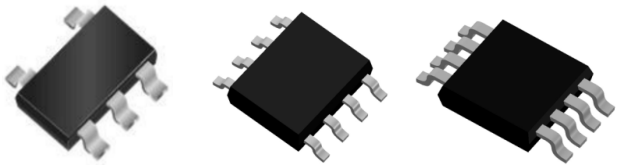
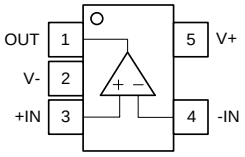
WS72551/WS72552

Zero-Drift, Single-Supply, Rail-to-Rail Input/Output Operational Amplifiers

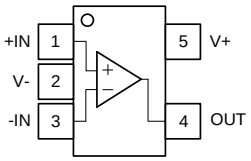
Http//:www.willsemi.com



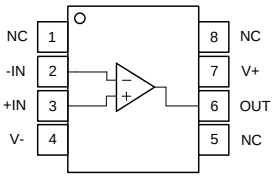
SOT23-5L **SOP-8L** **MSOP-8L**



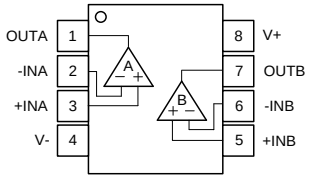
SOT23-5L
(WS72551EA-5/TR)



SOT23-5L
(WS72551E-5/TR)



SOP-8L/MSOP-8L



SOP-8L/MSOP-8L

Pin configuration (Top view)

Descriptions

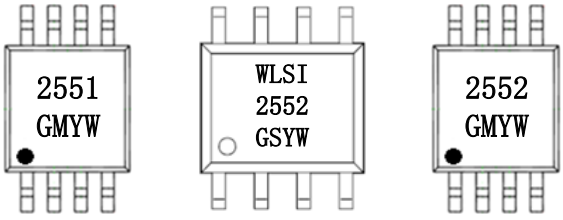
This family of amplifiers has ultra low offset, drift, and bias current. The WS72551 and WS72552 are single and dual amplifiers featuring rail-to-rail input and output swings respectively. All are guaranteed to operate from 2.5V to 5V with a single supply.

The WS72551/WS72552 provides the benefits previously found only in expensive auto-zeroing or chopper-stabilized amplifiers. These new zero-drift amplifiers combine low cost with high accuracy. No external capacitors are required.

With an offset voltage of only 3μV and drift of 0.008 μV/°C, the WS72551/WS72552 are perfectly suited for applications in which error sources cannot be tolerated. Temperature, position and pressure sensors, medical equipment, and strain gauge amplifiers benefit greatly from nearly zero drift over their operating temperature range. The rail-to-rail input and output swings provided by the WS72551/WS72552 make both high-side and low-side sensing easy.

The WS72551/WS72552 are specified for the extended industrial/automotive temperature range (-40°C to +125°C). The WS72551 single amplifier is available in 8-lead MSOP, 8-lead narrow SOIC and 5-lead SOT23-5L packages. The WS72552 dual amplifier is available in 8-lead MSOP and 8-lead narrow SOIC surface mount packages.

SOT23-5L **SOT23-5L** **SOP-8L**



MSOP-8L **SOP-8L** **MSOP-8L**

Applications

- Temperature sensors
- Pressure sensors
- Precision current sensing
- Strain gauge amplifiers
- Medical instrumentation
- Thermocouple amplifiers

Features

- Low offset voltage : 14 μV（MAX）
- Input offset drift : 0.008 μV/°C
- Overload recovery time : 150 μs
- Low supply current : 240 μA/OpAmp
- High gain, CMRR, PSRR : 130 dB
- Ultralow input bias current : 10 pA
- No external capacitors required
- 5 V/2.5 V single-supply operation
- Rail-to-rail input and output swing

Marking

2551 = Device code
2552 = Device code
GA = Special code
GE = Special code
GS = Special code
GM = Special code
Y = Year code
W = Week code

Order information

Device	Package	Shipping
WS72551S-8/TR	SOP-8L	4000/Reel &Tape
WS72551M-8/TR	MSOP-8L	4000/Reel &Tape
WS72551EA-5/TR	SOT23-5L	3000/Reel &Tape
WS72551E-5/TR	SOT23-5L	3000/Reel &Tape
WS72552S-8/TR	SOP-8L	4000/Reel &Tape
WS72552M-8/TR	MSOP-8L	4000/Reel &Tape

Pin Descriptions

	Pin Number	Symbol	Descriptions
WS72551S-8/TR and WS72551M-8/TR	1	NC	
	2	-IN	Inverting input
	3	+IN	Non-inverting input
	4	V-	Negative supply
	5	NC	
	6	OUT	Output
	7	V+	Positive supply
	8	NC	

	Pin Number	Symbol	Descriptions
WS72551EA-5/TR	1	OUT	Output
	2	V-	Negative supply
	3	+IN	Non-inverting input
	4	-IN	Inverting input
	5	V+	Positive supply

	Pin Number	Symbol	Descriptions
WS72551E-5/TR	1	+IN	Non-inverting input
	2	V-	Negative supply
	3	-IN	Inverting input
	4	OUT	Output
	5	V+	Positive supply

	Pin Number	Symbol	Descriptions
WS72552S-8/TR and WS72552M-8/TR	1	OUTA	Output
	2	-INA	Inverting input
	3	+INA	Non-inverting input
	4	V-	Negative supply
	5	+INB	Non-inverting input
	6	-INB	Inverting input
	7	OUTB	Output
	8	V+	Positive supply

Absolute Maximum Ratings(1)

Parameter	Rating	Unit
Supply Voltage(2)	6	V
Input Voltage	GND-0.2V to Vs+0.2	V
Differential Input Voltage	±5.0	V
ESD (Human Body Model)	7000	V
Output Short-Circuit Duration to GND	Indefinite	/
Storage Temperature Range	-65 to +150	°C
Junction Temperature Range	-65 to +150	°C
Lead Temperature Range（Soldering, 60 sec）	300	°C
Operating Temperature Range	-40 to +125	°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.

