Wide Vin 50V Non-synchronous Boost/Flyback/SEPIC Controller

FEATURES

Qualified for Automotive Applications
AEC-Q100 Qualified with the Following Results:
- Device Temperature Grade 1: -40°C to 125°C Ambient Operating Temperature Range
- Device HBM ESD Classification Level H2
- Device CDM ESD Classification Level C3B

Wide Input Voltage Range: 3.2V-50V

Low Shutdown Current 3.7uA

Low Quiescent operating Current: 450uA

Adjustable Switching Frequency: 100KHz to 2.2MHz

Inteq6ated Frequency Ditheringfor EMI Mitigation

External Frequency Synchronic

External Compensation

Supports additional Slope Compensation

22ms Internal Soft-start Time

Integrated Protection Feature

- Constant Peak-Current Protection Threshold Over Input Voltage
- Output Overvoltage Protection
- Adjust Under-Voltage Lockout
- Optional Hiccup Over Load Protection
- Thermal Shutdown Protection:165°C

MSOP-8L(3mm*3mm) Package

APPLICATIONS

Muti-output Flyback
LED Bias Supply
Portable Speaker Supply
Battery Powered Boost/Flyback/SEPIC application

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REVISION HISTORY

Revision 1.1: Update Device Order Information

DEVICE ORDER INFORMATION

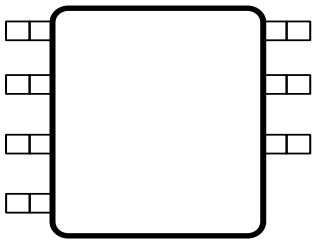
ORDERABLE DEVICE	PACKAGING TYPE	STANDARD PACK QTY	PACKAGE MARKING	PINS	PACKAGE DESCRIPTION
SCT81620QMTDR	Tape & Reel	4000	1620Q	8	8-Lead 3mm×3mm Plastic MSOP

ABSOLUTE MAXIMUM RATINGS

Over operating free-air temperature unless otherwise noted(1)

DESCRIPTION	MIN	MAX	UNIT
VIN	-0.3	62	V
DR	-1	6.6	V
ISEN, COMP, FB, FA/SYNC/SD	-5	5.5	V
Peak Driver Output Current		1(2)	A
Junction temperature(2)	-40	150	C

PIN CONFIGURATION



Top View: 8-Lead Plastic MSOP 3mmx3mm

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VIN	8	Power supply input pin

RECOMMENDED OPERATING CONDITIONS

Over operating free-air temperature range unless otherwise noted

PARAMETER	DEFINITION	MIN	MAX	UNIT
V_{IN}	Input voltage range	3.2	50	V
V_{CC}	VCC voltage range	3.2	6.1	V
T_J	Operating junction temperature	-40	125	°C

ESD RATINGS

PARAMETER	DEFINITION	MIN	MAX	UNIT
V_{ESD}	Human Body Model(HBM), per ANSI-JEDEC-JS-001-2014 specification, all pins	-2	+2	kV

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ELECTRICAL CHARACTERISTICS

V_{IN}=12V, T_J=-40°C~125°C, typical values are tested under 25°C.

