USER
MANUAL

SN6507 Development Kit

WÜRTH ELEKTRONIK MORE THAN YOU EXPECT

CAUTIONS AND WARNINGS

For safe and correct usage, please follow these instructions. Keep them for future reference.

CE

CAUTION
PCB Surfaces may become hot during operation! Wait at least 2 minutes following power-down before handling the board again.

CAUTION
This product contains parts that are ESD sensitive. Follow appropriate ESD procedures and guidelines when handling the evaluation board.

NOTE
Use only input supply voltage and output load current levels within the range stated in the Specification section of this document for each configuration of the evaluation board. Operation above these limits may cause erratic behavior and irreversible damage of the evaluation board.

Ambient temperature range: 5°C to 30°C. To reduce the likelihood of short circuits please keep away from paper clips, screws or any other electrical conductive parts. Put the PCBs on a stable flat surface. Keep away from dust and humidity

CE conformity declaration
Würth Elektronik herewith declares that the product fully complies with the relevant guidelines for CE conformity. The complete text of the CE conformity declaration together with the listed relevant guidelines can be viewed at the following website: www.we-online.com/doc

Before getting started with the SN6507 Development Kit read the Terms of Use for Evaluation Boards, Kits or Modules carefully.
These SN6507 Development Kit boards are not intended for resale and/or use in final customer applications or products.

WARNING: ONLY qualified personnel* should operate this board!
* Qualified personnel (skilled persons) is defined as an individual with relevant technical education, training, or experience to enable perceiving risks and avoiding hazards occurring during use of this product (Source: IEEE 82079-1 3.36).

Abbreviations

PCB	Printed Circuit Board		Ns	Number of Secondary Turns
ESD	Electrostatic Discharge		Np	Number of Primary Turns
CE	conformité européenne		P/N	Part Number
IEEE	Institute of Electrical and Electronics Engineers		DC	Direct Current
WE	Wurth Elektronik		MOSFET	Metal Oxide Semiconductor Field Effect Transistor
LDO	Low Dropout Regulator		GND	Ground
CISPR	Comité International Spécial des Perturbations Radioélectriques		UVLO	Undervoltage Lockout
			EMC	Electromagnetic Compatibility
IC	Integrated Circuit			

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1. INTENDED USE

The SN6507 Development Kit, created in collaboration with Texas Instruments, provides engineers with a complete solution to evaluate the performance of the SN6507 IC, featuring the WE-PPTI transformer line. The kit includes two boards: a fixed board (650796) offering $24\,V_{IN} - 15\,V_{OUT}$ with transformer 750319696, and a configurable board (650700) designed to support various application needs by allowing users to select between different transformers included in the kit.

This kit is intended for use in evaluating the SN6507 for applications such as motor drives, isolated power supplies for communication protocols (CAN, RS-485, RS-422, RS-232, SPI, I2C), medical instruments, solar inverters, and automation systems amongst others. The Würth Elektronik version of the boards is fully EMI compliant, meeting CISPR32 standards, ensuring optimal performance in a wide range of industrial and medical environments.

2. INTRODUCTION

This user guide describes the contents, specifications, configuration, and use of the SN6507 development kit. The kit is based on Texas Instruments' evaluation board SN6507DGQEVM, a push-pull converter using the SN6507 driver IC together with Würth Elektronik's **WE-PPTI Push-Pull Transformers** and passive components.

The **SN6507 development kit** helps designers to easily test and assess the performance of a push-pull auxiliary supply with different configurations.

3. EVALUATION KIT CONTENTS

The SN6507 development kit includes the following:

- Board-1: 650796 (fixed design tailored to Würth Elektronik transformer 750319696)
- Board-2: 650700 (configurable design allows evaluation of different transformers and specifications)
- 16 Transformer samples (see table 1 for a list of all parts included and corresponding specifications)

SN6507 DEVELOPMENT KIT

more details online

650 796 Fixed Board
Push-pull converter
Fixed design $24\,V_{IN} - 15\,V_{OUT}$
Transformer 750319696

650 700 Configurable Board
Push-pull converter
Allows to evaluate different transformers and specifications

750 319 693 $12\,V_{IN} - 24\,V_{OUT}$ Ns/Np 2.29	**750 319 949** $12\,V_{IN} - 30\,V_{OUT}$ Ns/Np 2.75	**750 320 325** $24\,V_{IN} - 3.3\,V_{OUT}$ Ns/Np 0.19	**750 319 694** $24\,V_{IN} - 5\,V_{OUT}$ Ns/Np 0.25
750 319 695 $24\,V_{IN} - 12\,V_{OUT}$ Ns/Np 0.57	**750 319 696** $24\,V_{IN} - 15\,V_{OUT}$ Ns/Np 0.71	**750 319 697** $24\,V_{IN} - 24\,V_{OUT}$ Ns/Np 1.07	**750 319 948** $24\,V_{IN} - 30\,V_{OUT}$ Ns/Np 1.36

Main Applications:
Motor drives: IGBT and SiC gate-driver supplies, Isolated power supply for CAN, RS-485, RS-422, RS-232, SPI, I2C, low-power LAN
Medical instruments, Solar inverters, protection relays, Factory automation, Building automation

Fig. 1: SN6507 Development kit – Inner compartment

Board Images:

Board-1: Fixed version (650796)
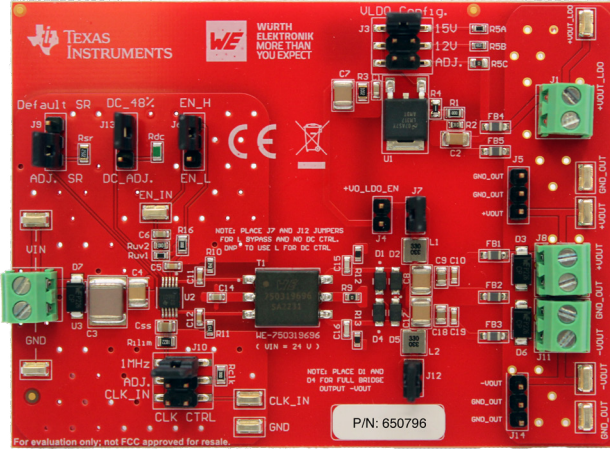For the absolut maximum ratings read **6. Specification and recommended use**

Fig. 2: Board-1: 650796 (fixed)

Board-2: Configurable version (650700)
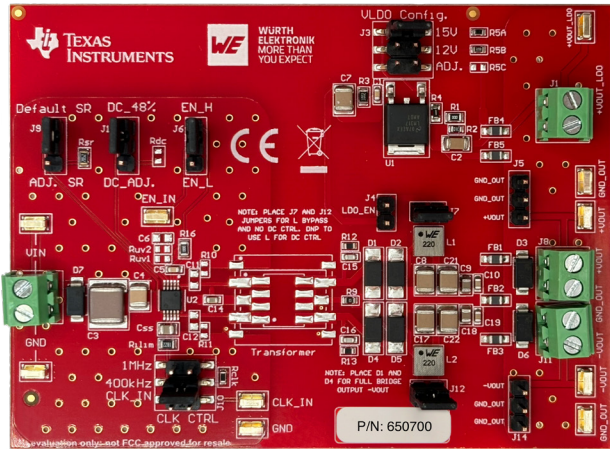For the absolut maximum ratings read **6. Specification and recommended use**

