Compact Controller for Stand-by and Parallel Operating Gen-sets

Inteli New Technology
Modular Gen-set Controller

IG-NT, IG-NTC, IG-EE, IG-EEC, IG-NT-BB, IG-NTC-BB, IS-NT-BB, IS-NTC-BB, IM-NT, IM-NTC-BB

Software version IGS-NT-3.0, IM-NT-3.0, May 2013

APPLICATION GUIDE

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Table of Contents

1. Available related documentation

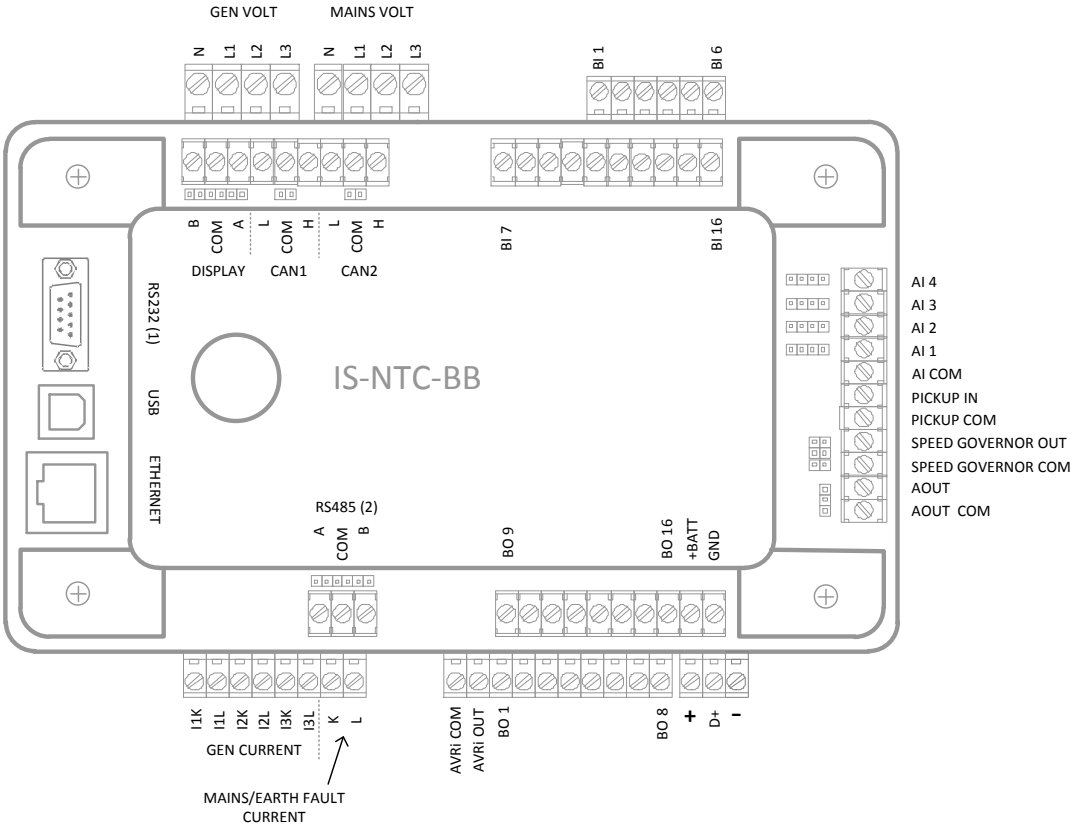
PDF files	Description
IGS-NT-SPTM-3.0 Reference Guide.pdf	General description of SPtM applications for InteliGen NT and InteliSys NT. Contains description of engine and generator control, control of power in parallel to mains operation, list of all Setpoints, Values, Logical Binary Inputs and Logical Binary Output.
IGS-NT-SPI-3.0 Reference Guide.pdf	General description of SPI applications for InteliGen NT and InteliSys NT. Contains description of engine and generator control, control of power in parallel to mains operation, list of all Setpoints, Values, Logical Binary Inputs and Logical Binary Output.
IGS-NT-MINT-3.0 Reference Guide.pdf	General description of MINT applications for InteliGen NT and InteliSys NT. Contains description of engine and generator control, powermanagement, list of all Setpoints, Values, Logical Binary Inputs and Logical Binary Output.
IGS-NT-Combi-3.0 Reference Guide.pdf	General description of Combi applications for InteliGen NT and InteliSys NT. Contains description of engine, and generator control in SPTM, SPI and MINT mode, powermanagement, list of all Setpoints, Values, Logical Binary Inputs and Logical Binary Output.
IGS-NT-COX-3.0 Reference Guide.pdf	General description of COX applications for InteliGen NT and InteliSys NT. Contains description of engine and generator control, powermanagement, list of all Setpoints, Values, Logical Binary Inputs and Logical Binary Output.
IGS-NT Application Guide 05-2013.pdf	Applications of InteliGen NT, InteliSys NT and InteliMains NT, examples of connection, description of PLC functions, Virtual and Shared peripheries.
IGS-NT Operator Guide 05-2013.pdf	Operator Guide for all hardware variation of InteliGen NT and InteliSys NT, InteliVision 5 and InteliVision 8.
IGS-NT Installation Guide 05-2013.pdf	Thorough description of installation and technical information about InteliGen NT, InteliSys NT and InteliMains NT and related accessories.
IGS-NT Communication Guide 05-2013.pdf	Thorough description of connectivity and communication for InteliGen NT, InteliSys NT and InteliMains NT and related accessories.
IGS-NT Troubleshooting Guide 05-2013.pdf	How to solve most common troubles with InteliGen NT and InteliSys NT controllers. Including the list of alarm massages.
IGS-NT & ID-DCU Accessory Modules 05-2013.pdf	Thorough description of accessory modules for IGS-NT family, technical data, information about installation of the modules, how to connect them to controller and set them properly.

2. IGS-NT family overview

2.1. InteliSys-NT hardware options

InteliSys (New technology) contains two main modules: IS-NTC-BB (Base box) and InteliVision 8 or IS-Display (Display unit). They can be mounted together for panel door mounting or IS-NTC-BB in the switchboard and InteliVision 8 or IS-Display in the panel door.

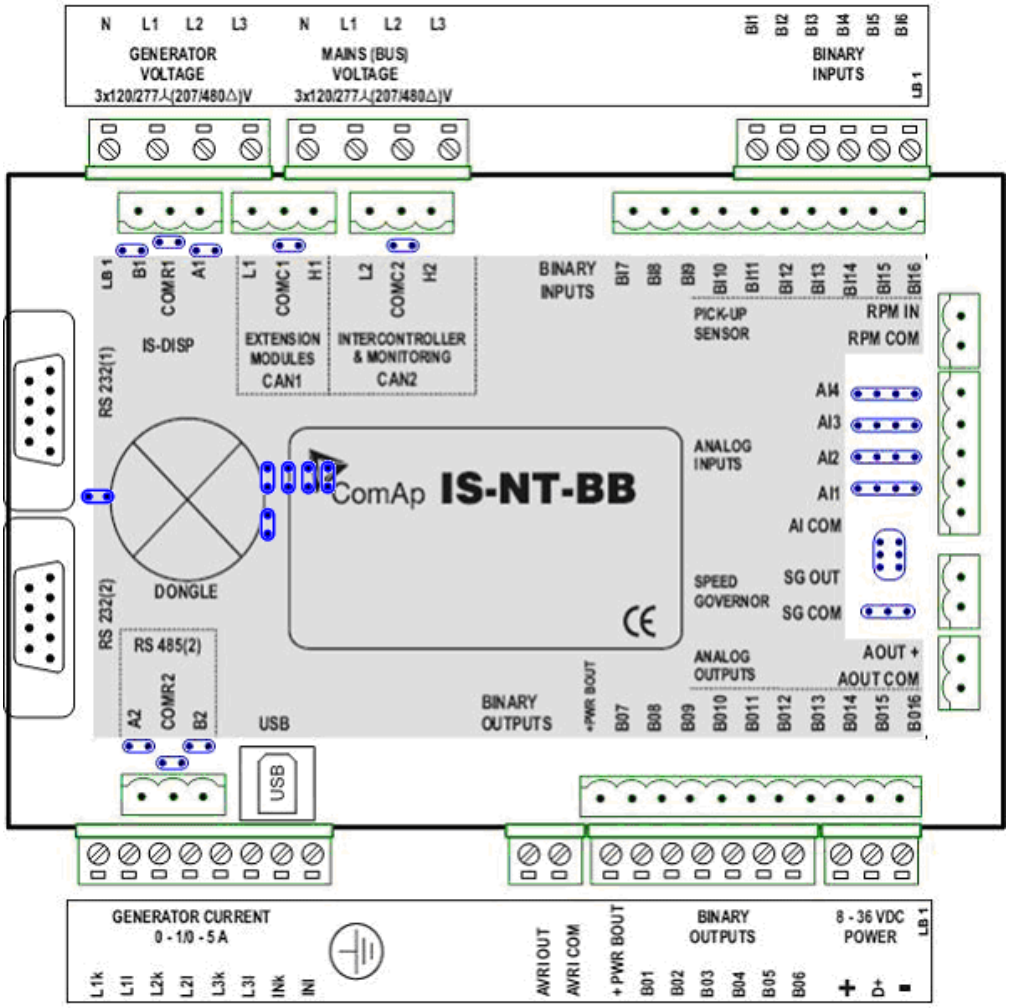
For wiring details, please refer to IGS-NT-Installation guide



IS-NTC-BB rear view

InteliSys (New technology) comes also in older model variant called IS-NT-BB (Base box) and can be also coupled with InteliVision 8 or IS-Display (Display unit). This HW modification differs in communication possibilities.

For wiring details, please refer to IGS-NT-Installation guide



InteliGen-NT hardware options

InteliGen controller is a compact controller produced with several hardware options.

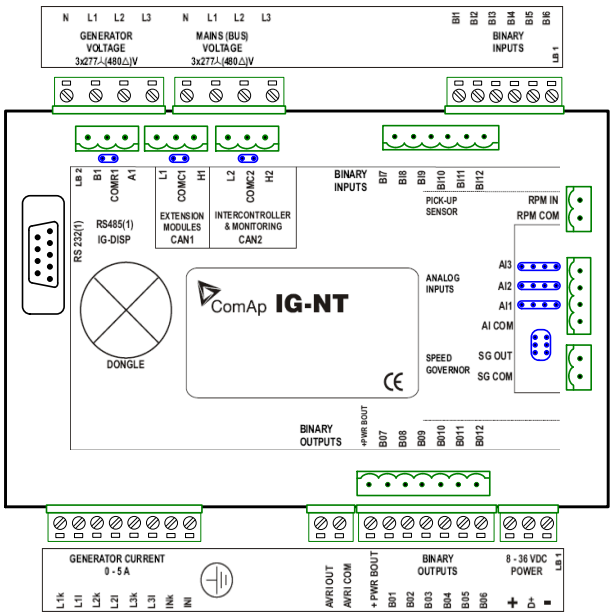
InteliGen controller range:

IG-NTC GC LT

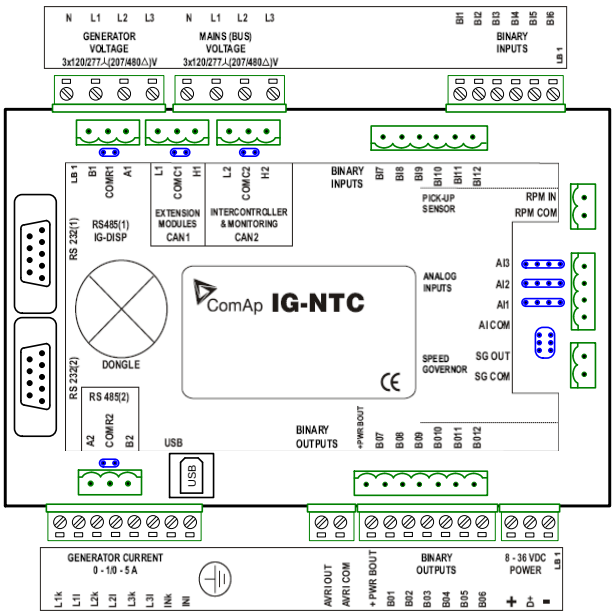
Low temperature version. The unit has a display heating foil that allows operation down to -40°C. Standard units are limited to -20°C. For details, please see the IGS-NT-Installation guide.

Graphical character alphabet support. In this version, one language based on graphical characters (e.g. Chinese) can be used. The standard unit supports languages based on Latin + Cyrillic characters only.

Extended functionality. The unit has two extra communication ports: (USB slave port + RS232 with internal converter to RS485). Also selectable AC voltage and current input ranges are available. For details, please see the Reference guide for a specific software configuration



IG-NT- rear view

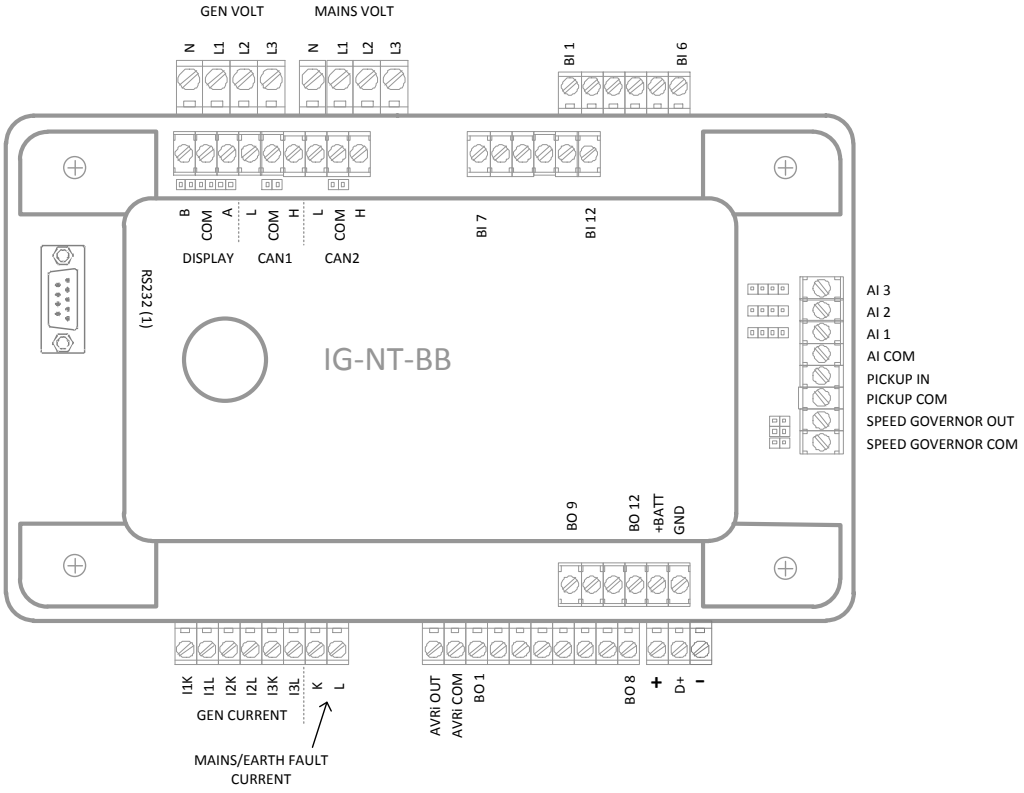


IG-NTC rear view

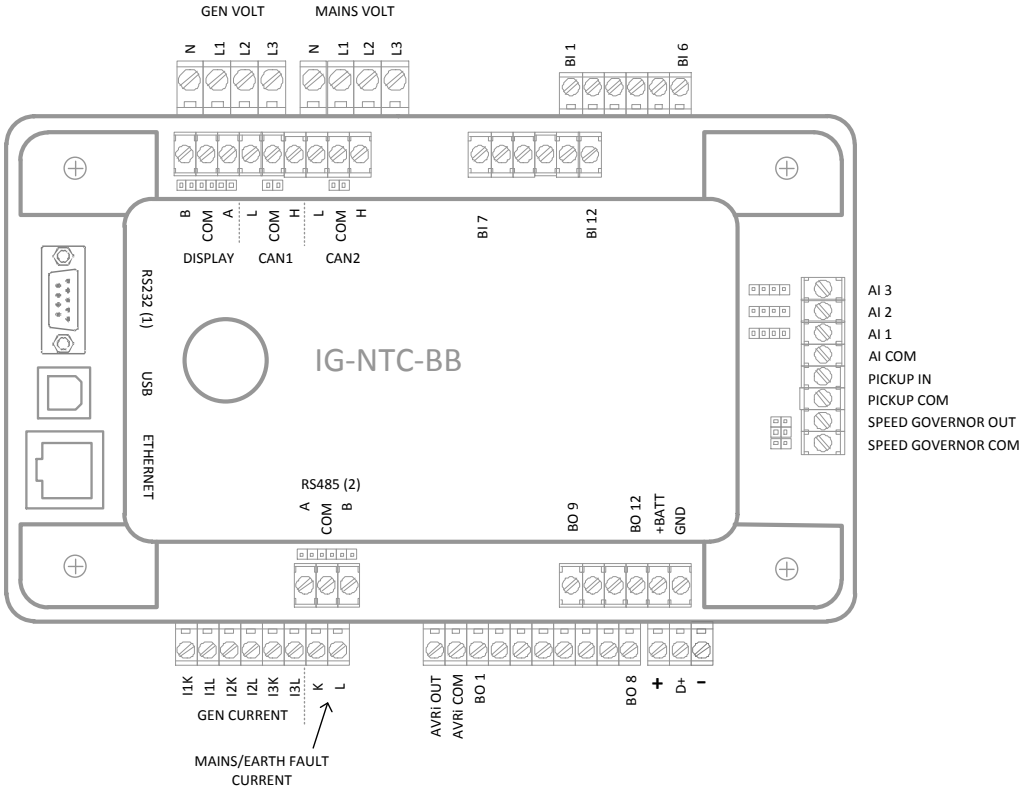
IG-NTC-BB

Base Box is the control unit without internal display. The control unit can be mounted into the switchboard on DIN rail.

Extended functionality. The unit has three extra communication ports: (USB slave port + Ethernet and RS485(2). Also selectable AC voltage and current input ranges are available. For details, please see the Reference guide for a specific software configuration



IG-NT-BB rear view



IG-NTC-BB rear view

2.2. InteliMains-NT hardware options

InteliMains controller is a compact controller produced with several hardware options.

InteliGen controller range:

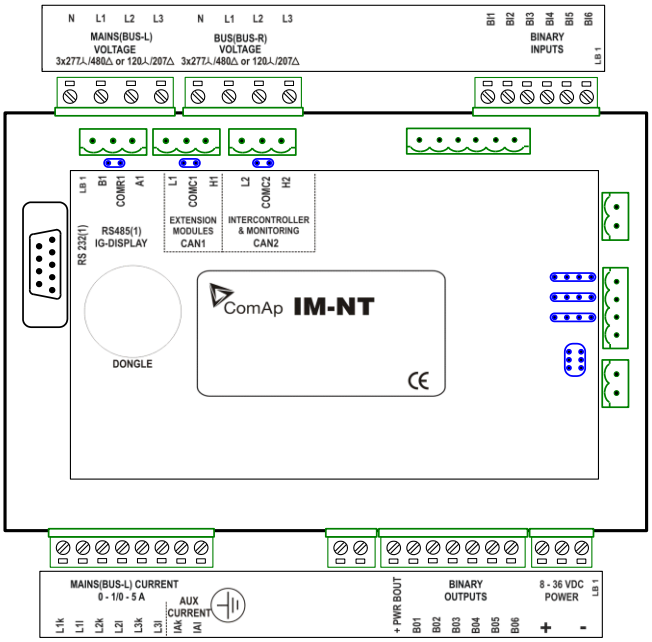
IM-NT GC LT

Low temperature version. The unit has a display heating foil that allows operation down to -40°C. Standard units are limited to -20°C. For details, please see the IGS-NT-Installation guide.

Graphical character alphabet support. In this version, one language based on graphical characters (e.g. Chinese) can be used. The standard unit supports languages based on Latin + Cyrillic characters only.

IM-NT (New technology)

IM-NT- rear view



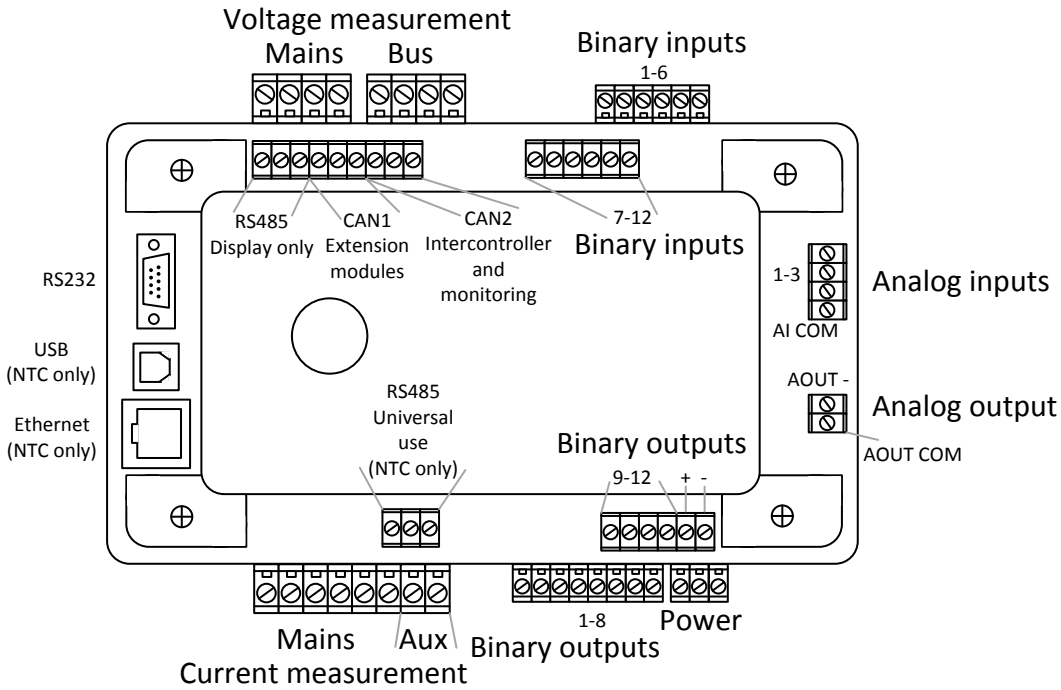
IM-NT-BB

Base Box is the control unit without internal display. IM-NT-BB can be mounted into the switchboard on the DIN rail.

IM-NTC-BB

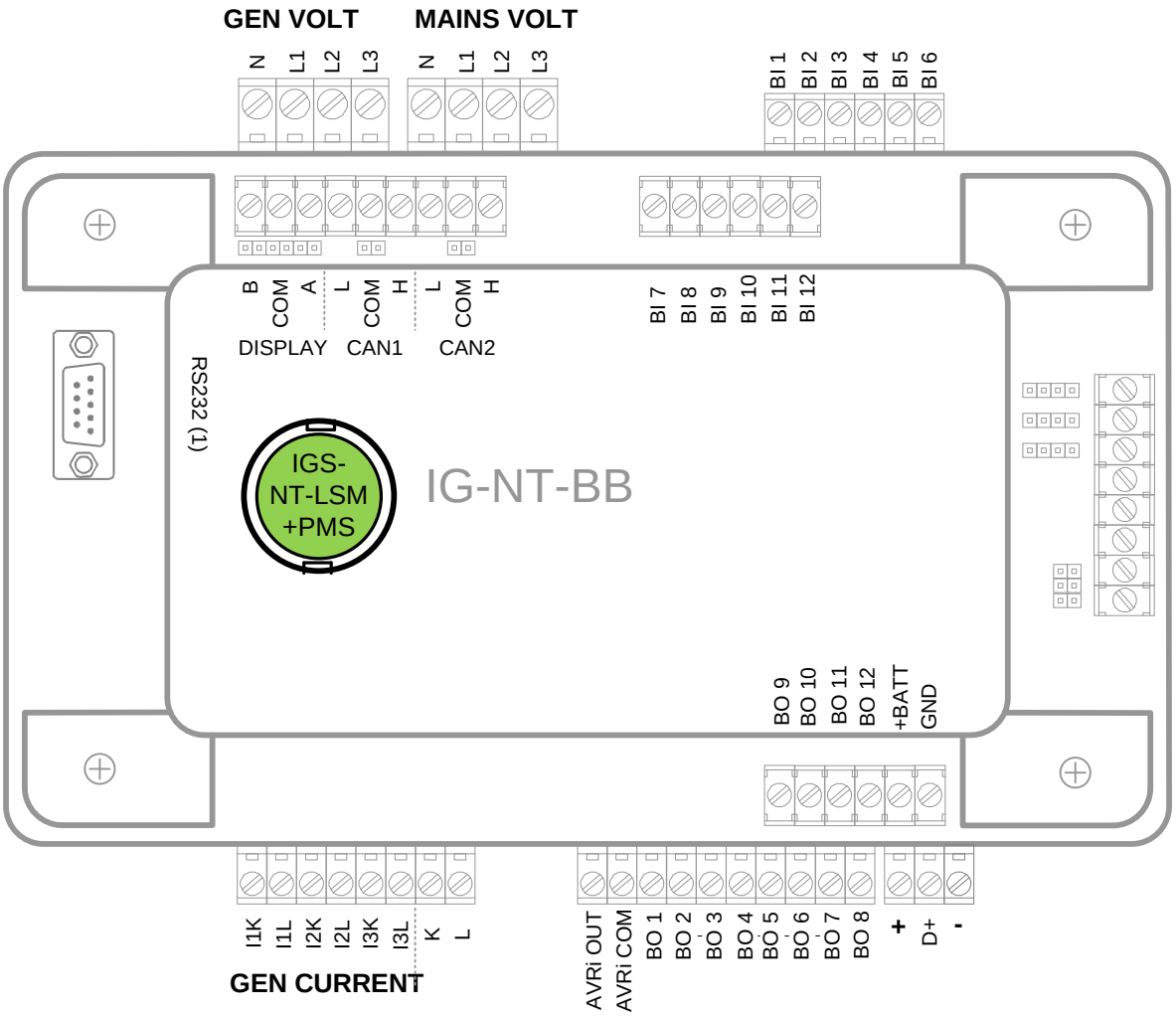
Base Box is the control unit without internal display. IM-NT-BB can be mounted into the switchboard on the DIN rail.

Extended functionality. The unit has three extra communication ports: (USB slave port + Ethernet and RS485(2). Also selectable AC voltage and current input ranges are available. For details, please see the Reference guide for a specific software configuration



2.3. Loadsharing and Power management

Dongle for load sharing, power management and additional PLC functions should be installed from the rear side of the controller under the rubber plug. The dongle label should remain visible as shown on the picture.



Back view on the IG-NT-BB unit with the IGS-NT-LSM+PMS dongle.

2.4. Inputs/outputs overview

	Binary Inputs	Binary Outputs	Analogue Inputs	Analogue Outputs	SpeedGov control	AVR control
IG-NT / IG-NT-BB	**12**	**12**	**3**	**-**	✓	✓
IS-NT / IS-NTC-BB	**16**	**16**	**4**	**1**	✓	✓
IM-NT	**6**	**6**	**0**	**0**	**-**	**-**
IM-NT-BB	**12**	**12**	**3**	**1**	**-**	**-**

2.5 Available extension modules overview

The table shows maximum number of particular modules that can be connected to IG/IS-NT controller. The total number of connected modules is limited by IG/IS-NT extension capacity:

- 12 groups of binary inputs
- 12 groups of binary outputs
- 10 groups of analog inputs
- 4 groups of analog outputs

1 group has 8 inputs/outputs.

IGS-PTM	IS-BIN16/8	IS-AIN8	IS-AIN8TC	I-AOUT8	IGL-RA15
4	6	10	10	4	4

2.6 Communication ports overview

	RS232 (1)	CAN1*	CAN2**	External display interface ***	Additional RS232 w RS485	USB 2.0 slave	Ethernet RJ45
IG-NT	✓	✓	✓	✓	**-**	**-**	**-**
IG-NT-BB	✓	✓	✓	✓	**-**	**-**	**-**
IG-NTC	✓	✓	✓	✓	✓	✓	**-**
IG-NTC-BB	✓	✓	✓	✓	✓	✓	✓
IS-NT	✓	✓	✓	✓	✓	✓	**-**
IS-NTC-BB	✓	✓	✓	✓	✓	✓	✓
IM-NT	✓	✓	✓	✓	**-**	**-**	**-**
IM-NT-BB	✓	✓	✓	✓	**-**	**-**	**-**
IM-NTC-BB	✓	✓	✓	✓	✓	✓	✓

*CAN1 - communication bus for external modules and ECU (J1939)
**CAN2 - communication bus for intercontroller and monitoring communication
***External display interface (RS485(1)) - communication with display (see appropriate reference guide).

2.7 Order codes overview

2.7.1 InteliSys-NT

InteliSys Base Box	IS-NT-BB
Local/Remote display for InteliSys	IS-Display*, InteliVision 8, InteliVision 5
Complete unit (IS-NT-BB+IS-Display)	IS-NT
Low temperature version of IS-Display	IS-Display LT *

* - GC feature included by default in all InteliVision 8 and IS-Display modules

2.7.2 InteliSys-NTC-BB

New InteliSys BaseBox unit	IS-NT**C**-BB

2.7.3 InteliGen-NT,

Controller basic type	IG-NT
Extended functionality	IG-NTC
Low temperature version	IG-NT LT
Extended functionality and low temperature	IG-NTC LT

* - GC feature included by default in all internal displays from 2010.

A common name for any of the above controllers is **IGS-NT**. This name is used for description of functions or features common to all IG-NT, IG-NT-BB and IS-NT, IS-NTC-BB controllers.

