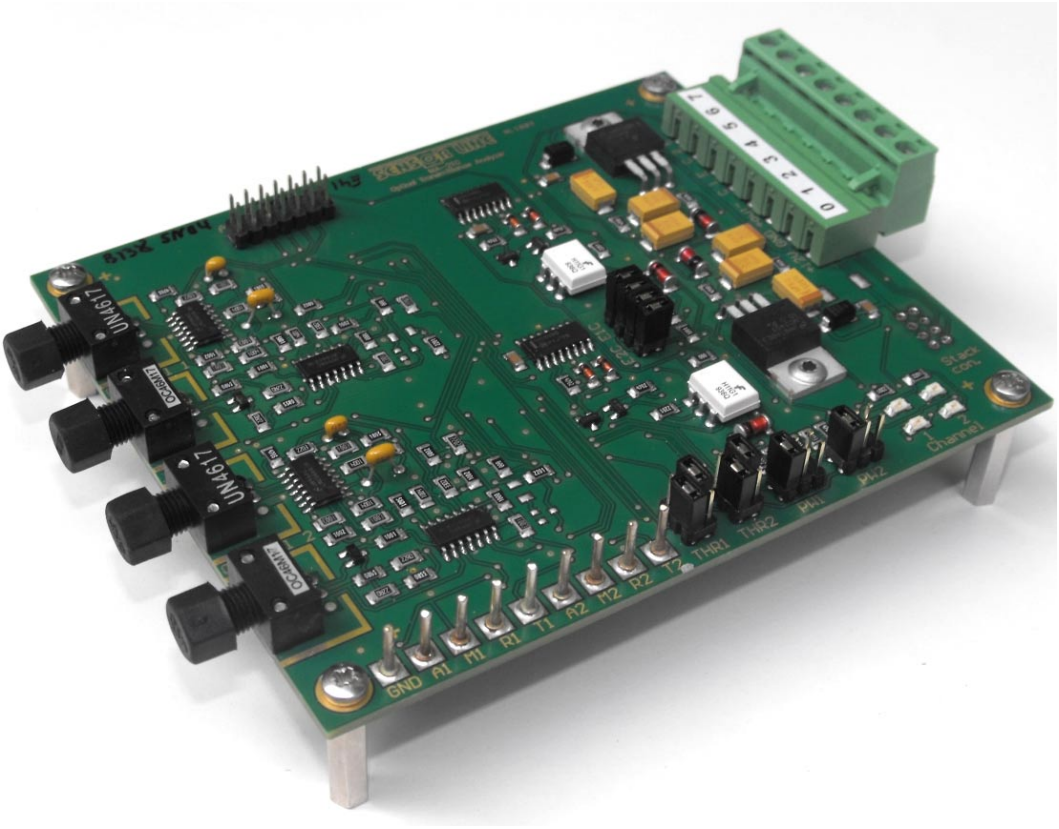
Optical Transmittance Analyzer

SL MA-210



User Manual

Revision 2.0
2012/07 – Plamper

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1. General

The SL MA-210 Optical Transmittance Analyzer (OTA) is an electronic interface that operates two fiber optic load sensors. The unit serves as an interface between fiber optic sensors and a processing unit on system level. It should be installed in a weather-proof road side cabinet.

1.1 Function

The MA-210 responds to the optical sensor signal in a dynamic (AC-coupled) manner, i.e. the electrical signal delivered when a load is applied to the sensor will decrease to zero as the load continues to be applied. At a selectable threshold, a digital trigger signal is generated for each channel. This signal can be forced to remain active for an selectable length of time. Aside from these selections the interface does not require any further adjustment.

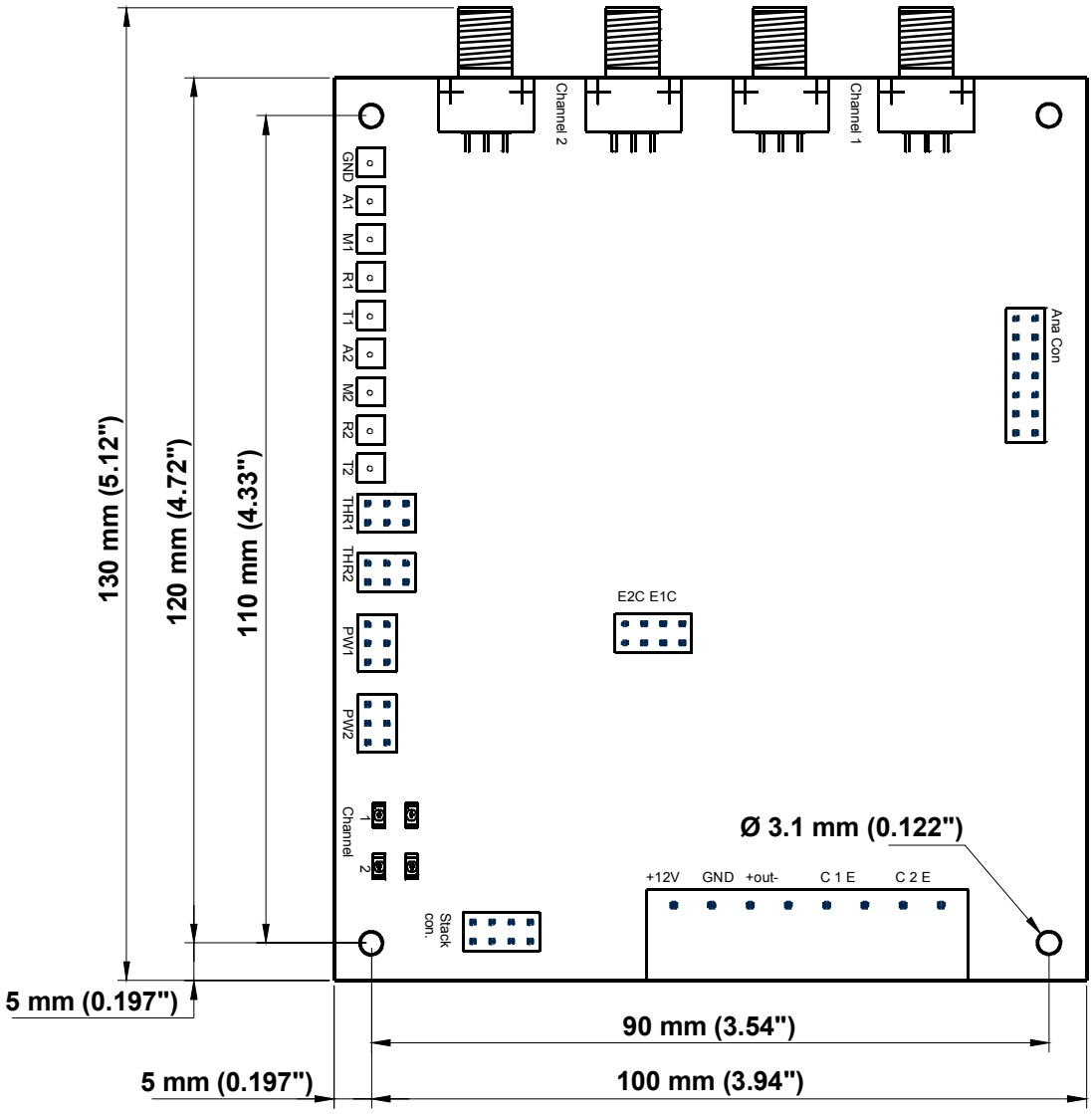
The output (trigger) signals are transmitted via optocouplers which behave similar to relays, allowing the use of a variety of output circuitry. In addition there is some output circuitry implemented on the board which can by configured by means of jumpers, thus minimizing the need for external wiring while still maintaining a maximum of output versatility.

