IXYS

EVBD4400

HALF BRIDGE DRIVER Evaluation Board

Features

- **High to low side isolation of 1000V**
- **Common-mode dv/dt immunity of greater than 50V/nanosecond**
- **On-chip generated negative gate drive**
- **Overcurrent protection by means of desaturation detection**
- **Under voltage lockout**
- **Fault indication output for system diagnostic**
- **Optimized power circuit layout**
- **High side bootstrap supply**
- **Sockets for freewheeling fast recovery diodes (FREDS)**
- **Flexibility of power level utilization**
- **5V compatible HCMOS input logic with hysterisis**
- **Protection from cross conduction of the half bridge**
- **Simple, fast and low cost means of evaluation and design**
- **Option for using IXDP630 with RC oscillator or IXDP631 with crystal oscillator for improved dead time accuracy.**
- **Three phase operation with the ability to attach additional slave driver boards.**

Introduction

The EVBD4400 evaluation board implements a single power phaseleg circuit on a double sided PCB with ground plane, using the proven ISOSMART™ HALF BRIDGE DRIVER CHIPSET - IXBD4410, IXBD4411, IXDP630. The IXDP631 is optional. This board includes all parts required for the circuit implementation so that you can just follow the instructions in this document and connect the board to the load and power. The kit consists of an assembled and tested PCB with two power devices.

Any power circuit is layout sensitive. The layout of this kit is a proven, working layout. The designer is invited to duplicate this layout in his system, following the evaluation of the driver chipset.

Most systems vary in their power level requirements and therefore the power devices used. Due to this fact and fluctuations in availability of power devices, the kit will not always include the same power devices. The designer is encouraged to use the power devices that are required for his system. The devices that are enclosed serve only for initial evaluation.

