Ordering number : EN4908A

BiCMOS LSI

LV9005M

Optical Sensor Switch IC

Overview

The LV9005M is an optical sensor switch IC that is fabricated in a medium breakdown voltage BiCMOS process. The LV9005M circuit structure includes a high-gain optical sensor amplifier, a comparator, an oscillator circuit, output drivers, LED drivers, and a synchronous detection and delay circuit. The use of this IC and a minimal number of external components allows the implementations of multifunction high-sensitivity applications that previously would have only been possible with a custom optical-switch IC.

Applications

- Factory automation (detectors for many types of parts and products)
- Home security (doorway and window sensors)
- Office automation equipment

Functions and Features

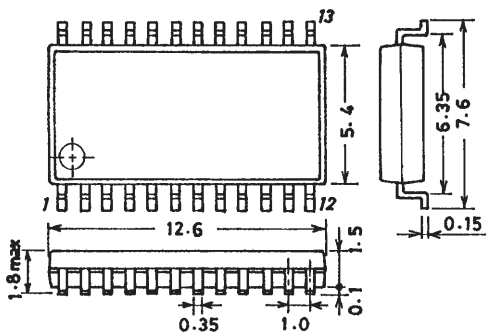
- Can be used with a wide range of supply voltages; from 5 to 30 V.
- Low power
- Outputs can be selected as PNP or NPN circuit types.
- Built-in high-gain amplifier
- Built-in stability and output display functions
- Supports both reflection and through type applications, and supports both sense on light and sense on dark applications.
- Built-in OCP and power on reset functions
- Built-in three-level comparator
- Synchronous detection scheme adopted for robust performance in the presence of ambient and scattered light.
- External photodiode detection scheme allows the LV9005M to support a wide range of application areas.
- Miniature flat package supports high density printed circuit board mounting.

Package Dimensions

unit: mm

3112-MFP24S

[LV9005M]



SANYO: MFP24S

Specifications

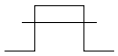
Absolute Maximum Ratings at Ta = 25°C

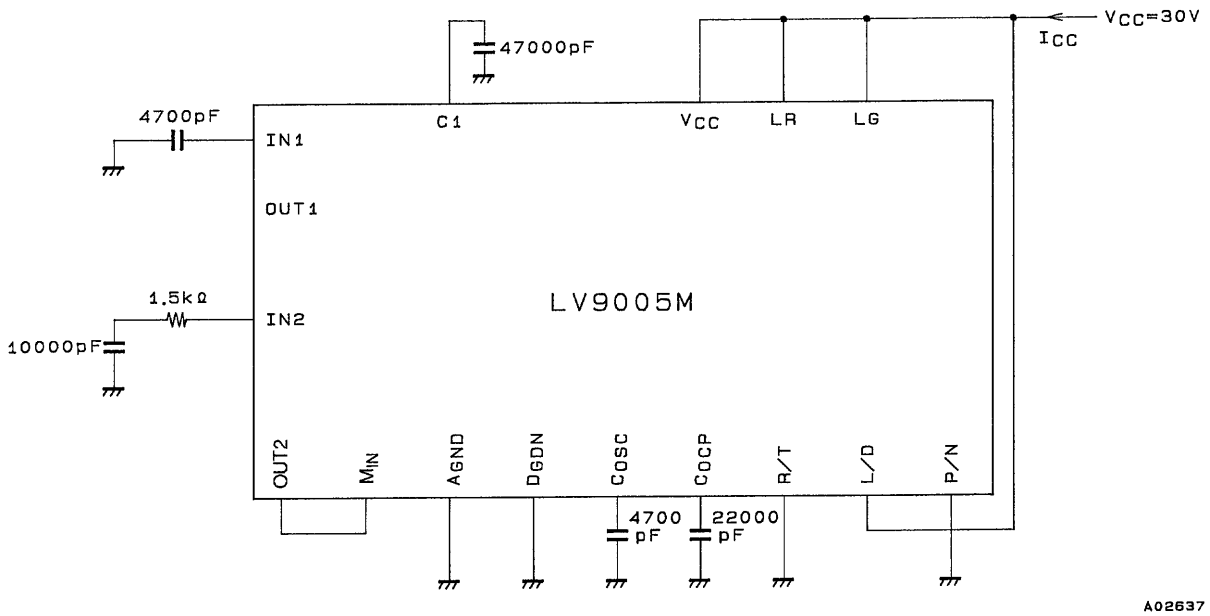
Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{CC} max		33	V
LD pin voltage	V_{LD}		33	V
Allowable power dissipation	Pd max		425	mW
Operating temperature	Topr		–20 to +85	°C
Storage temperature	Tstg		–40 to +125	°C

