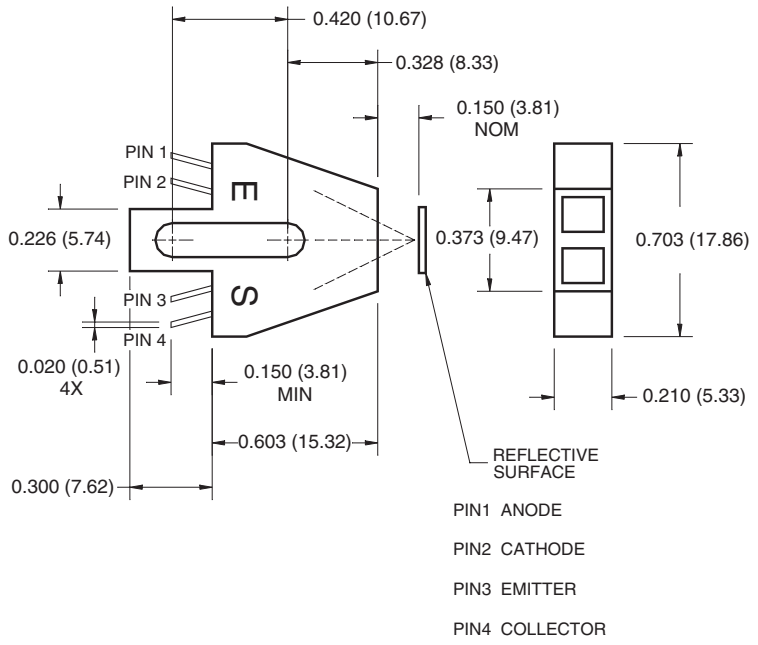
FAIRCHILD
SEMICONDUCTOR®

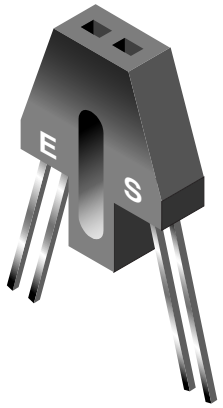
PHOTOTRANSISTOR REFLECTIVE OBJECT SENSOR

QRB1113 QRB1114

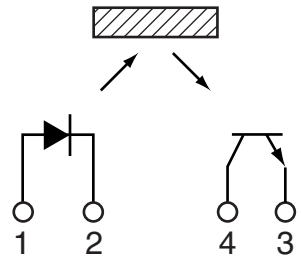
PACKAGE DIMENSIONS



NOTES:
1. Dimensions for all drawings are in inches (mm).
2. Tolerance of ± .010 (.25) on all non-nominal dimensions unless otherwise specified.



SCHEMATIC



DESCRIPTION

The QRB1113/1114 consists of an infrared emitting diode and an NPN silicon phototransistor mounted side by side on a converging optical axis in a black plastic housing. The phototransistor responds to radiation from the emitting diode only when a reflective object passes within its field of view. The area of the optimum response approximates a circle .200" in diameter.

FEATURES

- No contact surface sensing
- Phototransistor output
- Focused for sensing specular reflection
- Daylight filter on photosensor
- Dust cover

3/5/02 DS300350

FAIRCHILD
SEMICONDUCTOR®

PHOTOTRANSISTOR REFLECTIVE OBJECT SENSOR

QRB1113 QRB1114

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C unless otherwise specified)			
Parameter	**Symbol**	**Rating**	**Units**
Operating Temperature	T_{OPR}	-40 to +85	°C
Storage Temperature	T_{STG}	-40 to +85	°C
Soldering Temperature (Iron)(2,3,4)	T_{SOL-I}	240 for 5 sec	°C
Soldering Temperature (Flow)(2,3)	T_{SOL-F}	260 for 10 sec	°C
EMITTER			
Continuous Forward Current	I_F	50	mA
Reverse Voltage	V_R	5	V
Power Dissipation(1)	P_D	100	mW
SENSOR			
Collector-Emitter Voltage	V_{CEO}	30	V
Emitter-Collector Voltage	V_{ECO}	4.5	V
Collector Current		20	mA
Power Dissipation(1)	P_D	100	mW

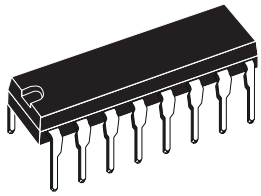
NOTES
1. Derate power dissipation linearly 1.67 mW/°C above 25°C.
2. RMA flux is recommended.
3. Methanol or isopropyl alcohols are recommended as cleaning agents.
4. Soldering iron 1/16" (1.6mm) minimum from housing.
5. D is the distance from the assembly face to the reflective surface.
6. Measured using an Eastman Kodak neutral test card with 90% diffused reflecting surface.
7. Cross talk is the photo current measured with current to the input diode and no reflecting surface.

