GEK-64467 INSTRUCTIONS MANUAL

Zone Selective Interlock Module TIM1/TIM3

For ABB Ekip trip units, EntelliGuard™ and microEntelliGuard™ Trip Units and legacy MicroVersaTrip® RMS-9 and Epic MicroVersaTrip™ Solid-State Programmers

Figure 1. Zone Selective Interlock (ZSI) Module

I. INTRODUCTION

A. What is Zone Selective Interlocking?

Zone selective interlocking is an optional feature of Electronic Trip Units (ETU) which provide added protection to the power system through an enhanced method of coordination. See Figure 1.

With zone selective interlocking, maximum system protection is provided because each circuit breaker responds to a ground fault (GF), short time (ST) or Instantaneous (INST) fault quickly with minimum time delay in its immediate zone, thereby subjecting the system to minimum stress. Simultaneously, the circuit breaker(s) closest to the fault will transmit an interlock signal to upstream circuit breakers, selectively shifting them to a longer time delay. This action prevents undesirable tripping of upstream circuit breakers, yet permits them to serve as back-up protection to the faulted zone.

B. What is a Zone Selective Interlock Module?

The Zone Selective Interlock (ZSI) module is an intermediate control device used between upstream and downstream circuit breakers to communicate with the ST,GF and INST zone selective interlock functions of the ETU. Please note, the ZSI module is not needed between Ekip trip units, only between Ekip trip units and legacy GE trip units (for example: EntelliGuard trip units).

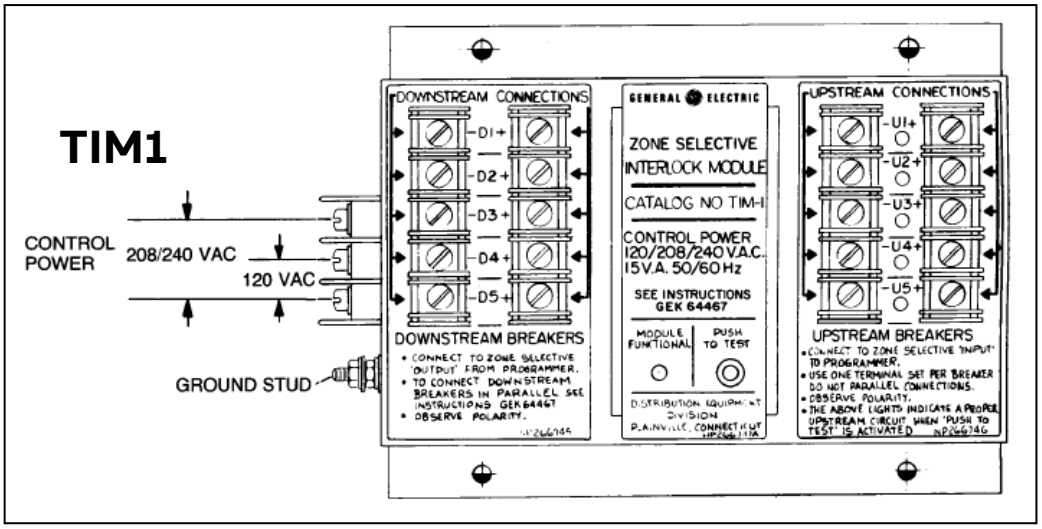

Figure 2. Control power for TIM1/TIM3 module is applied from left side of enclosure.

II. DESCRIPTION

A. General

The Zone Selective Interlock (ZSI) module receives a signal from a downstream ETU which causes the module to transmit a low-level interlock signal to an upstream ETU. The interlock signal causes the delay band to shift a lower delay band setting to a higher programmed one . The ST, INST and GF functions (if present) will be interlocked..

B. Downstream (Load)/Upstream (Source) Connection

Terminals are provided for the acceptance of wiring from downstream and upstream circuit breakers. Carefully note the polarity and instructions on the label of the ZSI module. See also Section IV, “Installing and Connecting the ZSI Module.”

C. Control power

Control power for the module is applied via the terminals on the left side of the enclosure. See Figure 2.

D. Energy Storage Feature

In the event that a fault occurs, the possibility for the loss of control power exists. To ensure the integrity of the signal transmitted to upstream circuit breakers and to ensure that coordination is not lost, the ZSI module has an energy storage feature that permits follow-through of the interlocking function in the event that control power is lost. (Refer to application note for greater detail.)

E. Test Feature

The ZSI module is provided with an integral test means which will provide an indication of:

- Simple module functionality
- Shorted or reverse polarity of the downstream wiring
- A proper upstream circuit

Use of the module test means is described in Paragraph III-F.

III. APPLICATION INFORMATION

A. Control Power Requirements

Cat. No. TIM1:
120/208/240 Vac-50/60 Hz-15 Vac max.
Input voltage tolerance +10% - 15%

Cat. No. TIM3:
120/208/240 Vac-50/60 Hz-15 Vac max.
Input voltage tolerance +10% - 15%

B. Max Ambient Temperature

The ambient temperature surrounding the module should not exceed 85°C.

C. Wiring

The wiring for the equipment shall be as follows:

1. a) Wiring from the circuit breaker with EntelliGuard Trip Units to the ZSI module shall be twisted pairs non-shielded, **AWG # 18-12.**

   b) Wiring from the circuit breaker with Ekip Touch / Hi-Touch Trip Units to the ZSI module shall be twisted pairs, shielded, **AWG # 22-16.**

2. Maximum recommended line length (distance between a circuit breaker and the ZSI module) is **1,000 feet (300 meter).**

3. Note that downstream/upstream connections and dc control power (if used) require proper observance of polarity. For downstream/upstream connections use RED for plus and WHITE for minus. For control power use BLACK for plus and WHITE for minus.

4. The signals being conducted via the downstream/upstream wiring are low-level signals (dry circuits). It is important, therefore, to ensure that splices are soldered connections (or other approved connections for dry circuits); also, if connectors are used, they should be gold-plated terminations. Standard terminal boards used for intermediate connections do not require gold plating.

D. Connections

A maximum of thirty zone selective "OUTPUTS" from downstream circuit breakers may be connected in parallel provided that:

- No more than six parallel "OUTPUTS" are used per downstream terminal set (e.g. D1; D2; D3, etc.). See Figure 3.
- Paralleling is done so that only one set of wires (one twisted pair) is connected to each downstream terminal set of the ZSI module.
- Wiring is per Section III-C and Figure 3.

See "**Downstream Connections**" portion of paragraph III-F to use the integral test means of the ZSI module as an aid in checking the downstream wiring.

Upstream Connections (Connections toward Power Source)

In some applications, it may be desirable to interlock an upstream circuit breaker from more than one Zone Selective Interlock module (e.g., it may be desirable to interlock a main circuit breaker from several separate zones). To accommodate coordination schemes that require this, up to four modules may be connected in parallel to one circuit breaker zone selective "INPUT."

III. APPLICATION INFORMATION (CONT'D)

Two basic rules that apply to upstream connections are:

1. The upstream connections of several Zone Selective Interlock modules (up to four) may be connected in parallel provided they are terminated in the zone selective "INPUT" of only one circuit breaker. See Figure 4.

2. NEVER parallel the Zone Selective Interlock "INPUT" connections of circuit breakers. Upstream connections must ALWAYS be terminated in the Zone Selective Interlock "INPUT" of only one programmer (ETU). See Figure 5.

E. Energy Storage Feature

The ZSI module has an energy storage feature which enables it to follow through with full interlock power should control power to the module be lost simultaneously with the initiation of an interlock signal.

Although the module is capable of operating immediately upon application of control power, the energy storage feature cannot be realized unless the module has been energized for one minute prior to the loss of control power. This is applicable whenever control power is removed and then reapplied.

Therefore, if there is a possibility that control power could be lost during the closing of a circuit breaker and coordination of upstream circuit breakers is important during that interval, the control power for the module should be either (1) derived from an independent source, or (2) derived from the line side of an upstream circuit breaker, with the closing of the downstream circuit breaker delayed by one minute.

