

SL-84 Programmable access controller / event logger

Installation manual

Version: PCB:R10 FW:8403x

Supersedes: 8402x

1. Advance notes

1.1. ID media, reader modules

The following text assumes that the SL-84 controller is used with iButtons as the ID medium and simple, passive, contact boxes for reading iButtons. There are other reader modules that can be connected to the SL-84 instead of the iButton reader boxes. These include readers for different ID media (magnetic cards, RF cards and tags, etc.) and extended functionality modules such as readers with PIN keyboards. This technical description will, however, assume that the simple iButton boxes are used (except where specifics of the various modules are discussed). This is for the sake of clarity and helps keep the manual slightly easier to digest.

1.2. Communication

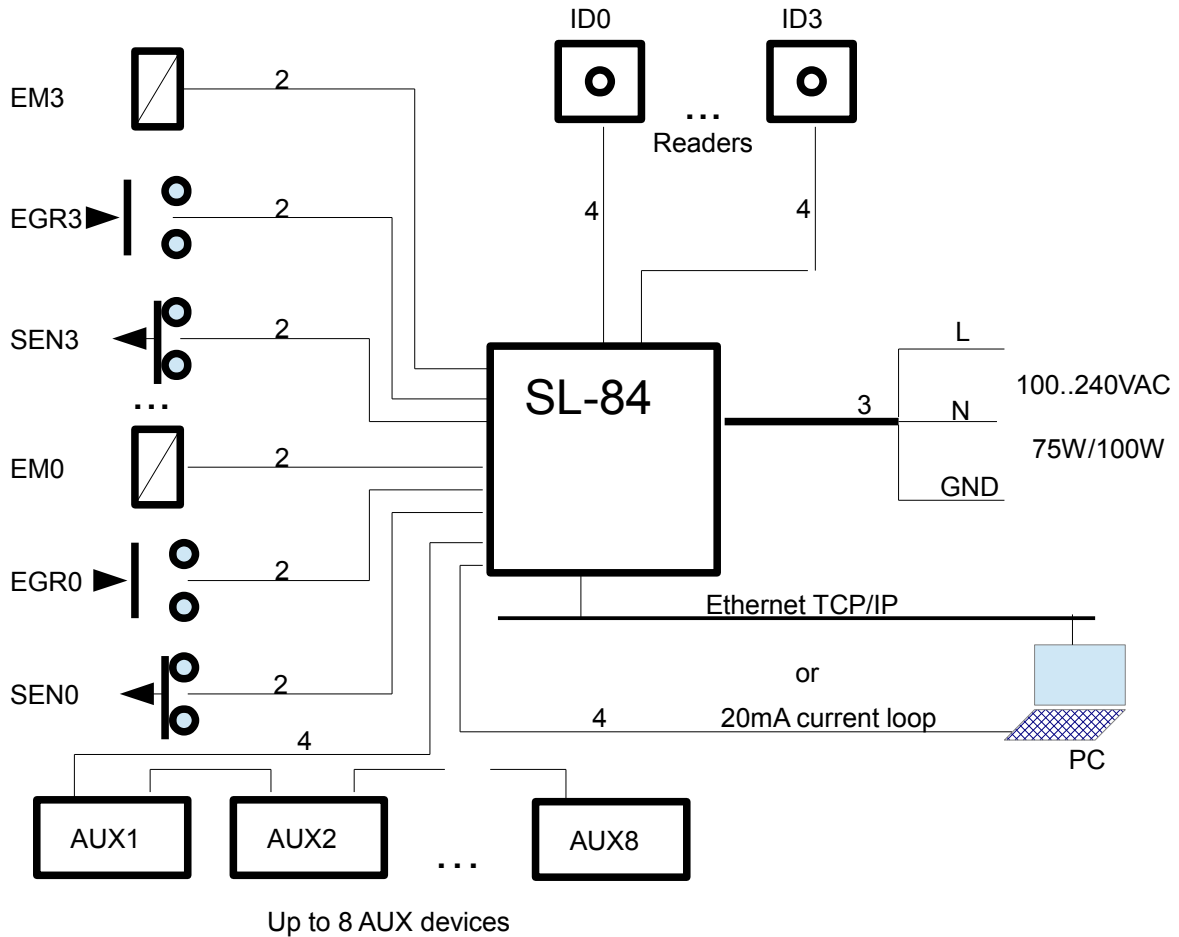
The text assumes the basic method of communication between the controller and the master PC, i.e. the current loop, which connects to the PC's COM port. The SL-84R10 controller has an onboard Tibbo NetModule, enabling direct connection to a network.

