SGM6612A
20V, 10A Fully-Integrated Synchronous Boost Converter with Load Disconnect Control

DESCRIPTION

The SGM6612A is a 20V high-efficient synchronous boost converter integrated with two 15mΩ power switches. This device offers small size power solution for portable equipment. The SGM6612A supports the resistor-programmable switching frequency up to 2.2MHz.

The SGM6612A has two operation modes, the pulse width modulation (PWM) mode and pulse frequency modulation (PFM). The PWM mode is applied at moderate to heavy load. The PFM mode is applied at light load to improve the efficiency.

The SGM6612A provides a built-in gate driver for external MOSFET to disconnect the output from input side during shutdown or output short condition. When the output is shorted and the short protection is triggered, the device enters into the hiccup mode for safety. In addition, the device also provides output over-voltage protection, inductor current limit protection and thermal shutdown.

The SGM6612A is available in a Green TQFN-3×3.5-13L package.

FEATURES

- **2.7V to 16V Input Voltage Range**
- **4.5V to 20V Output Voltage Range**
- **Up to 10A Resistor-Programmable Current Limit**
- **Up to 2.2MHz Resistor-Programmable Switching Frequency**
- **15mΩ Low R_{DSON} Internal MOSFETs**
- **95% Peak Efficiency (at V_{IN} = 7.2V, V_{OUT} = 16V, I_{OUT} = 2A)**
- **Gate Driver for Load Disconnection**
- **Hiccup Short Protection**
- **Over-Voltage Protection**
- **Auto PFM Mode at Light Load**
- **Available in a Green TQFN-3×3.5-13L Package**

APPLICATIONS

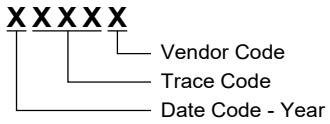
Portable Loudspeaker Boxes
LCD Display Source Driver
Supply for Power Amplifier and Motor Driver
Supply for USB Type-C

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM6612A	TQFN-3×3.5-13L	-40℃ to +85℃	SGM6612AYTQX13G/TR	6612A YTQX13 XXXXX	Tape and Reel, 4000

MARKING INFORMATION

NOTE: XXXXX = Date Code, Trace Code and Vendor Code.



Green (RoHS & HSF): SG Micro Corp defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances. If you have additional comments or questions, please contact your SGMICRO representative directly.

ABSOLUTE MAXIMUM RATINGS

BOOT Voltage ..... -0.3V to V_{SW} + 6V
VIN, SW, VOUT, DISDRV, EN Voltages ..... -0.3V to 23V
VCC, FB, COMP, FREQ, ILIM Voltages ..... -0.3V to 6V
Package Thermal Resistance
TQFN-3×3.5-13L, θ_{JA} ..... 66℃/W
Junction Temperature ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ..... +260℃
ESD Susceptibility
HBM 2000V
CDM 1000V

RECOMMENDED OPERATING CONDITIONS

Input Voltage Range ..... 2.7V to 16V
Output Voltage Range ..... 4.5V to 20V
Operating Ambient Temperature Range ..... -40℃ to +85℃
Operating Junction Temperature Range ..... -40℃ to +125℃

OVERSTRESS CAUTION

Stresses beyond those listed in Absolute Maximum Ratings may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect reliability. Functional operation of the device at any conditions beyond those indicated in the Recommended Operating Conditions section is not implied.

ESD SENSITIVITY CAUTION

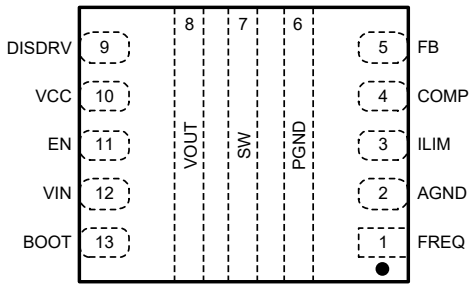
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because even small parametric changes could cause the device not to meet the published specifications.

DISCLAIMER

SG Micro Corp reserves the right to make any change in circuit design, or specifications without prior notice.

