19-3915; Rev 1; 1/07

High-Bandwidth T1/E1 Dual-SPDT Switches/ 4:1 Muxes

General Description

The MAX4818/MAX4819 high-bandwidth, low-on-resistance analog dual SPDT switches/4:1 multiplexers are designed to serve as integrated T1/E1 protection switches for 1+1 and N+1 line-card redundancy applications. Each MAX4818/MAX4819 replaces four electromechanical relays, significantly reducing board space, simplifying PC board routing, and reducing power consumption. These devices operate with ±3.3V or ±5V dual supplies for applications requiring T1/E1 signal switching in the line side of the interface transformer. Internal voltage multipliers drive the analog switches, yielding excellent linearity and low 4Ω typical on-resistance within the T1/E1 analog signal range. This high-bandwidth family of products is optimized for low return loss and matched pulse template performance in T1/E1 long-haul and short-haul applications.

The MAX4818/MAX4819 are available in a tiny 16-pin, 5mm x 5mm, thin QFN package and are specified over the extended -40°C to +85°C temperature range.

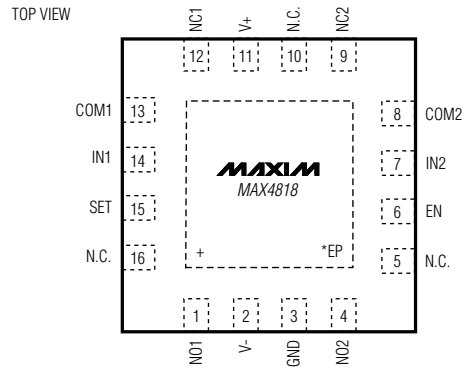
Applications

T1/E1 Redundancy Switching
Base Stations and Base-Station Controllers
Add and Drop Multiplexers
Multi-Service Provisioning Platforms
Edge Routers
Multi-Service-Switches (MSSs)
Digital Loop Carriers
Industrial Applications
Data Acquisition
Telecom Signal Switching
Test Equipment
Avionics

Features

- **Dual SPDT and 4:1 Multiplexer Configurations**
- **Dual-Supply Operation from ±3.3V to ±5V**
- **Single-Supply Operation from +6V to +11V**
- **Hot-Insertion Tolerant with No DC Path to the Supplies**
- **Low On-Resistance, R_{ON} = 4Ω (typ) and 6Ω (max)**
- **Over 350MHz -3dB Signal Bandwidth (MAX4818)**
- **Excellent Crosstalk and Off-Isolation Performance Over the T1/E1 Signal Spectrum: Over 110dB Crosstalk Attenuation at 1MHz (MAX4818)**
- **Low Current Consumption of 2mA (max)**
- **-40°C to +85°C Extended Temperature Range**
- **Space-Saving, 16-Pin, 5mm x 5mm Thin QFN**
- **SET Controls All Switches Simultaneously For Redundancy Switching (MAX4819)**

Pin Configurations



THIN QFN (5mm x 5mm)
***EXPOSED PADDLE CONNECTED TO V-**

Pin Configurations continued at end of data sheet.

Ordering Information

PART	TEMP RANGE	PIN-PACKAGE	CONFIGURATION	PACKAGE CODE
MAX4818ETE+	-40°C to +85°C	16 TQFN-EP*	2 x SPDT	T1655-3
MAX4819ETE+	-40°C to +85°C	16 TQFN-EP*	4:1 MUX	T1655-3

**EP = Exposed Paddle*
Devices are available in lead-free packages.

For pricing, delivery, and ordering information, please contact Maxim/Dallas Direct! at 1-888-629-4642, or visit Maxim's website at www.maxim-ic.com.

High-Bandwidth T1/E1 Dual-SPDT Switches/ 4:1 Muxes

ABSOLUTE MAXIMUM RATINGS

(All voltages referenced to GND unless otherwise noted.)
V+ .....-0.3V to +6V
V- .....-6V to +0.3V
V+ to V-.....-0.3V to +12V
IN_, A0, A1, SET, EN .....-0.3V to (V+) + 0.3V
NO_, NC_, COM_ .....-12V to +12V
NO_, to COM_, NC_ to COM_.....-18V to +18V
Continuous Current (NO_, NC_, COM_) ..... ±100mA
Continuous Current (Any Other Terminal) .....±30mA
Peak Current (NO_, NC_, COM_)
(pulsed at 1ms, 10% duty cycle).....±300mA
Continuous Power Dissipation (T_A = +70°C)
16-Pin Thin QFN 5mm x 5mm (derate 33.3mW/°C above T_A = +70°C) 2667mW
Operating Temperature Range ..... -40°C to +85°C
Storage Temperature Range ..... -65°C to +150°C
Junction Temperature .....+150°C
Lead Temperature (soldering, 10s) ..... +300°C

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS—Dual ±3.3V Supplies

(V+ = +3.3V ±10%, V- = -3.3V ±10%, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
ANALOG SWITCH							
Fault-Free Analog Signal Range	$V_{COM_}$ $V_{NO_}$ $V_{NC_}$			V-		V+	V
MAX4818 On-Resistance	R_{ON}	V+ = +3V, V- = -3V, $I_{COM_}$ = 30mA, $V_{NO_}$ or $V_{NC_}$ = +3V (Note 2)	T_A = +25°C		4	5	Ω
			T_A = T_{MIN} to T_{MAX}			6	
MAX4819 On-Resistance	R_{ON}	V+ = +3V, V- = -3V, $I_{COM_}$ = 30mA, $V_{NO_}$ or $V_{NC_}$ = +3V (Note 2)	T_A = +25°C		4	5	Ω
			T_A = T_{MIN} to T_{MAX}			6.2	
On-Resistance Match Between Channels	ΔR_{ON}	V+ = +3V, V- = -3V, $I_{COM_}$ = 30mA, $V_{NO_}$ or $V_{NC_}$ = +3V (Notes 2, 3)	T_A = +25°C		0.3	0.6	Ω
			T_A = T_{MIN} to T_{MAX}			0.8	
On-Resistance Flatness	$R_{FLAT(ON)}$	V+ = +3V, V- = -3V, $I_{COM_}$ = 30mA, $V_{NO_}$ or $V_{NC_}$ = -3V, 0V, +3V (Notes 2, 4)	T_A = +25°C		0.5	1.2	Ω
			T_A = T_{MIN} to T_{MAX}			1.5	
NO or NC Off-Leakage Current	$I_{NO_(OFF)}$ $I_{NC_(OFF)}$	V+ = +3.6V, V- = -3.6V, $V_{COM_}$ = -3V, +3V, $V_{NO_}$ or $V_{NC_}$ = +3V, -3V		-10		+10	nA
COM Off-Leakage Current	$I_{COM_(OFF)}$	V+ = +3.6V, V- = -3.6V, $V_{COM_}$ = -3V, +3V, $V_{NO_}$ or $V_{NC_}$ = +3V, -3V		-10		+10	nA
COM On-Leakage Current	$I_{COM_(ON)}$	V+ = +3.6V, V- = -3.6V, $V_{COM_}$ = -3V, +3V, $V_{NO_}$ or $V_{NC_}$ unconnected		-15		+15	nA

ELECTRICAL CHARACTERISTICS—Dual ±3.3V Supplies (continued)

(V+ = +3.3V ±10%, V- = -3.3V ±10%, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
FAULT							
Fault Analog Signal Range	$V_{COM_}$ $V_{NO_}$ $V_{NC_}$	V+ = +3.3V, V- = -3.3V		-11		+11	V
NO or NC Off-Leakage Current	$I_{NO_}$ $I_{NC_}$	V+ = +3.3V, V- = -3.3V, $V_{COM_}$ = +11V, -11V, $V_{NO_}$ or $V_{NC_}$ = -5.5V, +5.5V		-1		+1	µA
COM Off-Leakage Current	$I_{COM_}$	V+ = +3.3V, V- = -3.3V, $V_{COM_}$ = +11V, -11V, $V_{NO_}$ or $V_{NC_}$ = -5.5V, +5.5V		-1		+1	µA
SWITCH DYNAMIC CHARACTERISTICS							
MAX4818 Crosstalk (Note 5)	V_{CT1}	R_L = 50Ω, f = 1.024MHz, Figure 4			110		dB
	V_{CT2}	R_L = 50Ω, f = 30MHz, Figure 4			77		
MAX4819 All-Hostile Crosstalk (Note 6)	V_{HCT1}	R_L = 50Ω, f = 1.024MHz			50		dB
	V_{HCT2}	R_L = 50Ω, f = 30MHz			17		
Off-Isolation (Note 7)	V_{ISO1}	$V_{COM_}$ to $V_{NO_}$ or $V_{NC_}$, R_L = 50Ω, f = 1.024MHz, Figure 4			60		dB
	V_{ISO2}	$V_{COM_}$ to $V_{NO_}$ or $V_{NC_}$, R_L = 50Ω, f = 30MHz, Figure 4			30		
On-Channel -3dB Bandwidth	BW	R_S = R_L = 50Ω, Figure 4	MAX4818		350		MHz
			MAX4819		220		
COM On-Capacitance	$C_{ON(COM_)}$	f = 1MHz, Figure 5	MAX4818		20		pF
			MAX4819		40		
COM Off-Capacitance	$C_{OFF(COM_)}$	f = 1MHz, Figure 5	MAX4818		15		pF
			MAX4819		30		
NC/NO Off-Capacitance	C_{OFF}	f = 1MHz, Figure 5			7		pF
Charge Injection	Q	C_L = 1.0nF, V_{GEN} = 0, R_{GEN} = 0, Figure 3	MAX4818		35		pC
			MAX4819		60		
Fault Recovery Time	t_{REC}	$V_{NO_}$, $V_{NC_}$, $V_{COM_}$ = -11V			128		µs
Turn-On Time	t_{ON}	$V_{NO_}$ or $V_{NC_}$= +3V, R_L = 300Ω, C_L = 35pF, Figure 2	T_A = +25°C		20	50	µs
			T_A = T_{MIN} to T_{MAX}			50	
Turn-Off Time	t_{OFF}	$V_{NO_}$ or $V_{NC_}$= +3V, R_L = 300Ω, C_L = 35pF, Figure 2	T_A = +25°C		0.5	1	µs
			T_A = T_{MIN} to T_{MAX}			1	
Power-Up Delay	t_{DEL}				128		µs

High-Bandwidth T1/E1 Dual-SPDT Switches/ 4:1 Muxes

ELECTRICAL CHARACTERISTICS—Dual ±3.3V Supplies (continued)

