SGM2023
Quad, Low Power, Low Dropout, 200mA, RF-Linear Regulators

GENERAL DESCRIPTION

The SGM2023 is a quad, low-power, low-dropout, CMOS linear voltage regulator that operates from 2.5V to 5.5V input and delivers up to 200mA continuous current at each channel. An ultra low ground current (350μA at 0mA output current) makes this part attractive for battery operated power systems.

The SGM2023 also offers low dropout voltage (220mV at 200mA output) to prolong battery life in portable electronics. Systems requiring a quiet voltage source, such as RF applications, will benefit from the SGM2023 series' ultra low output noise (30μV_{RMS}) and high PSRR. An external noise bypass capacitor connected to the device's BP pin can further reduce the noise level.

Other features include a 10nA logic-controlled shutdown mode, output current limit and thermal shut-down protection.

SGM2023 is available in Green TQFN-3×3-16L package. It operates over an ambient temperature range of -40℃ to +85℃.

FEATURES

- **Low Output Noise: 30μV_{RMS} TYP (10Hz to 100kHz)**
- **Low Dropout Voltage:**
  220mV at 200mA Output Load Current
- **Low 350μA No-Load Supply Current**
- **High PSRR: 70dB at 1kHz**
- **Thermal-Overload Protection**
- **Output Current Limit**
- **10nA Logic Controlled Shutdown**
- **-40℃ to +85℃ Operating Temperature Range**
- **Available in Green TQFN-3×3-16L Package**

APPLICATIONS

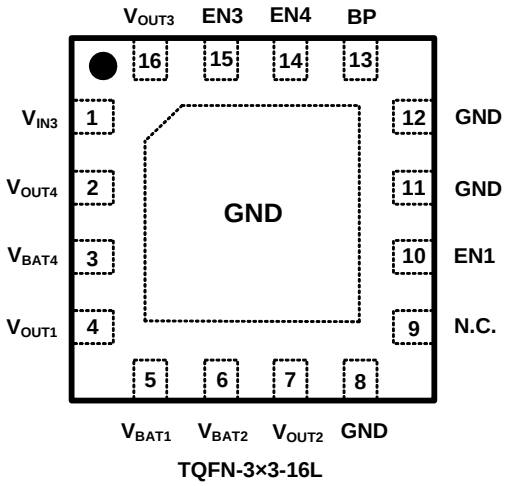
Cellular Telephones
Cordless Telephones
PHS Telephones
PCMCIA Cards
Modems
MP3 Player
Hand-Held Instruments
Palmtop Computers
Electronic Planners
Portable/Battery-Powered Equipment

PACKAGE/ORDERING INFORMATION

MODEL	PIN-PACKAGE	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKAGE OPTION
SGM2023	TQFN-3×3-16L	-40℃ to +85℃	SGM2023YTQ16/TR	2023TQ	Tape and Reel, 3000

PIN CONFIGURATION (TOP VIEW)

SGM2023YTQ16



TQFN-3×3-16L

CAUTION

This integrated circuit can be damaged by ESD if you don't pay attention to ESD protection. 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 very small parametric changes could cause the device not to meet its published specifications.

