0.4Ω Dual SPDT Negative Signal Handing Analog Switch

General Description

The ETQ5228M is an advanced CMOS analog switch fabricated in Sub−micron silicon gate CMOS technology. The part also features guaranteed Break Before Make (BBM) switching, assuring the switches never short the driver. The switches can handle negative signal down to -2V.

Features

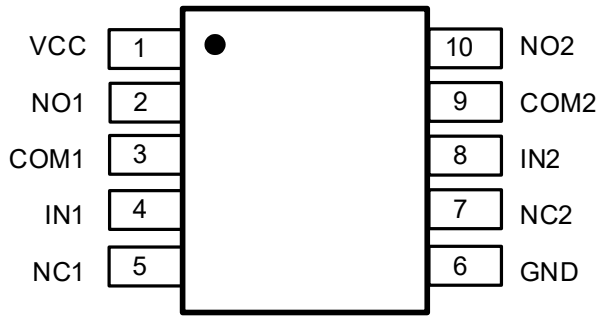
- Low R_{ON} is typical 0.4Ω @ V_{CC} =4.3V
- Single supply operation from 1.8V to 5.5V
- Full -2 V to V_{CC} signal handling capability
- High off-channel isolation
- Low standby current
- Low distortion
- Break-Before-Make(BBM) switching
- High continuous current capability is ±300mA through each switch
- Automotive AEC-Q100 Grade 2 Qualified
  - -- Ambient temperature range of -40°C to +105°C
  - -- ESD HBM 4kV PASS
  - -- ESD CDM 1.5kV PASS
- Package information:

Part No.	Package	Packing Option	MSL
ETQ5228M	MSOP10	Tape and Reel , 4K	Level 3

Application

- Advanced driver assistance systems (ADAS)
- Body electronics and lighting
- I^2C and SPI bus multiplexing
- Infotainment and cluster
- Body control modules
- Automotive head unit
- Telematics

Pin Configuration



ETQ5228M (MSOP10)

Top View

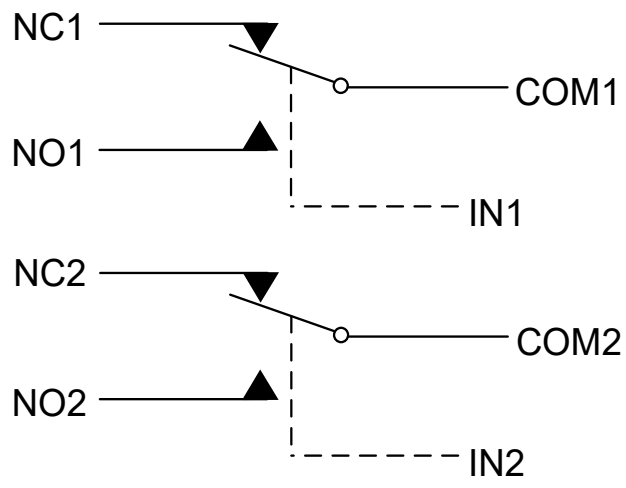
Pin Function

Pin NO.	Pin Name	Description
1	VCC	Power supply
2	NO1	Independent Channels
3	COM1	Common Channels
4	IN1	Controls
5	NC1	Independent Channels
6	GND	Ground (V)
7	NC2	Independent Channels
8	IN2	Controls
9	COM2	Common Channels
10	NO2	Independent Channels

Truth Table

IN1/2	NO1/2 to COM1/2	NC1/2 to COM1/2
0	OFF	ON
1	ON	OFF

Analog Symbol



Analog Symbol

Absolute Maximum Ratings

Symbol	Characteristic	Value	Unit
V_{CC}	Supply Voltage	-0.5～+6.5	V
V_{IS}	Analog Input Voltage	-2.5～V_{CC}+0.3 $\|V_{CC}-V_{IS}\|$ <6.5V	V
V_{IN}	Digital Select Input Voltage	-0.5～+6.5	V
V_O	Output Voltage	-2.5～V_{CC}+0.3 $\|V_{CC}-V_O\|$ <6.5V	V
I_{AN1}	Continuous DC Current from COM to NC/NO	±300	mA
$I_{AN1-PK1}$	Peak Current from COM to NC/NO, 10 Duty Cycle (1)	±500	mA
I_{CLMP}	Continuous DC Current into COM/NO/NC with Respect to V_{CC} or GND	±100	mA
T_S	Storage Temperature	-55 to 150	°C

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

Note1.Defined as 10% ON, 90% off duty cycle.

