

**Appendix A**

**U. S. DEPARTMENT OF COMMERCE**

NATIONAL OCEANIC AND ATMOSPHERIC

ADMINISTRATION

National Environmental Satellite Service Washington, DC. 20233

Specification No. 200.001 December 1, 1970

DATA COLLECTION PLATFORM RADIO SET SPECIFICATION

1. SCOPE

1. Scope. This specification describes Data Collection Platform Radio Sets (DCPRS) required by the National Oceanic and Atmospheric Administration (NOAA), U. S. Department of Commerce (DOC) to be used to receive and transmit data from a variety of DCPRSs through the Synchronous Meteorological Satellite/Geostationary Operational Environmental Satellite (SMS/GOEM) to a central Command and Data Acquisition (CDA) station located at Wallops Station, Virginia. The number of these DCPRSs may eventually exceed 10,000, therefore a cost effective system is required from the standpoint of reliability, original cost, and maintenance.

1.2 Functional Description.

1. Interrogated DCPRS. The interrogated DCPRS will consist of a re­ceiver, decoder, frequency control, modulator, transmitter, diplexer, and antenna. This DCPRS will receive an interrogation signal from the spacecraft, recognize its address and commands as specified in paragraph 3 (see Figure 1).
2. Timed DCPRS. The timed DCPRS shall consist of a timer, modulator, transmitter, and antenna. This type of DCPRS shall transmit at a predetermined time and frequency (see Figure 1).

2. APPLICABLE DOCUMENTS

2.1 Applicable Documents. The following documents, of exact issue shown, form a part of this specification to the extent specified herein. In the event of conflict between this specification and any referenced document, this specification shall govern.

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FUNCTIONAL BLOCK DIAGRAM OF DCPRS

Antenna

Interrogated DCPRS

**T**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  | Diplexer  OR  TR |  |  | *t* |
|  |  | | Or Switch  TR |  | |
|  |  |  |  |  |  |
| Transmitter | |  | Frequency  S  Syn  Synthesizer |  | Phase  Locked  Receiver | |
|  | |  | Synthesizer |  |  | |
|  | |  |  |  |  |  |
| Modulator | |  | Decoder Encoder |  | |  |
|  |  |  |  |  |  |  |

**Sensor Input**

Test Signal Input

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**Self-Timed DCPRS**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| CLOCK | |  | MODULATOR | TRANSMITTER | |  |
|  |  |  |  |  |  |  |

|  |  |
| --- | --- |
| ENCODER | |
|  |  |

**Sensor Input** **Test Signal Input**

Figure 1

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Industrial Documents

PB-173762; - Telcom Report TER 116, "Multiple Access Relaying

for a Synchronous Operational Meteorological

Satellite," September 14, 1966

PB-178^03 - Telcom TER 129B, "Geostationary Operational

Environmental Satellite (GOES) Data Collection System," Task I, Final Report, November 1967

PB-180197 - "Final Report of Study of Techniques for Development

of a Low-Cost Balloon Package Compatible with the NASA OMEGA Position-Locating Equipment Experiment," March 31, 1967

(Source: National Technical Information Service, U. S. Department of Commerce, Springfield, Virginia 22151.)

The Magnavox Co., "Data Collection Platform Study for the Synchronous Meteorological Satellite System," Final Report '

Radiation, "SMS Data Collection Platform Studies," Final Report, October 1970

(Source: To be supplied.)

Military Standards

MilStd 188B including August 29, 1961 revision

MilStd 810B - Environmental Test Methods, June 15, 1967

MilStd 129B - Marking for Shipment and Storage

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the issuing office or as directed by the contracting officer.) The present source of Military Specifications is:

Commanding Officer U. S. Naval Supply Center (Code DC-1) 5801 Tabor Avenue Philadelphia, Pennsylvania 19120

Government Specifications

FCC Rule and Regulations on RFI, Vol. II and V

DOC - NBS Code for Information Interchange FIPS PUB I, November 1, 1968

(Activities outside the Federal Government may obtain copies of Federal Specifications and Standards as outlined under General Information in the Index of Federal Specifications and Standards and at the prices indicated in the Index. The Index, which includes cumulative monthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U. S. Government Printing Office, Washington. D. C. 20025)

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**2.1.1 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply. Copies may be obtained from the" address listed under each publication.**

**Definition of Electrical Terms - Group 6$, January *2ks* 195>7**

**IEEE, Inc.**

**345 East 47th Street**

**New York, New York 10017**

**3. REQUIREMENTS**

**3.1 Components. All components must be from new stock. Values of  
capacitors and resistors shall be selected from commercial standard  
preferred values with ±10% tolerance, except for special close-tolerance  
requirements such as a meter multiplier. No component will be  
operated at electrical ratings in excess of 75%of manufacturers’maximum ratings.**

