Clinton
INSTRUMENT COMPANY

Model TST-10W & TST-10WJ Wireless Digital D.C. Spark Tester
Instruction Manual

BRC-W Control Unit, TSTW HV Power Supply, BD-051 and BR-0.3-2 Electrodes

Clinton Instrument Company

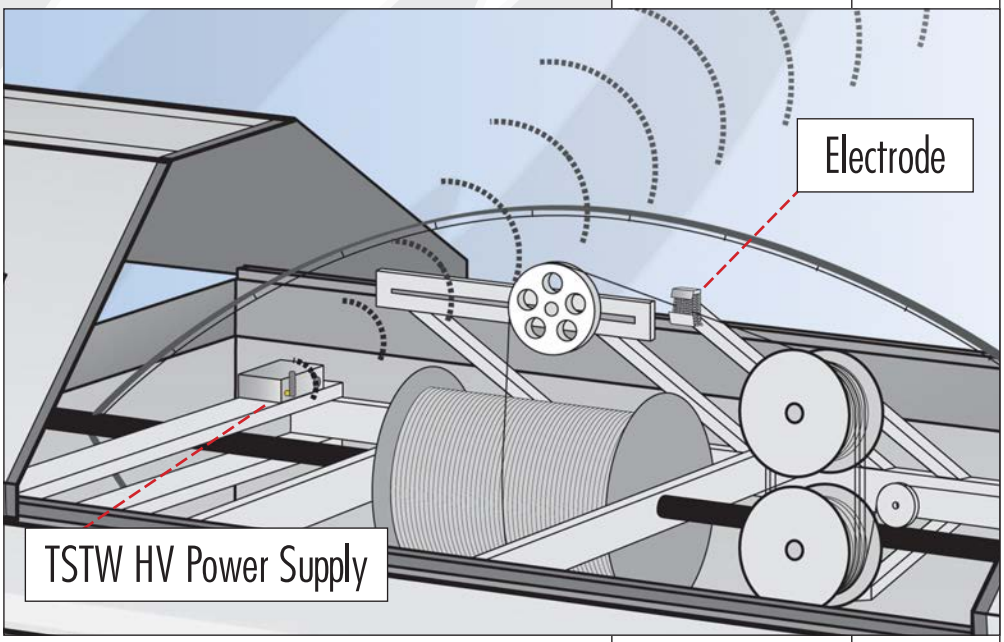
295 East Main Street
Clinton, CT 06413 USA
Telephone: 860.669.7548 Fax: 860.669.3825
www.clintoninstrument.com

MODEL TST-10W

Wireless Digital D.C. Spark Tester

- Reliable spark testing during twinning
- No control loop slip rings required
- Uses 24V DC from inside twinner
- Bare wire identification
- Digital voltage and fault count displays
- CE approved

BRC-W control unit with TSTW HV power supply & electrodes

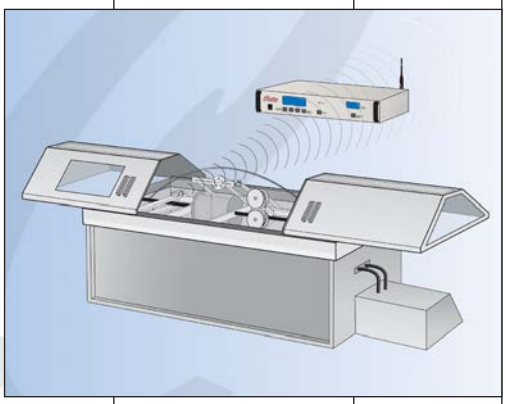


The Clinton TST-10W Wireless Digital D.C. Spark Tester instantly detects insulation damage to wire that can occur during the twinning operation. The TSTW high voltage power supply and miniature electrode sit within the rotating flyer of the twinning machine, identifying faults at the critical moment before the product is wound onto the takeup reel.

The wireless BRC-W control unit remains outside the twinner and may be located up to 50 feet away. Wireless communication between high voltage components and the control unit eliminates the need for troublesome control loop slip rings. A single slip ring can provide power to the test module if the required 24V signal is not readily available inside the twinner.

When damaged wire passes through the electrode, the wireless BRC-W control unit records the fault and provides process control outputs that can activate external lights or alarms, or stop the twinner. The fault detection circuitry differentiates pinholes from bare wire based on wire line speeds entered by the operator or input through a standard encoder input port. The BRC-W control unit can also exchange commands with a PLC or computer through the RS-485 serial interface or optional analog port.

The Model TST-10W Wireless D.C. Spark Tester conforms to IEC-1010-1 and is CE approved.