Recommended Operating Conditions

Symbol	Characteristic	Min	Max	Unit
V_{CC}	DC Supply Voltage	1.8	5.5	V
V_{IN}	Digital Select Input Voltage	GND	5.5	V
V_{IS}	Analog Input Voltage	-2	V_{CC}	V
T_A	Operating Temperature Range	-40	+105	°C
tr , t_f	Input Rise or Fall Time, SELECT	0	20	ns/V

Electrical Characteristics

Symbol	Parameter	Test Conditions	T_A=25°C			T_A=-40~105°C		Unit
			Min	Typ	Max	Min	Max	
V_{IH}	High-Level Input Voltage, Select Inputs	V_{CC} =1.8~5.5	0.95			1.2		V
V_{IL}	Low-Level Input Voltage, Select Inputs	V_{CC}=1.8~5.5			0.4		0.35	V
I_{IN}	Maximum Input Leakage Current, Select Inputs	V_{IN} =V_{CC} or GND V_{CC} =5.5V			±0.3		±1.0	uA
I_{OFF}	Power Off VCC Leakage Current	V_{IN} =5.5V V_{CC} =0V			±0.5		±1.0	uA
I_{CC}	Maximum Quiescent Supply Current	V_{CC} =5.5V, I_{OUT} =0 V_{IN} = V_{CC} or GND			±0.5		±2.0	uA
I_{CCT}	Increase in I_{CC} per Input	IN1=2.6V, IN2=0V,or IN2=2.6V, IN1=0V, V_{CC} =4.3V		4	6		15	uA
		IN1=1.8V, IN2=0V,or IN2=1.8V, IN1=0V, V_{CC} =4.3V		12	16		25	
$I_{COM(ON)}$	COM ON leakage Current (3)	V_{IN} = V_{IL} or $V_{IH.}$, V_{NO}=0.3V or 4.7V V_{NC} floating V_{NC}=0.3V or 4.7V V_{NO} floating V_{COM}=0.3Vor 4.7V V_{CC} =5.5V	-100		100	-700	700	nA
R_{ON}	On−Resistance (3)	I_{COM} = 100mA V_{IS}=-2V,-1V,0V, 0.7V,3.6V,4.3V V_{CC} =4.3V		0.4	0.8		1.0	Ω
		I_{COM} = 100mA, V_{IS}=-2V,-1V,0V, 0.7V,2.3V, 3V V_{CC} =3.0V		0.5	1.0		1.3	
R_{FLAT}	On−Resistance Flatness (3) (5)	I_{COM}=100mA V_{IS}=GND to V_{CC}, V_{CC} =4.3V			0.3		0.4	Ω
ΔR_{ON}	On−Resistance Match Between Channels (3) (4)	I_{COM}=100mA V_{IS}=1.5V V_{CC} =4.3V		0.1	0.2		0.3	Ω

Electrical Characteristics (Continued)

