MADR-009269

Single Driver for GaAs FET or PIN Diode Switches and Attenuators

Rev. V3

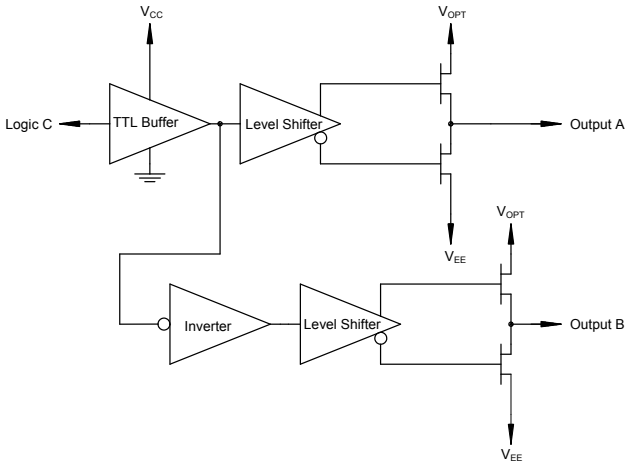
Features

- High Voltage CMOS Technology
- Complementary Outputs
- Positive Voltage Control
- CMOS device using TTL input levels
- Low Power Dissipation
- Low Cost Plastic SOIC-8 Package
- 100% Matte Tin Plating over Copper
- Halogen-Free “Green” Mold Compound
- RoHS* Compliant

Description

The MADR-009269 is a single channel CMOS driver used to translate TTL control inputs into complementary gate control voltages for GaAs FET microwave switches and attenuators. High speed analog CMOS technology is utilized to achieve low power dissipation at moderate to high speeds, encompassing most microwave switching applications. The output HIGH level is optionally 0 to 2 V (relative to GND) to optimize the intermodulation products of FET control devices at low frequencies. For driving PIN diode circuits, the outputs are nominally switched between +5 V & -5 V.

Functional Schematic



Ordering Information[1]

Part Number	Package
MADR-009269-000100	bulk packaging
MADR-009269-00GDIE	100 piece gel pack
MADR-009269-000DIE	100 piece waffle pack
MADR-009269-0001TR	1000 piece reel

1. Reference Application Note M513 for reel size information.

Pin Configuration[2]

Pin No.	Function
1	Output A
2	GND
3	V_{CC}
4	C, Logic
5	V_{EE}
6	V_{OPT}
7	GND
8	Output B

2. The bottom of the die should be isolated for part number MADR-009269-000DIE and MADR-009269-00GDIE.

* Restrictions on Hazardous Substances, European Union Directive 2011/65/EU.

DC Characteristics over Guaranteed Operating Range

Symbol	Parameter	Test Conditions	Units	Min.	Typ.	Max.
VIH	Input High Voltage	Guaranteed High Input Voltage	V	2.0	—	—
V_{IL}	Input Low Voltage	Guaranteed Low Input Voltage	V	—	—	0.8
V_{OH}	Output High Voltage	I_{OH} = -1 mA	V	V_{OPT} -0.1	—	—
V_{OL}	Output Low Voltage	I_{OL} = +1 mA	V	—	—	V_{EE} +0.1
I_{IN}	Input Leakage Current	V_{IN} = V_{CC} or GND, V_{EE} = min, V_{CC} = max, V_{OPT} = min or max	µA	-1	—	1
R_{NFET}	Output Resistance NFET On (to V_{EE})	V_{CC} = 5.0 V, V_{EE} = -5.0 V, V_{OPT} = 5.0 V, V_{OUT} = -4.9 V +25°C	Ω	—	30	—
R_{PFET}	Output Resistance PFET On (to V_{OPT})	V_{CC} = 5.0 V, V_{EE} = -5.0 V, V_{OPT} = 5.0 V, V_{OUT} = 4.9 V +25°C	Ω	—	30	—
I_{CC}	Quiescent Supply Current	V_{IN} = V_{CC} or GND, V_{EE} = -10.5 V, V_{CC} = 5.5 V, V_{OPT} = 5.5 V, No Output Load	µA	—	1	—
D I_{CC}	Additional Supply Current (per TTL Input pin)	V_{CC}= max, V_{IN} = V_{CC} -2.1 V	mA	—	1	—
I_{EE}	Quiescent Supply Current	V_{IN} = V_{CC} or GND, V_{EE} = -10.5 V, V_{CC} = 5.5 V, V_{OPT} = 5.5 V, No Output Load	µA	—	1	—
I_{OPT}	Quiescent Supply Current	V_{IN} = V_{CC} or GND, V_{EE} = -10.5 V, V_{CC} = 5.5 V, V_{OPT} = 5.5 V, No Output Load	µA	—	1	—

