MADR-008851-000100

PIN Diode Driver for Series / Shunt High Power Switches

Rev. P2

Features

- High Drive Current Capability (Up to 50 mA)
- Up to 32V Back Bias in Off State
- Single CMOS Logic Input with 10K Ohm Internal Pull Down Resistor
- Fast Switching
- Low Current Consumption
- Land Grid Array Package for SMT Applications
- 260°C Reflow Compatible
- RoHS* Compliant
- Tape and Reel Packaging Available

Description

The MADR-008851-000100 Switch Driver is designed to work with M/A-COM Technology Solutions line of series /shunt SPDT HMIC switches which operate in the power range of approximately 5 to 50W CW. It is capable to provide forward bias currents up to 50 mA for each diode in the series/shunt switch, with back bias voltage configurable from 12V to 32 V. It is packaged in a Land Grid Array surface mount package and is available in tape and reel packaging for high volume applications.

Sample boards are available with M/A-COM Tech 50W switch MASW-000834-13560T.

Ordering Information [1]

Part Number	Package
MADR-008851-000100	Bulk Packaging
MADR-008851-0001TR	300 piece Reel
MADR-008851-0001TB	Sample Board with Driver & MASW-000834-13560T Switch

1. Reference Application Note M513 for reel size information.

Pin Configuration

Pin No.	Pin Name	Pin No.	Pin Name
1	VCC	13	GND
2	GND	14	SH2
3	C1 (Logic)	15	GND
4	GND	16	RX Drive
5	VDD	17	GND
6	GND	18	GND
7	GND	19	GND
8	GND	20	GND
9	GND	21	GND
10	TX Drive	22	GND
11	GND	23	GND
12	SH1	-	-

Handling Procedures

Please observe the following precautions to avoid damage:

Solder & Assembly Cleaning

Driver is not approved for aqueous washing. No-clean solder is recommended

Static Sensitivity

Silicon Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

* Restrictions on Hazardous Substances, European Union Directive

• **North America** Tel: 800.366.2266 • **Europe** Tel: +353.21.244.6400
• **India** Tel: +91.80.43537383 • **China** Tel: +86.21.2407.1588
Visit www.macomtech.com for additional data sheets and product information.

Recommended Operating Conditions

Parameter	Test Conditions	Unit	Min	Typ	Max
VCC	Nominal VCC = 3.3 V Nominal VCC = 5.0 V	V V	3.0 4.5	3.3 5.0	3.6 5.5
VDD	Input Voltage	V	12.0	28.0	32.0
TX Series Diode Bias Current[2]	VDD = 12 V to 32 V	mA	—	—	50
RX Series Diode Bias Current[2]	VDD = 12 V to 32 V	mA	—	—	50
Shunt Diode Bias Current[3]	VDD = 12 V to 20 V VDD = 20 V to 32 V	mA mA	— —	— —	35 50
C1 (Low Level Input Voltage)	VCC = 3.0 V to 3.6V VCC = 4.5 V to 5.5 V	V V	0.0 0.0	0.0 0.0	0.8 0.3 x VCC
C1 (High Level Input Voltage)	VCC = 3.0 V to 3.6V VCC = 4.5 V to 5.5 V	V V	2.0 0.7 x VCC	VCC VCC	VCC VCC
PRF	50% duty cycle	KHz	DC	—	50

2. TX and RX currents are user selectable. Reference "Driver and SPDT Schematic" for suggested values.
3. A resistor needs to be connected between SH1 and SH2 to set the shunt diode bias current. Reference "Driver and SPDT Schematic" for suggested values.

Absolute Maximum Ratings [4,5]

Parameter	Absolute Maximum
VCC (+5V)	-0.5 V to +6.5 V
VDD (+28V)	-0.5 V to 40 V
C1 (Logic)	-0.5 V to 6.5 V
RX Sinking Current	60 mA
TX Sinking Current	60 mA
Power Dissipation in Still Air	100 mW
Operational Temperature	-40 to +85°C
Storage Temperature	-55 to +125°C

4. Exceeding any one or combination of these limits may cause permanent damage to this device.
5. M/A-COM Tech does not recommend sustained operation near these survivability limits.

