



TELEFRANG A18B



SIOX Bus Expander

R30

General Description

R30 has two SIOX bus interfaces, one with a 100 mA current generator. It permits copying selected data from either bus to the other with minimum delay, to stretch a bus beyond standard length, isolating bus sections and increasing available bus current. Up to 10 R30 may thus be connected in series.

The module also appears as a normal SIOX station, so that working modes etc can be controlled.

R30 is installed in a junction box, S00, for easy installation, even outdoors.



Block Diagram

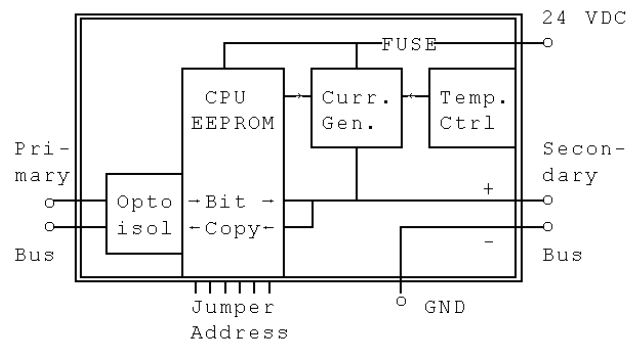


TABLE OF CONTENTS

- Installation and Startup 3
- Address Setup 4
- Power Supply 5
- Secondary Bus Current Control 5
- SIOX Message Transfer for R30 5
- Working Modes 7
- Parameter Setup 9
- Parameter Specifics / Working Modes 11
- Indicator LEDs 14
- Assistance 14
- Electrical Specifications 15
- Environmental Specifications 15
- Mechanical Specifications 15



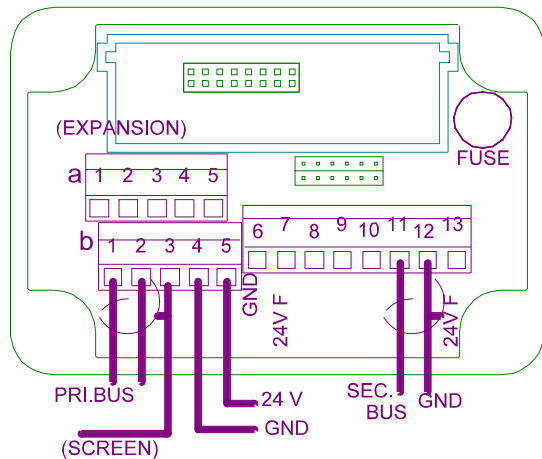
Installation and Startup

The R30 is installed in an R00 or S00 junction box, which can be prewired and permanently installed by an electrician. At commissioning, the test engineer sets the address jumpers in the box and plugs in the R30 module. The junction box is splash-proof (IP65) and may be used without any external casing in heavily distributed installations.

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 $2 * 50 \Omega$.

To power the module, two wires are connected to a local or centralized 24 V supply. The S00-1 box allows a 24 VAC supply with full-wave rectification even though the GND connection is maintained from terminal 4 to 6/12. Terminals 7 and 13 will still output 24VDC. S00-1 has no expansion terminals 1-5.

When a local supply is used, the optoisolated primary bus connection of R30 permits galvanic separation between that and the secondary bus.



The 2 or 3 wires for the primary bus and the two supply wires are installed in either of two parallel 5-pole terminal strips, a or b, in the junction box. The other strip is free for extension wiring to further distributed unit(s). The secondary bus is connected to the 8-pole terminal strip in the box. Two terminals, 6 and 12, are parallel with the supply GND terminals 4a/b of the 5-

pole strips. Two other terminals, 7 and 13, together with the R30 electronics are internally connected to the 24 V supply terminals through a fuse, thus serving



as a separately fused supply for the secondary bus.

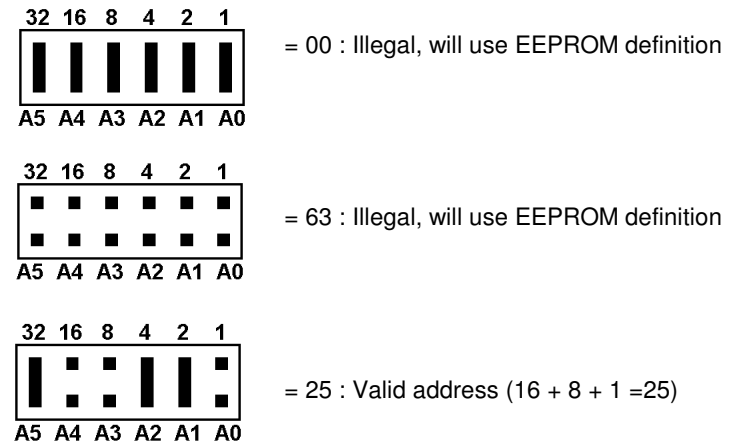
Terminals 11 and 12 are used to connect the secondary bus, 11 being the positive, "hot" terminal while 12 is connected to the GND terminals 4a, (4b,) 6. If a screened cable is used for the secondary bus, the screen should typically be connected to GND only in the R30.

