TL70 Wireless **MultiHop** Modular Tower Light

Datasheet

Sure Cross® Wireless MultiHop TL70 Tower Lights combine the best of Banner's popular Tower Light family with its reliable, field proven, Sure Cross wireless MultiHop architecture.

- Available in 900 MHz and 2.4 GHz ISM Bands
- Up to six colors, or five colors plus audible, in one device
- Rugged, water-resistant IP65 housing with UV-stabilized material
- Bright, uniform indicator segments appear gray when off to eliminate false indication from ambient light
- Two-way communication - light segments can be controlled with the input wires or the Gateway

Models

TL70 Base

Housing	Radio Band		Connection	Housing Color
B-TL70	DR2M	—	Q5	
Base Segment	DR2M = 2.4 GHz DR9M = 900 MHz		5 = 2 m, 5-wire Integral Cable 8 = 2 m, 8-wire Integral Cable Q5 = 5-pin M12/Euro-style Integral QD Q8 = 8-pin M12/Euro-style Integral QD QP5 = 150 mm (5.9 in) cable with 5-pin M12/Euro-style QD QP8 = 150 mm (5.9 in) cable with 8-pin M12/Euro-style QD Models with a quick disconnect require a mating cordset	Blank = Black C = Gray

TL70 Segments

Housing		Color/Alarm	Housing Color
SG-TL70	—	R	
TL70 Segment		G = Green Y = Yellow R = Red B = Blue W = White O = Orange A = Audible AL = Loud Audible ALM = Loud Multi-Tone Audible AP = Programmable Audible	Blank = Black C = Gray

Select the 5-pin base for tower light configurations of up to three modules. Select the 8-pin base for tower light configurations of up to six modules, or when the event counter will be enabled.

- Example base model number: B-TL70DR2M-Q5
- Example light segment model number: SG-TL70-G
- Example audible segment model number: SG-TL70-A

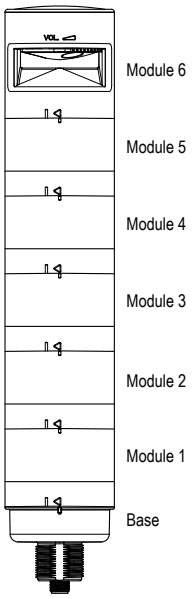
TL70 Pre-Assembled Models

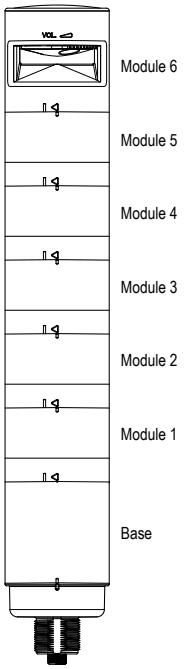
Housing	Radio Band	Color/Position 1	2	3	4	5	6	Audible Alarm*	Housing Color	Connection
TL70	DR2M	W	B	G	Y	R	O			Q
	DR2M = 2.4 GHz DR9M = 900 MHz	Blank = None G = Green Y = Yellow R = Red B = Blue W = White O = Orange						Blank = None A = Audible AL = Loud Audible AP = Programmable Audible * not available with six-light modules	Blank = Black C = Gray	Blank = 2 m Integral Cable Q = M12/Euro-style Integral QD QP = 150 mm (5.9 in) cable with M12/Euro-style QD Models with a quick disconnect require a mating cordset

- Example pre-assembled model number: TL70DR2MGYRAQ

Configuring the Modules

Turn on the appropriate DIP switch to set the order of the components, counting up from the tower light's base.



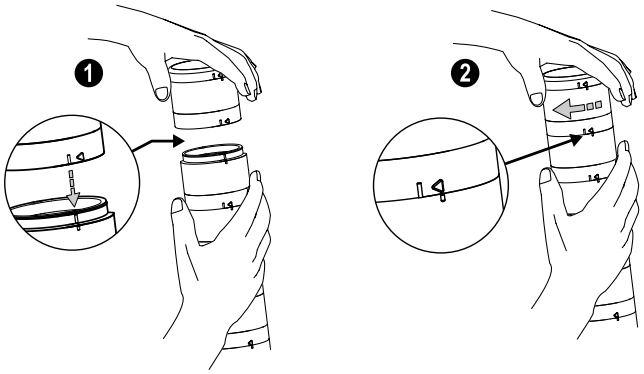


Assembly **Options**		DIP Switches							
		1	2	3	4	5	6	7	8
Light and Standard Audible Components	Module 1	ON							
	Module 2		ON						
	Module 3			ON					
	Module 4				ON				
	Module 5					ON			
	Module 6						ON		
Light Module Flash Rate	3 Hz							ON	OFF
	1.5 Hz							ON	ON
	Solid On*							OFF	OFF
Standard Audible Module Settings	Pulse 1.5 Hz							ON	OFF
	Chirp Alarm							ON	ON
	Siren Alarm							OFF	ON
	Continuous Alarm*							OFF	OFF

