WS72041

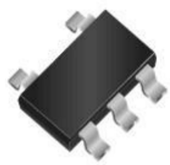
600nA Nano-Power Rail-to-Rail Input Output Operational Amplifiers

Http://www.omnivision-group.com

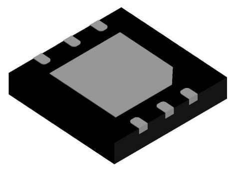
Descriptions

The WS72041 is a single 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 WS72041 has a gain-bandwidth product of 29kHz (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.

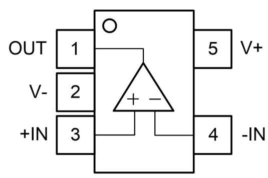
WS72041 is available with MSL 3 Level in SOT-23-5L and DFN2x2-6 packages. Standard products are Pb-Free and halogen-Free.



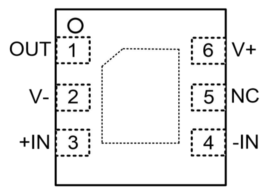
SOT-23-5L



DFN2x2-6

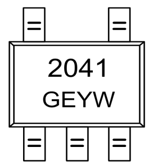


SOT-23-5L

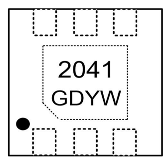


DFN2x2-6

Pin configuration (Top view)



SOT-23-5L



DFN2x2-6

Marking

2041 = Device code
GE = Special code
GD = 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
- Low Quiescent Current : 610nA Typical
- GBWP : 29kHz
- Rail-to-Rail Input/Output Swing
- Unity Gain Stable
- -40°C to 85°C Operation Temperature Range
- Available in Green SOT-23-5L and DFN2x2-6 Packages

Order Information

Device	Package	Shipping
WS72041E-5/TR	SOT-23-5L	3000/Reel &Tape
WS72041D-6/TR	DFN2x2-6	3000/Reel &Tape

Pin Descriptions (SOT-23-5L)

Pin Number	Symbol	Descriptions
1	OUT	Output
2	V-	Negative supply
3	+IN	Non-inverting input
4	-IN	Inverting input
5	V+	Positive supply

Pin Descriptions (DFN2x2-6)

Pin Number	Symbol	Descriptions
1	OUT	Output
2	V-	Negative supply
3	+IN	Non-inverting input
4	-IN	Inverting input
5	NC	No connection
6	V+	Positive supply

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.This 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 the 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, V_{SHDN} is unconnected.

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				2.8		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			5		μV_{P-P}
e_n	Input Voltage Noise Density	f=1kHz			125		nV/√Hz
R_{IN}	Input Resistance				>1		TΩ
CMRR	Common Mode Rejection Ratio	V_{CM}=0.1V to 4.9V	*	55	74		dB
V_{CM}	Common Mode Input Voltage Range		*	(V^-)-0.3		(V^+)+0.3	V
PSRR	Power Supply Rejection Ratio		*	60	86		dB
A_{VOL}	Open Loop Large Signal Gain	V_{OUT}=2.5V,R_{load}=100kΩ		80	120		dB
		V_{OUT}=0.1V to 4.9V, R_{load}=100kΩ	*	80	120		dB
V_{OL},V_{OH}	Output Swing from Supply Rail	R_{load}=100kΩ			3		mV
R_{OUT}	Closed-Loop Output Impedance	G=1,f=1kHz,I_{OUT}=0			0.7		Ω
I_{SC}	Output Short-Circuit Current	Sink or Source Current		12	20		mA
V_{DD}	Supply Voltage			1.6		5.5	V
I_Q	Quiescent Current		*		610	760	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			29		kHz
t_S	Settling Time: 1.5 to 3.5V, Unity Gain	0.1%			0.18		ms
	Settling Time: 2.45 to 2.55V, Unity Gain	0.1%			0.02		ms
SR	Slew Rate	A_V=1, V_{OUT}=1.5V to 3.5V, R_{load}=100kΩ, C_{load}=60pF			9		mV/μs
FPBW	Full Power Bandwidth[Note1]	$2V_{P-P}$			600		Hz

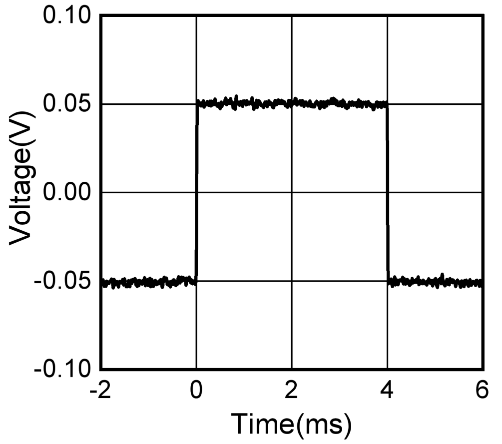
Note:

