

2 Product description

2.1 Application module FM 458-1 DP

Designation	Order No.
Application module FM 458-1 DP	6DD1607-0AA1 or 6DD1607-0AA2

The application module FM458-1 DP with the order number 6DD1607-0AA1 is replaced through the module with the order number 6DD1607-0AA2 (100 % compatible).

NOTE

Where two different values are specified for a feature (separated by „ / ”) in the manual, the first is valid for the module with the order number 6DD1607-0AA1 and the second for the module with the order number 6DD1607-0AA2.

The following CPUs (from V3.1.0) have been released for operation with the FM 458-1 DP application module.

Designation	Order No.
CPU412-1	6ES7 412-1XF03-0AB0
CPU412-2	6ES7 412-2XG00-0AB0
CPU414-2	6ES7 414-2XG03-0AB0
CPU414-3	6ES7 414-3XJ00-0AB0
CPU416-2	6ES7 416-2XK02-0AB0
CPU416F-2	6ES7 416-2FK02-0AB0
CPU416-3	6ES7 416-3XL00-0AB0
CPU417-4	6ES7 417-4XL00-0AB0
CPU414-4H	6ES7 414-4HJ00-0AB0
CPU417-4H	6ES7 417-4HL01-0AB0

2.1.1 Updating the Firmware of FM 458-1 DP

In which situations should I update the firmware?

After (compatible) function expansions the firmware should be upgraded to the latest version (update).

Where do I get the latest version of the firmware?

You can obtain the latest firmware versions from your Siemens partner or from the Internet (Siemens home page; Automation and Drives, Customer Support).

Updating the firmware

How to update the firmware (FW):

Step	Action required	CPU Response
1.	Transfer update files to a blank MMC using STEP 7 and your programming device.	-
2.	De-energize the FM458-1 DP and insert an MMC containing the FW update.	-
3.	POWER ON.	- The FM458-1 DP detects the MMC with the FW update automatically and starts the FW update. - All LEDs are lit during FW update. - After completion of the FW update, the STOP LED flashes.
4.	De-energize the FM458-1 DP and remove the MMC containing the FW update.	-

Table 2-1 Updating the firmware with MMC

2.1.2 Application and design

Application

The FM 458-1 DP application module has been designed for high-performance closed-loop control and technological applications (e.g. Motion Control) which can be freely configured using CFC and optionally SFC. It is designed for use in a SIMATIC S7-400 station.

Together with two additional plug-in expansion modules, the FM 458-1 DP allows a large number of high-dynamic applications, especially drive-related applications to be implemented.

These include, for example, closed-loop torque, speed and position controls for:

- Converter-fed DC and three-phase drives,
- Winder with closed-loop tension/dancer roll controls, coilers
- Multi-motor drives, "breakproof" electronic shaft
- Complex setpoint inputs for e.g. crosscutters/flying saws, gearbox/motor test stands
- High dynamic performance hydraulic drives in presses.

Expansion modules

Designation	Order No.
Input/output expansion module EXM 438-1	6DD1607-0CA1
Communications expansion module EXM 448	6DD1607-0EA0
Communications expansion module EXM 448-2	6DD1607-0EA2

The FM can be supplemented by the following expansion modules for fast process coupling:

- The I/O expansion module EXM 438-1 provides binary and analog I/O as well as incremental and absolute value encoders.
- The EXM 448 communications expansion module offers an additional PROFIBUS-DP interface (master or slave). Optionally, MASTERDRIVES plug-in modules, e.g. SLB for SIMOLINK and SBM2 for higher-resolution multi-turn encoders can be used to increase their functionality.

A maximum of two expansion modules can be used together with the FM 458-1 DP application. The following combinations are possible:

All of the possible combinations are permitted.

NOTES

The following restrictions exist when using the FM 458-1 DP application module in an S7-400 expansion controller (EC):

- Rack number of the EC 1..6
- EC is a UR1/UR2
- The coupling is realized through a K-bus capable IM pair: IM460-/461-0, or IM460-/461-3

The S7-CPU module must read-in signals from the SIMATIC I/O and send these to the FM 458-1 DP.