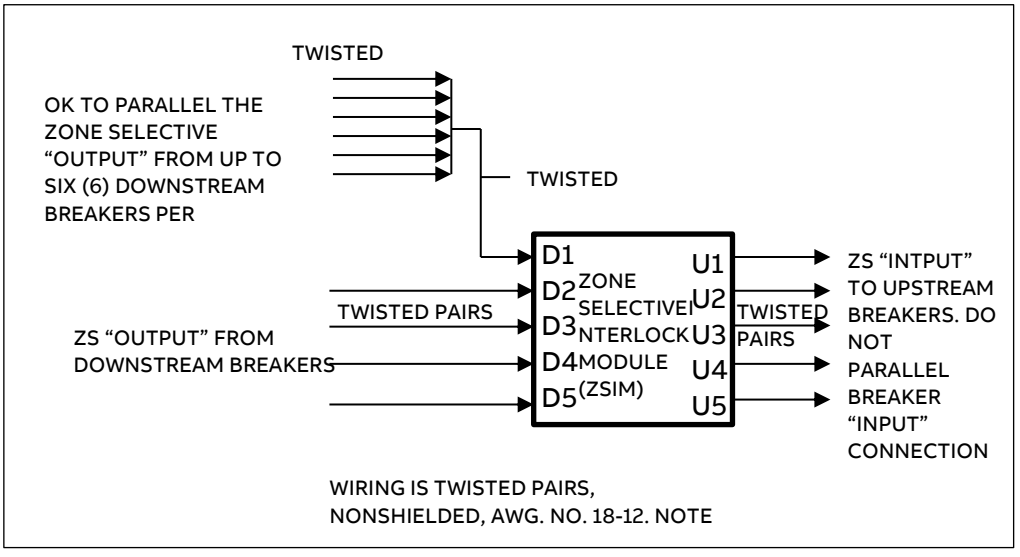

Figure 3. Wiring diagram showing "UPSTREAM" and "DOWNSTREAM" connections.

III. APPLICATION INFORMATION (CONT'D)

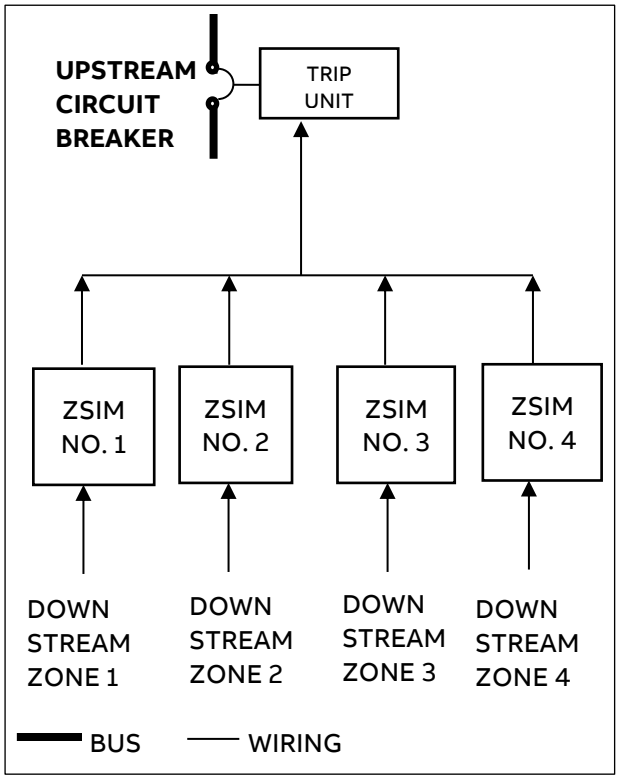

Figure 4. Interlocking one "UPSTREAM" breaker from several separate zones

F. Test Feature—How to Apply It

NOTE: To use the test feature, control power must be applied to the module.

Module Functionality:

The "MODULE FUNCTIONAL" light will illuminate whenever there is an interlock signal at the "DOWNSTREAM CONNECTIONS" terminals. This can be simulated manually by pushing the "PUSH TO TEST" button in the center of the module, thereby proving simple module functionality.

Downstream Connections:

If the "MODULE FUNCTIONAL" light is illuminated continuously (without pushing the "PUSH TO TEST" button), one or more of the following problems exist with the downstream circuits:

1. At least one set of wires connected to the "DOWNSTREAM CONNECTIONS" terminals, D1 through D5 are connected reverse polarity.
2. Downstream wiring is shorted.
3. An ETU in a downstream circuit breaker is defective.

To isolate the problem, remove the wires from the "DOWNSTREAM CONNECTIONS" terminals one at a time, noting when the "MODULE FUNCTIONAL" light goes out. This will identify the problematic circuit. The following checks may be useful in identifying the specific problem:

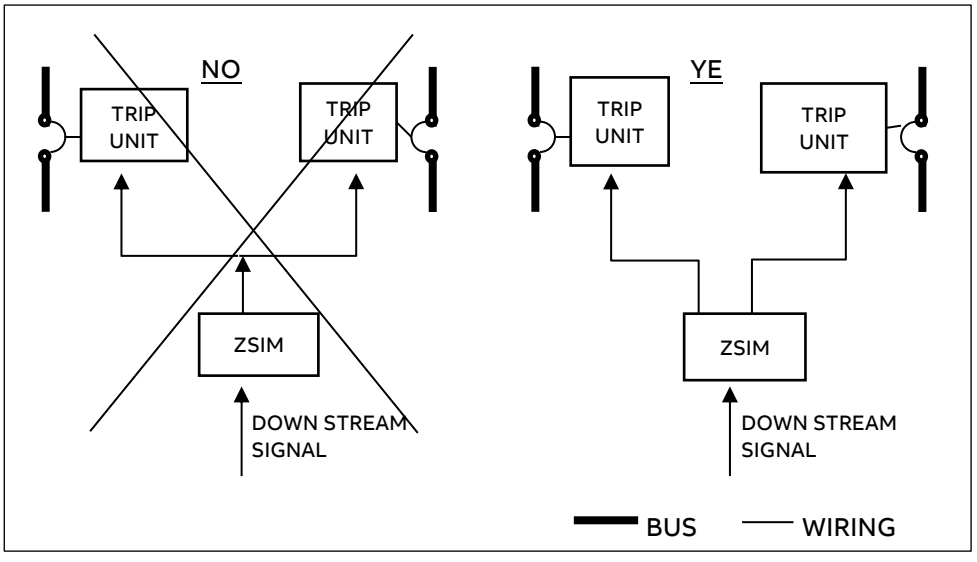

Figure 5. Do not parallel circuit breaker Zone Selective Interlock "INPUTS" to Breaker

III. APPLICATION INFORMATION (CONT'D)

- Check for reversed polarity by simply reversing the lead connections from what they were originally and observing whether the "MODULE FUNCTIONAL" light goes out.
- Check for shorted downstream wiring by checking between the disconnected wires with an ohmmeter.

IMPORTANT: The open circuit output voltage of the ohmmeter must be less than 16Vdc if the downstream ETU is connected.

Upstream Connections

An LED is provided for each set of upstream terminals (U1-U5). When the "PUSH TO TEST" button is pressed, these LEDS will light if the voltage developed across the upstream circuit is within an acceptable voltage window. Failure of a particular LED to light is an indication of one or more of the following upstream conditions:

- Reverse polarity
- Open circuit
- Shorted upstream wiring
- Improper resistivity of the upstream circuit

When Ekip TU is Upstream, LED will not glow. It is regular behavior with Ekip TU Upstream.

The following checks may be considered for isolating the problematic area:

- Check for reversed polarity by simply reversing the lead connections from what they were originally and observing whether the appropriate upstream LED "lights" when the "PUSH TO TEST" button is pressed.
- To check for open, shorted, or high-resistance connections in the upstream wiring, disconnect the circuit in question from the ZSI module and check the wiring with an ohmmeter.
- The ZSI module test means may be tested by disconnecting the wires from the U1-U5 terminal set in question and connecting it to a 390-ohm+/-20% resistor. The appropriate LED must light when the "PUSH TO TEST" button is pressed.
- NOTE: In the event that all connections to upstream terminals U1-U5 are open (or not connected), the five LED indicators may light without pushing the "PUSH TO TEST" button. This is not an abnormal condition. A valid test of the upstream circuits will always be obtained when the "PUSH TO TEST" button is activated.

Testing the Energy Storage Feature

As described in section III-E, the ZSI module has an energy storage feature that allows follow-through of the interlocking function in the event that a fault causes a simultaneous loss of power to the module. Energy storage is via an electrolytic capacitor which will have a tendency to lose capacitance over an extended period of time. Therefore, it is advisable to perform the following in-service check every 6-12 months and whenever additional upstream circuits are connected (added) to terminals U1-U5.

