SEMTECH
Today's Results...Tomorrow's Vision

VERY LOW DROPOUT 1.5 AMP REGULATOR WITH ENABLE

SC1565

October 29, 1999

TEL:805-498-2111 FAX:805-498-3804 WEB:http://www.semtech.com

DESCRIPTION

The SC1565 is a high performance positive voltage regulator designed for use in applications requiring very low dropout voltage at up to 1.5 Amps. Since it has superior dropout characteristics compared to regular LDOs, it can be used to supply 2.5V on motherboards or 2.8V on peripheral cards from the 3.3V supply thus allowing the elimination of costly heatsinks. Additionally, it has an enable pin to further reduce power dissipation while shut down. The SC1565 provides excellent regulation over variations in line, load and temperature.

The SC1565 is available in the popular SO-8 surface mount package with two internally preset output voltage options, which are also adjustable using external resistors.

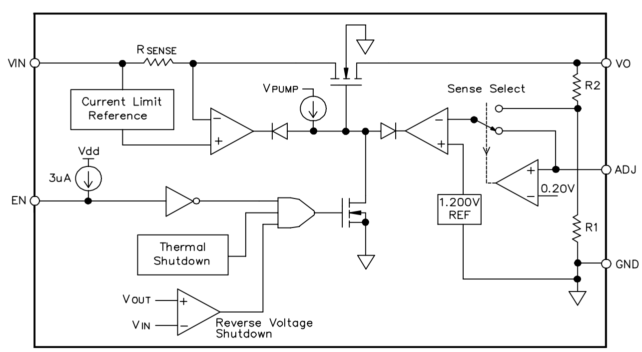
FEATURES

- 350mV dropout @ 1.5A
- Adjustable output from 1.2V to 4.8V
- 2.5V and 1.8V options (adjustable externally using resistors)
- Over current and over temperature protection
- Enable pin
- 10µA quiescent current in shutdown
- Low reverse leakage (output to input)
- Surface mount package
- Full Industrial temperature range

APPLICATIONS

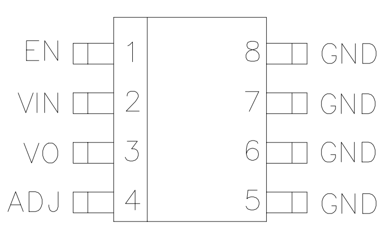
- Battery powered systems
- Motherboards
- Peripheral cards
- PCMCIA cards

BLOCK DIAGRAM



PIN CONFIGURATION

Top View



SO-8

ORDERING INFORMATION

DEVICE[(1)(2)]	PACKAGE
SC1565IS-X.X	SO-8

Notes:
(1) Where -X.X denotes voltage options. Available voltages are: 2.5V and 1.8V. Output voltage can be adjusted using external resistors, see Pin Description.
(2) Add suffix 'TR' for tape and reel.

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Max	Units
Input Voltage	V_{IN}	5.5	V
Power Dissipation	P_D	Internally Limited	W
Thermal Resistance Junction to Ambient[(1)]	θ_{JA}	65	°C/W
Operating Ambient Temperature Range	T_A	-40 to 85	°C
Operating Junction Temperature Range	T_J	-40 to 150	°C
Storage Temperature Range	T_{STG}	-65 to 150	°C
Lead Temperature (Soldering) 10 Sec.	T_{LEAD}	300	°C
ESD Rating	ESD	2	kV

Notes:
(1) 1 square inch of FR-4, double sided, 1 oz. minimum copper weight.

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PIN DESCRIPTIONS

Pin	Pin Name	Pin Functiom
1	EN	Enable Input. Pulling this pin below 0.4V turns the regulator off, reducing the quiescent current to a fraction of its operating value. The device will be enabled if this pin is left open. Connect to VIN if not being used.
2	VIN	Input voltage. For regulation at full load, the input to this pin must be between (VO + 0.7V) and 5.5V. Minimum VIN = 2.2V.
3	VO	This pin is the power output of this device.
4	ADJ	This pin, when grounded, sets the output voltage to that set by the internal feedback resistors. If external feedback resistors are used, the output voltage will be (See Application Circuit): $VO = \frac{1.200\ (R1 + R2)}{R2}$ Volts
5-8	GND	Reference ground. Use these pins for heatsinking the device.

