





**TMUX6219** SCDS420E - SEPTEMBER 2020 - REVISED JULY 2024

# TMUX6219 36V, Low Ron, 2:1 (SPDT) Switch with 1.8V Logic

### 1 Features

Dual supply range: ±4.5V to ±18V Single supply range: 4.5V to 36V

Low on-resistance: 2.1Ω Low charge injection: -10pC

High current support: 330mA (maximum) (VSSOP)

High current support: 440mA (maximum) (WSON)

-40°C to +125°C operating temperature

1.8V logic compatible

Fail-safe logic

Rail-to-rail operation

Bidirectional signal path

Break-before-make switching

## 2 Applications

- Factory automation and industrial controls
- Programmable logic controllers (PLC)
- Analog input modules
- Semiconductor test
- AC charging (Pile) station
- **Ultrasound scanners**
- Patient monitoring and diagnostics
- Optical networking
- Optical test equipment
- Remote radio units
- Wired networking
- Data acquisition systems
- Gas meters
- Flow transmitters

## 3 Description

The TMUX6219 is a complementary metal-oxide semiconductor (CMOS) switch in a single channel, 2:1 (SPDT) configuration. The device works with single supply (4.5V to 36V), dual supplies (±4.5V to ±18V), or asymmetric supplies (such as  $V_{DD}$  = 5V,  $V_{SS}$  = -8V). The TMUX6219 supports bidirectional analog and digital signals on the source (Sx) and drain (D) pins ranging from  $V_{SS}$  to  $V_{DD}$ .

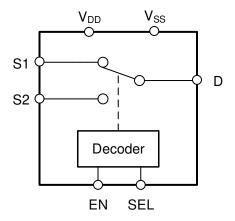
The TMUX6219 can be enabled or disabled by controlling the EN pin. When disabled, both signal path switches are off. When enabled, the SEL pin can be used to turn on signal path 1 (S1 to D) or signal path 2 (S2 to D). All logic control inputs support logic levels from 1.8V to V<sub>DD</sub>, ensuring both TTL and CMOS logic compatibility when operating in the valid supply voltage range. Fail-Safe Logic circuitry allows voltages on the control pins to be applied before the supply pin, protecting the device from potential damage.

The TMUX6219 is part of the precision switches and multiplexers family of devices. These devices have very low on and off leakage currents and low charge injection, allowing them to be used in high precision measurement applications.

#### **Package Information**

PART NUMBER	PACKAGE <sup>(1)</sup>	PACKAGE SIZE (2)					
TMUX6219	DGK (VSSOP, 8)	3mm × 4.9mm					
	RQX (WSON, 8)	2mm × 3mm					

- For more information, see Section 13
- The package size (length × width) is a nominal value and includes pins, where applicable.



TMUX6219 Block Diagram



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# **4 Pin Configuration and Functions**

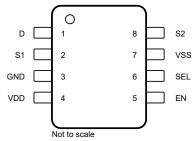


Figure 4-1. DGK Package, 8-Pin VSSOP (Top View)

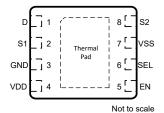


Figure 4-2. RQX Package, 8-Pin WSON (Top View)

### **Table 4-1. Pin Functions**

	PIN		PIN TYPE(1)		TVDE(1)	DESCRIPTION <sup>(2)</sup>
NAME	DGK	RQX	ITPE	DESCRIPTION.		
D	1	1	I/O	Drain pin. Can be an input or output.		
S1	2	2	I/O	Source pin 1. Can be an input or output.		
GND	3	3	Р	Ground (0V) reference		
V <sub>DD</sub>	4	4	Р	Positive power supply. This pin is the most positive power-supply potential. For reliable operation, connect a decoupling capacitor ranging from $0.1\mu F$ to $10\mu F$ between $V_{DD}$ and GND.		
EN	5	5	I	Active high logic enable, has internal pull-up resistor. When this pin is low, all switches are turned off. When this pin is high, the SEL logic input determine which switch is turned on.		
SEL	6	6	I	Logic control input, has internal pull-down resistor. Controls the switch connection as shown in Section 7.5.		
V <sub>SS</sub> 7 7		7	Р	Negative power supply. This pin is the most negative power-supply potential. In single-supply applications, this pin can be connected to ground. For reliable operation, connect a decoupling capacitor ranging from 0.1µF to 10µF between V <sub>SS</sub> and GND.		
S2	8	8	I/O	Source pin 2. Can be an input or output.		
Thermal Pa	ad		_	The thermal pad is not connected internally. It is recommended that the pad be tied to GND or VSS for best performance.		

- (1) I = input, O = output, I/O = input and output, P = power.
- (2) Refer to Section 7.4 for what to do with unused pins.

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## **5 Specifications**

### 5.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)(1) (2)

		MIN	MAX	UNIT
V <sub>DD</sub> - V <sub>SS</sub>			38	V
V <sub>DD</sub>	Supply voltage	-0.5	38	V
V <sub>SS</sub>		-38	0.5	V
V <sub>SEL</sub> or V <sub>EN</sub>	Logic control input pin voltage (SEL, EN) <sup>(3)</sup>	-0.5	38	V
I <sub>SEL</sub> or I <sub>EN</sub>	Logic control input pin current (SEL, EN) <sup>(3)</sup>	-30	30	mA
V <sub>S</sub> or V <sub>D</sub>	Source or drain voltage (Sx, D) <sup>(3)</sup>	V <sub>SS</sub> -0.5	V <sub>DD</sub> +0.5	V
I <sub>IK</sub>	Diode clamp current <sup>(3)</sup>	-30	30	mA
I <sub>S</sub> or I <sub>D (CONT)</sub>	Source or drain continuous current (Sx, D)		I <sub>DC</sub> + 10 % <sup>(4)</sup>	mA
T <sub>A</sub>	Ambient temperature	-55	150	°C
T <sub>stg</sub>	Storage temperature	-65	150	°C
T <sub>J</sub>	Junction temperature		150	°C
Р	Total power dissipation (DGK Package) <sup>(5)</sup>		460	mW
P <sub>tot</sub>	Total power dissipation (RQX Package) (6)		1110	mW

- (1) Stresses beyond those listed under Absolute Maximum Rating may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Condition. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) All voltages are with respect to ground, unless otherwise specified.
- (3) Pins are diode-clamped to the power-supply rails. Over voltage signals must be voltage and current limited to maximum ratings.
- (4) Refer to Source or Drain Continuous Current table for I<sub>DC</sub> specifications.
- 5) For DGK package: P<sub>tot</sub> derates linearily above T<sub>A</sub> = 70°C by 6.7mW/°C.
- (6) For RQX package:  $P_{tot}$  derates linearily above  $T_A = 70^{\circ}$ C by 16mW/°C.

### 5.2 ESD Ratings

			VALUE	UNIT
V <sub>(ESD)</sub>	Electrostatio discharge	Human body model (HBM), per ANSI/ESDA/ JEDEC JS-001, all pins <sup>(1)</sup>		\/
		Charged device model (CDM), per JEDEC specification JESD22-C101, all pins <sup>(2)</sup>	±500	V

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
- (2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

## 5.3 Thermal Information

Submit Document Feedback

		TMUX6219	TMUX6219	
	THERMAL METRIC <sup>(1)</sup>	DGK (VSSOP)	RQX (WSON)	UNIT
		8 PINS	8 PINS	
R <sub>0JA</sub>	Junction-to-ambient thermal resistance	152.1	62.9	°C/W
R <sub>0JC(top)</sub>	Junction-to-case (top) thermal resistance	48.4	54.0	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	73.2	31.0	°C/W
$\Psi_{JT}$	Junction-to-top characterization parameter	4.1	0.8	°C/W
$\Psi_{JB}$	Junction-to-board characterization parameter	71.8	30.9	°C/W
R <sub>θJC(bot)</sub>	Junction-to-case (bottom) thermal resistance	N/A	23.4	°C/W

 For more information about traditional and new thermal metrics, see the Semiconductor and IC Package Thermal Metrics application report.

## **5.4 Recommended Operating Conditions**

over operating free-air temperature range (unless otherwise noted)

		MIN	NOM MAX	UNIT
V <sub>DD</sub> – V <sub>SS</sub> (1)	Power supply voltage differential	4.5	36	V
$V_{DD}$	Positive power supply voltage	4.5	36	V
V <sub>S</sub> or V <sub>D</sub>	Signal path input/output voltage (source or drain pin) (Sx, D)	V <sub>SS</sub>	$V_{DD}$	V
V <sub>SEL</sub> or V <sub>EN</sub>	Address or enable pin voltage	0	36	V
I <sub>S</sub> or I <sub>D (CONT)</sub>	Source or drain continuous current (Sx, D)		I <sub>DC</sub> <sup>(2)</sup>	mA
T <sub>A</sub>	Ambient temperature	-40	125	°C

<sup>(1)</sup>  $V_{DD}$  and  $V_{SS}$  can be any value as long as 4.5 V  $\leq$  ( $V_{DD} - V_{SS}$ )  $\leq$  36 V, and the minimum  $V_{DD}$  is met. (2) Refer to *Source or Drain Continuous Current* table for  $I_{DC}$  specifications.

### 5.5 Source or Drain Continuous Current

at supply voltage of V<sub>DD</sub> ± 10%, V<sub>SS</sub> ± 10 % (unless otherwise noted)

CONTIN	UOUS CURRENT PER CHANNEL (I <sub>DC</sub> )	T <sub>A</sub> = 25°C	T <sub>A</sub> = 85°C	T <sub>A</sub> = 125°C	UNIT
PACKAGE	TEST CONDITIONS	1A - 25 C	1A - 65 C	1A - 125 C	ONT
RQX (WSON)	±15 V Dual Supply	440	270	130	mA
	+36 V Single Supply <sup>(1)</sup>	440	270	130	mA
	+12 V Single Supply	330	200	105	mA
	±5 V Dual Supply	330	200	105	mA
	+5 V Single Supply	230	140	90	mA
	±15 V Dual Supply	330	210	120	mA
	+36 V Single Supply <sup>(1)</sup>	300	190	110	mA
DGK (VSSOP)	+12 V Single Supply	240	160	100	mA
	±5 V Dual Supply	240	160	100	mA
	+5 V Single Supply	180	120	80	mA

<sup>(1)</sup> Specified for nominal supply voltage only.

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## 5.6 ±15 V Dual Supply: Electrical Characteristics

 $V_{DD}$  = +15 V ± 10%,  $V_{SS}$  = -15 V ±10%, GND = 0 V (unless otherwise noted) Typical at  $V_{DD}$  = +15 V,  $V_{SS}$  = -15 V,  $T_A$  = 25°C (unless otherwise noted)

	PARAMETER	TEST CONDITIONS	T <sub>A</sub>	MIN	TYP	MAX	UNIT
ANALOG	SWITCH						
		V <sub>S</sub> = -10 V to +10 V	25°C		2.1	2.9	Ω
R <sub>ON</sub>	On-resistance	$I_D = -10 \text{ mA}$	-40°C to +85°C			3.8	Ω
		Refer to On-Resistance	-40°C to +125°C			4.5	Ω
		V <sub>S</sub> = -10 V to +10 V	25°C		0.05	3.8 4.5 0.25 0.3 0.35 0.6 0.7 0.85 0.1 0.5 0.2 1.6 40 0.5 1 3 60	Ω
$\Delta R_{ON}$	On-resistance mismatch between channels	$I_{D} = -10 \text{ mA}$	-40°C to +85°C			0.3	Ω
	CHAINEIS	Refer to On-Resistance	-40°C to +125°C			0.35	Ω
		V <sub>S</sub> = -10 V to +10 V	25°C		0.5	0.05	Ω
R <sub>ON FLAT</sub>	On-resistance flatness	$I_S = -10 \text{ mA}$	-40°C to +85°C		0.85 0.01 0.05 0.2 1.6 40 0.05 1	Ω	
		Refer to On-Resistance	-40°C to +125°C			1 2.9 3.8 4.5 0.25 0.3 0.35 0.6 0.7 0.85 1	Ω
R <sub>ON DRIFT</sub>	On-resistance drift	V <sub>S</sub> = 0 V, I <sub>S</sub> = -10 mA Refer to On-Resistance	-40°C to +125°C		0.01		Ω/°C
		V <sub>DD</sub> = 16.5 V, V <sub>SS</sub> = -16.5 V	25°C	-0.2	0.05	2.1	nA
1	Source off leakage current <sup>(1)</sup>	Switch state is off $V_S = +10 \text{ V} / -10 \text{ V}$	-40°C to +85°C	-1.6			nA
'S(OFF)	Source on leakage current	V <sub>D</sub> = -10 V / -10 V V <sub>D</sub> = -10 V / + 10 V Refer to Off-Leakage Current	-40°C to +125°C	-40		40	nA
I <sub>D(OFF)</sub>	Drain off leakage current <sup>(1)</sup>	$V_{DD}$ = 16.5 V, $V_{SS}$ = -16.5 V Switch state is off $V_{S}$ = +10 V / -10 V $V_{D}$ = -10 V / + 10 V Refer to Off-Leakage Current	25°C	-1	0.05	1	nA
			-40°C to +85°C	-3		3	nA
			-40°C to +125°C	-60		60	nA
		V <sub>DD</sub> = 16.5 V, V <sub>SS</sub> = -16.5 V	25°C	-1	0.04	1	nA
I <sub>S(ON)</sub>	Channel on leakage current <sup>(2)</sup>	Switch state is on	-40°C to +85°C	-2		3.8 4.5 0.05 0.25 0.3 0.35 0.5 0.6 0.7 0.85 0.01 0.05 0.2 1.6 40 0.05 1 3 60 0.04 1 2 50 36 0.8 .005 2 .005 3 3 30 40 48 62 3 10 15	nA
I <sub>D(OFF)</sub> [ I <sub>S(ON)</sub> ( I <sub>D(ON)</sub> LOGIC INP V <sub>IH</sub> [		V <sub>S</sub> = V <sub>D</sub> = ±10 V Refer to On-Leakage Current	-40°C to +125°C	-50		50	nA
LOGIC IN	PUTS (SEL / EN pins)	-					
V <sub>IH</sub>	Logic voltage high		-40°C to +125°C	1.3		36	V
V <sub>IL</sub>	Logic voltage low		-40°C to +125°C	0		0.8	V
I <sub>IH</sub>	Input leakage current		-40°C to +125°C		0.005	2	μΑ
I <sub>IL</sub>	Input leakage current		-40°C to +125°C	-1	-0.005		μΑ
C <sub>IN</sub>	Logic input capacitance		-40°C to +125°C		3		pF
POWER S	SUPPLY					I.	
			25°C		30	40	μA
$I_{DD}$	V <sub>DD</sub> supply current	$V_{DD} = 16.5 \text{ V}, V_{SS} = -16.5 \text{ V}$ Logic inputs = 0 V, 5 V, or $V_{DD}$	–40°C to +85°C			48	μΑ
		Logic inputs – U V, 5 V, or V <sub>DD</sub>	-40°C to +125°C			62	μA
			25°C		3	10	μA
I <sub>SS</sub>	V <sub>SS</sub> supply current	$V_{DD}$ = 16.5 V, $V_{SS}$ = -16.5 V Logic inputs = 0 V, 5 V, or $V_{DD}$	-40°C to +85°C			0.05	μA
		Logic inputs = 0 v, 5 v, of V <sub>DD</sub>	-40°C to +125°C			25	μA

When  $V_S$  is positive,  $V_D$  is negative, or when  $V_S$  is negative,  $V_D$  is positive. When  $V_S$  is at a voltage potential,  $V_D$  is floating, or when  $V_D$  is at a voltage potential,  $V_S$  is floating.



