WS72144

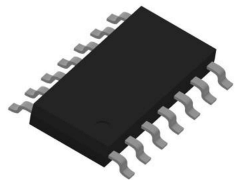
300nA Nano-Power Rail-to-Rail Input Output Operational Amplifiers

Http//:www.willsemi.com

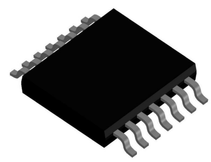
Descriptions

The WS72144 is a quad low-voltage operational amplifier with rail-to-rail input/output swing. Ultra low power makes this amplifier ideal for battery-powered and portable applications. The WS72144 has a gain-bandwidth product of 13kHz (TYP) and is unity gain stable. These specifications make this operational amplifier appropriate for low frequency applications, such as battery current monitoring and sensor conditioning.

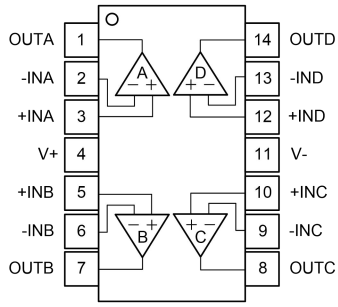
WS72144 is available with MSL 3 Level in SOP-14L package and TSSOP-14L package. Standard products are Pb-Free and halogen-Free.



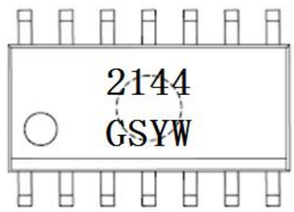
SOP-14L



TSSOP-14L



SOP-14L/TSSOP-14L
Pin configuration (Top view)



SOP-14L

TSSOP-14L

Marking

2144 = Device code
GS = Special code
GH = Special code
Y = Year code
W = Week code

Applications

- Handsets and Mobile Accessories
- Current Sensing
- Wireless Remote Sensors,Active RFID Readers
- Environment/Gas/Oxygen Sensors
- Threshold Detectors/Discriminators
- Low Power Filters
- Battery or Solar Powered Devices
- Sensor Network Powered by Energy Scavenging

Features

- Wide Supply Voltage : 1.6~5.5V
- Quiescent Current per Amplifier : 300nA Typical
- GBWP : 13kHz
- Rail-to-Rail Input/Output Swing
- Unity Gain Stable
- -40°C to 125°C Operation Temperature Range
- Available in Green SOP-14L and TSSOP-14L Packages

Order Information

Device	Package	Shipping
WS72144S-14/TR	SOP-14L	4000/Reel &Tape
WS72144H-14/TR	TSSOP-14L	4000/Reel &Tape

Pin Descriptions

Pin Number	Symbol	Descriptions
1	OUTA	Output
2	-INA	Inverting input
3	+INA	Non-inverting input
4	V+	Positive supply
5	+INB	Non-inverting input
6	-INB	Inverting input
7	OUTB	Output
8	OUTC	Output
9	-INC	Inverting input
10	+INC	Non-inverting input
11	V-	Negative supply
12	+IND	Non-inverting input
13	-IND	Inverting input
14	OUTD	Output

Absolute Maximum Ratings(1)

Parameter	Symbol	Value	Unit
Supply Voltage, ([V+] - [V-])	V_S(2)	6	V
Input Common Mode Voltage Range	V_{ICR}	(V-)-0.3 to (V+)+0.3	V
Output Short-Circuit Duration	t_{SO}(3)	Unlimited	/
Operating Fee-Air Temperature Range	T_A	-40 to 125	˚C
Storage Temperature Range	T_{STG}	-65 to 150	˚C
Junction Temperature Range	T_J	150	˚C
Lead Temperature Range	T_L	260	˚C

Note:

1. Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are only stress ratings, and functional operation of the device at these or any other conditions beyond those indicated under recommended operating conditions are not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
2. All voltage values, except differential voltage are with respect to network terminal.
3. A heat sink may be required to keep the junction temperature below the absolute maximum，depends on the power supply voltage and how many amplifiers are shorted. Thermal resistance varies the amount of PC board metal connected to the package. The specified values are for short traces connected to leads.

ESD, Electrostatic Discharge Protection

Symbol	Parameter	Condition	Minimum level	Unit
HBM	Human Body Model ESD	MIL-STD-883H Method 3015.8 JEDEC-EIA/JESD22-A114A	±8000	V
CDM	Charged Device Model ESD	JEDEC-EIA/JESD22-C101E	±2000	V
MM	Machine Model ESD	JEDEC-EIA/JESD22-A115	±400	V

Electronics Characteristics

The *denotes the specifications which apply over the full operating temperature range, otherwise specifications are at T_A = 27°C. V_S = 5V, V_{CM} = V_{OUT} = V_S/2, R_{load} = 100kΩ, C_{load} = 60pF.

