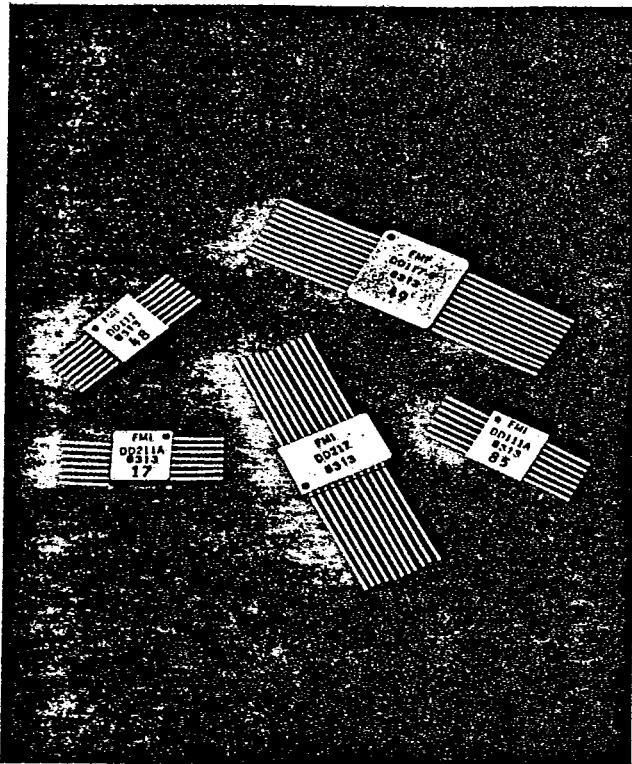




Microwave PIN Diode Drivers

7-52-21



FMI offers a complete lineup of PIN diode switch drivers with output current capability of 10 mA to 50 mA and switching speeds as fast as 6 ns. Thin film metalization on ceramic substrates insures low parasitic capacitance for fast switching, small size, and excellent reliability. FMI has been manufacturing switch driver hybrids for ten years and is the largest supplier of these devices to the RF switch industry. All FMI drivers are designed by our experienced engineering staff; thus, if the drivers listed in the table below do not meet your requirements, we would be happy to discuss a custom circuit to fit your exact needs.

FEATURES

- MIL-STD-883 Level B Screening
- TTL compatible inputs
- Inverting and Non-inverting modes
- Positive and negative output currents
- -55° to +125°C operating temp range
- -65° to +150°C storage temp range

Vcc = +5V, Vee = -12V

HIGH SPEED DRIVERS

MODEL	NO. OF DRIVERS	OUTPUT CURRENT ^①						MINIMUM OPEN CKT. OUTPUT (V)		MAXIMUM SWITCHING TIMES (NS)		MAX. REP. RATE (MHZ)	MAXIMUM INTERNAL CURRENT DRAIN (MA)		OPERATING VOLTAGE LIMITS (V) ^④				MAX. POWER DISSIPATION (W) ^⑤	
		D.C. (MA)		MINIMUM PEAK (MA)		+5V									VEE		100°C		25°C	
		POSITIVE	NEGATIVE																	
		MIN.	MAX.	MIN.	MAX.	POS.	NEG.	POS.	NEG.	TON	TOFF	+	-	MIN.	MAX.	MIN.	MAX.	CASE	AMB.	
DD111/M	1	12/24	18/36	12	18	100	150	2.5	5.5	25	25	5	45	25	4.5	5.5	5	16	0.8	0.5
DD211/M	2	12	18	12	18	100	150	2.5	5.5	25	25	5	90	50	4.5	5.5	5	16	1.6	0.5
DD211B	2	24	36	12	18	100	150	2.5	5.5	25	25	5	90	50	4.5	5.5	5	16	1.6	0.5
DD311A	1	8	12	24	36	300	300	4.0	11.0	6	8	20	15	15	4.5	5.5	5	16	0.8	0.5
DDF311/M	1	8	12	24	36	300	300	4.0	11.0	12	15	10	45	15	4.5	5.5	5	16	0.8	0.5
DDF2311	2	8	12	24	36	300	300	4.0	11.0	12	15	10	60	30	4.5	5.5	5	16	1.0	0.8
DDF3311	3	8	12	24	36	300	300	4.0	11.0	12	15	10	75	45	4.5	5.5	5	16	1.5	1.2
DDF4311	4	8	12	24	36	300	300	4.0	11.0	12	15	10	90	60	4.5	5.5	5	16	1.9	1.2
DDF5311	5	8	12	24	36	300	300	4.0	11.0	12	15	10	135	75	4.5	5.5	5	16	2.8	1.6
DDF6311	6	8	12	24	36	300	300	4.0	11.0	12	15	10	150	90	4.5	5.5	5	16	3.3	1.6

