









TMUX6201, TMUX6202 SCDS450B - NOVEMBER 2022 - REVISED SEPTEMBER 2024

TMUX620x 36V, Low-RON, 1:1 (SPST), 1-Channel Precision Switch With 1.8V Logic

1 Features

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

Low on-resistance: 1.2Ω Low charge injection: -10pC

-40°C to +125°C operating temperature

Integrated Pull-Down resistor on logic pins

1.8V logic compatible

Fail-safe logic

Rail-to-rail operation

Bidirectional signal path

Break-before-make switching

2 Applications

Optical networking

Optical test equipment

Wired networking

Factory automation and industrial controls

Programmable logic controllers (PLC)

Semiconductor test

Ultrasound scanners

Patient monitoring and diagnostics

Remote radio units

Data acquisition systems

3 Description

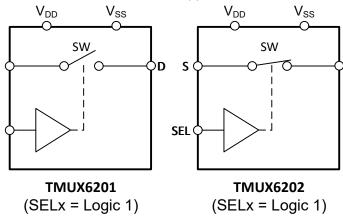
The TMUX620x is a complementary metal-oxide semiconductor (CMOS) in a single channel, 1:1 (SPST) configuration. The device works with a single supply (4.5V to 36V), dual supplies (±4.5V to ±18V), or asymmetric supplies (such as V_{DD} = 12V, V_{SS} = -5V). The TMUX620x supports bidirectional analog and digital signals on the source (S) and drain (D) pin ranging from V_{SS} to V_{DD}.

The TMUX620x can be enabled or disabled by controlling the SEL pin. When disabled, both signal path switches are off. All logic control inputs support logic levels from 1.8V to V_{DD}, which is compatible for both TTL and CMOS logic 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.

Package Information

PART NUMBER ⁽¹⁾	Active Logic	PACKAGE ⁽²⁾		
TMUX6201	Active Low	DGK (VSSOP, 8)		
TMUX6202	Active High	RQX (WQFN, 8)		

- See the Device Comparison Table.
- For more information, see Section 12.



Block Diagram



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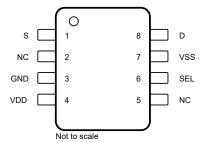
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4 Device Comparison Table

PRODUCT	DESCRIPTION
TMUX6201	1:1, 1-Ch. multiplexer, active Low
TMUX6202	1:1, 1-Ch. multiplexer, active High

5 Pin Configuration and Functions



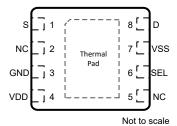


Figure 5-2. RQX Package, 8-Pin WSON (Top View)

Figure 5-1. DGK Package, 8-Pin VSSOP (Top View)

Table 5-1. Pin Functions

	PIN		TYPE ⁽¹⁾	DESCRIPTION(2)
NAME	DGK	RQX	ITPE	DESCRIPTION ⁽²⁾
S	1	1	I/O	Source pin. Can be an input or output.
NC	2	2	NC	No connection. Not internally connected.
GND	3	3	Р	Ground (0 V) reference
		Positive power supply. This pin is the most positive power-supply potential. For reliable operation, connect a decoupling capacitor ranging from 0.1 μF to 10 μF between V_{DD} and GND.		
NC	5	5	NC	No connection. Not internally connected.
SEL	6	6	I	Logic control input, has internal Pull-Down resistor. For information about the switch connection controls, see Section 8.5.
V _{SS} 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 0.1 μ F to 10 μ F between V _{SS} and GND.
D	8	8	I/O	Drain pin. Can be an input or output.
Thermal Pa	ıd		_	The thermal pad is not connected internally. No requirement to solder this pad, if connected it is recommended that the pad be left floating or tied to GND

- (1) I = input, O = output, I/O = input or output, P = power, NC = no connection.
- (2) For what to do with unused pins, refer to Section 8.4.

6 Specifications

6.1 Absolute Maximum Ratings

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

		MIN	MAX	UNIT
V _{DD} – V _{SS}			38	V
V_{DD}	Supply voltage	-0.5	38	V
V _{SS}		-38	0.5	V
V _{SEL} or V _{EN}	Logic control input pin voltage (SELx)	-0.5	38	V
I _{SEL} or I _{EN}	Logic control input pin current (SELx)	-30	30	mA
V _S or V _D	Source or drain voltage (Sx, Dx)	V _{SS} -0.5	V _{DD} +0.5	V
I _{IK}	Diode clamp current ⁽³⁾	-30	30	mA
I _S or I _{D (CONT)}	Source or drain continuous current (Sx, Dx)		I _{DC} + 10 % ⁽⁴⁾	mA
T _A	Ambient temperature	-55	150	°C
T _{stg}	Storage temperature	-65	150	°C
T _J	Junction temperature		150	°C

⁽¹⁾ Operation outside the Absolute Maximum Ratings may cause permanent device damage. Absolute Maximum Ratings do not imply functional operation of the device at these or any other conditions beyond those listed under Absolute Maximum Ratings. If used outside the Absolute Maximum Ratings but within the Absolute Maximum Ratings, the device may not be fully functional, and this may affect device reliability, functionality, performance, and shorten the device lifetime.

- (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_{DC} specifications.

6.2 ESD Ratings

			VALUE	UNIT			
TMUX620x	MUX620x						
V	Human body model (HBM), per ANSI/ESDA/ JEDEC JS-001, all pins ⁽¹⁾		±2000	V			
V _(ESD)		Charged device model (CDM), per ANSI/ESDA/ JEDEC JS-002, all pins ⁽²⁾	±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.

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6.3 Thermal Information

		TMU	TMUX620x			
	THERMAL METRIC ⁽¹⁾	DGK (VSSOP)	RQX (WQFN)	UNIT		
		8 PINS	8 PINS			
R _{0JA}	Junction-to-ambient thermal resistance	152.1	62.9	°C/W		
R _{0JC(top)}	Junction-to-case (top) thermal resistance	48.4	54.0	°C/W		
R _{0JB}	Junction-to-board thermal resistance	73.2	31.0	°C/W		
Ψ_{JT}	Junction-to-top characterization parameter	4.1	0.8	°C/W		
Ψ_{JB}	Junction-to-board characterization parameter	71.8	30.9	°C/W		
R _{0JC(bot)}	Junction-to-case (bottom) thermal resistance	N/A	23.4	°C/W		

⁽¹⁾ For more information about traditional and new thermal metrics, see the Semiconductor and IC Package Thermal Metrics application report.

6.4 Recommended Operating Conditions

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

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

 V_{DD} and V_{SS} can be any value as long as 4.5 V \leq ($V_{DD} - V_{SS}$) \leq 44 V, and the minimum V_{DD} is met. Refer to *Source or Drain Continuous Current* table for I_{DC} specifications.

6.5 Source or Drain Continuous Current

at supply voltage of V_{DD} ± 10%, V_{SS} ± 10 % (unless otherwise noted)

CONTINU	IOUS CURRENT PER CHANNEL (I _{DC}) (2)	T _Δ = 25°C	T _A = 85°C	T _A = 125°C	UNIT
PACKAGE	CONTINUOUS CURRENT PER CHANNEL (I _{DC}) (2) PACKAGE TEST CONDITIONS +36 V Dual Supply(1) ±15 V Dual Supply +12 V Single Supply ±5 V Dual Supply +36 V Single Supply(1)	1A - 25 C	1A - 65 C	1A - 125 C	UNIT
	+36 V Dual Supply ⁽¹⁾	420	260	130	mA
DSK (VSSOB)	±15 V Dual Supply	420	260	130	mA
DSK (V330F)	+12 V Single Supply	330	210	125	mA
	±5 V Dual Supply	300	200	120	mA
	+36 V Single Supply ⁽¹⁾	600	340	150	mA
RQX (WQFN)	±15 V Dual Supply	600	340	150	mA
INQX (VVQFIV)	+12 V Single Supply	500	300	145	mA
	±5 V Dual Supply	450	265	135	mA

Specified for nominal supply voltage only.

Refer to Total power dissipation (Ptot) limits in Absolute Maximum Ratings table that must be followed with max continuous current specification.



