



# UM11170

## TEA1936xDB1556 27 W compact power supply demo board

Rev. 1.03 — 7 January 2019

User manual  
COMPANY PUBLIC

### Document information

Information	Content
Keywords	TEA1936xDB1556, TEA1936x, TEA1999, adapter, switched-mode power supply (SMPS), synchronous rectifier
Abstract	This user manual describes the performance, technical data, and the connections of the TEA1936xDB1556 demo board. The TEA1936xDB1556 demo board operates at mains voltages from 90 V (AC) up to 264 V (AC) with an output voltage from 3 V, 5 V, and 12 V (DC) at a maximum output current of 3 A.



## Revision history

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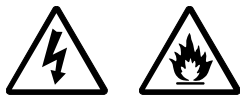
### Revision history

Rev	Date	Description
v.1	20181220	first issue

# 1 Introduction

**WARNING**

**Lethal voltage and fire ignition hazard**

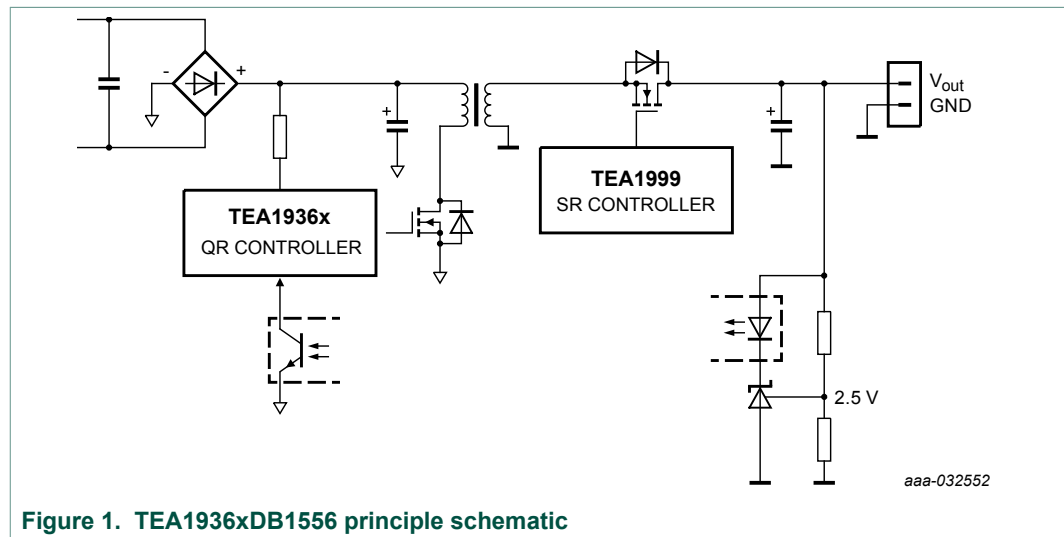


The non-insulated high voltages that are present when operating this product, constitute a risk of electric shock, personal injury, death and/or ignition of fire. This product is intended for evaluation purposes only. It shall be operated in a designated test area by personnel qualified according to 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 TEA1936xDB1556 demo board featuring the quasi-resonant (QR) controller TEA19361 and the synchronous rectifier controller (SR) TEA1999.

The TEA1936xDB1556 demo board is designed for delivering a maximum output power of 27 W at a maximum current of 3 A. Output voltages can be chosen from 3 V, 5 V, and 12 V using a soldering jumper.

The TEA1936xDB1556 provides an effective solution with a low output current ripple and high efficiency for 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 & 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

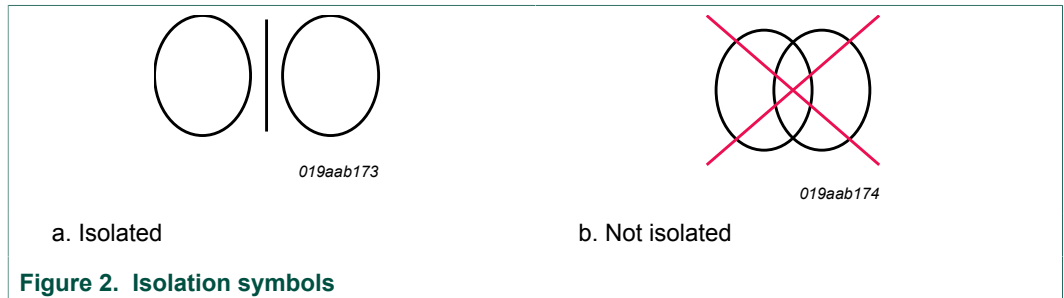
The new adapter platform of NXP Semiconductors helps designers of notebook adapters to maximize power output for smallest form-factor and with lowest bill of materials.

