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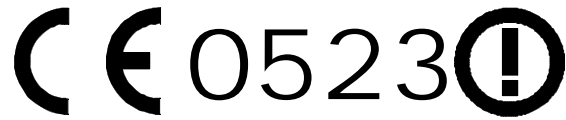
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PRODUCT CONFORMITY

SATEL I-LINK 100 / 200 / 300

Hereby, SATEL Oy declares that SATEL I-LINK 100 / 200 / 300 I/O converters are in compliance with the essential requirements and other relevant provisions of Directive 89/336/EEC. Therefore the equipment is labelled with the following CE-marking.



WARRANTY AND SAFETY INSTRUCTIONS

Read these safety instructions carefully before using the product:

Warranty will be void, if the product is used in any way, which is in contradiction with the instructions given in this manual, or if the housing of the radio modem has been opened or tampered with.

The radio modem is to be used only on frequencies allocated by local authorities and without exceeding the given maximum allowed output power ratings. SATEL is not responsible, if any products manufactured by it are used in unlawful ways.

The devices mentioned in this manual are to be used only according to the instructions described in this manual. Faultless and safe operation of the devices can be guaranteed only if the transport, storage, operation and handling of the devices are appropriate. This also applies to the maintenance of the products.

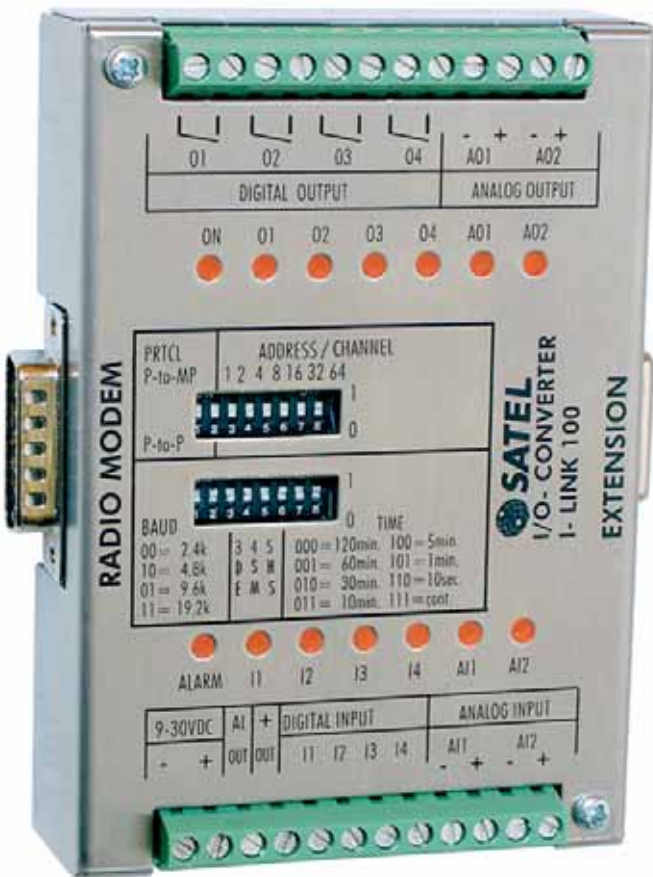
To prevent damage both the radio modem and any terminal devices must always be switched OFF before connecting or disconnecting the serial connection cable. It should be ascertained that different devices used have the same ground potential. Before connecting any power cables the output voltage of the power supply should be checked.

Salo, Finland 2005

1 GENERAL

1.1 SATEL I-LINK 100 I/O- converter

The SATEL I-LINK 100 is a Point-to-Point or Point-to-Multipoint transparent I/O-converter. The device works together with SATELLINE modems. A digital or analogue I-LINK 100 input-point can be set through the modem to be output in the other end. Point-to-Multipoint transmission is possible adopting software suitable for the SATEL I-LINK 100.



Output Connectors

O1...O4 Digital outputs
- + +/- for analogue
 outputs
AO1, AO2 Analogue outputs

Output indicators

ON PowerON/OFF
 indicator
O1-O4, AO1, AO2 Output indicators


Setting switches

PROTOCOL P-to-MP, Point-to-Multipoint
 P-to-P, Point-to-Point
ADDRESS / CHANNEL Multipoint address /
 Channel select *)
BAUD Baud rate settings
3 DE Alarm delay
4 SM Safe mode
5 HS Handshaking
TIME Transmission interval of
 analogue inputs

Input indicators

ALARM Indicator for failed
 transmission
I1...I4, AI1, AI2 Input indicators

Input Connectors

9-30VDC/ - + Supply Voltage
AL OUT  Alarm output
+ Common + for digital
 inputs and extension units
I1...I4 Digital inputs
AI1, AI2 Analogue inputs
- + - /+ for analogue inputs
RADIO MODEM Connector for radio modem
EXTENSION Connector for extension
 units

*) Valid only together with SATELLINE-1870 radio modems.

