



## M-T-T-M Open Transition

This document is intended to describe the components, required inputs and outputs, sequence of operations and the basic logic to implement ABB's transfer scheme for M-T-T-M applications.

### Contents

<b>M-T-T-M Open Transition .....</b>	<b>1</b>
<b>Single Line Diagrams .....</b>	<b>2</b>
<b>Required Inputs.....</b>	<b>3</b>
Main 1 Relay .....	3
Main 2 Relay .....	4
Tie Relay .....	4
<b>Required Outputs .....</b>	<b>5</b>
Main Breaker 1.....	5
Main Breaker 2.....	6
Tie Breakers .....	6
<b>Breaker Schematics .....</b>	<b>7</b>
Main Breaker 1.....	7
Main Breaker 2.....	8
Tie Breaker 1.....	9
Tie Breaker 2.....	10
<b>The sequence of operations for the ATS scheme would be as follows.....</b>	<b>10</b>
<b>Selector Switches .....</b>	<b>10</b>
<b>Normal Mode of Operation .....</b>	<b>11</b>
<b>Electrical interlocks .....</b>	<b>11</b>
<b>Automatic Mode .....</b>	<b>11</b>
<b>Selector switch device 43 in “Auto” .....</b>	<b>11</b>
<b>ATS Logic .....</b>	<b>12</b>
Main 1.....	12
Close/Open Logic .....	12
ATS Logic.....	12
Goose Signals .....	13

**ABB Inc.**

# ABB

Main 2.....	14
Close/Open Logic .....	14
ATS Logic.....	14
Goose Signals .....	15
Tie.....	16
Close/Open Logic .....	16
Tie Breaker 1 .....	16
Tie Breaker 2.....	16
Blackout .....	16
Loss of Source 1 .....	17
Return of Source 1 .....	18
Loss of Source 2 .....	19
Return of Source 2.....	20
Goose Signals .....	21
<b>Ethernet Communications .....</b>	<b>22</b>
HSR .....	23
PRP .....	23
<b>Bill of Material.....</b>	<b>24</b>

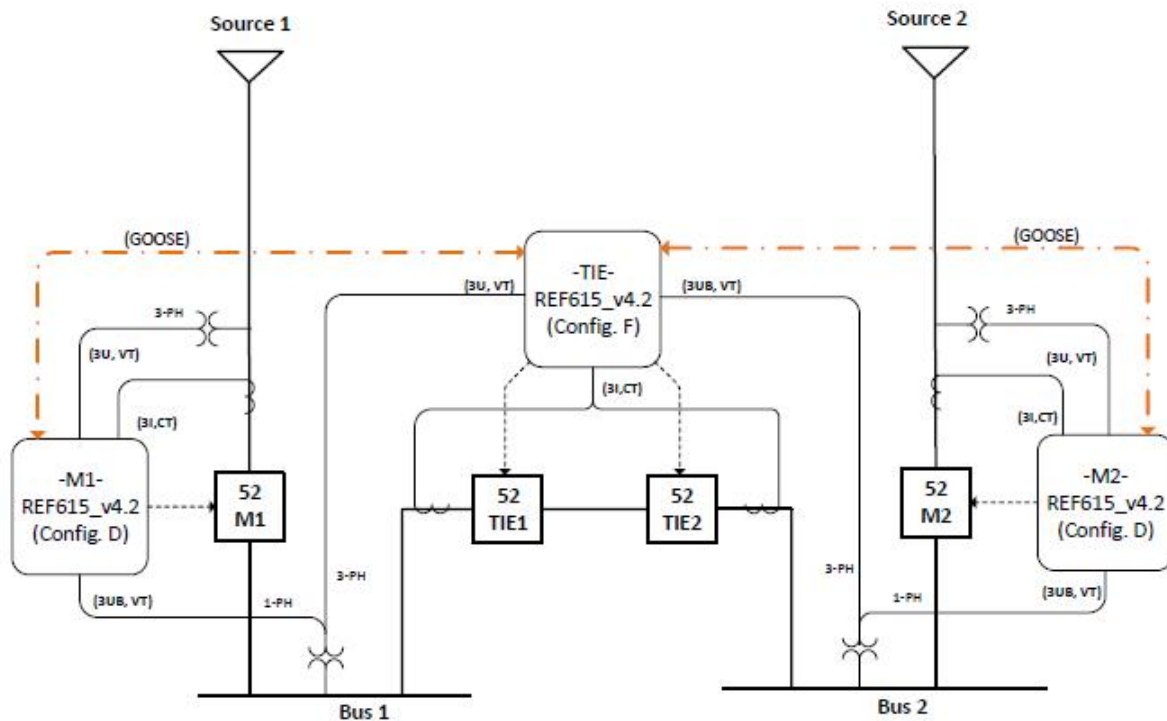
## Single Line Diagrams

The following is a one line diagram of the connections required to the relays for the implementation of the transfer scheme

**ABB Inc.**

# ABB

## SINGLE LINE DIAGRAM



Schemes: M-T-T-M Open Transition

Relays: Main 1 Relay Order Code: HAFDDADAFHE5BBN12E

Main 2 Relay Order Code: HAFDDADAFHE5BBN12E

Tie Relay Order Code: HAFFFAFHE5BBN12E

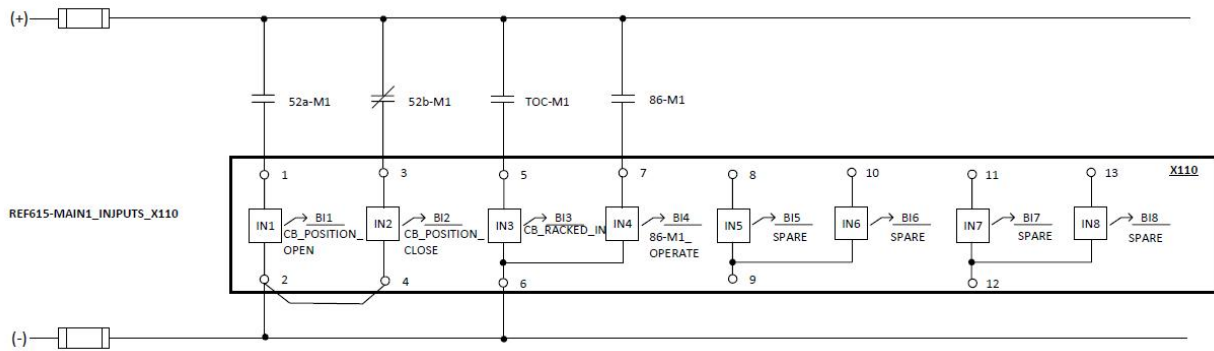
## Required Inputs

The following inputs to the each relays being used for the transfer scheme are required for the proper operation of this automatic transfer scheme.

