## General description:

Transceiver module in the 2.4GHz bandwidth for the management of the safety edge. The module is configurable or as a master (mobile part of the automation) or as a slave (fixed part of the automation), through an external pin. The power supply is in between 1.8 and 3.6 Volt. Single in-line module with dimension approximately of 51 x 25 mm, with an integrated PCB antenna or a UFL connector for external antenna.
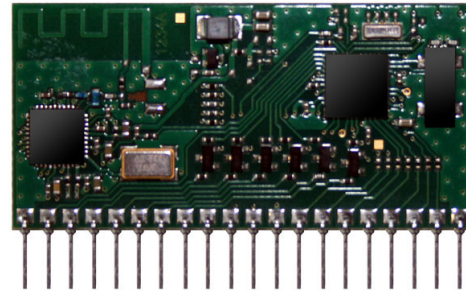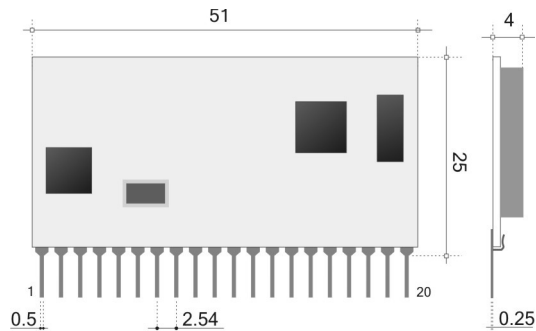
Electrical characteristics:

	Min.	Tip.	Max.	Unit
DC Levels				
Voltage Supply	1.8	3.0	3.6	V
Max Current Consumption		40		mA
Average Current Consumption (transmission interval 1 second)		80		uA
Average Current Consumption (transmission interval 50msec)		1.3		mA
Total Average Consumption (10 automation movements of 3 minutes in a day)		110		uA
RF				
Frequency Band		2400 – 2483		MHz
Modulation Type		GFSK		
Sensitivity		-93		dBm
Effective Radiated Power (E.R.P.)		0		dBm
Number of channels (automatic channel selection)		6		
Operative range		10		m
Bandwidth		1		MHz
Operating temperature	-20		+70	°C
Dimensions		51 x 25		mm

The module is configurable as a *master,* for the mobile part of automation, or in *slave mode,* for the fixed part.

In the master mode, the module can be connected to a 8k2 resistive safety edge, to a safety edge with contact NC (normally closed) or to an optical safety edge. This selection of the edge type can be realised with pins "Select edge type 1" and "Select edge type 2" (see pin out).

Master can have also connected a NC contact (see Pin 11 "Block Contact") thought for pedestrian entrance.

In case of optical safety edge selection, the module uses the open collector output "Optical Tx". Through this output pulses are sent to the optical transmitter. Moreover the module uses the digital input "Optical Rx" to verify the presence of pulses received from optical reiceiver.

Further, in order to reduce power consumption, module has a pin (output open collector) for the activation of the optical receiver. In this way the optical receiver it's enabled only when it's requested the reading.

NB: the management of the optical edge is not implemented yet.

In slave mode the module must have connected the "Lamp" input from gate/door control unit.

Indeed, if there are no motion by the automation, the radio communication between master and slave takes place each second in order to limit the current consumption but at the same time check the radio link and the correct functioning of the device.

When the automatism is activated, event showed by the "Lamp" line (toggle or keeping low the line from gate/door the central unit), by maximum 1,2 seconds **starts a quick radio transmission in order to guarantee a time of detection**, in case of pressure of the edge, not more than 150 msec to allow the entire automation to be comply to the safety normative. **This quick activity stops** when the "Lamp" line returns high or when the toggle ends.

The slave has also "Autotest" inputs usable to perform the test of the contacts of the edge as requested in the safety regulations.

There is also an input ("Autotest Polarity") that indicates the polarity of the line "Autotest" (active high or low/not connected).

The slave has two channels (relays) and to each channel can be associated 4 masters maximum (assignable everywhere).

Transmission protocol:
The data packet is 7 byte length plus the preamble and it includes the following information:
- A unique Identification code of device (3 bytes)
- Identification code of constructor (1 byte)
- Battery state
- Safety edge state
- Contact block state (pedestrian input)
- Checksum of transmitted bytes

The technical characteristics can change without notice. AUR°EL S.p.A doesn't assume the responsibility to the damages caused by an improper use of the device.