PIN CONFIGURATION

(TOP VIEW)



TQFN-3×3.5-13L

PIN DESCRIPTION

PIN	NAME	I/O	FUNCTION
1	FREQ	I	Adjustable Switching Frequency Pin. Put a resistor between this pin and the AGND to program the switching frequency. Do not leave this pin floating in application.
2	AGND	-	Analog Signal Ground.
3	ILIM	I	Adjustable Peak Switch Current Limit. Put a resistor between this pin and AGND to program the peak switch current limit.
4	COMP	O	Output of the Internal Error Amplifier. Put the loop compensation network between this pin and the AGND.
5	FB	I	Voltage Feedback. Connect to the resistor divider to program the output voltage.
6	PGND	PWR	Power Ground. It is connected to the source of the low-side MOSFET.
7	SW	PWR	The Switching Node Pin of the Converter. It is connected to the internal power MOSFETs.
8	VOUT	PWR	Boost Converter Output.
9	DISDRV	O	Gate Drive Output for the External Disconnect MOSFET. Connect this pin to the gate of the external MOSFET. When the load disconnect function is not used, leave it floating.
10	VCC	O	Output of the Internal Regulator. Put a capacitor of more than 1.0μF between this pin and ground.
11	EN	I	Enable Logic Input. Logic high enables the device. Logic low shuts down the device.
12	VIN	I	Power Supply.
13	BOOT	O	Gate Driver Supply of High-side MOSFET. Put a capacitor between this pin and the SW pin.

NOTE: I: input, O: output, PWR: power for the circuit.

ELECTRICAL CHARACTERISTICS

(V_{IN} = 2.7V to 14V and V_{OUT} = 16V, T_J = -40℃ to +125℃, typical values are at T_J = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Power Supply						
Input Voltage Range	V_{IN}		2.7		16	V
Minimum Input Voltage Range for Start-Up	V_{IN_SS}	T_J = +25℃		3.0	3.3	V
Input Voltage Under-Voltage Lockout Threshold	V_{IN_UVLO}	V_{IN} rising, T_J = -40℃ to +85℃		2.6	2.7	V
		V_{IN} falling, T_J = -40℃ to +85℃		2.5	2.6	
VIN UVLO Hysteresis	V_{IN_HYS}			100		mV
VCC Regulation Voltage	V_{CC}	I_{CC} = 5mA, V_{IN} = 6V		5		V
VCC UVLO Threshold	V_{CC_UVLO}	V_{CC} falling		2.2		V
Quiescent Current into VIN Pin	I_Q	IC enabled, no load, no ext. MOSFET, V_{IN} = 6V, V_{OUT} = 20V, V_{FB} = 1.23V, T_J = -40℃ to +85℃		0.35	0.5	μA
Quiescent Current into VOUT Pin				125	200	
Shutdown Current into VIN Pin	I_{SD}	IC disabled, V_{IN} = 6V, T_J = -40℃ to +85℃		1.2	3	μA
		IC disabled, V_{IN} = 16V, T_J = -40℃ to +85℃		3.7	6	
Leakage Current of Low-side MOSFET	I_{LS_LKG}	IC disabled, V_{IN} = 16V, V_{OUT} = V_{SW} = 20V, T_J = -40℃ to +85℃		0.1	5	μA
Output Voltage						
Output Voltage Range	V_{OUT}	f_{SW} = 530kHz	4.5		20	V
Output Over-Voltage Protection Threshold	V_{OVP}	V_{IN} = 8V, V_{OUT} rising	20.4	21	21.7	V
Power Switches						
High-side MOSFET On-Resistance	R_{DSON}	V_{CC} = 5V		15	27	mΩ
Low-side MOSFET On-Resistance		V_{CC} = 5V		15	27	mΩ
Power Stage Trans-Conductance (peak current ratio with comp voltage)	G_m	V_{CC} = 5V		12		A/V
Current Limit						
Resistor-Programmable Current Limit	I_{LIM}	R_{LIM} = 80.6kΩ, T_J = +25℃	7.6	9	10.8	A
Short Current Limit	I_{LIM_SHORT}			20		A
Voltage Reference						
Reference Voltage at FB Pin	V_{REF}	PWM operation	1.180	1.198	1.215	V
		Auto PFM operation		100.2%		V_{REF}
Leakage Current into FB Pin	I_{FB_LKG}			10	50	nA

ELECTRICAL CHARACTERISTICS (continued)

