems and Subsystems
- RCC 454-87, Glossary of Television Terms

2.2 Non-Government Documents

- ANSI/J-STD-001, Requirements for Soldered Electrical and Electronic Assemblies
- AS9100, Quality Management System Standard
- ISO9001, International Standards Organization Quality Management Systems
- ISO 10012, Quality Assurance Requirements for Measuring Equipment
- ANSI/ESD-S20.20, Development of an Electrostatic Discharge Control Program
- American National Standard Institute (ANSI) / National Conference of Standards Laboratories (NCSL) Z540-1, General Requirements for Calibration Laboratories and Measuring Equipment and Test Equipment
- International Telecommunication Union (ITU), Recommendation ITU-R BT.470-7, Conventional Analog Television Systems

2.3 Order of Precedence

In the event of a conflict between the text of this specification and the references cited herein, the text of this document takes precedence. Nothing in this specification, however, supersedes applicable laws and regulations.

3 REQUIREMENTS

The transmitter shall meet the performance specified in 3.1 under the environmental exposure conditions and the electromagnetic interference (EMI) conditions specified in 3.2.

3.1 Electrical Performance

3.1.1 Input Power

The transmitter shall operate from an unregulated direct current (DC) power source which meets the detailed requirements specified in MIL-STD-704F.

3.1.1.1 Voltage

The transmitter shall operate over the voltage range of 24Vdc to 32Vdc.

3.1.1.2 Current

The current consumption of the transmitter shall not be greater than 7.5 amperes. A transmitter current consumption of less than 5.0 amperes is desired.

3.1.1.3 Overvoltage and Undervoltage

The transmitter shall meet the time limits for over voltage for a 28Vdc system as specified in MIL-STD-704F. The transmitter is not required to meet output power requirements specified in 3.2.1 during the undervoltage (+20Vdc) time period specified in MIL-STD-704F.

3.1.1.4 Reverse Polarity

The transmitter shall not be damaged by reversal of the polarity of the input voltage specified in 3.1.1.1.

3.1.2 RF Output

3.1.2.1 Output Power

The output power shall be 10 watts minimum when operated into a 50 ohms load or any load with a voltage standing wave ratio (VSWR) less than or equal to 2:1 at any phase angle.

3.1.2.2 Carrier Frequency

The carrier frequency shall be tunable from 4400.0 to 4999.0 MHz in 1.0 MHz steps centered on the even MHz. Tuning shall be via a BCD switch user interface as specified in 3.1.2.4.

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3.1.2.3 Maximum Bandwidth

The transmitter maximum occupied bandwidth as defined in the RCC 106-07 standard shall be less than 12MHz. The transmitter RF output bandwidth shall also be limited to a maximum of 30MHz at -60dBc.

3.1.2.4 Frequency Selection

Transmitter frequency selection shall be via a remote BCD switch which is connected to the transmitter via a removable cable. The BCD switch shall display the transmitter frequency setting in MHz as indicated in Figure 2. The transmitter and BCD shall operate nominally for cable lengths up to 12 feet.

3.1.2.5 Frequency Stability

The carrier frequency shall be within 0.003 percent of the selected center frequency.

3.1.2.6 Output Load Mismatch

The transmitter shall not be damaged when operating into an open or short circuit. In addition operation shall not be impaired, except for reduced output power, when operating into a VSWR greater than 3:1.

3.1.2.7 Harmonic and Spurious Emissions

Harmonic and spurious emissions shall be limited to -25dBm in accordance with the Range Commanders Council Telemetry Standard, RCC-106-07.

3.1.3 Video Modulation

The modulation shall be true frequency modulation (FM). The video input shall be compatible with an National Television System Committee (NTSC) color and monochrome video source in accordance with International Telecommunication Union Recommendation ITU-R BT.470-7.

3.1.3.1 Modulation Sense

The transmitter frequency shall increase for a positive voltage input.

3.1.3.2 Frequency Response

The video input frequency response linearity shall be within +/-1.0dB from 6Hz to 6MHz.

