Clinton
INSTRUMENT COMPANY

Model TST-10B Wireless DC Spark Tester
Instruction Manual

RCW and TSTB

Clinton Instrument Company

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Contents

EU Declaration of Conformity

CE

We

The Clinton Instrument Company
295 East Main Street
Clinton, CT 06413
USA
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declare that the Declaration of Conformity is Issued under our sole responsibility and belongs to the following TST-10B Series Products:

Model: RCW	Display Digital Wireless for TSTB
Model: RCWA	Display Digital Wireless for TSTB with Analog Module
Model: RCWX	Display Digital Wireless for TSTB with Fieldbus Module
Model: TSTB	Wireless 2.4GH Negative DC Spark Tester

The object of the declaration described above is in conformity with the relevant Union Harmonization legislation:

2014/30/EU EMC Directive
2014/35/EU Low-Voltage Directive

The following Harmonized standards and technical specifications have been applied:

CISPR 11 Edition 5.0: 2009, A1: 2010	Conducted Emissions, Group 1, Class A
CISPR 11 Edition 5.0: 2009, A1: 2010	Radiated Emissions, Group 1, Class A
IEC 61000-4-2: 2008	Electrostatic Discharge
IEC 61000-4-3: 2006, A1:2007, A2:2010	Radiated Immunity
IEC 61000-4-4: 2004, A1: 2010	EFT/Burst, Power Ports and I/O Ports
IEC 61000-4-5: 2005	Surge Immunity, Power Ports
IEC 61000-4-6: 2008	Conducted Immunity, Power Ports and I/O Ports
IEC 61000-4-11: 2004	Voltage Dips and Interrupts
IEC 61010-1P: 2018	Safety Requirements

Clinton, CT USA May 2022

Donna Langley
President

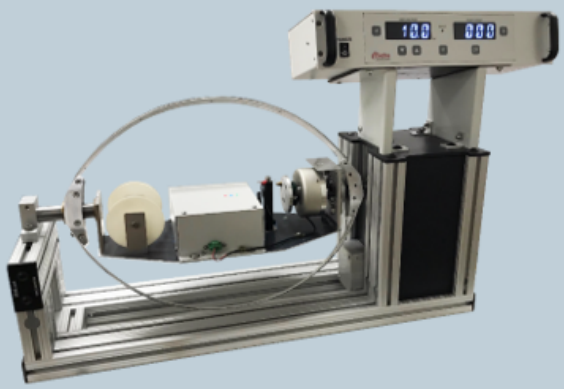
Ted P. Lane
Chief Engineer

Specifications

MODEL TST-10B System

Wireless Spark Tester for Double-Twist Bunchers (Twinners)

- Reliable Spark testing during twisting when the finished product winds inside the bow
- No control slip rings required
- Uses 24V DC from inside twinner
- DSP based voltage regulation and differentiation of four fault-types
- LED Display (removable up to 50 feet away)
- Customizable front panel password security
- Voltage Watchdog
- Communications: Modbus RTU via RS-485 Optional: Analog, Ethernet/IP, Modbus TCP, Profibus, PROFINET, DeviceNET



RCW control unit with TSTB HV power supply & electrodes shown mounted to a model bow twister (twinner)

The Clinton model TST-10B DC Spark Tester combines the latest in technology and innovative features for DC spark testing of wire and cable during twinning operations.

Using DSP based fault typing, the TST-10B is able to differentiate between four fault conditions: pinhole, direct metal contact, multi-pinhole, and gross bare wire.

The wireless RCW control unit remains outside the twinner and may be located up to 50 feet away. Wireless communication between the DCW high voltage test module and the RCW control unit eliminate the need for troublesome control slip rings, however, slip rings can provide power and ground to the test module if the required 24V and ground is not readily available inside the twinner.

The TST-10B can be quickly configured through a simple menu on the alphanumeric display. During spark testing, critical data such as test voltage, percent load, and counts for particular fault types can be easily accessed.

Additionally, descriptive codes inform the operator when there is an error. For example, when the external interlock is open.

Clinton INSTRUMENT COMPANY

The RCW can connect easily to a PLC with Modbus RTU via RS-485 full duplex. Optional Analog, DeviceNET, Ethernet/IP, PROFINET, Profibus, and Modbus TCP communications are available.

Wiring and setup is done externally; there is no need to open the unit. One form C and three form A relay contacts are located on the rear panel for easy connection to external alarms, lights, or machinery controlled by the spark tester.

Relay function may be selected from options including: high voltage ON indication, fault alarm, bare wire alarm, and voltage watchdog (when enabled, the equipment will alert when a preset upper or lower voltage is exceeded).

The TST-10B features a flexible front panel password security, locking out unauthorized changes to test voltage and other settings. The unit also monitors output voltage at the electrode and notifies the operator if voltage at the electrode should become disconnected.

The TST-10B spark tester series offers standard electrodes that meet UL, CSA, and all known international standards for wire products and production line speeds. Specifically designed electrodes are available to accommodate a wide range of product sizes and shapes.

The TST-10B can be automatically calibrated for voltage to IEC/CEI 6230, EN 50356, UL and NEMA with Clinton's STCAL System

TST-10B

SPECIFICATIONS

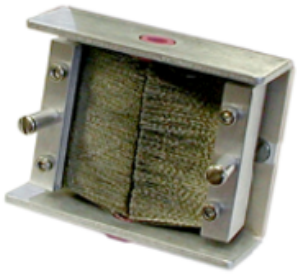
Voltage Test Range:	Approx. 500 volts to 10KV D.C. For test voltages below 2000 volts, contact factory for electrode recommendation.
Voltage Accuracy:	+/- 2% of reading
Output Power:	1.5 mA maximum
Fault Indication:	White 3-digit 20.32mm high LED display, amber fault indicating LED
Fault Resolution:	Variable with electrode length or directly configurable from 1 millisecond to 2 seconds
Detection Sensitivity:	Conforms to IEC 62230
Operating Modes:	Continuous HV/remove voltage on fault, momentary process control/latch until reset
Relay Outputs:	1 Form-C, 3 Form-A / Configurable Functionality Relay contacts rated 1A max @ 240VAC or 2A max @120VAC for both NO and NC circuits. Front panel or external reset. In non-latch modes, closure time is adjustable in 10 millisecond increments from 50 milliseconds to 2 ½ seconds
Power Requirements:	
RCW	100 to 240VAC 49-61 Hz. Power supply self-adjusting
TSTB	24V DC 2 amps
Safety	Designed to IEC-1010
Communications	Modbus RTU via RS-485
Optional Communications	Analog, Ethernet IP, Modbus TCP, Profibus, Profinet, DeviceNET

Electrode Options

BD-051	Bead Chain Assembly ½" Product Diameter, ½" along the wire line.
BR0.3-2	Brush Assembly 0.2" Product Diameter, 2" along the wire line. (Recommended for vertical wire paths and voltages under 2kV)

For additional electrode options, please consult factory

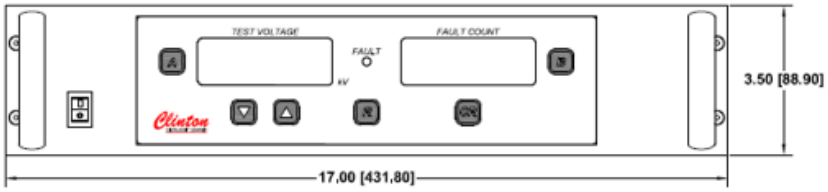
BD-051



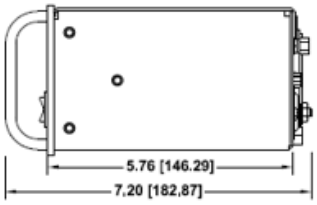
BR0.3-2

RCW Control Unit

Front View



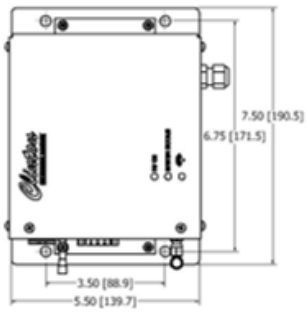
Side View



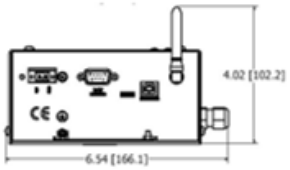
TSTB High Voltage Test Module

Side View

Top View



Rear View



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Specifications subject to change without notice 2/24 EN

Safety

Safety Symbol

The symbols depicted below are safety symbols placed on spark test equipment. It is important to understand the meaning of each.

Caution symbol. Caution- refer to the manual to protect against damage to the equipment or to avoid personal injury.

Risk of electric shock symbol.

Earth ground symbol.

Warning

If the RCW or the TSTB is used in a manner not specified by Clinton Instrument the protection provided by the equipment may be impaired and safety may be compromised

Dimensional Specifications

RCW : 89mmH x 432mmW x 183mmD (3.5” x 17” x 7.2”), 3.4kg (7.5lb)

TSTB : 73mmH x 167mmW x 191mmD (2.9” x 6.6” x 7.5”), 1.6kg (3.5lb)

Dimensions and weights are nominal

Environmental Conditions

The spark tester is designed to be safe under the following conditions:

- Indoor use.
- Altitude to 2000m.
- Temperatures from 5ºC to 40ºC.
- Humidity to 80% R.H. at 31ºC, decreasing linearly to 50% R.H. at 40ºC, Pollution Degree 2

The Clinton Instrument Company certifies that this equipment met its published specifications at the time of shipment. The calibrations of the equipment are checked against Measurement Standards (Reference) maintained by the Clinton Instrument Company. The accuracy of these standards is traceable to the national standards at the National Institute of Standards and Technology (NIST) or derived by ratio type measurements. For customer service or technical assistance with this equipment, please contact:

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Website: www.clintoninstrument.com
Email: support@clintoninstrument.com

Avoid the Risk of Fire!

Every time your wire line stops, be sure that the HV in the electrode goes off. If the HV remains ON while your wire line is stationary, the wire insulation within the electrode will heat and there is a danger of combustion. Refer to the table in "Installation" labelled "Terminal Block connections," under HV Enable on how to safely install your spark tester.

Caution: Pacemaker Warning

Clinton Instrument Company strongly advises any individual using a pacemaker or other such medical device to avoid operating or being in the vicinity of spark testers. Current studies indicate that such medical devices can malfunction in the presence of electrical and magnetic fields. When a fault occurs in the electrode of a Clinton spark tester, both high and low frequency electromagnetic fields are generated. The strengths of these emissions are unknown, since they depend on test voltage and other variables. The danger is greater when a customer does not ground the inner conductors of a test product. While Clinton cautions its customers to ground the test product for safety reasons, many times this warning is ignored. In this situation, both the spark tester and the entire length of the wire line will radiate these emissions. There is also a serious risk of electrical shock if an individual comes into contact with an ungrounded test product.
Email: support@clintoninstrument.com.

RF Exposure Warning

To satisfy FCC RF Exposure requirements for mobile type transmitting devices, a separation distance of 25 cm or more should be maintained between the antenna of this device and persons during operation, with exception of hands, wrists, feet, and ankles. To ensure compliance, operation at closer distance than this is prohibited.

Electrical Shock Hazard from Production Line Spark Testers

By Henry H. Clinton

The commonly accepted maximum values of 60Hz. current passing through the human adult body which permit a subject to let go of electrodes are nine milliamperes for males and six milliamperes for females. At 3000 Hz. this value increases to about 22 milliamperes for men and 15 milliamperes for women, DC currents do not present the same let-go problems, but a subject can readily let go at a level of 60 milliamperes. A continuous 60 Hz. current above 18 milliamperes stops breathing for the duration of the shock only. Ventricular fibrillation may occur above a level of 67 milliamperes. The reaction current level of 60 Hz. is about .5 milliamperes. Above this level a muscular reaction can occur which can cause a secondary accident. The DC and 3 kHz. Levels are probably considerably higher. Capacitor discharge energy of 50 Joules (watt-seconds) is regarded as hazardous.

