WS72321

Low-Power Rail-to-Rail Input Output Operational Amplifiers

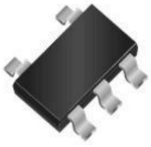
Http//:www.willsemi.com

Descriptions

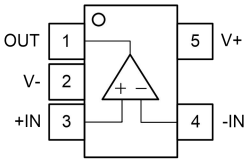
The WS72321 series is a single low-voltage operational amplifier with rail-to-rail input/output swing. Ultra low quiescent current makes this amplifier ideal for portable, battery operated equipment. The common mode input range includes ground making the device useful for low−side current−shunt measurements. The ultra small packages allow for placement on the PCB in close proximity to the signal source thereby reducing noise pickup.

The WS72321 is available with MSL 3 Level in SOT353(SC70-5L) package and SOT23-5L package. Standard products are Pb-Free and halogen-Free.

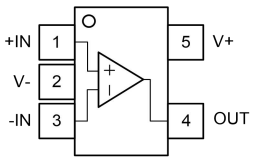
SOT353



SOT23-5L



SOT23-5L
（WS72321EO-5/TR）



SOT353
（WS72321B-5/TR）
&
SOT23-5L
（ WS72321E-5/TR）

Pin configuration (Top view)

Applications

- Active Filters
- Smoke/Gas Sensors
- Battery Powered Electronic Equipments
- Personal Medical Care

SOT353
WS72321B-5/TR

SOT23-5L
WS72321E-5/TR

SOT23-5L
WS72321EO-5/TR

Features

- Single Supply Voltage : 1.8~5.5V
- Quiescent Current : 48μA Typical
- GBWP : 1.5MHz
- Slew Rate : 1.1V/μs
- Offset Voltage : 3mV Maximum
- Offset Voltage Temp. Drift : 0.5μV / ˚C
- THD+N :-102dB@1kHz, -90dB@10kHz
- CMRR/PSRR : 104dB/111dB
- Output Short-Circuit Curr. : 43mA
- -40˚C to 125˚C Operation Range
- Drives 2kΩ Resistive Loads
- No Output Crossover Distortion
- No Phase Reversal from Overdriven Input
- Rail-to-Rail Input/Output Swing

Marking

2321 = Device code
GA = Special code
N5 = Special code
B5 = Special code
Y = Year code
W = Week code

Order Information

Device	Package	Shipping
WS72321B-5/TR	SOT353	3000/Reel &Tape
WS72321E-5/TR	SOT23 -5L	3000/Reel &Tape
WS72321EO-5/TR	SOT23 -5L	3000/Reel &Tape

Pin Descriptions (WS72321B-5/TR & WS72321E-5/TR)

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

Pin Descriptions (WS72321EO-5/TR)

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

Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Supply Voltage, ([V+] - [V-])	V_S(2)	6	V
Input Differential Voltage	V_{IDR}(3)	±6	V
Input Common Mode Voltage Range	V_{ICR}	(V^-)-0.2 to (V^+)+0.2	V
Output Short-Circuit Duration	t_{SO}	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. Differential voltages are at +IN with respect to –IN.

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
MM	Machine Model ESD	JEDEC-EIA/JESD22-A115	±500	V
CDM	Charged Device Model ESD	JEDEC-EIA/JESD22-C101E	±2000	V

Electronics Characteristics

The *denotes the specifications which apply over the full operating temperature range, otherwise specifications are at T_A = 25°C. V_S = 5V, V_{CM} = V_{OUT} = V_S/2, R_{load} = 100kΩ, C_{load} = 100pF.

