

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

For further technical specifications of the IO, refer to section 4.

Higher availability due to redundancy

Redundancy in this context refers to the integration of a "1 of 2" structure. Availability is enhanced by means of parallel operation of two AddFEM modules. If one AddFEM fails as a result of error, the standby module automatically takes over the functions.

Redundancy of an AddFEM 6DL3100-8AA is controlled by the integrated functions in the automation processor configuration. In contrast, this redundancy control is integrated in the system performance of an AddFEM 6DL3100-8AB/-8AC. The redundancy coupling function on this module is implemented by a fiber optic interface which is used to transfer the status and update data. The extensive, integrated redundancy mechanisms and self-diagnostics functions of AddFEM support automatic error detection and redundant changeover, without any user intervention.

Redundant PROFIBUS DP connection

The AddFEM is equipped with two PROFIBUS DP interfaces (DP A and DP B) which operate in parallel which support the implementation of redundant system structures. All process input data are routed to both PROFIBUS DP interfaces, whereas only the process output data of the currently active DP interface are passed to the output pins. The process output data of the currently passive DP interface are analyzed for the purpose of monitoring. The master standby status of both DP interfaces, i.e. the definition of which DP interface is active or passive with respect to the output data can be set by the automation processor.

Preparation functions

Certain partial automation functions, such as the position control of turbine loop control circuits, can be swapped to the AddFEM as preparation functions. These functions are referred to as front-end function (FEF.)

GSD file

The PROFIBUS DP parameters and properties of the IO (measuring ranges, filtering, for example) of an AddFEM operated on SIMATIC S7 and SIMATIC PCS 7 systems can be set in SIMATIC Manager using HW Config. When operated on a SIMADYN-D system, the corresponding settings are programmed using the COM-PROFIBUS software package.

For information on using the GSD file, refer to the "readme.pdf" on your AddFEM CD.

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.

Reaction to the failure of one of the two encoders:

If one of the two signals is lost, the velocity value of the faulty channel is stepped down to zero as in single-channel recording mode (see section 4 "Technical specifications".) The system freezes the sign status according to its value prior to the error. This method upholds the detection of the velocity at a single channel after an error has occurred. However, reversals of the rotational direction can no longer be detected.

Wire breaks can be detected by means of a parity check of the channel signals, for example. However, allowances must be made in this parity check for differences between the channel signals caused by mechanical inaccuracy in the velocity sensor (tooth edges) and acceleration (see the next section.) Due to the many possible applications, the channel-specific wire break detection cannot be configured on the module, but rather in plant-specific parameters on the host system.

Information about refreshing and possible velocity differences of both channels:

The internal algorithm of the module always calculates the frequency (for measuring the period) based on signal transitions, and thus at different times at the two "phase-shifted" encoders.

Velocity changes will therefore cause a slight deviation of the values indicated at channels 1 and 2, because one of the channels will always return (in alternating mode) the more recent value. The timeliness and accuracy can be increased in particular in the lower velocity range by forming an average of both channel values.

Allowances must be made for the following velocity difference (Δf) between both channels caused by acceleration actions:

$$\Delta f = \sqrt{f^2 + a} - f \quad (\text{at frequencies } \leq 125 \text{ Hz})$$

(a = acceleration, f = frequency)

$$\Delta f = a * 2 \text{ ms} \quad (\text{at frequencies } > 125 \text{ Hz})$$

Note: Simplified formula for encoders with detection of the rotational direction and channels operating at a phase shift of 90°.

3.3 Operating modes

System configurations

The AddFEM can be configured for operation in stand-alone or redundant mode on one or two PROFIBUS DP channels. There are four available system configurations. The configuration must be programmed. See also 5.6.1 "Adjustable parameters".

The AddFEM module does not automatically detect and adapt a configuration. The mode of operation is set up on the AddFEM using a PROFIBUS DP parameter frame, and is determined by the required system configuration.

Note:

The basic setting selected for the AddFEM redundancy mode supports the replacement of a 6DL3100-8AA module with a 6DL3100-8AB/-8AC module without conversion of the configuration.

