

UM11171

TEA1936xDB1528 60 W compact power supply demo board

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User manual
COMPANY PUBLIC

Document information

Information	Content
Keywords	TEA1936xDB1528, TEA1936x, TEA1999, SMPS, adapter, synchronous rectification
Abstract	This user manual describes the performance, technical data, and the connections of the TEA1936xDB1528 demo board. The TEA1936xDB1528 demo board operates at mains voltages from 90 V (AC) up to 264 V (AC). It has an output voltage of 12 V, 15 V, or 20 V (DC) at a maximum output current of 3.25 A.



Revision history

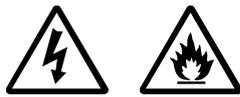
Revision history

Rev	Date	Description
v.1	20190111	first issue

1 Introduction

WARNING

Lethal voltage and fire ignition hazard

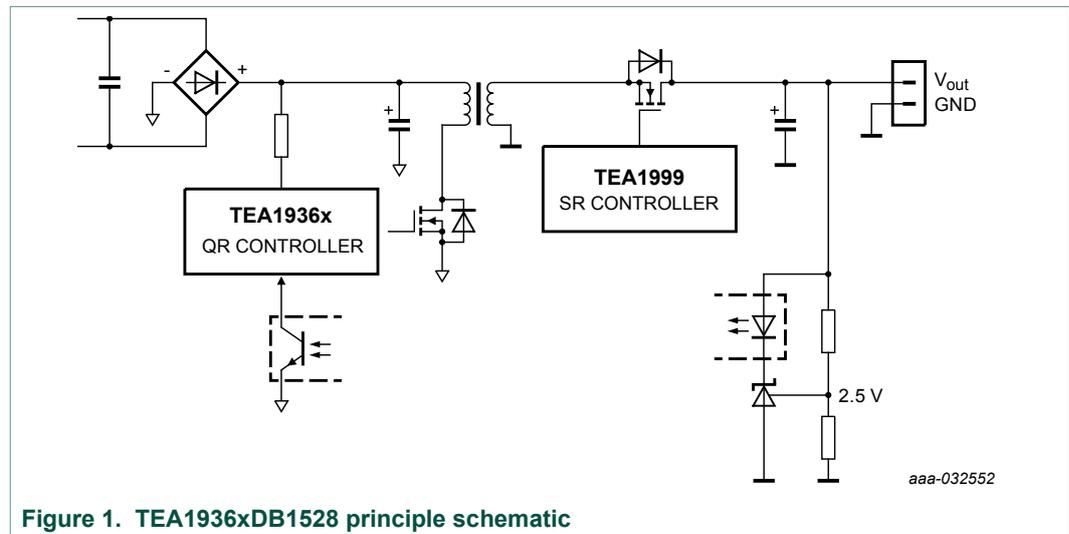


The non-insulated high voltages that are present when operating this product, constitute a risk of electric shock, personal injury, death and/or ignition of fire. This product is intended for evaluation purposes only. It shall be operated in a designated test area by personnel qualified according to local requirements and labor laws to work with non-insulated mains voltages and high-voltage circuits. This product shall never be operated unattended.

This user manual describes the operation of the TEA1936xDB1528 demo board featuring the quasi-resonant controller TEA19361 and the synchronous rectifier controller TEA1999.

The demo board is designed for delivering a maximum output power of 60 W at a maximum current of 3 A. Output voltages that can be chosen: 12 V, 15 V, and 20 V, using a soldering jumper.

The TEA1936xDB1528 provides an effective solution with a low output current ripple and high efficiency for switched-mode power supply (SMPS) adapter applications.



