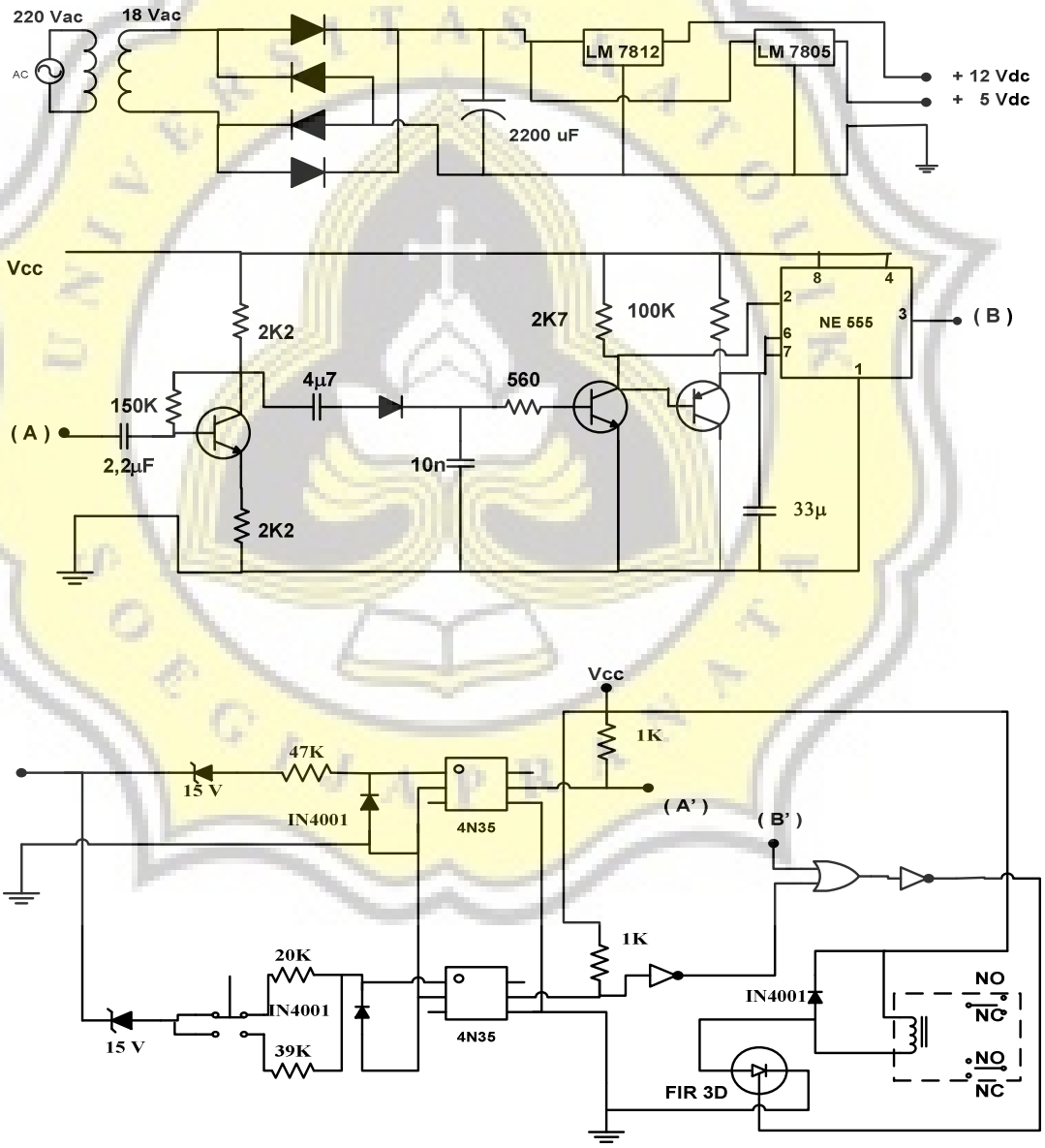
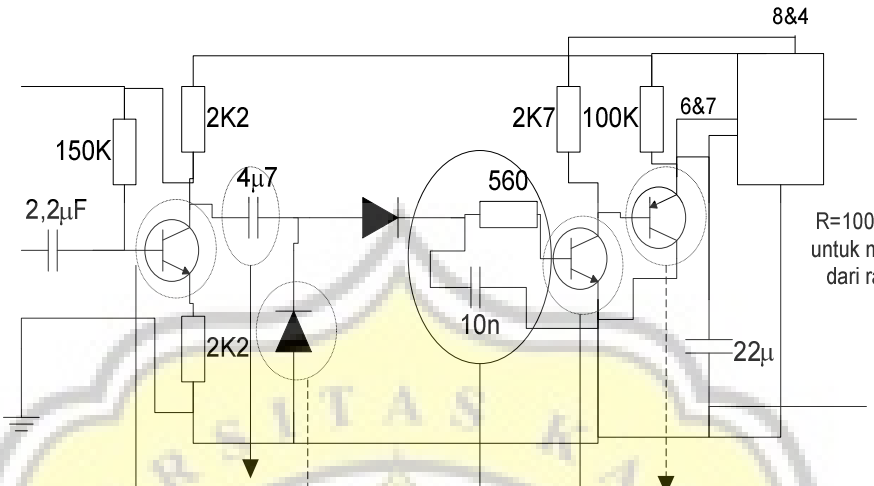
LAMPIRAN :

RANGKAIAN PEMUTUS JALUR AUDIO MELALUI SALURAN TELEPON





R=100K dan C 22µ berfungsi untuk mengatur interval waktu dari rangkaian monostable

Capasitor ini berfungsi sebagai capasitor by pass sehingga hanya tegangan ac yang dapat masuk ke rangkaian monostable

Berfungsi sebagai saklar untuk mengosongkan muatan pada capasitor

Berfungsi sebagai Low Pass Filter
dengan rumus f=1/RC
maka filter ini hanya melewatkan frekuensi 178 Khz
filter ini dipasang agar tidak ada frekuensi modulasi pada line telepon yang mengganggu kerja pemutus audio ini

Dioda ini menjaga agar tidak terjadi arus feedback dari capasitor 10n

C828 berfungsi sebagai saklar untuk mengaktifkan transistor s9012
R=2K7 dipasang untuk membatasi arus yang akan mengalir ke s9012 saat transistor c828 kondisi off dan untuk membatasi arus yang mengalir ke c828 saat transistro tersebut dalam kondisi on.
Dengan perhitungan sbb:
Ic max=50 mA, R=V/I=12volt/50mA=240Ω. Ini merupakan hambatan minimum,sedangkan hambatan maksimum R=V/I=(12-1.2)/1mA=10K8Ω

Ic=2mA,Ic=Ib*HFE maka Ibmin=0.03mA.Rmax=V/I=12/0.03mA=400kΩ.
Ie=Ib+Ic=2.03mA.Dengan VCE=5 volt. Maka Rc dan Re adalah R=(V-VCE)/Ie=7volt/2.03mA=3K4 maka minimal Rc dan Re adalah 1K7

MOTOROLA
SEMICONDUCTOR TECHNICAL DATA

Order this document
by 4N35/D

GlobalOptoisolator™

VDE | UL | CSA | SETI | SEMKO | DEMKO | NEMKO | BABT

6-Pin DIP Optoisolators Transistor Output

4N35*
4N36
4N37
[CTR = 100% Min]

*Motorola Preferred Device

STYLE 1 PLASTIC

STANDARD THRU HOLE
CASE 730A-04

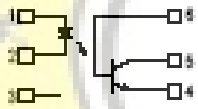
The 4N35, 4N36 and 4N37 devices consist of a gallium arsenide infrared emitting diode optically coupled to a monolithic silicon phototransistor detector.

- Current Transfer Ratio — 100% Minimum @ Specified Conditions
- Guaranteed Switching Speeds
- Meets or Exceeds all JEDEC Registered Specifications
- *To order devices that are tested and marked per VDE 0884 requirements, the suffix "V" must be included at end of part number. VDE 0884 is a test option.*

Applications

- General Purpose Switching Circuits
- Interfacing and coupling systems of different potentials and impedances
- Regulation Feedback Circuits
- Monitor & Detection Circuits
- Solid State Relays

SCHEMATIC



PIN 1. LED ANODE
2. LED CATHODE
3. N.C.
4. EMITTER
5. COLLECTOR
6. BASE

MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
INPUT LED			
Reverse Voltage	V_R	6	Volts
Forward Current — Continuous	I_F	60	mA
LED Power Dissipation @ T_A = 25°C with Negligible Power in Output Detector	P_D	120	mW
Derate above 25°C		1.41	mW/°C
OUTPUT TRANSISTOR			
Collector–Emitter Voltage	V_{CEO}	30	Volts
Emitter–Base Voltage	V_{EBO}	7	Volts
Collector–Base Voltage	V_{CBO}	70	Volts
Collector Current — Continuous	I_C	150	mA
Detector Power Dissipation @ T_A = 25°C with Negligible Power in Input LED	P_D	150	mW
Derate above 25°C		1.76	mW/°C
TOTAL DEVICE			
Isolation Surface Voltage(1) (Peak ac Voltage, 60 Hz, 1 sec Duration)	V_{ISO}	7500	Vac(pk)
Total Device Power Dissipation @ T_A = 25°C	P_D	250	mW
Derate above 25°C		2.94	mW/°C
Ambient Operating Temperature Range(2)	T_A	–55 to +100	°C
Storage Temperature Range(2)	T_{stg}	–55 to +150	°C
Soldering Temperature (10 sec, 1/16" from case)	T_L	260	°C

1. Isolation surge voltage is an internal device dielectric breakdown rating. For this test, Pins 1 and 2 are common, and Pins 4, 5 and 6 are common.
2. Refer to Quality and Reliability Section in Opto Data Book for information on test conditions.

Preferred devices are Motorola recommended choices for future use and best overall value.