Fig. 3: Board-2: 650700 (configurable)

WE-PPTI Push-Pull transformers

A series of transformers has been built and tailored for use with the configurable board of the **SN6507 Development kit**. They come in two variants: Toroid 1308 and EPX6 assemblies (figure 4). Table 1 lists the 24 transformers suitable for use with the configurable board of the **SN6507 Development kit** at their corresponding input and output voltages with a switching frequency of 400 kHz. The parts highlighted are included in the kit (2 units from each), whereas samples of the other transformers in table 1 can be readily ordered.
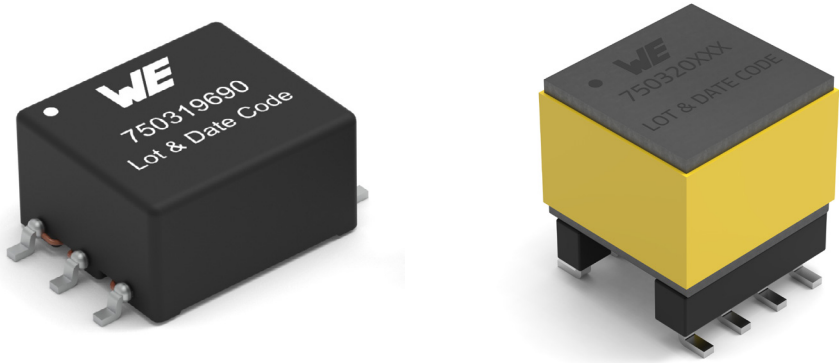

***Fig. 4:*** *WE Transformers for SN6507 Development kit: Toroid 1308 (left) and EPX6 bobbin (right)*

V_{in} (V)	V_{out} (V)	Order Code	Type	Ns/Np	Order Code	Type	Ns/Np
12	3.3	750320324		0.42	750320396		0.42
12	5	750319690		0.57	750320397		0.58
12	12	750319691		1.14	750320398		1.22
12	15	750319692		1.33	750320399		1.44
12	**24**	**750319693**		2.29	750320400		2.33
12	**30**	**750319949**	1308	2.75	750320401	EPX6	2.89
24	**3.3**	**750320325**		0.19	750320402		0.19
24	**5**	**750319694**		0.25	750320403		0.28
24	**12**	**750319695**		0.57	750320404		0.56
24	**15**	**750319696**		0.71	750320375		0.73
24	**24**	**750319697**		1.07	750320405		1.13
24	**30**	**750319948**		1.36	750320383		1.4

Table 1: *Suitable WE transformers and specification for use with the configurable board of this evaluation kit (highlighted parts are included in the kit)*

4. BOARD CONFIGURATION

The two boards included in the kit allow for easy evaluation of the DC-DC push-pull converter topology with different operating modes and output voltage configurations. These can be selected via jumpers and/or by adjusting the value of some resistors, as specified in this section.

Fig. 5: *Relevant Jumpers and connections for EN, SR and FSW Setup 650796*
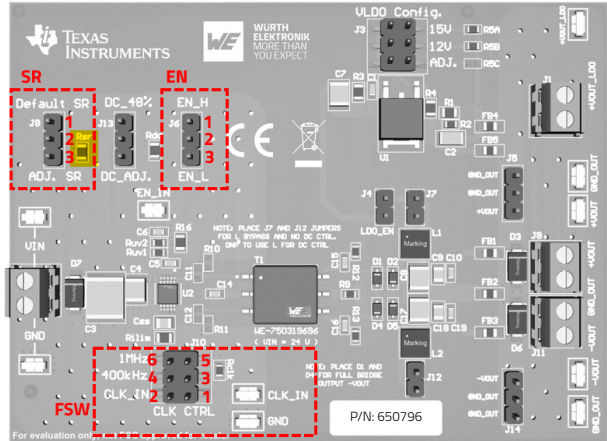
Enable switching (EN)

Pin header J6 allows to enable or disable the SN6507 IC with a jumper, as follows (figure 5):

- **Disable SN6507:**
  Connect pins 2 and 3 together with a jumper
- **Enable SN6507 without UVLO** (*)**:**
  Connect pins 1 and 2 together with a jumper
- **Enable SN6507 with UVLO** (*)**:**
  Leave all J6 pins unconnected. Ruv1 and Ruv2 must be populated (**)
- **Enable SN6507 with external signal:** Leave all J6 pins unconnected. Ruv1 and Ruv2 must be removed. An external signal must be applied to EN_IN for operation (see SN6507 datasheet for signal voltage levels).

(*) UVLO is the abbreviation for 'undervoltage lockout'.
(**) On board-1 650796 (fixed version), Ruv1 = 499 kΩ and Ruv2 = 100 kΩ are populated. This enables the SN6507 once the input voltage rises above 9 V. On board-2 (configurable), Ruv1 and Ruv2 are not populated. See page 18 of SN6507 datasheet (Ref[1]) for the calculation of UVLO resistors if used.

Slew-rate control (SR)

The slew-rate of the turn on and off transitions of the internal MOSFET transistors of the SN6507 can be set via pin header J9 and the resistor Rsr, as follows (figure 5):

- **Set default slew-rate:**
  Connect pins 1 and 2 together (sets default slew-rate of SN6507).
- **Set different slew-rate:**
  Connect pins 2 and 3 together and add Rsr of the required value.

Note: the resistor Rsr is populated on both boards with a value of 20.5 kΩ, which sets a slew-rate of 218 V/μs for the 750319696 transformer. See section 8.3.5 of SN6507 datasheet for guidance on adjusting Rsr for different slew-rates.

Switching frequency (FSW)

The switching frequency (fsw) is set via pin header J10 and resistor Rclk, as follows (figure 5):

- **Set fsw = 1 MHz:**
  Connect pins 5 and 6 together.
- **Set fsw = 400 kHz:**
  Connect pins 3 and 4 together.
- **Use external clock:**
  Connect pins 1 and 2 together and input external clock signal across CLK_IN and GND.

Note: Würth Elektronik transformers included in the kit have been optimized for a switching frequency of 400 kHz, and it is therefore advised to operate at this swiching frequency. Both boards use Rclk = 30 kΩ by default to set fsw = 400 kHz. On page 15 of SN6507 datasheet, details on selecting Rclk for a different switching frequency are given. Note that if no jumper is used on J10, the controller will stop switching. If using an external clock, please follow guidance provided on section 8.4.4 of SN6507 datasheet.