1.1 Key features

- Soldering jumper can set the output voltage
- Functionality user-configurable end of line
- Best-in-class energy efficiency meeting all DOE and EU CoC requirements
- Small size due to high near-full digital integration level and high W/CI power density
- Best in class thermal management
- Safe solution with extensive set of hardware-integrated protection features
- Complete one-stop-shop solution from NXP Semiconductors, minimizing development time and research and development costs

1.2 Applications

Mobile adapter with DC cable for:

- Notebooks

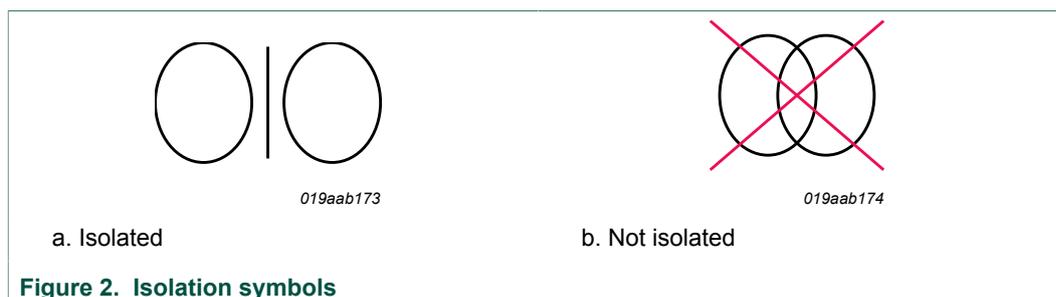
The new adapter platform of NXP Semiconductors helps designers of notebook adapters to maximize power output for smallest form-factor and with lowest bill of materials.

The result is a cost-effective design that meets the requirements published by Energy Star, the Department of Energy (DoE) in the United States, the Ecodesign Directive of the European Union, the European Code of Conduct, and other guidelines.

2 Safety warning

The demo board is connected to the mains voltage. Avoid touching the board while it is connected to the mains voltage and when it is in operation. When used in uncontrolled, non-laboratory environments, an isolated housing is obligatory. Galvanic isolation from the mains phase using a fixed or variable transformer is always recommended.

[Figure 2](#) shows the symbols on how to recognize these devices.



3 Specifications

Table 1. TEA1936xDB1528 specifications

When operating at 230 V (AC)

Symbol	Parameter	Value
V_{mains}	AC mains voltage	90 V (AC) up to 264 V (AC)
$P_{\text{out,max}}$	maximum output power	65 W
f_{mains}	mains frequency	50 Hz or 60 Hz
$P_{\text{out}}/P_{\text{in}}$	efficiency	> 92 % at $P_{\text{out(max)}}$
V_{out}	output voltage ^[1]	12 V, 15 V, and 20 V (DC)
$I_{\text{out(max)}}$	maximum output current	3.25 A
$V_{\text{ripple(burst)}}$	burst mode output voltage ripple	100 mV _{pp} at cable end
$V_{\text{ripple(full)}}$	output voltage ripple at continuous switching	80 mV _{pp} at cable end
EMI _C	conductive EMI	-3 dB
CMN	common-mode noise	< 2 V _{pp}
ESD	electrostatic discharge	± 15 kV through air
		± 8 kV via contact

[1] Default setting V_{out} : 12 V (DC).

TEA1936xDB1528 60 W compact power supply demo board

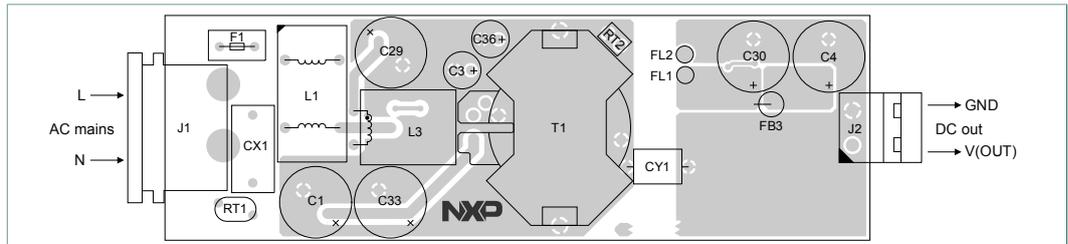


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Figure 5. TEA1936xDB1528 - bottom view

