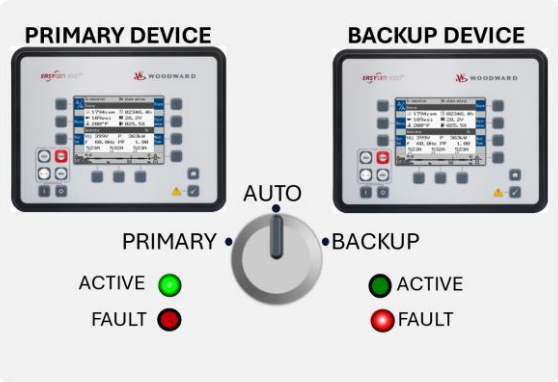
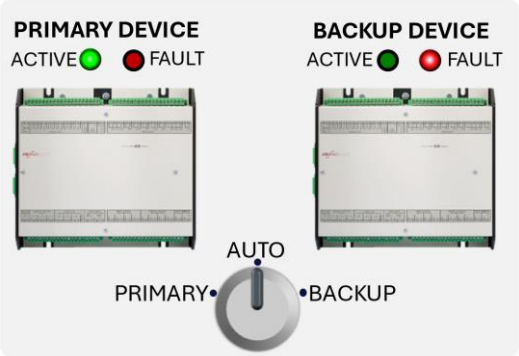
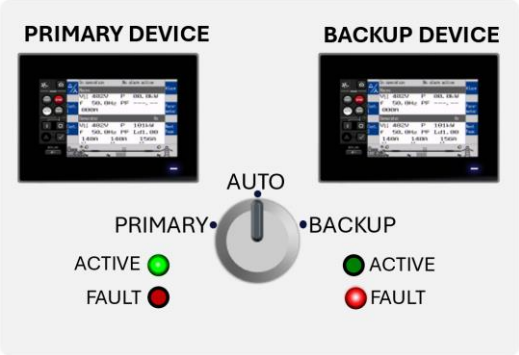






easYgen-3000XT Redundant Control Function

Optional Supplementary Information

Alert boxes

The following alert boxes can be used in this publication:

“DANGER” indicates a hazardous situation which, if not avoided, will result in death or serious injury.

“WARNING” indicates a hazardous situation which, if not avoided, could result in death or serious injury.

“CAUTION”, used with the safety alert symbol, indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

“NOTICE” is used to address practices not related to personal injury.

“IMPORTANT” is used to address practices not related to personal injury.

Personnel

WARNING!
Hazards due to insufficiently qualified personnel!

If unqualified personnel perform work on or with the control unit hazards may arise which can cause serious injury and substantial damage to property.

- **Therefore, all work must only be carried out by appropriately qualified personnel.**

For further Product Support Options, Product Service Options, Returning Equipment for Repair, and/or Engineering Services please download application note #37573.

Documentation itself

⚠WARNING

Read this entire application note and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment. Practice all plant and safety instructions and precautions.
Also consider the manuals for:

- easYgen-3000XT (B37574, B37580, B37581, B35244)

Failure to follow instructions can cause personal injury and/or property damage!

Any unauthorized modifications to or use of this equipment outside its specified mechanical, electrical, or other operating limits may cause personal injury and/or property damage, including damage to the equipment.
Any such unauthorized modifications: constitute "misuse" and/or "negligence" within the meaning of the product warranty thereby excluding warranty coverage for any resulting damage and invalidate product certifications or listings.

⚠CAUTION

This publication may have been revised or updated since this copy was produced. If the cover of the publication states "Translation of the Original Instructions", the original source may have been updated since this translation was made.
The latest version of most publications is available at

www.woodward.com

If a specific publication is not there, please contact a customer service representative to get the latest copy.

⚠WARNING

Ensure that there is an effective emergency shutdown possible!

1 Contents

2 Introduction

Applying two devices or more instead of one has been one of the favorite strategies design engineers use to enhance reliability of control systems. Starting from firmware version 2.17-0, the easYgen-3000XT series introduces a hot-swap redundancy feature. With two easYgens on one genset, the system ensures seamless, bump-free transitions should one controller fail - delivering maximum reliability when it matters the most.

If the parameter "Redundancy function" ID7499 is configured to "On", two easYgen-3000XTgenset controls are interoperating so that the primary control can be easily substituted by the backup control and vice versa. The swapping between the devices is controlled by the primary device (relay 1, self-test-relay) or by an external switch. The redundant function enables a warm swap. This means exchanging the controls during standing engine, is doable if the wiring of the external electrical circuit allows that. The exchange of a device while the other device is controlling the engine is executable (so called hot swap) but needs more effort in external wiring. This will be differentiated later in the external wiring description.

2.1 Designations

Designation	Meaning
Redundant control switch (S1)	This is a knob switch for the operator to determine which controller shall control the engine.
Primary device	This is the controller that runs as active device if both controllers are healthy, and the redundant control switch (S1) is in Automatic position. *Note: The location of the Primary device is fixed.*
Backup device	This is the controller that runs as NOTactive device if both controllers are healthy, and the redundant control switch (S1) is in Automatic position. *Note: The location of the Backup device is fixed.*
Active device	This is the easYgen that is controlling the genset. This easYgen runs in active mode.
NOTactive device	This is the easYgen that is currently not controlling the engine. This easYgen runs in NOTactive mode.

NOTICE

Both controls must be the same model with the same software revision.

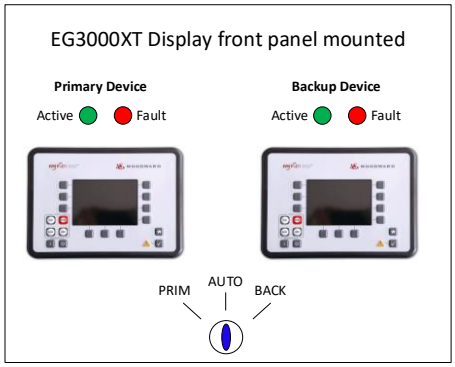
- The redundant function must be enabled on both controls.

- Both controls are interconnected via communication interface CAN2.
- The NOTactive device with display has locked operation mode push buttons
- Swapping the active mode while the engine is running can lead to an engine stop.
- To mix up gensets equipped with and without redundant easYgens is realizable as long the IP-Address-Allocation is considered.

When using the redundancy function, a few restrictions must be considered!
Refer to "Restrictions".

3 Installation examples

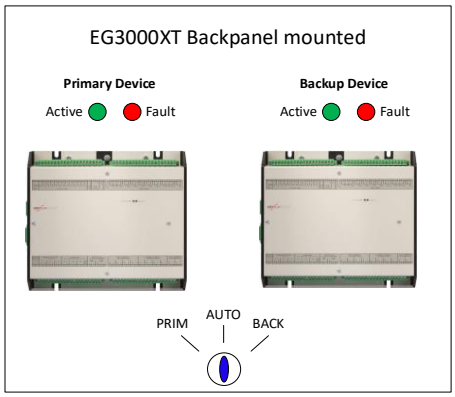
3.1 easYgens with display



Two easYgen with display are installed on front panel. Both devices are running, one is the active device.

- The green lamp shows the active device
- The red lamp shows the faulty device (self-test error)
- Switch on PRIM: Forcing the active mode in the Primary Device
- Switch on BACK: Forcing the active mode in the Backup Device
- Switch on AUTO: Running the Primary device in active mode with automatically switching active mode over to the Backup device.
- Only the active device accepts operation control

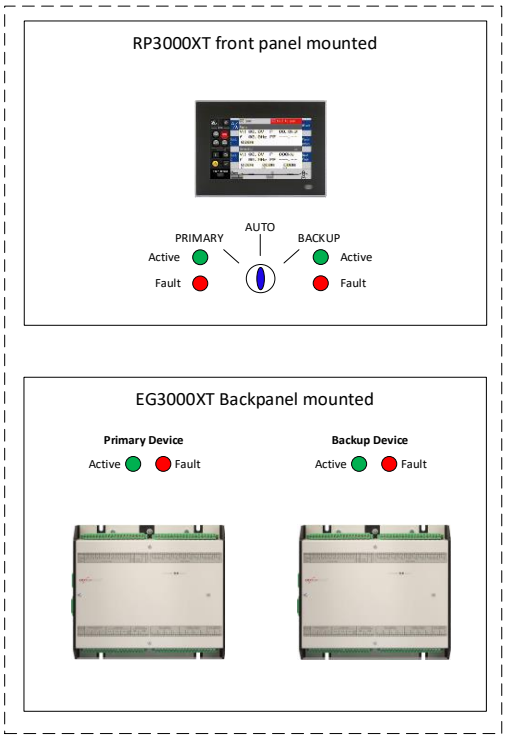
3.2 easYgens without display



Two easYgen without display installed on back panel. Both devices are running, one is the active device.