6.6 ±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 _A	MIN	TYP	MAX	UNIT
ANALOG	SWITCH						
			25°C		1.2	1.7	Ω
R _{ON}	On-resistance	$V_S = -10 \text{ V to } +10 \text{ V}$ $I_D = -10 \text{ mA}$	-40°C to +85°C			2	Ω
		10 - 10 MA	-40°C to +125°C			2.5	Ω
			25°C		0.3	0.5	Ω
R _{ON FLAT}	On-resistance flatness	$V_S = -10 \text{ V to } +10 \text{ V}$ $I_D = -10 \text{ mA}$	-40°C to +85°C			0.7	Ω
		10 10 MA	-40°C to +125°C			0.8	Ω
R _{ON DRIFT}	On-resistance drift	$V_S = 0 \text{ V}, I_S = -10 \text{ mA}$	-40°C to +125°C		0.01		Ω/°C
		V _{DD} = 16.5 V, V _{SS} = -16.5 V	25°C	-0.3	0.05	0.3	nA
I _{S(OFF)}	Source off leakage current ⁽¹⁾	Switch state is off V _S = +10 V / -10 V	-40°C to +85°C	-3.4		3.4	nA
		$V_D = -10 \text{ V} / + 10 \text{ V}$	-40°C to +125°C	-33		33	nA
		V _{DD} = 16.5 V, V _{SS} = -16.5 V	25°C	-0.3	0.05	0.3	nA
I _{D(OFF)}	Drain off leakage current ⁽¹⁾	Switch state is off V _S = +10 V / -10 V	-40°C to +85°C	-3.4		3.4	nA
, ,		$V_S = +10 \text{ V} / -10 \text{ V}$ $V_D = -10 \text{ V} / + 10 \text{ V}$	-40°C to +125°C	-33		33	nA
		V _{DD} = 16.5 V, V _{SS} = -16.5 V	25°C	-0.65	0.05	0.65	nA
I _{S(ON)}	Channel on leakage current ⁽²⁾	Switch state is on	-40°C to +85°C	-2		2	nA
Is(ON) ID(ON) CI LOGIC INPU V _{IH} LC		$V_S = V_D = \pm 10 \text{ V}$	-40°C to +125°C	-16		16	nA
LOGIC IN	PUTS (SEL / EN pins)						
V _{IH}	Logic voltage high		-40°C to +125°C	1.3		36	V
V _{IL}	Logic voltage low		-40°C to +125°C	0		0.8	V
I _{IH}	Input leakage current		-40°C to +125°C		0.4	2.2	μΑ
I _{IL}	Input leakage current		-40°C to +125°C	-0.1	-0.005		μΑ
C _{IN}	Logic input capacitance		-40°C to +125°C		3.5		pF
POWER S	SUPPLY		1				
			25°C		30	45	μΑ
I_{DD}	V _{DD} 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			50	μΑ
		Logic inputs – 0 v, 5 v, oi v _{DD}	-40°C to +125°C			55	μΑ
			25°C		7	12	μA
I _{SS}	V _{SS} 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			15	μΑ
		Logic iliputs – 0 v, 5 v, oi v _{DD}	-40°C to +125°C		-	17	μA

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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.

6.7 ±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 _A	MIN	TYP	MAX	UNIT
			25°C		120	140	ns
t _{ON}	Turn-on time from control input	$V_S = 10 \text{ V}$ $R_I = 300 \Omega, C_I = 35 \text{ pF}$	-40°C to +85°C			155	ns
		11, 000 11, 01 00 pi	-40°C to +125°C			140	ns
			25°C		130	150	ns
t _{OFF}	Turn-off time from control input	$V_S = 10 \text{ V}$ $R_1 = 300 \Omega, C_1 = 35 \text{ pF}$	-40°C to +85°C			160	ns
			-40°C to +125°C			190	ns
t _{ON (VDD)}	Device turn on time (V _{DD} to output)	V_{DD} rise time = 1 μ s R_L = 300 Ω , C_L = 35 pF	-40°C to +125°C		0.2		ms
t _{PD}	Propagation delay	$R_L = 50 \Omega$, $C_L = 5 pF$	25°C		450		ps
Q _{INJ}	Charge injection	V _S = 0 V, C _L = 100 pF	25°C		-15		рС
O _{ISO}	Off-isolation	$R_L = 50 \Omega$, $C_L = 5 pF$ $V_S = 0 V$, $f = 100 kHz$	25°C		-70		dB
O _{ISO}	Off-isolation	$R_L = 50 \Omega$, $C_L = 5 pF$ $V_S = 0 V$, $f = 1 MHz$	25°C		-46		dB
BW	–3 dB Bandwidth	R_L = 50 Ω , C_L = 5 pF V_S = 0 V	25°C		22		MHz
IL	Insertion loss	R_L = 50 Ω , C_L = 5 pF V_S = 0 V, f = 1 MHz	25°C		-0.11		dB
ACPSRR	AC Power Supply Rejection Ratio	V_{PP} = 0.62 V on V_{DD} and V_{SS} R_L = 50 Ω , C_L = 5 pF, f = 1 MHz	25°C		-40		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	25°C		0.0007		%
C _{S(OFF)}	Source off capacitance	V _S = 0 V, f = 1 MHz	25°C		45		pF
C _{D(OFF)}	Drain off capacitance	V _S = 0 V, f = 1 MHz	25°C		65		pF
C _{S(ON),} C _{D(ON)}	On capacitance	V _S = 0 V, f = 1 MHz	25°C		240		pF

6.8 36 V Single Supply: Electrical Characteristics

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

PARAMETER		TEST CONDITIONS	T _A	MIN	TYP	MAX	UNIT
ANALOG	SWITCH						
			25°C		1.35	1.8	Ω
R _{ON}	On-resistance	$V_S = 0 \text{ V to } 30 \text{ V}$ $I_D = -10 \text{ mA}$	-40°C to +85°C			2.2	Ω
		10 - 10 mA	-40°C to +125°C			2.6	Ω
			25°C		0.3	0.9	Ω
R _{ON FLAT}	On-resistance flatness	$V_S = 0 \text{ V to } 30 \text{ V}$ $I_S = -10 \text{ mA}$	-40°C to +85°C			1.2	Ω
		is – To find	-40°C to +125°C			1.3	Ω
R _{ON DRIFT}	On-resistance drift	V _S = 18 V, I _S = -10 mA	-40°C to +125°C		0.009		Ω/°C
		V _{DD} = 39.6 V, V _{SS} = 0 V	25°C	-0.65	0.05	0.65	nA
I _{S(OFF)}	Source off leakage current ⁽¹⁾	Switch state is off V _S = 30 V / 1 V	-40°C to +85°C	-7		7	nA
, ,		$V_D = 1 \text{ V} / 30 \text{ V}$	-40°C to +125°C	-55		55	nA
I _{D(OFF)}	Drain off leakage current ⁽¹⁾	$V_{DD} = 39.6 \text{ V}, V_{SS} = 0 \text{ V}$ Switch state is off $V_{S} = 30 \text{ V} / 1 \text{ V}$	25°C	-0.65	0.05	0.65	nA
			-40°C to +85°C	-7		7	nA
		$V_{D} = 1 \text{ V} / 30 \text{ V}$	-40°C to +125°C	-55		55	nA
	Channel on leakage current ⁽²⁾	V_{DD} = 39.6 V, V_{SS} = 0 V Switch state is on V_{S} = V_{D} = 30 V or 1 V	25°C	-0.85	0.05	0.85	nA
I _{S(ON)}			-40°C to +85°C	-4		4	nA
I _{D(ON)}			-40°C to +125°C	-55		55	nA
LOGIC IN	IPUTS (SEL / EN pins)			-			
V _{IH}	Logic voltage high		-40°C to +125°C	1.3		36	V
V _{IL}	Logic voltage low		-40°C to +125°C	0		0.8	V
I _{IH}	Input leakage current		-40°C to +125°C		0.4	2.2	μA
I _{IL}	Input leakage current		-40°C to +125°C	-0.1	-0.005		μA
C _{IN}	Logic input capacitance		-40°C to +125°C		3.5		pF
POWER S	SUPPLY	·		•		'	
		.,	25°C		30	53	μA
I_{DD}	V _{DD} 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			60	μA
			-40°C to +125°C			64	μA

⁽¹⁾ When V_S is positive, V_D is negative, or when V_S is negative, V_D is positive.

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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.

