Comments to Certification Standard
Draft Release Date: May 26, 2006
Prepared by Microcom Design, Inc.

Introduction:

For clarity suggest "Test Receiver/Demodulator" be referenced as NOAA's GOES DCS Tx Test Set; i.e. the nomenclature on the front panel of the unit. (a.k.a. Test Set, TS for short).

May also want to reference GOES DCS Tx Test Set manual along with Appendix A.

1.3 Nameplate Information:

On item "d) Approved antennas …" , can this just be type & gain (e.g. 11dB Yagi) vs. manufacturer & P/N ?

2.1.1 Inhibiting Transmissions

The wording "calculate the amount its internal clock differs from UTC" seems a bit incongruous here. If a unit could "calculate" the difference with any accuracy, it could simply reset the internal clock accordingly.

Perhaps this should be phrased more like …

"The DCPRS must include an algorithm to ensure that transmissions are inhibited whenever it's possible the internal clock differs by more than ± 0.25 seconds and it's not possible to obtain an accurate time synchronization from an external source."

3.1 DCPRS Message Format (Frame Synchronization Sequence)

The proposed **FSS** is only 3 bits different from the current "No Interleaver" FSS. Currently the demodulators at Wallops CDA are required to recognize an interleaver with 2 bits in error. As such, a single bit error in one of these 3 positions would result in an indeterminate sequence.

Proposed:	(MSB)	000 0110 0100 1010
Current (NI):	(MSB)	000 0010 1100 1110
Difference:	(MSB)	--- -X-- X--- -X–

The minimum distance on the existing Frame Sync Sequences is 6 bits.

3.1 DCPRS Message Format (GOES ID/DCP address)

Recommend changing "to form 4 – 8 bits Bytes" to "to form four 8-bit bytes"

3.6.2 End of Transmission (EOT)

Still believe the “Binary Mode” paragraph should be eliminated until a complete binary spec is adopted.

Alternate implementations could use a block count/size structure (similar to the ARGOS format) that would eliminate the need for using an EOT sequence.

Specifying the use of an EOT sequence requires that this sequence not be transmitted as noted in paragraph 3.6.1. However, no definition as how to avoid this is provided. While the probability of needing to send this 32-bit pattern in the data steam is obviously extremely low, it can occur and both the transmitters and the demodulators need a reciprocal approach to handling this situation.

4.1.1 RF Power Output

Microcom is in agreement with Philip Whaley and prefers the nominal reference and maximum specification as in the previous HDR CS rather than the ± 1dB.

Forcing a lower limit precludes creative solutions to operating under extreme conditions. For example, it may be desirable to idle back the RF Power if the input supply voltage is below it’s nominal level for an extended period of time (albeit still within the specified operating range), possibly indicating a damaged solar panel. Intelligent algorithms could then try to conserve the remaining battery life by lowering the transmission power to provide sufficient time for repairs to occur.

Numerous discussions have taken place with regard to ultimately lowering all transmit EIRPs in the future. Microcom not only believes that defining a maximum is in harmony with this goal, but would further suggest that a requirement for a mechanism to lower the output power be included in this CS.

Also, Microcom prefers the specific wording from the previous HDR CS of “power supply or temperature variation” versus “under any combination of operating conditions”.

Would also like to see power output specifically referenced to the “transmitter” not the “DCPRS”. Referencing the DCPRS and stating the power output in EIRP along with the clause “under any combination of operating conditions” seems to imply the antenna should also be included in the testing and in every configuration since the DCPRS includes the antenna.

Microcom recognizes this is not the intention of this section. During the normal course of certification testing, the antenna’s gain is used to determine the power output from the transmitter and then the testing proceeds by measuring the transmitter’s RF output power into ideal load (i.e. the Test Set) over power supply and temperature; obviously, the antenna can not be placed in the temperature chamber. Note also, that the power output in watts is needed to determine the final step in the spectral mask as well. Once the nominal power output is confirmed with the Test or an RF Power Meter, the Test Set’s 5MHz IF Gain can be set to correspond to the nominal EIRP power level. From this point, the Test Set’s Average Power message statistic can be used to confirm this requirement in EIRP over power supply and temperature.

