



860 DSPi BER User Guide

A bit error rate (BER) test is a simple and effective way to analyze signal quality. The test provides information about bit errors that occur prior to forward error correction (FEC) and those that occur after (post) FEC. There is a range of signal quality, or lack there of, where it is possible to correct errors. These errors are called pre-FEC errors. The post FEC errors are the ones that don't get corrected and therefore cause disruption to the data transmission. This transmission is any data that is transmitted on a cable system in packetized form, which includes video, voice or high speed internet data.

BER is the ratio of Errored Bits/Total Bits received. In as much as it takes time to receive bits; it makes sense to display the detected bit errors in a graphical format. The 860 DSPi impulse BER (iBER) test shows corrected and uncorrected errors over time. In BER testing, the analyzer dwells on a particular channel, counting good codewords and watching for individual errored codewords. There are a fixed number of bits per codeword, and a given error correction algorithm can only correct up to a fixed number of bits per codeword. This allows the 860DSPi to convert from errored codewords to errored bits and total codewords received to total bits received. The precision of a BER test depends on how many bits are observed. For example, to make a single BER calculation down to $1E-7$ the test needs to accumulate 10^7 bits (ten million). To verify performance down to $1E-9$, the instrument needs to observe 10^9 bits (one billion). Moreover, to prove that the detected BER constitutes a sustained (rather than one time) problem, and to obtain stable test results, perhaps three to five times the minimum number of bits should be collected. A 95% confidence level is obtained by analyzing three times the minimum number of bits, and a 99% confidence level would require analysis of 4.61 times the minimum number of bits. (Hranac, R., 11/1/07) This means that for a 256 QAM channel, for $1E-9$, which requires 1 billion bits minimum, and would take a little less than 25 seconds to analyze, the minimum time required for 95% confidence would be less than a minute and a half, for 99% confidence, less than two minutes.

Because impulse bit errors occur erratically, separated by varying intervals of time, the BER measurement result will change as time progresses. As bad bits occur, the result will be impacted, and if other bad bits don't occur, the measurement result will progressively improve. Of course, additional occurrences of bad bits will adjust the measurement result, depending on the number of bits received and the time passed. The final result takes into account the full time period of the measurement.

For Additional Help Contact
Trilithic Applications Engineering
1-800-344-2412 or 317-895-3600
support@trilithic.com or
www.trilithic.com

860 DSPi BER User Guide
P/N 0010275028 – Rev 2/08
1 of 3

The BER screen presents bit error statistics in several ways:
BER expressed as the ratio of Errored Bits to Total Bits

- This ratio is presented as a single number in the form “3E-7” or “7E-6”. The test begins with the BER shown as 0E-0, and it then changes over the course of the test to show the BER as errored bits are accumulated.
- Resulting values for both pre-FEC and post-FEC are given.

Total Corrected and Uncorrectable codewords, expressed as running totals.

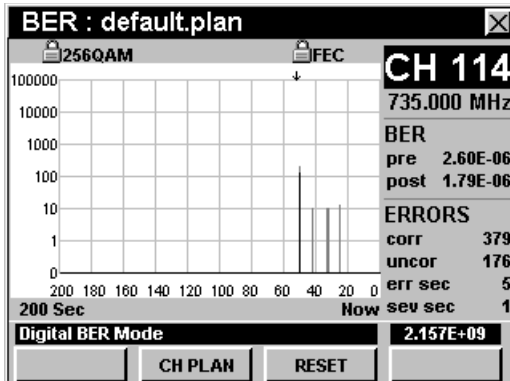
- This simply presents two “raw” numbers, one being the running total of codewords that were corrected using the FEC and the other representing the number of codewords that were not capable of being corrected by the FEC.

“Errored Seconds”, “Severely Errored Seconds”

- This is an indication of the number of seconds of data that contained one or more bits needing FEC correction. Seconds in which bits were successfully-repaired are shown as “errored,” and seconds in which a bit was too damaged to repair are called “Severely errored”.

Time graph

- Errored codewords are displayed as marks on a horizontal line that scrolls across the display. The advantage of this graph is that the displayed information is always meaningful regardless of the duration of the test and the graphical display makes patterns of reoccurrence easy to detect. Corrected codewords per unit time are shown in gray and uncorrectable codewords are shown in black.


BER

- **Pre:** before FEC repair
- **Post:** after FEC repair

ERRORS

- **Corr** = corrected codewords
- **uncor** = uncorrectable codewords
- **err sec** = errored seconds
- **sev sec** = severely errored seconds
- Total bits examined

RESET

- Re-starts BER test

Graph: Light gray lines are corrected errors. Black lines are uncorrectable errors. The most recent events are on the right edge of the graph, the earliest events are on the left.

X Scale (Horizontal): Number of seconds to adjust time scale, use LF/RT arrow keys to highlight and UP/DN arrow keys to change setting.

Y Scale (Vertical): number of errors in each interval of 1/200th the time represented by the full X Scale.

For Additional Help Contact
 Trilithic Applications Engineering
 1-800-344-2412 or 317-895-3600
support@trilithic.com or
www.trilithic.com

860 DSPi BER User Guide
 P/N 0010275028 – Rev 2/08
 2 of 3

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	0 x 10 ⁰	(No Errors)

References

Hranac, R., *Broadband: A Closer Look at BER, Part 2*, Communications Technology, 11/1/07

For Additional Help Contact
Trilithic Applications Engineering
1-800-344-2412 or 317-895-3600
support@trilithic.com or
www.trilithic.com

860 DSPi BER User Guide
P/N 0010275028 – Rev 2/08
3 of 3