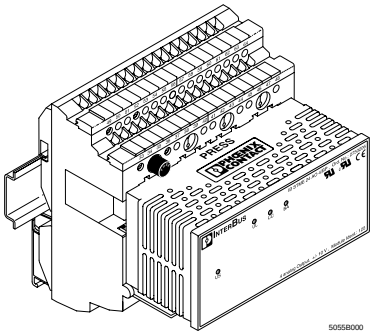
IB ST (ZF) 24 AO 4/BP

Analog Output Module With 4 Channels



Data Sheet 5055B 01/1999

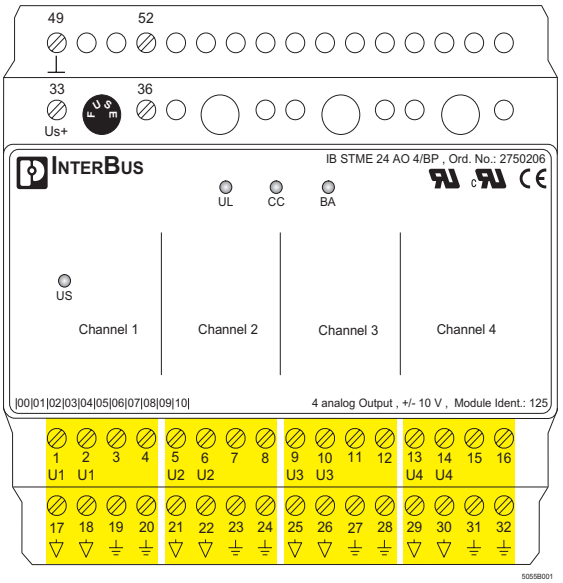


Figure 1 IB ST 24 AO 4/BP module

General information pertaining to ST modules can be found in the IBS SYS PRO UM E Manual.

Ground the mounting rail. The module is grounded by snapping it onto the mounting rail.

Terminal Assignment

Terminal	Signal
Us+	24 V I/O supply voltage
⊥	Ground of the supply voltage
U1 to U4	Voltage outputs channels 1 to 4
▽	Analog ground connection
⏚	Ground potential

Local Diagnostic and Status Indicators

Des.	Color	Meaning
UL	Green	Supply voltage for the module electronics
CC	Green	Cable check
BA	Green	Bus active
US	Green	24 V I/O supply voltage