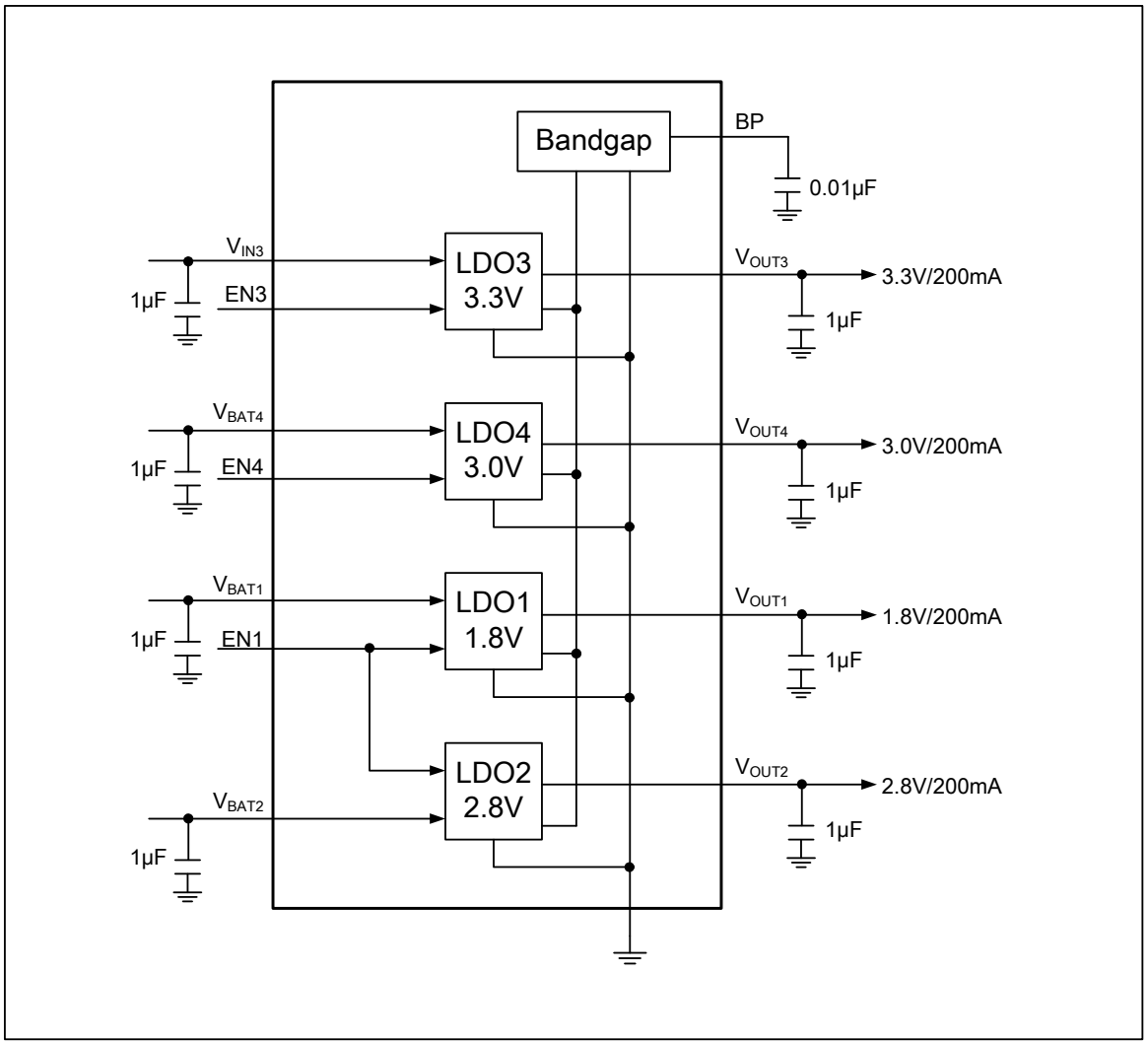
SGMICRO reserves the right to make any change in circuit design, specification or other related things if necessary without notice at any time. Please contact SGMICRO sales office to get the latest datasheet.

ABSOLUTE MAXIMUM RATINGS

IN to GND.....-0.3 V to 6V
Output Short-Circuit Duration .....Infinite
EN to GND.....-0.3V to V_{IN}
OUT, BP to GND..... -0.3V to (V_{IN} + 0.3V)
Operating Temperature Range..... -40℃ to +85℃
Junction Temperature.....150℃
Storage Temperature Range.....-65℃ to +150℃
Lead Temperature (soldering, 10s)..... 260℃
ESD Susceptibility
HBM.....4000V
MM.....400V

NOTE:
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

FUNCTION DIAGRAM



PIN DESCRIPTION

PIN	NAME	FUNCTION
1	V_{IN3}	Regulator Input. Bypass with a 1μF capacitor to GND. In application V_{IN3} is always powered by V_{BUS} of USB interface.