(V+ = +3.3V ±10%, V- = -3.3V ±10%, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
LOGIC INPUT (IN_, EN, SET, A0, A1)						
Input Voltage Low	V_{IL}				0.8	V
Input Voltage High	V_{IH}		2.4			V
Input Leakage Current	I_{IN}	$V_{IN_}$ = 0 or V+	-1		+1	µA
POWER SUPPLY						
Quiescent Positive Supply Current	I+	V+ = +3.6V, V- = -3.6V, $V_{IN_}$ = 0 or V+		0.8	2	mA
Quiescent Negative Supply Current	I-	V+ = +3.6V, V- = -3.6V, $V_{IN_}$ = 0 or V+		0.8	2	mA
Positive Supply Voltage	V+		3.0		3.6	V
Negative Supply Voltage	V-		-3.6		-3.0	V

ELECTRICAL CHARACTERISTICS—Dual ±5V Supplies

(V+ = +5V ±10%, V- = -5V ±10%, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
ANALOG SWITCH							
Fault-Free Analog Signal Range	$V_{COM_}$ $V_{NO_}$ $V_{NC_}$			V-		V+	V
MAX4818 On-Resistance	R_{ON}	V+ = +4.5V, V- = -4.5V, $I_{COM_}$ = 30mA, $V_{NO_}$ or $V_{NC_}$ = +3V (Note 2)	T_A = +25°C		4	5	Ω
			T_A = T_{MIN} to T_{MAX}			6	
MAX4819 On-Resistance	R_{ON}	V+ = +4.5V, V- = -4.5V, $I_{COM_}$ = 30mA, $V_{NO_}$ or $V_{NC_}$ = +3V (Note 2)	T_A = +25°C		4	5	Ω
			T_A = T_{MIN} to T_{MAX}			6.2	
On-Resistance Match Between Channels	ΔR_{ON}	V+ = +4.5V, V- = -4.5V, $I_{COM_}$ = 30mA, $V_{NO_}$ or $V_{NC_}$ = +3V (Notes 2, 3)	T_A = +25°C		0.3	0.6	Ω
			T_A = T_{MIN} to T_{MAX}			0.8	
On-Resistance Flatness	$R_{FLAT(ON)}$	V+ = +4.5V, V- = -4.5V, $I_{COM_}$ = 30mA, $V_{NO_}$ or $V_{NC_}$ = -3V, 0V, +3V (Notes 2, 4)	T_A = +25°C		0.5	1.2	Ω
			T_A = T_{MIN} to T_{MAX}			1.5	
NO or NC Off-Leakage Current	$I_{NO_(OFF)}$ $I_{NC_(OFF)}$	V+ = +5.5V, V- = -5.5V, $V_{COM_}$ = -5V, +5V, $V_{NO_}$ or $V_{NC_}$ = +5V, -5V		-10		+10	nA
COM Off-Leakage Current	$I_{COM_(OFF)}$	V+ = +5.5V, V- = -5.5V, $V_{COM_}$ = -5V, +5V, $V_{NO_}$ or $V_{NC_}$ = +5V, -5V		-10		+10	nA

ELECTRICAL CHARACTERISTICS—Dual ±5V Supplies (continued)

(V+ = +5V ±10%, V- = -5V ±10%, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
COM On-Leakage Current	$I_{COM_(ON)}$	V+ = +5.5V, V- = -5.5V, $V_{COM_}$ = -5V, +5V, $V_{NO_}$ or $V_{NC_}$ unconnected		-15		+15	nA
FAULT							
Fault Analog Signal Range	$V_{COM_}$ $V_{NO_}$ $V_{NC_}$	V+ =5V, V- = -5V		-11		+11	V
NO or NC Off-Leakage Current	$I_{NO_}$ $I_{NC_}$	V+ = 5V, V- = -5V, $V_{NO_}$ or $V_{NC_}$ = +11V, -11V, $V_{COM_}$ = -5.5, +5.5V		-1		+1	µA
COM Off-Leakage Current	$I_{COM_}$	V+ = 5V, V- = -5V, $V_{NO_}$ or $V_{NC_}$ = +11V, -11V, $V_{COM_}$ = -5.5, +5.5V		-1		+1	µA
SWITCH DYNAMIC CHARACTERISTICS							
MAX4818 Crosstalk (Note 5)	V_{CT1}	R_L = 50Ω, f = 1.024MHz, Figure 4			110		dB
	V_{CT2}	R_L = 50Ω, f = 30MHz, Figure 4			77		
MAX4819 All-Hostile Crosstalk (Note 6)	V_{HCT1}	R_L = 50Ω, f = 1.024MHz			50		dB
	V_{HCT2}	R_L = 50Ω, f = 30MHz			17		
Off-Isolation (Note 6)	V_{ISO1}	$V_{COM_}$ to $V_{NO_}$ or $V_{NC_}$, R_L = 50Ω, f = 1.024MHz, Figure 4			60		dB
	V_{ISO2}	$V_{COM_}$ to $V_{NO_}$ or $V_{NC_}$, R_L = 50Ω, f = 30MHz, Figure 4			30		
On-Channel -3dB Bandwidth	BW	R_S = R_L = 50Ω, Figure 4	MAX4818		350		MHz
			MAX4819		220		
COM On-Capacitance	$C_{ON(COM_)}$	f = 1MHz, Figure 5	MAX4818		20		pF
			MAX4819		40		
COM Off-Capacitance	$C_{OFF(COM_)}$	f = 1MHz, Figure 5	MAX4818		15		pF
			MAX4819		30		
NC/NO Off-Capacitance	C_{OFF}	f = 1MHz, Figure 5			7		pF
Charge Injection	Q	C_L = 1.0nF, V_{GEN} = 0, R_{GEN} = 0, Figure 3	MAX4818		35		pC
			MAX4819		60		
Fault Recovery Time	t_{REC}	$V_{NO_}$, $V_{NC_}$, $V_{COM_}$ = -11V			128		µs
Turn-On Time	t_{ON}	$V_{NO_}$ or $V_{NC_}$ = +3V, R_L = 300Ω, C_L = 35pF, Figure 2	T_A = +25°C		20	50	µs
			T_A = T_{MIN} to T_{MAX}			50	
Turn-Off Time	t_{OFF}	$V_{NO_}$ or $V_{NC_}$ = +3V, R_L = 300Ω, C_L = 35pF, Figure 2	T_A = +25°C		0.5	1	µs
			T_A = T_{MIN} to T_{MAX}			1	
Power-Up Delay	t_{DEL}				128		µs

High-Bandwidth T1/E1 Dual-SPDT Switches/ 4:1 Muxes

ELECTRICAL CHARACTERISTICS—Dual ±5V Supplies (continued)

(V+ = +5V ±10%, V- = -5V ±10%, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 1)

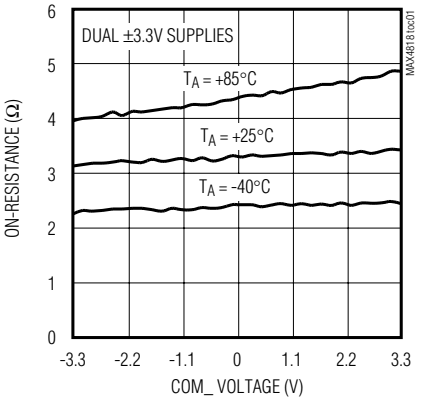
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
LOGIC INPUT (IN_, EN, SET, A0, A1)						
Input Voltage Low	V_{IL}				0.8	V
Input Voltage High	V_{IH}		2.4			V
Input Leakage Current	I_{IN}	$V_{IN_}$ = 0 or V+	-1		+1	µA
POWER SUPPLY						
Quiescent Positive Supply Current	I+	V+ = +5.5V, V- = -5.5V, V_{IN} = 0 or V+		0.9	2	mA
Quiescent Negative Supply Current	I-	V+ = +5.5V, V- = -5.5V, V_{IN} = 0 or V+		0.9	2	mA
Positive Supply Voltage	V+		4.5		5.5	V
Negative Supply Voltage	V-		-5.5		-4.5	V

Note 1: All parameters are production tested at T_A = +85°C and guaranteed by design over specified temperature range.
Note 2: Guaranteed by design, not production tested.
Note 3: $\Delta R_{ON} = R_{ON_(MAX)} - R_{ON_(MIN)}$.
Note 4: Flatness is defined as the difference between the maximum and minimum value of on-resistance as measured over the specified analog signal range.
Note 5: Between any two switches.
Note 6: All-hostile crosstalk from all OFF multiplexer inputs to the ON multiplexer channel. All-hostile crosstalk is tested by applying the same signal to all OFF inputs and measuring the crosstalk on the ON channel (COM terminal of the multiplexer.)
Note 7: Off-Isolation = $20\log_{10}$ [V_{COM} / (V_{NC} or V_{NO})], V_{COM} = output, V_{NC} or V_{NO} = input to OFF switch.

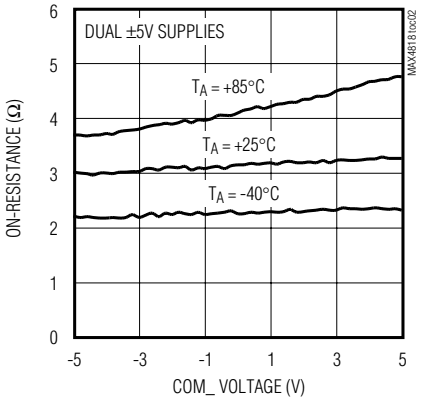
Typical Operating Characteristics

(V+ = +3.3V, V- = -3.3V, T_A = +25°C, unless otherwise noted.)

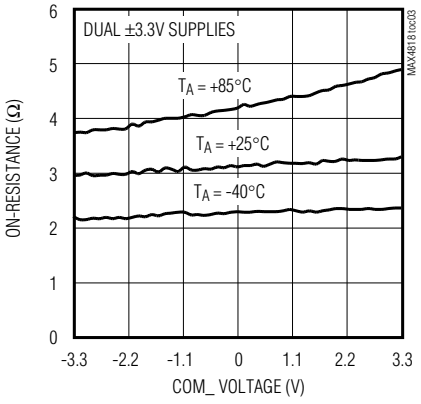
MAX4818 ON-RESISTANCE vs. COM_ VOLTAGE



MAX4818 ON-RESISTANCE vs. COM_ VOLTAGE



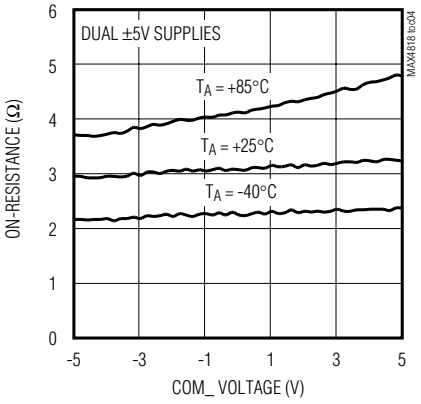
MAX4819 ON-RESISTANCE vs. COM_ VOLTAGE



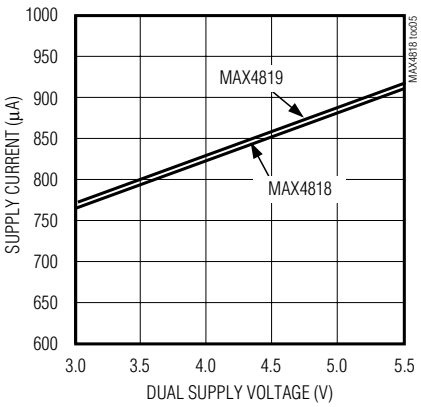
Typical Operating Characteristics (continued)

(V+ = +3.3V, V- = -3.3V, T_A = +25°C, unless otherwise noted.)

