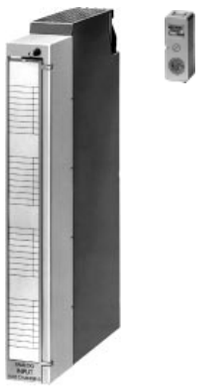
Analog input modules

Application



The analog input modules convert the analog signals from the process into digital values which can be processed by the programmable controller.

Design

Modules with 4, 8 or 16 inputs are available. The modules each require one slot.

The signal leads must be connected with front connectors. They can be labelled in the field on the front panel.

Measuring range modules required for signal conditioning are plugged into the module. Each module sets the measuring range for a group of 4 channels (inputs).

The 460-7 and 463-4 modules are reaction-free, the 463-4 module is also suitable for failsafe operation.

Functions such as wire break signalling, line frequency or measuring range are set using switches at the rear of the module.

Principle of operation

The analog input modules have different methods of operation. The 460-7, 465-7 and 463-4 modules work on an integrating measuring principle, whereas the 466-3 analog input module uses instantaneous value encoding. Analog-digital conversion is performed in the 460-7 and 465-7 modules by voltage-time conversion and in the 463-4 by voltage-frequency conversion. The 466-3 module employs successive approximation and has the shortest encoding time.

All modules indicate overrange errors. The 460-7 and 465-7 can also detect wire breakage in the sensor line for the Pt 100 (user-configurable).

All modules have a high degree of noise suppression.

Note

All the analog input modules of the S5-135U/-155U programmable controllers (see Section 4) can be used in the S5-115U with adapter casings.

An adapter casing is required for the 463-4 and 466-3 analog input modules (page 3/98).

The 463-4 module must not be operated in the third centrally connected ER 701-3 subrack for S5-115F.

Technical specifications

Analog input module	6ES5 460-7LA13	6ES5 465-7LA13	6ES5 463-4U.12
Number of inputs	**8** voltage/current inputs or **8** inputs for Pt 100 resistance thermometer	**16** voltage/current inputs or **8** inputs for Pt 100 resistance thermometer	**4** voltage/current inputs
Galvanic isolation	Yes	No	Yes
Input ranges (rated values)	**± 50 mV; ± 500 mV; Pt 100; ± 1 V; ± 5 V; ± 10 V; ± 20 mA; + 4 ... 20 mA** Input ranges can be selected for 4 channels at a time using measuring range modules		**0 ... 1 V, 0 ... 10 V, 0 ... 20 mA + 4 ... 20 mA** for two-wire and four-wire measuring transducers
Input resistance in the individual ranges	50 mV: ≧ 10 MΩ 500 mV: ≧ 10 MΩ Pt 100 : ≧ 10 MΩ 1 V: 90 kΩ; 2 ‰ 5 V: 50 kΩ; 2 ‰ 10 V: 50 kΩ; 2 ‰ 20 mA: 25 Ω; 1 ‰ 4 ... 20 mA: 31.2 Ω; 1 ‰		1 V: ≧ 10 MΩ; 10 V: 90 kΩ; 20 mA: 50 Ω 4 ... 20 mA: 62.5Ω
Types of connection of sensors	Two-wire connection; four-wire connection for Pt 100		Two-wire connection
Digital representation of the input signal	12 bit + sign or 13 bit two's complement (2048 units = rated value)		11 bit two's complement (1024 units = rated value)

Analog input modules (continued)

