











SCDS389C - AUGUST 2018 - REVISED DECEMBER 2018

TMUX1208 5-V Bidirectional 8:1, 1-Channel Multiplexer TMUX1209 5-V Bidirectional 4:1, 2-Channel Multiplexer

Features

Rail to Rail Operation

Bidirectional Signal Path

Low On-Resistance: 5 Ω

Wide Supply Range: 1.08 V to 5.5 V -40°C to +125°C Operating Temperature

1.8 V Logic Compatible

Fail-Safe Logic

Low Supply Current: 10 nA

Transition Time: 14 ns

Break-Before-Make Switching

ESD Protection HBM: 2000 V

Industry-Standard TSSOP and QFN Packages

Applications

Analog and Digital Multiplexing / Demultiplexing

HVAC: Heating, Ventilation, and Air Conditioning

Smoke Detectors

Video Surveillance

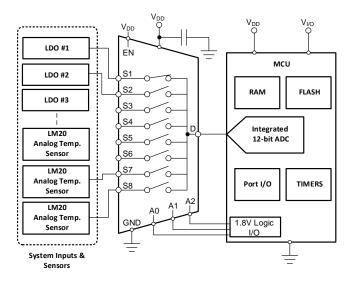
Electronic Point of Sale

Battery-Powered Equipment

Appliances

Consumer Audio

Application Example



3 Description

The TMUX1208 and TMUX1209 are general purpose complementary metal-oxide semiconductor (CMOS) multiplexers (MUX). The TMUX1208 offers 8:1 singleended channels, while the TMUX1209 offers differential 4:1 or dual 4:1 single-ended channels. Wide operating supply of 1.08 V to 5.5 V allows for use in a broad array of applications from personal electronics to building automation applications. The device supports bidirectional analog and digital signals on the source (Sx) and drain (D) pins ranging from GND to V_{DD} .

All logic inputs have 1.8 V logic compatible thresholds, 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.

Device Information⁽¹⁾

PART NUMBER	PACKAGE	BODY SIZE (NOM)
TMUX1208 TMUX1209	TSSOP (16)	5.00 mm × 4.40 mm
	QFN (16)	2.60 mm x 1.80 mm

(1) For all available packages, see the package option addendum at the end of the data sheet.

TMUX1208, TMUX1209 Block Diagram

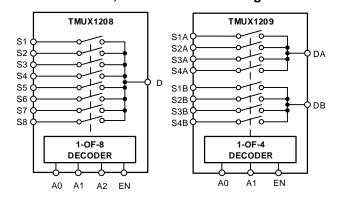




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4 Revision History

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

Changes from Revision B (November 2018) to Revision C	Page
Added device TMUX1209 to the data sheet	1
Changes from Revision A (September 2018) to Revision B	Page
Added RSV (QFN) thermal information to <i>Thermal Information:</i> table	5
Added footnote to clarify test conditions	8
Changes from Original (August 2018) to Revision A	Page
Changed the document status From: Advanced Information To: Production data	

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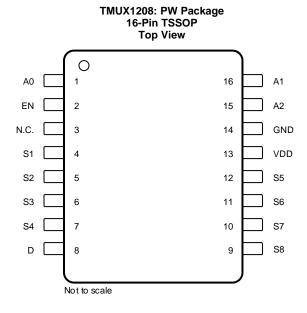
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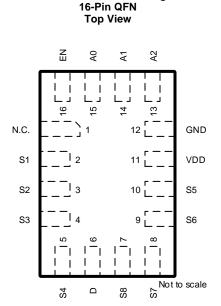


5 Device Comparison Table

PRODUCT	DESCRIPTION
TMUX1208	8:1, 1-Channel, single-ended multiplexer
TMUX1209	4:1, 2-Channel, differential multiplexer

6 Pin Configuration and Functions





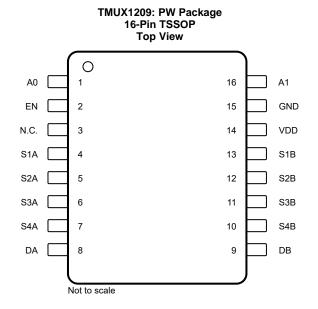
TMUX1208: RSV Package

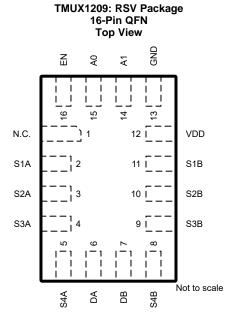
Pin Functions TMUX1208

PIN			TYPE ⁽¹⁾	DESCRIPTION
NAME	TSSOP	UQFN	ITPE\"	DESCRIPTION
A0	1	15	1	Address line 0. Controls the switch configuration as shown in Table 1.
EN	2	16	1	Active high logic input. When this pin is low, all switches are turned off. When this pin is high, the A[2:0] address inputs determine which switch is turned on.
N.C.	3	1	Not Connected	Not Connected
S1	4	2	I/O	Source pin 1. Can be an input or output.
S2	5	3	I/O	Source pin 2. Can be an input or output.
S3	6	4	I/O	Source pin 3. Can be an input or output.
S4	7	5	I/O	Source pin 4. Can be an input or output.
D	8	6	I/O	Drain pin. Can be an input or output.
S8	9	7	I/O	Source pin 8. Can be an input or output.
S7	10	8	I/O	Source pin 7. Can be an input or output.
S6	11	9	I/O	Source pin 6. Can be an input or output.
S5	12	10	I/O	Source pin 5. Can be an input or output.
VDD	13	11	Р	Positive power supply. This pin is the most positive power-supply potential. For reliable operation, connect a decoupling capacitor ranging from 0.1 μ F to 10 μ F between V _{DD} and GND.
GND	14	12	Р	Ground (0 V) reference
A2	15	13	1	Address line 2. Controls the switch configuration as shown in Table 1.
A1	16	14	1	Address line 1. Controls the switch configuration as shown in Table 1.

(1) I = input, O = output, I/O = input and output, P = power







Pin Functions TMUX1209

	PIN		TVD=(1)	PERCENTION
NAME	TSSOP	UQFN	TYPE ⁽¹⁾	DESCRIPTION
A0	1	15	I	Address line 0. Controls the switch configuration as shown in Table 2.
EN	2	16	I	Active high logic input. When this pin is low, all switches are turned off. When this pin is high, the A[1:0] address inputs determine which switch is turned on.
N.C.	3	1	Not Connected	Not Connected
S1A	4	2	I/O	Source pin 1A. Can be an input or output.
S2A	5	3	I/O	Source pin 2A. Can be an input or output.
S3A	6	4	I/O	Source pin 3A. Can be an input or output.
S4A	7	5	I/O	Source pin 4A. Can be an input or output.
DA	8	6	I/O	Drain pin A. Can be an input or output.
DB	9	7	I/O	Drain pin B. Can be an input or output.
S4B	10	8	I/O	Source pin 4B. Can be an input or output.
S3B	11	9	I/O	Source pin 3B. Can be an input or output.
S2B	12	10	I/O	Source pin 2B. Can be an input or output.
S1B	13	11	I/O	Source pin 1B. Can be an input or output.
VDD	14	12	Р	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.
GND	15	13	Р	Ground (0 V) reference
A1	16	14	I	Address line 1. Controls the switch configuration as shown in Table 2.