- The green lamp shows the active device
- The red lamp shows the faulty device (self-test error)
- Switch on PRIM: Forcing the active mode in the Primary Device
- Switch on BACK: Forcing the active mode in the Backup Device
- Switch on AUTO: Running the Primary device in active mode with automatically switching active mode over to the Backup device.
- Only the active device accepts operation control

3.3 easYgens without display with a single remote panel

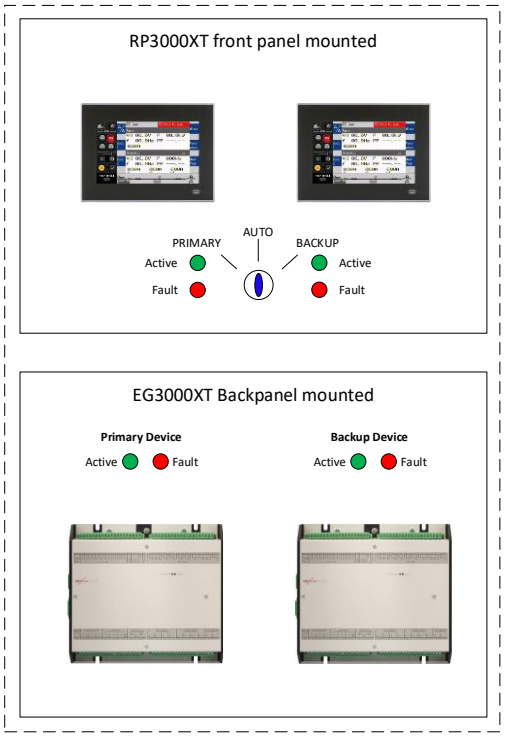


Two easYgen without display installed on back panel. Both devices are running, one is the active device.

Additionally on the front panel a remote panel is installed

- The green lamp shows the active device
- The red lamp shows the faulty device (self-test error)
- Switch on PRIM: Forcing the active mode in the Primary Device
- Switch on BACK: Forcing the active mode in the Backup Device
- Switch on AUTO: Running the Primary device in active mode with automatically switching active mode over to the Backup device.
- Only the active device accepts operation control

3.4 easYgens without display with a two remote panels



As an alternative to the one remote panel approach two remote panels are used.

It remains the same as the one remote panel approach, the difference is in emergency, if one remote panel fails the other can be used. Or there can be a comparison between Primary and Secondary remote panel if needed.

4 Indication

4.1 Indication Primary / Backup device

Whether a device is the Primary device or Backup device is indicated on the **ToolKit** Home Page.

4.2 Indication of the Mode

Whether a device is in Active mode or in NOTactive mode is indicated on the **ToolKit** Home Page.
On **HMI**: Home Page only the RF active mode is indicated as "RF active mode".

4.3 Logic variables

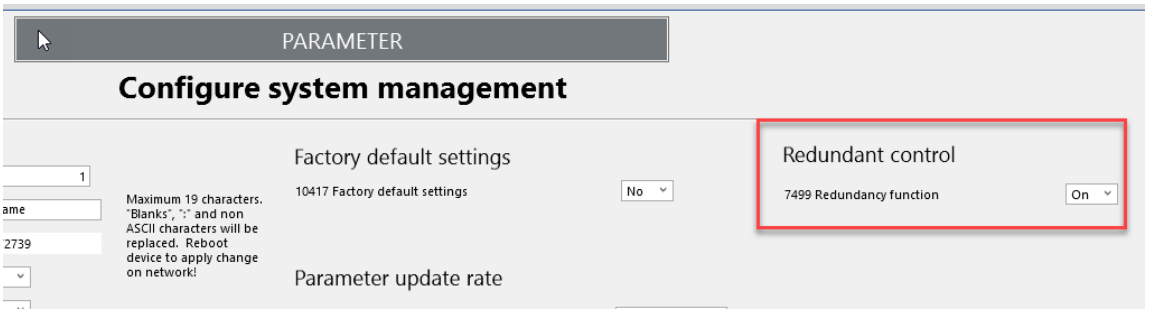
Redundant function (RF) provides the following dedicated logic variables:

- 02.49 RF primary device
- 02.50 RF backup device
- 02.51 RF active device
- 02.52 RF NOTactive device
- 02.53 RF communication (Flashing if CAN2 communication between primary and backup device is active.)
- 08.90 RF redundancy CAN 2: Redundant partner at CAN 2 not recognized.
- 08.91 RF Param. alignment: Parameter alignment mismatch
- 08.92 RF Alarm alignment: Alarm alignment mismatch

5 Design Details

5.1 Activation of redundancy feature

Use the “Configure system management” page to activate the redundancy feature via ToolKit



5.2 Activation of the active mode via Digital Input 12

The dedicated discrete input (DI12) controls the active mode. In cases where the redundancy control function is enabled via parameter "7499 Redundancy function", DI12 is occupied for the redundant function.

Function of DI12 in redundant function:

- With energized DI12 the control runs as active control.
- With de-energized DI12 the control runs as NOTactive control.
- The DI12 inputs of the two controls must be connected and inverted to each other. So that the input is only energized for one control at a time.

5.3 Activation of the primary/backup function via Digital Input 11

The dedicated discrete input (DI11) defines "primary" or "backup" control. In cases where the redundancy control function is enabled, the DI11 is occupied for the redundant function.

Function of DI11 in redundant function:

- With energized DI11 the control acts as Backup control.
- With de-energized DI11 the control acts as Primary Device.
- The DI11 inputs of the two controls must be connected and inverted to each other. So that the input is only energized for the backup control. DI11 will never change anymore in the life of the redundant setup. It helps to recognize independent on any setting of the control whether it is acting as Primary or Backup control. (This allows one common parameter file for both the controls).

5.4 Digital Inputs

All discrete inputs (except DI11 and DI12) are wired parallel to both the controllers.

5.5 Analog Inputs

It is not possible to connect resistance sensors to the analog inputs. (A parallel connection would result in incorrect measurements. Switching the sensors from one device to the other could result in uncontrolled behavior for a short time.)

5.6 Analog and Digital Outputs

Only the outputs of the active control shall be externally switched through. The outputs of the NOTactive control are not engaged.

