45LM Series Modules

Plug-in Logic and Display Modules for Q45 Series Photoelectric Sensors

Features

- Three plug-in modules are available:

Model	Functions
45LM58	Selectable output timing
45LM58D	Selectable output timing, plus signal strength display
45LMD	Signal strength display, only (no programmable functions)

- Models with selectable output timing offer the following timing logic functions (see page 2 or 3 for descriptions):
  - ON-delay
  - OFF-delay
  - ON- and OFF-delay
  - Retriggerable one-shot
  - Non-retriggerable one-shot
  - Delayed one-shot
  - ON-delayed one-shot
  - Repeat cycle timer
  - Limit timer
  - Rate sensor
  - Flip-flop (alternate action)
- Selectable timing ranges:

  0.01 to 0.15 seconds 0.1 to 1.5 seconds 1 to 15 seconds
- Delay and hold time ranges may be individually selected, and times precisely set, using 15-turn adjustment potentiometers. Delay or hold time may also be disabled (zero seconds).
- Module allows sensor output to be set for normally-open or normally-closed operation
- Models with signal strength display give a precise indication of excess gain; see page 4 for more information. Valuable for sensor setup and alignment, for critical evaluation of alternative sensing schemes, and for close monitoring of sensing performance over time (e. g., dirt build-up on lenses or progressive misalignment).

Specifications

Operating Temperature	-40° to +70°C (-40° to +158°F)
Timing Adjustments	**Models 45LM58.. only:** Two 15-turn clutched potentiometers with brass elements, accessible from outside at the top of sensor, beneath an o-ring sealed polycarbonate cover.
Timing Repeatability	**Models 45LM58.. only:** Plus or minus 2% of the timing range (maximum); assumes conditions of constant temperature and power supply.
Useful Time Range	**Models 45LM58.. only:** Useful time range is from maximum time down to 5% of maximum. When the timing potentiometer is set fully counterclockwise, time will be approximately 5% of maximum.
Response Time	**Models 45LM58.. only:** When the delay time is switched OFF, the card adds no measurable sensing response time.
LED Display	**Models 45LM..D only:** Seven-element LED display, visible through transparent top sensor cover. The more LEDs that are lit, the stronger is the received light signal; three LEDs lit is equivalent to an excess gain of about 1x (see page 4).

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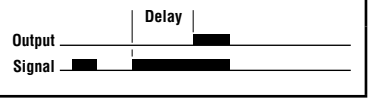
Setting Output Timing Function

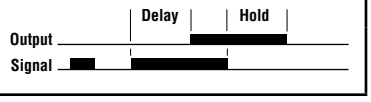
Models 45LM58 and 45LM58D (with signal strength display) may be set for one or several output timing functions. In addition, three adjustable timing ranges are available (see page 3).

Output Timing Function: **ON-delay**				
Switch 1	**Switch 2**	**Switch 3**	**Other Settings**	
OFF	OFF	OFF	Set Hold time to OFF	

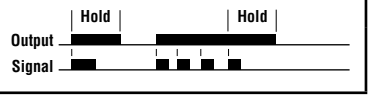
NOTE: ON-delay is selected via switches 4 and 5

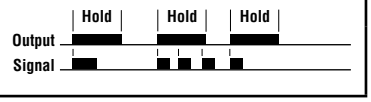
Output Timing Function: **OFF-delay (hold time)**				
Switch 1	**Switch 2**	**Switch 3**	**Other Settings**	
OFF	OFF	OFF	Set Delay time to OFF	

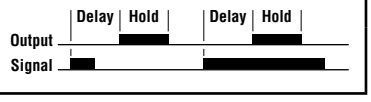
NOTE: OFF-delay is selected via switches 6 and 7

Output Timing Function: **ON- and OFF-delay**				
Switch 1	**Switch 2**	**Switch 3**	**Other Settings**	
OFF	OFF	OFF	–	

NOTES: • ON-delay is selected via switches 4 and 5
• OFF-delay is selected via switches 6 and 7

Output Timing Function: **Retriggerable one-shot**				
Switch 1	**Switch 2**	**Switch 3**	**Other Settings**	
ON	ON	OFF	–	

Output Timing Function: **Non-retriggerable one-shot**				
Switch 1	**Switch 2**	**Switch 3**	**Other Settings**	
ON	OFF	OFF	Set Delay time to OFF	

Output Timing Function: **Delayed one-shot**				
Switch 1	**Switch 2**	**Switch 3**	**Other Settings**	
ON	OFF	OFF	–	

