GlobalOptoisolator™

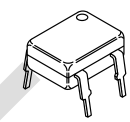
VDE | UL | CSA | SETI | SEMKO | DEMKO | NEMKO | BABT

Mini Zero-Crossing AC SSR

MOCZ500

Motorola Preferred Device

**OPTOISOLATOR
ZERO CROSS
TRIAC OUTPUT**



**CASE 730J–01
STYLE 1**

This device consists of a gallium arsenide infrared emitting diode optically coupled to a zero–cross triac circuit and a power triac. It is capable of driving loads up to 500 mA rms on AC voltages from 20 to 280 V rms.

- Provides Normally Open AC Output with 500 mA Rating @ 40°C
- Small Outline, Standard 6–PIN DIP Package
- Simplified Logic Control of 240 Vac Power
- High Input–Output Isolation of 7500 Vac (rms)
- 7 Amp Single Cycle Surge Capability
- Wide Load Power Factor Range 0.1–1
- Low Input/Output Capacitance

Applications:

- Logic to AC Line Interface
- Microprocessor to AC Line Peripheral
- Industrial Controls
- EM Relays and Contactors
- Small AC Motor Drives
- Incandescent Lamp Drive
- Appliance Solenoids
- Appliance Actuators
- Appliance Fan Motors
- Appliance Lights

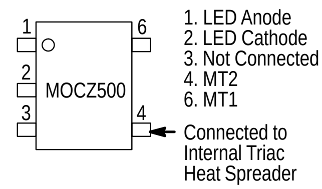
NEW DEVICE

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

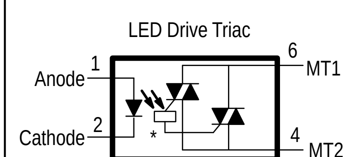
Rating	Symbol	Value	Unit
INPUT LED			
Reverse Voltage	V_R	6	V
Forward Current — Continuous	I_F	50	mA
OUTPUT TRIAC			
Off–State Output Terminal Voltage (1)	V_{DRM}	600	V
Peak Repetitive Surge Current (1 Cycle)	I_{TSM}	7	A
Main Terminal Fusing Current (t = 8.3 ms)	I^2T	0.4	A^2sec
On–State Current Range	I_T(rms)	0.030 to 0.500	A
Load Power Factor Range	pF	0.1 – 1.0	—
TOTAL DEVICE			
Isolation Surge Voltage (2)	V_{ISO}	7500	Vac(pk)
Total Power Dissipation @ T_A = 40°C (Device Soldered on PCB)	P_D	600	mW
Junction Temperature Range	T_J	–40 to +125	°C
Ambient Operating Temperature Range	T_A	–40 to +85	°C
Ambient Operating Relative Humidity @ T_A = 85°C	RH_A	85	%
Storage Temperature Range	T_{stg}	–40 to +125	°C
Soldering Temperature (10 sec)	T_L	260	°C

1. Test voltages must be applied within dv/dt rating.
2. Input–Output isolation voltage, V_{ISO}, is an internal device dielectric breakdown rating. For this test, pins 1 and 2 are common and pins 4 and 6 are common.

PINOUT



COUPLER SCHEMATIC



*ZERO VOLTAGE ACTIVATION

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

© Motorola, Inc. 1997

THERMAL CHARACTERISTICS

Characteristic	Symbol	Value	Unit
Thermal Resistance, Junction to Air (Device Soldered on PCB)	$R_{\theta JA}$	130	°C/W
Thermal Resistance, Junction to Case (Pin 4) (Device Soldered on PCB)	$R_{\theta JC}$	40	°C/W