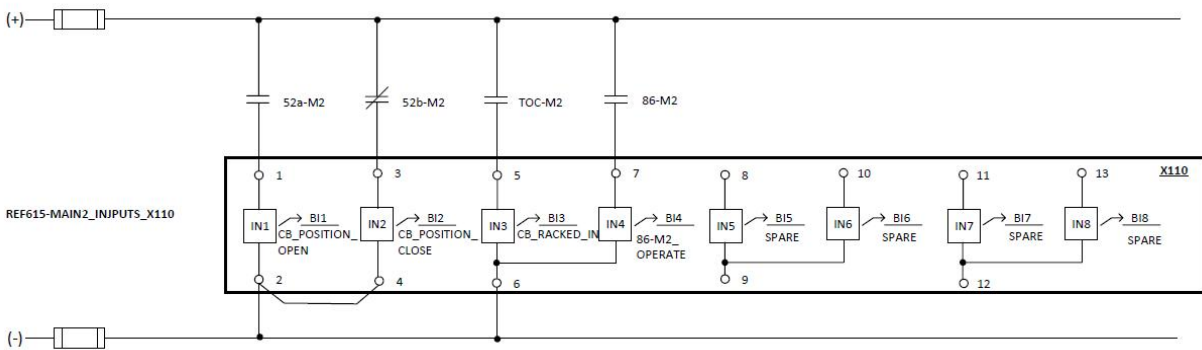
### Main 1 Relay

## ABB Inc.

# ABB



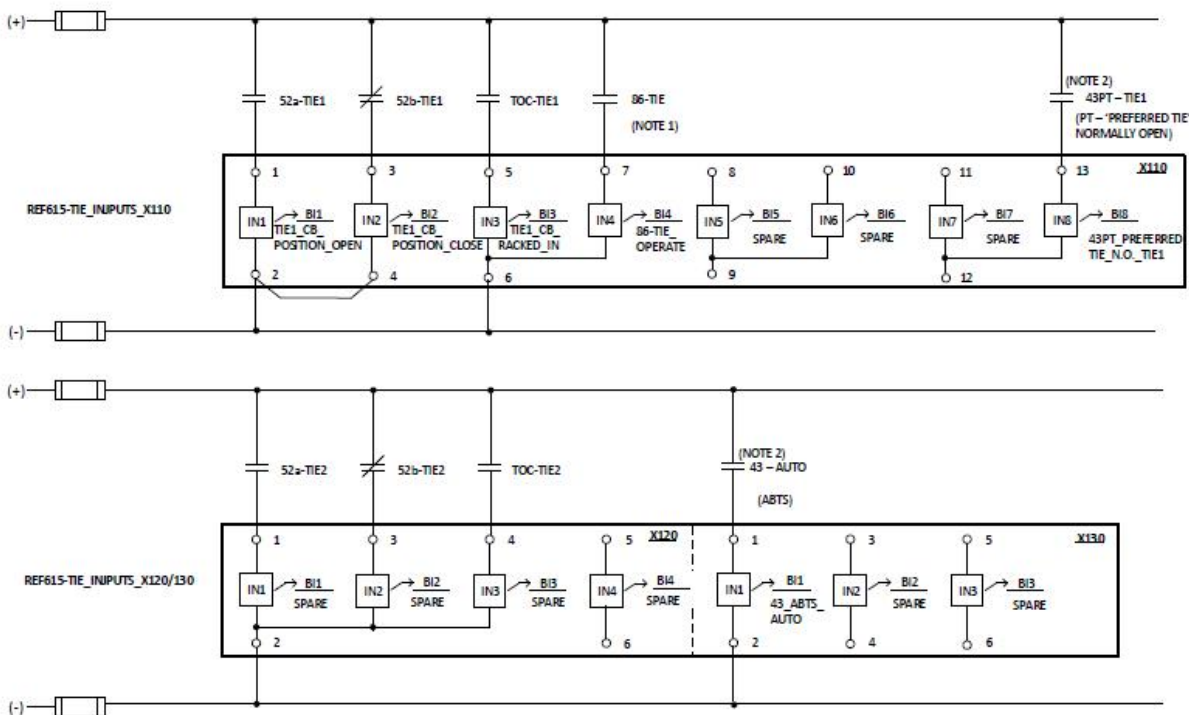
## Main 2 Relay



## Tie Relay

**ABB Inc.**

# ABB



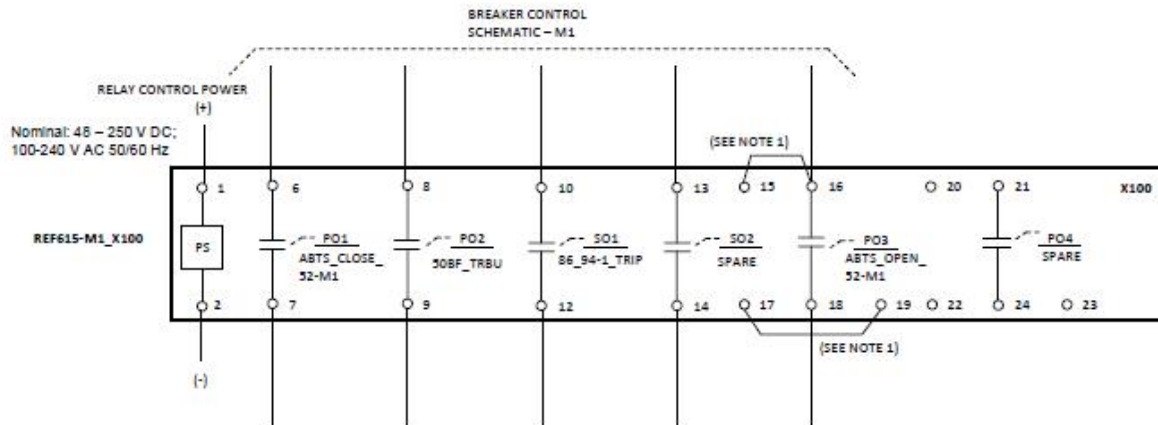
## Required Outputs

The following outputs from each of the relays being used for the transfer scheme are required for the proper operation of this automatic transfer scheme.

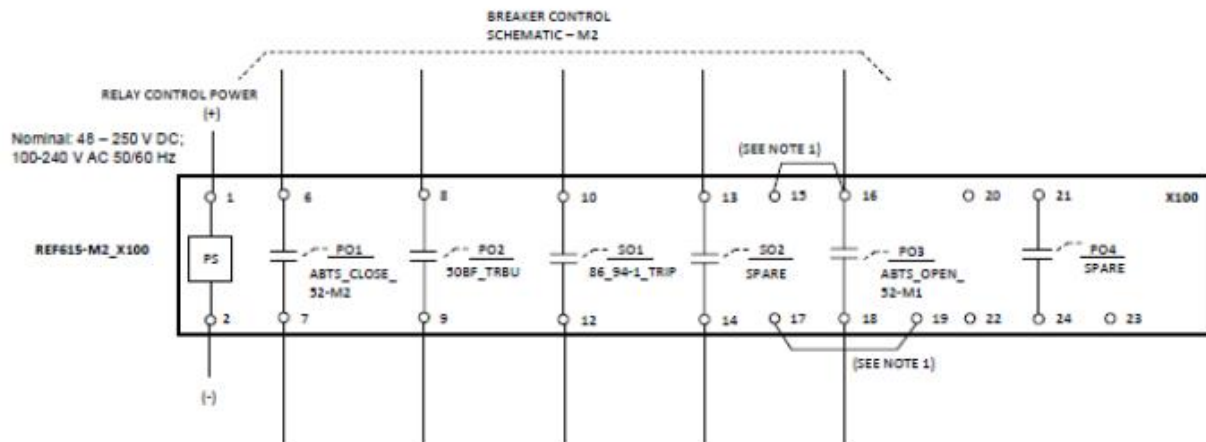
### Main Breaker 1

**ABB Inc.**

# ABB

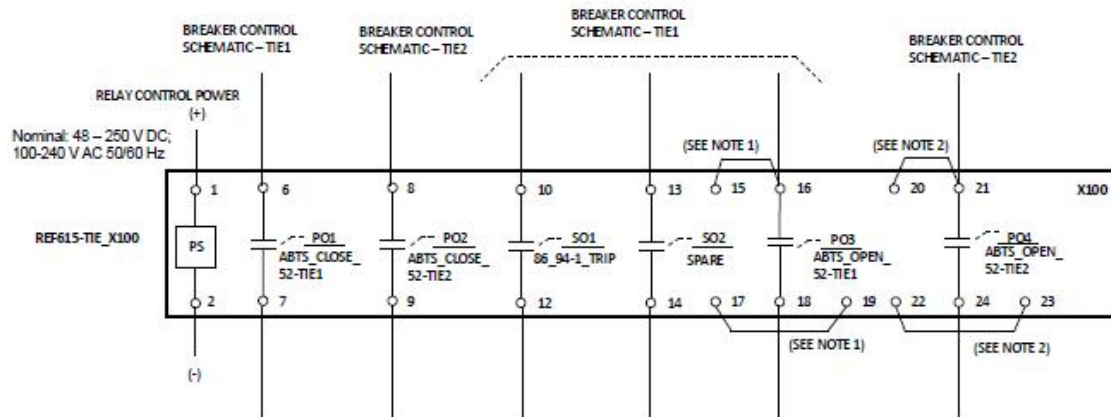


Main Breaker 2



Tie Breakers

**ABB Inc.**



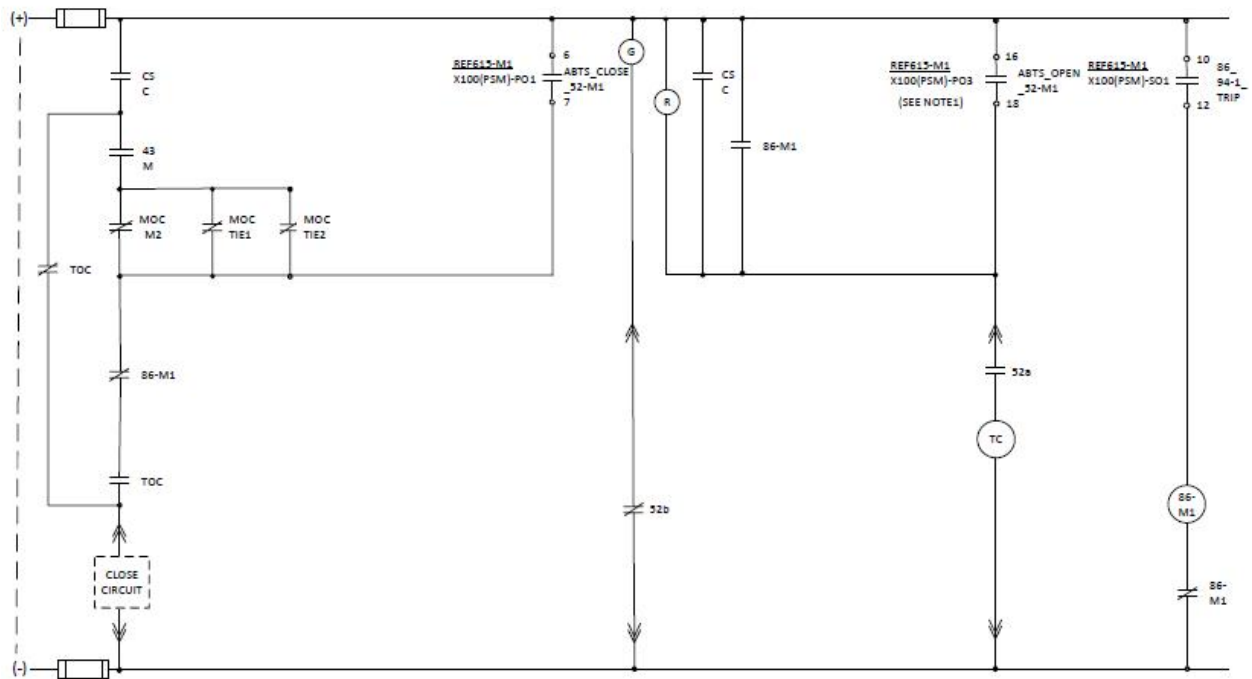
## Breaker Schematics

The following breaker schematics represent all the connections and electrical interlocks required for the proper operation of the Automatic Transfer Scheme

