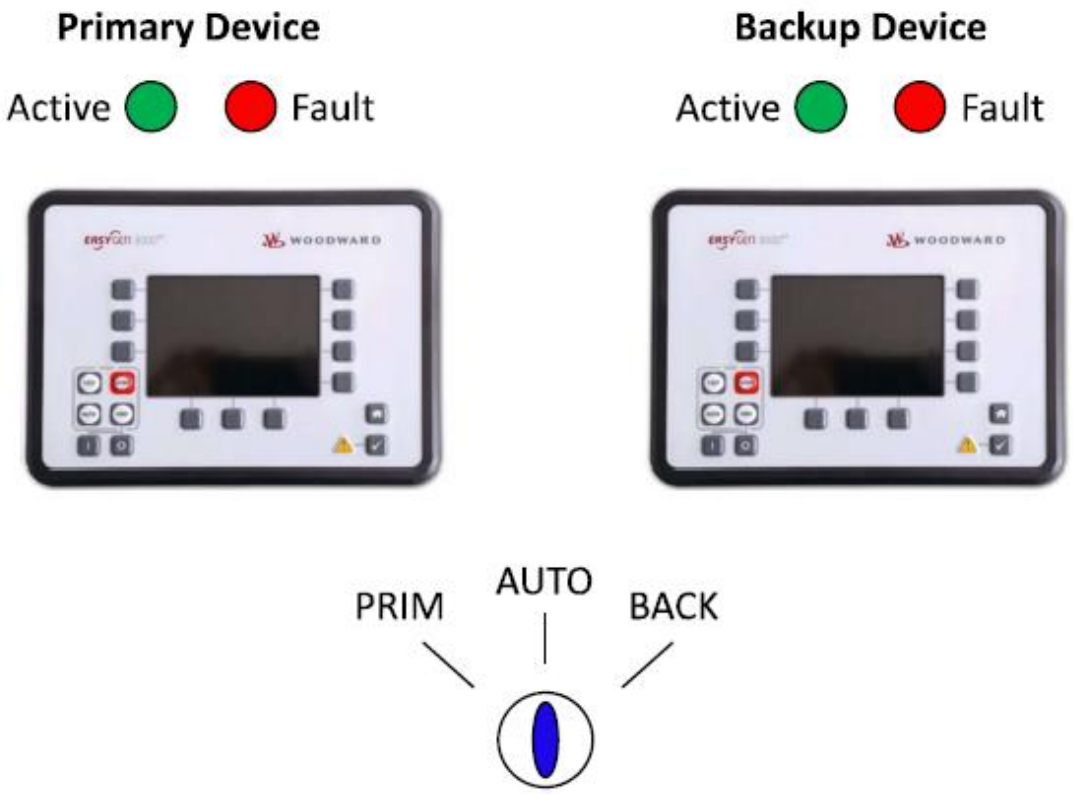
easYgen-3000XT Series

Manual | Genset Control

Excerpt: Chapter 6.6 – Redundant Control



easYgen-3100XT-P1 / 3200XT-P1 / 3200XT-P1-LT

Release 2.17-0

One Modbus read or write command to one slave will take at least 50 msec. The minimum permitted rate group is 100 msec. If now a mapping is configured in a way that it requires more writes to a device than fits into the required rate, or the slave has very long answer times, there will be a timeout error. The device will still read/write but it will not do it as quickly as required. This issue can be mitigated by defining slower rate groups or reducing the number of read/write commands.

6.6 Redundant Control Function

6.6.1 Introduction

If parameter "Redundancy function" 7499 is configured to "On", two easYgen3000XT genset controls are interoperate 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 as long the wiring of the external electrical circuit is allowing that.

The exchange of a device while the other device is controlling the engine is executable but needs more effort in the external wiring. This will be differentiated later in the external wiring description (refer to “6.6.6 Wiring Guidance”).

Designations

Designation	Meaning
Redundant Control Switch (S1)	This is a knob switch for the operator to determine which control shall control the engine.
Primary device	This is that control which runs as active device if both controls are healthy, and the redundant control switch is in Automatic position. *The location of the Primary device is fixed.*
Backup device	This is that control which runs as NOTactive device if both controls are healthy, and the redundant control switch is in Automatic position. *The location of the Backup device is fixed.*
Active Device	This is that easYgen which is controlling the engine. This easYgen runs in active mode.
NOTactive Device	This is that easYgen which 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 during running engine 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 redundant function, a few restrictions must be considered! Refer to “6.6.7 Restrictions”.

6.6.2 Designing Details

Activation of the active mode via Digital Input 12

The dedicated discrete input (DI12) controls the active mode. In cases the redundancy control function is enabled via parameter "7499 Redundancy function", the DI 12 is occupied for the redundant function.

Function of DI 12 in redundant function:

- With energized DI 12 the control runs as active control.
- With de-energized DI 12 the control runs as NOTactive control.
- The DI 12 inputs of the two controls must be connected inverted to each other. So that the input is only energized for one control at a time.

Activation of the primary/backup function via Digital Input 11

The dedicated discrete input (DI 11) defines "primary" or "backup" control. In cases the redundancy control function is enabled, the DI 11 is occupied for the redundant function.

Function of DI 11 in redundant function:

- With energized DI 11 the control is acting as Backup control.
- With de-energized DI 11 the control is acting as Primary Device.
- The DI 11 inputs of the two controls must be connected inverted to each other. So that the input is only energized for the backup control. DI 11 will be never changed 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 controls).

Digital Inputs

All discrete inputs (except DI 11 and DI 12) are parallel to both controllers.

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.)

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.

Device Number

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

IP-Adresses

The IP-Addresses of the Primary and Backup Control are free selectable. It is recommended to give 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

Behavior of the active control

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

Behavior of the NOTactive control

- If the control 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 “4.5.6.21 Redundant control CAN Interface 2 (RF) lost” and "RF Parameter alignment" refer to “4.5.6.22 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

6.6.3 Examples for Installation

This chapter shows some examples of how the redundant system can be set up.

The following applies to all examples.

There are 4 external indicator lamps. Two for each controller:

- The green lamp shows the active device.
- The red lamp shows which device is faulty (self-test relay has dropped down).