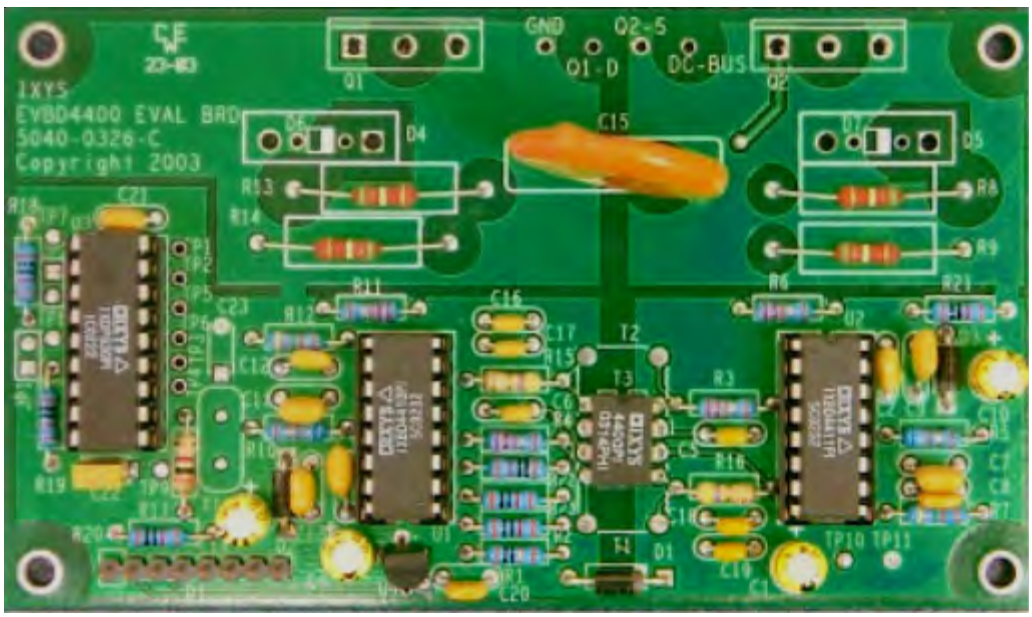


Figure 1: EVBD4400 Assembled PC board

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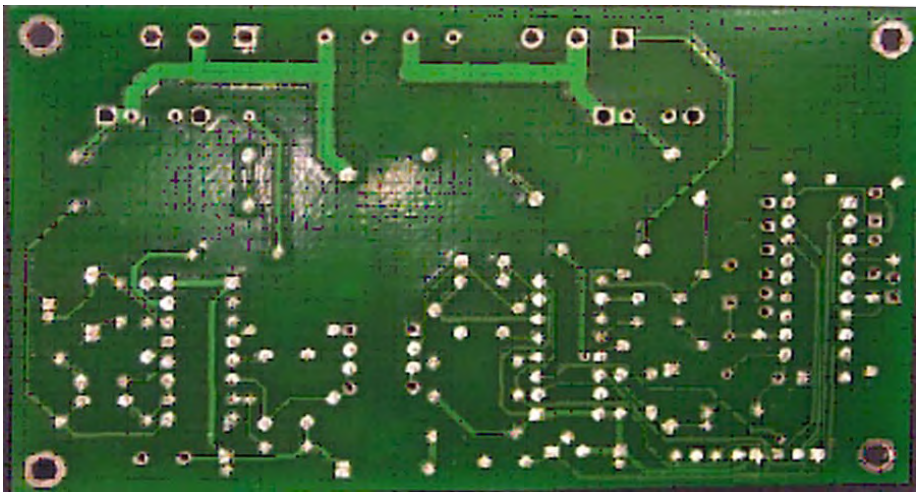


Figure 2: EVBD4400 PCB solder side

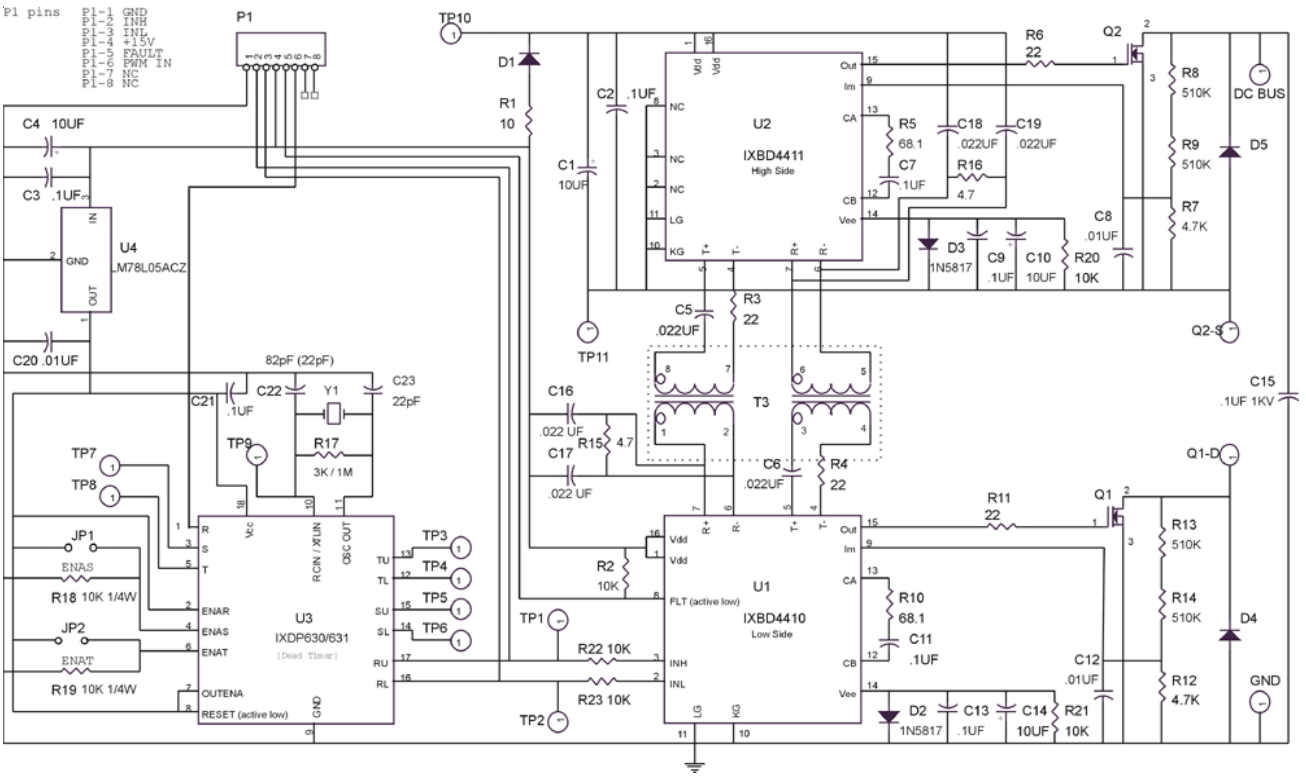


Figure 3: EVBD4400 PCB Schematic

ASSEMBLY:

Figure 3 is a complete schematic diagram of the board. This schematic indicates an application using MOSFET's. When IGBT are used, freewheeling diodes (D4&D5) are typically added.