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	±7000	V
MM	Machine Model ESD	JEDEC-EIA/JESD22-A115	±300	V
CDM	Charged Device Model ESD	JEDEC-EIA/JESD22-C101E	±2000	V

Electronics Characteristics

V_S = 5 V, V_{CM} = 2.5 V, V_o = 2.5 V, T_A = 25°C, unless otherwise noted.

Symbol	Parameter	Conditions		Min.	Typ.	Max.	Unit
V_{OS}	Offset Voltage				5	14	μV
I_B	Input Bias Current				10		pA
		-40°C≤T_A≤+85°C			50		pA
		-40°C≤T_A≤+125°C			0.5		nA
I_{OS}	Input Offset Current				6		pA
		-40°C≤T_A≤+85°C			50		pA
		-40°C≤T_A≤+125°C			0.5		nA
VCMR	Input Voltage Range			-0.1		5.1	V
CMRR	Common Mode Rejection Ratio	V_{CM}=-0.1 V to +5.1V		100	140		dB
A_{VO}	Large Signal Voltage Gain	V_O=0.3V to 4.7V, R_L=10kΩ		100	145		dB
		-40°C≤T_A≤+125°C			135		dB
△V_{OS}/△T	Offset Voltage Drift	-40°C≤T_A≤+125°C			0.01		μV/°C
V_{OH}	Output Voltage High	R_L=10kΩ to GND			6	10	mV
V_{OL}	Output Voltage Low	R_L=100kΩ to V+			4		mV
I_{SC}	Output Short-Circuit Limit Current			±58	±70		mA
PSRR	Power Supply Rejection Ratio	V_S = 2.7V to 5V		100	120		dB
I_{SY}	Supply Current / Amplifier	V_O=0V			265	340	μA
		-40°C≤T_A≤+125°C			290		μA
SR	Slew Rate	R_L=10kΩ			1.2		V/μs
Tor	Overload Recovery Time				150		us
GBP	Gain-Bandwidth Product				1.8		MHz
$e_{n\ p-p}$	Voltage Noise	0.1Hz to 10Hz			1.8		μV_{P-P}
e_n	Voltage Noise Density	f=1kHz			80		nV/√Hz

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.

Electronics Characteristics

V_S = 2.5 V, V_{CM} = 1.25 V, V_o = 1.25 V, T_A = 25°C, unless otherwise noted.

Symbol	Parameter	Conditions		Min.	Typ.	Max.	Unit
V_{OS}	Offset Voltage				3	14	μV
I_B	Input Bias Current				4		pA
		-40°C≤T_A≤+85°C			40		pA
		-40°C≤T_A≤+125°C			0.2		nA
I_{OS}	Input Offset Current				4		pA
	WS72552	-40°C≤T_A≤+85°C			40		pA
	WS72552	-40°C≤T_A≤+125°C			0.2		nA
VCMR	Input Voltage Range			-0.1		2.6	V
CMRR	Common Mode Rejection Ratio	V_{CM}=0 V to +2.5V		100	140		dB
		-40°C≤T_A≤+125°C					dB
A_{VO}	Large Signal Voltage Gain	V_O=0.3V to 2.2V, R_L=10kΩ		100	140		dB
△V_{OS}/△T	Offset Voltage Drift	-40°C≤T_A≤+125°C			0.008		μV/°C
V_{OH}	Output Voltage High	R_L=10kΩ to GND			10		mV
V_{OL}	Output Voltage Low	R_L=10kΩ to V+			10		mV
I_{SC}	Output Short-Circuit Limit Current				±20		mA
PSRR	Power Supply Rejection Ratio	V_S = 2.7V to 5V		100	120		dB
I_{SY}	Supply Current / Amplifier	V_O=0V			235	300	μA
		-40°C≤T_A≤+125°C			260		μA
SR	Slew Rate	R_L=10kΩ			1.2		V/μs
	Overload Recovery Time				160		us
GBP	Gain-Bandwidth Product				1.7		MHz
$e_{n\ p-p}$	Voltage Noise	0Hz to 10Hz			1.8		μV_{P-P}
e_n	Voltage Noise Density	f=1kHz			80		nV/√Hz

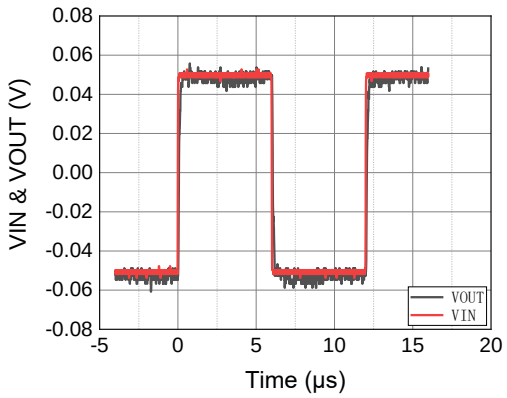
Note:

4. 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.
5. A heat sink may be required to keep the junction temperature below the absolute maximum rating when the output is shorted indefinitely.
6. 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.

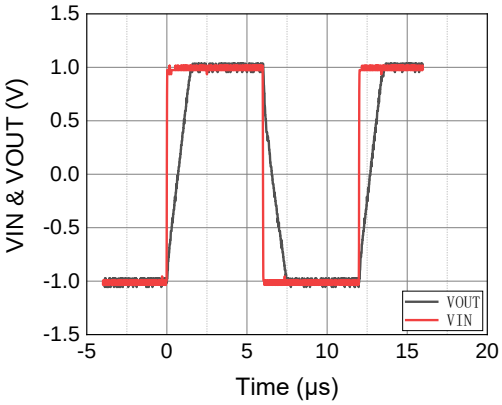
Typical Characteristics

T_A=25°C, V_{CC}=5V, R_L=10K, C_L=100pF, unless otherwise noted.

