



# SCT2233M

## REVISION HISTORY

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Rev 1.0: Release to market

Rev 1.1: Update DEVICE ORDER INFORMATION

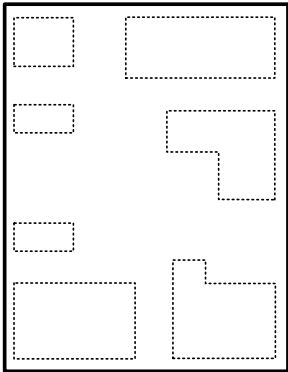
## DEVICE ORDER INFORMATION

ORDERABLE DEVICE	PACKAGING TYPE	STANDARD PACK QTY	PINS	PACKAGE DESCRIPTION
SCT2233MLUAR	Tape & Reel	5000	7	7L ECLGA (2.5mmX1.7mm)

## ABSOLUTE MAXIMUM RATING

Over operating free-air temperature unless otherwise noted<sup>(1)</sup>

SYMBOL	RATING	UNIT	PIN CONFIGURATION
$V_{IN}$	-0.3 to 19	V	
$V_{SW}$	-1 to 19	V	
$V_{SW} < 10ns$	-2.5 to 21	V	
$V_{BST}$	$V_{SW}-0.3$ to $V_{SW}+6$	V	
$V_{FB}$	-0.3 to 6.5	V	
$V_{EN}$	-0.3 to 6.5	V	
$T_J^{(2)}$	-40 to 125	C	
$T_{STG}$	-65 to 150	C	



SCT2233M Top View  
(2.5mm x 1.7mm)

(1) Stresses beyond those listed under Absolute Maximum Rating may cause device permanent damage. The device is not guaranteed to function outside of its Recommended Operation Conditions.

(2) The IC includes over temperature protection to protect the device during overload conditions. Junction temperature will exceed 150°C when over temperature protection is active. Continuous operation above the specified maximum operating junction temperature will reduce lifetime.





**TYPICAL CHARACTERISTICS**

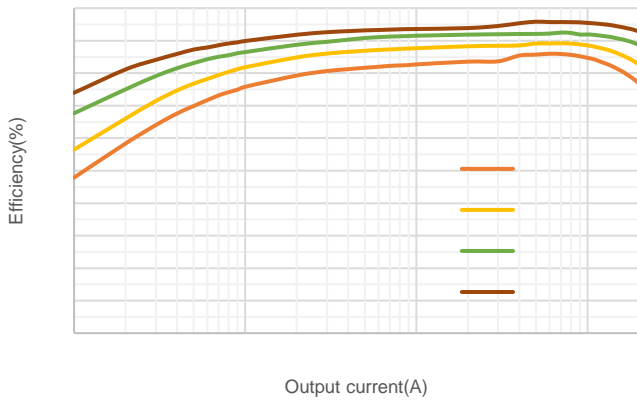


Figure 1. Efficiency vs Load Current (VIN=7.2V)

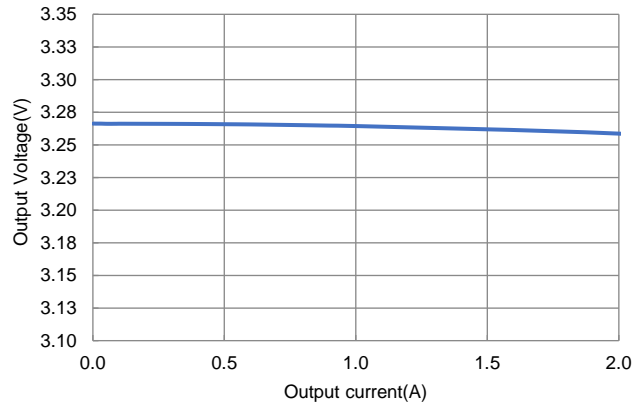


Figure 2. Load Regulation (VIN=5V)