Technical specifications

Analog input module	6ES5 460-7LA13	6ES5 465-7LA13	6ES5 463-4U.12
Measuring principle	Integrating	Integrating	Integrating
Conversion principle	Voltage-time conversion	Voltage-time conversion	Voltage-time conversion
Integration time (adjustable for optimum noise suppression)	20 ms at 50 Hz $16^2/_3$ ms at 60 Hz	20 ms at 50 Hz $16^2/_3$ ms at 60 Hz	20 ms at 50 Hz $16^2/_3$ ms at 60 Hz
Encoding time max. (single value encoding possible)	60 ms at 50 Hz 50 ms at 60 Hz (referred to nominal value)	60 ms at 50 Hz 50 ms at 60 Hz (referred to nominal value)	60 ms at 50 Hz $16^2/_3$ ms at 60 Hz
Cycle time for 4 inputs	—	—	20 ms at 50 Hz $16^2/_3$ ms at 60 Hz
8 inputs	0.48 s at 50 Hz	0.48 s at 50 Hz	—
16 inputs	—	0.96 s at 50 Hz	—
Permissible voltage between inputs or between inputs and the central earthing point (destruction limit) max.	± 18 V or max. ± 75 V for 1 ms with a pulse repeat rate of 50 pulses/second		± 30 V or max. ± 75 V for 1 ms with a pulse repeat rate of 100 pulses/second
Permissible voltage between the reference potential of a non-floating sensor and the central earthing point max.	75 V DC/60 V AC	± 1 V	75 V DC/60 V AC
Error indication for			
• Overranging	At 200 % of the nominal value (4095 units)		At 150 % of the nominal value
• Wire breakage of the sensor line	It can be designed for the ranges 50 mV, 500 mV and Pt 100		No
Noise suppression for f = n • (50/60 Hz ± 1%); n = 1,2 ...			
• Common mode noise (V_p < 1 V) min.	120 dB	86 dB	80 dB
• Series mode noise (peak noise value < rated value of the range) min.	40 dB	40 dB	40 dB
Basic error limits[1]	50 mV: ± 2 ‰ 1 V: ± 3.5 ‰ 500 mV: ± 1.5 ‰ 5 V: ± 3.5 ‰ Pt 100: ± 2 ‰ 10 V: ± 3.5 ‰	20 mA: ± 2.5 ‰ 4 ... 20 mA: ± 2.5 ‰	1.1 ‰
Operational error limits[1] (0 °C to 60 °C)	50 mV: ± 5 ‰ 1 V: ± 7.7 ‰ 500 mV: ± 4.5 ‰ 5 V: ± 7.7 ‰ Pt 100: ± 5 ‰ 10 V: ± 7.7 ‰	20 mA: ± 6.7 ‰ 4 ... 20 mA: ± 6.7 ‰	3.7 ‰
Cable length (shielded) max.	200 m (650 ft); max. 50 m (164 ft) at 50 mV	200 m (650 ft); max. 50 m (164 ft) at 50 mV	200 m (650 ft)
Supply voltage			
• Rated value	+ 24 V	+ 24 V	+ 24 V
• Ripple V_{pp}	3.6 V	3.6 V	3.6 V
• Permissible range (including ripple)	20 ... 30 V	20 ... 30 V	20 ... 30 V
• Value at t < 0.1 s	36 V	36 V	36 V
Current consumption			
• Internal (at 5 V) typ.	0.15 A	0.15 A	0.2 A
• External (at 24 V) typ.	0.1 A	—	0.15 A
Front connector	46-pin	46-pin	42-pin
Weight approx.	0.4 kg (0.9 lb)	0.4 kg (0.9 lb)	0.4 kg (0.9 lb)

1) In accordance with DIN 43 745; referred to nominal measuring range (5 V supply from power supply module).

Analog input modules (continued)

