MADR-011007

40-bit Serial to Parallel Driver for GaAs FETs

Rev. V2

Features

- 40-bit Serial to Parallel Converter
- 20-bit Multiplexer for TX Control bits
- Serial Out Ports for Diagnostics and Daisy Chaining
- Compatible with 5.0 V and 3.3 V CMOS Logic
- Built-in Active Pull-down for Logic Inputs
- Fast Switching
- Low Current consumption
- Lead-Free 6 mm 48-lead PQFN Package
- Halogen-Free “Green” Mold Compound
- RoHS* Compliant and 260°C Reflow Compatible

Description

The MADR-011007 is a 40-bit serial to parallel driver in a low cost 6 mm 48-lead PQFN plastic package. It is designed as the serial control interface for MACOM’s transmit module MAIA-010365 and receive module MAIA-009579. A 20-bit multiplexer is designed on-chip to provide TX bits control capability. High speed digital CMOS technology is utilized to achieve low power dissipation. Even though it is designed to drive GaAs FETs using a -5 V power supply, it can also be used as a general serial to parallel converter when using a +5 V power supply.

This driver, used in conjunction with MACOM’s MAIA-010365 S-Band radar transmit module, MAAP-011022 S-Band 7 W high power amplifier, and the MAIA-009579 receiver, provides a complete chipset for S-Band dual polarization air traffic control and weather radar applications.

Ordering Information[1]

Part Number	Package
MADR-011007-TR0500	500 piece reel

1. Reference Application Note M513 for reel size information.

Pin Configuration

Pin No.	Function	Pin No.	Function
1	TX2-phase 1	25	RX2-atten 4
2	TX1-phase 1	26	RX1-atten 4
3	TX1-phase 2	27	RX1-atten 3
4	TX1-phase 3	28	RX1-atten 2
5	TX1-phase 4	29	RX1-atten 1
6	TX1-phase 5	30	RX1-phase 6
7	TX1-phase 6	31	RX1-phase 5
8	TX1-atten 1	32	RX1-phase 4
9	TX1-atten 2	33	RX1-phase 3
10	TX1-atten 3	34	RX1-phase 2
11	TX1-atten 4	35	RX1-phase 1
12	TX2-atten 4	36	RX2-phase 1
13	TX2-atten 3	37	RX2-phase 2
14	TX2-atten 2	38	RX2-phase 3
15	TX2-atten 1	39	RX2-phase 4
16	TX2-phase 6	40	RX2-phase 5
17	GND	41	LOAD
18	VEE	42	CLK
19	TX_STATE	43	SER_IN
20	SNGL_DUAL	44	SER_OUT
21	RX2-phase 6	45	TX2-phase 5
22	RX2-atten 1	46	TX2-phase 4
23	RX2-atten 2	47	TX2-phase 3
24	RX2-atten 3	48	TX2-phase 2
		49	Paddle[2]

2. The exposed paddle centered on the package bottom must be either left "open" (no connection) or connected to V_{EE}.

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

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Guaranteed Operating Ranges[3,4,5]

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{EE}[6]	Negative DC Supply Voltage	-5.5	-5.0	-4.5	V
T_{OPER}	Operating Temperature	-40	25	85	°C
I_{OH}	DC Output Current - High	-1	—	—	mA
I_{OL}	DC Output Current - Low	—	—	1	mA

3. Unused logic inputs must be tied to either GND or V_{EE}.
4. 0.01 µF decoupling capacitors are required on the power supply line.
5. This driver can also operate at –3.3 V V_{EE}, but at slower speed.
6. When using positive logic, GND should be connected to positive power supply +5 V, and V_{EE} should be connected to ground.

Performance over Guaranteed Operating Range

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_{IH}	Input High Voltage	Guaranteed High Input Voltage	-1.5	0.0	0.0	V
V_{IL}	Input Low Voltage	Guaranteed Low Input Voltage	-5.5	-5.0	-3.5	V
V_{OH}	Output High Voltage	I_{OH} = -250 µA	—	-0.1	—	V
V_{OL}	Output Low Voltage	I_{OL} = 250 µA	—	V_{EE} + 0.1	—	V
I_{IN}	Input Leakage Current (per Input)	V_{IN} = GND or V_{EE}	—	80	—	µA
I_{OH}	DC Output Current-High (per Output)	V_{EE} = -5.0 V	-1	—	—	mA
I_{OL}	DC Output Current-Low (per Output)	V_{EE} = -5.0 V	—	—	1	mA
I_{EE}	Quiescent Supply Current	V_{IN} = GND or V_{EE}, No Output Load	—	—	400	µA
T_D	Propagation Delay	50% LOAD signal to 90% V_O	—	12	—	ns
C_{IN}	Input Capacitance	—	—	6	—	pF

