February 2000 E/OSD3

TO: All GOES Data Collection System (DCS) Radio Set Manufacturers, Builders, Experimenters, and Users

FROM: E/OSD - Gary Davis, Director Office of Systems Development

SUBJECT: GOES Data Collection System Radio Set (DCPRS) Certification Standards

To guarantee integrity of the GOES DCS as an operational system, the National Environmental Satellite Date Information Service (NESDIS) requires that all radio sets be certified before they can be used in the system.

Attached are the certification standards for Data Collection Platform Radio Sets (DCPRS's). Certification is achieved by demonstrating that the DCS radio set fulfills each of the standards set forth in the respective standard. NESDIS certification is "type certification", wherein a representative production unit is tested and found to fulfill all stated requirements. NESDIS certification of individual production units (those having the same model number) is not required. **As a standard, this document represents mandatory requirements--waivers will not be accepted.**

This document supersedes the prior DCPRS Certification Standards documents from the early 1980s. Existing DCP manufacturers will find these standards to be quite similar to those of the 1980s. A DCP radio set unit may be certified for operation in more than one mode (Self-Timed and Random, Self-Timed and Interrogated, Random and interrogated, etc.) providing the technical requirements/specifications of the respective standard are fulfilled.

Certification of a radio set is required when it is either a new DCPRS design as designated by a new model number or is a modification of an existing DCPRS design.

Re-certification is required when modifications (either hardware or software) have been made to a certified radio set, which affect the radio set's response to any of the requirements of the respective standard. This is true regardless of who makes the modification, whether it be the original manufacturer, an experimenter, a user in the field, or other. Also requiring re-certification are any models whose performance in the field is at variance with the performance of the radio set originally certified. Repairs to a set, as distinguished from modifications, do not necessitate re-certification except if a performance characteristic has been altered. Repairs by private concerns, other than the original manufacturer, should be performed only by those showing proof of proper Federal, Communication Commission licensing to do so on this class of equipment (Radio Telephone Operator Second Class).

Certification or re-certification is not a guarantee of performance to a user's satisfaction. It is solely intended to safeguard the GOES DCS for all users against preventable degradation or interference.

Certification, furthermore, does not automatically provide authority to transmit. Permission or a license to do so for a specific site must be obtained from the appropriate agency of the government concerned--which for U.S. Government users is the Interdepartmental Radio Advisory Committee (IRAC) and for other U.S. users is the Federal Communication Commission.

The attached standards are for certification of radio sets apply to DCPRS for use in the United States regional or domestic GOES DCS. They are not issued for certification of radio sets to operate in the GOES, METEOSAT (European Space Agency), and the Geostationary Meteorological Satellite (Japan) International Data Collection System (which uses a different transmit frequency band of 402.0 MHz to 402.1 MHz). Included in the attachment are the some of the certification requirements for the International GOES DCS. However, the certification process is not provided by NESDIS. Information about INTERNATIONAL system certification can be obtained by contacting Mr. Marlin Perkins, Chief, Data Collection and Direct Broadcast Branch, Code E/SP21, National Environmental Satellite Data and Information Service/NOAA, Washington, D.C. 20233 (Ph. (301) 763-8063).

All responsibility for obtaining NESDIS certification rests with the manufacturer and/or builder of the equipment. Certification testing is performed by the manufacturer with a NESDIS witness present. All test results are then complied in a report and forwarded to NESDIS. Testing is to be conducted at the Contractor's or builder's location and normally requires about one day. The salary, travel, and per them expenses/costs for the NESDIS representative to verify and certify this testing and the subsequent test results are to be paid by the certification requester (manufacturer/builder).

Arrangements for certification of radio sets for the NESDIS GOES DCS should be made directly to Edward C. Seman or Mr. Cyril Settles, Command and Data Acquisition Station (E/SO2), National nvironmental Satellite Data and Information Service/NOAA, P. 0. Box 39, Wallops Station, VA 23337, (Ph. (804) 824-3446).

Following the satisfactory completion of certification testing, a letter and certificate will be issued by NESDIS to the requester.

Attachment

GOES DATA COLLECTION SYSTEM DOMESTIC

CERTIFICATION STANDARDS

NOAA/NESDIS

July 1996

November 18, 1981 S/SE5.WEM

No. S23.010

Reprint 1996

SELF TIMED DATA COLLECTION PLATFORM
RADIO SET CERTIFICATION STANDARDS
(Revised November 1981)

Definitions

Transmission	The combination of clear radio carrier and all bits of identification, data and any special sequences sent by a DCP.
Message	Relates to all or a portion of the data segment of a transmission; the message is a segment of data that is fully defined in a DCP management data base; a transmission will contain one or more messages.
Header Word	An 8-bit character whose low order 6 bits make up a binary number that identified a format retry stored in a DCP management data base for a specific DCP. A header word begins each message.
DCP	Contains one record per DCP that includes Data Base the Management characteristics of each parameter measured, plus a list of format entries that will identify each potential data message that the DCP can formulate and transmit.
Parameter	Data element measured by a sensor. Common hydrometeorology parameters include stream stage, precipitation and temperature.
Parameter Cycle	A procedure used by a DCP in acquiring and formatting multiple readings obtained over a period of time. Generally a cycle consists of specific measurements taken at prescribed times within a defined interval. A DCP may acquire and report data for several such time intervals by precisely repeating the prescribed cycle for each consecutive interval.
Parameter Update value	Entry of a value (composite or point) for parameter into a DCP message. The value may be an instantaneous value or a computed value based on many sensor values measured since the last message update.
Two's Complement	A method of expressing negative numbers so that subtraction may be performed by a simple fixed-precision binary accumulator (adder). The negative value of a binary number is computed by complementing each bit and then adding one. (Example: The equation 4-6=-2 is computed as 4+(-6)=-2, which in 6-bit binary is 000100 + 111001 = 111101). The magnitude of a negative value is determine by taking its two's-complement. (i.e., -(-2)=+2 or -(11101)=000010).

1. RF POWER OUTPUT

The Effective Isotropic Radiated Power (EIRP), of a DCPRS and antenna shall not exceed 50 dBm under any combination of service conditions.

2. FREQUENCY CHARACTERISTICS

The DCPRS transmitted RF shall be in the 401.7 MHz to 402.0 MHz band. See Table 1. The DCPRS design, and the procedures specified in its associated Operations and Maintenance manual, shall provide a capability to adjust the transmit frequency to within +/-100 Hz.

3. STABILITY

a) Temperature

The transmitter carrier frequency shall change by less than +/-0.5 parts per million over the temperature range of -40°C to +50°C.

b) Long-Term

The long-term stability (including temperature variations) shall be better than ± one part per million per year.

c) Phase

The integrated phase noise on the transmit carrier shall be less than 3 degrees RMS when measured through a phase locked loop two sided noise bandwidth (2 BL) of 20 Hz and within +/-2 kHz (See Figure 1).

4. SPURIOUS EMISSIONS

a) Individual

The mean power of any emission supplied to the transmission line as compared with the mean power of the fundamental shall be in accordance with the following:

1) On any frequency removed from the assigned frequency (carrier frequency) by more than +/-1125 Hz but less than or equal to +/-2250 Hz at least 25 dB attenuation;

2) On any frequency removed from assigned frequency (carrier frequency) by more than +/-2250 Hz but less than or equal to +/-4500 Hz at least 35dB attenuation;

3) On any frequency removed from the assigned frequency (carrier frequency) by more than +/-4500 Hz at least 60 dB attenuation.