Internal Circuit Diagram

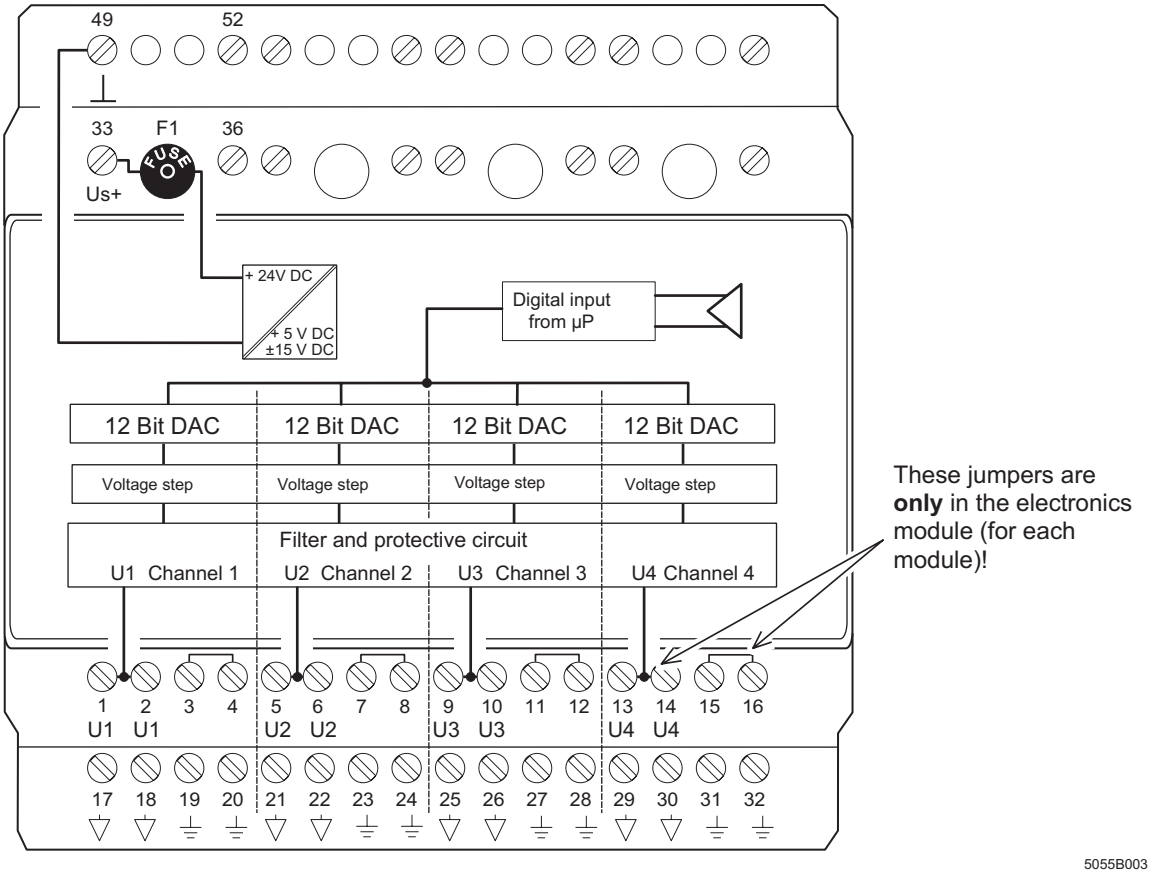


Figure 2 Internal wiring of the terminals (four channels)