Allowable Operating Ranges at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	V_{CC}		4.5 to 30	V
LD pin voltage	V_{LD}	High breakdown voltage input pins	V_{CC} to 0	V

Electrical Characteristics at Ta = 25°C, V_{CC} = 12 V (unless otherwise specified)

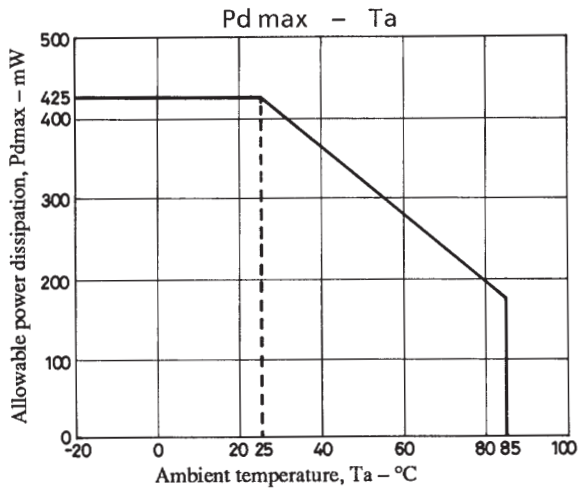
Parameter	Symbol	Conditions	min	typ	max	Unit
Preamplifier gain	V_{G1}	With a 20 kΩ input series resistance, f = 200 kHz (sine wave)	15	18	21	dB
Main amplifier gain	V_{G2}	f = 200 kHz (sine wave)	45	48	51	dB
Regulated power supply	V_{REG}	V_{CC} = 5 V, 5 mA DC load	3.72	4.0	4.28	V
Current drain	I_{CC}	Measured in the specified circuit*		3.0	4.5	mA
Input resistance	Z_{IN}		8.5	10	11.5	kΩ
[LED Output Block]						
Pulse level	V_{LEH}	With a 1 kΩ external resistor	2.9	3.2	3.6	V
Pulse period	T_{LE}	C_{OSC} = 4700 pF	300	380	460	µs
Pulse width	T_{PW}	 50%	4.2	5.2	6.2	µs
[Overcurrent Detection Voltage]						
PNP output (source)	OCP (P)	External transistor = PNP	V_{CC} – 1.1	V_{CC} – 1.35	V_{CC} – 1.6	V
NPN output (sink)	OCP (N)	External transistor = NPN	1.10	1.35	1.75	V
Comparator detection level (low)	$COMP_L$		0.33	0.44	0.55	V
Comparator detection level (middle)	$COMP_M$		0.60	0.74	0.88	V
Comparator detection level (high)	$COMP_H$		1.03	1.16	1.30	V
LG current	I_{LG}		2.05	2.65	3.25	mA
LR current	I_{LR}		1.12	1.72	2.32	mA
PNP drive current (source)	I_{SRC}		1.80	2.85	3.80	mA
NPN drive current (sink)	I_{SNK}		1.90	2.95	3.90	mA
Main amplifier output DC voltage	V_{OUT2}		1.20	1.40	1.56	V
RT input high voltage	$V_{IH}1$		4.0			V
RT input low voltage	$V_{IL}1$				1.0	V
LD input high voltage	$V_{IH}2$	High breakdown voltage input pins	4.0			V
LD input low voltage	$V_{IL}2$	High breakdown voltage input pins			1.3	V
P/N input high voltage	V_{PNH3}		4.0			V
P/N input low voltage	V_{PNL3}				1.0	V