Clinton DC spark testers are current limited to 5 milliamperes or less. Three kilohertz spark testers are limited to 4 milliamperes or less, and 60 Hz. types to 7 milliamperes. Impulse spark testers can deliver a maximum charge of about .2 Joules 248 times per second. All these spark testers have current outputs above the reaction level, but none above the let-go threshold level. Because of the possibility of secondary accidents caused by muscular reactions, operators should be protected against accidental shock. Electrodes are supplied with interlock switches, and these should not be disabled. The conductor under test should be grounded. If an operator must inspect the product by touching its surface while it is being spark tested, he should be electrically insulated from his environment, and any possible cause of a secondary accident caused by reaction should be eliminated.

For references, see: Dalziel, Ogden, Abbot, “Effect of Frequency on Let-Go Currents,” Transactions of A.I.E.E., Volume 62, December 1943, and Dalziel, “Electric Shock Hazard,” I.E.E.E., Spectrum, February 1972.

Installation

CAUTION:

The installation procedures listed below are to be performed by qualified service personnel only. Failure to follow these procedures may result in danger to personnel and equipment damage.

Unpacking

Remove the spark tester from the carton. Retain the packing material in the event that the unit is returned for calibration or service at some future time.

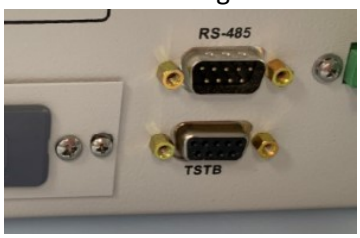
The following items are packed with the spark tester:

1. RCW Display
2. A power cord
3. A 9-Pin green terminal block connector for process control connections. After it is wired, it will plug into the terminal block on the back of the spark tester
4. A 4-Pin green terminal block connector for process control connections. After it is wired, it will plug into the terminal block on the back of the spark tester
5. RS-485 pairing cable 6 Foot Long
6. Antenna cable with magnetic base
7. Antenna with swivel base
8. TSTB Spark tester with Antenna
9. Quick Start Guide
10. Short Manual

Pairing the RCW and TSTB

The RCW and TSTB come paired from the factory, but it is important that each RCW/TSTB pair have a unique channel and PAN ID. This is done to avoid interference between RCW/TSTB pairs.
To pair the RCW/TSTB do the following:

1. Remove power from both RCW and TSTB.
2. Connect the RS-485 connecting cable from the RCW's TSTB connector to the TSTB's RCW Pairing connector.



3. Turn on just the RCW, the TSTB will get power from the serial cable.
4. Enter configuration by pressing both the Down button and CR buttons simultaneously.
5. Press the Down button until RF CON is displayed
6. Press the B button to enter RF Configuration
7. The first item to be configured is the channel. Press the CR button to edit this value, the UP and DOWN buttons to modify, and the CR button to save the value.
8. Use the Down button to edit the second item, the SYS ID (displayed as SYS).
9. Again, use the CR, UP and DOWN buttons as described in step 7.
10. Use the Down button to edit the third item, the Power (displayed as POW). It is recommended to start with the POW level set to MIN.
11. Again, use the CR, UP and DOWN buttons as described in step 7.
12. Use the Down button and the display will read PAIR HOLD.
13. Hold the B button down until the pairing starts.
14. When pairing is complete, the RCW will display PAIR DONE followed by REST ART
15. Remove power from the RCW, disconnect the cable.
16. The RCW/TSTB are now ready for operation.

Site Preparation

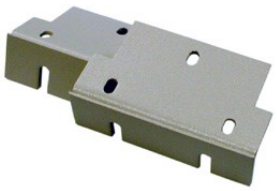
Select a suitable location for the RCW:

The RCW Digital DC wireless control unit is designed for use in a fixed location, permanently connected to its power source. The control unit may be mounted on a table or platform, placed in a rack, or installed on equipment such as a twiner. If necessary, the TSTB HV Test Module may be located as far as 50 feet from the RCW control unit. However, for best performance the RCW should be located as close to the TSTB as possible.

To mount the RCW on a horizontal surface:

Insert (2) M-6 screws through the mounting surface into the (4) tapped inserts. Be sure the screws do not extend into the chassis more than 1/2 inch (12mm).

To install the Optional RCW in a rack or panel:



To install the RCW in a rack or panel, the space must be 11cm H x 48cm W to ensure that there is a minimum clearance of 1 cm. on the top and bottom of the control unit for ventilation. Install the rack mount kit (supplied with the control unit) using the 6 8-32 x 1/2” screws and lock washers provided. Slide the control unit carefully into place. RS-485 cables for connection to a computer or PLC must be purchased separately. Refer to the manual for information on connecting the RS-485 interface.

Select a suitable location for the TSTB:

The TSTB test module is designed to be mounted inside the Twinner encloser. Locate the TSTB HV Test Module on the twinner cradle close to the electrode to minimize the length of the high voltage lead. Care must be taken to select the proper mounting position of the electrode. At least 1-inch (25 mm) clearance is required from any part of the electrode to any point on the machine frame. This is important, since the deflection of a bead chain by the passing wire can allow a high voltage arc to the machine frame. Should the required clearance not be available in your machine, extra insulating barriers should be used to prevent any arcing at the full output voltage of 10KV.

Trim the HV lead of the TSTB so that it reaches the electrode without excess length and connect it to the HV input.

If a bead chain electrode has been selected, it should be positioned to permit the wireline to travel through the upper half of the beads.

Provide for ventilation of the Test Module

As with any apparatus producing a spark or electrical corona, the TSTB Spark Tester produces ozone in the electrode region. While ozone reverts harmlessly to oxygen within a few minutes, an external air extraction system is recommended and should operate whenever the spark tester is in use. The exhaust of the external air extraction system should be discharged either outdoors or into some area well away from workers.

Power Wiring

Caution

The RCW is intended to be powered from a power cord containing 18ga or larger conductors with a ground wire. Reference included Clinton Instrument Co. part number 03780.

Mains Power:

Note that the spark tester has a self-adjusting power supply with an operating voltage range of 100V to 240V at 47-63 Hz. 240VA Maximum (Overvoltage Category II)

Maximum acceptable mains voltage fluctuation +/-10%

Ground the RCW:

Locate the ground stud on the back panel of the spark tester. Remove the outer nut and crimp terminal. Crimp a 16 awg. (1, 29 mm^2, 1, 31 cross section) stranded insulated wire (preferably green with a yellow stripe) to the crimp terminal. Fasten this to the ground stud and secure with the keps nut. Connect the other end to a safety ground system in accordance with EN 60204-1:1993, Section 5.2, Table 1.

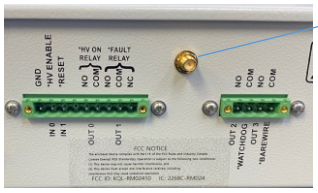
Supply Power to the TSTB:

Using 22 AWG (or Larger) wire and the green connector supplied with the unit, connect the TSTB to 24V DC. If you can acquire power through the cradle and if the cradle is grounded, use that as your power source. If the cradle does not offer power, then a power and ground slip ring must be provided. The power cord should be as short as possible. Connect the ring terminal on the TSTB ground stud to ground.

Ground the TSTB:

Locate the ground stud on the back panel of the spark tester. Remove the outer nut and crimp terminal. Crimp a 16 awg. (1, 29 mm^2, 1, 31 cross section) stranded insulated wire (preferably green with a yellow stripe) to the crimp terminal. Fasten this to the ground stud and secure with the keps nut. Connect the other end to the twinner cradle to bond the TSTB chassis and the Twinner cradle.

Antenna installation RCW:



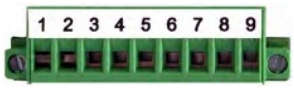
Mount the antenna for the RCW inside the enclosure were the TSTW will be located for best performance. This is done using the antenna extension cable with the Magnetic base included with the RCW. While the antenna can be mounted directly to the back of the RCW This is not recommended and will decrease the RF Link performance. Connect the Antenna extension cable here.

Terminal Block Wiring

Refer to the following table for information on pin functions. Locate the green terminal blocks on the back of the spark tester and its companion green terminal block connectors that came with the unit.

Relay Circuits rated for maximum 120V at 2amp, 240V at 1 Amp. (Overvoltage Category II)

Conductors connecting auxiliary equipment, relays and switches should be shielded 22 gauge or larger with double or reinforced insulation. The wires should be stripped back ¼" (6mm) and fed into the green terminal block connector at the proper pin number. Shields from con¬ductors connecting auxiliary equipment should be grounded to the safety ground terminal.



9 - Pin Terminal Block Connections	Pin No.	Designation	Conductor
HV Enable (IN0): **CAUTION:** For HV on the electrode, install a normally closed switch or relay contact** between pins 1&2. This switch or relay should open automatically when the wireline stop switch is activated or be opened manually by the system operator when the line stops. **FAILURE TO DO SO COULD RESULT IN A FIRE HAZARD** If the HV remains ON in the electrode when your line is stationary, the wire insulation in the electrode will heat and there is a danger of combustion. **External Reset (IN1):** To reset the spark tester fault relay with an external switch, wire a momentary switch** between pins 1&3. When these contacts close, the fault relay will return to a normal state. The interval that the contacts are closed must exceed 50 ms.	1	GND	(3) Minimum 22 ga. stranded conductors rated 250V, less than 10 meters in length, contained in a common insulating sheath
	2	HV ENABLE	
	3	RESET	
	4	not used	
HV ON Indication (OUT0): Dry relay contact pins 5&6 will close when the test voltage exceeds 500v. For an indication that HV is ON in the electrode, wire a lamp or auxiliary device* here.	5	NO	(3) Minimum 22 ga. stranded conductors rated 250V, less than 10 meters in length, contained in a common insulating sheath with double or reinforced insulation
	6	COM	
Process Control (OUT1): To activate external lights, alarms or relays* when a fault occurs, wire them between dry relay contact pins 9,8 & 7. If the output function is set to LCH or RVF the dry relay contacts will remain closed until the RESET button is pressed or when pins 1&3 are closed by remote switch or relay. If the output function is set to NLC, the dry relay contacts will return to normal state after the interval known as the AFMS (Any Fault Alarm Time) has elapsed.	7	NO	
	8	COM	
	9	NC	

* When connecting auxiliary equipment to dry relay contact pins 5, 6, 7, 8 or 9, observe maximum ratings of 120VAC at 2 amps, 240VAC at 1 amp.
**Switches and relays connected to pins 1,2, & 3 should be suitable for 24V low current applications.

4 - Pin Terminal Block Connections	Pin No.	Designation	Conductor
Watch Dog (OUT2): Dry relay contact pins 1&2 will close when the test voltage is between the VWDL (Voltage Watchdog Low Threshold) and the VWDH (Voltage Watchdog High Threshold) values.	1	NO	(3) Minimum 22 ga. stranded conductors rated 250V, less than 10 meters in length, contained in a common insulating sheath with double or reinforced insulation
	2	COM	
Bare Wire (OUT3): To activate external lights, alarms or relays* when a Bare Wire type fault occurs, wire them between dry relay contact pins 3 & 4. If the output function is set LCH or RVF, the dry relay contacts will remain closed until the RESET button is pressed or when pins 1&3 are closed by remote switch or relay output function is set to NLC, the dry relay contacts will return to normal state after the interval known as the ABMS (Any Bare Wire Alarm Time) has elapsed.	3	NO	
	4	COM	

*When connecting auxiliary equipment to dry relay contact pins 1, 2, 3,or 4, observe maximum ratings of 120VAC at 2 amps, 240VAC at 1 amp.

Connecting the Serial RS-485

The RCW is equipped with an RS-485 serial interface allowing the spark tester to receive commands and exchange information with a PLC or computer. Programming and control of voltage settings, which can be done manually on the RCW display, can also be done through this interface. Control display buttons can be disabled when the serial interface is in use. See the section entitled "RS-485 Interface" for connection and communication information.