2.7.4 InteliGen-NT-BB

Controller basic type	IG-NT-BB
Extended functionality	IG-NTC-BB

2.7.5 InteliMains-NT

Controller basic type	IM-NT GC
Full controller version	IM-NT GC LT

2.7.6 InteliMains-NT-BB

Controller basic type	IM-NT-BB

2.7.7 Displays

5,7” Colour display*	InteliVision 5
8” Colour display *	InteliVision 8
Monochromatic display for IS-NT-BB	IS-Display
Remote Display for InteliGen	IG-Display GC
Low temperature version of Remote Display for InteliGen	IG-Display GC LT
Low temperature version of Remote Display for InteliGen	IG-Display GC LT

* - Display can be connected to IS-NT-BB, IS-NTC-BB, IG-NT-BB, IG-NTC-BB, IM-NT-BB, IG-NT, IG-NTC controllers

2.7.8 Common modules

Module allowing Load sharing and Power management	**IGS-NT-LSM+PMS**
AVR interface	IG-AVRi
Transformer supplying IG-AVRi Input voltage 230-277, 400-480V	IG-AVRi-Trans/LV
Transformer supplying IG-AVRi Input voltage 100-120V	IG-AVRi-Trans/100

2.7.9 I/O expansion modules

Binary input and output module	IS-BIN16/8
Analogue input module	IS-AIN8
Analogue thermocouples module	IS-AIN8TC
Analogue output module	I-AOUT8
Remote annunciator	IGL-RA15
Combined module (BI, BO, AI, AO)	IGS-PtM
Relay board	I-RB8, I-RB16

For more information about accessory modules see *"Accessory modules for IG-NT, IS-NT, ID-DCU.pdf"*

2.7.10 Remote communication modules

CAN / USB, RS232, RS485 bridge for multiple controllers connection	I-LB+
RS232, CAN / Internet bridge for multiple controllers connection	IG-IB
Communication bridge for modbus communication	I-CB/Modbus

For more information about accessory modules see *"Accessory modules for IG-NT, IS-NT, ID-DCU.pdf"*

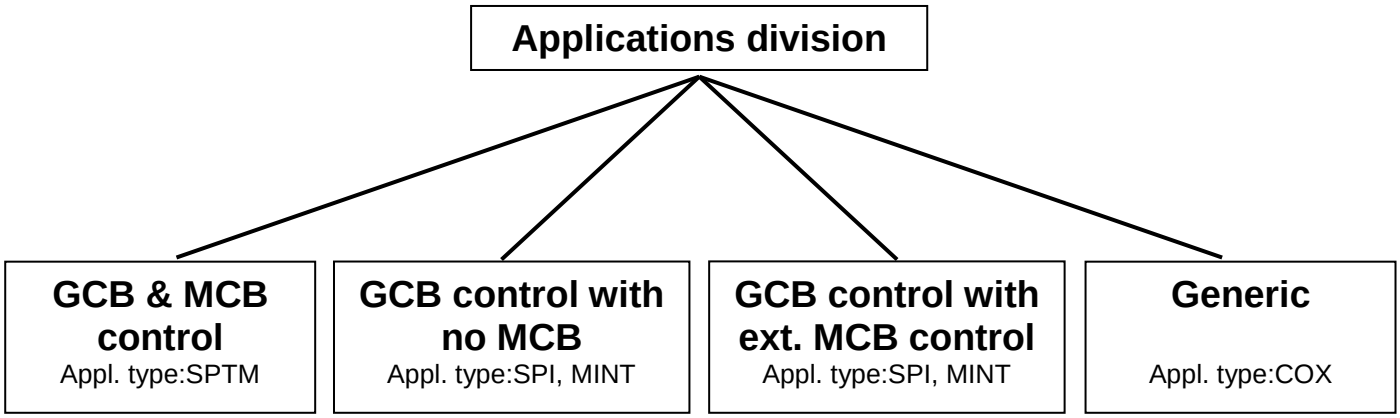
2.7.11 Communication bridges with Non-J1939 Electronic engines

Communication bridge for CAT diesel engines equipped with CCM (Customer communication module)	I-CB/CAT Diesel
Communication bridge for CAT diesel engines equipped with CCM (Customer communication module	I-CB/CAT Gas
Communication bridge for MTU diesel engines equipped with MDEC unit (2000/4000 series)	I-CB-MTU
Communication bridge for MTU gas engines equipped with SIAM unit (4000 series)	I-CB/MTU SIAM4000
Communication bridge for Deutz gas engines equipped with TEM Evolution	I-CB/Deutz TEM

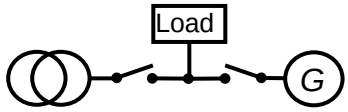
2.7.12 IGS-NT simulators

Single set simulator with IG-NTC GC	IG-NT-SK
Single set simulator with IS-NT	IS-NT-SK
Multiple set simulator with IG-NTC GC	IG-NTC GC-MK
Single set simulator with IS-NTC-BB and InteliVision 8	IS-NTC-IV8-SK
Single set simulator with IG-NTC-BB and InteliVision 5	IG-NTC-IV5-SK
Simulator of Multiple Genset Applications with Paralleling Gen-set Controllers and Color Displays	IG-NTC-MULTIKIT
Simulator of Multiple Genset Applications with Paralleling Gen-set and Mains Controllers and Color Displays	IS-NTC-MULTIKIT
Simulator of Multiple Gen-set Applications in a 2-Mains System	HS-MULTIKIT

3. InteliGen-NT, InteliSys-NT applications overview



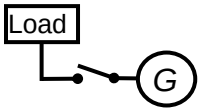
3.1 Applications with GCB & MCB control



Typical applications:

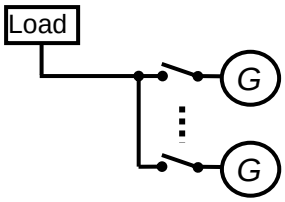
- AMF (SSB): Automatic mains failure start
- AMF with no break return
- Single set in Parallel to Mains with AMF (SPtM)
- Combined heat and power (CHP)
- Peak shaving
- Import/Export power control

3.2 Applications with GCB control and no MCB



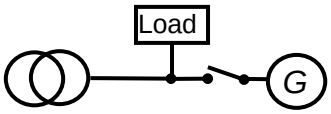
Typical applications:

- MRS (SPM): Manual or remote start/stop of a single engine



Typical applications:

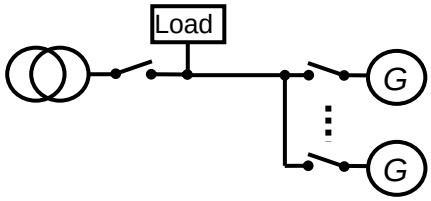
- Multiple sets running in island-parallel

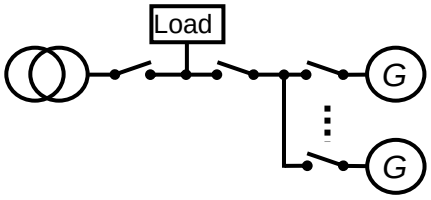


Typical applications:

- CHP with no island operation (no backup)

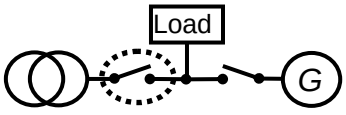
3.3 Applications with GCB control with external MCB control





Typical applications:

- AMF with multiple sets running in island-parallel. MCB controlled by a simple mains protection relay or InteliMains
- AMF with no break return (multiple sets). MCB controlled by InteliMains-NT.
- Parallel to Mains with AMF for multiple sets (CHP) MCB controlled by InteliMains-NT.



Typical applications:

- CHP with external MCB control. Normally the load is higher than gen-set capacity and non-preferential load must be switched off before gen-set can be switched to island operation.

3.4 Generic applications

Controller performs individual steps like:

- Gen-set start
- GCB dead bus closing
- Synchronizing
- Load control mode
- Reverse synchronizing
- Gen-set stop

Steps are driven by commands from an external device, e.g. PLC. This device is responsible for all sequencing (steps order).

Typical applications:

- Complex systems with several buses where PLC controls each step of the gen-set.
- Complex CHP applications controlled from a central PLC

4. Applications description

4.1 GCB& MCB Control

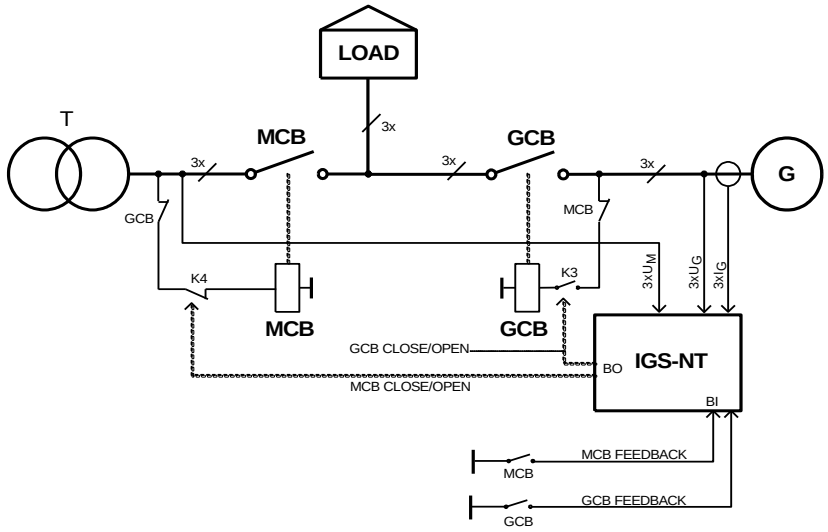
4.1.1 AMF – Automatic mains failure start

Specification

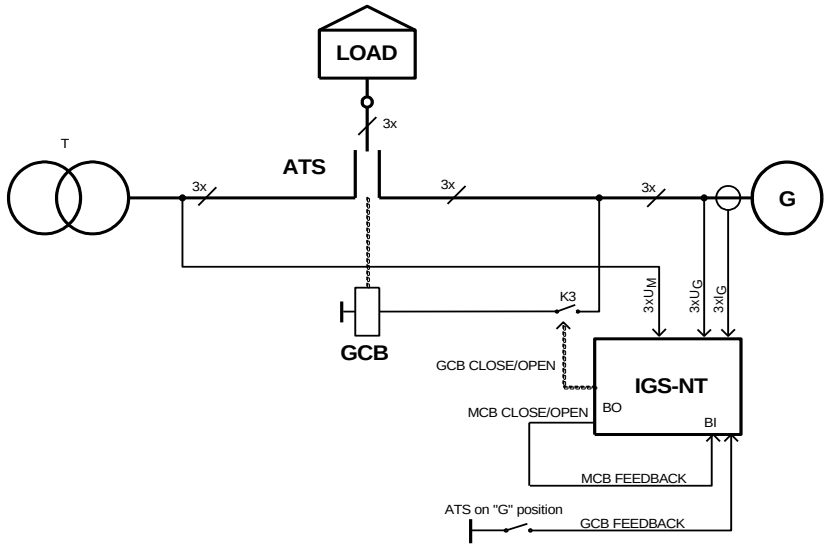
- Automatic gen-set start when the mains fails
- GCB & MCB full control or ATS control
- Break transfer on mains failure
- Break return on mains return (Load reclosing)
- Test mode (set running and waiting for mains failure)

MCB is automatically opened when Mains fails. GCB is closed when all required parameters are within the limits (Voltage and frequency). When Mains recovers GCB is opened and MCB is reclosed.

Two separate breakers – GCB and MCB



ATS – Automatic transfer switch



Hardware requirements

1x IGS-NT

Required application type: SPtM.ant

Required setting:

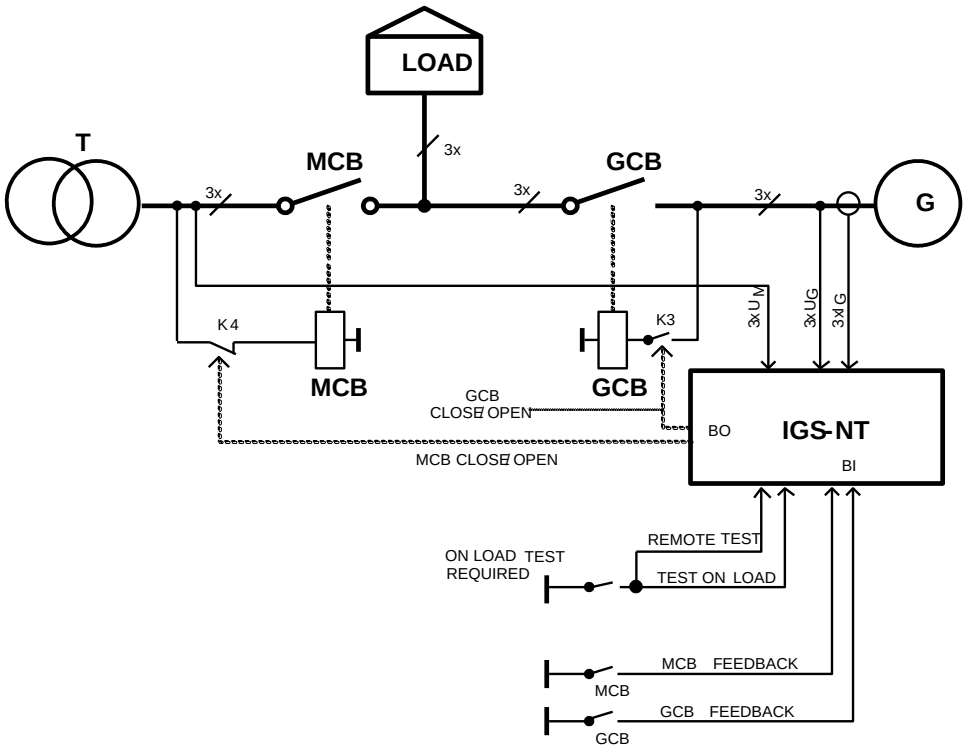
Setpoints group: ***ProcessControl***

Island enable:	YES
ParallelEnable	NO
Synchro enable	NONE
MFStart enable	YES

4.1.2. AMF + On Load Test

Specification

- Automatic gen-set start when the mains fails
- GCB & MCB full control or ATS control
- Break transfer on mains failure
- Break return on mains return (Load reclosing)
- Test mode (set running and waiting for mains failure)
- On Load Test - load transfer to gen-set (Island operation) and back to mains in TEST mode on **BI Test on load** activation/deactivation. There are 2 breaks in this operation. Controller may be forced to TEST mode by **BI Remote TEST**



Hardware requirements

1x IGS-NT

Required application type: SPtM.ant

Required setting:

Setpoints group: ***ProcessControl***

Island enable:	YES
ParallelEnable	NO
Synchro enable	NONE
MFStart enable	YES

4.1.3. Single Set Parallel to Mains

AMF with no break return or Long time Parallel to Mains

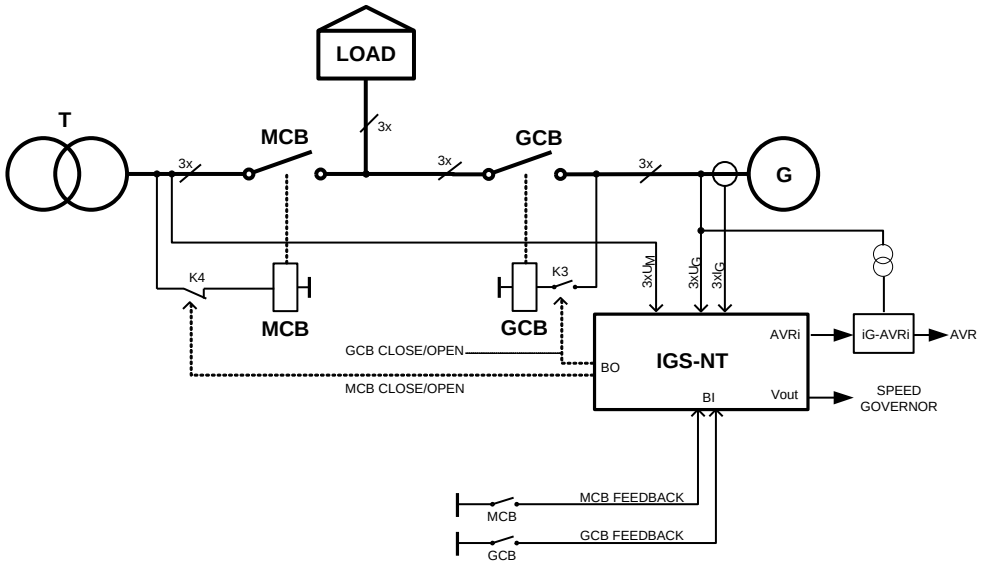
Specification

AMF with no break return

- Automatic gen-set start when the mains fails
- GCB & MCB full control
- Break transfer on mains failure
- No break return on mains return with soft load transfer
- Test mode (set running and waiting for mains failure with GCB opened)
- Short time parallel (normally mains protection not required by mains authority)
- Power control
- Voltage matching
- Reverse power protection

Long time Parallel to Mains

- Continuous parallel to mains operation
- Generator Base load and PF control
- Mains protections (Vector shift, voltage, frequency protections)
- No break transfer on mains failure(if the set was running before the mains failure and was capable to cover the load)



Hardware requirements

1x	IGS-NT	
1x	IG-AVRi	(when volt matching and PF control is required)
1x	IG-AVRi-TRANS/LV	(when IG-AVRi is used)

Required application type: SPtM.ant

Required setting:

Setpoints group: ***ProcessControl***
Island enable: YES
ParallelEnable YES
Synchro enable BOTH (In case of AMF with no break return where On load test is not used, this setpoint may be set to REVERSE only)
MFStart enable YES

4.1.4 SPtM + On Load Test

Specification

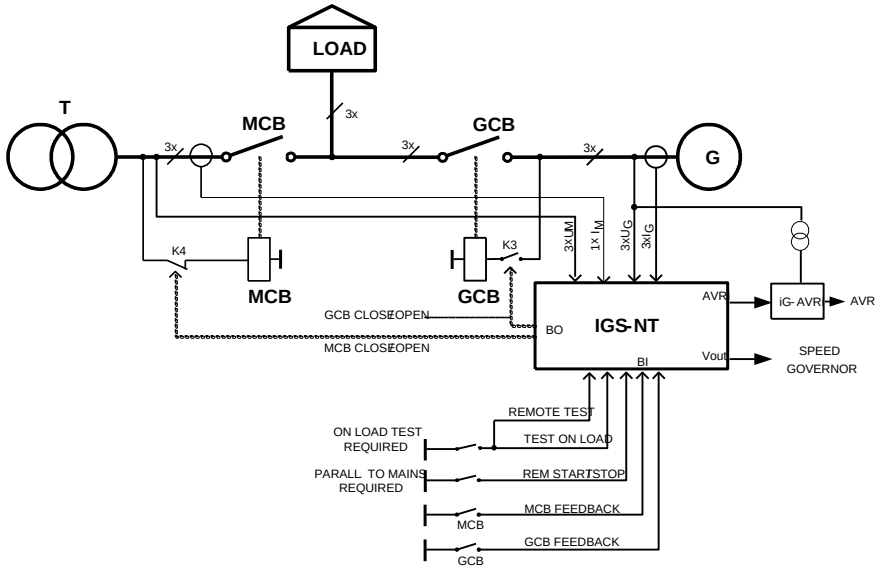
AMF with no break return + On load test

- Automatic gen-set start when the mains fails
- GCB & MCB full control
- Break transfer on mains failure
- No break return on mains return with soft load transfer
- Test mode (set running and waiting for mains failure with GCB opened)
- On Load Test – No break transfer to gen-set (Island operation) and no break return back to mains in TEST mode on **BI Test on load** activation/deactivation. Without Import/Export power measurement MCB is opened just after GCB closing and the gen-set is loaded instantly. With Import/Export power measurement MCB is opened when the Gen-set load is equal to the total load (Import load = 0)
- Short time parallel (normally mains protection not required by mains authority)
- Power control
- Voltage matching
- Reverse power protection

Peak shaving or Import/Export power control

- Mains Import / Export load and PF control or Base load and PF control
- Start based e.g. on imported load limit
- Continuous parallel to mains operation
- Mains protections (Vector shift, voltage, frequency protections)
- No break transfer on mains failure(if the set was running before the mains failure and was capable to cover the load)
- **BI Test on load** is not needed

AMF with no break return + On load test or Peak shaving or Import/Export power control



Hardware requirements

1x	IGS-NT	
1x	IG-AVRi	(when volt matching and PF control is required)
1x	IG-AVRi-TRANS/LV	(when IG-AVRi is used)

Required application System configuration/ default archive : SPtM.ant

Required setting:

Setpoints group: ***ProcessControl***

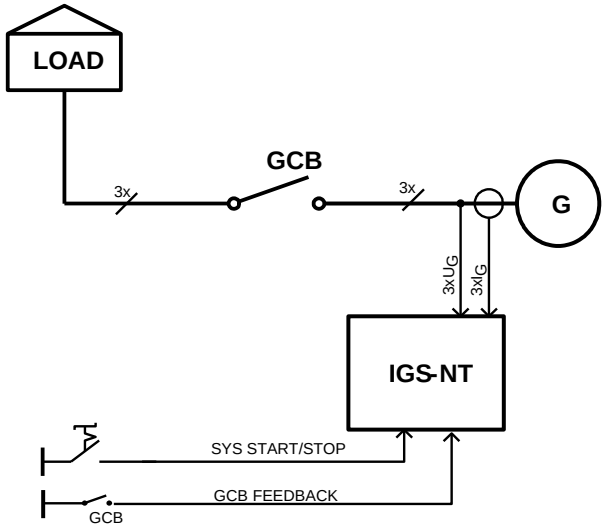
Island enable:	YES
ParallelEnable	YES
Synchro enable	BOTH
MFStart enable	YES

4.2 Applications with GCB control and no MCB

4.2.1 MRS - Manual & Remote Start and stop

Specification:

- No mains, no other set, pure island operation
- Automatic gen-set start when **BI Sys start/stop** is closed
- Closes GCB when generator voltage and frequency is within the limits
- GCB is blocked when voltage on bus terminals is > 15V.



Hardware requirements

1x IGS-NT

Required application System configuration/ default archive : MINT.ant

Required setting:

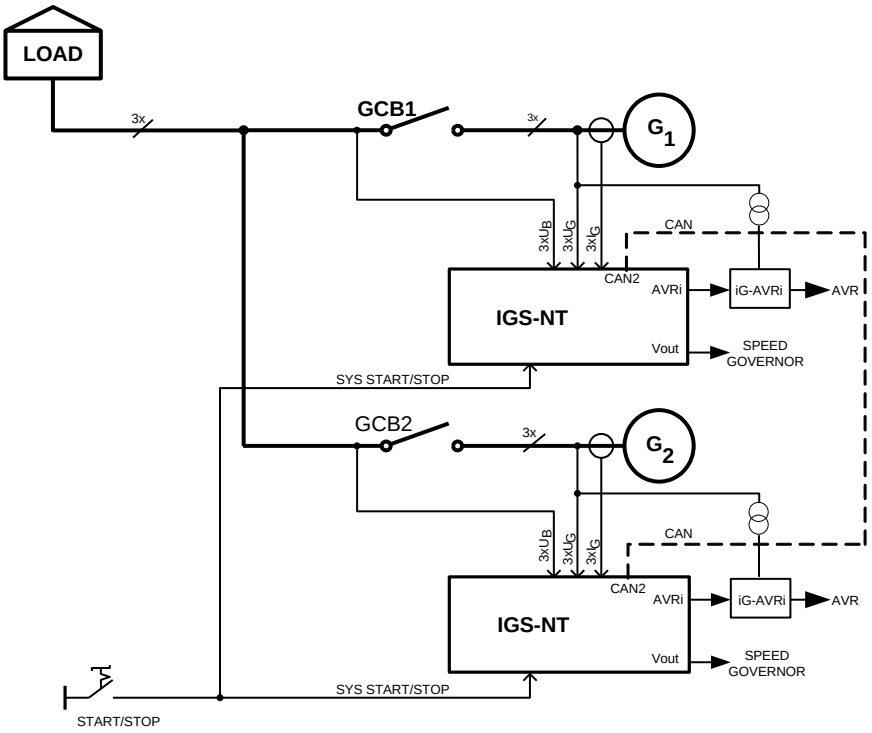
Setpoints group: ***Comms settings***
CAN2emptDetect DISABLED
Setpoints in groups **Pwr management**, **Sync/Load ctrl**, **Volt/PF ctrl** are not important. Setpoints **PwrManagement**:*#SysAMFstrtDel* and *#SysAMFstopDel* have to be set to 0.

4.2.2 Multiple sets in island

Specification

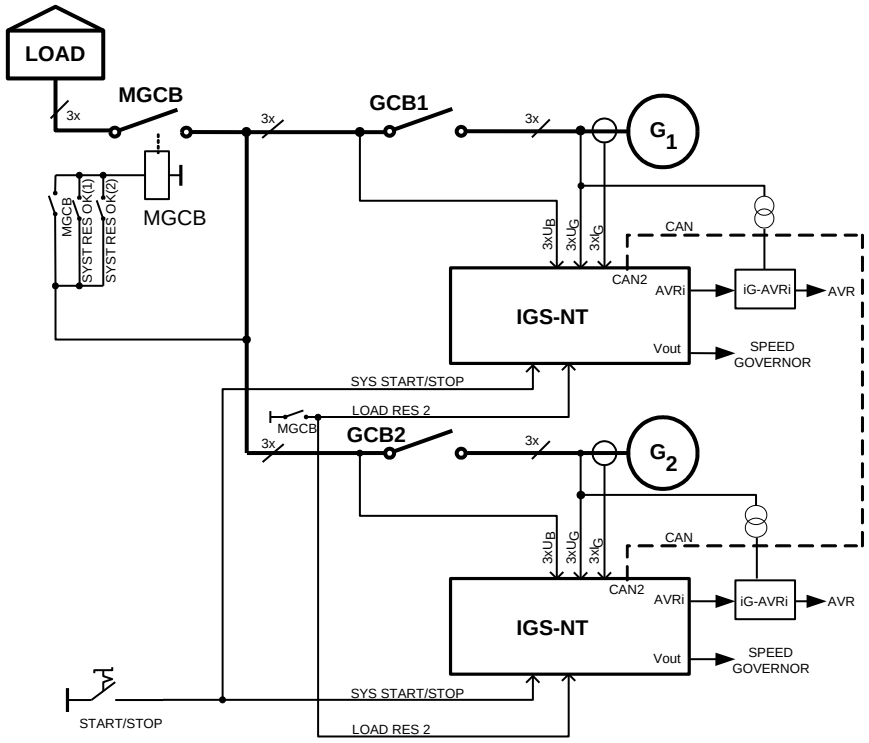
- Automatic start of required number of sets when **BI Sys start/stop** is closed
- Pwr management (load dependent start and stop)
- Sets' priority can be defined manually or automatically based on running hours equalization or load demand (most efficient combination)
- Load sharing and VAR sharing
- Gen-sets soft loading and unloading
- Voltage matching
- Reverse power protection
- MGCB support

Description without MGCB



- When **BI Sys start/stop** closes, sets are starting with a delay *SysAMFstrtDel*. The first set with a correct voltage and frequency closes the GCB to the dead bus, others are synchronized.
- When the relay **BI Sys start/stop** is opened, all GCBs are opened at the same time with a delay SysAMFstopDel.

Description with MGCB



- When **BI Sys start/stop** closes, sets are starting with a delay *SysAMFstrtDel*. The first set with a correct voltage and frequency closes the GCB to the dead bus, others are synchronized.
- **BI Load res 2** is controlled by MGCB to differentiate the load reserve necessary before closing of MGCB (setpoints *LoadRes Strt 2* and *LoadRes Stp 2*), and operational load reserve while the system is loaded (setpoints *LoadRes Strt 1* and *LoadRes Stp 1*).Typically before MGCB closing the higher reserve is needed to absorb the full load. Once loaded, the load reserve can be reduced to e.g. level of the biggest single consumer.
- MGCB is closed by **BO Syst res 1 OK** of any running genset and then held by MGCB feedback.
- When the relay **BI Sys start/stop** is opened, all GCBs are opened at the same time with a delay SysAMFstopDel. Loss of voltage at the bus opens MGCB.

Required application System configuration/ default archive : MINT.ant

Hardware requirements

nx	IGS-NT	
nx	IGS-NT-LSM+PMS	
nx	IG-AVRi	(when volt matching and VAR sharing is required)
nx	IG-AVRi-TRANS/LV	(when IG-AVRi is used)
1x	I-LB or IG-IB	(Optional – Refer to IGS-NT-Communication guide)

Hint:

Without IG-AVRi Droop VAR sharing must be used.

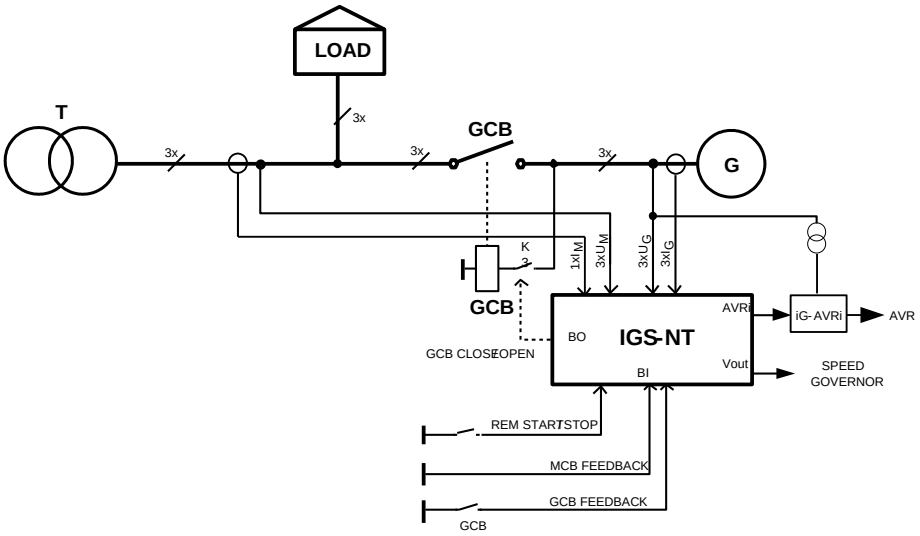
Required setting:

Set *SysAMFstrtDel* and *SysAMFstopDel* setpoints at 1s for fast response on **BI Sys start/stop**
Input MCB FEEDBACK should not be configured

4.2.3 SPI – parallel to Mains only

Specification

- Parallel only, no MCB
- **BI MCB feedback** permanently closed (can be arranged by integrated mini PLC internally)
- Start based on **BI Rem start/stop** or imported load limit
- Mains Import / Export load and PF control or Baseload and Base PF control
- Continuous parallel to mains operation
- Mains protections (Vector shift, voltage, frequency protections)
- GCB opens if mains fail is detected in AUT mode
- Automatic GCB re-synchronizing in case of a short Blackout
- Automatic stop in case of a long Blackout
- Voltage matching
- Reverse power protection



Required application System configuration/ default archive : SPI.ant

Hardware requirements

1x IGS-NT
1x IG-AVRi
1x IG-AVRi-TRANS/LV

Required setting:

Setpoints group: ***ProcessControl***

Island enable:	NO
ParallelEnable	YES
Synchro enable	FORWARD

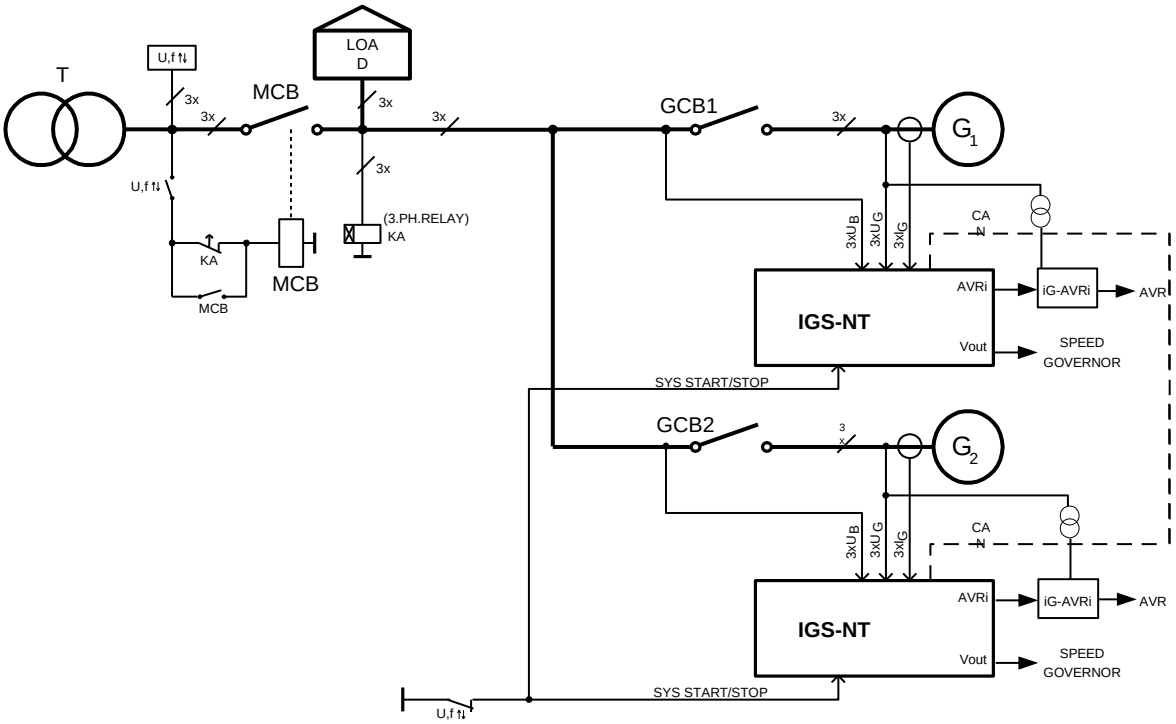
4.3 Applications with GCB control with external MCB control

