# Ultra-Low 0.5Ω Dual SPDT Analog Switch

General Description

The HM5223 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.

Features

- Ultra−Low RON<0.55Ω at V_{CC} =4.3 V
- Single Supply Operation from 1.65−4.3 V
- Low Crosstalk
- Full 0−V_{CC} Signal Handling Capability
- High Off−Channel Isolation
- Low Standby Current, <50 nA
- Low Distortion
- RON Flatness of 0.15Ω
- High Continuous Current Capability: ±300 mA Through Each Switch
- Applications in Cell Phone Audio Block/ Speaker and Earphone Switching Ring−Tone Chip / Amplifier Switching/Modems
- Package :QFN10L(1.8*1.4)

Pin Configuration
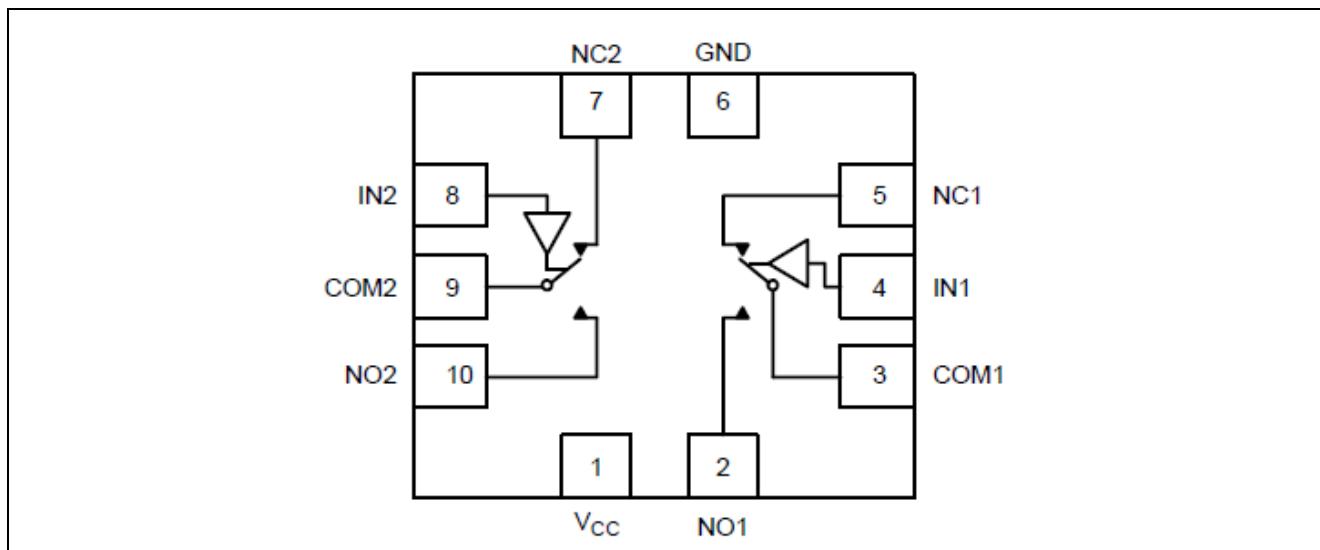
Pin Function

QFN PIN #	Symbol	FUNCTION
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	NC1，2
0	OFF	ON
1	ON	OFF

Absolute Maximum Ratings

Characteristic	Symbol	Value	Unit
Supply Voltage	V_{CC}	-0.5～+5.5	V
Analog Input Voltage	V_{IS}	-0.5～VCC+0.5	V
Digital Select Input Voltage	V_{IN}	-0.5～+5.5	V
Output Voltage	V_O	-0.5～VCC+0.5	V
Continuous DC Current from COM to NC/NO	I_{an1}	±300	mA
Peak Current from COM to NC/NO, 10 duty cycle (Note 1)	$I_{an1\text{-}pk1}$	±500	mA
Continuous DC Current into COM/NO/NC with respect to V_{CC} or GND	I_{clmp}	±100	mA

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.

