

T-52-11

IH6201



# IH6201 Dual CMOS Driver/Voltage Translator

## GENERAL DESCRIPTION

The IH6201 is a CMOS, Monolithic, Dual Voltage Translator; it takes low level TTL or CMOS logic signals and converts them to higher levels (i.e. to  $\pm 15V$  swings). This translator is typically used in making solid state switches, or analog gates.

When used in conjunction with the IH401A Varafets, the combination makes a complete solid state switch capable of switching signals up to 22Vpp and up to 20MHz in frequency. This switch is a "break-before-make" type (i.e.  $t_{off}$  time  $<$   $t_{on}$  time). The combination has typical  $t_{off} \approx 80ns$  and typ.  $t_{on} \approx 200ns$  for signals up to 20Vpp in amplitude.

A TTL "1" input strobe will force the  $\theta$  driver output up to  $V^+$  level; the  $\bar{\theta}$  output will be driven down to the  $V^-$  level. When the TTL input goes to "0", the  $\theta$  output goes to  $V^-$  and  $\bar{\theta}$  goes to  $V^+$ ; thus  $\theta$  and  $\bar{\theta}$  are 180° out of phase with each other. These complementary outputs can be used to create a wide variety of functions such as SPDT and DPDT switches, etc.; alternatively the complementary outputs can be used to drive N and P channel MOSFETs, to make a complete CMOS analog gate.

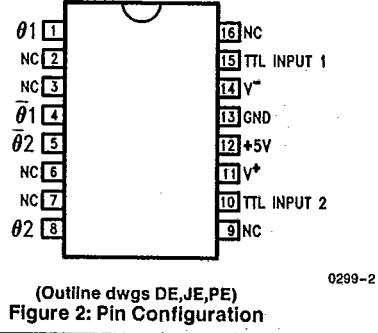
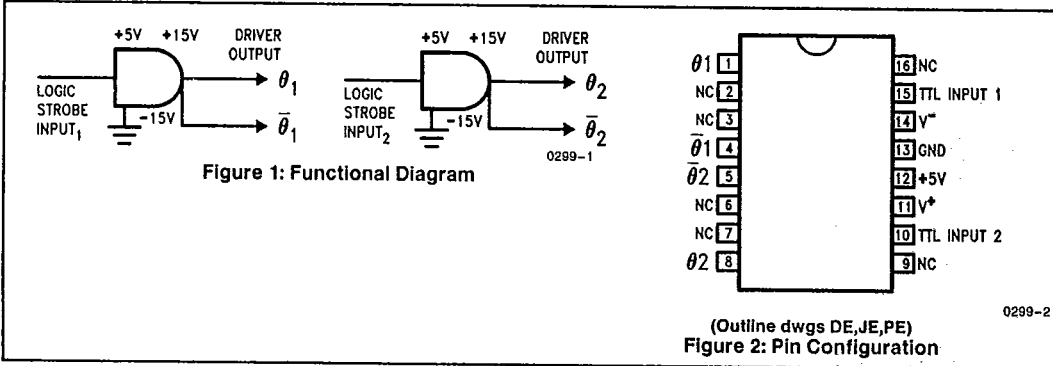
The driver typically uses +5V and  $\pm 15V$  power supplies, however a wide range of  $V^+$  and  $V^-$  is also possible. It is necessary that  $V^+ > 5V$  for the driver to work properly, however.

## FEATURES

- Driven Direct From TTL or CMOS Logic
- Translates Logic Levels Up to 30V Levels
- Switches 20V<sub>ACPP</sub> Signals When Used in Conjunction With the IH401A Varafet (As An Analog Gate)
- $t_{ON} \leq 300ns$  &  $t_{OFF} \leq 200ns$  for 30V Level Shifts
- Quiescent Supply Current  $\leq 100\mu A$  for Any State (D.C.)
- Provides Both Normal & Inverted Outputs

## ORDERING INFORMATION

Part Number	Temperature Range	Package
IH6201CJE	0°C to 70°C	16 Pin Cerdip
IH6201MJJE	-55°C to 125°C	16 Pin Cerdip
IH6201CPE	0°C to 70°C	16 Pin Plastic



HARRIS SEMICONDUCTOR'S SOLE AND EXCLUSIVE WARRANTY OBLIGATION WITH RESPECT TO THIS PRODUCT SHALL BE THAT STATED IN THE WARRANTY ARTICLE OF THE CONDITION OF SALE. THE WARRANTY SHALL BE EXCLUSIVE AND SHALL BE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS, IMPLIED OR STATUTORY, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR USE.