Trigger activity and sensor failure are signaled by individual LEDs for every channel.

1.2 Features

- Dynamic two-channel interface for detection of light power changes caused by activation of fiber-optic load sensors
- Optocoupler digital outputs
- Adjustable trigger threshold (0.3%, 0,5%, 1% and 1.5% relative light drop)
- Adjustable minimum trigger pulse duration (1ms, 22ms and 47ms)
- Trigger indication LED for each channel
- Error indication LED for each channel
- Reverse power protection
- Pre-wired output circuits configurable through jumper settings
- RoHS conform

1.3 Dimensions



Not to scale!

Component Height:	11 mm (0.44“) maximum 15 mm (0.59”)	inside of board perimeter (connector plug)
Board Thickness:	0.17 mm (0.067”)	
Component Lead Length:	2 mm (0.08”) maximum	

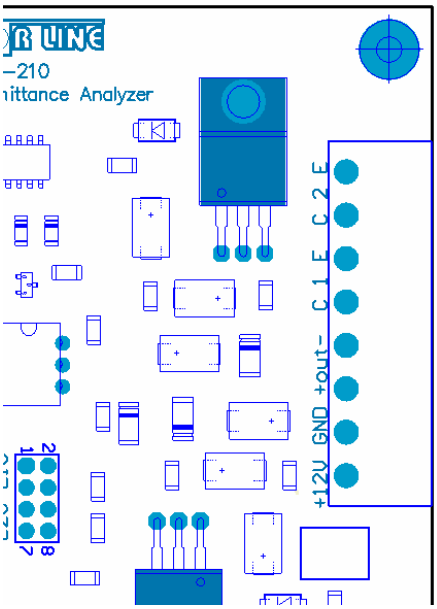
Minimum clearance of mounting holes to adjacent traces: 2.5 mm (0.1”)

Note: Connector plug increases board length by 10 mm (0.4”), not including space for wire terminations.

2. Connections

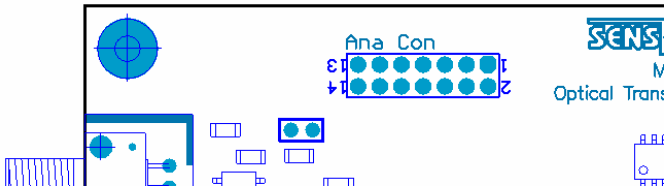
2.1 Electrical

2.1.1 Main Connector (8-pin pluggable screw terminal)



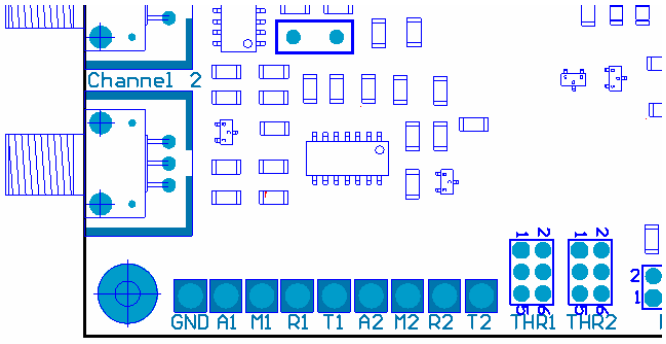
Terminal #	Label	Signal	Description
0	+12V	12...24 VDC	Board Supply Voltage
1	GND	GND (AGND)	Board Analog Ground
2	+ *(out)*	5...24 VDC	Output Supply Voltage
3	*(out)* –	DGND	Output Digital Ground
4	C *(1)*	C1	Collector Output of Channel 1
5	*(1)* E	E1	Emitter Output of Channel 1
6	C *(2)*	C2	Collector Output of Channel 2
7	*(2)* E	E2	Emitter Output of Channel 2