There is an external switch (S1) with three possible positions:

- 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.

easYgen display variant front panel mounted:

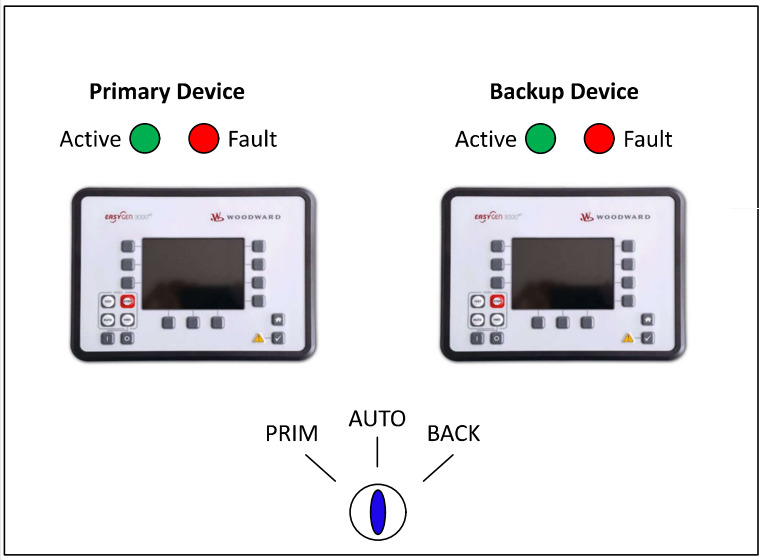


Fig. 341: Two easYgen with display are installed on front. Both devices are running, one is the active device

easYgen metal variant back panel mounted:

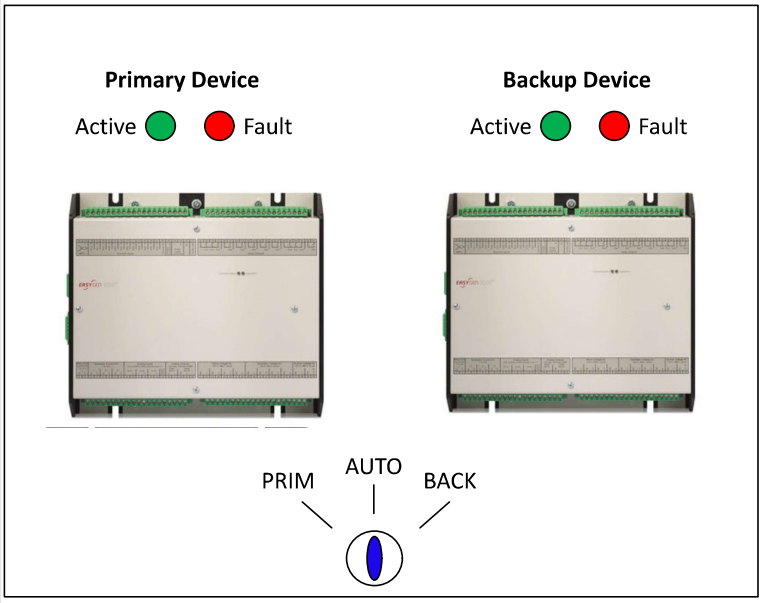


Fig. 342: Two easYgen installed back mounted. Both devices are running, one control is the active device.

easYgen metal variant back panel mounted with <u>two</u> Remote Panels "easYview"

If remote panels "easYview" has to be used, it is recommended to use two "easYview", one for the Primary device and one for the Backup device. This has the advantage that if a device fails, you can immediately recognize which device has failed.

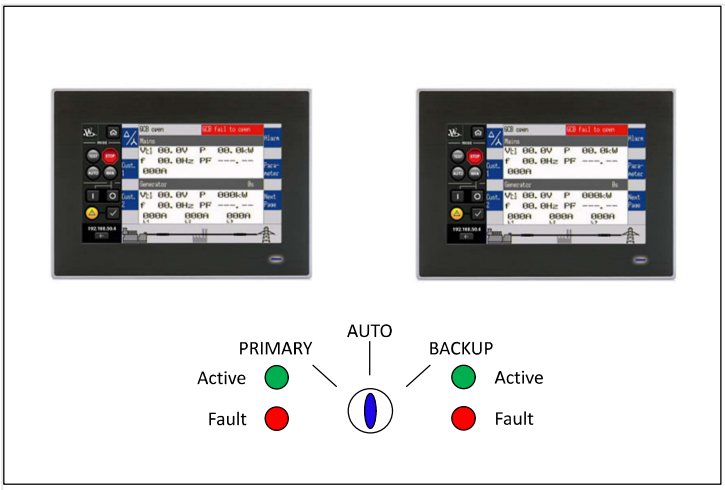


Fig. 343: Two easYview front panel mounted

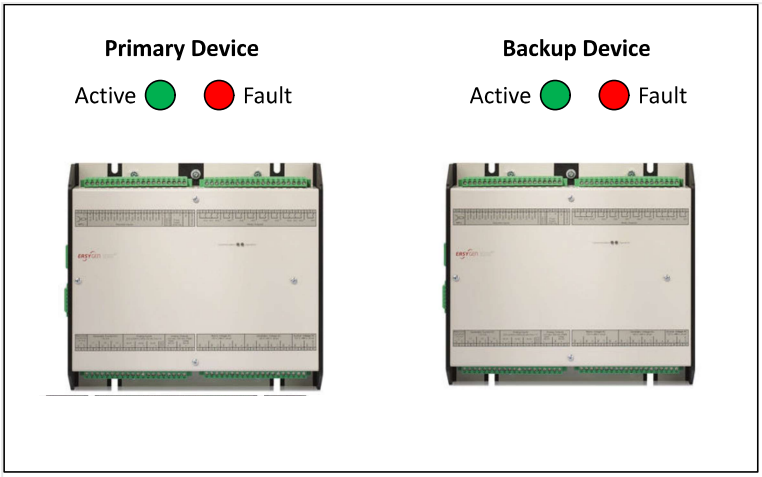


Fig. 344: Two easYgen back panel mounted

easYgen metal variant back panel mounted with <u>one</u> Remote Panel "easYview" (not recommened)

It is also possible to use only one easYview. However, this is not recommended as it is not possible to immediately recognize whether a device has failed. If, for example, the Backup device has failed and the easYview is currently displaying thePrimary device, this will not be noticed at first.

In addition, if the Ethernet cable is defective, it would no longer be possible to display any device at all.

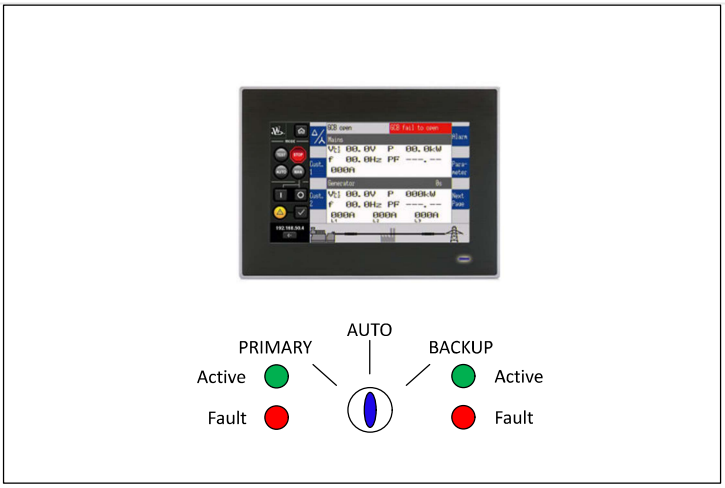


Fig. 345: One easYview front panel mounted

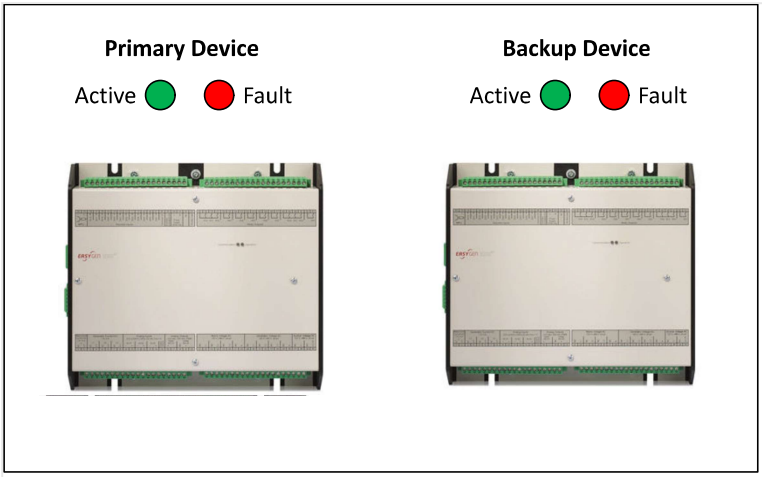


Fig. 346: Two easYgen back panel mounted

6.6.4 Indication

Indication Primary device and Backup device

Whether the device is the Primary device or Backup device is indicated on the ToolKit HOME PAGE.

