

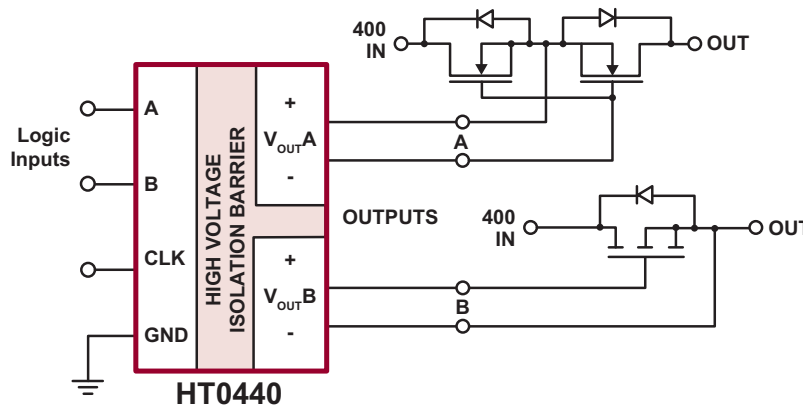
High Voltage Isolated MOSFET Driver

Features

- ▶ Switches up to $\pm 400\text{V}$ from ground referenced logic
- ▶ Provides $\pm 700\text{V}$ isolation between outputs
- ▶ No floating power supplies required to bias MOSFETs
- ▶ Operates isolated MOSFETs from 3.15V min., 5.5V max. logic inputs
- ▶ 1.0mA max. input operating current per channel
- ▶ No biasing current required from high voltage rails
- ▶ Low profile, surface-mount packaging
- ▶ Not recommended for applications with AC across input - output

The Supertex HT0440 is a dual, high voltage isolated driver utilizing Supertex's proprietary HVCMOS technology. It is designed to drive discrete MOSFETs configured as bi-directional or unidirectional switches. It can drive N-channel MOSFETs as high side switches up to 400V. The HT0440 has an internal clock which generates two independent DC isolated voltages to the outputs, V_{OUTA} and V_{OUTB} , when logic inputs A and B are at logic high. The internal clock can be disabled by applying an external clock signal to the CLK pin. This allows the power dissipation and AC characteristics to be tailored to meet specific needs. The HT0440 does not require any external power supplies. The internal supply voltage is supplied by either of the two logic inputs A or B when they are at logic high.

Figure 1

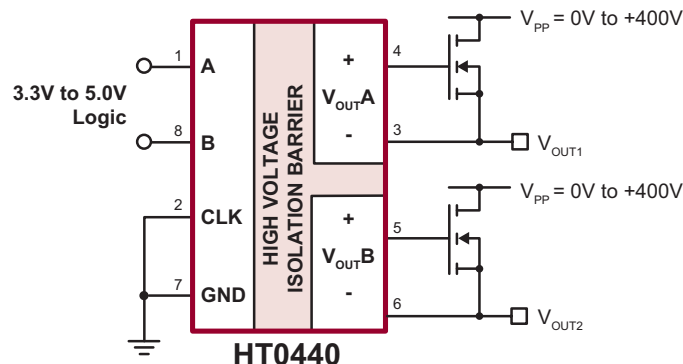


N-Channel High Side Switches

Driving high side N-channel MOSFETs from ground referenced logic requires a separate power supply that is 10 to 15V higher in potential than the high side rail. This is necessary to provide the gate bias to control the MOSFETs. Alternatively, a P-channel MOSFET can be used with a voltage level translation scheme that maintains a safe 10 to 15V differential between gate to source. As shown in Figure 2, an N-channel MOSFET can be driven from a floating gate drive

provided by the HT0440. As shown in the circuit, the input to the HT0440 is connected to the output of a microprocessor, thereby providing a convenient and safe interface. Another advantage is the lower cost of an N-channel MOSFET compared to a P-channel device, especially if low ON-resistance is necessary. This two chip solution is cost effective, since the component count is much lower than any other previously used method.

