

0.5Ω Dual SPDT Analog Switch

General Description

The ET5223 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.

ET5223 is offered QFN10L and MSOP10 package, which is ideal for small form factor portable equipment.

Features

- Ultra-low $R_{ON} \leq 0.5\Omega$ @ $V_{CC} = 4.3V$
- Single supply operation from 1.65V to 5.5V
- Full 0V to V_{CC} signal handling capability
- High off-channel isolation
- R_{ON} Flatness of 0.15Ω typical
- Very low standby current
- Very low distortion
- Break-Before-Make(BBM) switching
- High continuous current capability is $\pm 300mA$ through each switch
- Package information:

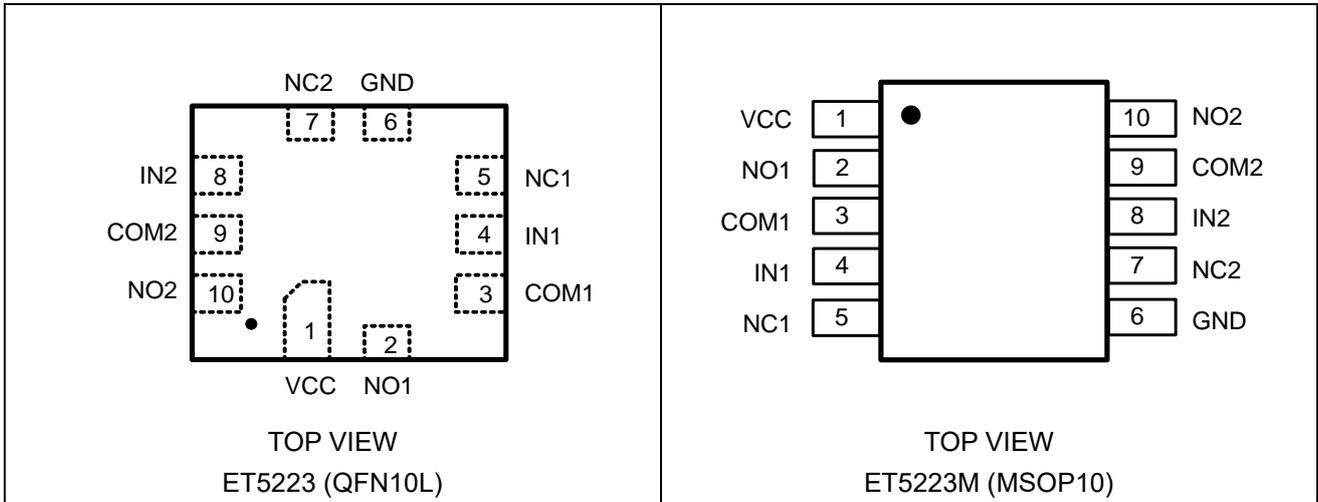
Part No.	Package	MSL
ET5223	QFN10L (1.8mm×1.4mm)	Level 1
ET5223M	MSOP10	Level 1

Application

- Smart Phones and Cellular Phones
- Cell Phone Audio Block/ Speaker
- Earphone Switching Ring-Tone Chip
- Amplifier Switching/Modems

