

MOTOROLA

SEMICONDUCTOR TECHNICAL DATA

Order this document
by MOC2A60-10/D

POWER OPTO™ Isolator

2 Amp Zero-Cross Triac Output

This device consists of a gallium arsenide infrared emitting diode optically coupled to a zero-cross triac driver circuit and a power triac. It is capable of driving a load of up to 2 amps (rms) directly, on line voltages from 20 to 280 volts ac (rms).

- Provides Normally Open Solid State AC Output with 2 Amp Rating
- 70 Amp Single Cycle Surge Capability
- Zero-Voltage Turn-on and Zero-Current Turn-off
- High Input-Output Isolation of 3750 vac (rms)
- Static dv/dt Rating of 400 Volts/μs Guaranteed
- 2 Amp Pilot Duty Rating Per UL508 ¶117 (Overload Test) and ¶118 (Endurance Test)  [File No. 129224]
- CSA Approved [File No. CA77170-1].
- SEMKO Approved Certificate #9507228
- Exceeds NEMA 2-230 and IEEE472 Noise Immunity Test Requirements (See Fig.14)

DEVICE RATINGS ($T_A = 25^\circ\text{C}$ unless otherwise noted)

Rating	Symbol	Value	Unit
--------	--------	-------	------

INPUT LED

Forward Current — Maximum Continuous	I_F	50	mA
Forward Current — Maximum Peak ($PW = 100\mu\text{s}$, 120 pps)	$I_F(\text{pk})$	1.0	A
Reverse Voltage — Maximum	V_R	6.0	V

OUTPUT TRIAC

Output Terminal Voltage — Maximum Transient (1)	V_{DRM}	600	V(pk)
Operating Voltage Range — Maximum Continuous ($f = 47 - 63 \text{ Hz}$)	V_T	20 to 280	Vac(rms)
On-State Current Range (Free Air, Power Factor ≥ 0.3)	$I_T(\text{rms})$	0.03 to 2.0	A
Non-Repetitive Single Cycle Surge Current — Maximum Peak ($t = 16.7 \text{ ms}$)	I_{TSM}	70	A
Main Terminal Fusing Current ($t = 8.3 \text{ ms}$)	I^2T	26	A^2sec
Load Power Factor Range	PF	0.3 to 1.0	—
Junction Temperature Range	T_J	-40 to 125	$^\circ\text{C}$

TOTAL DEVICE

Input-Output Isolation Voltage — Maximum(2) 47 – 63 Hz, 1 sec Duration	V_{ISO}	3750	Vac(rms)
Thermal Resistance — Power Triac Junction to Case (See Fig. 15)	$R_{\theta\text{JC}}$	8.0	$^\circ\text{C/W}$
Ambient Operating Temperature Range	T_{oper}	-40 to +100	$^\circ\text{C}$
Storage Temperature Range	T_{stg}	-40 to +150	$^\circ\text{C}$
Lead Soldering Temperature — Maximum (1/16" from Case, 10 sec Duration)	T_L	260	$^\circ\text{C}$

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 2, 3 and the heat tab are common, and pins 7 and 9 are common.

POWER OPTO is a trademark of Motorola, Inc.