2 SPECIFICATIONS

FEATURE	min-max	typical	note
Voltage	+9...+30 Vdc	24 Vdc, typical	
Power consumption	0.03...0.1 VA	-	
Serial Interface	RS-232 ± 15 Vdc	± 6 Vdc	active RS232
Extension Interface	-0.3...+6 Vdc	0.5...5 Vdc	active TTL
Response time	< 250 ms	< 300 ms	@ 9600 bps
Operational temperature	-25...+55 °C		
Transfer rates	2400 – 19200 bps		
Stability	± 1 %		@ for whole temp. range
ANALOGUE SIGNALS			
Inputs, 2 pcs	0 – 25 mA	4 – 20 mA	resistive 165 Ω
Outputs, 2 pcs	0 – 25 mA	4 – 20 mA	active
Sample interval	cont- 120min	-	selectable
Resolution		12 bits	
Accuracy		<0.4 %	
DIGITAL SIGNALS			
Inputs, 4 pcs	0 – 35 Vdc	0 – 30 Vdc	resistive 4-5 kΩ
Outputs, 4 pcs	0 – 250 Vac / 2 A	0 – 250 Vac / 2A	relay contacts
INDICATORS			
Indicators	Power ON/OFF, digital/analogue IN/OUT, Alarm		
OTHER OUTPUTS			
Alarm Output	0 – 35 Vdc / 30 mA	24 Vdc / 20 mA	active + 30 mA
GENERAL			
Casing	Stainless steel		
Fail-state	In the fail-state all I/O-points remain unchanged		
Connectors	D-15 for SATELLINE radio modem, D-15 for the extension module		
Size L x W x H	123 x 85 x 30		
Weight	120 g		
Mounting	Wall plate or DIN-rail		
IP	IP-20		
Modem compatibility	SATELLINE-2ASxE, 3AS-serie and SATELLINE-1870		

Connection between I-LINK 100 and SATELLINE radio modem

Direction	Signal	I-LINK100, D-15
←	+VB, DTR	1, 14, 15
←	GND, SGND	7, 8
→	RD	9
←	TD	11
←	RTS	13
→	CTS	6

3 FUNCTIONS

3.1 Operational Voltage, 9 – 30 Vdc

- The supply voltage is connected to the connector 9-30 VDC (-) and (+).
- + OUT connected to VDC through an internal fuse. The supply voltage for the extension units must be taken from this output. Can also be used for analogue input sensors.

3.2 Alarm output, AL OUT

- The AL OUT is activated if three (3) transmission fails occur in turn. When activated the output state goes to +VDC. When the transmitting I-LINK 100 sends information to another I-LINK 100 it requires a confirmation. In case there is a fail in transmission and the I-LINK does not receive the confirmation, the transmission will be resend maximum three (3) times or until a confirmation is received.

3.3 +OUT

- A voltage output for the extension units. Connected to +VDC through an internal fuse.

3.4 Digital Inputs (I1...I4) and Outputs (O1...O4)

- Inputs,
 - 4pcs. Activated with + voltage.
- Outputs,
 - 4pcs. Open relay contacts. Can be connected to any 0 - 250 Vac / 2A load.

3.5 Analogue inputs (A1 -, A1 +, A2-, A2+) and outputs (AO1-, AO1 +, AO2-, AO2+)

- Inputs,
 - 2 pcs. Normal range is 4 - 20 mA. Whole range is 0 – 25 mA showing that the limits have been exceeded. The input load is resistive 165 Ω.
- Outputs,
 - 2 pcs. Normal range is 4 – 20 mA.
- Sample Interval
 - Sample interval sets the time how often analogue information is sent. The sample interval can be selected using the 3 TIME-switches according to the time table i.e. "000" sends an analogue level sample in each 120 minutes intervals, "011" each 10 minutes etc. "111" will cause a continuous transmission. Due to modem's functionality this is about in each (1) second.

3.6 Indicators

- ON
 - Power ON/ OFF. Illuminated when +VCD connected.
- O1...O4, AO1, AO2
 - Showing the status of the output. Illuminated when there is information on the output. Flashing when range has been exceeded. OFF, when low state or nothing on the input.

- **ALARM**
 - Illuminated, if a fail in transmission has occurred. When the transmitting I-LINK 100 sends information to another I-LINK 100 it requires a confirmation. In case there is a fail in transmission and the I-LINK does not receive the confirmation, the transmission will be resend maximum three (3) times or until a confirmation is received.
- **I1...I4, AI1, AI2**
 - Showing the status of the input, illuminated steadily when the input is in the normal 4 – 20 mA range. Flashing when range has been exceeded. OFF, when low state or nothing on the input.

