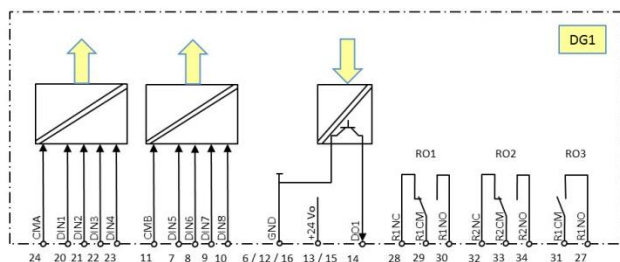


## PowerXL™

### DG1 Variable Frequency Drives Configuration of the digital I/Os



Level 3

- 1 – Fundamental – No previous experience necessary
- 2 – Basic – Basic knowledge recommended
- 3 – Advanced – Reasonable knowledge required
- 4 – Expert – Good experience recommended

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Powering Business Worldwide

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## Danger! - Dangerous electrical voltage!

- Disconnect the power supply of the device.
- Ensure that devices cannot be accidentally restarted.
- Verify isolation from the supply.
- Cover or enclose any adjacent live components.
- Follow the engineering instructions (AWA/IL) for the device concerned.
- Only suitably qualified personnel in accordance with EN 50110-1/-2 (VDE 0105 Part 100) may work on this device/system.
- Before installation and before touching the device ensure that you are free of electrostatic charge.
- The functional earth (FE, PES) must be connected to the protective earth (PE) or the potential equalization. The system installer is responsible for implementing this connection.
- Connecting cables and signal lines should be installed so that inductive or capacitive interference does not impair the automatic control functions.
- Suitable safety hardware and software measures should be implemented for the I/O interface so that an open circuit on the signal side does not result in undefined states.
- Deviations of the mains voltage from the rated value must not exceed the tolerance limits given in the specification, otherwise this may cause malfunction and/or dangerous operation.
- Emergency stop devices complying with IEC/EN 60204-1 must be effective in all operating modes. Unlatching of the emergency-stop devices must not cause a restart.
- Devices that are designed for mounting in housings or control cabinets must only be operated and controlled after they have been properly installed and with the housing closed.
- Wherever faults may cause injury or material damage, external measures must be implemented to ensure a safe operating state in the event of a fault or malfunction (e.g. by means of separate limit switches, mechanical interlocks etc.).
- Frequency inverters may have hot surfaces during and immediately after operation.
- Removal of the required covers, improper installation or incorrect operation of motor or frequency inverter may destroy the device and may lead to serious injury or damage.
- The applicable national safety regulations and accident prevention recommendations must be applied to all work carried on live frequency inverters.
- The electrical installation must be carried out in accordance with the relevant electrical regulations (e. g. with regard to cable cross sections, fuses, PE).
- Transport, installation, commissioning and maintenance work must be carried out only by qualified personnel (IEC 60364, HD 384 and national occupational safety regulations).
- Installations containing frequency inverters must be provided with additional monitoring and protective devices in accordance with the applicable safety regulations. Modifications to the frequency inverters using the operating software are permitted.
- All covers and doors must be kept closed during operation.
- To reduce the hazards for people or equipment, the user must include in the machine design measures that restrict the consequences of a malfunction or failure of the frequency inverter (increased motor speed or sudden standstill of motor). These measures include: – Other independent devices for monitoring safety related variables (speed, travel, end positions etc.).
- Electrical or non-electrical system-wide measures (electrical or mechanical interlocks).

Never touch live parts or cable connections of the frequency inverter after it has been disconnected from the power supply. Due to the charge in the capacitors, these parts may still be alive after disconnection. Consider appropriate warning signs.

## Disclaimer

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## 1 General

When operating devices of the series PowerXL™ DG1 in terminal mode, the control commands are applied via digital inputs. In addition the devices feed status signals back to the control system via digital outputs and relay contacts. The number of in- and outputs on the basic unit can be extended by using expansion modules, if required.

Inside this document following abbreviations are used:

- DI / DIN = digital inputs
- TI = input for thermistor connection
- DO = digital output
- RO = relay output
- VO = virtual output. This is an internal marker, which can be used like a digital output without having the need of a terminal. The marker can be assigned as a source for internal control signals.

The basic unit DG1 can be equipped with up to two expansion modules. The following inputs and outputs are available:

- Basic unit DG1
  - 8 digital inputs 24 V DC in 2 groups (4 inputs and one signal common for each group)
  - input to connect a thermistor (requires 2 digital inputs DI)
  - 1 static output 24 V DC (Open Collector)
  - 3 relay outputs (2 changeover contacts + 1 normally open)
  - 2 virtual relays
- Expansion module DXG-EXT-3RO
  - 3 relays (1 changeover contact + 2 normally open)
- Expansion module DXG-EXT-3DI3DO1T
  - 3 digital inputs 24 V DC with one signal common
  - input to connect a thermistor (requires 2 digital inputs DI)
  - 3 static outputs 24 V DC (Open Collector) with one signal common
- Expansion module DXG-EXT-6DI
  - 6 digital inputs 79 - 240 V in 2 groups (3 inputs and one signal common for each group)

The assignment of I/Os to functions can be configured by parameters.

This Application Note describes

- the terminals for the digital signals
- the expansion possibilities
- the technical data
- the assignment of terminals and functions

## 2 Hardware

The terminal blocks for the control signals are pluggable. The single blocks are mechanically coded to prevent mix-up. It is recommended to use shielded wires with a grounding of the shield at one end.

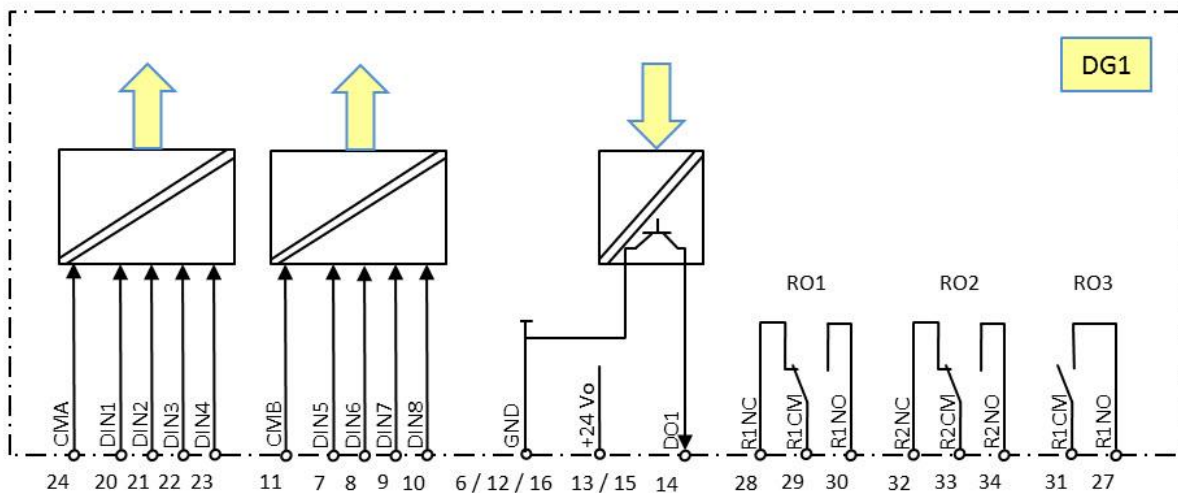
The user can adopt the assignment of terminals and functions to his application (see also chapter 3ff (inputs) and 4ff (outputs)).

The digital inputs can be used with positive logic as well as with negative logic. The digital outputs are of the type “open collector” and pull the potential to ground when activated. In the examples below positive logic is used.

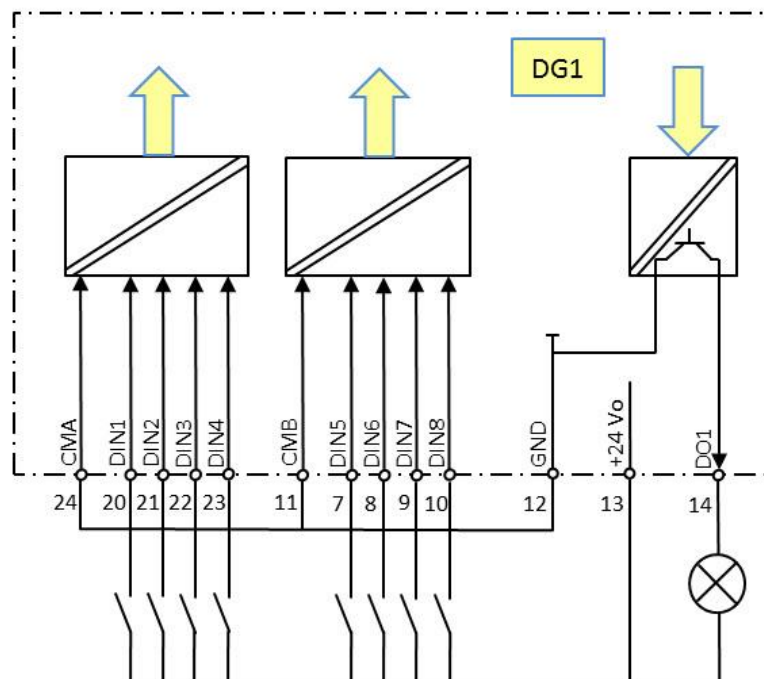
### 2.1 Basic unit DG1

	Designation	Function		Default
Basic unit DG1	13 / 15 (24V)	+24 V DC Control voltage	+24 V $\pm$ 15 %, max. 250 mA incl. expansion modules	.
	6 / 12 / 16 (GND)	Ground	Signal common for the internal reference voltage (+ 10 V, terminal 1), the control voltage (+24 V, terminals 13 and 15), the digital output DO1 (terminal 14) and the analog outputs AO1 (terminal 17) and AO2 (terminal 18)	-
	20 (DIN1)	Digital input 1	Digital input 18 ... 30 V DC 5 mA @ 24 V	IO Terminal 1 Start Signal 1 + IO Terminal 2 Start Signal 1
	21 (DIN2)	Digital input 2		IO Terminal 1 Start Signal 2 + IO Terminal 2 Start Signal 2
	22 (DIN3)	Digital input 3		Ext. Fault 1 NO
	23 (DIN4)	Digital input 4		Fault Reset
	24 (CMA)	Signal common A	Signal common for the digital inputs 1 to 4	
	7 (DIN5)	Digital input 5	Digital input 18 ... 30 V DC 5 mA @ 24 V	Preset Speed B0
	8 (DIN6)	Digital input 6		Preset Speed B1
	9 (DIN7)	Digital input 7		Not assigned
	10 (DIN8)	Digital input 8		Remote Control
	11 (CMB)	Signal common B	Signal common for the digital inputs 5 to 8	
	14 (DO1)	Digital output 1	Digital Output Open collector 50 mA max / 48 V max	Ready