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Pin Out

Pin	Pin out master (mobile part)	Pin out slave (fixed part)	I/O type
1	GND	GND	Power
2	Learning button	Learning button	Input
3	Status Led	Status Led	Output - Open collector
4	Optical edge activation	Low battery out	Output - Open collector
5	Optical Tx	Relay 1 block	Output - Open collector
6	Not Connected	Relay 2 block	Output - Open collector
7	Not Connected	Relay 1 8k2/NC/Optical Edge	Output - Open collector
8	Not Connected	Relay 2 8k2/NC/ Optical Edge	Output - Open collector
9	GND	GND	Power
10	Input 8k2 or contact NC	Low battery mode	Analogic input
11	Block Contact	Autotest 1	Input
12	VDD	VDD	Power
13	Not Connected	Autotest 2	Input
14	Master/slave mode	Master/slave mode	Input
15	Optical Rx	Autotest Polarity	Input
16	Select edge type 2	Lamp 2 (Lamp line)	Input
17	Select edge type 1	Lamp 1 (Lamp line)	Input
18	UART TX	UART TX	Output
19	UART RX	UART RX	Input
20	GND	GND	Power

Input state
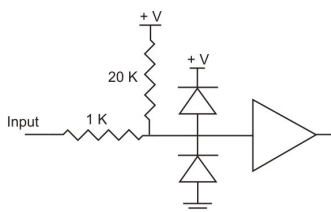
Output state
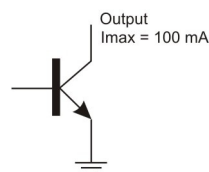
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Description Master pin

	Pin	Description
1	GND	Connect to ground plane.
2	Learning button	Pull-up input. Used to enter in learning mode (see "Learning procedure" section).
3	Status Led	Open collector output. Used to indicate module status: Learning, erasing, transmitted and received packet, low battery
4	Optical edge activation	Open collector output for enabling optical receive part of the module (NOT IMPLEMENTED YET)
5	Optical Tx	Open collector output: control pulse of the optical edge (NOT IMPLEMENTED YET).
6,7,8	Not connected	Do not connect anything to these pins.
9	GND	Connection to the ground.
10	Input 8k2 or contact NC	Analog input to connect the 8K2 resistive or NC contact edge.
11	Block Contact	Pull-up input to connect the NC contact of the pedestrian door
12	VDD	Voltage supply (1.8 – 3.6V).
13	Not connected	Do not connect anything to this pin.
14	Master/slave mode	Input pull up. Do not connect in order to select master mode.
15	Optical Rx	Input pulses from optical edge (NOT IMPLEMENTED YET).
16 17	Select edge type 2 Select edge type 1	Input pull up. Select edge type: Select edge type 1 = Sel. edge type 2 = GND : 8k2 safety edge Sel. edge type 1=GND, Sel. edge type 2=VDD : NC contact edge
18	UART TX	UART output (NOT IMPLEMENTED YET)
19	UART RX	UART input (NOT IMPLEMENTED YET)
20	GND	Connect to ground plane

Description Slave pin

	Pin	Description
1	GND	Connection to the ground
2	Learning button	Pull-up input. Used to enter in learning mode (see "Learning procedure" section)
3	Status Led	Open collector output. Used to indicate the module status: Learning, erasing, packet received, channel change
4	Low battery out	Open collector output. Signaling master low battery (see "Battery warning" section)
5	Relay 1 block	Open collector output. If the contacts (NC) of the pedestrian door of the edges associated with the channel 1 are closed, the output is forced to ground, otherwise the output is in high impedance.
6	Relay 2 block	Open collector output. If the contacts (NC) of the pedestrian door of the edges associated with the channel 2 are closed, the output is forced to ground, otherwise the output is in high impedance.
7	Relay 1 8k2/NC/Optical Edge	Open collector output. If the edges associated with the channel 1 are pressed, the output is in high impedance, otherwise the output is forced to the ground
8	Relay 2 8k2/NC/Optical Edge	Open collector output. If the edges associated with the channel 2 are pressed, the output is in high impedance, otherwise the output is forced to the ground
9	GND	Connect to ground plane
10	Low battery mode	Pull-up input. Do not connect it to select the impulsive mode, connect to the ground to select the continuous mode (see "Battery warning" section)
11	Autotest 1	Input. Autotest signal channel 1
12	VDD	Voltage supply (1.8 – 3.6V)
13	Autotest 2	Input. Autotest signal channel 2
14	Master/slave mode	Input pull up. Force it to ground to select the slave mode.
15	Polarity autotest	Pull-up Input. Do not connect to select the Active High autotest mode, connect to the ground to select the active low autotest mode or autotest not connected
16	Lamp 2	Input pull up. Lamp line channel 2.
17	Lamp 1	Input pull up. Lamp line channel 1.
18	UART TX	UART output (NOT IMPLEMENTED)
19	UART RX	UART input (NOT IMPLEMENTED)
20	GND	Connection to the ground

Learning procedure

Force the pin "Learning button" to ground for 1 second into slave.
After this time, the output "Status Led" goes to ground and then it starts a quick blinking each second to indicate that the learning procedure is on channel 1 of the slave module (Relay 1).
Forcing again the "Learning button" to the ground, the "Status Led" output performs a rapid double blink every second to indicate that the slave device is in learning mode for the channel 2 (Relay 2).
For any further forcing to the ground of the "Learning button", the slave changes the channel from the channel 2 to 1 or vice versa.
The module remains in learning procedure for 20 seconds after the last release of the button.