Technical specifications

Analog input module		6ES5 466-3LA11
Number of inputs		**8** differential inputs or **16** individual inputs (referred to ground) in 4 or 2 groups (selectable)
Galvanic isolation		Yes
Input ranges (rated values)		**0 ... 20 mA; 4 ... 20 mA; ± 20 mA** **0 ... 1.25 V; 0 ... 2.5 V; 0 ... 5 V; 1 ... 5 V; 0 ... 10 V** **± 1.25 V; ± 2.5 V; ± 5 V; ± 10 V** } selector switch lets you select these values for 4 channels separately
Input resistance in the individual ranges		Voltage measuring range: ≥ 10 MΩ Current measuring range: 125 MΩ
Types of connection of signal sensors		Two-wire connection
Digital representation of the input signal		13 bit two's complement or 12 bit abs. value + sign or 12 bit binary
Measuring principle		Instantaneous value encoding
Conversion principle		Successive approximation
Encoding time per channel	max.	250 µs
Cycle time for 8 inputs 16 inputs	 max. max.	 2 ms 4 ms
Permissible voltage between inputs or between inputs and the central earthing point (destruction limit)	max.	± 30 V (static) or ± 75 V for 1 ms with a pulse repeat rate of 50 pulses/second
Permissible voltage between the reference potential of a non-floating sensor and the central earthing point	max.	75 V DC/60 V AC
Error indication for • Overranging • Wire breakage of the sensor line		 Yes (overflow bit) No
Noise suppression for f = n · (50/60 Hz ± 1%); n = 1,2 ... • Common mode noise (V_p < 1 V) • Series mode noise (peak noise value < rated value of the range)	 min. min.	 70 dB 40 dB
Basic error limits[1] (at 20 °C)		Voltage ranges (except 0... 1.25 V; ± 1.25 V): 0.1 % Current ranges and 0... 1.25 V; ± 1.25 V: 0.12%
Operational error limits[1] (0 °C to 60 °C; for one year)		Voltage ranges (except 0... 1.5 V; ± 1.25 V): 0.2 % Current ranges and 0... 1.25 V; ± 1.25 V: 0.24%
Cable length (shielded)	max.	200 m (650 ft)
Current consumption • Internal (at 5 V) • External (at 24 V)	 typ. typ.	 0.7 A —
Front connector		43-pin
Weight	approx.	0.4 kg (0.9 lb)

1) In accordance with DIN 43 745; referred to nominal measuring range (5 V supply from power supply module).

Analog input modules (continued)

Ordering data	Order No.		Order No.
460-7 analog input module for S5-115U/H/F 8 inputs (current/voltage or Pt 100), input range set by measuring range module, floating	**6ES5 460-7LA13**	**466-3 analog input module** for S5-115U/H 16 individual inputs/ 8 differential inputs floating, with short encoding time	**6ES5 466-3LA11**
465-7 analog input module for S5-115U/H 16 inputs (current/voltage) or 8 inputs (Pt 100), input range set by measuring range module, non-floating	**6ES5 465-7LA13**	Operating instructions are included in the S5-115U manual (see page 3/23).	
To be ordered as a separate item:		**490 front connector** for AE 463-4, 466-3	
498 measuring range module for 4 channels		For screw terminals, 46-pin	**6ES5 490-7LB21**
± 50 mV; ± 500 mV; Pt 100	**6ES5 498-1AA11**	For crimp terminals, 46-pin	
± 1 V	**6ES5 498-1AA21**	• With 50 crimp contacts	**6ES5 490-7LA11**
± 5 V	**6ES5 498-1AA61**	• Without crimp contacts	**6ES5 490-7LA21**
± 10 V	**6ES5 498-1AA31**	For snap-on clip terminals, 46-pin	**6ES5 490-7LC11**
± 20 mA	**6ES5 498-1AA41**	**497 front connector** for AE 463-4	
+ 4 ... 20 mA; for 2-wire transducer	**6ES5 498-1AA51**	Crimp terminals, 42-pin	**6ES5 497-4UA12**
+ 4 ... 20 mA; for 4-wire transducer	**6ES5 498-1AA71**	Screw terminals, 42-pin	**6ES5 497-4UB31**
463-4 analog input module for S5-115U/H/F 4 inputs, floating		**K front connector** for AE 466-3 Crimp terminals, single-width, 43-pin	**6XX3 068**
For 50 Hz systems	**6ES5 463-4UA12**	Screw terminals, single-width, 42-pin	**6XX3 081**
For 60 Hz systems	**6ES5 463-4UB12**	**Adapter casing** for 463-4, 466-3 analog input modules	see page 3/98