NOTE All typical values have been characterized but are not tested.

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**ABSOLUTE MAXIMUM RATINGS**

V+ to V-	35V
V+	35V
V-	35V
V+ to V <sub>IN</sub>	40V
Operating Temperature	-55°C to +125°C
Storage Temperature	-65°C to +150°C
Lead Temperature (Soldering, 10sec)	300°C

**NOTE:** Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions above those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

**ELECTRICAL SPECIFICATIONS**

V+ = +15V, V- = -15V, V<sub>L</sub> = +5V

Item	Test Conditions	IH6201CDE			IH6201MDE			Units
		-25°C	+25°C	+85°C	-55°C	+25°C	+125°C	
θ or θ̄ driver output swing	V <sub>IN</sub> = 0V ⌋⌋ +3V Fig. 5B		28			28		V <sub>pp</sub>
V <sub>IN</sub> strobe level ("1") for proper translation	θ ≥ 14V θ̄ ≥ -14V	3.0	3.0	3.0		2.4		V <sub>D.C.</sub>
V <sub>IN</sub> strobe level ("0") for proper translation	θ ≥ -14V θ̄ ≥ 14V	0.4	0.4	0.4		0.8		V <sub>D.C.</sub>
I <sub>IN</sub> input strobe current draw (for 0V - 5V range)	V <sub>IN</sub> = 0V or +5V	±1	±1	10	±1	±1	10	μA
t <sub>on</sub> time	V <sub>IN</sub> = 0V ⌋⌋ C <sub>L</sub> = 30pF switching turn-on time fig. 5B		500			500		ns
t <sub>off</sub> time	V <sub>IN</sub> = 0V ⌋⌋ C <sub>L</sub> = 30pF switching turn-off time fig. 5B		500			500		ns
I+ (V+) power supply quiescent current	V <sub>IN</sub> = 0V or +5V	100	100	100	100	100	100	μA
I- (V-) power supply quiescent current	V <sub>IN</sub> = 0V or +5V	100	100	100	100	100	100	μA
I <sub>L</sub> (V <sub>L</sub> ) power supply quiescent current	V <sub>IN</sub> = 0V or +5V	100	100	100	100	100	100	μA



NOTE: All typical values have been characterized but are not tested.

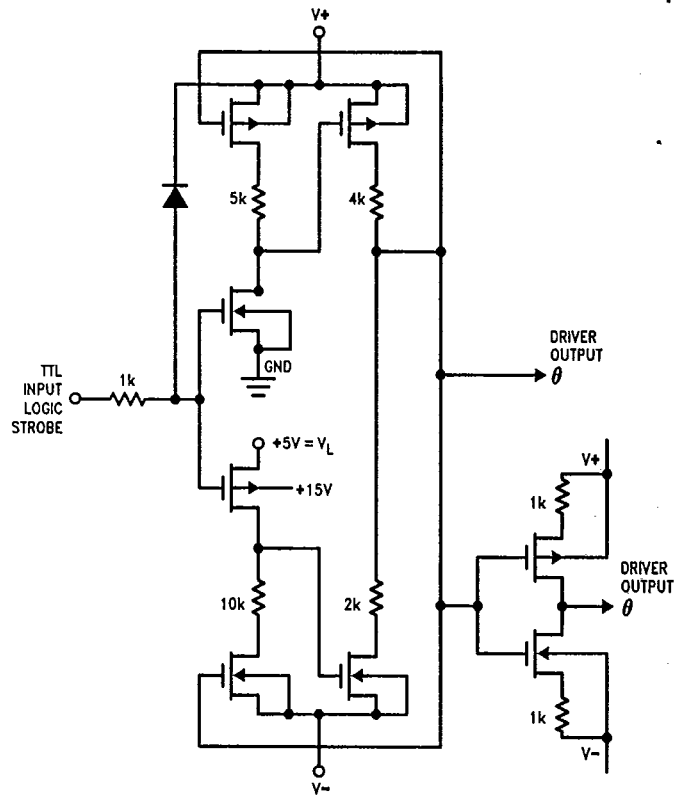


Figure 3: Schematic Diagram (One Channel)

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## APPLICATIONS

### Input Drive Capability

The strobe input lines are designed to be driven from TTL logic levels; this means 0.8V to 2.4V levels max. and min. respectively. For those users who require 0.8V to 2.0V operation, a pull-up resistor is recommended from the TTL output to +5V line. This resistor is not critical and can be in the 1k $\Omega$  to 10k $\Omega$  range.