5.7 Device Number

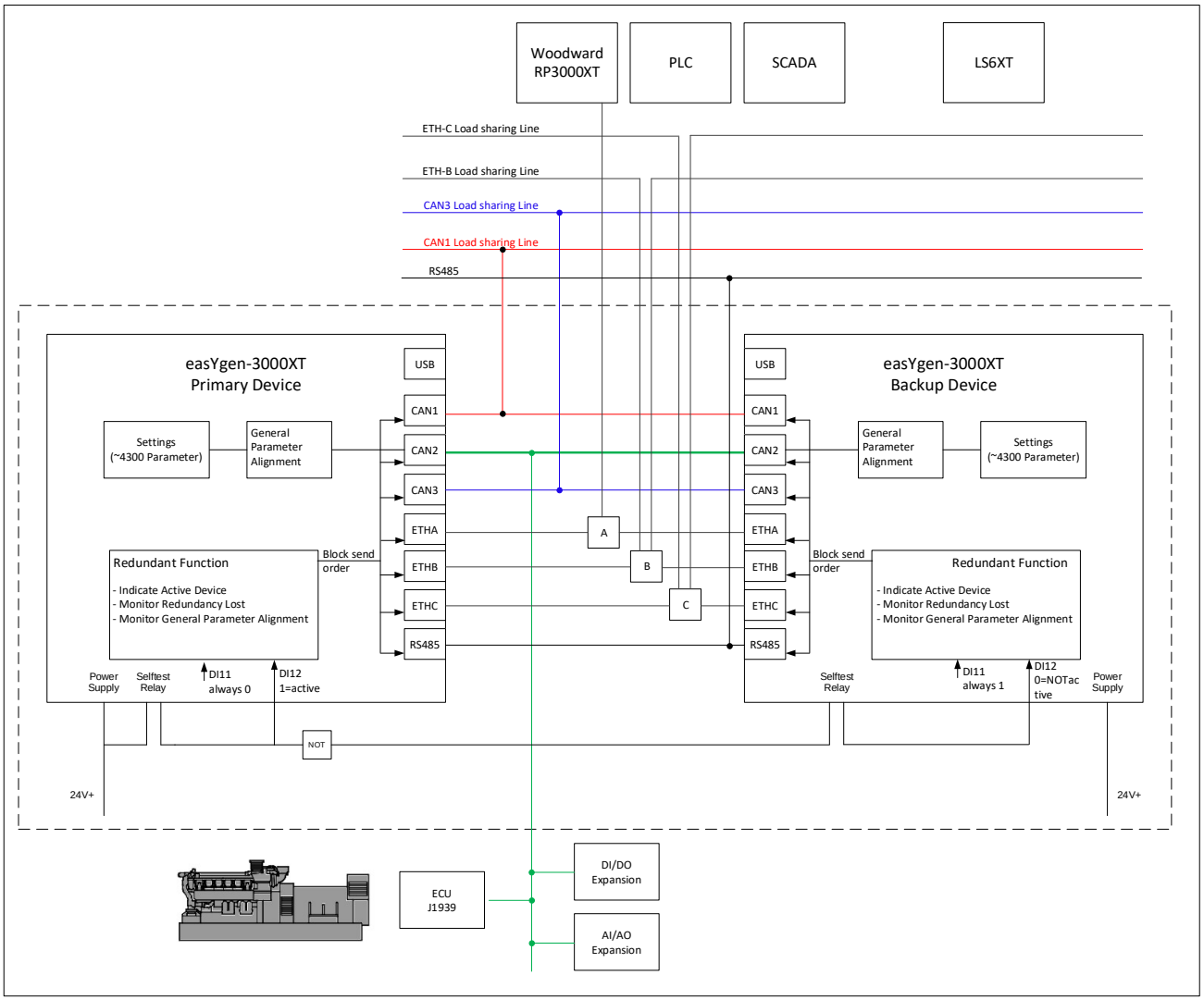
The Device number of primary and backup control is always the same independent on being active or NOTactive control.

5.8 IP-Addresses

The IP-Addresses of the Primary and Backup Control are freely selectable. It is recommended to assign the primary control an odd sub number and the backup control an even sub number. For example:

- Redundant unit 1
  - Primary control: xxx.xxx.xxx.001
  - Backup control: xxx.xxx.xxx.002
- Redundant unit 2
  - Primary control: xxx.xxx.xxx.003
  - Backup control: xxx.xxx.xxx.004

5.9 Communication Topology Overview



5.10 Behavior of the active control

If the controller is switched into active mode, the controller works like a standard easYgen, it takes over all control functions.

5.11 Behavior of the NOTactive control

- If a controller is switched into NOTactive mode, the transmitting of interfaces CAN1, 2, 3 are disabled. The receiving of data via these interfaces is not affected. (Exception: CAN 2 only sends a dedicated message to the active control e.g. for monitoring functions "RF redundancy CAN2" refer to “Redundant control CAN Interface 2 (RF) lost” and "RF Parameter alignment" refer to “Redundant control Parameter Alignment”)

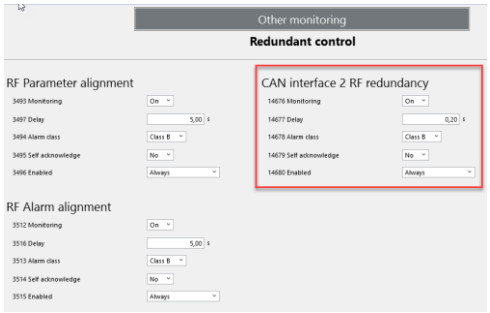
- If the control is switched into NOTactive mode, the transmitting of UDP messages ETH-A, B, C is disabled. The receiving of data via these interfaces is not affected.
- The NOTactive control is tracked with the current "operation mode" of the active control.
- The NOTactive control is tracked with the current "Engine shall run" command of the active control
- The alarms of the NOTactive control are acknowledged by the active control if the alarms are not active anymore.
- The NOTactive control classifies down all its shutdown alarms to B alarms. All alarms are generally forced onto self-acknowledge mode. This is needed to avoid locking alarms in the NOTactive control. This helps to prepare the NOTactive control for taking over when control comes into active mode.
- Mains decoupling alarm is ignored if the control is in NOTactive mode

6 Monitoring functions

The redundant function provides the following dedicated monitoring functions:

6.1 Redundant control CAN Interface 2 (RF) lost

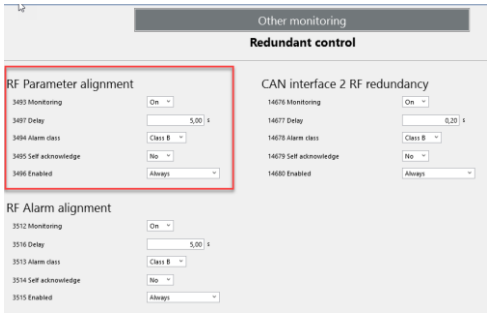
If the redundant control function (parameter "7499 Redundancy function") is configured to "on", this monitor checks if the device receives the expected CAN 2 messages from its redundant partner device. If the CAN 2 interface does not receive the expected message within 1000ms plus the configured delay time, an alarm will be initiated.



If this monitor function is triggered, the display indicates "RF redundancy CAN2" and the logical command variable " 08.90 RF redundancy CAN 2" will be enabled.

6.2 Redundant control Parameter Alignment

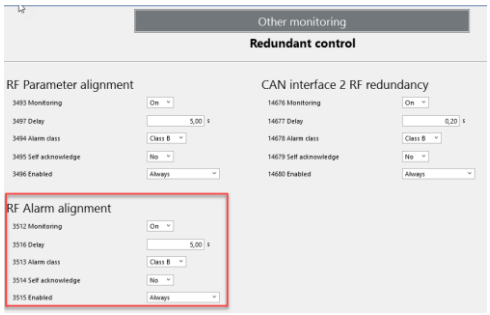
If the redundant control function (parameter "7499 Redundancy function") is configured to "on", this monitor checks if both redundant partner devices have their parameters configured the same way.
If any parameter is configured different between the both devices the alarm "RF Parameter alignment" is triggered and shown on the display. Additionally, the logical command variable " 08.91 RF Param. alignment" will be enabled.



The Ethernet address parameters of Eth-A, Eth-B and Eth-C in the Interfaces are not included in the parameter alignment monitor.

6.3 Redundant control Alarm Alignment

If the redundant control function (parameter "7499 Redundancy function") is configured to "on", this monitor checks if both redundant partner devices have the same active alarms.
If any active alarm difference is recognized between the both devices the alarm "RF Parameter alignment" is triggered and shown on the display. Additionally, the logical command variable " 08.92 RF Alarm alignment" will be enabled.



7 Wiring Guidance

This chapter provides guidance on how to wire the two easYgens of a redundant setup.
The following wiring proposal is based on the experiences Woodward made with the former off-the-shelf redundant control panel RGCP3400.

