45LM Series Modules

Datasheet

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

- Models with selectable output timing offer the following timing logic functions:
  - ON-delay
  - ON-delayed one-shot
  - OFF-delay
  - Repeat cycle timer
  - ON- and OFF-delay
  - Limit timer
  - Retriggerable one-shot
  - Rate sensor
  - Non-retriggerable one-shot
  - Flip-flop (alternate action)
  - Delayed one-shot
- 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 (0 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; valuable for sensor setup and alignment, for critical evaluation of alternative sensing schemes, and for close monitoring of sensing performance over time (for example, dirt build-up on lenses or progressive misalignment)

WARNING:
- **Do not use this device for personnel protection**
- Using this device for personnel protection could result in serious injury or death.
- This device does not include the self-checking redundant circuitry necessary to allow its use in personnel safety applications. A device failure or malfunction can cause either an energized (on) or de-energized (off) output condition.

Models

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

Install or Remove a Q45X Series Module

CAUTION:
- Shock Hazard
- An electrical shock hazard exists inside the device whenever power is applied. Failure to remove power when the device is open could result in injury.
- Remove all power to the device (and to the load) whenever the device will be opened.

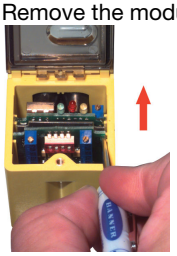
Note: It is not necessary to remove power to adjust the Sensitivity or Timing controls, as long as the black inner cover remains in place.

Modules (expansion cards) are installed and removed through the top of the sensor.

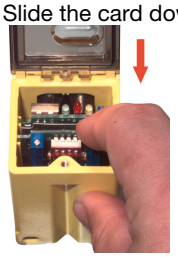
1. Remove power from the sensor and load.
2. Loosen the top cover screw.
3. Raise the cover. The cover is hinged at the front.

4. Insert a small screwdriver into one of the slots of the black inner cover, lift up, and remove the black inner cover.

5. If needed, remove a module.
   a) Insert a small, flat blade screwdriver or similar tool into the lift slot on the edge of the module to be removed.
   b) Gently pry up to disconnect the card and to raise it until you can grasp it with your fingers.
   c) Remove the module.



6. If needed, insert a module.
   a) Insert a module in the expansion slot so that the connector receptacles on the card align with the connector pins inside the sensor.
   b) Slide the card down into the slot until the connectors are fully engaged.



7. Reinstall the black inner cover.

Note: Some expansion cards are supplied with a new (replacement) black inner cover.

8. Close and secure the top cover.
9. Reapply power as desired.

Setting the 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.

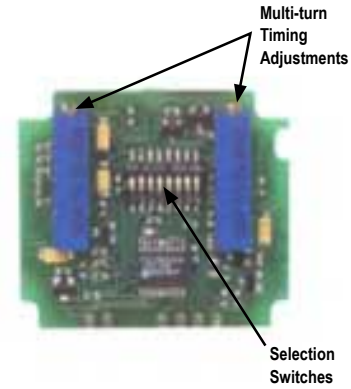


Figure 1. 45LM58 Features

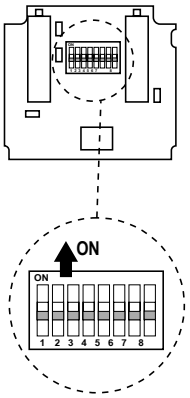
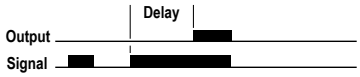
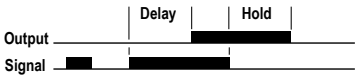
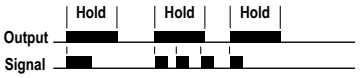
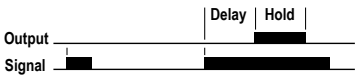
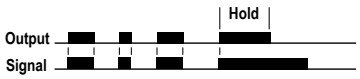
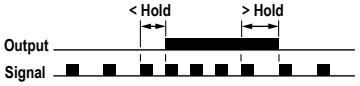


Figure 2. 45LM58 selection switch detail

Output Timing Function	Switch 1	Switch 2	Switch 3	Other Settings	Illustration	Notes
ON-delay	OFF	OFF	OFF	Set Hold time to OFF		ON-delay is selected via switches 4 and 5.
OFF-delay (hold time)	OFF	OFF	OFF	Set Delay time to OFF		OFF-delay is selected via switches 6 and 7.
ON- and OFF-delay	OFF	OFF	OFF	-		• ON-delay is selected via switches 4 and 5 • OFF-delay is selected via switches 6 and 7
Retriggerable one-shot	ON	ON	OFF	-		n/a
Non-retriggerable one-shot	ON	OFF	OFF	Set Delay time to OFF		n/a
Delayed one-shot	ON	OFF	OFF	-		n/a
ON-delayed one-shot	OFF	ON	OFF	-		n/a
Repeat cycle timer	OFF	OFF	ON	-		n/a
Limit timer	ON	OFF	ON	-		n/a
Rate sensor	OFF	ON	ON	-		n/a
Flip-flop	ON	ON	ON	-		n/a

Selecting the ON-Delay Time Range

Switch 4	Switch 5	Delay (min. to max.)
OFF	OFF	OFF – no delay
OFF	ON	0.01 s to 0.15 s
ON	OFF	0.1 s to 1.5 s
ON	ON	1 s to 15 s

Selecting a Hold Time (OFF-Delay) Range

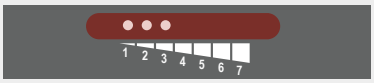
Switch 6	Switch 7	Hold (min. to max.)
OFF	OFF	OFF – no hold
OFF	ON	0.01 s to 0.15 s
ON	OFF	0.1 s to 1.5 s
ON	ON	1 s to 15 s

Selecting Output State

Logic	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

Table 1: The 7-segment LED array and its corresponding Excess Gain Values



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

The Q45's optional seven-element LED array 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:

```
Excess gain (E.G.) = light energy falling on receiver/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 1×.

Table 1 on p. 4 shows how excess gain relates to the LED array indicator.

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 increases the reliability of the sensing system. Contrast may be calculated if excess gain values are known for both the light and dark conditions:

```
Contrast = Excess gain (light condition)/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 Table 1 on p. 4) that correspond to the highest LED numbers registered for the light and dark conditions.

For example, if LEDs #1 through #6 turn ON in the light condition and LEDs #1 and #2 turn ON in the dark condition, the contrast is calculated as follows:

```
Contrast = 6×/0.5× = 12
```

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

The best sensor adjustment causes all seven LEDs to turn ON for the light condition, and causes no LEDs to turn 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):

```
Contrast is greater than 8×/0.25× = 32:1
```

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. The following table gives general guidelines for contrast values.

Table 2: Contrast values and corresponding guidelines

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.

Specifications

Operating Temperature
–40 °C to +70 °C (–40 °F to +158 °F)

Timing Adjustments
Models 45LM58xx 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 45LM58xx only: ±2% of the timing range (maximum); assumes conditions of constant temperature and power supply

Useful Time Range
Models 45LM58xx only: Useful time range is from maximum time down to 5% of maximum. When the timing potentiometer is set fully counterclockwise, time is approximately 5% of maximum.

Response Time
Models 45LM58xx only: When the delay time is switched OFF, the card adds no measurable sensing response time.

LED Display
Models 45LMxxD only: Seven-element LED display, visible through transparent top sensor cover. The more LEDs are lit, the stronger the received light signal; three LEDs lit is equivalent to an excess gain of about 1×.

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