2.1.2 Service Connector (14-pin header)



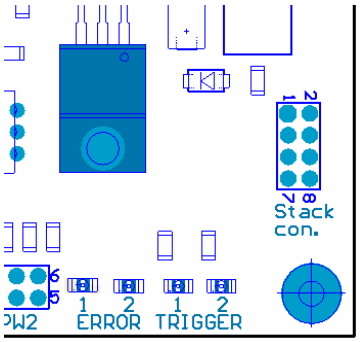
Pin #	Signal	Description
1	GND (AGND)	Board Analog Ground
2	GND (AGND)	Board Analog Ground
3	Vana1	Analog Load Signal Channel 1
4	Vmon1	Monitor Signal Channel 1
5	Vtrg1	Trigger Signal Channel 1
6	Vref1	Reference Voltage Channel 1
7	Vana2	Analog Load Signal Channel 2
8	Vmon2	Monitor Signal Channel 2
9	Vtrg2	Trigger Signal Channel 2
10	Vref2	Reference Voltage Channel 2
11	NC	Not connected
12	NC	Not connected
13	NC	Not connected
14	NC	Not connected

2.1.3 Measuring Pins



Pin #	Label	Signal	Description
1	GND	GND (AGND)	Board Analog Ground
2	A1	Vana1	Analog Load Signal Channel 1
3	M1	Vmon1	Monitor Signal Channel 1
4	R1	Vref1	Reference Voltage Channel 1
5	T1	Vtrg1	Trigger Signal Channel 1
6	A2	Vana2	Analog Load Signal Channel 2
7	M2	Vmon2	Monitor Signal Channel 2
8	R2	Vref2	Reference Voltage Channel 2
9	T2	Vtrg2	Trigger Signal Channel 2

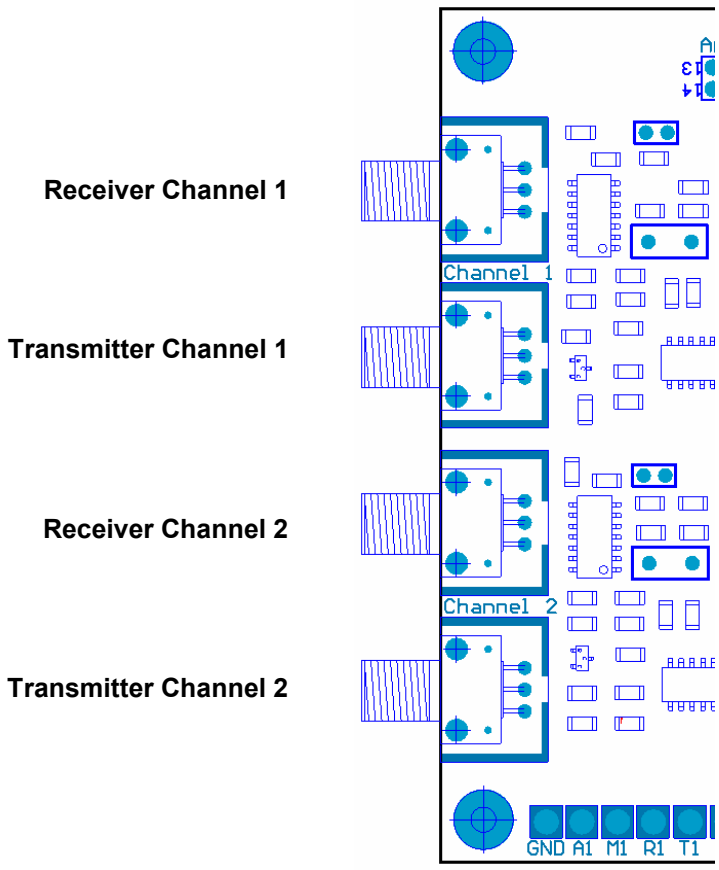
2.1.4 Stack Connector (8-pin Header)



Pin #	Signal	Description
1	12...24 VDC	Board Supply Voltage
2	12...24 VDC	Board Supply Voltage
3	GND (AGND)	Board Analog Ground
4	GND (AGND)	Board Analog Ground
5	5...24 VDC	Output Supply Voltage
6	5...24 VDC	Output Supply Voltage
7	DGND	Output Digital Ground
8	DGND	Output Digital Ground

Note: This connector is normally not assembled. It is only provided to allow for stacking several units in order to create multichannel interfaces where the supply voltage(s) only need to be connected once. This is actually intended to be done in the factory but can be accomplished by the customer as well.

2.2 Optical



Four fibre-optic SMA-905 (FSMA) receptacles. The feeder fibres of each channel can be connected in any order.

3. Output Circuitry

3.1 On-Board Pre-Wiring

The MA-210 output circuitry is intended to facilitate interfacing of the unit to the host system by minimizing the requirements for external wiring. In a majority of cases this can be accomplished using wires only without needing additional material such as extra terminal strips and so on.

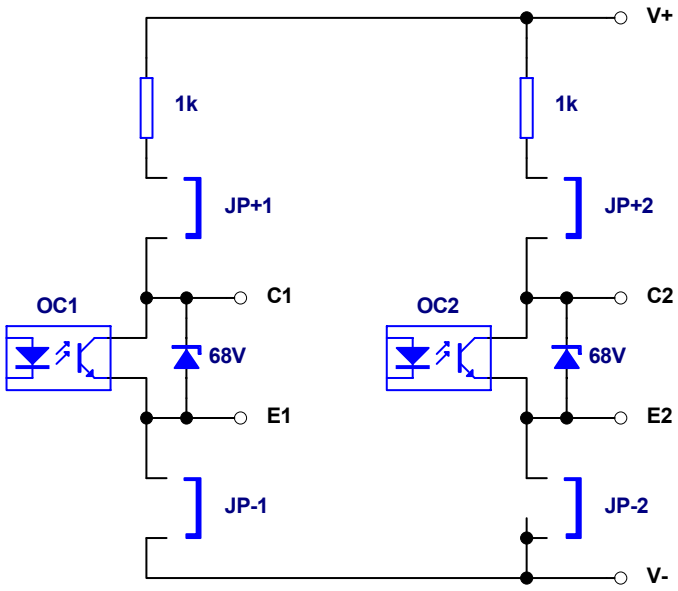


Fig. 1: MA-210 pre-wired output circuit

Fig. 1 shows the general arrangement: The signals are transmitted via optocouplers which have an NPN phototransistors as their output stages. Collectors and emitters of these phototransistors are directly connected to output terminals designated “C...” and “E...”.