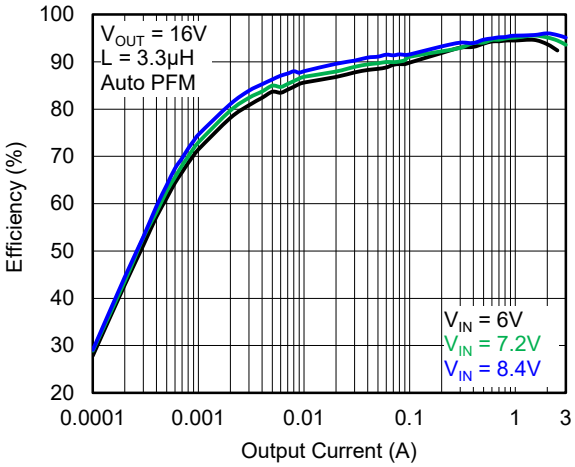
(V_{IN} = 2.7V to 14V and V_{OUT} = 16V, T_J = -40℃ to +125℃, typical values are at T_J = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
EN Logic						
EN Pin Logic High Threshold	V_{EN_H}		1.3			V
EN Pin Logic Low Threshold	V_{EN_L}				0.4	V
EN Pin Pull-Down Resistor	R_{EN}			700		kΩ
Error Amplifier						
COMP Pin Output High Voltage	V_{COMP_H}	High threshold, V_{FB} = V_{REF} - 100mV, R_{LIM} = 80.6kΩ		2.0		V
COMP Pin Output Low Voltage	V_{COMP_L}	Low threshold, V_{FB} = V_{REF} + 100mV, R_{LIM} = 80.6kΩ		0.4		V
Error Amplifier Trans-Conductance	G_{mEA}	V_{COMP} = 1.2V		270		μS
COMP Pin Sink Current	I_{SINK}	V_{FB} = V_{REF} + 100mV, V_{COMP} = 1.2V		160		μA
COMP Pin Source Current	I_{SOURCE}	V_{FB} = V_{REF} - 100mV, V_{COMP} = 1.2V		25		μA
Current Limit						
Waiting Time for Restart in Hiccup Mode	t_{HIC_OFF}			90		ms
Soft-Start						
Start-Up Time	$t_{START-UP}$			3.2		ms
Pre-Charge Time	t_{PRE_CHARGE}	T_J = +25℃	1.8	2.5	3.2	ms
Protection						
Thermal Shutdown Rising Threshold	T_{SD_R}	T_J rising		155		℃
Thermal Shutdown Falling Threshold	T_{SD_F}	T_J falling		130		℃
Switching Frequency						
Switching Frequency	f_{SW}	R_{FREQ} = 348kΩ	460	530	600	kHz
		R_{FREQ} = 842kΩ	205	245	285	
		R_{FREQ} = 75kΩ	1750	2050	2350	
Minimum On-Time	t_{ON_MIN}			120		ns
Gate Driver for Load Disconnect						
Driver Current for the External MOSFET	I_{GD_SINK}			55		μA

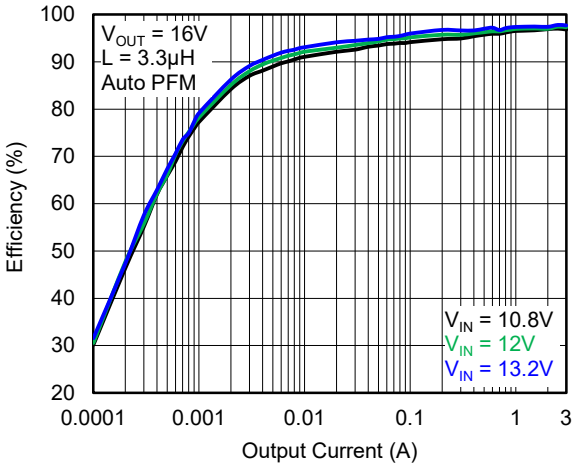
TYPICAL PERFORMANCE CHARACTERISTICS

At T_J = +25℃, V_{IN} = 7.2V and V_{OUT} = 16V, unless otherwise noted.