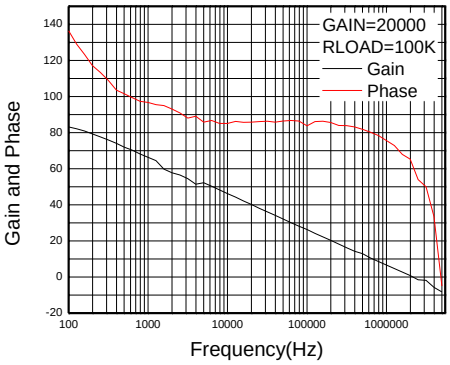
Small-Signal Step Response, 100mV Step



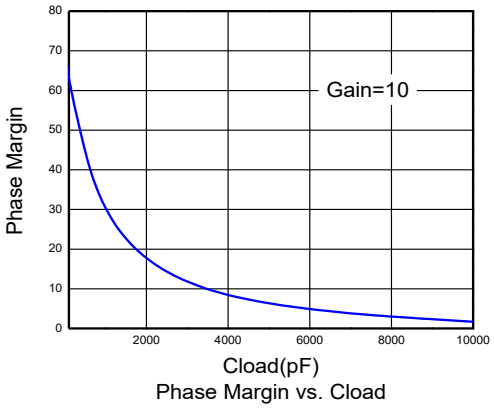
Large-Signal Step Response, 2V Step



Open-Loop Gain and Phase

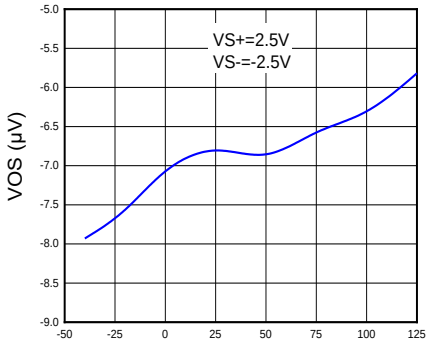


Cload vs. Phase Margin



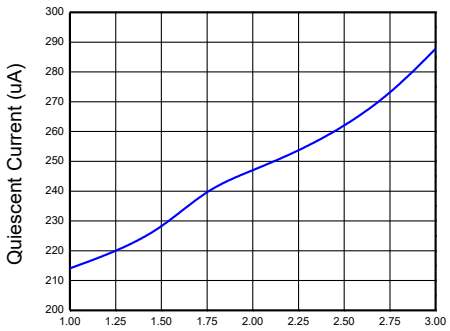
Phase Margin vs. Cload

Input Offset Voltage vs. Temperature



VOS vs. Temperature

Iq vs. Supply Voltage

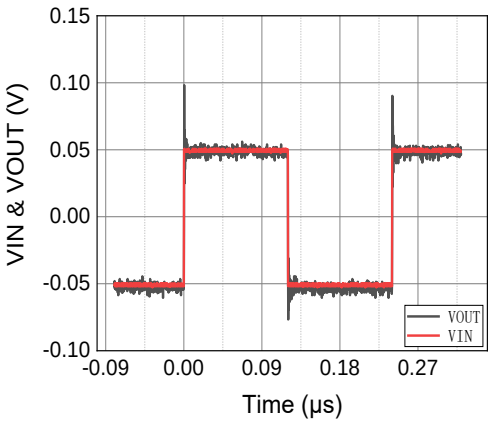


Quiescent Current vs. Supply Voltage

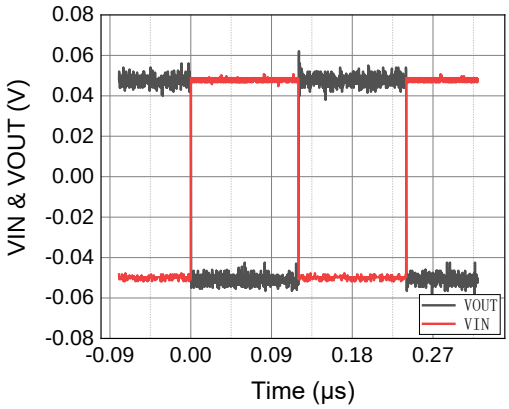
Typical Characteristics (continued)

T_A=25°C, V_{CC}=5V, R_L=10K, C_L=100pF, unless otherwise noted.

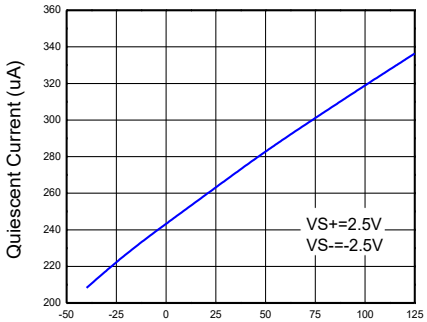
Over Shoot Voltage, C_{LOAD}=47nF, R_{LOAD}=10kΩ, Gain=+1