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. TEA1936xDB1556 specifications**

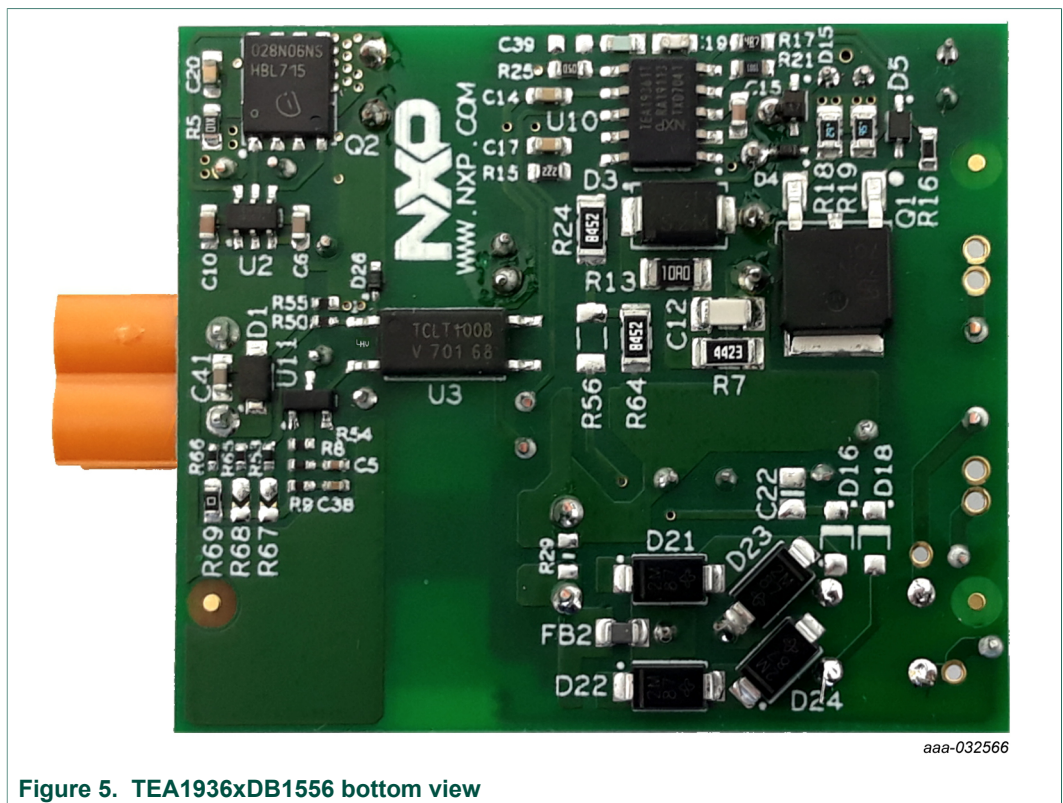
When operating at 230 V (AC)

Symbol	Parameter	Value
$V_{\text{mains}}$	AC mains voltage	90 V (AC) up to 264 V (AC)
$P_{\text{out(max)}}$	maximum output power	27 W
$f_{\text{mains}}$	mains frequency	50 Hz and 60 Hz
$P_{\text{out}} / P_{\text{in}}$	efficiency	> 91 % at $P_{\text{out(max)}}$
$V_{\text{out}}$	output voltage <sup>[1]</sup>	3 V, 5 V, and 12 V (DC)
$I_{\text{out(max)}}$	maximum output current	3 A
$V_{\text{ripple(burst)}}$	output voltage ripple at burst mode	100 mV <sub>pp</sub> at cable end
$V_{\text{ripple(full)}}$	output voltage ripple at continuous switching	80 mV <sub>pp</sub> at cable end
EMI <sub>C</sub>	conductive EMI	-3 dB
CMN	common-mode noise	< 2 V <sub>pp</sub>
ESD	electrostatic discharge	± 15 kV through air
		± 8 kV via contact

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

## 4 Board photographs





## 5 Board connections

The TEA1936xDB1556 demo board is a universal mains supplied application. Its output is the 2-pin header. The default setting for  $V_{out}$  is 3 V (DC).