- Allow the module to be energized with rated control power for a minimum of one minute.
- Interrupt control power and immediately push the "PUSH TO TEST" button. The "MODULE FUNCTIONAL" light must come on for at least one-third of a second (a long blink). Allow at least one minute charge time before repeating test.
- Failure to achieve the above noticeable time delay will require replacement of the energy storage capacitor.

G. Dielectric Testing

CAUTION: IF IT IS NECESSARY TO PERFORM DIELECTRIC TESTING, THE FOLLOWING PROCEEDURE MUST BE FOLLOWED, EXACTLY, OR DAMAGE TO THE ZSI MODULE WILL RESULT.

Every terminal on the ZSI module (except the ground stud) shall be shorted together and the potential applied between that point and the ground stud. The ZSI module may be tested at 1500 Vac for one minute or 11650 Vac for one second. The test current will not exceed 500 microamperes.

CAUTIONS

1. DO NOT TEST BETWEEN INDIVIDUAL TERMINALS AND GROUND
2. DO NOT TEST BETWEEN DOWNSTREAM/UPSTREAM TERMINALS.
3. ALL TERMINALS MUST BE SHORTED TOGETHER!

H. Fusing

Recommended control power input fusing is 0.5 amperes, 250 V (Littelfuse 312.500 or equivalent).

IV. INSTALLING AND CONNECTING THE ZSI MODULE

install To and connect the ZSI module, proceed as follows:

- read the application information (Section III).
- Wire the module in accordance with Figure 3.
- Torque terminals to 20 in-lbs.
- Connect control power. See label on the left side of the ZSI module. Refer also to Figure 2.
- Follow the instructions on the face of the ZSI module regarding connections. Pay particular attention to the polarity and nomenclature (i.e., downstream connections go to the “OUTPUT” of the programmers: upstream connections go to the “INPUT” of the programmer).
- Use the integral test means of the ZSI module to check downstream and upstream connections. See Section III-F.

V. CONNECTING TIM1 MODULE WITH CIRCUIT BREAKERS

TIM1 module is required to interface circuit breakers (both upstream & downstream) with EntelliGuard™ / microEntelliGuard™ Trip Units or legacy MicroVersaTrip® RMS-9 and Epic MicroVersaTrip™ Solid-State Programmers. These control modules can be EntelliGuard™ or microEntelliGuard™ Trip Units or legacy MicroVersaTrip® RMS-9 or Epic MicroVersaTrip™ Solid-State Programmers.

TIM1 Wiring Basics:

1. The GFZOUT terminals on the EntelliGuard G (GTU) are wired from the downstream breaker secondary disconnect to the DOWNSTREAM input on the TIM1 module.
2. The GFZIN terminals on the EntelliGuard G are wired from the upstream breaker secondary disconnect to the UPSTREAM input on the TIM1 module.
3. Polarity must be observed at all times for proper operation.

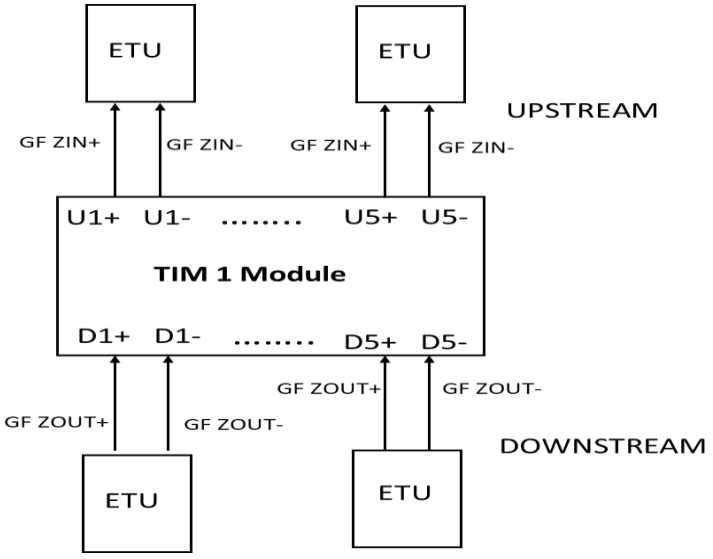

Figure 6. TIM 1 Wiring Diagram

VI. CONNECTING TIM3 WITH EKIP TOUCH /HI-TOUCH CIRCUIT BREAKERS

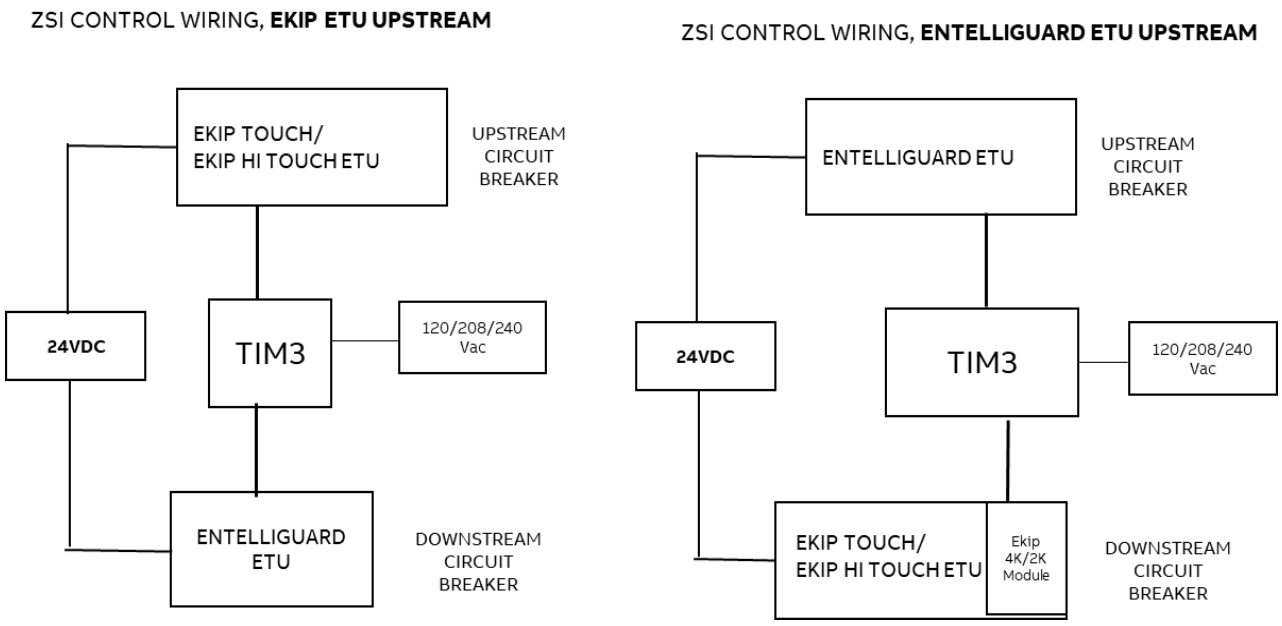

Figure 7: TIM 3 Wiring Diagram

NOTE: Ekip TU has additional voltage inputs possible

VII. INTERFACING DOWNSTREAM EKIP TOUCH/HI-TOUCH CIRCUIT BREAKER WITH TIM3 MODULE

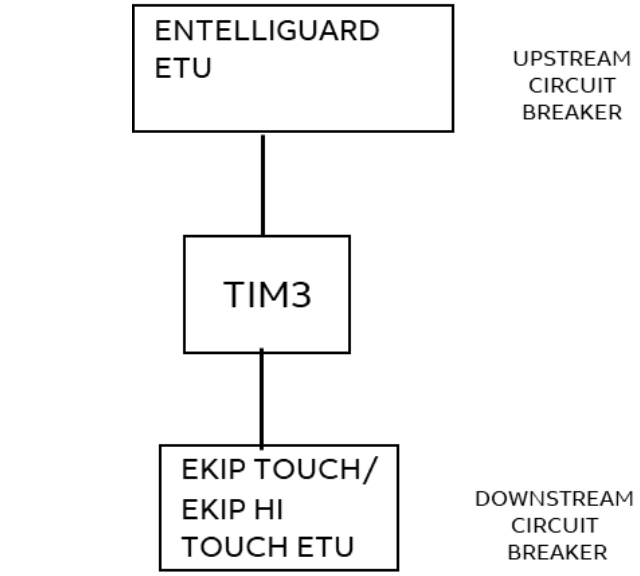

Figure 8: Interfacing Ekip with TIM 3

A. Connecting TIM3 to Ekip I/O Signalling module

Ekip I/O Signalling module is required to interface Downstream EKIP TOUCH/HI-TOUCH CIRCUIT BREAKER with TIM3 Module. A control signal from an Ekip I/O Signalling module, such as 4K Signalling module, is interfaced with the TIM3 Module terminals(D+/D-).