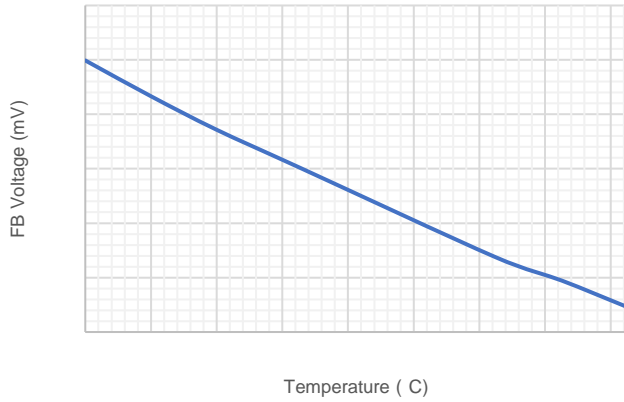


Figure 3. FB Voltage Vs. Temperature

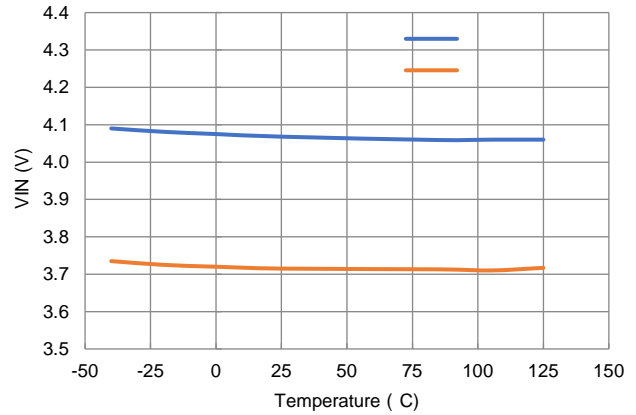


Figure 4. UVLO Vs. Temperature

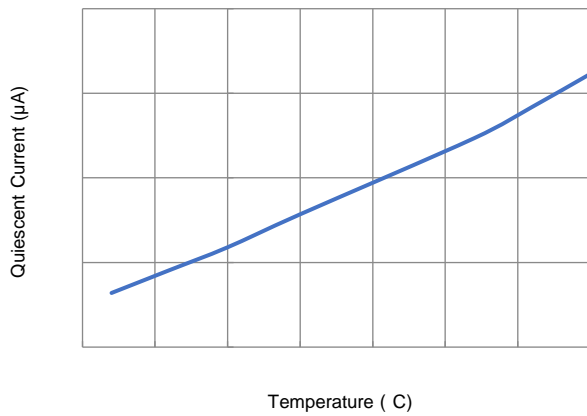


Figure 5. Quiescent Current Vs. Temperature

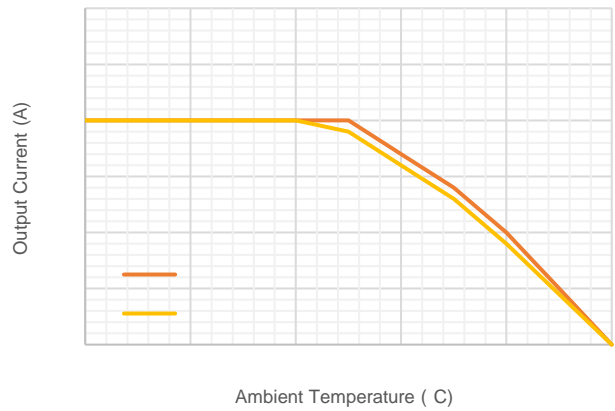


Figure 6. Thermal Derating (VOUT=1V, JA=60 C/W)

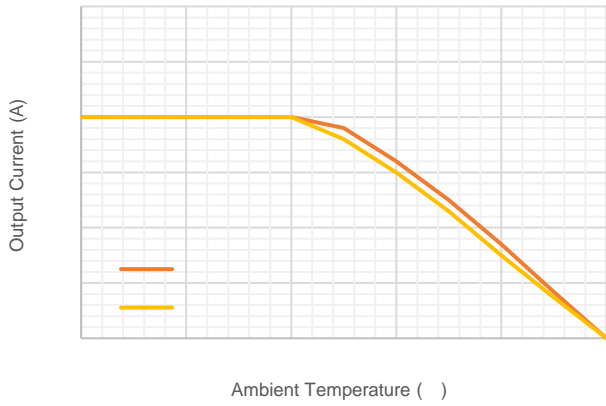


Figure 7. Thermal Derating (VOUT=1.8V,  $J_A=60^\circ\text{C/W}$ )