Truth Table

Control Input	Condition of Driver			Condition of Switch	
C1	TX Voltage	RX Voltage	SH Current	TX	RX
0	High	Low	Low	Off	On
1	Low	High	High	On	Off

DC Characteristics : T_A = +25°C, VCC = 3.0 to 5.5 V, VDD = 12 to 28 V

Parameter	Test Conditions	Unit	Min	Typ	Max
Quiescent VCC Supply Current	—	nA	—	50	—
Quiescent VDD Supply Current	—	mA	—	0.8	—
Output Back Bias Voltage RX TX SH1	 TX ON RX ON RX ON	 V V V	 — — —	 VDD - 0.5 VDD VDD - 0.5	 — — —
Output Resistance RX TX	 RX ON TX ON	 Ω Ω	 — —	 22.5 22.5	 — —

Switching Speed When Driving 50 pF Capacitive Loads[6]:

Testing Conditions	Symbol	Parameter	Unit	Typical Performance -40°C	Typical Performance +25°C	Typical Performance 85°C
VCC = +5.0 V VDD = +28 V I_{SERIES} = 50 mA	Switching Speed: TX T_{PLH} T_{PHL} Tr Tf	 50% CTL to 90% Voltage 50% CTL to 10% Voltage 10% - 90% 90% - 10%	 ns ns ns ns	 200 350 180 200	 330 420 320 250	 500 500 480 320
	Switching Speed: RX T_{PLH} T_{PHL} Tr Tf	 50% CTL to 90% Voltage 50% CTL to 10% Voltage 10% - 90% 90% - 10%	 ns ns ns ns	 200 360 180 220	 350 430 330 280	 520 520 500 350
VCC = +3.3 V VDD = +12 V I_{SERIES} = 50 mA	Switching Speed: TX T_{PLH} T_{PHL} Tr Tf	 50% CTL to 90% Voltage 50% CTL to 10% Voltage 10% - 90% 90% - 10%	 ns ns ns ns	 200 530 180 300	 400 580 370 320	 570 630 550 360
	Switching Speed: RX T_{PLH} T_{PHL} Tr Tf	 50% CTL to 90% Voltage 50% CTL to 10% Voltage 10% - 90% 90% - 10%	 ns ns ns ns	 200 600 180 330	 400 640 390 360	 580 700 570 400

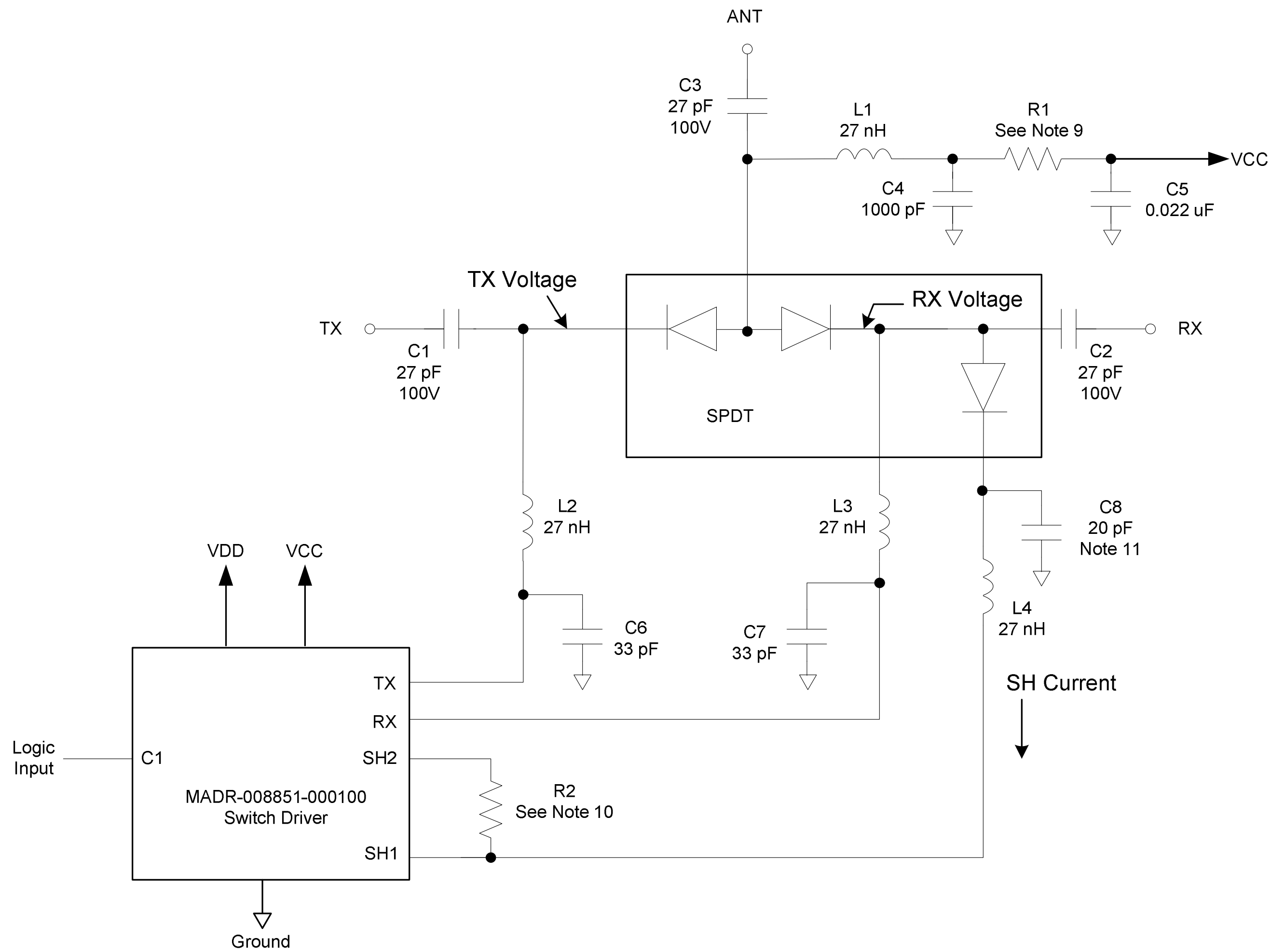
6. Switching parameters for the shunt output are not listed since they can only be measured with a diode switch.