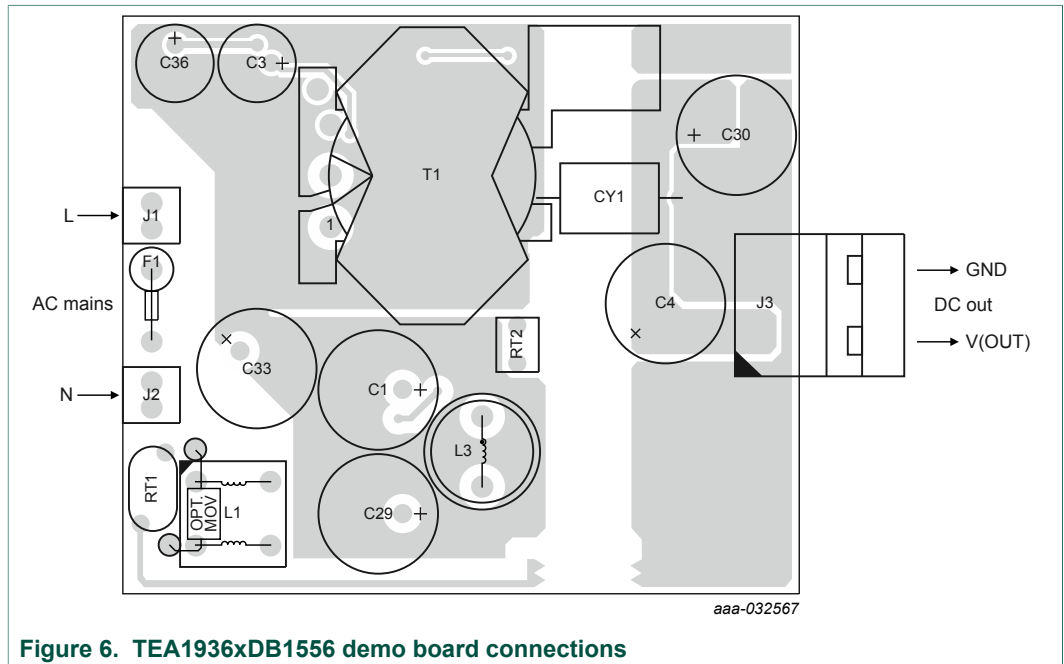


Figure 6. TEA1936xDB1556 demo board connections



## 6 Performance

### 6.1 Efficiency

**Table 2. Efficiency at 3 V output (PCB end)**

Load	Efficiency at 115 V (AC) (%)	Efficiency at 230 V (AC) (%)
10 % (0.3 A)	88.1	83.4
25 % (0.75 A)	88.9	85.3
50 % (1.5 A)	89.4	86.7
75 % (2.25 A)	89.8	87.2
100 % (3 A)	89.6	88.6
4-point average	89.4	86.9

**Table 3. Efficiency at 5 V output (PCB end)**

Load	Efficiency at 115 V (AC) (%)	Efficiency at 230 V (AC) (%)
10 % (0.3 A)	89.7	86.5
25 % (0.75 A)	90.4	87.9
50 % (1.5 A)	91.0	89.0
75 % (2.25 A)	91.1	89.6
100 % (3 A)	90.7	90.7
4-point average	90.8	89.3

**Table 4. Efficiency at 12 V output (PCB end)**

Load	Efficiency at 115 V (AC) (%)	Efficiency at 230 V (AC) (%)
10 % (0.3 A)	87.8	85.5
25 % (0.75 A)	90.4	88.7
50 % (1.5 A)	91.5	90.5
75 % (2.25 A)	91.8	91.6
100 % (3 A)	91.6	92.2
4-point average	91.3	90.7

