Instruction Booklet **IB019013EN**

Effective March 2019
Supersedes 01/2019

Zone selective interlocking test kit

For Digitrip 520M, 520MC and 1150 trip units

Contents

⚠ WARNING

ONLY QUALIFIED ELECTRICAL PERSONNEL SHOULD BE PERMITTED TO WORK ON THE EQUIPMENT.

⚠ CAUTION

SPECIFIC OPERATING PROCEDURES MUST BE DEVELOPED BY THE RESPONSIBLE PARTY DUE THE UNIQUE APPLICATION AND VAST VARIETY OF SYSTEM AND USER REQUIREMENTS. FAILURE TO DEVELOP SPECIFIC PROCEDURES COULD LEAD TO IMPROPER USE OR OTHER MORE SERIOUS CONSEQUENCES.

⚠ CAUTION

PLEASE READ AND UNDERSTAND THESE INSTRUCTIONS BEFORE ATTEMPTING TO OPERATE THE ZONE SELECTIVE INTERLOCKING TEST KIT.

⚠ CAUTION

DURING NORMAL OPERATION OF THE ZONE SELECTIVE INTERLOCKING TEST KIT, BREAKERS UNDER TEST WILL TRIP OPEN.

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Read before operating

The ZSI tester was designed to work with prescribed Digitrip settings and requires specific connections from the test box to the breakers under test. If these are not followed, the test will be invalid and you will get unexpected results.

The ZSI tester will not work with 520 trip units. It will only work with 520M, 520MC and 1150 trip units in Magnum DS breakers.

Setting the Digitrip time and multiplier settings

The ZSI test box can only accurately test the ZSI wiring scheme if each one of the Digitrips being tested are configured with the appropriate time and multiplier settings. These settings are shown in the tables below, Tables 1 and 2: Digitrip settings, as well as through the "DIGITRIP SETTINGS" button on the startup screen. For instruction on how to navigate to these settings on your Digitrip unit consult Table 3: Setting locations, and the Digitrip manuals: IL70C1037H05, and IL70C1036H06.

Table 1. Digitrip 1150+ settings

Parameter	Setting
LSIG	On
Long slope	I2T
Long PU	0.4 sec
Long time @ 6 X I_r	2.0 sec
Long memory	Off
Short slope	Flat
Short PU	3 X Ir
Short time	*Depends on zone: Z1 = 0.5 sec; Z2 = 0.3 sec; Z3 = 0.10 sec
Inst PU	4 x In
Gnd PU	0.3
Ground slope	Flat
Ground time	0.3 sec
Amp unbalance	Off
Amp unbalance time	10 sec
Phase loss	OFF
Main PU	10 x In
Maintenance mode	Disabled
Frequency	60 HZ
BC relay reset	Auto
Sliding demand	Off
Wave form capture	Off
Rev power sensing	Disabled

Table 2. Digitrip 520M, 520MC settings

Parameter	Setting	Parameter	Setting
Long delay setting	0.4	Long delay time @ 6xI_r	2
Short delay setting	3	Short delay time	*Depends on zone: Z1 = 0.5 sec; Z2 = 0.3 sec; Z3 = 0.10 sec
Instantaneous setting	OFF	Ground setting	0.4
Ground time	0.3	Arc flash reduction setting	R5
Arc flash reduction	OFF		

*Assuming Z1 is connected to main, Z2 is directly downstream of Z1, and Z3 is directly downstream of Z2.

Table 3. Settings locations

Digitrip unit	Location	Settings
520M 520MC	Rotary switches on front of Digitrip unit	Long delay setting, long delay time, short delay setting, short delay time, instantaneous setting, ground setting, ground time, arc flash reduction setting, arc flash reduction
1150+	PGM set →current	Curve type, long slope, long pu, long time, long memory, short slope, short pu, short time (all zones), inst PU, GND PU, ground slope, ground time, amp unbalance, amp unbalance time, phase loss
1150+	PGM set →system	Main PU, maintenance mode, frequency, BC relay reset, sliding demand, wave form capture, rev power sensing

Setup procedure

1. Ensure all Digitrip units have the settings required for ZSI testing. Fill out ZSI tester worksheets when a change must be made. See the end of this instruction manual for ZSI tester worksheets.