### Main Breaker 1

**ABB Inc.**

# ABB

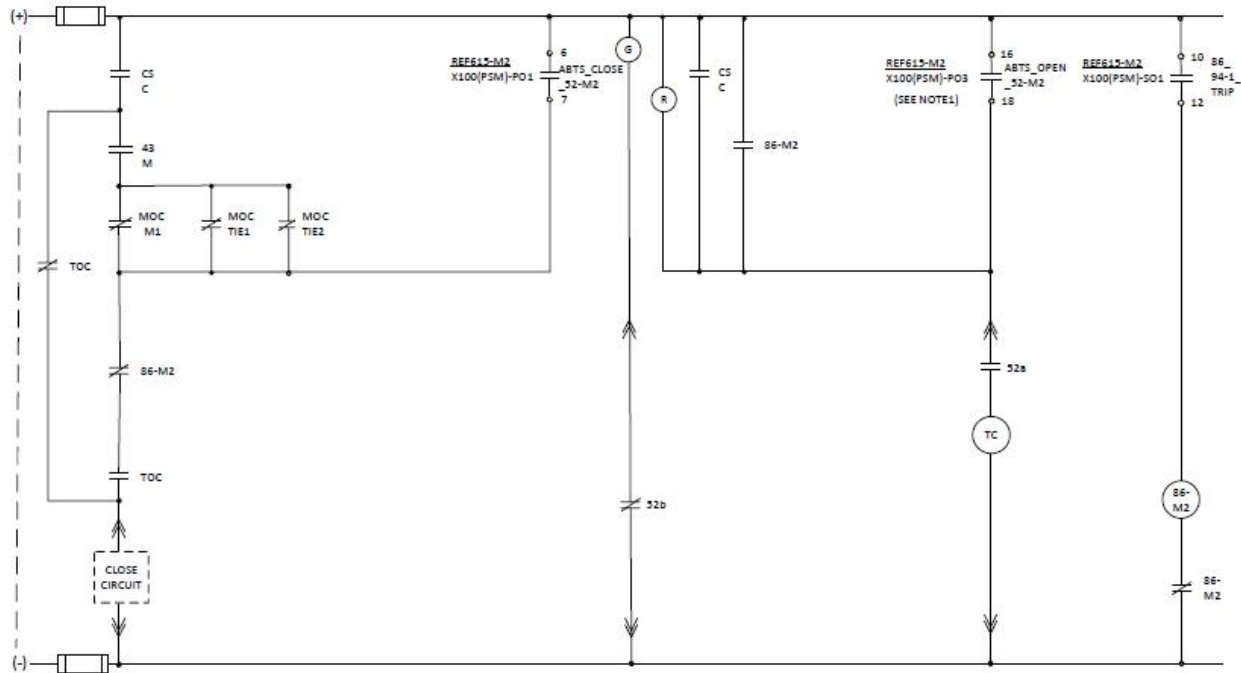


Main Breaker 2

**ABB Inc.**



# ABB



Tie Breaker 1

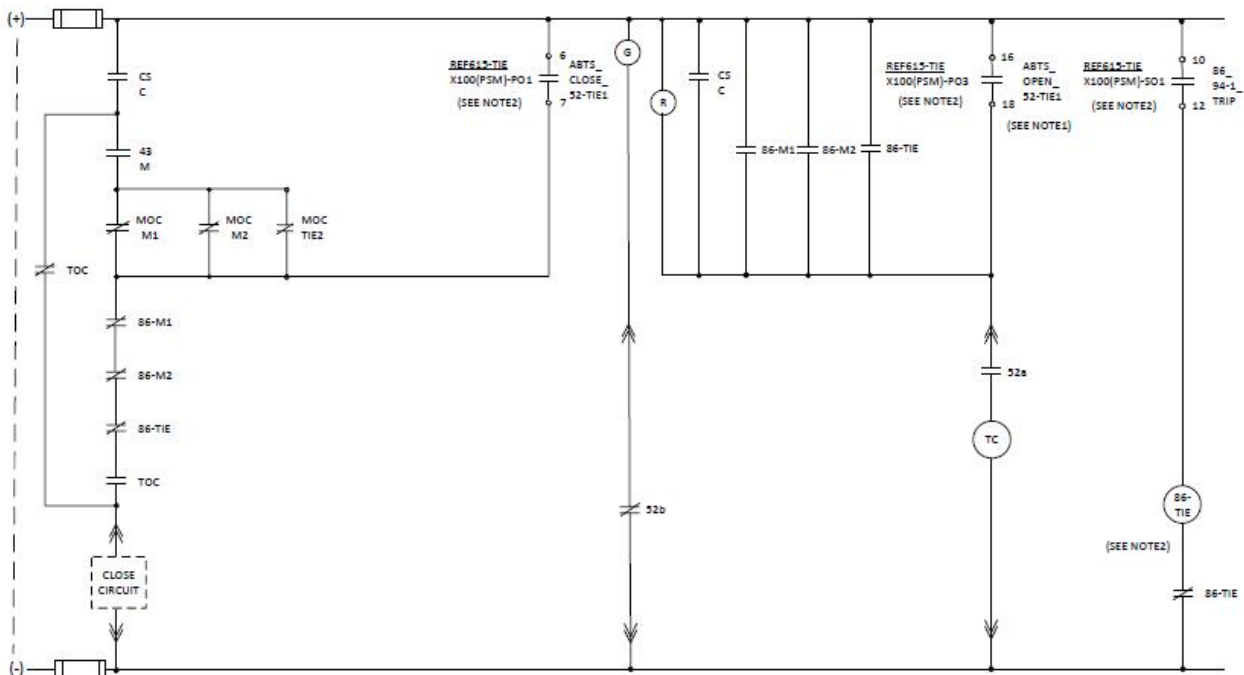
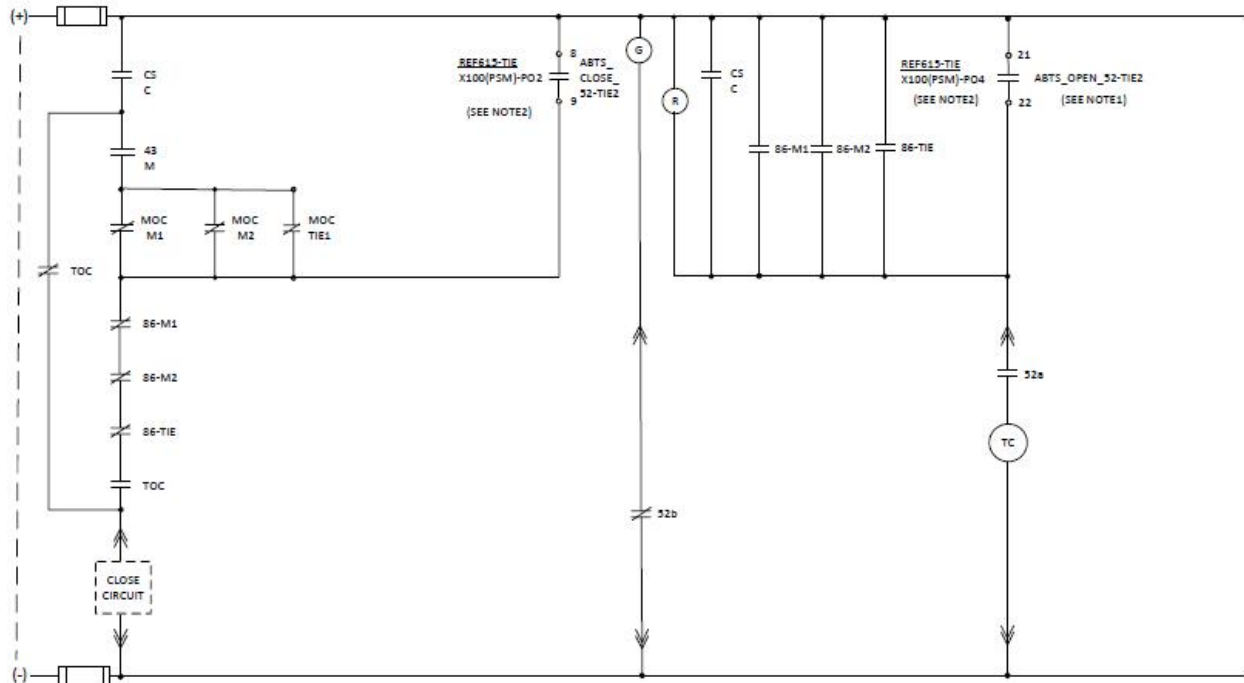


ABB Inc.



## Tie Breaker 2



**The sequence of operations for the ATS scheme would be as follows**

### Selector Switches

*43 M/A Manual/Auto Switch*

Describes manual or automatic operation for the transfer scheme

*43PT T1/T2 Preferred Tie Switch*

**ABB Inc.**



Only when 43 M/A switch is in "Auto", used to indicate what tie breaker should be normally open when system is in "Auto" and both incoming lines are available

### **Normal Mode of Operation**

The normal mode of operation would be with device 43 M/A switch in "Auto" mode, both incoming lines will be normally closed, and preferred tie breaker will be open as indicated by 43-PT switch. The alternate (non-preferred) tie breaker shall always be closed when 43 M/A switch is in "Auto" in order for the Automatic Transfer Scheme to work properly.

### **Electrical interlocks**

Under manual operation there is an electrical interlock between all incoming sources to prevent paralleling.

### **Automatic Mode**

**In order for any of the Automatic mode described in this section to work properly, please make sure that the preferred tie breaker is open as indicated by selector switch 43PT, and the non-preferred tie breaker is always closed.**

#### **Selector switch device 43 in "Auto"**

(a)

Loss of voltage (UV or NEG SEQ) on either incoming line will after a time delay cause its main breaker to open and then the preferred tie breaker will close, provided that voltage is present on the other incoming line.

When the voltage is restored, the preferred tie breaker will open after a time delay automatically and then the opened incoming line would close.

(b)

However, if the voltage is subsequently lost on the second line after the transfer has occurred as described in (a) above, the second line will after a time delay open and then the preferred tie would open.

Return of voltage on either line will after a time delay cause its main breaker to close, and then the preferred tie would close. When voltage returns to the other line, the preferred tie breaker will after a time delay open, and then the other line breaker will close, restoring the system to normal.

(c)

**ABB Inc.**

# ABB

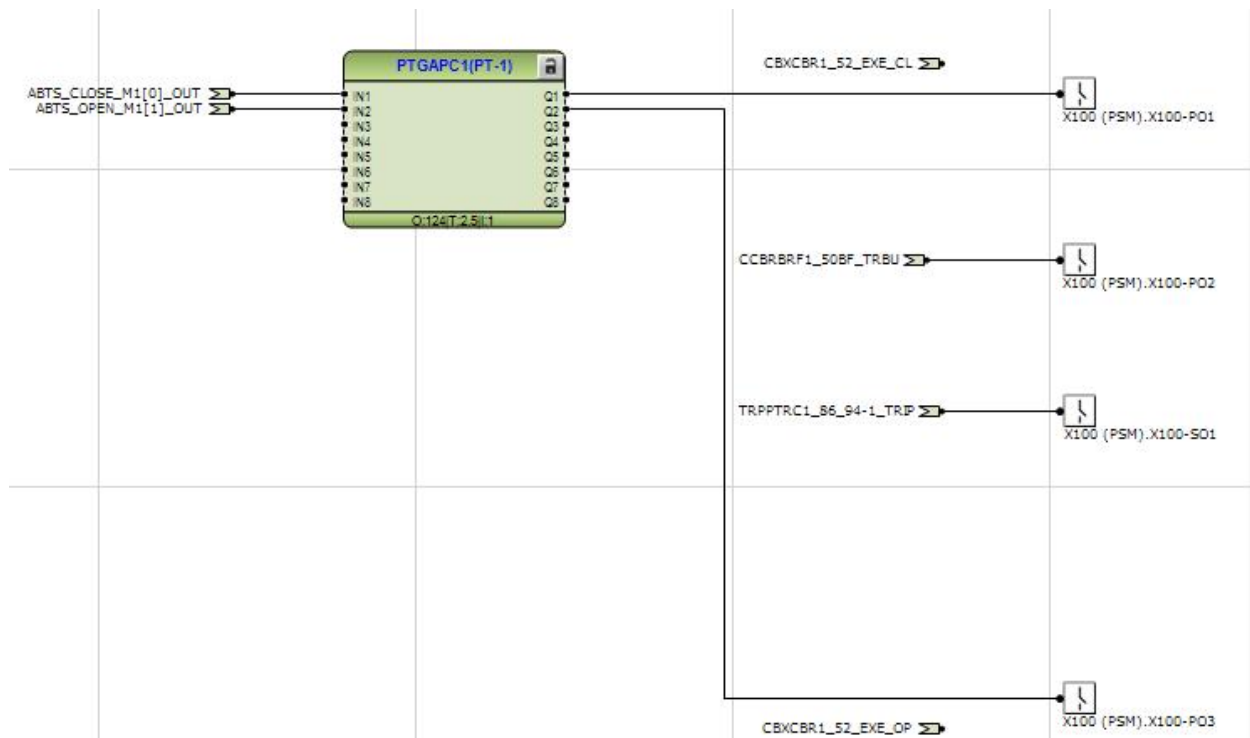
Simultaneous loss (or restoration) of both sources will after a time delay cause both main breakers to open (or close), leaving the preferred tie breaker open.