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Please refer to 1SDH001000R0516 for more details of Ekip 4k Signalling module. Note: 2K-1 and 2K-2 are also optional Signalling modules, but the 4K module is preferred due to its front facing Signalling LEDs (see the image below). These LEDs are useful when testing and troubleshooting a ZSI system.

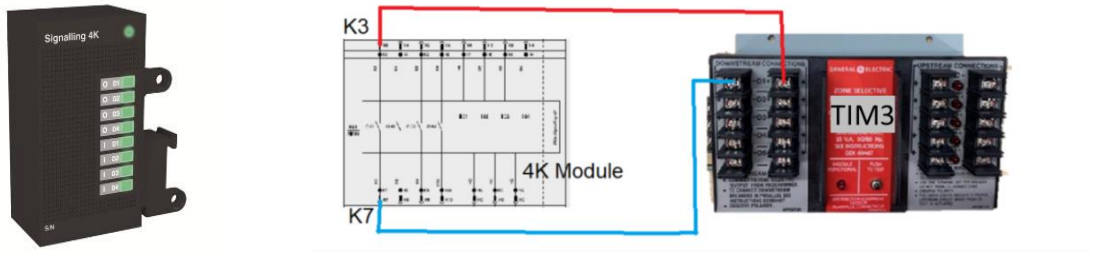

Figure 9: Interfacing Ekip signalling module with TIM 3

B. Steps to Configure the Ekip 4K /2K Signalling Modules

This setup example shows interfacing with specifically the Ekip 4K Signalling Module.

1. Use **Ekip Connect software** to connect Ekip Touch or Hi-Touch ETU:
   (This example is demonstrated with **Ekip Connect 3.2.7.0)**

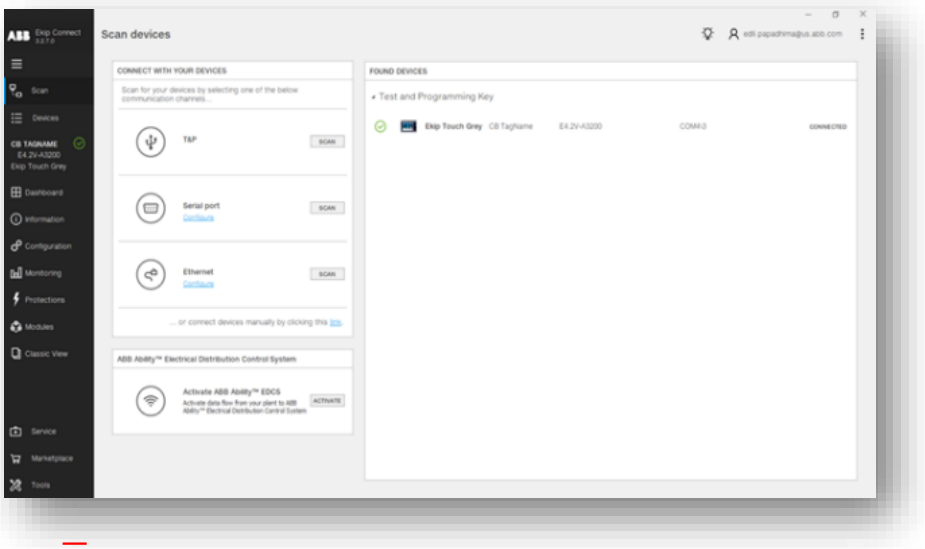

Figure 10: Ekip connect software

1. *Open **Classic** View*, Go to **Modules**, Select **Ekip**

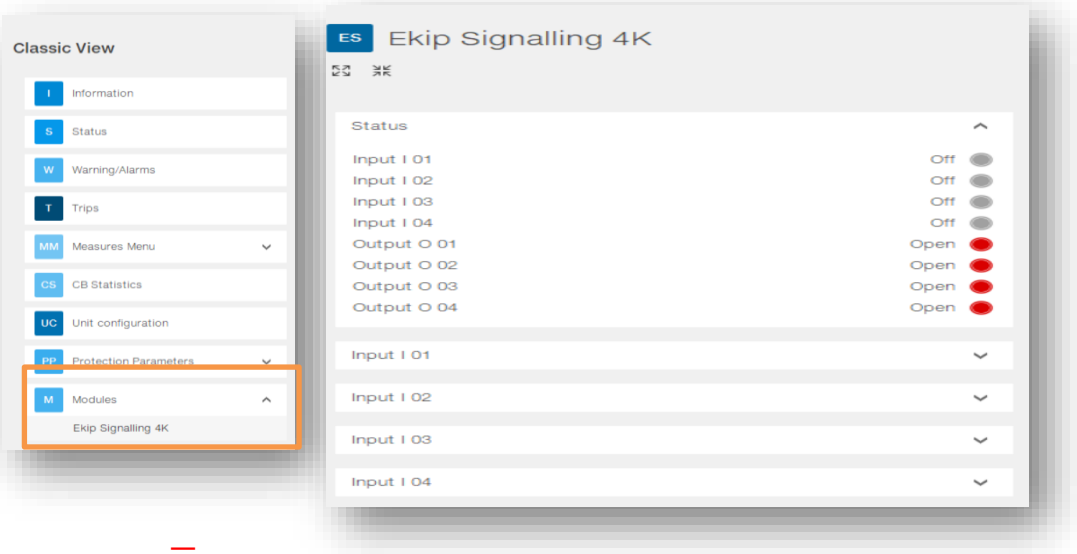

Figure 11: Ekip connect software : Classic view

a) ST ZSI

Set 4k Output 1 to Trigger when S Timing is active. Configure Normally OPEN contact type, Self-Latching OFF, Signal Source “Custom”. In menu select “Timing 1 L”. Change the value of “S timing” to 1. Apply the **settings**.
This will provide ST trigger output on Output 1 terminals (K3/K7). As mentioned previously, there are 4 outputs available in 4K module and any of them can be used. In this example, we are using Output 1 (K3 / K7).