3.7 Switches

- **PRTCL** , Protocol-switch
 - P-to-MP @ Point-to-Multipoint (Master-Slave) -operation.
 - P-to-P @ Point-to-Point –operation
- **ADDRESS / CHANNEL**
 - Used at Point-to-Multipoint- operation to select the individual I-LINK 100
 - Maximum number of addresses is127.
- **ADDRESS / CHANNEL**
 - The channel selector is used together with M2M-package and SATELLINE-1870 radio modems. More information about this in the user guide of M2M-package. NOTE! Check that the address switches are not used (ON) in Point-to-Point mode with other than SATELLINE-1870 radio modems.
- **BAUD kb/s**
 - The baud rate can be selected as follows:00=2.4, 10=4.8, 01=9.6, 11=19.2
- **3 DE** Delayed alarm setting
- **4 SM** Safe Mode setting
 - Immediate / Delayed Alarm
In case of a failure in the transmission, the alarm response can be selected from immediate alarm to 10 minutes delayed
 - Unchanged state / Safe Mode state
In case a failure in transmission, the outputs can be set to remain their status or change to "Safe Mode" which will switch all outputs to OFF-position. Safe Mode timing follows the setting of switch 3 DE, so it can be immediate or delayed.

The functions set by the dip –switches 3 and 4 are as follows:

3 DE 4 SM

- | | |
|---|---|
| 0 | 0 = Immediate Alarm / No Safe Mode |
| 0 | 1 = Immediate Alarm / Immediate Safe Mode |
| 1 | 0 = Alarm delayed by 10 minutes / No Safe Mode |
| 1 | 1 = Alarm delayed by 10 minutes / Safe Mode delayed by 10 minutes |

- **5 HS** For setting CTS-control (clear to send) On or OFF.
1 = CTS OFF, 0 = CTS ON.

- **TIME**

- Defines how often the analogue input message is transmitted. The intervals are as follows:

000=120 min	100=5 min
001=60 min	101=1 min
010=30 min	110=10 sec
011=10 min	111=continuous

4 OPERATION

Operation mode is selected by using the **PRTCL**-switch. The operations are Point-to-Point or Point-to-Multipoint. In Point-to-Point operation the system has one pair of units, whereas the inputs at one end will become outputs on the other end.

In Multipoint mode one master can command one or more (max 127) slaves.

4.1 Point- to-Point

Point-to-point operation is between two units. The inputs of one I-LINK 100 will be transferred to the outputs of other I-LINK 100.

4.1.1 Updating digital messages

Digital information (relay, switch etc.) will be sent to the other unit always, when there is a state change at the input.

4.1.2 Updating analogue messages

Analogue information will be sent to the other unit according to the TIME-setting or as well as digital information state changes.

4.1.3 Beginning with Point-to-Point operation

- Connect SATELLINE radio modem to I-LINK 100 directly to the RADIO MODEM - connector or using the interface cable
- The "PRTCL"- switch must be "0 " in the P-to-P-position.
- Before connecting the device to a power supply, connect first all inputs and outputs that are to be used.
- Select the SATEL I-LINK 100 BAUD-rate. 00=2.4, 10=4.8, 01=9.6, 11=19.2
- Check that the radio modem baud rate is same as for the I-LINK and the other parameters are "9600-N-8-1" (9600 bps is a default setting, but can be changed to be any of the BAUD-rates given above).
- Set the analogue message transmission time interval using TIME -switches as described above, if that feature is needed.
- When both units have these basic settings (TIME can be different) the supply voltage can be connected.
- NOTE! Check that the address switches are not used (ON) in Point-to-Point mode with other than SATELLINE-1870 radio modems.

4.2 Point-to-Multipoint

In this mode one Master can drive one or more slaves (max 127 pcs)

4.2.1 Updates

The updates are controlled by the Master which sends messages to the slaves or asks status information from them. As the master is the controlling unit the TIME settings of the I-LINK 100 is not valid.

There are two options on how to use the Point-to-Multipoint with the I-LINK 100.

1. You can have your own system and program and integrate I-LINK 100 into it; the commands are described below.
2. You can have an easy-to-use SATEL I-LINK PC-software.

4.3 Starting the Multipoint operation

- Connect one SATELLINE radio modem to the PC COM-Port. This one is the Master unit.
- Connect the I-LINK 100 Slave-units to the SATELLINE radio modems directly to I-LINK 100 Radio Modem connector or using a interface cable
- The "PRTCL"- switch must be "1 ", in the P-to-MP-position.
- Before connecting the device to a power supply, connect first all inputs and outputs that are to be used.
- Select the SATEL I-LINK 100 BAUD-rate. 00=2.4, 10=4.8, 01=9.6, 11=19.2
- Check that the radio modem baud rate is same as for I-LINK and that other parameters are "9600-N-8-1" (9600 bps is a default setting, but can be changed to be any of the BAUD-rates given above).
- Set the individual addresses to all slaves. (As this is a Master-Slave operation, the Slaves have to be addressed). All slaves must have different address.

4.4 Multipoint- message

There are four different main commands. The commands are:

Set message=**SET** - get message=**GET** - acknowledge=**ACK** - not acknowledged =**NACK**

All commands are ASCII-coded characters.