NOTES:

- 1 Output current measured into a 10 ohm load to ground.
- 2 Load is a 50 pF (39 + 10:1 scope probe) capacitor in parallel with a grounded cathode HP5082-0001 PIN diode. Ton is measured from 50% of input (from a 54AS00 gate) to +1 volt across diode load. Toff is measured from 50% of input to the rated open ckt. negative voltage across diode load.
- 3 Exclusive of current supplied to the load.
- 4 To avoid exceeding power ratings, the max. VEE should be held to 5 volts when driving grounded anode diodes.
- 5 Derate linearly to 175°C. Temperature is measured at case bottom which should be heat sunk if necessary.

DD111
DD111M*

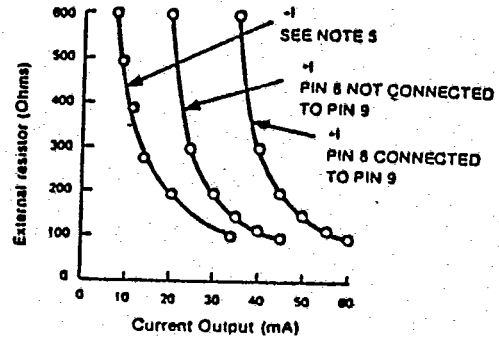
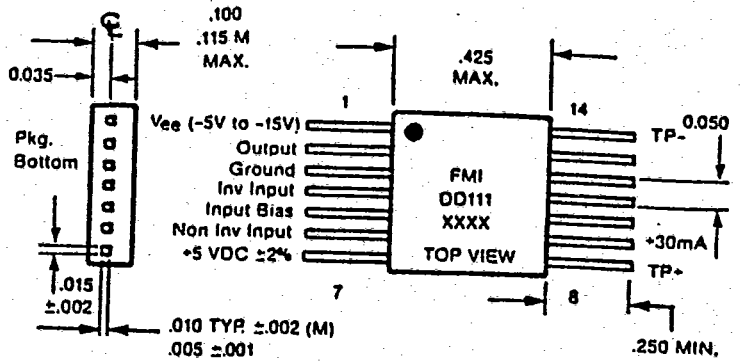
T-52-21

High Speed Drivers

A universal PIN diode driver with excellent noise immunity, very fast switching, 100 mA current spikes and available test points for increasing quiescent output current.

1. When using inverting input, connect bias pin 5 to non-inverting input pin 6.
2. When using non-inverting input, connect bias pin 5 to inverting input pin 4.
3. For +30 mA output current, connect pin 8 to pin 9.
4. For positive output currents other than 15 mA or 30 mA, an external resistor can be connected between pin 8 and +5V. See graph.
5. The negative output current varies with V_{ee} and is specified at -12V. When driving grounded anode diodes, V_{ee} should be kept at -5V where the negative current will be 5 mA. It may be increased by connecting a resistor from TP- (pin 14) to V_{ee} (pin 1). See figure.

* M suffix denotes welded metal package instead of standard epoxy-sealed ceramic package.

