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.

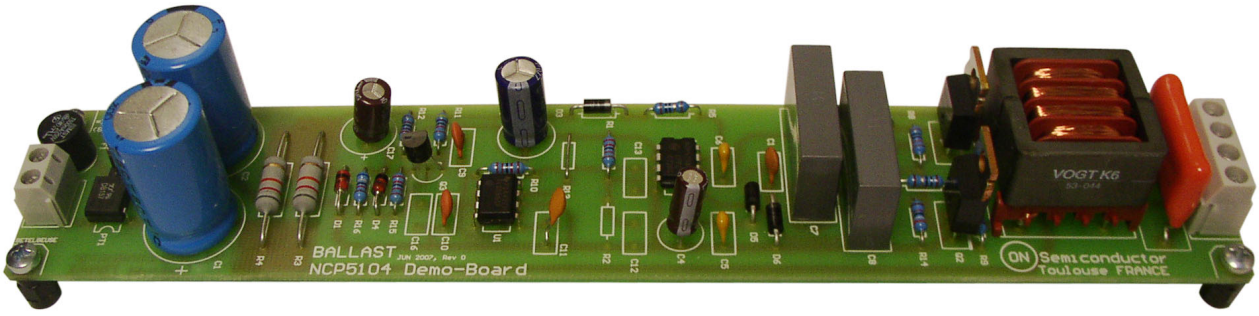

Figure 1. NCP5104 Evaluation Board

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.