**Semiconductors. Transistor circuits shall be designed to tolerate any specified combination of input signal and output load variation without component damage.**

1. **Electron Tubes. The use of electron tubes in the equipment shall be permissible only where cost and power considerations are clearly advantageous.**
2. **Cables and Wire. Cabling and wiring shall be of ample size and rating and high quality materials and shall be arranged so as to avoid mechanical damage during transporting, normal operation, or routine maintenance. Stranded wire is generally preferred and is mandatory for all short rigid connections. Primary power wiring shall be Underwriters Laboratory approved. Polytetrafloridethylene insulation and sleeving is preferred. Shielded wire shall have a plastic outer cover and shielding shall be of the braided type.**

**3.1.U Resistors. No resistor shall be operated at more than *$0%* of rated power.**

**3.1.5 Capacitors. No capacitor shall be operated at more than 5>C# of rated voltage.**

**3.2 Design and Construction. Design and construction shall be to good commercial standards. The equipment shall be demonstrably reliable and rugged. Modular construction is preferred.**

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**3.3 Operating Frequencies**

**3.3.1 Interrogated Mode. DCPRS received Radio Frequency (RF) shall be in the 460 to 470 MHz band (468.825 MHz has been requested). The transmitted RF shall be in the 401.700 to 402.000 MHz band, a center frequency of 401.850 MHz has been requested.**

**3.3.2 Self-Timed Mode. The transmitted radio frequencies of DCPRSs operating in this mode shall be in the 401.7 to 402 MHz with the timed system occupying the lower part of the band.**

**3.4 Frequency Control and Timing. Frequency control, and timing methods shall depend on the mode of operation. However, DCPRS radio sets operating in both modes shall be so designed as to prevent continuous transmission on failure.**

**3.4.1 Interrogated DCPRS. Frequency control shall be by means of a frequency synthesizer which shall employ a single basic oscillator phase-locked to the receiver carrier which shall be used to control the receiver and to derive the transmit frequencies.**

**3.4.1.1 Oscillator Aging Rate. The basic oscillator aging rate shall be less than 5x10-7per year.**

**3.4.1.2 Oscillator Stability**

**3.4.1.2.1 Temperature. The basic oscillator temperature stability shall be less than 5x10-7 over the temperature range as specified in 3.17.1.**

**3.4.1.2.2 Long Term. Long term stability shall be better than one part in 106 per year.**

**3.4.1.2.3 Short Term. Short term stability shall be better than one part in 109 per 0.25 seconds.**

**3.4.1.3 Tuning Range. Both the received and transmitted carrier shall be tunable over a frequency of ±150 kHz.**

**3.4.1.4 Acquisition Time. The receiver shall acquire and lock on the desired signal in 420 milliseconds or less from standby condition starting point when carrier is with ±10 Hz of the reference frequency in the IF amplifier.**

**3.4.1.5 Phase Lock Loop Characteristics. The receiver shall employ a phase lock technique to acquire and reproduce the received signal. The loop bandwidth shall by 10 Hz. In addition, the PLL shall be capable of tracking over a range of ±5 KHz centered at the received carrier frequency as specified in 3.3.1.**

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3.4.1.6 Spurious Responses. Spurious responses shall be more than 60 dB below desired responses. Local oscillator and mixing frequency signals shall not be measurable at the antenna or primary power input as measured at the demodulator output.

3.4.1.7 Channelization. The frequency synthesizer shall be capable of manually offsetting in the field the center carrier frequency specified in 3.3.1 to a minimum of 100 channels plus automatic shifting to a minimum of one channel by the spacecraft interrogation signal or internally actuated command.

3.4.2 Timed DCPRS. DCPRS operating in this mode shall internally actuate the transmitter from one to twelve-hour intervals. Turnoff shall be by a pulse generated at the end of data. Normally, transmission of data will be less than 30 seconds duration.

3.4.2.1 Timer Accuracy. The timer shall have an accuracy of 1x10-6.

3.4.2.2 Time Change. The timer shall have the capability of being manually set in the field for any 30-second period during a one to twelve-hour interval.