Assembly **Options**		DIP Switches									
		1	2	3	4	5	6	7	8	9	10
Loud Audible Module Settings	Pulse 1.5 Hz							ON	OFF		
	Chirp Alarm							ON	ON		
	Siren Alarm							OFF	ON		
	Continuous Alarm*							OFF	OFF		
	Low Intensity									OFF	OFF
	Med. Intensity									ON	OFF
	Med./Loud Intensity									OFF	ON
	Loud Intensity									ON	ON

* Factory default setting

Assembling the Modules

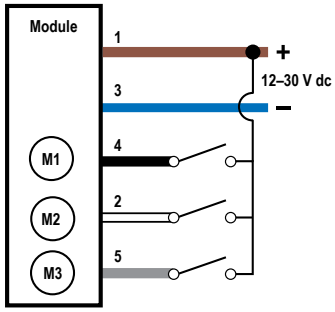


To assemble the modules:

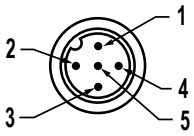
1. Align the notches on each module and press together.
2. Rotate the top module clockwise to lock into place (notches shown in the locked position).

Wiring Diagrams

PNP



Euro-style Male Pinouts

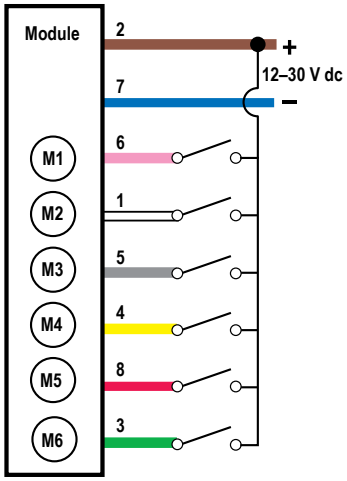


Key

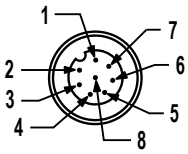
1 = brown
2 = white
3 = blue
4 = black
5 = gray

M1 = Module 1
M2 = Module 2
M3 = Module 3

PNP



Euro-style Male Pinouts



Key

1 = white
2 = brown
3 = green
4 = yellow
5 = gray
6 = pink
7 = blue
8 = red

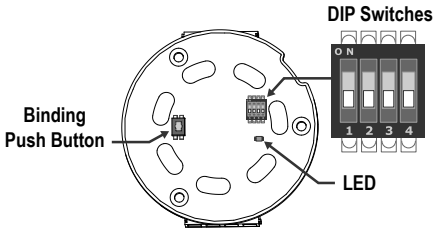
M1 = Module 1
M2 = Module 2
M3 = Module 3
M4 = Module 4
M5 = Module 5
M6 = Module 6

Input wires M1 through M6 can be used to either control the light segments or can be configured as external PNP Inputs. Refer to the DIP switch settings for configuration instructions.

Configuring the Radio Module

Set the Radio Module DIP Switches

Before applying power to the device, set the radio module's DIP switches. Default configurations are noted with (*).



Device **Settings**	DIP Switches			
	1	2	3	4
Transmit power 900 MHz radios: 1.00 Watt (30 dBm) 2.4 GHz radios: 0.065 Watts (18 dBm) and 60 ms frame	OFF *			
Transmit power 900 MHz radios: 0.25 Watts (24 dBm) 2.4 GHz radios: 0.065 Watts (18 dBm) and 40 ms frame	ON			
Input wires control light segments		OFF *		
Disables wired input control of light segments and converts wires to auxiliary Inputs		ON		
MultiHop radio setting: Slave			OFF *	
MultiHop radio setting: Repeater			ON	
Reserved				OFF *

Transmit Power Levels/Frame Size

The 900 MHz data radios can be operated at 1 watt (30 dBm) or 0.250 watt (24 dBm). For most models, the default transmit power is 1 watt.

