MachRoad

USER MANUAL for MachRoad

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Informative note :

This document describes the controls and options of the MachRoad models.

As the other Mach2000 models do not have the same software and hardware characteristics of MachRoad, they cannot make use of the functions described below.

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1 GENERAL DESCRIPTION OF THE MachRoad SYSTEMS

The MachRoad systems were specifically designed by STILA ENERGY S.p.A., for automating the lighting systems of road and motorway tunnels.

The basic technical characteristics and the main functions are the same as those of the Mach2000 systems, for which a manual and general description is available.

The purpose of this technical document is to provide a description of the specific software and hardware used in the most complex and advanced family of "flow regulators" ever produced by STILA ENERGY S.p.A.

2 SYSTEMS AND CONFIGURATIONS

Tunnel lighting systems consist of, everywhere, a line of always lighted lamps ("permanent") and, generally, from 1 to 3 lines which considerably increase ("reinforcements") the illumination of the first section of the tunnel to compensate for the changeover from daylight to tunnel darkness.

A line of lamps, usually every 4 or 5 of the "permanent" line, must be specified to include an emergency power supply (by UPS) if a black-out disables the systems, leaving the tunnel in complete darkness.

In the more complex configuration, three MachRoad appliances operate in a network connected to each other by their respective digital interfaces.

The main appliance (master) is connected - via a digital interface - to the luminosity sensor located outside the tunnel.

The two secondary appliances (slaves) receive the sensor signal from the interface installed on the master.

MachRoad MASTER: manages the "permanent" line, but, if the system thus specifies, it can sequentially power-up/down and control up to 4 "permanent" lines (circuits).

MachRoad SLAVE 1: manages the emergency line, usually know as "tracing", maintaining the luminous flux emitted by these lamps at the same level as the "permanent" line, to avoid, during night hours, the stroboscopic effect caused by 4/5 lamps on minimum flux and 1 on maximum flux.

MachRoad SLAVE 2: manages from 1 to 3 "reinforcements", lighting them sequentially and adjusting them to obtain the best proportion between external light (daylight) and internal tunnel light.

3 LUMINOSITY SENSOR

MachRoad appliances accept the typical analog input (4/20 mA) from a luminance meter, but also offer an interesting alternative.

From 1995, STILA ENERGY S.p.A. introduced luminosity measurement by a simple "photo-sensitive element". This sensor is installed in a container in IP65 protection class, and is connected - via a simple screened 2-pole cable - to a specific optoinsulated A/D converter, located in a protected zone inside MachRoad.

The success of this simple innovation was assured by the complete absence of trouble up to now, as verified on various MWs of appliances installed in tunnels, and by the very low cost of the sensor+digital interface 'system'.

Illumination measurement systems usually consist of a luminance-meter, which is a very costly electronic instrument with microprocessor, sensitive to the atmospheric discharges typical of mountain or foot-of-mountain zones, where tunnels are most often found.

4 DESCRIPTION OF HARDWARE

MachRoad appliances differ from the standard Mach2000 model, through their digital interface for controlling the sensor and the contactors (optional) for powering-up/down the different lines to be managed.

The following versions are available: indoor, outdoor (cabinet in polyamide reinforced with fibreglass) and partially protected. The latter is available in an on-plate version and, according to design project, can also be created on sliding rack boxes, of compact size and suitable for installation inside modules in "power center" type structural works.

The most economic configuration has only one MachRoad appliance to manage the "permanent" line, complete with interface and sensor, but with only one set of terminals with clearance for activating the reinforcement circuits (from 1 to 3). In this case the circuit power-up contactors must be installed in the tunnel's electrical panel.

5 DESCRIPTION OF SOFTWARE

STILA ENERGY S.p.A. has developed a new, revolutionary software for automating in-tunnel lighting systems.

The software makes it possible to fully customise management of the system as concerns its sizing, and the comfort one wishes to supply to users, and lastly, in terms of the desired energy saving.

