# VARAN INTERFACE for the DIAS Drive 3xx VAC 013


This VARAN interface module is used for communication between a DIAS drive and a control over the VARAN bus. It is integrated into the DIAS Drive.

It contains the safety functions SS1 (Safe Stop 1) (stop category 1 according to EN60204) for safely shutting down the amplifier and the "safe restart" STO (Safe Torque Off).

In addition, it contains the interface for digital inputs that can be used as a fast position-latch input.

Through the VARAN-Out port, the VARAN bus can be configured in a linear structure.

**Important information can be found in the DIAS-Drives Handbook!**

# Technical Data

## General

| | |
|---|---|
| Interface connections | 1 x VARAN-In (RJ45) (maximum length: 100 m)<br>1 x VARAN-Out (RJ45) (maximum length: 100 m)<br>1 x DIAS-Drive interface (26-pin blade terminal)<br>4 fast digital inputs<br>2 safety inputs for the SSI (SAFE Stop 1) and STO (SAFE Torque Off) safety functions. |

## Electrical requirements

| | | |
|---|---|---|
| Supply voltage | +5 V DC<br>(supplied by the DIAS-Drive) | |
| Current consumption of the voltage supply | Typically 400 mA | Maximum 500 mA |

## Input specifications

| Number of inputs | Digital inputs<br>(D-IN1 to D-IN4) | Safety inputs<br>(ENABLE_L and ENABLE_H) |
|---|---|---|
| Input voltage | Typically +24 V, maximal +30 V | Differential voltage between ENABLE_H (+) and ENABLE_L (-) typically 24 V, maximum 30 V |
| Signal level | Low: ≤+5 V, High: ≥+15 V | - |
| Switching threshold | Typically +9 V | Differential voltage between ENABLE_H (+) and ENABLE_L (-) typically 24 V, maximum 30 V<br>Low < +6 V, High > +14 V |
| Input current | 10 mA at +24 V | |
| Input delay | Typically 0,1 ms | Turn-on circa 20 ms,<br>Turn-off 0.5 s to 1 s |

## Relay specifications

| | |
|---|---|
| Number of relays | 1 x Relay output (contacts S3, S4) |
| Relay types | 1 x normally open |
| Power supply | +24 V DC |
| Switching time | <10 ms |
| Switching range | Max. 30 V DC/ min. 100 µA, max. 0.5 A |
| Switching power | Max. 42 V AC / min. 100 µA, max. 0.5 A |

**For USA and Canada:**

**The supply must be limited to:**
**a) max. 5 A at voltages from 0-20 V (0-28.3 Vp) or**
**b) 100 VA at voltages from 20-30 V (28.3-42.4 Vp)**

**The limiting component (e.g. transformer, power supply or fuse) must be certified by an NRTL (Nationally Recognized Testing Laboratory).**

## Safety conformity

| | | |
|---|---|---|
| Safety Integrity Level according to IEC EN 62061 | SIL 3 | |
| Performance Level according to EN ISO 13849-1 | PLe | |
| Probability of failure per hour | $PFH_D$ [$10^{-9}$] | 0,3 |
| Mean time to dangerous failure | $MTTF_D$ symmetrized [Years] | High |
| Proof Test Interval [Years] | 20 | |

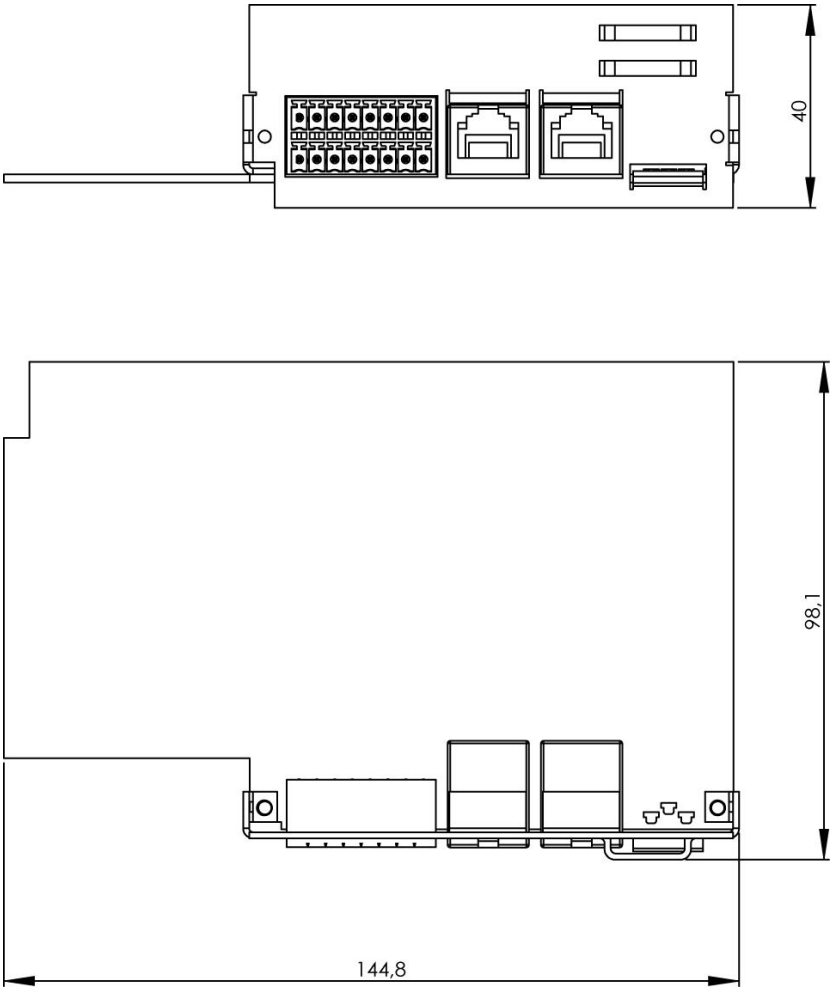
## Miscellaneous

| | |
|---|---|
| Article number | 16-059-013 |
| Hardware version | 2.x |
| Standardization | UL (336350) |