Indication of the Mode

Whether the device is in Active mode or in NOTactive mode is indicated on the **ToolKit** HOME PAGE as "Active mode" or "NOTactive mode".

On **HMI:** HOME PAGE only the RF active mode is indicated as "RF active mode".

Logic variables

The redundant function 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

6.6.5 Monitoring functions

The redundant function provides the following dedicated monitoring functions:

- RF Parameter alignment refer to “4.5.6.22 Redundant control Parameter Alignment”
- RF Alarm alignment refer to “4.5.6.23 Redundant control Alarm Alignment”
- CAN interface 2 RF redundancy refer to “4.5.6.21 Redundant control CAN Interface 2 (RF) lost”

6.6.6 Wiring Guidance

This chapter provides guidance on how to wire the two easYgen of a redundant setup.

The following wiring proposal is based on the experiences Woodward has made with the former redundant device RGCP3400.

The wiring covers 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 a loose contact, for example.)
  - If the primary control **and** the backup control fails, the backup control is connected as active.
- PRIM: The primary control is always connected as active control.
- BACK: The backup control is always connected as active control.

6.6.6.1 Wiring Power Supply, DI 11 and DI 12

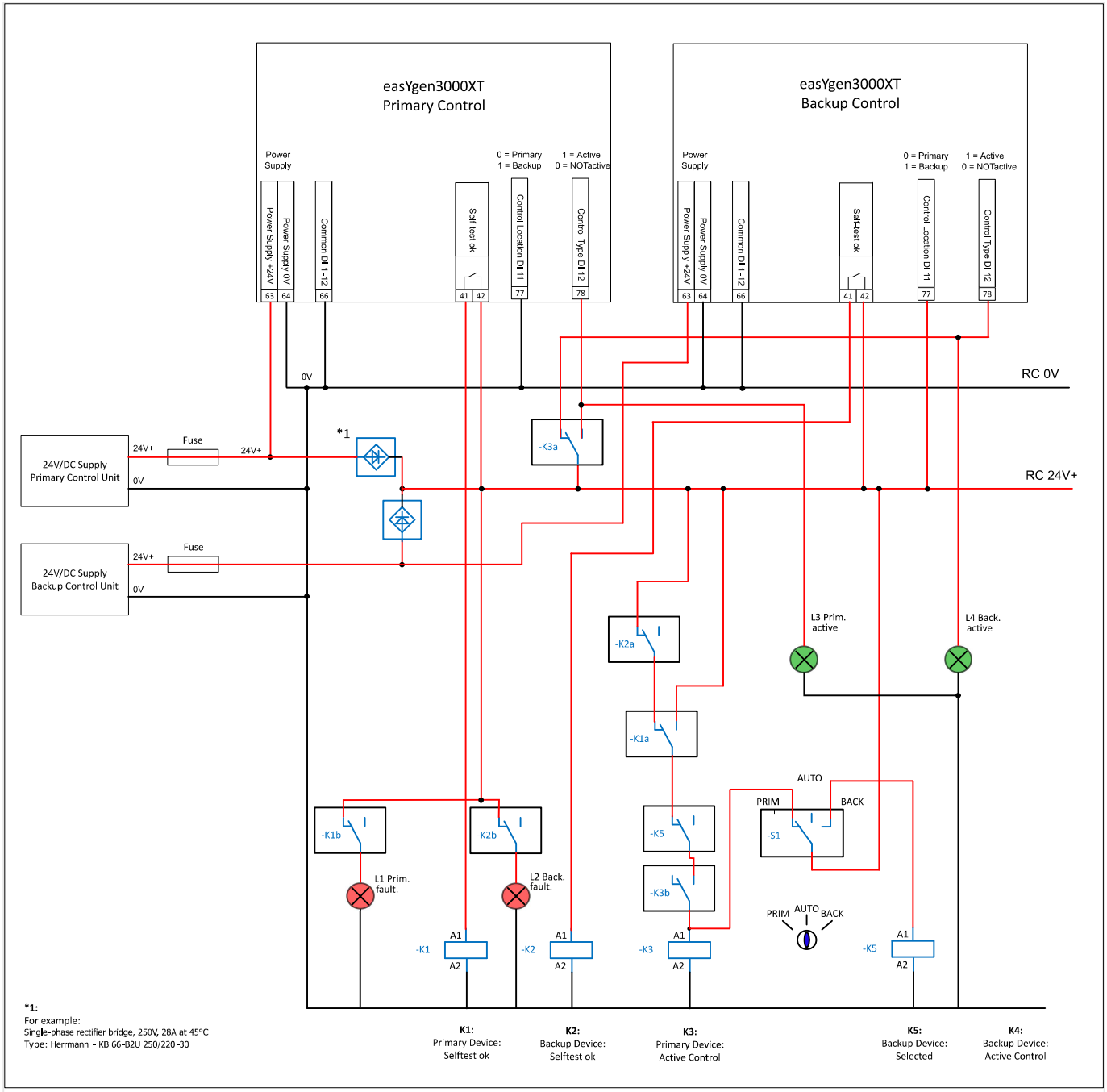


Fig. 347: Wiring power supply, DI 11 and DI 12

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+” in order to supply the relays and the digital inputs redundantly.

Digital Input 11, 12:

Digital Input 11 defines the backup control. DI 11 of the left-hand control is connected to "RC 0V", DI 11 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”.)

With the wiring described, the **backup control** is the active control after the supply voltage is applied.

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 DI 12 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 **becomes 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, de-energizes DI 12 of the primary control and energizes DI 12 of the backup control.
  - As 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.

"-K1" and "-K2" need a third contact for switching the analog inputs. (Refer to “6.6.6.9 Wiring Analog Inputs”.)

"-K3" needs a third contact for switching the analog outputs. (Refer to “6.6.6.10 Wiring Analog Outputs”.)