In addition, there are two more terminals provided. The first one, “V+”, is connected via a 1kΩ resistor and a jumper “JP+...” to the collector of each optocoupler. The second one, “V–“ is connected to its emitter via a jumper “JP–...“ only. The V+ and V– terminals are common for all channels, whereas each channel has its own jumpers and resistors. This allows for a variety of output configurations.

Please mind the Zener diodes which are omitted in the following drawings. They protect the optocouplers not only against over-voltage but also – rather aggressively – against reverse polarity. So whenever connecting a voltage source correct polarity should be observed for its own sake.

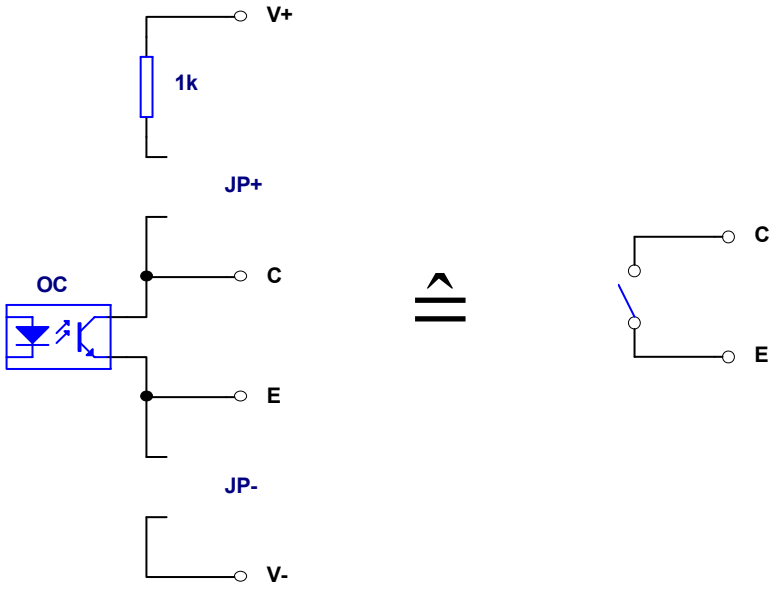


Fig. 2: Both jumpers removed → Simple switch between Terminals C and E

When, according to Fig. 2, none of both jumpers of a channel is installed, collector and emitter of the output transistor are only accessible via terminals C and E. The optocoupler then acts as a simple switch, where of course polarity must be obeyed: current can only flow into Terminal C and out of Terminal E.

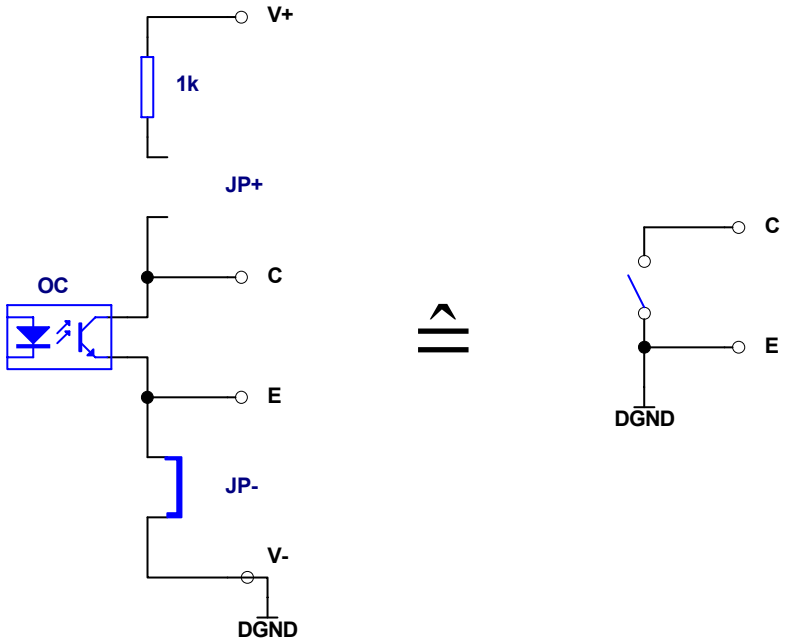


Fig. 3: Jumper JP– installed, Terminal V– grounded
→ Terminal E grounded, Switch between Terminal C and ground

When Jumper JP– is installed and Terminal V– is grounded as shown in Fig. 3 the switch also becomes grounded at its negative connection. In other words, the optocoupler then acts as a switch between Terminal C and ground, plus, ground is available at Terminal E.