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ELECTRICAL CHARACTERISTICS

Unless specified: $V_{EN} = V_{IN}$
Adjustable Option ($V_{ADJ} > V_{TH(ADJ)}$): V_{IN} = 2.2 to 5.5V and I_O = 10µA to 1.5A
Fixed Options (V_{ADJ} = GND): $V_{IN} = (V_O + 0.7V)$ to 5.5V and I_O = 0A to 1.5A
Values in **bold** apply over the full operating temperature range.

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
VIN						
Supply Voltage Range	VIN		**2.2**		**5.5**	V
Quiescent Current	I_Q	V_{IN} = 3.3V		0.75	**1.75**	mA
		V_{IN} = 5.5V, V_{EN} = 0V		10	**35**	µA
VO						
Output Voltage(1)	V_O	$V_{IN} = V_O$ + 0.7V, I_O = 10mA	$0.99V_O$	V_O	$1.01V_O$	V
(Internal Fixed Voltage)			**$0.98V_O$**	**V_O**	**$1.02V_O$**	
Line Regulation(1)	$REG_{(LINE)}$	$V_{IN} = (V_O$ + 0.25V) to 5.5V, I_{OUT} = 10mA		0.035	**0.3**	%
Load Regulation(1)	$REG_{(LOAD)}$	$V_{IN} = V_O$ + 0.7V		0.2	**0.4**	%
Dropout Voltage(2)	V_D	I_{LOAD} = 10mA		2.5	10	mV
					20	
		I_{LOAD} = 500mA		115	300	mV
					400	
		I_{LOAD} = 1A		225	400	mV
					500	
		I_{LOAD} = 1.5A		350	500	mV
					600	
Minimum Load Current(3)	I_O	$V_{IN} = V_O$ + 0.7V		1	**10**	µA
Current Limit	I_{CL}		**1.50**	2.50	**3.50**	A
ADJ						
Reference Voltage(1)	V_{REF}	V_{IN} = 2.2V, $V_{ADJ} = V_{OUT}$, I_O = 10mA	1.188	1.200	1.212	V
			1.176		**1.224**	
Adjust Pin Current(4)	I_{ADJ}	$V_{ADJ} = V_{REF}$		10	**50**	nA
Adjust Pin Threshold(5)	$V_{TH(ADJ)}$		**0.10**	0.20	**0.40**	V
EN						
Enable Pin Current	I_{EN}	V_{EN} = 0V, V_{IN} = 3.3V		1.5	**10**	µA
Enable Pin Threshold	V_{IH}	V_{IN} = 3.3V	**1.8**			V
	V_{IL}	V_{IN} = 3.3V			**0.4**	

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ELECTRICAL CHARACTERISTICS

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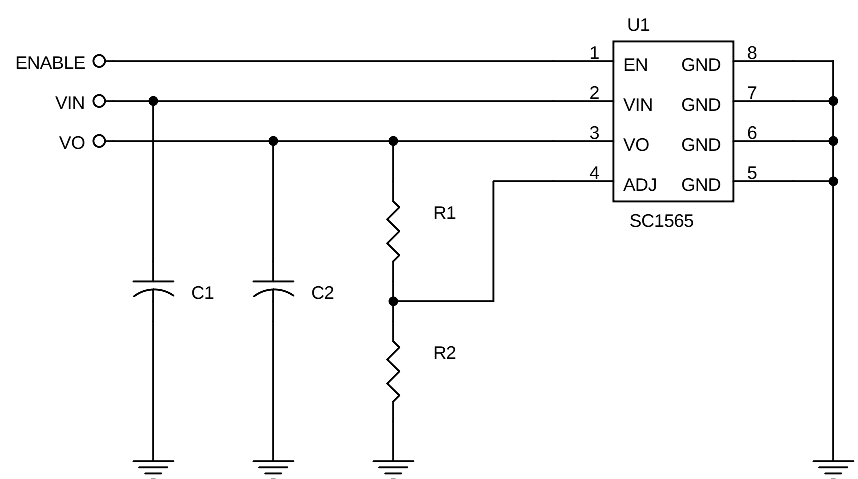
Fixed Options (V_{ADJ} = GND): $V_{IN} = (V_O + 0.7V)$ to 5.5V and I_O = 0A to 1.5A
Values in **bold** apply over the full operating temperature range.