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

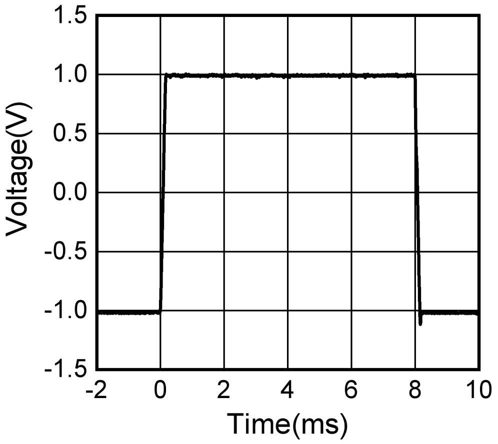
Typical Characteristics

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

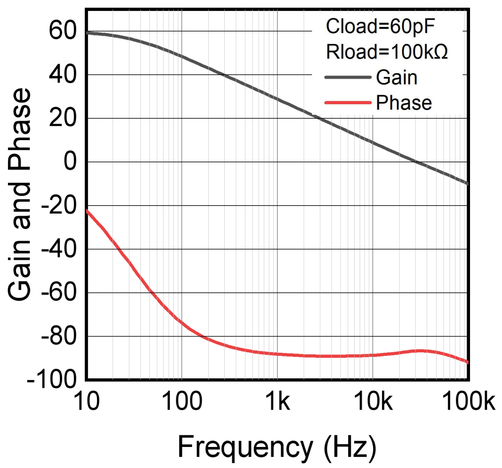
Small-Siganl Step Response, 100mV Step



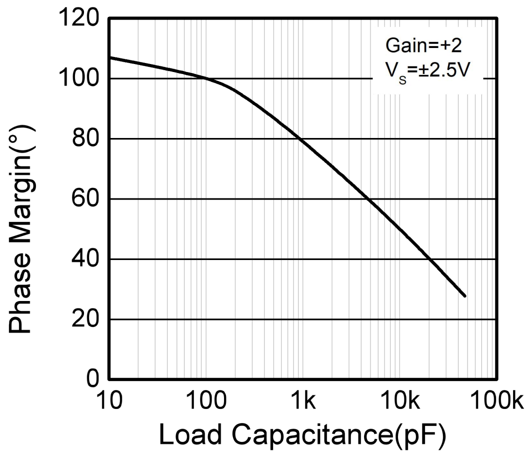
Large-Siganl Step Response, 2V Step



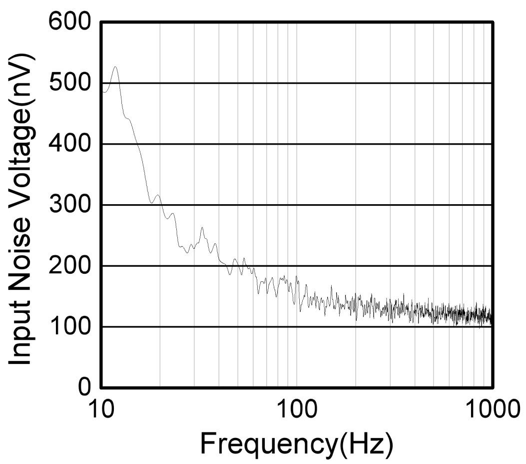
Open-Loop Gain and Phase



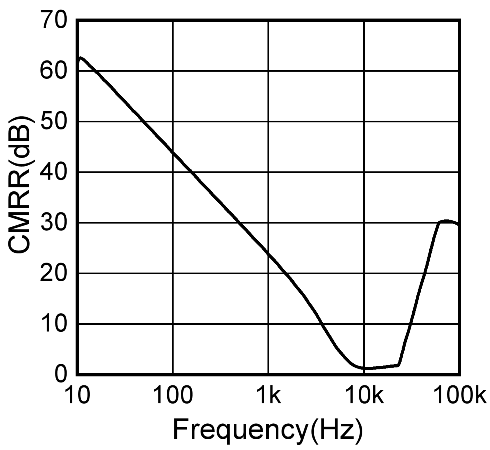
Phase Margin vs. C_{load} (Stable for Any C_{load})