Into master force the "Learning button" to ground for at least 2 seconds.
The "Status Led" output goes to ground.
Releasing the "Learning button", the master device enters in learning mode for 20 seconds.
During the learning procedure the master transmits a packet about every second (indicated with a blink of the "Status Led" output).
At the end of the learning procedure both on the master and on the slave, there is a blinking of the "Status Led" as signaling that learning procedure was successfull or not (see Chart).

Slave erasing procedure

Enter into learning procedure of a channel as indicated above, showed with one or two quick blinks every second of the "Status Led" output depending on the channel selected.
If you force the "Learning button" pin to the ground for at least 5 seconds, the "Status Led" output line is forced to ground.
By releasing the "Learning button" pin the erasing of the channel associated masters is performed as also the related signalling procedure (see Chart).

Master erasing procedure

In master device force the "Learning button" to the ground for at least 2 seconds. The "Status Led" output is forced to the ground. Keeping the "Learning button" to the ground for at least 8 seconds, the "Status Led" output goes into high impedance, and releasing the "Learning button" the erasing of the associated slave is performed, as reported by chart below.

NOTE 1: when a master is not associated with any slave (for example first power on or after an erasing) it does not transmit any RF signal but it remains in sleep mode. In order to reduce radio disturbances and to minimize the current consumption of a not used master, it is recommended to perform the erasing.

Chart report:

Device	Report (Status Led)	Event
Master	Quick blink	Tx of RF packet: about every second when the automation is stopped and every 50 msec with the automation in motion.
Slave	Quick blink	Rx of RF packet from any master.
Slave	Output forcing to the ground	Channel change (see NOTE 2).
Master	2 blinks of 0.5 seconds	Learning correctly performed.
Master	6 blinks of 0.5 seconds	Error in the learning procedure (see NOTE 3)
Master	3 blinks of 0.2 seconds	The erasing was successful
Slave	2 blinks of 0.5 seconds	Learning correctly performed
Slave	6 blinks of 0.5 seconds	Learning failed because memory is full
Slave	4 blinks of 0.5 seconds	Learning failed because the master is already in memory
Slave	3 blinks of 0.2 seconds	The erasing of the channel was successful

NOTE 2: in case of radio noise the slave module performs an automatic change of the RF channel**.** During the analysis of the best noise free channel (it takes a time in between 2 seconds up to a maximum of 12 seconds), the "Status Led" output is forced to the ground. In this state the Learning button pressure is not processed.
In order to start the Learning procedure user must wait the "Status Led" output is in high impedence.

NOTE 3: if the learning procedure is not successful, the master comes back to its previous state: if it did not have any associated slave, it goes in sleep mode, otherwise it keeps the slave with the previous association.

Working of the system

At the first power on, the slave selects the best free noise RF channel (during the selection, the "Status Led" output is forced to the ground).
Carry out the auto learning of the masters into the desired relays.
From this moment, each master transmits every second the status of the safety edge, of the block contact and of the battery.
In the case the safety edge is not pressed, the "Relay 1 8k2/NC/Optical Edge" and "Relay 2 8k2/NC/Optical Edge" outputs are forced to the ground, otherwise they are in high impedance.
Similarly for the NC block contact: if the contact is closed the "Relay 1 block" and "Relay 2 Block" outputs are forced to the ground, otherwise in high impedance.

In case of noises that cause the loss of the radio link with at least one master, the "Relay 1 Block", "Relay 2 Block", "Relay 1 8k2/NC/Optical Edge" and "Relay 2 8k2/NC/Optical Edge" outputs go in high impedance, and the slave changes the channel in order to search the freest from radio interference.
Then all masters automatically connect on the new channel chosen by the slave. This process has a maximum time of 20 seconds.

Automation stopped

In this condition the changing of the status of the safety edge is indicated on the slave with a maximum delay of about 1 second, and in the case of radio noise, the outputs "Relay 1 block", "Relay2 block", "Relay 1 8k2/NC/Optical Edge" and "Relay 2 8k2/NC/Optical Edge" go to high impedance with a maximum delay, from the last received package, of about 3.5 seconds.
In order to ensure a quicker notice of the pressure of the safety edge on the slave when the automation is moving (allowing to be compliant to the safety normative) the timing between one transmission and the next one is reduced to approximately 50 ms.
In this way, the notification of the pressure of the safety edge and of the block contact, with relative driving of the "Relay" lines, has a maximum delay of 50ms. In case of radio noise, the outputs "Relay 1 block", "Relay2 block", "Relay 1 8k2/NC/Optical Edge" and "Relay 2 8k2/NC/Optical Edge" go to high impedance with a maximum delay of about 150msec from the last packet received.