(1) I = input, O = output, I/O = input and output, P = power



7 Specifications

7.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted) $^{(1)}$ $^{(2)}$ $^{(3)}$

		MIN	MAX	UNIT
V_{DD}	Supply voltage	-0.3	6	V
V _{SEL} or V _{EN}	Logic control input pin voltage (EN, A0, A1, A2)	-0.3	6	V
I _{SEL} or I _{EN}	Logic control input pin current (EN, A0, A1, A2)	-30	30	mA
V _S or V _D	Source or drain voltage (Sx, D)	-0.5	V _{DD} +0.5	V
I _S or I _{D (CONT)}	Source or drain continuous current (Sx, D)	-30	30	mA
T _{stg}	Storage temperature	-65	150	°C
T _J	Junction temperature		150	°C

⁽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.

7.2 ESD Ratings

			VALUE	UNIT
V	Flootroctatio displayers	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins ⁽¹⁾	±2000	V
V(ESD)	V _(ESD) Electrostatic discharge	Charged device model (CDM), per JEDEC specification JESD22-C101, all pins (2)	±750	V

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

7.3 Recommended Operating Conditions

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

		MIN	NOM MAX	UNIT
V_{DD}	Supply voltage	1.08	5.5	V
V_S or V_D	Signal path input/output voltage (source or drain pin) (Sx, D)	0	V_{DD}	V
V_{SEL} or V_{EN}	Logic control input pin voltage (EN, A0, A1, A2)	0	5.5	V
T _A	Ambient temperature	-40	125	°C

7.4 Thermal Information

		TMUX1208	TMUX1208 / TMUX1209		
	THERMAL METRIC	PW (TSSOP)	RSV (QFN)	UNIT	
		16 PINS	16 PINS		
$R_{\theta JA}$	Junction-to-ambient thermal resistance	118.9	134.6	°C/W	
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	49.3	74.3	°C/W	
$R_{\theta JB}$	Junction-to-board thermal resistance	65.2	62.8	°C/W	
Ψ_{JT}	Junction-to-top characterization parameter	7.6	4.3	°C/W	
Ψ_{JB}	Junction-to-board characterization parameter	64.6	61.1	°C/W	
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	N/A	N/A	°C/W	

Product Folder Links: TMUX1208 TMUX1209

²⁾ The algebraic convention, whereby the most negative value is a minimum and the most positive value is a maximum.

⁽³⁾ All voltages are with respect to ground, unless otherwise specified.

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



7.5 Electrical Characteristics ($V_{DD} = 5 \text{ V} \pm 10 \text{ \%}$)

at $T_A = 25$ °C, $V_{DD} = 5$ V (unless otherwise noted)

	PARAMETER	TEST CONDITIONS	TA	MIN	TYP	MAX	UNIT
ANALO	G SWITCH						
		$V_S = 0 \text{ V to } V_{DD}$	25°C		5		Ω
R _{ON}	On-resistance	$I_{SD} = 10 \text{ mA}$	-40°C to +85°C			7	Ω
		Refer to On-Resistance	-40°C to +125°C			9	Ω
		$V_S = 0 V \text{ to } V_{DD}$	25°C		0.15		Ω
ΔR_{ON}	On-resistance matching between channels	$I_{SD} = 10 \text{ mA}$	-40°C to +85°C			1	Ω
	Charlies	Refer to On-Resistance	-40°C to +125°C			1	Ω
		$V_S = 0 \text{ V to } V_{DD}$	25°C		1.5		Ω
R _{ON}	On-resistance flatness	$I_{SD} = 10 \text{ mA}$	-40°C to +85°C		2		Ω
FLAT		Refer to On-Resistance	-40°C to +125°C		3		Ω
		V _{DD} = 5 V	25°C		±75		nA
	(1)	Switch Off	-40°C to +85°C	-150		150	nA
I _{S(OFF)}	Source off leakage current ⁽¹⁾	$V_D = 4.5 \text{ V} / 1 \text{ V}$ $V_S = 1 \text{ V} / 4.5 \text{ V}$ Refer to Off-Leakage Current	-40°C to +125°C	-175		175	nA
		V _{DD} = 5 V	25°C		±200		nA
	7(1)	Switch Off	-40°C to +85°C	-500		500	nA
I _{D(OFF)}	Drain off leakage current ⁽¹⁾	$V_D = 4.5 \text{ V} / 1 \text{ V}$ $V_S = 1 \text{ V} / 4.5 \text{ V}$ Refer to Off-Leakage Current	-40°C to +125°C	-750		750	nA
		V _{DD} = 5 V	25°C		±200		nA
$I_{D(ON)}$	Channel on leakage current	Switch On	-40°C to +85°C	-500		500	nA
I _{S(ON)}	3	V _D = V _S = 4.5 V / 1 V Refer to On-Leakage Current	-40°C to +125°C	-750		750	nA
LOGIC	INPUTS (EN, A0, A1, A2)						
V _{IH}	Input logic high		-40°C to 125°C	1.49		5.5	V
V _{IL}	Input logic low		-40°C to 125°C	0		0.87	V
I _{IH} I _{IL}	Input leakage current		25°C	±C	0.005		μΑ
I _{IH} I _{IL}	Input leakage current		-40°C to +125°C			±0.10	μΑ
C _{IN}	Logic input capacitance		25°C		1		pF
C _{IN}	Logic input capacitance		-40°C to +125°C			2	pF
POWER	RSUPPLY					<u> </u>	
	V cumply current	Logic inpute OV or F 5 V	25°C		0.02		μA
I _{DD}	V _{DD} supply current	Logic inputs = 0 V or 5.5 V	-40°C to +125°C			2.7	μΑ

⁽¹⁾ When $\rm V_S$ is 4.5 V, $\rm V_D$ is 1 V, and vice versa.

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Electrical Characteristics (V_{DD} = 5 V ±10 %) (continued)

at $T_A = 25$ °C, $V_{DD} = 5$ V (unless otherwise noted)

	PARAMETER	TEST CONDITIONS	TA	MIN	TYP	MAX	UNIT
DYNAM	IC CHARACTERISTICS						
		V _S = 3 V	25°C		14		ns
t _{TRAN}	Transition time between channels	$R_L = 200 \Omega, C_L = 15 pF$	-40°C to +85°C			33	ns
		Refer to Transition Time	-40°C to +125°C			33	ns
		V _S = 3 V	25°C		8		ns
t _{OPEN}	Break before make time	$R_L = 200 \Omega, C_L = 15 pF$	-40°C to +85°C	1			ns
(BBM)		Refer to Break-Before-Make	-40°C to +125°C	1			ns
		V _S = 3 V	25°C		14		ns
t _{ON(EN)}	Enable turn-on time	$R_L = 200 \Omega, C_L = 15 pF$	-40°C to +85°C			20	ns
		Refer to t _{ON(EN)} and t _{OFF(EN)}	-40°C to +125°C			20	ns
		V _S = 3 V	25°C		5		ns
t _{OFF(EN)}	Enable turn-off time	$R_L = 200 \Omega, C_L = 15 pF$	-40°C to +85°C			20	ns
		Refer to t _{ON(EN)} and t _{OFF(EN)}	-40°C to +125°C			20	ns
Q_C	Charge Injection	$V_S = V_{DD}/2$ $R_S = 0 \Omega$, $C_L = 1 nF$ Refer to Charge Injection	25°C		±9		рС
		$R_L = 50 \Omega$, $C_L = 5 pF$ f = 1 MHz Refer to Off Isolation	25°C		-62		dB
O _{ISO}	Off Isolation	$R_L = 50 \Omega$, $C_L = 5 pF$ f = 10 MHz Refer to Off Isolation	25°C		-42		dB
.,		$R_L = 50 \Omega$, $C_L = 5 pF$ f = 1 MHz Refer to Crosstalk	25°C		-62		dB
X _{TALK}	Crosstalk	$R_L = 50 \Omega$, $C_L = 5 pF$ f = 10 MHz Refer to Crosstalk	25°C		-42		dB
DW	Bandwidth - TMUX1208	$R_L = 50 \Omega$, $C_L = 5 pF$ Refer to Bandwidth	25°C		65		MHz
BW	Bandwidth - TMUX1209	$R_L = 50 \Omega$, $C_L = 5 pF$ Refer to Bandwidth	25°C		125		MHz
C _{SOFF}	Source off capacitance	f = 1 MHz	25°C		13		pF
C	Drain off capacitance - TMUX1208	f = 1 MHz	25°C		76		pF
C_{DOFF}	Drain off capacitance - TMUX1209	f = 1 MHz	25°C		38		pF
C _{SON}	On capacitance - TMUX1208	f = 1 MHz	25°C		85		pF
C _{DON}	On capacitance - TMUX1209	f = 1 MHz	25°C		42		pF