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Pin Configuration



Pin Function

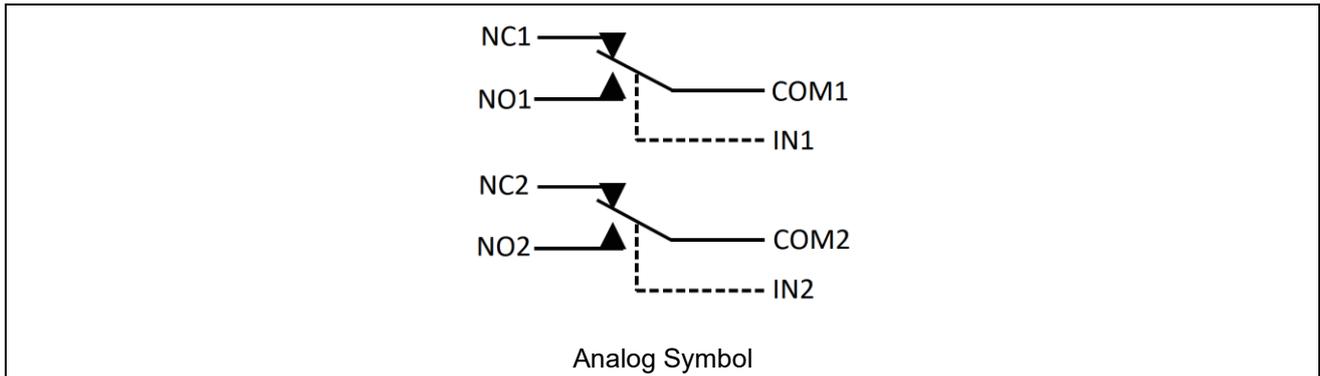
Pin NO.	Pin Name	Description
1	VCC	Power supply
2	NO1	Independent Channels
3	COM1	Common Channels
4	IN1	Controls
5	NC1	Independent Channels
6	GND	Ground (V)
7	NC2	Independent Channels
8	IN2	Controls
9	COM2	Common Channels
10	NO2	Independent Channels

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Truth Table

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

Analog Symbol



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Absolute Maximum Ratings

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

Characteristic	Symbol	Min	Max	Unit
DC Supply Voltage	V_{CC}	1.65	5.5	V
Digital Select Input Voltage	V_{IN}	GND	5.5	V
Analog Input Voltage	V_{IS}	-2	V_{CC}	V
Operating Temperature Range	T_A	-40	+85	°C
Input Rise or Fall Time, SELECT	t_r, t_f $V_{CC}=1.6V\sim 2.7V$	0	20	ns/V
	$V_{CC}=3.0V\sim 5.5V$	0	10	

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Electrical Characteristics

Typical: $T_A = 25^\circ\text{C}$, $V_{CC} = 3.3\text{ V}$, $I_{N1,2} = V_{CC}$ or GND;

Symbol	Parameter	Test Conditions	V_{CC}	$T_A=25^\circ\text{C}$			$T_A=-40\sim 85^\circ\text{C}$		Unit
				Min	Typ	Max	Min	Max	
DC Characteristics									
V_{IH}	High Level Input Voltage, Select Inputs ⁽⁷⁾		1.65~1.95	1.1			1.15		V
			2.3~2.5	1.2			1.25		
			2.7~3.0	1.4			1.45		
			3.3~3.6	1.6			1.65		
			4.3	1.8			1.85		
V_{IL}	Low Level Input Voltage, Select Inputs ⁽⁷⁾		1.65~1.95			0.25		0.20	V
			2.3~2.5			0.25		0.20	
			2.7~3.0			0.25		0.20	
			3.3~3.6			0.30		0.25	
			4.3			0.40		0.35	
I_{IN}	Maximum Input Leakage Current, Select Inputs	$V_{IN} = V_{CC}$ or GND	4.3			± 0.1		± 1.0	μA
I_{OFF}	Power Off Leakage Current	$V_{IN} = V_{CC}$ or GND	0			± 0.5		± 2.0	μA
I_{CC}	Maximum Quiescent Supply Current ⁽²⁾	$V_{IS} = V_{CC}$ or GND	1.65~4.3			± 1		± 2	μA
$I_{NO(OFF)}$ $I_{NC(OFF)}$	NC or NO Off Leakage Current	$V_{IN} = V_{IL}$ or V_{IH} V_{NO} or $V_{NC}=0.3\text{V}$ $V_{COM}=4.0\text{V}$	4.3	-5.0		5.0	-10	10	nA
$I_{COM(ON)}$	COM ON Leakage Current ⁽³⁾	$V_{IN} = V_{IL}$ or V_{IH} , $V_{NO}=0.3\text{V}$ or 4.0V V_{NC} floating $V_{NC}=0.3\text{V}$ or 4.0V , V_{NO} floating $V_{COM}=0.3\text{V}$ or 4.0V	4.3	-10		10	-100	100	nA
R_{ON}	On-Resistance ⁽³⁾ (Figure6)	$I_{COM} = 100\text{mA}$ $V_{IS}=0.3V_{CC}$, $0.5V_{CC}$, $0.7V_{CC}$	4.3		0.45	0.5		0.6	Ω
			3.6		0.5	0.55		0.65	
			3.0		0.55	0.6		0.7	
			2.7		0.6	0.7		0.8	
			2.3		0.65	0.8		0.9	
			1.8		1.1	1.8		2.0	