## 5.7 ±15 V Dual Supply: Switching Characteristics

 $V_{DD}$  = +15 V ± 10%,  $V_{SS}$  = -15 V ±10%, GND = 0 V (unless otherwise noted) Typical at  $V_{DD}$  = +15 V,  $V_{SS}$  = -15 V,  $T_A$  = 25°C (unless otherwise noted)

	PARAMETER	TEST CONDITIONS	T <sub>A</sub>	MIN	TYP	MAX	UNIT
		V <sub>S</sub> = 10 V	25°C		120	175	ns
TRAN	Transition time from control input	$R_L = 300 \Omega, C_L = 35 pF$	-40°C to +85°C				ns
		Refer to Transition Time	-40°C to +125°C			210	ns
		V <sub>S</sub> = 10 V	25°C		100	120 175 190 210 100 170 185 200 100 180 195 210 50 0.19 0.2 0.2 700 -10 -75 -55 -117 -106 40 -0.18	ns
ton (EN)	Turn-on time from enable	$R_L = 300 \Omega$ , $C_L = 35 pF$ Refer to Turn-on and Turn-off	–40°C to +85°C				ns
		Time	-40°C to +125°C				ns
		V <sub>S</sub> = 10 V	25°C		100	180	ns
toff (EN)	Turn-off time from enable	$R_L = 300 \Omega$ , $C_L = 35 pF$ Refer to Turn-on and Turn-off	-40°C to +85°C			195	ns
		Time	-40°C to +125°C			210	ns
		V <sub>S</sub> = 10 V,	25°C		50		ns
ВВМ	Break-before-make time delay	$R_L = 300 \Omega$ , $C_L = 35 pF$	-40°C to +85°C	1			ns
		Refer to Break-Before-Make	-40°C to +125°C	C 200  100 180  195  C 210  50  1 1  C 1  0.19  0.2  C 0.2  700  -10  -75  -55  -117  -106	ns		
		V <sub>DD</sub> rise time = 100 ns	25°C		0.19		ms
T <sub>ON (VDD)</sub>	Device turn on time (V <sub>DD</sub> to output)	$R_L = 300 \Omega, C_L = 35 pF$	-40°C to +85°C		120 175	ms	
, ,	(Վըը to output)	Refer to Turn-on (VDD) Time	-40°C to +125°C			ms	
t <sub>PD</sub>	Propagation delay	$R_L = 50 \Omega$ , $C_L = 5 pF$ Refer to Propagation Delay	25°C		700		ps
Q <sub>INJ</sub>	Charge injection	V <sub>D</sub> = 0 V, C <sub>L</sub> = 1 nF Refer to Charge Injection	25°C		-10		рС
O <sub>ISO</sub>	Off-isolation	$R_L$ = 50 $\Omega$ , $C_L$ = 5 pF $V_S$ = 0 V, f = 100 kHz Refer to Off Isolation	25°C		-75		dB
O <sub>ISO</sub>	Off-isolation	$R_L = 50 \Omega$ , $C_L = 5 pF$ $V_S = 0 V$ , $f = 1 MHz$ Refer to Off Isolation	25°C		-55		dB
X <sub>TALK</sub>	Crosstalk	$R_L = 50 \Omega$ , $C_L = 5 pF$ $V_S = 0 V$ , $f = 100 kHz$ Refer to Crosstalk	25°C		-117		dB
X <sub>TALK</sub>	Crosstalk	$R_L = 50 \Omega$ , $C_L = 5 pF$ $V_S = 0 V$ , $f = 1 MHz$ Refer to Crosstalk	25°C		-106		dB
BW	-3dB Bandwidth	$R_L = 50 \Omega$ , $C_L = 5 pF$ $V_S = 0 V$ Refer to Bandwidth	25°C		40		MHz
l <sub>L</sub>	Insertion loss	$R_L = 50 \Omega$ , $C_L = 5 pF$ $V_S = 0 V$ , $f = 1 MHz$	25°C		-0.18		dB
ACPSRR	AC Power Supply Rejection Ratio	$V_{PP}$ = 0.62 V on $V_{DD}$ and $V_{SS}$ $R_L$ = 50 $\Omega$ , $C_L$ = 5 pF, f = 1 MHz Refer to ACPSRR	25°C		-64		dB
THD+N	Total Harmonic Distortion + Noise	$V_{PP} = 15 \text{ V}, V_{BIAS} = 0 \text{ V}$ $R_L = 10 \text{ k}\Omega$ , $C_L = 5 \text{ pF}$ , $f = 20 \text{ Hz}$ to 20 kHz Refer to THD + Noise	25°C		0.0005		%
C <sub>S(OFF)</sub>	Source off capacitance	V <sub>S</sub> = 0 V, f = 1 MHz	25°C		33		pF
C <sub>D(OFF)</sub>	Drain off capacitance	V <sub>S</sub> = 0 V, f = 1 MHz	25°C		48		pF
$C_{S(ON)}$ , $C_{D(ON)}$	On capacitance	V <sub>S</sub> = 0 V, f = 1 MHz	25°C		148		pF



# 5.8 36 V Single Supply: Electrical Characteristics

 $V_{DD} = +36 \text{ V} \pm 10\%, V_{SS} = 0 \text{ V}, \text{GND} = 0 \text{ V} \text{ (unless otherwise noted)}$   $\text{Typical at V}_{DD} = +36 \text{ V}, V_{SS} = 0 \text{ V}, T_{A} = 25^{\circ}\text{C} \text{ (unless otherwise noted)}$ 

	PARAMETER	TEST CONDITIONS	T <sub>A</sub>	MIN	TYP	MAX	UNIT
ANALOG	SWITCH						
		V <sub>S</sub> = 0 V to 30 V	25°C		2.5	3.2	Ω
R <sub>ON</sub>	On-resistance	$I_D = -10 \text{ mA}$	-40°C to +85°C			4.2	Ω
		Refer to On-Resistance	-40°C to +125°C			4.9	Ω
		V <sub>S</sub> = 0 V to 30 V	25°C		0.1	0.2	Ω
$\Delta R_{ON}$	On-resistance mismatch between channels	$I_{D} = -10 \text{ mA}$	-40°C to +85°C			0.25	Ω
	Charmers	Refer to On-Resistance	-40°C to +125°C			0.3	Ω
		V <sub>S</sub> = 0 V to 30 V	25°C		0.3	1	Ω
R <sub>ON FLAT</sub>	On-resistance flatness	I <sub>S</sub> = -10 mA	-40°C to +85°C -40°C to +125°C  25°C -40°C to +85°C -40°C to +85°C -40°C to +85°C -40°C to +85°C -40°C to +125°C  25°C -40°C to +125°C  25°C -40°C to +125°C  -40°C to +125°C  -40°C to +125°C  -40°C to +85°C -40°C to +85°C -40°C to +85°C -40°C to +85°C -40°C to +125°C  -80  25°C -40°C to +125°C -80  25°C -40°C to +125°C		1.5	Ω	
		Refer to On-Resistance	-40°C to +125°C			2.5 3.2 4.2 4.9 0.1 0.2 0.25 0.3 0.3 1 1.5 2 0.009 0.05 0.3 3.5 60 0.05 1 6.2 80 0.05 0.4 4.5 70	Ω
R <sub>ON DRIFT</sub>	On-resistance drift	V <sub>S</sub> = 18 V, I <sub>S</sub> = -10 mA Refer to On-Resistance	-40°C to +125°C		0.009		Ω/°C
		V <sub>DD</sub> = 39.6 V, V <sub>SS</sub> = 0 V	25°C	-0.3	0.05	4.2 4.9 1 0.2 0.25 0.3 3 1 1.5 2 9 5 0.3 3.5 60 5 1 6.2 80 5 0.4 4.5 70 36 0.8 5 2 5 3	nA
lovore)	Source off leakage current <sup>(1)</sup>	Switch state is off V <sub>S</sub> = 30 V / 1 V	-40°C to +85°C	-3.5		3.5	nA
I <sub>S(OFF)</sub>	Source on leakage current	V <sub>D</sub> = 1 V / 30 V Refer to Off-Leakage Current	-40°C to +125°C	-60		60	nA
		V <sub>DD</sub> = 39.6 V, V <sub>SS</sub> = 0 V	25°C	-1	0.05	1	nA
I <sub>D(OFF)</sub>	Drain off leakage current <sup>(1)</sup>	Switch state is off V <sub>S</sub> = 30 V / 1 V	-40°C to +85°C	-6.2		6.2	nA
'D(OFF)	Drain on leakage current	V <sub>D</sub> = 1 V / 30 V Refer to Off-Leakage Current	-40°C to +125°C	-80		80	nA
		V <sub>DD</sub> = 39.6 V, V <sub>SS</sub> = 0 V	25°C	-0.4	0.05	0.4	nA
I <sub>S(ON)</sub>	Channel on leakage current <sup>(2)</sup>	Switch state is on $V_S = V_D = 30 \text{ V or } 1 \text{ V}$	-40°C to +85°C	-4.5		4.5	nA
I <sub>D(ON)</sub>		Refer to On-Leakage Current	-40°C to +125°C	-70		3.2 4.2 4.9 0.2 0.25 0.3 1 1.5 2 0.3 3.5 60 1 6.2 80 0.4 4.5 70 36 0.8 2	nA
LOGIC IN	PUTS (SEL / EN pins)						
V <sub>IH</sub>	Logic voltage high		-40°C to +125°C	1.3		36	V
V <sub>IL</sub>	Logic voltage low		-40°C to +125°C	0		0.8	V
I <sub>IH</sub>	Input leakage current		-40°C to +125°C		0.005	2	μΑ
I <sub>IL</sub>	Input leakage current		-40°C to +125°C	-1	-0.005		μΑ
C <sub>IN</sub>	Logic input capacitance		-40°C to +125°C		3		pF
POWER S	SUPPLY					'	
		.,	25°C		28	50	μΑ
$I_{DD}$	V <sub>DD</sub> supply current	$V_{DD}$ = 39.6 V, $V_{SS}$ = 0 V Logic inputs = 0 V, 5 V, or $V_{DD}$	-40°C to +85°C			58	μΑ
		J 15 15 2 1, 2 1, 3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	-40°C to +125°C			70	μΑ

<sup>(1)</sup> When  $V_S$  is 30 V,  $V_D$  is 1 V, or when  $V_S$  is 1 V,  $V_D$  is 30 V.

When  $V_S$  is at a voltage potential,  $V_D$  is floating, or when  $V_D$  is at a voltage potential,  $V_S$  is floating.



## 5.9 36 V Single Supply: Switching Characteristics

 $V_{DD}$  = +36 V ± 10%,  $V_{SS}$  = 0 V, GND = 0 V (unless otherwise noted) Typical at  $V_{DD}$  = +36 V,  $V_{SS}$  = 0 V,  $T_A$  = 25°C (unless otherwise noted)

	PARAMETER	TEST CONDITIONS	T <sub>A</sub>	MIN	TYP	MAX	UNIT
		V <sub>S</sub> = 18 V	25°C		110	170	ns
t <sub>TRAN</sub>	Transition time from control input	$R_L = 300 \Omega, C_L = 35 pF$	–40°C to +85°C			185	ns
		Refer to Transition Time	-40°C to +125°C			200	ns
		V <sub>S</sub> = 18 V	25°C		110	180	ns
t <sub>ON (EN)</sub>	Turn-on time from enable	$R_L = 300 \Omega$ , $C_L = 35 pF$ Refer to Turn-on and Turn-off	–40°C to +85°C			190	ns
, ,		Time	-40°C to +125°C			200	ns
		V <sub>S</sub> = 18 V	25°C		90	180	ns
t <sub>OFF (EN)</sub>	Turn-off time from enable	$R_L = 300 \Omega$ , $C_L = 35 pF$ Refer to Turn-on and Turn-off	-40°C to +85°C			195	ns
		Time	-40°C to +125°C			200	ns
		V <sub>S</sub> = 18 V,	25°C		44		ns
t <sub>BBM</sub>	Break-before-make time delay	$R_L = 300 \Omega, C_L = 35 pF$	-40°C to +85°C	1			ns
		Refer to Break-Before-Make	-40°C to +125°C	1			ns
		V <sub>DD</sub> rise time = 100 ns	25°C		0.17		ms
T <sub>ON (VDD)</sub>	Device turn on time (V <sub>DD</sub> to output)	$R_L = 300 \Omega, C_L = 35 pF$	-40°C to +85°C		0.19		ms
	(TDD to carpar)	Refer to Turn-on (VDD) Time	-40°C to +125°C		0.19		ms
t <sub>PD</sub>	Propagation delay	$R_L = 50 \Omega$ , $C_L = 5 pF$ Refer to Propagation Delay	25°C		920		ps
Q <sub>INJ</sub>	Charge injection	V <sub>D</sub> = 18 V, C <sub>L</sub> = 1 nF Refer to Charge Injection	25°C	-13			рС
O <sub>ISO</sub>	Off-isolation	$R_L = 50 \Omega$ , $C_L = 5 pF$ $V_S = 6 V$ , $f = 100 kHz$ Refer to Off Isolation	25°C		-75		dB
O <sub>ISO</sub>	Off-isolation	$R_L = 50 \Omega$ , $C_L = 5 pF$ $V_S = 6 V$ , $f = 1 MHz$ Refer to Off Isolation	25°C		-55		dB
X <sub>TALK</sub>	Crosstalk	$R_L = 50 \Omega$ , $C_L = 5 pF$ $V_S = 6 V$ , $f = 100 kHz$ Refer to Crosstalk	25°C		-117		dB
X <sub>TALK</sub>	Crosstalk	$R_L = 50 \Omega$ , $C_L = 5 pF$ $V_S = 6 V$ , $f = 1 MHz$ Refer to Crosstalk	25°C		-106		dB
BW	-3dB Bandwidth	$R_L = 50 \Omega$ , $C_L = 5 pF$ $V_S = 6 V$ , Refer to Bandwidth	25°C		38		MHz
IL	Insertion loss	$R_L = 50 \Omega$ , $C_L = 5 pF$ $V_S = 6 V$ , $f = 1 MHz$	25°C -0.19			dB	
ACPSRR	AC Power Supply Rejection Ratio	$V_{PP}$ = 0.62 V on $V_{DD}$ and $V_{SS}$ $R_L$ = 50 $\Omega$ , $C_L$ = 5 pF, f = 1 MHz Refer to ACPSRR	25°C		-60		dB
THD+N	Total Harmonic Distortion + Noise	$V_{PP}$ =18 V, $V_{BIAS}$ = 18 V $R_L$ = 10 k $\Omega$ , $C_L$ = 5 pF, f = 20 Hz to 20 kHz Refer to THD + Noise	25°C		0.0004		%
C <sub>S(OFF)</sub>	Source off capacitance	V <sub>S</sub> = 6 V, f = 1 MHz	25°C		35		pF
C <sub>D(OFF)</sub>	Drain off capacitance	V <sub>S</sub> = 6 V, f = 1 MHz	25°C		49		pF
C <sub>S(ON),</sub> C <sub>D(ON)</sub>	On capacitance	V <sub>S</sub> = 6 V, f = 1 MHz	25°C		146		pF