For 2.4 GHz radios, the transmit power is fixed at 0.065 watt (18 dBm) and DIP switch 5 is used to set the frame timing. The default position (OFF) sets the frame timing to 60 milliseconds. To increase throughput, set the frame timing to 40 milliseconds. Note that increasing the throughput decreases the battery life.

Prior to date code 15341 and radio firmware version 3.6, the frame timing was 40 ms (OFF) or 20 ms (ON).

MultiHop Radio Overview

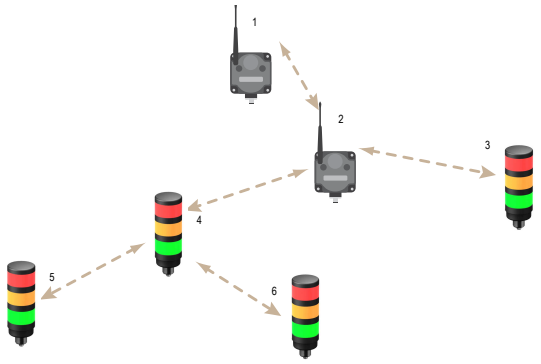
MultiHop networks are made up of one master radio and many repeater and slave radios.

The MultiHop networks are self-forming and self-healing networks constructed around a parent-child communication relationship. A MultiHop Radio is either a master radio, a repeater radio, or a slave radio.

- The master radio controls the overall wireless network.
- The repeater radios extend the range of the wireless network.
- The slave radios are the end point of the wireless network.

At the root of the wireless network is the master radio. All repeater or slave radios within range of the master radio connect as children of the master radio, which serves as their parent. After repeater radios synchronize to the master radio, additional radios within range of the repeater can join the network. The radios that synchronize to the repeater radio form the same parent/child relationship the repeater has with the master radio: the repeater is the parent and the new radios are children of the repeater. The network formation continues to build the hierarchical structure until all MultiHop radios connect to a parent radio. A MultiHop radio can only have one designated parent radio. If a radio loses synchronization to the wireless network it may reconnect to the network through a different parent radio.

For the simple example network shown below, the following relationships exist:



- Radio 1 is the master radio and is parent to radio 2 (repeater).
- Radio 2 (repeater) is child to radio 1 (master), but is parent to radios 3 (slave) and 4 (repeater).
- Radio 4 (repeater) is child to radio 2 (repeater), but is parent to radios 5 and 6 (both slaves).

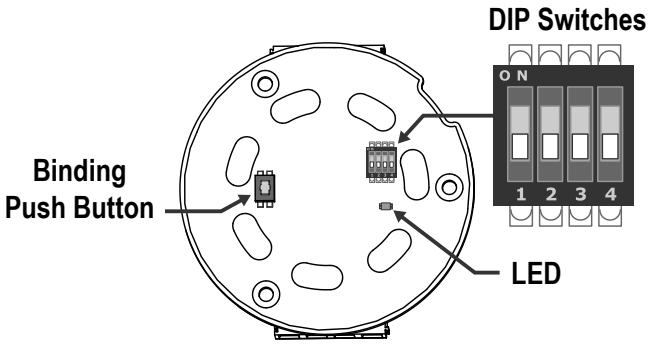
On the LCD of each device, the parent device address (PADR) and local device address (DADR) are shown.

MultiHop Master Radio. Within a network of MultiHop data radios, there is only one master radio. The master radio controls the overall timing of the network and is always the parent device for other MultiHop radios. The host system connects to this master radio.

MultiHop Repeater Radio. When a MultiHop radio is set to repeater mode, it acts as both a parent and a child. The repeater receives data packets from its parent, then re-transmits the data packet to the children within the repeater's network. The incoming packet of information is re-transmitted on both the radio link and the local serial link.

MultiHop Slave Radio. The slave radio is the end device of the MultiHop radio network. A radio in slave mode does not re-transmit the data packet on the radio link, only on the local serial (wired) bus.

Bind the TL70 Wireless **MultiHop** Modular Tower Light to Form Networks



Binding MultiHop radios ensures all MultiHop radios within a network communicate only with other radios within the same network. The MultiHop radio master automatically generates a unique binding code when the radio master enters binding mode. This code is then transmitted to all radios within range that are also in binding mode. After a repeater/slave is bound, the repeater/slave radio accepts data only from the master to which it is bound. The binding code defines the network, and all radios within a network must use the same binding code.