The pull-up inputs "Lamp 1" o "Autotest 1" for channel 1 and "Lamp 2" or "Autotest 2" for channel 2 are used, in order to speed up the radio transmission. **Therefore, it is mandatory to connect the "Lamp line" to ensure safety in the system. In case they are not connected, the maximum detection time even during the movement of the automation, is approximately of 3.5 seconds.**

Automation in motion and autotest input not connected to the gate/door control unit

In case of absence of the connection of "Autotest1" or "Autotest2" (depending on the channel), the start of the radio communication at 50msec occurs when the "Lamp" input changes from high to low value. Actually quick communication takes place with a maximum delay from the commutation of "Lamp line" of 1.2 seconds, therefore for this time, the system has a maximum detection time of 1.2 seconds. **To ensure the complete safety of the system is necessary to provide a "preblinking" time in gate/door control unit of at least 1.2 seconds.**
The quick radio communication (transmission data every 50 msec) is performed while the Lamp input is connected to the ground (in case of fixed lamp) or for the duration of the blinking (in case of blinking lamp).
NOTE: in this configuration is mandatory to force the "polarity autotest" input to the ground: autotest not connected.

Automation in motion and autotest input connected to the gate/door control unit

With autotest connected, the starting of radio communication at 50msec occurs from the commutation high-low of the "Autotest" input (in the case of autotest active low, "Autotest polarity" = GND) or low-high (in the case of autotest active high, "Autotest polarity" = VDD).

At the commutation of the "Autotest" input, the lines "Relay Block" and "Relay 8k2/NC/Optical Edge" go in high impedance and they are maintained in this state until the radio packets, from all masters associated to the channel, are not received, in other words up to 1,2 sec.

At this point "Relay block" and "Relay 8k2/NC/Optical Edge" are forced to the ground and the RF communication occurs in about 50 msec and keep going for the persistence of the "Lamp" input to the ground (in case of fixed lamp) or for the duration of the blinking (in case of blinking lamp) and then it comes back in the cycling phase of transmission every 1 second.

NOTE: if the "Lamp" line does not switch to the ground before two seconds from the "Autotest" input commutation, "Relay" outputs goes in high impedance for 500msec in order to block the movement of the automation. Therefore, even in this condition, it is required to connect the "Lamp" inputs to the gate/door control units.

Battery warning

To check the status of the battery in the master, force the "Learning button" to the ground and release it within 2 seconds (otherwise you get into learning mode). If the battery is charged, the output "Status Led" blinks one time, otherwise it blinks two times.

Into the slave, to notification of the low battery state of one or more masters, occurs depending on the mode selected:

- IMPULSIVE: at the reception of the packet by the master, with the information of battery low, the output "Low Battery Out" is forced to the ground for 30msec.

- CONTINUE: if at least one of the masters has a low battery, the output "Low Battery Out" is forced to the ground.

Follow two examples of possible application scenarios.

