



UM11075

QC4pDA1532 27 W QC4+ demo adapter

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User manual

Document information



Information	Content
Keywords	QC4pDA1532, TEA19051BTK, USB type-C, Quick Charge, QC2.0, QC3.0, QC4, QC4+, PPS
Abstract	This user manual describes the performance, technical data, and the connections of the QC4pDA1532 demo adapter. The charger operates at mains voltages from 90 V (AC) up to 264 V (AC) with an output voltage from 3.3 V (DC) up to 12 V (DC)



Revision history

Rev	Date	Description
v.1	20180531	first issue

1 Introduction

Warning	
	 <p>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.</p>

This user manual describes the operation of the QC4pDA1532 QC4+ demo adapter featuring the quasi-resonant controller TEA19361T, the synchronous rectifier controller TEA1993T, and the USB-PD Type-C and QC4+ controller TEA19051B.



The demo adapter is a prototype using first silicon and EEPROM with the latest QC4+ firmware. The adapter is intended for demonstration purposes only. For reference and further development, it is recommended to follow the guidance of the TEA1936xDB1530 reference design/user manual (UM11076) using the final version of the TEA19051B without EEPROM.

The demo adapter is designed for delivering a maximum output power of 27 W at a maximum current of 3 A. The following output voltages can be chosen:

- PD3.0: 5 V to 12 V
- QC4.0: 3.3 V to 11 V

The QC4+ demo adapter provides an effective solution with a low output current ripple and high efficiency for USB-PD and Quick Charge applications.

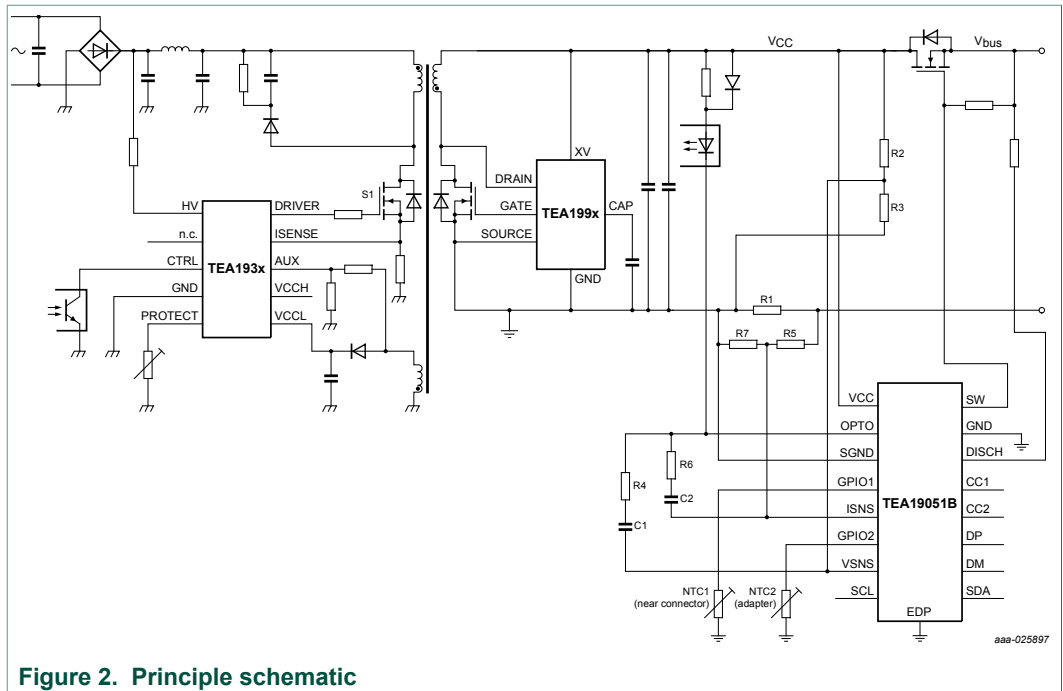


Figure 2. Principle schematic

1.1 Key Features

- Multi-protocol support for USB-PD 3.0, Quick Charge 2.0, 3.0, 4, and 4+
- Best-in-class energy efficiency meeting all DOE & EU CoC requirements
- < 50 mW no-load power, low audible noise, low output voltage ripple
- Small size due to high near-full digital integration level and > 15.9 W/Cl 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 R&D cost

1.2 Applications

Mobile chargers with Type-C cable for:

- Mobile phones
- Smart phones
- Tablets
- Notebooks

The new smart-charger platform of NXP Semiconductors helps designers of travel adapters to maximize power output for the smallest form-factor and at the lowest BOM cost.