Symbol	Parameter	Test Conditions	T_A=25°C			T_A=-40~105°C		Unit
			Min	Typ	Max	Min	Max	
t_{ON}	Turn−On Time [2] (Figure 1)	V_{IS}=1.5V, V_{CC} =2.5~3.3V		65	140		300	ns
		V_{IS}=1.5V, V_{CC} =3.3~5.5V		30	100		200	
t_{OFF}	Turn−Off Time [2] (Figure 1)	V_{IS}=1.5V, V_{CC} =2.5~3.3V		20	60		120	ns
		V_{IS}=1.5V, V_{CC} =3.3~5.5V		15	45		100	
t_{BBM}	Break-Before-Make Time [2] (Figure 2)	C_L=35pF, R_L=50Ω V_{IS}=1.5V, V_{CC} =2.5~3.3V		40		30		ns
		C_L=35pF, R_L=50Ω V_{IS}=1.5V, V_{CC} =3.3~5.5V		20		15		
t_{PD}	Propagation delay [2] (Figure 4)	C_L=0pF, R_L=50Ω V_{CC} =2.5~3.3V		0.8				ns
		C_L=0pF, R_L=50Ω V_{CC} =3.3~5.5V		0.6				ns
BW	On-Channel -3dB Bandwidth or Frequency Response [2] (Figure 5)	R_{IS}=50Ω		130				MHz
V_{ISO}	Off−Channel Isolation [2] (Figure 6)	F_{IS} = 100kHz, V_{IN} =GND or V_{CC} C_L=5pF， R_L= 50Ω V_{IS}=1V_{RMS}		-70				dB
Q	Charge Injection Select Input to Common I/O [2] (Figure 3)	V_{IN} = 0 or V_{CC} R_{IS}=0Ω,C_L=100pF R_L=1MΩ $Q=C_L×\Delta V_{OUT}$ V_{CC} =5.5V		3.5				pC
THD	Total Harmonic Distortion THD +Noise [2]	F_{IS}=20Hz to 20KHz R_L=50Ω,C_L=5pF V_{IS}=2V_{RMS} V_{CC} =3.6V		0.06				%
V_{CT}	Channel−to−Channel Crosstalk [2] (Figure 7)	F_{IS}= 100KHz, V_{IN} =GND or V_{CC} R_L= 50Ω,C_L=5pF V_{IS}=1V_{RMS}		-85				dB

Electrical Characteristics (Continued)

Symbol	Parameter	Test Conditions	T_A=25°C			T_A=-40~105°C		Unit
			Min	Typ	Max	Min	Max	
C_{IN}	Control Pin Input Capacitance (2)	V_{CC} =3.6V		2	4			pF
C_{NC}/C_{NO}	NC/NO Port Capacitance (2)	V_{CC} =3.6V		20	30			pF
C_{COM}	COM Port Capacitance When Switch is Enabled (2)	V_{CC} =3.6V		60	90			pF

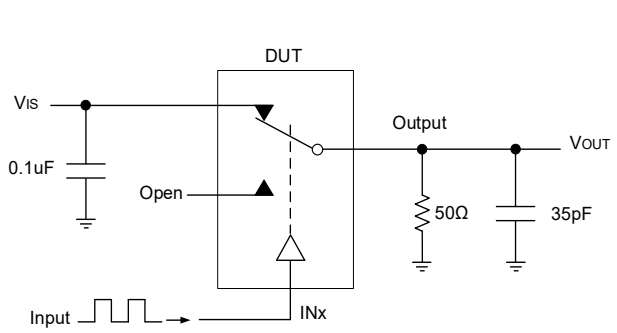
Note2. Guaranteed by design.

Note3. Guaranteed by design. Measurements do not include test circuit.

Note4. $\Delta R_{ON} = R_{ON(NC1)} - R_{ON(NC2)}$ or $R_{ON(No1)} - R_{ON(No2)}$ when V_{IS} is same.

Note5. Flatness is defined as the difference between the maximum and minimum value of on−resistance as measured over the specified analog signal ranges.

Test Circuit



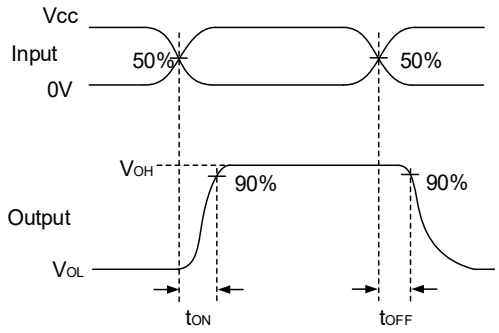
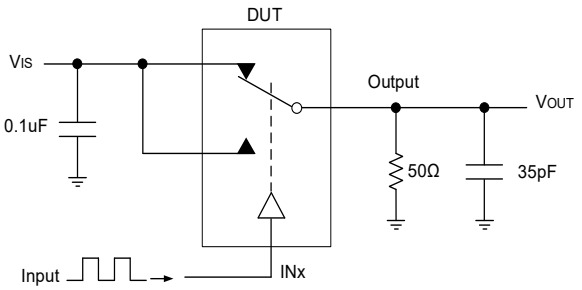