Over Shoot Voltage, C_{LOAD}=47nF, R_F=2kΩ, Gain=-1

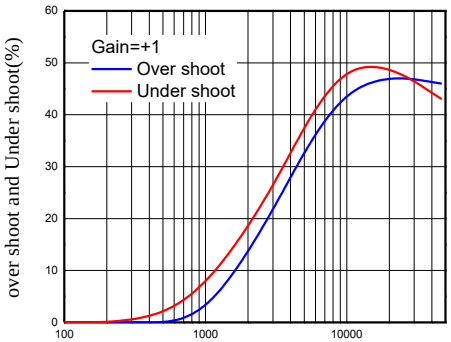


Iq vs. Temperature



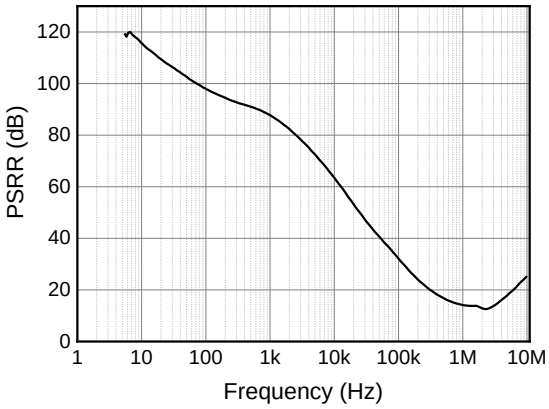
Quiescent Current vs. Temperature

Over/under shoot vs. Cload

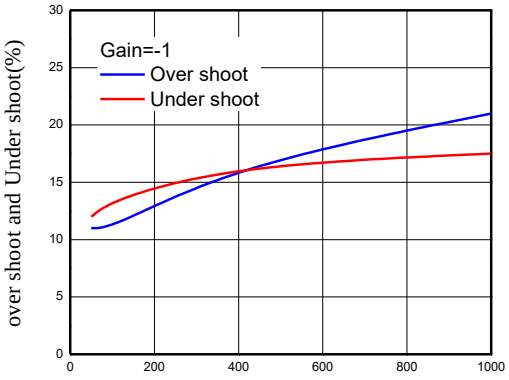


over shoot and Under shoot(%) vs. Cload

PSRR vs. Frequency



Over/under shoot vs. Cload

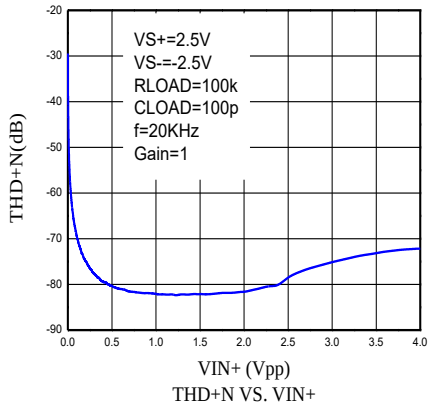


over shoot and Under shoot(%) vs. Cload

Typical Characteristics (continued)

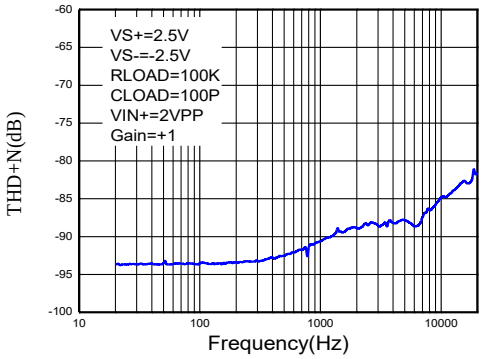
T_A=25°C, V_{CC}=5V, R_L=10K, C_L=100pF, unless otherwise noted.

THD+N vs. Vin F=20KHz



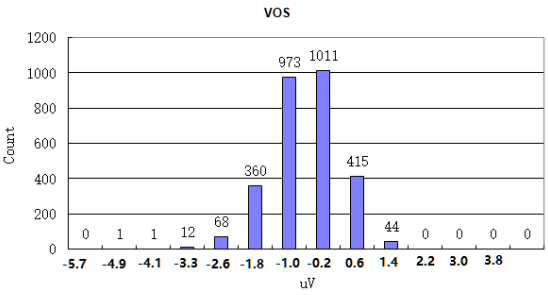
THD+N VS. VIN+

THD+N vs. Frequency

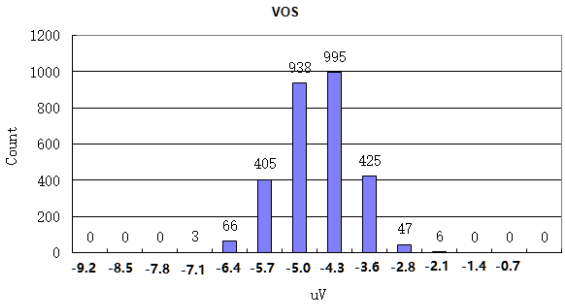


THD+Noise vs. Frequency

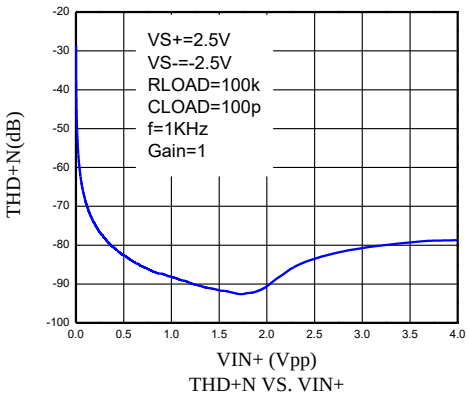
Input Offset Voltage Distribution（VS+=2.5V）



Input Offset Voltage Distribution（VS+=5V）

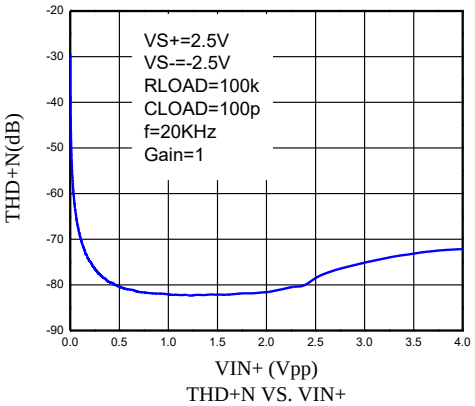


THD+Noise vs. Vin+, Gain=+1, f=1kHz, R_{LOAD}=100kΩ, C_{LOAD}=100pF



THD+N VS. VIN+

THD+Noise vs. Vin+, Gain=100, f=20kHz, R_{LOAD}=100kΩ, C_{LOAD}=100pF



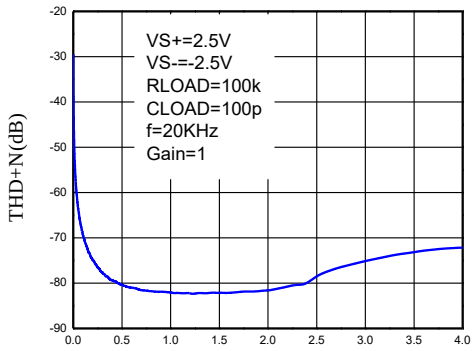
THD+N VS. VIN+

Typical Characteristics (continued)

T_A=25°C, V_{CC}=5V, R_L=10K, C_L=100pF, unless otherwise noted.