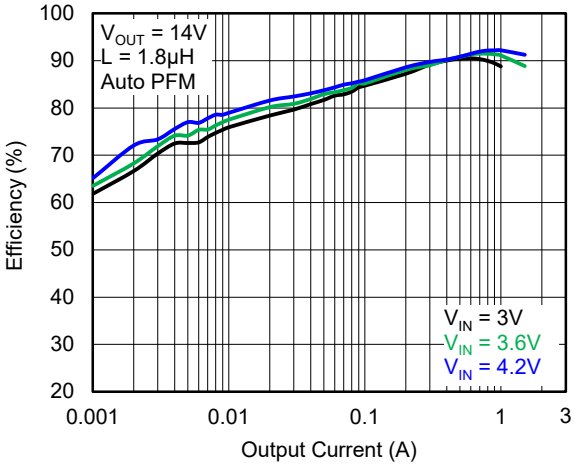
Efficiency vs. Output Current



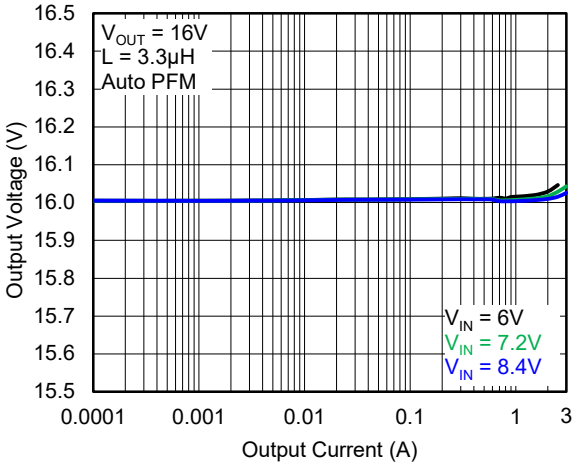
Efficiency vs. Output Current



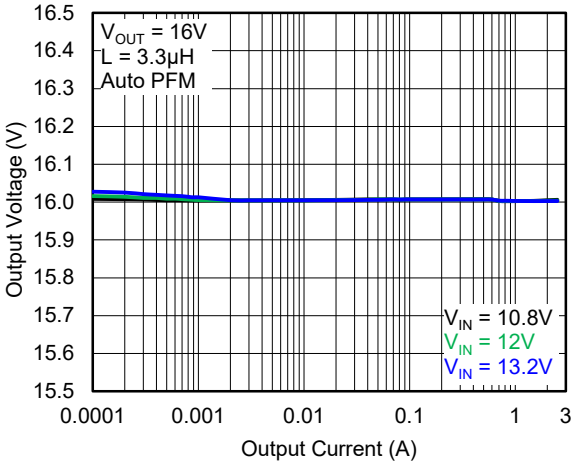
Efficiency vs. Output Current



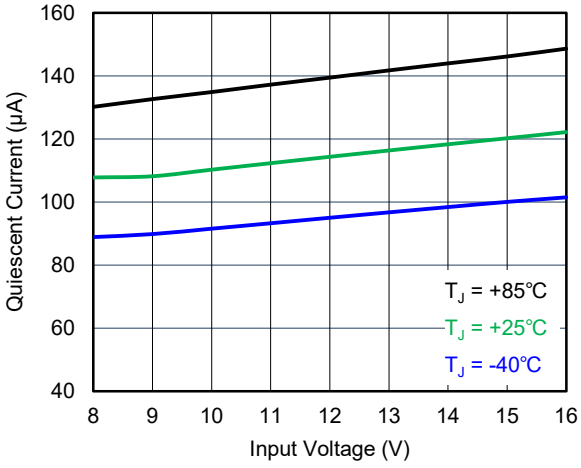
Output Voltage vs. Output Current



Output Voltage vs. Output Current



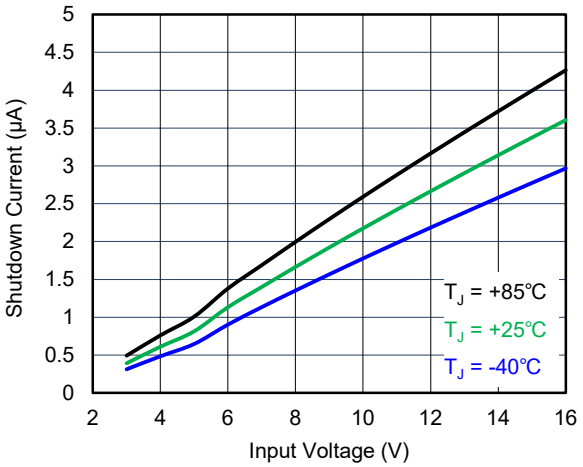
Quiescent Current vs. V_{IN}



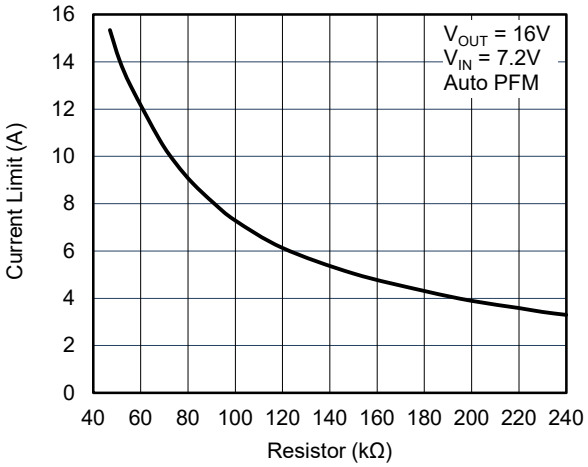
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_J = +25℃, V_{IN} = 7.2V and V_{OUT} = 16V, unless otherwise noted.

