

# UM10416

UBA2024BP/BT 25 W demo boards

Rev. 1 — 15 November 2010

User manual

## Document information

Info	Content
<b>Keywords</b>	UBA2024BP, UBA2024BT, half-bridge CFL driver, non-dimmable
<b>Abstract</b>	This document describes the correct use of the UBA2024BP and UBA2024BT half-bridge CFL driver demo boards for 120 V (AC) mains voltage and several circuit examples for up to 25 W



## Revision history

Rev	Date	Description
v.1	20101115	initial version

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# 1. Introduction

**WARNING**

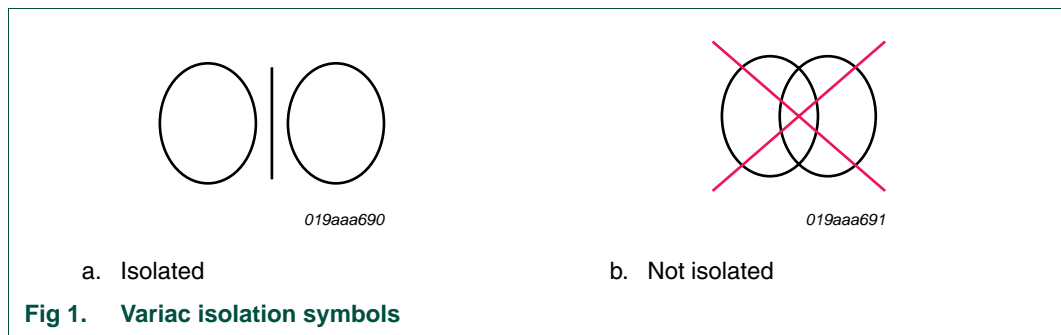
**Lethal voltage and fire ignition hazard**



The non-insulated high voltages that are present when operating this product, constitute a risk of electric shock, personal injury, death and/or ignition of fire.

This product is intended for evaluation purposes only. It shall be operated in a designated test area by personnel qualified according to local requirements and labor laws to work with non-insulated mains voltages and high-voltage circuits. This product shall never be operated unattended.

**Remark:** Galvanic isolation of the mains phase using a variable transformer is always recommended. These devices can be recognized by the symbols shown in [Figure 1](#).



## 1.1 General description

The UBA2024 circuit is a half-bridge driver IC which has been set-up to drive a standard PLC 4P 26W, G24q-3 socket based lamp or similar lamp types with a nominal lamp power of 24 W. The UBA2024 is available in two different versions, the UBA2024BP is the DIL8 package and the UBA2024BT is the SO14 package.

The total power dissipation is approximately 25 W at a nominal mains voltage of 120 V (RMS), 60 Hz. The demo boards can be easily configured to drive different Compact Fluorescent Lamps (CFL) at different power ratings. Several design examples show how by changing the inductor tap and applying a different lamp capacitor, different power ratings are achieved.

The UBA2024BP and UBA2024BT demo boards are not recommended for driving lower voltage linear lighting lamps such as the T5 or T8. The UBA2021 is a better option for these types of lamps.

The IC can drive lamps up to 26 W, provided the maximum junction temperature of the IC is not exceeded. The demo boards are designed to ensure the mains power dissipation is less than 25 W. Since there are no Total Harmonic Distortion (THD) requirements for mains power-dissipations less than 25 W, a preconditioning function is obsolete.

The circuit is set-up to perform a preheat so the lamp will switch on approximately 0.6 s after the mains voltage has been applied to the board.

Consult the application note *AN10966 "UBA 2024B CFL ballast 100 to 120 V (AC) without voltage doubler"* for detailed design steps on how to set-up lamps with other power ratings.

The mains voltage operating range is set between 100 V and 120 V (RMS).

The IC was intended as a cost-effective solution to drive CFL with an integrated ballast (CFLi) and as such no thermal protection or open lamp detection is implemented on the device. As the demo board has been designed around a detachable lamp, a protection circuit has been added to it to set the IC to a safe mode of operation when no lamp is attached to the circuit. This circuit is not needed in a typical CFL application.

**Remark:** If the UBA2024BP or UBA2024BT is used in a non-integrated ballast or a 'matchbox' type of ballast, the protection circuit is required.