Symbol	Parameter	Conditions	*	Min.	Typ.	Max.	Unit
V_{OS}	Input Offset Voltage	V_{CM}= V_S/2 and V_{CM}=GND	*	-3.0	±0.1	3.0	mV
α_{VOS}	Input Offset Voltage Drift				1.6		μV/°C
I_{IB}	Input Bias Current				<10		pA
I_{OS}	Input Offset Current				<10		pA
V_n	Input Voltage Noise	f=0.1Hz to10Hz			8		μV_{P-P}
e_n	Input Voltage Noise Density	f=1kHz			80		nV/√Hz
R_{IN}	Input Resistance				>1		TΩ
CMRR	Common Mode Rejection Ratio	V_{CM}=0.1V to 4.9V	*	55	75		dB
V_{CM}	Common Mode Input Voltage Range		*	(V-)-0.3		(V+)+0.3	V
PSRR	Power Supply Rejection Ratio		*	65	91		dB
A_{VOL}	Open Loop Large Signal Gain	V_{OUT}=2.5V,R_{load}=100kΩ			118		dB
		V_{OUT}=0.1V to 4.9V, R_{load}=100kΩ	*	85	118		dB
V_{OL},V_{OH}	Output Swing from Supply Rail	R_{load}=100kΩ			5		mV
R_{OUT}	Closed-Loop Output Impedance	G=1,f=1kHz,I_{OUT}=0			4.3		Ω
I_{SC}	Output Short-Circuit Current	Sink or Source Current		10	15		mA
V_{DD}	Supply Voltage			1.6		5.5	V
I_Q	Quiescent Current per Amplifier		*		300	450	nA
PM	Phase Margin	R_{load}=100kΩ, C_{load}=60pF			80		degrees
GM	Gain Margin	R_{load}=100kΩ, C_{load}=60pF			18		dB
GBWP	Gain-Bandwidth Product	f=1kHz			13		kHz
t_S	Settling Time: 1.5 to 3.5V, Unity Gain	0.1%			0.4		ms
	Settling Time: 2.45 to 2.55V, Unity Gain	0.1%			0.04		ms
SR	Slew Rate	A_V=1, V_{OUT}=1.5V to 3.5V, R_{load}=100kΩ, C_{load}=60pF			5		mV/μs
FPBW	Full Power Bandwidth[Note1]	2V_{P-P}			300		Hz

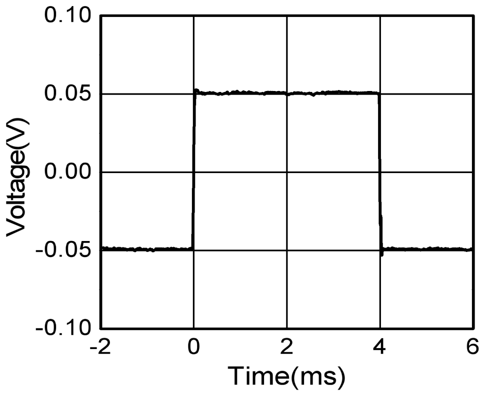
Note:

1. Full power bandwidth is calculated from the slew rate FPBW = SR/(π • V_{P-P}).

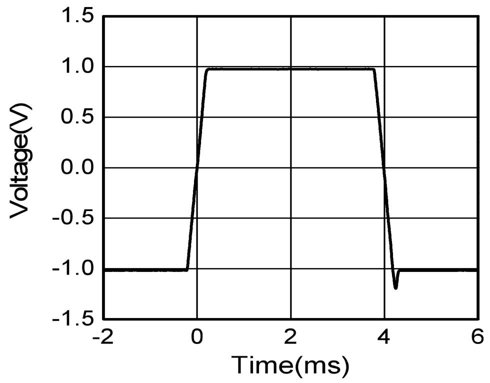
Typical Characteristics

T_A=25°C, V_S=5V, V_{CM}=V_S/2, unless otherwise noted

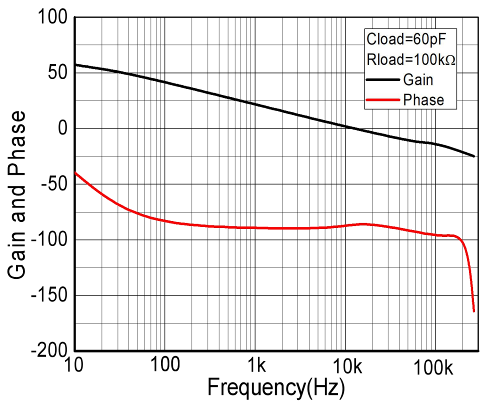
Small-Siganl Step Response, 100mV Step



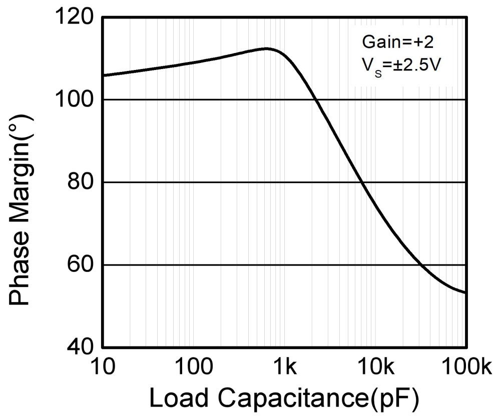
Large-Siganl Step Response, 2V Step



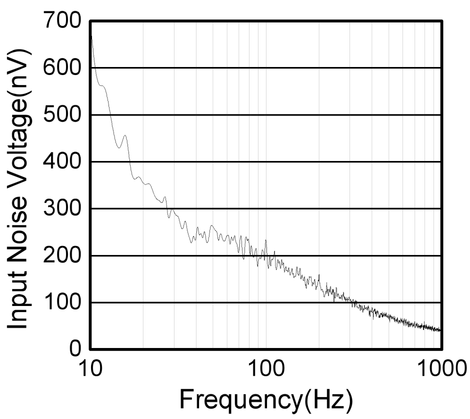
Open-Loop Gain and Phase



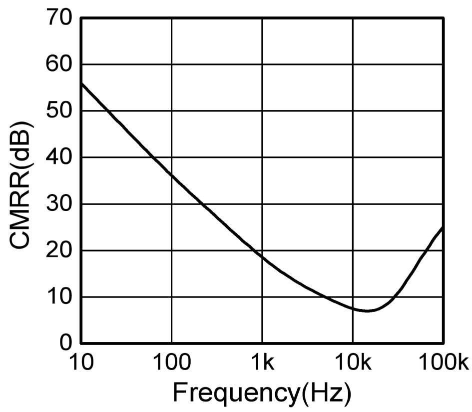
Phase Margin vs. C_{load} (Stable for Any C_{load})



Input Voltage Noise Spectral Density



CMRR vs. Frequency

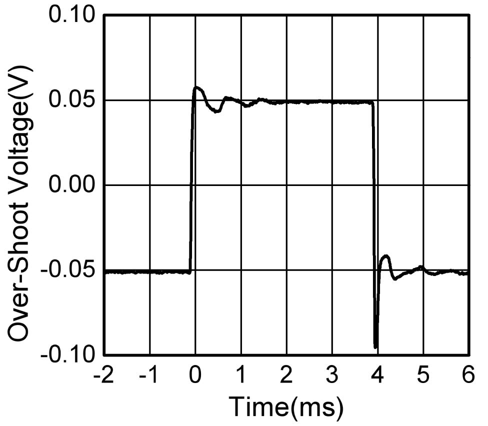


Typical Characteristics (continued)