SYMBOL

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TYPICAL CHARACTERISTICS

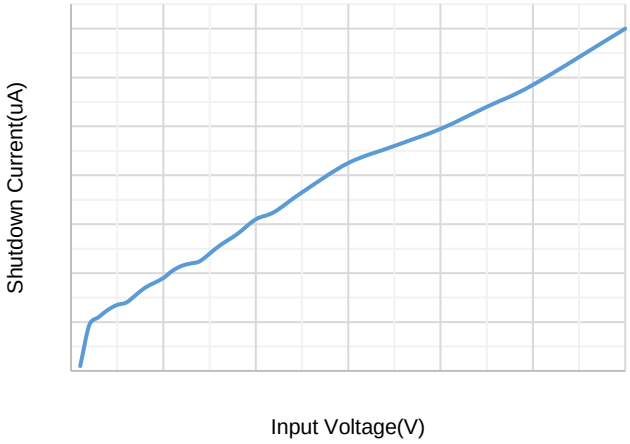

Figure 1. ISD vs Input Voltage

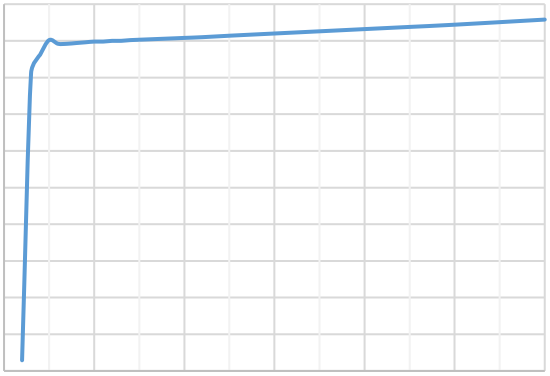

Figure 2. IQ vs Input Voltage

Figure 3. Switching Frequency vs RT

Figure 4. Switching Frequency vs Temperature

Figure 5. Efficiency vs Load Current, Boost, VOUT=12V

Figure 6. Efficiency vs Load Current, Sepic, VOUT=12V

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TYPICAL CHARACTERISTICS

Figure 7. VSENSN vs Input Voltage

Figure 8. DR Volage vs Input Voltage

Figure 9. COMP

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FUNCTIONAL BLOCK DIAGRAM

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$$V_{samp} \quad I_L * R_{SEN} \tag{1}$$

$$M_1 \quad M_{on} * R_{SEN} \tag{2}$$

$$M_2 \quad M_{off} * R_{SEN} \tag{3}$$

$$M_1 \quad M_{on} * R_{SEN} \quad Vin * R_{SEN} / L \tag{4}$$

$$M_2 \quad M_{off} * R_{SEN} \quad (Vout \quad Vin) * R_{SEN} / L \tag{5}$$

$$' V_{samp1} \quad (\frac{M_2 \quad M_{rc}}{M_1 \quad M_c} \quad V_{samp0} \tag{6}$$

$$' V_{samp1} \quad (\frac{M_{r2}}{M_1}) * \quad V_{samp0} \quad (\frac{D}{1 \quad D}) * \quad V_{samp0} \tag{7}$$

$$\left| (\frac{M_2 \quad M_c}{M_1 \quad M_c}) \right| <1 \tag{8}$$

$$M_c \quad V_{SL} * F_s \tag{9}$$

$$M_c \quad (V_{SL} \quad K * R_{SL}) * F_s \tag{10}$$

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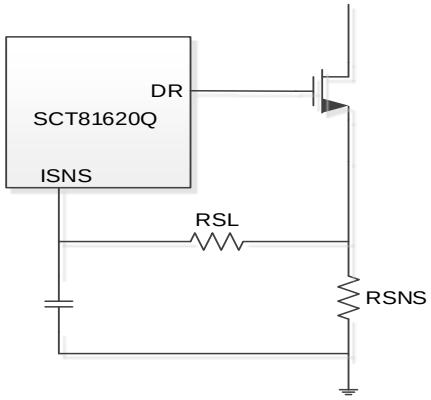

Figure13 .External RSL to increase slope compensation

Adjustable Peak Current Limit

$$I_{PEAK_CL} \quad \frac{V_{SENSE} \quad 40uA \quad R_{SL} \quad D}{R_{SNS}} \tag{11}$$

Where

V_{SENSE} is ISEN pin limiting voltage (Typ.=146.5mV)
$I_{PEAK-CL}$ is the inductor peak current limit
R_{SL} is Slope compensation resistor
D is Duty cycle
R_{SNS} is the Inductance peak current detection resistance

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Output Voltage

$$R_{FBT} \quad \frac{V_{OUT} \quad V_{REF}}{V_{REF}} \quad R_{FBB}$$

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APPLICATION INFORMATION

Typical Application (Boost)

