

High Speed Quad MOSFET Driver

Features

- ❑ 6ns rise and fall time
- ❑ 2 A peak output source/sink current
- ❑ 1.2V to 5V input CMOS compatible
- ❑ 5V to 12V total supply voltage
- ❑ Smart Logic threshold
- ❑ Low jitter design
- ❑ Quad matched channels
- ❑ Drives two N and two P Channel MOSFETs
- ❑ Outputs can swing below ground
- ❑ Low inductance quad flat no-lead package
- ❑ High-performance thermally-enhanced

Applications

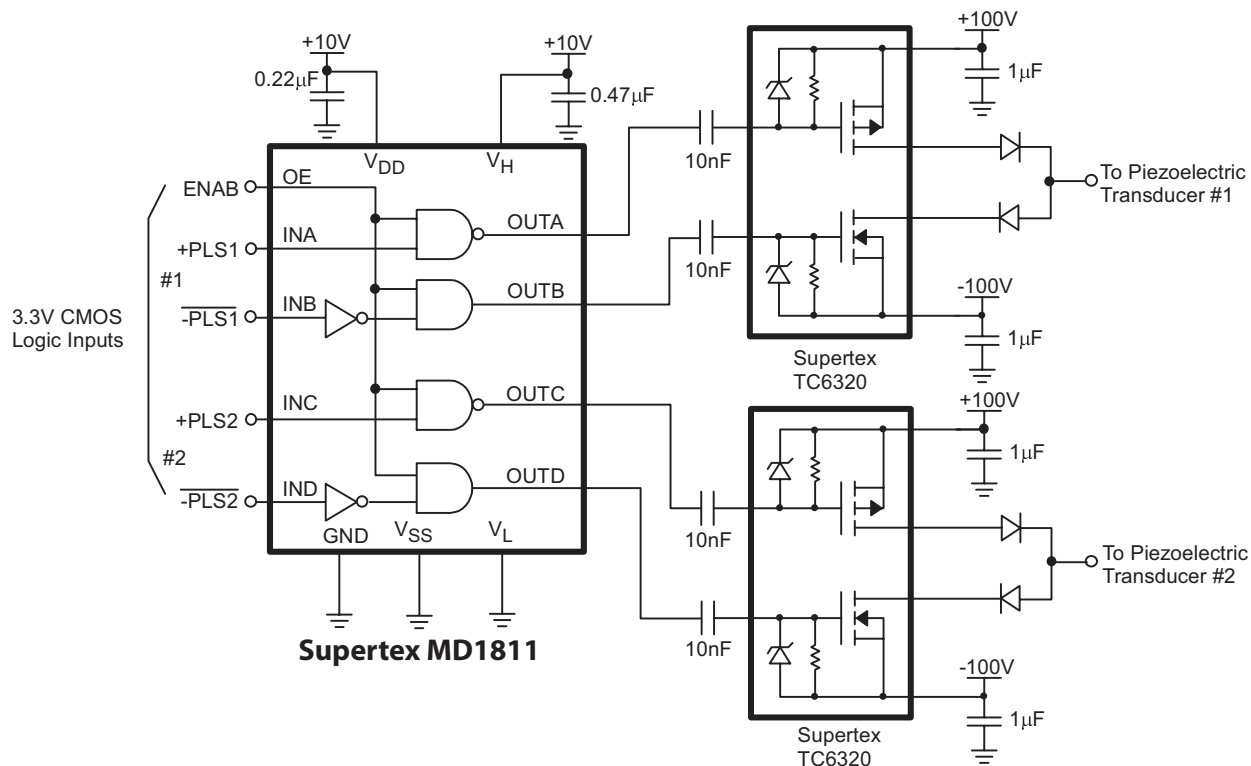
- ❑ Medical ultrasound imaging
- ❑ Piezoelectric transducer drivers
- ❑ Nondestructive evaluation
- ❑ PIN diode driver
- ❑ Clock driver/buffer
- ❑ High speed level translator

General Description

The Supertex MD1811 is a high speed, quad MOSFET driver designed to drive high voltage P/N-channel MOSFETs for medical ultrasound applications and other applications requiring a high output current for a capacitive load. The high-speed input stage of the MD1811 can operate from a 1.2 to 5.0 volt logic interface with an optimum operating input signal range of 1.8 to 3.3 volts. An adaptive threshold circuit is used to set the level translator switch threshold to the average of the input logic 0 and logic 1 levels. The input logic levels may be ground referenced, even though the driver is putting out bipolar signals. The level translator uses a proprietary circuit, which provides DC coupling together with high-speed operation.