## 2. Schematic diagram

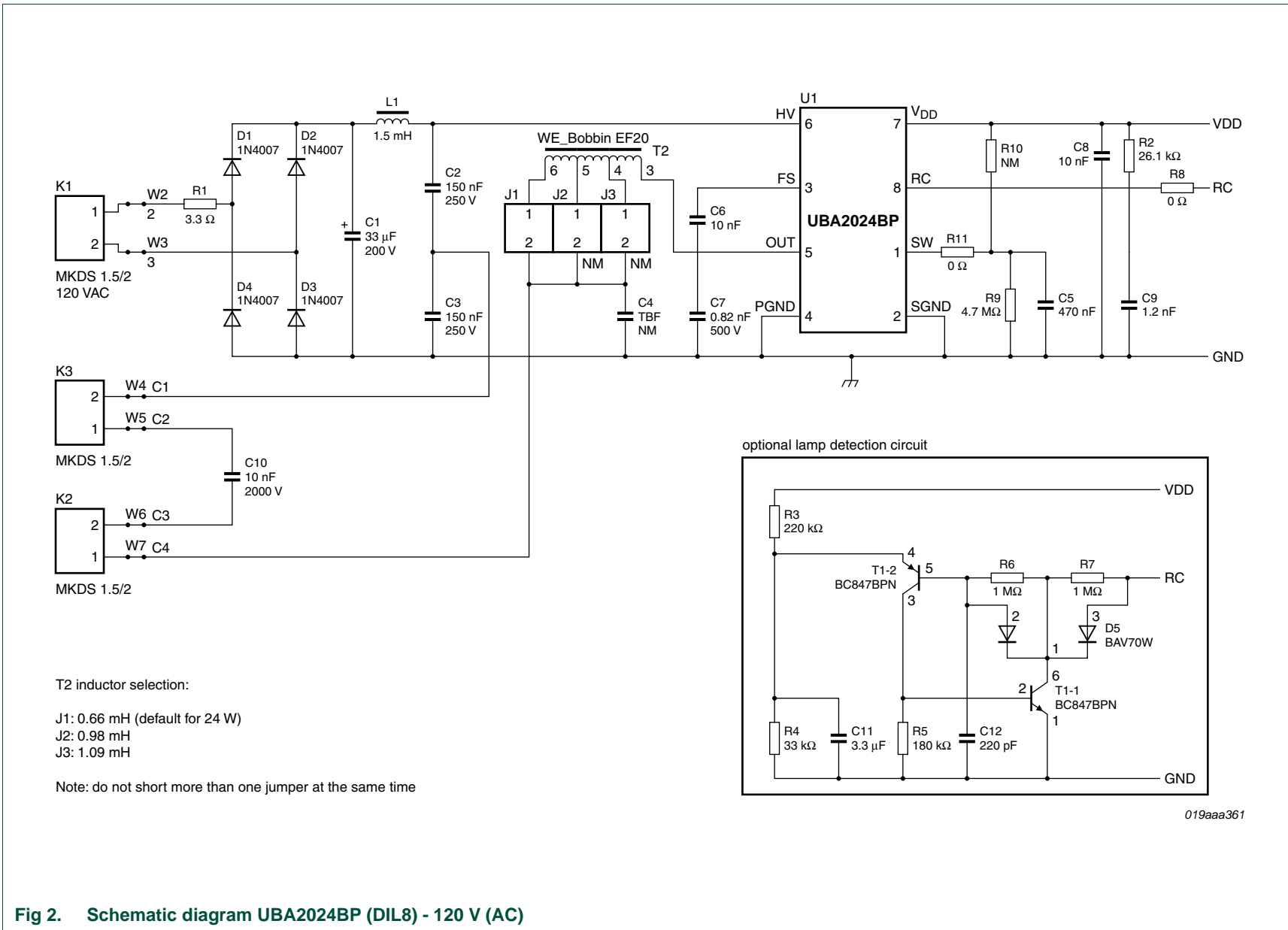
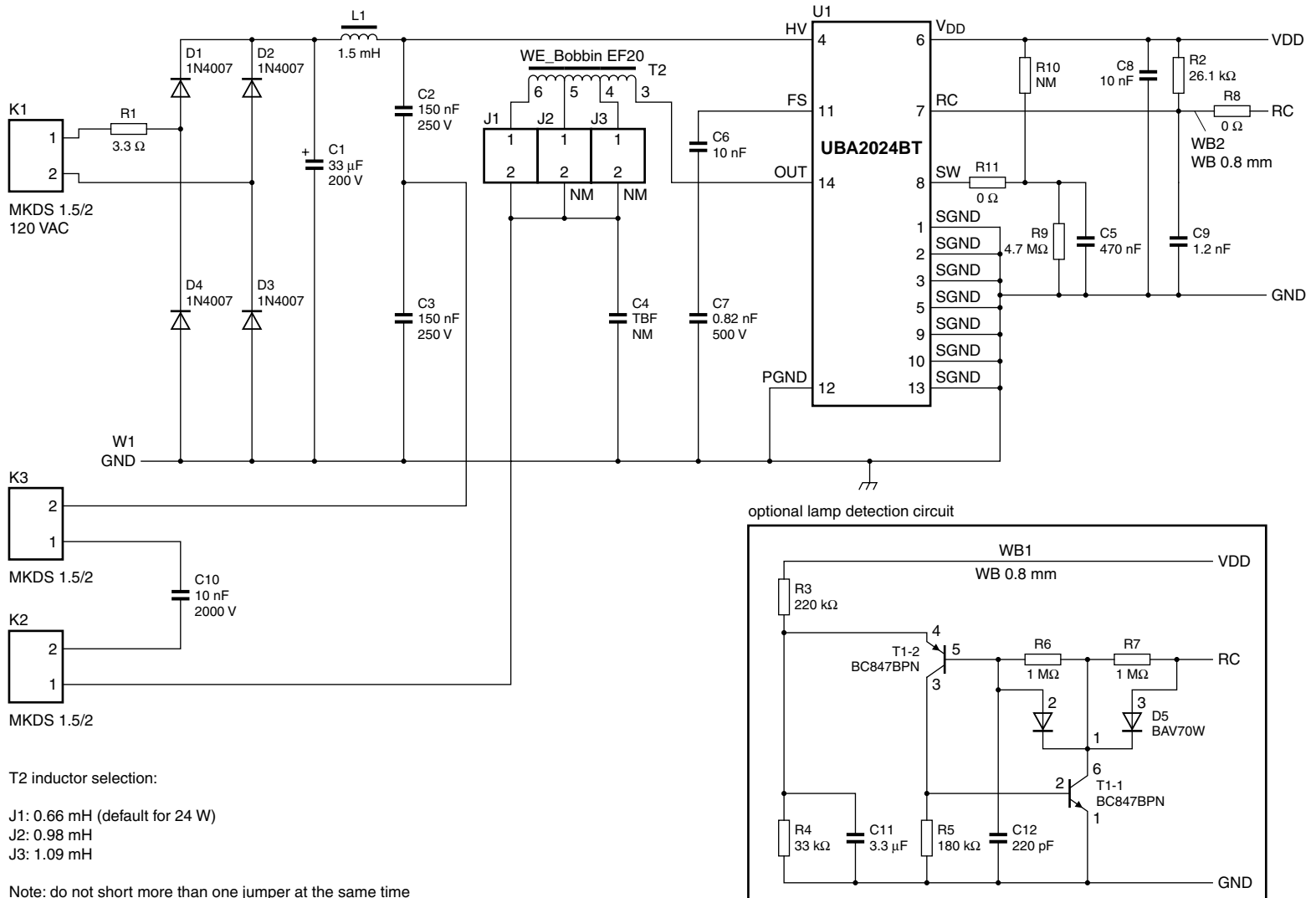


