0.5Ω Ultra Low On-Resistance Dual SPDT Analog Switch with Negative Swing Audio Capability

Features

- Single Supply Voltage Range: 2.3V to 5.5V
- Low On-Resistance: 0.5Ω (TYP) at V_+=4.5V
- -3V Negative Signal Passing
- Fast Switching Times:
  - t_{ON}: 100ns (TYP)
  - t_{OFF}: 100ns (TYP)
- Low On-Resistance Flatness
- -3dB Bandwidth: 80MHz
- High Off-Isolation: -79dB at 100KHz
- Low Crosstalk Rejection: -80dB at 100KHz
- TTL/CMOS Compatible
- Break-Before-Make Switching
- Operation Temperature Range: -40°C to 105°C
- Available in QFN 1.8mmX1.4mmX0.55mm-10L Package

Applications

Battery-powered equipment

Portable electronic device

Audio and video signal routing

General Description

AW35321QNR is a high performance, bidirectional, dual SPDT (single-pole/double-throw) analog switch with negative swing audio capability that features ultra-low R_{ON} of 0.5Ω (TYP) at 4.5V V_+. It operates over a wide V_+ range of 2.3V to 5.5V and is designed for break-before-make operation. The select input is TTL-level compatible.

AW35321QNR features very low quiescent current even when the control voltage is lower than the V+ supply. This feature makes it very suitable for multiple applications, such as portable electronic device, audio and video signal routing, etc. Low power consumption is also one of the important reasons that make it a good choice.

AW35321QNR is available in a Green QFN 1.8mmX1.4mmX0.55mm-10L package. It operates over an ambient temperature range of -40°C to 105°C.

Typical Application Circuit

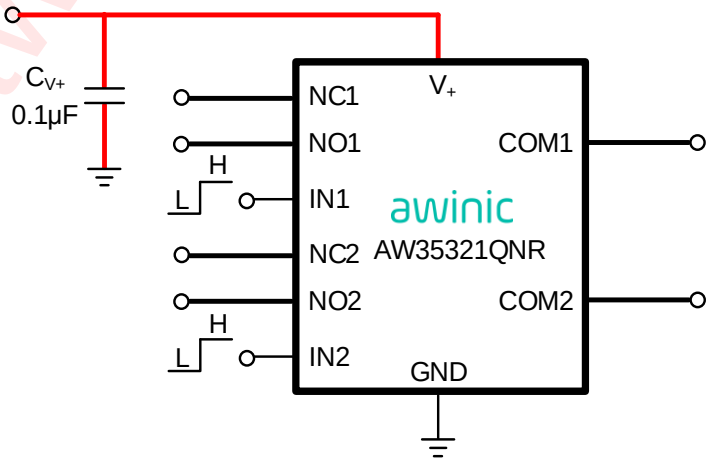


Figure 1 Typical Application Circuit of AW35321QNR

Pin Configuration And Top Mark

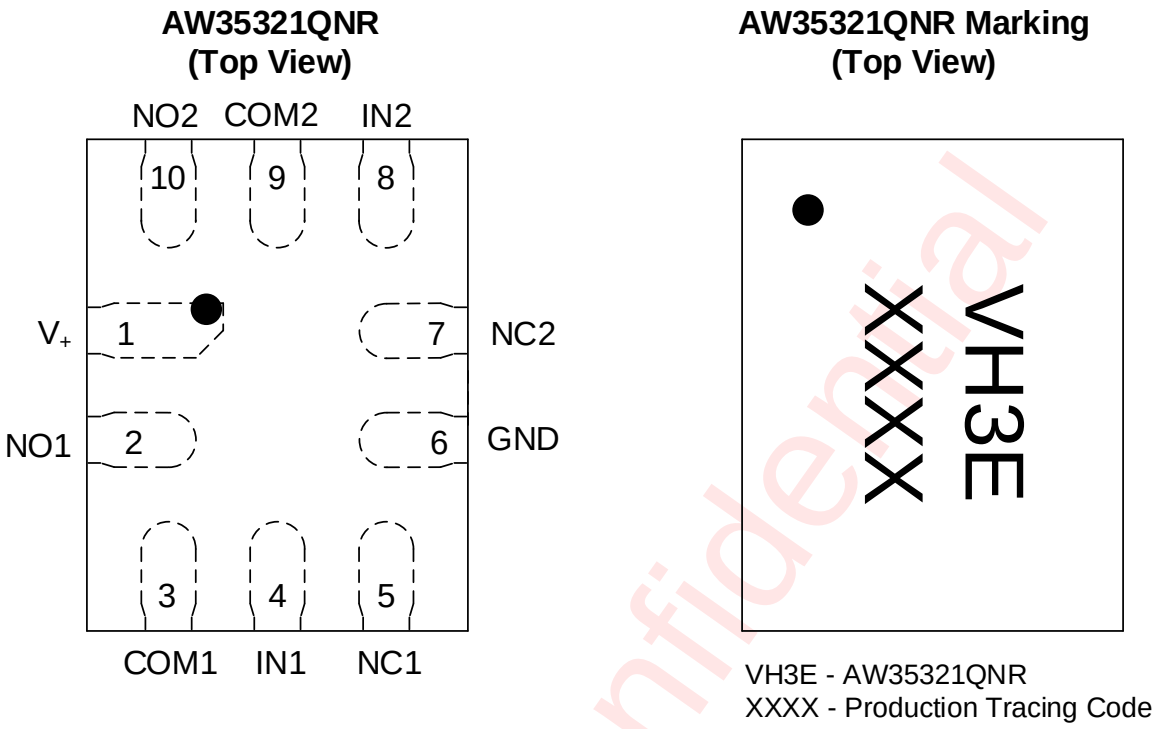


Figure 2 Pin Configuration and Top Mark

Pin Definition

No.	NAME	DESCRIPTION
1	V_+	Positive power supply
2, 10	NO1, NO2	Data port (normally open)
3, 9	COM1, COM2	Common data port
4, 8	IN1, IN2	Logic control pin to connect the COM pin to the NO or NC pin
5, 7	NC1, NC2	Data port (normally closed)
6	GND	Ground

Function Table

IN	NC to COM, COM to NC	NO to COM, COM to NO
L	ON	OFF
H	OFF	ON

To allow signals to pass between the NC and COM pins you must set the logic control IN pin low.