5 Board connections

The TEA1936xDB1528 demo board is a universal mains supplied application. Its output is the 2-pin header. The default setting for V_{out} is 12 V (DC).



aaa-032556

Figure 6. TEA1936xDB1528 demo board connections

6 TEA1936xDB1528 demo board performance

6.1 Efficiency

Table 2. Efficiency at 12 V output (PCB end)

Load	Efficiency at 115 V (AC) (%)	Efficiency at 230 V (AC) (%)
10 % (0.3 A)	87.4	86.5
25 % (0.75 A)	88.6	88.0
50 % (1.5 A)	90.2	89.8
75 % (2.25 A)	91.7	90.6
100 % (3 A)	92.2	91.5
4-point average	90.7	90.0

Table 3. Efficiency at 15 V output (PCB end)

Load	Efficiency at 115 V (AC) (%)	Efficiency at 230 V (AC) (%)
10 % (0.3 A)	87.5	87.3
25 % (0.75 A)	89.2	88.4
50 % (1.5 A)	91.0	90.2
75 % (2.25 A)	92.6	91.4
100 % (3 A)	92.5	92.2
4-point average	91.3	90.5

Table 4. Efficiency at 20 V output (PCB end)

Load	Efficiency at 115 V (AC) (%)	Efficiency at 230 V (AC) (%)
10 % (0.3 A)	86.4	86.0
25 % (0.75 A)	89.1	88.9
50 % (1.5 A)	91.4	90.9
75 % (2.25 A)	92.5	91.7
100 % (3 A)	92.4	93.2
4-point average	91.3	91.2