6.6.6.2 Wiring Discrete Inputs And MPU

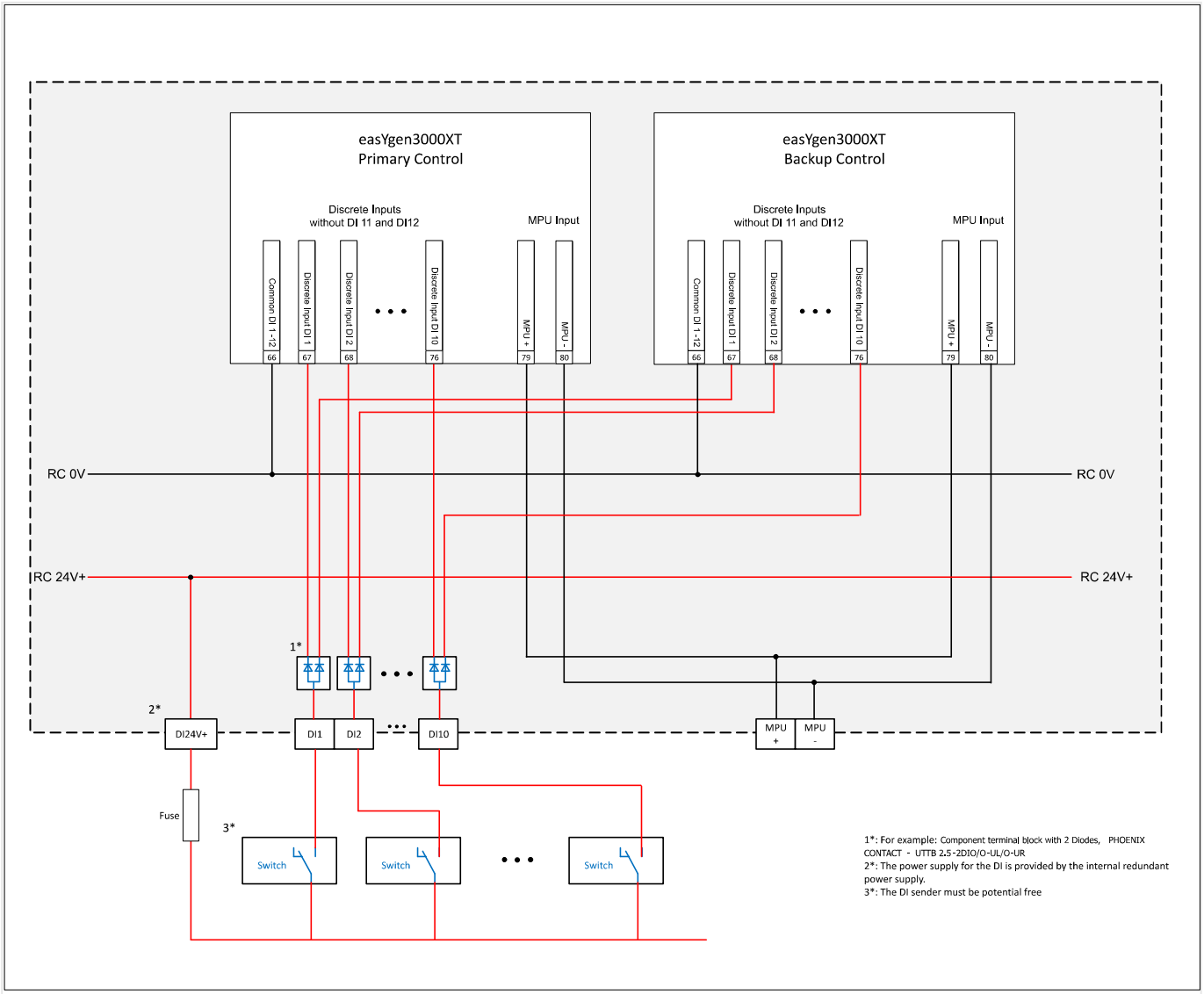


Fig. 348: Wiring DIs and MPU

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.

6.6.6.3 Wiring Discrete Outputs

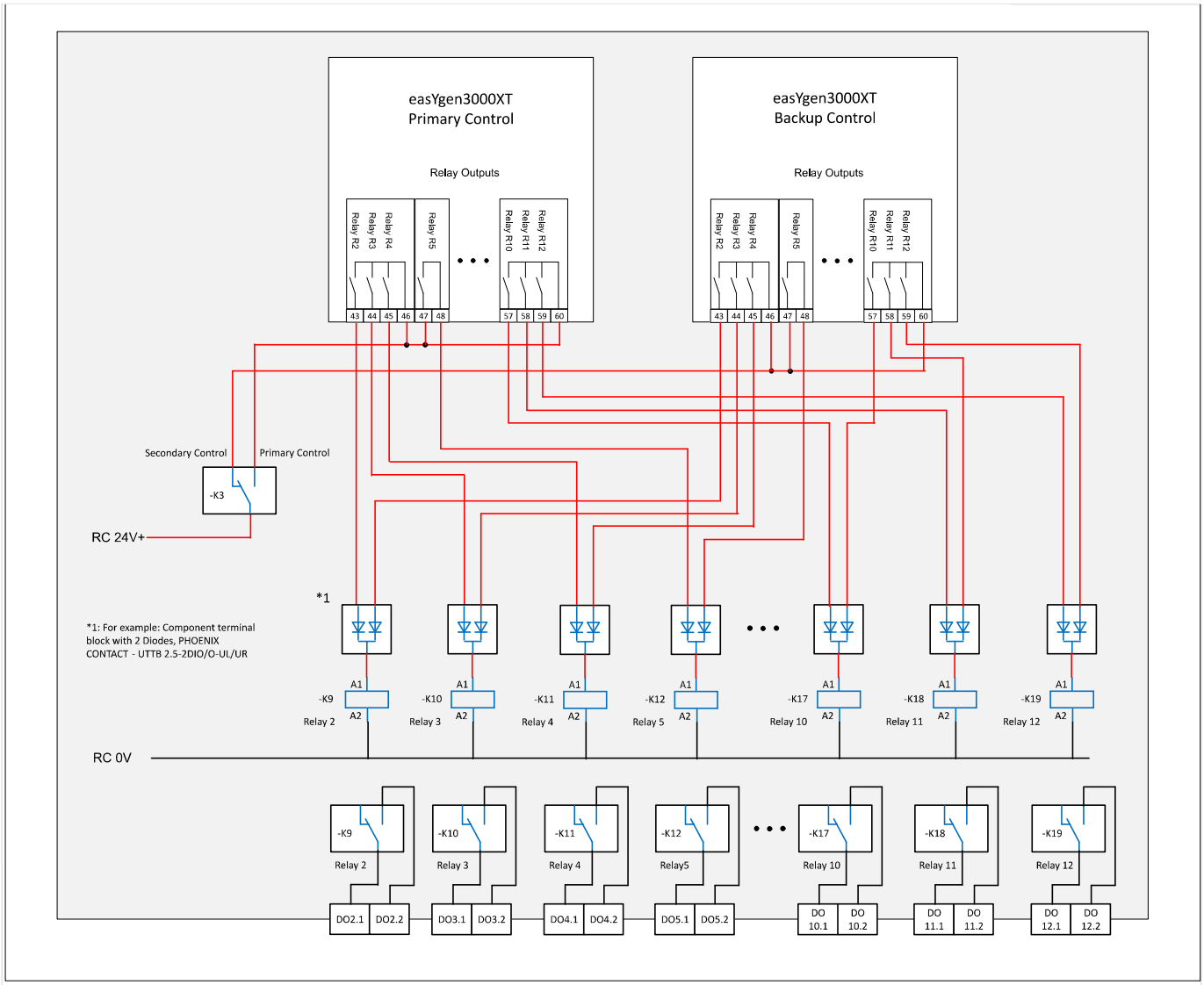


Fig. 349: Wiring DOs

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. (Refer to figure Fig. 347.)