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

REV 2

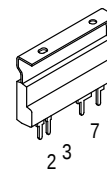
© Motorola, Inc. 1995

MOC2A60-10

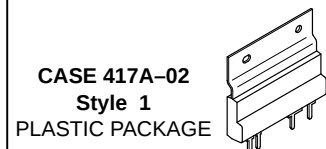
MOC2A60-5*

*Motorola Preferred Device

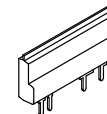
OPTOISOLATOR
2 AMP ZERO CROSS
TRIAC OUTPUT
600 VOLTS



CASE 417-02
Style 2
PLASTIC PACKAGE

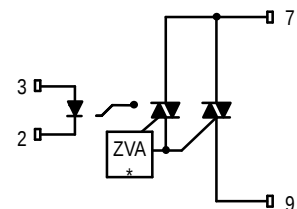


CASE 417A-02
Style 1
PLASTIC PACKAGE



CASE 417B-01
Style 1
PLASTIC PACKAGE

DEVICE SCHEMATIC



* Zero Voltage Activate Circuit

- 1, 4, 5, 6, 8. NO PIN
2. LED CATHODE
3. LED ANODE
7. MAIN TERMINAL 2
9. MAIN TERMINAL 1



MOTOROLA

MOC2A60-10 MOC2A60-5

ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
INPUT LED					
Forward Voltage ($I_F = 10\text{ mA}$)	V_F	1.00	1.17	1.50	V
Reverse Leakage Current ($V_R = 6.0\text{ V}$)	I_R	—	1.0	100	μA
Capacitance	C	—	18	—	pF

OUTPUT TRIAC

Off-State Leakage, Either Direction ($I_F = 0$, $V_{\text{DRM}} = 600\text{ V}$)	I_{DRM}	—	0.25	10	μA
Critical Rate of Rise of Off-State Voltage (Static) $V_{\text{in}} = 400\text{ vac(pk)}$ (1)(2)	$dv/dt(s)$	400	—	—	$\text{V}/\mu\text{s}$
Holding Current, Either Direction ($I_F = 0$, $V_D = 12\text{ V}$, $I_T = 200\text{ mA}$)	I_H	—	10	—	mA

COUPLED

LED Trigger Current Required to Latch Output Either Direction (Main Terminal Voltage = 2.0 V)(3)(4)	MOC2A60-10 $I_{\text{FT(on)}}$	—	7.0	10	mA
	MOC2A60-5 $I_{\text{FT(on)}}$	—	3.5	5.0	mA
On-State Voltage, Either Direction ($I_F = \text{Rated } I_{\text{FT(on)}}$, $I_{\text{TM}} = 2.0\text{ A}$)	V_{TM}	—	0.96	1.3	V
Inhibit Voltage, Either Direction ($I_F = \text{Rated } I_{\text{FT(on)}}$)(5) (Main Terminal Voltage above which device will not trigger)	V_{INH}	—	8.0	10	V
Commutating dv/dt (Rated V_{DRM} , $I_T = 30\text{ mA} - 2.0\text{ A(rms)}$, $T_A = -40 \pm 100^\circ\text{C}$, $f = 60\text{ Hz}$)(2)	$dv/dt(c)$	5.0	—	—	$\text{V}/\mu\text{s}$
Common-mode Input-Output dv/dt (2)	$dv/dt(\text{cm})$	—	40,000	—	$\text{V}/\mu\text{s}$
Input-Output Capacitance ($V = 0$, $f = 1.0\text{ MHz}$)	C_{ISO}	—	1.3	—	pF
Isolation Resistance ($V_{\text{I-O}} = 500\text{ V}$)	R_{ISO}	10^{12}	10^{14}	—	Ω

1. Per EIA/NARM standard RS-443, with $V_P = 200\text{ V}$, which is the instantaneous peak of the maximum operating voltage.
2. Additional dv/dt information, including test methods, can be found in Motorola applications note AN1048/D, Figure 43.
3. All devices are guaranteed to trigger at an I_F value less than or equal to the max I_{FT} . Therefore, the recommended operating I_F lies between the device's maximum $I_{\text{FT(on)}}$ limit and the Maximum Rating of 50 mA.
4. Current-limiting resistor required in series with LED.
5. Also known as "Zero Voltage Turn-On."

