SPDT 10W/50W$_{peak}$ Power Switch 500 MHz to 8.5 GHz

Features

- Frequency Range 500 MHz to 8.5 GHz
- Low insertion loss:
  0.30 dB @ 2.0 GHz
  0.30 dB @ 4.0 GHz
  0.40 dB @ 7.0 GHz
- High isolation:
  40 dB @ 2.0 GHz
  35 dB @ 4.0 GHz
  27 dB @ 6.0 GHz
- 10 W CW Power, 50 W_p Peak Power
- Low power consumption, less than 1 mW
- No external DC blocking capacitors on RF lines
- All RF ports OFF state
- Versatile 2.6...5.25 V power supply
- No need to supply negative voltages

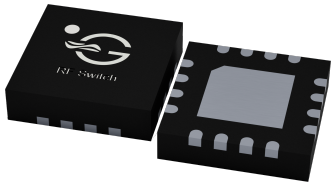


Figure 1: TS8223K in 3.0 x 3.0 mm^2 QFN 16-pin package.

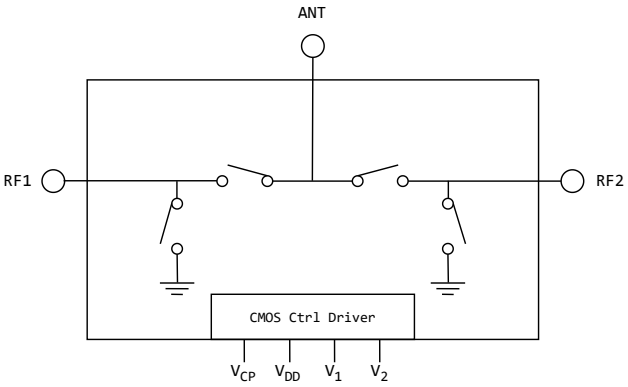


Figure 2: TS8223K functional diagram

Applications

- Drone datalinks
- Private mobile and defense radios
- Public safety handsets
- Cellular infrastructure
- Datalinks

RoHS

RoHS/Reach/Halogen free

General Description

The TS8223K is a 3rd Generation symmetrical reflective Single Pole Dual Throw (SPDT) switch designed for medium power switching applications. The TS8223K covers 500 MHz to 8.5 GHz bandwidth and provides low insertion loss, high isolation, and high linearity within a small package size. The TS8223K is a 10 W CW with peak power capability of 50 W, switch suitable for applications requiring low insertion loss, high isolation, and high linearity.

The TS8223K is packaged into a compact Quad Flat No lead (QFN) 3.0x3.0 mm^2 16-leads plastic package.

Ordering information

Table 1: Ordering Information

Device Part Number	Package Type	Notes
TS8223K	16 Pin 3.0x3.0x0.85 mm^3 QFN	Core part number
TS8223K-EVB	Evaluation Board	
TS8223KMTRPBF[1]	330 mm reel, 3 000pcs	Full reel

[1] MTRPBF - M: Manufacturing, TR: Tape and Reel, and PBF: lead free.

Table 2: Tape and Reel Information

Form	Quantity	Reel Diameter	Reel Width
Tape and Reel	3 000	13” (330mm)	18mm

Pin Assignment

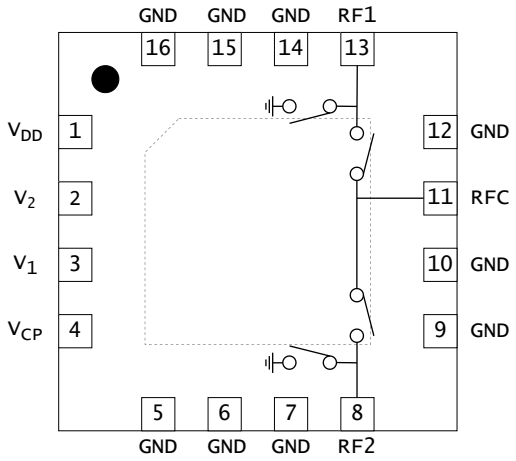


Figure 3: TS8223K pin assignment [top view]

Table 3: Pin Definition

Pin Number	Pin Name	Decription
1	V_{DD}	DC Power Supply
2	V_2	Switch control input 2
3	V_1	Switch control input 1
4	V_{CP}	Internal charge pump voltage output, connect a C_{VCP} capacitor to GND on this node.
5,6,7,9,10,12,14,15,16	GND	Connect to ground[2]
8	RF2	RF port 2
11	RFC	RFC port (antenna port)
13	RF1	RF port 1
17 [1]	GND	Ground thermal pad, please connect to GND

[1] The backside ground (thermal) pad of the package must be grounded directly to the ground plane of PCB with multiple vias, and adequate heat sinking must be used to ensure proper operation and thermal management.
[2] These pins are NC pins inside the package. To avoid floating pins around RF lines, we request these to be connected to ground.