TABLE 1 DCPRS TRANSMIT FREQUENCIES

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
1	401.7010	50	401.7745
2	401.7025	51	401.7760
3	401.7040	52	401.7775
4	401.7055	53	401.7790
5	401.7070	54	401.7805
6	401.7085	55	401.7820
7	401.7100	56	401.7835
8	401.7110	57	401.7850
9	401.7130	58	401.7865
10	401.7145	59	401.7880
11	401.7160	60	401.7895
12	401.7175	61	401.7910
13	401.7190	62	401.7925
14	401.7205	63	401.7940
15	401.7220	64	401.7955
16	401.7235	65	401.7970
17	401.7250	66	401.7985
18	401.7265	67	401.8000
19	401.7280	68	401.8015
20	401.7295	69	401.8030
21	401.7310	70	401.8045
22	401.7325	71	401.8060
23	401.7340	72	401.8075
24	401.7355	73	401.8090
25	401.7370	74	401.8105
26	401.7385	75	401.8120
27	401.7400	76	401.8135
28	401.7415	77	401.8150
29	401.7430	78	401.8165
30	401.7445	79	401.8180
31	401.7460	80	401.8195
32	401.7475	81	401.8210
33	401.7490	82	401.8225
34	401.7505	83	401.8240
35	401.7520	84	401.8255
36	401.7535	85	401.8270
37	401.7550	86	401.8285
38	401.7565	87	401.8300
39	401.7580	88	401.8315
40	401.7595	89	401.8330
41	401.7810	90	401.8345
42	401.7825	91	401.8360
43	401.7640	92	401.8375
44	401.7655	93	401.8390
45	401.7670	94	401.8405
46	401.7685	95	401.8420
47	401.7700	96	401.8435
48	401.7715	97	401.8450
49	401.7730	98	401.8465
		99	401.8480

TABLE 1 DCPRS TRANSMIT FREQUENCIES (CONT.)

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
100	**401.8495**	**150**	**401.9245**
101	**401.8510**	**151**	**401.9260**
102	**401.8525**	**152**	**401.9275**
103	**401.8540**	**153**	**401.9290**
104	**401.8555**	**154**	**401.9305**
105	**401.8570**	**155**	**401.9320**
106	**401.8585**	**156**	**401.9335**
107	**401.8600**	**157**	**401.9350**
108	**401.8615**	**158**	**401.9365**
109	**401.8630**	**159**	**401.9380**
110	**401.8645**	**160**	**401.9395**
111	**401.8660**	**161**	**401.9410**
112	**401.8675**	**162**	**401.9425**
113	**401.8690**	**163**	**401.9440**
114	**401.8705**	**164**	**401.9455**
115	**401.8720**	**165**	**401.9470**
116	**401.8735**	**166**	**401.9485**
117	**401.8750**	**167**	**401.9500**
118	**401.8765**	**168**	**401.9515**
119	**401.8780**	**169**	**401.9530**
120	**401.8795**	**170**	**401.9545**
121	**401.8810**	**171**	**401.9560**
122	**401.8825**	**172**	**401.9575**
123	**401.8840**	**173**	**401.9590**
124	**401.8855**	**174**	**401.9605**
125	**401.8870**	**175**	**401.9620**
126	**401.8885**	**176**	**401.9635**
127	**401.8900**	**177**	**401.9650**
128	**401.8915**	**178**	**401.9665**
129	**401.8930**	**179**	**401.9680**
130	**401.8945**	**180**	**401.9695**
131	**401.8960**	**181**	**401.9710**
132	**401.8975**	**182**	**401.9725**
133	**401.8990**	**183**	**401.9740**
134	**401.9005**	**184**	**401.9755**
135	**401.9020**	**185**	**401.9770**
136	**401.9035**	**186**	**401.9785**
137	**401.9050**	**187**	**401.9800**
138	**401.9065**	**188**	**401.9815**
139	**401.9080**	**189**	**401.9830**
140	**401.9095**	**190**	**401.9845**
141	**401.9110**	**191**	**401.9860**
142	**401.9125**	**192**	**401.9875**
143	**401.9140**	**193**	**401.9890**
144	**401.9155**	**194**	**401.9905**
145	**401.9170**	**195**	**401.9920**
146	**401.9185**	**196**	**401.9935**
147	**401.9200**	**197**	**401.9950**
148	**401.9215**	**198**	**401.9965**

(b) Combined

All combined transmitter spurious emissions within a +/-500 kHz bandwidth when

measured in a 50 Ohm load and with a duplexer (if used) connected, shall be down from the unmodulated carrier level by 50 dB. The measurement IF bandwidth shall be 30 kHz.

5. TRANSMISSION FORMAT (See Figure 2)

a) Preamble

Data transmissions shall be preceded by the following sequence:

1. A minimum of 0.5 seconds of unmodulated carrier.

2. A minimum of 0.48 seconds of alternating ones and zeros.

3. Exactly 0.15 seconds (15 bits) of the Maximal Length Sequence (MLS) sync word (100010011010111---MSB first).

4. Exactly 0.31 seconds (31 bits) Bose-Chaudhuri-Hocquenghem (BCH) coded address word (0011010010000101011101100011111---MSB first) is expressed as 3485763E in Hexidecimal.

Maximum duration of this preamble shall be 1.5 seconds.

As an additional operating mode, the DCPRS may transmit the following preamble:

5. A minimum of 4.9 seconds of unmodulated carrier.

6. A minimum of 2.4 seconds of alternating ones and zeros.

7. Exactly 0.15 seconds (15 bits) of the Maximal Length Sequence (MLS) sync word (100010011010111---MSB first).

8. Exactly 0.31 seconds (31 bits) Bose-Chaudhuri-Hocquenghem (BCH) coded address word (0011010010000101011101100011111---MSB first) is expressed as 3485763E in Hexidecimal.

Maximum duration of this additionally supported preamble shall be 8.0 seconds.

b) Data

All data transmissions shall be in accordance with the American Standard Code for Information Interchange (ASCII). Furthermore, the following ASCII control characters shall not appear in the DCPRS data message - DLE, NAK, SYN, ETB, CAN, GS, RS, SOH, STX, ETX, ENQ, ACK, and EOT.

c) End of Transmission

Immediately after sending the sensor data, shall transmit a End of Transmission

(EOT) code (bit pattern 00000100 - LSB first). This eight bit code is a ASCII EOT with odd parity. This code shall be sent continuously at the end of the sensor data no break) and return to the standby condition.

6. MANCHESTER ENCODING

All binary data shall be Non Return to Zero (NRZ) Manchester encoded (split phase).

7. MODULATION

a) Phase Shift Keying

All Manchester encoded binary data shall modulate the carrier in the following manner:

1) The carrier shall be the reference as zero phase.

2) A data "0" shall consist of a $+60^{\circ} \pm 5^{\circ}$ carrier phase shift for 5 milliseconds, followed by a $-60^{\circ} \pm 5^{\circ}$ carrier phase shift for 5 milliseconds.