Symbol	Parameter		Conditions		Min.	Typ.	Max.	Unit
V_{OS}	Input Offset Voltage		V_{CM}= V_S/2	*	-3.0	±0.1	3.0	mV
α_{VOS}	Input Offset Voltage Drift					0.5		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			4		μV_{P-P}
e_n	Input Voltage Noise Density		f=1kHz			30		nV/√Hz
			f=10kHz			23		
CMRR	Common Mode Rejection Ratio		V_{CM}=0.1V to 4.9V	*	80	104		dB
V_{CM}	Common Mode Input Voltage Range			*	(V^-)-0.2		(V^+)+0.2	V
PSRR	Power Supply Rejection Ratio			*	80	111		dB
A_{VOL}	Open Loop Large Signal Gain		V_{OUT}=0.1V to 4.9V, R_{load}=10kΩ	*	100	108		dB
V_{OH}	High Level Output Voltage		R_{load}=2kΩ			50		mV
			R_{load}=10kΩ			5		
V_{OL}	Low Level Output Voltage		R_{load}=2kΩ			40		mV
			R_{load}=10kΩ			5		
I_{SC}	Output Short-Circuit Current		Source Current			43		mA
			Sink Current			47		
I_Q	Quiescent Current			*		48	65	μA
PM	Phase Margin		R_{load}=100kΩ, C_{load}=100pF			60		degrees
GM	Gain Margin		R_{load}=100kΩ, C_{load}=100pF			-14		dB
GBWP	Gain-Bandwidth Product		f=1kHz			1.5		MHz
t_S	Settling Time	1.5 to 3.5V, Unity Gain	0.1%			1.9		μs
		2.45 to 2.55V, Unity Gain	0.1%			0.29		
SR	Slew Rate		A_V=1, V_{OUT}=1.5V to 3.5V, R_{load}=100kΩ, C_{load}=100pF			1.1		V/μs
FPBW	Full Power Bandwidth		$2V_{P-P}$			180		kHz
THD+N	Total Harmonic Distortion and Noise		f=1kHz, AV=1, R_{load}=100kΩ, V_{OUT}=$2V_{PP}$			-102		dB
			f=10kHz, AV=1, R_{load}=100kΩ, V_{OUT}=$2V_{PP}$			-90		

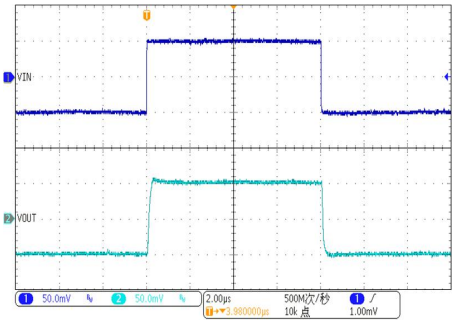
Note:

1. Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.
2. A heat sink may be required to keep the junction temperature below the absolute maximum rating when the output is shorted indefinitely.
3. Thermal resistance varies with the amount of PC board metal connected to the package. The specified values are for short traces connected to the leads.
4. Full power bandwidth is calculated from the slew rate FPBW = SR/($\pi \bullet V_{P-P}$).