4.3.1 Multiple AMF

Specification

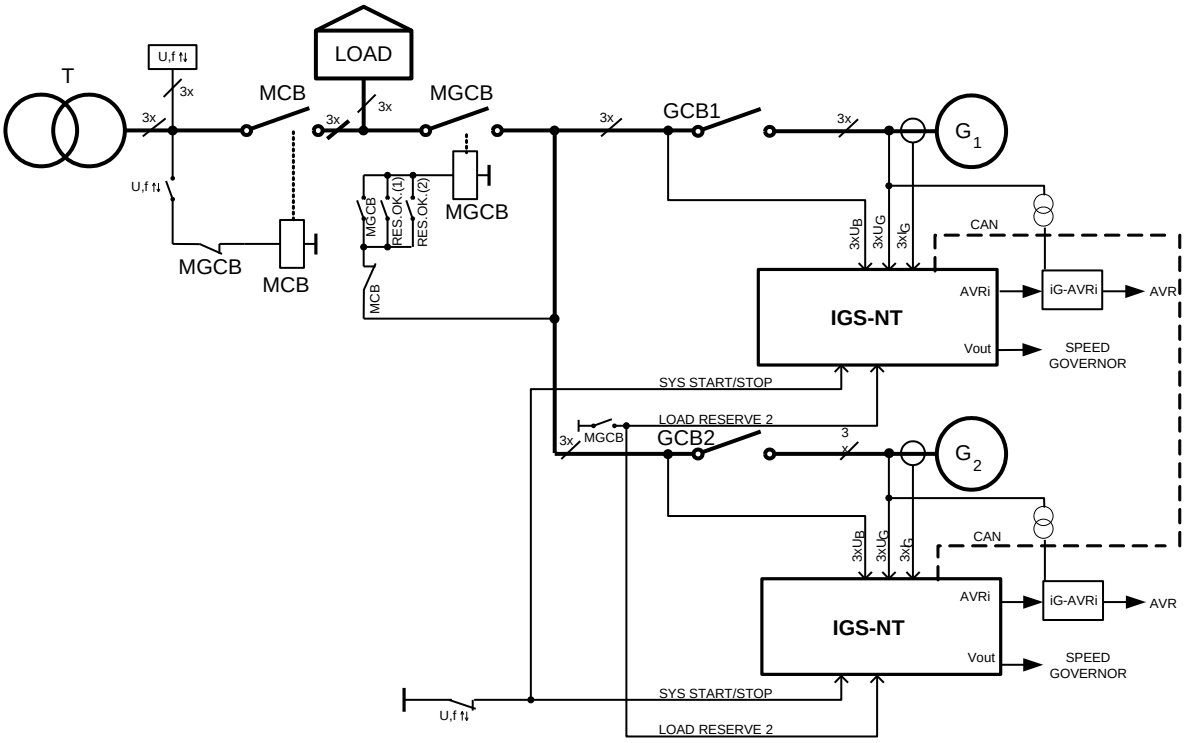
- Automatic gen-set start when the mains fails (**BI Sys start/stop** is closed)
- MCB controlled by mains protection relay
- Break transfer on mains failure
- Break return on mains return (Load reclosing)
- Pwr management (load dependent start and stop)
- Sets' priority can be defined manually or automatically based on running hours equalization or load demand (most efficient combination)
- Load sharing and VAR sharing
- Gen-sets soft loading and unloading
- Voltage matching
- Reverse power protection
- MGCB support

Description without MGCB



- The Uf↑↓ relay opens MCB after the mains fails. At the same time the Uf↑↓ relay closes **BI Sys start/stop** and the sets are starting with a delay *SysAMFstrtDel*. It is similar to setpoint *EmergStart del* in SPtM application. The first set with a correct voltage and frequency closes the GCB to the dead bus, others are synchronized.
- When the mains returns, Uf↑↓ relay opens **BI Sys start/stop** and all GCBs are opened at the same time with *SysAMFstopDel* delay. It is similar to setpoint *Mains Ret del* in SPtM application.
- Bus 3 phase voltage relay detects no voltage and with its time delay closes MCB

Description with MGCB



- The Uf↑↓ relay opens MCB after the mains fails. At the same time the Uf↑↓ relay closes **BI Sys start/stop** and the sets are starting with a delay *SysAMFstrtDel*. It is similar to setpoint *EmergStart del* in SPtM application. The first set with a correct voltage and frequency closes the GCB to the dead bus, others are synchronized.
- **BI Load res 2** is controlled by MGCB to differentiate the load reserve necessary before closing of MGCB (setpoints *LoadRes Strt 2* and *LoadRes Stp 2*), and operational load reserve while the system is loaded (setpoints *LoadRes Strt 1* and *LoadRes Stp 1*).Typically before MGCB closing the higher reserve is needed to absorb the full load. Once loaded, the load reserve can be reduced to e.g. level of the biggest single consumer.
- MGCB is closed by **BO Syst res 1 OK** of any running genset and then held by MGCB feedback.
- When the mains returns, Uf↑↓ relay opens **BI Sys start/stop** and all GCBs are opened at the same time with *SysAMFstopDel* delay. It is similar to setpoint *Mains Ret del* in SPtM application. Loss of voltage at the bus opens MGCB.
- Bus 3 phase voltage relay detects no voltage and with its time delay closes MCB

Hint:

Setpoint *SysAMFstrt del* is used for engines start delay after the mains fails. It is similar to setpoint *EmergStart del* in Single Stand-by.
Setpoint *SysAMFstp del* is used for GCB opening after the mains returns. Single Stand-by.

Required application System configuration/ default archive : MINT.ant

Hardware requirements

1x	Uf↑↓ (Simple mains protection relay)	
nx	IGS-NT	
nx	IGS-NT-LSM+PMS	
nx	IG-AVRi	(when volt matching and VAR sharing is required)
nx	IG-AVRi-TRANS/LV	(when IG-AVRi is used)
1x	I-LB+ or IG-IB	(Optional – Refer to IGS-NT-Communication guide)

Hint:

Without IG-AVRi Droop VAR sharing must be used.

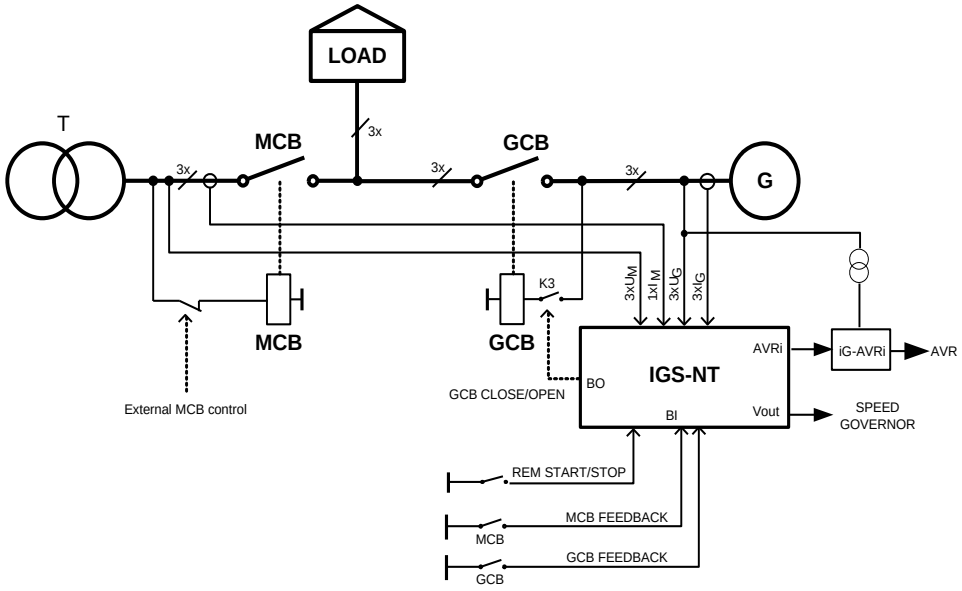
Required setting:

Input MCB FEEDBACK should not be configured.

4.3.2 SPI – External MCB / Island or Parallel

Specification

- No MCB control, only monitoring. MCB is controlled externally
- Continuous parallel to mains operation or Island operation
- Break transfer and break return in case of mains failure
- Start based on **BI Rem start/stop** or imported load limit
- Mains Import / Export load and PF control or Baseload and Base PF control
- Mains protections (Vector shift, voltage, frequency protections)
- GCB opens if mains fail is detected in AUT mode
- Automatic GCB re-synchronizing in case of a short Blackout
- If MCB is opened during the blackout, set closes to a dead bus and supplies the preferential load
- If the mains returns, gen-set must be manually unloaded, GCB opened and then the MCB closed again. Gen-set is resynchronized back to parallel operation
- Automatic stop in case of a long Blackout
- Voltage matching
- Reverse power protection



Required application System configuration/ default archive : SPI.ant

Hardware requirements

1x IGS-NT
1x IG-AVRi
1x IG-AVRi-TRANS/LV

Required setting:

Setpoints group: ***ProcessControl***

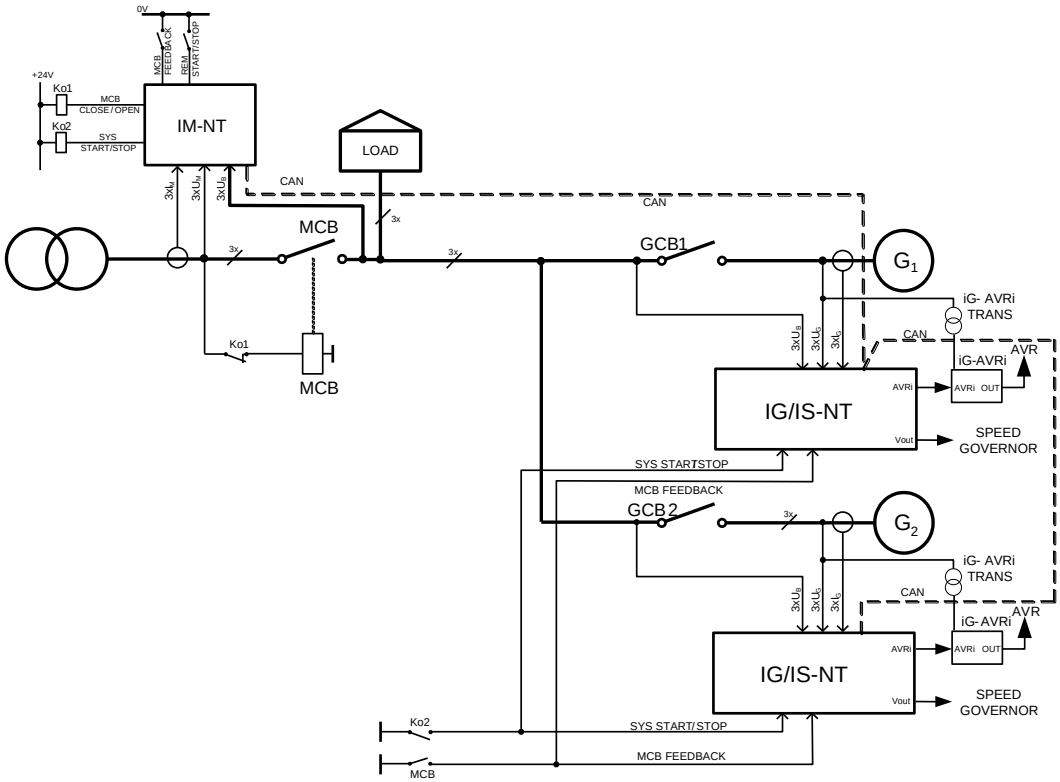
Island enable:	YES
ParallelEnable	YES
Synchro enable	FORWARD

4.3.3 Multiple parallel to Mains, MCB control from IM-NT

Specification

- Automatic gen-set start when the mains fails (BI *Sys start/stop* is closed)
- MCB controlled by IM-NT
- Break transfer on mains failure
- MCB synchronizing after mains return
- Pwr management (load dependent start and stop)
- Sets' priority can be defined manually or automatically based on running hours equalization or load demand (most efficient combination)
- Load sharing and VAR sharing
- Gen-sets soft loading and unloading
- Voltage matching
- Reverse power protection
- MGCB support

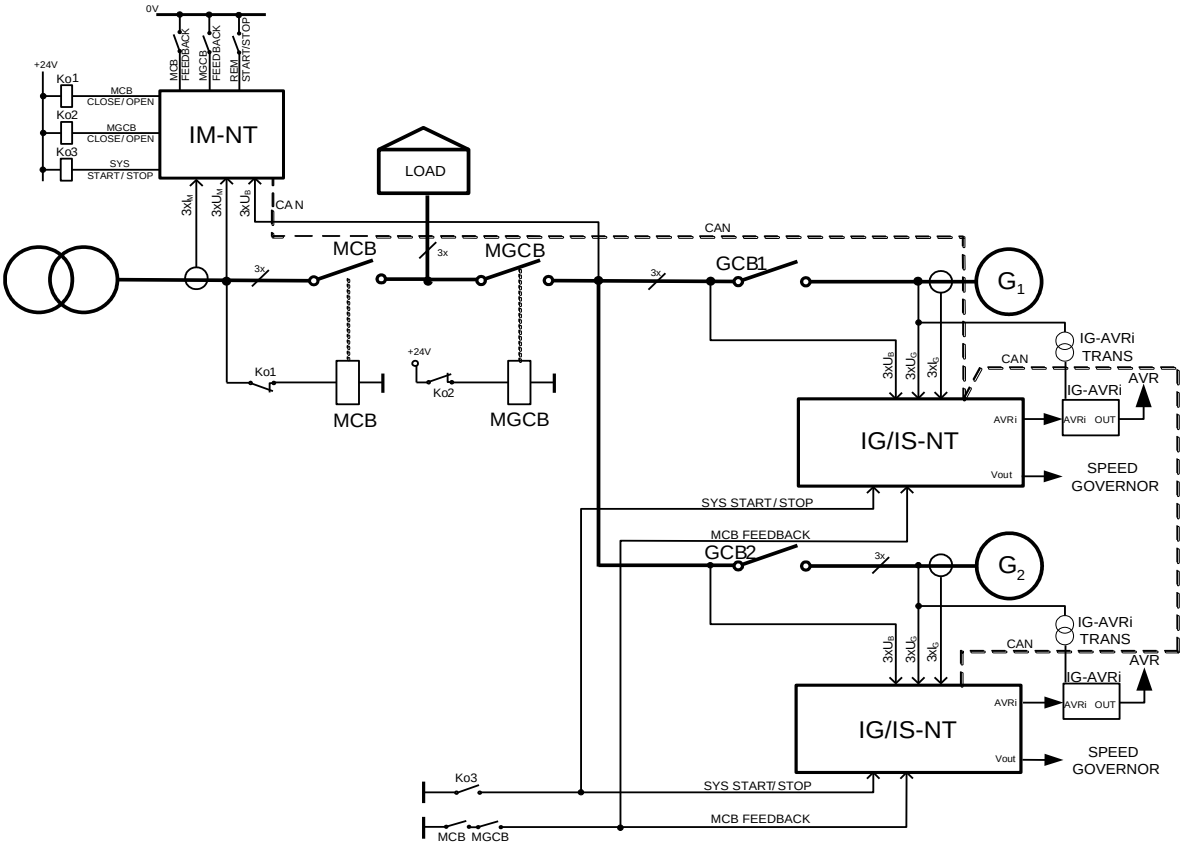
Description without MGCB



- The IM-NT controller opens MCB after the mains fails or after the gen-sets are running according to setpoint **AMF settings**:*MCB opens on*.
- The IM-NT controller closes binary output *Sys start/stop* which is connected to *Sys start/stop* inputs of the gen-set controllers if:
  a) If IM-NT binary input *Rem start/stop* gets active (AUT mode only).
  b) If AMF condition is sensed in IM-NT and the gen-set group should be started as stand-by power source (AUT mode only).
  c) If PeakShaving function senses that it is suitable to start the gen-set group in order to lower the mains import (AUT mode only).
  d) If Start button is pressed on IM-NT front panel or remotely (MAN mode only). The signal can be deactivated by pressing the Stop button. If the controller is switched from AUT to MAN mode, the internal status of the flip-flop circuit created by Start-Stop buttons is set to follow the previous state in AUT mode. E.g. if the gen-set group has run in an AMF situation in AUT mode, switching to MAN will not stop it (= Sys start/stop output stays active).

- After binary input *Sys start/stop* closes the gen-sets are starting with a delay *SysAMFstrtDel*. It is similar to setpoint *EmergStart del* in SPtM application. The first set with a correct voltage and frequency closes the GCB to the dead bus, others are synchronized.
- When the mains returns, IM-NT synchronizes gen-sets to the mains with limitations given by setpoints **ProcessControl**:*ParallelEnable* and *Synchro enable* (see Table on p.9 in IM-NT-MCB-MGCB-X.X.pdf).

Description with MGCB



- The IM-NT controller opens MCB after the mains fails or after the gen-sets are running according to setpoint **AMF settings**:*MCB opens on*.
- The IM-NT controller closes binary output *Sys start/stop* which is connected to *Sys start/stop* inputs of the gen-set controllers if:
  a) If IM-NT binary input *Rem start/stop* gets active (AUT mode only). Before the output *Sys start/stop* is activated, the MGCB close command is issued (if **ProcessControl**:*MGCBparalClose* = YES).
  b) If AMF condition is sensed in IM-NT and the gen-set group should be started as stand-by power source (AUT mode only). MGCB is not closed before the GCBs but only after a reasonable amount of gen-sets have synchronized to the bus (load reserve achived).
  c) If PeakShaving function senses that it is suitable to start the gen-set group in order to lower the mains import (AUT mode only). Before the output *Sys start/stop* is activated, the MGCB close command is issued (if **ProcessControl**:*MGCBparalClose* = YES).
  d) If Start button is pressed on IM-NT front panel or remotely (MAN mode only). The signal can be deactivated by pressing the Stop button. If the controller is switched from AUT to MAN mode, the internal status of the flip-flop circuit created by Start-Stop buttons is set to follow the previous state in AUT mode. E.g. if the gen-set group has run in an AMF situation in AUT mode, switching to MAN will not stop it (= Sys start/stop output stays active).
- After binary input *Sys start/stop* closes the gen-sets are starting with a delay *SysAMFstrtDel*. It is similar to setpoint *EmergStart del* in SPtM application. The first set with a correct voltage and frequency closes the GCB to the dead bus, others are synchronized.

- When the mains returns, IM-NT synchronizes gen-sets to the mains with limitations given by setpoints **ProcessControl**:*ParallelEnable* and *Synchro enable* (see Table on p.9 in IM-NT-MCB-MGCB-X.X.pdf).

Hint:
It is possible to use virtual shared inputs/outputs to connect for example Sys start/stop output from IM-NT to corresponding binary input of all controllers instead of hardwiring it. See chapter Shared virtual I/O periphery.

Required application System configuration/ default archive: IG/IS-MINT.ant and IM-MCB/MGCB.ant

PeakShaving function should be used in order to lower the mains import (AUT mode only).

PeakShaving settings:

PeakLevelStart:	*PeakLevelStop* to 32000 kW
PeakLevelStop:	0 to *PeakLevelStart* kW
PeakAutS/S del:	1-3200 s. Function is active only for *PeakAutS/S del* <> OFF.

If *PeakLevelStart* is reached for *PeakAutS/S del* time then the IM-NT controller closes binary output *Sys start/stop* which is connected to *Sys start/stop* inputs of the gen-set. *Sys start/stop* is deactivated after *PeakLevelStop* is reached for *PeakAutS/S* del.

Hint:
The Peak start/stop function activates the common output signal *Sys start/stop* in IM-NT. The signal is intended to be directly connected to Sys start/stop inputs of all gen-set controllers in the system, e.g. using SHBIN/SHBOUT peripherals.

Hardware requirements

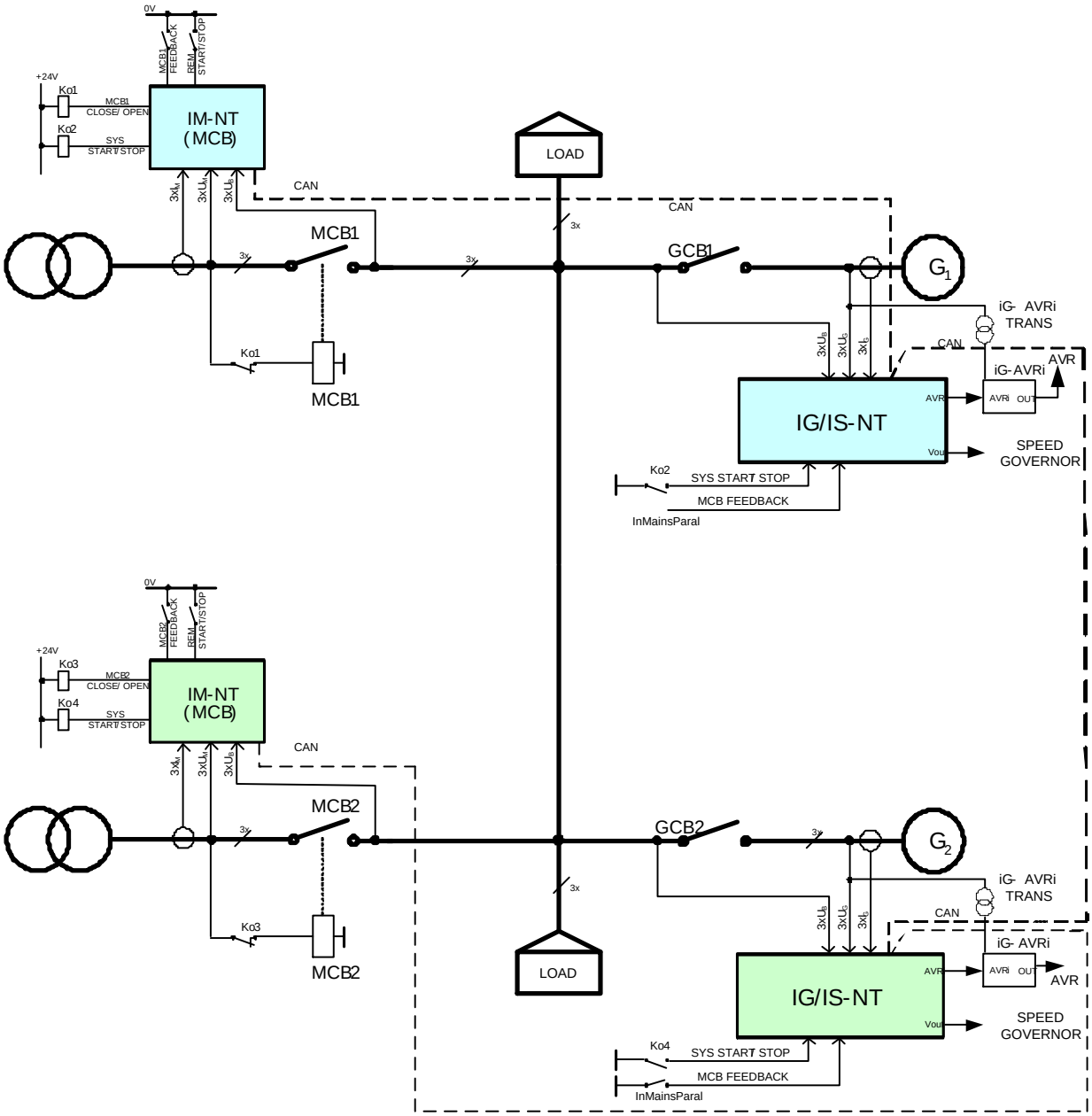
1x	IM-NT	
nx	IG/IS-NT	
nx	IGS-NT-LSM+PMS	
nx	IG-AVRi	(when volt matching and VAR sharing is required)
nx	IG-AVRi-TRANS/LV	(when IG-AVRi is used)
1x	I-LB+ or IG-IB	(Optional – Refer to IGS-NT-Communication guide)

Hint:
Without IG-AVRi Droop VAR sharing must be used.

4.3.4 Multiple parallel to Mains, MCB control from IM-NT

Specification

- Automatic gen-set start when the mains fails (BI *Sys start/stop* is closed)
- MCB controlled by IM-NT
- Break transfer on mains failure
- MCB synchronizing after mains return
- Pwr management (load dependent start and stop)
- Sets' priority can be defined manually or automatically based on running hours equalization or load demand (most efficient combination)
- Load sharing and VAR sharing
- Gen-sets soft loading and unloading
- Voltage matching
- Reverse power protection



Description

- The IM-NT (MCB) controller opens MCB after the mains fails or after the gen-sets are running according to setpoint **AMF settings**:*MCB opens on*.
- The IM-NT controller closes binary output *Sys start/stop* which is connected to *Sys start/stop* inputs of the gen-set controllers in the corresponding group if:
  - If IM-NT (MCB) binary input *Rem start/stop* gets active (AUT mode only).
  - If AMF condition is sensed in IM-NT (MCB) and the gen-set group should be started as stand-by power source (AUT mode only).
  - If PeakShaving function senses that it is suitable to start the gen-set group in order to lower the mains import (AUT mode only).
  - If Start button is pressed on IM-NT front panel or remotely (MAN mode only). The signal can be deactivated by pressing the Stop button. If the controller is switched from AUT to MAN mode, the internal status of the flip-flop circuit created by Start-Stop buttons is set to follow the previous state in AUT mode. E.g. if the gen-set group has run in an AMF situation in AUT mode, switching to MAN will not stop it (= Sys start/stop output stays active).
- After binary input *Sys start/stop* closes the gen-sets are starting with a delay *SysAMFstrtDel*. It is similar to setpoint *EmergStart del* in SPtM application. The first set with a correct voltage and frequency closes the GCB to the dead bus, others are synchronized.
- When the mains returns, IM-NT (MCB) synchronizes gen-sets to the mains with limitations given by setpoints **ProcessControl**:*ParallelEnable* and *Synchro enable* (see Table on p.9 in IM-NT-MCB-MGCB-X.X.pdf).
- The gen-set controllers know whether they are connected to the Mains from binary input *MCB feedback* that can be configured on binary output *InMainsParal* (using VPIO for instance). This binary output is distributed over the CAN bus and indicates which MCBs are closed and connected to the Mains. Based on this information the gen-set controllers are controlled by one or another IM-NT (MCB) controller.

Hardware requirements

2x	IM-NT	
nx	IG/IS-NT	
nx	IGS-NT-LSM+PMS	
nx	IG-AVRi	(when volt matching and VAR sharing is required)
nx	IG-AVRi-TRANS/LV	(when IG-AVRi is used)
1x	I-LB+ or IG-IB	(Optional – Refer to IGS-NT-Communication guide)

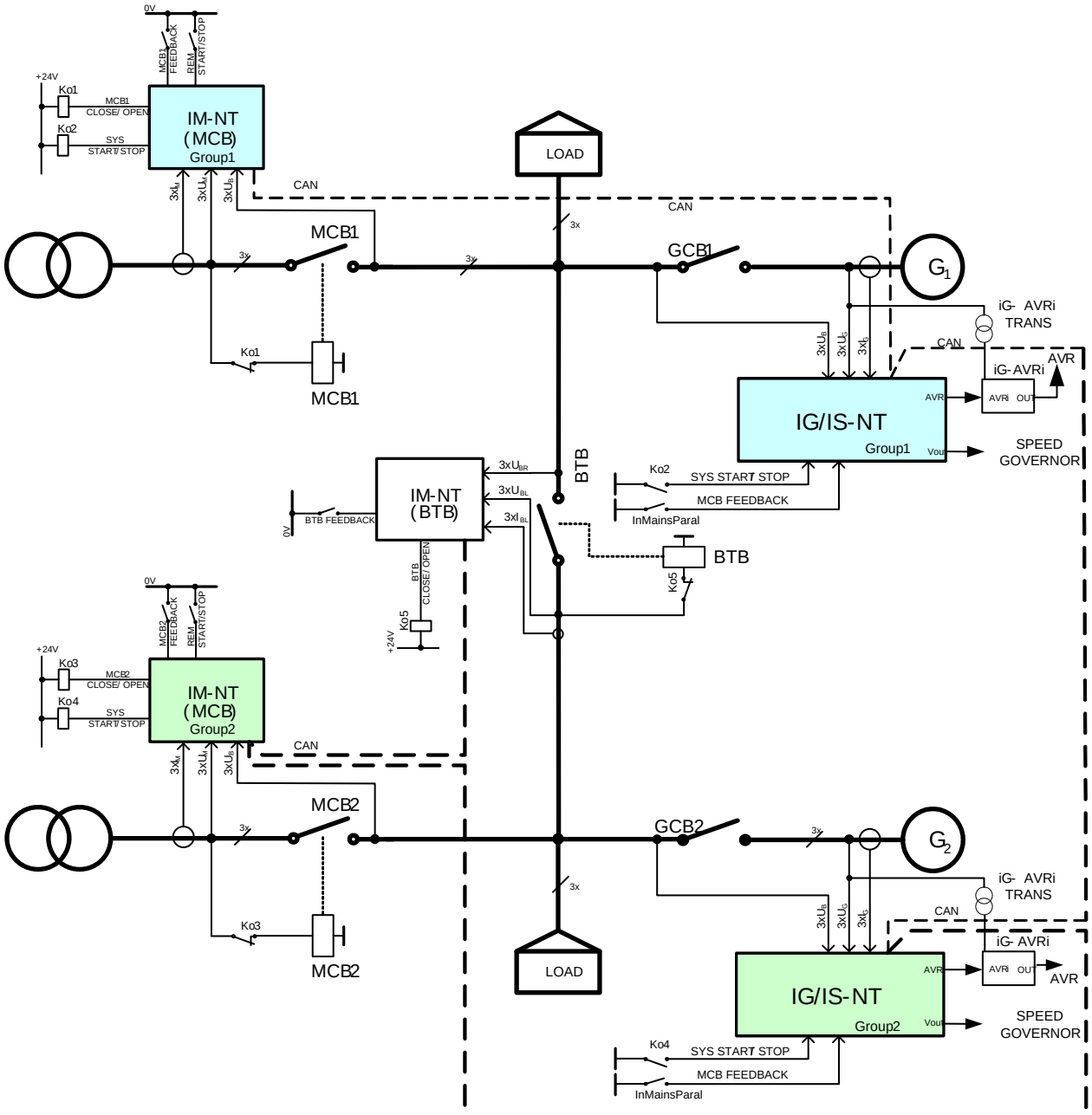
Hint:
Without IG-AVRi Droop VAR sharing must be used.

Required application System configuration/ default archive: IG/IS-MINT.ant and IM-MCB.ant

4.3.5 Multiple parallel to Mains, MCB and BTB control from IM-NT

Specification

- Automatic gen-set start when the mains fails (BI *Sys start/stop* is closed)
- MCB controlled by IM-NT
- Break transfer on mains failure
- MCB synchronizing after mains return
- BTB and MGCB synchronizing
- Pwr management (load dependent start and stop)
- Sets' priority can be defined manually or automatically based on running hours equalization or load demand (most efficient combination)
- Load sharing and VAR sharing
- Gen-sets soft loading and unloading
- Voltage matching
- Reverse power protection
- MGCB support



Description without MGCB

- The IM-NT (MCB) controller opens MCB after the mains fails or after the gen-sets are running according to setpoint **AMF settings**:*MCB opens on*.
- The IM-NT controller closes binary output *Sys start/stop* which is connected to *Sys start/stop* inputs of the gen-set controllers in the corresponding group if:
  - If IM-NT (MCB) binary input *Rem start/stop* gets active (AUT mode only).
  - If AMF condition is sensed in IM-NT (MCB) and the gen-set group should be started as stand-by power source (AUT mode only).
  - If PeakShaving function senses that it is suitable to start the gen-set group in order to lower the mains import (AUT mode only).
  - If Start button is pressed on IM-NT (BTB) front panel or remotely (MAN mode only). The signal can be deactivated by pressing the Stop button. If the controller is switched from AUT to MAN mode, the internal status of the flip-flop circuit created by Start-Stop buttons is set to follow the previous state in AUT mode. E.g. if the gen-set group has run in an AMF situation in AUT mode, switching to MAN will not stop it (= Sys start/stop output stays active).
- After binary input *Sys start/stop* closes the gen-sets are starting with a delay *SysAMFstrtDel*. It is similar to setpoint *EmergStart del* in SPtM application. The first set with a correct voltage and frequency closes the GCB to the dead bus, others are synchronized.
- When the mains returns, IM-NT (MCB) synchronizes gen-sets to the mains with limitations given by setpoints **ProcessControl**:*ParallelEnable* and *Synchro enable* (see Table on p.9 in IM-NT-MCB-MGCB-X.X.pdf).
- The gen-set controllers know whether they are connected to the Mains from binary input *MCB feedback* that can be configured on binary output *InMainsParal* (using VPIO for instance). This binary output is distributed over the CAN bus and indicates which BTBs are closed and so which logical groups are interconnected and connected to the Mains. Based on this information the gen-set controllers are controlled by one or another IM-NT (MCB) controller.

