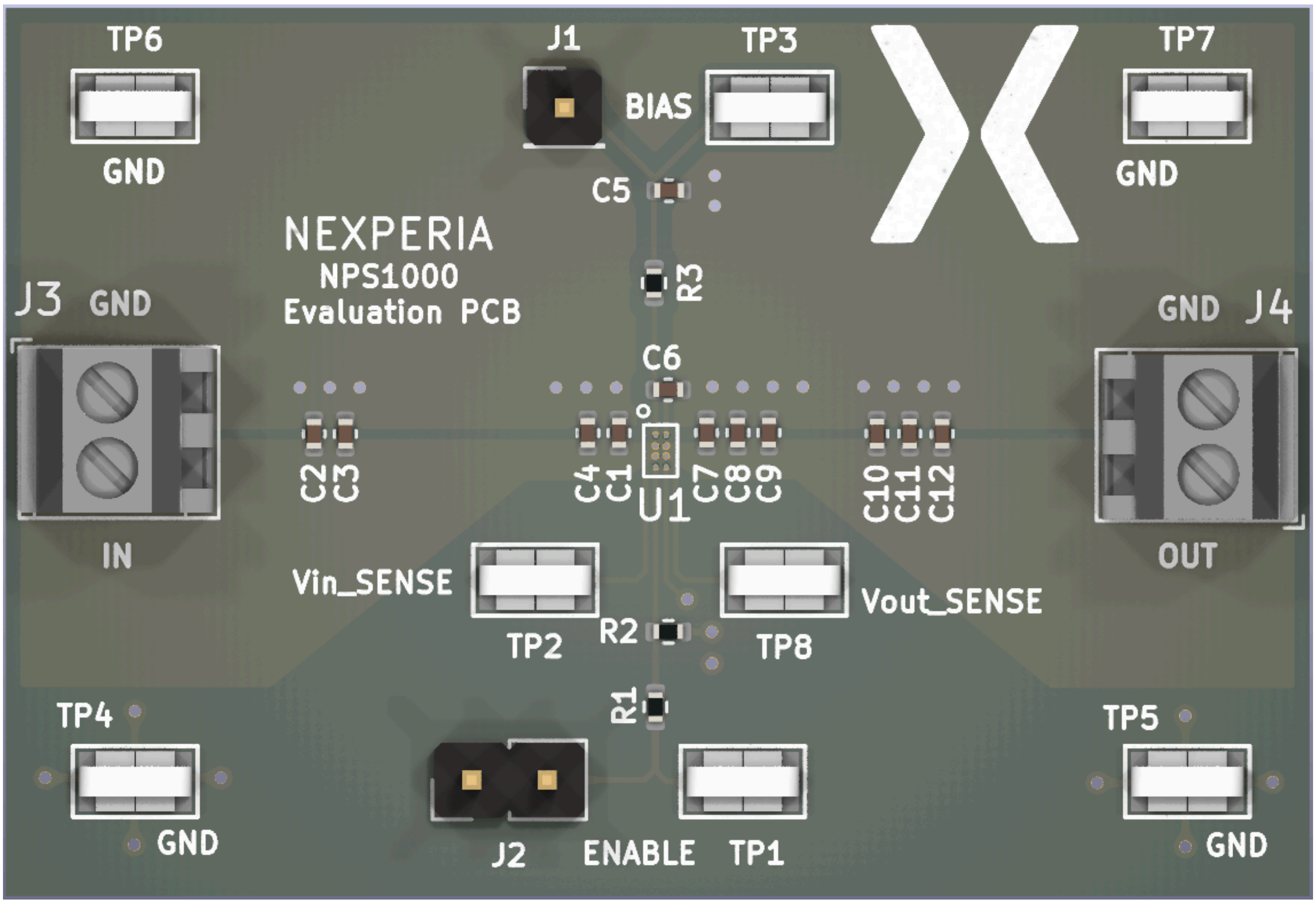
UM90027

Rev. 1.2 — 24 June 2024 User manual

NEVB-NPS1000 load switch evaluation board



Abstract: The NEVB-NPS1000 is a two-layer PCB containing the NPS1000 load switch device. The VIN and VOUT connections to the device and the PCB layout routing provides a low-resistance pathway into and out of the device under test. Test point connections allow the EVB user to control the device with user-defined test conditions and make accurate RON measurements.

