SC1157
Programmable Synchronous DC/DC Controller for Advanced Processors

POWER MANAGEMENT

Description

The SC1157 is a low-cost, full featured, synchronous voltage-mode controller designed for use in single ended power supply applications where efficiency is of primary concern. Synchronous operation allows for the elimination of heat sinks in many applications. The SC1157 is ideal for implementing DC/DC converters needed to power advanced microprocessors such as the Pentium® II , in both single and multiple processor configurations. Internal level-shift, high-side drive circuitry, and preset shoot-thru control, allows for use of inexpensive N-channel power switches.

SC1157 features include an integrated 4-bit VID DAC, temperature compensated voltage reference, triangle wave oscillator, current limit comparator, frequency shift over-current protection, and an internally compensated error amplifier.

The SC1157 operates at a fixed 140KHz, providing an optimum compromise between efficiency, external component size, and cost.

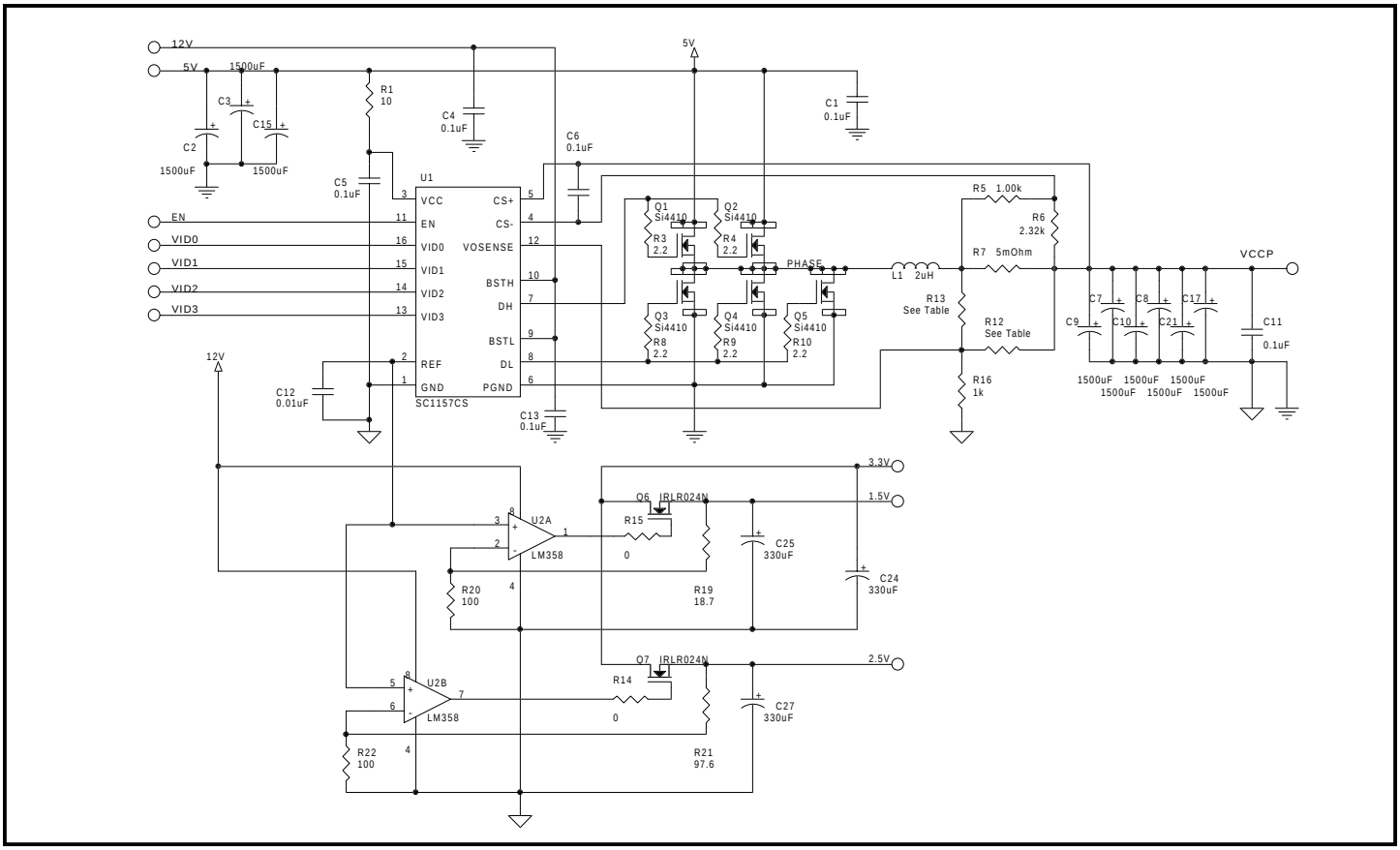
Features

- Low cost / full featured
- Synchronous operation
- 4 Bit VID DAC programmable output (1% tolerance)
- Designed to meet Intel VRM8.2 (Pentium® II)
- 1.5% Reference

Applications

- Pentium® II Core Supply
- Multiple Microprocessor Supplies
- Voltage Regulator Modules (VRM)