Figure 1. t_{ON} /t_{OFF}



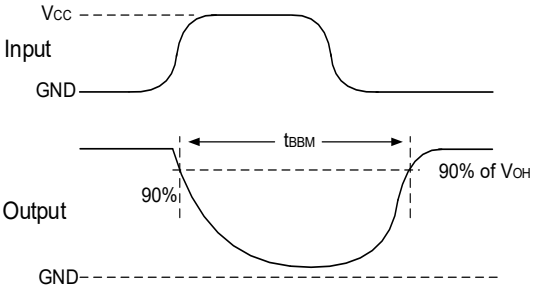
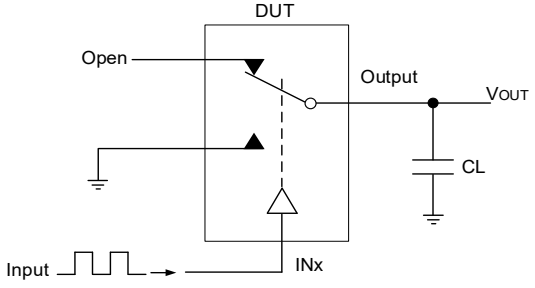


Figure 2. t_{BBM}



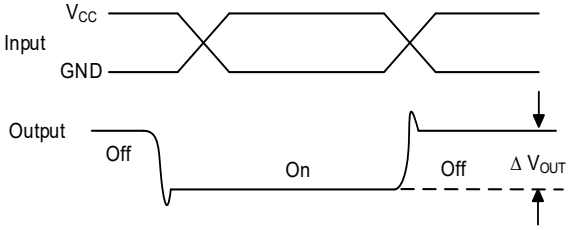


Figure 3. Charge Injection

Test Circuit (Continued)

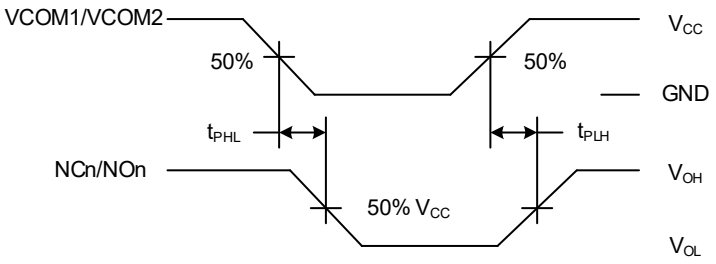


Figure 4. Propagation delay

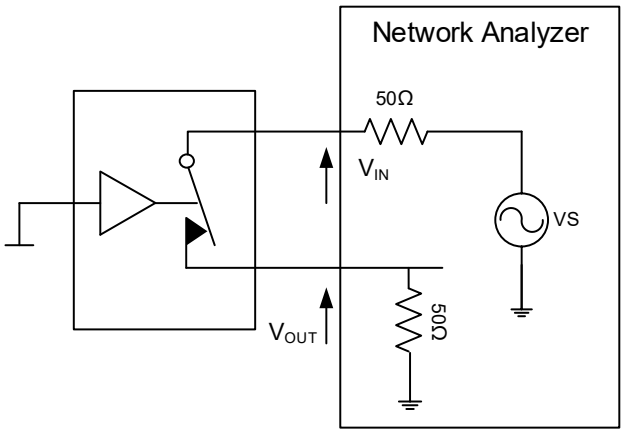
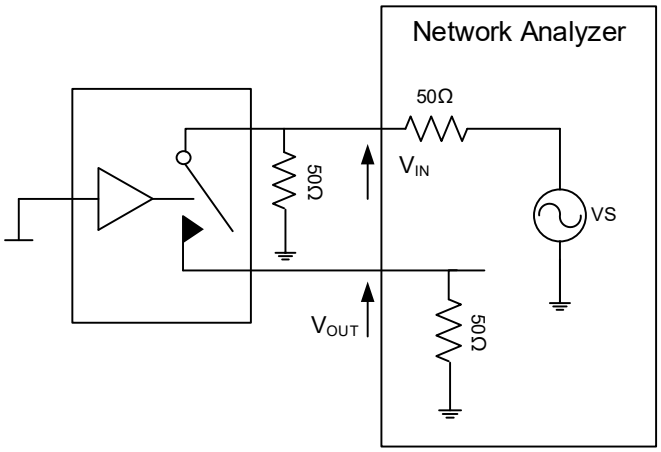


Figure 5. Bandwidth



Off-Isolation=20 Log(V_{OUT}/V_{IN})