### 6.2 Electromagnetic interference (EMI)

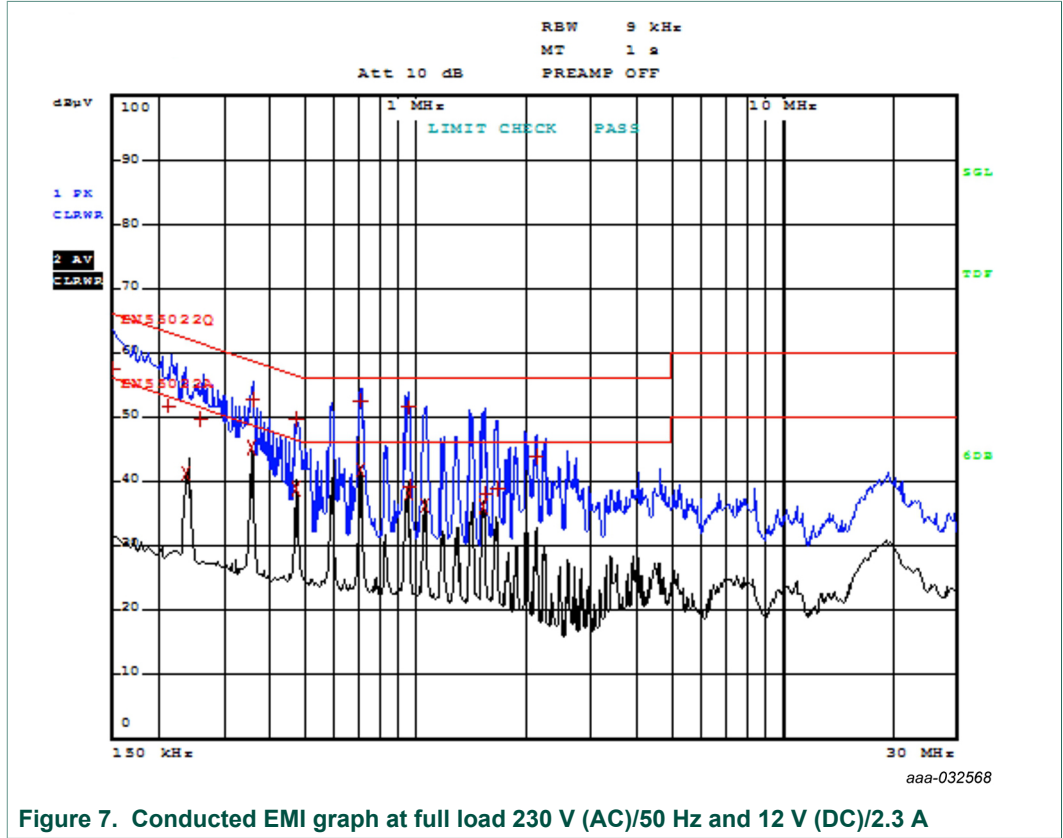


Figure 7. Conducted EMI graph at full load 230 V (AC)/50 Hz and 12 V (DC)/2.3 A

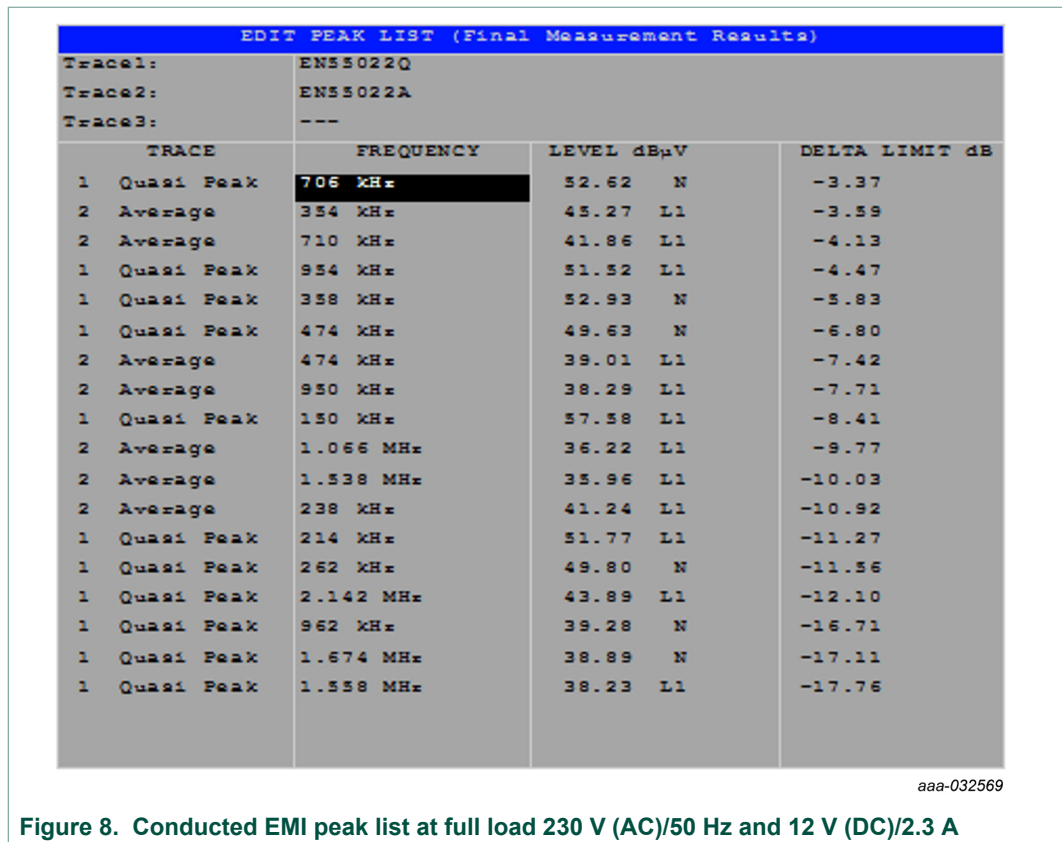


Figure 8. Conducted EMI peak list at full load 230 V (AC)/50 Hz and 12 V (DC)/2.3 A

## 7 Schematic

The schematic of the TEA1936xDB1556 comprises the quasi-resonant controller TEA19361 and the synchronous rectifier controller TEA1999.