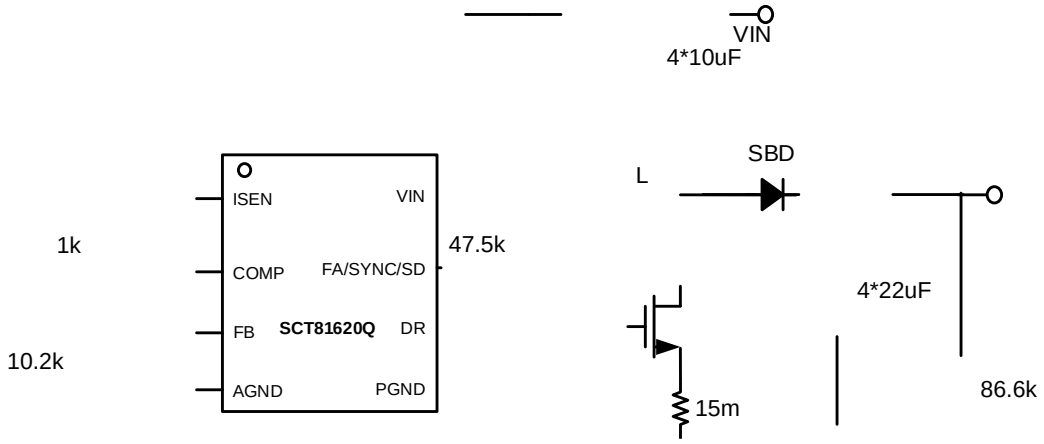

Figure 19. Application Schematic, 3V to 11V, 2A Boost Regulator at 400kHz

Design Parameters

Design Parameters	Example Value
Input Voltage	5V Normal 3V to 11V
Output Voltage	12V
Maximum Output Current	3A
Switching Frequency	400 KHz
Output voltage ripple (peak to peak)	75mV (Load=2A)

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Inductor Selection (Boost)

$$= \frac{\times}{\times} \quad (14)$$

Where

V_{OUT} is the output voltage of the boost converter
I_{OUT} is the output current of the boost converter
V_{IN} is the input voltage of the boost converter

$$= \frac{1}{\times \left(\frac{1}{-} + \frac{1}{}\right) \times} \quad (15)$$

Where

I_{LPP} is the inductor peak-to-

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Where

I_G is the gate drive current.

Output Diode Selection

$$I_{D(PEAK)} \quad \frac{I_{OUT}}{(1 \quad D)}, \quad I_L \tag{24}$$

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Application Waveforms

Vin=5V, Vout=12V, unless otherwise noted

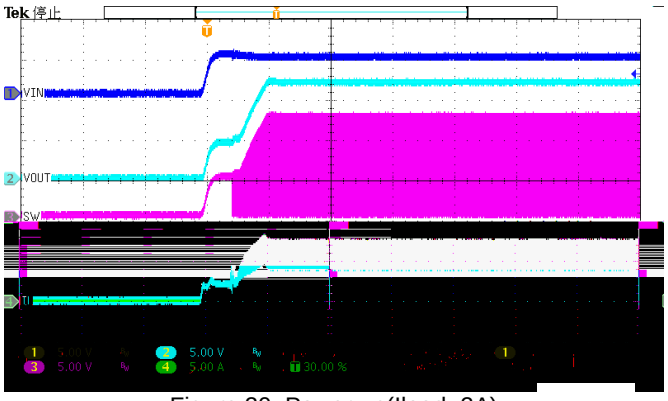

Figure 20. Power up(Iload=2A)

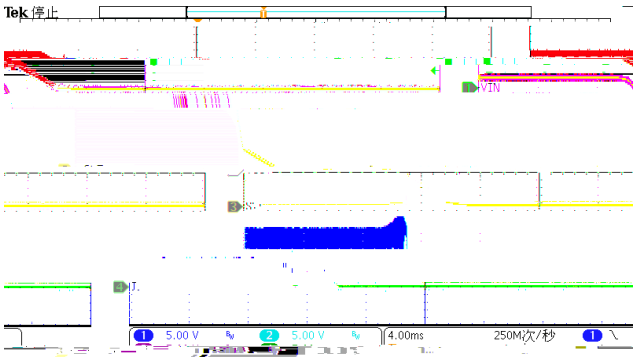

Figure 21. Power down(Iload=2A)

