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Testing telecommunication equipment using Pass/Fail mask testing with a Fluke ScopeMeter® 190 Series II

Application Note

Nowadays digital communication systems such as Synchronous Digital Hierarchy (SDH) in Europe and the Synchronous Optical Network (SONET) in North America require standard test methods.

The electrical signals are tested against the standard ITU pulse masks. The Fluke ScopeMeter 190 Series II portable oscilloscope offers a standard pass/fail function that can be used to perform these tests. The instrument is capable of storing up to 100 "fails" for further analysis.

The G.703 standard

G.703 is a standard originally introduced for voice and data transmission over digital networks. It is an ITU recommendation (formerly CCITT) that's associated with the PCM standard. Analog-voice to digital-data conversion according to PCM requires a bandwidth of 64 kb/s ($\pm$100 ppm), resulting in the basic unit for G.703. Through multiplexing this results in a T1 of 1.544 Mb/s and E1 of 2.048 Mb/s.

The electrical characteristics of the network interfaces are described in recommendation G.703. The signal limits for a 2.048 Mb/s signal are shown in Figure 1.
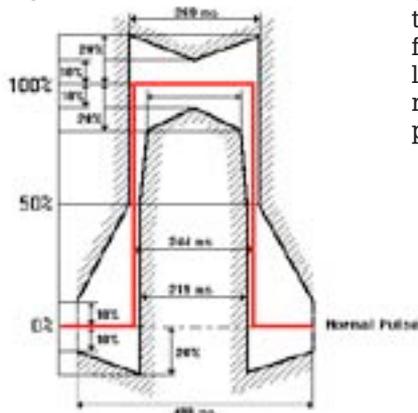
Multiple-channel testing using two different masks

A balun is used between the patch panel and a coaxial transmission line to match the impedance of the 120 Ω symmetrical line to a 75 Ω coaxial line. The input and output of the balun each has its specific mask.

The ScopeMeter 190 Series II portable oscilloscopes can simultaneously perform a pass/fail test at the input and output of the balun with different masks.

The floating and isolated inputs of the Fluke ScopeMeter 190 Series II test tools make these measurements possible without the risk of making unwanted groundings. Moreover, the high impedance probes allow for direct measurements without loading the line and without the need for an external differential probe.
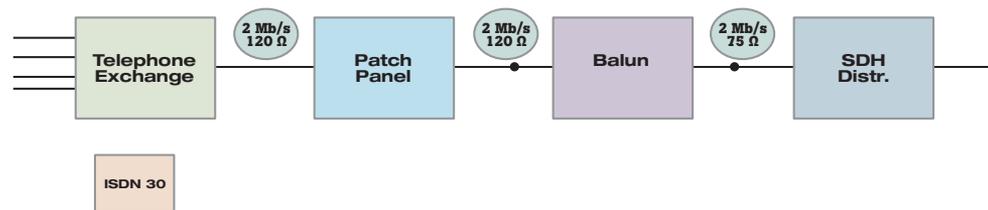
Editing the pass/fail templates

With FlukeView we can export a waveform into a spreadsheet and a custom template can be created by editing a waveform using Excel.

A reference template for pass/fail testing can be created by saving waveforms from FlukeView in .csv format and editing the waveform using, for

Figure 1. G703 – E1 template

Figure 2. ISDN30 network

example, Excel or Notepad—entering new values for each sample point.

The reference waveform requires a 300-point min-max waveform.

In figure 3, column B represents the minimum values of the mask (blue line in diagram) and column C represents the maximum values of the mask (red line in the diagram).

The areas to the left and right of the original template are of no interest for this pass/fail test which means minimum and maximum values are determined by the screen size.

Once the reference template is edited, it can be uploaded to the ScopeMeter using FlukeView (V5.0 or higher). Templates can be used as reference for testing on any combination of the four input channels. The trigger point should be at 50 % of the rising edge of the pulse.

For exact positioning, the top of the trigger symbol should be lined up with the 50% level of the template.

Simultaneously, a pass/fail test can be performed at up to four inputs using separate masks for each waveform. On input A, the input of a balun can be monitored using a template corresponding to a 120 Ω line impedance while input B monitors the output of the balun using a 75 Ω template.
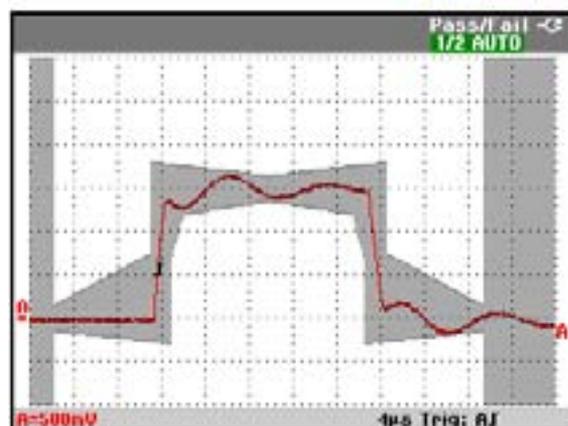
Conclusion

Pass/fail testing can be used for troubleshooting communication networks.

The flexibility of a portable high-performance instrument such as Fluke's ScopeMeter with a bandwidth of 200 MHz makes it a powerful tool for keeping telecommunication networks up and running.
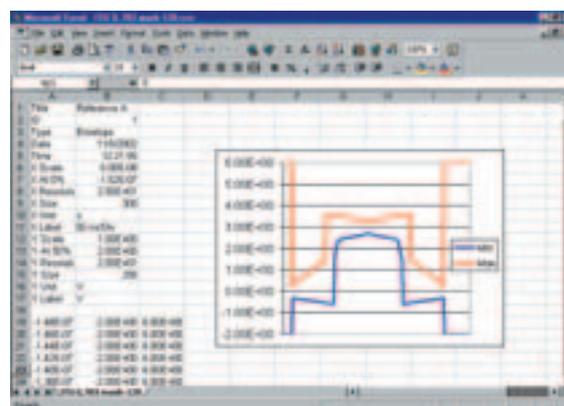
Figure 3. Example of an Excel edited ITU G.703 E1-coax mask.

Figure 4. Pass/fail template at the ScopeMeter.