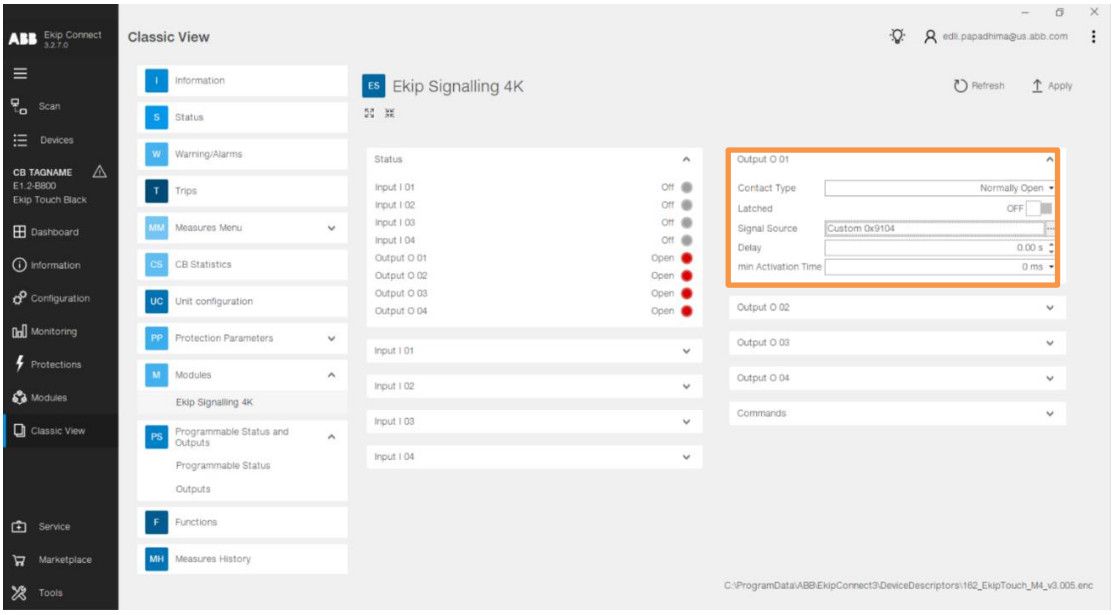

Figure 12: Classic view: Ekip signalling 4K output configuring

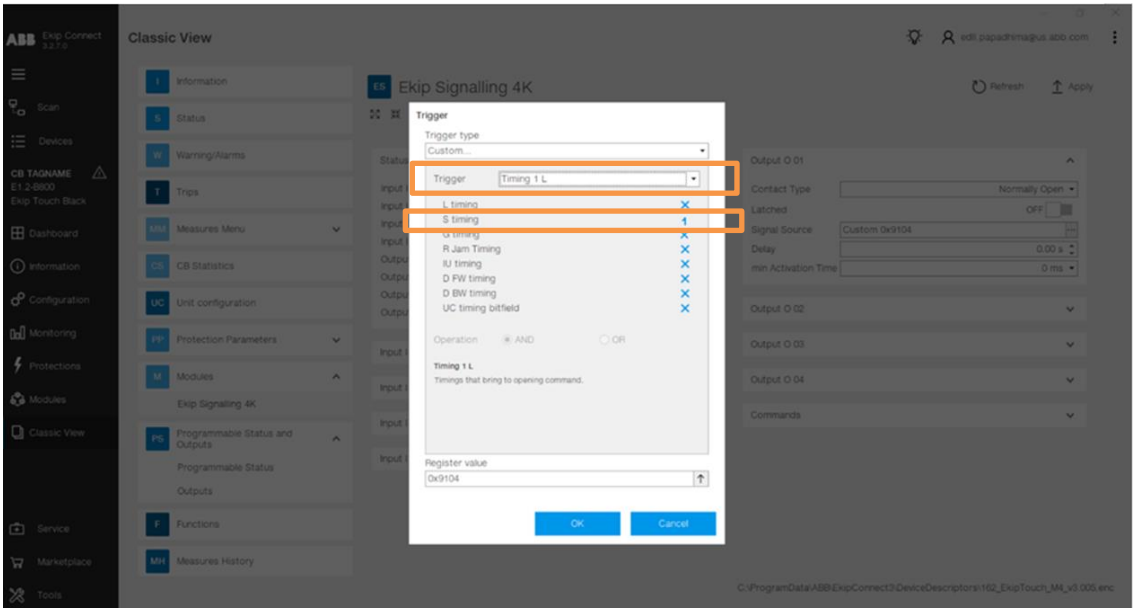

Figure 13: Ekip signalling 4K Module : Trigger configuring

b) GF ZSI

Set 4k Output 1 to Trigger when G Trip. Configure Normally OPEN contact type, Self-Latching OFF, Signal Source "Custom".

In menu select "Timing 1 L". Change the value of "G timing" to 1. Apply **the settings.** This will provide GF trigger output on Output 1 terminals (K3/K7).

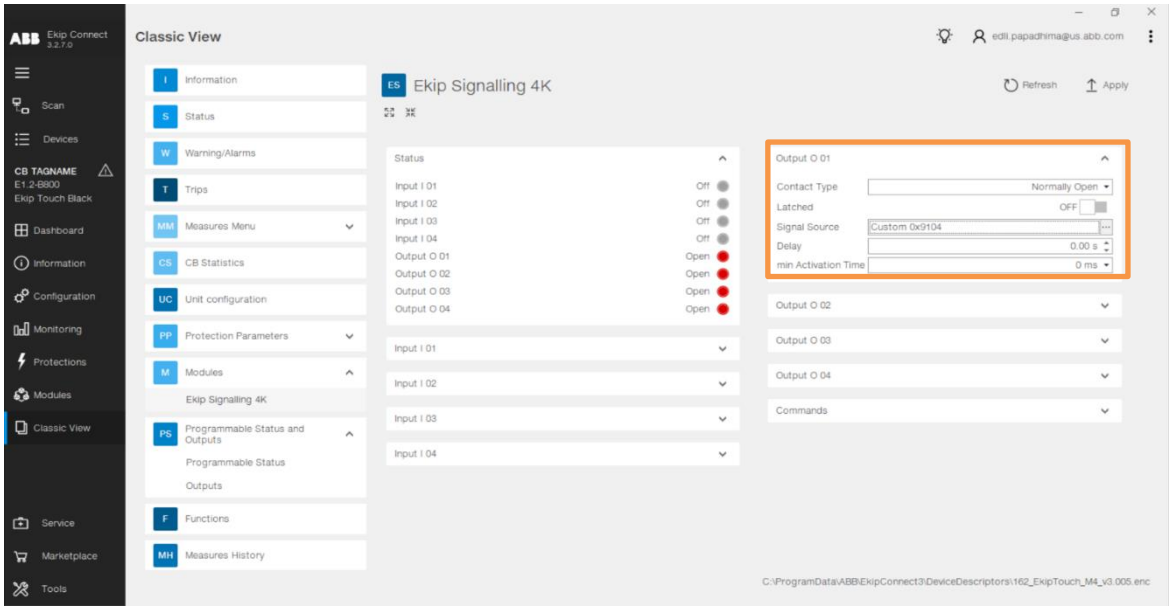

Figure 14: Ekip signalling 4K Module : Output configuring

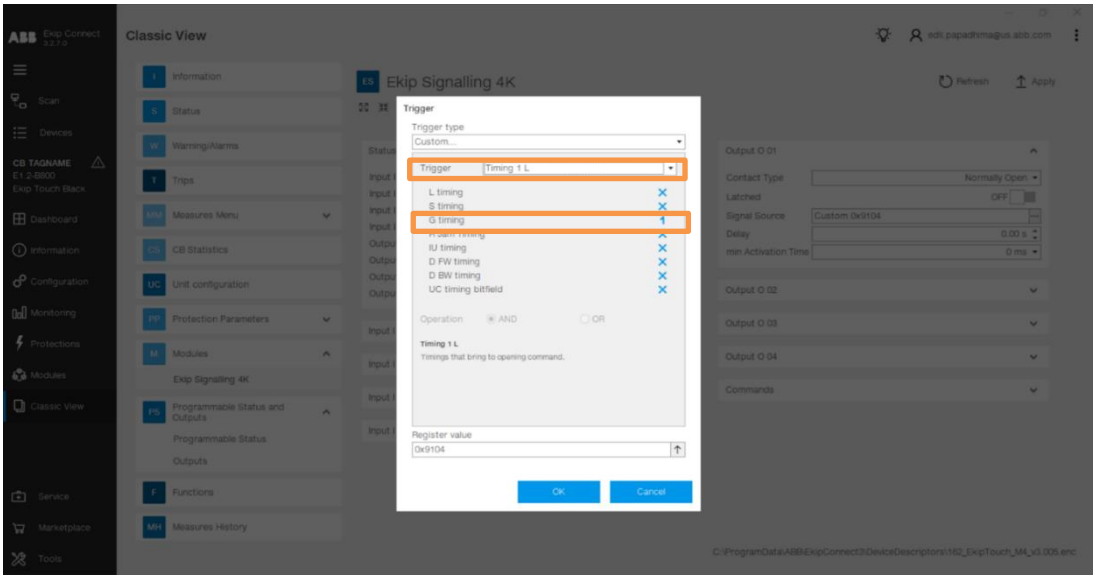

Figure 15: Ekip signalling 4K Module : Trigger configuring

Setting ST/GF Trip Time Delays :

To ensure coordination between upstream and downstream circuit breakers, follow the delay settings provided in the tables below:

SHORT TIME PROTECTION	
EKIP ST Delay Settings (T2 in ms)	**Entelliguard ZSI ST Bands that maintain Coordination**
40	5 to 17
50 /60/ 70	6 to 17
80 /90/ 100/110	7 to 17
120/130	8 to 17
140/150/160/170	9 to 17
180 to 280	10 to 17
290 to 340	11 to 17
350 to 420	12 to 17
430 to 500	13 to 17
510 to 590	14 to 17
600 to 670	15 to 17
680 to 760	16 to 17
770	17 to 17
780 to 800	**NO Coordination**

GROUND FAULT PROTECTION	
EKIP GF Delay Settings (T4 in ms)	**Entelliguard ZSI GF Bands that maintain Coordination**
40	3 to 14
50 /60/ 70	4 to 14
80 /90/ 100/110	5 to 14
120/130	6 to 14
140/150/160/170	7 to 14
180 to 250	8 to 14
300	9 to 14
350 to 400	10 to 14
450 to 500	11 to 14
550	12 to 14
600 to 650	13 to 14
700 to 750	14
800 to 1000	**NO Coordination**

Table 1: EKIP ETU Downstream and EntelliGuard ETU Upstream

Note: Instantaneous ZSI is not possible when an EKIP ETU is downstream from an EntelliGuard ETU

VIII. INTERFACING UPSTREAM EKIP ETU WITH TIM MODULE

This is required to interface downstream EntelliGuard/microEntelliGuard devices with upstream ABB SACE devices.