## 5.10 12 V Single Supply: Electrical Characteristics

 $V_{DD}$  = +12 V ± 10%,  $V_{SS}$  = 0 V, GND = 0 V (unless otherwise noted) Typical at  $V_{DD}$  = +12 V,  $V_{SS}$  = 0 V,  $T_A$  = 25°C (unless otherwise noted)

Typical at $V_{DD} = +12 \text{ V}$ , $V_{SS} = 0 \text{ V}$ , $I_A = 2$ PARAMETER		TEST CONDITIONS	T <sub>A</sub>	MIN	TYP	MAX	UNIT
ANALOG	SWITCH						
		V <sub>S</sub> = 0 V to 10 V	25°C		4.6	6	Ω
R <sub>ON</sub>	On-resistance	$I_D = -10 \text{ mA}$	-40°C to +85°C			7.5	Ω
		Refer to On-Resistance	-40°C to +125°C			8.4	Ω
		V <sub>S</sub> = 0 V to 10 V	25°C		0.08	0.2	Ω
$\Delta R_{ON}$	On-resistance mismatch between channels	I <sub>D</sub> = -10 mA	-40°C to +85°C			0.32	Ω
	Ondrinois	Refer to On-Resistance	-40°C to +125°C			0.35	Ω
		V <sub>S</sub> = 0 V to 10 V	25°C		1.2	2	Ω
R <sub>ON FLAT</sub>	On-resistance flatness	$I_{S} = -10 \text{ mA}$	-40°C to +85°C			2.2	Ω
		Refer to On-Resistance	-40°C to +125°C			2.4	Ω
R <sub>ON DRIFT</sub>	On-resistance drift	V <sub>S</sub> = 6 V, I <sub>S</sub> = -10 mA Refer to On-Resistance	-40°C to +125°C		0.017		Ω/°C
	Source off leakage current <sup>(1)</sup>	V <sub>DD</sub> = 13.2 V, V <sub>SS</sub> = 0 V	25°C	-0.5	0.05	0.5	nA
I <sub>S(OFF)</sub>		Switch state is off V <sub>S</sub> = 10 V / 1 V V <sub>D</sub> = 1 V / 10 V Refer to Off-Leakage Current	-40°C to +85°C	-2		2	nA
·5(OFF)			-40°C to +125°C	-30		30	nA
	Drain off leakage current <sup>(1)</sup>	$V_{DD}$ = 13.2 V, $V_{SS}$ = 0 V Switch state is off $V_{S}$ = 10 V / 1 V $V_{D}$ = 1 V / 10 V Refer to Off-Leakage Current	25°C	-0.5	0.05	0.5	nA
I <sub>D(OFF)</sub>			-40°C to +85°C	-3		3	nA
·D(OFF)			-40°C to +125°C	-50		50	nA
		V <sub>DD</sub> = 13.2 V, V <sub>SS</sub> = 0 V	25°C	-1.5	0.05	1.5	nA
$I_{S(ON)}$ $I_{D(ON)}$	Channel on leakage current <sup>(2)</sup>	Switch state is on $V_S = V_D = 10 \text{ V}$ or 1 V	-40°C to +85°C	-3		3	nA
ים(טא)		Refer to On-Leakage Current	-40°C to +125°C	-40		40	nA
LOGIC IN	PUTS (SEL / EN pins)					'	
V <sub>IH</sub>	Logic voltage high		-40°C to +125°C	1.3		36	V
$V_{IL}$	Logic voltage low		-40°C to +125°C	0		8.0	V
I <sub>IH</sub>	Input leakage current		-40°C to +125°C		0.005	2	μA
I <sub>IL</sub>	Input leakage current		-40°C to +125°C	-1	-0.005		μA
C <sub>IN</sub>	Logic input capacitance		-40°C to +125°C		3		pF
POWER S	SUPPLY						
		40.07/7/	25°C		10	35	μΑ
$I_{DD}$	V <sub>DD</sub> supply current	$V_{DD}$ = 13.2 V, $V_{SS}$ = 0 V Logic inputs = 0 V, 5 V, or $V_{DD}$	–40°C to +85°C			45	μΑ
			-40°C to +125°C			55	μΑ

<sup>(1)</sup> When  $V_S$  is 10 V,  $V_D$  is 1 V, or when  $V_S$  is 1 V,  $V_D$  is 10 V.

<sup>(2)</sup> When  $V_S$  is at a voltage potential,  $V_D$  is floating, or when  $V_D$  is at a voltage potential,  $V_S$  is floating.



## 5.11 12 V Single Supply: Switching Characteristics

 $V_{DD}$  = +12 V ± 10%,  $V_{SS}$  = 0 V, GND = 0 V (unless otherwise noted) Typical at  $V_{DD}$  = +12 V,  $V_{SS}$  = 0 V,  $T_A$  = 25°C (unless otherwise noted)

	PARAMETER	TEST CONDITIONS	T <sub>A</sub>	MIN	TYP	MAX	UNIT
		V <sub>S</sub> = 8 V	25°C		180	185	ns
t <sub>TRAN</sub>	Transition time from control input	$R_L = 300 \Omega, C_L = 35 pF$	-40°C to +85°C			215	ns
		Refer to Transition Time	-40°C to +125°C			235	ns
		V <sub>S</sub> = 8 V	25°C		120	180	ns
t <sub>ON (EN)</sub>	Turn-on time from enable	$R_L = 300 \Omega$ , $C_L = 35 pF$ Refer to Turn-on and Turn-off	-40°C to +85°C			210	ns
		Time	-40°C to +125°C			230	ns
		V <sub>S</sub> = 8 V	25°C		130	210	ns
t <sub>OFF (EN)</sub>	Turn-off time from enable	$R_L = 300 \Omega$ , $C_L = 35 pF$ Refer to Turn-on and Turn-off	-40°C to +85°C			235	ns
		Time	-40°C to +125°C			250	ns
		V <sub>S</sub> = 8 V,	25°C		40		ns
t <sub>BBM</sub>	Break-before-make time delay	$R_L = 300 \Omega, C_L = 35 pF$	-40°C to +85°C	1			ns
		Refer to Break-Before-Make	-40°C to +125°C	1			ns
		V <sub>DD</sub> rise time = 100 ns	25°C		0.19		ms
T <sub>ON (VDD)</sub>	Device turn on time (V <sub>DD</sub> to output)	$R_L = 300 \Omega, C_L = 35 pF$	-40°C to +85°C		0.2		ms
	(	Refer to Turn-on (VDD) Time	-40°C to +125°C		0.2		ms
t <sub>PD</sub>	Propagation delay	$R_L = 50 \Omega$ , $C_L = 5 pF$ Refer to Propagation Delay	25°C		740		ps
Q <sub>INJ</sub>	Charge injection	V <sub>D</sub> = 6 V, C <sub>L</sub> = 1 nF Refer to Charge Injection	25°C	-6			рС
O <sub>ISO</sub>	Off-isolation	$R_L = 50 \Omega$ , $C_L = 5 pF$ $V_S = 6 V$ , $f = 100 kHz$ Refer to Off Isolation	25°C		<b>-</b> 75		dB
O <sub>ISO</sub>	Off-isolation	$R_L = 50 \Omega$ , $C_L = 5 pF$ $V_S = 6 V$ , $f = 1 MHz$ Refer to Off Isolation	25°C		-55		dB
X <sub>TALK</sub>	Crosstalk	$R_L = 50 \Omega$ , $C_L = 5 pF$ $V_S = 6 V$ , $f = 100 kHz$ Refer to Crosstalk	25°C	°C –117			dB
X <sub>TALK</sub>	Crosstalk	$R_L = 50 \Omega$ , $C_L = 5 pF$ $V_S = 6 V$ , $f = 1 MHz$ Refer to Crosstalk	25°C		-106		dB
BW	–3dB Bandwidth	$R_L = 50 \Omega$ , $C_L = 5 pF$ $V_S = 6 V$ Refer to Bandwidth	25°C 42			MHz	
IL	Insertion loss	$R_L = 50 \Omega$ , $C_L = 5 pF$ $V_S = 6 V$ , $f = 1 MHz$	25°C -0.3			dB	
ACPSRR	AC Power Supply Rejection Ratio	$V_{PP}$ = 0.62 V on $V_{DD}$ and $V_{SS}$ $R_L$ = 50 $\Omega$ , $C_L$ = 5 pF, f = 1 MHz Refer to ACPSRR	25°C		-65		dB
THD+N	Total Harmonic Distortion + Noise	$V_{PP}$ = 6 V, $V_{BIAS}$ = 6 V $R_L$ = 10 k $\Omega$ , $C_L$ = 5 pF, f = 20 Hz to 20 kHz Refer to THD + Noise	25°C		0.0009		%
C <sub>S(OFF)</sub>	Source off capacitance	V <sub>S</sub> = 6 V, f = 1 MHz	25°C		38		pF
C <sub>D(OFF)</sub>	Drain off capacitance	V <sub>S</sub> = 6 V, f = 1 MHz	25°C		56		pF
C <sub>S(ON)</sub> ,	On capacitance	V <sub>S</sub> = 6 V, f = 1 MHz	25°C		150		pF



## 5.12 +5 V / -8 V Dual Supply: Electrical Characteristics

 $V_{DD} = +5 \text{ V} \pm 10\%, \ V_{SS} = -8 \text{ V} \pm 10\%, \ \text{GND} = 0 \text{ V} \ \text{(unless otherwise noted)}$  Typical at  $V_{DD} = +5 \text{ V}, \ V_{SS} = -5 \text{ V}, \ T_A = 25^{\circ}\text{C} \ \text{(unless otherwise noted)}$ 

rypiodi d	PARAMETER	TEST CONDITIONS	T <sub>A</sub>	MIN	TYP	MAX	UNIT
ANALOG	SWITCH						
		V <sub>DD</sub> = +5 V, V <sub>SS</sub> = -8 V	25°C		4.2	5.5	Ω
R <sub>ON</sub>	On-resistance	$V_S = V_{DD}$ to $V_{SS}$ $I_D = -10$ mA	-40°C to +85°C			6.8	Ω
		Refer to On-Resistance	-40°C to +125°C			7.6	Ω
		$V_S = V_{DD}$ to $V_{SS}$	25°C		0.1	0.23	Ω
$\Delta R_{ON}$	On-resistance mismatch between channels	$I_D = -10 \text{ mA}$	-40°C to +85°C			0.27	Ω
	Chamileis	Refer to On-Resistance	-40°C to +125°C			0.35	Ω
		$V_S = V_{DD}$ to $V_{SS}$	25°C		1	1.5	Ω
R <sub>ON FLAT</sub>	On-resistance flatness	$I_D = -10 \text{ mA}$	-40°C to +85°C			1.7	Ω
		Refer to On-Resistance	-40°C to +125°C			2	Ω
R <sub>ON DRIFT</sub>	On-resistance drift	$V_S = 0 \text{ V}, I_S = -10 \text{ mA}$ Refer to On-Resistance	-40°C to +125°C		0.019		Ω/°C
		V <sub>DD</sub> = +5.5 V, V <sub>SS</sub> = -8.8 V 25°C	25°C	-0.3	0.1	0.3	nA
I <sub>S(OFF)</sub>	Source off leakage current <sup>(1)</sup>	Switch state is off $V_S = V_{DD} - 1 / V_{SS} + 1$	-40°C to +85°C	-3		3	nA
15(OFF)	Source on leakage current	$V_D = V_{SS} + 1 / V_{DD} - 1$ Refer to Off-Leakage Current	-40°C to +125°C	-50		50	nA
	Drain off leakage current <sup>(1)</sup>	$\begin{split} &V_{DD} = +5.5 \text{ V}, V_{SS} = -8.8 \text{ V} \\ &\text{Switch state is off} \\ &V_{S} = V_{DD} - 1 / V_{SS} + 1 \\ &V_{D} = V_{SS} + 1 / V_{DD} - 1 \\ &\text{Refer to Off-Leakage Current} \end{split}$	25°C	-0.5	0.1	0.5	nA
I <sub>D(OFF)</sub>			-40°C to +85°C	-3		3	nA
·D(OFF)			-40°C to +125°C	-55		55	nA
	Channel on leakage current <sup>(2)</sup>	V <sub>DD</sub> = +5.5 V, V <sub>SS</sub> = -8.8 V	25°C	-0.5	0.1	0.5	nA
I <sub>S(ON)</sub>		Switch state is on $V_S = V_D = V_{DD} - 1 / V_{SS} + 1$	-40°C to +85°C	-3		3	nA
I <sub>D(ON)</sub>		Refer to On-Leakage Current	-40°C to +125°C	-40		40	nA
LOGIC INF	PUTS (SEL / EN pins)		-				
V <sub>IH</sub>	Logic voltage high		-40°C to +125°C	1.3		44	V
V <sub>IL</sub>	Logic voltage low		-40°C to +125°C	0		0.8	V
I <sub>IH</sub>	Input leakage current		-40°C to +125°C		0.005	2	μA
I <sub>IL</sub>	Input leakage current		-40°C to +125°C	-1	-0.005		μA
C <sub>IN</sub>	Logic input capacitance		-40°C to +125°C		3		pF
POWER S	UPPLY		-				
I <sub>DD</sub>		V <sub>DD</sub> = +5.5 V, V <sub>SS</sub> = -8.8 V Logic inputs = 0 V, 5 V, or V <sub>DD</sub>	25°C		24	30	μA
	V <sub>DD</sub> supply current		-40°C to +85°C			37	μA
			-40°C to +125°C			42	μΑ
			25°C		1	5	μΑ
I <sub>SS</sub>	V <sub>SS</sub> supply current	$V_{DD}$ = +5.5 V, $V_{SS}$ = -8.8 V Logic inputs = 0 V, 5 V, or $V_{DD}$	-40°C to +85°C			8	μΑ
			-40°C to +125°C			12	μA

 <sup>(1)</sup> When V<sub>S</sub> is positive, V<sub>D</sub> is negative, or when V<sub>S</sub> is negative, V<sub>D</sub> is positive.
 (2) When V<sub>S</sub> is at a voltage potential, V<sub>D</sub> is floating, or when V<sub>D</sub> is at a voltage potential, V<sub>S</sub> is floating.