Figure 2



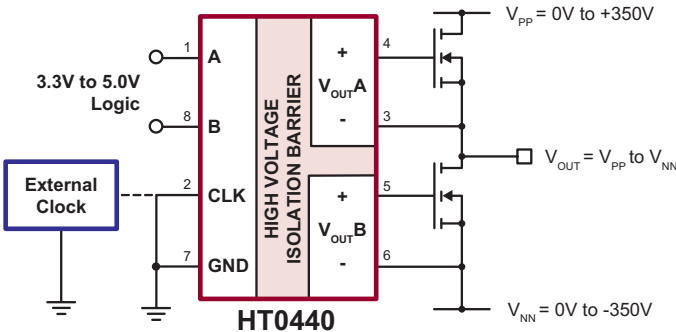
Totem Pole High Voltage Output

The high side, or “top-side,” switch in a totem pole configuration requires complicated drive and level translation schemes as mentioned earlier in this application note. A simple way of switching an output between positive and negative voltage rails directly from 5.0V logic is to use 2 N-channel MOSFETs with a single HT0440. Again, the floating and isolated outputs of the HT0440 are used to directly drive the top and bottom side N-channel MOSFETs. The logic control inputs can be exercised to produce break-before-make switching that eliminates potential short circuiting of the positive and negative rails. This easy technique enables the output to be switched between +350 and -350V by simply applying a +5.0V logic control to both logic

inputs of the HT0440. No other interfacing is required. The circuit is ideal for lower switching speed applications. An external clock can be used at a lower frequency than the on-chip clock of 1MHz to reduce current input demand into the logic control pins. In this case, Pin 2 is simply connected to the external clock instead of ground.

Compared to previously used schemes for driving MOSFETs, e.g. pulse transformers and optical isolators, this technique utilizes smaller and less costly components, thereby saving board space and cost.

Figure 3



Constant Resistance Analog Switch

Applications that require a constant ON-resistance over a wide range of analog signals will benefit considerably from the HT0440. Any MOSFET used in conjunction with a HT0440 will exhibit a fixed “ON” state resistance due to the constant value of voltage across the gate and source of the MOSFET switch (see Figure 5). This gate-source voltage differential will remain independent of the voltage level and polarity of the analog signal through the switch. Some examples of applications

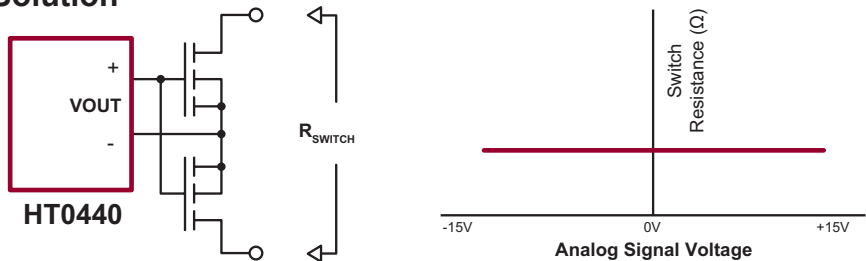
that benefit from this technique are high-end audio, sample and hold, and data conversion circuits.

Figure 4 shows a commonly used scheme for most Analog Switch ICs that utilizes an N- and P-channel MOSFET. A major disadvantage of this configuration is that the ON-resistance of the analog switch changes with variations in the amplitude of the signal voltage.