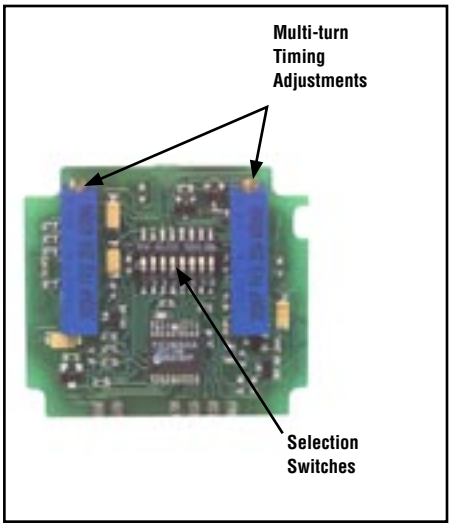


Figure 1. 45LM58 features

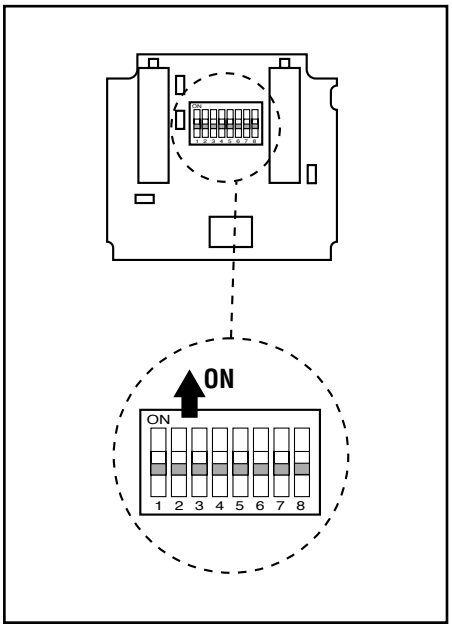


Figure 2. 45LM58 selection switch detail

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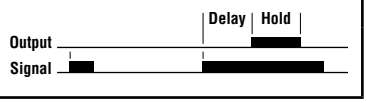
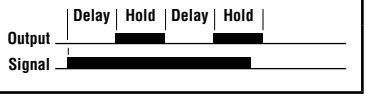
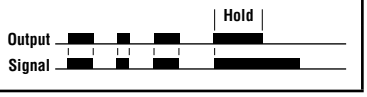
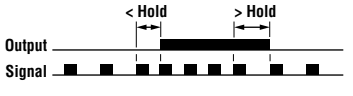
Output Timing Function: **ON-delayed one-shot**				
Switch 1	**Switch 2**	**Switch 3**	**Other Settings**	
OFF	ON	OFF	–	

Output Timing Function: **Repeat cycle timer**				
Switch 1	**Switch 2**	**Switch 3**	**Other Settings**	
OFF	OFF	ON	–	

Output Timing Function: **Limit timer**				
Switch 1	**Switch 2**	**Switch 3**	**Other Settings**	
ON	OFF	ON	–	

Output Timing Function: **Rate sensor**				
Switch 1	**Switch 2**	**Switch 3**	**Other Settings**	
OFF	ON	ON	–	

Output Function: **Flip-flop**				
Switch 1	**Switch 2**	**Switch 3**	**Other Settings**	
ON	ON	ON	–	

Selecting ON-Delay Time Range		
Switch 4	**Switch 5**	**Delay (min. to max.)**
OFF	OFF	OFF – no delay
OFF	ON	0.01 to 0.15 sec.
ON	OFF	0.1 to 1.5 sec.
ON	ON	1 to 15 sec.

Selecting Hold Time (OFF-Delay) Range		
Switch 6	**Switch 7**	**Hold (min. to max.)**
OFF	OFF	OFF – no hold
OFF	ON	0.01 to 0.15 sec.
ON	OFF	0.1 to 1.5 sec.
ON	ON	1 to 15 sec.

Selecting Output State	
Switch 8	**Output State**
Rate Sensor Logic	
ON	Output de-energizes above the set rate
OFF	Output energizes above the set rate
Flip-Flop Logic	
ON	Output changes state at trailing edge of signals
OFF	Output changes state at leading edge of signals
All Other Logic	
ON	Normally closed: output de-energizes during Hold time
OFF	Normally open: output energizes during Hold time

Measuring Excess Gain and Contrast

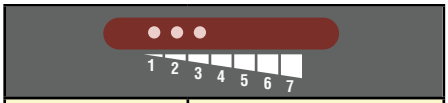
The seven-element LED array, available on models 45LM58D and 45LMD, may be used to measure the excess gain and contrast in any sensing situation and during sensor installation and maintenance.

Excess gain is a measurement of the amount of light energy falling on the receiver of a photoelectric sensor *over and above the minimum amount necessary to operate the sensor's amplifier.* Excess gain is expressed as a ratio:

$$\text{Excess gain (E.G.)} = \frac{\text{light energy falling on receiver}}{\text{amplifier threshold}}$$

The amplifier threshold is the point at which the sensor's output switches. The Q45's threshold corresponds to the #3 level of the LED array. That is, when LEDs #1 through #3 are lit, the excess gain of the received light signal is about "1x."

The table at right (Figure 3) shows how excess gain relates to the LED array indicator.



