SC1592
Low Dropout High Performance Adjustable Positive Voltage Regulator

POWER MANAGEMENT

Description

The SC1592 is a 3A low dropout high performance linear voltage regulator, that provides a low voltage, high current output with a minimum of external components, utilizing dual supply configuration.

The SC1592 offers a wide input voltage range from 1.25V to 16V and is ideal for applications that need to convert down to 0.8V.

Additionally, the SC1592 is fully protected with an externally programmable current limit, and thermal shutdown. Also, there is an EN input which enables or shuts down the device.

The SC1592 voltage regulator is available in 7-lead DDPAK and SOIC-8L EDP packages.

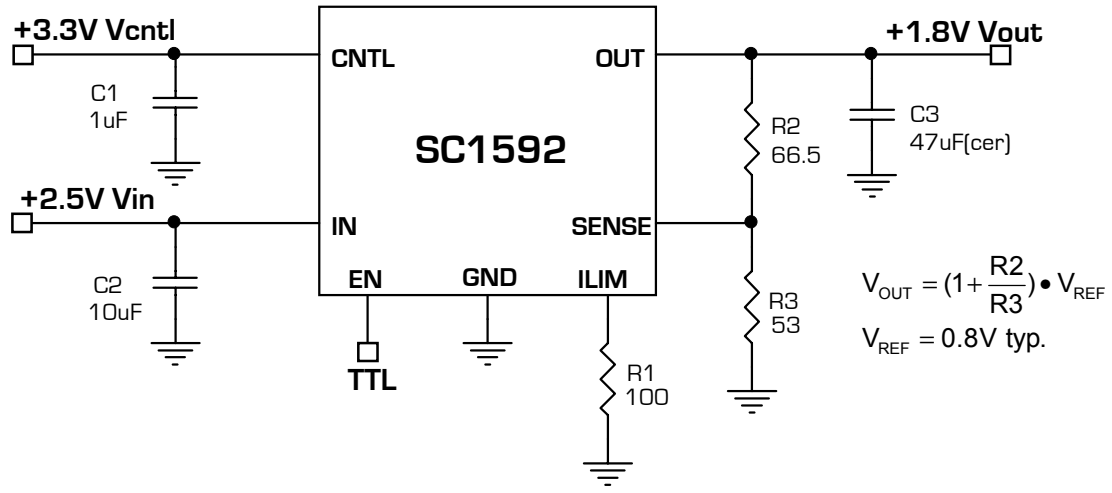
Features

- Wide input range, V_{IN} = 1.25V to 16V, V_{CNTL} = 3V to 16V
- 3A Guaranteed Output Current
- 260mV (typ) @ 3A dropout voltage in dual supply mode
- 1% Initial Accuracy
- Adjustable output voltage, down to 0.8V
- Programmable current limiting and thermal shutdown
- Fast transient response
- Excellent line and load regulation
- Power SO-8 and 7-lead DDPAK

Applications

- Low voltage logic supplies
- Microprocessor and chipset supplies
- Split plane microprocessor supplies
- Advanced graphics cards supplies
- Sound cards and auxiliary power supplies
- SMPS post regulator

Typical Application Circuit



Absolute Maximum Ratings

Exceeding the specifications below may result in permanent damage to the device, or device malfunction. Operation outside of the parameters specified in the Electrical Characteristics section is not implied.

Parameter	Symbol	Maximum	Units
Power Input Voltage	V_{IN}	18	V
Control Input Voltage	V_{CNTL}	18	V
Output Current	I_{OUT}	5	A
Power Dissipation	P_D	Internally Limited	W
Thermal Resistance Junction to Ambient DDPAK (1sq. in.) SOIC-8L EDP (1sq. in.)	θ_{JA}	 29 36.5	°C/W
Thermal Resistance Junction to Case DDPAK SOIC-8L EDP	θ_{JC}	 3 5.5	°C/W
Junction Temperature Range	T_J	-40 to +125	°C
Storage Temperature Range	T_{STG}	-65 to +150	°C
Lead Temperature (Soldering) 10 Sec.	T_{LEAD}	300	°C
ESD Rating (Human Body Model)	ESD	2	kV

Electrical Characteristics

Unless specified: V_{IN} = 2.5V, V_{EN} = V_{CNTL} = 3.3V, V_{OUT} = 1.8V, I_{OUT} = 10mA, R_{LIM} = 100Ω, T_J = T_A = 25°C.
Values in **bold** indicate -40°C < T_J < +125°C.

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Control Voltage	V_{CNTL}	V_{OUT} = V_{REF}	**3**		**16**	V
Reference Voltage	V_{REF}	V_{OUT} = V_{REF}	**792**	800	**808**	mV
Control Pin Current	I_{CNTL_EN}	V_{CNTL} = V_{IN} = V_{EN} = 16V V_{OUT} = V_{REF}; I_O = 0		3	**8**	mA
		V_{CNTL} = V_{IN} = V_{EN} = 16V V_{OUT} = V_{REF}; I_O = 3A		24		
Control Pin Current in Shutdown	I_{CNTL_DIS}	V_{CNTL} = V_{IN} = 16V V_{EN} = 0		1	**5**	µA
V_{IN} Line Regulation	$REG_{(LINE)}$	2.5V ≤ V_{IN} ≤ 16V		0.01	**0.1**	%/V
V_{CNTL} Line Regulation	$REG_{(CNTL)}$	3.3V ≤ V_{CNTL} ≤ 16V, V_{OUT} = V_{REF}		0.1	**0.4**	%/V
Load Regulation (1)	$REG_{(LOAD)}$	10mA ≤ I_{OUT} ≤ 2A, T_J = 25°C		0.8	1.5	%
		10mA ≤ I_{OUT} ≤ 3A, -40 < T_J < 125°C		1.4	**3**	%
Dropout Voltage	V_{DO}	I_{OUT} = 2A; V_{OUT} = 0.98 Vnom		160	**320**	mV
		I_{OUT} = 3A; V_{OUT} = 0.98 Vnom		260	**520**	

Electrical Characteristics (Cont.)

Unless specified: V_{IN} = 2.5V, V_{EN} = V_{CNTL} = 3.3V, V_{OUT} = 1.8V, I_{OUT} = 10mA, R_{LIM} = 100Ω, T_J = T_A = 25°C.
Values in **bold** indicate -40°C < T_J < +125°C.

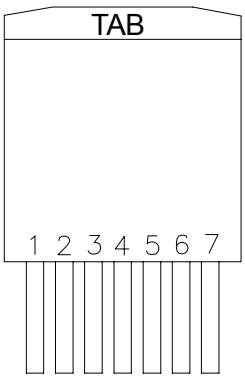
Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Thermal Shutdown	T_{SHUT}			150		°C
Thermal Shutdown Hysteresis				10		°C
SENSE Input Current				1		µA
Low Level EN					**0.8**	V
High Level EN			**2**			V
EN Input Current		V_{EN} = V_{CNTL} = 5V		55	**100**	µA
EN Impedance				65		KΩ
Current Limit Accuracy(2)	I_{LIM}		-20		+20	%

Notes:
(1) For load regulation use a 1ms current pulse width, d.c. ≤ 10% when measuring VOUT.