Scenario with all masters joined to channel 1

MASTER 1

MASTER 2

MASTER 3

MASTER 4

SLAVE

CH 1   CH 2

Lamp 1   AT_1   PHO
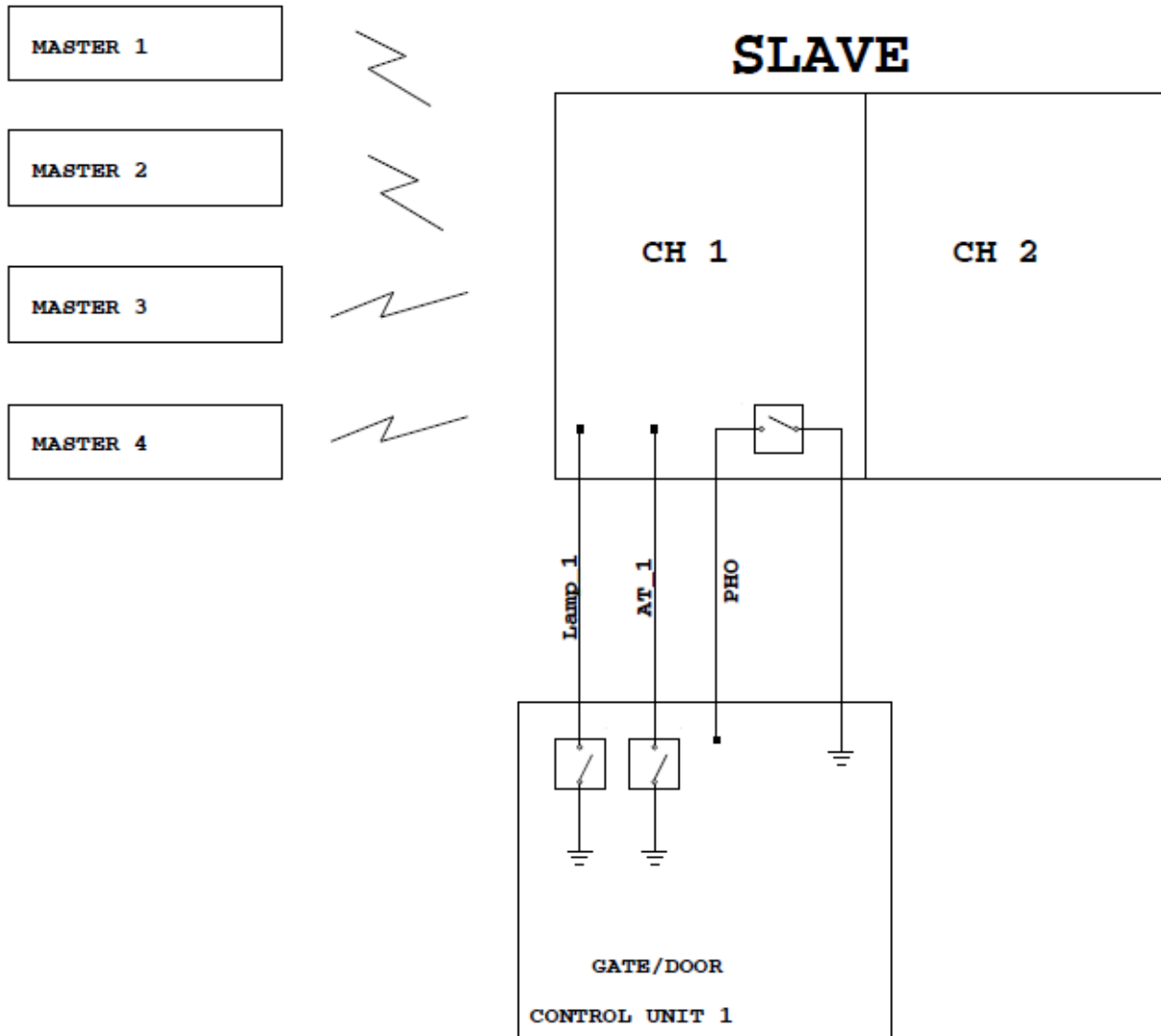
GATE/DOOR

CONTROL UNIT 1

Figure 1

In this scenario all masters (from 1 to 4) are associated to channel 1 of the slave.
Slave is connected to one gate/door control unit with related Lamp and Autotest (optional) inputs and PHO and Relay Block (pedestrian optional) outputs.

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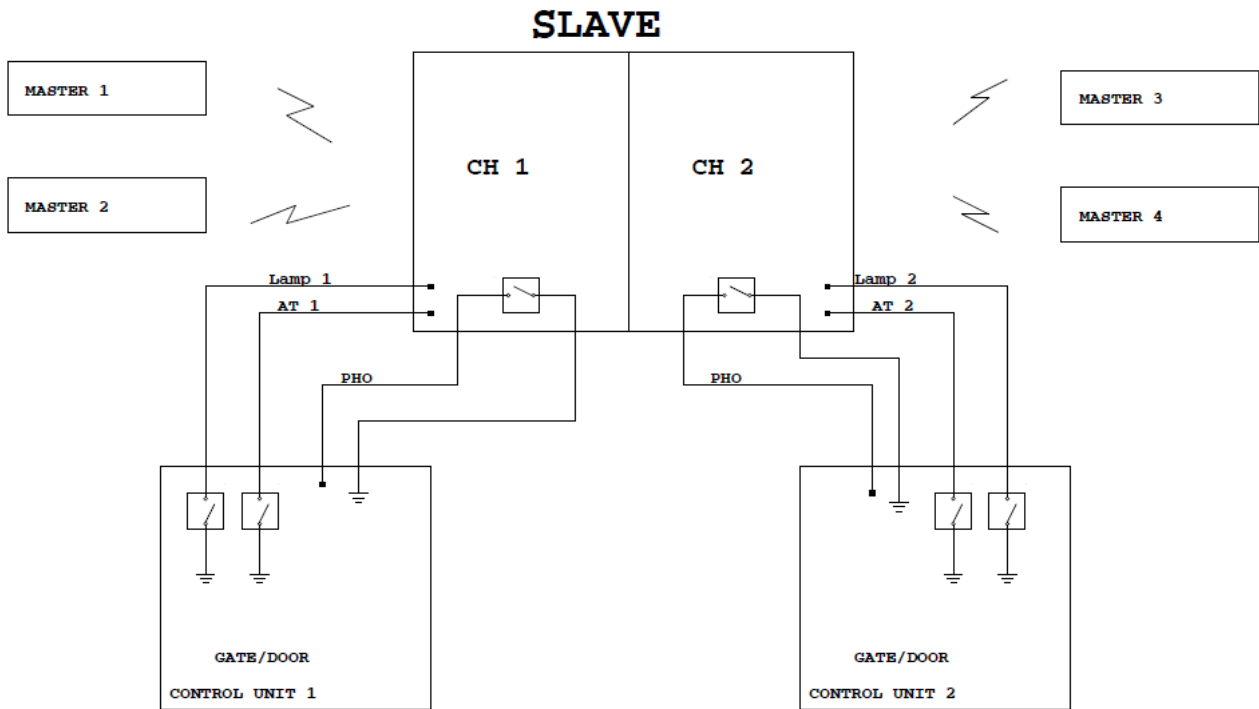**Scenario with two masters joined to channel 1 and two masters joined to channel 2**