## ATS Logic

The following logic describes what it has been implemented within each of the protective to perform the sequence of operation, as described under the sequence of operation section

### Main 1

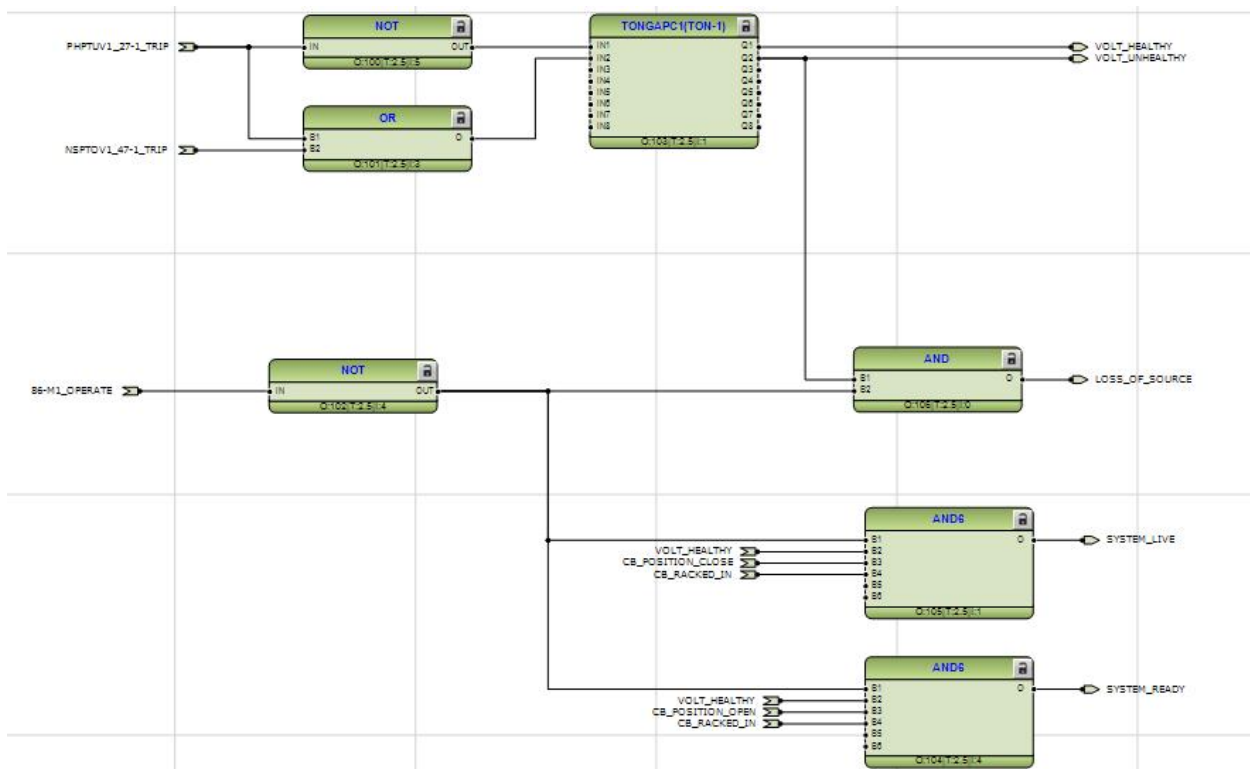
#### Close/Open Logic



#### ATS Logic

## ABB Inc.

# ABB



## Goose Signals

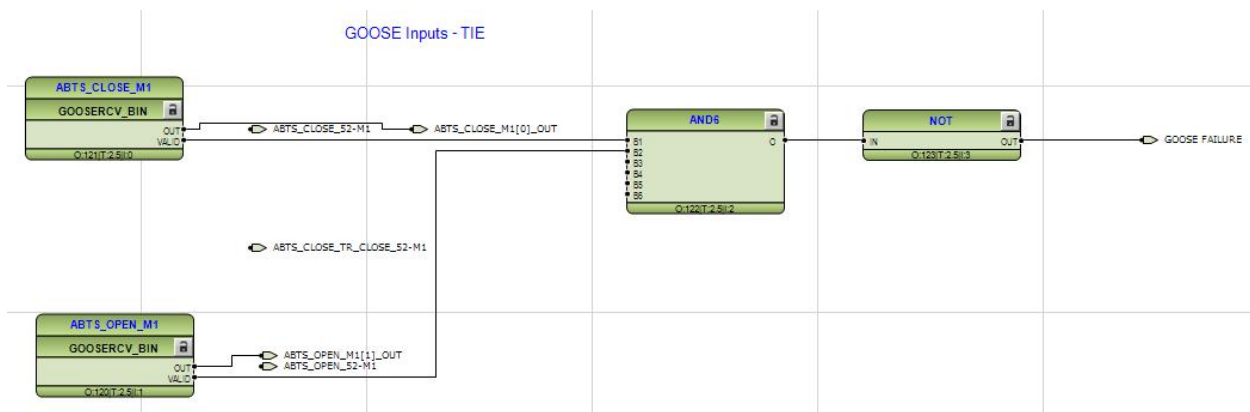
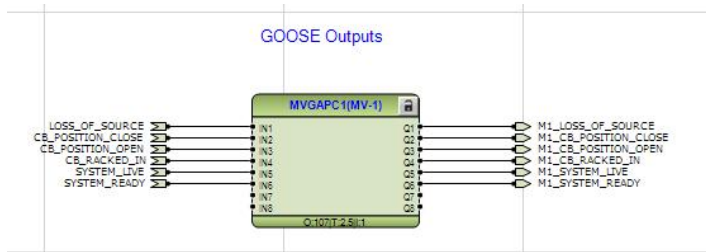


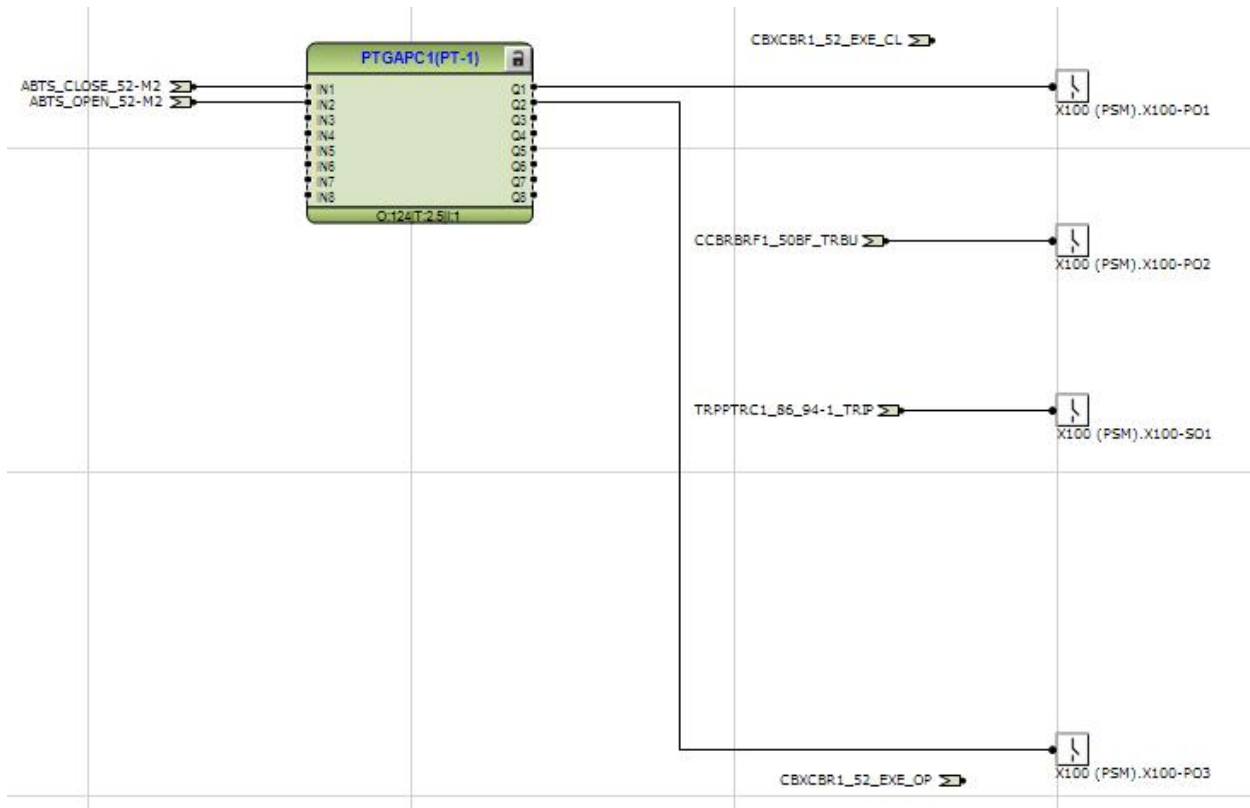
ABB Inc.

