

Testing a SIPROTEC GOOSE bus protection scheme using an OMICRON CMC

One of the common applications of GOOSE messages is to implement a ‘fast bus’ or ‘reverse interlocking’ bus protection scheme. In its most basic form (Figure 1) a directional overcurrent relay is installed on the incomer. If a fault is detected towards the bus the incomer relay will trip unless any of the feeder relays send it a blocking signal indicating that the fault is external to the bus.

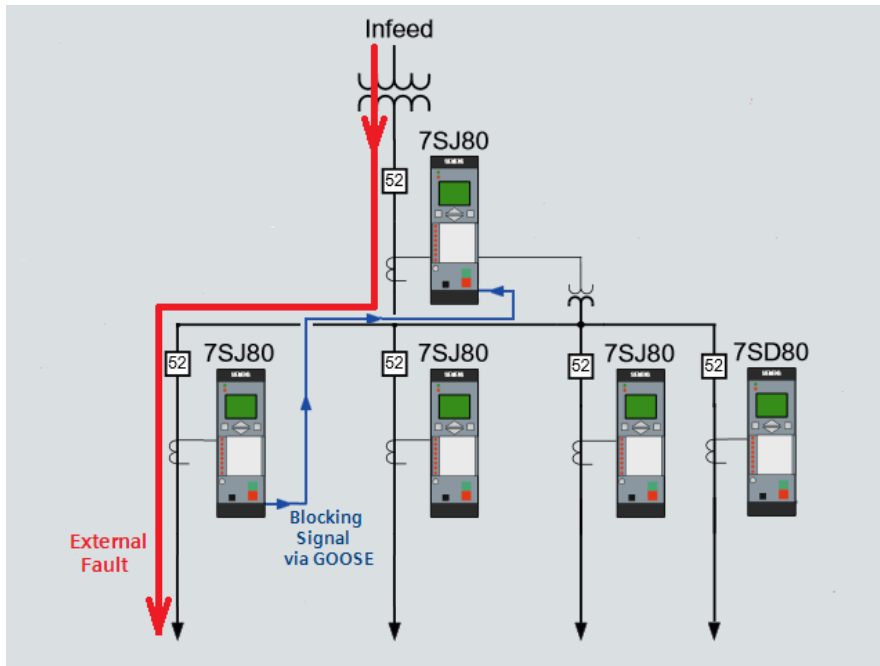


Figure 1. Reverse Interlocking Scheme

Ideally this type of scheme should be tested by primary or secondary injection into both the incomer and feeder relay at the same time. However there are often cases when access to only a single relay at once is possible. Since IEC61850 is an international standard, the use of a third-party test tool is possible. One such test tool is the OMICRON CMC.

Method

The relay-relay GOOSE application is created in DIGSI IEC 61850 System Configurator. The pickup (‘start’) of the overcurrent elements in each of the feeder relays is mapped to a GOOSE input in the incomer relay (Figure 2). Configuration is via drag and drop – DIGSI automatically takes care of the necessary low level details of the protocol.

GOOSE messages						
Source	CDC	Description	Subn...	Destination	Description	
IEC61850 station						*
GOOSE_OC_Block						*
FeedrA_7SJ801/PROT/LLN0/DataSet (2/100)			✓			*
FeedrA_7SJ801/PROT/PTOC6/Str	ACD	Protection/DMT I>/Pickup				
FeedrA_7SJ801/PROT/PTOC6/Str/3-pole	SPC	Protection/DMT I>/Pickup/3-pole		Incomr_7SJ804/CTRL/OCBlkGG101/SPCS01	Control/OCBlkGG101/GOOSE Overcurrent blocking from Feeder A	
FeedrB_7SJ801/PROT/LLN0/DataSet (2/100)			✓			*
FeedrB_7SJ801/PROT/PTOC6/Str	ACD	Protection/DMT I>/Pickup				
FeedrB_7SJ801/PROT/PTOC6/Str/3-pole	SPC	Protection/DMT I>/Pickup/3-pole		Incomr_7SJ804/CTRL/OCBlkGG101/SPCS02	Control/OCBlkGG101/GOOSE Overcurrent blocking from Feeder B	
FeedrC_7SJ801/PROT/LLN0/DataSet (2/100)			✓			*
FeedrC_7SJ801/PROT/PTOC6/Str	ACD	Protection/DMT I>/Pickup				
FeedrC_7SJ801/PROT/PTOC6/Str/3-pole	SPC	Protection/DMT I>/Pickup/3-pole		Incomr_7SJ804/CTRL/OCBlkGG101/SPCS03	Control/OCBlkGG101/GOOSE Overcurrent blocking from Feeder C	
FeedrD_7SD801/PROT/LLN0/DataSet (2/100)			✓			*
FeedrD_7SD801/PROT/PTOC2/Str	ACD	Protection/DMT I>/Pickup				
FeedrD_7SD801/PROT/PTOC2/Str/3-pole	SPC	Protection/DMT I>/Pickup/3-pole		Incomr_7SJ804/CTRL/OCBlkGG101/SPCS04	Control/OCBlkGG101/GOOSE Overcurrent blocking from Feeder D	

