Operation Manual

Product name : SI Unit

Model : EX250-SPR1

SMC CORPOLATION

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1. Precaution

Following safety requirements aim at the prevention of hazardous condition and the damage of instruments. Here, the hazard is classified in “Dangerous”, “Warning” and “Caution” on the level of hazard. Please refer to regulation of safety on ISO and JIS to ensure safety.

> **Warning :** Operator error may cause the death or serious injury.
>
> **Caution :** Operator error may cause the injury or equipment damage.

Warning

1. The product is designed to use in ordinary full automation equipment. Don’t use this product in equipment or instrument where human life may be directly injured or malfunction of failure may cause devastating loss.
2. Don’t disassemble the product to repair and modification.

Caution

Read this operation manual carefully to ensure the safety and proper operation.

Design,Selection

1. See the specification.
   Keep all requirements in the specification (Voltage, operating ambient temperature, impact) to avoid damage, malfunction and fire.
2. Specified maintenance space is necessary.
   Design must consider the space necessary for maintenance.

Installation,Adjustment,Wiring

1. Don’t drop nor hit the unit.
   Don’t apply impact more than 100m/s^2. Internal parts of SI unit may be damaged and malfunction.
2. Wire properly.
   SI unit may damage by improper wiring.
3. Don’t wire power supply line and high power line together
   Wire SI unit wiring (piping) and power line/high power line separately to avoid interference of noise and surge from high power line to the signal line.
4. Ensure the insulation of wiring.
   Insulation failure (mixture with other circuit, insulation between terminals etc.) may cause excessive voltage or current to SI unit which leads to damage the SI unit.
5. Keep the tightening torque.
   The screw should be tighten with the specified torque, otherwise IP67 protection can not be guaranteed.
6. Don’t apply repeated bend and tensile force.
   Wiring applying repeated bending stress and tensile force lead to cause disconnection.

Operating Condition

1. Never use in explosive environment.
   SI unit is not explosion proof. Operation in explosive environment may cause explosion accident.
2. Don't apply temperature cycle.
   Temperature cycle other than normal temperature change do harm to the internal part of SI unit.
3. Don't use where exposed to surge source.
   Device and instrument which generate big surge (Electromagnetic lifter, High frequency induction furnace, motor etc.) adjacent to the manifold solenoid valve with SI unit lead to cause the deterioration or damage of the switch internal circuit element. Consider the solution against surge and do not to mix lines.
4. Bits of wire and other foreign materials should not enter the product.
   Bits of wire and other foreign materials in SI unit may cause fire, failure or malfunction.
5. Mounting of SI unit on manifold and wiring from the conduit shall be treated as specified.
   Otherwise IP67 rating cannot be attained.

Maintenance

1. Periodic maintenance is recommended to avoid unexpected failure and malfunction.
2. Don't touch the terminal and internal board during energization to avoid malfunction, unit damage, and electric shock.

Safety instructions for power supply

1. User must supply power to input and solenoid separately single or dual power supplies can be used.
2. Choose UL recognized product for direct current power source to be mounted.
   (1) Limited voltage current circuit complying with UL508
   The power supply circuit made with secondary side coil of isolation transformer which satisfies the following condition
   Max. voltage (No load applied) : 30Vrms (42.4V peak) or less, and
   Max. current : 8A or less (Include when short), and restricted by the circuit protecting device (fuse) with rate in the table below

Voltage with no load (V peak)	Max. current rate
0 to 20 [V]	5.0
Exceeding 20 [V] up to 30 [V]	$\frac{100}{\text{Peak voltage}}$

   (2) Max. 30Vrms (42.4V peak) or less circuit (Class 2 circuit) which sources class 2 source unit complying with UL1310 or class 2 transformer complying with UL1585.

2. Outline

PROFIBUS

This bus is multi master type open field bus which gets International standard IEC61158 and European Field Bus standard EN50170 and EN50254.

This has master and slave and can transmit data to 127 stantions at the speed selected from 9.6kbps to 12Mbps. Transmission is done by twist pair cable (RS485) or optical fiber cable over a few km.

PROFIBUS-DP (Decentralized Periphery)

This makes it possible to transmit data at high speed between controller and field including remote I/O and drive. Transmission of 1kbyte I/O data within 1ms is available.

Serial interface unit(SI unit) for PROFIBUS-DP:EX250-SPR1

This can control ON/OFF of 32 points solenoid valve at maximum as slaves of PROFIBUS-DP. Additionally, this is the distributed I/O device where sensor signal input(digital) for 32 points at maximum is available if Input Block is connected.

Also, this is corresponding to IP67.

3. Specifications

3-1 . General specification

Item	Specification
Operating ambient temp.	+5 to +45℃
Operating ambient humidity	35 to 85% RH (No dew condensation)
Storage ambient temp.	-20 to +60℃
Vibration proof	10 to 57Hz 0.35mm (Constant amplitude) 57 to 150Hz 50m/s^2 (Constant acceleration)
Impact proof	150m/s^2 (peak), 11ms × three times in each direction ±X, Y and Z.
Noise immunity	Normal mode : ±1500V Pulse duration 1us Common mode : ±1500V Pulse duration 1us Radiation : ±1000V Pulse duration 1us
Withstand voltage	500V AC for 1min.
Insulation resistance	500V DC min10M ohm
Operating environment	No corrosive gas and no dust

3-2 . Electrical specification

Item		Specification
Power Voltage range, current consumption	Power for SI/Input Block Current consumption	19.2 to 28.8V DC Max 1.1A or less Depending on the number of Input Block stations and sensor specifications.
	Power for solenoid valve Current consumption	22.8 to 26.4V DC Max 2.0A or less Depending on number of solenoid valve station and specifications.
Solenoid valve connection spec.	Output type	P-ch MOS-FET Open drain type
	Connection load	Solenoid valve with protection circuit for 24V DC and 1.5W or less surge voltage.(made by SMC)
	Insulation type	Opto coupler type
	Residual Voltage	0.3V DC or less

3-3 . Communication specification

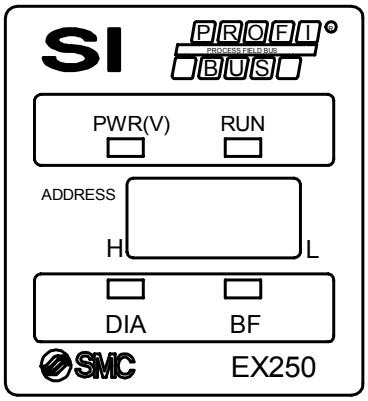
Item	Specification
Protocol	PROFIBUS-DP(EN50170, EN50254)
BUS･Interface	EIA RS-485
Communication form	Token passing
Transmission speed	9.6,19.2,93.75,187.5,500,1500,12000(kbps)
Transmission media	STP cable
Connect node	Max. 125 station
Network topology	Bus, tree, star
Cable length	Max. 23km(Repeater needed)
Freeze mode	Available
Sync mode	Available
Input point	Max. 32 points
Output point	Max. 32 points
ID number	1408hex(SW setting mode) 1409hex(HW setting mode)