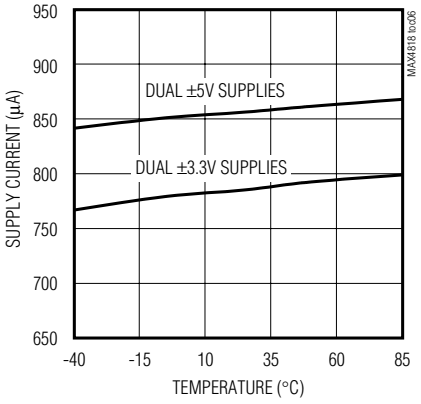
MAX4819 ON-RESISTANCE vs. COM_ VOLTAGE



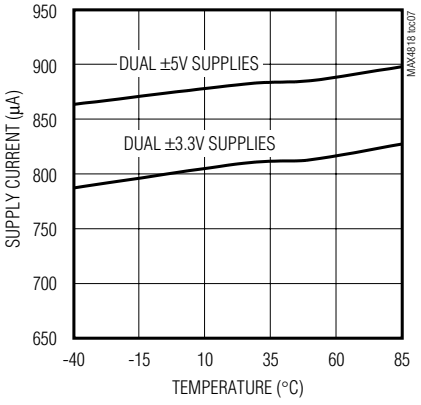
SUPPLY CURRENT vs. SUPPLY VOLTAGE



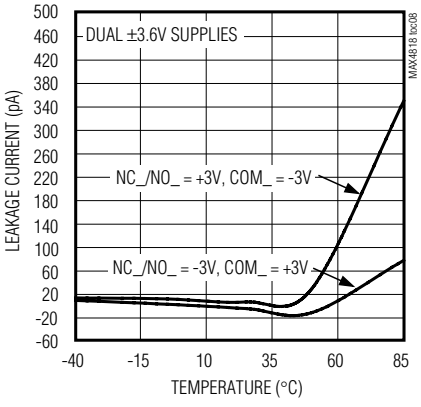
MAX4818 SUPPLY CURRENT vs. TEMPERATURE



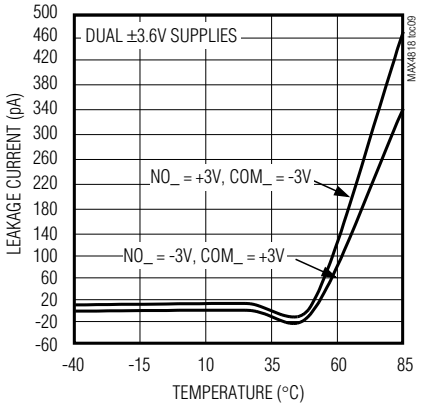
MAX4819 SUPPLY CURRENT vs. TEMPERATURE



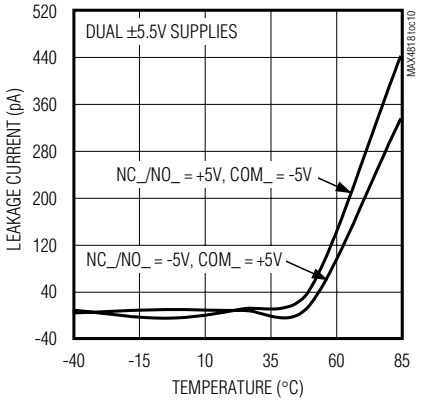
MAX4818 NC/NO(OFF) LEAKAGE CURRENT vs. TEMPERATURE



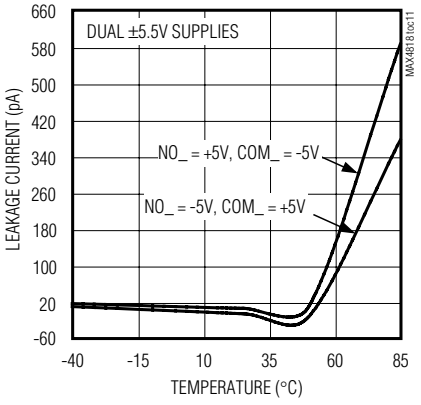
MAX4819 NO(OFF) LEAKAGE CURRENT vs. TEMPERATURE



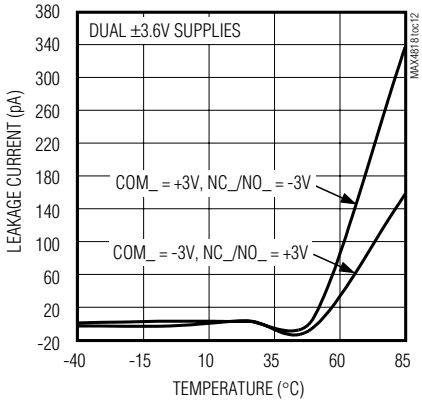
MAX4818 NC/NO(OFF) LEAKAGE CURRENT vs. TEMPERATURE



MAX4819 NO(OFF) LEAKAGE CURRENT vs. TEMPERATURE



MAX4818 COM(OFF) LEAKAGE CURRENT vs. TEMPERATURE

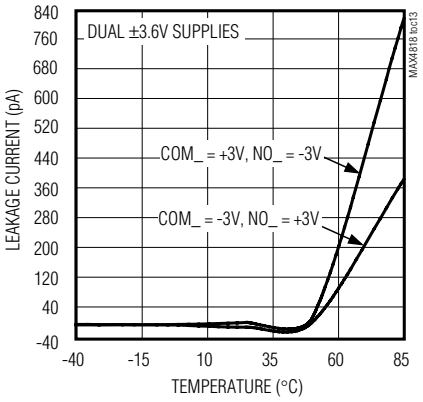


High-Bandwidth T1/E1 Dual-SPDT Switches/ 4:1 Muxes

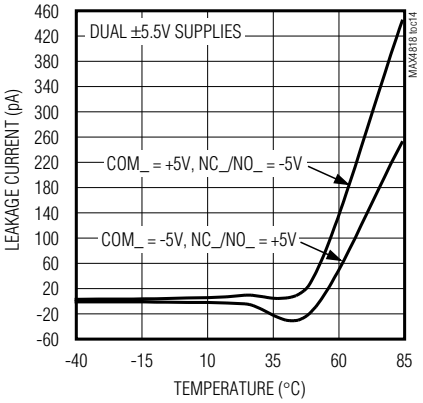
Typical Operating Characteristics (continued)

(V+ = +3.3V, V- = -3.3V, T_A = +25°C, unless otherwise noted.)

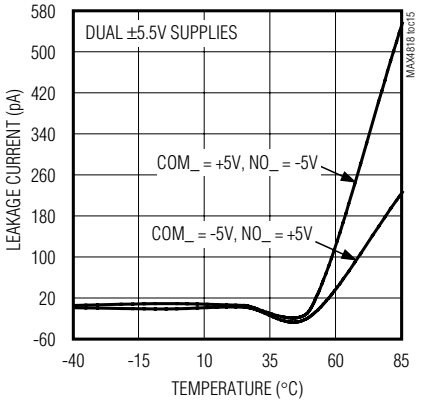
MAX4819 COM(OFF) LEAKAGE CURRENT vs. TEMPERATURE



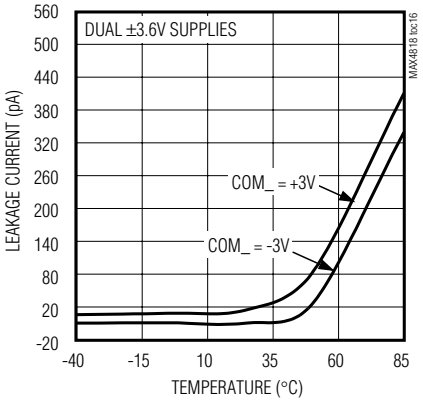
MAX4818 COM(OFF) LEAKAGE CURRENT vs. TEMPERATURE



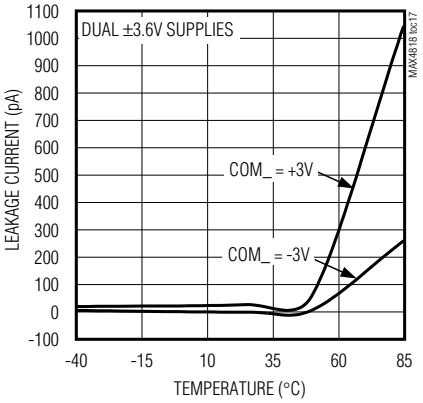
MAX4819 COM(OFF) LEAKAGE CURRENT vs. TEMPERATURE



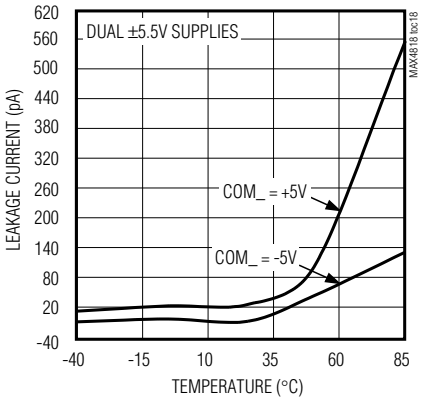
MAX4818 COM(ON) LEAKAGE CURRENT vs. TEMPERATURE



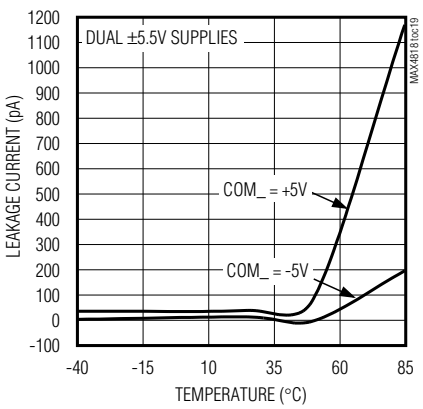
MAX4819 COM(ON) LEAKAGE CURRENT vs. TEMPERATURE