5,6,3	$V_{BAT1,2,4}$	Regulator Input. Bypass with a 1μF capacitor to GND. Connected together externally. In application $V_{BAT1,2,4}$ are always connected to battery directly.
8,11,12	GND	Ground. All GND pins must be connected together externally.
10,15,14	EN1,3,4	Shutdown Input. A logic low reduces the supply current to 10nA. Connect to V_{IN3} or $V_{BAT1, 4}$ for normal operation.
13	BP	Reference-Noise Bypass (fixed voltage version only). Bypass with a low-leakage 0.01μF ceramic capacitor for reduced noise at the output.
4	V_{OUT1}	LDO-1 Regulator Output. Sources up to 200mA. Bypass with a 1μF Capacitor to GND for V_{OUT1} = 1.8V/200mA.
7	V_{OUT2}	LDO-2 Regulator Output. Sources up to 200mA. Bypass with a 1μF Capacitor to GND for V_{OUT2} = 2.8V/200mA.
16	V_{OUT3}	LDO-3 Regulator Output. Sources up to 200mA. Bypass with a 1μF Capacitor to GND for V_{OUT3} = 3.3V/200mA.
2	V_{OUT4}	LDO-4 Regulator Output. Sources up to 200mA. Bypass with a 1μF Capacitor to GND for V_{OUT4} = 3.0V/200mA.
9	N.C.	Not Internally Connected.