6.6.6.4 Wiring Earth And D+

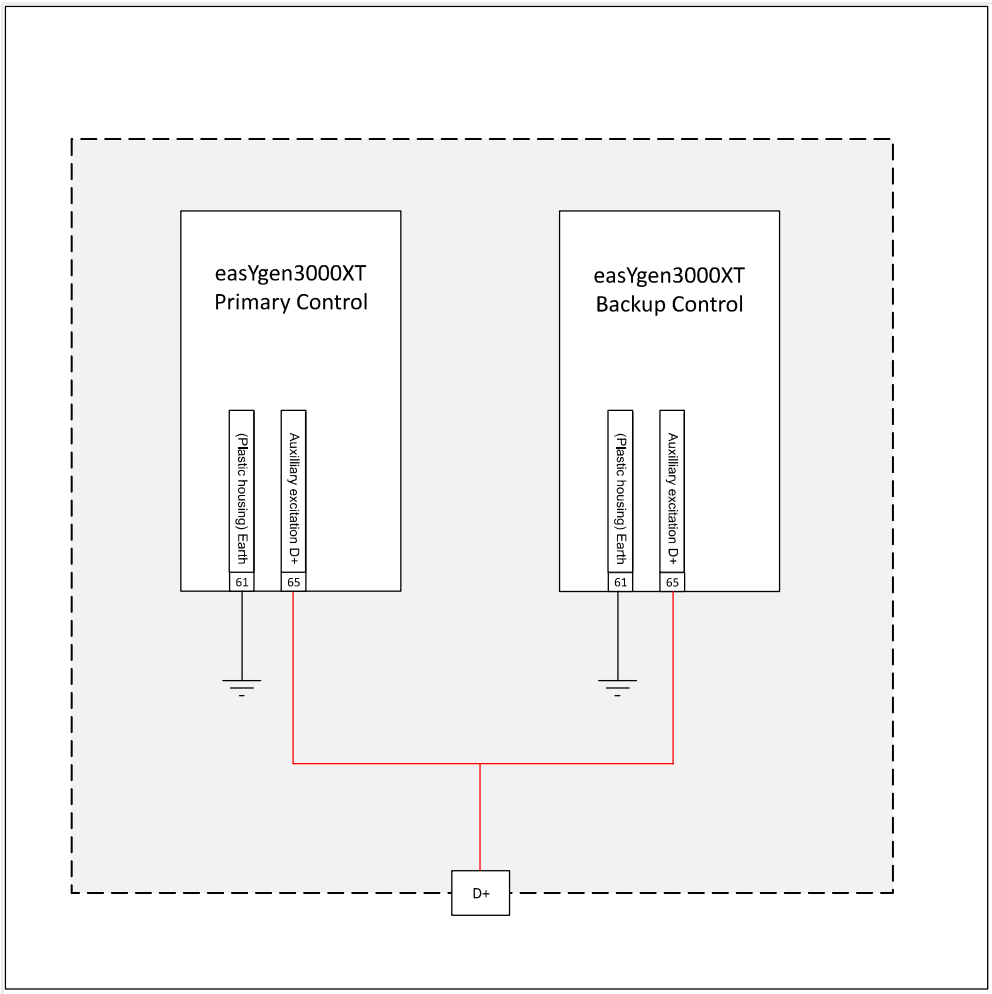


Fig. 350: Wiring Earth and D+

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!

6.6.6.5 Wiring CAN Interfaces

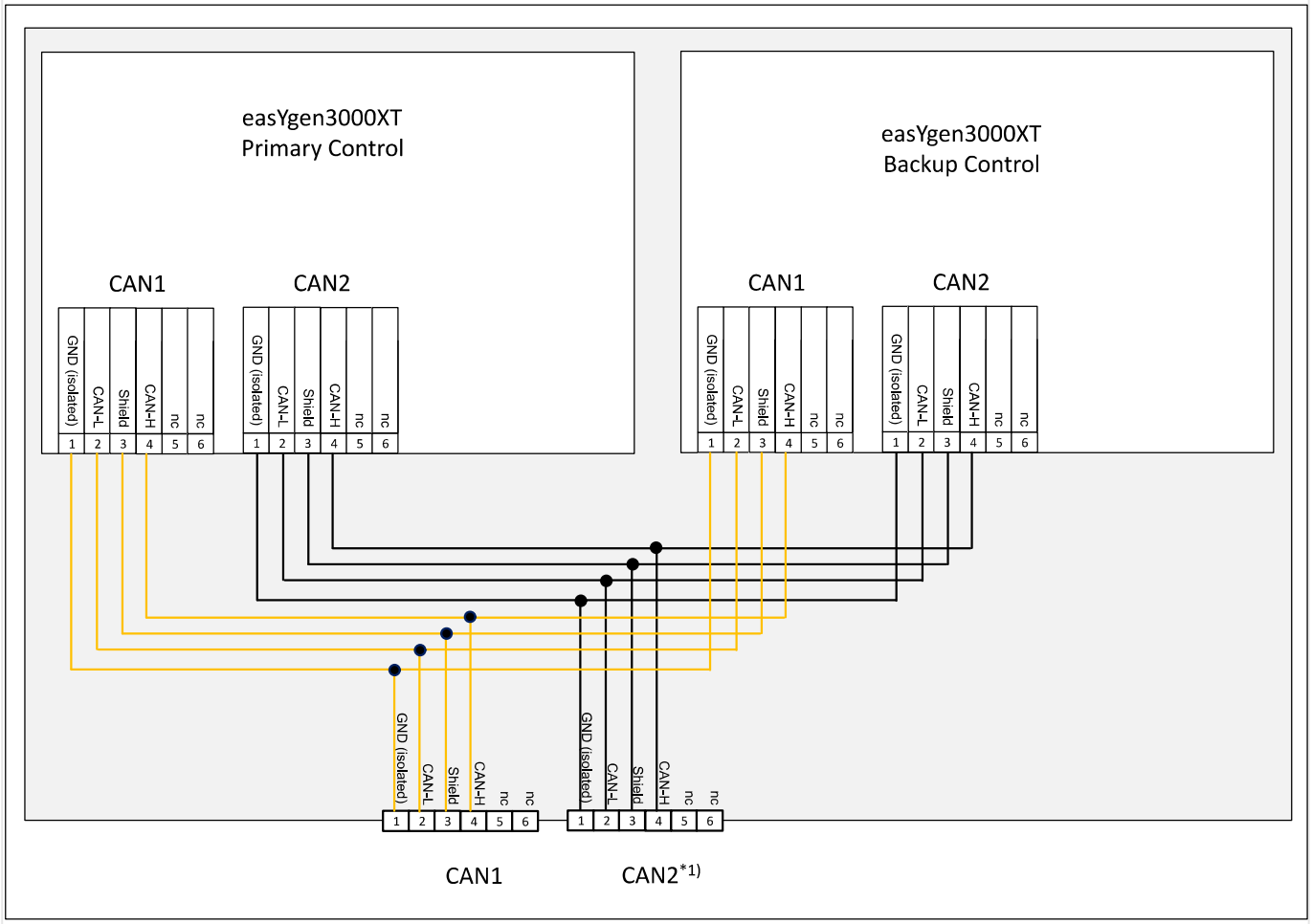


Fig. 351: Wiring CAN Interfaces

NOTICE!