Absolute Maximum Ratings

Table 4: Absolute Maximum Ratings $T_A = +25$°C unless otherwise specified[1].

Parameter	Symbol	Value	Unit
Electrical Ratings			
Power Supply Voltage	V_{DD}	5.5	V
Storage Temperature Range	T_{st}	-55...+125	°C
Operating Temperature Range	T_{op}	-40...+85	°C
Maximum Junction Temperature	T_j	+140	°C
Maximum RF CW input power[3]	RFx/RFC	41	dBm
Maximum RF peak input power, 1% duty cycle, 10μs pulse [2]	RFx/RFC	48	dBm
Thermal Ratings			
Thermal Resistance (junction-to-case) – Bottom side	$R_{\theta jc}$	25	°C/W
Thermal Resistance (junction-to-top)	$R_{\theta jt}$	39	°C/W
Soldering Temperature	T_{solder}	+260	°C
ESD Ratings			
Human Body Model (HBM)	Level 1B	500...<1000	V
Charged Device Model (CDM)	Level C3	≥1000	V
Moisture Rating			
Moisture Sensitivity Level	MSL	1	

[1] Maximum ratings are absolute ratings. Exposure to absolute maximum rating conditions for extended periods may affect device reliability and can cause permanent damage to the device. Exceeding one or a combination of the absolute maximum ratings may cause permanent and irreversible damage to the device and/or to surrounding circuit. Functional operation of the device is not implied in any conditions above those indicated in the Electrical Specifications section.
[2] Test frequency 800MHz.
[3] See Power De-rating table for low frequencies.

Electrical Specifications

Table 5: Electrical Specifications $T_A = +25°C; V_{DD} = +3.3V; 50\Omega$ Source/Load.

Parameter	Condition	Minimum	Typical	Maximum	Unit
Operating frequency	f	500		8500	MHz
Insertion loss	500 MHz		0.35		dB
unmatched, upto 8.5GHz	2.0 GHz		0.30		dB
$RFC - RFx$	4.0 GHz		0.35		dB
	6.0 GHz		0.35		dB
	8.5 GHz		0.55		dB
Isolation	500 MHz		55		dB
unmatched, upto 8.5GHz	2.0 GHz		43		dB
$RFC - RFx$	4.0 GHz		34		dB
	6.0 GHz		27		dB
	8.5 GHz		22		dB
Isolation[1]	500 MHz		tbd		dB
Isolation state	2.0 GHz		tbd		dB
$RFC - RFx$	4.0 GHz		tbd		dB
	6.0 GHz		tbd		dB
	8.5 GHz		tbd		dB

[1] Matched values are not guaranteed as they include performance of matching components. These components are beyond control of TagoreTech and therefore given values are indications, not guaranteed values.

Table 6: Electrical Specifications $T_A = +25°C; V_{DD} = +3.3V; 50\Omega$ Source/Load.

Parameter	Condition	Minimum	Typical	Maximum	Unit
Operating frequency	f	500		8500	MHz
Return Loss	500 MHz		-22		dB
unmatched, upto 8.5GHz	2.0 GHz		-20		dB
$RFC - RFx$	4.0 GHz		-18		dB
	6.0 GHz		-19		dB
	8.5 GHz		-16		dB

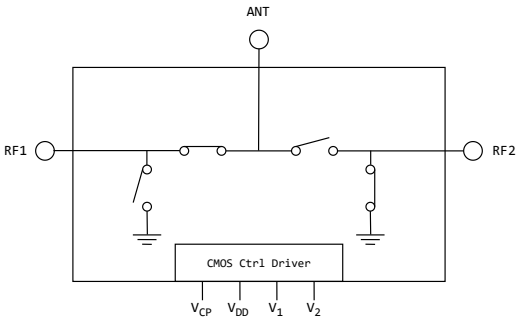
[1] Matched values are not guaranteed as they include performance of matching components. These components are beyond control of TagoreTech and therefore given values are indications, not guaranteed values.

Table 7: Electrical Specifications $T_A = +25°C; V_{DD} = +3.3V; 50\Omega$ Source/Load.