2. Open the ZSI test kit by releasing the two latches around the perimeter of the case.

3. Check that the contents of the ZSI test kit match the information provided in Table 4: ZSI test kit contents.

Table 4. ZSI test kit contents

Contents:	Quantity:
ZSI test box	1
Instruction manual	1
Power cord	1
Zone connection cord	3

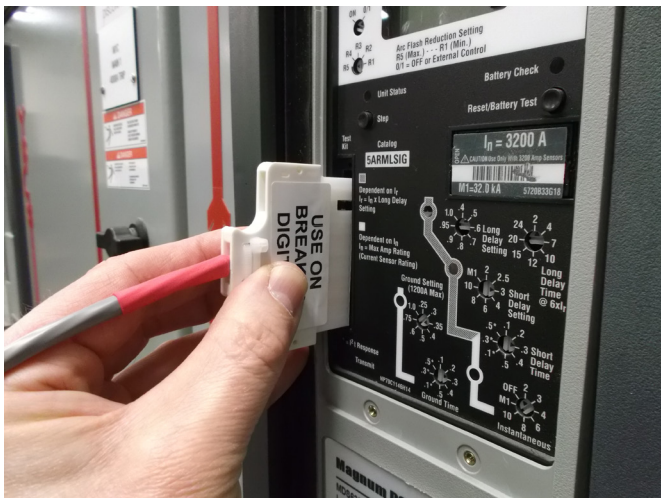
4. Plug the power cable into the ZSI test box.

5. Plug the power cable into a standard 120V outlet.

6. Refer to the "Test Sequence" screen in the "Navigating the HMI Screens" section to determine which series of tests need to be performed.
7. Refer to the "Zone Configurations" section to determine the correct cable connections for the desired test.
8. Plug a ZSI zone cable into one of the zone plugs on the ZSI test box, per the cable connections found in the "Zone Configurations" section.

9. Push down and screw the ring clockwise to fully secure the plug.
10. Repeat steps 8 and 9 for the other two ZSI zone cables.

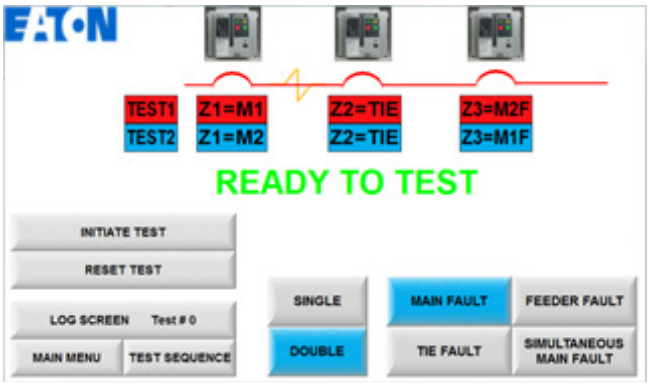
11. Locate the correct breaker for the test you are performing and remove the tamper resistant cover from the Digitrip unit if needed. Plug the other end of the appropriate ZSI zone cable into the Digitrip unit, applying even pressure to both ends of the plug.



12. Repeat step 11 for the other two ZSI zone cables, making sure they get plugged in to the correct zone.

13. Move the selector switch on the ZSI test box to the "ON" position.

14. Navigate to the "Test Screen" on the display panel.



15. Select "Single" or "Double" (based on the switchgear configuration being tested).

16. Select "Main Fault", "Tie Fault", or "Feeder Fault".

17. Press the "Initiate Test" button to start the test.

18. After the test is completed, press the "Reset Test" button to prepare the tester for the next test.

19. Select new parameters and perform the next test.

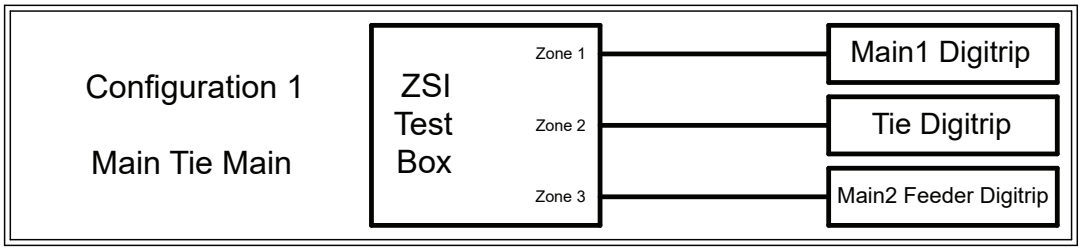
20. Remember to change which Digitrip units the ZSI zone cables are plugged into when changing tests to ensure correct results.