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

Characteristic	Symbol	Min	Typ	Max	Unit
INPUT LED					
Reverse Leakage Current (V_R = 6 V)	I_R	—	0.05	100	μA
Forward Voltage (I_F = 10 mA)	V_F	—	1.2	1.5	V
OUTPUT TRIAC					
Leakage with LED Off @ T_A = 85°C (V_{DRM} = 600 V)	I_{DRM}	—	—	100	μA
Critical Rate of Rise of Off–State Voltage (Static) (1) (Vp = 400 V)	dv/dt(s)	—	2,000	—	V/μs
LED On, Driver Holding Current	I_{H1}	—	150	500	μA
COUPLED					
LED Trigger Current Required to Latch Output (2) (3) (Main Terminal Voltage = 5 V)	$I_{FT(on)}$	—	—	10	mA
On–State Voltage (I_T = 500 mA)	V_{TM}	—	1.2	1.5	V
Inhibit Voltage ($I_F = I_{FT}$)	V_{INH}	—	10	20	V
Commutating dv/dt	dv/dt (c)	10	—	—	V/μs
Common–Mode Input–Output dv/dt	dv/dt (cm)	40,000	—	—	V/μs
Input–Output Capacitance	C_{ISO}	—	—	1	pF
Isolation Resistance @ 500 Vdc	R_{ISO}	10^{12}	—	—	Ohms

1. Additional dv/dt information, including test methods, can be found in Motorola applications note AN1048/D, Figure 40.
2. All devices are guaranteed to trigger at as I_F value less than or equal to the max I_{FT}. Therefore, the recommended operating I_F lies between the device's maximum I_{FT}(on) limit and the Maximum Rating of 60 mA.
3. Current–limiting resistor required in series with LED.

ENVIRONMENTAL TEST REQUIREMENTS

Test	Test Conditions
Autoclave	T_A = 121°C, RH = 100%, P = 15 PSIG, 48 Hr.
Moisture Resistance	Mil–Std–883, Method 1004
Temp Cycle	T_A = –40/+125°C, Air to Air, Dwell ≥ 15 min., Transfer ≤ 5 min., 200 Cycles
Resistance to Solder Heat	Mil–Std–750, Method 2031, 260°C followed by V_{ISO}
Lead Pull	Mil–Std–750, Method 2036, Condition A, 2 lbs., 1 min.

LIFE TEST REQUIREMENTS

Test	Test Conditions		Duration
	Environment	Bias	
High Temperature, Reverse Bias	T_A = +100°C	V_{TM} = 280 Vac	1000 Hr.
High Humidity, High Temperature, Reverse Bias	T_A = +85°C RH = 85%	V_{TM} = 100 Vdc Pin 4 = + Pin 6 = –	500 Hr.
Intermittent Operating Life	t_{on} = 2 min. t_{off} = 2 min. T_A = +25°C	I_F = 50 mA ITM = 60 mA	1000 Hr.
ESD	Human Body Model & Machine Models 1 & 2	N/A	N/A

TYPICAL ELECTRICAL CHARACTERISTICS

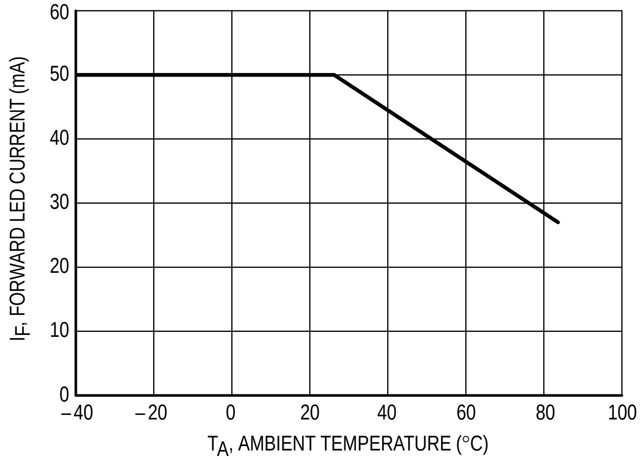


Figure 1. Maximum Allowable Forward LED Current versus Ambient Temperature $I_T = I_T$ Max