T_A=25°C, V_S=5V, V_{CM}=V_S/2, unless otherwise noted

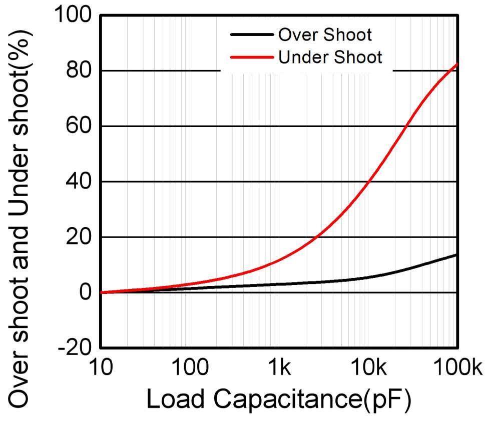
Over-Shoot Voltage

Gain=-1,C_{LOAD} = 40nF, V_S=±2.5V



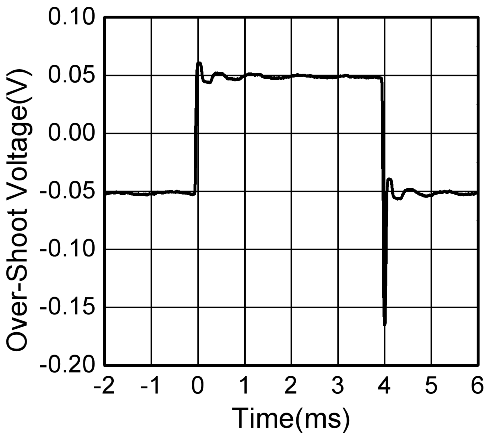
Over-Shoot % vs. C_{load}

Gain=-1,C_{LOAD} = 40nF, V_S=±2.5V



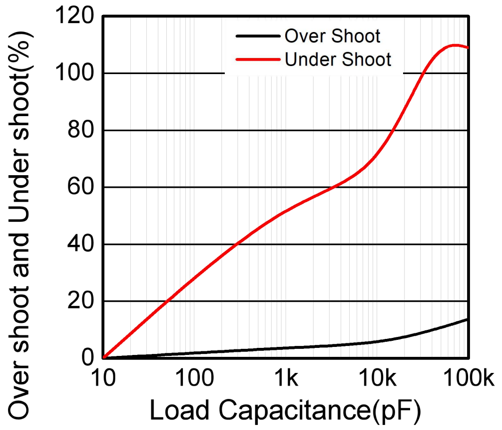
Over-Shoot Voltage

Gain=+1,C_{LOAD} = 40nF, V_S=±2.5V

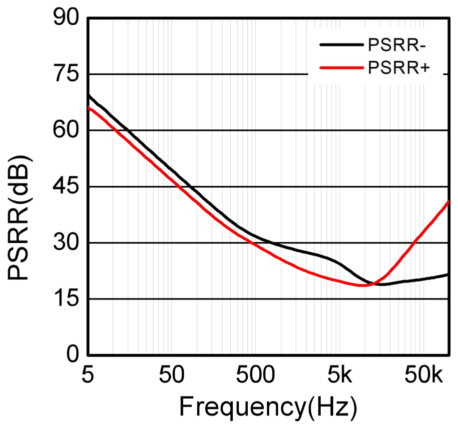


Over-Shoot % vs. C_{load}

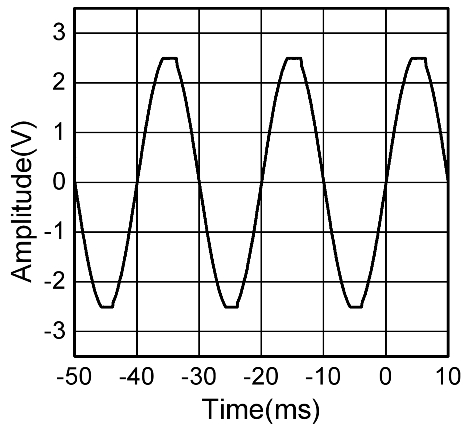
Gain =+1, C_{LOAD} = 40nF, V_S=±2.5V



Power-Supply Rejection Ratio



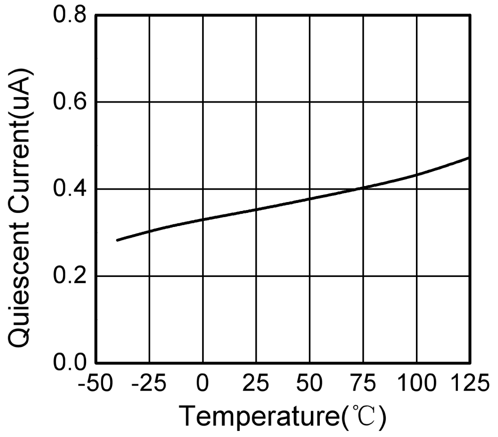
VIN = -0.2V to 5.7V, No Phase Reversal



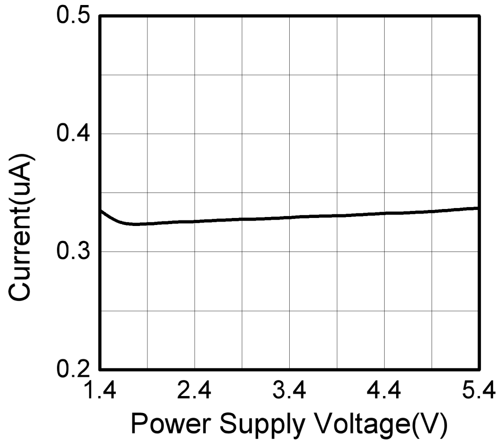
Typical Characteristics (continued)

T_A=25°C, V_S=5V, V_{CM}=V_S/2, unless otherwise noted

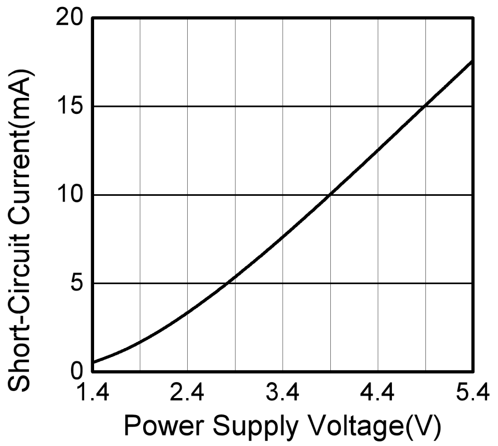
Quiescent Supply Current vs. Temperature



