RMB

Remote Maintenance Box

Designer's handbook

4189340577D

DEIF Improve Tomorrow

1. About the RMB and Designer's handbook

2. RMB components

3. Installing and configuring the cable sockets

4. Configure the system

1. About the RMB and Designer's handbook

1.1 How to use this document

This document is the **Designer's Handbook** for DEIF's remote maintenance solution. The document describes the installation, configuration and functions of the Remote Maintenance Box.

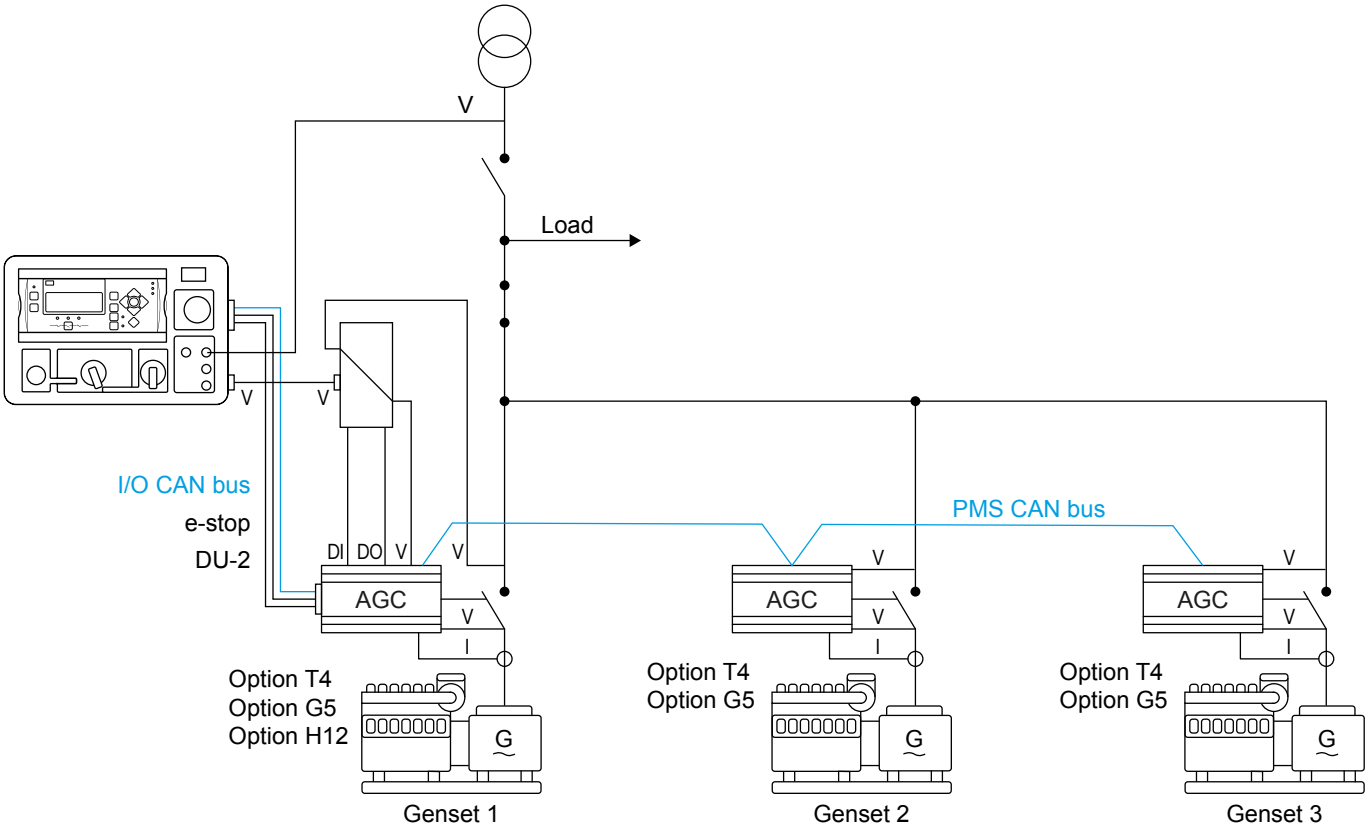
For more information about the remote maintenance box, see the **RMB Data sheet**, and **RMB Operator's manual** on the RMB documentation page. The **RMB Operator's manual** is a detailed step-by-step guide of how to operate the RMB, including notes and warnings.

1.2 RMB description

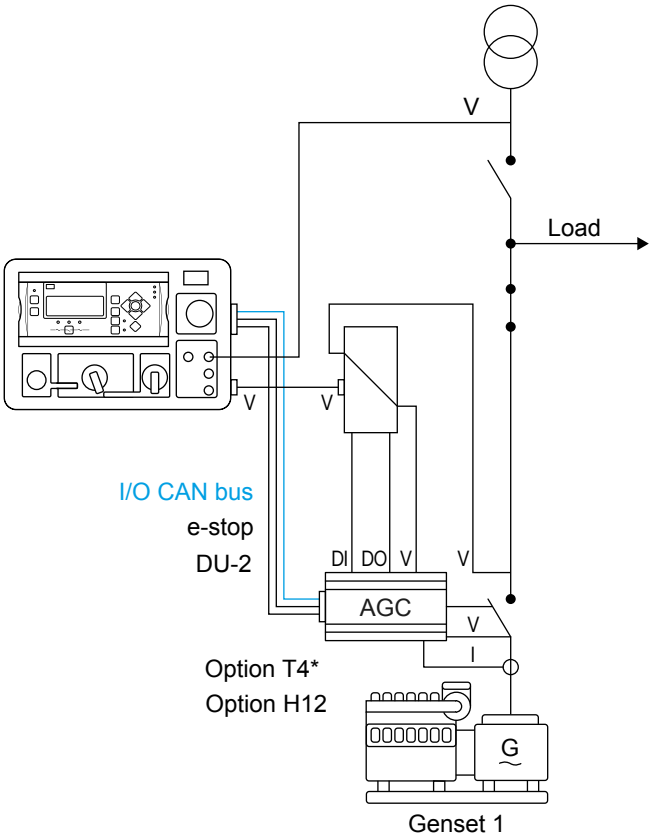
DEIF developed the Remote Maintenance Box to meet the demand for safe maintenance at transformer substations or other electrical installations where safe and reliable static sync (zero sync or phase lock loop) is requested. The RMB also enables operation where it is necessary or required to have the interface/operator panel close to the mains connection points.

The RMB is used with AGC-4 Mk II and/or AGC-4 genset controller(s) to deload a transformer or other equipment for maintenance. The RMB is also used with the AGC(s) to synchronise with the mains supply for recommissioning after maintenance.

