FLUKE®

In testing system performance at this central office, batteries are included

Testing battery banks with a ScopeMeter® test tool

Application Note

Testing Functions **Case Study**

Measuring tools: Fluke ScopeMeter® 196C Test Tool

Operator: SkyLine Membership Corp., telecommunication provider

Tests conducted: Load test, timed-discharge test, conductivity testing

For SkyLine Membership Corporation, a West Jefferson, North Carolina-based provider of telecommunications offerings to its owner-members, delivering a range of services from basic dial tone to high-bandwidth applications is what drives company growth. For Tom Edwards, a central-office (CO) technician at SkyLine, this focus on growth requires a relentless daily focus on that most practical and contemporary of technologies, the battery.

Banks of twenty-four 700-pound batteries, each rated at 4000 amp-hours and 16 to18 hours of reserve power, are the "third string" in SkyLine's power-assurance redundancy system. These battery banks are next in line to second-string standby generators that deliver power in the event of a power loss.

In the system, rectifiers supply the entire load of the CO with the current required. Connected in parallel to the rectifiers, the battery banks receive the same voltage as the load. If the AC source (either utility or generator) is interrupted, the batteries go online instantaneously to supply the equipment load demands of the CO — a seamless transition requiring no switching or mechanical interaction.

"Battery maintenance is paramount," says Edwards, who is responsible for the Alleghany County CO's digital switching and optical transport systems. "As a result, I've come to rely on an industry-standard handheld device, the Fluke 196C ScopeMeter® test tool, to give me comprehensive views of battery performance.

"Today I monitor banks of batteries with ScopeMeter by placing the load of the entire office on them and recording their performance on a trend screen. ScopeMeter allows me to see and record a wealth of information, including the minimum bank voltage and the point at which the batteries stabilize in relation to time."

Visibility is key

Edwards' rationale for carrying a ScopeMeter makes sense: "The more you can see, the more you can fix," he says. Edwards routinely uses no fewer than six of the integral functions routinely to keep an eye on operations:

Dual-trace monitoring enables him to contrast two signals — either one above the other, or the two superimposed — to determine variations in the signals or to spot a degradation in one or the other.

Trend plotting allows him to place the load of the central office on the batteries and record activity for further analysis. "I can record and archive the readings from a previous test to determine degradation in the overall health of the battery bank."

Spectrum analysis lets him view the frequency of a signal and detect any unwanted frequencies — such as noise in the CO's clock source that could provide equipment with an invalid clock signal.

Triggering options allow him to trigger on pulse widths, amplitudes, or edge characteristics in order to capture elusive glitches or transients.

Setups enable him to capture and save setup details for different testing scenarios and to reduce setup time during daily operations.

Waveform archival allows him to maintain performance histories. "I can visually see and record minimum voltages, waveshapes and a range of parameters," he says. "Archiving this data for future comparisons will give me a good indication of the total battery-bank health."

An outage is not an option

SkyLine provides service to over 36,000 access lines in four North Carolina counties and one county in east Tennessee. "Sparta, one of our 13 central-office locations, is equipped with a digital voice switch and optical transport equipment from which we extend fiber to the other offices," says Edwards. "Keeping the system up and running is our highest priority, and that means one thing: electrical utility power supplying the CO or a remote site may go down, but loss of dial tone and services to our customers is simply not an option."

To minimize the risks of a concentrated outage, SkyLine emphasizes network redundancy. For example, if a fiber optic cable is cut, traffic is automatically re-routed and an outage is avoided. Edwards himself follows a rigid schedule of checks to the CO batteries once a month, and a timed-discharge test twice a year to verify proper operation and stability. (See Figure 2.) "Trending with the ScopeMeter is invaluable here," he adds, "because it allows me to see any degradation from one test to the next."