AC Characteristics Over Guaranteed Operating Range[3]

Symbol	Parameter	Unit	Typical performance		
			-40°C	+25°C	+85°C
T_{PLH}	Propagation Delay	ns	20	22	25
T_{PHL}	Propagation Delay	ns	20	22	25
T_{TLH}	Output Transition Time (Rising Edge)	ns	5	5	8
T_{THL}	Output Transition Time (Falling Edge)	ns	4	4	5
T_{skew}	Delay Skew	ns	2.5	2.5	2.5
PRF (max)	50% Duty Cycle	MHz	DC	—	10
C_{IN}	Input Capacitance	pF	5	5	5

3. V_{CC} = +4.5 V, V_{EE} = -4.5 V, V_{OPT} = 0 V or +4.5 V, C_L = 25 pF, T_{RISE}, T_{FALL} = 6 ns

Truth Table

Input	Outputs	
C	A	B
Logic "0"	V_{EE}	V_{OPT}
Logic "1"	V_{OPT}	V_{EE}

Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

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

Guaranteed Operating Ranges[4,5,6]

Symbol	Parameter	Unit	Min.	Typ.	Max.
V_{CC}	Positive DC Supply Voltage	V	4.5	5.0	5.5
V_{EE}	Negative DC Supply Voltage	V	-10.5	-5.0	-4.5
V_{OPT}[7,8]	Optional DC Output Supply Voltage	V	0	—	V_{CC}
V_{OPT} - V_{EE}	Negative Supply Voltage Range	V	4.5	Note 7,8	16.0
V_{CC} - V_{EE}	Positive to negative Supply Range	V	9	10	16
T_{OPER}	Operating Temperature	°C	-40	+25	+85
I_{OH}	DC Output Current - High	mA	-50	—	—
I_{OL}	DC Output Current - Low	mA	—	—	50
T_{RISE}, T_{FALL}	Maximum Input Rise or Fall Time	ns	—	—	500