Fig 2. Schematic diagram UBA2024BP (DIL8) - 120 V (AC)



T2 inductor selection:  
 J1: 0.66 mH (default for 24 W)  
 J2: 0.98 mH  
 J3: 1.09 mH

Note: do not short more than one jumper at the same time

019aaa362

Fig 3. Schematic diagram UBA2024BT (SO14) - 120 V (AC)

### 3. Specification

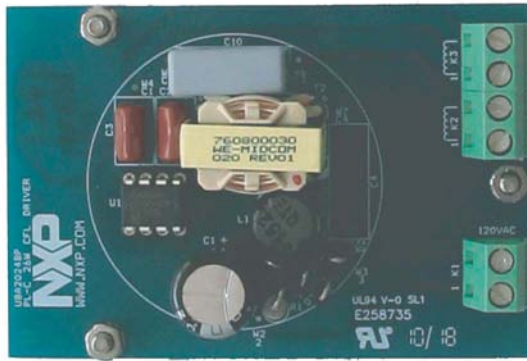


Fig 4. UBA2024BP (DIL8) demo board



Fig 5. UBA2024BT (SO14) demo board

The UBA2024BP and UBA2024BT demo boards are designed to drive a 26 W burner with a G24q-3 type of socket. The specifications are:

120 V (AC):

- Input voltage range: 120 V (AC);  $\pm 10\%$ ; 60 Hz
- Input power: 25 W at 120 V (AC)
- Input current: 400 mA at 120 V (AC)
- Power factor  $> 0.58$
- Running frequency 51 kHz; start frequency 82 kHz
- 600 ms preheat

protective circuits:

- No load and lamp removal protection using an external protection circuit

Burners:

- Philips PL-C 26 W; 4-pin; G24q-3
- Osram Dulux D/E 26 W; 4-pin; G24q-3
- General Electric F26DBX ECO 4P; G24q-3

Other burners that are safe to use are:

- Osram Dulux T/E 26 W; 4-pin; GX24q-3
- Philips PL-T 26 W; 4-pin; GX24q-3
- General Electric F26TBX ECO 4P; GX24q-3
- All T2 or T3 26 W burners with 80 V lamp voltage and 300 mA lamp current

### 3.1 Board connections

The connection to the lamp is very straight forward as shown in [Figure 6](#) and [7](#). Note that any UBA2024B application cannot be used with 230 V (AC) mains voltages.

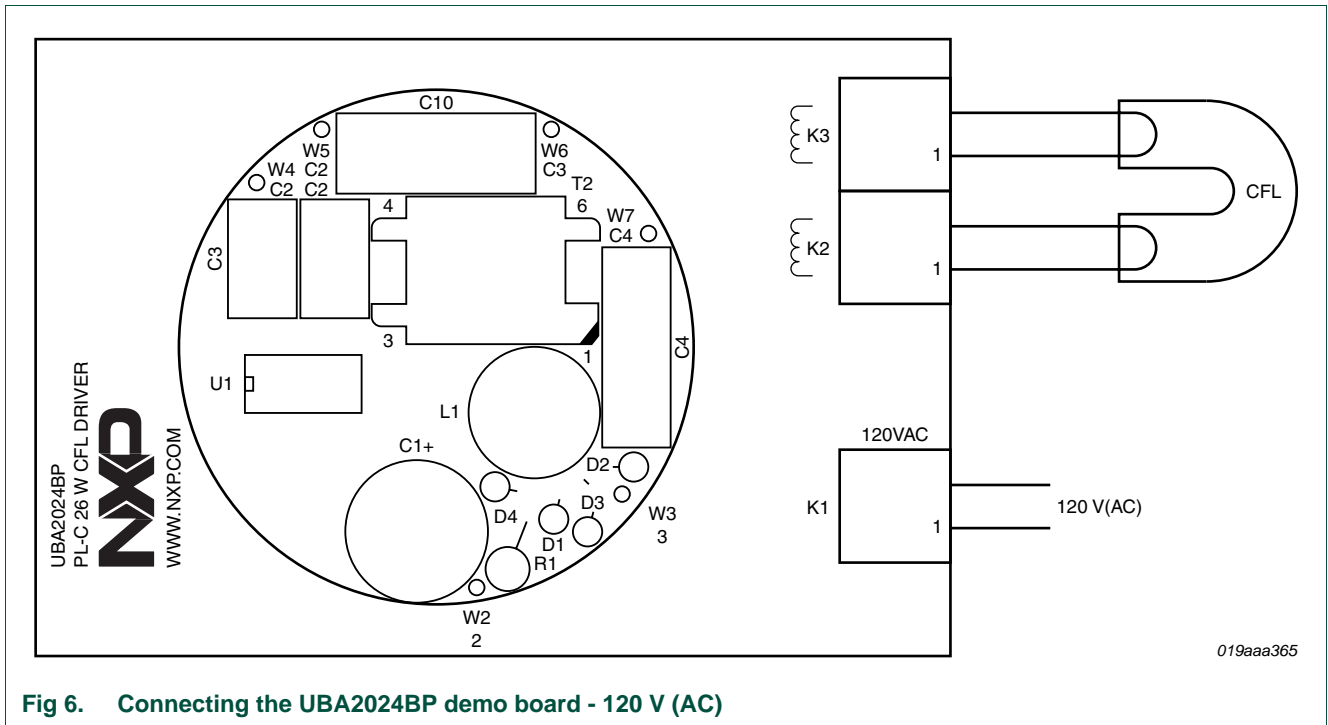


Fig 6. Connecting the UBA2024BP demo board - 120 V (AC)