Duty cycle control setup (figure 6)

The 'duty-cycle control' is an optional feature of the SN6507 which allows to improve line regulation, making the output voltage level less dependent on input voltage variations. This is achieved by generating the duty-cycle as a function of the input voltage (see SN6507 datasheet for more details). The pin header J13 allows the use of jumpers to enable and disable the duty-cycle control function (DC). With figure 6 as a reference, observe the following:

- **Disable DC control:**
  Connect pins 1 and 2 together of J13
- **Enable DC control:**
  Connect pins 2 and 3 together from J13. Rdc and Rclk must be populated. For single output configuration, jumper J7 must be open, allowing L1 into the circuit. For bipolar output configuration, both jumpers J7 and J12 must be open, allowing L1 and L2 into the circuit.
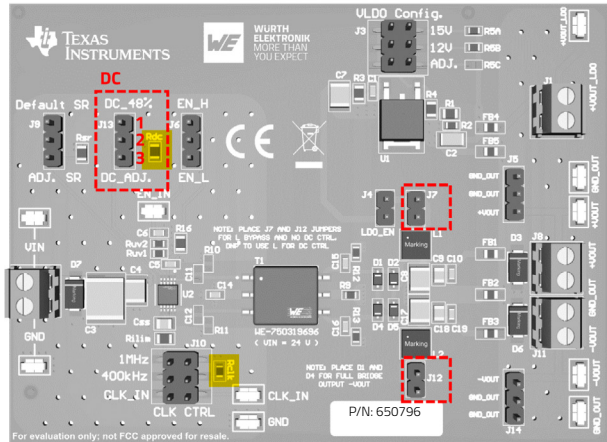
Fig. 6: Relevant jumpers and connections for duty-cycle control setup. Rclk and Rdc for duty cycle seeting marked in yellow

Important notes when using duty-cycle control:
- On 650796 board, populated resistors are Rclk = 30 kΩ and Rdc = 50.5 kΩ (see figure 6). They set a duty cycle of 0.25 at the nominal input voltage (24 V).
- On the configurable board, Rdc and Rclk are not populated. The value of R_{DC} must be calculated based on SN6507 datasheet guidelines depending on the transformer used and converter specification.
- The default value of inductors L1 and L2 on both boards is 22 µH (WE-MAPI 74438356220). The minimum inductance value for a set specification can be calculated with the formulae provided in SN6507 datasheet.

Regulated output setup (figure 7)

When using the standard single output voltage configuration, the linear voltage regulator (U1) can be used to obtain a tightly regulated output voltage, taken from J1 terminal. For this, the jumper on J4 must be in place.

- **Enable regulated output:**
  Connect J4 jumper and select output voltage with J3 jumper (*)
- **Disable regulated output:**
  Disconnect J4 jumper

(*) The pin header J3 within the regulator section of figure 7 allows to select the regulated output voltage, as follows:
  - For Vout = 15 V, connect pins 1 and 2 (default jumper connection on the board).
  - For Vout = 12 V, connect pins 3 and 4.
  - For a different Vout, connect pins 5 and 6 and populate a resistor R5C of the required value based on the LM317AM datasheet.
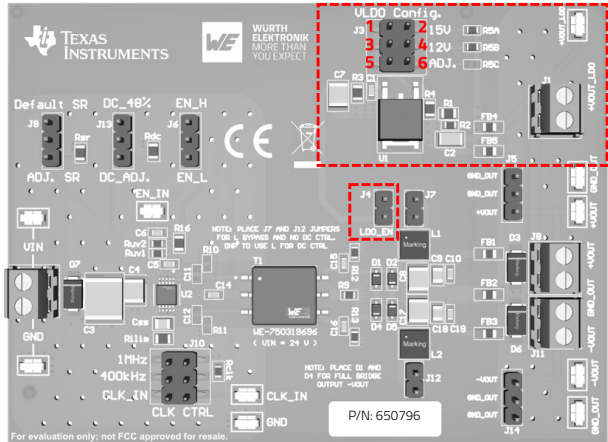

Fig. 7: Relevant jumpers and connections for regulated output setup

Pin headers J5 and J14 (figure 8)

Pin headers J5 and J14 serve as additional test points.
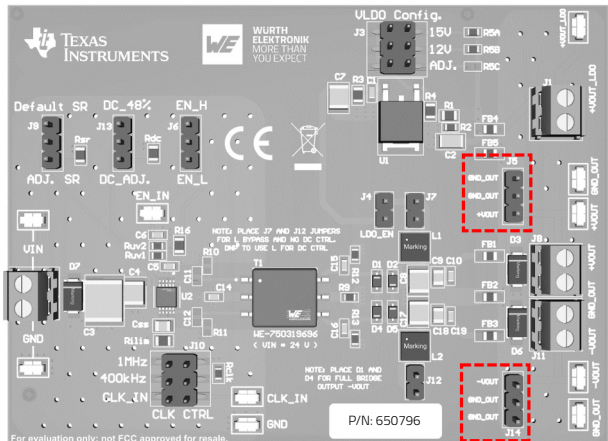**Do not connect any jumpers!**

Fig. 8: J5 and J14 pin headers – to use only as test points

Output voltage configuration

The output stage of the push-pull converter can be set in **three** different configurations, as explained in this section.

1. Single output configuration

For single output (figure 9), D2, D5 and R9 must be populated, connecting the center tap of the secondary winding to GND_OUT. The load is then connected across J8. This configuration allows the use of 'duty-cycle control' as well as regulated output with the appropriate jumper setup explained in previous section.

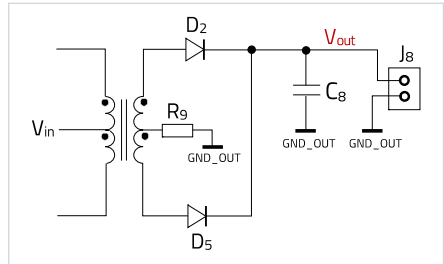The output voltage is calculated as
$V_{OUT} = n \cdot V_{IN}$

Fig. 9: *Circuit diagram detail single output configuration*

2. Bipolar output configuration

For bipolar output voltage (figure 10), diodes D1, D2, D4, D5 as well as R9 must all be populated. The loads for the positive and negative output voltage rails are connected to J8 and J11, respectively. Note that the regulated output could also be used here for the positive output voltage rail.

The positive and negative output voltages are calculated respectively as: $V_{OUT\_P} = n \cdot V_{IN}$ and
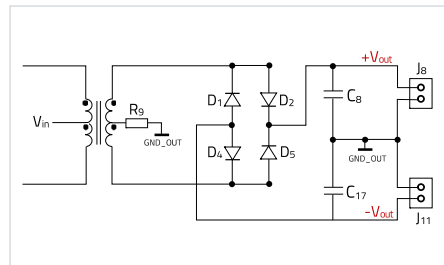$V_{OUT\_N} = -n \cdot V_{IN}$

Fig. 10: *Circuit diagram detail bipolar output configuration*

3. Voltage doubling configuration

In this configuration (figure 11), the output voltage obtained is around twice as high as for the single voltage configuration. The center tap of the secondary winding is floating and a full-wave output rectifier is used. For this, all diodes D1, D2, D4 and D5 must be populated and R9 removed.