When configuring/engineering the system, please ensure that the maximum load capability of the S7 power supply module is not exceeded as a result of the current drawn by the FM 458-1 DP module. When using an IM module, which is used to transfer power to other modules, its maximum load capability must also be observed.

Ground-free operation is not possible when using the EXM 438-1.

FM 458-1 DP is an “open type” and therefore only can be installed in closed switch cabinets or switch rooms.

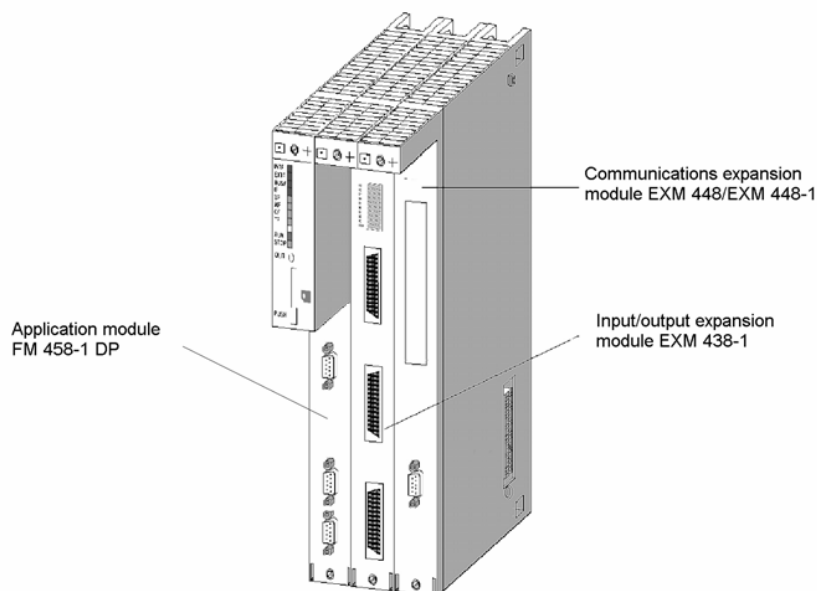


Fig. 2-1 FM 458-1 DP application module with two expansion modules

Design

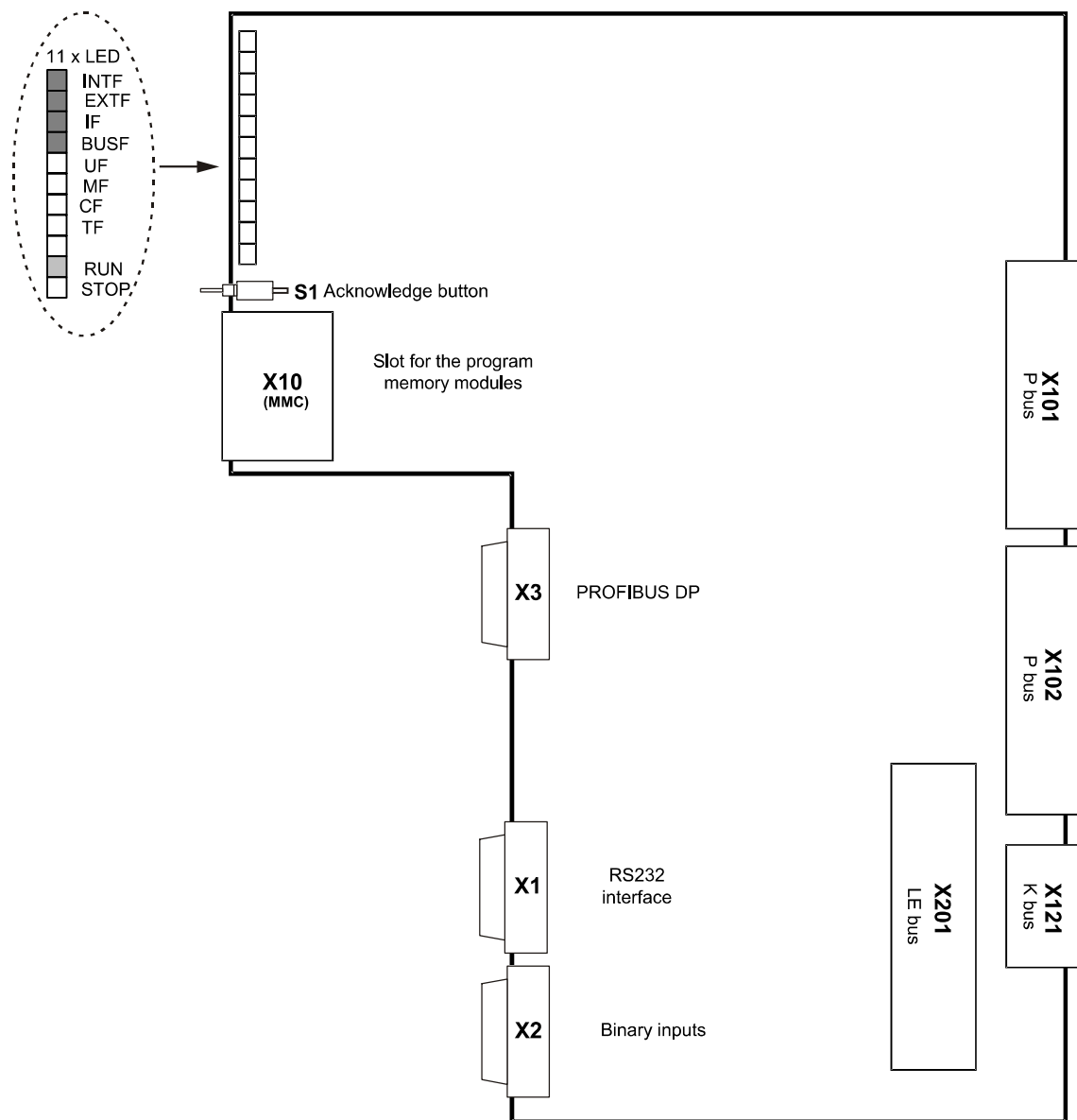


Fig. 2-2 Mechanical design of the FM 458-1 DP application module

2.1.3 Performance features

The FM 458-1 DP application module has been designed for high dynamic performance closed-loop control and technological applications in a SIMATIC S7-400 station. These control tasks can be freely configured using CFC or optionally SFC. Furthermore, it offers a PROFIBUS-DP connection.

- Computational performance
 - 64 bit RISC floating-point processor for arithmetic calculations
 - fastest cycle times of 0.1 ms – typical, 0.5 ms
 - 32-bit controller for communication tasks
- DRAM / SDRAM working memory
 - 16 / 64 MB
 - 12 MB / 60 MB useable for user program
 - the program code is loaded and expanded when initializing from the memory module
 - data memory for this operating system, user program, communications, message buffer, trace