To allow signals to pass between the NO and COM pins you must set the logic control IN pin high.

Ordering Information

Part Number	Temperature	Package	Marking	Moisture Sensitivity Level	Environmental Information	Delivery Form
AW35321QNR	-40°C ~ 105°C	QFN 1.8mmX1.4mmX 0.55mm-10L	VH3E	MSL1	ROHS+HF	3000 units/ Tape and Reel

Functional Block Diagram

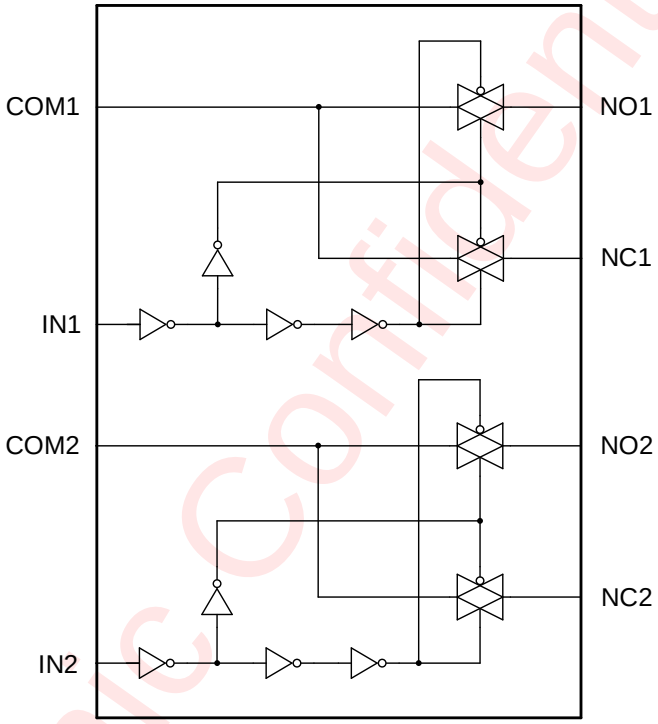


Figure 3 Functional Block Diagram

NOTE1: AW35321QNR features negative signal capability that allows signals below ground to pass through without distortion. AW35321QNR operates from a single +2.3V to +5.5V power supply. The data port signal swing of device is dependent of the supply voltage V_+. AW35321QNR can pass signals as high as V_+ and as low as (V_+)-5.5, including signals below ground with minimal distortion.

Absolute Maximum Ratings(NOTE2)

PARAMETERS	RANGE
Supply voltage range V_+	-0.3V to 6V
Logic control input voltage range V_{IN}	-0.3V to 6V
Switch I/O port voltage	(V_+)-5.5V to (V_+)+0.3V
Continuous current NO, NC or COM	±300mA
Peak current NO, NC or COM	±500mA
Maximum operating junction temperature T_{JMAX}	150°C
Storage temperature T_{STG}	-65°C to 150°C
Lead temperature (soldering 10 seconds)	260°C
ESD	
HBM (Human body model)(NOTE3)	±6kV
CDM(Charged device model) (NOTE4)	±1.5kV
Latch-Up	
Latch-Up(NOTE5)	+IT：200mA -IT：-200mA

NOTE2: Conditions out of those ranges listed in "absolute maximum ratings" may cause permanent damages to the device. In spite of the limits above, functional operation conditions of the device should within the ranges listed in "recommended operating conditions". Exposure to absolute-maximum-rated conditions for prolonged periods may affect device reliability.

NOTE3: The human body model is a 100pF capacitor discharged through a 1.5kΩ resistor into each pin. Test method: ESDA/JEDEC JS-001-2017.

NOTE4: All pins. Test Condition: ESDA/JEDEC JS-002-2022.

NOTE5: Test Condition: JEDEC78F.

Recommended Operating Conditions

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_+	Supply voltage	2.3		5.5	V
V_{IN}	Logic control input voltage	0		V_+	V
V_{NC}, V_{NO}, V_{COM}	Switch I/O port voltage	(V_+)-5.5		V_+	V
t_r, t_f	Input transition rise and fall rate			10	ns
Temp	Operating temperature range	-40		105	°C
C_{V+}	V_+ capacitance		0.1		μF

Electrical Characteristics—V_+=5V

Unless noted otherwise, V_+ voltage range of 4.5 V to 5.5 V, operating temperature range of –40°C to +105°C. Typical values are guaranteed for V_+=5V, TA=25°C.