Microcom believes this section should be worded so as to reflect how the testing should be performed.

4.2.3 Short Term Frequency Stability

The NOAA GOES DCS Tx Test Set provides the necessary frequency measurements at ten-second intervals as part of the message statistics.

4.4 DCPRS Phase Modulation and Noise

The NOAA GOES DCS Tx Test Set provides the necessary phase measurements to confirm the requirements of these sections.

4.4.1 Carrier Phase Noise

It was Microcom's understanding that this section was to be deleted in it's entirety, which we would not object to. However, if it is to remain, then it should be noted that the 300 BPS demodulator's PLL loop bandwidth is 10 radians/sec. This yields a closed loop bandwidth of ~1.6 Hz (for 1200 BPS, the bandwidths are all scaled by a factor of 4). As such, 1/f noise below 10Hz is particularly critical.

The NOAA GOES DCS Tx Test Set provides the necessary measurement with the proper bandwidth to confirm this requirement. Therefore if this requirement is to remain, then it is recommended that the Carrier Phase Noise be measured with the Test Set.

4.4.2 Phase Modulation Bias

Can be measured and confirmed by Test Set.

4.4.3 Total Phase Error (Re-title to RMS Phase Error?)

Can be measured and confirmed by Test Set.

4.5 DCPRS Transmit Spectrum

After running some tests Microcom believes that requiring a Resolution Bandwidth (RBW) of 1 Hz results in unreasonably long sweep times and is unnecessary. Provided below are four screen shots captured from Microcom's Agilent E4402B ESA-E Series Spectrum Analyzer (a fairly high-end and relatively new unit). Also provided below is a summary table detailing the effect of RBW on capture times.

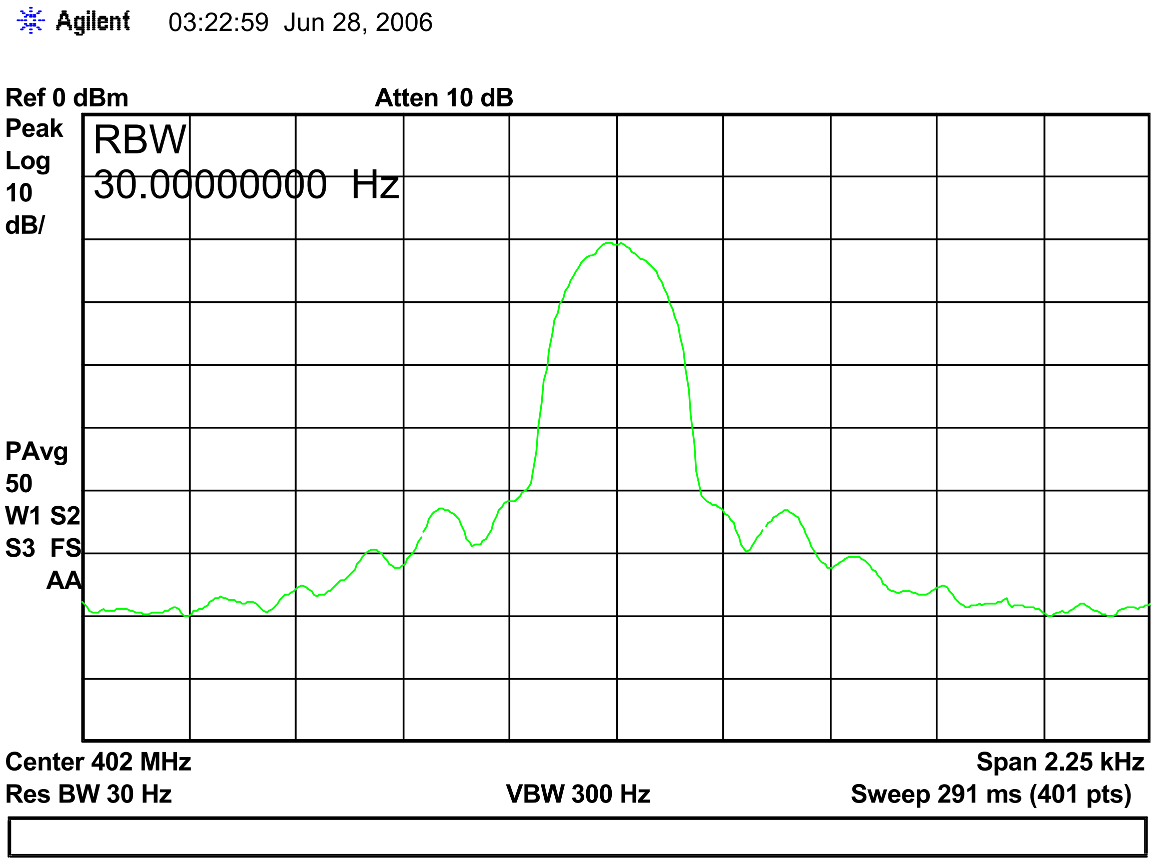
RBW	VBW	Sweep Time	Avg Mode	Avg Count	Capture Time
30 Hz	300 Hz	291 ms	Power RMS	50	25 s
10 Hz	100 Hz	717 ms	Power RMS	25	30 s
1 Hz	10 Hz	6.882 s	Power RMS	10	100 s
1 Hz	1 Hz	6.882 s	Video	10	110 s