28 (R1NC)	Relay 1 24V DC/6A; 48V DC/2A; 240V DC/6A; 125V DC/0,4A	Normally closed (NC)	RUN
29 (R1CM)		Common	
30 (R1NO)		Normally open (NO)	
32 (R2NC)	Relay 2 24V DC/6A; 48V DC/2A; 240V DC/6A; 125V DC/0,4A	Normally closed (NC)	Fault
33 (R2CM)		Common	
34 (R2NO)		Normally open (NO)	
27 (R3NO)	Relay 3 24V DC/6A; 48V DC/2A; 240V DC/6A; 125V DC/0,4A	Normally open (NO)	At speed
31 (R3CM)		Common	

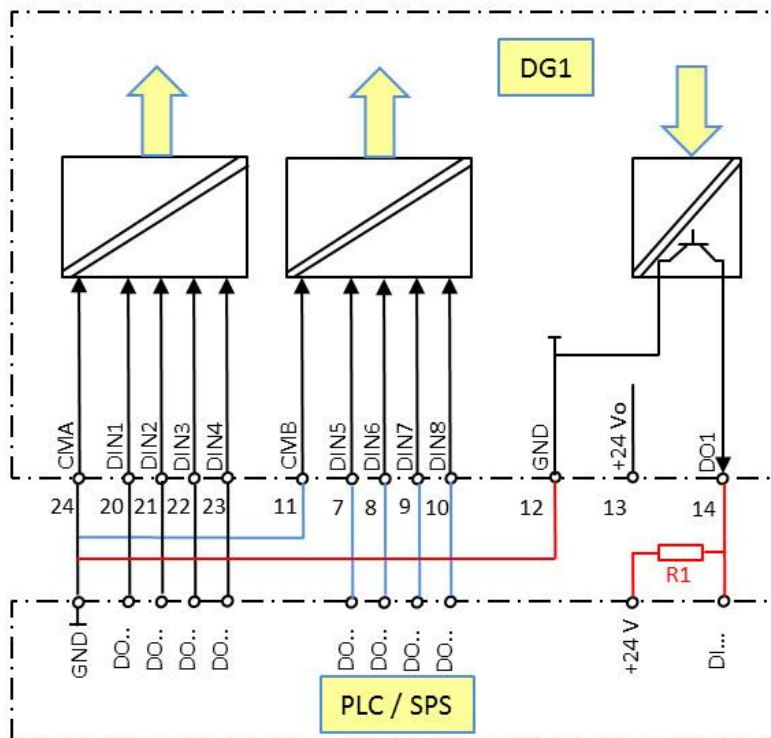


The 8 digital inputs are divided into 2 groups (4 inputs and 1 signal common for each group). DIN1 up to DIN4: signal common CMA / DIN5 up to DIN8: signal common CMB. The signal commons are potential-free. When the internal 24 V supply is used for the control signals, the respective signal common must be connected to Ground GND.



Control signals via contacts, using the internal 24 V supply of DG1

The digital output is of the type „open collector“. This means, that in case the output is activated, its potential is pulled to ground GND. The supply voltage (e.g. 24 V) must be directly connected to the load accordingly. The signal common for the digital output DO1 is GND.

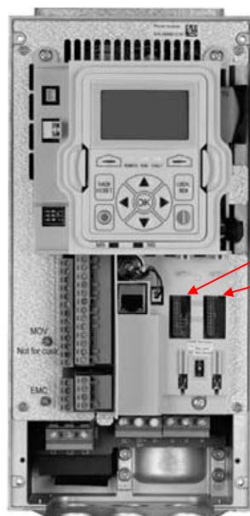


PLC control

In case an external voltage (e.g. coming from a PLC) is used it has to be noted, that the signal common of the digital inputs of DG1 must be connected with the one of the external voltage. It is also possible to have two different voltage sources for the two groups of digital inputs.

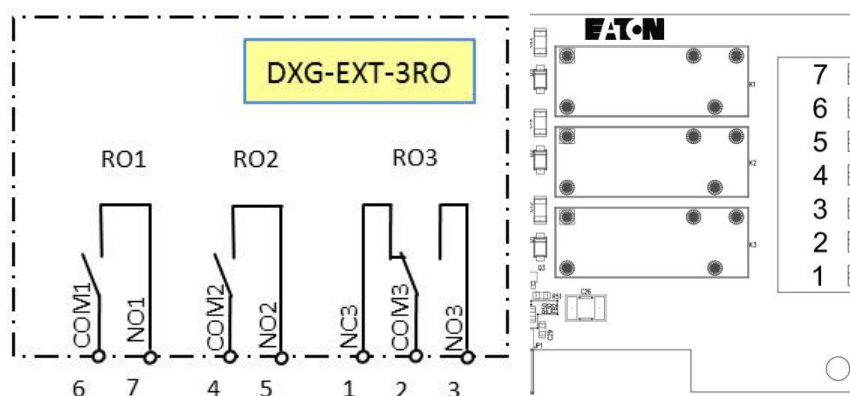
When the digital output DO1 is connected to a PLC input, the wiring depends on the type of PLC. In case it is a PLC with “sink logic”, DO1 and the PLC input can be connected directly without additional measures. In Europe mostly “source logic” is used, where the potential is not pulled to ground in case of activation, but a HIGH signal is applied to the PLC input. In this case a “pull up resistor “ (R1 in the drawing above) must be used, which applies 24 V to the input when DO1 is not active. When DO1 is activated the potential at the PLC input is pulled to ground. When programming the PLC it has to be noted, that the input has a LOW signal when DO1 is active.

## 2.2 Expansion modules



Maximum two expansion modules can be mounted in a DG1 variable frequency drive. They are plugged into the slots A and B.

### 2.2.1 DXG-EXT-3RO

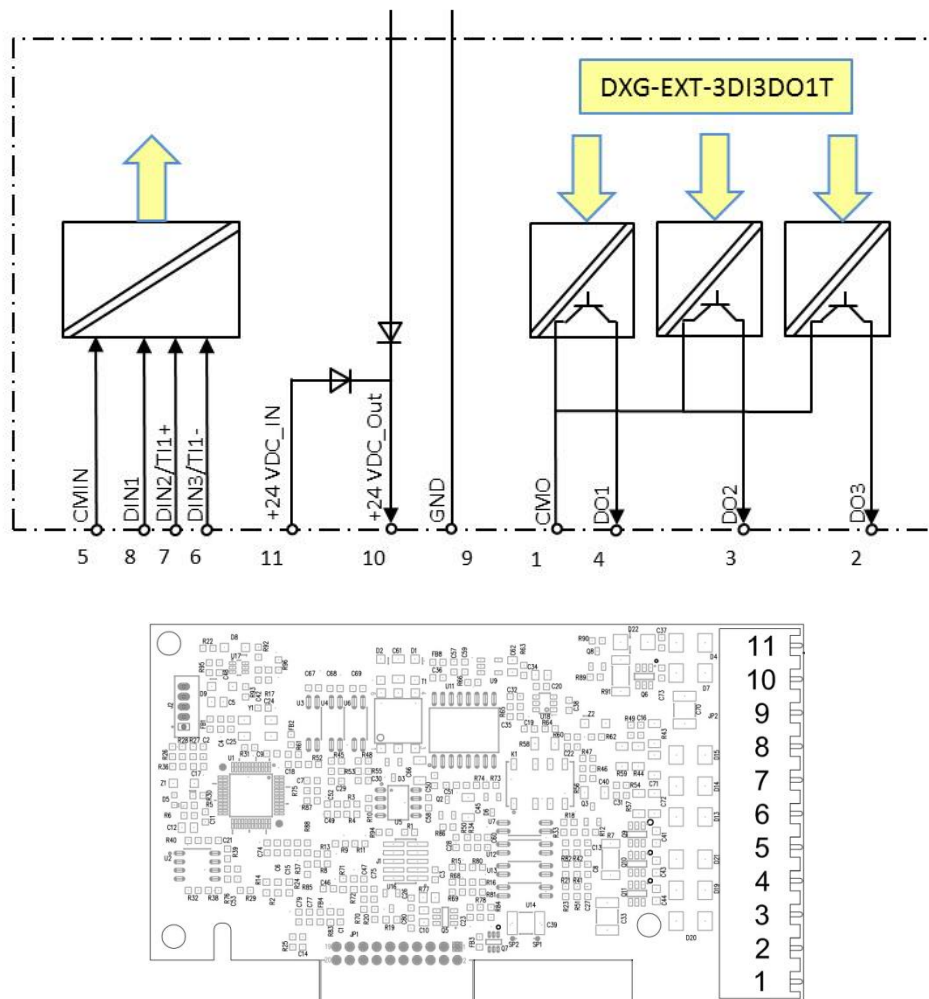


The expansion module DXG-EXT-3RO contains 3 additional potential-free relay outputs (1 changeover and 2 normally open (NO)). The function of the relays can be configured.

	Technical data
Number of contacts	2 Form A (normally open (NO)), 1 Form C (changeover)
Rated current	<2 A RMS
Rated voltage	250 V AC ; 24 V DC
Switching capacity	8 A @ 24 V DC; 8 A @ 250 V AC
Minimum load	10 mA@5 V DC

	Designation	Function	Default
DXG-EXT-3RO	1 (NC3)	Relay 3	8 A @ 24 V DC; 8 A @ 250 V AC; 0,4 A @ 125 VDC
	2 (COM3)		
	3 (NO3)		
	4 (COM2)	Relay 2	8 A @ 24 V DC; 8 A @ 250 V AC; 0,4 A @ 125 VDC
	5 (NO2)		
	6 (COM1)	Relay 1	8 A @ 24 V DC; 8 A @ 250 V AC; 0,4 A @ 125 VDC
	7 (NO1)		

## 2.2.2 DXG-EXT-3DI3DO1T



The expansion module DXG-EXT-3DI3DO1T contains 3 additional digital inputs with one signal common (CMIN, Terminal 5), 3 digital outputs (open collector) and one thermistor input. The signal common for the outputs is CMO, terminal 1. The thermistor connection requires two digital inputs. Only one additional digital input is available in this case.