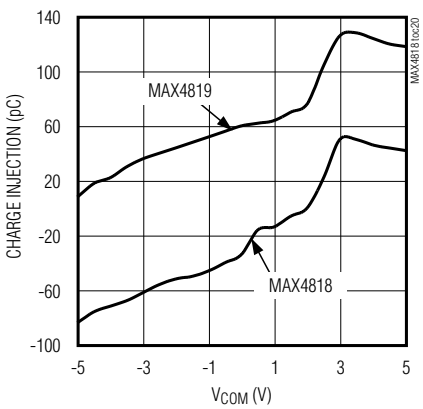
MAX4818 COM(ON) LEAKAGE CURRENT vs. TEMPERATURE



MAX4819 COM(ON) LEAKAGE CURRENT vs. TEMPERATURE



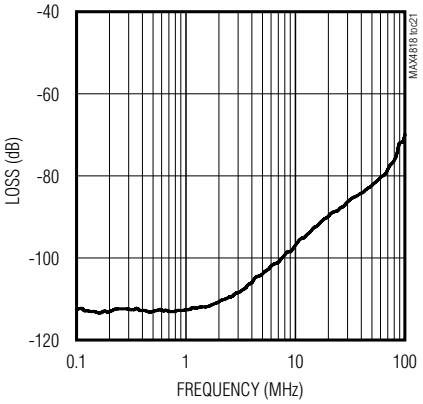
CHARGE INJECTION vs. COMMON VOLTAGE



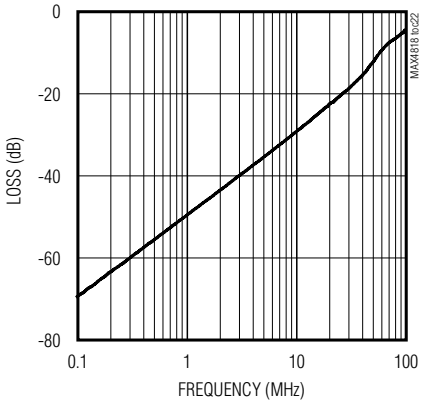
Typical Operating Characteristics (continued)

(V+ = +3.3V, V- = -3.3V, T_A = +25°C, unless otherwise noted.)

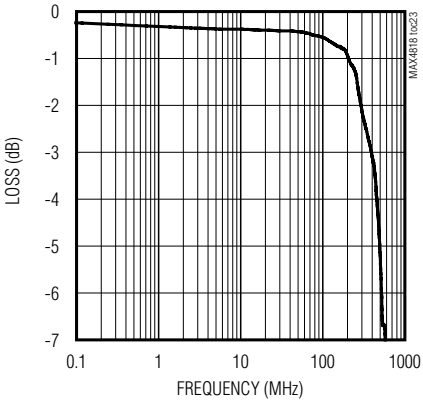
MAX4818 CROSSTALK vs. FREQUENCY



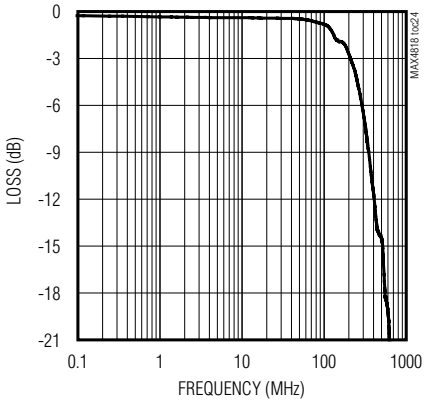
MAX4819 ALL-HOSTILE CROSSTALK vs. FREQUENCY



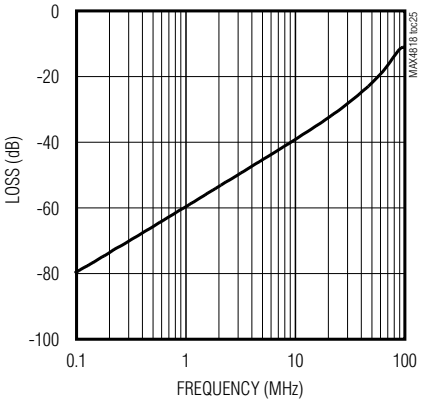
MAX4818 FREQUENCY RESPONSE



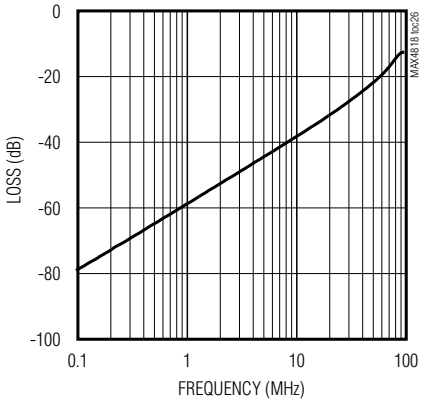
MAX4819 FREQUENCY RESPONSE



MAX4818 OFF-ISOLATION vs. FREQUENCY



MAX4819 OFF-ISOLATION vs. FREQUENCY

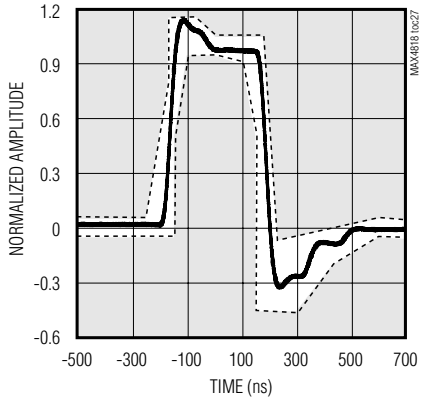


High-Bandwidth T1/E1 Dual-SPDT Switches/ 4:1 Muxes

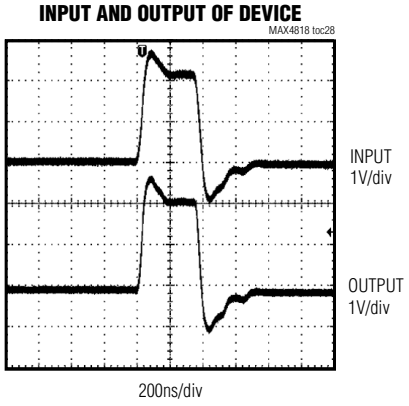
Typical Operating Characteristics (continued)

(V+ = +3.3V, V- = -3.3V, T_A = +25°C, unless otherwise noted.)

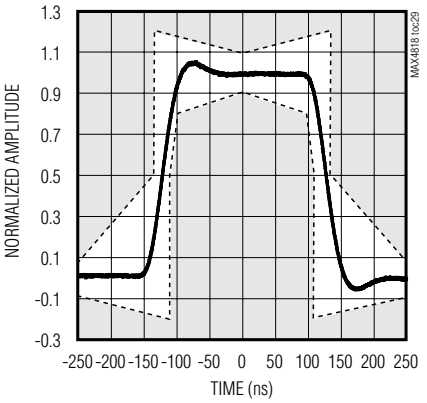
T1 (100Ω) PULSE TEMPLATE TEST



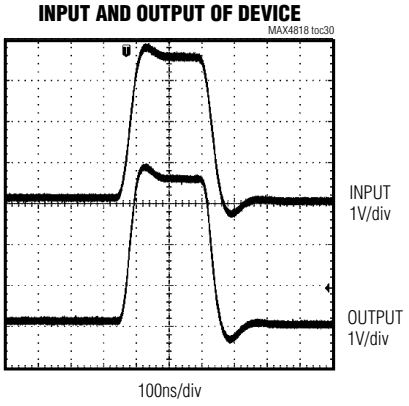
T1 (100Ω) SCOPE SHOT OF THE INPUT AND OUTPUT OF DEVICE



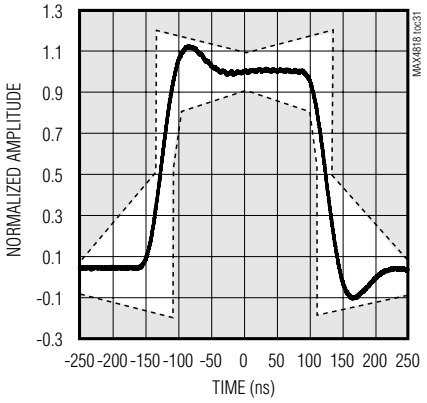
E1 (120Ω) PULSE TEMPLATE TEST



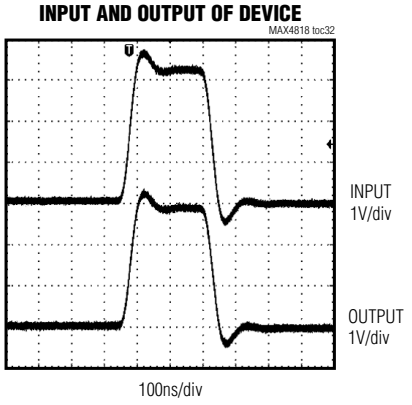
T1 (120Ω) SCOPE SHOT OF THE INPUT AND OUTPUT OF DEVICE



E1 (75Ω) PULSE TEMPLATE TEST



E1 (75Ω) SCOPE SHOT OF THE INPUT AND OUTPUT OF DEVICE



Pin Description

PIN		NAME	FUNCTION
MAX4818	MAX4819		
1	1	NO1	Analog Multiplexer Normally Open Terminal 1
2	2	V-	Negative Supply Voltage. Bypass V- to ground with a 0.1µF ceramic capacitor.
3	3	GND	Ground
4	12	NO2	Analog Multiplexer Normally Open Terminal 2
5, 10, 16	5, 8, 10, 16	N.C.	No Connect. Not Internally Connected.
6	6	EN	Enable Input. Connect EN to V+ or a logic-high for normal operation. Connect EN to ground to disable all switches.
7	—	IN2	Switch 2 Logic-Level Input (See Table 1)
8	—	COM2	Analog Switch Common Terminal 2
9	—	NC2	Analog Switch Normally Close Terminal 2
11	11	V+	Positive Supply Voltage. Bypass V+ to ground with a 0.1µF ceramic capacitor.
12	—	NC1	Analog Switch Normally Close Terminal 1
13	—	COM1	Analog Switch Common Terminal 1
14	—	IN1	Switch 1 Logic-Level Input (See Table 1)
15	15	SET	Logic Input. Drive SET logic-high to set all switches. (See Tables 1, 2)
—	4	NO4	Analog Multiplexer Normally Open Terminal 4
—	7	A0	Multiplexer Address Input 0 (See Table 2)
—	9	NO3	Analog Multiplexer Normally Open Terminal 3
—	13	COM	Analog Multiplexer Common Terminal
—	14	A1	Multiplexer Address Input 1 (See Table 2)
EP	EP	EP	Exposed Paddle. Connect exposed paddle to V- or leave unconnected.