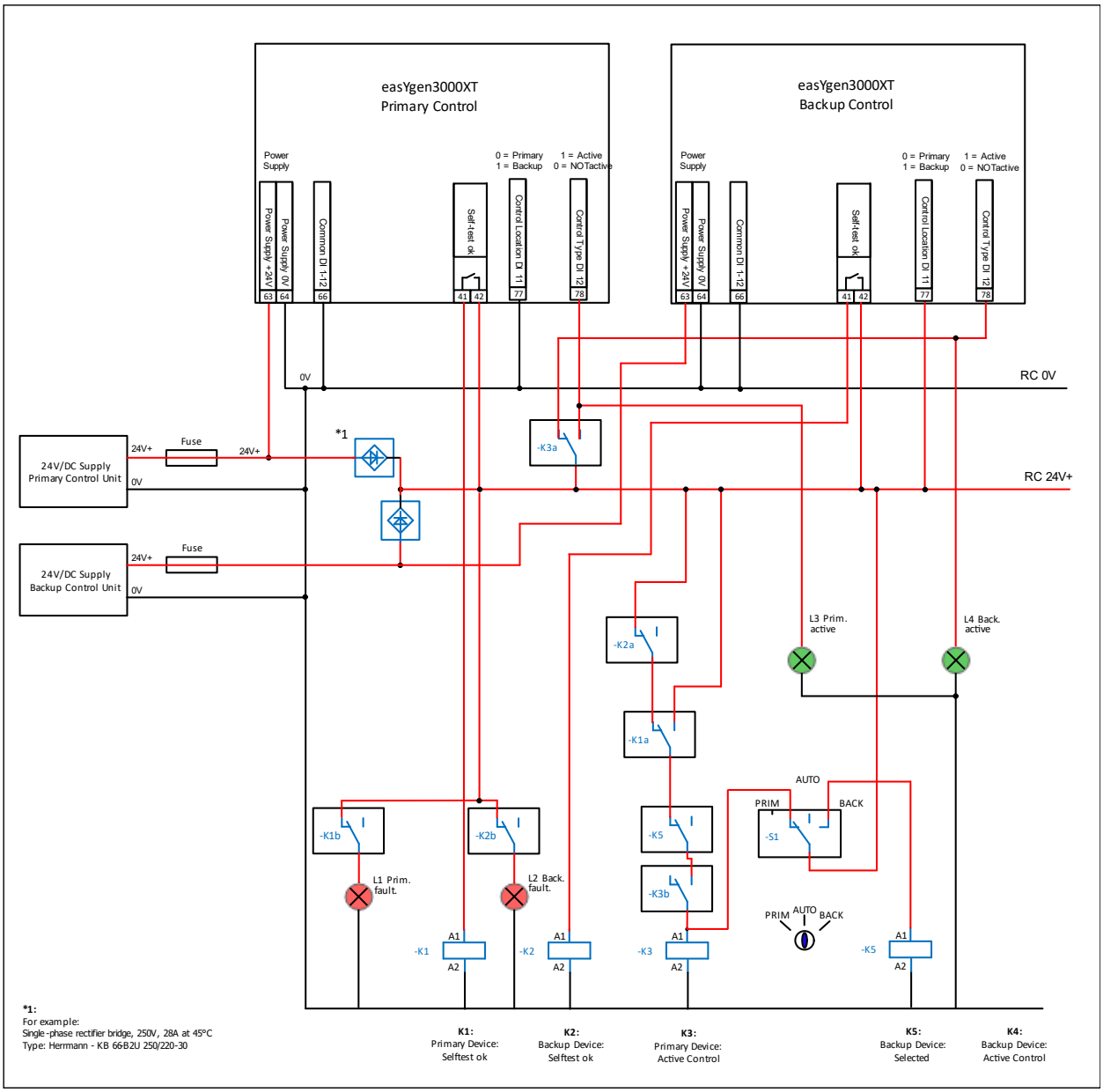
The wiring proposal covers the following requirements:

- The power supply is set up redundant.
- The power supply of the discrete inputs is created internally and therefore redundant too.
- An easYgen can be removed while the other control is controlling the engine.
- Potential bonded relay contacts of an easYgen can be isolated.

Control Switch "S1" provides the following functions:

- AUTO
  - If the primary control fails, the backup control becomes active. (If the primary control becomes ok again, the backup control remains active until "S1" is switched to "PRIM". This prevents continuous switching in the event of loose contact, for example.)
  - If the primary control and the backup control fail, the backup control is connected as active.
- PRIM
  - Primary control is always connected as active control.
- BACK
  - Backup control is always connected as active control.

7.1 Wiring Power Supply, DI 11 and DI 12



Power supply:

To provide redundancy, each control has its own power supply. The positive poles of both power supply units are combined via decoupling diodes to form “RC24V+” to supply the relays and the digital inputs redundantly.

Digital Input 11, 12:

Digital Input 11 defines the backup control. DI11 of the left-hand control is connected to "RC 0V", DI11 of the right-hand control is connected to "RC 24V+". This means that the left-hand control is the

primary control, and the right-hand control is the backup control. Refer to “Activation of the primary/backup function via Digital Input 11”

Digital Input 12 defines the active control. Refer to “Activation of the active mode via Digital Input 12”

Basic explanation wiring active device with different positions of switch S1:

- PRIM (The active mode is fixed to the primary control.)
  - "RC 24V+" energizes "-K3"
  - "-K3a" switches "RC 24V+" to DI12 of the primary control. This means that the primary control is always active control.
  - "-K3b" switches to the root contact of "-K5".

- AUTO and primary control is ok and active
  - "-K1" is energized by the self-test relay R1 of the primary control.
  - "-K1a" switches "RC 24V+" via "-K5" and "-K3b2 to "-K3".
  - At least "-K3a" still connects "RC 24V+" to DI 12 of the primary control. This means that the primary control is still the active control.
- AUTO and primary control is not ok, backup device is ok
  - "-K1" is not energized by the self-test relay R1 of the primary control anymore.
  - "-K1a" is in rest position and connected to "-K2a" which disconnects "RC 24V+":
  - "-K3" is de-energized.
  - "-K3a" (and "-K3b" selfholding contact) is in rest position, "RC 24V+" is passed to DI 12 of the backup control. This means that the backup control is the active control.