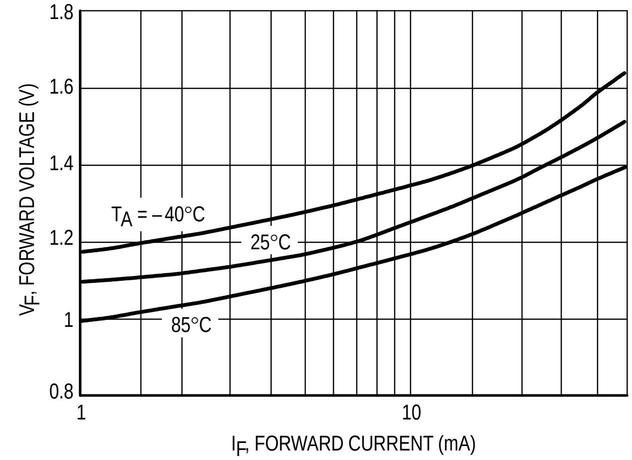


Figure 2. LED Forward Voltage versus LED Forward Current

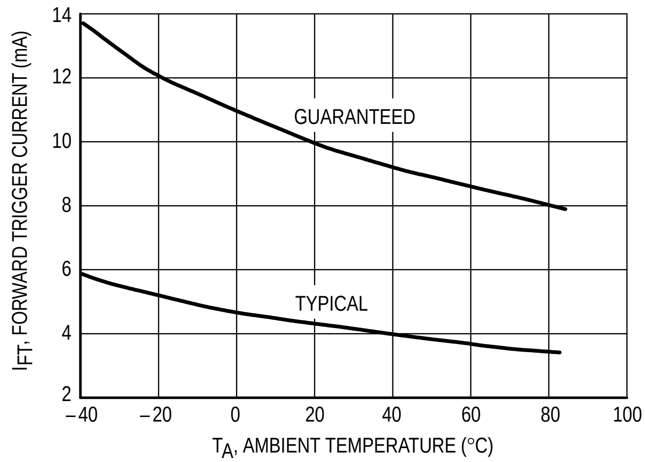


Figure 3. Forward Trigger Current versus Ambient Temperature

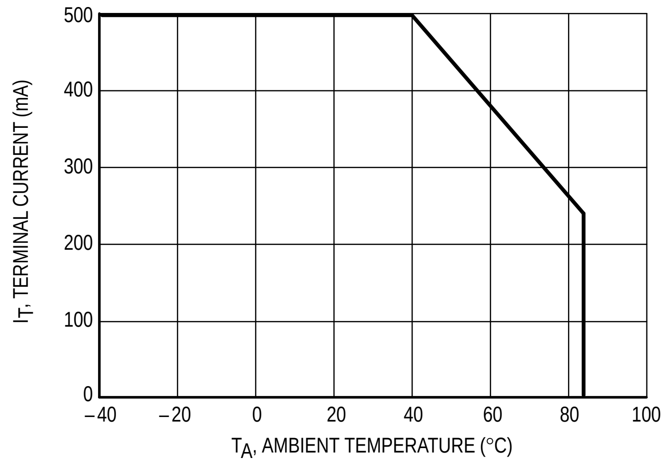


Figure 4. RMS ON–State Current versus Ambient Temperature

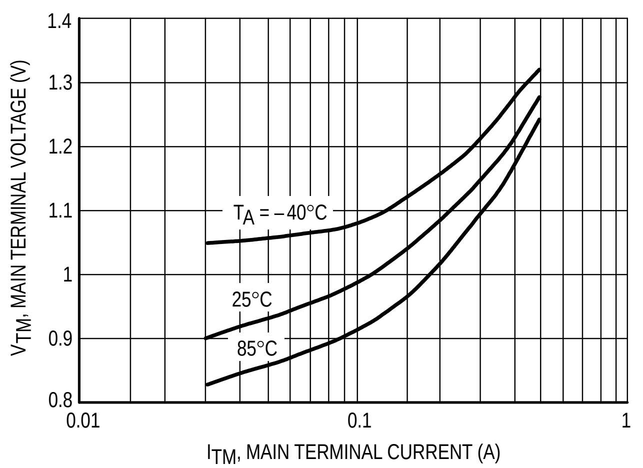


Figure 5. Main Terminal Voltage versus Main Terminal Current

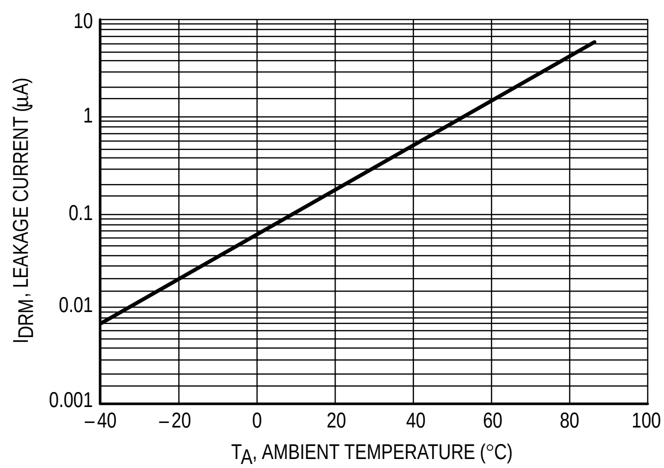


Figure 6. Typical Leakage Current versus Ambient Temperature

TYPICAL ELECTRICAL CHARACTERISTICS (continued)

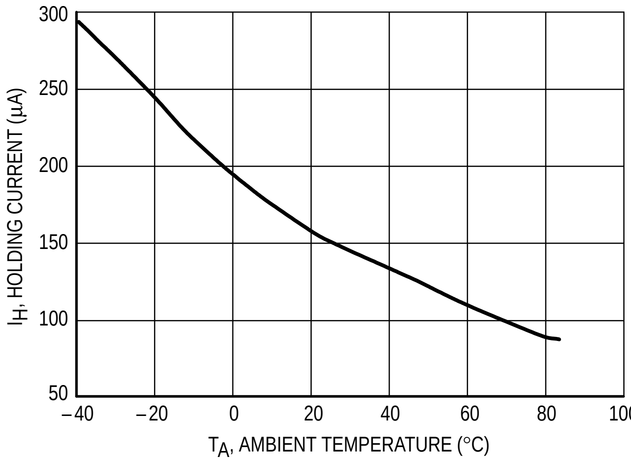


Figure 7. Holding Current versus Ambient Temperature

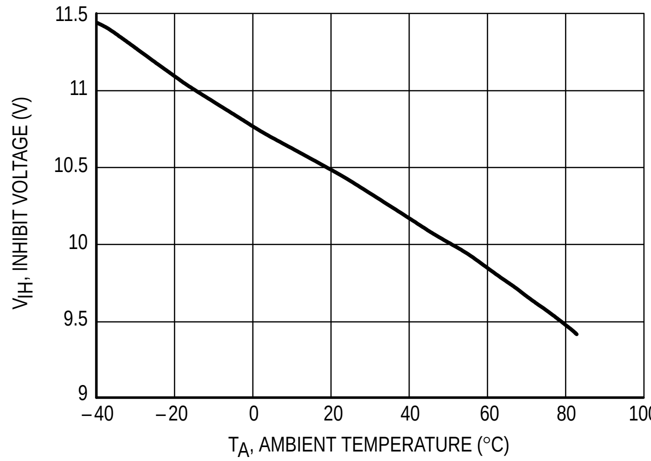


Figure 8. Inhibit Voltage versus Ambient Temperature

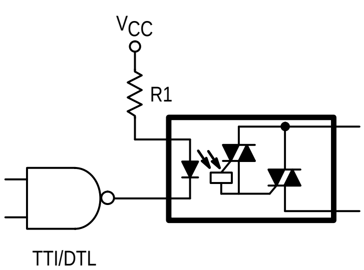
APPLICATION CONSIDERATIONS

Input Drive Circuit

The MOCZ500 SSR is guaranteed to trigger with an input current of 10 mA at 25°C. This trigger current increases with lower ambient temperatures as shown on Figure 3 Forward Trigger Current (I_{FT}) versus Ambient Temperature.

When the input drive circuit is capable to supply the MOCZ500 input LED trigger current, only a current limiting resistor in series with the LED is required. TTL, DTL and microcontrollers with enhanced current capability output ports are able to meet this requirement.

Most CMOS logic circuits and Microcontroller output ports are not rated to sink or source currents required to trigger the MOCZ500. In this case a drive circuit is required as shown in Figure 10 or a TTL buffer interface circuit as shown in Figure 9.