Detailed Description

The MAX4818/MAX4819 are each a high-bandwidth, low-on-resistance dual-SPDT analog switch/4:1 multiplexer, respectively. Both the MAX4818 and the MAX4819 are designed to serve as integrated T1/E1 analog protection switches for 1+1 and N+1 line-card redundancy applications. These devices replace electromechanical relays to save board space, reduce power consumption, and simplify PC board routing. The MAX4818/ MAX4819 allow the user to live insert the boards with no adverse effects.

The MAX4818/MAX4819 operate from ±3.3V or ±5V dual supplies, which are required for E1/T1 signal switching in the line-side of the interface transformer. Internal voltage multipliers supply the switches yielding excellent linearity and low on-resistance, typically 4Ω within the E1/T1 analog signal range. This high-bandwidth family of devices is optimized for low return loss and matched pulse template performance in E1/T1 short-haul and long-haul applications.

Logic Inputs

The MAX4818 has four digital control inputs: EN, SET, IN1, and IN2. The EN input enables the switches. A logic 1 on SET connects COM to the NO_ terminal. IN_ controls the switch when SET is low, as shown in Table 1.

The MAX4819 has four digital control inputs: EN, SET, A1, and A0. The EN input enables the multiplexer. A logic 1 on SET connects all NO_ to COM. A1 and A0 control which terminal will be connected to COM when SET is low, as shown in Table 2.

Analog Signal Levels

The on-resistance of the MAX4818/MAX4819 is very low and stable as the analog signals are swept from V- to V+ (see the *Typical Operating Characteristics*).

High-Bandwidth T1/E1 Dual-SPDT Switches/ 4:1 Muxes

Fault Protection

The fault protection of the MAX4818/MAX4819 allows the devices to handle input signals of more than twice the supply voltage without clamping the signal, latching up, or disturbing other cards in the system. The device detects when the input voltage drops below the negative supply. As soon as a fault condition is detected, the switch is immediately turned off for 128 clock cycles (typically 128µs). At the end of the 128µs timeout, the switch is turned back on for one clock cycle. At the end of the one clock cycle, if the signal is within the operating range, the switch will remain on. Otherwise, the device will turn the switch off again for 128 clock cycles. This will repeat until the signal is within the operating range. In T1/E1 redundancy applications, this can happen when the load resistor (RL) is removed or disconnected for any reason, as shown in Figure 1. Without a load resistor, the output voltage when using a 1:2 transformer can be as high as ±11V.

Hot Insertion

The MAX4818/MAX4819 tolerate hot insertions, thus are not damaged when inserted into a live backplane. Competing devices can exhibit low impedance when plugged into a live backplane that can cause high power dissipation leading to damage of the device itself. The MAX4818/MAX4819 have relatively high input impedance when V+ and V- supplies are unconnected or connected to GND. Therefore, the devices are not destroyed by a hot insertion. In order to guarrantee data integrity, the V+ and V- supplies must be properly biased.

Applications Information

T1/E1 N+1 Redundancy

Figures 6, 7, and 8 show a basic architecture for twisted-pair interface (120Ω, E1 or 100Ω, T1). Coaxial cable interface (75Ω, E1) can be illustrated with the same figures but without the single-ended to differential conversion stage. A single protection card can replace up to N line cards in a N+1 redundancy scheme. Figure 6 shows the switches sitting in the line cards where they can reroute any of the input/output signals to a protection line card. Figure 7 shows a "multiplexed" redundancy architecture using the MAX4819 where the multiplexers are in the line cards. This architecture is more scalable as the number of boards is increased. It also does not require a dedicated external switching card as the multiplexers reside in the line cards themselves. The number of signals routed through the backplane is substantially higher than in the switching-card architecture. Figure 8 shows a similar architecture, but the multiplexers reside in the protection switching card. These figures do not show the surge-protection elements and resistors for line termination/impedance matching.

Table 1. Dual SPDT Truth Table (MAX4818)

EN	SET	IN_	COM_ CONNECTION
0	X	X	NONE
1	0	0	NC_
1	0	1	NO_
1	1	X	NO_

(X = don't care.)

Table 2. 4:1 Multiplexer Truth Table (MAX4819)

EN	SET	A1	A0	COM CONNECTION
0	X	X	X	NONE
1	0	0	0	NO1
1	0	0	1	NO2
1	0	1	0	NO3
1	0	1	1	NO4
1	1	X	X	NO1, NO2, NO3, NO4

(X = don't care.)

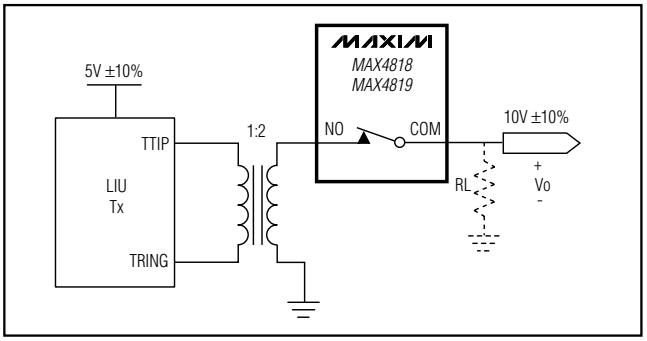


Figure 1. Fault Protection

Test Circuits/Timing Diagrams

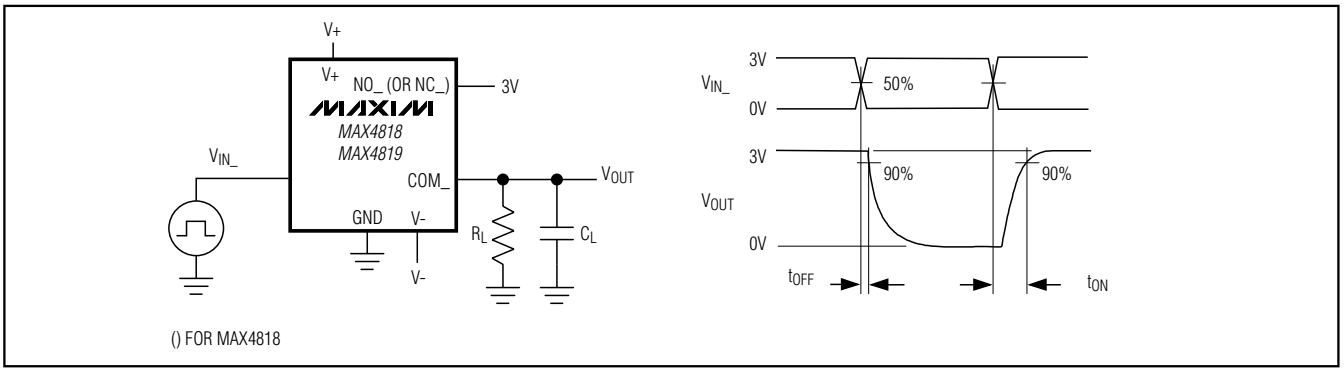


Figure 2. Switch Turn-On/Turn-Off Times

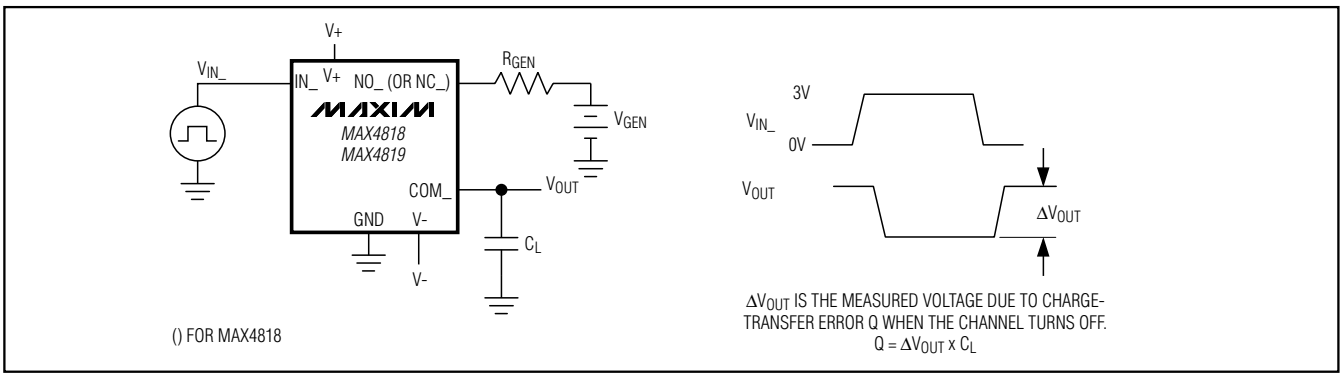


Figure 3. Charge Injection

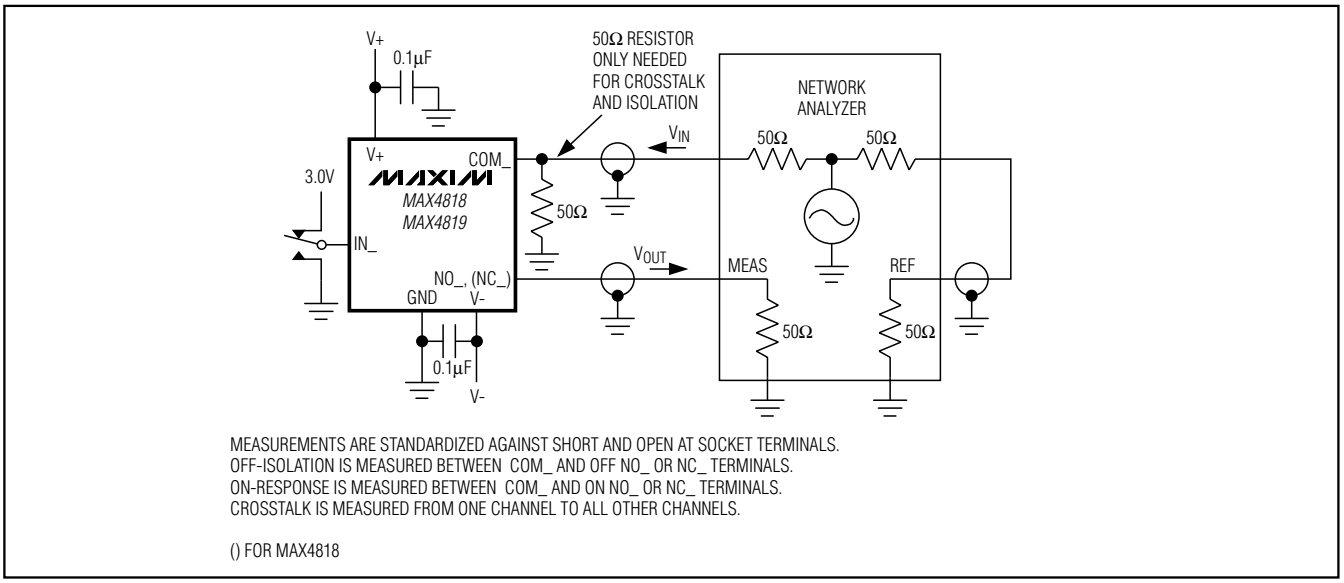


Figure 4. On-Loss, Off-Isolation, and Crosstalk

High-Bandwidth T1/E1 Dual-SPDT Switches/ 4:1 Muxes

Test Circuits/Timing Diagrams (continued)