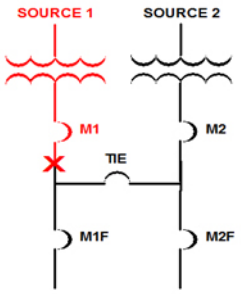
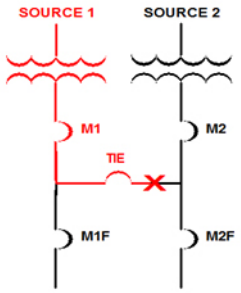
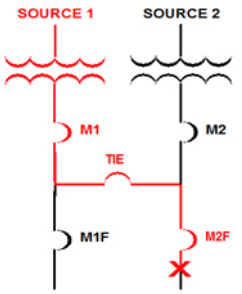
21. Once testing is complete, return the trip unit settings to the previous settings recorded on the worksheet.

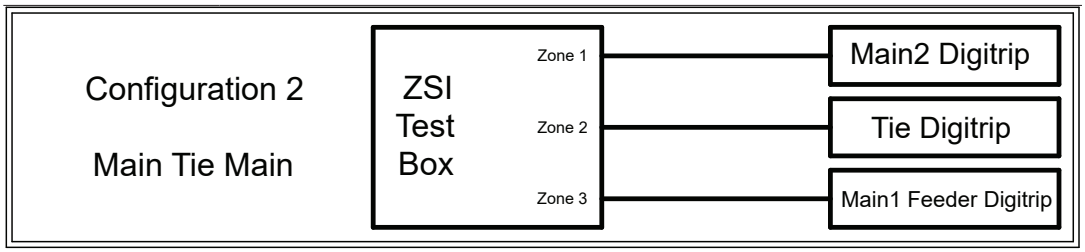
Zone configurations

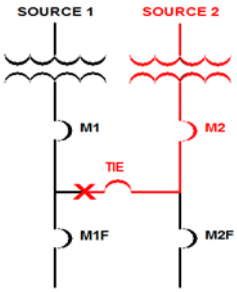
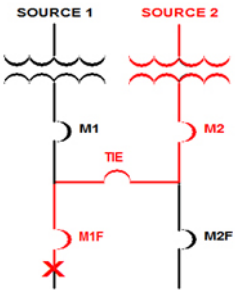
The figures below depict some of the most common ZSI wiring schemes. These configurations describe how to connect the ZSI plugs to the breakers to be tested and where each zone plug should be connected to the corresponding receptacle on the test box. The table below each figure describes the ZSI wiring scheme configuration and what the ZSI test box is testing on each configuration based on the selections made on the HMI. Circuit diagrams of these setups can be found in the "Zone Config" screen subsection of the "Navigating the HMI Screens" section in this manual.

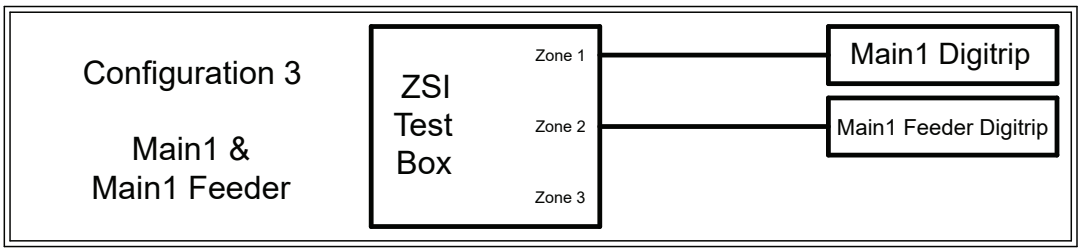
Note: For M-T-T-M, repeat test for each tie breaker.



Configuration 1 Arrangement double	Main fault: This simulates a fault originating between the M1 (main 1) breaker and the tie breaker	
	Tie fault: This simulates a fault on originating downstream of the M1 (main 1) breaker and the tie breaker.	
	Feeder fault: This simulates a fault originating on the load side of a feeder on the main 2 bus (main 2 feeder). This fault would flow through main 1, the tie breaker, and the main 2 feeder breaker.	



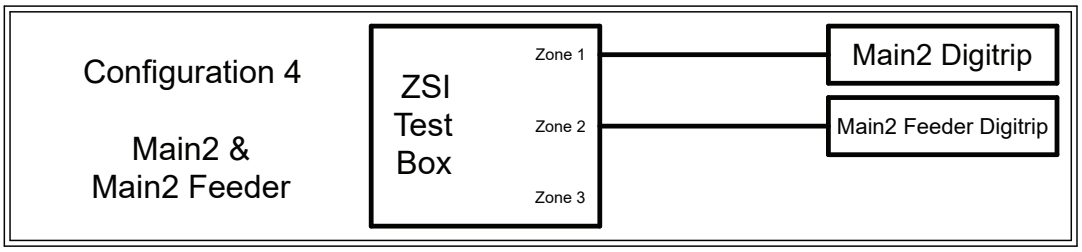
Configuration 2 Arrangement double	Main fault: This simulates a fault originating between the M2 (main 2) breaker and the tie breaker.	
	Tie fault: This simulates a fault originating downstream of the M2 (main 2) breaker and tie breaker.	
	Feeder fault: This simulates a fault originating on the load side of a feeder on the main 1 bus (main 1 feeder). This fault would flow through main 2, the tie breaker, and the main 1 feeder breaker.	