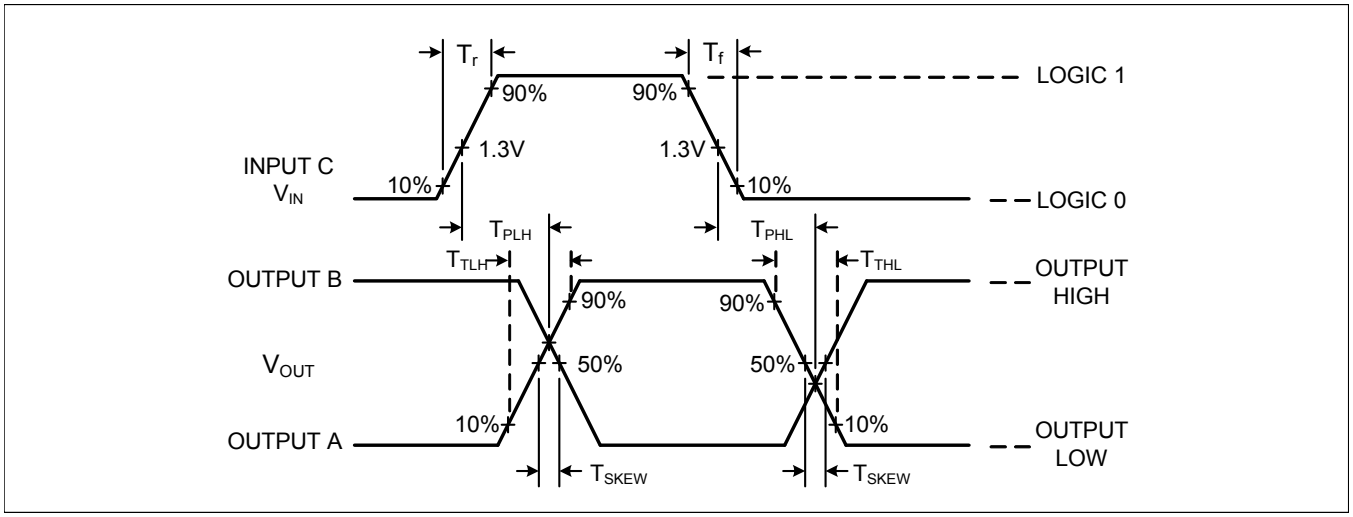
4. Unused logic inputs must be tied to either GND or V_{CC}.
5. MACOM recommends that V_{CC} be powered on before V_{EE}, and powered off after V_{EE}.
6. 0.01 µF decoupling capacitors are required on the power supply lines.
7. V_{OPT} is grounded in most cases when FETs are driven. To improve the intermodulation performance and the 1 dB compression point of GaAs control devices at low frequencies, V_{OPT} can be increased to between 1 and 2 V. The nonlinear characteristics of the GaAs control devices will approximate performance at 500 MHz. It should be noted that the control current that is on the GaAs MMICs will increase when positive controls are applied.
8. When this driver is used to drive PIN diodes, V_{OPT} is often set to +5 V, with V_{EE} set to -5 V.

Absolute Maximum Ratings[9]

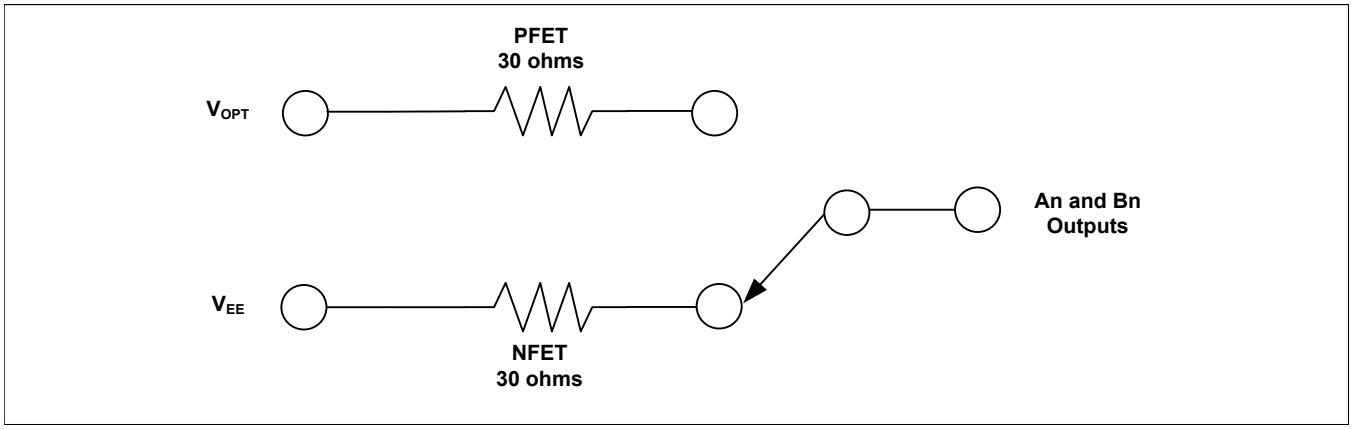
Symbol	Parameter	Unit	Min.	Max.
V_{CC}	Positive DC Supply Voltage	V	-0.5	7.0
I_{CC}	Positive DC Supply Current (-0.5 V ≤ V_{IN} ≤ 0.8 V; 2.0 V ≤ V_{IN} ≤ V_{CC} + 0.5 V; V_{CC} - V_{IN} ≤ 7.0 V)	mA	—	20
V_{EE}	Negative DC Supply Voltage	V	-11.0	0.5
I_{EE}	Negative DC Supply Current (per output)[10]	mA	-60	—
V_{OPT}	Optional DC Output Supply Voltage	V	-0.5	Note 11
I_{OPT}	Optional DC Output Supply Current (per output)[10]	mA	—	60
V_{OPT} - V_{EE}	Output to Negative Supply Voltage Range	V	-0.5	18.0
V_{CC} - V_{EE}	Positive to Negative Supply Voltage Range	V	-0.5	18.0
V_{IN}	DC Input Voltage	V	-0.5 Note 12	V_{CC} +0.5
V_O	DC Output Voltage	V	V_{EE} – 0.5	V_{OPT} + 0.5
P_D[13]	Power Dissipation in Still Air	mW	—	500
T_{OPER}	Operating Temperature	°C	-55	125
T_{STG}	Storage Temperature	°C	-65	150
ESD	ESD Sensitivity	kV	2.0	—

