

0.4Ω Dual SPDT Negative Signal Handling 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 $\pm 300mA$ 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:

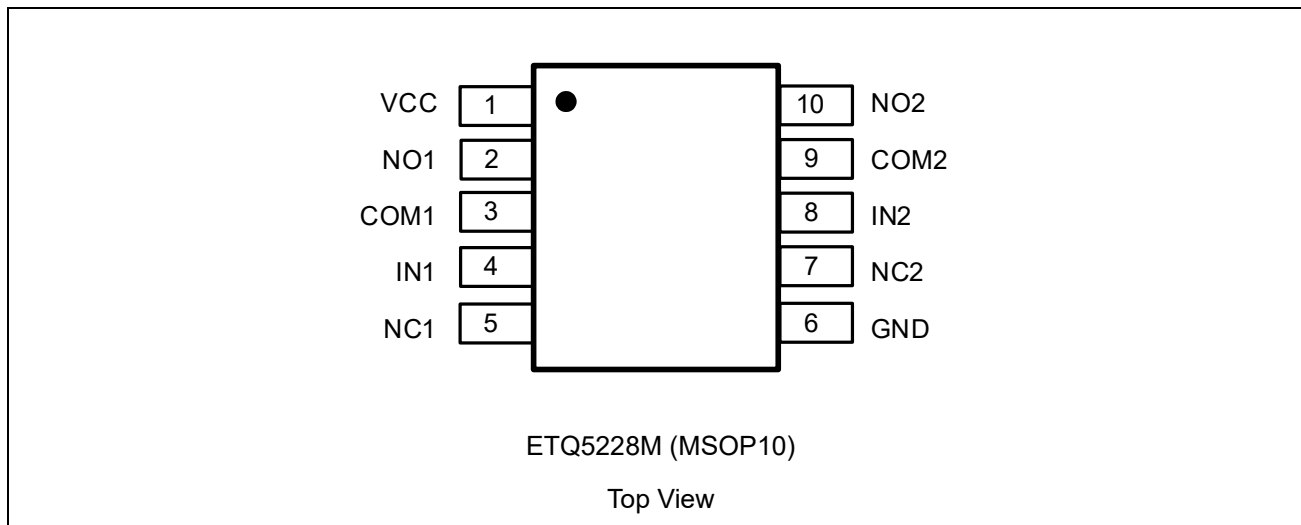
Part No.	Package	Packing Option	MSL
ETQ5228M	MSOP10	Tape and Reel , 4K	Level 3

Application

- Advanced driver assistance systems (ADAS)
- Body electronics and lighting
- I²C and SPI bus multiplexing
- Infotainment and cluster
- Body control modules
- Automotive head unit
- Telematics