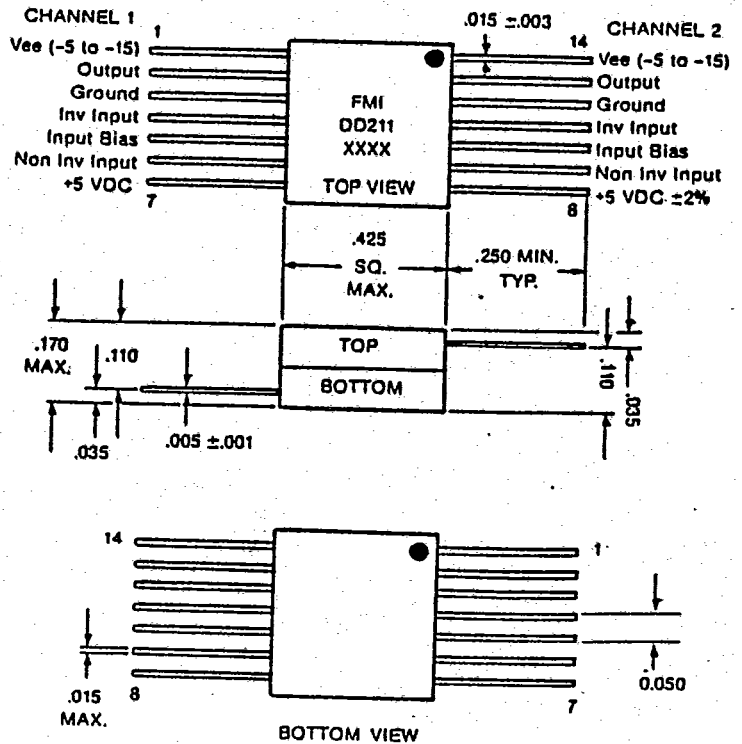


DD211
DD211B
DD211M*

Dual High Speed Drivers

A dual DD111 with current programming pins omitted. This driver is often used in SPDT applications by driving the inverting input of one channel and the noninverting input of the other channel from the same TTL input signal.

1. When using channel 1 inverting input pin 4, connect bias pin 5 to non-inverting input pin 6.
2. When using channel 2 inverting input pin 11; connect bias pin 10 to non-inverting pin 9.
3. When using channel 1 non-inverting input pin 6, connect bias pin 5 to inverting input pin 4.
4. When using channel 2 non-inverting input pin 9, connect bias pin 10 to inverting input pin 11.
5. The two drivers are identical except for quiescent positive output current which is nominally 15 mA for DD211 and 30 mA for DD211B.
6. When driving anode-grounded diodes, care must be exercised to avoid excessive power dissipation. V_{ee} should be limited to -10 volts at which point the negative output current will be approximately -10 mA. Consult factory for design assistance.



METAL WELDED PACKAGE

DD311A

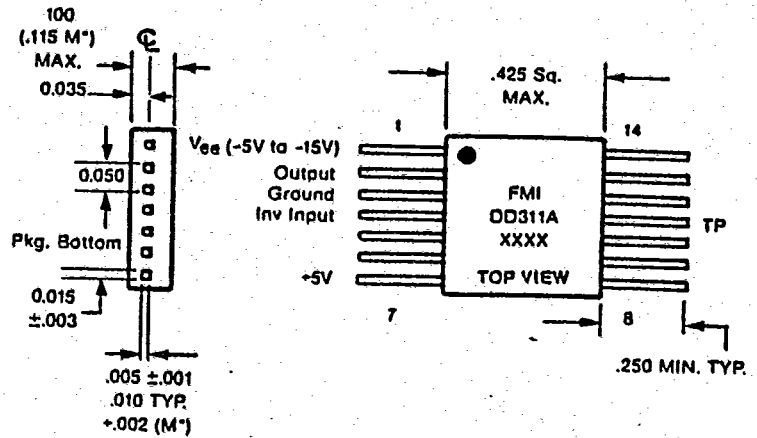
DD311AM*

Ultra High Speed SPST

An inverting only ultra high speed driver with 300 mA switching current spikes. The DD311A output (pin 2) is connected to a 360 ohm resistor paralleled with a 560 pF capacitor and the driven end (pin 11) of the resistor/capacitor combination is switched between +4 volts and -10 volts.