Start character= STX (02,HEX), in examples >

End character= ETX (03,HEX), in examples <

The GET and SET messages include also a Checksum field= **CRC** for error checking purposes. CRC must be inserted to messages by the user equipment.

Extension module definitions: FFF = no extensions, 1 = I-LINK 200, 2 = I-LINK 300

Example: 3 extension modules, I-LINK 200 + I-LINK 300 + I-LINK 200 = 121

General message structure

STX	DATA	CRC	ETX
-----	------	-----	-----

CRC-value is calculated from the DATA-message only (incl. addresses, extension definition, length and message)

SET-message

With SET-message the MASTER sets the states for the slave. After a sent message master waits for the acknowledgement. If everything was ok, the slave answers by sending an ACK-message. If the message was got but not understood (i.e. fail in CRC), the slave sends a NACK-message. The slave sends SET messages only by request. The master can send SET-messages any time.

The structure of a SET-message

STX	4C	12	FFF	0A	SET3000000	49A6	ETX
Start character	Receiver address	Sender address	Extension info	Length	MESSAGE	CRC-checksum	End character

The MESSAGE includes all commands to the unit. In the example it is SET3000000. The structure is as follows:

SET	3	000	000
Command	Setting of digital ports outputs	Setting of analogue port1	Setting of analogue port2

Message examples when the extension modules are used.

Example: 1 Extension module

I-LINK 200 (4 digital + 2 analogue I/O)

STX	01	02	1FF	11	SET20000002000000	3904	ETX
Start character	Receiver address	Sender address	Extension definition	Length	MESSAGE	CRC-checksum	End character

Example: 2 Extension modules

I-LINK 200 + I-LINK 300 (4 digital + 2 analogue and 6 digital I/O)

STX	01	02	12F	13	SET22001008000800F3	FBOB	ETX
Start character	Receiver address	Sender address	Extension definition	Length	MESSAGE	CRC-checksum	End character

Example: 3 Extension modules

I-LINK 200 + I-LINK 300 + I-LINK 200

(4 digital + 2 analogue and 6 digital and 4 digital + 2 analogue I/O)

STX	01	02	121	13	SET20000002000000F3 2000000	5318	ETX
Start character	Receiver address	Sender address	Extension definition	Length	MESSAGE	CRC-checksum	End character

Table for setting the digital output ON.

All Ports OFF= 0

Outputs 1-2-3-4																Outputs 5-6		
Port	1	2	2, 1	3	3, 1	3, 2	3,2, 1	4	4, 1	4, 2	4,2,1	4, 3	4,3,1	4,3,2	4,3, 2,1	5	6	5, 6
Value	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	1	2	3

Table for setting the analogue values (increases 0.006059082 mA / step)

Setting	000	001	002	003	004	FFF
Value mA	000	0,006	0,012	0,018	0,024	24,818

GET-message

With GET-message the Master can ask the status from the slave. GET-message is always answered by ACK-message followed by SET-message. If the slave receives the message, but it was not understood (i.e. fail in CRC), the slave answers with a NACK-message.

The structure of a GET-message is as follows:

STX	4C	12	03	GET	F475	ETX
Start character	Receiver address	Sender address	Length	Message	CRC-checksum	End character

Example: Slave address is 4C (76) and Master address is 12 (Decimal 18)

>4C1203GETF475<

ACK-message

The equipment that has received a GET or SET request, will answer with an ACK-message.

The structure of an ACK-message is as follows:

STX	4C	12	'6'	ETX
Start character	Receiver address	Sender address	ACK-character	End character

Example: Receiver address is 0x4C (76) and Sender address is 0x12 (Decimal 18):

>4C126<

NACK-message

The slave sends NACK-message, if it has got a GET or SET request, but has not been able to decode the request (for example error in CRC-check).

The structure of a NACK-message is as follows:

STX	4C	12	'F'	ETX
Start character	Receiver address	Sender address	NACK-character	End character

Receiver field is for receiver's address in two bytes and in hexadecimal number. Sender field is for sender's own address.

Example: The receiver address is 0x4C (76) and the sender address is 0x12 (Decimal 18):

>4C12F<

DIAGNOSTIC-message

The diagnostic-message sets the time interval for the next GET-message. The I-LINK starts counting according to the diagnostic time setting and if the next message comes within the set time nothing happens. If the message does not come within the set time, the I-LINK makes the predefined procedures. Any command from the master station resets the timer. The format is ASCII-HEX as for other commands.