The output stage of the MD1811 has separate power connections enabling the output signal L and H levels to be chosen independently from the supply voltages used for the majority of the circuit. As an example, the input logic levels may be 0 and 1.8 volts, the control logic may be powered by +5 and -5 volts, and the output L and H levels may be varied anywhere over the range of -5 to +5 volts. The output stage is capable of peak currents of up to ±2 amps, depending on the supply voltages used and load capacitance present. The OE pin serves a dual purpose. First, its logic H level is used to compute the threshold voltage level for the channel input level translators. Secondly, when OE is low, the outputs are disabled, with the A & C output high and the B & D output low. This assists in properly pre-charging the AC coupling capacitors that may be used in series in the gate drive circuit of an external PMOS and NMOS transistor pair.

Typical Application Circuit



Ordering Information

DEVICE	Package Options
	16-Lead 4x4x0.9 QFN
MD1811	MD1811K6-G
θ_{JA}	45°C/W (1oz. 4-layer 3x4inch PCB)

-G indicates package is RoHS compliant ('Green')



Absolute Maximum Ratings*

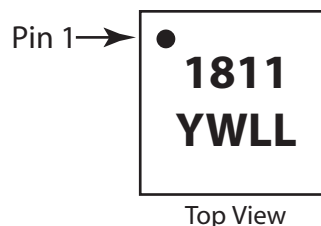
$V_{DD}-V_{SS}$, Logic Supply Voltage	-0.5V to +13.5V
V_H , Output High Supply Voltage	$V_L-0.5V$ to $V_{DD}+0.5V$
V_L , Output Low Supply Voltage	$V_{SS}-0.5V$ to $V_H+0.5V$
V_{SS} , Low Side Supply Voltage	-7V to +0.5V
Logic Input Levels	$V_{SS}-0.5V$ to $V_{SS}+7V$
Maximum Junction Temperature	+125°C
Storage Temperature	-65°C to 150°C
Soldering Temperature	235°C
Package Power Dissipation	2.2W

*Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied. Continuous operation of the device at the absolute rating level may affect device reliability. All voltages are referenced to device ground.

Product Marking Information

1 ST Line	Device Number	1811
2 ND Line	Year, Week Code, Lot Number	YWLL

Example: 5A88 means Lot #88 of first or second week in 2005

DC Electrical Characteristics ($V_H = V_{DD} = 12V$, $V_L = V_{SS} = GND = 0V$, $V_{OE} = 3.3V$, $T_J = 25^\circ C$)

Sym.	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{DD}-V_{SS}$	Logic supply voltage	4.5		13	V	
V_{SS}	Low side supply voltage	-5.5		0	V	
V_H	Output high supply voltage	$V_{SS}+2$		V_{DD}	V	
V_L	Output low supply voltage	V_{SS}		$V_{DD}-2$	V	
I_{DDQ}	V_{DD} quiescent current		0.8		mA	No input transitions, OE = 1
I_{HQ}	V_H quiescent current			10	μA	
I_{DD}	V_{DD} average current		8.0		mA	One channel on at 5.0Mhz, No load
I_H	V_H average current		26		mA	
V_{IH}	Input logic voltage high	$V_{OE}-0.3$		5	V	For logic inputs INA, INB, INC, and IND
V_{IL}	Input logic voltage low	0		0.3	V	
I_{IH}	Input logic current high			1.0	μA	
I_{IL}	Input logic current low			1.0	μA	
V_{IH}	OE Input logic voltage high	1.2		5	V	For logic input OE
V_{IL}	OE Input logic voltage low	0		0.3	V	
R_{IN}	Input logic impedance to GND	12	20	30	KΩ	
C_{IN}	Logic input capacitance		5	10	pF	

Outputs ($V_H = V_{DD} = 12V$, $V_L = V_{SS} = GND = 0V$, $V_{OE} = 3.3V$, $T_J = 25^\circ C$)