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Electrical Characteristics (Continued)

Symbol	Parameter	Test Conditions	VCC	T _A =25°C			T _A =-40~85°C		Unit
				Min	Typ	Max	Min	Max	
R _{FLAT}	On-Resistance Flatness ^{(3) (5)}	I _{COM} = 100mA V _{IS} =0.3V _{CC} , 0.5V _{CC} , 0.7V _{CC}	4.3		0.15	0.20		0.25	Ω
			3.6		0.15	0.20		0.25	
			3.0		0.15	0.20		0.25	
			2.7		0.15	0.20		0.25	
			2.3		0.20	0.35		0.40	
			1.8		0.9	1.2		1.3	
ΔR _{ON}	On-Resistance Match Between Channels ^{(3) (4)}	I _{COM} =100mA V _{IS} =0.3V _{CC} , 0.5V _{CC} , 0.7V _{CC}	2.7		0.05	0.15		0.25	Ω
AC Characteristics									
t _{PLH} t _{PHL}	Propagation delay ⁽²⁾		1.65~1.95		0.30	1.0			ns
			2.3~2.7		0.25	0.95			
			3.0~3.3		0.20	0.9			
			3.6~5		0.20	0.9			
t _{ON}	Turn-On Time (Figure 1)	V _{IS} =0.8V	1.65~1.95		30	70			ns
			2.3~2.7		20	50			
		V _{IS} =1.5V	3.0~3.3		15	40			
			3.6~4.3		10	30			
t _{OFF}	Turn-Off Time (Figure 1)	V _{IS} =0.8V	1.65~1.95		20	45			ns
			2.3~2.7		15	30			
		V _{IS} =1.5V	3.0~3.3		10	30			
			3.6~4.3		10	30			
t _{BBM}	Break-Before-Make Time ⁽⁶⁾ (Figure 2)	C _L =35pF R _{IS} =50Ω V _{IS} =1.5V	1.65~1.95	2	25				ns
			2.3~2.7	2	20				
			3.0~3.3	2	15				
			3.6~4.3	2	10				
BW	On-Channel -3dB Bandwidth or Frequency Response (Figure 4)	R _{IS} =50Ω	1.65~4.3		55				MHz
V _{ISO}	Off-Channel Isolation (Figure 4)	F _{IS} = 100kHz, V _{IN} =GND or V _{CC} C _L =5pF, R _L = 50Ω V _{IS} =1V _{RMS}	1.65~4.3		-60				dB

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Electrical Characteristics (Continued)

Symbol	Parameter	Test Conditions	V _{CC}	T _A =25°C			T _A =-40~85°C		Unit
				Min	Typ	Max	Min	Max	
Q	Charge Injection Select Input to Common I/O ⁽²⁾ (Figure3)	V _{IN} = 0 or V _{CC} R _{IS} =0Ω, C _L =100pF R _L =1MΩ Q=C _L ×ΔV _{OUT}	1.65~1.95		43				pC
			2.3~2.7		51				
			3.0~3.3		51				
			3.6~4.3		49				
THD	Total Harmonic Distortion THD +Noise (Figure 5)	F _{IS} =20Hz to 20KHz R _L =600Ω, C _L =50pF V _{IS} =1V _{RMS}	3.0		0.08				%
V _{CT}	Channel-to-Channel Crosstalk (Figure 4)	F _{IS} = 100KHz, V _{IN} =GND or V _{CC} R _L = 50Ω, C _L =5pF V _{IS} =1V _{RMS}	1.65~4.3		-90				dB
C _{IN}	Control Pin Input Capacitance		3.6		3.5				pF
C _{NC/CNO}	NC/NO Port Capacitance		3.6		40				pF
C _{COM}	COM Port Capacitance When Switch is Enabled		3.6		100				pF