1.3. Main features

- 24x2 character LCD for diagnostic purposes
- 4 configurable ID reader inputs (iButton, RF, PIN keyboard, etc.)
- 4 voltage-free sensor inputs
- 4 voltage-free egress inputs
- 4 jumper-configurable relay outputs (12VDC/voltage-free, two polarities)
- configurable relay-on times
- time & attendance function:: event buffer with 8192 events
- access control function: 4096 ID codes in table
- PLC-type configurability (all events can affect all outputs with conditions)
- random event generation on all ID inputs with variable probability
- 8 time events for generating signals (shop-floor jingles etc.)
- Forced entry alarms: door opened without corresponding relay being active
- "Door open too long" alarms with settable time limits
- AUX channel for up to 8 additional modules (readers, terminals etc.)
- Current loop interface (active): 4-wire link with PC (1000m cable)
- RJ-45 Ethernet TCP/IP connector for direct link to LAN
- 7Ah sealed lead battery for up to 24h functioning in case of power-cut
- battery charger (2,5A max)
- battery deep discharge protection
- AC fail alarm output
- most connectors available both as RJ-11 and detachable screw-terminals

2. General system description

Fig 1. System overview



- EM0..EM3** actuators: door strikes, turnstiles (settable to 12V or potential-free relay output)
- EGR0..EGR3** potential-free, normally open inputs, primarily for egress pushbuttons
- SEN0..SEN3** potential-free, normally closed inputs, primarily for door sensors (reed or microswitch)
- AUX1..AUX8** various additional modules attachable in a chain, e.g. readers, terminals, clock displays, etc.
- ID0.. ID3** reader modules for iButtons or RF tags

The SL-84 system is used for controlling the access of people to certain rooms or a building and/or logging their arrival and departure times for the purpose of security or time & attendance reporting.

An event record is the act of logging the event type, the current time and date and the code of the iButton or RF tag (if it's an ID event). This data is transferred to a PC at a convenient time for further processing.

ID events i.e. events that include a person's ID badge code are also called clockings. Other events can also be logged, such as the opening and closing of doors (SEN0..SEN3), the activation of egress buttons (EGR0..EGR3) and even the state of the AC input.

Access control is achieved by an electric door strike, turnstile or any other type of actuator. The most common is an electric door strike that is installed in the door frame. The lock can still be opened the old fashioned way with a key in case of system malfunction or a lengthy power cut. In normal circumstances the door is opened by making a clocking with an iButton or RF tag.

Four readers can be connected to a controller unit (although more can be attached via AUX devices). Readers have a contact cup for iButtons or an antenna for RF tags and two coloured LEDs to indicate a successful read and the activation of the corresponding relay output.

The controller unit is in a metal cabinet (38x40x8 cm). The same cabinet houses an AC/DC converter that supplies power to the controller board and a 12V 7Ah sealed lead-acid battery that provides a certain length of independent operation.

The controller unit is connected to a master PC via a serial link or directly to an Ethernet TCP/IP network.

The serial link is an isolated 20mA current loop and the distance to the PC can be up to 1000m.

2.1. Hardware

Comprises:

- controller PCB SL-84R10
- power supply (AC/DC module)
- metal case with hinged door (houses PCB, supply and battery)
- Readers: contact boxes for iButtons, RF tag readers etc.
- AUX devices in a daisy-chain
- ID badges: DS1990A iButtons, RF tags, RF cards, etc.
- SL-253 RS-232/Current loop converter (in case of connection to a PCs serial port)

2.2. Controller PCB

The diagram in Fig.2 shows the PCB. The following elements are important for installation:

- Reader inputs 1 to 4; These are along the top side of the PCB. Each reader input has a pair of connectors and either can be used: detachable 5mm screw terminal and RJ-11 telephone socket
- I/O connectors 1 to 4; These are along the left side of the PCB. I/O connectors are 6-way detachable 5mm screw terminals. Each comprises:
 - relay output, 1.5A max - resettable fuse protected, individually configurable (see jumper block)
 - sensor inputs (for reed or microswitch door sensors)
 - egress button input
- Jumper blocks for relay output configuration. Each relay output can be individually configured as:
 - 12V/NO 12V output, normally open (default setup, used for most door strikes)
 - 12V/NC 12V output, normally closed (used for fail-safe latches i.e. latches that are locked while powered)
 - NV/NO No Voltage, normally open (30V max) -if an external source is to be used for the actuator
 - NV/NC No Voltage, normally closed (30V max) - if an external source is to be used for the actuator

The jumper block for each relay output is configured by using 2 or 3 jumpers. The settings are illustrated on the top left edge of the PCB and also in this manual.

- AUX connector; on the bottom left side of the PCB; either a detachable 5mm screw terminal or RJ-11 telephone jack can be used. Longer cables (>20m) should be STP (using all 8 wires), so the screw terminal must be used. The AUX connector is used for attaching additional readers, terminals, clock displays etc. in a daisy-chain.