When interfacing upstream ABB circuit breakers with TIM3 module, to ensure coordination, we need to extend the (Szi/Gzi) signal by 50ms using the Ekip Connect Software. Refer Steps described in the next section to properly configure the 50 msec delay for Szi/Gzi signals.

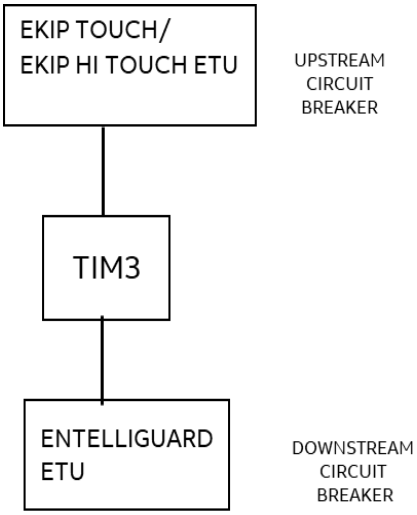

Figure 16: Interfacing upstream Ekip Module with TIM3

A. Connecting TIM3 to upstream circuit breaker

ZSI Wiring Diagram Connecting TIM3 to upstream EKIP TU Breaker is given below:

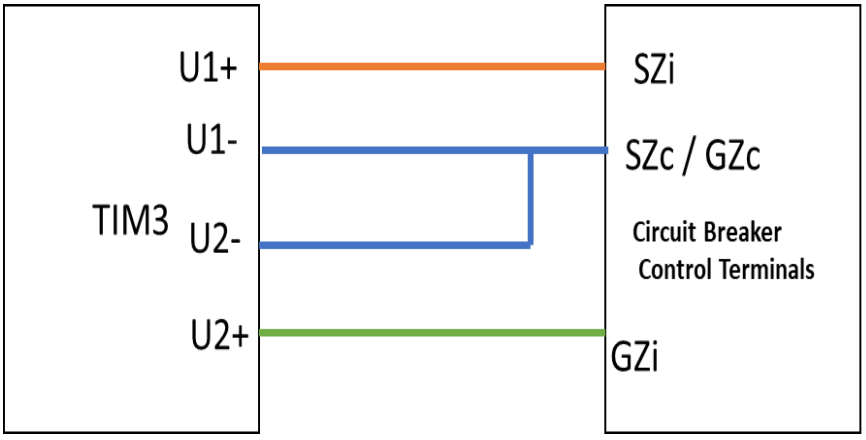

Figure 17: Interfacing Circuit Breaker with TIM3

B. Steps to configure additional time delay for Szi (for S-ZSI/I- ZSI) and Gzi (for G-ZSI) signals:

1. Use **Ekip Connect software** to connect Ekip ETU.
   (This example is demonstrated with **Ekip Connect 3.2.7.0)**

2. Open Classic View, Go to Functions, In Zone Selectivity Input Functions Select S Input (For Short Time or Instantaneous ZSI) or G Input (for Ground Fault ZSI). Change status of Programmable Status H to 1

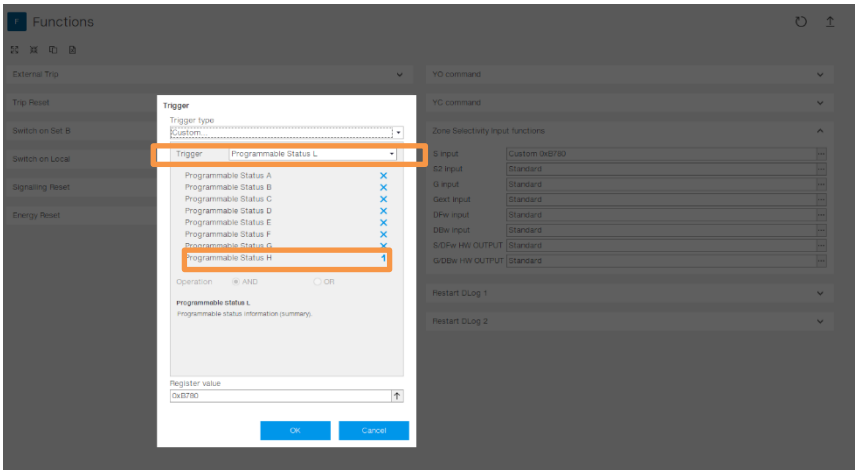

Figure 18: Trigger setting Menu

3. Open Classic View, Go to Programmable Status, Set Programmable Status Parameter H. Select “S zone sel In” or “G zone sel In”.

Then set delay in Programmable Status Parameter Delay menu as in the figure below.

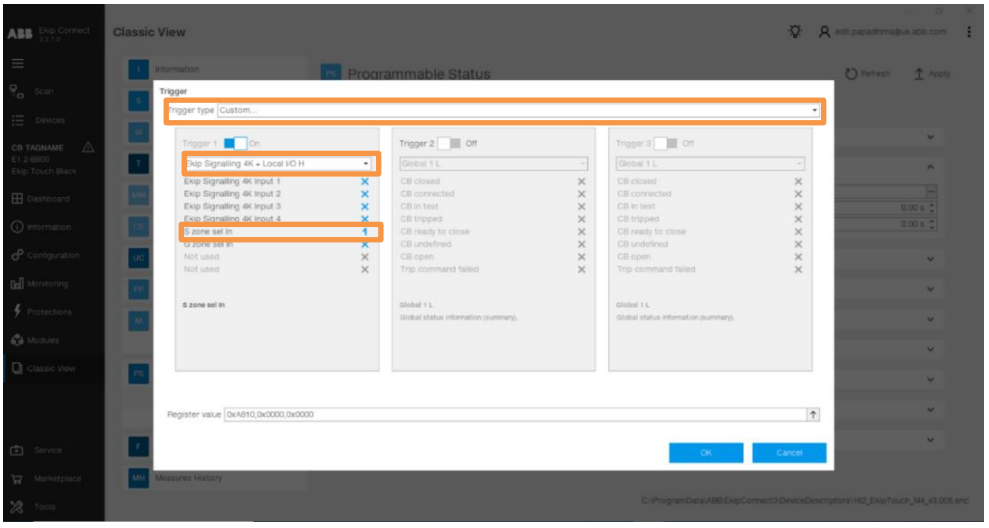

Figure 19: Setting delay in Programmable Status

4. In Programmable Status Parameter H, Set "Delay Off" to 50ms.

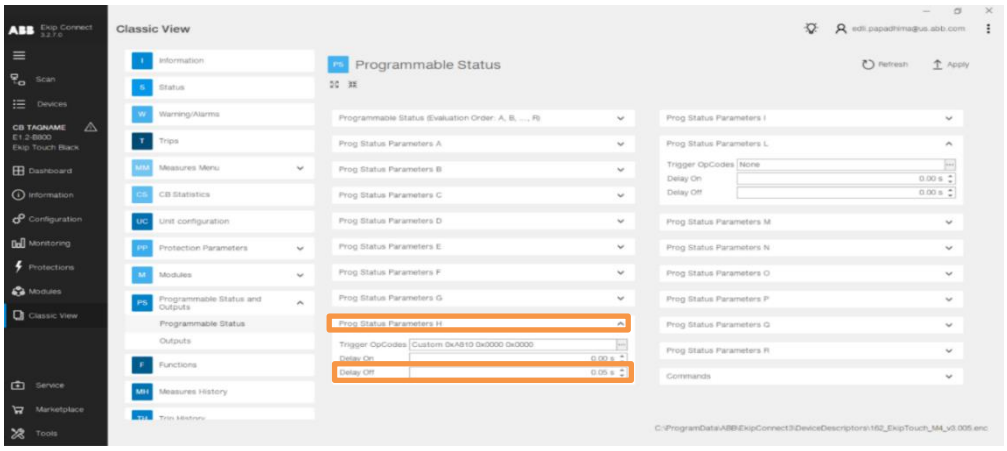

Figure 20: Setting Programmable Status

C. Setting ST/GF Trip time delays :

To ensure the coordination between upstream and downstream circuit breakers, follow the settings provided in the tables below.