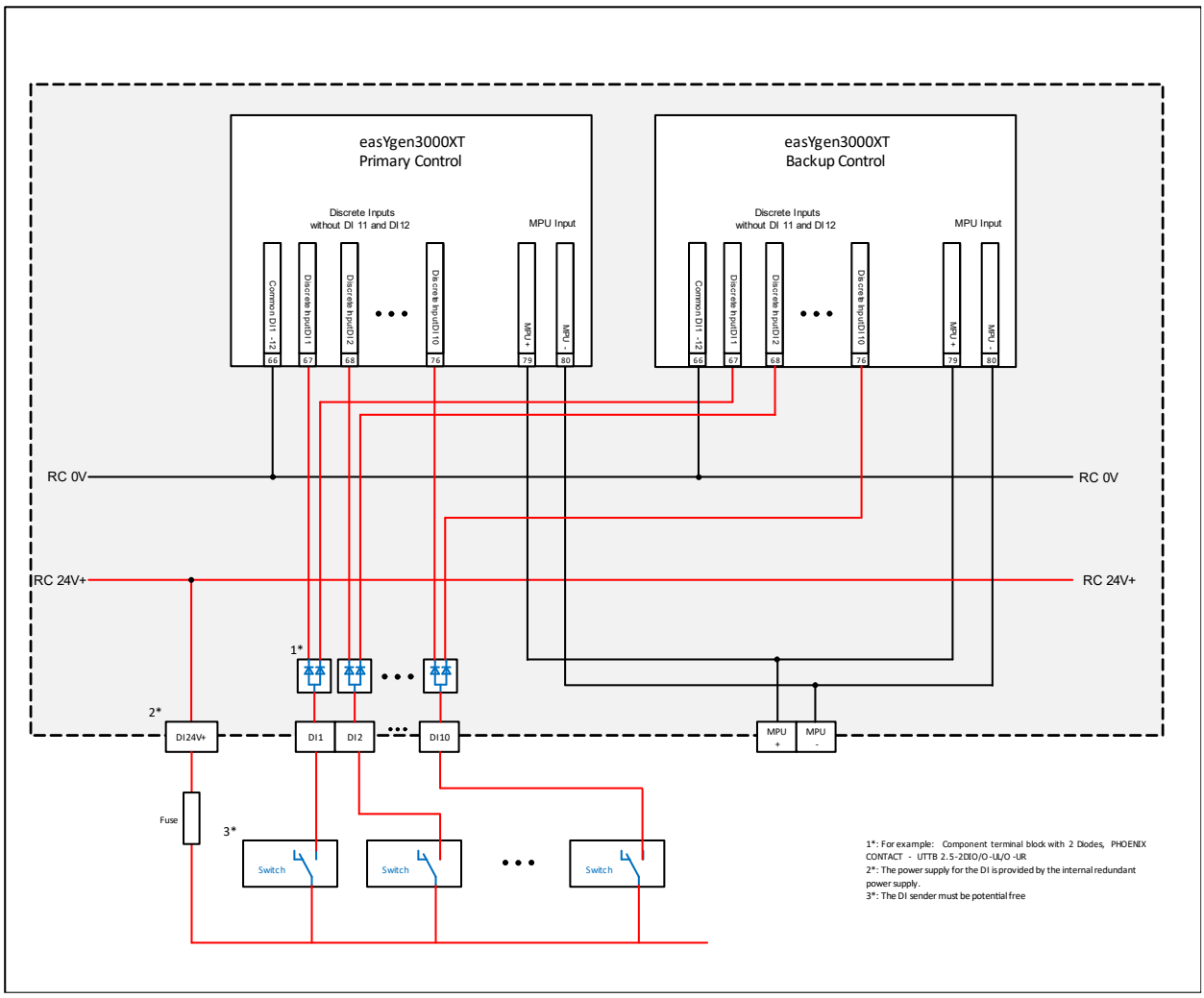
- AUTO and primary control become ok again for some reasons
  - "-K3" is not energized because the self-holding with contact "-K3b" is still open.
  - The backup device remains active as long as switched to "PRIM.

- BACK (The active mode is fixed to the backup control.)
  - "-K5" is energized and de-energizes "-K3". "-K3a" is in rest position, deenergizes DI 12 of the primary control and energizes DI 12 of the backup control.
  - As a result, the backup device is now the active control.
  - Control lamps L1 - L4:
  - L1 indicates that the primary control is faulty.
  - L2 indicates that the backup control is faulty.
  - L3 indicates that the primary control is the active control.
  - L4 indicates that the backup control is the active control.

NOTICE

"-K1" and "-K2" need a third contact for switching the analog inputs. Refer to “Wiring Analog Inputs”
"-K3" needs a third contact for switching the analog outputs. Refer to “Wiring Analog Outputs”.

7.2 Wiring Discrete Inputs And MPU



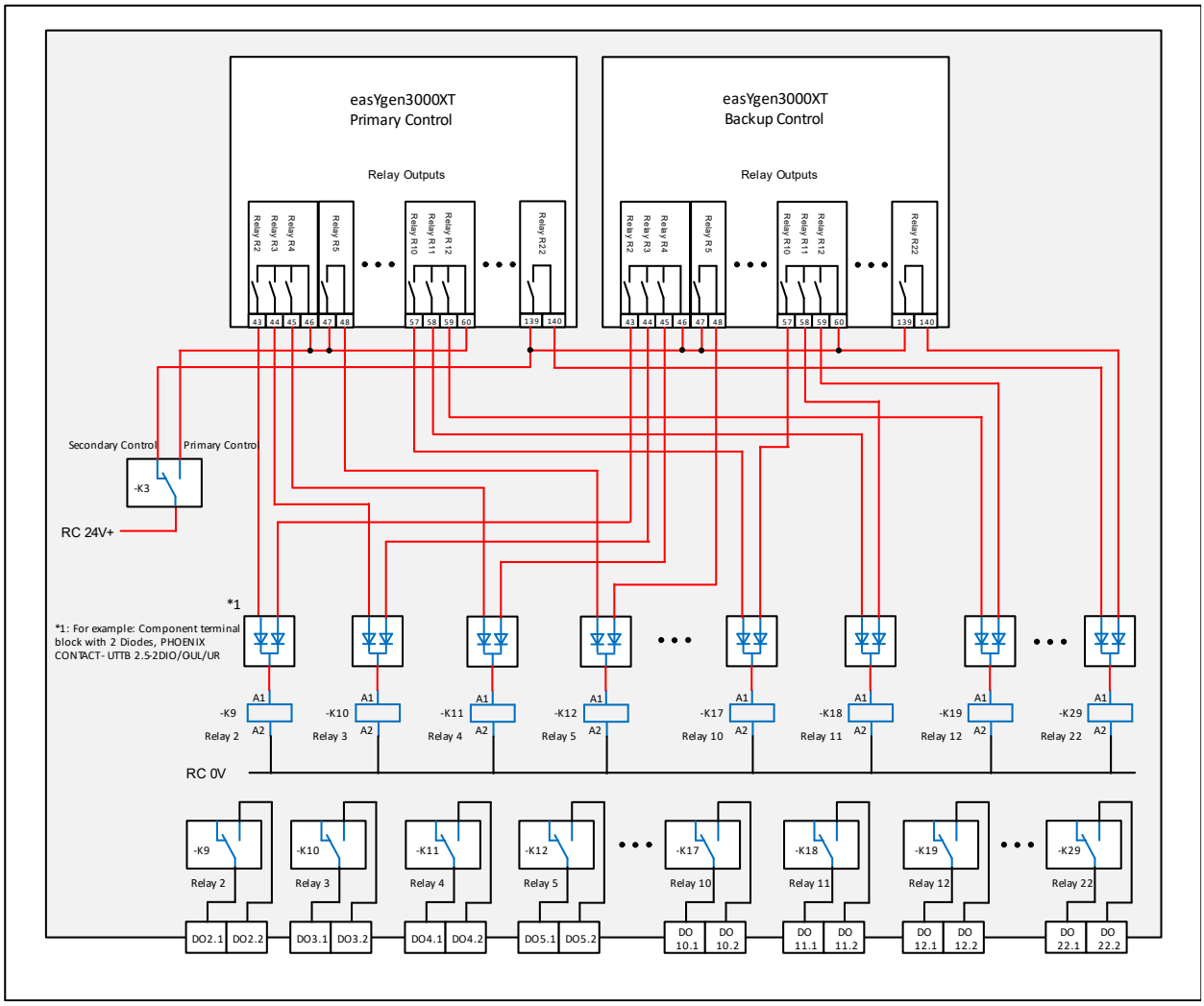
MPU (Pickup) Connection

The MPU input of the primary and the backup control can be connected directly in parallel.