- Current loop; on the bottom left side of the PCB; either a detachable 5mm screw terminal or RJ-11 telephone jack can be used.
- Network; RJ-45 vertical socket at the bottom of the PCB. The controller can be connected to a standard switch (direct cable) or a PC (crossover cable)
- Battery; on the bottom right side of the PCB; 2-way detachable 5mm screw terminal connector for 12V/7Ah sealed lead-acid battery. The battery is protected from deep-discharge (the controller switches itself off when the battery voltage drops under 10V) and should last much longer than unprotected batteries in case of long power-cuts. Even so, batteries should be replaced every two years.
- "No input voltage" alarm output; on the bottom right side of the PCB; 2-way detachable 5mm screw terminal. If the input voltage (14VDC) falls below 12V, this connector will get a current-limited (100mA) 12V level, which can be used for visual and/or audible signalling.
- 14VDC input; on the right side of the PCB at the bottom; this is the power input of the controller. It is connected to the AC/DC converter which should be set to 14V. The input is protected by a 5A self-healing fuse.
- SHLD - Shield connector; 3 two-way detachable 5mm screw terminals (one at the top side of the PCB, between reader inputs 1,2 & 3,4; two at the left side of the PCB, between I/O connectors 1,2 & 3,4 and above the AUX connector). These connectors enable the installer to connect the shields of shielded cables (STP) to the ground plane (metal case) thereby reducing the possibility of EMI problems.
- DIP switch (language, controller ID code)

The controller ID is in the range (00H – 3FH). This code is sent as the last character of each record. The purpose of this is to know the source controller for each record in the case that all data is saved in the same file. If there is more than one controller in the system, the DIP switches should be set so that the addresses differ.

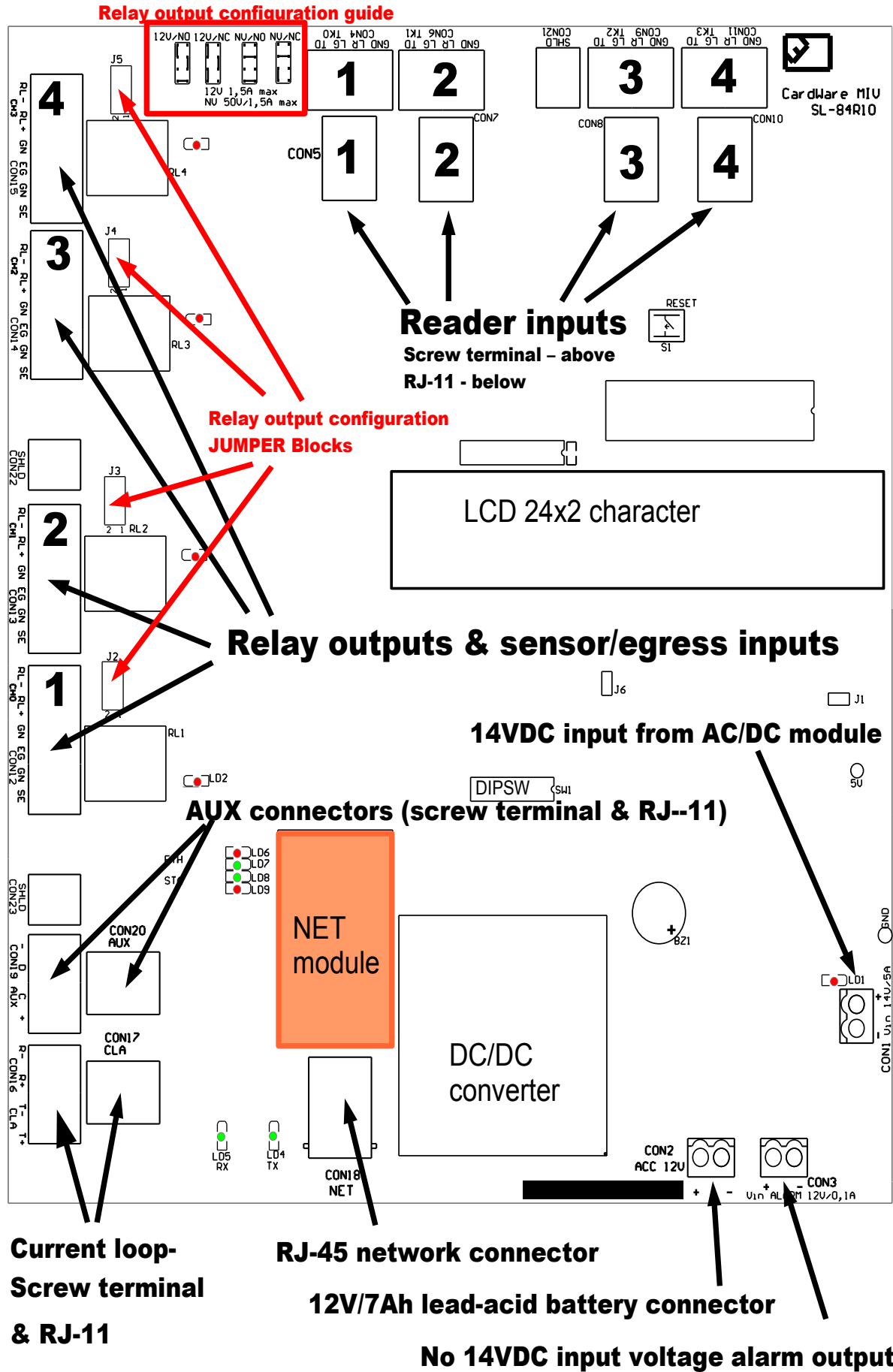
The address is set with switches SW1 to SW6 of the dip switch. SW1 is the lowest and SW6 is the highest bit of the address. If a switch is in the ON position, the respective bit is a '0', if it is in the OFF position it is a '1'.