## 5.13 +5 V / -8 V Dual Supply: Switching Characteristics

 $V_{DD} = +5 \text{ V} \pm 10\%, \ V_{SS} = -5 \text{ V} \pm 10\%, \ \text{GND} = 0 \text{ V} \ \text{(unless otherwise noted)}$  Typical at  $V_{DD} = +5 \text{ V}, \ V_{SS} = -5 \text{ V}, \ T_A = 25^{\circ}\text{C} \ \text{(unless otherwise noted)}$ 

	PARAMETER	TEST CONDITIONS	T <sub>A</sub>	MIN	TYP	MAX	UNIT
		V <sub>S</sub> = 3 V	25°C		180	190	ns
TRAN	Transition time from control input	$R_L = 300 \Omega, C_L = 35 pF$	-40°C to +85°C			220	ns
		Refer to Transition Time	-40°C to +125°C			240	ns
		V <sub>S</sub> = 3 V	25°C		120	180	ns
ON (EN)	Turn-on time from enable	$R_L = 300 \Omega, C_L = 35 pF$	-40°C to +85°C			215	ns
		Refer to Turn-on and Turn-off Time	-40°C to +125°C			240	ns
		V <sub>S</sub> = 3 V	25°C		130	220	ns
OFF (EN)	Turn-off time from enable	$R_L = 300 \Omega, C_L = 35 pF$	-40°C to +85°C			245	ns
		Refer to Turn-on and Turn-off Time	-40°C to +125°C			270	ns
		V <sub>S</sub> = 3 V,	25°C		60		ns
BBM	Break-before-make time delay	$R_L = 300 \Omega, C_L = 35 pF$	-40°C to +85°C	1			ns
		Refer to Break-Before-Make	-40°C to +125°C	1			ns
		V rigo timo = 1uo	25°C		0.19		ms
ON (VDD)	Device turn on time	$V_{DD}$ rise time = 1us R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35pF	-40°C to +85°C		0.19	1	ms
, ,	(V <sub>DD</sub> to output)	Refer to Turn-on (VDD) Time	-40°C to +125°C		0.19	1	ms
PD	Propagation delay	$R_L = 50 \Omega$ , $C_L = 5 pF$ Refer to Propagation Delay	25°C	650			ps
Q <sub>INJ</sub>	Charge injection	V <sub>D</sub> = 0 V, C <sub>L</sub> = 1 nF Refer to Charge Injection	25°C	14			рС
O <sub>ISO</sub>	Off-isolation	$R_L = 50 \Omega$ , $C_L = 5 pF$ $V_S = 0 V$ , $f = 100 kHz$ Refer to Off Isolation	25°C		-75		dB
O <sub>ISO</sub>	Off-isolation	$R_L = 50 \Omega$ , $C_L = 5 pF$ $V_S = 0 V$ , $f = 1 MHz$ Refer to Off Isolation	25°C		-55		dB
X <sub>TALK</sub>	Crosstalk	$R_L = 50 \Omega$ , $C_L = 5 pF$ $V_S = 0 V$ , $f = 100 kHz$ Refer to Crosstalk	25°C	-80			dB
X <sub>TALK</sub>	Crosstalk	$R_L = 50 \Omega$ , $C_L = 5 pF$ $V_S = 0 V$ , $f = 1MHz$ Refer to Crosstalk	25°C	-70			dB
ВW	-3dB Bandwidth	$R_L = 50 \Omega$ , $C_L = 5 pF$ $V_S = 0 V$ , Refer to Bandwidth	25°C		42		MHz
L	Insertion loss	$R_L = 50 \Omega$ , $C_L = 5 pF$ $V_S = 0 V$ , $f = 1 MHz$	25°C -0.3			dB	
ACPSRR	AC Power Supply Rejection Ratio	$V_{PP}$ = 0.62 V on $V_{DD}$ and $V_{SS}$ $R_L$ = 50 $\Omega$ , $C_L$ = 5 pF, f = 1 MHz Refer to ACPSRR	25°C		-68		dB
ΓHD+N	Total Harmonic Distortion + Noise	$V_{PP} = 5 \text{ V}, V_{BIAS} = 0 \text{ V}$ $R_L = 10 \text{ kΩ}, C_L = 5 \text{ pF},$ $f = 20 \text{ Hz to } 20 \text{ kHz}$ Refer to THD + Noise	25°C		0.001		%
C <sub>S(OFF)</sub>	Source off capacitance	V <sub>S</sub> = 0 V, f = 1 MHz	25°C		36		pF
C <sub>D(OFF)</sub>	Drain off capacitance	V <sub>S</sub> = 0 V, f = 1 MHz	25°C		53		pF
C <sub>S(ON),</sub> C <sub>D(ON)</sub>	On capacitance	V <sub>S</sub> = 0 V, f = 1 MHz	25°C		142		pF



## 5.14 ±5 V Dual Supply: Electrical Characteristics

 $V_{DD}$  = +5 V ± 10%,  $V_{SS}$  = -5 V ±10%, GND = 0 V (unless otherwise noted) Typical at  $V_{DD}$  = +5 V,  $V_{SS}$  = -5 V,  $T_A$  = 25°C (unless otherwise noted)

	PARAMETER	TEST CONDITIONS	T <sub>A</sub>	MIN	TYP	MAX	UNIT
ANALOG	SWITCH						
R <sub>ON</sub>		$V_{DD} = +4.5 \text{ V}, V_{SS} = -4.5 \text{ V}$ $V_{S} = -4.5 \text{ V} \text{ to } +4.5 \text{ V}$ $I_{D} = -10 \text{ mA}$	25°C		4	7.2	Ω
	On-resistance		–40°C to +85°C			8.6	Ω
		Refer to On-Resistance	-40°C to +125°C			10	Ω
		V <sub>S</sub> = -4.5 V to +4.5 V	25°C		0.1	0.3	Ω
$\Delta R_{ON}$	On-resistance mismatch between channels	$I_D = -10 \text{ mA}$	-40°C to +85°C			0.35	Ω
	Originiolo	Refer to On-Resistance	-40°C to +125°C			0.4	Ω
		V <sub>S</sub> = -4.5 V to +4.5 V	25°C		1.3	2.2	Ω
R <sub>ON FLAT</sub>	On-resistance flatness	$I_{D} = -10 \text{ mA}$	-40°C to +85°C			2.5	Ω
		Refer to On-Resistance	-40°C to +125°C			2.8	Ω
R <sub>ON DRIFT</sub>	On-resistance drift	V <sub>S</sub> = 0 V, I <sub>S</sub> = -10 mA Refer to On-Resistance	-40°C to +125°C		0.019		Ω/°C
	Source off leakage current <sup>(1)</sup>	$V_{DD}$ = +5.5 V, $V_{SS}$ = -5.5 V	25°C	-0.3	0.05	0.3	nA
le(OFF)		Switch state is off $V_S = +4.5 \text{ V} / -4.5 \text{ V}$ $V_D = -4.5 \text{ V} / +4.5 \text{ V}$ Refer to Off-Leakage Current	–40°C to +85°C	-1		1	nA
I <sub>S(OFF)</sub>			-40°C to +125°C	-30		30	nA
	Drain off leakage current <sup>(1)</sup>	$\begin{split} &V_{DD} = +5.5 \text{ V}, \text{ V}_{SS} = -5.5 \text{ V} \\ &\text{Switch state is off} \\ &V_S = +4.5 \text{ V} / -4.5 \text{ V} \\ &V_D = -4.5 \text{ V} / +4.5 \text{ V} \\ &\text{Refer to Off-Leakage Current} \end{split}$	25°C	-0.4	0.05	0.4	nA
I <sub>D(OFF)</sub>			-40°C to +85°C	-3		3	nA
'D(OFF)			-40°C to +125°C	-50		50	nA
	Channel on leakage current <sup>(2)</sup>	$V_{DD}$ = +5.5 V, $V_{SS}$ = -5.5 V Switch state is on $V_{S}$ = $V_{D}$ = ±4.5 V	25°C	-0.4	0.05	0.4	nA
I <sub>S(ON)</sub>			-40°C to +85°C	-3		3	nA
I <sub>D(ON)</sub>		Refer to On-Leakage Current	-40°C to +125°C	-40		40	nA
LOGIC IN	PUTS (SEL / EN pins)		1				
V <sub>IH</sub>	Logic voltage high		-40°C to +125°C	1.3		36	V
V <sub>IL</sub>	Logic voltage low		-40°C to +125°C	0		0.8	V
I <sub>IH</sub>	Input leakage current		-40°C to +125°C		0.005	2	μΑ
I <sub>IL</sub>	Input leakage current		-40°C to +125°C	-1	-0.005		μΑ
C <sub>IN</sub>	Logic input capacitance		-40°C to +125°C		3		pF
POWER S	SUPPLY						
		.,,	25°C		20	35	μΑ
$I_{DD}$	V <sub>DD</sub> supply current	$V_{DD}$ = +5.5 V, $V_{SS}$ = -5.5 V Logic inputs = 0 V, 5 V, or $V_{DD}$	–40°C to +85°C			40	μΑ
		Logio iriputo – o v, o v, oi vDD	-40°C to +125°C			50	μΑ
			25°C		0.001	5	μΑ
I <sub>SS</sub>	V <sub>SS</sub> supply current	$V_{DD}$ = +5.5 V, $V_{SS}$ = -5.5 V Logic inputs = 0 V, 5 V, or $V_{DD}$	–40°C to +85°C			8	μΑ
		3 4-2-2 2 3, 2 3, 3, 400	-40°C to +125°C			15	μΑ

When  $V_S$  is positive,  $V_D$  is negative, or when  $V_S$  is negative,  $V_D$  is positive.

When  $V_S$  is at a voltage potential,  $V_D$  is floating, or when  $V_D$  is at a voltage potential,  $V_S$  is floating.



## 5.15 ±5 V Dual Supply: Switching Characteristics

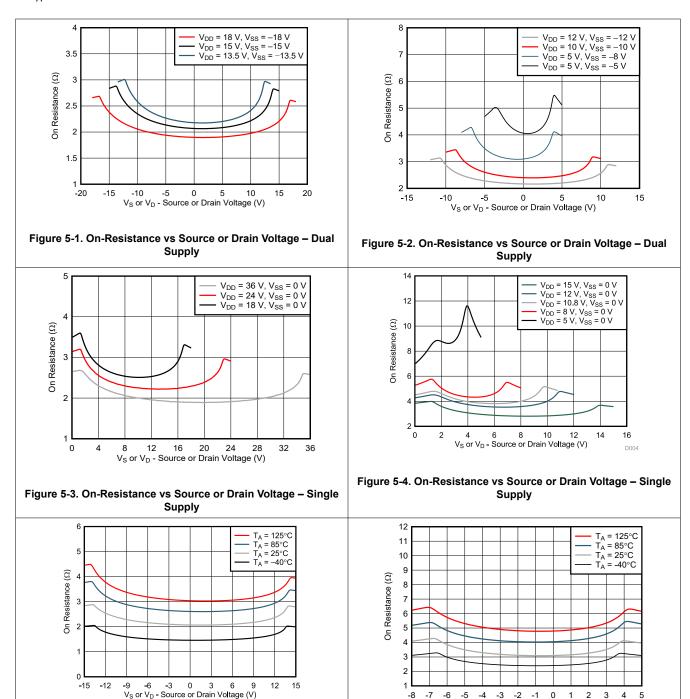
 $V_{DD}$  = +5 V ± 10%,  $V_{SS}$  = -5 V ±10%, GND = 0 V (unless otherwise noted) Typical at  $V_{DD}$  = +5 V,  $V_{SS}$  = -5 V,  $T_A$  = 25°C (unless otherwise noted)

