

Preface

Product family Add 7

The Add-on products of the Add 7 product family provide a cost-effective solution for the specific high-performance requirements in the field of process control and automation engineering. The design of these products is based on many years of experience in the field of process engineering, and on solid expertise with respect to the current system generation in the Siemens “Totally Integrated Automation” program.

As part of the Add 7 product family, the AddFEM Front End Module satisfies the special requirements of high-speed turbine control systems (different signal types, redundancy, high-speed detection and signal preparation etc.)

Enhancement to module type 6DL3100-8AC compared to 6DL3100-8AA

6DL3100-8AC offers the option of operating the AddFEM in redundant mode (module redundancy), and/or to process signal preparation functions on the AddFEM.

The AddFEM 6DL3100-8AC can be programmed in RUN using DPV1 services.

Further support

If you have any questions about the use of the products described in this manual and do not find the right answers, please contact your Siemens partner at your local Siemens Office or Agencies.

CE Label

Our products are compliant with EC Directive 2004/108/EC “Electromagnetic Compatibility, EC Directive 73/23/EEC “Low-voltage Directive”, and the European Harmonized Standards specified in those directives (EN).



You can view the EC Declaration of Conformity in the appendix. It is available to responsible authorities, according to the EC Directives mentioned earlier, at:

Siemens Aktiengesellschaft
Industry Sector Industry Automation Division
I IA CE SE PRM EN
Siemensallee 84
D 76181 Karlsruhe

Module power supply

The AddFEM power supply is designed to operate at a rated voltage of 24 V DC, and at a typical current consumption of 20 W. Voltage dips with a duration of at least 10 ms are buffered. The inrush current is limited to 3 A.

The AddFEM is equipped with an internal 24 V DC power supply for the analog outputs. The 24 V DC load voltage for the digital outputs must be generated by an external power supply which is wired to the X7 connectors.

Design

The AddFEM enclosure is made of stainless steel, and is prepared for screw-mounting or rail mounting.

The signal state of the digital IO is indicated by signal LEDs.

The operating and error states of AddFEM are indicated at 12 separate LEDs. The mode of operation is set by means of a key switch and slider.

The AddFEM front panel features eight 10-pin connectors (total of 80 IO pins) for the connection of process IO signals.

Certifications

In addition to the CE label, the AddFEM is also certified to UL/CSA.

1.1.1 Enhancement of 6DL3100-8AC variant (compared to -8AA/-8AB)

The enhanced DPV1 services of AddFEM are in particular suitable to provide dynamic parameter data (in acyclic mode) to the front-end functions (FEF.) These enhanced functions also support configuration changes in Run (= CiR = Configuration in RUN). CiR lets you reconfigure AddFEM parameters, such as enabling unused channels, or editing the parameters of active channels when using sensors with different technical specifications. The functionality also includes an option of reporting alarms with implicit acknowledgment mechanism for use by the front-end functions.

PROFIBUS DPV1

Variant 6DL3100-8AC (DPV1 slave) supports DPV1 services to IEC 61158 part 3-6. The DP master, of course, also has to meet those requirements (refer to the DP master documentation.)

PROFIBUS DPV2

Variant 6DL3100-8AC supports the PrmCommand to PROFIBUS Guideline 2.212 for the changeover of communications redundancy (changeover between DPV1 channels A and B), and provides redundancy status data for diagnostics functions.

The table below shows the new functions of the AddFEM DPV1 slave:

Function	DPV0 slave 6DL3100- 8AA/-8AB	DPV1 slave 6DL3100- 8AC	Comment
Cyclic data exchange	X	X	
Ayclic data exchange (read/write data record)	-	X	Programming the AddFEM in RUN.
DP master class 1 services (parameter assignment master)			Useful in particular to supply the front-end function with parameter values.
DP master class 2 services are not supported (SIMATIC PDM, for example)			
Diagnostics			
device-specific diagnostics	X	-	
ID-specific diagnostics	-	X	One alarm can be reported per diagnostics frame.
module status	-	X	
Channel-specific diagnostics	-	X	

Interfaces X1 and X2

- Redundancy interface X2
For redundant operation of two AddFEM modules.
- Service interface X1
For commissioning and maintenance.
Only with 6DL3100-8AC05 (AddFEM PoCo Plus), this interface is used as an additional redundancy interface for channel-selective redundancy switching of analog inputs for position feedback messages.

PROFIBUS DP connectors X3A und X3B

The AddFEM is equipped with two PROFIBUS connections for communication with the automation processor.

Process connections X4 to X7

The process IO signals are wired to sockets X4 to X7. The corresponding mating connectors are equipped with screw terminals for conductor cross-sections from 0.14 mm² to 1.5 mm² (AWG 28-16.)

Analog input signal filters

The analog input signals can be filtered digitally. The system provides 50 Hz, 60 Hz, 16 ^{2/3} Hz and 500 Hz* line filters. The filter parameters are set separately for each analog input (channel-specific) in the parameter frame. Options:

- no filtering
- 50 Hz
- 60 Hz
- 16 ^{2/3} Hz
- 500 Hz*

Default is "Turned off", which means no filtering.

* Configurable as of version 14 of 6DL3100-8AC

3.2 Operating principle of 2-channel speed monitoring with detection of the rotational direction

Channels 1 and 2 of AddFEM 6DL3100-8AA version 8 or higher, or ADFEM 6DL3100-8AB/-8AC version 7 or higher can be operated in frequency counting mode with detection of the rotational direction. This function requires the connection of a suitable (dual-channel) encoder to channels 1 and 2. The leading signal is connected to channel 1, and the lagging signal to channel 2.

Channel 3 can be used as separate, additional single-channel monitoring function, without detection of the rotational direction.

The (signed) frequency recorded in dual-channel mode is indicated at both channels 1 and 2 as follows:

The system calculates the value of the indicated frequency separately for each channel, based on the pulses of the connected encoder. The sign (rotational direction) is determined by the phase offset of both channels and assigned to the channels accordingly.

Master / reserve changeover

The master module is the active controller until it detects an error in its own system. In this case, it passes master mode to the standby module.

Note: AddFEM PoCo Plus 6DL3100-8AC05 features additional channel-selective redundancy mechanisms (see AddFEM PoCo Plus manual).

The handover of the master roles is always performed through error weighting. The error weight of a module is derived from the weighted sum of all individual errors. Errors that always affect the function of the module (e.g. memory errors) have a higher weight, whereas channel errors are handled with the lowest priority for the error weight.

Channel errors that are included in the error weight are taken from the monitoring of the 12 analog registrations, the 8 analog outputs as well as the 16 digital outputs (which can also be used as digital inputs).

Each channel is weighted with the same factor for determining the error weighting.

1. The signal range is monitored for the analog registration. With 4 to 20 mA signals, a channel error is set at a high or low violation of the range.

Measuring range Signal limit	4-20mA	0-20mA	+/-20mA	+/-30mA	0-10V	+/-10V
High	22.96mA	23.70mA	23.70mA	35.55mA	11.85V	11.85V
Low	1.185mA	-3.511mA	-23.70mA	-35.55mA	-1.760V	-11.85

2. For the analog output, the requested output signal and output signal read back are compared to determine if they match. A short circuit to ground or wire break cannot be detected if the output is set to 0.