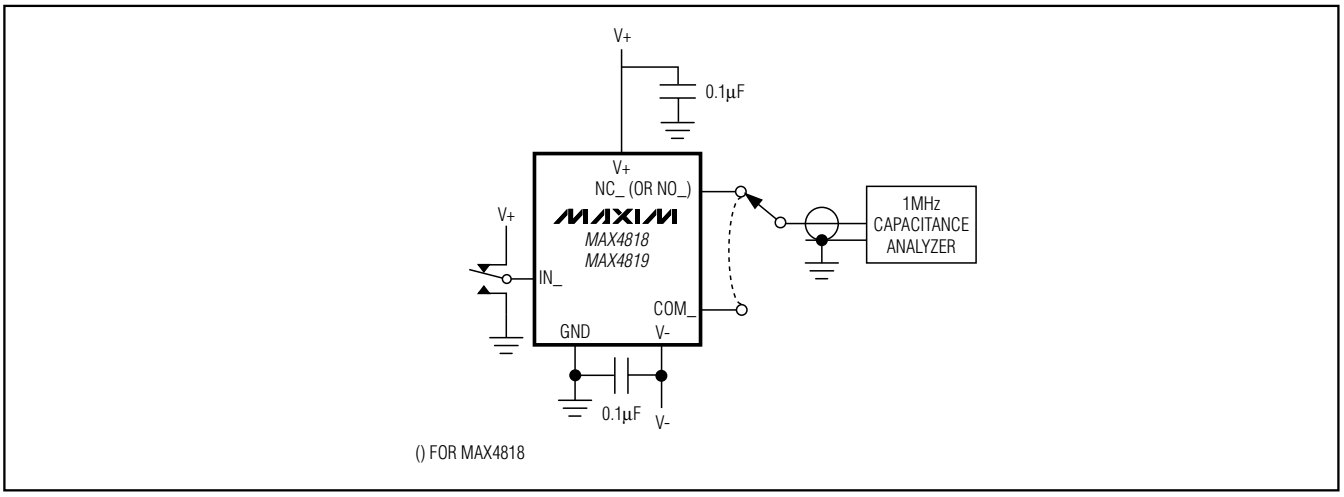


Figure 5. Channel Off-/On-Capacitance

The low on-resistance and high-bandwidth of the MAX4818/MAX4819 yield good pulse template and return-loss performance (see the *Typical Operating Characteristics*). The pulse template tests for E1 (twisted-pair interface 120Ω and coaxial interface 75Ω) and T1 (twisted-pair interface 100Ω) were tested using the Dallas DS2155 single-chip-transceiver evaluation board, and twelve switches in parallel with one switch closed and the other eleven open. The internal transmit termination feature must be disable when using this circuit. In order to use the same transmit resistors for E1 twisted-pair and coaxial cables, the Transmit Line Buildout Control Register (TLBC) is set to the value 6Ah. This sets the driver voltage so the output pulse has the right amplitude for both 120Ω (twisted pair) and 75Ω (coaxial) loads. The analog switches were powered with dual power supplies at ±5V.

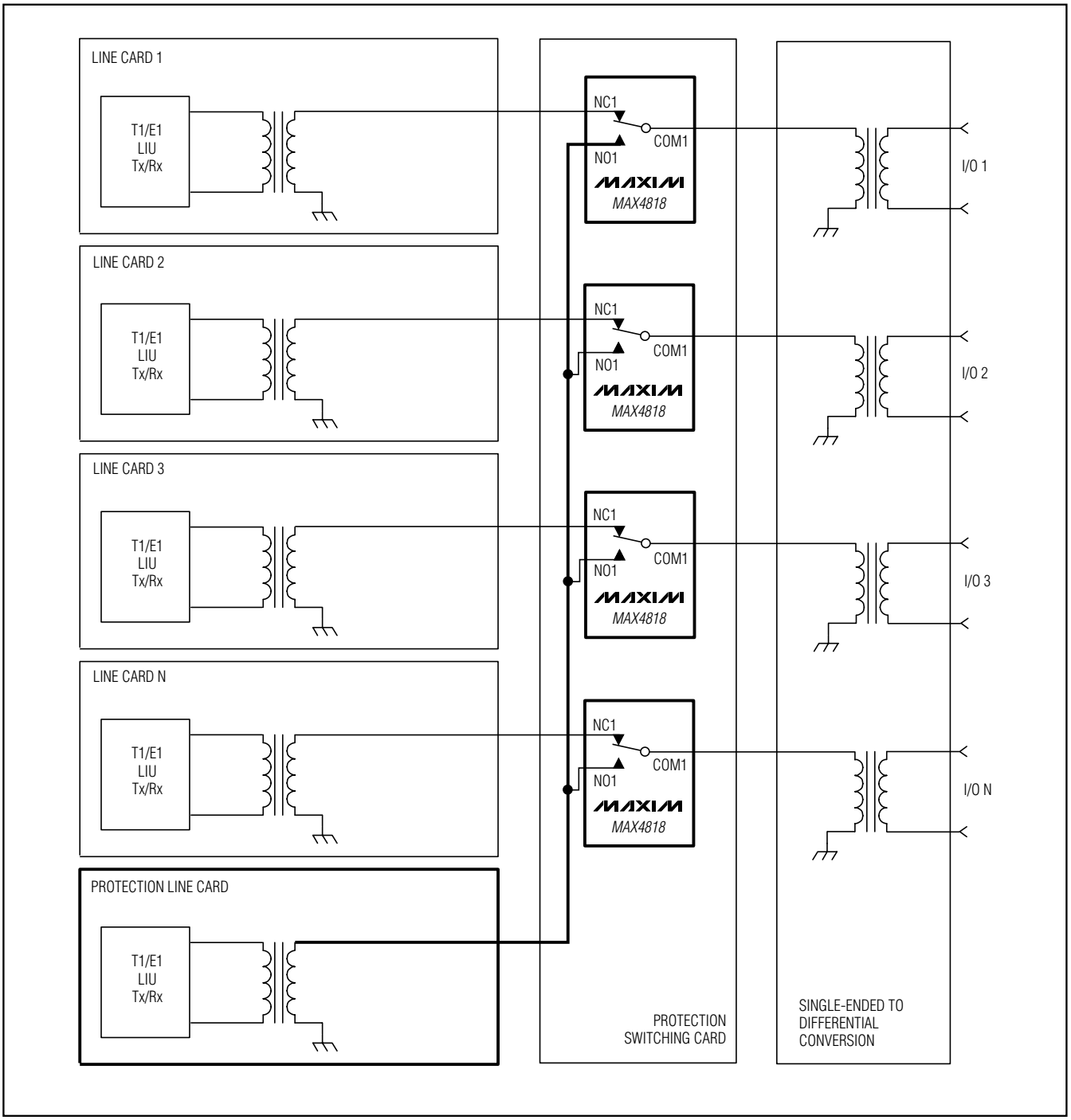


Figure 6. Switch Architecture for Twisted-Pair Cable (120Ω, E1 or 100Ω, T1). Same figure for Coaxial Cable (75Ω, E1) without the single-ended-to-differential conversion.

High-Bandwidth T1/E1 Dual-SPDT Switches/ 4:1 Muxes

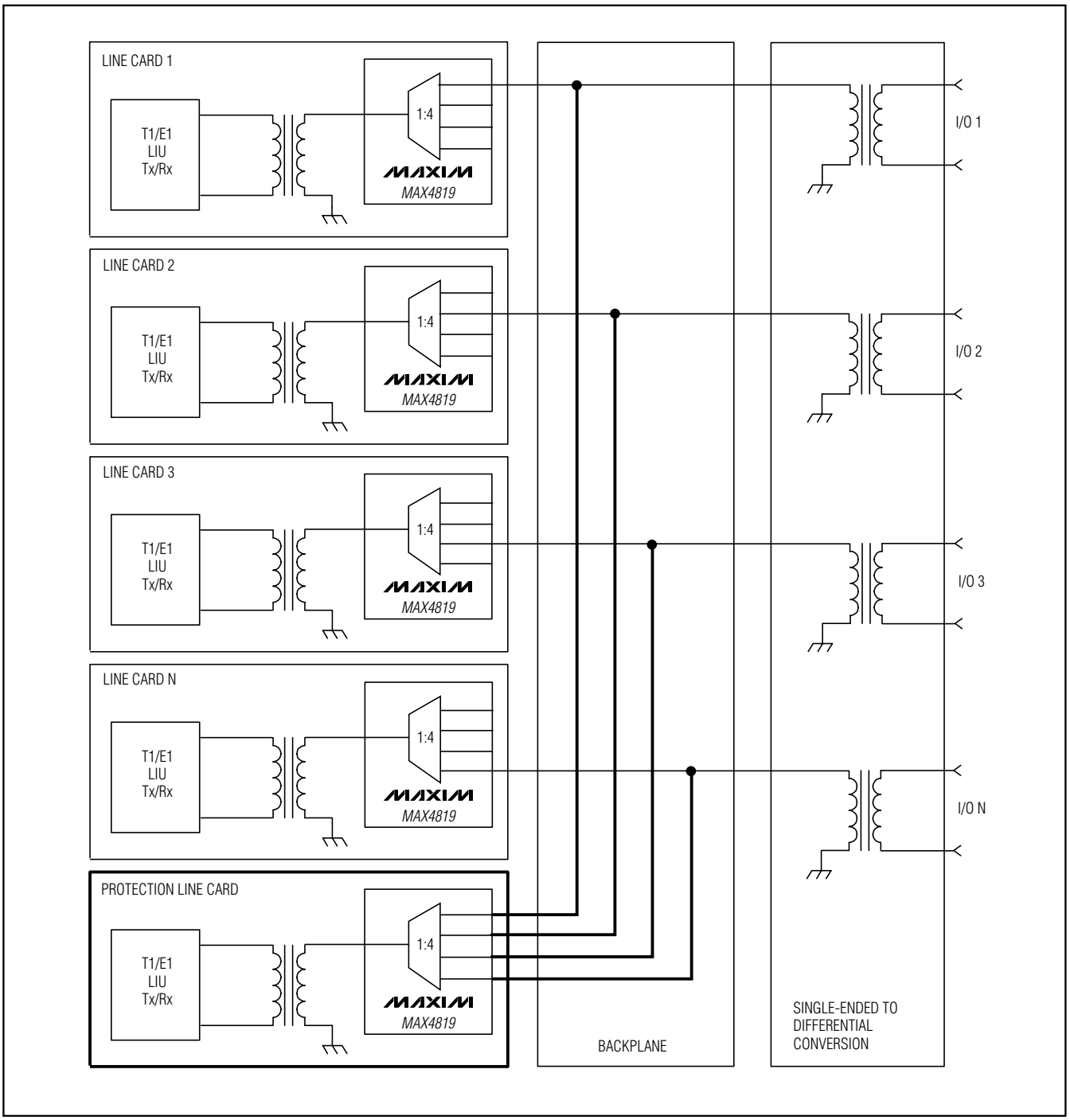


Figure 7. Multiplexed Redundancy Architecture with Multiplexer in the Line Cards for Twisted-Pair Cable (120Ω, E1 or 100Ω, T1). Same figure for coaxial cable (75Ω, E1) without the single-ended-to-differential conversion.