3) A data "1" shall consist of a $-60° \pm 5°$ carrier phase shift for 5 milliseconds, fo1lowed by a $+60° \pm 5°$ carrier phase shift for 5 milliseconds.

b) Data Rate

The data rate shall be 100 bit/s $\pm$0.03 bit/s.

c) Data Asymmetry

The data asymmetry shall not exceed $\pm$1% of the bit period.
The modulation definition is shown in Figure 3.

8. FAIL SAFE DESIGN

The DCPRS shall incorporate a "fail safe" design feature such that malfunctioning of the equipment shall in no way cause continuous transmission. The fail safe feature must incorporate a circuit independent of the normal transmission sequencer that permanently removes the supply voltage to the power amplifier. The fail safe shall prevent a transmission from exceeding 4½ minutes in duration. It sha11 also ensure a minimum of 60 seconds off-time between successive transmissions.

9. REPORTING TIME

a) Short Term

The DCPRS reporting time base shall be less than 0.5 parts per million over a temperature range of -40° C to + 50° C.

b) Long Term

Over the long term the reporting time base shall be such that it is always within 30 seconds of the assigned reporting time-- this is to be supported by analysis.

All transmission times and their duration shall be subject to the "fail safe" requirements of Section 8.

10. ANTENNA

a) Polarization

Polarization shall be right-hand circular, according to IEEE Standard 65.34.159 and have an axial ratio or equal to or less than 8 dB on axis.

b) Transmit Gain

A transmit gain shall be specified that results in the Maximum EIRP in paragraph 1 and the DCPRS so labeled.

November 16, 1981 S/SE5.WEM

No. S23.011

Reprint 1996

INTERROGATE DATA COLLECTION PLATFORM
RADIO SET CERTIFICATION STANDARDS
(Revised November 1981)

Definitions

Transmission	The combination of clear radio carrier and all bits of identification, data and any special sequences sent by a DCP.
Message	Relates to all or a portion of the data segment of a transmission; the message is a segment of data that is fully defined in a DCP management data base; a transmission will contain one or more messages.
Header Word	An 8-bit character whose low order 6 bits make up a binary number that identified a format retry stored in a DCP management data base for a specific DCP. A header word begins each message.
DCP	Contains one record per DCP that includes Data Base the Management characteristics of each parameter measured, plus a list of format entries that will identify each potential data message that the DCP can formulate and transmit.
Parameter	Data element measured by a sensor. Common hydrometeorology parameters include stream stage, precipitation and temperature.
Parameter Cycle	A procedure used by a DCP in acquiring and formatting multiple readings obtained over a period of time. Generally a cycle consists of specific measurements taken at prescribed times within a defined interval. A DCP may acquire and report data for several such time intervals by precisely repeating the prescribed cycle for each consecutive interval.
Parameter Update	Entry of a value (composite or point) for parameter into a DCP message. The value may be an instantaneous value or a computed value based on many sensor values measured since the last message update.
Two's Complement	A method of expressing negative numbers so that subtraction may be performed by a simple fixed-precision binary accumulator (adder). The negative value of a binary number is computed by complementing each bit and then adding one. (Example: The equation 4-6=-2 is computed as 4+(-6)=-2, which in 6-bit binary is 000100 + 111001 = 111101). The magnitude of a negative value is determine by taking its two's-complement. (i.e., -(-2)=+2 or -(11101)=000010).

1. RF POWER OUTPUT

The Effective Isotropic Radiated Power (EIRP), of a DCPRS and antenna shall not exceed 50 dBm under any combination of service conditions.

2. FREQUENCY CHARACTERISTICS

a) Received Frequency Characteristics

The DCPRS received radio-frequency (RF) shall be as follows:

1) The Geostationary Operational Environmental Satellite (GOES) East frequency - 468.8375 MHz.

2) The GOES West frequency - 468.8125 MHz or 468.825 MHz.

3) Furthermore, these frequencies shall be selectable without requiring realignment.

b) Transmit Frequency Characteristics

The DCPRS transmitted RF shall be in the 401.7 MHz to 402.0 MHz band. See Table 1. The DCPRS design, and the procedures specified in its associated Operations and Maintenance manual, shall provide a capability to adjust the transmit frequency to within +/-100 Hz.

3. STABILITY

a) Temperature

The transmitter carrier frequency shall change by less than +/-0.5 parts per million over the temperature range of -40°C to +50°C.

b) Long-Term

The long-term stability (including temperature variations) shall be better than ± one part per million per year.

c) Phase

The integrated phase noise on the transmit carrier shall be less than 3 degrees RMS when measured through a phase locked loop two sided noise bandwidth (2 BL) of 20 Hz and within +/-2 kHz (See Figure 1).

TABLE 1 DCPRS TRANSMIT FREQUENCIES

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27	401.7400	76	401.8135
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35	401.7520	84	401.8255
36	401.7535	85	401.8270
37	401.7550	86	401.8285
38	401.7565	87	401.8300
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47	401.7700	96	401.8435
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103	**401.8540**	**153**	**401.9290**
104	**401.8555**	**154**	**401.9305**
105	**401.8570**	**155**	**401.9320**
106	**401.8585**	**156**	**401.9335**
107	**401.8600**	**157**	**401.9350**
108	**401.8615**	**158**	**401.9365**
109	**401.8630**	**159**	**401.9380**
110	**401.8645**	**160**	**401.9395**
111	**401.8660**	**161**	**401.9410**
112	**401.8675**	**162**	**401.9425**
113	**401.8690**	**163**	**401.9440**
114	**401.8705**	**164**	**401.9455**
115	**401.8720**	**165**	**401.9470**
116	**401.8735**	**166**	**401.9485**
117	**401.8750**	**167**	**401.9500**
118	**401.8765**	**168**	**401.9515**
119	**401.8780**	**169**	**401.9530**
120	**401.8795**	**170**	**401.9545**
121	**401.8810**	**171**	**401.9560**
122	**401.8825**	**172**	**401.9575**
123	**401.8840**	**173**	**401.9590**
124	**401.8855**	**174**	**401.9605**
125	**401.8870**	**175**	**401.9620**
126	**401.8885**	**176**	**401.9635**
127	**401.8900**	**177**	**401.9650**
128	**401.8915**	**178**	**401.9665**
129	**401.8930**	**179**	**401.9680**
130	**401.8945**	**180**	**401.9695**
131	**401.8960**	**181**	**401.9710**
132	**401.8975**	**182**	**401.9725**
133	**401.8990**	**183**	**401.9740**
134	**401.9005**	**184**	**401.9755**
135	**401.9020**	**185**	**401.9770**
136	**401.9035**	**186**	**401.9785**
137	**401.9050**	**187**	**401.9800**
138	**401.9065**	**188**	**401.9815**
139	**401.9080**	**189**	**401.9830**
140	**401.9095**	**190**	**401.9845**
141	**401.9110**	**191**	**401.9860**
142	**401.9125**	**192**	**401.9875**
143	**401.9140**	**193**	**401.9890**
144	**401.9155**	**194**	**401.9905**
145	**401.9170**	**195**	**401.9920**
146	**401.9185**	**196**	**401.9935**
147	**401.9200**	**197**	**401.9950**
148	**401.9215**	**198**	**401.9965**

4. SPURIOUS EMISSIONS

a) Individual

The mean power of any emission supplied to the transmission line as compared with the mean power of the fundamental shall be in accordance with the following:

1) On any frequency removed from the assigned frequency (carrier frequency) by more than +/-1125 Hz but less than or equal to +/-2250 Hz at least 25 dB attenuation;

2) On any frequency removed from assigned frequency (carrier frequency) by more than +/-2250 Hz but less than or equal to +/-4500 Hz at least 35dB attenuation;

3) On any frequency removed from the assigned frequency (carrier frequency) by more than +/-4500 Hz at least 60 dB attenuation.

b) Combined

All combined transmitter spurious emissions within a +/-500 kHz bandwidth when measured in a 50 Ohm load and with a duplexer (if used) connected, shall be down from the unmodulated carrier level by 50 dB. The measurement IF bandwidth shall be 30 kHz.