TYPICAL CHARACTERISTICS

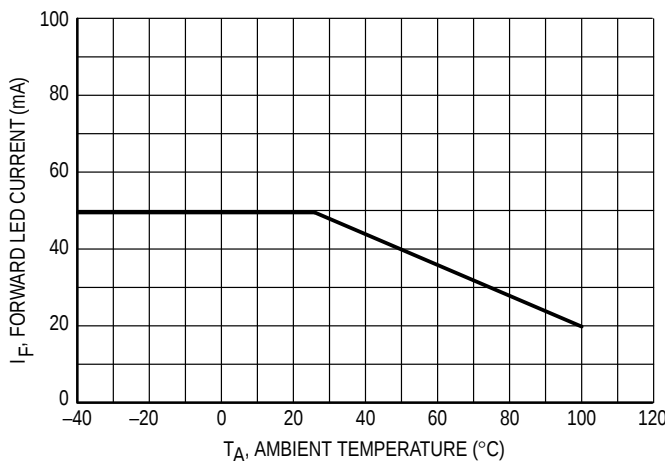


Figure 1. Maximum Allowable Forward LED Current versus Ambient Temperature

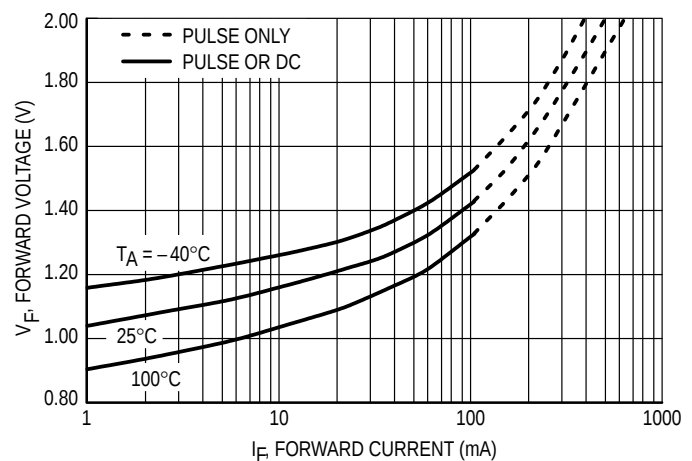


Figure 2. LED Forward Voltage versus LED Forward Current

MOC2A60-10 MOC2A60-5

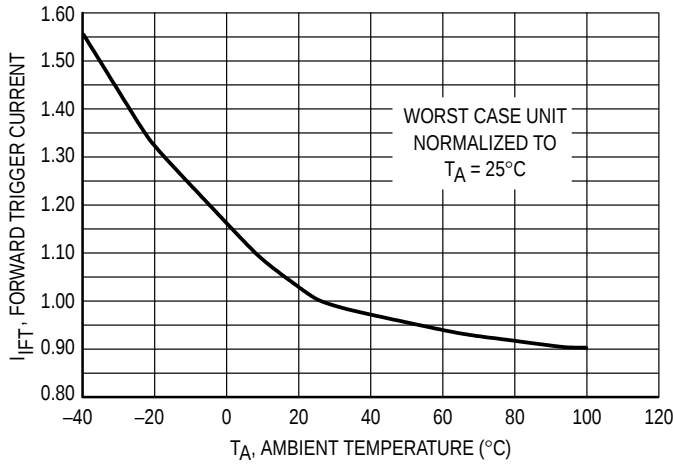


Figure 3. Forward LED Trigger Current versus Ambient Temperature

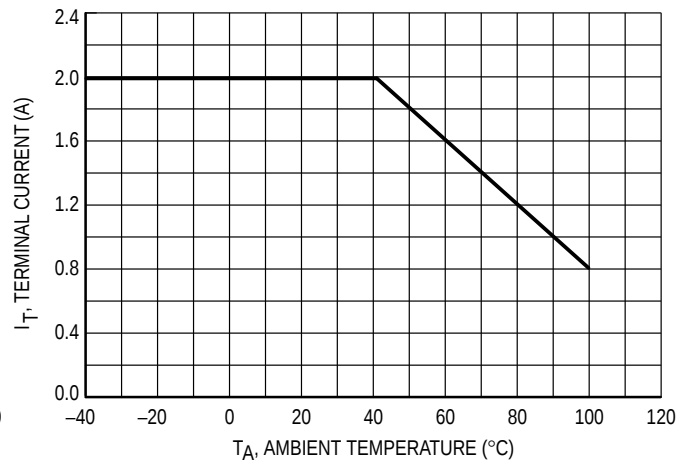


Figure 4. Maximum Allowable On-State RMS Output Current (Free Air) versus Ambient Temperature