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.

Supporting hardware (UTC) and software (TEO) for USB-PD are available for jump-starting application design.

1.3 Contents of the demo kit

The demo kit contains the following items:

- QC4+ charger
- USB type-C cable
- EU plug
- US plug
- UK plug
- AU plug

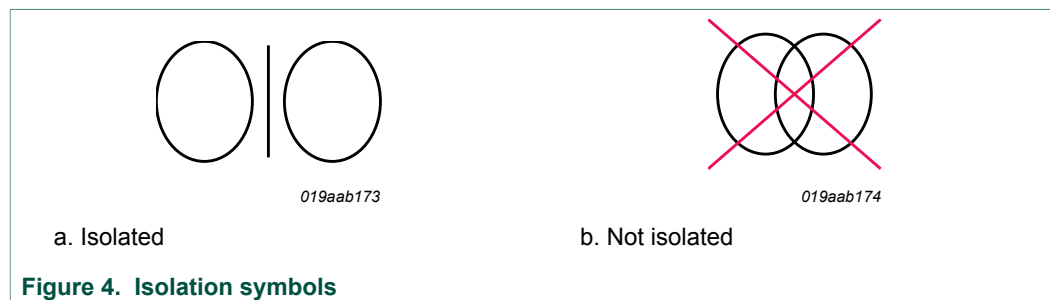


Figure 3. Contents of the demo kit

2 Safety warning

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

Figure 4 shows the symbols on how to recognize these devices.