Note that in this case the output voltage is taken from pin 2 of J8 (+Vout) to pin 1 of J11 (identified as '-Vout' on the board, but taken in this configuration as the output current return (ISO_REF)). The load must be connected across the mentioned pins. The regulated output cannot be used in this configuration, since 'GND_OUT' is floating.

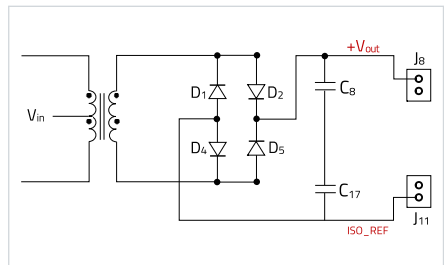The output voltage is calculated as:
$V_{OUT\_D} = 2 \cdot n \cdot V_{IN}$

Fig. 11: *Circuit diagram detail output voltage doubling*

5. TEST GUIDELINES

Test setup

This section shows the connection setup to test each output configuration as well as the recommended equipment and basic test procedure.

WARNING:
Do not short circuit the output of the DC/DC converter. Do not connect the input of the DC/DC converter in reverse polarity. To avoid damage, do not change jumpers while the board is in operation. Remove power from the board before changing jumper connections.
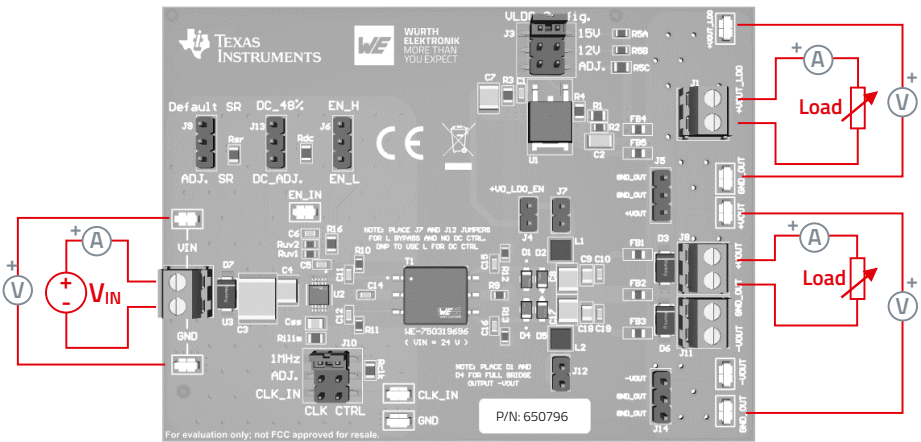

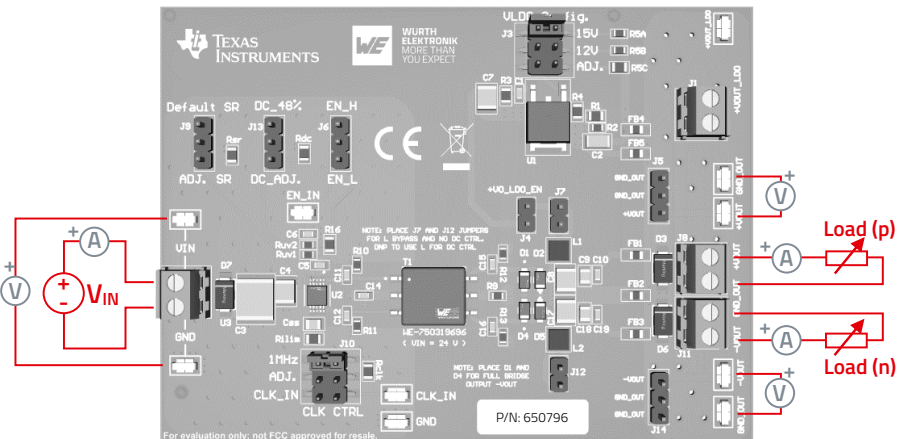**Fig. 12:** *Test connections for single output voltage configuration (regulated output optional)*

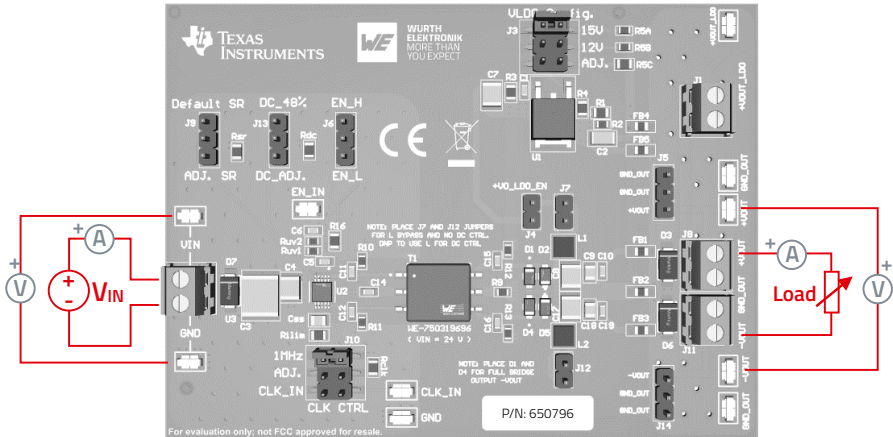**Fig. 13:** *Test connections for bipolar output voltage configuration*

Fig. 14: *Test connections for output voltage doubling configuration*

Test equipment

- Power source (recommended 30 V, 1 A or higher ratings, with current limiting capability)
- Electronic load(s) (recommended 40 V, 2 A or higher ratings)
- Digital multimeters or power analyzer
- Oscilloscope (200 MHz or higher bandwidth)

Recommended steps for power up and power down of the board

Power-up

1. Set the jumpers based on the target test configuration (see section 4).

2. Set current limit on the power suppy to 0.1 A

3. Turn on the power source at the recommended input voltage (see tables 2 and 3)
    a) If the input current is at the limit 0.1 A, then there is a problem on the board.
       Proceed to turn off the power source, recheck connections, and correct the fault.
    b) If the input current is below 0.1 A, then increase the power source current limit to 1.5 A maximum
       (depending on configuration).

4. Turn on electronic load(s) and proceed with tests.

Power-down

1. Turn off power source

2. Turn off electronic load(s)

3. Wait for **at least 2 minutes** to allow the components to cool down before handling the board again

6. SPECIFICATION AND RECOMMENDED USE

In this section, the recommended specification and usage considerations of each board in the kit are provided.

Board-1: Fixed version (650796)

Board-1 is operated from a fixed 24 V input voltage supply with the design optimized for the 750319696 transformer at a switching frequency of 400 kHz. Note that **only when using duty-cycle control,** a switching frequency of 1 MHz must be selected instead with jumper J10.