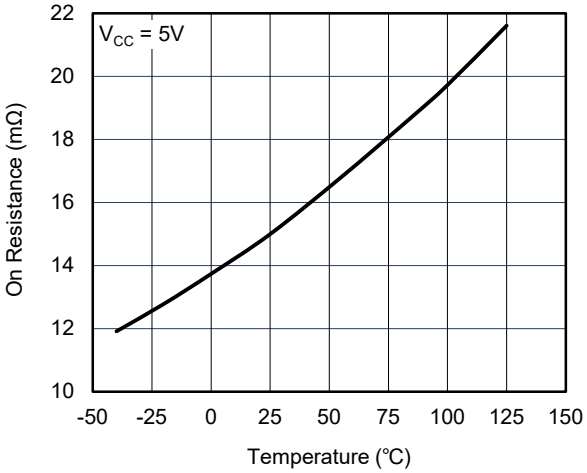
Shutdown Current vs. V_{IN}



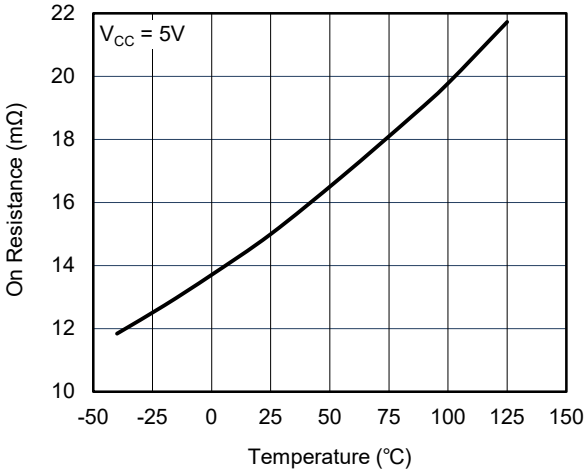
Switch Current Limit vs. Setting Resistor



