500mA SmartLDO™ With Power Up Signal Sequencing

PRELIMINARY - January 17, 2000 TEL:805-498-2111 FAX:805-498-3804 WEB:http://www.semtech.com

DESCRIPTION

The SC1545 was designed for instantly available motherboard applications. As part of the Semtech family of SmartLDO's it provides additional control functions not available in a standard LDO.

The device provides the capability to control three separate supplies. There is an on-board 500mA, 2.5V LDO with current limit protection, and drive pins for an N-channel MOSFET and a P-channel MOSFET. Internal logic circuitry ensures that the system starts up in a controlled manner, and that the correct outputs are enabled during specific sequences of BF_CUT and SLP.

The LDO draws its power from the 5V standby supply, and the N-channel MOSFET drive is derived from the 12V supply.

The SC1545 is available in the surface mount SO-8 package.

FEATURES

- 500mA LDO with Over Current Protection (OCP)
- ±2.5% LDO regulation over line, load and temperature
- Power sequencing for three supplies

APPLICATIONS

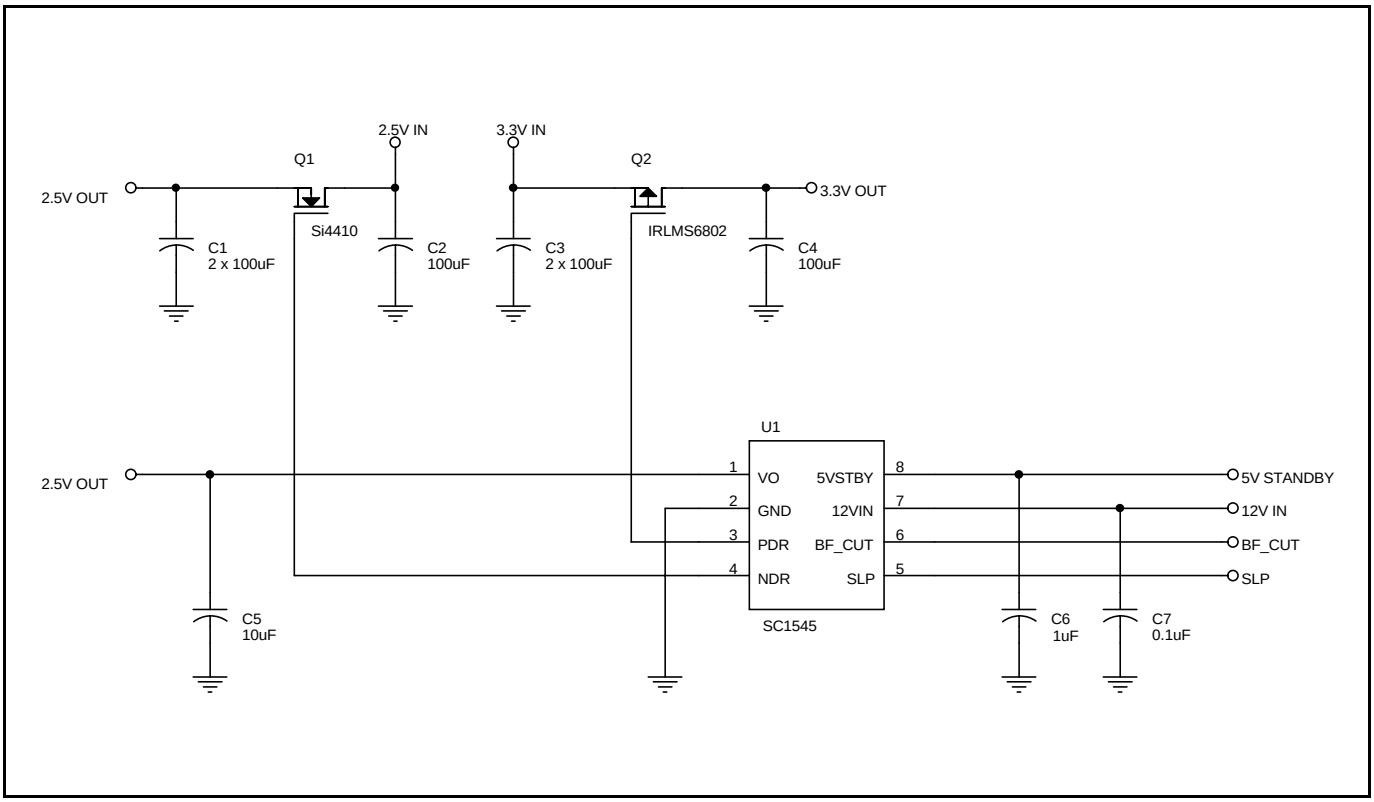
- Instantly available motherboards
- Embedded systems
- Desktop computers

