# UM10465

## TEA1713 and TEA1795 demo board for 150 W all-in-one PC adapter

**Rev. 1 — 28 September 2011** **User manual**

### Document information

| Info | Content |
|---|---|
| **Keywords** | TEA1713T, TEA1795T, 150 W, all-in-one PC adapter, GreenChip-SR, synchronous rectification, LLC, resonant, half-bridge, PFC, controller, converter, burst mode, power supply, demo board |
| **Abstract** | The TEA1713T includes a Power Factor Correction (PFC) controller and a controller for a Half-Bridge resonant Converter (HBC).<br>This user manual describes a 150 W resonant Switching Mode Power Supply (SMPS) for a typical all-in-one PC adapter design based on the TEA1713T and TEA1795T. The board provides an output of 19.5 V/7.7 A. It operates in normal mode for medium and high-power levels and in burst mode for low-power levels. Burst mode operation provides a reduction of power losses to increase performance.<br>The efficiency at high power is well above 90 % and the no load power consumption is well below 500 mW. |

## Revision history

| Rev | Date | Description |
|---|---|---|
| v.1 | 20110928 | first release |

## Contact information

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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.

## 1.1 Scope of this document

This document describes the 150 W all-in-one PC adapter demo board using the TEA1713T and TEA1795T. A functional description is provided, supported by a set of measurements to show the all-in-one PC adapter characteristics.

## 1.2 TEA1713T

The TEA1713T integrates a controller for PFC and a controller for an HBC. It provides the drive function for the discrete MOSFET of the up-converter and for the two discrete power MOSFETs in a resonant half-bridge configuration.

The resonant controller part is a high-voltage controller for a Zero Voltage Switching (ZVS) LLC resonant converter. It includes a high-voltage level shift circuit and several protection features such as OverCurrent Protection (OCP), Open-Loop Protection (OLP), Capacitive Mode Protection (CMP) and a general purpose latched protection input.

In addition to the resonant controller, the TEA1713T contains a PFC controller. The efficient operation of the PFC is obtained by functions such as quasi-resonant operation at high-power levels and quasi-resonant operation with valley skipping at lower power levels. OCP, OverVoltage Protection (OVP) and demagnetization sensing, ensures safe operation in all conditions.

The proprietary high-voltage BCD power logic process makes direct start-up from the rectified universal mains voltage in an efficient way possible. A second low voltage Silicon-On-Insulator (SOI) IC is used for accurate, hi-speed protection functions and control.

The combination of PFC and a resonant controller in one IC makes the TEA1713T suitable for all-in-one PC adapters.

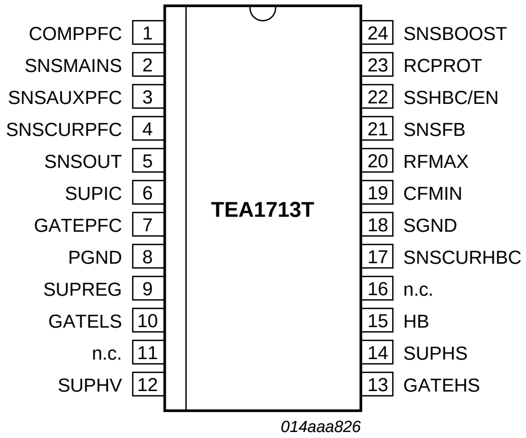


**Fig 1. Pin configuration TEA1713T**

## 1.3 TEA1795T

The TEA1795T GreenChip-SR is a synchronous rectification control IC that needs no external components to tune the timing. Used in all-in-one PC adapter designs, the GreenChip-SR offers a wide $V_{CC}$ operating range between 8.5 V and 38 V, minimizing the number of external components required and enabling simpler designs. In addition, the high driver output voltage (10 V) makes the GreenChip-SR compatible with all MOSFET brands.

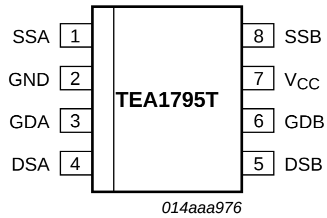


**Fig 2. Pin configuration TEA1795T**

## 1.4 Setup of the 150 W all-in-one PC adapter

The board can operate at a mains input voltage of between 90 V and 264 V (universal mains).

The demo board contains two subcircuits:

- A PFC of BCM-type
- An HBC of resonant LLC-type

Both converters are controlled by the TEA1713T.

At low-power levels, the converters operate in burst mode to reduce power losses.

The purpose of the demo board is to demonstrate the operation of the TEA1713T and TEA1795T in a single output supply including burst mode operation. The performance is according today's general standards and can be used as a starting point for further development.

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**Fig 3. TEA1713T demo board 150 W all-in-one PC adapter**

## 1.5 Input and output properties

**Table 1. Input data**

| Symbol | Description | Conditions | Specification | Unit |
|---|---|---|---|---|
| $V_i$ | input voltage | AC | 90 to 264 | V (RMS) |
| $f_i$ | input frequency | - | 47 to 60 | Hz |
| $P_{i(no\ load)}$ | no load input power | 230 V, 50 Hz | < 500 | mW |

**Table 2. Output data**

| Symbol | Description | Conditions | Specification | Unit |
|---|---|---|---|---|
| $V_o$ | output voltage | - | 19.5 | V |
| $V_{o(ripple)(p-p)}$ | peak-to-peak ripple voltage | 20 MHz bandwidth | < 150 | mV |
| $I_o$ | output current | continuous | 0 to 7.7 | A |

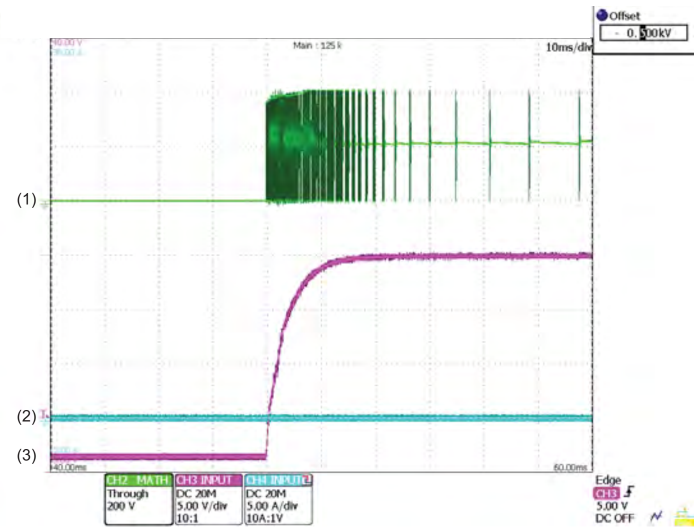
## 2. Measurements

### 2.1 Test facilities

- Oscilloscope: Yokogawa DL1640L
- AC power source: Agilent 6812B
- Electronic load: Agilent 6063B
- Digital power meter: Yokogawa WT210

### 2.2 Start-up behavior

The rise time of the output voltage (measured from 10 % to 90 % point of the nominal output) is between 8 ms to 15 ms, depending on the output current load.

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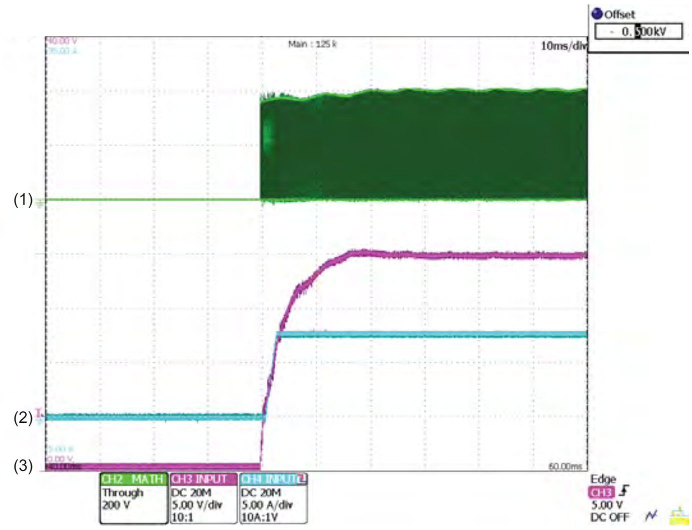
(1) HBC (green).

(2) $I_O$ (blue).

(3) $V_O$ (purple).

**Fig 4. Start-up behavior at $V_{mains}$ = 230 V and no load**




(1) HBC (green).

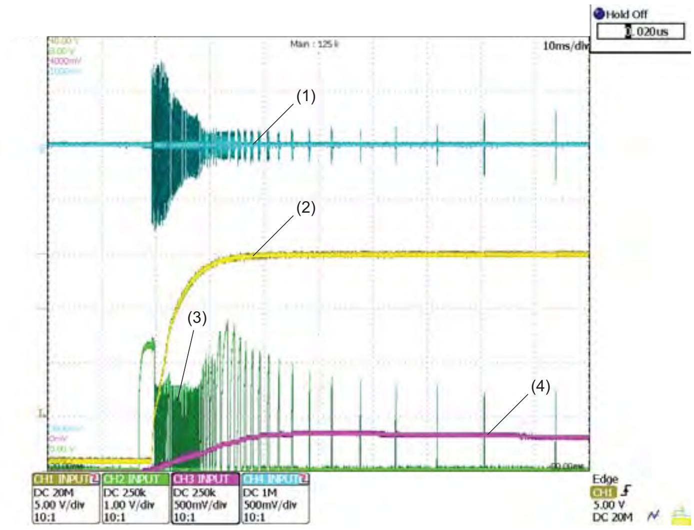
(2) $I_O$ (blue).

(3) $V_O$ (purple).