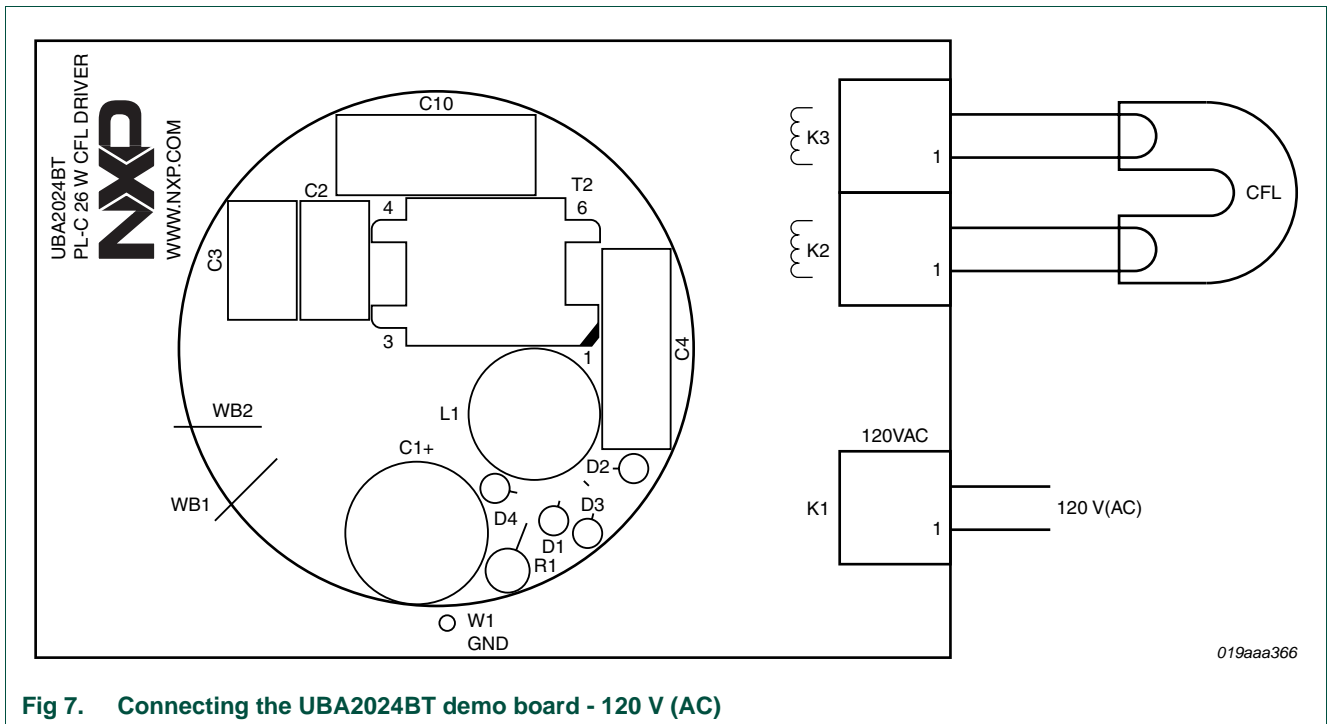


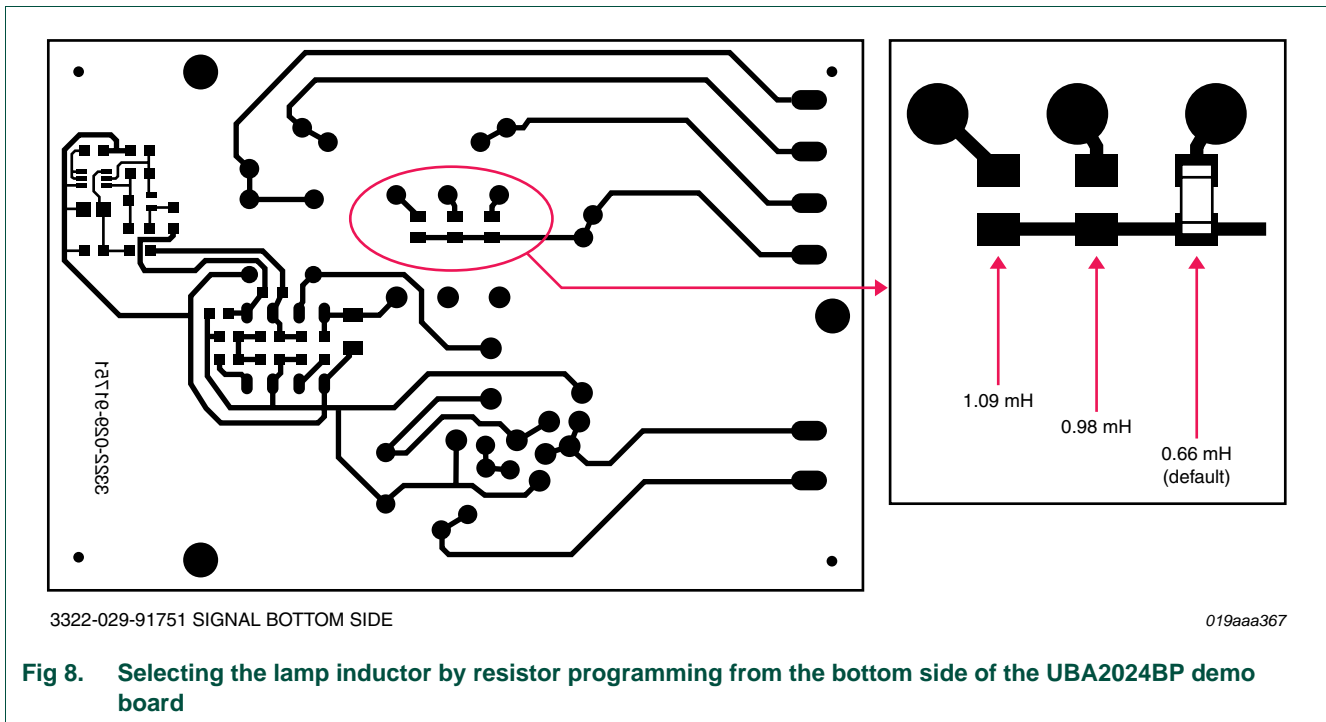
Fig 7. Connecting the UBA2024BT demo board - 120 V (AC)