Figure 2 DIGSI IEC 61850 System Configurator

If the GOOSE mapping has already been created in DIGSI, then getting this information into the OMICRON is as simple as exporting the Substation Configuration Description (SCD) file from DIGSI and importing it into the OMICRON GOOSE Configuration software.

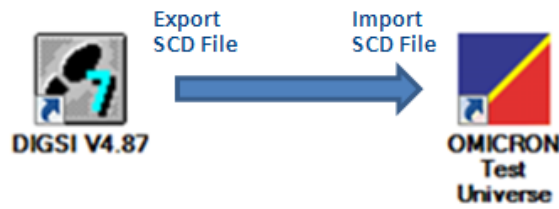


Figure 3. Export DIGSI SCD file, and Import in OMICRON GOOSE Configuration

By connecting the OMICRON into either the subnet or directly into a relay, the OMICRON software allows the CMC to either simulate or subscribe to any of the station. Again, configuration of this is via drag and drop – the relevant GOOSE data-set item is selected and mapped to a binary input or output of the CMC (Figure 4). These are then available for use as standard binary inputs/outputs in other parts of the Test Universe software.

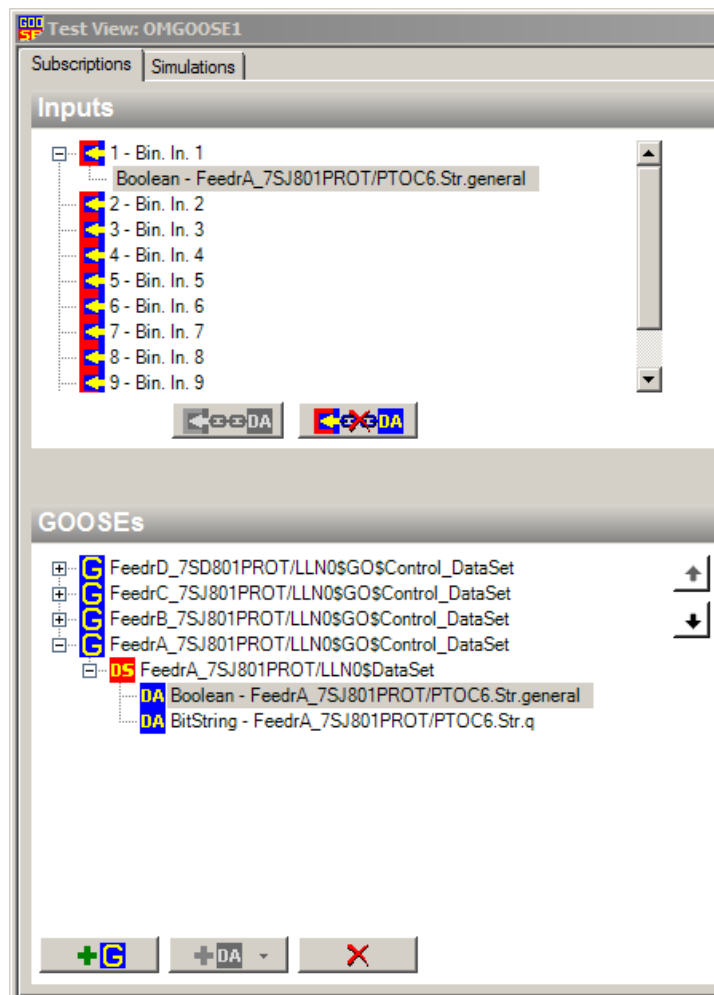


Figure 4. GOOSE data set mapping

By use of the Omicron secondary injection combined with its GOOSE functions each of the SIPROTEC relays in the fast-bus scheme can be tested individually.