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REV 2

MOTOROLA

4N35 4N36 4N37

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)(1)

Characteristic		Symbol	Min	Typ(1)	Max	Unit
INPUT LED						
Forward Voltage (I_F = 10 mA)	T_A = 25°C T_A = –55°C T_A = 100°C	V_F	0.8 0.9 0.7	1.15 1.3 1.05	1.5 1.7 1.4	V
Reverse Leakage Current (V_R = 6 V)		I_R	—	—	10	μA
Capacitance (V = 0 V, f = 1 MHz)		C_J	—	18	—	pF
OUTPUT TRANSISTOR						
Collector–Emitter Dark Current (V_{CE} = 10 V, T_A = 25°C) (V_{CE} = 30 V, T_A = 100°C)		I_{CEO}	— —	1 —	50 500	nA μA
Collector–Base Dark Current (V_{CB} = 10 V)	T_A = 25°C T_A = 100°C	I_{CBO}	—	0.2 100	20 —	nA
Collector–Emitter Breakdown Voltage (I_C = 1 mA)		$V_{(BR)CEO}$	30	45	—	V
Collector–Base Breakdown Voltage (I_C = 100 μA)		$V_{(BR)CBO}$	70	100	—	V
Emitter–Base Breakdown Voltage (I_E = 100 μA)		$V_{(BR)EBO}$	7	7.8	—	V
DC Current Gain (I_C = 2 mA, V_{CE} = 5 V)		h_{FE}	—	400	—	—
Collector–Emitter Capacitance (f = 1 MHz, V_{CE} = 0)		C_{CE}	—	7	—	pF
Collector–Base Capacitance (f = 1 MHz, V_{CB} = 0)		C_{CB}	—	19	—	pF
Emitter–Base Capacitance (f = 1 MHz, V_{EB} = 0)		C_{EB}	—	9	—	pF
COUPLED						
Output Collector Current (I_F = 10 mA, V_{CE} = 10 V)	T_A = 25°C T_A = –55°C T_A = 100°C	I_C (CTR)(2)	10 (100) 4 (40) 4 (40)	30 (300) — —	— — —	mA (%)
Collector–Emitter Saturation Voltage (I_C = 0.5 mA, I_F = 10 mA)		$V_{CE(sat)}$	—	0.14	0.3	V
Turn–On Time	(I_C = 2 mA, V_{CC} = 10 V, R_L = 100 Ω)(3)	t_{on}	—	7.5	10	μs
Turn–Off Time		t_{off}	—	5.7	10	
Rise Time		t_r	—	3.2	—	
Fall Time		t_f	—	4.7	—	
Isolation Voltage (f = 60 Hz, t = 1 sec)		V_{ISO}	7500	—	—	Vac(pk)
Isolation Current(4) ($V_{I–O}$ = 3550 Vpk) ($V_{I–O}$ = 2500 Vpk) ($V_{I–O}$ = 1500 Vpk)	4N35 4N36 4N37	I_{ISO}	— — —	— — 8	100 100 100	μA
Isolation Resistance (V = 500 V)(4)		R_{ISO}	10^{11}	—	—	Ω
Isolation Capacitance (V = 0 V, f = 1 MHz)(4)		C_{ISO}	—	0.2	2	pF

1. Always design to the specified minimum/maximum electrical limits (where applicable).
2. Current Transfer Ratio (CTR) = I_C/I_F x 100%.
3. For test circuit setup and waveforms, refer to Figure 11.
4. For this test, Pins 1 and 2 are common, and Pins 4, 5 and 6 are common.

TYPICAL CHARACTERISTICS

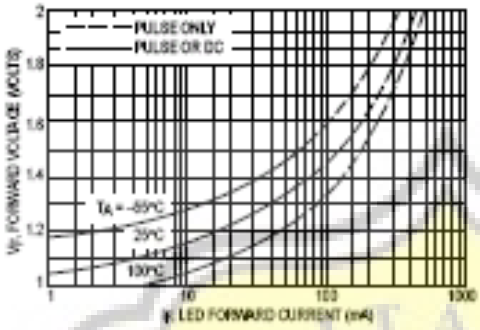


Figure 1. LED Forward Voltage versus Forward Current

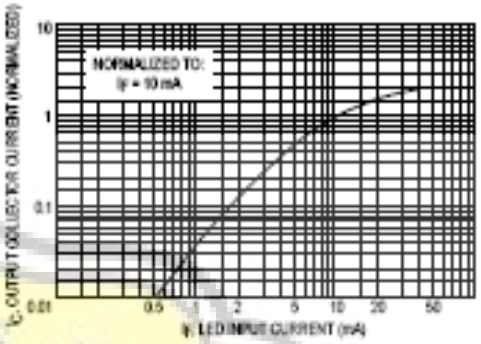


Figure 2. Output Current versus Input Current

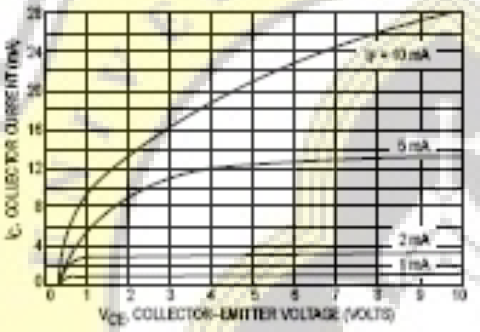


Figure 3. Collector Current versus Collector–Emitter Voltage

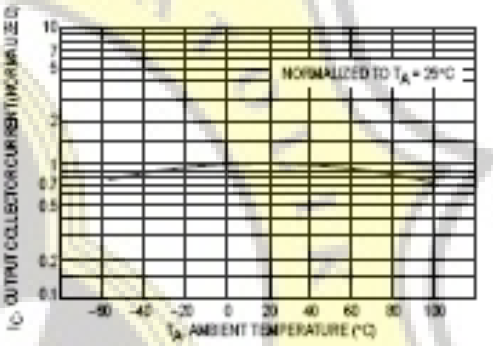


Figure 4. Output Current versus Ambient Temperature

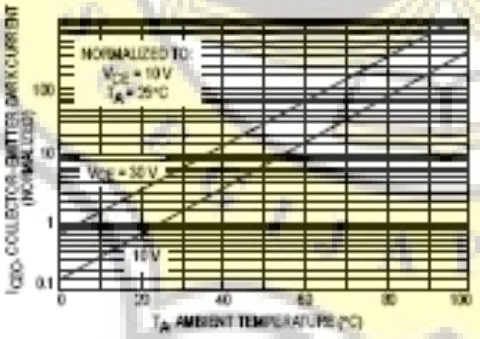


Figure 5. Dark Current versus Ambient Temperature

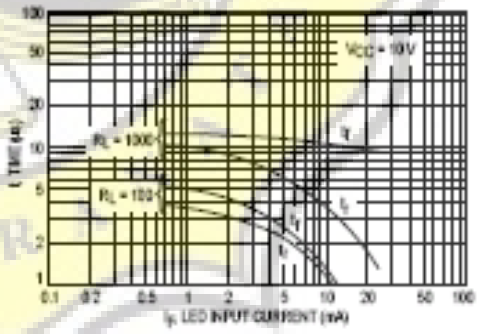


Figure 6. Rise and Fall Times (Typical Values)

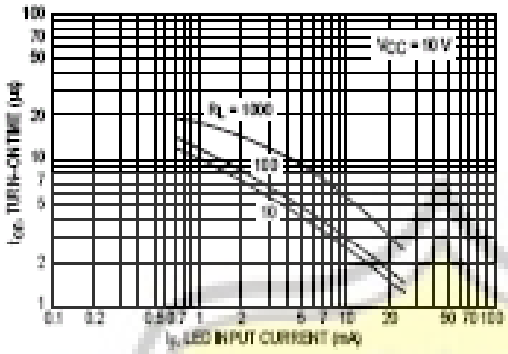


Figure 7. Turn–On Switching Times

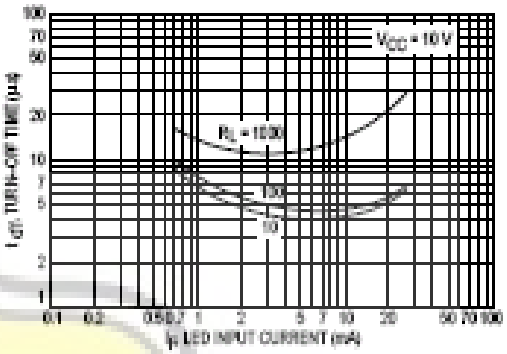


Figure 8. Turn–Off Switching Times

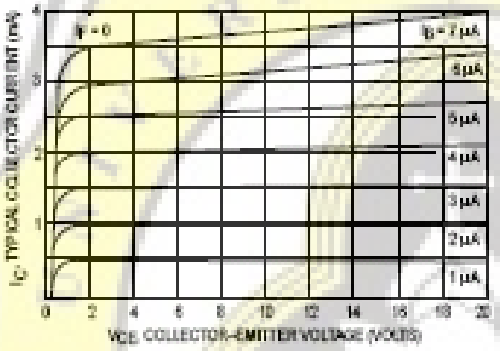


Figure 9. DC Current Gain (Detector Only)

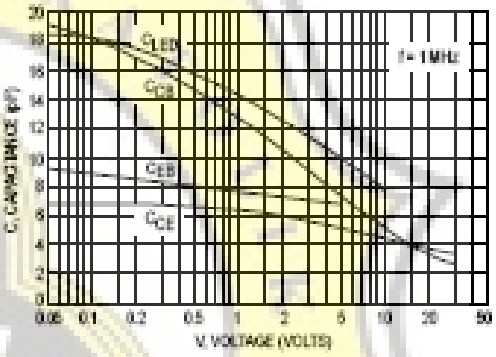


Figure 10. Capacitances versus Voltage

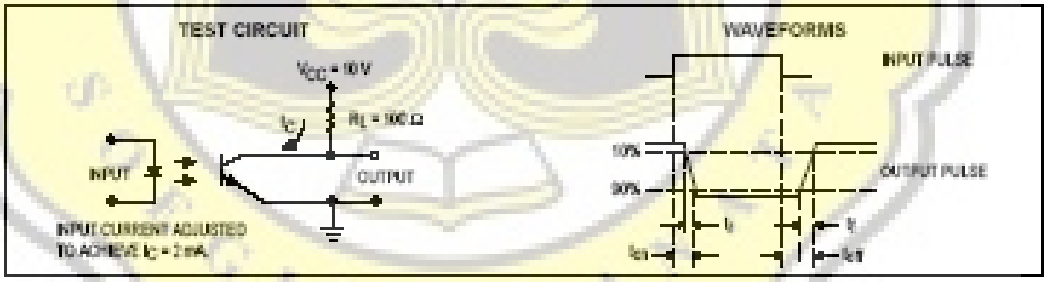
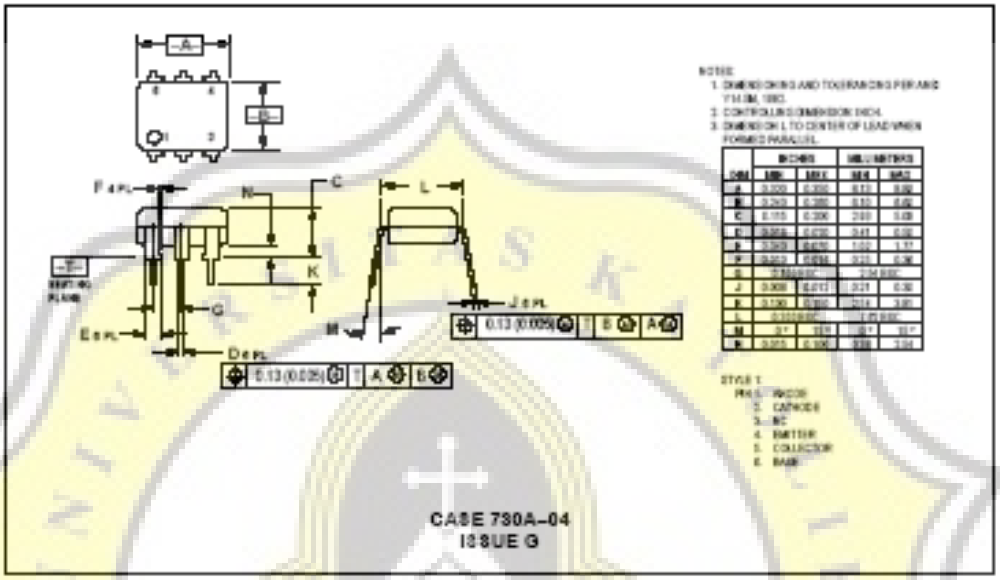
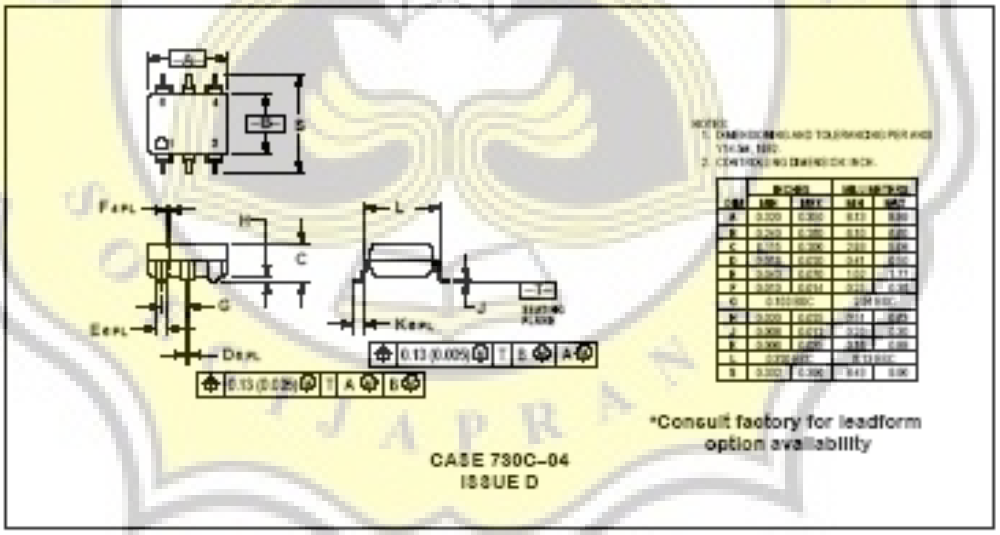