(2) Current limit is programmable, $I_{LIM} \approx \frac{240 \bullet V_{OUT}}{R_{LIM}}$

Pin Configurations

Top View



Pin Function	
1	ILIM
2	IN
3	CNTL
4	GND
5	OUT
6	SENSE
7	EN
TAB	GND

(TO-263-7L DDPAK)

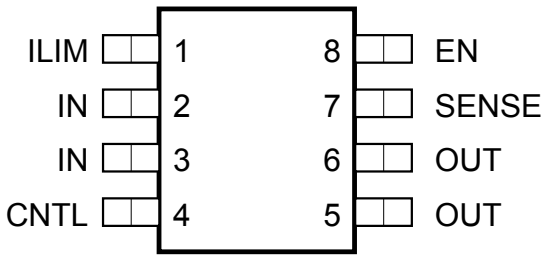
Ordering Information

Part Number	Package (1)	Temp. Range (T_J)
SC1592IMTR	TO-263-7L	-40°C to +125°C
SC1592ISTR	SOIC-8L EDP	
SC1592EVB(2)	Evaluation Board	

Notes:
(1) Only available in tape and reel packaging. A reel contains 800 devices for TO-263 package and 2500 devices for SOIC package.

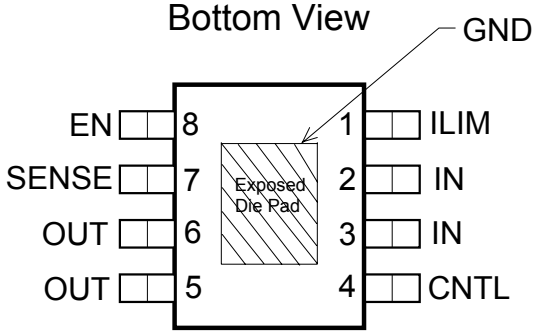
(2) When ordering Evaluation Board please specify package needed (TO-263(DDPAK) or SOIC(EDP)).

Top View



(SOIC-8L EDP)

Bottom View



(SOIC-8L EDP)

Pin Descriptions

Pin # DDPAK	Pin # SOIC	Pin Name	Pin Function
1	1	ILIM	Externally programmable current limit should be set at < 5A.
2	2, 3	IN	This is the collector input to the power device. The ouput load current is supplied through this pin.
3	4	CNTL	This pin is the bias supply for the control circuitry. The current flow into this pin will be approximately 1% of the output current. For the device to regulate, the voltage on this pin must be at least 1.5V greater than the output voltage, but no less than $V_{CNTL_MIN.}$
4, TAB	PAD	GND	Ground.
5	5, 6	OUT	This is the power output of the device.
6	7	SENSE	This is a feedback input.
7	8	EN	Enable input. When high, should be less or equal to $V_{CNTL.}$

Block Diagram

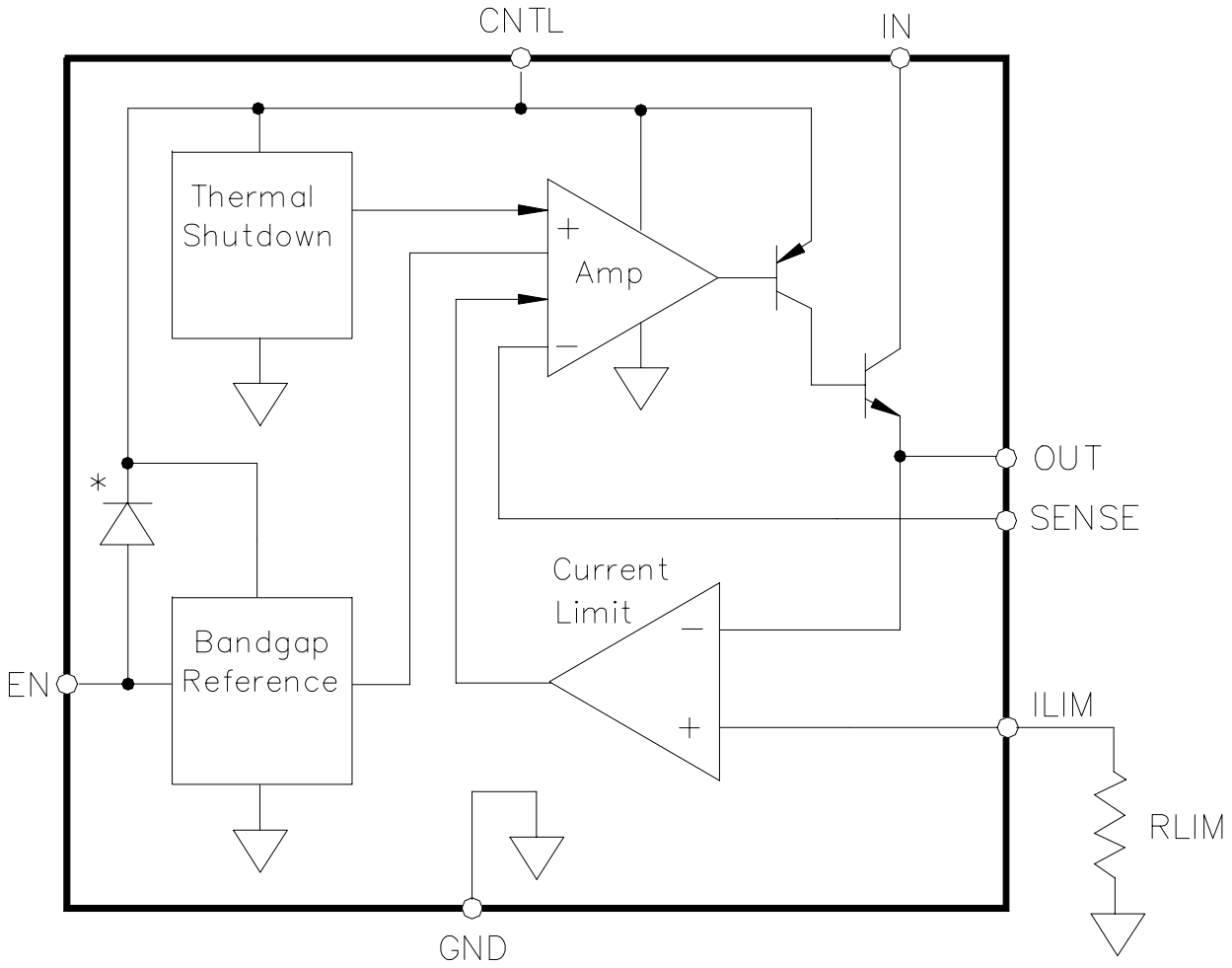


Figure 1

$$R_{LIM} \approx 240 \times \left[\frac{V_{OUT}}{I_{LIM}}\right]$$

I_{LIM} = Selected current limit value
V_{OUT} = Regulated output voltage
R_{LIM} = Externally programmable current limit resistor.

