SAS 523/525

Serial Interface Module for
SIMATIC® -S5 Systems

Manual

Edition 2.01

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Note:

The content of this manual has been checked for conformity with the hardware and software described. However, because differences cannot be ruled out, we cannot accept liability for complete conformity. The information given in this manual is revised regularly and any necessary corrections are included in subsequent editions. We are grateful for any suggestions for improvement.

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1 Introduction

This manual describes the SAS 523/525-1, SAS 523/525-2 and SAS 523/525-3 Serial Interface Modules of Systeme Helmholz GmbH. These modules are used in the programmable controllers of the SIMATIC S5 series (S5-115U to S5-155U). The SAS 523/525 modules are equipped with one serial interface. The modules SAS 523/525-2 have two and the modules SAS 523/525-3 have three serial interfaces. The physical transmission mode (RS232, TTY, RS422 etc.) can be adapted to the I/O devices by using the appropriate submodule.

The firmware of the SAS 525 module contains a number of protocols and procedures which can be selected by the user via the software. We are willing to supply a special driver on request.

1.1 Applications

The SAS 523/525 Serial Interface Modules are used in SIMATIC® S5 systems as intelligent interfaces for the serial input and output of data. The modules have their own processor which monitors the input and output of data, manages the transmit and receive buffers and executes integrated procedures.

The 25-way subminiature D sockets of the modules have the same layout as those of the CP 524, CP525 and CP 544 so that the modules can be connected via the standard cable.

The interface module can, for example, be connected to a keyboard, a terminal, a printer or be used for communication with other programmable controllers or a PC. The maximum transmission rate for this is 38400 baud. The transmission rate, data format and protocol are parameterized by the user.

You can set the transmission mode by slotting in an interface submodule. At present the following submodules are available:

- TTY
- RS232
- RS422/485 not isolated
- RS422/485 isolated

1.2 Principle of data transfer

All data which the interface module exchanges with the CPU are temporarily stored in the transmit or receive buffer. The Z80 processor then handles data traffic via the actual interface in conjunction with the appropriate firmware.

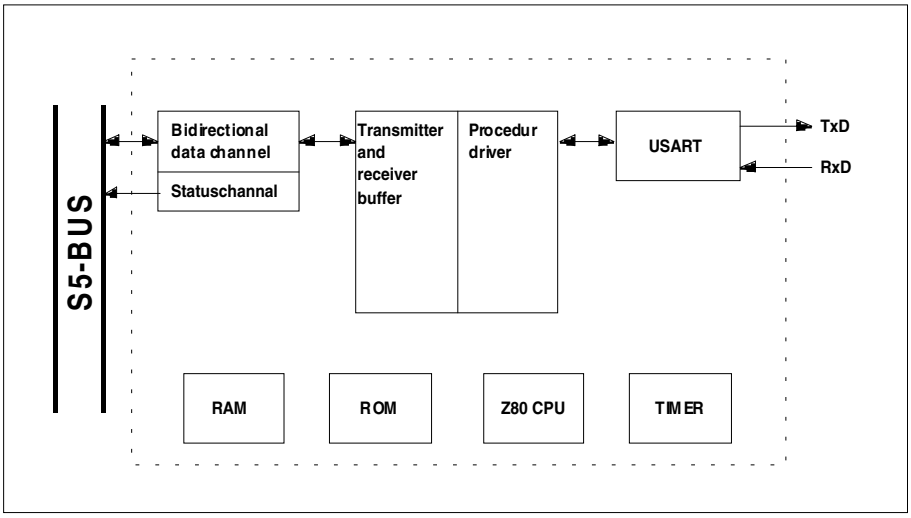


Fig. 1.2.1 Principle of data transfer with SAS modules

The advantage for the user is that complete data packets can be sent to the module. This packet is then managed and transmitted by the module itself. Incoming data are automatically received and buffered by the module.

1.3 Scope of supply

SAS 523:

- SAS 523 module
- SAS 523/525 manual

SAS 525:

- SAS 525 module
- SAS 523/525 manual

1.4 Accessories

SAS 523

• TTY interface submodule		700-523-1UA11
• RS232 interface submodule		700-523-1UA21
• RS422/485 interface submodule old		700-523-1UA31
• RS422/485 interface submodule new		
not isolated		700-523-1UA41
isolated		700-523-1UA51
• Standard FBs S5-115U		802-523-0AA11
with files:	SAS523ST.S5D	
	CPU945ST.S5D	
• Standard FBs S5-135U		802-523-0AA21
• Standard FBs S5-150U		802-523-0AA31
• Standard FBs S5-155U		802-523-0AA41
• Adapter casing for S5-115U		6ES5-491-0LB12

SAS 525

• TTY interface submodule		700-523-1UA11
• RS232 interface submodule		700-523-1UA21
• RS422/485 interface submodule old		700-523-1UA31
• RS422/485 interface submodule new		
not isolated		700-523-1UA41
isolated		700-523-1UA51
• Standard FBs S5-115U		802-525-0AA11
with files:	SAS525ST.S5D	
	CPU945ST.S5D	
• Standard FBs S5-135U		802-525-0AA21
• Standard FBs S5-155U		802-525-0AA41
• Adapter casing for S5-115U		6ES5-491-0LB12

2 Hardware

2.1 Module design

The SAS 523/525 interface modules are printed circuit boards in double-height Eurocard format with two 48-way backplane connectors in the ES 902 packaging system. The slot width is 1 1/3 of a standard plug-on station (SPS). The SAS 523/525-1 modules have one interface, the modules SAS 523/525-2 have two interfaces and the modules SAS 523/525-3 are equipped with three interfaces.

The following are located on the front panel of the modules:

1 One, two or three 25-way subminiature D sockets for the actual interfaces
2 Hexagon-head stud bolts for securing the connectors
3 Two tab connectors for the external power supply for TTY mode (for TTY mode only)

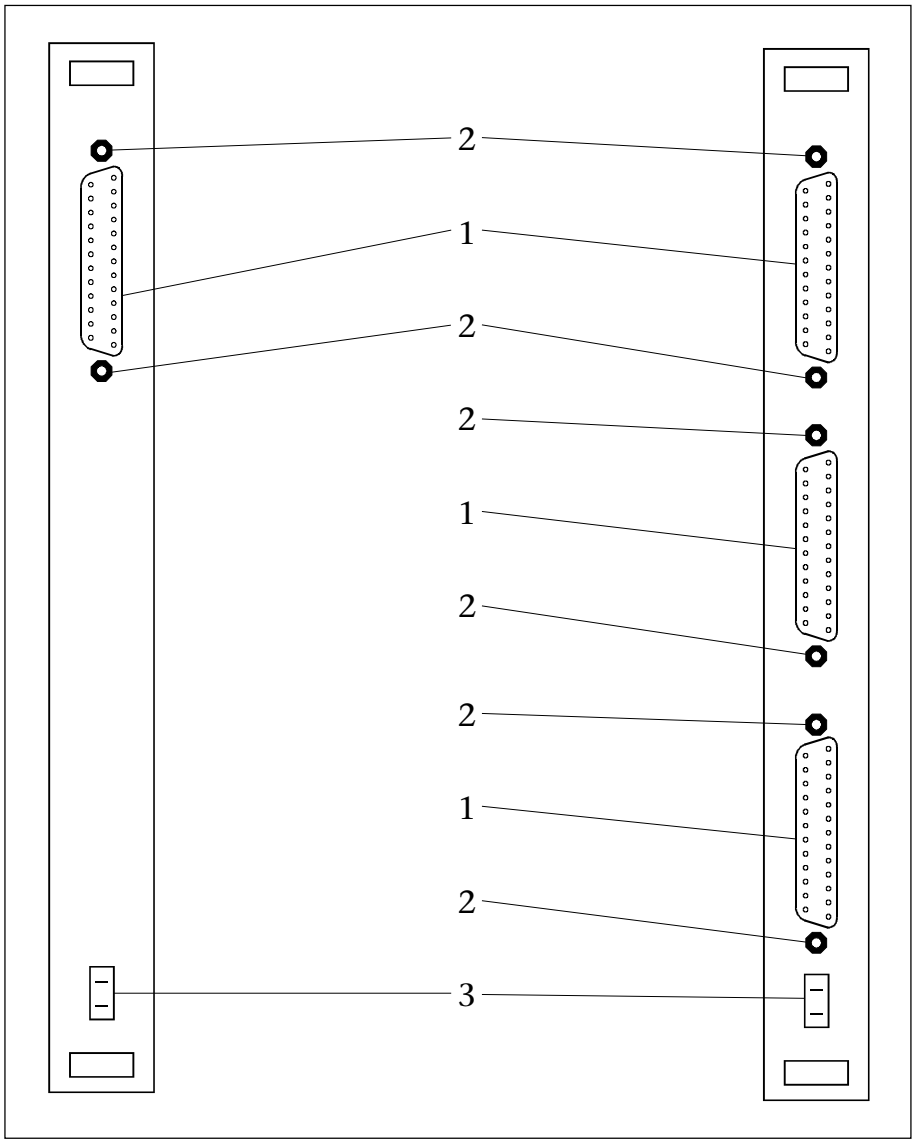
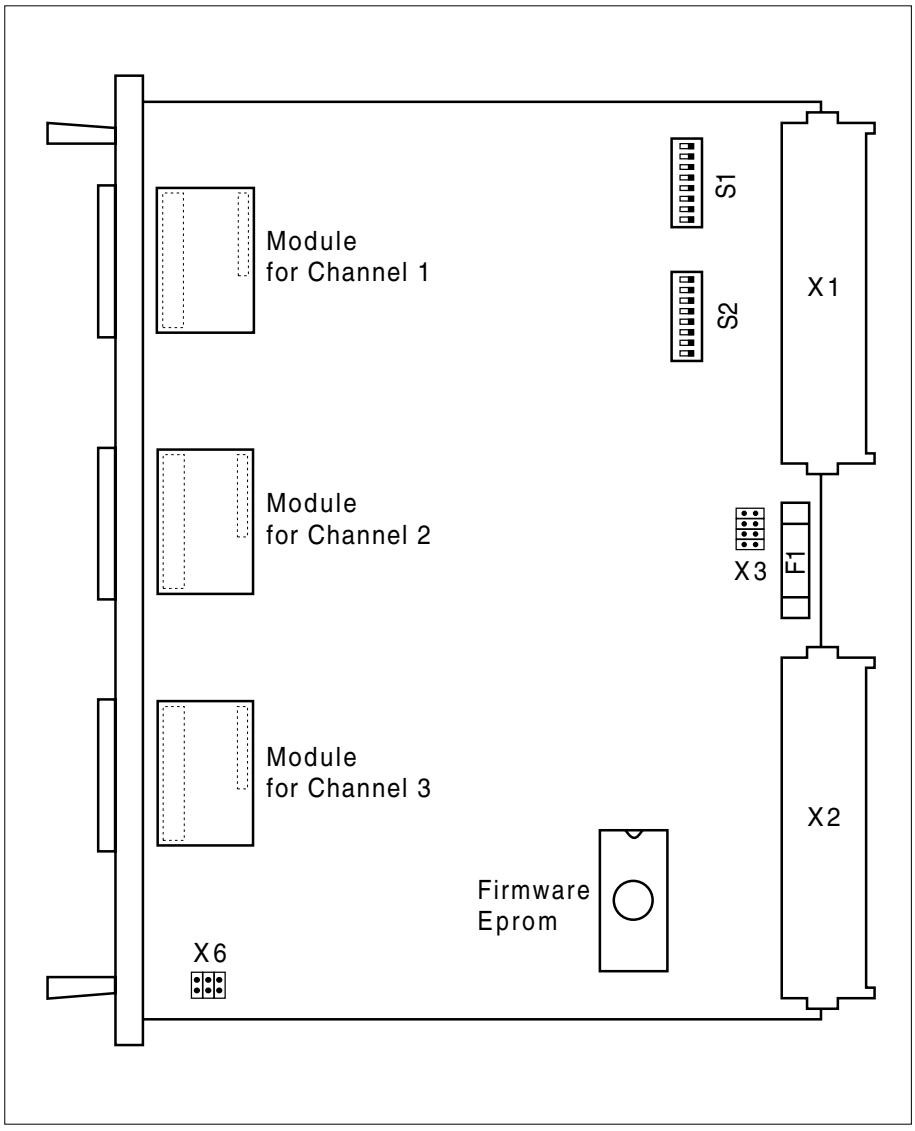


Fig. 2.1.1
Front panel of the interface modules SAS 523/525-1 (left) and SAS 523/525-3 (right)

On the main board the following elements are of importance to the user:

- **Switches S1 and S2**
  For setting the base address of the module
- **Jumper X3**
  Setting the internal 24V supply for TTY via the lower backplane connector (X2) or the upper backplane connector (X1)
- **Jumper X6**
  Setting 24V supply for TTY (internal or external)
- **F 1**
  250mA fuse to protect module if the IM switch is set incorrectly
- **Submodule slot for channels 1 to 3**
  The interface submodule for each channel is slotted in here.

Fig. 2.1.2
Main board
SAS 523/525-3



2.2 Technical data

Interfaces:
1 or 3 serial interfaces (TTY, RS232, RS422, RS485 freely selectable for each interface)

Transmission rates:
150, 300, 600, 1200, 2400, 4800, 9600, 19200, 38400 Baud

Protocols:
- ASCII transparent
- BREAK (for TTY)
- BUS handshake (RS422/485)
- PROLINE - Highspeed
- 3964/3964R with RK512 (for SAS 525 only)

Connector:
25-way subminiature D socket

Max. line length:

TTY	1000m
RS232	16m
RS422/485	1200m (shielded, twisted pair)

Power supply:

Base module	+ 5V; ±5%
For TTY submodule also	+ 24V; ±15% (internal or external)

Current consumption:

SAS 523/525-3	460 mA
SAS 523/525-2	410 mA
SAS 523/525-1	350 mA

Interface submodules:

RS232 submodule	10mA
RS422/485 submodule	140mA
TTY submodule	10mA (when active, load for 24V: 40mA per submodule)

Weight:

SAS 523/525-1	approx. 0.30 kg
SAS 523/525-2	approx. 0.37 kg
SAS 523/525-3	approx. 0.43 kg
Submodules	approx. 0.01 kg

Ambient conditions:

Operating temperature no forced-draft ventilation	0...55°C
Storage temperature	-20...70°C
Relative humidity	95% at 25°C (no condensation)

Operating altitude: max. 3000m above sea level

2.3 DIL switches and jumpers

2.3.1 Setting the addresses with DIL switches S1 and S2

The setting of the base address is made with the DIL switches S1 and S2 via which the module can be addressed by the programmable controller. This address only depends on the setting of these DIL switches and not on the slot in the PLC. The module can only be set in two modes.

Absolute address:

With the S5-155 addressing is only possible in the range of F0000h to FFFFFh

The base address of the module can be set over the entire address range of the programmable controller in this mode. For the module SAS 523/525-1 this address must be a multiple of four and for the modules SAS 523/525-2 and SAS 523/525-3 it must be a multiple of eight. The module SAS 523/525-1 is allocated four addresses, the modules SAS 523/525-2 and SAS 523/525-3 are allocated eight addresses from the set base address. The precondition for address setting is that the selected address range is not already assigned to a RAM or another module.

I/O address:

The SAS 523/525 Interface Modules can also be used in an expansion unit. To do this, the EU switch on DIL switch S2 must be set to ON. In the I/O area all those addresses can be used which are not read as part of the process image. The I/O bytes PY0 to PY127 can therefore not be used. The reason for this is the cyclic reading and writing of these I/O addresses by the PLC operating system to update the process image.