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
OVER TEMPERATURE PROTECTION						
High Trip level	T_{HI}			170		°C
Hysteresis	T_{HYST}			20		°C

NOTES:
(1) Low duty cycle pulse testing with Kelvin connections required.
(2) Defined as the input to output differential at which the output voltage drops to 1% below the value measured at a differential of 0.7V.
(3) Required to maintain regulation. Voltage set resistors R1 and R2 are usually utilized to meet this requirement. Adjustable versions only.
(4) Guaranteed by design.
(5) When V_{ADJ} exceeds this threshold, the "Sense Select" switch disconnects the internal feedback chain from the error amplifier and connects V_{ADJ} instead.

TYPICAL APPLICATION - EXTERNALLY SET OUTPUT VOLTAGE(1)(2)



$$VO = \frac{1.200\ (R1 + R2)}{R2}\ \text{Volts}$$

Notes:
(1) Maximum VO setpoint for 1.8V parts = 5.4V.
(2) This device is designed to operate with ceramic input and output capacitors.

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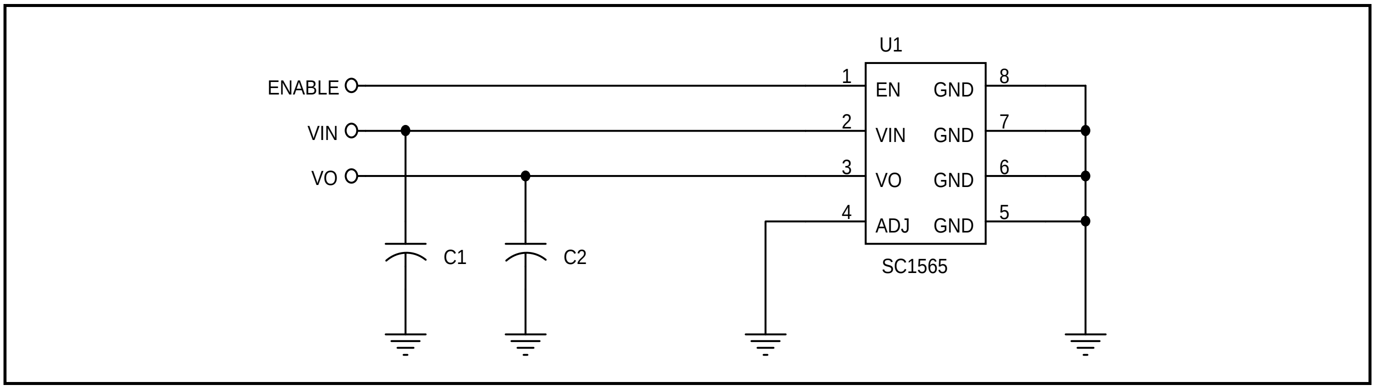
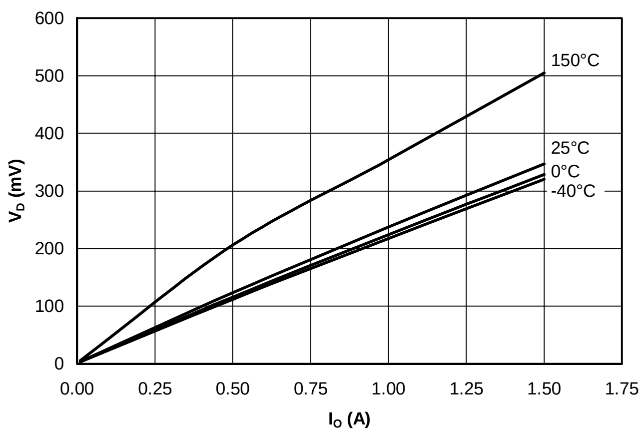
TYPICAL APPLICATION - INTERNALLY PRESET OUTPUT VOLTAGE(1)



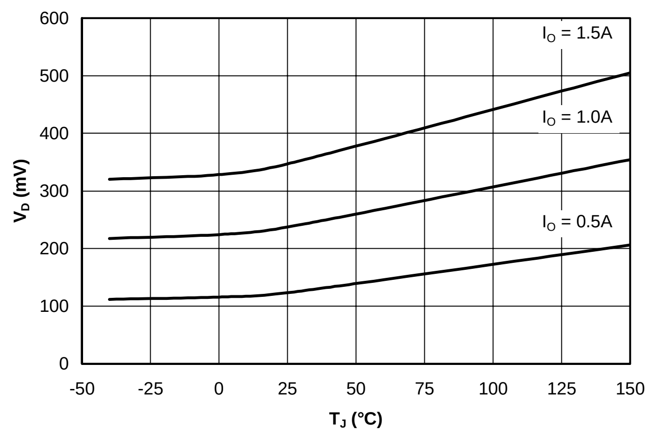
Notes:
(1) This device is designed to operate with ceramic input and output capacitors.