ELECTRICAL/OPTICAL CHARACTERISTICS (T_A = 25°C)						
Parameter	**Test Conditions**	**Symbol**	**Min.**	**Typ.**	**Max.**	**Units**
EMITTER						
Forward Voltage	I_F = 40 mA	V_F	—	—	1.7	V
Reverse Current	V_R = 5.0 V	I_R	—	—	100	µA
Peak Emission Wavelength	I_F = 20 mA	λ_{PE}	—	940	—	nm
SENSOR						
Collector-Emitter Breakdown Voltage	I_C = 1 mA	BV_{CEO}	30	—	—	V
Emitter-Collector Breakdown Voltage	I_E = 0.1 mA	BV_{ECO}	5	—	—	V
Collector-Emitter Dark Current	V_{CE} = 10 V, I_F = 0 mA	I_{CEO}	—	—	100	nA
COUPLED						
On-state Collector Current						
QRB1113	I_F = 40 mA, V_{CE} = 5 V D = .150"(5,6)	$I_{C(ON)}$	0.20	—	—	mA
QRB1114			0.60	—		
Collector-Emitter Saturation Voltage	I_F = 20 mA, I_C = 0.5 mA	$V_{CE\ (SAT)}$	—	—	0.4	V
Rise Time	V_{CE} = 5 V, R_L = 100 V $I_{C(ON)}$ = 5 mA	t_r	—	8	—	µs
Fall Time		t_f	—	8	—	
Cross Talk	I_F = 40 mA, V_{CE} = 5 V(7)	I_{CX}	—	—	1.00	µA

ULN2001A-ULN2002A
ULN2003A-ULN2004A

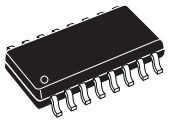
SEVEN DARLINGTON ARRAYS

- SEVEN DARLINGTONS PER PACKAGE
- OUTPUT CURRENT 500mA PER DRIVER (600mA PEAK)
- OUTPUT VOLTAGE 50V
- INTEGRATED SUPPRESSION DIODES FOR INDUCTIVE LOADS
- OUTPUTS CAN BE PARALLELED FOR HIGHER CURRENT
- TTL/CMOS/PMOS/DTL COMPATIBLE INPUTS
- INPUTS PINNED OPPOSITE OUTPUTS TO SIMPLIFY LAYOUT



DIP16

ORDERING NUMBERS: ULN2001A/2A/3A/4A



SO16

ORDERING NUMBERS: ULN2001D/2D/3D/4D

DESCRIPTION

The ULN2001A, ULN2002A, ULN2003 and ULN2004A are high voltage, high current darlington arrays each containing seven open collector darlington pairs with common emitters. Each channel rated at 500mA and can withstand peak currents of 600mA. Suppression diodes are included for inductive load driving and the inputs are pinned opposite the outputs to simplify board layout.

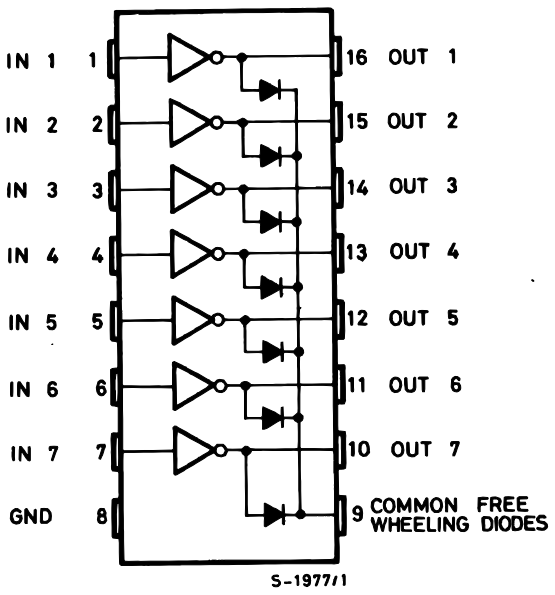
The four versions interface to all common logic families :

ULN2001A	General Purpose, DTL, TTL, PMOS, CMOS
ULN2002A	14-25V PMOS
ULN2003A	5V TTL, CMOS
ULN2004A	6–15V CMOS, PMOS

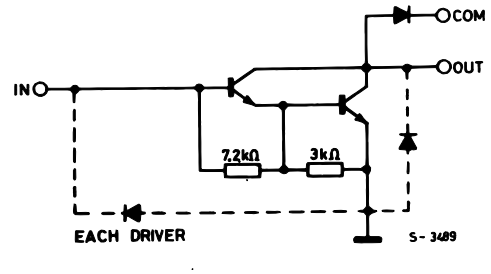
These versatile devices are useful for driving a wide range of loads including solenoids, relays DC motors, LED displays filament lamps, thermal printheads and high power buffers.