ORDERING INFORMATION

Part Number(1)	Package
SC1545CS	SO-8

Note:
(1) Add suffix 'TR' for tape and reel packaging.

TYPICAL APPLICATION CIRCUIT



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ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Maximum	Units
12V Input Voltage Range	12VIN	-0.3 to +15	V
5V Input Voltage Range	5VSTBY	-0.3 to +7	V
P-channel MOSFET Gate Drive	PDR	-0.3 to 5VSTBY	V
N-channel MOSFET Gate Drive	NDR	-0.3 to 12VIN	V
Input Pins		-0.3 to +7	V
Operating Ambient Temperature Range	T_A	0 to +70	°C
Operating Junction Temperature Range	T_J	0 to +125	°C
Storage Temperature Range	T_{STG}	-65 to +150	°C
Lead Temperature (Soldering) 10 Sec	T_{LEAD}	300	°C
Thermal Impedance Junction to Case	θ_{JC}	47	°C/W
Thermal Impedance Junction to Ambient(1)	θ_{JA}	65	°C/W
ESD Rating	ESD	2	kV

Note:
(1) 2 inch square of 1/16" FR-4, double sided, 1 oz. minimum copper weight.

ELECTRICAL CHARACTERISTICS

Unless specified, 12VIN = 12V, 5VSTBY = 5V, C_O = 100µF min., T_A = 25°C. Values in **bold** apply over full operating temperature range.

Parameter	Symbol	Test Conditions	MIN	TYP	MAX	Units
12VIN						
Supply Voltage	12VIN		**11.28**	12.00	**12.72**	V
Quiescent Current	I_{Q12}			800	1000	µA
					1200	
5VSTBY						
Supply Voltage	5VSTBY		**4.7**	5.0	**5.3**	V
Quiescent Current	I_{Q5}	LDO ON		9.5	11	mA
					12	
		LDO OFF		3.0	4.0	
					5.0	
Undervoltage Lockout (5V)						
UVLO Threshold	UVLO	5VSTBY rising	**4.1**	4.3	**4.5**	V
		5VSTBY falling	**3.9**	4.1	**4.3**	V
Hysteresis	HYST			200		mV
Logic Reset Threshold	RST		**1.5**	2.0	**2.5**	V

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ELECTRICAL CHARACTERISTICS (Cont.)

Unless specified, 12VIN = 12V, 5VSTBY = 5V, C_O = 100µF min., T_A = 25°C. Values in **bold** apply over full operating temperature range.