Absolute Maximum Ratings

Symbol	Parameter	Min.	Max.	Unit
V_{EE}	Negative DC Supply Voltage	-7.0	0.3	V
V_{IN}	DC Input Voltage	V_{EE} – 0.3	0.3	V
V_O	DC Output Voltage	V_{EE} – 0.3	0.3	V
T_{OPER}	Operating Temperature	-55	125	°C
T_{STG}	Storage Temperature	-65	150	°C
ESD	ESD Sensitivity (HBM)	2.0	—	kV

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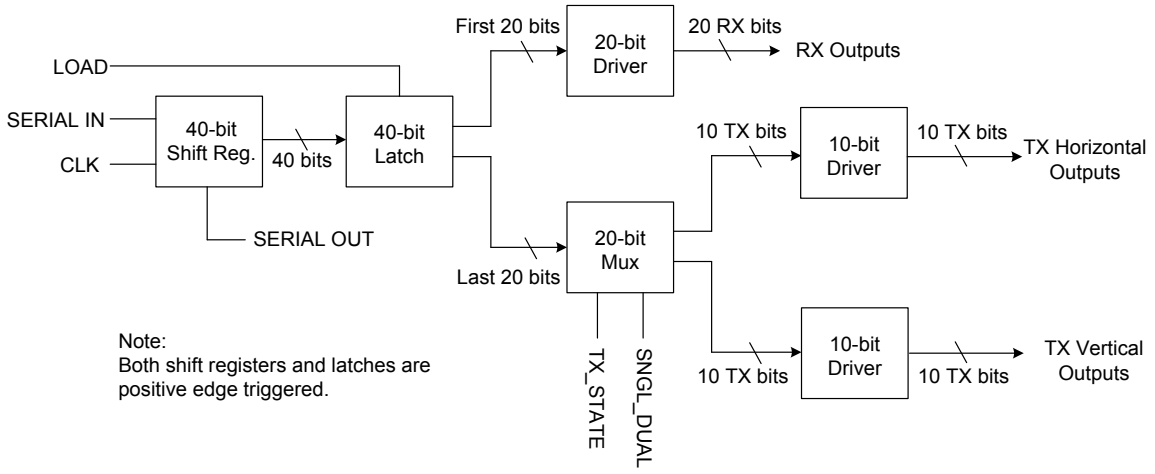
Function Diagram



Serial Bit Stream Definition[7]

Bit No.	Bit Function	Bit No.	Bit Function
1	RX2-phase 1	21	TX-phase 1-A
2	RX2-phase 2	22	TX-phase 1-B
3	RX2-phase 3	23	TX-phase 2-A
4	RX2-phase 4	24	TX-phase 2-B
5	RX2-phase 5	25	TX-phase 3-A
6	RX2-phase 6	26	TX-phase 3-B
7	RX2-atten 1	27	TX-phase 4-A
8	RX2-atten 2	28	TX-phase 4-B
9	RX2-atten 3	29	TX-phase 5-A
10	RX2-atten 4	30	TX-phase 5-B
11	RX1-phase 1	31	TX-phase 6-A
12	RX1-phase 2	32	TX-phase 6-B
13	RX1-phase 3	33	TX-atten 1-A
14	RX1-phase 4	34	TX-atten 1-B
15	RX1-phase 5	35	TX-atten 2-A
16	RX1-phase 6	36	TX-atten 2-B
17	RX1-atten 1	37	TX-atten 3-A
18	RX1-atten 2	38	TX-atten 3-B
19	RX1-atten 3	39	TX-atten 4-A
20	RX1-atten 4	40	TX-atten 4-B

7. Bit No. 1 should be the first bit going into the serial interface.

TX Mux Truth Table

Vertical Beam Bits		SNGL_DUAL	
		L	H
TX_STATE	L[8]	A[9]	B[9]
	H[8]	A	A

Horizontal Beam Bits		SNGL_DUAL	
		L	H
TX_STATE	L	B	A
	H	B	B

8. For V_{EE} = -5 V, Logic "L" = -5 V, and Logic "H" = 0 V.
9. "A" represents odd bits of the 20-bit TX bit stream, and "B" represents even bits of the 20-bit TX bit stream.

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.

