SGM4546
Dual-Channel, High Speed, High SPL Piezo-Sounder Driver

GENERAL DESCRIPTION

The SGM4546 is matched dual-channel high speed, high sound pressure level (SPL) piezo-sounder driver which is integrated boost DC/DC to achieve high driven voltage. The unique circuit design provides excellent performance for delivering 2A peak current to highly capacitive loads.

To reduce problems with time and clock skew, SGM4546 is a good choice, with matching delays and maintaining integrity of input to output pulse-widths. Matching rise/fall delay times improve the drive capability and speed. Non-overlapping drive technology is used to minimize the dynamic switching loss.

In order to get higher volume sound from piezo-Sounder, boost DC/DC is integrated to provide high driven voltage. The tiny packages make the device very suitable for space limited applications.

The SGM4546 is available in Green TDFN-3×3-14L and TSSOP-16 (Exposed Pad) packages. It operates over an ambient temperature range of -40℃ to +85℃.

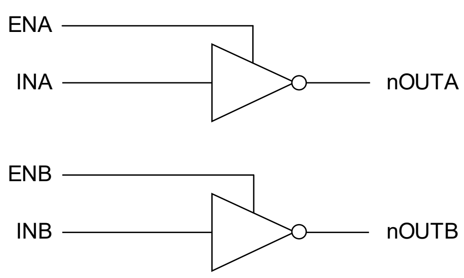
FEATURES

- **Integrated Boost DC/DC to Achieve 26V (MAX) Driven Voltage**
- **2A Peak Driven Current to Drive Capacitive Loads**
- **Power Supply Voltage Range: 1.8V to 5.5V**
- **High Speed Driver**
- **Very Short Rise Time and Fall Time**
- **Improved Response Times**
- **Matched Rise Time and Fall Time**
- **Independent Enable Control for Each Channel**
- **Reduced Clock Skew between Dual Channels**
- **Output is at Low under UVLO Protection, Enable Pin Floating or Disable Status**
- **High Noise Immunity**
- **Improved Clocking Rate**
- **Low Supply Current and Output Impedance**
- **-40℃ to +85℃ Operating Temperature Range**
- **Available in Green TSSOP-16 (Exposed Pad) and TDFN-3×3-14L Packages**

APPLICATION

Piezo-Sounder Driver

LOGIC SYMBOL



FUNCTION TABLE

ENA	ENB	INA	INB	nOUTA	nOUTB
H	H	L	L	H	H
H	H	L	H	H	L
H	H	H	L	L	H
H	H	H	H	L	L
L	L	H/L	H/L	L	L
Floating	Floating	H/L	H/L	L	L

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM4546	TDFN-3×3-14L	-40℃ to +85℃	SGM4546YTDK14G/TR	SGM 4546DK XXXXX	Tape and Reel, 4000
	TSSOP-16 (Exposed Pad)	-40℃ to +85℃	SGM4546YPTS16G/TR	SGM4546 YPTS16 XXXXX	Tape and Reel, 4000

MARKING INFORMATION

NOTE: XXXXX = Date Code and Vendor Code.

XXXXX

- Vendor Code
- Date Code - Week
- Date Code - Year

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

Input Supply Voltage (Boost DC/DC) .... -0.3V to 6V
EN and FB Pin Voltages .... -0.3V to V_{IN}
SW Switch Voltage 40V
VCC to GND .... -0.3V to 28V
ENA, ENB to GND .... -0.3V to 6V
INA, INB to GND .... -0.3V to V_{CC} + 0.3V
Combined Peak Output Current 4A
Package Thermal Resistance
TDFN-3×3-14L, θ_{JA} .... 80℃/W
TSSOP-16 (Exposed Pad), θ_{JA} .... 50℃/W
Junction Temperature .... +150℃
Storage Temperature Range .... -65℃ to +150℃
Lead Temperature (Soldering, 10s) .... +260℃
ESD Susceptibility
HBM 4000V
MM 200V
CDM 1000V

RECOMMENDED OPERATING CONDITIONS

Operating Temperature Range .... -40℃ to +85℃
Operating Junction Temperature Range .... -40℃ to +125℃
Input Voltage Range .... 1.8V to 5.5V

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

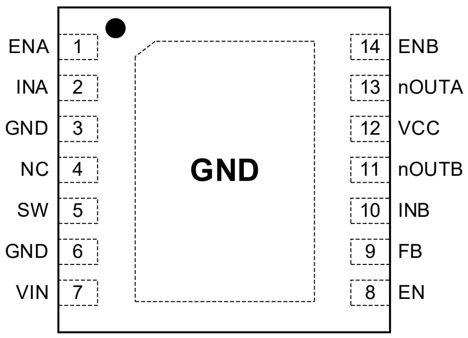
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance 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.

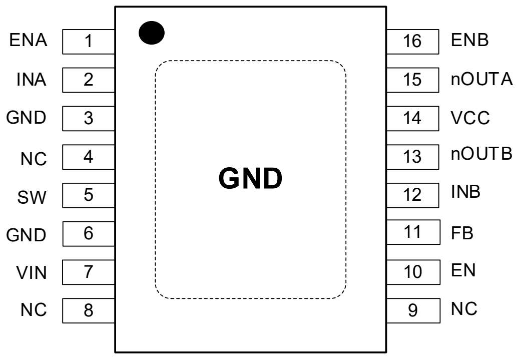
PIN CONFIGURATIONS

(TOP VIEW)



TDFN-3×3-14L

(TOP VIEW)



TSSOP-16 (Exposed Pad)

PIN DESCRIPTION

PIN		NAME	FUNCTION
TDFN-3×3-14L	TSSOP-16 (Exposed Pad)		
1	1	ENA	Enable Input for Channel A. A high signal on this pin will enable the channel A output. Logic low or floating will disable the output of channel A, regardless of the INA logic is high or low.
2	2	INA	Input for Channel A. Inverting channel input.
3, 6	3, 6	GND	Ground.
4	4, 8, 9	NC	No Connection.
5	5	SW	Switch Node. Drain connection of internal power MOSFET. Connect it to the inductor and Schottky diode.
7	7	VIN	Power Supply. Must be closely decoupled to GND with a capacitor.
8	10	EN	Enable Pin. When the EN pin is pulled to ground, the device will be shut down, and the supply current will be less than 1μA. Do not leave it floating.
9	11	FB	Feedback Pin. An external resistor divider programs the output voltage.
10	12	INB	Input for Channel B. Inverting channel input.
11	13	nOUTB	Output of Channel B.
12	14	VCC	Supply Input of Driver.
13	15	nOUTA	Output of Channel A.
14	16	ENB	Enable Input for Channel B. A high signal on this pin will enable the channel B output. Logic low or floating will disable the output of channel B, regardless of the INB logic is high or low.
Exposed Pad	Exposed Pad	GND	Ground.

ELECTRICAL CHARACTERISTICS

Driver Only

(V_{CC} = 24V, V_{ENA} = V_{ENB} = 3.3V, Full = -40℃ to +85℃, typical values are at T_A = +25℃, unless otherwise noted.)