Use as a terminating resistor in the S5-115

If no IM module is used in the S5-115, the SAS 523/525 Interface Module can be used instead of the terminating resistor on the IM slot. The terminating resistor is simulated by the module. For this, the switches IM and EG of the DIL switch S2 must be set to ON.

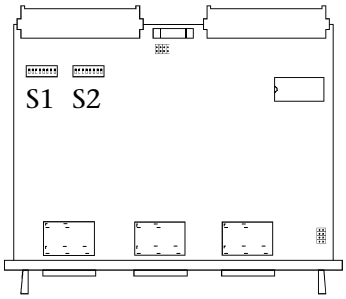
Attention! Short-circuit of 24V supply

If the module is not used in the IM slot, the IM switch of the DIL switch S1 must be set to OFF otherwise a short-circuit can occur on the 24V supply. However, the fuse F1 on the PCB prevents any serious damage.

The examples on the following pages illustrate address setting with DIL switches S1 and S2.

Attention! When using the connection IM308/ 318

The module **cannot** be used in the expansion unit if the IM308/ 318 modules are used for connecting the expansion unit.



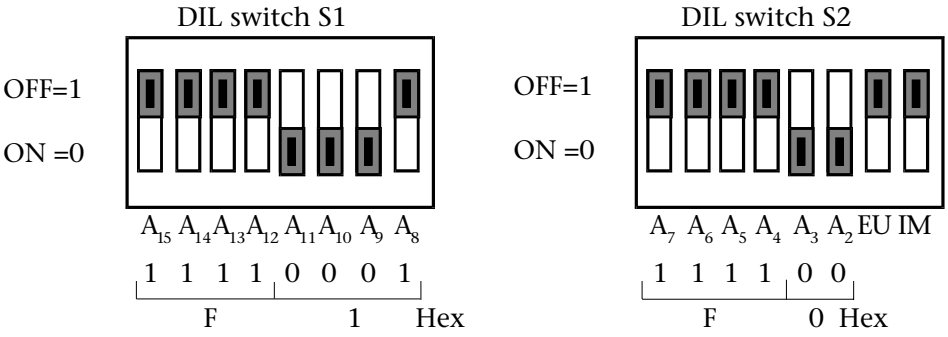
abs.	I/O	A_7	A_6	A_5	A_4	A_3	A_2
F080	PY128	1	0	0	0	0	0
F084	PY132	1	0	0	0	0	1
F088	PY136	1	0	0	0	1	0
F08C	PY140	1	0	0	0	1	1
F090	PY144	1	0	0	1	0	0
F094	PY148	1	0	0	1	0	1
F098	PY152	1	0	0	1	1	0
F09C	PY156	1	0	0	1	1	1
F0A0	PY160	1	0	1	0	0	0
F0A4	PY164	1	0	1	0	0	1
F0A8	PY168	1	0	1	0	1	0
F0AC	PY172	1	0	1	0	1	1
F0B0	PY176	1	0	1	1	0	0
F0B4	PY180	1	0	1	1	0	1
F0B8	PY184	1	0	1	1	1	0
F0BC	PY188	1	0	1	1	1	1
F0C0	PY192	1	1	0	0	0	0
F0C4	PY196	1	1	0	0	0	1
F0C8	PY200	1	1	0	0	1	0
F0CC	PY204	1	1	0	0	1	1
F0D0	PY208	1	1	0	1	0	0
F0D4	PY212	1	1	0	1	0	1
F0D8	PY216	1	1	0	1	1	0
F0DC	PY220	1	1	0	1	1	1
F0E0	PY224	1	1	1	0	0	0
F0E4	PY228	1	1	1	0	0	1
F0E8	PY232	1	1	1	0	1	0
F0EC	PY236	1	1	1	0	1	1
F0F0	PY240	1	1	1	1	0	0
F0F4	PY244	1	1	1	1	0	1
F0F8	PY248	1	1	1	1	1	0
F0FC	PY252	1	1	1	1	1	1

Allocation table for absolute address, I/O address and switching setting of the DIL switches S1 and S2.

Due to the fact that the address A2 is not evaluated with the modules SAS 52x-2 and SAS 52x-3, the setting of the switch A2 is irrelevant with these modules. Therefore with these modules only addresses in the table with a grey background are permitted.

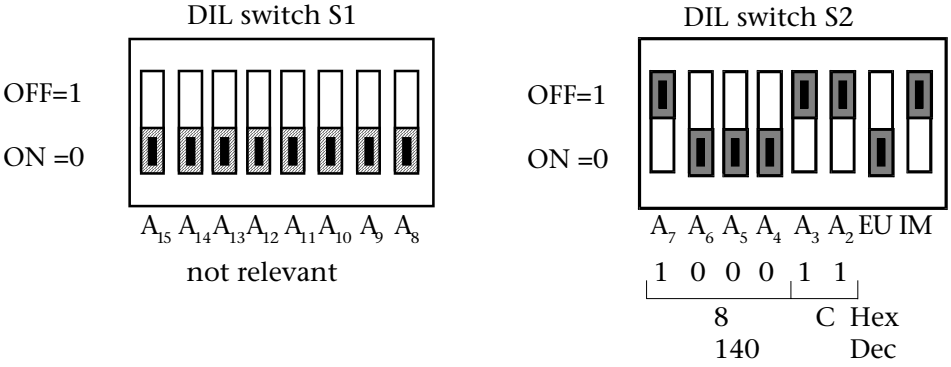
Example 1

The module is to be addressable in the central controller via base address F1F0h.



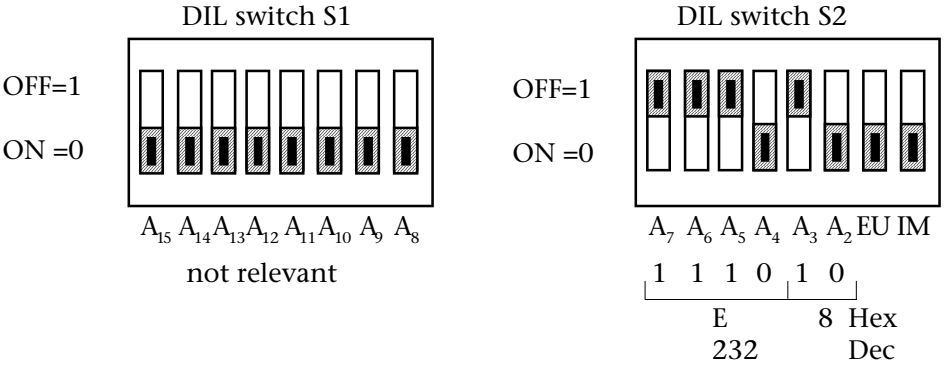
Example 2

The module is to be used in the expansion unit. The base address of the module is to be set to PY140 (=8Ch).



Example 3

The module is to be used in the IM slot in the central controller of the S5-115 and be addressed at base address PY232 (=F0E8h). (The 24V internal power supply is missing on this slot)



2.3.2 Jumper panels X3 and X6

If the module is operated with a TTY submodule as an active part of a current loop, the supply of the 20 mA current sources on the TTY submodules can either be internal or external.

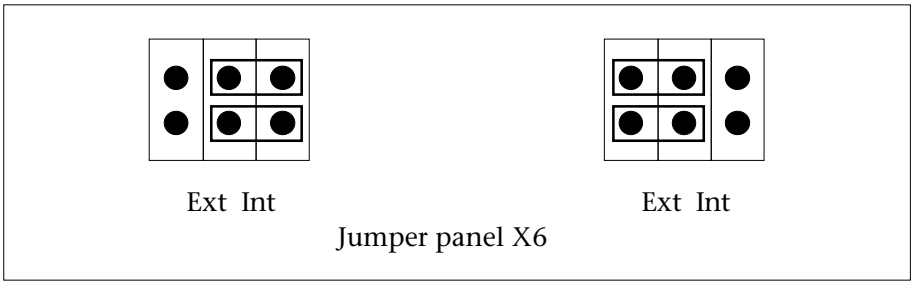
The internal 24 V supply comes from the S5 power supply unit via the upper or lower backplane connectors. An external DC supply of 10 to 36V (24V is a typical value) can be connected to both tab connectors on the front panel of a supply of the TTY submodule. The external 24V connector is equipped with reverse pole diodes so that any poling of the external voltage is permitted.

The source of the power supply is set with jumpers X3 and X6.

Jumper panel X6 selects whether the 24V supply of the TTY current loop is to be external via the two tab connectors on the front panel or via the S5 bus, if available. An internal supply is only possible when the 24V is available on the slot of the module. This is not the case on all the slots of the PLCs! Please refer to the figures in Section “Slots for the interface modules”.

For the power supply, the jumper of the jumper panel X6 must be set as in Fig. 2.3.1.

Fig. 2.3.1
Internal (left) and external (right) power supply of the TTY interface

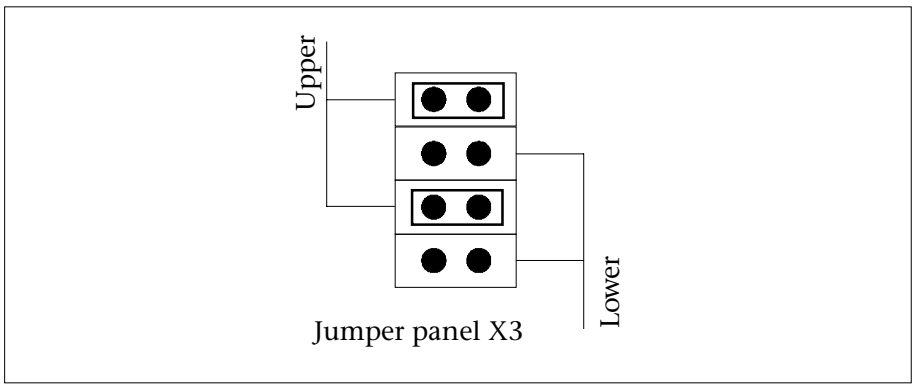


EMC resistance drops with internal supply of the TTY submodule

If an internal power supply is used with TTY operation the EMC resistance of the module will drop. This results from eliminating the galvanic isolation. If the interface module is used an installation with great electromagnetic interference the external power supply should always be selected.

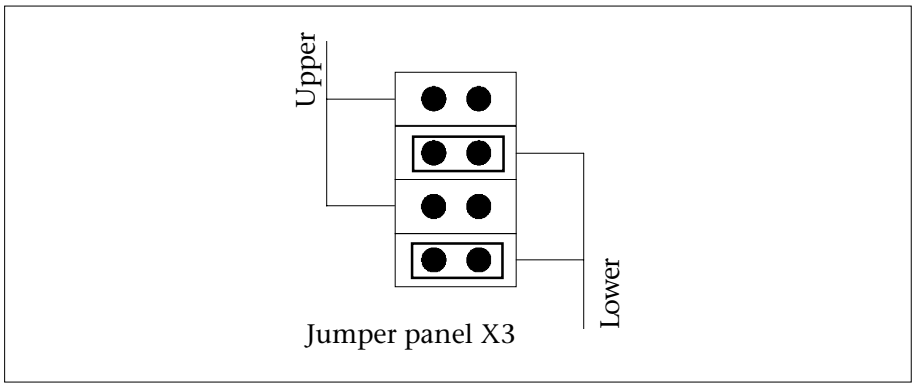
The different settings of jumper panel X3 are used to select whether the 24V should be taken from the upper or the lower backplane connector with internal supply of the TTY current loop. If the 24V is applied to the upper backplane connector X1 (this is the case with S5-115) then the jumper must be connected as follows:

Fig. 2.3.2
Power supply via the upper connector (S5-115)



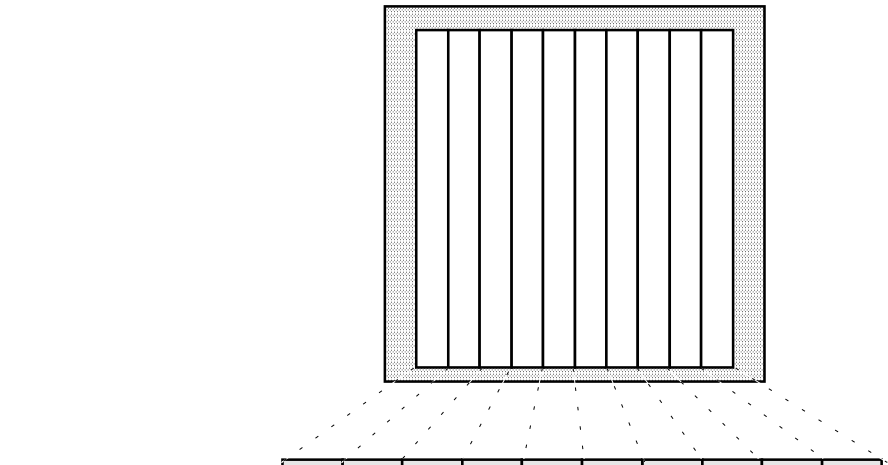
If the 24V is applied to the lower backplane connector (X2) (S5-135, S5-150 and S5-155) then the connectors must be connected as follows:

Fig. 2.3.3
Power supply via the lower connector (S5-135, S5-150, S5-155)



2.4 Slots for the interface modules

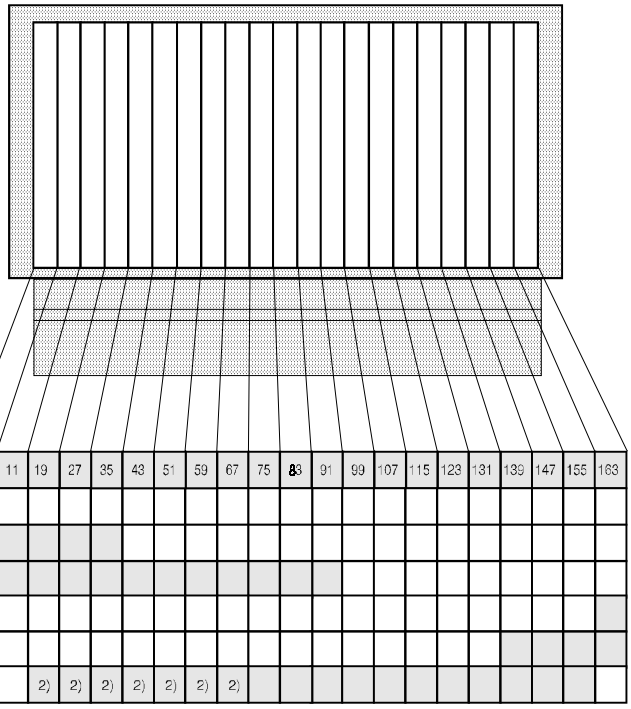
Fig. 2.4.1
Slots in the S5-115



Slots	PS	CPU	0	1	2	3	4	5	6	IM
Power supply module										
CPU module										
SAS523/525 interface module				1)	1)	1)	1)	1)	1)	3)
			2)	2)	2)	2)	2)	2)		3)

1) Connectable with modules having a treble terminal strip (CR 700-2).
2) The 24V for the active TTY interface is available at these slots.
3) Make sure it matches the DIL switches.