7.6 Electrical Characteristics ($V_{DD} = 3.3 \text{ V} \pm 10 \text{ \%}$)

at $T_A = 25$ °C, $V_{DD} = 3.3$ V (unless otherwise noted)

	PARAMETER	TEST CONDITIONS	TA	MIN T	P MAX	UNIT
ANALO	G SWITCH			1		
		$V_S = 0 \text{ V to } V_{DD}$	25°C		9	Ω
R _{ON}	On-resistance	$I_{SD} = 10 \text{ mA}$	-40°C to +85°C		15	Ω
		Refer to On-Resistance	-40°C to +125°C		17	Ω
		$V_S = 0 \text{ V to } V_{DD}$	25°C	0.	15	Ω
ΔR_{ON}	On-resistance matching between channels	$I_{SD} = 10 \text{ mA}$	-40°C to +85°C		1	Ω
	Charliers	Refer to On-Resistance	-40°C to +125°C		1	Ω
		$V_S = 0 \text{ V to } V_{DD}$	25°C		3	Ω
R_{ON}	On-resistance flatness	$I_{SD} = 10 \text{ mA}$	-40°C to +85°C		5	Ω
FLAT		Refer to On-Resistance	-40°C to +125°C		6	Ω
		V _{DD} = 3.3 V	25°C	±	75	nA
	Source off leakage current ⁽¹⁾	Switch Off	-40°C to +85°C	-150	150	nA
I _{S(OFF)} Source off leakage curre		$V_D = 3 \text{ V} / 1 \text{ V}$ $V_S = 1 \text{ V} / 3 \text{ V}$ Refer to Off-Leakage Current	-40°C to +125°C	-175	175	nA
		V _{DD} = 3.3 V	25°C	±2	00	nA
	(4)	Switch Off	-40°C to +85°C	-500	500	nA
I _{D(OFF)}	Drain off leakage current ⁽¹⁾	$V_D = 3 \text{ V} / 1 \text{ V}$ $V_S = 1 \text{ V} / 3 \text{ V}$ Refer to Off-Leakage Current	-40°C to +125°C	-750	750	nA
		V _{DD} = 3.3 V	25°C	±2	00	nA
$I_{D(ON)}$	Channel on leakage current	Switch On	-40°C to +85°C	-500	500	nA
I _{S(ON)}		V _D = V _S = 3 V / 1 V Refer to On-Leakage Current	-40°C to +125°C	-750	750	nA
LOGIC	INPUTS (EN, A0, A1, A2)			II.		
V _{IH}	Input logic high		-40°C to 125°C	1.35	5.5	V
V _{IL}	Input logic low		-40°C to 125°C	0	0.8	V
I _{IH} I _{IL}	Input leakage current		25°C	±0.0	05	μΑ
I _{IH} I _{IL}	Input leakage current		-40°C to +125°C		±0.10	μΑ
C _{IN}	Logic input capacitance		25°C		1	pF
C _{IN}	Logic input capacitance		-40°C to +125°C		2	pF
POWER	RSUPPLY				·	
	V comply comment	Logic inpute OV or F 5 V	25°C	0.	01	μΑ
I _{DD}	V _{DD} supply current	Logic inputs = 0 V or 5.5 V	-40°C to +125°C		1.5	μA

⁽¹⁾ When V_S is 3 V, V_D is 1 V, and vice versa.

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Electrical Characteristics (V_{DD} = 3.3 V ±10 %) (continued)

at $T_A = 25$ °C, $V_{DD} = 3.3$ V (unless otherwise noted)

Α	PARAMETER	TEST CONDITIONS	TA	MIN	TYP	MAX	UNIT
DYNAM	IC CHARACTERISTICS						
		V _S = 2 V	25°C		14		ns
t _{TRAN}	Transition time between channels	$R_L = 200 \Omega$, $C_L = 15 pF$	-40°C to +85°C			25	ns
		Refer to Transition Time	-40°C to +125°C			25	ns
		V _S = 2 V	25°C		8		ns
t _{OPEN}	Break before make time	$R_L = 200 \Omega, C_L = 15 pF$	-40°C to +85°C	1			ns
(BBM)		Refer to Break-Before-Make	-40°C to +125°C	1			ns
		V _S = 2 V	25°C		14		ns
t _{ON(EN)}	Enable turn-on time	$R_L = 200 \Omega, C_L = 15 pF$	-40°C to +85°C			25	ns
		Refer to t _{ON(EN)} and t _{OFF(EN)}	-40°C to +125°C			25	ns
		V _S = 2 V	25°C		7		ns
t _{OFF(EN)}	Enable turn-off time	$R_L = 200 \Omega$, $C_L = 15 pF$	-40°C to +85°C			13	ns
		Refer to t _{ON(EN)} and t _{OFF(EN)}	-40°C to +125°C			13	ns
Q_C	Charge Injection	$V_S = V_{DD}/2$ $R_S = 0 \Omega$, $C_L = 1 nF$ Refer to Charge Injection	25°C		±7		рС
		$R_L = 50 \Omega$, $C_L = 5 pF$ f = 1 MHz Refer to Off Isolation	25°C		-62		dB
O _{ISO}	Off Isolation	$R_L = 50 \Omega$, $C_L = 5 pF$ f = 10 MHz Refer to Off Isolation	25°C		-42		dB
V	Occasion	$R_L = 50 \Omega$, $C_L = 5 pF$ f = 1 MHz Refer to Crosstalk	25°C		-62		dB
X _{TALK}	Crosstalk	$R_L = 50 \Omega$, $C_L = 5 pF$ f = 10 MHz Refer to Crosstalk	25°C		-42		dB
D\\/	Bandwidth - TMUX1208	$R_L = 50 \Omega$, $C_L = 5 pF$ Refer to Bandwidth	25°C		65		MHz
BW	Bandwidth - TMUX1209	$R_L = 50 \Omega$, $C_L = 5 pF$ Refer to Bandwidth	25°C		125		MHz
C _{SOFF}	Source off capacitance	f = 1 MHz	25°C		13		pF
C	Drain off capacitance - TMUX1208	f = 1 MHz	25°C		76		pF
C _{DOFF}	Drain off capacitance - TMUX1209	f = 1 MHz	25°C		38		pF
C _{SON}	On capacitance - TMUX1208	f = 1 MHz	25°C		85		pF
C _{DON}	On capacitance - TMUX1209	f = 1 MHz	25°C		42		pF



7.7 Electrical Characteristics ($V_{DD} = 1.8 \text{ V} \pm 10 \text{ \%}$)

at $T_A = 25$ °C, $V_{DD} = 1.8 \text{ V}$ (unless otherwise noted)