The "RS-485" interface connector is located on the rear of the RCW directly under the "Display" connector.

Connecting to the Analog Interface (Optional)

The model RCW can be purchased with an optional analog interface. (Model RCWA) The analog interface allows the RCW to be controlled by a PLC with standard analog and Digital I/O. The connecting cable for this interface is not supplied by Clinton Instrument Company. The cable composition is normally dictated by the PLC, but ordinarily 22 AWG conductors (individually shielded or shielded pairs) are required. The maximum length of the cable is also determined by the equipment the RCW is being connected to. However, it is recommended that the cable length not exceed 10 meters.

See the section entitled "Analog Interface" for the details regarding this interface.

Installing the CompactCom™ Module (Optional)

The model RCW can be purchased with an optional Fieldbus Communications Interface. (Model RCWX) This interface will allow the installation of several fieldbus options. (DeviceNet, Ethernet IP, Modbus RTU, Modbus TCP, Profibus, Profinet)

To enable the Fieldbus Interface the proper CompactCom™ module will need to be installed into the RCW unit.

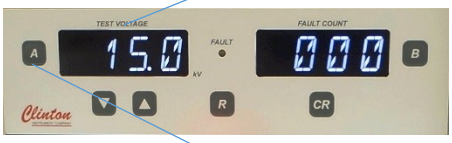
- First remove the Anybus Slot Cover from the rear of the spark tester.
- Remove the CompactCom™ module from the packaging.
- Slide the CompactCom™ module into the open slot on the rear of the spark tester.
- Secure the CompactCom™ module by tightening the 2 screws.

See the section entitled "Fieldbus Interface" for the details regarding this interface.

Spark Tester Controls

ON/OFF Power Switch

There are two power switches. One is located on the power entry module on the rear of the RCW. The second switch is located on the front panel. Both switches need to be turned on to power the unit.



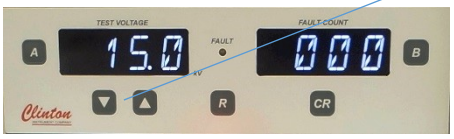
Voltmeter

The voltmeter will indicate the high voltage present at the electrode. The voltage is displayed in kV. When the output is set to 1,000V the display will read 1.0. A reading of 10.2 indicates that the test voltage at the electrode is 10.2kV DC.

This display can also display a “Percent Load” value and the “Set Point” value by pressing the “A” Button. These values will be displayed momentarily on the Voltmeter display and then will return to displaying the spark tester voltage at the electrode.

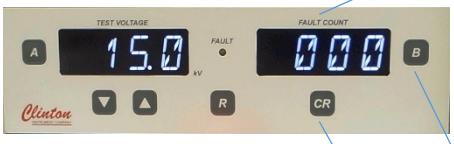
“A” Button

Pressing the “A” button will momentarily cycle the Voltage display through the “Percent Load” and the “Set Point” Values.



UP/DOWN ARROW (VOLTAGE ADJUST) buttons

The spark test voltage may be adjusted from 0 to the maximum voltage of 10,000V in 100 volt increments by pressing the up and down arrow buttons under the voltmeter. Press and hold a button to increase the speed at which you change the voltage setting.



Fault Counter

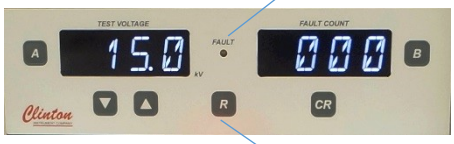
The 3-digit fault counter registers a count each time any fault type is detected in the electrode. This display can also momentarily show 4 additional fault counts by pressing the “B” button. These fault counts are Pinhole, Metal Contact, Multiple pinhole, Gross Bare wire. Press the CR button to reset the number of faults on the counter to 0.

“B” Button

Pressing the “B” button will momentarily cycle through the 4 additional fault count values. (Pinhole, Metal Contact, Multiple Pinhole, Gross Bare Wire)

“CR” COUNT RESET button

Pressing the “CR” button will reset all fault count values.



FAULT light

The FAULT light will illuminate in response to any fault condition and will mirror the Any Fault Alarm. It also indicates that the Any Fault Alarm relay contacts are in fault condition, activating any accessories that are connected. If the Any Fault Alarm output function is configured to the LCH mode the fault light will remain on, otherwise the FAULT light will turn off automatically. The FAULT light can be turned off in 3 ways: (1) by pressing the "R" button below it; or (2) by closing a momentary switch or relay contacts wired between Pins 1 & 3 of 9-Pin green panel terminal block on the rear panel; (3) though one of the serial communication interfaces.

"R" RESET button

Pressing the "R" button will reset all fault conditions and their corresponding Relay output. The RESET button will have no effect on the number of faults registered on the fault counter.

RF Status Indicator

This indicator will change from Red to Blue depending on the RF link Status.

Red – RF Link Status is Bad. This means the power to the TSTB is turned off or the RF power needs to be increased.

Yellow – RF Link Status is Poor. This means that the RF link is established but the data rate between the RCW and the TSTB is not at optimal performance. In this case the RF power should be increased.

Green – RF Link Status is Good. This is the optimal RF range for operation.

Blue – RF Link Status is Excellent. In this case the RF power could be decreased until the RF Link Status indicator is green.

Definition of Terms

Actual Voltage- Actual voltage is a metering winding on the high voltage transformer. This winding can be monitored remotely and indicates the level of voltage supplied to the electrode.

Any Fault Alarm- This alarm will respond when a fault of any type is detected. This alarm can be latched, and when latched the voltage can be removed or left on. When the alarm is not latched, the duration of this alarm is selectable. (See Latch, Non-Latch, & Remove Voltage on Fault, below).

Channel- Each channel has a different frequency. By varying the Channel on adjacent systems, the chance of RF interference is diminished

Electrode Voltage- This is a new feature, exclusive to Clinton's TST-10B spark tester, a separate circuit monitors the voltage at the electrode. The voltage is monitored by a high impedance sensing circuit providing immediate data about the voltage at the electrode. This data is crucial to differentiate the different fault types.

Fault Pulse- The fault pulse is a signal generated by the TST-10B when a defect is detected. This signal causes the front panel fault lamp to light, increments the fault counter, and initiates process control relays to change state. In general, the fault pulse must last at least as long as the fault stays in the electrode, in order for a single fault to be counted only one time.

Fault Sensitivity- Fault sensitivity refers to the amount of current that must pass through a pinhole or other defect type to be detected as a defect and typed accordingly.

Gross Barewire- Gross Barewire is defined as a fault where the wire conductor is exposed, allowing metal contact to be made with the electrode for a period of time equal to two and one-half times the electrode length.

High Voltage Enable- In order for the TST-10B to generate high voltage, the HV-ENABLE terminal must be connected to the GROUND terminal on the terminal block. This can be by direct wire jumper at the terminal block (pins 1 and 2) or the connection can be made remotely by switches or control relays.

Latch, Non-Latch, & Remove Voltage on Fault- These are the conditions under which the fault relay operates when a fault is detected.

Latch- When a fault is detected the fault relay will change state and remain in that state until a reset command is given, either by pressing the front panel reset button, connecting the RESET and GND terminals on the terminal block, or providing a remote reset command through the Compact Comm modules. High Voltage remains ON while the relay is latched.

Non-Latch- When a fault is detected, the fault relay will change state only for the amount of time the fault remains in the electrode. This time can be extended by changing the Process Control Duration Time.

Remove Voltage on Fault- When the unit is in Remove Voltage on Fault mode and a fault is detected, the relay will latch. When Remove Voltage on Fault is selected, high voltage will be disabled while the relay is latched, so the wire may be safely handled or inspected. When the system is reset either by pressing the front panel reset button, connecting the RESET and GND terminals on the terminal block, or providing a remote reset command through the Compact Comm modules, the system will be reset and high voltage will be restored.

Metal Contact- Sometimes referred to as BARE WIRE. A Metal Contact fault is defined as a defect or bare patch in the insulation that allows the electrode to come into momentary direct contact with the wire conductor. In order for a fault to be typed as a metal contact, the bead chain electrode must make physical contact with the conductor under test.

Multi-Pinhole- A Multi-Pinhole is defined as two or more pinhole faults closely spaced. It can also be a single fault of longer duration where no metal contact was made between the wire conductor and the electrode.

Pair- This operation links the RCW display to the TSTB high voltage test module. This allows multiple RCW-TSTB sets to be located near each other without interference.

System ID- This is a configurable identifier to ensure that each RCW/TSTB pair are unique.

Pinhole- A pinhole is defined as a short-duration fault where no direct metal contact between the wire conductor and the electrode is made.

Setpoint Voltage- This is the desired test voltage that is input through the front panel controls or remotely by PLC

Power- This is the Radio Frequency (RF) output power. It is advised to use the lowest setting to avoid creating interference with other RCW/TSTB pairs

RF Link Status- This represents the quality of the RF communications between the RCW and the TSTB

Voltage Watchdog- Test Voltage parameters may be set by users to ensure that adequate test voltages are always being used to test product. These values can be based off of upper/lower limits (WDL), or percentage of set point voltage (EVP).

New Features

Front Panel Security: The RCW system offers a customizable password protect option that can be enabled, if desired, to prevent operators from changing or accessing information. There are four levels of password protection that allow supervisors to choose exactly what the operators are able to access.

Communication Modules: An optional PCB may be added to the RCW for easy communication to most PLCs. This PCB can be factory installed or added later. Analog, DeviceNET, Ethernet/IP Profibus, Profinet, Modbus RTU, and Modbus TCP protocols are all available options. Communication protocols can easily be changed at any time with the purchase of an upgrade kit or a new plug-in module.

Redundant Voltage Monitoring: In addition to standard voltage monitoring, the RCW monitors the voltage at the electrode to verify correct voltages are being maintained.

Four output relays: One set of form C and three sets of form A relay contacts are located on the back of the RCW for easy connection to external alarms, lights, or machinery that will be

controlled by the spark tester. Relay functions can be selected from options including: High Voltage ON indication, Fault Alarm, All Bare Wire Alarm (this includes both Direct metal contact and gross bare wire conditions), and Voltage Watchdog.

Fault Typing: Detecting the flow of current during spark testing has always been the standard in spark testing. The TSTB revolutionizes the concept of fault detection by the use of DSP Based Fault Typing. We can now differentiate 4 types of fault conditions: Pinhole, direct metal contact, multi-pinhole, and gross bare wire.

Definitions of fault conditions:

- **Pinhole-** A pinhole is defined as a short-duration fault where no direct metal contact between the wire conductor and the electrode is made.
- **Multi-Pinhole-** A Multi-Pinhole is defined as two or more pinhole faults closely spaced. It can also be a single fault of longer duration where no metal contact was made between the wire conductor and the electrode.
- **Metal Contact**- Sometimes referred to as BARE WIRE. A Metal Contact fault is defined as a defect or bare patch in the insulation that allows the electrode to come into momentary direct contact with the wire conductor. In order for a fault to be typed as a metal contact, the bead chain electrode must make physical contact with the conductor under test.
- **Gross Barewire-** Gross Barewire is defined as a fault where the wire conductor is exposed, allowing metal contact to be made with the electrode for a period of time equal to two and one half times the electrode length.

Automatic Calibration with STCAL System: When calibrating with Clinton Model ST-CAL, there is no need to open the equipment, or to make any physical adjustments during the process. The TST-10B will communicate with a Tablet and Voltmeter to make all necessary adjustments. Calibration results, Serial information, and other optional information is provided on a Calibration Certificate which can either be printed to a network printer or exported to a USB stick to keep for future records.

Percent Load Meter: By toggling the A button on the control panel the voltage will change from volts to percent of current output being used to produce the test voltage in real time

Fault output options: remove voltage on fault for Alarm Modes

Spark Tester Configuration (Front Panel)

Navigating the Configuration Menu

This section will explain how to navigate and configure the unit from the configuration menu using an RC Display.