6.2 Electromagnetic interference (EMI)

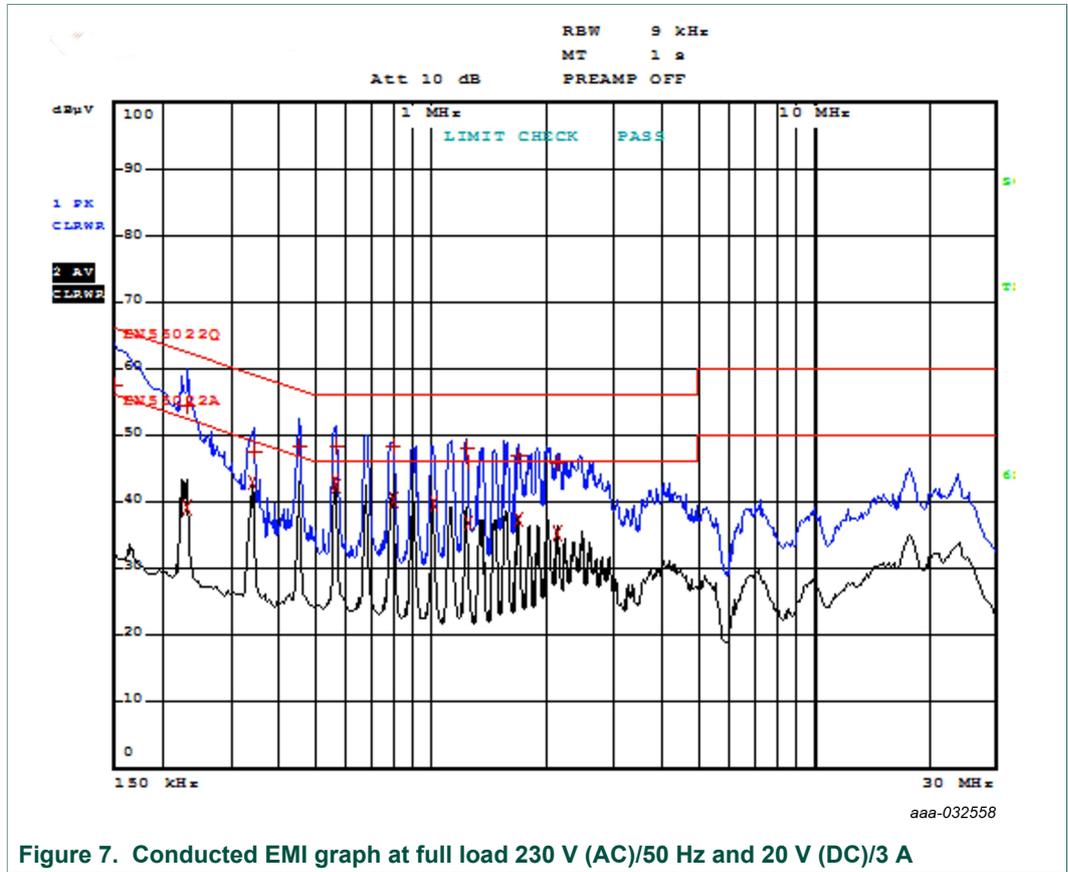


Figure 7. Conducted EMI graph at full load 230 V (AC)/50 Hz and 20 V (DC)/3 A