Accuracy of the current limit setting is better than ±20% over full operating temperature range.

*Internal ESD structure. In cases where EN is permanently tied to V_{IN}, it's recommended that a 10-20k resistor should be inserted in the link between EN and V_{IN}.

Application Information

The SC1592 is a 3A low dropout high performance linear voltage regulator. The SC1592 can be used for voltage applications as low as 0.8V and is ideal for down conversion utilizing dual supply configuration. This allows for extremely low dropout voltages with excellent load and line regulation. The SC1592 can be utilized in high voltage applications, with V_{IN} and V_{CNTL} up to 16V, providing there is adequate thermal management.

SC1592 is designed to meet stringent requirements of current generation microprocessors and other sensitive electronic devices. This is possible by employing an additional bias source, V_{CNTL}. The voltage of this supply needs to be at least 1.5V greater than the output voltage in order to achieve low dropout, typically less then 300mV.

Unlike most of the other high current linear regulators, the SC1592 provides a programmable current limit which can be set with a single resistor. The value of the programming resistor is:

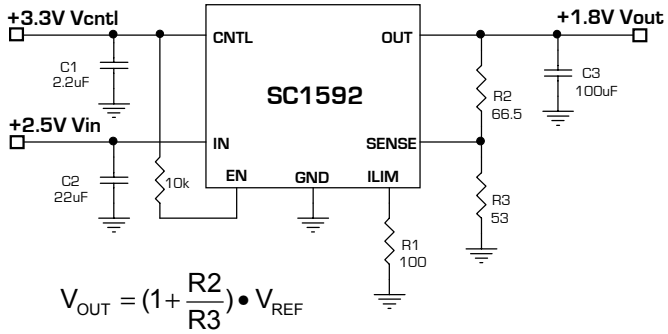
$$I_{LIM} \approx \frac{240 \bullet V_{OUT}}{R_{LIM}}$$

where I_{LIM} = selected current limit value
V_{OUT} = regulated output voltage
R_{LIM} = programmable current limit resistor

The SC1592 has a fast transient response that allows it to handle large load changes associated with high current applications. Proper selection of the of the output capacitor and it's ESR value determines stable operation and optimizes performance.

The typical application shown in Figure 2 was tested with a wide range of different capacitors. The circuit was found to be unconditionally stable with capacitor values from 47µF to 330µF and ESR ranging from 0.5mΩ to greater then 75mΩ.

It's recommended to maintain 5-10mA through the output divider network in order to have a tight load and line regulation. Initial accuracy of the internal voltage reference V_{REF} = 0.8V ±1% over full temperature range. This commands the use of 0.5% or better accuracy resistors to build a precision power supply.



$$V_{OUT} = (1 + \frac{R2}{R3}) \bullet V_{REF}$$

V_{REF} = 0.8V typ.

Figure 2

The circuit in Figure 2 shows a typical application of 2.5V to 1.8V conversion with a 3.3V control supply and the load range of up to 3A steady state. Considering the approximate 2W power being dissipated by the pass element of the SC1592, we are still able to choose an SO-8 EDP package with T_{JA} = 36.5°C/W mount on the 1sq.in. copper pad allocated for adequate heat transfer.

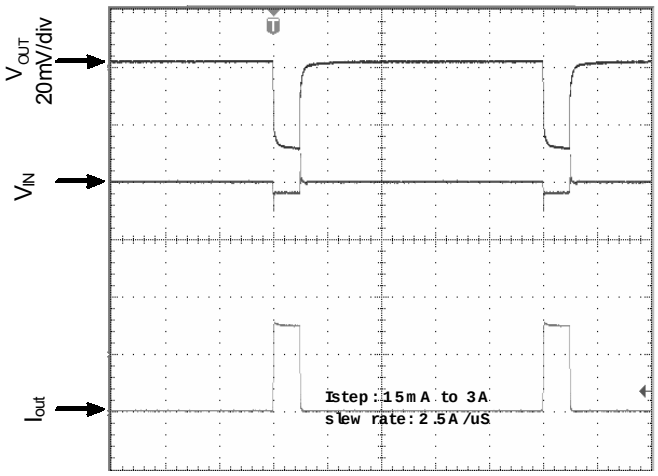
The ambient temperature in this case should not exceed 50°C. If this temperature range is too restrictive, then the DDPAK can be utilized, having T_{JA} = 29°C/W mount on the same size copper pad.

Input capacitor: A minimum of 10µF ceramic capacitor is recommended to be placed directly next to the Vin pin. This allows for the device being some distance from any bulk capacitance on the rail. Additionally, bulk capacitance may be added closely to the input supply pin of the SC1592 to ensure that Vin does not sag, improving load transient response.

Output capacitor: A minimum bulk capacitance of 33µF, 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 SC1592 is extremely tolerant of output capacitor ESR values and thus will also work comfortably with tantalum output capacitors.

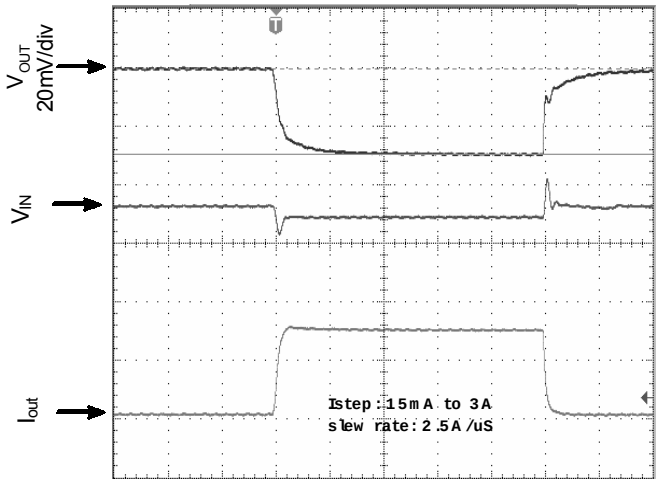
Typical Characteristics

Load Transient Reponse



V_{IN} = 2.5V
V_{OUT} = 1.8V
V_{CNTL} = 3.3V
C_{IN} = 22uF
C_{OUT} = 100uF

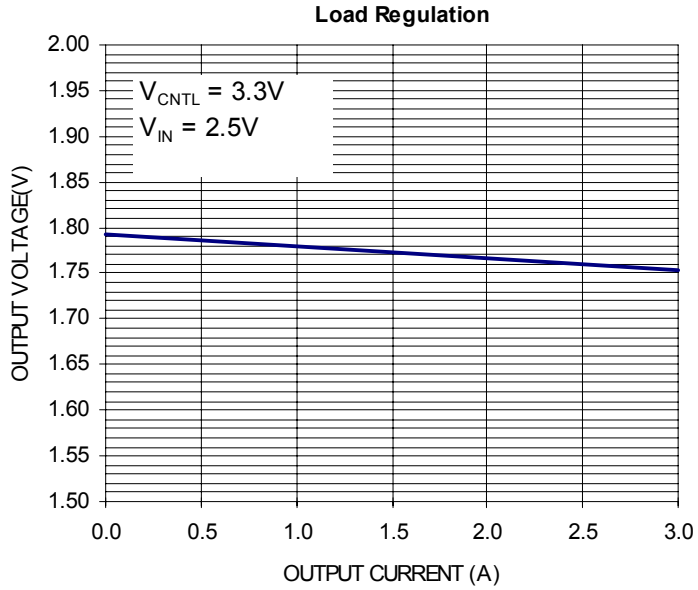
Time (2ms/div)