Test 1: Testing a feeder relay:

Testing of the feeder relay is to confirm that as soon as its overcurrent element picks up it transmits a suitable GOOSE blocking message. The Omicron is connected to inject a secondary current into the relay above the element pickup threshold. The Omicron is set to subscribe to the 'Start' GOOSE message expected to be transmitted by the relay. Since the SCD file was directly imported from DIGSI, all the protocol details of the GOOSE message will automatically be checked during the testing for conformance with what the incomer relay is expecting.

An Omicron test is created and executed to record the time taken from injection of current to receipt of the GOOSE message. Typically times expected will be the pickup time of the relay element plus just a few milliseconds.

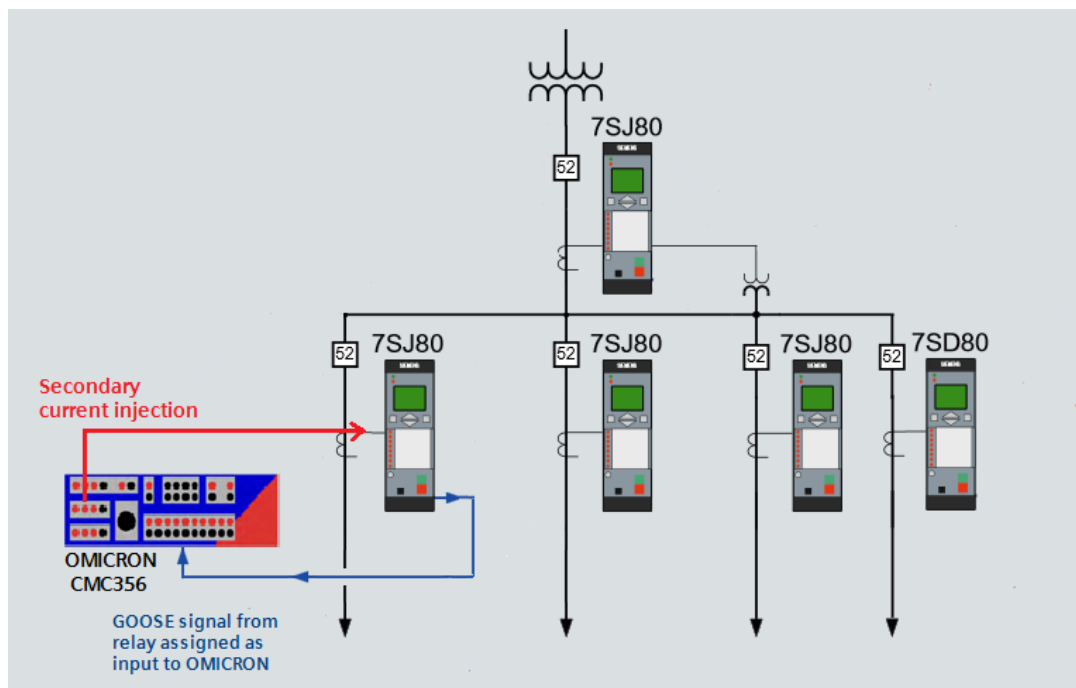


Figure 5. Testing Feeder Relay – confirming GOOSE message dispatch

Test 2: Testing the incomer relay

The incomer relay is tested to confirm that when it receives a blocking message via GOOSE that its directional overcurrent element does not issue a trip (Figure 7). The OMICRON is configured to simulate the GOOSE message that would come from one of the feeder relays. For testing, activation of this GOOSE transmission is via any of the mapped binary output functions of the Test Universe application (Figure 6).

Using the State Sequencer, the first state can be set to inject voltage and current into the relay without any GOOSE message transmission. After a short time delay (to match that recorded in Test 1) the second state should keep the analogue signals on, but activate the GOOSE message transmission by turning the relevant binary output on. A successful test is where the relay element does not trip.