3.4.2.3 Frequency Control. The transmitted frequency shall be controlled by a crystal oscillator.

3.4.2.4 Oscillator Aging Rate. See 3.4.1.1.

3.4.2.5 Oscillator Stability. See 3.4.1.2.

3.4.2.6 Tuning Range. The tuning range of the transmitter operating in the timed mode shall be ±150 kHz.

3.5 Antennas. The antennas for the two modes of operation of the DCPRS shall operate at the frequency specified in paragraph 3.3 and both antennas for both modes of operation shall have the following characteristics:

3.5.1 Bandwidth. The antenna shall have a bandwidth of 100 MHz centered at 430 MHz.

3.5.2 Pattern. The pattern shall be such as to allow ease of pointing. However, the beam-width shall be a maximum of 60° measured at the 3 dB point.

3.5.3 Gain. Gain shall be a minimum of 10 dB at the 3 dB point.

3.5.4 Polarization. Polarization shall be right-hand circular. According to IEEE standard 65.34.159.

3.5.5 Pointing. Antenna and mount shall be such as to allow ease of pointing and installation with simple equipment.

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3.5.6Standing Wave-Ratio (SWR). The SWR shall be less than 1.5 to 1 over the bandwidth specified in 3.5.1 above.

3.5.7 Impedance. Impedance of the antenna shall be nominally 50 ohms in both transmit and receive modes.

3.6 Diplexer of TR Switch. The interrogated DCPRS shall incorporate a diplexer or TR switch to allow a single antenna to be employed.

1. Frequency Range. The frequency range and bandwidth shall be as specified in paragraphs 3.3.1, 3.3.2, and 3.5.1.
2. Power Rating. The power rating shall be 50watts.
3. Insertion Loss Receive. The insertion loss on the receive mode shall be less than 0.5 dB.

3.6.I4 Insertion Loss Transmit. The insertion loss in the transmit mode shall be less than 0.5 dB.

3.6.5 Isolation. The transmitter frequencies at receiver terminals shall be less than 60 dB. The transmitter noise at receive frequency shall be less than 60 dB.

3.6.6Voltage Standing Wave Ratio (VSWR). The VSWR shall be less than 1.5 to 1 over the required transmit and receive frequency specified in paragraph 3.3.1.

3.6.7 Impedance. The impedance shall be 50ohms.

3.7 Receiver. A receiver shall be required for the interrogated DCPRS only.

1. Description. The receiver shall be required for DCPRS operating in the interrogated mode. This receiver shall receive signals from the SMS spacecraft continuously, which shall be the frequency specified in paragraph 3-3-1 and shall automatically acquire, amplify, and demodulate the coded signal so received.
2. Signal Characteristics. The received signal shall be Phase Shift Keyed (PSK) by a split phase (Manchester coded) interrogation signal at

a bit rate of 100 bits/second. In addition, this signal will be modulated (A.M., P.M., etc.), with a standard NBS time code.

3.7.3 Frequency Control. Frequency control of the receiver shall be  
as specified in paragraphs 3.4.1 through 3.4.1.7.

3.7.4Receiver Performance. The receiver shall be capable of accepting the signals as described in 3.7.2 and producing a binary signal with an error rate of less than 1x10-6. Pe = 1/2 e0.794 (E/No).

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**3.7.4.1 Tunability. The received carrier shall be tunable over a frequency of ±150 KHz.**

**3.7.4.2 Acquisition Bandwidth. The signal acquisition bandwidth shall be 10 Hz.**

**3.7.4.3 Acquisition Time. See paragraph 3.4.1.4.**

**3.7-4.4 Phase Lock Loop Characteristics. See paragraph 3.4.1-5.**

**3.7.4.5 Spurious Responses. See paragraph 3.4.1.6.**

**3.7.4.6 Linearity. Closed loop output versus input amplitude char­acteristics shall be a constant ratio ±1 dB up to an input level-of -100 dB.**

**3.7.4.7 Noise Figure. Front end noise figure referred to the antenna interface shall not exceed 7 dB.**

**3.7.4.8 Sensitivity. The receiver shall be capable of receiving and demodulating the signals described in paragraph 3.7.2 over a received signal range at the input to the receiver of -100 dBm maximum level to -130 dBm minimum level.**

**3.7.4.9 Overload. Receiver closed loop gain shall not vary more than 1 dB at -115 dBm due to a -70 dBm signal ±100 kHz or more from the desired signal.**

**3.7.4.10 SWR. The receiver shall be capable of receiving with a SWR of 1.5 to 1 maximum.**

**3.7-4.11 Impedance. The receiver input impedance shall be 50 ohms.**

**3.7.5 Standby Power Consumption.. Since the receiver shall operate continuously, it consumes the largest average power; therefore, a design goal of standby power consumption for the DCPRS in receive mode shall be 200 milliwatts.**

**3.8 Decoder. The DCPRSs operating in the interrogation mode shall be capable of decoding the binary 100 bit/sec interrogation signal described in paragraph 3.7.2.**

1. **Code Length. The code length shall be sufficient to interrogate 100,000 platforms of 17 bits plus two command bits plus additional bits for synchronization and error correction as required.**
2. **Probability of Correct Response. With the link error rate specified in paragraph 3.7.4, the decoder shall have a probability of a correct response of 0.999966.**

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3.8.3 Probability of Wrong Platform Responding. The probability of a platform other than the one interrogated responding is 1.36x10-10

3.9 Transmitter. This transmitter specification shall apply to  
DCPRS operating in both the interrogation and self-time mode.