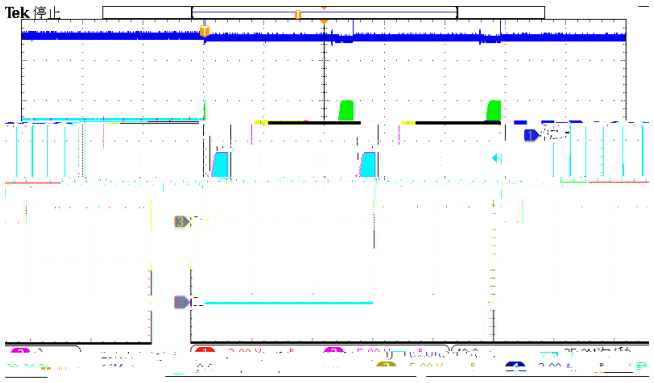

Figure 22. Over current protection (Iload=5A)

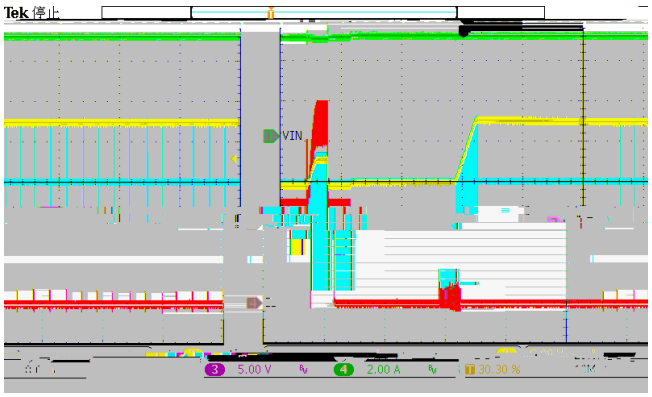

Figure 23. Over current recovery (Iload=5A)

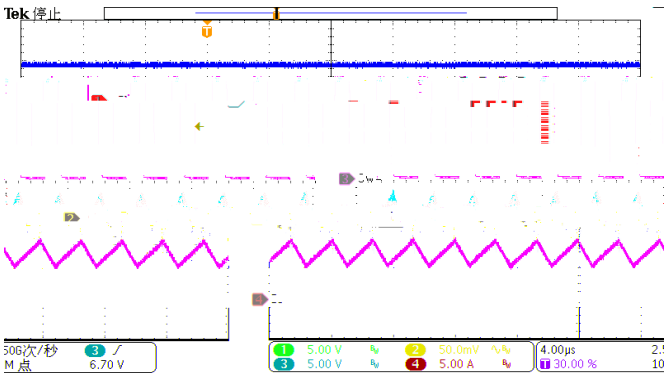

Figure 24. Steady-state (Iload=2A)

Figure 25. Sync Frequency

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Typical Application (Sepic)

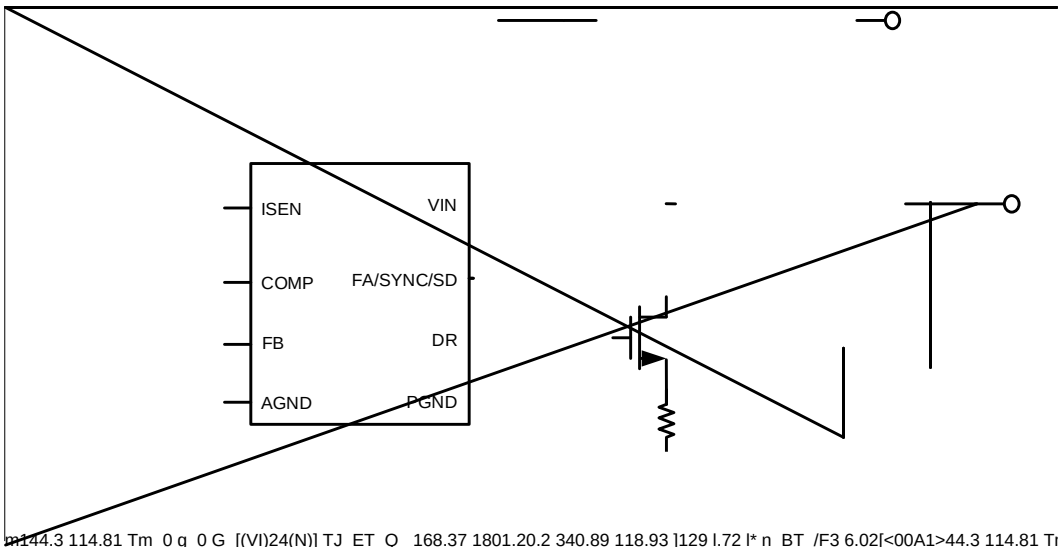

Figure 26. Application Schematic, 5V to 50V, 2A Sepic Regulator at 400kHz

Design

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Inductor Selection (Sepic)

$$' I_{L1} \quad I_{IN} \quad 40\% = I_O \quad \frac{V_O}{V_{IN_MIN}} \quad 40\% \tag{25}$$