3.1.3.3 Modulation Frequency Response

The transmitter deviation sensitivity shall be adjustable up to +/-6MHz for a 1V peak-to-peak input.

3.1.3.4 Pre-emphasis

The transmitter pre-emphasis shall be user selectable via user accessible switch or control line allowing the user to select NTSC 525 line or no pre-emphasis.

3.1.3.5 Input Impedance

The transmitter video input impedance shall be 75 ohms +/-5.0 percent shunted by a maximum of 30pF.

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3.1.3.6 Harmonic Distortion

The transmitter harmonic distortion shall be 2 percent maximum.

3.1.3.7 Incidental AM

The internally generated IAM of the transmitter shall not cause a peak-to-peak envelope voltage excursion greater than 5 percent of the carrier average envelope voltage for any modulating frequency.

3.1.3.8 Incidental FM

The internally generated IFM of the transmitter shall be no greater than 10kHz peak-to-peak when exposed to all operating environments.

3.1.4 Subcarrier Modulation

The transmitter shall support a subcarrier at 7.5MHz for voice modulation. The ability to support additional subcarriers at 4.83, 5.8, 6.2 and 6.8MHz via a user interface is desired but not required.

3.1.4.1 Subcarrier Frequency Stability

The subcarrier frequency shall be 7.5MHz +/-0.2 percent.

3.1.4.2 Subcarrier Input Mode Selection

The subcarrier input shall allow for user selection between an AC coupled 600 ohm balanced input for audio mode and a DC coupled 10k ohm single ended input for digital mode.

3.1.4.2.1 Balanced (Audio) Input Mode

The subcarrier balanced input shall have a minimum frequency response of 40Hz to 15kHz with 75 microsecond pre-emphasis. The input impedance shall be 600 ohms +/- 5.0 percent.

3.1.4.2.2 Single Ended (Digital) Input Mode

The subcarrier single ended input shall have a minimum frequency response of DC to 25kHz. The input impedance shall be 10k ohms +/-5.0 percent.

3.1.4.3 Subcarrier Minimum Deviation

The minimum subcarrier deviation shall be +/-75kHz.

3.1.4.3.1 Balanced Input Deviation Sensitivity

The subcarrier balanced input shall have a subcarrier frequency deviation of +/-75kHz, with a tolerance of 10 percent, for a sinewave input of 6.2Vpeak-to-peak at 400Hz.

3.1.4.3.2 Single Ended Input Deviation Sensitivity

The subcarrier single ended input shall have a subcarrier frequency deviation of +/-75kHz, with a 10 percent tolerance, for an input voltage of 0 to +12Vdc.

3.2 Environmental Requirements

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3.2.1 Temperature

The transmitter shall meet the performance requirements specified in 3.1 during and after exposure to temperatures ranging from 0 degrees F to +160 degrees F in accordance with DCP-O-018, temperature requirements for Category II aircraft in temperature controlled bay.

3.2.2 Vibration

3.2.2.1 Random Vibration

The transmitter shall meet the performance requirements specified in 3.1 during and after exposure to the DCP-O-018, Random Vibration Test Curve B for the durations specified for Category II aircraft.

3.2.2.2 Sine Vibration

The transmitter shall meet the performance requirements specified in 3.1 during and after exposure to the DCP-O-018, Sine Vibration Test Curve C for the durations specified for Category IV rotary wing aircraft.

3.2.3 Altitude

The transmitter shall meet the performance requirements specified in 3.1 during and after exposure to altitudes of 100k feet in accordance with the DCP-O-018, altitude requirements for Category II aircraft.

3.2.4 Humidity

The transmitter shall meet the performance requirements specified in 3.1 during and after exposure to RH of 95 percent at a maximum temperature of +160 degrees F in accordance with MIL-STD-810F.

3.2.5 EMI

The transmitter shall meet the requirements specified in MIL-STD-461F for Air Force, Army, and Navy aircraft.

3.3 Physical Characteristics

3.3.1 Dimensions

3.3.1.1 Transmitter Dimensions

The maximum transmitter dimensions including connectors shall conform to the outline drawing shown on Figure 1.