Example of RMB with three gensets



Example of RMB with one genset



NOTE For a single genset RMB application to use the most recent RMB operation software, option T4 is required.

For general AGC genset controller function descriptions, see the **AGC Designer's handbook**. See **Option G5** for AGC power management.

1.3 Software versions

This document applies to AGC-4 Mk II, software version 6.00.0 onwards, and AGC-4, software version 4.80.0 onwards.

1.4 Required and recommended AGC options

To use the RMB, the AGC must have the required options. Depending on the application, other options may also be useful.

AGC options required for all RMB applications

Option	Function	Requirements
J8	Sockets for the RMB cables	The first genset must have this option installed.
H12	CAN bus communication between the RMB and the AGC	The first genset controller must have this option.

AGC options required for RMB applications with multiple gensets

Option	Function	Requirements
G5	Power management	If there is more than one genset, each genset controller must have this option.
T4	RMB with multiple gensets	If there is more than one genset, each genset controller must have this option.

Recommended AGC options

Option	Functions	Recommendation
D1	Voltage regulation	This option is included in the standard AGC-4 Mk II. It is required in AGC-4 to regulate the voltage/power factor/reactive power.
E or F	Analogue regulator	Use analogue regulation, since relay regulation is not accurate enough for static synchronisation.
H12	Engine communication	This option is useful if the genset supports engine communication.
T4	RMB with multiple gensets	This option allows the controller(s) to use the functions in AGC-4 Mk II software version 6.00, or AGC-4 software version 4.80. The option is therefore also recommended for single genset applications.

1.5 Glossary

Term	Abbreviation	Description
AGC-4 Mk II, AGC-4	AGC	For the RMB, only AGC genset controllers are used.
First genset controller		The AGC with CAN bus ID 1. This controller has sockets installed for connection to the RMB. The first controller must also have option H12 for communication with the RMB.
Function selector		The RMB *Function select* switch, used to select the operating function.
Mains voltage measurement cables		The temporary cables plugged into the sockets on the top of the RMB. These are used for measuring the mains voltage during back synchronisation.
M-Logic		The PLC-type tool accessible from the utility software.
Multi-line-2	ML-2	A DEIF platform, which includes AGC-4 Mk II and AGC-4.
Other genset controllers		The genset controllers that are not the first controller. These controllers receive their set points from the first controller and are not directly connected to the RMB.
PC utility software	USW	
Power switch		The RMB switch used to adjust the genset(s) power up or down during genset synchronisation.

Term	Abbreviation	Description
Remote maintenance box	RMB	The DEIF product used with AGC-4 Mk II and AGC-4 controllers to deload a transformer so that maintenance can be done.
RMB cables		The data cable and the voltage cable. These cables connect the RMB to the first genset.
Software	SW	

1.6 Safety issues

Installing and operating the unit implies work with dangerous currents and voltages. Therefore, the installation should only be carried out by authorised personnel who understand the risks involved in working with live electrical equipment.

WARNING

Hazardous live currents and voltages

Be aware of the hazardous live currents and voltages. Do not touch any AC measurement inputs as this could lead to injury or death.

1.7 Warnings and notes

Throughout this document, warnings and notes with helpful user information is presented. To make sure that these are noticed, they are highlighted as follows.

Warnings

WARNING

This shows potentially dangerous situations.

If the guidelines are not followed, these situations could result in death, serious personal injury, and equipment damage or destruction.

Notes

NOTE Notes provide general information, which will be helpful for the reader to bear in mind.

1.8 Legal information and disclaimer

DEIF takes no responsibility for installation or operation of the generator set. If there is any doubt about how to install or operate the engine/generator controlled by the Multi-line 2 unit, the company responsible for the installation or the operation of the set must be contacted.

NOTE The Multi-line 2 unit is not to be opened by unauthorised personnel. If opened anyway, the warranty will be lost.

Disclaimer

DEIF A/S reserves the right to change any of the contents of this document without prior notice.

The English version of this document always contains the most recent and up-to-date information about the product. DEIF does not take responsibility for the accuracy of translations, and translations might not be updated at the same time as the English document. If there is a discrepancy, the English version prevails.

1.9 Copyright

2. RMB components

2.1 Components in general

The remote maintenance box easy to operate. It is tested according to hand tool standards, and therefore only robust components are used. See the **RMB Data sheet** for the technical specifications.

2.2 Display

The RMB contains a display, DU-2. This is the same as the first AGC DU-2 display. This allows the operator to see the same values on both displays. For example, the synchroscope, operating information, menus, status texts, and so on.

2.3 Function selector

The operator uses the multi-position *Function select* switch to select the RMB function to send to the first AGC. The switch is turned clockwise for each step. The sequence ends after 360 degrees.

More information
See the **RMB Operator's manual** for more information.

2.4 Power switch

The power set point is adjusted during mains deloading. The power switch is a spring return selector switch, to ensure that the switch returns to zero when released.

2.5 Lamp and buzzer

When the back synchronisation to mains is safe, the lamp for *Connect mains* and an internal buzzer are activated. These are only used during *Synchronisation to mains*. For the lamp and buzzer to be activated, the synchronisation must have been within the voltage limits and phase window for the specified time.

2.6 Mains voltage connections

Mains voltage measurement cables can quickly and easily be connected directly to the Remote Maintenance Box. 3-phase and 1-phase measurements are possible.

2.7 Shutdown

The shutdown button allows the operator to send a shutdown signal from the RMB to the first genset.

If the shutdown signal needs to shut down all the gensets, additional wiring is required. Alternatively, M-Logic can be configured to send a shutdown signal to the other gensets if the first genset receives a shutdown signal from the RMB.

3. Installing and configuring the cable sockets

3.1 Cable connections

To make the system flexible and secure, the RMB mode is based on pulse detection of the buttons and switches in the RMB. This allows the operator to disconnect the RMB without disturbing the system.

NOTE When the generator is running in island mode, you can disconnect the RMB without stopping the generator. When the RMB is reconnected, communication restarts automatically.

3.2 RMB cables

The RMB cables connect the first genset's AGC and the RMB. There are two RMB cables: One data cable and one voltage cable.

The tables below describes the wires of the RMB cables.

Data cable: UNITRONICR BUS IBS Yv UNITRONIC BUS IBS Yv COMBI, 3 × 2 × 0.25 + 3 × 1.0

Description	Pin no.	Cable wire colour	AGC terminals (option H12.2)	AGC terminals (option H12.8)
	EARTH	GN/YL		
+24 V DC	1	RED	1	1
0 V DC	2	BLUE	2	2
Beckhoff CAN-H	3	WHITE	CAN C: 29 CAN D: 32	CAN E: 130 CAN F: 133
Beckhoff CAN-GND	4	SCREEN		
Beckhoff CAN-L	5	BROWN	CAN C: 31 CAN D: 34	CAN E: 128 CAN F: 131
Shutdown	6	GREY/PINK	Free DI	Free DI
Not used	7			
DU-2 CAN-H	8	GREEN	Blue, or red/white cable	Blue, or red/white cable
Not used	9			
DU-2 CAN-L	10	YELLOW	Green, or red cable	Green, or red cable

NOTE The DU-2 CAN cables can be either blue CAN H and green CAN L; or red/white CAN H and red CAN L.

