

NCP5104BA36WGEVB

NCP5104 36 W Ballast Evaluation Board User's Manual



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EVAl BOARD USER'S MANUAL

Introduction

This document describes how the NCP5104 driver can be implemented in a ballast application. The scope of this evaluation board user's manual is to highlight the NCP5104 driver and not to explain or detailed how to build electronic ballast.

The NCP5104 is a high voltage power MOSFET driver providing two outputs for direct drive of 2 N-channel power MOSFETs arranged in a half-bridge configuration with only one input.

It uses the bootstrap technique to insure a proper drive of the High-side power switch. The driver works with one input to accommodate half-bridge topology with a fixed dead time of 520 ns.

Evaluation Board Specification

- Input Range : 85 Vac – 145 Vac OR 184 Vac – 265 Vac
- Ballast Output Power : 36 W (type PL-L 36W)
- Pre-heating Current : 295 mA
- Pre-heating Time : 1 second
- Nominal Current : 414 mA

Detailed Operation

The lamp ballast is powered via a half bridge configuration. The 2 power MOSFETs are driven with the NCP5104 driver. The driver is supplied by the V_{CC} 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 BRIDGE pin and VBOOT pin is refuelled via the diode D3 and the resistor R5 connected to V_{CC} . When Q2 is switched OFF the bootstrap capacitor C6 supplies the high side driver with a voltage equal to V_{CC} level minus the D3 forward voltage diode. Given the NCP5104 architecture, the driver copies the input signal to the high side driver, then it generates a fixed dead time (520 ns) before toggling the low side driver when the input pin level changes.

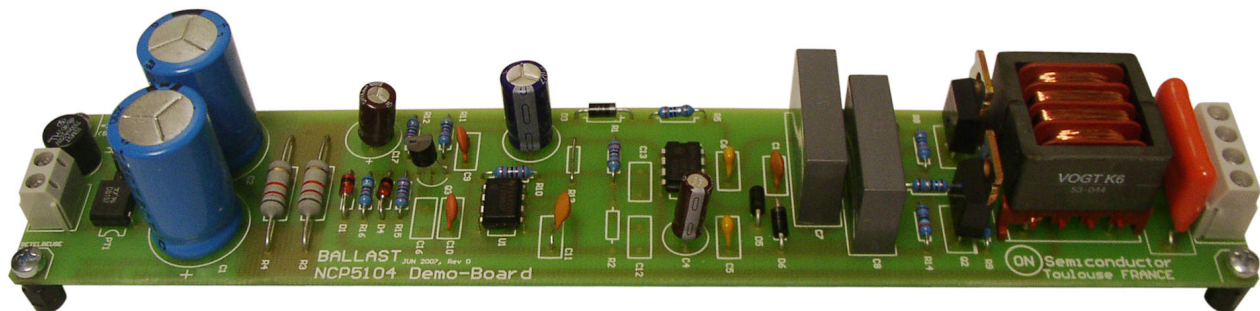


Figure 1. NCP5104 Evaluation Board

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

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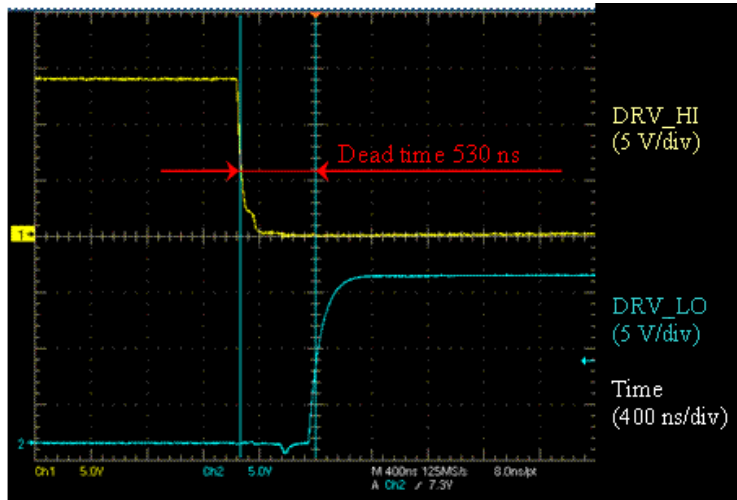