The current limit of the SN6507 IC is set by default to around 1.6 A in order to allow full-range testing to the user. However, this level is excessive for some configurations based on thermals. For safety considerations, when operating the board 'on-the-bench', at an ambient temperature of 20°C and without forced air cooling, limiting the output current to the value shown in table 2 for each specific configuration will ensure that the maximum surface temperature of any component on the board will be at a maximum of around 70 to 75°C. Note that the board can operate above these limits, but special attention to thermals would be required.

NOTE: For board-1, it is recommended to set the current limit of the input supply source to **0.8 A.**

Output Configuration	V_{in} (V)	SR (J9)	Fsw (kHz)	Linear regulator	DC Control	$I_{out\_1\_max}$ (A) (75°C)	$I_{out\_2\_max}$ (A) (75°C)	$I_{out\_REG\_max}$ (A) (75°C)
Single Output	24	Open	400	No	No	0.45	–	–
				15 V		–	–	0.25
				12 V		–	–	0.12
			1000	No	No	0.45	–	–
					Yes	0.5	–	–
Bipolar Output ($I_{out\_1} = I_{out\_2}$)			400	No	No	0.4	0.4	–
			1000			0.35	0.35	–
			1000		Yes	0.35	0.35	–
Voltage Doubling			400		No	0.35	–	–
			1000			0.35	–	–

Table 2: *Output current limit of board-1 for a maximum surface temperature of any component below around 75 °C*

Board-2: Configurable version (650700)

The second board in the **SN6507 Development kit** offers a high-degree of design flexibility. Users have the option to select a suitable transformer from those listed in previous table 1 and test it in the desired configuration. As a reference and similar to the previous case, in table 3 the maximum output current to keep the surface temperature of any component below 70 to 75 °C (with an ambient temperature of around 20 °C) is provided, alongside the limiting component(s). These results were obtained with single output configuration and 400 kHz switching frequency.

Transformer	V_{in} (V)	V_{out} (V)	Type	F_{sw} (kHz)	I_{out_1} (A) (75 °C)	Component (75 °C)
750320396	12	3.3	EPX6	400	0.9	D2, D5
750320397	12	5			0.9	D2, D5
750320398	12	12			0.75	D2, D5, U2
750320399	12	15			0.65	U2
750320400	12	24			0.4	U2
750320401	12	30			0.30	U2
750320402	24	3.3			1	D2, D5
750320403	24	5			0.85	D2, D5
750320404	24	12			0.85	D2, D5
750320375	24	15			0.85	D2, D5
750320405	24	24			0.65	U2, T1
750320383	24	30			0.4	U2
750320324	12	3.3	Toroid-1308		0.9	D2, D5
750319690	12	5			0.8	D2, D5
750319691	12	12			0.6	T1
750319692	12	15			0.65	U2
750319693	12	24			0.4	U2
750319949	12	30			0.3	U2, T1
750320325	24	3.3			0.9	D2, D5
750319694	24	5			0.85	D2, D5
750319695	24	12			0.8	D2, D5, T1
750319697	24	24			0.5	T1
750319948	24	30			0.3	T1

Table 3: *Output current limit of board-2 for a maximum surface temperature of any component below around 75 °C*

CAUTION:
Components surfaces may become very hot. Do not touch the board while in operation and wait at least 2 min after power-down before handling the board again.

7. EMC TEST RESULTS

The board-1 (650796) has been tested for electromagnetic emissions based on CISPR-32 Class B standard and limits. Components C20, L3 and FB1 to FB5 were added to pass the test. Note that these results provide insights into the EMC signature of the board, but the EMC performance when the auxiliary supply is integrated into a larger PCB and into a product may differ.

Board-1 (650796) test configuration: Vin = 24 V, Vout = 15 V, Fsw = 400 kHz, Iout = 0.5 A, single output

Fig. 15:
CISPR-32 Conducted emissions setup
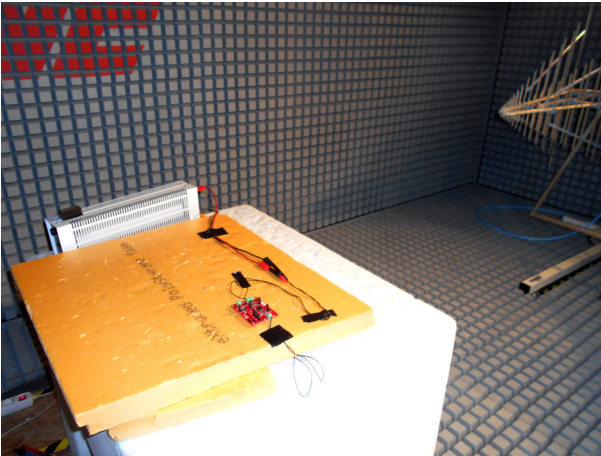
Fig. 16:
CISPR-32 Radiated emissions setup

Conducted emissions results (CISPR-32 Class B limits)

The switching frequency harmonic at 800 kHz (mostly differential mode noise) and the common-mode noise close to 30 MHz caused a failed test (figure 17), but they were corrected by adding L3 and C20 (figure 18).
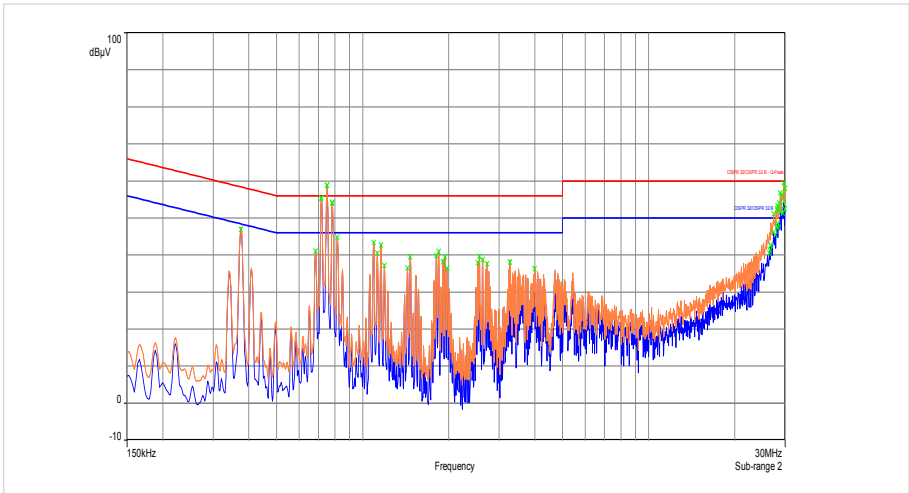