Electrical Isolation of the Function Areas

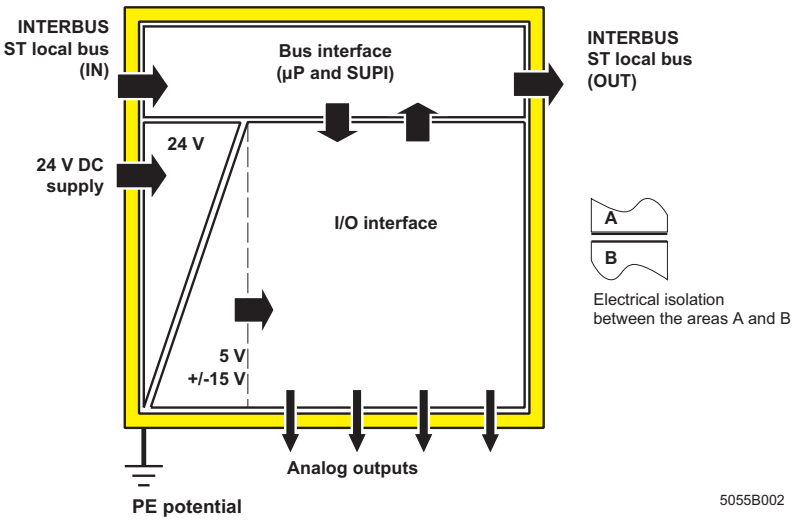


Figure 3 Electrical isolation of the single function areas

Connection Examples

Connection of the Supply Voltage

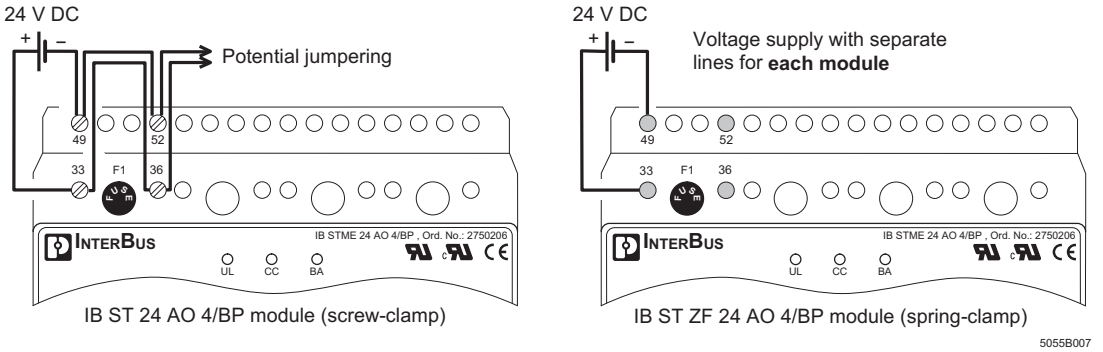


Figure 4 Connection of the supply voltage

Potential Jumpering in the Screw-Clamp Module:
To connect more modules, an external bridge is required between the terminals 33 (Us) and 36, and 49 (⊥) and 52.

Connecting Actuators with Different Cable Lengths

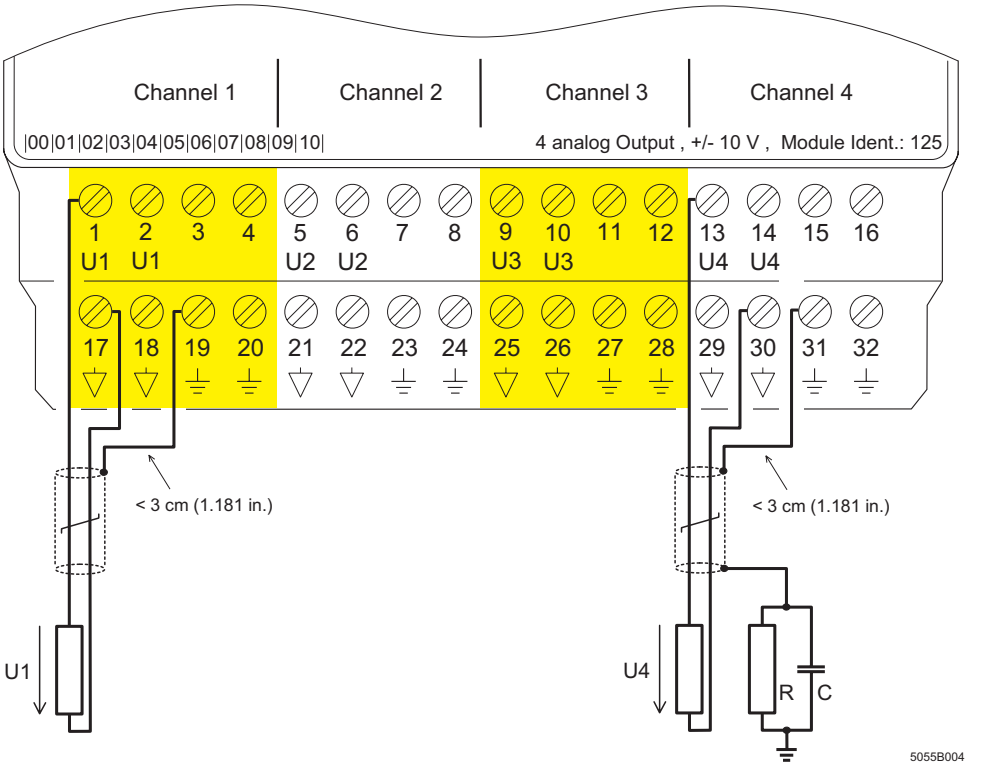


Figure 5 Connection of actuators

Channel 1: Voltage tap with shield connection for cable lengths **below 10 m (33 ft.)**

Channel 4: Voltage tap with shield connection for cable lengths **exceeding 10 m (33 ft.)**

When using cables with less than 10 m in length, connect one end of shield to the IB ST (ZF) 24 AO 4/BP module (see Figure 5).
When using cables with a length of more than 10 m in environments with heavy noise, we recommend connecting the shield also through an RC element to PE potential of the actuator (see Figure 5).
Typcially, the capacitor C should be rated between 1 and 15 nF. The resistor R should have at least 10 MΩ . The terminal points of the shield are directly connected with PE potential.

The terminals 1 and 2, 5 and 6, 9 and 10, 13 and 14 only have the same potential if the electronics module is plugged. The terminals 3, 4, 7, 8, 11, 12, 15, and 16 are not connected.