3-4 . Applicable solenoid valves

Representative series	Applicable series
VQC series	VQC1000, VQC2000, VQC4000
SV series	SV1000, SV2000,SV3000(Tierod base manifold)

4. LED indicator and Physical dimensions

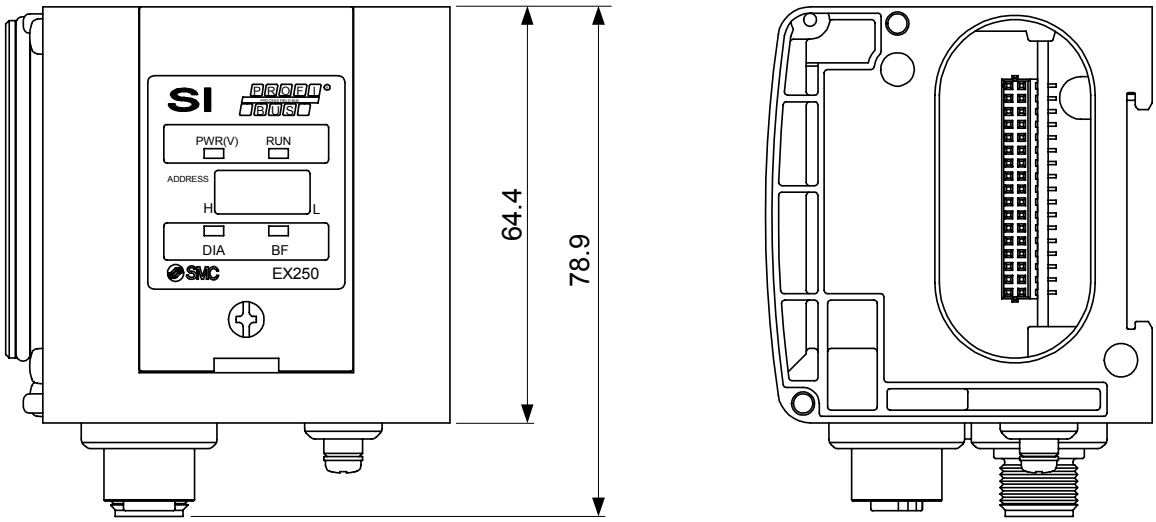
4-1 . LED indication

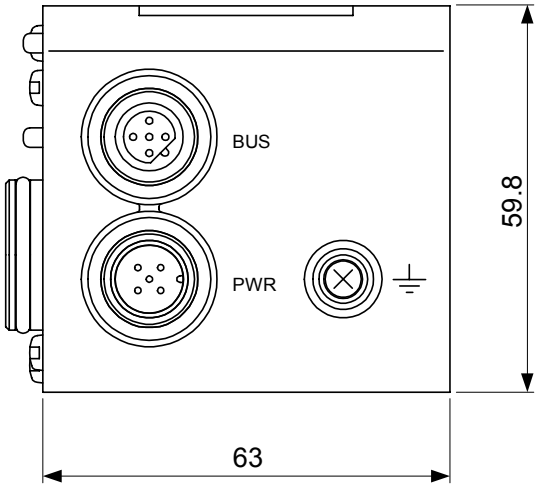


Indication	Contents
PWR(V)	Green lights up when power supply for solenoid valves is turned on. Disappear when supply voltage decreases below 19V.
RUN	Green lights up during operation(when power supply for SI unit is turned on.)
DIA	Red lights up when some failure is detected by self-diagnosis.
BF	Red lights up when bus failure is detected.