Configuration 3
Arrangement
single

Main fault: This simulates a fault originating on the load side of the main 1 breaker.

Feeder fault: This simulates a fault originating on the load side of the main 1 feeder breaker.

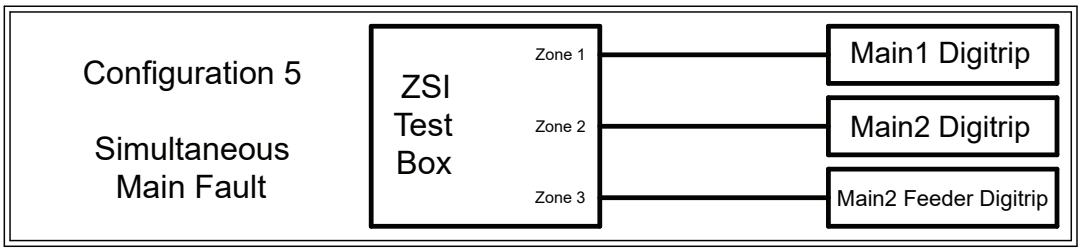


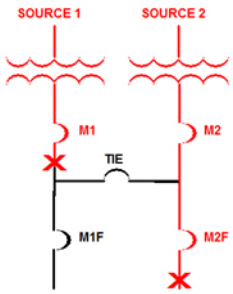
Configuration 4
Arrangement
single

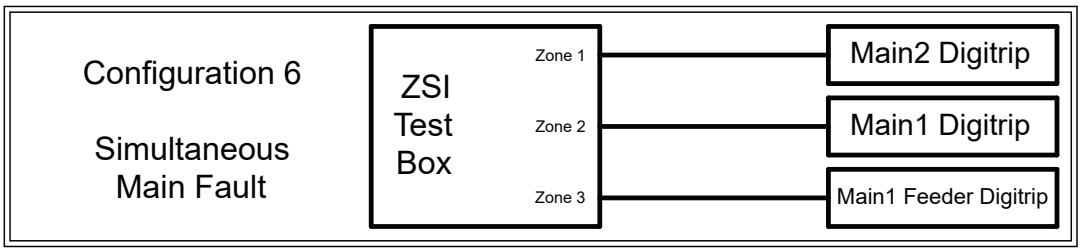
Main fault: This simulates a fault originating on the load side of the main 2 breaker.

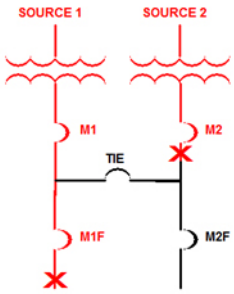
Feeder fault: This simulates a fault originating on the load side of the main 2 feeder breaker.

****Configuration 5 and 6 only need to be tested when there is a 6 diode arrangement.****



Configuration 5 Arrangement double (main + opposite feeder)	Simultaneous main fault: This simulates simultaneous faults. One originates on the load side of the main 1 breaker before the tie and the other originates on the load side of the main 2 feeder.	



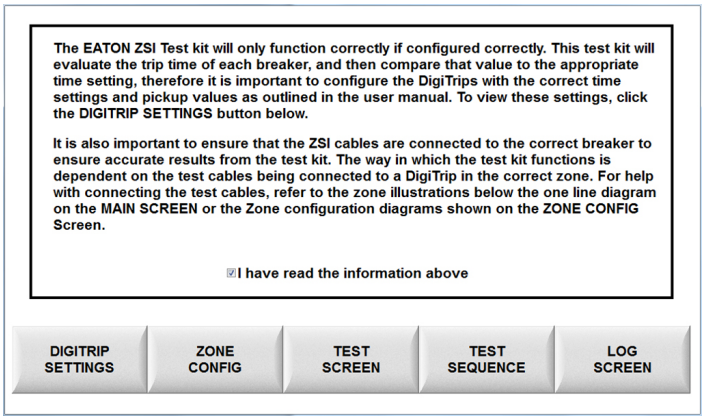
Configuration 6 Arrangement double (main + opposite feeder)	Simultaneous main fault: This simulates simultaneous faults. One originates on the load side of the main 2 breaker before the tie and the other originates on the load side of the main 1 feeder.	