PARAMETER	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
Input						
Input Signal High Threshold (V_{IH})		Full	1.6			V
Input Signal Low Threshold (V_{IL})		Full			0.7	V
Input Signal Hysteresis (V_{HYS})		Full		0.3		V
Input Signal High Current (I_{IH})	Inverting Input Current, V_{INX} = 24V	+25℃		6	8	μA
Input Signal Low Current (I_{IL})	Inverting Input Current, V_{INX} = 0V	+25℃		0.1	1	μA
Output						
Pull-Up Resistance (R_{OH})	Source Current = 100mA	+25℃		2.3	3.1	Ω
Pull-Down Resistance (R_{OL})	Sink Current = -100mA	+25℃		1.6	2.2	Ω
Peak Output Current (I_{PK})	Source Current, f = 1kHz, C_L =0.1μF	+25℃		2		A
	Sink Current, f = 1kHz, C_L =0.1μF	+25℃		-2		
Continuous Output Current (I_{DC})	Source/Sink Current	+25℃		±200		mA
Power Supply						
Power Supply Current (I_{CC})	V_{INA} = V_{INB} = V_{CC}, V_{ENA} = V_{ENB} = 3.3V	+25℃		1.27	1.70	mA
	V_{INA} = V_{INB} = V_{CC}, V_{ENA} = V_{ENB} = 0V	+25℃		0.18	0.24	
Supply Voltage Range (V_{CC})		+25℃	4.5		26.5	V
Under-Voltage Lockout on Threshold		+25℃		3.6	4	V
Under-Voltage Lockout Hysteresis		+25℃		0.5		V
Enable Logic						
ENx Input High Voltage (V_{ENxH})		Full	2.1			V
ENx Input Low Voltage (V_{ENxL})		Full			0.6	
ENx Input Hysteresis (V_{ENxHYS})		Full		0.8		
ENx Input High Current (I_{ENxH})	V_{ENA} = 5.5V or V_{ENB} = 5.5V	+25℃		22	28.5	μA
ENx Input Low Current (I_{ENxL})	V_{ENA} = 0V or V_{ENB} = 0V	+25℃		0.1	1	
Switching Characteristics						
Rise Time (t_R)	C_L = 1000pF	+25℃		12		ns
Fall Time (t_F)	C_L = 1000pF	+25℃		13		ns
Turn-On Delay Time (t_{D1})	See Figure 1	+25℃		21		ns
Turn-Off Delay Time (t_{D2})	See Figure 1	+25℃		23		ns
EN to Output Propagation Delay (t_{D3})	See Figure 2	+25℃		10		μs
EN to Output Propagation Delay (t_{D4})	See Figure 2	+25℃		27		ns
Over-Temperature Protection						
Thermal Shutdown Threshold (T_{SHDN})				150		℃
Thermal Shutdown Threshold Hysteresis (T_{HYS})				15		℃

ELECTRICAL CHARACTERISTICS (continued)

Boost Regulator Only

(V_{IN} = 2.4V, V_{EN} = V_{IN}, C_{IN} = 4.7μF, C_{OUT} = 1μF, L = 10μH, Full = -40℃ to +85℃, typical values are at T_A = +25℃, unless otherwise noted.)

PARAMETER	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
Supply Current						
Input Voltage Range (V_{IN})		Full	1.8		5.5	V
Shutdown Current (I_{SD})	V_{EN} = GND	Full		0.1	1	μA
Operating Quiescent Current (I_Q)	I_{OUT} = 0mA, not switching, V_{FB} = 1.3V	Full		20	35	μA
Under-Voltage Lockout Threshold (UVLO)		Full		1.5	1.9	V
Enable						
EN Input High Voltage (V_{IH_EN})		Full	1.3			V
EN Input Low Voltage (V_{IL_EN})		Full			0.4	V
EN Input Leakage Current	V_{EN} = GND or V_{IN}	Full		0.1	1	μA
Power Switch and Current Limit						
Maximum Switch Voltage (V_{SW})		Full			39	V
Minimum Off-Time (t_{OFF})		Full	270	430	570	ns
Maximum On-Time (t_{ON})		Full	4	6	8.5	μs
MOSFET On-Resistance (R_{DSON})	V_{IN} = 2.4V, I_{SW} = 200mA	Full		660	1100	mΩ
MOSFET Leakage Current (R_{DSON})	V_{SW} = 38V	Full			1	μA
Switch Current Limit (I_{LIM})		Full	210	400	500	mA
Output						
Adjustable Output Voltage Range (V_{OUT})		Full	V_{IN}		38	V
Feedback Reference Voltage (V_{FB})		+25℃	1.212	1.239	1.266	V
Feedback Leakage Current (I_{FB})	V_{FB} = 1.3V	Full			1	μA
Output Voltage Line Regulation (ΔV_{OUT})	V_{IN} = 1.8V to 5.5V, V_{OUT} = 18V, I_{LOAD} = 10mA, C_{FF} = not connected	+25℃		0.04		%/V
Output Voltage Load Regulation	V_{IN} = 2.4V, V_{OUT} = 18V, I_{OUT} = 0mA to 30mA	+25℃		0.15		%/mA

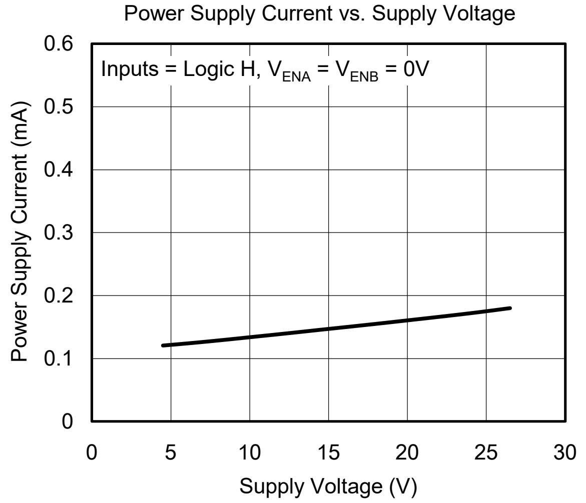
RECOMMENDED COMPONENTS OF TEST CIRCUITS

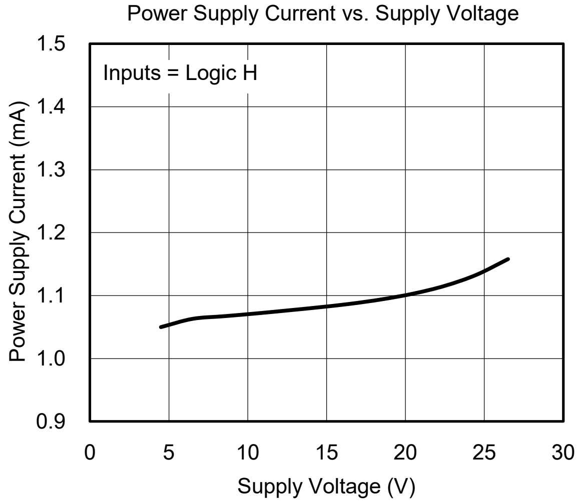
	COMPONENT		COMPONENT
INDUCTOR	10μH/CD75NP-100KC	CAPACITOR	4.7μF/C2012X7R1H475KT
	3.3μH/CD75NP-3R3MC		10μF/08055C106KAT2A
DIODE	B340		1μF/0805B105K500NT
CAPACITOR	1nF/C2012X7R1H102KT		22pF/GRM2165C1H220JZ01D