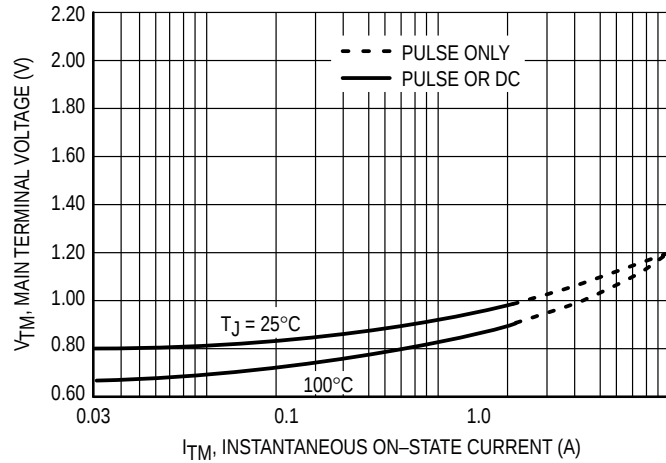


Figure 5. On-State Voltage Drop versus Output Terminal Current

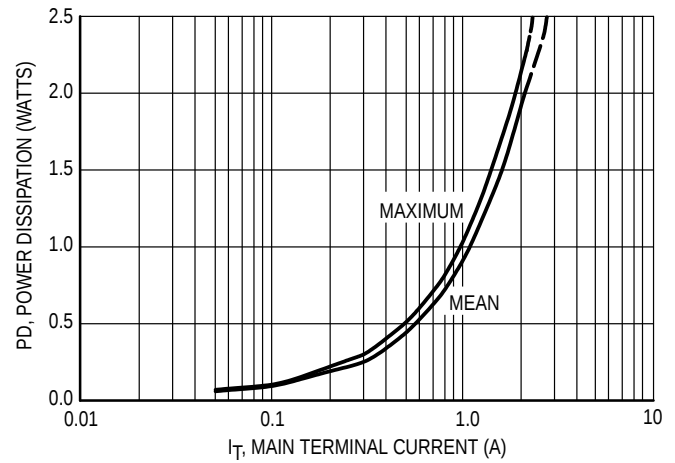


Figure 6. Power Dissipation versus Main Terminal Current

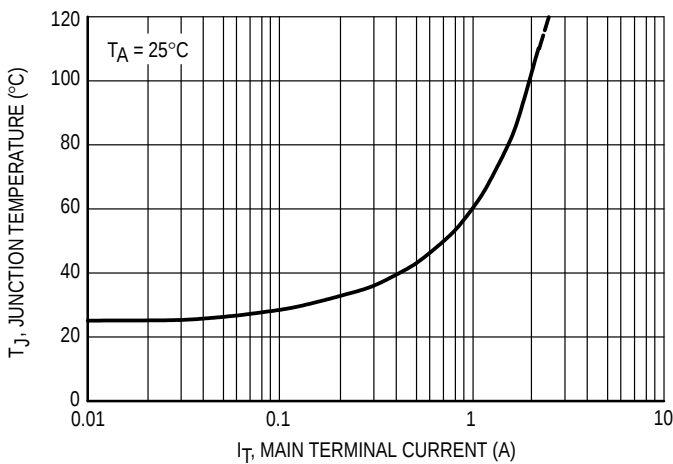


Figure 7. Junction Temperature versus Main Terminal RMS Current (Free Air)