Parameter	Symbol	Test Conditions	MIN	TYP	MAX	Units
VO						
LDO Output Voltage	V_O	4.7V ≤ 5VSTBY ≤ 5.3V,	-1.5%	2.525	+1.5%	V
		1mA ≤ I_O ≤ 500mA	**-2.5%**		**+2.5%**	
LDO Output Voltage During Load Transients(1)	$V_{O(T)}$	Load step between 0mA and 500mA at 8A/µs max.	**-3.0%**	2.525	**+3.0%**	V
Time To Regulation(2)	t_{REG}				**5**	µs
Inputs (BF_CUT & SLP)						
Input Resistance	R_{IN}	BF_CUT = SLP = 5V	**1.0**	10.0		MΩ
High Level Input Voltage	V_{IH}		**2.0**			V
Low Level Input Voltage	V_{IL}				**0.8**	V
NDR						
Peak Drive Current	$I_{NDR(PK)}$	Sinking: NDR = 0.5V Sourcing: NDR = 10V	**30**			mA
Output Voltage	V_{NDR}	Full ON, I_{NDR} = 100µA	**10**	12		V
Drive Low Delay	$t_{DL(N)}$	Measured from BF_CUT threshold to 90% of NDR			**150**	ns
Fall Time	$t_{f(N)}$	Measured from 90% to 10%			**1.0**	µs
Drive High Delay	$t_{DH(N)}$	Measured from BF_CUT/SLP threshold to 10% of NDR			**300**	ns
Rise Time	$t_{r(N)}$	Measured from 10% to 90%			**1.0**	µs
PDR						
Peak Drive Current	$I_{PDR(PK)}$	Sinking: PDR = 0.5V Sourcing: PDR = 3.5V	**30**			mA
Output Voltage	V_{PDR}	Full ON, I_{PDR} = 100µA	**3.5**	5		V
Drive Low Delay	$t_{DL(P)}$	Measured from BF_CUT threshold to 90% of PDR			**150**	ns
Fall Time	$t_{f(P)}$	Measured from 90% to 10%			**1.0**	µs
Drive High Delay	$t_{DH(P)}$	Measured from BF_CUT/SLP threshold to 10% of PDR			**300**	ns
Rise Time	$t_{r(P)}$	Measured from 10% to 90%			**1.0**	µs
Overcurrent Protection						
Current Limit Threshold	I_{CL}	V_O = 0V	**550**			mA

NOTES:
(1) The LDO will bring the output back to within the regular V_O limits in less than 10µs.
(2) External 2.5V ± 2.5% applied at output, turning off when NDR goes low. C_O = 100µF to 400µF, I_O = 50mA to 200mA.

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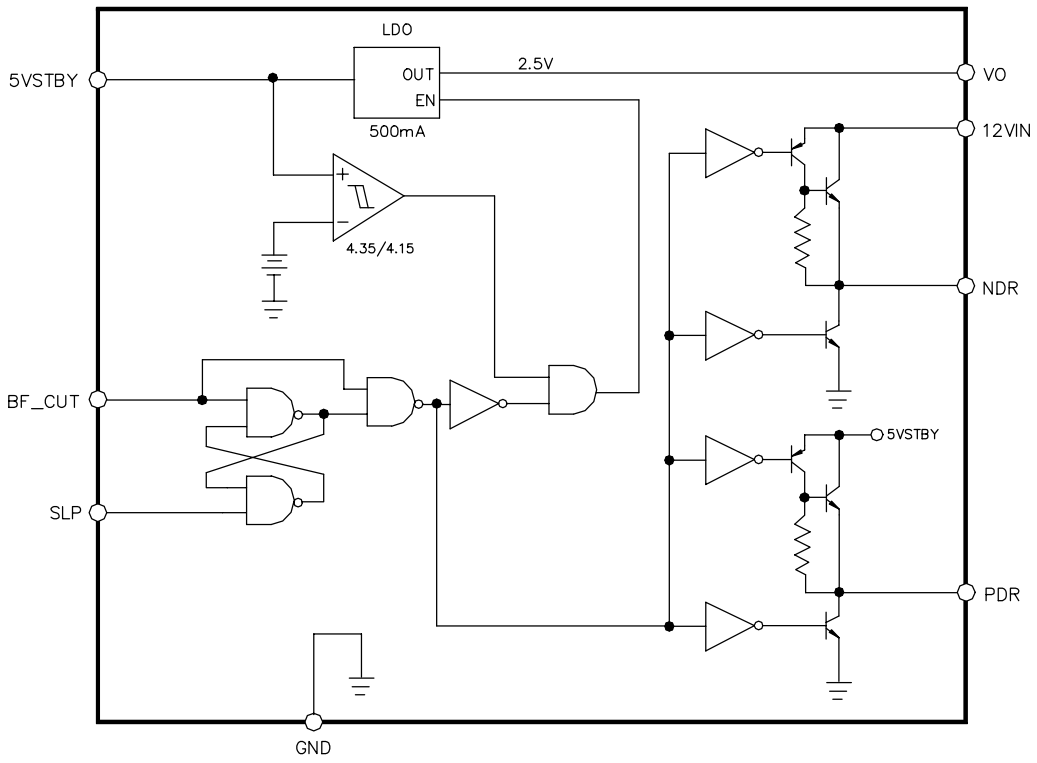
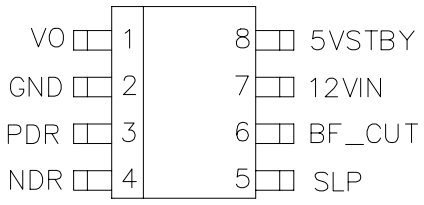
BLOCK DIAGRAM