1. The DD311A should be driven from an otherwise unloaded 54S, 54AS, or 54F type gate to achieve rated switching times. Input capacitance is approximately 50 pF.
2. To increase switching peak currents, add a capacitor of up to 560 pF between the output and TP pin.

* M suffix denotes welded metal package instead of standard epoxy-sealed ceramic package.



DDF311

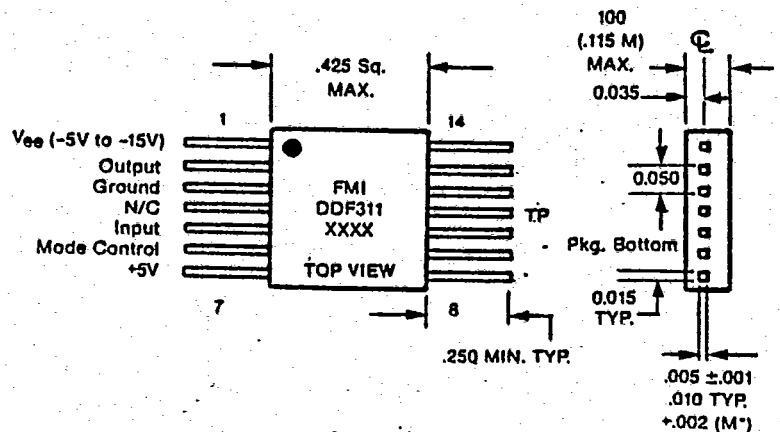
DDF311M*

High Speed Drivers

Single channel high speed drivers with 300 mA peak current spikes.

1. Inputs are non-inverting when Mode control has a logic high input.
2. Inputs are inverting when Mode control has logic low input.
3. To increase switching peak currents, add a capacitor of up to 560 pF between the output and TP pin.
4. Mode control and input pins are interchangeable within any one channel.
5. DDF311 Series drivers do not have a true current source output. Instead the output is connected to a 380-ohm resistor in parallel with a 560 pF capacitor and the driven end of this RC combination is switched between +4 and V_{ee} so that the negative output current varies directly with V_{ee} .

* M suffix denotes welded metal package instead of standard epoxy-sealed ceramic package.

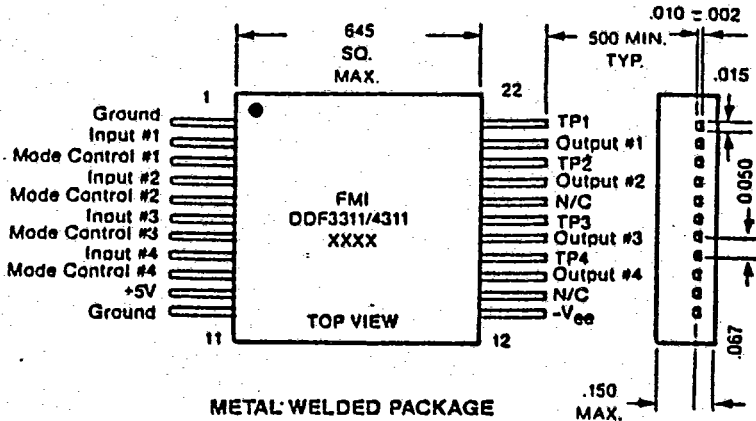
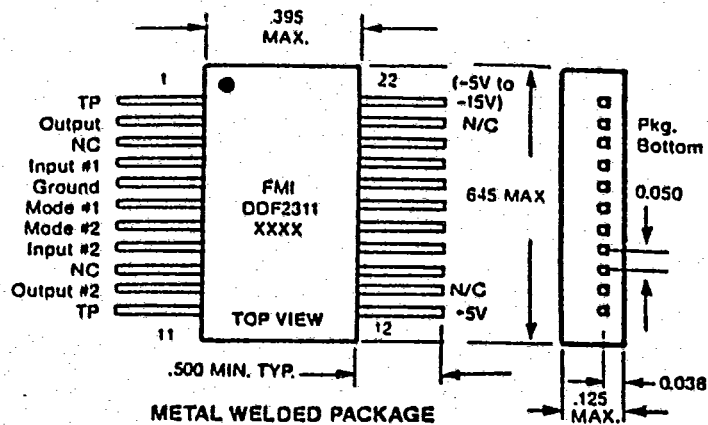