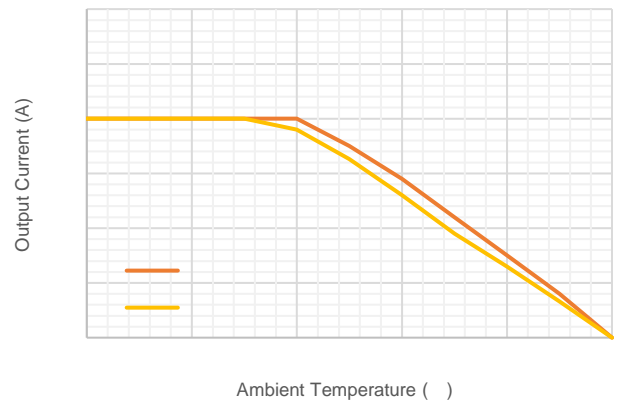


Figure 8. Thermal Derating (VOUT=3.3V,  $J_A=60^\circ\text{C/W}$ )

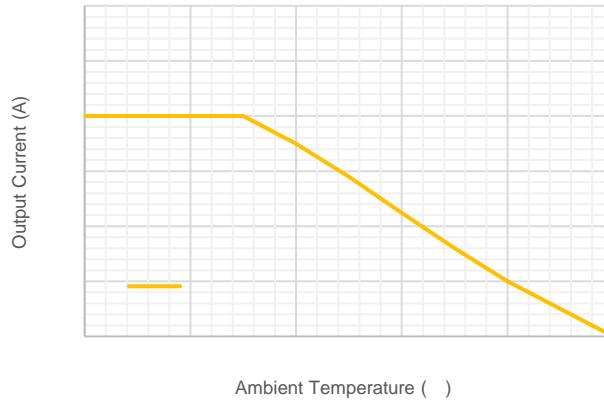
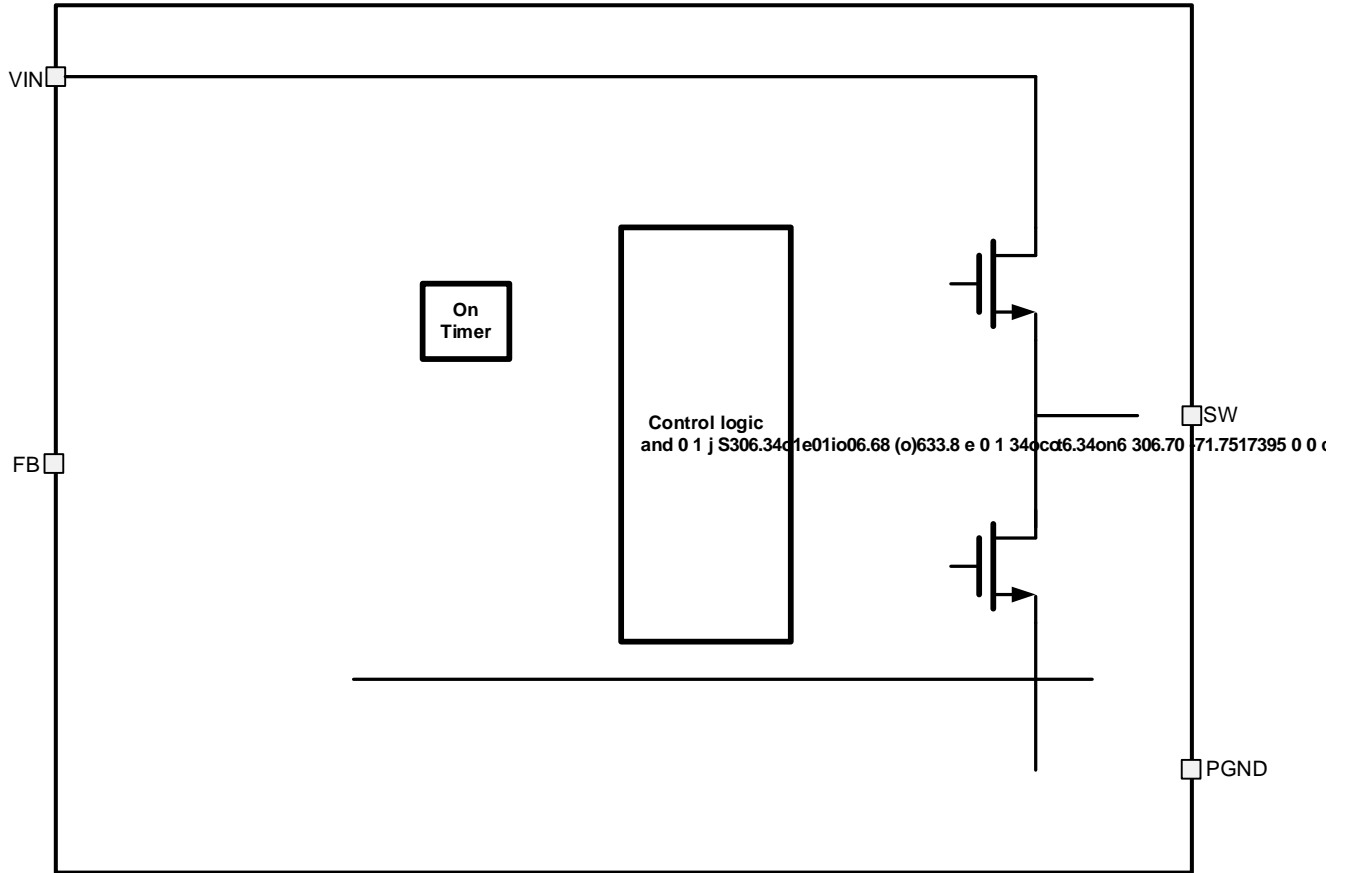