Input Voltage Noise Spectral Density



CMRR vs. Frequency

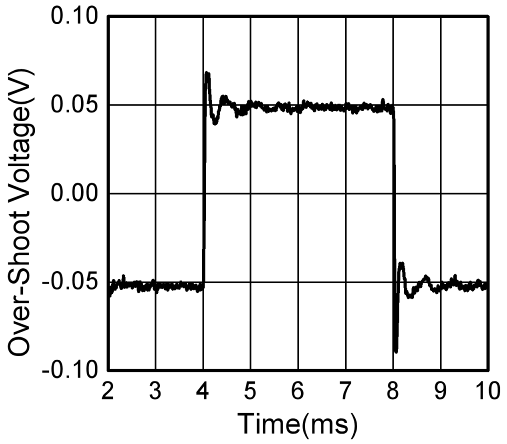


Typical Characteristics (continued)

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

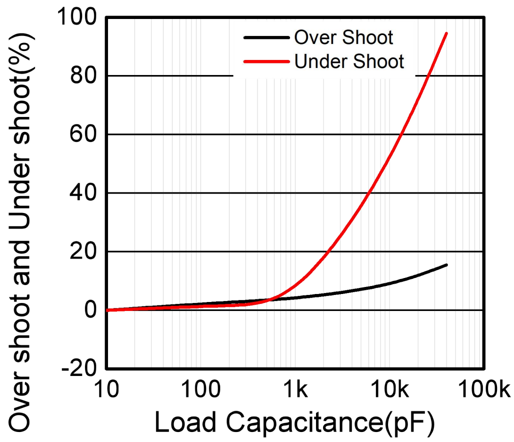
Over-Shoot Voltage

Gain=-1,C_{LOAD} = 40nF, V_S=±2.5V



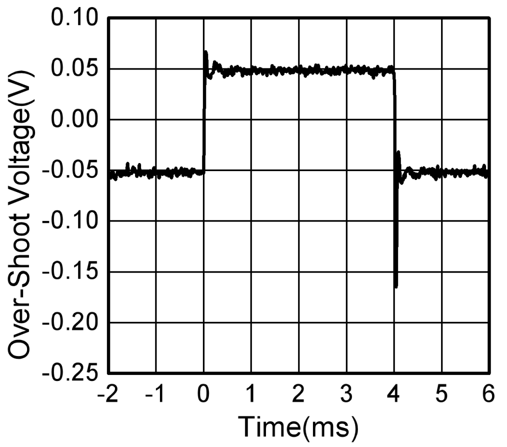
Over-Shoot % vs. C_{load}

Gain=-1,C_{LOAD} = 40nF, V_S=±2.5V



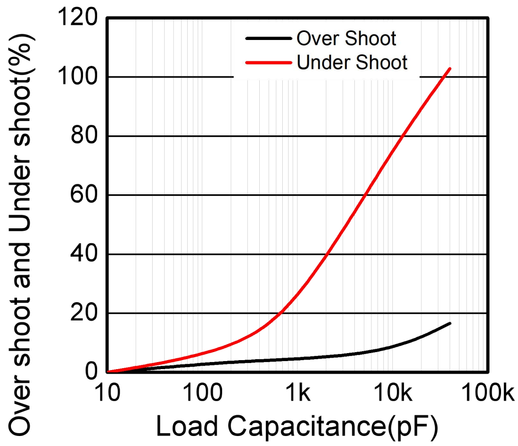
Over-Shoot Voltage

Gain=+1,C_{LOAD} = 40nF, V_S=±2.5V

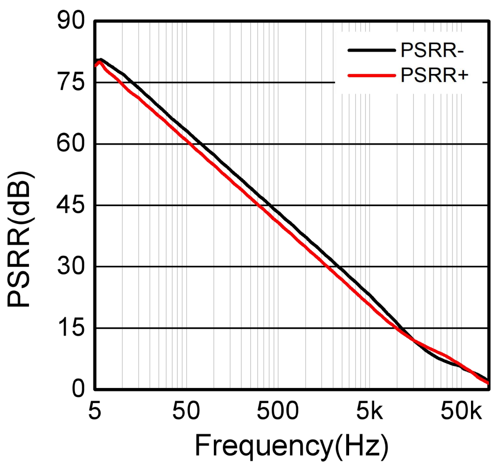