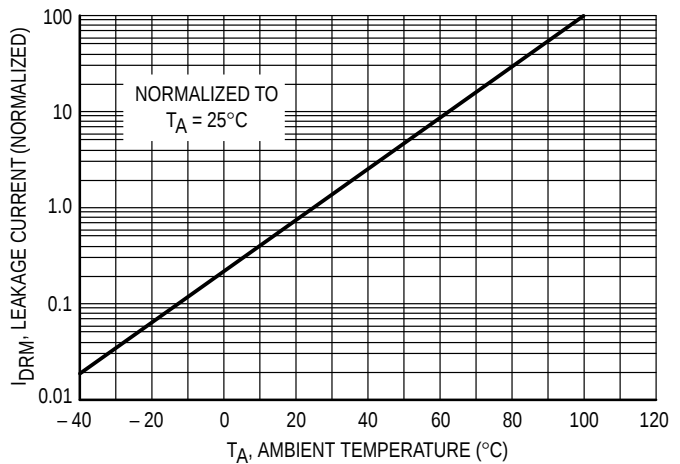
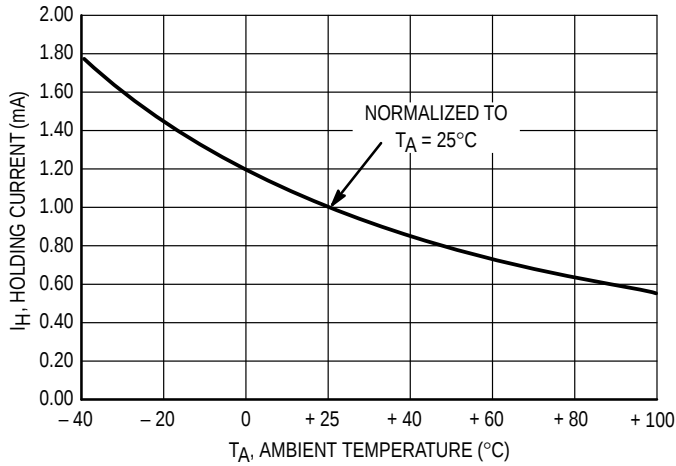
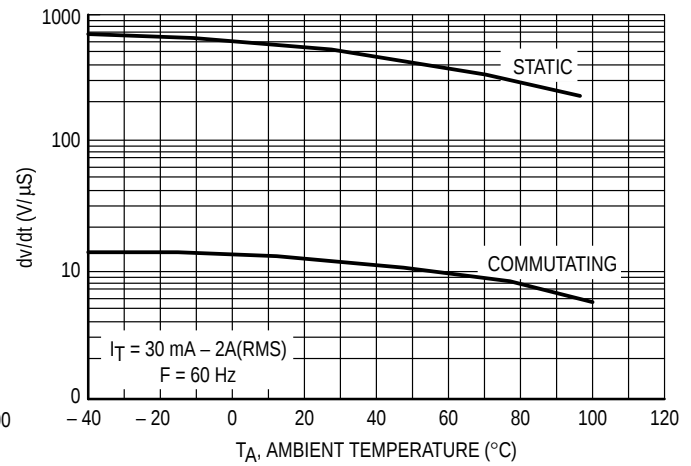
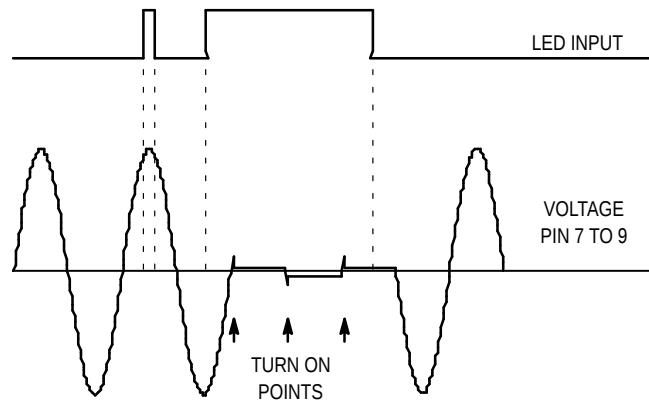
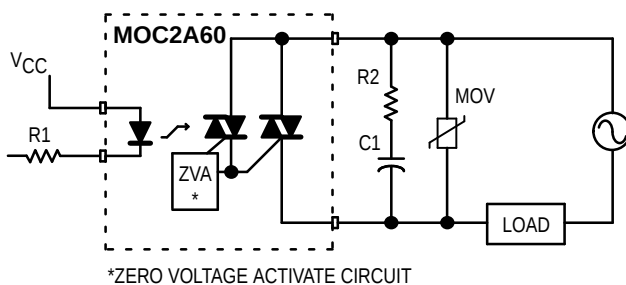


Figure 8. Leakage with LED Off versus Ambient Temperature

MOC2A60-10 MOC2A60-5**Figure 9. Holding Current versus Ambient Temperature****Figure 10. dv/dt versus Ambient Temperature****Figure 11. Operating Waveforms****Figure 12. Typical Application Circuit**

Select the value of R1 according to the following formulas:

- [1] $R1 = (V_{CC} - V_F) / \text{Max. } I_{FT} \text{ (on) per spec.}$
- [2] $R1 = (V_{CC} - V_F) / 0.050$

Typical values for C1 and R2 are 0.01 μF and 39 Ω , respectively. You may adjust these values for specific applications. The maximum recommended value of C1 is 0.022 μF . See application note AN1048 for additional information on component values.