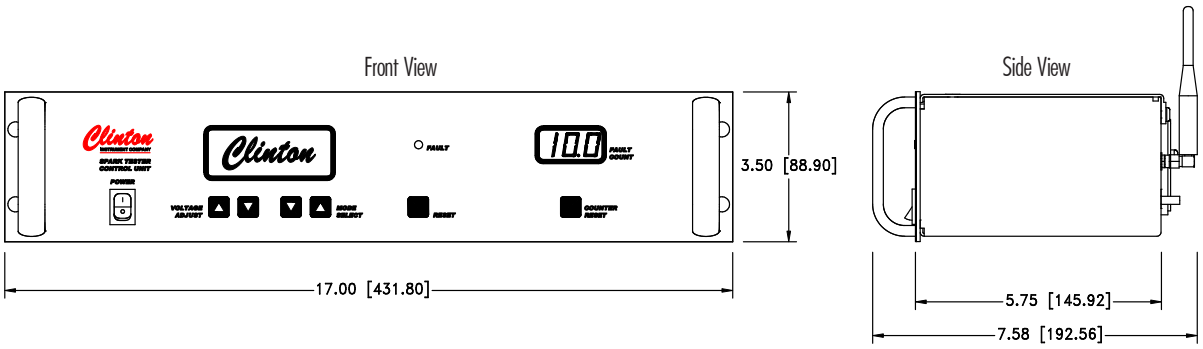
TST-10W
SPECIFICATIONS

Voltage Test Range	Approx. 500 volts to 10KV D.C. For test voltages below 2000 volts, contact factory for electrode recommendation.
Voltage Display	Graphics display, 2% accuracy.
Bare Wire Length	Approximately half of electrode length. Line speed entered manually or through encoder port.
Fault Response	Less than 1 millisecond.
Fault Resolution	5 milliseconds.
Output Current	1.5 milliamperes maximum.
Detection Sensitivity	Less than 600 ua. at 5KV
Operating Modes	Continuous HV/Remove HV on fault. Momentary Process Control/Latch until Reset. Fault/Pinhole & Bare.
Operating Indicators:	
High Voltage ON	Graphics display; high voltage ON relay.
Fault (pinholes and bares)	3-digit LED display; amber indicating light; fault relay.
Pinhole	Graphics display
Bare Wire	Graphics display; bare wire relay. Available when line speed is input manually or through encoder or tachometer.
Process Control	Relay form "C" contacts rated 2 amps max. for both NO and NC circuits for: External Reset; HV ON; Fault; Bare.

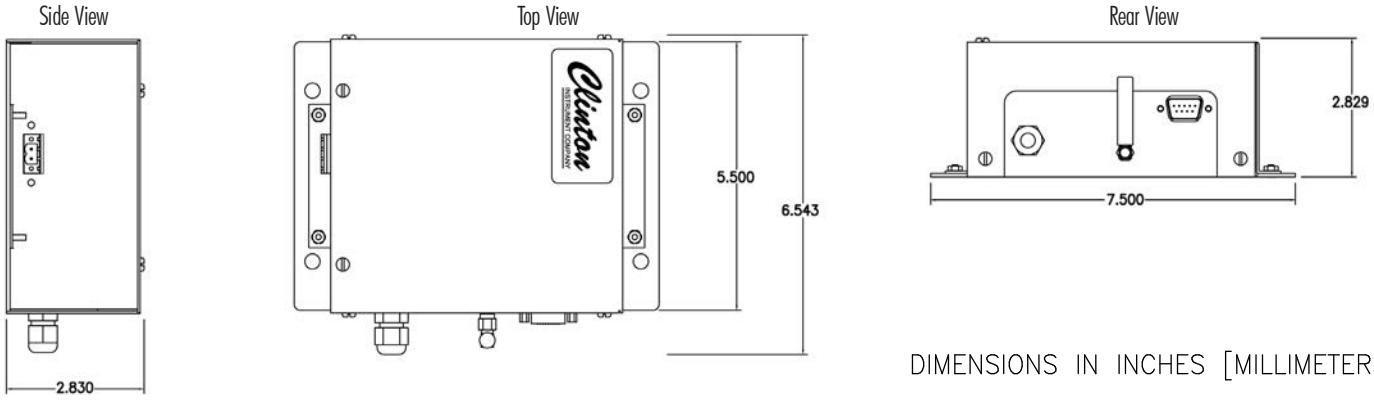
Communications	2.4gHz Wireless Connection. RS-485 Serial Interface. Analog (optional). Ethernet (optional). Profibus (optional).
Electrode Options	BD-051 Bead Chain. BR0.3-2 Brush (recommended for voltages under 2KV).
Dimensions:	
BRC-W Control Unit	17.0"W x 7.58"D x 3.5"H (432 mm W x 192 mm D x 89 mm H)
TSTW HV Test Module	7.5"W x 6.5"D x 2.8"H (191 mm W x 142 mm D x 71 mm H)
Weight:	
BRC-W Control Unit	6 lbs. (2.7kg.)
TSTW HV Test Module	3.5 lbs. (1.6 kg.)
Power Requirements:	
BRC-W	100 to 240V AC 1 amp 49-61 Hz. Self adjusting power supply.
TSTW	24V DC @ 2 amps max.
Safety	Conforms to IEC 1010-1, CE Approved.
Protected by US Patent Number 6,977,509.	

Please consult factory for help in choosing equipment for specific applications.

BRC-W Control Unit



TSTW High Voltage Test Module



DIMENSIONS IN INCHES [MILLIMETERS]

Clinton INSTRUMENT COMPANY
295 East Main St. • Clinton, CT 06413 USA • Tel: 860.669.7548 • Fax: 860.669.3825 • www.clintoninstrument.com

Declaration of Conformity

Manufacturer: .....The Clinton Instrument Company
Address: .....295 East Main Street
Clinton, CT USA 06413

Herewith declares that
Digital D.C. Spark Testers
Model Numbers TST-W and DC-A

is in conformity with the provisions of the following EEC directives:
89/236/EEC
73/23/EED

Conforms with the emissions requirements of EN 61326:1997: Including A1:1998 and A2:2001:
IEC 61000-3-2:2000 .....Harmonics
IEC 61000-3-3:1997 .....Flicker
CISPR16:1998 .....Class A, Conducted Emissions, 150 kHz to 30 MHz
CISPR16:1998 .....Class A, Radiated Emissions,30 MHz to 1GHz

Conforms with the immunity requirements of EN 61326:1997: Including A1:1998 and A2:2001:
IEC 1000-4-2:1995 .....Electrostatic Discharge
IEC 1000-4-3:1995 .....Radiated Immunity
IEC 1000-4-4:1995 .....EFT/Burst, Power and I/O Leads
IEC 1000-4-5:1995 .....Surge Immunity, Power Leads
IEC 1000-4-6:1996 .....Conducted Immunity, Power and I/O Leads
IEC 1000-4-11:1994 .....Voltage Dips and Interrupts

Conforms to the safety requirements of EN61010.

Clinton, CT USA October, 2005

Marianne Szreders
President

Ted P. Lane
Chief Engineer

Table of Contents

Safety

Safety Symbols

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.