PARAMETER		TEST CONDITION		TEMP	MIN	TYP	MAX	UNIT
ANALOG SWITCH								
V_{NO}, V_{NC}, V_{COM}	Analog signal range			full	(V_+)-5.5		V_+	V
R_{ON}	On-resistance	V_+=4.5V, 0V ≤ V_{NO} or V_{NC} ≤V_+, I_{COM}=-100mA, Test Circuit 1		25°C		0.5	0.7	Ω
				full			0.9	Ω
ΔR_{ON}	On-resistance match between channels	V_+=4.5V, 0V ≤ V_{NO} or V_{NC} ≤V_+, I_{COM}=-100mA, Test Circuit 1		25°C		0.1	0.15	Ω
				full			0.18	Ω
$R_{FLAT(ON)}$	On-resistance flatness	V_+=4.5V, 0V ≤ V_{NO} or V_{NC} ≤V_+, I_{COM}=-100mA, Test Circuit 1		25°C		0.1	0.15	Ω
				full			0.18	Ω
I_+	Power supply current	V_+=5V, V_{IN}=0V or 5V		full			1	μA
$I_{NO(OFF)}$, $I_{NC(OFF)}$	Switch off leakage current	V_+=5V, V_{NO} or V_{NC}=1V, 4.5V, V_{COM}=4.5V, 1V		full			1	μA
$I_{NO(ON)}$,$I_{NC(ON)}$, $I_{COM(ON)}$	Switch on leakage current	V_+=5V, V_{COM} =1V, 4.5V, V_{NO} or V_{NC} =1V, 4.5V or floating		full			1	μA
LOGIC CONTROL INPUTS								
V_{INH}	Input High Voltage			full	1.4			V
V_{INL}	Input Low Voltage			full			0.6	V
I_{IN}	Input Leakage Current	V_+ = 5V, V_{IN} = 0V or 5V		full		0.4	1	μA
DYNAMIC CHARACTERICS								
t_{ON}	Switch turn-on time	V_{NO} or V_{NC}=3V, R_L=50Ω, C_L=35pF, Test Circuit 2		25°C		100		ns
t_{OFF}	Switch turn-off time	V_{NO} or V_{NC}=3V, R_L=50Ω, C_L=35pF, Test Circuit 2		25°C		100		ns
T_{BBM}	Break-Before-Make time	V_{NO} or V_{NC}=3V, R_L=50Ω, C_L=35pF, Test Circuit 3		25°C		75		ns
O_{ISO}	Off isolation	Signal=0dBm, R_L=50Ω, C_L=5pF, Test Circuit 4	f=100kHz	25°C		-79		dB
X_{TALK}	Crosstalk	R_L=50Ω, C_L=5pF, Test Circuit 5	f=100kHz	25°C		-80		dB

PARAMETER		TEST CONDITION	TEMP	MIN	TYP	MAX	UNIT
BW	-3dB bandwidth	Signal=0dBm, R_L=50Ω, C_L=5pF, Test Circuit 6	25°C		80		MHz
Q	Charge injection	C_L=1nF, Test Circuit 7	25°C		50		pC
CAPACITANCE							
C_{ON}	On capacitance		25°C		70		pF
C_{OFF}	Off capacitance		25°C		40		pF

Electrical Characteristics—V_+=3V

Unless noted otherwise, V_+ voltage range of 2.7 V to 3.6 V, operating temperature range of –40°C to +105°C. Typical values are guaranteed for V_+=3V, TA=25°C.

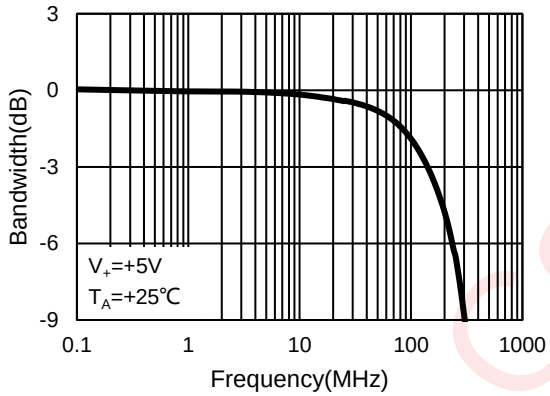
PARAMETER		TEST CONDITION	TEMP	MIN	TYP	MAX	UNIT
ANALOG SWITCH							
V_{NO}, V_{NC}, V_{COM}	Analog signal range		full	(V_+)-5.5		V_+	V
R_{ON}	On-resistance	V_+=2.7V, 0V ≤ V_{NO} or V_{NC} ≤V_+, I_{COM}=-100mA, Test Circuit 1	25°C		0.9	1.15	Ω
			full			1.3	Ω
ΔR_{ON}	On-resistance match between channels	V_+=2.7V, 0V ≤ V_{NO} or V_{NC} ≤V_+, I_{COM}=-100mA, , Test Circuit 1	25°C		0.1	0.16	Ω
			full			0.2	Ω
$R_{FLAT(ON)}$	On-resistance flatness	V_+=2.7V, 0V ≤ V_{NO} or V_{NC} ≤V_+, I_{COM}=100mA, Test Circuit 1	25°C		0.45	0.58	Ω
			full			0.68	Ω
I_+	Power supply current	V_+=3V, V_{IN}=0V or 3V	full			1	μA
$I_{NO(OFF)}$, $I_{NC(OFF)}$	Switch off leakage current	V_+=3.6V, V_{NO} or V_{NC}=0.3V, 3.3V, V_{COM}=3.3V, 0.3V	full			1	μA
$I_{NO(ON)}$,$I_{NC(ON)}$, $I_{COM(ON)}$	Switch on leakage current	V_+=3.6V, V_{COM} =0.3V, 3.3V, V_{NO} or V_{NC} =0.3V, 3.3V or floating	full			1	μA
LOGIC CONTROL INPUTS							
V_{INH}	Input High Voltage		full	1.3			V
V_{INL}	Input Low Voltage		full			0.5	V
I_{IN}	Input Leakage Current	V_+ = 3.6V, V_{IN} = 0V or 3.6V	full		0.3	1	μA
DYNAMIC CHARACTERICS							