(26)

$$L_1 \quad L_2 \quad L = \frac{V_{IN_MIN}}{I_L \quad f_{SW}} \quad D_{MAX} \tag{27}$$

f_{SW} is the switching frequency.

$$I_{L1_PEAK} \quad I_{IN} \quad \frac{I_L}{2} \quad I_O \quad \frac{V_O}{V_{IN_MIN}} \quad (1 \quad \frac{40\%}{2}) \tag{28}$$

$$I_{L2_PEAK} \quad I_O \quad \frac{' I_L}{2} \quad I_O \quad (1 \quad \frac{40\%}{2}) \tag{29}$$

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$$I_{COUT_RMS} \quad I_O \quad \sqrt{1 \frac{D_{MAX}}{u D_{MAX}}} \tag{41}$$

Figure 27. Output Voltage Ripple

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Application Waveforms

Vin=5V, Vout=12V, unless otherwise noted

Figure 28. Power up(Iload=2A)

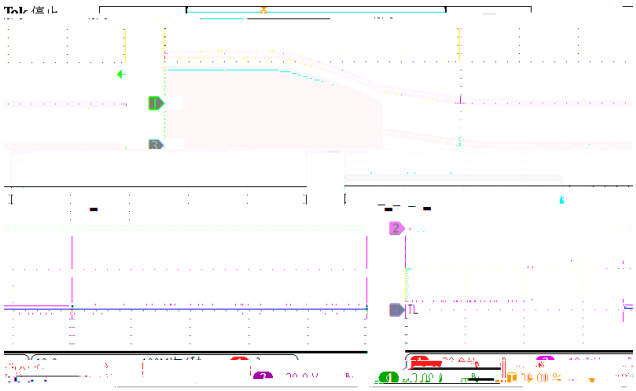

Figure 29. Power down(Iload=2A)

Figure 30. Shutdown remove

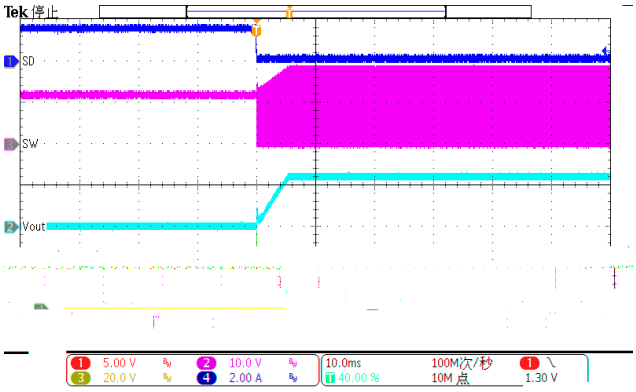

Figure 31. Shutdown remove

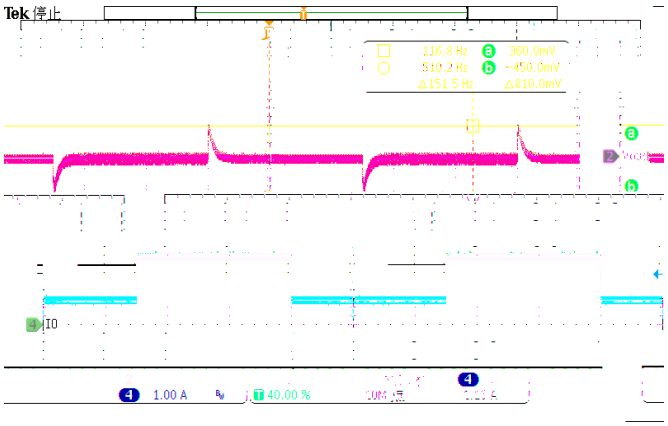

Figure 32. LoadTrans (Iload=0.5A-1.5A)