Hardware requirements

3x	IM-NT	
nx	IG/IS-NT	
nx	IGS-NT-LSM+PMS	
nx	IG-AVRi	(when volt matching and VAR sharing is required)
nx	IG-AVRi-TRANS/LV	(when IG-AVRi is used)
1x	I-LB+ or IG-IB	(Optional – Refer to IGS-NT-Communication guide)

Hint:
Without IG-AVRi Droop VAR sharing must be used.

Required application System configuration/ default archive: IG/IS-MINT.ant and IM-MCB/BTB.ant

Required setting:

example related to the first scheme above:

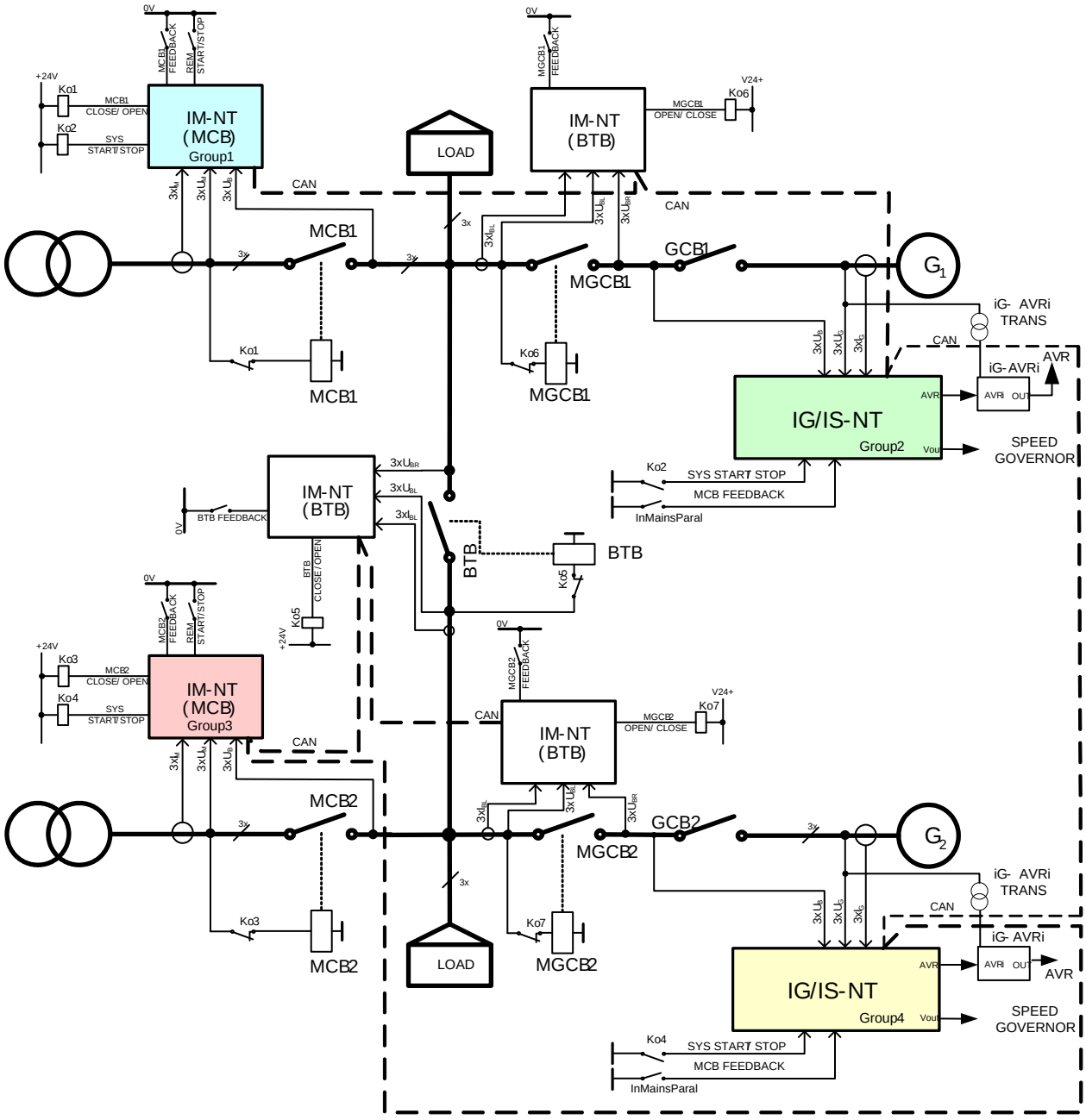
IM-NT (MCB1)
Control group = 1
GroupLinkLeft = COMMON (setting not important)
GroupLinkRight = COMMON (setting not important)
IGS-NT (GCB1)
Control group = 1
GroupLinkLeft = COMMON (setting not important)
GroupLinkRight = COMMON (setting not important)
IM-BTB
GroupLinkLeft = 2
GroupLinkRight = 1
IM-NT (MCB2)
Control group = 2
GroupLinkLeft = COMMON (setting not important)
GroupLinkRight = COMMON (setting not important)
IGS-NT (GCB2)

Control group = 2
GroupLinkLeft = COMMON (setting not important)
GroupLinkRight = COMMON (setting not important)

4.3.6 Multiple parallel to Mains, MCB and BTB (MGCB) control from IM-NT

Specification

- Automatic gen-set start when the mains fails (BI *Sys start/stop* is closed)
- MCB controlled by IM-NT
- Break transfer on mains failure
- MCB synchronizing after mains return
- BTB synchronizing
- Pwr management (load dependent start and stop)
- Sets' priority can be defined manually or automatically based on running hours equalization or load demand (most efficient combination)
- Load sharing and VAR sharing
- Gen-sets soft loading and unloading
- Voltage matching
- Reverse power protection



Description with MGCB

- The system with this topology has to be separated into 4 logical groups by 3 IM-NT (BTB) controllers. It is not possible to use IM-NT MGCB application for this purpose.
- The IM-NT (MCB) controller opens MCB after the mains fails or after the gen-sets are running according to setpoint **AMF settings**:*MCB opens on*.
- IM-NT (BTB) controller closes automatically BTB/MGCB if
  - bus voltages are within the limits (**Sync ctrl**:*Phase window*, *Voltage window*)
  - there is voltage on one of the buses and closing to dead bus is enabled by P**rocessControl**:*DeadBusClosing*
  - binary input *BTB disable* is not closed
  - it is enabled by setting of **ProcessControl**:*Synchro enable*, *Mains coupling* setpoints
- After binary input *Sys start/stop* closes the gen-sets are starting with a delay *SysAMFstrtDel*. It is similar to setpoint *EmergStart del* in SPtM application. The first set with a correct voltage and frequency closes the GCB to the dead bus, others are synchronized.

- When the mains returns, IM-NT (MCB) synchronizes gen-sets to the mains with limitations given by setpoints **ProcessControl**:*ParallelEnable* and *Synchro enable* (see Table on p.9 in IM-NT-MCB-MGCB-X.X.pdf).
- The gen-set controllers know whether they are connected to the Mains from binary input *MCB feedback* that can be configured on binary output *InMainsParal* (using VPIO for instance). This binary output is distributed over the CAN bus and indicates which BTBs are closed and so which logical groups are interconnected and connected to the Mains. Based on this information the gen-set controllers are controlled by one or another IM-NT (MCB) controller.

Hint:
It is possible to use virtual shared inputs/outputs to connect for example Sys start/stop output from IM-NT to corresponding binary input of all controllers instead of hardwiring it. See chapter Shared virtual I/O periphery. For BTB controllers the BI *BTB Feedback* should be configured as *Group link* input as well.

Hardware requirements

5x	IM-NT	
nx	IG/IS-NT	
nx	IGS-NT-LSM+PMS	
nx	IG-AVRi	(when volt matching and VAR sharing is required)
nx	IG-AVRi-TRANS/LV	(when IG-AVRi is used)
1x	I-LB+ or IG-IB	(Optional – Refer to IGS-NT-Communication guide)

Hint:
Without IG-AVRi Droop VAR sharing must be used.

Required application System configuration/ default archive: IG/IS-MINT.ant and IM-MCB/BTB.ant

Example related to the second scheme above:

IM-NT (MCB1)
Control group = 1
GroupLinkLeft = COMMON (setting not important)
GroupLinkRight = COMMON (setting not important)

IGS-NT (GCB1)
Control group = 2
GroupLinkLeft = COMMON (setting not important)
GroupLinkRight = COMMON (setting not important)

IM-NT (MGCB1) – BTB appl. used
GroupLinkLeft = 1
GroupLinkRight = 2

IM-NT (BTB)
GroupLinkLeft = 3
GroupLinkRight = 1

IM-NT (MGCB2) – BTB appl. used
GroupLinkLeft = 3
GroupLinkRight = 4

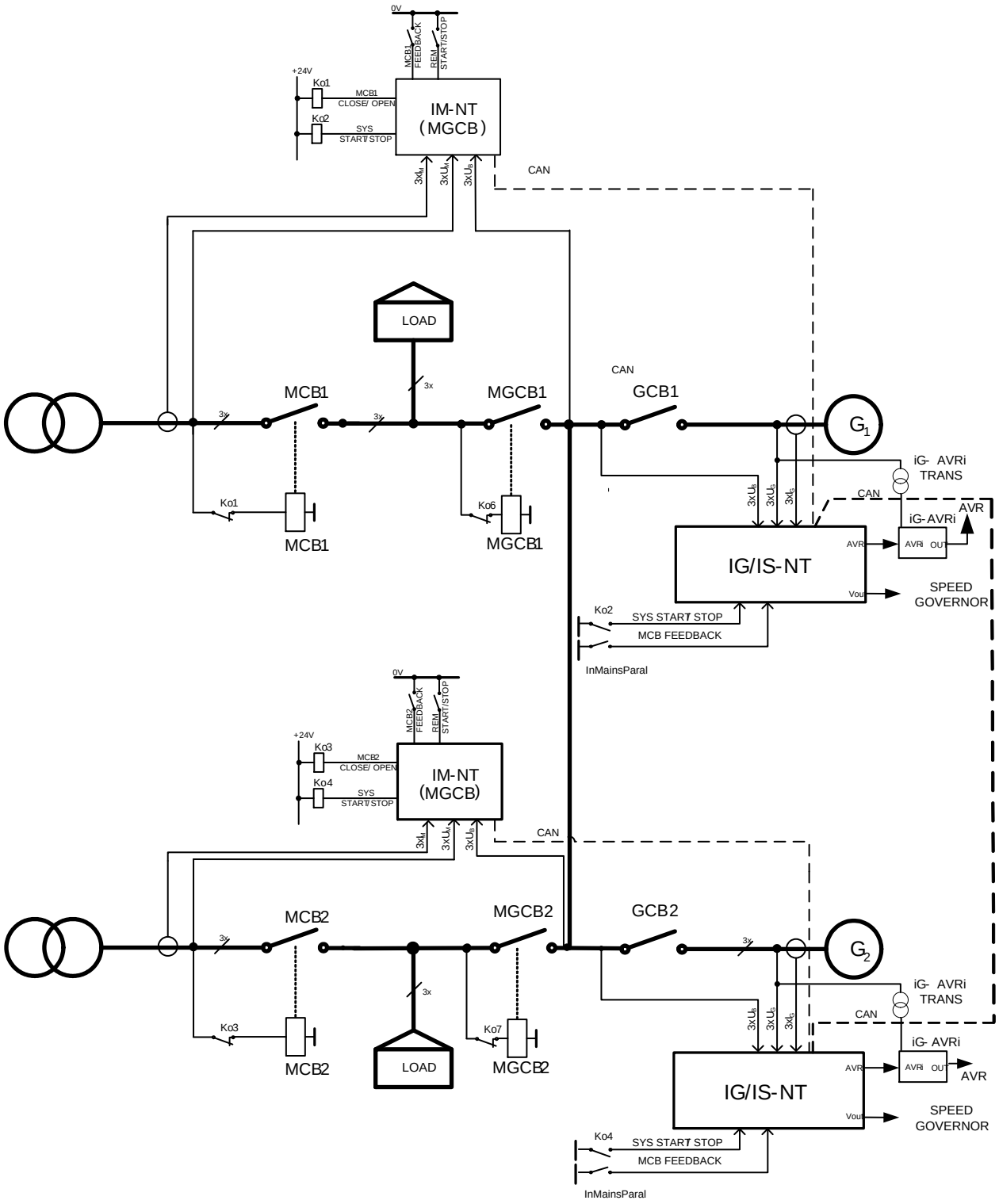
IM-NT (MCB2)
Control group = 3
GroupLinkLeft = COMMON (setting not important)
GroupLinkRight = COMMON (setting not important)

IGS-NT (GCB2)
Control group = 4
GroupLinkLeft = COMMON (setting not important)
GroupLinkRight = COMMON (setting not important)

4.3.7 Multiple parallel to Mains, MCB and MGCB control from IM-NT

Specification

- Automatic gen-set start when the mains fails (BI *Sys start/stop* is closed)
- MCB controlled by IM-NT
- Break transfer on mains failure
- MCB synchronizing after mains return
- MGCB synchronizing
- Pwr management (load dependent start and stop)
- Sets' priority can be defined manually or automatically based on running hours equalization or load demand (most efficient combination)
- Load sharing and VAR sharing
- Gen-sets soft loading and unloading
- Voltage matching
- Reverse power protection
- MGCB support



Description

- The IM-NT controller opens MCB after the mains fails or after the gen-sets are running according to setpoint **AMF settings**:*MCB opens on*.
- The IM-NT controller closes binary output *Sys start/stop* which is connected to *Sys start/stop* inputs of the gen-set controllers in the corresponding group if:
  - If IM-NT (MCB) binary input *Rem start/stop* gets active (AUT mode only).
  - If Start button is pressed on IM-NT front panel or remotely (MAN mode only). The signal can be deactivated by pressing the Stop button. If the controller is switched from AUT to MAN mode, the

internal status of the flip-flop circuit created by Start-Stop buttons is set to follow the previous state in AUT mode. E.g. if the gen-set group has run in an AMF situation in AUT mode, switching to MAN will not stop it (= Sys start/stop output stays active).
- If IM-NT binary input *Rem start/stop* gets active (AUT mode only). Before the output *Sys start/stop* is activated, the MGCB close command is issued (if **ProcessControl**:*MGCBparalClose* = YES).
- If AMF condition is sensed in IM-NT and the gen-set group should be started as stand-by power source (AUT mode only). MGCB is not closed before the GCBs but only after a reasonable amount of gen-sets have synchronized to the bus (load reserve achived).
- If PeakShaving function senses that it is suitable to start the gen-set group in order to lower the mains import (AUT mode only). Before the output *Sys start/stop* is activated, the MGCB close command is issued (if **ProcessControl**:*MGCBparalClose* = YES).

- After binary input *Sys start/stop* closes the gen-sets are starting with a delay *SysAMFstrtDel*. It is similar to setpoint *EmergStart del* in SPtM application. The first set with a correct voltage and frequency closes the GCB to the dead bus, others are synchronized.
- When the mains returns, IM-NT (MCB) synchronizes gen-sets to the mains with limitations given by setpoints **ProcessControl**:*ParallelEnable* and *Synchro enable* (see Table on p.9 in IM-NT-MCB-MGCB-X.X.pdf).
- The gen-set controllers know whether they are connected to the Mains from binary input *MCB feedback* that can be configured on binary output *InMainsParal* (using VPIO for instance). This binary output is distributed over the CAN bus and indicates which BTBs are closed and so which logical groups are interconnected and connected to the Mains. Based on this information the gen-set controllers are controlled by one or another IM-NT (MCB) controller.

Hardware requirements

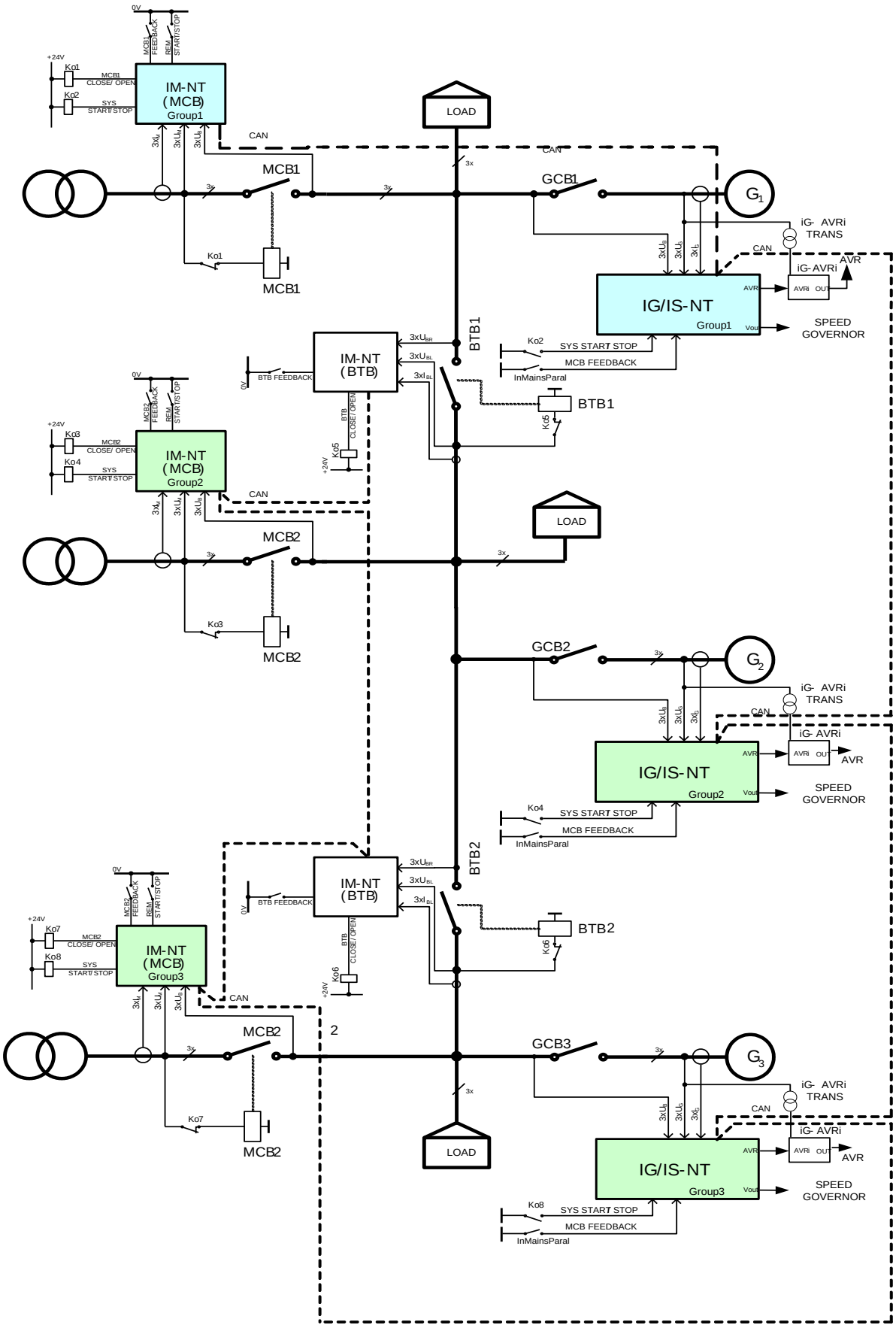
2x	IM-NT	
nx	IG/IS-NT	
nx	IGS-NT-LSM+PMS	
nx	IG-AVRi	(when volt matching and VAR sharing is required)
nx	IG-AVRi-TRANS/LV	(when IG-AVRi is used)
1x	I-LB+ or IG-IB	(Optional – Refer to IGS-NT-Communication guide)

Hint:

Without IG-AVRi Droop VAR sharing must be used.

Required application System configuration/ default archive: IG/IS-MINT.ant and IM-MGCB.ant

4.3.8 Multiple parallel to Mains, MCB and BTB control from IM-NT (3Mains)


IM-NT (MCB) Group1
IM-NT (MCB) Group2
IM-NT (MCB) Group3
IM-NT (BTB)
IG/IS-NT Group1
IG/IS-NT Group2
IG/IS-NT Group3
LOAD
MCB1
MCB2
GCB1
GCB2
GCB3
BTB1
BTB2
CAN
SPEED GOVERNOR
AVR
iG- AVRi TRANS
SYS START STOP
MCB FEEDBACK
InMainsParal
BTB FEEDBACK

Description

- The IM-NT (MCB) controller opens MCB after the mains fails or after the gen-sets are running according to setpoint **AMF settings**:*MCB opens on*.
- The IM-NT controller closes binary output *Sys start/stop* which is connected to *Sys start/stop* inputs of the gen-set controllers in the corresponding group if:
  - If IM-NT (MCB) binary input *Rem start/stop* gets active (AUT mode only).
  - If AMF condition is sensed in IM-NT (MCB) and the gen-set group should be started as stand-by power source (AUT mode only).
  - If PeakShaving function senses that it is suitable to start the gen-set group in order to lower the mains import (AUT mode only).
  - If Start button is pressed on IM-NT (BTB) front panel or remotely (MAN mode only). The signal can be deactivated by pressing the Stop button. If the controller is switched from AUT to MAN mode, the internal status of the flip-flop circuit created by Start-Stop buttons is set to follow the previous state in AUT mode. E.g. if the gen-set group has run in an AMF situation in AUT mode, switching to MAN will not stop it (= Sys start/stop output stays active).
- After binary input *Sys start/stop* closes the gen-sets are starting with a delay *SysAMFstrtDel*. It is similar to setpoint *EmergStart del* in SPtM application. The first set with a correct voltage and frequency closes the GCB to the dead bus, others are synchronized.
- When the mains returns, IM-NT (MCB) synchronizes gen-sets to the mains with limitations given by setpoints **ProcessControl**:*ParallelEnable* and *Synchro enable* (see Table on p.9 in IM-NT-MCB-MGCB-X.X.pdf).
- The gen-set controllers know whether they are connected to the Mains from binary input *MCB feedback* that can be configured on binary output *InMainsParal* (using VPIO for instance). This binary output is distributed over the CAN bus and indicates which BTBs are closed and so which logical groups are interconnected and connected to the Mains. Based on this information the gen-set controllers are controlled by one or another IM-NT (MCB) controller.

Hardware requirements

5x	IM-NT	
nx	IG/IS-NT	
nx	IGS-NT-LSM+PMS	
nx	IG-AVRi	(when volt matching and VAR sharing is required)
nx	IG-AVRi-TRANS/LV	(when IG-AVRi is used)
1x	I-LB+ or IG-IB	(Optional – Refer to IGS-NT-Communication guide)

Hint:

Without IG-AVRi Droop VAR sharing must be used.

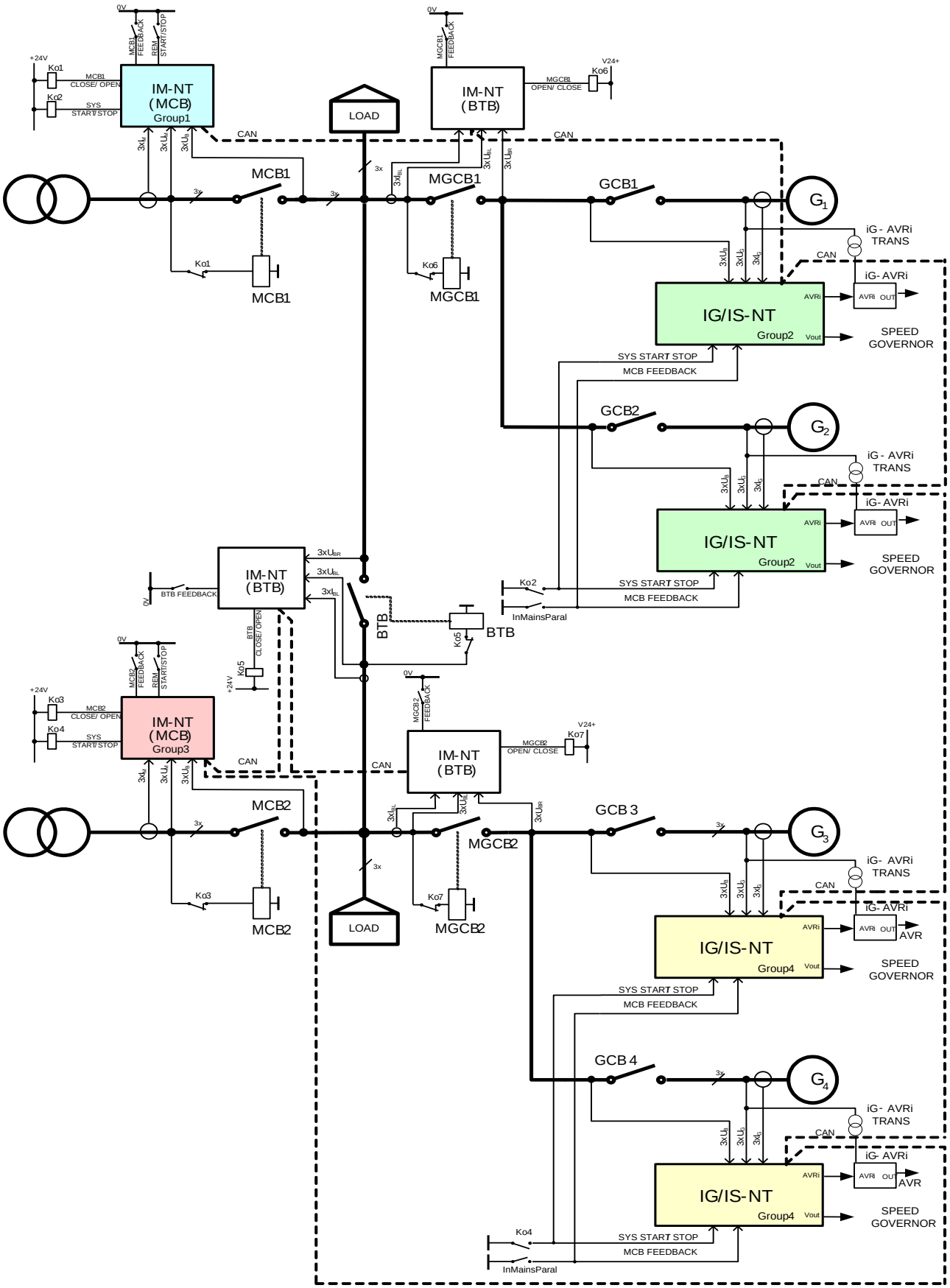
Required setting:

System without MGCB (example related to the first scheme above):

IM-NT (MCB1)
Control group = 1
GroupLinkLeft = COMMON (setting not important)
GroupLinkRight = COMMON (setting not important)
IGS-NT (GCB1)
Control group = 1
GroupLinkLeft = COMMON (setting not important)
GroupLinkRight = COMMON (setting not important)
IM-BTB 1
GroupLinkLeft = 2
GroupLinkRight = 1
IM-NT (MCB2)
Control group = 2
GroupLinkLeft = COMMON (setting not important)
GroupLinkRight = COMMON (setting not important)
IGS-NT (GCB2)
Control group = 2
GroupLinkLeft = COMMON (setting not important)
GroupLinkRight = COMMON (setting not important)

IM-BTB 2
GroupLinkLeft = 3
GroupLinkRight = 2
IM-NT (MCB3)
Control group = 3
GroupLinkLeft = COMMON (setting not important)
GroupLinkRight = COMMON (setting not important)
IGS-NT (GCB3)
Control group = 3
GroupLinkLeft = COMMON (setting not important)
GroupLinkRight = COMMON (setting not important)

4.3.9 Multiple parallel to Mains, MCB and BTB control from IM-NT (2Mains)



Description

- The system with this topology has to be separated into 4 logical groups by 3 IM-NT (BTB) controllers. It is not possible to use IM-NT MGCB application for this purpose.
- The IM-NT (MCB) controller opens MCB after the mains fails or after the gen-sets are running according to setpoint **AMF settings**:*MCB opens on*.
- IM-NT (BTB) controller closes automatically BTB/MGCB if
  - bus voltages are within the limits (**Sync ctrl**:*Phase window*, *Voltage window*)
  - there is voltage on one of the buses and closing to dead bus is enabled by P**rocessControl**:*DeadBusClosing*
  - binary input *BTB disable* is not closed
  - it is enabled by setting of **ProcessControl**:*Synchro enable*, *Mains coupling* setpoints
- After binary input *Sys start/stop* closes the gen-sets are starting with a delay *SysAMFstrtDel*. It is similar to setpoint *EmergStart del* in SPtM application. The first set with a correct voltage and frequency closes the GCB to the dead bus, others are synchronized.
- When the mains returns, IM-NT (MCB) synchronizes gen-sets to the mains with limitations given by setpoints **ProcessControl**:*ParallelEnable* and *Synchro enable* (see Table on p.9 in IM-NT-MCB-MGCB-X.X.pdf).
- The gen-set controllers know whether they are connected to the Mains from binary input *MCB feedback* that can be configured on binary output *InMainsParal* (using VPIO for instance). This binary output is distributed over the CAN bus and indicates which BTBs are closed and so which logical groups are interconnected and connected to the Mains. Based on this information the gen-set controllers are controlled by one or another IM-NT (MCB) controller.

Hint:

It is possible to use virtual shared inputs/outputs to connect for example Sys start/stop output from IM-NT to corresponding binary input of all controllers instead of hardwiring it. See chapter Shared virtual I/O periphery. For BTB controllers the BI *BTB Feedback* should be configured as *Group link* input as well.

Hardware requirements

5x	IM-NT	
nx	IG/IS-NT	
nx	IGS-NT-LSM+PMS	
nx	IG-AVRi	(when volt matching and VAR sharing is required)
nx	IG-AVRi-TRANS/LV	(when IG-AVRi is used)
1x	I-LB+ or IG-IB	(Optional – Refer to IGS-NT-Communication guide)

Hint:

Without IG-AVRi Droop VAR sharing must be used.