Navigating the HMI screens

Startup screens

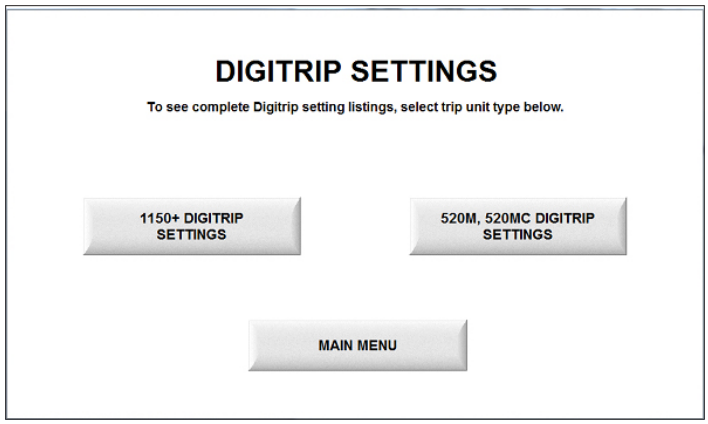
The screen shown below is the ZSI test box startup screen. This screen should show up each time the test box is powered on. If this screen does not show up when the device is powered on, contact Eaton customer support. The test program may need to be re-loaded.

These instructions reinforce the need to confirm that the breakers being tested have had the correct settings configured as well as the correct cable connections made to the ZSI best box. Please review the previous sections of this manual if there are any concerns over proper connections. Once the check box has been selected, the "Test Screen" button becomes visible.



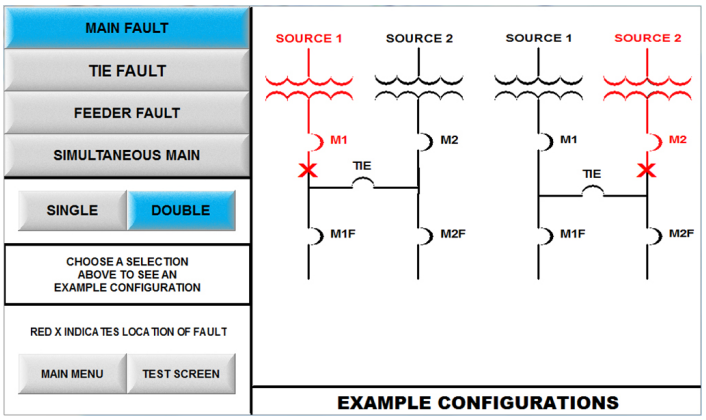
Digitrip settings screen

The "Digitrip Settings" button will take you to the Digitrip settings screen shown below. Here, you can select which Digitrip model you are testing and find all of the settings required to be enabled on the trip units in order to successfully test them using the ZSI test box.



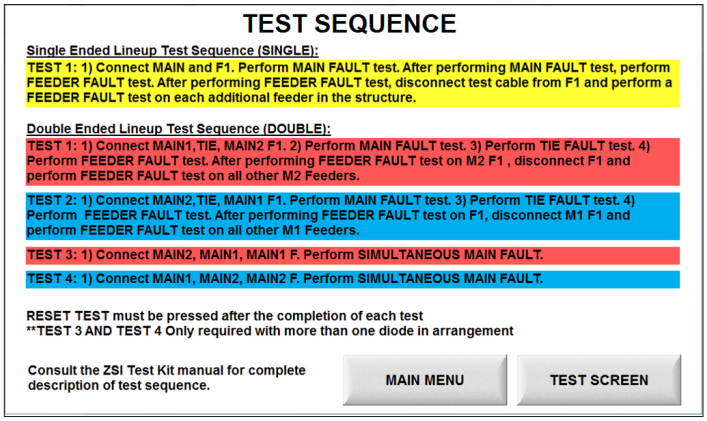
Zone configuration screen

The "Zone Config" button will take you to the zone configuration screen which will give you single line representations of the configurations tested based on your selections made regarding lineup arrangement and fault location. (Example shows double ended arrangement with a main fault.)



