R58B **Registration** Mark Sensor
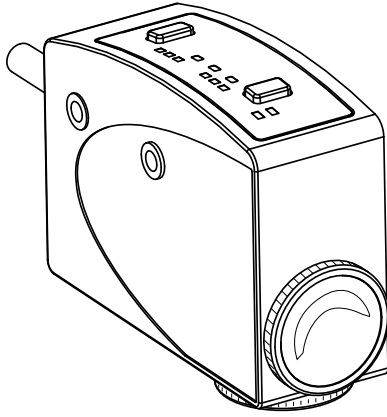
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Datasheet

Registration Mark Sensors with Three-Color Light Source and Fast Teach

- Ultra-fast 10 kHZ switching frequency
- Sensor automatically selects red, green, or blue LED during TEACH to optimize application contrast
- Outstanding color contrast sensitivity; detects 16 levels of gray scale
- Smart gain-control algorithm to maximize performance in low-contrast or high-gloss applications
- Fast TEACH via single-clicks on the TEACH push-button or remote input
- Sensor configuration options are easily changed via push-buttons or PLC compatible remote input
- Fixed-convergent sensing at 10 mm ±3 mm (0.39" ±0.12"); rectangular sensing image measure 1.2 mm x 3.8 mm (0.05" x 0.15") at 10 mm (0.39") from the lens
- Models available with either parallel or perpendicular sensing image (see Models)
- Rugged zinc alloy die-cast housing with high-quality acrylic lens suitable for food processing applications; rated IP67
- Models available with integral quick disconnect or Euro-style quick-disconnect pigtail

⚠️ **WARNING: Not To Be Used for Personnel Protection**

Never use this device as a sensing device for personnel **protection.** Doing so could lead to serious injury or death. This device does not include the self-checking redundant circuitry necessary to allow its use in personnel safety applications. A sensor failure or malfunction can cause either an energized or de-energized sensor output condition.

Models

Models [1]	Focus Distance	Supply Voltage	Output	Sensing Image **Orientation**
R58BPCRGB1			PNP	Parallel to sensor length
R58BNCRGB1	10 mm (0.39 in)	10 V dc to 30 V dc	NPN	
R58BPCRGB2			PNP	Perpendicular to sensor length
R58BNCRGB2			NPN	

Overview

R58B Registration Mark Sensor offer maintenance-free, solid-state reliability for typical color contrasts found in product and material registration applications. Fast 50-microsecond sensing response produces excellent registration repeatability, even in ultra-high-speed applications. This fast response, coupled with the small 1.2 × 3.8 mm (0.05 in × 0.15 in) sensing image, allows the detection of small and inconspicuous registration marks.

R58B sensors feature TEACH mode sensitivity adjustment by presenting two sensing conditions to the sensor. TEACH mode has two options: Static TEACH and Dynamic TEACH. Static TEACH is used to position the two sensing conditions individually. Dynamic TEACH provides a means for teaching a series of conditions on-the-fly; the R58B samples the sensing events and automatically sets the switchpoint between the lightest and darkest conditions. The sensor then determines which sensing condition is present for the shortest time and assigns the Output ON condition to that event (therefore, LO/DO selection is automatic). If necessary, the LO/DO setting can be reversed in Setup mode.

The sensor uses a tri-color LED during either teach process and automatically selects a red, green, or blue sensing beam, based on the contrast between the registration mark and its background. For applications where the user wishes to select the sensing beam color, individual colors may be enabled/disabled in Setup mode.

[1] Only Standard 2 m (6.5 ft) cable models are listed.
- To order the 9 m (30 ft) cable model, add suffix "W/30" to the model number (e.g., R58BPCRGB1 W/30).
- To order the 150 mm (6 in) pigtail with a 5-pin M12/Euro-style connector, add suffix "Q" to the model number (e.g., R58BPCRGB1Q).
- To order the integral 5-pin M12/Euro-style QD, add suffix "Q8" to the model number (e.g., R58BPCRGB1Q8).

The discrete NPN or PNP output can be configured in Setup mode to include a 30 millisecond OFF-delay if required.

Configuration is accomplished either by using the push-buttons on the sensor, or by supplying input pulses using the remote input. The buttons may be disabled using the remote input.