Setting command, CFS

Description (and size):

1	2	2	3	2	3	1	4	7...28	4	1
STX	4C	12	FFF	03	CFS	Safe mode	Time	Settings	CRC	ETX
Start character	Receiver address	Sender address	Extension info	Length	Safe mode	Com-mand	Set time	Port settings	Checksum	End character

[STX (1)] [Receiver (2)] [Extensions] [Length (2)] [CFS (3)] [Safe mode (1)] [Time (4)] [Settings...]
[CRC (4)] [ETX (1)]

[Extensions] Information about the extension units
 [Length] Length of the message
 [CFS] Name of the command, static "CFS".
 [Safe mode] Describes what must be done, if the time count is exceeded.
 "0" = does nothing.
 "1" = Sets the Alarm high.
 "2" = Sets all Output low and Alarm high.
 "3" = Sets all Output high and Alarm high.
 "4" = Sets the Outputs to pre-defined stages and Alarm high.

NOTE!

Setting-command saves always the state of the ports, regardless of the Time and Safe Mode settings.

[Time] Defines the polling time interval from the master station. If value is 0 it will not be counted. The resolution time value is described in minutes.

[Settings...] Includes the I-LINK 100 and extension output settings.

[Extensions] Describes the number and type of the extension units.

[CRC] Normal I-LINK 100 CRC.

Question command, CFG (similar behaviour than GET-command)

Description (and size):

[STX (1)] [Receiver (2)] [Sender (2)] [Length (2)] [CFG (3)] [ETX (1)]

[Length] Length of the message. In this static "03".

[CFG] The name of the command, static "CFG".

The CFG-question is acknowledged with ACK, followed by CFS, which describes the current settings.

NOTE! When the slave gets any message from the master after the alarm, it will automatically set all the output ports to the previous state.

VER-message

This message retrieves the SW-version of the I-LINK 100.

The structure of a VER-message is as follows:

STX	4C	12	FFF	03	VRS	V1.0A	6AE4	ETX
Start character	Receiver address	Sender address	Extensions	Length	Message	SW-version	CRC-checksum	End character

4.5 CRC-checksum function

The checksum to be used is a **16 bit CRC (Cyclic Redundancy Check) checksum**. (CRC-value is calculated from the DATA-message only (incl. addresses, extension definition, length and message).

The CRC used in the message protocol of I-LINK 100 is calculated in a similar way to the widely used CRC-CCITT but using slightly different values of parameters.

The parameters used in the calculation of CRC checksums are:

- *Polynomial* - Defines the polynomial for the calculation. I-LINK 100 uses the polynomial $X^{16} + X^{12} + X^5 + 1$ (i.e. 0x1021 for the algorithm of SATEL I-LINK 100)
- *Initial Value* = the value to be initially loaded in the crc register before the calculation.
- *Reverse Databits* = Reverse the bit order (lsb<->msb) of the data bytes before the calculation.
- *Reverse result before XOR* = is the bit order of the result of the calculation to be reversed or not before the final XOR operation.
- *XOR* = the final step - the value to be XORed with the result of the calculation.

The CRC used in the message format of SATEL I-LINK 100 is calculated using the parameters below:

- Polynomial = 0x1021 (CCITT)
- Initial Value = 0xFFFF
- XOR = FFFF
- Reverse Databits = Yes
- Reverse result before XOR = Yes

To compare, CRC-CCITT is calculated using the following parameters:

- Polynomial = 0x1021 (CCITT)
- Initial Value = 0xFFFF
- XOR = 0
- Reverse Databits = No
- Reverse result before XOR = No

Note: The contents of the Checksum field of the actual message can be derived by converting the 16 bit binary CRC checksum to four hex-ascii characters.

An example: if the checksum is 0001111100000010 (binary), the four ASCII characters of SSSS will be '1', 'F', '0' and '2' consequently.

The source code listing written in C language below can be applied to calculate the binary value of CRC:

```
unsigned short CRC_16 (unsigned char length, unsigned char *data)
{
    unsigned short crc_table[16] =
    {
        0x0000, 0x1081, 0x2102, 0x3183, 0x4204, 0x5285, 0x6306,
        0x7387,
        0x8408, 0x9489, 0xA50A, 0xB58B, 0xC60C, 0xD68D, 0xE70E,
        0xF78F
    };

    unsigned short crc = 0xFFFF;
    unsigned char tmp, index, i;

    for (i = 0; i < length; i++)
    {
        tmp = data[i];
        index = ((crc ^ tmp) & 0x000F);
        crc = ((crc >> 4) & 0xFFFF) ^ crc_table[index];
        tmp >>= 4;
        index = ((crc ^ tmp) & 0x000F);
        crc = ((crc >> 4) & 0xFFFF) ^ crc_table[index];
    }

    return (~crc);
}
```