ETQ5228M

Pin Configuration



Pin Function

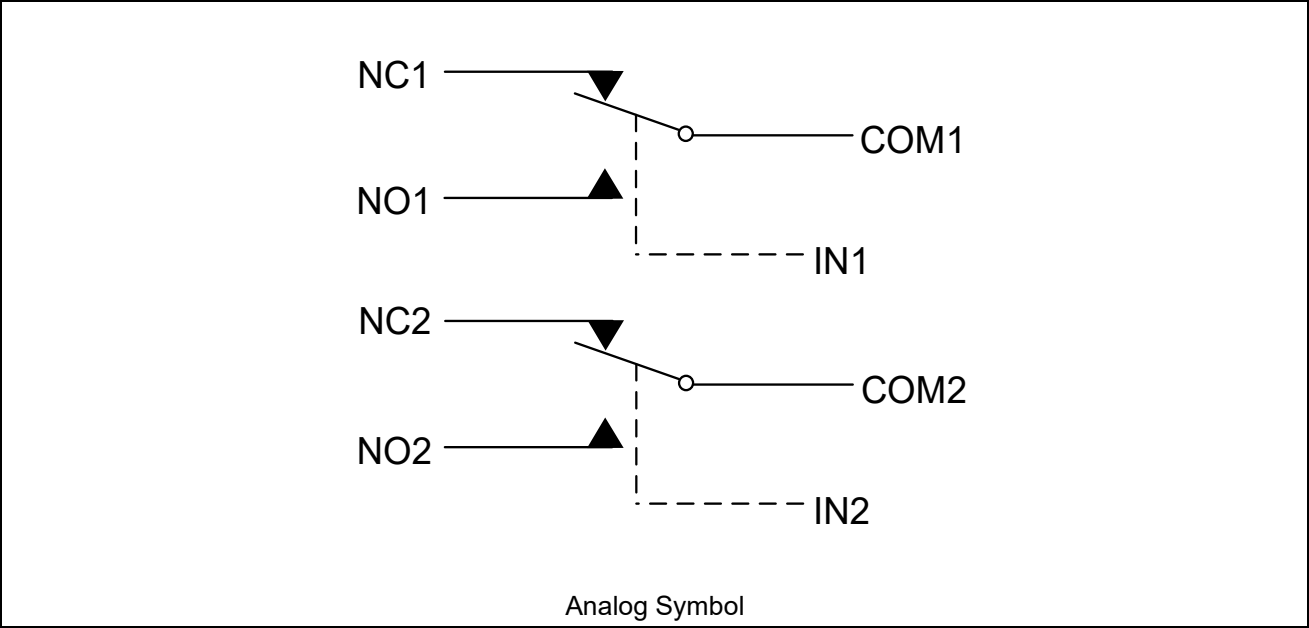
Pin NO.	Pin Name	Description
1	VCC	Power supply
2	NO1	Independent Channels
3	COM1	Common Channels
4	IN1	Controls
5	NC1	Independent Channels
6	GND	Ground (V)
7	NC2	Independent Channels
8	IN2	Controls
9	COM2	Common Channels
10	NO2	Independent Channels

ETQ5228M

Truth Table

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

Analog Symbol



ETQ5228M

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
t _r , t _f	Input Rise or Fall Time, SELECT	0	20	ns/V

ETQ5228M

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 _{CC} T	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} =0.3V or 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

ETQ5228M

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 ×ΔV _{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

ETQ5228M

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

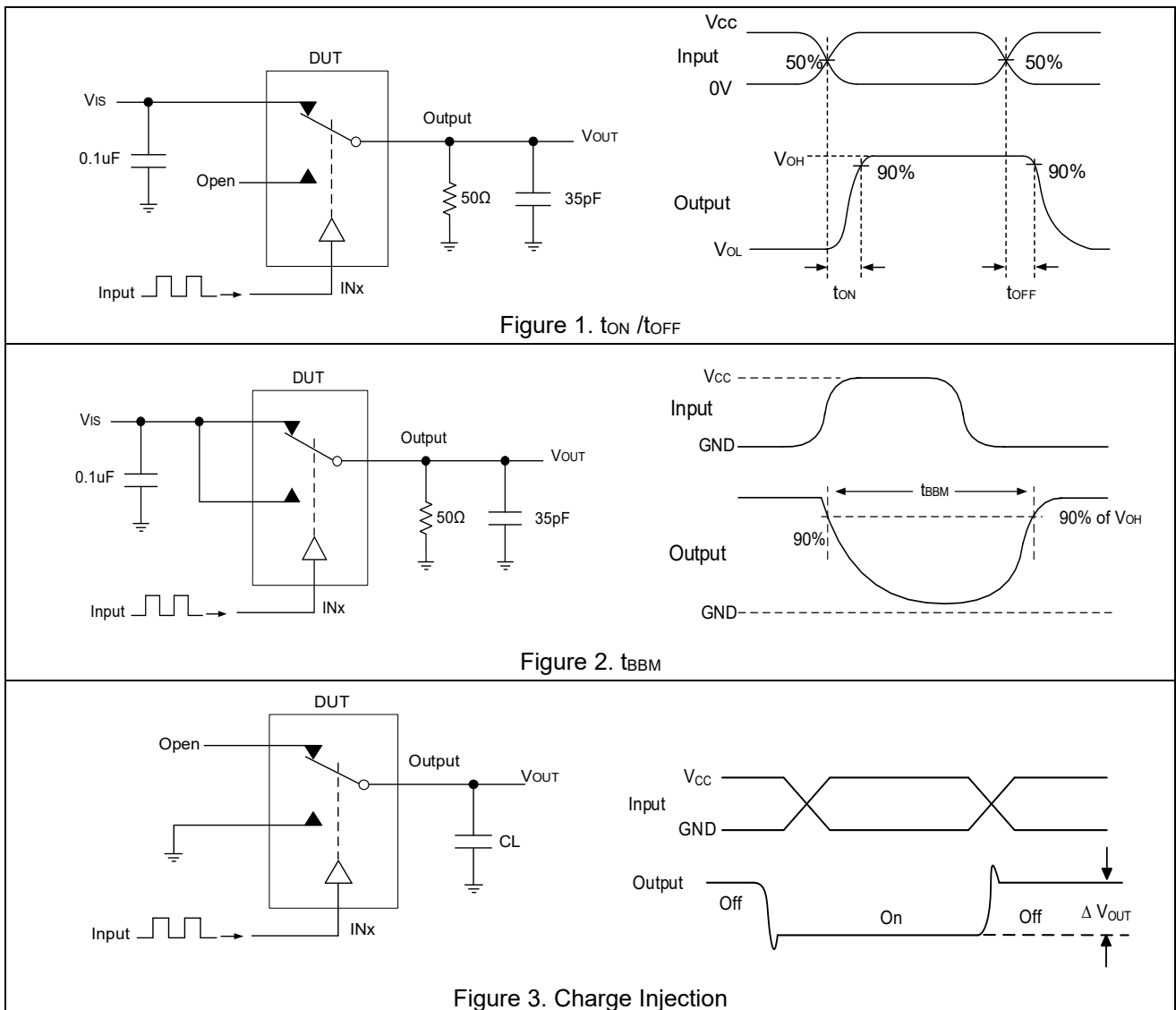
Note2. Guaranteed by design.