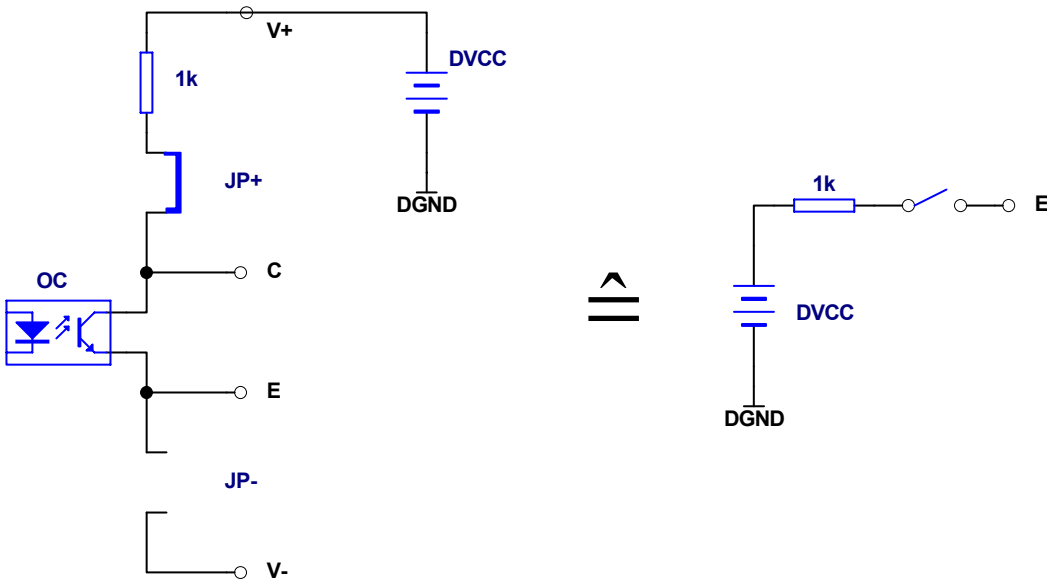


Fig. 4: Jumper JP+ installed, Jumper JP– removed, Terminal V+ powered
→ Voltage source with 1kΩ series resistor at Terminal E

When Jumper JP+ is installed instead of JP– and Terminal V+ is connected to some voltage DVCC according to Fig. 4 then a load can be switched via the optocoupler with a series resistance of 1kΩ.

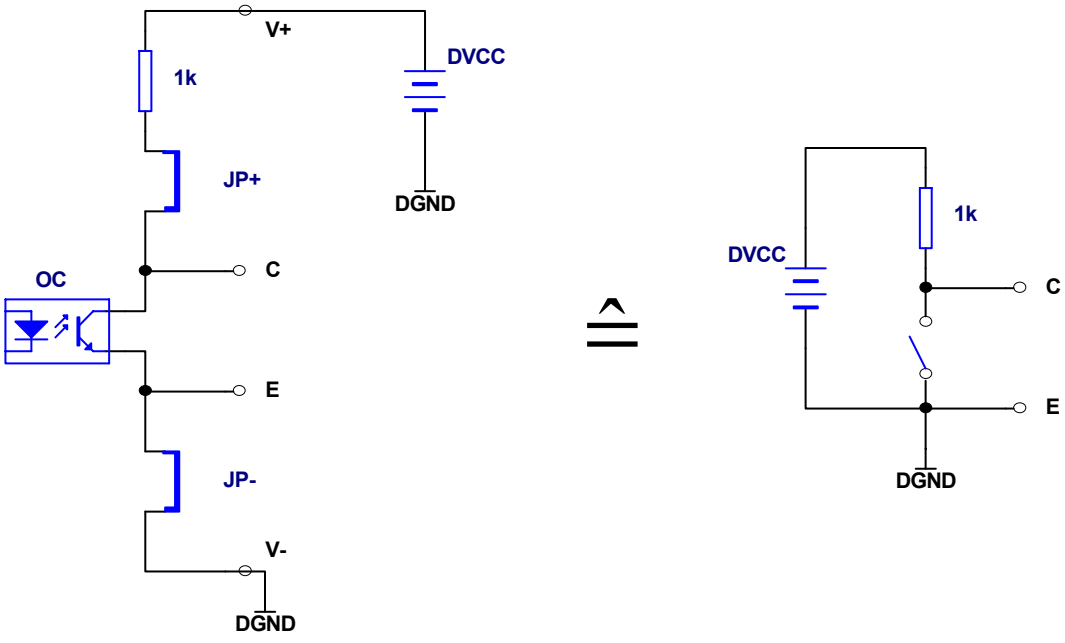


Fig. 5: Both jumpers installed, Terminal V– grounded, Terminal V+ powered
→ Terminal E grounded, inverted voltage output at Terminal C

Installation of both jumpers, grounding of Terminal V– and connection of a voltage source to Terminal V+ as shown in Fig. 5 establishes a true voltage output at Terminals C and E which can drive floating inputs.

3.2 Wiring Examples

Configuration of the MA-210 output can be done with or without a separate output power supply. If one is present it is recommendable to introduce a separate output ground as well. This may reduce interference of the connected circuitry with the analog signal porcessing significantly.

3.2.1 No Jumpers Installed (see Fig. 2)

It is obvious, that when neither of the jumpers is installed, it makes no sense to connect anything to the V+ or V– terminals. The on-board pre-wiring is disabled in this case and the optocoupler can be incorporated into any external circuitry. This causes some effort but offers a maximum of versatility.

