High Speed, Dual MOSFET Driver

Features

- 6.0ns rise and fall time with 1000pF load
- 2.0A peak output source/sink current
- 1.2V to 5V input CMOS compatible
- 4.5V to 13V total supply voltage
- Smart Logic threshold
- Low jitter design
- Dual matched channels
- Outputs can swing below ground
- Low inductance package
- Thermally-enhanced package

Applications

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

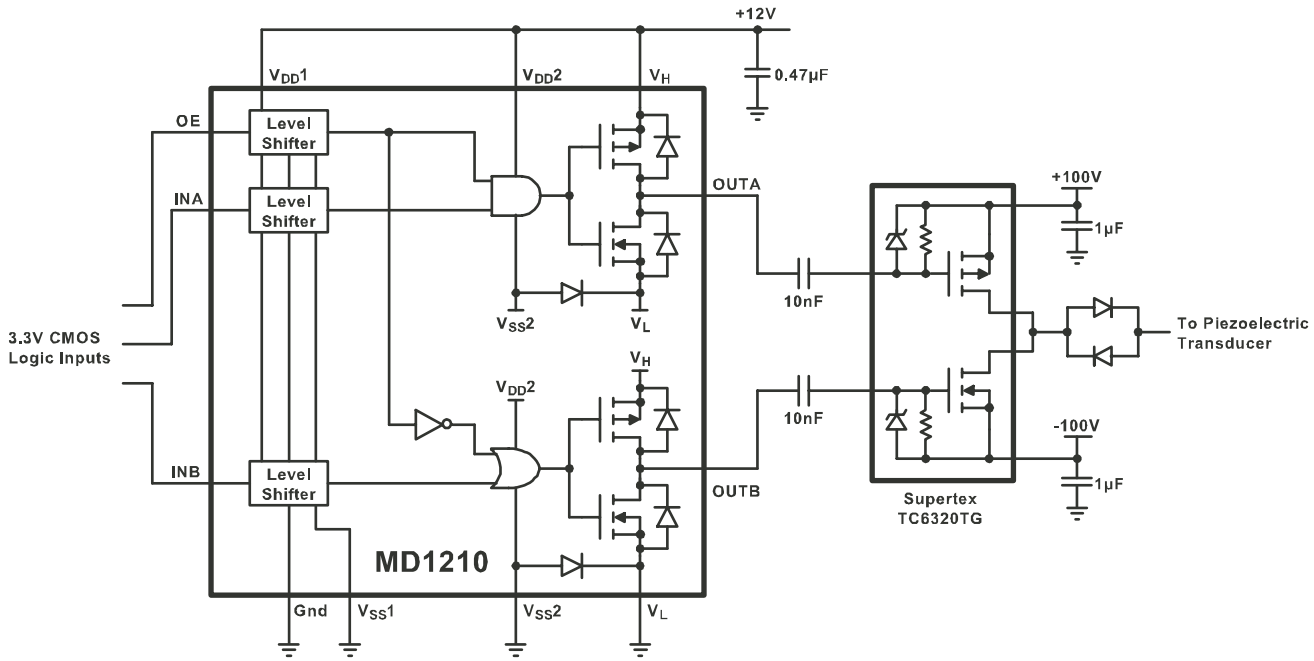
General Description

The Supertex MD1210 is a high speed, dual MOSFET driver. It is designed to drive high voltage N- and P-channel MOSFET transistors for medical ultrasound applications and other application requiring a high output current for a capacitive load. The high-speed input stage of the MD1210 can operate from 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 MD1210 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 +5.0 and –5.0 volts, and the output L and H levels may be varied anywhere over the range of –5.0 to +5.0 volts. The output stage is capable of peak currents of up to ±2.0 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 output high and the B 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



NR013105

Ordering Information

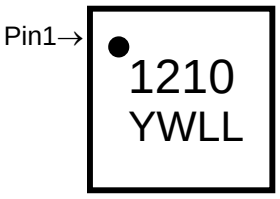
Device	Package Option
	12-lead 4x4x0.9 QFN
MD1210	MD1210K6

Product Marking Information		
1st line	1210	Device Number
2nd line	YWLL	Year, Week Code, Lot Number
Example: 5A88 means Lot #88 of first or second week in 2005		

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	-7.0V to +0.5V
Logic Input Levels	V_{SS}-0.5V to V_{SS}+7.0V
Maximum Junction Temperature	+125°C
Storage Temperature	-65°C to 150°C

**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.*



Top View

DC Electrical Characteristics

(Over operating conditions unless otherwise specified, V_H=V_{DD}1=V_{DD}2=12V, V_L=V_{SS}1=V_{SS}2=0V, V_{OE}=3.3V, T_J= 25°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}+2.0		V_{DD}	V	
V_L	Output low supply voltage	V_{SS}		V_{DD}-2	V	
I_{DD1Q}	V_{DD1} quiescent current		0.55		mA	No input transitions
I_{DD2Q}	V_{DD2} quiescent current			10	µA	
I_{HQ}	V_H quiescent current			10	µA	
I_{DD1}	V_{DD1} average current		0.88		mA	One channel on at 5.0Mhz, No load
I_{DD2}	V_{DD2} average current		6.6		mA	
I_H	V_H average current		23		mA	
V_{IH}	Input logic voltage high	V_{OE}-0.3		5.0	V	For logic inputs INA and INB.
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		5.0	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		5.0	10	pF	All Inputs
θ_{JA}	Thermal resistance to air		47		°C/W	1oz. 4-layer 3x4inch PCB with thermal pad and thermal via array.
θ_{JC}	Thermal resistance to case		7.0		°C/W	