Connection diagrams

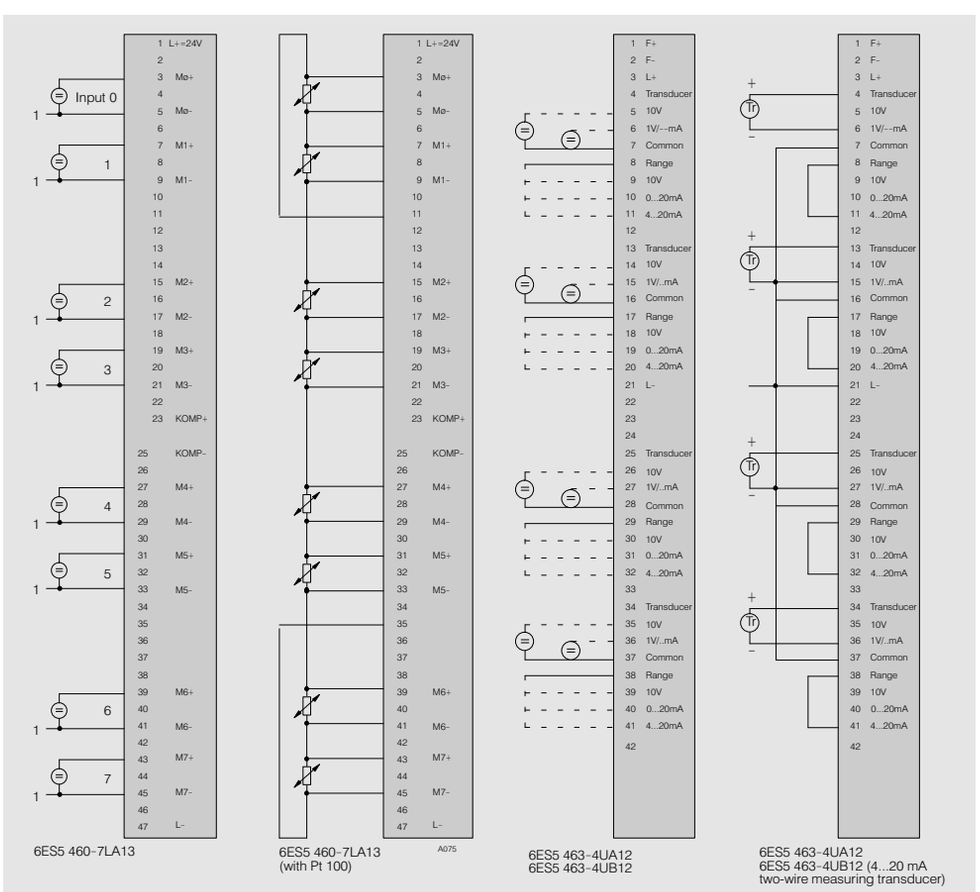


Fig. 3/30 Connection diagram for analog input modules

Analog input modules (continued)