Figure 4 - Conventional Approach



Figure 5 - HT0440 Solution

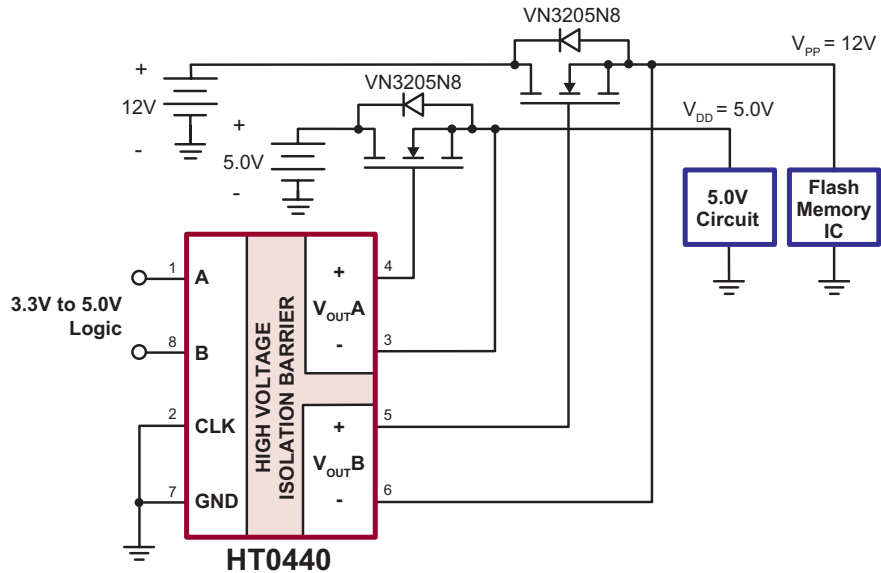


Power Management Circuits

With outputs that are not only electrically isolated from each other but also isolated from the logic controls and the ground reference, the HT0440 is useful in a variety of power management circuits. The simple application of input logic allows for power rails to directly switch up to 400V via high voltage

N-channel MOSFETS. The HT0440 structure, which has a high degree of galvanic isolation, independently controls two separate power circuits. These power loops need not even have the same ground reference as the logic signals; they can be totally floating systems with their own “ground” references.

Figure 6

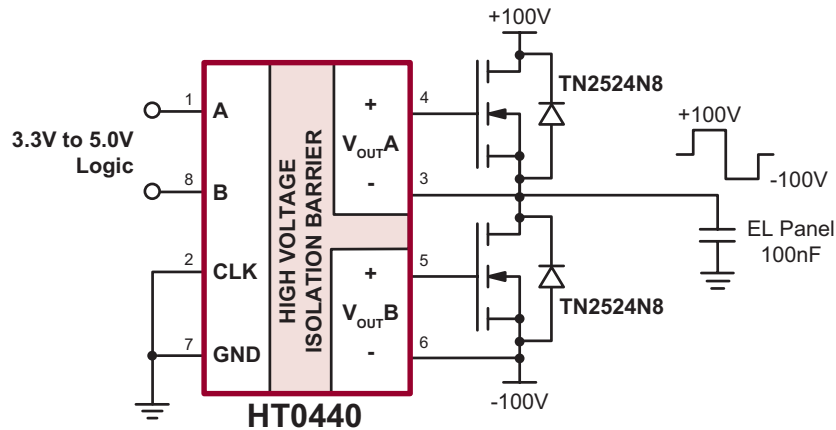


Electroluminescent Backlight Driver

The isolation feature of the HT0440 driver outputs make them ideal for driving Totem Pole N-channel MOSFETS between both positive and negative voltage rails. The low input logic current of the HT0440, together with the fact that it need not

be driven from a power supply, conserves power from batteries in portable systems. The low profile height and package size of the surface mounted HT0440 make it ideal for use in backlight systems in a portable application.