If there are several controllers in a system, each one must be set to a different ID.

Switches SW7 and SW8 set the language that is used for the service messages on the LCD.

SW7	SW8	language
ON	ON	Hungarian
ON	OFF	English
OFF	ON	Serbian
OFF	OFF	Greek

Fig.2 PCB



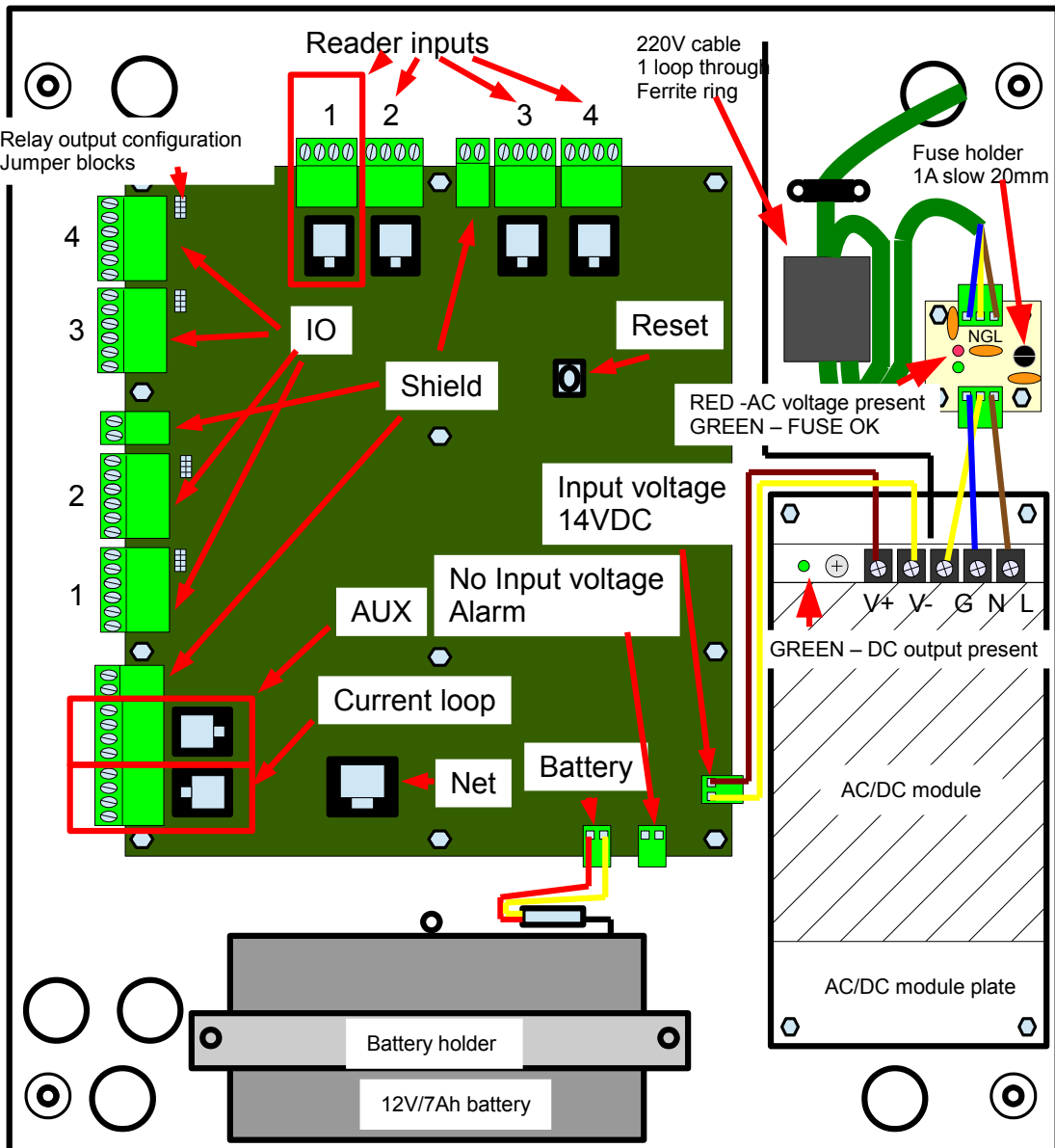


Fig. 3 SL-84R10 in case

2.3. Power Supply

1.) Connection plate with terminal blocks, fuse and varistors

The connection plate is where 220VAC is connected by a detachable terminal block. Care must be taken so that the live wire goes into the block marked (L). This is to ensure that the live wire goes through the fuse on the connection plate. Ground earth must be used and it is the installer's responsibility to check its availability and quality.

There is also a fuse on the LIVE input and varistors across the LIVE-NEUTRAL, LIVE-EARTH lines and NEUTRAL-EARTH.

2.) Ferrite ring around 220V supply cable

This is for suppressing high frequency symmetrical (common-mode) interference. In certain noisy environments it may be necessary to add a few more ferrite rings. One loop should be made through the ferrite ring.

3.) AC/DC converter

This converts 100-240VAC into 14VDC. Depending on versions, the power rating of the converter can be 50W or 75W. The nominal output voltage of the AC/DC converter is 15V, but it is set to 14V by a small variable resistor next to the terminal contacts.

4.) Sealed 12V/7Ah lead-acid battery

The battery provides autonomy in case of a power cut. Calculating the approximate duration of autonomy is only possible if the battery is in good condition and fully charged. We can only estimate the static power consumption and can only guess at variable drain on the battery e.g. high current door strike solenoids that draw power only when active. This depends on the number of door openings and the relay time and whether the door sensor input is used to power off the relay output when the door is closed again.