3. For the digital output, the signal is read back and monitored for short circuit to ground when the level is output as 1.

Master / reserve changeover without fiber-optic connection

The master station assigns the master / reserve mode if the fiber optic connection is missing or faulty. The decisive factor is here the current error rating of the modules.

Process IOs

Redundant AddFEM require absolutely "symmetrical", i.e. identical input and output signals (exception: "AddFEM PoCo Plus", see corresponding description).

Redundancy nodes

Redundant nodes represent fail-safety in systems containing several identical components. A redundancy node is considered independent, if the failure of one of the components does not impair the reliability of other nodes or of the entire system. In a “1-of-2” system, a component of the redundancy node may fail without impairing system functionality.

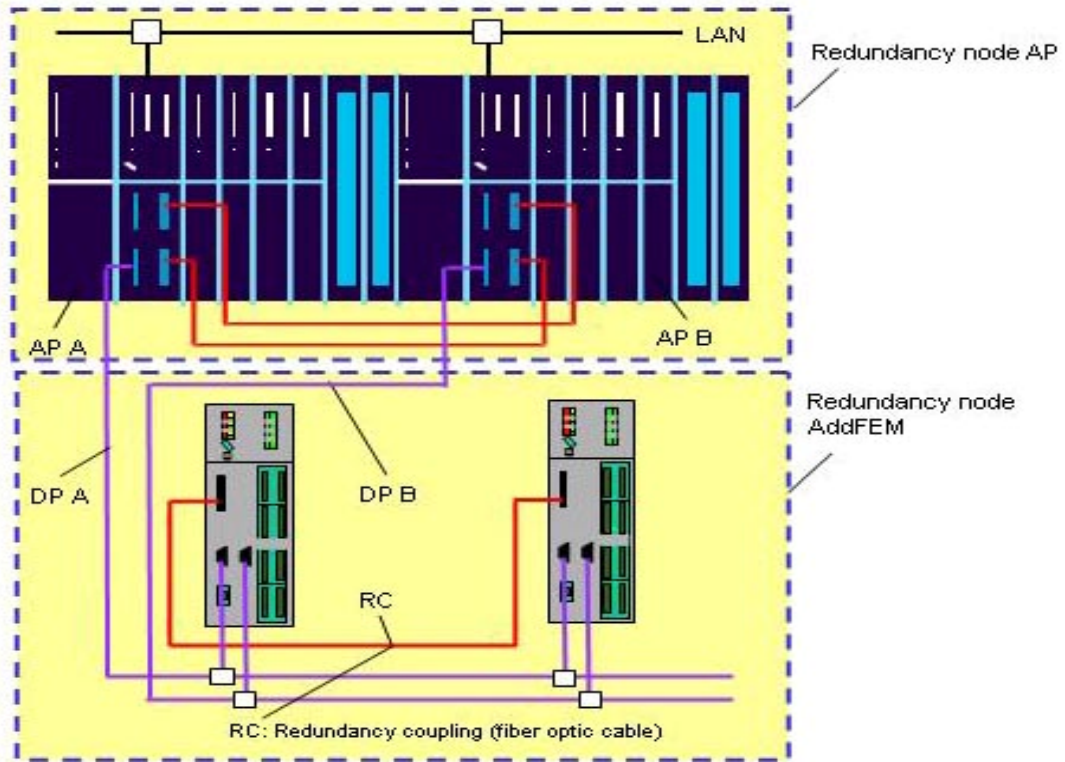


Fig. 3-5 System configuration with two redundancy nodes

The redundant automation processors AP A and AP B shown in Fig. 3-5 execute the same application software, such as a turbine loop control function, cyclically and in synchronism. One of the two systems (AP A or AP B) is the “master” station and actively controls the outputs. After an error has been detected in the master system, master control is automatically changed over to the standby station in a bumpless operation. The redundancy status and additional update information are exchanged between AddFEM A and AddFEM B across the redundancy coupling.

3.4.1 Redundant PROFIBUS DP connection

The PROFIBUS DP channels are basically of the same priority class. The AddFEM changes the channels if it detects a DP error, sign-of-life change / error, or when it receives a GCCL (Global Control Clear) frame. A changeover of DP channels by the AP is always initiated by the sign-of-life signal. Version 6DL3100-8AC supports

the PrmCommand to PROFIBUS Guideline 2.212 for the changeover of DP channels, and returns the redundancy status for diagnostics functions.

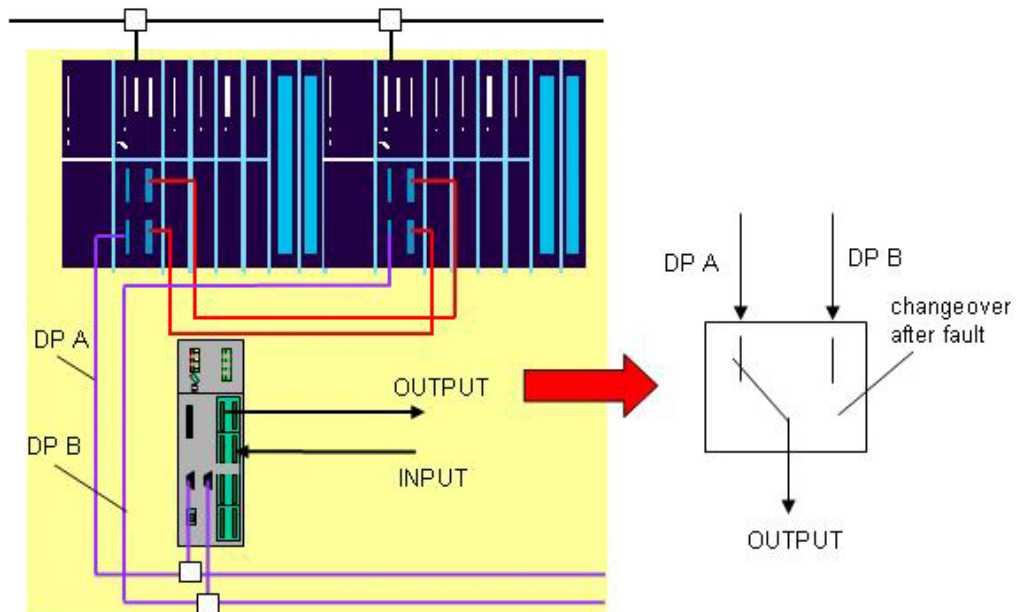


Fig. 3-6 Redundant PROFIBUS DP connection

The AddFEM and AP are interconnected via redundant PROFIBUS DP A and PROFIBUS DP B bus. Each AddFEM is equipped with two PROFIBUS DP connections. Both bus segments operate in parallel.

Input data (input) are always transferred in parallel to both automation processors. The AddFEM outputs only respond to the control signals of one of the two automation processors AP A or AP B, i.e. it always outputs either the output data of AP A or of AP B. For this reason, a master/reserve changeover also requires a corresponding adaptation of the AddFEM output status. The output information of the passive AP is analyzed for monitoring functions, and is then discarded.

The output-specific changeover is based on various criteria. The system always changes over to the operable interface as a reaction to coupling failure. In case of total failure, i.e. if both interfaces no longer receive any frames, the system outputs safety-oriented zero signals.