The construction of the R58B is extremely robust, with a die-cast metal housing, plastic optics, and IP67 leakproof design for harsh sensing environments.
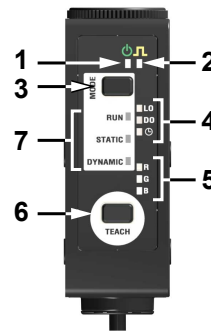
1. Power LED
2. Output LED
3. Mode Selection Button
4. Output Configuration LEDs
5. Emitter Color Configuration LEDs
6. TEACH Button
7. Mode Configuration LEDs

Figure 1. Sensor Features

Configuration Instructions

Sensor Mode Description

The R58B Registration Mark Sensor have three user-selectable modes of operation: Run Mode, Static Mode, and Dynamic Mode. The "active" Mode is selected by pressing the Mode push-button or via the remote input. For simplicity of operation, only certain features are enabled in each mode as described below.

- All Modes: The sensor detects registration marks based on the last taught conditions. Via the remote line the user may configure the operational mode and the output settings, enable/disable emitter color(s), lock/unlock push-buttons, and restore factory defaults.
- Run Mode: There is no TEACH button functionality in RUN Mode. Press and hold both push-buttons > 2 seconds to enter Set-up mode to configure the output settings or enable/disable emitter color(s).
- **Static** Mode: Using the TEACH push-button, the sensor can be quickly taught new sense conditions using a simple *Static TEACH Procedure*.
- Dynamic Mode: Using the TEACH push-button, the sensor can be taught on-the-fly using a simple *Dynamic Teach Procedure*.

LED	Indicates	
Power	ON: Normal sensor operation	
	OFF: Set-up Mode	
	Flashing: Push-button lock-out status	
Output	ON: Output is conducting	
	OFF: Output is not conducting	
	Slow Flash: TEACH Static OFF condition or Dynamic TEACH active	
	Fast Flash: Re-TEACH Static ON condition (prior static TEACH failed)	
Light Operate	ON: Light Operate (LO) operation	
Dark Operate	OFF: Dark Operate (DO) operation	
Off Delay	ON: 30 ms pulse stretcher (OFF-delay) is active	
	OFF: No OFF-delay	
Red, Green, Blue	Normal Operation	ON: Active emitter LED color
	Set-up Mode	ON: Enabled emitter LED colors
		Flashing: Allow Enabling/ Disabling of emitter LED colors
Run	ON: Run Mode is active	
Static	ON: Static Mode is active	
Dynamic	ON: Dynamic Mode is active	

Sensor Set-up

The R58B will power up in normal operation and begin sensing using the settings from the most recently taught registration mark. The sensitivity of the R58B may be quickly optimized to the application by using one of two available TEACH modes: Static TEACH or Dynamic TEACH.
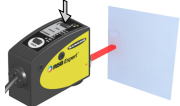
- **Static** TEACH: Both the Output ON and Output OFF conditions are presented to the sensor, and the sensitivity and emitter color are automatically selected to maximize sensing contrast.
- Dynamic TEACH: The registration mark and background are presented during actual sensing conditions (i.e. web moving) and the sensitivity and emitter color are automatically selected to maximize sensing contrast.

The sensor's operating parameters may be configured either via its push-buttons or via the remote input (gray wire). While in RUN mode, press and hold both buttons > 2 seconds to enter Set-Up mode. Pressing the Mode Push-button will cycle through the 4 possible output settings. Pressing the TEACH Push-button will cycle through the 7 combinations of emitter LED color. The indicators update to show the currently selected configuration. Press both buttons for > 2 s or wait 60 s to exit Set-up mode.

To use the remote input, connect the gray wire to a PLC or a NO (normally open) switch to 0 V dc. Set-up using the remote line is accomplished by following a sequence of input pulses (see following procedures). The duration of each pulse, and the period between multiple pulses, is defined as T: 0.04 seconds ≤ T ≤ 0.8 seconds

Static TEACH Procedure

1. Enter Static TEACH mode.

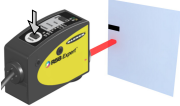| Method	Action	Result
Push **Button**	Press the Mode select button.	The sensor enters Static TEACH mode.
Remote Input	Select Static Mode; see *Remote Configuration Flowchart*	
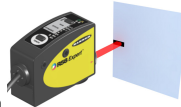
2. Align the light spot to the output ON condition. "Mark Operate" is shown.
3. TEACH the output ON condition.