- SRAM (256 kB / 512 kB)

The externally buffered SRAM contains the following data, which should be saved (non-volatile) even when the power fails:

 - fault diagnostics of the operating system ("exception buffer")
 - max. approx. 1000 / 2000 process quantities, configured using the SAV function block
 - data, traced using the message system or trace function (optional SRAM configuring)
- Replaceable program memories (2, 4, or 8 MB)
 - MMC (**M**icro **M**emory **C**ard), typical size: 2 MB
- Two interfaces are available to load the user program into the program memory:
 - via an MMC card slot (loading offline), e.g. field PG, USB prommer
 - directly from the PC via the MPI interface of a SIMATIC CPU (loading online)

- PROFIBUS DP interface with SIMATIC compatibility
 - equidistant (isochron)
 - lock-cycle synchronous
 - slave-to-slave communications capability
 - routing, e.g. teleservice
- 8 alarm tasks can be called via 8 binary inputs.
- RS 232 interface (V.24) with service protocol DUST1 (19.2 kBd) for:
 - Spline edit
 - Symtrace
- 11 LEDs to display the operating status
- Acknowledge button
Sporadically occurring faults (TF) or non-critical faults (FM) can be cancelled in the LED display using the acknowledge button. If another fault/error exists, then it is displayed after the first has been acknowledged.
- LE bus
The local expansion bus guarantees fast data transfer between the FM 458-1 DP application module and its expansion modules EXM 438-1 and EXM 448/EXM 448-2.