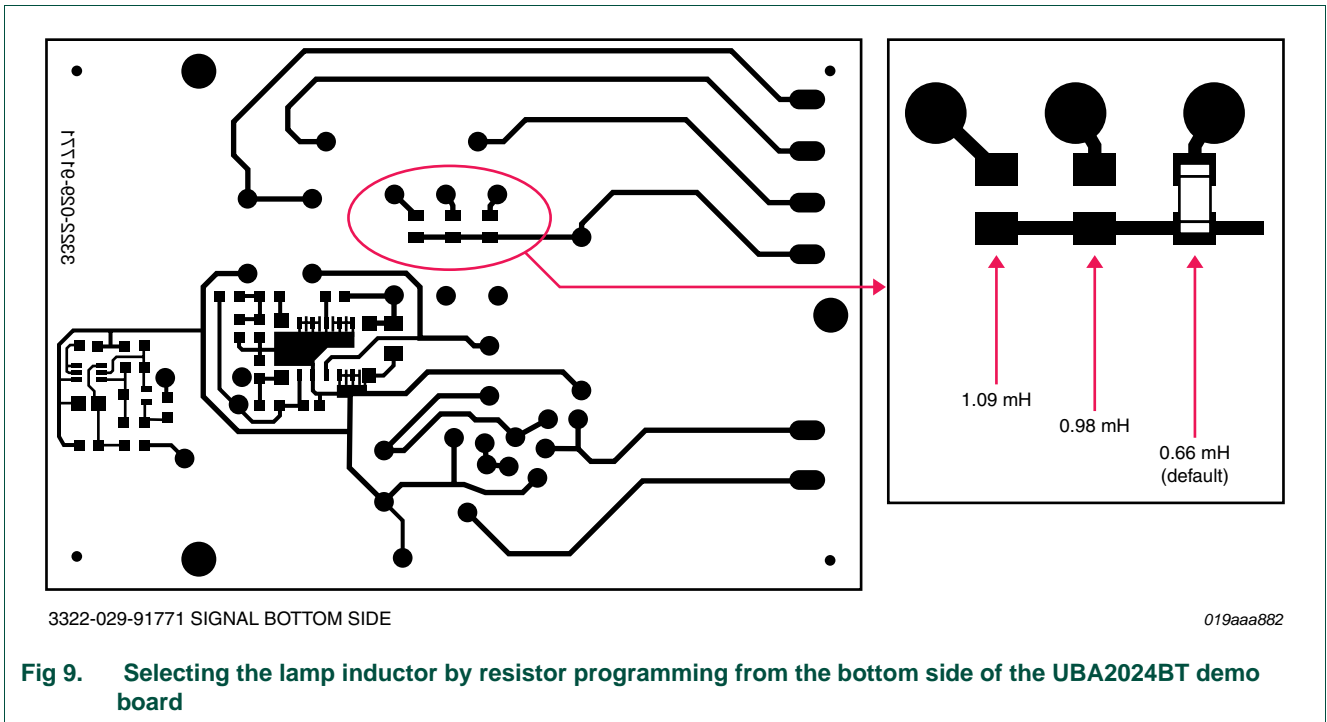


### 3.2 Lamp inductor selection

The inductor supplied with this board accommodates three inductors in one. This makes setting up the board for different lamp powers easier, since it is much easier to change the lamp capacitor than the lamp inductor. It also reduces design time (See [Section 5](#) and the application note *AN10966 "UBA 2024B CFL ballast 100 to 120 V (AC) without voltage doubler"*). [Figure 8](#) and [9](#) show how to select a different lamp inductor. The inductor can be set for 0.66 mH (factory default setting for the 26 W lamp), 0.98 mH, and 1.09 mH. The saturation current for the 0.66 mH inductor setting is 2 A at  $T_{amb} = 125\text{ }^{\circ}\text{C}$ .

**Remark:** Only short-circuit one jumper, otherwise the inductor windings are short circuited.





### 3.3 Bill of materials PL-C 4P 26 W lamp

**Table 1. Bill of material PL-C 4P 26 W lamp**

PL-C 4P 26 W lamp (24 W; 300 mA burner; requiring warm ignition;  $f_{bridge} = 51$  kHz)