The remaining terminals 6-10 and 13 are not used by R30.

When a proper supply and the SIOX bus is connected to the junction box, the communication can be tested. Unless otherwise requested, the module is preset at the factory to communicate at 4800 bits/s and the address set by the jumpers or else address 63. General principles for the SIOX bus and communications are discussed in a separate manual, the "SIOX System Description". Changes in operation modes are brought about by Parameter Setup Strings communicated over the SIOX bus, described on page 6.

Address Setup

There are two possible ways of defining one of the 63 addresses for an R30 module: either through jumpers in the junction box 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 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 $\phi 1$ 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 $\phi 1$ and used for all subsequent communications until this parameter is changed or a new power-up is performed.

Power Supply

The R30 is supplied from 24 - 35 V DC at 120 mA. If no current is to be generated to the secondary bus, the supply can vary from 12 V -35 V or, in some cases, be derived directly from the secondary bus. S00-1 allows an 18 -24V AC supply as well.

Secondary Bus Current Control

The R30 (R00 terminals 11 & GND) normally supplies 100 mA of current to the secondary bus to communicate with other, standard SIOX modules on this bus. General principles for the physical communication are described in a separate manual, "SIOX System Description".

Current may be varied under software control to supply 100 / 75 / 50 / 25 mA or no current at all. Lower currents are useful when, for example, the voltage drop over the bus wire resistance will become too high for 100 mA of short-circuit current. Note, that low currents decrease the maximum communication speed on a long bus with high distributed capacitance.

For difficult cases when the combination high speed and long bus with thin wires and high capacitance is required, current can be increased by installing one 50 mA R30 at each end of the bus, one with the primary bus left unconnected. This halves the short-circuit voltage drop. In most cases, however, it is better to split the long bus into two and connect them through a full-current R30.

Zero current from the generator may be specified when the two buses to be bridged both include their own current generators. Be careful to observe polarity when connecting the secondary bus to another generator! In contrast, polarity of the primary, optoisolated bus is arbitrary, just as with most other SIOX modules.

SIOX Message Transfer for R30

Data exchange between the central and the module can be achieved using either String or Data Mode messages on the primary bus.



A Data Mode Communication is a minimum two-way communication between the central and a module. Data Mode may be turned off in R30 by setting a flag in RAM/EEPROM parameter $\phi\phi$ (see page 7), preventing the module from any reaction and even letting another module use this Data Mode address.

In R30 the Data Mode answer contains status information about the buses.

Example communication when R30's address is 09:

From central (hex notation): **C 9 0 0**
Address 9

Answer from R30: **0 0 6 0**
Bus copy active, both buses OK

String Mode Communications use the same address as Data Mode but permit access to other functions than just setting/reading the status. The string from the central must therefore contain a parameter number, in this case two characters $0 0 - 0 9$. A typical communication for reading the error counter of the secondary bus will be:

From central: **C 0 0 9 3 0 3 9 B E 4 F**
Address 9 0 9 Sign-off/Checksum
Param. $\phi 9$ read

Answer from R30: **3 0 3 1 4 6 4 6 B E 5 4**
0 1 F F Sign-off/Checksum
Count = 01FF (hex)

To temporarily set 50 mA of secondary bus current, a write data = xxx2 to RAM parameter $\phi 1$ must be done. Note that this parameter also contains the module address:

From central: **C 0 0 9 3 8 3 1 3 0 3 9 3 0 3 2 B F 0 3**
Address 9 8 1 0 9 0 2 Sign-off/Chsm
RAM Write Value hex 0902 =addr 09, 2*25 mA

Answer from R30: **3 0 3 9 3 0 3 2 B F 7 5**
0 9 0 2 Sign-off/Checksum
Value 0902 (hex)



Working Modes

Direct Bus-to-Bus Copy

At delivery the module is set up to work as a repeater, both buses using the primary speed defined in parameter 00. Each character received on either bus is copied, bit by bit, to the other. Hereby the central may send a message of arbitrary length, and, after the last character has been copied, the R30 is immediately ready to start transmission of an answer in the other direction.

