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A 36 W Ballast Application with the NCP5181

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This document describes how the NCP5181 driver can be implemented in a ballast application. The scope of this application note is to highlight the NCP5181 driver and not to explain or detail how to build an electronic ballast.

The NCP5181 is a high voltage power MOSFET driver providing two outputs for direct drive of two N-channel power MOSFETs arranged in a half-bridge (or any other high-side + low-side topology) configuration.

It uses the bootstrap technique to ensure a proper drive of the high-side power switch. The driver works with two independent inputs to accommodate with any topology (including half-bridge, asymmetrical half-bridge, active clamp and full-bridge).

Demo Board Specification

- Input range : 85 - 145 Vac OR 184 - 265 Vac
- Ballast Output power : 36 W (type PL-L 36 W)
- Pre-heating current : 295 mA
- Pre-heating time : 1 second
- Nominal current : 414 mA

NOTE: BEFORE PLUGGING IN THE DEMO BOARD, MAKE SURE THE JUMPER IS IN THE CORRECT POSITION: IF J2 IS USED, THEN V_{in} MUST BE LOWER THAN 145 Vac.

Detailed Operation

The lamp ballast is powered via a half bridge configuration. The two power MOSFETs are driven with the NCP5181 driver. The driver is supplied by the VCC rail, and the high side driver is supplied by the bootstrap diode: when the low side power MOSFET (Q2) is switched ON, the BRIDGE pin is pulled down to the ground, thus the capacitor connected between the BRIDGE pin and VBOOT pin is refuelled via the diode D3 and the resistor R5 connected to VCC. When Q2 is switched OFF, the bootstrap capacitor C6 supplies the high side driver with a voltage equal to VCC level minus D3 forward voltage diode. Given the NCP5181 architecture, it is up to the designer to generate the right input signal polarity. This includes a dead time to avoid a short circuit between the high and low side power MOSFET.

The 555 timer generates only one signal for the driver, the second one, in opposite phase is built by inserting an NPN transistor (Q4) for inverting the signal. Afterwards, the dead time is built with R2, D2 and C13 (typically 260 ns, See Figure 1).

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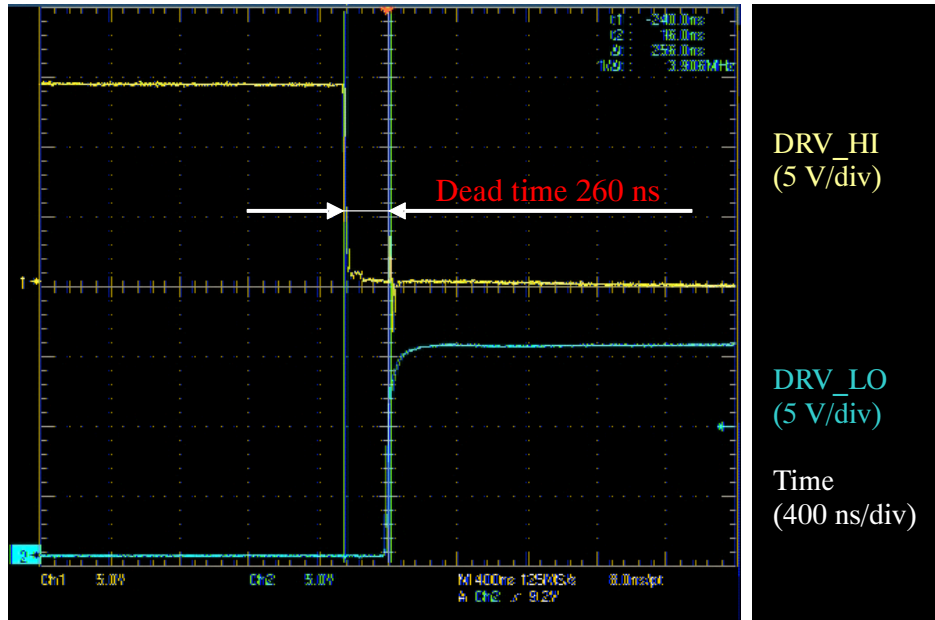