Switching Speed When Driving M/A-COM MASW-000834-13560T Switch[7]:

Testing Conditions	Symbol	Parameter	Unit	Typical Performance		
				-40°C	+25°C	85°C
VCC = +5.0 V VDD = +28 V I_{SERIES} = 50 mA I_{SHUNT} = 50 mA	TX Series Diode					
	T_{ON}	50% CTL to 90% RF	ns	250	450	600
	T_{OFF}	50% CTL to 10% RF	ns	400	520	600
	Tr	10% - 90% RF	ns	80	200	300
	Tf	90% - 10% RF	ns	200	250	300
	RX Series Diode					
	T_{ON}	50% CTL to 90% RF	ns	370	600	840
	T_{OFF}	50% CTL to 10% RF	ns	220	300	350
	Tr	10% - 90% RF	ns	150	300	500
	Tf	90% - 10% RF	ns	80	120	160
	RX Shunt Diode					
	T_{ON}	50% CTL to 90% Current	ns	480	550	620
	T_{OFF}	50% CTL to 10% Current	ns	100	100	100
	Tr	10% - 90% Current	ns	470	540	610
	Tf	90% - 10% Current	ns	90	90	90
VCC = +3.3 V VDD = +12 V I_{SERIES} = 50 mA I_{SHUNT} = 35 mA	TX Series Diode					
	T_{ON}	50% CTL to 90% RF	ns	460	620	820
	T_{OFF}	50% CTL to 10% RF	ns	630	770	900
	Tr	10% - 90% RF	ns	280	300	340
	Tf	90% - 10% RF	ns	400	350	320
	RX Series Diode					
	T_{ON}	50% CTL to 90% RF	ns	630	880	1200
	T_{OFF}	50% CTL to 10% RF	ns	470	550	650
	Tr	10% - 90% RF	ns	400	450	550
	Tf	90% - 10% RF	ns	280	200	200
	RX Shunt Diode					
	T_{ON}	50% CTL to 90% Current	ns	860	850	900
	T_{OFF}	50% CTL to 10% Current	ns	100	100	100
	Tr	10% - 90% Current	ns	850	840	880
	Tf	90% - 10% Current	ns	90	90	90