Voltage cable: OLFLEXR ROBUST 210 ØLFLEX ROBUST 210, 4 × 1.0 Q mm^2

Description	Pin no.	Cable wire (colour and no.)	AGC terminals
Voltage meas L1	1	BLACK 1	85
Voltage meas L2	2	BLACK 2	87

Description	Pin no.	Cable wire (colour and no.)	AGC terminals
Voltage meas L3	3	BLACK 3	89
Voltage meas N	4	BLACK 4	88
	EARTH	GN/YL	

3.3 RMB connector kit (option J8)

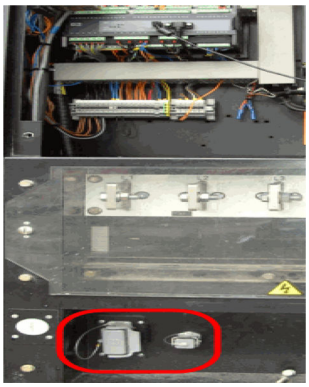
Option J8, the RMB connector kit, contains:

- One display CAN cable. Install this cable to connect the display on the first genset and the socket for the RMB data cable (the red/white and red wires).
- Two sockets. Install these on the first genset.

After installing J8, you can use the sockets on the first genset and on the RMB to easily connect the RMB cables. The RMB cables are option J10, J11 or J12.

Installing the data and voltage sockets

Here are two examples of how the sockets for the RMB data and voltage cables can be installed on the first genset.



NOTE If the two sockets are mounted behind a door or hatch, make sure that enough space is available to close the door or hatch when the RMB cables are connected.

3.4 Installing the data cable sockets

3.4.1 Power supply wiring

Wiring the auxiliary supply for the RMB

Connect a 24 V DC supply to pin 1 of the data cable socket, and 0 V DC to pin 2.

Fault indication

If the *Connect mains* light is lit when the RMB is connected, then the aux. supply is reversed (that is, + to – and – to +). The connections to pin 1 and 2 need to be swapped.

3.4.2 External inputs from RMB wiring

Connect AGC terminal 29/32/130/133 (CAN-H) to pin 3 of the data cable socket.

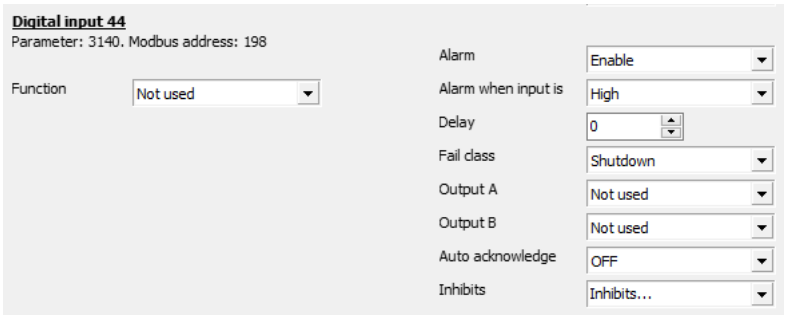
Connect AGC terminal 31/34/128/131 (CAN-L) to pin 5 of the data cable socket.

3.4.3 Shutdown

Connect the RMB emergency stop wire between pin 6 and any available AGC digital input.

Do not connect the RMB emergency stop wire in series with the AGC emergency stop. This would make it impossible to remove the box without stopping the genset.

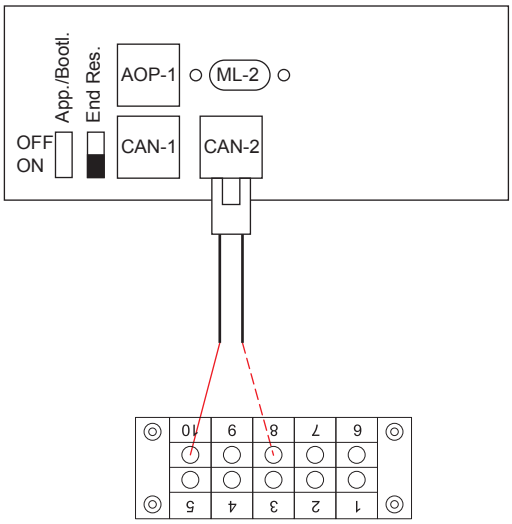
In the USW, under *I/O setup*, find the input. For *Alarm*, select **Enable**. Change the *Delay* to **0**. Change the *Fail class* to **Shutdown**. See the example on the right.



3.4.4 DU-2 wiring and CAN ID configuration

Wiring between the display and data socket

The diagram below shows the option J8 CAN cable connection between the back of the first genset's display and the data cable socket. Set the **End Res.** (resistor) dip switch on the back of the display to **ON**.



NOTE The DU-2 CAN bus communication is intended for DEIF use only and cannot be connected to other CAN bus systems.

CAN ID configuration

The CAN ID on the first genset DU-2 must be **1**. If it is set to **0**, CAN bus communication is deactivated.

To select the CAN ID:

1. On the first genset DU-2, press the Left, Up, and Right buttons at the same time,

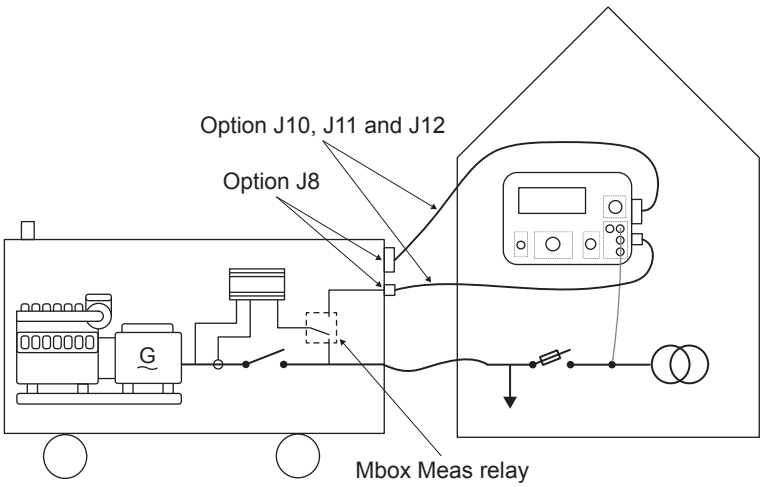
2. Use the Up and Down buttons to select **1**, then press ENTER.