Note2. Guaranteed by design

Note3. Guaranteed by design. Resistance measurements do not include test circuit or package resistance

Note4. ΔR_{ON} = R_{ON(MAX)} – R_{ON(MIN)} between NC1 and NC2 or between NO1 and NO2.

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

Note6. Guaranteed by design in -40°C.

Note7. V_{IH} level is recommended to be consistent with V_{CC} and V_{IL} level is GND to reduce I_{CC} current.

Test Circuit

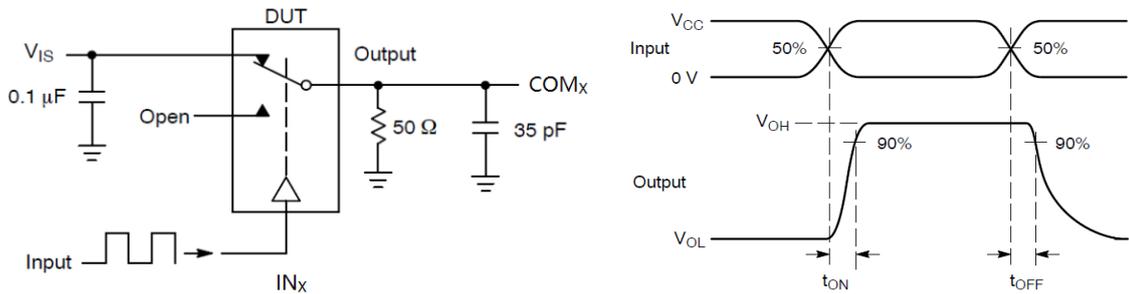


Figure1. t_{ON}/t_{OFF}