Discrete Inputs

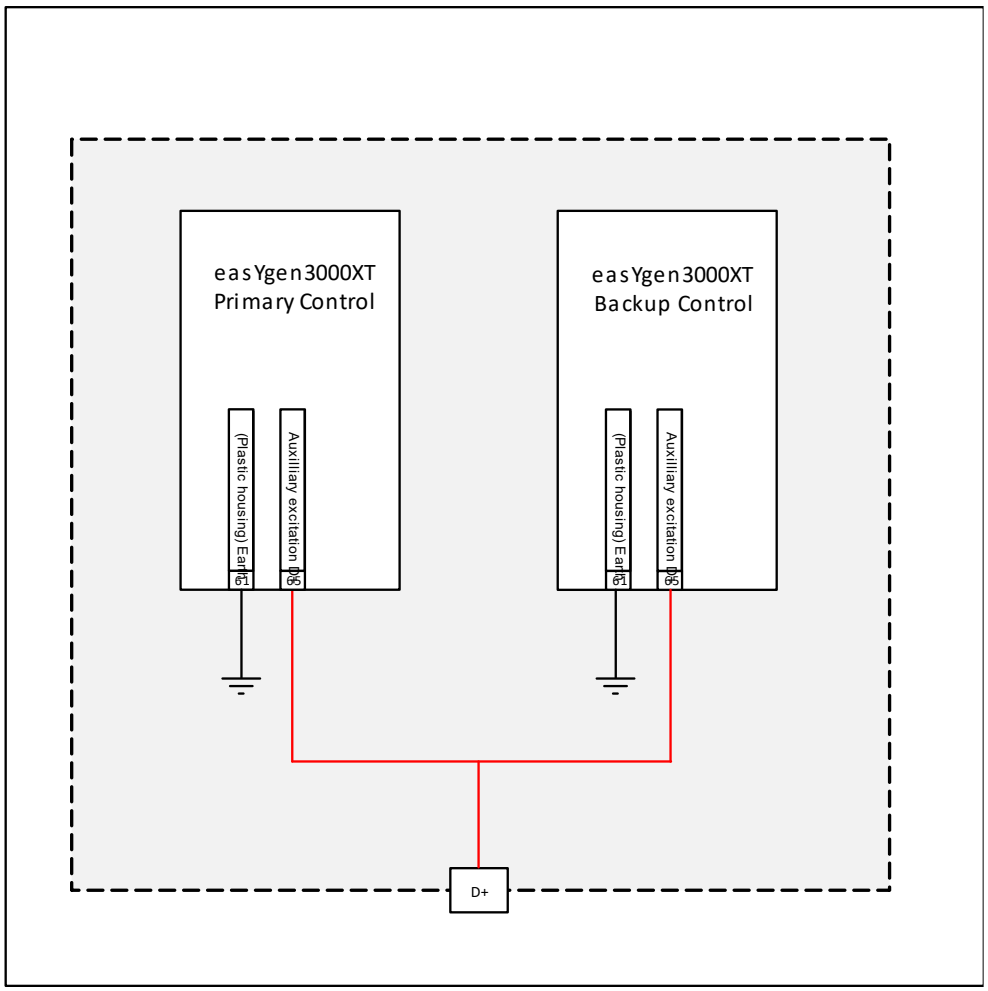
The digital inputs of the primary and backup control are connected via decoupling diodes.

7.3 Wiring Discrete Outputs



Each digital output is connected to a separate relay, like "-K9" for relay 2, via the decoupling diodes. Relay "-K3" ensures that the common relay terminals are only supplied with voltage at the active device.

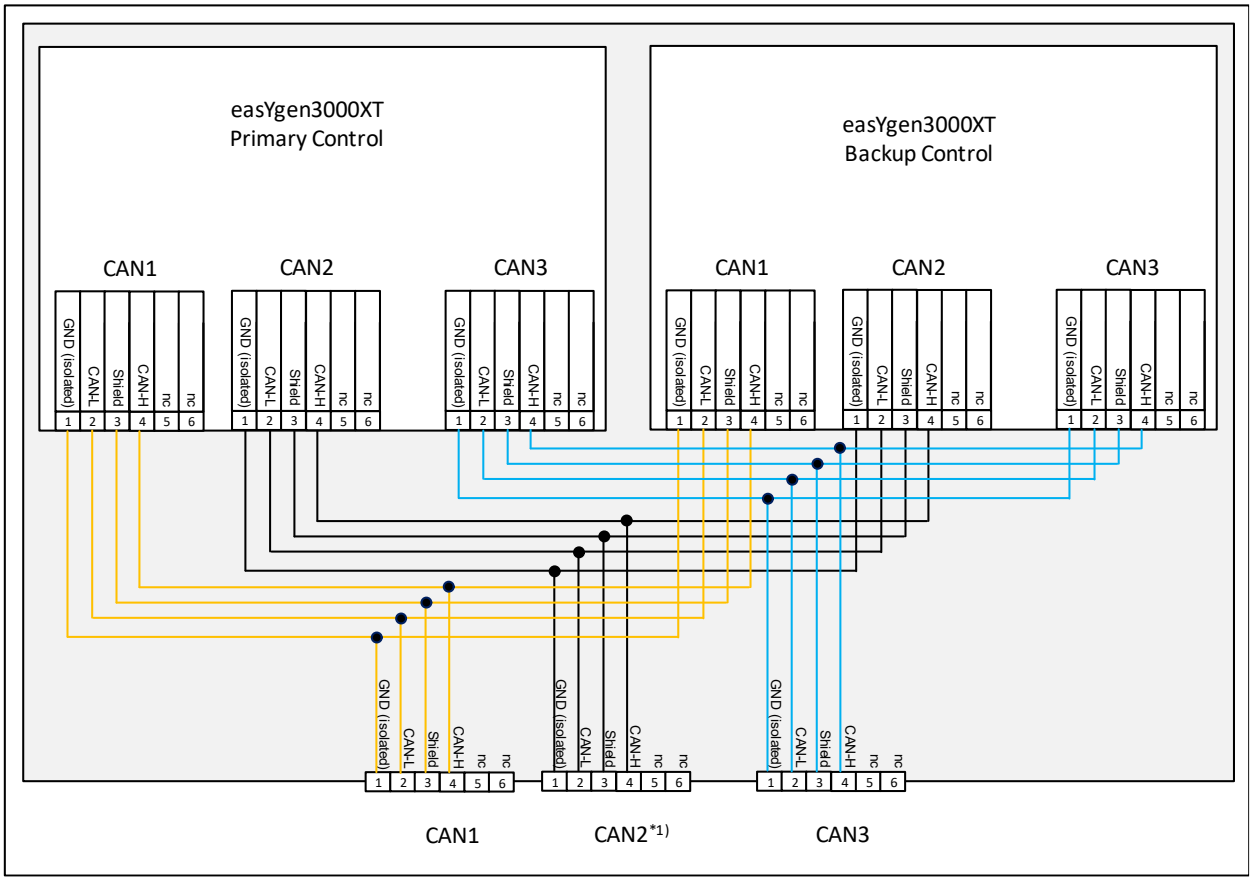
7.4 Wiring Earth And D+



NOTICE

Metal housing: Don't use terminal 61, take nut on the housing for earth.
As the easYgens contain an internal decoupling diode for "D+", no external diodes are required.
Please make sure that the current supplied by only one easYgen is sufficient for the alternator!