5. TRANSMISSION FORMAT (See Figure 2)

a) Preamble

Data transmissions shall be preceded by the following sequence:

1) A minimum of 0.5 seconds of unmodulated carrier.
2) A minimum of 0.48 seconds of alternating ones and zeros.
3) Exactly 0.15 seconds (15 bits) of the Maximal Length Sequence (MLS) sync word (100010011010111---MSB first).
4) Exactly 0.31 seconds (31 bits) Bose-Chaudhuri-Hocquenghem (BCH) coded address word (0011010010000101011101100011111---MSB first) is expressed as 3485763E in Hexidecimal.

Maximum duration of this preamble shall be 1.5 seconds.

As an additional operating mode, the DCPRS may transmit the following preamble:

5) A minimum of 4.9 seconds of unmodulated carrier.
6) A minimum of 2.4 seconds of alternating ones and zeros.
7) Exactly 0.15 seconds (15 bits) of the Maximal Length Sequence (MLS) sync word (100010011010111---MSB first).

8) Exactly 0.31 seconds (31 bits) Bose-Chaudhuri-Hocquenghem (BCH) coded address word (0011010010000101011101100011111---MSB first) is expressed as 3485763E in Hexidecimal.

Maximum duration of this additionally supported preamble shall be 8.0 seconds.

b) Data

All data transmissions shall be in accordance with the American Standard Code for Information Interchange (ASCII). Furthermore, the following ASCII control characters shall not appear in the DCPRS data message.. DLE, NAK, SYN, ETB, CAN, GS, RS, SOH, STX, ETX, ENQ, ACK, and EOT.

c) End of Transmission

Immediately after sending the sensor data, shall transmit a End of Transmission (EOT) code (bit pattern 00000100 - LSB first). This eight bit code is a ASCII EOT with odd parity. This code shall be sent continuously at the end of the sensor data no break) and return to the standby condition.

6. MANCHESTER ENCODING

All binary data shall be Non Return to Zero (NRZ) Manchester encoded (split phase).

7. MODULATION

a) Phase Shift Keying

All Manchester encoded binary data shall modulate the carrier in the following manner:

1) The carrier shall be the reference as zero phase.

2) A data "0" shall consist of a $+60^{\circ} \pm 5^{\circ}$ carrier phase shift for 5 milliseconds, followed by a $-60^{\circ} \pm 5^{\circ}$ carrier phase shift for 5 milliseconds.

3) A data "1" shall consist of a $-60° \pm 5°$ carrier phase shift for 5 milliseconds, fo1lowed by a $+60° \pm 5°$ carrier phase shift for 5 milliseconds.

b) Data Rate

The data rate shall be 100 bit/s $\pm$0.03 bit/s.

c) Data Asymmetry

The data asymmetry shall not exceed $\pm$1% of the bit period.
The modulation definition is shown in Figure 3.

8. FAIL SAFE DESIGN

The DCPRS shall incorporate a "fail safe" design feature such that malfunctioning of the equipment shall in no way cause continuous transmission. The fail safe feature must incorporate a circuit independent of the normal transmission sequencer that permanently removes the supply voltage to the power amplifier. The fail safe shall prevent a transmission from exceeding 4½ minutes in duration. It sha11 also ensure a minimum of 60 seconds off-time between successive transmissions.

9. INTERROGATION SIGNAL

a) Format (See Figure 4)

The DCPRS shall be capable of receiving and demodulating the following sequence:

1) 4 bit Binary Coded Decimal (BCD) time code followed by,

2) 15 bit MLS sync word (bit pattern 100010011010111) followed by,

3) 31 bit BCH interrogate address word (e.g. bit pattern 0011010010000101011101100011111--MSB first in Hexidecimal. The DCPRS shall respond to one or more assigned addresses with 1 second. The DCPRS shall respond whenever the received sequence is exact or within tow bits of the assigned address(es). All transmission times and their durations shall be subject to the "fail safe" requirement --see Section 8.

b) Acquisition Time

The receiver shall acquire lock-on to the interrogation signal format in two minutes or less, from standby conditions when the interrogation signal carrier is within +/- 100Hz. The acquisition shall be accomplished in the presence of modulation.

c) Level

The DCPRS shall lock-on and demodulate the interrogation signal over the range of -100 dBm maximum to -130 dBm minimum centered at the carrier frequencies specified in Section 2 and measured at the receiver antenna terminals.

d) Mean Time to Cycle Slip (MTCS)

The MTCS for the carrier tracking loop shall be equal to or greater than 1 minute.

10. ANTENNA

a) Polarization

Polarization shall be right-hand circular, according to IEEE Standard 65.34.159 and

have an axial ratio or equal to or less than 8 dB on axis.

b) Transmit Gain

A transmit gain shall be specified that results in the Maximum EIRP in paragraph 1 and the DCPRS so labeled.

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RANDOM REPORTING DATA COLLECTION PLATFORM
RADIO SET CERTIFICATION STANDARDS
(Revised November 1981)

Definitions

Transmission	The combination of clear radio carrier and all bits of identification, data and any special sequences sent by a DCP.
Message	Relates to all or a portion of the data segment of a transmission; the message is a segment of data that is fully defined in a DCP management data base; a transmission will contain one or more messages.
Header Word	An 8-bit character whose low order 6 bits make up a binary number that identified a format retry stored in a DCP management data base for a specific DCP. A header word begins each message.
DCP	Contains one record per DCP that includes Data Base the Management characteristics of each parameter measured, plus a list of format entries that will identify each potential data message that the DCP can formulate and transmit.
Parameter	Data element measured by a sensor. Common hydrometeorology parameters include stream stage, precipitation and temperature.
Parameter Cycle	A procedure used by a DCP in acquiring and formatting multiple readings obtained over a period of time. Generally a cycle consists of specific measurements taken at prescribed times within a defined interval. A DCP may acquire and report data for several such time intervals by precisely repeating the prescribed cycle for each consecutive interval.
Parameter Update	Entry of a value (composite or point) for into a parameter DCP message. The value may be an instantaneous value or a computed value based on many sensor values measured since the last message update.
Two's Complement	A method of expressing negative numbers so that subtraction may be performed by a simple fixed-precision binary accumulator (adder). The negative value of a binary number is computed by complementing each bit and then adding one. (Example: The equation 4-6=-2 is computed as 4+(-6)=-2, which in 6-bit binary is 000100 + 111001 = 111101). The magnitude of a negative value is determine by taking its two's-complement. (i.e., -(-2)=+2 or -(11101)=000010).

1. RF POWER OUTPUT

The Effective Isotropic Radiated Power (EIRP), of a DCPRS and antenna shall not exceed 50 dBm under any combination of service conditions.