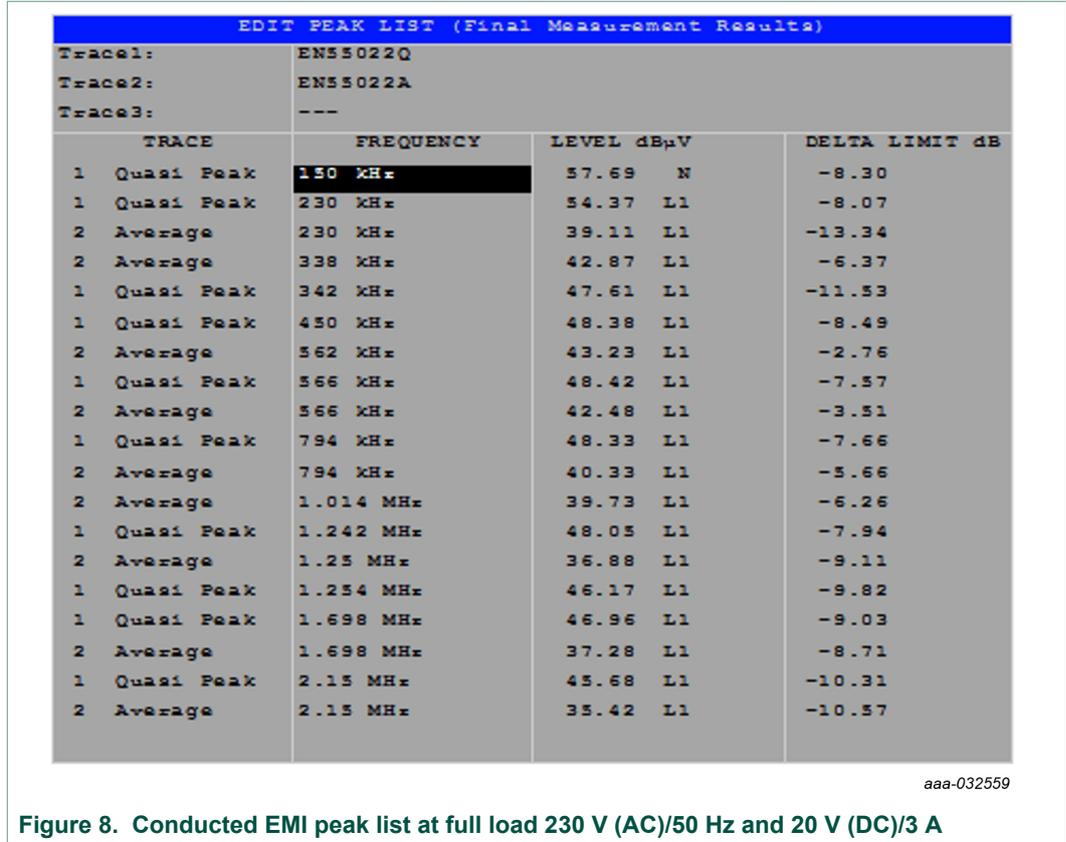


Figure 8. Conducted EMI peak list at full load 230 V (AC)/50 Hz and 20 V (DC)/3 A