Figure 9. Thermal Derating (VOUT=5V,  $J_A=60^\circ\text{C/W}$ )

**FUNCTIONAL BLOCK DIAGRAM**



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## OPERATION

### Adaptive On-time Control

The SCT2233M device is 4.2-8.5V input, 2A output, synchronous step-down converter module with internal power MOSFETs. Adaptive constant on-time (ACOT) control is employed to provide fast transient response and easy loop stabilization. At the beginning of each cycle, the high-side MOSFET is turned on for a fixed one shot time ON-time period. The one shot time is calculated by the converter's input voltage (VIN) and the output voltage (VOUT) cycle-by-cycle based to maintain a pseudo-fixed frequency over the input voltage range, hence it is called adaptive on-time control. SCT2233M turns off high-side MOSFET after the fixed on time and turns on the low-side MOSFET. SCT2233M turns off the low-side MOSFET once the output voltage dropped below the output regulation, the one-shot timer then reset and the high-side MOSFET is turned on again. The on-time is inversely proportional to the input voltage and proportional to the output voltage. It can be calculated using the following equation (1):

$$t_{ON} = \frac{V_{OUT}}{V_{IN} \times f_s} \quad (1)$$

Where:

- VOUT is the output voltage.
- VIN is the input voltage.
- fs is the switching frequency.

After an ON-time period, the regulator goes into the OFF-time period. The OFF-time period length depends on VFB in most cases. It will end when the FB voltage decreases below 0.8V, at which point the ON-time period is triggered. If the OFF-time period is less than the minimum OFF time, the minimum OFF time will be applied, which is around 220ns typical.

### Power Saving Mode (PSM)

The SCT2233M is designed with Power Save Mode (PSM) at light load conditions for high power efficiency. The regulator automatically reduces the switching frequency and extends Toff while no Ton changing during the light load condition to get high efficiency and low output ripple. As the output current decreases from heavy load condition, the inductor current decreases as well, eventually nearing zero current, this is the boundary between CCM and DCM. The low side MOSFET is turned off when the inductor current reaches zero level. The load is provided only by output capacitor, when FB voltage is lower than 0.8V, the next ON cycle begins. When the output current increases from light to heavy load the switching frequency increases to keep output voltage. The transition point to light load operation can be calculated using the following equation (2):

$$= \frac{I_{L\_min}}{f_s} \times \quad (2)$$

Where:

- TON is on-time

### VIN Power

The SCT2233M is designed to operate from an input voltage supply range between 4.2V to 8.5V, at least 0.1uF decoupling ceramic cap is recommended to bypass the supply noise. If the input supply locates more than a few inches from the converter, an additional electrolytic or tantalum bulk capacitor or with recommended 10uF may be required in addition to the local ceramic bypass capacitors.



## Under Voltage Lockout UVLO

The SCT2233M Under Voltage Lock Out (UVLO) default startup threshold is typical 4V with VIN rising and shutdown threshold is 3.67V with VIN falling. The more accurate UVLO threshold can be programmed through the precision enable threshold of EN pin.

## Enable and Start up

When applying a voltage higher than the EN high threshold (typical 1.2V/rise), the SCT2233M enables all functions and the device starts soft-start phase. The SCT2233M has the built in 3ms soft-start time to prevent the output overshoot and inrush current. When EN pin is pulled low, the internal

enable threshold is 1.2V (typical) and the device will be disabled.