- Programmable Power Supplies
- High Efficiency DC/DC Conversion

Typical Application Circuit



Absolute Maximum Ratings

Parameter	Symbol	Maximum	Units
VCC to GND	V_{IN}	-0.3 to 7	V
PGND to GND		±1	V
BST to GND		-0.3 to 15	V
Thermal Impedance Junction to Case	θ_{JC}	30	°C/W
Thermal Resistance Junction to Ambient	θ_{JA}	130	°C/W
Operating Temperature Range	T_A	0 to 70	°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	1.5	kV

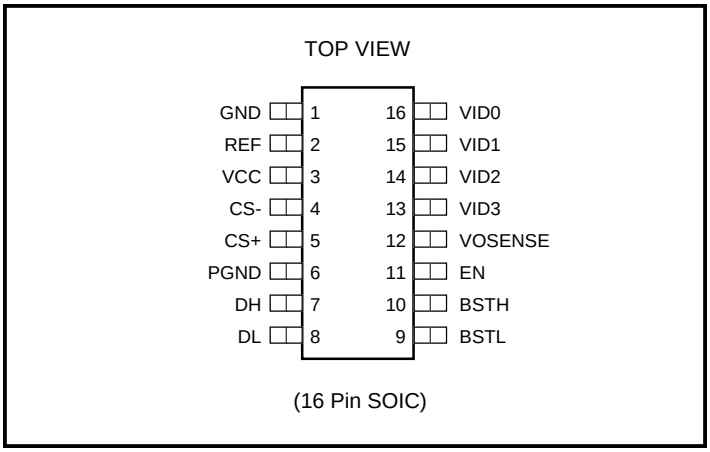
Electrical Characteristics

Unless specified: VCC = 4.75V to 5.25V; GND = PGND = 0V; FB = V_O; 0mV < (CS+ - CS-) < 60mV; T_J = 25°C

Parameter	Conditions	Min	Typ	Max	Units
Output Voltage		See VID Table.			
Supply Voltage	VCC	4.5		7	V
Supply current	VCC = 5.0V		8	15	mA
Load Regulation	I_O = 0.3A to 15A(1)		1		%
Line Regulation	All VID codes (1)		±0.15		%
Gain (AOL)	VOSENSE to VCCP		35		dB
Current Limit Voltage		60	70	80	mV
Oscillator Frequency		125	140	155	kHz
Buffered Reference Voltage	$I_{REF} \leq$ 1mA		1.25		V
Oscillator Max Duty Cycle		90	95		%
DH Sink/SourceCurrent	BSTH - DH = 4.5V, DH-PGNDH = 3V	1			A
DL Sink/Source Current	BSTL - DL = 4.5V, DL =PGNDL = 3V	1			A
Dead Time		50	100		ns
VID Pin Source current	VIDx ≤ 2.4V	30	100		µA

Note:
(1) Specification refers to Eval Board Schematic.
(2) This device is ESD sensitive. Use of standard ESD handling precautions is required.