PARAMETER		TEST CONDITION		TEMP	MIN	TYP	MAX	UNIT
t_{ON}	Switch turn-on time	V_{NO} or V_{NC}=1.5V, R_L=50Ω, C_L=35pF, Test Circuit 2		25°C		200		ns
t_{OFF}	Switch turn-off time	V_{NO} or V_{NC}=1.5V, R_L=50Ω, C_L=35pF, Test Circuit 2		25°C		200		ns
T_{BBM}	Break-Before-Make time	V_{NO} or V_{NC}=1.5V, R_L=50Ω, C_L=35pF, Test Circuit 3		25°C		135		ns
O_{ISO}	Off isolation	Signal=0dBm, R_L=50Ω, C_L=5pF, Test Circuit 4	f=100kHz	25°C		-79		dB
X_{TALK}	Crosstalk	R_L=50Ω, C_L=5pF, Test Circuit 5	f=100kHz	25°C		-80		dB
BW	-3dB bandwidth	Signal=0dBm, R_L=50Ω, C_L=5pF, Test Circuit 6		25°C		80		MHz
Q	Charge injection	C_L=1nF, Test Circuit 7		25°C		50		pC
THD	Total harmonic distortion	V_+=3.3V, V_{NO} or V_{NC}=1V_{PP}, R_L=16Ω, f=20Hz to 20kHz, Test Circuit 8		25°C		0.09		%
		V_+=3.3V, V_{NO} or V_{NC}=1V_{PP}, R_L=32Ω, f=20Hz to 20kHz, Test Circuit 8		25°C		0.045		%
		V_+=3.3V, V_{NO} or V_{NC}=1V_{PP}, R_L=600Ω, f=20Hz to 20kHz, Test Circuit 8		25°C		0.008		%
		V_+=3.3V, V_{NO} or V_{NC}=2V_{PP}, R_L=16Ω, f=20Hz to 20kHz, Test Circuit 8		25°C		0.2		%
		V_+=3.3V, V_{NO} or V_{NC}=2V_{PP}, R_L=32Ω, f=20Hz to 20kHz, Test Circuit 8		25°C		0.1		%
		V_+=3.3V, V_{NO} or V_{NC}=2V_{PP}, R_L=600Ω, f=20Hz to 20kHz, Test Circuit 8		25°C		0.008		%
		V_+=3.3V, V_{NO} or V_{NC}=4V_{PP}, R_L=16Ω, f=20Hz to 20kHz, Test Circuit 8		25°C		0.44		%
		V_+=3.3V, V_{NO} or V_{NC}=4V_{PP}, R_L=32Ω, f=20Hz to 20kHz, Test Circuit 8		25°C		0.21		%

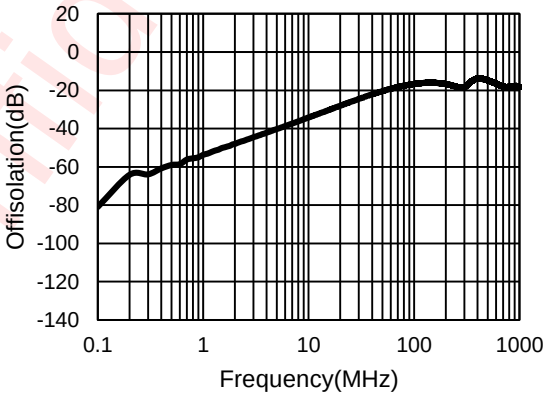
PARAMETER		TEST CONDITION	TEMP	MIN	TYP	MAX	UNIT
		V_+=3.3V, V_{NO} or V_{NC}=4V_{PP}, R_L=600Ω, f=20Hz to 20kHz, Test Circuit 8	25°C		0.013		%
CAPACITANCE							
C_{ON}	On capacitance		25°C		70		pF
C_{OFF}	Off capacitance		25°C		40		pF