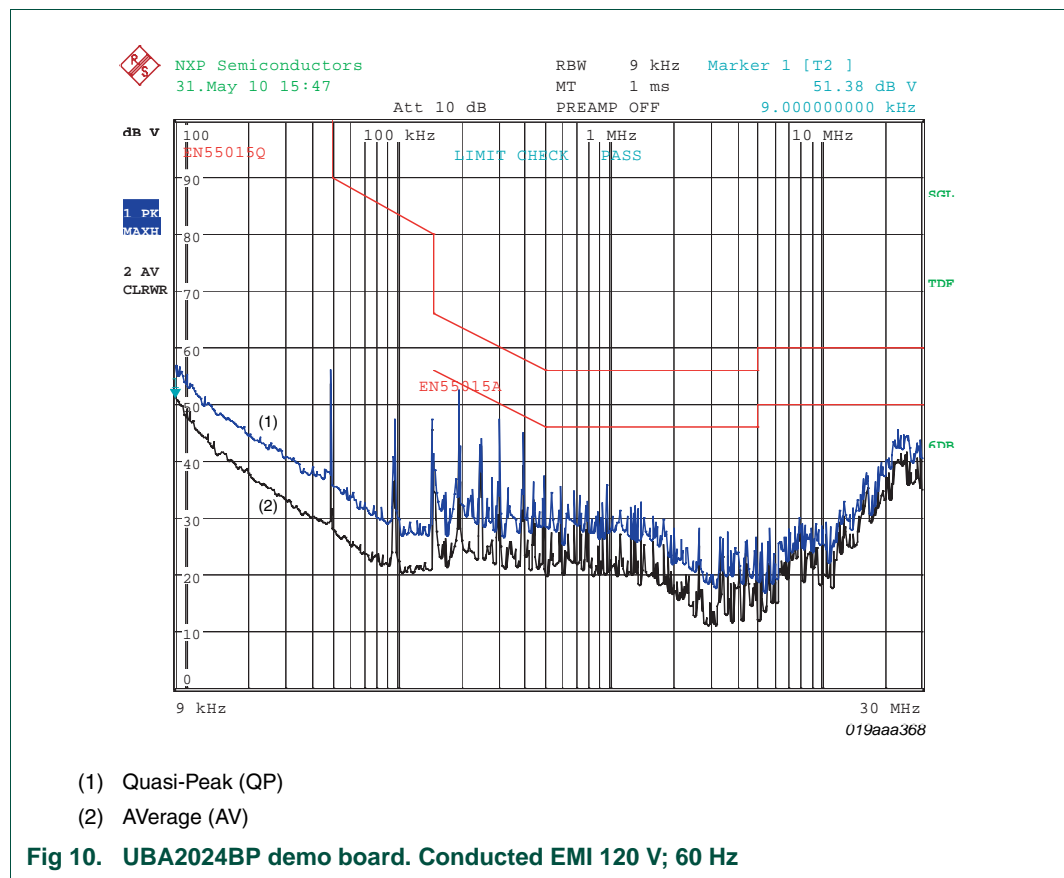
Reference	Description	Remarks	Value
R1	resistor, fusible 3R3/5 %/2 W NFR		3.3 $\Omega$ /2 W
R2	resistor, thick film, 26K1/1 %/0W1 0603	oscillator resistor	26.1 k $\Omega$ /0.1 W/1 %
R3 <sup>[1]</sup>	resistor, thick film, 220K/5 % /0W1 0603		220 k $\Omega$ /0.1 W
R4 <sup>[1]</sup>	resistor, thick film, 33K/5 %/0W1 0603		33 k $\Omega$ /0.1 W
R5 <sup>[1]</sup>	resistor, thick film, 180K/5 %/0W1 0603		180 k $\Omega$ /0.1 W
R6, R7 <sup>[1]</sup>	resistor, thick film, 1M/ 5 %/0W1 0603		1 M $\Omega$ /0.1 W
R8, R11	resistor, thick film, 0R/1 %/0W1 0603	short	0 $\Omega$
R9	resistor, thick film, 4M7/1 %/0W1 0603		4.7 M $\Omega$ /0.1 W/1 %
R10	-	not mounted	-
C1	capacitor, Al. El. 33 $\mu$ F/20 %/200V KXG	high temperature electrolytic type	33 $\mu$ F/200 V
C2, C3	capacitor, 150n/10 %/250V DME		150 nF/250 V
C4	-	not mounted	-
C5	capacitor, cer. 470n/10 %/10V X5R 0603		470 nF/10 V/10 %
C6, C8	capacitor, cer. 10n/20 %/50V X7R 0603		10 nF/50 V
C7	capacitor, cer. 0.82n/10 %/500V X7R 1206	dV/dt capacitor	0.82 nF/500 V
C9	capacitor, cer. 1n2/5 %/50V X7R 0603	oscillator capacitor	1.2 nF/50 V/5 %
C10	capacitor, 10n/5 %/2KV MKP	lamp capacitor	10 nF/2 kV/5 %
C11 <sup>[1]</sup>	capacitor, cer. 3 $\mu$ 3/20 %/10V Y5V 0805		3.3 $\mu$ F/10 V
C12 <sup>[1]</sup>	capacitor, cer. 220p/5 %/50V COG 0603		220 pF/50 V/5 %
D1, D2, D3, D4	diode, standard, 1 kV, 1 A	mains rectifier diode	1N4007
D5 <sup>[1]</sup>	diode, small signal, dual, 70 V 200 mA	double diode common cathode	BAV70W
L1	inductor, RF-choke, 1m5H, 1R7, 0A43, 10 %	radial type	1.5 mH/0.43 A
T1 <sup>[1]</sup>	transistor, dual, NPN/PNP 45 V 100 mA	combined PNP and NPN transistor	BC847BPN
T2	RF-choke, T-H BOBBIN EF-20	E-20 core WE760800030 Rev01 (select inductance with jumper)	0.66 mH (J1 in place)
U1	half-bridge CFL driver IC		UBA2024BP (DIL8) UBA2024BT (SO14)