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

The Clinton Instrument Company certifies that this equipment met its published specifications at the time of shipment. Clinton further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology to the extent allowed by the Institute's calibration facility. For customer service or technical assistance with this equipment, please contact:

The Clinton Instrument Company
295 East Main Street, Clinton, CT 06413 USA
Telephone: 860-669-7548 Fax: 860-669-3825
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.

RF Exposure Warning

To satisfy FCC RF Exposure AC 4424 requirements for mobile type transmitting devices, a separation distance of 20 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 3kHz. 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 system

1. BRC-W or BRC-WJ Control Unit.
2. Instruction manual.
3. TSTW or TSTWJ High Voltage Test Module with green connector.
4. An electrode. (Either a BD-051 bead chain or BR0.3-2 brush).
5. Rack mount kit.
6. Standard serial cable.
7. Power cable.
8. A green terminal block connector for process control connections. After it is wired, it will be plugged into the terminal block on the back of the BRC-W smart controller.
9. BRC-W tilt and swival 2.4GHz antenna, TSTW right angle 2.4GHz antenna.

Note: The TST-WJ and BRC-WJ are equipped with internal antennae only.

unique RF Channel between TSTW and BRC-W

Pair the units as a system:
To establish exclusive communication between your TSTW HV Test Module and the BRC-W control unit, connect the TSTW and the BRC-W with the serial cable provided, as shown to the left. Connect the power cord to the BRC-W and a power source. The TSTW should not be powered for this step.

Once the two units are connected, turn on the BRC-W control unit. The

BRC-W will automatically find the TSTW and configure the system.
After configuration, turn OFF the BRC-W, disconnect the serial cable and power cord, and mount the TSTW within the twinning machine as described in the following section.

If either the BRC-W or the TSTW is replaced, this procedure must be repeated to establish communication between the two components of the system.

RF Channel:
Once initially paired by doing the above steps, the RF Channel and RF Power can be set through the Configuration menu. If unit is going to be installed in the vicinity of another BRC-W and TSTW system, the two systems need to be on different channels.

As above, if either the BRC-W or TSTW is replaced, the channel will have to be set again after the system has been

Install the BRC-W control unit.

The BRC-W 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 twinner. If necessary, the TSTW HV Test Module may be located as far as 50 feet from the BRC-W control unit. Please consult factory for futher instructions.

To mount the BRC-W on a horizontal surface:

With a screwdriver, remove the (4) plastic feet from the tapped inserts in the bottom of the spark tester chassis. Insert (4) 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 BRC-W in a rack or panel:

To install the BRC-W in a rack or panel, the space must be 11cm H x 48cm W to insure 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 lockwashers 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.

Ground the BRC-W:

Locate the safety ground terminal on the back panel of the BRC-W. Remove the outer nut and the crimp terminal. Crimp a 16 ga. (1, 29 mm2, 1, 31 cross section) stranded insulated wire (preferably green with a yellow stripe) to the crimp terminal. Fasten this to the safety ground terminal 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.

Install the TSTW HV Test module and electrode.

Locate the TSTW HV Test Module on the twinner cradle close to the electrode in order 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.

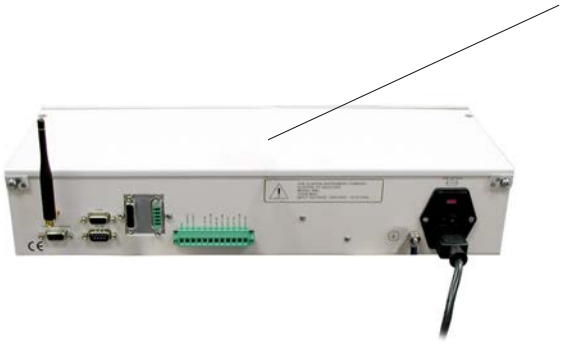
Trim the white HV lead of the TSTW so that it reaches the electrode without excess length, and connect it to the HV input.

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

Supply Power to the TSTW.

Using 22 gauge wire and the green connector supplied with the unit, connect the TSTW 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 TSTW ground stud to ground.

Install an external disconnecting device



Install an external switch or circuit breaker in close proximity to the spark tester and within easy reach of the operator. The switch or circuit breaker must meet the relevant requirements of IEC 947-1 and IEC 947-3 and should be marked as the disconnecting device for the equipment. The rating of the circuit breaker or fuse should be no greater than 5 amperes.

Caution: be sure the external disconnecting device is OFF and locked out before continuing.