	PARAMETER	TEST CONDITIONS	TA	MIN	TYP	MAX	UNIT
ANALO	G SWITCH						
		$V_S = 0 \text{ V to } V_{DD}$	25°C		40		Ω
R _{ON}	On-resistance	$I_{SD} = 10 \text{ mA}$	-40°C to +85°C			80	Ω
		Refer to On-Resistance	-40°C to +125°C			80	Ω
		$V_S = 0 \text{ V to } V_{DD}$	25°C		0.15		Ω
ΔR_{ON}	On-resistance matching between channels	$I_{SD} = 10 \text{ mA}$	-40°C to +85°C			1.5	Ω
	Glarificis	Refer to On-Resistance	-40°C to +125°C			1.5	Ω
		V _{DD} = 1.98 V	25°C		±75		nA
	0	Switch Off	-40°C to +85°C	-150		150	nA
Source off leakage current(1)		$V_D = 1.8 \text{ V} / 1 \text{ V}$ $V_S = 1 \text{ V} / 1.8 \text{ V}$ Refer to Off-Leakage Current	-40°C to +125°C	-175		175	nA
		V _{DD} = 1.98 V	25°C		±200		nA
I _{D(OFF)} Drain off leakage current ⁽¹⁾	Desir off loslesses surrent(1)	Switch Off	-40°C to +85°C	-500		500	nA
	$V_D = 1.8 \text{ V} / 1 \text{ V}$ $V_S = 1 \text{ V} / 1.8 \text{ V}$ Refer to Off-Leakage Current	-40°C to +125°C	-750		750	nA	
		V _{DD} = 1.98 V	25°C		±200		nA
$I_{D(ON)}$	Channel on leakage current	Switch On	-40°C to +85°C	-500		500	nA
I _{S(ON)}		V _D = V _S = 1.8 V / 1 V Refer to On-Leakage Current	-40°C to +125°C	-750		750	nA
LOGIC	INPUTS (EN, A0, A1, A2)						
V _{IH}	Input logic high		-40°C to +125°C	1.07		5.5	V
V _{IL}	Input logic low		-40°C to +125°C	0		0.68	V
I _{IH} I _{IL}	Input leakage current		25°C		±0.005		μΑ
I _{IH} I _{IL}	Input leakage current		-40°C to +125°C			±0.10	μΑ
C	Logic input capacitance		25°C		1		pF
C _{IN}	Logic input capacitance		-40°C to +125°C			2	pF
POWER	RSUPPLY						
l	V _{DD} supply current	Logic inputs = 0 V or 5.5 V	25°C		0.006		μΑ
I _{DD}	VDD supply culterit	Logic inputs = 0 v oi 5.5 v	-40°C to +125°C			0.95	μΑ

⁽¹⁾ When $V_{\mbox{\scriptsize S}}$ is 1.8 V, $V_{\mbox{\scriptsize D}}$ is 1 V, and vice versa.

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Product Folder Links: TMUX1208 TMUX1209



Electrical Characteristics (V_{DD} = 1.8 V ±10 %) (continued)

at $T_A = 25$ °C, $V_{DD} = 1.8 \text{ V}$ (unless otherwise noted)

	PARAMETER	TEST CONDITIONS	TA	MIN	TYP	MAX	UNIT
DYNAM	IC CHARACTERISTICS						
		V _S = 1 V	25°C		28		ns
t _{TRAN}	Transition time between channels	$R_L = 200 \Omega$, $C_L = 15 pF$	-40°C to +85°C			48	ns
		Refer to Transition Time	-40°C to +125°C			48	ns
		V _S = 1 V	25°C		16		ns
t _{OPEN}	Break before make time	$R_L = 200 \Omega, C_L = 15 pF$	-40°C to +85°C	1			ns
(BBM)		Refer to Break-Before-Make	-40°C to +125°C	1			ns
		V _S = 1 V	25°C		28		ns
t _{ON(EN)}	Enable turn-on time	$R_L = 200 \Omega$, $C_L = 15 pF$	-40°C to +85°C			48	ns
		Refer to t _{ON(EN)} and t _{OFF(EN)}	-40°C to +125°C			48	ns
		V _S = 1 V	25°C		16		ns
t _{OFF(EN)}	Enable turn-off time	$R_L = 200 \Omega$, $C_L = 15 pF$	-40°C to +85°C			27	ns
		Refer to t _{ON(EN)} and t _{OFF(EN)}	-40°C to +125°C			27	ns
Q_C	Charge Injection	$V_S = V_{DD}/2$ $R_S = 0 \Omega$, $C_L = 1 nF$ Refer to Charge Injection	25°C		-2		рС
		$R_L = 50 \Omega$, $C_L = 5 pF$ f = 1 MHz Refer to Off Isolation	25°C		-62		dB
O _{ISO}	Off Isolation	$R_L = 50 \Omega$, $C_L = 5 pF$ f = 10 MHz Refer to Off Isolation	25°C		-42		dB
V	Occasion	$R_L = 50 \Omega$, $C_L = 5 pF$ f = 1 MHz Refer to Crosstalk	25°C		-62		dB
X _{TALK}	Crosstalk	$R_L = 50 \Omega$, $C_L = 5 pF$ f = 10 MHz Refer to Crosstalk	25°C		-42		dB
D\\/	Bandwidth - TMUX1208	$R_L = 50 \Omega$, $C_L = 5 pF$ Refer to Bandwidth	25°C		65		MHz
BW	Bandwidth - TMUX1209	$R_L = 50 \Omega$, $C_L = 5 pF$ Refer to Bandwidth	25°C		125		MHz
C _{SOFF}	Source off capacitance	f = 1 MHz	25°C		13		pF
	Drain off capacitance - TMUX1208	f = 1 MHz	25°C		76		pF
C _{DOFF}	Drain off capacitance - TMUX1209	f = 1 MHz	25°C		38		pF
C _{SON}	On capacitance - TMUX1208	f = 1 MHz	25°C		85		pF
C _{DON}	On capacitance - TMUX1209	f = 1 MHz	25°C		42		pF



7.8 Electrical Characteristics ($V_{DD} = 1.2 \text{ V} \pm 10 \text{ \%}$)

at $T_A = 25$ °C, $V_{DD} = 1.2$ V (unless otherwise noted)

	PARAMETER	TEST CONDITIONS	TA	MIN	TYP	MAX	UNIT
ANALO	G SWITCH						
		$V_S = 0 \text{ V to } V_{DD}$	25°C		70		Ω
R _{ON}	On-resistance	$I_{SD} = 10 \text{ mA}$	-40°C to +85°C			105	Ω
		Refer to On-Resistance	-40°C to +125°C			105	Ω
		$V_S = 0 \text{ V to } V_{DD}$	25°C		0.15		Ω
ΔR_{ON}	On-resistance matching between channels	$I_{SD} = 10 \text{ mA}$	-40°C to +85°C			1.5	Ω
	onaniioo	Refer to On-Resistance	-40°C to +125°C			1.5	Ω
		V _{DD} = 1.32 V	25°C		±75		nA
	0(1)	Switch Off	-40°C to +85°C	-150		150	nA
S(OFF) Source off leakage current	burce off leakage current ⁽¹⁾ $V_D = 1.2 \text{ V } / 1 \text{ V}$ $V_S = 1 \text{ V } / 1.2 \text{ V}$ Refer to Off-Leakage Current		-175		175	nA	
		V _{DD} = 1.32 V	25°C		±200		nA
Drain off leakag	Drain off lookage current(1)	Switch Off	-40°C to +85°C	-500		500	nA
	Drain off leakage current ⁽¹⁾	$V_D = 1.2 \text{ V} / 1 \text{ V}$ $V_S = 1 \text{ V} / 1.2 \text{ V}$ Refer to Off-Leakage Current	-40°C to +125°C	-750		750	nA
		V _{DD} = 1.32 V	25°C		±200		nA
$I_{D(ON)}$	Channel on leakage current	Switch On	-40°C to +85°C	-500		500	nA
I _{S(ON)}		$V_D = V_S = 1.2 \text{ V} / 1 \text{ V}$ Refer to On-Leakage Current	-40°C to +125°C	-750		750	nA
LOGIC	INPUTS (EN, A0, A1, A2)						
V _{IH}	Input logic high		-40°C to +125°C	0.96		5.5	V
V_{IL}	Input logic low		-40°C to +125°C	0		0.36	V
I _{IH} I _{IL}	Input leakage current		25°C		±0.005		μΑ
I _{IH} I _{IL}	Input leakage current		-40°C to +125°C			±0.10	μΑ
C	Logic input capacitance		25°C		1		pF
C _{IN}	Logic input capacitance		-40°C to +125°C			2	pF
POWER	SUPPLY						
I	V cupply current	Logic inputs = 0 V or 5.5 V	25°C		0.005		μΑ
I _{DD}	V _{DD} supply current	Logic inputs = 0 v or 5.5 v	-40°C to +125°C			0.8	μΑ