Pin Configuration



Ordering Information

Device (1)	Package	Temp Range (T_J)
SC1157CS.TR	SO-16NB	0 to125°C

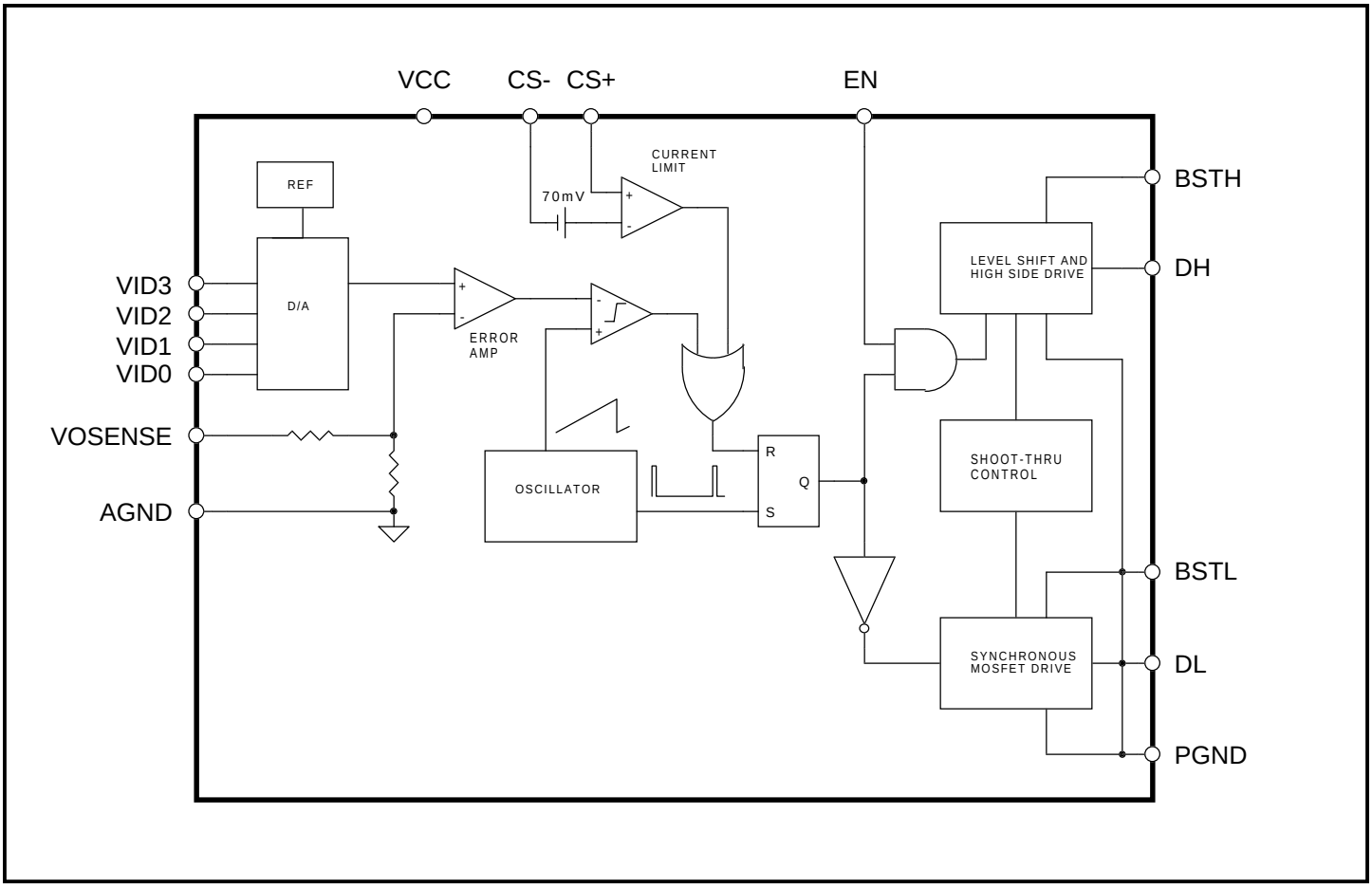
Note:
(1) Only available in tape and reel packaging. A reel contains 2500 devices.
(2) "NB" indicates 150 MIL body.

Pin Descriptions

Pin #	Pin Name	Pin Function
1	GND	Small Signal Analog and Digital Ground
2	REF	Buffered Reference output
3	VCC	Chip Supply voltage
4	CS-	Current Sense Input (negative)
5	CS+	Current Sense Input (positive)
6	PGND	Power Ground for High and Low Side Drivers
7	DH	High Side Driver Output
8	DL	Low Side Driver Output
9	BSTL	Supply for Low Side Driver (Boost)
10	BSTH	Supply for High Side Driver (Boost)
11	EN	Enable Pin, Logic low shuts down the converter, high or open for normal operation.
12	VOSENSE	Top end of internal feedback chain.
13	VID3 (1)	Programming Input (MSB)
14	VID2 (1)	Programming Input
15	VID1 (1)	Programming Input
16	VID0 (1)	Programming Input (LSB)

NOTE:
(1) All logic level inputs and outputs are open collector TTL compatible.