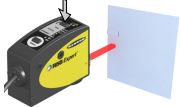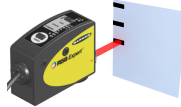| Method	Action	Result
Push **Button**	Press the TEACH button.	The Output and Emitter LEDs flash at 2 Hz to indicate that a TEACH is in progress.
Remote Input	Single-pulse the remote input.	
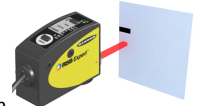
4. Align the light spot to the output OFF condition.
5. TEACH the output OFF condition.

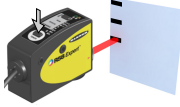| Method	Action	Result
Push **Button**	Press the TEACH push-button.	Sensor evaluates contrast and returns to normal operation. If inadequate contrast, the Output and Emitter LED flash rate will increase to 4Hz to indicate that the TEACH failed. Repeat TEACH starting at Step 2.
Remote Input	Single-pulse the remote input.	

Dynamic TEACH Procedure

1. Enter Dynamic TEACH mode.

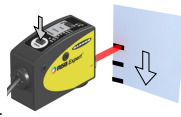| Method	Action	Result
Push **Button**	Pressing Mode select push-button.	The sensors enters Dynamic TEACH mode.
Remote Input	Select Dynamic Mode; see *Remote Configuration Flowchart*	

2. Align sensor to either mark or background.
3. Start the dynamic sampling.

Method	Action	Result
Push **Button**	Press the TEACH push-button.	The Output LED flashes at 2 Hz to indicate a Dynamic TEACH is in progress.
Remote Input	Single-pulse the remote line.	

4. Start moving the web past sensor. Present at least 2 marks.
5. End the dynamic sampling.

Method	Action	Result
Push **Button**	Press the TEACH button.	Sensor evaluates contrast. If adequate mark to background contrast, the sensor returns to normal operation using the new sense settings. If not, the Output Configuration and Emitter Color Configuration LEDs will alternately flash 4x to indicate that the TEACH failed and the sensor will return to normal operation without changing the sense settings.
Remote Input	Single-pulse the remote line to end Dynamic sampling.	

Installation Instructions

Mounting Considerations

The R58B Registration Mark Sensor includes a total of eight size M5 threaded holes used for mounting. These threaded holes are positioned to match the mounting hole patterns common to other registration mark sensors. The R58B includes four M5 x 0.8 x 6 mm stainless steel cap screws and a hex key wrench.

The R58B focus is 10 mm (0.39 in) from the lens surface. The R58B must be mounted within 3 mm (0.12 in) of this distance from the surface of the material for reliable sensing (*Figure 2* on page 4).

Consider the following when mounting the R58B:

- When sensing a registration mark on a reflective (shiny) material, mount the R58B at an angle which places the lens centerline at approximately 15° off perpendicular to the material's surface (*Figure 4* on page 4). This minimizes strong direct reflections (which tend to overwhelm the sensor), and allows the sensor to discern the relatively small optical contrast offered by differences in colors.
- Clear materials are poor reflectors of light. When sensing a mark printed on a clear material (for example, a clear poly web), position a reflective surface directly behind the clear material to return light to the R58B. The printed mark, regardless of its color, then becomes the dark condition, as it blocks the light from reaching the reflective surface. Most clear materials are also shiny; it is important to include a 15° skew angle when sensing clear materials (*Figure 4* on page 4).
- Whenever possible, sense a web material at a location where it passes over a tension bar or roller, to minimize the adverse effects of web "flutter" or sag (*Figure 3* on page 4).
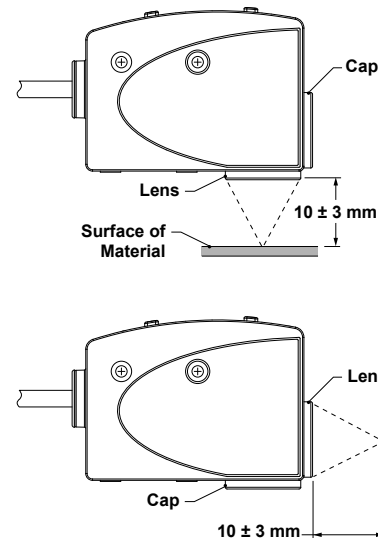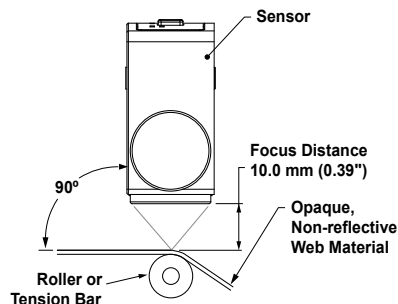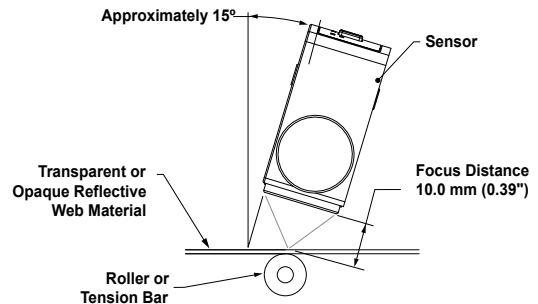