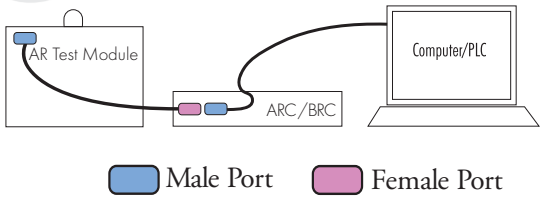
Block Wiring

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

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

Terminal Block Connections	Pin No.	Designation	Conductor
External Reset: 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. **HV Enable:** **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.	1	GND	(3) 22 ga. stranded conductors
	2	HV ENABLE	
	3	EXT RESET	
	4	not used	
Voltage Watchdog: If the Voltage Watchdog (set on the BRC-W front panel) is OFF, dry relay contact pins 5 & 6 will close when the test voltage exceeds 500v. If the Voltage Watchdog is ON and the test voltage is outside the Watchdog high and low voltage values, relay contact pins 5 & 6 will open. If the test voltage is within the Watchdog range, relay contact pins 5 & 6 will close. **HV ON Indication:** For an indication that HV is ON in the electrode, wire a lamp or auxiliary device* here.	5	HV ON NO	(3) 22 ga. stranded conductors rated 250V, less than 10 meters in length, contained in a common insulating sheath
	6	HV ON COM	
Bare Wire (minimum 1/2" long) Indication: To activate external lights, alarms or relays* when a bare wire fault occurs, wire them between dry relay contact pins 7,8 & 9. In Latch Mode (configured on the BRC-W front panel), the relay contacts will remain closed until the RESET button is pressed or when pins 1&3 are closed by remote switch or relay. In Non-Latch Mode, the relay contacts will return to normal state after the interval known as the PCd (Process Control Duration, configured on the front panel) has elapsed.	7	BARE NC	(3) 22 ga. stranded conductors rated 250V, less than 10 meters in length, contained in a common insulating sheath
	8	BARE COM	
	9	BARE NO	
Fault/Fault Limit Indication: To activate external lights, alarms, or relays when any pinhole or bare wire fault occurs, or alternately, when the Fault Limit value (configured on the BRC-W) is reached, wire them between relay contact Pins 10, 11, & 12. In Latch or Remove Voltage on Fault Mode, relay contacts FAULT NO & FAULT COM will remain closed until the RESET button is pressed or when Pins 1 & 3 are closed by remote switch or relay. In Non-Latch Mode, the relay contacts will return to normal state after the interval known as the Process Control Duration, configured on the BRC-W, has elapsed.	10	FAULT NC	(3) 22 ga. stranded conductors rated 250V, less than 10 meters in length, contained in a common insulating sheath
	11	FAULT COM	
	12	FAULT NO	
* When connecting auxiliary equipment to dry relay contact pins 5, 6, 7, 8, 9, 10, 11 or 12, 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.			

Connecting the RS-485 Interface



The TST-10W spark tester is equipped with an RS-485 serial interface so it can receive commands and exchange information with a PLC or computer. Programming and control of voltage settings, which can be done manually on the display, can also be done through this interface. Control display buttons are not disabled when the serial interface is in use.

Connect RS-485 cables as follows:

On the back of the BRC-W display there are two RS-485 ports. Connect the female port labeled "To test module," located on the left hand side, to the male port on the TSTW HV test module labeled "RS-485 port," with an RS-485 cable. Then connect the male port of the BRC-W labeled "RS-485 port" located on the left hand side, to a PLC or computer with an RS-485 cable.

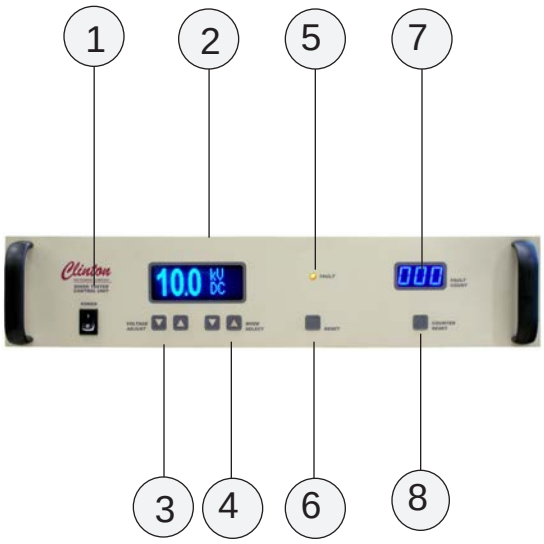
For information on the RS-485 interface, contact the factory.

Prepare your Product for Testing

- Insure 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. Efficient air wipes that can adequately dry the product before it enters the electrode are available from Clinton.
- 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. 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.

Spark Tester Controls

The BRC-W has three different operating modes: Normal Operation mode, Calibration mode, and Configuration mode. The spark tester controls are described in detail for each operating mode.



ON/OFF Power Switch (1)

This switch, located on the front panel of the BRC-W, controls power to the BRC-W and TSTW High Voltage Test Module.

Graphics Display (2)

In Normal Operation mode, the Graphics Display indicates the voltage at the electrode. When the output voltage is adjusted to 1.0 KV, the voltmeter will read 1.0. A reading of 10.0 indicates that the voltage at the electrode is 10 KV. The Mode Select Down button toggles the Graphics Display between Voltage and Detailed Display.

- **Voltage Display:** Shows the voltage in large characters.
- **Detailed Display:** Shows the voltage as well as pinhole & bare wire fault counts.

In Configuration mode, the Graphics Display shows one of the spark tester's functions. Use the up and down VOLTAGE ADJUST buttons to view the different functions. Use the MODE SELECT up and down buttons to modify the function.

NOTE: The display will refresh every 10 seconds. The refresh will appear as a blink to the user.

VOLTAGE ADJUST buttons (3)

In Normal Operation mode, the spark test voltage may be adjusted from 0 to 10,000 volts in 100 volt increments by pressing the up and down VOLTAGE ADJUST arrow buttons under the Graphics Display. Press and hold a button to increase the speed at which you change the voltage setting.

The test voltage can be turned OFF or ON from a remote location if: (1) the power switch is ON; and (2) there is a remote switch connected between Pins 1 & 2 of the terminal block that is located on the back of the unit.

In Configuration mode, press the VOLTAGE ADJUST down button to display the next spark tester function on the Graphics Display. Press the VOLTAGE ADJUST up button to display the previous spark tester function.

MODE SELECT buttons (4)

In Normal Operation mode, the MODE SELECT down button toggles the Graphics Display between Voltage and Detailed Display. The MODE SELECT Up button toggles the Graphics Display between the various spark tester functions that have been chosen.

In Configuration mode, press the MODE SELECT Up or Down button to modify the spark tester function shown on the Graphics Display.

FAULT light (5)

In Normal Operation Mode, the FAULT light will illuminate in response to a single pinhole fault in the electrode. It also indicates that the process control relay contacts are in fault condition, activating any accessories that are connected. If the Latch on Fault function is ON, the FAULT light can be turned OFF in 2 ways: (1) by pressing the RESET button below it; or (2) closing a momentary remote switch or relay contacts wired between Pins 1 & 3 of the green rear panel terminal block. Simultaneously, the fault counter relay contacts will reset to normal position. If the Latch function is OFF, the FAULT light will go OFF automatically and the fault relay will return to the normal state after an interval known as the Process Control Duration (programmed on the front panel) has elapsed.