Please note:

- Maximum Emax 2 GF setting for the UL version is 400ms
- Maximum Emax 2 ST setting for the UL version is 400ms

SHORT TIME PROTECTION	
Entelliguard ST Delay Band	**EKIP ST Delay Settings (T2 in ms)that maintain Coordination**
1	125 and above
2	135 and above
3	146 and above
4	166 and above
5	208 and above
6	240 and above
7	291 and above
8	322 and above
9	365 and above
10	531 and above
11	615 and above

GROUND FAULT PROTECTION	
Entelliguard GF Delay Band	**EKIP GF Delay Settings (T4 in ms) that maintain Coordination**
1	146 and above
2	166 and above
3	208 and above
4	240and above
5	291 and above
6	322 and above
7	365 and above
8	587 and above
9	615 and above
10	740 and above
11	865 and above
12	990 and above
13	No Coordination
14	No Coordination

Table 2: EKIP ETU Upstream and EntelliGuard ETU Downstream

IX. I - ZSI

EntelliGuard/MicroEntelliGuard devices downstream can coordinate with EKIP Touch/Hi touch devices upstream in the Instantaneous protection region. To achieve Instantaneous ZSI it is needed to connect the signals similarly to Short Time zone selectivity and follow the **Steps to Configure the additional time delay for Szi (for S-ZSI/I- ZSI)** as explained in Page 13-14. For this to become active, the Instantaneous function must be set to ON (I3=ON) as well as ZSI.

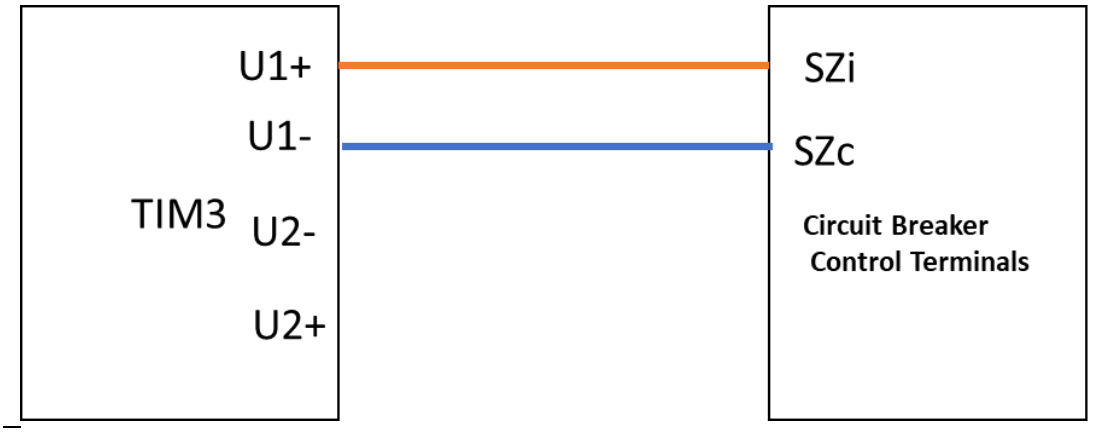

Figure 21: Interfacing TIM3 Module with ABB SACE

In this configuration Entelliguard/Micro Entelliguard devices downstream with EKIP Touch / Hi touch devices upstream):

- If upstream breaker with Instantaneous function I3=ON and I-ZSI being OFF

the ultimate selectivity limit will be that of the I3 instantaneous trip threshold of upstream breaker

- If upstream breaker with Instantaneous function I3=OFF or I-ZSI being ON (with I3=ON)

the ultimate selectivity limit is equal to the Icw value of the supply-side upstream circuit-breaker with Current limiting breaker being down-stream. the ultimate selectivity limit is equal as per the table explained in DET760 If the down-stream being non-current limiting.

- Refer DET760G and 1SDC007100G0205 for more details on Instantaneous and I-ZSI Selectivity.

X. SYSTEM CORDINATION USING ZONE SELECTIVE INTERLOCKING

Circuit breakers and Power Switches equipped with advanced trip units can help to improve the protection to zones between circuit breakers using zone-selective interlocking. As shown on Figure 6, when a downstream circuit breaker detects a fault, it signals the upstream device to shift to a preset “restrained” time delay band, allowing the downstream device to clear the fault while the upstream device provides backup protection. During a fault between two circuit breakers equipped with zone-selective interlocking, the upstream breaker can clear the fault using a preset “unrestrained” setting adjusted to the minimum delay band because it receives no interlock signal from a downstream circuit breaker.

The zone interlocking feature requires a zone-selective interlock module between each zone. The module is an intermediate control device used between upstream and downstream circuit breakers to communicate between circuit breakers. The ZSI wiring module, Cat. No. TIM1/TIM3 , requires 120/208/240Vac control Power, 15VA minimum. The module can communicate with up to 30 downstream circuit breakers and up to 5 upstream circuit breakers provided all circuit breakers share the same zone.

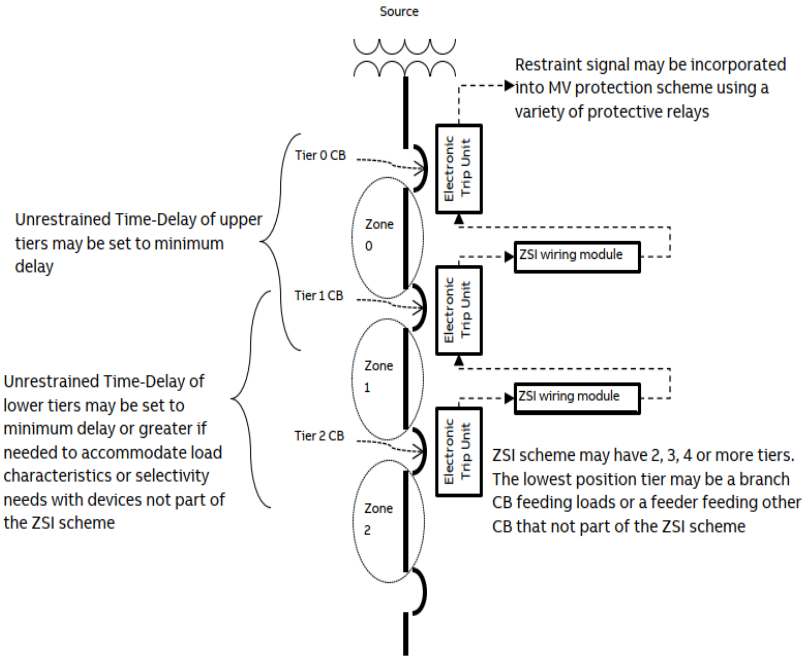

Figure 22: Diagram of Zone Selective Interlock

The ABB ZSI functions may be field tested using the EntelliGuard toolkit (for legacy GE devices) or the Ekip Connect software (for Ekip Touch and Hi-Touch devices). For Ekip devices, also refer to ABB publications DEH-583 (for legacy GE devices) and 9AKK107991A2521 (for Ekip Touch and Hi-Touch devices) provides further instructions on how to test ZSI in ABB circuit breakers in the field.