Figure 11. Switching Time Test Circuit and Waveforms

PACKAGE DIMENSIONS

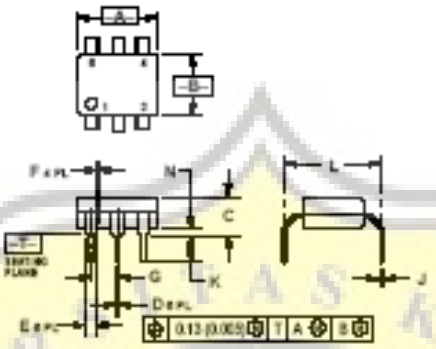


CASE 730A–04
ISSUE G



*Consult factory for leadform option availability

CASE 730C–04
ISSUE D



*Consult factory for leadform option availability

CASE 730D–05
ISSUE D

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TECHNICAL DATA
DATA SHEET 828, REV.-

HERMETIC POWER SCHOTTKY RECTIFIER

Features:

- Very Low Forward Voltage Drop
- Low Power Loss, High Efficiency

MAXIMUM RATINGS ALL RATINGS ARE AT T_A = 25 C UNLESS OTHERWISE SPECIFIED

RATING	SYMBOL	MAX.	UNITS
PEAK INVERSE VOLTAGE	PIV	60	Volts
MAXIMUM DC OUTPUT CURRENT @ T_C=100 °C	I_O	16	Amps
PEAK SINGLE CYCLE SURGE CURRENT t_p = 8.3 msec	I_{FSM}	75	Amps
MAXIMUM JUNCTION CAPACITANCE	C_T	1600	pF
MAXIMUM THERMAL RESISTANCE	R_{thJC}	0.77	°C/W
MAXIMUM OPERATING AND STORAGE TEMPERATURE	$T_{J\ stg}$	-65 to + 150	°C

ELECTRICAL CHARACTERISTICS

CHARACTERISTIC		SYMBOL	MAX.	UNITS
MAXIMUM PEAK FORWARD VOLTAGE DROP (PER LEG) (I_F = 16 AMPS)	T_A = 25°C	V_f	0.56	Volts
	T_A = 125°C		0.46	
MAXIMUM REVERSE CURRENT I_r @ PIV (PER LEG)	T_A = 25°C	I_r	4.0	mA
	T_A = 125°C		280	

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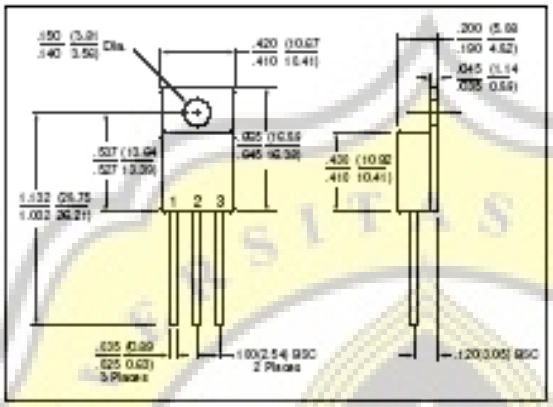
TECHNICAL DATA
DATA SHEET 828, REV. -

Mechanical Dimensions: In Inches / mm



SINGLE

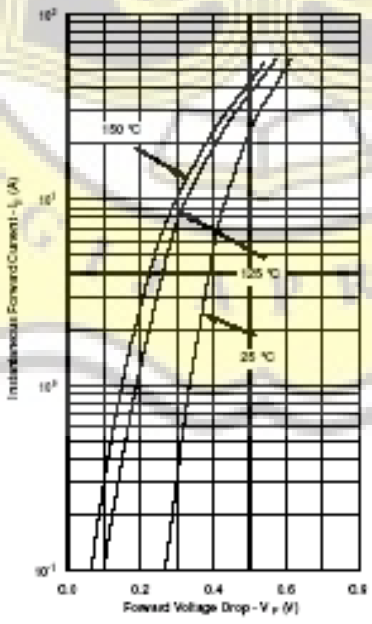
TO-257

PINOUT TABLE

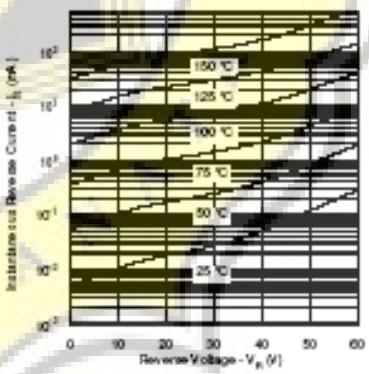
TYPE	PIN 1	PIN 2	PIN 3
SINGLE RECTIFIER	CATHODE	ANODE	ANODE

Vf curves are for bare chip SD175SA60 only, un-packaged.

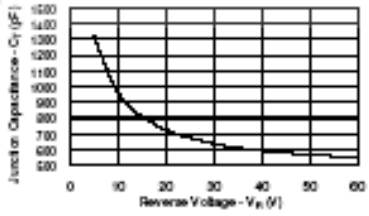
Typical Forward Characteristics



Typical Reverse Characteristics



Typical Junction Capacitance



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TECHNICAL DATA

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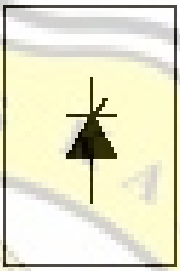
International
IOR Rectifier

SAFEIR Series
12TTS08

PHASE CONTROL SCR



V_T < 1.2V @ 8A
I_{TSM} = 140A
V_{RRM} = 800V

Description/Features

The 12TTS08 SAFEIR series of silicon controlled rectifiers are specifically designed for medium power switching and phase control applications. The glass passivation technology used has reliable operation up to 125° C junction temperature.

Typical applications are in input rectification and crow-bar (soft start) and these products are designed to be used with International Rectifier input diodes, switches and output rectifiers which are available in identical package outlines.

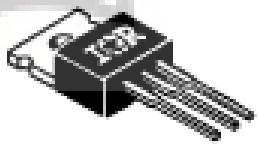
Output Current in Typical Applications

Applications	Single-phase Bridge	Three-phase Bridge	Units
Capacitive input filter T_A = 55°C, T_J = 125°C, common heatsink of 1°C/W	13.5	17	A

Major Ratings and Characteristics

Characteristics	12TTS08	Units
$I_{T(AV)}$ Sinusoidal waveform	8	A
$I_{T(RMS)}$	12.5	A
V_{RRM}/V_{DRM}	800	V
I_{TSM}	140	A
V_T @8A, T_J=25°C	1.2	V
dv/dt	150	V/µs
di/dt	100	A/µs
T_J range	-40to125	°C

Package Outline



TO-220AC

Also available in SMD-220 package (series 12TTS..S)

Voltage Ratings

Part Number	V_{RRM}, maximum peak reverse voltage V	V_{DRM}, maximum peak direct voltage V	I_{RRM}/I_{DRM} 125°C mA
12TTS08	800	800	1.0

Absolute Maximum Ratings

	Parameters	12TTS08	Units	Conditions
$I_{T(AV)}$	Max. Average On-state Current	8	A	@T_C = 108°C, 180° conduction half sine wave
$I_{T(RMS)}$	Max. RMS On-state Current	12.5		
I_{TSM}	Max. Peak One Cycle Non-Repetitive	120	A	10ms Sine pulse, rated V_{RRM} applied, T_J = 125°C
	Surge Current	140		10ms Sine pulse, no voltage reapplied, T_J = 125°C
I^2t	Max. I^2t for fusing	72	A^2s	10ms Sine pulse, rated V_{RRM} applied, T_J = 125°C
		100		10ms Sine pulse, no voltage reapplied, T_J = 125°C
$I^2\sqrt{t}$	Max. $I^2\sqrt{t}$ for fusing	1000	$A^2\sqrt{s}$	t = 0.1 to 10ms, no voltage reapplied, T_J = 125°C
V_{TM}	Max. On-state Voltage Drop	1.2	V	@8A, T_J = 25°C
r_t	On-state slope resistance	16.2	mΩ	T_J = 125°C
$V_{T(TO)}$	Threshold Voltage	0.87	V	
I_{RM}/I_{DM}	Max. Reverse and Direct	0.05	mA	T_J = 25 °C; V_R = rated V_{RRM}/ V_{DRM}
	Leakage Current	1.0		T_J = 125 °C
I_H	Typ. Holding Current	30	mA	Anode Supply = 6V, Resistive load, Initial I_T=1A
I_L	Max. Latching Current	50	mA	Anode Supply = 6V, Resistive load
dv/dt	Max. rate of rise of off-state Voltage	150	V/µs	T_J = 25°C
di/dt	Max. rate of rise of turned-on Current	100	A/µs	

Triggering

	Parameters		12TTS08	Units	Conditions
P_{GM}	Max. peak Gate Power		8.0	W	
$P_{G(AV)}$	Max. average Gate Power		2.0		
$+I_{GM}$	Max. peak positive Gate Current		1.5	A	
$-V_{GM}$	Max. peak negative Gate Voltage		10	V	
I_{GT}	Max. required DC Gate Current to trigger		20	mA	Anode supply = 6V, resistive load, T_J = - 65°C
			15		Anode supply = 6V, resistive load, T_J = 25°C
			10		Anode supply = 6V, resistive load, T_J = 125°C
V_{GT}	Max. required DC Gate Voltage to trigger		1.2	V	Anode supply = 6V, resistive load, T_J = - 65°C
			1		Anode supply = 6V, resistive load, T_J = 25°C
			0.7		Anode supply = 6V, resistive load, T_J = 125°C
V_{GD}	Max. DC Gate Voltage not to trigger		0.2		T_J = 125°C, V_{DRM} = rated value
I_{GD}	Max. DC Gate Current not to trigger		0.1	mA	T_J = 125°C, V_{DRM} = rated value