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



ETQ5228M

Test Circuit (Continued)

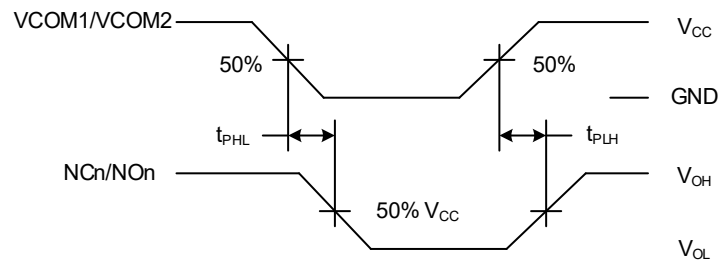


Figure 4. Propagation delay

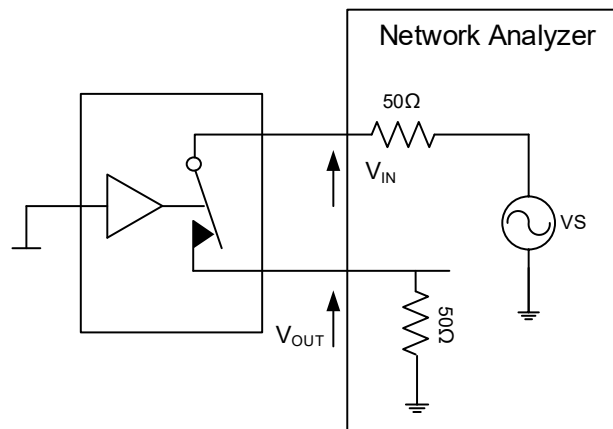


Figure 5. Bandwidth

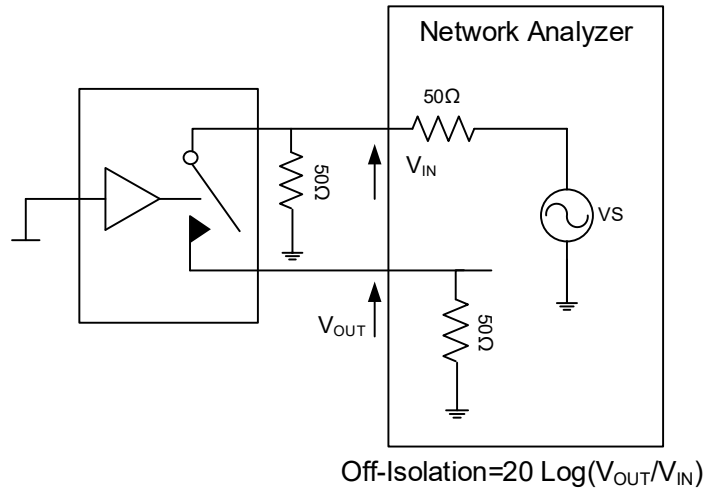


Figure 6. Channel Off Isolation

Test Circuit (Continued)

