MTS-5100

Protective Relay Test System

MANTA™
TEST SYSTEMS

At a Glance

Capabilities

Steady-state testing

Dynamic testing - step/ramp/state sequence

Transient waveform testing

GPS time synchronized testing

Exclusive Features & Benefits

Direct front panel interface for all functions

Intuitive operation

Exceptional productivity for common tasks

All-in-one, no options required

Very high VA current output channels

Realistic fault quantities and waveforms
(Even under ordinary manual testing)

Onboard memory + USB memory drive

Test Applications

Transmission & Distribution: overcurrent, under/overvoltage, directional overcurrent, distance, frequency, line differential, transformer differential (1-phase, 3-phase), bus differential, capacitor protection, out-of-step, synchrocheck, reclosing, breaker failure, lockout, time-delay, and auxiliary relays

Generator Protection and Control: differential, loss-of-field, under/overvoltage, overexcitation, stator ground, negative sequence, frequency, unbalance, reverse power, out-of-step, synchronizing, Synchro-check, lockout, time-delay, and auxiliary relays

Industrial: overcurrent, under/overvoltage, transformer differential, bus differential, capacitor, overload, motor protection, lockout, time-delay, and auxiliary relays

Other: Current, Voltage, Watt, VAR, and Frequency transducers and metering

The MTS-5100 Protective Relay Test System

What Can It Do For You?

The MTS-5100 is the most powerful all-in-one relay test system with a direct front panel interface for all functions, without exception! The ideal system for testing and calibrating protective relays using traditional test techniques or applying realistic power system simulations.

Easily test single overcurrent relays to multi-terminal end-to-end schemes with this one box. No add-ons. No hidden costs. The MTS-5100 includes all the power (VA) that you need for old electromechanical relays in each output channel to minimize connection changes, with all of the output current and voltage channels you need for modern microprocessor-based relays. Powerful productivity functions and built-in intelligence make it a simple task to perform realistic power system simulations which increases productivity and effectiveness. You can even save your test results directly from the front panel to simplify your NERC/FERC reporting requirements.

All the Necessary Output Channels and Inputs for Protection and Control Relay Testing

- 6 AC/DC Currents
  6x30Arms, 3x60Arms,1x180Arms

- 4 AC/DC Voltages
  4x250Vrms, 1x750Vrms

- 12 Contact / 0-250Vrms Voltage inputs

- 4 Contact outputs

- Transducer voltage/input

- USB Memory

- GPS input

- IRIG input

- IRIG output

- IEC 61850

10.4" screen! Larger than most tablet computers.