Entering configuration: While the RC Display is in normal run mode, hold the "Down Button & CR Button" for approximately four seconds. The system will enter configuration mode and voltage output will be disabled. If the display has been locked by a PIN, a PIN entry screen will be presented. For more information see "RC Display Security" below.

"A" Button: If pressed while at a top-level menu item it will exit configuration. If pressed while inside a submenu, it will return to the top-level menu item.

"B" Button: If pressed it will enter the sub menu of the currently selected menu item.

"CR" Button: Used to change settings in a sub menu. Pressing the CR button once will enable edit mode and display  . Use "up and down" arrows to toggle between sub menu options.
Pressing the CR again will remove the * and save the changed selection.

RC Display Security (PIN)

To Lock / Unlock the RC Display manually, hold the A & B Buttons for at least four seconds.

If the display is locked it will require entry of the PIN number before it will unlock. The factory default PIN code is 111.

If the display is unlocked, the display will lock to the **"PLM"** mode that is set in the configuration menu. For more information see "Configuration Menu Options" below.

Configuration Menu Options

 --

This configures the "Output Function" assigned to the hardware output labeled "OUT0", XXX is the configured function. For sub menu items, see the "Spark Tester Outputs" section of this manual.

 --

This configures the "Output Function" assigned to the hardware output labeled "OUT1", XXX is the configured function. For sub menu items, see the "Spark Tester Outputs" section of this manual.

 --

This configures the “Output Function” assigned to the hardware output labeled “OUT2”, XXX is the configured function. For sub menu items, see the “Spark Tester Outputs” section of this manual.

This configures the “Output Function” assigned to the hardware output labeled “OUT3”, XXX is the configured function. For sub menu items, see the “Spark Tester Outputs” section of this manual.

This displays that the High Voltage Enable “HVE” is assigned to the hardware input labeled “IN0”. This input is not re-assignable.

This displays that the Fault Reset “FR” is assigned to the hardware input labeled “IN1”. This input is not re-assignable.

This is the password (PIN) configuration menu. For sub menu items press B.

PIN protect RC Display on power up:

When “Yes”, the unit will be locked in the mode defined by “PLM”. When “No”, the unit will not be locked on power up.

PIN lock mode: This can be set to “0”, “1”, “2”, or “3”.

When the unit is locked, the different modes will lockout the following functions on the RC Display.

“0”: Configuration Menu Access.

“1”: Configuration Menu Access, Voltage Adjust.

“2”: Configuration Menu Access, Voltage Adjust, CR Button.

“3”: Configuration Menu Access, Voltage Adjust, CR Button, R Button.

This is where the PIN number is displayed and can be modified. The factory default PIN code is 111.

This configures the voltage parameters for the unit.

This configures the unit's maximum voltage with 1 decimal place. If more precision is needed, use FADJ. The setting of AUT will allow the maximum the unit will produce.

"AUT": Automatic maximum voltage
"xx.x": The value of the new limit

This configures the unit's maximum voltage using VLIM as a starting point to allow 2 decimal places. The setting of AUT will allow the maximum the unit will produce.

"AUT": Automatic maximum voltage
"x.xx": The value of the new limit

This configures which voltage to monitor when limiting the voltage. use when the unit's maximum voltage using VLIM as a starting point to allow 2 decimal places. The setting of AUT will allow the maximum the unit will produce.

"AV": Actual voltage as read from the high voltage power supply
"EV": Electrode voltage as read from the electrode

This configures the settings associated with fault detection for the unit.

This configures the unit's fault sensitivity mode. See Fault Sensitivity in the "Definition of Terms" section of the manual for more information. The values range from TS0 (normal sensitivity) to TS4 (maximum reduced sensitivity)

It is recommended that this be configured to the electrode length in inches.

The Fault Pulse “FP” time of the unit may be set to Auto “AUT” or set to a numeric value. See Fault Pulse Length in the “Definition of Terms” section of the manual for more information.

“AUT”: Auto mode uses default information to calculate a fault pulse.

The Line Speed “LS” time of the unit may be set to Auto “AUT” or set to a numeric value in **feet per minute**. See Fault Pulse Length in the “Definition of Terms” section of the manual for more information.

“AUT”: Auto mode uses the maximum line speed possible for the configured electrode length in fault pulse calculation (EX. 2 Inch Electrode = 3333 Feet per minute).

The Fault Resolution “FR” may be set to Auto “AUT” or set to a numeric value in inches between faults.

“AUT”: Auto mode uses default information to calculate a fault pulse.

The “FR” setting will affect how different types of faults are categorized. See the “New Features” section of this manual for more information on Fault Typing.

Fault Filtering Mode. This mode is to prevent specific false counting problems. Consult the Factory for details at support@clintoninstrument.com

“ON” Filter is Enabled

“OFF” Filter is Disabled

This configures the RF Module settings in both the RCW and TSTB.

This configures the RF module’s channel. It is recommended that each RCW/TSTB pair have a unique channel.

This is the network ID used between the RCW and TSTB. It is recommended that each RCW/TSTB pair have a unique PAN ID.

This is the RF transmit power. It is best to keep the power level as low as possible to avoid creating interference with other RCW/TSTB pairs.

To pair the RF modules of the RCW/TSTB Press and hold the B button. The steps of the pairing will be displayed followed by PAIR DONE. Eventually REST ART will be displayed. The pairing process should only take about 60 seconds. If the pairing does not complete, cycle power on the RCW and retry the pairing.

Configures the External RS-485 Modbus Communications port. Changes will not take effect until the system is restarted.

This configures the RS-485 Modbus Slave Address, where “XXX” is the slave address.

Configures the unit’s RS-485 Baud Rate, where “XXX” is the Baud Rate in bps.

Function Available on units with FW version b0107 and up. (Units shipped after 9/15/23)

Turn this function “ON” to enable support for the 92664 CompactCom Communication PCB Assembly.

Turn this Function “OFF” if there is no CompactCom Communication PCB Assembly installed in the unit.

For Non-IP based Fieldbus, the following Node address menu will be displayed.

Node address for non-IP based networks. (Will only be displayed if applicable)

For IP based Fieldbus the following menu items will be displayed.

Sets the DHCP mode “ON” or “OFF”. The default state is “OFF”

IP Address (1—255), Default (10) Ex. **10**.10.10.101

IP Address (1—255), Default (10) Ex. 10.**10**.10.101

IP Address (1—255), Default (10) Ex. 10.10.**10**.101

IP Address (1—255), Default (10) Ex. 10.10.10.**101**

Subnet Mask (1—255), Default (10) Ex. **10**.10.10.101

Subnet Mask (1—255), Default (10) Ex. 10.**10**.10.101

Subnet Mask (1—255), Default (10) Ex. 10.10.**10**.101

Subnet Mask (1—255), Default (10) Ex. 10.10.10.**101**

Gateway (1—255), Default (10) Ex. **0**.0.0.0

Gateway (1—255), Default (10) Ex. 0.**0**.0.0

Gateway (1—255), Default (10) Ex. 0.0.**0**.0

Gateway (1—255), Default (10) Ex. 0.0.0.**0**

This displays the local configuration option.

"ON " : When "ON" the IP Settings or Node Address used in the CompactCom communication module will be loaded from the Spark tester on power up.

"OFF" : When "OFF" the CompactCom communication module will use the IP Settings or Node Address last stored in the CompactCom module.

This displays the current firmware version for the TST-10B and the RC. This information will be useful when contacting Clinton Instrument Company for technical support.

Press the “B” Button once to display the TSTB firmware version number.

Press the “Down” Button once to display the TSTB firmware build number.

Press the “Down” Button once to display the TSTB firmware Build Code. (Spark Tester ST)

Press the “Down” Button again to display the TSTB Display firmware build revision.

Press the “Down” Button once to display the RCW firmware build number.

Press the “Down” Button again to display the RCW firmware Build Code. (Spark Tester ST)

Press the “Down” Button again to display the RCW Display firmware build revision.

Press the “Down” Button again to display the maximum output voltage.

Press the “Down” Button again to display the maximum output power.

Displays the last **factory** calibration date when the "B" button is pressed. (MM.DD YYYY)

Factory calibrations are valid for a period of one year.

When B is pressed, the calibration due date will be displayed in the following format: "MM.DD" "YYYY".

Note: The CAL DUE date is based on the CAL DATE value.

When B is held for no less than 5 seconds a progress bar will be displayed and the unit will enter Manual Calibration mode. For more information, see the "Manual Calibration" Section of this manual.

When B is held for no less than 5 seconds a progress bar will be displayed and factory defaults will be reset in the unit.

Spark Tester Inputs

Input functions are assigned to input pins labeled IN0 and IN1 located on the terminal block, so that the unit will perform the required task.

High Voltage Enable (HVE)

To enable high voltage, install a wire jumper, normally closed switch, or relay between pins 1 & 2.

See the 9-Pin Terminal Block Connections table in the Terminal Block Wiring section of this manual for more information.

Fault Reset (FR)

To reset the spark tester fault relay with an external switch or relay, wire a momentary switch between pins 1 & 3. When these contacts close, the fault relay will return to a normal state. The interval that the contacts are closed must exceed 50 ms.

Spark Tester Outputs

Output Functions are designed to relay information to an alarm, PLC, etc. The Output functions can be assigned to output pins labeled 'OUT 0, OUT 1, OUT 2, and OUT 3.

General Outputs

Output Disabled (OFF)

This output will not do anything, under any condition.

Cover Open (CVO):

This output will change state when the safety interlock cover is open. If the safety interlock cover is closed, the spark tester is able to produce high voltage.

System OK (SOK)

This output will change state when there is a hardware malfunction that could cause the unit to operate outside of acceptable limits.

Discharge Bar (DIS)

This output is the discharge bar output. When enabled, it will be activated when the voltage is enabled, and the voltage setting is above 0 and disabled when the voltage is set to 0 or the voltage is disabled.

High Voltage Enable (HVE)

This output will change state when the unit meets all conditions to generate high voltage.

Voltage Monitor Output Options

High Voltage On Lamp (HVL)

This output will change state when the actual voltage is equal to or above the set **"HVON"** configuration item value and will turn off when the voltage is equal to or below the set **"HVOF"** configuration item value.

 – High Voltage On (HVON)

Set in kV. If the actual voltage goes above this set point, any "HVL" output will change state.

 – High Voltage Off (HVOF)

Set in kV. If the actual voltage drops below this set point, any **"HVL"** output will change state.

Note – It is recommended that **"HVOF"** and **"HVON"** differ by at least .2kV and that **"HVOF"** never be set higher than **"HVON"**.

High Voltage Watchdog (WDL)

The WDL output will change state when the actual voltage being produced (displayed) is between the set **"VWDL"** and **"VWDH"** limit values.

 – Voltage Watchdog Low Limit. Set in kV. (VWDL)

 – Voltage Watchdog High Limit. Set in kV. (VWDH)

Note – It is recommended that **"VWDL"** and **"VWDH"** differ by at least 1kV and that "**VWDL"** is never set above the "**VWDH"** limit value.

For more information on the Voltage Watchdog, see the "New Features" section of this manual.

Electrode Voltage Percent Based Watchdog (EVP)

The EVP output will change state when the electrode voltage monitor is within plus or minus the configured **"EVWP"** percentage of the set voltage. Example: Set point is 10kV, **"EVWP"** is 10%. If the electrode voltage is between 9kV and 11kV the output will signal.

 – Electrode Voltage Watchdog Percent (EVWP)

Set as a percentage.

For more information on the Voltage Watchdog, see the "New Features" section of this manual.

Actual Voltage Percent Based Watchdog (AVP)

This output will change state when the main output voltage monitor is within plus or minus the configured "AVWP" percentage of the set voltage. Example: Set point is 10kV, **"AVWP"** is 10%. If the actual voltage is between 9kV and 11kV the output will be high.