9. All voltages are referenced to GND. All inputs and outputs incorporate latch-up protection structures.
10. The maximum I_{EE} and I_{OPT} are specified under the condition of V_{CC} = 5.5 V, V_{EE} = -5.5 V, V_{OPT} = 5.5 V, and the total power dissipation is within 500 mW in still air.
11. The absolute maximum rating for V_{OPT} is V_{CC} +0.5 V, or +7.0 V, whichever is less.
12. If V_{CC} ≥ 6.5 V, then the minimum for V_{IN} is V_{CC} -7.0 V.
13. Derate -7 mW/°C from 65°C to 85°C.

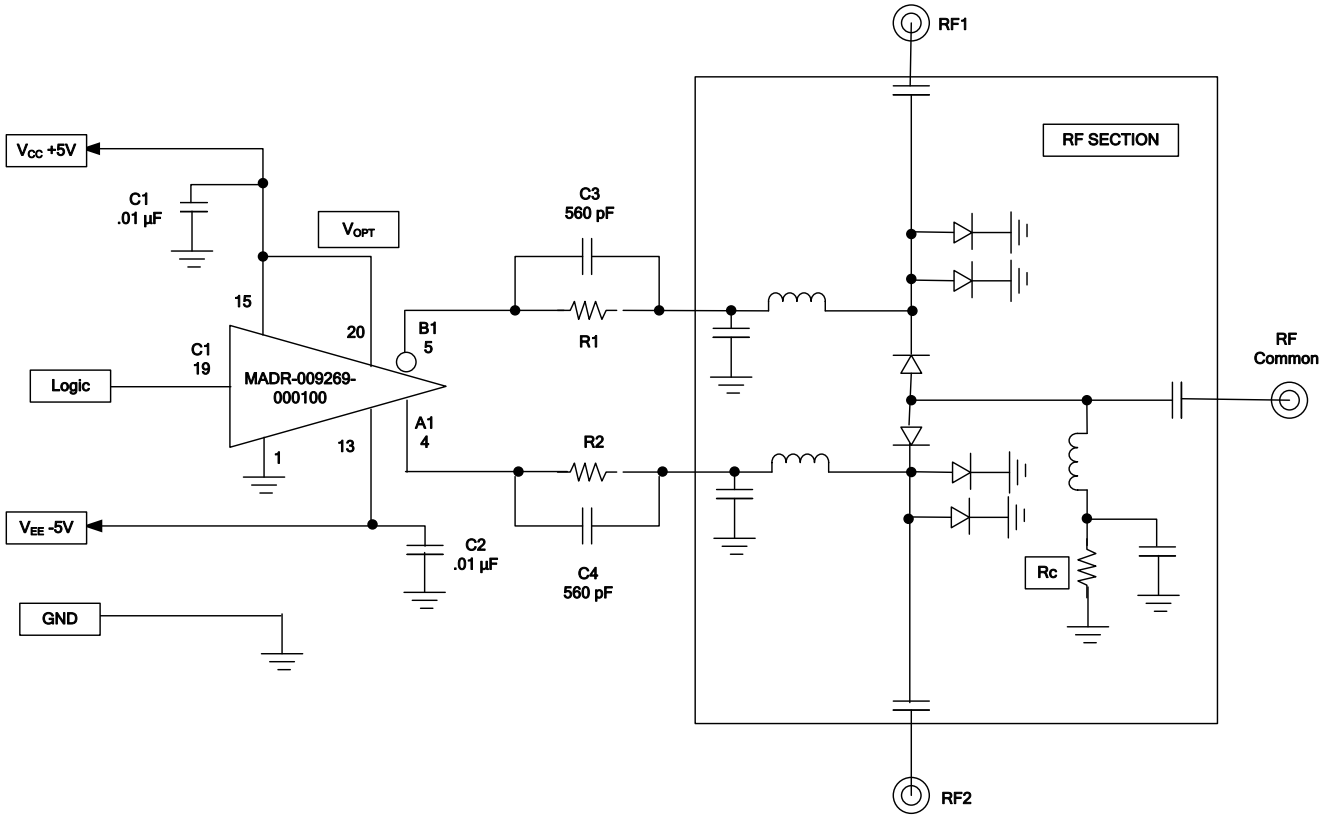
Switching Waveforms



Equivalent Output Circuit for A and B Outputs (50 mA load at 25°C)