Required setting:

System with MGCBs (example related to the second scheme above):

IM-NT (MCB1)
Control group = 1
GroupLinkLeft = COMMON (setting not important)
GroupLinkRight = COMMON (setting not important)

IGS-NT (GCB1)
Control group = 2
GroupLinkLeft = COMMON (setting not important)
GroupLinkRight = COMMON (setting not important)

IGS-NT (GCB2)
Control group = 2
GroupLinkLeft = COMMON (setting not important)
GroupLinkRight = COMMON (setting not important)

IM-NT (MGCB1) – BTB appl. used
GroupLinkLeft = 1
GroupLinkRight = 2

IM-NT (BTB)
GroupLinkLeft = 3
GroupLinkRight = 1

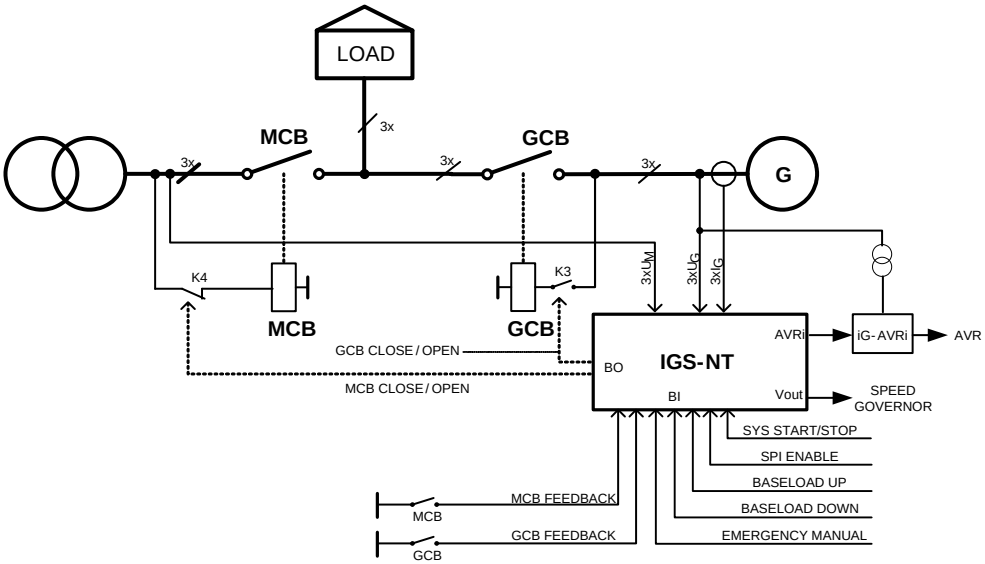
IM-NT (MGCB2) – BTB appl. used
GroupLinkLeft = 3
GroupLinkRight = 4
IM-NT (MCB2)
Control group = 3
GroupLinkLeft = COMMON (setting not important)
GroupLinkRight = COMMON (setting not important)
IGS-NT (GCB3)
Control group = 4
GroupLinkLeft = COMMON (setting not important)
GroupLinkRight = COMMON (setting not important)
IGS-NT (GCB4)
Control group = 4
GroupLinkLeft = COMMON (setting not important)
GroupLinkRight = COMMON (setting not important)

4.4 Combi applications

4.4.1 Single applications SPI and SPTM

Specification

- The SPI application is selected if BI *SPI enable* is closed.
- The SPTM application is selected if BI *SPI enable* is opened or not configured.
- **The only possibility to switch on-line between applications is using the *Emergency manual* input. No BI (= *MultipleEnable*, *SPI enable*) changes are accepted until this input is activated and consequently deactivated!**
- The other possibility is to switch off the power supply - when powering on again, the actual state of binary inputs is read and corresponding application is selected.
- Binary inputs Baseload up and Baseload down increase/decrease actual required power by Analog External Baseload (**ProcessControl:** *Load ctrl PTM* = ANEXT BASELOAD) via the pre-defined ExtValue1 of the IG/IS-NT-Combi archive.
- Setpoints from ProcessControl group are located in group in ProcCtrlSingle.
- Other setpoint groups are consolidated from all three applications SPI, SPTM and MINT, i.e. there are groups AMF settings (from SPI/SPtM) and Pwr management (from MINT).



Hardware requirements

1x IGS-NT
1x IG-AVRi (when volt matching and PF control is required)

1x IG-AVRi-TRANS/LV (when IG-AVRi is used)

Required application type: Combi.ant

Required setting:

Island enable:	YES
ParallelEnable	YES
Synchro enable	BOTH
MFStart enable	YES
ManualFuseSync	ENABLED/DISABLED (if enabled, the controller does not try to open the MCB if there is a mains failure) – important only for SPtM mode
Sync timeout	NO TIMEOUT/ 1 - 1800 (for infinite synchronization set setpoint Sync timeout = NO TIMEOUT)

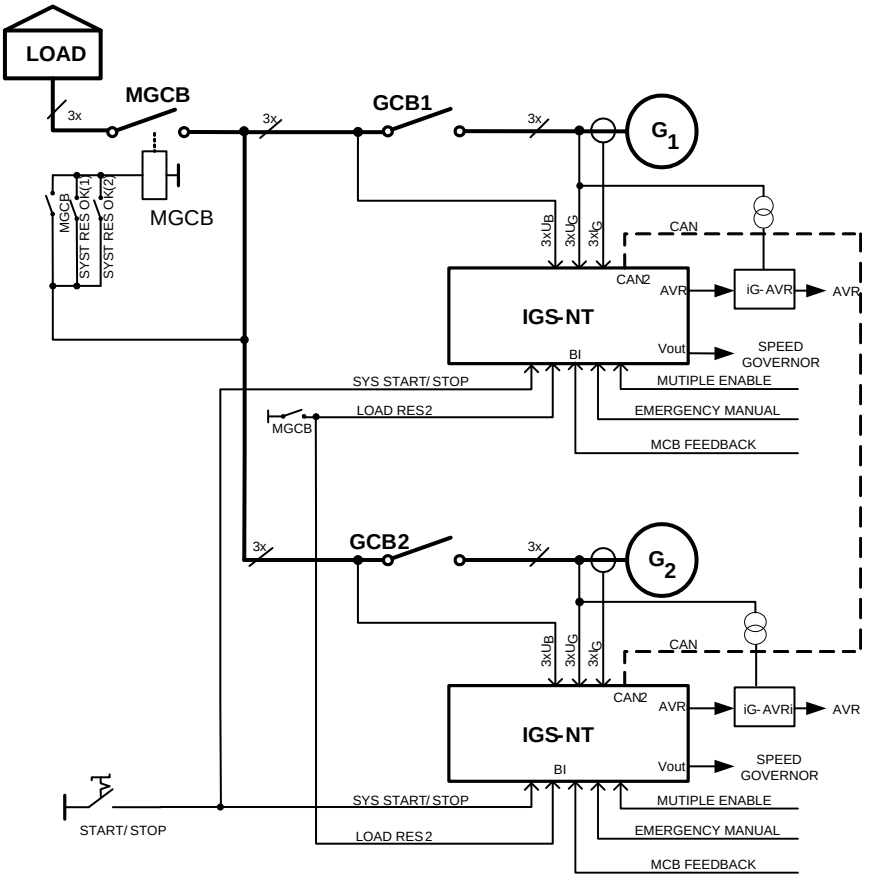
Hint:

For *ManualFuseSync* and *Sync timeout* setpoints, you can additionally use the Force value feature, so you can switch between std. sync and manual fuce sync using binary input.

4.4.2 MINT application

Specification

- The MINT application is selected if BI *MultipleEnable* is closed.
- **The only possibility to switch on-line between applications is using the *Emergency manual* input. No BI (= *MultipleEnable*, *SPI enable*) changes are accepted until this input is activated and consequently deactivated!**
- The other possibility is to switch off the power supply - when powering on again, the actual state of binary inputs is read and corresponding application is selected.
- Setpoints from ProcessControl group are located in group in ProcCtrlMulti.
- Other setpoint groups are consolidated from all three applications SPI, SPTM and MINT, i.e. there are groups AMF settings (from SPI/SPtM) and Pwr management (from MINT).



Hardware requirements

nx	IGS-NT	
nx	IGS-NT-LSM+PMS	
nx	IG-AVRi	(when volt matching and VAR sharing is required)
nx	IG-AVRi-TRANS/LV	(when IG-AVRi is used)
1x	I-LB+ or IG-IB	(Optional – Refer to IGS-NT-Communication guide)

Hint:

Without IG-AVRi Droop VAR sharing must be used.

Required application System configuration/ default archive : Combi.ant

Required setting:

Set *SysAMFstrtDel* and *SysAMFstopDel* setpoints at 1s for fast response on **BI Sys start/stop**

5. Virtual peripherals

5.1 Integrated PLC

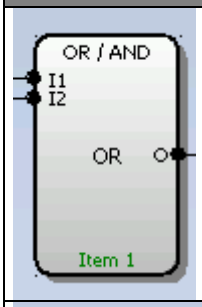
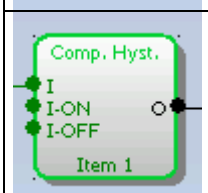
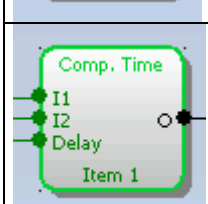
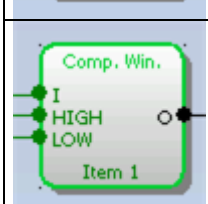
The NT family controllers contain a virtual PLC module that can be “connected” to the system. The activation of the PLC is done in the Modules card in GenConfig. PLC module is added automatically if at least one PLC block is configured in the PLC Editor in GenConfig.

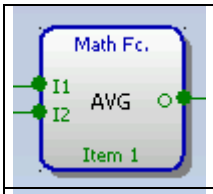
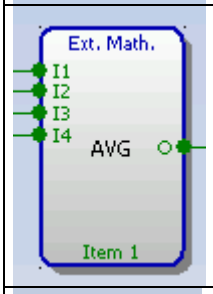
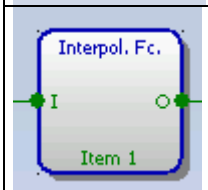
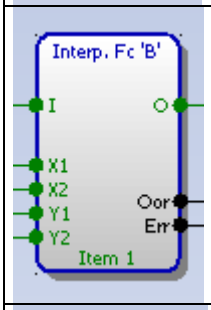
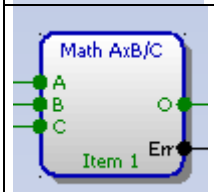
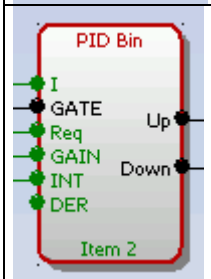
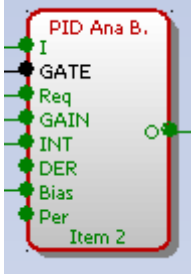
Depending on the controller HW type, a different number of functions and function types is available. See the table below for complete overview.

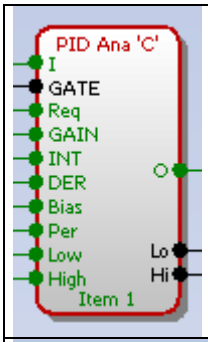
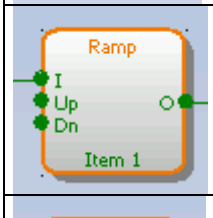
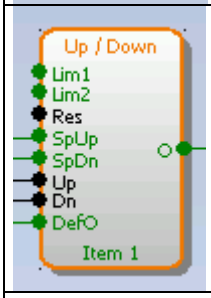
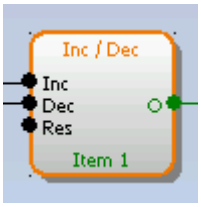
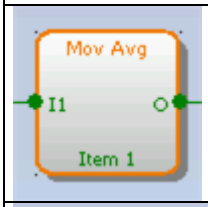
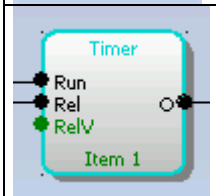
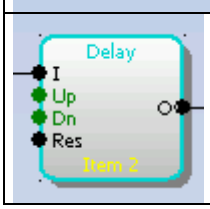
The internal PLC can simplify or even avoid the external logic in a switchboard, bringing another level of control system integration.

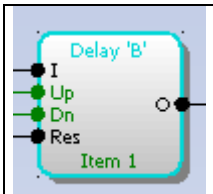
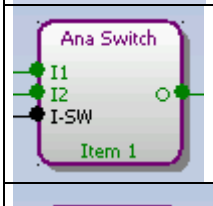
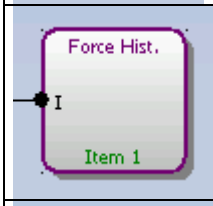
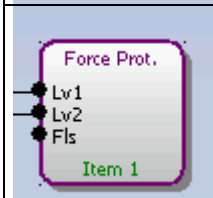
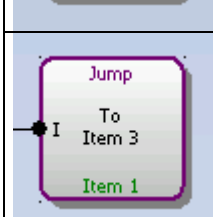
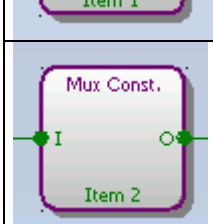
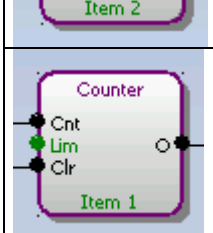
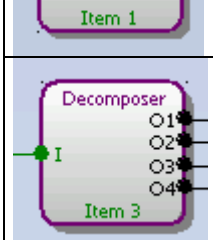
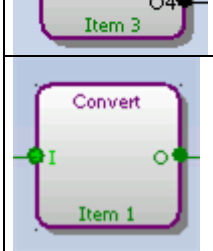
The PLC has analog and binary inputs and outputs that can be interfaced to any suitable controller analog value, physical or logical binary input and output.

List of function types:

CONFIG ITEM	SELECTION AVAILABLE	IG-NT	IS-NT AND IM-NT	NOTE*
	**OR/AND**	32	128	AND, OR 2 to 8 inputs Binary output
	**XOR/RS**	32	128	XOR, RS (flip-flop) 2 inputs Binary output
	**Comp Hyst**	4	16	Analog input Two limits Binary output
	**Comp Time**	4	8	Analog input One limit + delay Binary output
	**Comp.Win**	4	16	Window comparator Analog input, two limits, analog output. Binary output is active when input is within limits.

	**Math Fc**	2	16	ADD, SUB, ABS, AVG, MAX, MIN Two analog inputs Analog output
	**Ext Math Fc**	2	8	Math functions with expandable number of inputs up to 8. Selectable: ADD, AVG, MAX, MIN 8 analog inputs, 1 analog output.
	**Interp. Fc**	N/A	N/A	**This function was replaced with new version Interp. Fc 'B'.** Linear interpolation Analog input Analog output Interpolation definition only by constant
	**Interp. Fc 'B'**	1	8	Linear interpolation Analog inputs (Input value, interpolation definition inputs) Analog output Binary outputs (Out of Range, Data Invalid)
	**Math AxB/C**	N/A	4	
	**PID Bin**	N/A	4	PID control loop with binary output
	**PID Ana B.**	N/A	N/A	**This function was replaced with new version PID Ana 'C'.** PID - Analog output jumps to adjustable Bias value when Gate input is active (instead zero as before) and starts from Bias.

	**PID Ana 'C'**	N/A	4	PID - Analog output jumps to adjustable Bias value when Gate input is active (instead zero as before) and starts from Bias.
	**Ramp**	2	4	Ramp - Analog input, analog output. Two setpoints for Ramp-up and down speed (in number of units per second). Enable-Up, Enable-Down: Enables/Disables the ramp.
	**Up/Down**	2	4	Analog output changing within 2 limits (by defined rate of change - ramp) when Up/Down input is active.
	**Inc/Dec**	2	2	Analog output (internal register) can be Increased / Decreased by one with rising edge of binary input "Inc" / "Dec" in range from 0 to adjustable limit (max 65535). Register is Inc / Decreased over zero when "Cycle" option is ticked. Register stops on 0 even other Dec pulses come (or on Max for Inc pulses) when "Cycle" option is not ticked. Example of "Cycle" when Max = 5: 1-2-3-4-5-0-1-... or ...4-3-2-1-0-5-4- ... Example of "No-Cycle" when Max = 5: 1-2-3-4-5-5-5-... or ...4-3-2-1-0-0-0- ... Binary input "Reset" switch the Analog output to adjustable "Default" value.
	**Mov Avg**	1	2	Analog input, Analog output Performs averaging (filtering) of the input value with selectable weight and period
	**Timer**	1	4	Periodic signal generator Binary output Analog input
	**Delay**	N/A	16	**Some or all blocks of this function were replaced with new version Delay 'B'.** Adjustable rising and falling edge delay

	**Delay 'B'**	8	8	Adjustable rising and falling edge delay with selectable range in seconds, minutes or hours.
	**Ana Switch**	2	16	Two analog inputs Analog output Binary input as selector
	**Force Hist**	4	4	Binary input causes history record when changes from 0 to 1
	**Force Prot**	4	4	Adjustable protection levels, based on PLC evaluation
	**Jump**	4	4	Binary input Enabled / Disabled jump over the selected number of the next following PLC blocks. Jumps to the last one when number of blocks is higher than existing. Jump size is fix, adjustable during the configuration procedure only.
	**Mux Const.**	4	4	The block works as a multiple constant selected by an analog value. The output value is set to the constant with index equal to the input value
	**Counter**	1	4	Edges counter One limit Binary output
	**Decomp**	4	4	Selected part of Analog input can be decomposed (decoded) to four binary outputs.
	**Convert**	4	8	Converts any "Short" and "Long" analog value format to (signed) Integer format compatible with all PLC analog inputs. The invalid Analog output is indicated (####) when Analog input value is out of Integer range.

NOTE:
For information on PLC module configuration, see GenConfig manual or context help. (press F1 button in GenConfig).

Table of PLC blocks – differences between consequent versions (changes are in bold)

GROUP	PLC BLOCK	IS-NT AND IM-NT VER. 2.6	IS-NT AND IM-NT VER. 3.0	IG-NT VER. 2.6	IG-NT VER. 3.0	IG-NT-MCHP VER. 2.6	IG-NT-MCHP VER. 3.0
Logical function	OR/AND	**200 (128)**	**128**	32	32	32	32
	XOR/RS	**200 (128)**	**128**	32	32	32	32
Comparators	Comp Hyst	16	16	4	4	4	4
	Comp Time	8	8	4	4	4	4
	Comp Win	16	16	4	4	4	4
Math operations	Math Fc	16	16	2	2	2	2
	Ext math Fc	8	8	2	2	2	2
	Interp. Fc	**8**	**N/A**	**1**	**N/A**	**1**	**N/A**
	Interp. Fc 'B'	**N/A**	**8**	**N/A**	**1**	**N/A**	**1**
	Math AxB/C	**N/A**	**4**	**N/A**	**N/A**	**N/A**	**N/A**
Regulators	PID Ana B	**4**	**N/A**	**N/A**	**N/A**	**2**	**N/A**
	PID Ana 'C'	**N/A**	**4**	**N/A**	**N/A**	**N/A**	**2**
	PID Bin	4	4	N/A	N/A	2	2
Ramp functions	Ramp	4	4	2	2	2	2
	Up/Down	4	4	2	2	2	2
	Inc/Dec	2	2	2	2	2	2
	Mov Avg	2	2	1	1	1	1
Time functions	Timer	4	4	1	1	1	1
	Delay	**24**	**16**	**8**	**N/A**	**8**	**N/A**
	Delay 'B'	**N/A**	**8**	**N/A**	**8**	**N/A**	**8**
Others	Ana Switch	16	16	2	2	2	2
	Force Hist	4	4	4	4	4	4
	Force Prot	4	4	4	4	4	4
	Jump	4	4	4	4	4	4
	Mux Const.	4	4	4	4	4	4
	Counter	4	4	1	1	1	1
	Decomp	4	4	4	4	4	4
	Convert	8	8	4	4	8	8

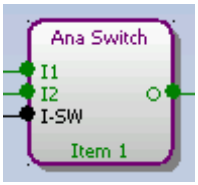
NOTE:
In version IS-NT-2.6, there were 200 OR/AND and XOR/RS functions available. Maximum configurable functions with binary output were 128 so the limit of OR/AND and XOR/RS functions was in fact 128.

Functions description

IMPORTANT
All analog inputs representing time are entered into PLC with one decimal in the range 0,0 – 3276,7 sec, i.e. if there is 100 seconds measured / converted at an analog input and the measurement is without decimal point, it is interpreted for PLC function as 10.0 seconds. For example in CMPT, Timer, Delay functions.

PLC Block: Analog switch (Multiplexer)

Symbol



Inputs

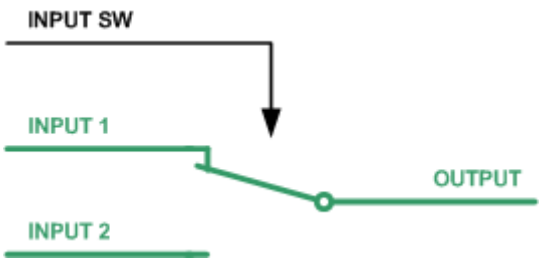
Input	Type	Range[dim]	Function
Input 1	A	Any	Input value 1
Input 2	A	Same as 'Input 1'	Input value 2
Input SW	B	N/A	Switch input

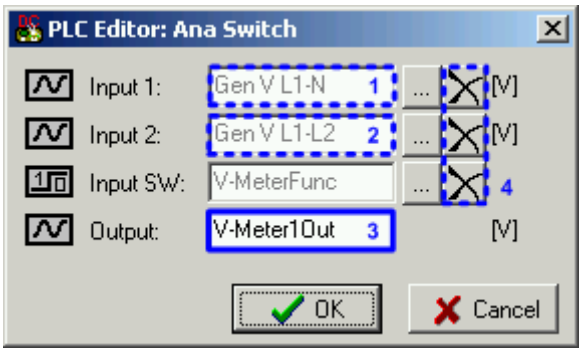
Outputs

Output	Type	Range[dim]	Function
Output	A	Same as 'Input 1'	Copy of 'Input 1' or 'Input 2' depending of the 'Input SW' state

Description

The block works as a multiplexer. If the binary input SW is inactive, the block copies the value of analog input 1 onto the analog output. If the binary input SW is active, the block copies the value of analog input 2 onto the output.





1. If you want the input 1 to be a constant, write the constant into this box. Otherwise go back to the sheet, create an input on it and connect the sheet input to the block input by dragging a wire.
2. If you want the input 2 to be a constant, write the constant into this box. Otherwise go back to the sheet, create an input on it and connect the sheet input to the block

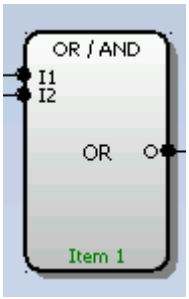
input by dragging a wire.
3. Rename the output.

NOTE:
Press the button (4) if you need to delete the currently configured source from the box.

NOTE:
The inputs are assigned to their sources in the sheet by **dragging a wire** from the input to the source.

PLC BLOCK: AND/OR

Symbol



Inputs

INPUT	TYPE	RANGE[DIM]	FUNCTION
Input 1..8	B	N/A	Inputs 1..8

Outputs

OUTPUT	TYPE	RANGE[DIM]	FUNCTION
Output	B	N/A	Result of the logical operation.

Description

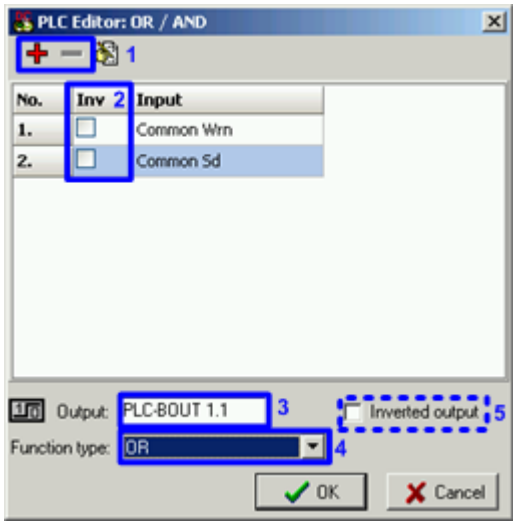
The block performs logical operation AND / OR of 2 - 8 binary operands. The inputs as well as the output can be inverted.

FUNCTION AND

I_1	I_2	O
0	0	0
0	1	0
1	0	0
1	1	1

FUNCTION OR

I_1	I_2	O
0	0	0
0	1	1
1	0	1
1	1	1

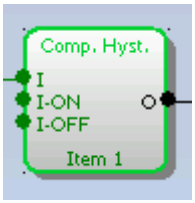


1. Use these buttons to add/remove inputs (up to 8).
2. The inputs can be inverted.
3. Rename the block output.
4. Select function of the block.
5. The output to be inverted.

NOTE:
The inputs are assigned to their sources in the sheet by **dragging a wire** from the input to the source.

PLC BLOCK: COMPARATOR WITH HYSTERESIS

Symbol



Inputs

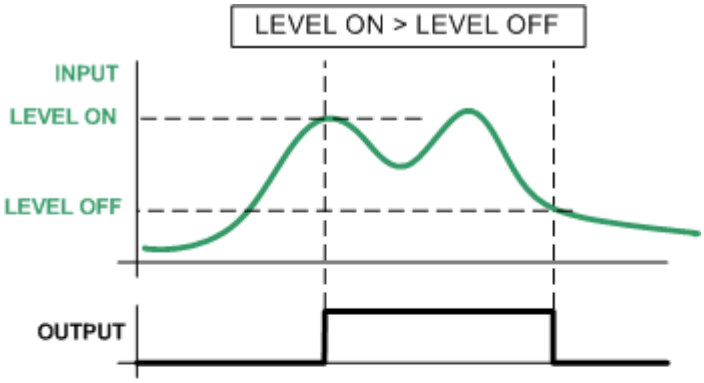
INPUT	TYPE	RANGE[DIM]	FUNCTION
Input	A	Any	Compared value
Input ON	A	Same as 'Input'	Comparation level for switching on
Input OFF	A	Same as 'Input'	Comparation level for switching off

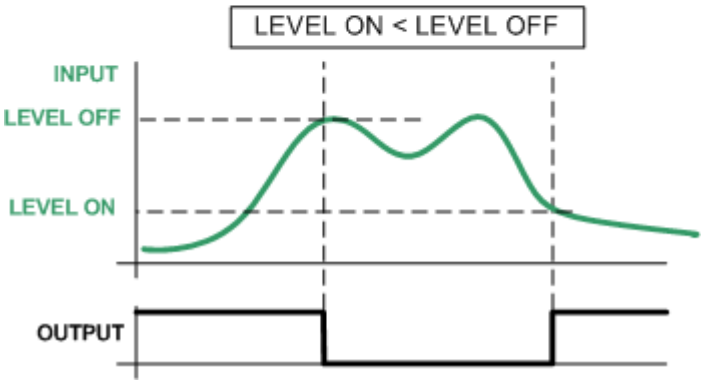
Outputs

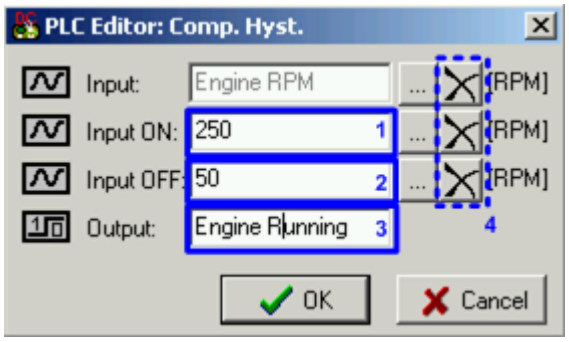
OUTPUT	TYPE	RANGE[DIM]	FUNCTION
Output	B	N/A	Comparator output

Description

The block compares the input value with the comparation levels. The behavior depends on whether the ON level is higher than OFF level or vice versa.







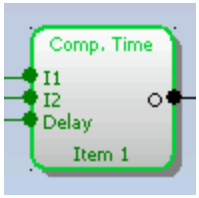
1. If you want the ON level to be a constant, write the constant into this box. Otherwise go back to the sheet, create an input on it and connect the sheet input to the block input by dragging a wire.
2. If you want the OFF level to be a constant, write the constant into this box. Otherwise go back to the sheet, create an input on it and connect the sheet input to the block input by dragging a wire.
3. Rename the output.

NOTE:
Press the button (4) if you need to delete the currently configured source from the box.

NOTE:
The inputs are assigned to their sources in the sheet by **dragging a wire** from the input to the source.

PLC BLOCK: COMPARATOR WITH DELAY

Symbol



Inputs

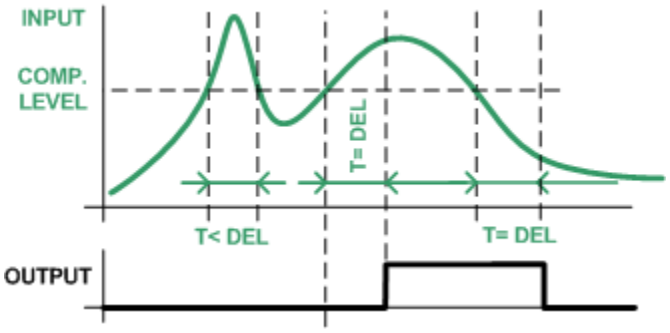
INPUT	TYPE	RANGE[DIM]	FUNCTION
Input 1	A	Any	Compared value
Input 2	A	Same as 'Input 1'	Comparation level
Delay	A	0.0..3000.0 [s]	Comparation delay

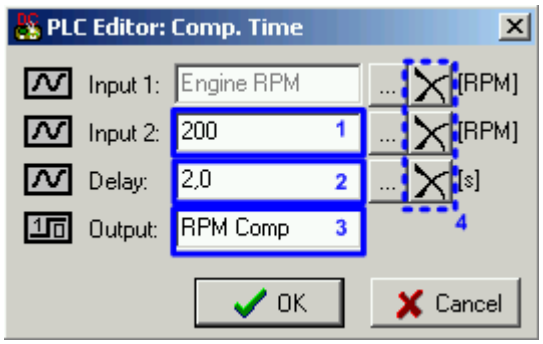
Outputs

OUTPUT	TYPE	RANGE[DIM]	FUNCTION
Output	B	N/A	Comparator output

Description

The block works as an analog switch. It compares the input value with the comparation level. The output will switch on if the input is equal or higher than the comparation level for time longer than the delay.





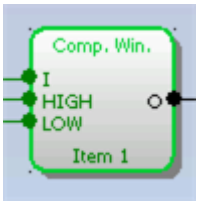
1. If you want the comparation level to be a constant, write the constant into this box. Otherwise go back to the sheet, create an input on it and connect the sheet input to the block input by dragging a wire.
2. If you want the delay value to be a constant, write the constant into this box. Otherwise go back to the sheet, create an input on it and connect the sheet input to the block input by dragging a wire.
3. Rename the output.

NOTE:
Press the button (4) if you need to delete the currently configured source from the box.

	NOTE: The inputs are assigned to their sources in the sheet by **dragging a wire** from the input to the source.

PLC BLOCK: WINDOW COMPARATOR

Symbol



Inputs

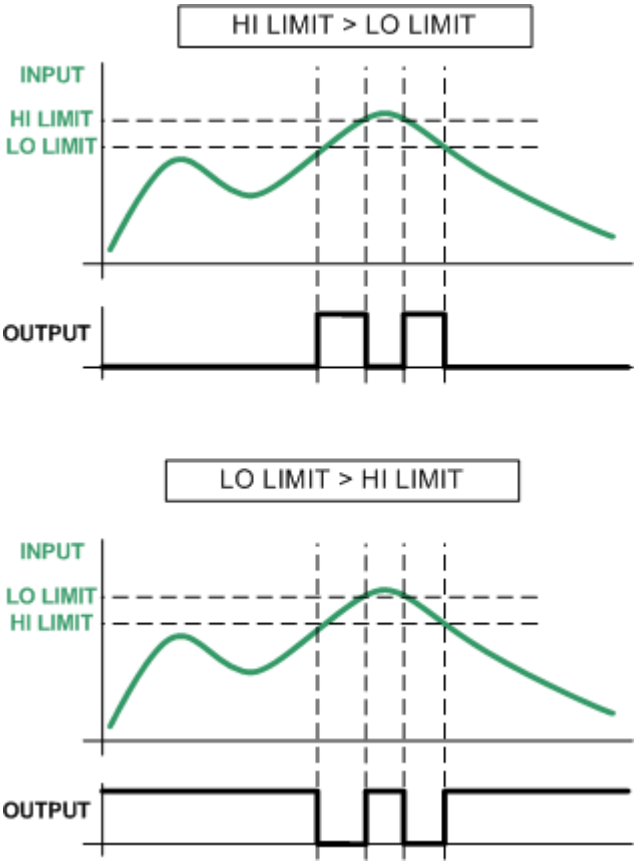
INPUT	TYPE	RANGE[DIM]	FUNCTION
Input	A	Any	Compared value
Input HIGH	A	Same as 'Input'	Upper window limit
Input LOW	A	Same as 'Input'	Lower window limit

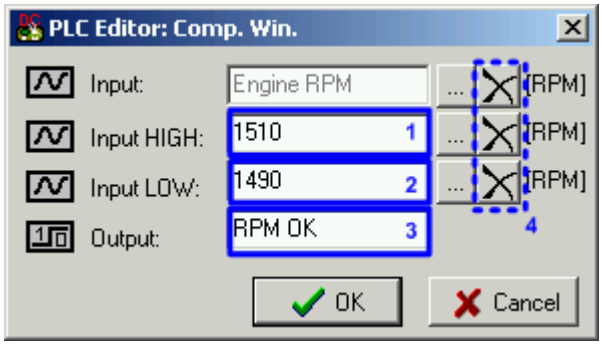
Outputs

OUTPUT	TYPE	RANGE[DIM]	FUNCTION
Output	B	N/A	Comparator output

Description

The block output is switched on whenever the input value is in the range defined by Lo and Hi levels.