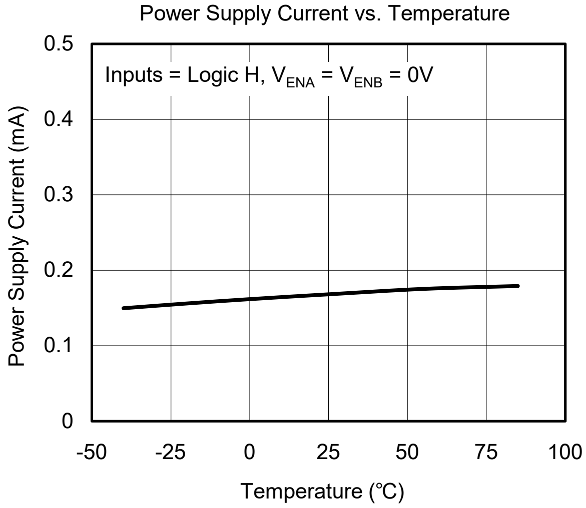
TYPICAL PERFORMANCE CHARACTERISTICS

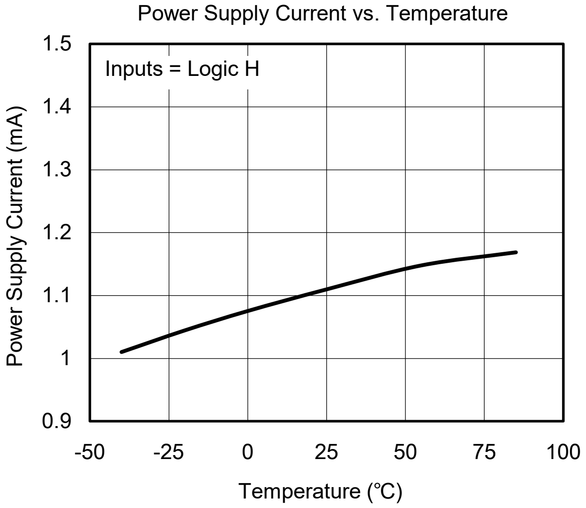
Driver Only

T_A = +25℃, V_{CC} = 24V, V_{ENA} = V_{ENB} = 5V, C_{IN} = 4.7μF, C_{nOUTA} = C_{nOUTB} =1nF, unless otherwise noted.







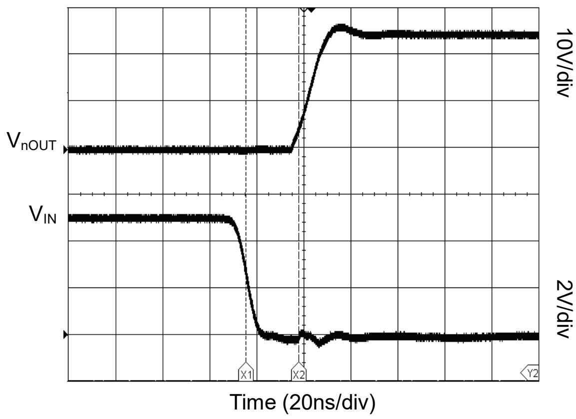


TYPICAL PERFORMANCE CHARACTERISTICS (continued)

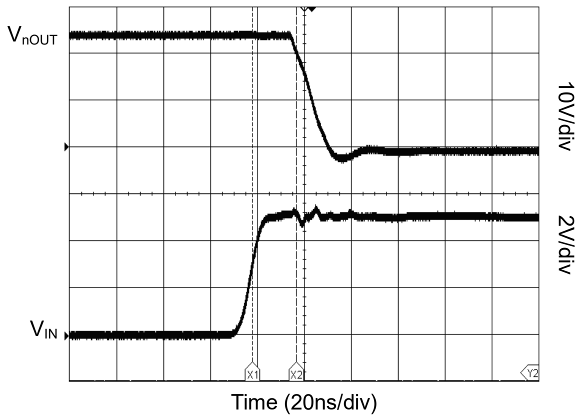
Driver Only

T_A = +25℃, V_{CC} = 24V, V_{ENA} = V_{ENB} = 5V, C_{IN} = 4.7μF, C_{nOUTA} = C_{nOUTB} =1nF, unless otherwise noted.

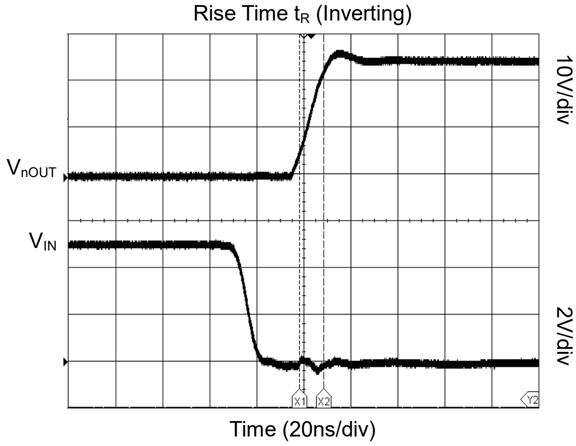
Turn-On Delay Time t_{D1} (Inverting)



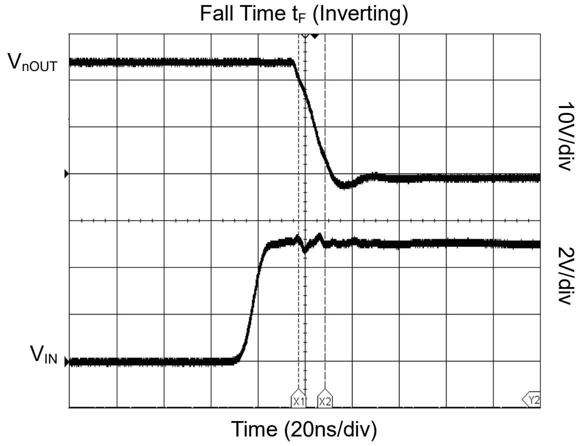
Turn-Off Delay Time t_{D1} (Inverting)



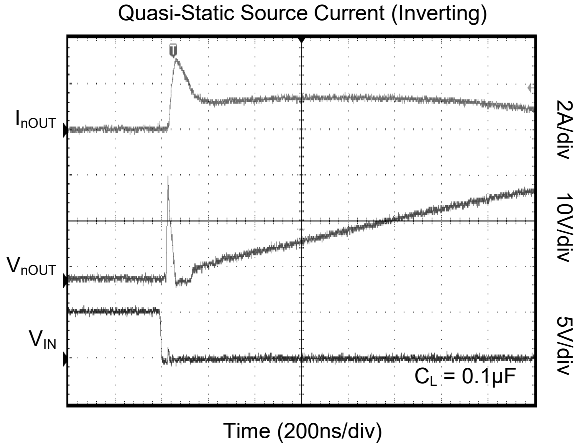
Rise Time t_R (Inverting)



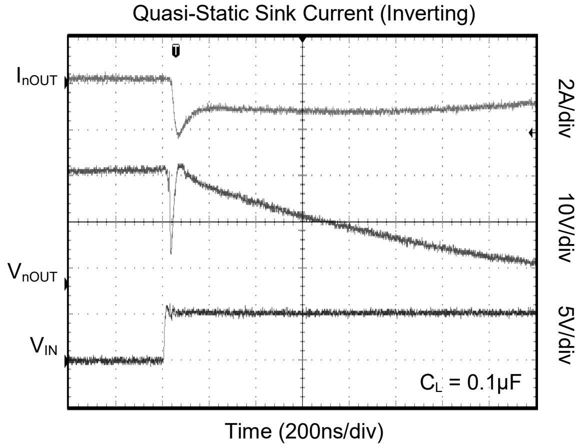
Fall Time t_F (Inverting)



Quasi-Static Source Current (Inverting)



Quasi-Static Sink Current (Inverting)