6.9 36 V Single Supply: Switching Characteristics

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

PARAMETER		TEST CONDITIONS	T _A	MIN	TYP	MAX	UNIT
			25°C		105	140	ns
t _{ON}	Turn-on time from control input	$V_S = 18 \text{ V}$ $R_1 = 300 \Omega, C_1 = 35 \text{ pF}$	–40°C to +85°C			150	ns
		11t_ 000 12, 0t_ 00 pi	–40°C to +125°C			180	ns
			25°C		125	150	ns
t _{OFF}	Turn-off time from control input	$V_S = 18 \text{ V}$ $R_1 = 300 \Omega, C_1 = 35 \text{ pF}$	–40°C to +85°C			160	ns
		1.1 000 11, 0[00 p.	-40°C to +125°C			180	ns
			25°C		0.17		ms
t _{ON (VDD)}	Device turn on time (V _{DD} to output)	V_{DD} rise time = 1 μs R_L = 300 Ω, C_L = 35 pF	–40°C to +85°C		0.19		ms
	(VDD to output)	11t_ 000 12, 0t_ 00 pi	-40°C to +125°C		0.19		ms
t _{PD}	Propagation delay	$R_L = 50 \Omega$, $C_L = 5 pF$	25°C		1000		ps
Q _{INJ}	Charge injection	V _S = 18 V, C _L = 100 pF	25°C	-18			рC
O _{ISO}	Off-isolation	$R_L = 50 \Omega$, $C_L = 5 pF$ $V_S = 6 V$, $f = 100 kHz$	25°C		-66		dB
O _{ISO}	Off-isolation	$R_L = 50 \Omega$, $C_L = 5 pF$ $V_S = 6 V$, $f = 1 MHz$	25°C		-46		dB
BW	–3 dB Bandwidth	$R_L = 50 \Omega$, $C_L = 5 pF$ $V_S = 6 V$	25°C		22		MHz
IL	Insertion loss	$R_L = 50 \Omega$, $C_L = 5 pF$ $V_S = 6 V$, $f = 1 MHz$	25°C		-0.11		dB
ACPSRR	AC Power Supply Rejection Ratio	V_{PP} = 0.62 V on V_{DD} and V_{SS} R_L = 50 Ω , C_L = 5 pF, f = 1 MHz	25°C	-63			dB
THD+N	Total Harmonic Distortion + Noise	V_{PP} = 18 V, V_{BIAS} = 18 V R_{L} = 10 k Ω , C_{L} = 5 pF, f = 20 Hz to 20 kHz	25°C	0.0007			%
C _{S(OFF)}	Source off capacitance	V _S = 18 V, f = 1 MHz	25°C		45		pF
C _{D(OFF)}	Drain off capacitance	V _S = 18 V, f = 1 MHz	25°C		68		pF
C _{S(ON),} C _{D(ON)}	On capacitance	V _S = 18 V, f = 1 MHz	25°C		240		pF

6.10 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)

PARAMETER		TEST CONDITIONS	T _A	MIN	TYP	MAX	UNIT
ANALOG	SWITCH		<u> </u>				
			25°C		2.1	3.2	Ω
R _{ON}	On-resistance	$V_S = 0 \text{ V to } 10 \text{ V}$ $I_D = -10 \text{ mA}$	-40°C to +85°C			3.8	Ω
		ID TO TILA	-40°C to +125°C			4.2	Ω
			25°C		0.5	1.2	Ω
R _{ON FLAT}	On-resistance flatness	$V_S = 0 \text{ V to } 10 \text{ V}$ $I_S = -10 \text{ mA}$	-40°C to +85°C			1.4	Ω
		15 10 11/10	-40°C to +125°C			1.6	Ω
R _{ON DRIFT}	On-resistance drift	$V_S = 6 \text{ V}, I_S = -10 \text{ mA}$	-40°C to +125°C		0.017		Ω/°C
		V _{DD} = 13.2 V, V _{SS} = 0 V	25°C	-0.4	0.05	0.4	nA
I _{S(OFF)}	Source off leakage current ⁽¹⁾	Switch state is off V _S = 10 V / 1 V	-40°C to +85°C	-3		3	nA
		$V_D = 1 \text{ V } / 10 \text{ V}$	-40°C to +125°C	-25		25	nA
I _{D(OFF)}	Drain off leakage current ⁽¹⁾	V _{DD} = 13.2 V, V _{SS} = 0 V Switch state is off V _S = 10 V / 1 V	25°C	-0.4	0.05	0.4	nA
			-40°C to +85°C	-3		3	nA
		$V_{\rm D} = 10 \text{ V} / 10 \text{ V}$	-40°C to +125°C	-25		25	nA
	Channel on leakage current ⁽²⁾	V_{DD} = 13.2 V, V_{SS} = 0 V Switch state is on V_{S} = V_{D} = 10 V or 1 V	25°C	-0.65	0.05	0.65	nA
I _{S(ON)}			-40°C to +85°C	-2		2	nA
I _{D(ON)}			-40°C to +125°C	-12		12	nA
LOGIC IN	PUTS (SEL / EN pins)						
V _{IH}	Logic voltage high		-40°C to +125°C	1.3		36	V
V _{IL}	Logic voltage low		-40°C to +125°C	0		0.8	V
I _{IH}	Input leakage current		-40°C to +125°C		0.4	2.2	μA
I _{IL}	Input leakage current		-40°C to +125°C	-0.1	-0.005		μA
C _{IN}	Logic input capacitance		-40°C to +125°C		3.5		pF
POWER S	SUPPLY	·				'	
		., ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	25°C		27	35	μA
I_{DD}	V _{DD} 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			40	μA
			-40°C to +125°C			45	μA

⁽¹⁾ When V_S is positive, V_D is negative, or when V_S is negative, V_D is positive.

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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.



6.11 12 V Single Supply: Switching Characteristics

 $\begin{aligned} &V_{DD} = +12 \text{ V} \pm 10\%, \text{ V}_{SS} = 0 \text{ V}, \text{ GND} = 0 \text{ V} \text{ (unless otherwise noted)} \\ &\text{Typical at V}_{DD} = +12 \text{ V}, \text{ V}_{SS} = 0 \text{ V}, \text{ T}_{A} = 25^{\circ}\text{C} \text{ (unless otherwise noted)} \end{aligned}$

	PARAMETER	TEST CONDITIONS	T _A	MIN	TYP	MAX	UNIT
			25°C		125	145	ns
t _{ON}	Turn-on time from control input	$V_S = 8 V$ $R_1 = 300 \Omega, C_1 = 35 pF$	–40°C to +85°C			160	ns
		11t_ 000 12, 0t_ 00 pi	-40°C to +125°C			180	ns
			25°C		150	180	ns
t _{OFF}	Turn-off time from control input	$V_S = 8 V$ $R_1 = 300 \Omega, C_1 = 35 pF$	-40°C to +85°C			205	ns
		1.1 000 11, 0[00 p.	-40°C to +125°C			220	ns
t _{ON (VDD)}	Device turn on time (V _{DD} to output)	V_{DD} rise time = 1 μ s R_L = 300 Ω , C_L = 35 pF	-40°C to +125°C		0.2		
t _{PD}	Propagation delay	$R_L = 50 \Omega$, $C_L = 5 pF$	25°C		1000		ps
Q _{INJ}	Charge injection	V _S = 6 V, C _L = 100 pF	25°C		-4		рС
O _{ISO}	Off-isolation	$R_L = 50 \Omega$, $C_L = 5 pF$ $V_S = 6 V$, $f = 100 kHz$	25°C	-65			dB
O _{ISO}	Off-isolation	$R_L = 50 \Omega$, $C_L = 5 pF$ $V_S = 6 V$, $f = 1 MHz$	25°C	-45			dB
BW	–3 dB Bandwidth	R_L = 50 Ω , C_L = 5 pF V_S = 6 V	25°C	23			MHz
Ι _L	Insertion loss	$R_L = 50 \Omega$, $C_L = 5 pF$ $V_S = 6 V$, $f = 1 MHz$	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 Ω , C_L = 5 pF, f = 1 MHz	25°C	-40			dB
THD+N	Total Harmonic Distortion + Noise	$V_{PP} = 6 \text{ V}, V_{BIAS} = 6 \text{ V}$ $R_L = 10 \text{ k}\Omega$, $C_L = 5 \text{ pF}$, f = 20 Hz to 20 kHz	25°C	0.0009			%
C _{S(OFF)}	Source off capacitance	V _S = 6 V, f = 1 MHz	25°C		53		pF
C _{D(OFF)}	Drain off capacitance	V _S = 6 V, f = 1 MHz	25°C		75		pF
C _{S(ON)} , C _{D(ON)}	On capacitance	V _S = 6 V, f = 1 MHz	25°C		240		pF