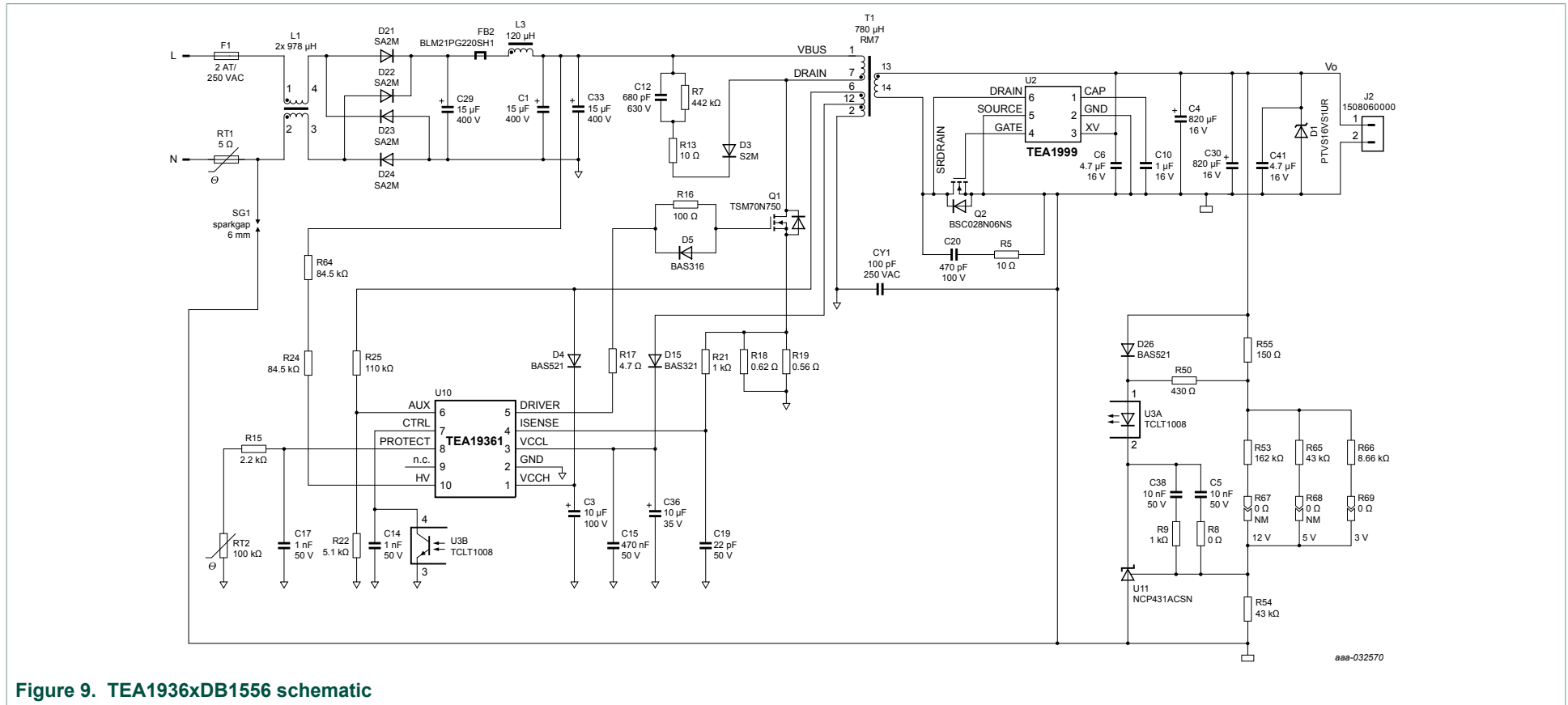


Figure 9. TEA1936xDB1556 schematic

## 8 Bill of materials (BOM)

Table 5. TEA1936xDB1556 bill of materials

Reference	Description and values	Part number	Manufacturer
C1	capacitor; 15 $\mu$ F; 20 %; 400 V; ALU; THT	EKM156M2G F16RR	Samxon
C3	capacitor; 10 $\mu$ F; 20 %; 100 V; ALU; THT	100YXJ10M 5X11	Rubycon
C4	capacitor; 820 $\mu$ F; 20 %; 16 V; ALU; THT	827AVG016 MFBJ	Illinois Capacitor Inc
C5	capacitor; 100 nF; 10 %; 50 V; X7R; 0402	C1005X7R1 H104K050BB	TDK
C6; C41	capacitor; 4.7 $\mu$ F; 10 %; 16 V; X5R; 0603	C1608X5R1 C475K080A C	TDK
C10	capacitor; 1 $\mu$ F; 10 %; 16 V; X7R; 0603	-	-
C12	capacitor; 680 pF; 10 %; 630 V; X7R; 1206	C1206C681K BRAC	KEMET
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; C33	capacitor; 15 $\mu$ F; 20 %; 400 V; ALU; THT	EKM156M2G F16RR	Samxon
C30	capacitor; 820 $\mu$ F; 20 %; 16 V; ALU; THT	827AVG016 MFBJ	Illinois Capacitor Inc
C36	capacitor; 10 $\mu$ F; 20 %; 35 V; ALU; THT	UVR1V100M DD6TP	Nichicon Corp
C38	capacitor; 10 nF; 10 %; 50 V; X7R; 0402	-	-
C39	capacitor; 6.8 pF; 5 %; 50 V; C0G; 0603; NM	-	-
CY1	capacitor; 100 pF; 10 %; 250 V (AC); B; THT; X1/Y2	DE2B3KY10 1KA2BM01F	Murata
D1	TVS; unidirectional; 16 V; maximum 15.4 A at 26.0 V	PTVS16VS1 UR	NeXperia USA Inc
D3	diode; 1 kV; 2 A	S2M	Fairchild
D4	diode; 300 V; 250 mA	BAS521	NeXperia USA Inc
D5	diode; 100 V; 250 mA	BAS316	NXP Semiconductors
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; 2 A	SA2M-E3-61 T	Vishay