The CAN ID of the first genset DU-2 has now been selected.

NOTE By default, the CAN ID for the DU-2 on the RMB is **2** or **3**. If there are communication problems, check the RMB DU-2 CAN ID.

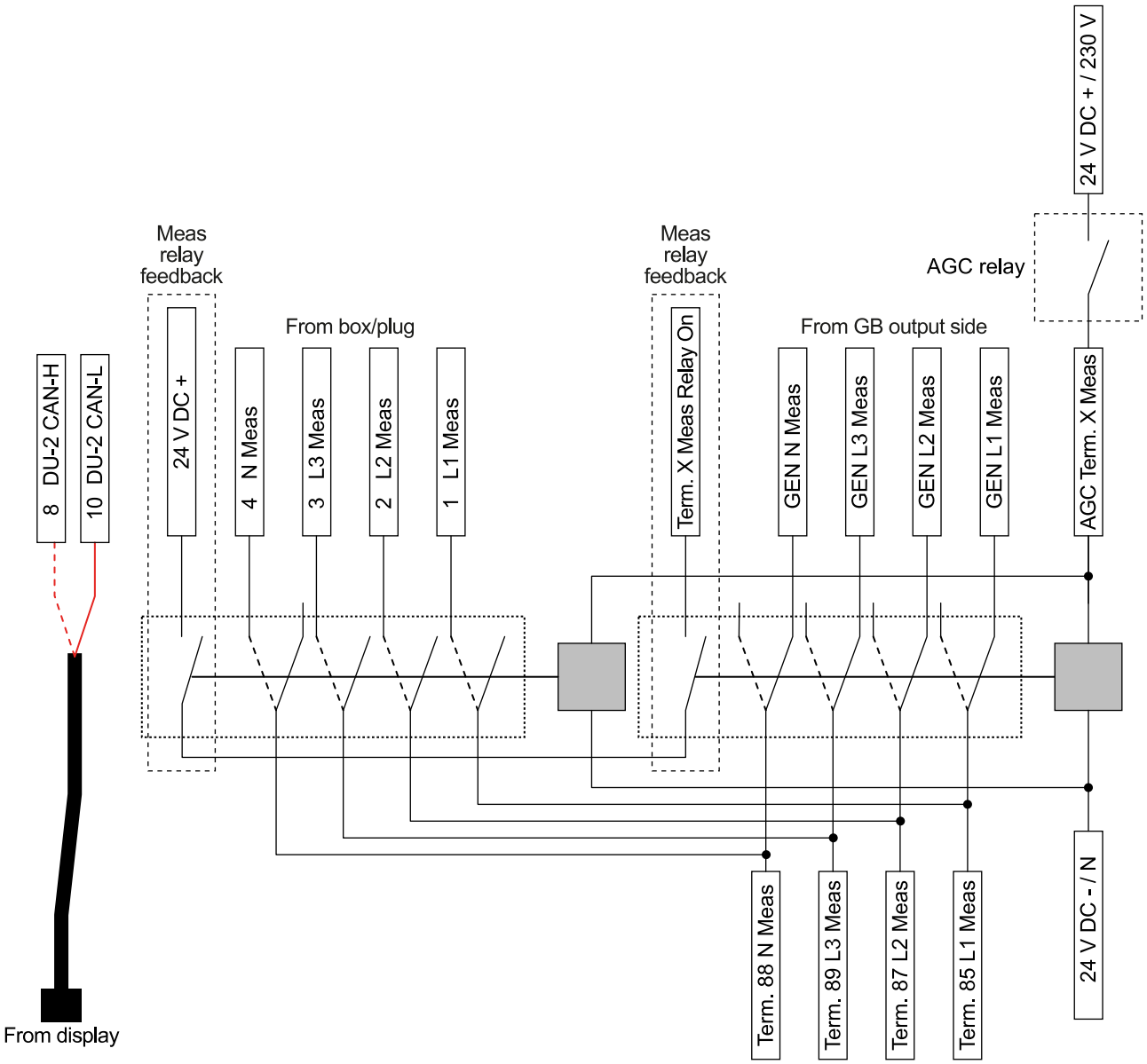
3.5 Installing the voltage sockets and relay

For the back synchronisation to the mains (after maintenance is complete), the AGC must use the mains voltage. DEIF recommends installing relays to ensure that the AGC voltage measurements change. An example is shown by *Mbox Meas relay* on the diagram below. The relay changes the voltage measurements from the genset busbar side to the mains measurement from the RMB.



3.5.1 Two measurement relay solution

Two relays are used to switch between the two voltage measurement points, generator and the Remote Maintenance Box (mains).