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

6.6.6.6 Wiring Ethernet A

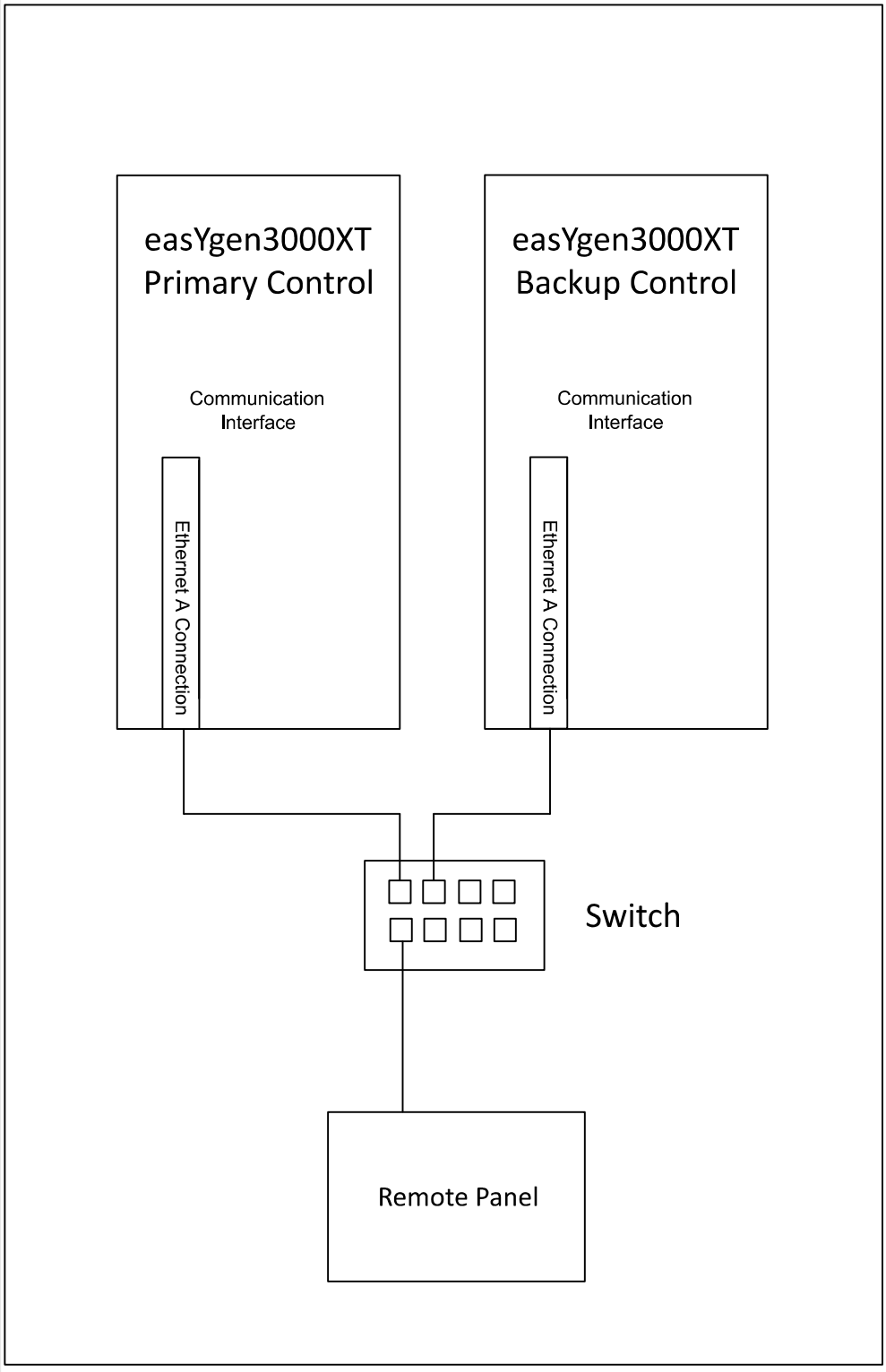


Fig. 352: Wiring Ethernet A

6.6.6.7 Wiring AC Voltage Measurement

AC-voltage-measurement is connecterd in parallel on both devices.