4-2 . Physical dimensions

EX250-SPR1



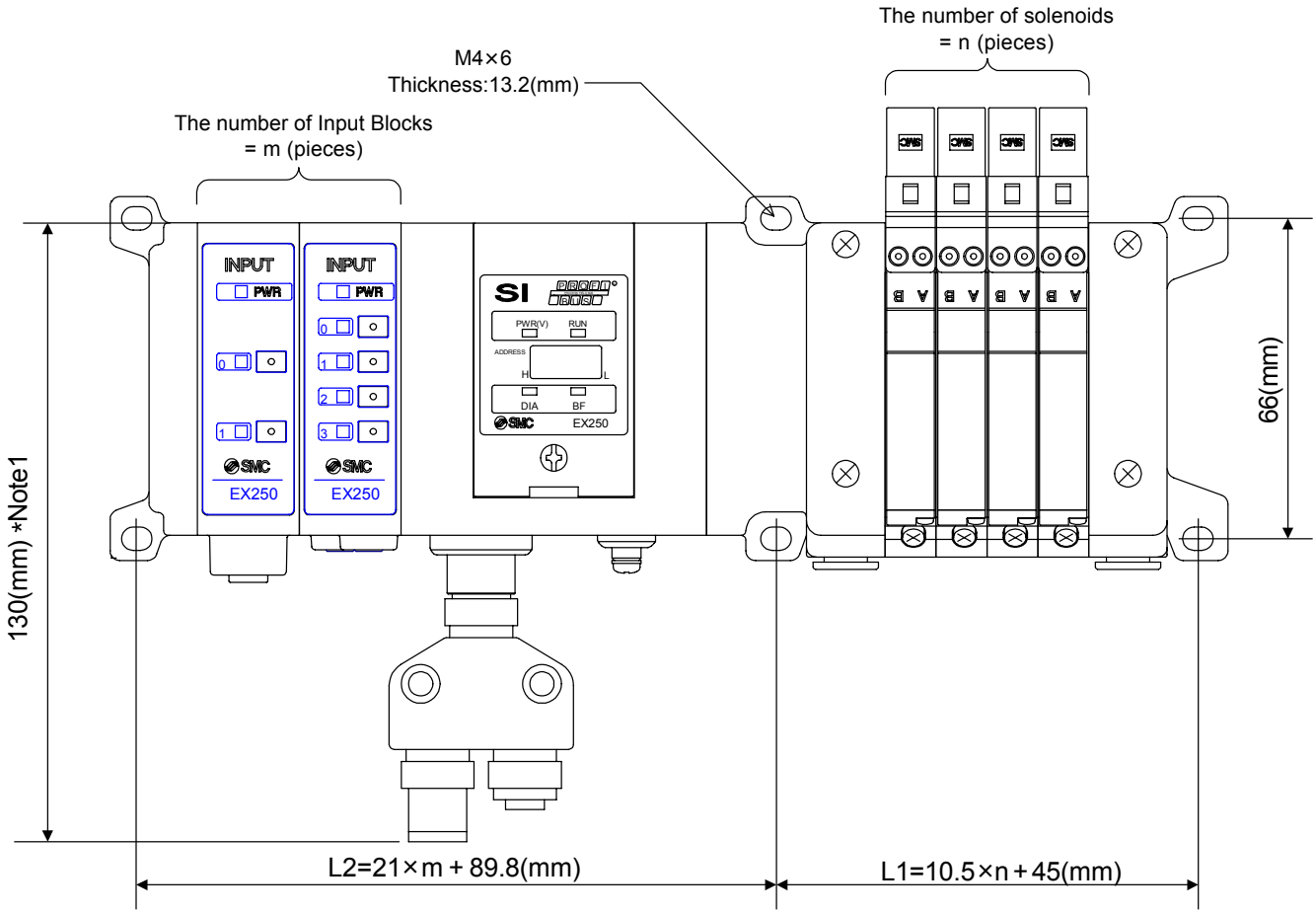


5. Installation and Maintenence

How to set

Having mounting hole, it can't be set to BUS independently. Be sure to connect manifold to SI unit for setting.

And if Input Block is unnecessary, connect End Plate directly to SI unit.



*Note1 The size when connecting BusTee with the SI unit directly.

For example, the table below shows the size when manifold of VQC1000 series connected.
Please refer to an individual catalog for the size when other manifolds are connected.

n_m / L	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
L1	45	55.5	66	76.5	87	97.5	108	118.5	129	139.5	150	160.5	171	181.5	192	202.5	213
L2	89.8	110.8	131.8	152.8	173.8	194.8	215.8	236.8	257.8	278.8	299.8	320.8	341.8	362.8	383.8	404.8	425.8

Wiring (for power supply, communication and input) and piping are done on only one side.
On the side, make a space for wiring and piping.

Maintenance

Addition of Input Block

1.Remove screws from End Plate.
2.Mount attached tie rod.
3.Connect additional Input Block.
4.Connect End Plate and tighten removed screws by specified tightening torque. (0.6N·m)

Exchange of SI unit

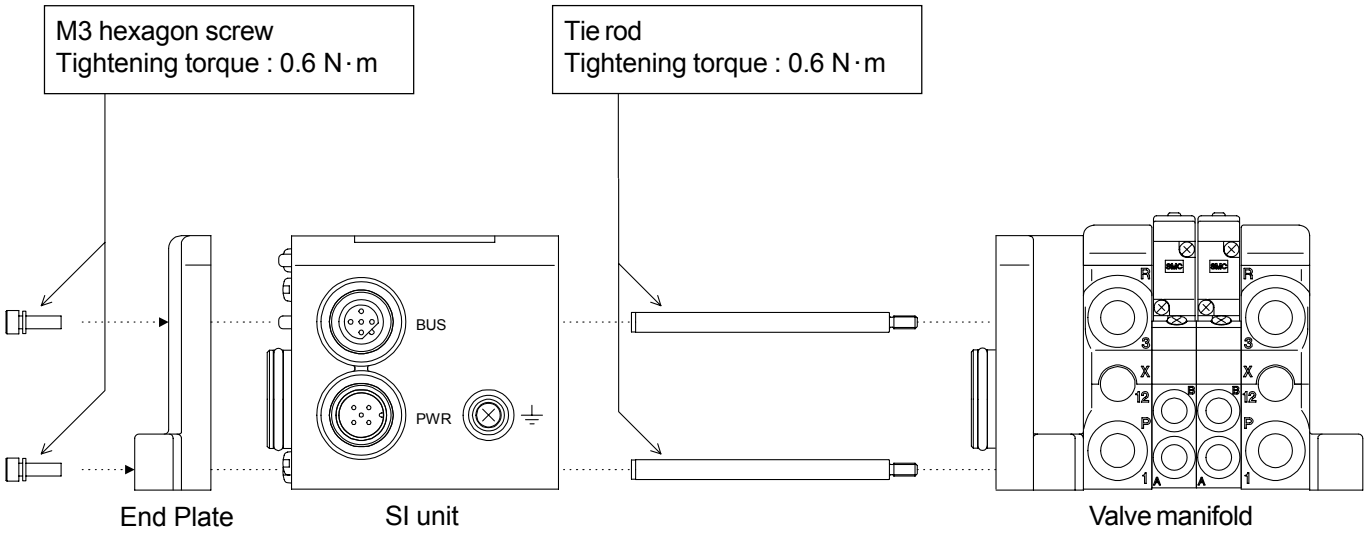
1.Remove screws from End Plate and release connection of each unit.
2.Replace old SI unit with new one. (Tie rod does not need to be removed.)
3.Connect End Plate and tighten removed screws by specified tightening torque. (0.6N·m)

Caution for maintenance

(1) Be sure to turn-off all power supplies.
(2) Be sure that there is no forign object in any of units.
(3) Be sure that gasket is lined properly.
(4) Be sure that tightening torque is according to specification.

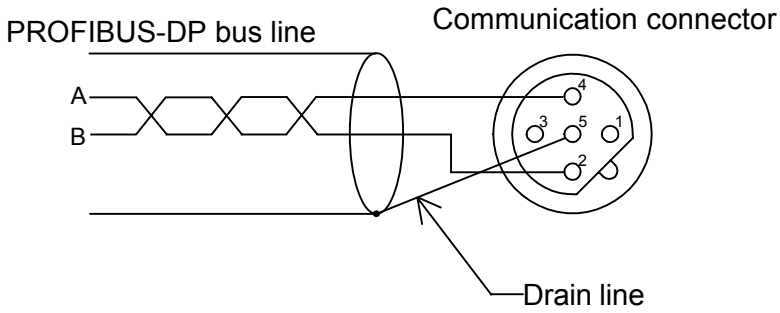
If these items are not kept, it may lead to the breakage of substrate or intrusion of liquid or dust into the units.