R1 for V_{CC} (low) 4.5 V, I_{FT} = 10 mA, V_F LED = 1.2 V, V_{OL} = 0.5 V
R1 = (4.5 V – 1.2 V – 0.5 V): 10 mA = 280 Ω
Choose 270 Ω

Figure 9. Input Drive Circuit

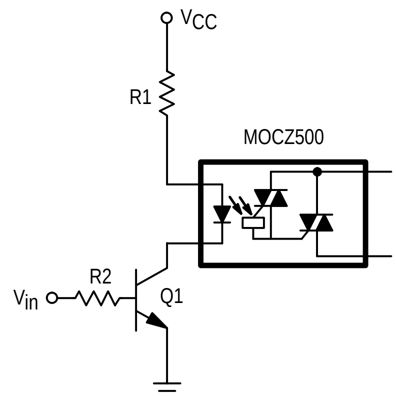
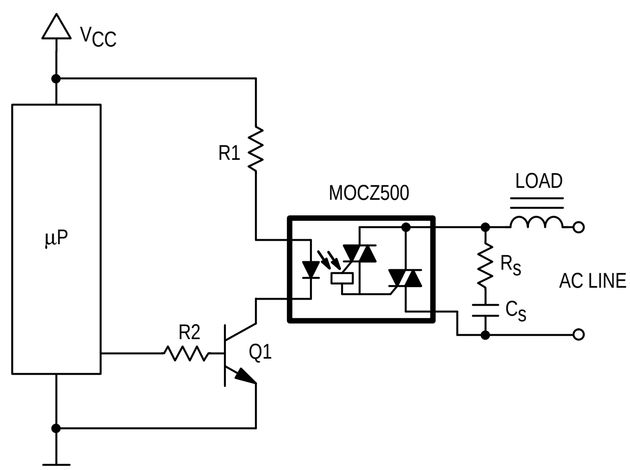


Figure 10. Noninverting Discrete NPN Buffer and Level Shifter

Snubber Circuit

Snubberless operation of resistive loads is possible, but snubbers are recommended for all applications. A typical application is shown in Figure 11. The snubber attenuates the high kickback voltages and commutating dv/dt generated by inductive loads during the turn off of the SSR. It also protects the SSR from line transients generated elsewhere within the equipment (for example inductive loads switched by mechanical contacts such as relays manual on/off switches etc.) or outside the equipment such as air conditioners, electrical heaters and motors.



Buffer Circuit
R1 = (V_{CC} – V_{FLED} – V_{sat} Q1): I_F MOCZ500
R2 = 10 kΩ
Q1 = General Purpose Trans. NPN
Typical Snubber circuit:
For inductive and resistive loads R_S = 45 Ω C_S = 0.01 µF

Figure 11. Typical Application with an µP Output Buffer

Snubbers are also necessary to pass noise immunity tests such as IEC1000 4–4 for fast transients. In this test fast rising high voltage spikes are superimposed onto the line voltage to simulate AC line transients.

Switching Loads with Currents Below the Minimum Current Rating

The MOCZ500 is capable to switch any inductive or resistive load within its rating of minimum 30 mA and a maximum of 500 mA RMS.

At operating currents below the minimum specified value the Power triac remains in the off state and the triac driver carries the current. This may cause a problem, because the triac driver has a significant lower commutating dv/dt than the power triac. For loads below 30 mA AC rms a snubber is mandatory. Evaluations with various low current inductive and resistive loads concluded that a snubber of R = 100 Ω and C = 10 nF is sufficient.