2. FREQUENCY CHARACTERISTICS

The DCPRS transmitted RF shall be in the 401.7 MHz to 402.0 MHz band. See Table 1. The DCPRS design, and the procedures specified in its associated Operations and Maintenance manual, shall provide a capability to adjust the transmit frequency to within +/-100 Hz.

3. STABILITY

(a) Temperature

The transmitter carrier frequency shall change by less than +/-0.5 parts per million over the temperature range of -40°C to +50°C.

(b) Long-Term

The long-term stability (including temperature variations) shall be better than ± one part per million per year.

(c) Phase

The integrated phase noise on the transmit carrier shall be less than 3 degrees RMS when measured through a phase locked loop two sided noise bandwidth (2 BL) of 20 Hz and within +/-2 kHz (See Figure 1).

4. SPURIOUS EMISSIONS

(a) Individual

The mean power of any emission supplied to the transmission line as compared with the mean power of the fundamental shall be in accordance with the following:

1) On any frequency removed from the assigned frequency (carrier frequency) by more than +/-1125 Hz but less than or equal to +/-2250 Hz at least 25 dB attenuation;

2) On any frequency removed from assigned frequency (carrier frequency) by more than +/-2250 Hz but less than or equal to +/-4500 Hz at least 35dB attenuation;

3) On any frequency removed from the assigned frequency (carrier frequency) by more than +/-4500 Hz at least 60 dB attenuation.

TABLE 1 DCPRS TRANSMIT FREQUENCIES

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
1	401.7010	50	401.7745
2	401.7025	51	401.7760
3	401.7040	52	401.7775
4	401.7055	53	401.7790
5	401.7070	54	401.7805
6	401.7085	55	401.7820
7	401.7100	56	401.7835
8	401.7110	57	401.7850
9	401.7130	58	401.7865
10	401.7145	59	401.7880
11	401.7160	60	401.7895
12	401.7175	61	401.7910
13	401.7190	62	401.7925
14	401.7205	63	401.7940
15	401.7220	64	401.7955
16	401.7235	65	401.7970
17	401.7250	66	401.7985
18	401.7265	67	401.8000
19	401.7280	68	401.8015
20	401.7295	69	401.8030
21	401.7310	70	401.8045
22	401.7325	71	401.8060
23	401.7340	72	401.8075
24	401.7355	73	401.8090
25	401.7370	74	401.8105
26	401.7385	75	401.8120
27	401.7400	76	401.8135
28	401.7415	77	401.8150
29	401.7430	78	401.8165
30	401.7445	79	401.8180
31	401.7460	80	401.8195
32	401.7475	81	401.8210
33	401.7490	82	401.8225
34	401.7505	83	401.8240
35	401.7520	84	401.8255
36	401.7535	85	401.8270
37	401.7550	86	401.8285
38	401.7565	87	401.8300
39	401.7580	88	401.8315
40	401.7595	89	401.8330
41	401.7810	90	401.8345
42	401.7825	91	401.8360
43	401.7640	92	401.8375
44	401.7655	93	401.8390
45	401.7670	94	401.8405
46	401.7685	95	401.8420
47	401.7700	96	401.8435
48	401.7715	97	401.8450
49	401.7730	98	401.8465
		99	401.8480

TABLE 1 DCPRS TRANSMIT FREQUENCIES (CONT.)

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
100	401.8495	150	401.9245
101	401.8510	151	401.9260
102	401.8525	152	401.9275
103	401.8540	153	401.9290
104	401.8555	154	401.9305
105	401.8570	155	401.9320
106	401.8585	156	401.9335
107	401.8600	157	401.9350
108	401.8615	158	401.9365
109	401.8630	159	401.9380
110	401.8645	160	401.9395
111	401.8660	161	401.9410
112	401.8675	162	401.9425
113	401.8690	163	401.9440
114	401.8705	164	401.9455
115	401.8720	165	401.9470
116	401.8735	166	401.9485
117	401.8750	167	401.9500
118	401.8765	168	401.9515
119	401.8780	169	401.9530
120	401.8795	170	401.9545
121	401.8810	171	401.9560
122	401.8825	172	401.9575
123	401.8840	173	401.9590
124	401.8855	174	401.9605
125	401.8870	175	401.9620
126	401.8885	176	401.9635
127	401.8900	177	401.9650
128	401.8915	178	401.9665
129	401.8930	179	401.9680
130	401.8945	180	401.9695
131	401.8960	181	401.9710
132	401.8975	182	401.9725
133	401.8990	183	401.9740
134	401.9005	184	401.9755
135	401.9020	185	401.9770
136	401.9035	186	401.9785
137	401.9050	187	401.9800
138	401.9065	188	401.9815
139	401.9080	189	401.9830
140	401.9095	190	401.9845
141	401.9110	191	401.9860
142	401.9125	192	401.9875
143	401.9140	193	401.9890
144	401.9155	194	401.9905
145	401.9170	195	401.9920
146	401.9185	196	401.9935
147	401.9200	197	401.9950
148	401.9215	198	401.9965

(b) Combined

All combined transmitter spurious emissions within a +/-500 kHz bandwidth when measured in a 50 Ohm load and with a duplexer (if used) connected, shall be down from the unmodulated carrier level by 50 dB. The measurement IF bandwidth shall be 30 kHz.

5. TRANSMISSION FORMAT (See Figure 2)

(a) Preamble

Data transmissions shall be preceded by the following sequence:

1. A minimum of 0.5 seconds of unmodulated carrier.

2. A minimum of 0.48 seconds of alternating ones and zeros.

3. Exactly 0.15 seconds (15 bits) of the Maximal Length Sequence (MLS) sync word (100010011010111---MSB first).

4. Exactly 0.31 seconds (31 bits) Bose-Chaudhuri-Hocquenghem (BCH) coded address word (0011010010000101011101100011111---MSB first) is expressed as 3485763E in Hexidecimal.

Maximum duration of this preamble shall be 1.5 seconds.

(b) Data

All data transmissions shall be in accordance with the standard format for random reporting (Appendix A). Furthermore, the following ASCII control characters shall not appear in the DCPRS data message.. DLE, NAK, SYN, ETB, CAN, GS, RS, SOH, STX, ETX, ENQ, ACK, and EOT.

(c) End of Transmission

Immediately after sending the sensor data, shall transmit a End of Transmission (EOT) code (bit pattern 00000100 - LSB first). This eight bit code is a ASCII EOT with odd parity. This code shall be sent continuously at the end of the sensor data no break) and return to the standby condition.

6. MANCHESTER ENCODING

All binary data shall be Non Return to Zero (NRZ) Manchester encoded (split phase).

7. MODULATION

(a) Phase Shift Keying

All Manchester encoded binary data shall modulate the carrier in the following

manner:

1. The carrier shall be the reference as zero phase.

2. A data "0" shall consist of a +60° ±5° carrier phase shift for 5 milliseconds, followed by a -60° ±5° carrier phase shift for 5 milliseconds.

3. A data "1" shall consist of a -60° ±5° carrier phase shift for 5 milliseconds, fo1lowed by a +60° ±5° carrier phase shift for 5 milliseconds.

(b) Data Rate

The data rate shall be 100 bit/s ±0.03 bit/s.

(c) Data Asymmetry

The data asymmetry shall not exceed ±1% of the bit period.
The modulation definition is shown in Figure 3.