Figure 7



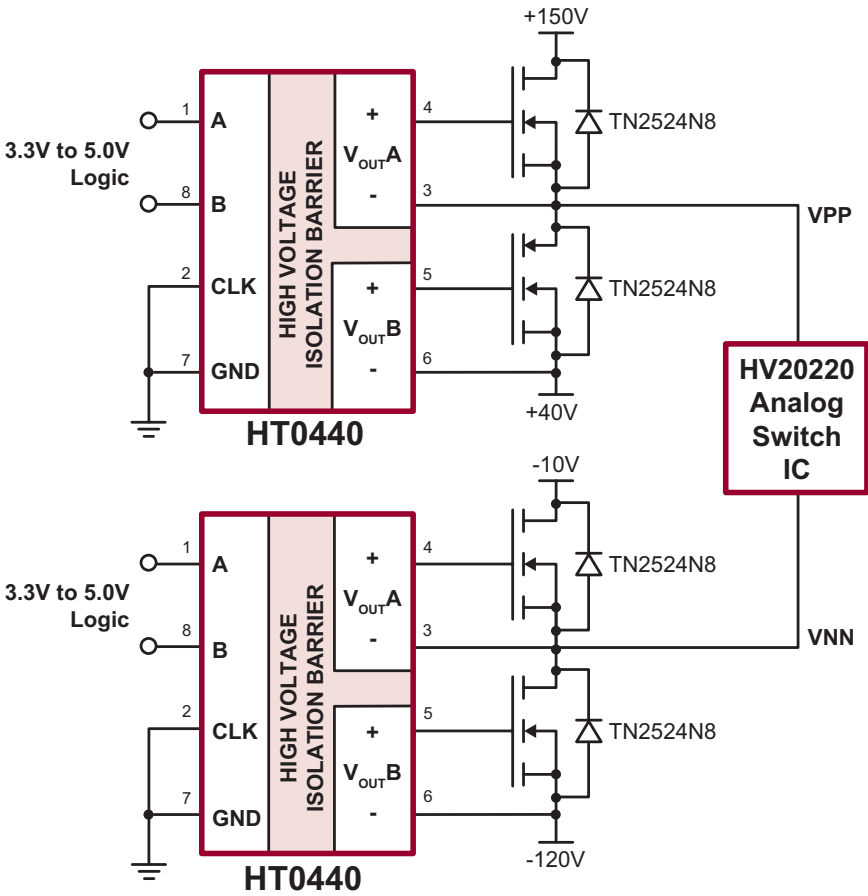
High Voltage Selector Switch

The HT0440 is compatible in voltage capability with the wide range of high voltage driver ICs from Supertex. Figure 8 shows an HV20220 Analog Switch used in a typical ultra-sound detection system.

connected to the outputs of the HV20220, different levels of high voltages need to be applied to the analog switch. The HT0440 driver offers a simple and cost effective way to achieve this control. In applications where high board density is required, the low power dissipation and surface mount packaging of the HT0440 make it an ideal solution.

To exercise the required control on piezoelectric transducer

Figure 8



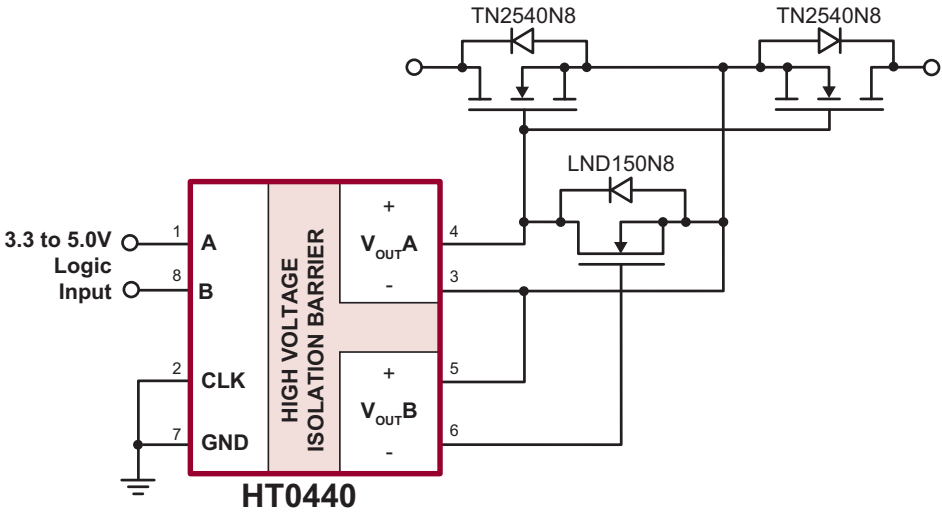
Fast Turn-off Break-Before-Make Switch

The turn-on time of a typical driver is related to the input capacitance of the MOSFET it is driving. T_{ON} is $0.25 \times 10^6 \times (\text{MOSFET } C_{ISS})$. Similarly, the turn-off time of the driver is $10^6 \times (\text{MOSFET } C_{ISS})$.

In this situation, t_{OFF} is greater than t_{ON} . For a system using multiple switches, however, there may be a problem

since some switches will close before others open. Using the HT0440 as shown in Figure 9 will provide a solution to this problem and ensure that the correct switches open before others close. To achieve turn-off time that is less than turn-on time, a small depletion-mode MOSFET placed on the output of the HT0440 (as shown) will slow t_{ON} such that the circuit exhibits break-before-make switching.