ELECTRICAL CHARACTERISTICS

(V_{IN} = $V_{OUT\ (NOMINAL)}$ + 0.5V or 2.5V [1], T_A = -40°C to +85°C. Typical values are at T_A = +25°C, unless otherwise noted.)

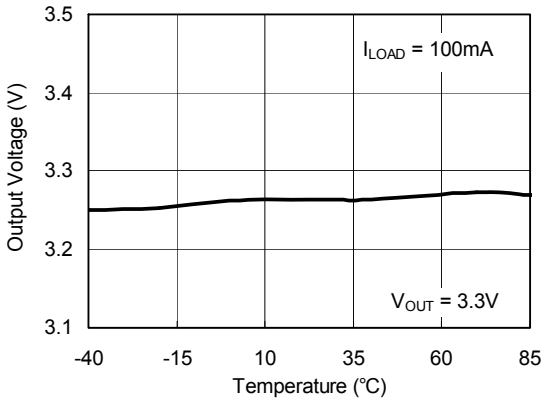
PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Input Voltage	V_{IN}			2.5		5.5	V
Output Voltage Accuracy [1]		I_{OUT} = 0.1mA, T_A = +25°C		-2		+2	%
Maximum Output Current				200			mA
Current Limit	I_{LIM}			210	350		mA
Ground Pin Current	I_Q	No load, EN = 2V			350	550	μA
Dropout Voltage [2]		I_{OUT} = 1mA			1		mV
		I_{OUT} = 200mA			220	330	
Line Regulation [1]	ΔV_{LNR}	V_{IN} = 2.5V or (V_{OUT} + 0.5V) to 5.5V, I_{OUT} = 1mA			0.01	0.15	%/V
Load Regulation	ΔV_{LDR}	I_{OUT} = 0.1mA to 200mA, C_{OUT} = 1μF			0.0005	0.004	%/mA
Output Voltage Noise	e_n	f = 10Hz to 100kHz, C_{BP} = 0.1μF, C_{OUT} = 10μF			30		μV_{RMS}
Power Supply Rejection Rate	PSRR	C_{BP} = 0.1μF, I_{LOAD} = 50mA, C_{OUT} = 1μF	f = 100Hz		72		dB
			f = 1kHz		70		dB
SHUTDOWN							
EN Input Threshold	V_{IH}	V_{IN} = 2.5V to 5.5V		1.5			V
	V_{IL}					0.4	
EN Input Bias Current	$I_{B(SHDN)}$	EN = 0V and EN = 5.5V	T_A = +25°C		0.01	1	μA
			T_A = +85°C		0.01	1	
Shutdown Supply Current	$I_{Q(SHDN)}$	EN = 0.4V	T_A = +25°C		0.01	1	μA
			T_A = +85°C		0.01	1	
Shutdown Exit Delay [3]		C_{BP} = 0.01μF, C_{OUT} = 1μF, No load	T_A = +25°C		30		μs
THERMAL PROTECTION							
Thermal Shutdown Temperature	T_{SHDN}				160		℃
Thermal Shutdown Hysteresis	ΔT_{SHDN}				15		℃

NOTES:
1. V_{IN} = $V_{OUT(NOMINAL)}$ + 0.5V or 2.5V, whichever is greater.
2. The dropout voltage is defined as V_{IN} - V_{OUT}, when V_{OUT} is 100mV below the value of V_{OUT} for V_{IN} = V_{OUT} + 0.5V. (Only applicable for V_{OUT} = +2.5V to +3.3V.)
3. Time needed for V_{OUT} to reach 95% of final value.