Keywords: Load switch, evaluation board (EVB)

1. Introduction

The NEVB-NPS1000 is a dedicated PCB featuring the Nexperia load switch IC NPS1000, see Fig. 1.

The board is a 2-layer PCB with a substantial ground layer. The PCB layout routing provides a low-resistance pathway into and out of the device under test. The test points are designed as separate voltage sensing connections on the PCB for accurate voltage and R_{ON} measurements where the test results are not influenced by voltage drops created by the load current. Solid input and output connections are provided with convenient test-point connection pins as well as robust solder pins. There are several connection terminals for GND and test points at the input and output of the load switch to allow a simple and very convenient connection of oscilloscope probes.

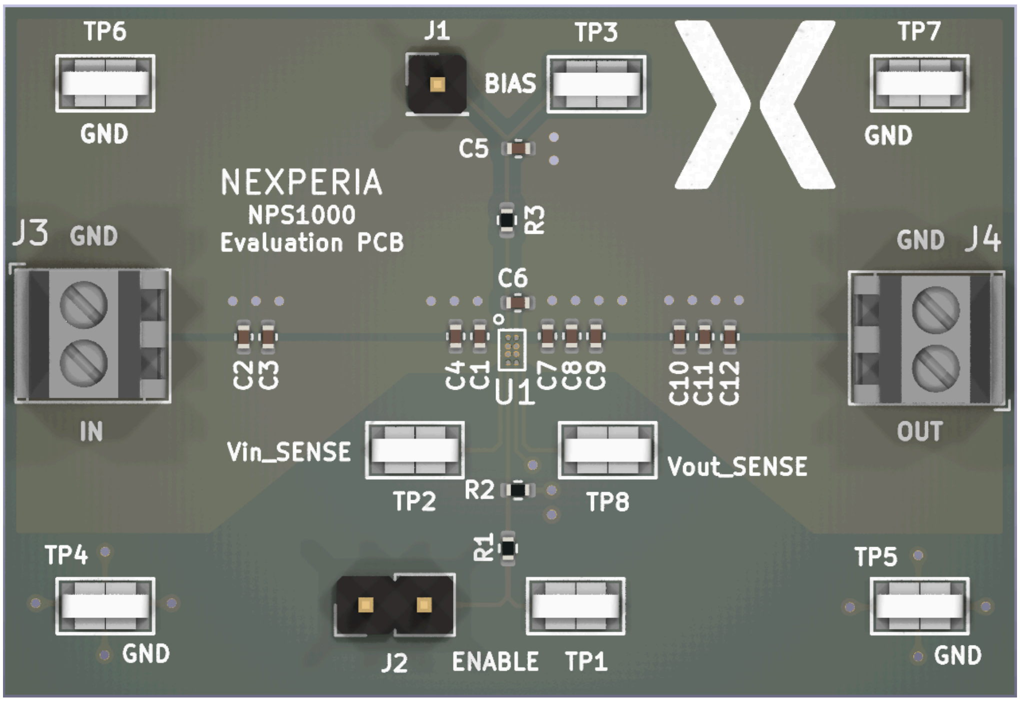


Fig. 1. NEVB-NPS1000- evaluation board for load switch IC NPS1000

1.1. EVB key parameters

- EVB name = NEVB-NPS1000
- Device = NPS1000
- EVB input voltage range (VIN): 0.5 V to 1 V
- EVB maximum current = 600 mA RMS (1.5 A peak)
- EVB features:
  - Soft start
  - Over temperature protection
  - Bias UVLO protection

1.2. Features

- Input voltage can be supplied via the test points J3 (VIN), VIN can range from 0.5 V to 1 V.
- A test load can be connected to terminal J4 (VOUT).
- Alternatively, there are GND test points at TP4, TP5, TP6, and TP7.
- Decoupling capacitors are connected to VIN at the input of the EVB and close to the load switch IC. The same holds for the output.
- The enable pin (EN) and the bias pin (BIAS) both have convenient connections to a pin header and miniature test point, which allows seamless oscilloscope connection while driving the pins with external sources.
- VIN_Sense (TP2) and VOUT_Sense (TP8) are used when accurate measurements of the input or output are required. Make R_{ON} measurements using these Kelvin sense connections when measuring the voltage drop from VIN to VOUT.