The MOV may or may not be needed depending upon the characteristics of the applied ac line voltage. For applications where line spikes may exceed the 600 V rating of the MOC2A60, an MOV is required.

MOC2A60-10 MOC2A60-5

Use care to maintain the minimum spacings as shown. Safety and regulatory requirements dictate a minimum of 8.0 mm between the closest points between input and output conducting paths, Pins 3 and 7. Also, 0.070 inches distance is required between the two output Pins, 7 and 9.

Keep pad sizes on Pins 7 and 9 as large as possible for optimal performance.

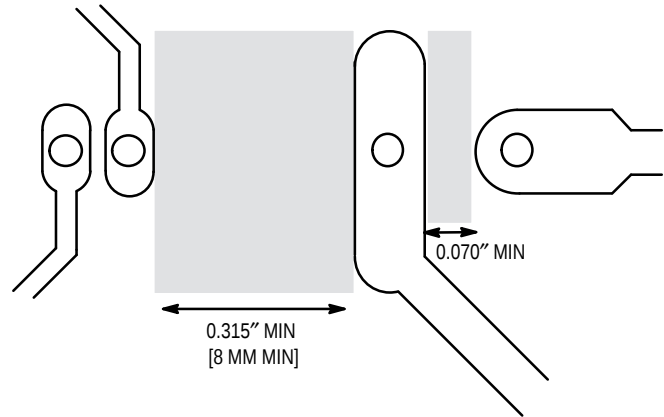


Figure 13. PC Board Layout Recommendations

Each device, when installed in the circuit shown in Figure 14, shall be capable of passing the following conducted noise tests:

- IEEE 472 (2.5 KV)
- Lamp Dimmer (NEMA Part DC33, § 3.4.2.1)
- NEMA ICS 2–230.45 Showering Arc
- MIL–STD–461A CS01, CS02 and CS06

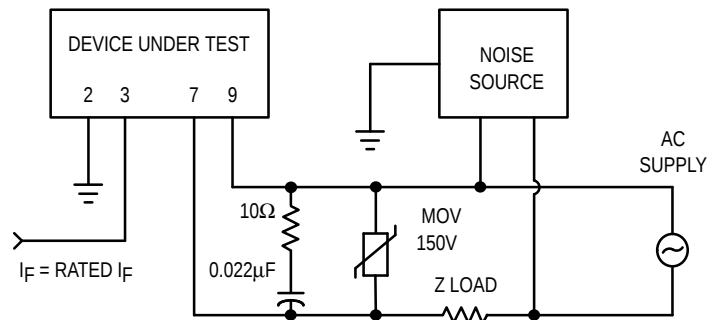
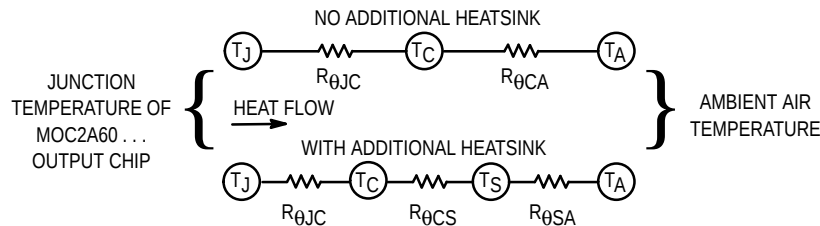


Figure 14. Test Circuit for Conducted Noise Tests



Terms in the model signify:

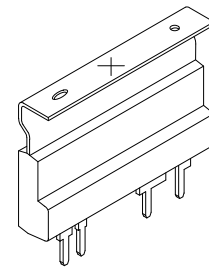
T_A = Ambient temperature
 T_S = Optional additional heat sink temperature
 T_C = Case temperature
 T_J = Junction temperature
 P_D = Power dissipation