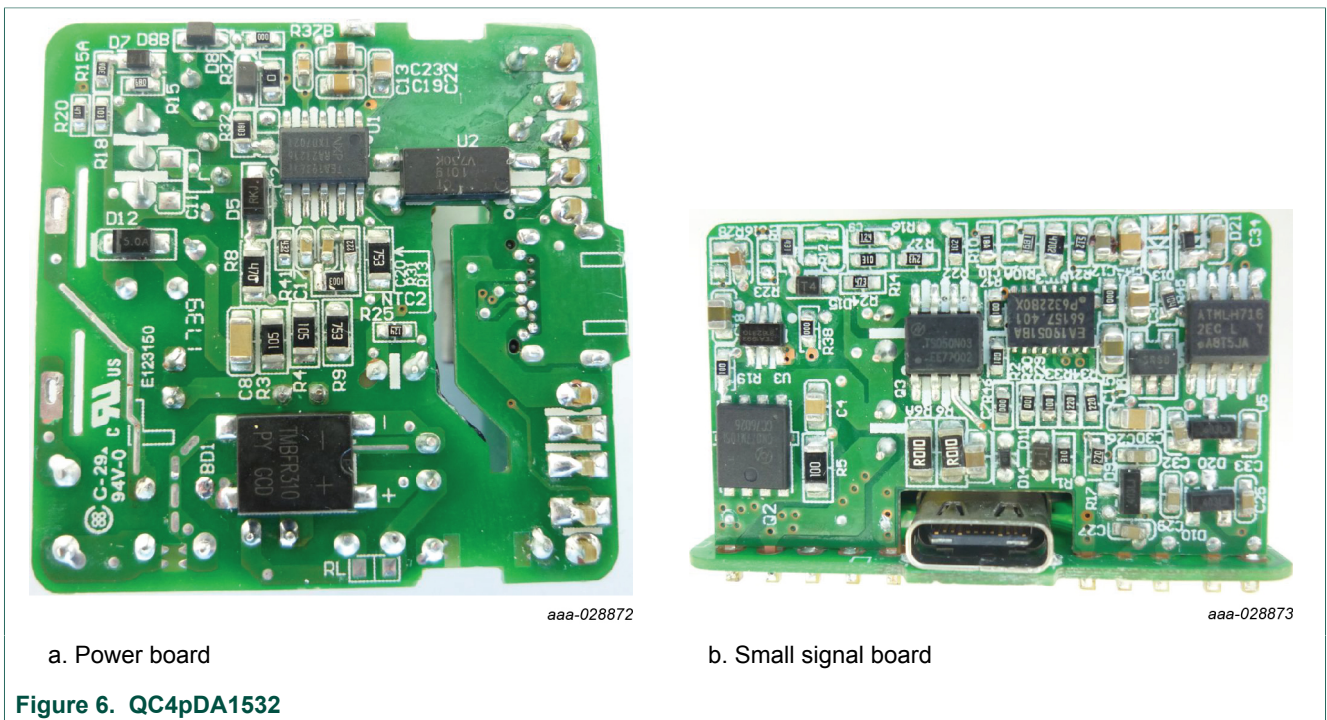
3 Specifications

Table 1. QC4pDA1532 Specifications

When operating at 230 V (AC)

Symbol	Parameter	Value
V_{mains}	AC mains voltage	90 V (AC) to 264 V (AC)
$P_{\text{o(max)}}$	maximum output power	27 W
f_{mains}	mains frequency	50 Hz to 60 Hz
P_{idle}	no-load input power	< 50 mW
η	efficiency ($V_{\text{out}} = 9 \text{ V}$; $I_{\text{out}} = 3 \text{ A}$)	> 89 % at $P_{\text{o(max)}}$
V_{out}	output voltage	3.3 V (DC) to 12 V (DC)
$I_{\text{o(max)}}$	maximum output current	3 A
$V_{\text{o(ripple)full}}$	output voltage ripple at continuous switching	< 100 mV _{pp} at cable end
EMI_{C}	conductive EMI	-7 dB
ESD	electrostatic discharge	±8 kV through air ±4 kV via contact

4 Board photographs



5 Board connections

The QC4pDA1532 demo adapter is a universal mains supplied charger with type-C output connector. Programmable settings can be provided via the IPS system using the MTP configuration utility.