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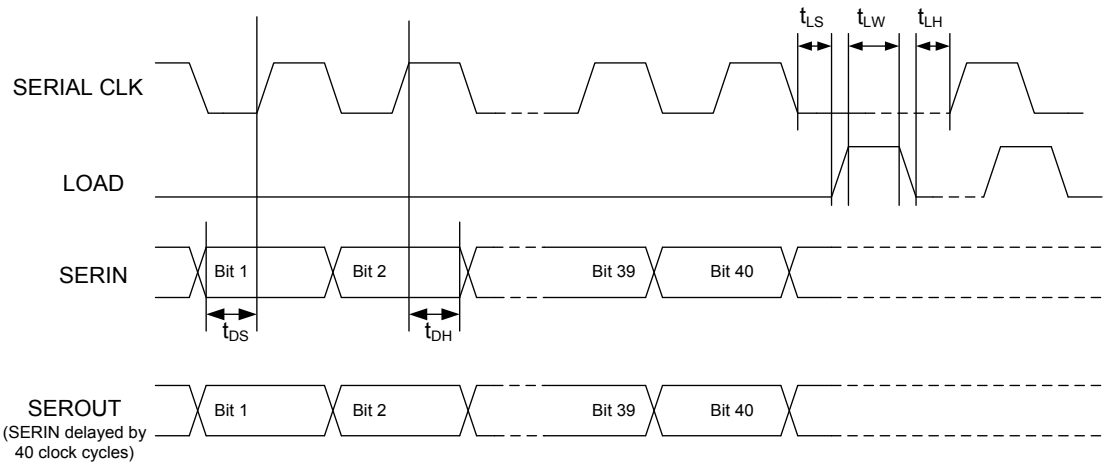
Serial Interface Timing Diagram



Serial Interface Timing Characteristics

		Typical performance			
Symbol	**Parameter**	**-40°C**	**+25°C**	**+85°C**	**Unit**
t_{SCK}	Min. Serial Clock Period	100	100	100	ns
t_{DS}	Min. DATA Set-up Time	20	20	20	ns
t_{DH}	Min. DATA Hold Time	20	20	20	ns
t_{LS}	Min. LOAD Set-up Time	20	20	20	ns
t_{LW}	Min. LOAD Pulse Width	20	20	20	ns
t_{LH}	Min. Serial CLK Hold Time from LOAD	20	20	20	ns

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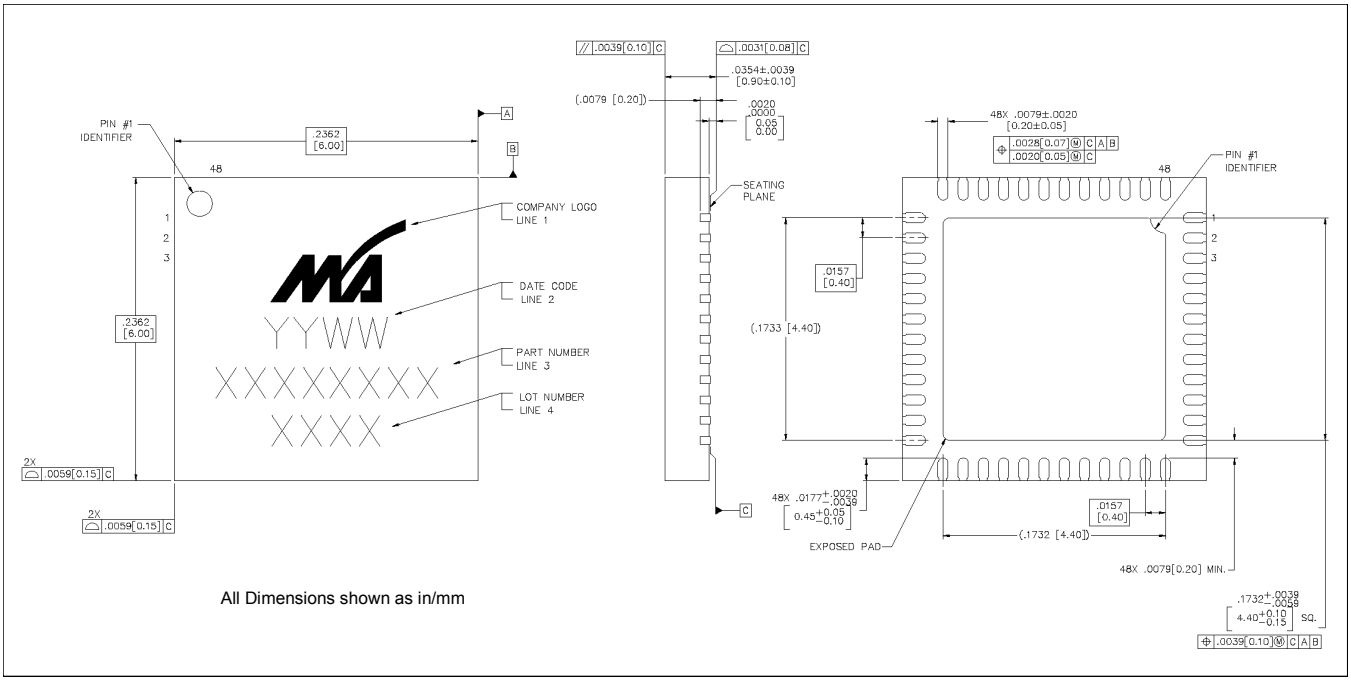
Lead-Free 6 mm 48-Lead PQFN†



† Reference Application Note S2083 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 1 requirements.
Plating is NiPdAuAg.

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