## Environmental conditions

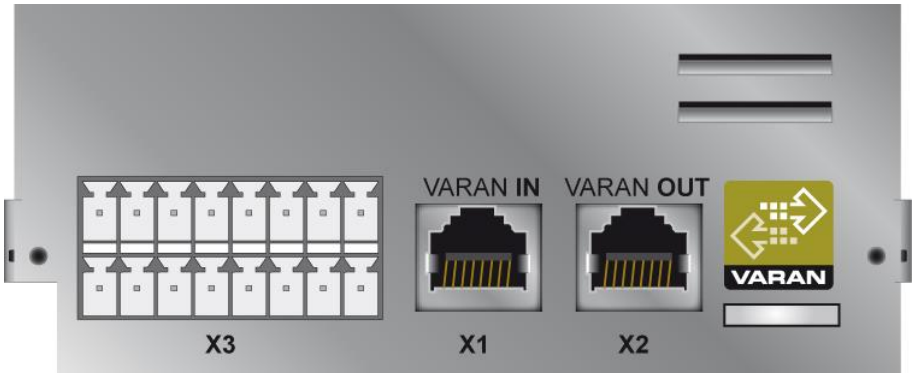
| | | |
|---|---|---|
| Storage temperature | -20 – +85 °C | |
| Environmental temperature | 0 – +60 °C | |
| Humidity | 0 - 95 %, uncondensed | |
| EMV stability | Tested in the DIAS Drive according to EN61800-3 | |
| Shock resistance | EN 60068-2-27 | 150 m/s² |
| Protection Type | EN 60529 | IP 20 |
| Pollution degree | 2 | |

## Mechanical Dimensions

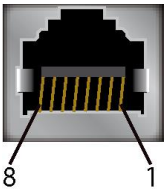



Integrated into the SDD3xx servo amplifier

## Connector Layout

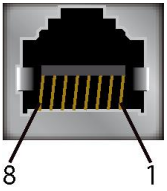



**X1: VARAN-In**




| Pin | Function |
|---|---|
| 1 | TX/RX+ |
| 2 | TX/RX- |
| 3 | RX/TX+ |
| 4 – 5 | - |
| 6 | RX/TX- |
| 7 – 8 | - |

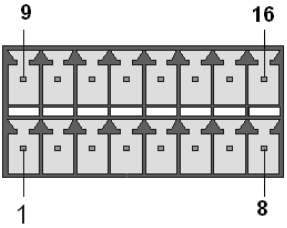
**X2: VARAN-Out**




| Pin | Function |
|---|---|
| 1 | TX/RX+ |
| 2 | TX/RX- |
| 3 | RX/TX+ |
| 4 - 5 | - |
| 6 | RX/TX- |
| 7 - 8 | - |

**Further information about the VARAN bus can be found in the VARAN bus specifications!**

**X3: IO**



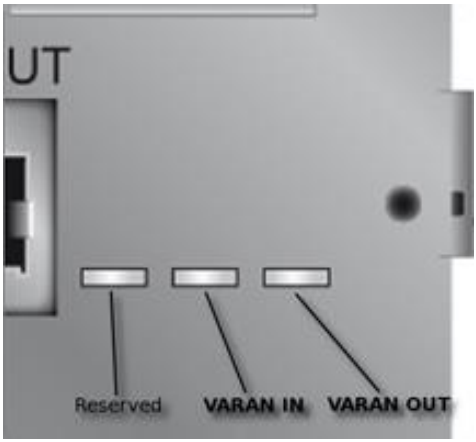

| Pin | Function |
|---|---|
| 1 | ENABLE_L |
| 2 | ENABLE_H |
| 3 | Reserved |
| 4 | Reserved |
| 5 | Not used |
| 6 | Not used |
| 7 | S3 |
| 8 | S4 |
| 9 | Reserved |
| 10 | Reserved |
| 11 | Reserved |
| 12 | Ext. GND |
| 13 | D-IN 1 |
| 14 | D-IN 2 |
| 15 | D-IN 3 |
| 16 | D-IN 4 |

**Applicable connectors**

**X3:** 2 x 8-pin Phoenix plug with spring terminal FMC1, 5/8-ST-3.5

**For the stress relief, it is important to ensure that the minimum bend radius (eight times the cable diameter) of the cable is not exceeded!**

## Status Displays




| LED | LED color | Definition | |
|---|---|---|---|
| VARAN IN | Green | LINK | Lights when the connection between the two PHYs is established |
| | Yellow | ACTIVE | Lights when data is received or sent over the VARAN bus. |
| VARAN OUT | Green | LINK | Lights when the connection between the two PHYs is established. |
| | Yellow | ACTIVE | Lights when data is received or sent over the VARAN bus. |

## Additional Safety Information

The safety module "Safe Restart Lock" in an integral component of the DIAS Drive 3xx and is already installed with delivery; it meets the conditions required for safe operation according to SIL 3 in compliance with IEC 62061 and according to PL e in compliance with EN 13849-1.

Safety modules can only be powered by supplies that meet the requirements for PELV in compliance with EN60294.

Installation, mounting, programming, initial start-up, operation, maintenance and discarding of safety modules can only be performed by qualified personnel.

**Qualified personnel** in this context are people, who have completed training or have trained under supervision of qualified personnel and have been authorized to operate and maintain safety-related equipment, systems and facilities in compliance with the strict guidelines and standards of safety technology.

**For your own safety and the safety of others, use safety modules for their designated purpose.**

**Designated use also applies to correct EMV installation.**

**Non-designated use in this context applies to**

- Any changes made to the Safety modules or the use of damaged modules
- The use of the Safety modules outside of technical framework described in these operating instructions
- The use of the Safety modules outside of the technical data described in these operating instructions (see the "Technical data" sections of the respective production).