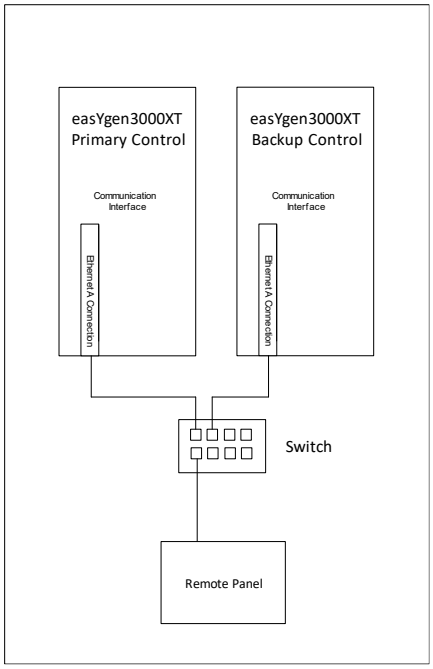
7.5 Wiring CAN Interfaces

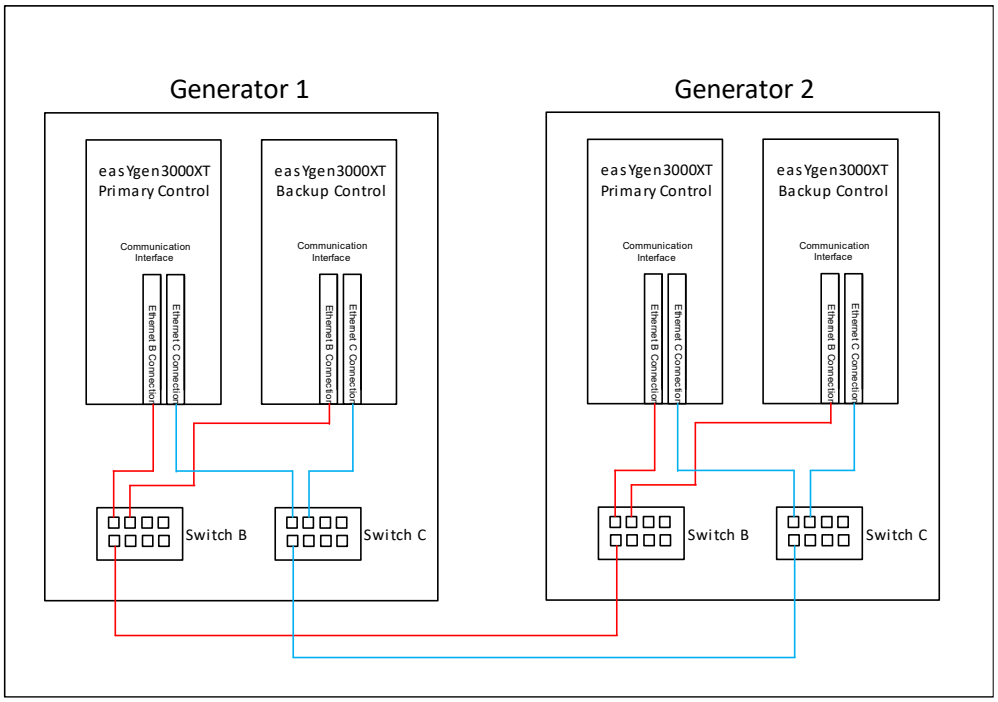


IMPORTANT

CAN2 is mandatory to wire between primary and backup control even if CAN2 is not used otherwise. (It is needed for the data exchange between the two controls.)

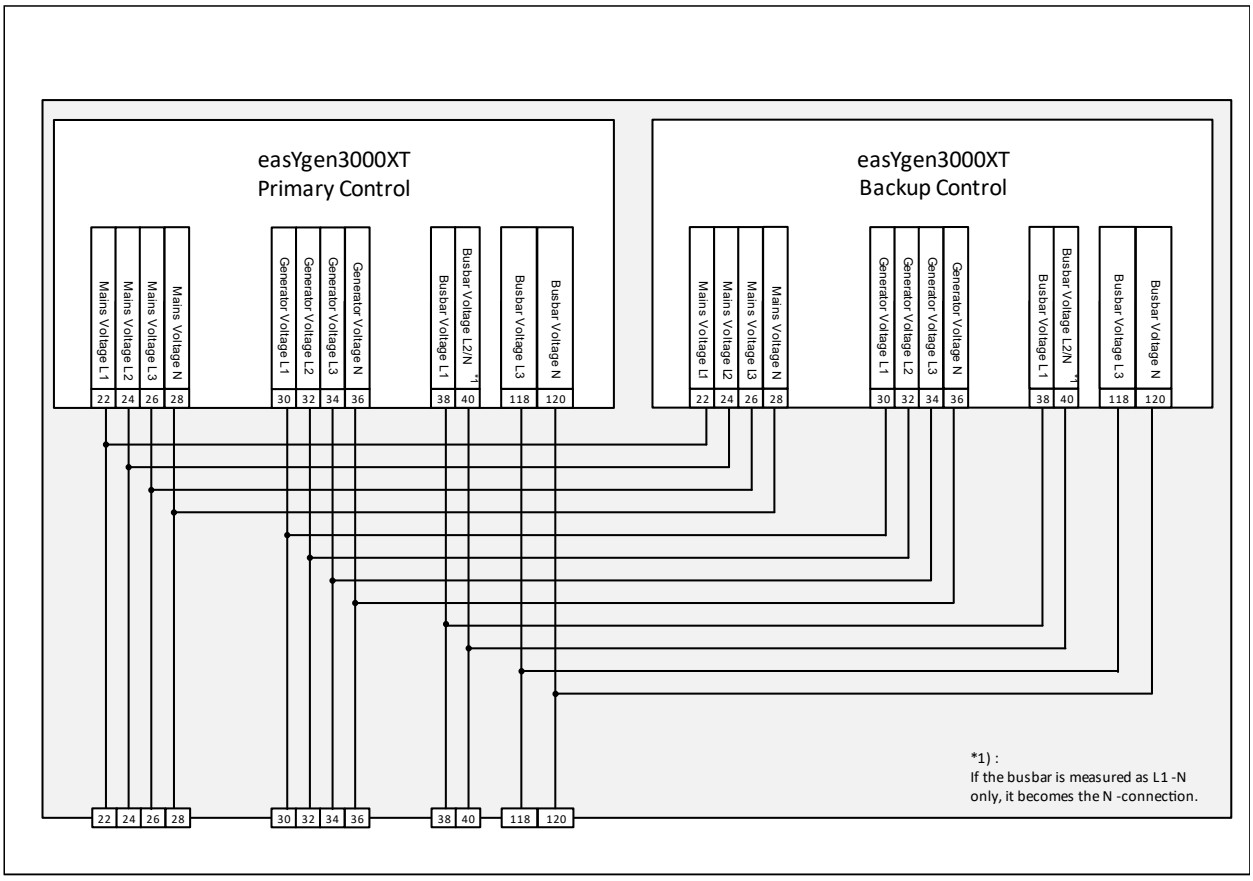
7.6 Wiring Ethernet A, B, C





7.7 Wiring AC Voltage Measurement

AC-voltage-measurement is connected in parallel to both devices.