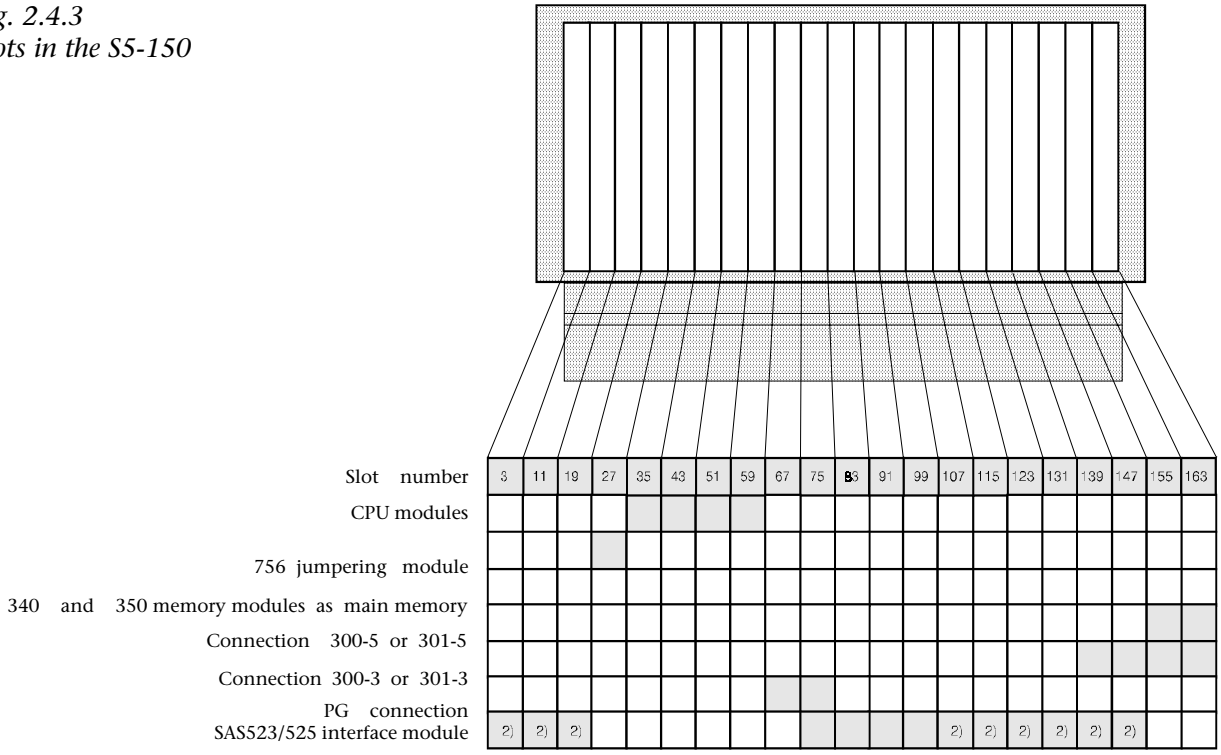
Fig. 2.4.2
Slots in the S5-135



Slot number	3	11	19	27	35	43	51	59	67	75	83	91	99	107	115	123	131	139	147	155	163
Coordinator																					
R, S, M processors																					
Communication processors																					
300-5 or 301-5 interfaces																					
300-3, 301-3 and 302 interfaces																					
SAS523/525 interface module			2)	2)	2)	2)	2)	2)	2)												

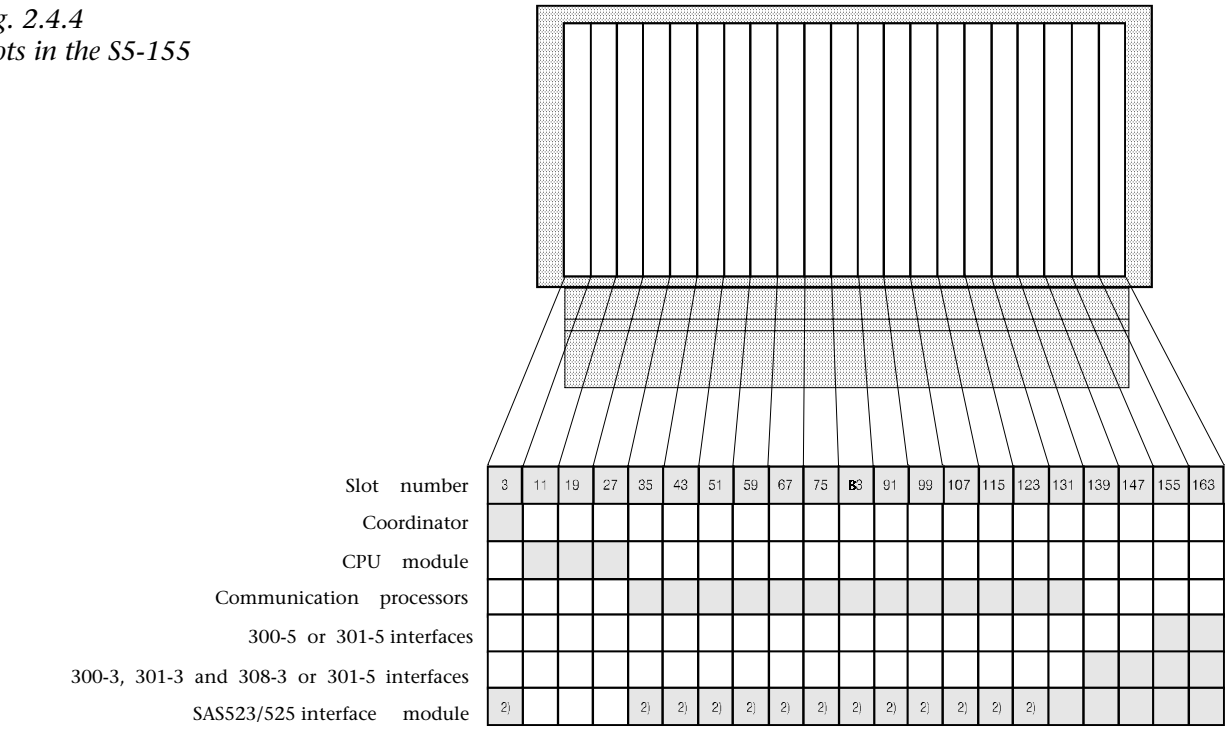
1) Connectable with modules having a treble terminal strip (CR 700-2)
2) The 24V for the active TTY interface is available at these slots.
3) Make sure it matches the DIL switches.

Fig. 2.4.3
Slots in the S5-150



1) Connectable with modules having a treble terminal strip (CR 700-2).
2) The 24V for the active TTY interface is available at these slots.
3) Make sure it matches the DIL switches.

Fig. 2.4.4
Slots in the S5-155



1) Connectable with modules having a treble terminal strip (CR 700-2).
2) The 24V for the active TTY interface is available at these slots.
3) Make sure it matches the DIL switches.

2.5 Layout of modules and pin assignment

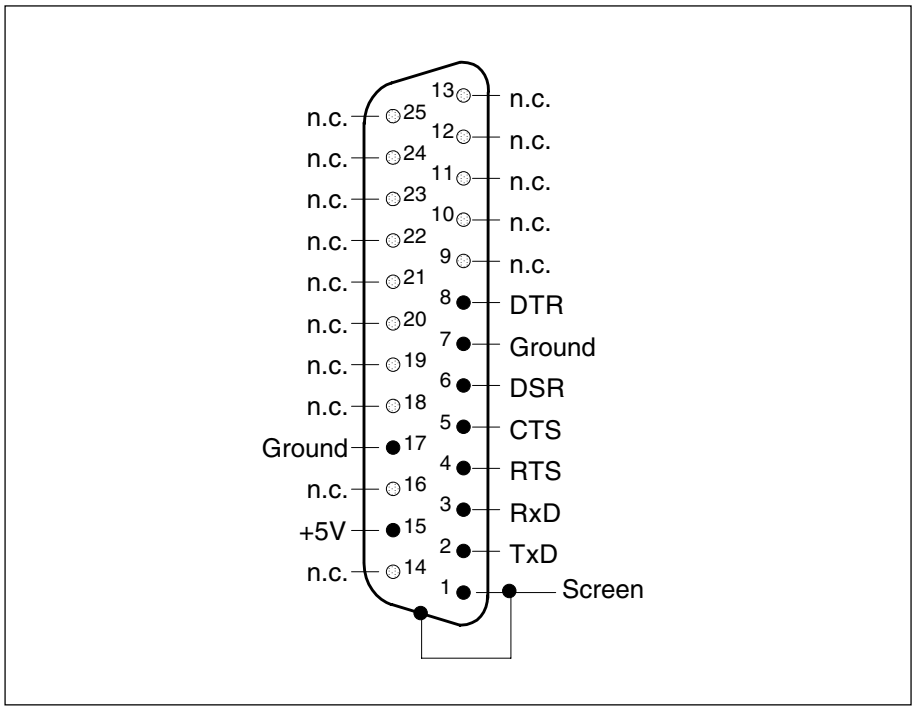
The physical charateristics of the interfaces can be determined by plug-in submodules. Three different interfaces can be slotted in this way (with SAS 52X-3).

2.5.1 RS232 submodule

No preadjustments are carried out on the module when using the RS232. Fig. 2.5.1 shows the pin assignment of the 25-way connector (front) when using the RS232 submodule.

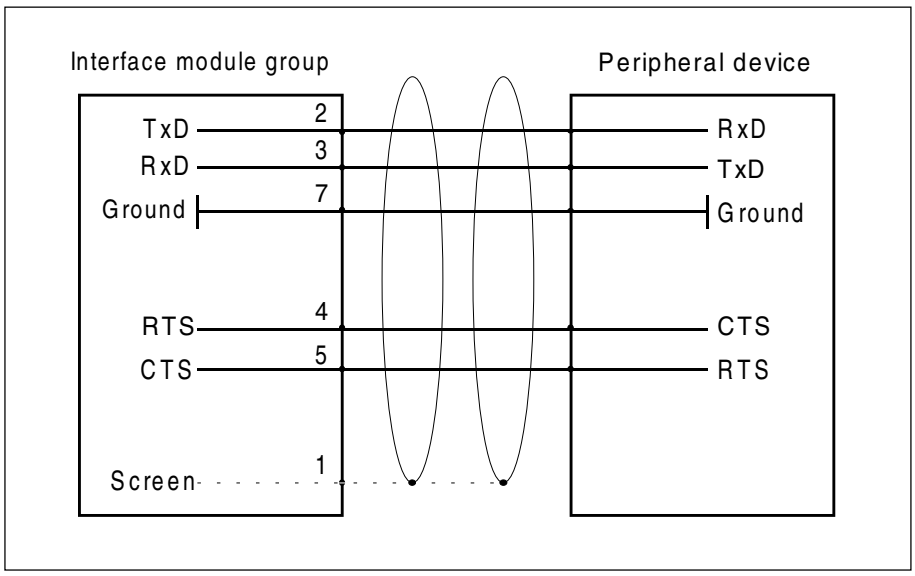
The connection via the RS232 interface can be established with or without handshake. When using as an RS232 interface, a hardware handshake via the signals RTS and CTS is used. The I/O device must be able to process these handshake signals.

Fig. 2.5.1
Pin assignment for the RS232 submodules



If the peripheral device operates with a DTR/DSR handshake then these signals must be used to service RTS/CTS of the interface. The standard firmware does not support DTR/DSR! If the RS232 connection is made without handshake, e.g. because the peripheral device does not provide a handshake signal then RTS and CTS need not be activated. The interface then operates without handshake.

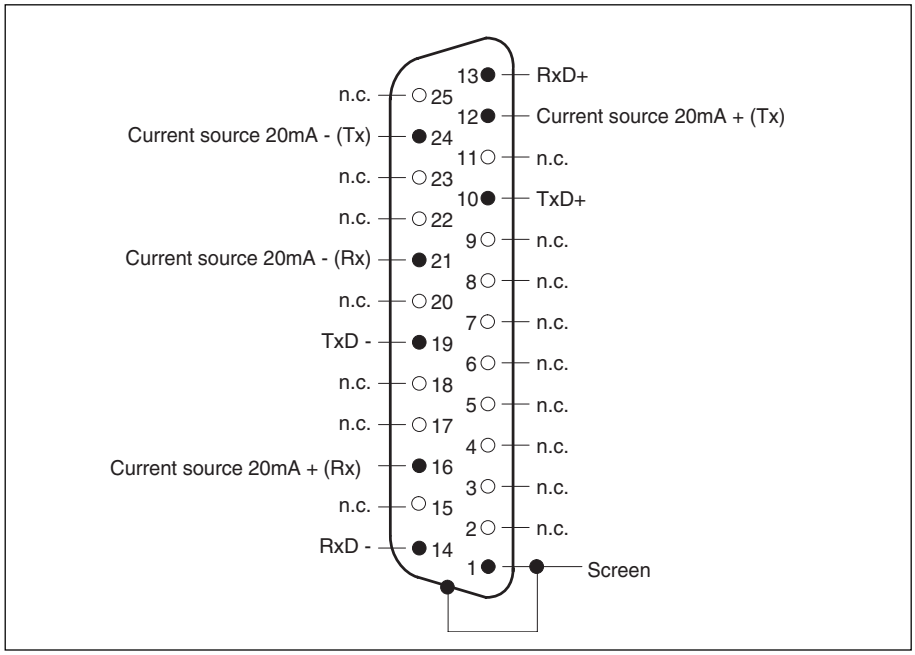
Fig. 2.5.2
RS232 connection



2.5.2 TTY submodule

When using the TTY submodule no preadjustments need be made the module. Fig. 2.5.3 shows the pin assignment of the 25-way front connector when using the TTY submodule.

Fig. 2.5.3
Pin assignment when using the TTY submodule



By different wiring of the terminating resistor it can be determined whether the module is used as an active or as a passive part of the current loop. In the active TTY mode both power units supply the required current to the loop. If the module is used as a passive TTY interface then the I/O devices take over supply of the loop.