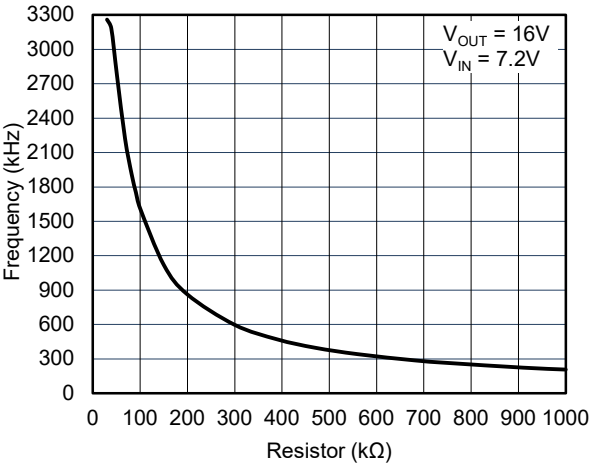
LS R_{DSON} vs. Temperature



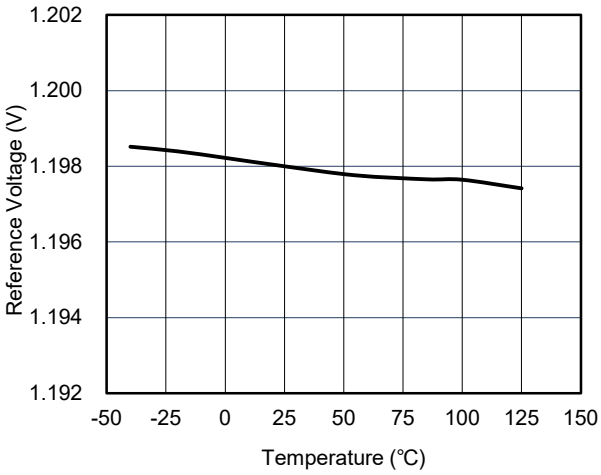
HS R_{DSON} vs. Temperature



Frequency vs. Setting Resistor



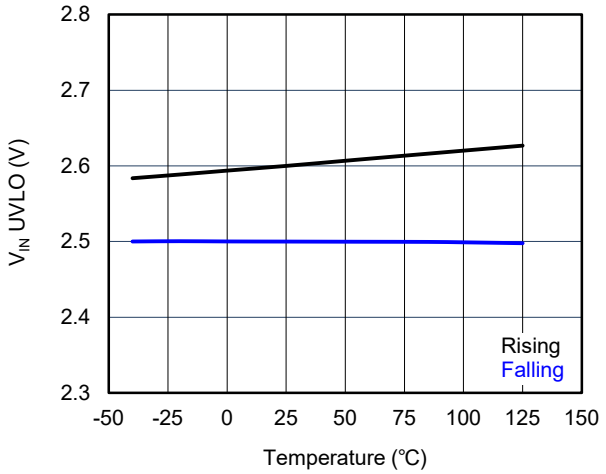
Reference Voltage vs. Temperature



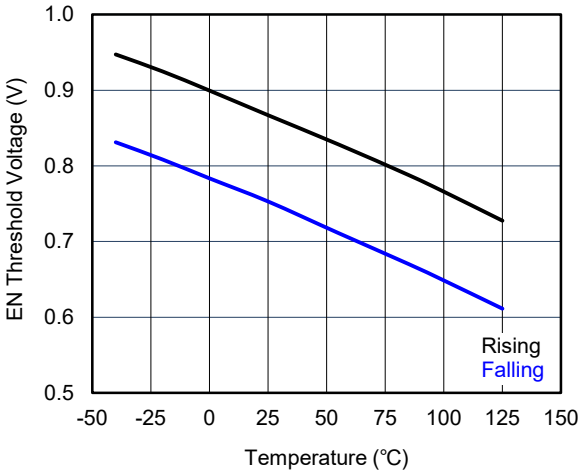
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_J = +25℃, V_{IN} = 7.2V and V_{OUT} = 16V, unless otherwise noted.

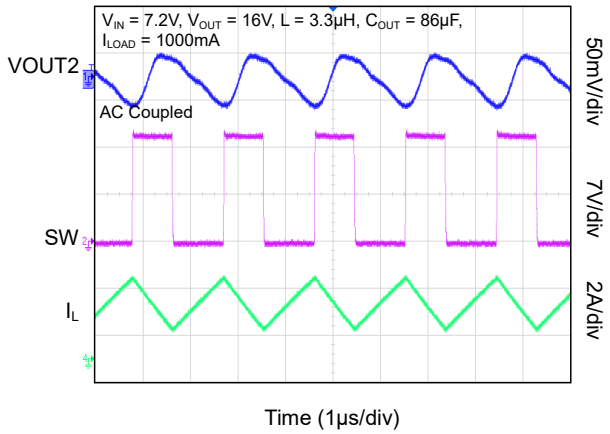
V_{IN} UVLO Rising/Falling Threshold vs. Temperature



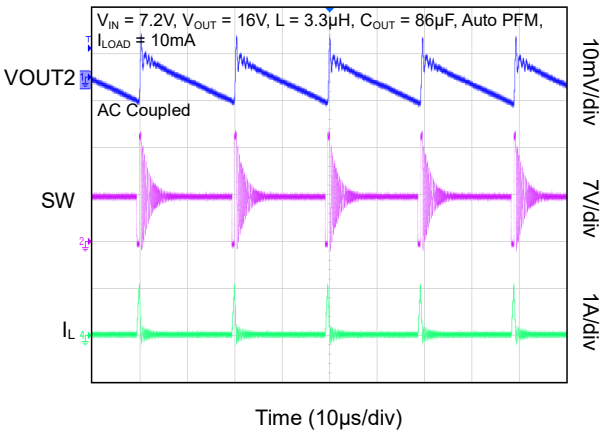
EN Rising/Falling Threshold vs. Temperature