Programming Data

ID code	$7D_{hex}$ (125_{dec})
Length code	4_{hex}
Input address area	0 bytes
Output address area	8 bytes
Parameter channel (PCP)	0 bytes
Register length	8 bytes

INTERBUS OUT Process Data Word

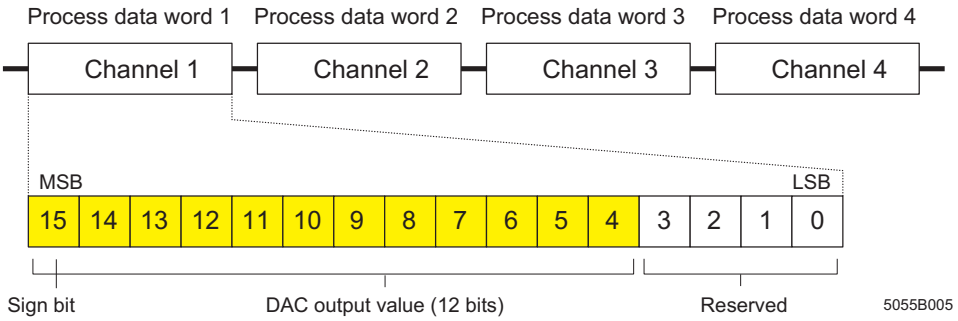


Figure 6 Sequence of the four INTERBUS OUT process data words in the INTERBUS ring and representation of the bits of the first process data word

Bits 0, 1, 2, and 3 are reserved. The value of these bits is insignificant. Bit 15 is the sign bit. If it has the value 0, the output value is positive. If bit 15 is set to 1, the output value is negative.

Assignment of the Module Terminals to the INTERBUS Reference

INTERBUS reference	Word	Word x															
	Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Byte	Byte 0								Byte 1							
	Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Module terminals channel 1	Signal	Sign bit	Terminals 1 and 2: Voltage output Terminals 3 and 4: Not used														
	Analog ground		Terminals 17 and 18														
	Shield		Terminals 19 and 20														
Module terminals channel 2	Signal	Sign bit	Terminals 5 and 6: Voltage output Terminals 7 and 8: Not used														
	Analog ground		Terminals 21 and 22														
	Shield		Terminals 23 and 24														
Module terminals channel 3	Signal	Sign bit	Terminals 9 and 10: Voltage output Terminals 11 and 12: Not used														
	Analog ground		Terminals 25 and 26														
	Shield		Terminals 27 and 28														
Module terminals channel 4	Signal	Sign bit	Terminals 13 and 14: Voltage output Terminals 15 and 16: Not used														
	Analog ground		Terminals 29 and 30														
	Shield		Terminals 31 and 32														

INTERBUS OUT Process Data Word for the Voltage Outputs (Example)																	
Voltage output **-10 V to +10 V**	Analog value (V)	Process data word															
		Hex.	Binary (two's complement) MSB														LSB
			15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
10 V minus 1 quantization step	9.9951	7FF0	0	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0
10 V minus 2 quantization steps	9.9902	7FE0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
Half positive output range final value	5.0000	4000	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 positive quantization step = 4.88 mV		0010	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Zero	0.0000	0000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 negative quantization step = -4.88 mV		FFF0	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0
Half negative output range final value	-5.0000	C000	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-10 V plus 1 positive quantization step	-9.9951	8010	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
-10 V	-10.0000	8000	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Technical Data