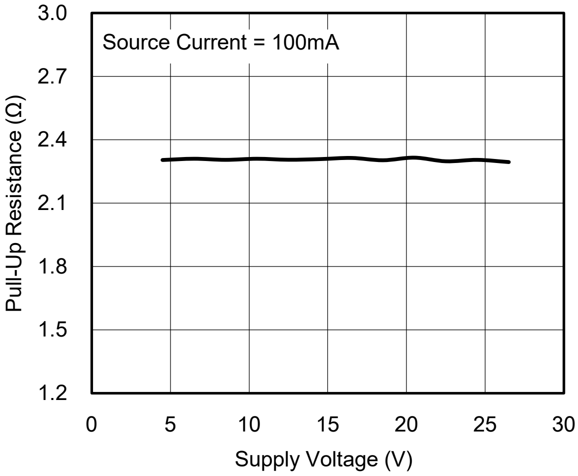


TYPICAL PERFORMANCE CHARACTERISTICS (continued)

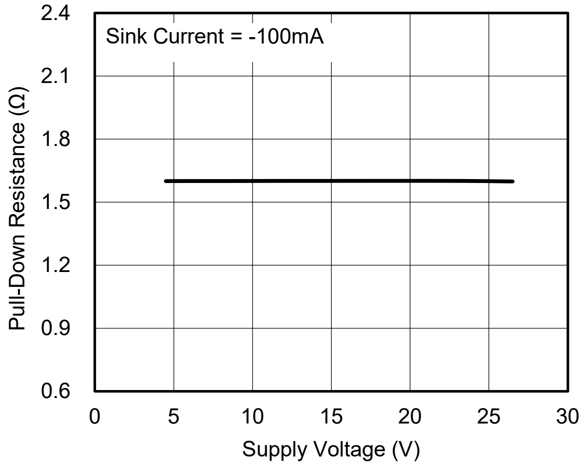
Driver Only

T_A = +25℃, V_{CC} = 24V, V_{ENA} = V_{ENB} = 5V, C_{IN} = 4.7μF, C_{nOUTA} = C_{nOUTB} =1nF, unless otherwise noted.

Pull-Up Resistance vs. Supply Voltage

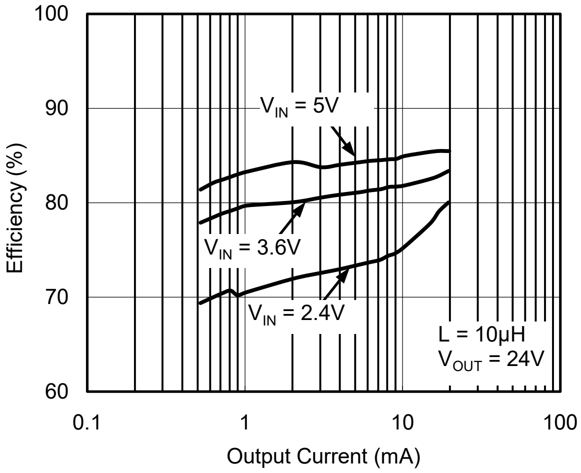


Pull-Down Resistance vs. Supply Voltage

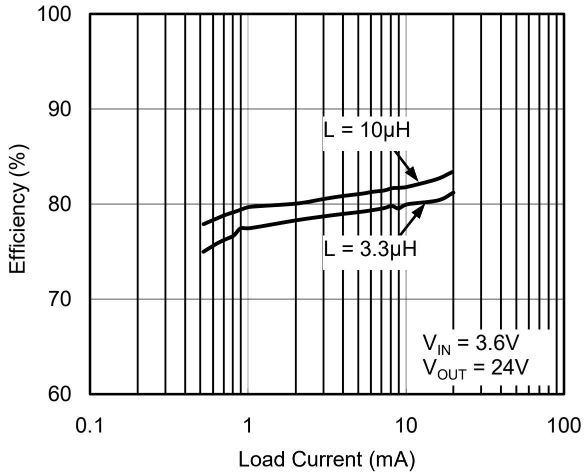


Boost Regulator Only

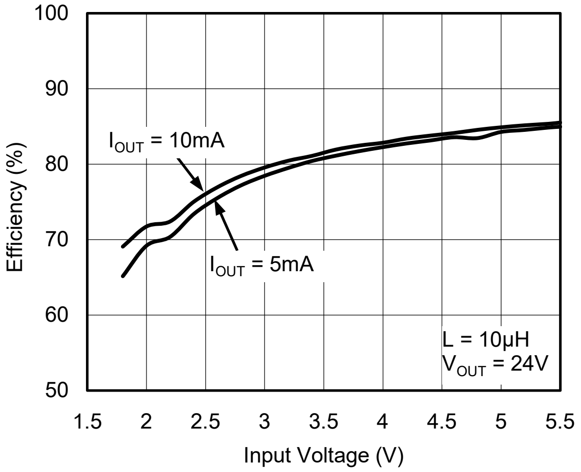
Efficiency vs. Output Current



Efficiency vs. Load Current



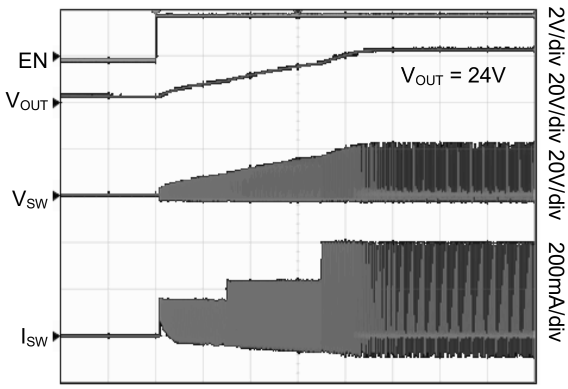
Efficiency vs. Input Voltage



TYPICAL PERFORMANCE CHARACTERISTICS (continued)

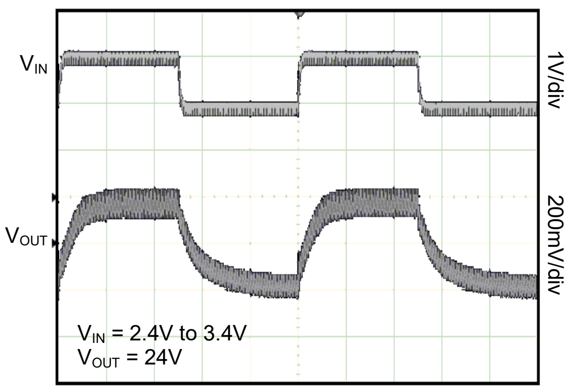
Boost Regulator Only

Start-Up



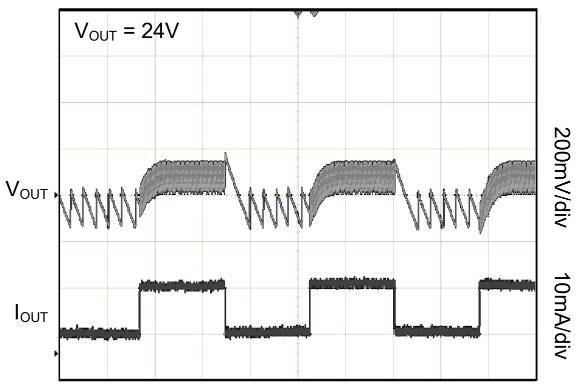
Time (200μs/div)

Line Transient Response



Time (200μs/div)

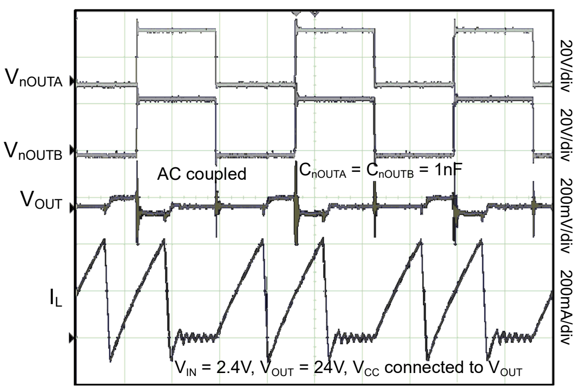
Load Transient Response



Time (200μs/div)