**Fig 5. Start-up behavior at $V_{mains}$ = 100 V and full load**

## 2.3 Protection levels on SNSCURHBC and SNSOUT during start-up

During start-up the voltage at pin RCPROT (protection timer) always rises. SNSCURHBC detects the initial high primary current and SNSOUT starts at a low voltage. After the first switching cycles the levels become normal for operation and the charging of RCPROT ends. The voltage level on RCPROT now decreases to zero again by the external discharge resistor that is part of the RCPROT system. During normal start-up the initial charging of RCPROT must not trigger a protection (4 V level).

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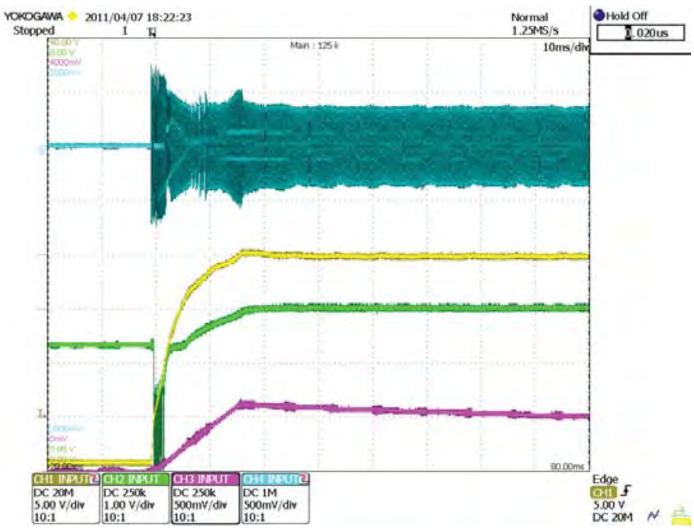
(1) $V_{SNSCURHBC}$ (blue).

(2) $V_O$ (yellow).

(3) $V_{SNSOUT}$ (green).

(4) $V_{RCPROT}$ (purple).

**Fig 6. SNSCURHBC and/or SNSOUT initially charges the protection timer. Start-up at $V_{mains}$ = 230 V and no-load (0 A)**

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(1) $V_{SNSCURHBC}$ (blue).

(2) $V_O$ (yellow).

(3) $V_{SNSOUT}$ (green).

(4) $V_{RCPROT}$ (purple).

**Fig 7. SNSCURHBC and/or SNSOUT initially charges the protection timer. Start-up at $V_{mains}$ = 100 V and full load (7.7 A)**

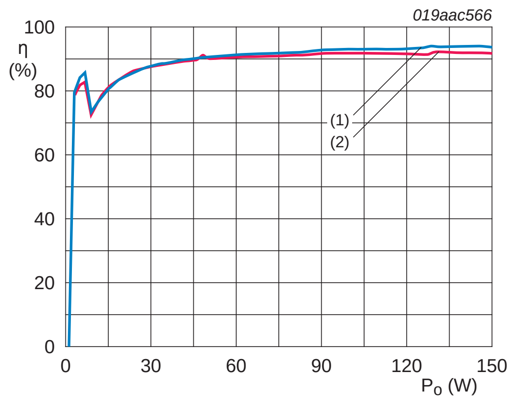
## 2.4 Efficiency

### 2.4.1 Efficiency characteristics

Efficiency measurements were made measuring the output voltage on the board (not taking into account the losses in an output connection cable).

**Table 3. Efficiency results**

| Conditions | Energy star 2.0 efficiency requirement (%) | Efficiency (%) | | | | |
|---|---|---|---|---|---|---|
| | | Average | 25 % load | 50 % load | 75 % load | 100 % load |
| 100 V, 60 Hz | > 87 | 91.2 | 89.1 | 91.4 | 92.1 | 92.3 |
| 230 V, 50 Hz | > 87 | 92.2 | 89.3 | 92.6 | 93.2 | 93.6 |




(1) Input of 230 V

(2) Input 100 V

**Fig 8. Efficiency at an input voltage of 100 V and 230 V**

### 2.4.2 Power Factor Correction (PFC)

**Table 4. Power Factor correction (PFC)**

| Condition | Energy Star 2.0 requirement | Output power (W) | Power factor |
|---|---|---|---|
| 90 V, 60 Hz | - | 150 | 0.99 |
| 100 V, 60 Hz | - | 150 | 0.99 |
| 115 V, 60 Hz | ≥ 0.9 | 150 | 0.99 |
| 230 V, 50 Hz | - | 150 | 0.95 |
| 264 V, 50 Hz | - | 150 | 0.92 |

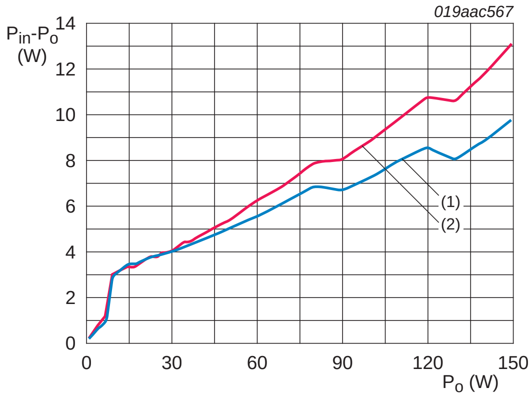
### 2.4.3 No-load power consumption

**Table 5. Output voltage and power consumption at no-load**

| Condition | Energy Star 2.0 requirement (mW) | Output voltage (V) | No load power consumption (mW) |
|---|---|---|---|
| 90 V, 60 Hz | ≤ 500 mW | 19.5 | 220 |
| 100 V, 60 Hz | ≤ 500 mW | 19.5 | 230 |
| 115 V, 60 Hz | ≤ 500 mW | 19.5 | 240 |
| 230 V, 50 Hz | ≤ 500 mW | 19.5 | 250 |
| 264 V, 50 Hz | ≤ 500 mW | 19.5 | 260 |

## 2.5 Behavior in burst mode operation

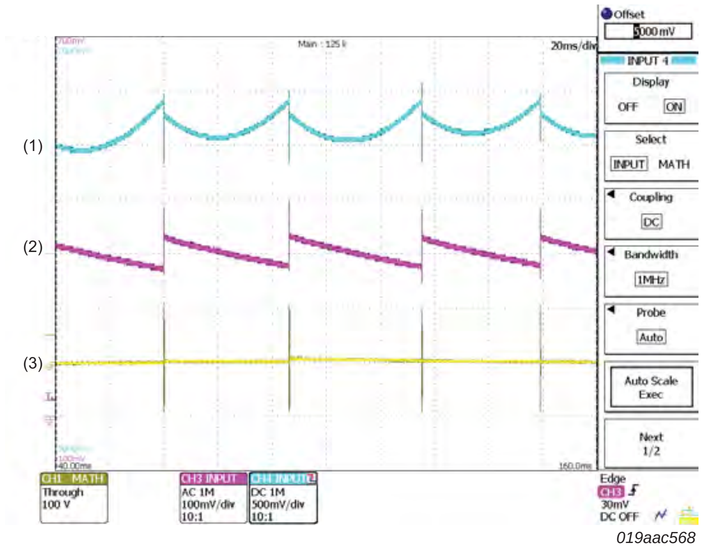
In order to reach the no load power consumption requirements (seeSection 2.4.3), burst mode operation is implemented to improve the performance at low output load. For the demo board burst mode is active below approximately 5 W output power.




(1) $V_{mains}$ = 100 V

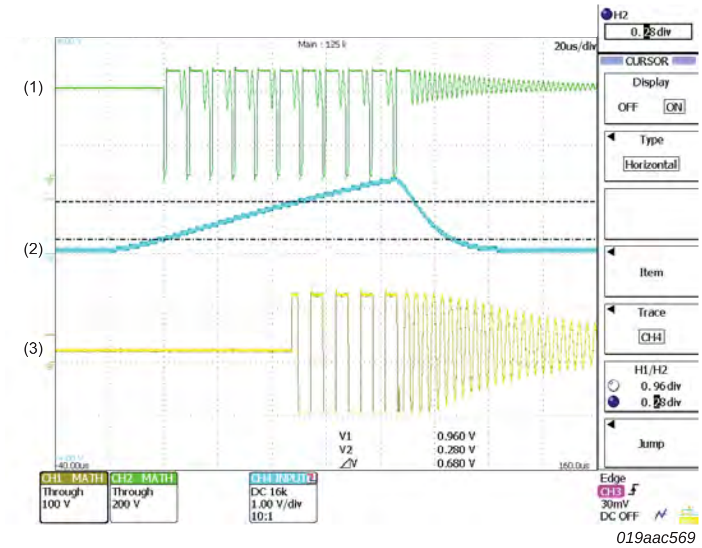
(2) $V_{mains}$ = 230 V

**Fig 9. Reduction of power losses as a function of output power**




(1) $V_{SNSFB}$ (blue).
(2) $V_O$ (purple).
(3) HBC (yellow).

**Fig 10. Burst mode operation at $V_{mains}$ = 230 V and no-load**




(1) HBC (green).
(2) $V_{SNSOUT}$ (blue).
(3) PFC (yellow).

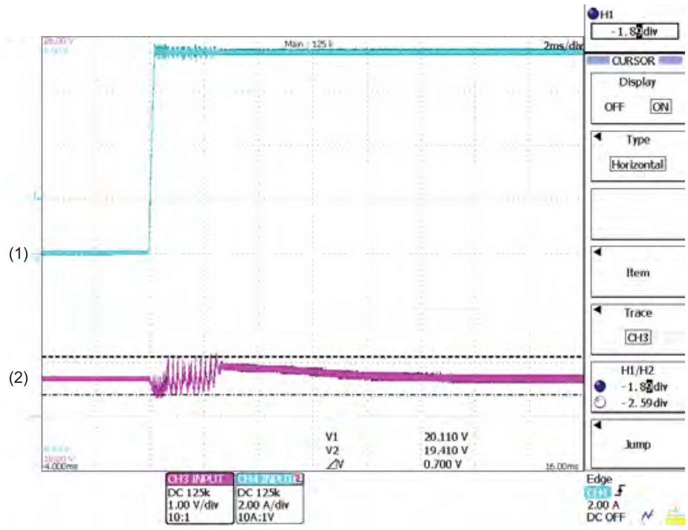
**Fig 11. Switch on/off PFC and HBC by $V_{SNSOUT}$ in burst mode operation**

The interruptive character of burst mode can lead to the generation of unwanted audible noise. As the supply in burst mode only operates at low-power levels, audible noise levels are low.

