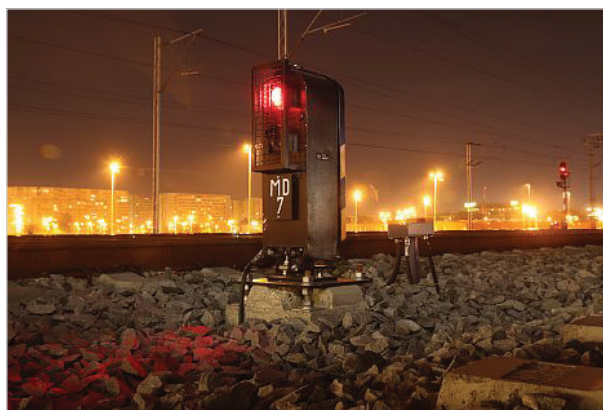


# Railway LED signals

## Main signal, Shunting and Limit Track LED signals

### Device features and capabilities:

- Developed specifically as a replacement for incandescent light bulbs on Siemens SpDrS-64 relay interlocking
- Compatible for use with Domino 55 relay interlocking and various electronic interlocking
- LL-000-m can be adopted according to customer requirements for different interlocking systems
- Modular and flexible design capable of supporting a wide range of operating conditions
- No changes are needed in the interlocking system
- Day and Night mode of operation with different lighting level
- Possibility to adjust the lighting level according to user requirements
- Blinking operation with frequency of 1Hz
- Operating with various input voltages both AC and DC
- Provides two filament operation, including auxiliary filament test on red aspect
- Supplied in own housing or as an LED module
- Use of high quality Cree or Osram LEDs in the device
- Completely galvanically isolated device from interlocking system
- Different levels of protection in the device (over-voltage, over-current and temperature protection for electronic circuits)
- Safe at fault and long service life
- Behavior of the device as a light bulb substitute (voltage and current are in phase)
- Fulfills SIL4 requirements according to CENELEC standards



### Basic description

LL-000-m is an LED light source used for main railway signals, designed as a replacement for two filament light bulbs on relay interlocking (SpDrS-64 or Domino55). LL-000-m provides full compatibility with the light bulb interface, i.e. day-time, night-time and blinking operation as well as continuous auxiliary filament test on the red aspect. Due to the complex operating requirements of a relay interlocking, LL-000-m implements a modular and flexible design capable of supporting wide range of operating conditions, applicable on different types of interlocking systems. When used on the SpDrS-64, LL-000-m doesn't require any modifications on the interlocking system, other than replacing light bulb housing with LL-000-m or replacing just light bulb with LED module.

The main advantage of the LED signal over the incandescent light bulb signal (for SpDrS-64, Domino 55 or any other relay based interlocking systems) is considerably longer life time and availability which greatly reduces maintenance cost.

LL-000-m can also satisfy different electronic interlocking requirements.

This use case proves the advantage of the modular design as it reduces costs of adapting LL-000-m to different kind of interlockings. Light source of LL-000-m consists of several individually controlled and monitored high current LEDs. LL-000-m proves that bulk glass lens and light bulbs are not necessary. Due to the fact that LL-000-m uses color LEDs, color filters are also not necessary. This also means that color phantom signals are not possible.

This use case was successfully proven on railway infrastructure where around 3000 pcs of LED signals of the Institute Mihajlo Pupin were installed and commissioned on Railway corridor sections.

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## Technical characteristics for LED modules

Input voltage range AC:	from 10VAC to 50VAC (transformers are used to make voltages suitable for LED modules)
Input voltage range DC:	from 10VDC to 50VDC
Current consumption:	up to 1.6A
Rated power:	from 15VA to 30VA (normal working range)
Operating temperature range:	from -40°C to +85°C (ambient temperature)

## Technical characteristics for LED signals

Input voltage range AC:	from 50VAC to 240VAC
Input voltage range DC:	from 10VDC to 50VDC
Current consumption:	up to 1.6A
Rated power:	from 15VA to 30VA (normal working range)
Operating temperature range:	from -40°C to +85°C (ambient temperature)
Distance from the station:	up to 5km with railway cable 0.9mm (loop resistance 56.6Ω/km)
Housing material:	aluminum alloy housing
Housing protection:	IP54 level for standard use, can be upgraded to IP68
Signal diameter:	70mm, 100mm, 136mm, 160mm, 200mm, 210mm
Available colors:	Red, Yellow, Green, White and Blue
Electrical protection:	Galvanic isolation, integrated thermal, over-current, over-voltage and transient protection
Mode of operation:	Day and Night mode of operation with different lighting level
States of operation:	Three different states of operation so that interlocking can detect device state

Module can operate in interlocking system with one (only main) or two filaments (main an auxiliary).

If used with one filament (only main, with for example electronic interlocking system) there are three different states of operation:

1. Normal state Works properly, both LEDs work, the device returns the rated nominal current to interlocking system
2. Alarm state Device detected that one of the LEDs stopped working, the device returns the alarm current to interlocking system
3. Error state Device detected that both LEDs stopped working, the device returns the fault current to interlocking system

If used with two filaments (main and auxiliary, with for example relay interlocking system) device can imitate light bulb, there are three different states of operation:

1. Normal state Works properly, both LEDs work, the device returns the rated nominal current to interlocking system for main filament, auxiliary filament test on red aspect
2. Alarm state Device detected that one of the LEDs stopped working, the device turns of current consumption on main filament and starts working on auxiliary filament with nominal current to interlocking system
3. Error state Device detected that both LEDs stopped working, the device returns the fault current to both filaments of interlocking system (no current draw)



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