The ULN2001A/2002A/2003A and 2004A are supplied in 16 pin plastic DIP packages with a copper leadframe to reduce thermal resistance. They are available also in small outline package (SO-16) as ULN2001D/2002D/2003D/2004D.

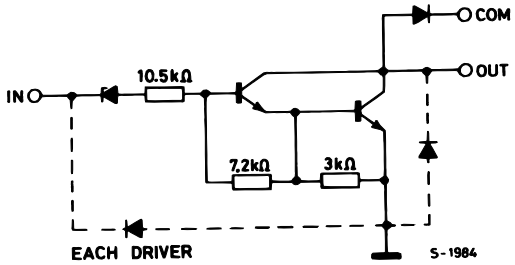
PIN CONNECTION



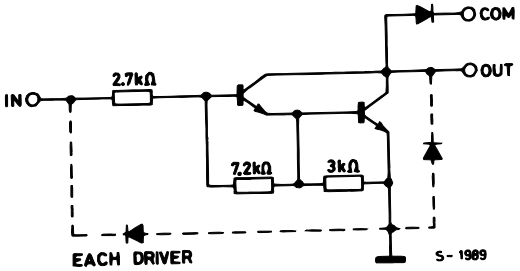
SCHEMATIC DIAGRAM



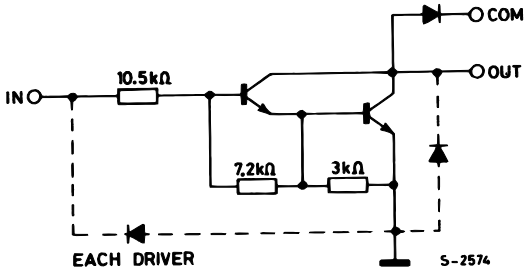
Series ULN-2001A
(each driver)



Series ULN-2002A
(each driver)



Series ULN-2003A
(each driver)



Series ULN-2004A
(each driver)

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_o	Output Voltage	50	V
V_{in}	Input Voltage (for ULN2002A/D - 2003A/D - 2004A/D)	30	V
I_c	Continuous Collector Current	500	mA
I_b	Continuous Base Current	25	mA
T_{amb}	Operating Ambient Temperature Range	– 20 to 85	°C
T_{stg}	Storage Temperature Range	– 55 to 150	°C
T_j	Junction Temperature	150	°C

THERMAL DATA

Symbol	Parameter		DIP16	SO16	Unit
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max.	70	120	°C/W

ELECTRICAL CHARACTERISTICS (T_{amb} = 25°C unless otherwise specified)

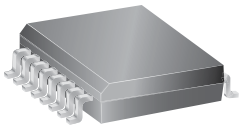
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit	Fig.
I_{CEX}	Output Leakage Current	V_{CE} = 50V T_{amb} = 70°C, V_{CE} = 50V T_{amb} = 70°C for ULN2002A V_{CE} = 50V, V_i = 6V for ULN2004A V_{CE} = 50V, V_i = 1V			50 100 500 500	µA µA µA µA	1a 1a 1b 1b
$V_{CE(sat)}$	Collector-emitter Saturation Voltage	I_C = 100mA, I_B = 250µA I_C = 200 mA, I_B = 350µA I_C = 350mA, I_B = 500µA		0.9 1.1 1.3	1.1 1.3 1.6	V V V	2 2 2
$I_{i(on)}$	Input Current	for ULN2002A, V_i = 17V for ULN2003A, V_i = 3.85V for ULN2004A, V_i = 5V V_i = 12V		0.82 0.93 0.35 1	1.25 1.35 0.5 1.45	mA mA mA mA	3 3 3 3
$I_{i(off)}$	Input Current	T_{amb} = 70°C, I_C = 500µA	50	65		µA	4
$V_{i(on)}$	Input Voltage	V_{CE} = 2V for ULN2002A I_C = 300mA for ULN2003A I_C = 200mA I_C = 250mA I_C = 300mA for ULN2004A I_C = 125mA I_C = 200mA I_C = 275mA I_C = 350mA			 13 2.4 2.7 3 5 6 7 8	V	5
h_{FE}	DC Forward Current Gain	for ULN2001A V_{CE} = 2V, I_C = 350mA	1000				2
C_i	Input Capacitance			15	25	pF	
t_{PLH}	Turn-on Delay Time	0.5 V_i to 0.5 V_o		0.25	1	µs	
t_{PHL}	Turn-off Delay Time	0.5 V_i to 0.5 V_o		0.25	1	µs	
I_R	Clamp Diode Leakage Current	V_R = 50V T_{amb} = 70°C, V_R = 50V			50 100	µA µA	6 6
V_F	Clamp Diode Forward Voltage	I_F = 350mA		1.7	2	V	7

