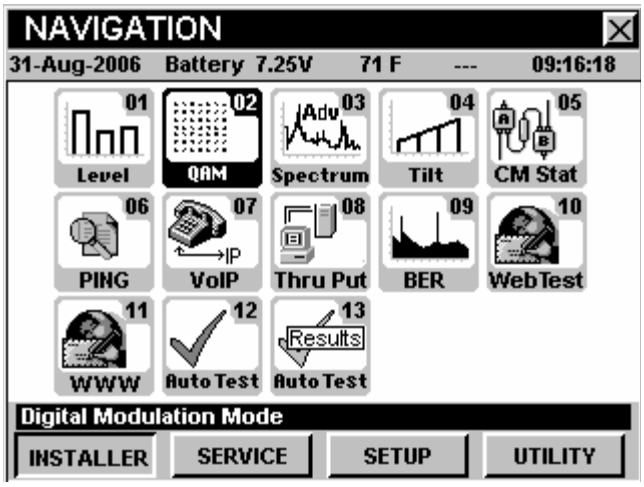
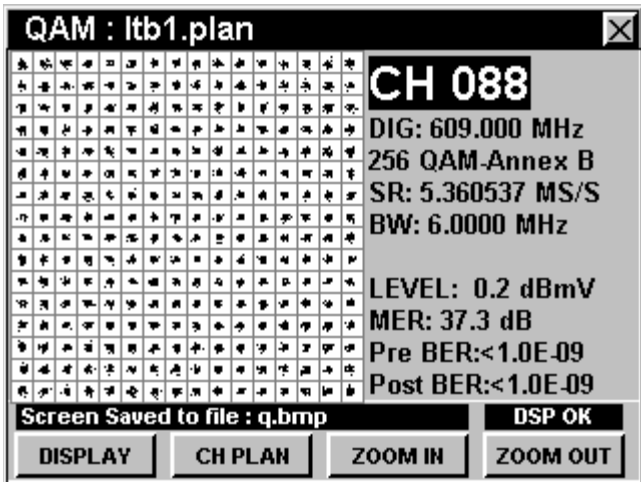
TRILITHIC **Application Note**

860 DSPi QAM

The Communication industry uses two simple measurements to describe the quality of data communications: MER and BER. Both measure the effect of noise and other disturbances on the transmitted bits. BER measures how often symbols are pushed into neighboring symbols "territories," causing these symbols to be misinterpreted. BER is expressed as the ratio of errored bits per some number of bits sent (given as a power of 10). BER does not measure the purity or condition of the QAM signal itself, though a poor BER is an indicator of poor quality. Because the BER measurement detects and counts every misinterpreted bit, it is a sensitive indicator of problems caused by transient or "bursty" noise interference.





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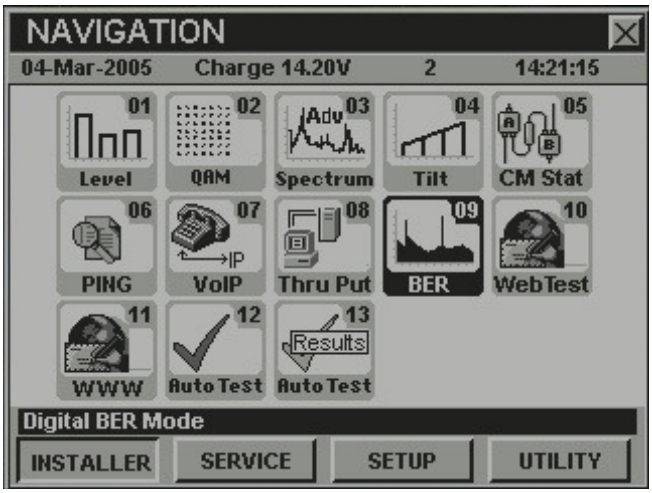
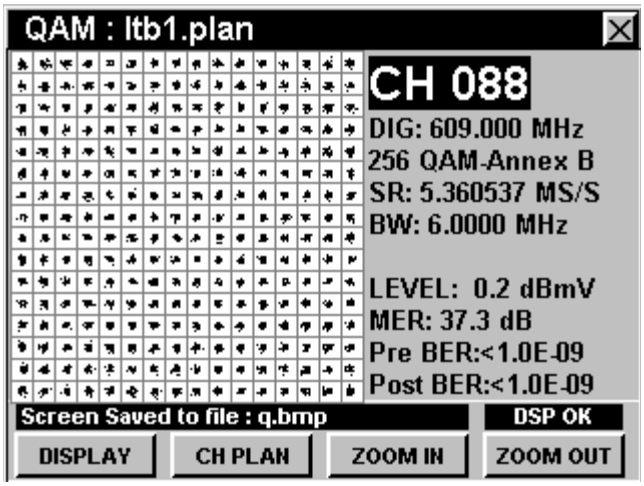
The 860DSP literally counts the bits with the IL-1 option. When trying to measure BER at $1x10^{-9}$ it is good engineering practice to wait until the meter has received enough bits to measure $1x10^{9}$ or one billion bits. With a 256 QAM channel this will take approximately 30 seconds.