Assembly and disconnection of unit



6. Wiring and Setting

6-1. Communication wiring



Cable : Shielded twisted pair cable(Type-A cable)

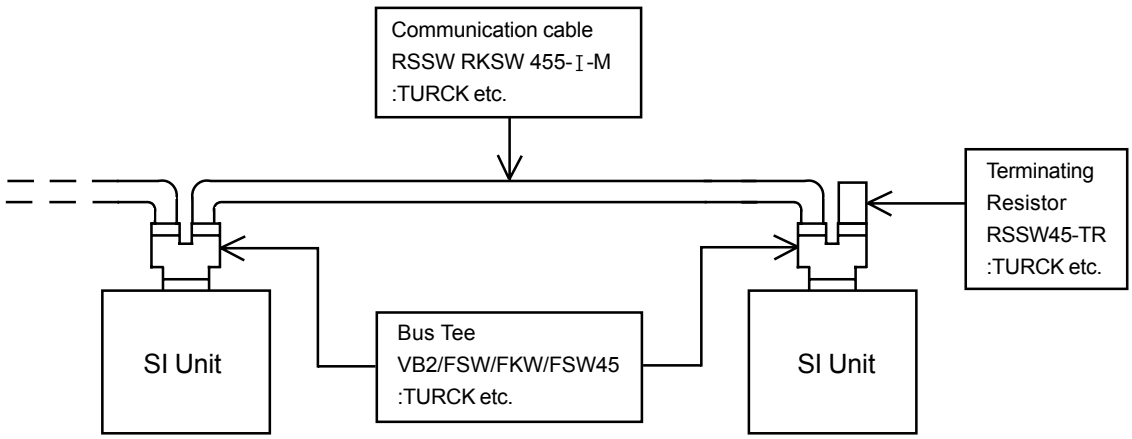
Impedance	135 to 165 ohm(3 to 20MHz)
Capacity between conductors	30pF/m or less
Conductor resistance	110ohm/km or less
Cable diameter	0.64mm or more
Conductor area	0.34mm^2 or more

・Transmission speed & Maximum wiring length

Baud rate(kbps)	9.6	19.2	93.75	187.5	500	1500	12000
Wiring length(m)	1200			1000	400	200	100

・Terminator

It is necessary to attach bus terminator resistance to the units located at the ends of transmission line.

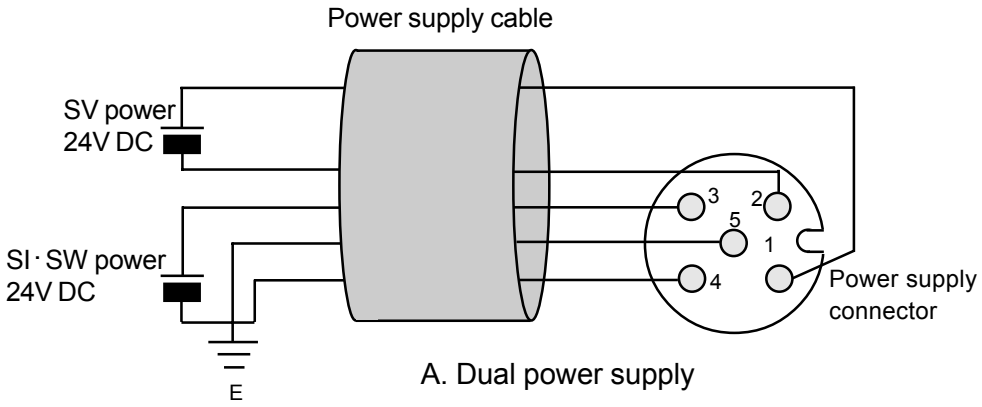


Contact each manufacture about Communication cable, Bus Tee and Terminating Resistor.

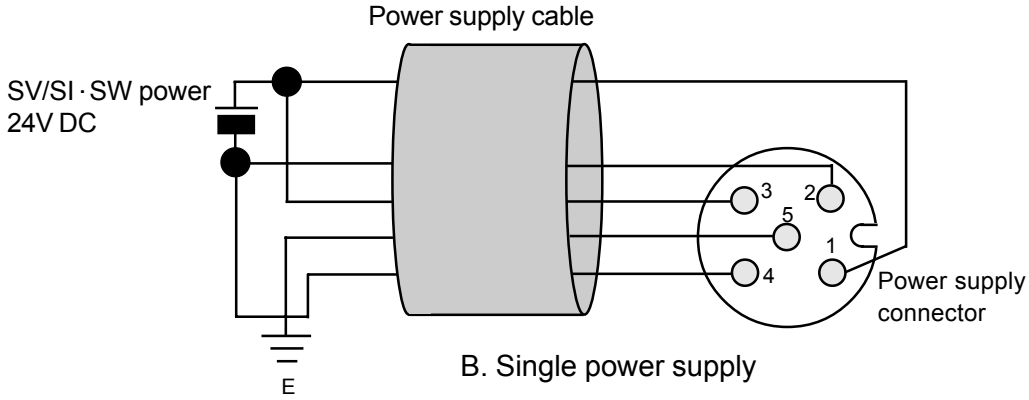
6-2 . Wiring of power supply

Power supply line inside the unit has individual power supplies for solenoid valve actuation (SV power supply) and for Control parts and Sensor (SI · SW power supply). Supply 24V DC for each of them.

Either single or dual power supply is available.



A. Dual power supply

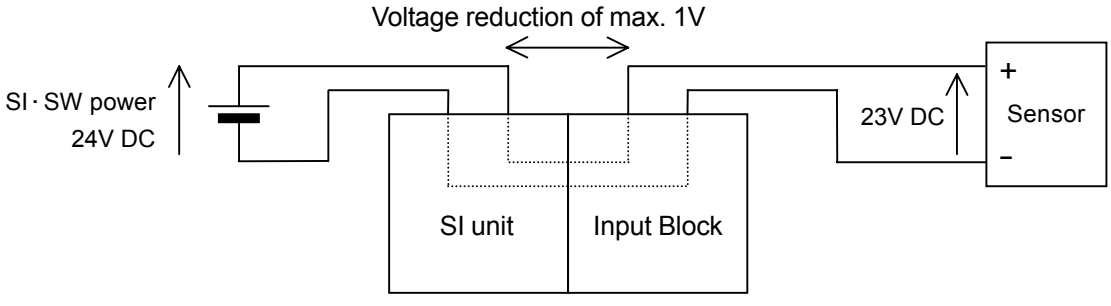


B. Single power supply

*In case of single power supply, pay attention to the range of each supply voltage.

Power for sensor is supplied to sensor connected with Input Block. Select sensor concerning voltage drop up to max. 1V inside the unit at this moment.

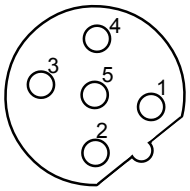
If sensor requires 24V, it is necessary to lower power supply voltage for sensor slightly or secure power supply for sensor separately without going through SI unit so that sensor input voltage can be 24V with actual loading (allowable voltage of power supply : 19.2V to 28.8V).



Communication connector

M12 5pin reverse socket

Example of connected Bus Tee: TURCK VB2/FSW/FKW/FSW45 etc.