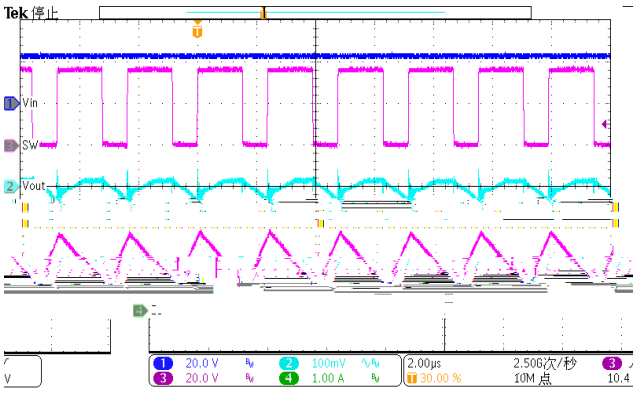

Figure 33. steady-state (Iload=2A)

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Layout Guideline

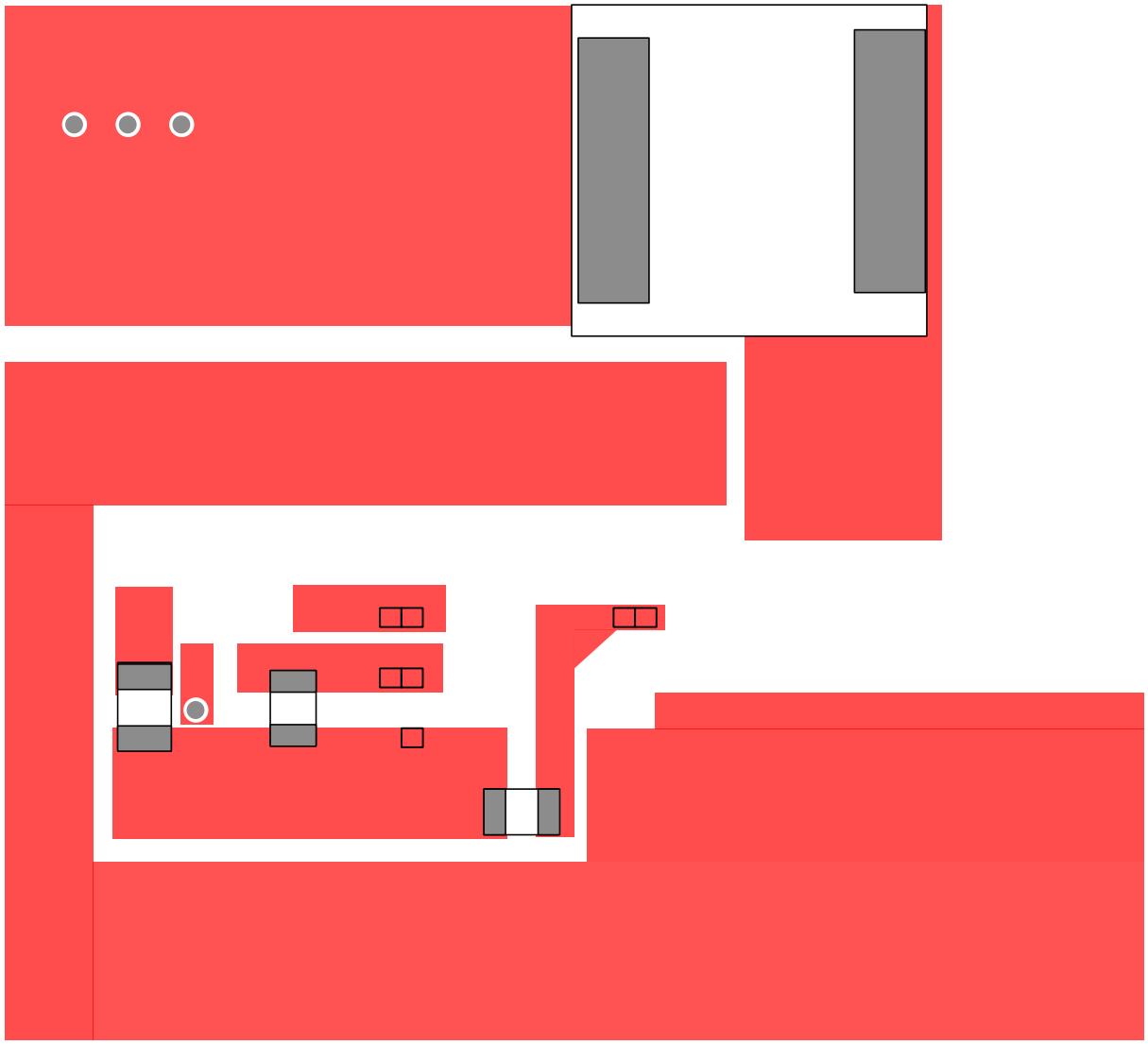

Figure 34. BOOST PCB Layout

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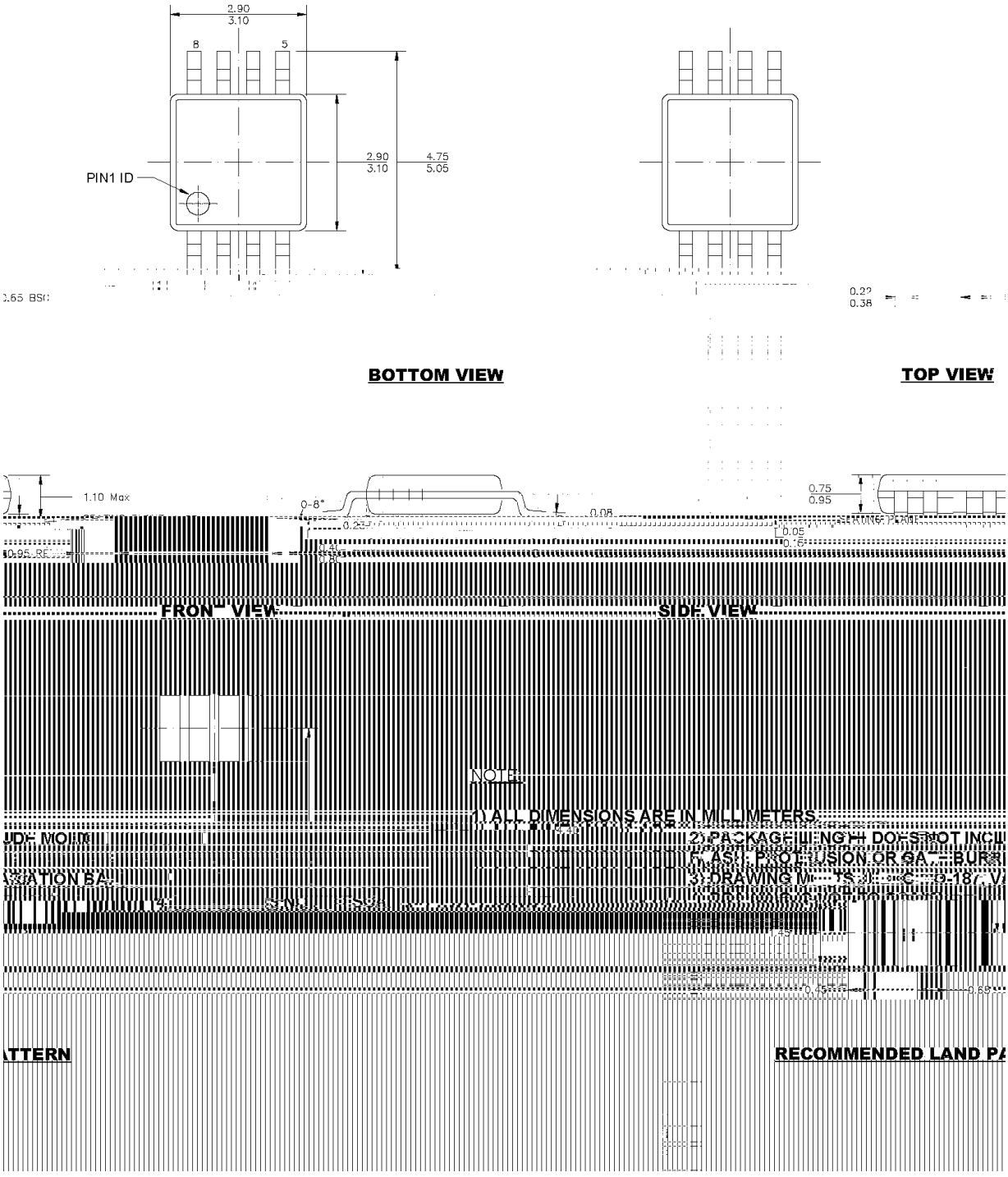