**In addition, observe the warnings in the other sections of these instructions. These instructions are visibly emphasized with a symbol.**

- Only qualified personnel are authorized to install the "safe restart" STO (Safe Torque off) and set the parameters.
- All control devices (switches, relays, PLC, etc.) and the control closet must meet the requirements for EN 13849 This consists of:

  – Door switches, etc. with at least IP54 protection.
  – Control classes with at least IP54 protection.
- The proper cables and end-sleeves must be used
- All cables that affect safety (i.e. control cables for the ENABLE_L and ENABLE_H inputs) must be laid in a conduit outside of the control cabinet.
  Short or crossed circuits in the signal lines must be avoided! See EN ISO 13849
- The terminal connections X3/Pin 2, Pin 4, Pin 10 and Pin 12 are labeled as reserved and cannot be laid externally!
- When using the SS1 (Safe Stop 1) safety function, the typical turn-off delay is 0.5 seconds. Subsequent actions that require the STO (Safe Torque Off) function (i.e. manual access to the machine), can only be released after 1 second.
- If external forces influence axes that are used with the STO safety function (e.g. hanging load), additional measures must be taken (such as an electromagnetic double-surface spring brake, instead of a permanent magnet brake).

**Failure to follow the above safety measures can lead to severe injuries.**

The main power supply for the servo amplifier must be disconnected using the main switch for the following instances:

- Cleaning, maintenance or repairs
- Extended still-stand periods

**Failure to follow the above safety measures can lead to severe injuries.**

# Additional Information

## "Safe Restart" STO (Safe Torque Off)

The DIAS Drive, in combination with the optional VARAN interface, supports the safety functions SS1 (Safe Stop 1) and STO (Safe Torque Off), and meets the requirements for Category 4 Performance Level "e" according to EN ISO 13849-1 and SIL3 according to EN 62061.
For his purpose, the servo amplifier has two safe inputs ENABLE_L und ENABLE_H.

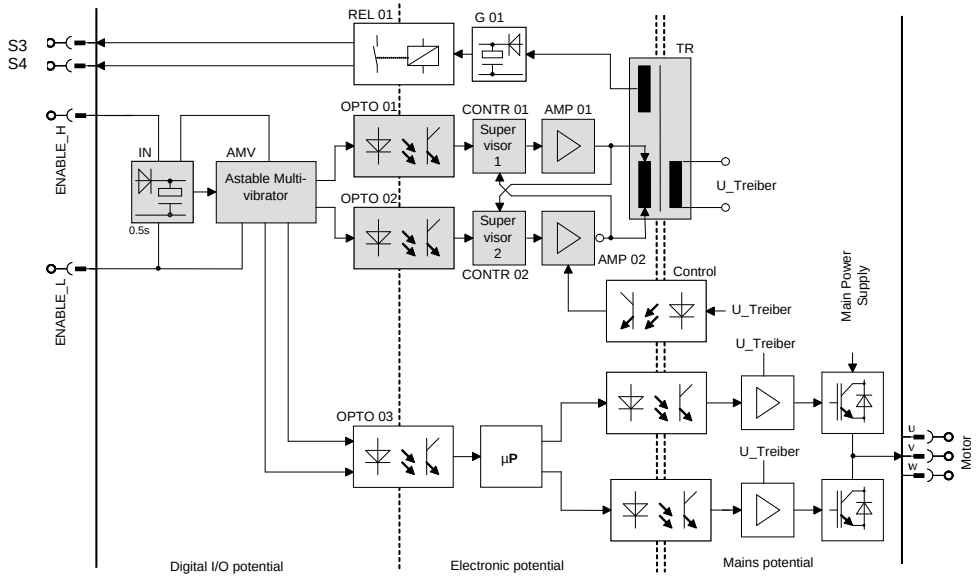
The relay output S1/S2 can be used to provide the status of the safety function. It is not safety-relevant, but can be used to test the external safety function.

The stop brake control is not a component of the safety function. If a safe shutdown of the stop brake is required, the +24 V-BR brake supply must also be shut down externally.

For the 24 V supply, only PELV/SELV can be used.

**Implementation**

The following block diagram gives an overview of the internal switching circuit.




Block diagram for safe restart lock

The blocks in the diagram above have the following functions:

**Block IN**

The input block IN generates the supply voltage for the AMV block. This is formed from the voltage difference between ENABLE_H and ENABLE_L. Power is therefore available shortly after the appropriated signal is applied to ENABLE_H and ENABLE_L. The voltage difference between ENABLE_H and ENABLE_L must exceed the minimum HIGH signal.

The LOW signal ranges from 0 V to +5 V.
The High signal ranges from +15 V to +30 V.

If the input voltage is disconnected, the block maintains the supply voltage for the AMV block for approximately 400 ms. Because the differential voltage is supplied to the OPTO03 block without a delay, the motor can be actively slowed before the amplifier goes into the safe status by disabling U_Treiber.

**Blocks AMV, OPTO 01 and OPTO 02**

As long as the AMV block is powered by the IN input block, it generates a pulse with a constant frequency that is transmitted to the sequential electronics through blocks OPTO 01 and OPTO 02.

**Blocks CONTR 01, CONTR 02, AMP 01, AMP 02 and TR**

These blocks form a safe switching power supply, which generates the driver voltage for U_Treiber through the transformer TR01. It is ensured that the switching supply cannot transmit any energy when no control signal is sent from the AMV block over OPTO 01 and OPTO 02.

**Blocks G01 and REL01**

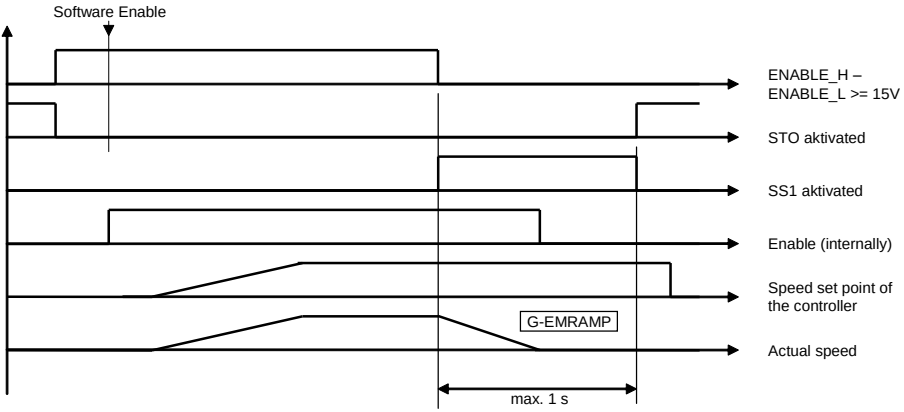
The relay output S1/S2 is closed when the servo amplifier is supplied with 24 V and the safety function is active. The two blocks are not safety-relevant.