## SCT2233M

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triggered and the controller keeps the OFF state. A new switching cycle will begin only when the measured voltage is higher than limit voltage. If output loading continues to increase, output will drop below the UVP, and SS pin is discharged such that output is 0V. Then the device will count for 7 cycles of soft-start time for hiccup waiting time and restart normally after 7 cycles' soft-start period.

### **Bootstrap Voltage Regulator**

An external bootstrap capacitor between BST and SW pin powers floating high-side power MOSFET gate driver. The bootstrap capacitor voltage is charged from an integrated voltage regulator when high-side power MOSFET is off and low-side power MOSFET is on.

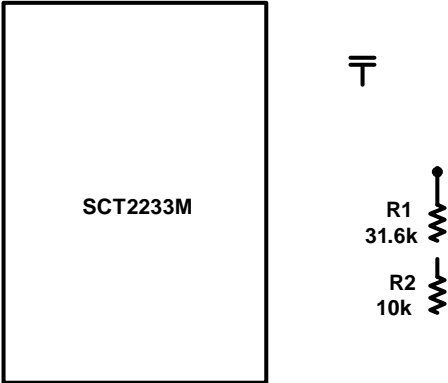
### **Thermal Shutdown**

Once the junction temperature in the SCT2233M exceeds 155°C, the thermal sensing circuit stops converter switching and restarts with the junction temperature falling below 130°C. Thermal shutdown prevents the damage on device during excessive heat and power dissipation condition.

**APPLICATION INFORMATION**

**Typical Application**

○ UT



**SCT2233M**

Application Waveforms

Vin=8.5V, Vout=3.3V, unless otherwise noted

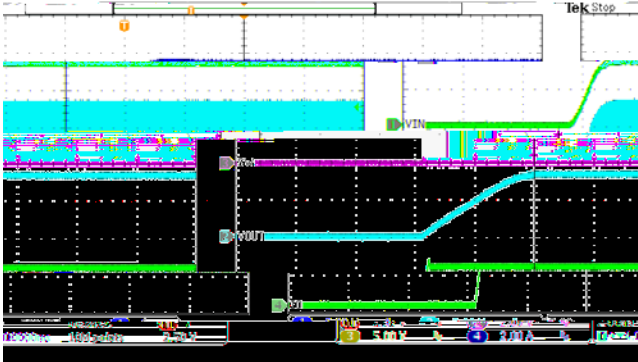


Figure 12. Power up (Iload=2A)

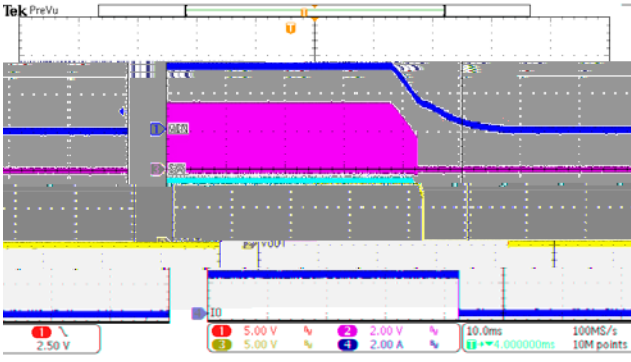


Figure 13. Power down (Iload=2A)

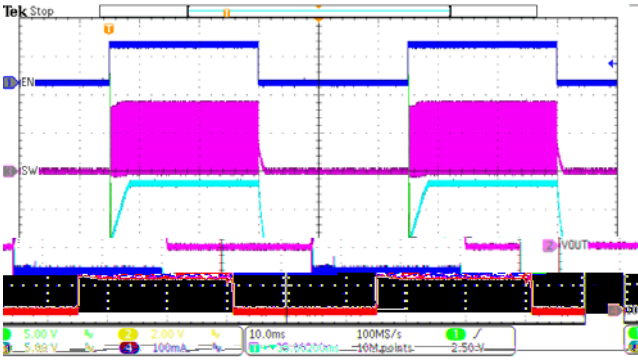


Figure 14. EN toggle (Iload=0.1A)