Figure 9

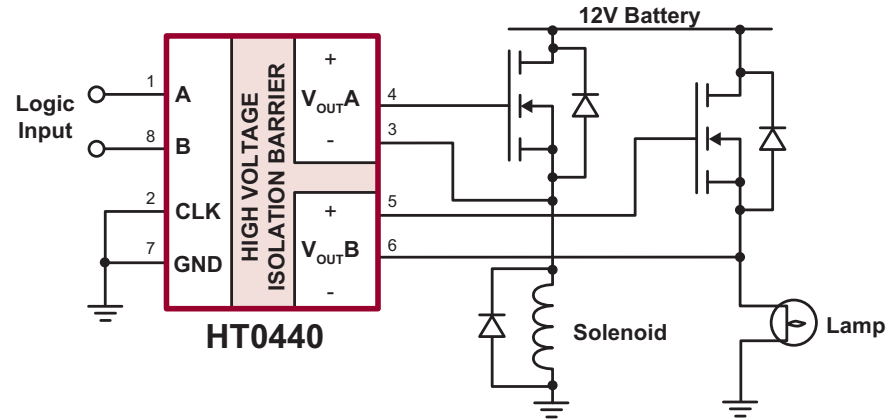


Automotive High Side Switches

In automotive applications requiring large MOSFETs, an N-channel MOSFET with the same R_{ON} and BV_{DSS} as a P-channel will be half the size of the P-channel device and, cost-wise, would be a more effective solution.

The floating gate drive of the HT0440 allows direct interface of a 5.0V microprocessor output to an N-channel MOSFET. An important advantage of using the HT0440 is that isolation is provided between the load, which is usually in a high transient voltage environment, and the low voltage control circuitry.

Figure 10

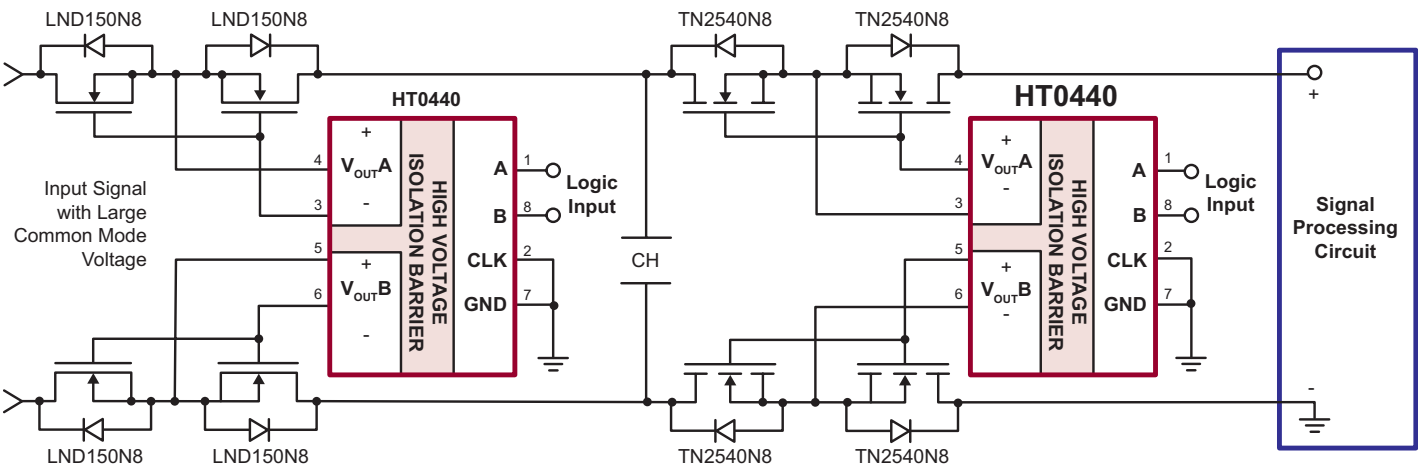


Data Acquisition Using Flying Capacitor

Present solutions for collecting and routing analog data into data acquisition systems usually use relays or opto-coupled systems. Although these solutions provide the necessary isolation from the analog line to the control line, they have significant drawbacks. They are typically large, high profile devices that draw considerable power and exhibit slow switching speeds. With the HT0440, higher speeds are achieved in routing the

signals, and there is no degradation of the isolation voltage. Additionally, higher board density and a lower profile solution is provided with the HT0440 in the SO-8 package. Another advantage is greatly reduced power consumption. Figure 11 shows a solution using the HT0440, LND150N8 (depletion-mode MOSFETs) and TN2540N8 (enhancement mode MOSFETs) all manufactured by Supertex in surface mount packages.