Figure 2. Mounting Distance and Lens Positions

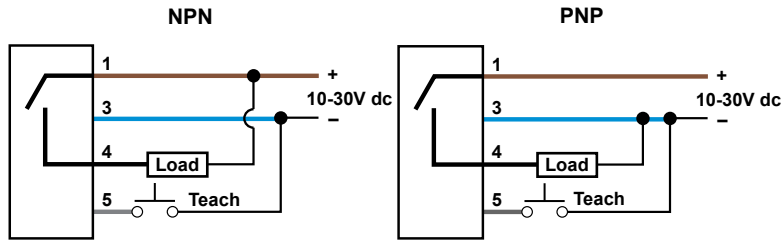Mount the sensor perpendicular to non-reflective (matte) materials

Figure 3. Mounting for Matte Material

Mount the sensor at approximately 15° from perpendicular to transparent and opaque reflective materials

Figure 4. Mounting for Transparent and Opaque Material

Wiring Diagrams

NPN

```
1 ——————————— + 
                10-30V dc
3 ——————————— −
4
  Load
5 ——o o—— Teach
```

PNP

```
1 ——————————— + 
                10-30V dc
3 ——————————— −
4
  Load
5 ——o o—— Teach
```

Wiring Key:

1 = Brown

2 = White (No connection)

3 = Blue

4 = Black

Specifications

Supply Voltage and Current
10 V dc to 30 V dc (10% maximum ripple within specified limits)
Supply current (exclusive of load current): 75 mA max at 10 V dc; 35 mA at 30 V dc

Supply Protection Circuitry
Protected against reverse polarity and transient over voltages

Repeatability
15 microseconds

Output Configuration
Single output: one current sourcing (PNP) or one current sinking (NPN) open-collector transistor by model

Output Rating
ON-state load current: 100 mA max
OFF-state leakage current: NPN < 200 microamps; PNP < 10 microamps (see Application Note 1)
NPN Saturation: < 1.6V at 100 mA
PNP Saturation: < 3.0V at 100 mA

Output Protection Circuitry
Protected against false pulse on power up and continue overload or short-circuit of output

Output Response Time
50 microseconds
Note: 1 second delay on power-up; output does not conduct during this time

Construction:
Housing: Zinc alloy die-cast and steel housing with black painted finish and o-ring sealed lens and lens port cap
Lens: Acrylic
Lens port cap and lens holder: ABS
Push-buttons: Thermoplastic elastomer
Labels: Polycarbonate

Application Notes
1. NPN OFF-state leakage current is < 200 µA for load impedances > 3kΩ or optically isolated loads. For load current of 100 mA, leakage is < 1% of load current.
2. Do not mount the sensor directly perpendicular to shiny surfaces; position it at approximately a 15° angle in relation to the sensing target (see Installation Notes).
3. Minimize web or product "flutter" whenever possible to maximize sensing reliability.