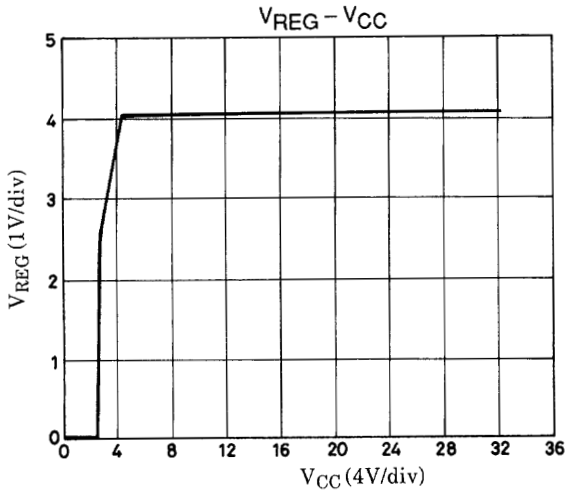


Note: * Current drain test circuit

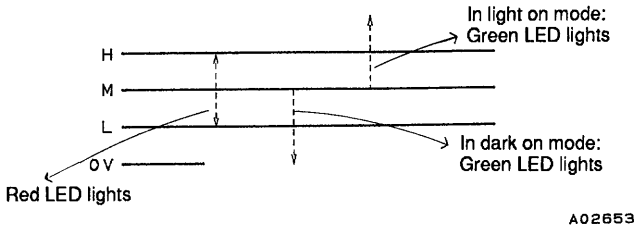
Design Specifications

Parameter	Symbol	Conditions	Ratings	Unit
Synchronization pull-in range	PIR	T_{EL} = LED pulse period, transmission mode	0.55 T_{LE} to 1.45 T_{LE}	µs
Power on reset	T_{POR}		13.5	ms
Response time	T_D	Oscillator external capacitor C_{OCP} = 4700 pF	2 T_{LE}	µs
Oscillator period	T_{OSC}	Oscillator external capacitor C_{OCP} = 4700 pF	380	µs
Hysteresis	V_H		$0.7^{+0.2}_{-0.15}$	Vp-p
[OCP Pulse]				
Pulse period	$T_{OCP\ (N)}$	C_{OCP} = 22000 pF	7.0	ms
Pulse width	$T_{OCPW\ (N)}$		55	µs
Pulse period	$T_{OCP\ (P)}$		7.0	ms
Pulse width	$T_{OCPW\ (P)}$		55	µs

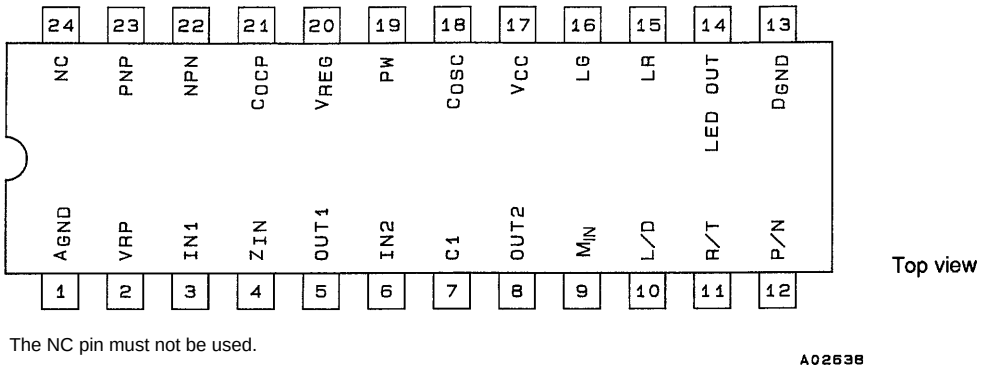




Functional Description

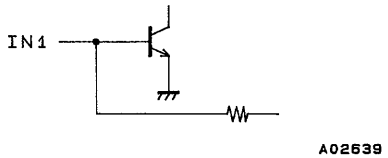
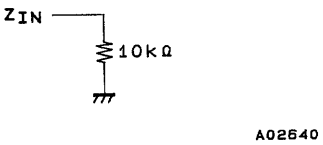
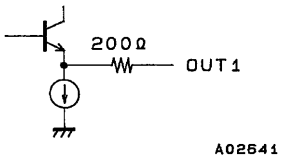
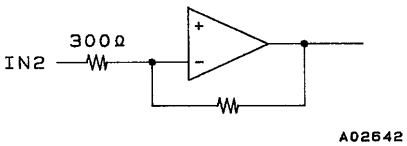
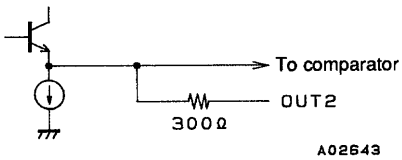
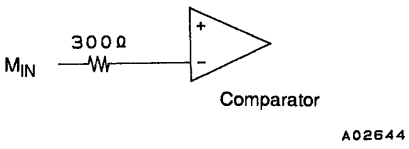
Item	Symbol	Description
R/T SW	R/T	Reflection/through switching. *: A separate illumination oscillator is used in transmission mode.
Reflect	R	Input voltage = high (V_{REG}) or open
Through	T	Input voltage = low (GND)
L/D SW	L/D	Light/dark switching
Light	L	Input voltage = high (V_{CC}) or open
Dark	D	Input voltage = low (GND)
P/N SW	P/N	Output PNP/NPN switching
PNP mode	PNP	Input voltage = high (V_{REG}) or open
NPN mode	NPN	Input voltage = low (GND)
Output protection		Built-in overcurrent (load short) protection circuit
Comparator and display ranges		
Output type		NPN, PNP, two outputs
Mode relationship		Light on mode → Light detected: output on, dark detected: output off
		Dark on mode → Light detected: output off, dark detected: output on