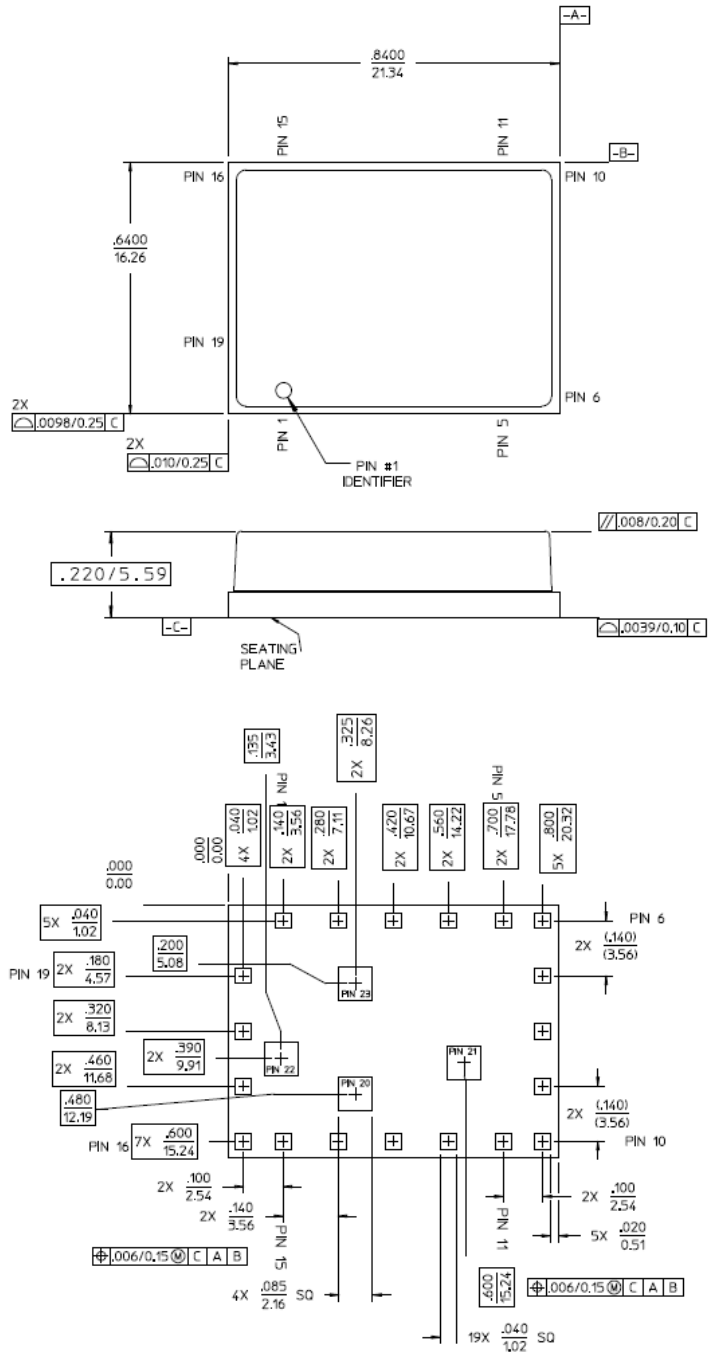
7. Switching parameters were measured with a 10 dBm, 2 GHz RF input.

Driver and SPDT Schematic for 2 GHz Applciations[8,9,10,11,12,13,14]



8. Forward Bias Diode Voltage: ΔVf is ~0.9V @ 22 mA; ΔVf is ~1.0V @ 35 mA
9. R1 is calculated by (VCC - ΔVf) / I_{series} - 22 Ω, where I_{series} is the desired forward bias current for the series diodes. For 20 mA load current, R1 = 178 Ω @ VCC = 5.0V and 93 Ω @ VCC = 3.3V. For 50 mA load current, R1 = 57.6 Ω @ VCC = 5.0V and 24 Ω @ VCC= 3.3V.
10. R2 is calculated by (VDD - ΔVf) / I_{shunt}, where I_{shunt} is the desired forward bias current for the shunt diode. The power rating is calculated by I_{shunt} x (VDD - ΔVf). For 28V VDD and 20 mA of I_{shunt}, R2 should use a 1W, 1.3k ohm resistor.
11. C8 is already built-in for M/A-COM MASW-000834-13560T switch.
12. The current through the back-biased diodes will be the leakage current for the diodes
13. C1-C7, L1-L4, R1, R2, and the switch are discrete components that should be installed on the user's board. It is recommended that Coilcraft 0603CS-27NXJLW or equivalent be used for L1-L4 at 2 GHz. For other frequency band, C1-C3 and L1-L4 should be adjusted.
14. The switching speed will be affected by the value of VCC, VDD, C6, C7, the size of the PIN diodes, and the forward bias currents. Use higher VCC and VDD, and lower forward bias currents for faster switching.

Lead-Free Land Grid Array, 0.64 in x 0.84 in †



† Reference Application Note M538 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 1 requirements.