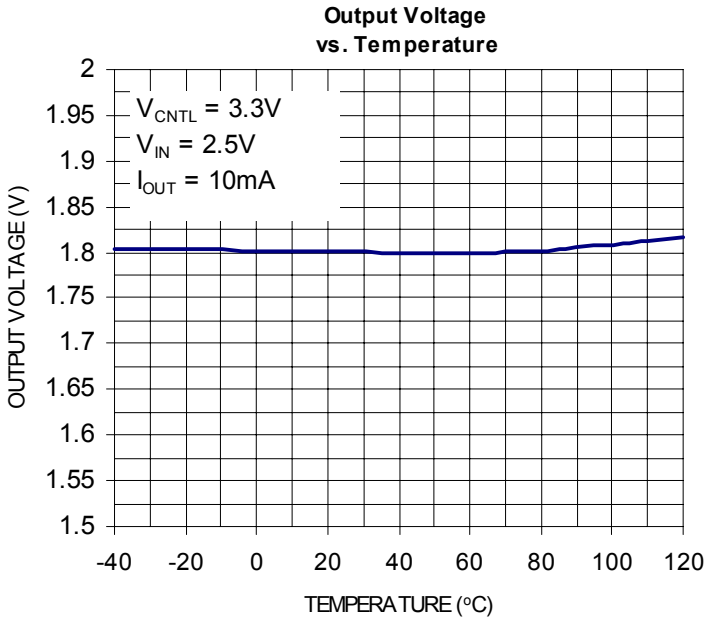


V_{IN} = 2.5V
V_{OUT} = 1.8V
V_{CNTL} = 3.3V
C_{IN} = 22uF
C_{OUT} = 100uF

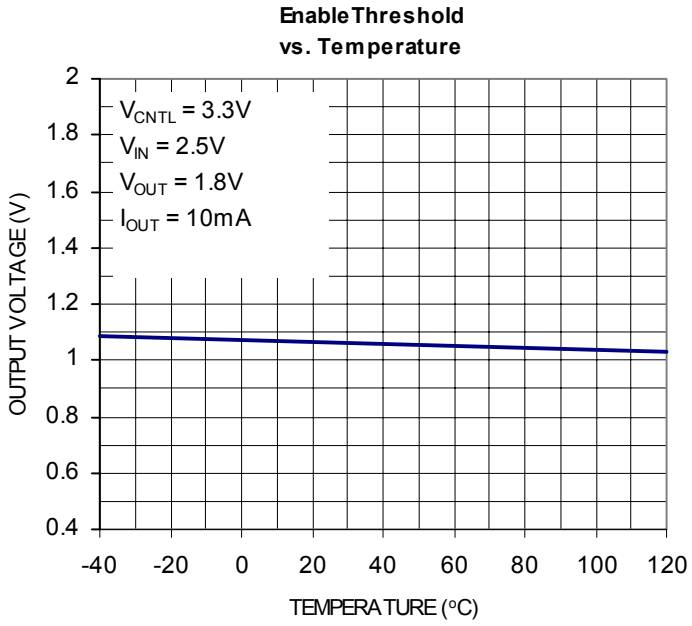
Time (200us/div)

Typical Characteristics (Cont.)



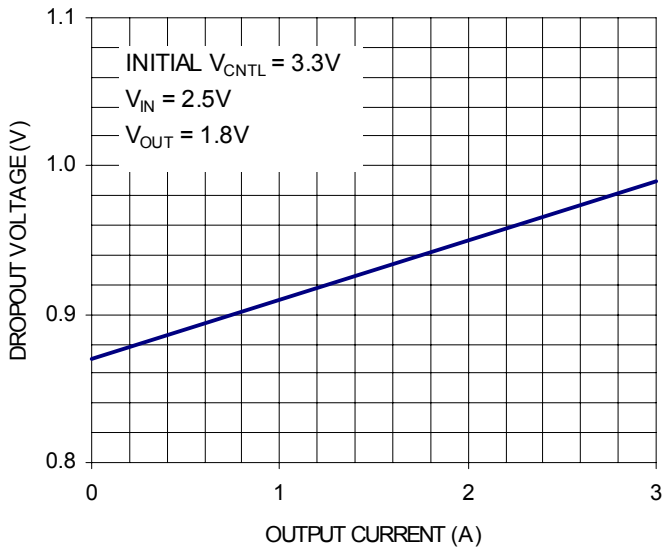


Typical Characteristics (Cont.)

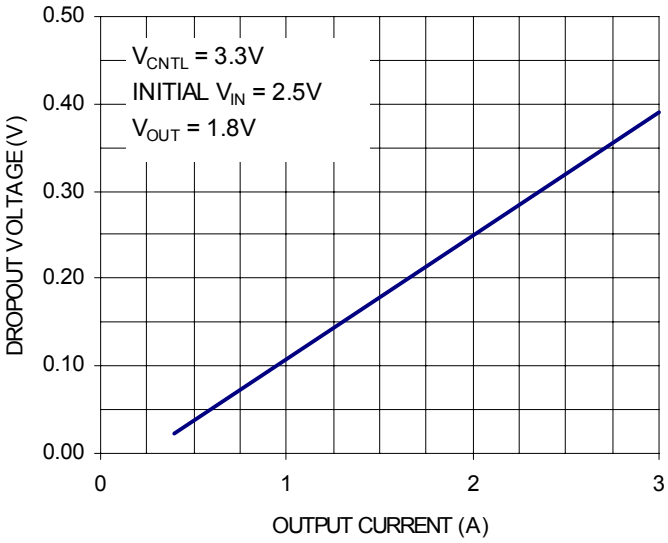


Typical Characteristics (Cont.)