DMOS Full-Bridge Motor Driver

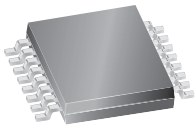
Features and Benefits

- Single supply operation
- Very small outline package
- Low $R_{DS(ON)}$ outputs
- Sleep function
- Internal UVLO
- Crossover current protection
- Thermal shutdown protection

Packages:



Package LB, 16-pin SOIC with internally fused pins



Package LP, 16-pin TSSOP with exposed thermal pad

Not to scale

Description

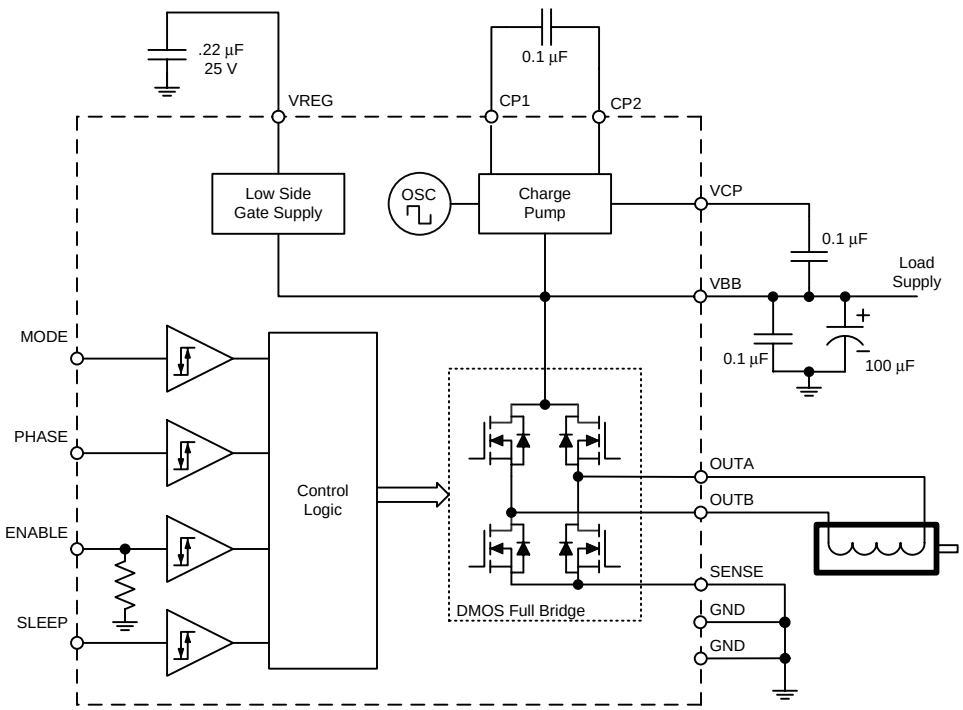
Designed for PWM (pulse width modulated) control of dc motors, the A3949 is capable of peak output currents to ±2.8 A and operating voltages to 36 V.

PHASE and ENABLE input terminals are provided for use in controlling the speed and direction of a dc motor with externally applied PWM control signals. Internal synchronous rectification control circuitry is provided to reduce power dissipation during PWM operation.

Internal circuit protection includes thermal shutdown with hysteresis, undervoltage monitoring of V_{BB} and V_{CP} , and crossover current protection.

The A3949 is supplied in a choice of two power packages, a 16-pin plastic SOIC with a copper batwing tab (part number suffix *LB*), and a low profile (1.1mm) 16-pin TSSOP (suffix *LP*) with exposed power tab. Both packages are lead (Pb) free, with 100% matte tin leadframes.