Note

In addition to the AddFEM's changeover of bus channels, the automation processor may also actively initiate a changeover, i.e. it can actively output a control command to set the active bus interface DP A or DP B.

3.5 Signal preparation functions with AddFEM (applies only to 6DL3100-8AC)

AddFEM 6DL3100-8AC supports signal preparation functions for the execution of specific automation functions, such as the position control in turbine control loops. These functions can be used to outsource time-sensitive functions requiring short cycle times for the transfer of data from the master AP to the AddFEM, and thus relieve the master AP from time-sensitive tasks. This signal preparation function is referred to as front-end function (FEF.)

The FEF functions are provided as preset functions, which can be especially configured with additional parameters by the user thus be optimized for the relevant process.

The following FEF functions can be ordered and the additional functions are described separately in the appropriate directories on the CD:

- 6DL3100-8AC02: AddFEM PoCo (position control) for fast control
- 6DL3100-8AC03: AddFEM SOE (Sequence of Event) for fast time-stamping of digital input signals.
- 6DL3100-8AC05: AddFEM PoCo Plus, extension of AddFEM PoCo, in particular the use of channel-selective redundancy.

Note: Additional customer-specific solutions that have been created only for a limited group of customers are not listed here; they are described separately.

Siemens offers an extended range of FEF functions. If your current automation components do not offer any solutions, or only cost-intensive solutions, for customer-specific applications, you can order customized solutions in the form of loadable FEF from Siemens.

Contact partner for the creation of further customized FEF applications:

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Phone.: +49 (911) 750-2331
E-mail: kathrin.starschich@siemens.com

4.1 Technical specifications

General data	
Dimensions (H x W x D)	295 mm x 75 mm x 209 mm
Weight	2.8 kg
Input voltage, rated value permissible range	24 V DC static: 19.2 V DC to 30 V DC dynamic: 18.5 V to 30.2 V
Rated input current Module supply Load supply	0.8 A 8 A
Inrush current Peak Half intensity width	3 A, limited 100 ms
Buffering of power failure	at least 10 ms, at input voltage 19.2 V DC to 30 V DC
Cumulative power loss of AddFEM - Module supply - Supply at digital inputs - Supply at analog inputs - Switching and feed forward losses at digital outputs on load power supply	max. 33 W (cumulative) max. 20 W max. 4 W max. 1 W max. 8 W
Module power supply fusing	2.5 A, fast-blow (internal protection, not replaceable)
Load power supply fusing	2 x 7 A, fast-blow (internal protection, not replaceable)
<u>Electrical isolation</u> The module consists of several electrically isolated function groups. The potential difference between these function groups may not exceed 50 V when the system is in operation. Assignment of signals and connections to the various function groups: a) Analog IO (connectors X4/1 to X4/20, and X5/1 to X5/20), including the internal microcontroller area b) Count pulse inputs (connectors X6/1 to X6/4) c) Digital inputs 5 to 8 (connectors X6/6 to X6/10) d) Digital inputs 9 to 12 (connectors X6/11 to X6/15) e) Digital inputs 13 to 16 (connectors X6/16 to X6/20) f) Digital outputs 1 to 8 (connectors X7/1 to X7/10) g) Digital outputs 9 to 16 (connectors X7/11 to X7/20) h) PROFIBUS DP connector X3A i) PROFIBUS DP connector X3B j) Module power supply 24 V DC k) Enclosure	

PROFIBUS DP interfaces	
Number of interfaces	2
Transmission rate	9.6 kbps to 12 Mbps
Max. cable length of a bus segment terminated at both ends	100 m
Permitted load on the 5-V power supply of the bus for the connection of further nodes without internal power supply	max. 80 mA per interface
For detailed information on PROFIBUS, refer to SIMATIC NET, PROFIBUS Networks manual, order no. 6GK1970-5CA20-0AA0!	

IO cycle times (PROFIBUS and connectors X4 to X7)	
Analog signal acquisition	666.667 µs
Analog signal output	666.667 µs
Digital signal acquisition ¹⁾	666.667 µs
Digital signal output	666.667 µs
Count pulse input	2 ms

¹⁾ Refresh signal at intervals of 666.667 µs. Signal filtering incurs an additional dead time of 666.667 µs between acquisition and output.

Digital inputs (channels 5 to 16)	
Number of inputs	12
Type of input to IEC 61131-2	Type 1
Voltage range	- 30 V DC to + 30 V DC
0 signal level	- 30 V DC to + 5 V
1 signal level	+ 11 V to + 30 V
48 V contact voltage	no
Connection of BEROs supported	yes
Min. current at input voltage	5 mA at 11 V (see Fig. 4-1)
Delay time (TID)	50 μ s at 0 > 1 signal transition 50 μ s at 1 > 0 signal transition
Displays	Front panel LEDs; indicate the converted values read by the internal microcontroller unit.
Terminal assignments	See appendix A, connector X6, page A-2

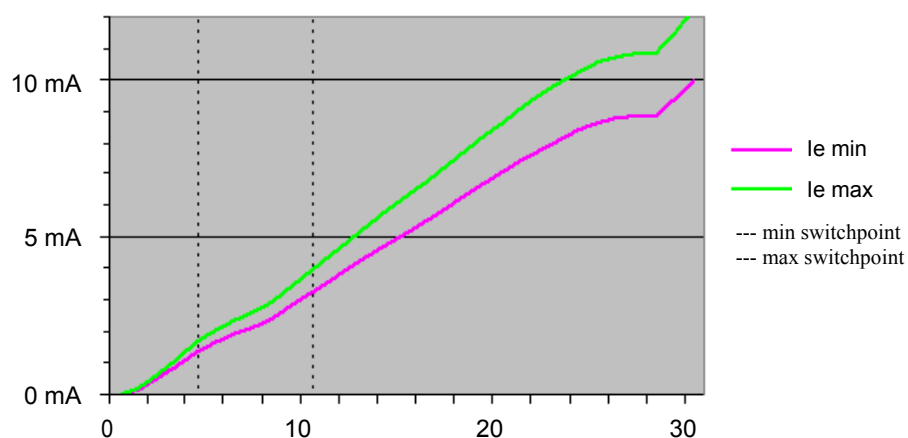


Fig. 4-1 Trend of digital inputs with tolerances of input current I_e

Digital inputs (channels 17 to 32)	
Depending on the configuration, the pins of connector X7 can be operated as digital output or as digital inputs (channels 17 to 32). Below are the technical specifications of these pins when used as digital inputs.	
Number of inputs	16
Type of input to IEC 61131-2	Type 1
Voltage range	- 30 V to + 30 V DC
0 signal level	- 30 V to + 5 V
1 signal level	+ 11 V to + 30 V
48 V contact voltage	no
Connection of BEROs supported	no
Input current	~0.34 mA at 11 V / ~0.84 mA at 24 V
Delay time (TID)	50 μ s at 0 to 1 signal transition 50 μ s at 1 to 0 signal transition
Displays	Front panel LEDs indicate the converted values read by the internal microcontroller unit.
Terminal assignments	See appendix A.1, connector X7, page A-2