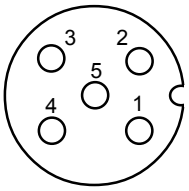


Pin No.	Description	Function
1	VP	Supply voltage for Terminating Resistor
2	A-N	Minus to send/receive data
3	DGND	Ground for Terminating Resistor
4	B-P	Plus to send/receive data
5	SHIELD	Shield

Power supply connector

M12 5pin plug

Example of connected cable：SMC EX500-AP0[]0-S etc.

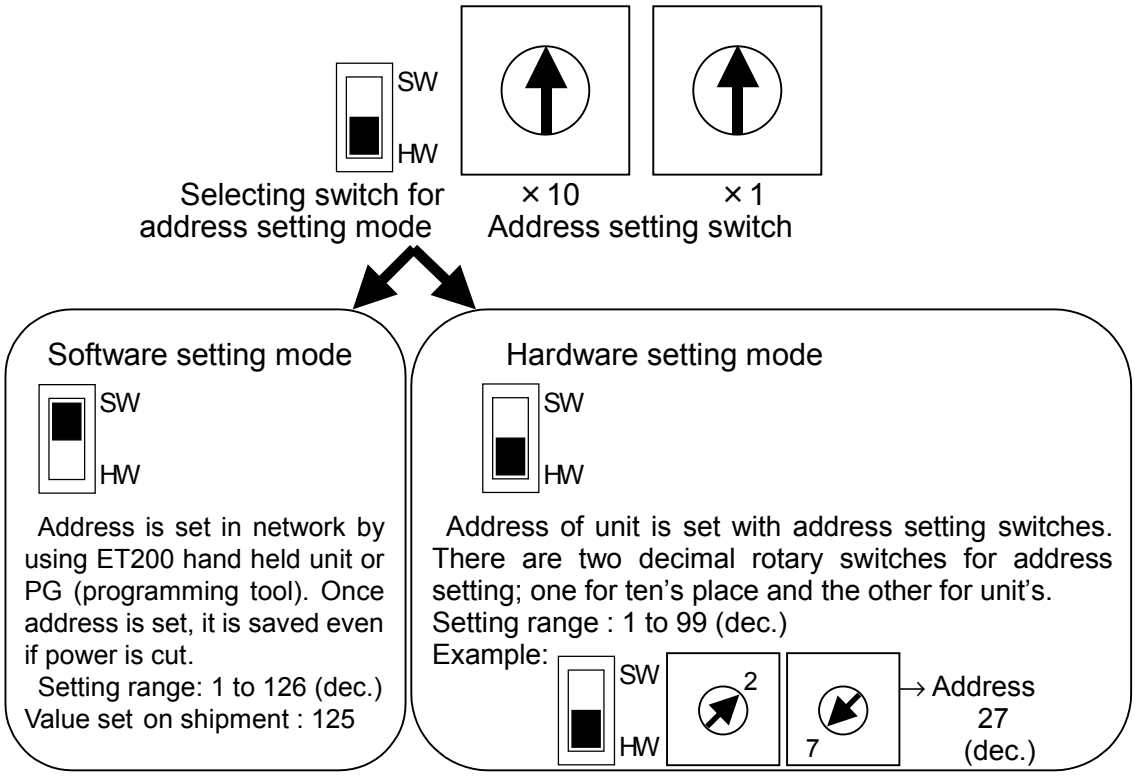


Pin No.	Description	Function
1	SV24V	+24V for solenoid valve.
2	SV0V	0V for solenoid valve
3	SW24V	+24V for SI unit and Input Block
4	SW0V	0V for SI unit and Input Block
5	E	Earth

6-3 . Address setting

Be sure to turn power supply off before setting the switches off before setting the switches of SI unit.

Switch installed in cover of SI unit is available for setting of address.



∗ When software setting mode is selected, address setting switches are not effectual. Moreover, software setting mode and hardware setting mode differ in ID numbers of units. (See "6-5. Configuration" for details.)

6-4. Diagnostic functions

PROFIBUS-DP has diagnostic functions which allows to monitor condition of slave between master - slaves. When it gets out of standard, SI unit sends diagnostic information showing error to master and, at the same time, turns on DIA indication.

The following diagnostic functions are available.

Functions	Contents
Solenoid valve power supply voltage monitoring	Detects that solenoid valve voltage has decreased to approx. 19V or less.
Detect cutting fuse of Input Block	Fuse of Input Block melts and cut, and detects that sensor supply power has been turned off.

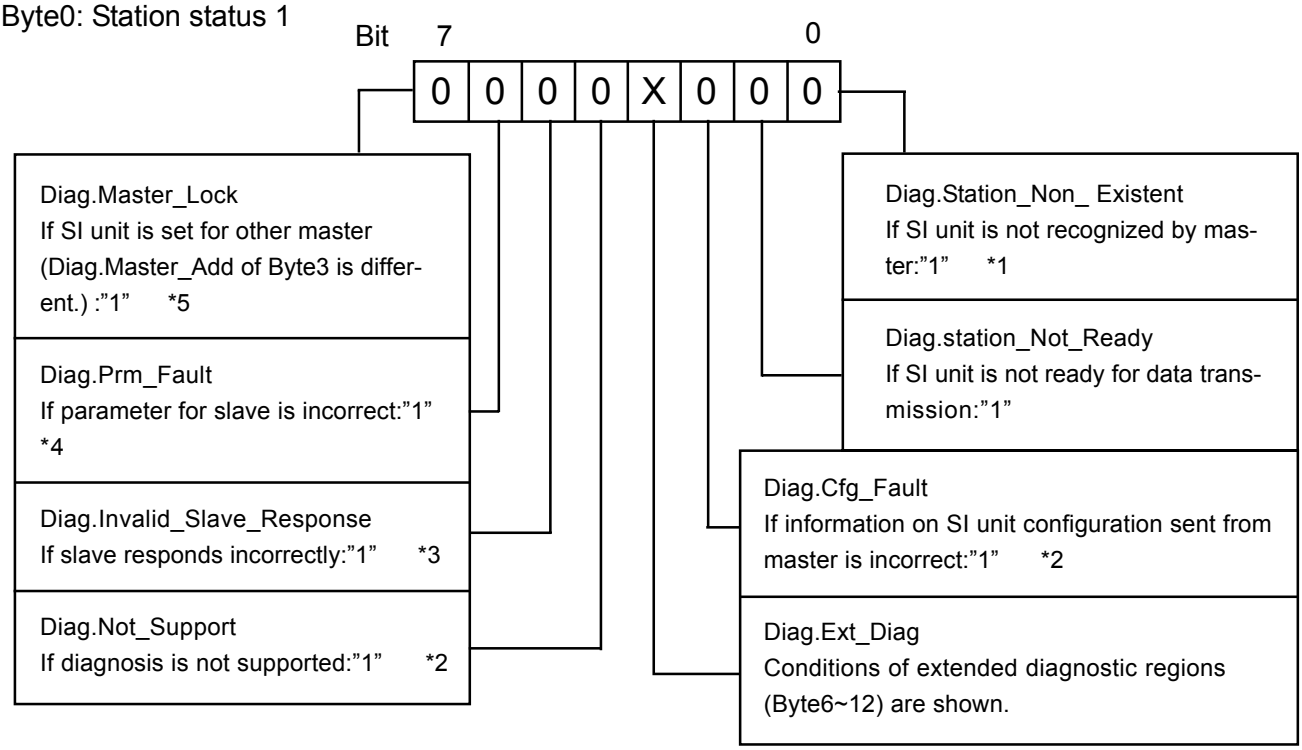
Diagnostic information consists of 13 bytes. The first 6 bytes shows information specified by PROFIBUS and the rest, 7 bytes , is peculiar to unit.