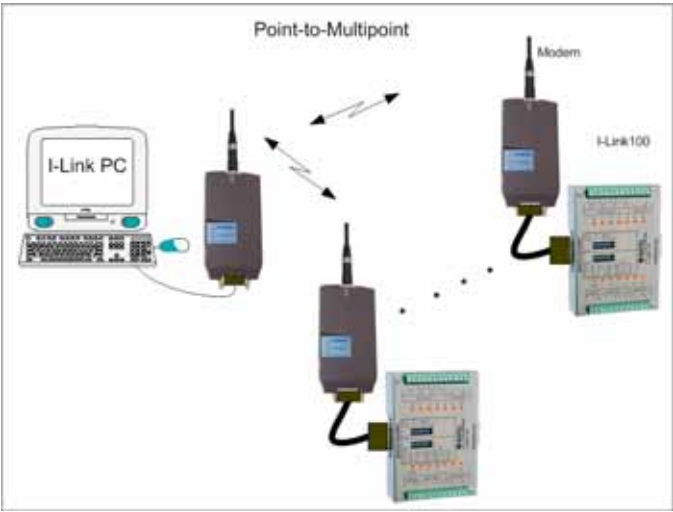

5 FACTORY SETTINGS

The I-LINK 100 I/O-converter is shipped with the following default settings (unless specifically ordered with settings other than those listed below):

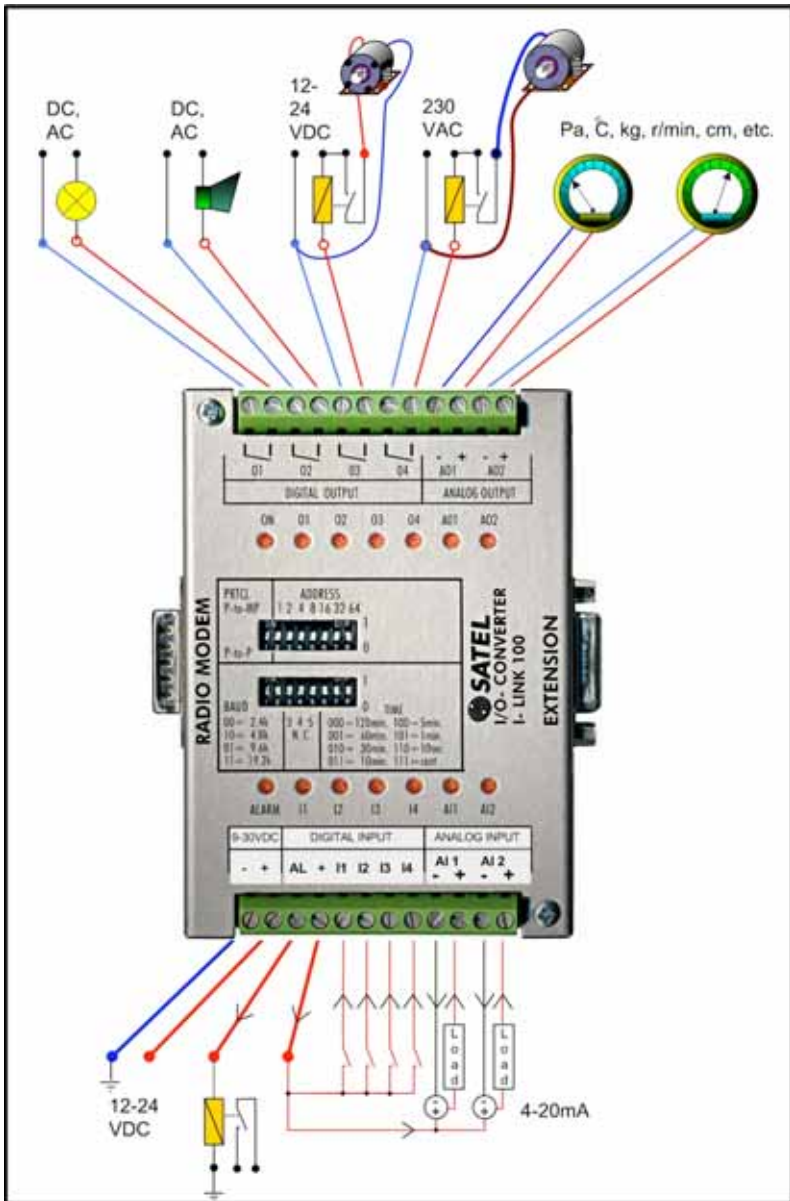
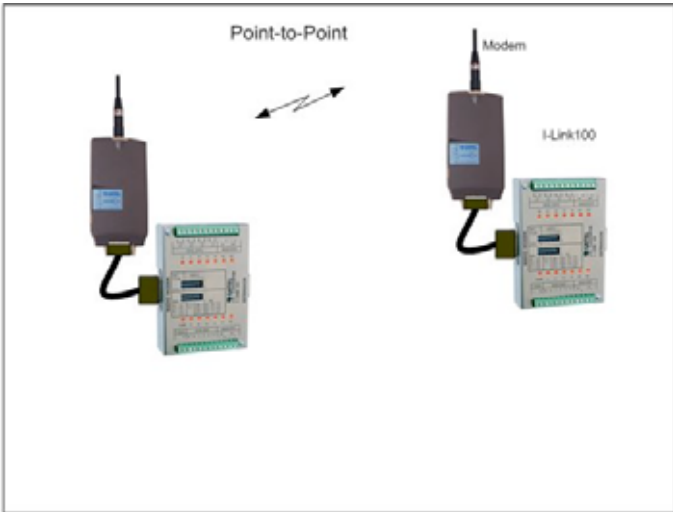
FIXED SETTINGS DEFINED AT THE TIME OF ORDER		
PRTCL, protocol-switch	P-to-P	= Point-to-Point
ADDRESS	0000000	
BAUD	01	= 9600 bps
3 DE, Alarm delay	0	= no delay
4 SF, Safe mode	0	= Safe Mode OFF
5 HS Handshaking	0	= CTS ON
TIME, Analogue transmission interval	000	= 120 minutes