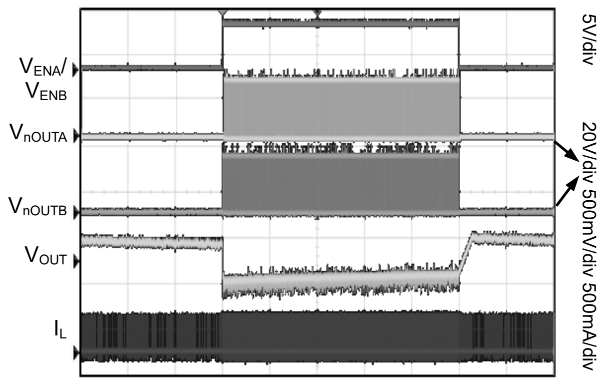
Driver Driven By Boost Regulator

PWM Switching Operation



Time (2μs/div)

Load Transient Response



V_{IN} = 2.4V, V_{OUT} = 24V, V_{CC} connected to V_{OUT} , C_{nOUTA} = C_{nOUTB} = 1nF

Time (20ms/div)

TIMING TABLE OF DRIVER

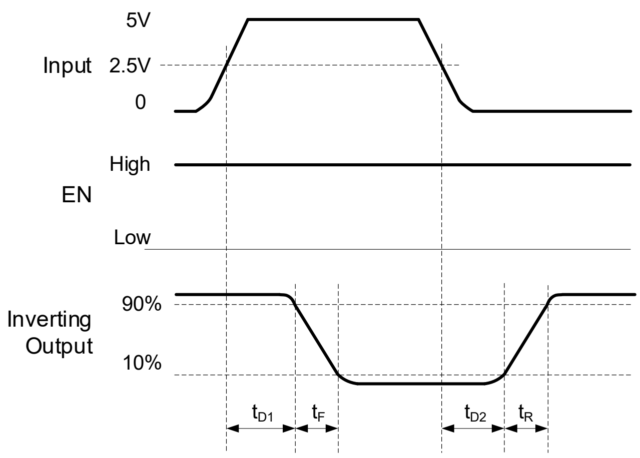


Figure 1. Inverting Input Driver Operation

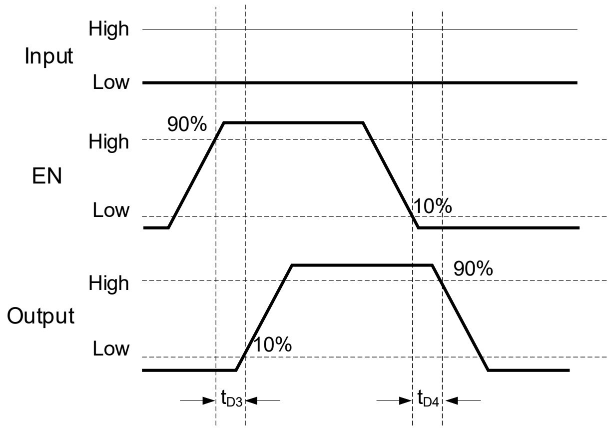


Figure 2. Enable Function (For Inverting Input Driver Operation)