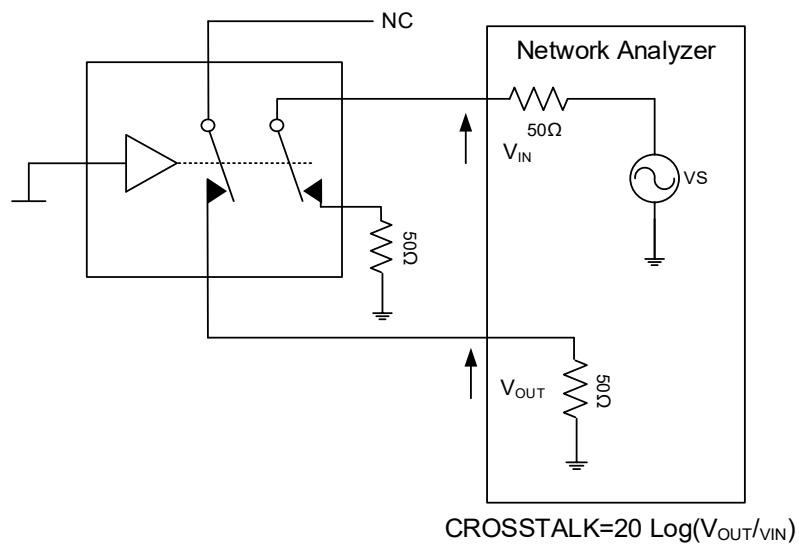


Figure 7. Non-Adjacent Channel-to-Channel Crosstalk

Typical Characteristics

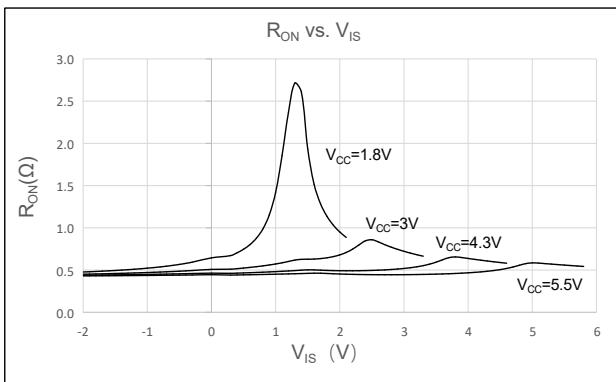


Figure 8. On-Resistance vs. V_{IS}

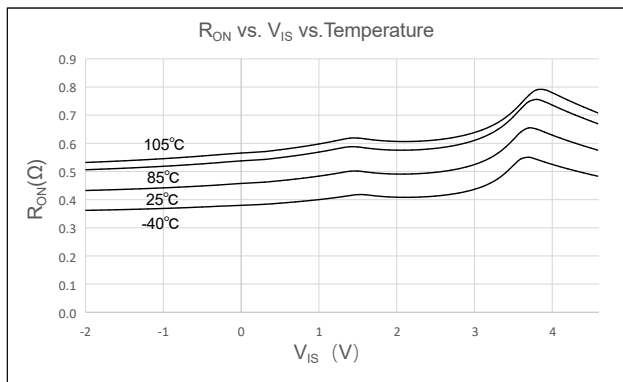


Figure 9. R_{ON} vs. V_{IS} vs. Temperature @ $V_{CC}=4.3V$

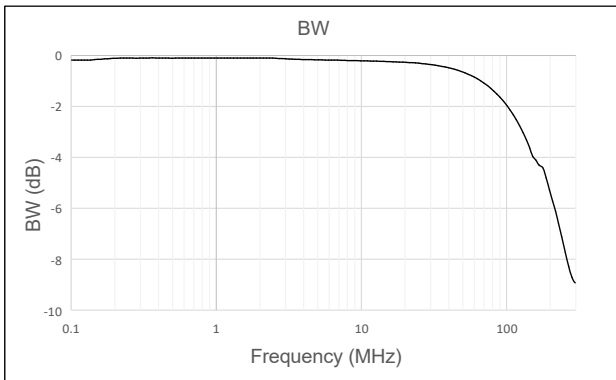


