FREEDOM
Communication Technologies

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To whom it may concern,

As early as October of 2015 Cobham AvComm has circulated a white paper with the title "*Is Your Digital RF Communication System Optimized to Provide the High Performance it was Designed to Deliver?*[1]" This paper claims that a service monitor currently in the market place does not have the "Deviation Meter Flatness" required to properly measure deviation or to make digital measurements.

When I reviewed this paper in December it was obvious to me that the unnamed specification cited came from the R8000 data sheet (a Freedom Communication Technologies Product), but the datasheet was improperly interpreted, ***making the claim contained in the paper totally false***. At the time I did not think much more about this as false claims by Cobham sales personnel are common, and we have dealt with such false claims for years.

However I have now heard more and more reports that even though the paper itself does not call out the R8000 name, in person Cobham sales representatives are telling end users that the test equipment with the "deviation meter flatness" issue is the R8000 product from Freedom Communication Technologies. As such I now feel compelled to respond to this "white paper" and the verbal claims by Cobham sales representatives that the R8000 does not have the "flatness" to measure deviation or make digital measurements.

Executive Summary

The information presented in the Cobham AvComm White Paper that the "Demodulation Output Amplitude Flatness" somehow degrades the internal analog and digital measurements made by the R8000 is incorrect. The output flatness characteristic of the DEMOD port only affects the analog signal presented at the port and has absolutely nothing to do with RF measurements made inside the R8000. A simplified block diagram of the RX path in the R8000 is presented to indicate where and when the "Demodulation Output Amplitude Flatness" is applicable. In addition an industry standard method to create signals with a known "peak deviation" is used to demonstrate that the R8000 does provided accurate deviation measurements as indicated by data sheet. The results are then confirmed by measurement of the same signals with a Rohde & Schwarz FSV Signal and Spectrum Analyzer.

Response to Cobham AvComm White Paper

Starting with the source of the claim, The AvComm White Paper lists the following information:

FM Deviation Measurement (with flatness specified)[4]:

Demodulation Range: Up to ±75 kHz
Accuracy: ±5% plus residual FM
Amplitude Flatness: ±0.2 dB (300 Hz to 3 kHz), 1 dB point at 20 kHz

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This source cited is listed as “4. Actual specification from a Digital Service Monitor, circa 2015.”

Multiple customers have indicated that Cobham sales personnel verbally told them the above information is from the R8000 data sheet. So let’s review what the R8000 data sheet actual says:

FM DEVIATION MEASUREMENT
Demodulation Range: Up to ±75 kHz
Accuracy: ±5% plus residual FM
Frequency Response: Selectable per the following:
- **Low Pass Filters: 300 Hz, 3 kHz, 20 kHz**
- **High Pass Filters: 1 Hz, 300 Hz, 3 kHz**

Demodulation Output Level:
- **6.25 kHz B/W: 2.56V / 1 kHz**
- **12.5 kHz B/W: 1.28V / 1 kHz**
- **25 kHz B/W: 0.64V / 1 kHz**
- **50 kHz B/W: 0.32V / 1 kHz**
- **100 kHz B/W: 1.6V / 10 kHz**
- **200 kHz B/W: 0.8V / 10 kHz**

Demodulation Output Amplitude Flatness: ±0.2 dB (300 Hz to 3 kHz),1dB point @ 20kHz
Demodulation Output Impedance: 100 ohms nominal