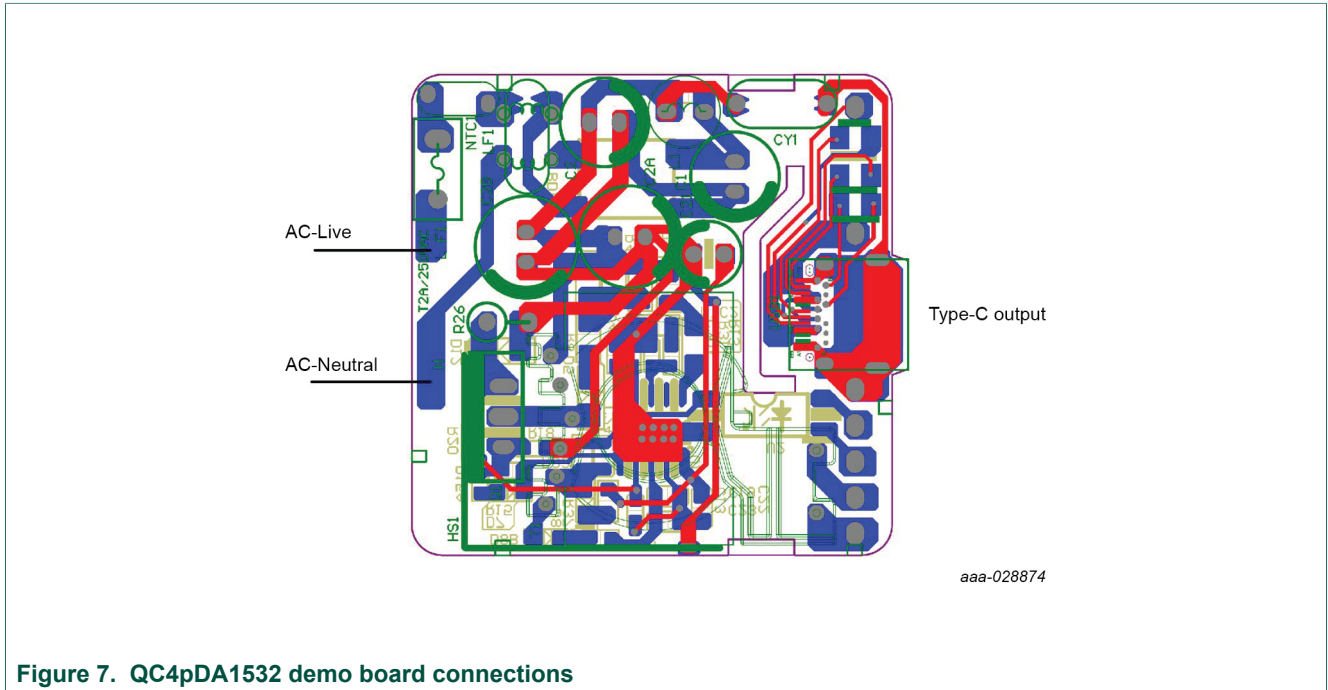


Figure 7. QC4pDA1532 demo board connections

6 PDO settings

Table 2 gives the PDO settings for the charger.

Table 2. PDO settings

PDO (#)	V _o (V)	I _o (A)
1	5	3
2	9	3
3	12	2.25
4	3.3 V to 5.9 V	3
5	3.3 V to 11 V	2.45

PDO4 and PDO5 are auxiliary PDOs. The text on the charger may be different from the settings in Table 2.