Characteristic	Symbol	Min	Max	Unit
DC Supply Voltag	V_{CC}	1.65	4.3	V
Digital Select Input Voltage	V_{IN}	GND	4.3	V
Analog Input Voltage	V_{IS}	GND	V_{CC}	V
Operating Temperature Range	T_A	-45	+85	℃
Input Rise or Fall Time, SELECT	t_r, t_f V_{CC}=1.6V-2.7V V_{CC}=3.0V-4.3V	0 0	20 10	ns/V

Electrical Characteristics

Symbol	Parameter	Test Conditions	V_{CC}±10%	T_A=25℃			T_A=-40℃～+85℃		Unit
				Min	Typ	Max	Min	Max	
DC Characteristics									
V_{IH}	High−Level Input Voltage, Select Inputs		1.65-1.95	1.1			1.1		V
			2.3-2.5	1.2			1.2		
			2.7-3.0	1.3			1.3		
			3.0-3.6	1.4			1.4		
			4.3	1.5			1.5		
V_{IL}	Low−Level Input Voltage, Select Inputs		1.65-1.95			0.25		0.25	V
			2.3-2.5			0.25		0.25	
			2.7-3.0			0.25		0.25	
			3.0-3.6			0.30		0.30	
			4.3			0.40		0.40	
I_{IN}	Maximum Input Leakage Current, Select Inputs	V_{IN} =VCC or GND	4.3			±0.1		±1.0	uA
I_{OFF}	Power Off Leakage Current	V_{IN} =VCC or GND	0			±0.5		±2.0	uA
I_{CC}	Maximum Quiescent Supply Current (Note 2)	SELECT, V_{IS}= V_{CC} or GND	1.65-4.3			±1		±2	uA
$I_{NO(OFF)}$ $I_{NC(OFF)}$	NC or NO Off Leakage Current	V_{IN} = V_{IL} or V_{IH} V_{NO} or V_{NC}=0.3V V_{COM}=4.0V	4.3	-5.0		5.0	-10	10	nA
$I_{COM(ON)}$	COM ON Leakage	V_{IN} = V_{IL} or $V_{IH.,}$ V_{NO}=0.3V or 4.0V	4.3	-10		10	-100	100	nA

	Current (Note 3)	V_{NC} floating V_{NC=}0.3V or 4.0V V_{No} floating V_{COM}=0.3Vor 4.0V							
R_{ON}	On−Resistance (Note 3)	V_{IS}=GND to VCC I_{IN}= 100mA	4.3		0.45	0.5		0.55	Ω
			3.6		0.5	0.55		0.65	
			3.0		0.5	0.55		0.65	
			2.3		0.6	0.7		0.8	
			1.8		0.9	1.0		1.1	
R_{FLAT}	On−Resistance Flatness(Note 3) (Note 5)	I_{COM}=100mA V_{IS}=1.5V	4.3		0.15	0.20		0.20	Ω
			3.6		0.15	0.20		0.20	
			3.0		0.15	0.20		0.20	
			2.7		0.15	0.20		0.20	
			2.3		0.20	0.25		0.25	
			1.65		0.35	0.45		0.45	
ΔR_{ON}	On−Resistance Match Between Channels(Note 3) (Note 4)	I_{COM}=100mA V_{IS}=1.5V	2.7		0.1				Ω

AC Characteristics

t_{PLH} t_{PHL}	Propagation delay		1.65-1.95		0.30				ns
			2.3-2.7		0.25				
			3.0-3.3		0.20				
			3.6-4.3		0.20				
t_{ON}	Turn−On Time (Figure 1)	V_{IS}=0.8V	1.65-1.95		120				ns
		V_{IS}=1.5V	2.3-2.7		65	85			
			3.0-3.3		42	55			
			3.6-4.3		40	55			
t_{OFF}	Turn−Off Time (Figure 1)	V_{IS}=0.8V	1.65-1.95		45				ns
		V_{IS}=1.5V	2.3-2.7		18	30			
			3.0-3.3		16	30			
			3.6-4.3		15	30			
t_{BBM}	Break−Before−Make Time(Note6)(Figure 2)	C_L=35pF R_{IS}=50Ω V_{IS}=1.5V	1.65-1.95	2	17				ns
			2.3-2.7	2	10				
			3.0-3.3	2	8				
			3.6-4.3	2	7				
BW	On−Channel −3dB	R_{IS}=50Ω	1.65-4.3		55				MHz

