257xR Firmware Changes
v5.1.2   18 January 2005

This document describes the firmware changes implemented in v5.1.2 of the 257xR ballast analyzer. It does not include firmware changes implemented in earlier versions.

This firmware may be uploaded into any 257xR presently having v5.0 or higher firmware. If used with a 1500 load chassis, the 1510 or 1512 controller should have version v3.0 or higher firmware installed.

Version v5.1.2 adds the following additional features.

The 257xR v5.1.2 firmware adds a third ballast output measurement mode, HF+LF. This adds the ability to measure High Frequency (HF) ballast outputs synchronized to the line frequency. This enables the user to see the expected voltage and current measurements when the ballast output contains a high amount of modulation at line frequency.

Reminder:

Startup Profile in General Purpose (GP) Mode, plus Startup and History Profiles in Test Mode
The data graphed is the maximum value measured during the period covered by each data point. Effectively, both profiles in Test Mode are startup profiles, each with different time scales. This is why the History Profile in Test Mode is called a Sequence Profile.

History Profile when in GP mode
Data graphed is the mean value measured during the period covered by each data point.

New Feature Operation

HF+LF Operation
The sampling is exactly synchronized to the HF part of the signal (in order to measure harmonics on the ballast output), and is only synchronized to the Low Frequency (LF) part "on average." Because of this, the HF+LF mode will always be a little noisier than either LF or HF modes.

The bandwidth of the high frequency (i.e. all tube) signal circuitry is typically 20MHz (-3dB) for a non-HID unit, and about 2MHz for an HID unit.

In the HF or HF+LF modes, the sampling rate can vary between 500ksps and 2.0Msps. It is varied to yield the following operation.

- **In HF and HF+LF modes.** The sampling rate is set such that there is an integer number of blocks of 64 samples, in the nearest integer number of input cycles, which yields an overall period closest to 512usec. This provides the basic measurement cycle in HF and HF+LF modes. These measurements are used for all results in HF mode, and for profiles (history, sequence and startup) only in HF+LF mode.

- **In HF+LF mode.** The closest number of periods, in the measured line input frequency to the ballast, is calculated as described above. Each HF+LF measurement cycle for non-graphical results is taken over the nearest integer number of 512us blocks in this period, with the remainder from each period being carried into the next measurement. All the same results as those for the HF mode, are also internally computed. These are used to determine the modulation depth results only.

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- **In HF+LF mode.** There are actually 2 separate accumulations of the RMS values being maintained at all times. The start and end of these are offset from each other by one-half cycle of the line input to the ballast. In this manner, we can give one-half cycle response time to changes, while maintaining whole cycle synchronization.

Note: The synchronization to the HF signal is always exact, but the synchronization to the LF part (in HF+LF mode) is only exact on average, not on a cycle by cycle basis.

- After selection/computation of the desired sample rate, a check is made that an integer number of half cycles of the applied waveform is not one sample (within 1%). This can only happen at very high input frequencies. If this case is detected, then the measurement period is extended by 2% (i.e. to about 520us) and the sampling rate is recomputed. This done to prevent the samples from being exactly synchronous to each input cycle, with each cycle being sampled in exactly the same place, and with only one sample per half cycle. If this occurs, then the measurement system will fail because the input waveform frequency effectively becomes "folded" by the sampling down to DC.

Note: All RMS type measurements are made (as described in the Xitron Methods Guide booklet) by numerically accumulating the squared value of each sample. This accumulation is maintained over the entire measurement period. The RMS result is computed at the end of the measurement period by using this sum of squared values divided by the number of samples taken, and this result then has its square-root taken, thus producing the RMS result.

Reminder:
When in GP mode, the unit must "know" the nominal line frequency. This is set in the **LINE & LOADING** configuration menu. This is used to correctly scale the filter constant used to perform Result Averaging. If the actual line frequency deviates greatly from the value entered, then the Result Averaging will not perform correctly. The difference between 50Hz and 60Hz is not an issue, but 50/60Hz to 400Hz will be very noticeable. This could easily be overlooked when not controlling the line source with the 257xR. Even worse, this could easily be left at zero, which will disable Result Averaging totally for all line-related results (e.g. all Line side data, and tube side RMS data in LF or HF+LF modes).

When in HF+LF mode, there MUST be some HF content present for the analyzer to sync on, as this is the primary source of sync. The LF part (from the line side) is only the secondary sync source. Thus, when there is no HF content available, the analyzer does not sync at all, not even to the LF frequency.

The Result Averaging issue with "knowing" nominal line frequency is also true in TEST SEQUENCE mode. In this case, the nominal line frequency is part of each test step definition.

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