2. Schematic

Fig. 2 shows the schematic diagram of the NEVB-NPS1000 evaluation board. The components, solder pins, connectors and test points described in the feature list above can be found here.

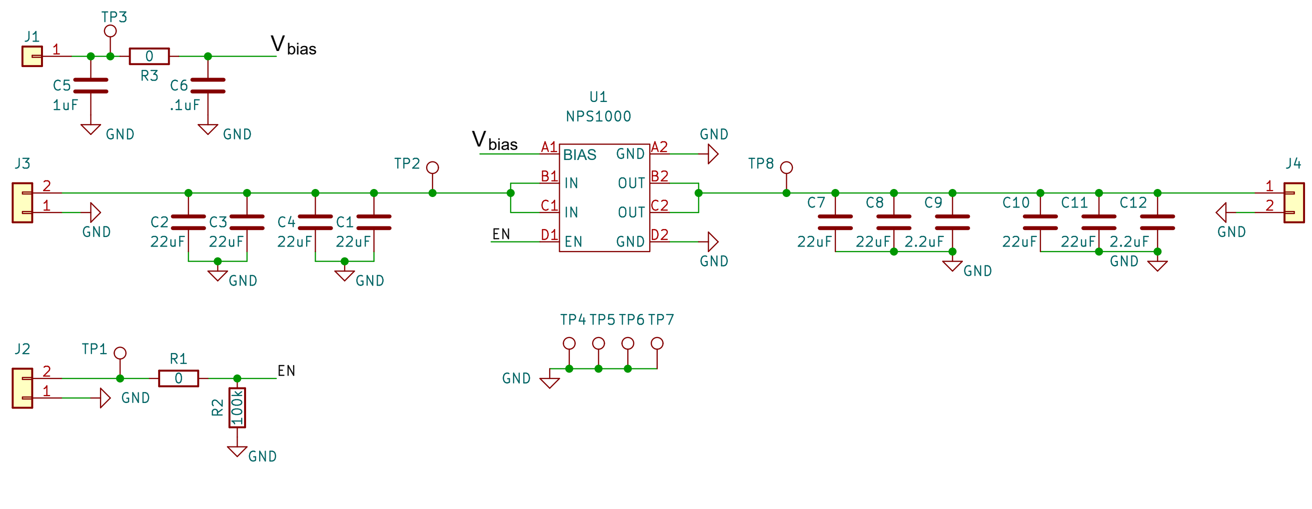
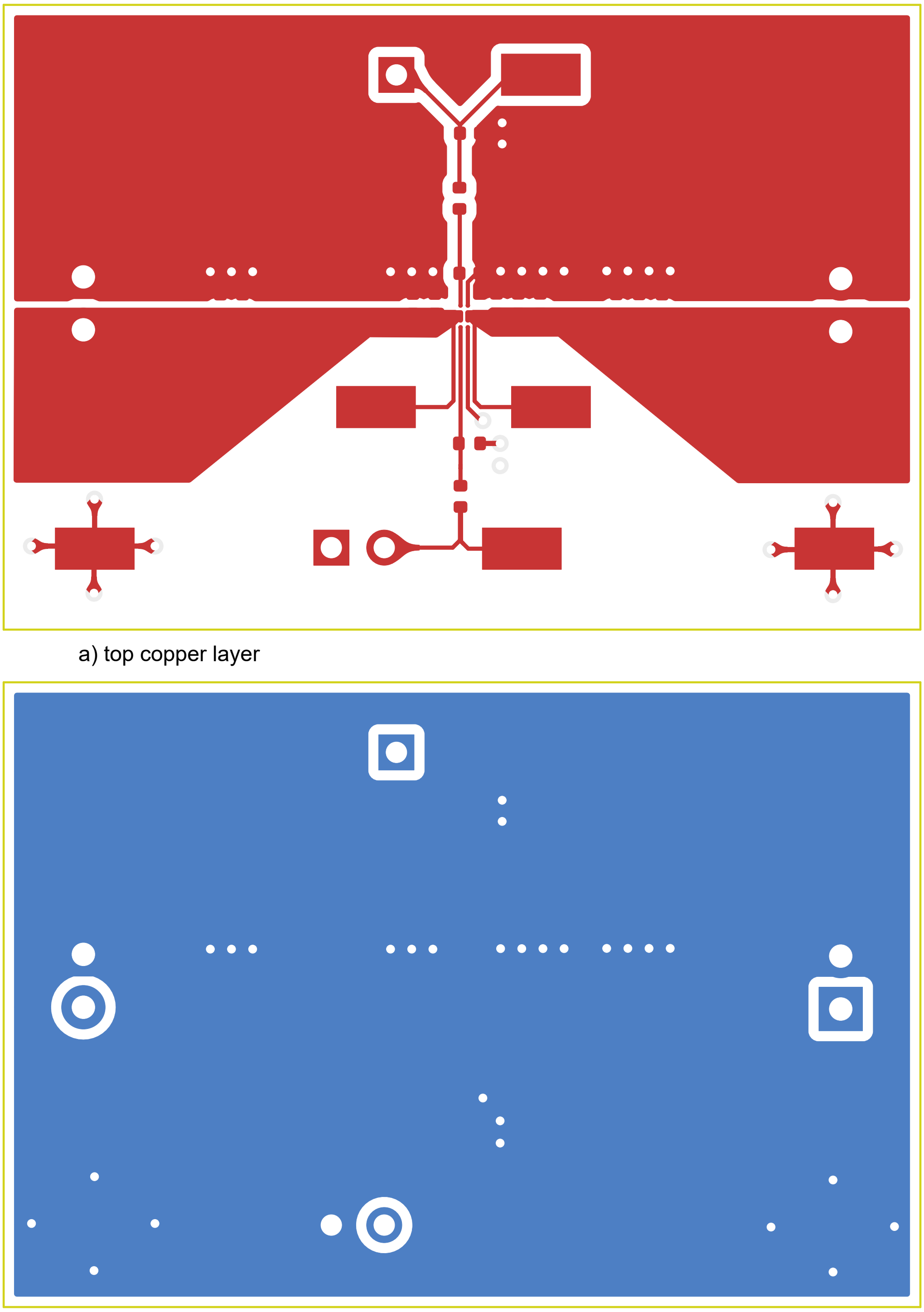