The software makes it possible to :

- decide the power-up "point" (in terms of luminosity) of every circuit including both "permanent" and 'reinforcement" circuit/s;
- decide the minimum and maximum operating voltage for each "circuit"';
- decide, just by pressing one key - whether to eliminate/disable management of a circuit via the software (e.g. due to a fault in the system);

Even finer adjustments can be carried out by intervening also on the sensitivity of the photo-sensor, which can be set directly by the user at his discretion (but only following a short training course) on the digital interface

The supply conditions for this type of appliance generally also specify commissioning (at a charge) by the technicians of STILA ENERGY S.p.A.

6 INSTALLATION OF MachRoad

MachRoad is installed in a similar way to all Mach2000 systems: the connection must be made in series, downstream of the 'lights' master switch and upstream of the differential thermal breakers located to protect the lines.

The versions with 2 or more output lines, will have, in addition to the input terminals (MachRoad power supply) as many outputs (4-pole) as the number of lines to be managed.

The sensor which is fitted in a small box in IP65 class, must be installed on the end of the tunnel entrance opening with the glass panel facing the road carriageway.

The system was designed to measure an overall lighting value, and not that on a restricted area of asphalt, and, therefore, it is highly stable and not (intentionally) influenceable by shadows or other transitory phenomena which can cause brief but significant reading errors, and, therefore, errors in generating the desired illumination values.

7 HOW TO USE MachRoad

This Appendix describes how to use the "tunnels" program correctly and is supplied to integrate the "Use manual" of the standard Mach2000 systems.

The basic programming and use of the main functions of the MachRoad appliances are the same as for those of the Mach2000 standard.

For all the basic programming instructions, refer to the Mach2000 Standard Use Manual up to paragraph 6.1 inclusive.

8 TUNNEL PROGRAM

The first operation to carry out after basic programming, is to input the operational parameters of the "tunnel" program. This is the procedure for accessing the "tunnel" program:
from the main menu, use keys ◄ ► to find the following screen:

			P	R	O	G	R	A	M						
			M	O	D	I	F	I	C	A	T	I	O	N	

Press key "ENTER" to automatically change over to the following screen:

S	T	A	B	L	E	.		V	O	L	T	A	G	E	
L	U	M	I	N		-		T	U	N	N	E	L		

Using keys ◄ ► shift the cursor (the words flash) over "tunnel" and press the "Enter" key to automatically show the following screen:

			P	E	R	M	A	N	E	N	T				
V	M	I	N	1	6	0			V	M	A	X	2	3	0

At this step of the program, you input the minimum and maximum voltage of the permanent line only.
When the screen appears (VMIN flashes), to confirm the input value, press "ENTER"; otherwise, to modify voltage (resolution1 V between 160 and 230 V.), press keys ▲ ▼ and confirm the new value by pressing the "ENTER" key.
The VMAX parameter flashes automatically. In the same way, you can accept or modify the set value.
After confirming VMAX, press "ENTER", to transfer automatically to the programming of the parameters of "reinforcement 1".

9 REINFORCEMENT PROGRAMMING

Important preliminary note: the voltage range that can be programmed for the reinforcements is, in common with the "permanent" line, from160 to 230 V. (VMIN and VMAX).

In the simpler configuration of MachRoad, both the "permanent" line and the "reinforcements" are managed by a single appliance. In this case, non exclusion with key "F1" of the "permanent" line, generates an automatic increase from 160 to 185 V (software constraint) of the VMIN Minimum value, which can be programmed.

The purpose of this constraints to prevent - while the reinforcements are operating - the "permanent " line too from being supplied at an excessively low voltage thus generating insufficient lighting of the central part of the tunnel during daylight hours.

This usually happens with tunnels of over 500 metres in length, or, in any event, equipped with a "permanent " line of inadequate power.

The application of one appliance only is therefore recommended only for fairly short tunnels, or partially equipped with windows, with a reasonable amount of natural light.

If the "permanent" line is excluded or programmed, the following screen will automatically appear:

R	**I**	**N**	**F**		**1**			**V**	**M**	**I**	**N**	**=**	**1**	**6**	**0**
L	**U**	**M**	**=**	**1**	**0**	**0**		**V**	**M**	**A**	**X**	**=**	**2**	**2**	**0**

Input voltage values VMIN and VMAX (resolution 1 V. between 160 and 230 V.) and confirm them with "ENTER" in the same way as described for the "permanent " line.