Symbol	Parameter	Test Conditions								Unit
	Bandwidth or Frequen –cy Response (Figure 4)									
V_{ISO}	Off−Channel Isolation (Figure 4)	F_{IS} = 100kHz, V_{IN} =GND to V_{CC} C_L=5pF，R_L= 50Ω V_{IS}=1V RMS	1.65-4.3		-66					dB
Q	Charge Injection Select Input to Common I/O (Figure 3)	V_{IN} = 0 or V_{CC} R_{IS}=0Ω,C_L=100pF R_L=1MΩ $Q=C_L×\Delta V_{Out}$	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	F_{IS}=20Hz to 20KHz R_L=600Ω,C_L=50pF V_{IS}=2V RMS	3.0		0.08					%
V_{CT}	Channel−to−Channel Crosstalk (Figure 4)	F_{IS}= 100KHz, V_{IN} =GND to V_{CC} R_L= 50Ω,C_L=5pF V_{IS}=1V RMS	1.65-4.3		-72					dB
C_{IN}	Control Pin Input Capacitance		3.6		3.5					pF
C_{NC}/C_{NO}	NC/NO Port Capacitance		3.6		60					pF
C_{COM}	COM Port Capacitance When Switch is Enabled		3.6		200					pF

Note 2. Guaranteed by design

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

4. $\Delta R_{ON} = R_{ON(MAX)} − R_{ON(MIN)}$ between NC1 and NC2 or between NO1 and NO2.