Figure 2. Dead Time Between the High and Low-Side Driver

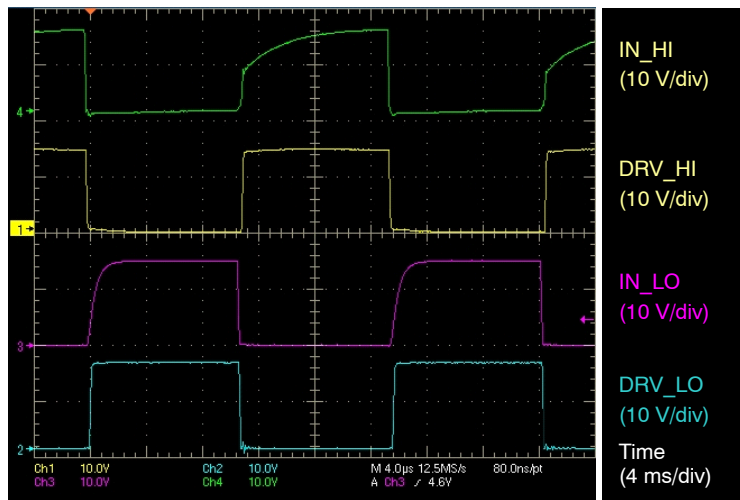


Figure 3. Input Output Timing Diagram

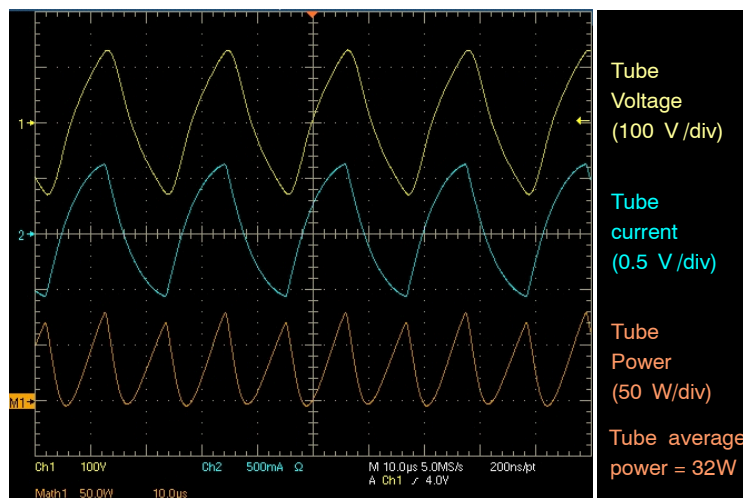


Figure 4. Tube Signals