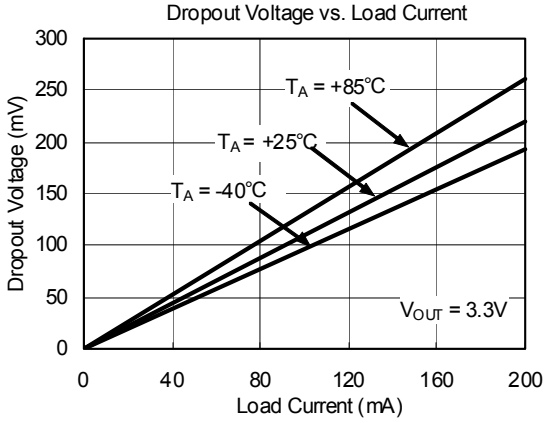
TYPICAL OPERATING CHARACTERISTICS

V_{IN} = $V_{OUT(NOMINAL)}$ + 0.5V or 2.5V (whichever is greater), C_{IN} = 1μF, C_{OUT} = 1μF, C_{BP} = 0.01μF, T_A = +25℃, unless otherwise noted.

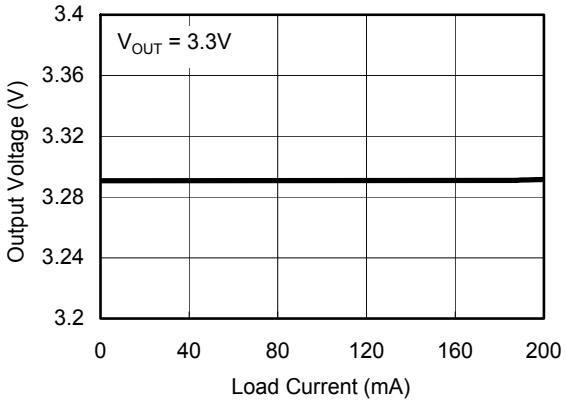
Output Voltage vs. Temperature



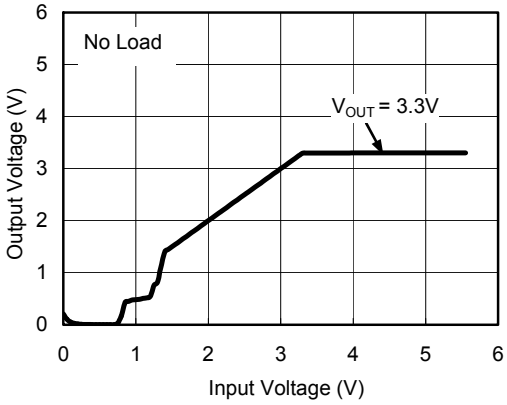
Dropout Voltage vs. Load Current



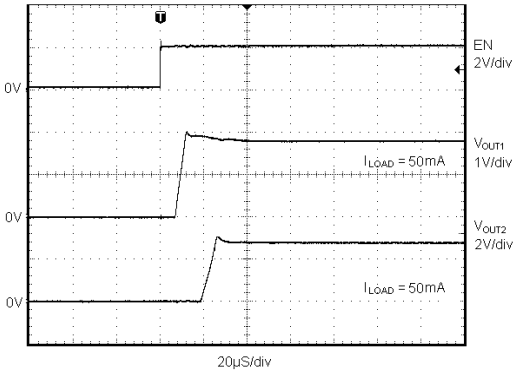
Output Voltage vs. Load Current



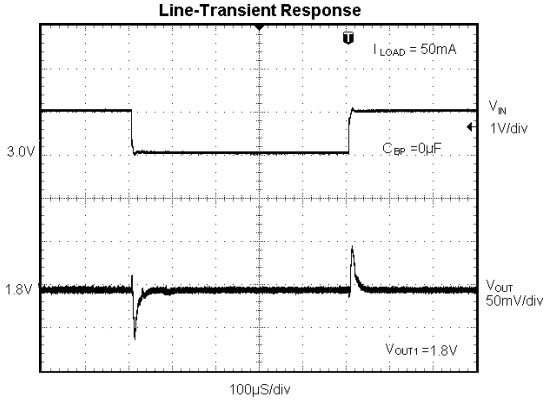
Output Voltage vs. Input Voltage



Shutdown Exit Delay



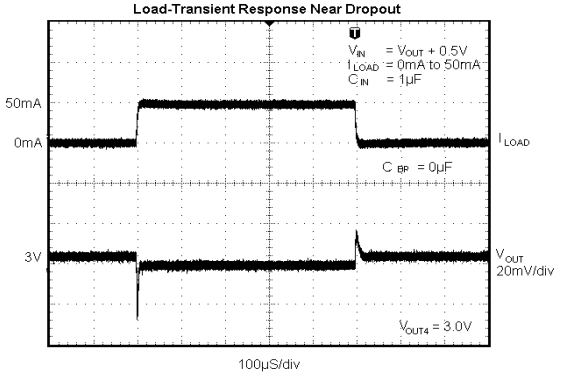
Line-Transient Response



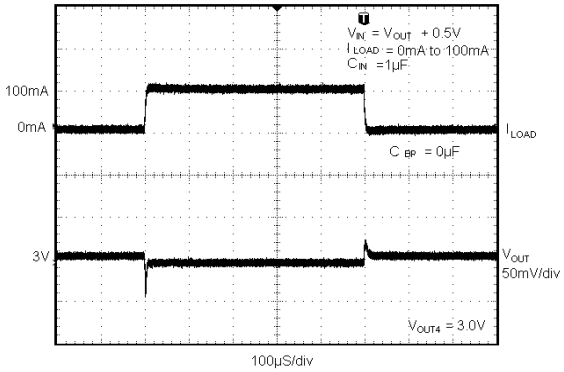
TYPICAL OPERATING CHARACTERISTICS

V_{IN} = $V_{OUT(NOMINAL)}$ + 0.5V or 2.5V (whichever is greater), C_{IN} = 1μF, C_{OUT} = 1μF, C_{BP} = 0.01μF, T_A = +25℃, unless otherwise noted.