Functional Block Diagram



Selection Guide

Part Number	Package	Packing
A3949SLB-T	16-pin, SOIC	47 per tube
A3949SLBTR-T	16-pin, SOIC	1000 per reel
A3949SLP-T	16-pin, TSSOP	96 per tube
A3949SLPTR-T	16-pin, TSSOP	4000 per reel

Absolute Maximum Ratings

Characteristic	Symbol	Notes	Rating	Units
Load Supply Voltage	V_{BB}		36	V
		Peak < 2 µs	38	V
Logic Input Voltage	V_{IN}		–0.3 to 7	V
Sense Voltage	V_{SENSE}		0.5	V
Output Current, Repetitive	I_{OUT}	Output current rating may be limited by duty cycle, ambient temperature, and heat sinking. Under any set of conditions, DO NOT exceed the specified I_{OUT} or T_J.	±2.8	A
Operating Ambient Temperature	T_A	Range S	–20 to 85	ºC
Maximum Junction Temperature	T_J(max)		150	ºC
Storage Temperature	T_{stg}		–55 to 150	ºC

Package Thermal Characteristics*

Characteristic	Symbol	Note	Rating	Units
Package Thermal Resistance	$R_{\theta JA}$	LB package, measured on 2-layer PCB with 2 in^2 2-oz. copper each side	52	°C/W
		LP package, measured on 4-layer PCB based on JEDEC standard	34	°C/W

*Additional information is available on the Allegro website

ELECTRICAL CHARACTERISTICS at T_A = 25°C, V_{BB} = 8 V to 36 V (unless otherwise noted)

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Output-On Resistance	R_{DSON}	Source driver, I_{OUT} = –2.8 A, T_J = 25°C	–	.4	.48	Ω
		Source driver, I_{OUT} = –2.8 A, T_J = 125°C	–	.68	–	Ω
		Sink driver, I_{OUT} = 2.8 A, T_J = 25°C	–	.3	.43	Ω
		Sink driver, I_{OUT} = –2.8 A, T_J = 125°C	–	.576	–	Ω
Body Diode Forward Voltage	V_F	Source diode, I_F = –2.8 A	–	1.1	1.3	V
		Sink diode, I_F = 2.8 A	–	1	1.3	V
Motor Supply Current	I_{BB}	f_{PWM} < 50 kHz	–	6	8.5	mA
		Charge pump turned on; outputs disabled	–	3	4.5	mA
		Sleep mode	–	–	10	µA
Logic Input Voltage PHASE, ENABLE, MODE	$V_{IN(1)}$		2.0	–	–	V
	$V_{IN(0)}$		–	–	0.8	V
Logic Input Voltage SLEEP	$V_{IN(1)}$		2.7	–	–	V
	$V_{IN(0)}$		–	–	0.8	V
Logic Input Current PHASE, MODE pins	$I_{IN(1)}$	V_{IN} = 2.0 V	–	< 1.0	20	µA
	$I_{IN(0)}$	V_{IN} = 0.8 V	–	< –2.0	–20	µA
Logic Input Current ENABLE pin	$I_{IN(1)}$	V_{IN} = 2.0 V	–	40	100	µA
	$I_{IN(0)}$	V_{IN} = 0.8 V	–	16	40	µA
Logic Input Current SLEEP pin	$I_{IN(1)}$	V_{IN} = 2.7 V	–	27	50	µA
	$I_{IN(0)}$	V_{IN} = 0.8 V	–	< 1	10	µA
Propagation Delay Times	t_{pd}	From PWM change to source or sink turn on	–	600	–	ns
		From PWM change to source or sink turn off	–	100	–	ns
Crossover Delay	t_{COD}		–	500	–	ns
Protection Circuitry						
UVLO Enable Threshold		VBB rising	–	6	–	V
UVLO Hysteresis			–	250	–	mV
Thermal Shutdown Temp.	T_J		–	170	–	°C
Thermal Shutdown Hysteresis	ΔT_J		–	15	–	°C

National Semiconductor

July 2006

LM555 Timer

General Description

The LM555 is a highly stable device for generating accurate time delays or oscillation. Additional terminals are provided for triggering or resetting if desired. In the time delay mode of operation, the time is precisely controlled by one external resistor and capacitor. For astable operation as an oscillator, the free running frequency and duty cycle are accurately controlled with two external resistors and one capacitor. The circuit may be triggered and reset on falling waveforms, and the output circuit can source or sink up to 200mA or drive TTL circuits.