RESET button (6)

In Normal Operation mode, if the Latch function is ON, the RESET button will return the fault relay contacts to their normal state and turn OFF the FAULT light. The RESET button will have no effect on the number of faults registered on the LED Display.

The RESET button is used to move the spark tester into and out of the Configuration mode.

LED Display (7)

In Normal Operation mode, the LED Display registers a count each time a pinhole fault is detected in the electrode.

In Configuration mode, LED Display displays "SYS, " indicating that the spark tester is in Configuration Mode.

Counter Reset (8)

In Normal Operation, press the COUNTER RESET button to reset the number of faults on the LED Display to 0.

Spark Tester Configuration

1. In order to configure the system, the TSTW must be connected to the BRC-W by the serial cable provided or power must be supplied to the TSTW separately.
2. Turn OFF the BRC-W. Press and hold in the RESET button while turning ON the ON/OFF power switch. The LED Display will read SYS, indicating that you can now configure the spark test system. Release the RESET button.
3. The first of the functions described in the table on the following page will be displayed on the Graphics Display.
4. Press an up or down VOLTAGE ADJUST button to view a different function.
5. Press an up or down MODE SELECT button to select a different option for that function.
6. Repeat this sequence for all available functions.
7. When you have made your choices for each of the functions, press the RESET button and they will be accepted and saved by the system. The system will immediately begin to operate according to the new system configuration with the voltage at the last preset value.

Fault Indication Functions			
Function	Function Description	Option	Option Description
Fault Mode	Operation of fault relay	Non-Latch	If Fault Limit = 0 and Bare Wire Indication is not enabled (Line Spd Src = None), faults will cause process control relay contacts FAULT NC, FAULT COM & FAULT NO (pins 10, 11 & 12) to energize momentarily, returning to normal position after the PC Duration interval has elapsed. Voltage in the electrode remains ON. NOTE: If a Fault Limit value >1 has not been exceeded or a bare wire is detected, the BRC Fault Mode setting will override this setting.
		Latch	If Fault Limit = 0 and Bare Wire Indication is not enabled (Line Spd Src = None), faults will cause process control relay contacts FAULT NC, FAULT COM & FAULT NO (pins 10, 11 & 12) to latch until manual or remote reset. Voltage in the electrode remains ON. NOTE: If a Fault Limit value >1 has not been exceeded or a bare wire is detected, the BRC Fault Mode setting will override this setting.
		Rem Volt (Remove Voltage on Fault)	If Fault Limit = 0 and Bare Wire Indication is not enabled (Line Spd Src = None), faults will cause process control relay contacts FAULT NC, FAULT COM & FAULT NO (pins 10, 11 & 12) to latch until manual or remote reset. Voltage in the electrode will be removed until manual or remote reset. NOTE: If a Fault Limit value >1 has not been exceeded or a bare wire is detected, the BRC Fault Mode setting will override this setting.
PC Duration	Process Control Duration	Numeric value .05-2.5 sec.	The Process Control Duration operates only in Non-Latch mode. It is an interval that begins when a fault is detected in the electrode and it determines the length of time the process control relay contacts FAULT NC, FAULT COM & FAULT NO (pins 10, 11 & 12) remain closed, energizing auxiliary equipment connected to those contacts. The PC Duration may be set for lengths from 50ms. to 2-1/2 sec. Many alarms and lights require a signal of at least one second in length before responding; the relay contact closure time should be set to the duration needed to activate accessories connected to the relay. If a second arc should occur in the electrode before the Process Control Duration has elapsed, the contacts remain closed until the interval has ended. If Fault Limit = 0 and Bare Wire Indication is not enabled (Line Spd Src = None), faults will cause process control relay contacts FAULT NC, FAULT COM & FAULT NO (pins 10, 11 & 12) to energize for the period of the PC Duration, returning to normal position after the PC Duration interval has elapsed. Voltage in the electrode remains ON. NOTE: If a Fault Limit value >1 has not been exceeded or a bare wire is detected, the BRC Fault Mode setting will override this setting.

Elec Length	Electrode Length along the Wire Line	Number 1,2,3,4,5	This represents a 1", 2", 3", 4" or 5" long electrode length along the wire line (the horizontal dimension of the electrode that will cover your test product). Use 1 for the BD-051 or BR0.3-2 electrode.
Flt Sens	Fault Sensitivity. Regulates the fault threshold current.	Number 0 - 4	0 = most sensitive/lowest fault threshold current. 4 = least sensitive/highest fault threshold current. Products with higher capacitive loading characteristics may induce false counting when the fault threshold current is at its maximum level.
Watch Dog Functions			
Function	Function Description	Option	Option Description
Enab Vlt Wtch	Enable Voltage Watchdog	No	
		Yes	The HV ON relay contacts HV ON NO and HV ON COM (Pins 5 & 6) will open if the actual voltage in the electrode moves outside the Voltage Watchdog Lo and Voltage Watchdog Hi settings. Alarms connected to these contacts alert that the spark tester voltage is at an incorrect level.
Volt Watch Lo	Minimum acceptable voltage setting	0.0 - 10.0kV	This value is the lowest voltage at which the HV ON relay contacts will remain closed. When the set voltage or actual voltage in the electrode drops below this value, the HV ON NO and HV ON COM relay contacts will open.
Volt Watch Hi	Maximum acceptable voltage setting	0- 10.0kV but 200V less than Volt Watch Lo value	This value is the highest voltage at which the HV ON relay contacts will remain closed. When the set voltage or actual voltage in the electrode rises above this value, the HV ON NO and HV ON COM relay contacts will open.
Meas System	unit of measure for line speed or number of encoder pulses	Standard	feet
		Metric	meters
Bare Wire Functions If bare wire information is required, the wire line speed must be input to the BRC-W, either through the front panel, serial interface, or direct encoder or tachometer input. Faults 1/2" long or more will be identified as bare wire faults.			
Function	Function Description	Option	Option Description