Pin Assignment



Note: The NC pin must not be used.

Pin Functions

Pin No.	Symbol	I/O circuit type	Notes
3	IN1		Amplifier first stage input (Capacitor coupled to the external circuit.)
4	Z_{IN}		Photodiode series (load) resistance (Used when not used with an external resistor.)
5	OUT1		Amplifier first stage output
6	IN2		Output amplifier input
8	OUT2		Output amplifier output
9	M_{IN}		Comparator middle input (This pin sets the hysteresis. The hysteresis is maximum when this pin is open, and minimum when this pin is shorted to pin 8.)
10	L/D	Light on mode → V_{CC} Dark on mode → 0 V	Light/dark mode switching This pin has a built-in noise filter (delay time: $2T_{LE}$)
11	R/T	Reflect mode → 4 V (V_{REG}) or open Through mode → 0 V	Reflect/through mode switching

Continued on next page.

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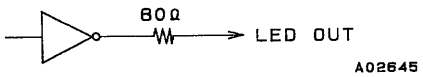
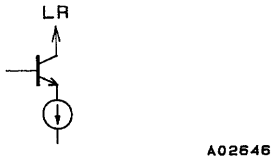
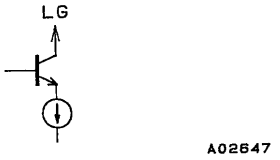
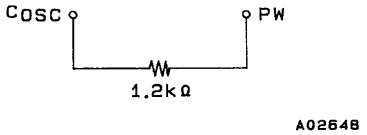
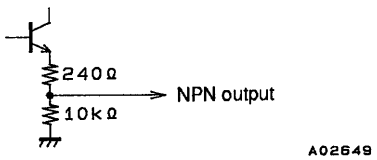
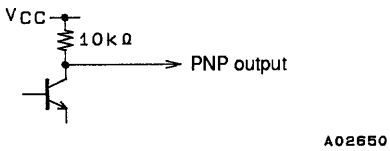
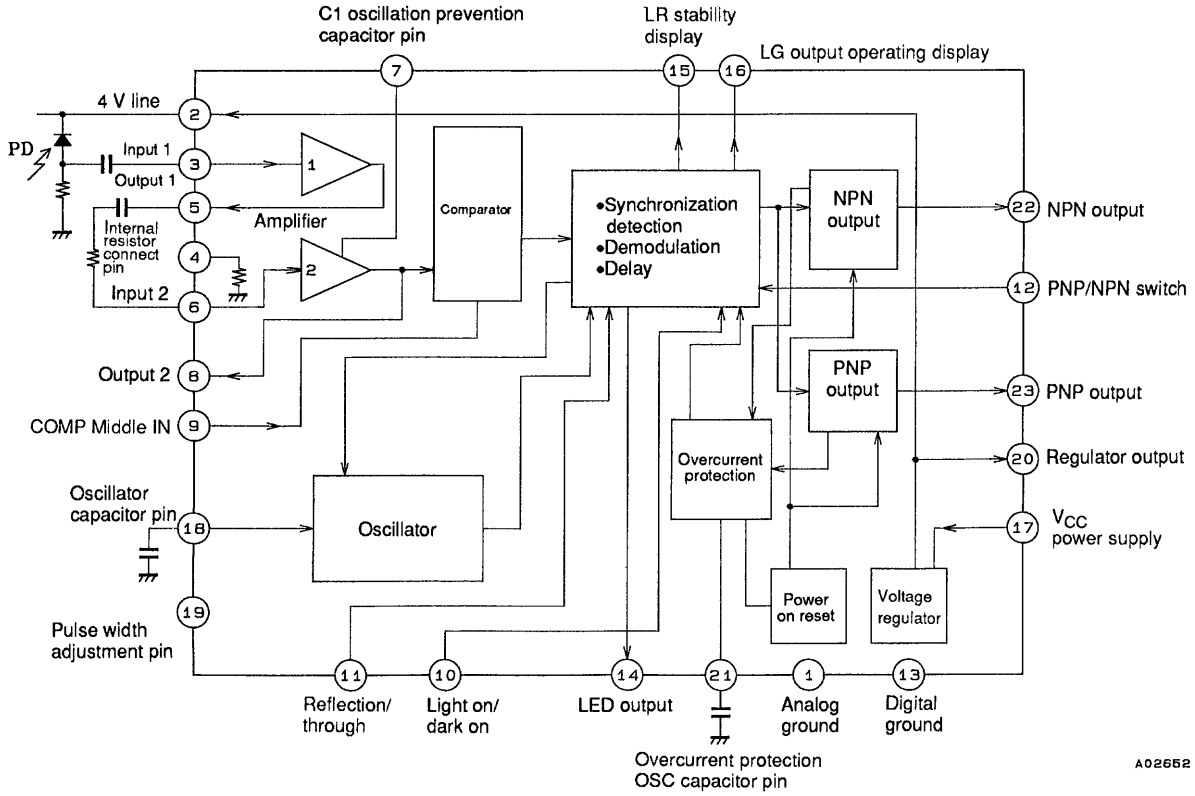
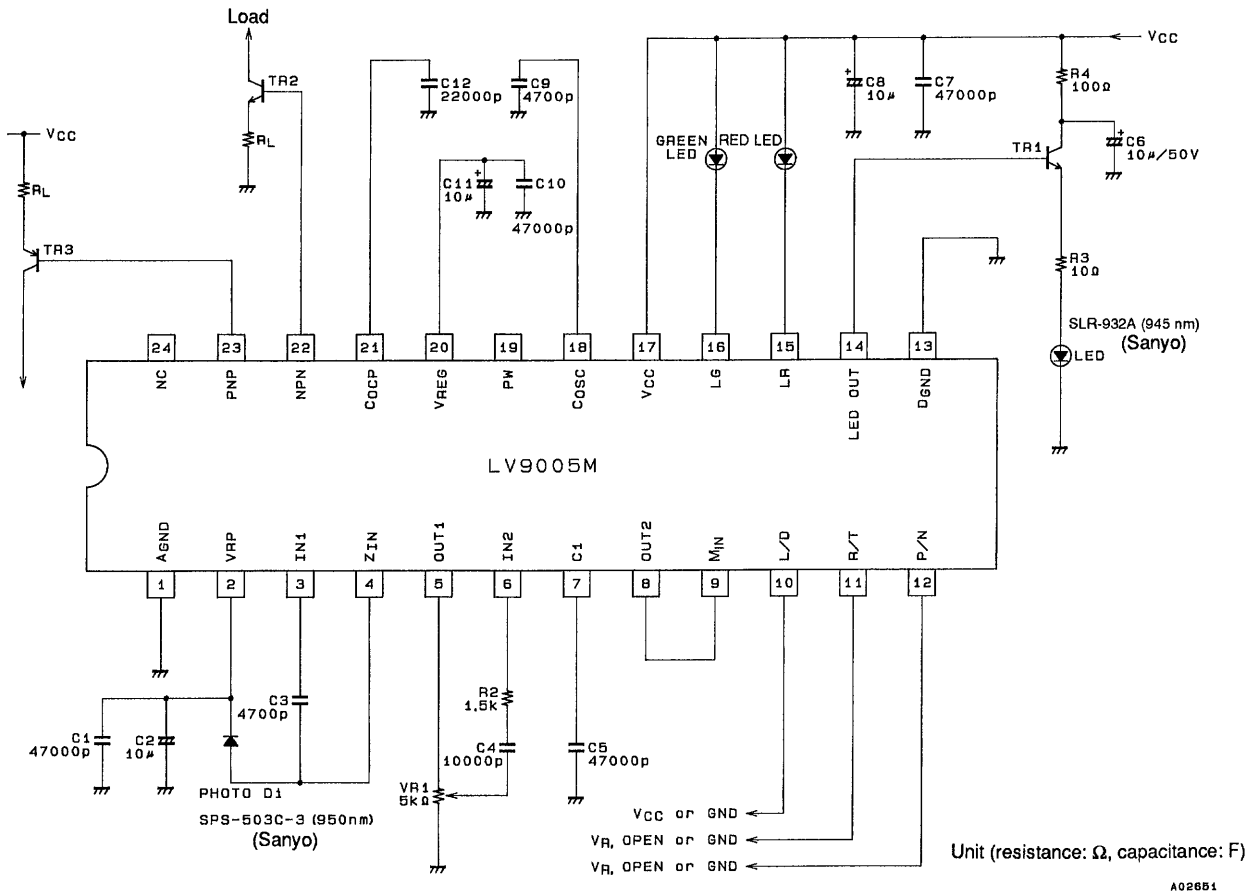
Pin No.	Function	I/O circuit type	Notes
12	P/N	PNP mode → 4 V (V_{REG}) or open NPN mode → 0 V	PNP/NPN switching
14	LED OUT		Light source LED drive output
15	LR		Red LED (display) connection
16	LG		Green LED (display) connection
18	C_{OSC}		Oscillator capacitor connection
19	PW		Light source LED pulse width adjustment (Connect pins 18 and 19 through an external resistor to narrow the pulse width from the illumination LED.)
20	V_{REG}	V_{REG} = V_{RP} (Pin 2)= 4 V	Regulator output
21	C_{OCP}		OCP pulse oscillator capacitor connection
22	NPN		NPN transistor connection output
23	PNP		PNP transistor connection output