PIN CONFIGURATION

Top View



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PIN DESCRIPTION

Pin	Pin Name	Pin Function
1	VO	LDO 2.5V output.
2	GND	Logic and power ground.
3	PDR	Gate drive signal for P-channel MOSFETs.
4	NDR	Gate drive signal for N-channel MOSFETs.
5	SLP	Control input #1.
6	BF_CUT	Control input #2.
7	12VIN	+12V input supply. Used for generating NDR only.
8	5VSTBY	+5V input supply.

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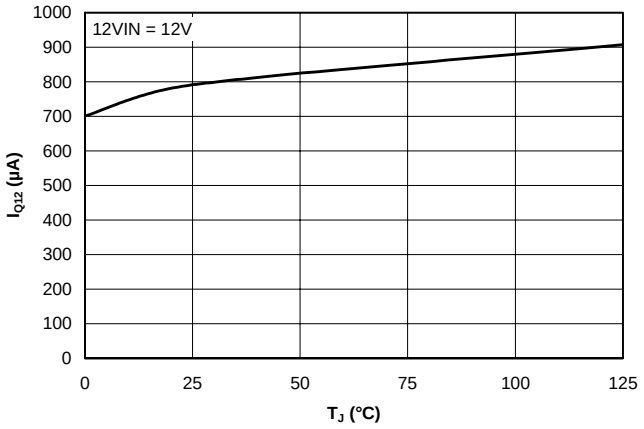
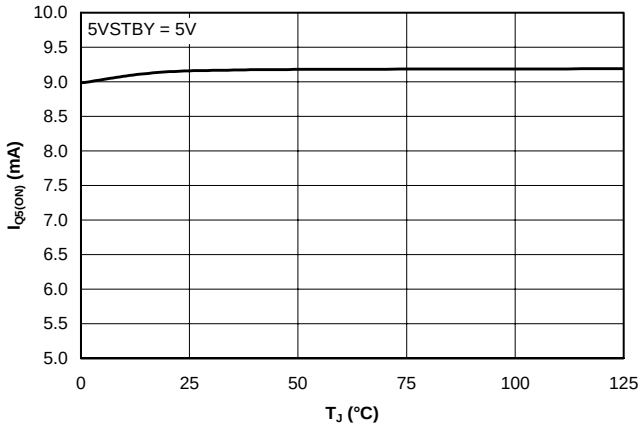
TYPICAL CHARACTERISTICS

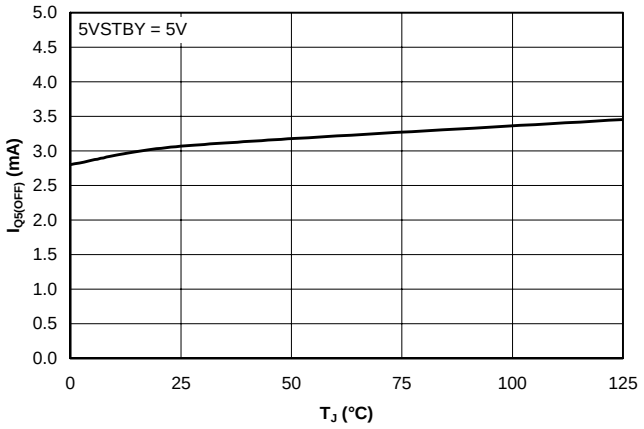
12VIN Quiescent Current vs. Junction Temperature