Over-Shoot % vs. C_{load}

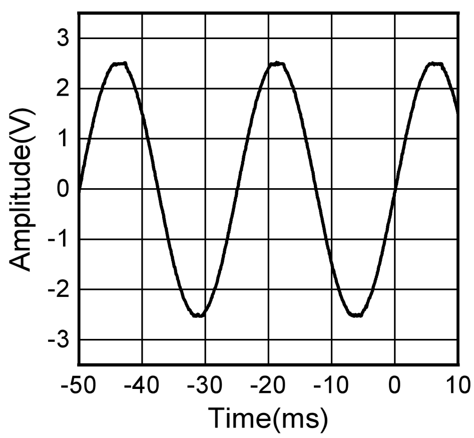
Gain =+1, C_{LOAD} = 40nF, V_S=±2.5V



Power-Supply Rejection Ratio



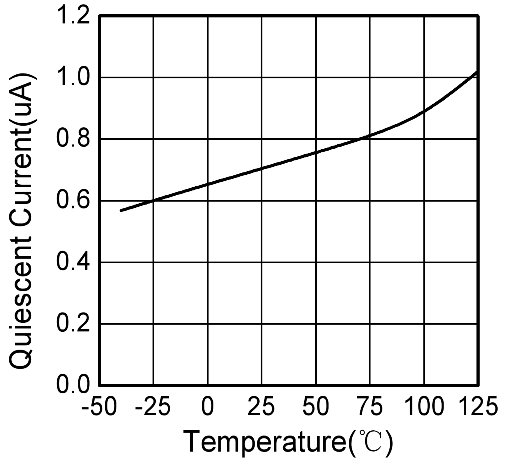
VIN = -0.2V to 5.7V, No Phase Reversal



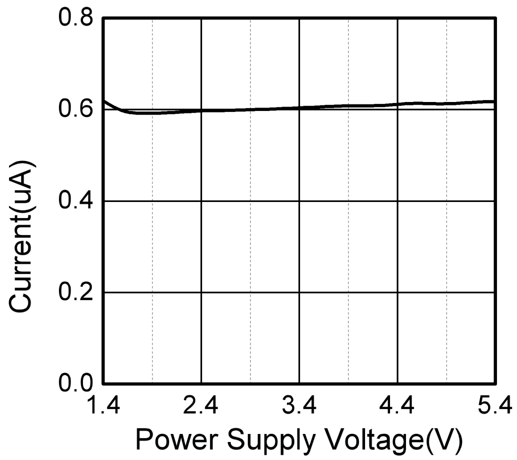
Typical Characteristics (continued)

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

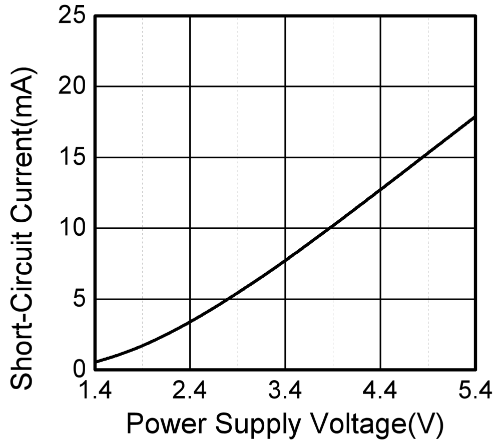
Quiescent Supply Current vs. Temperature



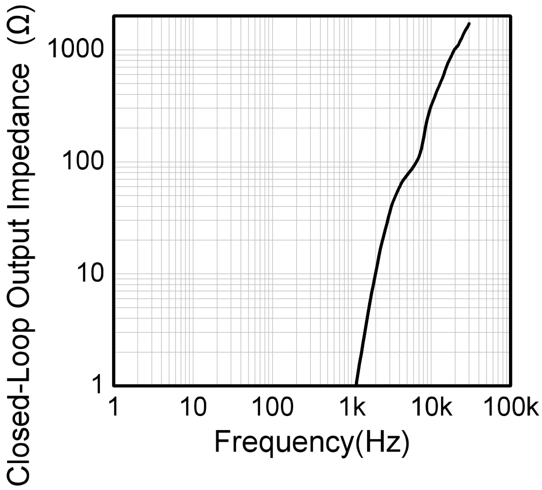
Quiescent Supply Current vs. Supply Voltage