Equivalent Circuit Block Diagram

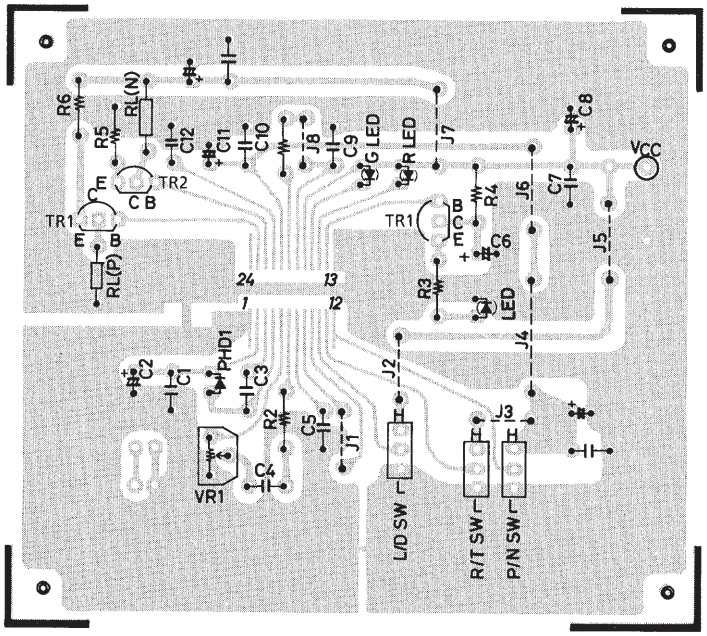


Application Circuit



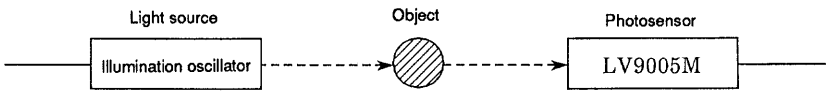
Note: 1. A_{GND} and D_{GND} are connected within the IC.
2. The photodiode and LEDs specified here are examples only. The devices actually used should be chosen based on the particular application.
3. The OCP detection level is determined by the voltage across RL plus the Tr2 (or TR1) VBE voltage.

Sample Printed Circuit Board Pattern (copper side)

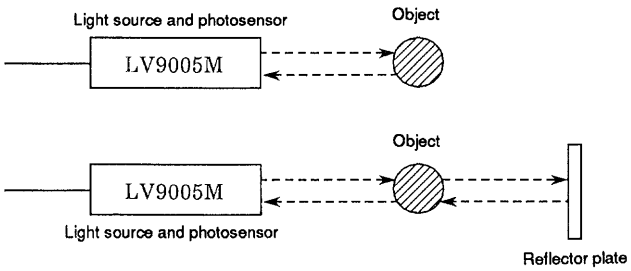


Sample LV9005M Applications

Through type optoelectronic switch



Reflection type optoelectronic switch



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