To see diagnostic information with master, refer to PROFIBUS specifications and manual for master.

Example : SIEMENS　S7-300,400
System function SFC13 “DPNORM_DG” is used. As error is detected by diagnosis, OB82（diagnostic interrupt organization block）is automatically called out and the error can be solved by programming error processing logic for OB82. CPU turns “STOP” if program is not loaded in OB82.

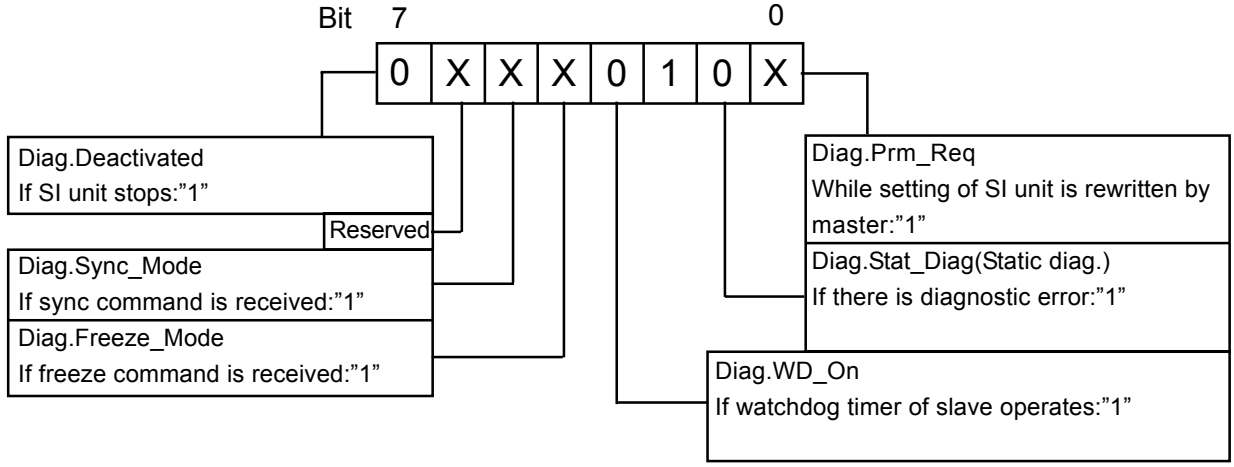
Configurations of diagnostic information are as follows. (Normal values are shown. “X” is variable.)

Byte0: Station status 1

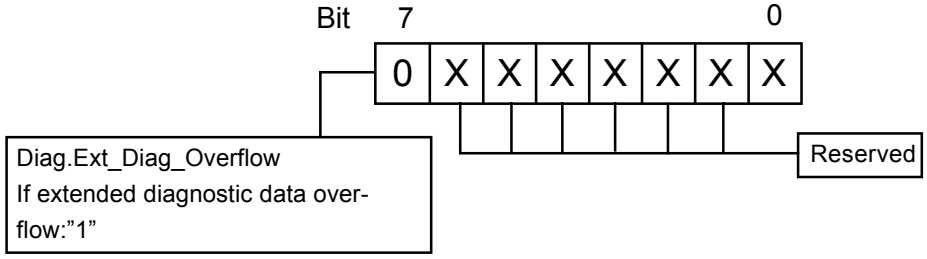


If other values than normal are shown, it may be due to the following factors.
*1) Communication line is not connected properly. / Unit is not turned on.
*2) SI unit is not correctly set by master (PLC).
*3) Bus is in bad condition. (effect of noise, unmatched impedance, etc.)
*4) Descriptions of SI unit parameter file are incorrect. (parameter length, ID number, etc.)
*5) Multiple masters on one bus set the same SI unit as a slave.

Byte1: Station status 2



Byte2: Station status 3



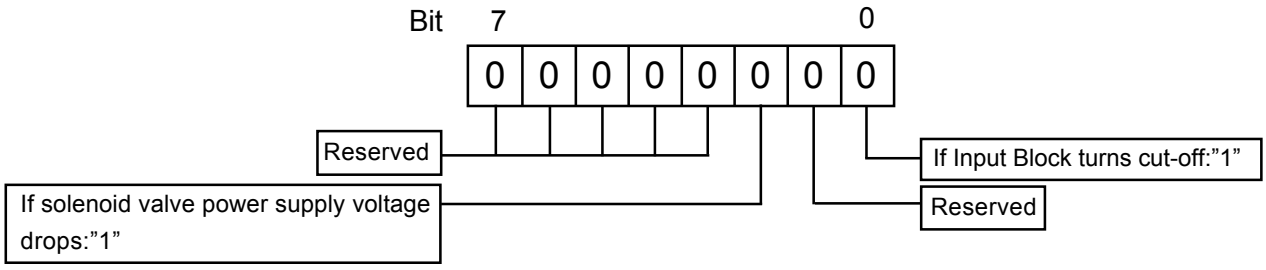
Byte3: Diag.Master_Add
Mastar address is shown.

Byte4,5: Ident_Number
SI unit ID numbers are shown.

	Byte4	Byte5
SW setting mode:	14h	08h
HW setting mode:	14h	09h

Byte6: Diag_Headder 07h
Size of extended diagnostic data is shown in byte.(fixed value)

Byte7:SI unit diagnostic information



Byte8～12:Reserved (All 00h)

6-5 . Configuration

For PROFIBUS-DP, configuration information peculiar to each device (ID number, data format, corresponding baud rate, etc.) is supplied in the form of device data base file (GSD File).

Prepare GSD File for SI unit referring to “6-7. GSD File".

GSD File of SI unit differ depending on address setting mode (which is changed over by selecting switch for address setting mode).