7 Schematic

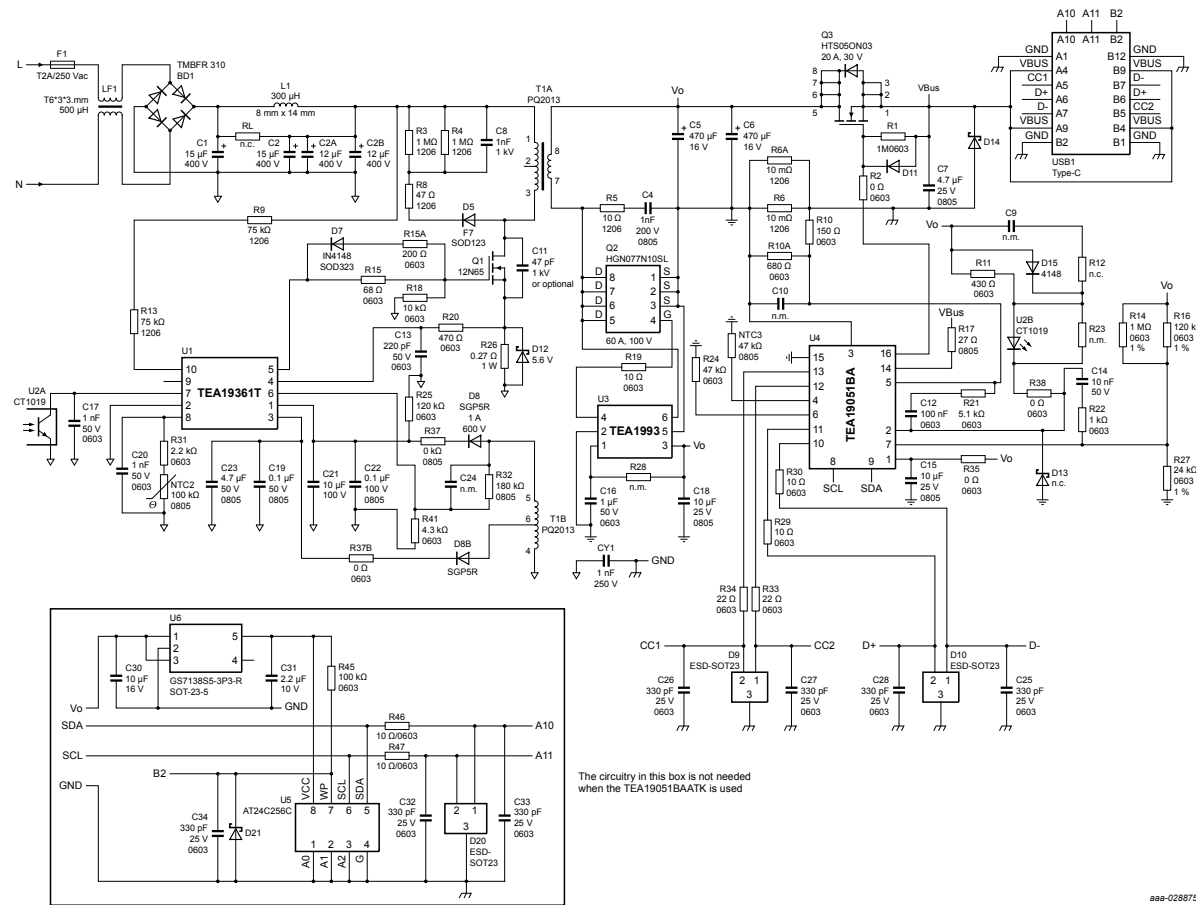


Figure 8. QC4pDA1532 schematic diagram

The schematic of the QC4pDA1532 comprises the quasi-resonant controller TEA19361T, the synchronous rectifier controller TEA1993T, and a preliminary version of the USB-PD/QC controller TEA19051B. To have the same performance as when using the TEA19051BAATK, this preliminary version requires an external EEPROM.

8 Bill Of Materials (BOM)

Table 3. QC4pDA1532

Reference	Description and values	Part Number	Manufacturer
BD1	diode bridge; TMBFR310	-	-
C1; C2	capacitor; 15 μ F; 400 V; KM 105; 8 mm \times 18 mm	-	-
C2A; C2B	capacitor; 12 μ F; 400 V; KM 105; 8 mm \times 14 mm	-	-
C4	capacitor; 1 nF; 200 V	-	-
C5; C6	470 μ F; 16 V; 5 mm \times 10 mm	-	-
C7	capacitor; 4.7 μ F; 25 V; 0805	-	-
C8	capacitor; 1 nF; 1 kV	-	-
C9; C10; C11; C24	capacitor; not mounted	-	-
C12	capacitor; 100 nF; 50 V	-	-
C13	capacitor; 220 pF; 50 V; 0603	-	-
C14	capacitor; 10 nF; 50 V	-	-
C15	capacitor; 10 μ F; 25 V; 0805	-	-
C16	capacitor; 1 μ F; 50 V; 0603	-	-
C17; C20	capacitor; 1 nF; 50 V; 0603	-	-
C18	capacitor; 10 μ F; 25 V; 0603	-	-
C19	capacitor; 0.1 μ F; 50 V; 0805	-	-
C21	capacitor; electrolytic; 10 μ F; 100 V	-	-
C22	capacitor; 0.1 μ F; 100 V; 0805	-	-
C23	capacitor; 4.7 μ F; 50 V; 0805	-	-
C25; C26; C27; C28	capacitor; 330 pF; 25 V; 0603	-	-
CY1	capacitor; 1 nF; 250 V	-	-
D5	diode; standard recovery; F7; SOD123	-	-
D7	diode; 1N4148; SOD323	-	-
D8; D8B	diode; SGP5R; 1 A; 600 V; SOD123	-	-
D9; D10	diode; ESD; SOT23	-	-
D11	diode; 25 V; SOD323	-	-
D12	diode; zener; 5.6 V	-	-
D13	diode; not mounted	-	-
D14	diode; zener; 25 V; 323	-	-
D15	diode; 4148	-	-
F1	fuse T2A; 250 V (AC)	-	-
L1	inductor; 300 μ H; I_{sat} = 600 mA; 8 mm \times 14 mm	-	-
LF1	inductor; common mode; 500 μ H; ring core: 6 mm \times 3 mm \times 3 mm; 2 \times 9.5 turns 0.3 mm wire	-	-