Outputs *(V_H=V_{DD}1=V_{DD}2=12V, V_L=V_{SS}1=V_{SS}2=0V, V_{OE}=3.3V, T_J=25°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	

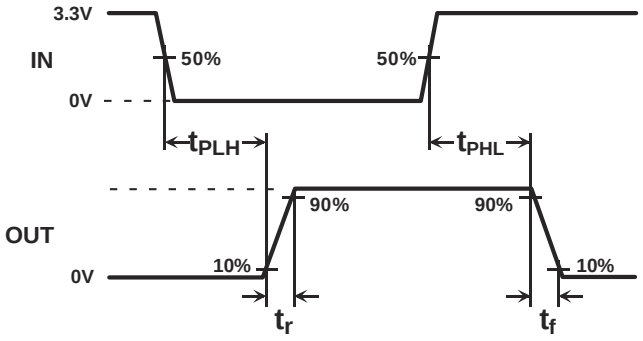
AC Electrical Characteristics *(V_H=$V_{DD}1$=$V_{DD}2$=12V, V_L=$V_{SS}1$=$V_{SS}2$=0V, V_{OE}=3.3V, T_J=25°C)*

Sym	Parameter	Min	Typ	Max	Units	Conditions
t_{irf}	Inputs or OE rise & fall time			10	ns	Logic input edge speed requirement
t_{PLH}	Propagation delay when output is from low to high		7.0		ns	No load, see timing diagram Input signal rise/fall time 2ns
t_{PHL}	Propagation delay when output is from high to low		7.0		ns	
t_{POE}	Propagation delay OE to outputs		9.0		ns	
t_r	Output rise time		6.0		ns	C_{LOAD}=1000pF, see timing diagram Input signal rise/fall time 2ns
t_f	Output fall time		6.0		ns	
$\lvert t_r - t_f \rvert$	Rise and fall time matching		1.0	TBD	ns	
$\lvert t_{PLH}-t_{PHL} \rvert$	Propagation low to high and high to low matching		1.0		ns	
Δt_{dm}	Propagation delay Match		±2.0	TBD	ns	Device to device delay match