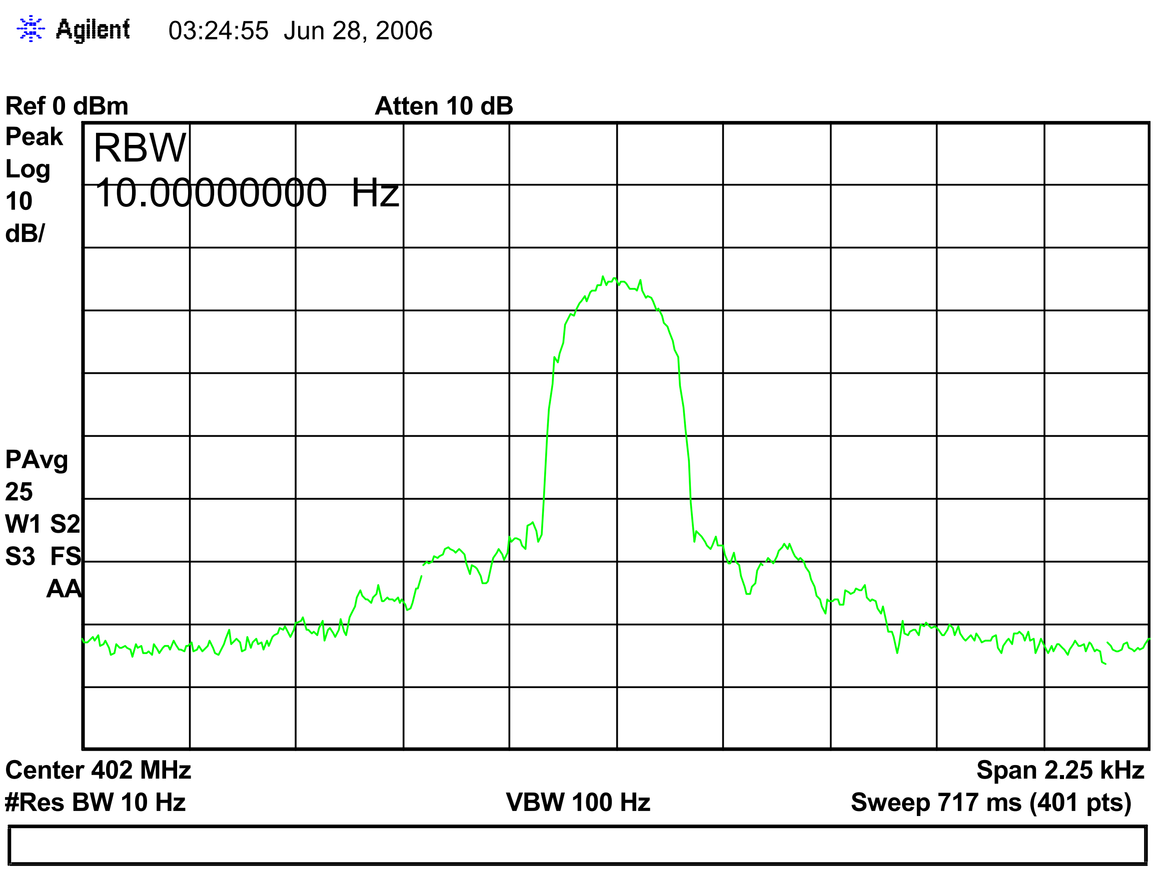
As is clear from these data and the screen shots, the least smooth trace and the longest capture time occurred with an RBW and VBW of 1 Hz in Video Average Mode.