To assemble the kit, simply solder the MOSFET power devices included or install devices specific to your application. Note gate, drain, source orientation of power devices when installing on the PC board.

NOTES:

a) The ICs and Power devices are static sensitive and require special handling.

b) Use any power device that is suitable for your application. The PCB was designed to accept devices with TO-247 packages. Two IXYS power devices are included in the kit with their data sheet. D4 and D5 are required only if Q1 and Q2 are IGBTs, and thus are not included in your kit. (A recommendation for D4 & D5 is in the Bill of Materials). D6, D7 footprints provide a smaller package or footprint option.

c) Use any convenient method of interconnection at GND, Q1-D, Q2-S,DC-BUS. The hole spacing is a standard 5.08mm and will fit common terminal blocks. (A recommendation for a connector 'P2' that the PCB will accept is in the Bill of Materials and is available from Digi-Key among others).

d) For fault detection, R2 is pulled up to the supply voltage of the front end logic. If the FLT (fault) signal is to be sensed by TTL logic, remove R2 and connect FLT externally from P1-5 to +5V through a pull up resistor.

e) For half bridge applications, insert a jumper between Q1-D and Q2-S.

f) The gate resistors, R6 and R11, will depend on the power device size that is used. Twenty two ohm resistors are installed and should work for most applications.

g) Dead time is provided by timing components R17, C22 and is fixed at roughly 2.5 µ. See IXDP630 data sheet for calculation and modification of the dead time value.

DATA SHEETS:

The following list provides direct web links for the IXYS devices included with this kit. Please visit the IXYS web site at www.ixys.com for a complete overview of the entire IXYS product line.

IXTH 6N90 Power MOSFETS:
http://www.ixys.com/91543.pdf

IXDB4410/11 Half Bridge Driver Chip Set:
http://www.ixys.com/96528.pdf

IXDP630 Digital Dead Time Generator
http://www.ixys.com/98568.pdf

TX02-4400 Interface Transformer
http://www.ixys.com/99016.pdf

It is also possible to construct your own pulse transformers from scratch using the guidelines presented in the discussion located at http://www.ixys.com/t092702.pdf.

Bill of Materials

Reference	Qty.	Description	Mfr.	Part No.
U1	1	Low side gate driver I.C.	IXYS	IXBD4410PI
U2	1	High side gate driver I.C	IXYS	IXBD4411PI
U3	1	Dead time generator I.C. (IXDP631 optional)	IXYS	IXDP630
U4	1	5V regulator	National Semi.	LM78L05ACZ
D1	1	1A, 1000V high speed diode	ITS	BYT11-1000
U1, U2	2	16 pin socket	Assmann	A16-LC-TT
U3	1	18 pins socket	Assmann	A18-LC-TT
D2, D3	2	20V, 1A Shottky diode	Diodes Inc	1N5817
Q1, Q2	2	High voltage power device	IXYS	IXTH6N90
T1	1	Interface transformer	IXYS	TX02-4400PI
R1	1	10 ohm, 1/4 W resistor		
R15, 16	2	4.7ohm, 1/4 W resistors		
R3, 4, 6, 11	4	22 ohm, 1/4 W resistors		
R5, 10	2	68 ohm, 1/4 W resistors		
R7, 12	2	4.7k ohm, 1/4 W resistors		
R2, 18, 19	3	10k ohm, 1/4 W resistor		
R8, 9, 13, 14	4	510k ohm, 1 W resistors		
R17	1	3k ohm, 1/4 W IXDP630 osc timing resistor		
C22	1	82pF IXDP630 osc timing cap		
C2,3,7,9,11,13, 21	7	.1mF, 50V, ceramic cap	Panasonic	
C5, 6, 16,17,18,19	6	.022mF, 50V, cermaic cap	Panasonic	
C8,12, 20	3	.01mF, 50V, ceramic cap	Panasonic	
C1,4,10,14	4	10mF, 25V, alum elect cap	Panasonic	
C15	1	.1mF, 1000V, ceramic cap	Sprague	10GAP10
P1	1	8 pin header (cut into a 8 pin header)	Berg	68000-236
JP1, JP2	2	2 pin header/ jumpers (cut into 2 pin headers)	Berg	68000-236
NOT INCLUDED:				
U3	1	Crystal based dead time generator	IXYS	IXDP631
D4, D5	2	12A, 1000V fast recovery diode	IXYS	DSEI12-10A
P2	1	4 pole terminal block	Altech Corp.	AKZ250/4
R17	1	1M ohm, 1/4 W IXDP631 osc load resistor		
C22, 23	2	Crystal load capacitors, 22pF 50V ceramic	Panasonic	
Y1	1	Crystal for IXDP631 operation	Pletronics	