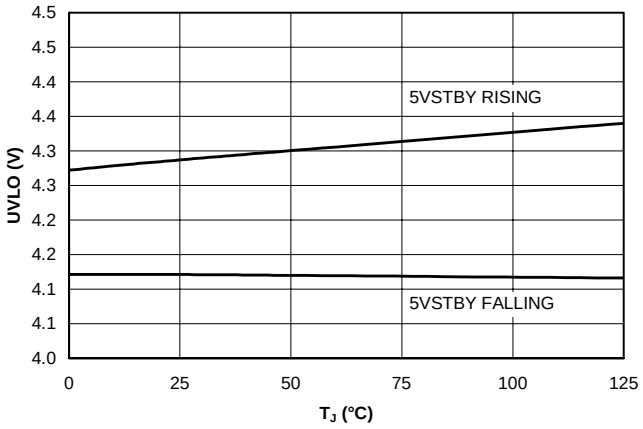
5VSTBY Quiescent Current (ON) vs. Junction Temperature



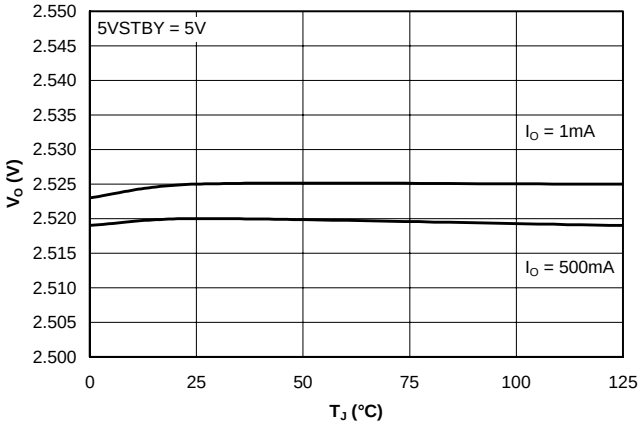
5VSTBY Quiescent Current (OFF) vs. Junction Temperature



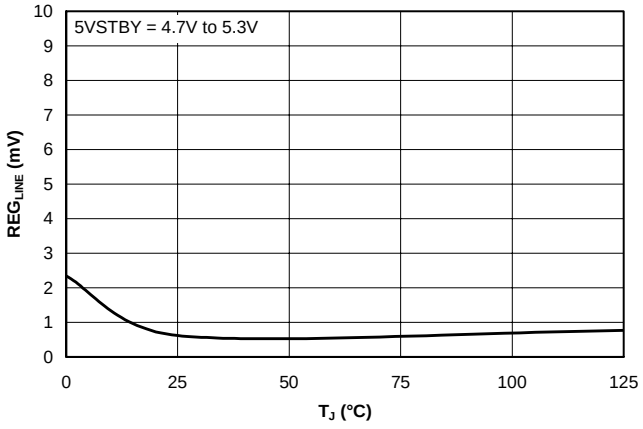
5VSTBY Under Voltage Lockout vs. Junction Temperature



LDO Output Voltage vs. Junction Temperature



LDO Line Regulation vs. Junction Temperature



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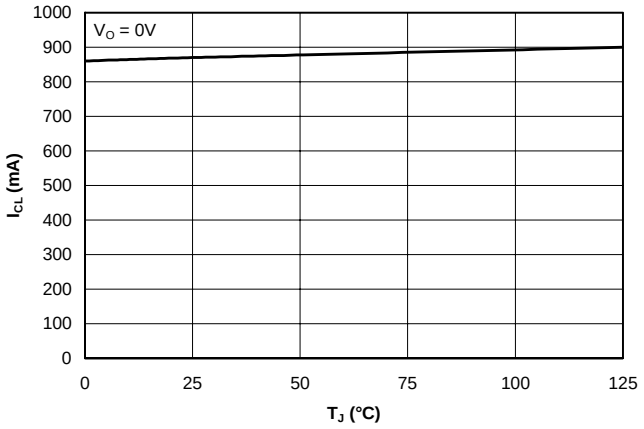
TYPICAL CHARACTERISTICS (Cont.)

VDO Current Limit vs. Junction Temperature



TIMING DIAGRAMS

Power up signal sequencing is shown in Figure 1. BF_CUT, PDR and NDR follow the power rails up to their final values. SLP goes to its high value when the power rails have stabilized, ~25msec after power on. BF_CUT is pulled low a period T1 after SLP goes high. T1 can be as short as 1msec. Typical measured values are ~200msec. The 2.5V LDO output stays OFF through this sequence.