Dropout Voltage (Control Supply)

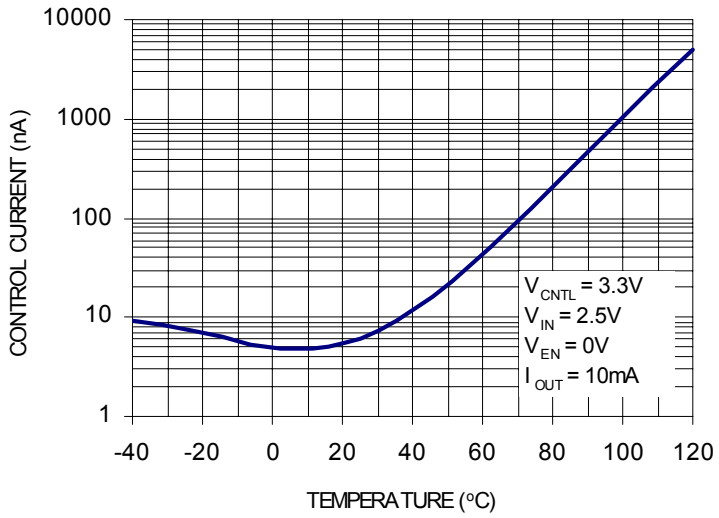


Dropout Voltage (Input Supply)

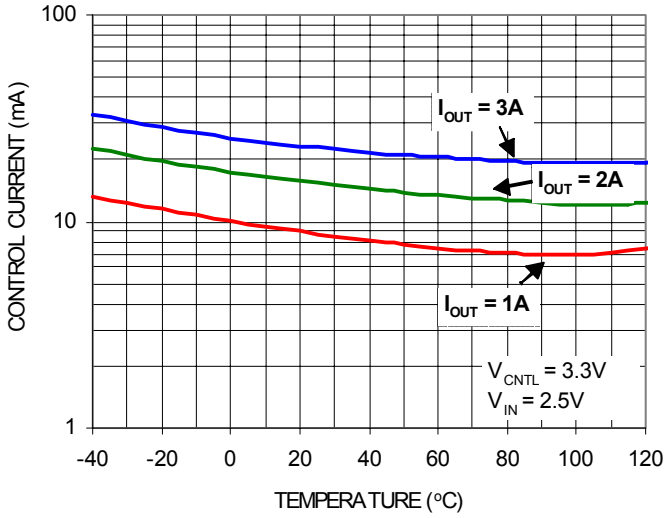


Typical Characteristics (Cont.)

Contol Current vs. Temperature (In Shutdown)

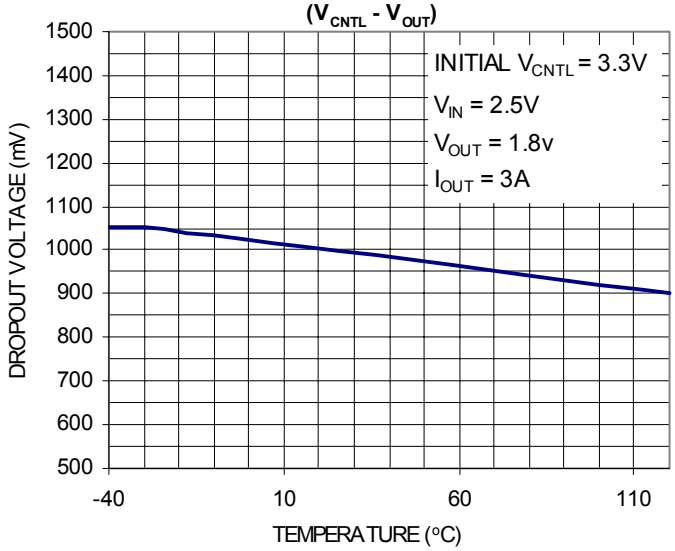


Control Current vs Temperature (In Regulation)

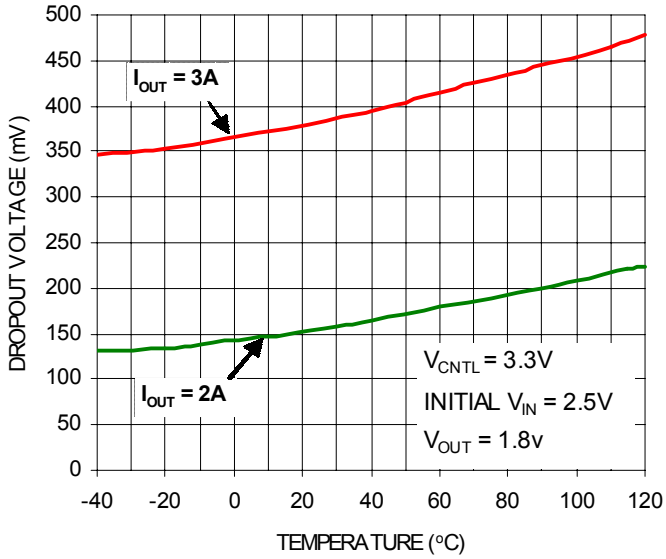


Typical Characteristics (Cont.)

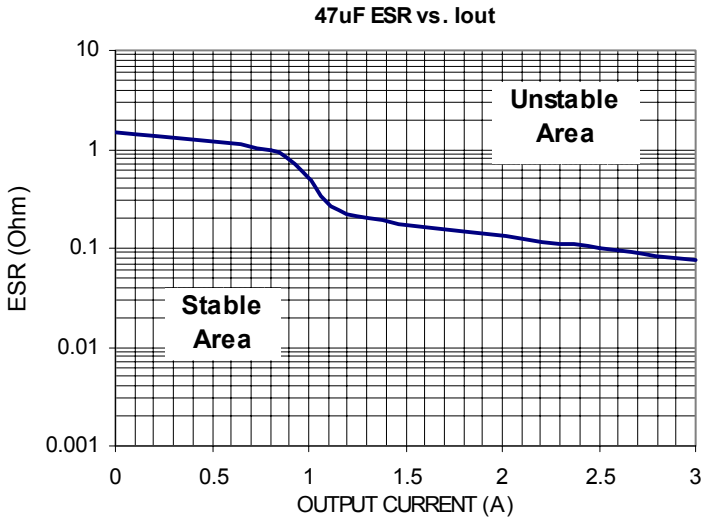
Dropout Voltage vs. Temperature (V_{CNTL} - V_{OUT})