The "LUM" parameter determines the power-up threshold of "reinforcement 1 " and can be modified (resolution 1 point between 60 and 110 points) as ever by using keys ▲ ▼ and confirming it with the "ENTER" key.

Reinforcement 1, in common with the "permanent" line, can also be easily disabled via software, by pressing key "F1" (the words "reinforcement 1 disabled" appear). Use this option in the following cases:

- the appliance is intended for managing the "permanent" line or the "tracing" line;
- the system has only 1 or 2 reinforcements and the tunnel "manager" wishes to considerably shift the power-up threshold of reinforcement 1, by inputting it only on the threshold of reinforcement No.2 or No. 3, in order to obtain high energy saving or, simply, because the tunnel ha a very good "permanent" line in terms of the illumination it provides;
- there is fault in the lighting system and you wish to absolutely inhibit power-up of the reinforcement circuit.

IMPORTANT: we advise you, at least initially, to input the minimum value (60 points) for powering up reinforcement 1 in order to determine the system's maximum luminosity performance. It will be possible, on request of the tunnel management Body, to increase at any time the power-up threshold and to thus save more on energy.

If the 60 point minimum threshold does not produce a power-up point adequate for the User's needs or desires, the user can intervene on the interface to adjust the "gain" on the reading received from the luminosity sensor.
The technicians of STILA ENERGY S.p.A. must be called in for these adjustments.

IMPORTANT: THE POWER-DOWN THRESHOLD OF THE REINFORCEMENTS HAS A NEGATIVE FIXED HYSTERESIS OF 10 POINTS: therefore, in the case of reinforcement 1, if a power-up value of 60 points was input, the reinforcement will stay powered for all the higher values, but power-down will only occur when the luminosity drops to 50 points (60-10 points).

The aim is to avoid continuous power-ups/downs caused by the matching of the circuit power-up value with the circuit power-down value.

After the "reinforcement 1" circuit has been excluded or programmed, the "reinforcement 2" screen appears automatically:

R	**I**	**N**	**F**		**2**			**V**	**M**	**I**	**N**	**=**	**1**	**7**	**0**
L	**U**	**M**	**=**	**1**	**5**	**0**		**V**	**M**	**A**	**X**	**=**	**2**	**2**	**0**

The programming or exclusion methods are the same as those used for "reinforcement 1". The only variation concerns the power-up threshold of "reinforcement 2", which can be programmed between 120 and 150 points, with minimum resolution of 1 point.

After the "reinforcement 2" circuit has been excluded or programmed, the "reinforcement 3" screen appears automatically:

R	**I**	**N**	**F**		**3**			**V**	**M**	**I**	**N**	**=**	**1**	**8**	**0**
L	**U**	**M**	**=**	**2**	**0**	**0**		**V**	**M**	**A**	**X**	**=**	**2**	**2**	**0**

The programming or exclusion methods are the same as those used of "reinforcements 1 and 2". The only variation concerns the power-up threshold of "reinforcement 3", which can be programmed between 160 and 200 points, with minimum resolution of 1 point.

10 IMPORTANT CHECKS

The operations, performed above, concerning the parameters of the "permanent" line and the "reinforcements" cannot be considered complete the appliance cannot be started, unless all the parameters described in the standard use manual (at least up to paragraph 7 excluded) - valid for all the Mach2000 and MachRoad systems, have first of all been input.
Programming the basic parameters is an essential aspect: MachRoad stabilises output voltage at the precision and speed defined in the “CONFIGURATION” program step, and every power-up of the reinforcements implies a start-up and lamp warming cycle, defined in the “START-UP” program step.

11 DESCRIPTION OF THE PROGRAM LOGIC

The voltage and luminosity values for the permanent line and for the reinforcements were input in the four screens (permanent and 3 reinforcements).

These values will be used for creating a conversion table (generated by a specific algorithm) which will start from a hexadecimal value of "0" and will terminate at a value, also hexadecimal, of "255".

There will always be a total of 256 luminosity points ("0" included).

Creating the table automatically is no simple task, therefore, to grasp the concept, you should imagine 4 adjoining segments, whose lengths and inclinations are defined by every single screen: after reading - via the decoding of the A/D converter - the luminosity value supplied by the photo-sensor, MachRoad adjusts the value of the output voltage in relation to the set table, and decides whether to power-up/down the reinforcements and what output voltage is necessary for adequate adjustment of the luminous flux.