Switching

	Parameters	12TTS08	Units	Conditions
t_{gt}	Typical turn-on time	0.8	µs	T_J = 25°C
t_{rr}	Typical reverse recovery time	3		T_J = 125°C
t_q	Typical turn-off time	100		

Thermal-Mechanical Specifications

	Parameters		12TTS08	Units	Conditions
T_J	Max. Junction Temperature Range		-40 to 125	°C	
T_{stg}	Max. Storage Temperature Range		-40 to 125		
R_{thJC}	Max. Thermal Resistance Junction to Case		1.5	°C/W	DC operation
R_{thJA}	Max. Thermal Resistance Junction to Ambient		62		
R_{thCS}	Typ. Thermal Resistance Case to Heat Sink		0.5		Mounting surface, smooth and greased
wt	Approximate Weight		2 (0.07)	g (oz.)	
T	Mounting Torque	Min.	6 (5)	Kg-cm (lbf-in)	
		Max.	12 (10)		
	Case Style		TO-220AC		

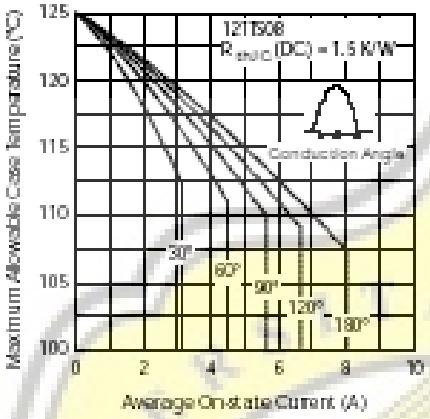


Fig. 1 - Current Rating Characteristics

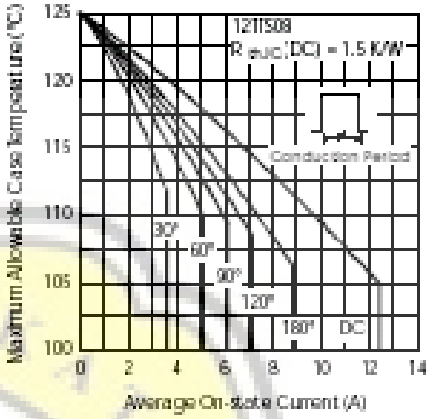


Fig. 2 - Current Rating Characteristics

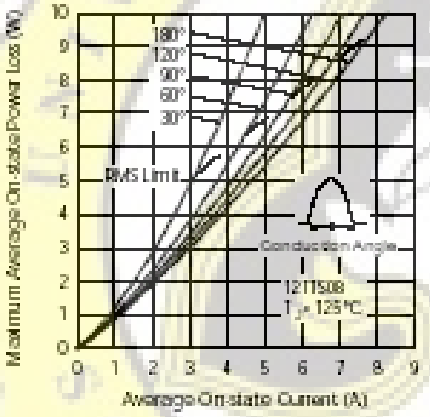


Fig. 3 - On-state Power Loss Characteristics

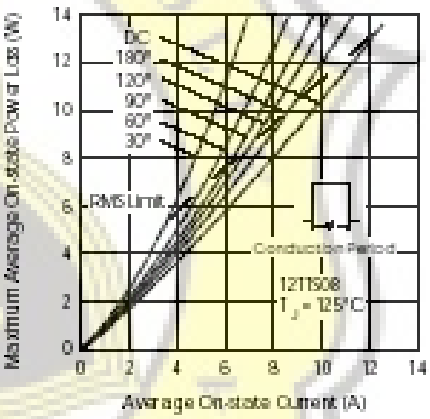


Fig. 4 - On-state Power Loss Characteristics

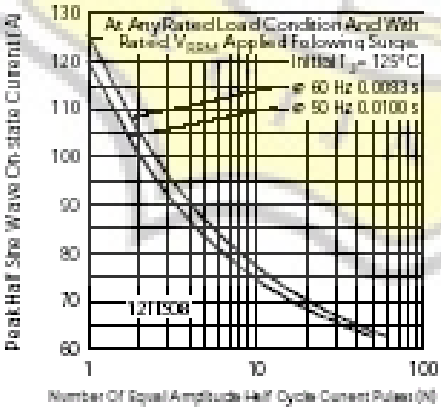


Fig. 6 - Maximum Non-Repetitive Surge Current

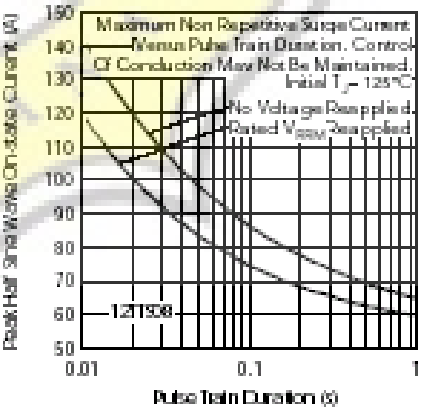


Fig. 7 - Maximum Non-Repetitive Surge Current

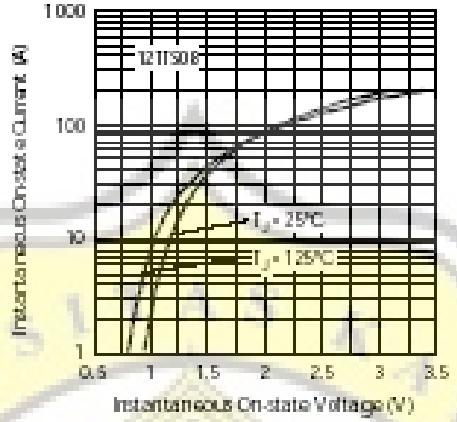


Fig. 7 - On-state Voltage Drop Characteristics

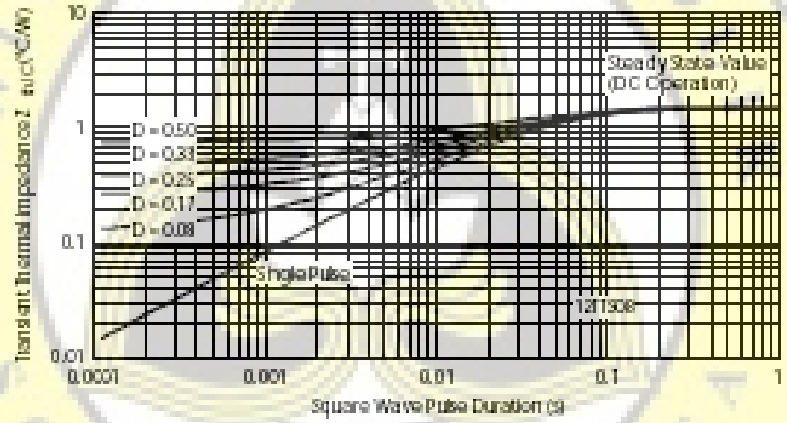
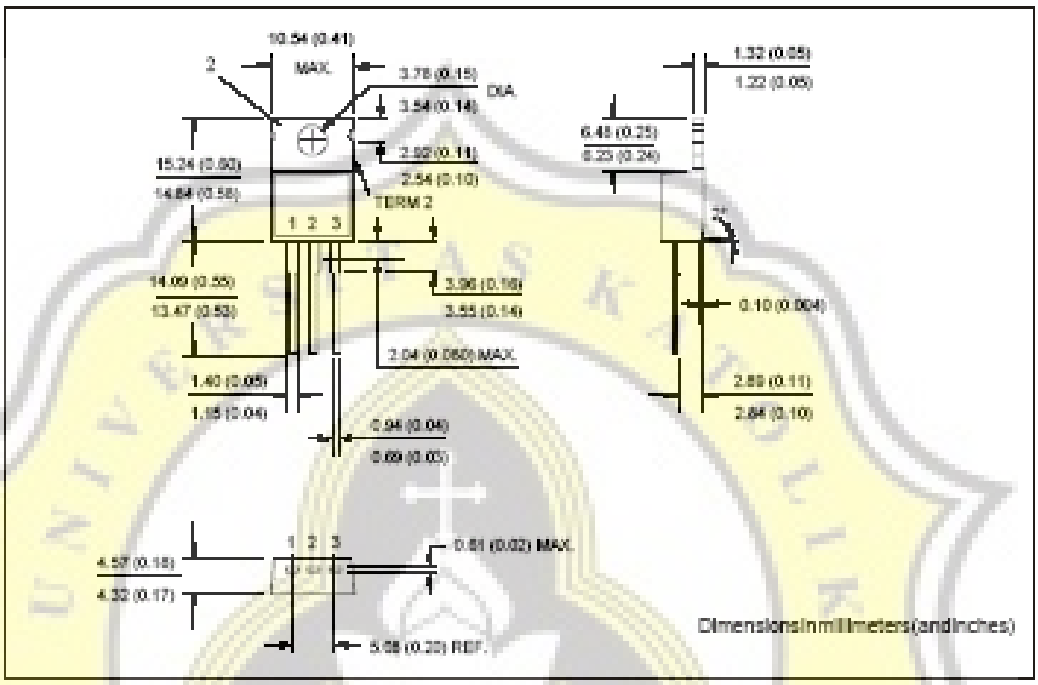
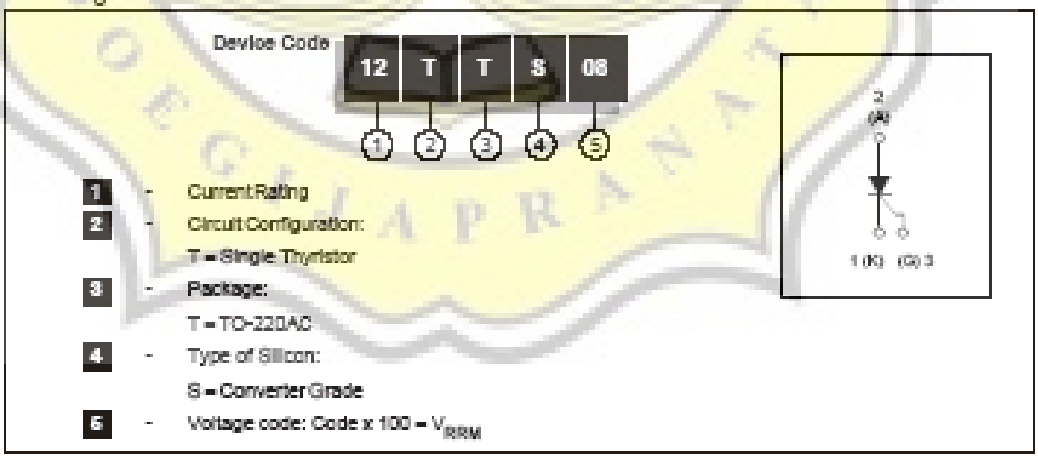


Fig. 8 - Thermal Impedance Z_{thJC} Characteristics

Outline Table



Ordering Information Table



International
IOR Rectifier

WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245 U.S.A. Tel: (310) 322-3331 Fax: (310) 322-3332
EUROPEAN HEADQUARTERS: Hurst Green, Oxted, Surrey RH8 9BB, U.K. Tel: ++ 44 1883 732020 Fax: ++ 44 1883 733408
IR CANADA: 7321 Victoria Park Ave., Suite #201, Markham, Ontario L3R 2Z8 Tel: (905) 475 1897, Fax: (905) 475 8801
IR GERMANY: Saalburgstrasse 157, 61350 Bad Homburg Tel: ++ 49 6172 96590 Fax: ++ 49 6172 965933
IR ITALY: Via Liguria 49, 10071 Borgaro, Torino Tel: ++ 39 11 4510111 Fax: ++ 39 11 4510220
IR FAR EAST: K&H Bldg., 2F, 30-4 Nishi-Ikebukuro 3-Chome, Toshima-Ku, Tokyo, Japan 171 Tel: 81 3 3983 0086 Fax: 81 3 3983 0642
IR SOUTHEAST ASIA: 315 Outram Road, #10-02 Tan Boon Liat Building, SINGAPORE 0316. Tel: 65 221 8371, Fax: 65 221 8372.