⁽¹⁾ When $V_{\mbox{\scriptsize S}}$ is 1.2 V, $V_{\mbox{\scriptsize D}}$ is 1 V, and vice versa.

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Electrical Characteristics (V_{DD} = 1.2 V ±10 %) (continued)

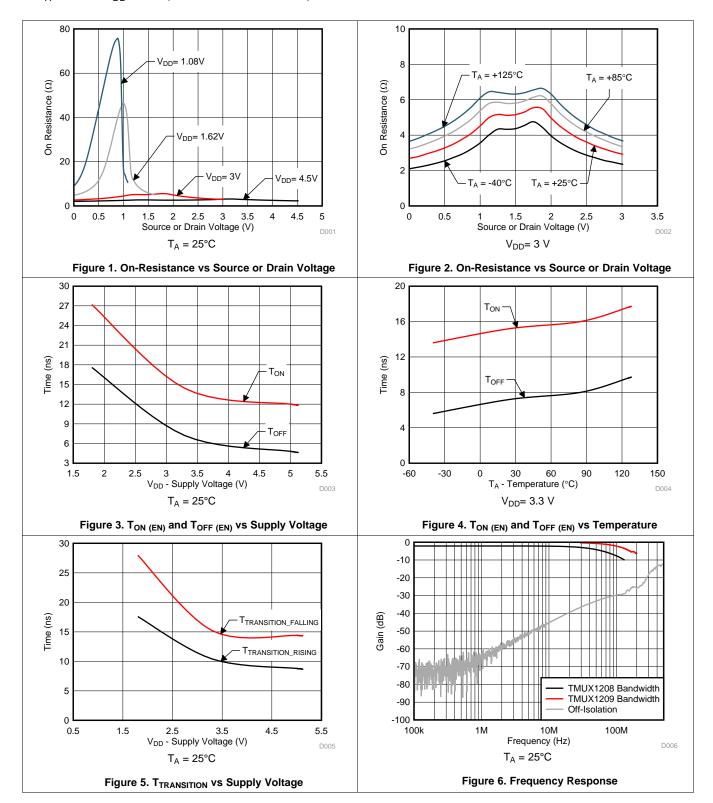
at $T_A = 25$ °C, $V_{DD} = 1.2 \text{ V}$ (unless otherwise noted)

Α	PARAMETER	TEST CONDITIONS	TA	MIN	TYP	MAX	UNIT
DYNAM	IC CHARACTERISTICS						
		V _S = 1 V	25°C		60		ns
t _{TRAN}	Transition time between channels	$R_L = 200 \Omega$, $C_L = 15 pF$	-40°C to +85°C			210	ns
		Refer to Transition Time	-40°C to +125°C			210	ns
		V _S = 1 V	25°C		28		ns
t _{OPEN}	Break before make time	$R_L = 200 \Omega, C_L = 15 pF$	-40°C to +85°C	1			ns
(BBM)		Refer to Break-Before-Make	-40°C to +125°C	1			ns
		V _S = 1 V	25°C		60		ns
t _{ON(EN)}	Enable turn-on time	$R_L = 200 \Omega, C_L = 15 pF$	-40°C to +85°C			190	ns
		Refer to t _{ON(EN)} and t _{OFF(EN)}	-40°C to +125°C			190	ns
		V _S = 1 V	25°C		45		ns
t _{OFF(EN)}	Enable turn-off time	$R_L = 200 \Omega$, $C_L = 15 pF$	-40°C to +85°C			150	ns
		Refer to t _{ON(EN)} and t _{OFF(EN)}	-40°C to +125°C			150	ns
Q_C	Charge Injection	$V_S = V_{DD}/2$ $R_S = 0 \Omega$, $C_L = 1 nF$ Refer to Charge Injection	25°C		±2		рС
		$R_L = 50 \Omega$, $C_L = 5 pF$ f = 1 MHz Refer to Off Isolation	25°C		-62		dB
O _{ISO}	Off Isolation	$R_L = 50 \Omega$, $C_L = 5 pF$ f = 10 MHz Refer to Off Isolation	25°C		-42		dB
V	Occasion	$R_L = 50 \Omega$, $C_L = 5 pF$ f = 1 MHz Refer to Crosstalk	25°C		-62		dB
X _{TALK}	Crosstalk	$R_L = 50 \Omega$, $C_L = 5 pF$ f = 10 MHz Refer to Crosstalk	25°C		-42		dB
D\\/	Bandwidth - TMUX1208	$R_L = 50 \Omega$, $C_L = 5 pF$ Refer to Bandwidth	25°C		65		MHz
BW	Bandwidth - TMUX1209	$R_L = 50 \Omega$, $C_L = 5 pF$ Refer to Bandwidth	25°C		125		MHz
C _{SOFF}	Source off capacitance	f = 1 MHz	25°C		13		pF
	Drain off capacitance - TMUX1208	f = 1 MHz	25°C		76		pF
C _{DOFF}	Drain off capacitance - TMUX1209	f = 1 MHz	25°C		38		pF
C _{SON}	On capacitance - TMUX1208	f = 1 MHz	25°C		85		pF
C _{DON}	On capacitance - TMUX1209	f = 1 MHz	25°C		42		pF

TEXAS INSTRUMENTS

7.9 Typical Characteristics

at $T_A = 25$ °C, $V_{DD} = 5$ V (unless otherwise noted)





8 Detailed Description

8.1 Overview

8.1.1 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. The measurement setup used to measure R_{ON} is shown below. Voltage (V) and current (I_{SD}) are measured using this setup, and R_{ON} is computed as shown in Figure 7 with $R_{ON} = V / I_{SD}$:

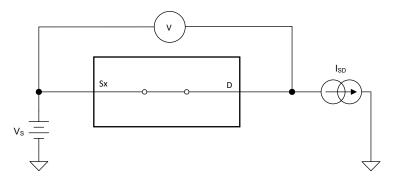


Figure 7. On-Resistance Measurement Setup

8.1.2 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 $I_{D(OFF)}$.

The setup used to measure both off-leakage currents is shown in Figure 8.