Count pulse inputs ¹⁾ (channels 1 to 3)	
Number of inputs	3
Type of input to IEC 61131-2	Type 1 / 2
Voltage range	- 28 V DC to + 28 V DC
0 signal level	- 28 V to + 3 V
1 signal level	+ 8 V to + 28 V
Demand factor when operated at a voltage > 26 V	The count pulse inputs are also specifically designed to handle low input voltages (high signal detection => 8 V.) To limit power losses, either the input voltage must be limited to 26 V, or a 60% pulse/pause ratio with a maximum pulse width of 1 minute must be maintained, or only two of the three inputs may be set high at any given time.
Load	1 k Ω to 3 k Ω
Current/ voltage profile across the working range	See Fig. 4-1!
Dealy time (TID)	50 μ s at 0 > 1 signal transition 50 μ s at 1 > 0 signal transition
Cyclic evaluation of all signals	2 ms Noise pulses < 10.667 μ s are suppressed by filtering. Additional hardware evaluation by counters.
Input frequency (f_m)	0 kHz to 20 kHz
Counter resolution	32 bit
Measuring accuracy	better than 10^{-4} of measrued value
Refresh interval	2 ms
Measuring time at frequencies < 800 Hz	20 ms
Filter	At each refresh scan cycle point, the system recalculates the frequency based on a mean value derived from the count pulses logged within the last 20 ms.
Detection of the rotational direction	The rotational direction can be determined by coupling channels 1 and 2. See section 3.2 (supported as of version 8 of 6DL3100-8AA, version 7 of 6DL3100-8AB, and by all versions of 6DL3100-8AC)
Displays	Front panel LEDs; indicate the converted values read by the internal microcontroller unit.
Terminal assignments	See appendix A, connector X6, page A-2

¹⁾ Count pulse inputs may also be used as digital inputs!

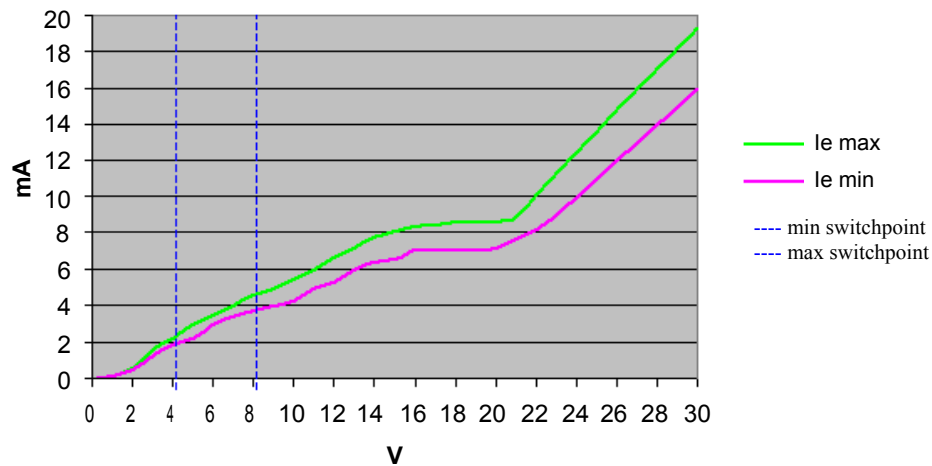


Fig. 4-2 Count pulse inputs, current-/voltage diagramm including tolerances of input current I_e

Reaction of the count pulse/rotational direction detection functions to interruption of the pulses (due to wire break, for example)

A) Single-channel mode (without rotational direction detection)

(applies to 6DL3100-8AA/-8AB version 7 or higher, and to all 6DL3100-8AC)

Frequency output will be limited according to the period of the last recorded pulse if no more count pulses are received. The limit frequency F is derived from the period T since the last pulse by the formula

$$F = 1/(T - \text{dead time}) * 1.5$$

The dead time of 0 ms to max. 2 ms is derived from the detection cycle time.

In practical life, we derive the limit frequencies from the output limit (see the table below), provided the original frequency measured prior to the pulse failure was higher.

The value will be set to zero on expiration of 10 s. (frequencies below 0.1 Hz are not recorded.)

Interval T since last pulse	Limiting of frequency output to the values listed below
0 ms to max. 2 ms	Old frequency is retained. At a detection cycle ≤ 2 ms, a missing pulse can not be detected.
2 ms to max. 4 ms	Limiting to max. 750 Hz
4 ms to max. 6 ms	Limiting to max. 375 Hz
8 ms to max. 10 ms	Limiting to max. 187.5 Hz
18 ms to max. 20 ms	Limiting to max. 83.3 Hz
48 ms to max. 50 ms	Limiting to max. 31.3 Hz
98 ms to max. 100 ms	Limiting to max. 15.3 Hz
0.998 s to max. 1 s	Limiting to max. 1.5 Hz
9.998 s to max 10 s	Limiting to max. 0.15 Hz
> 10 s	Output will be set to 0, i.e. frequencies below 0.1 Hz will not be recorded, or always set to 0.

B) Reaction of the dual-channel count pulse / velocity detection

(with detection of the rotational direction) to channel failure:

(applies to 6DL3100-8AA version 8 or higher; 6DL3100-8AB version 7 or higher, and all 6DL3100-8AC)

If one of the two channels fails, the velocity value is stepped down to zero as in single-channel detection. The sign is frozen at the state it had prior to the error event. It is thus still possible to detect the velocity using only one channel, however, without detection of any changes in the rotational direction.

Note

For information on wire break monitoring, refer to section 3.2, "Operating principle of 2-channel speed monitoring with detection of the rotational direction"

WARNING

False signal acquisition when using old firmware versions and a wire break occurs

If modules with obsolete versions for count pulse/speed measurement with detection of rotational direction (e.g., for use of water turbines) are used, in the event of a sensor failure or wire break the speed and rotational direction may no longer be correctly detected at times.

This may cause property damage depending on the process control.

For speed measurement and rotational direction detection, use only modules with the following versions (or later):

6DL3100-8AA: Version 8

6DL3100-8AB: Version 7

6DL3100-8AC: All versions are permissible

Digital outputs ¹⁾	
Number of outputs	16 digital semiconductor outputs
Rated output voltage	DC 24 V
Output voltage at 0 signal	< 1 V
Output voltage at 1 signal	supply voltage – 2 V
Max. output current	500 mA Parallel wiring of outputs for higher currents is supported.
Output current at 100% demand factor	500 mA
Cumulative output current	8 A
Effect of repeated overload on multi-circuit modules	none
Monitoring of short-circuit to M	yes
Short circuit-proof	yes
Max. lamp load per output	5 W
Inductive loads	Connection of inductive loads is supported. Compared to standard suppression diodes, the suppression voltage of integrated suppression diodes is increased by 39 V, and accelerate the shutoff of the current and, thus, of the final control element. However, the maximum suppression power (1 W) may not be exceeded.
Typical values: Max. inductivity at $I \leq 500$ mA and $f \leq 1$ Hz	8 H (without external suppression diode)
Max. inductivity at $I < 250$ mA and any f	unlimited
Max. inductivity with external suppression diode	unlimited
Output delay (TQD, Totzeit) between command output and response of the output (start of current rise)	20 μ s at 0 > 1 signal transitions 20 μ s at 1 to 0 signal transitions
Output response time (TQT) between command output and transient state of the output current at 500 mA	50 μ s at 0 > 1 signal transitions 50 μ s at 1 > 0 signal transitions
Reaction to the interruption of runtime controlled by the master processing unit	Shutoff of the outputs
Reaction to dips and interruption of the power supplies L1+ or L2+ at X7/1 or X7/11	The output voltage follows the supply voltage.
Displays	The voltage level of the digital outputs is logged by the internal digital inputs of the module, and is then converted and read by the internal microcontroller unit. The microcontroller unit outputs the read states to the front panel LEDs.
Terminal assignments	See appendix A.1, connector X7, page A-2

¹⁾ Digital outputs may also be used as digital inputs!