	PARAMETER	TEST CONDITIONS	T <sub>A</sub>	MIN	TYP	MAX	UNIT
		V <sub>S</sub> = 3 V	25°C		300	400	ns
t <sub>TRAN</sub>	Transition time from control input	$R_L = 300 \Omega, C_L = 35 pF$	-40°C to +85°C			490	ns
		Refer to Transition Time	-40°C to +125°C			550	ns
		V <sub>S</sub> = 3 V	25°C		220	300	ns
t <sub>ON (EN)</sub>	Turn-on time from enable	$R_L = 300 \Omega$ , $C_L = 35 pF$ Refer to Turn-on and Turn-off	-40°C to +85°C			350	ns
		Time	-40°C to +125°C			380	ns
		V <sub>S</sub> = 3 V	25°C		210	280	ns
t <sub>OFF (EN)</sub>	Turn-off time from enable	$R_L = 300 \Omega$ , $C_L = 35 pF$ Refer to Turn-on and Turn-off	-40°C to +85°C			330	ns
		Time	-40°C to +125°C			350	ns
		V <sub>S</sub> = 3 V,	25°C		50		ns
t <sub>BBM</sub>	Break-before-make time delay	$R_L = 300 \Omega, C_L = 35 pF$	-40°C to +85°C	1			ns
		Refer to Break-Before-Make	-40°C to +125°C	1			ns
		V <sub>DD</sub> rise time = 100 ns	25°C		0.19		ms
T <sub>ON (VDD)</sub>	Device turn on time (V <sub>DD</sub> to output)	$R_L = 300 \Omega, C_L = 35pF$	-40°C to +85°C		0.19	1	ms
	(VDD to output)	Refer to Turn-on (VDD) Time	-40°C to +125°C		0.19	1	ms
t <sub>PD</sub>	Propagation delay	$R_L = 50 \Omega$ , $C_L = 5 pF$ Refer to Propagation Delay	25°C		650		ps
Q <sub>INJ</sub>	Charge injection	V <sub>D</sub> = 0 V, C <sub>L</sub> = 1 nF Refer to Charge Injection	25°C	-5			рС
O <sub>ISO</sub>	Off-isolation	$R_L = 50 \Omega$ , $C_L = 5 pF$ $V_S = 0 V$ , $f = 100 kHz$ Refer to Off Isolation	25°C		<b>-</b> 75		dB
O <sub>ISO</sub>	Off-isolation	$R_L = 50 \Omega$ , $C_L = 5 pF$ $V_S = 0 V$ , $f = 1 MHz$ Refer to Off Isolation	25°C		-55		dB
X <sub>TALK</sub>	Crosstalk	$R_L = 50 \ \Omega$ , $C_L = 5 \ pF$ $V_S = 0 \ V$ , $f = 100 \ kHz$ Refer to Crosstalk	25°C	25°C –117			dB
X <sub>TALK</sub>	Crosstalk	$R_L = 50 \Omega$ , $C_L = 5 pF$ $V_S = 0 V$ , $f = 1 MHz$ Refer to Crosstalk	25°C	-106			dB
BW	-3dB Bandwidth	$R_L = 50 \Omega$ , $C_L = 5 pF$ $V_S = 0 V$ , Refer to Bandwidth	25°C	43			MHz
IL	Insertion loss	$R_L = 50 \Omega$ , $C_L = 5 pF$ $V_S = 0 V$ , $f = 1 MHz$	25°C -0.35			dB	
ACPSRR	AC Power Supply Rejection Ratio	$V_{PP}$ = 0.62 V on $V_{DD}$ and $V_{SS}$ $R_L$ = 50 $\Omega$ , $C_L$ = 5 pF, f = 1 MHz Refer to ACPSRR	25°C		-68		dB
THD+N	Total Harmonic Distortion + Noise	$V_{PP}$ = 5 V, $V_{BIAS}$ = 0 V $R_L$ = 10 k $\Omega$ , $C_L$ = 5 pF, f = 20 Hz to 20 kHz Refer to THD + Noise	25°C 0.001			%	
C <sub>S(OFF)</sub>	Source off capacitance	V <sub>S</sub> = 0 V, f = 1 MHz	25°C		40		pF
C <sub>D(OFF)</sub>	Drain off capacitance	V <sub>S</sub> = 0 V, f = 1 MHz	25°C		60		pF
C <sub>S(ON),</sub> C <sub>D(ON)</sub>	On capacitance	V <sub>S</sub> = 0 V, f = 1 MHz	25°C		150		pF



## 5.16 Typical Characteristics

at  $T_A = 25$ °C



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 $V_{DD} = 15 \text{ V}, V_{SS} = -15 \text{ V}$ 

Figure 5-5. On-Resistance vs Temperature

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1 2 3 4

-5

-7 -6

-8

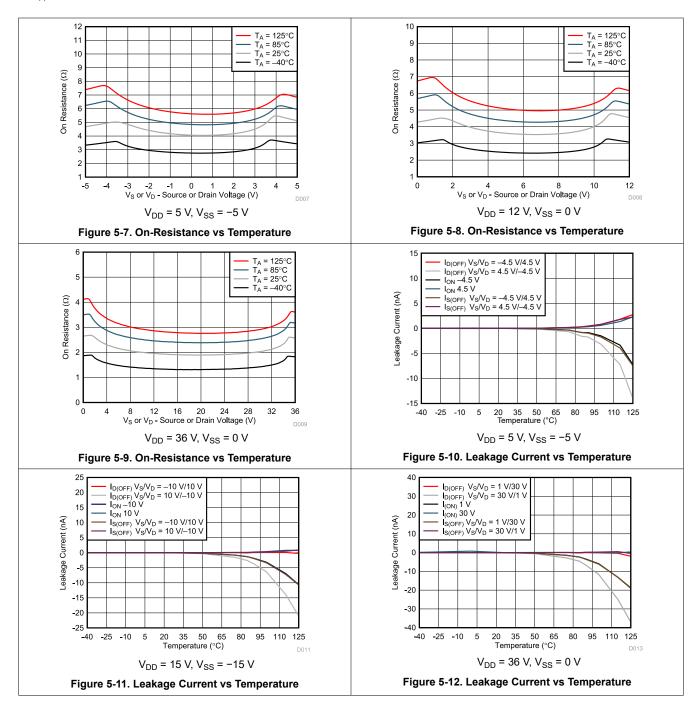
-4 -3 -2 -1 0

Figure 5-6. On-Resistance vs Temperature

V<sub>S</sub> or V<sub>D</sub> - Source or Drain Voltage (V)

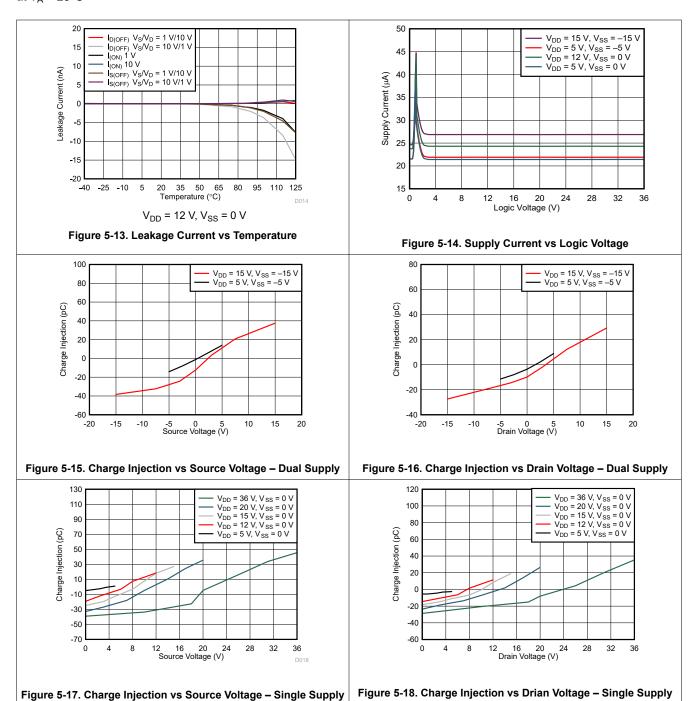
 $V_{DD} = 5 \text{ V}, V_{SS} = -8 \text{ V}$ 

at T<sub>A</sub> = 25°C





at  $T_A = 25$ °C

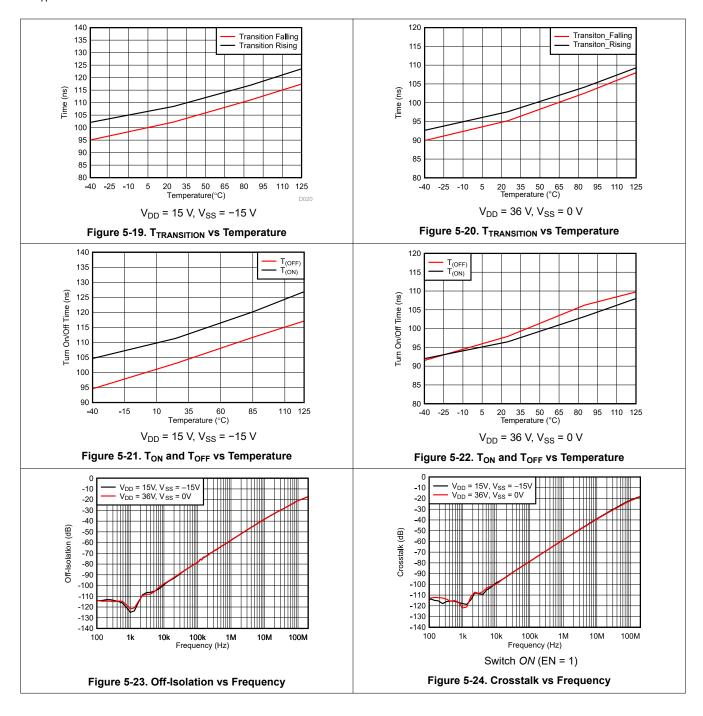


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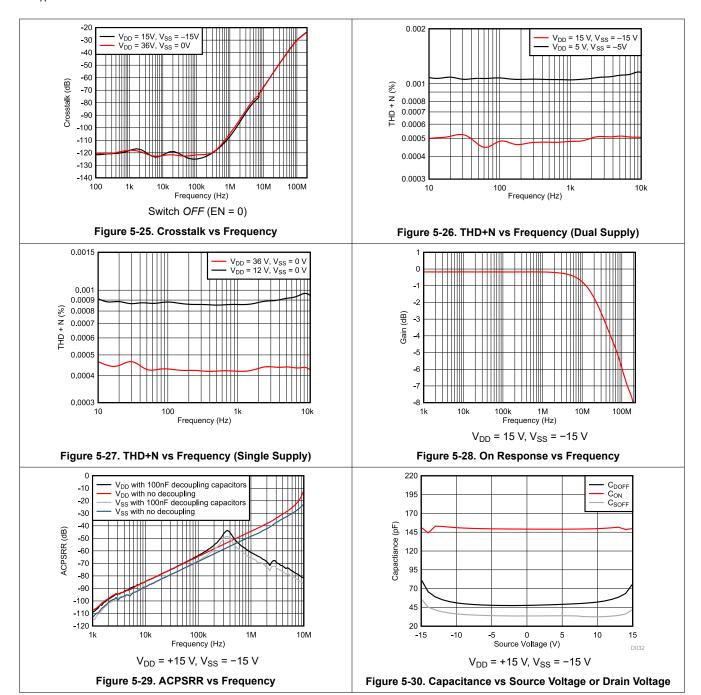


at T<sub>A</sub> = 25°C





at  $T_A = 25$ °C

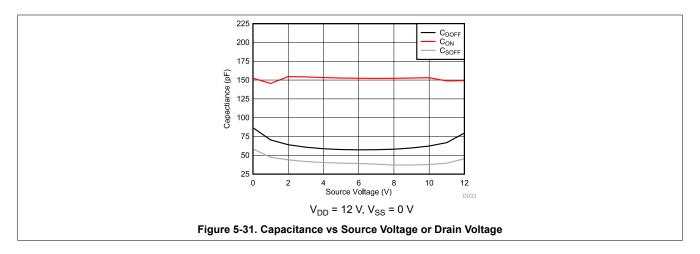


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at T<sub>A</sub> = 25°C



### **6 Parameter Measurement Information**

### 6.1 On-Resistance

The on-resistance of a device is the ohmic resistance between the source (Sx) and drain (D) pins of the device. The on-resistance varies with input voltage and supply voltage. The symbol  $R_{ON}$  is used to denote on-resistance. Figure 6-1 shows the measurement setup used to measure  $R_{ON}$ . Voltage (V) and current ( $I_{SD}$ ) are measured using the following setup, where  $R_{ON}$  is computed as  $R_{ON} = V / I_{SD}$ :

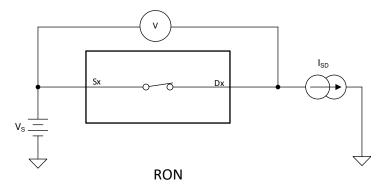


Figure 6-1. On-Resistance

### 6.2 Off-Leakage Current

There are two types of leakage currents associated with a switch during the off state:

- 1. Source off-leakage current.
- 2. Drain off-leakage current.

Source leakage current is defined as the leakage current flowing into or out of the source pin when the switch is off. This current is denoted by the symbol  $I_{S(OFF)}$ .

Drain leakage current is defined as the leakage current flowing into or out of the drain pin when the switch is off. This current is denoted by the symbol  $I_{D(OFF)}$ .

Figure 6-2 shows the setup used to measure both off-leakage currents.

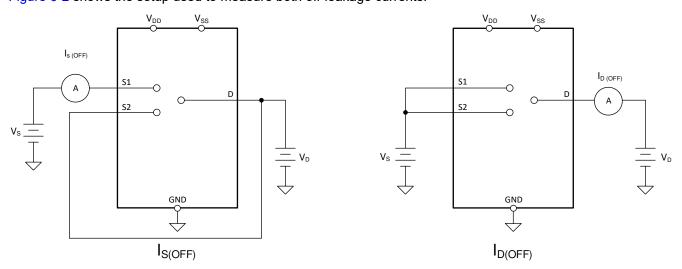


Figure 6-2. Off-Leakage Measurement Setup

### 6.3 On-Leakage Current

Source on-leakage current is defined as the leakage current flowing into or out of the source pin when the switch is on. This current is denoted by the symbol  $I_{S(ON)}$ .

Drain on-leakage current is defined as the leakage current flowing into or out of the drain pin when the switch is on. This current is denoted by the symbol  $I_{D(ON)}$ .

Either the source pin or drain pin is left floating during the measurement. Figure 6-3 shows the circuit used for measuring the on-leakage current, denoted by  $I_{S(ON)}$  or  $I_{D(ON)}$ .

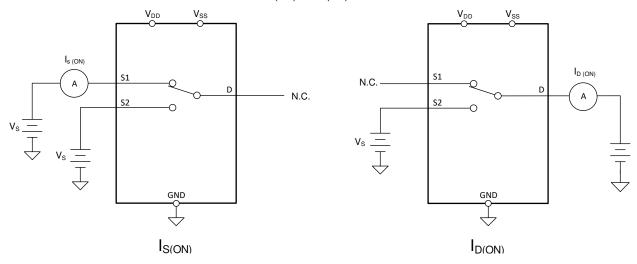


Figure 6-3. On-Leakage Measurement Setup

#### **6.4 Transition Time**

Transition time is defined as the time taken by the output of the device to rise or fall 90% after the address signal has risen or fallen past the logic threshold. The 90% transition measurement is utilized to provide the timing of the device. System level timing can then account for the time constant added from the load resistance and load capacitance. Figure 6-4 shows the setup used to measure transition time, denoted by the symbol  $t_{TRANSITION}$ .

