TELEFRANG AB

64 DI / DO Module S27

General Description

S27 is a general purpose digital I/O module with 64 I/O pins, individually selectable as inputs or outputs. Each output can supply 130 mA and includes short circuit protection. Through the built-in CPU, selectable options include digitally filtered and edge triggered inputs with levels selectable from 0 - 35 V, PLC programming, multiplexing, watchdogs etc. The module communicates with the central computer via the opto-isolated SIOX bus.

Order Number: 6S27 SIOX 64 DI / DO Module
6S27-1 Optional Terminal Card for S27

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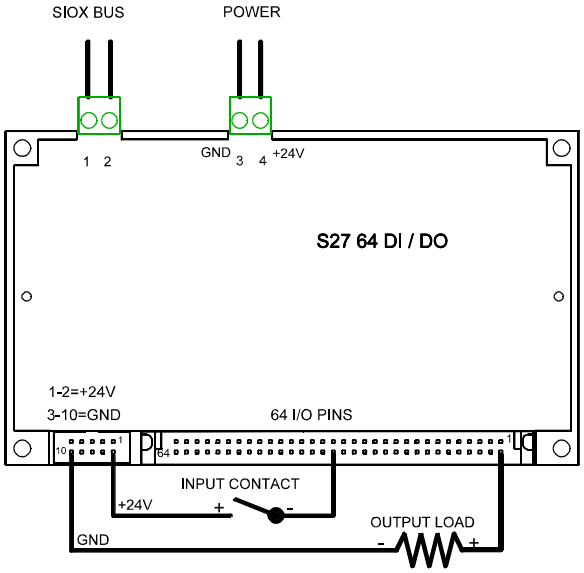
Installation and Startup

The module is equipped with one 2-terminal and one 10-terminal power connector, a 2-terminal SIOX bus connector and a 64-terminal I/O connector (DIN 41612B). The 10- and 64-terminal connectors are suitable e.g. for standard flat cables.

To get the module "up and running" all that has to be done is to connect power to terminals 3 (ground) and 4 (+24 V DC), connect the unpolarized SIOX bus to terminals 1 and 2, and connect relays, pushbuttons, etc. to inputs and outputs.

The SIOX modules should be interconnected through a two-wire, low capacitance twisted pair. Shielded cables may be used but unless a correct strategy for shield grounding is adopted, it may prove to be of little benefit. Instead, the capacitance between the shield and the bus wires will add to the total capacitive load on the SIOX bus and decrease the maximum distance over which communication can be carried out for a given bit rate. The total resistance of the bus should not be higher than 2 * 50 Ω.

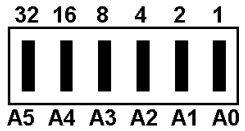


The communication bus is opto-isolated from the rest of the module.

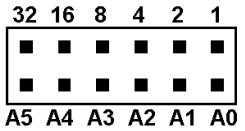
The module is set up at the factory to communicate at 4800 bits/s using address 1, in Data Mode using Single Data and one address. All I/O's are preset as digital inputs. General principles for the SIOX bus and communications are described in a separate manual, "SIOX System Description".

Address Setup

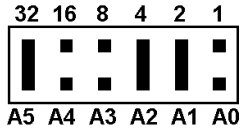
There are two possible ways of defining one of the 63 addresses for an S27 module: either through jumpers located inside the unit or by the internal EEPROM in the module. If any combination of jumpers except all six installed or all six removed is used at power-up, the module will choose this jumper combination as the correct address. The panel has to be removed in order to access the jumpers.



= 00 : Illegal, will use EEPROM definition



= 63 : Illegal, will use EEPROM definition



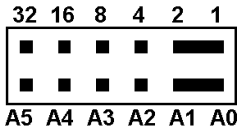
= 25 : Valid address (16 + 8 + 1 = 25)

The jumper positions A0 - A5 contribute their values 1, 2, 4, 8, 16 and 32 when the corresponding jumper is removed.
All jumpers installed would generate the invalid address 0, and all jumpers removed would be equal to the "reserve" address 63. In this case, the module checks its internal parameter 01 for a valid address number. Should none be found, address 63 will be selected.

