

### Features

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

### Description

M/A-COM's MADR-008851-000100 Switch Driver is designed to work with M/A-COM's line of series / shunt SPDT HMIC switches which operate in the power range of approximately 5 to 20W 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 20W switch MASW-000834-13560T.

### Ordering Information <sup>1</sup>

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:

### 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.

### Moisture Sensitivity

The MSL rating for this part is defined as Level 3 per IPC/JEDEC J-STD-020. Parts shall be stored and/or baked as required for MSL Level 3 parts.

\* Restrictions on Hazardous Substances, European Union Directive

### 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 <sup>2</sup>	VDD = 12 V to 32 V	mA	—	—	50
RX Series Diode Bias Current <sup>2</sup>	VDD = 12 V to 32 V	mA	—	—	50
Shunt Diode Bias Current <sup>3</sup>	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

- TX and RX currents are user selectable. Reference "Driver and SPDT Schematic" for suggested values.
- 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 <sup>4,5</sup>

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

- Exceeding any one or combination of these limits may cause permanent damage to this device.
- M/A-COM 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
0	High	Low	Low	Off	On
1	Low	High	High	On	Off

### DC Characteristics : $T_A = +25^\circ\text{C}$ , $V_{CC} = 3.0$ to $5.5$ V, $V_{DD} = 12$ 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 ON	V	—	VDD - 0.5	—
TX	RX ON	V	—	VDD	—
SH1	RX ON	V	—	VDD - 0.5	—
Output Resistance					
RX	RX ON	$\Omega$	—	22.5	—
TX	TX ON	$\Omega$	—	22.5	—

### Switching Speed When Driving 50 pF Capacitive Loads<sup>6</sup>:

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

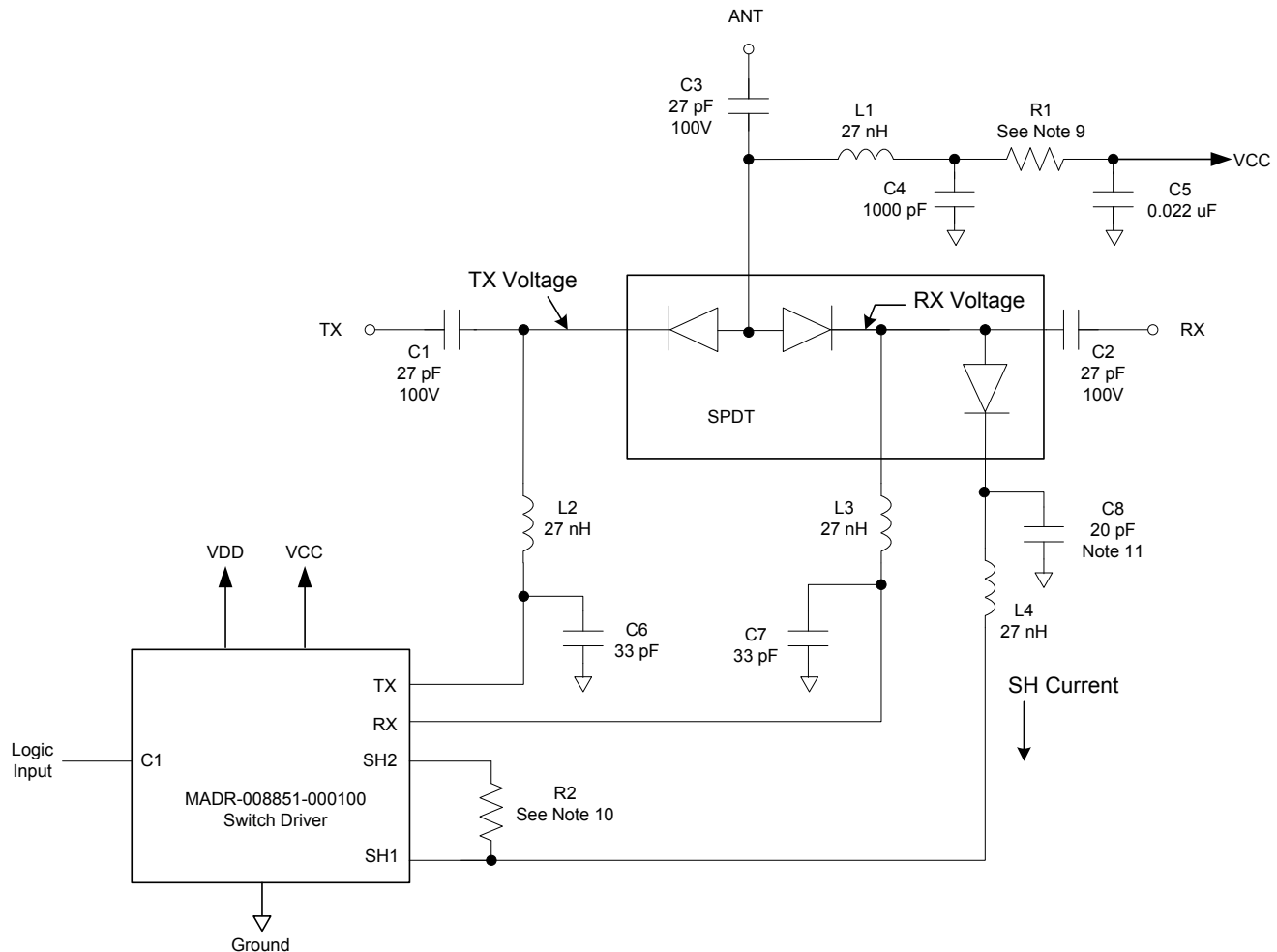
6. Switching parameters for the shunt output are not listed since they can only be measured with a diode switch.