Approximate values:

12V 7Ah battery = 84Wh

SL-4R10 board with no relays active: cca. 3W

RF reader: cca 3W i.e two RF readers = 6W

AUX devices: add power of all attached AUX devices (the max. drain on the AUX channel is around 15W)

Charging

The battery is trickle-charged with a constant voltage of around 13.7V and a maximum current of 2.5A.

Discharge protection

If the battery voltage falls below 10V, the controller is switched off and the drain of the battery becomes just a few mA. Even so, always disconnect the battery if the controller is disconnected from the AC supply for a longer period.

2.4. iButton reader

This is a plastic or aluminium box with mounting holes for screws on the back plate. It holds the iButton contact cup and two coloured LEDs.

Signalling:

- read OK -green or yellow
- relay activated -red

It should be noted here that the red led always lights up on contact box n (n=1,2,3,4) when relay n is activated. The activation of relay n can happen for various reasons, depending on the configuration of the controller. It can happen, for instance, due to the touching of an iButton to a *different* reader or the closing of an egress input. As mentioned, there are alternative readers, but these will be dealt with in a later section. Also, see the technical descriptions of the respective readers.

2.5. Connectors and cables

Input/Output 6-pin screw terminals (CON12, CON13, CON14, CON15)

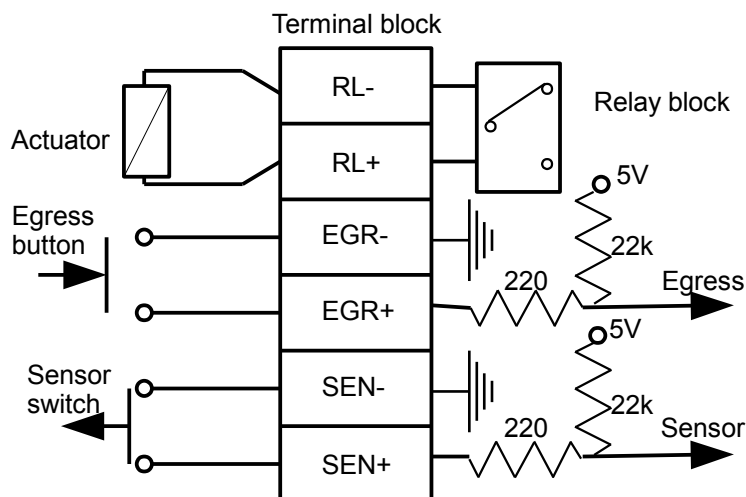
The screw terminals on the top left of the controller board provide access to the I/O functions of the 4 channels.

