

TLM-1 TOWER LIGHT MONITOR V4.0

INSTALLATION and OPERATING INSTRUCTIONS

SYSTEM OVERVIEW

The TLM-1 Tower Light Monitor is a microprocessor-based system designed to monitor the status of incandescent tower lighting systems. The system will monitor up to eight beacon bulbs and eight marker bulbs. Alarm outputs include single bulb failure, flasher failure or out-of-tolerance condition and photocell failure. Status outputs are provided for beacon on/off and tower lights on/off. All outputs are opto-isolated for lightning protection when connected to external remote site monitoring equipment.

The monitor is designed to be installed at the electrical circuit breaker panel even if the flasher and/or photocell is located on or near the tower and is fed by a single 120- or 240-volt circuit. The current feeding the tower circuit is sampled by a current transformer located at the circuit breaker and is fed to the monitor circuit board where it is processed. With all lights operating on the tower, the monitor automatically calibrates itself for the number of bulbs in the system.

SPECIFICATIONS

Lighting type:	FAA Style A incandescent obstruction lighting standard using type L-864 beacons and type L-810 obstruction (marker) lights
	Note: Beacon levels must flash together (multiple units are required for alternating or sequenced flashing systems)
Capacity:	Up to eight 620-watt or six 700-watt beacon bulbs and eight 116-watt marker bulbs (120-volt operating voltage)
Sample method:	Current transformer; microprocessor controlled monitoring
Timing accuracy:	Referenced to 60 Hz line frequency (not compatible with 50 Hz)
Alarm outputs:	Photocell failure
	Flasher failure (alarms for continuous on or off, duty cycle tolerance and flash rate tolerance)
	Bulb failure (separate alarm outputs for beacon and marker failures)
Status outputs:	Tower lights on/off
	Beacon lights on/off
	(Alarm and status outputs are opto-isolated and are rated at 20 mA and 30 V maximum)
Power Requirement:	9 - 12 volts AC/DC at 100 mA (120-volt wall adapter included)
Size:	6" L x 3.2" H x 2" D clear plastic enclosure

INSTALLATION

Important! Installation requires access to the tower light circuit breaker and potentially lethal voltages. A qualified electrician should be employed to make any changes to the electrical system. All applicable electrical codes must be followed.

Note! Refer to the installation example diagrams for current transformer wiring.

Locate the circuit breaker for the tower lights and turn it off. For 120-volt systems, remove the wire from the breaker and pass it through the current transformer hole (direction is not important). For 240-volt systems, remove the wires from the breaker and pass them through the current transformer *in the opposite direction*. For 208- or 240-volt systems that are then stepped down to 120 volts, pass one of the 208/240 wires through the current transformer twice (one loop around the transformer). Do not pass the neutral or ground wire through the current transformer. Reconnect the wire(s) to the circuit breaker (do not reset the circuit breaker at this time).

Mount the monitor enclosure near the circuit breaker panel and connect the current transformer to the monitor using the cable supplied ("CT OUT" terminals on the current transformer to the "CT IN" terminals on the monitor board - polarity is not important). After the current transformer and monitor are connected, the tower light circuit breaker can be reset. Tower lights should not be operated without the current transformer connected to the monitor.

Note! The current transformer cable can be extended several hundred feet if necessary. Shielded, twisted-pair cable should be used to avoid noise ingress.

Connect the wires from the AC adapter to the "AC/DC IN" terminal on the monitor board (polarity is not important). Plug the AC adapter into a 120 VAC receptacle.

Note! It is recommended that a 120 VAC receptacle be wired to the tower light circuit to supply the monitor. This method will cause the monitor to alarm the remote monitor system if the breaker should trip during daylight when the tower lights are normally off. If the monitor is supplied from a separate circuit, a daytime trip of the tower light circuit breaker will not cause an alarm until the photocell timer has expired (up to 20 hours).

Connect the remote monitoring system to the tower light monitor. As long as power is applied, the monitor provides a continuous closure between the "COMMON" terminal and each of the alarm terminals ("PHOTOCELL, FLASHER, BEACON, MARKER and ALARM") under a no-alarm condition. An alarm condition causes an open circuit on that alarm terminal (active high). If dipswitch no. 4 is set to "ON", the "PHOTOCELL, FLASHER, BEACON and MARKER" alarms are changed to active low. This mode allows these alarms to be paralleled with other units where multiple towers are monitored (such as directional arrays) to save on status inputs on the remote monitoring equipment. If this mode is used, the "ALARM" output from each unit should be wired to the remote monitoring system as a failsafe and to indicate which tower is causing the specific alarm. The "LIGHTS STATUS" and "BEACON STATUS" terminals provide a closure when the tower lights and beacons are on, respectively. These outputs act like dry contacts - the remote monitoring equipment must provide pull-up resistance if necessary. Polarity is important in this case - the alarm terminals must be positive with respect to the "COMMON" terminal. A remote alarm reset can be accomplished by providing a closure from the remote monitoring system to the "GROUND" and "RESET" terminals (opto-isolated).