## 2.6 Transient response

Normal load transients lead to a ripple on the output voltage of < 800 mV.




(1) $I_O$ (blue)

(2) $V_O$ (purple)

**Fig 12. Load-step behavior; typical load-step from zero to full load**

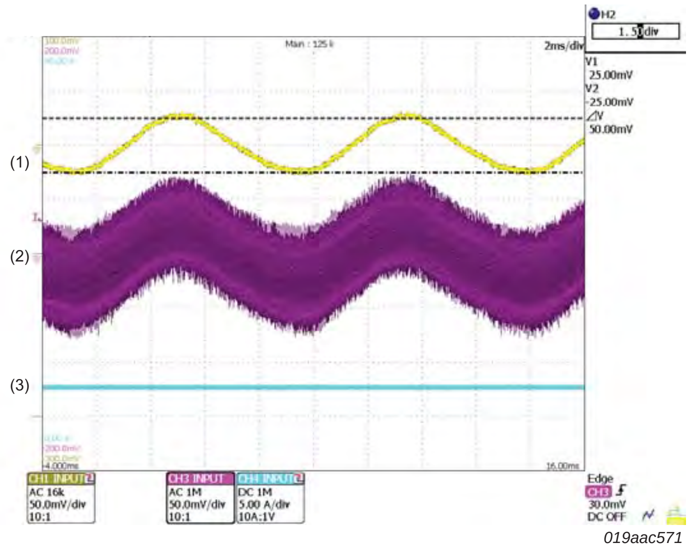
## 2.7 Output ripple voltage and noise

Ripple and noise are measured at full output load, buffered with a 10 μF capacitor in parallel with a high-frequency 0.1 μF capacitor.

The varying input voltage of the resonant converter causes a frequency component in the output ripple voltage that is related to the mains voltage frequency: 50 Hz or 60 Hz. The switching frequency of the resonant converter causes the other component in the output ripple voltage.

**Table 6. Ripple and noise test results**

| Mains voltage | Mains frequency | Output power | Ripple frequency | Voltage ripple |
|---|---|---|---|---|
| 90 V to 264 V | 50 Hz or 60 Hz | 150 W | 50 Hz or 60 Hz | 52 mV (p-p) |
| 90 V to 264 V | 50 Hz or 60 Hz | 150 W | 215 kHz | 68 mV (p-p) |

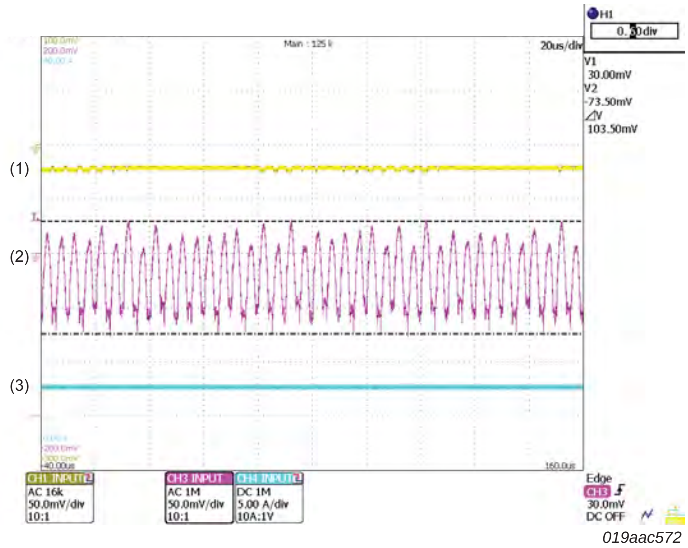



(1) $V_O$ (yellow).

(2) $V_O$(ripple)(p-p) (purple).

(3) $I_O$ (blue).

**Fig 13. Output voltage ripple at full load (2 ms/div scale)**




(1) $V_O$ (yellow).

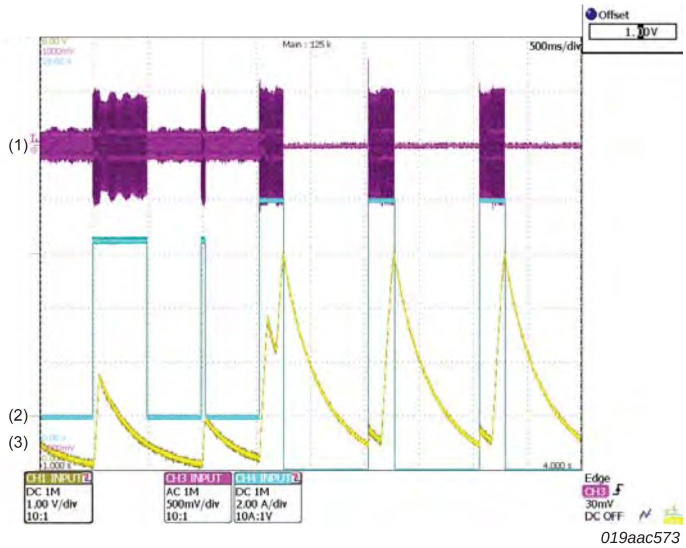
(2) $V_{O(ripple)(p-p)}$ (purple).

(3) $I_O$ (blue).

**Fig 14. Output voltage ripple at full load (20 μs/div scale)**

## 2.8 OverPower Protection (OPP)

Tested with a higher current (dynamic overload) on the output voltage, the OPP is activated when the current exceeds 10 A (195 W). This corresponds to a load condition that is 30 % higher than the rated power for continuous use. The OPP is detected by the SNSCURHBC function of the TEA1713T that monitors the primary resonant current. When the voltage on the SNSCURHBC pin exceeds 0.5 V (or –0.5 V) the protection timer is started.




(1) $V_{SNSCURHBC}$ (purple).

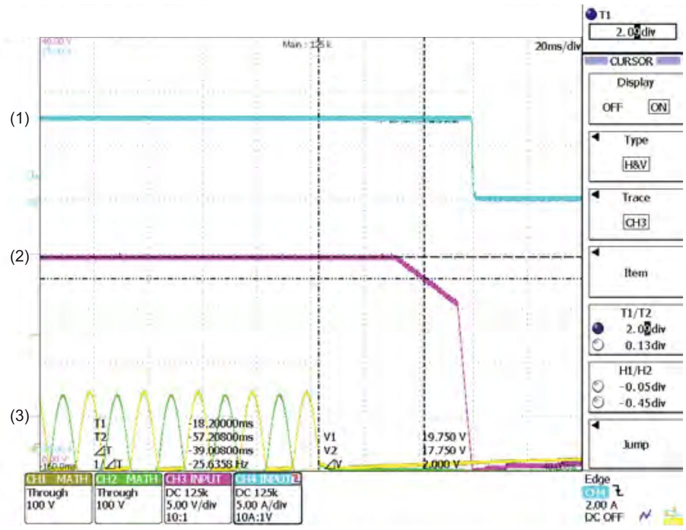
(2) $I_O$ (blue).

(3) $V_{RCPROT}$ (yellow).

**Fig 15. Dynamic current load leading to OPP**

## 2.9 Hold-up time

The output is set to full load and the mains supply voltage of 100 V is disconnected. The time that passes before the output voltage falls below 90 % of its initial value is then measured. The hold-up time is 39 ms.




(1) $I_O$ (blue).

(2) $V_O$ (purple).

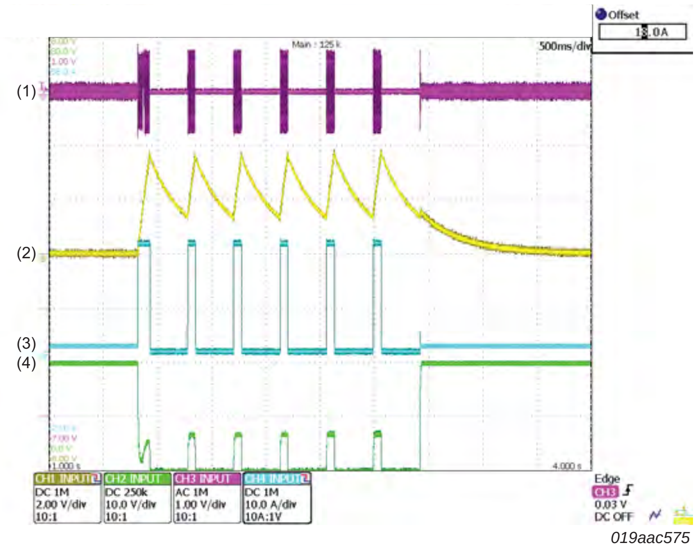
(3) $V_{mains}$ (green and yellow).

**Fig 16. Hold-up time**

## 2.10 Short-circuit protection

A short circuit on the output of the resonant converter causes the primary current to increase. This is detected by the SNSCURHBC function leading to running on maximum frequency until the protection timer RCPROT reaches its protection level (4 V). The RCPROT function performs its restart timer function and restarts again when the voltage has dropped to 0.5 V. When the short-circuit is removed, the converter starts up and operates as normal.

This is the main protection mechanism. Under certain conditions, other protections can be activated during the output short circuit test.