Sym.	Parameter	Min.	Typ.	Max.	Units	Conditions
R_{SINK}	Output sink resistance			12.5	Ω	$I_{SINK} = 50mA$
R_{SOURCE}	Output source resistance			12.5	Ω	$I_{SOURCE} = 50mA$
I_{SINK}	Peak output sink current		2.0		A	
I_{SOURCE}	Peak output source current		2.0		A	

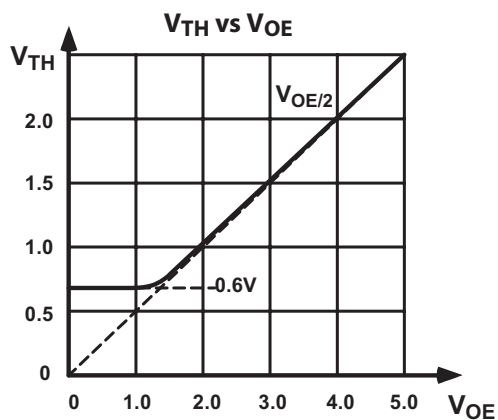
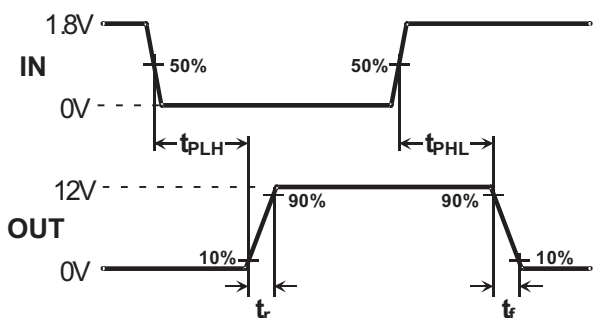
AC Electrical Characteristics ($V_H = V_{DD} = 12V$, $V_L = V_{SS} = GND = 0V$, $V_{OE} = 3.3V$, $T_J = 25^\circ C$)

Sym.	Parameter	Min.	Typ.	Max.	Units	Conditions
t_{irf}	Input or OE rise & fall time			10	ns	Logic input edge speed requirement
t_{PLH}	Propagation delay when output is from low to high		7		ns	$C_{LOAD} = 1000pF$, see timing diagram Input signal rise/fall time 2ns
t_{PHL}	Propagation delay when output is from high to low		7		ns	
t_{POE}	Propagation delay OE to output		9		ns	
t_r	Output rise time		6		ns	
t_f	Output fall time		6		ns	
$ t_r - t_f $	Rise and fall time matching		1.0		ns	
$ t_{PLH} - t_{PHL} $	Propagation low to high and high to low matching		1.0		ns	
Δt_{dm}	Propagation delay matching		± 2.0		ns	Device to device delay match

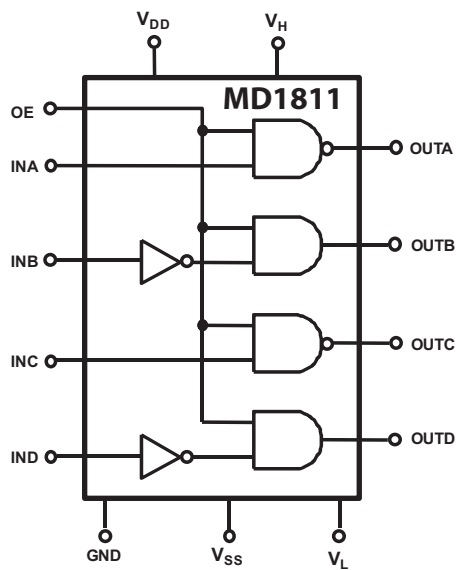
Logic Truth Table

Logic Inputs			Output	
OE	INA	INB	OUTA	OUTB
H	L	L	V_H	V_H
H	L	H	V_H	V_L
H	H	L	V_L	V_H
H	H	H	V_L	V_L
L	X	X	V_H	V_L
OE	INC	IND	OUTC	OUTD
H	L	L	V_H	V_H
H	L	H	V_H	V_L
H	H	L	V_L	V_H
H	H	H	V_L	V_L
L	X	X	V_H	V_L