# ABB



Main 2

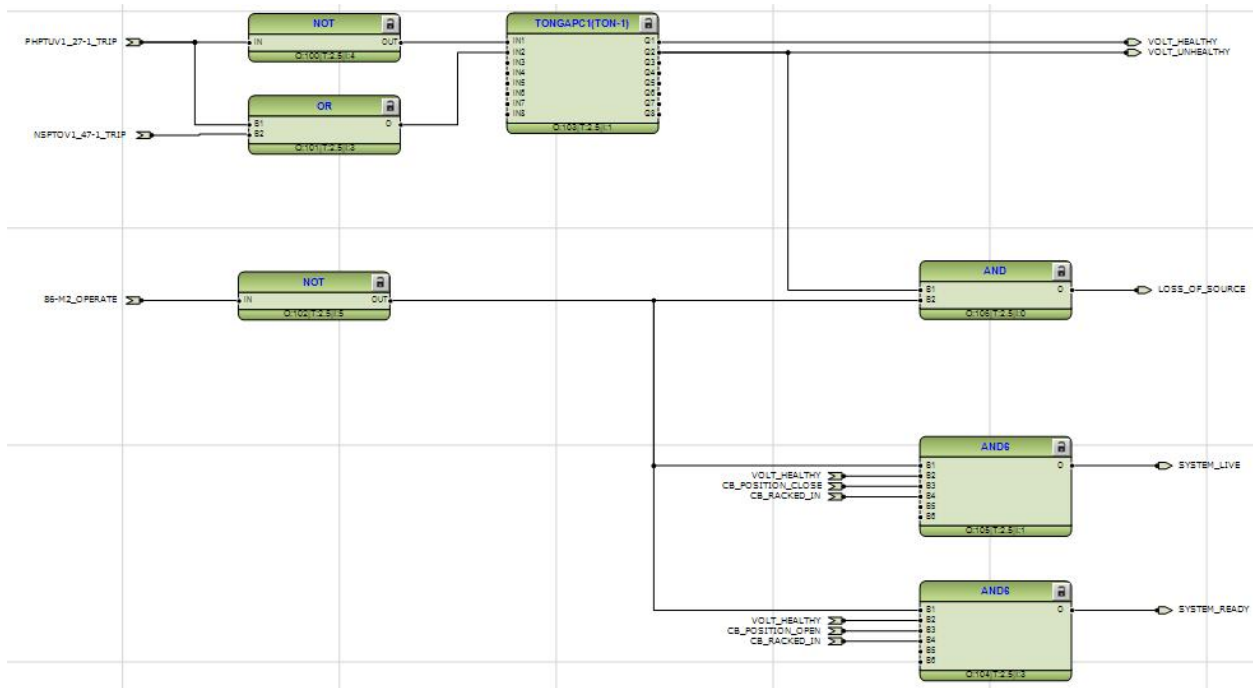
Close/Open Logic



ATS Logic

**ABB Inc.**

# ABB



## Goose Signals

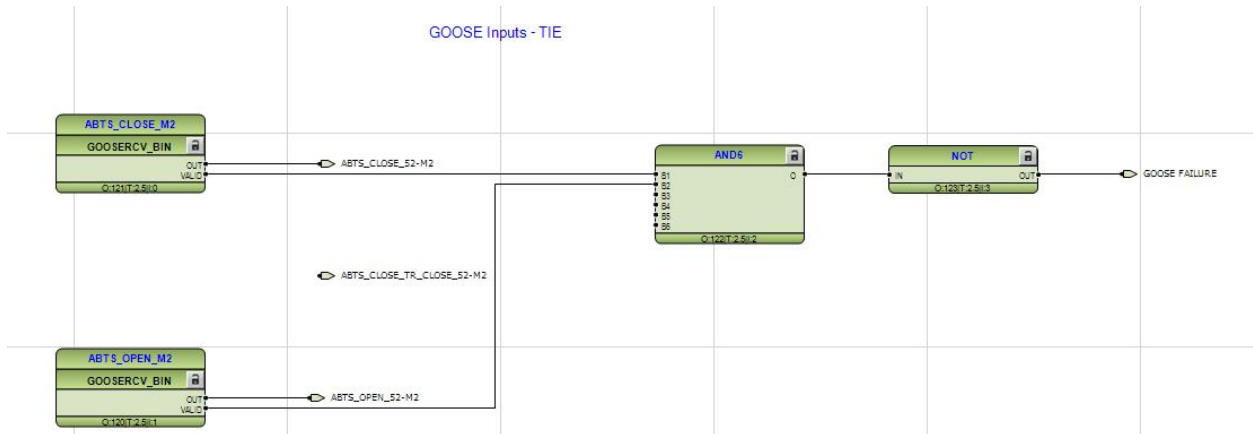
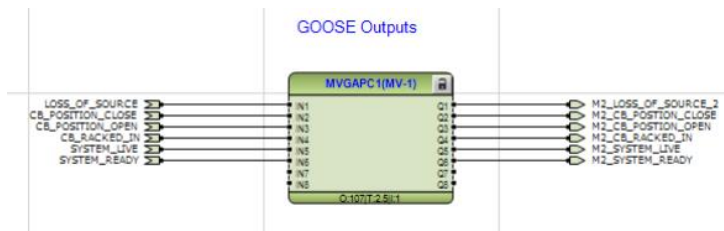


ABB Inc.

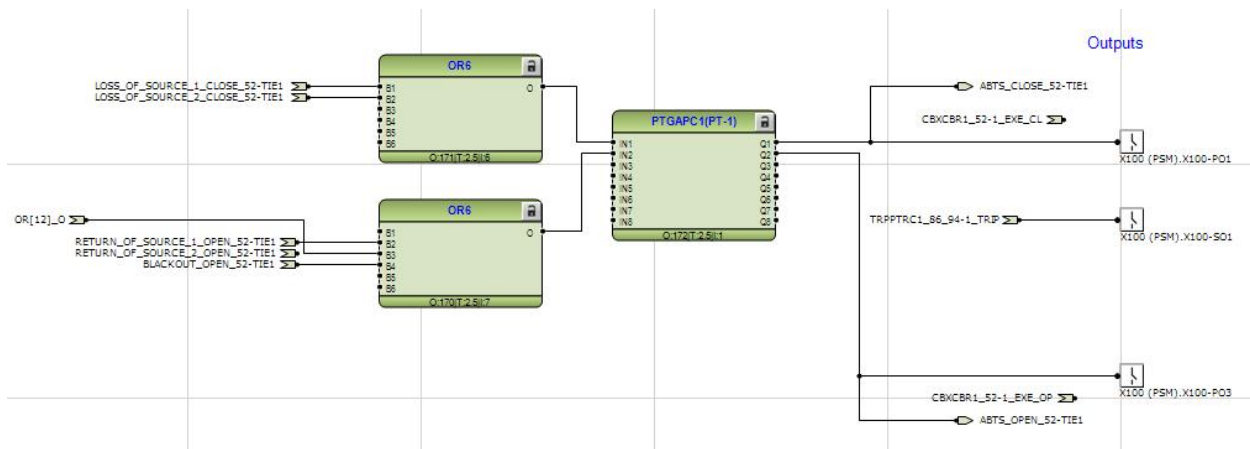
# ABB



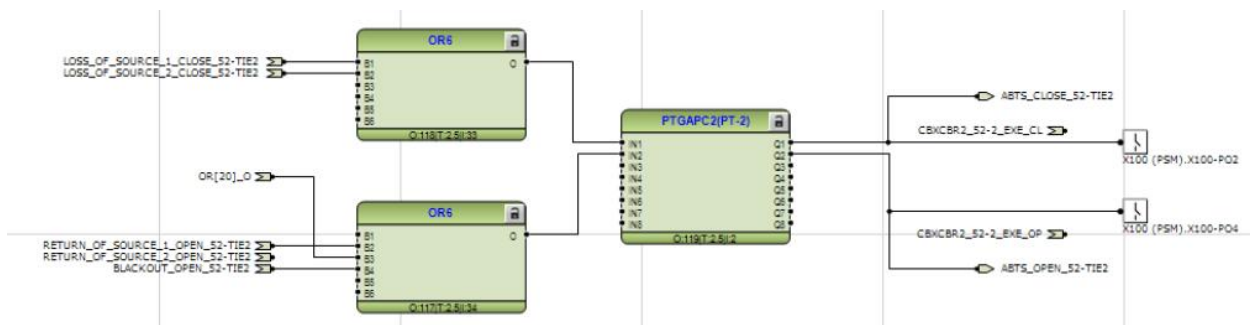
Tie

Close/Open Logic

Tie Breaker 1



Tie Breaker 2

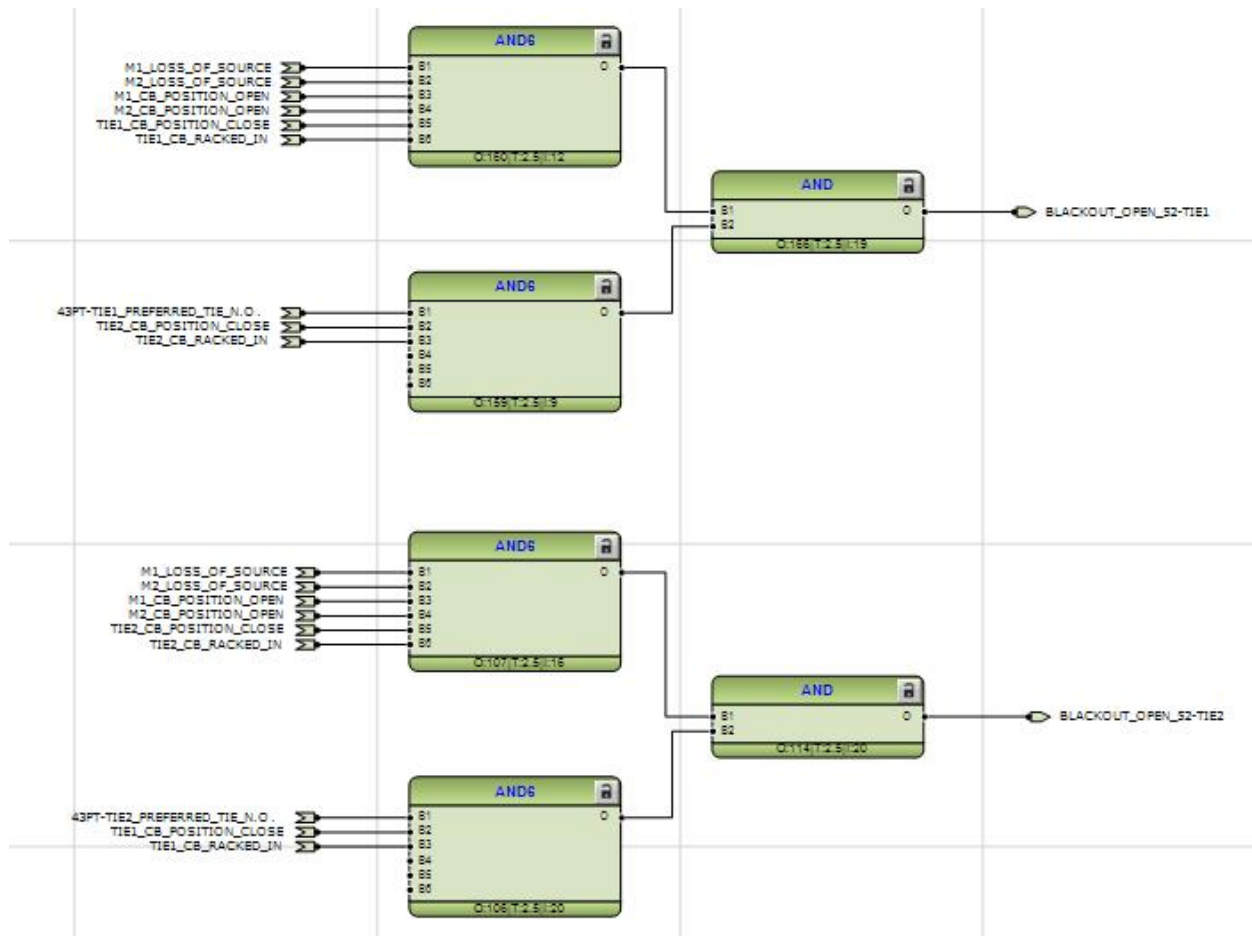


Blackout

ABB Inc.