Fig. 2.5.4
TTY Connection (SAS 523/525 is active)

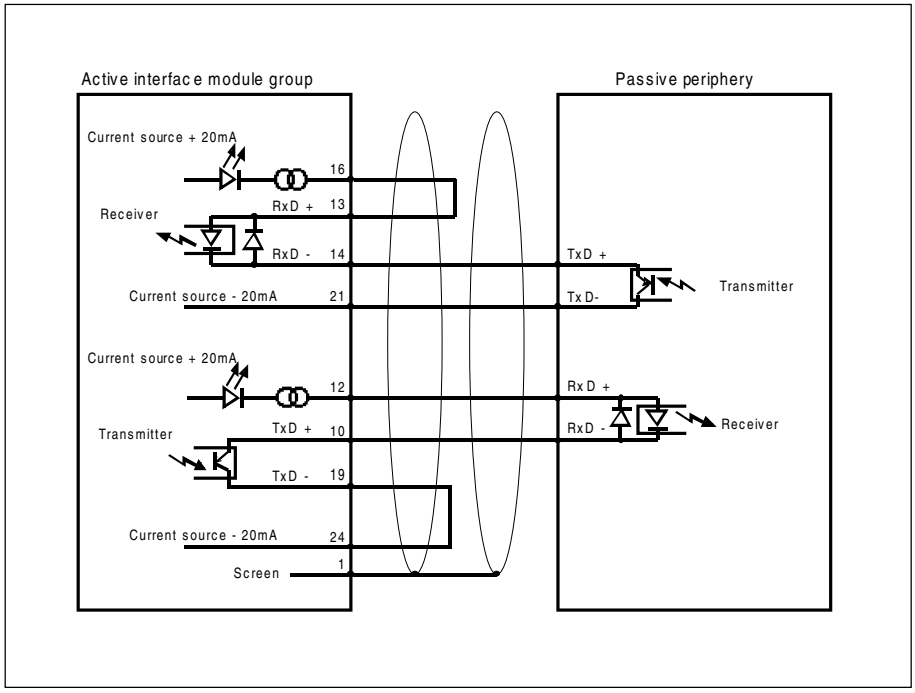
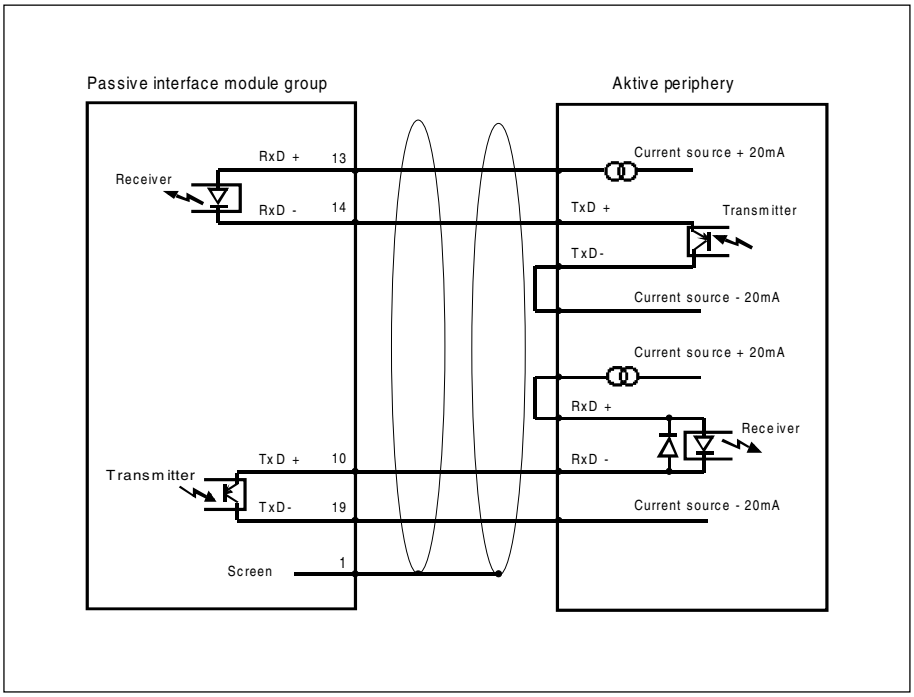


Fig. 2.5.5
TTY connection (SAS 523/525 is passive)



2.5.3 RS422/485 submodule (old version)

Before using of the RS422/485 submodule (old version), soldered jumpers must be set on the component side of the printed circuit board.

When using the module in a point-to-point four line connection the jumpers must be soldered as shown in Fig 2.5.6.

When using the module in a bidirectional two line connection (point-to-point or bus) the jumpers are to be soldered as shown in Fig. 2.5.7. In this mode of operation, switchover of the driver from transmitter to receiver is made with the RTS output of the USART. This mode is only possible with the appropriate firmware. The standard firmware supports this in the bus handshake mode (refer to Section 3.7).

When operating in a four line bus system, the soldered jumpers are to be made as shown in Fig. 2.5.8.

When used as an end module, the appropriate jumpers and terminating resisistors must be connected. By end modules we mean the physical modules of a multi-drop connection which are furthest away from each other.

Important!

Please ensure that the total resistance does not drop below 60 ohm and that the remote device can operate the maximum load of 60 ohm when connecting the terminating resistors (120 ohm on the R2422/485 submodule of the SAS board).

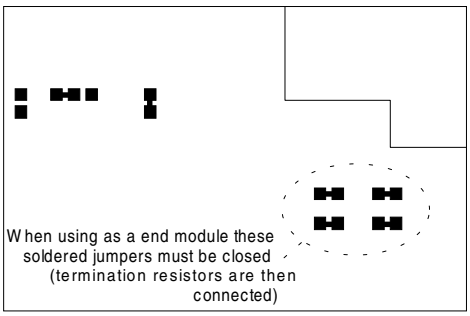


Fig. 2.5.6 Operartion of the RS422/485 submodule in point-to-point connection (four line).

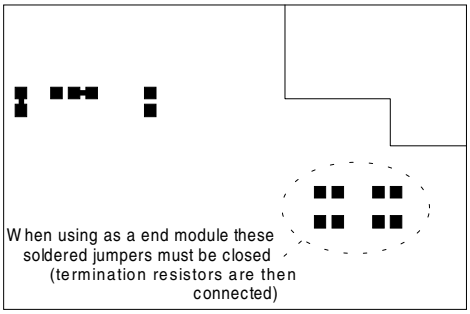
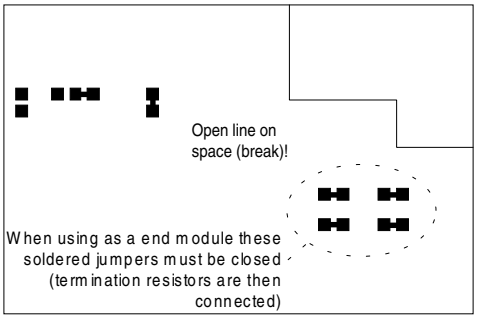


Fig. 2.5.7 Operation of the RS422/485 submodule in the bidirectional two line technique (bus).

Fig. 2.5.8
Operation of the RS422/485 submodule in the four line bus systems (in this figure the position of the jumpers for the termination resistors can be seen).



2.5.4 RS422/485 submodule (new version)

The RS422/485 (new version) is supplied in non-isolated and isolated versions (refer to 1.4 “Accessories”). Before operation, jumpers must be set on the component side of the printed circuit board. Both module versions are set in the same way.

With operation of the module in a point-to-point four line connection, the solder jumpers are to be soldered as in Fig. 2.5.9.

When using the module in a bidirectional two line connection (point-to-point or bus) the jumpers must be soldered as shown in Fig. 2.5.10. In this mode of operation, switchover of the driver from transmitter to receiver is made with the RTS output of the USART. This mode is only possible with the appropriate firmware. The standard firmware supports this in the bus handshake mode (refer to Section 3.7).

When operating in a four line bus system, the soldered jumpers are to be made as shown in Fig. 2.5.11.

When used as an end module, the appropriate jumpers and terminating resisistors must be connected. By end modules we mean the physical modules of a multi-drop connection which are furthest away from each other.

Important!

Please ensure that the total resistance does not drop below 60 ohm and that the remote device can operate the maximum load of 60 ohm when connecting the terminating resistors (120 ohm on the R2422/485 submodule of the SAS board).

Fig. 2.5.9
Operation of the RS422/485 submodule in point-to-point connection (four line)

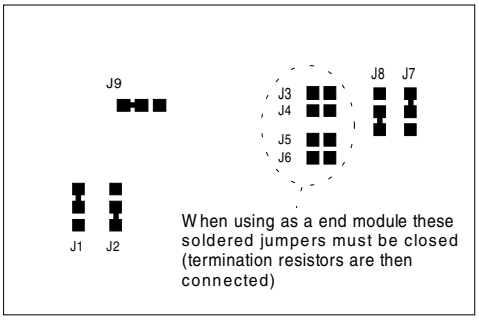


Fig. 2.5.10
Operation of the RS422/485 submodule in point-to-point connection (four line)

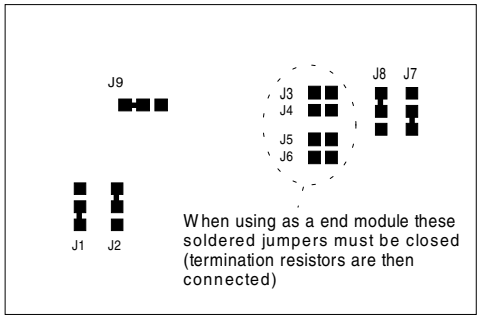
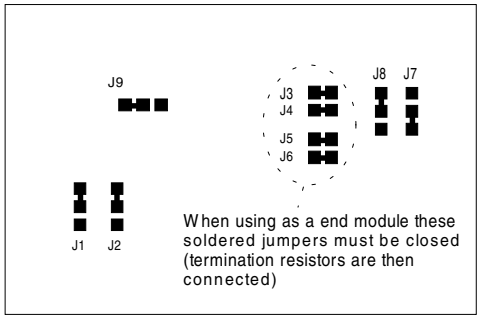


Fig. 2.5.11
Operation of the RS422/485 submodule in the four line bus system (in this figure the position of the jumpers for the termination resistors can be seen)



The soldered jumpers have the following meanings:

J1 Switchover two line (1)/four line (2)
J2 Driver always transmits (1)/driver transmit/receive (2)

J3..J6 Terminating resistors (always connect them together)

J3 Connect terminating resistors receiver (pins 13 + 14)
J4 Connect terminating resistors receiver (pins 13 + 14)
J5 Connect terminating resistors transmitter (pins 10 + 19)
J6 Connect terminating resistors transmitter (pins 10 + 19)

J7,J8 Level of the open line with the terminating resistors connected (Always connect these jumpers together)

J7 (1), J8 (2) Open line on space (point-to-point)
J7 (2), J8 (1) Open line on mark (bus system)

J9 Direction switching by pin 3 (RTS) (1)/
Direction switching by pin 11 (2)

(1) Means, jumper from the center pin to the pin on the marked side (side with the marking “J1” etc.)
(2) Means, jumper from the center pin to the pin on the side opposite the marked side

2.5.5 Pin layout RS 422/485 module

Fig. 2.5.12
Pin layout with RS422/485 submodule (four line)

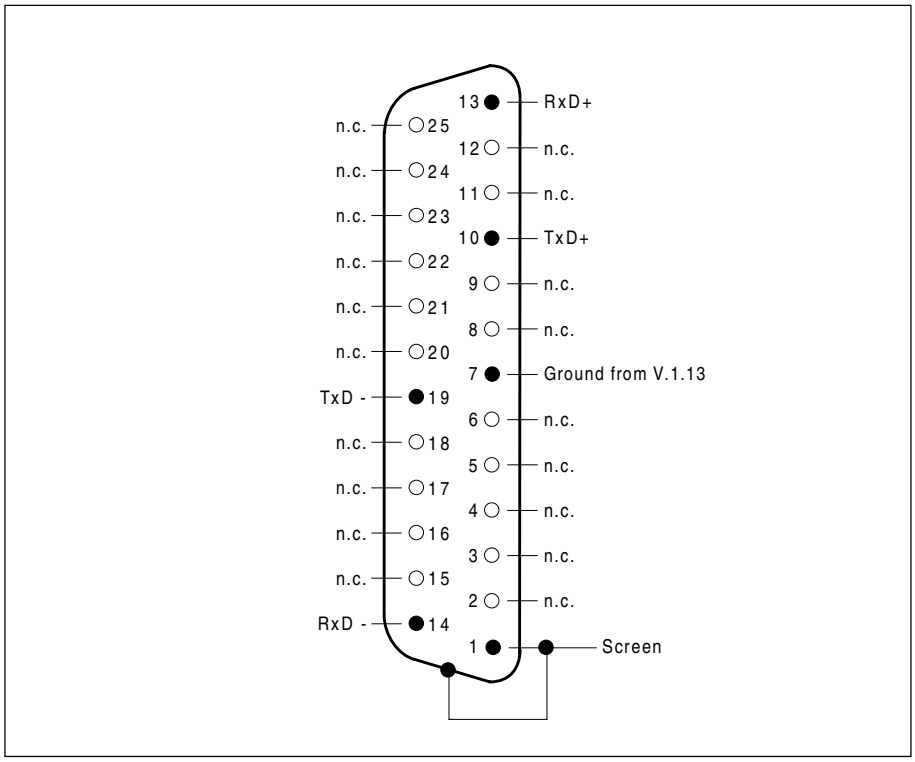


Fig. 2.5.13
Pin layout with RS422/485 submodule (two line)

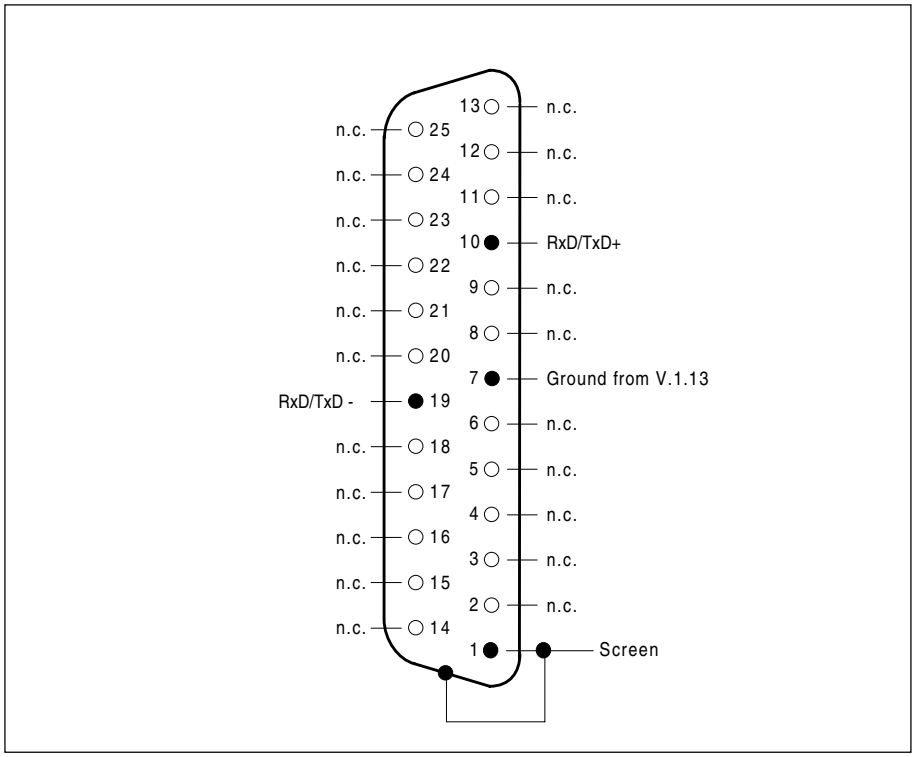
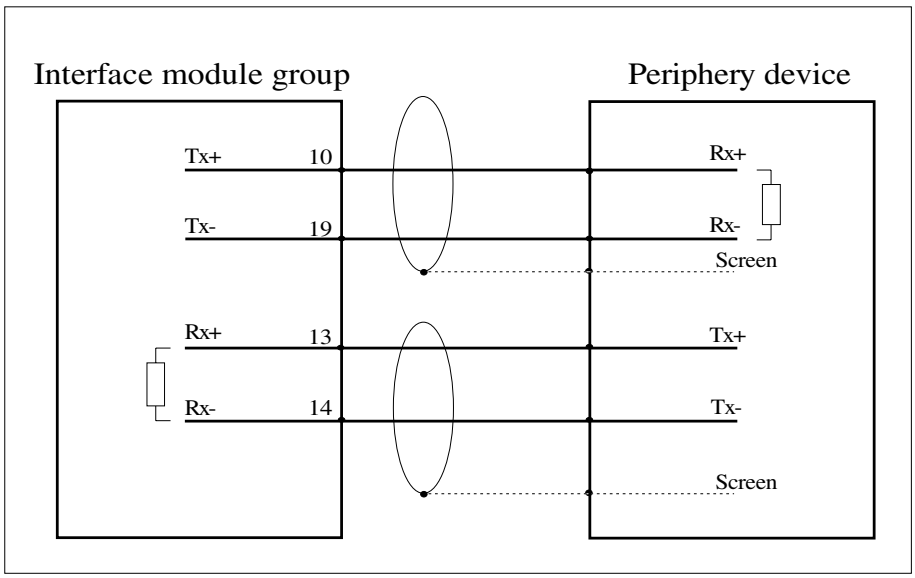