OPERATION:

For performance evaluation and power system design please note the following:

a) The assembled board can be ran with the IXDP630/631 removed by applying complementary 5V square waves with proper "dead time" to the input pins INL (P1-3) and INH (P1-2).

For standard IXDP630 operation, R17 and C22 have been loaded with their respective values represented on the bill of materials. These values are for demonstration and may not be appropriate for your application. Change values as needed. For IXDP631 operation, load R17, C22, C23 with the recommended load components as outlined in the IXDP630/631 data sheet along with the crystal at the frequency of choice. R17 and C22 serve a dual purpose depending on which dead timer is selected.

The IXDP630 is hardwired for phase 'R' operation, see 630/631 data sheet, with pins OUTENA, ENAR, and RESET tied high. PWM drive input signal for ' R' phase is applied to P1-6.

To add phases 'S' and / or 'T', enable phases with jumpers at JP1 and/or JP2 and apply PWM phase drive signals to TP7 and/ or TP8 taking the respective complementary outputs from TP3 through TP6. Note that TP1-TP15 are through-hole pads that have been added to the board to serve as convenient solder and / or test points.

If additional 'slave' boards are to be used for mutiple phase operation, R17 - R19, C20 - C23, and Y1 do not need to be installed on the addtional slave boards.

b) Be careful with ground connections. Avoid ground loops. In general, connect the grounds as shown in Figure 4 to minimize ground bounce effects. This is particularly important when three "High/Low side driver design kits" are connected together with a single IXDP630 to form a three phase drive system, such as that shown in Figure 5.

c) Before using the PCB at full power or attempting a short circuit test, make sure that a proper high voltage electroytic capacitor is connected between DC BUS and GND as shown in Figure 4. The leads to this capacitor should be as short as possible to minimize any stray inductance.

d) Figure 4 shows the load terminated at point A. This point could be connected to a number of places depending on the application. For example: Connection to ground will test the high side device. Connection to DC BUS will test the low side device. It could also be connected to the center point of a capacitive divider (UPS systems).

e) Figure 5 shows a three phase power system implementation with a load configured in a Y (star). It could also be configured in a DELTA configuration. Please note the grounding scheme. Cut the connection between "ground plane 2" and "ground plane 4" on the components side of the PCB and solder a 10 Ohm resistor between these ground planes. The GND of each board is terminated to a single ground point.