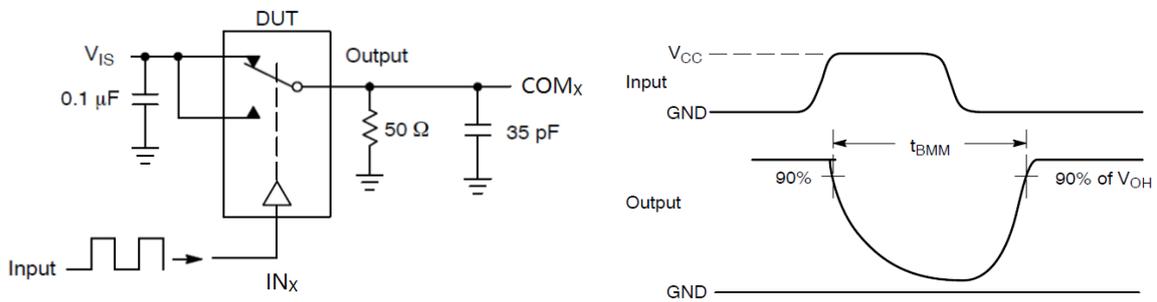


Figure2. t_{BMM}

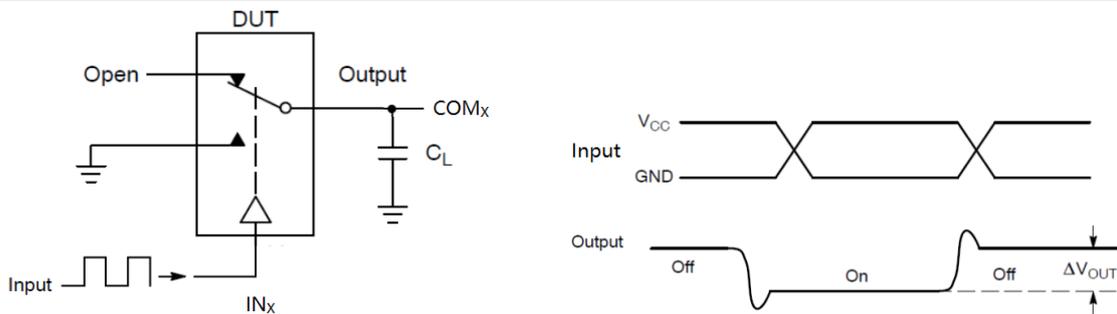


Figure3. Charge Injection

Test Circuit (Continued)

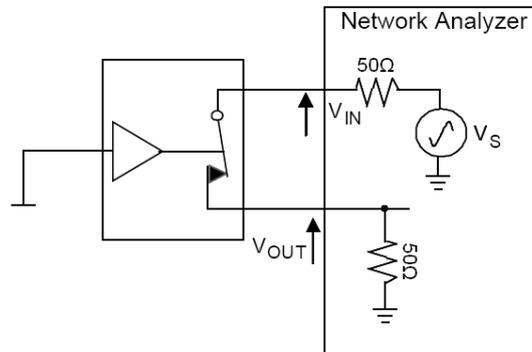
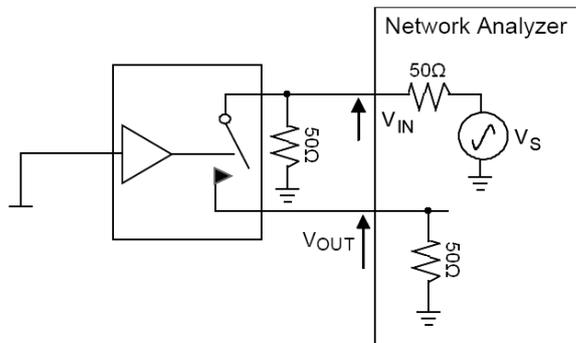
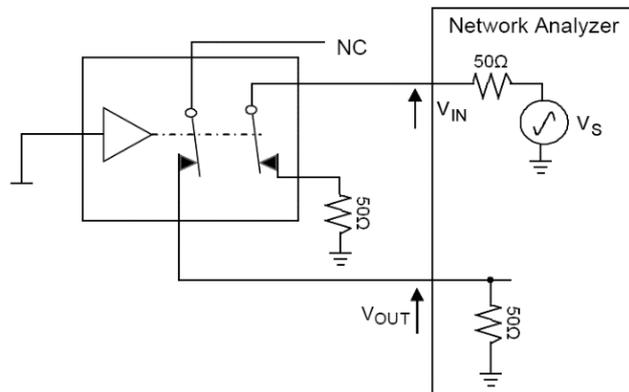


Figure4. Bandwidth



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

Figure5. Channel Off Isolation



$$\text{CROSSTALK} = 20 \text{ Log } (V_{\text{OUT}} / V_{\text{IN}})$$

Figure6. Non-Adjacent Channel-to-Channel Crosstalk

Test Circuit (Continued)