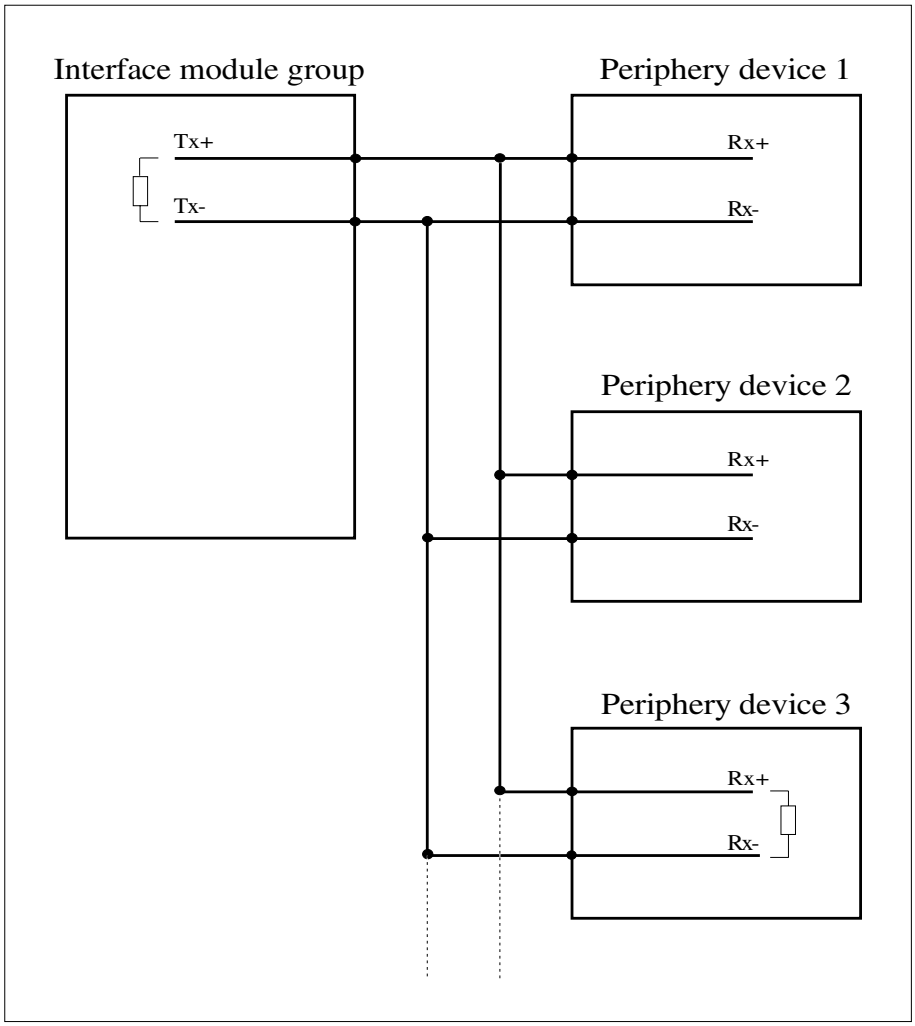
Fig. 2.5.14
Point-to-Point connection with RS422/485 submodule



Two twisted pairs, which must be especially shielded, are to be used for the Tx an Rx lines. Only in this way can the noise immunity protection of the differential current interface be used to full advantage.

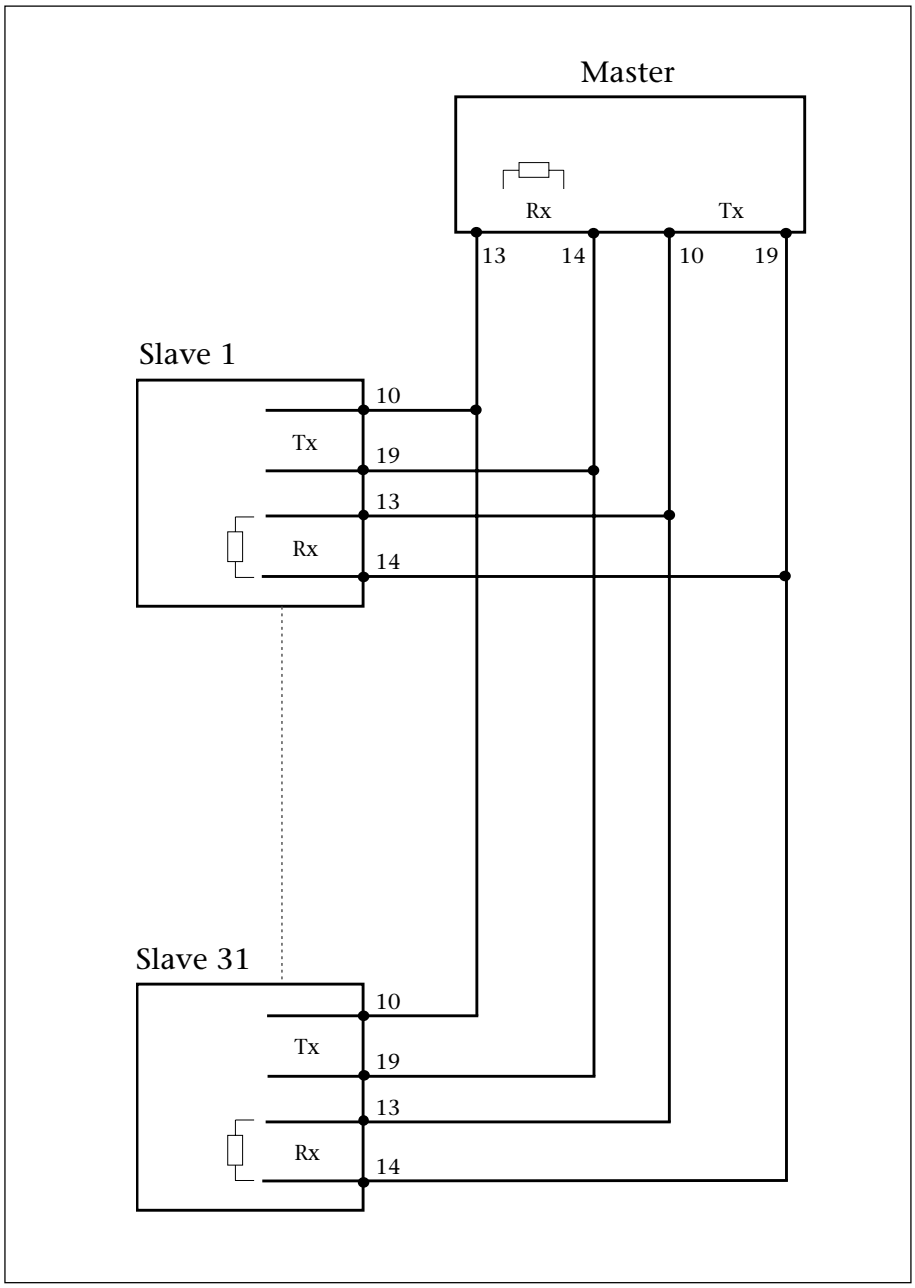
If there are to be more external devices than receivers connected to the interface modules then the multi-drop connection must be selected.

Fig. 2.5.15
Multi-drop connection with SAS 523/525 (two line)



Should there be more external devices connected to a bus then the four line bus connection is to be selected.

Fig. 2.5.16
Four line bus connection (Master/Slave) RS422/485 submodule



3 Software

Operation of the module by the user is performed using data handling blocks which can be supplied with the module. However, there is a way of activating the module directly. Both possibilities are described below.

3.1 Scope of supply of software for SAS 523

Floppy disk: 5.25" DD DS

Format: PCP/M 720 KB

The program file SAS523ST.S5D is on the disk for the S5-115 to S5-155. For the S5-115 there is an additional file CPU945ST.S5D which is used with the CPU 945.

The file contains the following components:

FB190	KONFIG
FB191	SEND
FB192	RECEIVE
FB193	PROZ-UM

3.2 Scope of supply of software for SAS 525

Floppy disk: 5.25" DD DS

Format: PCP/M 720 KB

The program file SAS525ST.S5D is on the disk for the S5-115 to S5-155. For the S5-115 there is an additional file CPU945ST.S5D which is used with the CPU 945.

The file contains the following components:

FB190	KONFIG
FB191	SEND
FB192	RECEIVE
FB193	PROZ-UM
FB194	KONFIG64
FB195	PASSIV
FB196	AKTIV
FB197	RESET64
FB198	HIA:EMP2
FB199	HIA:SND2

3.3 Module startup

After switching on the PLCs, the 523/525 Interface Module is parameterized to the default setting by the firmware:

- 9600 Baud
- Even parity
- Eight data bits
- Two stop bits
- Standard transmission (no procedure)

If you want to use this default setting then no extra parameterization of the module is necessary. Every other setting requires parameterization of the module after cold or warm restart (appropriate OB for PLC in question).

3.4 Parameterization using the data handling block KONFIG (FB 190)

With the data handling block FB190 KONFIG the default parameters which are automatically set when the module is started up can be changed . The FB190 is called when a cold or warm restart is made (appropriate OB for PLC in question).

Important! This block does not save scratchpad flags (MW200-254).

After FB190 in OB, has been called, the following parameter list is output:

Designation/ Format/ Explanation

ADR	KH	Base address of the module
KAN	KF	Channel number of the module
BAUD	KF	Ident. number for baud rate
ZEI	KF	Character length in the bit
PARI	KC	Parity data
STOP	KY	Number of stop bits
FEHL	BY	Error byte

ADR

Entry of the base address to which the module is set. This base address must correspond with the DIL switches S1 and S2 (refer to Section “DIL switches and jumpers”).

KAN

The number of the channel via which the data are to be transmitted or received. With modules SAS 523/525-1 there must always be a one, with modules SAS 523/525-2 one or two and with modules SAS 523/525-3 one to three channels are permitted.

BAUD

Entry of the ident number with which the various rates are set. The allocation of ident numbers to baud rates is shown in the following table:

Ident. no.	Baud rate
1	150
2	300
3	600
4	1200
5	2400
6	4800
7	9600
8	19200
9	38400

ZEI

The character length, that means the number of bits per character which are transferred. 7 bits are allowed for pure ASCII transfers and 8 bits for hexadecimal transfers.

PARI

Entry of parity:

GE for even
UG for odd
OH without parity

STOP

Number of stop bits:
1.0 = 1 stop bit
1.5 = 1 1/2 stop bits
2.0 = 2 stop bits

FEHL

Output of an error number if parameterization is terminated with an error. The error data is self-acknowledging, i.e. the byte is reset to zero after elimination of the error source and a warm restart is made (refer to Section “Error codes”).

Example

Channel 1 of the module is to be set:

- 19200 baud
- 7 bits/character
- 1 stop bit
- Odd parity

The DIL switches S1 and S2 on the module are set to the address F1F0h. Any error which might occur is to be stored in MB 20.

Fig. 3.4.1
Program example parameterization

```
      :SPA FB 190
NAME  #KONFIG
ADR   :KH F1F0      Base address
KAN   :KF +1        Channel number
BAUD  :KF +8        Identification for baud rate
ZEI   :KF +7        7 bits per character
PARI  :KC UG        Odd parity
STOP  :KY 1,0       1 stop bit
FEHL  :MB 20        Error code in flag byte 20
```

3.5 Data output using the data handling block SEND (FB191)

With the data handling block FB191 SEND data, which have been stored in the PLC in a data block, can be sent to an I/O device via the interface. It should be noted that, with the S5-115, only up to 64 bytes can be transferred per run of the FB191. With other PLCs, assembly into 254 byte blocks is possible.

Important!

This block does not save scratchpad flags (MW200-254).

After FB191 has been called, the following parameter list is output:

Designation/Format/Explanation

ADR	KH	Base address of the module
K/DB	KY	Number of channel/ Data module number
ANF	W	Beginning of transmit buffer
ANZ	W	Number of bytes to be transferred
FRG	BI	Release and handshake bit
FEHL	BY	Error byte

ADR

Entry of the base address to which the module is set. This base address must correspond with the DIL switches S1 and S2 (refer to Section “DIL switches and jumpers”).

K/DB

K = number of the data channel via which the data are to be transmitted. With SAS 523/525-1 modules this must always be set to 1. With modules SAS 523/525-2, channel numbers 1 and 2 are permitted and, with modules SAS 523/525-3, channel numbers 1 to 3.

DB = number of the DB which contains the data to be sent.

ANF

Note!
The operation changes the values of ANF and ANZ during the transfer.

Word variable (MW, DW) which contains the number of the data word from which the data to be sent are stored in the data block parameterized in DB.

ANZ

Word variable that contains the number of **bytes** to be transmitted.

FRG

Flag bit over which the data output are be activated. If this bit is set then the specific data are given by the parameters DB, ANF and ANZ via the data channel of the switching module under K. If all data are transferred by the data handling block to the SAS 523/525 then this bit is reset to zero by the operation software. This indicates to the user that data was given (handshake).

FEHL

Output of an error number when an error occurs during data output. When operation is correct the error number is zero. The error output is self-acknowledging, this means that after the error has been eliminated and a warm restart of the FB191 has been made, the byte is reset to zero. That is why the evaluation of the error byte should be evaluated by the user program even immediately after the FB191 has been run (refer to Section “Error code”).

Example

500 bytes (250 data words) should be transferred out of the DB15 from the DW3. The DIL switches S1 and S2 are set to the start address F1F0h, the flag 30.0 is used as an enable bit. Possible error code should be stored in the flag byte 31.

Fig. 3.5.1
Example application FB191

```
      :U   M 30.0          Job still running
      :SPB =OVER           Then continue
      :
      :L   KF +500
      :T   MW 40           The flag word contains the
      :                    bytes to be output
      :L   KB 3
      :T   MW 42           The flag word contains the
      :                    number of the data word
      :                    from which the data are
OVER  :                    stored
      :UN  M 30.0
      :S   M 30.0          Enable flag
      :
      :SPA FB 191
NAME  #SEND
ADR   :KH F1F0             Absolute base address
K/DB  :KY 1,15             Channel number / DB number
ANF   :MW 42
ANZ   :MW 40
FRG   :M 30.0              Enable flag
FEHL  :MB 31               Error code in flag byte 31
```

3.6 Data reception using data handling block RECEIVE (FB192)

Data from the peripheral device can be received via the interface. The data firstly intermediately buffered on the module and can be read into a data block using the data handling block Receive (FB192).

Important!

This block does not save scratchpad flags (MW200-254).

After FB192 has been called, the following parameter list is output:

Designation/ Format/ Explanation

ADR	KH	Base address of the module
K/DB	KY	Number of channel/ Data module number
SZ	W	Write pointer
LZ	W	Read pointer
ANF	KF	Beginning of transmit buffer
ANZ	KF	Number of reserved data words for the receive buffer
FEHL	BY	Error byte

ADR

Entry of the base address to which the module is set. This base address must correspond with the DIL switches S1 and S2 (refer to Section “DIL switches and jumpers”).

K/DB

K = number of the data channel via which the data are to be transmitted. With SAS 523/525-1 modules this must always be set to 1. With modules SAS 523/525-2, channel numbers 1and 2 are permitted and, with modules SAS 523/525-3, channel numbers 1 to 3.

DB = number of the DB which contains the data to be sent.

SZ

The write pointer is increased by the data handling block after entry of a byte into the receive data block. The write pointer represents an index for the receive buffer. If the write pointer reaches the end of the buffer range then it is reset to the start of the buffer (circulating buffer principle).

LZ

The read pointer can be controlled by the user when he has called and processed the data from the receive DB . The number of bytes received can be evaluated from the difference between the write and read pointers, whereby the evaluation of the write and read pointers carried out be the user can be made differently (see example).