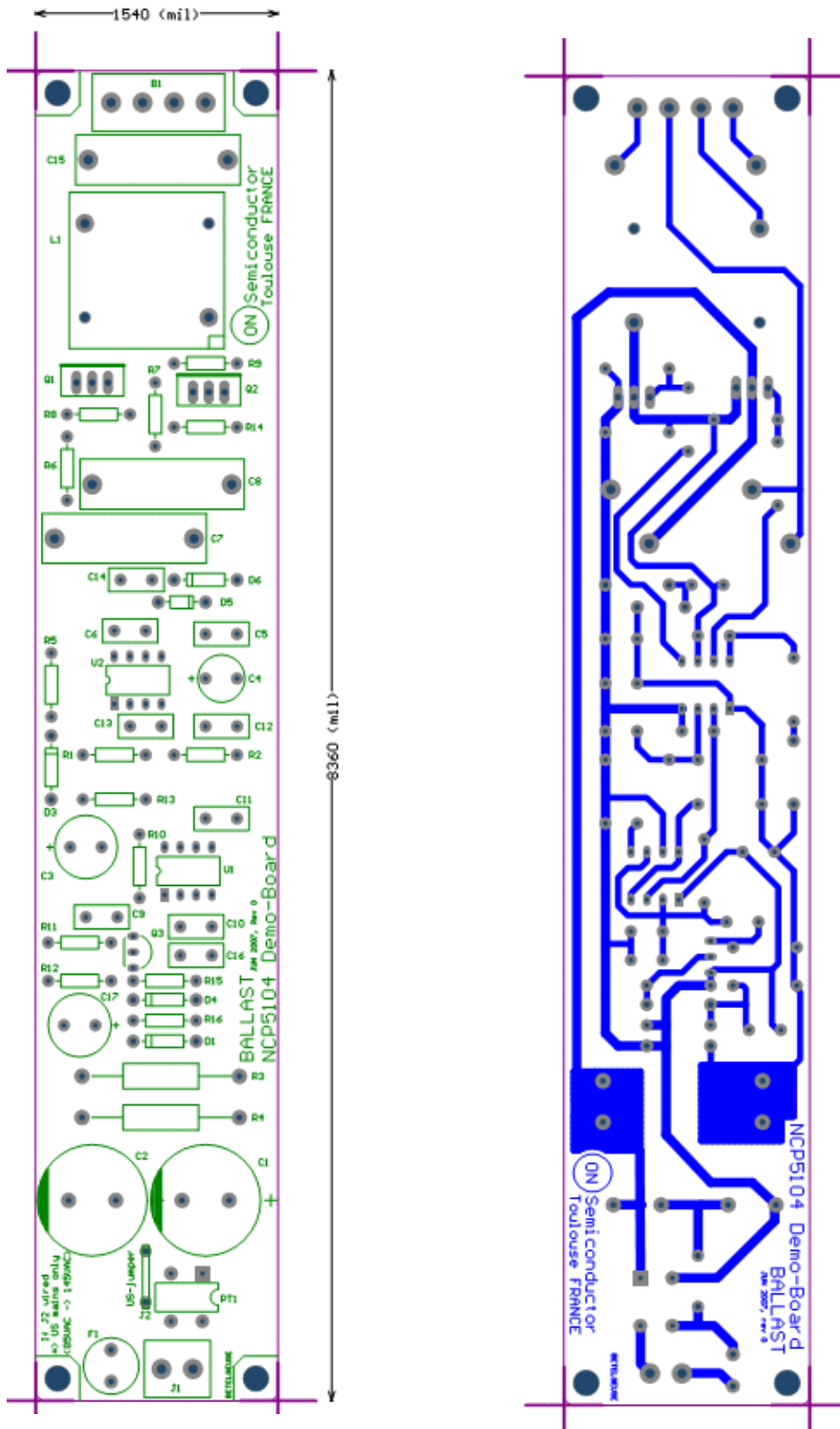


Figure 6. PCB Printout: Top and Bottom View

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Table 1. BILL OF MATERIAL FOR THE NCP5104 EVALUATION BOARD*