8. FAIL SAFE DESIGN

The DCPRS shall incorporate a "fail safe" design feature such that malfunctioning of the equipment shall in no way cause continuous transmission. The fail safe feature must incorporate a circuit independent of the normal transmission sequencer that permanently removes the supply voltage to the power amplifier. The fail safe shall prevent a transmission from exceeding 4½ minutes in duration. It sha11 also ensure a minimum of 60 seconds off-time between successive transmissions.

9. REPORTING TIME

The time of report transmissions shall be uniformly random within the reporting interval. All transmission times and their durations shall be subject to the limitations of the "fail-safe" requirement - see Section 8.

10. ANTENNA

(a) Polarization

Polarization shall be right-hand circular, according to IEEE Standard 65.34.159 and have an axial ratio or equal to or less than 8 dB on axis.

(b) Transmit Gain

A transmit gain shall be specified that results in the Maximum EIRP in paragraph 1 and the DCPRS so labeled.

SCOPE

As specified in the applicable DCPRS certification specifications*, a random transmission has the following contents or characteristics.

- o 0.5 seconds of carrier
- o 0.48 seconds of alternating** one-zero (48 bits)
- o 15 bits of a message synchronization pattern** (100010011010111, MSB first)
- o 31 bits of address** (assigned uniquely to a DCP).
- o N x 8 bits of data**, transmitted LSB first.
- o 8 bits of an end-of-transmission sequence**.
- o 100 bps data rate**.

The format to be described herein applies only to the use of the 8-bit data characters identified above as data. All provisions of the certification standard remain intact and applicable.

This data standard is specifically intended to permit direct and immediate interpretation of environmental parameters transmitted through the GOES-DCS in the random mode. Adherence to this standard is mandatory unless a waiver has been obtained from NOAA/NESDIS.

NOTE: This standard does not establish limits on message length or transmission rate. Limitations on these parameters will be negotiated between NOAA/NESDIS and individual users.

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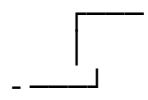
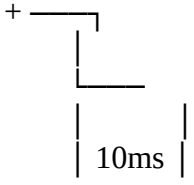
*S23.012, available from NOAA/NESDIS

**Manchester-encoded where, data 1 is +



and

data 0 is -



General

This standard specifies a standard format for Data Collection Platforms (DCP's) transmitting on random reporting channels. The format has been structured so as to also be compatible with many self-timed (in particular) and interrogated DCP's. The standard is based heavily on two assumptions: First, the proper interpretation and utilization of random data requires a data processing element within the data flow. Second, that the format of all transmissions from a complying platform can be decodable through the use of a properly constructed data base which is to be contained within the data processing facility.

This standard defines the necessary attributes of both a DCP and a data base to make the data processible and useful. The manner in which a DCP can be described by the data base determines both the format and the operating characteristics of the DCP.

DCPRS Message Format

The DCPRS transmission format is set forth in paragraph 3.1 for the pre-amble (carrier, clock, and FSS), the GOES ID code, and Flag Word (see Figure 1). The sensor or message data shall consist of a single 8-bit header word, followed by data from one or more sensors. As shown in Figure 2, the header word is always a number between 0 and 63 and represents the entry number in a DCP information file which describes the format being used for that message. Thus, a DCP is capable of transmitting up to 64 different formats and each format can be determined fully by knowing the header word and accessing a data base for that particular DCP.

PRE-AMBLE	**GOES ID 31-BIT ADDRESS**	**FLAG WORD**	**MESSAGE 1**	**SP**	**MESSAGE 2**	**SP**	**MESSAGE N**	**EOT**

Figure 1. DCPRS Transmit Format

EIGHT BIT HEADER WORD	**SENSOR 1 DATA**	**SENSOR 2 DATA**	**SENSOR N DATA**

Figure 2. DCPRS Message or Sensor Data Format

The sensor data after each header word must adhere to the following requirements:

1. Pseudo Binary Data Format

All header and sensor data will be converted to pseudo binary, regardless of its format from the sensor (analog, BCD, grey-coders, events, etc.). All data will be transmitted in a "modified ASCII" format utilizing 6- bits of an 8-bit character to represent part of each binary number. For data requiring 12-bit precision, two consecutive modified ASCII characters are needed as shown in the example below:

P	1	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	P	1	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}

1st DATA CHARACTER 2nd DATA CHARACTER

12-Bit Precision Data

For 18-bit precision, three characters are required:

P	1	2^{17}	2^{16}	2^{15}	2^{14}	2^{13}	2^{12}	P	1	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	P	1	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}

1st DATA CHARACTER 2nd DATA CHARACTER 3rd DATA CHARACTER

18-Bit Precision Data

Note that bits 7 and 8 of each character are a *"one" and an odd parity bit, respectively*. Thus, data is always expressed by N characters, each character representing N x 6 bits of information. Data within a character is transmitted least significant bit first.

*The 6-bit binary data sequence of all ones may be transmitted as 01111111 (an ASCII "DEL" character) or 10111111 (an ASCII “?” character).

2. Signed Parameters

Many parameters, temperatures in particular, may be expressed with negative values. In addition, the direction of change in a reading is often useful information and similar such parameter-related flags should also be handled efficiently. Therefore, data may be expressed in one of three ways:

a) as a positive fixed point value of precision (N x 6);

b) as a signed value in two's complement form having a precision of (plus or minus) (N x 6 -1); or

c) as a positive fixed point number of precision (N x 6 -1) with the high order bit used as a flag.

As an example of a negative value, a temperature value of 17 degrees below zero could be expressed with six bits as 101111. Whereas, a signed value of *+17 degrees would be expressed as 010001. See "Definitions" for an explanation of two's complement arithmetic.

For parameters not having negative values, but designated as being a parameter with a f lag, the high order bit is the f lag and the remaining bits are data in binary form. The precise interpretation of the flag bit is to be defined in the DCP's associated data base. As an example, the 11 bit precision accumulated precipitation value of 000001111011 (123) could indicate both the value of 1.23 inches (accumulated) and the fact that it is raining at the time of the measurement. Conversely, a value of 100001111011 indicates the same reading but signifies that no perceptible change has occurred since the last sensor update.

3. Order of Reporting

The most current data will be reported first within the DCP message.

4. Limitations on Data Content

This standard per se, places no restriction on the number of parameters being sensed, the accuracy of the measurements, or the number of readings within a message. The format of the message must, however, be describable by a data base (located in the receive system's computer) containing, as a minimum, the following elements:

a) For each parameter being reported;

1) Precision of the measurement being reported. This will always be a multiple of 6 (6, 12, 18, 24, etc.) unless it is a signed parameter or has a high-order flag bit (than it is 5, 11, 17, 23, etc.).

2) A flag indicating whether or not the data signed, or has a flag bit.

3) Calibration coefficients which will be applied to the data (if necessary).

b) For each possible format to be transmitted;

1) The message format number (0-63) which corresponds to the 8-bit header word beginning each message.

2) Parameter cycle time (in seconds or minutes) - an N/A (not appropriate) flag may be used to indicate data is not reported in cycles.

3) Cycle offset (in minutes) -- the time delay from the end of the last complete up-date cycle, reported, to the beginning of transmission. If this value is N/A, the data is assumed to be transmitted in real-time, or the time delay between measurement and reporting is to be reported as a parameter within the message. This value will be *N/A for random or interrogated transmissions.