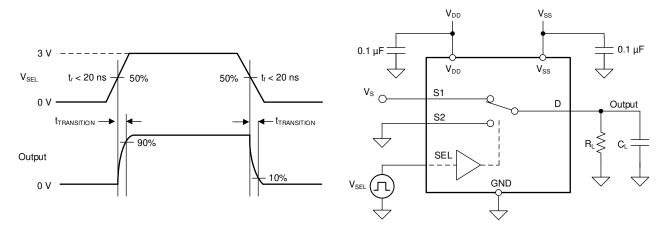


Figure 6-4. Transition-Time Measurement Setup

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## 6.5 t<sub>ON(EN)</sub> and t<sub>OFF(EN)</sub>

Turn-on time is defined as the time taken by the output of the device to rise to 90% after the enable has risen past the logic threshold. The 90% measurement is utilized to provide the timing of the device. System level timing can then account for the time constant added from the load resistance and load capacitance. Figure 6-5 shows the setup used to measure turn-on time, denoted by the symbol  $t_{ON(EN)}$ .

Turn-off time is defined as the time taken by the output of the device to fall to 10% after the enable has fallen past the logic threshold. The 10% measurement is utilized to provide the timing of the device. System level timing can then account for the time constant added from the load resistance and load capacitance. Figure 6-5 shows the setup used to measure turn-off time, denoted by the symbol t<sub>OFF(EN)</sub>.

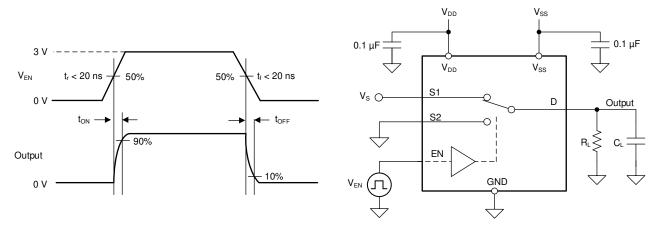


Figure 6-5. Turn-On and Turn-Off Time Measurement Setup

#### 6.6 Break-Before-Make

Break-before-make delay is a safety feature that prevents two inputs from connecting when the device is switching. The output first breaks from the on-state switch before making the connection with the next on-state switch. The time delay between the *break* and the *make* is known as break-before-make delay. Figure 6-6 shows the setup used to measure break-before-make delay, denoted by the symbol t<sub>OPEN(BBM)</sub>.

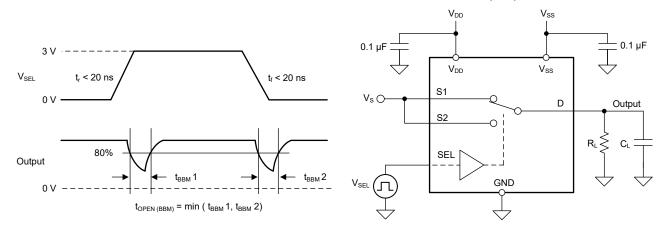


Figure 6-6. Break-Before-Make Delay Measurement Setup

Product Folder Links: TMUX6219

## 6.7 t<sub>ON (VDD)</sub> Time

The  $t_{ON\ (VDD)}$  time is defined as the time taken by the output of the device to rise to 90% after the supply has risen past the supply threshold. The 90% measurement is used to provide the timing of the device turning on in the system. Figure 6-7 shows the setup used to measure turn on time, denoted by the symbol  $t_{ON\ (VDD)}$ .

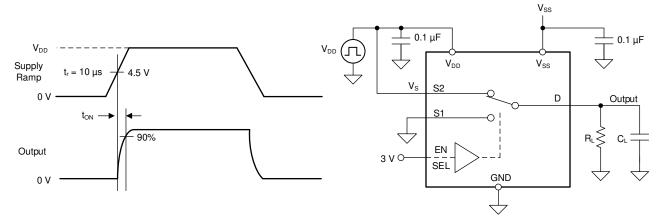


Figure 6-7. t<sub>ON (VDD)</sub> Time Measurement Setup

## 6.8 Propagation Delay

Propagation delay is defined as the time taken by the output of the device to rise or fall 50% after the input signal has risen or fallen past the 50% threshold. Figure 6-8 shows the setup used to measure propagation delay, denoted by the symbol  $t_{PD}$ .

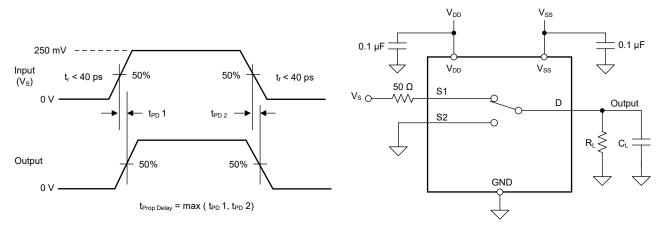


Figure 6-8. Propagation Delay Measurement Setup

### 6.9 Charge Injection

The TMUX6219 has a transmission-gate topology. Any mismatch in capacitance between the NMOS and PMOS transistors results in a charge injected into the drain or source during the falling or rising edge of the gate signal. The amount of charge injected into the source or drain of the device is known as charge injection, and is denoted by the symbol Q<sub>C</sub>. Figure 6-9 shows the setup used to measure charge injection from source (Sx) to drain (D).

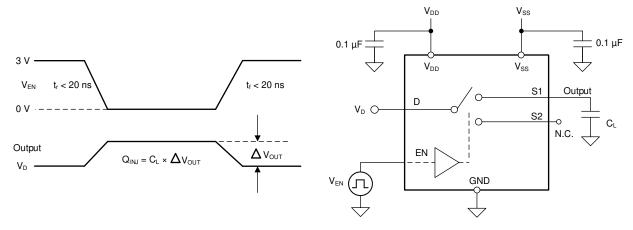


Figure 6-9. Charge-Injection Measurement Setup

#### 6.10 Off Isolation

Off isolation is defined as the ratio of the signal at the drain pin (D) of the device when a signal is applied to the source pin (Sx) of an off-channel. Figure 6-10 shows the setup used to measure, and the equation used to calculate off isolation.

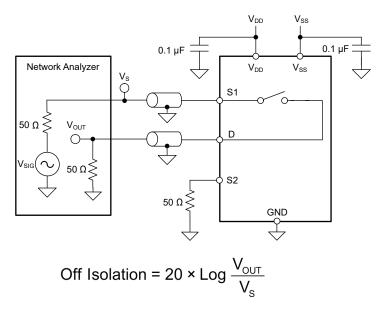


Figure 6-10. Off Isolation Measurement Setup

### 6.11 Crosstalk

Crosstalk is defined as the ratio of the signal at the drain pin (D) of a different channel, when a signal is applied at the source pin (Sx) of an on-channel. Figure 6-11 shows the setup used to measure, and the equation used to calculate crosstalk.

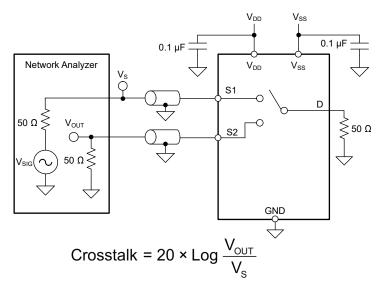


Figure 6-11. Crosstalk Measurement Setup

#### 6.12 Bandwidth

Bandwidth is defined as the range of frequencies that are attenuated by less than 3 dB when the input is applied to the source pin (Sx) of an on-channel, and the output is measured at the drain pin (D) of the device. Figure 6-12 shows the setup used to measure bandwidth.

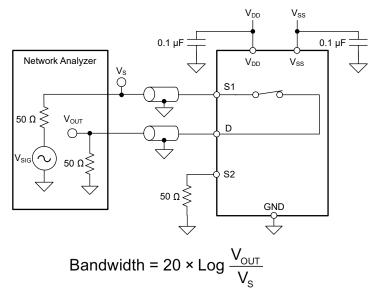


Figure 6-12. Bandwidth Measurement Setup

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#### 6.13 THD + Noise

The total harmonic distortion (THD) of a signal is a measurement of the harmonic distortion, and is defined as the ratio of the sum of the powers of all harmonic components to the power of the fundamental frequency at the mux output.

The on-resistance of the device varies with the amplitude of the input signal and results in distortion when the drain pin is connected to a low-impedance load. Total harmonic distortion plus noise is denoted as THD + N.

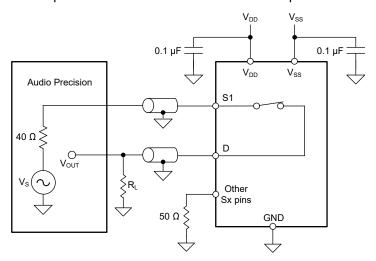


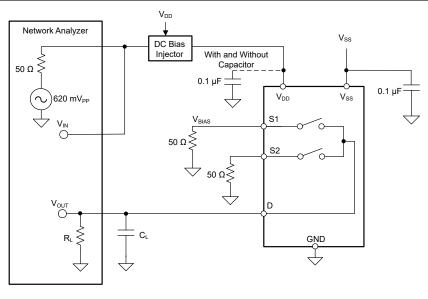
Figure 6-13. THD + N Measurement Setup

## 6.14 Power Supply Rejection Ratio (PSRR)

PSRR measures the ability of a device to prevent noise and spurious signals that appear on the supply voltage pin from coupling to the output of the switch. The DC voltage on the device supply is modulated by a sine wave of 620 mV $_{\rm PP}$ . The ratio of the amplitude of signal on the output to the amplitude of the modulated signal is the ACPSRR. A high ratio represents a high degree of tolerance to supply rail variation.

This helps stabilize the supply and immediately filter as much of the supply noise as possible.





$$PSRR = 20 \times Log \frac{V_{OUT}}{V_{IN}}$$

Figure 6-14. ACPSRR Measurement Setup



## 7 Detailed Description

### 7.1 Overview

The TMUX6219 is a 2:1, 1-channel switch. Each input is turned on or turned off based on the state of the select line and enable pin.

### 7.2 Functional Block Diagram

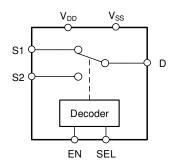


Figure 7-1. TMUX6219 Functional Block Diagram

### 7.3 Feature Description

### 7.3.1 Bidirectional Operation

The TMUX6219 conducts equally well from source (Sx) to drain (D) or from drain (D) to source (Sx). Each channel has very similar characteristics in both directions and supports both analog and digital signals.

### 7.3.2 Rail to Rail Operation

The valid signal path input or output voltage for TMUX6219 ranges from V<sub>SS</sub> to V<sub>DD</sub>.

### 7.3.3 1.8V Logic Compatible Inputs

The TMUX6219 has 1.8-V logic compatible control for all logic control inputs. 1.8-V logic level inputs allows the TMUX6219 to interface with processors that have lower logic I/O rails and eliminates the need for an external translator, which saves both space and BOM cost. For more information on 1.8V logic implementations refer to Simplifying Design with 1.8V logic Muxes and Switches.

### 7.3.4 Fail-Safe Logic

The TMUX6219 supports Fail-Safe Logic on the control input pins (EN and SEL) allowing for operation up to 36V above ground, regardless of the state of the supply pins. This feature allows voltages on the control pins to be applied before the supply pin, protecting the device from potential damage. Fail-Safe Logic minimizes system complexity by removing the need for power supply sequencing on the logic control pins. For example, the Fail-Safe Logic feature allows the logic input pins of the TMUX6219 to be ramped to +36V while  $V_{DD}$  and  $V_{SS}$  = 0V. The logic control inputs are protected against positive faults of up to +36V in powered-off condition, but do not offer protection against negative overvoltage conditions.

### 7.3.5 Latch-Up Immune

Latch-up is a condition where a low impedance path is created between a supply pin and ground. This condition is caused by a trigger (current injection or overvoltage), but once activated, the low impedance path remains even after the trigger is no longer present. This low impedance path may cause system upset or catastrophic damage due to excessive current levels. The latch-up condition typically requires a power cycle to eliminate the low impedance path.

The TMUX62xx family of devices are constructed on Silicon on Insulator (SOI) based process where an oxide layer is added between the PMOS and NMOS transistor of each CMOS switch to prevent parasitic structures from forming. The oxide layer is also known as an insulating trench and prevents triggering of latch up events due to overvoltage or current injections. The latch-up immunity feature allows the TMUX62xx family of switches and multiplexers to be used in harsh environments.

### 7.3.6 Ultra-Low Charge Injection

The TMUX6219 has a transmission gate topology, as shown in Figure 7-2. Any mismatch in the stray capacitance associated with the NMOS and PMOS causes an output level change whenever the switch is opened or closed.

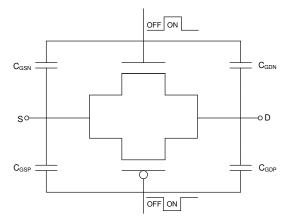


Figure 7-2. Transmission Gate Topology

The TMUX6219 contains specialized architecture to reduce charge injection on the source (Sx). To further reduce charge injection in a sensitive application, a compensation capacitor (Cp) can be added on the drain (D). This will ensure that excess charge from the switch transition will be pushed into the compensation capacitor on the drain (D) instead of the source (Sx). As a general rule, Cp should be 20× larger than the equivalent load capacitance on the source (Sx). Figure 7-3 shows charge injection variation with source voltage with different compensation capacitors on the Drain side.

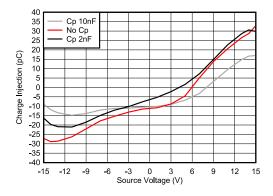


Figure 7-3. Charge Injection Compensation

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### 7.4 Device Functional Modes

When the EN pin of the TMUX6219 is pulled high, one of the switches is closed based on the state of the SEL pin. When the EN pin is pulled low, both of the switches are in an open state regardless of the state of the SEL pin. The control pins can be as high as 36V.