LED Number	Approximate Gain
#1	0.25x
#2	0.5x
#3	1.0x
#4	2.0x
#5	4.0x
#6	6.0x
#7	8.0x

Figure 3. The 7-segment LED array and its corresponding excess gain values

Contrast is the ratio of the amount of light falling on the receiver in the "light" state as compared to the "dark" state. Contrast is also referred to as "light-to-dark ratio." Optimizing the contrast in any sensing situation will increase the reliability of the sensing system. Contrast may be calculated if excess gain values are known for both the light and dark conditions:

$$\text{Contrast} = \frac{\text{Excess gain (light condition)}}{\text{Excess gain (dark condition)}}$$

To determine the contrast for any sensing application, present both the "light" and "dark" conditions to the Q45, and read the signal for each. Take the ratio of the two numbers (from Figure 3) that correspond to the highest LED numbers registered for the "light" and "dark" conditions.

For example, if LEDs #1 through #6 come ON in the "light" condition and LEDs #1 and #2 come ON in the "dark" condition, the contrast (referring to Figure 3) is calculated as follows:

$$\text{Contrast} = \frac{6x}{0.5x} = 12$$

This value is expressed as "12:1" or "twelve-to-one."

The best sensor adjustment will cause all seven LEDs to come ON for the "light" condition, and will cause no LEDs to come ON in the "dark" condition. In this situation (such as an application in which a box breaks the beam of an opposed mode emitter and receiver):

$$\text{Contrast is greater than } \frac{8x}{0.25x} = 32{:}1$$

Of course, it is not always possible to adjust a sensor to maintain this much contrast. However, it is important to always adjust a sensor for the greatest amount of contrast possible for any sensing situation. The LED signal strength indicator array makes this easy. Figure 4 gives general guidelines for contrast values.

Contrast Ratio	Recommendation
1.2 or less	***Unreliable.*** Use an alternative sensing scheme.
1.2 to 2	***Poor contrast.*** Minor sensing system variables will affect sensing reliability.
2 to 3	***Low contrast.*** Sensing environment must remain perfectly clean and all other sensing variables must remain stable.
3 to 10	***Good contrast.*** Minor sensing system variables will not affect sensing reliability.
10 or greater	***Excellent contrast.*** Sensing should remain reliable as long as the sensing system has enough excess gain for operation.

Figure 4. Contrast values and corresponding guidelines

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Removing and Installing the Plug-In Modules

CAUTION . . .
Electrical Shock Hazard

An electrical shock hazard exists inside the sensor whenever power is applied.

Remove all power to the sensor (and to the load) whenever the transparent top cover will be raised and the black inside cover will be removed.

Failure to remove power while these covers are removed could result in injury.

NOTE: It is not necessary to remove power simply to adjust the Sensitivity or Timing controls, as long as the black inside cover remains in place.

To remove or install any of the 45LM modules (done through the top of the sensor), perform the following steps:

1) Remove all power from the sensor and load.
2) Loosen the top cover hold-down screw and raise the transparent cover (it is hinged).
3) Insert a small screwdriver into one of the slots at the front of the black inner cover, lift and remove (Figure 5).
4) Insert a small screwdriver into one of the slots at the side of the module to be removed and pry it up until you can grasp it with your fingers and remove (Figure 6).
5) Press the new module into place (Figure 7).
6) Replace the black cover, then the transparent hinged cover, and tighten the hold-down screw.
7) Reapply power as desired.

NOTE: If only installing a new module (and not removing an old one), skip step 4.

Figure 5. Insert a small screwdriver into the slot and lift the black cover to remove.

Figure 6. Using the small screwdriver in the module slot if necessary to nudge the module loose, lift the module up and out.

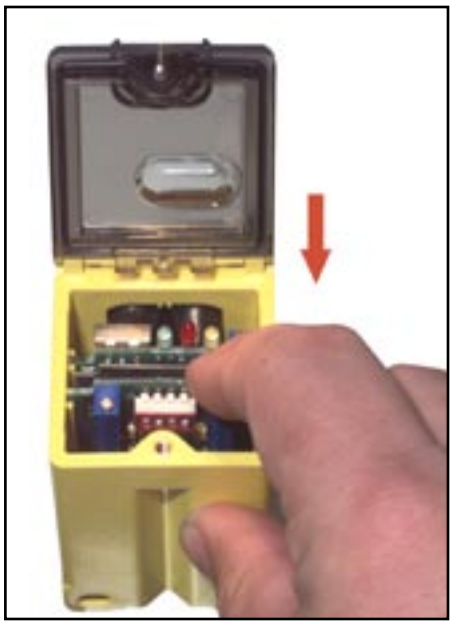

Figure 7. Slide the new module into place, pressing until it fits snugly.

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These sensors do NOT include the self-checking redundant circuitry necessary to allow their use in personnel safety applications. A sensor failure or malfunction can cause either an energized or de-energized sensor output condition. Consult your current Banner Safety Products catalog for safety products which meet OSHA, ANSI and IEC standards for personnel protection.

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Banner Engineering Corp., 9714 Tenth Ave. No., Minneapolis, MN USA 55441 • Phone: 763.544.3164 • www.bannerengineering.com • Email: sensors@bannerengineering.com