 Actual Voltage Watchdog Percent (AVWP)

Set as a percentage.

For more information on the Voltage Watchdog or Actual Voltage vs Electrode Voltage, see the "Definition of Terms" section of this manual.

Percent Load Limit (PLL)

This output will change state when the percent load reaches or exceeds the Percent Load Limit PLLT. **See the "Definition of Terms" section of the manual for more information.**

Percent Load Limit Threshold (PLLT)

Set as a percentage of the maximum current.

Fault Output Options

Fault Pulse (FPL)

This output will change state when a fault occurs. **See the "Definition of Terms" section of the manual for more information.**

When fault pulse times are shorter than 50mS, timings may not be exact when using relay type outputs.

Any Fault Alarm (AFA)

This output will operate in 3 different modes, **"NLC"**,**"LCH"**,**"RVF"**. The Any Fault alarm is triggered by any high voltage fault that occurs. **See the "Definition of Terms" section of the manual for more information.**

Any Fault Alarm Mode (AFMO)

 – Non Latch Mode (NCL)

The output will change state for the configured "AFMS" time.

 – Latch Mode (LCH)

The output will change state until it is reset at the front panel or remotely.

 – Remove Voltage on Fault (RVF)

The output will change state and the test voltage will be disabled until it is reset at the front panel or remotely.

Any Fault Alarm Time (AFMS)

Set in seconds (.01 – 5.0). If "AFMO" is set to "NLC", this is the time for which the output will change state.

Pinhole Alarm (PHA)

This output will operate in 2 different modes, **"NLC"**,**"LCH"**. The Pinhole alarm will respond only to a 'Pinhole' fault type. **See the "New Features" section of the manual for more information on fault typing.**

Pinhole Alarm Mode (PHMO)

– Non Latch Mode (NLC)

The output will change state for the configured "PHMS" time.

– Latch Mode (LCH)

The output will change state until it is reset at the front panel or remotely.

Pinhole Alarm Time (PHMS)

Set in seconds (.01 – 5.0). If "PHMO" is set to "NLC", this is the time for which the output will change state.

Metal Contact Alarm (MCA)

This output will operate in 2 different modes, **"NLC"**,**"LCH"**. The Metal Contact alarm will respond only to a 'direct metal contact' fault type. See the "Fault Typing" section of the manual for more information.

Metal Contact Alarm Mode (MCMO)

– Non Latch Mode (NLC)

The output will change state for the configured "MCMS" time.

– Latch Mode (LCH)

The output will change state until it is reset at the front panel or remotely.

Metal Contact Alarm Time (MCMS)

Set in seconds (.01 – 5.0). If "MCMO" is set to "NLC", this is the time for which the output will change state.

Multi Pinhole Alarm (MPA)

This output will operate in 2 different modes, **"NLC"**,**"LCH"**. The Multi Pinhole alarm will respond only to a 'Multi Pinhole' fault type. See the "Fault Typing" section of the manual for more information.

Multi Pinhole Alarm Mode (MPMO)

 – Non Latch Mode (NLC)

The output will change state for the configured “MPMS” time.

 – Latch Mode (LCH)

The output will change state until it is reset at the front panel or remotely.

 Multi Pinhole Alarm Time (MPMS)

Set in seconds (.01 – 5.0). If “MPMO” is set to “NLC”, this is the time for which the output will change state.

Gross Barewire Alarm (GBA)

This output will operate in 2 different modes, **“NLC”**,**”LCH”**. The Gross Barewire alarm will respond only to a ‘Gross Barewire’ fault type. See the “Fault Typing” section of the manual for more information.

 Gross Barewire Alarm Mode (GBMO)

 – Non Latch Mode (NLC)

The output will change state for the configured “GBMS” time.

 – Latch Mode (LCH)

The output will change state until it is reset at the front panel or remotely.

 Gross Barewire Alarm Time (GBMS)

Set in seconds (.01 – 5.0). If “GBMO” is set to “NLC”, this is the time for which the output will change state.

Any Fault Limit (AFL)

This output will change state when the “Any Fault” Count is equal to or greater than the configured **“AFLT”**.

 Any Fault Count Limit (AFLT)

Amount of counts allowed before the output responds.

Pinhole Limit (PHL)

This output will change state when the “Pinhole” count is equal to or greater than the configured **“PHLT”**.

Pinhole Count Limit (PHLT)

Amount of counts allowed before the output responds.

Metal Contact Limit (MCL)

This output will change state when the "Metal Contact" count is equal to or greater than the configured **"MCLT"**.

Metal Contact Count Limit (MCLT)

Amount of counts allowed before the output responds.

Multi Pinhole Limit (MPL)

This output will change state when the "Multi Pinhole" count is equal to or greater than the configured **"MPLT"**.

Multi Pinhole Count Limit (MPLT)

Amount of counts allowed before the output responds.

Gross Barewire Limit (GBL)

This output will change state when the "Gross Barewire" count is equal to or greater than the configured **"GBLT"**.

Gross Barewire Count Limit (GBLT)

Amount of counts allowed before the output responds.

Fault Combination Limit (FCL) – Must be configured via USB computer interface

This output will change state when the conditions of the 'COLT' are met.

Fault Combination Limit Mode (COLT)

"0": The output will change state when either the Pinhole Count, or the Multi Pinhole Count are equal to or greater than the ''MPLT" or "PHLT".

"1": The output will change state when either the Metal Contact count, or the Gross Bare Wire Count are equal to or greater than 'GBLT' or 'MCLT'

Any Barewire Alarm (ABW)

This output will operate in 2 different modes, **"NLC"**,**"LCH"**. The Any Barewire alarm will respond only to a Metal Contact or Gross Barewire fault type. See the "Fault Typing" section of the manual for more information.

Any Barewire Alarm Mode (ABMO)

 – Non Latch Mode (NLC)

The output will change state for the configured "ABMS" time.

 – Latch Mode (LCH)

The output will change state until it is reset at the front panel or remotely.

Any Barewire Alarm Time (ABMS)

Set in seconds (.01 – 5.0). If **"ABMO"** is set to **"NLC"**, this is the time for which the output will change state.

Any Pinhole Alarm (APH)

This output will operate in 2 different modes, **"NLC"**,**"LCH"**. The Any Pinhole alarm will respond only to a Pinhole or Multi pinhole fault type. See the "Fault Typing" section of the manual for more information.

Any Pinhole Alarm Mode (APMO)

 – Non Latch Mode (NLC)

The output will change state for the configured "APMS" time.

 – Latch Mode (LCH)

The output will change state until it is reset at the front panel or remotely.

Any Pinhole Alarm Time (APMS)

Set in seconds (.01 – 5.0). If **"APMO"** is set to **"NLC"**, this is the time for which the output will change state.

Fault Typing

The TST-10B has the ability to distinguish between four different types of faults. The four types of faults consist of: *Pinhole, Metal Contact, Multi Pinhole, and Gross Barewire*.

PINHOLE

A high voltage discharge where the electrode does not make physical contact with the conductor of the product being tested.

DIRECT METAL CONTACT

A high voltage discharge where the electrode makes physical contact with the conductor of the product being tested. There is no minimum length detectable, however, electrode design may impact performance of metal contact detection.

MULTI PINHOLE

A series of high voltage discharges, no less than 2.5 x electrode length where the electrode does not make physical contact with the conductor of the product being tested.

Note: Although an accurate line speed is not required for Multi Pinhole Fault Typing, the minimum length typed as a Multi Pinhole Fault, (2.5 x Electrode Length) is reliant on an accurate Line speed.

GROSS BAREWIRE

A period of time, no less than 2.5 x electrode length where the electrode makes direct metal contact to the conductor of the product being tested.

Note: Although an accurate line speed is not required for Gross Barewire Fault Typing, the minimum length typed as a Gross Barewire Fault, (2.5 x Electrode Length) is reliant on an accurate line speed.

Spark Tester Configuration (USB)

Contact factory for details at support@clintoninstrument.com

Testing Your Product

CAUTION: During installation, the spark tester was programmed to report and respond to faults in specific ways. Internal settings must not be changed except by qualified personnel.

1. Place your product in the bead chain electrode. Be sure the wire is centered in the electrode.
2. Verify that the product conductor(s) are grounded. If this is not the case, do not proceed. Contact service personnel to review the spark tester installation.
3. Turn ON the external disconnecting device to bring power to the spark tester.
4. Turn the spark tester power switch ON. Push the front panel 'R' (Reset) button and the 'CR' (Counter Reset) button if necessary, so that the fault counter displays 0.
5. Start the wire line. Press the VOLTAGE ADJUST up arrow button until the voltmeter indicates the desired test voltage value.
6. **CAUTION:** Do not touch the wire while it is being tested.
7. The spark tester will operate in accordance with the settings selected during "Installation" and "Front Panel Programming."

CAUTION: When the spark tester is operated with bare wire in the electrode for an extended length of time, i.e., several minutes or longer, damage to the equipment may result. This condition should be avoided, either by switching the spark tester OFF manually or by a zero-speed switch operated by the machinery. Similarly, if the HV remains ON in the electrode while your wire line is stationary, the product insulation within the electrode will heat and there is a **danger of combustion.** Refer to the table "Terminal Block Wiring" in the Installation section of this manual on how to safely install your spark tester.

Preparing your Product for Testing

- Ensure that the product to be tested is dry as it enters the spark test electrode. A continuous film or sheath of water on the product can provide an effective electrical path to the nearest grounded point. Surface leakage can trigger a false count in the spark tester.
- Ground the product conductor(s). This is a safety precaution as well as a requirement of most spark test specifications. Please see the paper, "Grounding of Conductors during the Spark Test," included in this manual.
- Position the product in the center of the electrode, through the safety end guards. Be sure it will remain centered as it is being drawn through the electrode assembly. Lateral wire vibration which may be imperceptible can cause phantom faults to register on the spark tester. Properly positioned guides installed at entry to and exit from the electrode can eliminate this condition.

RS-485 Interface

The 9-Pin D-Subminiature connector for the RS-485 Multi-Drop Full Duplex Interface port is located on the back of the spark tester. It is labeled RS-485. The spark tester can receive commands and requests from a computer or PLC through this port.

The RS-485 Port uses a standard Modbus RTU communication protocol. For Parameter Addresses see the section entitled "Field Bus Parameter Address".

RS-485 Connector

The pin configuration for the RS-485 port is listed in the table below.

Pin #	Name
1	TX-
2	TX+
3	RX-
4	RX+
5	GND
6	NC
7	NC
8	NC
9	NC

RS-485 Parameters

The default parameters of for the RS-485 Serial port as listed below. To change the port address or the baud rate see the Configuration Menu Options. Note if the unit is being controlled directly from the RS-485 port on the back panel, the PLC will need to poll REMOTE ENABLE (location 5) at least every 500ms to keep the unit from turning off the voltage.

The default Parameters are listed in the table below.