SETUP PROCEEDURE FOR 700-WATT BEACON LAMPS, 208- to 120-VOLT SUPPLY SYSTEMS and COMBINING FLASHER ALARM with BEACON ALARM

Use this procedure if the beacon lamps are 700 watts and/or the 120-volt tower light supply is stepped down from 208 volts and the current transformer is used in the 208-volt circuit. Also use this procedure if it is necessary to combine the flasher and beacon alarms.

SETUP DIPSWITCH SETTINGS

Unplug the power supply. Set the dipswitches as described below:

Note! Switch to the right is "ON", top switch is No. 1.

Switch No. 1: If the current transformer is placed in a 208-volt circuit that is then stepped down to 120 volts for the lighting circuit, then set this switch to "ON".
If 120- or 240-volt supplies are used, then set this switch to "OFF" (default).

Switch No. 2: If 700-watt beacon lamps are used then set this switch to "ON".
If 620-watt beacon lamps are used then set this switch to "OFF" (default).

Note! Two loops through the current transformer are required on 208- or 240-volt circuits that are then stepped down to 120 volts.

Switch No. 3: To combine the FLASHER and BEACON alarms to a single BEACON alarm, set this switch to "ON". In this mode a beacon lamp failure will cause a BEACON alarm and a flasher failure will cause both a BEACON and FLASHER alarm. This mode is provided to eliminate a status input if necessary.
For independent FLASHER and BEACON alarms, set this switch to "OFF" (default).

While pressing the "CAL" button, power up the unit. The "CAL" light will flash at a 1 Hz rate confirming the unit is in the setup mode. Now release the "CAL" button; this will set the unit up for the desired operating mode(s). Next, power-cycle the unit; the "CAL" light will return to the 10 Hz flash rate indicating normal operation. These settings will be used until another setup is performed and they are retained if the unit loses power or is calibrated. Return the dipswitches to the previous settings used for normal operation. The unit is now ready for calibration.

OPERATING DIPSWITCH SETTINGS

Note! Switch to the right is "ON", top switch is No. 1.

Switch No. 1: If there is a marker light used in the Antenna Tuning Unit (AM stations) for humidity control that is on continuously (located before the tower flasher/photocell unit in the circuit), then set this switch to "ON". This setting will cause the monitor to ignore this bulb and give correct a correct tower lights on/off status. This bulb must be a 116-watt marker lamp.

Switch No. 2: If this switch is set to "OFF", the photocell timer is set to 20 hours. If the monitor does not detect the tower lights status change during this time span, a "PHOTOCELL" alarm will occur.

If this switch is set to "ON", the photocell timer is inhibited. Use this setting if tower lights are always operating (photocell not used).

Switch No. 3: If this switch is set to "OFF", the "PHOTOCELL, FLASHER, BEACON or MARKER" alarms will be cleared after the alarm condition is corrected (the "ALARM" output must be cleared by pressing the reset button).

If this switch is set to "ON", the "PHOTOCELL, FLASHER, BEACON or MARKER" alarms can be cleared by pressing the reset button twice; however, these alarms will reoccur if the alarm condition persists. Use this setting for holding the alarms until manually reset.

Switch No. 4: If this switch is set to "OFF", the "PHOTOCELL, FLASHER, BEACON and MARKER" alarms are active high; if the switch is set to "ON" these alarms are active low. Using active low alarms allows for paralleling of multiple units to save on status requirements of the remote monitoring system when used with directional arrays.

Note! Using the active low alarm mode compromises the failsafe feature of the unit unless the "ALARM" output is also used (this output is always active high).

CALIBRATION

All tower lights should be on and flashing normally before calibrating the monitor. When this is confirmed, press the "CAL" button. The "CAL" light will go out for a few seconds while the unit "looks" at the tower lights and sets up the operating constants for the system. Any changes to the number of bulbs on the tower will require a calibration. It is also recommended that a calibration be performed after a tower re-lamping.