4) A list of parameters contained within the message (or parameter cycle, if the data is reported in cycles): along with the time of the sensor update relative to the beginning of the message. If any given parameter is updated (reported) several times within a cycle, that parameter (with the corresponding time) will be listed for each update.

If time delay is itself a reported parameter, it will be listed in the data base--the *DCP will transmit this value immediately before all parameters associated with it.

5) Cycles per message (if appropriate). This value indicates the number of times the listed parameters are repeated. An N/A flag would indicate either no repeats, or an indeterminate number of parameter groups (a time delay value,

with one or more data values).

6) Multiple Messages Within A Transmission. A transmission may contain more than one message. Generally, multiple messages will be used when two or more formats (as defined in the data base) are needed to transmit all the desired data. Multiple massages can also be utilized to transmit new data along with previously transmitted data --- where possible, multiple parameter cycles should be utilized in lieu of multiple messages.

Transmissions containing multiple messages will have a single ASCII space character (00100000 - LSB first) between each message. Note: the seventh bit (underlined) is a zero and thus is not a valid data character.

7) Bad Data. If a sensor fails, or if for some reason the DCP is unable to transmit, proper data, an ASCII (/) character (00101111) may be substituted for each data character. Note, the 7th bit of this character is not a one, and cannot therefore be a valid data character.

INTERNATIONAL

DCS USERS GUIDE

A N N E X 4

CERTIFICATION SPECIFICATIONS

INTERNATIONAL CERTIFICATION SPECIFICATIONS

1. RADIO FREQUENCY OUTPUT POWER

The Effective Isotropic Radiated Power (EIRP) of the DCPRS and antenna including the interconnecting cable shall not exceed 52 dBm under any combination of service conditions.

2. TRANSMIT FREQUENCY

The transmitted radio-frequency signal shall be in the 402.001 MHz to 402.100 MHz band.

Table 1 provides the frequency of the unmodulated carrier for the 33 channels.

3. FREQUENCY STABILITY

3.1 Temperature and Long-Term

The transmitting carrier frequency stability shall be better than 1.5 parts per million against temperature variations and aging altogether. This specification applies typically over the temperature range of -20°C to +50°C and over one year, unless specified differently by the DCP Operator.

3.2 Short-Term

The phase jitter on the transmit carrier shall be less than 3 degrees RMS when measured through a phase lock loop two sided noise bandwidth (2BL) of 20 Hz and within 2 kHz (see Figure 1).

4. ELECTROMAGNETIC INTERFERENCE

Any transmitter spurious emissions, when measured with modulation and with antenna and diplexer connected, shall be down from the unmodulated carrier level by 60 dB (referred to a measurement bandwidth of 500 Hz, corresponding to -62 dB at 300 Hz).

5. TRANSMIT DATA

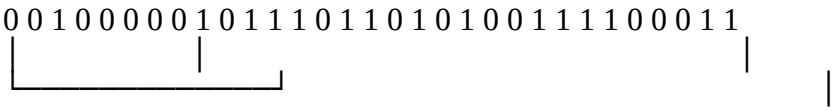
After 5 seconds of unmodulated carrier, the carrier shall he modulated with the bit and message synchronization data patterns which are 2.5 seconds of alternate "1" "O" data bits, and the 46 bit preamble consisting of the 15 bit MLS synchronization word followed by the 31 bit BCH command word. The binary data shall be Manchester encoded and shall modulate the carrier in the following manner: a data "O" shall consist of +60° carrier phase shift for 5 millisecond followed by -60° carrier phase shift for 5 milliseconds, and a data "1" shall consist of -60° carrier phase shift for 5 milliseconds followed by +60° carrier phase shift for 5 milliseconds (see Figure 2). The phase of the 5 second unmodulated carrier shall correspond to the phase zero of the modulated carrier.

TABLE 1 TRANSMIT FREQUENCIES

Channel No.	Frequency MHz
1	402.002500
2	402.005500
3	402.008500
4	402.011500
5	402.014500
6	402.017500
7	402.020500
8	402.023500
9	402.026500
10	402.029500
11	402.032500
12	402.035500
13	402.038500
14	402.041500
15	402.044500
16	402.047500
17	402.050500
18	402.053500
19	402.056500
20	402.059500
21	402.062500
22	402.065500
23	402.068500
24	402.071500
25	402.074500
26	402.077500
27	402.080500
28	402.083500
29	402.086300
30	402.089500
31	402.092500
32	402.095500
33	402.098500

6. END OF TRANSMISSION

The End of Transmission code is 31 bits long. The first 8 bits of it correspond to the EOT character of the International Alphabet No. 5.



EOT - First transmitted bit

Last transmitted bit

7. FAIL-SAFE DESIGN

The DCPRS shall incorporate a "fail-safe" design feature such that malfunctioning of the equipment shall in no way cause continuous transmission. Furthermore, provision shall be made to automatically terminate the transmission at a time not to exceed the platform's allocated transmission plus 30 seconds.

8. ANTENNA POLARIZATION

Polarization shall be right-hand circular according to CCIR Report No. 321 (XIIIth Plenary Assembly, 1974, Vol. XII).

9. START SIGNAL

The DCPRS shall provide a start signal at the required time of transmission. This start signal will initiate the read-out of data from the interface unit.

10. TIMING ACCURACY

The timer which determines the DCPRS reporting time shall be of sufficient accuracy to ensure that the DCPRS reporting time is maintained to within 30 seconds of its assigned reporting time. The timer shall provide for a reporting interval of 1 to 12 hours in 1 hour steps. Furthermore, the timer shall be capable of being set in steps of 60 seconds.

11. CLOCK OUTPUT

The DCPRS shall provide a 100Hz clock frequency which shall be used to clock in the reply data. The 100Hz clock frequency shall have a long term and temperature stability of better than 50 parts per million.

12. DATA INPUT

The DPCRS shall accept, from an interface unit with environmental sensors or manual data input device, a serial bit flow NRZ-L, 100 bits/sec coded in International Alphabet No. 5.

FIGURE 1. Phase Noise Measurement Principle.