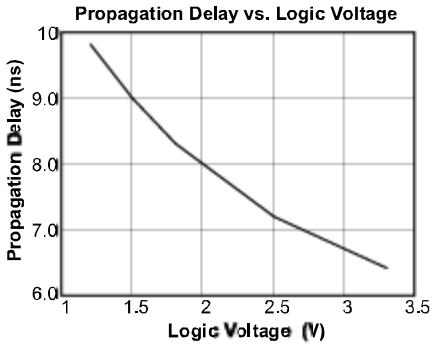
Logic Truth Table

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

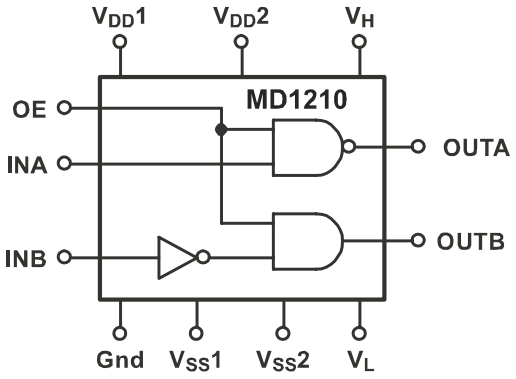
Timing Diagram



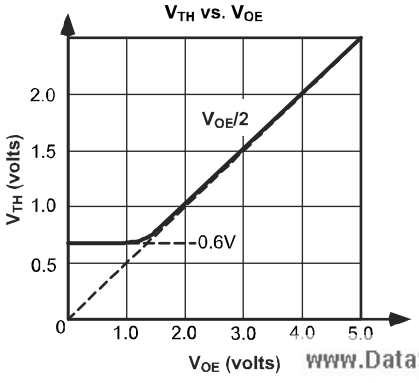
Propagation Delay



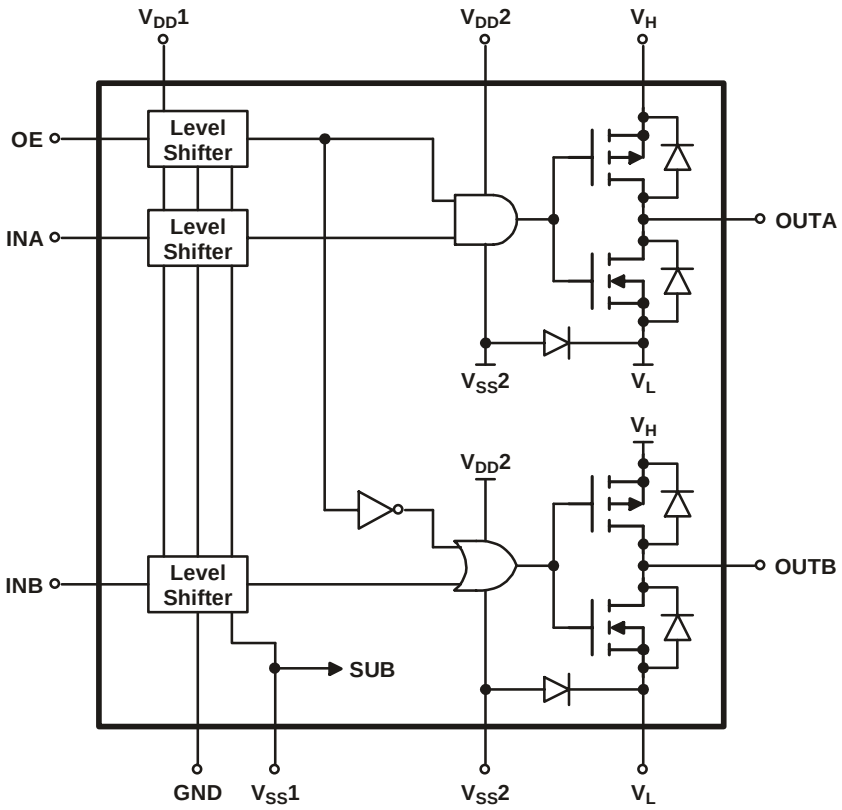
Simplified Block Diagram



Logic Input Threshold



Detailed Block Diagram



Application Information

For proper operation of the MD1210, low inductance bypass capacitors should be used on the various supply pins. The GND input pin should be connected to the digital ground. The INA, INB, and OE pins should be connected to their logic source with a swing of GND to logic level high which is 1.2 to 5.0 volts. Good trace practices should be followed corresponding to the desired operating speed. The internal circuitry of the MD1210 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 $V_{SS}1$, $V_{SS}2$, 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 connections $V_{DD}1$ and $V_{DD}2$ should have a ceramic bypass capacitor to the ground plane with short leads and decoupling components to prevent resonance in the power leads. A common capacitor and voltage source may be used for these two pins, which should always have the same DC voltage applied. For applications sensitive to jitter and noise, separate decoupling networks may be used for $V_{DD}1$ and $V_{DD}2$.

The supplied voltages of V_H and V_L determine the output logic levels. These two pins can draw fast transient currents of up to 2.0A, so they should be provided with an appropriate bypass capacitor located next to the chip pins. A ceramic capacitor of up to 1.0µF 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 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 resistor in series with the output signal to obtain better waveform integrity at the load terminals. This will of course reduce the output voltage slew rate at the terminals of a capacitive load.

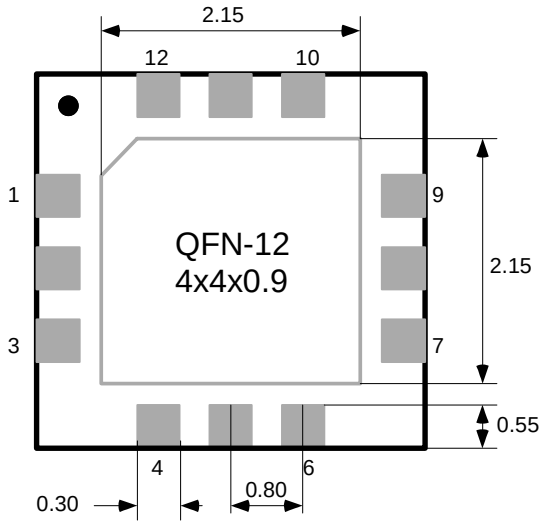
Pay particular attention to the parasitic coupling from the driver output to the input signal terminals. This feedback may cause oscillations or spurious waveform shapes on the edges of signal transitions. Since the input operates with signals down to 1.2V even small coupled voltages may cause problems.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

Pin Description

$V_{DD}1$	High side analog circuit and level shifter supply voltage. Should be at the same potential as $V_{DD}2$.
$V_{DD}2$	High side gate drive supply voltage
$V_{SS}1$	Low side analog circuit and level shifter supply voltage. Should be at the same potential as $V_{SS}2$.
$V_{SS}2$	Low side gate drive supply voltage
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 threshold transition between logic level high and low for INA and INB. When OE is low, OUTA is at V_H and OUTB is at V_L regardless of INA and INB.
INA	Logic input. Controls OUTA 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.
INB	Logic input. Controls OUTB 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.
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.

Pin Configuration

Pin #	Function
1	INA
2	V_L
3	INB
4	GND
5	$V_{SS}1$
6	$V_{SS}2$
7	OUTB
8	V_H
9	OUTA
10	$V_{DD}2$
11	$V_{DD}1$
12	OE
Note	Thermal Pad, and substrate are connected to Pin#5,$V_{SS}1$



(Top View, mm)

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