The table can be modified from a keyboard, from a portable PC, or from a remote station via modem or GSM module .

IMPORTANT: all the functions, including the test for identifying the end-of-life lamps, are active also in the MachRoad appliances.
For detailed instructions, consult the Mach2000 standard user manual.

12 MAINTENANCE

The routine maintenance required by the MachRoad systems is the same as that of the Standard DEL Mach2000 models (Chap. 16, page 35 of this Manual).

If the appliances are located inside the tunnel, the most important maintenance operation is the exhaustion of the conductive (and non-conductive) dust very rapidly forming in these particular appliances.

In any case, as these applications are expected to operate round-the-clock, we suggest a check and overall at least every six months.

13 SDL20 LUMINANCE PROBE

The SDL20 probe was designed for the specific use in road tunnels.

The technology uses a photodiode and relevant filter designed for the luminance reading (Cd/m²) within a solid angle of 20 degrees according to the Norm CIE 88/90.

The respect of the Norm UNI 11095 is obtained through the correct positioning of the SDL20 according to the indications given by the above Norm and the use of the MachRoad Power Controller.

The MachRoad takes care of all the necessary tuning and settings within the limits of the lighting installation resulting from the original project thus ensuring the correct distribution of the luminous flux at all times.

The transmission of the measures by the SDL20 happens through the conversion of the luminance values into a 4÷20 mA analogical signal.

The housing of the SDL20 transmitter has an IP67 protection level. The device as a whole comes in a container for outdoor use and IP55 protection level suitable for wall or mast mounting thanks to an adjustable bracket.

The SDL20 must be placed and well oriented according to the braking distance of the vehicles and the road typology.

The 4÷20 mA signal, through a screened and well sized cable, reaches the MachRoad, where it is converted in digital values.

The MachRoad, based on the values received, will automatically make all the necessary adjustments and turn on or switch off the series of lamps connected to the different circuits within the tunnel.

- The MachRoad software, specifically developed for road tunnels, makes sure that the following functions are taken care of automatically:
- The sequential turning on and switching off of up to three "Accrued Light" circuits.
- Output voltage adjustment of the "Accrued Light" circuits as well as the "Permanent" circuit (if connected to the MachRoad).
- Setting up of the adjustable "range" (minimum and maximum voltages) independently for each circuit.
- Generating the correct start-up and warm-up cycles for the lamps

13.1 TECHNICAL SPECIFICATIONS

13.1.1 SPECIFICATIONS FOR THE HOUSING (IP 55)

The weather-proof housing is made of an extruded "anticorodal" compound material worked out with a CNC milling machine and painted with pearl-white epoxydic powders (RAL1013).
The mounting of the transmitter inside the housing is on an adjustable sledge and the access to the transmitter can be made at all times by simply sliding out the upper part of said housing.

Easy access	Internal through pass cables
Stainless steel screws	Anti-aging seals
Front screen in tempered glass	Epoxydic powder paint
Adjustable wall or mast mounting bracket	Dimensions: 92 x 83 x 185 mm

13.1.2 SPECIFICATIONS FOR THE TRANSMITTER (IP67)

Input voltage	10 ÷ 40 V dc
Current consumption	10 mA
Output signal	4÷20 mA
Sensor	Phto-diode
Spectral field V curb	V (λ)
Reading range	0,2 ÷ 5000 Cd/m²
Sensibility	0,5 ÷ 50 mV/ (Cd/m²)
Reading angle	20° as per CIE 88/90 norm
Operating temperatures	-20 ÷ + 60 °C
Protection level	IP 67

13.1.3 CE CONFORMITY OF THE TRANSMITTER

Safety	EN 61000 - 4 -2 , EN 61010-1 LEVEL 3
Electrostatic discharge	EN 61000 - 4 -2 LEVEL 3
Electrostatic fast transient	EN 61000 - 4 -4 LEVEL 3
High energy source	EN 61000 - 4 -5 LEVEL 3
Voltage variations	EN 61000 - 4 –11
Electromagnetic interference susceptibility	IEC 1000 – 4 – 3
Electromagnetic interference emission	EN 55020 class B

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