Figure 2

In this scenario two masters (1 and 2) are associated to channel 1 of slave and two masters (3 and 4) are associated to channel 2.
Slave is connected to two gate/door control units, each one with related Lamp and Autotest (optional) inputs and PHO and Rele Block (pedestrian optional) outputs.

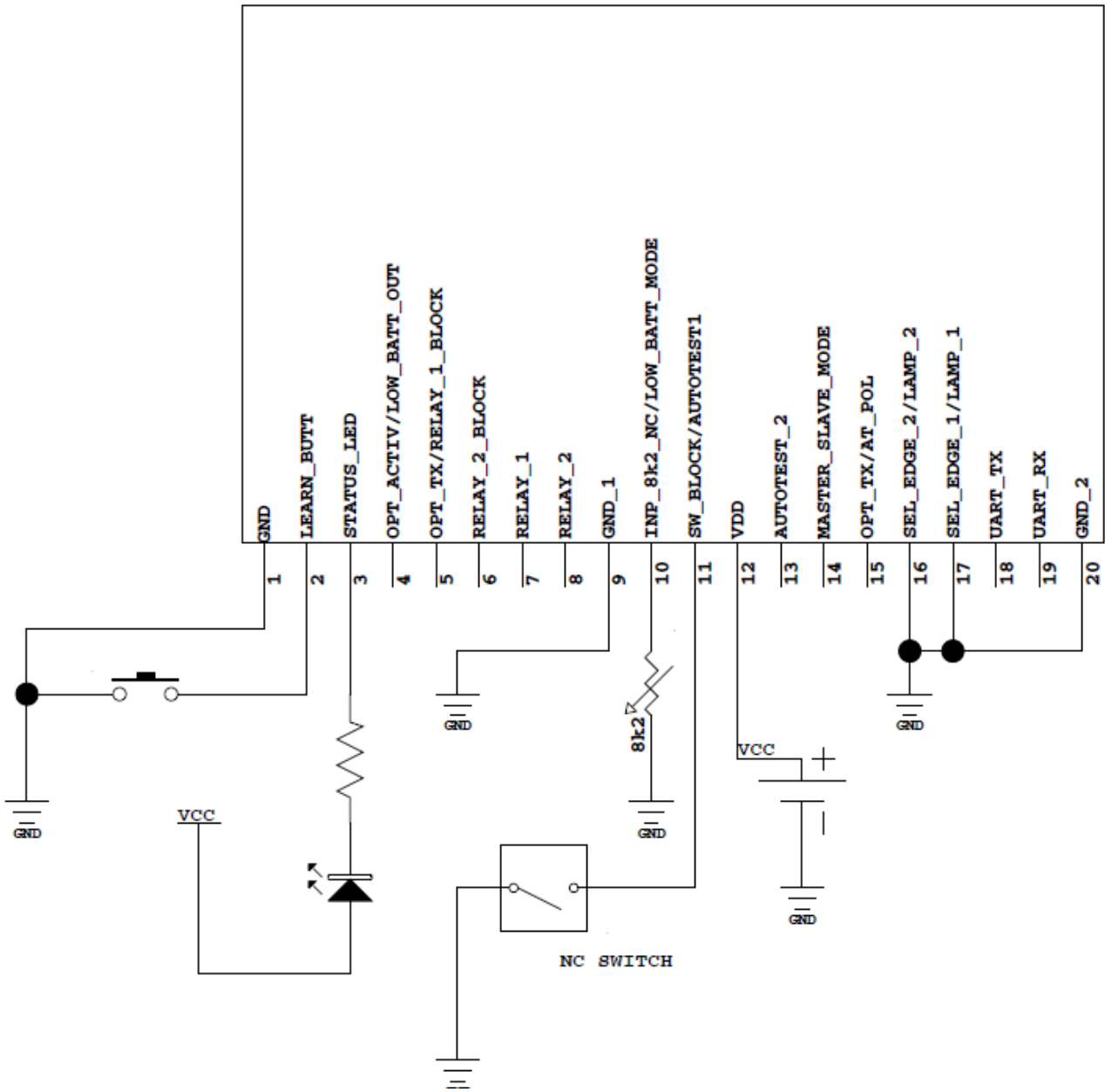**Master with resistive safety edge application electrical schematic**