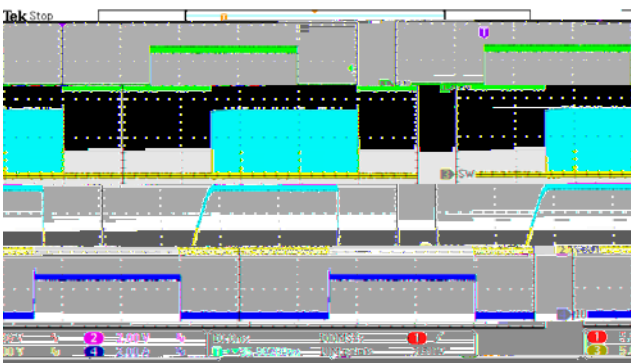


Figure 15. EN toggle (Iload=2A)

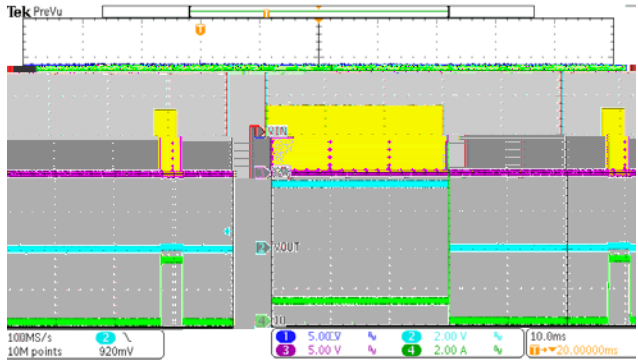


Figure 16. Over Current Protection (1A to hard short)

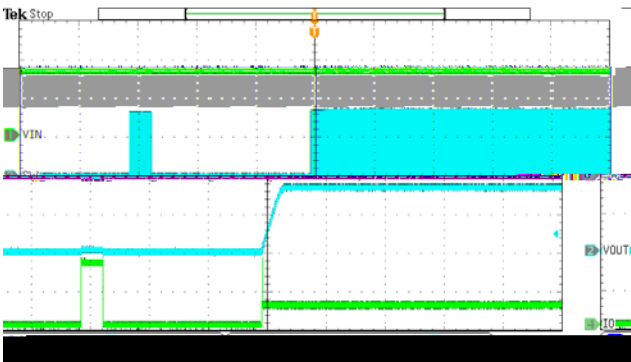


Figure 17. Over Current Release (hard short to 1A)

## Application Waveforms

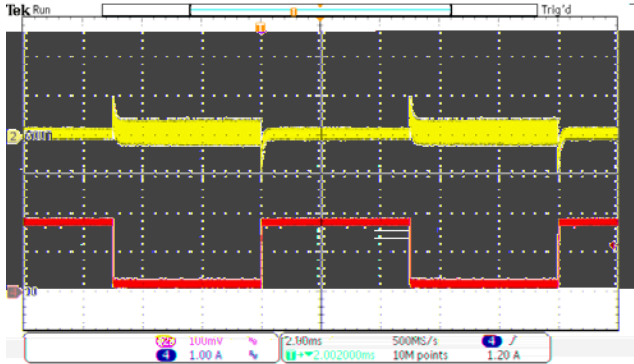


Figure 18. Load Transient (0.2A-1.8A, 0.1A/us)

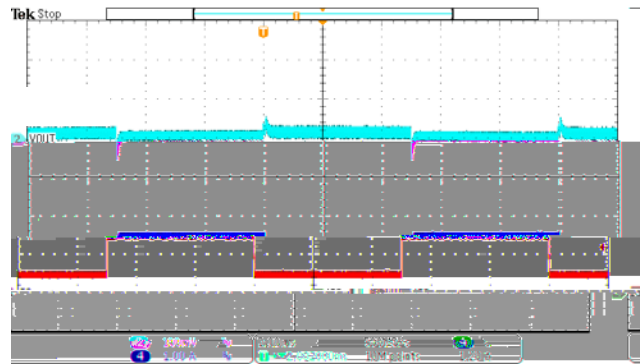


Figure 19. Load Transient (0.5A-1.5A, 0.1A/us)

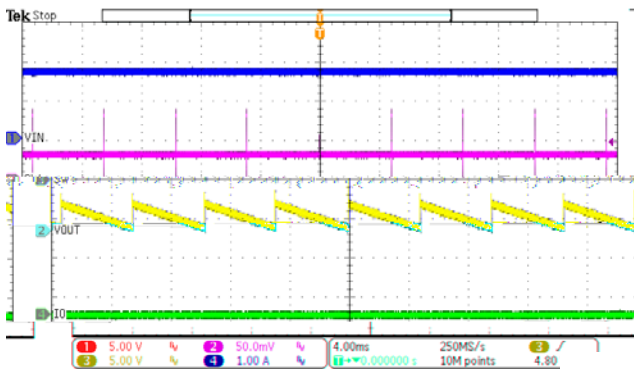


Figure 20. Output Ripple (Iload=0A)