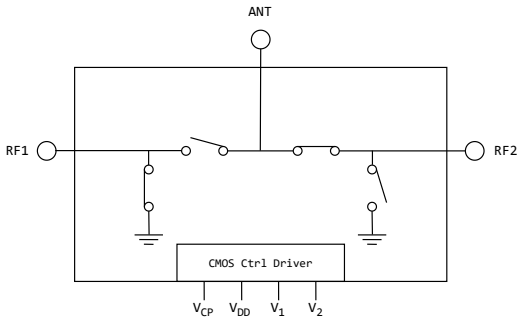
Parameter	Condition	Minimum	Typical	Maximum	Unit
Operating frequency	f	1		7200	MHz
Harmonic Distortion					
H_2	800MHz, P_{in} =40dBm		tbd		dBc
H_3	800MHz, P_{in} =40dBm		td		dBc
IIP3	800MHz		tbd		dBm
Power and Compression point					
P_{maxCW}[2]	Max RF CW Power		40		dBm
P_{maxpeak}	Max RF Peak Power		47		dBm
$P_{\text{maxhot RFx}}$[5]	Max RF CW Power, hot switching		tbd		dBm
$P_{\text{maxhot RFC}}$[5]	Max RF CW Power, hot switching		tbd		dBm
$P_{0.1\text{dB}}$	800MHz, CW		41		dBm
$P_{1\text{dB}}$[1]	800MHz, CW		43		dBm
$P_{\text{peak0.1dB}}$	800MHz, 1% duty cycle, 10μs pulse		47		dBm
Noise					
CP switching noise[4]	RBW=1kHz		-140		dBm
Switching Time					
t_{ON}	Switch ON time		250		ns
t_{OFF}	Switch OFF time		250		ns
t_{RISE}	Switch RISE time		200		ns
t_{FALL}	Switch FALL time		200		ns
t_{wON}	Minimum Switch ON time		1		μs
t_{wOFF}	Minimum Switch OFF time		1		μs
$f_{\text{PRR}}, C_{\text{VCP}} = 1\text{nF}$[3]	Maximum pulse repetition rate		1		kHz
$f_{\text{PRR}}, C_{\text{VCP}} = 10\text{nF}$[3]	Maximum pulse repetition rate		1.4		kHz
$f_{\text{PRR}}, C_{\text{VCP}} = 100\text{nF}$[3]	Maximum pulse repetition rate		1.8		kHz
$f_{\text{PRR}}, V_{\text{CPext}} = -18\,\text{V}$[6]	Maximum pulse repetition rate		>20		kHz
$t_{\text{startup}}, C_{\text{VCP}} = 1\text{nF}$[3]	startup time		0.8		ms
$t_{\text{startup}}, C_{\text{VCP}} = 10\text{nF}$[3]	startup time		7		ms
$t_{\text{startup}}, C_{\text{VCP}} = 100\text{nF}$[3]	startup time		40		ms
Power Supply, DC					
Control voltage	Power Supply V_{DD}	2.6	3.3	5.25	V
	All control pins high, V_{ih}	1.0	3.3	5.25	V
	All control pins low, V_{il}	-0.3	0	0.5	V
Control current	All control pins high, I_{ih}			7.5	μA
	All control pins low, I_{il}		0		μA
Current consumption	I_{DD}, active mode (V_{DD} on)		160	260	μA

[1] $P_{1\,\text{dB}}$ has been given for comparison reasons only. Please do not exceed Absolute Maximum ratings.
[2] See Power De-rating table
[3] With internal charge pump and with C_{VCP}.
[4] Above 250 MHz. For operation at VHF frequencies, below 250 MHz, consider charge pump bypass switch version, if charge pump noise is critical for your application. Please contact TagoreTech for more information.
[5] Dependent on thermal design and surrounding circuits.
[6] External -18 V applied to V_{CP} pin.