| Designator | Qty. | Description | Value | Tolerance | Footprint | Manufacturer | Manufacturer Part Number | Substitution Allowed |
|------------|------|------------------------|------------------------|-----------|------------|-------------------------|--------------------------|----------------------|
| B1 | 2 | Connector | 2" | 0% | Rad5.08 mm | Weidmuller | PM5.08/2/90 | Yes |
| C1,C2 | 2 | Electrolytic Capacitor | 47 μ F/400 V | 0.2 | Radial | Panasonic | ECA2GM470 | Yes |
| C11 | 1 | Capacitor | 10 nF/100 V | 10% | Radial | Murata | RPER72A103K2M1B05A | Yes |
| C12, C13 | 2 | Capacitor | NC | - | Radial | - | - | Yes |
| C14 | 1 | Capacitor | 220 pF/1,000 V | 10% | Radial | Panasonic | PICECKA3A221KBP | Yes |
| C15 | 1 | Capacitor | 6.8 nF/1,600 V | 5% | Radial | BC Comp. | 2222 375 30682 | Yes |
| C16 | 1 | Capacitor | NC | - | Radial | - | - | Yes |
| C17 | 1 | Electrolytic Capacitor | 100 μ F/16 V | 20% | Radial | Panasonic | ECA1CM101 | Yes |
| C3 | 1 | Electrolytic Capacitor | 220 μ F/16 V | 20% | Radial | BC Comp. | 2222-13555221 | Yes |
| C4 | 1 | Electrolytic Capacitor | 4.7 μ F/63 V | 20% | Radial | Nippon Chemi-con | SMEVB4.7UF63V | Yes |
| C5, C6 | 2 | Capacitor | 100 nF/50 V | 10% | Radial | Murata | RPER71H104K2M1A05U | Yes |
| C7, C8 | 2 | Capacitor | 220 nF/400 V | 10% | Radial | Vishay | MKT1822422405 | Yes |
| C9, C10 | 2 | Capacitor | 220 pF/100 V | 5% | Radial | Murata | RPE5C2A221J2M1Z05A | Yes |
| D1 | 1 | Zener Diode | 15 V/1.3 W | 5% | Axial | Vishay | BZX85C15 | Yes |
| D3, D5, D6 | 3 | Rectifier Diode | 1 A/400 V | 0% | Axial | ON Semiconductor | 1N4936G | Yes |
| D4 | 1 | Zener Diode | 5.1 V/1.3 W | 5% | Axial | Vishay | BZX85C5V1 | Yes |
| F1 | 1 | Fuse | 500 mA/250 V | 0% | Radial | Schurter | 0034-6612 | Yes |
| J1 | 1 | Connector | 2" | 0% | Rad5.08 mm | Weidmuller | PM5.08/2/90 | Yes |
| J2 | 1 | Resistor | 0 Ω /0.25 W | 0% | Axial | Multicomp | MCF 0.25W 0R | Yes |
| L1 | 1 | Inductor | 1.4 mH | - | - | Yogt | 53-044 | No |
| PT1 | 1 | Diode Bridge | 600 V/1 A | 0% | DIL | General Semiconductor | DF06M | Yes |
| Q1, Q2 | 2 | Power MOSFET N-channel | 8 A/500 V | 0% | TO220 | International Rectifier | IRF840LC | Yes |
| Q3 | 1 | NPN Transistor | 100 mA/45 V | 0% | TO92 | ON Semiconductor | BC547B | Yes |
| R1, R15 | 1 | Resistor | 22 k Ω /0.33 W | 5% | Axial | Neohm | CFR25J22K | Yes |
| R10 | 1 | Resistor | 33 k Ω /0.33 W | 5% | Axial | Neohm | CFR25J33K | Yes |
| R11 | 1 | Resistor | 47 k Ω /0.33 W | 0.05 | Axial | Neohm | CFR25J47K | Yes |
| R12 | 1 | Resistor | 27 k Ω /0.33 W | 5% | Axial | Neohm | CFR25J27K | Yes |
| R13 | 1 | Resistor | 0 Ω /0.25 W | 5% | Axial | Multicomp | MCF 0.25W 0R | Yes |
| R14 | 1 | Resistor | 390 k Ω /0.33 W | 5% | Axial | Neohm | CFR25J390K | Yes |
| R16 | 1 | Resistor | 68 k Ω /0.33 W | 5% | Axial | Neohm | CFR25J68K | Yes |
| R2 | 1 | Resistor | NC | - | Axial | - | - | Yes |
| R3, R4 | 2 | Resistor | 82 k Ω /3 W | 5% | Axial | BC Comp. | 232219514823 | Yes |
| R5, R6, R7 | 3 | Resistor | 10 Ω /0.33 W | 5% | Axial | Neohm | CFR25J10R | Yes |
| R8, R9 | 2 | Resistor | 10 k Ω /0.33 W | 5% | Axial | Neohm | CFR25J10K | Yes |
| U1 | 1 | CMOS IC | Analog/Timer | 0% | DIP8 | Texas Instruments | TLC555CP | No |
| U2 | 1 | NCP5104 | NCP5104 | - | DIP8 | ON Semiconductor | NCP5104 | No |

*All devices are Pb-free.