Note!

If the read pointer is not prompted, or the write pointer not reset, then there is an error message indicating a buffer overflow.

ANF

Entry of the first data word in the receive data block from which the receive data should be entered.

ANZ

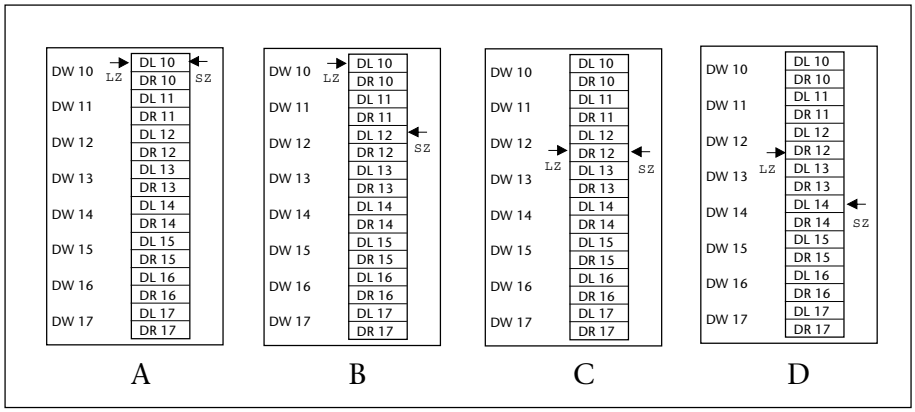
Number of the reserved data words in the receive data block for the receive buffer. The size of the receive buffer must be matched to the amount of data and the processing speed. It has proven useful to set the buffer length one data word longer than necessary (SZ points to the beginnning again if the buffer is completely full

FEHL

Output of the error number is a malfunction occurs when running the data handling block. The error data is self-acknowledging, this means that after elimination of the error source and after rerunning the FB192, the byte is reset to zero. This is why the error number should be evaluated immediately after running through the FB192 (refer to Section “Error Messages”).

Examples:

Fig. 3.6.1
Example 1 for the write and read pointer



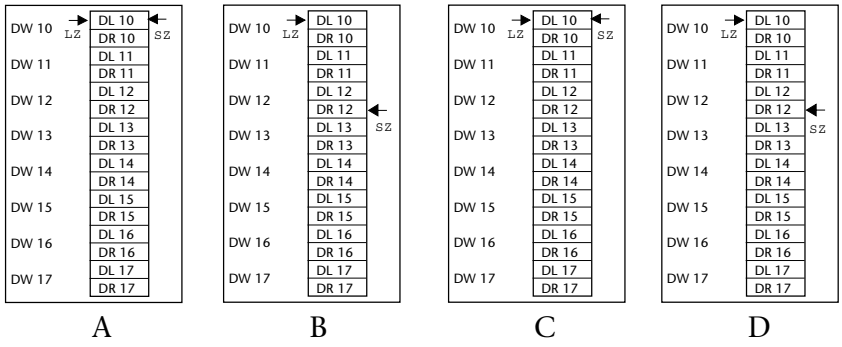
Here are two examples to demonstrate how to use the write and read pointers. The examples assume that the receive buffer starts from data word 10 (parameter ANF) and that a total of 8 data words of the data block are reserved for the receive buffer.

Before reception of data the write and read pointers indicate DW10 (Fig. 3.6.1A). The relative offset at the beginning of the buffer range is zero. The difference between the write and read pointers is also zero. If, for example, 5 bytes are received from the I/O device they would be entered alternately in the data word left (DL) and data word right (DR). The write pointer is incremented

by 1 with each incoming byte. Therefore after receiving 5 bytes it has the value 5 which corresponds to the relative offset to the beginning of the buffer range. The write pointer now shows the next free position in the receive DB (Fig. 3.6.1 B).

There are now three possibilities for evaluation. After the user program has read out the incoming data which is now in the receive buffer from DL10 to DL12, it increases the position of the read pointer by the number of the bytes which have been read

Fig. 3.6.2
Example 2 for the write and read pointer



out. If the user has read out all 5 bytes then the read pointer is on the position of the write pointer and shows the user that there is no more data available (Fig. 3.6.1 C). New incoming data cause the write pointer to increase (Fig. 3.6.1 D).

The second evaluation possibility is to leave the read pointer on zero and to reset the write pointer to zero after the data has been read out. The write pointer always indicates the number of received bytes (Fig. 3.6.2).

Data is to be received via Channel 1 and stored into DB 20. 200 words are to be reserved for the receive buffer in DB 20 starting from data word 10. The DIL switches S1 and S2 are set to the address F180h. Any error which might occur is to be stored into flag byte 40.

Fig. 3.6.3
Program example

```
      :SPA FB 192
NAME  #RECEIVE
ADR   :KH F180       Absolute base address
K/DB  :KY 1,20       Channel 1 / DB 20
SZ    :MW 120
LZ    :MW 122
ANF   :KF +10
ANZ   :KF +200
FEHL  :MB 40         Error code in flag byte 40
```

3.7 Parameterization of the handshake using the data handling block PROZ-UM (FB193)

The default setting of the module is RTS/CTS handshake

With this module additional special handshakes can be installed on the interface board.

Break handshake (only TTY)
This handshake is, for example, supported by the printer PT88 from Siemens. With an activated break handshake data is only transmitted when no break is received on the interface. The break handshake is only supported within the ASCII procedure.

Bus handshake (only RS422/485)
When this handshake is active the transmission bus driver is only connected to the bus when there is data in the transmission buffer. The bus handshake is only supported within the ASCII procedure and is only designed for the slaves in the bus system. Observe the jumper settings of the module (refer to Section "RS422/485 submodule").

After FB 193 has been called, the following parameter list is output:

Designation/ Format/ Explanation

ADR	KH	Base address of the module
KAN	KF	Channel number of the module
PAR	KC	Handshake identification
FEHL	MB	Transfer byte for error number

ADR

Entry of the base address to which the module is set. This base address must correspond with the DIL switches S1 and S2 (refer to Section "DIL switches and jumpers").

KAN

The number of the channel via which the data are to be transmitted or received. With modules SAS 523/525-1 this must always be set to 1. With modules SAS 523/525-2, channel numbers 1 and 2 permitted and, with modules SAS 523/525-3, channel numbers 1 to 3.

PAR

PAR	KC	BR	with Break Handshake
PAR	KC	BS	with Bus Handshake
PAR	KC	RC	with RTS/CTS Handshake

FEHL

with an error is terminated. The error output is self-acknowledging, i.e. after elimination of the error source and calling FB193 again, the byte is reset to zero. An error description can be found in Section "Error Messages".

3.8 Parameterization block KONFIG64 (FB194) for procedure 3964(R) with frame format RK512 (SAS 525 only)

This function block is used to initialize the module and procedure for the 3964(R) procedure with frame format RK512. This block must therefore be called in all restart blocks (OB20/ OB21/ OB22), separately for each serial channel.

Important for S5-135U, S5-150U and S5-155U!

On the block version for the S5-135U, S5-150U and S5-155U, all scratchpad flags used are buffered in the HTDB on version 2.00 and higher. This permits operation there with restart and retentive flags. On versions before 2.00, operation with a warm restart (manually by keystroke or automatically with POWER-ON) is not permitted and cold restart must be programmed for POWER-ON using DX0.

After FB194 has been called, the following parameter list is output:

Designation/ Format/ Explanation

HTDB	B	No. of the data block for internal data of the data channel
ADR	KH	Base address of the module
KAN	KF	Channel number of the data channel
BAUD	KF	Code number for baud rate
BCC	KC	With or without BCC
PRIO	KC	Priority entries
FEHL	MB	Transfer byte for error number

HTDB

Data block for storing internal data of the selected data channel (KAN). The data block must have a length of at least 37 words. You require a separate data block for every data channel. Permissibles values: 3 to 255.

ADR

Entry of the base address to which the module is set. This base address must correspond with the DIL switches S1 and S2 (refer to Section “DIL switches and jumpers”).

KAN

The number of the channel via which the data are to be transmitted or received. With modules SAS 523/525-1 this must always be set to 1. With modules SAS 523/525-2, channel numbers 1 and 2 permitted and, with modules SAS 523/525-3, channel numbers 1 to 3.

BAUD

Entry of the ident number with which the various rates are set. The allocation of the ident number to the corresponding baud rate is shown in the following table:

Ident. No.	Baud rate
1	150
2	300
3	600
4	1200
5	2400
6	4800
7	9600
8	19200
9	38400

With simultaneous use of three channels the maximum baud rate should be observed.

Basically, the procedure can be made on each channel of the module with of maximum transfer rate of 38400 bit/s. The simultaneous use of Procedure 3964 with a maximum transfer rate is only possible on two channels whilst, in this case, the third channel allows a normal ASCII transfer also with a speed of 38400 bit/s.
If the SAS board is equipped with a 10 MHz quartz oscillator (next to the fuse) and therefore with faster components, this limitation to 2 channels no longer applies.

BCC

Here, either the procedure 3964 (without BCC) or 3964R (with BCC) can be used.

BCC	KC	JA	with BCC
	KC	NO	without BCC

Only a module can obtain high priority

PRIO

The setting of the priority is of importance in a conflict situation. The module with the higher priority obtains permission to transmit when a simultaneous transmission demand is made by both partners.

PRIO	KC	HO	High priority
PRIO	KC	NI	Low priority

FEHL

Output of the error number in an error byte when parameterization is terminated with an error. The error output is self-acknowledging, i.e. after elimination of the error source and calling FB194 again, the byte is reset to zero. An error description can be found in Section “Error Messages”.

3.9 Data handling block PASSIV (FB195) for the 3964(R) procedure with frame format RK512 (SAS 525 only)

FB 195 processes all passive jobs, i.e. it can receive data from an active remote station or send data to it if required. After module FB194 has been called, the following parameter list is output:

To avoid loading the cycle time, only up to 128 bytes are transmitted to or from the SAS board per cycle. The operation uses scratchpad flags starting at MB200. If your application works with timer OBs **and** scratchpad flags starting at MB200, you must save them.

After FB195 the following parameter list is output:

Designation/ Format/ Explanation

HTDB	DB	No. of the data block for internal data of the data channel
WIED	BI	Warm restart bit *(only for S5-135U, S5-150U and S5-155U on Version 2.00 and higher)*

HTDB

Number of the data block for management of the internal data of the data channel in question with a minimum length of 37 words. The same data block must be entered for this channel as with FB194 (KONFIG64).

WIED

Important for S5-135U, S5-150U and S5-155U!

Warm restart bit with which the data handling software and the SAS board are informed that a warm restart has occurred (manually by keystroke or automatically with POWER-ON). You require a separate warm restart bit for each data channel which must be set in OB21 and OB22. This bit is automatically reset by FB195 or FB196 after detection. The timeout OB (OB23) must also be available because a timeout before detection of the warm restart bit by the SAS board can be generated at address HTDB-DW0 after a warm restart.

It is possible to recognize if data has arrived from an active remote station via the coordination flag which must be agreed to by the active and the passive partners.

Fig. 3.9.1 Example program: application of a coordination flag

```
      :                  Declared coord. flag
      :                  = M 111.0
      :SPA FB 195
NAME  #PASSIV
HTDB  :DB 191
      :
      :UN  M 111.0
      :BEB
      :                  Processing of data
      :R   M 111.0       Reset the coord. flag
      :BEA
```

3.10 Data handling module ACTIVE (FB196) for the procedure 3964(R) with frame format RK512 (SAS 525 only)

This module is for the procesing of active telegrams and enables selection of a number of commands which either activate a transmission sequence (transmission mode) or request data from a passive partner (fetch mode).

To avoid loading the cycle time, only up to 128 bytes are transmitted to or from the SAS board per cycle. The operation uses scratchpad flags starting at MB200. If your application works with timer OBs **and** scratchpad flags starting at MB200, you must save them.

After FB196 has been called, the following parameter list is output:

Designation/ Format/ Explanation

HTDB	DB	No. of the data block for internal data of the data channel
BEF	W	Command
QUEL	W	Data source
ZIEL	W	Destination were the data is to be written
DBDX	KC	For fetch commands, the data destination is a DB or DX *(Parameter new on Version 2.01, not for S5-115 CPU941-944)*
ANZ	W	Number of words/bytes to be transferred
KOOM	W	Coordination flag
STAT	BY	Flag byte for transfer of the processing status
FEHL	BY	Flag byte for recording the error number
WIED	BI	Warm restart bit *(only for S5-135U, S5-150U and S5-155U as from Version 2.00)*
FRG	BI	Release bit for start of the procedure

HTDB

Number of the data block for management of the internal data of the data channel in question with a minimum length of 37 words. The same data block must be entered as with FB194 (KONFIG64).

BEF

The required commend must be enter here. Command descriptions and a list of commands are contained in Section 4.

QUEL

Note!
Data blocks 0 to 2 are never permissible

Indicates the data source. The source is to be given in own device when in the "transmission mode". The data source of the partner is in the "fetch mode".

Please note that ***neither*** the block specified in HTDB ***nor DB0 to DB2*** must be used.

Allowed are entries in KY a,b formats, whereby "a" is the data block and "b" is the data word.

ZIEL

Note!
Data blocks 0 to 2 are never permissible

Indicates the destination where the data are to be stored. In the transmission mode the destination is to be entered into the partner device, in the fetch mode the data destination is in the own device. It is only possible to enter a DB number or an absolute address.

Please note that ***neither*** the block specified in HTDB ***nor DB0 to DB2*** must be used. Allowed are entries in KY a,b formats, whereby "a" is the data block and "b" is the data word.

DBDX

This parameter is only evaluated with fetch commands (e.g. EM) and defines whether a data block DB or an extended data block DX is to be used. To define an extended data block as the data destination for transmit commands, please use the commands with 'O' as their first letter (e.g. OZ).

BCC	KC	DB	Destination is a DB
	KC	DX	Destination is a DX

ANZ

Here, the number of words/bytes is to be entered.

In words for commands:	AB, AD, AS, AT, AX, AZ, EB, ED, ES, ET, EX, EZ, OB, OD, OS, OT, OX, OZ.
In bytes for commands:	AA, AE, AM, AP, AQ, EA, EE, EM, EP, EQ, OA, OE, OM, OP, OQ.

KOOM

Contains the coordination flag in the passive partner. Entries between KY 0.0 to KY 255.7, which correspond to flags 0.0 to 255.7, are allowed.

STAT

Only the flag range of 0.0 to 199.7 are to be used this designator!

Indicates the processing status of the program. The individual bits have the following meaning:

Bit no.	Meaning	Mode
0	Transmission active	active
1	Fetch active	active
2	Receive active	passive
3	Fetch active	passive
4	Not used	
5	Error indicated to partner	passive
6	Procedure error in error byte (ZI)	
7	Procedure error in error byte from remote device (PI)	

The allocation of the status byte shows that with call of the FB196 activities of the passive module can be evaluated with the coordination flag.

FEHL

Contains the error number. A list of the error messages can be found in Section “Error Messages”.

WIED

Important for S5-135U, S5-150U and S5-155U!

Warm restart bit with which the data handling software and the SAS board are informed that a warm restart has occurred (manually by keystroke or automatically with POWER-ON). You require a separate warm restart bit for each data channel which must be set in OB21 and OB22. This bit is automatically reset by FB195 or FB196 after detection, the enable flag is reset and error 254 is entered (abort by warm restart). The timeout OB (OB23) must also be available because a timeout before detection of the warm restart bit by the SAS board can be generated at address HTDB-DW0 after a warm restart.