3.3.1.1.1 Transmitter Mounting

The transmitter shall incorporate mounting holes as indicated in Figure 1 to allow for mounting using four 8-32 screws. Flanges or a recessed edge design is preferred to minimize screw length.

3.3.1.1.2 Transmitter Crash Loads

The transmitter mounting structure shall ensure that the transmitter remains in place for a

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peak crash safety load of 30g.

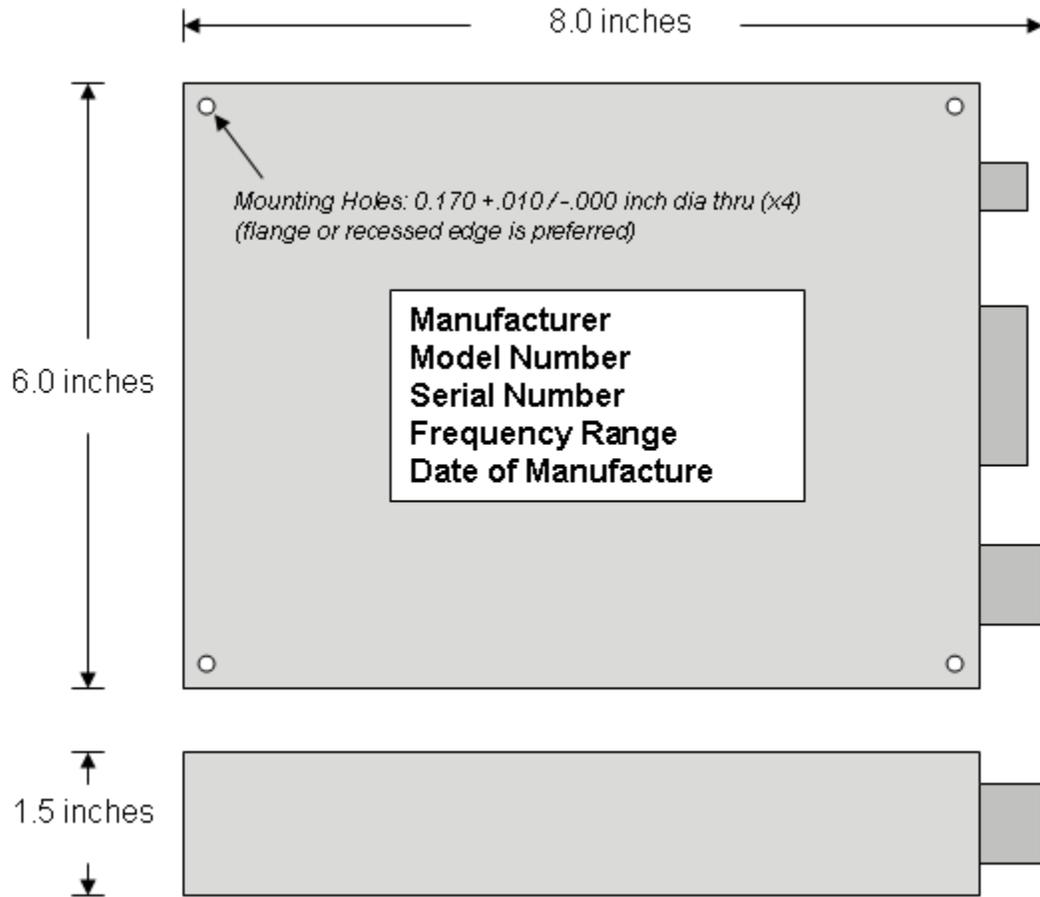


Figure 1: Maximum Transmitter Outline Dimensions

3.3.1.2 BCD Switch Dimensions

The maximum transmitter dimensions including connectors shall conform to the outline drawing shown on Figure 2.

3.3.1.2.1 BCD Switch Mounting

The BCD switch shall incorporate mounting holes as indicated in Figure 2 to allow for mounting using four 8-32 screws. Flanges or a recessed edge design is preferred to minimize screw length.