(1) $V_{SNSCURHBC}$ (purple)

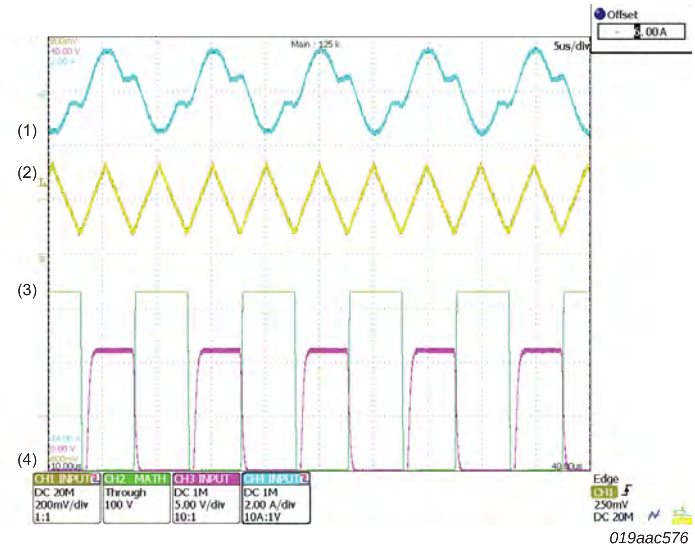
(2) $V_{RCPROT}$ (yellow)

(3) $I_O$ (blue)

(4) $V_O$ (green)

**Fig 17. Protection and restart at output short-circuit**

## 2.11 Resonant current measurements



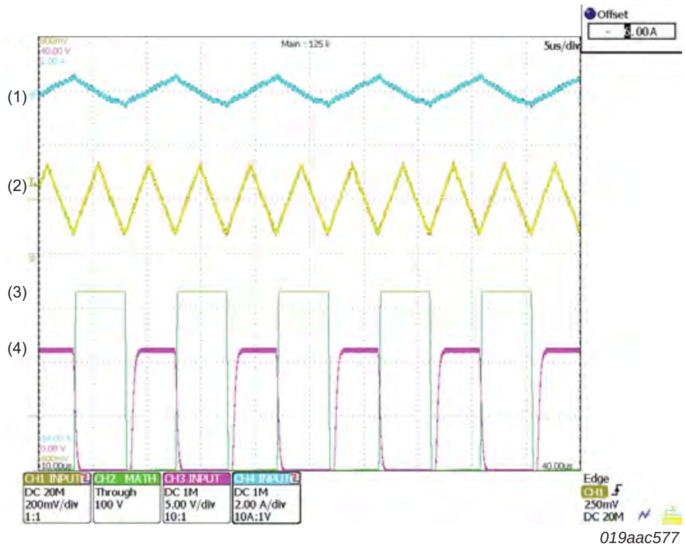

(1) $I_{resonant\_primary}$ (blue)

(2) $V_{CFMIN}$ (yellow)

(3) $V_{HB}$ (green)

(4) $V_{GATE\_MOSFET\_LS}$ (purple)

**Fig 18. Resonant current (full load $I_o$ = 7.7 A)**



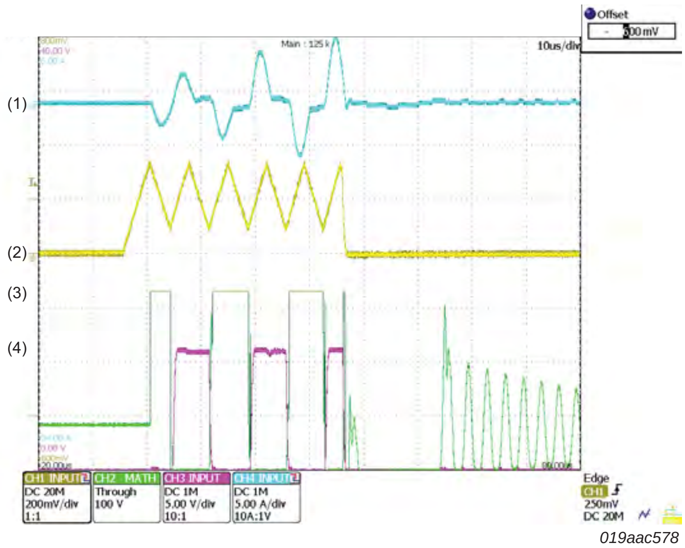

(1) $I_{resonant\_primary}$ (blue).

(2) $V_{CFMIN}$ (yellow).

(3) $V_{HB}$ (green).

(4) $V_{GATE\_MOSFET\_LS}$ (purple).

**Fig 19. Resonant current (low load $I_o$ = 0.5 A)**




(1) $I_{resonant\_primary}$ (blue).

(2) $V_{CFMIN}$ (yellow).

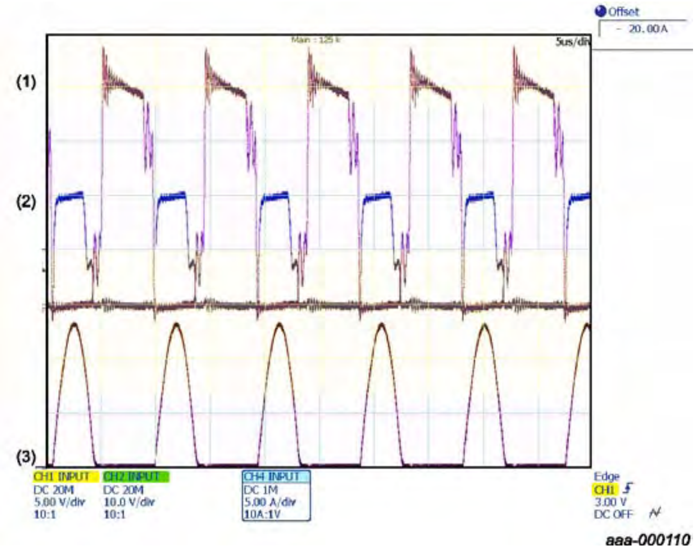
(3) $V_{HB}$ (green).

(4) $V_{GATE\_MOSFET\_LS}$ (purple).

**Fig 20. Resonant current (no-load $I_o$ = 0 A)**

### 2.12 Synchronous Rectification

The TEA1795T IC is used for synchronous rectification and replaces the rectifier diodes at the secondary side of the resonant adapter.




(1) $V_{DRAIN}$ (purple)

(2) $V_{GATE}$ (blue)

(3) $I_{resonant\_secundary}$ (red)

**Fig 21. Resonant, switching and secondary currents at nominal output**

## 3. Circuit diagram

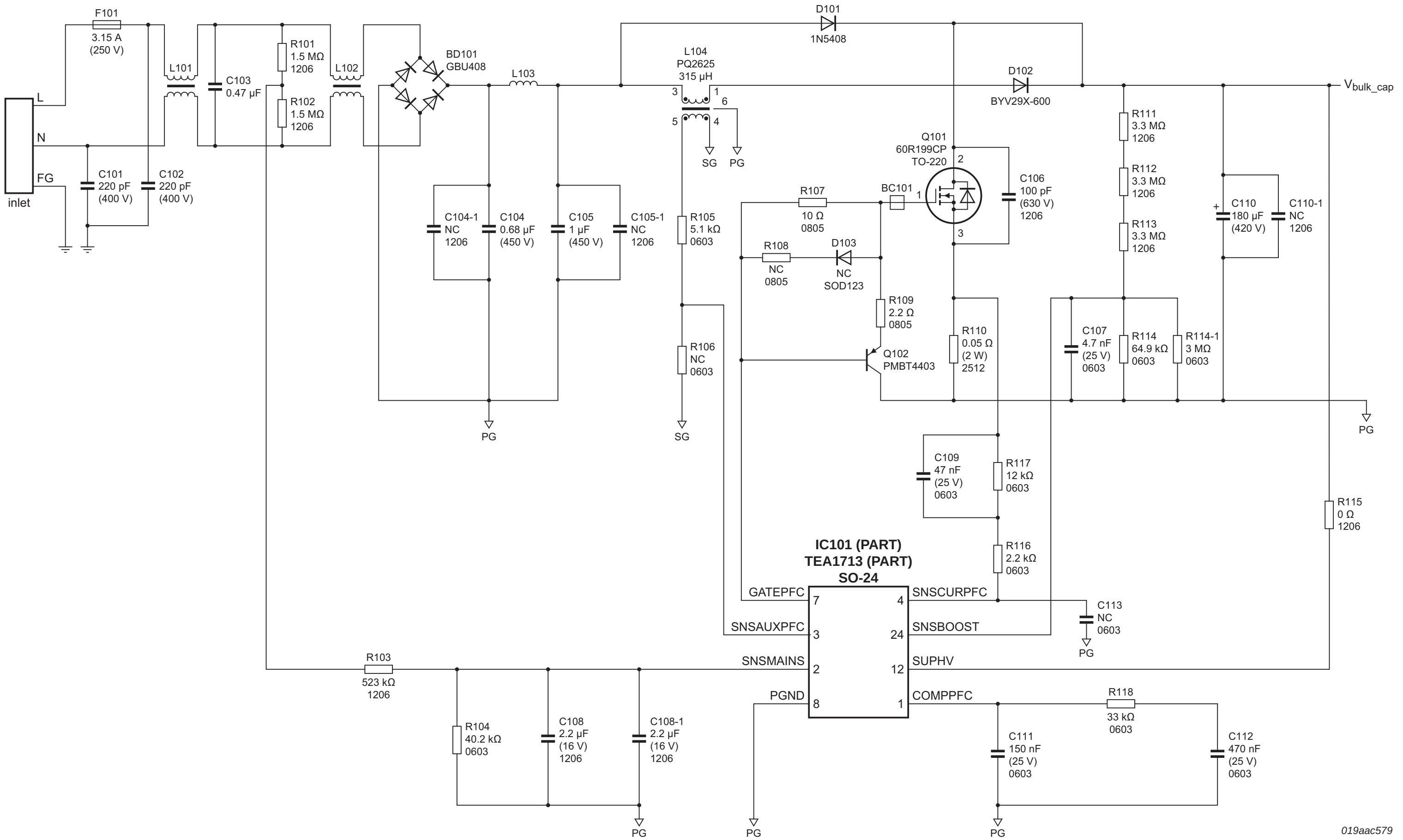



Fig 22. Circuit diagram TEA1713T 150 W demo board (PFC part)