3

Connection diagrams

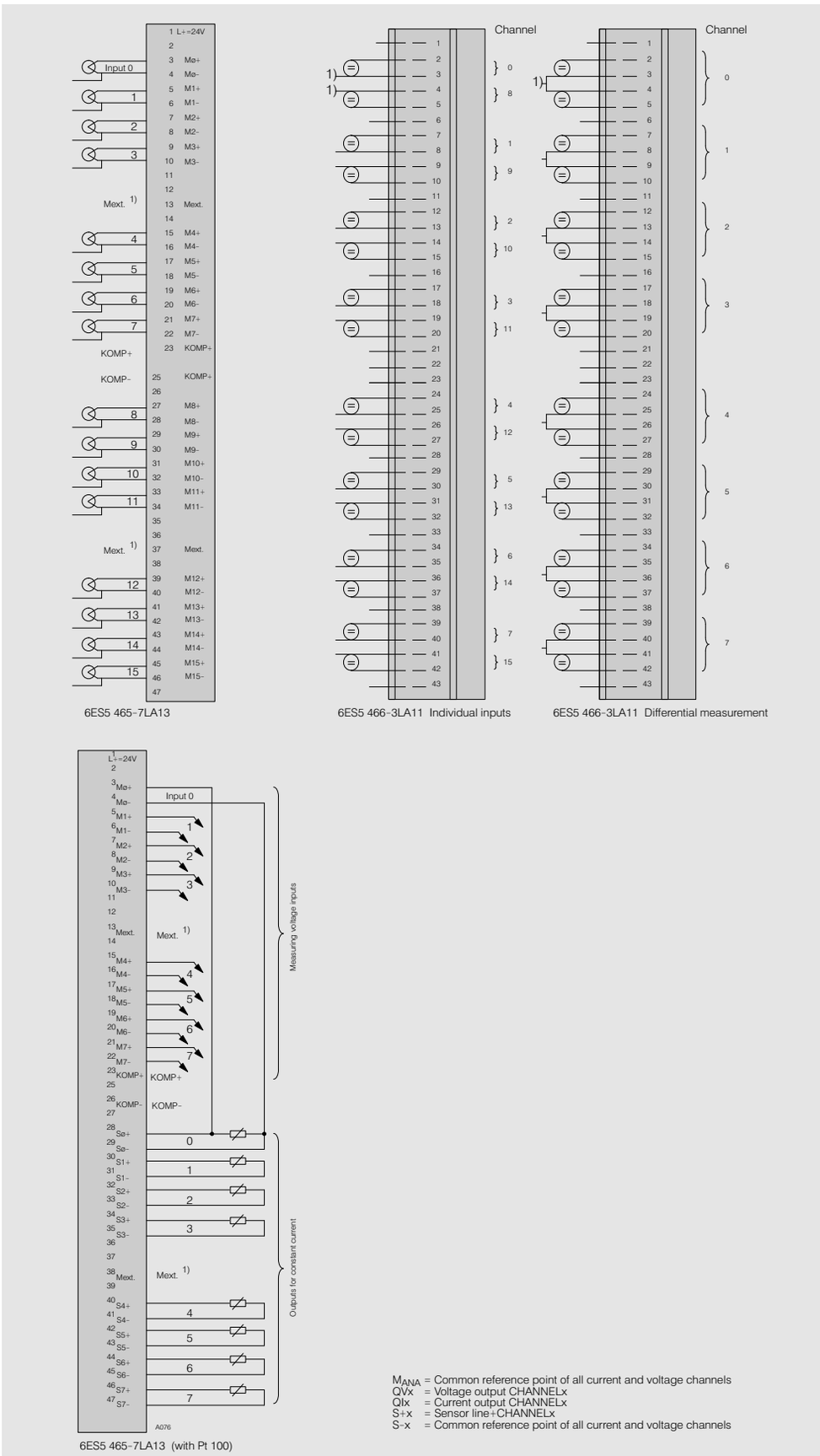


Fig. 3/31 Connection diagrams for analog input modules

Analog output modules

Application

The analog output modules convert digital values from the programmable controller into the analog signals required by the process.

Design

Three analog output modules are available with 8 outputs each and a range of output voltages. The modules each require one slot.

The signal leads must be connected with front connectors. They can be labelled in the fields on the front panel. The modules and front connectors can be inserted and removed under power. The module address (byte parameter when programming) is slot-dependent and need therefore not be set on the module.

Principle of operation

The CPU of the central controller transmits output values in digital form to the processor of the analog output module. These are converted to analog voltages by a digital-analog converter and a sample-and-hold procedure.

A voltage-current converter is also used to generate the corresponding output currents.The voltage and current output ranges for each module are fixed.

Note

All the analog output modules of the S5-135U/155U programmable controllers (see Section 4) can be used in the S5115U with adapter casings.

Technical specifications

Analog output module		6ES5 470-7L.13
Number of outputs (voltage and current outputs)		**8**
Galvanic isolation		Yes (not between the outputs)
Output ranges (rated values)		
• 6ES5 470-7LA12		**±10 V; 0...20 mA**
• 6ES5 470-7LB12		**±10 V**
• 6ES5 470-7LC12		**+1...5 V; +4...20 mA**
Load resistance		Only ohmic resistance
• For voltage outputs	min.	3.3 kΩ
• For current outputs	max.	300 Ω
Load connection		Load to the 0 V terminal
Digital representation of the output signal		12 bit two's complement (1024 units = rated value)
Conversion time		1 ms
Permiss. overload capability	approx.	25 % (up to 1280 units)
Short-circuit protection		Yes
Short-circuit current (voltage output)	approx.	25 mA

