

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

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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 |

- 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 ^{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 |

- Exceeding any one or combination of these limits may cause permanent damage to this device.
- 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 | |
| 0 | High | Low | Low | TX | RX |
| 1 | Low | High | High | On | Off |

PIN Diode Driver for Series / Shunt High Power Switches

Rev. P2

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 | Ω | — | 22.5 | — |
| TX | TX ON | Ω | — | 22.5 | — |

Switching Speed When Driving 50 pF Capacitive Loads⁶:

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

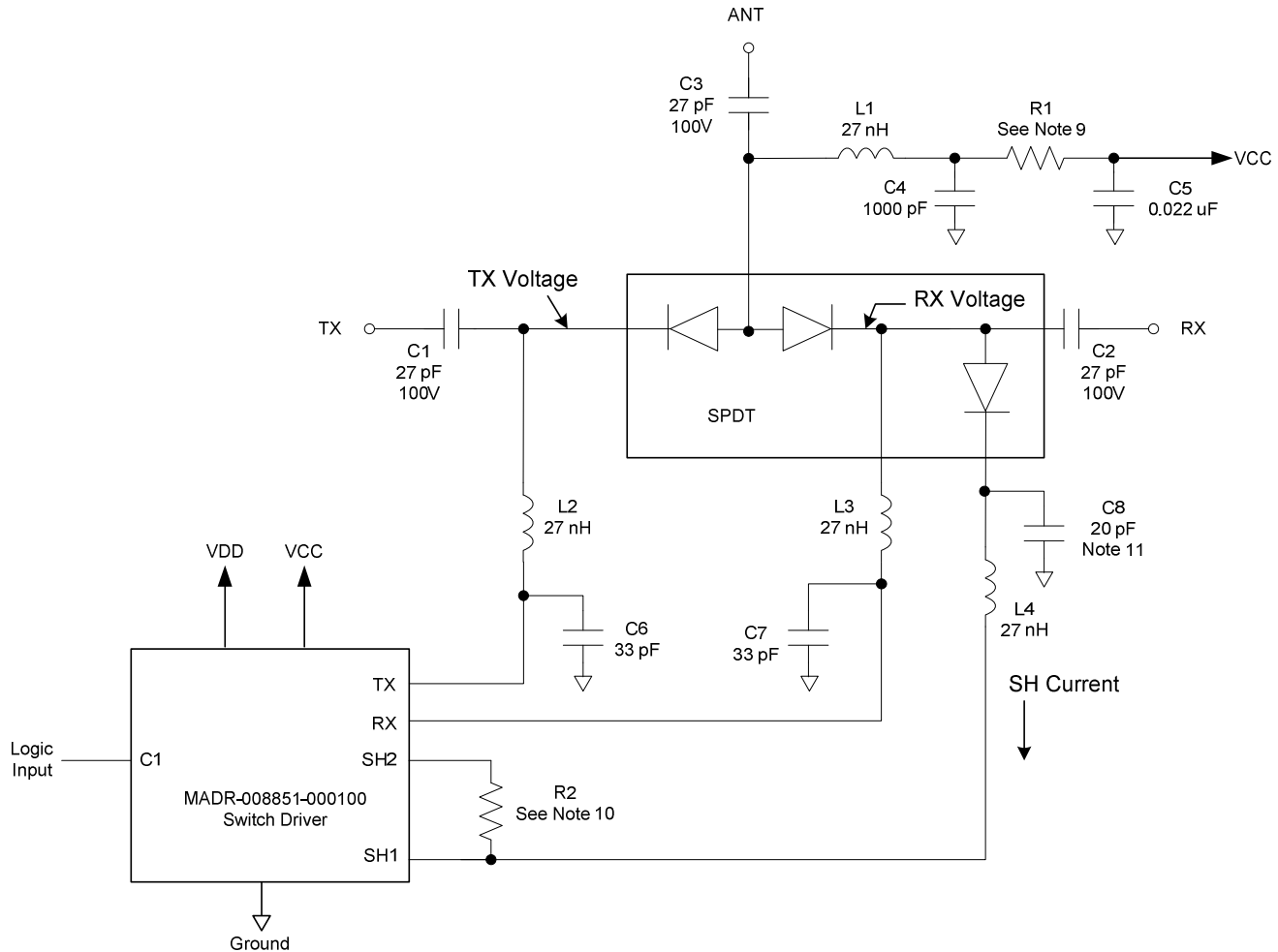
6. Switching parameters for the shunt output are not listed since they can only be measured with a diode switch.