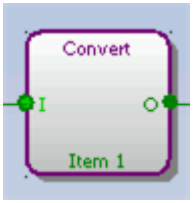


1. If you want the Hi level to be a constant, write the constant into this box. Otherwise go back to the sheet, create an input on it and connect the sheet input to the block input by dragging a wire.
2. If you want the Lo level to be a constant, write the constant into this box. Otherwise go back to the sheet, create an input on it and connect the sheet input to the block input by dragging a wire.
3. Rename the output.

NOTE:
Press the button (4) if you need to delete the currently configured source from the box.

NOTE:
The inputs are assigned to their sources in the sheet by **dragging a wire** from the input to the source.

PLC BLOCK: CONVERT

Symbol	

Inputs

INPUT	TYPE	RANGE[DIM]	FUNCTION
Input	A	Any	Input

Outputs

OUTPUT	TYPE	RANGE[DIM]	FUNCTION
Output	A	Adjustable	Output

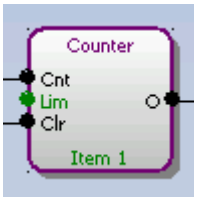
Description

The block converts the input value of any data type to an INTEGER16 value. If the input value is out of INTEGER16 range, the output value is set to invalid status (0x8000).

NOTE:
The inputs are assigned to their sources in the sheet by **dragging a wire** from the input to the source.

PLC BLOCK: COUNTER

Symbol



Inputs

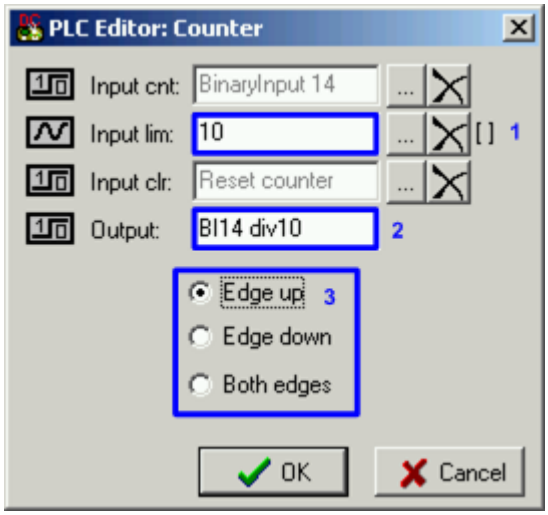
INPUT	TYPE	RANGE[DIM]	FUNCTION
Input Cnt	B	N/A	Input at which the edges are counted
Input Lim	A	0..32767 [-]	Counter value limit for activation of the output.
Input Clr	B	N/A	Reset input

Outputs

OUTPUT	TYPE	RANGE[DIM]	FUNCTION
Output	B	N/A	Output is activated when the counter value exceeds the limit

Description

The block works as a counter of edges (selectable rising, falling or both) with reset input and adjustable counting limit. The maximal counter value is 32767. The counter value is lost when the controller is switched off. The output is activated when the counter value reaches equal or higher value than the adjusted limit and remain active until the block is reset. Activating of the reset input resets the counter value to 0, deactivates the output. Holding the reset input active blocks counting.

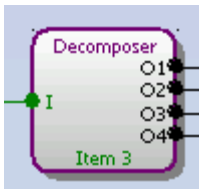


1. Adjust limit value. The counter output is activated when the counter gets over this value. The limit can be constant as well as a setpoint or any other analog value.
2. Rename the output.
3. Select edges which will be counted.

NOTE:
The inputs are assigned to their sources in the sheet by **dragging a wire** from the input to the source.

PLC BLOCK: DECOMPOSER

Symbol



Inputs

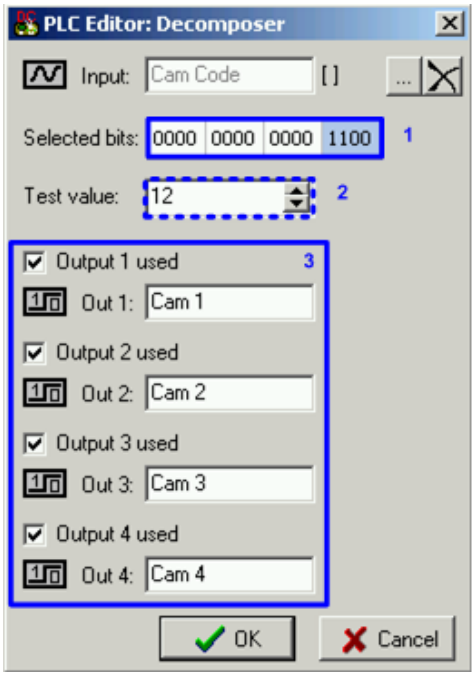
INPUT	TYPE	RANGE[DIM]	FUNCTION
Input	A	Any	Value to be "decomposed" to bits

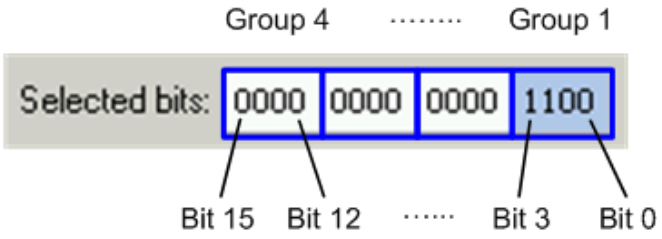
Outputs

OUTPUT	TYPE	RANGE[DIM]	FUNCTION
Out 1	B	N/A	Bit 0,4,8,12 - according to selected group of bits.
Out 2	B	N/A	Bit 1,5,9,13 - according to selected group of bits.
Out 3	B	N/A	Bit 2,6,10,14 - according to selected group of bits.
Out 4	B	N/A	Bit 3,7,11,15 - according to selected group of bits.

Description

The block converts the input analog value to binary form and provides selected bits as binary outputs. The block can be used e.g for creation of a camswitch as described in the Inc/Dec module.



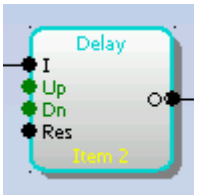


1. Select which group of bits will be mapped to the outputs.
2. Write a number into this box to see the binary form of the number in the selector (1). This box is for test purpose only and does not influence the behavior of the block.
3. Select which outputs will be used and rename them.

NOTE:
The inputs are assigned to their sources in the sheet by **dragging a wire** from the input to the source.

PLC BLOCK: DELAY

Symbol

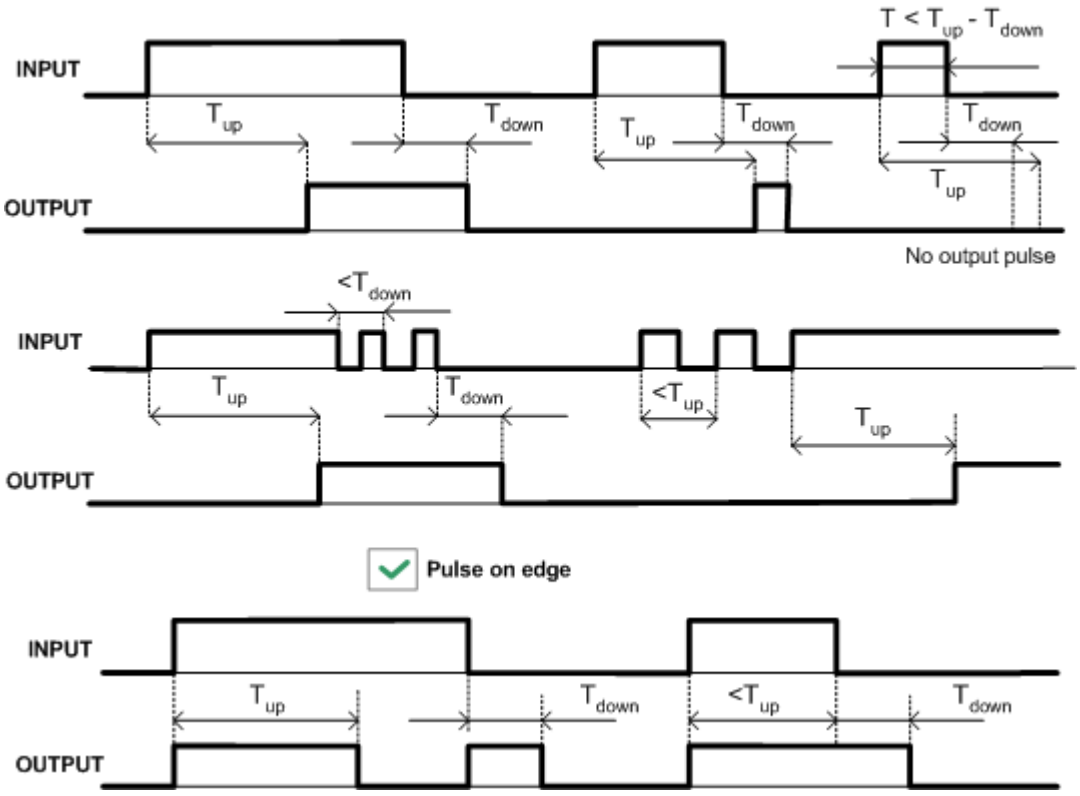
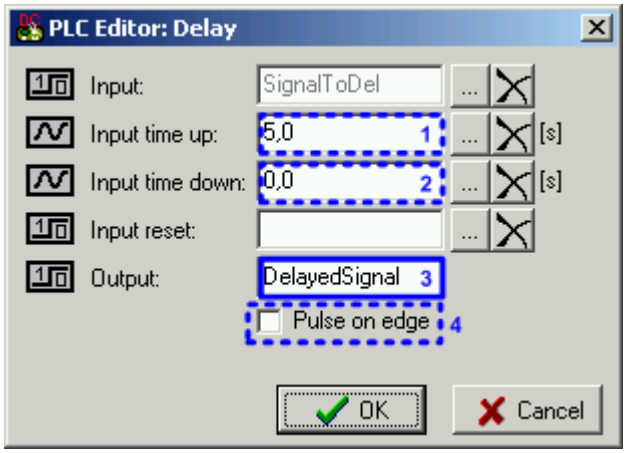


Inputs

INPUT	TYPE	RANGE[DIM]	FUNCTION
Input	B	N/A	Input signal to be delayed
Input time up	A	-3200.0..3200.0 [s]	Delay of the rising edge resp. pulse length generated by rising edge of the input
Input time down	A	-3200.0..3200.0 [s]	Delay of the falling edge resp. pulse length generated by falling edge of the input
Input reset	B	N/A	Resets the output to logical 0. The output remains in logical 0 while this input is active.

Outputs

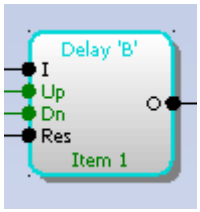
OUTPUT	TYPE	RANGE[DIM]	FUNCTION
Output	B	N/A	Output signal

Description	This block can work in two modes of operation: • **Delay mode** - the rising edge at the output is generated with delay of "input time up" when a rising edge at the input is detected. The falling edge at the output is generated with delay of "input time down" when a falling edge at the input is detected. If the delayed falling edge at the output came earlier than the delayed rising edge, then no pulse would be generatated at the output. • **Pulse mode** - a pulse of "input time up" length is generated at the output when a rising edge is detected, a pulse of "input time down" length is generated at the output when a falling edge is detected.   1. Adjust the delay of rising edge. If you want the delay to be a constant, write the constant into the box. Otherwise connect the input to any other analog object. 2. Adjust the delay of falling edge. If you want the delay to be a constant, write the constant to the box. Otherwise connect the input to any other analog object.

	3. Rename the output. 4. Select the operation mode (described above) **NOTE:** The inputs are assigned to their sources in the sheet by **dragging a wire** from the input to the source.

PLC BLOCK: DELAY - S/M/H (TYPE 'B')

Symbol



Inputs

INPUT	TYPE	RANGE[DIM]	FUNCTION
Input	B	N/A	Input signal to be delayed
Input time up	A	-3200.0..3200.0 [s, m, h]	Delay of the rising edge resp. pulse length generated by rising edge of the input
Input time down	A	-3200.0..3200.0 [s, m, h]	Delay of the falling edge resp. pulse length generated by falling edge of the input
Input reset	B	N/A	Resets the output to logical 0. The output remains in logical 0 while this input is active.

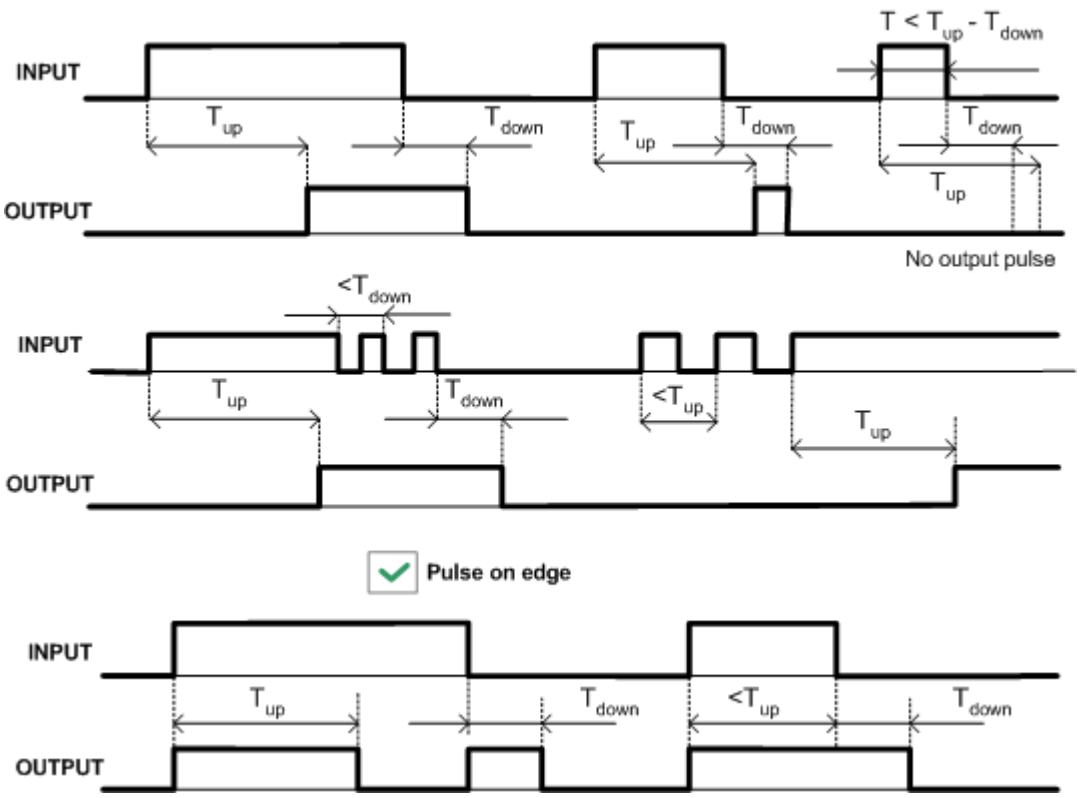
Outputs

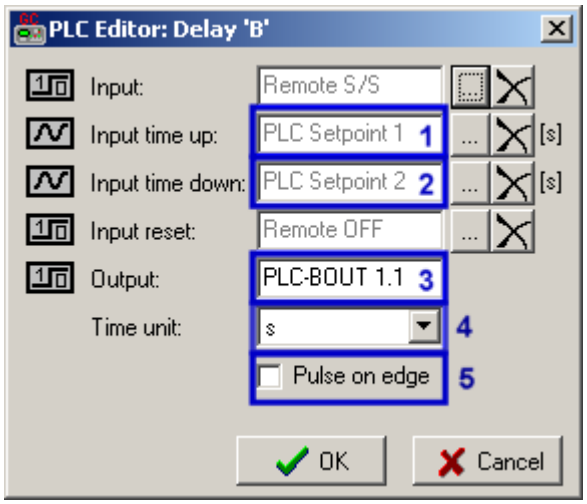
OUTPUT	TYPE	RANGE[DIM]	FUNCTION
Output	B	N/A	Output signal

Description

This block can work in two modes of operation:

- **Delay mode** - the rising edge at the output is generated with delay of "input time up" when a rising edge at the input is detected. The falling edge at the output is generated with delay of "input time down" when a falling edge at the input is detected. If the delayed falling edge at the output came earlier than the delayed rising edge, then no pulse would be generatated at the output.
- **Pulse mode** - a pulse of "input time up" length is generated at the output when a rising edge is detected, a pulse of "input time down" length is generated at the output when a falling edge is detected.



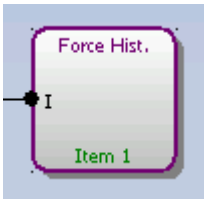


1. Adjust the delay of rising edge. If you want the delay to be a constant, write the constant into the box. Otherwise connect the input to any other analog object.
2. Adjust the delay of falling edge. If you want the delay to be a constant, write the constant to the box. Otherwise connect the input to any other analog object.
3. Rename the output.
4. Select time unit (seconds/minutes/hours)
5. Select the operation mode (described above)

NOTE:
The inputs are assigned to their sources in the sheet by **dragging a wire** from the input to the source.

NOTE:
This block is available in version 3.0 and later.

PLC BLOCK: FORCE HISTORY RECORD

Symbol	
Inputs	

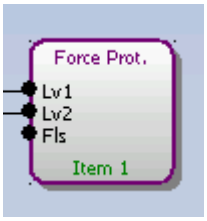
INPUT	TYPE	RANGE[DIM]	FUNCTION
Input	B	N/A	A record with configured text is recorded into the controller history when the input is activated.

Outputs	
Description	This block writes a record with defined text into the history when the input is activated.

1. Enter the text, which will be used for the "reason" column of the record.

NOTE:
The inputs are assigned to their sources in the sheet by **dragging a wire** from the input to the source.

PLC BLOCK: FORCE PROTECTION

Symbol	
Inputs	

INPUT	TYPE	RANGE[DIM]	FUNCTION
Lvl 1	B	N/A	The input activates yellow level of the configured protection if it is configured.
Lvl 2	B	N/A	The input activates red level of the configured protection if a red level protection is configured.
Fls	B	N/A	The input activates sensor fail if a red level protection is configured.

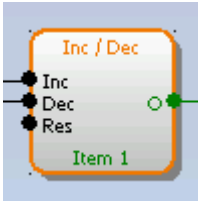
Outputs	
Description	This block issues alarms of configured type and text when appropriate binary input is activated.

1. Select the protection type from the list.
2. Enter the message, which will appear in the Alarmlist together with the prefix according to protection type when the protection is activated.
3. Go back to the drawing and attach wires to the inputs. Inputs are enabled and disabled according to selected protection type (e.g. if warning is selected, then "Lvl 2" input is disabled). Because of this the protection type must be configured first and then wires can be attached.

NOTE:
The inputs are assigned to their sources in the sheet by **dragging a wire** from the input to the source.

PLC BLOCK: INC/DEC

Symbol



Inputs

INPUT	TYPE	RANGE[DIM]	FUNCTION
Inc	B	N/A	Rising edge of the input increments the output by 1.
Dec	B	N/A	Rising edge of the input decrements the output by 1.
Reset	B	N/A	Rising edge of the input sets the output to default value.

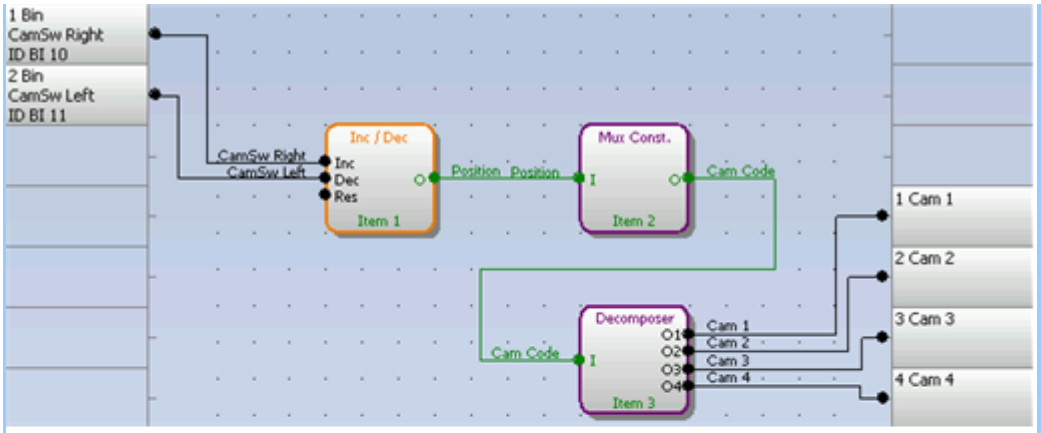
Outputs

OUTPUT	TYPE	RANGE[DIM]	FUNCTION
Output	A	0..Max [-]	Output value

Description

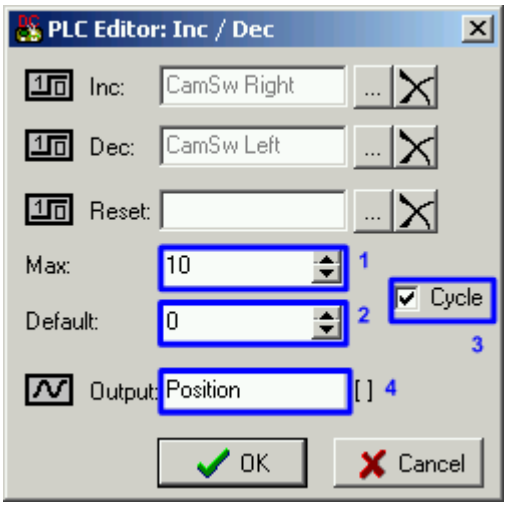
The output of the block is incremented/decremented by every rising edge at the input "Inc"/"Dec". The initial and maximal values of the output are adjustable. The output can be reset to the initial value by the input "Reset". The block can work in cyclical mode (e.g. ...4-5-0-1-2-3-4-5-0-1...) or non-cyclical mode (e.g. ...0-0-1-2-3-4-5-5...).

EXAMPLE:
The module can be used e.g. together with a Decomposer and Multiplexed constant for creation of a camswitch.



Position	Cam Code	Cam1	Cam2	Cam3	Cam4
1	3	0	0	1	1
2	10	1	0	1	0
3	11	1	0	1	1
4	6	0	1	1	0
5	5	0	1	0	1
6	12	1	1	0	0
7	9	1	0	0	1
8	0	0	0	0	0

EXAMPLE: CAMSWITCH

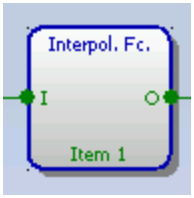


1. Adjust the upper limit of the output.
2. Adjust the initial value of the output after reset.
3. Select whether the output will work in cyclic or non-cyclic mode.
4. Rename the output.

NOTE:
The inputs are assigned to their sources in the sheet by **dragging a wire** from the input to the source.

PLC BLOCK: INTERPOLATION

Symbol



Inputs

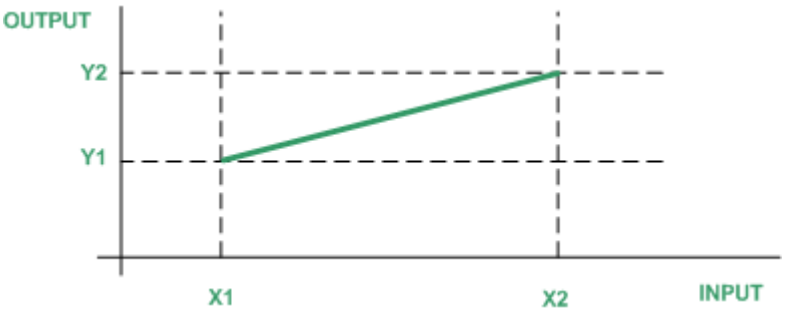
INPUT	TYPE	RANGE[DIM]	FUNCTION
Input	A	X1..X2 []	Input value

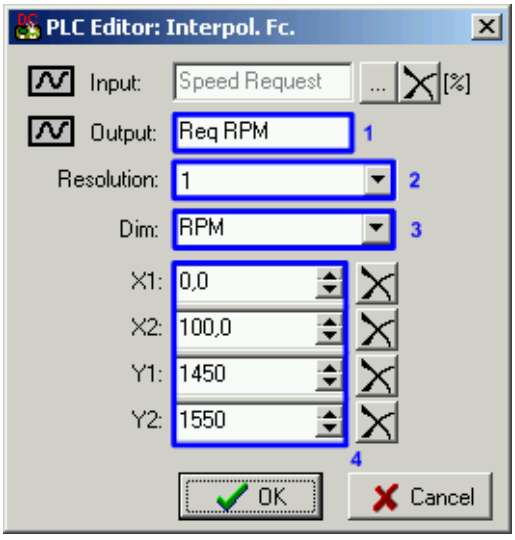
Outputs

OUTPUT	TYPE	RANGE[DIM]	FUNCTION
Output	A	Y1..Y2 []	Transformed value

Description

This block performs a linear transformation of the input. The transformation function is defined by two pairs of points [X1, Y1] and [X2, Y2]. The function works only within the region defined by X1,X2. Outside the region the output is an invalid value (-32768). The block can be used e.g. for changing of decimal resolution of a value.





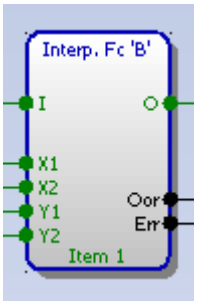
1. Rename the output.
2. Adjust resolution (number of decimal positions) of the output.
3. Adjust dimension of the output.
4. Enter the points of the transformation function. The value of X1 must be lower than the value of X2, however Y1 needn't to be lower than Y2, i.e. the characteristic can be also negative.

NOTE:
The inputs are assigned to their sources in the sheet by **dragging a wire** from the input to the

	source.

PLC BLOCK: INTERPOLATION - CONFIGURABLE (TYPE 'B')

Symbol



Inputs

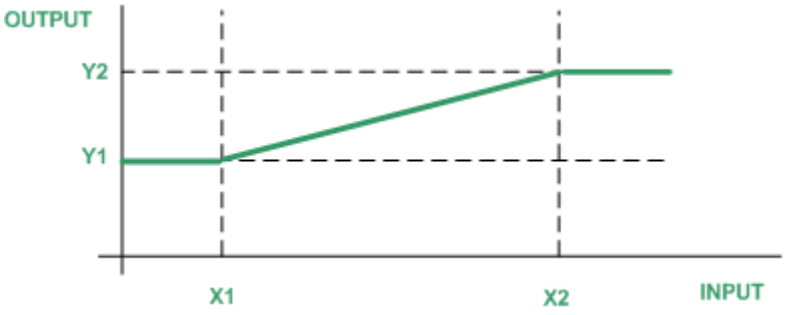
INPUT	TYPE	RANGE[DIM]	FUNCTION
Input	A	X1..X2 []	Input value
X1	A	-32000..32000 []	Low X limit of definition
X2	A	-32000..32000 []	High X limit of definition
Y1	A	-32000..32000 []	Low Y limit of definition
Y2	A	-32000..32000 []	High Y limit of definition

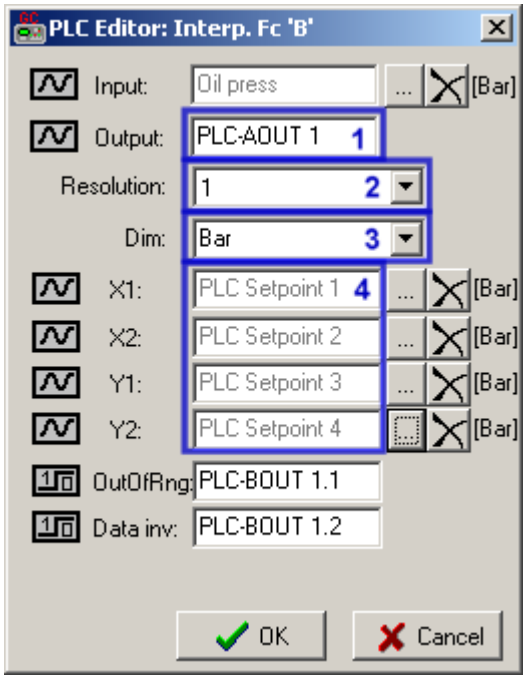
Outputs

OUTPUT	TYPE	RANGE[DIM]	FUNCTION
Output	A	Y1..Y2 []	Transformed value
OutOfRange	B	N/A	Input is out of range <X1;X2>
Data Invalid	B	N/A	Value on analog output is invalid

Description

This block performs a linear transformation of the input. The transformation function is defined by two pairs of points [X1, Y1] and [X2, Y2]. If the input lies inside of the interval <X1;X2> the value of output is given by the conversion if the input of the function lies outside of this interval the output of the function is saturated on the high or low limit given by the value of Y1 or Y2 (the binary output *OutOfRange* gets active). All parameters can be set as a constant or can be assigned to any analog value or setpoint of the controller. Resolution of all input parameters is automatically set as resolution of input of the function. If any of the inputs of the function gets invalid the binary output *DataInvalid* gets active and the output of the interpolation function is set to value -32768.



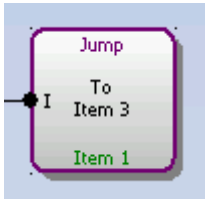


1. Rename the output.
2. Adjust resolution (number of decimal positions) of the output.
3. Adjust dimension of the output.
4. Enter the points of the transformation function or select source value for this points. The value of X1 must be lower than the value of X2, however Y1 needn't to be lower than Y2, i.e. the characteristic can be also negative.

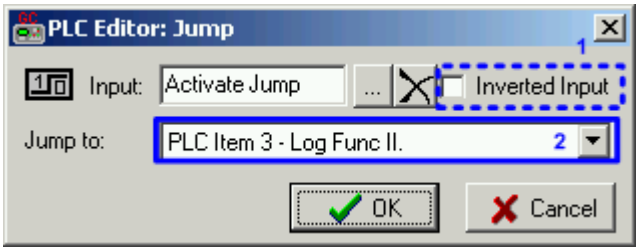
NOTE:
The inputs are assigned to their sources in the sheet by **dragging a wire** from the input to the source.

NOTE:
This block is available in version 3.0 and later.

PLC BLOCK: JUMP

Symbol	
Inputs	
Outputs	
Description	If the input is active, then a group of following PLC blocks is skipped and the PLC program continues execution at the block that is specified in the block jump.

INPUT	TYPE	RANGE[DIM]	FUNCTION
Input	B	N/A	Input which activates the jump.

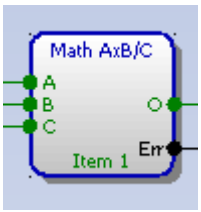


1. Select if the input will be inverted at the enter of the block.
2. Select the destination PLC block to which the block will jump.

NOTE:
The inputs are assigned to their sources in the sheet by **dragging a wire** from the input to the source.