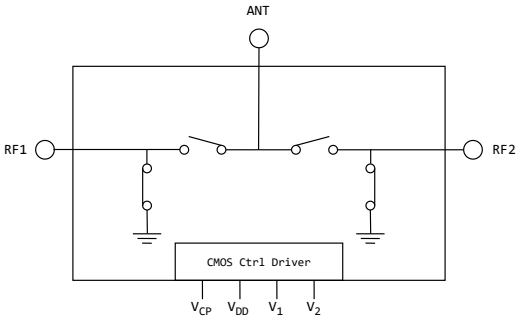
Switch Control table



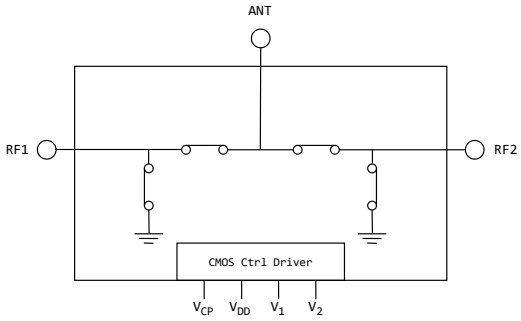
RFC-RF1 ON



RFC-RF2 ON



ISO (Isolation state)

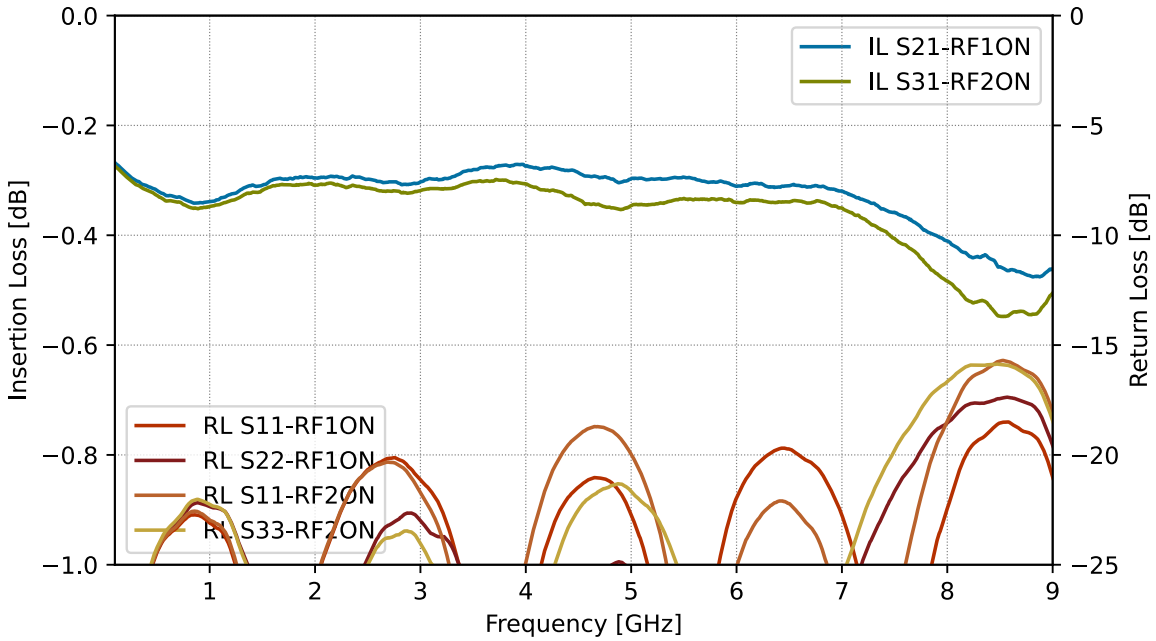


V_{DD} off state

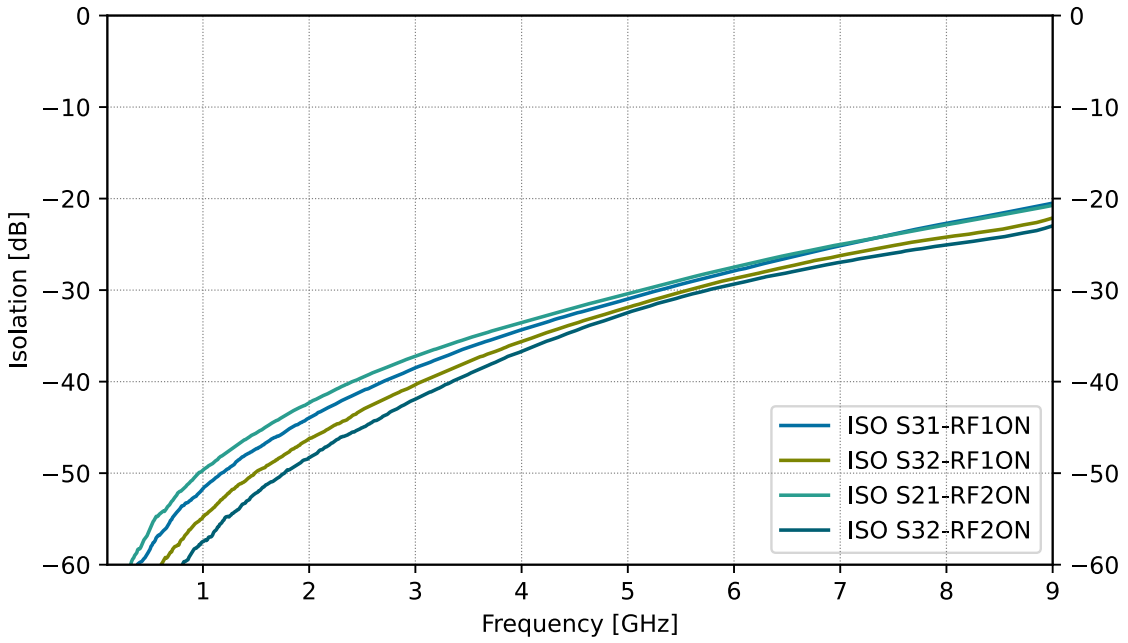
Typical characteristics

Performance upto 8.5 GHz

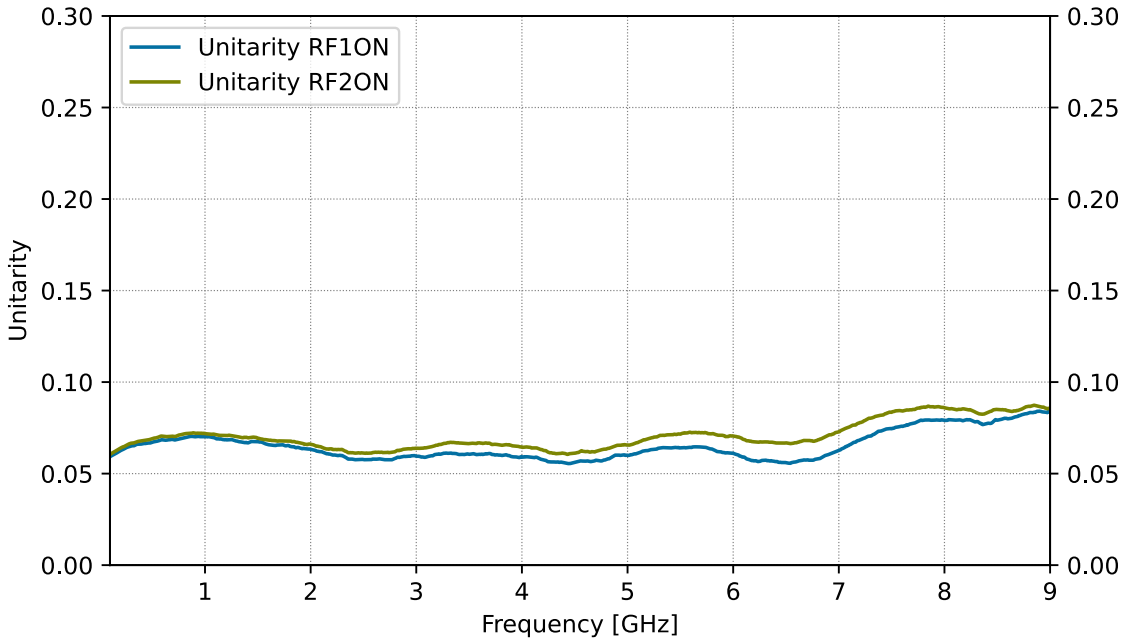
These measurements have been taken from TS8223K EVK, CPW losses have been de-embedded from the measurements. Device does not require any matching components for operation upto 8.5 GHz.



Insertion loss and Return loss, RFC − RFx.



Isolation between RFC to non-active RFx and active RFx to non-active RFx.



RFC − RFx Unitarity, Power absorption by TS8223K $1 - |S_{11}|^2 - |S_{21}|^2 - |S_{31}|^2$.

Glossary

IL	Insertion loss
ISO	Isolation
RL	Return loss
VSWR	Voltage Stading Wave Ratio
RFC	RF Common port, sometimes referred as ANT
RFx	RF Port number x
Unitarity	Describes power absorption of the component, $1 - \|S_{11}\|^2 - \|S_{21}\|^2 - \|S_{31}\|^2$

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Changelog

Table 8: Changelog

Date	Revision	Notes
11/05/2025	0.1	First release of Product Brief
11/08/2025	0.11	Pin-out added