Customizable default settings. Get started right after power-up

Proven bank machine style interface with context sensitive buttons

Most used screens only one keypress away

Control multi-phase quantities/outputs using only one parameter

Display nearly any electrical parameter you want calculated in real-time

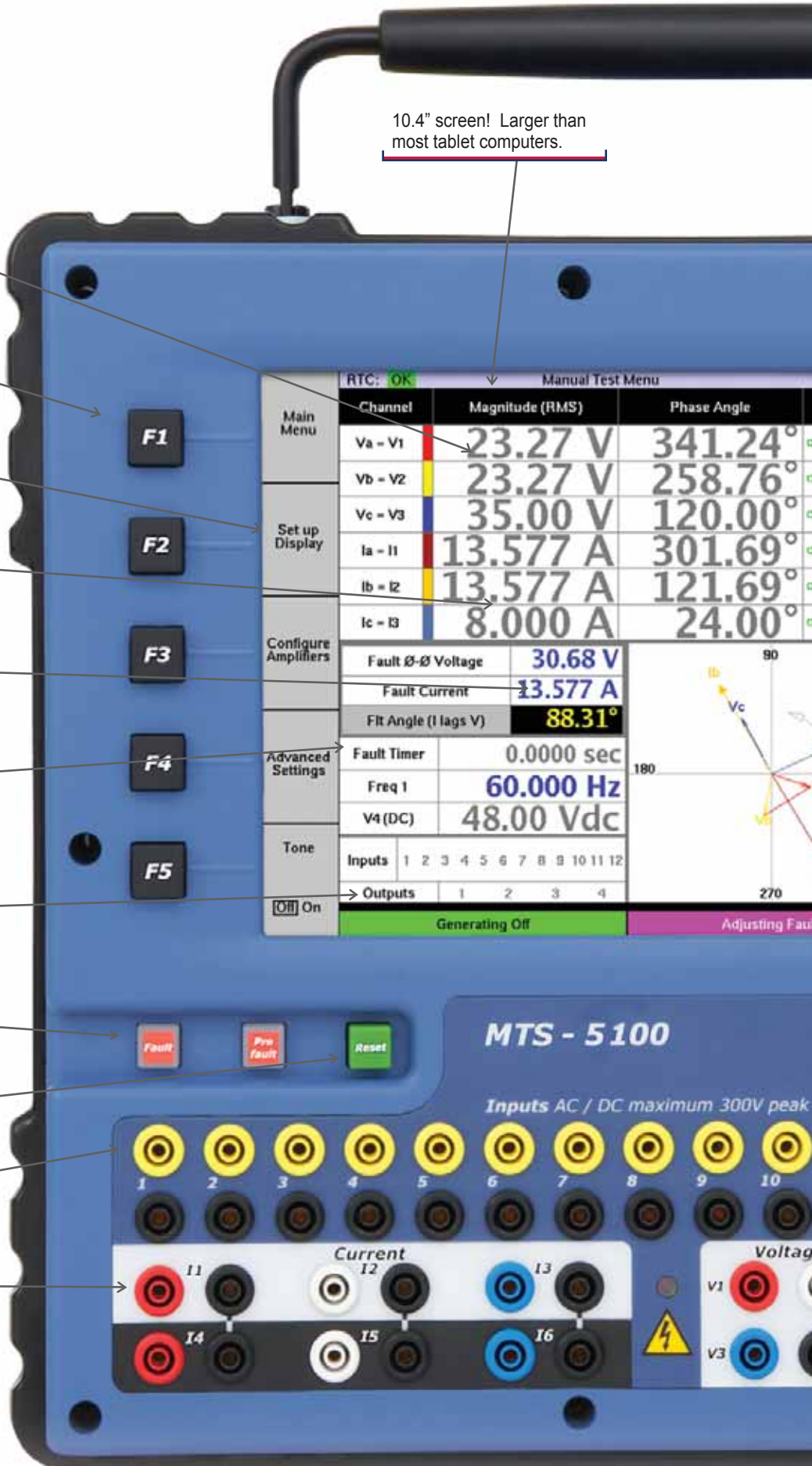Only the information you want in the user-defined area

All parameters can be adjusted off-line before applying them to the relay or online while the relay is energized.

Dedicated frequent-use pushbuttons

Dedicated reset/disable button for safety

12 wet/dry input sensing contacts

6 AC/DC current ouput for 6x30Arms, 3x60Arms, 1x180Arms

Device screen labels:

RTC: OK   Manual Test Menu

Channel	Magnitude (RMS)	Phase Angle
Va = V1	23.27 V	341.24°
Vb = V2	23.27 V	258.76°
Vc = V3	35.00 V	120.00°
Ia = I1	13.577 A	301.69°
Ib = I2	13.577 A	121.69°
Ic = I3	8.000 A	24.00°

Fault Ø-Ø Voltage	30.68 V
Fault Current	13.577 A
Flt Angle (I lags V)	88.31°
Fault Timer	0.0000 sec
Freq 1	60.000 Hz
V4 (DC)	48.00 Vdc

Inputs 1 2 3 4 5 6 7 8 9 10 11 12
→ Outputs 1 2 3 4

Generating Off   Adjusting Fau

Main Menu
Set up Display
Configure Amplifiers
Advanced Settings
Tone
Off On

F1 F2 F3 F4 F5

Fault   Pre fault   Reset

MTS - 5100

Inputs AC / DC maximum 300V peak

Current   I1 I2 I3 I4 I5 I6   Voltag   V1 V3
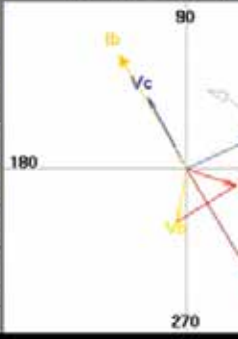
Backlit display visible in the brightest sun

One box to carry. No PC required!