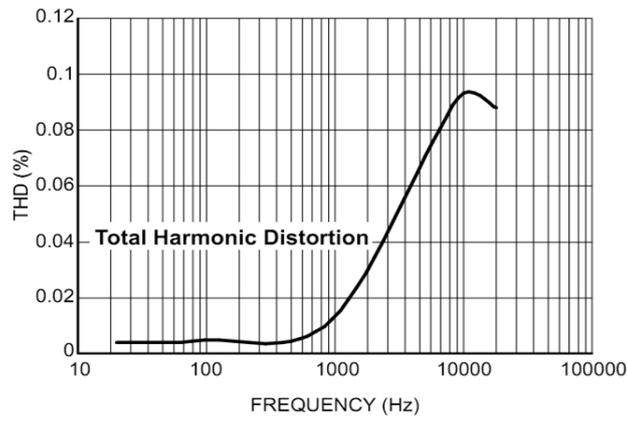


Figure 7. Frequency (Hz) VS THD

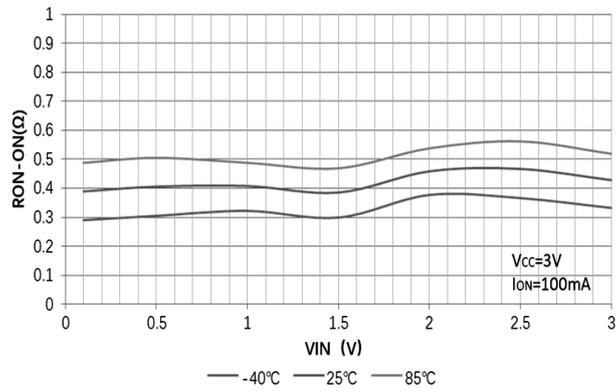
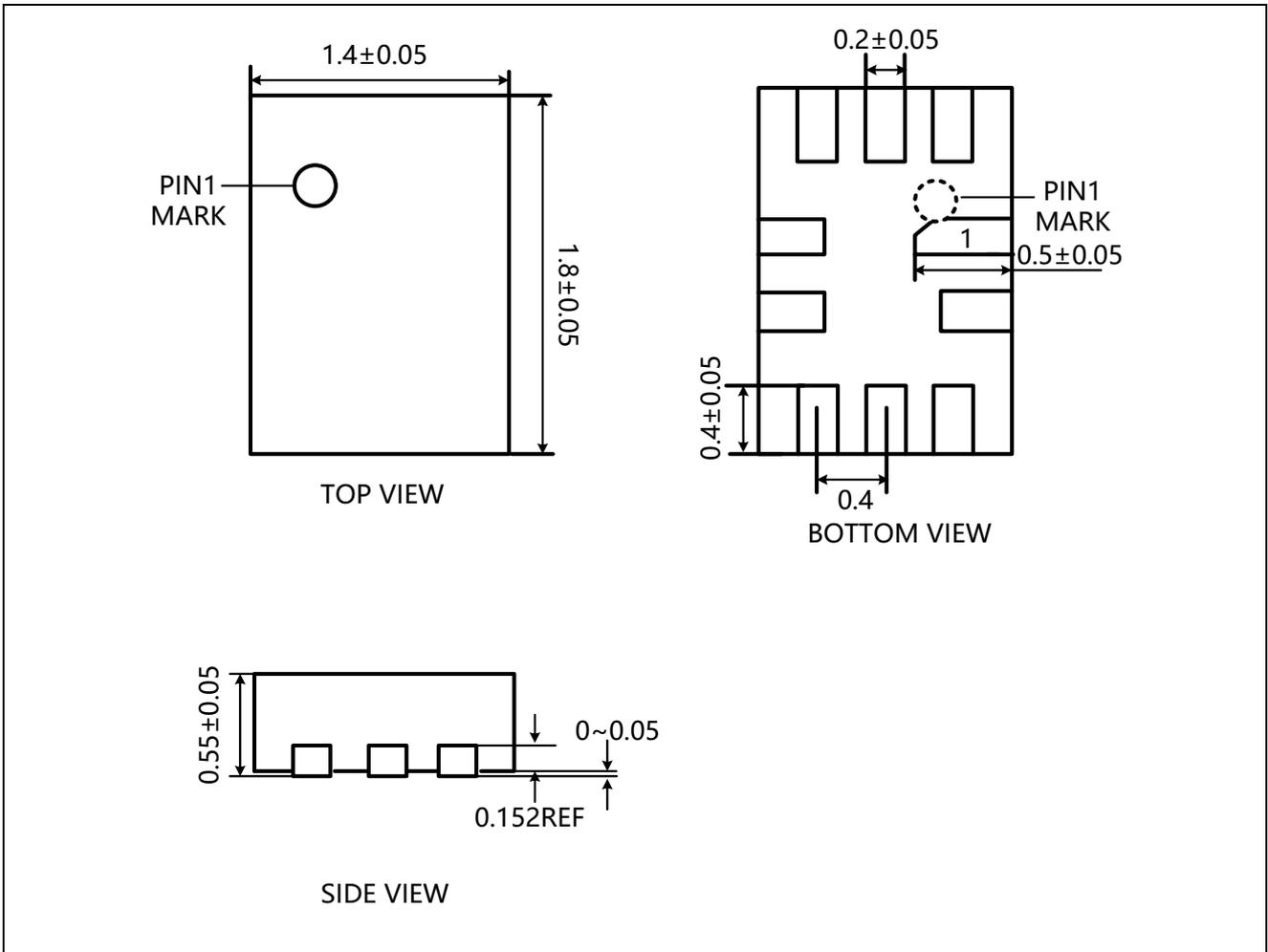