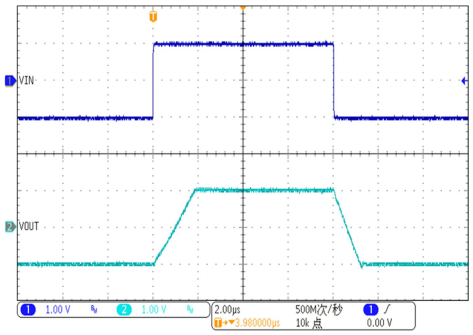
Typical Characteristics

T_A=25°C, V_S=±2.5V, V_{CM}=0V, unless otherwise noted

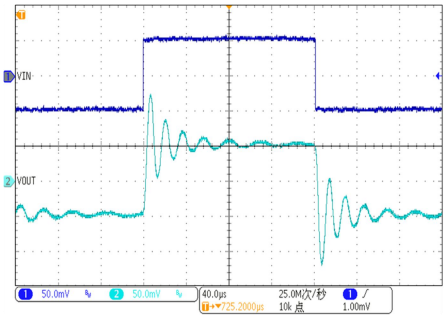
Small-Siganl Step Response, 100mV Step



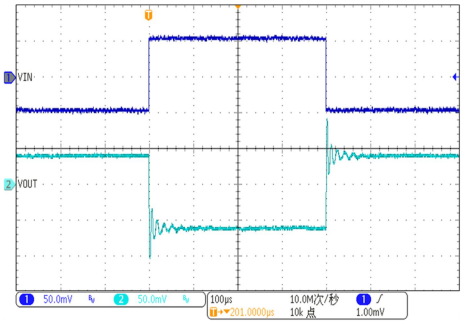
Large-Siganl Step Response, 2V Step



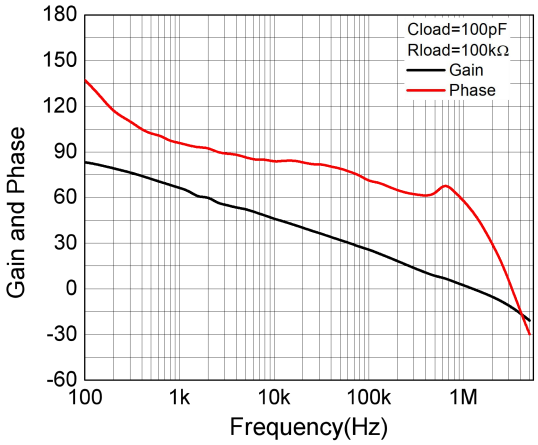
Over Shoot Voltage, C_{load}=47nF, R_{FB}=10kΩ, Gain=+1



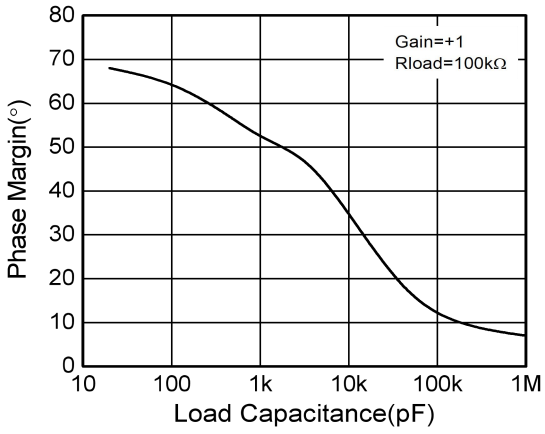
Over Shoot Voltage, C_{load}=47nF, R_{load}=40kΩ, Gain=-1



Open-Loop Gain and Phase



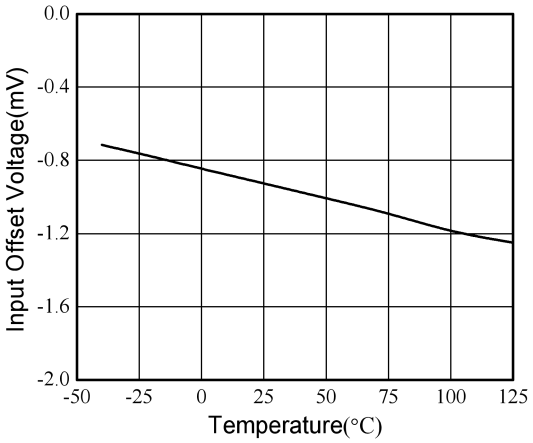
Phase Margin vs. C_{load} (Stable for Any C_{load})



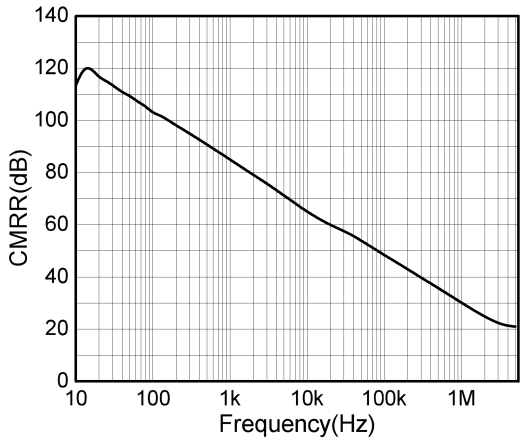
Typical Characteristics (continued)