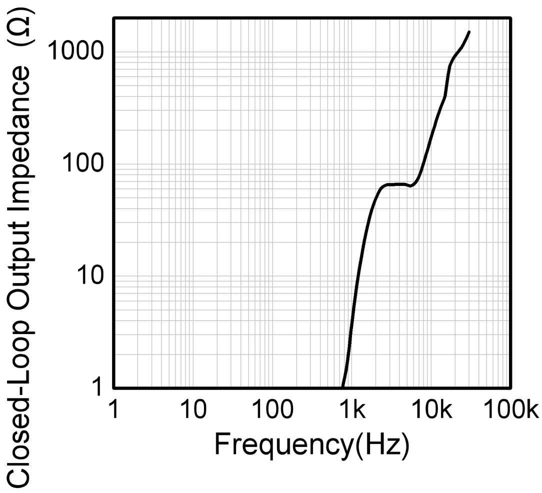
Quiescent Supply Current vs. Supply Voltage



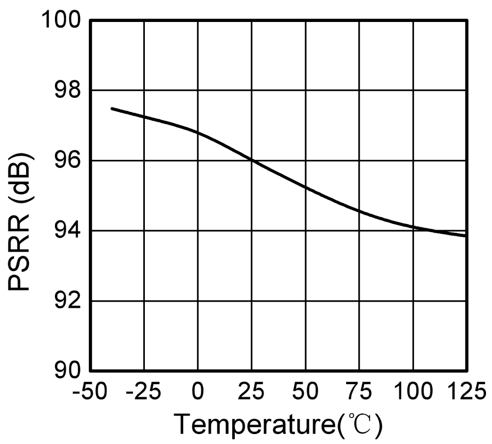
Short-Circuit Current vs. Supply Voltage



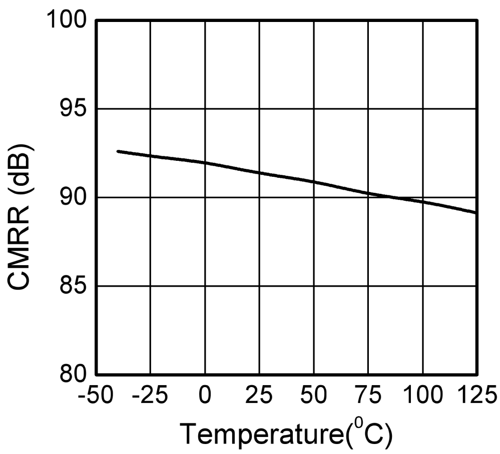
Closed-Loop Output Impedance vs. Frequency



PSRR vs. Frequency



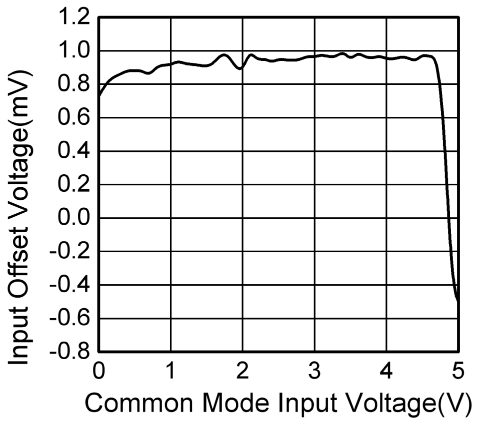
CMRR vs. Temperature



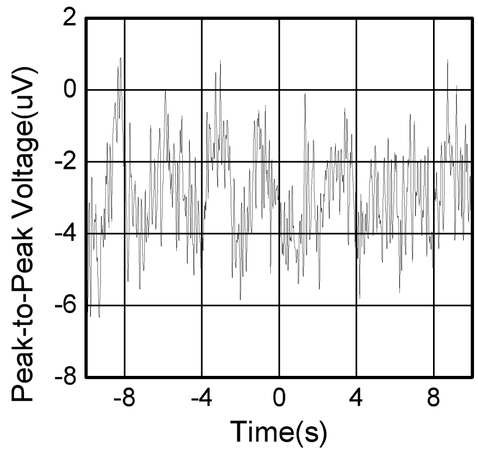
Typical Characteristics (continued)