Figure 3

Master with NC switch safety edge application electrical schematic
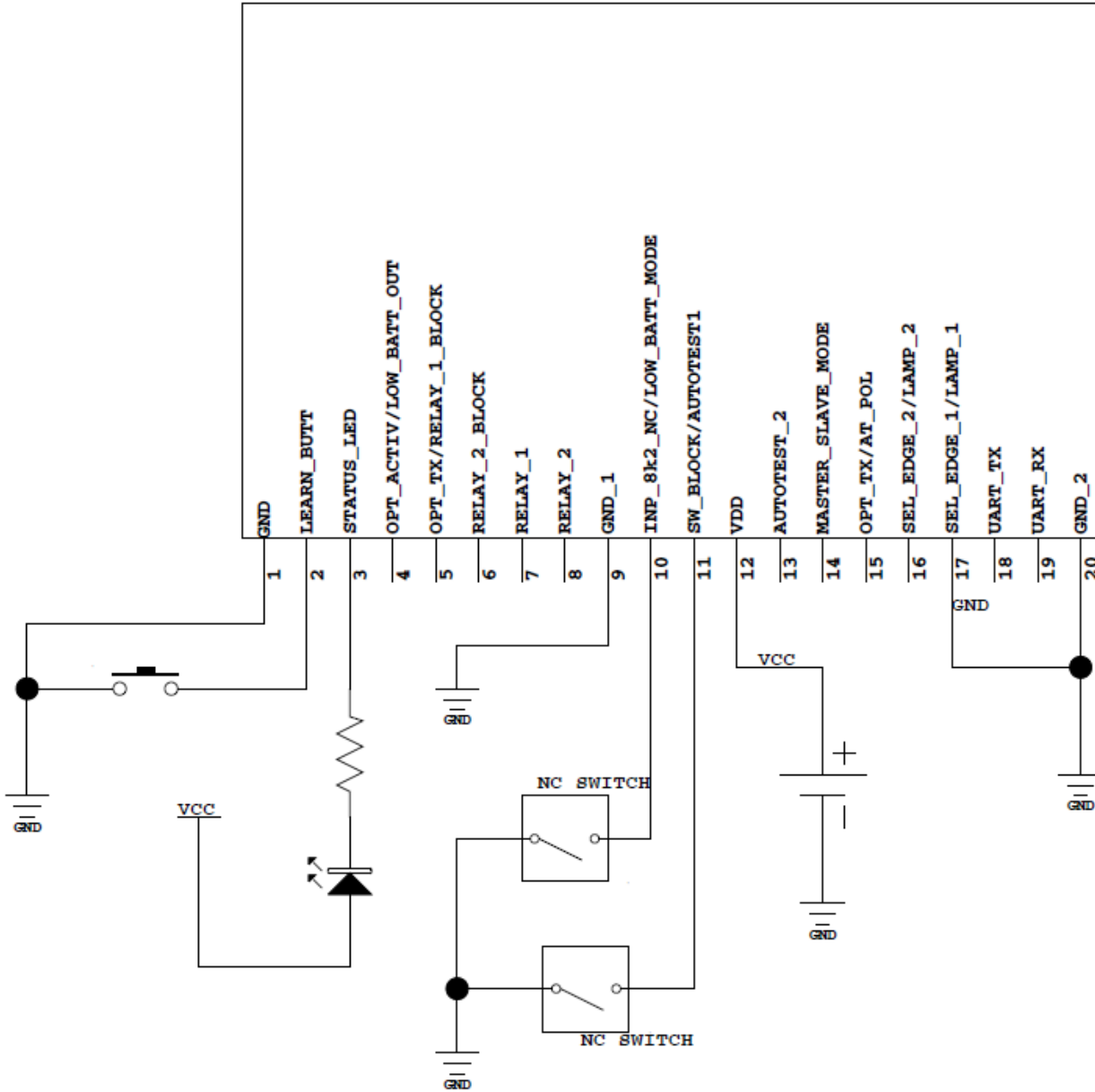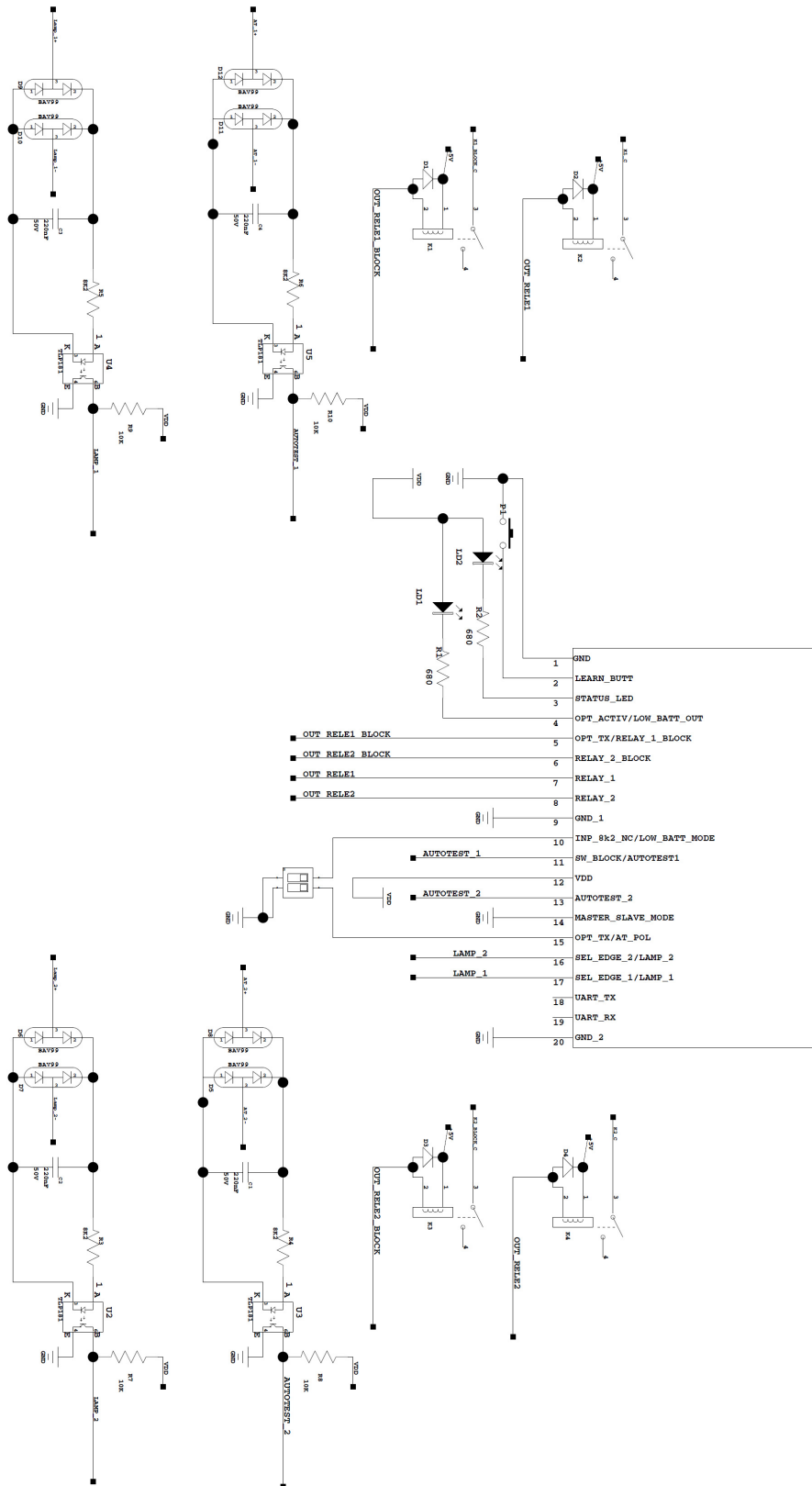