Snappy screen response after any button press never keeps you wondering what is happening

Quick, direct numerical entry with reliable, industrial quality buttons

No repeat presses. Immediate click action and audible beep feedback

No sore fingers! Low activation pressure, superior tactile feel pushbuttons

Quick access to help for each screen, plus user tutorial pages

Intelligent fault modes simplify complex 3-phase control for real-life Power simulations

Instantly see the output using the live phasor diagram (analog display)

Smooth continuous adjustments for pickup tests with the fine resolution dial

Use GPS or IRIG signals for built-in End-to-End Testing

0-20mA or 0-10V inputs for transducer testing

Use the IRIG Out to synchronize devices

VGA output for external monitor or projector

TCP/IP or RS-232 ports for IEC 61850, computer control or communication

USB 2.0 ports for USB memory devices, keyboard, or mouse

Quick power up (<40s)

4 digital output contacts with 5A/250Vac or 0.4A/300Vdc rating

4 Voltage outputs for 4x250Vac, 1x750Vac

13:00:09
Status
Test Report
V4 DC On/Off
Off On
Fault Type
Ø-N Ø-Ø
3Ø
Arbitrary
Rotate Fault
A-B B-C C-A
State
Prefault Fault
A-B

F6
F7
F8
F9
F10

7 8 9 CE
4 5 6 ±
1 2 3
0 .
Enter
Help

GPS Antenna   IRIG In   Transducer
±10V - Max. - ±20mA
IRIG Out
Video   RS 232
Ethernet Remote
120/240VAC 50/60Hz Max. 15A

MANTA
TEST SYSTEMS

Outputs
11 12
Max. 0.4A / 250V
V4
Vn
1 2
3 4

5

Be Productive the Very First Day

Novices and veterans alike need help to keep up with the rapid advances in protection technology to contend with the complexities of testing today's sophisticated relays and systems. In fact, a IEEE Power System Relaying Committee's Survey on Relay Test Practices found that *"most relay test personnel receive fewer than 16 hours of relay training per year."** That's why we started from scratch to create a truly *"intuitive to use"* relay test set, so that you'll be productive from the very first day. The MTS-5100 provides built-in intelligence to simplify its advanced testing capabilities and controls required for multiple input and output channels. Here are a few examples:

Relay Specific Productivity Screens

Relay test screens that simplify the testing of common relay types. Each screen is designed to get the job done in the fewest number of steps.

Differential Test Screen

You've tested differential relays before, but can you remember the formulae and test connections for the different configurations?

The MTS-5100 configures itself, draws pictures of the connections, lists the formulae, and calculates the results.
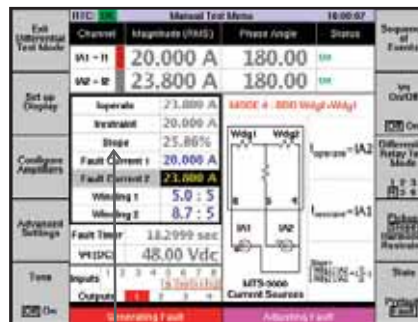
Built-in configurations for common relays (BDD, HU, SEL-387, etc.) including relays with six-current inputs

Built-in configurations for standard tests

Direct display of operate and restraint currents plus slope

Impedance/Distance Test Screen

The impedance test screen simplifies single and 3-phase impedance element testing. Only information essential to testing these elements is presented on this screen.
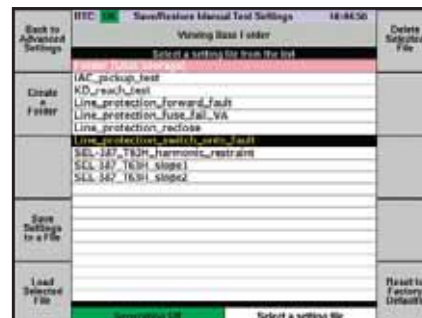
Compare impedance directly to relay characteristics

Direct calculated impedance display

Immediately Recall Saved Tests

Improve your efficiency even more by saving settings for often used tests right in the built-in memory and recalling them later. Use a USB memory device to use your test settings with any MTS-5100.