Test sequence screen

The "Test Sequence" button will take you to the test sequence screen describing the required test sequence in order to validate correct ZSI operation based on the arrangement you have selected (Single vs double ended arrangements)



Test screen

The "Test Screen" button will take you to the main testing screen where all the tests will be performed. The screen gives the user options to select what system and test to perform, as well as options to navigate to other useful screens for reference information such as test sequence. You can find a detailed description and explanation of the elements in the testing screen in Table 5: Test screen elements.

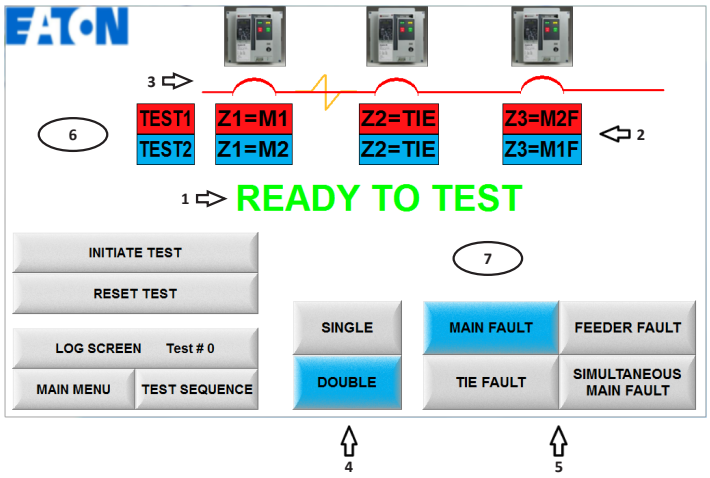
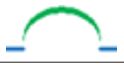
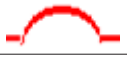
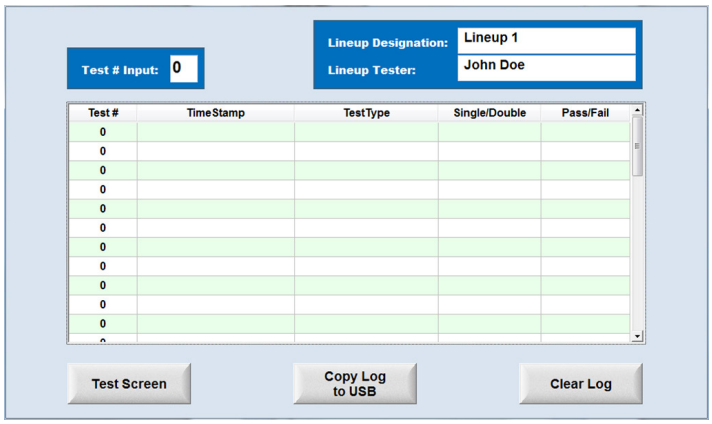


Table 5. Test screen elements

1:	This area of the screen describes whether or not the test is ready to be performed. If the test indicates not ready to test, simply press the reset test button. If it will not reset, check the ZSI test plugs and their connections to the trip units.
2:	This area of the screen shows the test zone configurations that are valid based on your selections made on the screen (See 4 and 5).
3:	This area of the screen shows the state of the breakers after a test. 3a shows a tripped breaker and 3b shows a non-tripped breaker. The method of monitoring internal trip commands on the trip unit may not match the true state of the breaker. The test can be done with breakers open or closed. The lightning bolt shown in 3c indicates what breaker(s) the fault is flowing through. 3a:  3b:  3c: 
4:	This area of the screen is where the buttons are that allow a user to test specific fault locations based on the arrangement selected (single or double ended, see 5).
5:	This area of the screen is where buttons are that allow a user to change the arrangement of the switchgear lineup being tested.
6:	After a test is performed, this area displays a timer that is relative and useful when troubleshooting any issues related to the wiring of the test box. These are not true trip times, but can be used to determine ZSI functionality.
7:	This is the area where the test results will be displayed. 7a indicates a passed Zone 1 test and 7b indicates a failed test. When a test fails, the reason for failure as well as guidance towards correcting the issue will be displayed below the test failed message. 7c is an example of a failed single ended arrangement test with a fault on the feeder with a missing restraint jumper. 7a: ZONE 1 TEST PASSED 7b: ZONE TEST FAILED 7c: Z2 TRIPPED TOO FAST. CHECK RESTRAINT JUMPER ON Z2.

Log screen button

The "Log Screen" button will take you to the log screen where the test results will be automatically recorded and displayed.



Copying test results to a flash drive

1. Enter test information in the "Lineup Designation" and "Lineup Tester" fields. The above example shows Lineup 1 and John Doe.
2. Insert a flash drive into the USB port on the front side of the tester box, located below the power switch.
3. Press the "Copy Log to USB" button on the display screen.