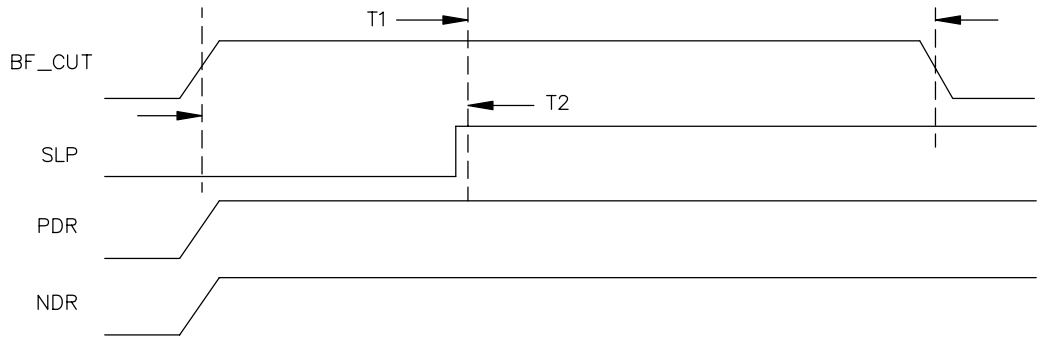


Figure 1: Power Up Signal Sequencing

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TIMING DIAGRAMS (Cont.)

After power up, there are two possible signal sequences that the device will see. The first sequence is with SLP staying HIGH and BF_CUT transitioning from LOW to HIGH, remaining HIGH for an undetermined period and then going back to LOW. At this point, the system state is back to where it was at the end of the power up sequence. The sequence is shown in Figure 2 (below). During these BF_CUT transitions, the propagation delays, rise and fall times and going into regulation times for PDR, NDR and VO are described in Electrical Characteristics on page 3. The first sequence can start at any time after the end of the power up sequence.

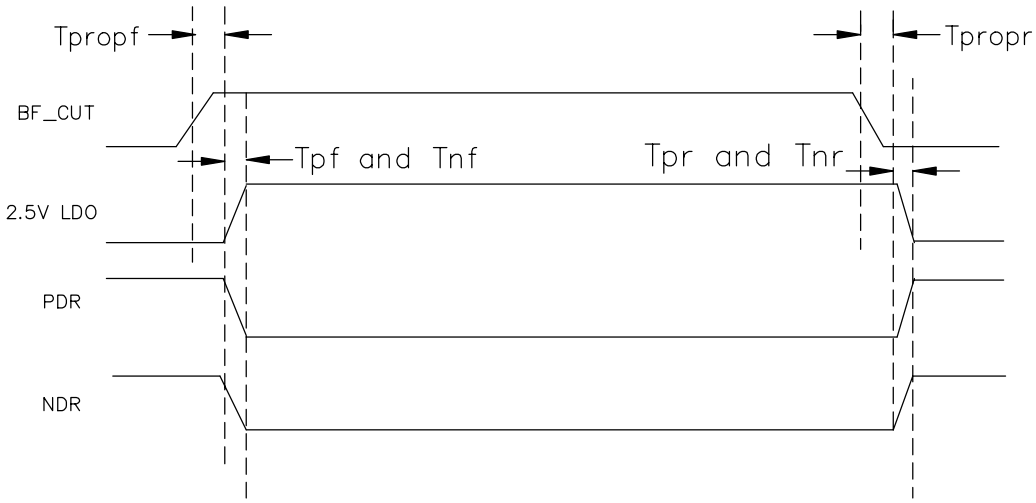

Figure 2: 1st Sequence Timing

Signal sequencing for the second possible sequence is shown in Figure 3. BF_CUT goes from LOW to HIGH and SLP goes from HIGH to LOW, 30µsec to 65µsec (T3) later. When BF_CUT goes HIGH, PDR and NDR go LOW and the 2.5V LDO turns ON. When SLP goes LOW, PDR and NDR return to HIGH and the 2.5V LDO turns OFF. BF_CUT will stay HIGH and SLP will stay low for an undetermined time, after which SLP will go HIGH. A minimum of 1msec (T4) later, BF_CUT will go LOW and the system is back at the end of the power up sequence. Typical measured values of T4 are ~250msec. During all transitions, the propagation delays, rise and fall times, and going into regulation times for PDR, NDR and 2.5V LDO are described in Electrical Characteristics on page 3. The second sequence can start at any time after the end of the power up sequence.

