APPENDIX A- Recommended Test Equipment and Test Set Up

At a minimum, the following test equipment or approved equal are required.

NOAA GOES DCS Tx Test Set (TS) - The TS provides sufficient information to confirm the vast majority of the CS specifications. Also, the TS provides convenient test points on the front and rear of the unit that simplify connections to other required or user preferred test equipment (e.g. Spectrum Analyzer, Oscilloscope). Complete details of the use of the NOAA TS are provided in the *NOAA GOES DCS Certification Test Set Operation Manual.*

Provided below is an example of the Test Set output (line numbers are for reference only). Some output statistics not directly related to CS testing have been turned off).

Line	Test Set Output
1	CP=+48.2
2	101000001011001110N
3	7710061A20
4	001THE QUICK BROWN FOX JUMPED OVER THE LAZY DOGS BACK
5	002THE QUICK BROWN FOX JUMPED OVER THE LAZY DOGS BACK
6	003THE QUICK BROWN FOX JUMPED OVER THE LAZY DOGS BACK
7	004THE QUICK BROWN FOX JUMPED OVER THE LAZY DOGS BACK
8	005THE QUICK BROWN FOX JUMPED OVER THE LAZY DOGS BACK
9	.
10	.
11	.
12	066THE QUICK BROWN FOX JUMPED OVER THE LAZY DOGS BACK
13	067THE QUICK BROWN FOX JUMPED OVER THE LAZY DOGS BACK
14	068THE QUICK BROWN FOX JUMPED OVER THE LAZY DOGS BACK
15	069THE QUICK BROWN FOX JUMPED OVER THE LAZY DOGS BACK
16	070THE QUICK BROWN FOX JUMPED OVER THE LAZY DOGS BACK
17	EOT RECEIVED
18	BER =0
19	Par Errs =0
20	Freq Dev =+20.7,+20.1
21	Avg Power=+48.0
22	Sym Total=15432
23	Car RMS =0.16,67
24	Good Phases 15424 of 15424, 100.0%
25	P 0 = +0.24, 0.76 RMS,1897, +48.07
26	P 45 = +0.13, 0.75 RMS,1881, -0.01
27	P 90 = -0.15, 0.69 RMS,1675, +0.01
28	P 135 = -0.18, 0.77 RMS,1949, +0.01
29	P 180 = +0.04, 0.74 RMS,1853, +0.00
30	P 225 = -0.15, 0.80 RMS,2136, -0.05
31	P 270 = -0.22, 0.76 RMS,2029, -0.06
32	P 315 = +0.32, 0.77 RMS,2004, -0.06
33	P Avg = +0.01, 0.75 RMS, +0.32
34	Msg Lng =01:43.492
35	Car Time =0.500
36	Clk Bits =3
37	Frequency/Symbol Rate
38	0, +20.7
39	10, +20.7, +150.0140
40	20, +20.6, +150.0130
41	30, +20.6, +150.0126
42	40, +20.5, +150.0132
43	50, +20.5, +150.0129
44	60, +20.4, +150.0131
45	70, +20.3, +150.0137
46	80, +20.2, +150.0131
47	90, +20.2, +150.0124
48	100, +20.1, +150.0122
50	Avg, +20.4, +150.0130
51	Min, +20.1, +150.0122
52	Max, +20.7, +150.0140
53	END OF STATISTICS

As shown above, the TS makes signal quality measurements of all the signal variables of power, frequency, and phase. In the test case, the measurements are required to be made in different sequences and accuracies. However, multiple specifications can be confirmed at a single power supply/temperature point simply by sending a single short duration messages. The table below provides a summary of some of the capabilities/features of the TS with references to the example output above and the applicable specification section.