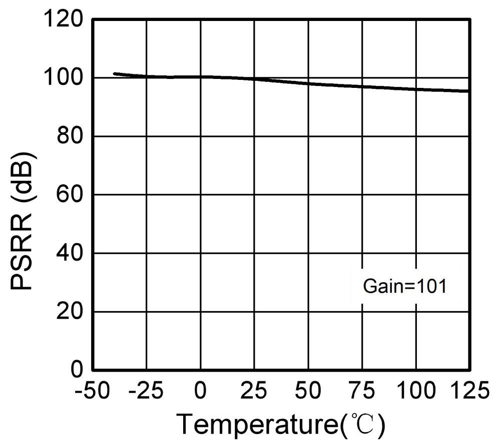
Short-Circuit Current vs. Supply Voltage



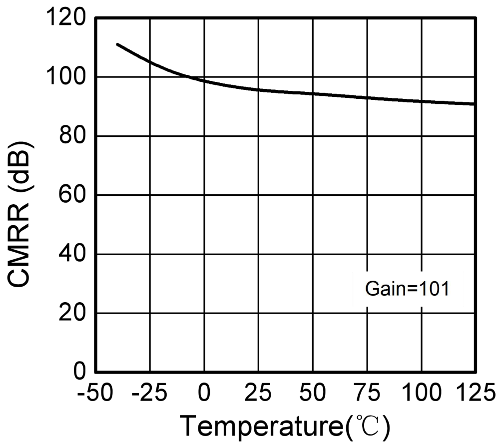
Closed-Loop Output Impedance vs. Frequency



PSRR vs. Frequency



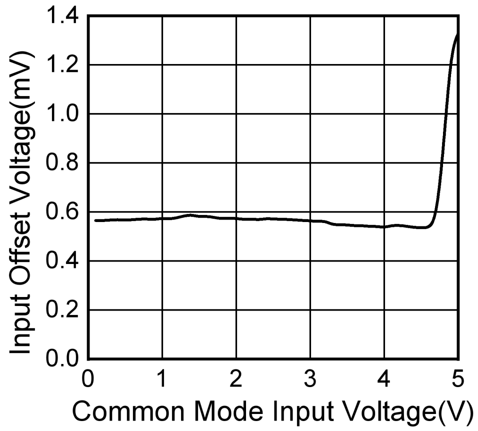
CMRR vs. Temperature



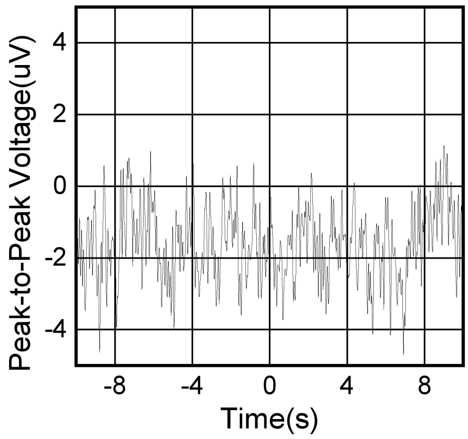
Typical Characteristics (continued)

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

Input Offset Voltage vs. Common Mode Input Voltage

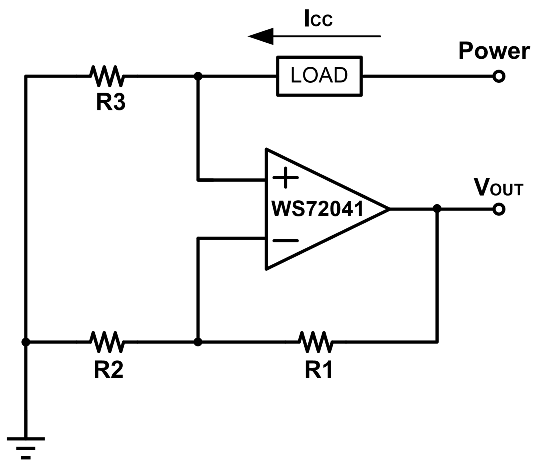


0.1Hz to 10Hz Time Domain Output Voltage Noise



Application Circuit

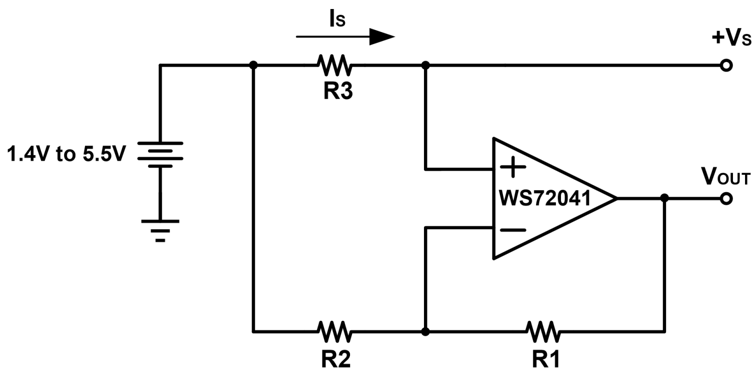
(1) WS72041 in Low Side Battery Current Sensor