### Switching Speed When Driving M/A-COM MASW-000834-13560T Switch<sup>7</sup>:

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

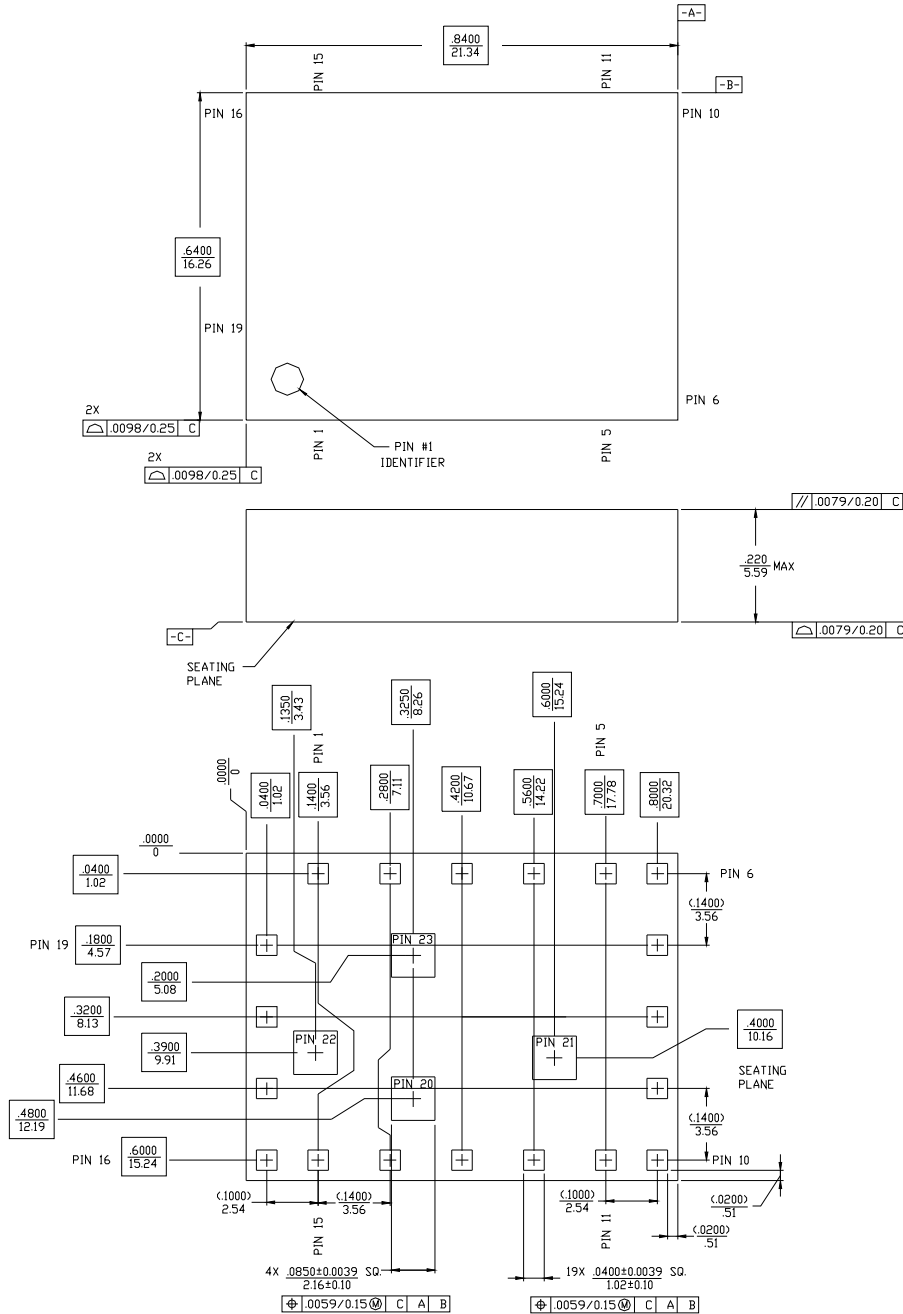
7. Switching parameters were measured with a 10 dBm, 2 GHz RF input.

### Driver and SPDT Schematic for 2 GHz Applications<sup>8,9,10,11,12,13,14</sup>



8. Forward Bias Diode Voltage:  $\Delta Vf$  is  $\sim 0.9V$  @ 22 mA;  $\Delta Vf$  is  $\sim 1.0V$  @ 35 mA
9. R1 is calculated by  $(VCC - \Delta Vf) / I_{series} - 22 \Omega$ , where  $I_{series}$  is the desired forward bias current for the series diodes. For 20 mA load current,  $R1 = 178 \Omega$  @  $VCC = 5.0V$  and  $93 \Omega$  @  $VCC = 3.3V$ . For 50 mA load current,  $R1 = 57.6 \Omega$  @  $VCC = 5.0V$  and  $24 \Omega$  @  $VCC = 3.3V$ .
10. R2 is calculated by  $(VDD - \Delta Vf) / I_{shunt}$ , where  $I_{shunt}$  is the desired forward bias current for the shunt diode. The power rating is calculated by  $I_{shunt} \times (VDD - \Delta Vf)$ . 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 3 requirements.

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