When using 4000 series CMOS logic, the input strobe is connected direct to the 4000 series gate output and no pull up resistors, or any other interface, is necessary.

When the input strobe voltage level goes below Gnd (i.e. to -15V) the circuit is unaffected as long as V<sup>+</sup> to V<sub>IN</sub> does not exceed absolute maximum rating.

### Output Drive Capability

The translator output is designed to drive the IH401A Varafets; these are N-channel JFETs with built-in driver diodes. Driver diodes are necessary to isolate the signal source from the driver/translator output; this prevents a forward bias condition between the signal input and the +V<sub>CC</sub> supply. The IH6201 will drive any JFET provided some sort of isolation is added.

NOTE: All typical values have been characterized but are not tested.

You will notice in Figure 4 that a "referral" resistor has been added from 2N4391 gate to its source. This resistor is needed to compensate for the inadequate charge area curve for isolation diode i.e. if C vs. V plot for diode  $\leq 2$  [C vs. V plot for output JFET] switch won't function; then adding this resistor overcomes this condition. The "referral" resistor is normally in the 100k $\Omega$  to 1M $\Omega$  range and is not too critical.

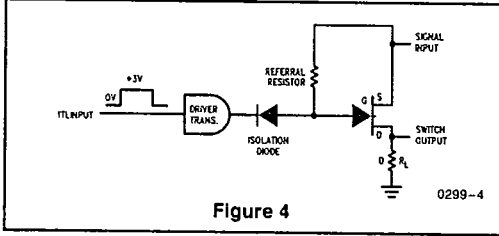


Figure 4

### Making a Complete Solid State Switch That Can Handle 20Vpp Signals

The limitation on signal handling capability comes from the output gating device. When a JFET is used, the pinch-off of the JFET acting with the  $V^-$  supply does the limiting. In fact max. signal handling capability =  $2(V_p + (V^-)) V_{pp}$  where  $V_p$  = pinch-off voltage of JFET chosen, i.e.  $V_p = 7V$ ,  $V^- = -15V$   $\therefore$  max. signal handling =  $2(7V + (-15V)) V_{pp} = 2(7V - 15V) V_{pp} = 2(-8V) V_{pp} = -16V_{pp}$ . Obviously to get  $\geq 20V_{pp}$ ,  $V_p \geq 5V$  with  $V^- = -15V$ . Another simple way to get 20Vpp with  $V_p = 7V$ , is to increase  $V^-$  to  $-17V$ . In fact using  $V^+ = +12V$  or  $+15V$  and setting  $V^- = -18V$  allows one to switch 20Vpp with the IH401A. The advantage of using the  $V_p = 7V$  pinch-off (along with unsymmetrical supplies), over the  $V_p = 5V$  pinch-off (and  $\pm 15V$  supplies), is that you will have a much lower  $R_{DS(ON)}$  for the  $V_p = 7V$  JFET (i.e. for the 2N4391).

$$r_{DS(ON)} \approx 22\Omega, \quad r_{DS(ON)} \approx 35\Omega$$

$$V_p = 7V, \quad V_p = 5V$$

The IH6201 is a dual translator, each containing 4 CMOS FET pairs. The schematic of one-half of an IH6201, driving one-quarter of an IH401A, is shown in Figure 5A.