**Function**

The safety functions in the DIAS Drive are controlled over two digital inputs.

The following table shows the status that the ENABLE_L and ENABLE_H inputs must assume to enable normal operation or trigger the safety function.

| Input Status | | Relay output S3/S4 | Description |
|---|---|---|---|
| **ENABLE_L** | **ENABLE_H** | | |
| Open | Open | When the servo amplifier is supplied with 24 V, the inputs are closed after a minimum delay 0.4 of seconds and a maximum of 1 seconds | **Safe status of the drive system** |
| Low | Low | When the servo amplifier is supplied with 24 V, the inputs are closed after a minimum delay 0.4 of seconds and a maximum of 1 seconds | • Single channel safe status only when using classic I/O technology<br>• **Safe status of the drive system,** when a safe output is used by a Safe PLC, also when ENABLE_L is connected with „Ext. GND“ |
| Low | Open | | |
| Low | High | Open | **Drive system ready** |




Timing Diagram

If the ENABLE_L and ENABLE_H are changed from any status to the "Drive Ready" status, the servo amplifier is not immediately enabled. In addition, in the software (**K-EN** = 1) or the corresponding bit in the "control word" must be set so that the software "enable" can be set and the drive therefore switched to the operational mode.

**Function Test**

The safety function test is required to ensure correct operation. The entire safety circuit must be tested for full functionality.
Tests must be performed at the following times:

- After installation
- In regular intervals, or at least once a year.

If the function test results in an invalid machine status, the error must be found and corrected before the safety function is retested. If the error reoccurs during the function test, the machine can no longer be operated.

Failure to follow the above safety measures can lead to severe injuries and damage.

**Test conditions**

The total safety circuit must be tested for functionability

The function test is performed from the following start condition:

- An operation-ready servo drive system
- Safe input ENABLE_L is LOW and ENABLE_H is HIGH
- Software application is running
- Motor(s) running

Depending on the wiring:

1. Both the ENABLE_L and ENABLE_H inputs are opened

**or** if ENABLE_L is connected to "Ext. GND" and the safe output of a Safety PLC is used for ENABLE_H.

2. ENABLE_H is open or LOW (depending on the wiring).

The motor speed is expected to slow to null and the relay output S1/S2 to close after a minimum delay of 0.4 s and a maximum of 1s when the servo drive is supplied with 24 V.

The servo drive system should go into safe mode.

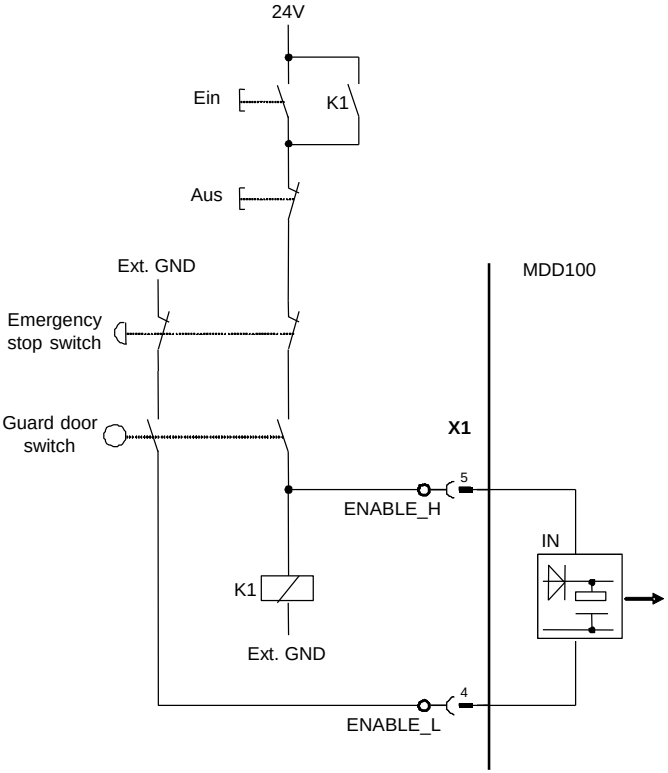
**Example Connection with Switching Contacts**

To meet the requirements of safety category 4, performance level "e" for EN 13849-1 and SIL3 according to EN 62061, a two-channel control must be provided for the safety functions.

The wiring for both connections must be provided with protective insulation (to avoid the "external voltage supply" error).

For ENABLE_H this means, the other signals that can have a 24 V potential must be wired separately.

For ENABLE_L this means, the other signals that can have "Ext. GND" potential must be wired separately. Because the 24 V auxiliary voltage in the control cabinet is normally grounded, caution must be taken to avoid a short-circuit with PE. The can occur through, for example, wiring in a cable duct.




The schematic shows the possible wiring for use of conventional switch contacts.