### 2.2.2.1 Digital inputs

	Technical data
Number of inputs	3 with one signal common (CMIN, terminal 5)
Rated voltage $U_e$	24 V DC (30 V DC max.) LOW < 10 V DC, HIGH > 18 V DC
Rated current $I_e$	5 mA @ 24 VDC
Input resistance	> 5 k $\Omega$
Input logic	Positive and negative logic
Isolation voltage	500 V DC

### 2.2.2.2 Digital outputs

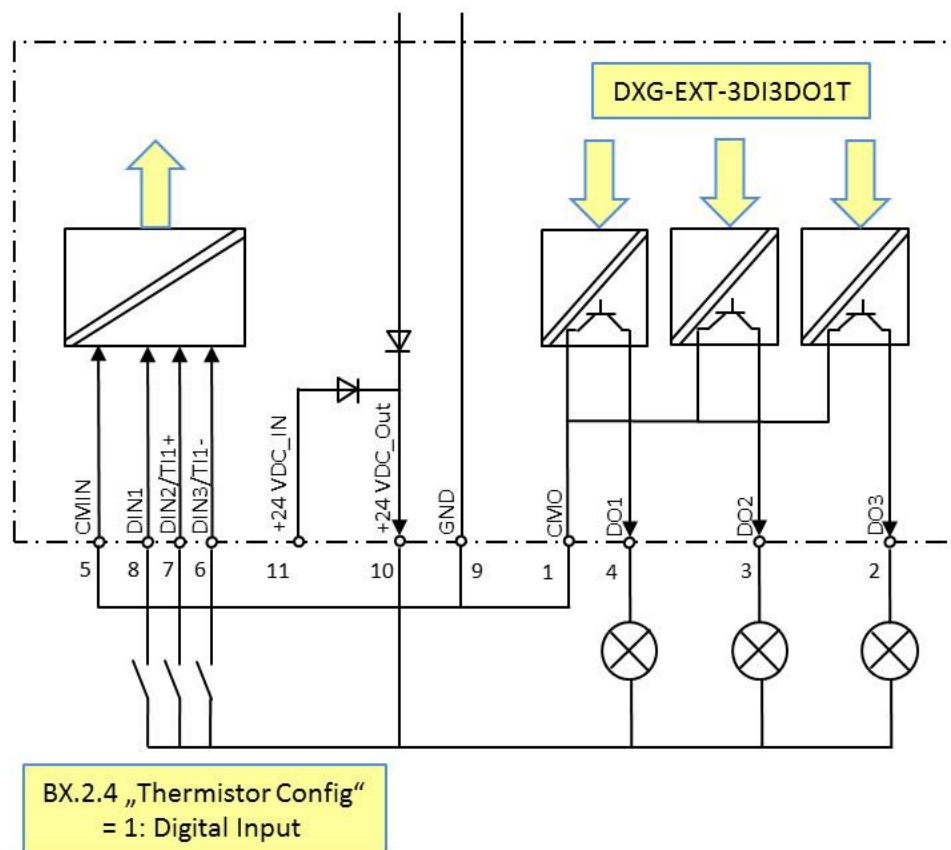
	Technical data
Number of outputs	3 outputs with one signal common (CMO, terminal 1)
Kind of output	OC (Open Collector)
Rated voltage $U_e$	24 V DC
Output voltage range	Max. 36 V DC
Output current range	Max. 50 mA per output

Note: In case the digital outputs are supplied with 24 V from the basic device DG1 it has to be noted, that the maximum capacity of the 24 V supply is limited to 250 mA. The sum of all input and output currents of the basic device and the expansion cards have to be taken into account. When necessary, an external 24 V power supply must be used.

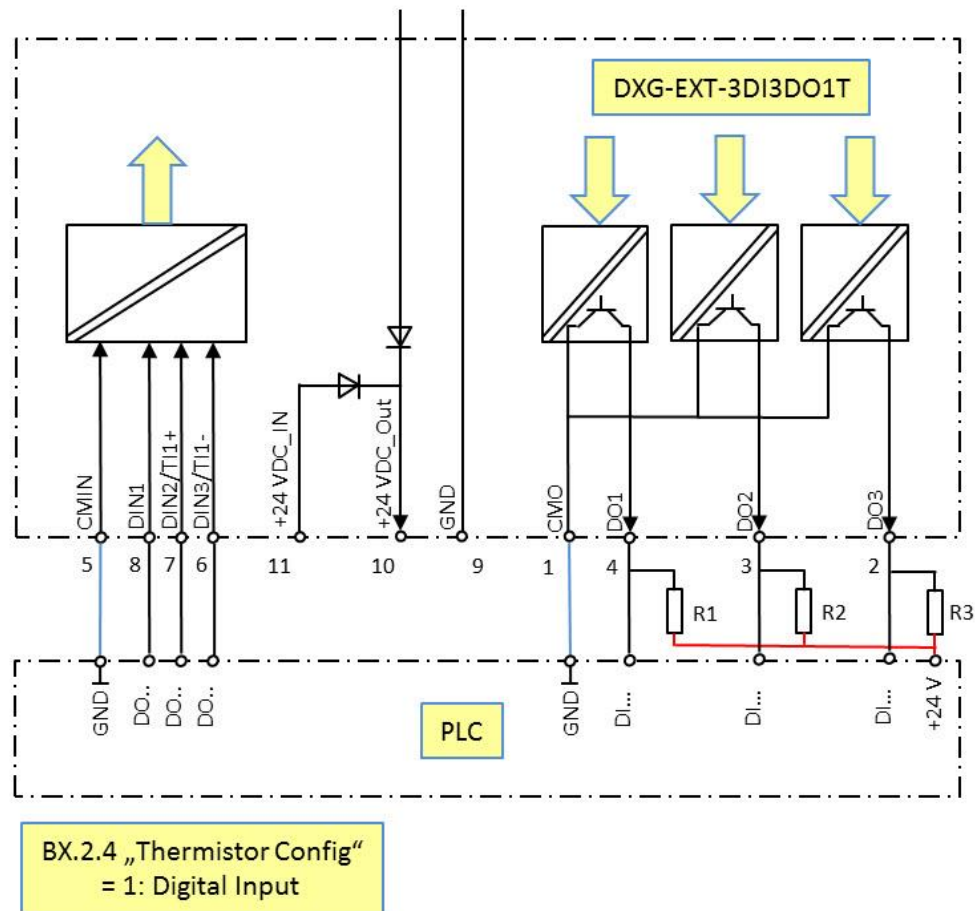
### 2.2.2.3 External 24V supply

	Technical data
Rated voltage $U_e$	24 V DC $\pm 10\%$
Maximum current	1 A
Protective device	External fuse 1 A (no internal short-circuit protection on DXG-EXT-3DI3DO1T)

### 2.2.2.4 Wiring examples



Control signals via contacts using the internal 24 V supply of DG1



PLC control

See also chapter 2.1

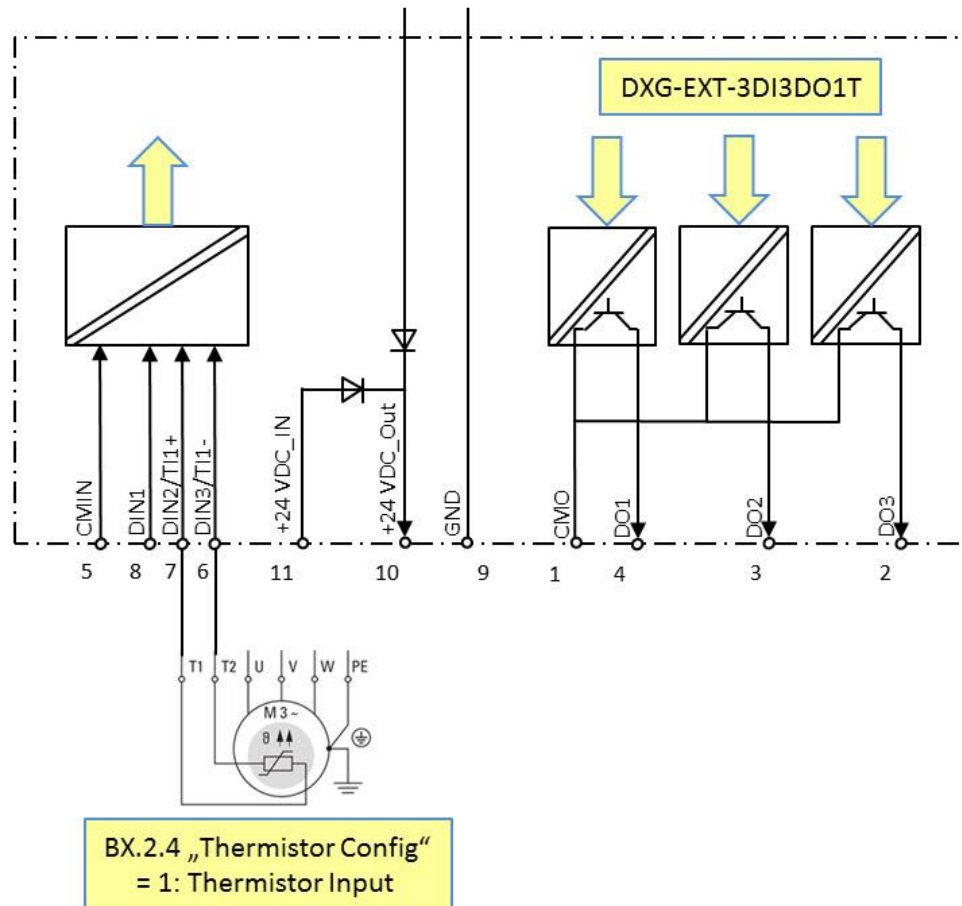
### 2.2.2.5 Thermistor

The connection of a thermistor requires 2 digital inputs. The function must be activated with the parameter BX.2.4 “Thermistor Config (BX.2.4 = “1: Thermistor Input”). The status is displayed with parameter BX.1.6 “Thermistor State”.

Resistance of the thermistor	Display with BX.1.6 „Thermistor State“
1.8K $\Omega$ to 10 $\Omega$	0: Normal
> 4.7K $\Omega$	1: Open
< 10 $\Omega$	2: Short
BX.2.4 = „0: Digital Input“	3: Not Configured

Parameter	Name	Range	Default
BX.1.6	Thermistor State	0: Normal 1: Open 2: Short 3: Not Configured	Read only
BX.2.4	Thermistor Config	0: Digital Input 1: Thermistor Input	0

Note: The letter „X“ in the parameter designation is used as a wildcard. Instead of the letter a number appears on the keypad or inside the parameter software, which depends on the slot (A or B) in which the expansion module mounted.



Connection of a thermistor

ATTENTION: Variable frequency drives of the series DG1 are designed according IEC / EN 61800-5-1, which requires double isolation between mains circuits and circuits with low voltage. Inside the drive power part and control part are separated accordingly. In case temperature sensors inside the motor are connected to DG1 and the remaining digital input (DIN1, terminal 8) is used at the same time it has to be noted, that the sensors have to be double isolated against the motor windings, not to weaken the overall insulation system!