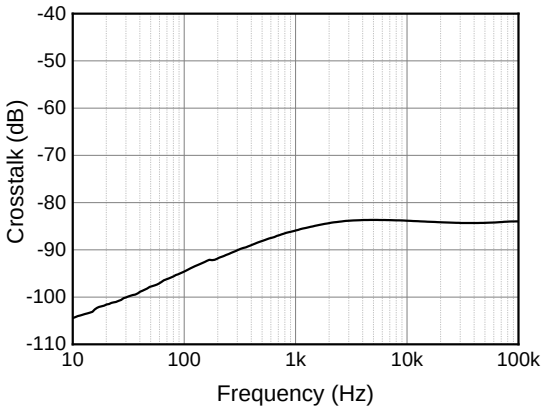
THD+Noise vs. Frequency, Gain=+1,

V_{in}+=2V_{pp} R_{LOAD}=100kΩ, C_{LOAD}=100pF



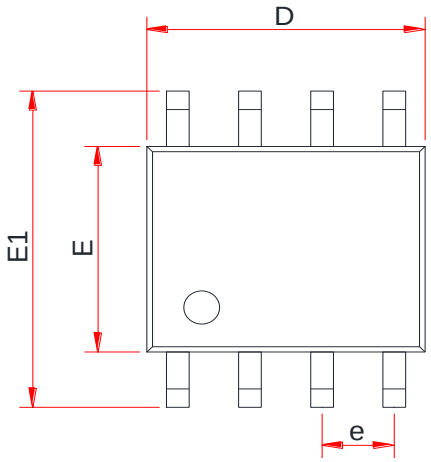
THD+N VS. VIN+

Crosstalk, (WS72552 only)

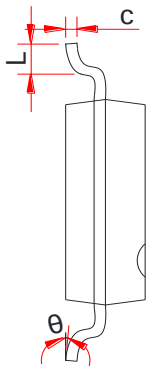


PACKAGE OUTLINE DIMENSIONS

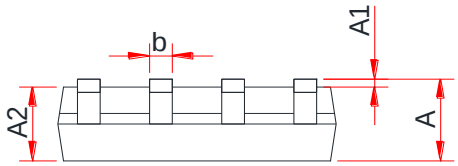
SOP-8L



TOP VIEW



SIDE VIEW



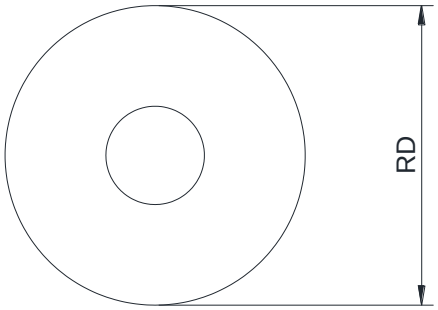
SIDE VIEW

Symbol	Dimensions In Millimeters (mm)		
	Min.	Typ.	Max.
A	1.35	1.55	1.75
A1	0.05	0.15	0.25
A2	1.25	1.40	1.65
b	0.33	-	0.51
c	0.15	-	0.26
D	4.70	4.90	5.10
E	3.70	3.90	4.10
E1	5.80	6.00	6.20
e	1.27BSC		
L	0.40	-	1.27
θ	0°	-	8°

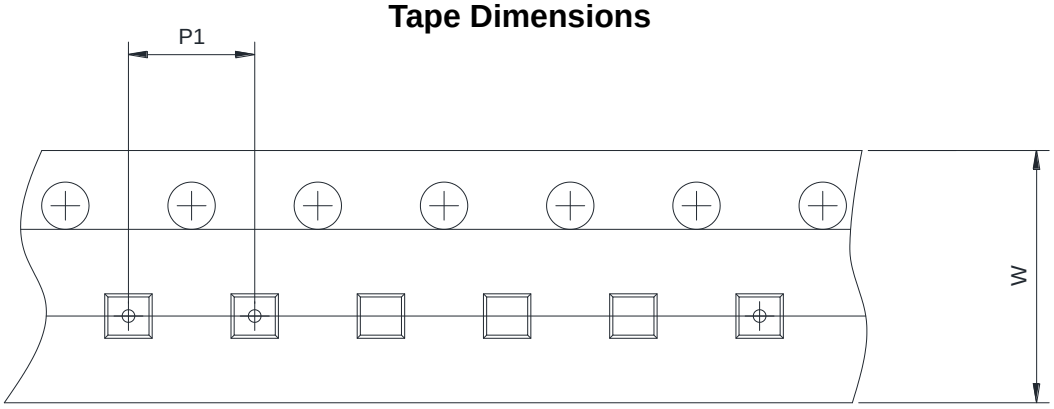
TAPE AND REEL INFORMATION

SOP-8L

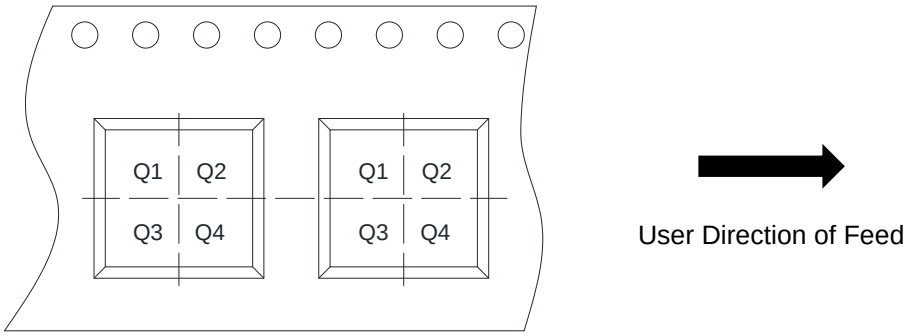
Reel Dimensions



Tape Dimensions



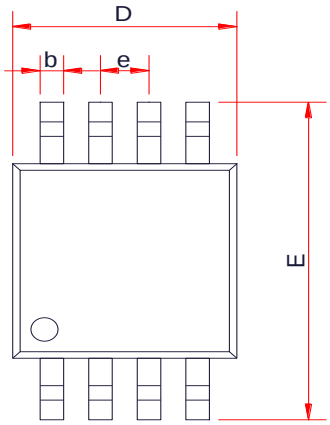
Quadrant Assignments For PIN1 Orientation In Tape