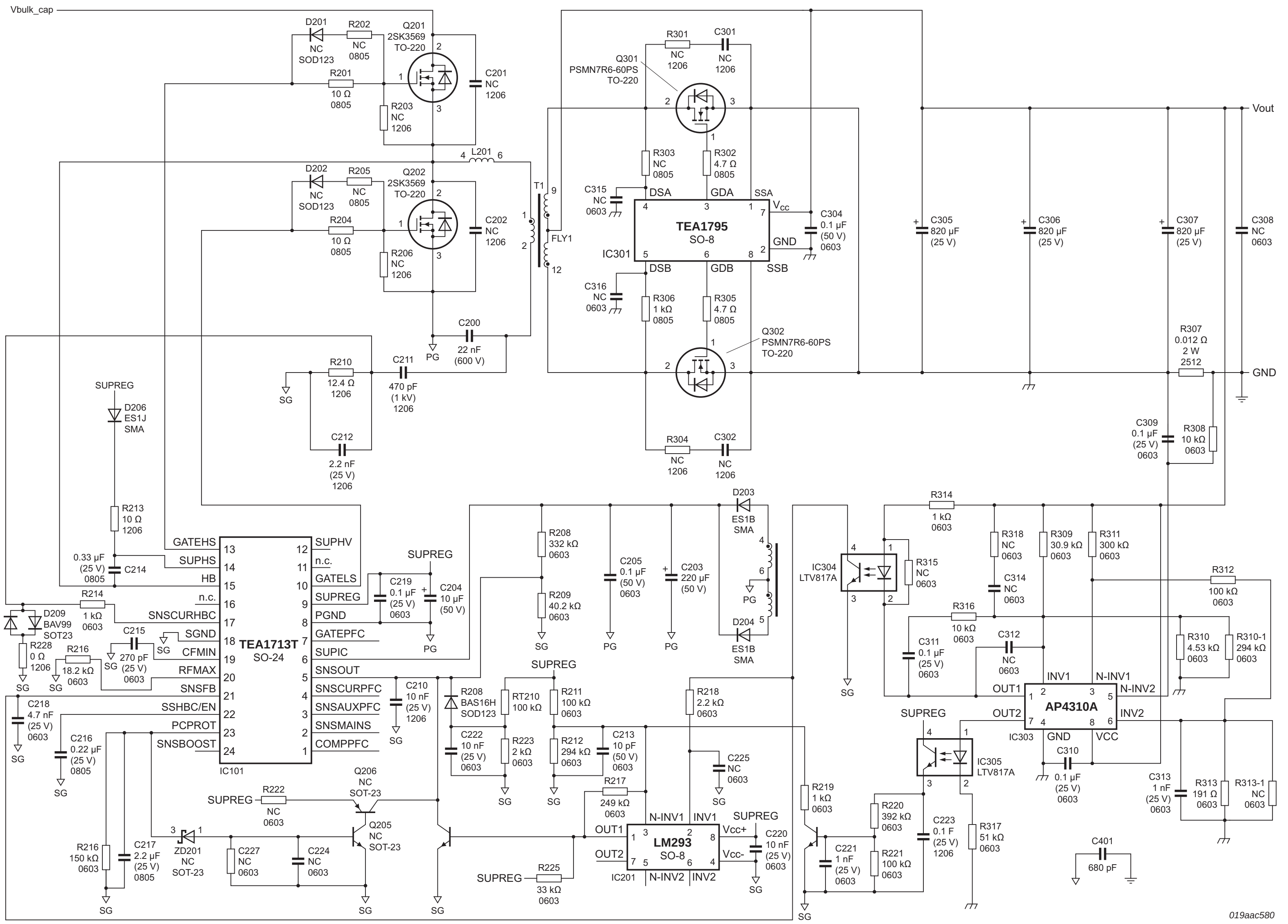



Fig 23. Circuit diagram TEA1713T 150 W demo board (HBC part)