The selected address, either from the jumpers or the EEPROM, is finally saved in the RAM parameter 01 and used for all subsequent communications until this parameter is changed or a new power-up is performed.

A special feature is added to help recover "lost" modules, i.e. when an unknown bit rate and/or address are selected or the PLC runs a program that erroneously alters parameters affecting the communication. To recover such a module, carry out the following steps:

1. Disconnect power.
2. Remove all address jumpers except for A0 and A1 but **rotate** these two jumpers 90G from their normal position. Please refer to the figure below.



3. Apply power. The module will now communicate at 4800 bits/s using address 63 with the PLC and any options disabled.
4. Check and reconfigure the module for proper operation.
5. Restore a correct jumper address.

Indicator LEDs

Two LEDs in the top left of the module indicate SIOX bus status:

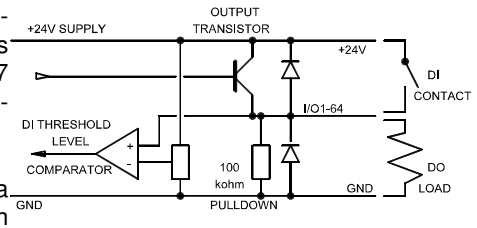
The GREEN LED is lit when a bus voltage is applied and flickers a little as communications are sent on the bus. If this LED is dark, the SIOX central and wiring must be checked.

The RED LED is lit each time the module answers to a call to the preset address as described above. If the green LED is on but not the red, check the supply of the module and then the central communications.

Inputs / Outputs Hardware

Each of the 64 I/O channels includes the following hardware:

An active output transistor pulls the output pin up to the (+24 V) supply. The load is connected between the respective output pin and ground. Each output is guaranteed to source minimum 130 mA. The outputs are short-circuit protected. An output is enabled in parameters 04 - 07 and activated in parameters 08 - 0B, see page 15.



All inputs are connected to a comparator with a common reference voltage level that permits presetting the threshold voltage to

anywhere between 0,25 V and 35 V above ground. Pulling the input pin to above the threshold voltage activates the software bit that represents the input. Each input may, however, be independently inverted in the software by setting a bit in the parameters 0C - 0F.

Power Supply

The power supply voltage range is 18 V to 35 V DC. The power leads must be designed to carry the load current (theoretically up to 10 A). Recommended minimum area is 1 mm^2 (AWG 18).

The module can be supplied with power either through the 2-terminal power plug, terminals 3 (Ground) and 4 (+24 V DC) or through the 10-pin flat cable header to the left of the I/O connector, although the latter is mainly intended as power connection for the loads.

Since S27 is an extremely compact module, the temperature rise in the module must be considered. As stated, each output can source up to 130 mA. At this current, activating 64 outputs generate 5 W of internal heating which is close to the maximum permissible at 55 GC ambient temperature. Fewer output channels or proportionally lower current per channel will increase the margin.

I/O Connection Options

The 10-pin and the 64-pin I/O connectors are intended for either flat cables or an add-on board, S27-1, equipped with screw terminals.

Note that a typical flat cable lead can carry max 0,5 A, so the eight parallel Ground pins in the 10-pole header should carry max 4 A return current from outputs. A direct connection from the loads to the power supply is recommended.

8/16 Lead Flat cables

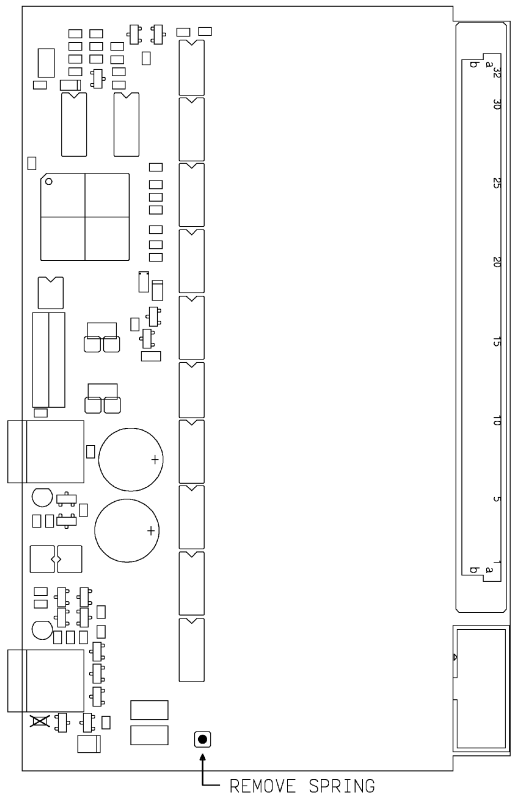
The I/O pins may be split into groups of 8 or 16 pins by dividing the flat cable in 8 or 4 parts. By using the 8th or 16th lead in each group as an active high output, it may serve as the common +24V connection for the other 7/15 input pins.