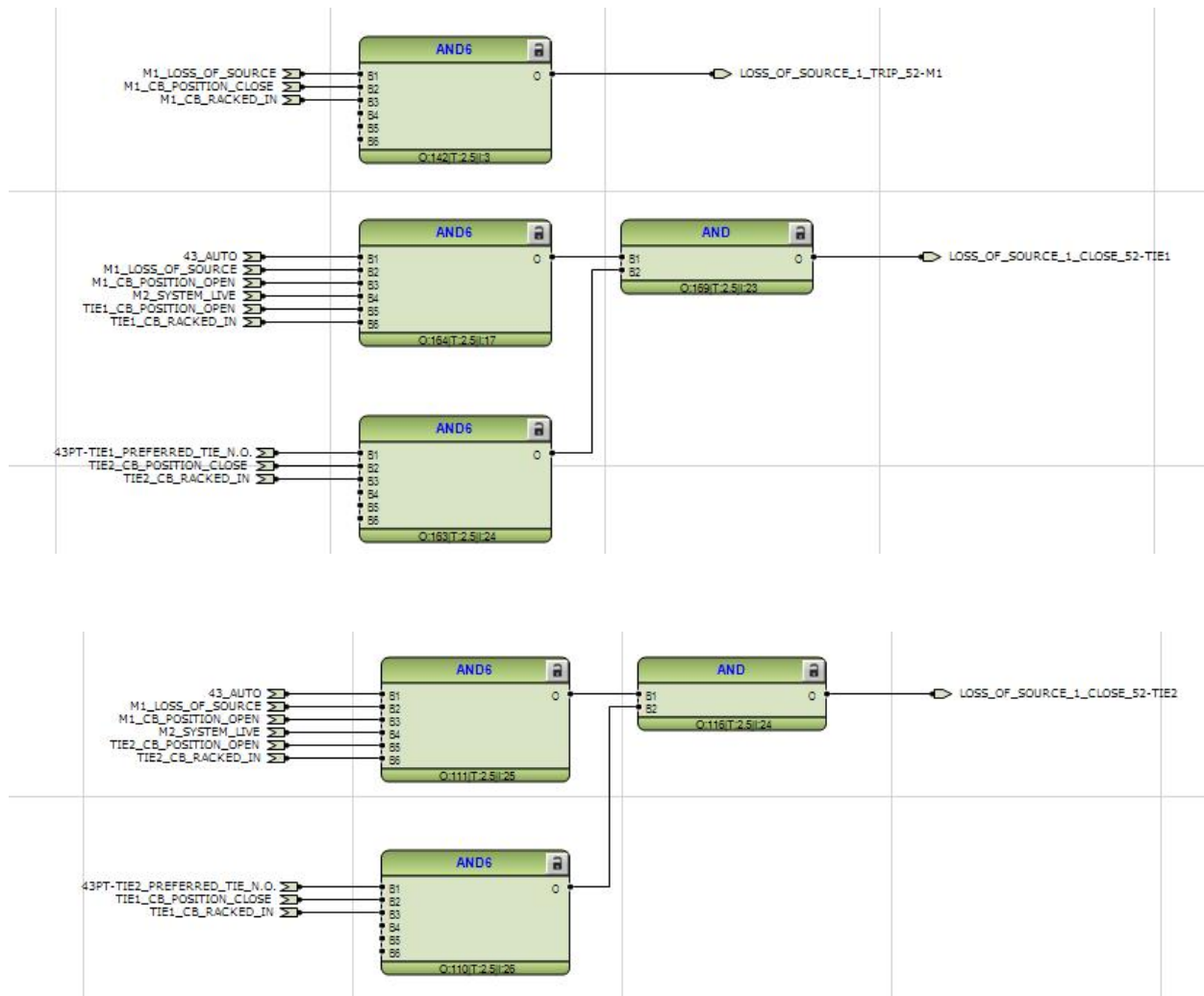
# ABB



Loss of Source 1

**ABB Inc.**

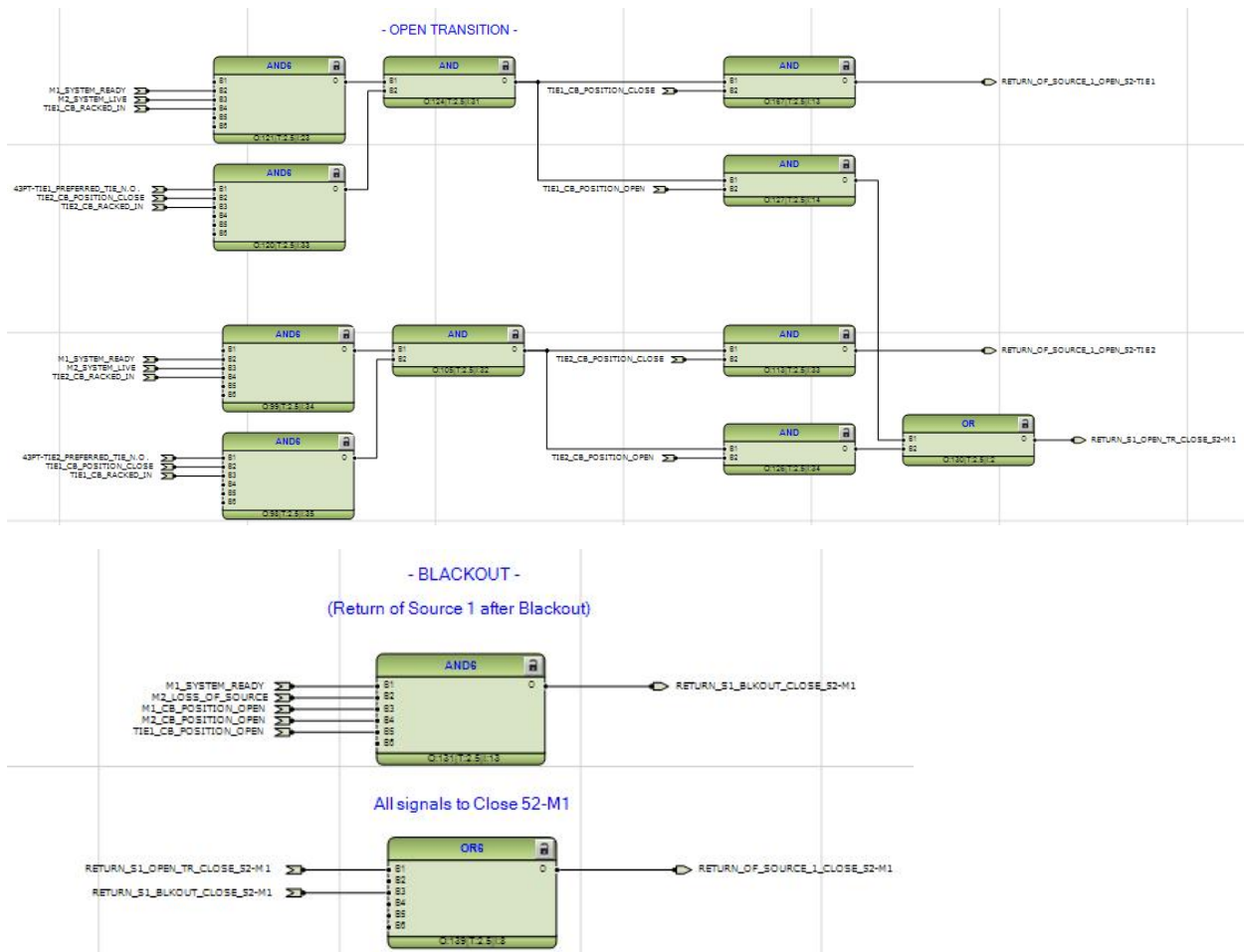
# ABB



Return of Source 1

**ABB Inc.**

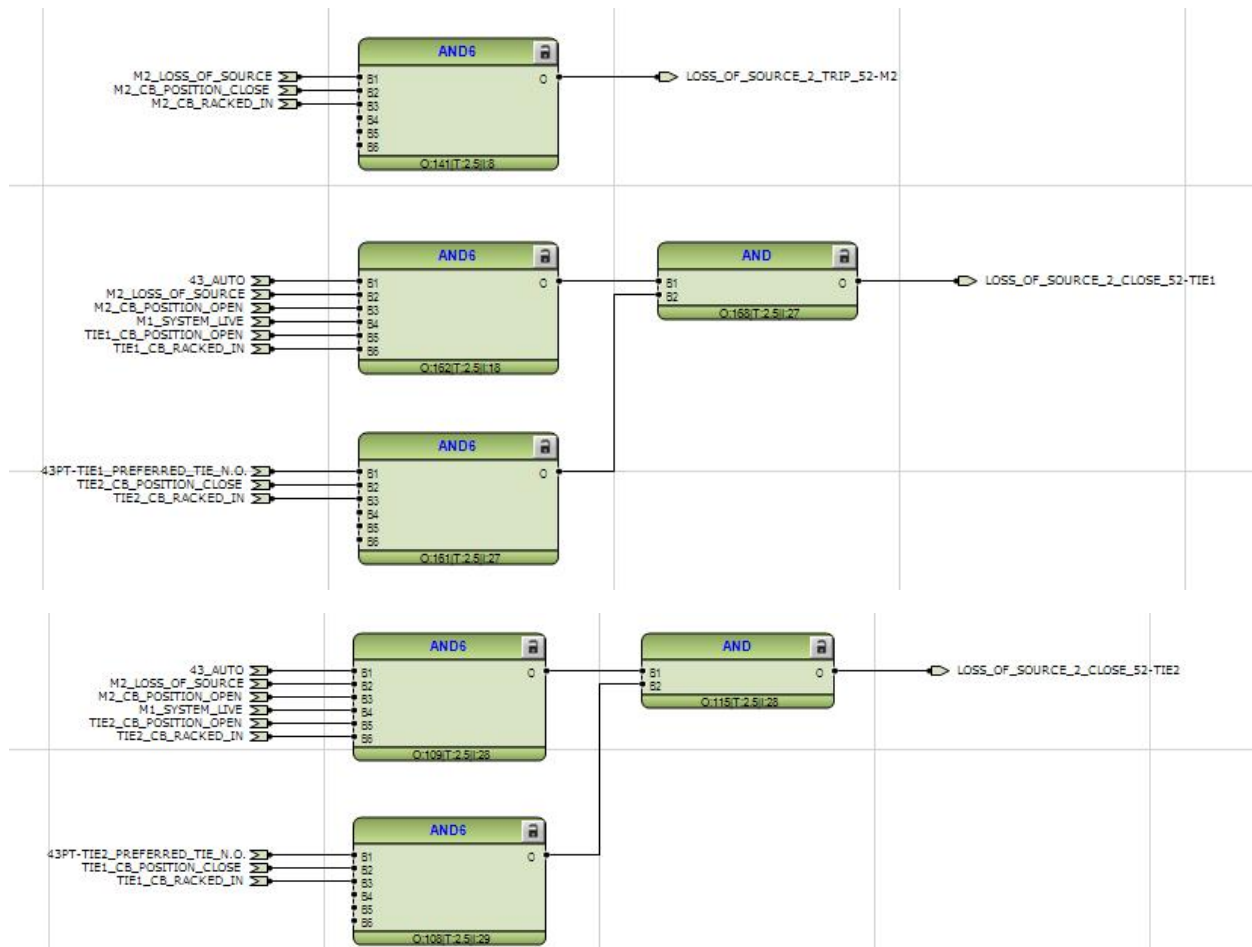
# ABB



Loss of Source 2

**ABB Inc.**

# ABB



Return of Source 2

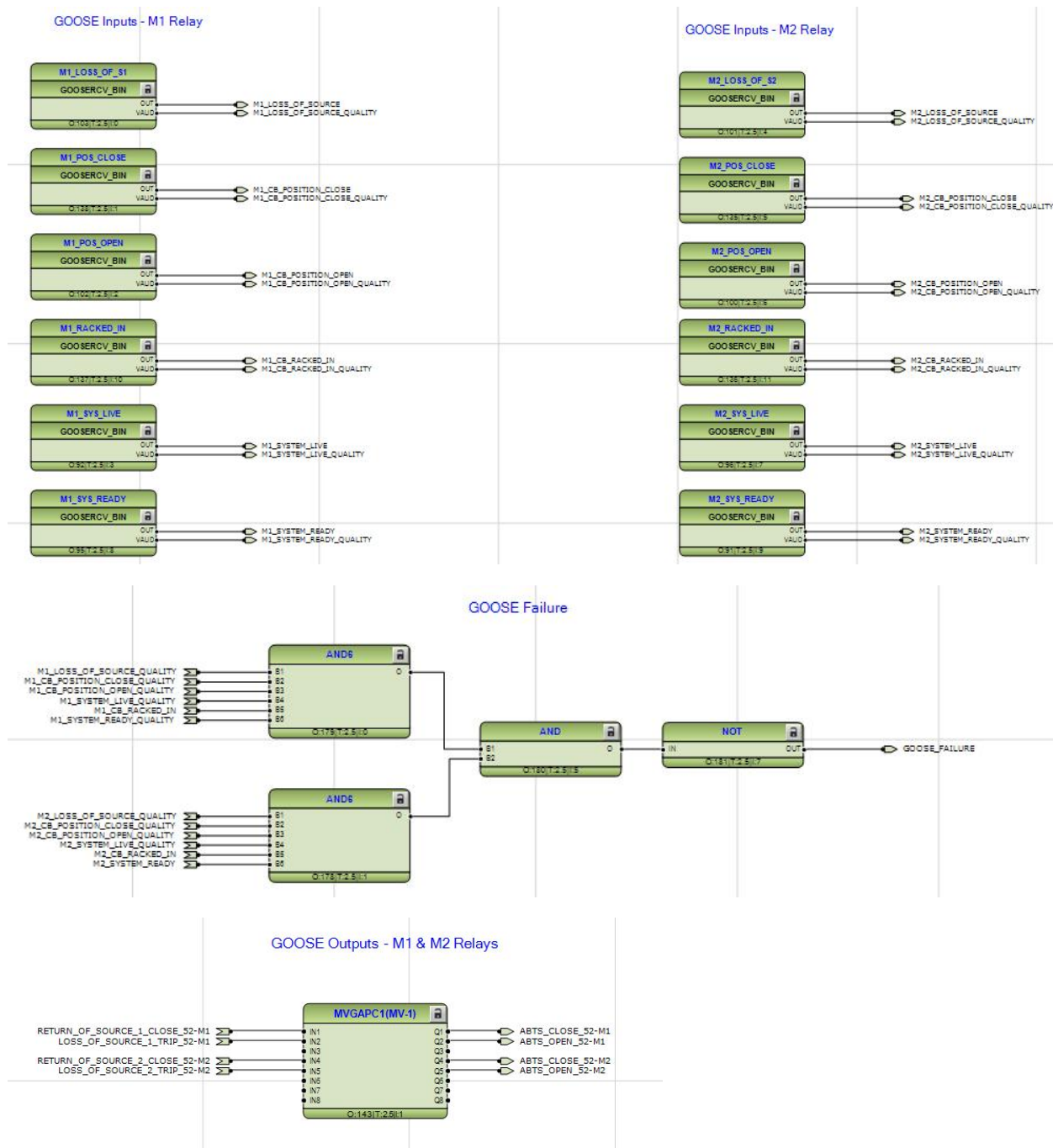
**ABB Inc.**

The diagram illustrates a complex logic circuit, likely for a safety or control system. It features several logic gates (AND, OR, XOR) and signal inputs/outputs. Key components include:

- Inputs:** M2\_SYSTEM\_READY, M1\_LOSS\_OF\_SOURCE, M1\_SYSTEM\_LIVE, M2\_SYSTEM\_LIVE, M1\_SYSTEM\_READY, M2\_SYSTEM\_READY, M1\_LOSS\_OF\_SOURCE, M1\_SYSTEM\_LIVE, M2\_SYSTEM\_LIVE, M1\_SYSTEM\_READY, M2\_SYSTEM\_READY, M1\_LOSS\_OF\_SOURCE, M1\_SYSTEM\_LIVE, M2\_SYSTEM\_LIVE.
- Logic Gates:** AND, OR, XOR, and a central block labeled "- BLACKOUT - (Return of Source 2 after Blackout)".
- Outputs:** OR120\_O, OR121\_O, OR122\_O, OR123\_O, OR124\_O, OR125\_O, OR126\_O, OR127\_O, OR128\_O, OR129\_O, OR130\_O, OR131\_O, OR132\_O, OR133\_O, OR134\_O, OR135\_O, OR136\_O, OR137\_O, OR138\_O, OR139\_O, OR140\_O, OR141\_O, OR142\_O, OR143\_O, OR144\_O, OR145\_O, OR146\_O, OR147\_O, OR148\_O, OR149\_O, OR150\_O, OR151\_O, OR152\_O, OR153\_O, OR154\_O, OR155\_O, OR156\_O, OR157\_O, OR158\_O, OR159\_O, OR160\_O, OR161\_O, OR162\_O, OR163\_O, OR164\_O, OR165\_O, OR166\_O, OR167\_O, OR168\_O, OR169\_O, OR170\_O, OR171\_O, OR172\_O, OR173\_O, OR174\_O, OR175\_O, OR176\_O, OR177\_O, OR178\_O, OR179\_O, OR180\_O, OR181\_O, OR182\_O, OR183\_O, OR184\_O, OR185\_O, OR186\_O, OR187\_O, OR188\_O, OR189\_O, OR190\_O, OR191\_O, OR192\_O, OR193\_O, OR194\_O, OR195\_O, OR196\_O, OR197\_O, OR198\_O, OR199\_O, OR200\_O, OR201\_O, OR202\_O, OR203\_O, OR204\_O, OR205\_O, OR206\_O, OR207\_O, OR208\_O, OR209\_O, OR210\_O, OR211\_O, OR212\_O, OR213\_O, OR214\_O, OR215\_O, OR216\_O, OR217\_O, OR218\_O, OR219\_O, OR220\_O, OR221\_O, OR222\_O, OR223\_O, OR224\_O, OR225\_O, OR226\_O, OR227\_O, OR228\_O, OR229\_O, OR230\_O, OR231\_O, OR232\_O, OR233\_O, OR234\_O, OR235\_O, OR236\_O, OR237\_O, OR238\_O, OR239\_O, OR240\_O, OR241\_O, OR242\_O, OR243\_O, OR244\_O, OR245\_O, OR246\_O, OR247\_O, OR248\_O, OR249\_O, OR250\_O, OR251\_O, OR252\_O, OR253\_O, OR254\_O, OR255\_O, OR256\_O, OR257\_O, OR258\_O, OR259\_O, OR260\_O, OR261\_O, OR262\_O, OR263\_O, OR264\_O, OR265\_O, OR266\_O, OR267\_O, OR268\_O, OR269\_O, OR270\_O, OR271\_O, OR272\_O, OR273\_O, OR274\_O, OR275\_O, OR276\_O, OR277\_O, OR278\_O, OR279\_O, OR280\_O, OR281\_O, OR282\_O, OR283\_O, OR284\_O, OR285\_O, OR286\_O, OR287\_O, OR288\_O, OR289\_O, OR290\_O, OR291\_O, OR292\_O, OR293\_O, OR294\_O, OR295\_O, OR296\_O, OR297\_O, OR298\_O, OR299\_O, OR300\_O, OR301\_O, OR302\_O, OR303\_O, OR304\_O, OR305\_O, OR306\_O, OR307\_O, OR308\_O, OR309\_O, OR310\_O, OR311\_O, OR312\_O, OR313\_O, OR314\_O, OR315\_O, OR316\_O, OR317\_O, OR318\_O, OR319\_O, OR320\_O, OR321\_O, OR322\_O, OR323\_O, OR324\_O, OR325\_O, OR326\_O, OR327\_O, OR328\_O, OR329\_O, OR330\_O, OR331\_O, OR332\_O, OR333\_O, OR334\_O, OR335\_O, OR336\_O, OR337\_O, OR338\_O, OR339\_O, OR340\_O, OR341\_O, OR342\_O, OR343\_O, OR344\_O, OR345\_O, OR346\_O, OR347\_O, OR348\_O, OR349\_O, OR350\_O, OR351\_O, OR352\_O, OR353\_O, OR354\_O, OR355\_O, OR356\_O, OR357\_O, OR358\_O, OR359\_O, OR360\_O, OR361\_O, OR362\_O, OR363\_O, OR364\_O, OR365\_O, OR366\_O, OR367\_O, OR368\_O, OR369\_O, OR370\_O, OR371\_O, OR372\_O, OR373\_O, OR374\_O, OR375\_O, OR376\_O, OR377\_O, OR378\_O, OR379\_O, OR380\_O, OR381\_O, OR382\_O, OR383\_O, OR384\_O, OR385\_O, OR386\_O, OR387\_O, OR388\_O, OR389\_O, OR390\_O, OR391\_O, OR392\_O, OR393\_O, OR394\_O, OR395\_O, OR396\_O, OR397\_O, OR398\_O, OR399\_O, OR400\_O, OR401\_O, OR402\_O, OR403\_O, OR404\_O, OR405\_O, OR406\_O, OR407\_O, OR408\_O, OR409\_O, OR410\_O, OR411\_O, OR412\_O, OR413\_O, OR414\_O, OR415\_O, OR416\_O, OR417\_O, OR418\_O, OR419\_O, OR420\_O, OR421\_O, OR422\_O, OR423\_O, OR424\_O, OR425\_O, OR426\_O, OR427\_O, OR428\_O, OR429\_O, OR430\_O, OR431\_O, OR432\_O, OR433\_O, OR434\_O, OR435\_O, OR436\_O, OR437\_O, OR438\_O, OR439\_O, OR440\_O, OR441\_O, OR442\_O, OR443\_O, OR444\_O, OR445\_O, OR446\_O, OR447\_O, OR448\_O, OR449\_O, OR450\_O, OR451\_O, OR452\_O, OR453\_O, OR454