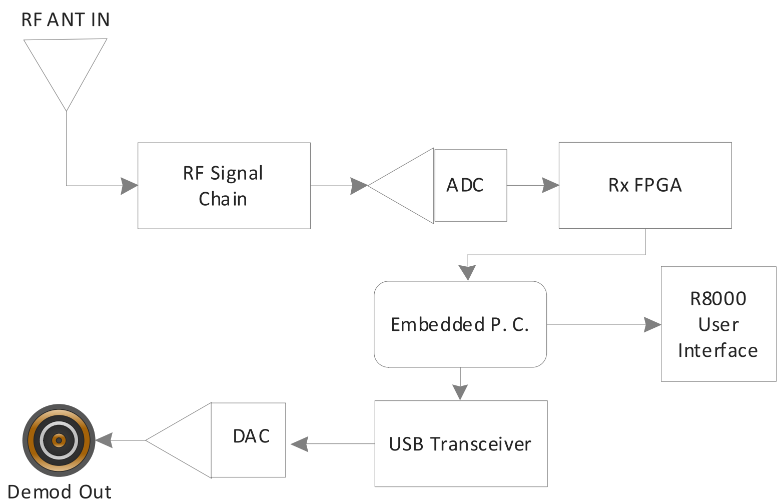
The statement “with flatness specified” in the AvComm paper is NOT from the data sheet but was added by the writers of the AvComm paper. There is an output flatness listed for the hardware demodulation output port, along with output impedance and output levels, but this would have no effect to the internal FM measurement capabilities of the R8000. This distinction, obvious to any engineer or competent technician, was apparently not clear to the writers of the AvComm paper. ***Note that the authors also changed the description “Demodulation Output Amplitude Flatness” to just “Amplitude Flatness” and placed it next to FM Deviation Measurement Accuracy.*** Changing the data sheet information in this way could mislead the reader of the white paper. To help avoid such a “mistake” in the future the data sheet has been updated in the following way:

FM DEVIATION MEASUREMENT
Demodulation Range: Up to ±75 kHz
Accuracy: ±5% plus residual FM
Frequency Response: Selectable per the following:
Low Pass Filters: 300 Hz, 3 kHz, 20 kHz
High Pass Filters: 1 Hz, 300 Hz, 3 kHz

DEMOD HARDWARE CHARACTERISTICS
Demodulation Output Level:
6.25 kHz B/W: 2.56V / 1 kHz
12.5 kHz B/W: 1.28V / 1 kHz
25 kHz B/W: 0.64V / 1 kHz
50 kHz B/W: 0.32V / 1 kHz
100 kHz B/W: 1.6V / 10 kHz
200 kHz B/W: 0.8V / 10 kHz
Demodulation Output Amplitude Flatness: ±0.2 dB (300 Hz to 3 kHz),1dB point @ 20kHz
Demodulation Output Impedance: 100 ohms nominal

The authors of the AvComm paper then create an analysis of projected poor performance based on the fabricated premise that the DEMOD output port flatness will detrimentally effect the internal R8000 calculation of deviation.

This is of course not possible as can be seen in the following simplified block diagram of the R8000 receive system.



[Figure: Simplified RF to DEMOD block diagram]

The RF carrier with the modulation enters the antenna or RF I/O port and after attenuation and down conversion it is sampled by a high speed analog to digital converter (ADC). The digital data can now be processed by digital filters to isolate the signal of interest, run FFT algorithms to recover frequency specific information and power and also demodulation algorithms to recover the original base band data. All deviation and power level measurements are made at this point inside the digital processing system. This measurement information is then reported to the user interface for display. If the user desires to have the demodulated signal output to out the physical hardware port on the front of the unit, then the Demodulated data will go to a digital to analog converter (DAC) for output to the port. It is the output process that introduces the “demodulation output amplitude flatness” listed in the data sheet.

So it can be clearly seen that there is no relationship between the “flatness” specification and the deviation measurements or the digital measurements made by the R8000, as claimed by the writers of the Cobham white paper.

The mistake made in the white paper is easily seen, but now that deviation measurement performance of the R8000 has been challenged, let’s look specifically at that issue.

The simplest way to demonstrate the performance of the R8000 is to measure it directly.

There is a simple way to use a signal generator and a spectrum analyzer to create signals with exact known peak deviations. This method has been used to calibrate analog deviation meters and is discussed in detail the Agilent application Note 150-1[2].