Analog inputs	
Input impedance across the signal range for current measurement for voltage measurement	41.8 Ω 100 k Ω
Measuring error Max. error at 25 °C Temperature coefficient	$\pm 0.12 \%$, at 0 V CMV ± 25 ppm/K
Max. error across the temperature range	$\pm 0.2 \%$ relative to measuring range limit at a CMV of max. 2 V
Digital resolution of the D/A converter	13 bit + sign
Value of the least significant bit (LSB) bei Strommessung bei Spannungsmessung	4 μ A 2 mV
Highest permissible continuous overload (no damage)	60 V
Output of the digitized analog value under load	118 %
Input type	Differential
CMV range	± 6 V
CMV suppression DC 50 Hz 60 Hz	- 0.05 % / V 55 dB 55 dB
Total system input transfer time (TAID + TAIT)	52 μ s
Scan time including settling time	20 μ s
Scan cycle interval time	104.167 μ s
Input filter of the first order Transition frequency	880 Hz
Mean value formation across four measurements Transitional frequency including input filter	700 Hz
Max. short-term offset during any defined electrical error test	See EMC data (section 4.2)
Conversion method	successive approximation / parallel conversion of 4 channels
Mode of operation	autoscan
Calibration	not required
Terminal assignments	See appendix A.1, connector X5, page A-1!

Analog inputs (continued)		
Measuring ranges of current inputs / overflow range	0 mA to 20 mA / – 3.511 mA to 23.7 mA 4 mA to 20 mA / – 1.185 mA to 22.96 mA ± 20 mA / ± 23.7 mA ± 30 mA / ± 35.55 mA	
Signal limits of the current inputs (triggers channel error)		
Range	Low signal limit	High signal limit
0-20 mA	-3.511 mA	23.70 mA
4-20 mA	1.185 mA	22.96 mA
+/- 20 mA	-23.70 mA	23.70 mA
+/- 30 mA	-35.55 mA	35.55 mA
Measuring range/overflow range of voltage inputs only at channels 1 to 6	0 V to 10 V / -1.755 V to 11.85 V ± 10 V / ± 11.85 V	
Signal limits of the voltage inputs (triggers channel error)		
Range	Low signal limit	High signal limit
0-10 V	-1.76 V	11.85 V
+/-10 V	-11.85 V	11.85 V
Number and function of inputs	6 current measuring inputs, 6 current/voltage measuring inputs	
Crosstalk between channels at		
DC	≤ 60 dB	
50 Hz	≤ 60 dB	
60 Hz	≤ 60 dB	
Non-linearity	< 0.01 %	

Analog outputs	
Number of analog outputs	8
Max. error at 25°C	± 0.15 %
Temperature coefficient	± 100 ppm / K
Max. error across the temperature range	± 0.4 %
Value of the least significant bit (LSB)	13 bit + sign
Value of the least significant bit (LSB)	8 µA
Total system transfer time (TAQD + TAQT)	1 ms
Transient time across the full range	0.6 ms
Overshoot	0.2 %
Max. short-term offset during any defined electrical error test	See EMC data (section 4.2)
Terminal assignments	See appendix A.1, connector X4, page A-1
Max. permitted inductive load	1 H
Power Off operations	Buffer time up to 10 ms. With prolonged failure, power on is determined by software functions
Conversion method	parallel conversion of all 8 output channels
Current output range unipolar / overflow range / load	0 ... 20 mA / ± 23.5 mA / 480 Ω 4 ... 20 mA / – 4,96 bis + 22,96 mA / 480 Ω
Current output range bipolar / overflow range / load	± 20 mA / ± 23.5 mA / 480 Ω ± 30 mA / ± 35.55 mA / 300 Ω
Current output bipolar (only channels 1 to 4) ¹⁾	± 50 mA / ± 59.26 mA / 150 Ω
Output current monitoring tolerance	4 %
Cross-talk between channels at:	
DC	≤ 60 dB
50 Hz	≤ 60 dB
60 Hz	≤ 60 dB
Non-linearity	± 0.1 %
Output ripple	± 0.1 %

¹⁾ In order to protect the module, the analog outputs 1 to 4 are limited to an average load of 40 mA. The extension of the current range of those outputs to 50 mA / 59.26 mA is only intended for the control of final control elements with integral action. A max. current of 59,26 mA is provided to this purpose for a limited time.

The current is monitored by the software and limited as follows.

Mean value limiting: At a current output programmed for operation at ±50 mA, the mean value of the output current is calculated based on a delay element of the first order which has a time constant of 10 s. If the current exceed a mean value of 40 mA, both the output current and its mean value will be limited to ±40 mA.

4.2 Safety, environmental conditions and EMC

Certifications:

6DL3100-8AA/-8AB/-8AC is certified to:

- UL-Recognition-Mark: Underwriters Laboratories (UL) to Standard UL 508
- CSA-Certification-Mark: Canadian Standard Association (CSA) to Standard C 22.2 No. 142

CE label

6DL3 100-8AA/-8AB/-8AC meets requirements of EC Directive 2004/108/EC "Electromagnetic Compatibility"

Safety	
Device standard	EN 61131-2, IEC 61131-2, parts 11 to 14
Inherent heating	The enclosure made of steel sheet is subject to an excess temperature of approx. 20 K under full load. The temperature limit of 70 °C is thus exceeded at an ambient temperature of 60 °C, which still allows unprotected contact without any risk of injury (to DIN EN 61131-2.).
Power supply	The 24 V DC power supply must be a safety extra-low voltage which is safely isolated from mains. This isolation may be implemented in accordance with VDE 0100 Part 410 , HD 384.4.41 , IEC 60364-4-41 (as functional extra-low voltage with safe isolation PELV) or to EN 60950-1, IEC 60950-1 (as safety extra-low voltage SELV).
Installation safety requirements	6DL3100-8AA/-8AB/-8AC is an "open equipment" to DIN EN 61131-2 standard, and according to UL/CSA certification an "open type." In order to satisfy operational safety requirements with respect to mechanical strength, non-inflammability, stability and touch protection, the following installation methods are mandatory:: Installation in a suitable cabinet Installation in a suitable enclosure Certified only to DIN EN 61131-2: Installation in a closed switch room with appropriate equipment
Electrical isolation	Isolation of the areas specified in section 4.1 is designed for normal operation at a rated voltage of 50 V. The routine insulation test is carried out to UL 508 (test voltage/duration 707 V DC / 1 min, or optional at 849 V DC / 1 s when the test object is switched off.
Foreign matter and water-proofing	Degree of protection IP20 to IEC 529, i.e. protected against contact with standard test fingers. Not water-proof.
Sound emission	None

Reliability	
MTBF value to SN 29500	23 years, at an ambient temperature of 40 °C at the module