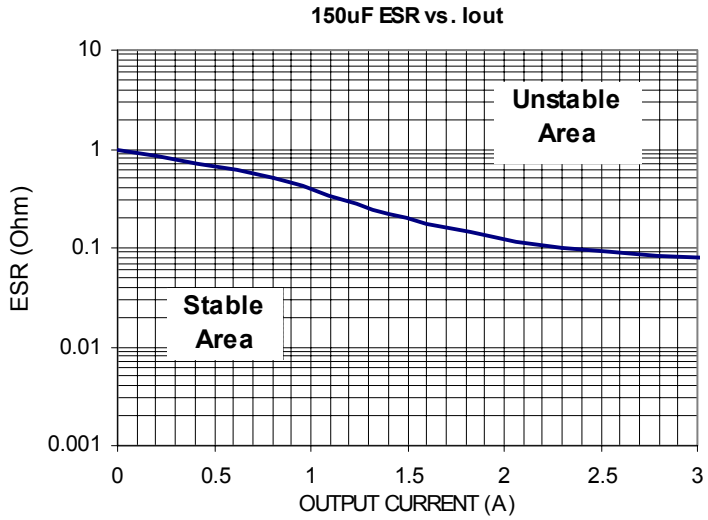


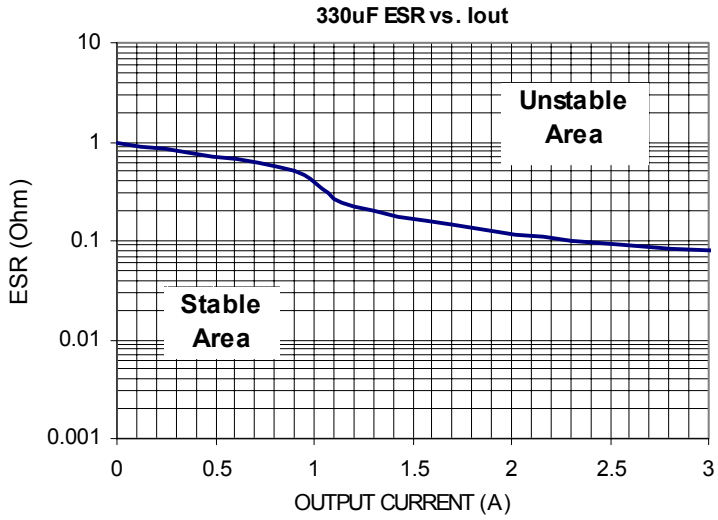
Dropout Voltage vs. Temperature (V_{IN} - V_{OUT})



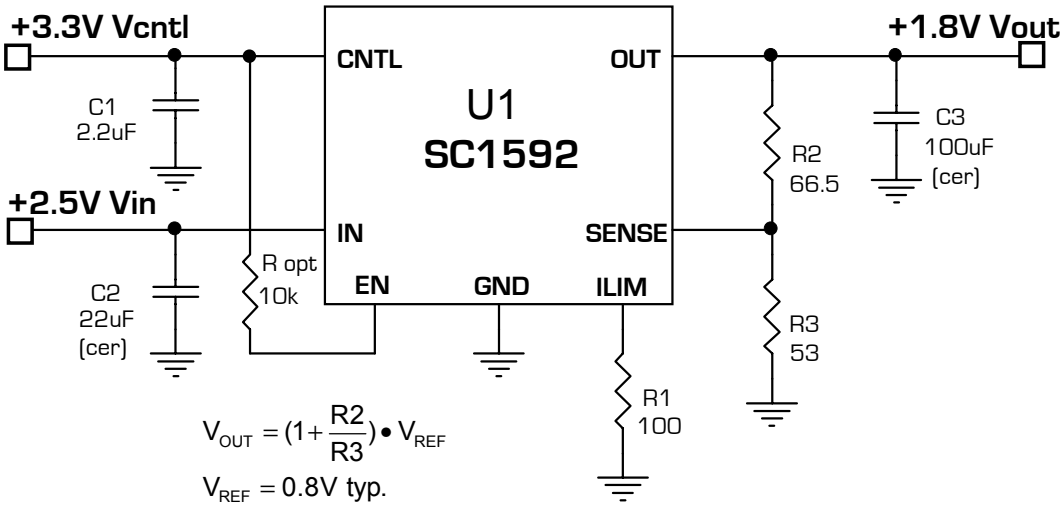
Typical Characteristics (Cont.)