6.12 ±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 _A		MIN	TYP	MAX	UNIT
ANALOG	SWITCH			-			
		V _{DD} = +4.5 V, V _{SS} = -4.5 V	25°C		2.3	3.5	Ω
R _{ON}	On-resistance	$V_S = -4.5 \text{ V to } +4.5 \text{ V}$	-40°C to +85°C			4.4	Ω
		$I_D = -10 \text{ mA}$	-40°C to +125°C			4.9	Ω
			25°C		0.8	1.5	Ω
R _{ON FLAT}	On-resistance flatness	$V_S = -4.5 \text{ V to } +4.5 \text{ V}$ $I_D = -10 \text{ mA}$	-40°C to +85°C			1.8	Ω
		.5	-40°C to +125°C			2	Ω
R _{ON DRIFT}	On-resistance drift	$V_S = 0 \text{ V}, I_S = -10 \text{ mA}$	-40°C to +125°C		0.019		Ω/°C
		V_{DD} = +5.5 V, V_{SS} = -5.5 V	25°C	-0.4	0.02	0.4	nA
I _{S(OFF)}	Source off leakage current ⁽¹⁾	Switch state is off $V_S = +4.5 \text{ V} / -4.5 \text{ V}$	-40°C to +85°C	-1.5		1.5	nA
		$V_D = -4.5 \text{ V} / + 4.5 \text{ V}$	-40°C to +125°C	-20		20	nA
	Drain off leakage current ⁽¹⁾	V_{DD} = +5.5 V, V_{SS} = -5.5 V Switch state is off V_{S} = +4.5 V / -4.5 V V_{D} = -4.5 V / + 4.5 V	25°C	-0.4	0.02	0.4	nA
I _{D(OFF)}			-40°C to +85°C	-1.5		1.5	nA
, ,			-40°C to +125°C	-20		20	nA
	Channel on leakage current ⁽²⁾	V_{DD} = +5.5 V, V_{SS} = -5.5 V Switch state is on	25°C	-0.4	0.02	0.4	nA
I _{S(ON)}			-40°C to +85°C	-1		1	nA
I _{D(ON)}		$V_S = V_D = \pm 4.5 \text{ V}$	-40°C to +125°C	-20		20	nA
LOGIC IN	PUTS (SEL / EN pins)						
V _{IH}	Logic voltage high		-40°C to +125°C	1.3		36	V
V _{IL}	Logic voltage low		-40°C to +125°C	0		0.8	V
I _{IH}	Input leakage current		-40°C to +125°C		0.4	2.2	μA
I _{IL}	Input leakage current		-40°C to +125°C	-0.1	-0.005		μΑ
C _{IN}	Logic input capacitance		-40°C to +125°C		3.5		pF
POWER S	SUPPLY					'	
			25°C		24	35	μΑ
I_{DD}	V _{DD} 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			38	μA
			-40°C to +125°C			42	μΑ
		.,	25°C		4	9	μΑ
I _{SS}	V _{SS} supply current	$V_{DD} = +5.5 \text{ V}, V_{SS} = -5.5 \text{ V}$ Logic inputs = 0 V, 5 V, or V_{DD}	-40°C to +85°C			11	μΑ
			-40°C to +125°C			12	μA

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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.



6.13 ±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 _A	MIN	TYP	MAX	UNIT
			25°C		145	180	ns
t _{ON}	Turn-on time from control input	$V_S = 3 V$ $R_1 = 300 \Omega, C_1 = 35 pF$	–40°C to +85°C			220	ns
		11t_ 000 12, 0t_ 00 pi	–40°C to +125°C			240	ns
			25°C		170	220	ns
t _{OFF}	Turn-off time from control input	$V_S = 3 V$ $R_1 = 300 \Omega, C_1 = 35 pF$	–40°C to +85°C			240	ns
		1.1, 000 11, 01 00 p.	–40°C to +125°C			260	ns
			25°C		0.19		ms
t _{ON (VDD)}	Device turn on time (V _{DD} to output)	V_{DD} rise time = 1 μs R_L = 300 Ω, C_L = 35 pF	–40°C to +85°C		0.19		ms
	(VDD to suspat)	11, 000 12, 01 00 pi	–40°C to +125°C		0.19		ms
t _{PD}	Propagation delay	$R_L = 50 \Omega$, $C_L = 5 pF$	25°C		500		ps
Q _{INJ}	Charge injection	V _S = 0 V, C _L = 100 pF	25°C	-3			рC
O _{ISO}	Off-isolation	$R_L = 50 \Omega$, $C_L = 5 pF$ $V_S = 0 V$, $f = 100 kHz$	25°C		-66		dB
O _{ISO}	Off-isolation	$R_L = 50 \Omega$, $C_L = 5 pF$ $V_S = 0 V$, $f = 1 MHz$	25°C		-46		dB
BW	–3 dB Bandwidth	$R_L = 50 \Omega$, $C_L = 5 pF$ $V_S = 0 V$	25°C		23		MHz
IL	Insertion loss	$R_L = 50 \Omega$, $C_L = 5 pF$ $V_S = 0 V$, $f = 1 MHz$	25°C		-0.20		dB
ACPSRR	AC Power Supply Rejection Ratio	$\begin{split} &V_{PP} = 0.62 \text{ V on V}_{DD} \text{ and V}_{SS} \\ &R_L = 50 \Omega\text{ , }C_L = 5 \text{ pF,} \\ &f = 1 \text{ MHz} \end{split}$	25°C	-68			dB
THD+N	Total Harmonic Distortion + Noise	$V_{PP} = 5 \text{ V}, V_{BIAS} = 0 \text{ V}$ $R_L = 10 \text{ k}\Omega, C_L = 5 \text{ pF},$ $f = 20 \text{ Hz} \text{ to } 20 \text{ kHz}$	25°C	0.001			%
C _{S(OFF)}	Source off capacitance	V _S = 0 V, f = 1 MHz	25°C		56		pF
C _{D(OFF)}	Drain off capacitance	V _S = 0 V, f = 1 MHz	25°C		77		pF
C _{S(ON),} C _{D(ON)}	On capacitance	V _S = 0 V, f = 1 MHz	25°C		240		pF



6.14 Typical Characteristics

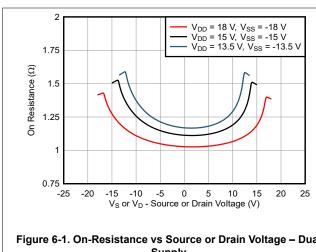


Figure 6-1. On-Resistance vs Source or Drain Voltage - Dual Supply

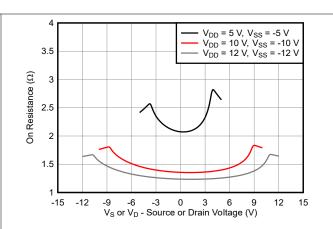


Figure 6-2. On-Resistance vs Source or Drain Voltage - Dual Supply

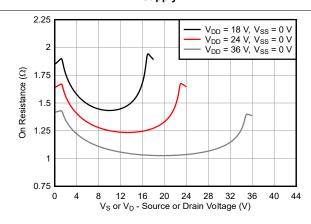


Figure 6-3. On-Resistance vs Source or Drain Voltage - Single Supply

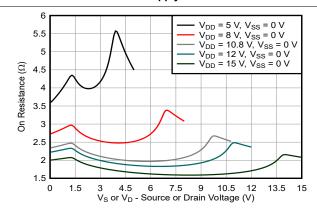
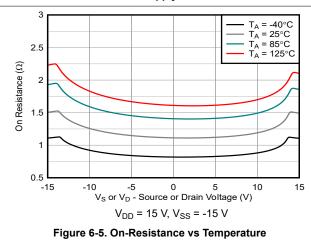
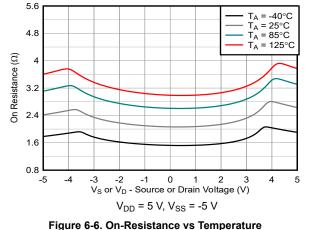
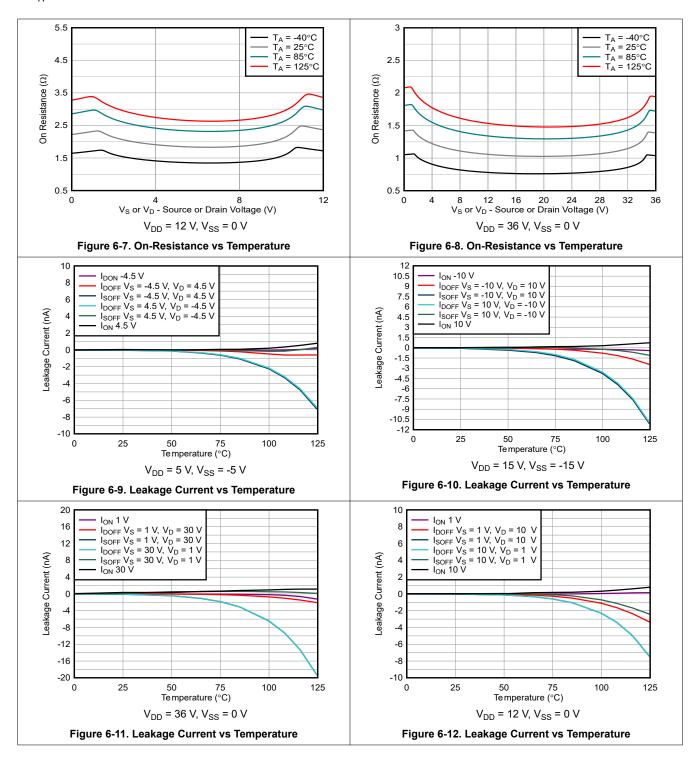