Figure 1. Dead Time Between the High and Low Side Driver

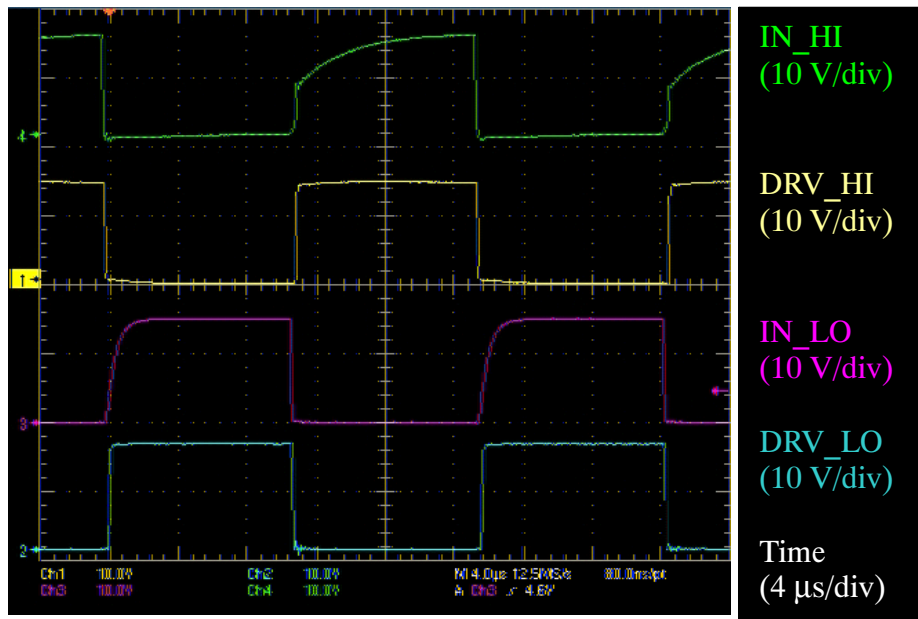


Figure 2. Input Output Timing Diagram

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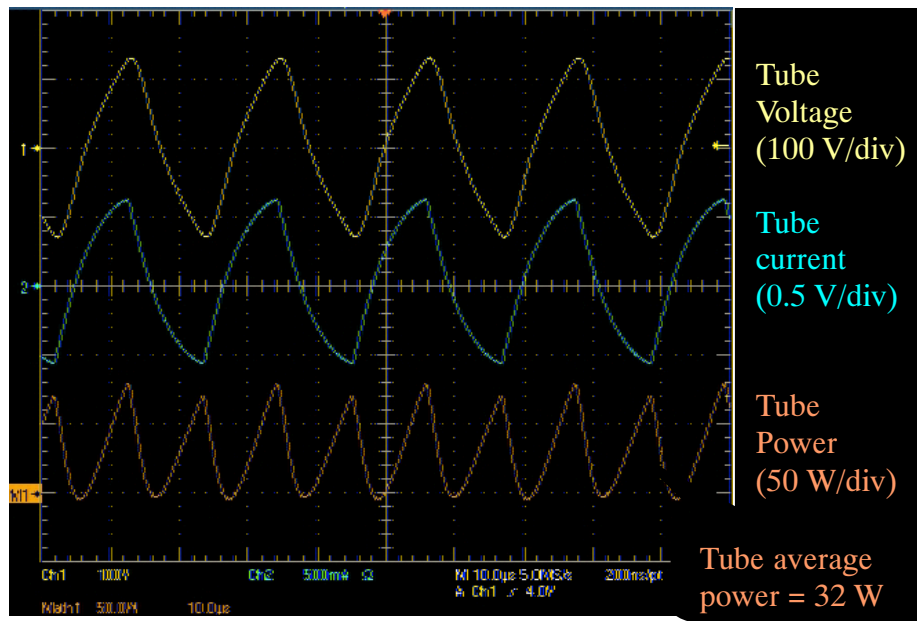