Typical Characteristics

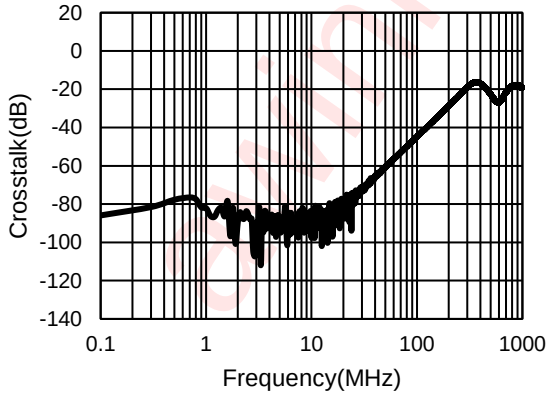
Bandwidth vs. Frequency



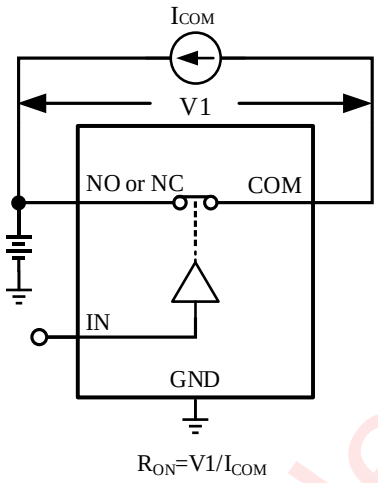
Off-Isolation vs. Frequency



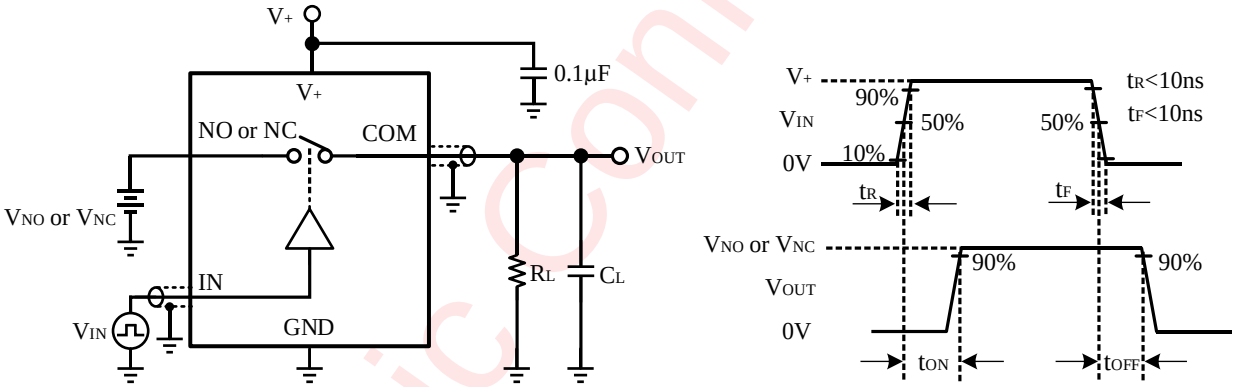
Crosstalk vs. Frequency



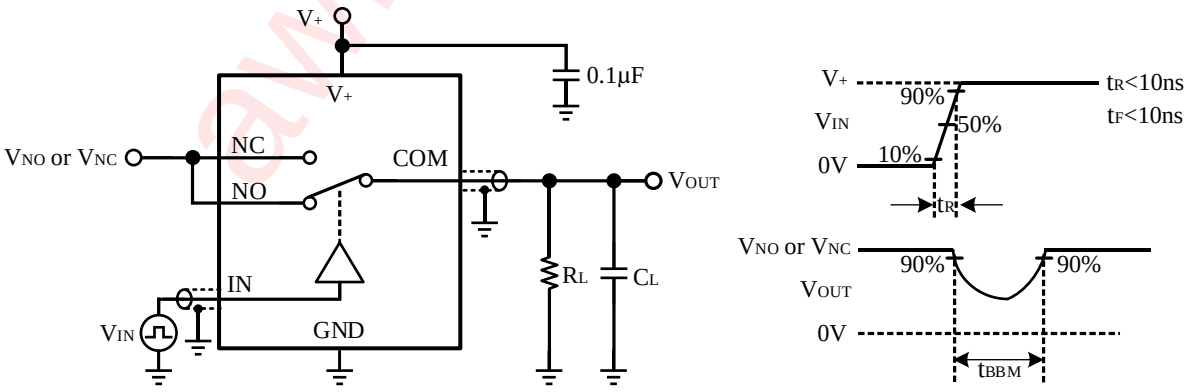
Test Circuits



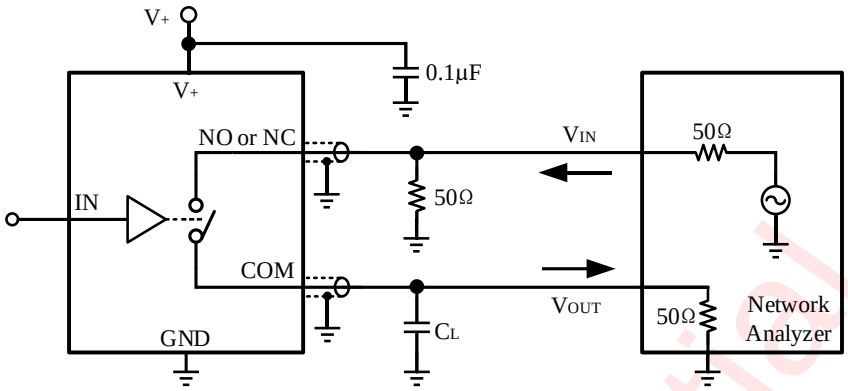
Test Circuit 1 On-Resistance



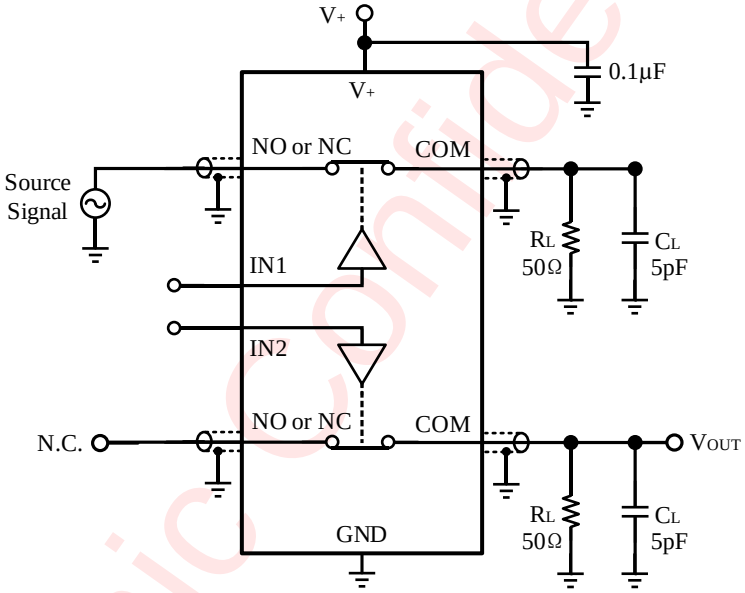
Test Circuit 2 Switching Times



Test Circuit 3 Break-Before-Make Time Delay(t_{BBM})