DDF2311
DDF3311
DDF4311

Two, Three, and Four Channel High Speed Drivers

Multiple independent high speed drivers with 300 mA peak current spikes.

1. Inputs are non-inverting when Mode control has a logic high input.
2. Inputs are inverting when Mode control has a logic low input.
3. To increase switching spike currents, add a capacitor of up to 560 pF between the output and TP pins.
4. Mode control and input pins are interchangeable within any one channel.
5. When driving anode-grounded diodes, excessive power dissipation must be avoided. V_{ee} should be limited to -8V with -5V recommended.
6. The DDF2311/3311/4311 do not have a true current source output. Instead the output is connected to a 380-ohm resistor in parallel with a 560 pF capacitor and the driven end of this RC combination is switched between +4V and V_{ee} so that the negative output current varies directly with V_{ee} .



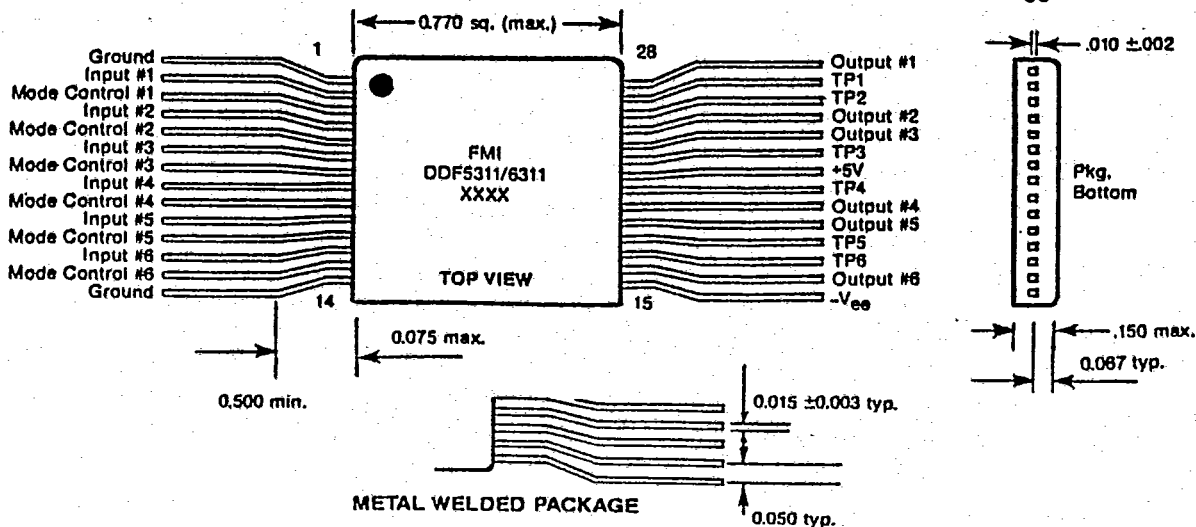
DDF5311
DDF6311

Five and Six Channel High Speed Drivers

Independent high speed drivers with 300 mA peak current spikes.

1. Inputs are non-inverting when Mode control has a logic high input.
2. Inputs are inverting when Mode control has a logic low input.
3. To increase switching spike currents, add a capacitor of up to 560 pF between the output and TP pins.