The TMUX6219 can be operated without any external components except for the supply decoupling capacitors. The EN pin has an internal pull-up resistor of 4 M $\Omega$  and SEL pin has internal pull-down resistor of 4 M $\Omega$ . If unused, the EN pin must be tied to V<sub>DD</sub> and SEL pin must be tied to GND to ensure the device does not consume additional current as highlighted in Implications of Slow or Floating CMOS Inputs. Unused signal path inputs (S1, S2, or D) should be connected to GND.

#### 7.5 Truth Tables

Table 7-1 provides the truth tables for the TMUX6219.

Table 7-1. TMUX6219 Truth Table

EN	SEL	Selected Source Connected To Drain (D) Pin		
0	X <sup>(1)</sup>	All sources are off (HI-Z)		
1	0	S1		
1	1	S2		

(1) X denotes do not care.

## 8 Application and Implementation

#### Note

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes, as well as validating and testing their design implementation to confirm system functionality.

## **8.1 Application Information**

TMUX6219 is part of the precision switches and multiplexers family of devices. TMUX6219 offers low RON, low on and off leakage currents and ultra-low charge injection performance. These properties make TMUX6219 ideal for implementing high precision industrial systems requiring selection of one of two inputs or outputs.

### 8.2 Typical Application

### 8.2.1 Power Amplifier Gate Driver

One application of the TMUX6219 is for input control of a power amplifier gate driver. Utilizing a switch allows a system to control when the DAC is connected to the power amplifier and can stop biasing the power amplifier by switching the gate to V<sub>SS</sub>. The wide dual supply range of ±4.5V to ±18V allows the switch to work with GaN power amplifiers, and the wide single supply range 4.5V to 36V works well with LDMOS power amplifiers.

Figure 8-1 shows the TMUX6219 configured for control of the power amplifier gate driver in GaN application.

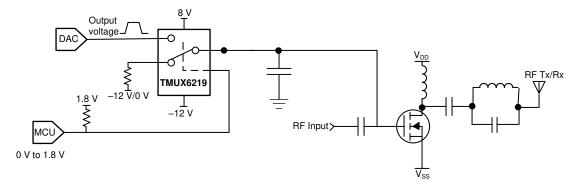


Figure 8-1. Power Amplifier Gate Driver

#### 8.2.2 Design Requirements

For the design example, use the parameters listed in Table 8-1.

Table 8-1. Design Parameters

PARAMETERS	VALUES				
FARAIVIETERS	GAN application	LDMOS application			
Supply (V <sub>DD</sub> )	8V	5V			
Supply (V <sub>SS</sub> )	-12V	0V			
MUX I/O signal range	-12V to 8V (Rail-to-Rail)	0V to 5V (Rail-to-Rail)			
Control logic thresholds	1.8V compatiable (up to V <sub>DD</sub> )	1.8V compatiable (up to V <sub>DD</sub> )			
EN	EN pulled high to enable the switch	EN pulled high to enable the switch			

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### 8.2.3 Detailed Design Procedure

The application shown in Figure 8-1 demonstrates how to toggle between the DAC output and low signal voltage for control of a GaN power amplifier using a single control input. The DAC output is utilized to bias the gate of the power amplifier and can be disconnected from the circuit using the select pin of the switch. The TMUX6219 can support 1.8V logic signals on the control input, allowing the device to interface with low logic controls of an FPGA or MCU. The TMUX6219 can operate without any external components except for the supply decoupling capacitors. The select pin has an internal pull-down resistor to prevent floating input logic. All inputs to the switch must fall within the recommended operating conditions of the TMUX6219 including signal range and continuous current. For this design with a positive supply of 8V on V<sub>DD</sub> and negative supply of −12V on V<sub>SS</sub>, the signal range can be 8V to -12V. The maximum continuous current (I<sub>DC</sub>) can be up to 330mA as shown in the Recommended Operating Conditions table for wide-range current measurement.

### 8.2.4 Application Curve

The low on and off leakage currents of TMUX6219 and ultra-low charge injection performance make this device ideal for implementing high precision industrial systems. Figure 8-2 shows the plot for the charge injection versus source voltage for the TMUX6219.

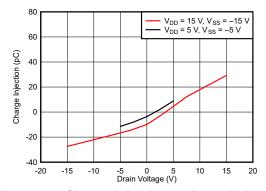


Figure 8-2. Charge Injection vs Drain Voltage

## 9 Power Supply Recommendations

The TMUX6219 operates across a wide supply range of of ±4.5V to ±18V (4.5V to 36V in single-supply mode). As shown in Figure 8-1, the device also performs well with asymmetrical supplies such as  $V_{DD}$  = 5V and  $V_{SS}$  = -8V.

Power-supply bypassing improves noise margin and prevents switching noise propagation from the supply rails to other components. Good power-supply decoupling is important to achieve optimum performance. For improved supply noise immunity, use a supply decoupling capacitor ranging from 0.1  $\mu$ F to 10  $\mu$ F at both the  $V_{DD}$ and V<sub>SS</sub> pins to ground. Place the bypass capacitors as close to the power supply pins of the device as possible using low-impedance connections. TI recommends using multi-layer ceramic chip capacitors (MLCCs) that offer low equivalent series resistance (ESR) and inductance (ESL) characteristics for power-supply decoupling purposes. For very sensitive systems, or for systems in harsh noise environments, avoiding the use of vias for connecting the capacitors to the device pins may offer superior noise immunity. The use of multiple vias in parallel lowers the overall inductance and is beneficial for connections to power and ground planes. Always ensure the ground (GND) connection is established before supplies are ramped.

Product Folder Links: TMUX6219

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## 10 Layout

### 10.1 Layout Guidelines

When a PCB trace turns a corner at a 90° angle, a reflection can occur. A reflection occurs primarily because of the change of width of the trace. At the apex of the turn, the trace width increases to 1.414 times the width. This increase upsets the transmission-line characteristics, especially the distributed capacitance and self–inductance of the trace which results in the reflection. Not all PCB traces can be straight and therefore some traces must turn corners. Figure 10-1 shows progressively better techniques of rounding corners. Only the last example (BEST) maintains constant trace width and minimizes reflections.

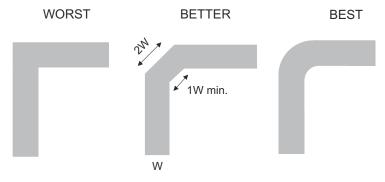


Figure 10-1. Trace Example

Route high-speed signals using a minimum of vias and corners which reduces signal reflections and impedance changes. When a via must be used, increase the clearance size around it to minimize its capacitance. Each via introduces discontinuities in the signal's transmission line and increases the chance of picking up interference from the other layers of the board. Be careful when designing test points, through-hole pins are not recommended at high frequencies.

Figure 10-2 shows an example of a PCB layout with the TMUX6219. Some key considerations are as follows:

- Decouple the supply pins with a 0.1µF and 1µF capacitor, and place the lowest value capacitor as close to the pin as possible. Make sure that the capacitor voltage rating is sufficient for the supply voltage.
- Keep the input lines as short as possible.
- Use a solid ground plane to help reduce electromagnetic interference (EMI) noise pickup.
- Do not run sensitive analog traces in parallel with digital traces. Avoid crossing digital and analog traces if possible, and only make perpendicular crossings when necessary.
- Using multiple vias in parallel will lower the overall inductance and is beneficial for connection to ground planes.

### 10.2 Layout Example

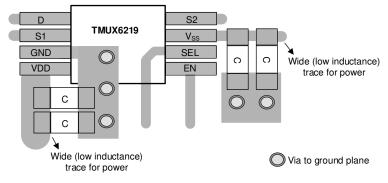


Figure 10-2. TMUX6219 DGK Layout Example

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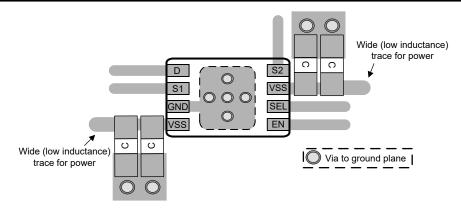


Figure 10-3. TMUX6219 RQX Layout Example



# 11 Device and Documentation Support

## 11.1 Documentation Support

#### 11.1.1 Related Documentation

For related documentation, see the following:

- Texas Instruments, Improve Stability Issues with Low CON Multiplexers application brief
- Texas Instruments, Improving Signal Measurement Accuracy in Automated Test Equipment application brief
- Texas Instruments, Multiplexers and Signal Switches Glossary application report
- Texas Instruments, QFN/SON PCB Attachment application report
- Texas Instruments, Quad Flatpack No-Lead Logic Packages application report
- Texas Instruments, Simplifying Design with 1.8V logic Muxes and Switches application brief
- Texas Instruments, System-Level Protection for High-Voltage Analog Multiplexers application report
- Texas Instruments, True Differential, 4 x 2 MUX, Analog Front End, Simultaneous-Sampling ADC Circuit
  application report

## 11.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. In the upper right corner, click on *Alert me* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

# 11.3 Support Resources

TI E2E<sup>™</sup> support forums are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

Linked content is provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's Terms of Use.

#### 11.4 Trademarks

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## 11.5 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

#### 11.6 Glossary

TI Glossary

This glossary lists and explains terms, acronyms, and definitions.

## 12 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision D (July 2022) to Revision E (July 2024)	Page
Changed IIH max specification	6
Changes from Revision C (June 2022) to Revision D (July 2022)	Page
Changed the status of the RQX package from: preview to: active	1
<ul> <li>Added +5 V / -8 V electrical and switching characteristics tables</li> </ul>	40

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Changes from Revision B (January 2021) to Revision C (June 2022)					
Added the RQX package details to the Pin Configuration and Functions section	3				
Changes from Revision A (October 2020) to Revision B (January 2021)	Page				
Changed the document status From: Advanced Information To: Production Data	1				

# 13 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

Product Folder Links: TMUX6219

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#### PACKAGING INFORMATION

Orderable part number	Status	Material type	Package   Pins	Package qty   Carrier	RoHS	Lead finish/	MSL rating/	Op temp (°C)	Part marking
	(1)	(2)			(3)	Ball material	Peak reflow		(6)
						(4)	(5)		
TMUX6219DGKR	Active	Production	VSSOP (DGK)   8	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	X219
TMUX6219DGKR.B	Active	Production	VSSOP (DGK)   8	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	X219
TMUX6219DGKRG4	Active	Production	VSSOP (DGK)   8	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	X219
TMUX6219DGKRG4.B	Active	Production	VSSOP (DGK)   8	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	X219
TMUX6219RQXR	Active	Production	WSON (RQX)   8	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	H219
TMUX6219RQXR.B	Active	Production	WSON (RQX)   8	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	H219

<sup>(1)</sup> Status: For more details on status, see our product life cycle.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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<sup>(3)</sup> RoHS values: Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

<sup>(4)</sup> Lead finish/Ball material: Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

<sup>(5)</sup> MSL rating/Peak reflow: The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

<sup>(6)</sup> Part marking: There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

# PACKAGE OPTION ADDENDUM

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#### OTHER QUALIFIED VERSIONS OF TMUX6219:

Automotive : TMUX6219-Q1

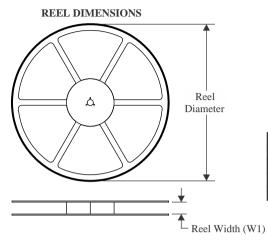
NOTE: Qualified Version Definitions:

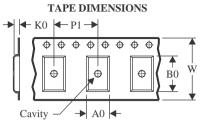
• Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

# **PACKAGE MATERIALS INFORMATION**

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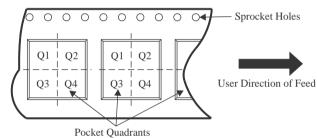
## TAPE AND REEL INFORMATION





A0	Dimension designed to accommodate the component width
В0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

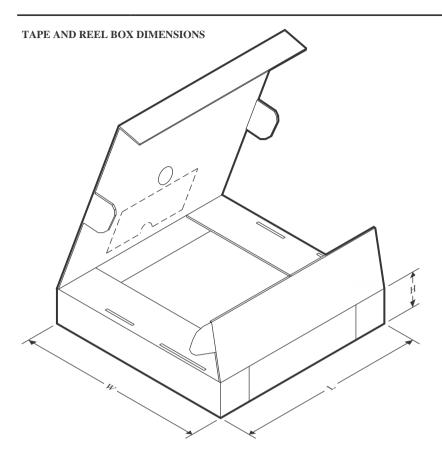
## QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



#### \*All dimensions are nominal

Device	Package Type	Package Drawing		SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TMUX6219DGKR	VSSOP	DGK	8	2500	330.0	12.4	5.25	3.35	1.25	8.0	12.0	Q1
TMUX6219DGKRG4	VSSOP	DGK	8	2500	330.0	12.4	5.25	3.35	1.25	8.0	12.0	Q1

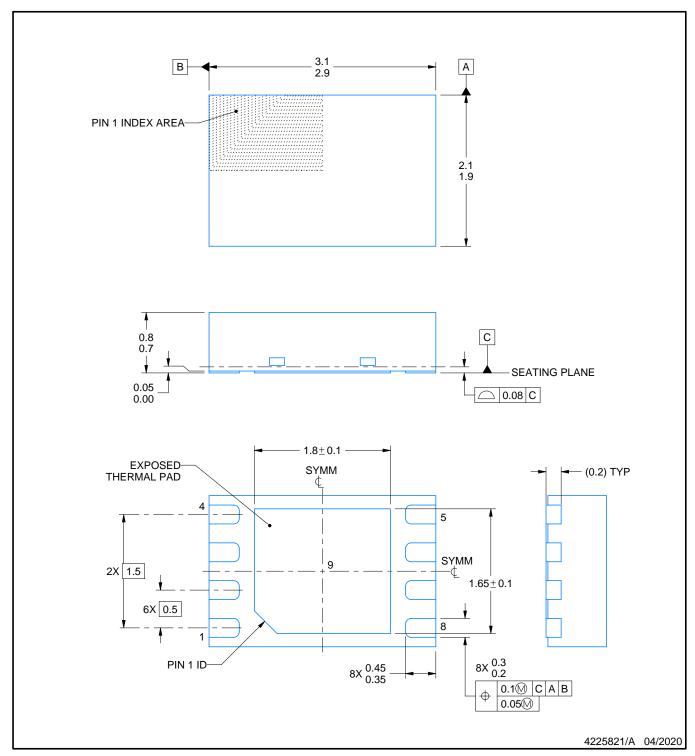
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## \*All dimensions are nominal

	Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TMUX	(6219DGKR	VSSOP	DGK	8	2500	366.0	364.0	50.0
TMUX6	219DGKRG4	VSSOP	DGK	8	2500	366.0	364.0	50.0

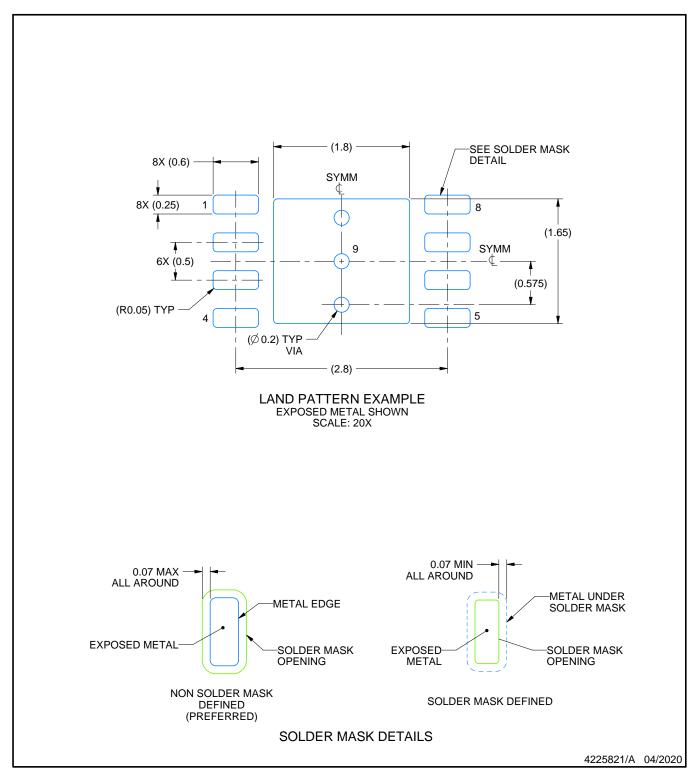




## NOTES:

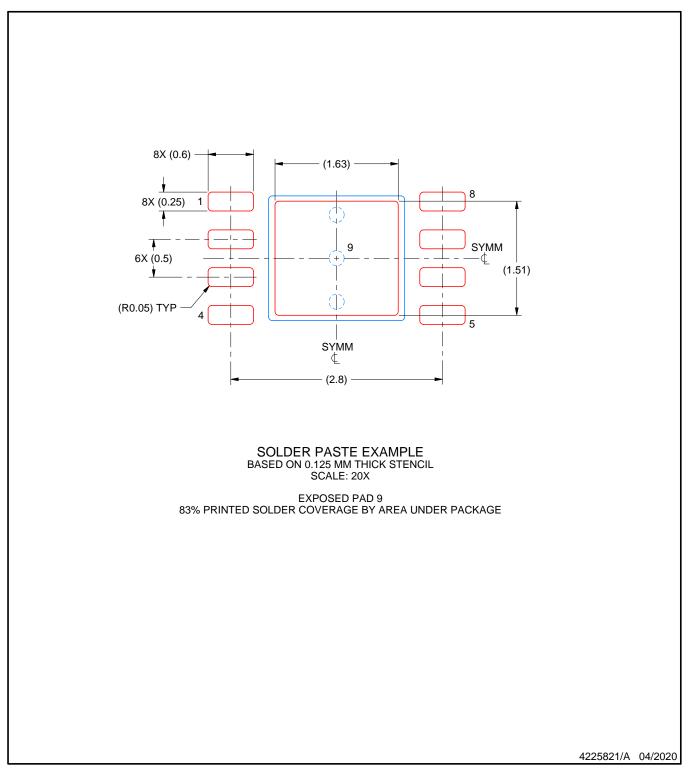
- 1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
  2. This drawing is subject to change without notice.
- 3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.





- 4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).
- 5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.



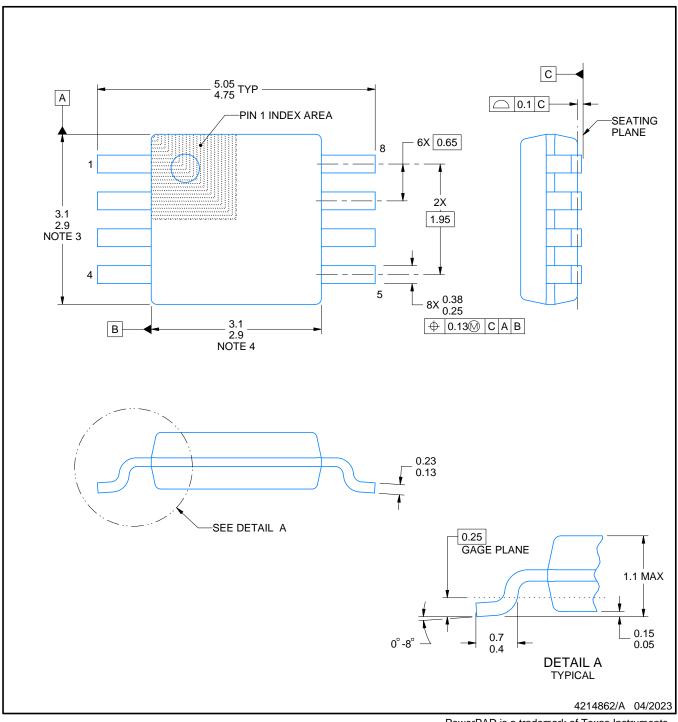


<sup>6.</sup> Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.





SMALL OUTLINE PACKAGE



## NOTES:

PowerPAD is a trademark of Texas Instruments.

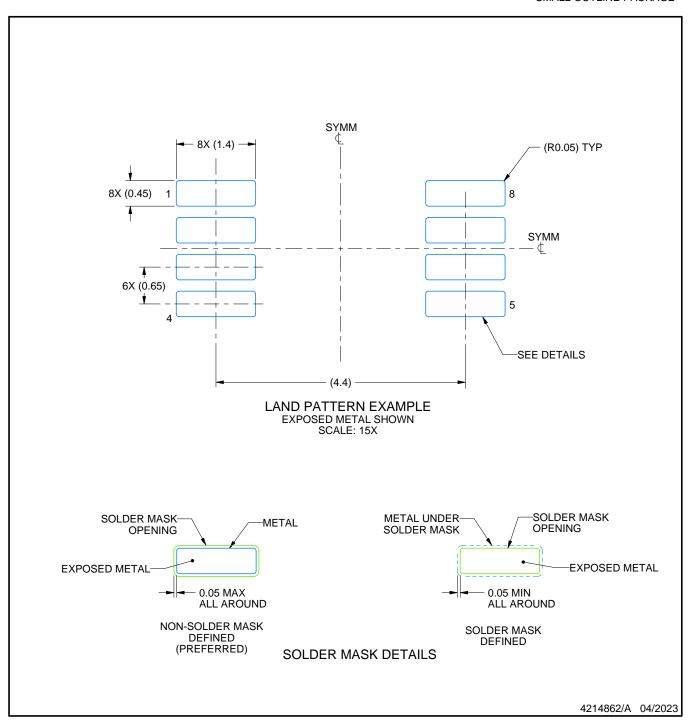
- 1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.

  2. This drawing is subject to change without notice.

  3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not
- exceed 0.15 mm per side.
- 4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
- 5. Reference JEDEC registration MO-187.



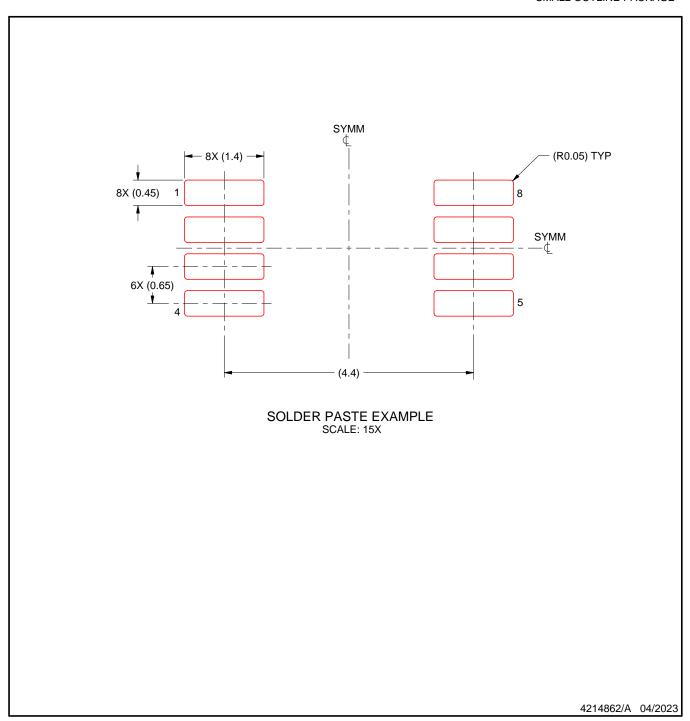
SMALL OUTLINE PACKAGE



- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
- 8. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.
- 9. Size of metal pad may vary due to creepage requirement.



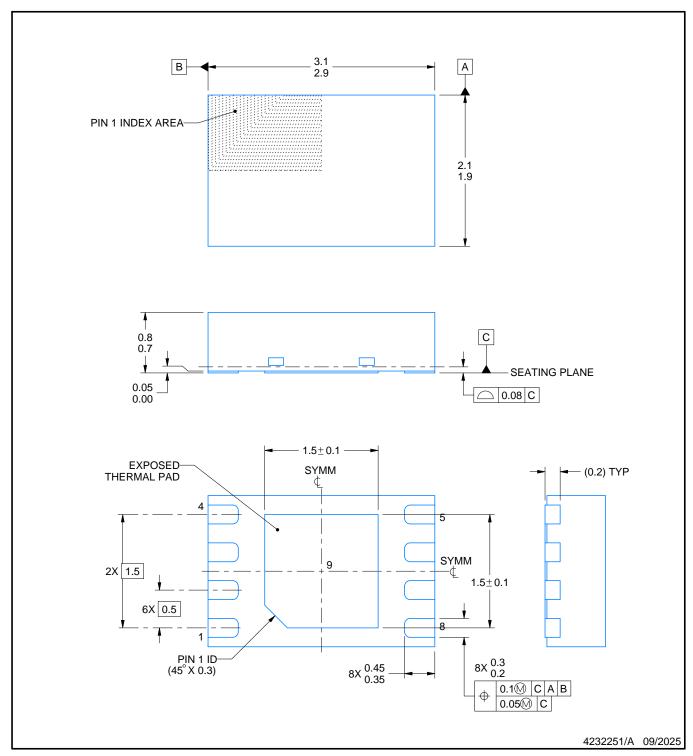
SMALL OUTLINE PACKAGE



- 11. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
- 12. Board assembly site may have different recommendations for stencil design.



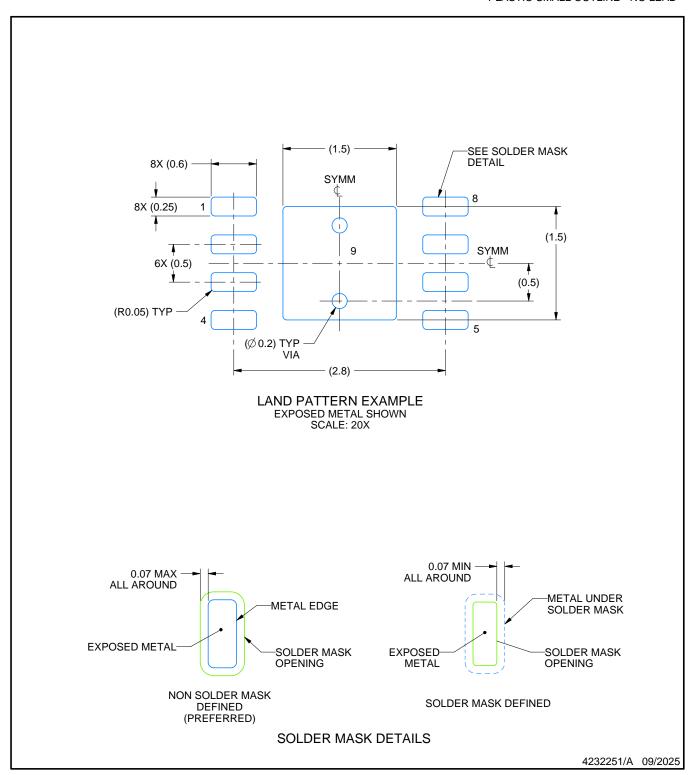




## NOTES:

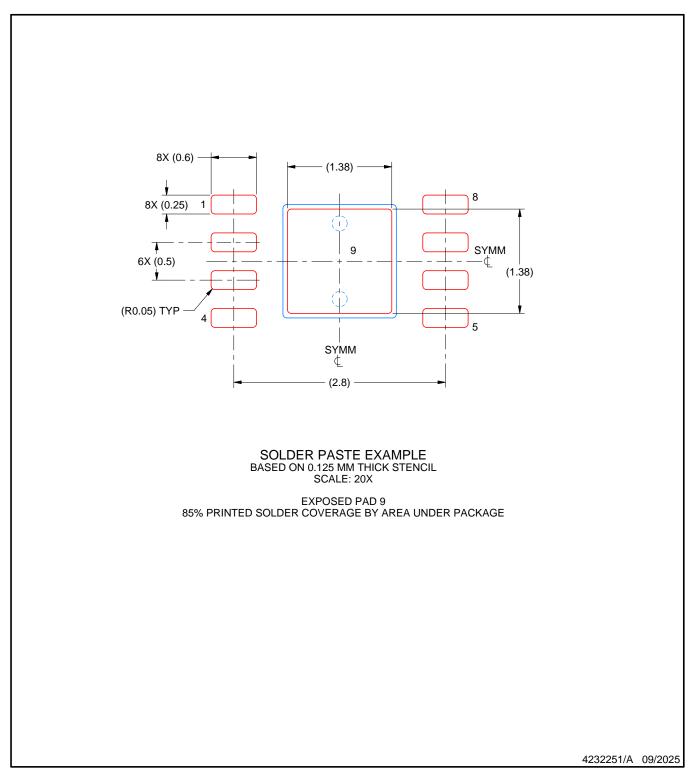
- 1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
  2. This drawing is subject to change without notice.
- 3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.





- 4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).
- 5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.





NOTES: (continued)

6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.



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