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HIGH-ORDER Modulation Schemes
Comparison of operational levels for representative
Satellite Antennas

OVERVIEW

In cooperation with a major satellite provider and a major program vendor, SSE recently tested four popular satellite antennas that serve CATV, Broadcast, Private Cable and other services. The purpose was to determine if these antennas provide adequate performance characteristics to operate in the new "high-order" (DVB S2) modulation schemes that are becoming the preferred technology for satellite programming delivery. The new modulation schemes provide for multiple channels of programming via a single transponder. In order to do this a satellite antenna must generate adequate RF energy levels and, further, must isolate the cross-polarization energy of the target satellite and transponder and also isolate the RF energy/signal from the adjacent satellites. Set out below are the results of our test protocols and our comments.

Site: Superior Satellite Engineers
Columbia Falls, MT 48:22:25 North Lat.
114:10:51 West Long.

Test equipment: Hewlett Packard Model 8591E Spectrum Anylyzer
Hewlett Packard Model 7574A Plotter
Motorola DSR 6100 Satellite Receiver

Superior Satellite Engineers proprietary Feed System
Norsat Model 3220 Phase-lock Loop LNBs
20º Noise-temperature,
±10 dB Stability Factor,
62 dB Gain (nominal)

Antennas		
	*SSE Model 8345	4.5m
	**SSE Model 37 (Prodelin reflector)	3.7m
	**SSE Model 38 (Patriot reflector)	3.8m
	**SSE Model 38A (Andersen reflector)	3.8m

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Satellite - Galaxy 14, transponders 9 and 14 (ESPN HD)

*SSE mfg complete antenna, mount, feed system
**configured with SSE proprietary Feed System

COMPARISON DATA

ANTENNA & Config.	GALAXY 14 Transponder 9 EB/No	Transponder 14 EB/No	(avg.) Loss
SSE 4.5m			
On-boresight	11.9	11.7	-------
2º off-boresight	11.4 (-0.5)	11.1 (-0.6)	- .55
*4º off-boresight	9.4 (-2.5)	6.5 (-5.2	- 3.9
Prodelin 3.7m			
On-boresight	10.0	10.0	-------
2º off-boresight	6.8 (-2.4)	6.8 (-2.4)	- 2.4
Patriot 3.8m			
On-boresight	10.9	10.5	-------
2º off-boresight	10.0 (0.00)	8.7 (-1.8)	- 9.0
Andersen 3.8m			
On-boresight	11.1	10.0	-------
2º off-boresight			

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OBSERVATIONS and COMMENTS (per antenna/mfg)

SSE 4.5
We can see from the above that the 4.5m antenna exhibits insignificant Loss (average .55 EB/No Value) when aligned at ± 2º from the boresight position, and still easily supports the EB/No operational requirements. Note though, that the 4.5m suffers significant Loss on Transponder 14 when aligned at 4º off-boresight. We attribute the major up-tick in Loss - at 4º off-boresight - to the fact that one or both of the adjacent satellites has major high-order modulation schemes in operation that interfere with the target satellite and transponder (G14, transponder 14).

SSE 37 (Prodelin)
For most normal operations the SSE 37 is okay for boresight-only operations with nominal Margin levels. But, with an average of 2.8 EB/No value Loss when aligned at 2º off-boresight it is not recommended for Multiple-Satellite Feed System operations where high-order modulation schemes are employed.

SSE 38 (Patriot)
The 3.8m Patriot-configured system exhibits good EB/No values in both boresight and 2º off-boresight alignment. However, due to certain anomalies observed with the Patriot reflector we do not recommend using it for off-boresight reception on Galaxy 14 or other satellites/transponders with high-order Modulation Schemes. We are unable to explain why there is no detectable Loss with this antenna on Transponder 9 (Gal. 14) when the alignment is shifted to 2º off-boresight. This is most likely due to an inaccuracy in the reflector surface.

SSE 38A (Andersen)
The SSE/Anderson system also exhibits acceptable operation Levels with reference bore-sight configuration. We are not recommending it for Multiple-Satellite operations if the target satellite-transponder is using high-order Modulation delivery.

NOTE:
We have had numerous reports of rain-fade issues associated with 3.7m and 3.8m antennas with reference to the new high-order modulation schemes. This is unusual in that the C-band satellite environment is generally not affected significantly by rain-fade attenuation. We are not sure how to

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explain this anomaly, other than we think that perhaps the high-order Modulation Schemes are much more affected by moisture-driven attenuation than ordinary satellite transmissions with smaller antennas. We have not noted, nor received any field report's to indicate the bigger (4.5m and larger) antennas have been thus affected.

GENERAL

At this point it does not appear that we are faced with an immediate "the-sky-is-falling" situation. ESPN recently concluded a major migration to Galaxy 14, using DVB S2. There were a few failures associated with 3.7m and 3.8m antennas, some of which we replaced with our Series 8345 (4.5m) Antenna System. In general, we were able to assist our customers by having them point the (3.7m and 3.8m) antennas to boresight on Galaxy 14 and "peak" the antennas carefully in all three (azimuth, elevation and cross-polarization) axes. Some users are still having good results using our Multiple-Satellite Feed System with the 3.7m and 3.8m antennas to receive Galaxy 18 (123º) and Galaxy 12 (127º) with Galaxy 14 (125º) as the target/boresight satellite. We have significant concerns though, that as more and more programmers convert to the DVB S2 kinds of operations, we may see the Interference levels from the target-satellite cross-pole and the adjacent-satellite Interference combine to a level that the receiver may not generate adequate EB/No operating levels