Figure 10. Bandwidth vs. Frequency @ $V_{CC}=3.6V$

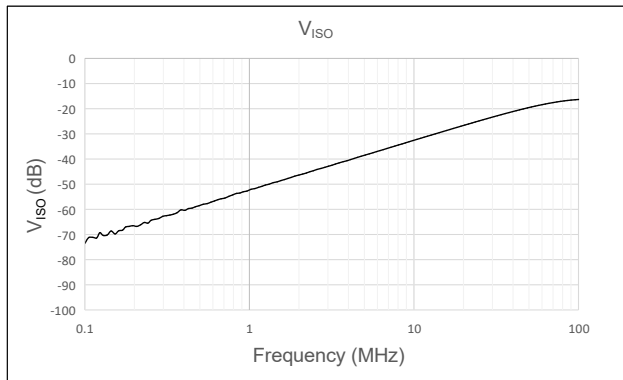


Figure 11. V_{ISO} vs. Frequency @ $V_{CC}=3.6V$

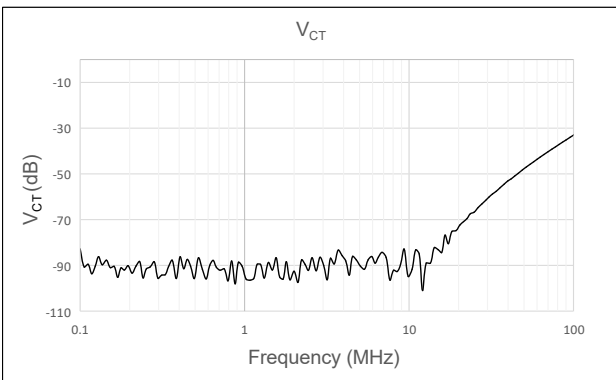


Figure 12. V_{CT} vs. Frequency @ $V_{CC}=3.6V$

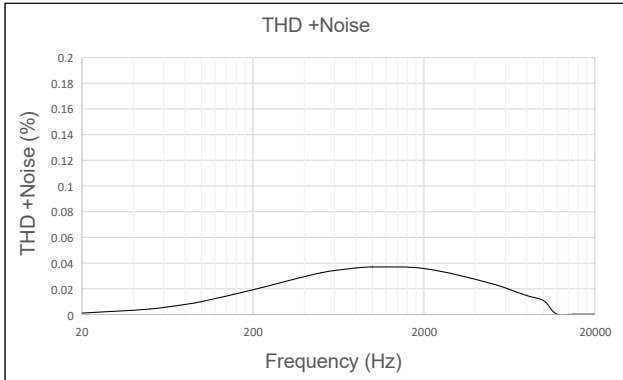
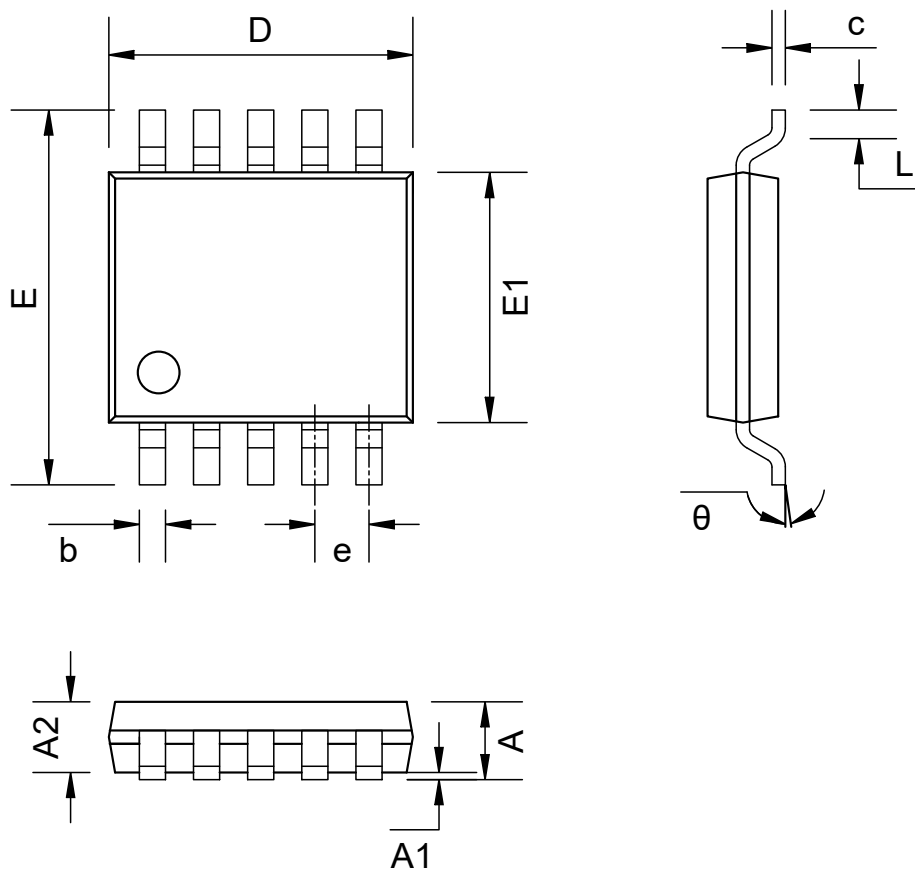