S27-1 Panel Card

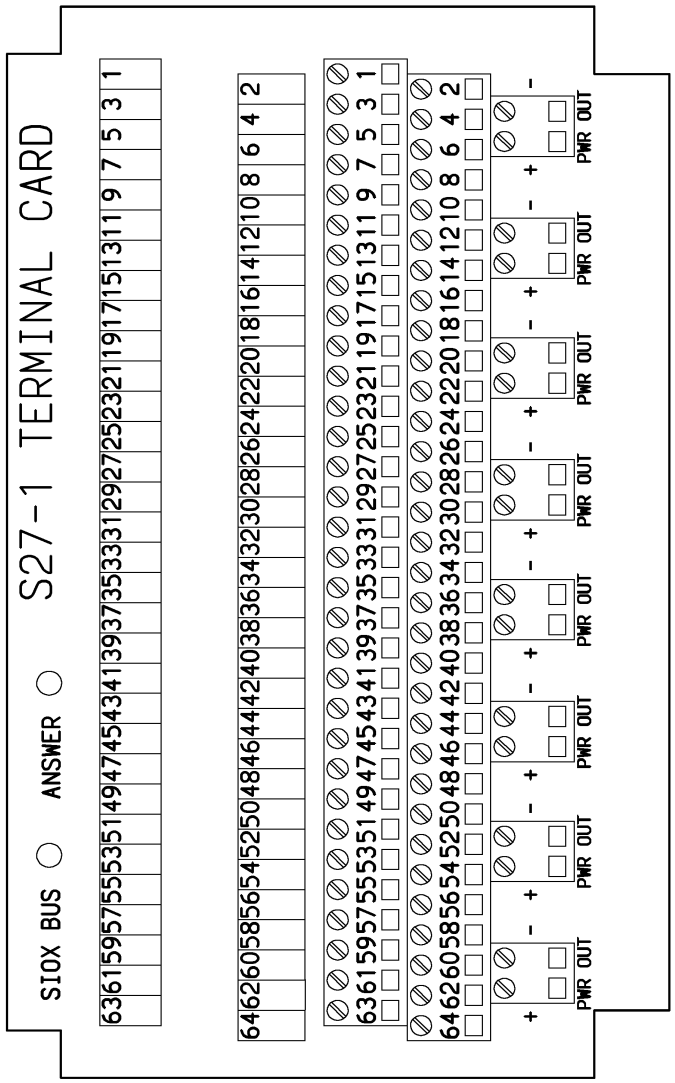
This optional board replaces the aluminium panel and provides screw terminals and indicator LEDs for each of the 64 channels as well as 8 terminals for +24 V and Ground, forming an extremely compact unit. Note that +24 V at above 2 A should be supplied to terminal 4 of the module, not the panel card since only two +24 V pins connect the panel to the main board's output transistors.

Note! Before installing the S27-1 Terminal Card together with an S27 module, remove the small steel spring mounted on a short pin located on the circuit board just inside the SIOX bus connection. Normally, this spring will provide an electric connection between the panel and the unit's ground plane. However, if used together with the S27-1, it might cause short-circuit to ground for some I/O-signals.

Position of the spring is marked at the drawing below.