Application Circuit for Low Side Battery Current Sensor

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

(2) WS72041 in High Side Battery Current Sensor

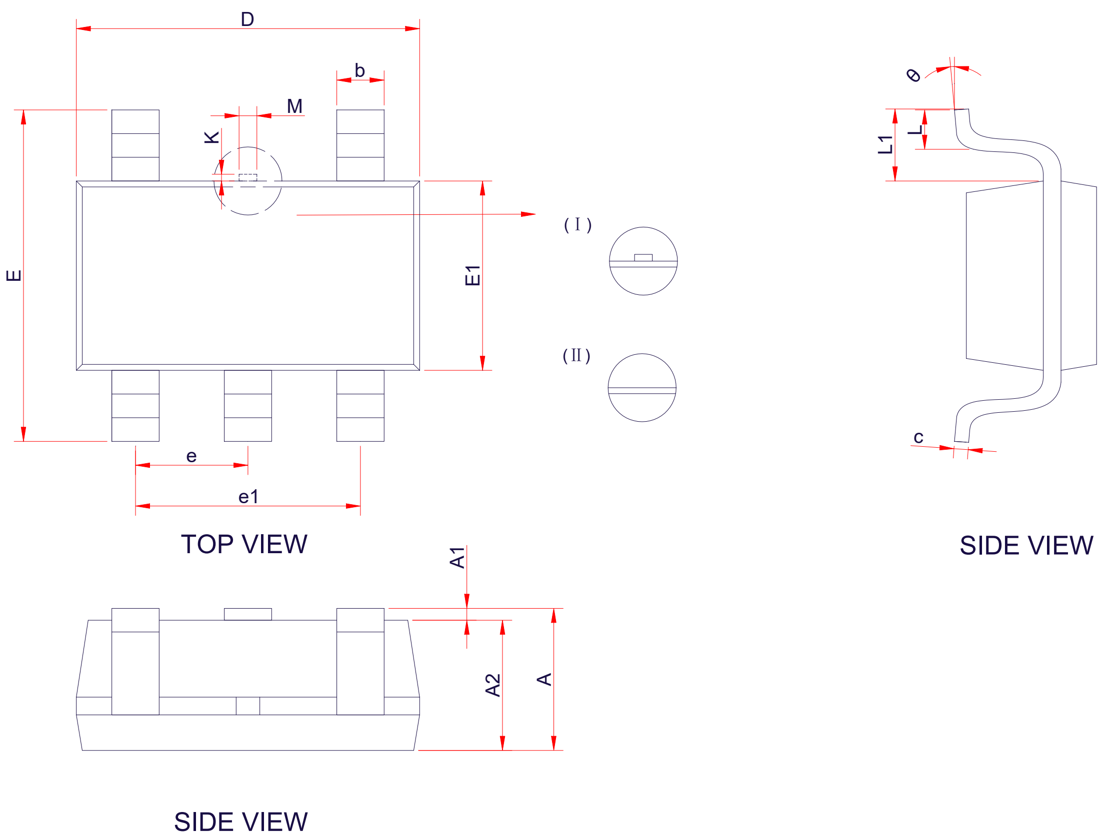


Application Circuit for High Side Battery Current Sensor

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

PACKAGE OUTLINE DIMENSIONS

SOT-23-5L

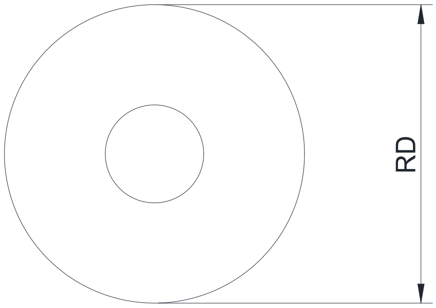


Symbol	Dimensions in Millimeters		
	Min.	Typ.	Max.
A	-	-	1.45
A1	0.00	-	0.15
A2	0.90	1.10	1.30
b	0.30	0.40	0.50
c	0.10	-	0.21
D	2.72	2.92	3.12
E	2.60	2.80	3.00
E1	1.40	1.60	1.80
e	0.95 BSC		
e1	1.90 BSC		
L	0.30	0.45	0.60
M	0.10	0.15	0.25
K	0.00	-	0.25
θ	0°	-	8°