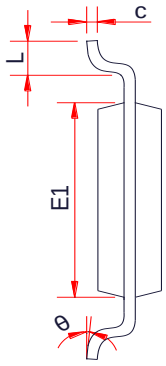
RD	Reel Dimension	☐ 7inch	☑ 13inch		
W	Overall width of the carrier tape	☐ 8mm	☑ 12mm		
P1	Pitch between successive cavity centers	☐ 2mm	☐ 4mm	☑ 8mm	
Pin1	Pin1 Quadrant	☑ Q1	☐ Q2	☐ Q3	☐ Q4

PACKAGE OUTLINE DIMENSIONS

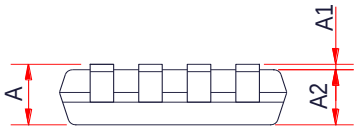
MSOP-8L



TOP VIEW



SIDE VIEW



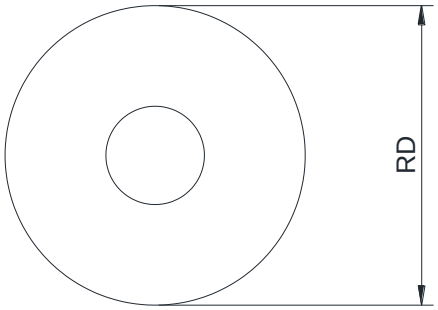
SIDE VIEW

Symbol	Dimensions In Millimeters (mm)		
	Min.	Typ.	Max.
A	-	-	1.10
A1	0.02	-	0.15
A2	0.75	0.80	0.95
b	0.25	-	0.38
c	0.09	-	0.23
D	2.90	3.00	3.10
E	4.75	4.90	5.05
E1	2.90	3.00	3.10
e	0.65 BSC		
L	0.40	-	0.80
θ	0°	-	6°