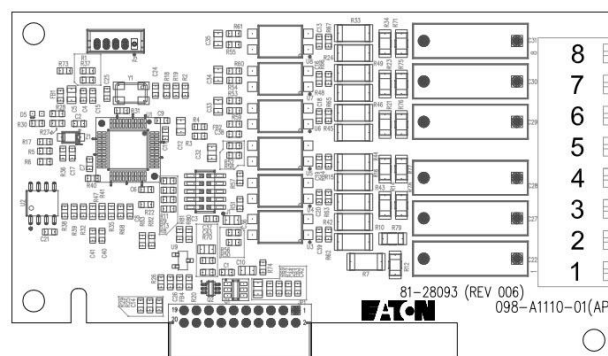
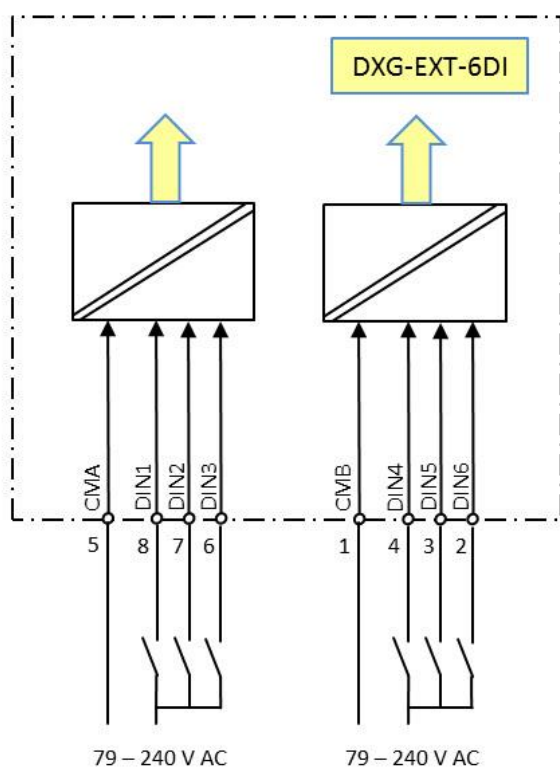
#### 2.2.2.6 Terminal connections

	Designation	Function	
DXG-EXT-3DI3DO1T	1 (CMO)	Signal common of the digital outputs DO1 ... DO3	Isolated from 24V DC_IN, 24V DC_OUT and GND
	2 (DO3)	Digital output 3	Open collector, 50 mA / 36 V max
	3 (DO2)	Digital output 2	Open collector, 50 mA / 36 V max
	4 (DO1)	Digital output 1	Open collector, 50 mA / 36 V max
	5 (CMIN)	Signal common of the digital inputs DIN1 ... DIN3	Isolated from 24V DC_IN, 24V DC_OUT and GND
	6 (DIN3/TI1+)	Digital input 3	24V DC
	7 (DIN2/TI1-)	Digital input 2	24V DC
	8 (DIN1)	Digital input 1	24V DC
	9 (GND)	Ground	Signal common for 24V DC IN/OUT
	10 (24VDC_OUT)	Internal control voltage	24 V supply from the basic unit DG1. Load capacity to be considered. Short circuit proof.
	11 (24VDC_IN)	External control voltage	24 V DC Input. Not short circuit proof

### 2.2.3 DXG-EXT-6DI

The expansion module DXG-EXT-6DI contains six additional digital inputs in the voltage range 79 ... 240 V AC.

	Technical Data
Number of Inputs	6 inputs (2 groups, 3 inputs per signal common)
Rated input voltage	240 VAC
Rated frequency	50 / 60 Hz
Voltage level "HIGH"	79 ... 240 V AC
Standby current	< 15 mA
Voltage level "LOW"	0 ... 40 V AC
Input logic	Positive and negative logic
Isolation voltage	1500 V AC



	Designation	Function
DXG-EXT-6DI	1 (CMB)	Signal common
	2 (DIN6)	Digital input 6
	3 (DIN5)	Digital input 5
	4 (DIN4)	Digital input 4
	5 (CMA)	Signal common
	6 (DI3)	Digital input 3
	7 (DI2)	Digital input 2
	8 (DIN1)	Digital input 1

### 3 Digital inputs

The variable frequency drives of the series PowerXL™ DG1 can be used universally with a lot of configuration possibilities. When commissioning the drive a „source“ out of a selection list is assigned to a certain function, e.g. external fault. It is possible to assign different functions to the same source.

#### 3.1 Parameter list

„0: DigIN:NormallyOpen“ → Signal is constantly LOW

„1: DigIN:NormallyClose“ → Signal is constantly HIGH

Parameter	Name	Range	Default
P3.1	IO Terminal 1 Start Stop Logic	0: Forward - Reverse 1: Start - Reverse 2: Start - Enable 3: Start Pulse – Stop Pulse	0: Forward - Reverse
P3.2	IO Terminal 1 Start Signal 1	0: DigIN:NormallyOpen 1: DigIN:NormallyClose 2: DigIN 1 3: DigIN 2 4: DigIN 3 5: DigIN 4 6: DigIN 5 7: DigIN 6 8: DigIN 7 9: DigIN 8 10: DigIN: A: IO1: 1 (on DXG-EXT-3DI3DO1T) 11: DigIN: A: IO1: 2 (on DXG-EXT-3DI3DO1T) 12: DigIN: A: IO1: 3 (on DXG-EXT-3DI3DO1T) 13: DigIN: A: IO5: 1 (on DXG-EXT-6DI) 14: DigIN: A: IO5: 2 (on DXG-EXT-6DI) 15: DigIN: A: IO5: 3 (on DXG-EXT-6DI) 16: DigIN: A: IO5: 4 (on DXG-EXT-6DI) 17: DigIN: A: IO5: 5 (on DXG-EXT-6DI) 18: DigIN: A: IO5: 6 (on DXG-EXT-6DI) 19: DigIN: B: IO1: 1 (on DXG-EXT-3DI3DO1T) 20: DigIN: B: IO1: 2 (on DXG-EXT-3DI3DO1T) 21: DigIN: B: IO1: 3 (on DXG-EXT-3DI3DO1T) 22: DigIN: B: IO5: 1 (on DXG-EXT-6DI) 23: DigIN: B: IO5: 2 (on DXG-EXT-6DI) 24: DigIN: B: IO5: 3 (on DXG-EXT-6DI) 25: DigIN: B: IO5: 4 (on DXG-EXT-6DI) 26: DigIN: B: IO5: 5 (on DXG-EXT-6DI) 27: DigIN: B: IO5: 6 (on DXG-EXT-6DI) 28: Time Channel 1 29: Time Channel 2 30: Time Channel 3 31: RO1 Function 32: RO2 Function 33: RO3 Function 34: Virtual RO1 Function 35: Virtual RO2 Function	2: DigIN: 1
P3.3	IO Terminal 1 Start Signal 2	like P3.2	3: DigIN: 2

Parameter	Name	Range	Default
P3.4	Thermistor Input Select	0: Digital Input 1: Thermistor Input	0: Digital Input
P3.5	Reverse	like P3.2	0: (NO)
P3.6	Ext. Fault 1 NO	like P3.2	4: DigIN: 3
P3.7	Ext. Fault 1 NC	like P3.2	1: (NC)
P3.8	Fault Reset	like P3.2	5: DigIN: 4
P3.9	Run Enable	like P3.2	1: (NC)
P3.10	Preset Speed B0	like P3.2	6: DigIN: 5
P3.11	Preset Speed B1	like P3.2	7: DigIN: 6
P3.12	Preset Speed B2	like P3.2	0: (NO)
P3.13	PID1 Control Enable	like P3.2	1: (NC)
P3.14	PID2 Control Enable	like P3.2	1: (NC)
P3.15	Accel/Decel Time Set	like P3.2	0: (NO)
P3.16	Accel/Decel Prohibit	like P3.2	0: (NO)
P3.17	No Access To Param	like P3.2	0: (NO)
P3.18	Accel Pot Value	like P3.2	0: (NO)
P3.19	Decel Pot Value	like P3.2	0: (NO)
P3.20	Reset Pot Zero	like P3.2	0: (NO)
P3.21	Remote Control	like P3.2	9: DigIN: 8
P3.22	Local Control	like P3.2	0: (NO)
P3.23	Remote 1 / 2 Select	like P3.2	0: (NO)
P3.24	Second Motor Para Select	like P3.2	0: (NO)
P3.25	Bypass Start	like P3.2	0: (NO)
P3.26	DC Brake Active	like P3.2	0: (NO)
P3.27	SmokeMode	like P3.2	0: (NO)
P3.28	FireMode	like P3.2	0: (NO)
P3.29	Fire Mode Ref 1 / 2 Select	like P3.2	0: (NO)
P3.30	PID1 Set Point Select	like P3.2	0: (NO)
P3.31	PID2 Set Point Select	like P3.2	0: (NO)
P3.32	Jog Enable	like P3.2	0: (NO)
P3.33	Start Timer 1	like P3.2	0: (NO)
P3.34	Start Timer 2	like P3.2	0: (NO)
P3.35	Start Timer 3	like P3.2	0: (NO)
P3.36	AI Ref Source Select	like P3.2	0: (NO)
P3.37	Motor Interlock 1	like P3.2	0: (NO)
P3.38	Motor Interlock 2	like P3.2	0: (NO)
P3.39	Motor Interlock 3	like P3.2	0: (NO)
P3.40	Motor Interlock 4	like P3.2	0: (NO)
P3.41	Motor Interlock 5	like P3.2	0: (NO)
P3.42	Emergency Stop	like P3.2	1: (NC)
P3.43	Bypass Overload	like P3.2	0: (NO)
P3.44	Fire Mode Direction Invert	like P3.2	0: (NO)
P3.45	IO Terminal 2 Start Stop Logic	0: Forward - Reverse 1: Start - Reverse 2: Start - Enable 3: Start Pulse – Stop Pulse	0: Forward - Reverse
P3.46	IO Terminal 2 Start Signal 1	like P3.2	2: DigIN: 1
P3.47	IO Terminal 2 Start Signal 2	like P3.2	3: DigIN: 2
P3.48	Ext. Fault 2 NO	like P3.2	0: (NO)
P3.49	Ext. Fault 2 NC	like P3.2	1: (NC)

Parameter	Name	Range	Default
P3.50	Ext. Fault 3 NO	like P3.2	0: (NO)
P3.51	Ext. Fault 3 NC	like P3.2	1: (NC)
P3.55	Parameter Set 1 / 2 Select	like P3.2	0: (NO)
P3.56	Deragging Enable	like P3.2	0: (NO)
P3.57	HOA On/Off	like P3.2	1: (NC)
P18.6.7	PrimePump Enable	like P3.2	0: (NO)

### 3.2 Parameter description

Name	Description
P3.1 IO Terminal 1 Start Stop Logic	Parameter P3.1 "IO Terminal 1 Start Stop Logic" assigns different functionalities during start and stop to "IO Terminal 1 Start Signal 1" (P3.2) and "IO Terminal 1 Start Signal 2" (P3.3).  Details see Application Note AP040176EN „DG1, Starting, Stopping and Operation“
P3.2 IO Terminal 1 Start Signal 1	
P3.3 IO Terminal 1 Start Signal 2	
P3.4 Thermistor Input Select	The setting of P3.4 determines, if the digital inputs DI7 and DI8 are used as normal digital inputs or if they are configured for a thermistor connection. P3.4 = 0: Digital Input P3.4 = 1: Thermistor Input
P3.5 Reverse	When P3.1 „IO Terminal 1 Start Stop Logic“ = „3: Start Pulse – Stop Pulse“, the sense of rotation depends on the signal at the source defined with P3.5 "Reverse". LOW = Right rotating field (cw) HIGH = Left Rotating field (ccw)
P3.6 Ext. Fault 1 NO	Determination of the source for External Fault 1 LOW = No fault HIGH = Fault
P3.7 Ext. Fault 1 NC	Determination of the source for External Fault 1 LOW = Fault HIGH = No fault
P3.8 Fault Reset	A rising edge of the signal at the source defined with P3.8 „Fault Reset“ resets fault and warning messages.
P3.9 Run Enable	Determination of the source for the Run Enable signal LOW = Run Enable not active HIGH = Run Enable active
P3.10 Preset Speed B0  P3.11 Preset Speed B1  P3.12 Preset Speed B2	Binary coded selection of the preset speeds Value of P3.10 = $2^0$ Value of P3.11 = $2^1$ Value P3.12 = $2^2$  Example: select Preset Speed 5: $5 = 1 \cdot 2^0 + 0 \cdot 2^1 + 1 \cdot 2^2 (= 1 + 0 + 4)$ <b>P3.10 = HIGH, P3.11 = LOW, P3.12 = HIGH</b>
P3.13 PID1 Control Enable	Determination of the source to enable PID controller PID1 LOW = PID1 disabled HIGH = PID1 enabled
P3.14 PID2 Control Enable	Determination of the source to enable PID controller PID2 LOW = PID2 disabled HIGH = PID2 enabled