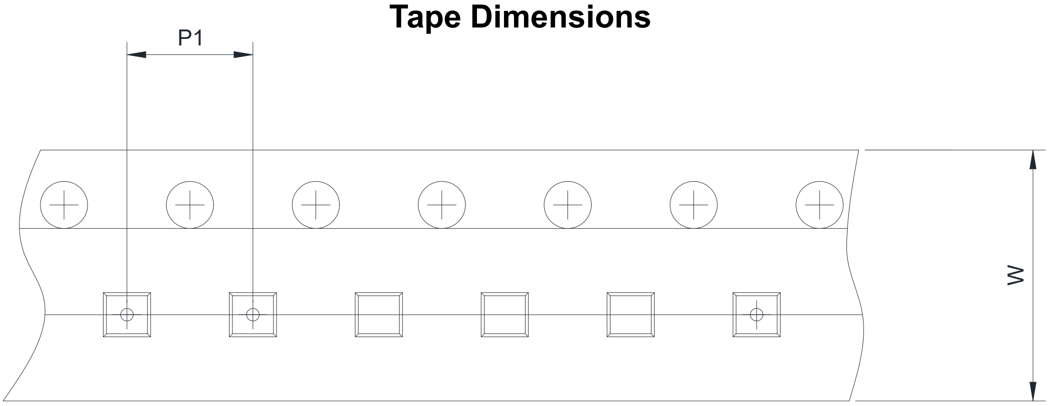
TAPE AND REEL INFORMATION

SOT-23-5L

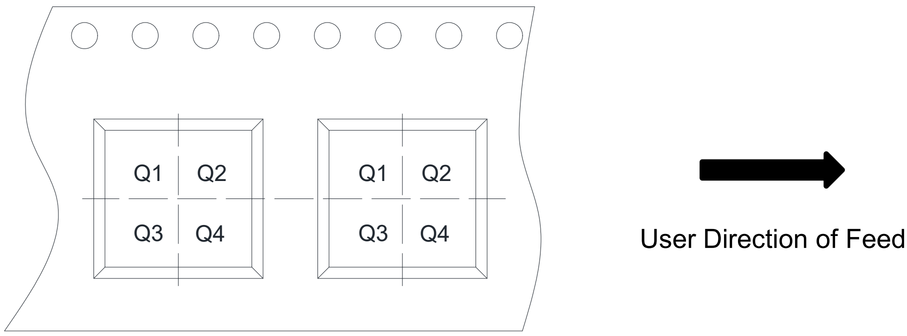
Reel Dimensions



Tape Dimensions



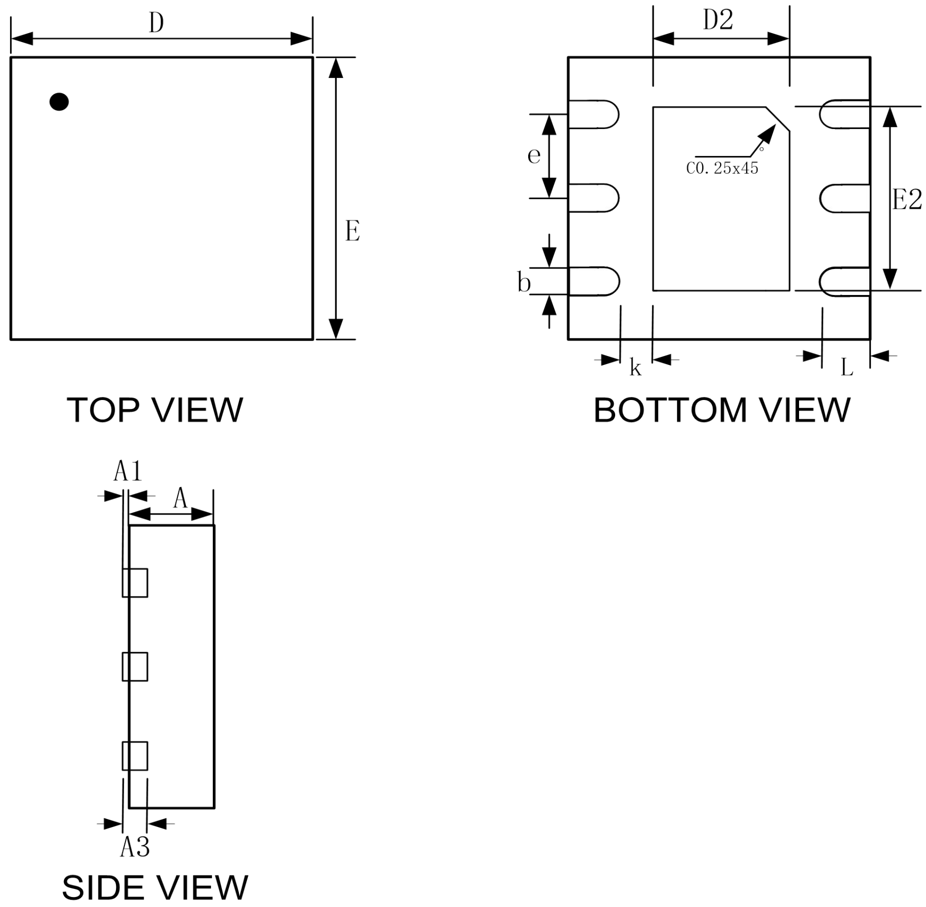
Quadrant Assignments For PIN1 Orientation In Tape