This bus-copy may be turned OFF and ON in parameter 07. By selective turning OFF the secondary buses of several R30s, all connected to a common primary bus, and turning ON only one of them at a time, it is possible to communicate with a certain address on that secondary bus, although the same address exists on other buses. Each R30 must have a unique address. At maximum, 30 R30s, each with some 30 SIOX modules connected to the secondary bus, permits a network with 900 modules. All normal communications may be carried out with each of the 900 SIOX slaves, provided that two R30 accesses are included when switching to a new secondary network.

Address Expansion

The mode above uses only standard communications and the same baudrate on all sub-buses, since it uses the bit-by bit copy method. R30, however, can be set to handle String Text Mode for expanded addressing, by setting parameter 04 to xx2x. This mode is, in other types of SIOX modules, used to send and receive application texts, which normally is not required in R30. The other communication modes in the R30, String Setup and Data Mode are not affected.

Each text message, received by an R30 is retransmitted on its secondary bus with the R30 address character removed. The remainder constitutes a String message to a slave module.

Up to 63 R30 (or a mix with normal modules) can be connected to a primary bus. Data Mode messages cannot be transferred this way.

Each secondary bus can handle up to 63 normal modules using up all addresses on that bus. This totals over 3900 modules, with the only limitation that each message from the central must be somewhat non-standard.

The expansion is best shown by an example, where a **read parameter 09** in module address 04 is to be carried out in one secondary bus. This bus is connected to an R30 at address 02 on the primary bus:



From central:

C0	42	04	30	39	BE	12
R30 #02	Slave 04	0	9	Sign-off/Checksum		
				Param. 09 read		

Copy made by R30 to its secondary bus:

C0	04	30	39	BE	54
Slave 04	0	9	Sign-off/Checksum		
			Param. 09 read		

R30 modifies the checksum character to suit the secondary bus and the slave module, who does not know anything about the R30 address on the primary bus.

Answer from Slave:	30	31	46	46	BE	54
	0	1	F	F	Sign-off/Checksum	
			Value = 01FF (hex)			

Answer from R30:	30	31	46	46	BE	54
	0	1	F	F	Sign-off/Checksum	

The answer is copied character by character without any changes.

A **text message** is handled similarly:

C0	42	44	48	45	4C	4C	4F	BE	47
R30 #02	Slave 04	H	E	L	L	O	Sign-off/Chksm		

Copy made by R30 to its secondary bus:

C0	44	48	45	4C	4C	4F	BE	09
-----------	-----------	-----------	-----------	-----------	-----------	-----------	-----------	-----------

Empty answer from Slave:	BE	41
	Sign-off/Checksum	

Unless special software with the extend address capability is available, these "double-level" messages must be set up as text strings to the R30. Sending texts to a module is simple, just begin the text with an extra character A,B,C,...,},~, for secondary bus address 1.....63, respectively.

The buses may work with different speeds. If a secondary bus speed is equal to the primary bus, the answer to the central will be delayed two character times, one in each direction. In most such cases, the protocol timeout factor must be increased to 2 or 3. When the secondary speed is lower, much longer factors must be used

Mailbox Mode



By setting parameter 04 to xx1x, a MAILBOX mode is enabled, where the R30 works independently as a slave on both buses. The external masters on the buses can simultaneously read and write parameters in the R30, especially the unused numbers 0A - 3F.

String texts may be sent to the module from either master. They are stored in independent 250 character buffers and collected by the other master at next String Text communication. As with other text modules, R30 warns if such a buffer is nearly full by modifying its answer sign-off. Next message of the length specified in parameter 04 may then not be accepted.

The module occupies the same address on both buses, but can use another bitrate on the secondary bus, as specified by parameter 05. MAILBOX is activated by setting the mode in EEPROM plus the reset bit in RAM parameter 07 for a full initiation. Any direct bus-to-bus copy is automatically turned OFF.

Parameter Setup

The R30 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 containing 16-bit parameter variables is automatically copied to the RAM, and the information is used to control the module. This data can be handled in two ways:

- 1) Reading or changing the setup parameters using String Mode commands. In this way 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 cells are modified as well. Information in controlling parameters immediately affect functions of the module (except mode and bus speed changes).
- 2) Since also handling results are continually stored in RAM parameters, current status and counters may be read at any time.

Below follows a description of each parameter position. All values are shown in hexadecimal notation.