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

6. Guaranteed by design in -40℃.
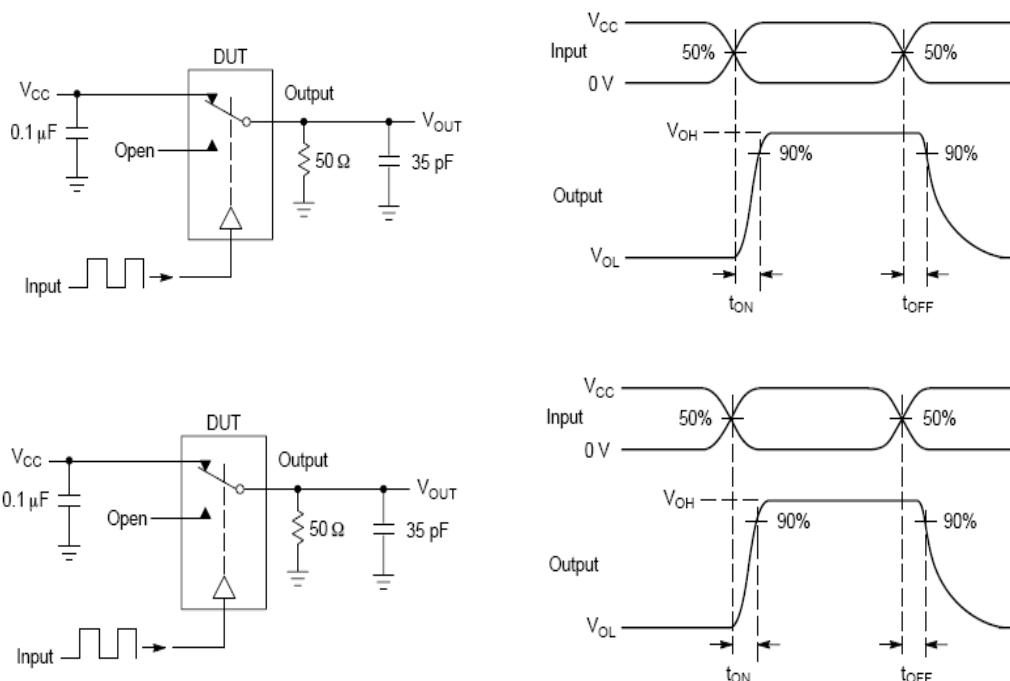
Figure1: t_{ON}/t_{OFF}
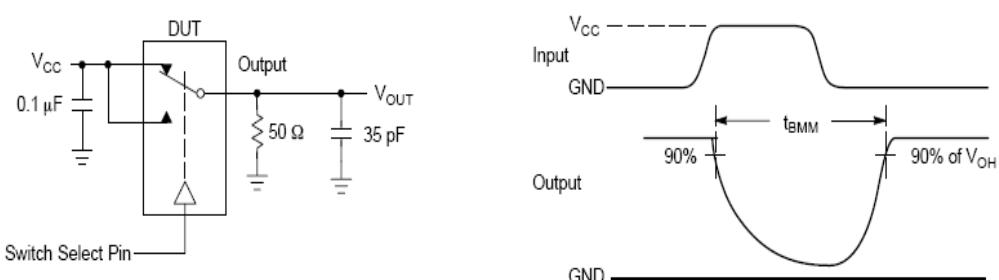
Figure2 : t_{BBM}
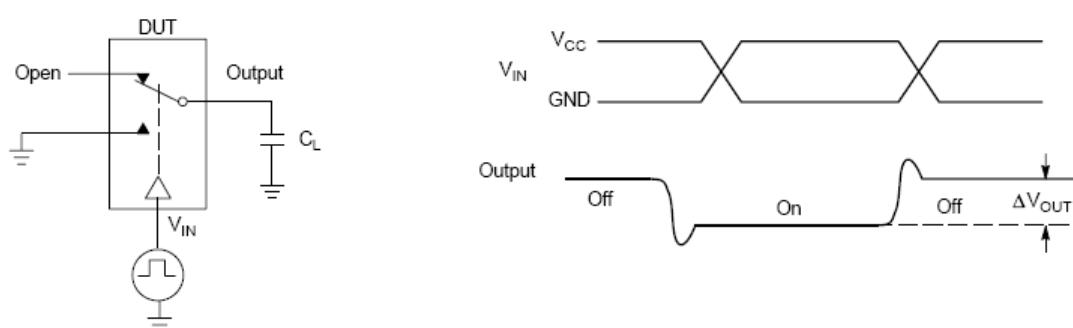
Figure3: Charge Injection
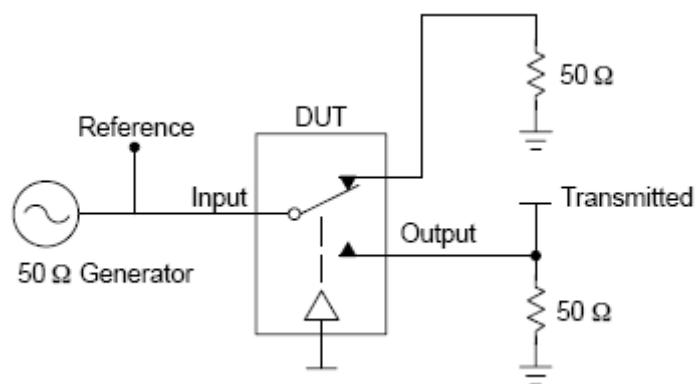
$$V_{ISO}=20\log（V_{OUT}/V_{IN}）$$
$$V_{ONL}=20\log（V_{OUT}/V_{IN}）$$
$$V_{CT}=20\log（V_{OUT}/V_{IN}）$$
$$BW=\text{the frequency 3dB below } V_{ONL}$$