GSD File:	Smc_1408.gsd	(in software setting mode)
	Smc_1409.gsd	(in hardware setting mode)

How to set master for SI unit application is shown with SIEMENS STEP7 for example.

① Copy SI unit GSD File (Smc_140*.gsd) below the optional directory.

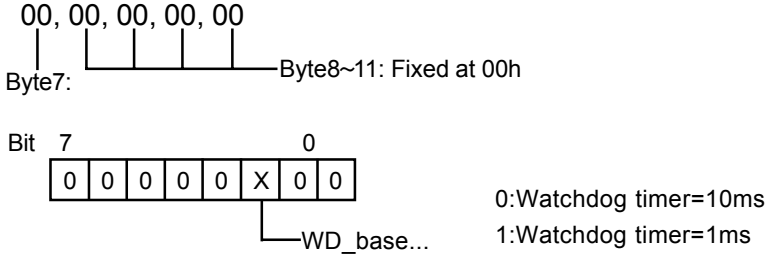
② Set up STEP7 and execute “Options”－”Install New *.GSE Files” with HW Configuration tool.

③ Open Hardware Catalog to find out additional “SI UNIT” icon under the PROFIBUS DP - Additional Field Devices. Drag and drop ”SMC EX250-SPR1 SW” (file for software setting mode) or “SMC EX250-SPR1 HW ” (file for hardware setting mode) shown below the icon so as to add them to PROFIBUS-DP line.

④ For the rest, follow the setting procedure for Distributed I/O device (address parameter).

Parameter setting

The following 5 bytes out of 12 bytes are user parameter. The rest of 7 bytes are parameter common to PROFIBUS-DP devices. (Refer to specifications of PROFIBUS-DP.) Generally, users are allowed to set user parameter only.



I/O Configuration

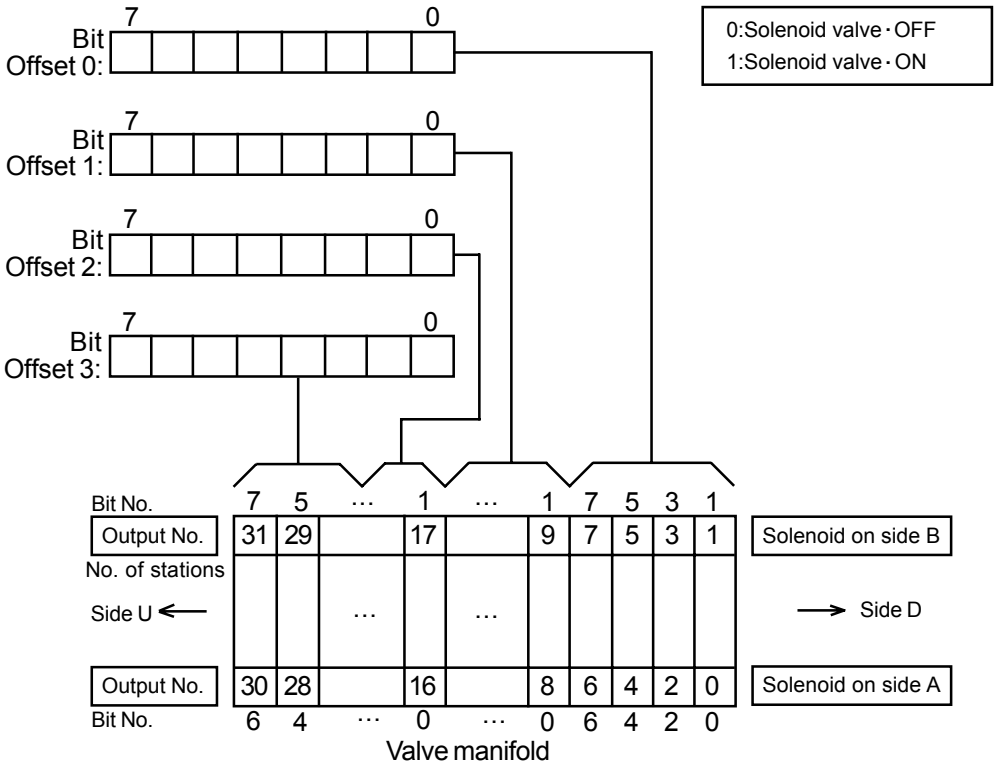
I/O configuration of SI unit is shown below. (Refer to manuals or other information of master for details such as definition of numbers.)

Byte(Slot)	No.	Type	Length	Unit
0	163(A3H)	Output	4	Byte
1	147(93H)	Input	4	Byte

6-6 . Assignment of I/O No.

Correspondence between output data and valve manifold

Output data



* Output numbers are assigned to stations from side D to U of manifold in order. (See manual of each valve manifold for the directions of side D and U)
* Standard manifold is wired in double. Output numbers are assigned to side A and B alternatively. In case of single solenoid valve, output on side B is free.[Refer to fig.(a)]
* Mixed (single and double) wiring is available as long as wiring specifications designate it. This allows output numbers to be specified without having free output.[Refer to fig.(b)]
* Each bit of data sent from master (4 bytes) shows ON/OFF (0: OFF,1: ON) of solenoid valve. Starting from LSB of the first byte (Offset0), output numbers are assigned to all the bits in numeric order.

[a]

	No.	station No.	No.	
double	4	3	5	
single	2	2	3	free
double	0	1	1	

[b]