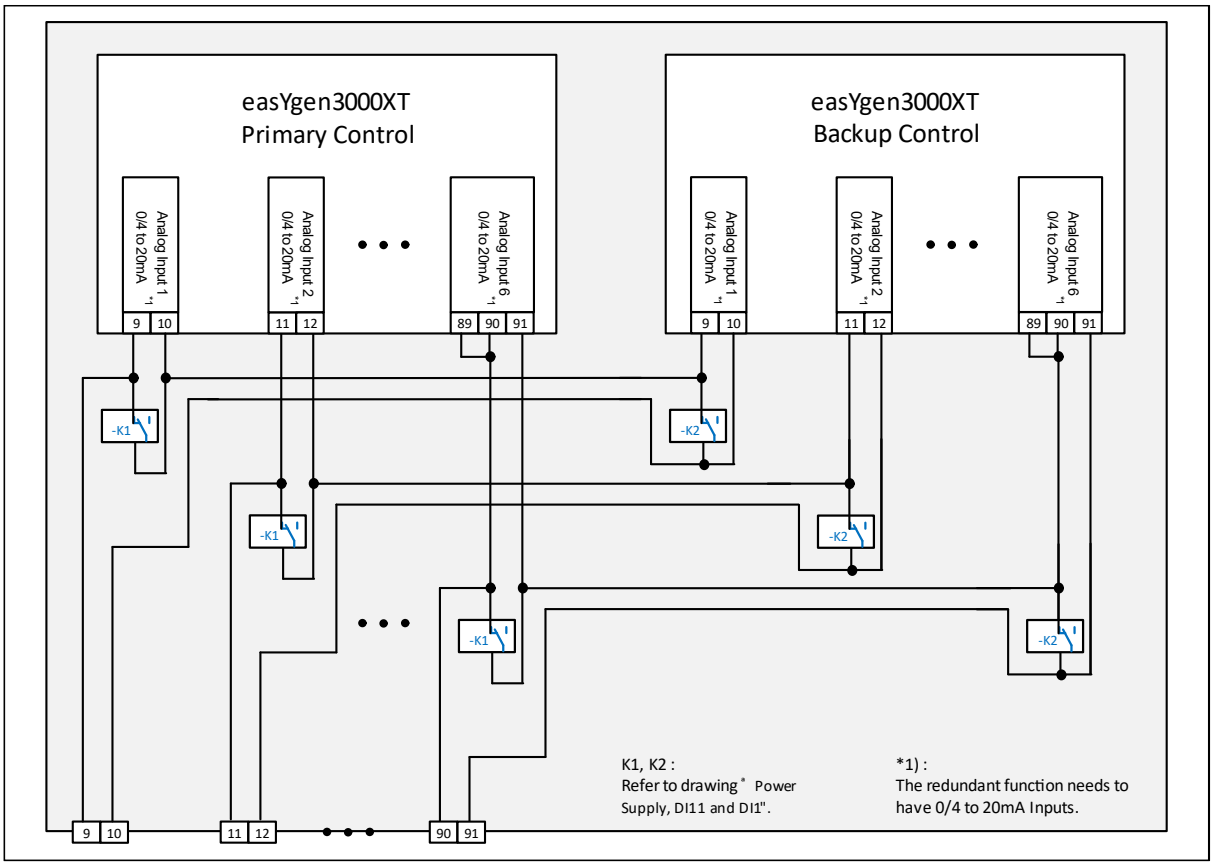


Wiring AC Voltage Measurement

WARNING

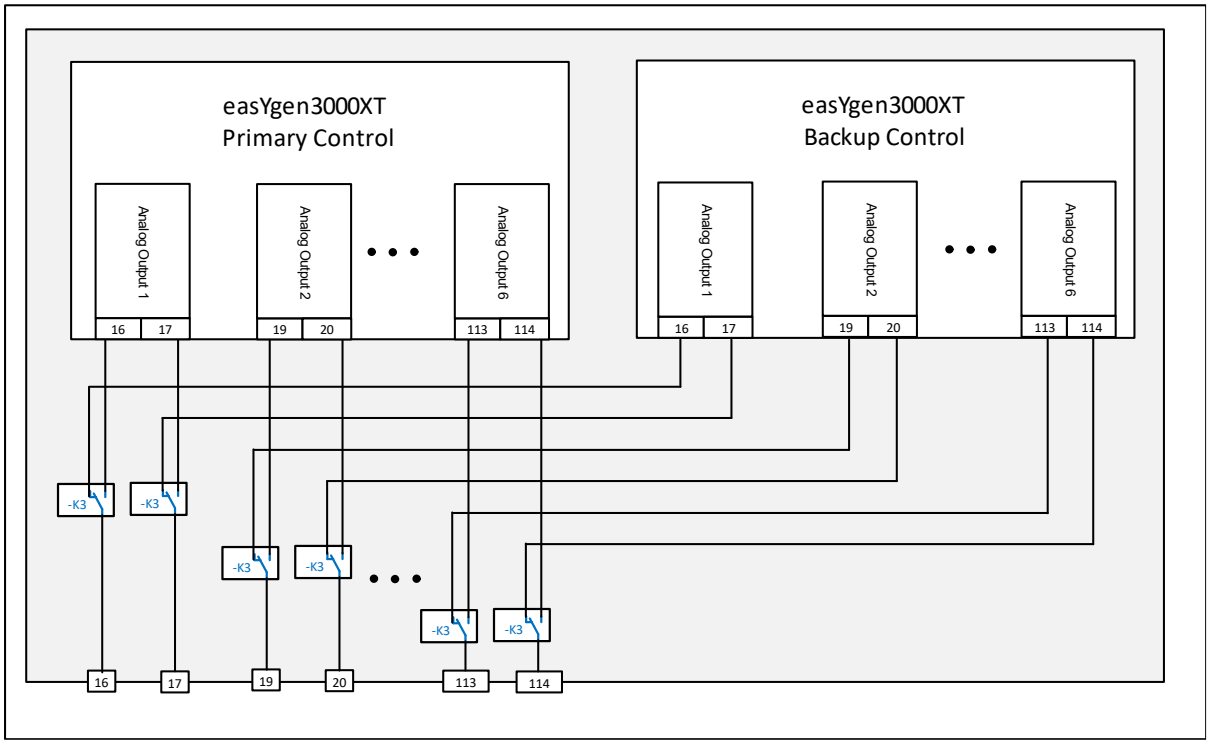
If one of the two devices is removed, care must be taken to ensure that the current transformer outputs are bridged! (E.g. as shown in the figure above with Wago touchproof test sockets.)

7.8 Wiring Analog Inputs



To ensure that the circuit is not interrupted when a control is removed, the circuits of the analog inputs must be closed with the self-test relays “-K1” for primary, “-K2” for backup control. The figure shows both relays in the rest position. The analog inputs can normally simply be connected in parallel. It is not possible to connect resistance sensors to the analog inputs.

7.9 Wiring Analog Outputs



To ensure that only the analog outputs of the active device are used, the outputs are switched via relay "-K3".

7.10 Restrictions

This chapter describes some restrictions on the functions of the easYgen devices that must be considered when using the redundant function.

7.10.1 Software related restrictions

Item	Function	Comment
1.1	The Analog Inputs are only usable as 0/4 to 20mA inputs and voltage inputs. It is not possible to connect resistance sensors to the analog inputs.	When using the current analog inputs of the easYgen, the current flow for the other input must be maintained by bridging before removing a device. Refer to “Wiring Analog Inputs”
1.2	The Analog outputs are switched over from primary control to backup control. The switching time must be considered.	Usually, each speed governor and AVR should accept that. The result could be a small ripple in the frequency/active power according to voltage/reactive power, if a hot swap occurs.
1.3	Digital Inputs 11 and 12 cannot be used as usual.	They are fixed for the redundant functions. Refer to “Wiring Power Supply, DI 11 and DI 12”
1.4	The auxiliary excitation D+ (terminal 65) will drive the double current during engine start if both controls are ok.	It must be ensured that the alternator can work with single and double current.
1.5	The relay output R1 (terminal 41/42 "ready for operation"/self-test) cannot be used as usual.	The relays R1 of both controls are used for redundant control self-test purposes. These relays outputs provide information about the status of the two controls and can be integrated into the emergency stop function.
1.6	The GCB close relay R06 (terminals 49/50) must work with close pulse mode. The self-holding of the GCB must be maintained outside or in the GCB itself.	To provide a proper hot swap or exchange of one control, the GCB close order must be an active order.
1.7	The GCB open relay R07 (terminals 51/52) must work with normally open contacts. Contacts open -> No opening of GCB. Contacts closed -> Opening of GCB.	To provide a proper hot swap or exchange of one control, the GCB open order must be an active order.
1.8	Be aware that there may be gaps of a few milliseconds when transferring from one control to the other with the proposed wiring through the external relays. Additional precautions may	To provide a proper hot swap or exchange of one control, the GCB open order must be an active order.

	have to be taken here, e.g. for the fuel relay and the neutral contactor.	

7.10.2 Hardware related restrictions

Item	Function	Comment
2.1	Digital input 12 cannot be used for the "Neutral Interlocking" function because it is used for the redundant function.	This is why the LogicsManager equation "86.54 LM: NC is closed" was introduced for. The default value is DI12 and must be adjusted when using the redundant function and "Neutral Interlocking".
2.2	Parameter "GCB close command" must be configured to "Impulse" mode.	Because of hot swap or exchange capability, the "Steady" mode is not usable.
2.3	The run-up synchronization is not recommended.	Due to a possible hot swap exactly during run-up synchronization, a proper run-up synchronization cannot be guaranteed.
2.4	The "Load dependent start/stop" function is not recommended.	Because of the hot swap and exchange capability, the LDSS of the backup control is properly not tracked accordingly. The "Generator load" mode should be avoided completely!
2.5	The engine "Warm-up mode" should not be "Time controlled". It should rely on a real measurement e.g. coolant temperature.	Due to the exchange capability, the backup control would run again due to the time-controlled active power increase.
2.6	The "Auto idle mode" is not recommended.	Due to the exchange capability, the backup control would run again the idle procedure.

Table: Hardware related restriction

8 Notice