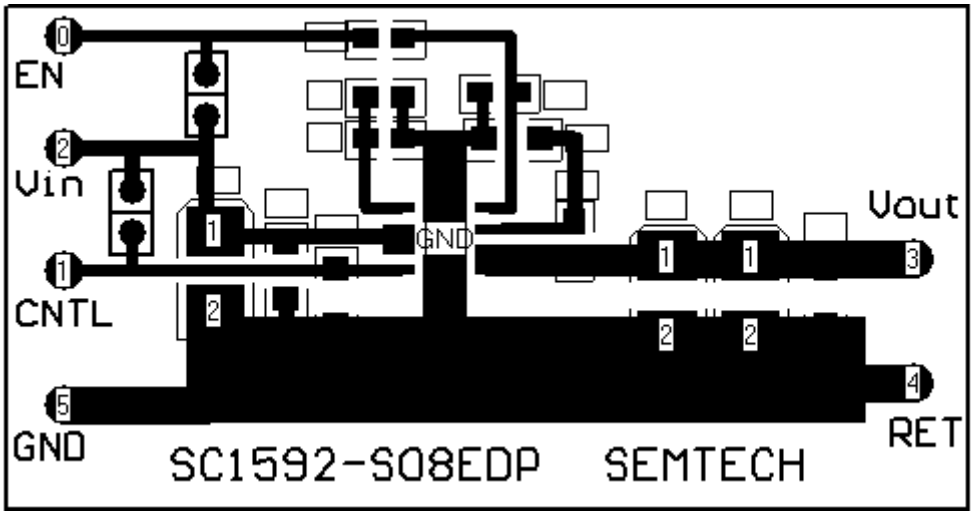


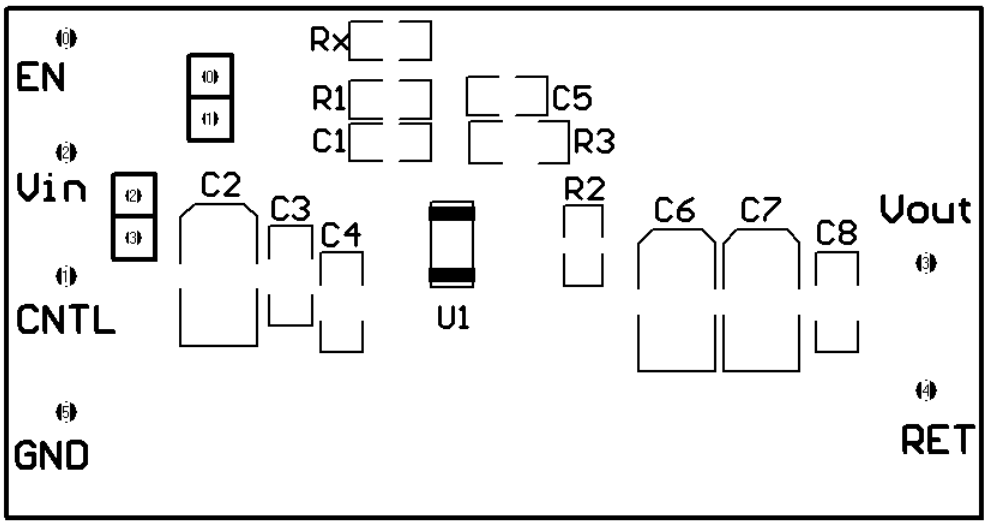
Evaluation Board Schematic

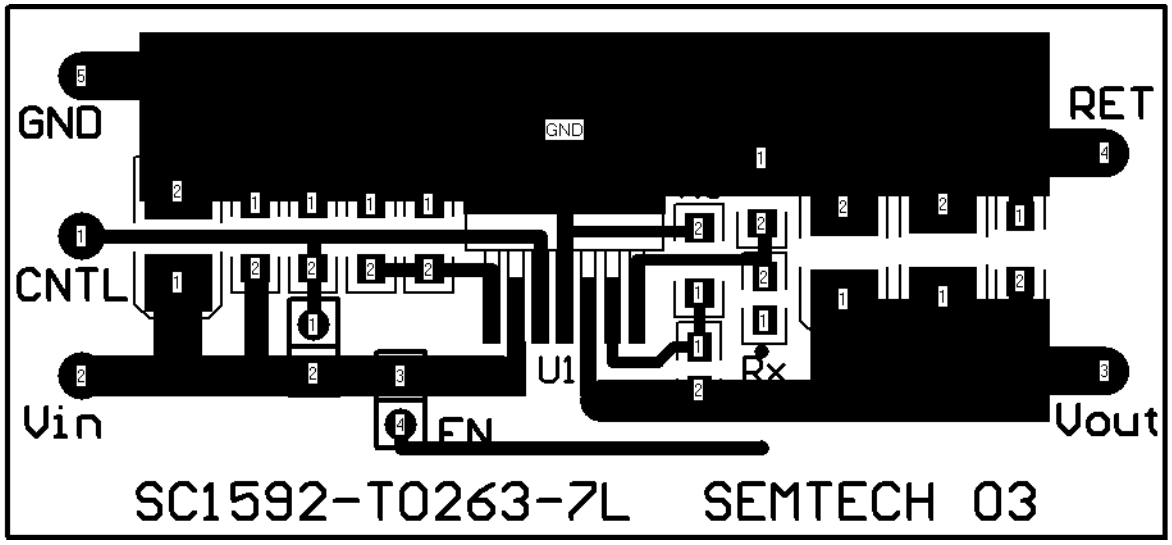


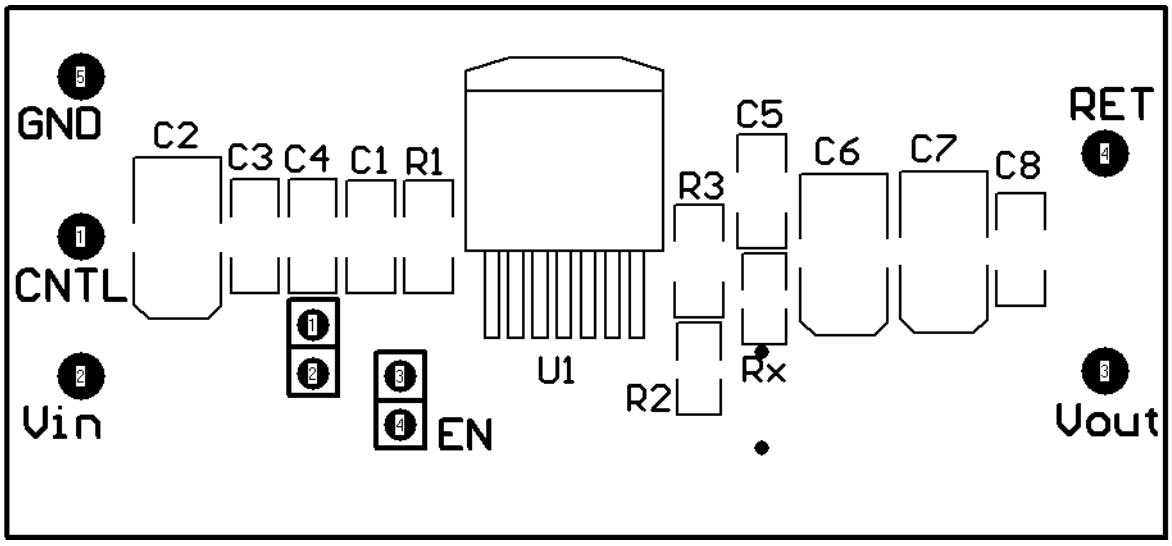
Evaluation Board Schematic - Bill of Material

Ref	Qty	Reference	Part Number/Value	Manufacturer
1	1	C1	2.2uF, 16V, Ceramic, 1206	Murata or similar
2	1	C2	22uF, 10V, Ceramic, 1210	Murata or similar
3	1	C3	100uF, 6.3V, Ceramic, 1812	Murata or similar
4	1	R1	100, ±5%, 0805	Any
5	1	R2	66.5, ±0.5%, 0805	Any
6	1	R3	53, ±0.5%, 0805	Any
7	1	Ropt	10K, ±10%, 0805	Any
8	1	U1	SC1592	Semtech Corp.

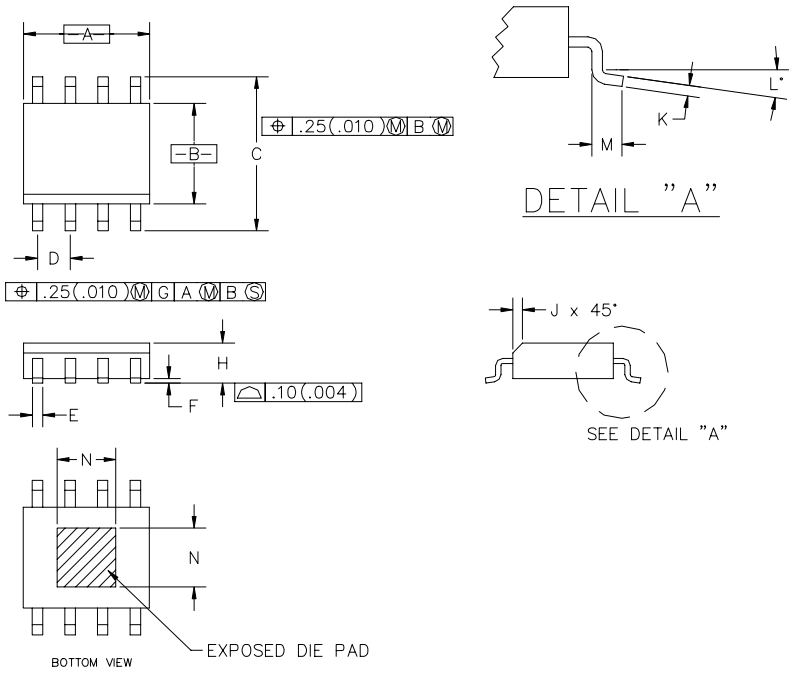

EN
Vin
CNTL
GND
Vout
RET
GND
SC1592-SO8EDP SEMTECH


EN
Vin
CNTL
GND
Rx
R1
C1
C5
R3
R2
C2
C3
C4
U1
C6
C7
C8
Vout
RET


GND
GND
RET
CNTL
U1
Rx
Vin
EN
Vout
SC1592-TO263-7L SEMTECH 03


GND
C2
C3
C4
C1
R1
C5
C6
C7
C8
R3
RET
CNTL
U1
R2
Rx
Vin
EN
Vout

Outline Drawing - SOIC-8L EDP



DIMENSIONS					
DIM	INCHES		MM		NOTE
	MIN	MAX	MIN	MAX	
A	.189	.195	4.80	4.95	2
B	.152	.157	3.86	4.00	3
C	.230	.244	5.84	6.20	
D	.050	BSC	1.27	BSC	
E	.014	.020	0.35	0.51	
F	.001	.005	.025	.127	
H	.056	.066	1.42	1.68	
J	.010	.016	0.25	0.41	
K	.007	.010	0.19	0.25	
L	0°	8°	0°	8°	
M	.016	.035	0.41	0.89	
N	.086	.094	2.19	2.39	4