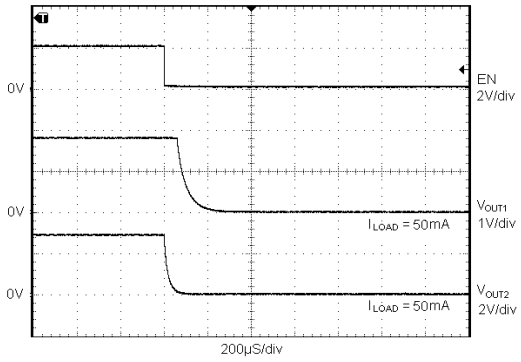
Load-Transient Response Near Dropout



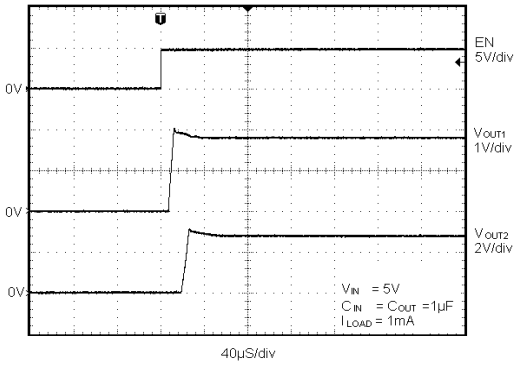
Load-Transient Response



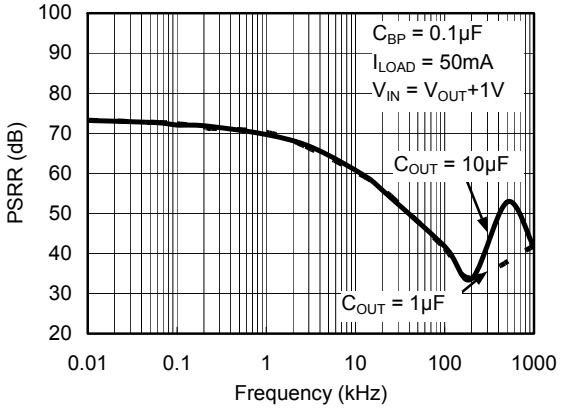
Entering Shutdown



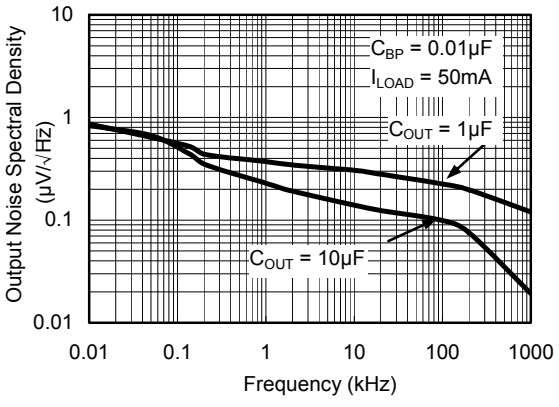
Start Up



Power-Supply Rejection Ratio vs. Frequency



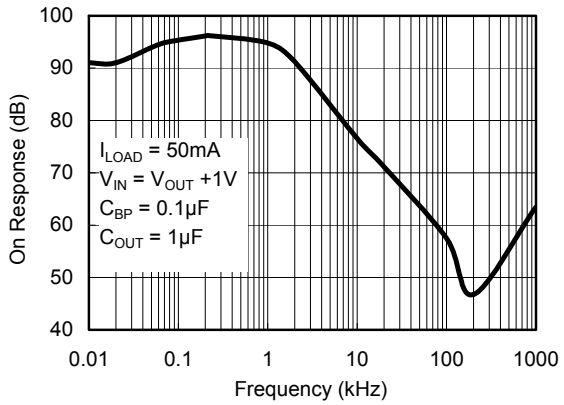
Output Noise Spectral Density vs. Frequency



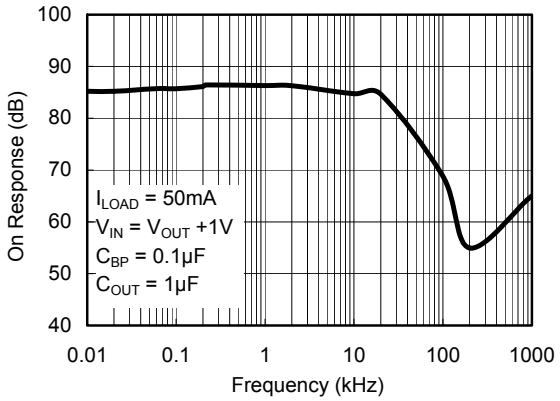
TYPICAL OPERATING CHARACTERISTICS

V_{IN} = $V_{OUT(NOMINAL)}$ + 0.5V or 2.5V (whichever is greater), C_{IN} = 1μF, C_{OUT} = 1μF, C_{BP} = 0.01μF, T_A = +25℃, unless otherwise noted.