Analog output module		6ES5 470-7L.13
Open-circuit voltage (current output)	approx.	18 V
Voltage between the reference potential of the load (0 V connection) and the housing	max.	60 V AC/75 V DC
Linearity in the rated range		± 2.5 ‰; ± 3 units
Operational limits (0 to + 55 °C)		± 6 ‰
Cable length (shielded)	max.	200 m (650 ft)
Supply voltage		
• Rated value		+ 24 V
• Ripple V_{pp}		3.6 V
• Permissible range (including ripple)		20...30 V
• Value at t < 0.1 s		36 V
Power consumption		
• Internal (at 5 V)	typ.	0.25 A
• External (at 24 V)	typ.	0.3 A
Front connector		46-pin
Weight	approx.	0.4 kg (0.9 lb)

Analog output modules (continued)

Ordering data	Order No.		Order No.
470-7LA analog output module for S5-115U/H/F 8 outputs; ± 10 V/0 ... 20 mA	**6ES5 470-7LA13**	Operating instructions are included in the S5-115U manual (see page 3/23).	
470-7LB analog output module for S5-115U/H/F 8 outputs; ± 10 V	**6ES5 470-7LB13**	**490 front connector** For screw terminals, 46-pin	**6ES5 490-7LB21**
470-LC analog output module for S5-115U/H/F 8 outputs; + 1 ... 5 V; + 4 ... 20 mA	**6ES5 470-7LC13**	For crimp terminals, 46-pin • With 50 crimp contacts • Without crimp contacts	**6ES5 490-7LA11** **6ES5 490-7LA21**
		For snap-on clip terminals, 46-pin	**6ES5 490-7LC11**