Name	Description
P3.15 Accel/Decel Time Set	Determination of the source to switch between ramp 1 and ramp 2 LOW = Ramp 1 (P1.3 / P1.4) HIGH = Ramp 2 (P7.13 / P7.14)
P3.16 Accel/Decel Prohibit	Determination of the source to freeze the ramp output P3.16 = LOW → Each change of the speed reference is passed to the speed controller with a delay according to the set ramp. P3.16 = HIGH → The output of the ramp is frozen with the value, which was present before the HIGH signal was applied. Changes of the reference, e.g. at the analog input, do not lead to a speed change. When the HIGH signal is removed, the drive ramps to the speed according to the actual reference.
P3.17 No Access to Param	LOW = A change of parameter values is possible. HIGH = A change of parameter values is not possible.
P3.18 Accel Pot Value	Determination of the source for the acceleration command, when using a digital reference (Motor Pot). When the signal is active, the speed reference is increased with a rate defined with P7.7 "Motor Pot Ramp Time" [Hz/s]. The maximum value is P1.2 "Max Frequency". When acceleration and deceleration commands are active simultaneously, acceleration gets priority. LOW = Reference will not be increased HIGH = Reference will be increased
P3.19 Decel Pot Value	Determination of the source for the deceleration command, when using a digital reference (Motor Pot). When the signal is active, the speed reference is decreased with a rate defined with P7.7 "Motor Pot Ramp Time" [Hz/s]. The minimum value is P1.1 "Min Frequency". When acceleration and deceleration commands are active simultaneously, acceleration gets priority. LOW = Reference will not be decreased HIGH = Reference will be decreased
P3.20 Reset Pot Zero	A HIGH signal at the source specified here leads to a reset of the digital reference to P1.1 "Min Frequency". A reset is also possible during RUN. In this case the drive ramps to the minimum frequency.
P3.21 Remote Control	Determination of the source to force remote control. When this signal is active the drive changes to remote control, not depending on the selection with the keypad. LOW = Mode of operation according to keypad setting HIGH = Remote Control When HIGH signal is applied to the sources defined with P3.21 and P3.22 simultaneously, P3.22 „Local Control“ gets priority.
P3.22 Local Control	Determination of the source to force local control. When this signal is active the drive changes to local control, not depending on the selection with the keypad. LOW = Mode of operation according to keypad setting HIGH = Local Control When HIGH signal is applied to the sources defined with P3.21 and P3.22 simultaneously, P3.22 „Local Control“ gets priority.
P3.23 Remote 1 / 2 Select	Selects between „Remote1“ and „Remote2“ in remote control mode, where different sources for the control commands and the reference can be assigned to. LOW = Remote1 HIGH = Remote2

Name	Description
P3.24 Second Motor Para Select	Selection of the motor parameter set LOW = Motor parameter set 1 HIGH = Motor parameter set 2
P3.25 Bypass Start	Changeover between speed control and bypass LOW = Speed control HIGH = Bypass (Rising edge necessary)
P3.26 DC Brake Active	A HIGH signal at the source defined with P3.26 enables DC braking. LOW = No DC braking possible HIGH = DC braking enabled
P3.27 Smoke Mode	The Smoke Mode is activated with a HIGH signal at the source defined with P3.27 "Smoke Mode". In this case the drive ramps to the speed defined with P15.6 "Smoke Purge Frequency". When removing the signal the drive ramps to the speed according to the normal speed reference. When P3.27 is set to "0: DigIN:NormallyOpen" Smoke Mode is disabled. LOW = Smoke Mode disabled HIGH = Smoke Mode enabled  See also AP040065EN „DG1 Smoke Mode and Fire Mode“
P3.28 Fire Mode	A signal at the source defined with P3.28 activates the fire mode. Fire mode remains active until it is reset.  P15.1 "Fire Mode Function" = "0: Closing Contact" LOW = Fire Mode not active HIGH = Fire Mode active  P15.1 "Fire Mode Function" = "1: Opening contact" LOW = Fire Mode active HIGH = Fire Mode not active  See also AP040065EN „DG1 Smoke Mode and Fire Mode“
P3.29 Fire Mode Ref 1 / 2 Select	Selection of the preset frequency, used in Fire Mode LOW = „Fire Mode Freq Ref 1“ (P15.4) HIGH = „Fire Mode Freq Ref 2“ (P15.5)  See also AP040065EN „DG1 Smoke Mode and Fire Mode“
P3.30 PID1 Set Point Select	Selection between the channels Set Point 1 and Set Point 2 of PID controller PID1 LOW = Set Point 1 HIGH = Set Point 2
P3.31 PID2 Set Point Select	Selection between the channels Set Point 1 and Set Point 2 of PID controller PID2 LOW = Set Point 1 HIGH = Set Point 2
P3.32 Jog Enable	Enabling of the jog mode LOW = Not in jog mode HIGH = Jog mode The motor turns with the speed defined with P7.6 „Jog Reference“.
P3.33 Start Timer 1	Selection of the source to activate timer 1 in case it is event controlled. The run time of timer 1 can be set with P19.26. Additionally the timer must be enabled with P19.27.

Name	Description
P3.34 Start Timer 2	Selection of the source to activate timer 2 in case it is event controlled. The run time of timer 2 can be set with P19.28. Additionally the timer must be enabled with P19.29.
P3.35 Start Timer 3	Selection of the source to activate timer 3 in case it is event controlled. The run time of timer 3 can be set with P19.30. Additionally the timer must be enabled with P19.31.
P3.36 AI Ref Source Select	Changeover between the reference sources AI1 and AI2 LOW = Analog input AI1 HIGH = Analog input AI2
P3.37 Motor Interlock 1  P3.38 Motor Interlock 2  P3.39 Motor Interlock 3  P3.40 Motor Interlock 4  P3.41 Motor Interlock 5	In a multi pump system with one speed controlled motor and multiple single speed ones, P3.37 up to P3.41 feed back, if the drives are ready to be used. This function must be activated with P18.1.7 „Interlock Enable”. LOW = Motor is not ready HIGH = Motor is ready  See also AP040128EN „DG1 in Pump and Fan Applications” Note: Motor 1 is the speed controlled one.
P3.42 Emergency Stop	Determination of the source for the emergency stop signal. By default, P3.42 = “1: DigIN NormallyClose”. This means, that the emergency stop signal is applied constantly. Removing the signal leads to a coast of the motor and a fault message is generated. Note: This fault message must not be reset. As soon as the emergency stop signal is reapplied, the fault is reset automatically.
P3.43 Bypass Overload	In bypass operation the motor is protected by an external motor overload relay. A trip of the external relay can be included into the fault management of the variable frequency drive. During proper operation the source, defined with P3.43 “Bypass Overload” must have a LOW signal. When this signal changes to HIGH, a fault message is generated.
P3.44 Fire Mode Direction Invert	Reversal in Fire Mode. The source selected with P3.44 may not have a HIGH signal at the time when fire mode is activated. If this is the case, no reversal will take place. The signal for the reversal must be applied simultaneously or after the command for fire mode activation. LOW = no reversal HIGH = reversal (rising edge)  See also AP040065EN „DG1 Smoke Mode and Fire Mode”
P3.45 IO Terminal 2 Start Stop Logic	Parameter P3.45 “IO Terminal 2 Start Stop Logic” assigns different functionalities during start and stop to “IO Terminal 2 Start Signal 1” (P3.46) and “IO Terminal 2 Start Signal 2” (P3.47).  Details see Application Note AP040176EN „DG1, Starting, Stopping and Operation”
P3.46 IO Terminal 2 Start Signal 1	
P3.47 IO Terminal 2 Start Signal 2	

Name	Description
P3.48 Ext. Fault 2 NO	Determination of the source for External Fault 2 LOW = No fault HIGH = Fault
P3.49 Ext. Fault 2 NC	Determination of the source for External Fault 2 LOW = Fault HIGH = No fault
P3.50 Ext. Fault 3 NO	Determination of the source for External Fault 3 LOW = No fault HIGH = Fault
P3.51 Ext. Fault 3 NC	Determination of the source for External Fault 3 LOW = Fault HIGH = No fault
P3.55 Parameter Set 1 / 2 Sel	Selection of the parameter set LOW = Parameter set 1 HIGH = Parameter set 2
P3.56 Deragging Enable	When parameter 3.56 „Deragging Enable“ is assigned to a terminal (P18.1.12 = „4: Digital Input“), the deragging mode of a pump system is activated by a rising edge of the respective signal. The deragging cycle will be performed according to the respective settings. When the signal is applied during normal operation, the drive changes to deragging mode for the time of the deragging cycle. A command other than the rising edge of the “Deragging Enable” signal, e.g. a START signal, is not necessary. Once the deragging has started, the “Deragging Enable” signal can be removed.
P3.57 HOA On/Off	To operate the drive, a HIGH signal must be applied to the source defined with P3.57 „HOA On/Off“. In case this signal is missing, the drive cannot be started respectively ramps down to standstill.
P18.6.7 Prime Pump Enable	A HIGH signal starts the pipe filling procedure. The signal must be applied already when starting the drive. Otherwise the pipe filling will not be performed and the motor ramps to the speed, which is determined by the output signal of the PID controller. When removing the signal during the pipe fill procedure, the drive also ramps to the speed according to the PID output signal. LOW = Pipe filling not activated HIGH = Pipe filling activated  See also AP040128EN „DG1 in Pump and Fan Applications“

### 3.3 Displaying the status of the digital inputs

The actual status of the digital inputs can be displayed with the keypad and with the configuration software InControl.