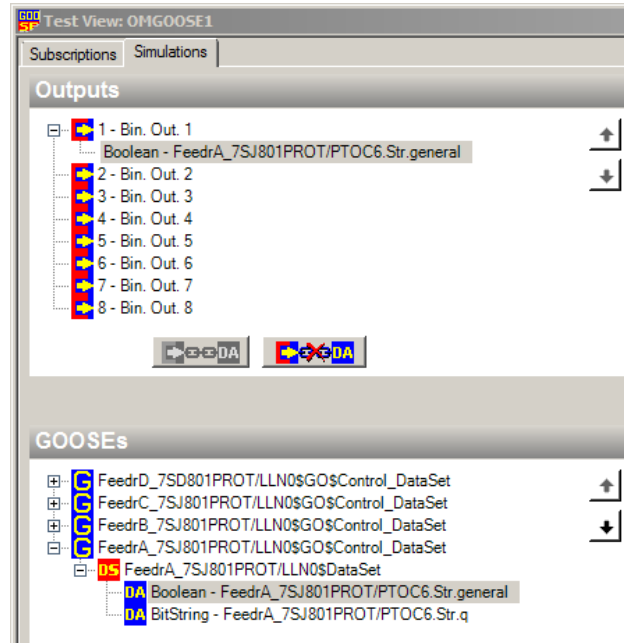


Figure 6. Using a binary output to generate blocking GOOSE message

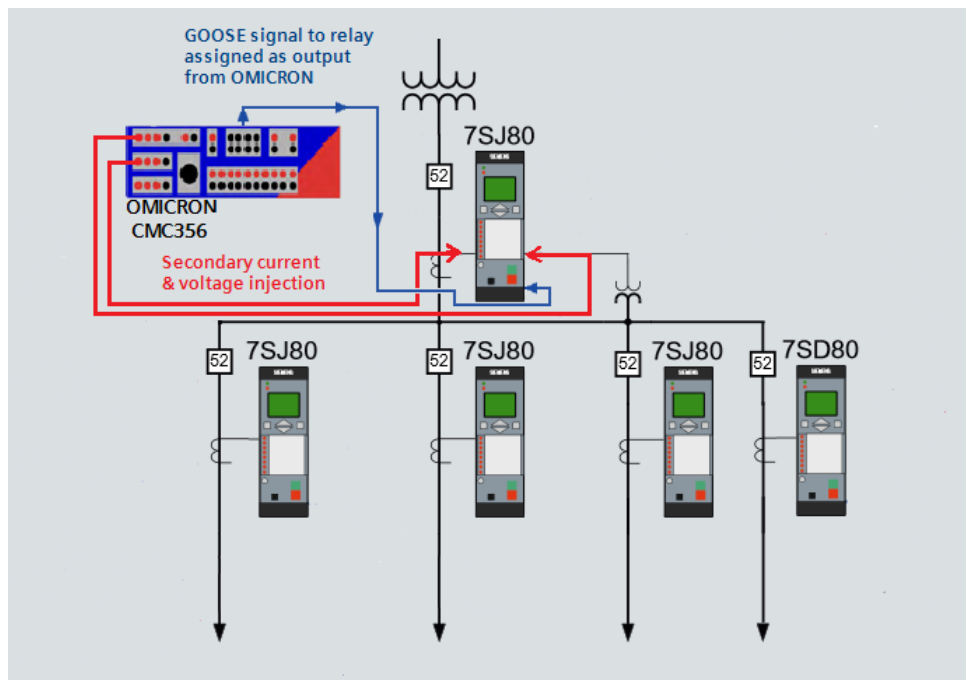


Figure 7. Testing In-come blocking with received GOOSE message

More Information:

For further details of how to use DIGSI and SIPROTEC relays to build a reverse-interlock scheme refer to the Siemens IEC 61850 Standard Application Examples, or contact HV Power:

http://www.energy.siemens.com/ecc_pool/SIPROTEC_Applications/c90e7b3d-8d6d-438f-a031-fffa04483bc/IEC61850_Applications_en.pdf