PLC BLOCK: MATHEMATICAL FUNCTION MULTIPLICATION/DIVIDING (AXB/C)

Symbol



Inputs

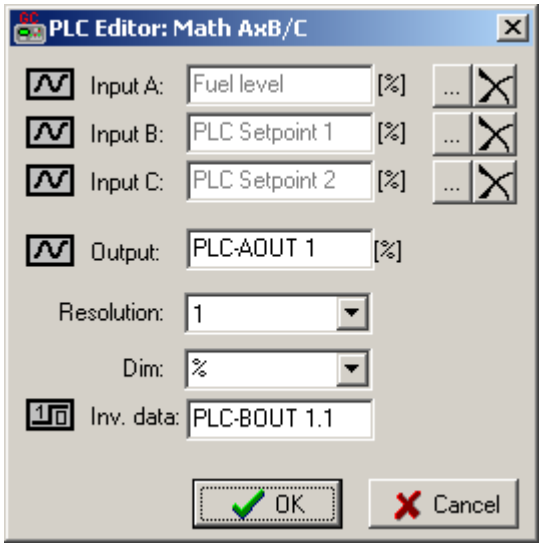
INPUT	TYPE	RANGE[DIM]	FUNCTION
Input A	A	Any	First multiplicant
Input B	A	Same as 'Input 1'	Second multiplicant
Input C	A	Same as 'Input 1'	Divider

Outputs

OUTPUT	TYPE	RANGE[DIM]	FUNCTION
Output	A	Same as 'Input 1'	Result of the mathematical operation.
Data Invalid	B	N/A	Atribute of invalid data on output

Description

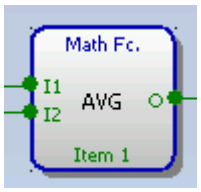
The block multiplication/dividing (AxB/C) realizes the mathematic operation of three operands (multiplication and dividing). The function can be used e.g. for scaling of values. In case of any invalid data on any of the inputs the output of the function is set to the invalid value -32768 and binary output *DataInvalid* gets active. The result of multiplication AxB is calculated as first and is stored into 32 bits long value. Whereas the output register is only 16 bits long value, the divider of the operation (input C) has to be selected properly to match the output value of the operation into interval <-32767;32767>. If the result of the operation is out of this range the output of the function is set to invalid value -32768 and the binary output *DataInvalid* gets active.



NOTE:
The inputs are assigned to their sources in the sheet by **dragging a wire** from the input to the source.

NOTE:
This block is available in version 3.0 and later.

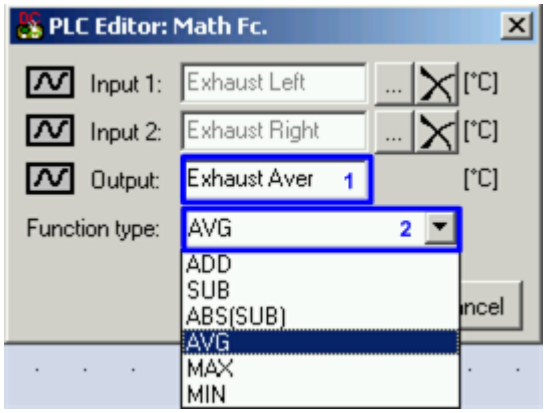
PLC BLOCK: MATHEMATICAL FUNCTION I

Symbol	
Inputs	
Outputs	
Description	The block performs basic mathematical operations of 2 operands.

INPUT	TYPE	RANGE[DIM]	FUNCTION
Input 1	A	Any	Input 1
Input 2	A	Same as 'Input 1'	Input 2

OUTPUT	TYPE	RANGE[DIM]	FUNCTION
Output	A	Same as 'Input 1'	Result of the mathematical operation.

- ADD: Addition
- SUB: Subtraction
- ABS(SUB): Absolute value of subtraction
- AVG: Average
- MIN: Minimum of two
- MAX: Maximum of two

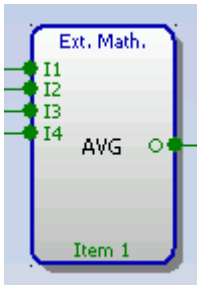


1. Rename the output
2. Select the mathematical operation

NOTE:
The inputs are assigned to their sources in the sheet by **dragging a wire** from the input to the source.

PLC BLOCK: MATHEMATICAL FUNCTION II

Symbol



Inputs

INPUT	TYPE	RANGE[DIM]	FUNCTION
Input 1	A	Any	Input 1
Input 2..8	A	Same as 'Input 1'	Inputs 2..8

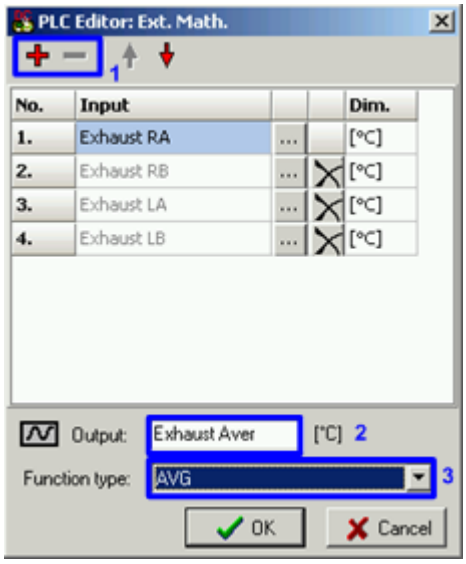
Outputs

OUTPUT	TYPE	RANGE[DIM]	FUNCTION
Output	A	Same as 'Input 1'	Result of the mathematical operation.

Description

The block performs basic mathematical operations of 2 - 8 operands.

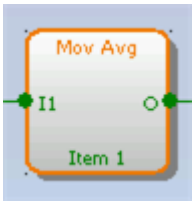
- ADD: Addition
- AVG: Average
- MIN: Minimal value
- MAX: Maximum value



1. Use these buttons to add and remove inputs (up to 8)
2. Rename the output
3. Select the mathematical operation

NOTE:
The inputs are assigned to their sources in the sheet by **dragging a wire** from the input to the source.

PLC BLOCK: MOVING AVERAGE

Symbol	

Inputs

INPUT	TYPE	RANGE[DIM]	FUNCTION
Input	A	Any	Input value

Outputs

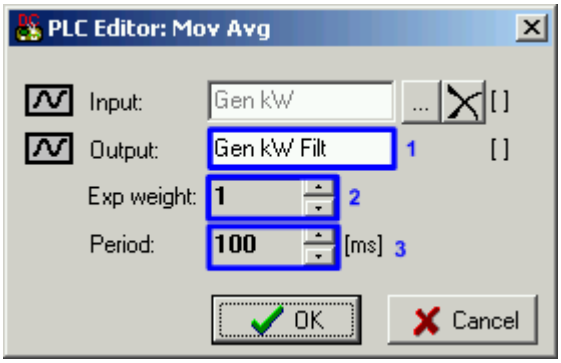
OUTPUT	TYPE	RANGE[DIM]	FUNCTION
Output	A	Same as the input	Floating average of the input value

Description

The function calculates average of *N* last samples of the input value. The rate of sampling is adjustable.

Typical usage of this function is filtering of a value (quantity) whose instantaneous value fluctuates rapidly around it's mean, which is changing slower. Using a filered value may avoid problems with further processing of the value e.g. in other PLC blocks or in a supervisory system.

Example of such value can be genset power at a gas engine operating in parallel to mains mode. Even if the mean value is constant, the instantaneous value may fluctuate rapidly due to misfiring.

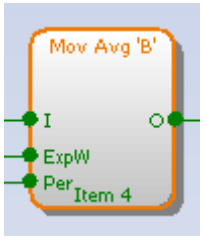


1. Rename the output.
2. The number of consequent samples *N* is given as $2^{exp\ weight}$. I.e. adjust 3 for 8 samples, 4 for 16 samples, 5 for 32 samples etc...
3. Adjust the sampling rate.

NOTE:
The inputs are assigned to their sources in the sheet by **dragging a wire** from the input to the source.

PLC BLOCK: MOVING AVERAGE (TYPE 'B')

Symbol



Inputs

INPUT	TYPE	RANGE[DIM]	FUNCTION
Input	A	Any	Input value
Exp weight	A	1..5 []	Exp weight value
Period	A	100..5000 [ms]	Period value

Outputs

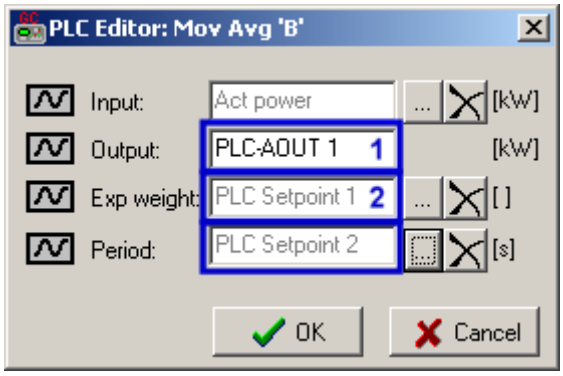
OUTPUT	TYPE	RANGE[DIM]	FUNCTION
Output	A	Same as the input	Floating average of the input value

Description

The function calculates average of *N* last samples of the input value. The rate of sampling is adjustable.

Typical usage of this function is filtering of a value (quantity) whose instantaneous value fluctuates rapidly around it's mean, which is changing slower. Using a filered value may avoid problems with further processing of the value e.g. in other PLC blocks or in a supervisory system.

Example of such value can be genset power at a gas engine operating in parallel to mains mode. Even if the mean value is constant, the instantaneous value may fluctuate rapidly due to misfiring.



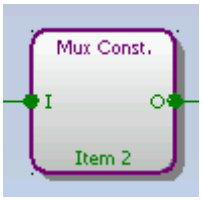
1. Rename the output.
2. The number of consequent samples *N* is given as $2^{exp\ weight}$. I.e. adjust 3 for 8 samples, 4 for 16 samples, 5 for 32 samples etc...
3. Adjust the sampling rate.

NOTE:
The inputs are assigned to their sources in the sheet by **dragging a wire** from the input to the source.

NOTE:
This block is available in some customer branches only.

PLC BLOCK: MULTIPLEXED ANALOG CONSTANT

Symbol



Inputs

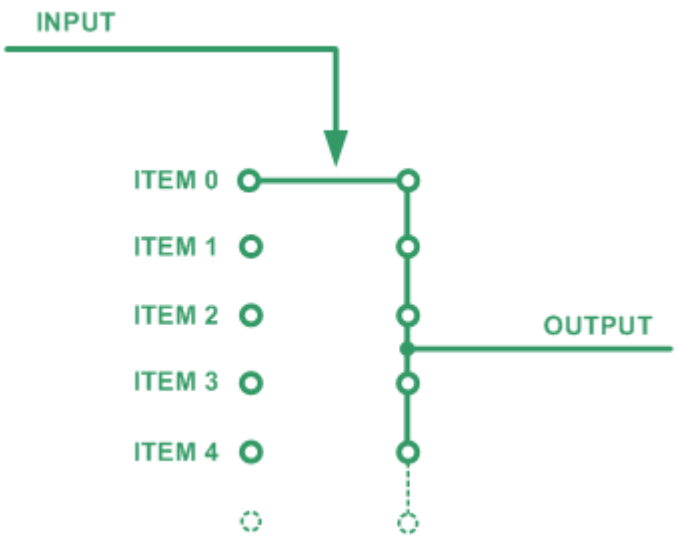
INPUT	TYPE	RANGE[DIM]	FUNCTION
Input	A	0..31 [-]	Selects which constant will be sent to the output

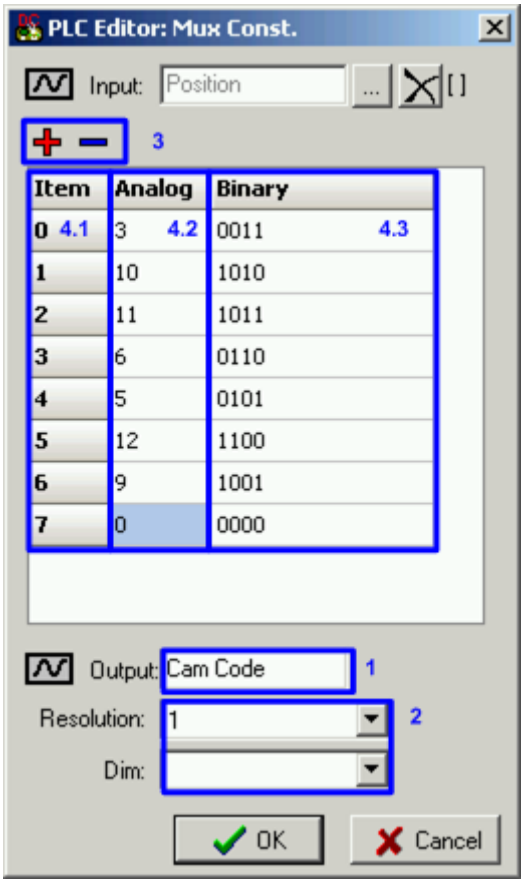
Outputs

OUTPUT	TYPE	RANGE[DIM]	FUNCTION
Output	A	Adjustable	Output value is one of the constants selected by the input

Description

The block works as a multiple constant selected by an analog value. The output value is set to the constant with index equal to the input value. The block can be used e.g for creation of a camswitch as described in the Inc/Dec module.



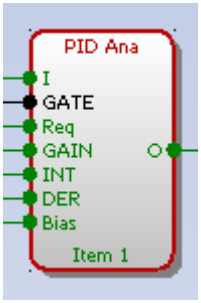


1. Rename the output.
2. Adjust resolution and dimension.
3. Use the buttons to add/remove constants (up to 32).
4. Adjust values of the constants. The column "Item" (4.1) represents indexes of the constants, which are used for selecting of the active constant. The value of the constant can be entered either in decimal form (4.2) or in binary form (4.3).

NOTE:
The inputs are assigned to their sources in the sheet by **dragging a wire** from the input to the source.

PLC BLOCK: PID REGULATOR WITH ANALOG OUTPUT

Symbol



Inputs

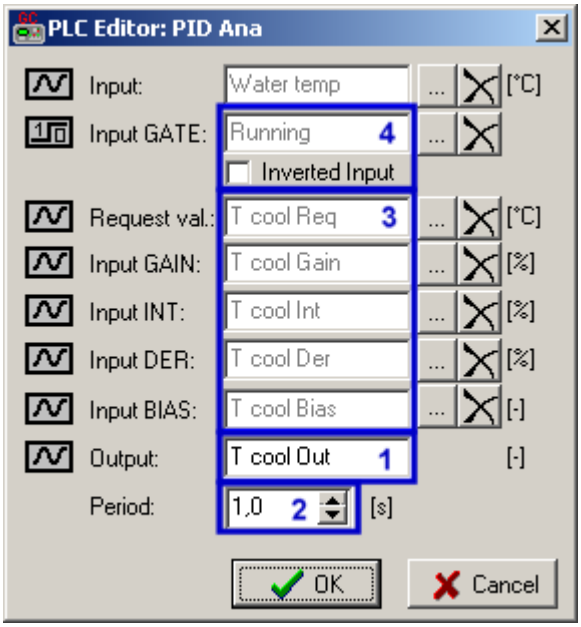
INPUT	TYPE	RANGE[DIM]	FUNCTION
Input	A	Any	Regulated value
Requested val.	A	Same as 'input'	Required value
Gain	A	-100.00..100.00 [%]	Gain of the regulator
Int	A	-100.00..100.00 [%]	Integrative part of the regulator
Der	A	-100.00..100.00 [%]	Derivative part of the regulator
Bias	A	-10000..10000 [-]	Value of the output while the regulator is off
Gate	B	N/A	Regulator on/off input

Outputs

OUTPUT	TYPE	RANGE[DIM]	FUNCTION
Output	A	-10000..10000 [-]	Actuator control output

Description

The block is a PID regulator with analog output and adjustable regulation period. The function of the regulator can be disabled by the gate input. While the regulator is disabled, the output is set to bias value.



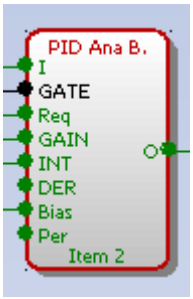
1. Rename the output.
2. Adjust regulation period. The period should be adjusted according to the speed of the response of the system, e.g. longer period for slower systems, shorter period for faster systems.

3. You may want to have some regulation parameters, as e.g. derivative part or bias, constant. In such a case write the constant directly into the appropriate box. If there is a source configured, it must be deleted prior to writing of the constant.
4. If you need the regulator to run only if certain condition is fulfiled, use the gate input. Create a binary value representing the condition (e.g. using other plc blocks) and connect it to the gate input. The regulator will then work only if the gate input is active. If the gate input is not connected, the regulator works all the time the controller is switched on.

NOTE:
The inputs are assigned to their sources in the sheet by **dragging a wire** from the input to the source.

PLC BLOCK: PID REGULATOR WITH ANALOG OUTPUT (TYPE 'B')

Symbol



Inputs

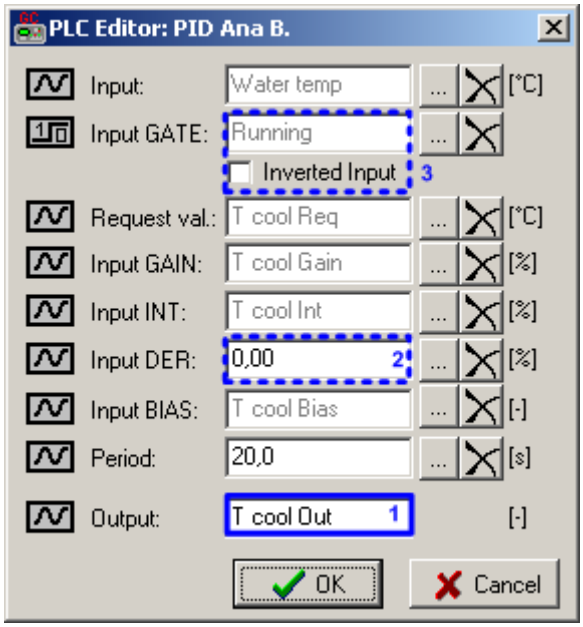
INPUT	TYPE	RANGE[DIM]	FUNCTION
Input	A	Any	Regulated value
Requested val.	A	Same as 'input'	Required value
Gain	A	-100.00..100.00 [%]	Gain of the regulator
Int	A	-100.00..100.00 [%]	Integrative part of the regulator
Der	A	-100.00..100.00 [%]	Derivative part of the regulator
Bias	A	-10000..10000 [-]	Value of the output while the regulator is off
Period	A	0.1..600.0 [s]	Regulation period. The period should be adjusted according to the speed of the response of the system, e.g. longer period for slower systems, shorter period for faster systems.
Gate	B	N/A	Regulator on/off input

Outputs

OUTPUT	TYPE	RANGE[DIM]	FUNCTION
Output	A	-10000..10000 [-]	Actuator control output

Description

The block is a PID regulator with analog output and adjustable regulation period. The function of the regulator can be disabled by the gate input. While the regulator is disabled, the output is set to bias value.

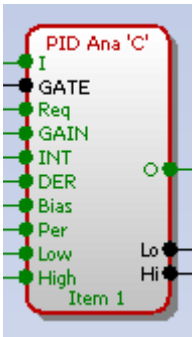


1. Rename the output.
2. You may want to have some regulation parameters, as e.g. derivative part or bias, constant. In such a case write the constant directly into the appropriate box. If there is a source configured, it must be deleted prior to writing of the constant.
3. If you need the regulator to run only if certain condition is fulfiled, use the gate input. Create a binary value representing the condition (e.g. using other plc blocks) and connect it to the gate input. The regulator will then work only if the gate input is active. If the gate input is not connected, the regulator works all the time the controller is switched on.

NOTE:
The inputs are assigned to their sources in the sheet by **dragging a wire** from the input to the source.

PLC BLOCK: PID REGULATOR WITH ANALOG OUTPUT WITH CONFIGURABLE OUTPUT LIMIT (TYPE 'C')

Symbol



Inputs

INPUT	TYPE	RANGE[DIM]	FUNCTION
Input	A	Any	Regulated value
Input Gate	B	N/A	Regulator on/off input
Requested val.	A	Same as 'input'	Required value
Input GAIN	A	-100.00..100.00 [%]	Gain of the regulator
Input INT	A	-100.00..100.00 [%]	Integrative part of the regulator

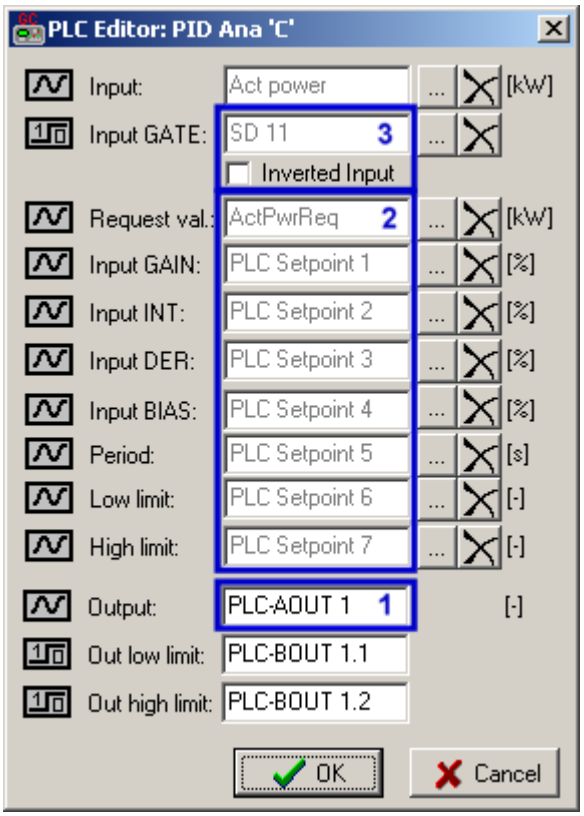
	Input DER	A	-100.00..100.00 [%]	Derivative part of the regulator
	Input BIAS	A	-10000..10000 [-]	Value of the output while the regulator is off
	Period	A	0,0..600,0 [s]	Period of regulator (speed of response of the system
	Low limit	A	-10000..10000 [-]	Low limit of the output, if output reaches this value, the internal integration of the block is stopped. Normally set to -10000
	High limit	A	-10000..10000 [-]	High limit of the output, if output reaches this value, the internal integration of the block is stopped. Normally set to 10000

Outputs

OUTPUT	TYPE	RANGE[DIM]	FUNCTION
Output	A	-10000..10000 [-]	Actuator control output
Out low limit	B	N/A	This attribute confirms that the output reached the LowLimit value
Out high limit	B	N/A	This attribute confirms that the output reached the HiLimit value

Description

The block is a PID regulator with analog output and adjustable regulation period. The function of the regulator can be disabled by the gate input. While the regulator is disabled, the output is set to bias value.



1. Rename the output.
2. You may want to have some regulation parameters, as e.g. derivative part or bias, constant. In such a case write the constant directly into the appropriate box. If there is a source configured, it must be deleted prior to writing of the constant. Adjust regulation period. The period should be adjusted according to the speed of the response of the system, e.g. longer

period for slower systems, shorter period for faster systems.

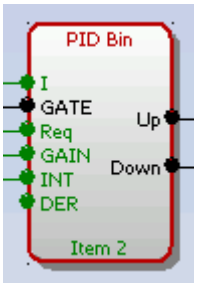
3. If you need the regulator to run only if certain condition is fulfiled, use the gate input. Create a binary value representing the condition (e.g. using other plc blocks) and connect it to the gate input. The regulator will then work only if the gate input is active. If the gate input is not connected, the regulator works all the time the controller is switched on.

NOTE:
The inputs are assigned to their sources in the sheet by **dragging a wire** from the input to the source.

NOTE:
This block is available in version 3.0 and later.

PLC BLOCK: PID REGULATOR WITH UP/DOWN BINARY OUTPUTS

Symbol



Inputs

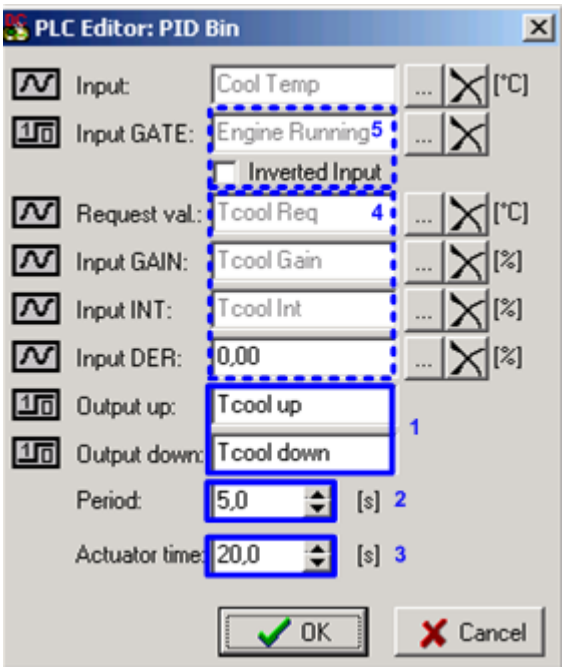
INPUT	TYPE	RANGE[DIM]	FUNCTION
Input	A	Any	Regulated value
Requested val.	A	Same as 'input'	Required value
Gain	A	-100.00..100.00 [%]	Gain of the regulator
Int	A	-100.00..100.00 [%]	Integrative part of the regulator
Der	A	-100.00..100.00 [%]	Derivative part of the regulator
Gate	B	N/A	Regulator on/off input

Outputs

OUTPUT	TYPE	RANGE[DIM]	FUNCTION
Output up	B	N/A	Actuator control - Raise
Output down	B	N/A	Actuator control - Lower

Description

The block is a PID regulator with binary outputs up/down and adjustable regulation period. The function of the regulator can be disabled by the gate input.

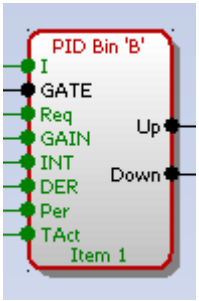


1. Rename the outputs.
2. Adjust regulation period. The period should be adjusted according to the speed of the response of the system, e.g. longer period for slower systems, shorter period for faster systems.
3. Adjust the actuator time. It is time that the actuator (servo etc.) needs for changing position from fully closed to fully open.
4. You may want to have some regulation parameters, as e.g. derivative part, constant. In such a case write the constant directly into the appropriate box. If there is a source configured, it must be deleted prior to writing of the constant.
5. If you need the regulator to run only if certain condition is fulfiled, use the gate input. Create a binary value representing the condition (e.g. using other plc blocks) and connect it to the gate input. The regulator will then work only if the gate input is active. If the gate input is not connected, the regulator works all the time the controller is switched on.

NOTE:
The inputs are assigned to their sources in the sheet by **dragging a wire** from the input to the source.

PLC BLOCK: PID REGULATOR WITH UP/DOWN BINARY OUTPUTS (TYPE 'B')

Symbol



Inputs

INPUT	TYPE	RANGE[DIM]	FUNCTION
Input	A	Any	Regulated value
Requested val.	A	Same as 'input'	Required value
Gain	A	-100.00..100.00 [%]	Gain of the regulator

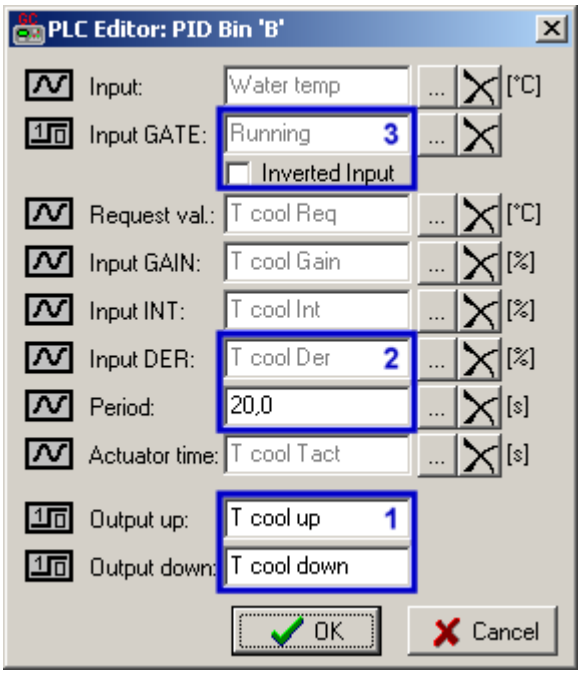
	Int	A	-100.00..100.00 [%]	Integrative part of the regulator
	Der	A	-100.00..100.00 [%]	Derivative part of the regulator
	Period	A	0.1..600.0 [s]	Regulation period. The period should be adjusted according to the speed of the response of the system, e.g. longer period for slower systems, shorter period for faster systems.
	Actuator time	A	0.1..60.0 [s]	Actuator time. It is time that the actuator (servo etc.) needs for changing position from fully closed to fully open.
	Gate	B	N/A	Regulator on/off input

Outputs

OUTPUT	TYPE	RANGE[DIM]	FUNCTION
Output up	B	N/A	Actuator control - Raise
Output down	B	N/A	Actuator control - Lower

Description

The block is a PID regulator with binary outputs up/down and adjustable regulation period. The function of the regulator can be disabled by the gate input.



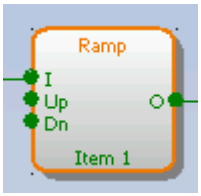
1. Rename the outputs.
2. You may want to have some regulation parameters, as e.g. derivative part, constant. In such a case write the constant directly into the appropriate box. If there is a source configured, it must be deleted prior to writing of the constant.
3. If you need the regulator to run only if certain condition is fulfiled, use the gate input. Create a binary value representing the condition (e.g. using other plc blocks) and connect it to the gate input. The regulator will then work only if the gate input is active. If the gate input is not connected, the regulator works all the time the controller is switched on.

NOTE:
The inputs are assigned to their sources in the sheet by **dragging a wire** from the input to the source.

	NOTE: This block is available in some customer branches only.

PLC BLOCK: ANALOG RAMP

Symbol



Inputs

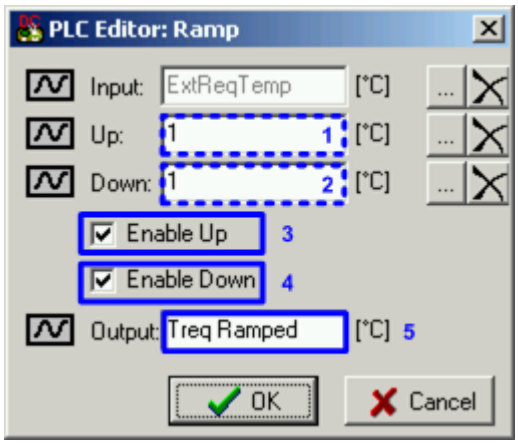
INPUT	TYPE	RANGE[DIM]	FUNCTION
Input	A	Any	Input value to be ramped.
Up	A	Same as input	Maximal rising rate of the output per one second.
Down	A	Same as input	Maximal lowering rate of the output per one second.

Outputs

OUTPUT	TYPE	RANGE[DIM]	FUNCTION
Output	A	Same as input	Ramped value

Description

This block limits the maximal rate of change at the output. The maximal rates up and down are adjustable separately and ramping down and up can be enabled/disabled separately.

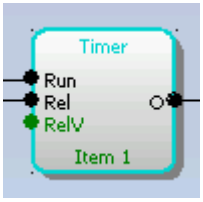


1. Adjust the maximal rising rate of the output per one second. If you want the delay to be a constant, write the constant into the box. Otherwise connect the input to any other analog object.
2. Adjust the maximal lowering rate of the output per one second. If you want the delay to be a constant, write the constant into the box. Otherwise connect the input to any other analog object.
3. Tick the checkbox to activate the rising rate limitation.
4. Tick the checkbox to activate the lowering rate limitation.
5. Rename the output.

NOTE:
The inputs are assigned to their sources in the sheet by **dragging a wire** from the input to the source.