Figure 8. R_{ON} VS V_{IN}

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Package Dimension

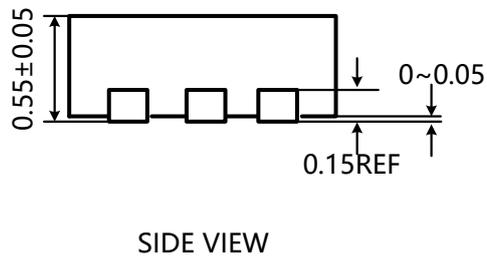
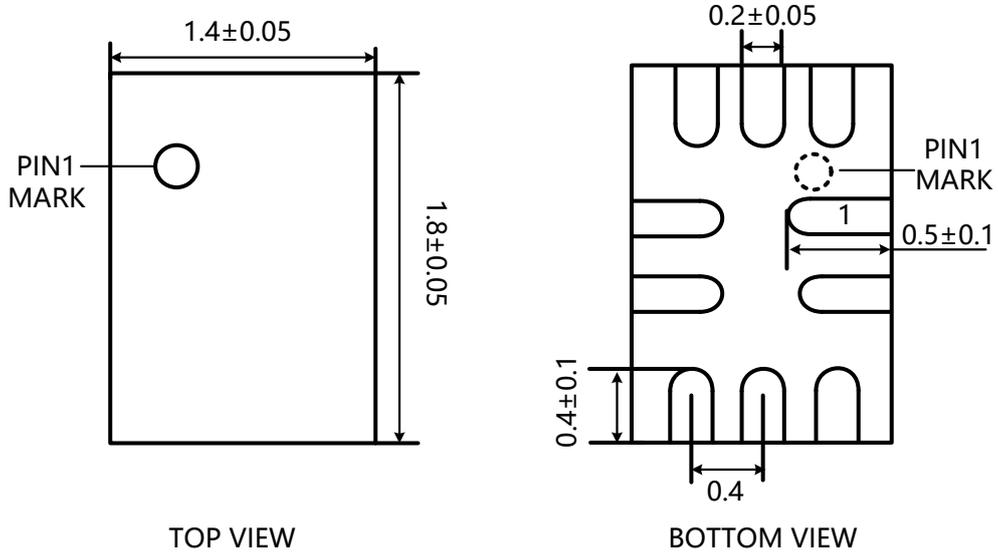
QFN10L(1)



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Package Dimension(Continued)