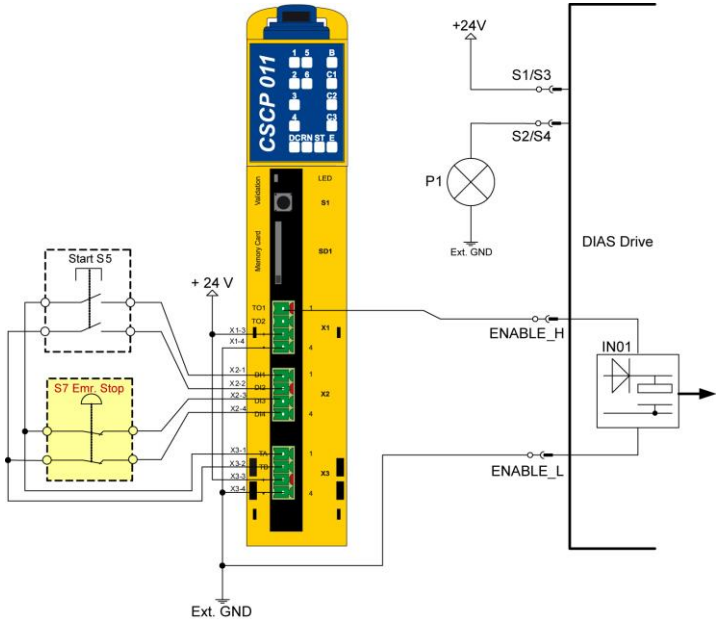
**Example: Safety PLC Application**

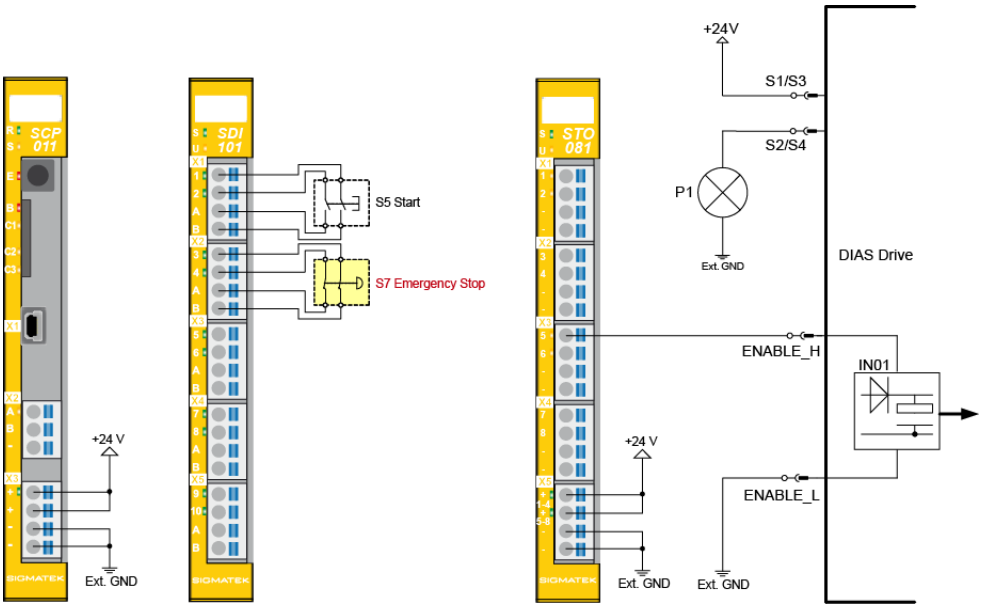
To meet the requirements of safety category 4, performance level "e" for EN 13849-1 and SIL 3 according to EN 62061, an error-proof output of a safety PLC must be used.

There are two Types of error-safe outputs.

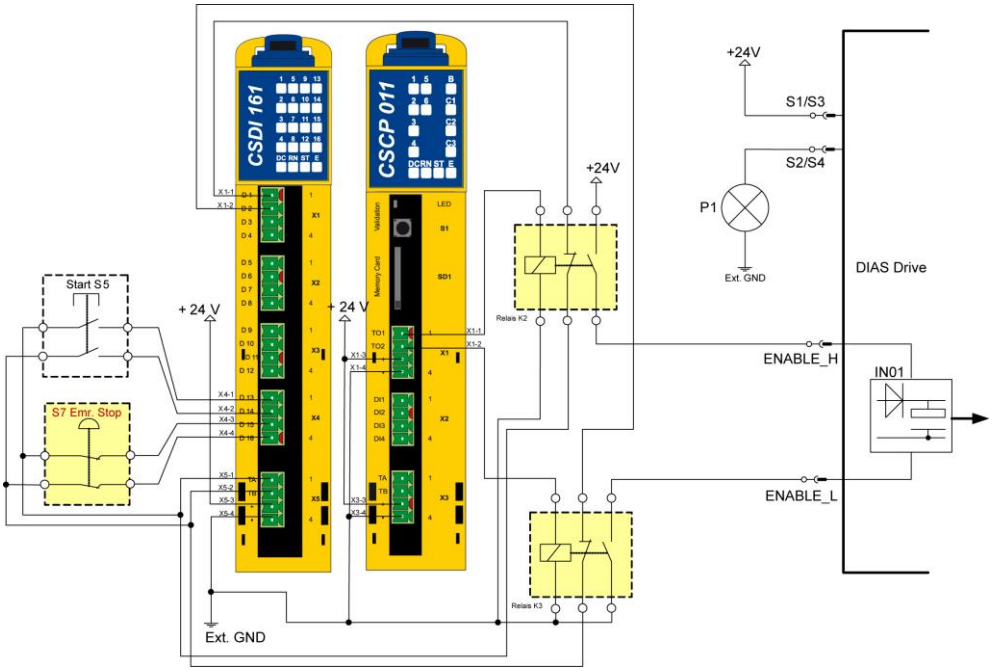
1. A simple error-safe output, which functions based on "Ext. GND" only. This is then connected to the ENABLE_H input.
   The wiring for both connections must be provided with protective insulation (to avoid the "external voltage supply" error).