2.1.4 Supplementary components

Component	Designation	Order No.
Program memory - MMC Program memory module, 2 Mbyte - MMC Program memory module, 4 Mbyte - MMC Program memory module, 8 Mbyte	MMC	6ES7953-8LL00-0AA0 6ES7953-8LM00-0AA0 6ES7953-8LP10-0AA0
<u>PROFIBUS bus cable</u> with PROFIBUS bus terminal with integrated terminating resistors and plug-in cable		Refer to Siemens, Industrial Communications and Field Devices, Catalog IK PI 2000 e.g. 6GK1500-0AA00
<u>PROFIBUS bus cable</u> with PROFIBUS bus coupler with integrated terminating resistors (up to 12 Mbit/s)		Refer to Siemens, Industrial Communications and Field Devices, Catalog IK PI 2000 e.g. 6ES7972-0BB10-0XA0 6ES7972-0BB40-0XA0
<u>Cable for PC</u> (9-pin/9-pin) to connect to an FM 458-1 DP	SC57	6DD1684-0FH0
<u>Cable for FM 458-1 DP</u> (9-pin/10-pin) to connect an SBxx or SU12 to the binary inputs of the FM 458-1 DP, length: 2m	SC64	6DD1684-0GE0
<u>Interface module</u> 10 pin direct connection (1:1 converter)	SU12	6DD1681-0AJ1
<u>Interface module</u> Binary inputs and outputs	SB10	6DD1681-0AE2
<u>Interface module</u> Binary inputs 24/48 V	SB61	6DD1681-0EB3
power supply connector for Interface module SB10, SB61	SM11	6DD1680-0BB0

Table 2-2 Supplementary components for the FM 458-1 DP application module

For further informations about the interface modules see documentation "SIMADYN D Hardware"