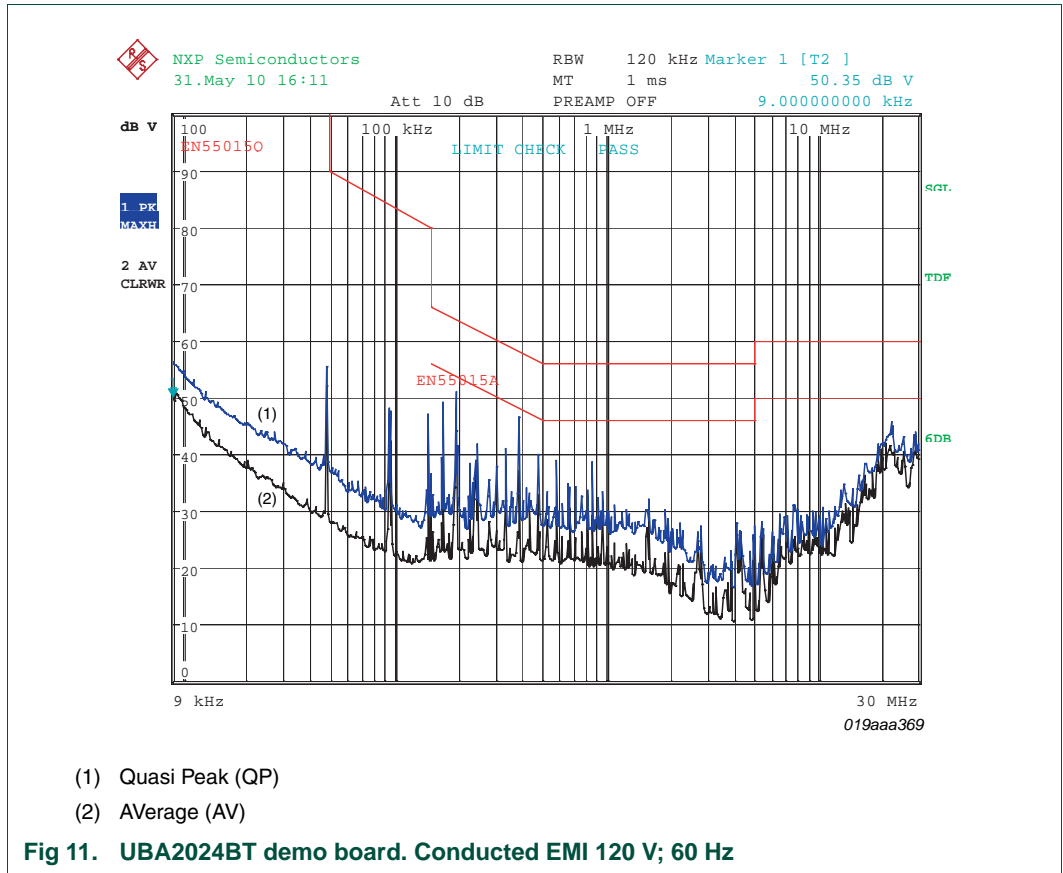
[1] Component(s) needed for the optional lamp detection circuit

### 4. Conduction emissions test

Conducted emissions have been measured in neutral and line wires using a pre-compliance test set-up and considering the limits for lighting applications, i.e. EN55015. The measurements have been performed at 120 V (AC) line voltage. The results are shown in Figure 10 and 11. The emission level is below both the quasi-peak and the average limits with an acceptable margin.

The measurements taken are only valid for this particular board design. The board layout can be used as a guide to create the working design but there is no absolute guarantee that the final product will pass the conducted EMI test. The board shown is only part of a total product (including housing and wiring) that needs to pass.





## 5. Examples of other lamp powers

### 5.1 PL-C 4P 13 W lamp

**Table 2. Bill of material PL-C 4P 13 W lamp**

PL-C 4P 13W lamp (12.5 W; 165 mA burner; requiring warm ignition;  $f_{\text{bridge}} = 63$  kHz)

Reference	Description	Remarks	Value
R1	resistor, fusible 5R6/5 %/2W NFR		5.6 $\Omega$ /2 W
R2	resistor, thick film, 22K6/1 %/0W1 0603	oscillator resistor	22.6 k $\Omega$ /0.1 W/1 %
R3 <sup>[1]</sup>	resistor, thick film, 220K/5 %/0W1 0603		220 k $\Omega$ /0.1 W
R4 <sup>[1]</sup>	resistor, thick film, 33K/5 %/0W1 0603		33 k $\Omega$ /0.1 W
R5 <sup>[1]</sup>	resistor, thick film, 180K/5 %/0W1 0603		180 k $\Omega$ /0.1 W
R6, R7 <sup>[1]</sup>	resistor, thick film, 1M/ 5 %/0W1 0603		1 M $\Omega$ /0.1 W
R8, R11	resistor, thick film, 0R/1 %/0W1 0603	short	0 $\Omega$
R9	resistor, thick film, 4M7/1 %/0W1 0603		4.7 M $\Omega$ /0.1 W/1 %
R10	-	not mounted	-
C1	capacitor, Al. El. 22 $\mu$ F/20 %/200V KXG	high temperature electrolytic type	22 $\mu$ F/200 V
C2, C3	capacitor, 150n/10 %/250V DME		150 nF/250 V
C4	-	not mounted	-
C5	capacitor, cer. 470n/10 %/10V X5R 0603		470 nF/10 V/10 %
C6, C8	capacitor, cer. 10n/20 %/50V X7R 0603		10 nF/50 V
C7	capacitor, cer. 0.47n/10 %/500V X7R 1206	dV/dt capacitor	0.47 nF/500 V
C9	capacitor, cer. 1n2/5 %/50V X7R 0603	oscillator capacitor	1.2 nF/50 V/5 %
C10	capacitor, 4n7/5 %/2KV MKP	lamp capacitor	4.7 nF/2 kV/5 %
C11 <sup>[1]</sup>	capacitor, cer. 3 $\mu$ 3/20 %/10V Y5V 0805		3.3 $\mu$ F/10 V
C12 <sup>[1]</sup>	capacitor, cer. 220p/5 %/50V COG 0603		220 pF/50 V/5 %
D1, D2, D3, D4	diode, standard, 1 kV, 1 A	mains rectifier diode	1N4007
D5 <sup>[1]</sup>	diode, small signal, dual, 70 V 200 mA	double diode common cathode	BAV70W
L1	inductor, RF-choke, 1m5H, 1R7, 0A43, 10 %	radial type	1.5 mH/0.43 A
T1 <sup>[1]</sup>	transistor, dual, NPN/PNP 45 V 100m A	Combined PNP and NPN transistor	BC847BPN
T2	RF-choke, T-H BOBBIN EF-20	E-20 core WE760800030 Rev01 (select inductance with jumper)	0.98 mH (J2 in place)
U1	half-bridge CFL driver IC		UBA2024BP (DIL8) UBA2024BT (SO14)