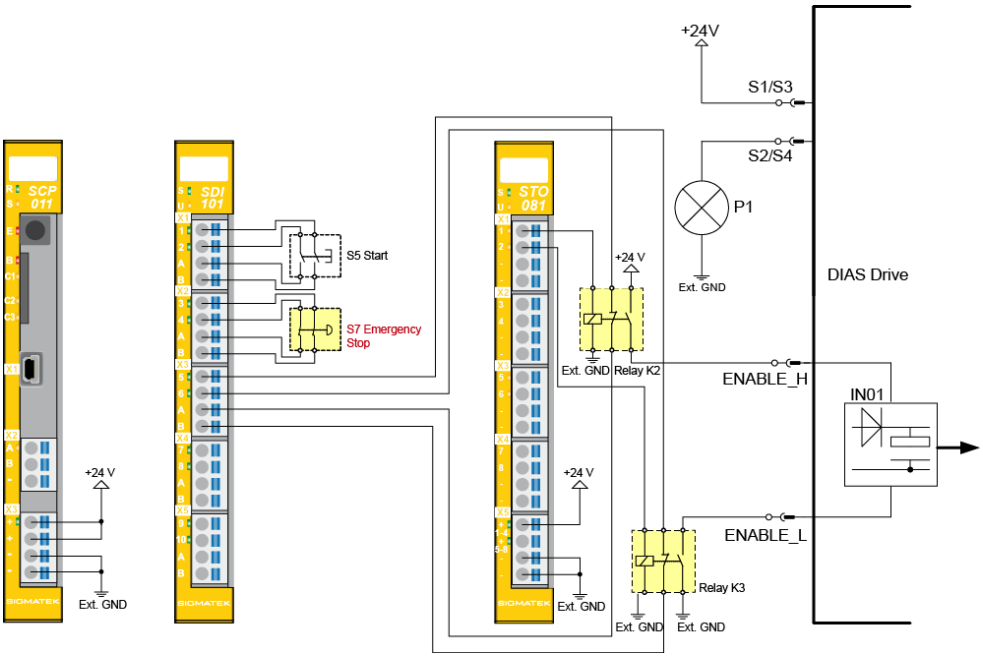
   In this case, ENABLE_L is connected to "Ext. GND"




SCP 011
SDI 101
STO 081
S5 Start
S7 Emergency Stop
+24 V
Ext. GND
+24V
S1/S3
S2/S4
P1
Ext. GND
DIAS Drive
ENABLE_H
IN01
ENABLE_L
+24 V
Ext. GND
Ext. GND

2. Two-channel error-proof relay output, with which the + output is connected to ENABLE_H and the – output to ENABLE_L.




+24V
S1/S3
S2/S4
P1
Ext. GND
DIAS Drive
SCP 011
SDI 101
STO 081
S5 Start
S7 Emergency Stop
+24 V
Ext. GND
Relay K2
ENABLE_H
IN01
ENABLE_L
Relay K3
Ext. GND
Ext. GND
Ext. GND
+24 V
+24 V
Ext. GND
Ext. GND

# Addressing

| *Address (hex)* | *Size (bytes)* | *Access* | *Description* | *Reset value* |
|---|---|---|---|---|
| **Axis 1** | | | | |
| 0000 | 1 | r/w | Transmit Execution Register<br>Bit 0: 1 = Start Object Transfer<br>Bit 1: 1 = Repeat Object Transfer<br>Bit 2: 1 = Enable Value 3-5<br>Bit 3…7: Reserved | 00 |
| 0001 | 1 | r/w | Reserved | 00 |
| 0002 | 1 | r/w | Drive Control Byte | 00 |
| 0003 | 1 | r/w | Object Address | 00 |
| 0004 | 4 | r/w | Object Value | 00000000 |
| 0008 | 4 | r/w | Value 1 | 00000000 |
| 000C | 4 | r/w | Value 2 | 00000000 |
| 0010 | 4 | r/w | Value 3 | 00000000 |
| 0014 | 4 | r/w | Value 4 | 00000000 |
| 0018 | 4 | r/w | Value 5 | 00000000 |
| 001C | 4 | r/w | Reserved | 00000000 |
| 0020 | 1 | r/w | Receive Status Register<br>Bit 0: 1 = Executed Object Transfer<br>Bit 1: 1 = CRC Error<br>Bit 2…7: Reserved | 00 |
| 0021 | 1 | r/w | Reserved | 00 |
| 0022 | 1 | r/w | Digital In/Out Byte | 00 |
| 0023 | 1 | r/w | Transmit Control Byte | 00 |
| 0024 | 4 | r/w | Object Value | 00000000 |
| 0028 | 4 | r | Value 6 | 00000000 |
| 002C | 4 | r | Value 7 | 00000000 |
| 0030 | 4 | r | Value 8 | 00000000 |
| 0034 | 4 | r | Value 9 | 00000000 |
| 0038 | 4 | r | Value 10 | 00000000 |
| 003C | 4 | r/w | Reserved | - |

| | | | | |
|---|---|---|---|---|
| **Axis 2** | | | | |
| 0040 | 1 | r/w | Transmit Execution Register<br>Bit 0: 1 = Start Object Transfer<br>Bit 1: 1 = Repeat Object Transfer<br>Bit 2: 1 = Enable Value 3-5<br>Bit 3…7: Reserved | 00 |
| 0041 | 1 | r/w | Reserved | 00 |
| 0042 | 1 | r/w | Drive Control Byte | 00 |
| 0043 | 1 | r/w | Object Address | 00 |
| 0044 | 4 | r/w | Object Value | 00000000 |
| 0048 | 4 | r/w | Value 1 | 00000000 |
| 004C | 4 | r/w | Value 2 | 00000000 |
| 0050 | 4 | r/w | Value 3 | 00000000 |
| 0054 | 4 | r/w | Value 4 | 00000000 |
| 0058 | 4 | r/w | Value 5 | 00000000 |
| 005C | 4 | r/w | Reserved | 00000000 |
| 0060 | 1 | r/w | Receive Status Register<br>Bit 0: 1 = Executed Object Transfer<br>Bit 1: 1 = CRC Error<br>Bit 2…7: Reserved | 00 |
| 0061 | 1 | r/w | Reserved | 00 |
| 0062 | 1 | r/w | Digital In/Out Byte | 00 |
| 0063 | 1 | r/w | Transmit Control Byte | 00 |
| 0064 | 4 | r/w | Object Value | 00000000 |
| 0068 | 4 | r/w | Value 6 | 00000000 |
| 006C | 4 | r/w | Value 7 | 00000000 |
| 0070 | 4 | r/w | Value 8 | 00000000 |
| 0074 | 4 | r/w | Value 9 | 00000000 |
| 0078 | 4 | r/w | Value 10 | 00000000 |
| 007C | 4 | r/w | Reserved | - |
| **Axis 3** | | | | |
| 0080 | 1 | r/w | Transmit Execution Register<br>Bit 0: 1 = Start Object Transfer<br>Bit 1: 1 = Repeat Object Transfer<br>Bit 2: 1 = Enable Value 3-5<br>Bit 3…7: Reserved | 00 |
| 0081 | 1 | r/w | Reserved | 00 |
| 0082 | 1 | r/w | Drive Control Byte | 00 |