Before using the TL70 devices, you must bind them to the MultiHop master radio and assign a device ID using the master's rotary dials. There are no physical switches or dials on the TL70 radio. To bind and address an TL70, follow these steps.

On the **MultiHop** Master Radio

1. Apply power to the master radio.
2. Triple click button 2 to enter binding mode. For the two LED/button models, both LEDs flash red and the LCD shows *BINDNG and *MASTER. For single LED/button models, the LED flashes alternatively red and green.
3. Using the rotary dials, select the Device ID to assign to the TL70. Use the left rotary dial for the left digit and the right rotary dial for the right digit. For example, to assign your TL70 to Device ID 10, set the left dial to 1 and the right dial to 0.

On the **MultiHop** TL70 Radio

1. Click the button on TL70 three times to place the TL70 into binding mode. After entering binding mode, the TL70 LEDs blink slowly, alternating between red and green. After the TL70 receives a valid binding code from the MultiHop Master Radio, the red and green LEDs are both illuminated continuously, resulting in a slightly orange light. The red and green LEDs simultaneously flash four times to indicate that the TL70 accepts the binding code. The TL70 enters RUN mode.
2. After binding a TL70 to the MultiHop Master Radio and assigning it a unique Device ID, write the Device ID on the TL70's label.
3. Repeat this sequence (TL70 steps 1 and 2) for as many TL70s as you need to bind. If two TL70s are accidentally assigned the same Device ID, rerun the binding procedure on one of the TL70s to reassign the ID. The binding sequence may be run on a TL70 as many times as necessary.

On the **MultiHop** Master Radio

1. To exit binding mode, double click button 2 on the MultiHop master radio. The master radio reboots and enters RUN mode.

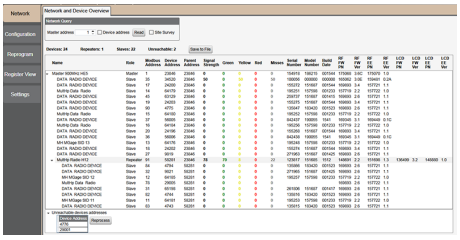
Slave and Repeater TL70 Wireless **MultiHop** LED Behavior

All bound radios set to slave or repeater modes follow this LED behavior after powering up.

Process Steps	Response	LED
1	Apply power to the radio	Solid red and green (orange) for 8 seconds
2	The slave/repeater searches for a parent device.	Flashes red
3	A parent device is detected. The slave/repeater searches for other parent radios within range.	Solid red
4	The slave/repeater selects a suitable parent.	Solid red and green (orange)
5	The slave/repeater attempts to synchronize to the selected parent.	Solid red
6	The slave/repeater enters RUN mode.	Solid green, then flashes green
7	The slave/repeater is synchronized to the parent.	Flashes green
	Serial data packets begin transmitting between the slave/repeater and its parent radio.	Flashes red and green (orange)

MultiHop Configuration Tool

Use Banner's MultiHop Configuration Tool software to view your MultiHop radio network and configure the radio and its I/O.



The MultiHop Configuration Tool connects to a MultiHop master radio using one of four methods.

- Serial; using a USB to RS-485 (for RS-485 radios) or a USB to RS-232 (for RS-232 radios) converter cable.
- Modbus TCP; using an Ethernet connection to an Ethernet radio master.
- Serial DXM; using a USB cable to a DXM Controller to access a MultiHop master radio.
- TCP DXM: using an Ethernet connection to a DXM Controller to access a MultiHop master radio.

For MultiHop DX80DR* models, Banner recommends using BWA-UCT-900, an RS-485 to USB adapter cable with a wall plug that can power your 1 Watt MultiHop radio while you configure it. The adapter cable is not required when connecting to a DXM Controller.

Download the most recent software revision from Banner Engineering's website: *www.bannerengineering.com/wireless*.