Note! The "CAL" light normally flashes at a 10 Hz rate to indicate the microprocessor is operating.

OPERATION

Daytime: All lights on the monitor should be on except for the "L/S" and B/S" (Lights Status and Beacon Status).

Nighttime: All lights on the monitor should be on and the "B/S" (Beacon Status) light should be flashing in cadence with the beacon lights.

Note! If dipswitch 4 is set to "ON", the "PHOTOCELL, FLASHER, BEACON and MARKER" lights should be off.

Note! It may take up to thirty seconds for the "BEACON" and "MARKER" alarms and up to four minutes for the "FLASHER" alarm to be activated after an alarm condition has occurred. After an alarm condition is corrected, it may take a few minutes for the alarm to be cleared (the "ALARM" output can only be cleared by the reset button).

BEACON-ONLY or MARKER-ONLY OPERATION

For structures that have only constant-burning marker lamps or only flashing beacons, the unit will automatically detect the lamp configuration during calibration and disable the alarm output for the type of light not present.

ALARM and STATUS CONDITIONS

ALARMS:

PHOTOCELL (P/C): Monitor has not detected a change in the "lights status" condition in 20 hours (dipswitch no. 2 setting "OFF").

FLASHER (FLS): There are three types of flasher failures that will cause a flasher alarm: flasher continuously on or off, flasher rate out of tolerance and flasher on/off ratio out of tolerance. When a flasher alarm occurs, the "CAL" light will flash in the following manner to indicate which failure type caused the alarm:

One repeating flash: flasher continuously on or off

Two repeating flashes: flasher rate out of tolerance (less than 20 or more than 40 flashes per minute)

Three repeating flashes: flasher on/off ratio out of tolerance (less than 36 or more than 69 percent ON period of the total ON and OFF period)

Simultaneous failure types are indicated by a sequence of each type of flash. When the alarm is cleared, the "CAL" light will return to the normal 10 Hz flash rate.

The flasher alarm can be cleared by pressing the reset button twice; however, it will reoccur if flasher problem is not corrected.

BEACON (BCN): Activates on a bulb failure or flasher continuously off.

Note! For marker-only operation the beacon and flasher alarms are disabled. The "FLS", "BCN" and "B/S" lights are always off in this mode.

MARKER (MKR): Activates on a bulb failure.

Note! For beacon-only operation the marker alarm is disabled. The "MKR" light is always off in this mode.

ALARM (ALM): Activates with any of the above alarms. This alarm can be cleared by pressing the reset button once. If this alarm is reset after a bulb failure, a second bulb failure will cause another alarm. If the alarm is reset again, the alarm will reoccur if the problem is not corrected.

STATUS:

LIGHTS (L/S): Indicates if tower lights are on or off. Flashes with beacons if all marker lights are out.

BEACON (B/S): Indicates if beacons are on or off (flashes with beacons).

MULTIPLE ALARM and STATUS CONDITIONS:

Certain tower light system failures will cause an alarm and an abnormal status condition:

A flasher failure in the OFF state will result in Flasher and Beacon alarms in addition to the Beacon status light remaining off.

A flasher failure in the ON state will result in Flasher alarm in addition to the Beacon status light remaining on.

If all marker lights are out, the Lights status will flash along with the Beacon status (a marker alarm will result also).

If all alarm and status lights are off, the monitor has lost power.

RESET and CALIBRATE BUTTONS

RESET: The first press will reset the "ALARM" output, the second press will reset the "PHOTOCELL, FLASHER, BEACON and MARKER" alarm outputs. Pressing the reset button for five seconds will start the current sample readout sequence described below.

Note! If dipswitch 3 is "ON", RESET must be pressed twice to clear the "PHOTOCELL, FLASHER, BEACON and MARKER" alarm outputs.

CAL: Pressing this button performs a monitor calibration. Any changes to the number of bulbs in the system requires a calibration. It is also recommended that a calibration be performed after a tower re-lamping.