3.9.1 Power Output. The RF power output of the transmitter shall be 5 watts minimum.

3.9.2 Modulation. The modulator shall be capable of receiving binary signals from the encoder specified in paragraph 3.10 or from an external test source and PSK the carrier at a rate of up to 500 bits/sec.

3.9.3 Frequency Control. Frequency control shall be as specified in paragraph 3.4.

3.9.4 Timing Accuracy. Timing accuracy shall be as specified in paragraph 3.4.

3.9.5 Electro Magnetic Interference (EMI). The transmitter spurious  
emissions, as measured with modulation, and antenna and diplexer  
connected, shall be down from the unmodulated carrier level by the  
following:

Non-harmonically related spurious 50 dB

Second harmonic 26 dB

Third harmonic 35 dB

Fourth harmonic and higher 50 dB

1. SWR. The loaded transmitter SWR shall be less than 1.5 to 1.
2. Impedance. The output impedance of the transmitter shall be 50 ohms.

3.10 Encoder. The DCPRS operating in both interrogation and timed  
configuration shall be capable of accepting data in an ASCII format

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at 110 baud. (No encoder required.) In addition to ASCII require­ment the contractor will consider accepting binary inputs from a minimum of ten sensors and encoding these signals for serial transmission. The bit rate of the input data shall be set by either the 110 baud ASCII or 100 bits/sec NRZ binary. Therefore, if special codes are adopted for error correction or to improve the data col­lection telecommunications transmission system, an encoder shall be required. In addition, the DCPKS shall be capable of receiving signals with the following characteristics:

1. Logic Levels. Logic shall be Binary Coded Decimal (BCD) weighted 1.2.4.8 code. Binary ‘1’= 2.8 volts to 5volts capable of supplying 25 micro-amps. Binary ‘0’= 0.4 volts or less capable of supplying 1.2 milli-amperes.
2. Interrogation Enable. Interrogation shall be enabled by a plus 3.6 volts to 5.0 volts. Pulse of 3> seconds or less capable of supplying 225 micro-amps. Interrogation to begin not less than 0.45 to ±0.15 seconds after interrogation enable pulse goes high.

3.11. Prime Power. The DCPKS shall be capable of working with external prime power sources. These may be batteries only, batteries with chargers, or a power supply. Therefore, DC voltages and voltage operating ranges shall be compatible with these power sources. Suitable protection devices, i.e., circuit breakers, fuses, and interlocks shall be used to protect against overload during operation and maintenance. Provision shall be made to monitor the condition of the prime power source either by interrogation command or by an internally actuated signal.

3.12 Duty Cycle. All elements of the DCPRS shall be capable of continuous operation. However, the normal operating mode shall be receiver at standby continuous3 other radio set components on 30 seconds or less every six hours. The interrogated DCPRS shall be capable of interrogation upon request at non-normal periods.

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**3.13 Packaging. Package size and weight shall be held to a minimum. Provisions shall be made for adequate heat dissipation and easy accessibility to components for maintenance. Construction shall be tamper proof and shall include a tampering alarm signal.**

**3.14 Producibility. The DCPRS herein specified shall be so designed as to enable them to be produced in large quantities at low cost.**

**3.15 Maintainability. The design of the DCPRS shall be such as to ensure ease of maintenance and shall be designed for six months' unattended operation.**

**3.16 Operating Life. The DCPRS shall be designed to be the most cost  
effective from a production and maintenance standpoint over a five-year period.**

**3.17 Environment Conditions**

1. **Temperature Range. The DCPRS shall operate as specified from -20°C to +50"C and shall be capable of withstanding without damage non-operating and in storage temperatures of -70°C to +70°C.**
2. **Humidity. Equipment shall withstand without damage in both operating and non-operating conditions from 0 to 100$ relative humidity at temperatures from -20°C to +25°C.**
3. **Weather (Antenna and Transmission Line). The DCPRS antenna and transmission line shall withstand the following:**
4. **Ice and Snow. Ice and snow up to two inches of ice together with snow load of 50 pounds per square foot.**
5. **Rain. Rain up to 5 inches per hour.**
6. **Wind. A wind speed of 150 knots, wind blown sand 100 knots.**