These are:

1. Sensor input
2. Egress input
3. Actuator (relay) output: 12V/2,5A or voltage-free

Fig.3 is a diagram of one channel (one of the four 6-pin screw terminals):

Fig.4 IO connector



Notes:

- the Egress and Sensor inputs have additional EMC and overvoltage protection that is not shown on this diagram
- The relay output terminals are connected with a 30V varistor, so no voltages higher than 28V should be used

The two relay blocks can each be configured using jumpers:

- **12V/NO** 12V Normally Open
Default: no voltage
12V appear across the RL+,RL- terminals when the relay is active
Use for: 12V door strikes
- **12V/NC** 12V Normally Closed
Default: 12V
No voltage across the RL+,RL- terminals when the relay is active
Use for: fail-safe (fire) door strikes, electromagnetic locks
- **NV/NO** No Voltage Normally Open
Default: relay open
Use for: externally powered (e.g. 24V) actuators
- **NV/NC** No Voltage Normally Closed
Default: relay closed
Use for: externally powered (e.g. 24V) actuators

Fig. 5 Jumper settings for relay blocks

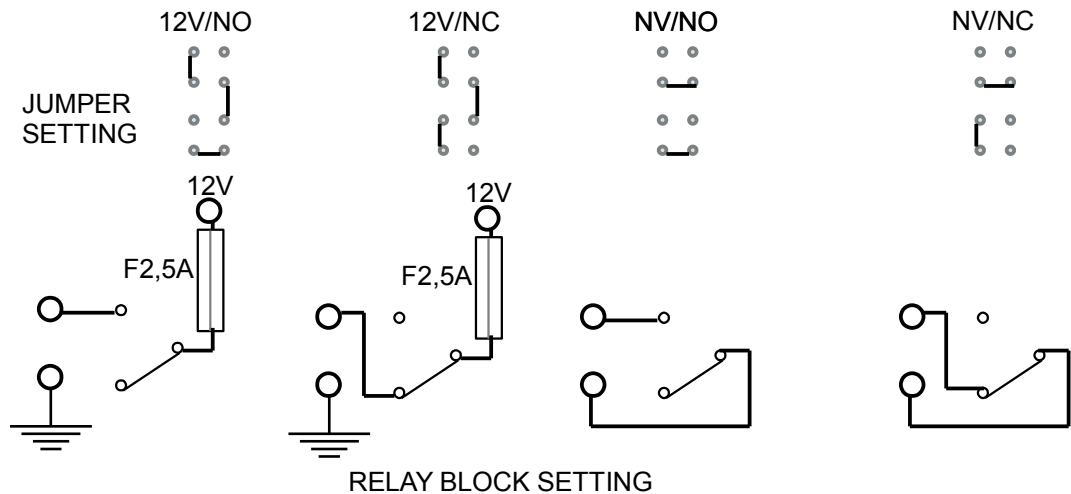


Fig. 5 shows the four possible relay block configurations and their corresponding jumper settings.

NOTE for 12V/NO and 12V/NC settings:

The actuator (door strike etc.) you want to attach to the relay output may have a fly-back diode in which case polarity is important!

Readers (TK0, TK1, TK2, TK3)

The readers have both a telephone (RJ-11) connector and a detachable 4-pin terminal block. These connectors are connected in parallel, so either can be used, depending on the type of cable used. Cable length should not exceed 20m.

RJ-11 connectors (CON5, CON7, CON8, CON10)

Flat 4-wire telephone cables can be used, with 6/4 phone plugs (RJ-11). The cable used for the readers is such that the little plastic levers of the plugs should be on the same side of the cable (either the side with the stripe or the one without) on both ends of the cable.

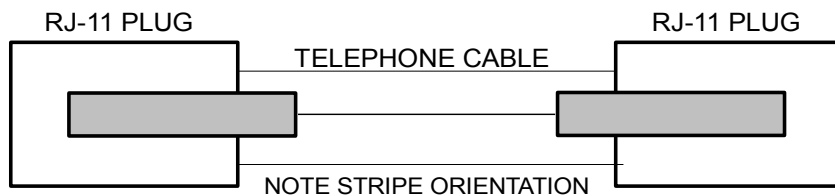


Fig. 6: flat phone cable with RJ-11 plugs

4-pin screw terminals (CON4, CON6, CON9, CON11)

Some reader modules do not have screw terminals, just RJ-11 sockets. In this case an RJ-11/screw terminal adapter must be used. Markings on the reader's screw terminal or the adapter are either the same as on CON4, CON6 or are shown in the table below.

Wires should be connected one-to-one i.e. GND to GND, LR to LR(L1) etc.

CON4,6,9,11	Reader/Adapter
GND	GND
LR	L1
LG	L2
TD	D

AUX Interface (CON19, CON20)

The AUX interface is a 4-wire bidirectional interface for connecting peripheral units to the SL-84 controller. The protocol is very similar to the I²C bus, with the two other wires being GND and V+.