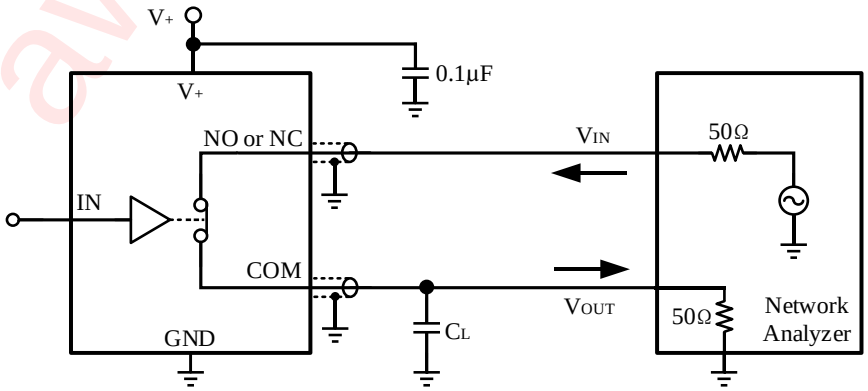


Test Circuit 4 Off Isolation

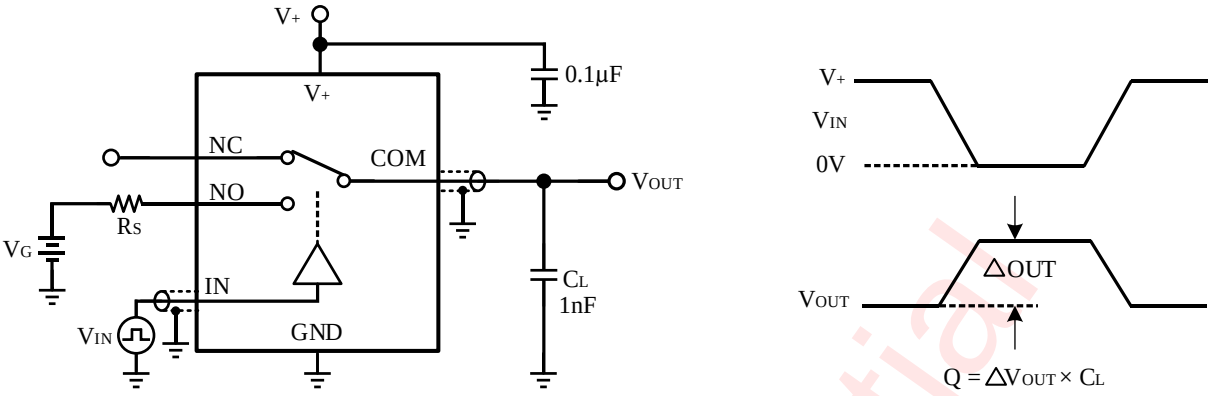


$$\text{Channel-to-Channel Crosstalk} = -20 \times \log \frac{V_{NO \text{ or } NC}}{V_{OUT}}$$

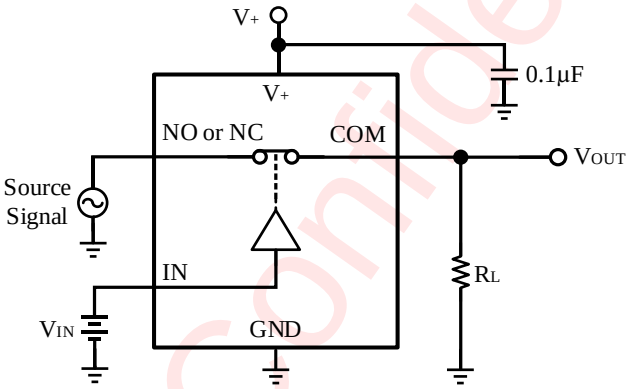
Test Circuit 5 Channel-to-Channel Crosstalk



Test Circuit 6 -3dB Bandwidth



Test Circuit 7 Charge Injection (Q)



Test Circuit 8 Total Harmonic Distortion (THD)

Application Information

AW35321 features negative signal capability that allows signals below ground to pass through without distrotion. AW35321 operates from a single 2.3V to 5.5V supply. The input and output signal swing of the device is dependant on the supply voltage V_+. The device can pass signals as high as V_+ and as low as V_+—5.5V.

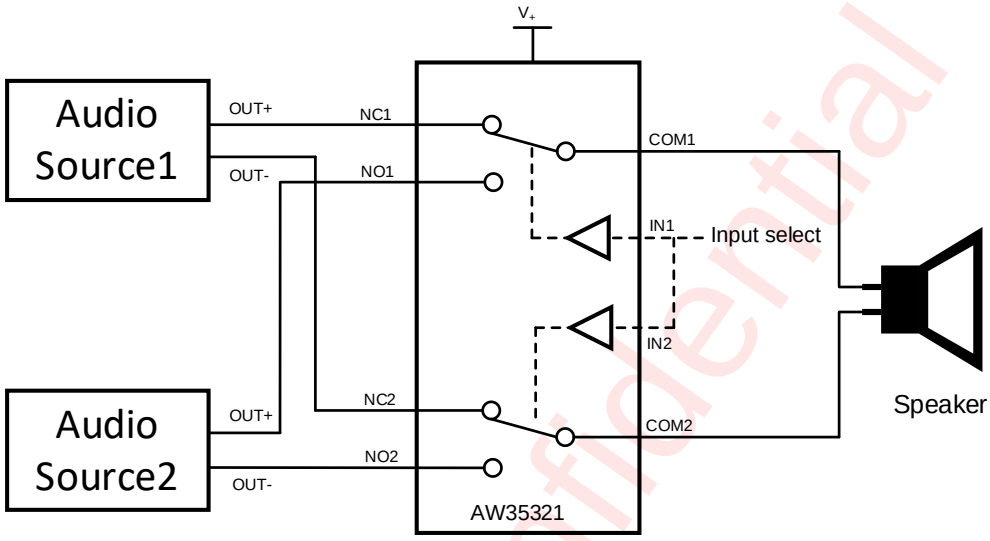


Figure 4 Typical Application

Table 1 shows the input-output signal swing the user can get with different supply voltages.

Table 1. Input-output signal swing

Supply Voltage(V_+)	Min (V_{NC},V_{NO},V_{COM})=V_+-5.5	Max (V_{NC},V_{NO},V_{COM})=V_+
5.5V	0V	5.5V
4.2V	-1.3V	4.2V
3.3V	-2.2V	3.3V
3V	-2.5V	3V
2.5V	-3V	2.5V

PCB Layout Consideration

It is recommended to place a bypass capacitor as close to the supply pin V_+ as possible to help smooth out lower frequency noise to provide better load regulation across the frequency spectrum.

Minimize trace lengths and vias on the single paths in order to preserve signal integrity.