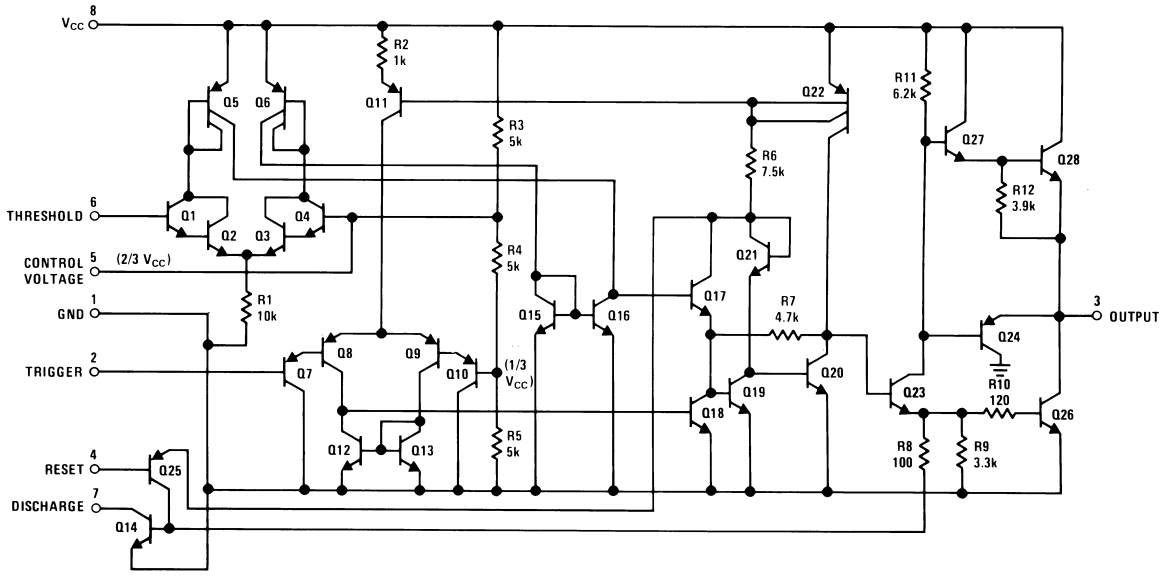
Features

- Direct replacement for SE555/NE555
- Timing from microseconds through hours
- Operates in both astable and monostable modes
- Adjustable duty cycle
- Output can source or sink 200 mA
- Output and supply TTL compatible
- Temperature stability better than 0.005% per ˚C
- Normally on and normally off output
- Available in 8-pin MSOP package

Applications

- Precision timing
- Pulse generation
- Sequential timing
- Time delay generation
- Pulse width modulation
- Pulse position modulation
- Linear ramp generator

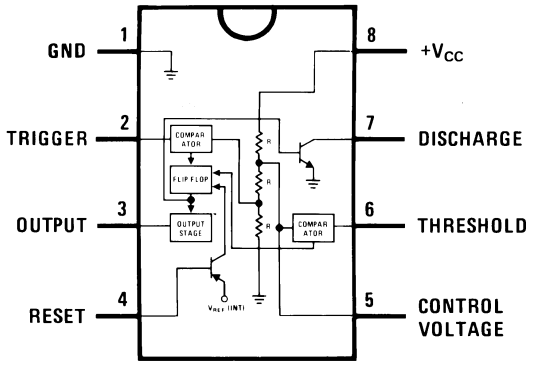
Schematic Diagram



00785101

Connection Diagram

Dual-In-Line, Small Outline and Molded Mini Small Outline Packages



00785103

Top View

Ordering Information

Package	Part Number	Package Marking	Media Transport	NSC Drawing
8-Pin SOIC	LM555CM	LM555CM	Rails	M08A
	LM555CMX	LM555CM	2.5k Units Tape and Reel	
8-Pin MSOP	LM555CMM	Z55	1k Units Tape and Reel	MUA08A
	LM555CMMX	Z55	3.5k Units Tape and Reel	
8-Pin MDIP	LM555CN	LM555CN	Rails	N08E

Absolute Maximum Ratings (Note 2)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

Supply Voltage	+18V
Power Dissipation (Note 3)	
LM555CM, LM555CN	1180 mW
LM555CMM	613 mW
Operating Temperature Ranges	
LM555C	0˚C to +70˚C
Storage Temperature Range	−65˚C to +150˚C

Soldering Information

Dual-In-Line Package	
Soldering (10 Seconds)	260˚C
Small Outline Packages	
(SOIC and MSOP)	
Vapor Phase (60 Seconds)	215˚C
Infrared (15 Seconds)	220˚C

See AN-450 “Surface Mounting Methods and Their Effect on Product Reliability” for other methods of soldering surface mount devices.