Switching Speed When Driving M/A-COM MASW-000834-13560T Switch⁷:

| 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 |
| | T _r | 10% - 90% RF | ns | 80 | 200 | 300 |
| | T _f | 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 |
| | T _r | 10% - 90% RF | ns | 150 | 300 | 500 |
| T _f | 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 | |
| T _r | 10% - 90% Current | ns | 470 | 540 | 610 | |
| T _f | 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 |
| | T _r | 10% - 90% RF | ns | 280 | 300 | 340 |
| | T _f | 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 |
| | T _r | 10% - 90% RF | ns | 400 | 450 | 550 |
| T _f | 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 | |
| T _r | 10% - 90% Current | ns | 850 | 840 | 880 | |
| T _f | 90% - 10% Current | ns | 90 | 90 | 90 | |

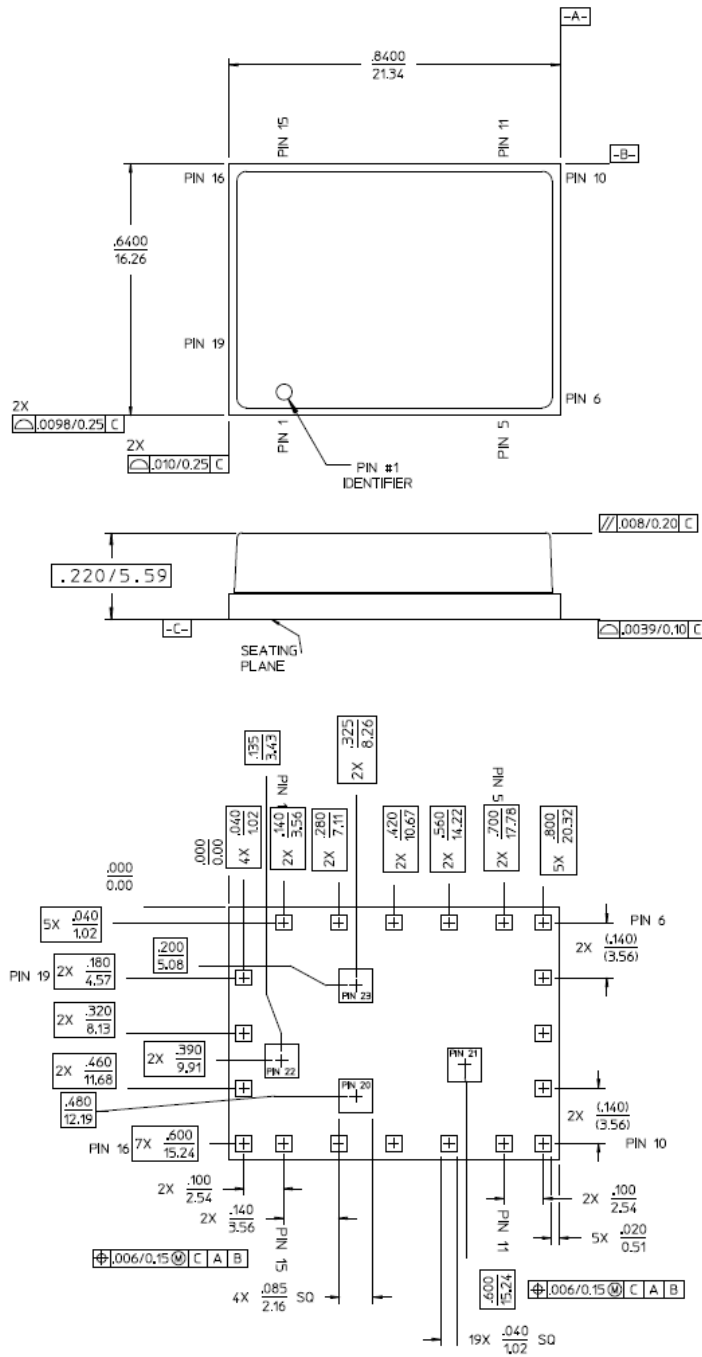
7. Switching parameters were measured with a 10 dBm, 2 GHz RF input.

Driver and SPDT Schematic for 2 GHz Applications^{8,9,10,11,12,13,14}



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

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