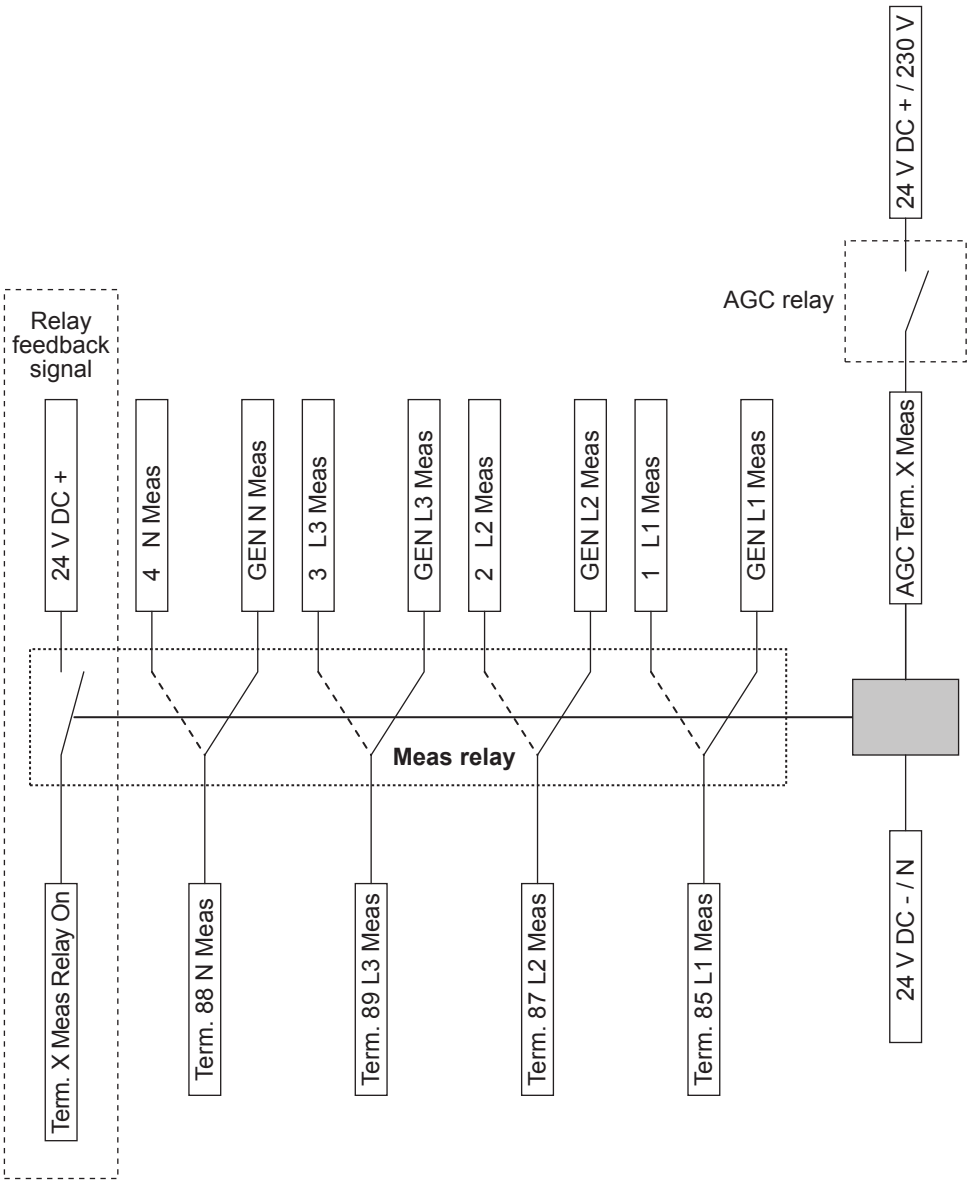
WARNING

High voltages

High voltages may be present between the poles on the relay (mains/generator).

3.5.2 One measurement relay solution

One relay is used to switch between the two voltage measurement points, generator and the Remote Maintenance Box (mains).



WARNING

High voltages

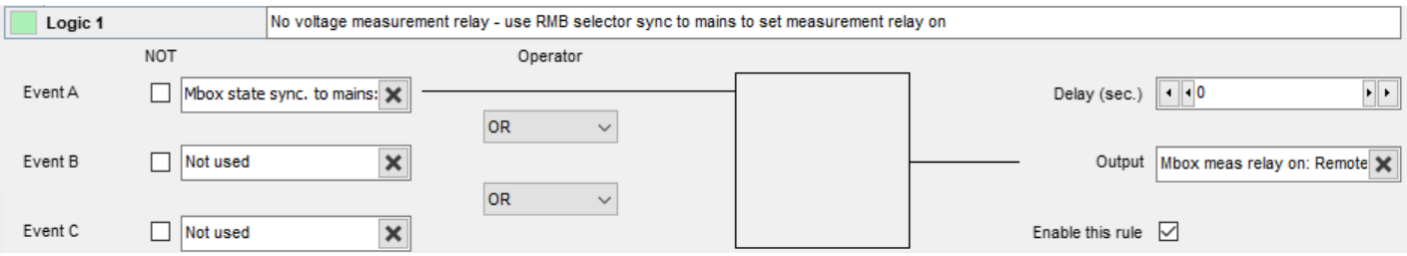
High voltages may be present between the poles on the relay (mains/generator).

3.5.3 No relay available/possible

If a relay with feedback for changing the AGC voltage measurement from the busbar side to the RMB measurement is not possible, the operator has to change the measurement before changing the function selector to *Sync to mains*.

You can create M-Logic so that when the function selector is at *Sync to mains*, the AGC acts as if the voltage measurement relay is activated:

- Event A: *Mbox state sync. to mains*.
- Output: *Mbox meas relay on*.



WARNING

Voltage reference

If no relay is used, double-check the voltage reference before any sync to mains is performed.

WARNING

Wiring errors

Wiring errors and/or failing to change the measurement can lead to human injury and death.

3.5.4 Voltage reference from the mains

For synchronisation to mains (also known as back synchronisation), manual connections to measure the mains voltage (that is, a voltage reference line) are necessary.

WARNING

Hazardous live currents and voltages

Beware of the hazardous live currents and voltages when connecting the voltage reference line.

WARNING

Voltage reference line

It is the operator's responsibility to make sure that the voltage reference line is connected correctly.

3.5.5 Voltage measurement relay

A relay output from the first controller should be wired to an external relay that can change the busbar-side voltage measurements for the first genset controller to the mains voltage measurements. For additional safety, the position feedback for the external relay can be wired to a digital input on the first controller.

Use M-Logic to assign the functions to the external measurement output and input.

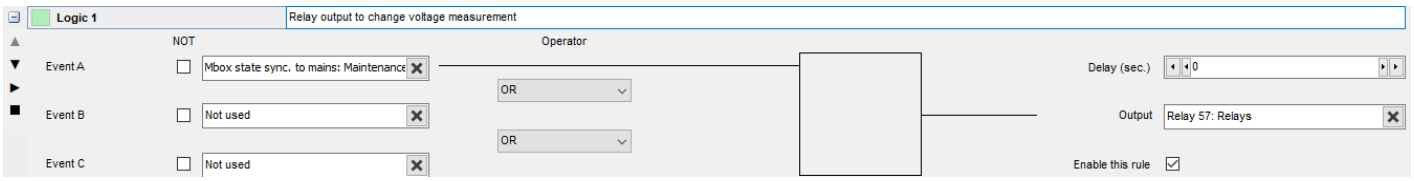
Configure the external measurement relay output

For the output from the AGC to the external measurement relay, in the USW, under *I/O setup*, find the output. For the alarm function, select **M-Logic / Limit relay**.

For the input from the external measurement relay to the AGC, *I/O setup* is not required.

Configure the relay output to change the voltage measurement

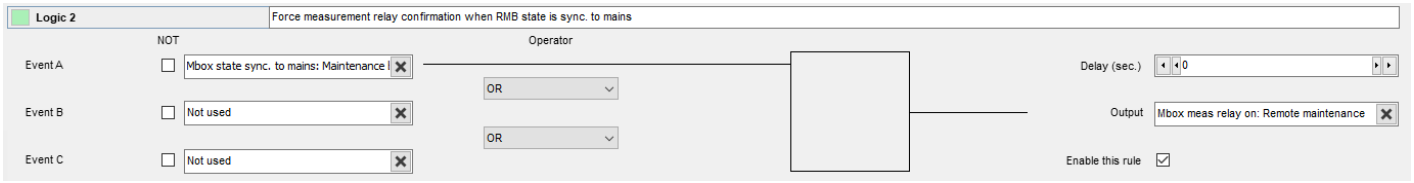
When the RMB function selector is at *Synchronisation to mains*, the AGC must activate the relay to change the voltage measurement.