[1] Component(s) needed for the optional lamp detection circuit

## 5.2 PL-C 4P 18W lamp

**Table 3. Bill of material PL-C 4P 18W lamp**

PL-C 18 W lamp (16.5 W; 210 mA burner; requiring warm ignition;  $f_{bridge} = 43$  kHz)

Reference	Description	Remarks	Value
R1	resistor, fusible 5R6/5 %/2W NFR		5.6 $\Omega$ /2 W
R2	resistor, thick film, 30K1/1 %/0W1 0603	oscillator resistor	30.1 k $\Omega$ /0.1 W/1 %
R3 <sup>[1]</sup>	resistor, thick film, 220K/5 %/0W1 0603		220 k $\Omega$ /0.1 W
R4 <sup>[1]</sup>	resistor, thick film, 33K/5 %/0W1 0603		33 k $\Omega$ /0.1 W
R5 <sup>[1]</sup>	resistor, thick film, 180K/5 %/0W1 0603		180 k $\Omega$ /0.1 W
R6, R7 <sup>[1]</sup>	resistor, thick film, 1M/ 5 %/0W1 0603		1 M $\Omega$ /0.1 W
R8, R11	resistor, thick film, 0R/1 %/0W1 0603	short	0 $\Omega$
R9	resistor, thick film, 4M7/1 %/0W1 0603		4.7 M $\Omega$ /0.1 W/1 %
R10	-	not mounted	-
C1	capacitor, Al. El. 33 $\mu$ F/20 %/200V KXG	high temperature electrolytic type	33 $\mu$ F/200 V
C2, C3	capacitor, 150n/10 %/250V DME		150 nF/250 V
C4	-	not mounted	-
C5	capacitor, cer. 470n/10 %/10V X5R 0603		470 nF/10 V/10 %
C6, C8	capacitor, cer. 10n/20 %/50V X7R 0603		10 nF/50 V
C7	capacitor, cer. 0.68n/10 %/500V X7R 1206	dV/dt capacitor	0.68 nF/500 V
C9	capacitor, cer. 1n2/5 %/50V X7R 0603	oscillator capacitor	1.2 nF/50 V/5 %
C10	capacitor, 10n/5 %/2KV MKP	lamp capacitor	10 nF/2 kV/5 %
C11 <sup>[1]</sup>	capacitor, cer. 3 $\mu$ 3/20 %/10V Y5V 0805		3.3 $\mu$ F/10 V
C12 <sup>[1]</sup>	capacitor, cer. 220p/5 %/50V COG 0603		220 pF/50 V/5 %
D1, D2, D3, D4	diode, standard, 1 kV, 1 A	mains rectifier diode	1N4007
D5 <sup>[1]</sup>	diode, small signal, dual, 70 V 200 mA	double diode common cathode	BAV70W
L1	inductor, RF-choke, 1m5H, 1R7, 0A43, 10 %	radial type	1.5 mH/0.43 A
T1 <sup>[1]</sup>	transistor., dual, NPN/PNP 45 V 100 mA	combined PNP and NPN transistor	BC847BPN
T2	RF-choke, T-H BOBBIN EF-20	E-20 core WE760800030 Rev01 (select inductance with jumper)	1.09 mH (J3 in place)
U1	half-bridge CFL driver IC		UBA2024BP (DIL8) UBA2024BT (SO14)

[1] Component(s) needed for the optional lamp detection circuit

## 6. Inductor specification

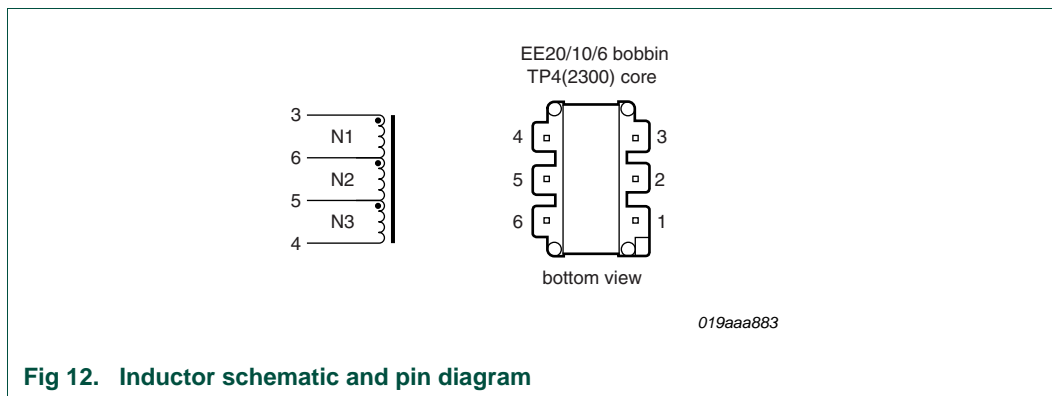


Table 4. Inductor selection

Pin	Windings	Inductor value
3 - 6	$N1 = 140$	0.66 mH
3 - 5	$N1 + N2 = 171$	0.98 mH
3 - 4	$N1 + N2 + N3 = 181$	1.09 mH



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