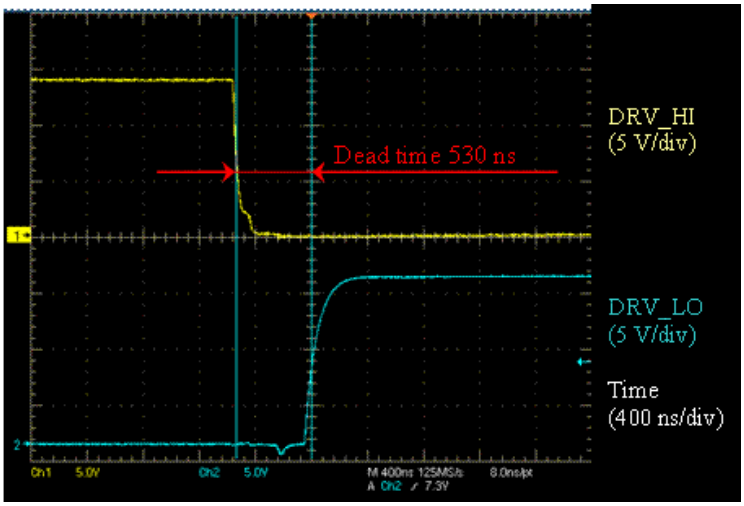

Figure 2. Dead Time Between the High and Low-Side Driver

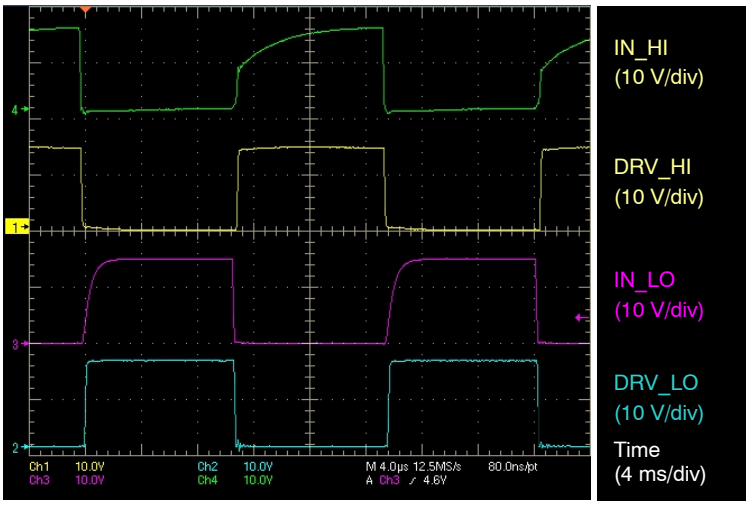

Figure 3. Input Output Timing Diagram

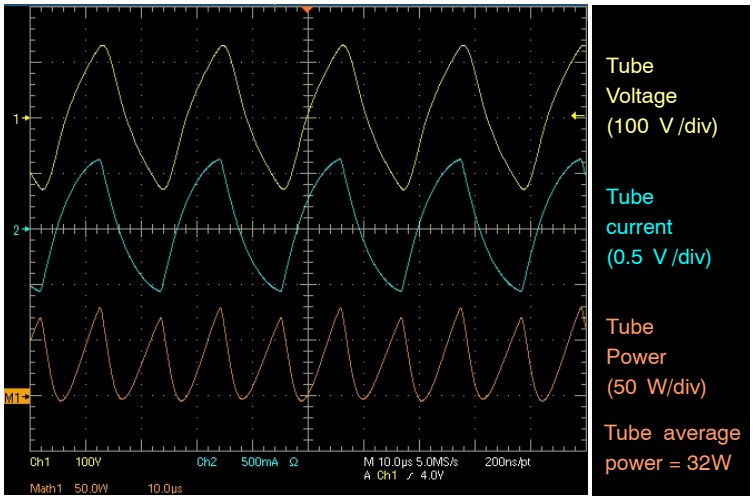

Figure 4. Tube Signals

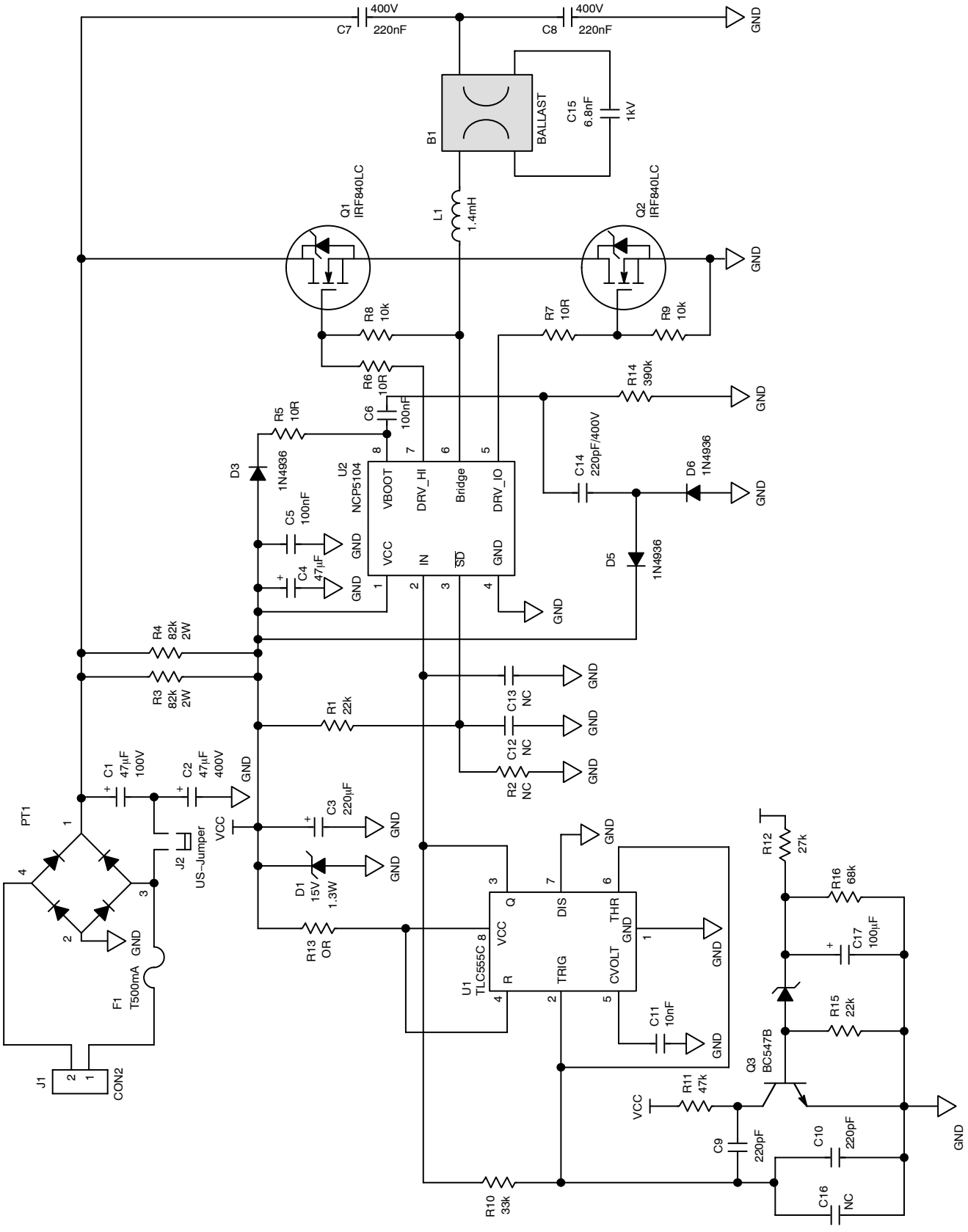

Figure 5. NCP5104 Evaluation Board Schematic

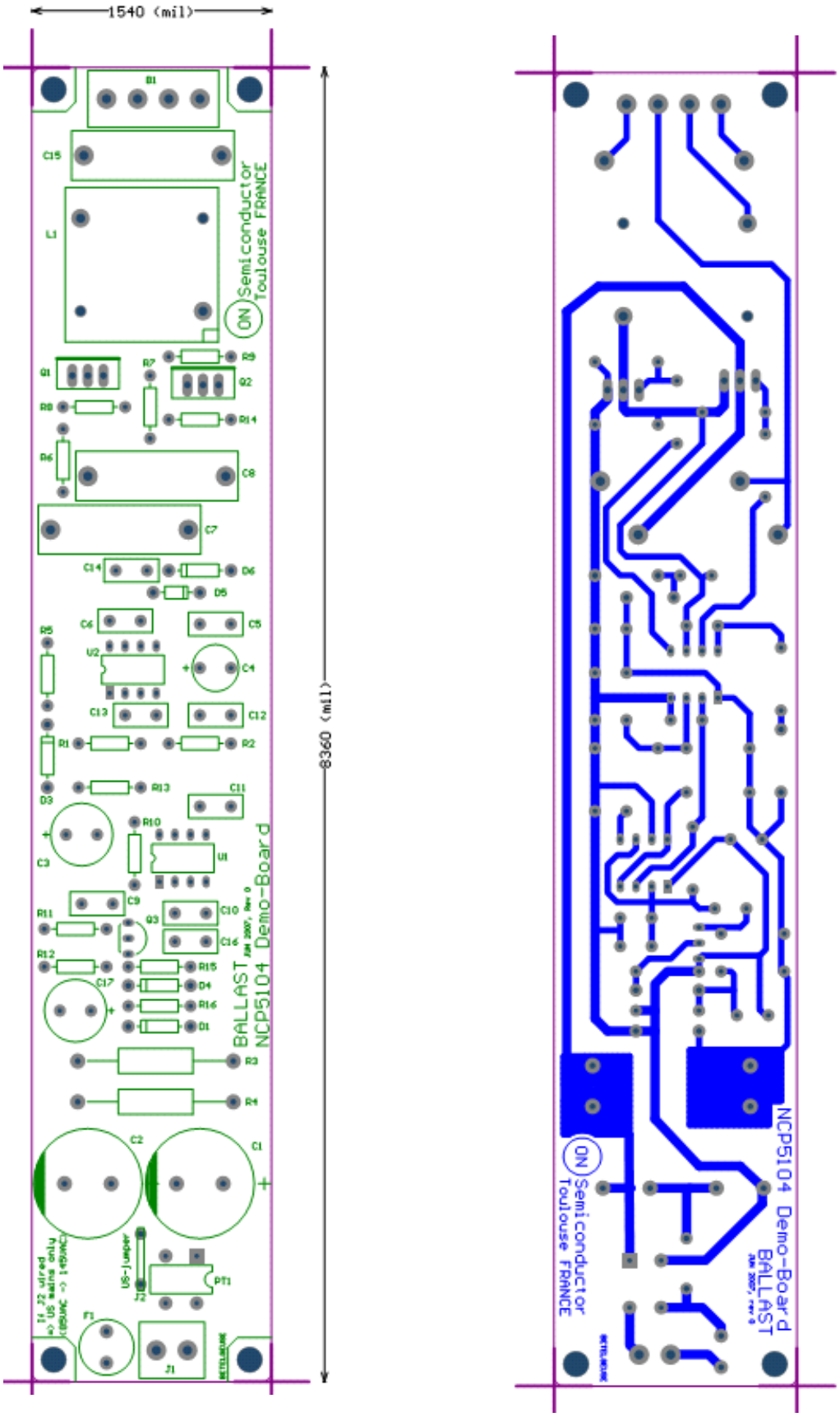

Figure 6. PCB Printout: Top and Bottom View

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 μF/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 μF/16 V	20%	Radial	Panasonic	ECA1CM101	Yes