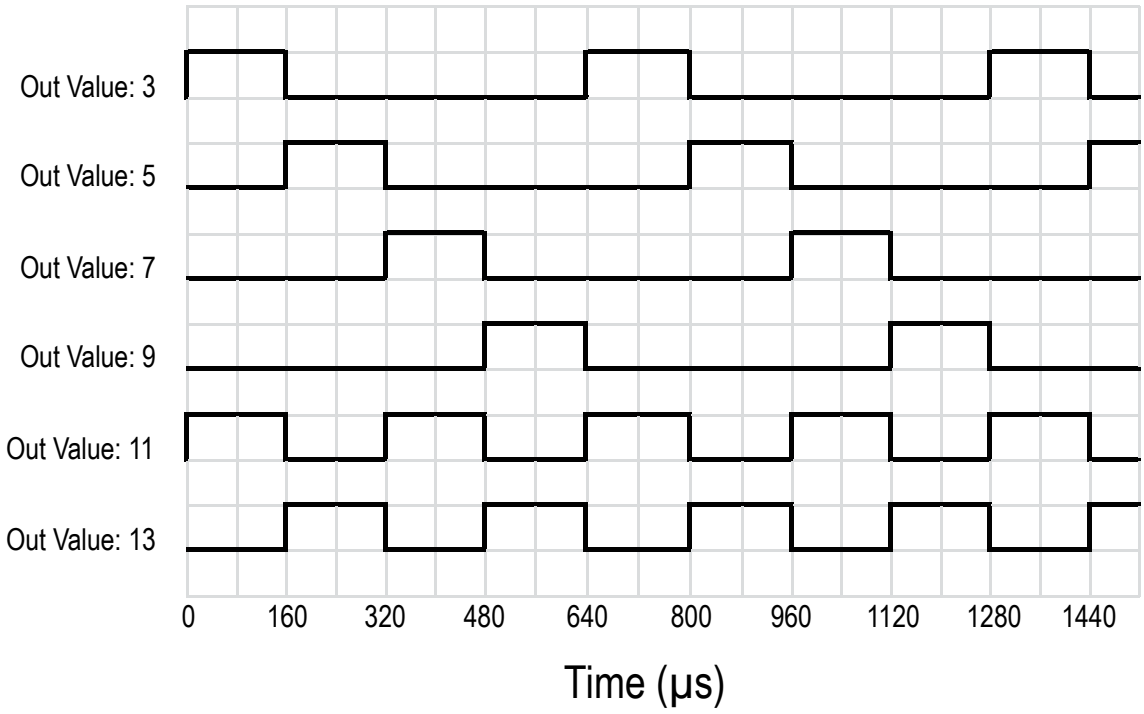
Modbus Registers

Modbus Holding Register (4xxxx)	I/O Type	I/O Range		Holding Register **Representation** (Dec.)		Module #
		Min.	Max.	Min.	Max.	
1	Discrete IN 1	0	1	0	1	M1
2	Discrete IN 2	0	1	0	1	M2
3	Discrete IN 3	0	1	0	1	M3
4	Discrete IN 4	0	1	0	1	M4
5	Discrete IN 5	0	1	0	1	M5
6	Discrete IN 6	0	1	0	1	M6
501	Light OUT 1	0	65535	0	65535	M1
502	Light OUT 2	0	65535	0	65535	M2
503	Light OUT 3	0	65535	0	65535	M3
504	Light OUT 4	0	65535	0	65535	M4
505	Light OUT 5	0	65535	0	65535	M5
506	Light OUT 6	0	65535	0	65535	M6

Flash **Pattern**

Write specific values to the light OUT registers to control the light's behavior.

Light OUT Register Value	Light **Operation**
1	On
3	Flashing at 1.5 Hz
5	Delay of 160 µs, then flashing at 1.5 Hz
7	Delay of 320 µs, then flashing at 1.5 Hz
9	Delay of 480 µs, then flashing at 1.5 Hz
11	Flashing at 3 Hz
13	Delay of 160 µs, then flashing at 3 Hz



Example -- Lights Racing Up the Stack

To program all four lights to come on at a different time to appear to race up the light stack, write a 3 to M1, 5 to M2, 7 to M3, and a 9 to M4.

Specifications

Tower Light

Supply Voltage and Current

12 V dc to 30 V dc (Outside the USA: 12 V dc to 24 V dc, ± 10%) [1]
900 MHz Consumption: Maximum current draw is < 40 mA and typical current draw is < 30 mA at 24 V dc. (2.4 GHz consumption is less.)