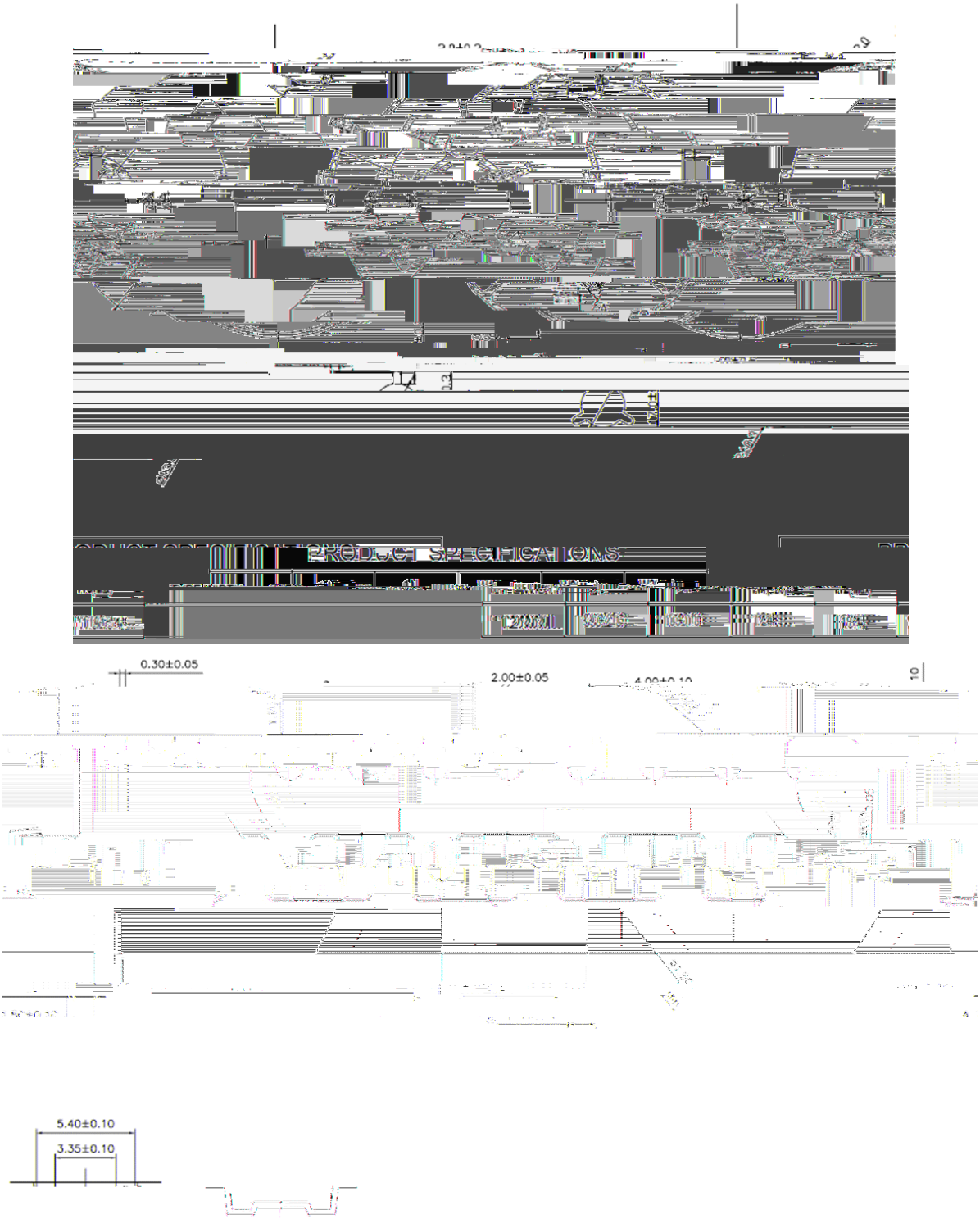
PACKAGE INFORMATION



TAPE AND REEL INFORMATION



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