Clearing the test log

1. Press the "Clear Log" button on the display screen to remove the tests displayed on the log screen.

Repeating a test

1. To repeat a test that has already been recorded on the log screen, enter the desired test number in the "Test # Input" field.
2. Press the "Test Screen" button to display the test screen.
3. Perform the desired test. *

* Remember to navigate to the next desired test afterwards, or overwrite of subsequent tests will occur. The log screen cannot store more than 40 tests.

Error messages explained/troubleshooting guide

Table 6: Error messages details a list of all of the potential error messages that will appear on the HMI along with suggested fixes. In the event of a problem with the device or its operation, Table 7: Troubleshooting can be used to trouble shoot the ZSI test kit.

Table 6. Error messages

Zone 1 error messages		
Selection	**Error message**	**Corrective action**
Single/double - main fault	Z1 tripped too slow	Check ZI(B8) connection on Z1. Z1 is receiving restrain signal. Ensure self-restraining jumper is not installed.
Single/double - main fault	Z1 didn't trip	Check trip unit settings and ZSI configuration map to ensure trip plugs are installed in correct breakers.
Single/double - main fault	Z2 tripped during Z1 test	Check trip unit settings and ZSI configuration map to ensure trip plugs are installed in correct breakers.
Single/double - main fault	Z3 tripped during ZX1 test	Check trip unit settings and ZSI configuration map to ensure trip plugs are installed in correct breakers.
Zone 2 error messages		
Double - tie	Z2 trippped too slow	Ensure Z2 does not have restrain jumper installed from ZI(B8) to Z(B9) on Z2 ZSI contacts.
Single - feeder	Z2 trippped too fast	Ensure Z2 has restrain jumper installed from ZI(B8) to ZO(B9) on Z2 ZSI contacts.
Double - tie	Z2 trippped too fast	Z2 may not be receiving restrain signal, check continuity from Z2-ZI(B8) to Z3-ZO(B9).
Single - feeder	Z2 did not trip	Check trip unit settings and ZSI configuration map to ensure trip plugs are installed in correct breakers.
Single/double - feeder/tie	Z1 tripped during Z2 test	Check trip unit settings and ZSI configuration map to ensure trip plugs are installed in correct breakers.
Double - tie	Z3 tripped during Z2 test	Check trip unit settings and ZSI configuration map to ensure trip plugs are installed in correct breakers.
Z3 error messages		
Double – feeder fault	Z3 trippped too slow	Check trip unit settings and ZSI configuration map to ensure trip plugs are installed in correct breakers.
Double – feeder fault	Z3 trippped too fast	Ensure Z3 has restrain jumper installed from ZI(B8) to ZO(B9) on Z3 ZSI contacts.
Double – feeder fault	Z3 didn't trip	Check trip unit settings and ZSI configuration map to ensure trip plugs are installed in correct breakers.
Double – feeder fault	Z2 tripped during Z3 test	Z2 may not be receiving restrain signal, check continuity from Z2-ZI(B8) to Z3-ZO(B9).
Double – feeder fault	Z1 tripped during Z3 test	Z1 may not be receiving restrain signal, check continuity from Z1 ZSI signal ZI(B8) to Z2 ZSI signal ZO(B9).
Double – feeder fault	Z1 and Z3 did not trip	Check trip unit settings and ZSI configuration map to ensure trip plugs are installed in correct breakers.

Table 7. Troubleshooting

Symptom	**Probable cause**	**Corrective action**
Tests repeatedly do not pass	ZSI zone cables are plugged in to wrong breakers or zones. or Digitrip settings are not correct	Consult the "Zone Configurations" section, page 5 to correct mistakes or Consult the "Setting the Digitrip Time & Multiplier Settings" section to correct mistakes
ZSI test box does not load startup screen when powered on	Test program is not loaded properly	Contact the Eaton customer support with this problem.
Test screen button is not present	Checkbox is not checked on startup screen	Read the information on the startup screen and select the check box

ZSI breaker testing work sheet Digitrip 520M, 520MC

The following are the test settings used while programming the 520M and 520MC Digitrip units. If a parameter setting does not match the one required for testing, record it in the space provided, and then modify the setting to match the chart. After testing, remember to change your settings back to the states you record below.