Indicator Color or Audible Model	Maximum Current (mA)	
	at 12 V dc	at 30 V dc
Blue, Green, White	420	150
Red, Yellow, Orange	285	120
Standard Audible	30	30
Loud Audible (Intensity 1)	18	14
Loud Audible (Intensity 2)	40	28
Loud Audible (Intensity 3)	160	70
Loud Audible (Intensity 4)	350	110

Supply **Protection** Circuitry

Protected against transient voltages

Indicators

1 to 6 colors depending on model (Green, Red, Yellow, Blue, White, and Orange)
LEDs are independently selected
Flash Rates: 1.5 Hz ±10% and 3 Hz ±10%

Indicator Response Time

Off Response: 150 µs (maximum) at 12 V dc to 30 V dc
On Response: 180 ms (maximum) at 12 V dc; 50 ms (maximum) at 30 V dc

Indicator **Characteristics**

Color	Dominant Wavelength (nm) or Color Temperature (CCT)	Color Coordinates[2]		Lumen Output (Typical at 25 °C)
		X	Y	
Green	525 nm	–	–	92
Red	625 nm	–	–	40
Yellow	590 nm	–	–	22
Blue	470 nm	–	–	32
White	5000 K	–	–	125
Orange	–	0.66	0.33	33

Operating Conditions

–40 °C to +50 °C (–40 °F to +122 °F)
95% at +50 °C maximum relative humidity (non-condensing)

Environmental **Rating**

IEC IP65

Certifications

Audible Alarm

Standard Audible: 2.6 KHz ± 250 Hz oscillation frequency; maximum intensity (typical) 92 dB at 1 m (3.3 ft)
Loud Audible: 2.6 KHz ± 250 Hz oscillation frequency; maximum intensity (typical) at 1 m (3.3 ft)

DIP Switches		Max Intensity (Loud Audible)
9	10	
ON	ON	Intensity 4: 101 dB
OFF	ON	Intensity 3: 99 dB
ON	OFF	Intensity 2: 92 dB
OFF	OFF	Intensity 1: 85 dB

Audible Adjustment

Standard Audible Adjustment: Rotate the cover until the desired volume is reached
Loud Audible Electronic Adjustment: Select the desired volume using DIP switches 9 and 10
Typical **Reduction** in Sound Intensity with Audible Adjustment (maximum to minimum):

- Standard Audible: 8 dB
- Loud Audible: 16 dB

Connections

5-pin M12/Euro-style quick disconnect, 8-pin M12/Euro-style quick disconnect, 150 mm (5.9 in) PVC cable with an M12/Euro-style quick disconnect, or 2 m (6.5 ft) unterminated cable, depending on model

Construction

Bases, Segments, Covers: polycarbonate

Vibration and Mechanical Shock

Vibration 10 Hz to 55 Hz 0.5 mm p-p amplitude per IEC 60068-2-6
Shock 15G 11 ms duration, half sine wave per IEC 60068-2-27

Required Overcurrent **Protection**

WARNING: Electrical connections must be made by qualified personnel in accordance with local and national electrical codes and regulations.

Overcurrent protection is required to be provided by end product application per the supplied table.
Overcurrent protection may be provided with external fusing or via Current Limiting, Class 2 Power Supply.
Supply wiring leads < 24 AWG shall not be spliced.
For additional product support, go to *www.bannerengineering.com*.

Supply Wiring (AWG)	Required Overcurrent **Protection** (Amps)
20	5.0
22	3.0
24	2.0
26	1.0
28	0.8
30	0.5

[1] For European applications, power this device from a Limited Power Source as defined in EN 60950-1.
[2] Refer to CIE 1931 chromaticity diagram or color chart, to show equivalent color with indicated color coordinates.

Radio

Radio Range[3]
900 MHz, 1 Watt (Internal antenna): Up to 3.2 km (2 miles)
2.4 GHz, 65 mW (Internal antenna): Up to 1000 m (3280 ft) with line of sight

Minimum **Separation** Distance
900 MHz, 1 Watt: 4.57 m (15 ft)
900 MHz, 150 mW and 250 mW: 2 m (6 ft)
2.4 GHz, 65 mW: 0.3 m (1 ft)