Parameter	Default Value
Baud Rate	19,200
Data Bits	8
Stop Bits	1
Parity	None
Flow Control	None
Station Number	10

Analog Interface

Analog Interface Pin Functions

Pin No.	Description	Function	Notes
1	Remote Process control pulse (collector)	This output will activate when any fault type is detected and will remain on for the Any Fault Alarm Time.	Max. Voltage 30V DC, Max. Current 150mW.
2	Remote Process control pulse (emitter)		Max. Voltage 30V DC, Max. Current 150mW.
3	Remote Bare Wire pulse (collector)	This output will activate when any bare wire type fault is detected and will remain on for the Any Bare Wire Alarm Time.	Max. Voltage 30V DC, Max. Current 150mW.
4	Remote Bare Wire pulse (emitter)		Max. Voltage 30V DC, Max. Current 150mW.
5	Local/Remote Source	When the spark tester is turned ON, a +12V or a +24V at this pin will change the voltage setting from LOCAL to REMOTE. Only then can an analog voltage control the spark tester voltage through pin 6. The voltage control on the front panel of the spark tester will be disabled.	
6	0-10 input control voltage	If pin 5 is set to REMOTE, a 0-10V DC voltage input at this pin changes the spark tester's output voltage proportionally	
7	Remote Fault pulse (collector)	This output will activate when any fault type is detected and will remain on for the Fault Pulse Time.	Max. Voltage 30V DC, Max. Current 150mW.
8	Remote Fault pulse (emitter)		Max. Voltage 30V DC, Max. Current 150mW.
9	Ground	0- 10v reference ground.	
10	Ground		
11	Count Reset	A Momentary +12V or a +24V signal at this pin will reset the fault count when remote is Enabled	
12	Count Preset Open Collector	Current sinking NPN open collector output.	Max. Voltage 30V DC, Max. Current 150mW.
13	DC output	This is a +24V DC output which can be used as a voltage source for the Opto Isolated outputs.	
14	Chassis ground, cable shield	This should be used for the cable shield ground connection	
15	0-10v remote output	This is a 0-10V DC output proportional to the spark tester's high voltage output.	1 meg impedance

Fieldbus Communications Interface

The model RCW can be purchased with an optional Fieldbus Communications Interface. (Model RCWX) This interface will allow the installation of several communication options. (DeviceNet, Ethernet IP, Modbus RTU, Modbus TCP, Profibus, Profinet). For each interface a EDS file and support documentation will be provided to assist in the integration.

For Parameter Addresses see the section entitled "Fieldbus Parameter Addresses". For the specific fieldbus specific data see the section entitled "Fieldbus Specific Information".

Fieldbus Communications Parameters

The following table shows the default communication parameters for the various fieldbuses that are supported by the RCWX Spark Tester. See the section entitled CIC XM Utility for the steps required to modify these parameters. Note, the Data Sizes are fixed and cannot be changed

Interface Types	Parameter	Default
Modbus RTU	Station Number	40
Modbus RTU*	Interface (RS-232 or RS-485)	RS-232
Profibus	Station Address	40
DeviceNet	Node Address	40
Modbus TCP Ethernet IP Profinet	IP Address	10.10.10.101
Modbus TCP Ethernet IP Profinet	Subnet Mask	255.255.255.0
Modbus TCP Ethernet IP Profinet	Gateway	10.10.10.120
Modbus TCP Ethernet IP Profinet	DHCP	Off
Profinet	Station Name**	""
All	Data Sizes	Output: 32 Words *** Input: 32 Words ***

* This is factory set as RS-232. If two wire RS-485 or four wire RS-485 is required, consult the factory.

** On the Profinet module is the Station Name is not set, the MS LED will flash 3 times. This value can be set by the Profinet Master.

*** Specify the Output Words first followed by the Input Words.

Fieldbus Spark Tester Parameter Addresses

The fieldbus parameters are 2 bytes each. The LSB will be at the lower byte offset, the MSB at the higher byte offset. As an example, the setpoint is 5000 volts (1388H in hexadecimal). The setpoint is at a word address 5. When reading the two bytes of the setpoint the LSB (value of 88H) would be received first and the MSB (value of 13H) would be received second. Some PLCs start with addresses of 0, some start with 1. The table below assumes the addresses start with 0.

REMOTE ENABLE must be set to 1 before any other parameters can be modified. When set, REMOTE ENABLE locks out voltage control from the display.

The unit responds to changes in data. For example, the REMOVE VOLTAGE COMMAND and the AF RESET COMMAND can be activated initially by changing their values to 1. Subsequent changes must use a value that differs from the previous one. For example, to activate either of these commands again their values could be changed to 0.

Command	Address	R/W	Notes
RESERVED	0	-	
RESERVED	1	-	
REMOVE VOLTAGE COMMAND	2	W	Will turn off/on the voltage without changing the setpoint
AF RESET COMMAND	3	W	Will reset All Fault Alarms
REMOTE ENABLE	4	RW	Enables Data writes from External bus
SETPOINT VOLTS	5	RW	Requested voltage in Volts
ACTIVE LINE SPEED	6	RW	Line Speed in ft/m
VMON VOLTS	7	R	Voltage at metering windings (Actual Voltage) in Volts
EVMON VOLTS	8	R	Voltage at Electrode in Volts
IMON PERCENT LOAD	9	R	Percent of maximum load on the system
AF COUNT	10	RW	All fault count (Write 0 To Clear This Count)
PH COUNT	11	RW	Pinhole fault count (Write 0 To Clear This Count)
MC COUNT	12	RW	Metallic Contact fault count (Write 0 To Clear This Count)
MP COUNT	13	RW	Multi-pinhole fault count (Write 0 To Clear This Count)
GB COUNT	14	RW	Gross Bare Wire fault count (Write 0 To Clear This Count)
STATUS FLAGS 0	15	R	See Definitions below
STATUS FLAGS 1	16	R	See Definitions below
ALARM_MODES	17	RW	AF, ABW, APH*
AF_ALARM_MS	18	RW	
ABW_ALARM_MS	19	RW	
APH_ALARM_MS	20	RW	
AF_LIMIT_VALUE	21	RW	
PH_LIMIT_VALUE	22	RW	
MC_LIMIT_VALUE	23	RW	
MP_LIMIT_VALUE	24	RW	
GB_LIMIT_VALUE	25	RW	
GPO_0_1_FUNCTION	26	RW	function for both GPO_0 and GPO_1***
GPO_2_3_FUNCTION	27	RW	function for both GPO_2 and GPO_3***
AV_WDL_LOW_VOLTAGE	28	RW	
AV_WDL_HIGH_VOLTAGE	29	RW	

* The value for the alarm modes is as follows: AF_ALARM *16 + ABW_ALARM * 4 + APH_ALARM

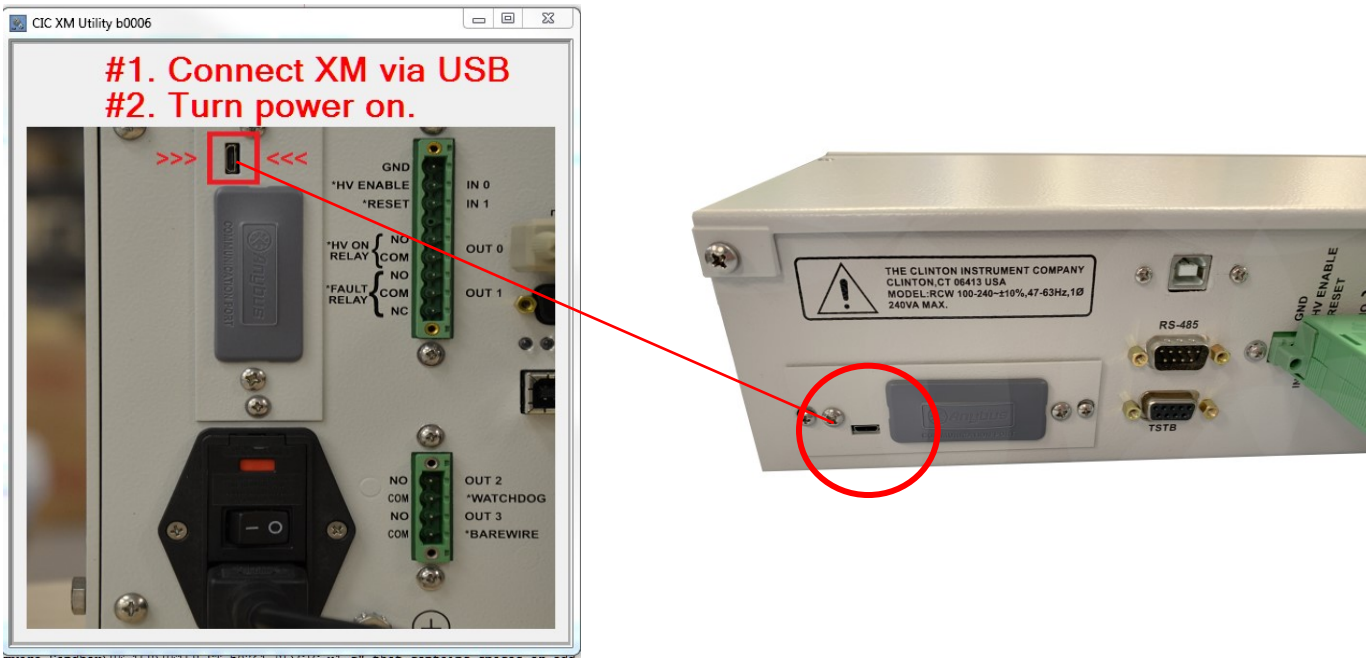
** The values are: 0 – startup, 1111h – initialization, 5555h- interface online (ready)

*** The lower value (GPO_0 or GPO_2) is in the LSB and the upper in the MSB

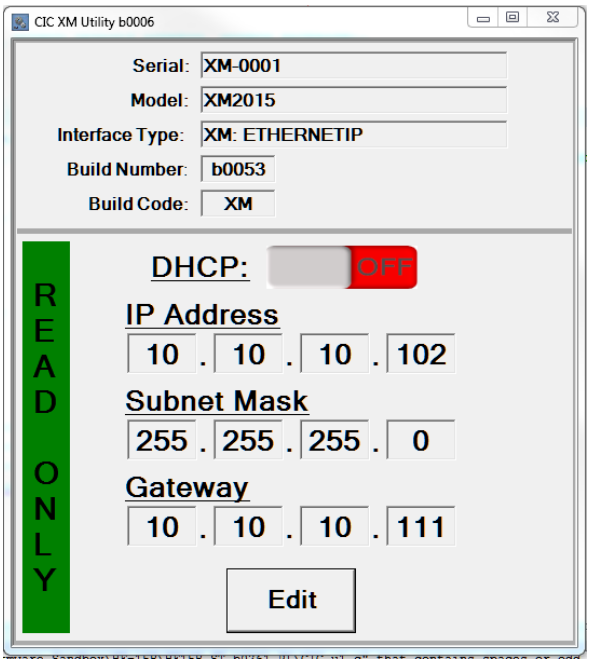
Below are the individual bits for Status Word 0			
GLOBAL VOLTAGE ENABLED	Bit 0	R	Set when all conditions allow voltage to be generated
AV HVL STATUS	Bit 1	R	Set when the Actual Voltage >= HVL On voltage
AV WDL STATUS	Bit 2	R	Set when voltage is in the range of the Watchdog Low and High levels
FP STATUS	Bit 3	R	Set when the fault is detected and cleared at end of fault pulse duration
AF ALARM STATUS	Bit 4	R	State of the AF Alarm cleared by Fault Reset
PH ALARM STATUS	Bit 5	R	State of the PH Alarm cleared by Fault Reset
MC ALARM STATUS	Bit 6	R	State of the MC Alarm cleared by Fault Reset
MP ALARM STATUS	Bit 7	R	State of the MP Alarm cleared by Fault Reset
GB ALARM STATUS	Bit 8	R	State of the GB Alarm cleared by Fault Reset
AF COUNT LIMIT STATUS	Bit 9	R	Set if AF Count >= AF Count Limit cleared by Fault Count Reset
PH COUNT LIMIT STATUS	Bit 10	R	Set if PH Count >= PH Count Limit cleared by Fault Count Reset
MC COUNT LIMIT STATUS	Bit 11	R	Set if MC Count >= MC Count Limit cleared by Fault Count Reset
MP COUNT LIMIT STATUS	Bit 12	R	Set if MP Count >= MP Count Limit cleared by Fault Count Reset
GB COUNT LIMIT STATUS	Bit 13	R	Set if GB Count >= GB Count Limit cleared by Fault Count Reset
FAULT COMBO LIMIT STATUS	Bit 14	R	Set if Fault Combo Count >= Fault Combo Count Limit cleared by Fault Count Reset
AVSP WD PERCENT STATUS	Bit 15	R	Set when Actual Voltage is within the AVSP Percent of the Setpoint
Below are the individual bits for Status Word 1			
EVSP WD PERCENT STATUS	Bit 0	R	Set when Electrode Voltage is within the EVSP Percent of the Setpoint
ABW ALARM STATUS	Bit 1	R	Indicates a Bare Wire fault has been detected cleared by Fault Reset
APH ALARM STATUS	Bit 2	R	Indicates a Pinhole fault has been detected cleared by Fault Reset
GPO 0 STATUS	Bit 8	R	State of General Purpose Output 0
PERCENT_LOAD_LIMIT_STATUS	Bit 4	R	Indicates if the Percentage Load Limit has been reached or exceeded
GPO 1 STATUS	Bit 9	R	State of General Purpose Output 1
GPO 2 STATUS	Bit 10	R	State of General Purpose Output 2
GPO 3 STATUS	Bit 11	R	State of General Purpose Output 3
GPI 0 STATUS	Bit 12	R	State of General Purpose Input 0
GPI 1 STATUS	Bit 13	R	State of General Purpose Input 1
GPI 2 STATUS	Bit 14	R	State of General Purpose Input 2
GPI 3 STATUS	Bit 15	R	State of General Purpose Input 3