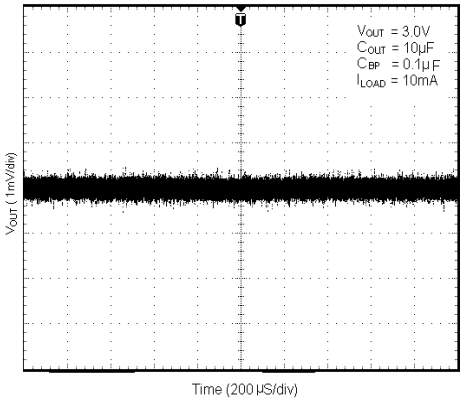
Crosstalk vs. Frequency



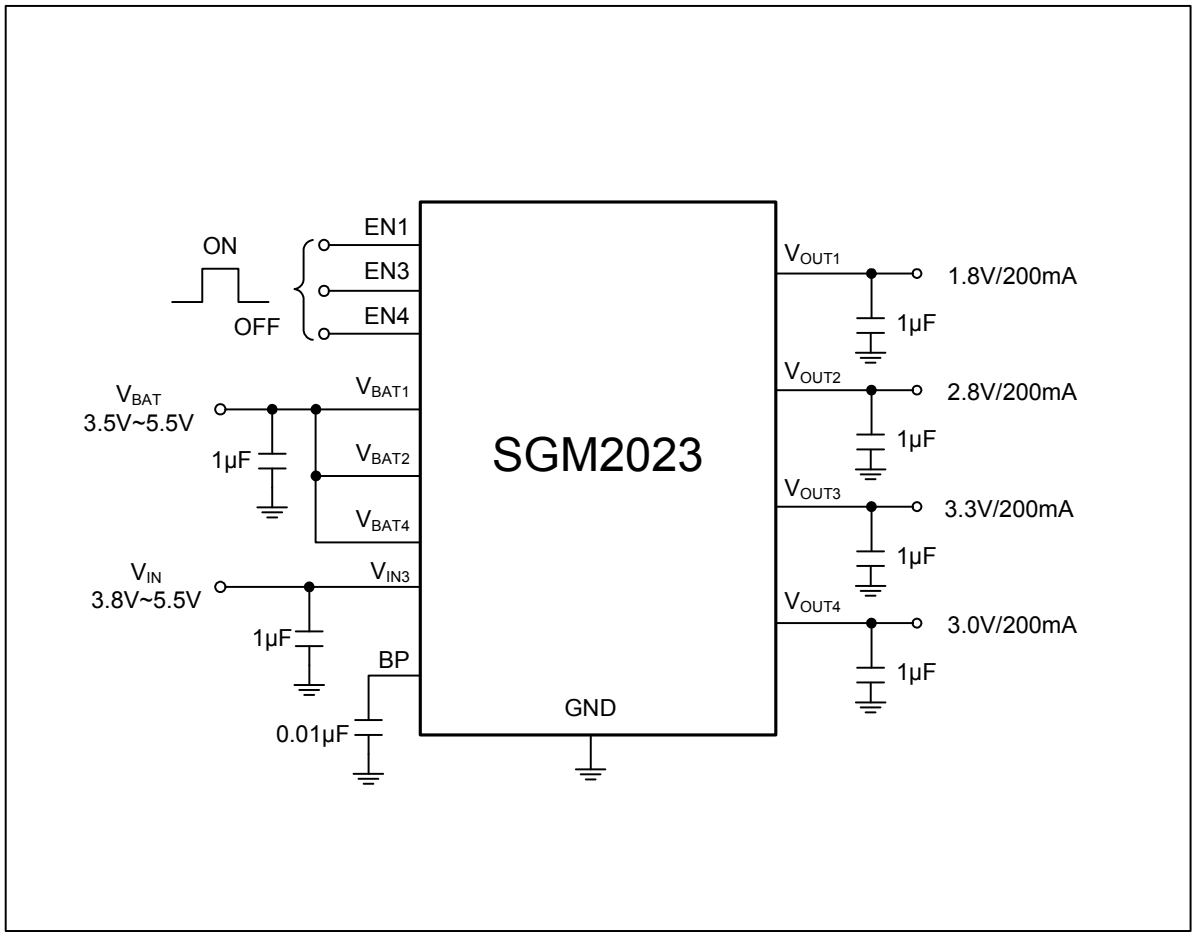
Off-Isolation vs. Frequency



Output Noise 10Hz to 100KHz



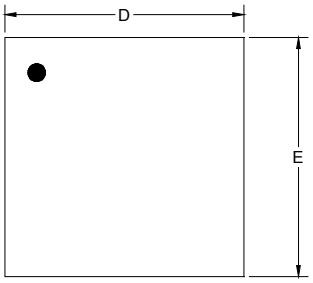
TYPICAL APPLICATION CIRCUIT



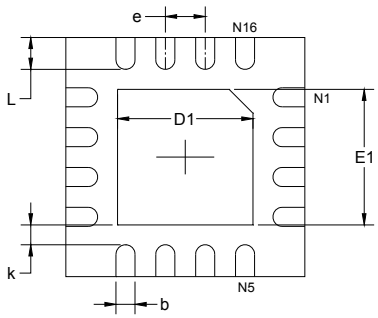
NOTES:
1. V_{BAT1}, V_{BAT2} and V_{BAT4} should be connected together and input voltage should not be less than 2.5V.
2. Since channel2 enable signal is gained from channel1's output, only after channel1 starts up normally, channel2 starts to output 1.8V.
3. The input voltage of channel2 required to maintain voltage ranging from 3.3V to 5.5V.
4. To ensure stability, LDO's input and output terminals need to have a capacitor (no less than 1μF) respectively.
5. BP pin must be decoupled by a low-leakage 0.01μF ceramic capacitor in order to reduce output noise.