FAIRCHILD SEMICONDUCTOR™

Discrete POWER & Signal Technologies

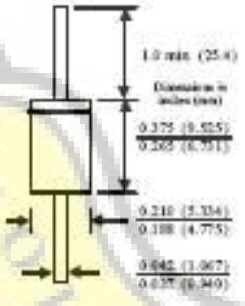
1.5KE6.8(C)A - 1.5KE440(C)A

Features

- Glass passivated junction.
- 1500W Peak Pulse Power capability at 1.0 ms.
- Excellent clamping capability.
- Low incremental surge resistance.
- Fast response time: typically less than 1.0 ps from 0 volts to BV for unidirectional and 5.0 ns for bidirectional.
- Typical I_R less than 1.0 µA above 10V.

DO-201AE

COLOR BAND DENOTES CATHODE



DEVICES FOR BIPOLAR APPLICATIONS

- Bidirectional types use CA suffix.
- Electrical characteristics apply in both directions.

1500 Watt Transient Voltage Suppressors

Absolute Maximum Ratings*

T_A = 25°C unless otherwise noted

Symbol	Parameter	Value	Units
P_{PPM}	Peak Pulse Power Dissipation at T_A = 25°C, Tp=1ms	minimum 1500	W
I_{PPM}	Peak Pulse Current	see table	A
P_D	Steady State Power Dissipation .375" lead length @ T_A = 75°C	5.0	W
I_{FSM}	Peak Forward Surge Current superimposed on rated load (JEDEC method) (Note 1)	200	A
T_{stg}	Storage Temperature Range	-65 to +175	°C
T_J	Operating Junction Temperature	-65 to +175	°C

*These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.

Note 1: Measured on 8.3 ms single half-sine wave. Duty cycle = 4 pulses per minute maximum.

Transient Voltage Supressors
(continued)

Electrical Characteristics
T_A = 25°C unless otherwise noted

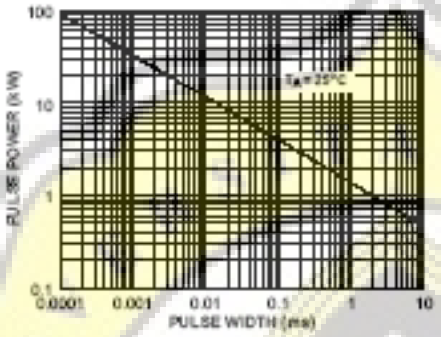
Uni-directional Bi-directional (C) Device	Reverse Stand-off Voltage V_{RWM} (V)	Breakdown Voltage V_{BR} (V) min	max	Test Current I_T(mA)	Max Clamping Voltage @IPPM V_C(V)	Max Peak Pulse Surge Current I_{PPM} (A)	Max Reverse Leakage V_{RWM} I_R (uA)*
1.5KE6.8(C)A	5.80	6.45	7.14	10	10.5	143	1000
1.5KE7.5(C)A	6.40	7.13	7.88	10	11.3	133	500
1.5KE8.2(C)A	7.02	7.79	8.61	10	12.1	124	200
1.5KE9.1(C)A	7.78	8.65	9.55	1	13.4	112	50
1.5KE10(C)A	8.55	9.50	10.5	1	14.5	103	10
1.5KE11(C)A	9.40	10.5	11.6	1	15.6	96.2	5
1.5KE12(C)A	10.2	11.4	12.6	1	16.7	90.0	5
1.5KE13(C)A	11.1	12.4	13.7	1	18.2	82.0	5
1.5KE15(C)A	12.8	14.3	15.8	1	21.2	71.0	5
1.5KE16(C)A	13.6	15.2	16.8	1	22.5	67.0	5
1.5KE18(C)A	15.3	17.1	18.9	1	26.2	59.5	5
1.5KE20(C)A	17.1	19.0	21.0	1	27.7	54.2	5
1.5KE22(C)A	18.8	20.9	23.1	1	30.6	49.0	5
1.5KE24(C)A	20.5	22.8	25.2	1	33.2	45.2	5
1.5KE27(C)A	23.1	25.7	28.4	1	37.5	40.0	5
1.5KE30(C)A	25.6	28.5	31.5	1	41.4	36.2	5
1.5KE33(C)A	28.2	31.4	34.7	1	45.7	33.0	5
1.5KE36(C)A	30.8	34.2	37.8	1	49.9	30.1	5
1.5KE39(C)A	33.3	37.1	41.0	1	53.9	28.0	5
1.5KE43(C)A	36.8	40.9	45.2	1	59.3	25.3	5
1.5KE47(C)A	40.2	44.7	49.4	1	64.8	23.2	5
1.5KE51(C)A	43.6	48.5	53.6	1	70.1	21.4	5
1.5KE56(C)A	47.8	53.2	58.8	1	77.0	19.5	5
1.5KE62(C)A	53.0	58.9	65.1	1	85.0	17.7	5
1.5KE68(C)A	58.1	64.6	71.4	1	92.0	16.3	5
1.5KE75(C)A	64.1	71.3	78.8	1	104.0	14.6	5
1.5KE82(C)A	70.1	77.9	86.1	1	113.0	13.3	5
1.5KE91(C)A	77.8	86.5	95.5	1	125.0	12.0	5
1.5KE100(C)A	85.5	95.0	105.0	1	137.0	11.0	5
1.5KE110(C)A	94.0	106.0	116.0	1	152.0	9.9	5
1.5KE120(C)A	102.0	114.0	126.0	1	165.0	9.1	5
1.5KE130(C)A	111.0	124.0	137.0	1	179.0	8.4	5
1.5KE150(C)A	128.0	143.0	158.0	1	207.0	7.2	5
1.5KE160(C)A	136.0	152.0	168.0	1	219.0	6.8	5
1.5KE170(C)A	145.0	162.0	179.0	1	234.0	6.4	5
1.5KE180(C)A	154.0	171.0	189.0	1	246.0	6.1	5
1.5KE200(C)A	171.0	190.0	210.0	1	274.0	5.5	5
1.5KE220(C)A	185.0	209.0	231.0	1	328.0	4.6	5
1.5KE250(C)A	214.0	237.0	263.0	1	344.0	4.5	5
1.5KE300(C)A	256.0	285.0	315.0	1	414.0	3.8	5
1.5KE350(C)A	300.0	333.0	368.0	1	482.0	3.2	5
1.5KE400(C)A	342.0	380.0	420.0	1	548.0	2.8	5
1.5KE440(C)A	376.0	418.0	462.0	1	602.0	2.6	5

* For bidirectional parts with V_{RWM} <10V, the I_R max limit is doubled.

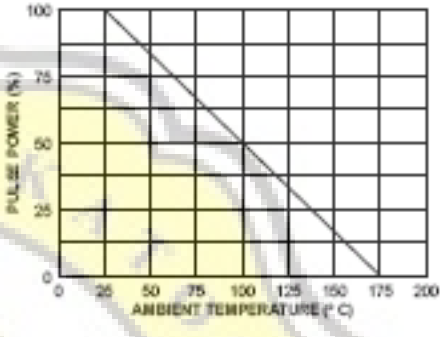
Transient Voltage Supressors
(continued)

Typical Characteristics

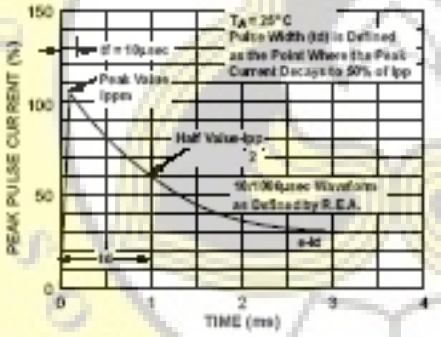
Peak Pulse Power Rating Curve



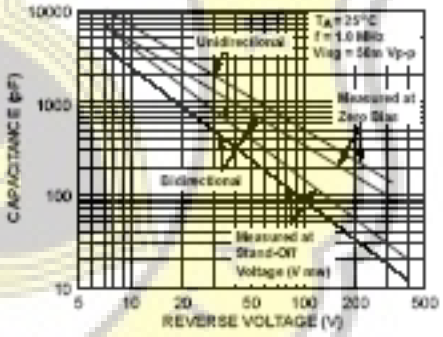
Pulse Derating Curve



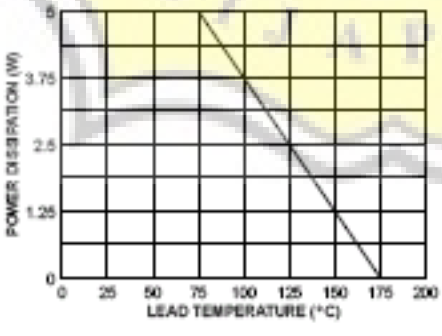
Pulse Waveform



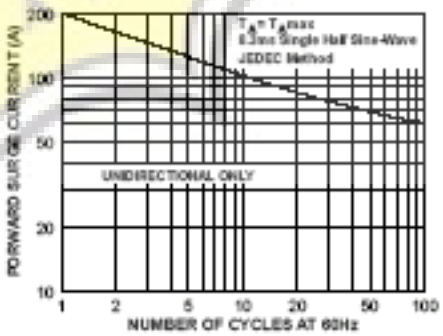
Junction Capacitance



Steady State Power Derating Curve



Non-Repetitive Surge Current



DATA SHEET

NE/SA/SE555/SE555C
Timer

Product data
Supersedes data of 1994 Aug 31

2003 Feb 14

Philips
Semiconductors

PHILIPS

DESCRIPTION

The 555 monolithic timing circuit is a highly stable controller capable of producing accurate time delays, or oscillation. In the time delay mode of operation, the time is precisely controlled by one external resistor and capacitor. For a stable operation as an oscillator, the free running frequency and the duty cycle are both accurately controlled with two external resistors and one capacitor. The circuit may be triggered and reset on falling waveforms, and the output structure can source or sink up to 200 mA.