6 CONNECTION EXAMPLES

Point-to-Multipoint with one master and two slaves



Transparent Point-to-Point application



7 ACCESSORIES

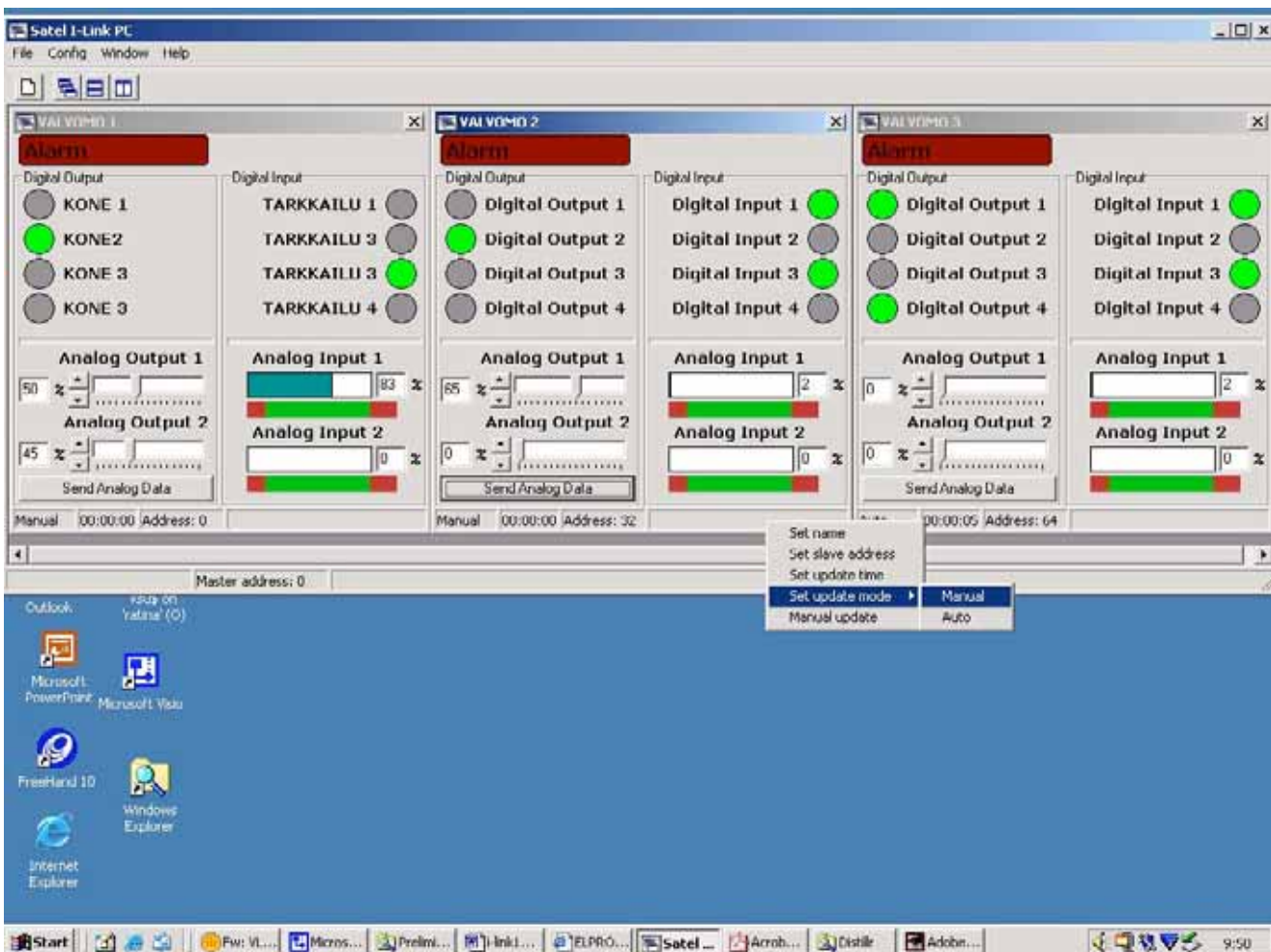
INTERFACE CABLES FOR CONNECTING OF I-LINK 100 AND SATELLINE RADIO MODEMS

Point-to-Point	CRS-TSU	I-LINK 100	SATELLINE-2ASxE , 3AS-serie
Point-to-Point	CRS-18IF	I-LINK 100	SATELLINE-1870
Point-to-Multipoint	CRS-2F	PC	SATELLINE-2ASxE , 3AS-serie
Point-to-Multipoint	CRS-18F	PC	SATELLINE-1870

SATEL I-LINK PC and PC Pro

Complete program that makes it possible to operate a Multipoint system with a Personal Computer. SATEL I-LINK PC is a basic version of the program. SATEL I-LINK PC Pro is more detailed professional version.