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TEST PROCEDURE

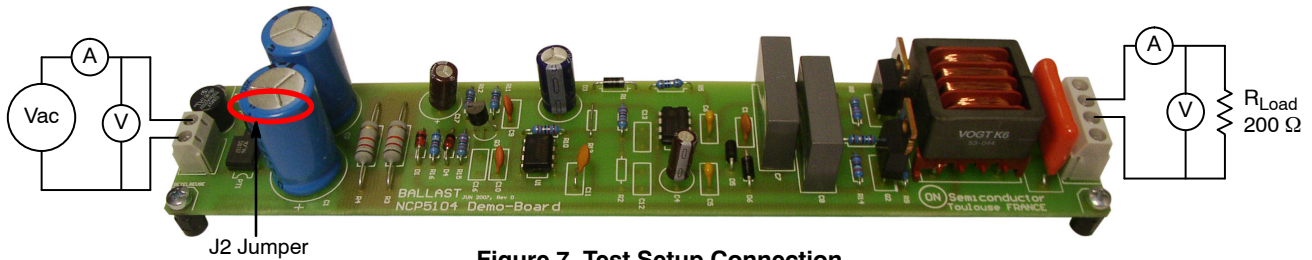


Figure 7. Test Setup Connection

Table 2. REQUIRED EQUIPMENT

| | | |
|---|------------------------------|-------------------|
| AC Power Source can be able to Deliver 230 V _{rms} or 110 V _{rms} | Two Voltmeters | Two Ampere Meters |
| 1 Resistive Load: 200 Ω/50 W | One NCP5104 Evaluation Board | - |

Test Procedure

1. First of all check if you need or not the jumper #2 (J2 on the board close the diode bridge). This jumper must be removed in case of European mains (230 Vac input voltage) and have to be placed in case of US mains (110 Vac). This jumper is used to build a voltage doublers just after the bridge diode in case of US mains input voltage range.
2. Connect the test setup as shown in Figure 7:

- AC Source

- Voltmeter and Ampere Meter on the Load
 - Load on the Output
3. Apply 230 Vac for European mains or 110 Vac for US mains on the input connector.
 4. Check I_{Load} and V_{Load} with the appropriate value in the Table 3.
 5. If you get the correct output and input voltage, you can connect a 36 W fluorescent tube on the output (see Figure 8).

Table 3. TEST RESULTS

| Input Mains | J2 | V _{IN} (V _{rms}) | I _{IN} (A _{rms}) | V _{Load} (V _{rms}) | I _{Load} (A _{rms}) |
|-------------|---|-------------------------------------|-------------------------------------|---------------------------------------|---------------------------------------|
| European | Removed | 230 V | 278 mA | 303 V | 370 mA |
| US | Yes → Max Input Voltage: 132 V _{rms} | 110 V | 514 mA | 263 V | 340 mA |

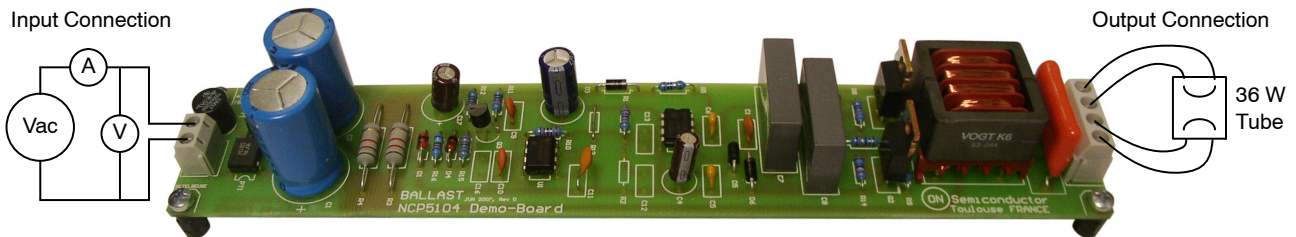


Figure 8. Ballast Connection

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