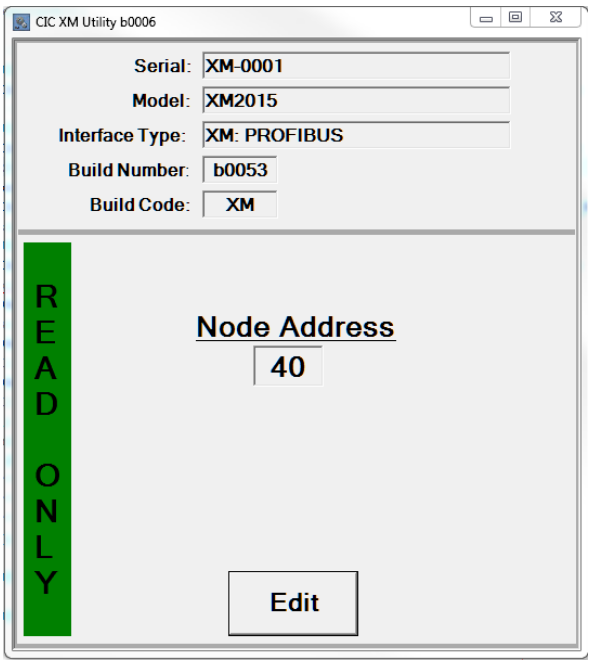
CIC XM Utility

To configure any of the active CompactCom™ modules (DeviceNet, Ethernet IP, Modbus RTU, Modbus TCP, Profibus, Profinet), plug in a micro USB cable and run the CIC XM Utility. If the USB cable is not connected the CIC XM Utility will prompt for the USB cable as shown.

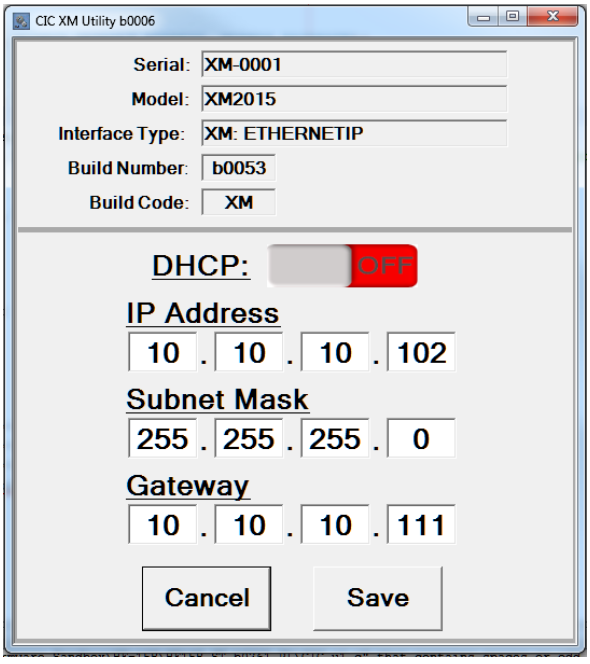


Once the cable is connected you will get one of two edit screens. The first is for Ethernet based fieldbus types (Ethernet IP, Modbus TCP and Profinet) shown on the left. The second type of edit screen is for non-Ethernet based fieldbuses (DeviceNet, Profibus, Modbus RTU) shown on the right. Note the Read Only indicator.



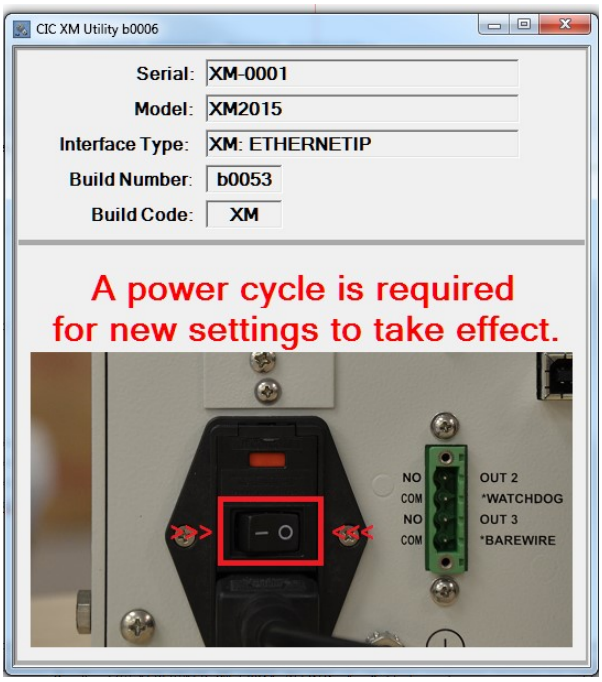


To modify these values, press the Edit Button. The Read Only indicator disappears indicating that the values can be modified. An example is shown below.



Once edits are complete, press the Save Button. The following screen will be shown indicating a power cycle is required.

Once power has been cycled the new values will be used.



Calibration

The Spark Tester may be reasonably expected to retain its accuracy for a period of one year from the date of calibration under conditions of normal use.
CAUTION: The calibration procedures listed below are to be performed by qualified service personnel experienced in high voltage safety procedures only. Failure to follow these procedures may result in danger to personnel and equipment.

The following is a list of recommended equipment for use in calibrating the TST-10B.

- Electrostatic Voltmeter (EVM) – Manufactured by Sensitive Research
- ST-CAL with LFVM – Manufactured by Clinton Instrument Company

ST-CAL Calibration

The TSTB can be calibrated through an automated process using the STCAL system with an LFVM.

To perform the calibration with the STCAL please follow the instructions for the STCAL system.

EVM Calibration Procedure

The EVM has a mirrored area to assist in eliminating errors in reading. The correct way to read the meter is to move the viewing position (your eye) until the reflection of the needle in the mirror is directly behind the needle itself and observe the needle position on the scale. This eliminates any parallax error that might result from viewing the meter at a slight angle.

Connecting the EVM

1. Before connecting to the EVM, turn ON the spark tester and adjust the voltage to 0 using the VOLTAGE ADJUST down arrow button. Turn OFF the spark tester.
2. With the power to the RCW and TSTB Spark Tester turned off connect the high voltage input on the EVM to the Spark Tester electrode. Use the shortest high voltage lead possible. For bead chain and brush electrodes connect the alligator clip directly to the electrode. For roller type electrodes you may need to wrap the high voltage roller with uninsulated wire and connect the alligator clip to the wire.
3. Set the EVM range Selector to the 5kV range. Then Zero the EVM.

Taking Calibration Readings

4. Turn on the RCW and TSTB and adjust the spark tester voltage to 3.00KV. Record the voltage reading on the EVM.
5. Repeat this step for all required test voltages in the current test voltage range of the EVM.
6. Turn off the spark tester and adjust the EVM range to for the remaining readings. Repeat these steps for all required test voltages.

Note: Each time the Range is changed on the EVM the needle should be adjusted to Zero.

Adjusting the Calibration

Entering the Calibration Mode

7. Press and hold the Down Arrow Button and the CR Button for approximately 4 seconds. The spark tester will enter the configuration mode and disable the high voltage output.
8. If the display is locked, you will need to unlock the display with the PIN. See "RC Security" section for more information.
9. Press the Down Arrow until "MCAL" is displayed on the voltage display.

Adjusting the Spark Tester Output voltage and Voltage Monitor

10. Press the "B" button for several seconds until "VOUT" is displayed on the voltage display.
11. Press the "R" button. The Fault Count display should show "S.00.0" representing the set point value.
12. Using the UP/DOWN arrows adjust the output voltage up so that the Fault Count display shows "S.01.0" for 1kV.
13. Check the actual output voltage on the EVM, if this value is not within the rated specification for the TST-10B Press the "CR" button. The Fault Count display will change to "*.01.0".
14. Using the UP/DOWN arrows adjust the reading on the EVM until the reading is within the rated tolerance for the TSTB or as close to the value on the Fault count display.
15. Once the EVM and the value on the Fault Counter match press the "R" button two times to display the nominal voltage value "01.0".
16. Press the DOWN arrow and "VZER" is displayed on the voltage display.
17. Press the "B" button once and the VMON and EVMON are automatically adjusted.
18. Press the UP button and "VOUT" is displayed on the voltage display.
19. Repeat these steps until all calibration values are within tolerance.
20. Once calibration is complete press the "A" button once to exit the Manual calibration mode.

Note: Calibration intervals begin at 1kV and are to be performed at 1kV increments.

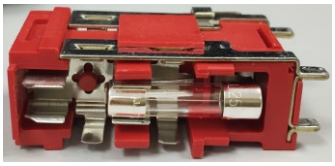
Maintenance

Fuses

The fuses in this equipment are not expected to fail in normal operation. Their failure may be an indication of equipment malfunction requiring qualified repair personnel.

There is one fuse associated with the spark tester's operating voltage, located in the ON/OFF power switch on the back panel of the unit.

This Fuse should only be replaced with a 5x20mm 2-amp high breaking time delay fuse (T2AH), CIC Part Number 92665. Failure to install the proper fuse may cause damage to the equipment.



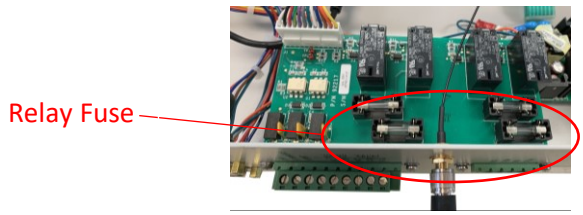
After the fuse is replaced, the RCW shall be tested prior to the equipment being returned to service.

Only Qualified repair personnel who are aware of the electrical hazards involved should remove the cover of the RCW to access the 4 Relay fuses.

Four additional fuses that could be defective are found on the relay output printed circuit board, behind the back panel. These fuses may have hazardous voltages supplied by customer connected equipment.

Before removing the Cover to access these fuses the RCW should be disconnected from power and the 2 relay terminal block connectors should be removed. Failure to do so may result in electric shock.

These fuses should only be replaced with a 5x20mm 2-amp low breaking time delay fuse (T2A), CIC Part Number 02606. Failure to install the proper fuse can cause damage to this equipment or equipment that is connected to the relay terminals.



After a fuse is replaced the operation of the RCW as well as the equipment connected to the relay terminals should be checked for proper operation prior to being returned to service.

Periodic Inspection

It is important to inspect the electrode and electrode mounting plate periodically for residue and wear.

Insulation and water deposits can reduce the effectiveness of the spark test. The red electrode mounting plate may be wiped with a clean, dry cloth. Bead chain assemblies contaminated with insulation residue should be removed from the high voltage test module and cleaned with a wire brush. Broken safety covers and mounting plates and electrode assemblies with worn brushes or missing beads should be replaced immediately.

The red electrode mounting plate, clear cover, and bead chain assemblies are subject to damage and contamination that is not always visible. They should be replaced if current leakage occurs.