Block Diagram



Theory of Operation

The voltage at the VOSENSE pin is applied, through the internal precision resistor feedback chain, to the inverting input of the error amplifier. The non-inverting input of the error amplifier is supplied with a DC voltage derived by the DAC from the internal trimmed bandgap voltage reference. The output of the error amplifier is compared to the triangular output of the internal oscillator to generate a fixed frequency, variable duty cycle pulse train. The internal oscillator uses an on-chip capacitor and precision trimmed current sources to set the frequency to 140 kHz. The generated pulse train is gated with the output of the current limit latch and the inhibit signal to produce a drive signal for the upper FET. It is also inverted to produce a drive signal for the lower FET. These FET drive signals are modified by the “shoot-through control” circuitry so that the top FET turn-on is delayed until the bottom FET has turned off, and visa-versa.

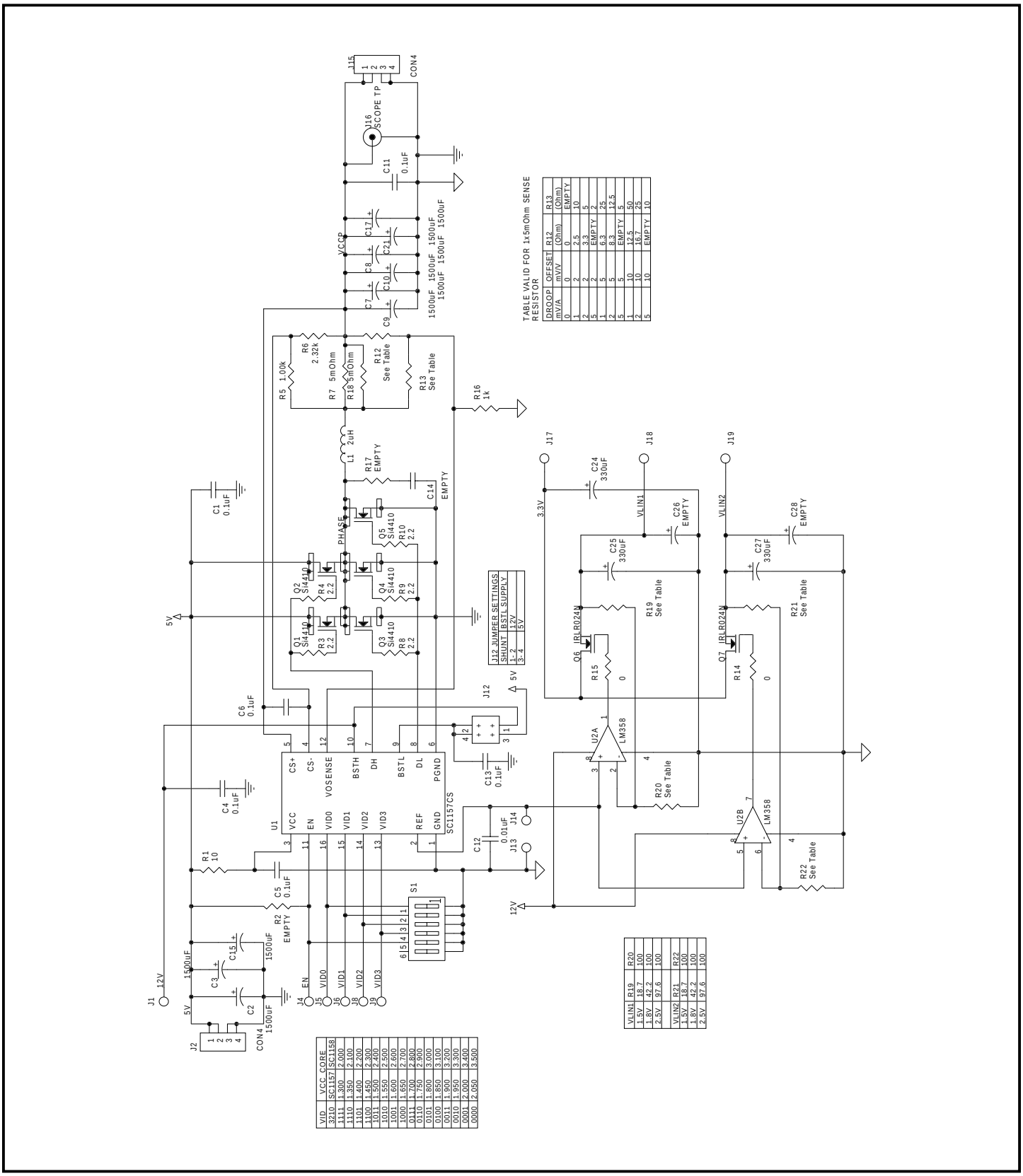
The current limit latch is set (ending the upper FET drive pulse early) if the current limit comparator indicates an overcurrent condition. The latch is reset at the start of each oscillator period.