TEST CIRCUIT OF DRIVER

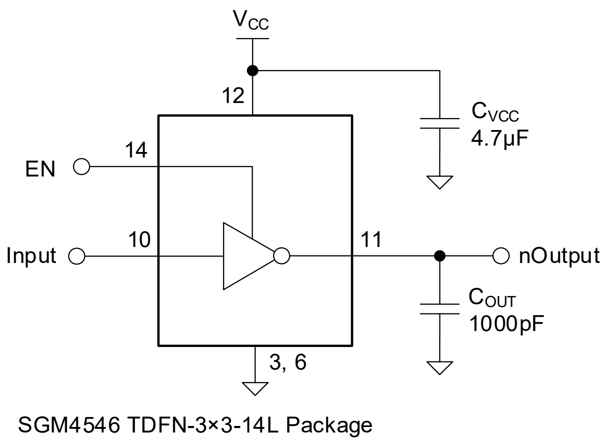


Figure 3. Standard Test Configuration

FUNCTIONAL BLOCK DIAGRAM

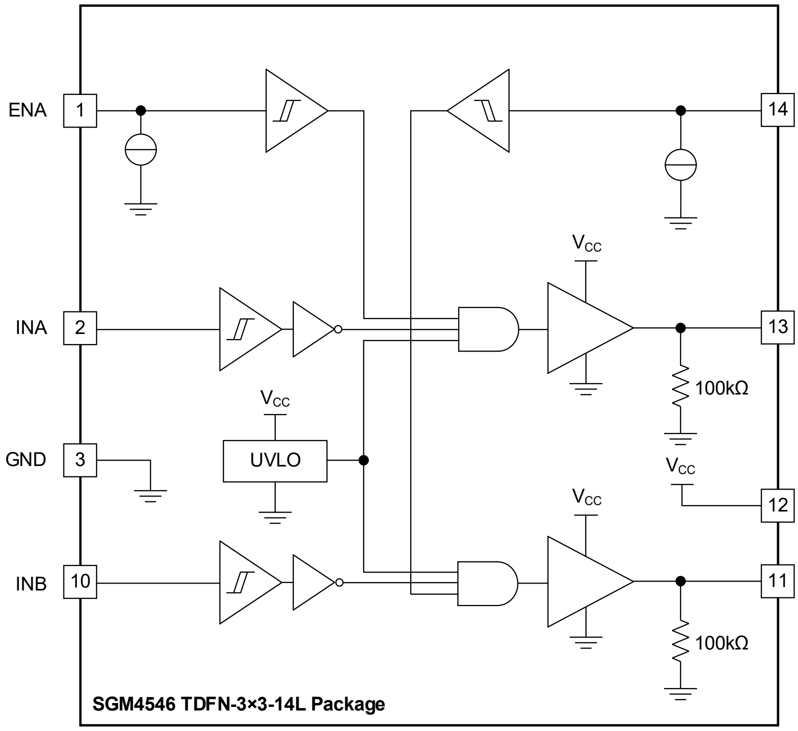


Figure 4. Block Diagram of Driver

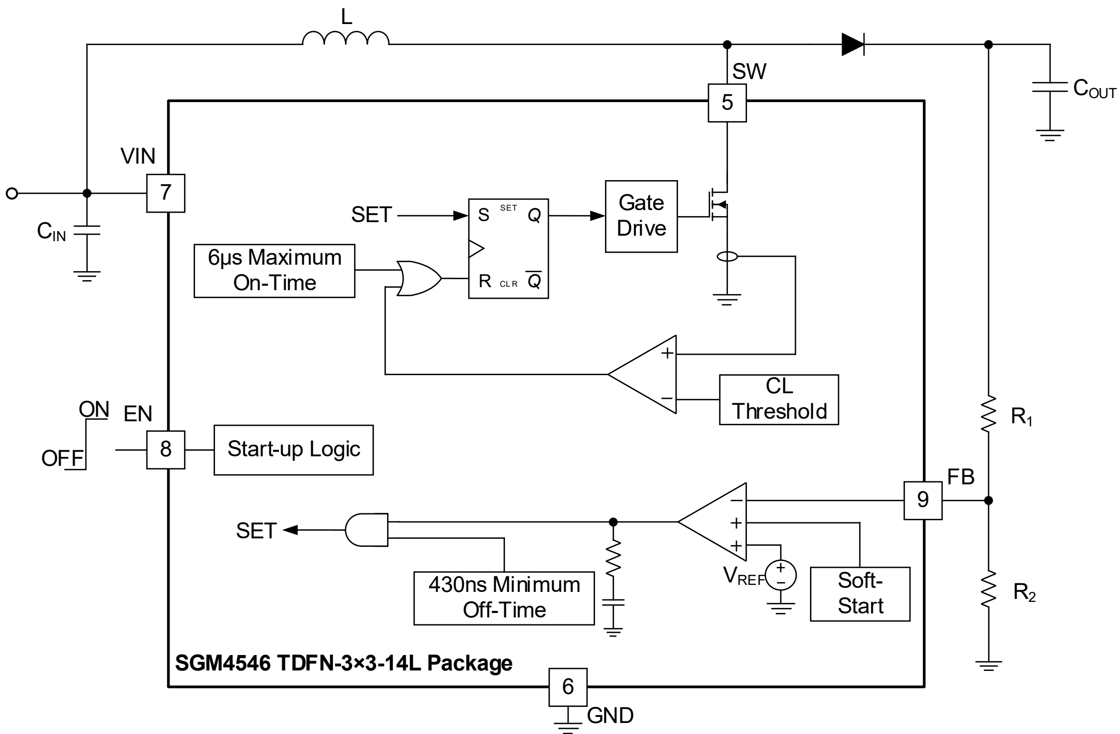


Figure 5. Block Diagram of Boost Regulator

APPLICATION INFORMATION OF BOOST REGULATOR

The SGM4546's output voltage regulation architecture is inherently stable, thus the inductance does not affect the stability of the device. The load current and conversion ratio affect the switching frequency of SGM4546. The recommended inductance of SGM4546 ranges from 2.2μH to 47μH. The selected inductance should ensure that the LS on-time does not exceed 6μs (TYP) maximum on-time, and the peak current of 400mA (TYP) should be reached within the 6μs for proper operation.

Equation below calculates the maximum switching frequency. The selected inductance determines the maximum switching frequency of SGM4546.

$$f_{S(MAX)} = \frac{V_{IN(MIN)} \times (V_{OUT} - V_{IN})}{I_P \times L \times V_{OUT}}$$

where I_P is peak current. L is selected inductor value. $V_{IN(MIN)}$ is the highest switching frequency occurs at the minimum input voltage.

If the above calculation does not exceed the maximum switching frequency, use equation below to calculate the actual switching frequency at the nominal load.

$$f_{S(ILOAD)} = \frac{2 \times I_{LOAD} \times (V_{OUT} - V_{IN} + Vd)}{{I_P}^2 \times L}$$

where I_{LOAD} is nominal load current. Vd is rectifier diode forward voltage (typically 0.3V).

Lower inductance results in higher switching frequency, but the efficiency is reduced with the increased switching frequency. Use equation below to calculate the maximum available load current once the inductance is selected.

$$I_{LOAD(MAX)} = \eta \frac{{I_P}^2 \times L \times f_{S(MAX)}}{2 \times (V_{OUT} - V_{IN})}$$

where $f_{S(MAX)}$ is maximum switching frequency as calculated previously. η is expected converter efficiency (typically 70% to 85%).

The position of operation point, the maximum load current, is at where the converter begins to enter the continuous conduction mode. In general, the converter is supposed to operate in discontinuous conduction mode.

The selected inductor should have a saturation rating higher than the 400mA (TYP) peak current limit. The DC resistance of the selected inductor affects the conversion efficiency, and lower DC resistance results in higher efficiency.

Table 1. Recommended Inductor for Typical Applications

INDUCTOR	COMPONENT	COMMENTS
10μH	Sumida CR32-100	High efficiency
10μH	Sumida CDRH3D16-100	High efficiency
10μH	Murata LQH4C100K04	High efficiency
4.7μH	Sumida CDRH3D16-4R7	Small solution size
4.7μH	Murata LQH3C4R7M24	Small solution size

APPLICATION INFORMATION OF BOOST REGULATOR (continued)

Output Voltage Setting

Connecting a resistive divider on the FB pin programs the output voltage of SGM4546. Use equation below to program the output voltage. R_1 is the top feedback resistor and R_2 is the bottom feedback resistor. The recommended value for R_2 should be less than 200kΩ, and the maximum value for R_1 should be less than 2.2MΩ.

$$V_{OUT} = 1.239V \times \left(1 + \frac{R_1}{R_2}\right)$$

A feedforward capacitor in parallel with R_1 is recommended to improve the stability of SGM4546. Use equation below to calculate the required feedforward capacitance.

$$C_{FF} = \frac{1}{2 \times \pi \times \frac{f_S}{20} \times R_1}$$

where:
R_1 is upper resistor of voltage divider.
f_S is switching frequency of the converter at the nominal load current.
C_{FF} is choose the value closest to the calculated result.

If there is no feedforward capacitor or the chosen value which is very low, the SGM4546 will appear double pulses or a pulse burst rather than a single pulse at the SW node, which results in higher output voltage ripple.

Lower switching frequency requires larger feedforward capacitor, and larger feedforward capacitance results in poor line regulation. The selected feedforward capacitor should be as small as possible.

EN Pin Protection

Power input V_{IN} may exhibit very high voltage spike (> 2 × V_{IN}) under certain situations such as hot swap or hot-insertion. In order to prevent SGM4546 from being damaged by high voltage spike and protect EN pin during power-on, when connecting EN to V_{IN}, a pull-up resistor (> 1kΩ) is recommended to be added between EN and VIN instead of connecting them directly.

Line and Load Regulation

The SGM4546 requires a 45mV peak-to-peak voltage ripple on the FB pin to achieve good line regulation. For application with constraint on the total output capacitance, a feedforward capacitor is recommended to increase the voltage ripple coupled to the FB pin. It is recommended to use small inductor value to increase the switching frequency which will reduce the output voltage ripple, as well as the voltage ripple coupled to the feedback pin. In addition, a capacitor connected in parallel with the bottom feedback resistor can reduce the voltage ripple on the feedback pin down to 45mV, a starting point for this capacitor value could be the same as the chosen feedforward capacitor.

Output Capacitor Selection

A low ESR ceramic capacitor is recommended to place at the SGM4546's output. Use equation below to estimate the output voltage ripple under normal operation.

$$\Delta V_{OUT} = \frac{I_{OUT}}{C_{OUT}} \times \left(\frac{1}{f_{S(IOUT)}} - \frac{I_P \times L}{V_{OUT} + Vd - V_{IN}}\right) + I_P \times ESR$$

where:
I_P is peak current.
L is selected inductor value.
I_{OUT} is nominal load current.
$f_{S(IOUT)}$ is switching frequency at the nominal load current as calculated previously.
Vd is rectifier diode forward voltage (typically 0.3V).
C_{OUT} is selected output capacitor.
ESR is output capacitor ESR value.

APPLICATION INFORMATION OF BOOST REGULATOR (continued)

Input Capacitor Selection

Boost converter's input capacitor sees continuous current throughout the entire switching cycle. A 4.7μF ceramic capacitor is recommended to place as close as possible between the VIN pin and GND pin of SGM4546. For the applications where the SGM4546 is located far away from the input source, a 47μF or higher capacitance capacitor is recommended to damp the wiring harness's inductance.