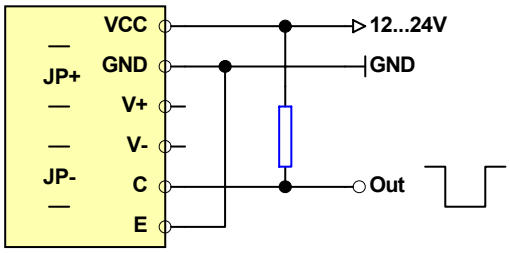


Fig. 6: External pull-up resistor with common board and output supply

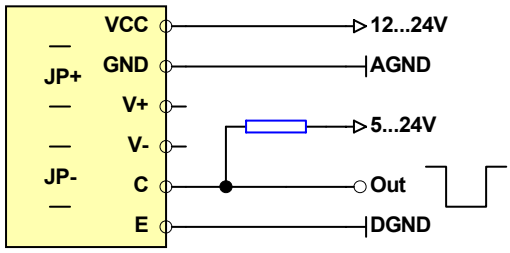


Fig. 7: External pull-up resistor with separate board and output supply

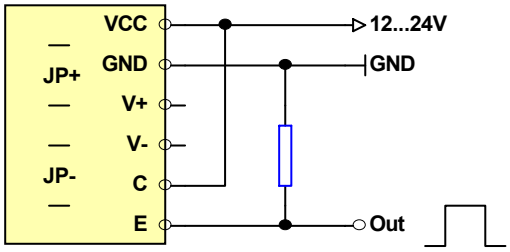


Fig. 8: External pull-down resistor with common board and output supply

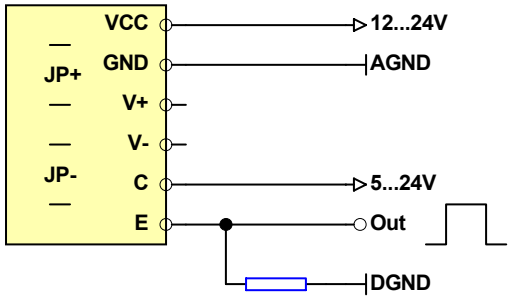


Fig. 9: External pull-down resistor with separate board and output supply

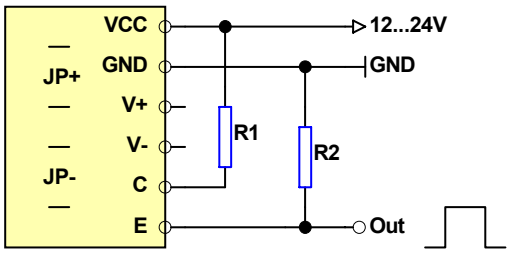


Fig. 10: Non-inverted output level adjustment with common board and output supply

$$V_{High} \approx \frac{R_2}{R_1 + R_2} \cdot (V_{cc} - 1V)$$

$V_{Low} \approx 0$ (GND)

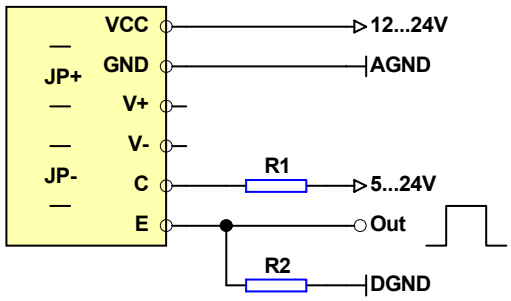


Fig. 11: Non-inverted output level adjustment with separate board and output supply

$$V_{High} \approx \frac{R_2}{R_1 + R_2} \cdot (V_{R1} - 1V)$$

$V_{Low} \approx 0$ (DGND)

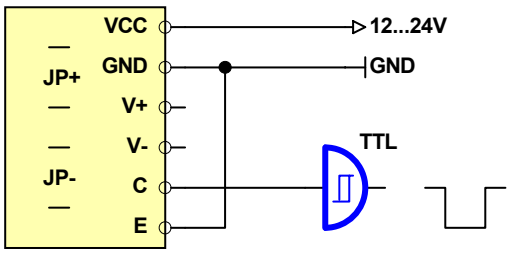


Fig. 12: Driving a TTL gate with common board and output supply

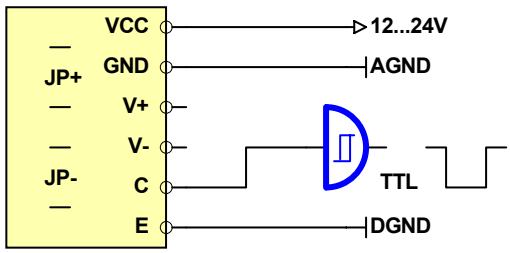


Fig. 13: Driving a TTL gate with separate board and output supply

Note: Open TTL inputs behave as if connected to high-level. The above option applies to such inputs only. Floating (e.g. CMOS) inputs must be driven according to Fig. 6 to 9.

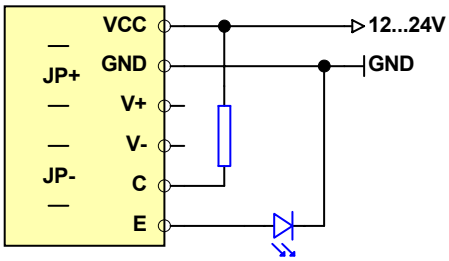


Fig. 14: Driving a LED or an optocoupler with common board and output supply

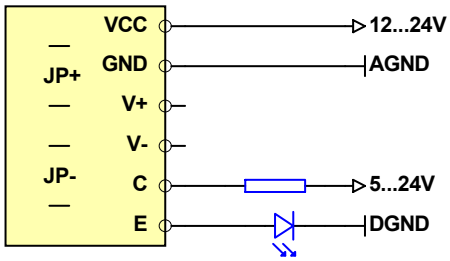


Fig. 15: Driving a LED or an optocoupler with separate board and output supply

3.2.2 JP– Installed (see Fig. 3)

The circuits given below differ from the corresponding circuits in section 3.2.1 only in that the ground wires are not connected directly to the optocoupler's emitter but via the V– terminal and the JP– jumper instead. However, since the V– terminal is common there is only one wire needed to establish this connection for all channels.