XI. SYSTEM CORDINATION USING ZONE SELECTIVE INTERLOCKING (CONT"D)

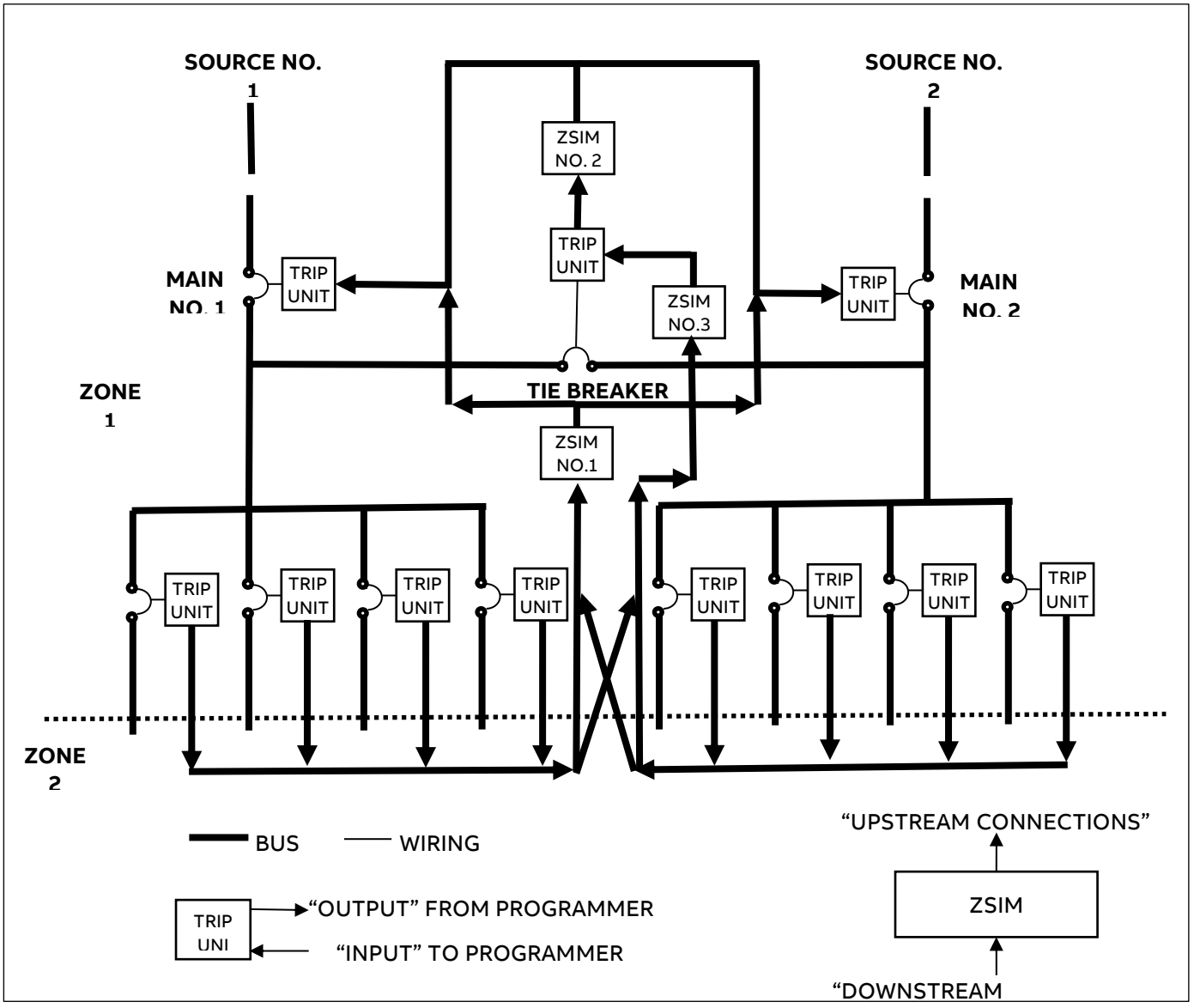

Figure 23: Zone selective interlocking of a Double-ended Substation

Note that ZSI module No. 1 interlocks both mains and ZSI module No. 3 separately interlocks the TIE for the occurrence of a fault on the load side of any of the feeder circuit breakers (Zone 2).

ZSI module #2 is an option which provides coordination between the tie circuit breaker and the main circuit breakers (i.e. the TIE will trip first in the event of a bus fault in Zone 1. Without ZSI module #2, a bus fault in Zone 1 could cause tripping of both the tie breaker and main(s).

III. CIRCUIT DESCRIPTION

The following is a brief circuit description of the ZSI module. See Figure 27 for circuit diagram.

The “DOWNSTREAM CONNECTIONS” consist of five separate terminal sets, each set providing a voltage reference input via a resistor divider network to a voltage comparator. This voltage reference is compared to a second internal comparator reference. If the reference at the “DOWNSTREAM CONNECTIONS” is higher than the comparator reference there is no output at the “UPSTREAM CONNECTIONS” of the module.

When an interlock signal (Logic O) is received at any of the downstream terminals, the comparator will go “HIGH”. This actuates the electronic switch and provides an output voltage at all “UPSTREAM CONNECTIONS”;the output from the electronic switch will also illuminate the “MODULE FUCTIONAL” LED.

The window detectors sense the voltage across each of the five terminal sets for “UPSTREAM CONNECTIONS” and will illuminate an LED if the voltage across its particular terminal is set within an acceptable voltage window. Therefore, the window detectors (with their associated LED) serve to indicate that a proper upstream circuit exists.

The “PUSH TO TEST” button is a means by which a downstream interlock signal can be simulated, thereby providing a test means for module functionality and proper upstream circuitry.

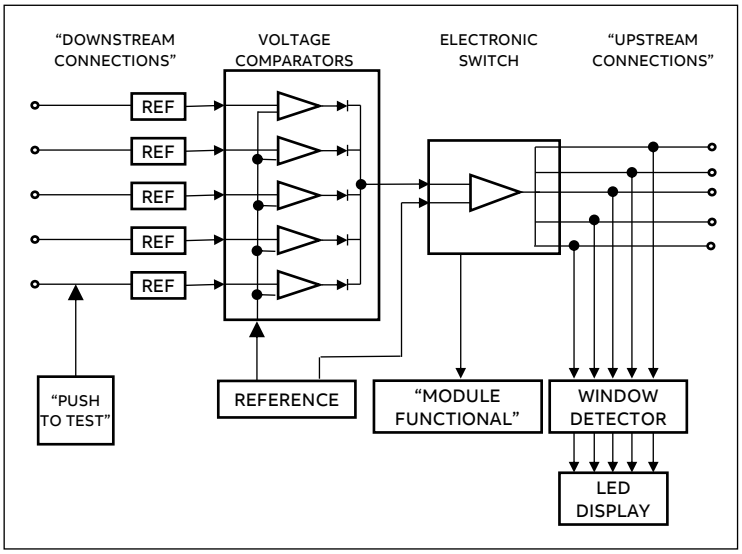

Figure 27. Zone Selective Interlock Module circuit diagram

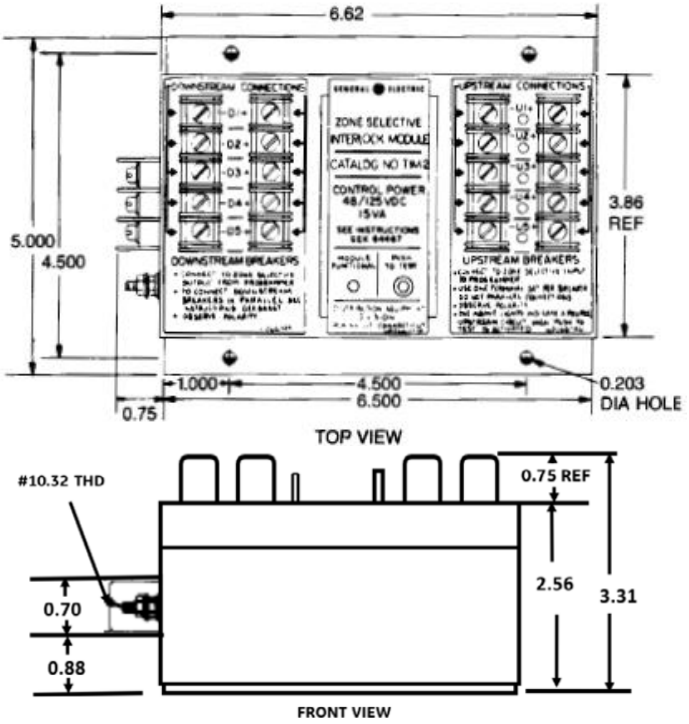

Figure 28. Outline Diagram

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