2.1.5 Connections

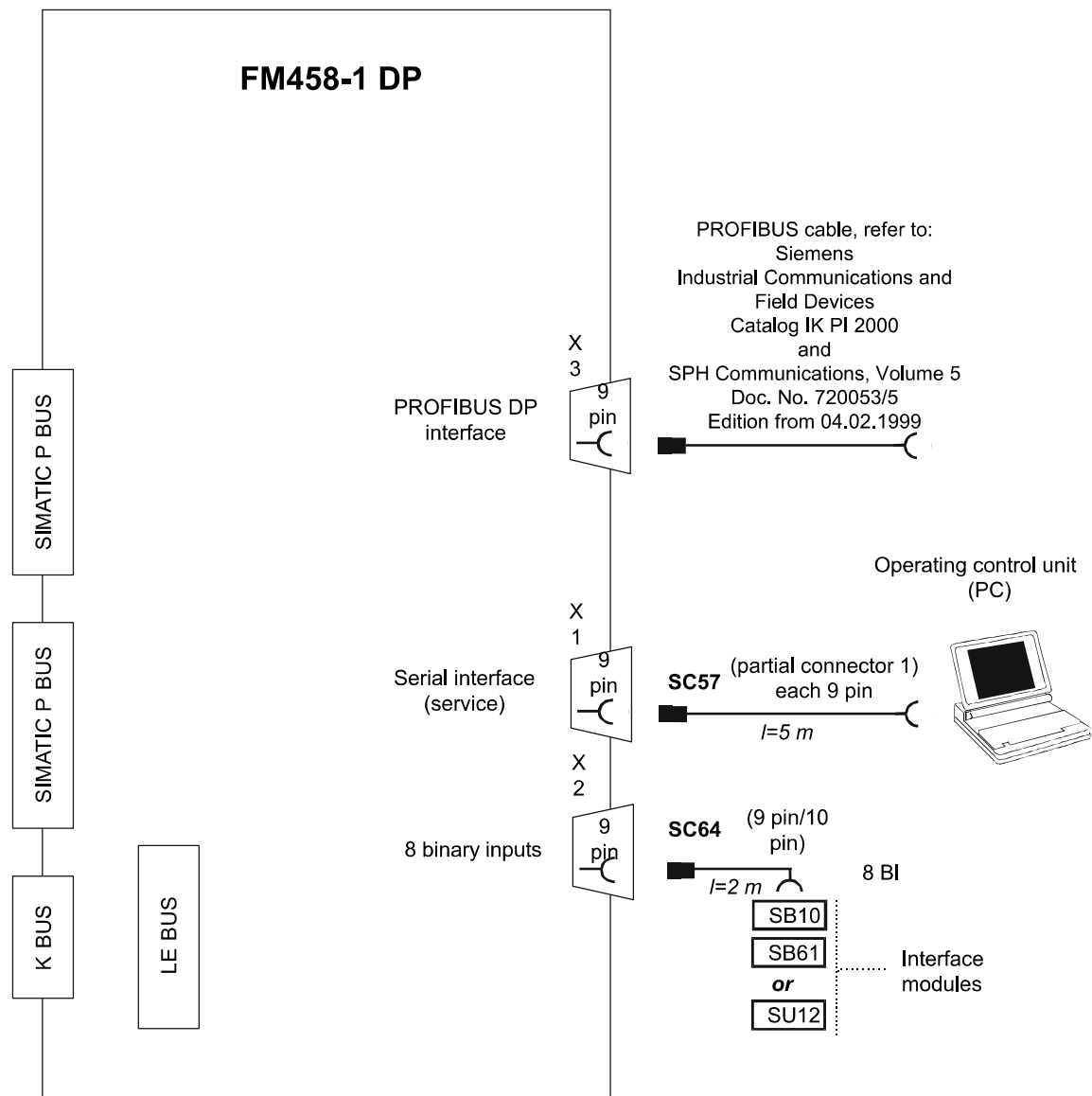
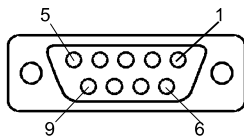


Fig. 2-3 Possibilities of connecting the FM 458-1 DP application module

Serial service interface (X1)



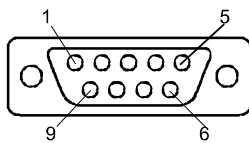
An operator control or configuring-PC is connected to the 9-pin sub-D socket via the SC57 PC cable.

X1	
PIN	Designation
1	-
2	Receive -Data In
3	Transmit Data Out
4	-
5	Ground 0V
6	-
7	-
8	-
9	-
Enclosure	Shield

SC57	
PIN FM-side	PIN PC-side
-	-
2	3
3	2
-	-
5	5

Table 2-3 Connector assignment of X1 and SC57 cable

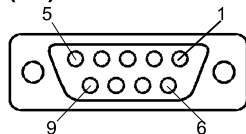
Binary inputs (X2)



The binary inputs are connected at the 9-pin sub-D socket via cable SC64.

PIN	Designation
1	Interrupt input 1
2	Interrupt input 3
3	Interrupt input 5
4	Interrupt input 7
5	Ground 0V
6	Interrupt input 2
7	Interrupt input 4
8	Interrupt input 6
9	Interrupt input 8
Enclosure	Shield

Table 2-4 Connector assignment of X2

PROFIBUS interface (X3)

The PROFIBUS DP interface is connected to the 9-pin sub-D socket.

PIN	Designation
1	Not assigned / Ground M24V (non-isolated)
2	Not assigned
3	Line B (input/output)
4	RTS from AS (input)
5	Ground 5Vexternal, floating
6	5Vexternal power supply voltage, floating
7	Not assigned / supply voltage P24V (non-isolated)
8	Line A (input/output)
9	RTS from PG (output)
Enclosure	Shield

Table 2-5 Connector assignment of X3

NOTE

Maximal permissible load for 5Vexternal: 90 mA

**WARNING**

There is a potential danger that connectors X1 and X3 are interchanged (both connectors are sub-D 9 socket connectors).