TYPICAL CHARACTERISTICS

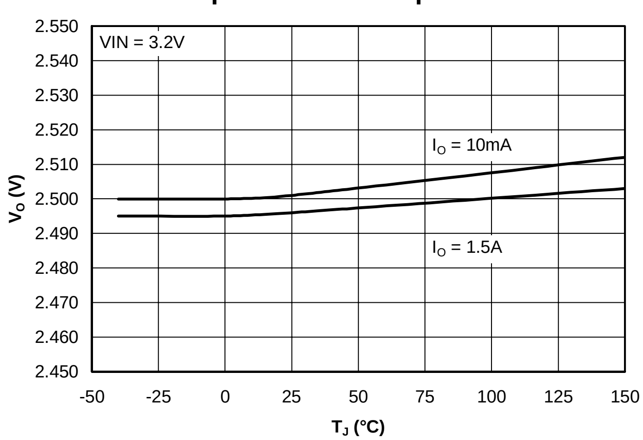
Dropout Voltage vs. Output Current vs. Junction Temperature



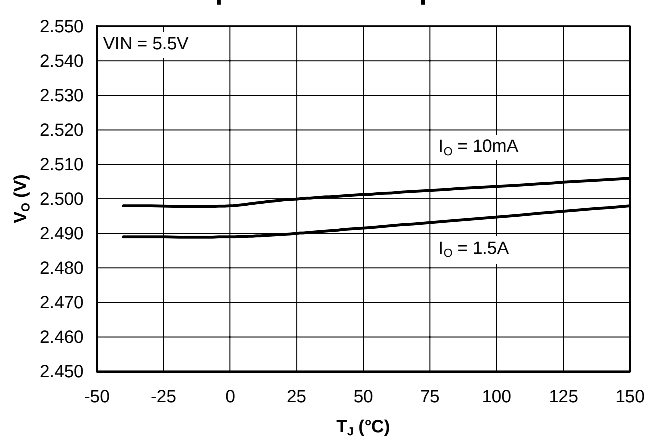
Dropout Voltage vs. Junction Temperature vs. Output Current



Output Voltage (2.5V) vs. Junction Temperature vs. Output Current



Output Voltage (2.5V) vs. Junction Temperature vs. Output Current



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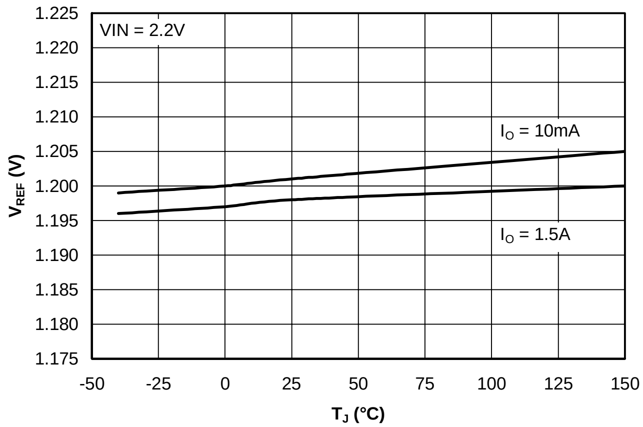
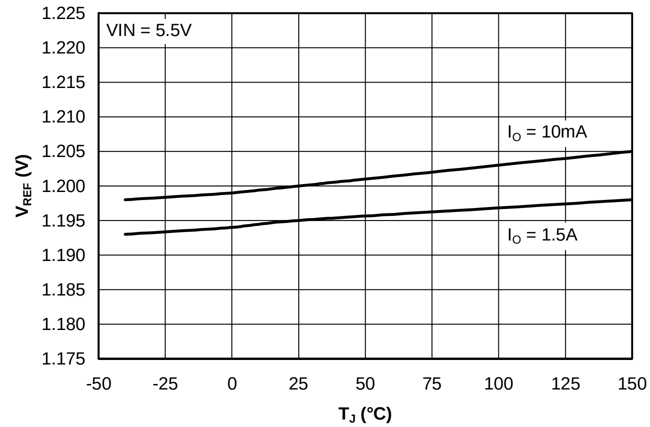
TYPICAL CHARACTERISTICS (Cont.)