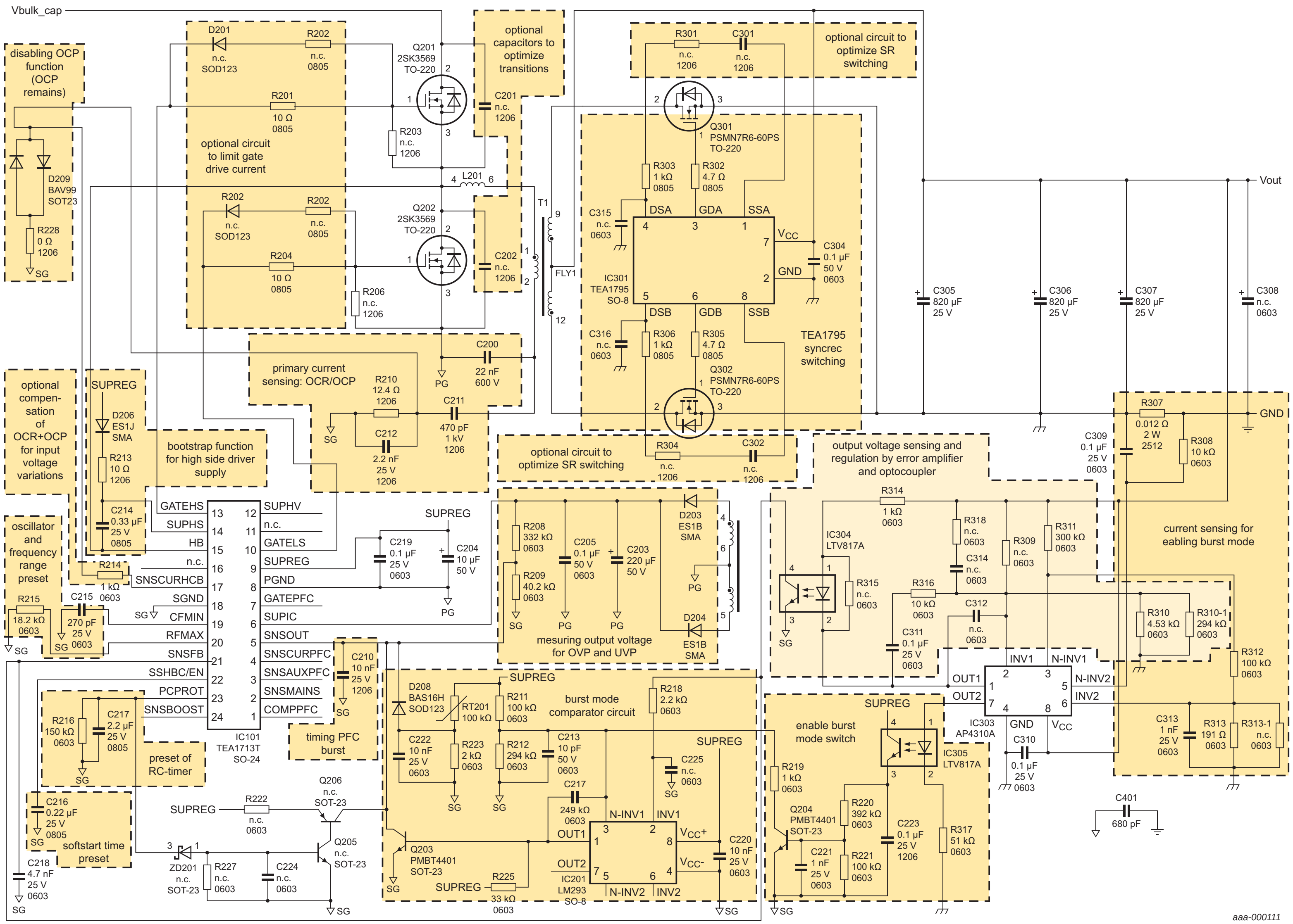



**Fig 24. Circuit diagram TEA1713T 150 W demo board (HBC part)**

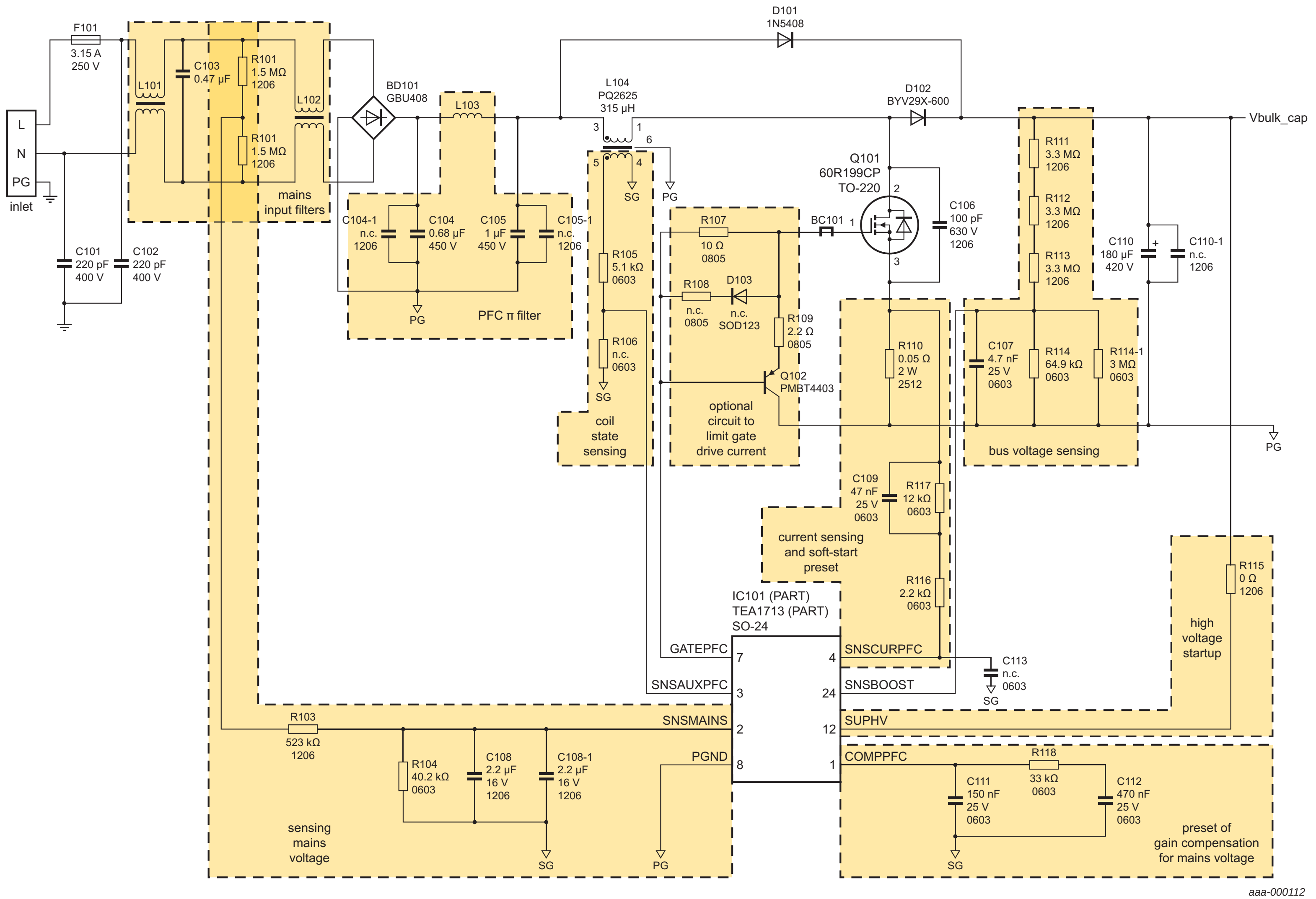



**Fig 25. Circuit diagram TEA1713T 150 W demo board (PFC part)**

## 4. PCB layout

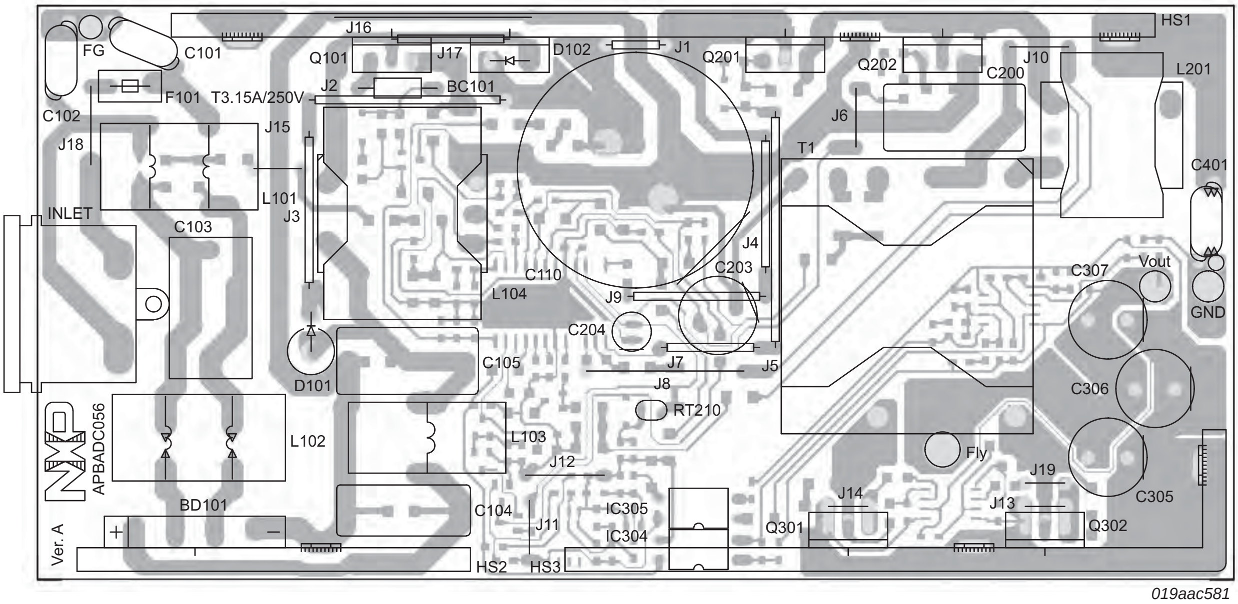



**Fig 26. Demo board PCB layout (copper tracks and areas)**

## 5. Bill Of Materials (BOM)

Table 7 provides detailed component information for the TEA1713T and TEA1795T demo board for 150 W all-in-one PC adapter.

**Table 7. BOM for the TEA1713T and TEA1795Tdemo board**

| Item | Location | Quantity | Description |
|---|---|---|---|
| 1 | BC101 | 1 | bead core; axial lead; WBRH3.5*4.7*0.8; 3L |
| 2 | BD101 | 1 | bridge diode; GBU408; Lite-On 4 A; 800 V |
| 3 | C101; C102 | 2 | ceramic; Y1-capacitor; KX/Murata 220 pF; 250 V (AC) |
| 4 | C103 | 1 | MKP/HJC; X-capacitor; 0.47 μF; 275 V (AC) |
| 5 | C104 | 1 | MPPN/HJC; radial lead 680 nF; 450 V (DC) |
| 6 | C105 | 1 | MPPN/HJC; radial lead 1 μF; 450 V (DC) |
| 7 | C106 | 1 | MLCC; SMD 1206; NPO; 100 pF; 630 V |
| 8 | C107; C218 | 2 | MLCC; SMD 0603; X7R; 4.7 nF; 25 V |
| 9 | C108; C108-1 | 2 | MLCC; SMD 1206; X7R; 2.2 μF; 16 V |
| 10 | C109 | 1 | MLCC; SMD 0603; X7R; 47 nF; 25 V |
| 11 | C110 | 1 | electrolytic capacitor; NCC; 180 μF/420 V; KMQ (W 30 mm × H 25 mm) |
| 12 | C111 | 1 | MLCC; SMD 0603; X7R; 150 nF; 25 V |
| 13 | C112 | 1 | MLCC; SMD 0603; X7R; 470 nF; 25 V |
| 14 | C200 | 1 | MP3/HJC; radial lead 22 nF; 600 V |
| 15 | C203 | 1 | E/C; radial lead; 105 °C; 10 × 16 mm; KY/NCC 220 μF; 50 V |
| 16 | C204 | 1 | E/C; radial lead; 105 °C; 5 × 11 mm; KY/NCC 10 μF; 50 V |

**Table 7. BOM for the TEA1713T and TEA1795Tdemo board** *…continued*

| Item | Location | Quantity | Description |
|---|---|---|---|
| 17 | C205; C304 | 2 | MLCC; SMD 0603; X7R; 100 nF; 50 V |
| 18 | C210 | 1 | MLCC; SMD 1206; X7R; 10 nF; 25 V |
| 19 | C211 | 1 | MLCC; SMD 1206; NPO; 470 pF; 1 kV |
| 20 | C212 | 1 | MLCC; SMD 1206; X7R; 2.2 nF; 25 V |
| 21 | C213 | 1 | MLCC; SMD 0603; X7R; 10 pF; 50 V |
| 22 | C214 | 1 | MLCC; SMD 0805; X7R; 330 nF; 25 V |
| 23 | C215 | 1 | MLCC; SMD 0603; X7R; 270 pF; 25 V |
| 24 | C216 | 1 | MLCC; SMD 0805; X7R; 220 nF; 25 V |
| 25 | C217 | 1 | MLCC; SMD 0805; X7R; 2.2 μF; 25 V |
| 26 | C219; C309; C310; C311 | 4 | MLCC; SMD 0603; X7R; 100 nF; 25 V |
| 27 | C220; C222 | 2 | MLCC; SMD 0603; X7R; 10 nF; 25 V |
| 28 | C221; C313 | 2 | MLCC; SMD 0603; X7R; 1 nF; 25 V |
| 29 | C223 | 1 | MLCC; SMD 1206; X7R; 100 nF; 25 V |
| 30 | C305; C306; C307 | 3 | electrolytic capacitor; NCC; 820 μF; 25 V; KZH (W 10 mm × H 20 mm) |
| 31 | C401 | 1 | ceramic; Y1-capacitor; KX/Murata; 680 pF; 250 V (AC) |
| 32 | D101 | 1 | general purpose diode; NXP Semiconductors; 1N5408; 3 A; 1 KV |
| 33 | D102 | 1 | ultrafast power diode; BYV29X-600 |
| 34 | D203; D204 | 2 | ultrafast rectifier; SMA; ES1B; 1 A; 100 V |
| 35 | D206 | 1 | ultrafast rectifier; SMA; ES1J; 1 A; 600 V |
| 36 | D208 | 1 | high speed switching diode; SOD123F; BAS16H; 100 V |
| 37 | D209 | 1 | high speed double diode; SOT23; BAV99; 75 V |
| 38 | F101 | 1 | fuse; MST(CONQUER); 3.15 A; 250 V |
| 39 | IC101 | 1 | resonant power supply control IC with PFC; NXP Semiconductors; SO24; TEA1713T |
| 40 | IC201 | 1 | low power dual voltage comparator; SO8; LM293 |
| 41 | IC301 | 1 | GreenChip synchronous rectifier controller; SO8; TEA1795T; NXP Semiconductors |
| 42 | IC303 | 1 | dual opamp and voltage reference; SO8; AP4310A; BCD |
| 43 | IC304; IC305 | 2 | high density mounting type photocoupler; DIP 4; LTV817A; LiteOn |
| 44 | Inlet | 1 | AC inlet 3P |
| 45 | L101 | 1 | EMI choke; 7.35 mH; SA382/HJC |
| 46 | L102 | 1 | EMI choke; 11.07 mH; SA383/HJC |
| 47 | L103 | 1 | filter choke 170 μH; SA384/HJC |
| 48 | L104 | 1 | PFC choke; PQ2625/315uH; SA136/HJC |
| 49 | L201 | 1 | choke; ATQ2116.8/44 μH; SA135/HJC |
| 50 | T1 | 1 | XFMR; PQ3221/800uH; SA137/HJC |
| 51 | Q101 | 1 | MOSFET; IPA60R199CP; TO220; Infineon; 16 A; 600 V |
| 52 | Q102 | 1 | PNP switching transistor; PMBT4403; SOT23; NXP Semiconductors |
| 53 | Q201; Q202 | 2 | MOSFET; 2SK3569; TO220; Toshiba; 10 A; 600 V |
| 54 | Q203; Q204 | 2 | NPN switching transistor; SOT23; NXP Semiconductors; PMBT4401 |
| 55 | Q301; Q302 | 2 | MOSFET; PSMN7R6-60PS; TO220AB; NXP Semiconductors; 92 A; 60 V |