Electrical Characteristics (Notes 1, 2)

(T_A = 25˚C, V_{CC} = +5V to +15V, unless othewise specified)

Parameter	Conditions	Limits			Units
		LM555C			
		Min	Typ	Max	
Supply Voltage		4.5		16	V
Supply Current	V_{CC} = 5V, R_L = ∞		3	6	
	V_{CC} = 15V, R_L = ∞ (Low State) (Note 4)		10	15	mA
Timing Error, Monostable					
Initial Accuracy			1		%
Drift with Temperature	R_A = 1k to 100kΩ, C = 0.1µF, (Note 5)		50		ppm/˚C
Accuracy over Temperature			1.5		%
Drift with Supply			0.1		%/V
Timing Error, Astable					
Initial Accuracy			2.25		%
Drift with Temperature	R_A, R_B = 1k to 100kΩ, C = 0.1µF, (Note 5)		150		ppm/˚C
Accuracy over Temperature			3.0		%
Drift with Supply			0.30		%/V
Threshold Voltage			0.667		x V_{CC}
Trigger Voltage	V_{CC} = 15V		5		V
	V_{CC} = 5V		1.67		V
Trigger Current			0.5	0.9	µA
Reset Voltage		0.4	0.5	1	V
Reset Current			0.1	0.4	mA
Threshold Current	(Note 6)		0.1	0.25	µA
Control Voltage Level	V_{CC} = 15V	9	10	11	V
	V_{CC} = 5V	2.6	3.33	4	
Pin 7 Leakage Output High			1	100	nA
Pin 7 Sat (Note 7)					
Output Low	V_{CC} = 15V, I_7 = 15mA		180		mV
Output Low	V_{CC} = 4.5V, I_7 = 4.5mA		80	200	mV

Electrical Characteristics (Notes 1, 2) (Continued)

(T_A = 25˚C, V_{CC} = +5V to +15V, unless othewise specified)

Parameter	Conditions	Limits			Units
		LM555C			
		Min	Typ	Max	
Output Voltage Drop (Low)	V_{CC} = 15V				
	I_{SINK} = 10mA		0.1	0.25	V
	I_{SINK} = 50mA		0.4	0.75	V
	I_{SINK} = 100mA		2	2.5	V
	I_{SINK} = 200mA		2.5		V
	V_{CC} = 5V				
	I_{SINK} = 8mA				V
	I_{SINK} = 5mA		0.25	0.35	V
Output Voltage Drop (High)	I_{SOURCE} = 200mA, V_{CC} = 15V		12.5		V
	I_{SOURCE} = 100mA, V_{CC} = 15V	12.75	13.3		V
	V_{CC} = 5V	2.75	3.3		V
Rise Time of Output			100		ns
Fall Time of Output			100		ns

Note 1: All voltages are measured with respect to the ground pin, unless otherwise specified.

Note 2: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not guarantee specific performance limits. Electrical Characteristics state DC and AC electrical specifications under particular test conditions which guarantee specific performance limits. This assumes that the device is within the Operating Ratings. Specifications are not guaranteed for parameters where no limit is given, however, the typical value is a good indication of device performance.

Note 3: For operating at elevated temperatures the device must be derated above 25˚C based on a +150˚C maximum junction temperature and a thermal resistance of 106˚C/W (DIP), 170˚C/W (S0-8), and 204˚C/W (MSOP) junction to ambient.

Note 4: Supply current when output high typically 1 mA less at V_{CC} = 5V.

Note 5: Tested at V_{CC} = 5V and V_{CC} = 15V.

Note 6: This will determine the maximum value of $R_A + R_B$ for 15V operation. The maximum total ($R_A + R_B$) is 20MΩ.

Note 7: No protection against excessive pin 7 current is necessary providing the package dissipation rating will not be exceeded.

Note 8: Refer to RETS555X drawing of military LM555H and LM555J versions for specifications.

LITEON

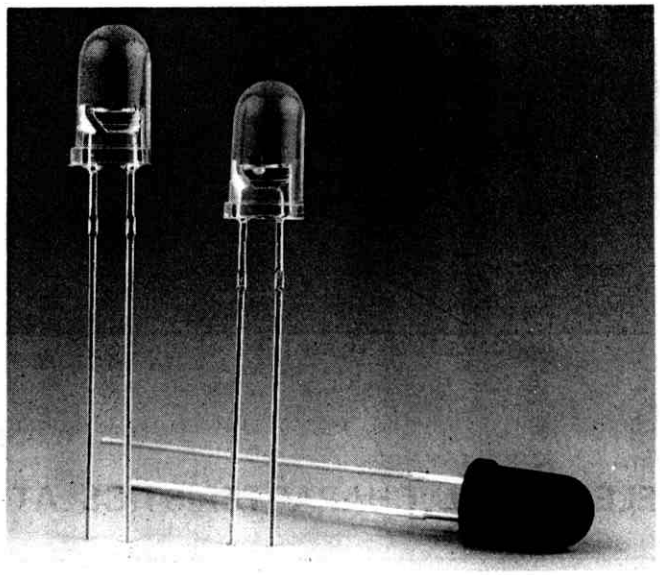
NPN T-1 ¾ STANDARD 5φ PHOTOTRANSISTOR

LTR-3208/3208E

Bob Gee

FEATURES

- WIDE RANGE OF COLLECTOR CURRENTS.
- LENSED FOR HIGH SENSITIVITY.
- LOW COST PLASTIC PACKAGE.