Pos. hex	Value hex	Function
00	8xxx	<u>Write All</u> parameters permitted, including memory cells that normally mustn't be changed.
	2xxx	<u>No Data Mode</u> permitted (no effect, no answer).
	1xxx	<u>2 Data</u> characters transmitted in Data Mode.
	0xxx	<u>1 Data</u> character transmitted in Data Mode.
	x3xx- x9xx	<u>Transmission Speed</u> 9=19200, 8=9600, 7=4800, 6=2400, 5=1200, 4=600, 3=300 bits/second. Other values are invalid and revert to 4800. Write to EEPROM and reset in parameter 07 to change.
	xx01	Only <u>One Address</u> is accepted.
01	01xx- 3Fxx	<u>Module Address</u> 01 - 3F (1 - 63).
	xx00- xx04	<u>Secondary Bus Current</u> : 00, 25, 50, 75 or 100 mA
02	0000	<u>Options</u> reserved for customer specific functions.
03	XXXX	<u>Reserve</u> , for future software extensions.
04	01xx- 50xx	<u>Text Answer Length</u> for text transfers from either bus.
	xx1x	<u>Mailbox</u> working as a slave station on both buses.
	xx2x	<u>Extended Addressing</u> replacing String Text mode.
05	0009- 0003	<u>Secondary Bus Speed</u> for applications not using the bus-to-bus copy. 9=19200 bits/s, 8=9600, 7=4800, 6=2400, 5=1200, 4=600 and 3=300 bits/s.
06	00xx- FFxx	<u>Temperature Reference Value</u> at 25 °C. 00 or FF disables the thermistor bus current limiter.
	xx00- xxFF	<u>Current Temperature Value</u> continually compared with 1/10 of the Temperature Reference.



Pos. hex	Value hex	Function
07	2xxx	<u>Primary Bus OK</u> status, cleared when this bus is shorted. The cleared state can only be identified in MAILBOX mode on the secondary bus.
	1xxx	<u>Secondary Bus OK</u> status, cleared when this bus is shorted.
	x8xx	<u>Secondary-to-Primary Buffer Full</u> (e.g. in MAILBOX)
	x4xx	<u>Primary-to-Secondary Buffer Full</u> (e.g. in MAILBOX)
	x1xx	<u>Hot Module</u> , set as long as internal temperature is too high, possibly limiting secondary bus current.
	xx10	<u>Reset</u> whole R30, using original EEPROM values. This flag is automatically cleared after reset.
	xx08	<u>Flush Secondary-to-Primary Bus</u> (autoclearing flag)
	xx04	<u>Flush Primary-to-Secondary Bus</u> (autoclearing flag)
	xx00	<u>Bit Copy</u> to / from secondary bus (normal state).
	xx01	<u>Inhibit Bit Copy</u> to / from secondary bus.
08	XXXX	<u>Primary Bus Total Errors</u> counter, incremented each time a parity or format error occurs. It does, however, not increment on continued short-circuits, message composition errors or missing answers.
09	XXXX	<u>Secondary Bus Total Errors</u> counter, see above.

Parameter Specifics / Working Modes

Double Data, Speed and Number of Addresses (00)

The central computer can send messages in Data Mode using either 1 or 2 data characters. In Single Data Mode R30 cannot receive any command, just answer with 14 of the 16 status bits in parameter 7, while a 0080 received in Double Data Mode turns the bus-to-bus bitcopy off. The first hex digit in parameter 00 can be set either to 0xxx or 1xxx for single/double Data Mode receive characters.



The Transmission Speed is normally 4800 bits/s. To change it, send a Setup String command setting the station's first EEPROM parameter to 9xx for 19200 bits/s; 8xx for 9600; 7xx for 4800; 6xx for 2400; 5xx for 1200; 4xx for 600 or 3xx for 300 bits/s. Note, that a module will carry out a power-up reset when the write cycle has been carried out.

The number of communication addresses is defined in the same parameter. R30 can only use one single address, irrespective of the setting, which should not be changed from 01.

Module Address and Secondary Bus Current (01)

This parameter can be set to a value 01xx - 3Fxx, specifying the module address 1 - 63. At power-up the RAM parameter is set to reflect either a valid jumper address (not 00 or 63), a valid EEPROM parameter value (not 00), or the default number 63 = hex 3Fxx.

The last of the four digits in parameter 01 specifies the current generator capacity on the secondary bus, xxxF-xxx4 setting 100 mA, xxx3 75 mA, xxx2 50 mA and xxx1 25 mA.

xxx0 turns the generator OFF, leaving a normal slave bus interface to be supplied by another current generator. In such a case, make sure to connect the correct polarity to R30's secondary bus. One gets careless being accustomed to the arbitrary polarity of ordinary slaves and R30's primary bus connection.