ElectroMagnetic Compatibility (EMC)	
The specified values apply to systems equipped with shielded process cables for analog signals. Digital signal cables may unshielded. The values specified apply to conditions without shielding effect of a cabinet, and without additional external protective elements.	
Stress	Test values
Radiated noise	Limit class A to EN 55011 / 2000 Group 1
RF interference on cables and cable shielding to IEC / EN 61000-4-6	10 V 9 kHz to 80 MHz 9 kHz to 80 MHz (with 80 % amplitude modulation of 1 kHz) Possible deviation of analog output signals < 3 %
RF radiation to IEC / EN 61000-4-3	10 V/m 80 MHz bis 1 GHz (with 80 % amplitude modulation of 1 kHz) 10 V/m 900 MHz (with 50 % pulse modulation)
Burst pulses (high-speed transient disturbance variables) to IEC / EN 61000-4-4	±2 kV on power supply lines and signal lines
High-energy surge pulse (1.2/50 ms surge pulse) to IEC 61000-4-5 Asymmetrical coupling Symmetrical coupling	±2 kV at the power supply lines ±2 kV at the signal lines Coupling effect on unshielded cables carrying binary signals, and on the cable shielding of shielded analog signals and PROFIBUS DP ±1 kV a power supply and signal lines <u>Information on 1.2/50 ms pulse/surge test:</u> The surge test simulates high-energy disturbance which might be coupled to cables with a length of more than approx. 10 m, thus being superimposed on user signals, depending on ambient conditions (to standards.) The period of the various noise signals generated by the surge pulse lies within the range of the sampling frequency/ cycle time of the module. At those extremely short cycle times, hardware filtering is an inadequate means of suppressing noise signals, because of the unwanted filtering effect on user signals. The 50 or 60 Hz filter should therefore be switched on at the analog outputs if surge noise coupling on signal lines is to be expected due to given ambient conditions and cable lengths. With active filter, distortion of analog signals due to surge coupling is reduced to less than 2 %. Without filtering, short-term signal distortion of 60% can be expected at the analog inputs.
Immunity against discharge of static electricity to the housing and parts of the structure to IEC / EN 61000-4-2	±6 kV Contact discharge ±8 kV Air discharge

Climatic conditions	
Temperature (ambient temperature) Operation	Tested to DIN EN 60068-2-1, DIN EN 60068-2-2, 0 °C to + 50 °C at rated load (see chapter 4.1) 0 °C to + 55 °C at rated load; digital outputs 5, 6, 7, 8, 13, 14, 15 and 16 but with max. 200 mA load 0 °C to + 60 °C at rated load; digital outputs 3 to 8 and 11 to 16, but with max. 120 mA load; Input voltage at the binary inputs max. ± 28 V; normal operation on PROFIBUS, without load on the additional PROFIBUS supply for 80 mA (i.e. no nodes without internal supply, for example, fiber optic converters, connectable) maximum temperature gradient 10 °C / hour
Storage / packaged ready for shipping	Tested to DIN EN 60068-2-1 and DIN EN 60068-2-2: - 40 °C to + 70 °C maximum temperature gradient 5 °C / hour (Risk of dewing at higher temperature gradients. Dewing is not permitted.) With longer shelf times it is advisable to put the modules into operation for approx. one hour at regular intervals, in order to prime the electrolytic capacitors: At shelf temperatures up to 40 °C: after 5 years within the first 10 years, then at intervals of 3 years; At shelf temperatures above 40 °C: at intervals of 2 years;
Relative humidity Operation	max. 95 % at + 25 °C, dewing is not permitted, corresponds with relative humidity (RH) stress group 2 to IEC 61131-2. Tested to IEC 60068-2-78: 95 % at 30 °C
Storage / packaged ready for shipping	Max. 95 % at + 25 °C, dewing not permitted; Tested to IEC 60068-2-30: 95 % at 25 °C to 55 °C
Barometric pressure	Storage: 1080...660 hPa (-1000 to + 3500 m) Operation: 1080...900 hPa (-1000 to + 1000 m) The cooling effect is reduced at higher elevations, i.e. the high temperature limit may be reduced (guide value: 10 K/1000 m, starting at 1000 m above sea level)
Pollutant concentration	SO ₂ < 0.5 ppm, rel. humidity < 60 %, no condensation H ₂ S < 0.1 ppm, rel. humidity < 60 %, no condensation

Mechanical ambient conditions	
Vibration operational, with screw mounting or rail mounting (see section 5.1)	Tested to DIN EN 60068-2-6: 10 Hz to 58 Hz: amplitude 0.075 mm 58 Hz to 500 Hz: acceleration 1 g (10 m/s ²) Excitation signal: floating sine wave Frequency transient: 1 octave/min, 10 cycles per axis
Packaged ready for shipping	Tested to DIN EN 60068-2-6: 5 Hz to 8.5 Hz: amplitude 3.5 mm 8.5 Hz to 500 Hz: acceleration 1 g (10 m/s ²) Excitation signal: floating sine wave Frequency transients: 1 octave/min, 10 cycles per axis

Mechanical ambient conditions	
Continuous shock operational, screw-mount or rail-mount test object (see section 5.1)	Tested to DIN EN 60068-2-29: Half-wave sinusoidal: 10 g (100 m/s^2) for 16 ms 100 shocks per axis Note: rail mounting to DIN EN 60715 (min. material thickness. 2.2 mm.) In addition to the side brackets, a center bracket is required for DIN rails with a length of 19 inches in order to ensure safe and rigid fixation of the module on the rails Tested to DIN EN 60068-2-27: Half-wave sinusoidal: 25 g (250 m/s^2). duration 6 ms 1000 shocks per axis
Packaged for shipping	

Dust endangering functionality	
The AddFEM must be protected against the ingress of any conductive and corrosive matter. For other dust and sand particles, conditions of use to IEC 60 721-3-3 classe 3S2.	
Special features	
QC	to ISO 9001

Interconnecting redundant IO

All analog and digital outputs of an AddFEM can be wired in parallel to outputs of the same type at another AddFEM for the redundant control of final control elements (see Figure 5-11).

This applies likewise to the analog voltage inputs and digital inputs.

See Figure 5-5 and Figure 5-6 for redundant interconnection of current inputs.

Note:

Redundant AddFEM must be supplied with absolutely symmetrical I/O signals. Individual channels can also be operated in non-redundancy mode and wired differently only with AddFEM PoCo Plus 6DL3100-8AC05 with extended redundancy design in redundant configuration.