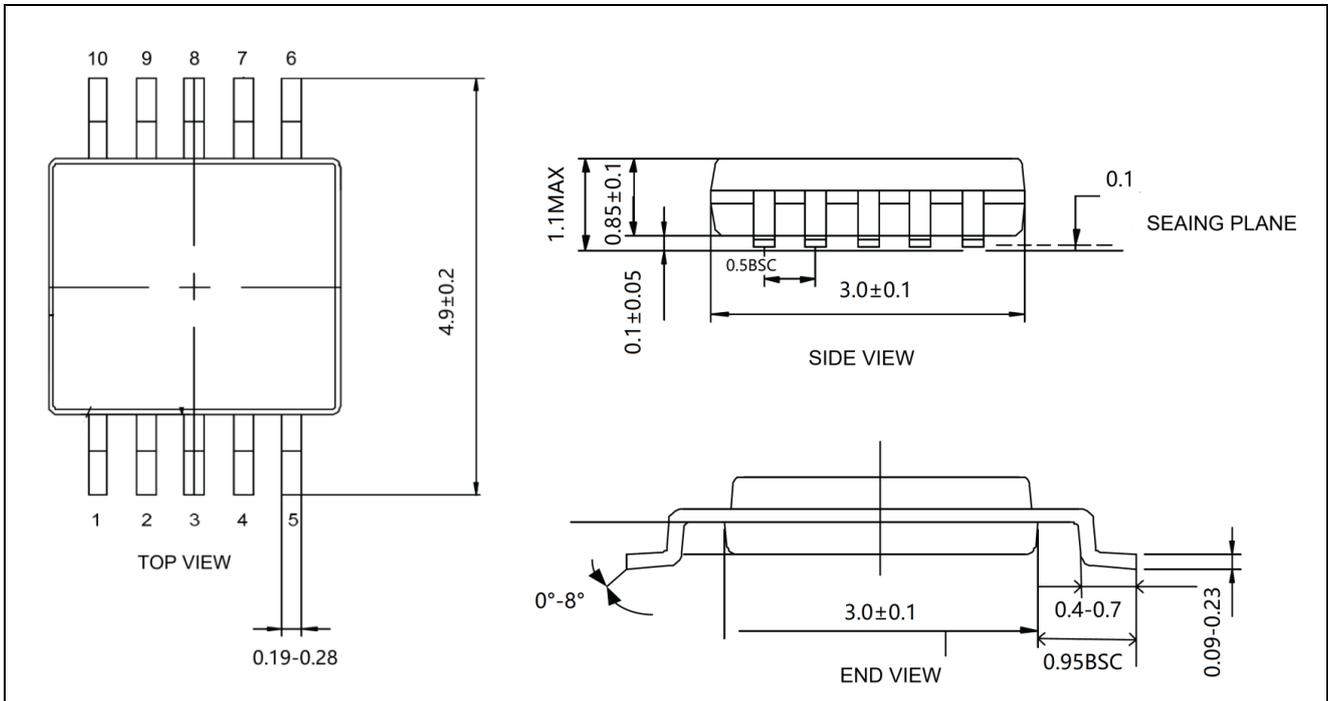
QFN10L(2)



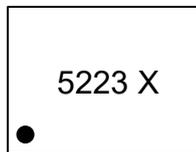
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Package Dimension(Continued)

MSOP10



Marking Information



5223 - Part Number

X - Tracking Number

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

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Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
1.0	2018-05-16	Original Version	Wuxj	Wuxj	Zhuji
1.1	2018-06-25	DC Supply Voltag Max rise to 5.5V from 4.3V	Wuxj	Wuxj	Liuji
1.2	2018-06-28	Add MSOP10 package	Wuxj	Wuxj	Liuji
1.3	2019-01-31	Adjust test condition in DC characteristic	Wuxj	Wuxj	Liuji
1.4	2019-03-01	Revise package size	Wuxj	Wuxj	Liuji
1.5	2019-03-21	Update VIH and VIL and RON	Liuxm	Liuxm	Zhuji
1.6	2019-04-12	According to the test results Update Typical Value of Turn-On Time, Turn-OFF Time, Off-Channel Isolation, Channel-to-Channel Crosstalk	Liuxm	Liuxm	Liuji
1.7	2019-06-25	Updated: 1.VIH, VIL Test Spec 2.RON,RFLAT, Δ RON Test Conditions 3.Add max Δ RON value 4.Add max tPLH,tPHL,tON,tOFF value 5.THD Test Conditions 6.RON curve graph	Liuxm	Liuxm	Zhuji
1.8	2020-03-16	Documents check and formalize	Shib	Shib	Liuji
1.9	2022-08-29	Update Typeset	Huyt	Liuji	Liuji