RETRIEVING STORED AND REAL-TIME CURRENT SAMPLES

When the TLM-1 is calibrated, it stores a current sample for the markers and a sample for the beacons. These samples are compared to the real-time samples taken after calibration to determine if there is a lamp failure. Each sample consists of a four-digit number that is scaled to the current for that sample (it is not the actual amperes). There are four samples: stored marker current, stored beacon current, real-time marker current and real-time beacon current. Both the stored calibration samples and the real-time samples can be retrieved by the following procedure (tower lights must be operating):

Press and hold the RESET button for five seconds. The unit will sequence through each sample and display it in 8-4-2-1 BCD format using the MKR, BCN, FLS and P/C lights in that order. The CAL, B/S, L/S and ALM lights will cycle for each number in the sample. Here is a sample sequence showing a BCD count from zero to nine:

	<u>MKR</u>	<u>BCN</u>	<u>FLS</u>	<u>P/C</u>		<u>VALUE</u>
CAL on	off	off	off	off	1 st stored marker sample digit = 0	
B/S on	off	off	off	on	2 nd stored marker sample digit = 1	0123
L/S on	off	off	on	off	3 rd stored marker sample digit = 2	
ALM on	off	off	on	on	4 th stored marker sample digit = 3	
CAL on	off	on	off	off	1 st stored beacon sample digit = 4	
B/S on	off	on	off	on	2 nd stored beacon sample digit = 5	4567
L/S on	off	on	on	off	3 rd stored beacon sample digit = 6	
ALM on	off	on	on	on	4 th stored beacon sample digit = 7	
CAL on	on	off	off	off	1 st real-time marker sample digit = 8	
B/S on	on	off	off	on	2 nd real-time marker sample digit = 9	8901
L/S on	off	off	off	off	3 rd real-time marker sample digit = 0	
ALM on	off	off	off	on	4 th real-time marker sample digit = 1	
CAL on	off	off	on	off	1 st real-time beacon sample digit = 2	
B/S on	off	off	on	on	2 nd real-time beacon sample digit = 3	2345
L/S on	off	on	off	off	3 rd real-time beacon sample digit = 4	
ALM on	off	on	off	on	4 th real-time beacon sample digit = 5	

After the sequence is complete, the unit returns to normal operation. The real-time samples will vary slightly with voltage fluctuations but should remain close to the stored samples that were taken during calibration. These samples are for reference only and are used for troubleshooting purposes. It is a good idea to log a set of these samples initially for comparison in case of problems later on.

Approximate sample values for 120-volt markers and beacons are:

	<u>120 volts or 240 volts stepped down to 120 volts</u>	<u>208 volts stepped down to 120 volts</u>
116-watt marker lamp:	0090	0104
620-watt beacon lamp:	0090	0104
700-watt beacon lamp:	0102	0117

Multiply each value by the number of lamps to get the total sample value for that lamp type.

CHECKING QUALITY of the CURRENT SAMPLE

The TLM-1 provides a way to check the amount of noise on the current sample at the input to the unit. To activate this mode power down the unit and press both the "CAL" and "RESET" buttons while powering up the unit. The "P/C", "FLS", "BCN" and "MKR" lights are now a signal-to-noise (S/N) indicator. If all lights are on, the S/N is good; if the "P/C" light is off, the S/N is lower and so on. The "BCN" light toggles to indicate the S/N present when the beacons are on (light on) and for the markers (light off). Lower S/N readings indicate a higher deviation from the bulb constants that were stored during calibration and may be caused by excessive RF on the sample. The unit should operate reliably with only the "MKR" light on; however, any rearrangement or shielding of the wiring that results in the most lights on will improve reliability.

After two minutes, the TLM-1 will revert to normal operation.

FCC and FAA Requirements:

The FCC requires notice to the FAA of any beacon bulb failure, flasher failure (beacons continuously on), or dark tower within thirty minutes of discovery of the problem. The FAA will request the tower registration number and issue a NOTAM (Notice to Airmen) of the tower problem. The FAA will give the tower owner 15 days to correct the problem; however, the problem should be corrected as soon as possible and the FAA contacted when the tower is returned to compliance so the NOTAM can be canceled. Failure to follow this procedure can result in hefty fines from the FCC.

FCC rules regarding tower lighting can be found at www.fcc.gov.

See FAA Advisory Circular AC 70/7460-1K "Obstruction Marking and Lighting" for lighting standards (specifically Red Obstruction Lighting Standards - FAA Style A).

See FAA Advisory Circular AC 150/5345-43F "Specifications for Obstruction Lighting Equipment" for flash characteristics (specifically Table 4 - Flash Characteristics for Obstruction Lights, Type L-864).

Warranty and Service:

FM Services warrants this product to be free of defects for one year after purchase. If you experience a problem or have a question about installation or operation, please call (336) 667-7091 or email at info@towermonitor.com

FCC Part 15 and Industry Canada ICES-003 Verification Notice

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at their own expense.

This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.