Vertical RJ-11 connector pinout:

1	V+	12V-13,8V, 0,9A max
2	CLK	SCL equivalent
3	DATA	SDA equivalent
4	GND	

The AUX modules can be daisy-chained on the AUX interface, each having an address which is defined by a pre-set base address (for that type of device) and one or more jumpers or DIP switches for setting the sub-addresses.

Each AUX unit has two 4-pin RJ-11 connectors, one for the incoming cable (from the master i.e. terminal), the other towards the following unit in the daisy-chain.

The last (and only the last) unit in the chain must have the two jumpers for pull-up resistors set.

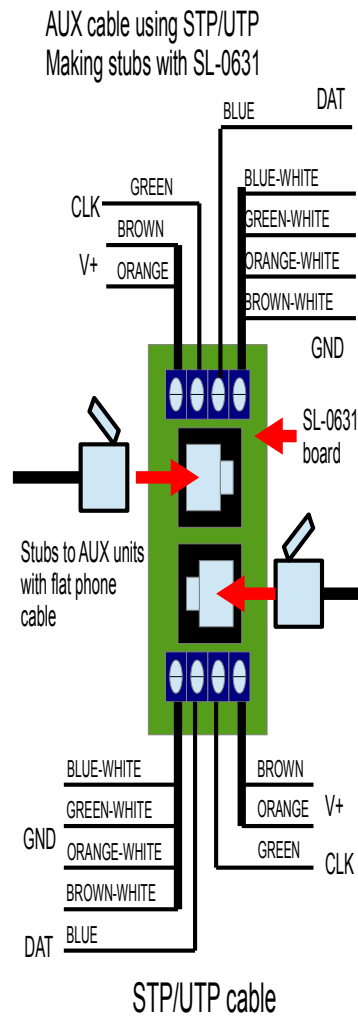
Current firmware on the SL-84 (8403) supports up to 8 different AUX units connected to a master.

Flat phone cable can be used if only one AUX unit is connected and a short cable (< 10m) is used.

If a longer cable and/or a daisy-chain of several AUX units is to be used, UTP (or STP if cables are laid in a noisy environment) should be used. The wires should be used in the following way:

1	V+	Brown, Orange
2	CLK	Green
3	DATA	Blue
4	GND	Brown-White, Orange-White, Green-White, Blue-White

This is how the main STP cable should be wired. This can be up to 60m long. Any AUX devices can be connected to it by short stubs using flat phone cable. The stubs can be made by breaking the main cable with adapter boards (SL-0631) which have two 4-way screw-terminals and two RJ-11 phone sockets all connected in parallel.



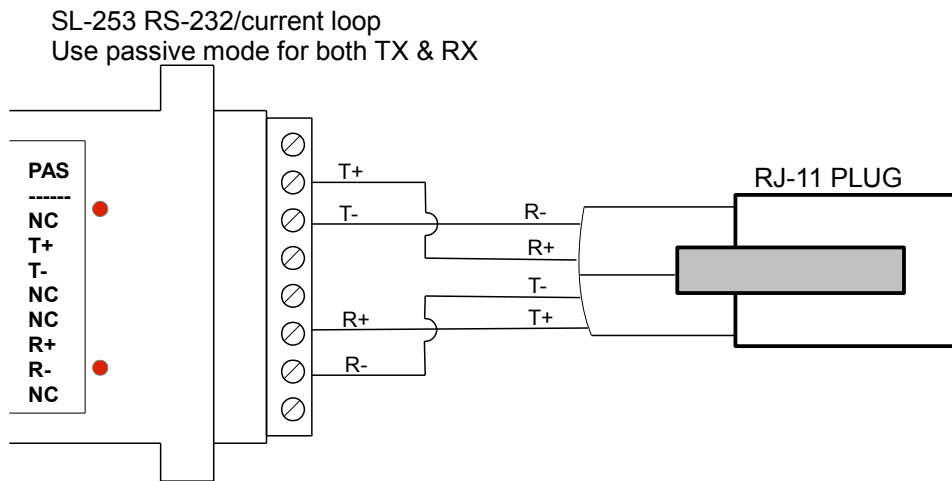
Serial communication - Current Loop Active (CON16, CON17)

The SL-84R10 board has an active current loop channel, with two connectors: CON12 - 4 pin detachable screw terminal and CON13 - top-entry 6/4 RJ-11 socket.