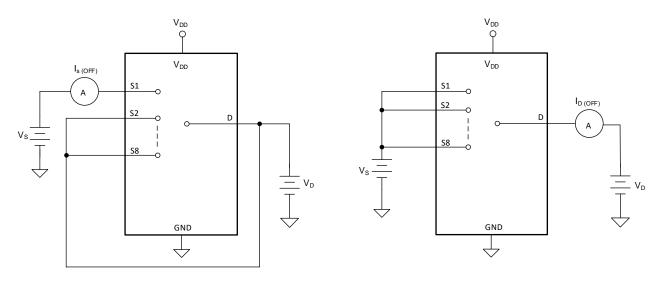


Figure 8. Off-Leakage Measurement Setup



8.1.3 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 9 shows the circuit used for measuring the on-leakage current, denoted by $I_{S(ON)}$ or $I_{D(ON)}$.

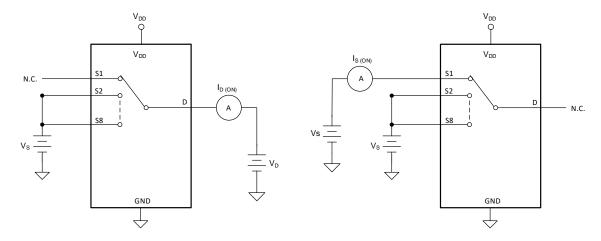


Figure 9. On-Leakage Measurement Setup

8.1.4 Transition Time

Transition time is defined as the time taken by the output of the device to rise or fall 10% after the address signal has risen or fallen past the logic threshold. The 10% 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 10 shows the setup used to measure transition time, denoted by the symbol transition.

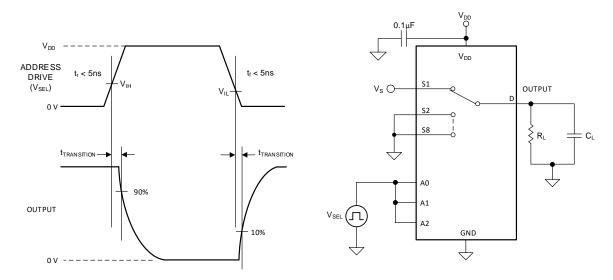


Figure 10. Transition-Time Measurement Setup



8.1.5 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 11 shows the setup used to measure break-before-make delay, denoted by the symbol t_{OPEN(BBM)}.

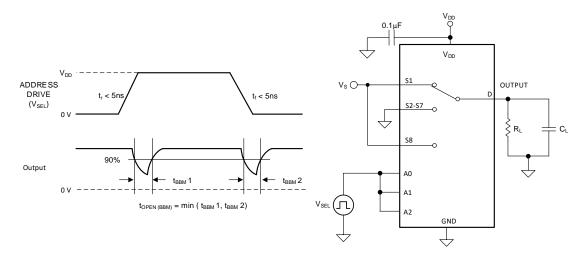


Figure 11. Break-Before-Make Delay Measurement Setup

8.1.6 $t_{ON(EN)}$ and $t_{OFF(EN)}$

Turn-on time is defined as the time taken by the output of the device to rise to 10% after the enable has risen 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 12 shows the setup used to measure transition time, denoted by the symbol $t_{\text{ON(EN)}}$.

Turn-off time is defined as the time taken by the output of the device to fall to 90% after the enable has fallen 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 12 shows the setup used to measure transition time, denoted by the symbol $t_{OFF(EN)}$.

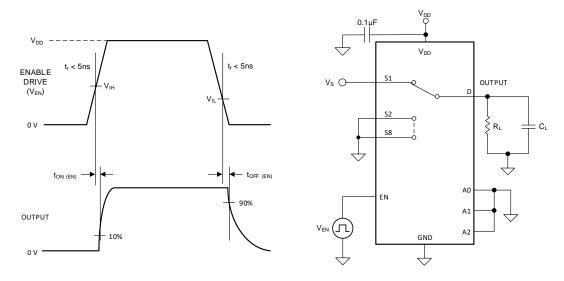


Figure 12. Turn-On and Turn-Off Time Measurement Setup



8.1.7 Charge Injection

The TMUX1208 and TMUX1209 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 13 shows the setup used to measure charge injection from source (Sx) to drain (D).

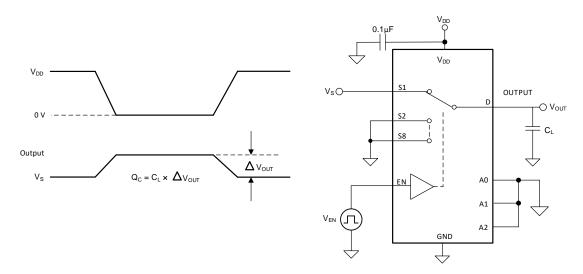


Figure 13. Charge-Injection Measurement Setup

8.1.8 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 14 shows the setup used to measure, and the equation to compute off isolation.

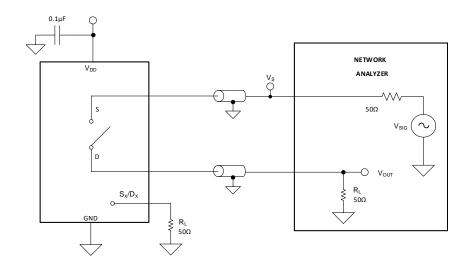


Figure 14. Off Isolation Measurement Setup

Off Isolation = $20 \cdot \text{Log}\left(\frac{V_{\text{OUT}}}{V_{\text{S}}}\right)$ (1)



8.1.9 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 15 shows the setup used to measure, and the equation used to compute crosstalk.

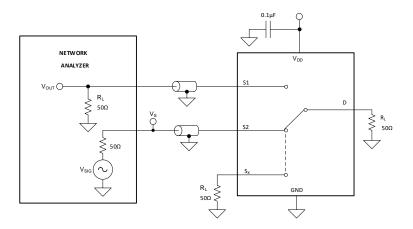


Figure 15. Channel-to-Channel Crosstalk Measurement Setup

Channel-to-Channel Crosstalk =
$$20 \cdot Log \left(\frac{V_{OUT}}{V_{S}} \right)$$
 (2)

8.1.10 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 16 shows the setup used to measure bandwidth.

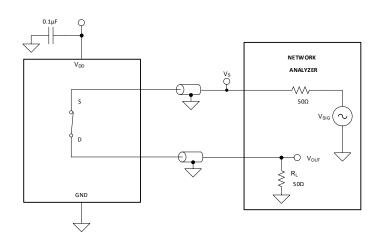


Figure 16. Bandwidth Measurement Setup

Attenuation =
$$20 \cdot \text{Log}\left(\frac{V_2}{V_1}\right)$$
 (3)



8.2 Functional Block Diagram

The TMUX1208 is an 8:1, single-ended (1-ch.), mux. The TMUX1209 is an 4:1, differential (2-ch.), mux. Each channel is turned on or turned off based on the state of the address lines and enable pin.

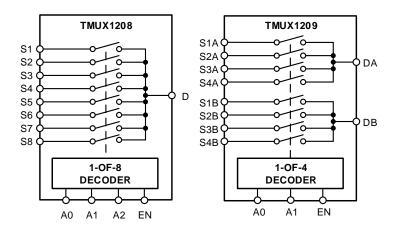


Figure 17. TMUX1208, TMUX1209 Functional Block Diagrams

8.3 Feature Description

8.3.1 Bidirectional Operation

The TMUX1208 and TMUX1209 conduct 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.

8.3.2 Rail to Rail Operation

The valid signal path input/output voltage for TMUX1208 and TMUX1209 ranges from GND to V_{DD}.