8 Bill of materials (BOM)

Table 5. TEA1936xDB1528 bill of materials

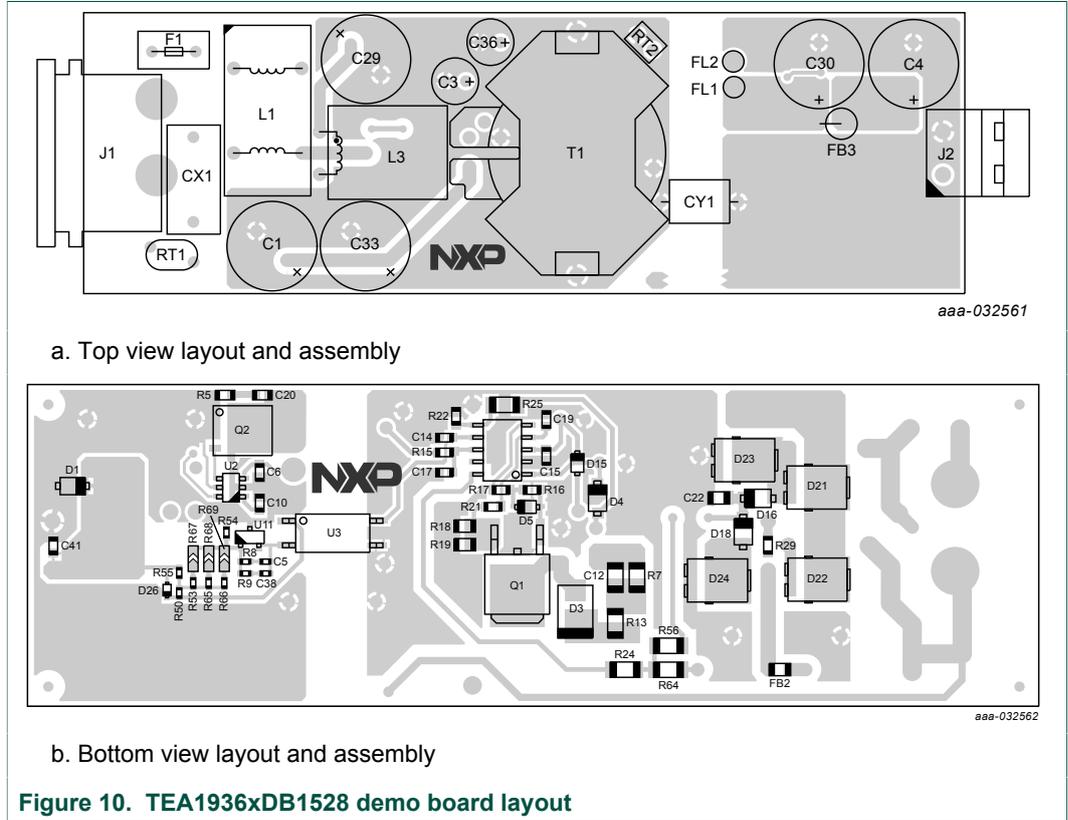
Reference	Description and values	Part number	Manufacturer
C1	capacitor; 33 μ F; 20 %; 400 V; ALU; THT	EKM336M2G G20RR	Samxon
C3	capacitor; 10 μ F; 20 %; 100 V; ALU; THT	100YXJ10M 5X11	Rubycon
C4	capacitor; 560 μ F; 20 %; 25 V; ALU; THT	A750MS567 M1EAAE015	KEMET
C5	capacitor; 100 nF; 10 %; 50 V; X7R; 0402	C1005X7R1 H104K050BB	TDK
C6	capacitor; 4.7 μ F; 10 %; 25 V; X5R; 0603	C1608X5R1 E475K080	TDK
C10	capacitor; 1 μ F; 10 %; 25 V; X7R; 0603	-	-
C12	capacitor; 2.2 nF; 10 %; 630 V; X7R; 1206	MC1206B22 2K631CT	Multicomp
C14; C17	capacitor; 1 nF; 10 %; 50 V; X7R; 0603	-	-
C15	capacitor; 470 nF; 10 %; 50 V; X7R; 0603	C1608X7R1 H474K	TDK
C19	capacitor; 22 pF; 5 %; 50 V; C0G; 0603	-	-
C20	capacitor; 470 pF; 10 %; 100 V; X7R; 0603	-	-
C22	capacitor; 6.8 nF; 10 %; 630 V; X7R; 0805; NM	C0805C682K BRACU	KEMET
C29	capacitor; 33 μ F; 20 %; 400 V; ALU; THT	EKM336M2G G20RR	Samxon
C30	capacitor; 560 μ F; 20 %; 25 V; ALU; THT	A750MS567 M1EAAE015	KEMET
C33	capacitor; 33 μ F; 20 %; 400 V; ALU; THT	EKM336M2G G20RR	Samxon
C36	capacitor; 10 μ F; 20 %; 35 V; ALU; THT	UVR1V100M DD6TP	Nichicon
C38	capacitor; 10 nF; 10 %; 50 V; X7R; 0402	-	-
C41	capacitor; 10 μ F; 10 %; 25 V; X5R; 0603	C1608X5R1 E106M080	TDK
CX1	capacitor; 100 nF; 20 %; 630 V; MKP; THT; X2	BFC233920 104	Vishay
CY1	capacitor; 100 pF; 10 %; 250 V (AC); B; THT; X1/Y2	DE2B3KY10 1KA2BM01F	Murata
D1	TVS; Unidirectional; 24 V; maximum 10.3 A at 38.9 V	PTVS24VS1 UR	NeXperia USA Inc
D3	diode; 1 kV; 2 A	S2M	Fairchild Semiconductor Inc
D4	diode; 1 kV; 1 A	S1ML	Taiwan Semiconductor
D5	diode; 100 V; 250 mA	BAS316	NeXperia USA Inc