C3	1	Electrolytic Capacitor	220 μF/16 V	20%	Radial	BC Comp.	2222−13555221	Yes
C4	1	Electrolytic Capacitor	4.7 μF/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 kΩ/0.33 W	5%	Axial	Neohm	CFR25J22K	Yes
R10	1	Resistor	33 kΩ/0.33 W	5%	Axial	Neohm	CFR25J33K	Yes
R11	1	Resistor	47 kΩ/0.33 W	0.05	Axial	Neohm	CFR25J47K	Yes
R12	1	Resistor	27 kΩ/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 kΩ/0.33 W	5%	Axial	Neohm	CFR25J390K	Yes
R16	1	Resistor	68 kΩ/0.33 W	5%	Axial	Neohm	CFR25J68K	Yes
R2	1	Resistor	NC	–	Axial	–	–	Yes
R3, R4	2	Resistor	82 kΩ/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 kΩ/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.

TEST PROCEDURE

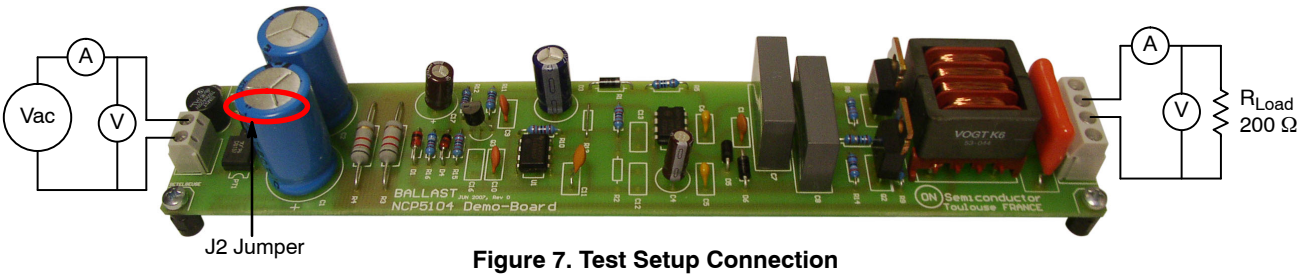

Figure 7. Test Setup Connection

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 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

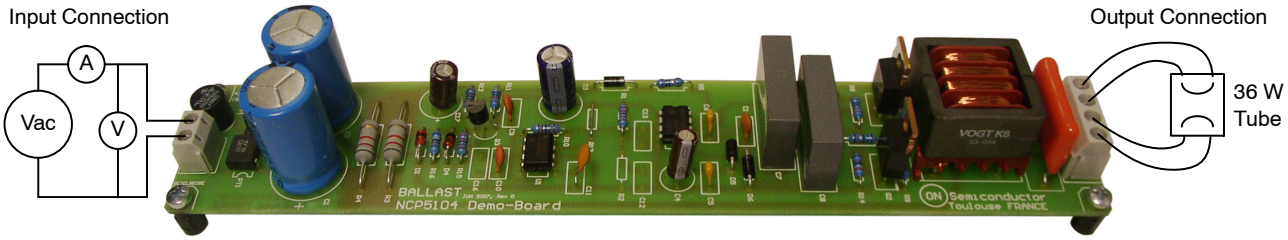

Figure 8. Ballast Connection

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