8.3.3 1.8 V Logic Compatible Inputs

The TMUX1208 and TMUX1209 has 1.8-V logic compatible control for all logic control inputs. The logic input thresholds scale with supply but still provide 1.8-V logic control when operating at 5.5 V supply voltage. 1.8-V logic level inputs allows the multiplexers 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 Fail-Safe Logic

The TMUX1208 and TMUX1209 have Fail-Safe Logic on the control input pins (EN, A0, A1, A2) allowing for operation up to 5.5 V, regardless of the state of the supply pin. 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 select pins of the TMUX1208 or TMUX1209 to be ramped to 5.5 V while V_{DD} = 0 V. Additionally, the feature enables operation of the multiplexers with V_{DD} = 1.2 V while allowing the select pins to interface with a logic level of another device up to 5.5 V.



Feature Description (continued)

8.3.5 Device Functional Modes

When the EN pin of the TMUX1208 is pulled high, one of the switches is closed based on the state of the address lines. Similarly, when the EN pin of the TMUX1209 is pulled high, two of the switches are closed based on the state of the address lines. When the EN pin is pulled low, all the switches are in an open state regardless of the state of the address lines.

8.3.6 Truth Tables

Table 1 and Table 2 show the truth tables for the TMUX1208 and TMUX1209, respectively.

EN	A2	A1	A0	Selected Inputs Connected To Drain (D) Pin
0	X ⁽¹⁾	X ⁽¹⁾	X ⁽¹⁾	All channels are off
1	0	0	0	S1
1	0	0	1	S2
1	0	1	0	S 3
1	0	1	1	\$4
1	1	0	0	S 5
1	1	0	1	\$6
1	1	1	0	S 7
1	1	1	1	\$8

Table 1. TMUX1208 Truth Table

(1) X denotes don't care.

Table 2. TMUX1209 Truth Table

EN	A1	A0	Selected Input Connected To Drain (DA, DB) Pins
0	X ⁽¹⁾	X ⁽¹⁾	All channels are off
1	0	0	S1A and S1B
1	0	1	S2A and S2B
1	1	0	S3A and S3B
1	1	1	S4A and S4B

(1) X denotes don't care.



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. Customers should validate and test their design implementation to confirm system functionality.

9.1 Application Information

The TMUX12xx family offers good system performance across a wide operating supply (1.08V to 5.5V). These devices include 1.8V logic compatible control input pins that enable operation in systems with 1.8V I/O rails. Additionally, the control input pins support Fail-Safe Logic which allows for operation up to 5.5V, regardless of the state of the supply pin. This protection stops the logic pins from back-powering the supply rail. These features make the TMUX12xx a family of general purpose multiplexers and switches that can reduce system complexity, board size, and overall system cost.

9.2 Typical Application

One useful application to take advantage of the TMUX1208 features is multiplexing various signals into an ADC that is integrated into a MCU. Utilizing an integrated ADC in a MCU allows a system to minimize cost with a potential tradeoff of system performance when compared to an external ADC. The multiplexer allows for multiple inputs/sensors to be monitored with a single ADC pin of the device, which is critical in systems with limited I/O. The TMUX1209 is suitable for similar design example using differential signals, or as two 4:1 multiplexers.

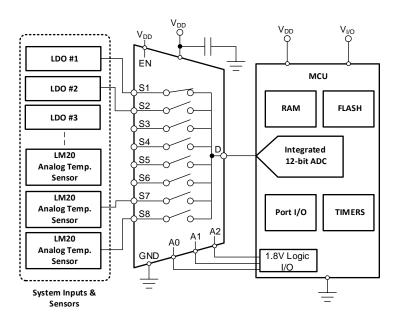


Figure 18. Multiplexing Signals to Integrated ADC

9.3 Design Requirements

For this design example, use the parameters listed in Table 3.

Table 3. Design Parameters

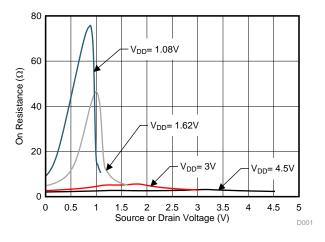
PARAMETERS	VALUES
Supply (V _{DD})	5.0 V
I/O signal range	0 V to V _{DD} (Rail to Rail)
Control logic thresholds	1.8 V compatible



9.4 Detailed Design Procedure

The TMUX1208 and TMUX1209 can be operated without any external components except for the supply decoupling capacitors. If the parts desired power-up state is disabled, the enable pin should have a weak pull-down resistor and be controlled by the MCU via GPIO. All inputs being muxed to the ADC of the MCU must fall within the recommend operating conditions of the TMUX1208 and TMUX1209 including signal range and continuous current. For this design with a supply of 5 V the signal range can be 0 V to 5 V and the max continuous current can be 30 mA.

9.5 Application Curve



 $T_A = 25^{\circ}C$

Figure 19. On-Resistance vs Source or Drain Voltage

10 Power Supply Recommendations

The TMUX1208 and TMUX1209 operate across a wide supply range of 1.08 V to 5.5 V. Do not exceed the absolute maximum ratings because stresses beyond the listed ratings can cause permanent damage to the devices.

Power-supply bypassing improves noise margin and prevents switching noise propagation from the V_{DD} supply 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 μF to 10 μF from V_{DD} 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 planes.



11 Layout

11.1 Layout Guidelines

11.1.1 Layout Information

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

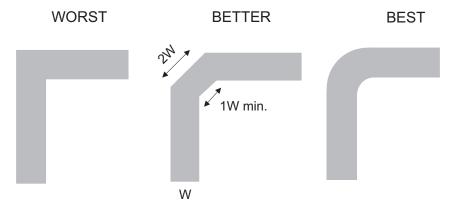


Figure 20. Trace Example

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, throughhole pins are not recommended at high frequencies.

Figure 21 illustrates an example of a PCB layout with the TMUX1208. Some key considerations are:

- Decouple the V_{DD} pin with a 0.1- μ F capacitor, placed as close to the pin as possible. Make sure that the capacitor voltage rating is sufficient for the V_{DD} supply.
- 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.

11.2 Layout Example

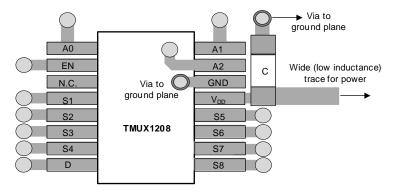


Figure 21. TMUX1208 Layout Example



12 Device and Documentation Support

12.1 Documentation Support

12.1.1 Related Documentation

Texas Instruments, Simplifying Design with 1.8 V logic Muxes and Switches.

Texas Instruments, QFN/SON PCB Attachment.

Texas Instruments, Quad Flatpack No-Lead Logic Packages.

12.2 Related Links

The table below lists quick access links. Categories include technical documents, support and community resources, tools and software, and quick access to order now.

Table 4. Related Links

PARTS	PRODUCT FOLDER	ORDER NOW	TECHNICAL DOCUMENTS	TOOLS & SOFTWARE	SUPPORT & COMMUNITY
TMUX1208	Click here	Click here	Click here	Click here	Click here
TMUX1209	Click here	Click here	Click here	Click here	Click here

12.3 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.

12.4 Community Resources

The following links connect to TI community resources. Linked contents are 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.

TI E2E™ Online Community TI's Engineer-to-Engineer (E2E) Community. Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

Design Support *TI's Design Support* Quickly find helpful E2E forums along with design support tools and contact information for technical support.

12.5 Trademarks

E2E is a trademark of Texas Instruments.

12.6 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.

12.7 Glossary

SLYZ022 — TI Glossary.

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

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.