#### 3.3.1 Basic unit DG1

Number	Name	Description
M16	DI1, DI2, DI3	Status of the digital inputs DI1, DI2, DI3 On = HIGH signal at the respective input Off = LOW signal at the respective input
M17	DI4, DI5, DI6	Status of the digital inputs DI4, DI5, DI6 On = HIGH signal at the respective input Off = LOW signal at the respective input
M18	DI7, DI8	Status of the digital inputs DI7, DI8 On = HIGH signal at the respective input Off = LOW signal at the respective input

#### 3.3.2 Expansion module DXG-EXT-3DI3DO1T

Number	Name	Description
BX.1.3	DI1, DI2, DI3	Status of the digital inputs DI1, DI2, DI3 On = HIGH signal at the respective input Off = LOW signal at the respective input
BX.1.5	Thermistor Resistor	Resistance of a connected thermistor

#### 3.3.3 Expansion module DXG-EXT-6DI

Number	Name	Description
BX.1.3	DI1, DI2, DI3	Status of the digital inputs DI1, DI2, DI3 On = HIGH signal at the respective input Off = LOW signal at the respective input
BX.1.4	DI4, DI5, DI6	Status of the digital inputs DI4, DI5, DI6 On = HIGH signal at the respective input Off = LOW signal at the respective input

## 4 Digital outputs

The function of the digital outputs of a variable frequency drives of the series PowerXL™ DG1 is configurable.

The states „active“ and „not active“ bear the following meaning:

- active
  - The relay of a relay output (RO) is energized.
  - The potential of a digital output (DO) is pulled to GND (Open Collector, see also chapter 2ff).
- not active
  - The relay of a relay output (RO) is de-energized.
  - The potential of a digital output (DO) is not pulled to GND (Open Collector, see also chapter 2ff).

### 4.1 Assigning functions to digital outputs

The function of a digital output is selected out of a list with multiple possibilities. The same function can be assigned to multiple digital outputs at the same time, but not reverse. The single functions are described in chapter 4.3.

#### 4.1.1 Basic unit DG1

The setting of the parameters P5.1 to P5.6 determine the functions, which are assigned to the digital outputs. In addition on and off delays can be configured for relay outputs.

While the relays RO1 and RO2 have changeover contacts, RO 3 has a single normally open (NO) contact. Its functionality can be inverted with P5.38 „RO3 Reverse“.

P5.38 „RO3 Reverse“ = No → When RO3 is active, the relay contact is closed.

P5.38 „RO3 Reverse“ = Yes → When RO3 is active, the relay contact is opened.

Note: With P5.38 „RO3 Reverse“ = „Yes“, the relay is de-energized when the output is activated. If a time delay is required in this case, the parameter P5.37 „RO3 Off Delay“ must be used. When the output is deactivated, P5.36 „RO3 On Delay“ is effective.

Parameter	Name	Range	Default
P5.1	DO1 Function	0: Not Used 1: Ready 2: Run 3: Fault 4: Fault invert 5: Warning 6: Reversed 7: At Speed 8: Zero Frequency 9: Freq Limit 1 Superv 10: Freq Limit 2 Superv 11: PID1 Superv 12: PID2 Superv 13: OverHeat Fault 14: OverCurrent Regular	1: Ready

Parameter	Name	Range	Default
		15: OverVoltage Regular 16: UnderVoltage Regular 17: 4ma Ref Fault/Warning 18: Ext Brake Control 19: Ext Brake Inverted 20: Torq Limit Superv 21: Ref Limit Superv 22: Control from I/O 23: U-Requested Rotation Di- rection 24: Thermistor Fault Output 25: Fire Mode 26: In Bypass Mode 27: Ext Fault/Warning 28: Remote Control 29: Jog Speed Select 30: Motor Therm Protection 31: FB Digital Input 1 32: FB Digital Input 2 33: FB Digital Input 3 34: FB Digital Input 4 35: Damper Control 36: TC1 Status 37: TC2 Status 38: TC3 Status 39: In E-Stop 40: Power Limit Superv 41: Temp Limit Superv 42: Analog Input Superv 43: Motor 1 Control 44: Motor 2 Control 45: Motor 3 Control 46: Motor 4 Control 47: Motor 5 Control 48: Logic Fulfilled 49: PID1 Sleep 50: PID2 Sleep 51: Motor Current 1 Superv 52: Motor Current 2 Superv 53: Second AI Limit Superv 54: DC Charge Switch Close 55: Preheat Active 56: Cold Weather Active 57: Prime Pump Active 58: 2th Stage Ramp Frequency Active 59: STO Fault Output 60: Run Bypass/Drive 61: Bypass Overload	
P5.2	RO1 Function	like P5.1	2: Run
P5.32	RO1 On Delay	0 s ... +320 s	0 s

Parameter	Name	Range	Default
P5.33	RO1 Off Delay	0 s ... +320 s	0 s
P5.3	RO2 Function	like P5.1	3: Fault
P5.34	RO2 On Delay	0 s ... +320 s	0 s
P5.35	RO2 Off Delay	0 s ... +320 s	0 s
P5.4	RO3 Function	like P5.1	7: At Speed
P5.36	RO3 On Delay	0 s ... +320 s	0 s
P5.37	RO3 Off Delay	0 s ... +320 s	0 s
P5.38	RO3 Reverse	0: No 1: Yes	0: No
P5.5	Virtual RO1 Function	like P5.1	0: Not Used
P5.6	Virtual RO2 Function	like P5.1	0: Not Used

#### 4.1.2 Expansion module DXG-EXT-3RO

The setting of the parameters BX.2.1 up to BX.2.3 determine, which function is assigned to the relay outputs.

While the relays RO1 and RO2 have a single normally open (NO) contact, RO3 has a changeover contact.

Parameter	Name	Range	Default
BX.2.1	RO1 Function	like P5.1	0: Not Used
BX.2.2	RO2 Function	like P5.1	0: Not Used
BX.2.3	RO3 Function	like P5.1	0: Not Used

Note: The letter „X“ in the parameter designation is used as a wildcard. Instead of the letter a number appears on the keypad or inside the parameter software, which depends on the slot (A or B) in which the expansion module mounted.

#### 4.1.3 Expansion module DXG-EXT-3DI3DO1T

Parameter	Name	Range	Default
BX.2.1	DO1 Function	like P5.1	0: Not Used
BX.2.2	DO2 Function	like P5.1	0: Not Used
BX.2.3	DO3 Function	like P5.1	0: Not Used

Note: The letter „X“ in the parameter designation is used as a wildcard. Instead of the letter a number appears on the keypad or inside the parameter software, which depends on the slot (A or B) in which the expansion module mounted.

## 4.2 Displaying the status of the digital outputs

### 4.2.1 Basic unit DG1

Number	Name	Description
M19	DO1, Virtual RO1, Virtual RO2	Status of the digital output DO1 and the virtual relays VO1 and VO2 On = Output active Off = Output not active
M20	RO1, RO2, RO3	Status of the output relays RO1, RO2, RO3 On = relay contact closed Off = relay contact open

### 4.2.2 Expansion module DXG-EXT-3RO

Number	Name	Description
BX.1.3	RO1, RO2, RO3	Status of the output relays RO1, RO2, RO3 On = relay contact closed Off = relay contact open

### 4.2.3 Expansion module DXG-EXT-3DI3DO1T

Number	Name	Description
BX.1.4	DO1, DO2, DO3	Status of the output relays DO1, DO2, DO3 On = Output active Off = Output not active

## 4.3 Configuration possibilities of the digital outputs

The parameters mentioned in chapter 4.1ff, determine the function, which is assigned to the digital outputs DO..., RO... and Virtual RO. The following chapters the functionality is described.

### 4.3.1 Signalling of operating conditions

See also Application Note AP040176EN "DG1 Starting, Stopping and Operation"

Selected function	Behavior of the output
1: Ready	The output is active, when the drive is ready to run - supplied with voltage - no active fault message
2: Run	The output is active during run - supplied with voltage - no active fault message - START signal present respectively the drive is still ramping down after the removal of the START signal.
6: Reversed	The digital output is active, when there is left rotating field (ccw) at the inverter output. When changing the sense of rotation, the status of the output doesn't change with the reverse signal, but when the direction of the field at the inverter output changes from cw to ccw.
22: Control from I/O	The output is active, when the control commands are applied via terminals, not depending on the operation mode („Local“ or „Remote“).

Selected function	Behavior of the output
23: Un-Requested Rotation Direction	The output is active, when the direction of the motor doesn't correspond to the one selected with the reference value respectively the control commands. This happens for example when reversing. As soon as the reverse command is given, the digital output is activated. When the drive has finished the deceleration phase and starts to turn into the other direction, the output is deactivated.
25: Fire Mode	The output is active when the external signal to activate the fire mode is applied to the source selected with P3.28 "Fire Mode". Note: The signal doesn't give the information, if the drive operates in fire mode, but if the respective signal at the terminal is present!
26: In Bypass Mode	The output is active when the drive is in bypass mode.
28: Remote Control	The output is active when „Remote Control“ is selected. At the same time the LED „Remote“ on the keypad is lighting.
29: Jog Speed Select	The output is active, when the drive is in jog mode.
39: In E-Stop	The output is active when at the source, defined with P3.42 "Emergency Stop", is a LOW signal.
54: DC Charge Switch Close	The output is active, when the DC link is charged and the charging resistor is bypassed.
55: Preheat Active	The output is active, when the "Preheat Mode" is enabled with P9.46 and the temperature is inside the range defined with P9.48 "Preheat Enter Temp" and P9.49 "Preheat Quit Temp".
56: Cold Weather Active	The output is active, when the drive is in „Cold Weather Mode“.  See also Application Note AP040058DE "DG1, Operating at low Temperatures"
58: 2th Stage Ramp Frequency Active	The output is active, when ramp 2, set with P7.13 "Accel Time 2" and P7.14 „Decel Time 2" is active.
60: Run Bypass/Drive	The output is active, when the drive is in bypass mode and receives a START command. In this case the external bypass is activated by the digital output.
61: Bypass Overload	The output is active, when an external overload relay reports an overload condition by applying a HIGH signal to the source defined with P3.43. The output remains active until the fault is reset.

### 4.3.2 Fault and warning signals

The choices „3: Fault“, „4: Fault Invert“ and „5: Warning“ are collective messages. This means, that one arbitrary fault or warning triggers the output.

See also Application Note AP040176EN "DG1 Starting, Stopping and Operation"

Selected function	Behavior of the output
3: Fault	An arbitrary fault activates the output. The fault must be reset.
4: Fault Invert	An arbitrary fault deactivates the output. The fault must be reset.
5: Warning	An arbitrary warning activates the output. The warning disappears after about 5 s. It can also be reset.
13: OverHeat Fault	The output will be activated at an overtemperature of the device. A reset signal deactivates the output.
14: OverCurrent Regular	The output will be activated when an overcurrent is detected on the motor side. A reset signal deactivates the output.