T_A=25°C, V_S=5V, V_{CM}=V_S/2, unless otherwise noted

Input Offset Voltage vs. Common Mode Input Voltage

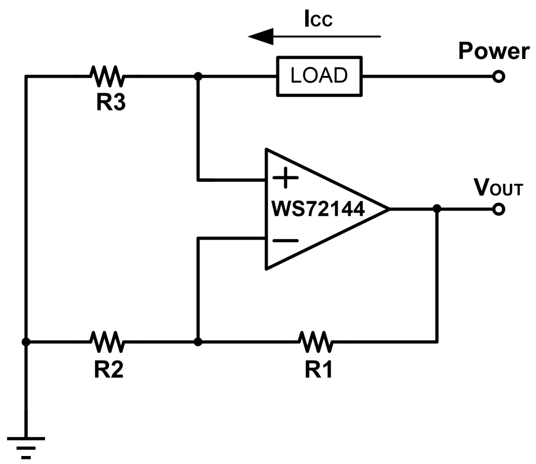


0.1Hz to 10Hz Time Domain Output Voltage Noise



Application Circuit

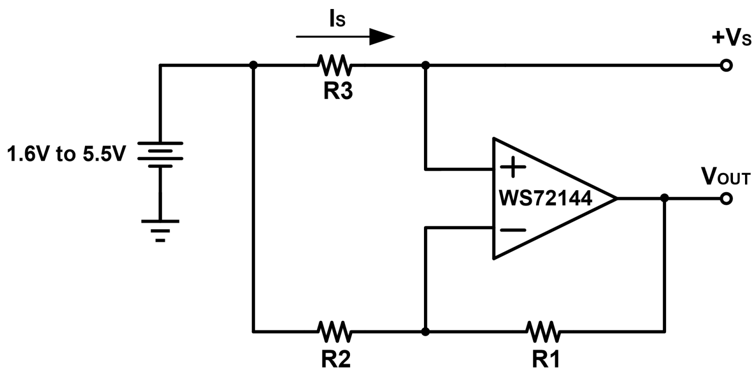
(1) WS72144 in Low Side Battery Current Sensor



Application Circuit for Low Side Battery Current Sensor

$$V_{OUT} = I_{CC} \times R_3 \times (\frac{R_1}{R_2} + 1)$$

(2) WS72144 in High Side Battery Current Sensor

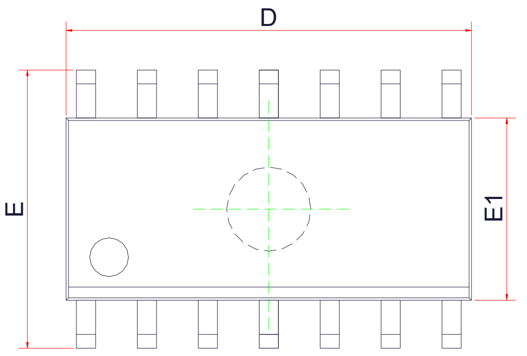


Application Circuit for High Side Battery Current Sensor

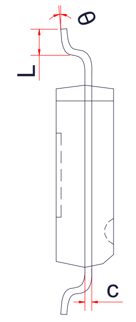
$$I_S = \frac{+V_S - V_{OUT}}{R_1 \times R_3 \div R_2}$$

PACKAGE OUTLINE DIMENSIONS

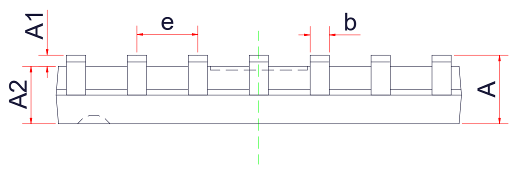
SOP-14L



TOP VIEW



SIDE VIEW



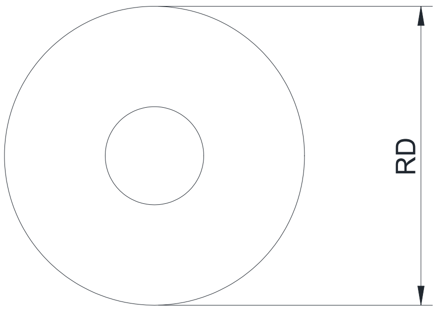
SIDE VIEW

Symbol	Dimensions In Millimeters (mm)		
	Min.	Typ.	Max.
A	-	-	1.75
A1	0.10	-	0.25
A2	1.25	-	-
b	0.31	0.41	0.51
c	0.10	-	0.25
D	8.45	8.65	8.85
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27 BSC		
L	0.40	-	1.27
θ	0°	-	8°