LE-bus connection

An expansion module (EXM438-1 or EXM 448/EXM 448-2) can be inserted at this 5 x 24-pin socket connector.

P-bus connection

Two 5 x 17-pin socket connectors are the connectors on SIMATIC S7 backplane bus. K-bus connection

A 5 x 7-pin socket connector is provided to connect to the SIMATIC K bus.

Interface modules

The terminals for the binary inputs are available via the interface modules.

Interface modules	Function
SB10, SU12	Electrical 1:1 connection, no signal conversion
SB61	With electrical isolation and signal conversion

Refer to Catalog ST DA for information on the interface modules.

NOTE

The operation of the FM 458-1 DP is only allowed with these interface modules.

The interface modules are "open type" and therefore only can be installed in closed switch cabinets or switch rooms.

2.1.6 Status displays

There are eleven LED displays on the front panel of the FM 458-1 DP. They provide information about its actual operating status and data for diagnostics. After the voltage runs-up, all LEDs are "DARK".

LED	Color	Status	Significance
INTF	Red	Bright	Internal fault , user program is not running
EXTF	Red	Bright	External fault (External Failure) e.g. bus fault, connection failed The fault is resolved after troubleshooting outside the module.
IF	Red	Bright	Initialization error For errors which occur when initializing the system, the user program does not start. Initialization errors due to incorrect modules or modules which are incorrectly inserted with respect to how they were originally configured
BUSF	Red	Bright	PROFIBUS DP- bus fault Bus fault for CPUs with integrated DP interface
		Flashing	One or several slaves at the PROFIBUS DP interface do not respond.
UF	Yellow	Flashing	User error User program runs, can be controlled by the user with the USF function block
MF	Yellow	Bright	Monitoring error The user program runs, error during initialization which permits standard operation to start, e.g. missing or discharged buffer battery.
CF	Yellow	Bright	Communications error The user program runs, incorrectly configured communications or erroneous connection to SIMATIC S7-CPU or EXM 448
TF	Yellow	Bright	Task administration error The user program runs, the following error cases are possible: <i>Cycle error</i> a task was not able to be completed within the task sampling time. <i>Task back-up</i> if the task is not tagged as a task to run with the highest priority - but it must be restarted. <i>No free local buffer</i> the data buffer is no longer enabled. Task start is bypassed. <i>Software Watchdog</i> if the basic sampling time is not processed four times one after the other. The basic clock cycle timer is re-initialized with the configured basic sampling time and processing is continued.
RESERVED	Yellow	Dark	Don't care
RUN	Green	Bright	RUN condition The user program runs, the module operates normally also if UF, MF, CF or TF = "bright"
		Flashing	Initialization running

STOP	Yellow	Bright	STOP status The user program is not running, the module is at stop, e.g. or fatal system, initialization errors or the S7-CPU is at stop
		Flashing	Download running in the STOP condition.

Table 2-6 Significance of the LED status displays

Errors can be acknowledged by pressing the acknowledge button. If an additional error exists, it is displayed after the first error has been acknowledged.

NOTE

More information on the diagnostic possibilities, refer to the User Documentation Manual "STEP 7 option packages for D7-SYS", Chapter "Basis software", Section "Diagnostics".

2.1.7 Behavior of the FM458-1 DP from the perspective of the S7-400 CPU when the operating state changes

Behavior when transferring data sets at operating state transitions

- Transition of the FM458-1 DP from STOP->RUN:
The data sets, configured in the CFC (using @CPB, CRV, CTV) are, before the transition to RUN, set-up on the FM side. The configured data sets are only enabled for the S7-CPU after the communications processing on the FM side has completely established its administration. In RUN, this takes several task cycles on the FM side. On the S7-CPU, this is detected in the user program in so much that the SFC58 (WR_REC) still supply value 0x80B0 and the SFC59 (RD_REC) still supply value 0x80C0 as return value. Values are only transferred between the FM458-1 DP and S7-CPU if these SFCs return a value of 0.
- Transition of the FM458-1 DP from RUN->STOP:
When the STOP state is reached, FM458-1 DP designates all of the configured data sets, as non-available. Just like the case above, this is then detected in the user program, on the CPU side, using the return values 0x80B0 and 0x80C0.
- Behavior for POWER ON:
The configured data sets are set-up but are only released, just like at the transition from STOP->RUN, after several task cycles in RUN.