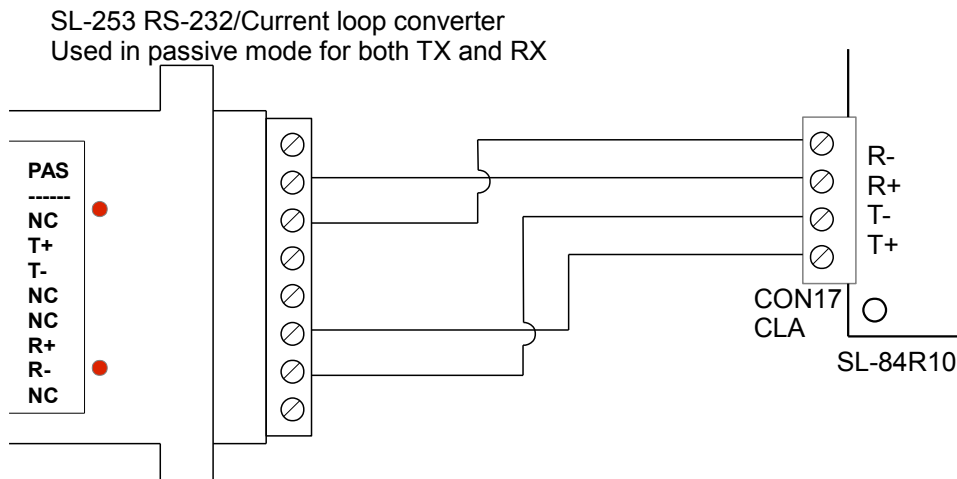
Since the current loop interface is active, meaning that the 20mA current is supplied for both the RX and TX channels by the SL-84R10 board, the SL-253 current loop converter should be wired as "passive". Cable length can be up to 1000m.

Note that there is no jumper to select the type of communication used, serial or ethernet. Serial communication over the current loop can occur even if the Tibbo Ethernet module is installed, provided that the two are not used at the same time.

RJ-11 connector (CON17)



4-pin terminal block (CON16)



Input voltage - 2 pin terminal block (CON1)

CON1 is the input connector for the 14VDC the SL-84 uses for normal operation.

The input is protected against reverse polarity and high input voltages by a 5A/30V self-healing fuse and a 15,3V/5A zener diode.

The presence and correct polarity of the input voltage is shown by a red LED (LD1) just above CON1.

Battery connector - 2 pin terminal block (CON2)

CON2 is used to connect a sealed lead-acid battery (12V/7Ah) to the SL-84. The battery is charged through a self-healing 2,5A/30V fuse that acts as a current limiter in case the battery is faulty or totally discharged. The open-source voltage (i.e. the trickle charge voltage) on CON1 should be around 13,7-13,8V.

Input voltage low ALARM - 2 pin terminal block (CON3)

CON3 is the 12V/100mA alarm output for signalling a missing or low voltage on CON1 (input voltage).

If the input voltage falls below 12,3V, a voltage of 12V appears on CON3. This can be used for a or a signal lamp.

The output is protected by a self-healing 140mA fuse, so consumption should be considered when choosing the signalling method.

Shield - 2 pin terminal block (CON21, CON22, CON23)

CON21, CON22 and CON23 are connected to the PCBs ground plane and the metal case. In case of EMI problems or just for the sake of proper engineering practice, the shields of used shielded cables can be connected to these connectors.

2.6. Firmware 8403x (x is a version letter a,b,...)

- After a reset, self-test routines are called. The LCD is initialised and a non-destructive test of the internal and external RAM is made. The ROM checksum is also checked.

During the self-test procedure, the following screen is shown (just before the end of the self-test routine):

F	D	3	1		D	:	7	1		X	0	1	F	F	I	C								
A	S	M	:	2	.	0	a			C	:		8	4	0	3	i							

- The 4-digit hex number in the top-left corner is a reset-code, which gives an indication of where the program was when the reset occurred. Since a reset can happen due to a watchdog timeout, this code is very useful in tracking down possible firmware bugs.
- The byte after 'D;' is the value set on the DIP switch
- X represents the start of the XRAM test, the four hex characters represent the page counter
- I represents the start of the internal RAM test
- C represents the start of the ROM checksum test
- the lower row provides information on the versions of the assembler and C parts of the firmware

After the self-test routines, the integrity of the buffered clocking data and pointers is checked. If the pointers have been corrupted, the controller resets them. This will be indicated by a '0' registration counter i.e. an empty buffer.

If the buffer pointers are corrupt after a reset, the FATAL_RESET COUNTER is incremented, otherwise the RESET COUNTER is incremented. These two counters can be read out with a Status command. They are revolving 16-bit counters and are useful in tracking down problems like missing clocking data or corrupted access tables.

If these counters show a tendency to increment, that means that there is most probably an EMI problem, and additional filtering is needed for the power lines (off-line UPS, isolation-transformer, additional ferrites, etc.).

The problem may also be caused by bad earthing i.e. the protective ground wire is not connected to a proper low-resistance ground.