**Table 7. BOM for the TEA1713T and TEA1795Tdemo board** *…continued*

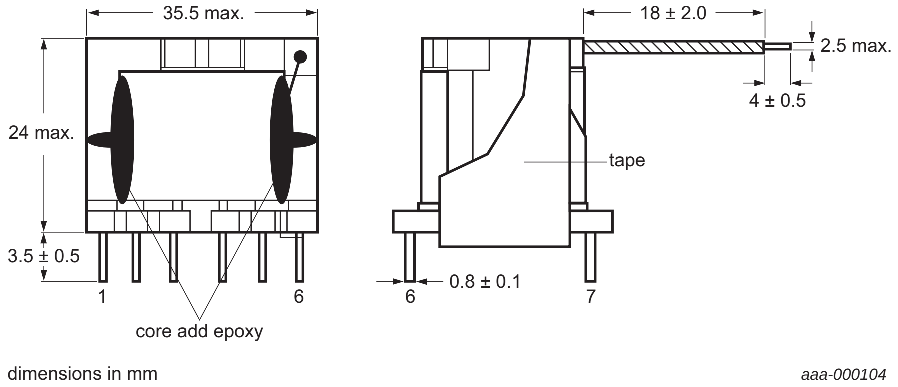
| Item | Location | Quantity | Description |
|---|---|---|---|
| 56 | R101; R102 | 2 | resistor; SMD 1206; thin film; 1.5 MΩ; 5 % |
| 57 | R103 | 1 | resistor; SMD 1206; thin film; 523 kΩ; 1 % |
| 58 | R104 | 1 | resistor; SMD 0603; thin film; 40.2 kΩ; 1% |
| 59 | R105 | 1 | resistor; SMD 0603; thin film; 5.1 kΩ; 1 % |
| 60 | R107; R201; R204 | 3 | resistor; SMD 0805; thin film; 10 Ω; 5 % |
| 61 | R109 | 1 | resistor; SMD 0805; thin film; 2.2 Ω; 5 % |
| 62 | R110 | 1 | resistor; SMD 2512/2W RLP; thin film; 0.05 Ω; 1 %; TAI |
| 63 | R111; R112; R113 | 3 | Resistor; SMD 1206; thin film; 3.3 MΩ; 1 % |
| 64 | R114 | 1 | resistor; SMD 0603; thin film; 64.9 kΩ; 1 % |
| 65 | R114-1 | 1 | resistor; SMD 0603; thin film; 3 MΩ; 1 % |
| 66 | R115; RJ1; RJ2; RJ3; RJ4; RJ5; RJ6; RJ7; RJ8; RJ9; RJ10; RJ11; RJ12; RJ13; RJ14; RJ15; R228 | 17 | resistor; SMD 1206; thin film; 0 Ω; 5 % |
| 67 | R214; R219; R314 | 3 | resistor; SMD 0603; thin film; 1 KΩ; 1 % |
| 68 | R117 | 1 | resistor; SMD 0603; thin film; 12 kΩ; 5 % |
| 69 | R118; R225 | 2 | resistor; SMD 0603; thin film; 33 kΩ; 5 % |
| 70 | R208 | 1 | resistor; SMD 0603; thin film; 332 kΩ; 1 % |
| 71 | R209 | 1 | resistor; SMD 0603; thin film; 40.2 kΩ; 1 % |
| 72 | R210 | 1 | resistor; SMD 1206; thin film; 12.4 Ω; 1 % |
| 73 | R213 | 1 | resistor; SMD 1206; thin film; 10 Ωm; 1 % |
| 74 | R211; R221; R312 | 3 | resistor; SMD 0603; thin film; 100 kΩ; 1 % |
| 75 | R212 | 1 | resistor; SMD 0603; thin film; 294 kΩ; 1 % |
| 76 | R215 | 1 | resistor; SMD 0603; thin film; 18.2 kΩ; 1 % |
| 77 | R216 | 1 | resistor; SMD 0603; thin film; 150 kΩ; 1 % |
| 78 | R217 | 1 | resistor; SMD 0603; thin film; 249 kΩ; 1 % |
| 79 | R116; R218 | 2 | resistor; SMD 0603; thin film; 2.2 kΩ; 5 % |
| 80 | R220 | 1 | resistor; SMD 0603; thin film; 392 kΩ; 1% |
| 81 | R223 | 1 | resistor; SMD 0603; thin film; 2 kΩ; 1 % |
| 82 | R308; R316 | 2 | resistor; SMD 0603; thin film; 10 kΩ; 1 % |
| 83 | RT201 | 1 | NTC thermistor; TTC3A104F4192EY; Thinking; 100 kΩ; 1 % |
| 84 | R302; R305 | 2 | resistor; SMD 0805; thin film; 4.7 Ω; 5 % |
| 85 | R303; R306 | 2 | resistor; SMD 0805; thin film; 1 kΩ; 1 % |
| 86 | R307 | 1 | resistor; SMD 2512/2W RLP; TAI; thin film; 12 mΩ; 1 % |
| 87 | R309 | 1 | resistor; SMD 0603; thin film; 30.9 kΩ; 1 % |
| 88 | R310 | 1 | resistor; SMD 0603; thin film; 4.53 kΩ; 1 % |
| 89 | R310-1 | 1 | resistor; SMD 0603; thin film; 294 kΩ; 1 % |
| 90 | R311 | 1 | resistor; SMD 0603; thin film; 300 kΩ; 1 % |
| 91 | R313 | 1 | resistor; SMD 0603; thin film; 191 Ω; 1 % |
| 92 | R317 | 1 | resistor; SMD 0603; thin film; 51 kΩ; 1 % |

**Table 7. BOM for the TEA1713T and TEA1795Tdemo board** *…continued*

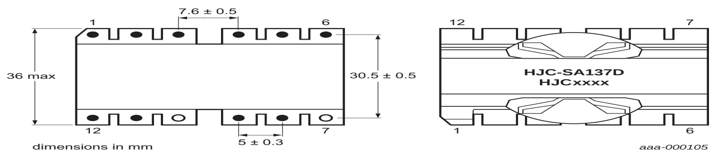
| Item | Location | Quantity | Description |
|---|---|---|---|
| 93 | HS1 | 1 | heatsink-HS1 for Q101; D102; Q201; Q202 |
| 94 | HS2 | 1 | heatsink-HS2; for BD101 |
| 95 | HS3 | 1 | heatsink-HS3; for Q301; Q302 |