* For details on the IEEE Survey on Relay Test Practices, see www.pes-psrc.org

You Use It, With or Without a PC

## Single Button Access for Steady-State Injections

Many tests only require a simple single-phase or 3-phase injection. Just one button from the main screen is the manual test screen, where you can immediately energize the outputs and test the device. Phase sequence, amplitude and frequency automatically default to your pre-defined system defaults.

Intelligent Phase-Phase & 3-Phase Adjustment

Select phase-neutral or phase-phase or 3-phase adjustment. For phase-phase, just 3 parameters control phase-phase voltage, current and fault phase angle, changing appropriate amplitude and phase angle settings of outputs automatically in order to correctly simulate phase faults.

Similarly, for 3-phase faults, changing the fault current, fault voltage and phase angle changes the outputs of all 3 phases simultaneously.
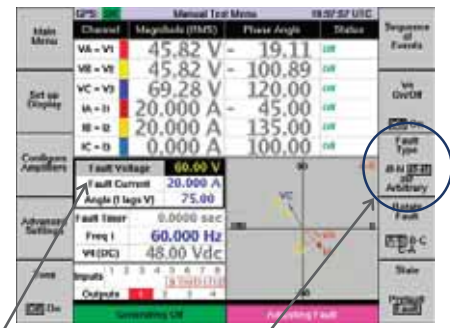
Rotate fault parameters to the next phase with a single button press
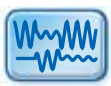
Ramping and State Sequencing

For applications such as rate-of-change of frequency relays, motor bus transfer schemes, or simply automatic pickup testing, ramp one or all parameters directly from the front panel.

For reclosing scheme testing or evolving faults, set up multi-state tests directly from the front panel.

Ramp any combination of parameters independently in any state

Contact outputs can simulate breaker status signals, permissive signals, etc.

Control sequencing using fixed durations and/or changes detected on input channels

7

How many of your relay panels still look like this?

"High Va Output for Electromechanical Relays"

The rest of the world may have gone all digital, but the truth is that it may be a decade or more before the installed base of electromechanical relays is displaced by digital relays. Hence, the need for high power current outputs remains. The MTS-5100 deals with this reality head-on, with up to 900 VA per channel in 3-Phase mode! That is more VA capability than all other modern relay test sets.

Don't be fooled by VA comparisons between manufacturers. The highest burden E-M relays require high compliance voltages and the MTS-5100 provides this. Paralleling channels on other test sets may increase available current, but it will not increase the output compliance voltage. Their low output compliance voltages will not be able to inject those higher currents into high burdens.

For high set instantaneous elements, parallel all current channels for up to 0-180Arms with 2400 VA of single phase current with a single button press. Control the magnitude and phase angle of the paralleled group as if it were one channel on all other screens. Fast, simple, intuitive.

"Realistic Output Waveforms Even When Using Traditional (Manual) Test Methods"

The North American Electric Reliability Council, (NERC) has emphasized time and again **"The use of increasingly complex protection systems demands careful planning, contingency analysis, personnel training and ongoing review. …** *Protection systems should be tested with methods which mimic actual conditions as closely as possible".*** We have seen the growing application of transient testing of protective relays. Now you can get some of the benefits of realistic test waveforms, even when using traditional (manual) test methods, where others must resort to computer driven methods. Here are some examples:

Automatic Current DC Offset & Controlled Fault Inception Angle

The exponentially decaying DC offset component of real-world fault currents can be automatically generated by the MTS-5100. This ensures realistic test waveforms essential for testing today's high-speed, sub-cycle, line and bus protection relays. Even electromechanical relays, such as the Westinghouse KD, are known to operate incorrectly in response to test currents high di/dt without an exponentially decaying DC component.** Not accounting for DC offset has also been identified as a key cause of mis-operations in generator protection and breaker failure protection relays.**

The fault inception angle can also be controlled directly from the front panel. The fault inception angle has a significant affect on the degree of DC offset as well as the operation time of high speed protection.
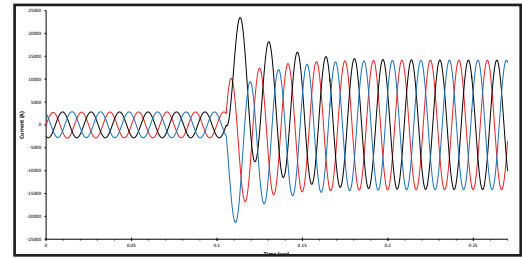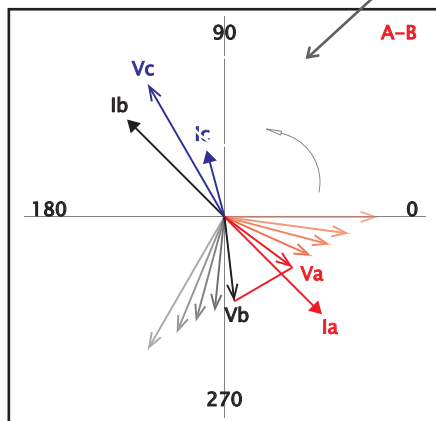

Realistic fault currents for a 3-phase fault (30°IA inception angle)
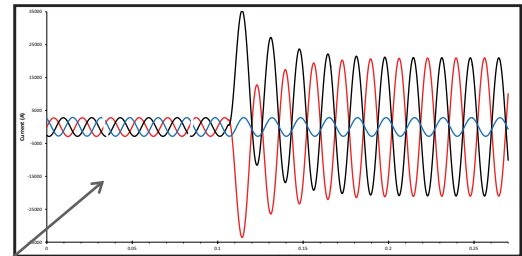
Realistic fault currents for a phase fault (90°IA inception angle)

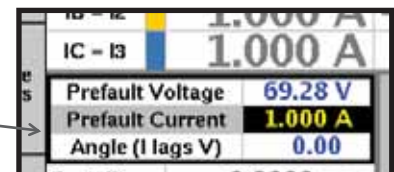Affect of load automatically included with a single setting

True Phase-Fault Simulation

The MTS-5100 automatically calculates realistic voltage and current phasors without zero sequence components for phase faults. This is especially important to properly test relays which employ zero sequence impedance or negative sequence impedance directional supervision, residual current supervision or sophisticated polarization and/or fault phase selection techniques.** Other test sets allow control of phase-phase voltage and current to simulate phase faults, but often produce high zero sequence voltages not present in the real world that can prevent elements from operating correctly. You only need to change one voltage, current, and angle value to ensure realistic outputs to realistically simulate the most common faults to ensure correct element operation.

Easily Include the Affects of Load

Simulating actual in-service conditions as closely as possible also includes accounting for load. Failure to account for increasing load on the network or the effects of load on protection operation has been shown to contribute to protection system failure.** With the MTS-5100, the affect of load can be automatically included with a single setting.

Transient Waveform Playback and GPS

(1) Connect GPS antenna (or IRIG-B input)

USB memory drive for rapid waveform file transfer

Built-in GPS receiver means less equipment to carry

The built-in high capacity memory even allows direct playback of events such as power swings and motor starts.

(2) Select waveform file

Select file from data memory or USB memory drive.

Transient playback tests the response of protection relays to real world waveforms. Performance under these simulated "actual conditions" can be analyzed and verified in ways not possible with traditional-sinusoidal phasor based testing.* This is an invaluable way to assure that a protection system will operate satisfactorily for known and often difficult fault conditions for that system.