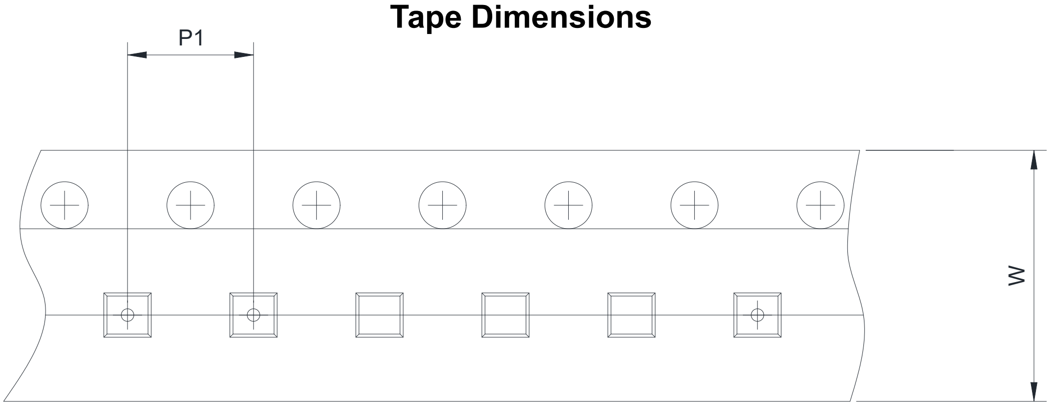
TAPE AND REEL INFORMATION

SOP-14L

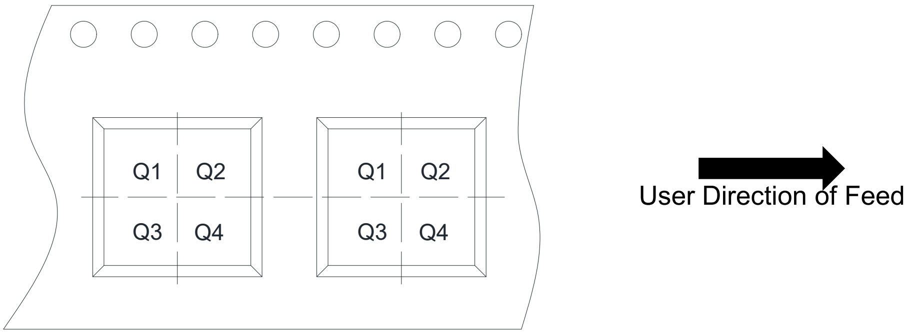
Reel Dimensions



Tape Dimensions



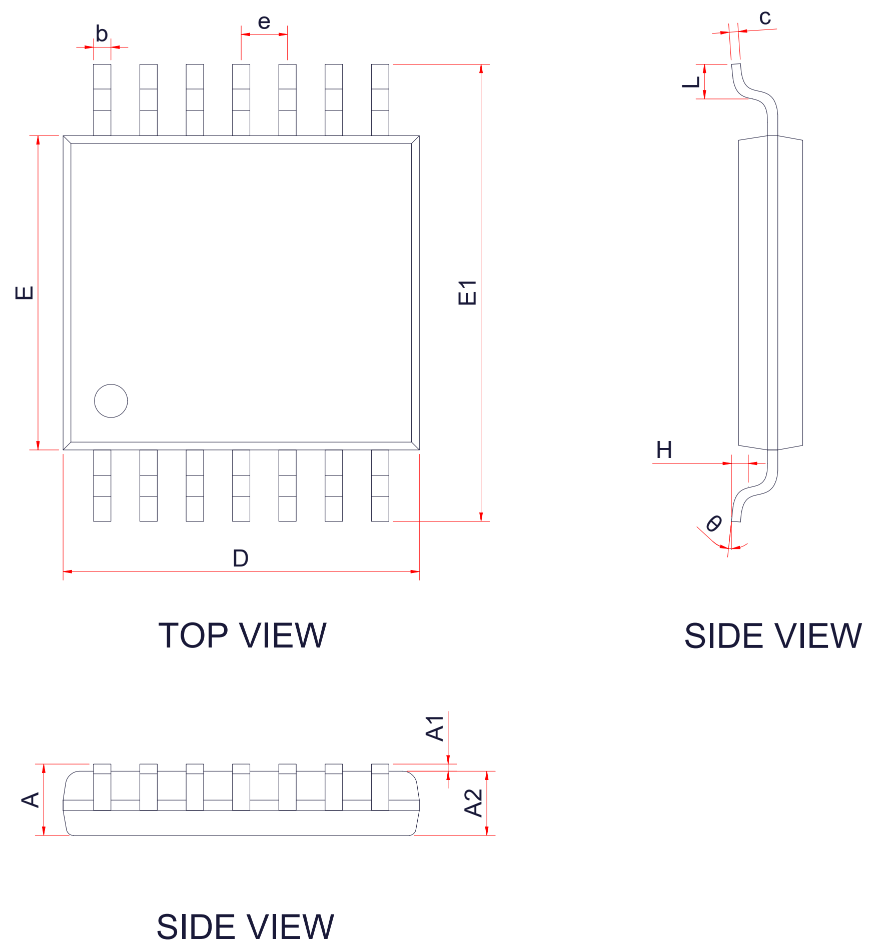
Quadrant Assignments For PIN1 Orientation In Tape