VID Table

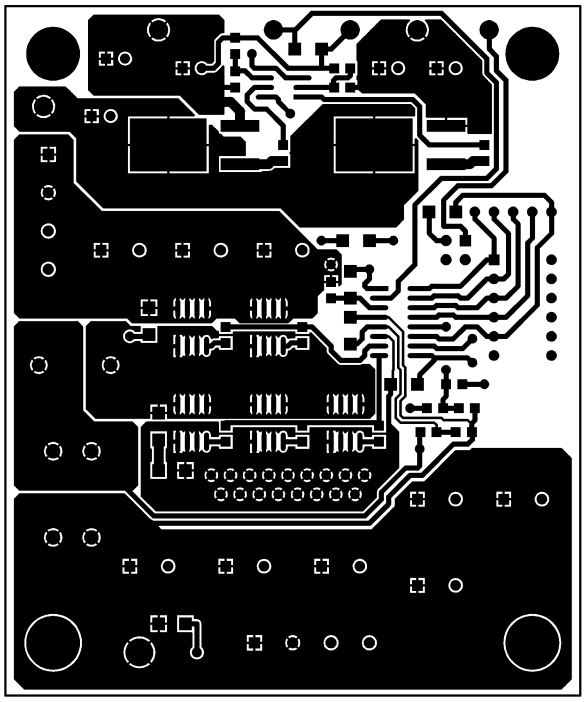
Unless specified: VCC = 4.75V to 5.25V; GND = PGND = 0V; FB = V_O; 0mV < (CS+ - CS-) < 60mV; T_J =0°C to 85°C

Parameter	Conditions	Vid 3210	Min	Typ	Max	Units
Output Voltage (1)	I_O = 2A in Evaluation Board	1111	1.287	1.300	1.313	V
		1110	1.337	1.350	1.364	
		1101	1.386	1.400	1.414	
		1100	1.436	1.450	1.465	
		1011	1.485	1.500	1.515	
		1010	1.535	1.550	1.566	
		1001	1.584	1.600	1.616	
		1000	1.634	1.650	1.667	
		0111	1.683	1.700	1.717	
		0110	1.733	1.750	1.768	
		0101	1.782	1.800	1.818	
		0100	1.832	1.850	1.869	
		0011	1.881	1.900	1.919	
		0010	1.931	1.950	1.970	
		0001	1.980	2.000	2.020	
		0000	2.030	2.050	2.070	