T_A=25°C, V_S=±2.5V, V_{CM}=0V, unless otherwise noted

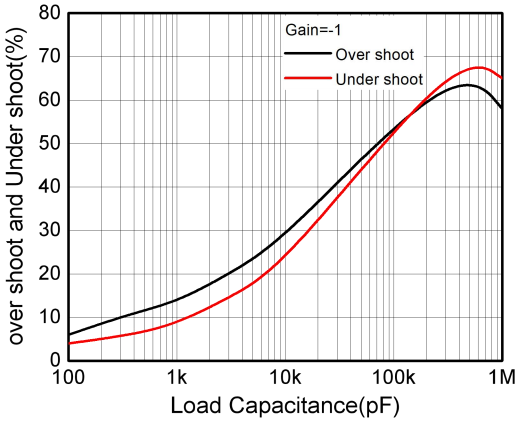
Input Offset Voltage vs. Temperature



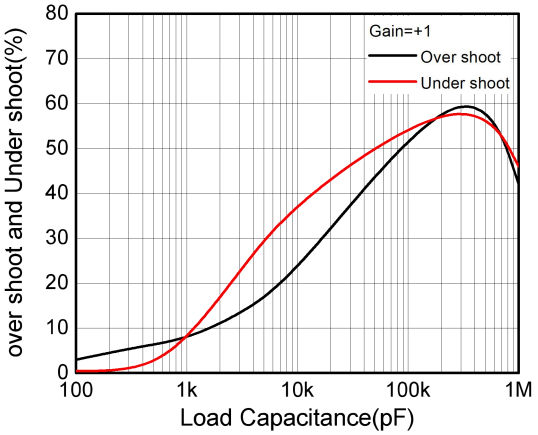
CMRR vs. Frequency



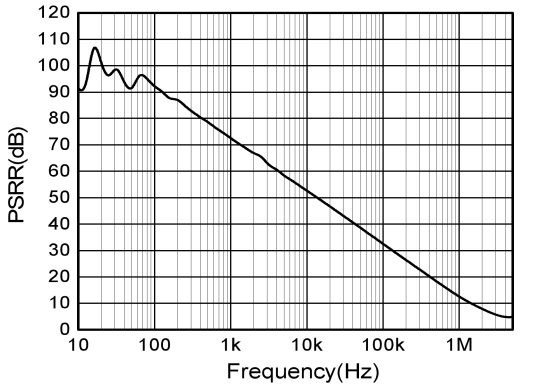
Over-Shoot % vs. C_{load}
Gain=-1, RFB=20kΩ



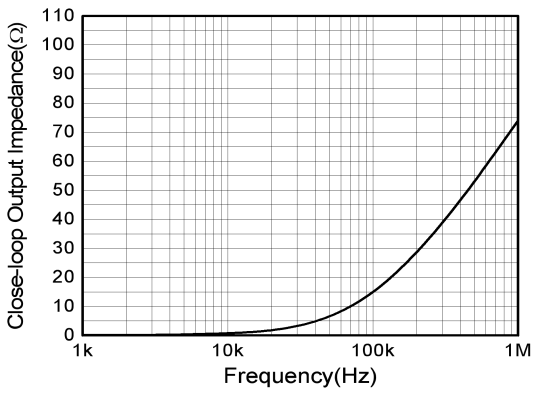
Over-Shoot % vs. C_{load}
Gain=+1



PSRR vs. Frequency



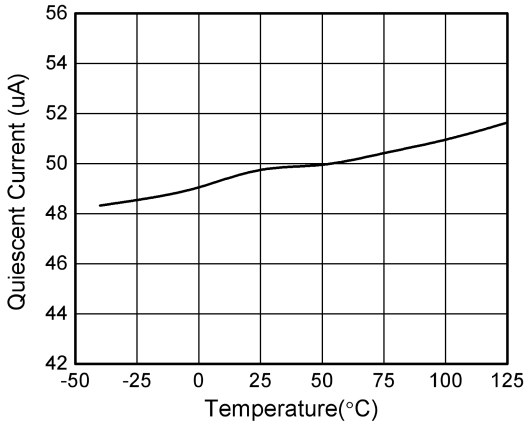
Closed-Loop Output Impedance vs. Frequency



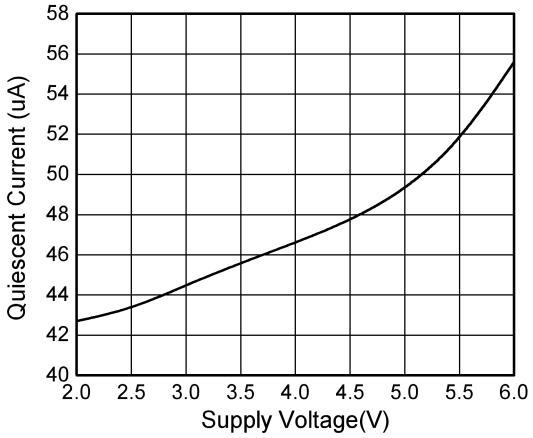
Typical Characteristics (continued)