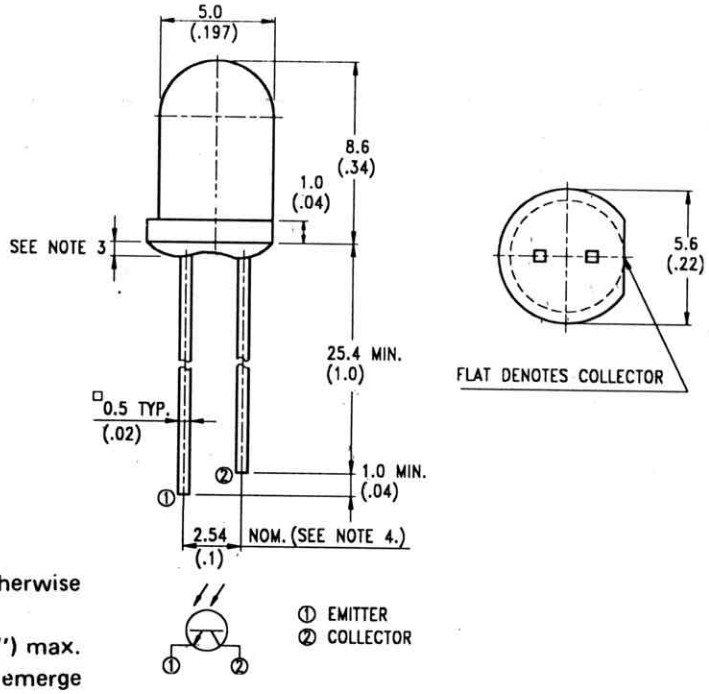


DESCRIPTION

The LTR-3208 series consist of a NPN silicon phototransistor mounted in a lensed, clear plastic, end looking package. The lensing effect of the package allows an acceptance half angle of 10° measured from the optical axis to the half power point. This series is mechanically and spectrally matched to the LTE-4208 series of infrared emitting diodes.

The LTR-3208E is a special dark plastic package that cut the visible light and suitable for the detectors of infrared applications.

PACKAGE DIMENSIONS



NOTES:

1. All dimensions are in millimeters (inches).
2. Tolerance is ±0.25mm (.010") unless otherwise noted.
3. Protruded resin under flange is 1.5mm (.059") max.
4. Lead spacing is measured where the leads emerge from the package.
5. Specifications are subject to change without notice.

ABSOLUTE MAXIMUM RATINGS AT T_A = 25 °C

PARAMETER	MAXIMUM RATING	UNIT
Power Dissipation	100	mW
Collector-Emitter Voltage	30	V
Emitter-Collector Voltage	5	V
Operating Temperature Range	−55 °C to + 100 °C	
Storage Temperature Range	−55 °C to + 100 °C	
Lead Soldering Temperature [1.6mm (0.063in) From Body]	260 °C for 5 Seconds	

ELECTRICAL CHARACTERISTICS AT T_A = 25 °C

PARAMETER	SYMBOL	PART NO LTR—	MIN	TYP	MAX	UNIT	TEST CONDITION
Collector-Emitter Breakdown Voltage	$V_{(BR)\ CEO}$		30			V	I_C = 1 mA E_e = 0 mW/cm²
Emitter-Collector Breakdown Voltage	$V_{(BR)\ ECO}$		5			V	I_E = 100 μA E_e = 0 mW/cm²
Collector Emitter Saturation Voltage	$V_{CE\ (SAT)}$				0.4	V	I_C = 0.5 mA E_e = 0.5 mW/cm²
Rise Time	T_r			10		μS	V_{CC} = 30 V I_C = 800 μA R_L = 1 kΩ
Fall Time	T_f			5		μS	
Collector Dark Current	I_{CEO}				100	nA	V_{CE} = 10 V E_e = 0 mW/cm²
On State Collector Current	$I_{C\ (ON)}$	3208	1	4		mA	V_{CE} = 5 V E_e = 1 mW/cm² λ = 940 nm
		3208E	1	2		mA	