Behavior for K-bus transfer at operating state transitions

- Transition of the FM458-1 DP from STOP->RUN:
The BSEND (SFB12) on the S7-CPU side outputs an error message until the FM458-1 DP has completely established the communications administration in RUN. In the RUN state, this procedure lasts several cycles. This is signaled on the S7-CPU side in the user program using the ERROR and STATUS return values. ERROR has a value of 1 and STATUS a value of 7. This means that the partner block (in this case, the BRCV on the FM side) is in the incorrect state. ERROR goes to 0 as soon as BRCV is ready to receive data on the FM side.

- Transition of the FM458-1 DP from RUN->STOP:
As soon as the FM458-1 DP has reached the STOP state, the outputs of block BSEND (SFB12) are set as follows:
ERROR = 0 and STATUS = 7.
 - Behavior for POWER ON: (refer to STOP->RUN).
- Diagnostics data set 0 and operating states**
- Using diagnostics data set 0, FM458-DP signals whether it is in the STOP or in the RUN state. This data set can be evaluated by the user program on the S7-CPU side. The user can read diagnostics data set 0 of the FM458-1 DP, e.g. with SFC59 (RD_REC) using data set number 0. The structure of this diagnostics data set can be found under the module diagnostics info in the help or in the documentation "STEP 7 - System and Standard Functions for S7-300 and S7-400".
- The net data area from the perspective of the operating states**
- The net data area from the user program can always be written in the S7-CPU. However, data is only processed if the FM458-1 DP is in RUN.
- Diagnostics alarm**
- In HW Config, it is possible to configure the FM458-1 DP so that it generates diagnostic alarms. The reason for generating a diagnostic alarm is an operating state change. The diagnostics alarm is evaluated in the user program in OB82 (I/O_FLT).
 - When does the FM generate a diagnostics alarm:
 - Change from RUN->STOP
 - Change from STOP->RUN, if this transition was not initiated by the S7-CPU (e.g. as a result of an operator action on the PG)
 - Withdraw/insert the MMC
- Process alarms**
- It is possible to configure the FM458-1 DP in HW Config so that it may generate process alarms. In this case, block PAS7 is used on the FM to configure this function.
 - The FM458-1 DP only sends process alarms to the S7-CPU in the RUN state.

2.1.8 Technical data

Order No.	Application module FM 458-1 DP		6DD1607-0AA1 / 6DD1607-0AA2	
Program memory	Usable MMC-Cards: 2, 4 or 8 MB			
Serial service interface (X1)	RS232 interface (V.24) - Service protocol - Data transfer rate		- DUST1 19.2 kbaud	
Binary inputs (X2)	Number		8	
	Electrical isolation		No (only via optional IF modules)	
	Input voltage - permissible range - nominal voltage - for a 0 signal - for a 1 signal		-1 V to +33 V 24 V -1 V to +6 V or open-circuit inputs +13.5 V to +33 V	
	Input current - for a 0 signal, typical - for a 1 signal, typical		0 mA 3 mA	
	Delay time per channel, max.		100 µs	
PROFIBUS DP interface (X3)	Data transfer rate		max. 12 Mbaud	
Voltage, currents	Nominal voltages at 25° C		Typical current drain (typical = 2/3 max.)	
	+5 V		2.2 A / 1.5 A	
	Battery +3.4V		15 µA	
Power loss	Power loss, typical		11 W / 7.5 W	
ambient temperature	ambient temperature		max. 40° C	
			max. 50° C only in stand alone mode with the interface modules SU12, SB10 and SB61 with the cable SC64	
Dimensions	Assignment, slots		1	
	Dimensions W x H x D [mm]		260 x 197 x 20.32	
	Weight		1.0 kg	

2.2 I/O expansion module EXM 438-1

Designation	Order No.
I/O expansion module EXM 438-1	6DD1607-0CA1

2.2.1 Application and design

Application

The EXM 438-1 expansion module provides additional binary and analog I/O as well as incremental- and absolute value encoders. Fast data transfer with the FM 458 application module is realized via the internal LE bus. The power supply is obtained via the P bus of SIMATIC S7-400. It is not possible to directly transfer process data via the P bus.