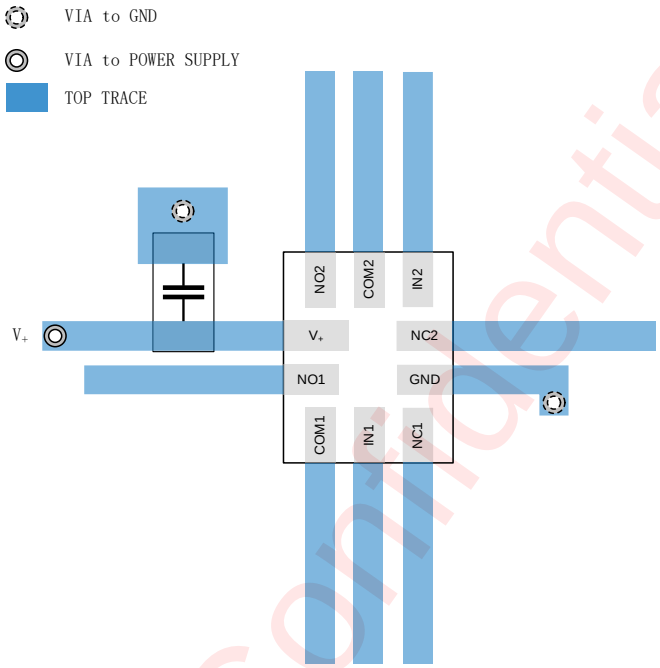
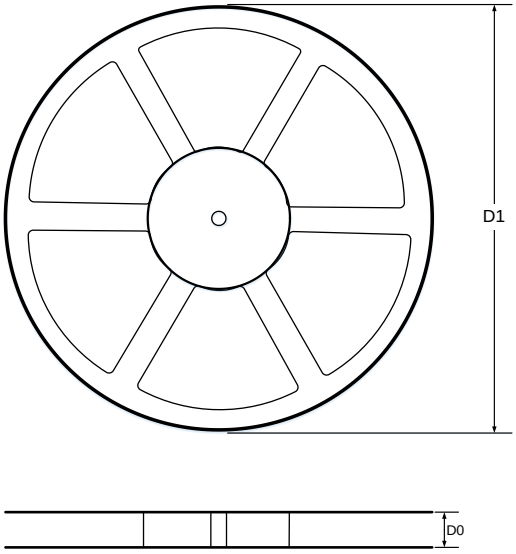


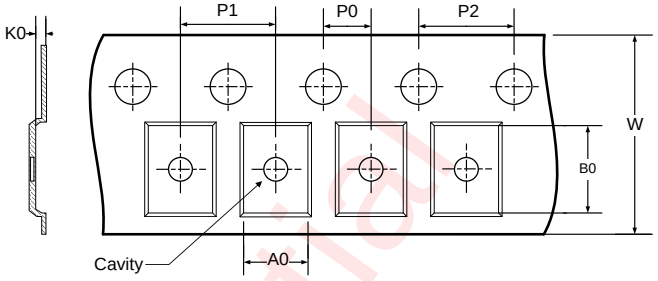
Figure 5 PCB Layout example

Tape And Reel Information

REEL DIMENSIONS

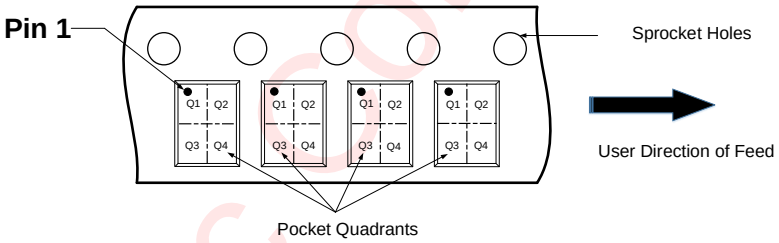


TAPE DIMENSIONS



A0：Dimension designed to accommodate the component width
B0：Dimension designed to accommodate the component length
K0：Dimension designed to accommodate the component thickness
W：Overall width of the carrier tape
P0：Pitch between successive cavity centers and sprocket hole
P1：Pitch between successive cavity centers
P2：Pitch between sprocket hole
D1：Reel Diameter
D0：Reel Width

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



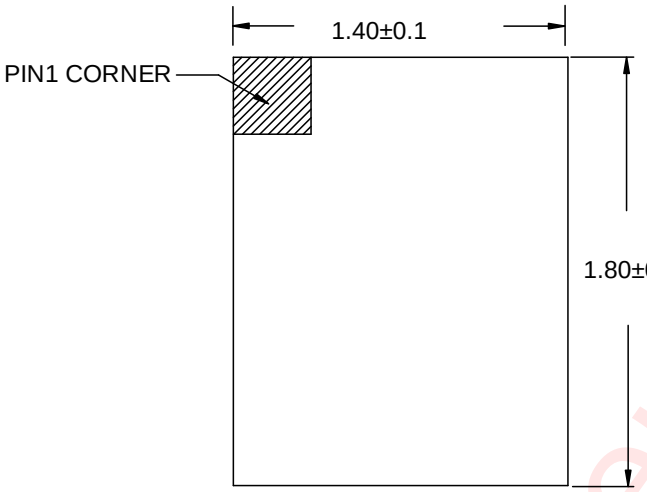
Note：The above picture is for reference only. Please refer to the value in the table below for the actual size

DIMENSIONS AND PIN1 ORIENTATION

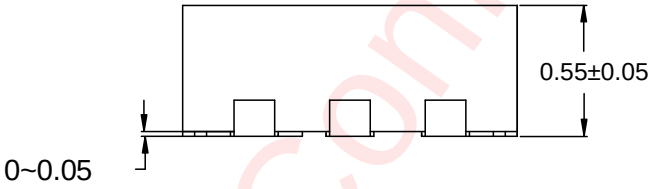
D1 (mm)	D0 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
178.00	8.40	1.58	2.04	0.73	2.00	4.00	4.00	8.00	Q1