4. Mode control and input pins are interchangeable within any one channel.
5. When driving anode-grounded diodes, excessive power dissipation must be avoided. V_{ee} should be limited to -8V with -5V recommended.
6. These drivers do not have a true current source output. Instead the output is connected to a 380-ohm resistor in parallel with a 560 pF capacitor and the driven end of this RC combination is switched between +4V and V_{ee} so that the negative output current varies directly with V_{ee} .



HIGH CURRENT DRIVERS

$V_{CC} = +5V, V_{EE} = -12V$

MODEL	NO. OF DRIVERS	OUTPUT CURRENT ①				MINIMUM OPEN CKT. OUTPUT (V)		MAXIMUM SWITCHING TIMES (NS)		MAX. REP. RATE (MHZ)	MAXIMUM INTERNAL CURRENT DRAIN (MA)		OPERATING VOLTAGE LIMITS (V)				MAX. POWER DISSIPATION (W)	
		D.C. (MA)				POS.	NEG.	TON	TOFF		+5V	VEE	+5V		VEE		100°C CASE	25°C AMB.
		POSITIVE		NEGATIVE									MIN.	MAX.	MIN.	MAX.		
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		MIN.	MAX.	MIN.	MAX.				
DD217	2	24/40	36/60	24/40	36/60	4.0	11.0	100	200	1	30	15	4.5	5.5	3	16	1.0	0.8
DD320	3	16	24	16	24	4.0	11.0	100	200	1	50	25	4.5	5.5	3	16	1.5	1.2
DD350	3	40	60	40	60	4.0	11.0	100	200	1	50	25	4.5	5.5	3	16	1.5	1.2
DD420	4	16	24	16	24	4.0	11.0	100	200	1	60	30	4.5	5.5	3	16	1.9	1.2
DD450	4	40	60	40	60	4.0	11.0	100	200	1	60	30	4.5	5.5	3	16	1.9	1.2
DD620	6	16	24	16	24	4.0	11.0	100	200	1	90	45	4.5	5.5	3	16	2.8	1.2
DD650	6	40	60	40	60	4.0	11.0	100	200	1	90	45	4.5	5.5	3	16	2.8	1.2

NOTES:

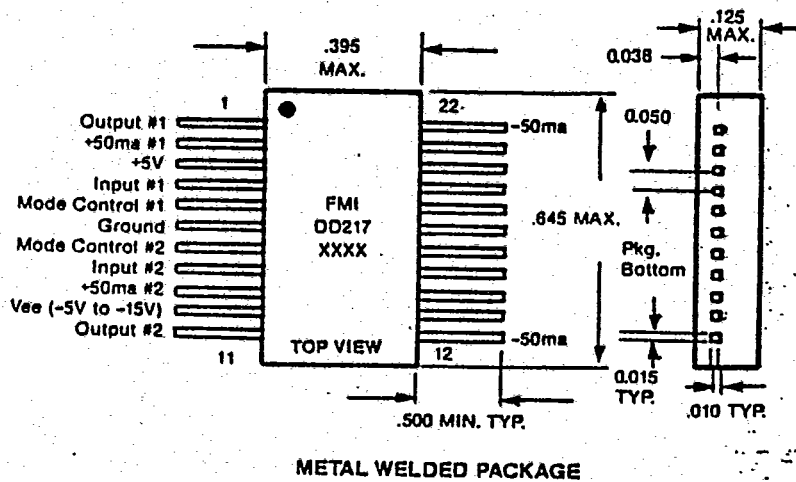
- Output current measured into a 10 ohm load to ground.
- Load is a 100 pF capacitor in parallel with a grounded cathode MA47120 PIN diode.
Ton is measured from 50% of the input voltage (from a 5400AS00 gate) to +1 volt across diode load.
Toff is measured from 50% of the input voltage to the rated open ckt. negative voltage across diode load.
- Exclusive of current supplied to the load.
- VEE max. should be -5 volts if used with grounded anode diodes. See note with individual device data.
- Derate linearly to 175°C. Temperature is measured at case bottom which should be heat-sunk if necessary.