## TEA1936xDB1556 27 W compact power supply demo board

Reference	Description and values	Part number	Manufacturer
D26	diode; 300 V; 250 mA	BAS521	NeXperia USA Inc
F1	fuse; slow blow; 250 V (AC); 2 A	MCPMP2A2 50V	Multicomp
FB2	fbead; 0.009 $\Omega$ ; 6 A; 0805	BLM21PG22 0SH1	Murata
J3	header; terminal block; 1 $\times$ 2-way; 5.08 mm	1508060000	Weidmüller
L1	inductor; CM; EE7.0; Cu = 0.27 mm; 18T:18T	inductor; common mode	NXP Semiconductors
L3	inductor; 120 $\mu$ H; 850 mA	TEA1936DB1556 (L3) / 744772121	NXP Semiconductors/Würth Elektronik
Q1	MOSFET-N; 700 V; 6 A	TSM70N750 CP	Taiwan Semiconductor
Q2	MOSFET-N; 60 V; 100 A	BSC028N06 NS	Infineon
R5	resistor; 10 $\Omega$ ; 1 %; 63 mW; 0603	-	-
R7	resistor; 442 k $\Omega$ ; 1 %; 660 mW; 500 V; 1206	ERJP08F44 23V	Panasonic
R8	resistor; 5.1 k $\Omega$ ; 1 %; 63 mW; 0402	-	-
R9; R21	resistor; 1 k $\Omega$ ; 1 %; 63 mW; 0402	-	-
R13	resistor; 10 $\Omega$ ; 1 %; 250 mW; 1206	-	-
R15	resistor; 2.2 k $\Omega$ ; 1 %; 63 mW; 0603	-	-
R16	resistor; 100 $\Omega$ ; 1 %; 100 mW; 0603	-	-
R17	resistor; 4.7 $\Omega$ ; 1 %; 100 mW; 0603	-	-
R18	resistor; 0.62 $\Omega$ ; 1 %; 250 mW; 0805	ERJS6QFR6 2V	Panasonic
R19	resistor; 0.56 $\Omega$ ; 1 %; 250 mW; 0805	ERJS6QFR5 6V	Panasonic
R22	resistor; 5.1 k $\Omega$ ; 1 %; 63 mW; 0603	-	-
R24; R56; R64	resistor; 84.5 k $\Omega$ ; 1 %; 660 mW; 500 V; 1206	ERJP08F84 52V	Panasonic
R25	resistor; 110 k $\Omega$ ; 1 %; 63 mW; 0603	-	-
R29	resistor; not mounted; 1 k $\Omega$ ; 1 %; 63 mW; 0603	-	-
R50	resistor; 430 $\Omega$ ; 1 %; 100 mW; 0402	ERJ2RKF43 00X	Panasonic
R53	resistor; 162 k $\Omega$ ; 1 %; 63 mW; 0402	-	-
R54; R65	resistor; 43 k $\Omega$ ; 1 %; 63 mW; 0402	-	-
R55	resistor; 150 $\Omega$ ; 1 %; 100 mW; 0402	ERJ2RKF15 00X	Panasonic
R66	resistor; 8.66 k $\Omega$ ; 1 %; 63 mW; 0402	-	-
R67; R68	resistor; jumper; not mounted; 0 $\Omega$ ; 63 mW; 0603	-	-

Reference	Description and values	Part number	Manufacturer
R69	resistor; jumper; 0 $\Omega$ ; 63 mW; 0603	-	-
RT1	ICL; 5 $\Omega$ ; 25 %; 1 A; 6 mm	SL05 5R001-A	Ametherm
RT2	resistor; NTC; 100 k $\Omega$ ; 5 %; 100 mW; 4190 K	NTCLE100E 3104JB0	Vishay
T1	transformer; RM7; 780 $\mu$ H	TR1077	NXP Semiconductors
U2	Synchronous Rectifier Controller; TEA1999	TEA1999	NXP Semiconductors
U10	SMPS Controller; TEA19361	TEA19361	NXP Semiconductors
U11	adjustable voltage regulator; 1 %; 100 mA	NCP431ACS NT1G	ON Semiconductors
U3	optocoupler; NPN; 70 V; 50 mA	TCLT1008	Vishay





## 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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Date of release: 7 January 2019

Document identifier: UM11170