General	
Housing dimensions (width x height x depth)	118 mm (4.65 in.) x 116 mm (4.57 in.) x 117 mm (4.61 in.)
Operating mode	Process data operation with 4 words
Connection method of the actuators	2-wire technology
Total power consumption	3.2 W, typical
Permissible operating temperature	From 0°C (32°F) to 55°C (131°F)
Permissible storage temperature	From -25°C (-13°F) to 70°C (158°F)
Degree of protection	IP 20 DIN 40050, IEC 60529
Class of protection	Class 3 VDE 0106, IEC 60536
Humidity	75% on average, 85% occasionally, no condensation
Air pressure (operation)	From 80 kPa to 106 kPa, 2000 m (6562 ft.) above sea level
Electrical isolation	Test voltage
Bus/outputs	500 V AC, 1 min., 50 Hz
Supply voltage/outputs	500 V AC, 1 min., 50 Hz
Supply voltage/protective conductor	500 V AC, 1 min., 50 Hz
I/O voltage/protective conductor	500 V AC, 1 min., 50 Hz
Emitted interference	EN 50081-2, Class A
Processor monitoring	Watchdog circuit
Preferred installation position	Wall mounting
Protective ground connection	Via DIN rails
Weight	600 g, typical

Interface	
INTERBUS ST interface	ST cable (supplied with the module)

Power Consumption	
Communications power	9 V
Current consumption from the local bus	100 mA, typical; 130 mA, maximum
Power consumption from the local bus	1 W, typical
I/O voltage U_S	24 V DC
Current consumption of U_S	90 mA, typical
Power consumption from power supply unit and application side (24 V supply)	2.2 W, typical

I/O Supply Voltage (U_S)	
Nominal value	24 V DC
Permissible ripple	3.6 V_{pp} within the permissible voltage range
Permissible voltage range (including ripple)	Operation: 18.5 V DC to 30.2 V DC
Current consumption of U_S	90 mA, typical
Electrical isolation	Via DC/DC converter
Test voltage	500 V AC (50 Hz for 1 min.)
Protection against polarity reversal	Via diodes connected in series
Transient protection	Yes
Overload protection	Fuse F1 in base element IBS TR5 0,4 AT
Failure detection	Yes
Power consumption from power supply unit and application side (24 V supply)	2.2 W, typical

Analog Voltage Outputs	
Number	4
Output area	-10 V to +10 V
Output current	5 mA, maximum
Permissible load resistance	At least 2 kΩ
Representation of output value	16 bit two’s complement
Quantization	12 bits (4096 steps) or 4.88 mV/quantization step
D/A conversion time of all channels	1 ms (incl. slew rate), maximum
Transient protection	Yes

Analog Voltage Outputs	(Continued)
Basic error limit	±0.1% of the output range final value of 10 V
Derating	No derating
Separate shield connection	Yes

Tolerance Behavior and Temperature Response of the Voltage Outputs (Error Indications Refer to the Final Value of the Output Range (10 V Voltage))		
Offset error at 23°C (73.4°F)	**Typical**	**Maximum**
Total offset voltage	±0.1%	±0.2%
Gain error at 23°C (73.4°F)	±0.2%	±0.4%
Differential non-linearity	< ±0.04%	±0.04%
Temperature response at 0°C (32°F) to +55°C (158°F)		
Offset voltage drift T_{KVO}	±10 ppm/K	±20 ppm/K
Gain drift T_{KG}	±20 ppm/K	±80 ppm/K
Total voltage drift $T_{Ktot} = T_{KVO} + T_{KG}$	±30 ppm/K	±100 ppm/K
Total error of the voltage inputs (**0°C (32°F) to 55°C (131°F)**) (offset error + gain error + linearity error + drift error)	±0.36%	±0.5%

The max. total error at 0°C (32°F) to 55°C (131°F) is ±0.5% for the voltage outputs of the output range final value of +10V.

Additional Tolerances Influenced by Electromagnetic Fields

Type of Electromagnetic Interference	Deviation of the Output Value
Radiated-noise immunity acc. to IEC 60801-3: 1984 (field strength 10 V/m)	< ±2%
Conducted high-frequency interference (0.15 KHz to 80 MHz) acc. to IEC 60801-6: 1992 Class 3 ENV 50141: 1993	< ±2%
Transient interferences (burst) acc. to IEC 60801-4 Class 3: 1988	< ±0.5%
Transient interferences (burst) acc. to IEC 60801-4 Class 4: 1988	< ±0.5%

All error indications are typical and refer to the output range final value of 10 V.