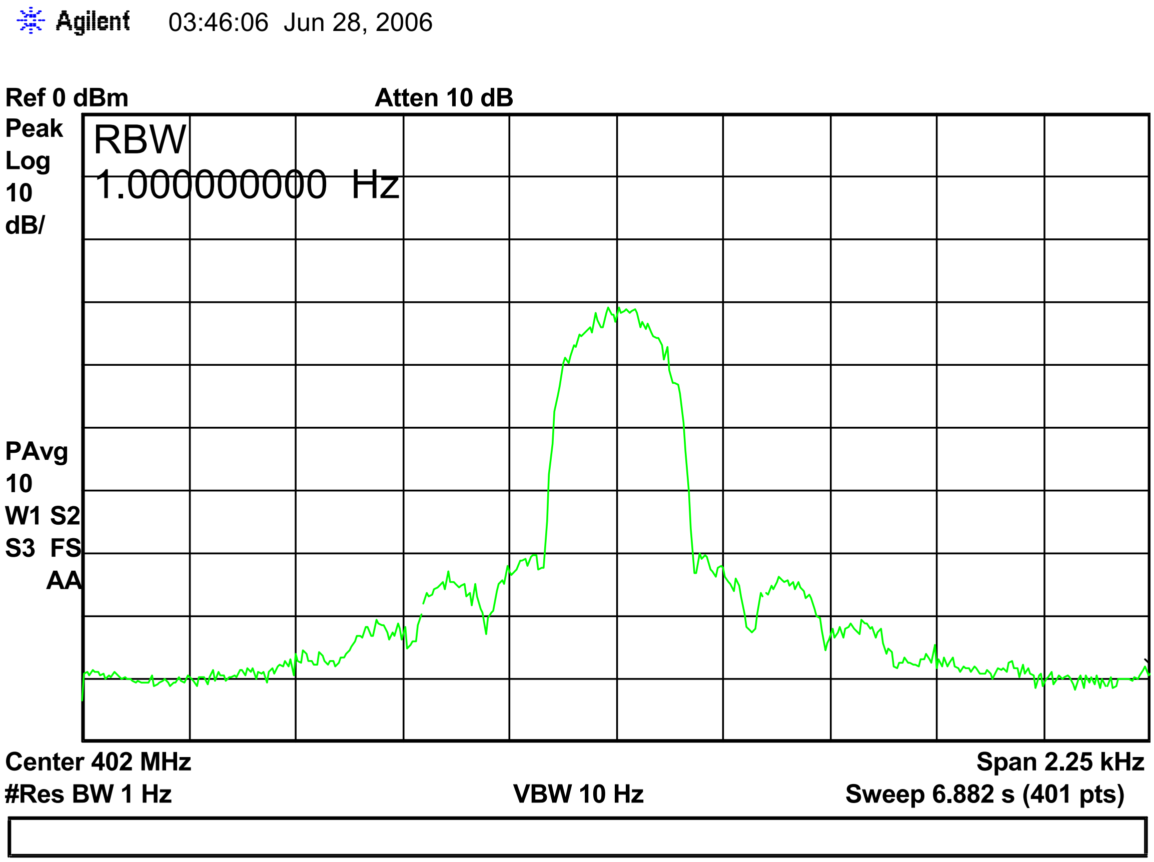
It should be noted that Agilent recommends using RMS Power averaging and a 10:1 VBW-to-RBW ratio for capturing signals such as these (see Agilent Application Note 1303). Further, the Agilent E4402B automatically selects 10:1 ratio when Power averaging is enabled and a 1:1 ratio when Video averaging is selected.