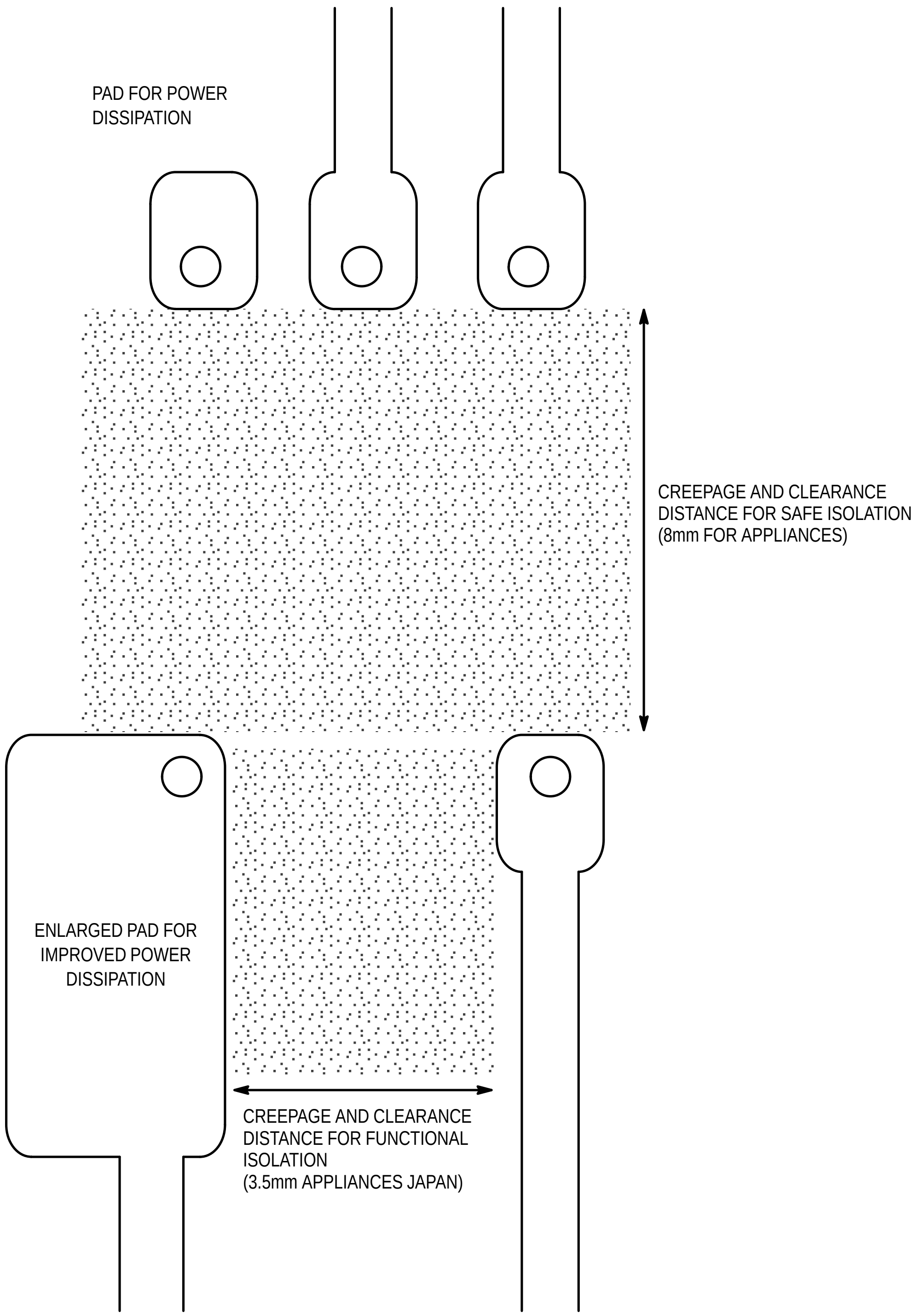


Figure 12.