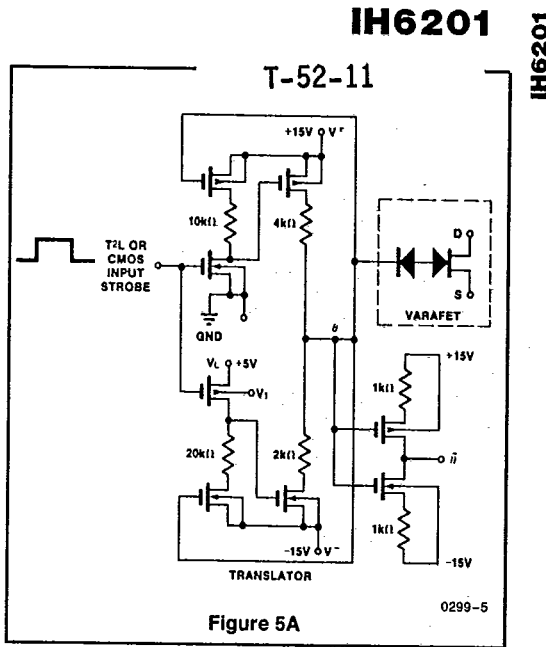


Figure 5A

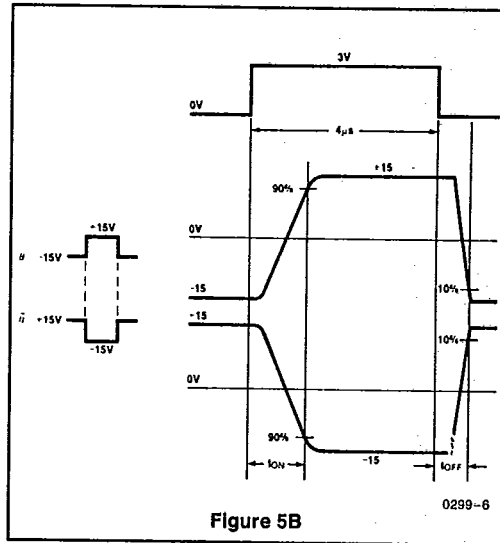


Figure 5B

**NOTE:** Each translator output has a  $\theta$  and  $\bar{\theta}$  output.  $\theta$  is just the inverse of  $\bar{\theta}$ .

A very useful feature of this system is that one-half of an IH6201 and one-half of an IH401A can combine to make a SPDT switch, or an IH6201 plus an IH401A can make a dual SPDT analog switch (See Figure 8).

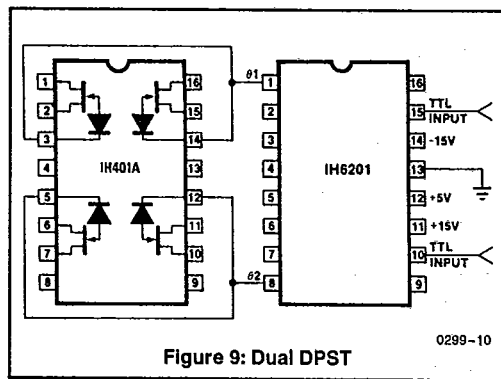
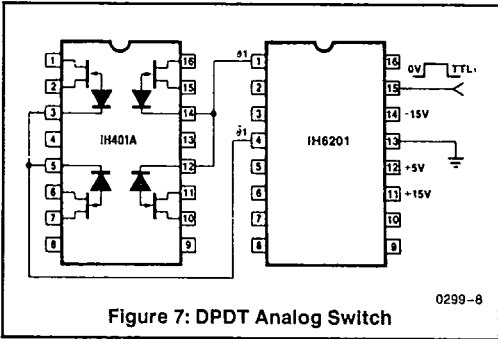
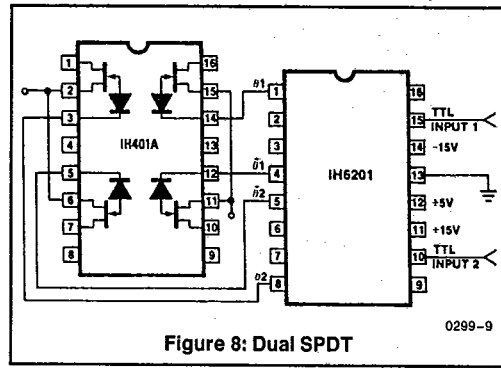
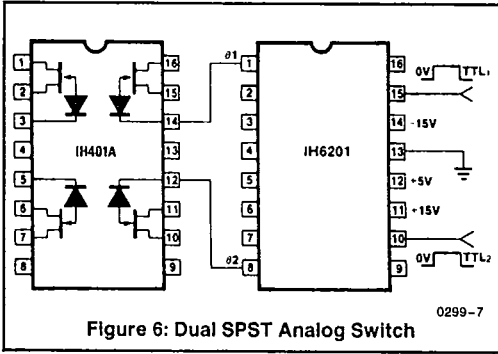
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**APPLICATIONS (Continued)**



NOTE: Either switch is turned on when strobe input goes high.

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