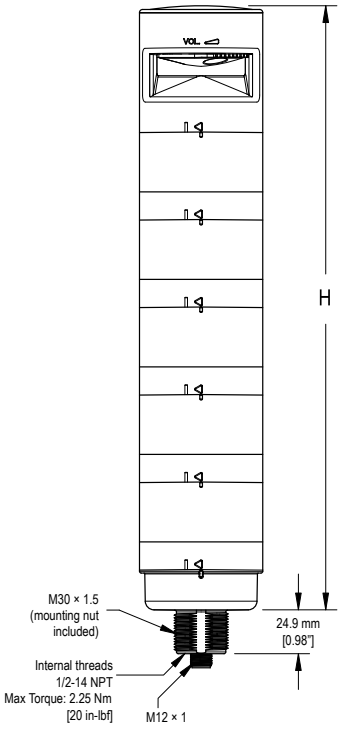
Spread Spectrum Technology
FHSS (Frequency Hopping Spread Spectrum)

900 MHz Compliance (1 **Watt)**
FCC ID UE3RM1809: This device complies with FCC Part 15, Subpart C, 15.247
IC: 7044A-RM1809

2.4 GHz Compliance
FCC ID UE300DX80-2400 - This device complies with FCC Part 15, Subpart C, 15.247
ETSI EN 300 328 V1.8.1 (2012-06)
IC: 7044A-DX8024

Radiated Immunity HF
10 V/m (EN 61000-4-3)

Dimensions

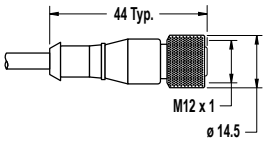
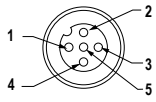
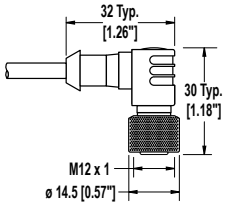


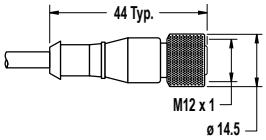
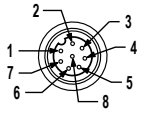
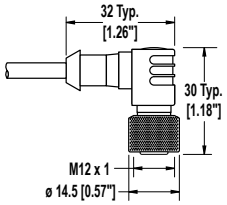
Model	Height (H)
1 light module	87.6 mm (3.45 in)
1 light module, 1 audible module	144.3 mm (5.68 in)
2 light modules	137.3 mm (5.41 in)
2 light modules, 1 audible module	194 mm (7.64 in)
3 light modules	187 mm (7.36 in)
3 light modules, 1 audible module	243.7 mm (9.59 in)
4 light modules	236.7 mm (9.32 in)
4 light modules, 1 audible module	293.4 mm (11.55 in)
5 light modules	286.4 mm (11.28 in)
5 light modules, 1 audible module	343.1 mm (13.5 in)

[3] Range depends on the environment and decreases significantly without line of sight. Always verify your wireless network's range by performing a Site Survey.

Accessories

Cordsets

5-Pin Threaded M12/Euro-Style Cordsets—Single Ended				
Model	Length	Style	Dimensions	Pinout (Female)
MQDC1-501.5	0.50 m (1.5 ft)	Straight		 1 = Brown 2 = White 3 = Blue 4 = Black 5 = Gray
MQDC1-506	1.83 m (6 ft)			
MQDC1-515	4.57 m (15 ft)			
MQDC1-530	9.14 m (30 ft)			
MQDC1-506RA	1.83 m (6 ft)	Right-Angle		
MQDC1-515RA	4.57 m (15 ft)			
MQDC1-530RA	9.14 m (30 ft)			

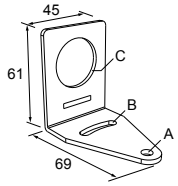
8-Pin Threaded M12/Euro-Style Cordsets with Open-Shield				
Model	Length	Style	Dimensions	Pinout (Female)
MQDC2S-806	1.83 m (6 ft)	Straight		 1 = White 2 = Brown 3 = Green 4 = Yellow 5 = Gray 6 = Pink 7 = Blue 8 = Red
MQDC2S-815	4.57 m (15 ft)			
MQDC2S-830	9.14 m (30 ft)			
MQDC2S-850	15.2 m (50 ft)			
MQDC2S-806RA	1.83 m (6 ft)	Right-Angle		
MQDC2S-815RA	4.57 m (15 ft)			
MQDC2S-830RA	9.14 m (30 ft)			
MQDC2S-850RA	15.2 m (50 ft)			

All measurements are listed in millimeters, unless noted otherwise.