FRG

If this flag has the value 1 then transmission or data request is started. After the job has been processed or abort on error, the enable flag of FB196 is reset to zero.

3.11 RESET64 (FB197) (SAS 525 only)

This data handling block sets the procedure 3964(R) into the default state for the specified data channel. The initialization settings of the interface remain (baud rate, protocol options). This block is not required during normal operation.

If the value 0 is passed as the data channel, a RESET is performed on the parameterization channel.

Important for S5-135U, S5-150U and S5-155U!

On the component version for the S5-135U, S5-150U and S5-155U on Version 2.00 and higher, all scratchpad flags used are buffered in the HTDB.

After FB197 has been called the following parameter list is output:

Designation / Format / Explanation

HTDB	DB	No. of the data block for internal data of the data channel
KAN	KF	Channel number of the data channel
FEHL	BY	Flag byte for the error number

HTDB

Data block for storing internal data of the selected data channel (KAN). The data block must have a length of at least 37 words. You require a separate data block for each data channel.

KAN

Number of the data channel that must be reset (the permissible values are 1 to 3). The initialization settings of the interface (baud rate, protocol options) are retained. If the value 0 is passed as the data channel, a RESET is performed on the parameterization channel.

FEHL

Output of the error number in an error byte if parameterization has terminated with an error. Error output is self-acknowledging, i.e. the byte is reset to zero after the cause of error has been remedied and FB194 has run again. For an error description see Section “Error messages”.

3.12 FB198/FB199 (only SAS 525)

This module must be loaded into the PLC if operating with a 3964(R) transfer. You receive help routines for data transfer from and to the SAS 525 and are called by the data handling modules (FB195, FB196).

With S5 115 (CPU 941...943) the normal Step5 is exited during the processing of this module and branches into the microprogram level of the S5 (MC51 assembler code). Due to this, the cycle time load of the data handling block is reduced.

The routines for the CPUs 944 and 945 are not programmed in assembler only in Step 5, cause of shorter process time.

Deactivate assembly language routines

By setting the date 29.0 in the data block HTDB, the assembler routines can be switched off. The data transfer is then made with Step5 commands whereby the cycle time load is increased.

4 General instructions for use of the data handling block with the 3964

The logical part of procedure 3964 creates the connection between an passive and an active partner. In doing this, the active side has the possibility to send data to the remote station (TRANSMIT) or to retrieve data from there (FETCH). The passive side processes the telegrams sent by the active side and corresponding reacts. Due to a connection between the two modules each side can be simultaneously passive as well as active.

In order to realize this operation there are two data handling modules available on the S5:

FB195	For processing passive functions
FB196	For processing active functions

The following commands are recognized and processed by the data handling block. The S5-115 CPU941-944 does not have DX extended data blocks. Commands with a DX source or destination are therefore not permitted for this PLC and cause an error message. For a list of error messages see Section “Error messages”.

Transmit commands, transmitting data (data destination is a DB)

*The parameter DBDX is **not** evaluated!*

Command	Meaning
AA	Transmit the output process image
AB	Transmit from the OS area (operating system data)
AD	Transmit from a data block DB
AE	Transmit from the input process image
AM	Transmit from the flag area
AP	Transmit from the normal I/O byte area
AQ	Transmit from the extended I/O byte area
AS	Transmit the memory content (physical address)
AT	Transmit from the timer area
AX	Transmit from an extended data block DX
AZ	Transmit from the counter area

Transmit commands, transmitting data (data destination is a DX)

*The parameter DBDX is **not** evaluated!*

Command	Meaning
OA	Transmit the output process image
OB	Transmit from the OS area (operating system data)
OD	Transmit from a data block DB
OE	Transmit from the input process image
OM	Transmit from the flag area
OP	Transmit from the normal I/O byte area
OQ	Transmit from the extended I/O byte area
OS	Transmit the memory content (physical address)
OT	Transmit from the timer area
OX	Transmit from an extended data block DX
OZ	Transmit from the counter area

The corresponding data range is transmitted and stored by the receiver in a DB or DX data block. The commands AS and OS (transmission of the contents of an address range) are exceptions. With this command it is possible to write directly to the remote station. With the CPU945 and S5-155U the specified destination address becomes bit 4 to bit 19 of the physical address of the PLC. 0 is added to bits 0 to 3.

Fetch commands, fetching data (data desination is a DB)

A value KC = 'DB' is passed in the DBDX parameter!

Command	Meaning
EA	Request from the output process image
EB	Request from the OS area (operating system data)
ED	Request from a data block DB
EE	Request from the input process image
EM	Request from the flag area
EP	Request from the normal I/O byte area
EQ	Request from the extended I/O byte area
ES	Request from the memory content (physical address)
ET	Request from the timer area
EX	Request from an extended data block DX
EZ	Request from the counter area

Fetch commands, fetching data (data desination is a DX)

A value KC = 'DX' is passed in the DBDX parameter!

Command	Meaning
EA	Request from the output process image
EB	Request from the OS area (operating system data)
ED	Request from a data block DB
EE	Request from the input process image
EM	Request from the flag area
EP	Request from the normal I/O byte area
EQ	Request from the extended I/O byte area
ES	Request from the memory content (physical address)
ET	Request from the timer area
EX	Request from an extended data block DX
EZ	Request from the counter area

Independent of the data source (inputs, flags, timers etc.), the requested data information is received in a data block DB or DX. The only exception is the command ES (request of the contents from an address range). With this it is possible to write directly to the local memory cells. With the CPU945 and S5-155U the specified destination address becomes bit 4 to bit 19 of the physical address of the PLC. 0 is added to bits 0 to 3.

5 Application examples for operation software

5.1 FB194 KONFIG64 -procedure parameterization

The FB194 must be called for initialization of the procedure driver.

```
      :SPA FB 194
NAME #KONFIG64
DBHB :DB 191        Data block 191 (37 words)
ADR  :KH F180       Base address of the module
KAN  :KF +1         Channel 1
BAUD :KF +7         Baud rate 9600
BCC  :KC JA         With BCC
PRIO :KC NI         Low priority
FEHL :MB 255        Error flag
      :
```

Parameterization of Channels 2 and 3 must be made in two further calls of FB 194. It should be noted that the given data blocks are different for each channel.

5.2 FB 195 PASSIVE - processing passive telegrams

```
      :U   M 10.0    Warm restart flag not used,
      :R   M 10.0    because DX0 is programmed for
      :              cold restart
      :
      :SPA FB 195    Call passive frames
NAME #PASSIV
HTDB :DB 191
WIED :M 10.0
```

Content of DX0 (e.g. for S5-135U):

```
DW 0 :KH  4D41      DX0 identification
DW 1 :KH  534B
DW 2 :KH  5830
DW 3 :KH  0201      RESTART and RUN behavior
DW 4 :KH  1001      Autom. restart after POWER-ON
DW 5 :KH  EEEE      End identification
```

5.3 FB196 ACTIVE - processing active frames

```
        :L   KC EX          Fetch from extended
        :T   MW 10          data block DX
        :L   KY 100,0       Source is DX100 from DW0
        :T   MW 12
        :L   KY 101,0       Destination is DB101 from
        :                   DW0
        :T   MW 14
        :L   KB 100         Length = 100 words
        :T   MW 16
        :L   KY 255,255     Without coordination flag
        :T   MW 18
        :
        :U   M 9.0          Do not use warm restart flag
        :R   M 9.0          because DX0 programmed for
        :                   cold restart
        :
        :SPA FB 196
   NAME #AKTIV
   HTDB =DB 191
   BEF  =MW 10
   QUEL =MW 12
   ZIEL =MW 14
   DBDX =KC DB              Destination is a DB (DB101)
   ANZ  =MW 16
   KOOM =MW 18
   STAT =MB 197
   FEHL =MB 198
   WIED =M 9.0
   FRG  =M 199.0
        :
        :U   M 199.0        FRG=1 then function active
        :BEB
        :
        :S   M 199.0        Set FRG=0 to 1 and restart
        :                   transmit function
        :BEA
```

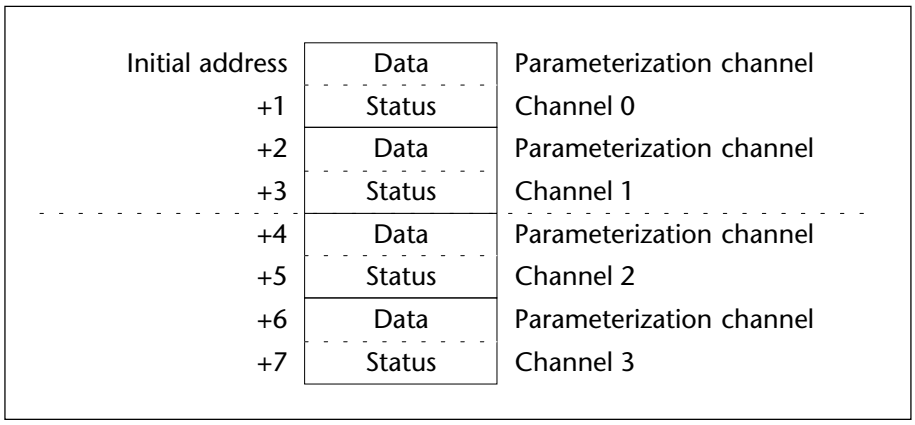
The user of the data handling block FB 196 must note that a 2nd job is only started when the previous job has been terminated (e.g. M 199.0 = 0).

6 Operation of the modules without application of the data handling modules

The module SAS 523/525-1 allocates four of the consecutive addresses in the address area of the programmable controller and the SAS 523/525-2 and SAS 523/525-3 allocates eight. The lowest of these addresses is set with the DIL switches on the module. Setting is described in detail in Section “DIL switches and jumpers”.

The module has two or four channels. Each channel is allocated two addresses whereby Channel 0 has special importance for the parameter channel.

Fig. 6.1
Address allocation of the module

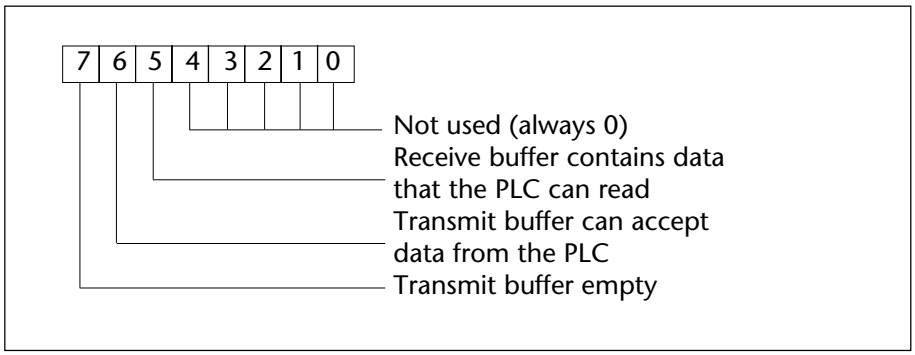


Commands are transferred via Channel 0 which enables modification of internal parameters, deletion of buffers and the resetting of the module. Data transfer in and out of the module is made via channels 1 to 3.

Each channel consists of two consecutive addresses. In the lowest addresses there are the data which are bidirectionally exchanged with the module. The status of the corresponding channel can be read in the addresses which is one higher. A description of the address is not possible.

Status bits:

Fig. 6.2
Bit allocation of the status byte



Bit 7

When this bit is set then the transmit buffer of the corresponding channel is empty. Therefore a telegram with a maximum of 254 bytes can be written into the data channel without any further status enquiry. If a byte was written, access is again possible on the data channel of the S5, however the module acknowledges this access only after approximately 18 micro seconds with READY. This time is required in order to process the data in the module. If there are data in the transmit buffer then they are automatically transmitted by the corresponding interface.

Bit 6

The set bit indicates the readiness of the transmitter channel. An inquiry should be made to the bit beforehand with an individual access. If the transmitter channel is not ready, the module will not acknowledge and there is an acknowledgement delay in the S5 program (QVZ).

Note!

A buffer overflow is not intercepted on the module due to time reasons. Control of buffer allocation must be made by the user or intercepted by the standard software.

Bit 5

This bit is set when the module receives data. The received data is in the input buffer. This bit should, if the corresponding channel operates as a receiver, be cyclically inquiried so that the data can be called if required. Otherwise there could be an overflow in the receive buffer.

Note!

When Bit 5 is zero then no call is to take place because the module on the data channel does not acknowledge. This leads to timeout ni teh the S5 program. The time required by the module to prepare a further character in the receiver channel is approximately 20 micro seconds.

6.1 Parameterization channel

The modules can give commands via the parameter channel (Channel 0). The commands are given in the form of single or multi-byte instructions. The first byte is the command byte and contains the command code in the higher-valued nibble and the lower-valued byte contains the channel number of the channel for the command.

The following commands are available:

0 Reset of the complete module (all channels)
1 Buffer reset for one channel
2 Change of baud rate for one channel
3 Change of the data format for one channel
4 Protocol selection for one channel
5 Output of the version number for the firmware
6 Special functions

Note!
Command acknowledgement must be called

Each command, apart from command 0 (reset) and command 10h (command channel reset), is acknowledged by the module by retransmitting from the second byte on Channel 0. The command is repeated once again in the first acknowledge byte. The result (error number) of the command execution is transferred in the second byte. These two acknowledge bytes must be called from Channel 0 because only after is a new command excepted.

6.2 Command 0: MODULE RESET

Note!
No command acknowledgement here

This command is a one byte command.

The command does not require a channel number because it is valid for the complete module. It is automatically activated with a POWER-ON from the PLC when the module is addressed in the I/O area. With this command the module is put into a condition which corresponds to a restart (refer to Section “Module startup”). The baud rate, procedure etc. are lost. Before a new command can be sent, it is necessaty to wait for a delay of at least 6 milliseconds.

6.3 Command 1: Reset of transmit and receive buffer

This command is a one byte command.

The number of the channel is to be given in the lower value nibble. The transmit and receive buffer of the specified channel are deleted.

Commands	10h	Reset for the command channel *(This command is not acknowledged)*
	11h	Reset for the buffer of channel 1 *(Read 2-byte command acknowledgement)*
	12h	Reset for the buffer of channel 2 *(Read 2-byte command acknowledgement)*
	13h	Reset for the buffer of channel 3 *(Read 2-byte command acknowledgement)*

6.4 Command 2: Setting of baud rate

This command is a two byte command.