Refer to the “Troubleshooting” section for assistance with electrical problems.

Troubleshooting

CAUTION: Troubleshooting is to be performed by qualified service personnel only. Failure to follow the procedures in this manual may result in danger to personnel and equipment damage.

Phantom Faults are being indicated.

1. Lateral wire line vibration or water may be present. See “Installation” for information on drying, centering, and restraining the product in the electrode.
2. The high voltage mounting plate may be contaminated with dirt or conductive material. Clean the mounting plate or replace.
3. Inspect proper grounding of inner conductor.
4. If, after 1,2, & 3 have been corrected, you still experience false counting due to a capacitive loading effect on your test product, change the “FD-CON” FSMO setting in the Configuration menu from “NOR” to “RED”. Note that your spark tester will no longer meet the BS Standard for sensitivity but will still meet the NEMA Standard for sensitivity.

The Fault Count Displays “E.EXI”

1. There is no switch or relay contact between Pins 1 & 2 (GND and HV ENABLE). Refer to the table in “Installation” labelled “Terminal Block Connections,” under HV ENABLE.

The Fault Count Displays “E.RVF”

1. The voltage was removed due to the spark tester being in the remove voltage on fault mode. To clear this press the “R” button on the front panel.

The Fault Count Displays “E.RVC”

1. The voltage was removed by a command through either the RS-485 serial interface or through the fieldbus port. The voltage will need to be re-enabled through that port.

The Fault Count Displays “E.HVD”

1. The high voltage will not turn on due to a possible hardware failure. Please contact the Clinton Instrument Company for assistance

After adjusting the voltage with the product in the electrode, a lower voltage is displayed.

1. The spark tester may have reached the highest voltage possible for this product due to a capacitive loading effect from the test product. Consult the factory regarding your application.

Equipment at relay terminals COM and NO or NC is not activating when fault occurs

1. The PCD (Process Control Duration) value may be too short for the auxiliary equipment to recognize.
2. Check fuse on main pc board.

The spark tester controls are on, but the equipment does not function.

1. The high voltage test module interlock switch is not closed.
2. The terminal block connector is not plugged in.
3. There is no switch or relay contact between Pins 1 & 2 (GND and HV ENABLE). Refer to the table in "Installation" labelled "Terminal Block Connections" under HV ENABLE.

I forgot my PIN code

Contact factory for details at support@clintoninstrument.com

Setting Factory Defaults

When factory defaults are set from the configuration menu, the unit will restore all settings to the default values. The only exceptions are that Serial Numbers and Calibration Information will be saved so that the unit will not need recalibration.

Replacement Parts

RCW

Part Number	Description
92666	2-amp high breaking time delay fuse (T2AH), 5x20mm (For 91061)
92211	Front Panel for RC Display
03081	ON/OFF Switch Carling 621-1-591909W
92393	Assembly PCB RCW Main
92464	Assembly PCB RF Module Interface RM024
91061	Power entry module (ON/OFF Switch)
92217	Assembly PCB Relay
92441	Power Supply
92283	4 – Pin Terminal Block Connector Kit (Green)
91069	9 – Pin Terminal Block Connector Kit (Green)
03780	Power Cord
92590	Antenna RP-SMA 10 ft RDMNT
91212	Antenna Tilt and Swivel 2.4GHz
02606	2-amp low breaking time delay fuse (T2A), 5x20mm (For 92217 PCB)

TSTB

Part Number	Description
92408	Assembly PCB TSTB Main
92464	Assembly PCB RF Module Interface RM024
92419	Assembly PCB Divider
92348	Power Supply 10KV 15W w/i10 Option
91210	Antenna Right-Angle RCS Series 2.4GHz
91311	Wire High Voltage

Note: Printed circuit boards are carefully constructed and calibrated at the factory. Components are not supplied for field repair of boards. Please return faulty circuit boards to the factory or to your Clinton sales representative for evaluation.

Optional Accessories

Part Number	Description
STCAL-LF	STCAL Low Frequency Calibration System
STCAL-SM	Sensitivity Test System
BR0.3-2	Electrode Brush 0.2” max Prod DIA, 2” L
BD-051	Miniature Bead Chain Electrode
92273-DN	Module CompactCom DeviceNet
92273-EI	Module CompactCom EtherNet/IP
92273-MR	Module CompactCom Modbus RTU
92273-MT	Module CompactCom Modbus TCP
92273-PB	Module CompactCom Profibus
92273-PN	Module CompactCom Profinet

Warranty

The information contained in this document is subject to change without notice. The Clinton Instrument Company makes no warranty of any kind with regard to this material, including, but not limited to, the implied warranties or merchantability and fitness for a particular purpose.
The Clinton Instrument Company shall not be liable for errors contained herein or for incidental damages in connection with the furnishing, performance, or use of this material.
We warrant to the original purchaser that the equipment described herein is free from defects in materials and workmanship for a period of one year from the date of invoice, our obligation under this warranty being limited to repair or replacement of the defective parts. This warranty does not apply to fuses, lamps, or any normally expendable parts. Any part appearing to have defects in material or workmanship, upon our examination only and as determined by us, and providing the equipment has not been subject to abuse, misuse, or alteration, will be repaired or replaced at no charge for materials and labor, either upon receipt of the defective part or equipment, transportation charges prepaid, at our plant or at the equipment location, as selected by us. No parts or equipment shall be returned without our prior permission. Any parts replaced under this warranty shall be warranted until the expiration date of the original warranty.

The warranties herein are in lieu of all other warranties, expressed or implied, and of all other obligations or liabilities on our part concerning this equipment.

Grounding of Conductors during the spark test

MEASURING & TESTING — clinton instrument company

Grounding of conductors during the spark test

by Henry Clinton

Nearly all industry-wide specifications for insulated wire and cable pertaining to in-line spark testing require the grounding or earthing of the conductors under test. It is the purpose of this discussion to examine the reasons for this and to define the conditions which allow for a safe and effective spark test when conductors are not grounded. Although this testing mode cannot be used to satisfy most industry specifications, it can be useful when quality must be strictly monitored and conductor grounding is inconvenient or impossible.

D-C spark testing

If a direct potential is used for spark testing, it is absolutely necessary to ground the conductor or conductors under test. In Fig. 1, C_g represents the capacitance of the product to ground, which could be in the range of 100 to 2,000 picofarads, depending on the size and length of the conductor.

If the conductor is not grounded, the potential on the conductor with respect to ground will rise when the first insulation fault passes through the electrode. This is because C_g charges towards the D-C test potential applied to the electrode through the arc.

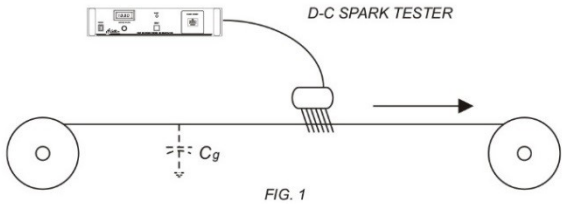


FIG. 1

If the conductor is not grounded but is initially at ground potential, when the first insulation defect passes through the electrode, an arc forms between the electrode and the conductor. The current flowing through this arc charges capacitance C_g, elevating the potential of the conductor by a value which is a function of arc time duration and the value of the current. After the defect or fault has completed its passage through the electrode, C_g retains this elevated potential, since C_g has no discharge path to ground. The effective test potential on the product insulation is now reduced by this retained conductor potential. If a second insulation flaw traverses the electrode, additional charging of C_g takes place, further reducing the effective test potential. Eventually the effective test potential falls below that required to cause an arc to occur on the passage of an insulation flaw, and all subsequent flaws will be undetected. Usually, current and traverse time are large enough to sully charge C_g on the passage of the first flaw, so it will be the only one detected.

Furthermore, the entire length of product is now charged to the test potential. If the operator accidentally comes into contact with the conductor or with a flawed insulation area anywhere along the wire line, C_g can discharge through his body to ground. If by coincidence a faulted insulation area is within the electrode, the maximum current output of the spark tester can also pass through his body. While this current , in the case of Clinton spark testers, is well below a dangerous level, the involuntary muscular reaction resulting from this event can itself cause a secondary accident.

It is thus apparent that from the dual standpoints of utility and safety the conductors of a product being spark tested with a D-C potential should be grounded.

A-C spark testing, general

If an A-C potential is used for the spark test, and the conductors are not grounded, the diagram in Fig. 2 applies.

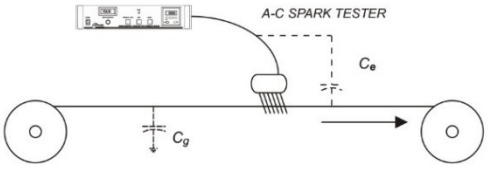
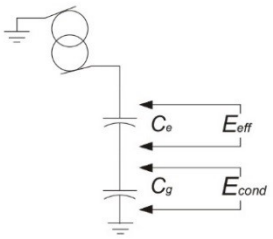


FIG. 2

Note that the electrode to product capacitance C_e is shown, and that C_e and C_g comprise a voltage divider which determines the A-C potential from conductors to ground, and also the effective test potential applied across the product insulation.



$$\frac{E_{eff}}{E_{cond}} = \frac{C_g}{C_e}$$

$$E_{cond} = E_{app} - E_{eff}$$

$$E_{eff} = \frac{C_g}{C_e\ C_g} E_{app}$$

If C_g is very large compared to C_e, Eeff is nearly equal to Eapp. For example, if C_e = 5pf and C_g - 1000pf, 99.5% of the applied test potential is impressed across the product insulation. If C_g is 100pf, however, the effective test voltage drops to 95% of the applied value.

Power mains frequency testing

When an insulation defect passes through the electrode, the arc which forms to the ungrounded conductor in effect connects the conductor to the electrode. If the spark tester operates at the

mains frequency, the ungrounded conductor will be elevated to nearly the full test potential. If an operator comes into contact with a bare spot in the insulation at this time, current can flow through his body to ground. The maximum value of this current will be the maximum output level of the spark tester. For Clinton mains frequency spark testers this level is less than the " let-go" threshold and is not dangerous in itself However, as in the D-C case, the event is unexpected and unpleasant, and can lead to a secondary accident. From the standpoint of flaw detection, the detector circuitry must differentiate between normal electrode current and the new level when the arc connects C_g to the electrode, which is a small increment. As in the D-C case, grounding of the conductors under test is a practical necessity.

High Frequency spark testing

When the A-C test frequency is increased to 3Khz, two dramatic changes occur. First, because a short electrode is used, the capacitance to the conductor C_e is kept small. For a 2 in. electrode C_e might be typically 2 to 20pf, increasing with the applied potential. The other change is the low reactance of Cg, which allows the current to be conducted readily to ground through a capacitive path rather than by direct connection.

The ratio of C_g /C_e is usually high, so that nearly all of the applied test potential appears across the product insulation. When an insulation flaw passes through the electrode, current drawn from the spark tester increases sharply in this same ratio, subject to the current limiting characteristics of the test equipment. This means that flaws can be detected reliably. If required, C_g can be increased by passing a considerable length of the product close to the grounded surface.

Although the maximum resistive current which can be delivered by a Clinton 3Khz spark tester is well below the "let-go" threshold, a mild shock could still be experienced if an operator contacts a bare spot on the product while a second defect is in the electrode. For this reason the entire line should be provided with protective guards to prevent this.

The ratio of C_g/C_e can be experimentally determined by measuring Econd, the conductor to ground potential, with a high impedance A-C volt-meter or an oscilloscope.

$$\frac{C_g}{C_e} = \frac{E_{app} - E_{cond}}{E_{cond}}$$

Summary

Spark testing of ungrounded conductors is usually not permitted by industry-wide specifications, and is unsatisfactory in any event if D-C or A-C power mains frequency test potentials are used. A satisfactory test for quality control purposes can be made on ungrounded conductors at 3Khz, however, if proper precautions are followed.

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