PACKAGE OUTLINE DIMENSIONS

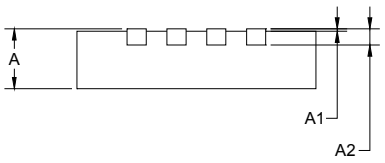
TQFN-3×3-16L



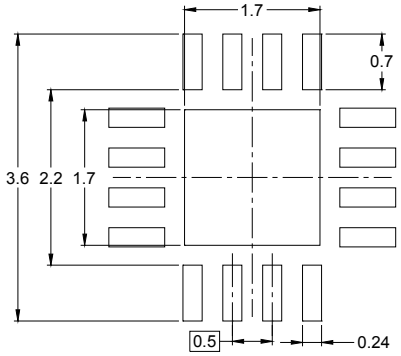
TOP VIEW



BOTTOM VIEW



SIDE VIEW

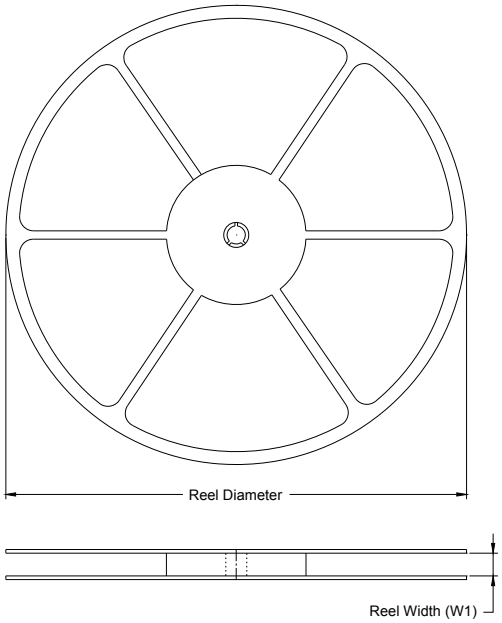


RECOMMENDED LAND PATTERN (Unit: mm)

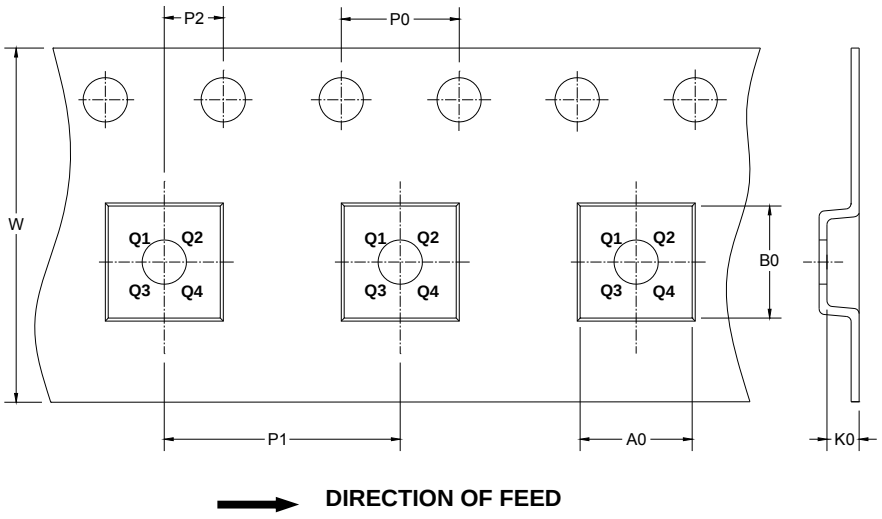
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A2	0.203 REF		0.008 REF	
D	2.900	3.100	0.114	0.122
D1	1.600	1.800	0.063	0.071
E	2.900	3.100	0.114	0.122
E1	1.600	1.800	0.063	0.071
k	0.200 MIN		0.008 MIN	
b	0.180	0.300	0.007	0.012
e	0.500 TYP		0.020 TYP	
L	0.300	0.500	0.012	0.020

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS

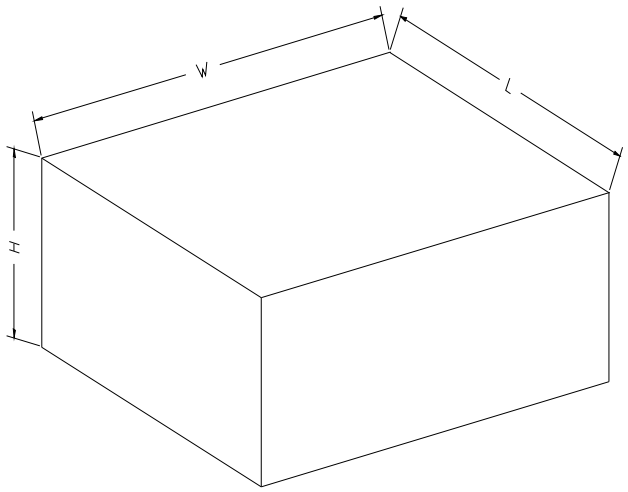


NOTE: The picture is only for reference. Please make the object as the standard.

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-3×3-16L	13″	12.40	3.35	3.35	1.13	4.00	4.00	2.00	12.00	Q1

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