Fig. 2. NEVB-NPS1000 schematic diagram

3. PCB layout

Fig. 3 shows the PCB layout of the NEVB-NPS1000. The PCB measures 44 mm x 30 mm and has two copper layers, the top copper layer is shown in a), the bottom layer is shown in b). Figure Fig. 4 shows the PCB silkscreen.



a) top copper layer

b) bottom copper layer

Fig. 3. NEVB-NPS1000 PCB layout

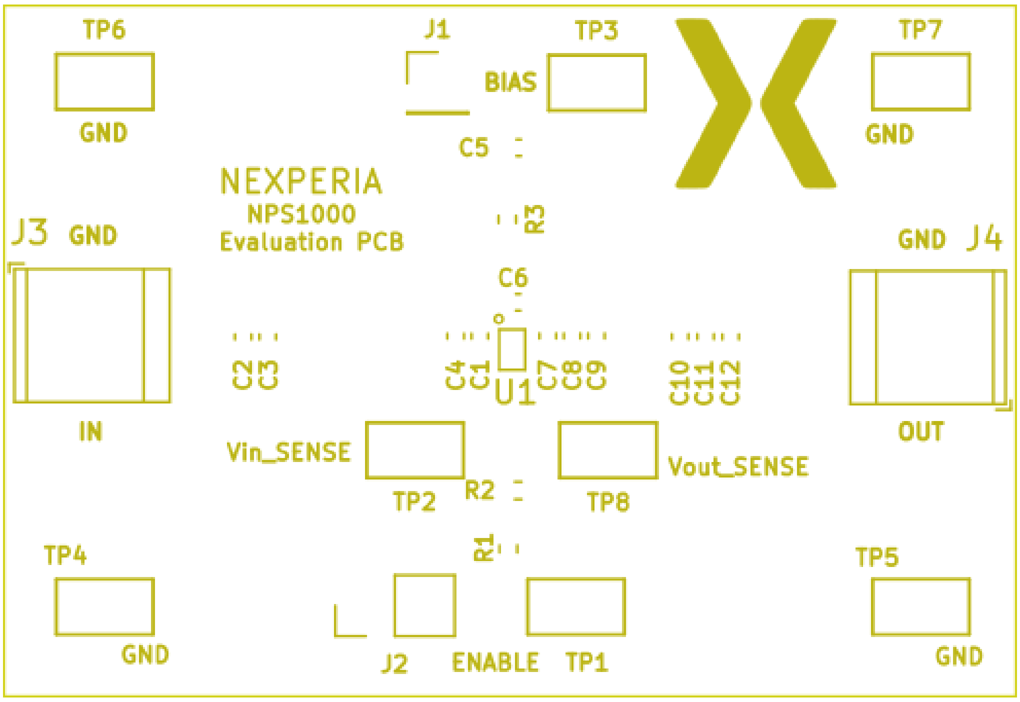


Fig. 4. NEVB-NPS1000 PCB silkscreen

4. Bill of Materials (BOM)

Table 1. NPS1000 EVB Bill of Materials

Reference designator	Quantity	Description	MFG	Component
	1	Printed Circuit Board		PCB
C1, C2, C3, C4,C7, C8, C10, C11	8	22 µF ±20% 4V Ceramic Capacitor X6S 0402 (1005 Metric)	Murata	GRM158C80G 226ME01J
C6	1	0.1 µF ±20% 10V Ceramic Capacitor X7R 0402 (1005 Metric)	Taiyo Yuden	LMF105B7104MVHF
C9, C12	2	2.2 µF ±20% 10V Ceramic Capacitor X7S 0402 (1005 Metric)	Murata	GRM155C71A 225ME11D
C5	1	1 µF ±10% 10V Ceramic Capacitor X7R 0402 (1005 Metric)	Murata	GRM155Z71A1 05KE01J
J1	1	CONN HEADER VERT 1POS	TE Connectivity	103327-1
J3, J4,	2	CONN HEADER VERT 2POS 2.54MM	TE Connectivity	282834-2
J2	1	CONN HEADER VERT 2POS 2.54MM	TE Connectivity	103327-2
R1,R3	2	0 Ohms Jumper Chip Resistor 0402 (1005 Metric) Automotive AEC-Q200 Thick Film	Vishay Dale	CRCW04020000 Z0EDC
R2	1	RES 100K OHM 1% 1/16W 0402	Yageo	RC0402FR-07100KL
TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8	8	PC TEST POINT MINIATURE	Keystone	5019
U1	1	NPS1000 Load Switch IC Package_WLCSP8_SOT8068	Nexperia	NPS1000

5. Set up and operation

The NEVB-NPS1000 board is easy to set up and operate. This chapters gives some instructions for proper use.

5.1. Input supply

The input voltage source VIN is connected to the points J3 (IN), VIN. This is where the positive lead is connected and accepts 0.5 V to 1 V. It is recommended to limit the current from the external power supply to 4.5 A to prevent damage to the device in an overcurrent event. The points J3 (GND), J4 (GND), TP4, TP5, TP6, TP7 are the ground connections.

The bias voltage source V_{bias} is connected to the points J1 and TP3. This is where a separate bias voltage supply is used to power the device. The recommended voltage range for V_{bias} is 2.3 V to 5 V.

5.2. Load switch output

Loads at the output can be connected via the connection terminal J4 (OUT). The direct ground connections are appropriately labeled across the EVM as well as J4 (GND). The range of load currents that can be supported are 0 A to 0.6 A RMS continuous with a 1.5 A peak current.

5.3. Enable control

Connector J2 connects the enable input EN of the load switch IC to either a separate supply or GND, hence turning the load switch IC ON or OFF. The range of voltages the EN pin can accommodate are from 0 V to 5 V. The voltage threshold at which the device turns from its OFF state to its ON state is 0.72 V on the EN pin. External control signals can be applied via J2 pin 2 from an external function generator for example see Fig. 5. A minimum of 5 μs on/off time is required for toggling the EN high or low depending on the desired state of the load switch.