Figure 4

Slave application electrical schematic

Picture 5

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Device usage

In order to obtain the performances described in the technical specifications and to comply with the operating conditions which characterize the Certification, the device must be mounted on a printed circuit taking into account the following:

Voltage Supply

1. The module must be powered by a low voltage safety source protected against short circuits. Maximum allowed voltage variations: 1.8÷3.6V.
2. Decoupling near the device with a ceramic capacitor of at least 100.000 pF.

Ground:

It must surround in the best possible way the welding area of the device. The ground plane should be made in the lower face and must not be present near the integrated antenna in order to avoid coupling.

Other components:

1. When mounting the module parallel to the PCB do not include tracks near integrated antenna.
2. Keep the device away from all other components of the circuit (more than 5 mm)
3. Keep particularly far away and shielded all microprocessors and their clock circuits.

Reference Standards

The device **WIRELESS SAFETY EDGE MODULE 2.4GHz** comply with the European standards **EN 300-400 Class I** and **EN 301-489** with maximum power supply of 3.6V. The product has been tested according to EN 60950 and can be used inside a special housing that ensures compliance with the above mentioned regulations. The device must be powered by a low voltage safety source protected against short circuits.

The use of the module is foreseen inside housings that assure the overcoming of standards EN 61000 not directly applicable to the module itself. In particular, it is the user's care isolation antenna as the RF output of the transmitter is not able to support directly the electrostatic charges foreseen by the standard EN 61000-4-2.

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