Basically, the application note shows how Bessel function analysis is used to determine the relation between the carrier and sideband amplitudes of the modulated wave. From this analysis it can be determined that a specific list of Modulation index’s will result in a suppressed carrier. As the modulation index is calculated from the peak frequency deviation and the frequency of the modulated signal, you can use this knowledge to create any peak deviation you want and confirm the result by adjusting the carrier to minimal power (noise floor). For reference here, the first five “Mod index” that have carrier zero characteristics are: 2.40, 5.52, 8.65, 11.79 and 14.93.

From the R8000 data sheet the specification for FM Deviation is:

Demodulation Range: Up to ±75 kHz
Accuracy: ±5% plus residual FM

To make the measurements I put an R8000 in Duplex mode to generate a very precise FM signal out the GEN port and back into the antenna port. I selected a range of Peak deviations to produce from 1 to 75 kHz. Using one of the listed “mod index” with zero carrier I selected the desired peak deviation and calculated the exact modulation frequency to create that desired peak deviation.

Then using the spectrum analyzer I adjusted the tone amplitude until the center carrier was driven into the noise floor (carrier zero). At that point the generated signal will have exactly the desired peak deviation. Then setting the appropriate RX bandwidth I allowed the R8000 to "measure" the peak deviation and recorded the reported deviation measurement.

Then to confirm the measurement result I moved the R8000 generated signal (with no change) to the input of a Rohde & Schwarz FSV (with analog modulation analysis option), set its appropriate bandwidth and recorded the deviation measurement. Results are listed in the table below.

Note: RF frequency used for all of this test is 422.5 MHz with an output power of -10 dBm.

				R8000			Rohde & Schwarz FSV			R8000
Mod Index	Mod freq (Hz)	Level setting (kHz)	Exact Peak Dev (kHz)	RF BW	Measured Peak Dev (kHz)	% error	RF BW	Measured Peak Dev (kHz)	% error	% error of Level setting
5.52	181.2	1.012	1	25	1	0.00%	25	1.007	0.70%	1.20%
2.4	1250	3.036	3	25	2.99	-0.33%	25	2.999	-0.03%	1.20%
14.93	502.3	7.585	7.5	25	7.51	0.13%	25	7.51	0.13%	1.13%
8.65	1156.1	10.107	10	50	10.03	0.30%	50	10.04	0.40%	1.07%
5.52	5434.8	29.976	30	100	29.61	-1.30%	100	30.05	0.17%	-0.08%
8.65	8670.5	75.572	75	200	73.3	-2.27%	200	75.04	0.05%	0.76%

From the above table it can be clearly seen that the R8000 does meet its data sheet specification of 5% up to 75 kHz deviation. The measurements of the same FM signals by the Rohde & Schwarz FSV demonstrate that I did not "rig" or compromise the test. In fact it is seen that the R8000 has similar measurement results to the Rohde & Schwarz up to peak deviation of 10 kHz. As a bonus measurement, in the last column I also calculate the error of the R8000 "level setting" on the generated signal. This data shows that the R8000 sets the output deviation to within 2% of requested.

Summary

The information presented in the Cobham AvComm White Paper is incorrect and could mislead end users to falsely assume the R8000 cannot make accurate analog or digital measurements. The verifiable test results above clearly demonstrate that R8000 does in fact meet its stated specifications out to 75 kHz.

The COBHAM tag line is "The most important thing we build is trust." Yet the authors of the referenced AvComm white paper used misinformation to promote Cobham test equipment. The reader must decide for himself whether such tactics are indeed trust-building.

I hope that I have given you a better understanding of the R8000 and what FREEDOM Communication Technologies strives for. Our desire is to design and manufacture great products that will provide excellent value to our customers.

We trust that the authors will correct this misleading white paper with the appropriate and necessary clarifications.

Sources:

1) "Is Your Digital RF Communication System Optimized to Provide the High Performance it was Designed to Deliver?", by Mike Fortna, Senior Product Marketing Engineer, Cobham AvComm and Rob Barden, Director of Product Marketing, Cobham AvComm. Undated.

2) Agilent Spectrum Analysis Amplitude and Frequency Modulation, Application Note 150-1, pages 14-19. http://literature.agilent.com/litweb/pdf/5954-9130.pdf