Configure the feedback input in M-Logic to confirm the change in the voltage measurement

For safety, DEIF recommends feedback from the external relay that changes the voltage measurement is wired to a digital input, to confirm that the measurement is changed.

Alternatively, if feedback from the external relay is not possible, you can use M-Logic to force the voltage measurement confirmation when the RMB function selector is at *Synchronisation to mains*, as shown below.

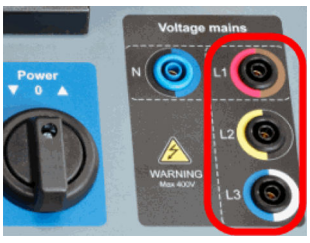


WARNING

Unsynchronised connection

If the voltage measurement for the master genset controller is not changed to mains, the gensets appears to be perfectly synchronised with the mains. To prevent loss of life and damage to equipment from an unsynchronised connection, the operator must ensure that the voltage measurement is actually changed to the mains.

3.5.6 Three-phase measurement



All three phases are connected on the Remote Maintenance Box, which means that the synchronisation check is carried out for all three phases.

Using 3-phase measurements in a three-phase system

By default, the AGC uses three-phase measurements for a three-phase system. The RMB can therefore use a three-phase voltage reference during back synchronisation. The voltage reference lines are plugged into the L1, L2 and L3 sockets on the RMB.

NOTE When using three-phase measurement, it is not necessary to connect the neutral, as it is calculated internally by the AGC.

Phase sequence check

When all three phases are used to measure the voltage, the AGC automatically runs a phase sequence check.

NOTE Additional information regarding phase sequence check can be found in the **AGC Designer's Handbook**.

WARNING

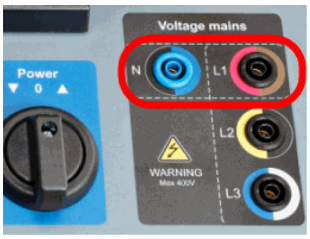
Make sure the three-phase system is OK

It is the operator's responsibility to make sure that the entire three-phase system is OK before closing the breaker or connecting the fuses.

3.5.7 One-phase measurement

Common neutral connection between generator and transformer

Only one phase and neutral are connected on the Remote Maintenance Box to measure voltage at the mains. This can only be done if the neutral of the generator and the transformer is correctly connected, so the common measurement point is the same.



WARNING

Make sure the three-phase system is OK

It is the operator's responsibility to make sure that the entire three-phase system is OK before closing the breaker or connecting the fuses.

The static synchronisation to the mains can be done by measuring one phase only, which means that the synchronisation check is only done for one phase.

Using 1-phase measurements in a three-phase system

It is possible for the RMB to use a 1-phase measurement during back synchronisation in a three-phase system. The voltage reference lines are plugged into the L1 and N sockets on the RMB. You must also change the AC configuration in the first AGC to **1 phase L1** for the back synchronisation. You can do this using parameter *9130* or M-Logic (*Output, Command AC, Select single phase system*).

Remember to change the AC configuration back to 3 phase L1L2L3 after back synchronisation.

No phase sequence check

When measurement is carried out with one phase and neutral only, phase sequence check is not possible. So it is strongly recommended to check the voltage across the breaker/fuse before any connection is established.

NOTE It is the operator's responsibility to make sure that the phase sequence is correct before closing the breaker or connecting the fuses.

Using a 1-phase system

The AGC and RMB can also be used in a 1-phase AC system. The RMB then uses a 1-phase measurement during back synchronisation in a one-phase system. The voltage reference lines are plugged into the L1 and N sockets on the RMB.

4. Configure the system

4.1 Application configuration

RMB applications consist of only gensets, and you can therefore use easy connect to set up the application from the display unit DU-2 or TDU 107.

More information
See **Easy connect** in **Option G5 Power management**.

Alternatively, you can use the plant configuration in the Utility Software (USW) to set up and activate the application.

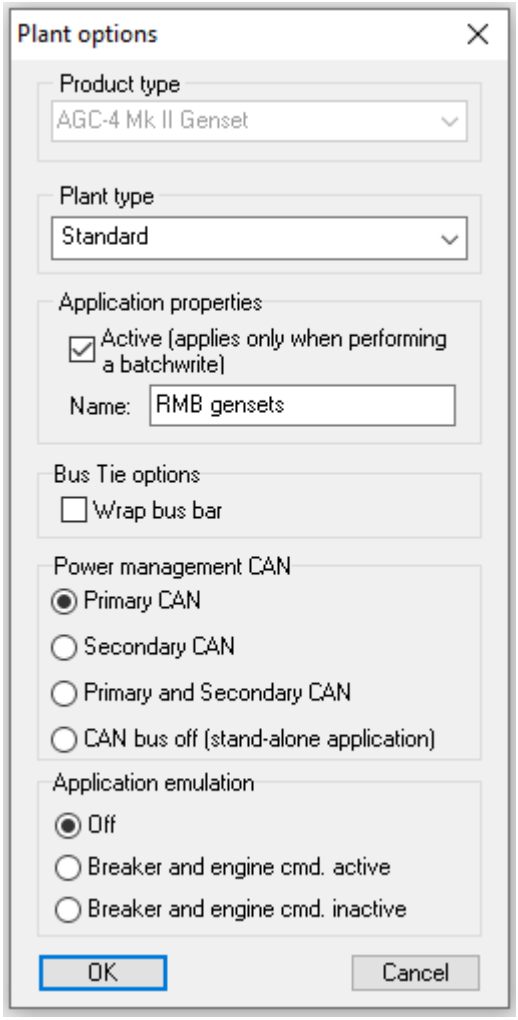
4.2 Application configuration using the utility software

Configure the application using the utility software on the **Application configuration** page. You can also use the utility software help (press F1).

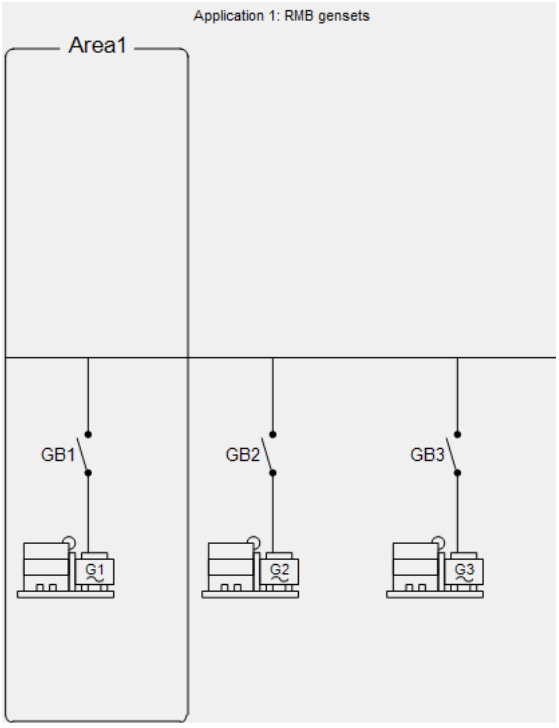
4.2.1 Multiple gensets

Add gensets to match the number of gensets used with the RMB. The first AGC (the one connected to the RMB) must have the CAN ID 1.