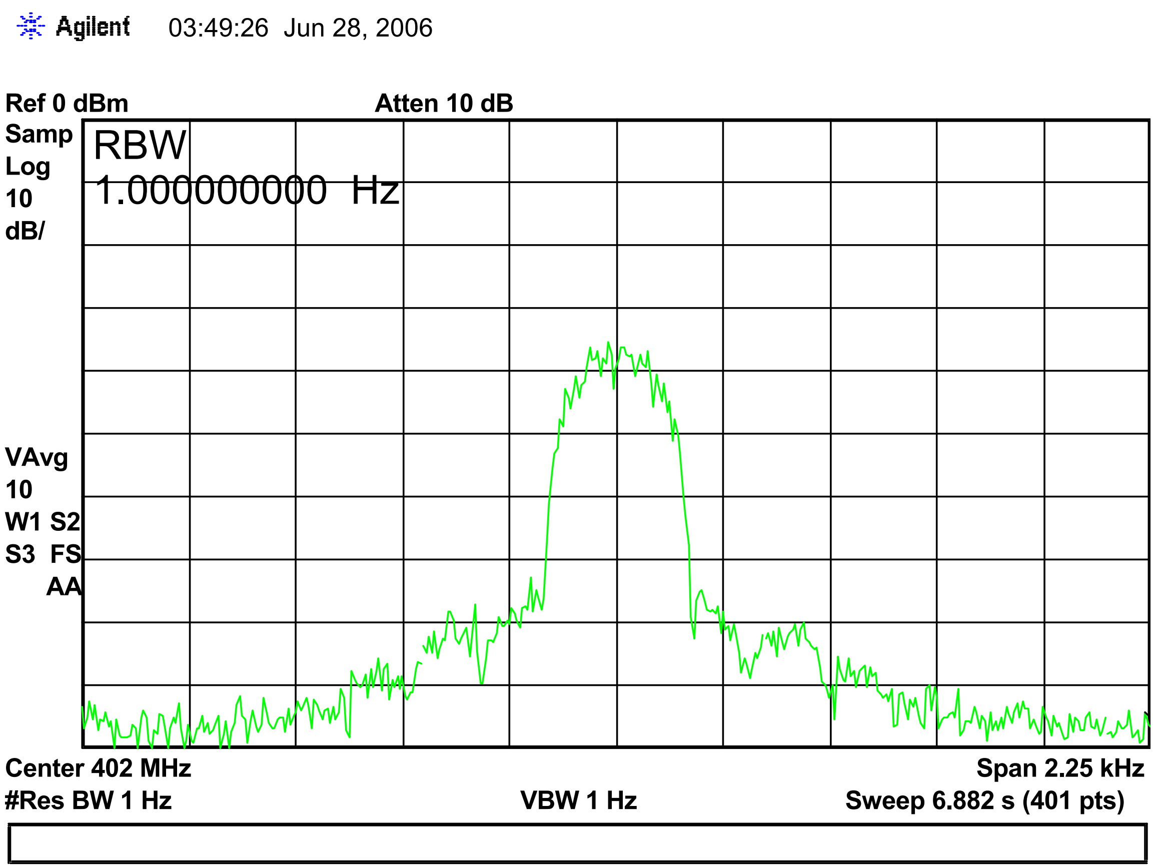
As is indicated in the table, when using a RBW of 1 Hz, the averaging count was reduced to only 10 sweeps so as to result in a capture time roughly equivalent to the fail-safe limit (i.e 110 seconds. Note that simply opening the RBW to 10 Hz allows the averaging count to be increased to 25 sweeps and still results in a complete capture taking a third to a fourth of the time. Beyond just speeding up the time to complete an individual capture, reducing the sweep time will significantly improves the overall test time since operating a transmitting for extended periods of time raises the temperature of the unit (due to self-heating). As such, extra time has to be expended to allow the unit to return to the ambient temperature before capturing the next run when each capture takes a long time.