Text String Length and Special Modes (04)

R30 can work as an intelligent gateway between two buses, in which case text strings may be sent out on either bus. The first half of parameter 04 specifies the maximum number of characters in a string up to the maximum 80 (=hex 50) allowed by the protocol. Limiting the length does not affect R30's willingness to receive 80 character strings whenever possible.

The same definition is also used to determine if a receiving buffer is nearly full and probably cannot receive next text message of the specified length. The Ready bit in the answer sign-off is then cleared and the Buffer Full bit in parameter 07 is set. As long as a text buffer is full the module will not answer to any further text strings unless they are empty.

Setting the parameter to xx1x enables the MAILBOX mode, where the module works independently as a slave on both buses. Bitcopy is disabled when MAILBOX is active.



Setting the parameter to xx2x enables the EXTENDED ADDRESS mode, where the module can receive messages from the primary bus in text mode, modify and retransmit them on the secondary bus. Direct bus-to-bus copy is disabled when this mode is active.

Secondary Bus Baudrate (05)

When the two SIOX buses are set to run independently, for other purposes than direct copy between the buses, the secondary bus may need a communication speed different from that of the primary bus. Setting the EEPROM parameter 05 to xxx9 defines the secondary speed to 19200 bits/s, xxx8 to 9600, xxx7 to 4800, xxx6 to 2400, xxx5 to 1200, xxx4 to 600 and xxx3 to 300 bits/s. The module must be reset in order to set the new bit rate.

Module Temperature Supervision (06)

The limited cooling possibilities of a compact IP65 box may create problems at high ambient temperatures. A shorted secondary bus at 35 V 100 mA causes an internal dissipation of 3.5 W. Therefore the R30 includes a thermistor to check the internal temperature and, if necessary, reduce the generator current in one or two 25 mA steps.

First half of parameter 06 can be preset to the measured thermistor value at 25 °C, while the second half of the (RAM) parameter reflects the thermistor value at current temperature. A typical value would read 40C0, indicating a temperature of approximately 50 °C. When temperature has risen to 70 °C the generator current will decrease 25 mA below the definition in parameter 01, and at 85 °C yet another 25 mA.

The current control can be disabled by setting the parameter to 00xx or FFxx. Other limiting temperatures can be selected by changing the reference definition TTxx. The original definition can be restored by reading the last two digits when the module's temperature is 25 °C and storing them in the first two digits.

Bus Control and Status (07)

This status parameter is also sent from the module in answer to a Data Mode communication. The normal answer should consequently read hex 3000, indicating that bus copy is active, both buses are working and that no overheating limiting takes place.

Setting the parameter to xx1x restarts the whole R30, just as at a power-up. All RAM parameter are lost and replaced by the values in EEPROM. The xx1x bit clears itself.

When parameter 07 is set at xxx1, either through Data Mode double character



receive = xx + x1 or a String Mode write = xxx1, the automatic BIT-BY-BIT COPY from primary to secondary bus and vice versa is turned OFF. This is done automatically when MAILBOX or EXTENDED ADDRESSING is active, so to reactivate the bitcopy after a mode change, this bit may need to be cleared again (or a reset carried out).

Indicator LEDs

Four LEDs along the top edge of the module offer assistance during installation (from left to right):

Green indicates that the primary bus is OK

Red blinks at each answer from R30 on the primary bus

Red is lit at overtemperature

Green indicates that the secondary bus is OK

Assistance

on safety and technical matters is available from:

TELEFRANG AB
Victor Hasselblads Gata 9
S-421 31 V FRÖLUNDA
SWEDEN

Tel: +46 31 40 30 60
Fax: +46 31 40 20 25
E-mail: info @telefrang.se

**Electrical Specifications (T_{amb} = 20 °C)**

	Min	Typ	Max	Unit
Power Supply Voltage	15	24	35	V DC
S00-1 with AC supply	18	24	27	V AC
Sec. Current Consumption		20		mA
Including Current Generator			130	mA
Primary Bus Current Load		1		mA
Communication/Copy Speed	0.3		19.2	kbit/s
Direct Bus-To-Bus Copy Delay		½ bittime +30		µs

Environmental Specifications

Operating Temperature Range	-20	+45	°C
Storage Temperature Range	-20	+70	°C

Mechanical Specifications

Case Size (R30 + R00 Box)	94 x 65 x 58	mm
Weight (R30)	25	g
Weight (R00)	140	g
Weight (S00)	175	g