DD217

Dual High Current Driver

Two independent universal medium speed (100ns) drivers with separate positive and negative quiescent output current programming and separate input logic mode control. This driver is often used in SPDT applications by driving both inputs from the same TTL input signal and applying opposite logic inputs to the two mode controls.

- Inputs are inverting when Mode control has a logic high input.
- Inputs are non-inverting when Mode control has a logic low input.
- To increase positive output current from the normal +30 mA to +50 mA, connect +50 mA pin to +5V.
- To increase negative output current from the normal -30 mA to -50mA, connect -50mA pin to V_{ee}.
- The negative output current does not vary with V_{ee} which should not exceed -5V when driving grounded anode diodes to avoid high power dissipation in the drivers.

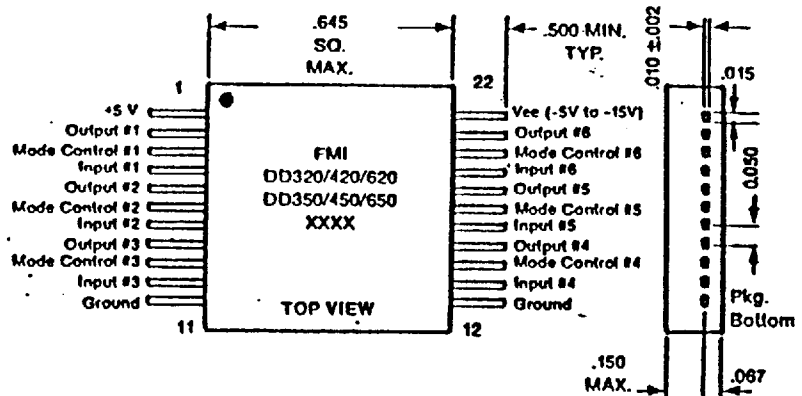


DD320 DD350
DD420 DD450
DD620 DD650

Three, Four, and Six Channel High Current Drivers

Multiple independent medium speed drivers with separate input logic mode controls. Logic inputs are true TTL unit loads.

1. Inputs are inverting when Mode control has a logic high input.
2. Inputs are non-inverting when Mode control has a logic low input.
3. Mode control and input pins are interchangeable within any one channel.
4. The negative output current does not vary with Vee which should not exceed -5V when driving grounded anode diodes to avoid high power dissipation in the drivers.
5. The last two digits of the part number signify output current. Other currents are available on special order.



APPLICATION NOTES

PIN Diode Switching Times

PIN diodes are used as RF switches because of their low off-capacitance/on-resistance product. However they store a significant charge during conduction that must be removed before they will turn off. Typically, this is specified as storage time (TS) which is made to look better than it might be by rating it with a high ratio of reverse (IR) to forward (IF) current. When switching these diodes with a non-spike driver, the typical TS will be multiplied by the specified ratio. For example, the MA47120 has a TS of 12 ns with IF=20 mA and IR=200 mA. With symmetrical currents as delivered by FMI high current drivers, the TS becomes 120 ns. FMI high speed drivers supply a spike of several hundred mA at turn-on and turn-off to shorten the TS of the PIN diode.

Other Diode Drivers

In addition to these standard circuits, FMI produces a wide range of custom-designed drivers. These include a dual ECL-Input driver (DD212) and a 28-channel 50 mA driver (DD2850). FMI is also one of the largest independent custom hybrid manufacturers in the United States. Please contact the factory or your local FMI representative for a quote on your driver requirements or your own custom hybrid circuit.

Heat Sinking

The power dissipated in FMI PIN diode switches is conducted to the bottom of the package. The thin walls leading to the top of the package represent a high thermal resistance. The total power in the hybrid is the sum of its own current drain times the voltage of each supply plus the output current of each driver times the supply voltage less the VF of the PIN diode. The total can be substantial especially in the multiple high current drivers. If your calculations show that the hybrid should be heat-sunk, you may find it convenient to place it top down on the pc board so that the bottom of the hybrid may be mounted directly to the metal case of your package.



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