**3.17.1\* Elevation. The DCPRS shall operate as specified at elevations of from sea level to 15,000 feet and be capable of being transported at altitudes of 49,000 feet.**

**3.17.5 Shock and Vibration. The DCPRS shall withstand without mechanical or electrical damage the maximum shock and vibration anticipated while being transported by common commercial transportation or over rough roads and terrain.**

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**3.17.6 Environmental Consideration. The DCPRS packaging shall protect against salt atmosphere, sand, dust, and rain during operation, transportation, and temporary storage.**

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**3.18 Identification and Marking. The functions of all controls and indicators shall be permanently marked on the panel using letters not less than 1/8-inch high. All cable connectors, test points, and coaxial connectors shall be marked by symbols or numbers. The DCPRS shall permanently display in a prominent location a standard Department of Commerce nameplate conforming to NESS Drawing No. S200.001.**

3.19**Interchangeability. Units of this specification which perform the same function for both the interrogated and self-timed DCPRS and. all units which have the same part number shall be physically and electrically interchangeable.**

4..**RELIABILITY AND QUALITY CONTROL**

**4.1 General. The DCPRS reliability and quality control provision shall**

**be in accordance with high production rates, low-cost equipment, and good**

**commercial practices.**

**4.2 Contractor Inspection. The contractor shall be responsible for \_  
performing all necessary quality control inspection to ensure compliance   
with all the system requirements Specified herein.**

4.3**Visual Inspection. Visual inspection shall be performed on all**

**materials, components, hardware, assemblies, etc., prior to, during, and**

**after fabrication for each item produced. A "mutually agreed upon" method of inspection marking shall be used.**

**4.4 Electrical Inspection. Electrical inspection shall be 100 percent of production prior to, during and after fabrication.**

**4.5 Performance Testing. The contractor shall provide N0AA/D0C with sufficient signed and dated documentation (test data and reports) to verify that the completed equipment meets all the performance requirements of this specification under the environmental condition specified prior to and upon delivery.**

**4.6 Quality Control. The contractor shall ensure to the satisfaction of the N0AA/D0C that he has available, and utilizes correctly, gaging, measuring, and test equipment of the required accuracy and calibration and that the instruments are of the proper type and range to make measurements of the required accuracy. The contractor shall have available a set of master gages, standards, and appropriate instruments to conduct regularly scheduled calibrations of his inspection and test equipment. Records of such calibration shall be maintained, dated, and signed by the contractor and made available for N0AA/D0C review and inspection.**

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4.7 Rejection and Resubmittal. Delivered equipment that fails to meet all the requirements of this specification shall be rejected and re­turned to the contractor. Prior to resubmittal, the contractor shall furnish the Department of Commerce Procurement Division and the NOAA/DOC Contract Monitor full particulars, in writing, regarding the cause and action taken to correct the defects,

4.8 Workmanship. The workmanship shall be first class in every respect. All components and finished equipment shall be free from any defect which might affect their serviceability or appearance.

5. MONITORING OR WORK

5.1 Monitoring of Work. Authorized representatives of NOAA/DOC shall have access as desired to all portions of contractor's plant relating to work performed under this contract.

**6. CONTRACTOR'S OBLIGATIONS**

6.1 Contractor's Obligations. The contractor shall provide two of each complete system as described in paragraph 1, with performance as stated in paragraph 3.

7.MANUALS AND REPORTS

7.1 Manuals and Reports. The contractor shall furnish monthly progress letters to the Contract Monitor giving current status of each equipment. In addition, two instruction manuals shall be supplied with each type of DCPRS delivered (plus one reproducible for each type) of such scope as to enable persons at a technician level to install, operate, and maintain the equipment. The information contained in the manual shall be presented in a manner consistent with good commercial practice. The manual shall provide at least the following coverage: schematics, installation procedures, operating procedures, maintenance procedures, theory of operation, dimensions and weight. In addition, the manual shall include, but not be restricted to

a**)**b) c) d) e)

f)A description of the system and its operation

A complete block diagram, wiring, and schematic drawing

Parts layout (drawings or identified photographs)

A complete parts list and recommended spares

Adjustment procedures

Troubleshooting suggestions for major system failures

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8. TEST AND CHECKOUT

8.1 Test and Checkout. Contractor shall test and check out, with,\_

modifications if necessary, all equipment items furnished. The test

plan and test methods must be approved prior to acceptance testing.

Copies of the final test data shall be supplied with the final report.

All test equipment necessary to test, check out, and demonstrate

operation of the DCPRS shall be furnished as deliverable items.