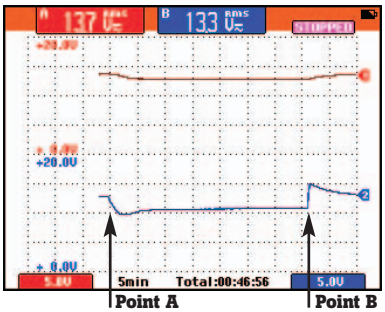

Figure 2. A check of cells from two independent batteries reveals a fault with Battery 2 (trace 2). A charger is removed from both batteries at Point A. Battery 1 holds its charge, but Battery 2 shows a precipitous drop in voltage. At Point B, the charger is placed on both batteries again, but the fault with Battery 2 remains evident.

Conductivity testing is also key, but with a twist. "With four seasons in a year, the batteries in our remote facilities have to endure four different temperature cycles. As the temperature drops, battery conductivity also decreases, and this is an excellent time to spot a problem that would not show up in warmer weather."

Perfect timing

While maintaining 100 percent uptime in digital switching equipment requires continuous DC power output, the quality of voice service from the switch relies greatly on signal timing.

When a customer makes a call, the equipment samples the customer's voice eight thousand times per second to digitize it. Sending that signal over fiber requires an electrical-to-optical conversion on the transmitting end, an optical-to-electrical conversion on the other end, and finally a digital-to-analog conversion.

"Timing is everything," says Edwards. "Each signal has to be properly terminated, but the trick is to foresee a problem from improper signal termination that could ripple on down the line." Edwards again points to his dictum — 'the more you can see, the more you can fix' — as a governing factor.

"I use ScopeMeter's dual-trace mode to place one signal above the other. (See Figure 3.) "Signal A and Signal B are of the same frequency and are in phase, but Trace B is unacceptable. That's clear from the ragged edges. In that one picture, I discover that Signal B is not properly terminated. In this case, seeing is much more than believing. Seeing is understanding."

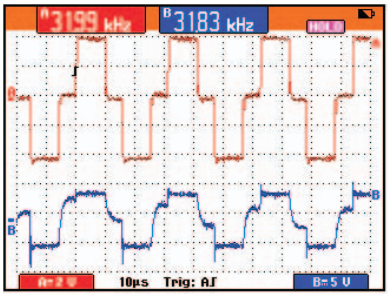

Figure 3. A ScopeMeter shot of SkyLine's CO timing source provides graphic detail that reveals an improper signal termination. The source signal in trace A shows the crisp edges and "shoulders" of a good signal. Trace B has the same frequency as trace A, and is in phase with trace A, but its edges and shoulders are not nearly as "clean". These indicators suggest improper signal termination.

Classical troubleshooting

With ScopeMeter on call for just eight months at SkyLine, Edwards is well on his way toward compiling a comprehensive set of reference waveforms for use in evaluating circuits and systems at the CO and beyond. Using ScopeMeter's storage function, he can invoke the classical troubleshooting technique of the Known Good Unit, or KGU. By comparing a "known good" waveform to its counterpart from the same reference node in the working system, he gains two advantages: 1) he can depict the characteristics of the correct waveform for personnel who may not be familiar with the system, and 2) he can compare the reference signal and its counterpart to determine visually whether a fault is occurring at the node in question.

"A ScopeMeter is a tool not only for analysis but for storage," says Edwards, "and a stored waveform is great for explaining signal characteristics to a technician who is learning the ropes of signal analysis." According to Edwards, variations between reference and captured waveforms can help pinpoint a problem that might otherwise be undetectable, both to the inexperienced and experienced eye.

An industry in flux

As the telecom industry moves to provide bandwidths made possible only over fiber-based networks (fiber to the home, or FTTH), high-precision tools will be required as a defense against problems, says Edwards. "Communication providers must have the vision to enhance their networks in order to offer new services and features that will keep them in step with technology and steps ahead of the competition."

As SkyLine moves into this future of telecommunications, he adds, the need to understand and embrace changes is paramount. And so is the need for the right tools. "ScopeMeter has become a valuable asset in my work and across our industry. I could give any number of rationales for saying so, but it all boils down to this: a picture is still worth a thousand words."

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