Figure 13. THD + Noise vs. Frequency @ $V_{CC}=3.6V$

ETQ5228M

Package Dimension

MSOP10

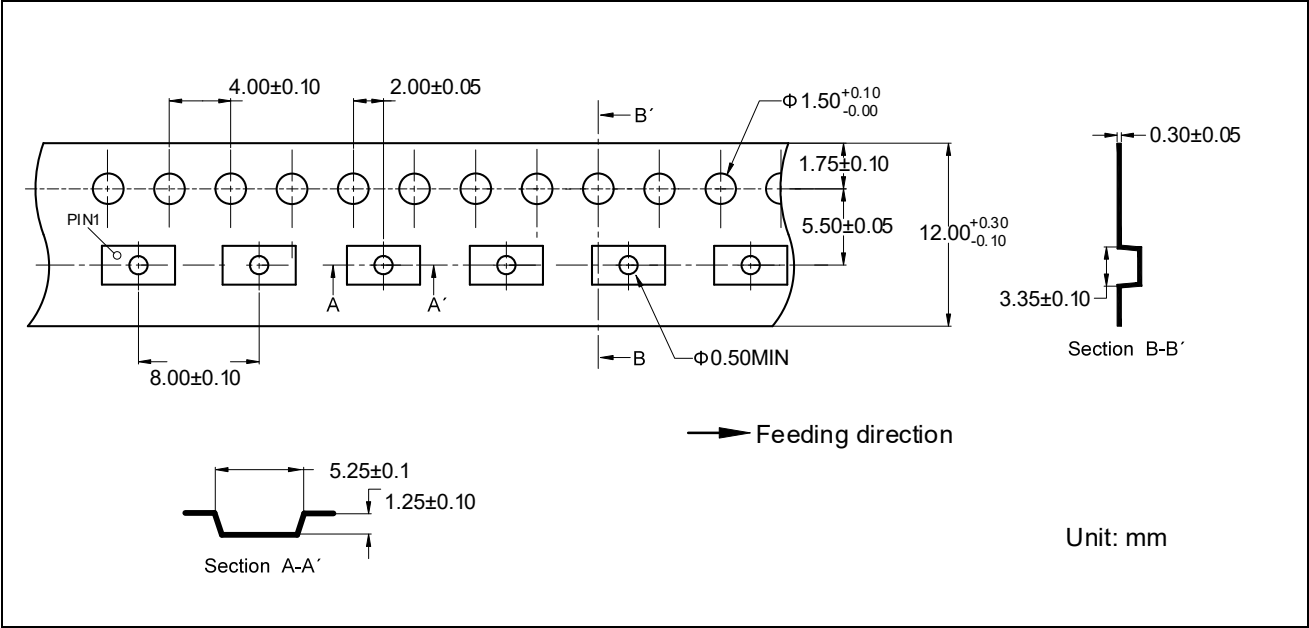


COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

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°

ETQ5228M

Tape Information



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