T_A=25°C, V_S=±2.5V, V_{CM}=0V, unless otherwise noted

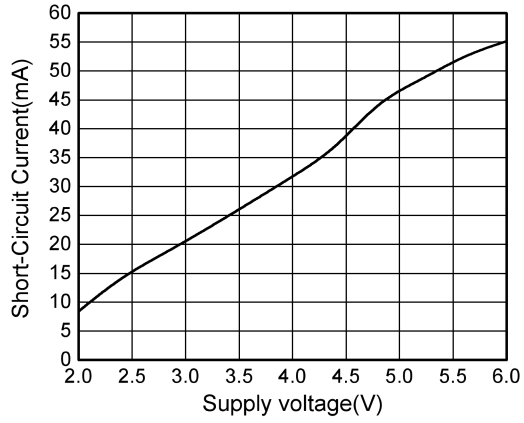
Quiescent Supply Current vs. Temperature



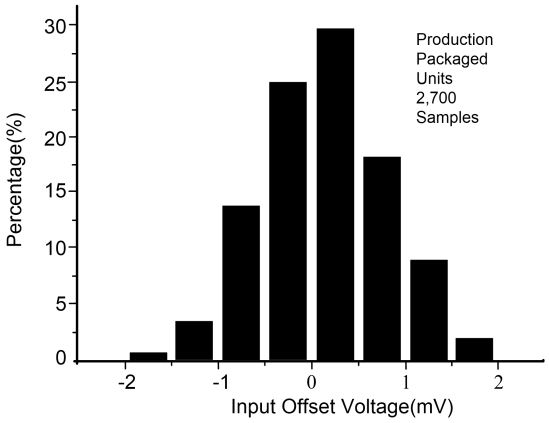
Quiescent Supply Current vs. Supply Voltage



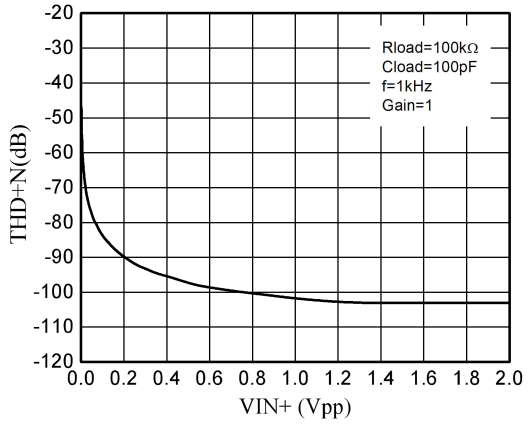
Short-Circuit Current vs. Supply Voltage



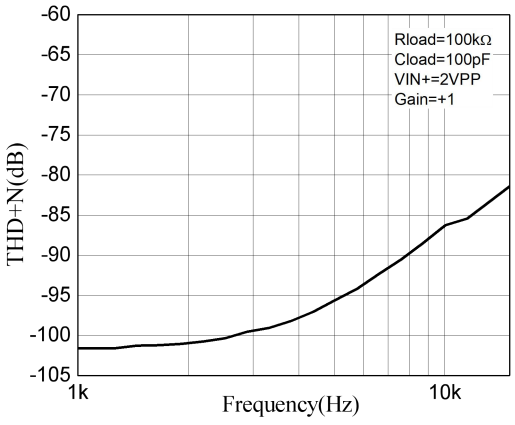
Input Offset Voltage Distribution



THD+Noise vs. Vin+



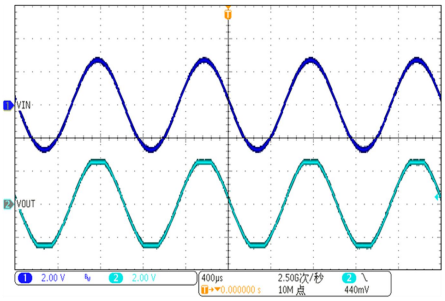
THD+Noise vs. Frequency



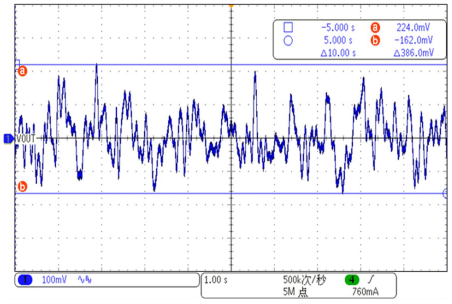
Typical Characteristics (continued)