Schottky Diode Selection

The external rectification diode selection is critical to ensure device performance. A high speed and low forward voltage drop diode is recommended to improve efficiency. The average current rating of the diode should be higher than the peak load. The breakdown voltage of the selected diode should be higher than the programmed output voltage with margin, for example, a 12V output application requires a minimal of 20V breakdown voltage.

Layout Considerations

In addition to component selection, layout is a critical step to ensure the performance of any switch mode power supplies. Poor layout can result in system instability, EMI failure, and device damage. Thus, place the inductor, input and output capacitors as close to the IC as possible. Wide and short traces can be used to minimize PCB inductance for current carrying traces.

For Boost converter, the output capacitor's current loop from V_{OUT} pin back to the GND pin of the device should be as small as possible.

TYPICAL APPLICATION CIRCUIT

In externally driven piezo-sounder or ultra-sound transducer application, the typical circuit is shown in Figure 6.

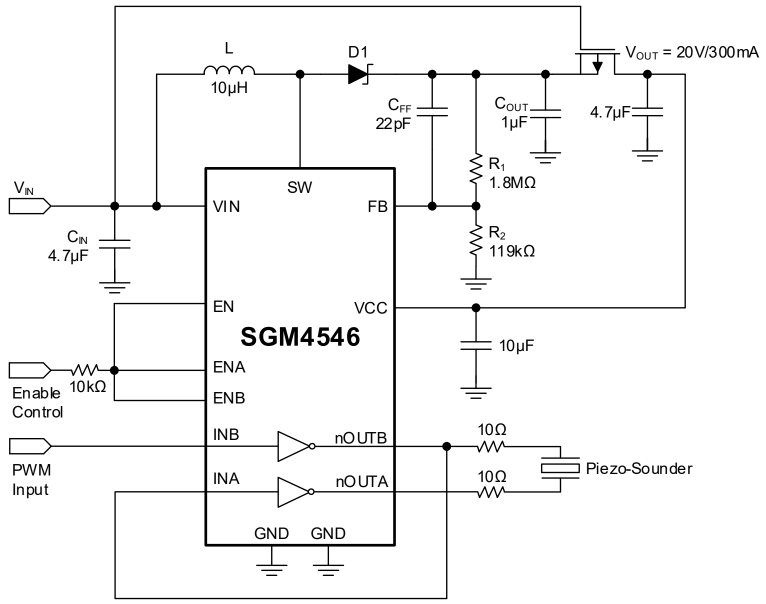


Figure 6. Typical Circuit for Externally Driven Piezo-Sounder or Ultra-Sound Transducer

In self-driven piezo-sounder application, the typical circuit is shown in Figure 7.

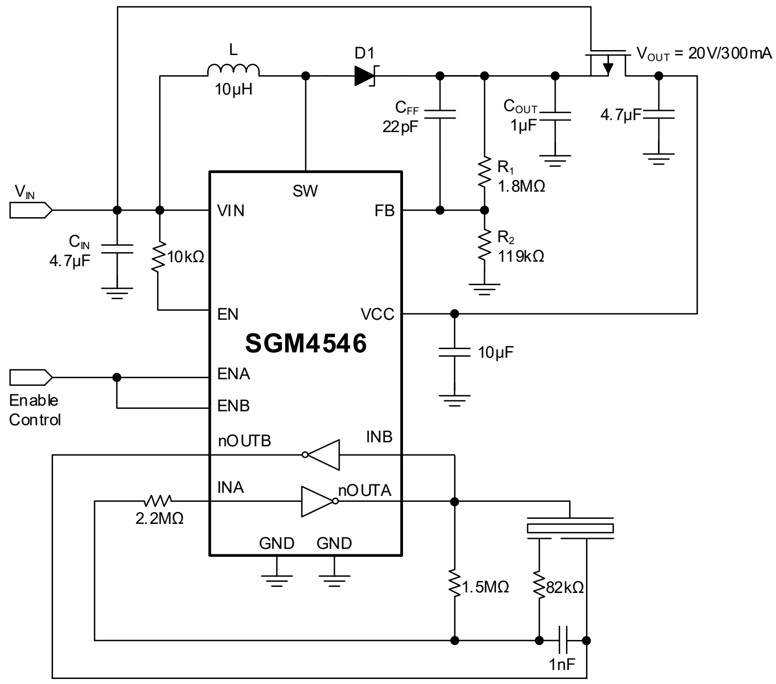


Figure 7. Typical Circuit for Self-Driven Piezo-Sounder

REVISION HISTORY

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

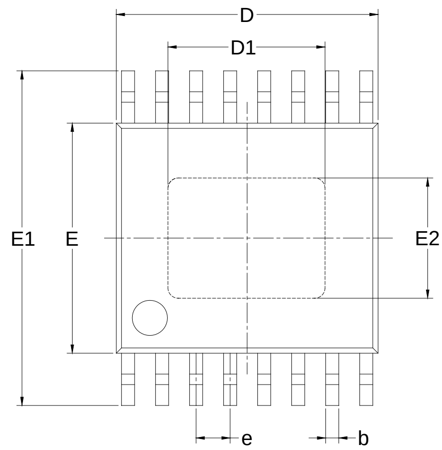
FEBRUARY 2023 – REV.A.1 to REV.A.2	Page
Updated Detailed Description and Application Information sections	12, 13, 14

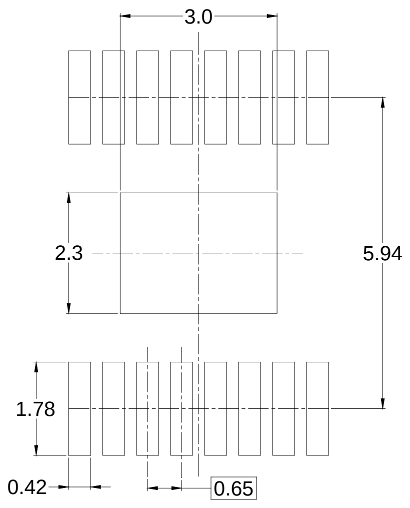
JUNE 2017 – REV.A to REV.A.1	
Added TSSOP-16 (Exposed Pad) Package	All
Added Typical Application Circuit (Figure 6)	15

Changes from Original (SEPTEMBER 2016) to REV.A	
Changed from product preview to production data	All

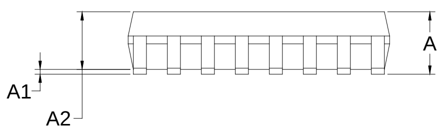
PACKAGE OUTLINE DIMENSIONS

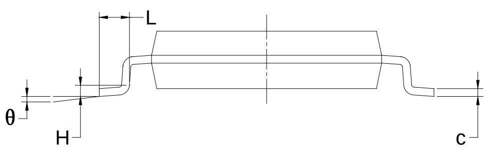
TSSOP-16 (Exposed Pad)





RECOMMENDED LAND PATTERN (Unit: mm)