| | | | | |
|---|---|---|---|---|
| 0083 | 1 | r/w | Object Address | 00 |
| 0084 | 4 | r/w | Object Value | 00000000 |
| 0088 | 4 | r/w | Value 1 | 00000000 |
| 008C | 4 | r/w | Value 2 | 00000000 |
| 0090 | 4 | r/w | Value 3 | 00000000 |
| 0094 | 4 | r/w | Value 4 | 00000000 |
| 0098 | 4 | r/w | Value 5 | 00000000 |
| 009C | 4 | r/w | Reserved | 00000000 |
| 00A0 | 1 | r/w | Receive Status Register<br>Bit 0: 1 = Executed Object Transfer<br>Bit 1: 1 = CRC Error<br>Bit 2…7: Reserved | 00 |
| 00A1 | 1 | r/w | Reserved | 00 |
| 00A2 | 1 | r/w | Digital In/Out Byte | 00 |
| 00A3 | 1 | r/w | Transmit Control Byte | 00 |
| 00A4 | 4 | r/w | Object Value | 00000000 |
| 00A8 | 4 | r/w | Value 6 | 00000000 |
| 00AC | 4 | r/w | Value 7 | 00000000 |
| 00B0 | 4 | r/w | Value 8 | 00000000 |
| 00B4 | 4 | r/w | Value 9 | 00000000 |
| 00B8 | 4 | r/w | Value 10 | 00000000 |
| 00BC | 4 | r/w | Reserved | - |
| **Axis 3 – Telegram Type 2 (Fast Axis)** | | | | |
| 00C0 | 1 | w* | Transmit Execution Register<br>Bit 4 : 1 = Enable Telegram Typ 2<br>Bit 5 : 1 = Direct Access | 00 |
| 00C1 | 1 | w* | reserved | 00 |
| 00C2 | 1 | w* | Drive Control Byte | 00 |
| 00C3 | 1 | w* | reserved | 00 |
| 00C4 | 4 | w* | Value 3 | 00000000 |
| 00C8 | 4 | w* | Value 4 | 00000000 |
| 00CC | 4 | w* | Value 5 | 00000000 |
| 00D0 | 16 | - | reserved | - |
| 00E0 | 1 | r/w | reserved | 00 |

| | | | | |
|---|---|---|---|---|
| 00E1 | 1 | r/w | reserved | 00 |
| 00E2 | 1 | r/w | Digital In/Out Byte | 00 |
| 00E3 | 1 | r/w | Transmit Control Byte | 00 |
| 00E4 | 4 | r/w | Value 8 | 00000000 |
| 00E8 | 4 | r/w | Value 9 | 00000000 |
| 00EC | 4 | r/w | Value 10 | 00000000 |
| 00F0 | 16 | r/w | reserved | - |

**For additional addressing, see the VARAN bus specifications**

**More addressing applications can be found in the DIAS drive parameter documentation.**

## Recommended Shielding for VARAN

The real-time VARAN Ethernet bus system exhibits very robust characteristics in industrial environments. Through the use of IEEE 802.3 standard Ethernet physics, the potentials between an Ethernet line and sending/receiving components are separated. Messages to a bus participant are immediately repeated by the VARAN Manager in the event of an error. The shielding described below is principally recommended.

For applications in which the bus is run outside the control cabinet, the correct shielding is required. Especially when for structural reasons, the bus line must be placed next to strong electromagnetic interference.

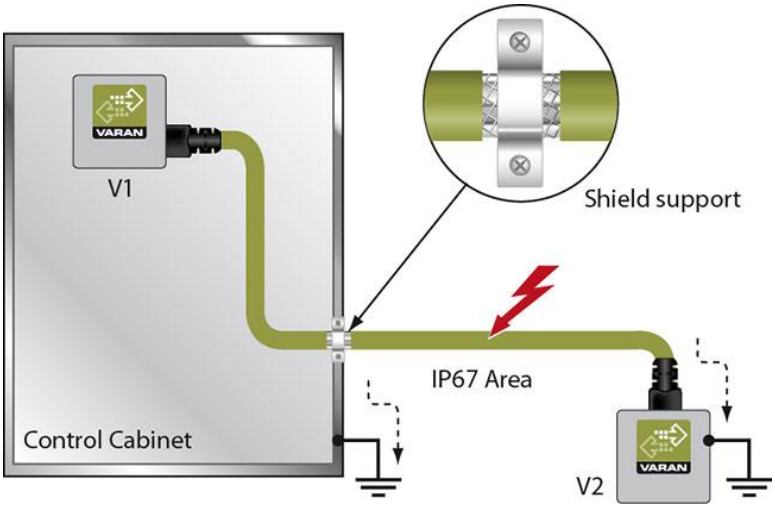
SIGMATEK recommends the use of CAT5e industrial Ethernet bus cables.

For the shielding, an S-FTP cable should be used.
An S-FTP bus is a symmetric, multi-wire cable with unshielded pairs. For the total shielding, a combination of foil and braiding is used. A non-laminated variant is recommended.