Line Spd Src	Line Speed Source	None	
		Encoder	Wire the encoder to J 5-pin line speed connector on rear of BRC-W, per section entitled, "Adding a Line Speed Encoder." Encoder pulses per foot or meter will be entered in Pulse per Ft./meter function below.
		Panel	Use when wire line speed is known and no Encoder or Tachometer is to be used. Enter wire line speed in Line Speed function below.
		Tach	Wire tachometer to the J 5-pin line speed connector on rear of BRC-W. Below, enter Max Speed fim fpm or mom and enter Max Voltage the tachometer can generate.
Pulse per m or ft.	Use only when Line Spd Src = Encoder.	0 - 1000	Enter the number of pulses per foot or meter generated by the Encoder wired to BRC-W.
Line Speed	Use only when Line Spd Src = Panel.	0 - 9999	Enter the wire line speed in fpm or mpm. For use when line speed is entered on the front panel, and an Encoder ot Tachometer is not connected to the BRC-W.
Max Speed	Use only when Line Spd Src = Tach.	0 - 10,000	Enter the maximum speed of the Tachometer wired to the BRC-W in fpm or mpm.
Max Voltage	Use only when Line Spd Src = Tach.	0.0 - 24.0V	Enter the maximum voltage that the Tachometer wired to the BRC-W can generate.
Fault Limit Function			
Function	Function Description	Option	Option Description
Fault Limit	Limit on Fault Count	Number 1 - 999	Fault relay contacts FAULT NC, FAULT COM and FAULT NO (Pins 10, 11 & 12) will operate in accordance with the Fault Mode setting until the Fault Limit value is reached. The fault relay contacts will then operate in accordance with the BRC Fault Mode and BRC PC Duration settings. Pinhole faults will continue to register on the LED Display.
		Number 0	Fault relay contacts FAULT NC, FAULT COM and FAULT NO (Pins 10, 11 & 12) will operate per the BRC Fault Mode and BRC PC Duration settings.
BRC-W Functions			
Function	Function Description	Option	Option Description

BRC Flt Mode	Operation of BRC-W Fault Relay	Non-Latch	If a Fault Limit value has been entered, the process control relay contacts FAULT NC, FAULT COM & FAULT NO (pins 10, 11 & 12) will energize momentarily when the Fault Limit has been reached, returning to normal position after the BRC PC Duration interval has elapsed. NOTE: Before the Fault Limit is reached, the spark tester will respond to faults in accordance with the Fault Mode and PC Duration settings, not the BRC Fault Mode or BRC PC Durantion settings. If a Fault Limit value has not been entered, when a fault occurs in the electrode, the process control relay contacts FAULT NC, FAULT COM & FAULT NO (pins 10, 11 & 12) close momentarily, returning to normal position after the PC Duration interval has elapsed. Voltage in the electrode remains ON.
		Latch	If a Fault Limit has been entered, the process control relay contacts FAULT NC, FAULT COM & FAULT NO (pins 10, 11 & 12) will latch when the Fault Limit has been reached and will stay closed until manual or remote reset. Voltage in the electrode remains ON. NOTE: Before the Fault Limit is reached, the spark tester will respond to faults in accordance with the Fault Mode and PC Duration settings. If a Fault Limit value has not been entered, when a fault occurs in the electrode, the process control relay contacts FAULT NC, FAULT COM & FAULT NO (pins 10, 11 & 12) latch until manual or remote reset. Voltage in the electrode remains ON.
		Rem Volt (Remove Voltage)	If a Fault Limit has been entered, the process control relay contacts FAULT NC, FAULT COM & FAULT NO (pins 10, 11 & 12) will latch when the Fault Limit has been reached and will stay closed until manual or remote reset. Voltage in the electrode will be removed until manual or remote reset. NOTE: Before the Fault Limit is reached, the spark tester will respond to faults in accordance with the Fault Mode and PC Duration settings. If a Fault Limit Value has not been entered, when a fault occurs in the electrode, the process control relay contacts FAULT NC, FAULT COM & FAULT NO (pins 10, 11 & 12) latch until manual or remote reset. Voltage in the electrode will be removed until manual or remote reset.

BRC PC Dur	BRC Process Control Duration	Numeric value .05-2.5 sec.	The BRC PC Duration operates only in Non-Latch mode. It may be set for lengths from 50ms. to 2-1/2 sec. Many alarms and lights require a signal of at least one second in length before responding; the relay contact closure time should be set to the duration needed to activate accessories connected to the relay. If a second arc should occur in the electrode before the BRC PC Duration has elapsed, the contacts remain closed until that interval has ended. If a Fault Limit has been entered and the unit is in BRC Non-Latch mode, the process control relay contacts FAULT NC, FAULT COM & FAULT NO (pins 10, 11 & 12) will energize for the BRC Process Control Duration when the Fault Limit has been reached, returning to normal position after the BRC PC Duration interval has elapsed. NOTE: Before the Fault Limit is reached, the spark tester will respond to faults in accordance with the Fault Mode and PC Duration settings, not the BRC Fault Mode or BRC PC Duration settings. If a Fault Limit has not been entered and the unit is in BRC Non-Latch mode, the process control relay contacts FAULT NC, FAULT COM & FAULT NO (pins 10, 11 & 12) will energize for the BRC Process Control Duration when a fault is detected in the electrode, returning to normal position after the BRC PC Duration interval has elapsed.