3.3.1.2.2 BCD Switch Crash Loads

The BCD switch mounting structure shall ensure that the BCD switch remains in place for a peak crash safety load of 30g.

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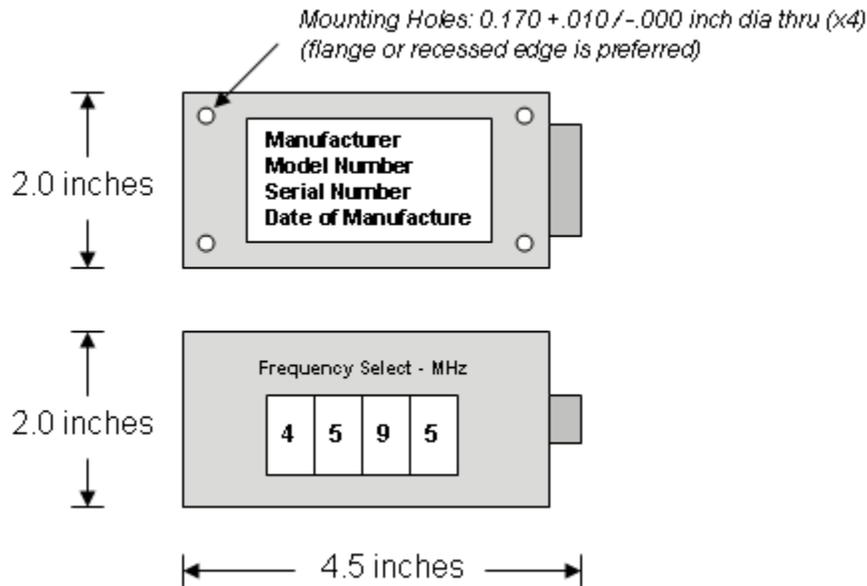


Figure 2: Maximum BCD Switch Outline Dimensions

3.3.2 Weight

The transmitter shall weigh a maximum of 65 ounces. The remote BCD switch shall weigh a maximum of 10 ounces.

3.3.3 Connectors

The transmitter shall utilize flight qualified hermetically sealed connectors.

3.3.3.1 Power Input Connector

The transmitter power input connector shall utilize a PT02H-8-4P or PT02H12-10P type connector.

3.3.3.2 RF Output Connector

The transmitter RF output connector shall utilize a SMA or TNC jack type connector.

3.3.3.3 Video Input

The transmitter video input connector shall utilize a BNC jack type connector.

3.3.3.4 BCD Connectors

The BCD switch and transmitter shall incorporate MDM-15 type connectors for attachment of user selected cable lengths.

3.3.3.5 Connector Locations

Connectors shall be located on only one face of the transmitter and BCD switch as indicated on Figures 1 and 2.

3.4 Design and Construction

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3.4.1 Materials and Processes

The materials and processes used in manufacture of the transmitter and BCD switch shall be appropriate for the intended application.

3.4.2 Standards of Manufacture

3.4.2.1 Product Cleanliness

No oils or solid lubricants of any kind shall be used on any part of the transmitter after final cleaning.

3.4.2.2 Soldering

Procedures and requirements for preparation and soldering of electrical connections shall be in accordance with ANSI/J-STD-001, Class 3.

3.4.2.3 Working Environment

The supplier shall provide adequate facilities for the fabrication, assembly, and testing of transmitters.

4 VERIFICATION

4.1 Qualification Testing

The supplier shall perform qualification testing on sample sets of transmitter and BCD switch hardware as specified in the contract or purchase order. The qualification samples shall be manufactured using the same methods, materials, parts, processes, equipment and procedures proposed for production.

4.1.1 Qualification Test Requirements

Qualification testing shall be performed to verify that the proposed transmitter and BCD switch set design will meet the requirements specified in 3.1 and 3.2.

4.1.2 Qualification Test Hardware and Data

Qualification test hardware and data related to qualification testing shall be delivered to purchaser for evaluation.

4.1.3 Qualification by Similarity

The requirement for qualification testing may be waived by the purchaser if the purchaser determines that the proposed hardware has been previously qualified for a similar application at acceptable levels.