	No.	station No.	No.
double	3	3	4
single	2	2	—
double	0	1	1

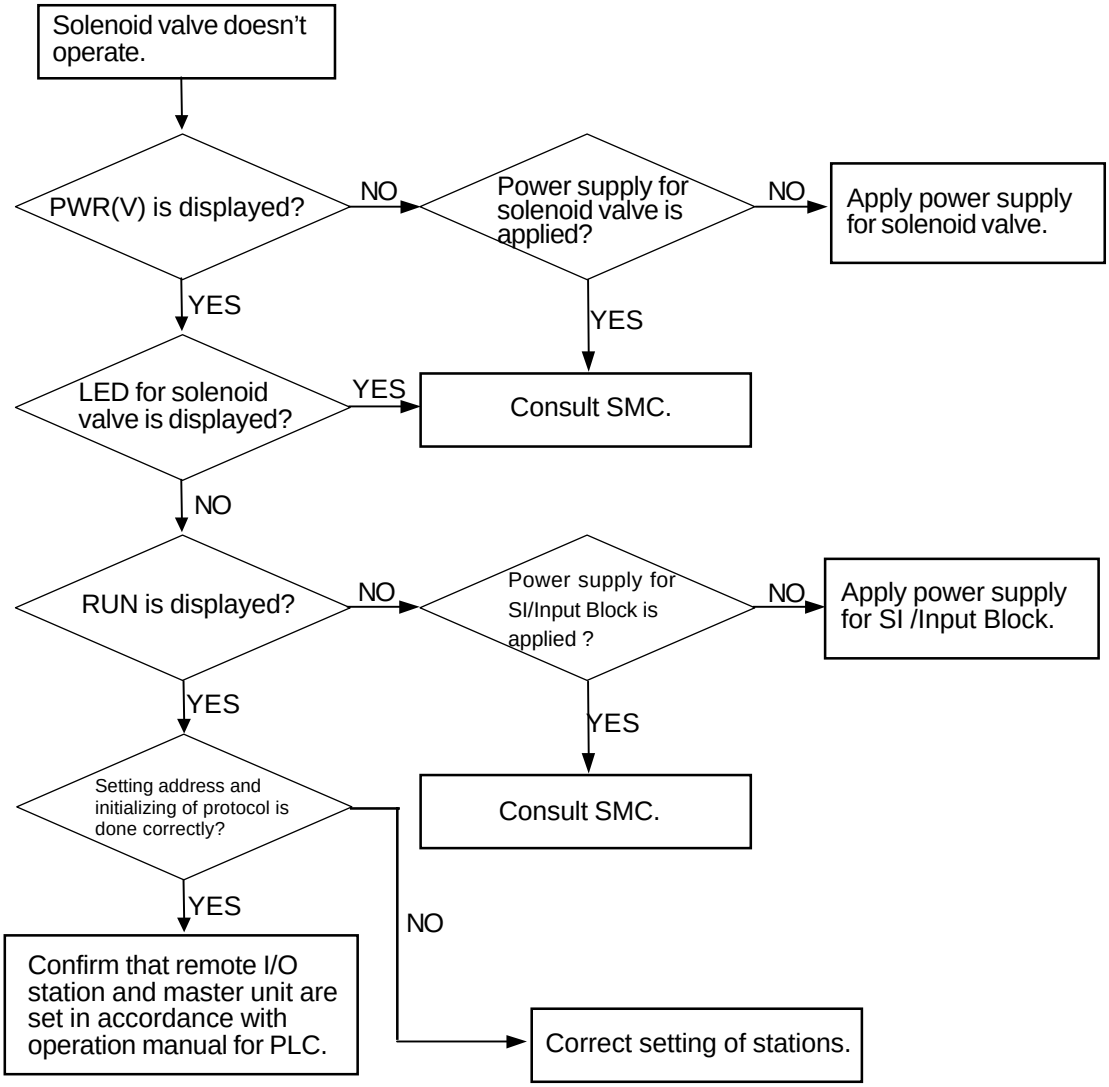
6-7.GSD File

EX250-SPR1·SW setting mode(SMC_1408.GSD)

```
;SMC SI-Unit(SI Valve Manifold) EX250-SPR1 SW 32O/32I
;Name: SMC_1408.GSD
;Version:     1.0
;
;Date:        06.09.1
;
#Profibus_DP
GSD_Revision = 1
Vendor_Name = "SMC Pneumatic"
Model_Name = "EX250-SPR1(SW)"
Revision = "V1.1"
Ident_Number = 0x1408
Protocol_Ident = 0
Station_Type = 0
FMS_supp = 0
Hardware_Release = "1"
Software_Release = "1"
;
9.6_supp = 1
19.2_supp = 1
93.75_supp = 1
187.5_supp = 1
500_supp = 1
1.5M_supp = 1
3M_supp = 1
6M_supp = 1
12M_supp = 1
MaxTsdr_9.6 = 60
MaxTsdr_19.2 = 60
MaxTsdr_93.75 = 60
MaxTsdr_187.5 = 60
MaxTsdr_500 = 100
MaxTsdr_1.5M = 150
MaxTsdr_3M = 250
MaxTsdr_6M = 450
MaxTsdr_12M = 800
;
Redundancy = 0
Repeater_Ctrl_Sig = 2
24V_Pins = 0
Implementation_Type = “SPM2”
;
Freeze_Mode_supp = 1
Sync_Mode_supp = 1
Auto_Baud_supp = 1
Set_Slave_Add_supp = 1
User_Prm_Data_len = 5
User_Prm_Data = 0x00,0x00,0x00,0x00,0x00
Max_Diag_Data_Len = 13
Min_Slave_Intervall = 1
Slave_Family = 3
Modular_Station = 0
Modul_Offset = 0
Max_Module = 1
Max_Input_Len = 4
Max_Output_Len = 4
Max _Data_Len = 8
;
Module = "DP-Kompaktgeraet 32A/32E" 0xA3,0x93
EndModule
```

EX250-SPR1·HW setting mode(SMC_1409.GSD)

```
;SMC SI-Unit(SI Valve Manifold) EX250-SPR1 HW 32O/32I
;Name: SMC_1409.GSD
;Version:     1.0
;
;Date:        06.09.01
;
#Profibus_DP
GSD_Revision = 1
Vendor_Name = "SMC Pneumatic"
Model_Name = "EX250-SPR1(HW)"
Revision = "V1.1"
Ident_Number = 0x1409
Protocol_Ident = 0
Station_Type = 0
FMS_supp = 0
Hardware_Release = "1"
Software_Release = "1"
;
9.6_supp = 1
19.2_supp = 1
93.75_supp = 1
187.5_supp = 1
500_supp = 1
1.5M_supp = 1
3M_supp = 1
6M_supp = 1
12M_supp = 1
MaxTsdr_9.6 = 60
MaxTsdr_19.2 = 60
MaxTsdr_93.75 = 60
MaxTsdr_187.5 = 60
MaxTsdr_500 = 100
MaxTsdr_1.5M = 150
MaxTsdr_3M = 250
MaxTsdr_6M = 450
MaxTsdr_12M = 800
;
Redundancy = 0
Repeater_Ctrl_Sig = 2
24V_Pins = 0
Implementation Type = “SPM2”
;
Freeze_Mode_supp = 1
Sync_Mode_supp = 1
Auto_Baud_supp = 1
Set_Slave_Add_supp = 0
User_Prm_Data_len = 5
User_Prm_Data = 0x00,0x00,0x00,0x00,0x00
Max_Diag_Data_Len = 13
Min_Slave_Intervall = 1
Slave_Family = 3
Modular_Station = 0
Modul Offset = 0
Max_Module = 1
Max_Input_Len = 4
Max_Output_Len = 4
Max_Data_Len = 8
;
Module = "DP-Kompaktgeraet 32A/32E" 0xA3,0x93
EndModule
```

7. Trouble shooting

When SI unit doesn't operate properly, follow the flowchart below and resolve it.