Figure 6-4. On-Resistance vs Source or Drain Voltage - Single Supply

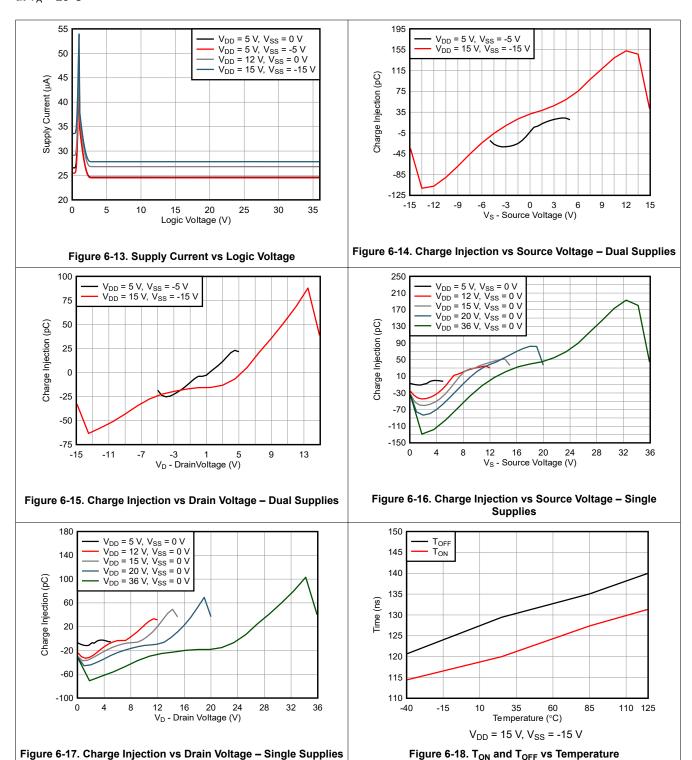




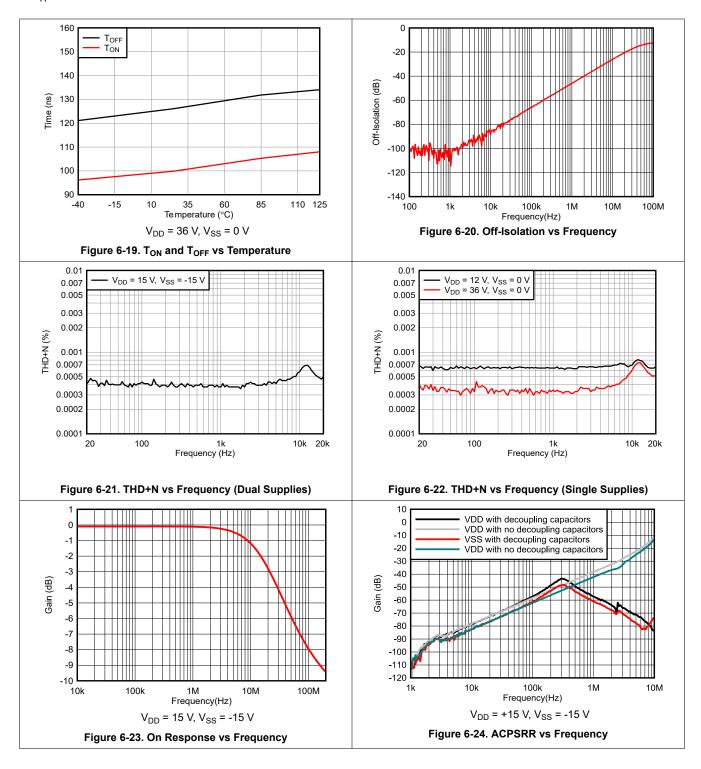






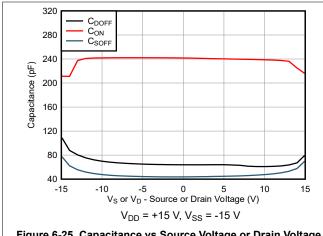








at T_A = 25°C



320 C_{DOFF} C_{ON} C_{SOFF} 280 240 Capacitance (pF) 200 160 120 80 40 0 12 $V_{DD} = 12 \text{ V}, V_{SS} = 0 \text{ V}$

Figure 6-25. Capacitance vs Source Voltage or Drain Voltage

Figure 6-26. Capacitance vs Source Voltage or Drain Voltage

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7 Parameter Measurement Information

7.1 On-Resistance

The on-resistance of a device is the ohmic resistance between the source (Sx) and drain (Dx) 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 7-1 shows the measurement setup used to measure R_{ON} . Voltage (V) and current (I_{SD}) are measured using this setup, and R_{ON} is computed with $R_{ON} = V / I_{SD}$.

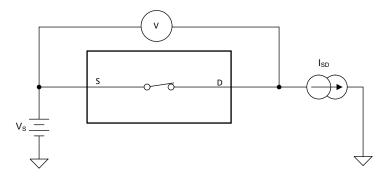


Figure 7-1. On-Resistance Measurement Setup

7.2 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 7-2 shows the setup used to measure both Off-Leakage currents.

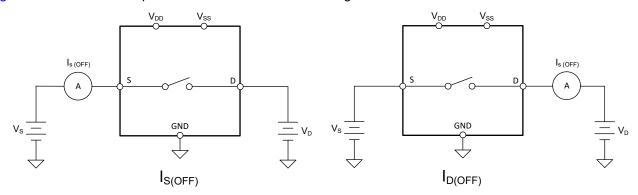


Figure 7-2. Off-Leakage Measurement Setup

7.3 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 7-3 shows the circuit used for measuring the On-Leakage current, denoted by $I_{S(ON)}$ or $I_{D(ON)}$.

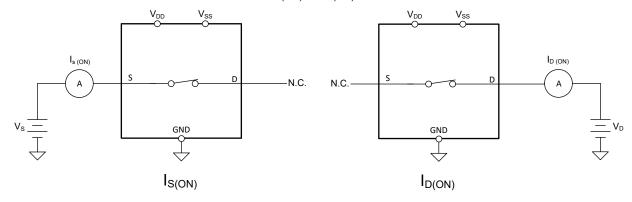


Figure 7-3. On-Leakage Measurement Setup

7.4 t_{ON} and t_{OFF} Time

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 7-4 shows the setup used to measure Turn-On time, denoted by the symbol to.

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 7-4 shows the setup used to measure Turn-Off time, denoted by the symbol t_{OFF}.

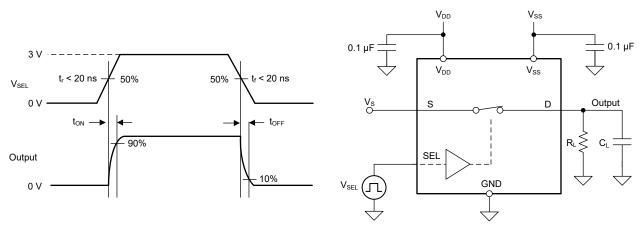


Figure 7-4. Turn-On and Turn-Off Time Measurement Setup

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7.5 t_{ON (VDD)} 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 7-5 shows the setup used to measure turn on time, denoted by the symbol $t_{ON~(VDD)}$.

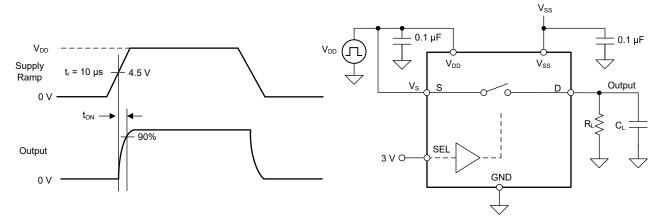


Figure 7-5. t_{ON (VDD)} Time Measurement Setup

7.6 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 7-6 and Equation 1 shows the setup used to measure propagation delay, denoted by the symbol t_{PD} .