Mounting Brackets

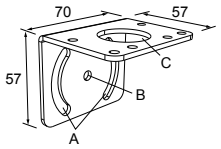
SMB30A
- Right-angle bracket with curved slot for versatile orientation
- Clearance for M6 (¼ in) hardware
- Mounting hole for 30 mm sensor
- 12-ga. stainless steel

Hole center spacing: A to B=40
Hole size: A=ø 6.3, B= 27.1 x 6.3, C=ø 30.5



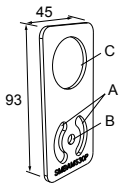
SMB30MM
- 12-ga. stainless steel bracket with curved mounting slots for versatile orientation
- Clearance for M6 (¼ in) hardware
- Mounting hole for 30 mm sensor

Hole center spacing: A = 51, A to B = 25.4
Hole size: A = 42.6 x 7, B = ø 6.4, C = ø 30.1



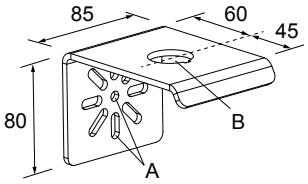
SMBAMS30P
- Flat SMBAMS series bracket
- 30 mm hole for mounting sensors
- Articulation slots for 90°+ rotation
- 12-ga. 300 series stainless steel

Hole center spacing: A=26.0, A to B=13.0
Hole size: A=26.8 x 7.0, B=ø 6.5, C=ø 31.0



SSA-MBK-EEC1
- Single 30 mm hole
- 8 gauge steel, black finish (powder coat)
- Front surface for customer applied labels

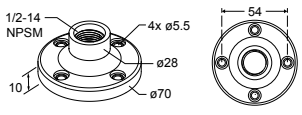
Hole size: A = ø 7 , B = ø 30

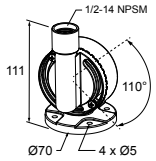


All measurements are listed in millimeters, unless noted otherwise.

Elevated Mount System

Model			Features	Components
SA-M30 - Black Polycarbonate			• Streamlined black PC or Gray PC thread cover • Covers M30 thread on the light base • Mounting hardware included	
SA-M30C - Gray Polycarbonate				
Polished 304 Stainless Steel	Black Anodized Aluminum	Clear Anodized Aluminum	• Elevated-use stand-off pipe (½ in. NPSM/DN15) • Polished 304 stainless steel, black anodized aluminum, or clear anodized aluminum surface • ½ in. NPT thread at both ends • Compatible with most industrial environments	
SOP-E12-150SS 150 mm (6 in) long	SOP-E12-150A 150 mm (6 in) long	SOP-E12-150AC 150 mm (6 in) long		
SOP-E12-300SS 300 mm (12 in) long	SOP-E12-300A 300 mm (12 in) long	SOP-E12-300AC 300 mm (12 in) long		
SOP-E12-900SS 900 mm (36 in) long	SOP-E12-900A 900 mm (36 in) long	SOP-E12-900AC 900 mm (36 in) long		
SA-E12M30 - Black Acetal			• Streamlined black acetal or white UHMW mounting base adapter/cover • Connects between ½ in. NPSM/DN15 pipe and 30 mm (1-3/16 in) drilled hole • Mounting hardware included	
SA-E12M30C - White UHMW				

Pipe **Mounting** Flange			
Model	Features	**Construction**	
SA-F12	• For use elevated stand-off pipes (½ in, NPSM/DN15) • M5 mounting hardware and nitrile gasket included	Die-cast zinc base with black paint	

Foldable **Mounting** Brackets			
Model	Features	**Construction**	
SA-FFB12	• For use with 1/2 inch stand-off pipes • Stainless steel hardware	Black polycarbonate	
SA-FFB12C		Gray polycarbonate	

LMB Sealed Right-Angle Brackets

Model	**Description**	**Construction**	
LMB30RA	Direct-Mount Models: Bracket kit with base, 30 mm adapter, set screw, fasteners, o-rings, and gaskets	Black polycarbonate	
LMB30RAC		Gray polycarbonate	
LMBE12RA	Pipe-Mount Models: Bracket kit with base, ½-14 pipe adapter, set screw, fasteners, o-rings, and gaskets. For use with stand-off pipe (listed and sold separately)	Black polycarbonate	
LMBE12RAC		Gray polycarbonate	

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