Setting (required for testing)	Original setting	Setting (required for testing)	Original setting
Long delay setting (0.4)	______	Short delay time Z1* (0.50 sec)	______
Short delay setting (3)	______	Short delay time Z2* (0.30 sec)	______
Instantaneous setting (off)	______	Short delay time Z3* (0.10 sec)	______
Ground time (0.3)	______	Ground time (0.4)	______
Arc flash reduction (off)	______	Arc flash reduction setting (R5)	______
Long delay time @ 6xI_r (2)	______		

Breaker Name: _______ Breaker Position: ________

Setting (required for testing)	Original setting	Setting (required for testing)	Original setting
Long delay setting (0.4)	______	Short delay time Z1* (0.50 sec)	______
Short delay setting (3)	______	Short delay time Z2* (0.30 sec)	______
Instantaneous setting (off)	______	Short delay time Z3* (0.10 sec)	______
Ground time (0.3)	______	Ground time (0.4)	______
Arc flash reduction (off)	______	Arc flash reduction setting (R5)	______
Long delay time @ 6xI_r (2)	______		

Breaker Name: _______ Breaker Position: ________

Setting (required for testing)	Original setting	Setting (required for testing)	Original setting
Long delay setting (0.4)	______	Short delay time Z1* (0.50 sec)	______
Short delay setting (3)	______	Short delay time Z2* (0.30 sec)	______
Instantaneous setting (off)	______	Short delay time Z3* (0.10 sec)	______
Ground time (0.3)	______	Ground time (0.4)	______
Arc flash reduction (off)	______	Arc flash reduction setting (R5)	______
Long delay time @ 6xI_r (2)	______		

Breaker Name: _______ Breaker Position: ________

Setting (required for testing)	Original setting	Setting (required for testing)	Original setting
Long delay setting (0.4)	______	Short delay time Z1* (0.50 sec)	______
Short delay setting (3)	______	Short delay time Z2* (0.30 sec)	______
Instantaneous setting (off)	______	Short delay time Z3* (0.10 sec)	______
Ground time (0.3)	______	Ground time (0.4)	______
Arc flash reduction (off)	______	Arc flash reduction setting (R5)	______
Long delay time @ 6xI_r (2)	______		

Breaker Name: _______ Breaker Position: ________

* Assuming Z1 is connected to main, Z2 is directly downstream of Z1, and Z3 is directly downstream of Z2.

** If supplied.

ZSI breaker testing work sheet Digitrip 1150+

The following are the test settings used while programming the 1150+ Digitrip unit. If a parameter setting does not match the one required for testing, record it in the space provided, and then modify the setting to match the chart. After testing, remember to change your settings back to the states you record below.

Setting (required for testing)	Original setting	Setting (required for testing)	Original setting
Curve type (LSIG**)		Ground slope** (flat)	
Long slope (I^2T)		Ground time (0.30 sec)	
Long PU (0.4 sec)		Amp unbalance (off)	
Long time @ 6 X Ir (2.0 sec)		Amp unbalance time (10 sec)	
Long memory (off)		Phase loss (off)	
Short slope (flat)		Main PU (10 x I_n)	
Short PU (3.0 x I_r)		Maintenance mode (disabled)	
Short time Z1* (0.50 sec)		Frequency (60 Hz)	
Short time Z2* (0.30 sec)		BC relay reset (auto)	
Short time Z3* (0.10 sec)		Sliding demand (off)	
Inst PU (4 x I_n)		Wave form capture (off)	
Gnd PU (0.3)		Rev power sensing (disabled)	

Breaker name: _____ Breaker position: _____

Setting (required for testing)	Original setting	Setting (required for testing)	Original setting
Curve type (LSIG**)		Ground slope** (flat)	
Long slope (I^2T)		Ground time (0.30 sec)	
Long PU (0.4 sec)		Amp unbalance (off)	
Long time @ 6 X Ir (2.0 sec)		Amp unbalance time (10 sec)	
Long memory (off)		Phase loss (off)	
Short slope (flat)		Main PU (10 x I_n)	
Short PU (3.0 x I_r)		Maintenance mode (disabled)	
Short time Z1* (0.50 sec)		Frequency (60 Hz)	
Short time Z2* (0.30 sec)		BC relay reset (auto)	
Short time Z3* (0.10 sec)		Sliding demand (off)	
Inst PU (4 x I_n)		Wave form capture (off)	
Gnd PU (0.3)		Rev power sensing (disabled)	

Breaker name: _____ Breaker position: _____

* Assuming Z1 is connected to main, Z2 is directly downstream of Z1, and Z3 is directly downstream of Z2.

** If supplied.

Zone selective interlocking test kit
For Digitrip 520M, 520MC and 1150 trip units

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1000 Eaton Boulevard
Cleveland, OH 44122
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Printed in USA
Publication No. IB019013EN / TBG 001418
March 2019

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