Adjustments
MODE Push-button—Selects Operating Mode
TEACH Push-button—Initiate Teach from STATIC or DYNAMIC Mode
Both Push-buttons >2 s—Enter Sensor Set-up (only accessible from RUN Mode)
Remote Input (gray wire)—Input for remote Set-up of the sensor (PLC compatible)

Connections
PVC-jacketed 5 conductor 2 m (6.5 ft) or 9 m (30 ft) cable with internal strain relief
Integral 5-pin M12/Euro-style QD fitting
150 mm (6 in) cable with a 5-pin M12/Euro-style QD fitting

Indicators
LO Light Operate: Red
O Off-delay: Red
DO Dark Operate: Red
TL Output: Yellow
⏻ Power: Green
Mode: Green
(R) Red: Red
(G) Green: Green
(B) Blue: Blue

Tri-Color LED Sensing Image
Rectangular: 1.2 mm × 3.8 mm (0.05 in × 0.15 in) at 10 mm (0.39 in) from face of lens; image oriented either parallel or perpendicular to sensor length
Red: 636 nm; Green: 525 nm; Blue: 472 nm

Operating Conditions
Operating Temperature: −10 °C to +55 °C (+14 °F to +131 °F)
Storage Temperature: −20 °C to +80 °C (−4 °F to +176 °F)
90% at +50 °C maximum relative humidity (non-condensing)

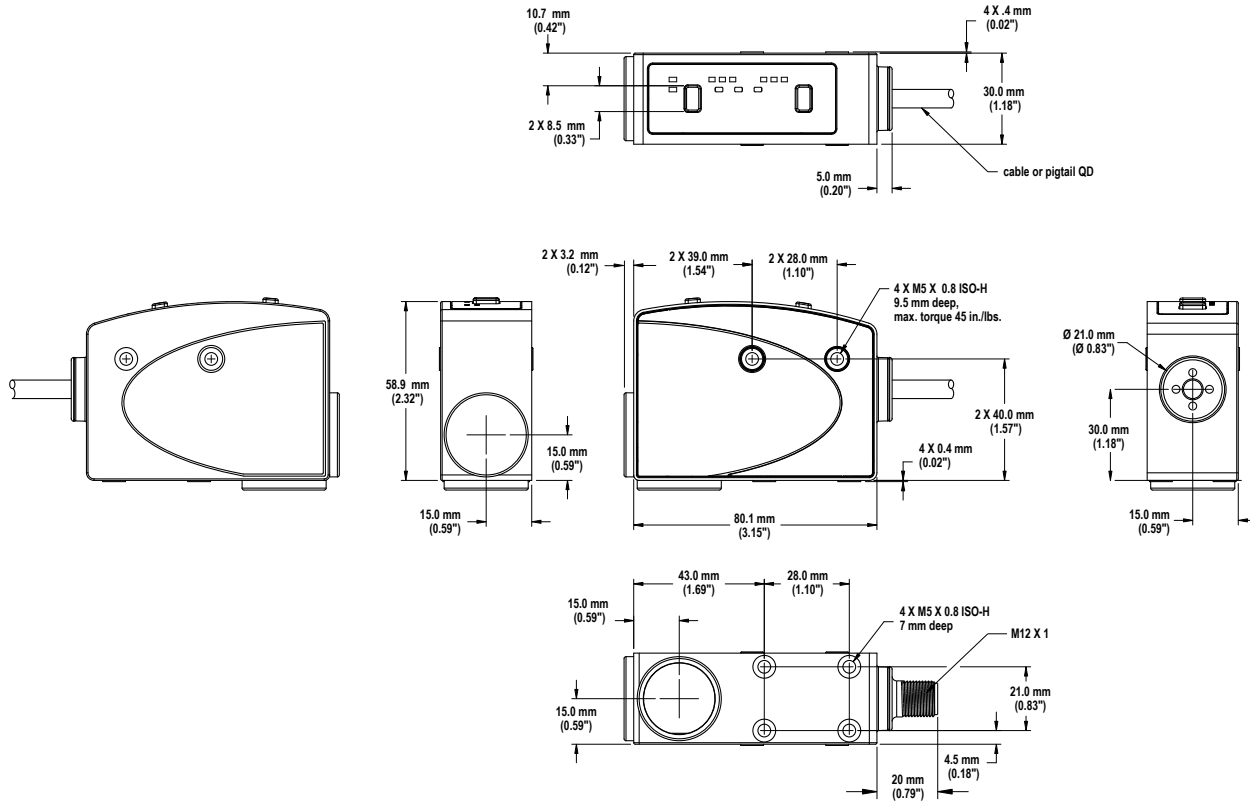**Environmental Rating**
IEC IP67

Vibration and Mechanical Shock
All models meet IEC 68-2-6 and IEC 68-2-27 testing criteria