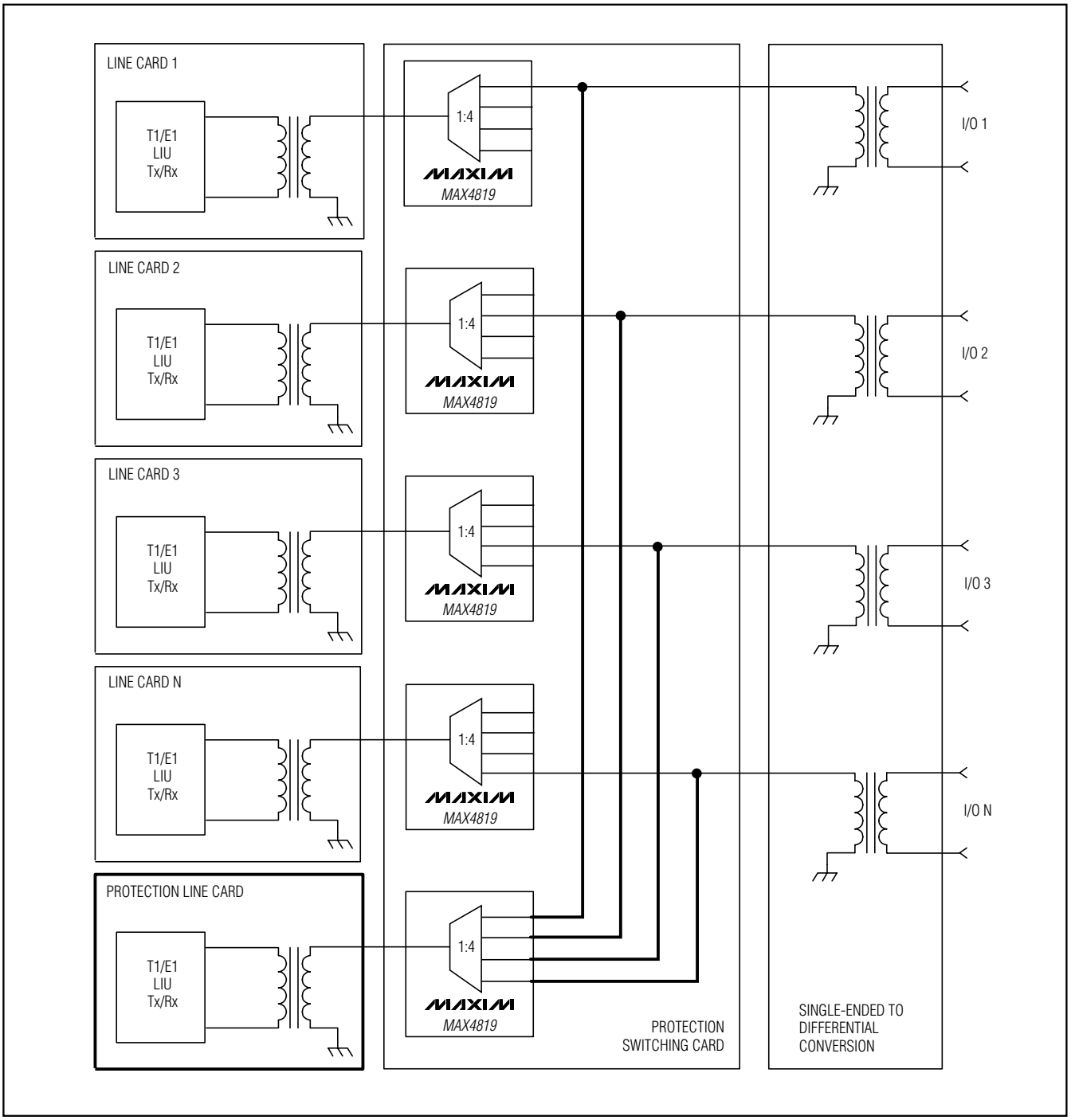
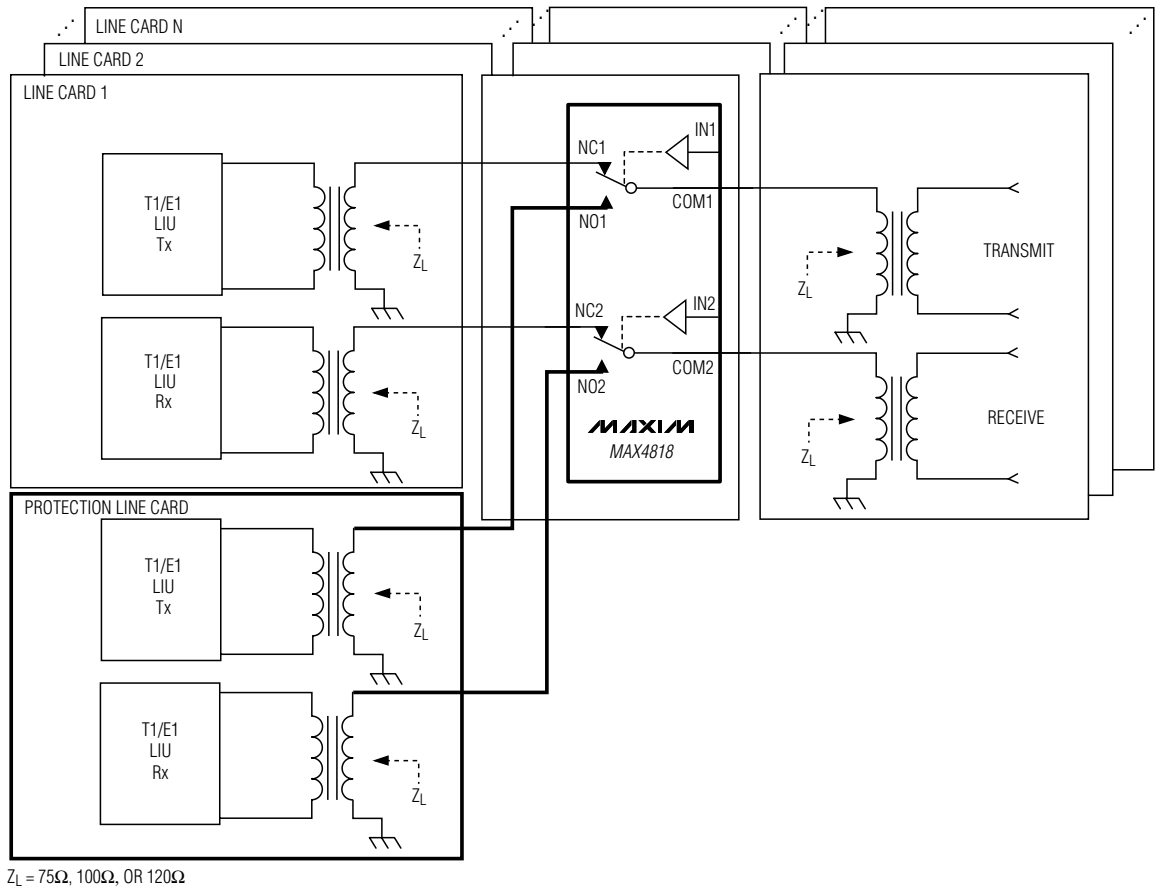


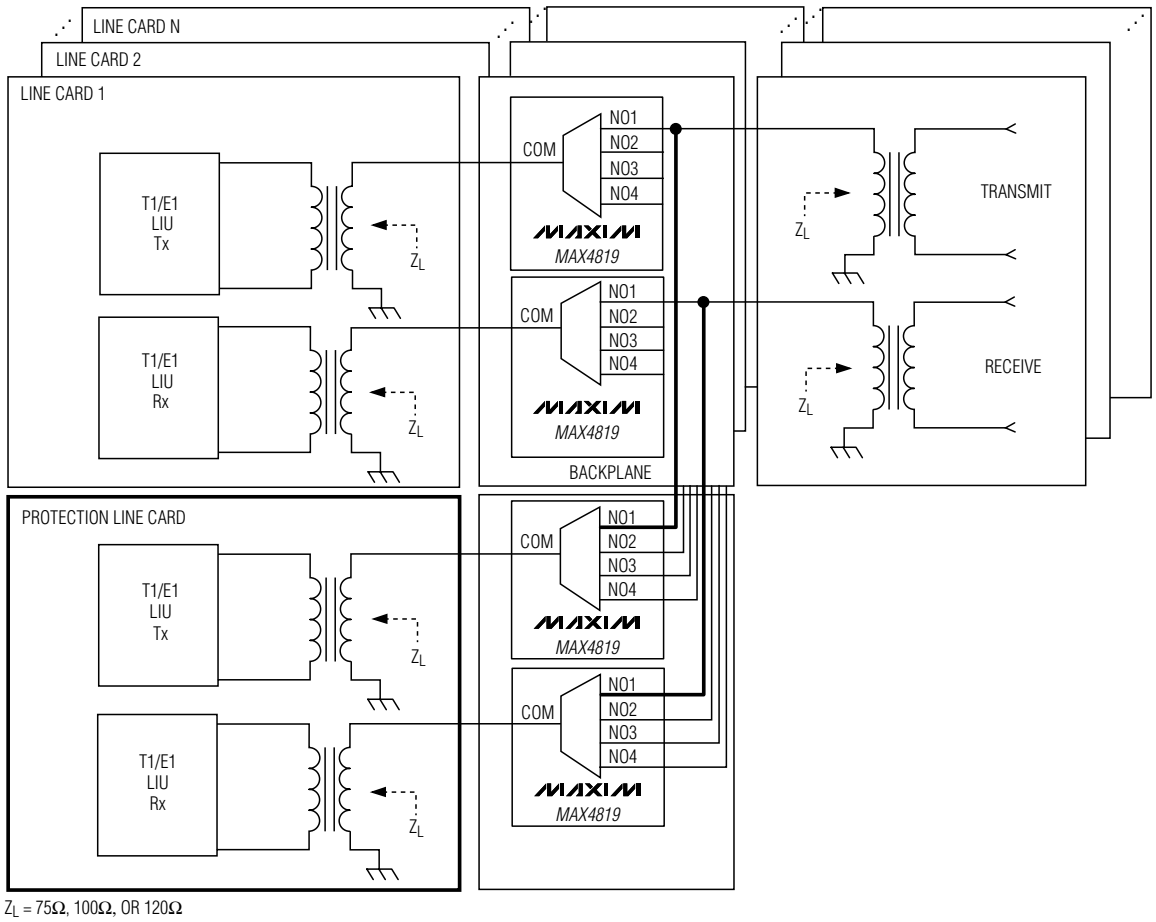
Figure 8. Multiplexed Redundancy Architecture with Multiplexer Out of the Line Cards for Twisted-Pair Cable (120Ω, E1 or 100Ω, T1). Same figure for coaxial cable (75Ω, E1) without the single-ended-to-differential conversion.