Figure 11

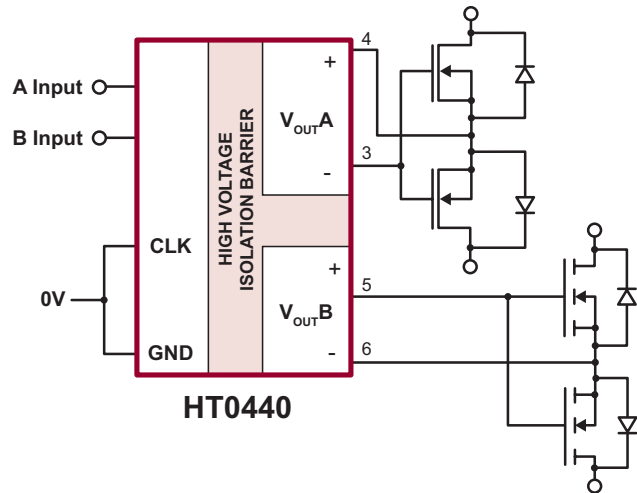


Solid State Relay

The HT0440 technology allows multiple channel drives to be integrated in a monolithic IC. The 2 channel HT0440 has galvanic $\pm 400\text{V}$ isolation between the outputs and logic inputs, and $\pm 700\text{V}$ isolation between output channels. The HT0440 driver along with the MOSFET switches is analogous to a relay. The HT0440 will drive both depletion-mode and enhancement-

mode bidirectional MOSFETs, thereby giving either normally open and normally closed “contacts.” The low profile SO-8 surface mount HT0440 gives this solution an added advantage over the single channel high profile opto packages, and is also lower in cost.

Figure 12

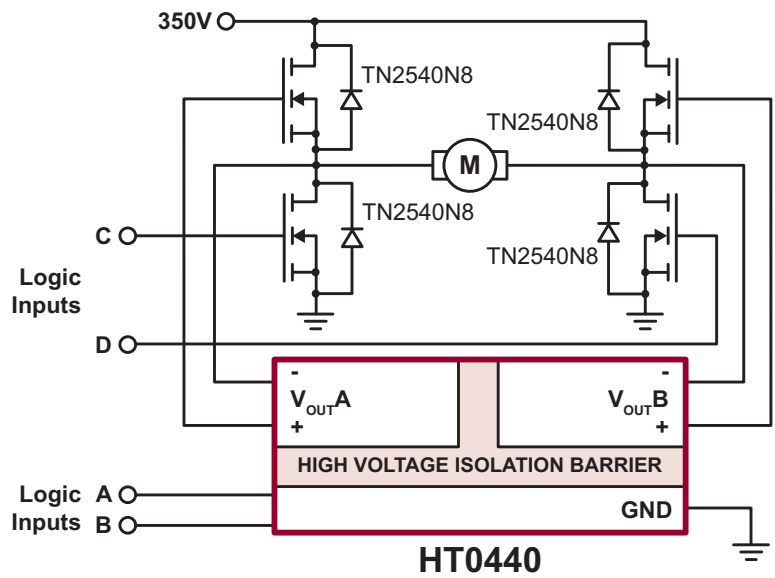


High and Low Side Motor Drivers

Motor drive that requires on/off as well as reverse control often use P-channel, MOSFET switches in the top end of H-bridge configurations. With the HT0440, these P-channel FETs can be replaced by less expensive N-channel switches. This solu-

tion is particularly attractive where it is only necessary to have a forward/reverse control without any critical speed control. Shown below are 4 N-channel MOSFETS configured with a HT0440 driver to provide a cost effective solution.

Figure 13



Supertex inc. does not recommend the use of its products in life support applications, and will not knowingly sell them for use in such applications unless it receives an adequate “product liability indemnification insurance agreement.” **Supertex inc.** does not assume responsibility for use of devices described, and limits its liability to the replacement of the devices determined defective due to workmanship. No responsibility is assumed for possible omissions and inaccuracies. Circuitry and specifications are subject to change without notice. For the latest product specifications refer to the **Supertex inc.** (website: <http://www.supertex.com>)