Dimensions

10.7 mm
(0.42")

4 X .4 mm
(0.02")

30.0 mm
(1.18")

2 X 8.5 mm
(0.33")

5.0 mm
(0.20")

cable or pigtail QD

2 X 3.2 mm
(0.12")

2 X 39.0 mm
(1.54")

2 X 28.0 mm
(1.10")

4 X M5 X 0.8 ISO-H
9.5 mm deep,
max. torque 45 in./lbs.

Ø 21.0 mm
(Ø 0.83")

58.9 mm
(2.32")

15.0 mm
(0.59")

2 X 40.0 mm
(1.57")

4 X 0.4 mm
(0.02")

30.0 mm
(1.18")

15.0 mm
(0.59")

80.1 mm
(3.15")

15.0 mm
(0.59")

43.0 mm
(1.69")

28.0 mm
(1.10")

15.0 mm
(0.59")

4 X M5 X 0.8 ISO-H
7 mm deep

M12 X 1

15.0 mm
(0.59")

21.0 mm
(0.83")

4.5 mm
(0.18")

20 mm
(0.79")

All measurements are listed in millimeters [inches], unless noted otherwise.

Accessories

Quick-Disconnect (QD) Cordsets

5-Pin Threaded M12/Euro-Style Cordsets—with Shield				
Model	Length	Style	Dimensions	Pinout (Female)
MQDEC2-506	1.83 m (6 ft)	Straight	44 Typ. / M12 x 1 / ø 14.5	1 = Brown 2 = White 3 = Blue 4 = Black 5 = Gray
MQDEC2-515	4.57 m (15 ft)			
MQDEC2-530	9.14 m (30 ft)			
MQDEC2-550	15.2 m (50 ft)			
MQDEC2-506RA	1.83 m (6 ft)	Right-Angle	32 Typ. [1.26"] / 30 Typ. [1.18"] / M12 x 1 / ø 14.5 [0.57"]	
MQDEC2-515RA	4.57 m (15 ft)			
MQDEC2-530RA	9.14 m (30 ft)			
MQDEC2-550RA	15.2 m (50 ft)			