T_A=25°C, V_S=±2.5V, V_{CM}=0V, unless otherwise noted

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

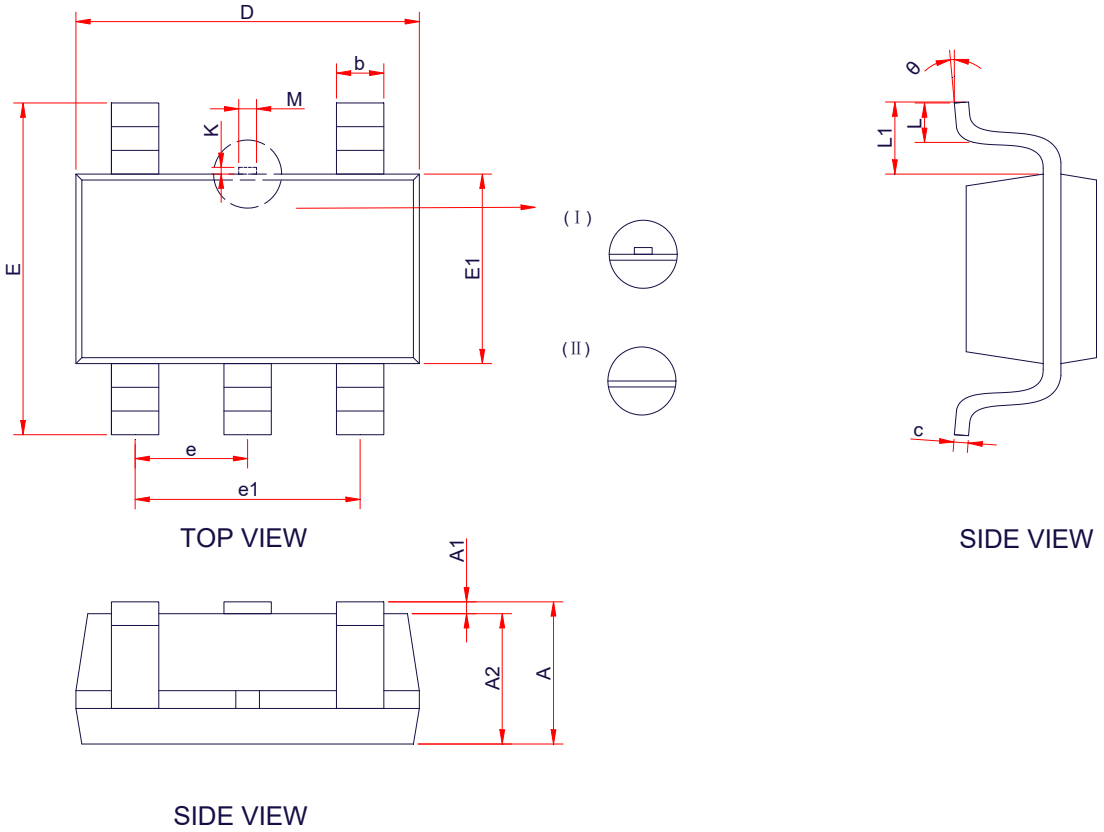


0.1Hz to 10Hz Integrated Input Noise, Gain = 10000



PACKAGE OUTLINE DIMENSIONS

SOT-353(SC70-5L)

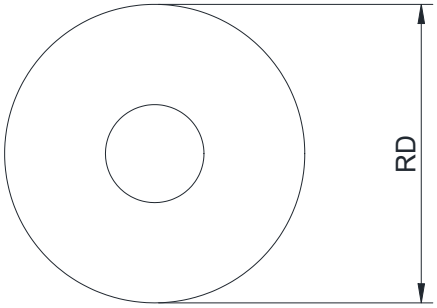


Symbol	Dimensions in Millimeters		
	Min.	Typ.	Max.
A	0.80	0.95	1.10
A1	0.00	-	0.10
A2	0.80	0.90	1.00
b	0.15	0.25	0.35
c	0.08	-	0.20
D	2.00	2.10	2.20
E1	1.15	1.25	1.35
E	2.15	2.30	2.45
e	0.65 Typ.		
e1	1.20	1.30	1.40
L1	0.50 Ref.		
L	0.26	0.36	0.46
M	0.10	0.15	0.25
K	0.00	-	0.25
θ	0 °	-	14 °