Figure 6. Channel Off Isolation

Test Circuit (Continued)

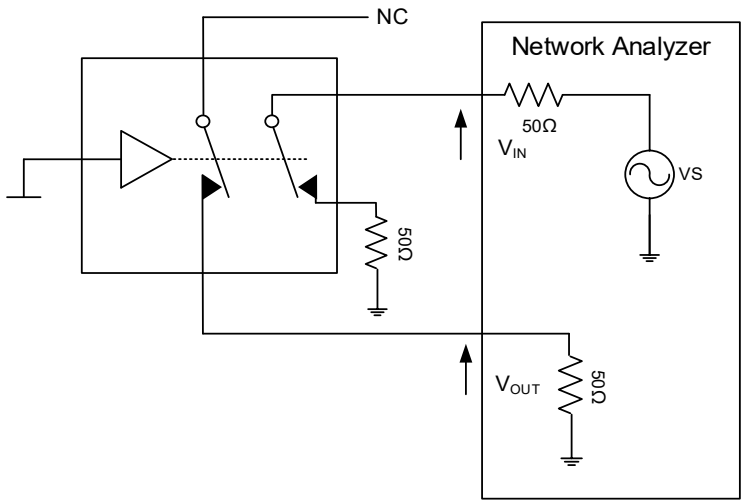


Figure 7. Non-Adjacent Channel-to-Channel Crosstalk

Typical Characteristics

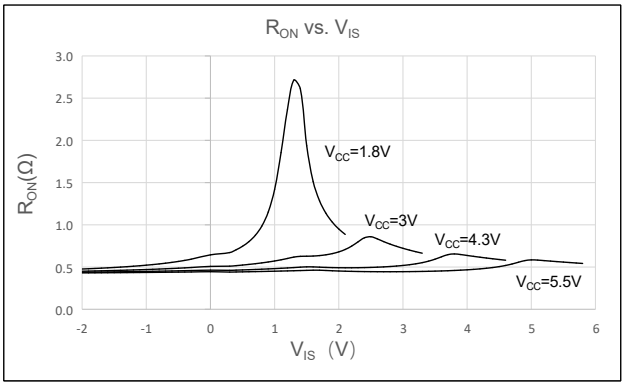


Figure 8. On-Resistance vs. V_{IS}

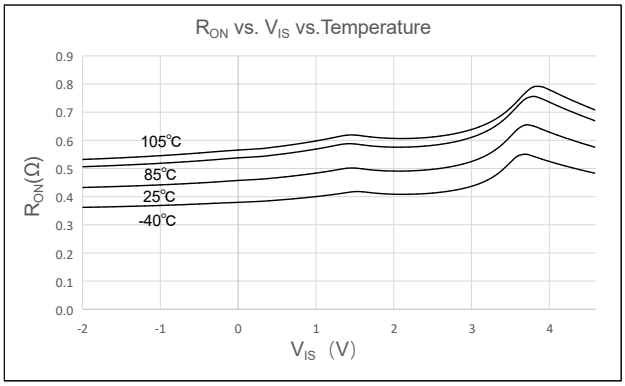


Figure 9. R_{ON} vs. V_{IS} vs. Temperature @V_{CC}=4.3V