High-Bandwidth T1/E1 Dual-SPDT Switches/ 4:1 Muxes

Typical Operating Circuits



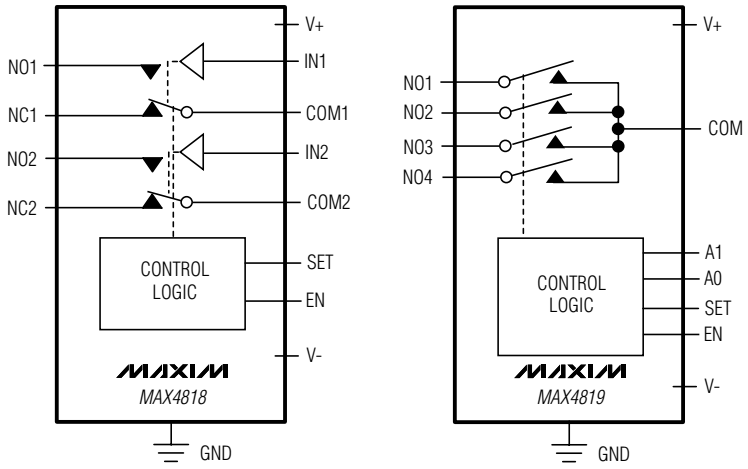
Typical Operating Circuits (continued)



Z_L = 75Ω, 100Ω, OR 120Ω

High-Bandwidth T1/E1 Dual-SPDT Switches/ 4:1 Muxes

Functional Diagram

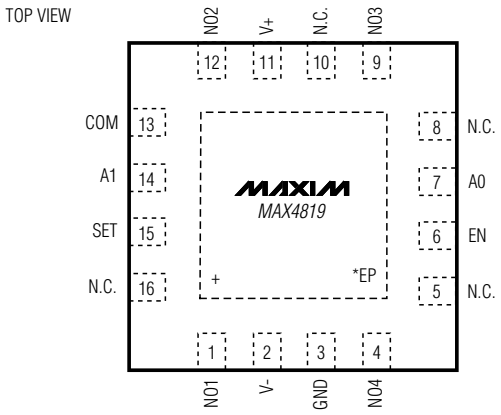


Chip Information

PROCESS: BiCMOS

CONNECT EXPOSED PADDLE TO V-.

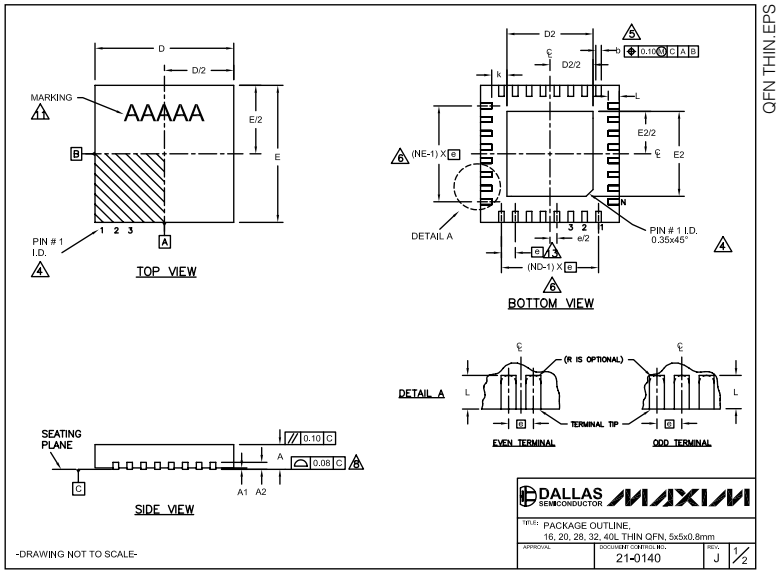
Pin Configurations (continued)



THIN QFN (5mm x 5mm)
***EXPOSED PADDLE CONNECTED TO V-**

Package Information (continued)

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to **www.maxim-ic.com/packages**.)



COMMON DIMENSIONS															
PKG.	16L 5x5			20L 5x5			28L 5x5			32L 5x5			40L 5x5		
SYMBOL	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.70	0.75	0.80	0.70	0.75	0.80	0.70	0.75	0.80	0.70	0.75	0.80	0.70	0.75	0.80
A1	0	0.02	0.05	0	0.02	0.05	0	0.02	0.05	0	0.02	0.05	0	0.02	0.05
A2	0.20 REF.			0.20 REF.			0.20 REF.			0.20 REF.			0.20 REF.		
b	0.25	0.30	0.35	0.25	0.30	0.35	0.20	0.25	0.30	0.20	0.25	0.30	0.15	0.20	0.25
D	4.90	5.00	5.10	4.90	5.00	5.10	4.90	5.00	5.10	4.90	5.00	5.10	4.90	5.00	5.10
E	4.90	5.00	5.10	4.90	5.00	5.10	4.90	5.00	5.10	4.90	5.00	5.10	4.90	5.00	5.10
e	0.80 BSC.			0.65 BSC.			0.50 BSC.			0.50 BSC.			0.40 BSC.		
k	0.25	-	-	0.25	-	-	0.25	-	-	0.25	-	-	0.25	-	-
L	0.30	0.40	0.50	0.45	0.55	0.65	0.45	0.55	0.65	0.30	0.40	0.50	0.30	0.40	0.50
N	16			20			28			32			40		
ND	4			5			7			8			10		
NE	4			5			7			8			10		
JEDEC	WHHB			WHHC			WHHD-1			WHHD-2			---		

EXPOSED PAD VARIATIONS						
PKG. CODES	D2			E2		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
T1655-2	3.00	3.10	3.20	3.00	3.10	3.20
T1655-3	3.00	3.10	3.20	3.00	3.10	3.20
T1655N-1	3.00	3.10	3.20	3.00	3.10	3.20
T2055-3	3.00	3.10	3.20	3.00	3.10	3.20
T2055-4	3.00	3.10	3.20	3.00	3.10	3.20
T2055-5	3.15	3.25	3.35	3.15	3.25	3.35
T2855-3	3.15	3.25	3.35	3.15	3.25	3.35
T2855-4	2.60	2.70	2.80	2.60	2.70	2.80
T2855-5	2.60	2.70	2.80	2.60	2.70	2.80
T2855-6	3.15	3.25	3.35	3.15	3.25	3.35
T2855-7	2.60	2.70	2.80	2.60	2.70	2.80
T2855-8	3.15	3.25	3.35	3.15	3.25	3.35
T2855N-1	3.15	3.25	3.35	3.15	3.25	3.35
T3255-3	3.00	3.10	3.20	3.00	3.10	3.20
T3255-4	3.00	3.10	3.20	3.00	3.10	3.20
T3255-5	3.00	3.10	3.20	3.00	3.10	3.20
T3255N-1	3.00	3.10	3.20	3.00	3.10	3.20
T4055-1	3.40	3.50	3.60	3.40	3.50	3.60
T4055-2	3.40	3.50	3.60	3.40	3.50	3.60

**SEE COMMON DIMENSIONS TABLE

NOTES:
1. DIMENSIONING & TOLERANCING CONFORM TO ASME Y14.5M-1994.
2. ALL DIMENSIONS ARE IN MILLIMETERS. ANGLES ARE IN DEGREES.
3. N IS THE TOTAL NUMBER OF TERMINALS.
4. THE TERMINAL #1 IDENTIFIER AND TERMINAL NUMBERING CONVENTION SHALL CONFORM TO JESD 95-1 SPP-012. DETAILS OF TERMINAL #1 IDENTIFIER ARE OPTIONAL, BUT MUST BE LOCATED WITHIN THE ZONE INDICATED. THE TERMINAL #1 IDENTIFIER MAY BE EITHER A MOLD OR MARKED FEATURE.
5. DIMENSION b APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.25 mm AND 0.30 mm FROM TERMINAL TIP.
6. ND AND NE REFER TO THE NUMBER OF TERMINALS ON EACH D AND E SIDE RESPECTIVELY.
7. DEPOPULATION IS POSSIBLE IN A SYMMETRICAL FASHION.
8. COPLANARITY APPLIES TO THE EXPOSED HEAT SINK SLUG AS WELL AS THE TERMINALS.
9. DRAWING CONFORMS TO JEDEC MO220, EXCEPT EXPOSED PAD DIMENSION FOR T2855-3 AND T2855-6.
10. WARPAGE SHALL NOT EXCEED 0.10 mm.
11. MARKING IS FOR PACKAGE ORIENTATION REFERENCE ONLY.
12. NUMBER OF LEADS SHOWN ARE FOR REFERENCE ONLY.
13. LEAD CENTERLINES TO BE AT TRUE POSITION AS DEFINED BY BASIC DIMENSION "e", ±0.05.

-DRAWING NOT TO SCALE-

DALLAS SEMICONDUCTOR MAXIM
TITLE: PACKAGE OUTLINE, 16, 20, 28, 32, 40L THIN QFN, 5x5x0.8mm
APPROVAL
DOCUMENT CONTROL NO. 21-0140
REV. J
2/2

Revision History

Pages changed at Rev 1: 1, 12, 21

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