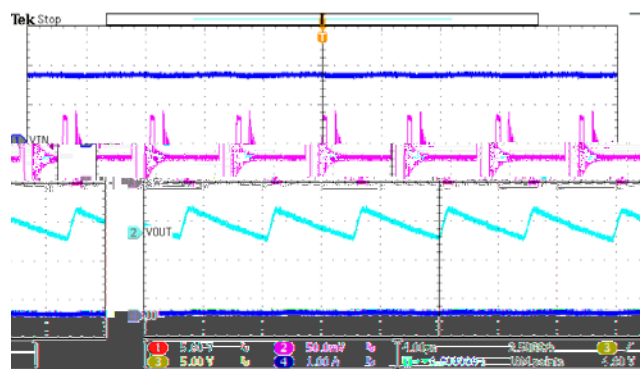


Figure 21. Output Ripple (Iload=0.1A)

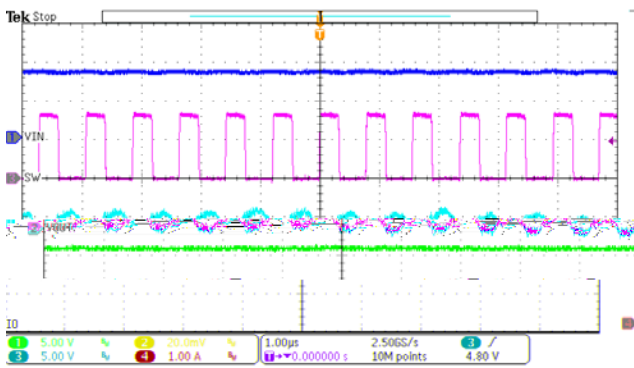


Figure 22. Output Ripple (Iload=2A)

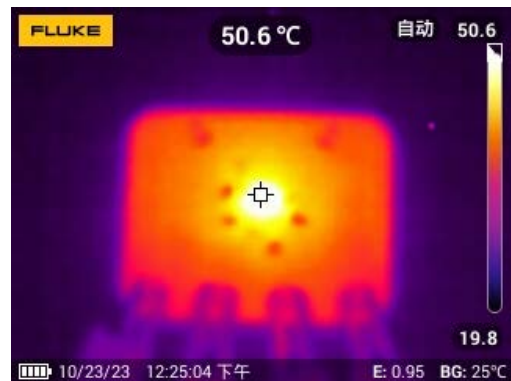


Figure 23. Thermal, 3.3Vout/2A

**Layout Guideline**

The regu7 (5.T /H3 <</ >>BDC 1oo 4D)-5 Tm-j8.6534 180 14.04 4 /H3 <</ >>B.002 >>B.002icee27 ( 4 /H3 <</ >>f4

0 /5.52Diee5.De808.6he .de i Sr WPe

# SCT2233M

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## Thermal Considerations

The maximum IC junction temperature should be restricted to 125°C under normal operating conditions. Calculate



## PACKAGE INFORMATION (7L ECLGA )

7L ECLGA TOP VIEW

7L ECLGA BOTTOM VIEW

7L ECLGA SIDE VIEW

7L ECLGA RECOMMENDED LAND PATTERN

### NOTE:

1. Drawing proposed to be made a JEDEC package outline MO-220 variation.
2. Drawing not to scale.
3. All linear dimensions are in millimeters.
4. Thermal pad shall be soldered on the board.
5. Dimensions of exposed pad on bottom of package do not include mold flash.
6. Contact PCB board fabrication for minimum solder mask web tolerances between the pins.

## TAPE AND REEL INFORMATION

SYMBOL	MILLIMETER		
	MIN	NOM	MAX
Ž A	176	178	330
Ž N	58	60	62
W1	124	-	-
W2	-	-	144
TYPE WIDTH	-	12.00	-

SYMBOL	MILLIMETER		
	MIN	NOM	MAX
AO	1.90	2.00	2.10
BO	2.70	2.80	2.90
KO	1.3	1.35	1.45