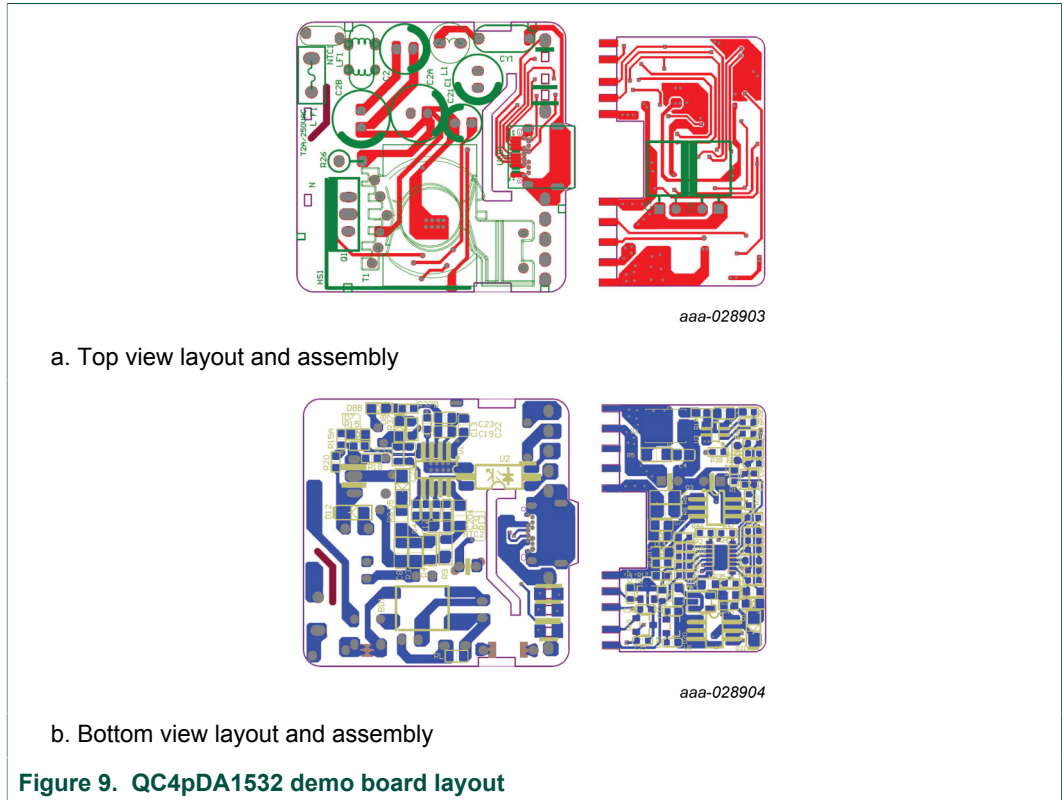
Reference	Description and values	Part Number	Manufacturer
NTC2	resistor; NTC; 100 kΩ; 0805	-	-
NTC3	resistor; NTC; 47 kΩ; 0805	-	-
Q1	MOSFET-N; 12 A; 650 V	-	-
Q2	MOSFET-N; 100 V; $R_{ds} = 6.4 \text{ m}\Omega$	HGN077N10SL	Hunteck
Q3	MOSFET-N; 30 V; $R_{ds} = 3.9 \text{ m}\Omega$	HTS050N03	Hunteck
R1	resistor; 1 MΩ; 0603	-	-
R2	resistor; 0 Ω; 0603	-	-
R3; R4	resistor; 1 MΩ; 1206	-	-
R5	resistor; 10 Ω; 1206	-	-
R6; R6A	resistor; 10 mΩ; 1 %; 1206	-	-
R8	resistor; 47 Ω; 1206	-	-
R9; R13	resistor; 75 kΩ; 1206	-	-
R10	resistor; 150 Ω; 1 %; 0603	-	-
R10A	resistor; 680 Ω 1 %; 0603	-	-
R11	resistor; 430 Ω; 0603	-	-
R12; R23; R28	resistor; not mounted	-	-
R14	resistor; 1 MΩ 1 %; 0603	-	-
R15	resistor; 68 Ω; 0603	-	-
R15A	resistor; 200 Ω; 0603	-	-
R16	resistor; 120 kΩ; 1 %; 0603	-	-
R17	resistor; 27 Ω; 0805	-	-
R18	resistor; 10 kΩ; 0603	-	-
R19; R29; R30; R46; R47	resistor; 10 Ω; 0603	-	-
R20	resistor; 470 Ω; 0603	-	-
R21	resistor; 5.1 kΩ; 0603	-	-
R22	resistor; 1 kΩ; 0603	-	-
R24	resistor; 47 kΩ; 0603	-	-
R25	resistor; 120 kΩ; 0603	-	-
R26	resistor; 0.27 Ω; 2 %; 1 W	-	-
R27	resistor; 24 kΩ; 1 %; 0603	-	-
R31	resistor; 2.2 kΩ; 0603	-	-
R32	resistor; 180 kΩ; 0805	-	-
R33; R34	resistor; 22 Ω; 0603	-	-
R35; R37B; R38	resistor; 0 Ω; 0603	-	-