In all the screen captures below, the span was set to 2,250 Hz (225 Hz per Div) so that the spectral mask steps align with the vertical grid. Actually capturing a valid spectral trace when the transmitter has to operate for 100 seconds or more can be problematic if the transmitter under test has a short term frequency drift close to the accepted limit of 1 Hz/sec. Such a transmitter would still be in spec (both short and long term) but would cause the spectral picture to shift by nearly ½ a division; smearing the averaged trace.


Agilent
03:22:59 Jun 28, 2006
Ref 0 dBm
Atten 10 dB
Peak
Log
10
dB/
RBW
30.00000000 Hz
PAvg
50
W1 S2
S3 FS
AA
Center 402 MHz
Span 2.25 kHz
Res BW 30 Hz
VBW 300 Hz
Sweep 291 ms (401 pts)


Agilent
03:24:55 Jun 28, 2006
Ref 0 dBm
Atten 10 dB
Peak
Log
10
dB/
RBW
10.00000000 Hz
PAvg
25
W1 S2
S3 FS
AA
Center 402 MHz
Span 2.25 kHz
#Res BW 10 Hz
VBW 100 Hz
Sweep 717 ms (401 pts)


Agilent
03:46:06 Jun 28, 2006
Ref 0 dBm
Atten 10 dB
Peak
Log
10
dB/
RBW
1.000000000 Hz
PAvg
10
W1 S2
S3 FS
AA
Center 402 MHz
Span 2.25 kHz
#Res BW 1 Hz
VBW 10 Hz
Sweep 6.882 s (401 pts)


Agilent
03:49:26 Jun 28, 2006
Ref 0 dBm
Atten 10 dB
Samp
Log
10
dB/
RBW
1.000000000 Hz
VAvg
10
W1 S2
S3 FS
AA
Center 402 MHz
Span 2.25 kHz
#Res BW 1 Hz
VBW 1 Hz
Sweep 6.882 s (401 pts)

As was noted previously, the above data was captured using a relatively new SA, and a 1 Hz RBW with a 2250 Hz span required ~ 6.9 seconds per sweep; the same setting on a useful but slightly older model SA (an HP 8560E) resulted in a sweep time of 9.0 seconds (a 30% increase).

All the times provided so far are for a transmitter being tested at 300 BPS. Applying the same 1 Hz RBW to 1200 BPS testing with the requisite factor of four increase in the span width increases the sweep time on the Agilent E4402B from 6.882 seconds to 20.65 seconds. The same change on the HP 8560E pushes the sweep time from 9.0 seconds to 34.2 seconds. Note that these are single sweep times (i.e. one pass across the screen) and do not account for the time to update the average trace; which must be significant as 10 averaged sweeps at 6.9 seconds per sweep took over 100 seconds not just 69-70 seconds.

Taking all this into account, Microcom recommends that the Resolution Bandwidth for 300 BPS be defined to be between 10 and 30 Hz, and the 1200 RBW be between 30 and 100 Hz. Further Microcom recommends that the VBW be specified to be consistent with the averaging mode used (Video vs. Power). Microcom reviewed the NTIA requirements and could not find any definitive requirement as to what RBW should be utilized. Section 1.1.3 of Annex M: Measurement Methods simply states …

> "The appropriate resolution bandwidth of the measurement system varies depending on the modulation type and frequency band but should not be greater than the necessary bandwidth of the transmitter being measured."

Microcom also recommends that a reasonable span range and RBW be defined for checking harmonics and spurious. While the spectral mask defines the limit, clearly this should not be from DC to Light.

Additonal Notes/Comments

See separate document for revised Appendix A

Appendix E is not necessary and can be deleted.

Missing commas after first clause in sections 2.1.2 and 2.2