GPS synchronized end-to-end testing is a proven method for verifying communication assisted transmission protection schemes by employing GPS time code signals.* No other method can guarantee the absolute phase, frequency and time synchronization required, and the MTS-5100 has the integrated facilities to:

- Display and store waveforms
- Built-in, standard GPS receiver
- Sequence of events recording
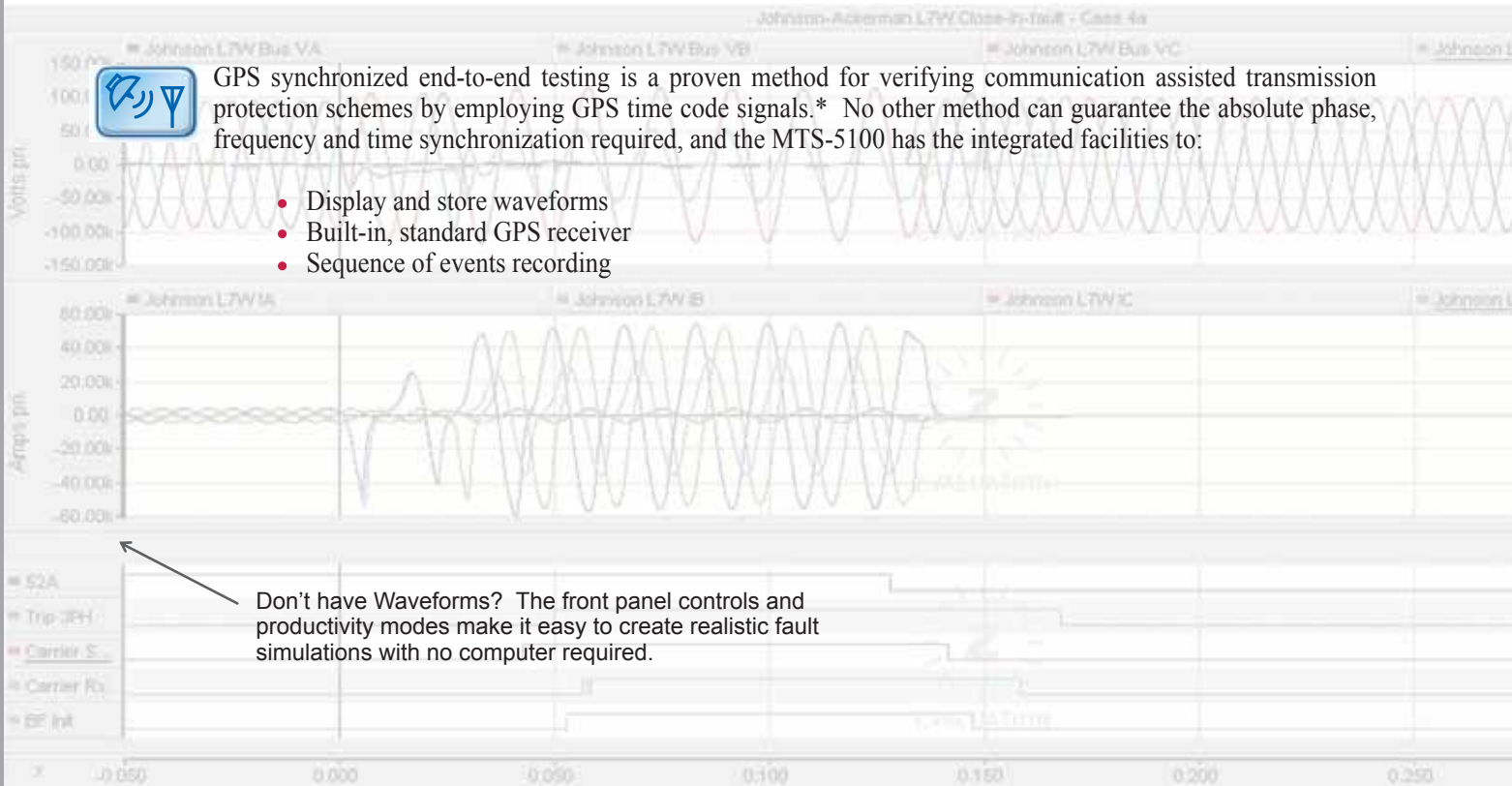
Don't have Waveforms? The front panel controls and productivity modes make it easy to create realistic fault simulations with no computer required.