TEA1936xDB1528 60 W compact power supply demo board

Reference	Description and values	Part number	Manufacturer
D15	diode; 200 V; 250 mA	BAS321	NeXperia USA Inc
D16; D18	diode; not mounted; 1 kV; 1 A	S1ML	Taiwan Semiconductor
D21; D22; D23; D24	diode; 1 kV; 3 A	AS3PM	Vishay
D26	diode; 300 V; 250 mA	BAS521	NeXperia USA Inc
F1	fuse; slow blow; 250 V (AC); 3.15 A	MST3.15A2 50V	Multicomp
FB2	fbead; 0.009 Ω; 6 A; 0805	BLM21PG22 0SH1	Murata
FB3	ferrite bead; diameter 3.5 mm; 50 Ω; at 50 MHz; 1 turn	K5B RH 3.5 x 4.5 x 0.8	King core Taiwan
J1	header; mains inlet	770W-X2-10	Qualtek Electronics Corp
J2	header; terminal block; 1 × 2-way; 5.08 mm	1508060000	Weidmüller
L1	inductor CM; 2 × 4.7 mH	TEA1936xDB1528 v1	NXP Semiconductors
L3	inductor; 120 μH; 1 A	LHL10TB12 1K	Taiyo Yuden Japan
Q1	MOSFET-N; 800 V; 17 A	IPD80R280 P7	Infineon
Q2	MOSFET-N; 100 V; 90 A	BSC060N10 NS3	Infineon
R5	resistor; 10 Ω; 1 %; 63 mW; 0603	-	-
R7	resistor; 100 kΩ; 1 %; 660 mW; 1206	ERJP08F10 03V	Panasonic
R8	resistor; 5.1 kΩ; 1 %; 63 mW; 0402	-	-
R9; R21	resistor; 1 kΩ; 1 %; 63 mW; 0402	-	-
R13	resistor; jumper; 0 Ω; 250 mW; 1206	-	-
R15	resistor; 2.2 kΩ; 1 %; 63 mW; 0603	-	-
R16	resistor; 100 Ω; 1 %; 100 mW; 0603	-	-
R17	resistor; 4.7 Ω; 1 %; 100 mW; 0603	-	-
R18; R19	resistor; 0.33 Ω; 1 %; 250 mW; 0805	ERJS6QFR3 3V	Panasonic
R22	resistor; 5.6 kΩ; 1 %; 63 mW; 0603	-	-
R24; R64	resistor; 84.5 kΩ; 1 %; 660 mW; 500 V; 1206	ERJP08F84 52V	Panasonic
R25	resistor; 133 kΩ; 1 %; 660 mW; 500 V; 1206	ERJP08F13 33V	Panasonic
R29	resistor; not mounted; 1 kΩ; 1 %; 63 mW; 0603	-	-
R50	resistor; 120 Ω; 1 %; 100 mW; 0402	ERJ2RKF12 00X	Panasonic
R53	resistor; 169 kΩ; 1 %; 63 mW; 0402	-	-

Reference	Description and values	Part number	Manufacturer
R54	resistor; 24.3 k Ω ; 1 %; 63 mW; 0402	-	-
R55	resistor; 150 Ω ; 1 %; 100 mW; 0402	ERJ2RKF1500X	Panasonic
R56	resistor; not mounted; 84.5 k Ω ; 1 %; 660 mW; 500 V; 1206	ERJP08F8452V	Panasonic
R65	resistor; 121 k Ω ; 1 %; 63 mW; 0402	-	-
R66	resistor; 93.1 k Ω ; 1 %; 63 mW; 0402	-	-
R67; R68	resistor; jumper; not mounted; 0 Ω ; 63 mW; 0603	-	-
R69	resistor; jumper; 0 Ω ; 63 mW; 0603	-	-
RT1	ICL; not mounted; 5 Ω ; 25 %; 1 A; 6 mm	SL05 5R001-A	Ametherm Inc
RT2	res.; NTC; 100 k Ω ; 5 %; 100 mW; 4190 K	NTCLE100E3104JB0	Vishay
T1	transformer; RM10; 370 μ H	RM10 (TR1083)	NXP Semiconductors
U2	synchronous rectifier controller; TEA1999	TEA1999	NXP Semiconductors
U10	SMPS controller; TEA19361	TEA19361	NXP Semiconductors
U11	adjustable voltage regulator; 1 %; 100 mA	NCP431ACSNT1G	ON Semiconductors
U3	optocoupler; NPN; 70 V; 50 mA	TCLT1008	Vishay

9 Board layout



10 Abbreviations

Table 6. Abbreviations

Acronym	Description
CMN	common-mode noise
EMI	electromagnetic interference
ESD	electrostatic discharge
QR	quasi-resonant
SMPS	switched-mode power supply
SR	synchronous rectifier/rectification

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Contents

1 Introduction 3

1.1 Key features 4

1.2 Applications4

2 Safety warning 4

3 Specifications 5

4 Board photographs6

5 Board connections7

6 TEA1936xDB1528 demo board performance8

6.1 Efficiency8

6.2 Electromagnetic interference (EMI) 9

7 Schematic 11

8 Bill of materials (BOM) 12

9 Board layout 15

10 Abbreviations 15

11 Legal information 16

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