S27-1 Terminal Blocks



Master Mode Communications

The S27 may act as a bus master for other SIOX modules. This mode is initiated by setting the module address to 00 both in EEPROM and on the address jumpers. Alternatively, the internal PLC program can set the Master flag in parameter 01. From a specified list in parameters 40 - 7F communications will be run and results stored and handled by the programmable PLC functions. This mode is described in detail in the separate SIOX PLC manual.

Spy Mode Communications

When the S27 acts as a slave on the SIOX bus, it automatically listens to communications between the central and other slave modules as well. Which messages that are to be reported are defined in the same EEPROM parameters as in Master Mode. Since the resulting information can be put to use only by the PLC, Spy Mode is detailed in the SIOX PLC manual.

Slave Communications

The S27 module communicates as a slave using various message types defined in the manual "SIOX System Description". All message types may be used in any order as long as these types are allowed by the setup. For high integrity networks, however, Data Mode should only be permitted together with the Double Comm Mode settable in parameter 01. (See page 14).

1. Data Mode Message. One Address, Single Data.

In receiving this message type, S27 behaves as a basic I/O module with only the 14 lowest input numbers and 7 lowest outputs. The data transmitted to the module controls the outputs (if any are enabled), while the answer contains a mix of the current state of inputs and enabled outputs.

2. Data Mode Message. Two - Eight Addresses, Single Data.

The module responds to the 1 - 7 addresses immediately above the basic jumper/EEPROM address. Addresses thus specified above the 63rd cannot be accessed. Data to the second - eighth addresses each set seven possible outputs in a separate group of 8 I/O's as described above. (Outputs 9-15, 17-23, 25-31, 33-39, 41-47, 49-55, 57-63). The 14-bit answer is identical in two addresses, reporting I/O pins 1-14, 17-30, 33-46, 49-62.

3. Data Mode Message. One - Four Address(es), Double Data.

For this message type the module receives two data bytes in each communication. They can therefore control 14 outputs if such are enabled, the same I/O pins as are included in the answer. The numbers 1-14, 17-30, 33-46, 49-62 can be recognized from the single data answer above.

4. String Setup Mode. One Address.

This message type is used to read or change one configuration parameter in RAM or EEPROM. All internal parameters can be read or written, e.g. 08 - 0B, each writing/reading 16 I/O pins. Refer to particulars for each parameter on page 14.

5. String Text Mode message. One Address.

This message type can be used by the PLC to receive and transmit multiple parameters, special settings, etc. A flag in parameter 00 inhibits this text handler, making it identical to String Setup, matching some older programs.

I/O Soft Functions

The module includes a microprocessor that controls communication and pre processes information. This CPU checks and controls all inputs and outputs regularly according to control parameters in various registers. Results, such as detection of overloaded outputs and inactive to active transitions on inputs, are stored in other parameters accessible by the central computer.

Inversion of Inputs

Each input can be set individually to invert input data. Because of this, the terms inactive and active are used instead of high and low, 1 and 0, etc. In the normal non-inverted mode an active input corresponds to voltages above the threshold voltage and vice versa for inverted mode. Parameters 0C - 0F control input inversion.

Debounce on Inputs

Inputs are checked every millisecond and the results made available in RAM parameters to the internal PLC and the communication. By combining several readings, however, noisy or bouncing inputs can be delayed until the level has stabilized. The debounce time can be set in 4 ms increments in the lower half of parameter 3. Maximum debounce time is 1020 ms (hex FF) and minimum time (00) is below 1 ms. This setting is common to all inputs I1 - I64 but not to overload sense of outputs.

Edge Triggered Inputs

Each input can be set individually to register an inactive to active transition.

This event is stored in the memory and is transmitted to the central computer at the next communication even though the particular input already has become inactive again. If that communication is successful, the event is cleared in the module and a new edge-trig may be signalled. To avoid interaction, the PLC has separate registers for the edge detection, which can be cleared via a flag in the PLC. It is therefore possible to identify an old edge in the central computer, although that same event already is ancient history in the local PLC.

The edge-trig feature is controlled by parameters 18 - 1B. Note that the same registers also report any enabled outputs that are currently active but short-circuited. Which is which is determined by the output enable parameters Ø4 - Ø7.