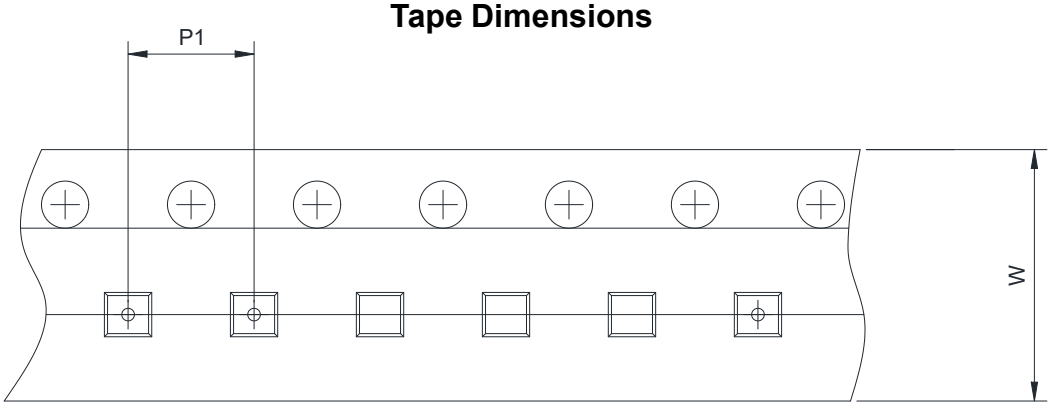
TAPE AND REEL INFORMATION

SOT-353(SC70-5L)