\_O, OR455\_O, OR456\_O, OR457\_O, OR458\_O, OR459\_O, OR460\_O, OR461\_O, OR462\_O, OR463\_O, OR464\_O, OR465\_O, OR466\_O, OR467\_O, OR468\_O, OR469\_O, OR470\_O, OR471\_O, OR472\_O, OR473\_O, OR474\_O, OR475\_O, OR476\_O, OR477\_O, OR478\_O, OR479\_O, OR480\_O, OR481\_O, OR482\_O, OR483\_O, OR484\_O, OR485\_O, OR486\_O, OR487\_O, OR488\_O, OR489\_O, OR490\_O, OR491\_O, OR492\_O, OR493\_O, OR494\_O, OR495\_O, OR496\_O, OR497\_O, OR498\_O, OR499\_O, OR500\_O, OR501\_O, OR502\_O, OR503\_O, OR504\_O, OR505\_O, OR506\_O, OR507\_O, OR508\_O, OR509\_O, OR510\_O, OR511\_O, OR512\_O, OR513\_O, OR514\_O, OR515\_O, OR516\_O, OR517\_O, OR518\_O, OR519\_O, OR520\_O, OR521\_O, OR522\_O, OR523\_O, OR524\_O, OR525\_O, OR526\_O, OR527\_O, OR528\_O, OR529\_O, OR530\_O, OR531\_O, OR532\_O, OR533\_O, OR534\_O, OR535\_O, OR536\_O, OR537\_O, OR538\_O, OR539\_O, OR540\_O, OR541\_O, OR542\_O, OR543\_O, OR544\_O, OR545\_O, OR546\_O, OR547\_O, OR548\_O, OR549\_O, OR550\_O, OR551\_O, OR552\_O, OR553\_O, OR554\_O, OR555\_O, OR556\_O, OR557\_O, OR558\_O, OR559\_O, OR560\_O, OR561\_O, OR562\_O, OR563\_O, OR564\_O, OR565\_O, OR566\_O, OR567\_O, OR568\_O, OR569\_O, OR570\_O, OR571\_O, OR572\_O, OR573\_O, OR574\_O, OR575\_O, OR576\_O, OR577\_O, OR578\_O, OR579\_O, OR580\_O, OR581\_O, OR582\_O, OR583\_O, OR584\_O, OR585\_O, OR586\_O, OR587\_O, OR588\_O, OR589\_O, OR590\_O, OR591\_O, OR592\_O, OR593\_O, OR594\_O, OR595\_O, OR596\_O, OR597\_O, OR598\_O, OR599\_O, OR600\_O, OR601\_O, OR602\_O, OR603\_O, OR604\_O, OR605\_O, OR606\_O, OR607\_O, OR608\_O, OR609\_O, OR610\_O, OR611\_O, OR612\_O, OR613\_O, OR614\_O, OR615\_O, OR616\_O, OR617\_O, OR618\_O, OR619\_O, OR620\_O, OR621\_O, OR622\_O, OR623\_O, OR624\_O, OR625\_O, OR626\_O, OR627\_O, OR628\_O, OR629\_O, OR630\_O, OR631\_O, OR632\_O, OR633\_O, OR634\_O, OR635\_O, OR636\_O, OR637\_O, OR638\_O, OR639\_O, OR640\_O, OR641\_O, OR642\_O, OR643\_O, OR644\_O, OR645\_O, OR646\_O, OR647\_O, OR648\_O, OR649\_O, OR650\_O, OR651\_O, OR652\_O, OR653\_O, OR654\_O, OR655\_O, OR656\_O, OR657\_O, OR658\_O, OR659\_O, OR660\_O, OR661\_O, OR662\_O, OR663\_O, OR664\_O, OR665\_O, OR666\_O, OR667\_O, OR668\_O, OR669\_O, OR670\_O, OR671\_O, OR672\_O, OR673\_O, OR674\_O, OR675\_O, OR676\_O, OR677\_O, OR678\_O, OR679\_O, OR680\_O, OR681\_O, OR682\_O, OR683\_O, OR684\_O, OR685\_O, OR686\_O, OR687\_O, OR688\_O, OR689\_O, OR690\_O, OR691\_O, OR692\_O, OR693\_O, OR694\_O, OR695\_O, OR696\_O, OR697\_O, OR698\_O, OR699\_O, OR700\_O, OR701\_O, OR702\_O, OR703\_O, OR704\_O, OR705\_O, OR706\_O, OR707\_O, OR708\_O, OR709\_O, OR710\_O, OR711\_O, OR712\_O, OR713\_O, OR714\_O, OR715\_O, OR716\_O, OR717\_O, OR718\_O, OR719\_O, OR720\_O, OR721\_O, OR722\_O, OR723\_O, OR724\_O, OR725\_O, OR726\_O, OR727\_O, OR728\_O, OR729\_O, OR730\_O, OR731\_O, OR732\_O, OR733\_O, OR734\_O, OR735\_O, OR736\_O, OR737\_O, OR738\_O, OR739\_O, OR740\_O, OR741\_O, OR742\_O, OR743\_O, OR744\_O, OR745\_O, OR746\_O, OR747\_O, OR748\_O, OR749\_O, OR750\_O, OR751\_O, OR752\_O,

Automation	4300 Coral Ridge Drive Coral Spring, FL 33065	Telephone: (954) 752-6700 Telefax: (954) 345-5329
------------	--	--

# ABB



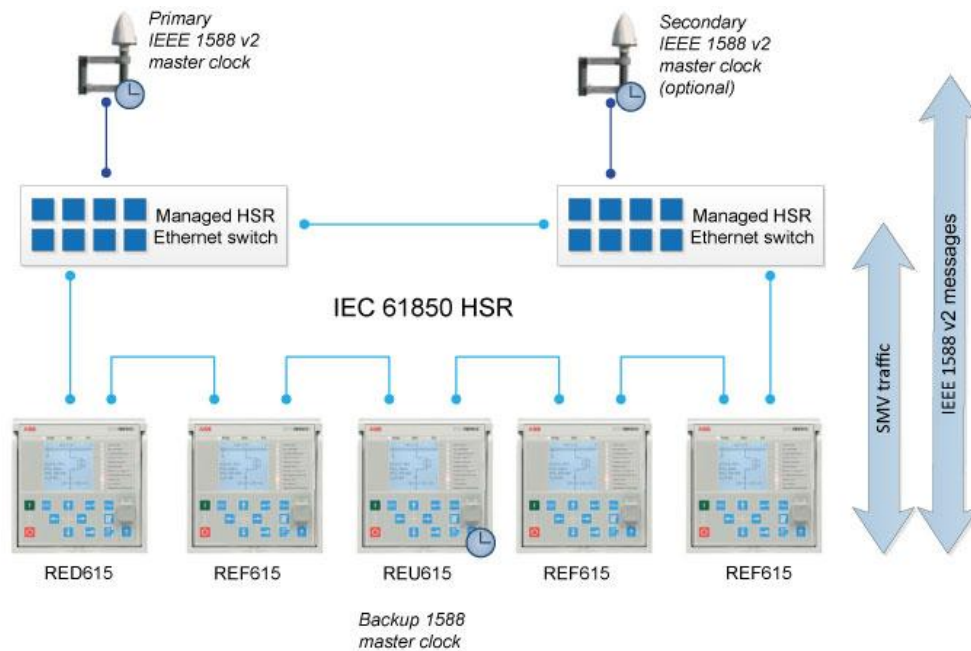
## Ethernet Communications

The following schemes represents the preferred communications between relays to transmit GOOSE signals and to ensure that reliable communications exist for the implementation of the transfer scheme

**ABB Inc.**

# ABB

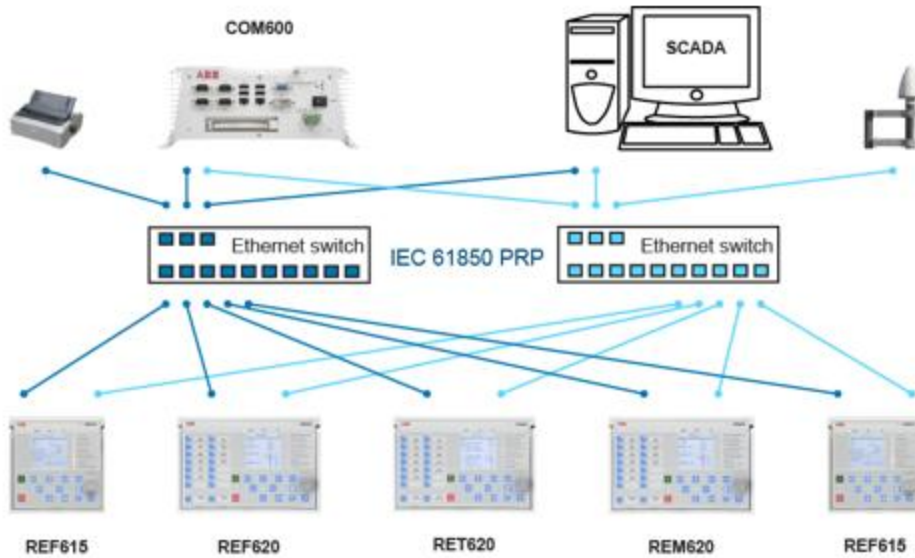
## HSR



## PRP

**ABB Inc.**

# ABB



## Bill of Material

43 M/A Manual/Auto switch

43-PT T1/T2 Preferred Tie Switch

(3) Lockout Relays

(2) REF615 Ordering Code: HAFDDADAFHE5BBN12E for the Mains

(1) REF615 Ordering Code: HAFFFAFAFHE5BBN12E for the Ties

(1) Ethernet Switch

**ABB Inc.**