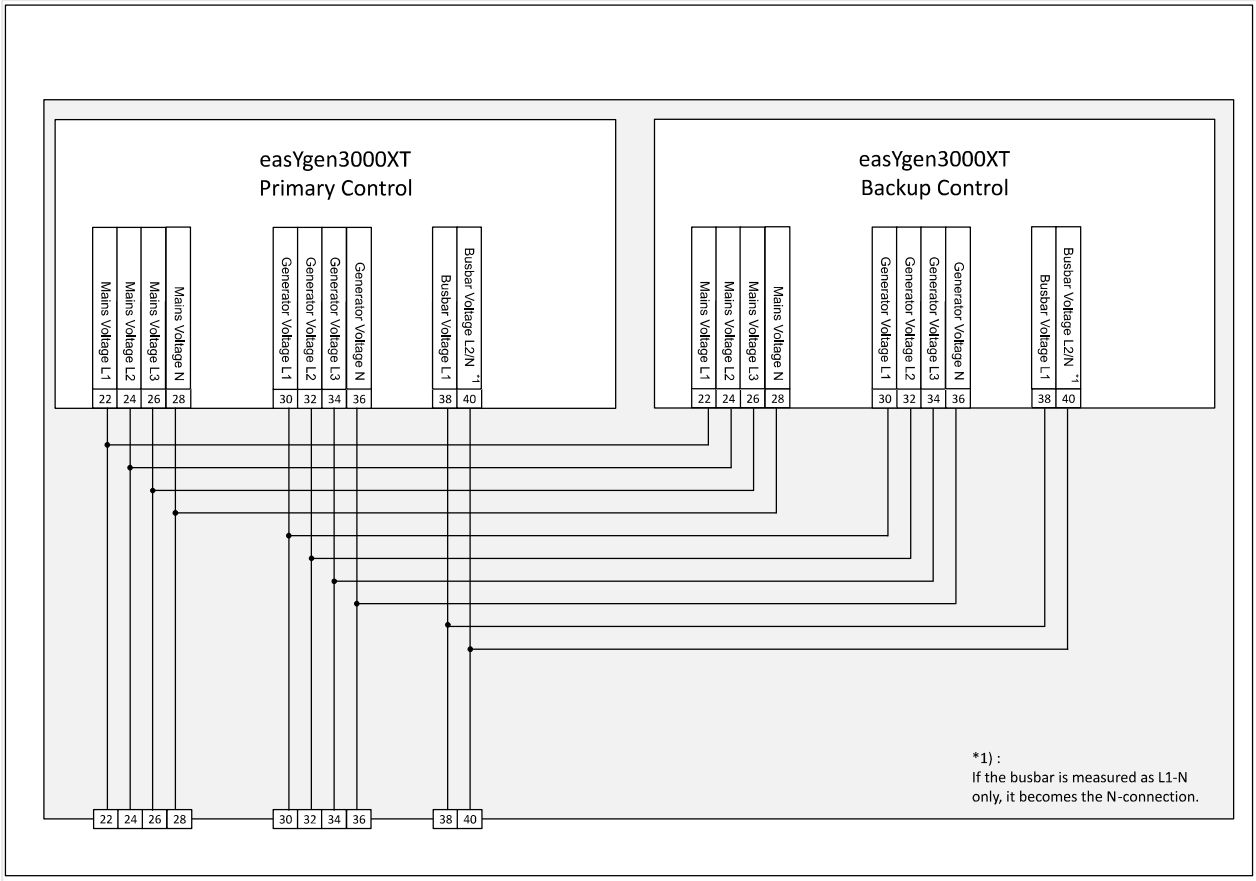


Fig. 353: Wiring AC Voltage Measurement

6.6.6.8 Wiring AC Current Measurement

AC-current-measurement (CT) is connected in series on both devices

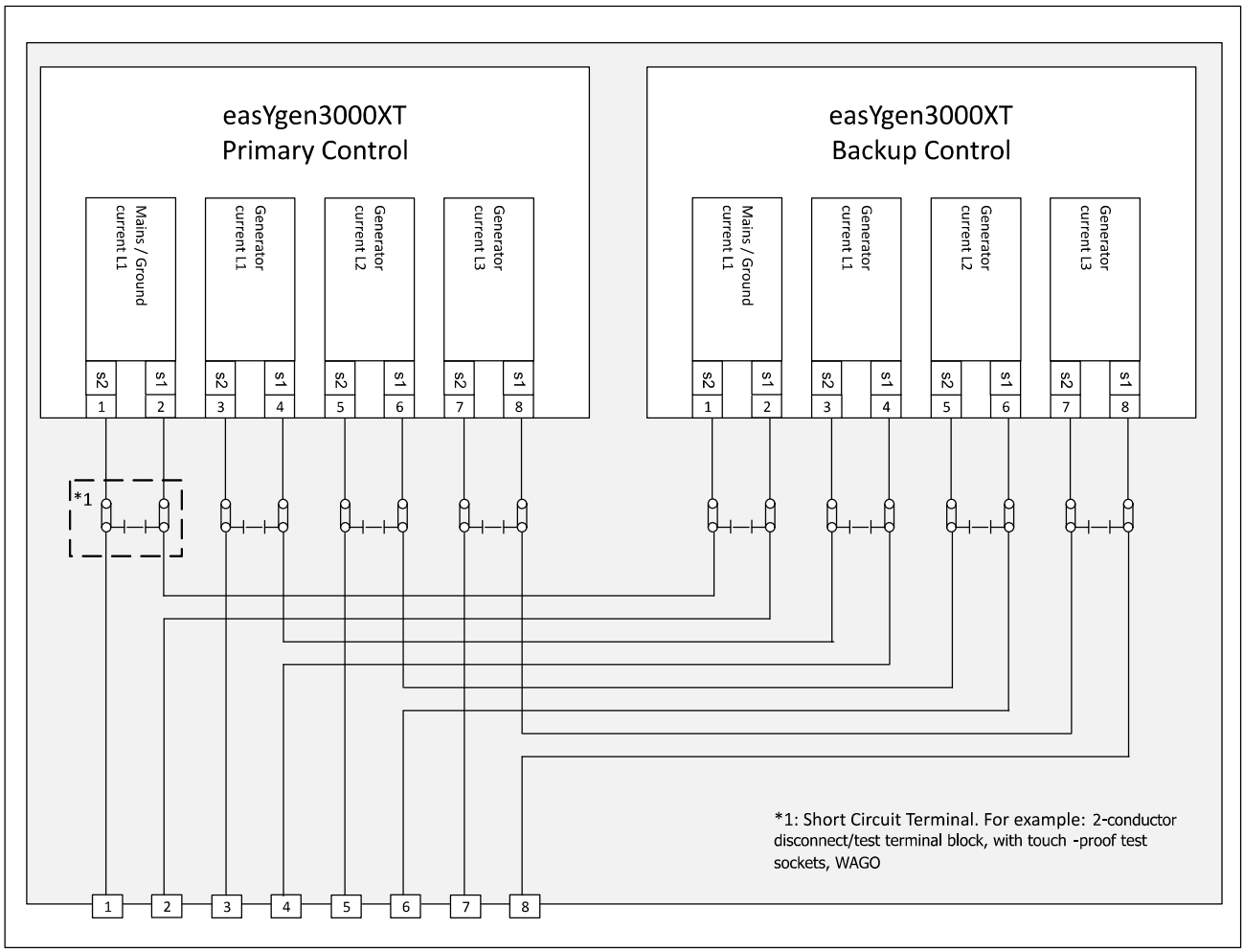


Fig. 354: Wiring AC Current Measurement

NOTICE!