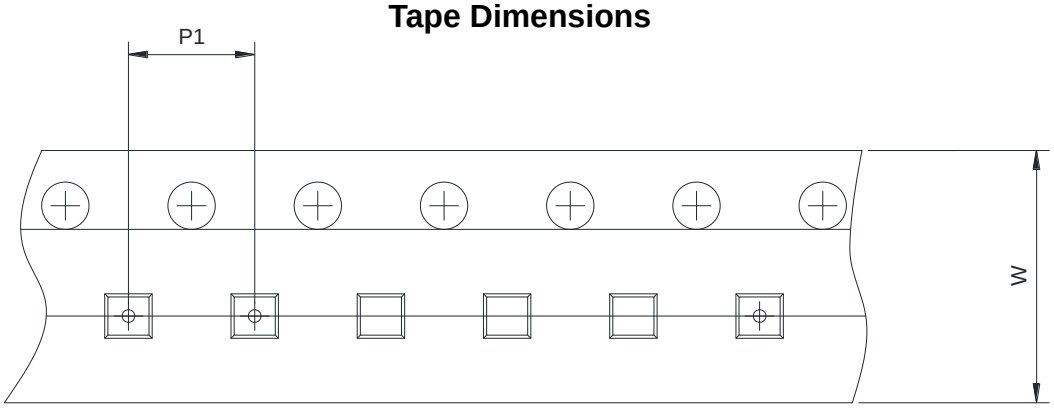
TAPE AND REEL INFORMATION

MSOP-8L

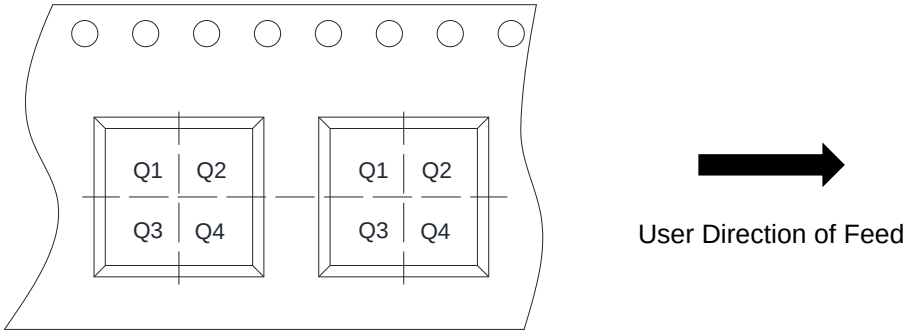
Reel Dimensions



Tape Dimensions



Quadrant Assignments For PIN1 Orientation In Tape

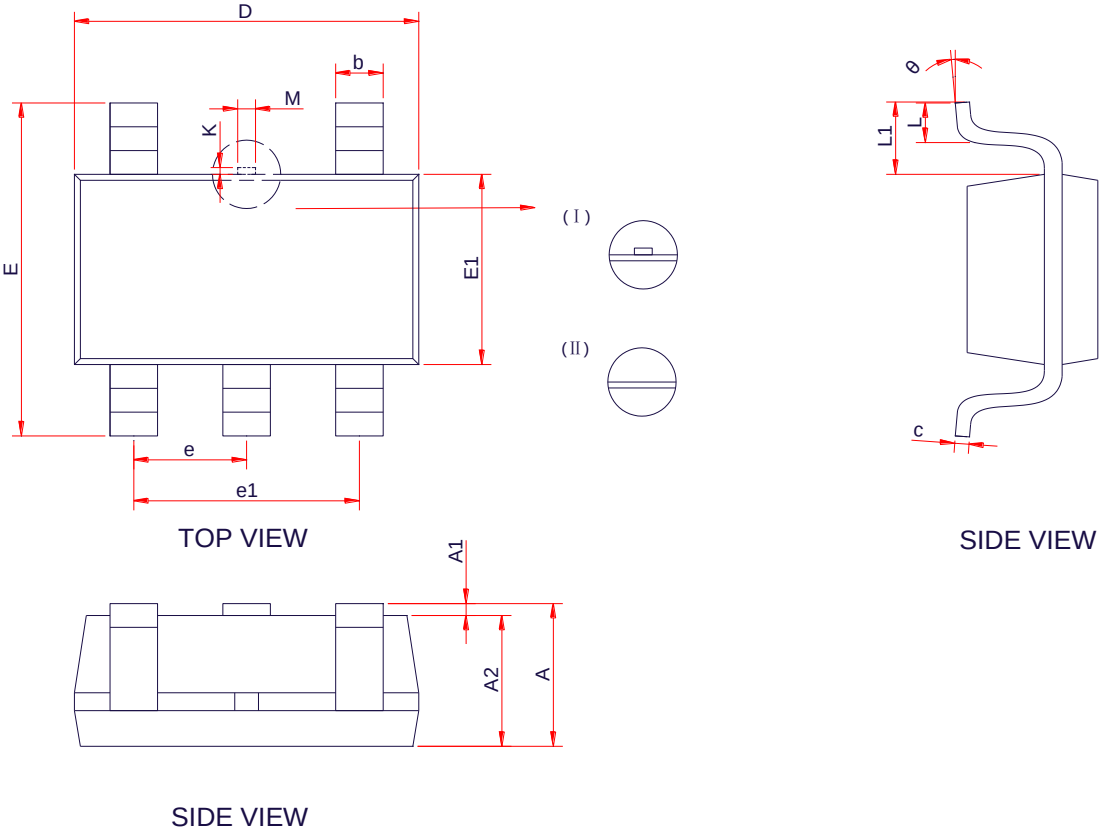


RD	Reel Dimension	☐ 7inch ☑ 13inch
W	Overall width of the carrier tape	☐ 8mm ☑ 12mm
P1	Pitch between successive cavity centers	☐ 2mm ☐ 4mm ☑ 8mm
Pin1	Pin1 Quadrant	☑ Q1 ☐ Q2 ☐ Q3 ☐ Q4

PACKAGE OUTLINE DIMENSIONS

SOT23-5L

(WS72551EA-5/TR)



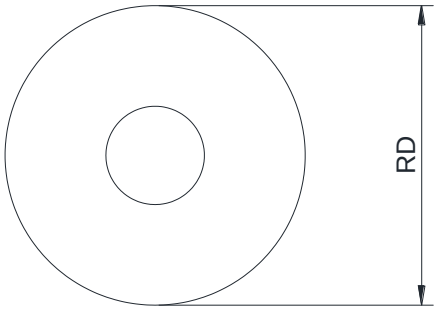
Symbol	Dimensions in Millimeters		
	Min.	Typ.	Max.
A	-	-	1.45
A1	0.00	-	0.15
A2	0.90	1.10	1.30
b	0.30	0.40	0.50
c	0.10	-	0.21
D	2.72	2.92	3.12
E	2.60	2.80	3.00
E1	1.40	1.60	1.80
e	0.95 BSC		
e1	1.90 BSC		
L	0.30	0.45	0.60
M	0.10	0.15	0.25
K	0.00	-	0.25
θ	0°	-	8°

TAPE AND REEL INFORMATION

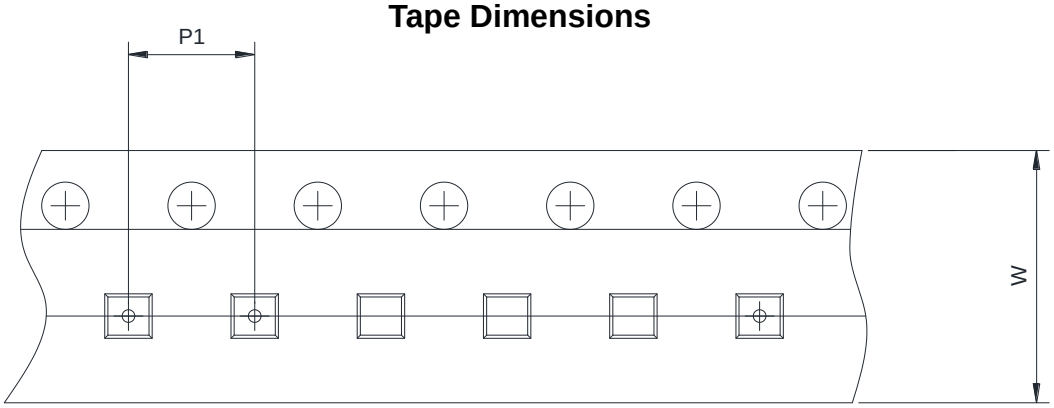
SOT23-5L

(WS72551EA-5/TR)