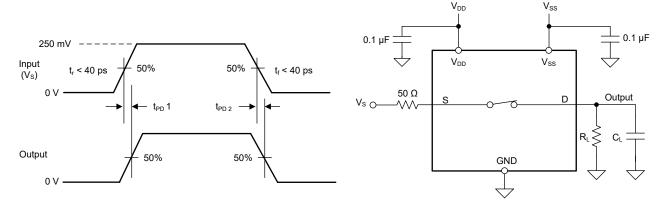


Figure 7-6. Propagation Delay Measurement Setup

$$t_{Prop\ Delay} = max\left(t_{PD}\ 1,\ t_{PD}\ 2\right) \tag{1}$$

7.7 Charge Injection

The TMUX620x devices have 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_C . Figure 7-7 shows the setup used to measure charge injection from source (Sx) to drain (Dx).

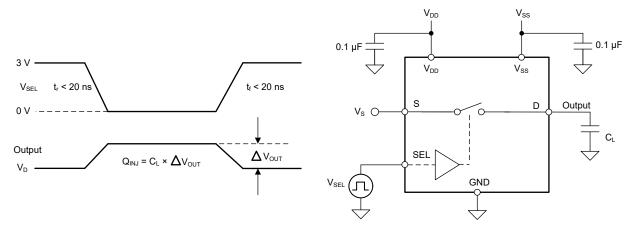


Figure 7-7. Charge-Injection Measurement Setup

7.8 Off Isolation

Off isolation is defined as the ratio of the signal at the drain pin (Dx) of the device when a signal is applied to the source pin (Sx) of an off-channel. The characteristic impedance, Z_0 , for the measurement is 50 Ω . Figure 7-8 and Equation 2 shows the setup used to measure off isolation. Use off isolation equation to compute off isolation.

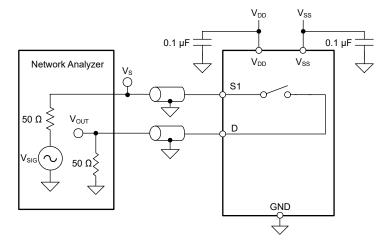


Figure 7-8. Off Isolation Measurement Setup

$$Off - Isolation = 20 \times Log\left(\frac{V_{OUT}}{V_S}\right)$$
 (2)

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7.9 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 (Dx) of the device. The characteristic impedance, Z_0 , for the measurement is 50 Ω . Figure 7-9 and Equation 3 shows the setup used to measure bandwidth.

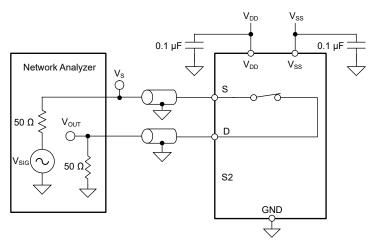


Figure 7-9. Bandwidth Measurement Setup

$$Bandwidth = 20 \times Log\left(\frac{V_{OUT}}{V_S}\right)$$
 (3)

7.10 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.

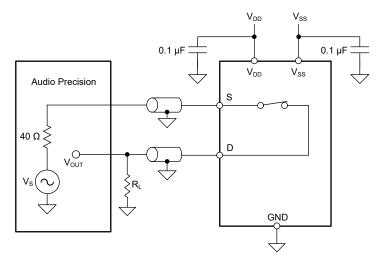


Figure 7-10. THD + N Measurement Setup

7.11 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 100 mV_{PP} . The ratio of the amplitude of signal on the output to the amplitude of the modulated signal is the AC PSRR.

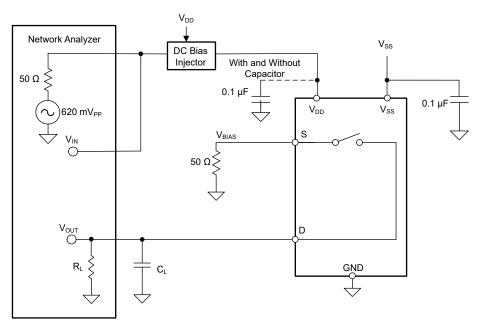


Figure 7-11. AC PSRR Measurement Setup

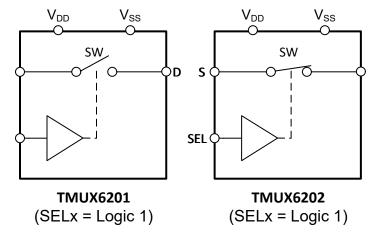
$$PSRR = 20 \times Log\left(\frac{V_{OUT}}{V_{IN}}\right) \tag{4}$$

8 Detailed Description

8.1 Overview

The TMUX620x are 1:1, 1-channel switches. The switch is turned on or turned off based on the state of the select pin.

8.2 Functional Block Diagram



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8.3 Feature Description

8.3.1 Bidirectional Operation

The TMUX620x conducts equally well from source (S) to drain (D) or from drain (D) to source (S). The switch has very similar characteristics in both directions and supports both analog and digital signals.

8.3.2 Rail-to-Rail Operation

The valid signal path input and output voltage for TMUX620x ranges from V_{SS} to V_{DD}.

8.3.3 1.8 V Logic Compatible Inputs

The TMUX620x has 1.8 V logic compatible control for all logic control inputs. 1.8 V logic level inputs allows the device 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 1.8 V logic implementations, refer to Simplifying Design with 1.8 V logic Muxes and Switches.

8.3.4 Integrated Pull-Down Resistor on Logic Pins

The TMUX6201 and TMUX6202 have internal weak Pull-Down resistors to GND to ensure the logic pins are not left floating. The value of this Pull-Down resistor is approximately 4 M Ω , but is clamped to about 1 μ A at higher voltages. This feature integrates an external component and reduces system size and cost.

8.3.5 Fail-Safe Logic

The TMUX620x supports Fail-Safe Logic on the control input pins (SEL) allowing for operation up to 36 V 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 TMUX620x to be ramped to +36 V while V_{DD} and V_{SS} = 0 V. The logic control inputs are protected against positive faults of up to +36 V in powered-off condition, but do not offer protection against negative over-voltage conditions.

8.3.6 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 over-voltage), 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 TMUX620x 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 over-voltage or current injections. The Latch-Up immunity feature allows the TMUX620x family of switches and multiplexers to be used in harsh environments.

8.3.7 Ultra-Low Charge Injection

Figure 8-1 shows how the TMUX620x devices have a transmission gate topology. Any mismatch in the stray capacitance associated with the NMOS and PMOS causes an output level change whenever the switch is opened or closed.

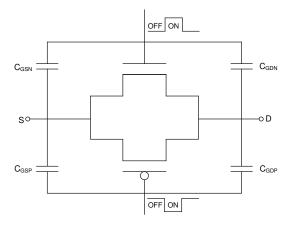


Figure 8-1. Transmission Gate Topology

The TMUX620x contains specialized architecture to reduce charge injection on the Drain (Dx). To further reduce charge injection in a sensitive application, a compensation capacitor (Cp) can be added on the Source (S). This will push excess charge from the switch transition into the compensation capacitor on the Source (S) instead of the Drain (D). As a general rule, Cp should be 20x larger than the equivalent load capacitance on the Drain (D). Figure 8-2 shows charge injection variation with different compensation capacitors on the Source side. This plot was captured on the TMUX6219 as part of the TMUX62xx family with a 100pF load capacitance.

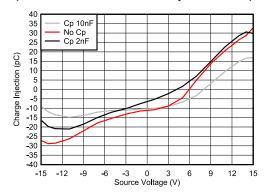


Figure 8-2. Charge Injection Compensation

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8.4 Device Functional Modes

When the SEL pin of the TMUX620x is pulled high, the switches will close. When the SEL pin is pulled low, the switches will open. The control pins can be as high as 36V.

The TMUX620x can be operated without any external components except for the supply decoupling capacitors. The SEL pin has an internal Pull-Down resistor of $4M\Omega$. If unused, then the SEL pin must be tied to GND to make sure the device does not consume additional current as highlighted in Implications of Slow or Floating CMOS Inputs.

8.5 Truth Tables

Table 8-1 provides the truth tables for the TMUX620x.

Table 8-1. TMUX620x Truth Table

SEL	Selected Source Connected To Drain (D) – TMUX6201	Selected Source Connected To Drain (D) – TMUX6202
0	S	All sources are off (HI-Z)
1	All sources are off (HI-Z)	S

9 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.