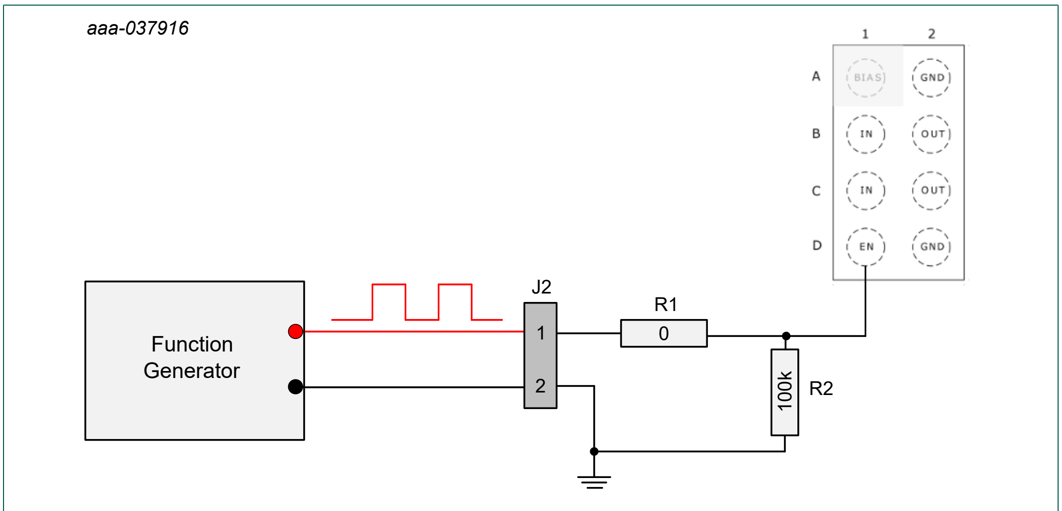


Fig. 5. NEVB-NPS1000 enable options

5.4. Voltage sense test points

The NEVB-NPS1000 includes Kelvin sense test points for VIN and VOUT, these are labeled VIN_Sense and VOUT_Sense. These test pins allow for precise measurement of the input and output voltages present at the package pins of the load switch IC. At these test points there is no influence from voltage drop due to the impedance of the PCB traces. R_{on} can be evaluated with exact results at these test points as:

$$R_{ON} = \frac{(VIN\_Sense - VOUT\_Sense)}{I_{OUT}} \quad (1)$$

5.5. Start-up operation

To start operating the NEVB-NPS1000, connect a power supply with 0.5 V to 1 V to VIN. The load switch needs to be enabled by a separate control signal to J2 Pin 2 (EN), and by applying a voltage between 2.3 V and 5 V to the V_{bias} pin located at J1 (BIAS).

The order of operation for powering the load switch is as follows:

1) Turn on the bias voltage (2.3 V to 5 V)

2) Apply voltage to VIN (0.5 V to 1 V)

3) Apply voltage at EN to turn on the device (1.2 V to 5 V)

4) Turn on load

Various output loads can be applied to the switch by using the J4 terminal (0 A to 0.6 A RMS with 1.5 A peak). When the EN pin is asserted high, the output of the NPS1000 is enabled. When the EN is disabled, the output rail will discharge through the internal quick output discharge resistance of the device.

6. Test configurations

6.1. Dynamic parameter testing

Dynamic parameters like the smooth turn-on of the NPS1000 can be measured at VOUT_Sense using an oscilloscope. At TP1 the enable signal can be accessed and used as trigger signal.

Fig. 6 shows the oscilloscope connection points for measurement of VIN and VOUT with triggering from the enable input. With the same set-up the fall time of VOUT can be measured.