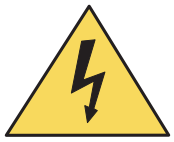
RF Channel Functions

Function	Function Description	Option	Option Description
RF Channel		0-42	Channel ID to which both the TSTW and the BRC-W will be set.
RF Power	Power Output of the Radio	Full	Default setting and the maximum power of the radio. In most cases this setting should not need to be changed. Necessary for installations that have the TSTW and BRC-W 30-50 feet apart.
		Half	Medium power output of the radio. Can be used if the TSTW and the BRC-W are 10-30 feet apart.
		Quarter	Lowest power output of the radio. Should only be used if the TSTW and the BRC-W are less than 10 feet apart.

Time and Date Functions

Function	Function Description	Option	Option Description
Set Time /Date		No	
		Yes	When selected, you may proceed to the following functions.
Month		Jan - Dec	
Day		1 - 31	
Year		00 - 99	
Hour	24-hour clock	0 - 23	
Minute		0 - 59	

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. Thread your product through 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 RESET button and the COUNTER RESET button, if necessary, so that both the Graphics Display detailed screen indicating the fault count and the LED Display show 0.
5. Start the wire line. Press the VOLTAGE ADJUST up arrow button until the Graphics Display voltage setting 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 "Spark Tester Configuration." See the table on the following page for spark test modes that are available.

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 Connections" in the Installation section of this manual on how to safely install your spark tester.

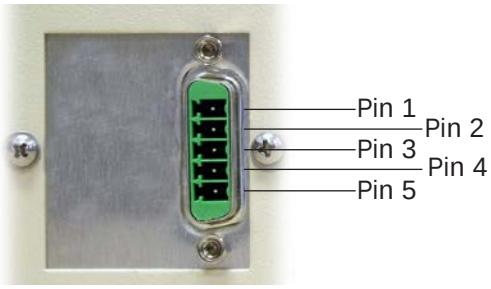
Spark Tester Modes

Below are the sample settings for different spark test modes:

Spark Tester Mode	Display Configuration	Terminal Block Connections
No Fault Limit Indication enabled High voltage in the electrode stays ON continuously during fault detection Fault relay closes for 1 second only when a fault occurs, signalling devices on terminal pins 10, 11, and 12 No Voltage Watchdog enabled No separate bare wire identification	Elec Length 1 Enable Vlt Wtchdog No Line Spd Src None Fault Limit 0 (Fault Mode and PC Duration values are ignored) BRC Non-Latch Mode BRC PC Duration 1.0 second	Normally closed switch between Pins 1 & 2 (to enable HV in the electrode) Auxiliary devices on Pins 10, 11 & 12
Fault Limit Indication set at 20 faults Until the Fault Limit of 20 faults is reached, high voltage in the electrode stays ON continuously during fault detection and fault relay closes for 1 second only when a fault occurs, signalling devices on terminal pins 10, 11, and 12. When the Fault Limit is reached, the spark tester fault relay latches (Pins 10, 11 & 12) and the voltage goes OFF Voltage Watchdog enabled, set between 1.0 kV and 2.0 KV. When the voltage exceeds 2.0KV, relay contact pins 5 & 6 energize No Encoder or Tach attached, line speed of 500 fpm entered through front panel of BRC-W, enabling Bare Wire function. Bare Wire detection will signal Pins 7, 8 & 9	Fault Limit 20 BRC Rem Voltage Mode Non-Latch Mode PC Duration 1.0 second Elec Length 1 Enable Vlt Wtchdog Yes Volt Watch Lo 1.0kV Volt Watch Hi 2.0kV Line Spd Src Panel Meas Sys Standard Line Speed 500 fpm	Normally closed switch between Pins 1 & 2 (to enable HV in the electrode) Auxiliary devices on Pins 10, 11 & 12 Bare wire signal received by device attached to Pins 7, 8 & 9 Voltage watchdog device wired to Pins 5 & 6.

Adding a Line Speed Encoder

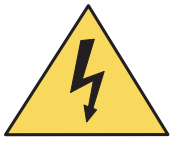
Pin 1	Ground
Pin 2	12v out
Pin 3	+5v out
Pin 4	Encoder input
Pin 5	+24v out



For additional information, consult the factory.

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.

Clinton recommends an accurately calibrated high voltage probe with input resistance of 1000 megohms (for example, a Fluke 80K - 40 high voltage probe or equivalent) or Electrostatic Voltmeter (EVM) in conjuction with a digital voltmeter.

Calibration

1. Before connecting to the calibrating voltmeter, turn ON the BRC-W and adjust its voltage to 0 using the VOLTAGE ADJUST down arrow button. Turn OFF the spark tester.
2. With the power OFF, zero the calibrating voltmeter. Clip the HV lead from the calibrating voltmeter to the electrode, using high voltage insulated wire.
3. Connect the ground terminal of the calibrating voltmeter to ground and set to the correct range.
4. Turn the spark tester ON. Using the VOLTAGE ADJUST buttons, slowly increase the spart tester's voltage until its voltmeter reads the exact test voltage at which the spark tester is most often used (for example, 500V, 800V, 1kV, etc.); record the BRC-W graphics display voltage reading at each of these points.
5. Compare the BRC-W graphics voltage display readings to the voltmeter true voltages. If the BRC-W voltage readings are within factory specifications (within 2% of the calibrating voltmeter reading), turn OFF the spark tester and disconnect the voltmeter from the spark tester and GND.
6. If the readings are not within tolerance, do not disconnect the voltmeter. Proceed to the next section.

Recalibration

7. Using the VOLTAGE ADJUST arrow buttons, adjust the voltage to 1.0kV. Turn OFF the spark tester.
8. Enter Calibration Mode: press and hold the COUNTER RESET

and the VOLTAGE ADJUST down buttons as you turn ON the BRC-W ON/OFF Power Switch. Hold in the buttons until the Graphics Display reads "Entering Calib".

9. Press and hold the VOLTAGE ADJUST and COUNTER RESET buttons down and turn ON the spark tester. The spark tester's LED Display will display the following:

   This readout indicates that the spark tester is at a Set Point (SP) of 1kV rms.