# 6. Appendix 1 - Resonant transformer data

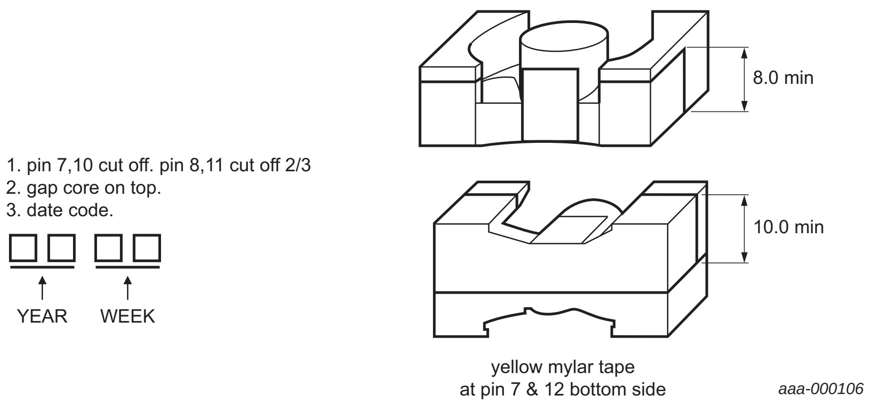
## 6.1 Transformer diagram




a. Side and end views




b. Bottom and top views




c. Mounting instructions

**Fig 27. Resonant transformer data: HJC-SA137D**

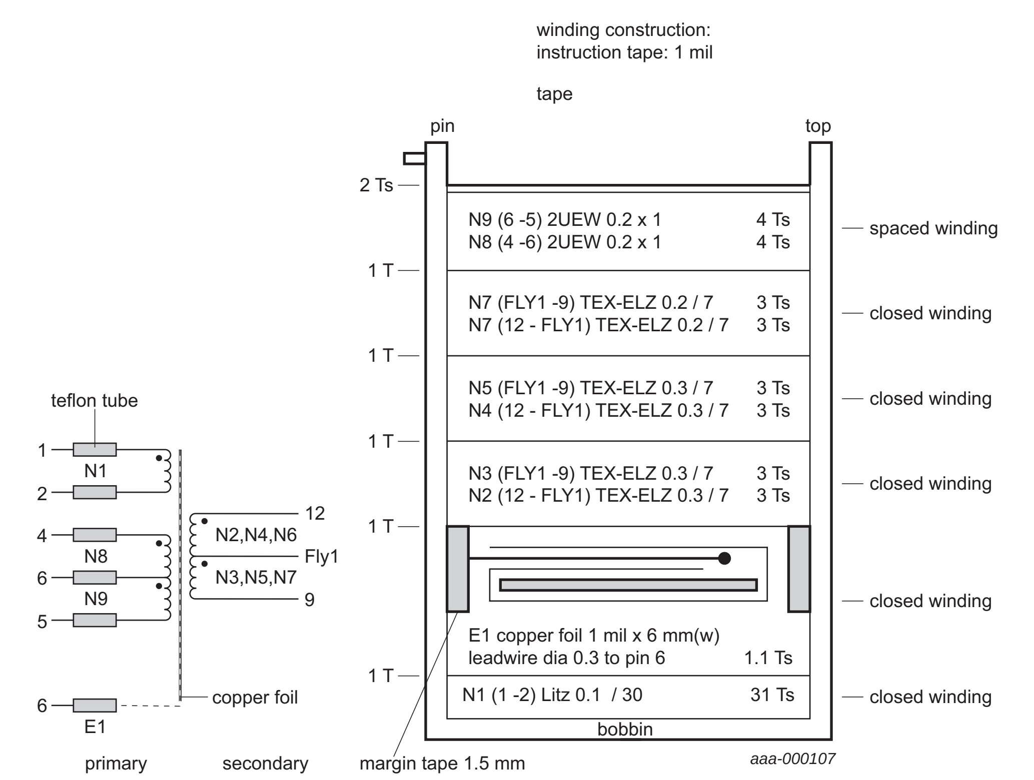



**Fig 28. Transformer schematic diagram and winding overview**

## 6.2 Transformer electrical specification

**Table 8. Electrical specification**

*See Table note 1, Table note 2 and Table note 3 for the relevant measuring conditions.*

| Parameter | Start | Finish | Specification |
|---|---|---|---|
| Inductance[1] | 1 | 2 | 800 µH; ±3 % |
| Leakage inductance[1] | 1 | 1 | sec short; 15 µH maximum |
| DC resistance[2] | 1 | 2 | 165 mΩ maximum |
| | 4 | 5 | 490 mΩ maximum |
| | 12 | fly1 | 6.10 mΩ maximum |
| Voltage ratio[3]; input 1, 2 | 4 | 5 | 2.58 V (RMS) ±0.08 V (RMS) |
| | 12 | fly1 | 0.975 V (RMS) ±0.08 V (RMS) |
| | fly1 | 9 | 0.975 V (RMS) ±0.08 V (RMS) |

[1] Measured with HP: 4284A LCR meter (or equivalent), f = 100 kHz, V = 1 V (RMS) at 25 °C.

[2] Measured with CHEN HWA 502 AC meter (or equivalent) at 25 °C.

[3] Measured with CHEN HWA 310 meter (or equivalent); 20 kHz, 10 V (RMS).

# 7. Appendix 2 - PFC coil data

## 7.1 Transformer schematic diagram and winding specification

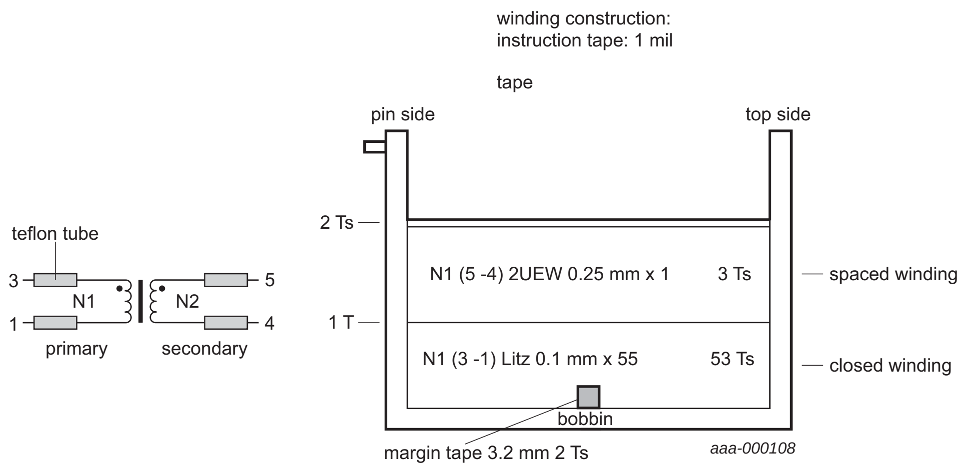



**Fig 29. Transformer schematic diagram and winding overview**

## 7.2 Transformer electrical specification

**Table 9. Electrical specification**

*See Table note 1 for the relevant measuring conditions.*

| Parameter | Start | Finish | Specification |
|---|---|---|---|
| Inductance[1] | 3 | 1 | 315 μH; ±3 % |
| Leakage inductance[1] | 3 | 1 | not applicable |

[1] Measured with HP: 4284A LCR meter (or equivalent), f = 100 kHz, V = 1 V (RMS) at 25 °C.

## 7.3 Core, bobbin and marking

**Core and bobbin:**

- Core: PQ2625 (JPP-44A)
- Bobbin: PM9820
- Ae: 120 mm$^2$

**Marking:**

- HJC-SA136A

# 8. Appendix - Choke coil data

## 8.1 Choke coil schematic diagram and winding specification

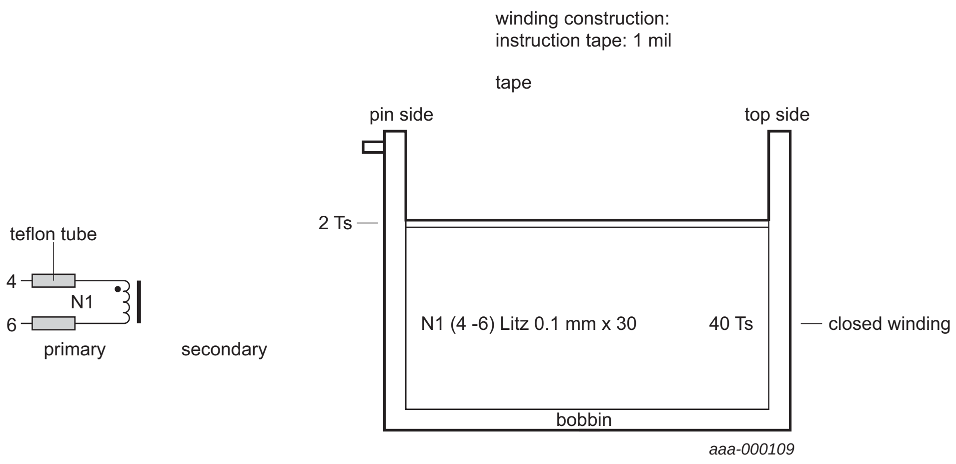



**Fig 30. Transformer schematic diagram and winding overview**

## 8.2 Transformer electrical specification

**Table 10. Electrical specification**

*See Table note 1 and Table note 2 or the relevant measuring conditions.*

| Parameter | Start | Finish | Specification |
|---|---|---|---|
| Inductance[1] | 4 | 6 | 44 μH; ±3 % |
| Leakage inductance[1] | 3 | 1 | not applicable |
| DC resistance[2] | 4 | 6 | 145 MΩ maximum |

[1] Measured with HP: 4284A LCR meter (or equivalent), f = 100 kHz, V = 1 V (RMS) at 25 °C.

[2] Measured with CHEN HWA 502 AC meter (or equivalent) at 25 °C.

## 8.3 Core, bobbin and marking

**Core and bobbin:**

- Core: ATQ21/16.8 (JPP-44A)
- Bobbin: PM9820

**Marking:**

- HJC-SA135

# 9. Abbreviations

Table 11. Abbreviations

| Acronym | Description |
|---|---|
| BCM | Boundary conduction Mode |
| CMP | Capacitive Mode Protection |
| EMC | ElectroMagnetic Compatibility |
| EMI | ElectroMagnetic Interference |
| HBC | Half-Bridge resonant Converter |
| MOSFET | Metal-Oxide Semiconductor Field-Effect Transistor |
| OCP | OverCurrent Protection |
| OPP | OverPower Protection |
| OVP | OverVoltage Protection |
| OLP | Open-Loop Protection |
| PCB | Printed-Circuit Board |
| PFC | Power Factor Correction |
| SOI | Silicon-On-Insulator |
| ZVS | Zero Voltage Switching |

# 10. References

[1] **TEA1713T —** data sheet - resonant power supply control IC with PFC

[2] **TEA1795T —** data sheet - GreenChip synchronous rectifier

[3] **AN10881 —** application note - resonant power supply control IC with PFC

[4] **UM10379 —** user manual - 250 W LCD-TV demo board

[5] **UM10450 —** user manual - 90 W notebook adaptor demo board

[6] **Calculation sheet —** http://www.nxp.com/technical_support/designportal/llc

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Date of release: 28 September 2011
Document identifier: UM10465