Setting the mode of operation

When using SIMATIC S7, you can configure the PROFIBUS DP parameters in HW-Config of SIMATIC Manager. Use the COM-PROFIBUS software package to make the corresponding settings for other systems.

Mode	Host	AddFEM	PROFIBUS
0	single-channel	single-channel	1 PROFIBUS DP segment
1	redundant	single-channel	2 PROFIBUS DP segments
2	single-channel	Redundant	1 PROFIBUS DP segment
3	redundant	Redundant	2 PROFIBUS DP segment

Note

After POWER ON, the AddFEM holds the STARTUP (LED RUN flashes) state until its operating mode parameters are set (see section 5.6.1).

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 kΩ to 3 kΩ
Current/ voltage profile across the working range	See Fig. 4-1!
Dealy time (TID)	50 μs at 0 > 1 signal transition 50 μs at 1 > 0 signal transition
Cyclic evaluation of all signals	2 ms Noise pulses < 10.667 μs 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!

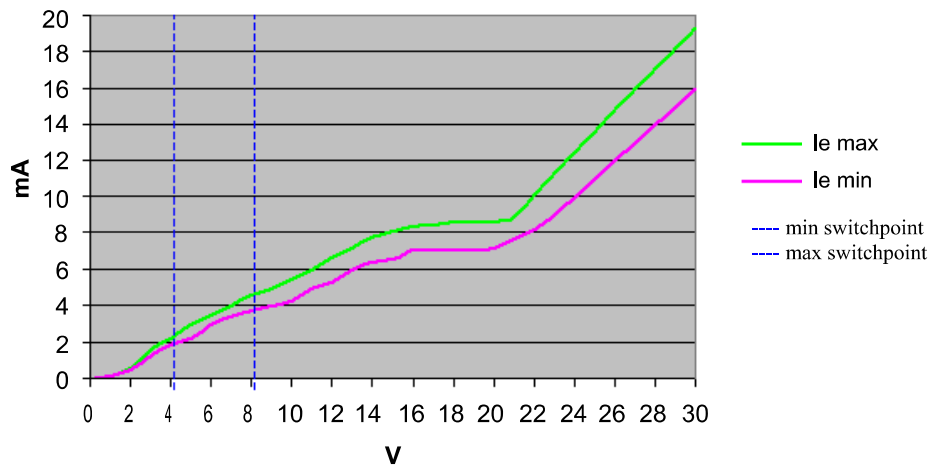


Fig. 4-2 Count pulse inputs, current-/voltage diagram including tolerances of input current I_e

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

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

5.1 Installing the AddFEM

The brackets of the AddFEM are adaptable and are thus suitable for mounting the AddFEM module on DIN rail, or for wall-mounting.

Always secure the 24 V DC power supply and process cables on the strain relief.

Installation to DIN EN 61131-2

6DL3100-8AA/-8AB/-8AC is an “open equipment“ according to DIN EN 61131–2 standard, and an “open type“ according to UL/CSA certification.

In order to satisfy safety requirements with respect to mechanical strength, non-inflammability, stability and touch protection, the following installation options 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.

 CAUTION
Danger of burns to hands from hot surface
Hot surface can cause burns
The temperature rise of the metal enclosure at full load is approximately 20 K. At an ambient temperature of 60 °C, the temperature limit of 70 °C is exceeded. This limit represents the maximum temperature up to which unprotected contact without risk of injury (according to DIN EN 61131-2) is possible.
Do not touch the enclosure without appropriate protective measures when the ambient temperature is > 50 °C.

Mounting options

Module mounting options:

- Mounting on double DIN rail (factory configuration)
- Direct screw-mounting on a wall

DIN rail mounting

The minimum clearance (measured center <-> center) between the top and bottom DIN rail is 165.1 mm (see the dimensional drawing for DIN rail mounting.) The minimum stiffness of the DIN rail structure must be sufficient to ensure safe fixation of the module. We therefore recommend the installation of rails to DIN EN 60715 (minimum material thickness: 2.2 mm), with a fastening pitch of less than 25 cm. DIN rails with a length of 19 inches should be bolted at the sides and in the middle.

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 <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> 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!