Figure 4. -3dB Bandwidth／Off Channel Isolation/On Channel Loss(BW)/Crosstalk
(On Channel to Off Channel)/V_{ONL}
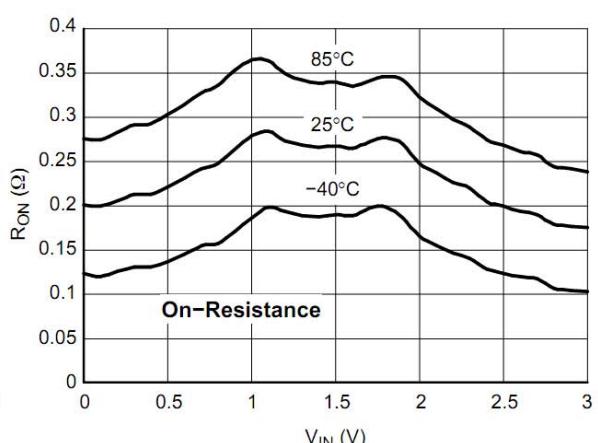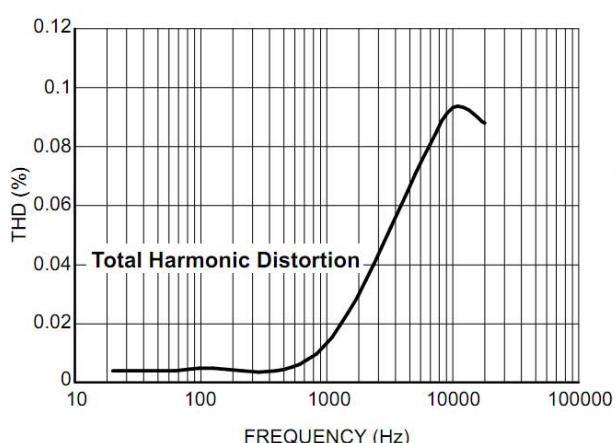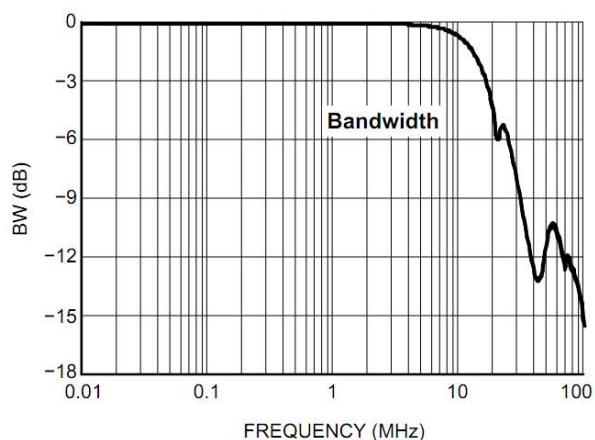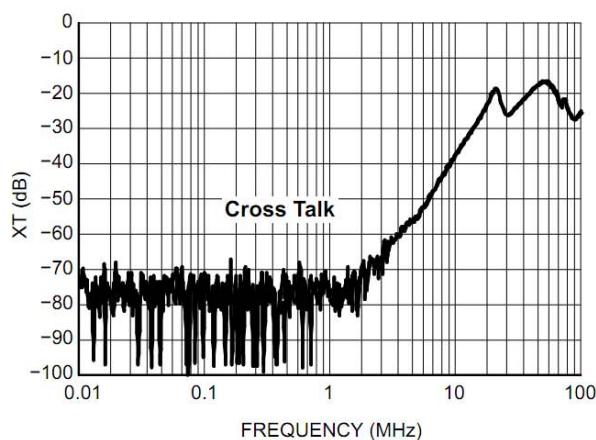
Package Dimension

QFN10L

COMMON DIMENSIONS(MM)			
PKG.	UT:ULTRA THIN		
REF.	MIN.	NOM.	MAX
A	0.50	0.55	0.60
A1	0.00	—	0.05
A3	0.15 REF.		
D	1.35	1.40	1.45
E	1.75	1.80	1.85
b	0.15	0.20	0.25
L	0.30	0.40	0.50
L1	0.40	0.50	0.60
e	0.40 BSC		