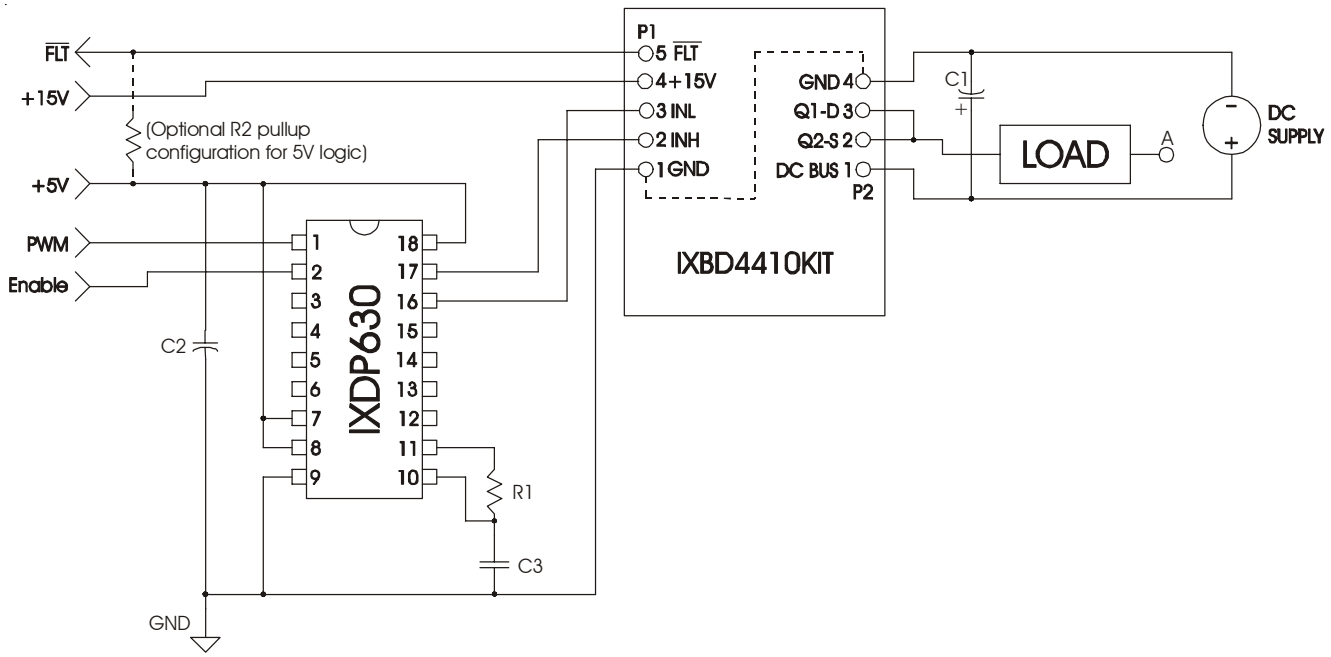


Figure 4: Dead Time Generator & Load Termination

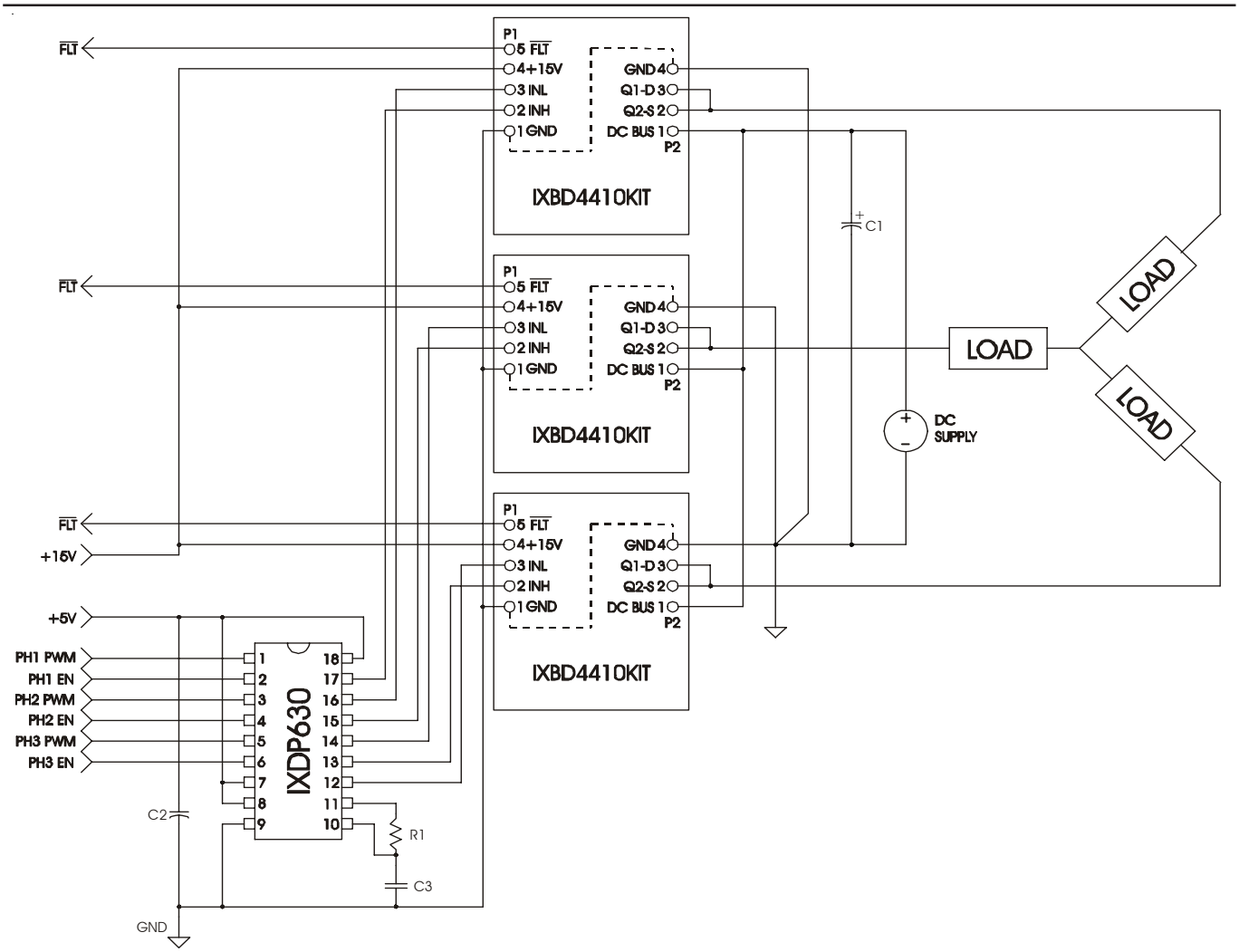


Figure 5: Three Phase Configuration with Dead Time Generator

In Figures 4 & 5, the schematic assumes the designer will be using some type of external control system for starting the circuit and/or reseting the circuit in the event a fault occures. As an alternative, Figure 6 demonstrates a simple and inexpensive Start/Reset logic circuit for manually implementing fault protection.

With the addition of High Current MOSFET Drivers on the outputs, the IXBD4410/11's typical 2A Peak Output Current capability can be "boosted" to drive the latest IXYS MOSFETS & IGBT's.

Figure 6 shows the addition of two IXDD414's. These are CMOS high-speed MOSFET drivers that have a 14A Peak Output Drive Capability, allowing the 4410/11 chipset to drive a pair of IXFK90N20Q 90A/ 200V Power Mosfets. (The 2 ohm gate resistors shown should be Non-Inductive High Performance Film resistors such at those available from Caddock. Particular attention also needs to be paid to Suppy Bypassing, Grounding, and minimizing the Output Lead Inductance when designing such a high power circuit layout).