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

DFN2×2-6

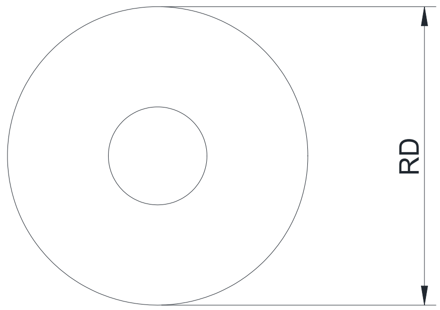


Symbol	Dimensions In Millimeters (mm)		
	Min.	**Typ.**	**Max.**
A	0.70	0.75	0.80
A1	0.00	0.02	0.05
A3	-	0.20 REF	-
b	0.25	0.30	0.35
D	2.00 BSC		
E	2.00 BSC		
D2	0.70	0.80	0.90
E2	1.40	1.50	1.60
e	0.65 BSC		
L	0.30	0.35	0.40
k	0.25	-	-

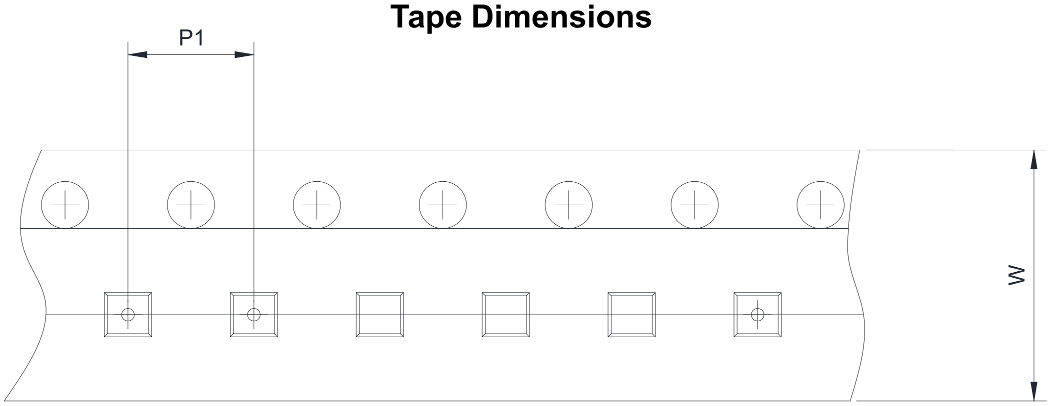
TAPE AND REEL INFORMATION

DFN2×2-6

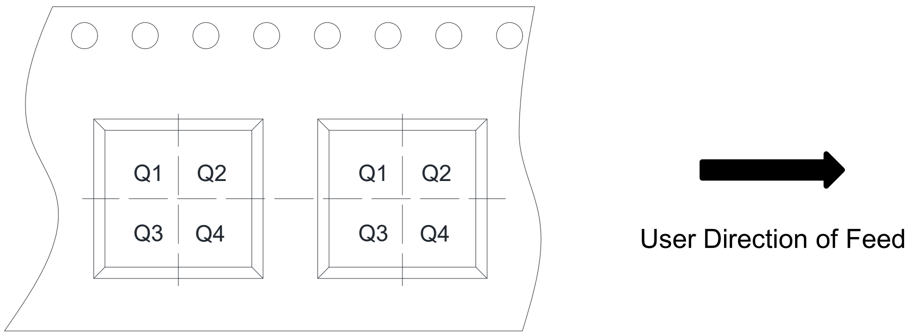
Reel Dimensions



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

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