Typical Application for a SPDT Switch

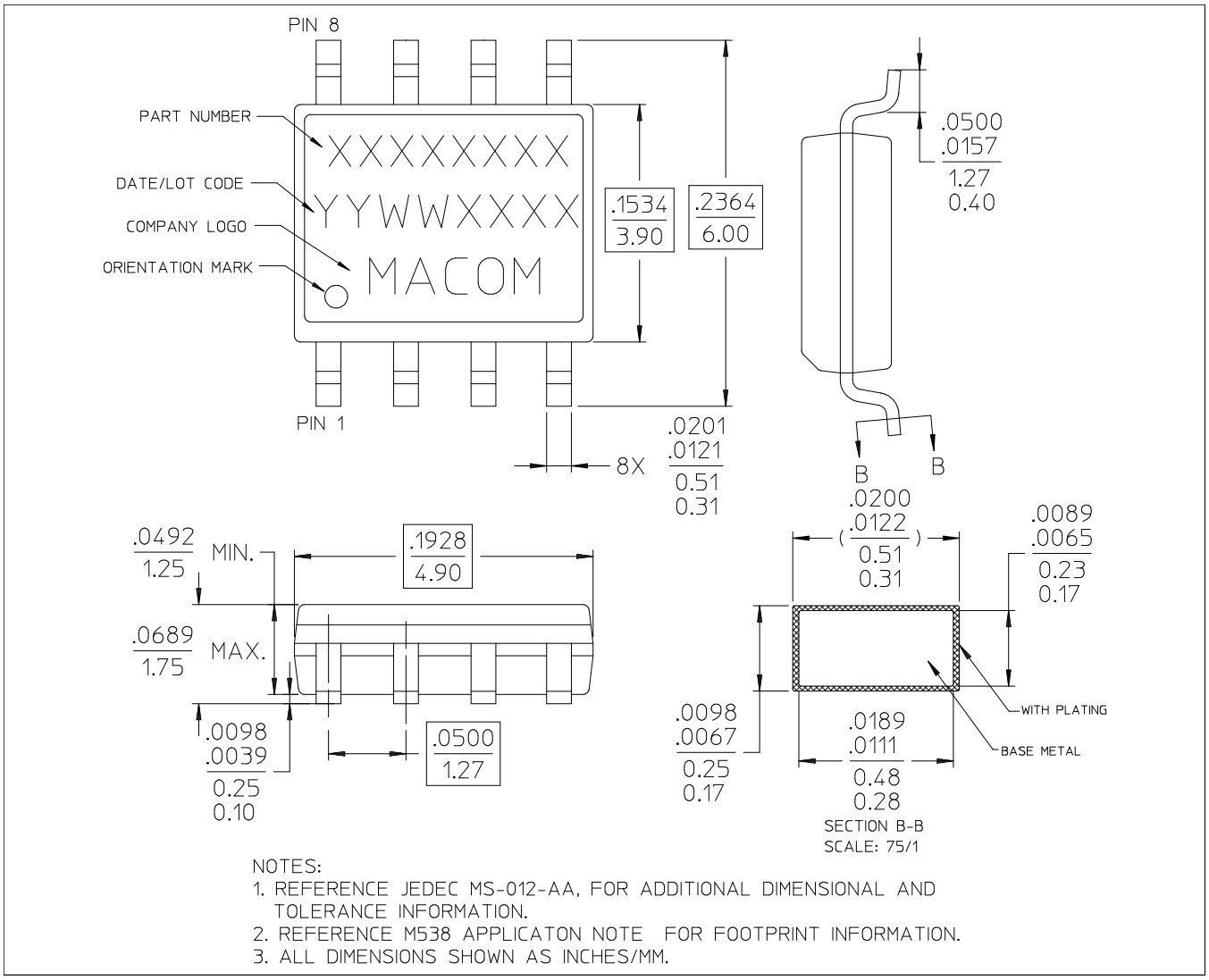


Description of Circuit

The MADR-009269 provides a pair of complementary outputs that are each capable of driving a maximum of ±50 mA into a load. In addition, with proper capacitor selection (C3 & C4) used in parallel with the current setting resistor (R1 & R2), additional spiking current can be achieved.

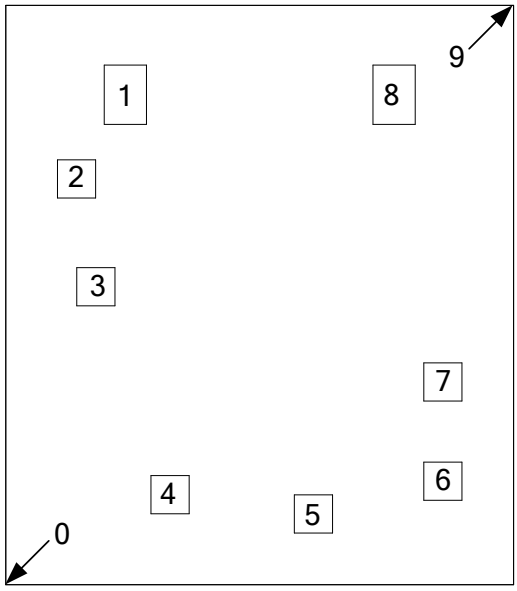
To achieve the non-inverting and inverting complementary voltages, each output is switched between two internal FETs. The FETs are connected to V_{OPT} for the positive output and V_{EE} for the negative output. V_{OPT} and V_{EE} are adjustable for various configurations and have the following limitations: V_{EE} can be no more negative than -10.5 volts; V_{OPT} can be no more positive than +5.5 volts and V_{OPT} must always be less than or equal to V_{CC}. Increasing V_{OPT} beyond V_{CC} will prevent the device from switching states when commanded to by the logic input. The most common configuration is to drive V_{EE} at -5.0 volts with V_{CC} and V_{OPT} tied together at +5.0 volts.

Lead-Free, SOIC-8†



† Reference Application Note M538 for lead-free solder reflow recommendations.
Plating is 100% matte tin over copper.

Die Outline



Pad Configuration[14,15]

Die Size: 1130 x 1290 µm (nominal)

Pad No.	X (µm) nominal	Y (µm) nominal	Pad Size (µm) X x Y
0	0	0	Lower left edge of die
1	266.40	1092.35	94 x 132
2	157.50	903.70	85 x 85
3	200.40	663.65	85 x 85
4	365.30	200.45	85 x 85
5	684.35	157.50	85 x 85
6	972.50	230.50	85 x 85
7	972.50	451.45	85 x 85
8	863.60	1092.35	94 x 132
9	1130	1290	Upper right edge of die

14. All X,Y dimensions are at bond pad center.
15. Die thickness is 8.0 mils.