All dimensions are nominal

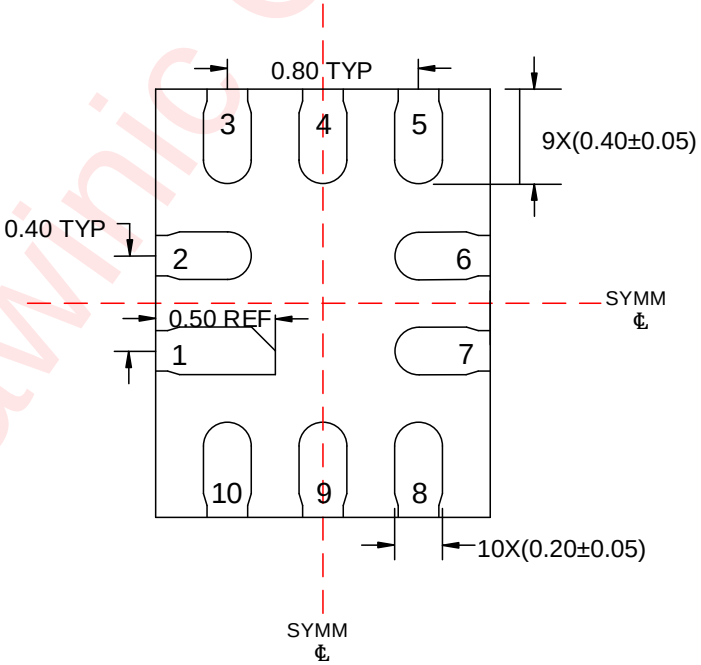
Package Description



TOP VIEW



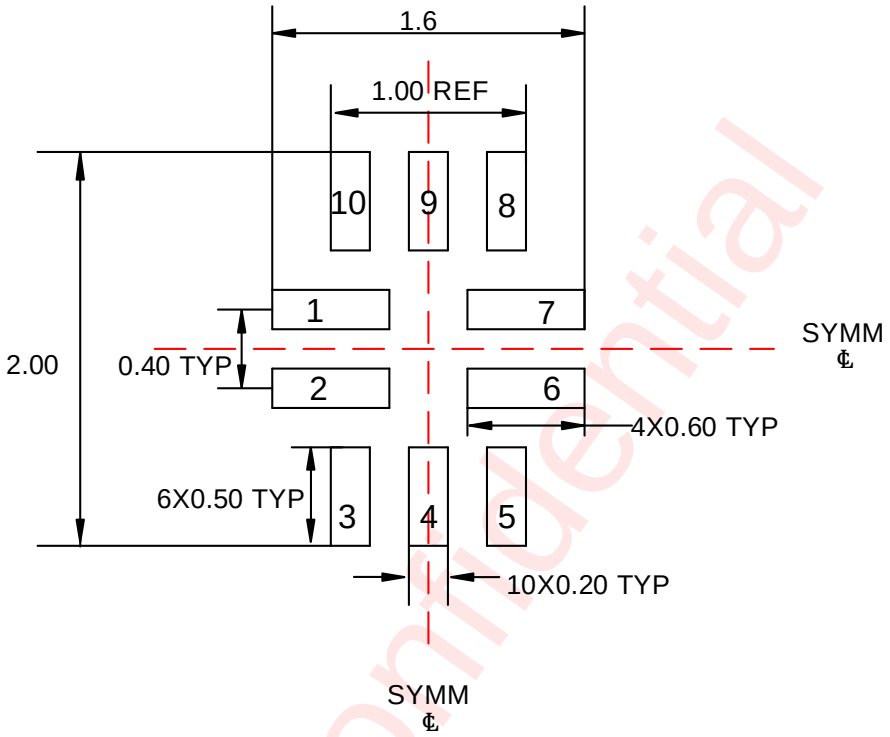
SIDE VIEW

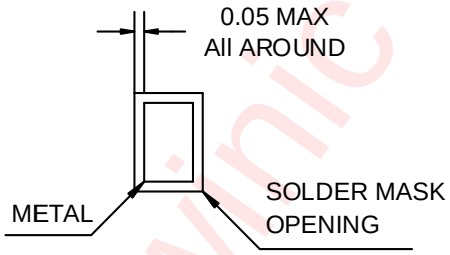


BOTTOM VIEW

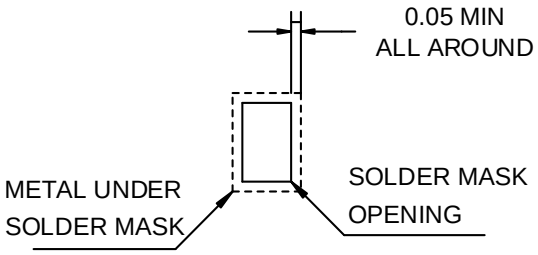
Unit:mm

Land Pattern Data





NON SOLDER MASK DEFINED



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Unit:mm

Revision History

Version	Date	Change Record
V1.0	Aug. 2023	Datasheet V1.0 released
V1.1	Aug. 2023	Update 'Operating temperature range' from '–40°C to +85°C' to '–40°C to +105°C'
V1.2	Sept. 2023	1. Figure 4 Typical Application 'V_{CC}' update to 'V_+'(P12); 2. Figure 5 PCB Layout example 'V_{CC}' update to 'V_+', 'IN' update to 'IN1'.
V1.3	Nov. 2023	1. Add MAX value at 25°C of R_{ON}, ΔR_{ON}, $R_{FLAT(ON)}$ (P5, P6); 2. Add MAX value from –40°C to +105°C of R_{ON}, ΔR_{ON}, $R_{FLAT(ON)}$ (P5, P6).

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