Mounting Brackets

SMB55A
- 15° offset bracket
- 12-gauge stainless steel

SMB55F
- Flat-mount bracket
- 12-gauge stainless steel

SMB55RA
- Right-angle bracket
- 12-gauge stainless steel

SMB55S
- 15° offset bracket
- 12-gauge stainless steel

Replacement Lens

UC-R55
- Replacement lens for R58A, R58B, and R58E
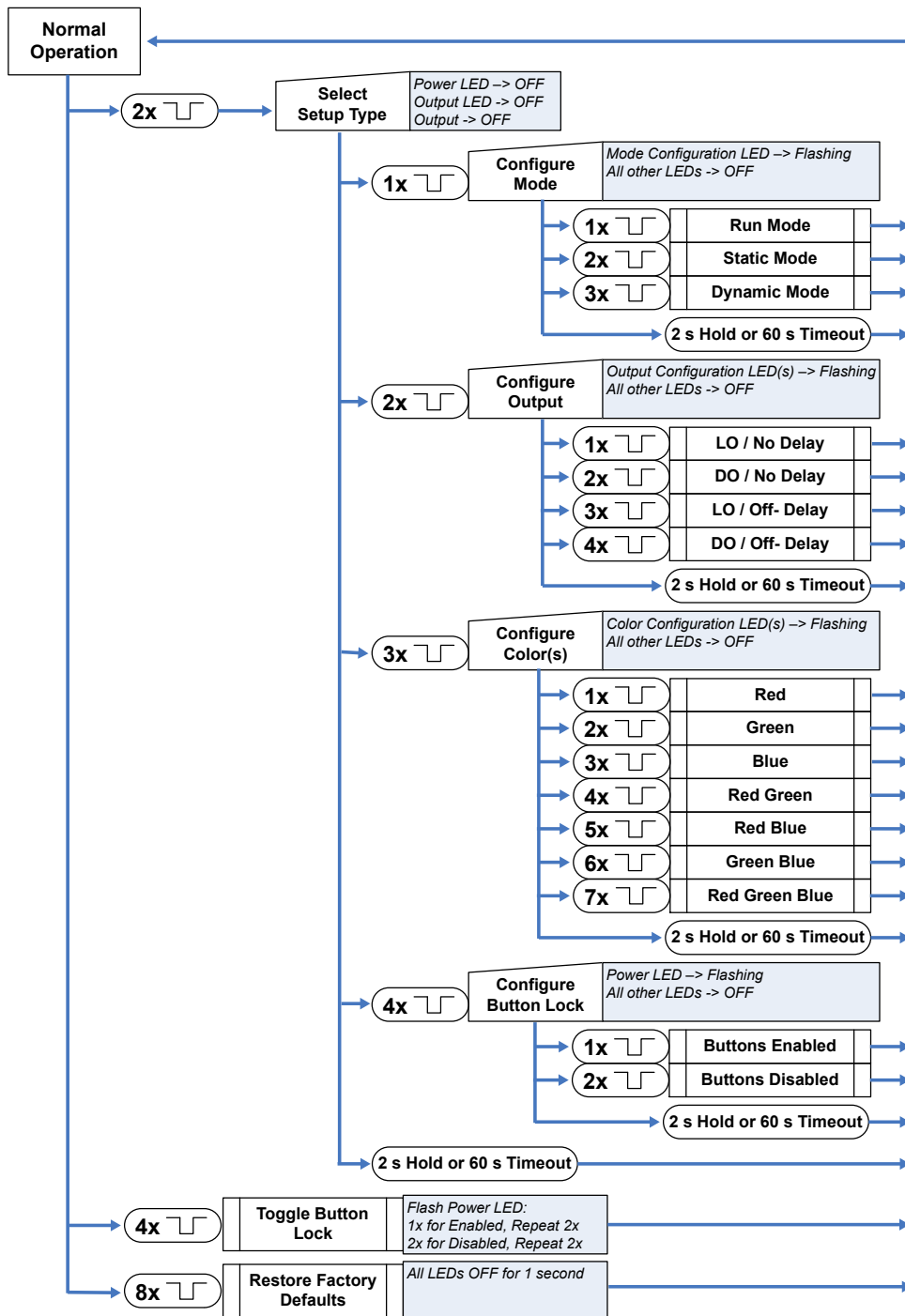
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Remote **Configuration** Flowchart

Normal Operation

2x ⎍⎍ → **Select Setup Type**
Power LED –> OFF
Output LED –> OFF
Output -> OFF

1x ⎍ → **Configure Mode**
Mode Configuration LED –> Flashing
All other LEDs -> OFF

- **1x** ⎍ → **Run Mode**
- **2x** ⎍ → **Static Mode**
- **3x** ⎍ → **Dynamic Mode**
- **2 s Hold or 60 s Timeout**

2x ⎍ → **Configure Output**
Output Configuration LED(s) –> Flashing
All other LEDs -> OFF

- **1x** ⎍ → **LO / No Delay**
- **2x** ⎍ → **DO / No Delay**
- **3x** ⎍ → **LO / Off- Delay**
- **4x** ⎍ → **DO / Off- Delay**
- **2 s Hold or 60 s Timeout**

3x ⎍ → **Configure Color(s)**
Color Configuration LED(s) –> Flashing
All other LEDs -> OFF

- **1x** ⎍ → **Red**
- **2x** ⎍ → **Green**
- **3x** ⎍ → **Blue**
- **4x** ⎍ → **Red Green**
- **5x** ⎍ → **Red Blue**
- **6x** ⎍ → **Green Blue**
- **7x** ⎍ → **Red Green Blue**
- **2 s Hold or 60 s Timeout**

4x ⎍ → **Configure Button Lock**
Power LED –> Flashing
All other LEDs -> OFF

- **1x** ⎍ → **Buttons Enabled**
- **2x** ⎍ → **Buttons Disabled**
- **2 s Hold or 60 s Timeout**

2 s Hold or 60 s Timeout

4x ⎍ → **Toggle Button Lock**
Flash Power LED:
1x for Enabled, Repeat 2x
2x for Disabled, Repeat 2x

8x ⎍ → **Restore Factory Defaults**
All LEDs OFF for 1 second

A click (⎍ᵀ) is defined as 40 ms < T < 800 ms.