9.1 Application Information

TMUX620x is part of the precision switches and multiplexers family of devices. TMUX620x offers low RON, low on and off leakage currents and Ultra-Low charge injection performance. These properties make TMUX620x ideal for implementing high precision industrial systems requiring selection of one of two inputs or outputs.

9.2 Typical Applications

9.2.1 TIA Feedback Gain Switch

One application of the TMUX620x is to configure the feedback on a discrete transimpedance amplifier (TIA) implementation. Often, TIAs are used in applications such as photodiode inputs, which then feeds into an ADC or MCU/processor. Depending on the expected strength of the photodiode input, and the needed accuracy, multiple gain levels are needed. A switch like the TMUX620x allows for different gain values to be selected, changing the level of amplifications. This solution can be scaled, but as much as needed for multiple gain options.

Figure 9-1 shows the TMUX620x configured with a precision op amp to enable multiple gains.

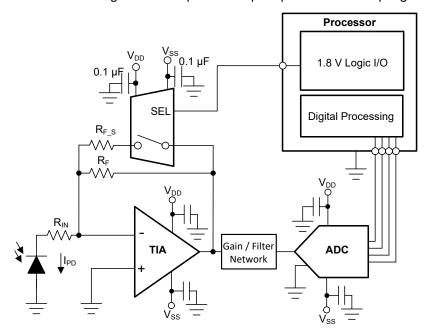


Figure 9-1. TIA Feedback Control

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9.2.1.1 Design Requirements

For this design example, use the parameters listed in Table 9-1.

Table 9-1. Design Parameters

PARAMETERS	VALUES			
Supply (V _{DD})	15V			
Supply (V _{SS})	-15V			
MUX I/O signal range	−15V to 15V (Rail-to-Rail)			
Control logic thresholds	1.8V compatible (up to V _{DD})			

9.2.1.2 Detailed Design Procedure

Figure 9-1 shows an application that demonstrates how the TMUX620x can be used to select the gain of a TIA amplifier. Here R_F is used to prevent any open loop configuration. For the lowest error, the R_{ON} of the switch should be much smaller than $R_{F,S}$, as this will scale linearly with the potential error.

The TMUX620x 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 TMUX620x 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 recommend operating conditions of the TMUX620x including signal range and continuous current. For this design with a positive supply of 15V on V_{DD} and negative supply of -15V on V_{SS} , the signal range can be 15V to -15V. The maximum continuous current (I_{DC}) can be up to 330mA (for wide-range current measurement, see the Section 6.4 section).

9.2.1.3 Application Curves

The low on and off leakage currents of TMUX620x and Ultra-Low charge injection performance make this device ideal for implementing high precision industrial systems. The TMUX620x contains specialized architecture to reduce charge injection on the source (Sx) (for more details, see Section 8.3.7). Figure 9-2 shows the plot for the charge injection versus source voltage for the TMUX620x.

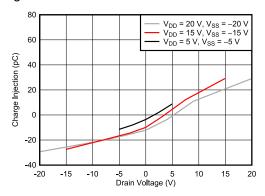


Figure 9-2. Charge Injection vs Source Voltage

9.3 Power Supply Recommendations

The TMUX620x operates across a wide supply range of ± 4.5 V to ± 18 V (4.5 V to 36 V in single-supply mode). The device also performs well with asymmetrical supplies such as $V_{DD} = 12$ V and $V_{SS} = -5$ V.

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 μ F to 10 μ F at both the V_{DD} and V_{SS} 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 ground and power planes. Always ensure the ground (GND) connection is established before supplies are ramped.

9.4 Layout

9.4.1 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 9-3 shows progressively better techniques of rounding corners. Only the last example (BEST) maintains constant trace width and minimizes reflections.

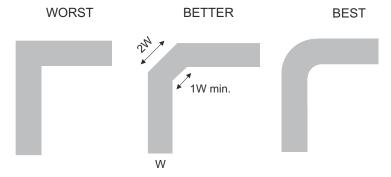


Figure 9-3. Trace Example

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 9-4 shows an example of a PCB layout with the TMUX620x. Some key considerations are as follows:

- For reliable operation, connect a decoupling capacitor ranging from 0.1 μF to 10 μF between VDD/VSS and GND. We recommend a 0.1 μF and 1 μF capacitor, placing 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.

Product Folder Links: TMUX6201 TMUX6202



9.4.2 Layout Example

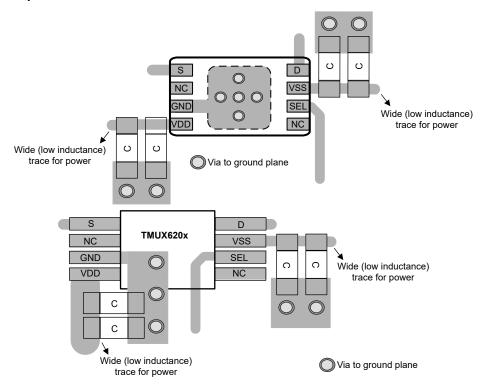


Figure 9-4. TMUX620x Layout Example



10 Device and Documentation Support

10.1 Documentation Support

10.1.1 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 1.8 V 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

10.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. Click on *Notifications* 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.

10.3 Support Resources

TI E2E[™] 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.

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10.5 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.

10.6 Glossary

TI Glossary

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

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11 Revision History

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

Changes from Revision A (March 2023) to Revision B (September 2024)					
Included Break-before-make time delay for TMUX7213	7				
Updated Truth Table information	<u>27</u>				
Updated Power Amplifier Gate Driver figure	28				
Changes from Revision * (November 2022) to Revision A (March 2023)	Page				
, , , , ,	<u></u>				
Changes from Revision * (November 2022) to Revision A (March 2023) Changed the status of the data sheet from: Advanced Information to: Production Data	P				

12 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.

www.ti.com 23-May-2025

PACKAGING INFORMATION

Orderable part number	Status	Material type	Package Pins	Package qty Carrier	RoHS	Lead finish/ Ball material	MSL rating/ Peak reflow	Op temp (°C)	Part marking (6)
						(4)	(5)		
TMUX6201RQXR	Active	Production	WSON (RQX) 8	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	H201
TMUX6201RQXR.B	Active	Production	WSON (RQX) 8	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	H201
TMUX6202RQXR	Active	Production	WSON (RQX) 8	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	H202
TMUX6202RQXR.B	Active	Production	WSON (RQX) 8	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	H202

⁽¹⁾ 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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⁽²⁾ Material type: When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

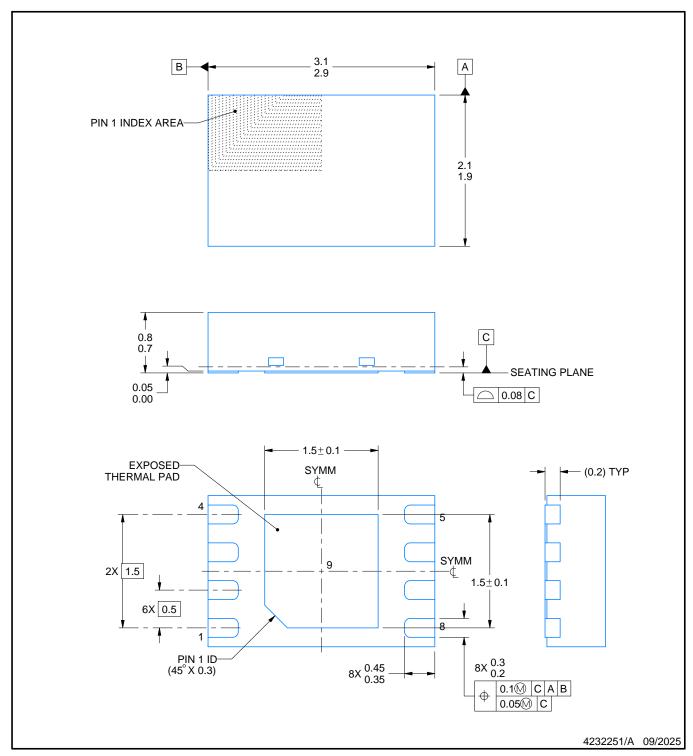
⁽³⁾ RoHS values: Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

⁽⁴⁾ 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.

⁽⁵⁾ 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.

⁽⁶⁾ 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.