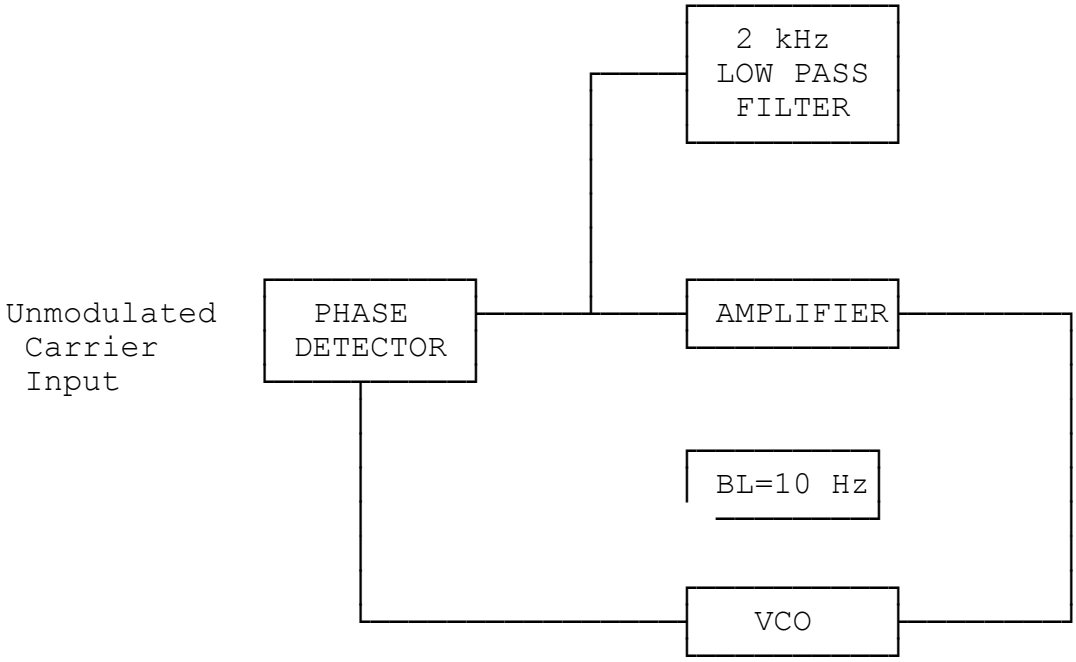
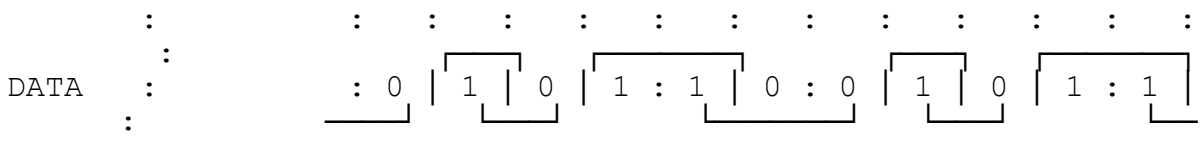


FIGURE 2. Modulation Definition.



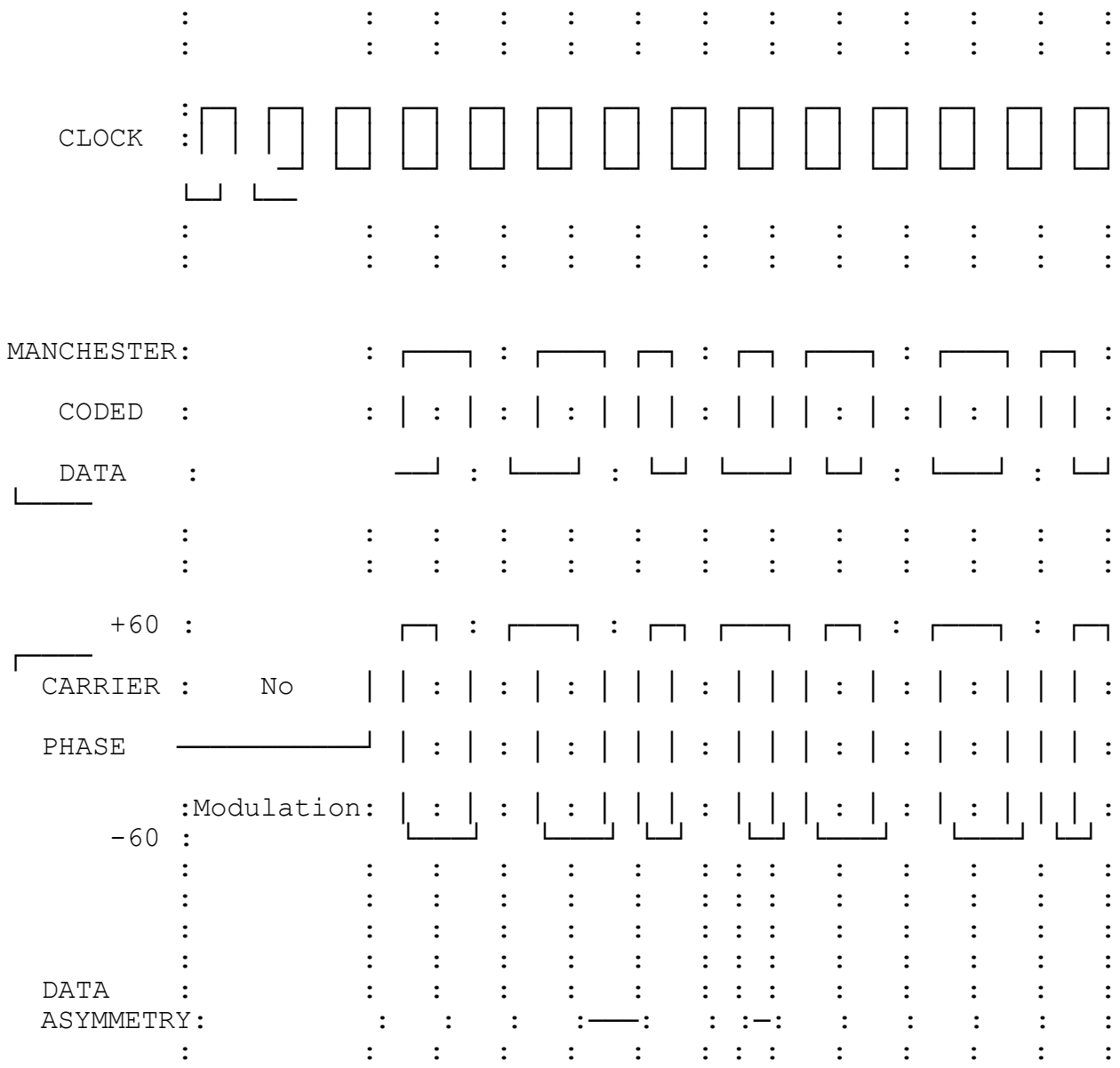
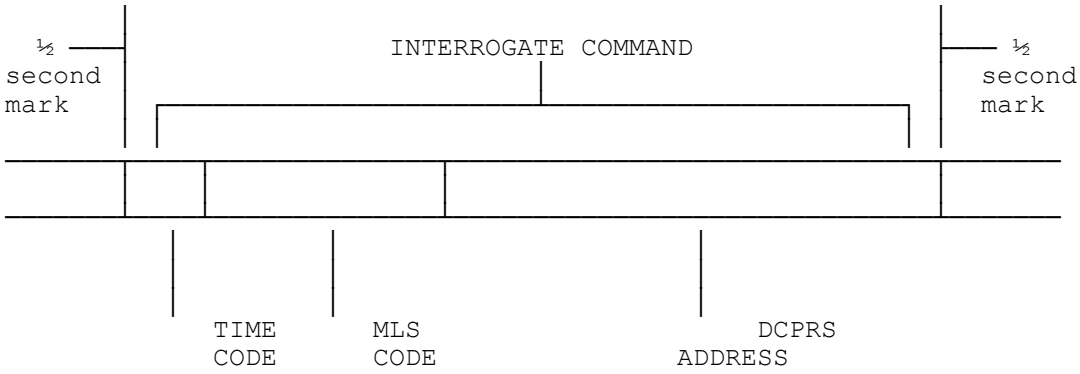

CLOCK
MANCHESTER
CODED
DATA
+60
CARRIER
No
PHASE
Modulation
-60
DATA
ASYMMETRY

FIGURE 4. Interrogate Message Format.



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