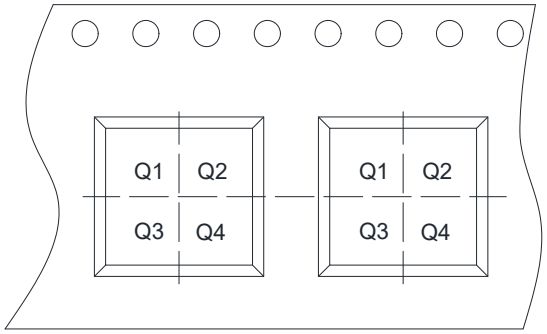
Reel Dimensions



Tape Dimensions



Quadrant Assignments For PIN1 Orientation In Tape

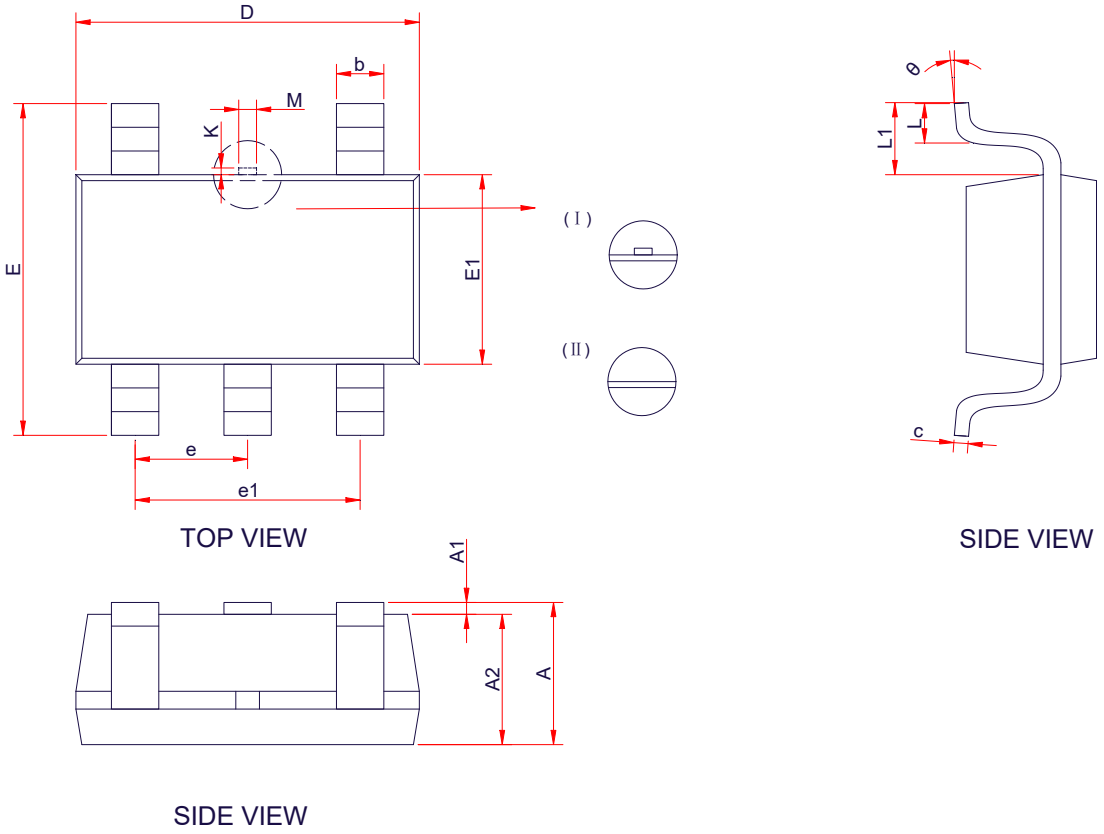


User Direction of Feed

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

PACKAGE OUTLINE DIMENSIONS

SOT-23-5L

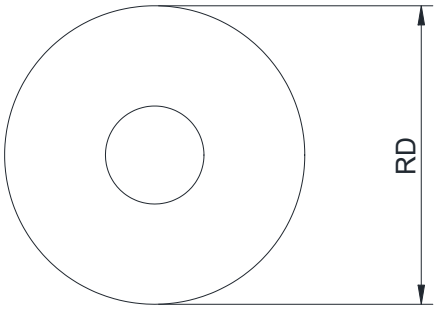


Symbol	Dimensions in Millimeters		
	Min.	Typ.	Max.
A	-	-	1.45
A1	0.00	-	0.15
A2	0.90	1.10	1.30
b	0.30	0.40	0.50
c	0.10	-	0.21
D	2.72	2.92	3.12
E	2.60	2.80	3.00
E1	1.40	1.60	1.80
e	0.95 BSC		
e1	1.90 BSC		
L	0.30	0.45	0.60
M	0.10	0.15	0.25
K	0.00	-	0.25
θ	0°	-	8°

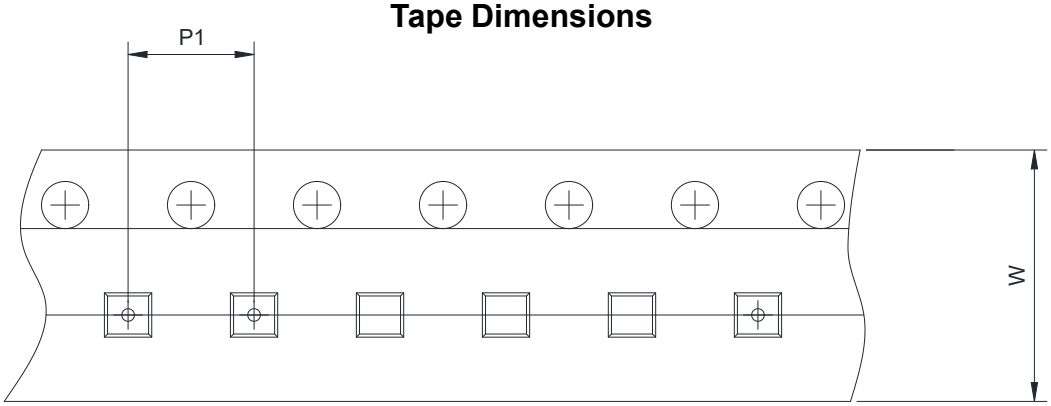
TAPE AND REEL INFORMATION

SOT-23-5L

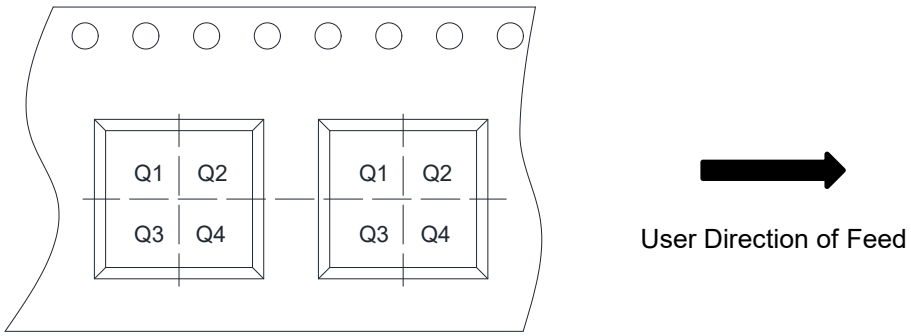
Reel Dimensions



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