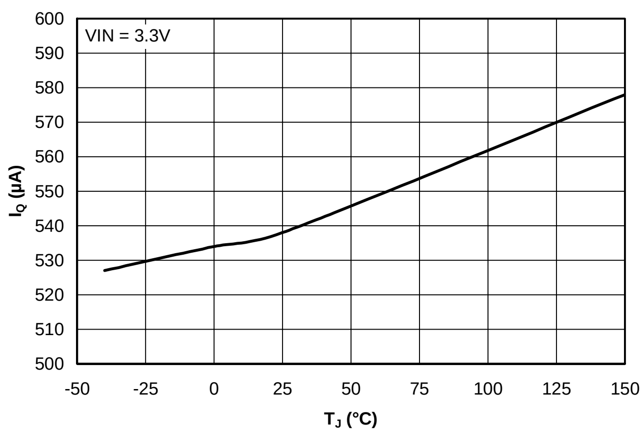
Reference Voltage vs. Junction Temperature vs. Output Current



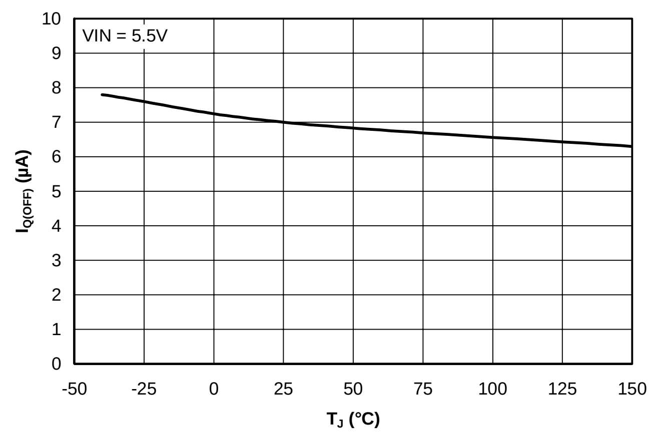
Reference Voltage vs. Junction Temperature vs. Output Current



Quiescent Current vs. Junction Temperature



Off-State Quiescent Current vs. Junction Temperature



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APPLICATIONS INFORMATION

Introduction

The SC1565 is intended for applications such as graphics cards where high current capability and very low dropout voltage are required. It provides a very simple, low cost solution that uses very little pcb real estate. Additional features include an enable pin to allow for a very low power consumption standby mode, and a fully adjustable output.

Component Selection

Input capacitor - a 4.7µF ceramic capacitor is recommended. This allows for the device being some distance from any bulk capacitance on the rail. Additionally, input droop due to load transients is reduced, improving load transient response. Additional capacitance may be added if required by the application.

Output capacitor - a minimum bulk capacitance of 10µF, along with a 0.1µF ceramic decoupling capacitor is recommended. Increasing the bulk capacitance will improve the overall transient response. The use of multiple lower value ceramic capacitors in parallel to achieve the desired bulk capacitance will not cause stability issues. Although designed for use with ceramic output capacitors, the SC1565 is extremely tolerant of output capacitor ESR values and thus will also work comfortably with tantalum output capacitors.

External voltage selection resistors - the use of 1% resistors, and designing for a current flow ≥ 10µA is recommended to ensure a well regulated output (thus R2 ≤ 120kΩ).

Thermal Considerations

The power dissipation in the SC1565 is approximately equal to the product of the output current and the input to output voltage differential:

$$P_D \approx (VIN - VOUT) \bullet I_O$$

The absolute worst-case dissipation is given by:

$$P_{D(MAX)} = (VIN_{(MAX)} - VOUT_{(MIN)}) \bullet I_{O(MAX)} + VIN_{(MAX)} \bullet I_{Q(MAX)}$$

For a typical scenario, VIN = 3.3V ± 5%, VOUT = 2.8V and I_O = 1.5A, therefore:

$VIN_{(MAX)}$ = 3.465V, $VOUT_{(MIN)}$ = 2.744V and $I_{Q(MAX)}$ = 1.75mA,

Thus $P_{D(MAX)}$ = 1.09W.