FEATURES

- Turn-off time less than 2 µs
- Max. operating frequency greater than 500 kHz
- Timing from microseconds to hours
- Operates in both astable and monostable modes
- High output current
- Adjustable duty cycle
- TTL compatible
- Temperature stability of 0.005% per °C

APPLICATIONS

- Precision timing
- Pulse generation
- Sequential timing
- Time delay generation
- Pulse width modulation

PIN CONFIGURATION

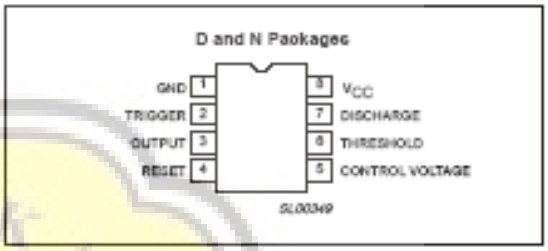


Figure 1. Pin configuration

BLOCK DIAGRAM

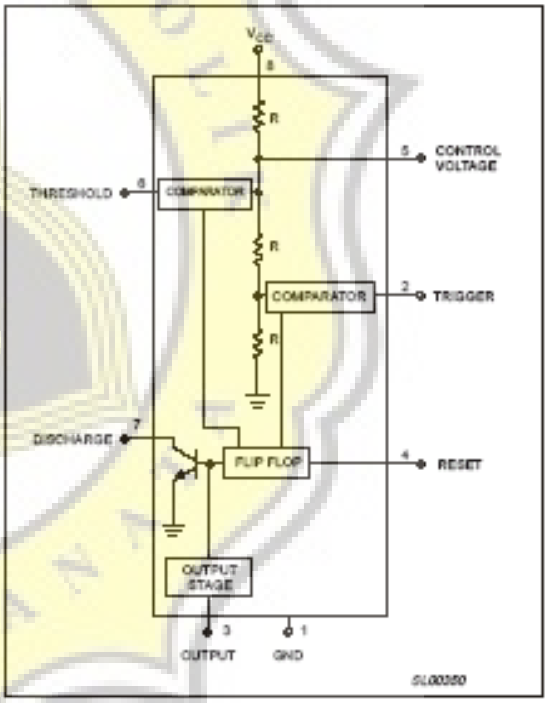


Figure 2. Block Diagram

ORDERING INFORMATION

DESCRIPTION	TEMPERATURE RANGE	ORDER CODE	DWG #
8-Pin Plastic Small Outline (SO) Package	0 to +70 °C	NE555D	SOT96-1
8-Pin Plastic Dual In-Line Package (DIP)	0 to +70 °C	NE555N	SOT97-1
8-Pin Plastic Small Outline (SO) Package	−40 °C to +85 °C	SA555D	SOT96-1
8-Pin Plastic Dual In-Line Package (DIP)	−40 °C to +85 °C	SA555N	SOT97-1
8-Pin Plastic Dual In-Line Package (DIP)	−55 °C to +125 °C	SE555CN	SOT97-1
8-Pin Plastic Dual In-Line Package (DIP)	−55 °C to +125 °C	SE555N	SOT97-1

EQUIVALENT SCHEMATIC

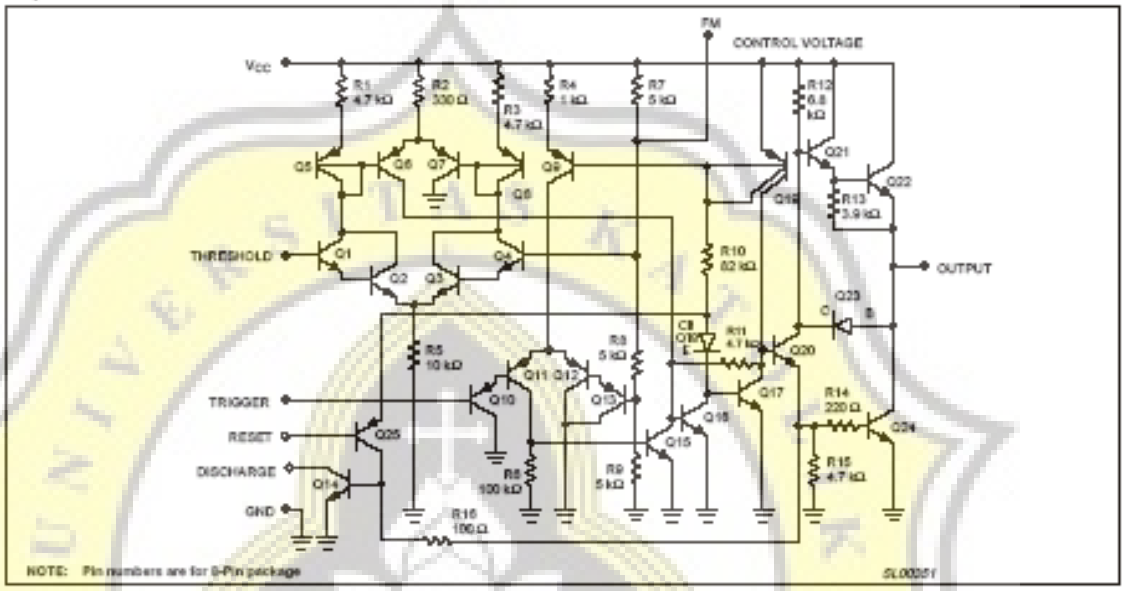


Figure 3. Equivalent schematic

ABSOLUTE MAXIMUM RATINGS

SYMBOL	PARAMETER	RATING	UNIT
V_{CC}	Supply voltage		
	SE555	+18	V
	NE555, SE555C, SA555	+16	V
P_D	Maximum allowable power dissipation[1]	600	mW
T_{amb}	Operating ambient temperature range		
	NE555	0 to +70	°C
	SA555	−40 to +85	°C
	SE555, SE555C	−55 to +125	°C
T_{stg}	Storage temperature range	−65 to +150	°C
T_{SOLD}	Lead soldering temperature (10 sec max)	+230	°C

NOTE:
1. The junction temperature must be kept below 125 °C for the D package and below 150°C for the N package. At ambient temperatures above 25 °C, where this limit would be derated by the following factors:
   D package 160 °C/W
   N package 100 °C/W

DC AND AC ELECTRICAL CHARACTERISTICS

T_{amb} = 25 °C, V_{CC} = +5 V to +15 V unless otherwise specified.

SYMBOL	PARAMETER	TEST CONDITIONS	SE666			NE555/SA666/SE555C			UNIT
			Min	Typ	Max	Min	Typ	Max	
V_{CC}	Supply voltage		4.5		18	4.5		16	V
I_{CC}	Supply current (low state)[1]	V_{CC} = 5 V, R_L = ∞		3	5		3	6	mA
		V_{CC} = 15 V, R_L = ∞		10	12		10	15	mA
t_M	Timing error (monostable) initial accuracy[2]	R_A = 2 kΩ to 100 kΩ C=0.1 µF		0.5	2.0		1.0	3.0	%
$\Delta t_M/\Delta T$	Drift with temperature			30	100		50	150	ppm/°C
$\Delta t_M/\Delta V_S$	Drift with supply voltage			0.05	0.2		0.1	0.5	%/V
t_A	Timing error (astable) initial accuracy[2]	R_A, R_B = 1 kΩ to 100 kΩ C = 0.1 µF		4	6		5	13	%
$\Delta t_A/\Delta T$	Drift with temperature	V_{CC} = 15 V			500			500	ppm/°C
$\Delta t_A/\Delta V_S$	Drift with supply voltage			0.15	0.6		0.3	1	%/V
V_C	Control voltage level	V_{CC} = 15 V	9.6	10.0	10.4	9.0	10.0	11.0	V
		V_{CC} = 5 V	2.9	3.33	3.8	2.6	3.33	4.0	V
V_{TH}	Threshold voltage	V_{CC} = 15 V	9.4	10.0	10.6	8.8	10.0	11.2	V
		V_{CC} = 5 V	2.7	3.33	4.0	2.4	3.33	4.2	V
I_{TH}	Threshold current[3]			0.1	0.25		0.1	0.25	µA
V_{TRIG}	Trigger voltage	V_{CC} = 15 V	4.8	5.0	5.2	4.5	5.0	5.6	V
		V_{CC} = 5 V	1.45	1.67	1.9	1.1	1.67	2.2	V
I_{TRIG}	Trigger current	V_{TRIG} = 0 V		0.5	0.9		0.5	2.0	µA
V_{RESET}	Reset voltage[4]	V_{CC} = 15 V, V_{TH} = 10.5 V	0.3		1.0	0.3		1.0	V
I_{RESET}	Reset current	V_{RESET} = 0.4 V		0.1	0.4		0.1	0.4	mA
	Reset current	V_{RESET} = 0 V		0.4	1.0		0.4	1.5	mA
V_{OL}	LOW-level output voltage	V_{CC} = 15 V							
		I_{SINK} = 10 mA		0.1	0.15		0.1	0.25	V
		I_{SINK} = 50 mA		0.4	0.5		0.4	0.75	V
		I_{SINK} = 100 mA		2.0	2.2		2.0	2.5	V
		I_{SINK} = 200 mA		2.5			2.5		V
		V_{CC} = 5 V							
		I_{SINK} = 8 mA		0.1	0.25		0.3	0.4	V
		I_{SINK} = 5 mA		0.05	0.2		0.25	0.35	V
V_{OH}	HIGH-level output voltage	V_{CC} = 15 V							
		I_{SOURCE} = 200 mA		12.5			12.5		V
		I_{SOURCE} = 100 mA	13.0	13.3		12.75	13.3		V
		V_{CC} = 5 V							
		I_{SOURCE} = 100 mA	3.0	3.3		2.75	3.3		V
t_{OFF}	Turn-off time[5]	V_{RESET} = V_{CC}		0.5	2.0		0.5	2.0	µs
t_R	Rise time of output			100	200		100	300	ns
t_F	Fall time of output			100	200		100	300	ns
	Discharge leakage current			20	100		20	100	nA

NOTES:

1. Supply current when output high typically 1 mA less.
2. Tested at V_{CC} = 5 V and V_{CC} = 15 V.
3. This will determine the max value of R_A+R_B, for 15 V operation, the max total R = 10 MΩ, and for 5 V operation, the max. total R = 3.4 MΩ.
4. Specified with trigger input HIGH.
5. Time measured from a positive-going input pulse from 0 to 0.8×V_{CC} into the threshold to the drop from HIGH to LOW of the output. Trigger is tied to threshold.