* See www.mantatest.com for references to technical papers on these subjects.

Synchronized Testing Made Effortless

(3) Check selected channels

Check satellite lock and co-ordinate with remote terminals (for time synchronized testing)

Channels are automatically assigned to COMTRADE file contents upon loading. Change if required.

(4) Initiate test

Press FAULT (Synchronizes test to top of the next minute in case of GPS synchronized testing).

(5) Verify operation

Save results to a file if desired for later reference

After the test executes, verify correct operation directly on the sequence of events graph or table.
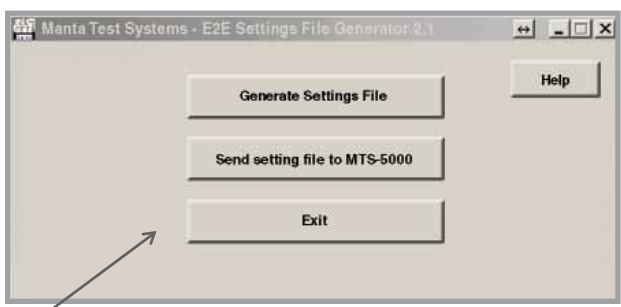
Don't have a COMTRADE file? You can perform end-to-end testing from the manual test screen and create tests on the fly or apply values supplied from the engineer. Use our E2E Settings File Generator to convert tests from spreadsheet or SS1 format to a MTS-51000 test file for easy conversion and playback.

Standardize Tests

Create and save test plans for any protective relay test using the standard MTS-5100 interface… no PC required.

Test with ready-built device specific procedures or create your own test procedure. All test plans can be saved before, during, or after a test. Test settings can be:

- Stored on the MTS-5100 in-use
- Stored, uploaded, or executed via USB memory drive
- Stored or uploaded from any network-enabled computer using standard FTP protocols
- Easily transferred to other users or MTS-5100 test sets via USB stick, email, or FTP

The ability to save any test allows you to:

- Easily customize and restore your favorite MTS-5100 front panel configurations
- Quickly apply commonly used test procedures
- Create test plans for all the relays in your system to perform identical tests during maintenance
- Quickly modify test plans for new applications and standardize tests between users
- Share test procedures with all users

REMOTE CONSOLE — Interactive PC-Based Testing

Manta Test Systems also offers our *Remote Console* program for PC-oriented users. This program can be used to control the MTS-5100 via any TCP/IP network. The interface is nearly identical to the MTS-5100 front panel so there are no new screens to learn.

Remote Console works without an MTS-5100 by creating a virtual test set on your computer so you can:

- Create, test, and save test plans before the job starts to increase productivity and reduce testing times
- Train new users without an actual test set that could be better used testing relays
- Help users in the field using your *Remote Console* to give exact instructions

RAPID REPORTER® — Automatic Reporting

Create reports that can be viewed by anyone who uses a web browser via the MTS-5100 front panel with no external software or PC required… or use *RapidReporter®* software to save, organize, and generate custom reports built to your specifications.

The MTS-5100 can create test reports using the universal xml format which include your test results and every setting in the test set at the moment of test. You can create your own filters to import this information to any existing or future data storage program in your organization, or use *RapidReporter®* to:

- Organize, sort, and view your results
- Quickly review evaluations for Pass/Fail
- Correct or revise user supplied information (Test set generated results are locked)
- Create and save custom title page templates
- Create and save custom report templates with as much or as little information as you require
- Create flexible rules which allow different templates for different tests
- Only print the results that matter to you with any level of detail required
- Create an open-source database of your results which can be linked to other programs in your organization
- Automatically generate and organize a summary of relays for your NERC/FERC reporting requirements.

**This is only a sampling of what the MTS-5100 has to offer.
Book a demonstration and find out more today!**