The first byte contains the command identification and the number of the interface channel and the second byte contains the identification for the corresponding baud rate. The following table shows the arrangement between identication and baud rates:

Identification	Baud rate
1	150
2	300
3	600
4	1200
5	2400
6	4800
7	9600
8	19200
9	38400

Example: Channel 2 is to be set to 4800 bauds

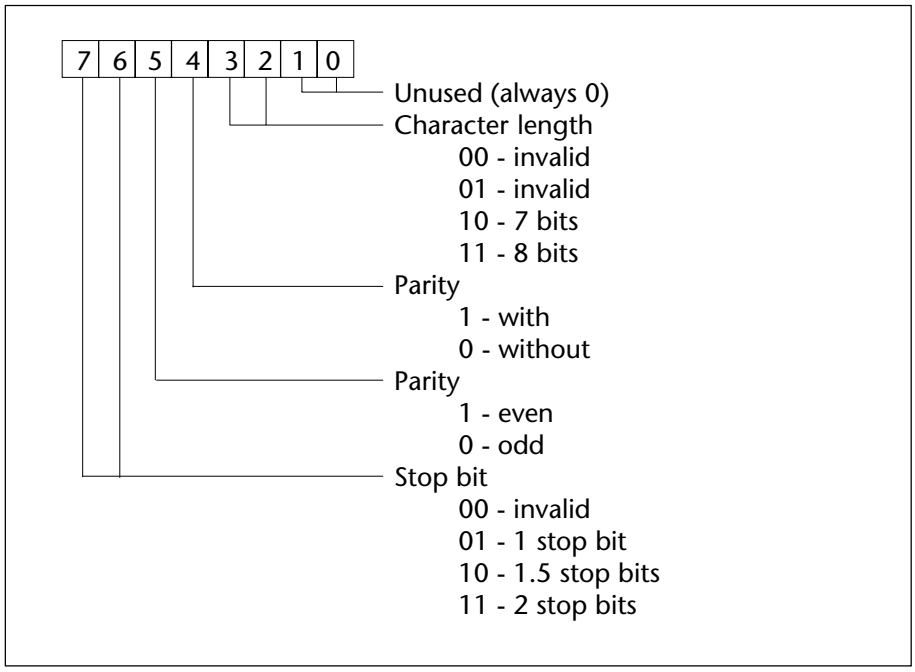
1st byte: 22h 2nd byte: 06h

6.5 Command 3: Change data format

This command is a two byte command.

The command and the channel number are entered into the first byte. The data for the data format is in the second byte

Fig. 6.3
Bit assignment of teh mode byte



Example: Channel 1 is to be parameterized:

- 7 data bits
- 1 stop bit
- Odd parity

This results in:
- Command 31h
- Mode byte 0101 1000 = 58h

6.6 Command 4: Protocol selection

This command is a multi-byte command.

The command is used for the selection of combined procedures. The partially differing lengths of parameter transfers require knowledge of the internal structure of the procedurs and out of the bounds of this manual. Therefore please use out standard data handling modules for procedure switching.

6.7 Command 5: Read version identity

This command is a one byte command.

The version number of the firmware is given back. Transfer of the channel number is not required because the same version identification is used for all channels. The version identification consists of 16 bytes ASCII text and can be called out of Channel.

Example: The active version number is to be called.

Command 50h

Output: SAS-523/1_V_1.02 (_ is a space)

6.8 Command 6: Special functions

This command has a variable number of bytes (depending on the function).

Special functions are called. The first byte contains the command identification and the number of the interface channel onto which the function is to be applied. In the second byte, the operation expects one of the function numbers listed below. Depending on the function selected, further bytes follow the second byte with information about this function.

Function numbers:

00 = Reserved
01 = Break on
02 = Break off
03 = Break with time
3rd byte : Break duration in ms

(tolerance ± 10 %, contance ± 300 µs)

04 = Break with time
3rd byte : Break duration in 10 ms

(tolerance ± 10 %, contance ± 300 µs)

Example: A break with a period of 23ms is to be transmitted to Channel 2

1st byte: 62h 2nd byte: 03h 3rd byte: 17h

7 Error messages

The error bytes of the module can be divided into three groups:

- Parameter error
- Hardware error
- Procedure error

7.1 Parameter error

Note:
All data are decimal

0 No error
1 Wrong command
2 Wrong channel number
3 Wrong baud rate value
4 Wrong character length
5 Wrong number of stop bits
6 Wrong parity entry
7 Wrong procedure selection number
8 Wrong number of procedure parameters

7.2 Hardware error

A hardware error does not necessarily mean there is a defective module. Check the following:

- Does the address setting correspond with the program?
- Is the module correctly connected?
- Is the module plugged into the correct slot in the PLC?
- Are the modules completely plugged?
- Is there an address overlap with other modules?

Note:
All data are decimal

100 Module does not acknowledge
101 Error in the module. No command acknowledgement from the board within a set timeout.
102 Command acknowledgment failed. The command transmitted has been incorrectly acknowledged.

7.3 ASCII procedure error

Note:
All data are decimal

10 Procedure parameter ASCII is wrong
11 Channel does not acknowledge
12 DB number is not permitted
13 DB not available
14 DB is too short
15 Receive buffer overflow
16 Negative number in the parameter ANF
17 Negative number in the parameter ANZ
18 Break duration 0 ms not permitted
19 Break already ON or expecting
20 Break already OFF
21 Delaybreak is already expected
22 Await transmit Break (until transmit buffer empty) if Break is aborted
23 Delaybreak still running. Break ON/OFF aborted

7.4 3964 / RK512 procedure error

RK512 procedure errors differ between central initiative ZI (error with active partner) and the I/O initiative PI (error with passive partner).

Note!
All data are decimal

ZI	PI	Description
00	00	No error
01[1)]		Reaction telegram from the passive partner not received
03		Entered code has wrong format (e.g. with FB 196: with FEHL a flag byte is expected, when an flag word is entered Error 03 appears).
05		Number of words/bytes to be transferred is smaller/ same zero.
07		Operating module was overwritten by outside software
08	08	Transmit buffer allocated in the SAS
09[1)]	10[1)]	Connection defect between SAS525 and PLC (e.g. PLC in stop)
15	16	Unknown command parameter (1st letter)
19	20	DB too short, not available, inputs, outputs, time generator or counter not available/ DB not permitted
21	22	Unknown command parameter (2nd letter)
23	24	The HTDB was used as source/ target DB
	50	The coordination flag is still set with the partner.
	52[1)]	The number of the transmitted net data does not correspond with the number entered into the block header.
	54[1)]	Synchronization error, wrong telegram number received - Firmware expects a sequence block telegram with KK recognition - Firmware does not expect sequence telegram
225		CPU 941 not known
226		CPU 942 not known
227		CPU 943 not known
228		CPU 944 not known
241		PEU (I/O not clear)
242		QVZ (acknowledgement delay)
243		QVZ-ST
254		AKTIV abort by warm restart
255		Timeout during communication between PLC and SAS (The volume of data has not been processed fast enough)

[1)] Error messages that are generated by the SAS board

Appendix

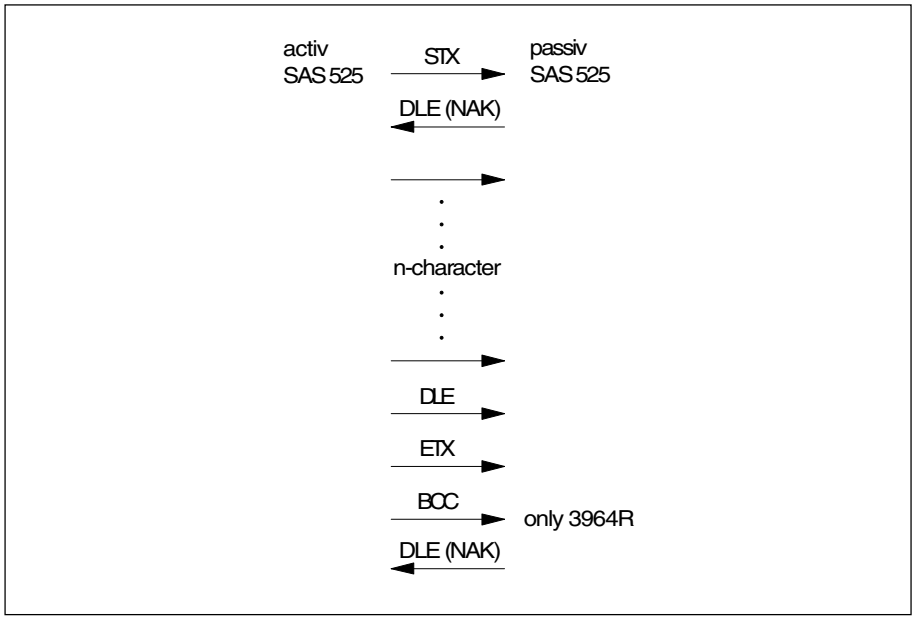
A 3964 / 3964R protocol

The 3964 / 3964R protocol is an asynchronous data transmission protocol for point-to-point connection. Both stations have equal priority.

A conflict can occur if both stations want to establish a connection at the same time. For this reason, a higher priority is assigned to a station in practice so that the station with the lower priority delays its transmit request if a conflict occurs.

The connection is established by transmitting the STX character. The remote station must respond with DLE within a timeout of 550 ms. If the remote station responds with NAK, with any other character or if the timeout elapses without a response, connection establishment has failed. After a total of five unsuccessful attempts, the driver aborts the procedure and signals an error to the program that called it.

Fig. A/1
3964/3964R protocol



If the connection establishment succeeds, the net data contained in the output buffer are transmitted. Each DLE found in the buffer is doubled and is transmitted as two DLE characters. The remote station expects characters within a character timeout of 220 ms, otherwise it transmits NAK.

After the buffer content has been transmitted, the driver appends the characters DLE-ETX as an end identifier. With the 3964R protocol, a BCC (block check) is also transmitted. The block check is derived by XORing all the characters transmitted.

If the remote station now sends the DLE character within the timeout, the data block is accepted without error and transmission is complete.

If the remote station responds with NAK, any other character or the timeout elapses without a response, the driver repeats transmission of the data block. After a total of five attempts, the procedure is aborted and an error is signaled to the program that called it.

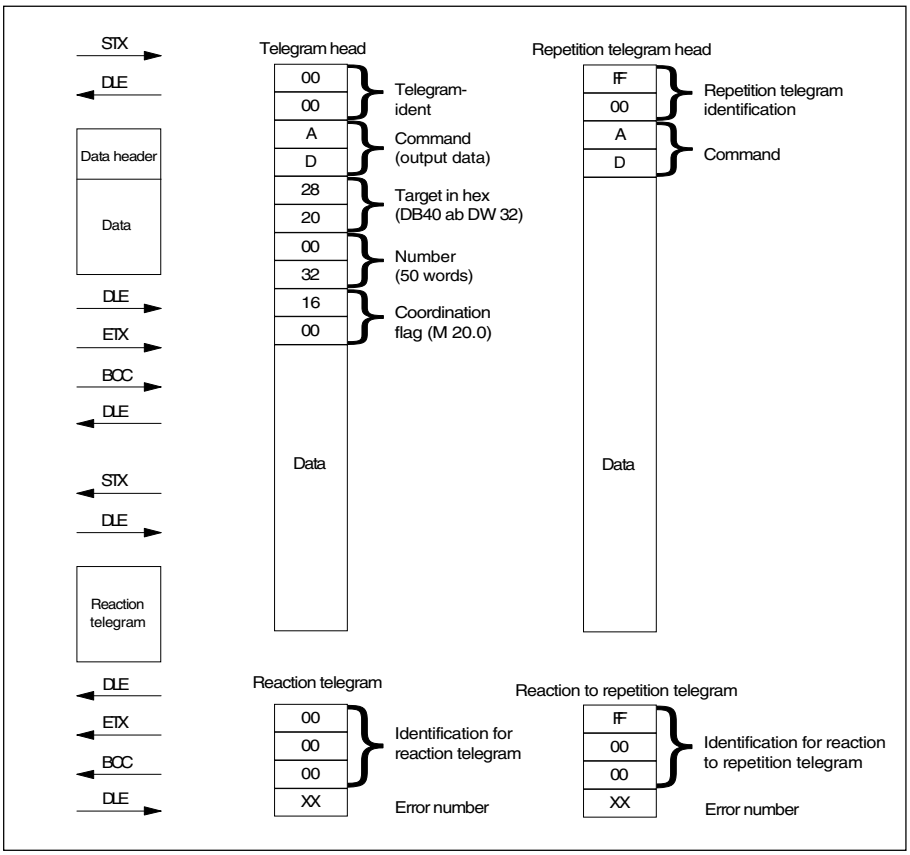
If the remote station transmits NAK while transmission is running, the driver terminates the block and repeats transmission as described above.

B RK512 computer link procedure

The RK512 procedure uses the 3964 / 3964R protocol to exchange data. Not only the net data but also frame headers are transmitted that define the type and content of the data to be transmitted. The structure of the frame header is specially suitable for data exchange between PLCs of the SIMATIC® range.

The procedure is divided into the two options: transmit data and request data (see Figs. A/2 and A/3).

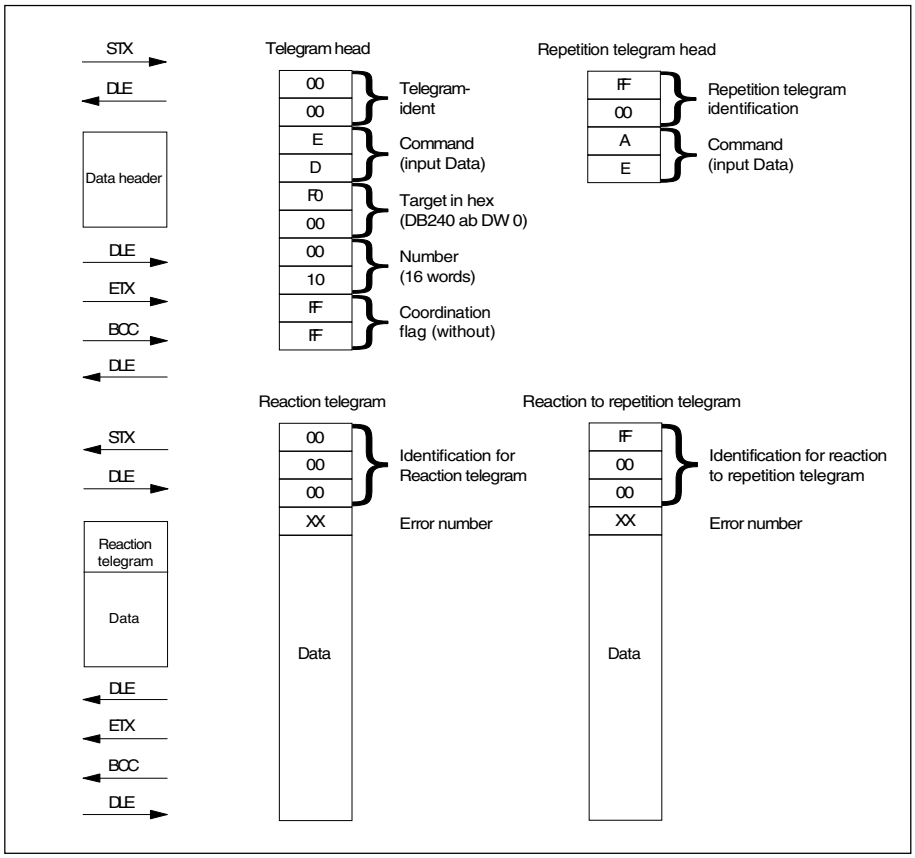
Fig. A/2
Transmit frame



The data are transmitted with a maximum length of 128 bytes per block. Greater volumes of data are assembled into blocks. The last block contains only the remaining data.

Each block is acknowledged by the remote station with an acknowledgement frame. The acknowledgement frame is also transmitted with the 3964 / 3964R protocol.

Fig. A/3
Fetch frame



On a negative acknowledgement (error number < > 0) or after a response timeout has elapsed, the block transmitted is repeated. After a total of three retries, the procedure is aborted and an error is sent to the user (timeout). Because the 3964 / 3964R protocol makes five transmission attempts and the RK 512 procedure makes three, the total number of retries before a timeout is detected is fifteen. If an error no. is transmitted, the procedure is aborted immediately by both stations.

Logical timeouts until the frame is repeated:

150	Bd	=	13	sec
300	Bd	=	10	sec
600	Bd	=	7	sec
1200	Bd	=	5	sec
2400	Bd	=	5	sec
4800	Bd	=	5	sec
9600	Bd	=	5	sec
19200	Bd	=	5	sec
38400	Bd	=	5	sec