Please note: If this feature is used with the automatically communicating SIOX protocol the AUTO OFF feature is recommended. Thereby communication with the S27 register stops until data has been fetched by the application. When edges have been fetched, the ready flag is cleared again and new communications start.

Two subsequent communications with the same register in S27 are regarded by the S27 as a retransmission after an error. Therefore the edges stored in the S27 are not cleared until S27 identifies a different type of communication, with another register or another address.

Overload Detection

These four parameters 18 - 1B show which activated outputs that are currently overloaded. The same parameters are used to enable edge-triggered inputs, but the overload bits are always read-only and not affected by writing into the parameters.

Input - Output Registers

The four parameters Ø8 - ØB control the outputs. In the RAM parameters only those bits that are currently allowed as outputs (see parameters Ø4 - Ø7) may be set, the others being read-only input data. Combining input and output bits in this way permits easy read/write access through a single communication. Should you want to separate inputs and outputs, this can be done by setting full 16 bit parameters as input or outputs.

PLC Controlled Outputs

Any output can be controlled either by the internal PLC program execution or by a communication from the central computer. To avoid confusion the PLC is given precedence and four parameters, 1C - 1F, indicate which outputs are reserved for the PLC. Communication checks these registers before changing an output. These lockout parameters can of course be modified from the

central and are by default cleared to ØØØØ. When a PLC program is designed, the proper bits in these registers should be set in EEPROM.

Note that the last eight bits in parameter 1F are set automatically when the PLC runs an instruction that modifies Q8 - Q1, the least significant output bits.

Communication Watchdog

This feature consists of a timer located in the high half of parameter Ø3. The timer can be preset in 0,25 s increments and is restarted each time a successful communication with the module is carried out.
Should communication cease for longer than the preset time (max 65 s), outputs controlled by the communication will be deactivated until the next successful communication. When the timer is cleared, the watchdog has no effect on the outputs. PLC controlled bits are not affected by this watchdog.

Communication Options

These bits control communication modes. They are located in parameters ØØ and Ø1 in the module.

Restart of the module is accomplished by writing hex FFFF to parameter ØØ. For example, to change the bit rate of a remote S27, first write the corresponding code into EEPROM parameter ØØ, then write hex FFFF to the same parameter (in EEPROM or RAM). The module will now restart and commence communication on the new bit rate.

Disable Data Mode Output disables the possibility to control outputs in Data Mode. This mode relies only on parity checking to eliminate inadvertent changes on outputs as a result of communication errors.

Double Communication is an alternate method to increase output data integrity in Data Mode. If this option is active, the data controlling the outputs must be the same for two consecutive communications to change the outputs.

RTC, Real Time Clock

Parameter 17 contains a 16-bit seconds counter and the second half of parameter 16 a prescaler with 10 ms resolution, counting from xxØØ to xx63. This may be used by the PLC, e.g. as a long period timer or as an alarm time marker. In order to fine tune the counting speed which depends on the CPU clock, the first half of the parameter 16 may be preset, preferably in EEPROM. A value between EØxx and 1Fxx decreases/increases the speed up to J0,5% compared with the default ØØxx. Note that the xtal still varies a little with temperature etc. The exact time should be preset from a central from time to time to maintain accuracy.

Parameter Description

The S27 contains two types of memory: RAM for temporary storage for as long as the module is connected to a power supply, and EEPROM for long-term storage of working modes, parameters and initialization values after a power disconnect. At power-up, the EEPROM variables are automatically copied to the RAM, and the information is used to control the module. All EEPROM setup values may be copied again if data = FFFF is written to the first parameter (number 00). This initiates a full soft reset, using previous EEPROM value for this parameter.

By using String Mode commands, any variable may be read or modified at any time, either temporarily in RAM or permanently in EEPROM. In the latter case, the corresponding RAM cell is modified as well. Information in controlling parameters immediately affect the function of the module.

As a general rule, features are typically active when a parameter is set to a non-zero value. When in doubt about a function, the parameter can therefore safely be set to 0000.