To connect the 24V DC power supply of the binary inputs and outputs, terminals 9 and 10 on the SU13 interface module must be used:

- Terminal 9: 24V
- Terminal 10: M

These terminals have been designed so that the polarity cannot be interchanged.

Design

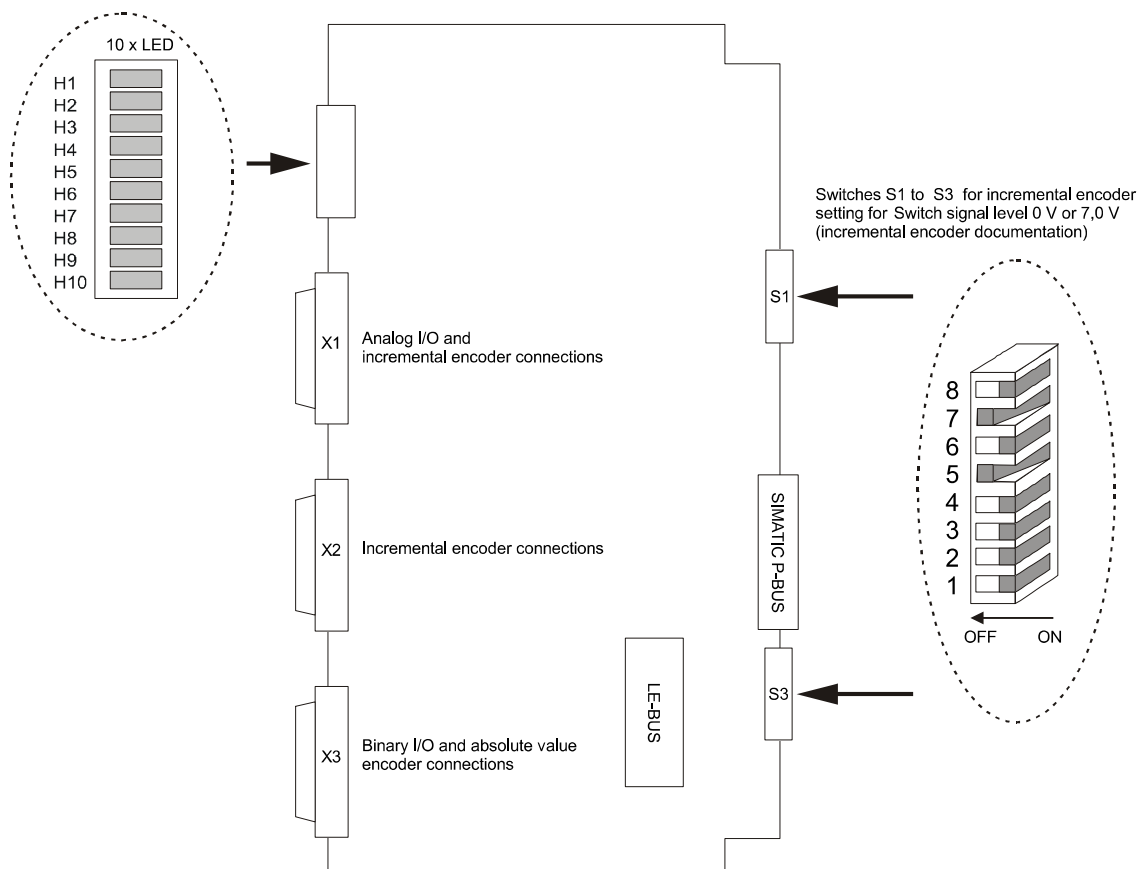


Fig. 2-4 Mechanical design of the I/O EXM 438-1 expansion module