Eval Board Schematic

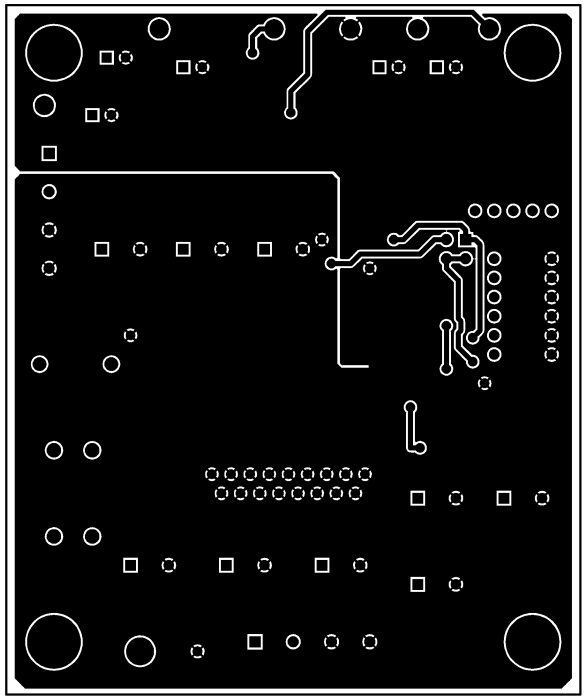


Eval Board Gerber Plots



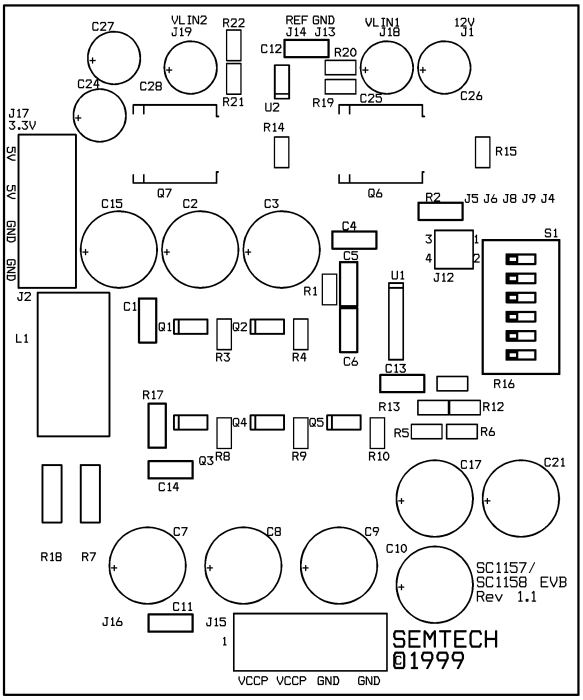
TOP COPPER

SEMTECH
SC1157
EVAL BOARD



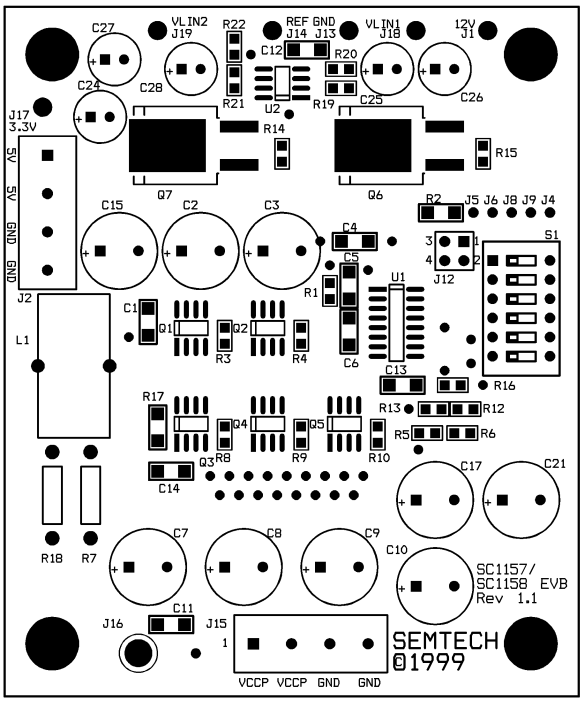
BOTTOM COPPER

SEMTECH
SC1157
EVAL BOARD



SILK SCREEN TOP

SEMTECH
SC1157
EVAL BOARD



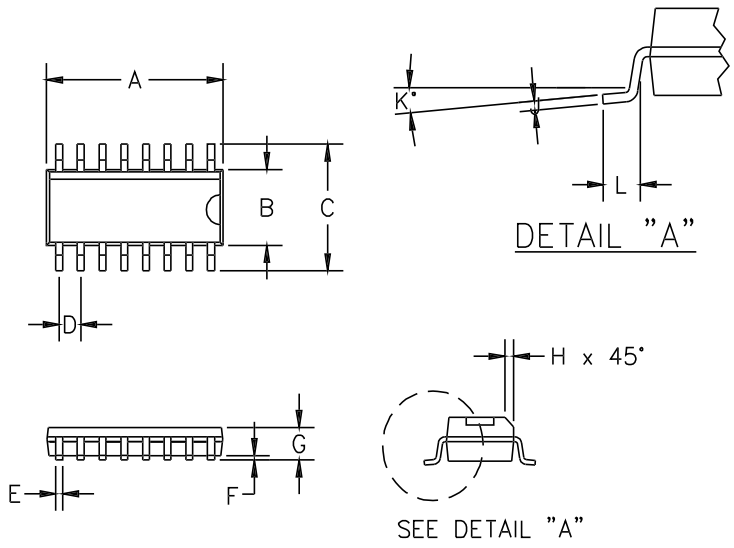
ASSY TOP

SEMTECH
SC1157
EVAL BOARD

Eval Board Bill of Materials

Item	Qty.	Reference	Value	Notes
1	6	C1, C4, C5, C6, C11, C13	0.1uF	
2	9	C2, C3, C7, C8, C9, C10, C15, C17, C21	1500uF	Low ESR Sanyo MV-AX or equivalent
3	1	C12	0.01uF	
4	5	R2, C14, R17, C26, C28	EMPTY	
5	3	C24, C25, C27	330uF	
6	1	L1	2uH	6 Turns 16AWG on Micrometals T60-52 Core
7	5	Q1, Q2, Q3, Q4, Q5	Si4410	
8	2	Q6, Q7	IRLR024N	
9	1	R1	10	
10	5	R3, R4, R8, R9, R10	2.2	
11	1	R5	1.00k	1%
12	1	R6	2.32k	1%
13	2	R18, R7	5mOhm	IRC OAR1
14	6	R12, R13, R19, R20, R21, R22	See Table	
15	2	R14, R15	0	
16	1	R16	1k	