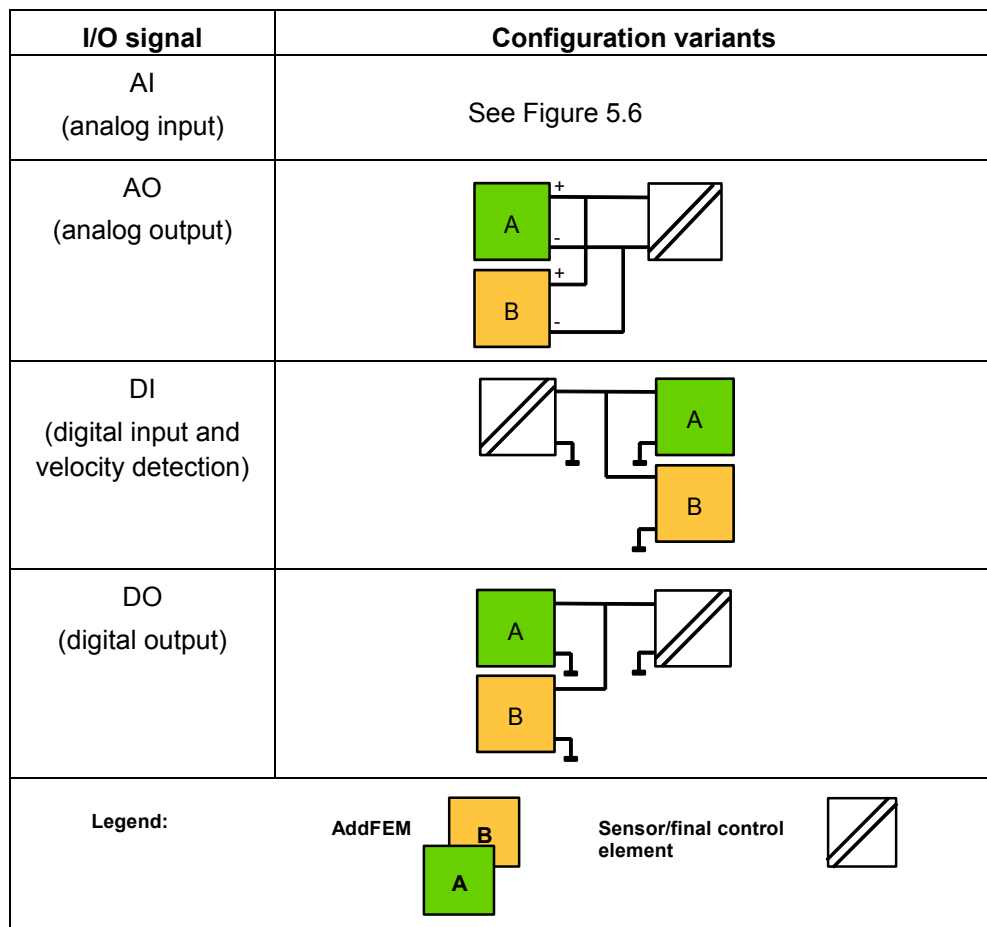


Fig. 5-11 Possible redundancy configurations

Redundancy characteristics of the analog outputs

The analog outputs of redundant AddFEMs can only be enabled or disabled on the AddFEM master. A 50%/50% load distribution between the master and reserve module is only possible for the control outputs with AddFEM PoCo 6DL3100-8AC02 and AddFEM PoCo Plus 6DL3100-8AC05.

Cabinet technology

You may install the AddFEM alongside with distributed IO devices or master processing units of the SIMATIC S7, SIMATIC PCS 7 or SIMADYN-D family in the same switch cabinet. Siemens has optimized its switch cabinet technology according to the special requirements of these system families.

The cabinets consist of system-specific and neutral modules which are compliant with CE standard, i.e. these are compliant with EMC Directives on electromagnetic compatibility. The cabinets safely prevent unauthorized access, and mechanical influences, contamination and corrosion.

Due to their modularity and variability, the cabinets can be easily adapted to satisfy requirements of diverse plant types and dimensions.

Your contact partner for the configuration and installation of customized system cabinets:

Siemens AG
Industry Sector Industry Automation Division
I IA CE SE PRM EN 1
Mr. Rieder
Phone: +49 721 595-2528
Fax: +49 721 595-4711
Siemensallee 84
D- 76181 Karlsruhe

Hardware maintenance

Faulty AddFEM modules cannot be repaired on-site, and must be shipped back to SIEMENS. Always keep the AddFEM dry when cleaning it.

Accessories (cables and connectors)

Add FEM connector set for process cable connections and module power supply (one set required per AddFEM), order no. 6DL9900-8AA.

The set consists of:

- 8 connectors, each with 10 screw terminals for wiring the process cables of a module to sockets X4 A/B to X7 A/B
- 1 connector, with 2 screw terminals, for wiring the 24 V DC power supply to the module

PROFIBUS DP cables and connectors for the AddFEM:

The current order numbers for these accessories are available either in the Siemens catalog "Industrial Communication", or on the Internet at

<http://www.automation.siemens.com/mcms/automation/en/industrial-communications/profibus/Pages/Default.aspx>

Fiber optic cable for the redundant connection (1 cable per redundancy pair)

Note: Only 6DL3100-8AC05 requires two cables per redundancy pair

Length: 1.6 m. Siemens order no.: 6DL9901-8AA

5.5 Resetting errors with module redundancy

External errors at the analog or digital outputs (for example, due to external wire break) cannot be reset by the reserve AddFEM after an error is cleared because the reserve AddFEM no longer outputs signals and therefore cannot check the line status. In order to restore the correct redundancy status after external error correction, these errors must be reset manually on the reserve module.

Use the procedure described below to do this.

Exception: Only applicable to 6DL3100-8AC05: the option now exists to use a T3000 driver command for online functional testing of analog outputs that were switched off due to errors and to restart these outputs without any disruption. For more information, see the manual for AddFEM PoCo Plus 6DL3100-8AC05

NOTICE

Master/reserve switchover is possible following deletion of the saved errors on the reserve AddFEM, in spite of the presence of output errors

If the saved errors on the reserve AddFEM are deleted, this module can initially assume the role of master AddFEM again despite the continued presence of other errors at the outputs.

Only after the reserve AddFEM (with deleted output errors) assumes the master role is it capable of checking the process execution, detecting pending errors of the outputs again, and responding to errors appropriately.

If the causes of the errors at the outputs have not been eliminated, the signal output may be incorrect or missing up until conclusion of the error check (duration: maximum of 12.66 ms for the analog outputs), which may lead to process disturbances.

You should therefore ensure that the cause of the error is eliminated before performing this procedure.

NOTICE

Processing of out-of-date error status in the event of a forced master/reserve switchover

A forced master/reserve switchover (e.g., by turning the key-operated switch on the master AddFEM to STOP) also causes the reserve AddFEM to check and correct the error status after it assumes the master role.

However, the higher-level drivers initially process the old error status still saved. As a result, corresponding reactions, e.g., switchover from automatic to manual for upstream controller blocks, may be triggered for a brief time. Depending on the configuration, the reactions may cause process disturbances.

Therefore, you should only use the procedure describe below.