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PACKAGE OPTION ADDENDUM

10-Dec-2020

PACKAGING INFORMATION

www.ti.com

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan	Lead finish/ Ball material	MSL Peak Temp	Op Temp (°C)	Device Marking (4/5)	Samples
							(6)				
TMUX1208PWR	ACTIVE	TSSOP	PW	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	TM1208	Samples
TMUX1208RSVR	ACTIVE	UQFN	RSV	16	3000	RoHS & Green	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	1B4	Samples
TMUX1209PWR	ACTIVE	TSSOP	PW	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	TM1209	Samples
TMUX1209RSVR	ACTIVE	UQFN	RSV	16	3000	RoHS & Green	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	1D2	Samples

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

(2) RoHS: TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (CI) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

- (3) MSL, Peak Temp. The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.
- (4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.
- (5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.
- (6) Lead finish/Ball material Orderable Devices 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.

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PACKAGE OPTION ADDENDUM

10-Dec-2020

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OTHER QUALIFIED VERSIONS OF TMUX1208:

Automotive: TMUX1208-Q1

NOTE: Qualified Version Definitions:

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

PACKAGE MATERIALS INFORMATION

www.ti.com 3-Jun-2022

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
TMUX1208PWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
TMUX1208RSVR	UQFN	RSV	16	3000	178.0	13.5	2.1	2.9	0.75	4.0	12.0	Q1
TMUX1209PWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
TMUX1209RSVR	UQFN	RSV	16	3000	178.0	13.5	2.1	2.9	0.75	4.0	12.0	Q1

www.ti.com 3-Jun-2022



*All dimensions are nominal

7 III dilitorio di Citto i i i i i i i i i i i i i i i i i i								
	Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
	TMUX1208PWR	TSSOP	PW	16	2000	356.0	356.0	35.0
	TMUX1208RSVR	UQFN	RSV	16	3000	189.0	185.0	36.0
	TMUX1209PWR	TSSOP	PW	16	2000	356.0	356.0	35.0
	TMUX1209RSVR	UQFN	RSV	16	3000	189.0	185.0	36.0



SMALL OUTLINE PACKAGE



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. 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-153.



SMALL OUTLINE PACKAGE



NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



SMALL OUTLINE PACKAGE



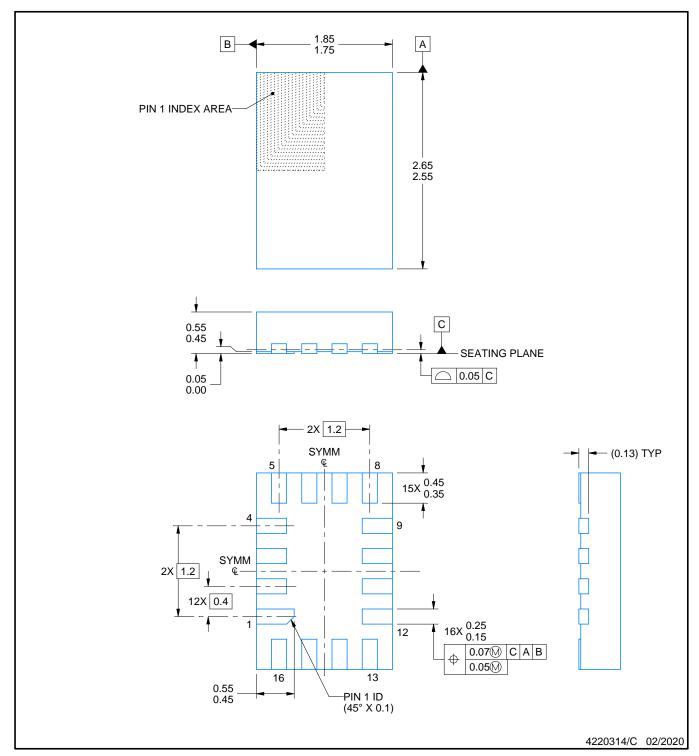
NOTES: (continued)

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





ULTRA THIN QUAD FLATPACK - NO LEAD

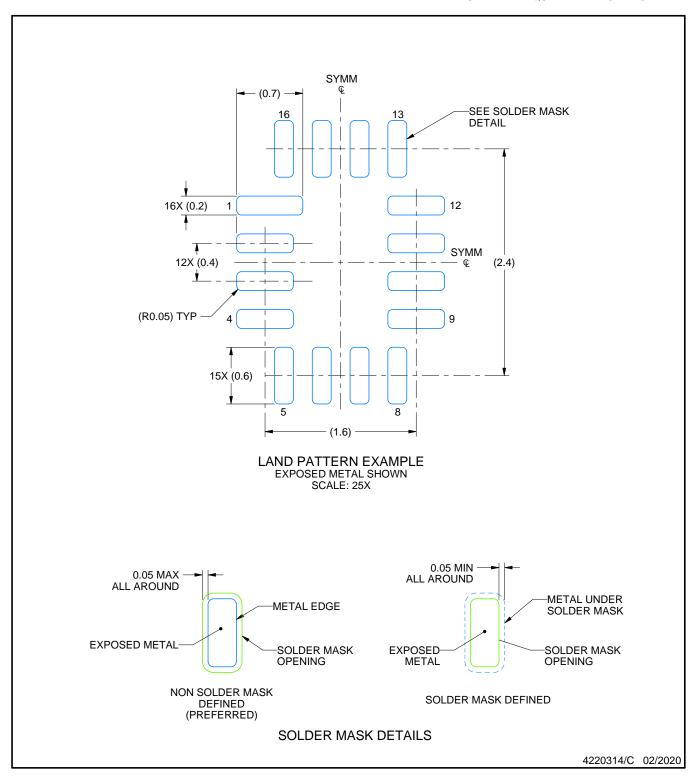


NOTES:

- All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
 This drawing is subject to change without notice.



ULTRA THIN QUAD FLATPACK - NO LEAD

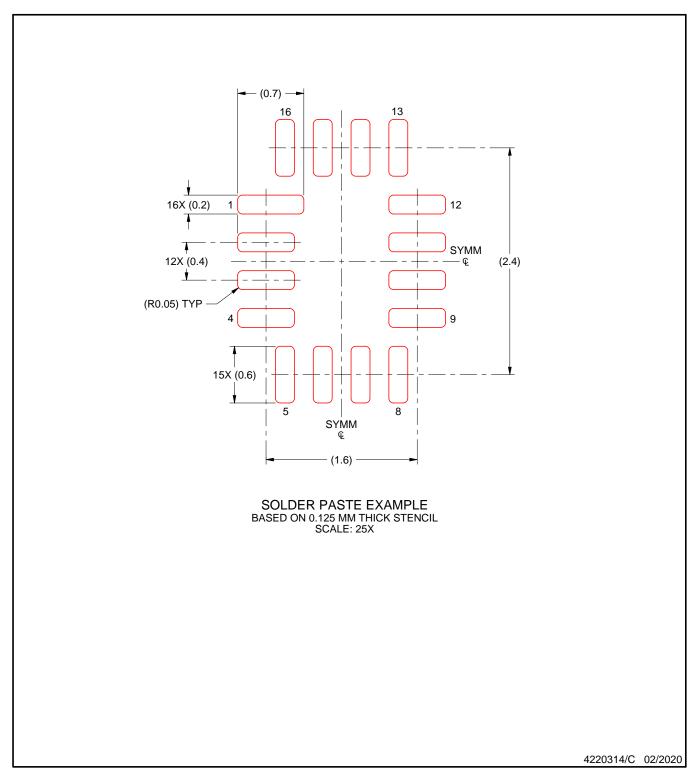


NOTES: (continued)

3. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).



ULTRA THIN QUAD FLATPACK - NO LEAD



NOTES: (continued)

4. 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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