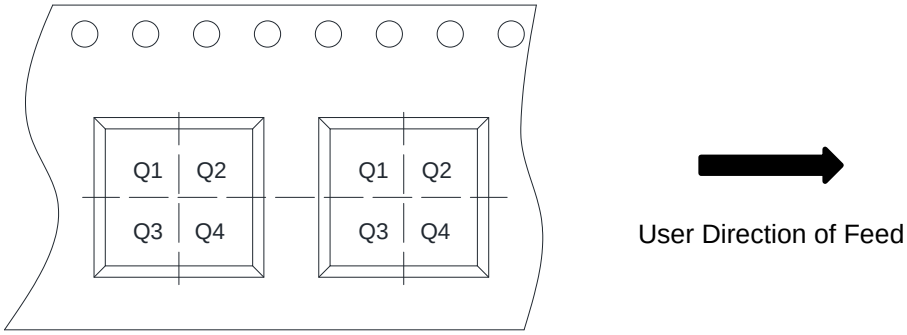
Reel Dimensions



Tape Dimensions



Quadrant Assignments For PIN1 Orientation In Tape

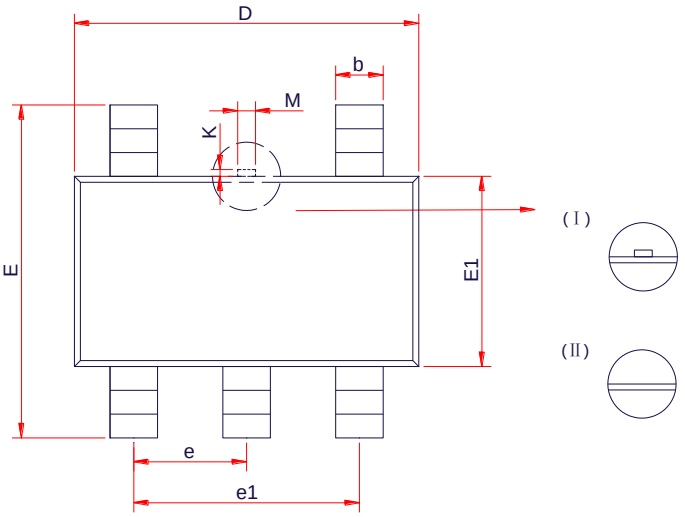


RD	Reel Dimension	☑ 7inch	☐ 13inch		
W	Overall width of the carrier tape	☑ 8mm	☐ 12mm	☐ 16mm	
P1	Pitch between successive cavity centers	☐ 2mm	☑ 4mm	☐ 8mm	
Pin1	Pin1 Quadrant	☐ Q1	☐ Q2	☑ Q3	☐ Q4

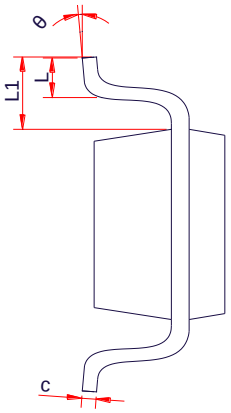
PACKAGE OUTLINE DIMENSIONS

SOT23-5L

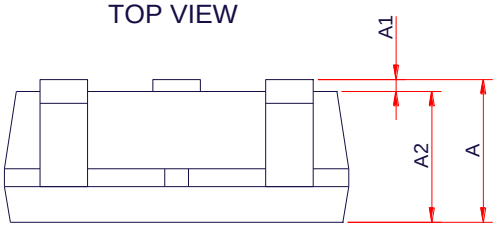
(WS72551E-5/TR)



TOP VIEW



SIDE VIEW



SIDE VIEW

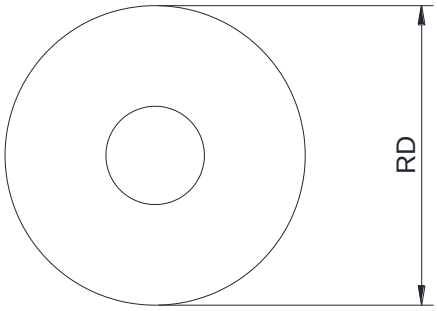
Symbol	Dimensions in Millimeters		
	Min.	Typ.	Max.
A	-	-	1.25
A1	0.00	-	0.15
A2	1.00	1.10	1.20
b	0.36	-	0.45
c	0.14	-	0.20
D	2.826	2.926	3.026
E	2.60	2.80	3.00
E1	1.526	1.626	1.726
e	0.90	0.95	1.00
e1	1.80	1.90	2.00
L	0.30	0.40	0.60
M	0.10	0.15	0.25
K	0.00	-	0.25
θ	0°	-	8°

TAPE AND REEL INFORMATION

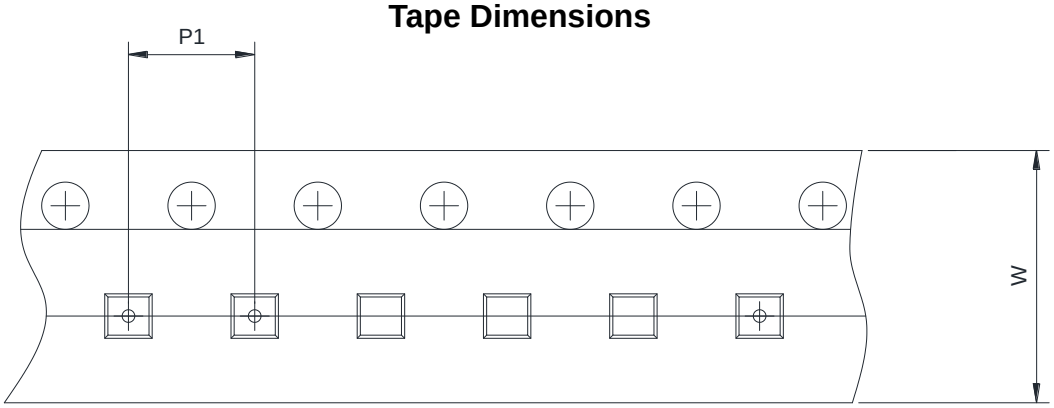
SOT23-5L

(WS72551E-5/TR)

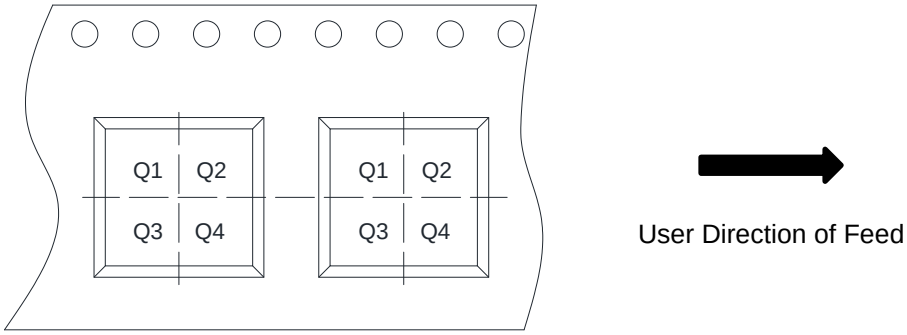
Reel Dimensions



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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