Plant options for RMB



RMB gensets application example

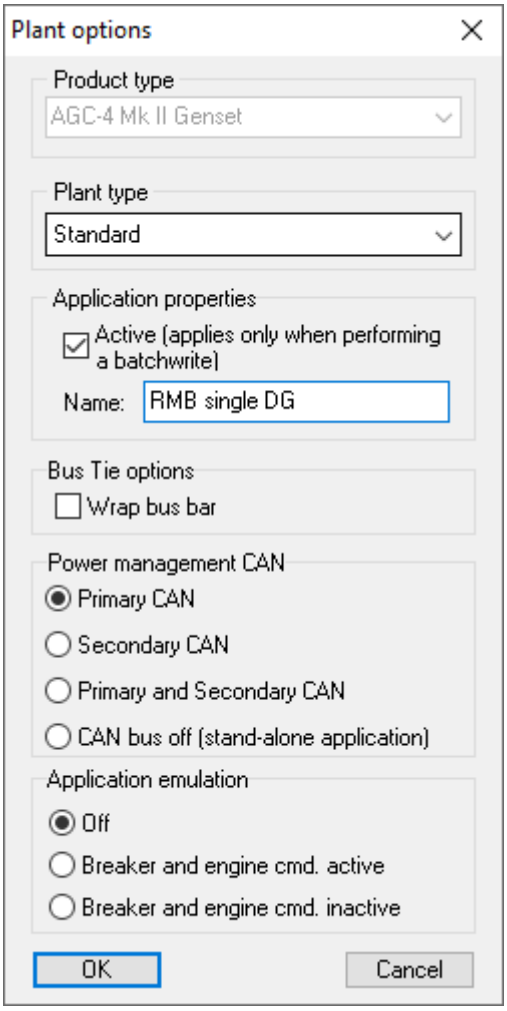


NOTE Option T4 is required for the configuration above. If option T4 and the configuration above are used, the AGC uses the most recent RMB operation software.

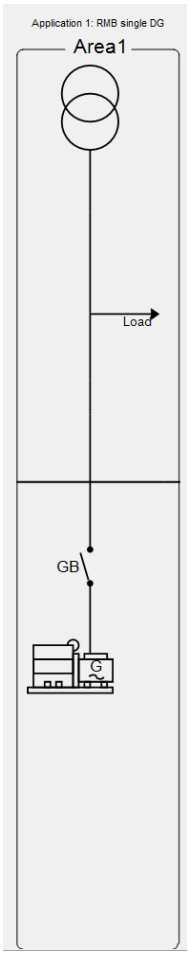
4.2.2 Single genset

A single genset must be connected to the mains, but without a mains breaker. The AGC connected to the RMB must have the CAN ID 1.

Single DG option for RMB



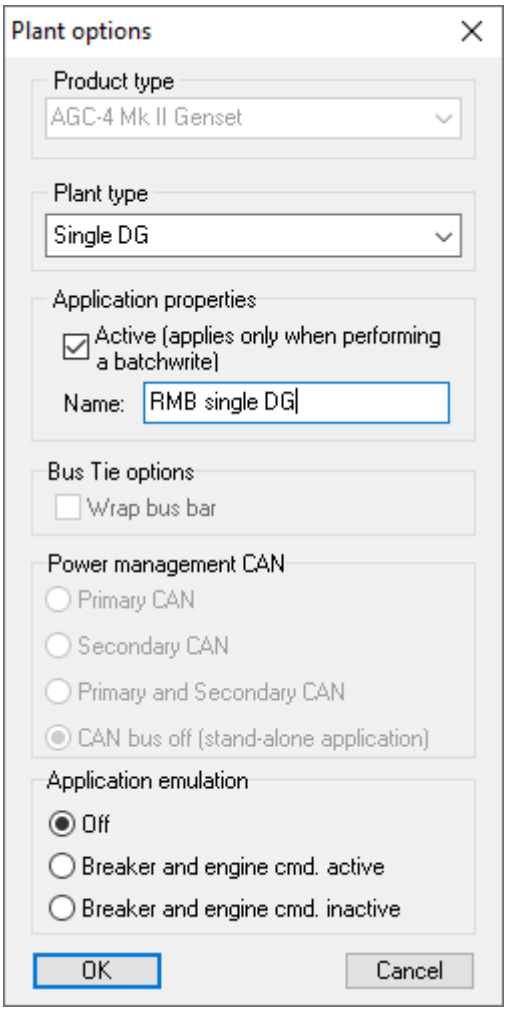
Single DG application example



NOTE Option T4 is required for the configuration above. If option T4 and the configuration above are used, the AGC uses the most recent RMB operation software.

Backwards compatibility for RMB with a single genset

If you have a single genset without option T4, under *Plant type*, select **Single DG**. The AGC then uses the RMB operation from before AGC-4 Mk II software version 6.00, or AGC-4 software version 4.80. Without option T4, the controller mode is always *Semi*. A single genset must be in an application with mains, but without a mains breaker.



Note that for both older and new RMB operation the power switch is updated to use a percentage of genset size (this was previously kW).

4.3 Parameter configuration

In addition to normal genset controller and power management configuration, the following parameters can be configured.

The RMB is connected to the first genset controller, where the *Int. comm. ID* (parameter 7531) must be **1**.

First genset controller parameters

Parameter	Name	Range	Default	Details
6070	Genset Mode	-	-	Select **Remote maintenance**. The controller uses the step selected in the remote maintenance box to automatically select the correct type of synchronisation. For example, for *Synchronisation to mains*, the controller automatically uses static synchronisation.
7052	Contr. sett. cosphi	0.1 to 1	0.9	To minimise the current to/from the mains after deloading, configure this to match the PF at the mains. This makes the VAr regulation of the generator more stable. If you do not do this, the frequency drifts when the mains breaker is opened/the fuses are removed.
7053	Contr. sett. cosphi	Inductive Capacitive	Inductive	Configure this to match the load requirement.