Selected function	Behavior of the output
15: OverVoltage Regular	The output will be activated with an overvoltage in the DC link. A reset signal deactivates the output.
16: UnderVoltage Regular	<p>The reaction of the output depends on the setting of P9.5 „Uvolt Fault Response”.</p> <p>P9.5 = “0: No Action” → the output will not be activated.</p> <p>P9.5 = “1: Warning” → The output is activated at mains undervoltage and deactivated automatically after about 5 s or with a reset signal.</p> <p>P9.5 = “2: Fault” and “3: Fault, Coast” → The output is activated at mains undervoltage and deactivated with a reset signal.</p>
17: 4mA Ref Fault/Warning	<p>The reaction of the output depends on the setting of P9.1 „4mA Input Fault”.</p> <p>P9.1 = “0: No Action” → the output will not be activated.</p> <p>P9.1 = “1: Warning” and “2: Warning: Previous Freq” and “3: Warning: Preset Freq” → The output is activated with the 4 mA fault and deactivated automatically after about 5 s or with a reset signal.</p> <p>P9.1 = “4: Fault” and “5: Fault, Coast” → The output is activated with a 4mA fault and deactivated with a reset signal.</p>
24: Thermistor Fault Output	<p>To get this message, the thermistor inputs must be configured accordingly.</p> <p>The reaction of the output depends on the setting of P9.19 „Thermistor Fault Response”.</p> <p>P9.19 = “0: No Action” → the output will not be activated.</p> <p>P9.19 = “1: Warning” → The output is activated at a thermistor fault and deactivated automatically after about 5 s or with a reset signal.</p> <p>P9.19 = “2: Fault” and “3: Fault, Coast” → The output is activated at a thermistor fault and deactivated with a reset signal.</p>
27: Ext Fault/Warning	<p>The reaction of the output depends on the setting of P9.3 „External Fault”</p> <p>P9.3 = “0: No Action” → the output will not be activated.</p> <p>P9.3 = “1: Warning” → The output is activated at an external fault and deactivated automatically after about 5 s or with a reset signal.</p> <p>P9.3 = “2: Fault” and “3: Fault, Coast” → The output is activated at an external fault and deactivated with a reset signal.</p>
30: Motor Therm Protection	<p>The reaction of the output depends on the setting of P9.8 „Motor Thermal Protection”.</p> <p>P9.8 = “0: No Action” → the output will not be activated.</p> <p>P9.8 = “1: Warning” → The output is activated at an overtemperature of the motor and deactivated automatically after about 5 s or with a reset signal.</p> <p>P9.8 = “2: Fault” and “3: Fault, Coast” → The output is activated at an overtemperature of the motor and deactivated with a reset signal.</p>

Selected function	Behavior of the output
59: STO Fault Output	<p>The reaction of the output depends on the setting of P9.56 „STO Fault Response”.</p> <p>P9.56 = “0: No Action” → the output will not be activated.</p> <p>P9.36 = “1: Warning” → The output is activated when the connection between the terminals STO+ and STO- is interrupted and deactivated automatically after about 5 s.</p> <p>P9.56 = “2: Fault” and “3: Fault, Coast” → The output is activated when the connection between the terminals STO+ and STO- is interrupted and deactivated with reconnection automatically.</p>

### 4.3.3 Monitoring the analog inputs

There are two possibilities to supervise analog inputs „Analog Input Superv“ and „Second Analog AI Supv“. These two signals can be assigned to analog inputs on the basic unit DG1. It is also possible to assign both signals to the same analog input.

Selected function	Behavior of the output
42: AI Level Check	<p>This choice activates the output, when the signal at an analog input exceeds respectively undercuts a set threshold. The setting of P5.21 “AI Supv Select” determines, which analog input is supervised. The behavior of the output depends on the setting of P5.22 “AI Limit Supv”.</p> <p>P5.22 = “0: No Limit” → the output will not be activated.</p> <p>P5.22 = “1: Low Limit Superv” → The output is activated, when the signal at the analog input is lower than the threshold set with P5.23 “AI Limit Supv Val”</p> <p>P5.22 = “2: High Limit Superv” → The output is activated, when the signal at the analog input is higher than the threshold set with P5.23 “AI Limit Supv Val”</p> <p>P5.48 provides the setting of a hysteresis.</p>
53: AI Level2 Check	<p>This choice activates the output, when the signal at an analog input exceeds respectively undercuts a set threshold. The setting of P5.43 “Second AI Supv Select” determines, which analog input is supervised. The behavior of the output depends on the setting of P5.44 “Second AI Limit Supv”.</p> <p>P5.44 = “0: No Limit” → the output will not be activated.</p> <p>P5.44 = “1: Low Limit Superv” → The output is activated, when the signal at the analog input is lower than the threshold set with P5.45 “Second AI Limit Supv Val”</p> <p>P5.44 = “2: High Limit Superv” → The output is activated, when the signal at the analog input is higher than the threshold set with P5.45 “Second AI Limit Supv Val”</p> <p>P5.49 provides the setting of a hysteresis.</p>

Parameter	Name	Range	Default
P5.21	AI Supv Select	0: AI 1 1: AI 2	0
P5.22	AI Limit Supv	0: No Limit 1: Low Limit Superv 2: High Limit Superv	0
P5.23	AI Limit Supv Val	0.00 ... 100.00 %	0.00 %
P5.48	AI1 Supv Hyst	1.00 ... 10.00 %	1.00 %
P5.43	Second AI Supv Select	0: AI 1 1: AI 2	0
P5.44	Second AI Limit Supv	0: No Limit 1: Low Limit Superv 2: High Limit Superv	0
P5.45	Second AI Limit Supv Val	0.00 ... 100.00 %	0.00 %
P5.49	Second AI1 Supv Hyst	1.00 ... 10.00 %	1.00 %

#### 4.3.4 Speed- and frequency dependent signals

Selected function	Behavior of the output
7: At Speed	The output is active, when the speed of the motor corresponds to the one set with the speed reference. The output is not active when the device is disabled and during acceleration and deceleration..
8: Zero Frequency	The output is active, when the output frequency is 0 Hz, even when the variable frequency drive is disabled.
9: Freq Limit 1 Superv	<p>This choice activates the output, when a frequency threshold is exceeded respectively undercut. The behavior of the output depends on the setting of P5.7 "Freq Limit 1 Supv".</p> <p>P5.7 = "0: No Limit" → the function is deactivated.</p> <p>P5.7 = "1: Low Limit Superv" → The output is activated, when the output frequency is lower than the threshold set with P5.8 "Freq Limit 1 Supv Val", even when the drive is disabled.</p> <p>P5.7 = "2: High Limit Superv" → The output is activated, when the output frequency is higher than the threshold set with P5.8 "Freq Limit 1 Supv Val"</p> <p>P5.7 = „3: Brake-on Control“ is used to control a mechanical brake with the variable frequency drive.</p> <p>P5.50 provides the setting of a hysteresis.</p>
10: Freq Limit 2 Superv	<p>This choice activates the output, when a frequency threshold is exceeded respectively undercut. The behavior of the output depends on the setting of P5.9 "Freq Limit 2 Supv".</p> <p>P5.9 = "0: No Limit" → the function is deactivated.</p> <p>P5.9 = "1: Low Limit Superv" → The output is activated, when the output frequency is lower than the threshold set with P5.10 "Freq Limit 2 Supv Val", even when the drive is disabled.</p> <p>P5.9 = "2: High Limit Superv" → The output is activated, when the output frequency is higher than the threshold set with P5.10 "Freq Limit 2 Supv Val"</p> <p>P5.9 = „3: Brake-off Control“ is used to control a mechanical brake with the variable frequency drive.</p> <p>P5.9 = „4: Brake on/off Control“ is used to control a mechanical brake with the variable frequency drive.</p> <p>P5.51 provides the setting of a hysteresis.</p>
21: Ref Limit Superv	<p>This choice activates the output, when the speed reference at the input of the ramp exceeds respectively undercuts a threshold. The behavior of the output depends on the setting of P5.13 "Ref Limit Supv".</p> <p>P5.13 = "0: No Limit" → the function is deactivated.</p> <p>P5.13 = "1: Low Limit Superv" → The output is activated, when the speed reference at the input of the ramp is lower than the threshold set with P5.14 "Ref Limit Supv Val", even when the drive is disabled.</p> <p>P5.13 = "2: High Limit Superv" → The output is activated, when the speed reference at the input of the ramp is higher than the threshold set with P5.14 "Ref Limit Supv Val"</p> <p>P5.53 provides the setting of a hysteresis.</p>

Parameter	Name	Range	Default
P5.7	Freq Limit 1 Supv	0: No limit 1: Low Limit Superv 2: High Limit Superv 3: Brake-on Control	0
P5.8	Freq Limit 1 Supv Val	0.00 Hz ... f-max (P1.2)	0.00 Hz
P5.50	Freq Limit 1 Supv Hyst	0.1 ... 1.0 Hz	0.1 Hz
P5.9	Freq Limit 2 Supv	0: No limit 1: Low Limit Superv 2: High Limit Superv 3: Brake-off Control 4: Brake on/off Control	0
P5.10	Freq Limit 2 Supv Val	0.00 Hz ... f-max (P1.2)	0.00 Hz
P5.51	Freq Limit 2 Supv Hyst	0.1 ... 1.0 Hz	0.1 Hz
P5.13	Ref Limit Supv	0: No limit 1: Low Limit Superv 2: High Limit Superv	0
P5.14	Ref Limit Supv Val	0.00 Hz ... f-max (P1.2)	0.00 Hz
P5.53	Ref Limit Supv Hyst	0.1 ... 1.0 Hz	0.1 Hz

#### 4.3.5 Torque dependent signals

Selected function	Behavior of the output
20: Torq Limit Superv	<p>This choice activates the output, when a torque threshold is exceeded respectively undercut. The behavior of the output depends on the setting of P5.11 "Torque Limit Superv".</p> <p>P5.11 = "0: No Limit" → the function is deactivated.</p> <p>P5.11 = "1: Low Limit Superv" → The output is activated, when the torque is lower than the threshold set with P5.12 "Torque Limit Supv Val".</p> <p>P5.11 = "2: High Limit Superv" → The output is activated, when the torque is higher than the threshold set with P5.12 "Torque Limit Supv Val".</p> <p>P5.11 = „3: Brake-off Control“ is used to control a mechanical brake with the variable frequency drive.</p> <p>100 % torque corresponds to the rated torque of the connected motor based on the set motor data. P5.52 provides the setting of a hysteresis.</p>

Parameter	Name	Range	Default
P5.11	Torque Limit Supv	0: No limit 1: Low Limit Superv 2: High Limit Superv 3: Brake-off Control	0
P5.12	Torque Limit Supv Val	-1000 ... +1000 %	100 %
P5.52	Torque Limit Supv Hyst	0.0 ... 10.0 %	1.0 %

### 4.3.6 Power dependent signals

Selected function	Behavior of the output
40: Power Limit Superv	<p>This choice activates the output, when a power threshold is exceeded respectively undercut. The behavior of the output depends on the setting of P5.19 "Power Limit Supv".</p> <p>P5.19 = "0: No Limit" → the function is deactivated.</p> <p>P5.19 = "1: Low Limit Superv" → The output is activated, when the power is lower than the threshold set with P5.20 "Power Limit Supv Val".</p> <p>P5.19 = "2: High Limit Superv" → The output is activated, when the power is higher than the threshold set with P5.20 "Power Limit Supv Val".</p> <p>100 % power corresponds to the rated power of the connected motor based on the set motor data. P5.55 provides the setting of a hysteresis.</p>