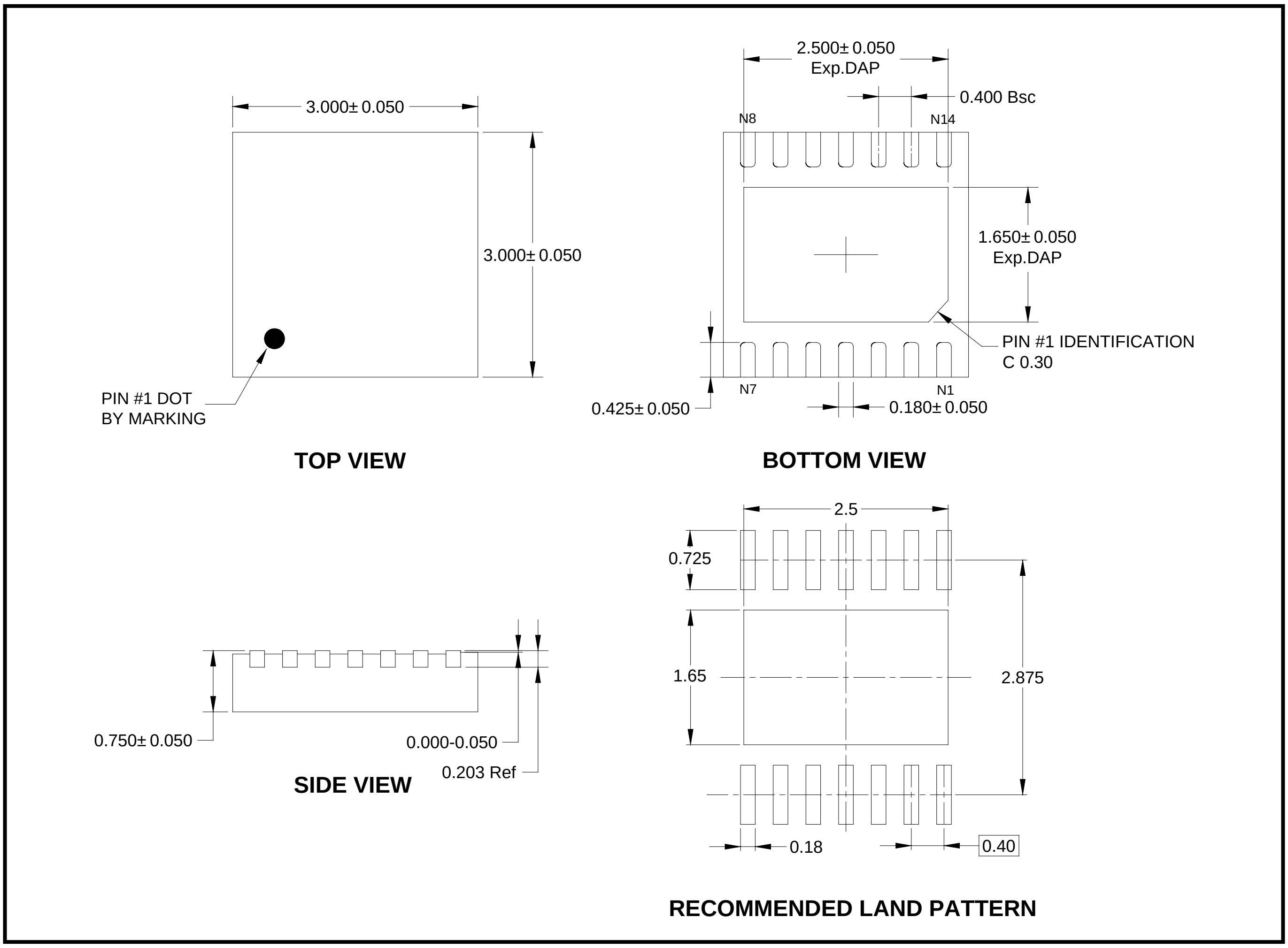


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A		1.100		0.043
A1	0.050	0.150	0.002	0.006
A2	0.800	1.000	0.031	0.039
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	4.900	5.100	0.193	0.201
D1	2.900	3.100	0.114	0.122
E	4.300	4.500	0.169	0.177
E1	6.250	6.550	0.246	0.258
E2	2.200	2.400	0.087	0.094
e	0.650 BSC		0.026 BSC	
L	0.500	0.700	0.02	0.028
H	0.25 TYP		0.01 TYP	
θ	1°	7°	1°	7°

NOTES:
1. Body dimensions do not include mode flash or protrusion.
2. This drawing is subject to change without notice.

PACKAGE OUTLINE DIMENSIONS

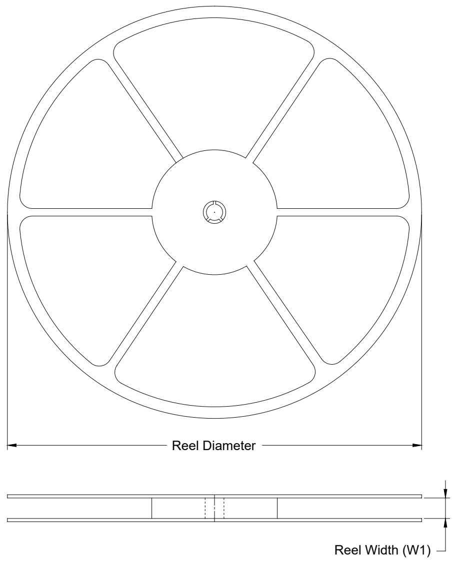
TDFN-3×3-14L



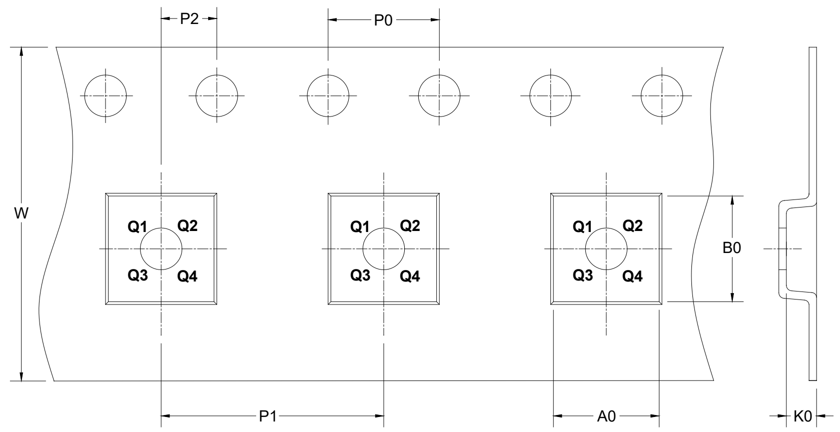
NOTES:
1. All linear dimensions are in millimeters.
2. This drawing is subject to change without notice.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



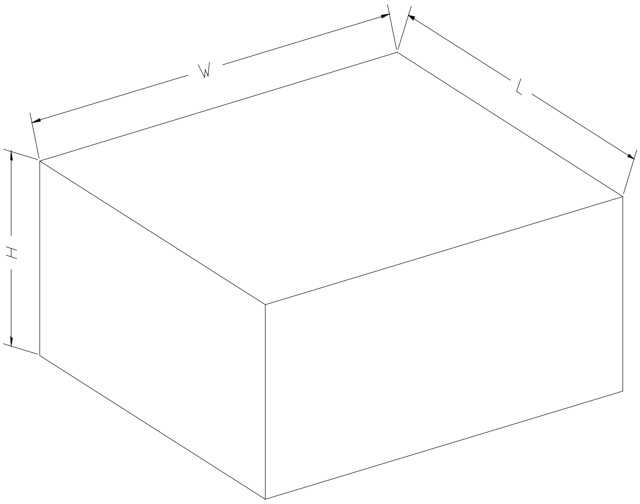
NOTE: The picture is only for reference. Please make the object as the standard.

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
TSSOP-16 (Exposed Pad)	13″	12.4	6.80	5.40	1.50	4.0	8.0	2.0	12.0	Q1
TDFN-3×3-14L	13″	12.4	3.35	3.35	1.13	4.0	8.0	2.0	12.0	Q1

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