10. Press the COUNTER RESET button. The BRC-W LED Display will display the following:

    This readout indicates the spark tester's Voltage Output (UO).

11. Adjust the voltage using the VOLTAGE ADJUST buttons until the calibrating voltmeter reads the equivalent of what is displayed in the LED Display (1kV).

12. Press the COUNTER RESET button. The BRC-W LED Display will display the following:

    This readout indicates the spark tester's Actual Voltage (AU).

13. Press a VOLTAGE ADJUST arrow button just once to adjust the voltage readout toward 10.0kV. Every time you press a VOLTAGE ADJUST button, you will see the FAULT light flash, and after a few seconds, the voltage readout will reflect the change. Repeat this step until the AU (actual voltage) displayed on the BRC-W Graphics Display matches the calibrating voltmeter reading.

14. Turn OFF the BRC Smart Controller.

15. Return to steps 1 through 6 above to take calibration readings.

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.

Periodic Inspection

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

Insulation and water deposits can reduce the effectiveness of the spark test. Bead chain assemblies contaminated with insulation residue should be removed from the high voltage test module and cleaned with a wire brush. Broken electrode assemblies with worn brushes or missing beads should be replaced immediately.

Refer to the "Troubleshooting" section for assistance with electrical problems.

Troubleshooting

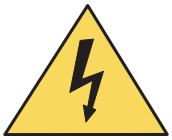
CAUTION: Troubleshooting is to be performed by qualified service personnel only. Failure to follow the procedures in this manual may result in danger to personnel and equipment damage.

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. Inspect proper grounding of inner conductor.
3. If, after above steps have been corrected, you still experience false counting due to a capacitive loading effect on your test product, contact the factory to determine the correct sensitivity levels.

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

1. Disconnect the mains power, remove the cover of the control unit and inspect the interior. All cables should be checked visually to make sure plugs are properly engaged and all wires are intact. Look for evidence of damage to circuit board components. Make sure hardware is tight.
2. Repeat this procedure for the TSTW. To gain access to the interior, remove the four screws and cover. use a good worklight to carry out inspection of the interior wiring and circuit board.
3. If nothing out of order is detected, localize the problem by substituting another TSTW or control unit. Further substitution can be carried out by changing circuit boards, making sure that all plugs are proerly inserted. Be sure to reestablish the wireless communication channel between the BRCW control unit and the TSTW any time components are replaced.
4. 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.



Equipment at Relay Terminals COM, NO and/or NC is not Activated when a fault occurs.

1. The BRC PC Duration or PC Duration (process control duration) value in system configuration may be too short for the auxiliary equipment to recognize.
2. Check fuse on the BRC-W main pc board.

BRC-W Control Unit says "Searching for TST-W... Test Module Comm Lost".

1. Ensure that the TSTW has power by either measureing directly with a voltmeter or checking the LED on the main TSTW PCB is illuminated.
2. Verify that the TSTW and BRC-W have their antennas securely mounted.
3. If the RF Power is set to Full try setting it to Half.
4. Follow the procedure entitled, "Create a unique RF Channel between TSTW and BRC-W Control Unit." If one of these units has been replaced or if something has gone wrong with the pairing, the wireless communication channel may have been disrupted and must be reestablished.
5. Attemp to change channel, possible interfierance.

The spark tester is not functioning as set up in Fault Mode.

1. The BRC Fault Mode and the BRC PC Duration settings takesprecedence over the Fault Mode setting if the Fault Limit is 0. If the Fault Limit is greater than 0, the Fault Mode and BRC Duration settings apply until the Fault Limit is reached. When the Fault Limit is reached, the BRC Fault Mode and BRC PC Duration settings apply.

Replacement Parts

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 quick and inexpensive repair and calibration.

Part Number	Description
TSTW and TSTWJ Parts	
91178	Assy PCB DC Test Module
90003	Power Supply 10kV DC
92080 or 92080-J	Module RF 2.4GHz
91155	Assy PCB TSTW Power Supply
91210	Antenna Right Angle RCR Series 2.4 GHz for TSTW only
91311	Wire High Voltage
BRC- and BRC-WJ Parts	
91161	Assy PCB Display
91194I	Display Graphic 140 x 32
91148	Assy PCB BRC Main
03018	ON/OFF Switch Carling 621-1-591909W
00473	Power Supply 40W
91061	Power Entry Module (ON/OFF Switch)
91159	Assy PCB Encoder INput Module
91212	Antenna Right Angle RCL Series for BRC-W only
92080 or 92080-J	Module RF 2.4 GHz
02603	Fuse 1 amp low breaking time delay, 5 x 20 mm
RM	Rack Mount Kit

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.

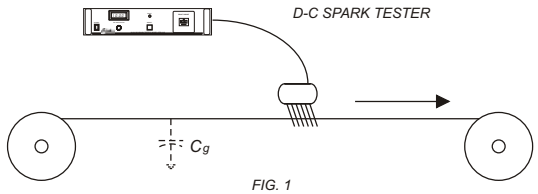


FIG. 1

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.

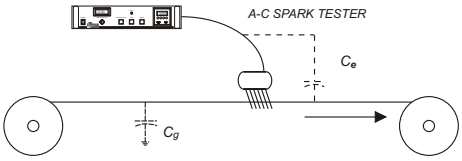
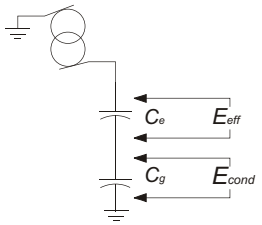


FIG. 2

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

Reprinted from March 1986 Issue of Wire Journal

MEASURING & TESTING

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.

Henry Clinton is president of Clinton Instrument Co., Clinton, CT.

CLINTON INSTRUMENT COMPANY

295 East Main Street
Clinton, CT 06413 USA
Telephone: 860-669-7548 Fax: 860-669-3825
Electronic Instrumentation For Industry

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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.