Fig. 17: CISPR-32 Class B - Conducted emissions results without L3 and C20
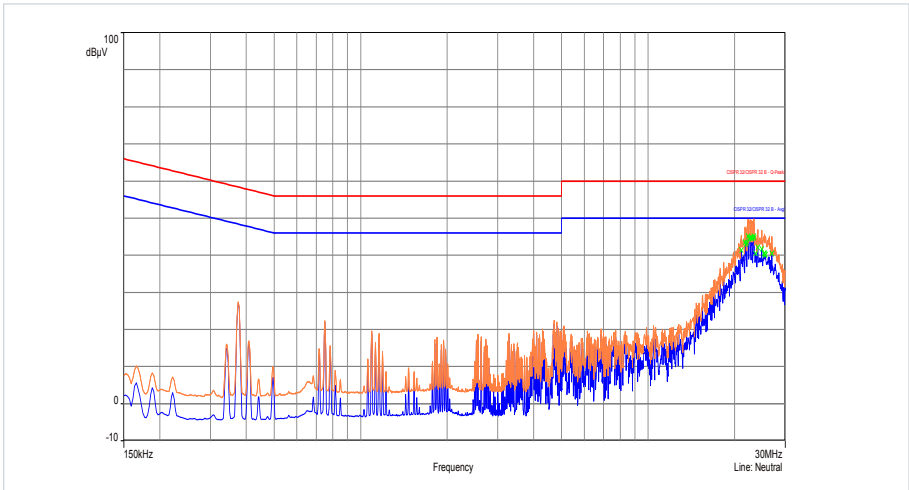

Fig. 18: CISPR-32 Class B Conducted emissions results with L3 and C20

Radiated emissions results (CISPR-32 Class B limits)

The radiated emissions signature shows high common-mode noise between 40 and 100 MHz (mainly due to the output diodes characteristics) and around 200 MHz (due to GND planes on the board acting as antenna), both causing a failed test. These were corrected with C20 and FB1 to FB5 ferrite beads.
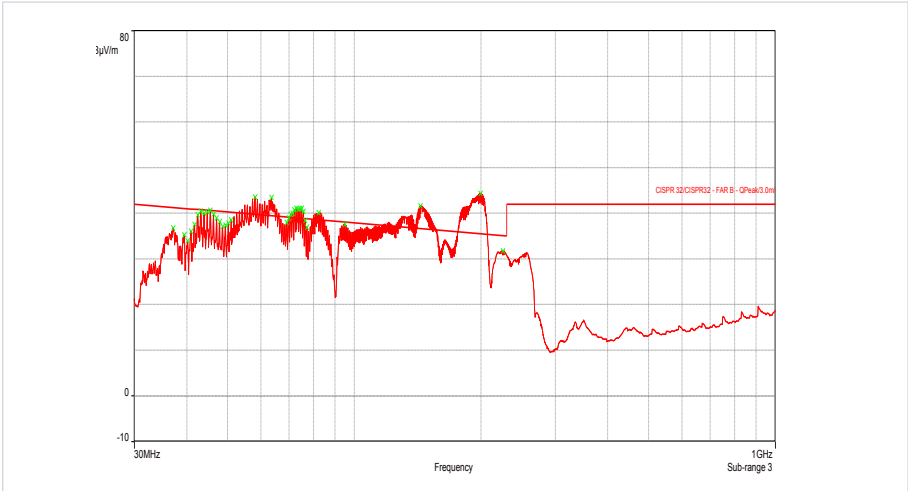

Fig. 19: CISPR-32 Class B Radiated emissions results without C20, L3, FB1 to FB5

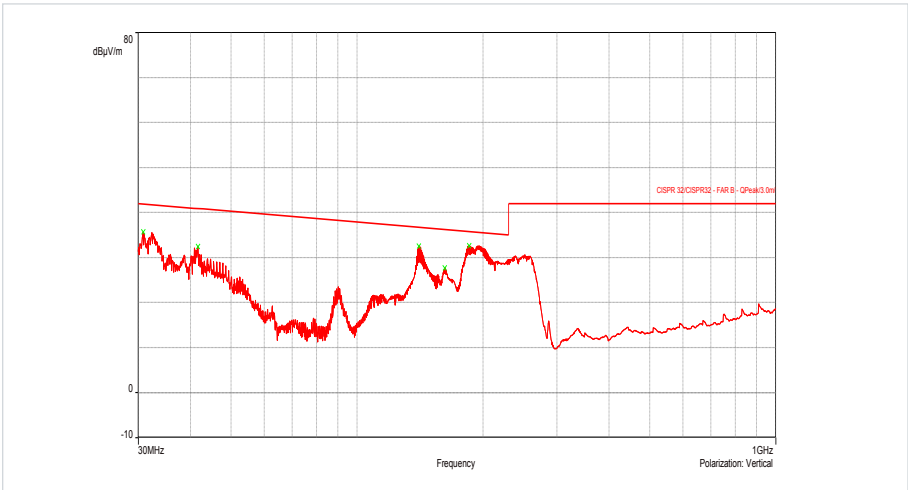**Fig. 20:** CISPR-32 Class B Radiated emissions results with C20, L3, FB1 to FB5

8. SCHEMATIC

The generic schematic of both boards is shown below. The only difference is that C21 and C22 are not present in board-1. The PCB layout and bill-of-materials (BoM) of each board are shown in sections 9 and 10.
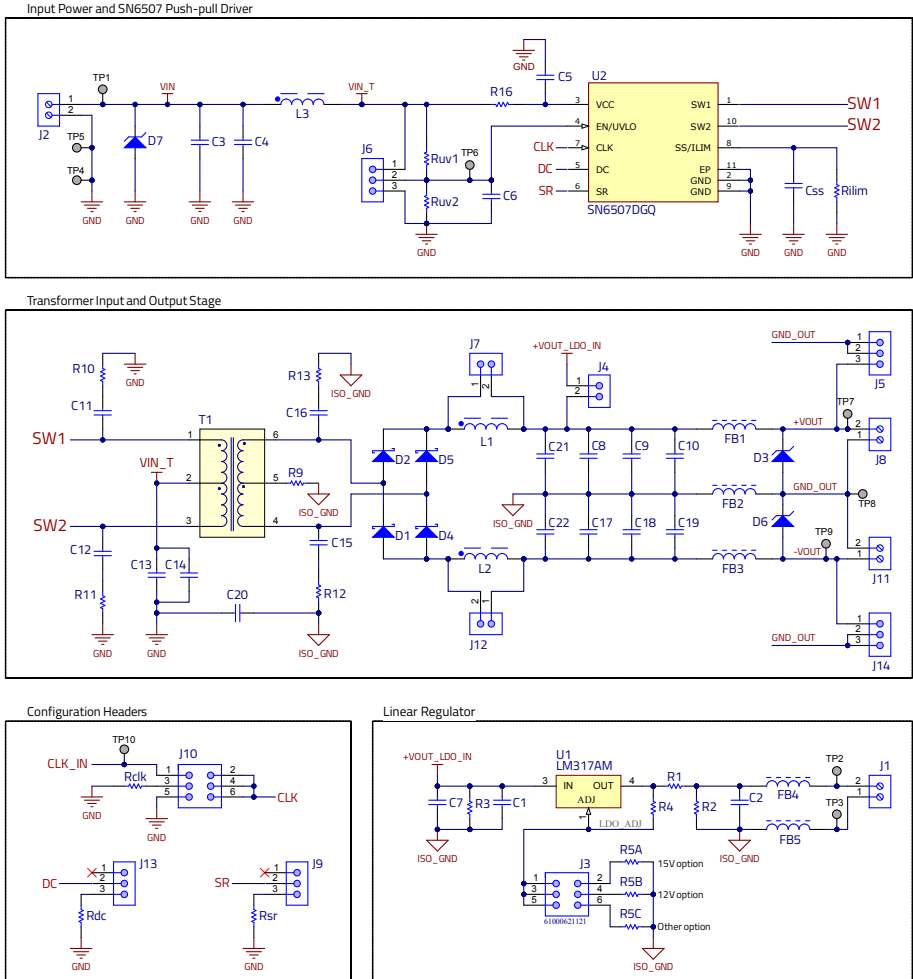