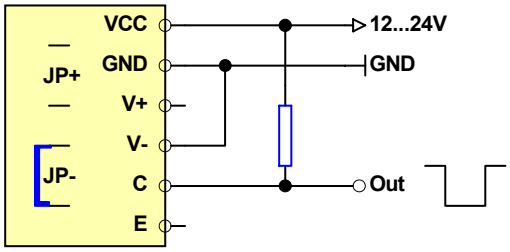


Fig. 16: External pull-up resistor with common board and output supply

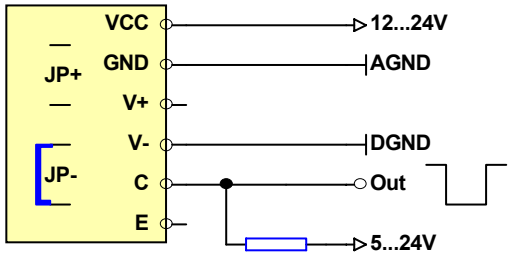


Fig. 17: External pull-up resistor with separate board and output supply

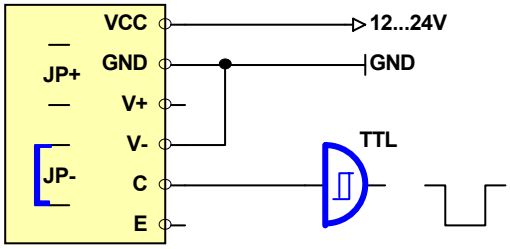


Fig. 18: Driving a TTL gate with common board and output supply

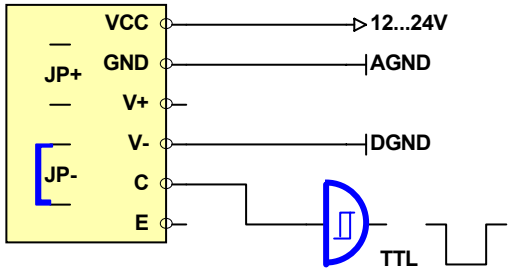


Fig. 19: Driving a TTL gate with separate board and output supply

Note: Open TTL inputs behave as if connected to high-level. The above option applies to such inputs only. Floating (e.g. CMOS) inputs must be driven according to Fig. 16 to 17.

3.2.3 JP+ Installed (see Fig. 4)

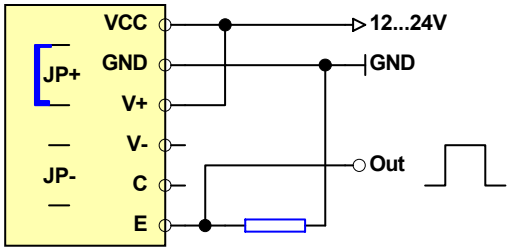


Fig. 20: Output level adjustment with common board and output supply

$$V_{High} \approx \frac{R}{R+1k\Omega} \cdot (V_{cc} - 1V)$$

$V_{Low} \approx 0$ (GND)

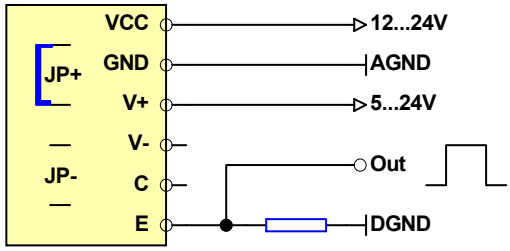


Fig. 21: Output level adjustment with separate board and output supply

$$V_{High} \approx \frac{R}{R+1k\Omega} \cdot (V_{+} - 1V)$$

$V_{Low} \approx 0$ (DGND)

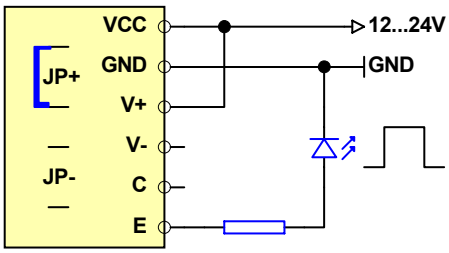


Fig. 22: Driving a LED or an optocoupler with common board and output supply

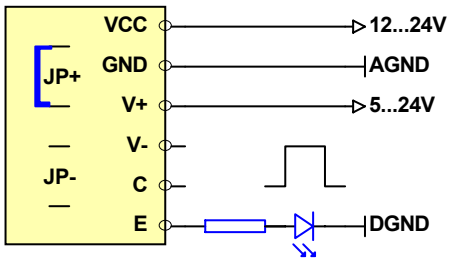


Fig. 23: Driving a LED or an optocoupler with separate board and output supply

Note: The internal 1k resistor will deliver about 1 mA of current per volt of V+ to Terminal E. The external resistor is only needed if this is too much. Also, with a separate output supply the current can be adjusted via V+, thus also rendering the external resistor unnecessary.

3.2.4 Both Jumpers Installed (see Fig. 5)

Installing both jumpers allows for creating a voltage output (as opposed to a switch) without the need of any external components.

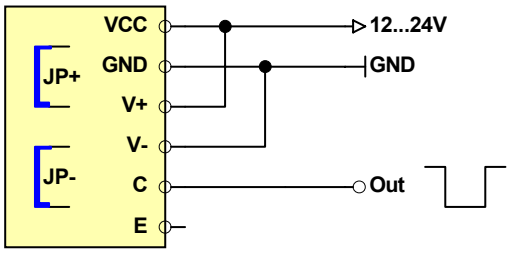


Fig. 24: Simple voltage output with common board and output supply

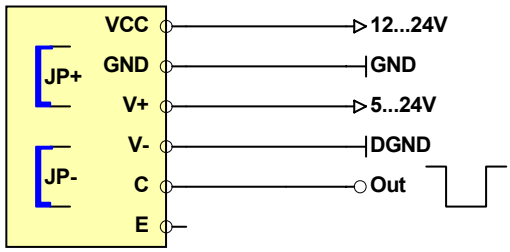
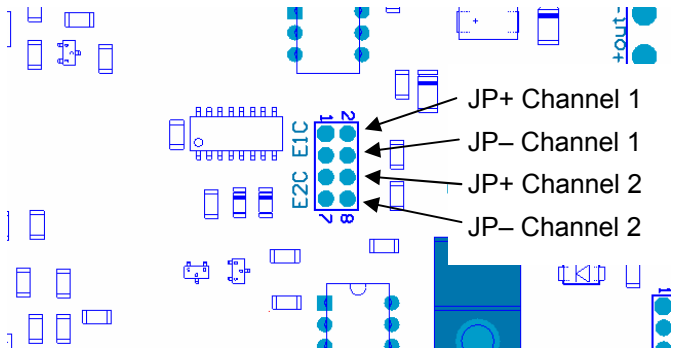