Thermal Considerations

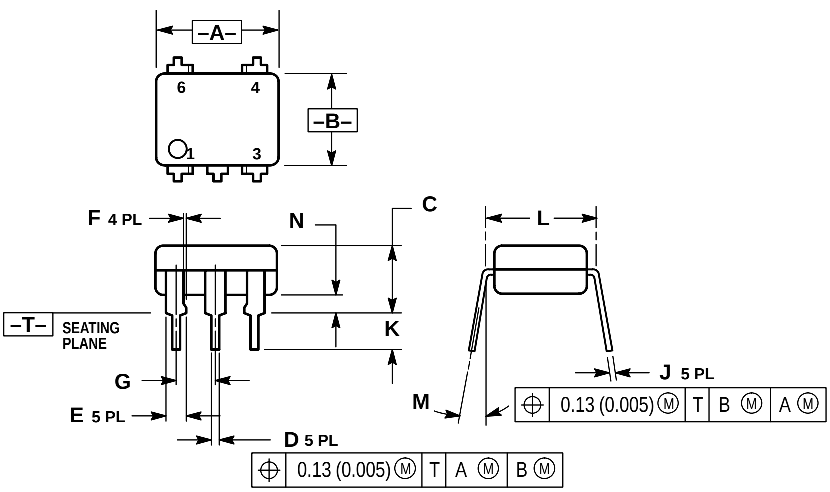
Heat generated inside the MOCZ500's power triac is transferred through the leads to the circuit board where it is dissipated. It is therefore important to solder all leads to the circuit board. Pin 4 is thermally and electrically direct connected to the Power triac and carries the highest amount of thermal energy. For loads which approach the maximum current rating of the SSR it is advisable to layout the pad size for pin 4 as large as possible. See Figure 12 which considers thermal and Regulatory requirements on a PCB.

Regulatory Safety Considerations

The MOCZ500 is designed to meet the National and International Regulatory requirements for safe isolation between input and output and functional isolation creepage and clearance distances between the AC output pins.

Many equipment standards demand a creepage and clearance distance between input and output circuit of 8mm and a thickness through insulation of 0.4mm (16 mil). All Motorola Optocouplers do meet the thickness through insulation requirement. Product with lead bend option "T" meets the creepage path requirement. The most stringent requirement for creepage and clearance between the AC output pins is 3.5mm. Figure 12 shows a PCB pattern layout which meets the regulatory requirements for 115 Vrms and 240 Vrms supply line applications.

OUTLINE DIMENSIONS



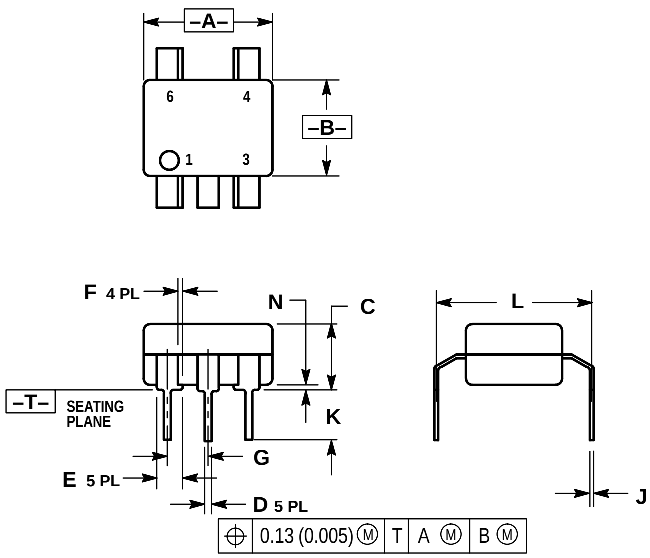
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.

DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX
A	0.320	0.350	8.13	8.89
B	0.240	0.260	6.10	6.60
C	0.115	0.200	2.93	5.08
D	0.016	0.020	0.41	0.50
E	0.040	0.070	1.02	1.77
F	0.010	0.014	0.25	0.36
G	0.100 BSC		2.54 BSC	
J	0.008	0.012	0.21	0.30
K	0.100	0.150	2.54	3.81
L	0.300 BSC		7.62 BSC	
M	0°	15°	0°	15°
N	0.015	0.100	0.38	2.54

STYLE 1:
PIN 1. LED ANODE
2. LED CATHODE
3. NC
4. MAIN TERMINAL
5. ABSENT
6. MAIN TERMINAL

CASE 730J–01
ISSUE O

OUTLINE DIMENSIONS (continued)