TYPICAL PERFORMANCE CHARACTERISTICS

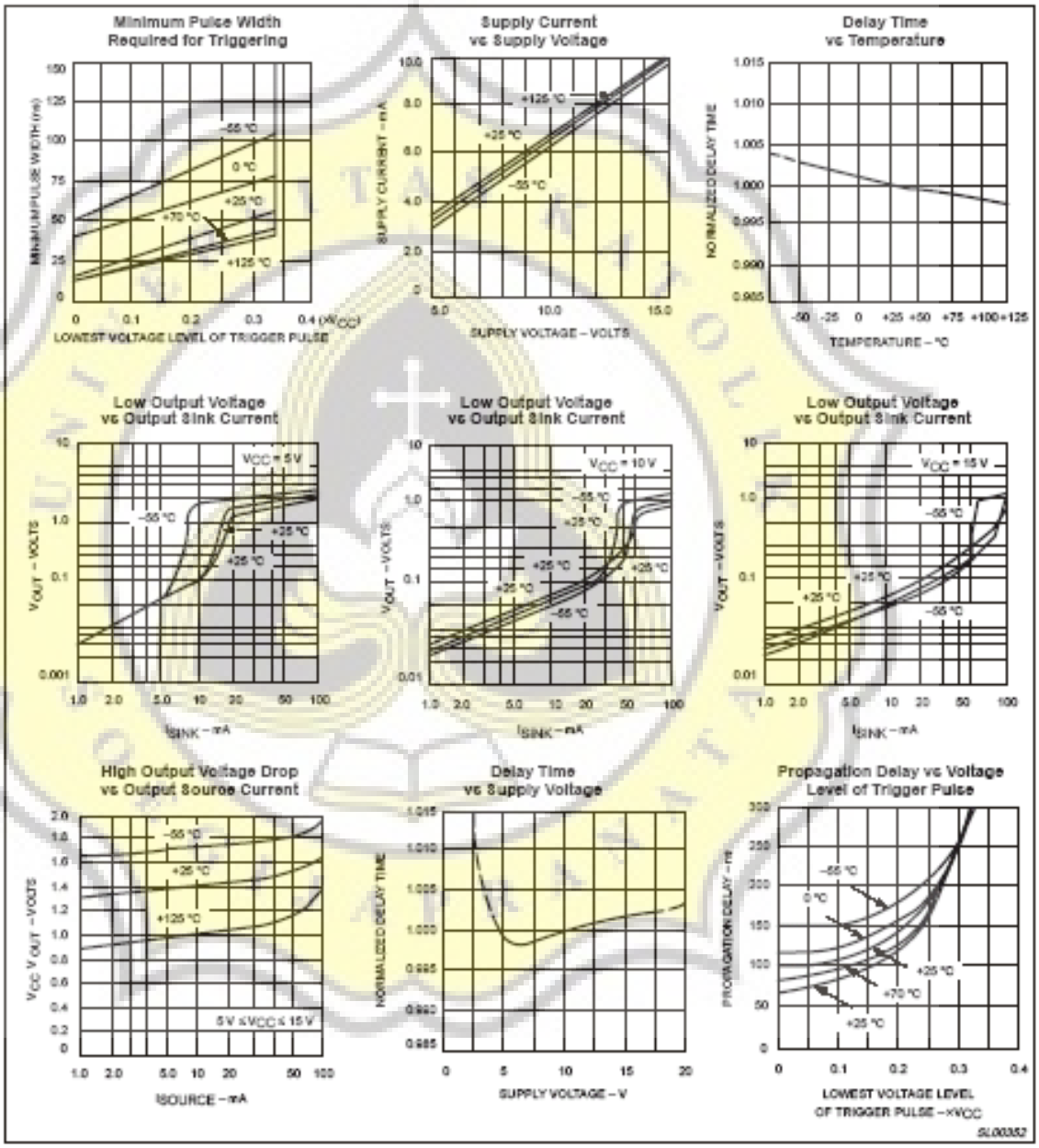


Figure 4. Typical Performance Characteristics

TYPICAL APPLICATIONS

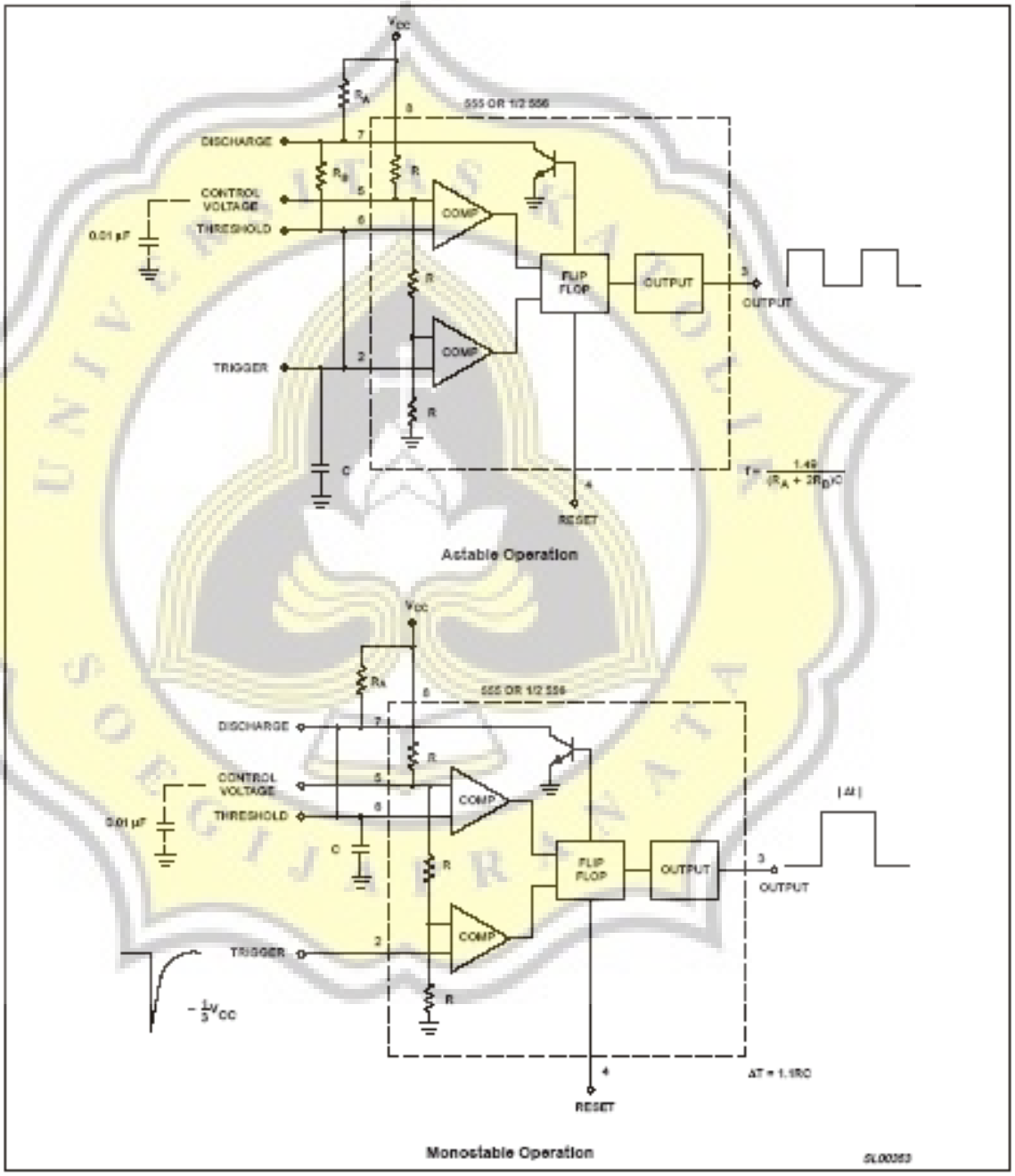


Figure 6. Typical Applications

TYPICAL APPLICATIONS

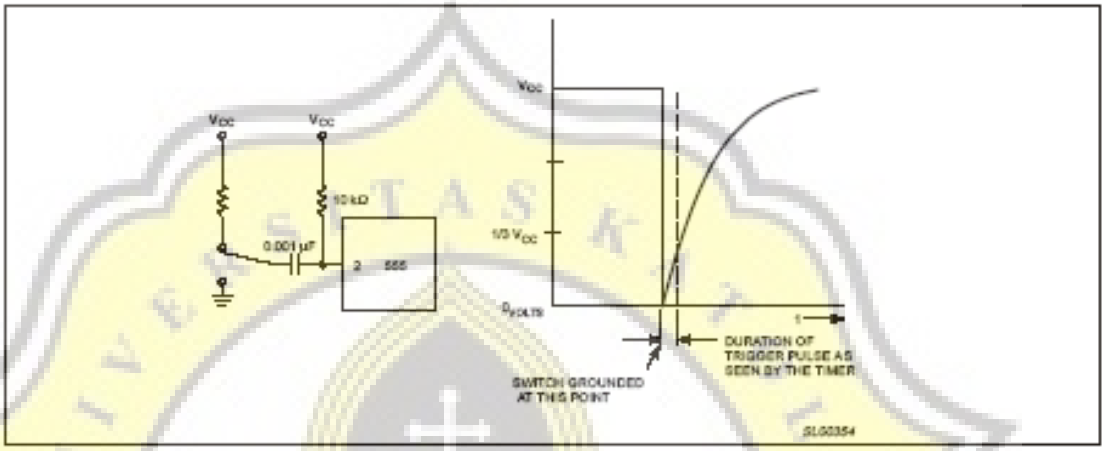


Figure 6. AC Coupling of the Trigger Pulse

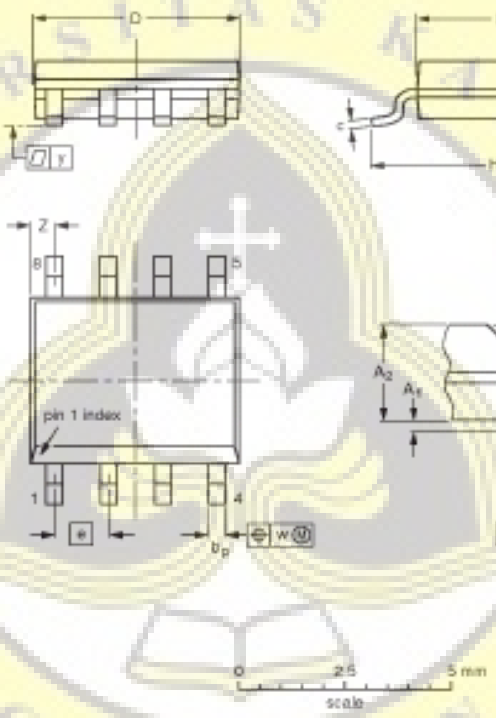
Trigger Pulse Width Requirements and Time Delays

Due to the nature of the trigger circuitry, the timer will trigger on the negative going edge of the input pulse. For the device to time out properly, it is necessary that the trigger voltage level be returned to some voltage greater than one third of the supply before the time out period. This can be achieved by making either the trigger pulse sufficiently short or by AC coupling into the trigger. By AC coupling the trigger, see Figure 6, a short negative going pulse is achieved when the trigger signal goes to ground. AC coupling is most frequently used in conjunction with a switch or a signal that goes to ground which initiates the timing cycle. Should the trigger be held low, without AC coupling, for a longer duration than the timing cycle the output will remain in a high state for the duration of the low trigger signal, without regard to the threshold comparator state. This is due to the predominance of Q_{15} on the base of Q_{16}, controlling the state of the bi-stable flip-flop. When the trigger signal then returns to a high level, the output will fall immediately. Thus, the output signal will follow the trigger signal in this case.

Another consideration is the "turn-off time". This is the measurement of the amount of time required after the threshold reaches 2/3 V_{CC} to turn the output low. To explain further, Q_1 at the threshold input turns on after reaching 2/3 V_{CC}, which then turns on Q_5, which turns on Q_6. Current from Q_5 turns on Q_{16} which turns Q_{17} off. This allows current from Q_{19} to turn on Q_{20} and Q_{24} to given an output low. These steps cause the 2 µs max. delay as stated in the data sheet.

Also, a delay comparable to the turn-off time is the trigger release time. When the trigger is low, Q_{10} is on and turns on Q_{11} which turns on Q_{15}. Q_{15} turns off Q_{16} and allows Q_{17} to turn on. This turns off current to Q_{20} and Q_{24}, which results in output high. When the trigger is released, Q_{10} and Q_{11} shut off, Q_{15} turns off, Q_{16} turns on and the circuit then follows the same path and time delay explained as "turn off time". This trigger release time is very important in designing the trigger pulse width so as not to interfere with the output signal as explained previously.