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

6.6.6.9 Wiring Analog Inputs

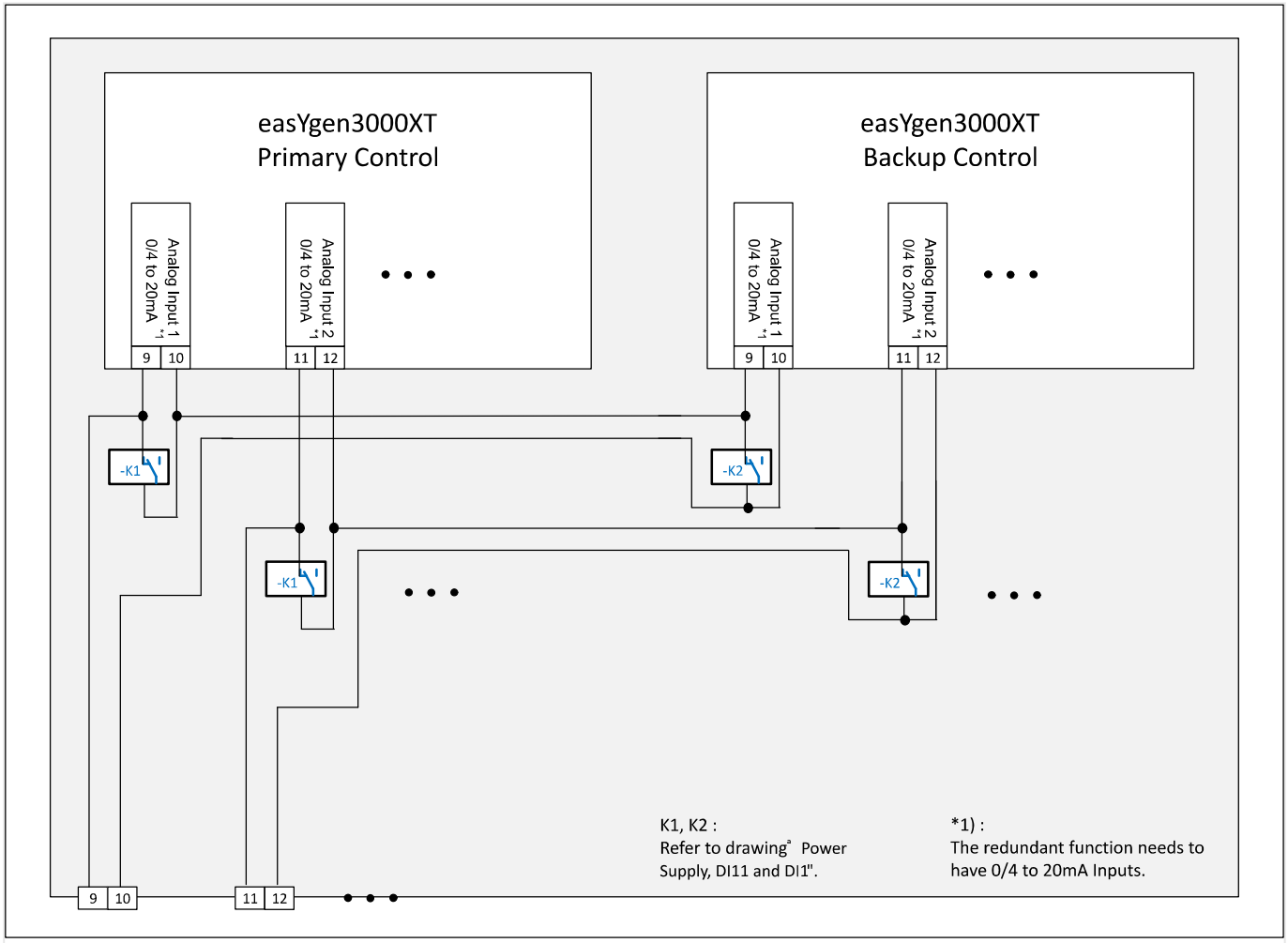


Fig. 355: Wiring Analog Inputs

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. (Refer to figure Fig. 347.)

The analog inputs can normally simply be connected in parallel.

It is not possible to connect resistance sensors to the analog inputs.

6.6.6.10 Wiring Analog Outputs

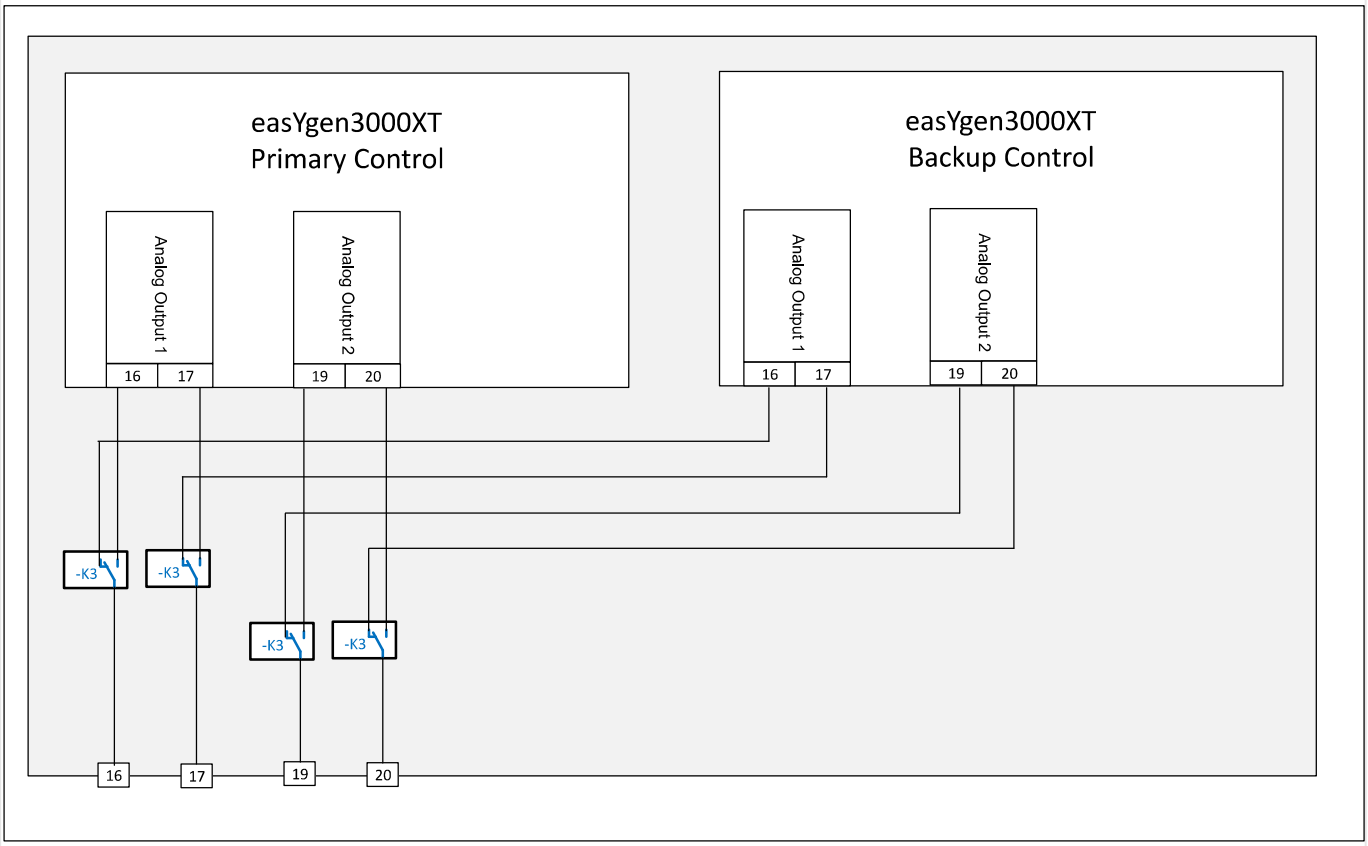


Fig. 356: Wiring Analog Outputs

To ensure that only the analog outputs of the active device are used, the outputs are switched via relay "-K3". (Refer to ⮡ Fig. 347.)

6.6.7 Restrictions

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

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 ⮡ “6.6.6.9 Wiring Analog Inputs”.)
1.2	The Analog outputs are switched over from the primary control to the 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 accordingly 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 ⮡ “6.6.6.1 Wiring Power Supply, DI 11 and DI 12”.)

Item	Function	Comment
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 have to be taken here, e.g. for the fuel relay and the neutral contactor.	To provide a proper hot swap or exchange of one control, the GCB open order must be an active order.

Table 133: 1.) Hardware related restriction

Item	Function	Comment
2.1	Digital input 12 can not 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" (refer to ⮡ 1946.)
2.2	Parameter "GCB close command" must be configured to "Impulse" mode (refer to ⮡ 3414).	Because of hot swap or exchange capability, the "Steady" mode is not usable.
2.3	The "Load dependent start/stop" function (⮡ 12930) 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!
2.4	The engine "Warm-up mode" (⮡ 5533) should be not "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.
2.5	The "Auto idle mode" (⮡ 12570 is not recommended.	Due to the exchange capability, the backup control would run again the idle procedure.

Table 134: 2.) Hardware related restriction