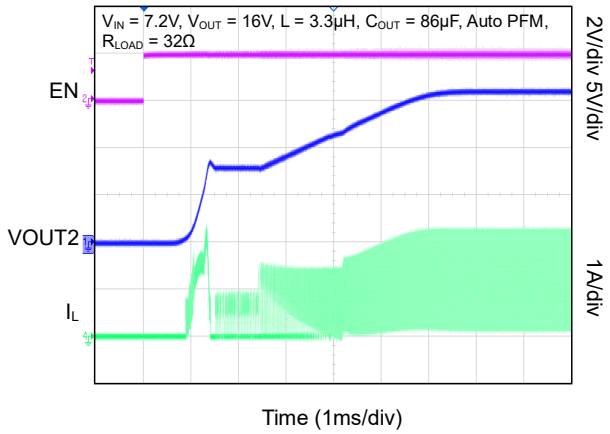
Steady State 1000mA



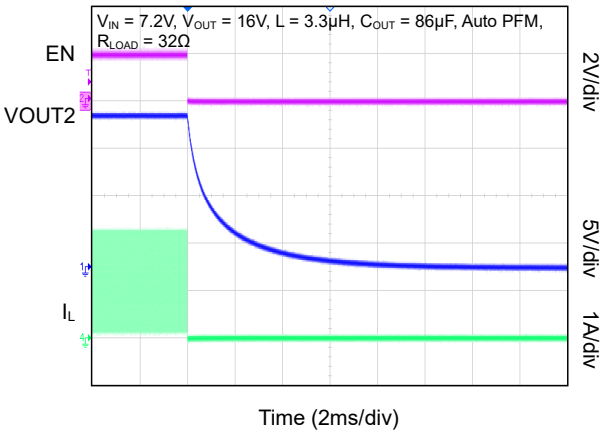
Steady State 10mA



Start-Up by EN



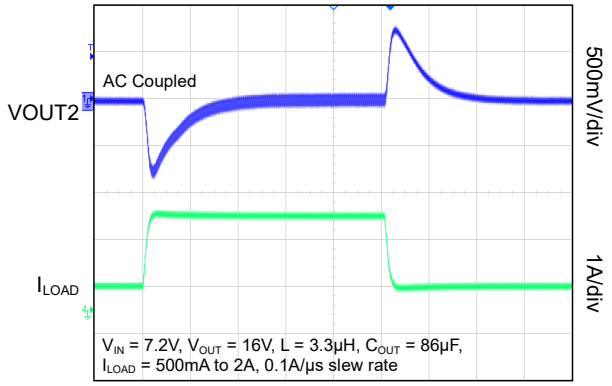
Shutdown by EN



TYPICAL PERFORMANCE CHARACTERISTICS (continued)

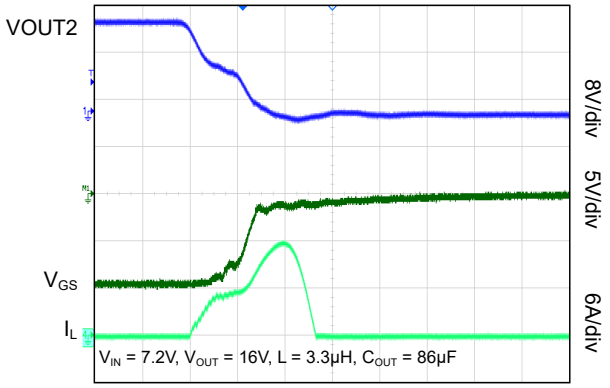
At T_J = +25℃, V_{IN} = 7.2V and V_{OUT} = 16V, unless otherwise noted.

Load Transient



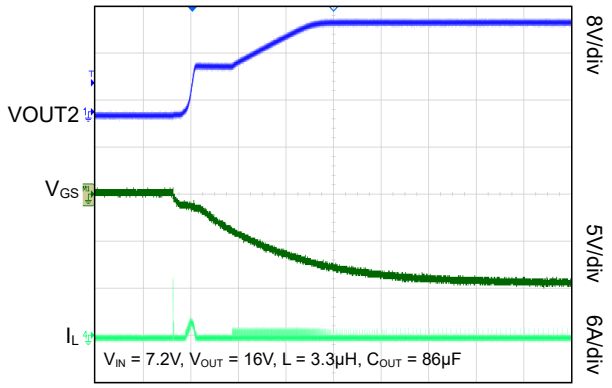
Time (200μs/div)

Output Short Release (with Load Disconnect MOSFET)



Time (10μs/div)

Output Short Release (with Load Disconnect MOSFET)



Time (2ms/div)

REVISION HISTORY

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

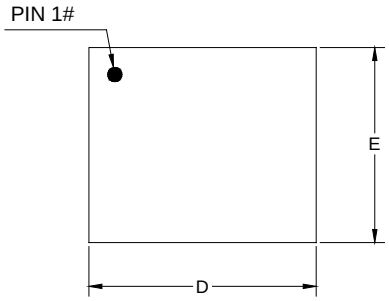
MAY 2021 – REV.A.1 to REV.A.2	Page
Updated Electrical Characteristics section	4

DECEMBER 2020 – REV.A to REV.A.1	Page
Updated Package/Ordering Information section	2

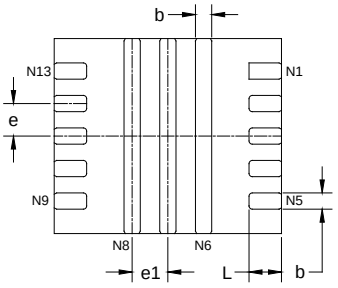
Changes from Original (OCTOBER 2020) to REV.A	Page
Changed from product preview to production data	All