$R_{\theta SA}$ = Thermal resistance, heat sink to ambient
 $R_{\theta CA}$ = Thermal resistance, case to ambient
 $R_{\theta CS}$ = Thermal resistance, heat sink to case
 $R_{\theta JC}$ = Thermal resistance, junction to case

Values for thermal resistance components are: $R_{\theta CA} = 36^\circ\text{C/W/in}$ maximum
 $R_{\theta JC} = 8.0^\circ\text{C/W}$ maximum

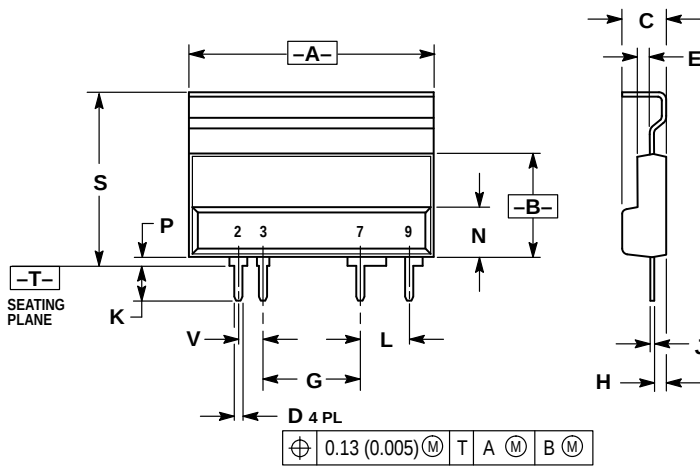
The design of any additional heatsink will determine the values of $R_{\theta SA}$ and $R_{\theta CS}$.

$T_C - T_A = P_D (R_{\theta CA})$
 $= P_D (R_{\theta JC}) + R_{\theta SA}$, where P_D = Power Dissipation in Watts.



Thermal measurements of $R_{\theta JC}$ are referenced to the point on the heat tab indicated with an 'X'. Measurements should be taken with device orientated along its vertical axis.

Figure 15. Approximate Thermal Circuit Model

MOC2A60-10 MOC2A60-5**PACKAGE DIMENSIONS**

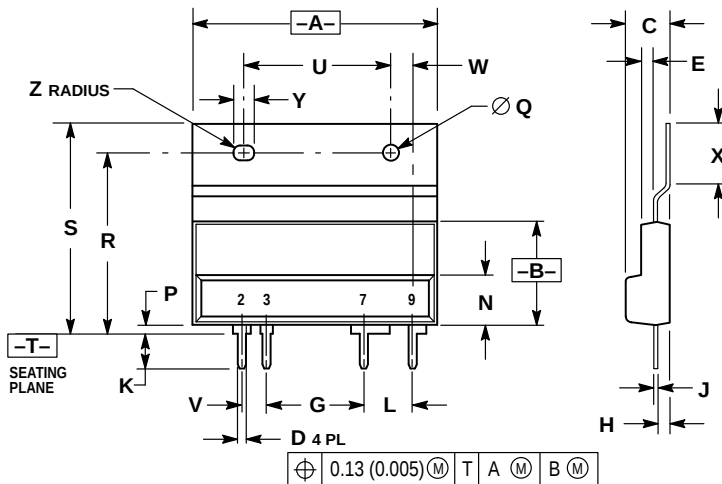
- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: INCH.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.965	1.005	24.51	25.53
B	0.416	0.436	10.57	11.07
C	0.170	0.190	4.32	4.83
D	0.025	0.035	0.64	0.89
E	0.040	0.060	1.02	1.52
G	0.400 BSC		10.16 BSC	
H	0.040	0.060	1.02	1.52
J	0.012	0.018	0.30	0.46
K	0.134	0.154	3.40	3.91
L	0.200 BSC		5.08 BSC	
N	0.190	0.210	4.83	5.33
P	0.023	0.043	0.58	1.09
S	0.695	0.715	17.65	18.16
V	0.100 BSC		2.54 BSC	