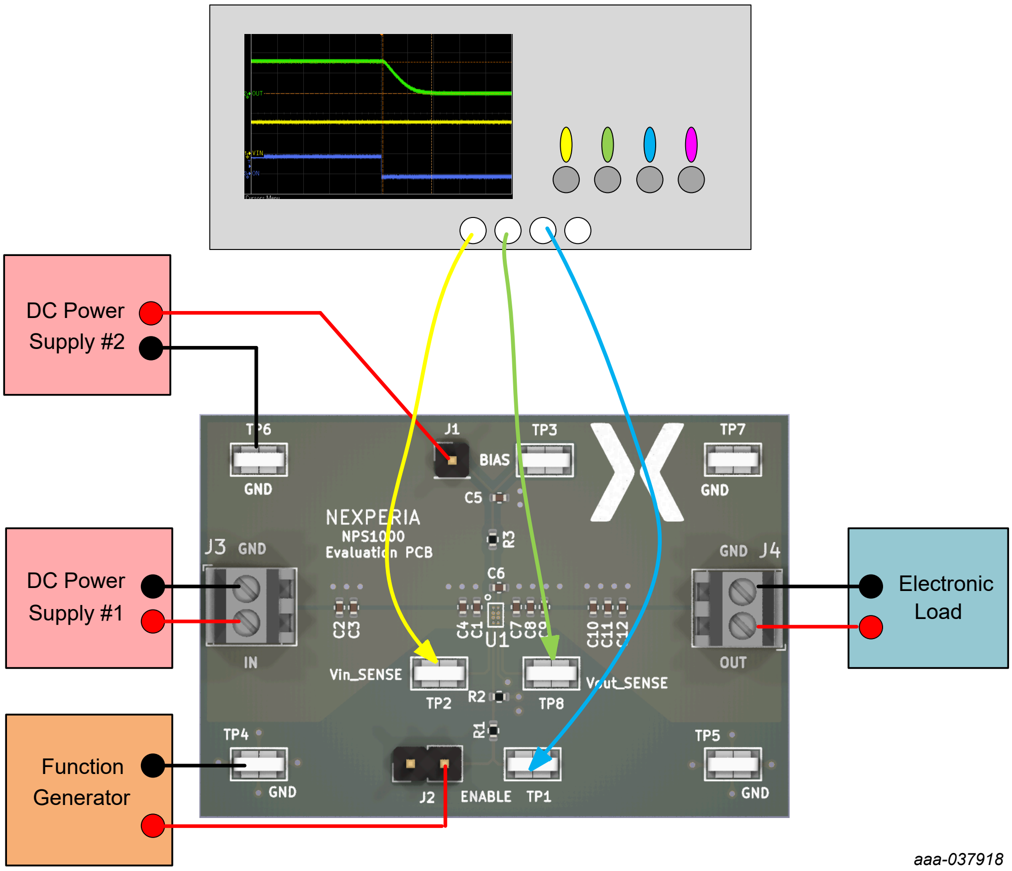


Fig. 6. Measurement set-up for dynamic parameters e.g. VOUT rise and fall times

6.1.1. Rise time (t_r) and fall time (t_f)

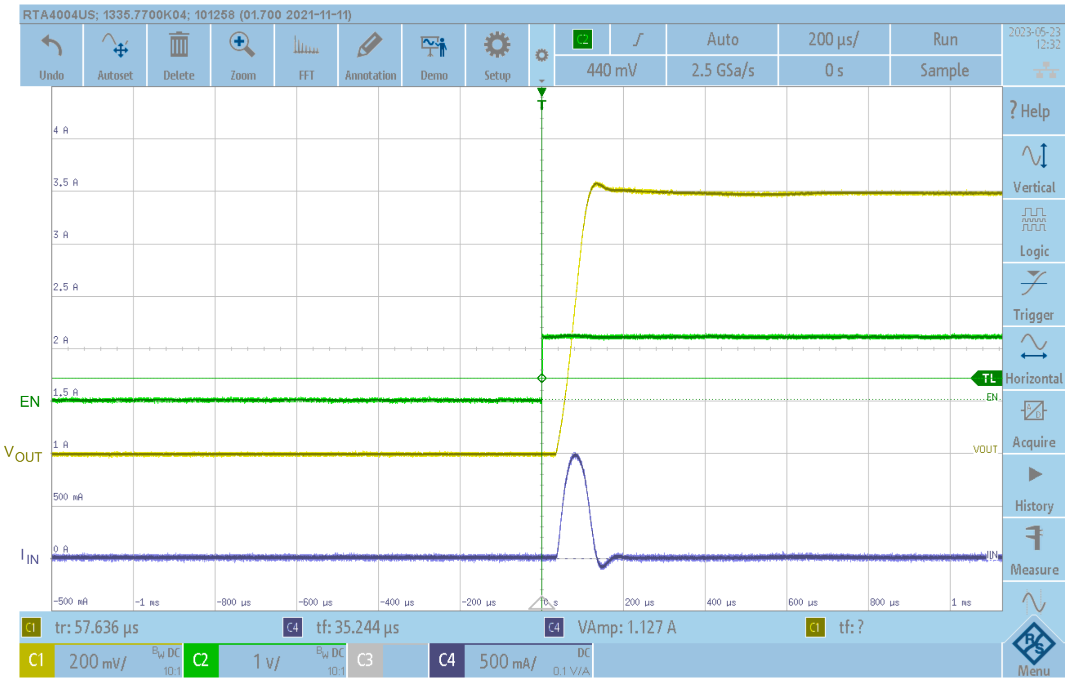
The rise time and fall times of the NPS1000 output can be measured using the test set up in Fig. 6. For a typical test set up:

1) Set the bias voltage supply of the supply between 2.3 V and 5 V at J1 or TP3

2) Set the input voltage supply between 0.5 V and 1.0 V at J3 (VIN)

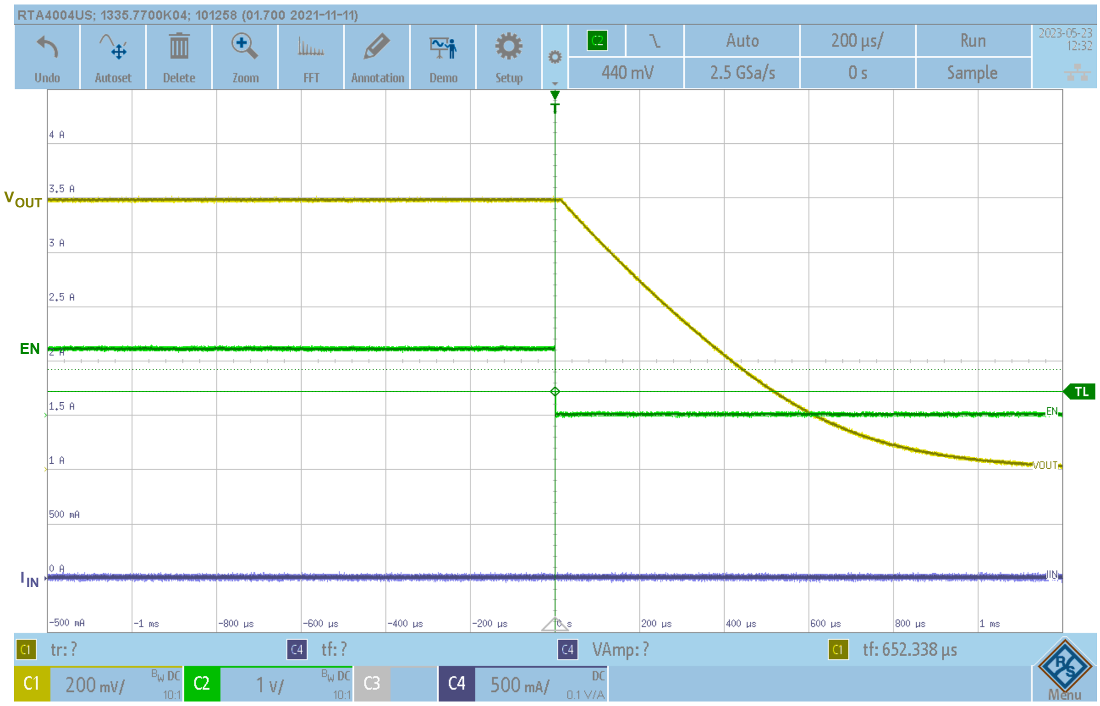
3) Configure an oscilloscope to trigger on the rising (for rise time) or falling (for fall time) edge of the EN signal. This will allow the capture of the output waveform once the trigger level is met. The EN signal can be set between 0 V and 5 V using a function generator to program the EN pulse. The enable high threshold for the EN pin is 0.72 V and the enable low threshold for the EN pin is 0.32 V. This input is located at J2 or TP1. Vout_SENSE is located at TP8.

Fig. 7 and Fig. 8 show the rise time and fall time measurements of the NPS1000.



VIN = 1 V; EN = 1.2 V; Vbias = 2.5 V; C_{Load} = 66 µF; Temperature = 25 °C

Fig. 7. Oscilloscope plot for output rise time (t_r)



VIN = 1 V; EN = 1.2 V; Vbias = 2.5 V; C_{Load} = 66 µF; Temperature = 25 °C

Fig. 8. Oscilloscope plot for output fall time (t_f)

7. Revision history

Table 2. Revision history

Revision number	Date	Description
1.2	2024-06-24	Board name corrected in Section 3.
1.1	2024-04-05	Board name corrected in Section 1.1.
1.0	2024-02-19	Initial version.

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