17	1	U1	SC1157CS	SEMTECH
18	1	U2	LM358	

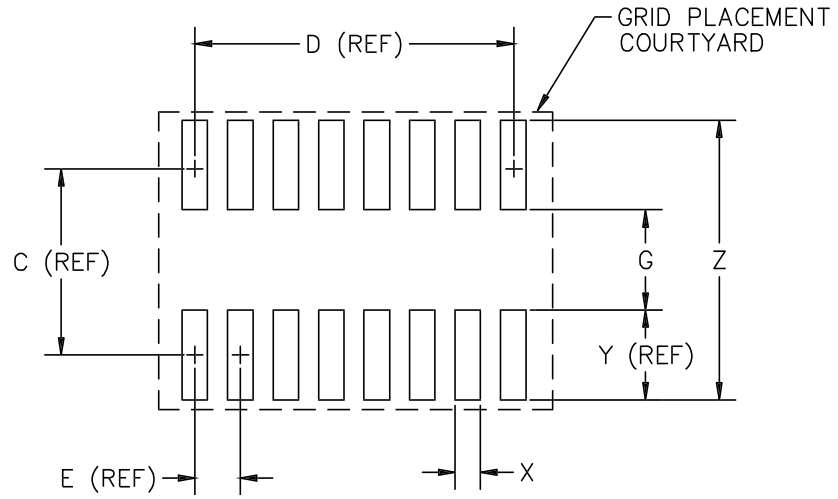
Outline Drawing - SO-16



DIMENSIONS					
DIM	INCHES		MM		NOTE
	MIN	MAX	MIN	MAX	
A	.386	.393	9.80	10.0	[2]
B	.150	.158	3.80	4.00	[2]
C	.228	.244	5.80	6.20	–
D	.050 BSC		1.27 BSC		–
E	.013	.020	0.33	0.51	–
F	.004	.010	.10	.25	–
G	.053	.069	1.35	1.75	–
H	.010	.020	.25	.50	–
J	.007	.010	.19	.25	–
K	0°	8°	0°	8°	–
L	.016	.050	.40	1.27	–

[2] DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTUSIONS

Land Pattern - SO-16



DIMENSIONS					
DIM	INCHES		MM		NOTE
	MIN	MAX	MIN	MAX	
C	–	.197	–	5.00	–
D	–	.35	–	8.89	–
E	–	.05	–	1.27	–
G	.102	.110	2.60	2.80	–
X	.02	.03	.60	.80	–
Y	–	.095	–	2.40	–
Z	.28	.29	7.20	7.40	–

[1] GRID PLACEMENT COURTYARD IS 22 X 16 ELEMENTS (11mm X 8mm) IN ACCORDANCE WITH THE INTERNATIONAL GRID DETAILED IN IEC PUBLICATION 97.

Contact Information

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