5.6.1 Adjustable parameters

Parameter	Range/Value	Remarks
Operating mode AddFEM	"Standard not redundant " "AS red., AddFEM not red. " "AS not red., AddFEM red. " "AS red., AddFEM red."	Mode 0 Mode 1 Mode 2 Mode 3 (see also section 3.3 "Operating modes")
Redundant AddFEM	"No redundant partner" "PROFIBS-Address: 1"	This parameter is available only with "SIMATIC PCS7" configuration. Default setting is "No redundant partner"
Input type/range AI 1 Input type/range AI 6	"Current 4...20 mA" "Current 0...20 mA" "Current +/-20 mA" "Current +/-30 mA" "Voltage +/-10 V" "Voltage 0...10 V"	The analog inputs 1 to 12 support channelselective adjustments. The analog inputs 1 to 6 can be programmed for operation as voltage or current input mode.
Input type/range AI 1 Input type/range AI 6	"Current 4...20 mA" "Current 0...20 mA" "Current +/-20 mA" "Current +/-30 mA"	Analog inputs 7 to 12 can only be use in current input mode.
Output type/range AO 1 Output type/range AO 8	"Current 4...20 mA" "Current 0...20 mA" "Current +/-20 mA" "Current +/-30 mA" "Current +/-50 mA"	The analog outputs 1 to 8 support channel selective adjustments. They are implemented for operation in current output mode Note: If the current range is set to +/- 50 mA, the analog outputs are limited to a mean load of 40 mA to protect the module. Please see technical specification: Analog outputs
Counter 1	"Ident. of rot. direction off" "Ident. of rot. direction on"	Counter 1 can be programmed for operation with or without detection of the rotational direction. If detection of the rotational direction is enabled, channel 1 returns the leading and channel 2 the lagging signal.
Filter AI 1 Filter AI 12	"No filter" "Filter 50 Hz" "Filter 60 Hz" "Filter 16 2/3 Hz" "Filter 500 Hz"	A filter function can be programmed for each analog input to suppress the relevant mains frequency. Sth system provides filters for 50 Hz, 60 Hz, 16 2/3 Hz and 500 Hz ¹⁾ . The filtering can be set individually for each analog input (channel-selective). Default setting is "No filter" i.e. disabled! ¹⁾ As of version 14 of 6DL3100-8AC
Delayed shutoff (if the host CPU becomes unavailable briefly. For details please see 0 "Delayed shutoff ")	"0 ms" "10 ms" "20 ms" "50 ms" "100 ms" "200 ms" "500 ms" (default) "1 s" "2 s" "3 s"	The AddFEM is capable of compensating short-term gaps in the execution cycle of the host CPU, for example, when the system updates redundant APs. A "hard" shutoff of the outputs is not carried out unless the set tolerance time has expired

Table 5-8 Adjustable parameters

5.6.2 Integration in automation systems

Siemens provides drivers and / or configurations for the integration of AddFEM in various host systems. Those drivers support the easy integration of AddFEM in different system environments. A description of this integration and of its configuration is available in the manuals and documentation of the relevant systems.

5.6.2.1 Overview of automation systems

System	CPU/PROFIBUS interface	AddFEM type	GSD	Comment
SPPA-T3000	S7 400 with internal on-board PROFIBUS interface or with CP443-5 EXT expansion module	6DL3100-8AC 6DL3100-8AC02 6DL3100-8AC03 6DL3100-8AC05	SiT680A3.GS? (Standard for SPPA-T3000)	GSD model name: AddFEM/SPPA-T3000 - Suitable for hardware proxies on the SPPA-T3000 system - Configuration of AddFEM in HW Config as "redundant standard slave" (automatic integration in redundant bus systems) is supported - Diagnostics interrupts are supported - No editable parameters – parameters are always assigned in acyclic DP-V1 jobs - Front-End-Function: configurable PoCo, PoCo Plus and SoE
S7-400/FM458 TXP AS 620T	S7 400/FM458-1_DP with internal on-board PROFIBUS interface, with external EXM448 expansion module	6DL3100-8AC	SiF080A3.GS? (Standard for FM458)	GSD model name: AddFEM/FM458 - Suitable for integration in the DP interface of FM458 - Diagnostics interrupts are not supported - Basic functionality (IO) + redundancy changeover of AddFEM with fiber optic connection - Front-End-Function: not configurable
SIMATIC PCS7	S7 400 with internal on-board PROFIBUS interface or with CP443-5 EXT expansion module	6DL3100-8AC 6DL3100-8AC02 6DL3100-8AC03	Si0580A3.GS? (Standard for SIMATIC PCS 7)	GSD model name: AddFEM/PCS7/PARAM - Suitable for PCS7 channel drivers - Configuration of AddFEM in HW Config as "redundant standard slave" (automatic integration in redundant bus systems) is supported - Diagnostics interrupts are supported - Front-End-Function: configurable PoCo and SoE
TXP AS 620 B	SIMATIC S5 155H/ AS 620 B with PROFIBUS communications module	6DL3100-8AC	SiT080A3.GS? (Standard for TXP AS 620 B)	GSD model name: AddFEM/TXP S5 - Suitable for integration in TXP S5 with IM308-C - Diagnostics interrupts are not supported - Front-End-Function: not configurable
SIMADYN D TXP AS 620 T	PM6 (PM5) with CS7 communications module, and SS52 communications module for the PROFIBUS DP interface	6DL3100-8AA	Si0180A3.GS?	GSD model name: Add FEM, Type -8AA Basic functionality (only IO)
		6DL3100-8AB	Si0280A3.GS?	GSD model name: Add FEM, Type -8AB Not for new projects!
S7-400/FM458 TXP AS 620T	S7 400/FM458 EXM448 expansion module for the PROFIBUS DP - interface	6DL3100-8AA	Si0180A3.GS?	GSD model name: Add FEM, Type -8AA Basic functionality (IO) + redundancy changeover of AddFEM with fiber optic connection
		6DL3100-8AB	Si0280A3.GS?	GSD model name: Add FEM, Type -8AB Not for new projects!

		6DL3100-8AC	SIF080A3.GS?	GSD model name: AddFEM/FM458 • Suitable for integration in the DP interface of FM458 • Diagnostics interrupts are not supported • Basic functionality (IO) + redundancy changeover of AddFEM with fiber optic connection • Front-End-Function: not configurable
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Table 5-9 Overview of automation systems

5.6.2.2 Integration in SIMATIC PCS7

For information on the integration of AddFEM in SIMATIC PCS7, refer to the following documentation:

AddFEM

Getting Started – First steps in commissioning

SIMATIC_PCS7_Driver

The manuals are located on the AddFEM CD

5.6.2.3 Integration in SPPA-T3000

For information on the integration of AddFEM in SPPA-T3000, refer to the Online documentation of the system.

5.6.2.4 Integration in TELEPERM XP

For information on the integration of AddFEM in TXP, refer to this TXP documentation:

Manual

SPPA-T2000

(TELEPERM XP)

Automation system AS 620

Field bus

Release 8.1

Section 15 of this manual contains the operating instructions

Flexible Field device integration in TXP:

5.7 Troubleshooting

5.7.1 Failure and hot-swapping redundant AddFEMs

The decisive factor in ensuring uninterrupted operation of the AddFEM modules is their hot-swap capability.

Initial situation

Failure	Reaction of the AddFEM modules
An AddFEM fails	The partner module assumes the master function

Replacement requirements

With 6DL3100-8AC, different revisions are capable of redundancy (with the exception of revision 13).

The following should be noted for revision 13 only:

The module to be coupled with revision 13 must have the same revision or a later revision.

Procedure

NOTICE

Undesired master/reserve switchover (when redundancy cable is inserted online)

If the fiber optic redundancy connector is inserted while the reserve module is switched on and in RUN mode, this can cause multiple undesired master/reserve switchovers in the event that errors with equal error weight are pending on both modules (e.g., due to external faults in process signals connected to both modules).

If the input signals for the master and reserve AddFEM differ only slightly, multiple switchover may cause a disturbance in the process execution.

Therefore, you should always follow the described procedure for module replacement (see step 5 in Table 5-10).