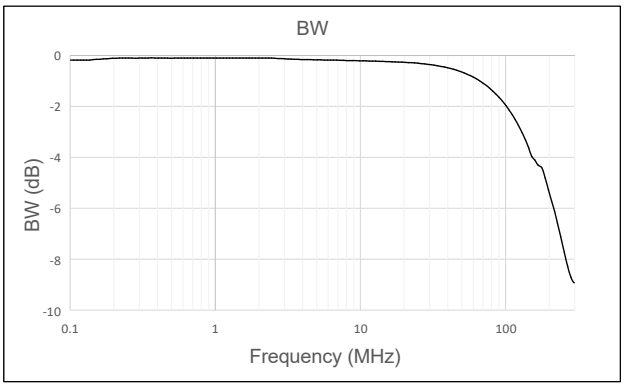


Figure 10. Bandwidth vs. Frequency @V_{CC}=3.6V

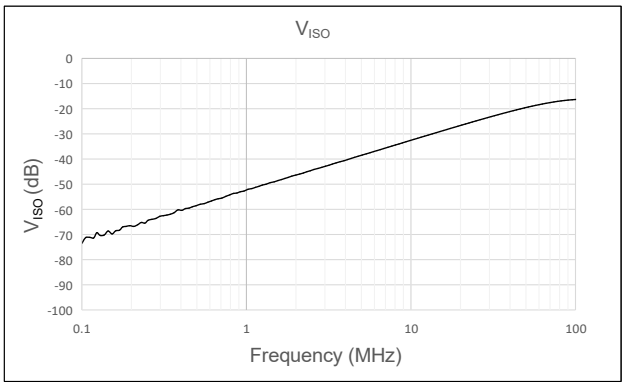


Figure 11. V_{ISO} vs. Frequency @V_{CC}=3.6V

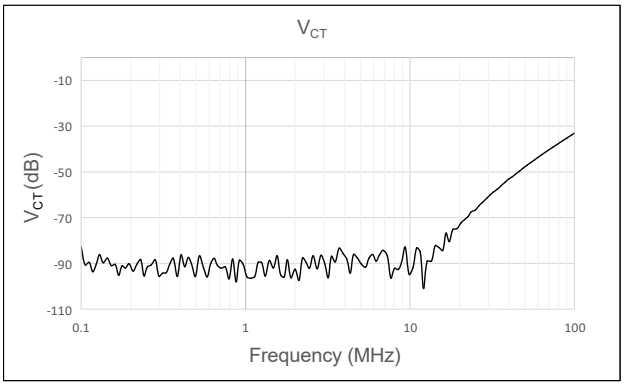


Figure 12. V_{CT} vs. Frequency @V_{CC}=3.6V

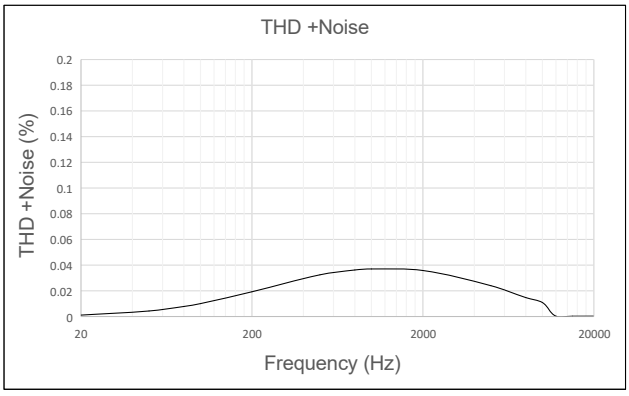
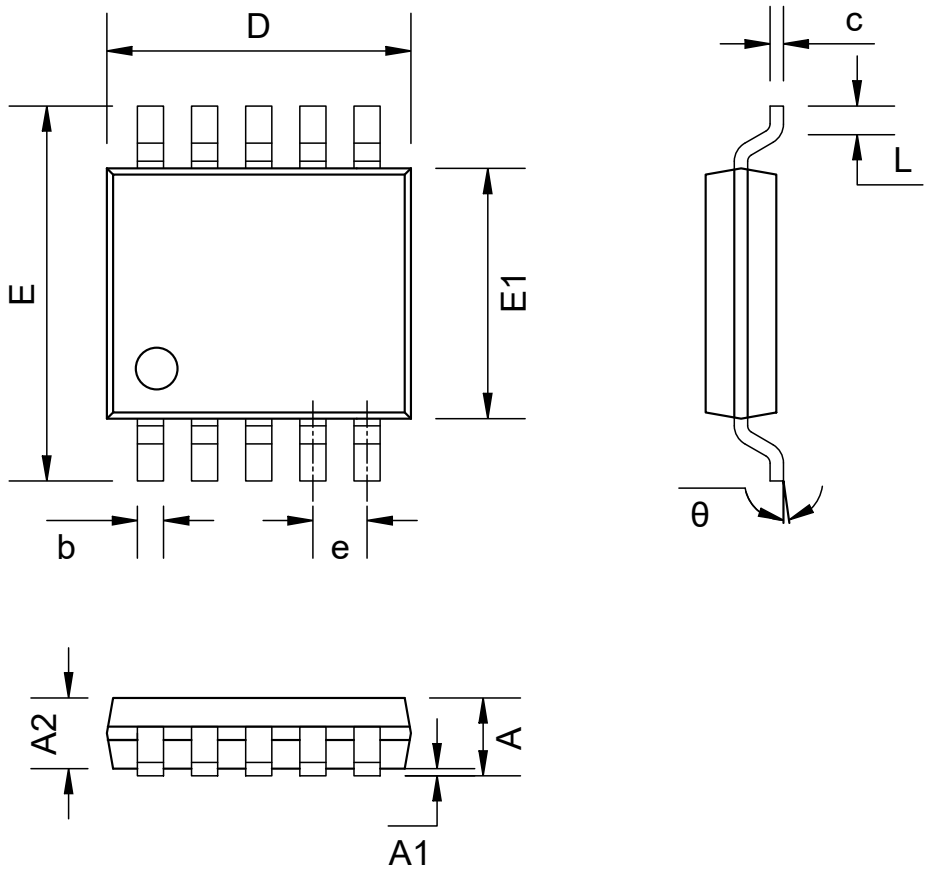