4.2 Acceptance Testing

The supplier shall perform acceptance testing on all production units delivered.

4.2.1 Acceptance Test Requirements

The electrical performance requirements specified in 3.1 shall be verified for each transmitter during acceptance testing. The environmental requirements specified in 3.2.1 and 3.2.2 shall be verified for each transmitter during acceptance testing.

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4.2.2 Acceptance Test Data

Acceptance test results shall be delivered to purchaser with each unit delivered.

4.3 Quality Assurance

The supplier shall have a quality management system in place that complies with the quality system requirements of AS9100 or ISO9001.

4.3.1 The Equipment and Inspection Facilities

The supplier shall ensure that test and inspection facilities of sufficient accuracy, quality, and quantity are established and maintained to conduct the required testing and inspections.

4.3.2 Calibration System

The supplier shall have a documented calibration system that meets the requirements of ISO 10012, Quality assurance requirements for measuring equipment, or the American National Standard Institute (ANSI) / National Conference of Standards Laboratories (NCSL) Z540-1, General Requirements for Calibration Laboratories and Measuring Equipment and Test Equipment standards.

4.3.3 Inspections and Data Requirements

The supplier shall perform all required inspections and tests to insure that all articles and materials conform to contract requirements and applicable drawings and specifications. Such inspections and tests shall encompass the receiving, processing, fabrication, assembly, end-item and shipping phases.

4.3.4 Electrical / Electronic Articles and Materials

The supplier shall develop an approved method of detecting counterfeit parts and a way of permanently removing them from the Electrical, Electronic and Electromechanical (EEE) parts purchasing network. The supplier shall notify NASA QA of any identification of counterfeit parts used in manufacturing or found in receiving inspection.

4.3.5 Electrostatic Discharge (ESD) Protection Program:

The supplier shall follow an approved ESD Control Program based on ANSI/ESD S20.20, ESD Association Standard for the Development of an Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices). Parts must be properly packaged and identified as required in ANSI/ESD-S20.20. All goods will be placed in conductive or static-dissipative packages, tubes, carriers, conductive bags, etc., for shipment. The packaging must be clearly labeled to indicate that it contains electrostatic sensitive goods. Electrical parts that may be used or shipped in conjunction with ESD sensitive parts shall be treated as ESD sensitive.

4.3.6 Verification of Serviceability

The supplier shall include a tag, label or similar instrument stating that the materials delivered are serviceable.

5 HARDWARE DELIVERY

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5.1 Packaging

Material shall be packed for shipment in such a manner that will ensure acceptance by a common carrier and safe delivery at destination.

5.2 Certificate of Conformance

The delivered material shall include a certificate of conformance.

6 ABBREVIATIONS AND ACRONYMS

AC	Alternating Current
AM	Amplitude Modulation
ANSI	American National Standard Institute
ASTM	American Society for Testing and Materials
BCD	Binary Coded Decimal
dB	decibels
dBc	decibels relative to unmodulated carrier
dBm	decibels relative to one milliwatt
BNC	Bayonette Neill-Concelman
DC	Direct Current
DCP	Dryden Centerwide Procedure
DFRC	Dryden Flight Research Center
EEE	Electrical, Electronic and Electromechanical
EMI	Electro-Magnetic Interference
ESD	Electro Static Discharge
F	Fahrenheit
FM	Frequency Modulation
Hz	Hertz
IAM	Incidental Amplitude Modulation
IFM	Incidental Frequency Modulation
ISO	International Organization for Standardization
ITU	International Telecommunication Union
kHz	kilohertz
MHz	Megahertz
MIL	Military
NASA	National Aeronautics and Space Administration
NCSL	National Conference of Standards Laboratories
NTSC	National Television System Committee
QA	Quality Assurance
RCC	Range Commanders Council
RF	Radio Frequency
RH	Relative Humidity
SMA	Sub-Miniature Series A
STD	Standard
TNC	Threaded Neill-Concelman
V	volts
Vdc	volts direct current
VSWR	voltage standing wave ratio