Figure 3. Tube signals

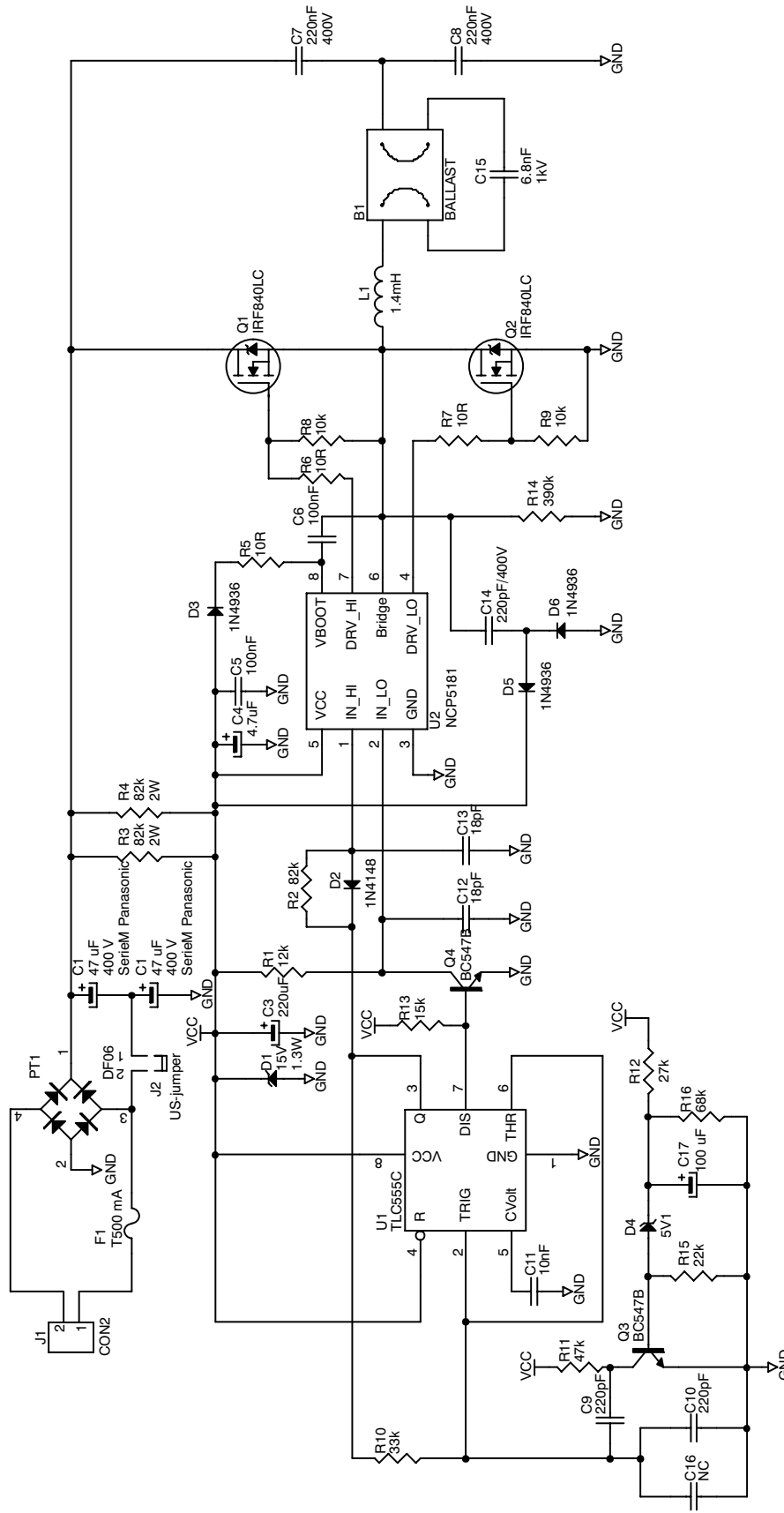


Figure 4. Demo Board Schematic

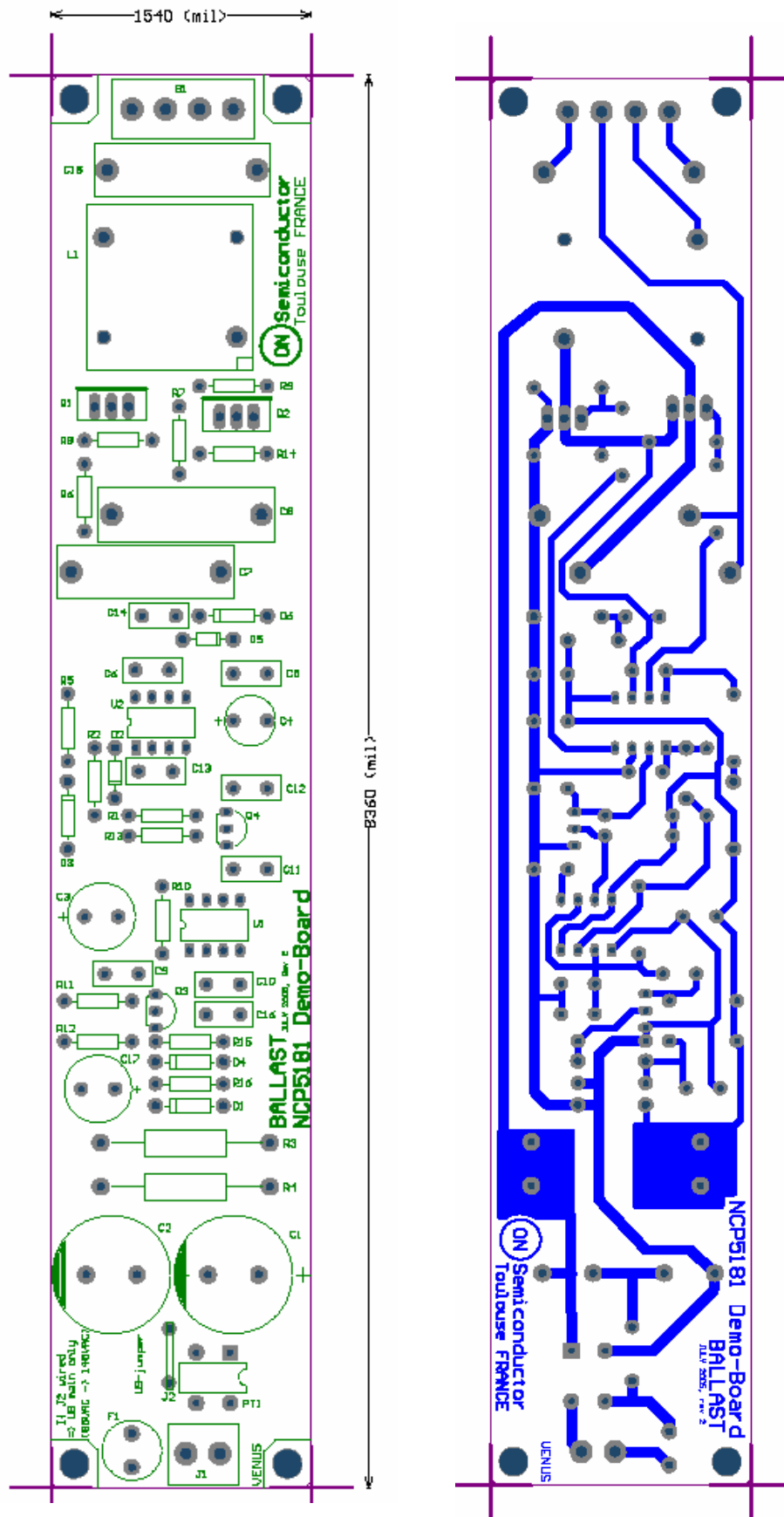



Figure 5. PCB Printout: Top and Bottom View

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Bill of Material

Part Type	Designator	Manufacturer	Description
Connector	B1, J1	-	Connector
47 μ F/400 V	C1,C2	Panasonic	M Series
220 pF	C10	Generic	Capacitor
10 nF	C11	Generic	Capacitor
18 pF	C12, C13	Generic	Capacitor
220 pF /400 V	C14	Generic	Capacitor
6.8 nF/1 kV	C15	Generic	Capacitor
NC	C16	-	Capacitor
100 μ F	C17	Generic	Capacitor
220 μ F	C3	Generic	Capacitor
4.7 μ F/50 V	C4	Generic	Capacitor
100 nF	C5	Generic	Capacitor
100 nF	C6	Generic	Capacitor
220 nF/400 V	C7, C8	Generic	Capacitor
220 pF	C9	Generic	Capacitor
BZX85C15V	D1	Generic	15 V Zener diode
1N4148	D2	Generic	Signal diode
1N4936	D3, D5, D6	ON Semiconductor	Fast Recovery rectifier
BZX85C5V1	D4	Generic	5V1 Zener diode
T500 mA	F1	Generic	Fuse
US-jumper	J2	-	Jumper for US main supply only
1.4 mH	L1	VOGT	VOGT 53-044
DF06M	PT1	-	600V Diode Bridge
IRF840LC	Q1, Q2	IRF	Low Charge N-Channel MOSFET
BC547B	Q3, Q4	Generic	NPN transistor
12k	R1	Generic	Resistor
33k	R10	Generic	Resistor
47k	R11	Generic	Resistor
27k	R12	Generic	Resistor
15k	R13	Generic	Resistor
390k	R14	Generic	Resistor
22k	R15	Generic	Resistor
68k	R16	Generic	Resistor
82k	R2	Generic	Resistor
82k/2W	R3, R4	Generic	Resistor 2W power type
10R	R5, R6, R7	Generic	Resistor
10k	R8, R9	Generic	Resistor
TLC555C	U1	Texas Instrument	CMOS 555 timer
NCP5181	U2	ON Semiconductor	NCP5181

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