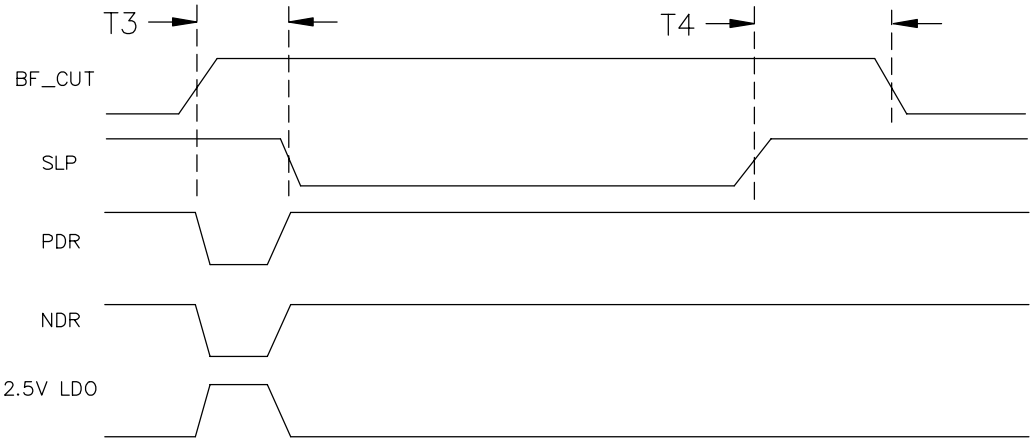

Figure 3: 2nd Sequence Timing

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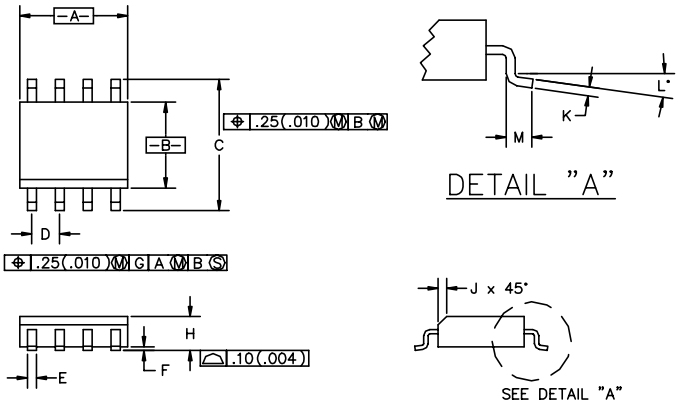
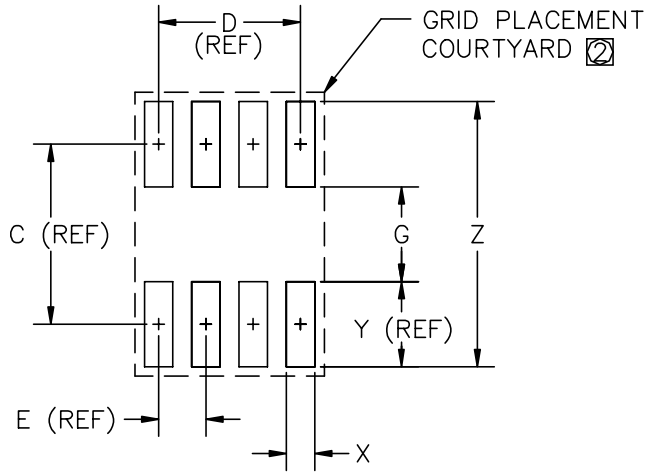
OUTLINE DRAWING



JEDEC
REF: MS-012AA

DIMENSIONS					
DIMN	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	

MINIMUM LAND PATTERN - SO-8



DIMENSIONS (1)					
DIMN	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

ECN99-694
ECN00-831