PACKAGE OUTLINE DIMENSIONS

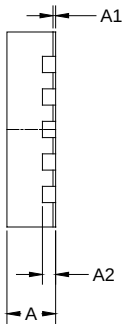
TQFN-3×3.5-13L



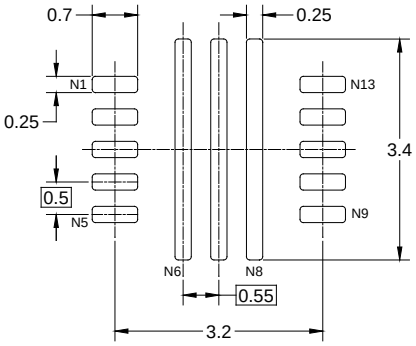
TOP VIEW



BOTTOM VIEW



SIDE VIEW



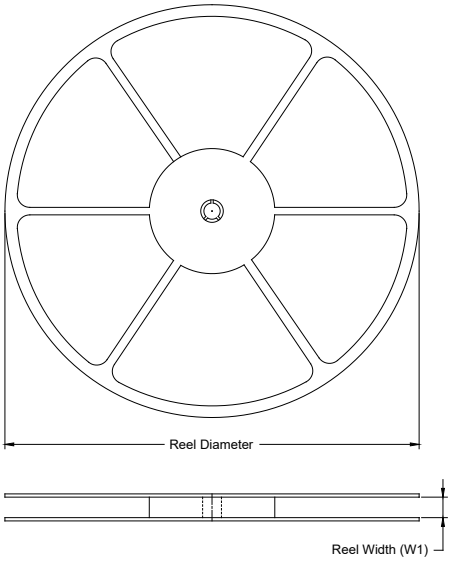
RECOMMENDED LAND PATTERN (Unit: mm)

Symbol	Dimensions In Millimeters		
	MIN	MOD	MAX
A	0.700	0.750	0.800
A1	0.000	0.020	0.050
A2	0.203 REF		
b	0.200	0.250	0.300
D	3.450	3.500	3.550
E	2.950	3.000	3.050
L	0.450	0.500	0.550
e	0.500 BSC		
e1	0.550 BSC		

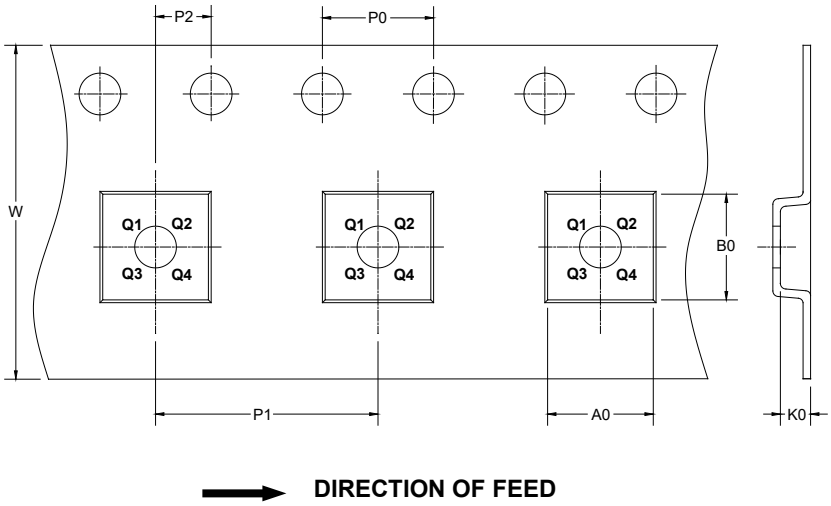
NOTE: This drawing is subject to change without notice.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



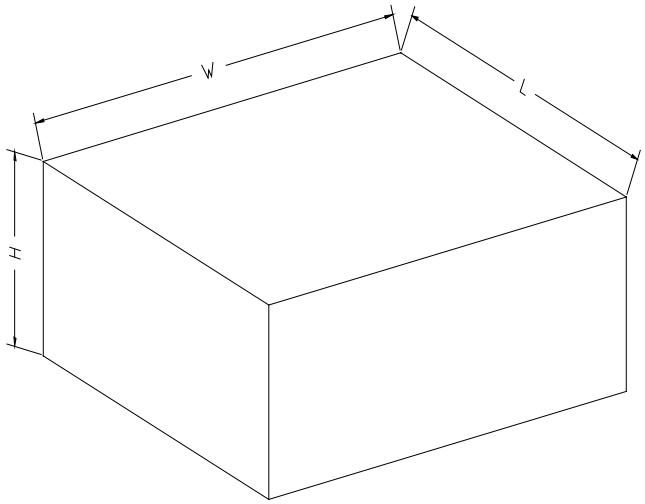
NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
TQFN-3×3.5-13L	13″	12.4	3.30	3.80	1.05	4.0	8.0	2.0	12.0	Q2

DD0001

CARTON BOX DIMENSIONS



NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF CARTON BOX

Reel Type	Length (mm)	Width (mm)	Height (mm)	Pizza/Carton
13″	386	280	370	5

DD0002