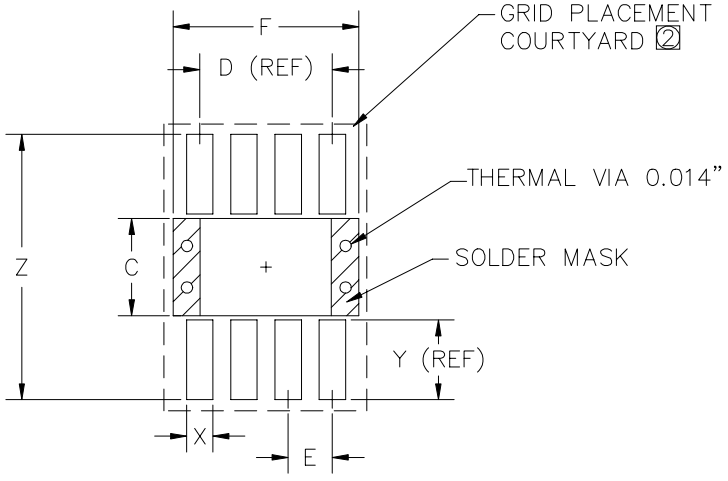
4 END USER SHOULD VERIFY ACTUAL SIZE OF EXPOSED THERMAL DIE PAD FOR SPECIFIC DEVICE APPLICATION.

3 DIMENSION "B" DOES NOT INCLUDE INTER-LEAD FLASH OR PROTUSIONS. INTER-LEAD FLASH AND PROTUSIONS SHALL NOT EXCEED .25 mm (.010") PER SIDE.

2 DIMENSION "A" DOES NOT INCLUDE MOLD FLASH, PROTUSIONS OR GATE BURRS. MOLD FLASH, PROTUSIONS AND GATE BURRS SHALL NOT EXCEED .15 mm (.010") PER SIDE.

1 CONTROLLING DIMENSION : MILLIMETER

Land Pattern - SOIC-8L EDP

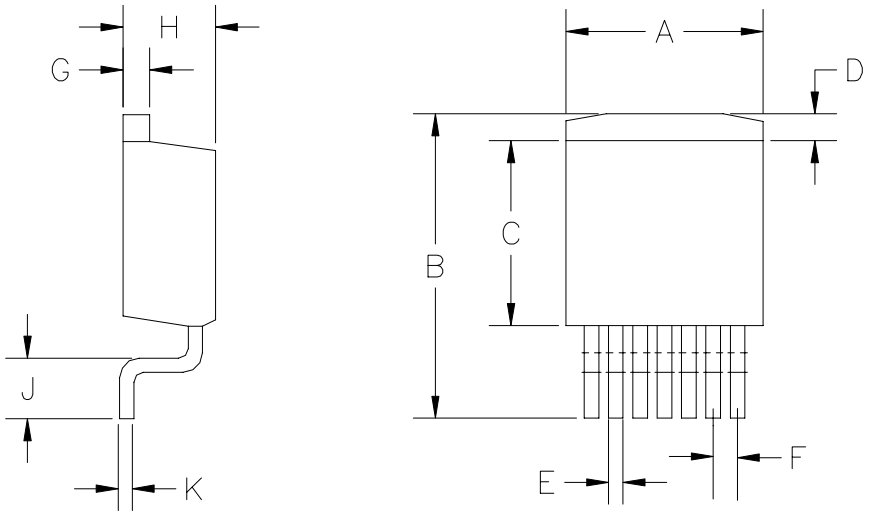


DIMENSIONS 1					
DIM	INCHES		MM		NOTE
	MIN	MAX	MIN	MAX	
C	.095	.100	2.41	2.54	–
D	–	.150	–	3.81	REF
E	–	.050	–	1.27	BSC
F	.200	.210	5.08	5.33	–
X	.025	.030	0.64	0.80	–
Y	.070	.075	1.78	1.91	REF
Z	.310	.320	7.87	8.13	–

2 GRID PLACEMENT COURTYARD IS 12 X 16 ELEMENTS (6mm X 8mm) IN ACCORDANCE WITH THE INTERNATIONAL GRID DETAILED IN THE IEC PUBLICATION 97.

1 CONTROLLING DIMENSIONS: MILLIMETERS.

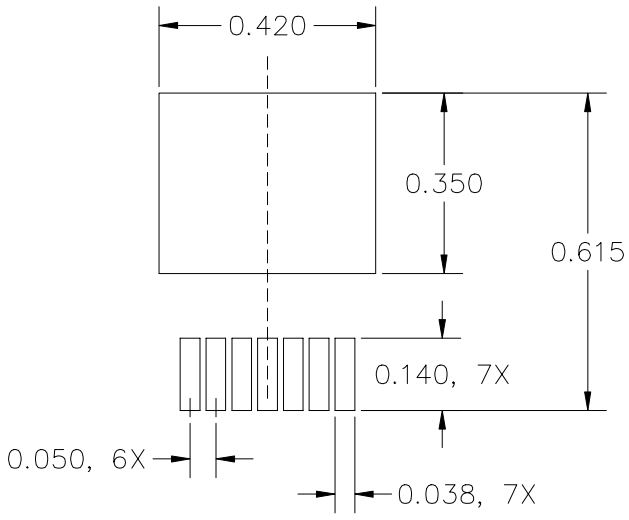
Outline Drawing - TO-263-7L (DDPAK)

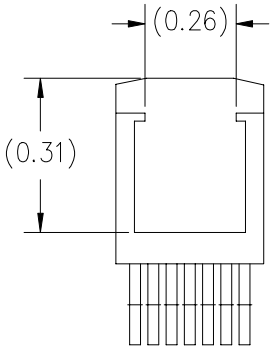


DIMENSIONS					
DIM	INCHES		MM		NOTE
	MIN	MAX	MIN	MAX	
A	.396	.406	10.05	10.31	—
B	.580	.620	14.73	15.75	—
C	.326	.336	8.28	8.53	—
D	.055	0.86	1.40	1.68	—
E	.026	.036	0.86	0.91	—
F	.050 BSC		1.27 BSC		—
G	.045	.055	1.14	1.40	—
H	.170	.180	4.31	4.57	—
J	.090	.110	2.29	2.79	—
K	.017	.023	0.43	0.58	—

(1) CONTROLLING DIMENSION : INCHES.

Recommended Land Pattern - TO-263-7L (DDPAK)





BACK VIEW
(FOR REFERENCE)

Contact Information

Semtech Corporation
Power Management Products Division
200 Flynn Road, Camarillo, CA 93012
Phone: (805)498-2111 FAX (805)498-3804