Fig. 25: Simple voltage output with separate board and output supply

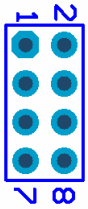
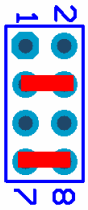
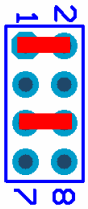
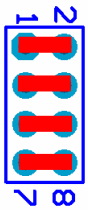
4. Configuration

4.1 On-Board Output Pre-Wiring

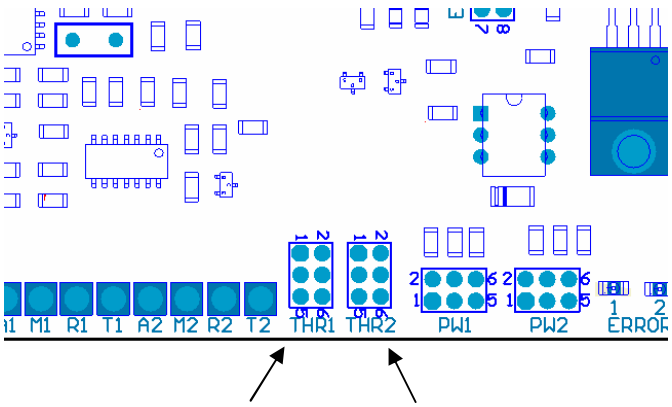


The jumpers of the on-board output pre-wiring are accepted by a 2x4-pin header. With the fibre-optic receptacles pointing to the left, this header is located somewhat right below the middle of the board and labeled *E2C E1C*.

The different output configurations described in Section 3 are established as shown below.

Jumpers	Outputs configured according to
	Fig. 2, Section 3.2.1
	Fig. 3, Section 3.2.2
	Fig. 4, Section 3.2.3
	Fig. 5, Section 3.2.4

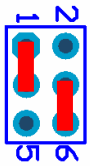
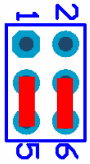
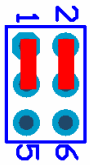
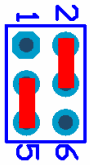
4.2 Selection Of Trigger Threshold



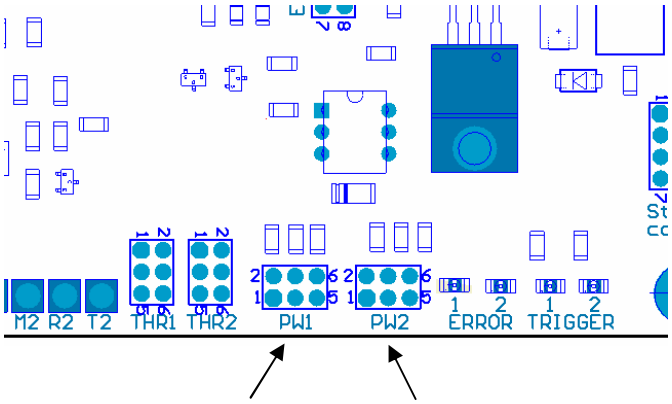
Trigger Threshold

With the fibre-optic receptacles pointing to the left, the headers for trigger threshold selection are located at the bottom edge of the board just right to the measuring pins and labeled *THR1* and *THR2*.

The trigger threshold of each channel is determined by <u>two</u> jumpers placed as shown below.

Jumpers	Trigger Threshold
	0.3%
	0.5%
	1.0%
	1.5%

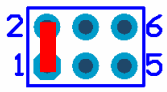
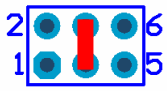
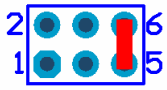
4.3 Selection Of Minimum Trigger Pulse Duration



Trigger Pulse Duration

With the fibre-optic receptacles pointing to the left, the headers for the selection of trigger pulse duration are located at the bottom edge of the board just right to the headers for trigger threshold (see Section 4.2) and labeled *PW1* and *PW2*.

The minimum trigger pulse duration of each channel is determined by <u>one</u> jumper placed as shown below.

Jumper	Trigger Pulse min.
	1 ms
	22 ms
	47 ms

5. Getting Started

5.1 Installation

1) Fix the interface with screws and spacers. Take care that any vibrations or shocks will not affect the board and in specific the fiber optic connectors.

2) Remove the safety caps from LED transmitter and photodetector.

3) Connect the sensor SMA connectors with transmitters and photodetectors of each channel. Fasten properly the sensor SMA connectors with transmitters and photo detectors in order to obtain smallest attenuation, but avoid any violence; especially do not use pliers. The connectors of transmitter and photodetector of each channel may be interchanged.

4) Connect the power supply (or power supplies) to the respective terminals.

5) Connect the signal output terminals to your system.

5.2 Test

1) Switch the power supply on.

2) Drive across the embedded sensors and monitor the trigger signals by watching the Trigger LEDs.

3) Test the sensor failure signal of each channel by disconnecting one of its fiber connectors. The respective Error LED must come on within few seconds.

6. Specifications

Board Supply Voltage:	+12 to +24 VDC
Board Supply Current (continuous):	< 300 mA
Output Supply Voltage:	+ 5 to +24 VDC
Rating of Optocouplers:	60V / 25mA
Trigger Thresholds:	0.3% / 0.5% / 1% / 1.5% of light transmittance drop
Minimum Trigger Pulse Duration:	1 ms / 22 ms / 47 ms
Sensor Attenuation for MA-210 RED:	3 – 23 dB (red transmitter)
Sensor Attenuation for MA-210 IR:	3 – 33 dB (infrared transmitter)
Speed Range:	1 to 250 km/h
Feeder Length:	up to 250 meters
Certification:	RoHS
LED Risk Group:	RG 0 (safe) *

* According to DIN EN 62471. Please note: In spite of the official classification SENSOR LINE recommends to avoid staring into the transmitter for longer periods, regardless whether light is visible or not.

Important notice