Using this figure, and assuming $T_{A(MAX)}$ = 70°C, we can calculate the maximum thermal impedance allowable to maintain $T_J \le$ 150°C:

$$R_{TH(J-A)(MAX)} = \frac{(T_{J(MAX)} - T_{A(MAX)})}{P_{D(MAX)}} = \frac{(150 - 70)}{109} = 73.4°C / W$$

This should be achievable using pcb copper area to aid in conducting the heat away, such as one square inch of copper connected to the ground pins of the device. Internal ground/power planes and air flow will also assist in removing heat. For higher ambient temperatures it may be necessary to use additional copper area.

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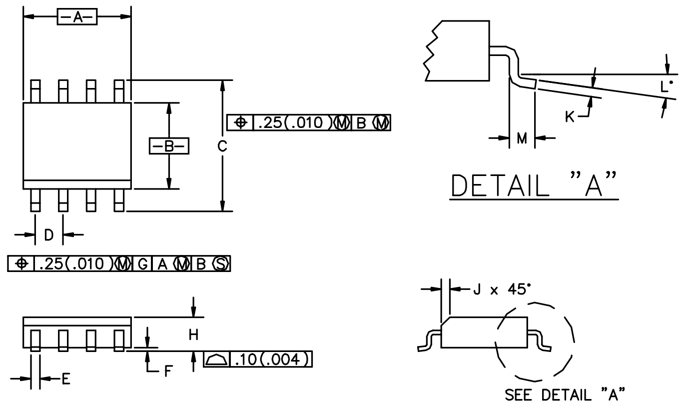
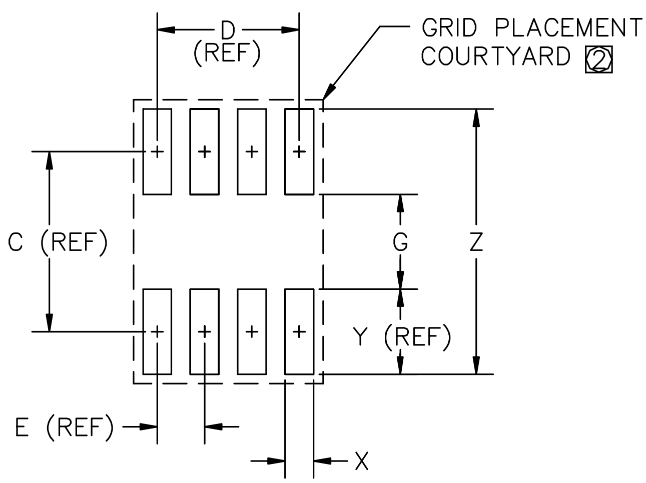
OUTLINE DRAWING - SO-8

JEDEC
REF: MS-012AA



DIMENSIONS					
DIM^N	INCHES		MM		NOTE
	MIN	MAX	MIN	MAX	
A	.188	.197	4.80	5.00	
B	.149	.158	3.80	4.00	
C	.228	.244	5.80	6.20	
D	.050 BSC		1.27 BSC		
E	.013	.020	0.33	0.51	
F	.004	.010	0.10	0.25	
H	.053	.069	1.35	1.75	
J	.011	.019	0.28	0.48	
K	.007	.010	.19	.25	
L	0°	8°	0°	8°	
M	.016	.050	0.40	1.27	

LAND PATTERN - SO-8



DIMENSIONS 1					
DIM^N	INCHES		MM		NOTE
	MIN	MAX	MIN	MAX	
C	–	.19	–	5.00	–
D	–	.15	–	3.81	–
E	–	.05	–	1.27	–
G	.10	.11	2.60	2.80	–
X	.02	.03	.60	.80	–
Y	–	.09	–	2.40	–
Z	–	.29	7.20	7.40	–

2 GRID PLACEMENT COURTYARD IS 12x16 ELEMENTS (6 mm X 8mm) IN ACCORDANCE WITH THE INTERNATIONAL GRID DETAILED IN IEC PUBLICATION 97.

1 CONTROLLING DIMENSION: MILLIMETERS

652 MITCHELL ROAD NEWBURY PARK CA 91320