Parameter Description Summary

Parameter Address	Factory Default	Function
00	0701	Control bits and bit rate
01	0100	Address and control bits
02	0000	Customer options
03	0000	Time-out and debounce time
04-07	0000	Output Enable bits
08-0B	0000	Output Control / Input Status bits
0C-0F	0000	Input Inversion Enable bits
10	0000	Output Current Limit/Inputs' Threshold Level
11	0000	PLC program counter
12	0000	PLC time-base and run flags
13	0000	PLC status flags
14	0000	PLC 16 bit V accumulator
15	0000	PLC 16 bit T timer
16	0000	RealTimeClock adjustment and 10 ms count
17	0000	RealTimeClock seconds counter
18-1B	0000	Inputs' Edge-trig Enable / Short-c Outputs
1C-1F	0000	PLC Controlled Outputs mask
20-3F	0000	Free for PLC data (byte addresses 40 - 7F).
40-7F	0000	Spy/Master Mode communication configuration or for PLC use (byte addresses 80 - FF).
80-3FF	0000	PLC program/Logging area (byte addresses 100 - 7FF), refer to PLC manual.

Detailed Parameter Description

Address	Data	Function
00	8xxx	Enable write to all parameters.
	4xxx	Inhibit String Text Mode, where the PLC can submit text answers, making it equal to String Setup Mode.
	2xxx	Inhibit Data Mode to prevent output changes due to communication noise.
	1xxx	Enable Double Data Mode, 2 data characters expected in Data Mode, permitting 1025 different analogue output levels instead of just 128 in single Data Mode.
	xNxx	Bit rate, must be set in EEPROM and followed by a reset to have effect. N = 3 = 300 bits/s N = 4 = 600 bits/s N = 5 = 1200 bits/s N = 6 = 2400 bits/s N = 7 = 4800 bits/s N = 8 = 9600 bits/s N = 9 = 19200 bits/s
	xxxN	Number of permitted addresses in DataMode. In this module N may be 1 to 8 in Single Byte DataMode and 1 to 4 in Double Byte DataMode.
	xx01-xx08	Number of Addresses accepted in Data Mode.
	FFFF	The module is restarted by writing hex FFFF.
Address	Data	Function
01	NNxx	01 - 3F = first address of module. The seven highest addresses limit the maximum number of Data Mode addresses.
	8xxx	Master Flag. Set by the PLC program when the S27 is to start communications on its own.
	xx8x	Spy Inhibit Flag. Spy area will be free for general use.

	xxx2	Double Communications. When set, two identical communications are required to control outputs in Data Mode.
02	XXXX	Options for customer specific functions.
03	TTxx	Time-out before clearing outputs if communication stops: TT = 00 = no time-out. TT = 01 to FF = time-out (250ms - 65s) in 250 ms steps.
	xxDD	Inputs debounce time: DD = 00 = no debounce, i.e. 1 ms. DD = 01 to FF = debounce in 4 ms steps.
04	XXXX	Enable Output bits for I/O pins 64-49. When a bit is 0, the output transistor cannot be turned ON and the input status is shown in the corresponding bit in parameter 08. When a bit is 1, setting the corresponding bit in parameter 08 activates the output transistor and shows any short-circuit condition in parameter 18.
05	XXXX	Enable Output bits for I/O pins 48-33.
06	XXXX	Enable Output bits for I/O pins 32-17.
07	XXXX	Enable Output bits for I/O pins 16-1.
08	XXXX	Output Activation / Input Status for I/O 64-49.
09	XXXX	Output Activation / Input Status for I/O 48-33.
0A	XXXX	Output Activation / Input Status for I/O 32-17.

Address	Data	Function
0B	XXXX	Output Activation / Input Status for I/O 16-1.
0C	I I I I	Input Inversion Enable bits for Inputs 64-49: 0 = no input data inversion. 1 = invert input data.
0D	I I I I	Input Inversion Enable bits for Inputs 48-33.
0E	I I I I	Input Inversion Enable bits for Inputs 32-17.