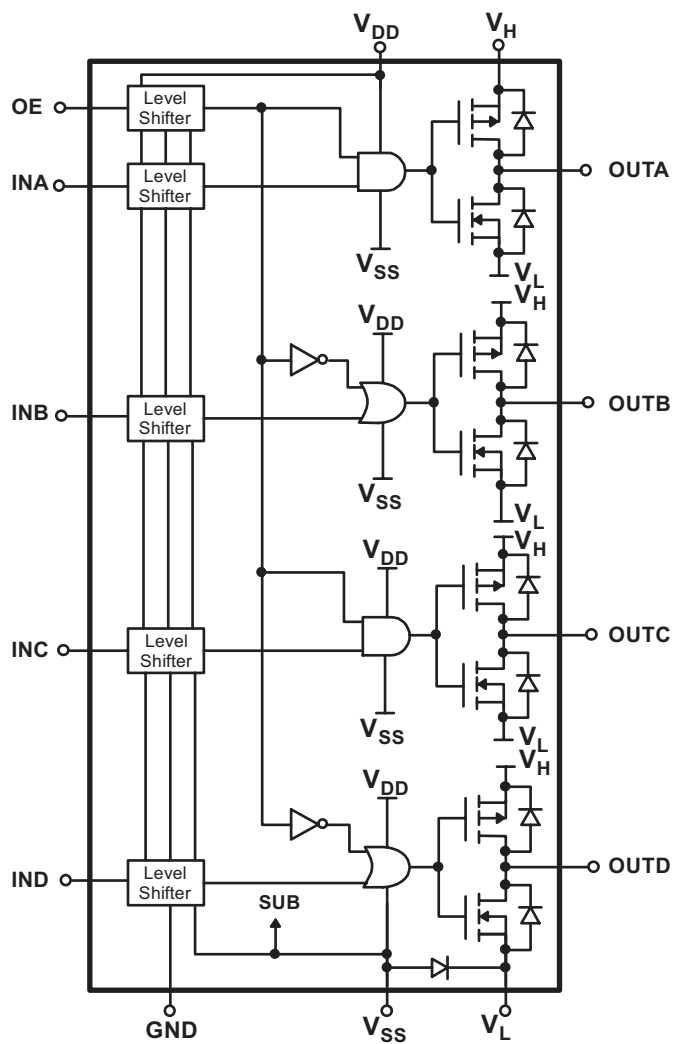
Timing Diagram and V_{TH} / V_{OE} Curve



Simplified Block Diagram



Detailed Block Diagram



Application Information

For proper operation of the MD1811, low inductance bypass capacitors should be used on the various supply pins. The GND pin should be connected to the logic ground. The INA, INB, INC, IND, and OE pins should be connected to a logic source with a swing of GND to V_{LL} , where V_{LL} is 1.2 to 5.0 volts. Good trace practices should be followed corresponding to the desired operating speed. The internal circuitry of the MD1811 is capable of operating up to 100MHz, with the primary speed limitation being the loading effects of the load capacitance. Because of this speed and the high transient currents that result with capacitive loads, the bypass capacitors should be as close to the chip pins as possible. Unless the load specifically requires bipolar drive, the V_{SS} , and V_L pins should have low inductance feed-through connections directly to a ground plane. If these voltages are not zero, then they need bypass capacitors in a manner similar to the positive power supplies. The power connection V_{DD} should have a ceramic bypass capacitor to the ground plane with short leads and decoupling components to prevent resonance in the power leads.

The voltages of V_H and V_L decide the output signal levels. These two pins can draw fast transient currents of up to 2A, so they should be provided with an appropriate bypass capacitor located

next to the chip pins. A ceramic capacitor of up to 1.0 μ F may be appropriate, with a series ferrite bead to prevent resonance in the power supply lead coming to the capacitor. Pay particular attention to minimizing trace lengths, current loop area and using sufficient trace width to reduce inductance. Surface mount components are highly recommended. Since the output impedance of this driver is very low, in some cases it may be desirable to add a small series resistance in series with the output signal to obtain better waveform transitions at the load terminals. This will of course reduce the output voltage slew rate at the terminals of a capacitive load.