Reference	Description and values	Part Number	Manufacturer
R37	resistor; 0 Ω ; 0805	-	-
R41	resistor; 4.3 k Ω ; 0603	-	-
RL	resistor; not mounted; 0805	-	-
T1	Transformer	T027 C 0002 01 1741 1.0 E218007 SBI4.2 80BH	KTEC
U1	TEA19361T	TEA19361T	NXP Semiconductors
U2	CT1019	CT1019	CT micro
U3	TEA1993T	TEA1993T	NXP Semiconductors
U4	TEA19051BA	TEA19051BA	NXP Semiconductors
USB1	Type-C connector	-	-

Table 4. Components that can be left out when using TEA19051BAATK

Reference	Description and values	Part Number	Manufacturer
C30	capacitor; 10 μ F; 16 V	-	-
C31	capacitor; 2.2 μ F; 10 V	-	-
C32; C33; C34	capacitor; 330 pF; 25 V; 0603	-	-
D20	diode; ESD-SOT23	-	-
D21	diode; zener; SOD123	-	-
R45	resistor; 100 k Ω ; 0603	-	-
U5	EEPROM; 256 kb; I ² C;	AT24C256C	Microchip
U6	voltage regulator	GS7138S5	GStek

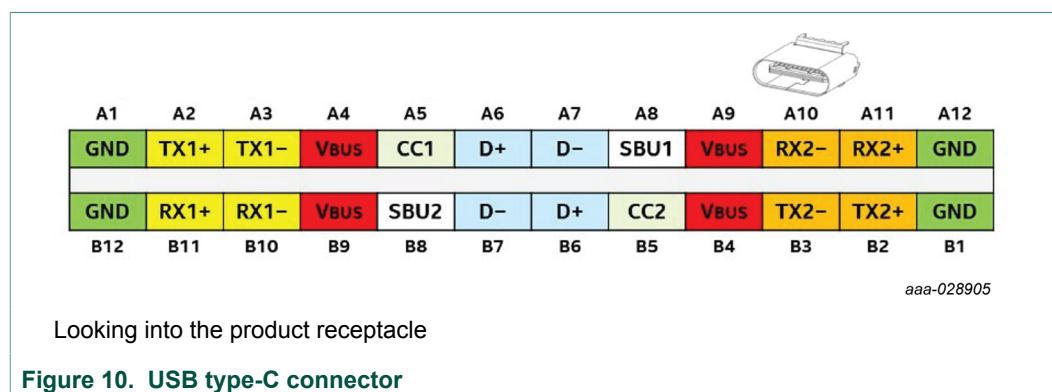
9 Layout



10 Firmware update

The pins A10 and A11 of the USB type-C connector are respectively connected to the SDA and SCL pins of the TEA19051B. Pin B2 of the USB type-C connector is connected to the Write Protect (WP) pin of the EEPROM.

With the help of an adapter board, it is now possible to reprogram the EEPROM without opening the casing of the adapter.



11 Board update

[Table 5](#) shows which modifications have to be done, when the TEA19051BAATK is placed.

Table 5. Modification list when placing the TEA19051BAATK

Reference	Modification
C25; C26; C27; C28; C32; C33	remove
C30; C31; C32; C33; C34	remove
D9	replace with PESD15VS2UT
D10	replace with PESD5V2S2UT
D21	remove
R6A	remove
R10	change value from 150 Ω to 330 Ω (1 %)
R10A	change value from 680 Ω to 2.2 kΩ (1 %)
R46; R47	remove
U4	replace with TEA19051BAATK
U5; U6	remove

12 Abbreviations

Table 6. Abbreviations

Acronym	Description
MTP	Multiple Times Programmable
PD	Power Delivery
PDO	Power Data Object
QC	Quick Charge
TEO	TEA1905 Evaluation Overdrive
USB	Universal Serial Bus

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Contents

1	Introduction	3
1.1	Key Features	4
1.2	Applications	4
1.3	Contents of the demo kit	5
2	Safety warning	6
3	Specifications	6
4	Board photographs	7
5	Board connections	8
6	PDO settings	8
7	Schematic	9
8	Bill Of Materials (BOM)	10
9	Layout	13
10	Firmware update	14
11	Board update	14
12	Abbreviations	15
13	Legal information	16

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