Fig. 21: Generic schematic of board-1 (650796) and board-2 (650700) (C21 and C22 not present in board-1)

9. PCB LAYOUT

Board-1: 650796 (Fixed version)
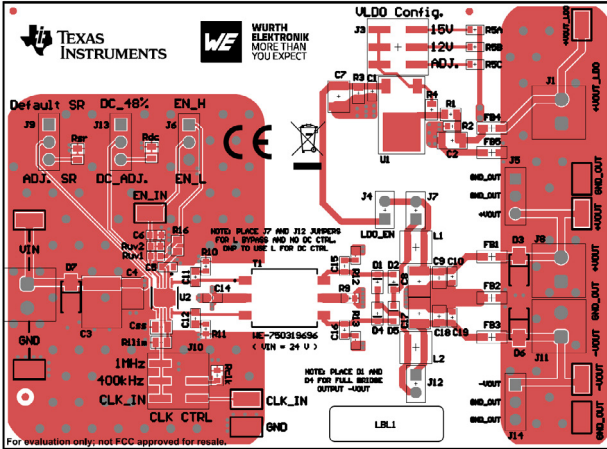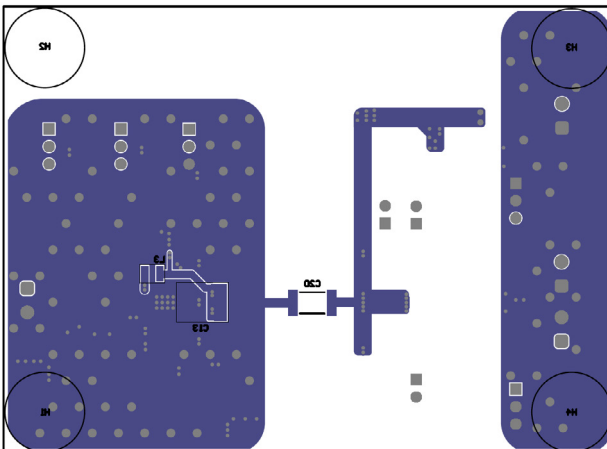

Fig. 22: *Top layer copper of board-1*

Fig. 23: *Bottom layer copper of board-1*
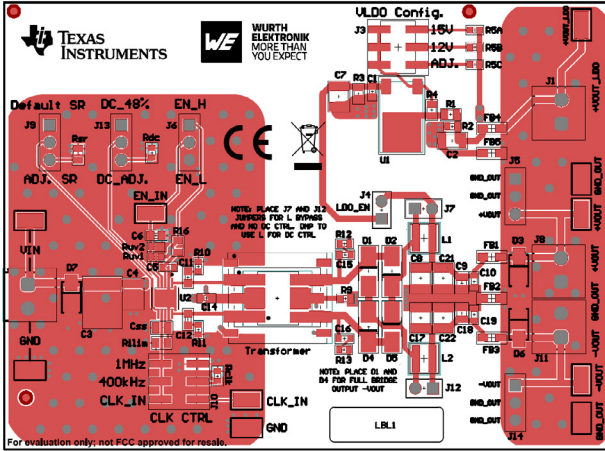
Board-2: 650700 (Configurable version)
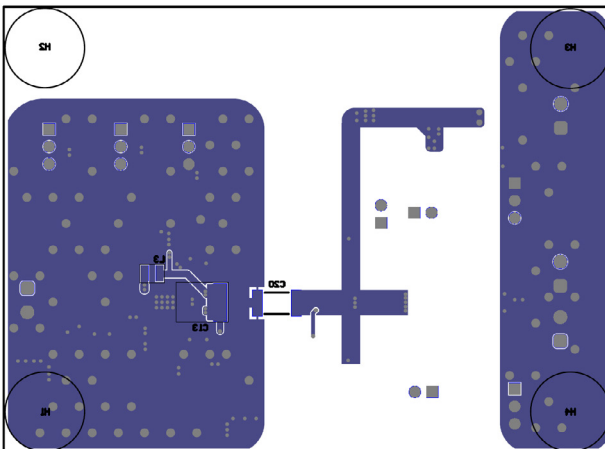