RD	Reel Dimension	☐ 7inch ☑ 13inch
W	Overall width of the carrier tape	☐ 8mm ☐ 12mm ☑ 16mm
P1	Pitch between successive cavity centers	☐ 2mm ☐ 4mm ☑ 8mm
Pin1	Pin1 Quadrant	☑ Q1 ☐ Q2 ☐ Q3 ☐ Q4

PACKAGE OUTLINE DIMENSIONS

TSSOP-14L

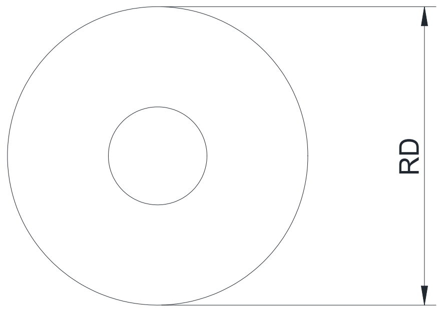


Symbol	Dimensions in Millimeters		
	Min.	Typ.	Max.
A	-	-	1.20
A1	0.05	-	0.15
A2	0.80	0.90	1.00
b	0.19	-	0.30
c	0.09	-	0.20
D	4.90	5.00	5.10
E	4.30	4.40	4.50
E1	6.25	6.40	6.55
e	0.65 BSC		
L	0.50	0.60	0.70
H	0.25Typ		
θ	1 °	-	7 °

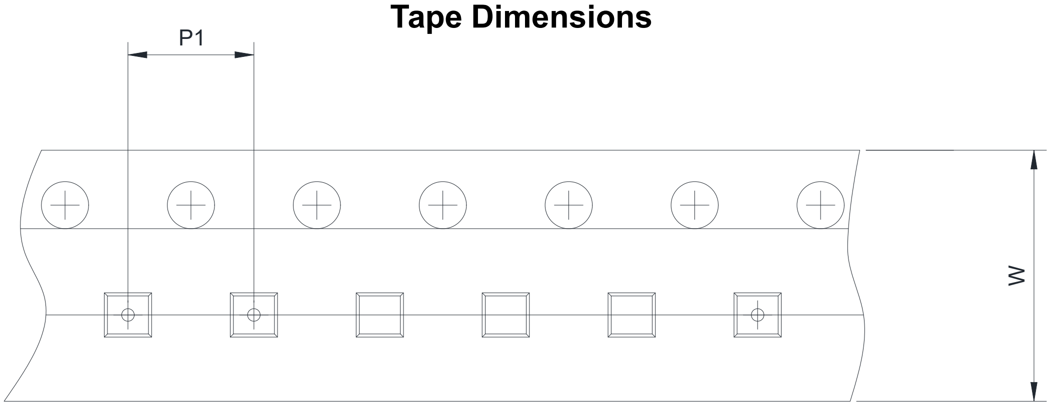
TAPE AND REEL INFORMATION

TSSOP-14L

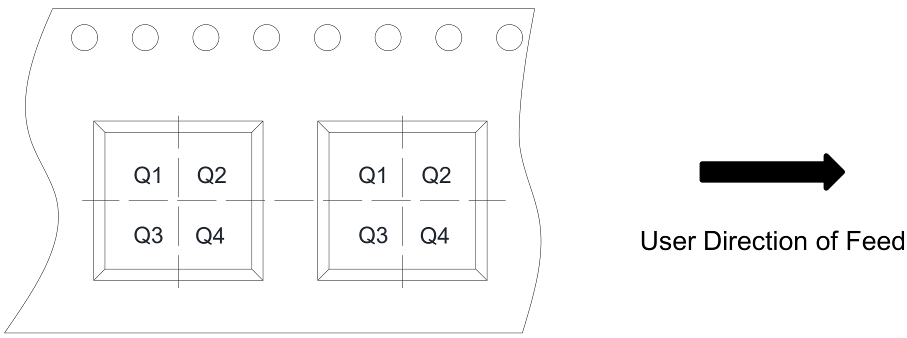
Reel Dimensions



Tape Dimensions



Quadrant Assignments For PIN1 Orientation In Tape



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