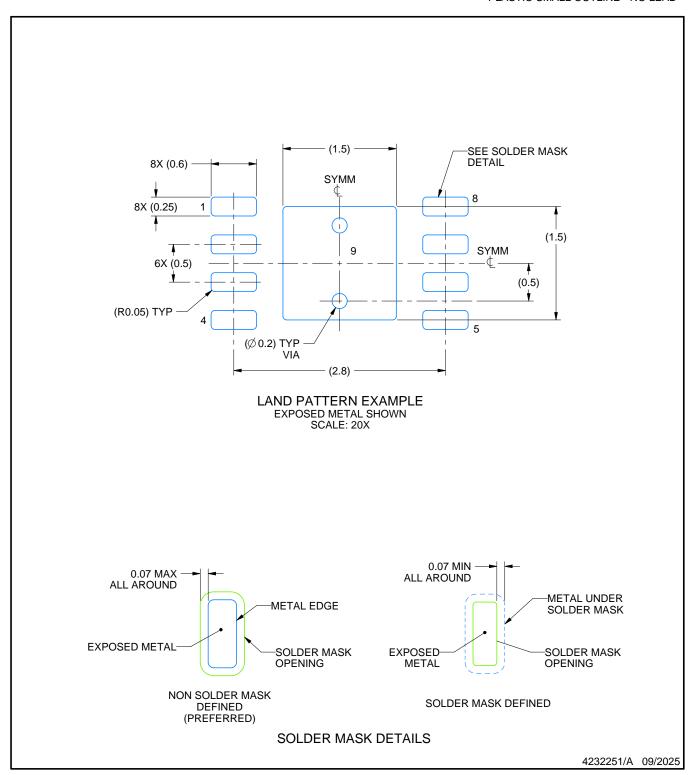




NOTES:

- 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.

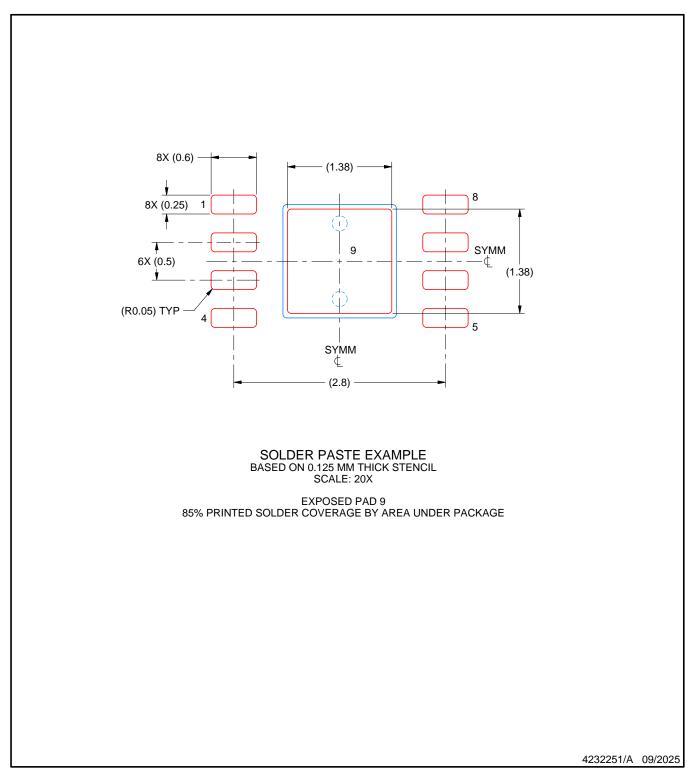




NOTES: (continued)

- 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.



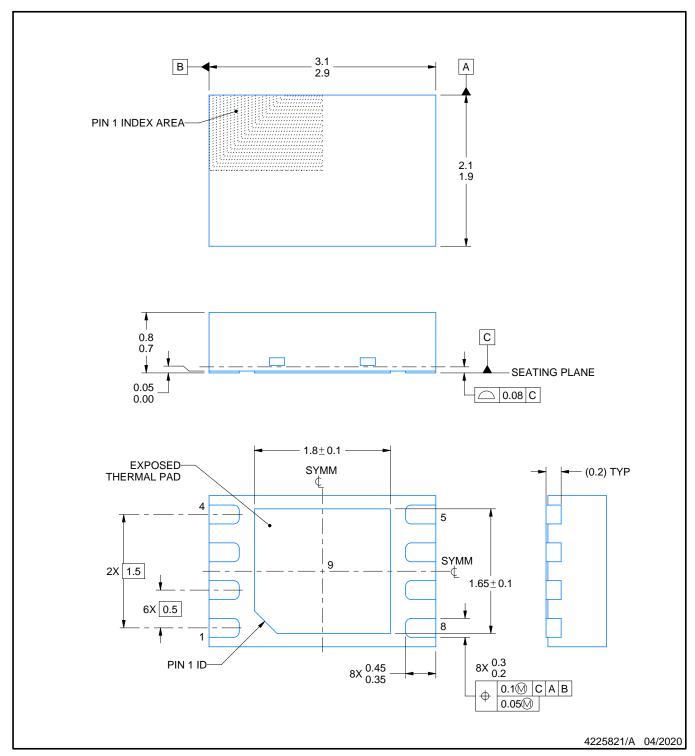


NOTES: (continued)

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



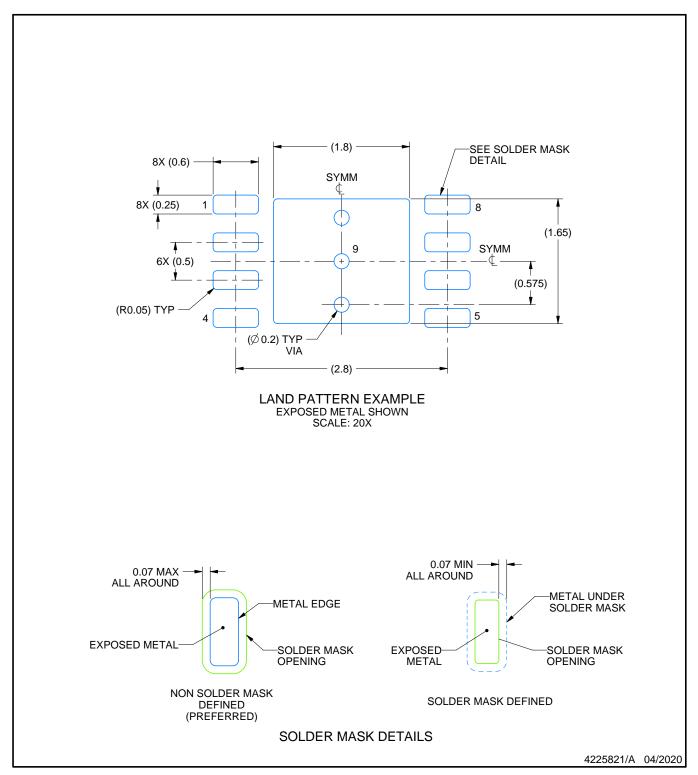




NOTES:

- 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.
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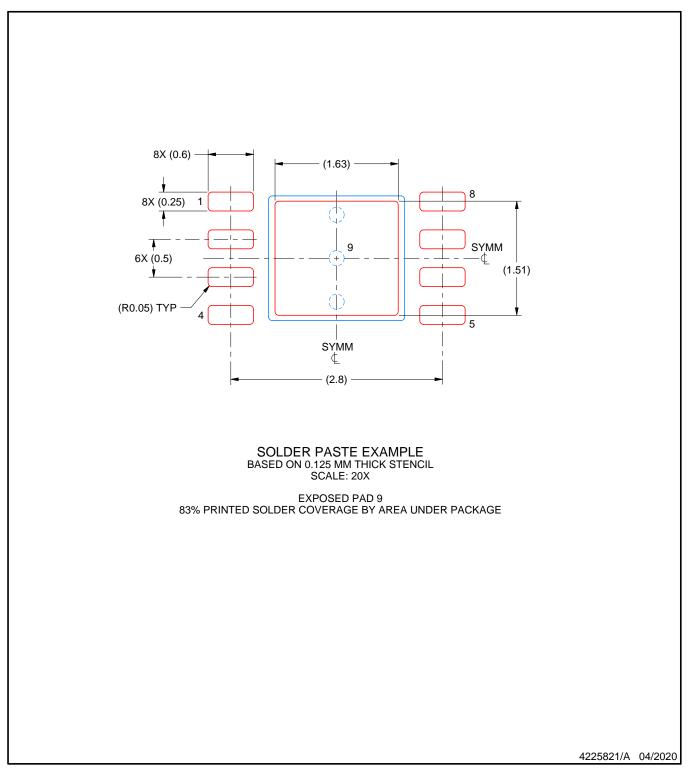




NOTES: (continued)

- 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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