Fig. 24: *Top layer copper of board-2*

Fig. 25: *Bottom layer copper of board-2*

10. BILL OF MATERIALS (BOM)

Reference	Description	Package	Manufacturer	Order Code
	Bill-of-materials for BOARD-1 (650796)			
C1, C5, C6, C14	WCAP-CSGP 100 nF, 100 VDC	0603	WE	885012206120
C2	WCAP-CSGP 10 uF, 50 VDC	1206	WE	885012108022
C3, C13	WCAP-CSGP 10 uF, 100 VDC	2220	WE	885012214006
C4	WCAP-CSGP 1 uF, 100 VDC	1210	WE	885012209069
C7, C8, C17	WCAP-CSGP 10 uF, 50 VDC	1210	WE	885012209073
C9, C18	WCAP-CSGP 1 uF, 50 VDC, 0805	0805	WE	885012207103
C10, C19	WCAP-CSGP 100 nF, 50 VDC	0603	WE	885012206095
C11, C12	Not populated	0603	N/A	N/A
C15, C16	WCAP-CSGP 68 pF, 100 VDC	0603	WE	885012006078
C20	WCAP-CSSA 2.2 nF, 250 VAC, X1/Y2	2211	WE	8853522130151
Css	WCAP-CSGP 2.2 uF, 10 VDC	0805	WE	885012207024
FB1 to FB5	WE-CBF-HC 1.5 kΩ @ 100 MHz, 1A	0805	WE	742792097
D1, D2, D4, D5	40 V, 0.75 A Schottky rectifier	SOD-323	Nexperia	BAT165AX
D3, D6, D7	WE-TVSP 36 VDC, 6.9 Apeak	SMA	WE	824500361
J1, J2, J8, J11	WR-TBL 2 pin, 3.5 mm, 10 A, 300 VAC	THT	WE	691214110002
J3, J10	WR-PHD 6 pin, dual row, 2.54 mm, Vertical	SMT	WE	61000621121
J4, J7, J12	WR-PHD 2 pin, 2.54 mm, Vertical	THT	WE	61300211121
J5, J6, J9, J13, J14	WR-PHD 3 pin, 2.54 mm, Vertical	THT	WE	61300311121
H1 to H4	Bumpon, Hemisphere, 0.44 x 0.20, Clear	N/A	3M	SJ-5303 (CLEAR)
L1, L2	WE-MAPI 4020 22 µH, 1.85 A, 0.25 Ω	SMD	WE	74438356220
L3	WE-PMI Power Inductor	1050	WE	74479887222A
LBL1	Thermal Printable Label, 0.650" x 0.200"		Brady	THT-14-423-10
R1, R16	WRIS-RSKS Resistor 0 Ω, 0.125 W	0805	WE	560112120002
R2	WRIS-RSKS Resistor 10 kΩ, 0.1 W, 5%	0603	WE	560112116012
R3	WRIS-RSKS Resistor 10 kΩ, 0.25 W, 1%	0805	WE	560112120004
R4	WRIS-RSKS Resistor 240 Ω, 0.1 W, 1%	0603	WE	560112116089
R5A	WRIS-RSKS Resistor 2.67 kΩ, 1%, 0.1 W	0603	WE	560112116127
R5B	WRIS-RSKS Resistor 2 kΩ, 1%, 0.1 W	0603	WE	560112116091
R9, R5C	WRIS-RSKS Resistor 0 Ω, 5%, 0.1 W	0603	WE	560112116001
R10, R11	Not populated	0603	N/A	N/A
R12, R13	WRIS-RSKS Resistor 100 Ω, 0.1 W, 5%	0603	WE	560112116008
Rclk	WRIS-RSKS Resistor 30 kΩ, 0.1 W, 1%	0603	WE	560112116107
Rilim	Resistor 18.2 kΩ, 0.125 W, 1%	0805	Panasonic	ERJ-6ENF1822V
Rsr	Resistor 20.5 kΩ, 0.125 W, 1%	0805	Panasonic	ERJ-6ENF2052V
Ruv1	Resistor 499 kΩ, 1%, 0.1 W	0603	Yageo	RC0603FR-07499KL
Ruv2	Resistor 100 kΩ, 1%, 0.1 W	0603	WE	560112116004
Rdc	Resistor 50.5 kΩ, 0.1%, 0.125 W	0805	Yageo	RT0805BRD0750K5L
SH-J1 to SH-J7	Shunt, 100 mil, Gold plated, Black	N/A	WE	609002115121
T1	Push-pull Transformer 24 V to 15 V, 2.5 kVac	SMD	WE	750319696
TP1 to TP10	Test Point, Miniature	SMD	Keystone	5019
U1	Adjustable Linear Regulator 1.5 A, 1%	TO-252-3	TI	LM317AMDT
U2	36 V Push-Pull Transformer Driver	HVSSOP	TI	SN6507DGQ

Table 4: Bill-of-materials for board-1 (650796)

Bill-of-materials for BOARD-2 (650700)				
Reference	Description	Package	Manufacturer	Order Code
C1, C5, C14	WCAP-CSGP 100 nF, 100 VDC	0603	WE	885012206120
C2	WCAP-CSGP 10 uF, 50 VDC	1206	WE	885012108022
C3, C13	WCAP-CSGP 10 uF, 100 VDC	2220	WE	885012214006
C4	WCAP-CSGP 1 uF, 100 VDC	1210	WE	885012209069
C6, C11, C12	Not populated	0603	N/A	N/A
C7, C8, C17, C21, C22	WCAP-CSGP 1 0uF, 50 VDC	1210	WE	885012209073
C9, C18	WCAP-CSGP 1 uF, 50 VDC, 0805	0805	WE	885012207103
C10, C19	WCAP-CSGP 100 nF, 50 VDC	0603	WE	885012206095
C15, C16	WCAP-CSGP 68 pF, 100 VDC	0603	WE	885012006078
C20	WCAP-CSSA 2.2 nF, 250 VAC, X1/Y2	2211	WE	8853522130151
Css	WCAP-CSGP 2.2 µF, 10 VDC	0805	WE	885012207024
FB1 to FB5	WE-CBF-HC 1.5 kΩ @ 100 MHz, 1A	0805	WE	742792097
D1, D2, D4, D5	100 V, 2 A Schottky barrier rectifier	SOD-323	Nexperia	PMEG10020AELP
D3, D6, D7	WE-TVSP 36 VDC, 6.9 Apeak	SMA	WE	824500361
J1, J2, J8, J11	WR-TBL 2 pin, 3.5 mm, 10 A, 300 VAC	THT	WE	691214110002
J3, J10	WR-PHD 6 pin, dual row, 2.54 mm, Vertical	SMT	WE	61000621121
J4, J7, J12	WR-PHD 2 pin, 2.54 mm, Vertical	THT	WE	61300211121
J5, J6, J9, J13, J14	WR-PHD 3 pin, 2.54 mm, Vertical	THT	WE	61300311121
H1 to H4	Bumpon, Hemisphere, 0.44 x 0.20, Clear	N/A	3M	SJ-5303 (CLEAR)
L1, L2	WE-MAPI 4020 22 µH, 1.85 A, 0.25 Ω	SMD	WE	74438356220
L3	WE-PMI Power Inductor	1050	WE	74479887222A
LBL1	Thermal Printable Label, 0.650" x 0.200"		Brady	THT-14-423-10
R1, R16	WRIS-RSKS Resistor 0 Ω, 0.125 W	0805	WE	560112120002
R2	WRIS-RSKS Resistor 10 kΩ, 0.1 W, 5%	0603	WE	560112116012
R3	WRIS-RSKS Resistor 10 kΩ, 0.25 W, 1%	0805	WE	560112120004
R4	WRIS-RSKS Resistor 240 Ω, 0.1 W, 1%	0603	WE	560112116089
R5A	WRIS-RSKS Resistor 2.67 kΩ, 1%, 0.1 W	0603	WE	560112116127
R5B	WRIS-RSKS Resistor 2 kΩ, 1%, 0.1 W	0603	WE	560112116091
R9	WRIS-RSKS Resistor 0 Ω, 5%, 0.1 W	0603	WE	560112116001
R5C, R10, R11, Rdc, Ruv1, Ruv2	Not populated	0603	N/A	N/A
R12, R13	WRIS-RSKS Resistor 100 Ω, 0.1 W, 5%	0603	WE	560112116008
Rclk	WRIS-RSKS Resistor 30 kΩ, 0.1 W, 1%	0603	WE	560112116107
Rilim	Resistor 18.2 kΩ, 0.125 W, 1%	0805	Panasonic	ERJ-6ENF1822V
Rsr	Resistor 20.5 kΩ, 0.125 W, 1%	0805	Panasonic	ERJ-6ENF2052V
SH-J1 to SH-J7	Shunt, 100 mil, Gold plated, Black	N/A	WE	609002115121
T1	Not populated	SMD	N/A	Select
TP1 to TP10	Test Point, Miniature	SMD	Keystone	5019
U1	Adjustable Linear Regulator 1.5 A, 1%	TO-252-3	TI	LM317AMDT
U2	36 V Push-Pull Transformer Driver	HVSSOP	TI	SN6507DGQ

Table 5: Bill-of-materials for board-2 (650700 Configurable)

11. IMPORTANT NOTES

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