STYLE 2:
 PIN 2. LED CATHODE
 3. LED ANODE
 7. TRIAC MT
 9. TRIAC MT

CASE 417-02
PLASTIC
STANDARD HEAT TAB
ISSUE C

ORDER "F" SUFFIX
HEAT TAB OPTION
(EX: MOC2A60-10F)



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

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.965	1.005	24.51	25.53
B	0.416	0.436	10.57	11.07
C	0.170	0.190	4.32	4.83
D	0.025	0.035	0.64	0.89
E	0.040	0.060	1.02	1.52
G	0.400 BSC		10.16 BSC	
H	0.040	0.060	1.02	1.52
J	0.012	0.018	0.30	0.46
K	0.134	0.154	3.40	3.91
L	0.200 BSC		5.08 BSC	
N	0.190	0.210	4.83	5.33
P	0.023	0.043	0.58	1.09
Q	0.057	0.067	1.45	1.70
R	0.734	0.754	18.64	19.15
S	0.840	0.870	21.34	22.10
U	0.593	0.613	15.06	15.57
V	0.100 BSC		2.54 BSC	
W	0.074	0.094	1.88	2.39
X	0.265	0.295	6.73	7.49
Y	0.079	0.089	2.01	2.26
Z	0.026	0.036	0.66	0.91

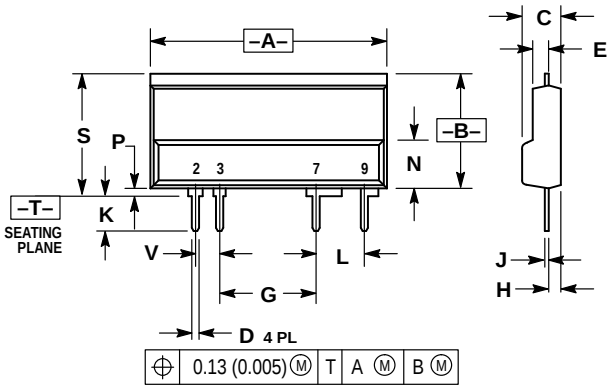
STYLE 1:
 PIN 2. LED CATHODE
 3. LED ANODE
 7. TRIAC MT
 9. TRIAC MT

CASE 417A-02
PLASTIC
FLUSH MOUNT HEAT TAB
ISSUE A

MOC2A60-10 MOC2A60-5

PACKAGE DIMENSIONS — CONTINUED

ORDER "C" SUFFIX
HEAT TAB OPTION
(EX: MOC2A60-10C)



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

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.965	1.005	24.51	25.53
B	0.416	0.436	10.57	11.07
C	0.170	0.190	4.32	4.83
D	0.025	0.035	0.64	0.89
E	0.040	0.060	1.02	1.52
G	0.400 BSC		10.16 BSC	
H	0.040	0.060	1.02	1.52
J	0.012	0.060	0.30	0.46
K	0.134	0.154	3.40	3.91
L	0.200 BSC		5.08 BSC	
N	0.190	0.210	4.83	5.33
P	0.023	0.043	0.58	1.09
S	0.439	0.529	11.15	13.44
V	0.100 BSC		2.54 BSC	

- STYLE 1:
PIN 2. LED CATHODE
3. LED ANODE
7. TRIAC MT
9. TRIAC MT

CASE 417B-01
PLASTIC
CUT HEAT TAB
ISSUE O

MOC2A60-10 MOC2A60-5

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 can and do vary in different applications. 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.

How to reach us:

USA / EUROPE: Motorola Literature Distribution;
P.O. Box 20912; Phoenix, Arizona 85036. 1-800-441-2447

JAPAN: Nippon Motorola Ltd.; Tatsumi-SPD-JLDC, Toshikatsu Otsuki,
6F Seibu-Butsuryu-Center, 3-14-2 Tatsumi Koto-Ku, Tokyo 135, Japan. 03-3521-8315

MFAX: RMFX0@email.sps.mot.com – TOUCHTONE (602) 244-6609
INTERNET: http://Design-NET.com

HONG KONG: Motorola Semiconductors H.K. Ltd.; 8B Tai Ping Industrial Park,
51 Ting Kok Road, Tai Po, N.T., Hong Kong. 852-26629298

**MOC2A60-10/D**