**The VARAN cable must be secured at a distance of 20 cm from the connector for protection against vibration!**

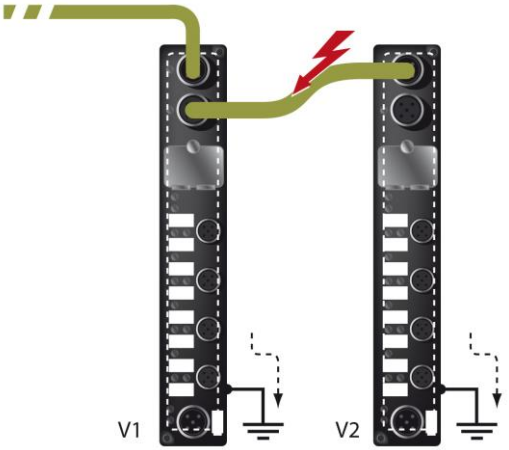
## 1. Wiring from the Control Cabinet to an External VARAN Component

If the Ethernet lines are connected from a VARAN component to a VARAN node located outside the control cabinet, the shielding should be placed at the entry point to the control cabinet housing. All noise can then be dissipated before reaching the electronic components.



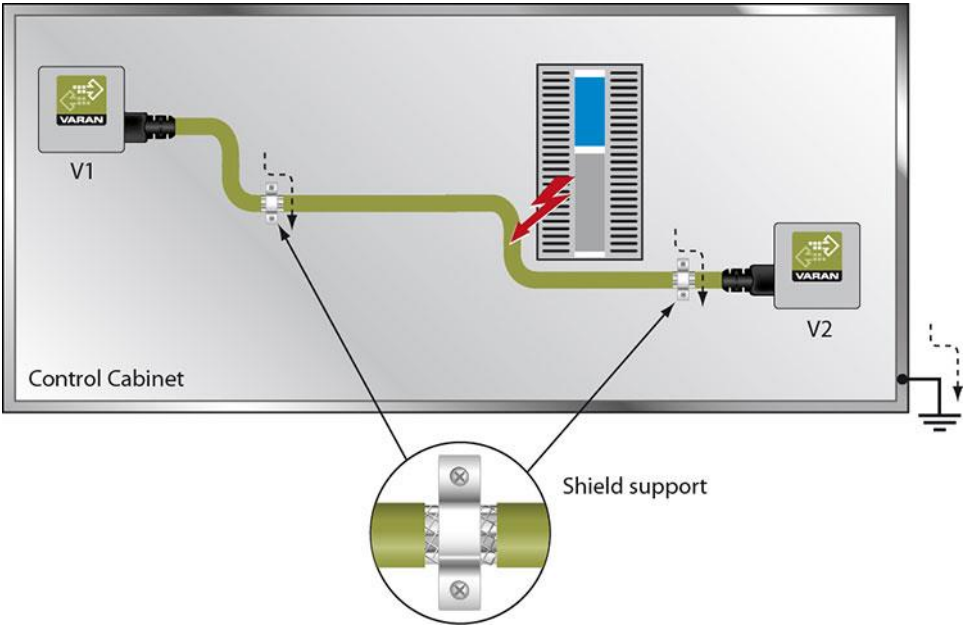
## 2. Wiring Outside of the Control Cabinet

If a VARAN bus cable must be placed outside of the control cabinet only, no additional shield connection is required. This requires that only IP67 modules and connectors be used. These components are very robust and noise resistant. The shielding for all sockets in IP67 modules are internally connected to common bus or electrically connected to the housing, whereby the deflection of voltage spikes does not flow through the electronics.



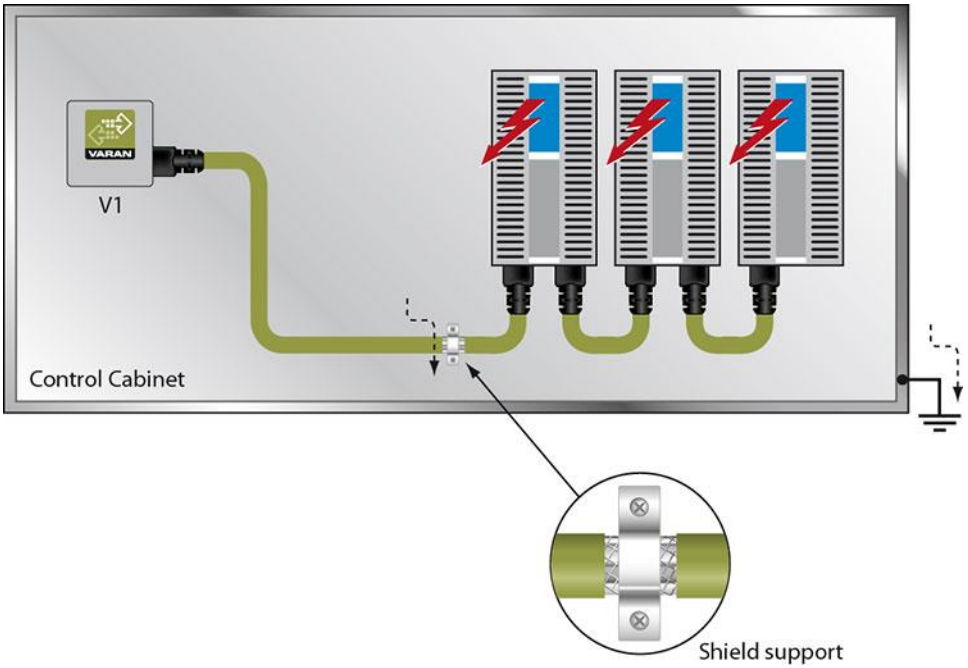
## 3. Shielding for Wiring Within the Control Cabinet

Sources of strong electromagnetic noise located within the control cabinet (drives, Transformers, etc.) can induce interference in a VARAN bus line. Voltage spikes are dissipated over the metallic housing of a RJ45 connector. Noise is conducted over the control cabinet without additional measures needed on the circuit board of electronic components. To avoid error sources with data exchange, it is recommended that shielding be placed before any electronic components in the control cabinet.



## 4. Connecting Noise-Generating Components

When connecting power lines to the bus that generate strong electromagnetic noise, the correct shielding is also important. The shielding should be placed before a power element (or group of power elements).



## 5. Shielding Between Two Control Cabinets

If two control cabinets must be connected over a VARAN bus, it is recommended that the shielding be located at the entry points of each cabinet. Noise is therefore prevented from reaching the electronic components in both cabinets.