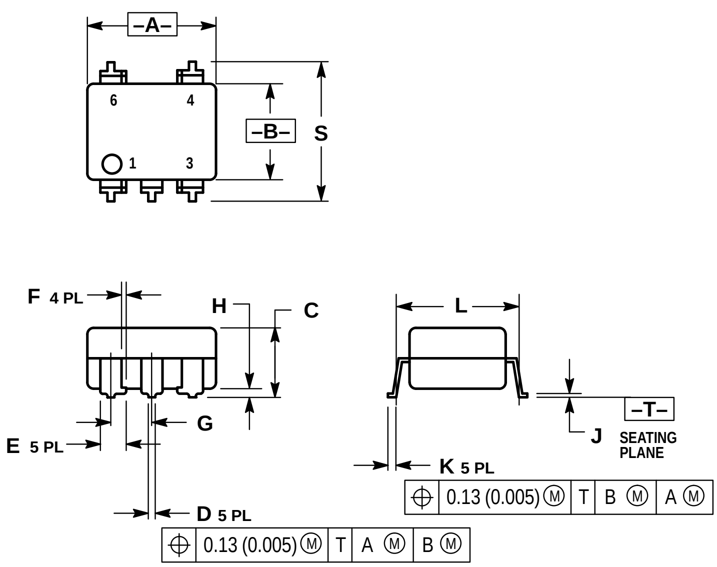


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	8.13	8.89	0.320	0.350
B	6.10	6.60	0.240	0.260
C	2.93	5.08	0.115	0.200
D	0.41	0.50	0.016	0.020
E	1.02	1.77	0.040	0.070
F	0.25	0.36	0.010	0.014
G	2.54 BSC		0.100 BSC	
J	0.21	0.30	0.008	0.012
K	2.54	3.81	0.100	0.150
L	10.16	10.80	0.400	0.425
N	0.38	1.02	0.015	0.040

STYLE 1:
PIN 1. LED ANODE
2. LED CATHODE
3. NC
4. MAIN TERMINAL
5. ABSENT
6. MAIN TERMINAL

CASE 730K–01
ISSUE O



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.320	0.350	8.13	8.89
B	0.240	0.260	6.10	6.60
C	0.115	0.200	2.93	5.08
D	0.016	0.020	0.41	0.50
E	0.040	0.070	1.02	1.77
F	0.010	0.014	0.25	0.36
G	0.100 BSC		2.54 BSC	
H	0.020	0.025	0.51	0.63
J	0.008	0.012	0.20	0.30
K	0.006	0.035	0.16	0.88
L	0.320 BSC		8.13 BSC	
S	0.332	0.390	8.43	9.90

STYLE 1:
PIN 1. LED ANODE
2. LED CATHODE
3. NC
4. MAIN TERMINAL
5. ABSENT
6. MAIN TERMINAL

CASE 730L–01
ISSUE A

Motorola reserves the right to make changes without further notice to any products herein. Motorola makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does Motorola assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. "Typical" parameters which may be provided in Motorola data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. Motorola does not convey any license under its patent rights nor the rights of others. Motorola products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the Motorola product could create a situation where personal injury or death may occur. Should Buyer purchase or use Motorola products for any such unintended or unauthorized application, Buyer shall indemnify and hold Motorola and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that Motorola was negligent regarding the design or manufacture of the part. Motorola and Ⓜ are registered trademarks of Motorola, Inc. Motorola, Inc. is an Equal Opportunity/Affirmative Action Employer.

Mfax is a trademark of Motorola, Inc.

How to reach us:
USA / EUROPE / Locations Not Listed: Motorola Literature Distribution; P.O. Box 5405, Denver, Colorado 80217. 303–675–2140 or 1–800–441–2447

Mfax™: RMFAX0@email.sps.mot.com – TOUCHTONE 602–244–6609
– US & Canada ONLY 1–800–774–1848
INTERNET: http://www.mot.com/SPS/

JAPAN: Nippon Motorola Ltd.; Tatsumi–SPD–JLDC, 6F Seibu–Butsuryu–Center, 3–14–2 Tatsumi Koto–Ku, Tokyo 135, Japan. 81–3–3521–8315

ASIA / PACIFIC: Motorola Semiconductors H.K. Ltd.; 8B Tai Ping Industrial Park, 51 Ting Kok Road, Tai Po, N.T., Hong Kong. 852–26629298