Connection diagrams

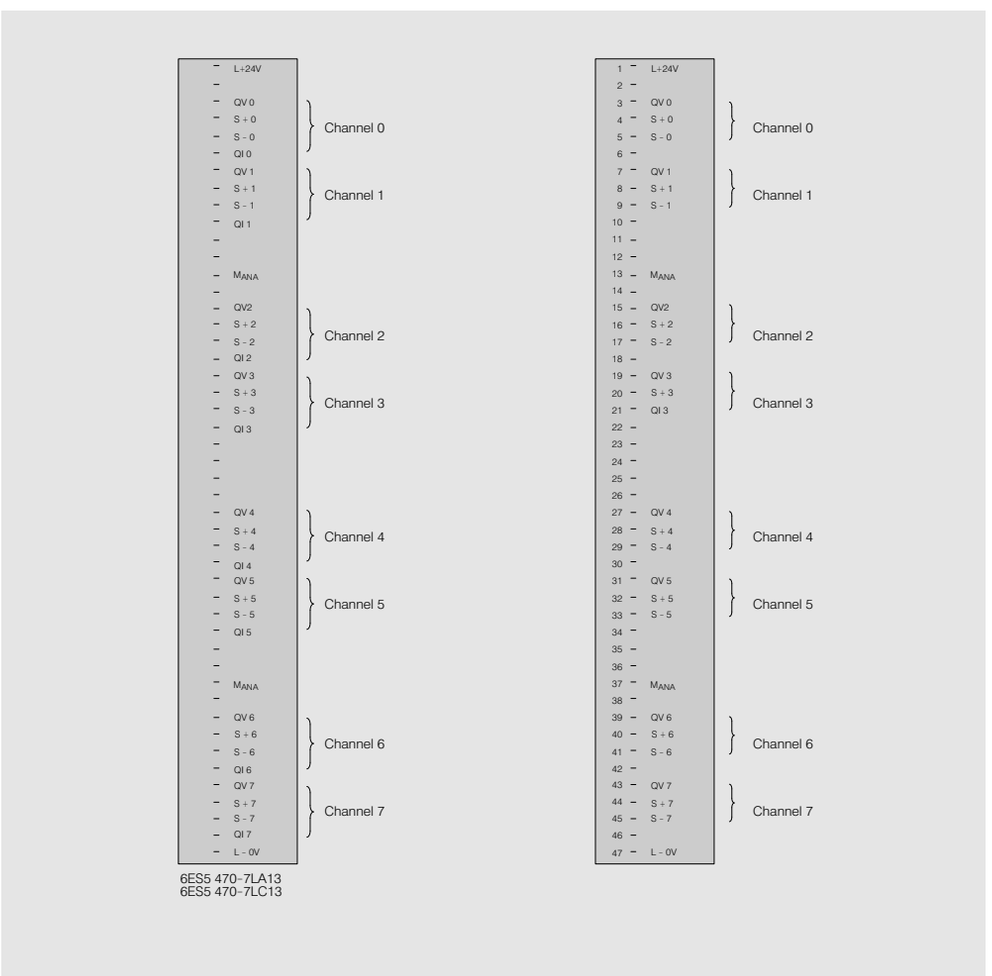


Fig. 3/32 Connection diagrams for analog output modules

LA 776 power output module

Application

The LA 776 power output module is used for driving resistive loads, such as heating resistors and radiant heaters, with fullwave control. It can control up to eight loads operating at voltages of 230 V AC or 400 V AC.

Each of the eight channels can operate a load with a rated current of up to 2.5 A. If only every other channel is used, loads with rated currents of up to 5 A can be operated. If currents above the permissible limits are required, the LA 580 power output module should be used (see Catalog ST 58).

Design

The module can be plugged into any of the slots for digital input or output modules in the S5-115U programmable controller.

The module requires one slot.

Note
A fan subassembly may be required (see page 3/77).

Principle of operation

There are two different, parameter-selectable operating modes:

- Simple digital output, in which the module operates as a digital output module. When an output is set, all half-waves of the supply voltage are switched through to the load. This is the equivalent of a manipulated variable of 100%.
- Setpoint-related output, in which each channel can be assigned a manipulated variable of between 0 and 99% of the maximum ouput capacity. The number of sinusoidal half-waves to be switched through to the connected load within a set time is derived from this manipulated variable. In order to prevent line voltage dips as a result of simultaneous switching when several channels are assigned the same setpoint, the starting times for each channel are staggered by a specified number of half-waves.

The module has a monitoring facility which detects

- Overheating in the power section
- Interruptions or short-circuits in the radiant heater circuits
- Blowing of fuses (the fuses of the individual outputs are accessible when the front connector is removed)

LA 776 power output module (continued)

Technical specifications

Number of outputs		**8**
Galvanic isolation		Yes (not between the outputs)
Supply voltage		
V_{pos} (for loads)		
• Rated value		**230/400 V AC**
• Frequency		47...63 Hz
• Permissible range		180...420 Hz
Output voltage		Half-waves, triggered at zero crossing of voltage
Output voltage and switching capacity		
at 230/400 V		
(ambient temperature 55 °C)		
• Using every channel		
Without fan	max.	1.25 A (290W/500 W)
With fan	max.	2.5 A (580 W/2000 W)
• Using every other channel		
Without fan	max.	2.5 A (580 W/1000 W)
With fan	max.	5.0 A (1160 W/2000 W)
Type of load		Ohmic loads with $I_{inp} \leq 2\ I_N$
Protection against overheating		Thermostat on heat sink
Response temperature		
• Delayed response at		+75 °C ± 3 °C
• Instantaneous response at		+85 °C ± 3 °C
Short-circuit protection		
1 fuse per output		6.3 A/500 V AF
Overvoltage protection		Varistor 420 V
Residual current at "0" signal (leakage current)	max.	7.6 mA per assigned channel at 420 V, 60 Hz
Cable resistance for short-circuit protection	max.	5.8 Ω (10 Ω at 380 V)
Cable length		
• Unshielded		100 m (328 ft)
• Shielded		500 m (1640 ft)
Insulation voltage rating (external connections to housing, internal connections, other groups)		
• In acc. with VDE 0160		250 V
• Tested with		1500 V
Power consumption		
• Internal (at 5 V)		90 mA
Heat losses (rated operation)		1.1 W per ampere output current (max. 20 W)
Front connector		24-pin, screw terminal
Weight	approx.	1.1 kg (2.4 lb)

Ordering data

	Order No.
LA 776 power output module 8 outputs 230/400 V AC, 1.25 A or 2.5 A (with fan)	**6ES5 776-7LA13**
To be ordered as a separate item: **LA 776 power output module manual**	
German	**6ES5 998-1FA11**
English	**6ES5 998-1FA21**
490 front connector, 24-pin	**6ES5 490-7LB11**
LA 580 power output module	see Catalog SL 10 (ST 58)