Output Behavior of the Voltage Outputs

Supply Voltage of the Module	Supply Voltage of the BK Module	Bus Status	INTERBUS OUT Process Data Words 1 to 4	Behavior/Status of the Analog Outputs
From 0 V to 24 V	24 V	In operation	$xxxx_{hex}$	Keep last value
From 0 V to 24 V	0 V	In operation	0000_{hex}	0 V
From 24 V to 0 V	Varies	In operation	$yyyy_{hex}$	0 V
24 V	From 0 V to 24 V	In operation	$xxxx_{hex}$	Keep last value
0 V	From 0 V to 24 V	In operation	0000_{hex}	0 V
Varies	From 24 V to 0 V	In operation	$yyyy_{hex}$	0 V
From 0 V to 24 V	From 0 V to 24 V	In operation	$xxxx_{hex}$	Keep last value
24 V	24 V	Interrupted	$xxxx_{hex}$	Keep last value
24 V	0 V	Interrupted	0000_{hex}	0 V
0 V	24 V	Interrupted	0000_{hex}	0 V
24 V	24 V	Reset	$xxxx_{hex}$	Keep last value
24 V	0 V	Reset	0000_{hex}	0 V
0 V	24 V	Reset	0000_{hex}	0 V

Key:

$xxxx_{hex}$ Hexadecimal encoded value acc. to table on page 7.

Keep last value Output of the last output value **before** a power supply or a bus has broken down. The value is stored in the module and is encoded available in the INTERBUS OUT process data words 1 to 4 ($xxxx_{hex}$). During breakdown, the output is 0 V. If the module is connected for the first time the memory contains the value 0 V.

$yyyy_{hex}$ Hexadecimal encoded output value which is sent from the control or computer system in the current bus cycle.

Response of the Control System or Computer to a Hardware Signal for Different Control or Computer Systems

Signal	Control or Computer System	Status After the Switching Operation	
		INTERBUS OUT Process Data Words 1 to 4 (hexadecimal)	Analog Outputs U_{out}
NORM*	AEG-Schneider Automation	0000	0 V
BASP	Siemens S5	0000	0 V
CLAB	Bosch	0000	0 V
SYSFAIL	VME	0000	0 V
CLEAR OUT	Klöckner-Moeller IPC	0000	0 V
SYSFAIL	PC	0000	0 V

* On controller boards for AEG-Schneider Automation control systems it is possible to set the NORM signal in such a way that the INTERBUS OUT process data words 1 to 4 and the analog outputs keep the last value.

Response to a Control Command to the INTERBUS Controller Board

Command	Status After the Switching Operation	
	INTERBUS OUT Process Data Words 1 to 4	Analog Outputs U_{out}
STOP	Keep last value	Keep last value
ALARM STOP (reset)	Keep last value	Keep last value

Mechanical Tests	
Vibration test (EN 60068-2-6; IEC 60068-2-6)	Acceleration amplitude above the limit frequency 2g (operation); 5g (transport)
Shock test (EN 60068-2-27; IEC 60068-2-27)	Max. acceleration: 15g Shock duration: 11 ms Max. acceleration: 25g Shock duration: 6 ms
Mechanical noise (EN 60068-2-64; IEC 60068-2-64)	Acceleration density 30 to 200 Hz: 0.25 m^2/s^3 Effective acceleration: 7.8g

Module Error Messages	
Breakdown of the I/O voltages from ±15 V DC and/or 5 V DC	Yes
Breakdown of F1 fuse for the I/O supply voltage U_S	Yes
Breakdown of the I/O supply voltage U_S 24 V DC	Yes

Ordering Data

Description	Order Designation	Order No.
Analog output module (screw-clamp)	IB ST 24 AO 4/BP	27 52 52 1
Analog output module (spring-clamp)	IB ST ZF 24 AO 4/BP	27 50 61 7
Module electronics	IB STME 24 AO 4/BP	27 50 20 6
Replacement terminal block (screw-clamp)	IB STTB 24 AO 4/SF	27 53 05 4
Replacement terminal block (spring-clamp)	IB STTB ZF 24 AO 4/SF	27 50 86 6
Fuse 400 mA (slow-blow)	IBS TR5 0,4 AT	27 53 47 8