Parameter Type	**Example Line(s)**	**Section(s)**	**Notes**
Carrier	1 & 35	3.1	Carrier Detect & Duration
Clock	2 & 36	3.1	3 Clock Bits = **101**0000001011001110N
FSS	2	3.1	FSS = 10**10000001011001110N**
GOES ID	3	3.1	ID = **7710061A**20
Flag	3	3.1	ID = 7710061A**20**
Scrambling Modulation	4-16	3.2 3.3 3.5	Message data confirms Scrambling and Modulation; also supports Trellis Encoding.
Encoding	18	3.3 3.5	BER = Bit Errors Received = bits corrected by trellis decoder. 0 => Proper Trellis & Modulation Encoding.
Encoder Flush	22 & 24	3.4	The difference between the Sym Total & Good Phase Total = Encoder Flush Symbols (2 Bits/Symbol) *Note: Front Panel Test Points could be used with oscilloscope to turn off time, or TS could be modified to incorporate this test ± ~60 microseconds.*
Format	3-16	3.6	Flag & Message Data used to confirm Format
EOT	17	3.6.2	Receipt of non-printable EOT confirmed
RF Power	21	4.1.1	Average power to 0.1 dB provided in relative EIRP. TS provides absolute power measurement for initial setting of IF Gain adjust. Once set, message statistics provide relative measurements over temp & power.
Channel Tuning/ Frequency	20	4.2.1.	TS can be tuned to any GOES DCS channel using a menu system, proper reception of message on selected channels within frequency limit confirms transmitter tuning – room temp & nominal power test.
Freq, Long	20	4.2.2	Frequency error at start and end of message confirms Long Term Frequency Stability over power and temp
Freq, Short	37-52	4.2.3	Frequency table provides requisite ten-second measurement.
Symbol Rate	37-52	4.2.3	Symbol Rate table provides ten-second measurements, along with summary stats (Avg, Min, & Max). Messages less than 10 seconds provide single value.
Carrier PN	23	4.4.1	Carrier Phase Noise measured during preamble. TS also provides special Carrier Test mode for measuring power, frequency, and phase noise of constant carrier.

Parameter Type	Example Line(s)	Section(s)	Notes
Phase Bias	25-33	4.4.2	Phase Modulation Bias measured for all 8-ary symbols. Summary line (P Avg) provides numerical average and absolute magnitude of worst case bias.
Phase Error	25-33	4.4.3	RMS Phase Error computed for all symbols and composite average also provided.
Fail-safe	17 & 34	4.6	The total message length in minutes and seconds can be used to confirm fail-safe operation by forcing a message longer then the limit. The TS should indicate "No EOT" and a length not to exceed 110 seconds.

Laptop or IBM PC - To interface with the NOAA GOES DCS Tx Test Set. Must have a commercially available RS-232 serial port terminal application.

Spectrum Analyzer (SA) - The SA is needed to perform spectrum tests. The SA must be able to measure to the third harmonic at 1206 MHz and have the Resolution Bandwidth, averaging capability, etc. necessary to demonstrate compliance with the required spectrum.

General Purpose Oscilloscope - To measure the turn off time of the DCP message (see Section 3.4). May also be used to measure and/or observe the relationship of the "I" and "Q" signals.

Environmental Test Chamber (ETC) - The ETC is used to control the ambient test temperature of the DCP unit under test. A –40C to 50C range or greater is required.

Power Supply (PS) – The PS provides DC power to DCP unit under test and must be capable of being adjusted to the specified operating range (see Section 4.0).

The following test equipment or equal may be useful and/or used in place of the TS where applicable.

Frequency Meter (FM) - A FM may be used to measure transmit frequencies (401.7 to 402.1 MHz) and to measure the transmit symbol rate. When measuring transmit frequencies, the FM must have an absolute accuracy of ± 1Hz. When measuring the symbol rate, the FM must have and accuracy of 0.001%.

Digital Multi-Meter (DMM) - The DMM may be used for power supply voltage and other measurements as deemed appropriate.

RF Power Meter (RFPM) - The RFPM is used to measure the RF power amplifier output power. The response needs to be to RMS power. When using a RFPM, the total signal power out of the DCPRS shall be measured without external filtering. Power measurements shall be made specifically for un-modulated carrier, clock, and random 8 PSK modulation under standard conditions. Accuracy shall be ±0.25 dB or better. If the measurements are equal (within measurement tolerance), only 8 PSK modulated power need be measured at other conditions.

NOTE: A Bird Wattmeter Model 43 is intended to measure CW signals ± 5% of full scale. It

uses diode detectors to measure the peak value and is calibrated in RMS. A true RMS RFPM should be specified, such as a HP436A in conjunction with the calibrated attenuation provided in the TS.

Signal Generator (SG) *– No signal generator is required, the TS provides the requisite mix down.*

Low Frequency Signal Controller/Modulator *– Not required.*

DCPRS Test Capabilities Required

The following special features should be designed into the DCPRS to facilitate testing.

1) Ability to disable or enable the DCP fail-safe circuitry as needed. Either a software or a hardware disable may be used. However, in either case the ability to disable the fail-safe circuitry must not be readily available to the end user, and must not be documented.
2) Ability to provide a number of test modulation sequences, including the following:

a) Carrier only	carrier phase noise, frequency
b) Clock pattern "0-1"	clock pattern check and symbol rate
c) Random octal pattern	spectrum
d) Repeating short message sequence	format checks
e) Longer message, repeating pattern	phase, power, and spectral measurements