Parameter	Name	Range	Default
P5.19	Power Limit Supv	0: No limit 1: Low Limit Superv 2: High Limit Superv	0
P5.20	Power Limit Supv Val	-200.0 ... +200.0 %	0.0 %
P5.55	Power Limit Supv Hyst	0.1 ... 10.0 %	0.1 %

### 4.3.7 Current dependent signals

Selected function	Behavior of the output
51: Motor Current 1 Supv	<p>This choice activates the output, when a current threshold is exceeded respectively undercut. The behavior of the output depends on the setting of P5.39 "Motor Current 1 Supv".</p> <p>P5.39 = "0: No Limit" → the function is deactivated.</p> <p>P5.39 = "1: Low Limit Superv" → The output is activated, when the current is lower than the threshold set with P5.40 "Motor Current 1 Supv Value".</p> <p>P5.39 = "2: High Limit Superv" → The output is activated, when the current is higher than the threshold set with P5.40 "Motor Current 1 Supv Value".</p> <p>P5.39 = „3: Brake-off Control“ is used to control a mechanical brake with the variable frequency drive.</p> <p>P5.46 provides the setting of a hysteresis.</p>

Selected function	Behavior of the output
52: Motor Current 2 Supv	<p>This choice activates the output, when a current threshold is exceeded respectively undercut. The behavior of the output depends on the setting of P5.41 "Motor Current 2 Supv".</p> <p>P5.41 = "0: No Limit" → the function is deactivated.</p> <p>P5.41 = "1: Low Limit Superv" → The output is activated, when the current is lower than the threshold set with P5.42 "Motor Current 2 Supv Value".</p> <p>P5.41 = "2: High Limit Superv" → The output is activated, when the current is higher than the threshold set with P5.42 "Motor Current 2 Supv Value".</p> <p>P5.41 = „3: Brake-off Control“ is used to control a mechanical brake with the variable frequency drive.</p> <p>P5.47 provides the setting of a hysteresis.</p>

Parameter	Name	Range	Default
P5.39	Motor Current 1 Supv	0: No limit 1: Low Limit Superv 2: High Limit Superv 3: Brake-off Control	0
P5.40	Motor Current 1 Supv Value	0 ... 200 % I <sub>e</sub>	100 % I <sub>e</sub>
P5.46	Motor Current 1 Supv Hyst	0.1 ... 1 A	0.1 A
P5.41	Motor Current 2 Supv	0: No limit 1: Low Limit Superv 2: High Limit Superv 3: Brake-off Control	0
P5.42	Motor Current 2 Supv Value	0 ... 200 % I <sub>e</sub>	100 % I <sub>e</sub>
P5.47	Motor Current 2 Supv Hyst	0.1 ... 1 A	0.1 A

#### 4.3.8 Temperature dependent signals

Selected function	Behavior of the output
41: Temp Limit Superv	<p>This choice activates the output, when a set temperature threshold is exceeded respectively undercut. The behavior of the output depends on the setting of P5.17 "Temp Limit Superv".</p> <p>P5.17 = "0: No Limit" → the function is deactivated.</p> <p>P5.17 = "1: Low Limit Superv" → The output is activated, when the temperature is lower than the threshold set with P5.18 "Temp Limit Supv Val".</p> <p>P5.17 = "2: High Limit Superv" → The output is activated, when the temperature is higher than the threshold set with P5.18 "Temp Limit Supv Val".</p> <p>P5.54 provides the setting of a hysteresis.</p>

Parameter	Name	Range	Default
P5.17	Temp Limit Supv	0: No limit 1: Low Limit Superv 2: High Limit Superv	0
P5.18	Temp Limit Supv Val	-10 ... 75 °C	40 °C
P5.54	Temp Limit Supv Hyst	0.1 ... 10.0 °C	1.0 °C

### 4.3.9 Monitoring of the PID controllers

See also Application Note AP040164EN “DG1 PID Controller”

Selected function	Behavior of the output
11: PID1 Superv	Supervision of the error value of PID controller PID1. The supervision must be activated with P5.24. The digital output is active, when the error value for a time defined with P5.27 is outside the tolerance band defined with P5.25 and P5.26. The supervision is not active when the PID controller is disabled.
12: PID2 Superv	Supervision of the error value of PID controller PID2. The supervision must be activated with P5.28. The digital output is active, when the error value for a time defined with P5.31 is outside the tolerance band defined with P5.29 and P5.30. The supervision is not active when the PID controller is disabled.
49: PID1 Sleep	The output is active, when the PID controller PID1 is in sleep mode.
50: PID2 Sleep	The output is active, when the PID controller PID2 is in sleep mode.

Parameter	Name	Range	Default
P5.24 (P5.28)	PID1 Superv Enable (PID2 Superv Enable)	0: Disabled 1: Enabled	0
P5.25 (P5.29)	PID1 Superv Upper Limit (PID2 Superv Upper Limit)	Depending on the process variable set with the parameters P10.4 (P11.4) and P10.7 (P11.7)	0
P5.26 (P5.30)	PID1 Superv Lower Limit (PID2 Superv Lower Limit)		0
P5.27 (P5.31)	PID1 Superv Delay (PID2 Superv Delay)	0 ... 3000 s	0 s

### 4.3.10 Status of the timers

See also Application Note AP040172EN “DG1 Real Time Clock and Use of the Timers”

Selected function	Behavior of the output
36: TC1 Status	The output is active during the run time of Timer 1 (P19.26).
37: TC2 Status	The output is active during the run time of Timer 2 (P19.28).
38: TC3 Status	The output is active during the run time of Timer 3 (P19.30).

#### 4.3.11 Pump and fan control

See also Application Note AP040128EN „DG1 in Pump and Fan Applications“

Selected function	Behavior of the output
35: Damper Control	The output becomes active by applying a START signal and starts an auxiliary drive, e.g. to open a valve. After an adjustable time or after receiving a feedback signal via a digital input the drive starts. The output is deactivated by removing the START signal.
43: Motor 1 Control	Control of single speed pumps in a multi pump system with one speed controlled motor and multiple single speed ones. The digital output is active, when the respective single speed pump shall run.
44: Motor 2 Control	
45: Motor 3 Control	
46: Motor 4 Control	
47: Motor 5 Control	
57: Prime Pump Active	The output is active during pipe fill at start.

#### 4.3.12 Control of a mechanical brake

See also Application Note AP040176EN “DG1 Starting, Stopping and Operation”

Selected function	Behavior of the output
18: Ext Brake Control	The output is active, when the mechanical brake shall be active. The output is not active, when the mechanical brake shall be lifted.
19: Ext Brake Inverted	The output is active, when the mechanical brake shall be lifted. The output is not active, when the mechanical brake shall be active.

#### 4.3.13 Signals via fieldbus

Selected function	Behavior of the output
31: FB Digital Input 1	The digital outputs are linked to information coming from the control word via fieldbus. See manual of the respective fieldbus.
32: FB Digital Input 2	
33: FB Digital Input 3	
34: FB Digital Input 4	

#### 4.3.14 Combining signals

Selected function	Behavior of the output
48: Logic Fulfilled	Two functions, listed in chapter 4.3ff can be logically combined (see below). When the logic is fulfilled, the output is activated.

The functions to be linked are selected with the parameters P6.2 “Logic Operation Input A” and P6.3 “Logic Operation Input B”. Description see chapter 4.3ff. The type of linkage depends on the setting of P6.1 “Logic Function Select”.

P6.1 = „0: AND“ → Both conditions must be fulfilled to activate the output.

P6.1 = „1: OR“ → At least one condition must be fulfilled to activate the output.

P6.1 = „2: XOR“ → One condition must be fulfilled to activate the output. Are both conditions fulfilled simultaneously, the output will be deactivated.

P6.1 = 0: AND			P6.1 = 1: OR			P6.1 = 2: XOR		
Logik Operation Input		Digital Output	Logik Operation Input		Digital Output	Logik Operation Input		Digital Output
A (P6.2)	B (P6.3)		A (P6.2)	B (P6.3)		A (P6.2)	B (P6.3)	
0	0	0	0	0	0	0	0	0
1	0	0	1	0	1	1	0	1
0	1	0	0	1	1	0	1	1
1	1	1	1	1	1	1	1	0

Parameter	Name	Range	Default
P6.1	Logic Function Select	0: AND 1: OR 2: XOR	0
P6.2	Logic Operation Input A	0: Not Used 1: Ready 2: Run 3: Fault 6: Reversed 7: Warning 8: Zero Frequency 9: Control from I/O 14: Run Bypass/Drive 15: Ext Brake Control 16: In Bypass Mode 17: At Speed 18: Remote Control 19: Freq Limit 1 Superv 20: Freq Limit 2 Superv 22: PID1 Superv 23: PID2 Superv 24: OverHeat Fault 28: 4mA Ref Fault/Warning 29: OverCurrent Regular 30: OverVoltage Regular 31: UnderVoltage Regular 32 Torq Limit Superv 33: Ref Limit Superv 34: Un-Requested Rotation Direction 35: Thermal Fault/Warning 36: Bypass Enable 37: Jog Speed Select 38: Motor Therm Protection 39: FB Digital Input 1 40: FB Digital Input 2 41: FB Digital Input 3 42: FB Digital Input 4 43: Damper Control 44: TC1 Status 45: TC2 Status 46: TC3 Status 47: In E-Stop 48: Power Limit Superv 49: Temp Limit Superv 50: Analog Input Superv 51: Motor 1 Control 52: Motor 2 Control 53: Motor 3 Control	0

Parameter	Name	Range	Default
		54: Motor 4 Control 55: Motor 5 Control 56: Logic Fulfilled	
P6.3	Logic Operation Input B	like P6.2	0

#### 4.3.15 Configuration example

In remote control, the contact of RO3 shall open 2 seconds after having reached the speed according to the set speed reference.

The relay output RO3 has a normally open contact (NO), which closes when activating the output. In this example it is required, that the contact opens when the output is activated. Therefore P5.38 has to be set accordingly.

→ P5.38 „RO3 Reverse“ = YES (see 4.1.1)

The relay output shall be active, when a certain logic function is fulfilled („Remote Control“ AND „At Speed“).

→ P5.4 „RO3 Function“ = 48: Logic fulfilled (see 4.3.14)

The linkage of both signals shall be of type AND.

→ P6.1 „Logic Function Select“ = 0: AND

First condition is, that the drive operates in the “Remote Control” mode.

→ P6.2 „Logic Operation Input A“ = 18: Remote Control (see 4.3.1)

Second condition is, that the drive shall have the speed according to the set speed reference.

→ P6.3 „Logic Operation Input B“ = 17: At Speed (see 4.3.4)

The relay output shall not be activated as soon as the conditions are fulfilled, but with a delay of 2 seconds. The activation of the output relay has to be delayed accordingly. In this case it has to be noted, that the output relay has a normally open (NO) contact, which will be de-energized when the output is activated. The 2 s delay must therefore be set with P5.37 and not with P5.36!

→ P5.37 „RO3 Off Delay“ = 2 s (see 4.1.1)