MER and BER measurements detect different types of impairments. MER is the measurement in dB of the RMS error magnitude over the average symbol magnitude. The higher the error magnitude, the lower the MER. MER essentially assigns a value to the “fuzziness” of the symbol cluster. The larger or fuzzier the cluster becomes, the lower the MER. Consequently, the farther the dots move from their ideal locations, the poorer the MER. Each symbol or “dot” on the constellation is framed by decision boundaries. When the carrier falls inside the boundaries, the information is transmitted without errors. MER determines how much margin the system has before failure. Low MER is not noticeable on the subscriber’s picture until system failure. MER is a good figure of merit for the QAM signal.

BER is a good indicator of fast, intermittent transients.





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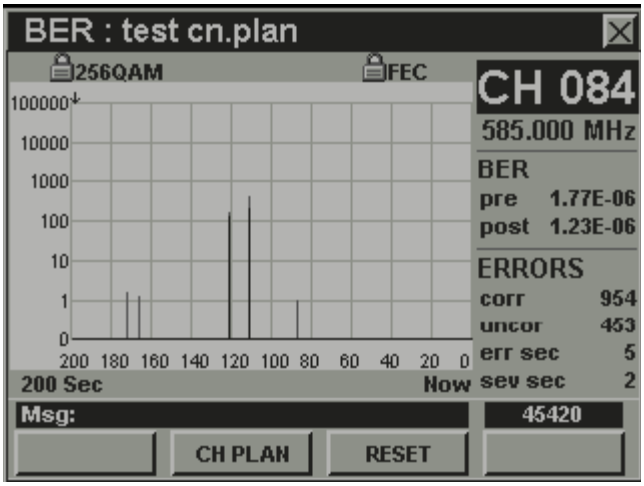

Impairments include:

- Laser clipping (most common cause)
- Sweep interference
- Corroded or loose connections
- Microphonics

Therefore, if you have high MER but errors are present, they are probably caused by intermittent interference. This shows up on a constellation diagram as a lone dot that is away from the main cluster. The best way to test this is with the 860DSP in the BER mode. Gray lines are Pre-BER errors and Black lines are Post-BER errors. It is much easier to see BER errors in this mode than one lone dot on the constellation and the time duration can be set from 200, 400, or 600 seconds. This is a very useful tool to help the technician to isolate and fix ingress problems, since the BER errors are graphically displayed vs time, instead of trying to see just a few lone dots separate from the cluster on the constellation screen.

Scientific Notation

1.00E+00	1/1	One
1.00E-01	1/10	One in Ten
1.00E-02	1/100	One in One Hundred
1.00E-03	1/1,000	One in One Thousand
1.00E-04	1/10,000	One in Ten Thousand
1.00E-05	1/100,000	One in One Hundred Thousand
1.00E-06	1/1,000,000	One in One Million
1.00E-07	1/10,000,000	One in Ten Million
1.00E-08	1/100,000,000	One in One Hundred Million
1.00E-09	1/1,000,000,000	One in One Billion
1.00E-10	1/10,000,000,000	One in Ten Billion
1.00E-11	1/100,000,000,000	One in One Hundred Billion
1.00E-12	1/1,000,000,000,000	One in One Trillion
0.00E-00	$0x10^0$	(No Errors)

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