PLC BLOCK: TIMER

Symbol



Inputs

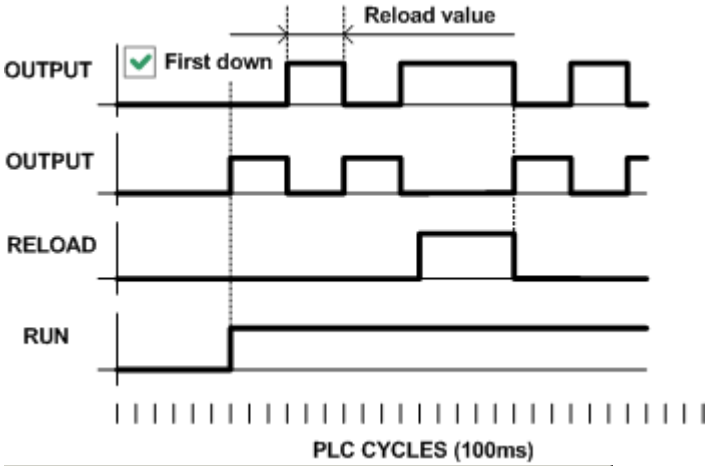
INPUT	TYPE	RANGE[DIM]	FUNCTION
Run	B	N/A	The timer runs only if this input is active or not connected
Reload	B	N/A	This input reloads the timer to the initial value
Reload val.	A	0..32767 [-]	Initial value of the timer.

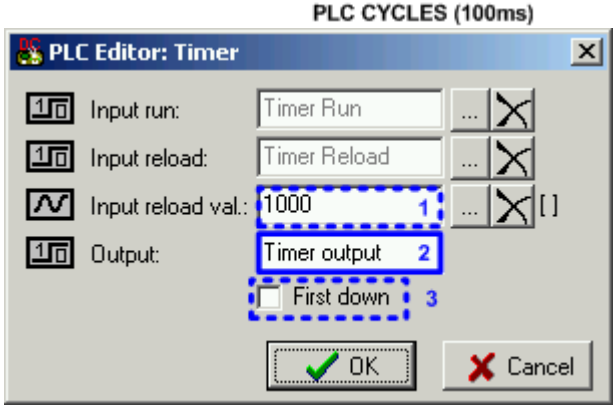
Outputs

OUTPUT	TYPE	RANGE[DIM]	FUNCTION
Output	B	N/A	Timer output

Description

The block works as a countdown timer which is decreased by 1 every PLC cycle. The timer initial value is adjustable by the "Reload val" input. As the PLC cycle lasts 100ms, the timer duration equals to "Reload val"/10 [s]. The timer is automatically reloaded with the initial value when it reaches zero or it can be reloaded in any other moment using the "reload" input. The timer is held at reload value until the reload input is deactivated. The timer output is inverted always when the timer is reloaded.

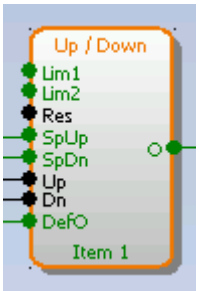




1. Adjust the reload value. The duration of the timer (in seconds) is given by the reload value divided by 10. The reload value can be either constant or a setpoint or any other analog object.

	2. Rename the output. 3. If you want the output to start at logical 0, tick this checkbox. Otherwise the output will start at logical 1. **NOTE:** The inputs are assigned to their sources in the sheet by **dragging a wire** from the input to the source.

PLC BLOCK: UP/DOWN

Symbol	

Inputs

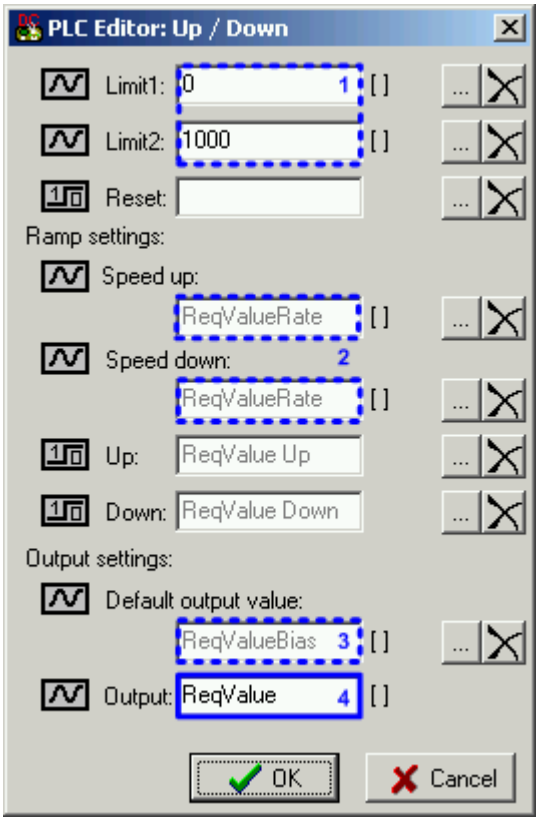
INPUT	TYPE	RANGE[DIM]	FUNCTION
Lim 1	A	-32768..32767 [-]	Lower limit of the analog output
Lim 2	A	-32768..32767 [-]	Upper limit of the analog output
Speed up	A	-32768..32767 [-]	Rising rate of the analog output per second
Speed down	A	-32768..32767 [-]	Lowering rate of the analog output per second
Default output value	A	-32768..32767 [-]	Bias value of the output. The output is initialized to this value when the controller is switched on, when the reset input is activated or when both Speed up and Speed down inputs are active.
Up	B	N/A	The output is raising it's value with the adjusted rate while this input is active.
Down	B	N/A	The output is lowering it's value with the adjusted rate while this input is active.
Reset	B	N/A	The output is set and held at bias value while this input is active.

Outputs

OUTPUT	TYPE	RANGE[DIM]	FUNCTION
Output	A	Lim1..Lim2 [-]	Output value

Description

This block works as an analog ramp controlled by binary inputs "up" and "down". The ramp rates and output limits are adjustable as well as bias value. The output can be reset to bias value by the reset input.

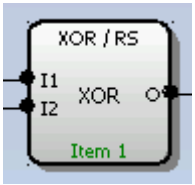


1. Adjust the output limits. If you want them to be constants, write the constants into the box. Otherwise connect the inputs to any other analog objects (e.g. PLC setpoints).
2. Adjust the output rates for raising and lowering. If you want them to be constants, write the constants into the box. Otherwise connect the inputs to any other analog objects (e.g. PLC setpoints).
3. Adjust the output bias value. If you want it to be constant, write the constant into the box. Otherwise connect the input to any other analog object (e.g. PLC setpoint).
4. Rename the output.

NOTE:
The inputs are assigned to their sources in the sheet by **dragging a wire** from the input to the source.

PLC BLOCK: XOR/RS

Symbol



Inputs

INPUT	TYPE	RANGE[DIM]	FUNCTION
Input 1	B	N/A	Input 1
Input 2	B	N/A	Input 2

Outputs

OUTPUT	TYPE	RANGE[DIM]	FUNCTION
Output	B	N/A	Result of the logical operation.

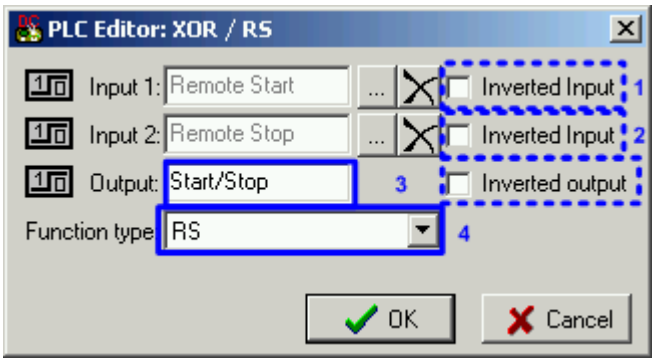
Description	The block provides logical function of two values - XOR or RS flip-flop. Both inputs and output can be inverted.

FUNCTION XOR

I_1	I_2	O
0	0	0
0	1	1
1	0	1
1	1	0

FUNCTION RS

R	S	Q_{n+1}
0	0	Q_n
0	1	1
1	0	0
1	1	0



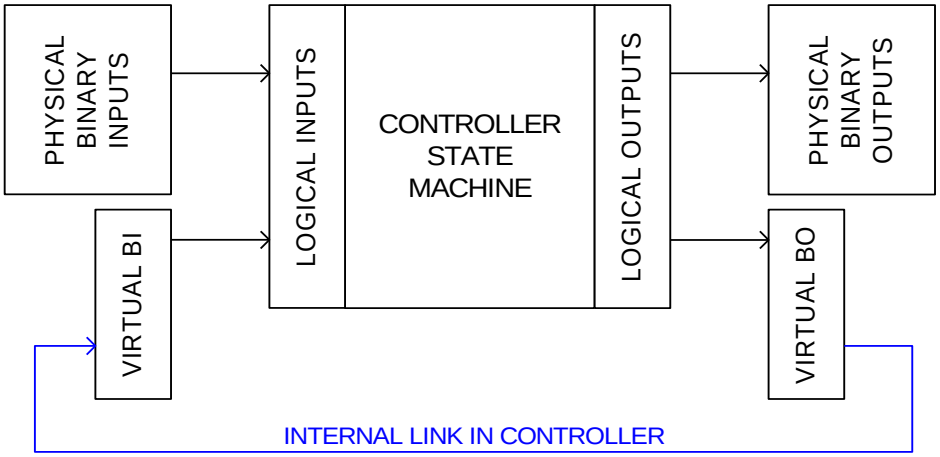
1. The input 1 can be inverted prior to entering the function.
2. The input 2 can be inverted prior to entering the function.
3. Rename the output. The output can be inverted.
4. Finally select the type of the function.

NOTE:
The inputs are assigned to their sources in the sheet by **dragging a wire** from the input to the source.

5.2 Internal Virtual I/O Periphery

The controller features many logical outputs, i.e. outputs that could be configured to physical outputs (terminals of the controller itself or of expansion modules). But sometimes it is necessary to bring the output signal back to the input, if a special behaviour is required.
E.g. logical binary output *Batt volt* is linked with only a Warning type alarm, and from some reason it is required that the engine be stopped in this case (at certain site). You can achieve this by bringing the signal to physical output and then connect it to a physical input. Then this input can be configured with a Shutdown type protection. The disadvantage of the above solution is that you are losing one input and one output of the controller / expansion module, which is costly.
The virtual periphery simulates this within the controller, bringing a group of “physical outputs”, linked with a group of “physical inputs”. So you can configure a logical output of the controller to this module, and then configure a protection (or a link to logical input) to the “physical input“ part of the module, as you would do with real inputs.

The same can be done with PLC I/O, so e.g. a complex evaluation of a protection in PLC can be brought directly to an input configured for this protection type.



5.3 Shared virtual I/O periphery

It is often required that certain signals be brought to all controllers in the group. For example MCB feedback, System Start/Stop, Common Shutdown signal etc. These are all binary signals.
Sometimes analog signals are required as well, like engine room temperature signal, where too high temperature can cause the nominal power of all gen-sets in the room to be reduced (power derating function).
IG/IS-NT controllers have a provision to make it easier when designing such an application. These controllers have a sophisticated system of shared virtual modules, where one controller is a signal server and the other controllers are recipients of this signal. The signals are distributed via the CAN bus which typically interconnects all the controllers on one site.

Configuration

These virtual modules can be added / removed like any other HW module in GenConfig / card Modules. Then they appear in the list of inputs or outputs in the card I/O.

SHBOUT/SHAOUT modules

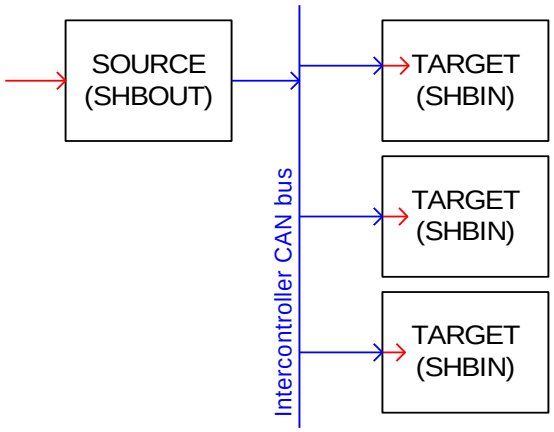
They behave like standard output modules, but the signals assigned to them don't appear on any physical output, instead of that are distributed via the CAN bus to other controllers. Each module has 8 outputs.

SHBIN/SHAIN modules

They behave like standard input modules, i.e. you can assign any logical input signal that is available in the controller to them, or configure a protection based on their activity. Each module has 8 inputs.

SHBOUT + SHBIN modules

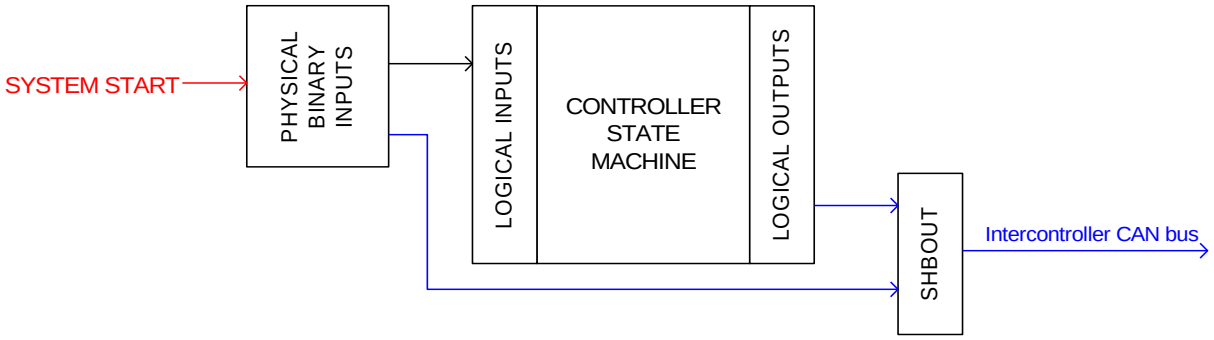
There are six channels (i.e. 6 groups of 8 binary inputs/outputs) available for binary signal sharing. Each channel can have its source (SHBOUT module) in different controller. All other controllers can be configured as the recipients of this channel (SHBIN module).



Hint:

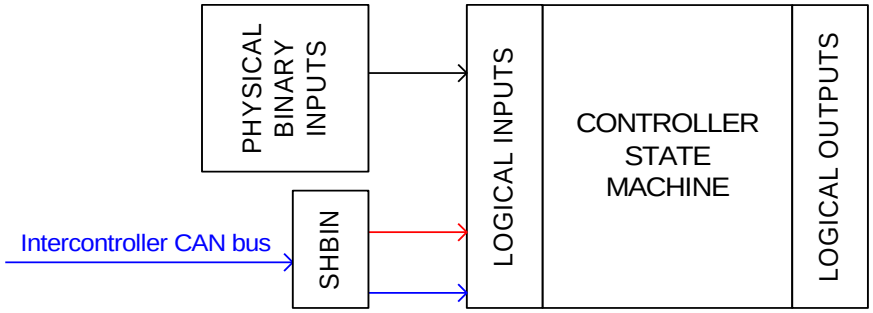
If more controllers are selected to be the source for one channel, only the controller with the lowest CAN address is taken into account, and all controllers report a "SHBinCfgErr" message in Alarmlist.

The picture below shows the principle of the SHBOUT module. It can distribute the forwarded states of physical binary inputs, or some signals created inside the controller's FW or PLC:

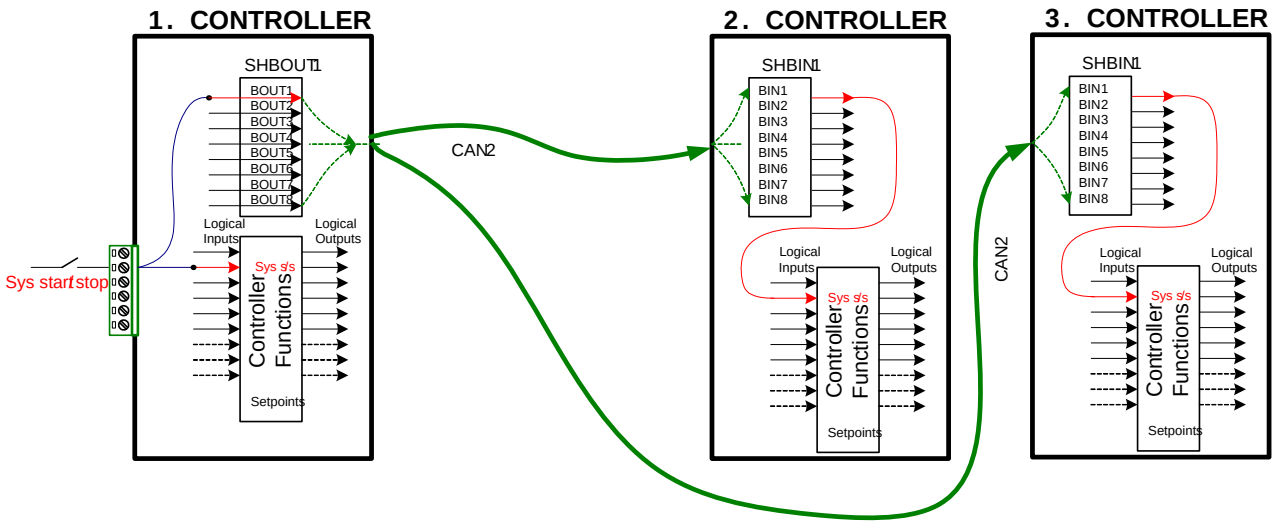


In this particular example, the SYSTEM START signal which should command the start / stop for all the controllers on the site, is transferred from the terminal (physical binary input) to the SHBOUT module.

All other controllers on the site should be configured in the way that the signal is picked up in the same position (1-8) where it has been assigned to in SHBOUT module. The signal is then picked up from the module and can be used by the controller's FW or PLC like any other physical binary input:

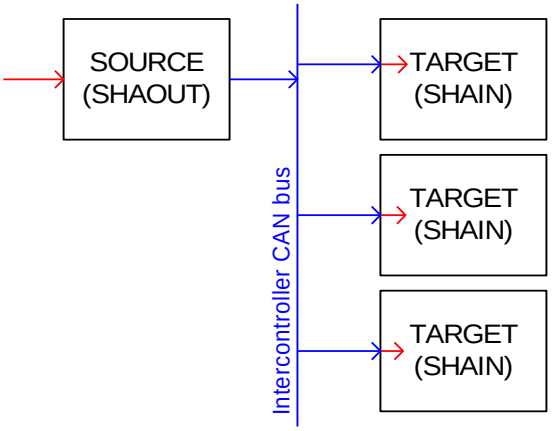


Together looks like this:



SHAOUT + SHAIN modules

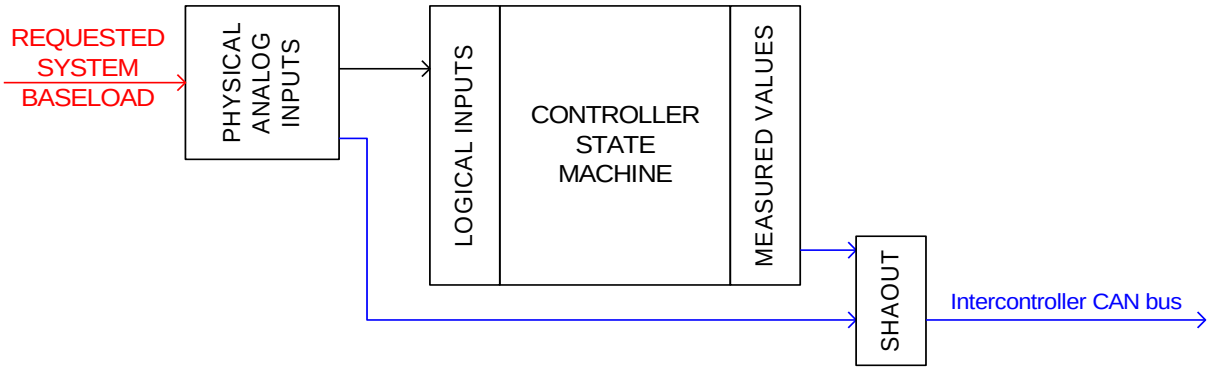
There is two channels (i.e. two group of 8 analog inputs/outputs) available for analog signal sharing. The channel can have its source (SHAOUT module) only in one controller. All other controllers can be configured as the recipients of this channel (SHAIN module).



Hint:

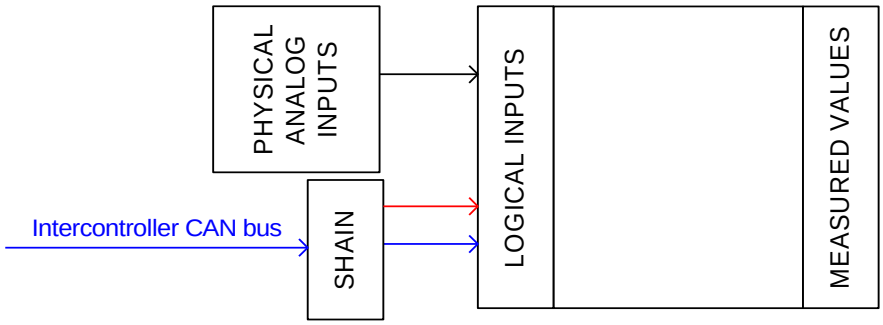
If more controllers are selected to be the source for the analog channel, only the controller with the lowest CAN address is taken into account, and all controllers report a “SHAinCfgErr” message in Alarmlist.

The picture below shows the principle of the SHAOUT module. It can distribute the forwarded values of externally measured (physical) analog inputs, as well as the values measured or computed inside the controller’s FW or PLC:

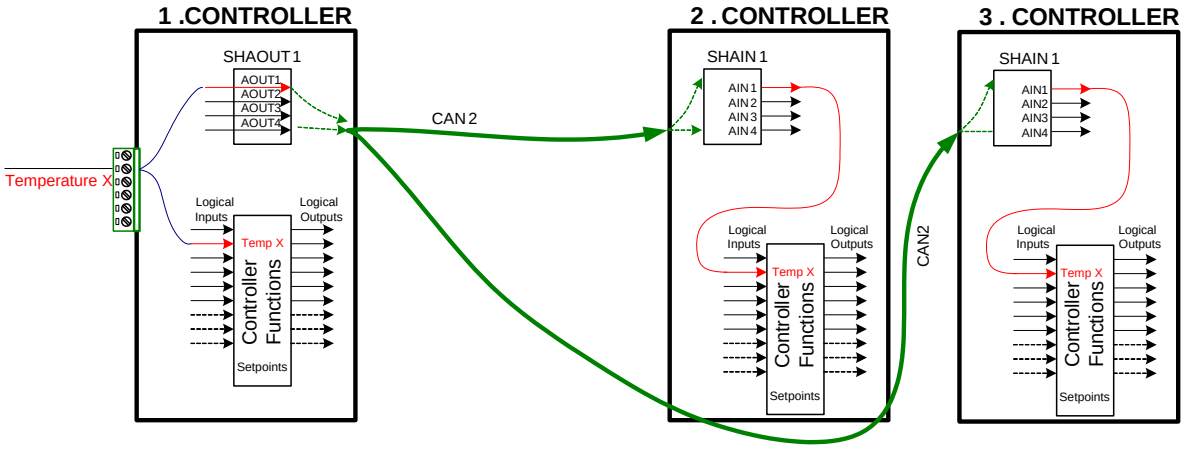


In this particular example, the value of externally requested System Baseload value (MLC:AnExSysBld) should be distributed to all controllers on the site. It is transferred from the terminal (physical analog input) to the SHAOUT module.

All other controllers on the site should be configured in the way that the value is picked up in the same position (1-8) where it has been assigned to in SHAOUT module. The value is then picked up from the module and can be used by the controller's FW or PLC like any other physical analog input:



Together looks like this:



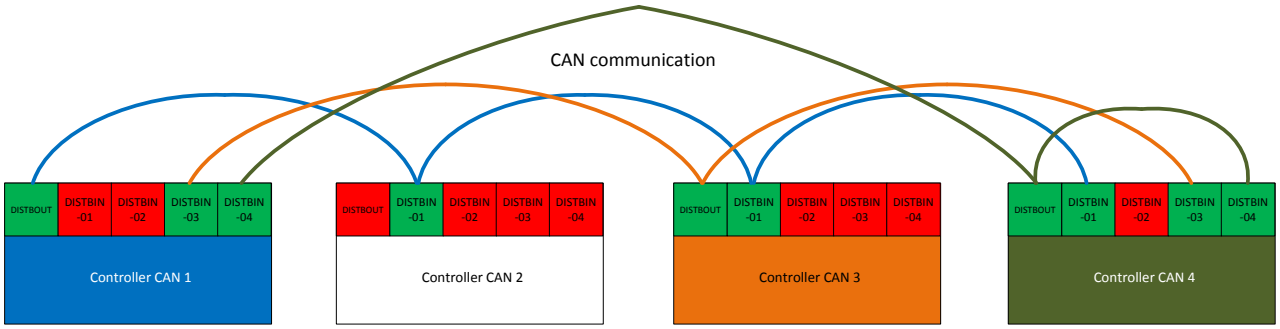
5.4 Distributed Binary Peripheries

Distributed Binary Inputs and Outputs (DISTBIN and DISTBOUT modules) are available in BaseBox type firmware of InteliGen, InteliSys and InteliMains. Thanks to this, it is possible to share Binary and Analog values between all the controllers via CAN bus, thus saving physical Inputs and Outputs and excess wiring.

DISTBIN and DISTBOUT work in a different way than SHBIN and SHBOUT. Each controller has one pack of eight DISTBOUT available (if not configured or no function is assigned to any output, it does not broadcast them). The number of DISTBOUT module is not shown in the configuration and it is always corresponding to the CAN address of the controller (e.g. the controller with address 5 will be broadcasting DISTBOUT-05 which can be received if module DISTBIN-05 is configured in another controller. Up to 32 DISTBIN modules can be configured (meaning that the controller will be receiving all DISTBOUT from all the controller, even his own).

It is not possible to change the name of DISTBIN inputs or add protections.

In the example below you can see 4 controllers with various DISTBIN and DISTBOUT configuration (green modules are configured, red modules are not configured). The color of each controller corresponds to the color of the lines that represent distributed binaries by this particular controller. The source of the broadcast is the DISTBOUT module, DISTBIN modules are receiving these inputs and they may be utilized in the configuration (however, it is not possible to use them for protections and change their name in the configuration).



NOTE:
SHUTDOWN (RED) or YELLOW (WARNING) types of the protection on DISTBIN modules can be configured. If corresponding broadcasted message is not received, controller issue an alarm according to the adjusted type of the protection.

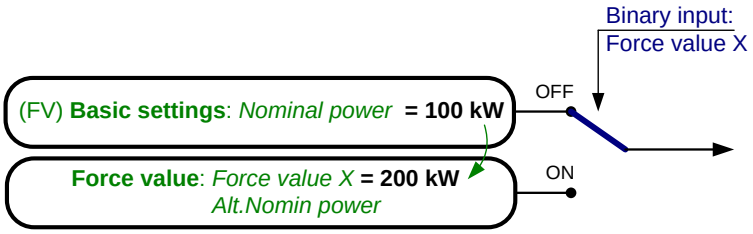
HINT
Controller sends Distributed Binary Outputs each 100ms if there are any changes in any bit position. If there are no changes, controller sends the information with period 1s.

NOTE:
DISTBIN and DISTBOUT function is not available for IM-NT-GC controller.

6 Other Controller Configuration Functions

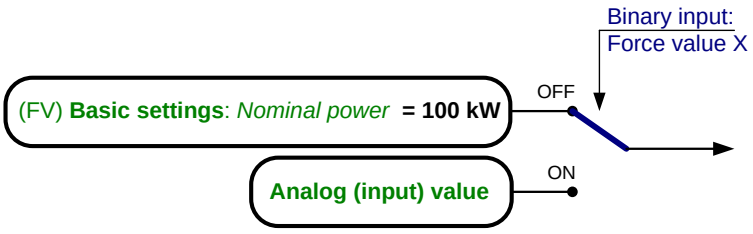
6.1 Force value

Force value feature enables a Binary input to switch between two different values of a setpoint:



BI: Force value	Nominal power
Opened	100 kW
Closed	200 kW

Or between (FV) setpoint and Analog input (or in general any value):



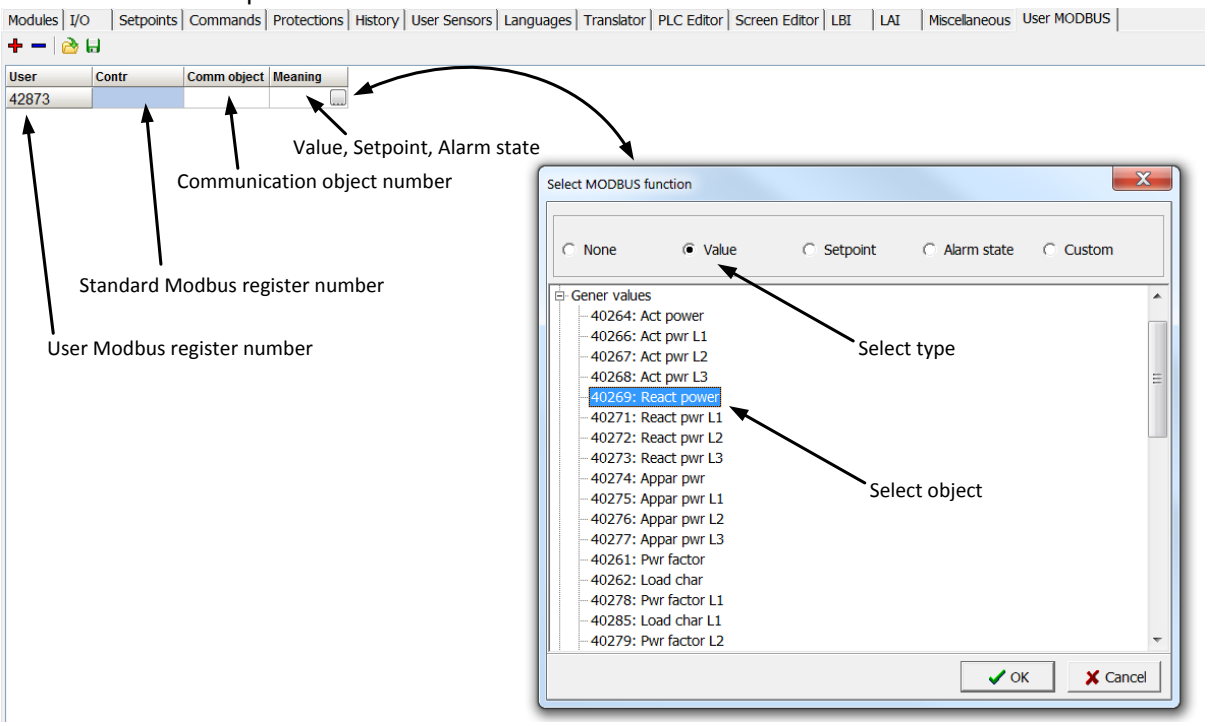
BI: Force value	Nominal power
Opened	100 kW
Closed	Analog input (given by the curve converted output)

Hint:

If Force value is active, it is not possible to change setpoint value (e.g. from InteliMonitor). Force value has to be deactivated first. Active force Value is displayed on the screen of the appropriate setpoint with the mark. See reference manual for InveliVision 5, InteliVision 8 and InteliMonitor to see more details.
Configure Force value in GenConfig.

6.2 User MODBUS

Users can define Modbus registers from 42873 to 43000. Values, setpoints and Alarm states can be specified for these new Modbus registers to prepare the Modbus protocol for batch reading and writing or to standardize Modbus protocol between FW versions or branches.



NOTE:
User MODBUS function is not available for non-BB type controllers.