Figure 13. THD +Noise vs. Frequency @V_{CC}=3.6V

Package Dimension

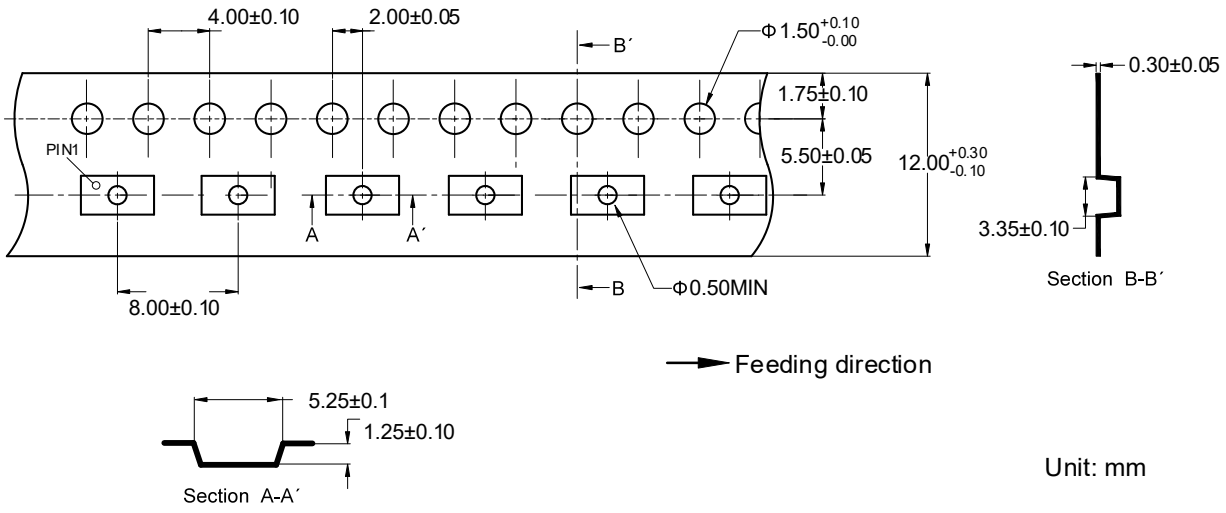
MSOP10



COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

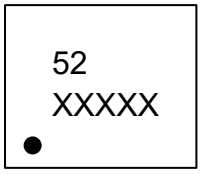
SYMBOL	MIN	NOM	MAX
A	-	-	1.10
A1	0.05	0.10	0.15
A2	0.75	0.85	0.95
b	0.18	-	0.27
c	0.13	-	0.20
D	2.90	3.00	3.10
E	4.75	4.90	5.05
E1	2.90	3.00	3.10
e	0.40	0.50	0.60
L	0.40	0.55	0.70
θ	0°	-	8°

Tape Information



Marking Information

MSOP10



52 - Part Number

XXXXX - Tracking Number

Note: X (Tracking Number) is variable, according to the wafer lot number.

Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
0.0	2024-09-27	Preliminary Version	Qin-peilong	Lu-hao	Liu-jiaying
1.0	2025-02-06	Original Version	Li-changxiao	Lu-hao	Liu-jiaying
1.1	2025-07-22	Update EC table and Typical Characteristics	Li-changxiao	Lu-hao	Liu-jiaying