Parameter	Name	Range	Default	Details
7055	ContrSet cosphi or Q	Off Superior Fixed Q	Off	The AGC ignores the selection in this parameter when **Remote maintenance** is selected in 6070. The first genset controller sends the cos phi set point to the other genset controllers.
7845	CAN E 128.LO-130HI	-	-	If you connect the RMB CAN bus to the genset controller CAN E, you must use **External I/Os**. To use CAN F, configure 7846.
7971	CAN1 Type	-	-	Use **Beckoff**. To use CAN2, configure 7981.
7972	CAN1 Baudrate	-	-	Use **250k Baud**.
7973	CAN1 ID	10 to 64	10	You must use **10**. To use CAN2, configure 7983.
8922	Multistart set1	Auto calculation Start 1 DG ... Start 32 DG	Auto calculation	In RMB operation, the controllers ignore this parameter. All gensets are always started. When the load has been transferred and the RMB is set to island, the load dependent start/stop feature stops unnecessary gensets.
8923	Min. run. set 1	0 to 32	1	Select the minimum number of connected gensets.
8924	Multistart conf	Multi start set 1 Multi start set 2	Multi start set 1	Select the multi-start parameter set to use. If you want to use set 2, configure parameters 8925 and 8926.

Other genset controller parameters

Parameter	Name	Range	Default	Details
6070	Genset Mode	-	-	Select **Power management**.

4.4 PID regulation for static synchronisation

The RMB uses static synchronisation to back sync to the grid after the maintenance.

Two PID regulators are used when static synchronisation is required. First, the *f sync* regulator brings the phase into the window. When in the window, the *Phase* regulator regulates for static synchronisation.

If the load fluctuates or you have trouble stabilising for back sync, you can use the following parameters to adjust the PID settings.

f sync regulator

Parameter	Name	Range	Default
2041	f sync. Kp	0 to 60	2.5
2042	f sync. Ti	0 to 60 s	1.5 s
2043	f sync. Td	0 to 2 s	0 s

Phase regulator

Parameter	Name	Range	Default
2061	Phase Kp	0 to 60	0.5
2062	Phase Ti	0 to 60 s	3 s
2063	Phase Td	0 to 2 s	0 s

NOTE Use analogue regulation for static synchronisation. Relay regulation is not sufficiently accurate.

More information
See the **AGC Designer's Handbook** for more information about adjusting the PID regulator and static synchronisation.

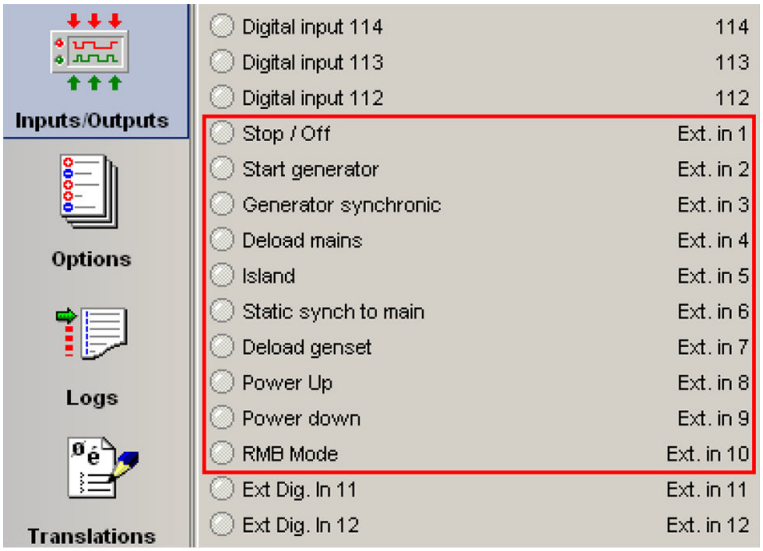
4.5 Inputs from the RMB

The AGC receives the inputs from the RMB over the Beckhoff CAN communication wires. These are shown as external digital inputs in the AGC. On the **I/O status** page in the USW you can see the status of the RMB selector switch and power switch. The external digital inputs are assigned as follows:

External DI	Function	M-Logic > Events > Inputs	M-Logic > Events > Maintenance box
1	Stop/Off	Ext. I/O Dig. In 1	Mbox state off
2	Start generator	Ext. I/O Dig. In 2	Mbox state start
3	Generator synchronisation	Ext. I/O Dig. In 3	Mbox state sync.
4	Deload mains	Ext. I/O Dig. In 4	Mbox state deload mains
5	Island	Ext. I/O Dig. In 5	Mbox state Island
6	Static sync to mains	Ext. I/O Dig. In 6	Mbox state sync. to mains
7	Deload genset(s)	Ext. I/O Dig. In 7	Mbox state deload
8	Power up	Ext. I/O Dig. In 8	-
9	Power down	Ext. I/O Dig. In 9	-
10	RMB mode	Ext. I/O Dig. In 10	Mbox state connected

Using translation to rename the inputs from the RMB

You can use the translation function in the USW to rename the external digital input texts in the first AGC, so that the texts in the input/output list correspond to the RMB switches.

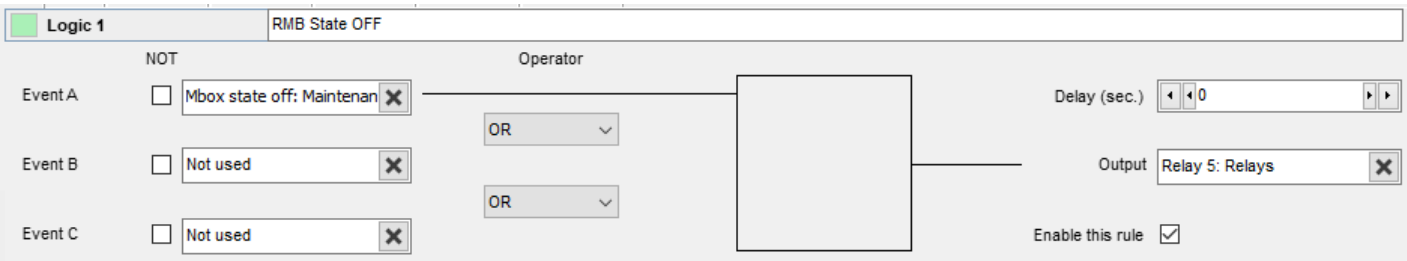


NOTE On the **Translations** page, load all the texts from the AGC. You can then use the search function to locate each external digital input. You can also use the USW help function [F1] for more information on how to translate texts.

M-Logic

You can configure M-Logic so that the different remote maintenance states enable outputs. Note however that you cannot overrule the function from the RMB function selector.

Example: RMB state OFF activates relay 5



NOTE In the relay configuration, select *M-Logic / Limit relay*.