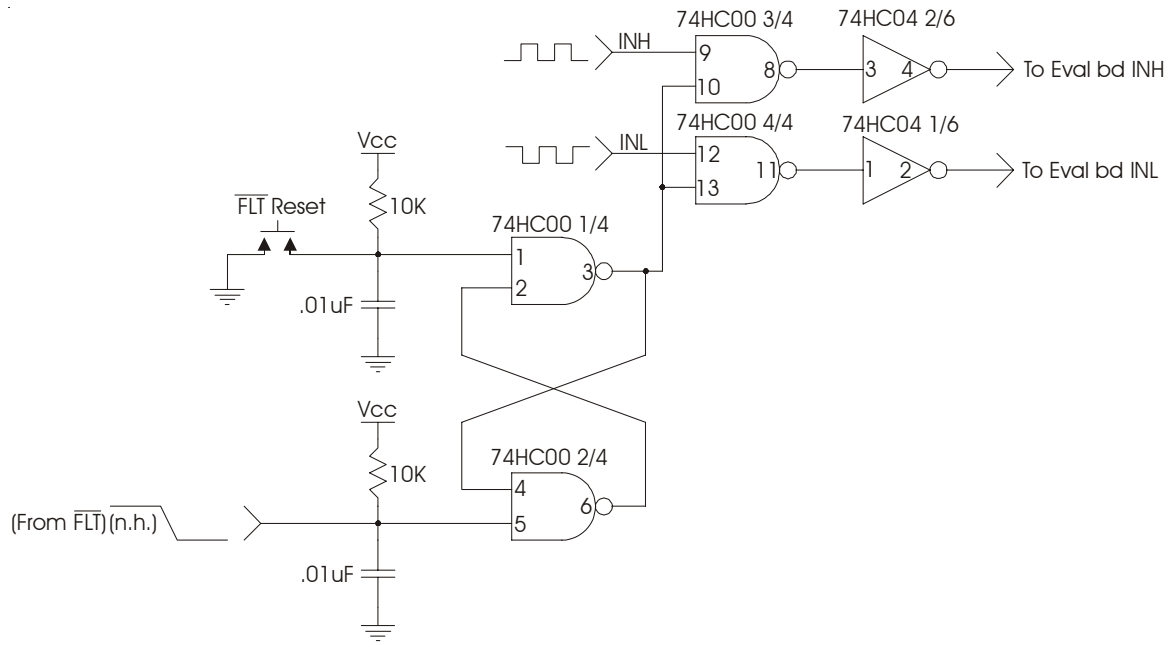


Figure 6: Simple Fault Protection Logic Circuit

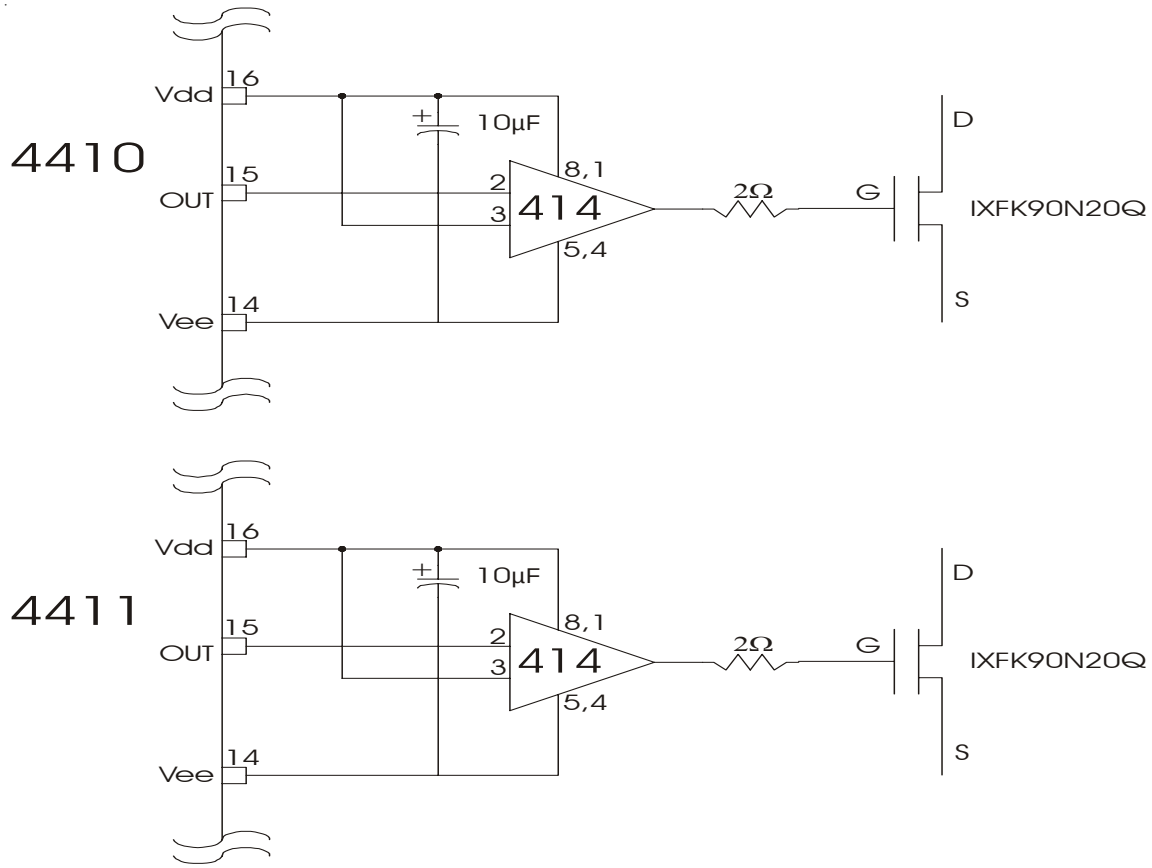


Figure 7: Boosting the 4410/11 outputs for larger MOSFETs.