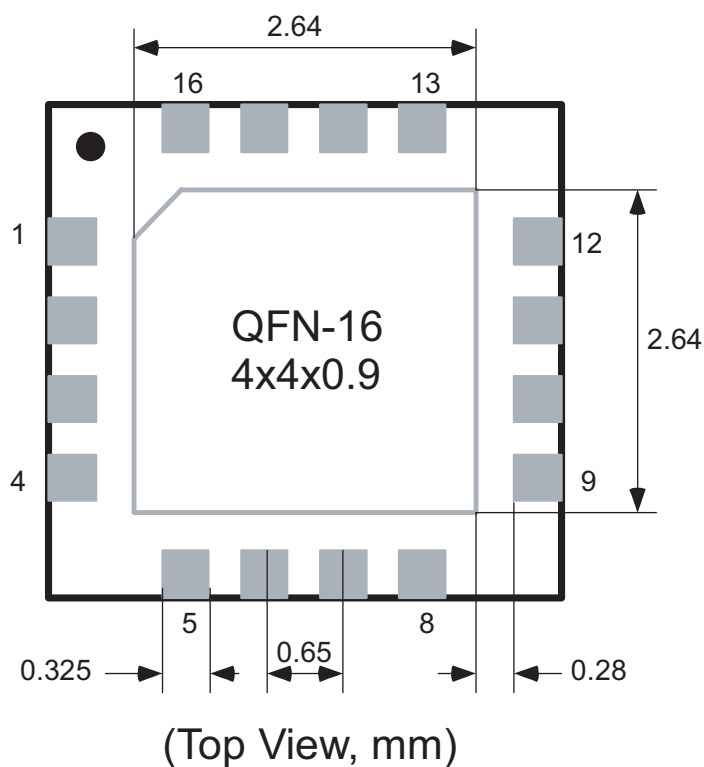
Pay particular attention that parasitic couplings are minimized from the output to the input signal terminals. The parasitic feedback may cause oscillations or spurious waveform shapes on the edges of signal transitions. Since the input operates with signals down to 1.2V even small coupled voltages may cause problems. Use of a solid ground plane and good power and signal layout practices will prevent this problem. Be careful that a circulating ground return current from a capacitive load cannot react with common inductance to cause noise voltages in the input logic circuitry.

Pin Description

V_{DD}	High side analog circuit, level shifter and gate drive supply voltage.
V_{SS}	Low side analog circuit, level shifter and gate drive supply voltage. V_{SS} must be connected to the most negative potential of voltage supplies and powered-up first.
V_H	Supply voltage for P-channel output stage
V_L	Supply voltage for N-channel output stage
GND	Logic input ground reference
OE	Output-Enable logic input. When OE is high, $(V_{OE} + V_{GND})/2$ sets the logic threshold level for inputs, When OE is low, OUTA and OUTC are at V_H , OUTB and OUTD are at V_L , regardless of the inputs INA, INB, INC or IND. Keep OE low until IC powered up
INA, INB, INC, IND	Logic input. Controls output when OE is high. Input logic high will cause the output to swing to V_L . Input logic low will cause the output to swing to V_H . Keep all logic inputs low until IC powered up.
OUTA	Output driver. Swings from V_H to V_L . Intended to drive the gate of an external P-channel MOSFET via a series capacitor. When OE is low, the output is disabled. OUTA will swing to V_H turning off the external P-channel MOSFET.
OUTB	Output driver. Swings from V_H to V_L . Intended to drive the gate of an external N-channel MOSFET via a series capacitor. When OE is low, the output is disabled. OUTB will swing to V_L turning off the external N-channel MOSFET.
OUTC	Output driver. Swings from V_H to V_L . Intended to drive the gate of an external P-channel MOSFET via a series capacitor. When OE is low, the output is disabled. OUTC will swing to V_H turning off the external P-channel MOSFET.
OUTD	Output driver. Swings from V_H to V_L . Intended to drive the gate of an external N-channel MOSFET via a series capacitor. When OE is low, the output is disabled. OUTD will swing to V_L turning off the external N-channel MOSFET.
Substrate	The IC substrate is internally connected to the thermal pad. Thermal Pad and V_{SS} must be connected externally.

Pin Configuration

Pin #	Function
1	INB
2	V_L
3	GND
4	V_L
5	INC
6	IND
7	V_{SS}
8	OUTD
9	OUTC
10	V_H
11	V_H
12	OUTB
13	OUTA
14	V_{DD}
15	INA
16	OE
Note	Thermal Pad, and Pin #7 (V_{SS}), must be connected externally



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