Layout of the **SATEL I-LINK PC** Multipoint-program



8 EXTENSION MODULES

General

1... 3 extension modules can be connected to SATEL I-LINK 100. The system functions both on Point-to-Point and Multipoint protocols. At Point-to-Point protocol the respective extension modules operate as pairs according to their address setting. The extension modules must always be connected to I-LINK 100 control unit, they do not operate alone.

I-LINK 200, 4 digital and 2 analogue inputs and outputs

I-LINK 300, 6 digital inputs and outputs

Assembly

The modules are joined together by connecting the EXTENSION and To EXTENSION connectors as in the picture. The extension modules can be joined in any order. The number of extension modules is 1...3 pcs (I-LINK 100 + 1...3 extension modules).

I-LINK 100 Main module

4 digital

2 analogue I/O-ports

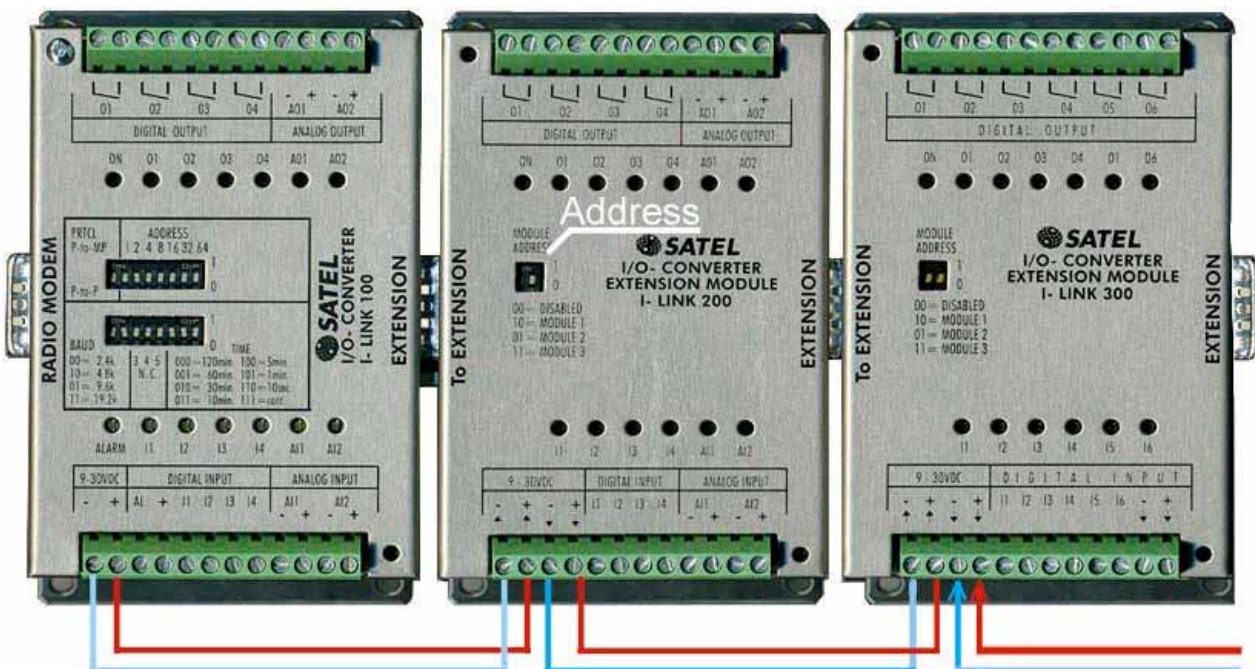
I-LINK 200 Extension

4 digital

2 analogue I/O-ports

I-LINK 300 Extension

6 digital I/O-ports



Connections

The I/O-ports of the extension modules are connected same way as the main unit's I/O-ports. The supply voltage is not linked through the modules, so it must be connected using the green screw contacts. The supply voltage must be connected directly to the I-LINK 100. The I-LINK 100 is equipped with an internal fuse (self recovery type), therefore the extension must get the supply voltage from the pin +OUT. If there are many Extension modules the linking can be done what is the most practical for the wire work (see the picture).

Settings

Extension modules that are working as pairs in Point-to-Point operation must be same type and have same address. The address is set by the "Module Address"- switches. The alternatives are: 00=Module not in operation, 01, 10 and 11. Location is shown in the picture as "Address".