SO8: plastic small outline package; 8 leads; body width 3.9 mm **SOT96-1**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

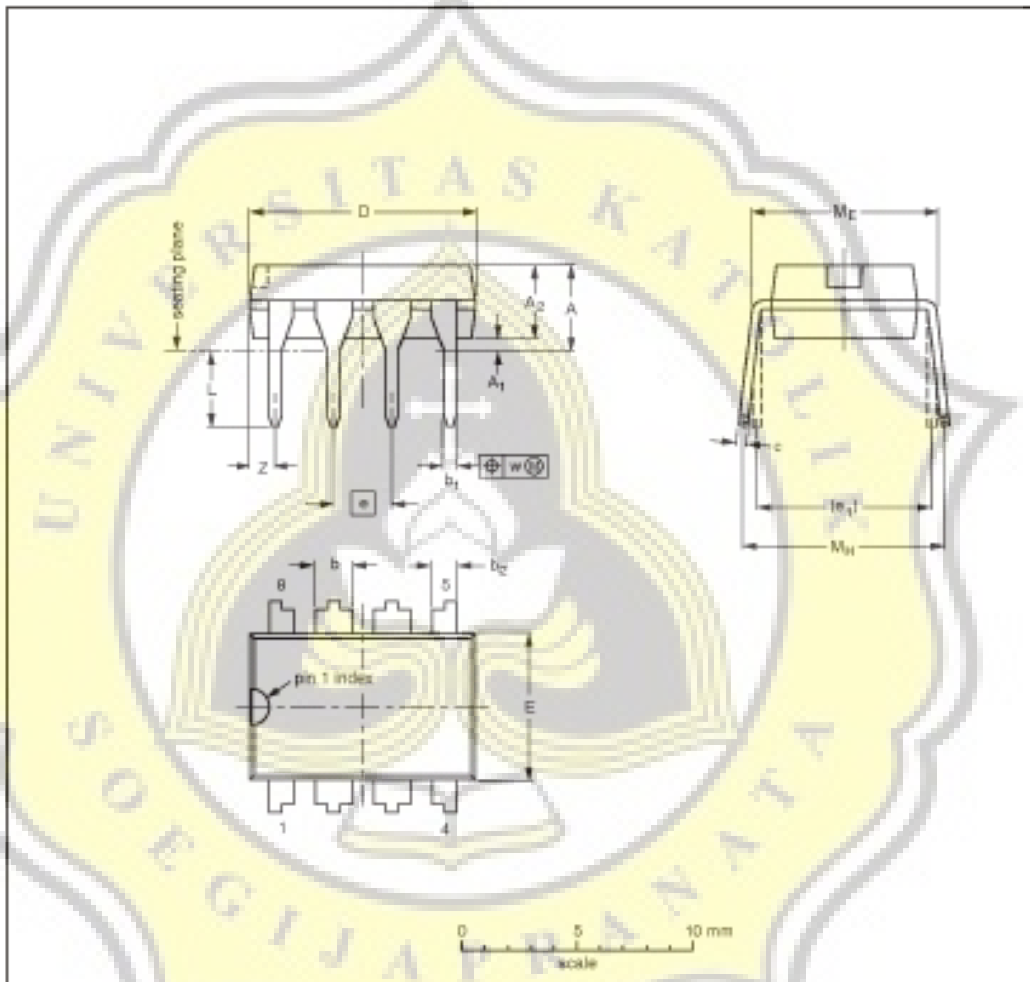
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(2)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	5.0 4.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.010 0.004	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.20 0.19	0.16 0.15	0.050	0.244 0.228	0.041	0.039 0.016	0.028 0.024	0.01	0.01	0.004	0.028 0.012	

Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT96-1	076E03	MS-012				~~97-05-22~~ 99-12-27

DIP8: plastic dual in-line package; 8 leads (300 mil) SOT97-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A1 min.	A2 max.	b	b1	b2	c	D (1)	E (1)	e	e1	L	ME	MH	w	Z (1) max.
mm	4.2	0.51	3.2	1.73 1.14	0.53 0.38	1.07 0.89	0.36 0.23	9.8 9.2	6.48 6.20	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	1.15
inches	0.17	0.020	0.13	0.068 0.045	0.021 0.015	0.042 0.035	0.014 0.009	0.39 0.38	0.26 0.24	0.10	0.30	0.14 0.12	0.32 0.31	0.39 0.33	0.01	0.045

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT97-1	050G01	MO-001	SC-504-8			~~95-02-04~~ 99-12-27

REVISION HISTORY

Rev	Date	Description
_2	20030214	**Product data (9397 750 11128); ECN 853-0038 28168 of 06 November 2002. Supersedes Product specification dated August 31, 1994.** Modifications: • Remove all cerdip information from the data sheet. Package type discontinued. • 'Absolute maximum ratings' table: T_{SOLD} rating changed from '+300 °C' to '+230 °C'.
	19940831	**Product specification; ECN 853-0038 13721 of 31 August 1994.** (Filename = NE_SA555X.pdf)

Data sheet status

Level	Data sheet status [1]	Product status [2] [3]	Definitions
I	Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
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[3] For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

Definitions

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Limiting values definition — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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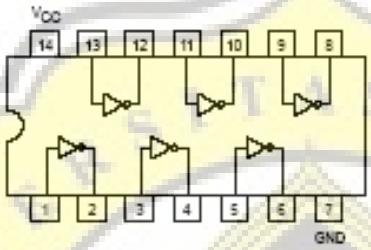
MOTOROLA

HEX INVERTER

SN54/74LS04

HEX INVERTER
LOW POWER SCHOTTKY



J SUFFIX
CERAMIC
CASE 632-08

N SUFFIX
PLASTIC
CASE 646-06

D SUFFIX
SOIC
CASE 751A-02

ORDERING INFORMATION

SN54LSXXJ	Ceramic
SN74LSXXN	Plastic
SN74LSXXD	SOIC

GUARANTEED OPERATING RANGES

Symbol	Parameter		Min	Typ	Max	Unit
V_{CC}	Supply Voltage	54 74	4.5 4.75	5.0 5.0	5.5 5.25	V
T_A	Operating Ambient Temperature Range	54 74	−55 0	25 25	125 70	°C
I_{OH}	Output Current — High	54, 74			−0.4	mA
I_{OL}	Output Current — Low	54 74			4.0 8.0	mA

DC CHARACTERISTICS OVER OPERATING TEMPERATURE RANGE (unless otherwise specified)

Symbol	Parameter		Limits Min	Typ	Max	Unit	Test Conditions	
V_{IH}	Input HIGH Voltage		2.0			V	Guaranteed Input HIGH Voltage for All Inputs	
V_{IL}	Input LOW Voltage	54			0.7	V	Guaranteed Input LOW Voltage for All Inputs	
		74			0.8			
V_{IK}	Input Clamp Diode Voltage			−0.65	−1.5	V	V_{CC} = MIN, I_{IN} = −18 mA	
V_{OH}	Output HIGH Voltage	54	2.5	3.5		V	V_{CC} = MIN, I_{OH} = MAX, V_{IN} = V_{IH} or V_{IL} per Truth Table	
		74	2.7	3.5		V		
V_{OL}	Output LOW Voltage	54, 74		0.25	0.4	V	I_{OL} = 4.0 mA	V_{CC} = V_{CC} MIN, V_{IN} = V_{IL} or V_{IH} per Truth Table
		74		0.35	0.5	V	I_{OL} = 8.0 mA	
I_{IH}	Input HIGH Current				20	μA	V_{CC} = MAX, V_{IN} = 2.7 V	
					0.1	mA	V_{CC} = MAX, V_{IN} = 7.0 V	
I_{IL}	Input LOW Current				−0.4	mA	V_{CC} = MAX, V_{IN} = 0.4 V	
I_{OS}	Short Circuit Current (Note 1)		−20		−100	mA	V_{CC} = MAX	
I_{CC}	Power Supply Current Total, Output HIGH				2.4	mA	V_{CC} = MAX	
	Total, Output LOW				6.6			

Note 1: Not more than one output should be shorted at a time, nor for more than 1 second.

AC CHARACTERISTICS (T_A = 25°C)

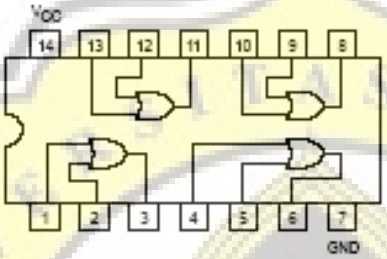
Symbol	Parameter	Limits Min	Typ	Max	Unit	Test Conditions
t_{PLH}	Turn-Off Delay, Input to Output		9.0	15	ns	V_{CC} = 5.0 V, C_L = 15 pF
t_{PHL}	Turn-On Delay, Input to Output		10	15	ns	

MOTOROLA

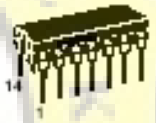
QUAD 2-INPUT OR GATE

SN54/74LS32

QUAD 2-INPUT OR GATE
LOW POWER SCHOTTKY



J SUFFIX
CERAMIC
CASE 632-08



N SUFFIX
PLASTIC
CASE 646-06

D SUFFIX
SOIC
CASE 751A-02

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SN74LSXXN	Plastic
SN74LSXXD	SOIC

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Symbol	Parameter		Min	Typ	Max	Unit
V_{CC}	Supply Voltage	54 74	4.5 4.75	5.0 5.0	5.5 5.25	V
T_A	Operating Ambient Temperature Range	54 74	−55 0	25 25	125 70	°C
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I_{OL}	Output Current — Low	54 74			4.0 8.0	mA

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Symbol	Parameter		Limits Min	Typ	Max	Unit	Test Conditions	
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V_{IL}	Input LOW Voltage	54			0.7	V	Guaranteed Input LOW Voltage for All Inputs	
		74			0.8			
V_{IK}	Input Clamp Diode Voltage			−0.65	−1.5	V	V_{CC} = MIN, I_{IN} = −18 mA	
V_{OH}	Output HIGH Voltage	54	2.5	3.5		V	V_{CC} = MIN, I_{OH} = MAX, V_{IN} = V_{IH} or V_{IL} per Truth Table	
		74	2.7	3.5		V		
V_{OL}	Output LOW Voltage	54, 74		0.25	0.4	V	I_{OL} = 4.0 mA	V_{CC} = V_{CC} MIN, V_{IN} = V_{IL} or V_{IH} per Truth Table
		74		0.35	0.5	V	I_{OL} = 8.0 mA	
I_{IH}	Input HIGH Current				20	µA	V_{CC} = MAX, V_{IN} = 2.7 V	
					0.1	mA	V_{CC} = MAX, V_{IN} = 7.0 V	
I_{IL}	Input LOW Current				−0.4	mA	V_{CC} = MAX, V_{IN} = 0.4 V	
I_{OS}	Short Circuit Current (Note 1)		−20		−100	mA	V_{CC} = MAX	
I_{CC}	Power Supply Current Total, Output HIGH				6.2	mA	V_{CC} = MAX	
	Total, Output LOW				9.8			

Note 1: Not more than one output should be shorted at a time, nor for more than 1 second.

AC CHARACTERISTICS (T_A = 25°C)

Symbol	Parameter	Limits Min	Typ	Max	Unit	Test Conditions
t_{PLH}	Turn-Off Delay, Input to Output		14	22	ns	V_{CC} = 5.0 V C_L = 15 pF
t_{PHL}	Turn-On Delay, Input to Output		14	22	ns	