0F	I I I I	Input Inversion Enable bits for Inputs 16-1.
10	xLxx	Digital Outputs Current Limit (factory set).
	xxTH	Threshold Level for all inputs: 00 = half supply voltage (default). 01-7F = $^{1}/_{128}$ - $^{127}/_{128}$ of supply voltage. 80 = TTL level (1,4 V). 81-FF = 0,25 - 32 V fixed voltage. **Note:** this parameter is write-protected thru the 8xxx bit in parameter 0. The Digital Outputs Current Limit value must be preserved, otherwise the outputs drive capability can be lost.
11	xxPC	00 - FF = PLC program counter.
12	TTxx	00 - FF = PLC timer tick size 00 = 1/16 s (default) 01 - FF = TT/1024 s 40 gives the same time as 00
	xx2x	Single Stepping of an instruction has been performed.
	xx1x	Single Step a PLC instruction. 0 = continuous run. 1 = perform single step, cleared automatically.
	xxx1-xxx8	PLC Task 1-8 running. 0 = PLC stopped.
	x1xx	Valid communication with module occurred.
	xx2x	PLC overflow flag L.
	xx1x	PLC carry flag C.
	xxx1	PLC bit accumulator A.

Address	Data	Function
13	x8xx	When set, it clears the PLC edge inputs register without affecting the edges communicated to the central. The flag is cleared automatically.
	x4xx	Outputs Watchdog flag. 0 = watchdog not triggered. 1 = watchdog triggered.
14	VVVV	8000 - 7FFF = -32768 - +32767 16 bit PLC integer accumulator V.
15	TTTT	0000 - FFFF = PLC timer T. Tick rate is defined in parameter 12.
16	AATT	RealTimeClock adjustment and 10ms count. E0xx-00xx-1Fxx = decrease/maintain/increase speed. xx00-xx63 = 10 ms count.
17	XXXX	RTC seconds counter, 16 bits, max 65535 s.
18	XXXX	Input Edge-Trig Enable / Short-circuited Outputs when the corresponding bit in parameter 04 is set; I/O pins 64-49.
19	XXXX	Input Edge-Trig Enable / Short-circuited Outputs; I/O pins 48-33.
1A	XXXX	Input Edge-Trig Enable / Short-circuited Outputs; I/O pins 32-17.
1B	XXXX	Input Edge-Trig Enable / Short-circuited Outputs; I/O pins 16-1.
1C	XXXX	PLC Controlled Outputs when the corresponding bit in parameter 04 is set; DO pins 64-49.
1D	XXXX	PLC Controlled Outputs; DO pins 48-33.
1E	XXXX	PLC Controlled Outputs; DO pins 32-17.
1F	XXXX	PLC Controlled Outputs; DO pins 16-1

Address	Data	Function
20 - 3F	XXXX	Free for PLC use (byte addresses 40 - 7F).
40 - 7F	XXXX	Spy/Master Mode communications (byte addresses 80 - FF). The area will be free for general PLC use if the Spy Inhibit flag in parameter 1 is set.
80 - FF		PLC program area (byte addresses 100 - 1FF) .
100 - 3FF		EEPROM parameter accesses: PLC program overlays/Logging area (byte addresses 200 - 7FF). Corresponding RAM parameters reserved by system.

For further information about the PLC, Spy and Master Modes, please refer to the "SIOX PROGRAMMABLE CONTROLLER" manual.

Electrical Specifications (T_{amb} = 20 GC)

	Min	Typ	Max	Unit
Power Supply Voltage	18	24	35	V DC
Power Supply Current (Outputs off, inputs inactive)	15	20	25	mA
Power Supply Current (Outputs on, no load)	60	80	100	mA
Input Voltage Range	-0,5	24	35	V
Input Impedance		38		kE
Output Saturation Voltage (100 mA)			0,25	V
Output Load Current			130	mA
Output Short Circuit Current		170	200	mA
SIOX Bus Current (no Communication)		0,9	1	mA

Environmental Specifications

Operating Temperature Range	0	+55	GC
Storage Temperature Range	-20	+70	GC

Mechanical Specifications

Dimensions (excluding 35 mm DIN clip)	140 x 81 x 25	mm
Weight S27	180	g
Weight S27-1	110	g

Further information

can be obtained from

Telefrang AB
Telephone +46 (0)31 40 30 60
Email info@telefrang.se