NCV78514 Evaluation kit documentation

Automotive intelligent LED Driver

Evaluation kit contents

NCV78514 evaluation PCB

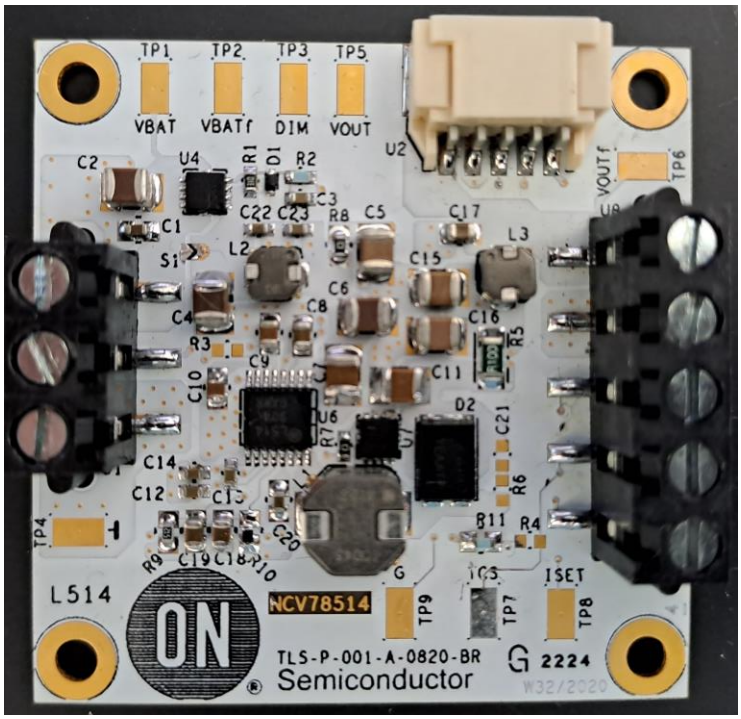
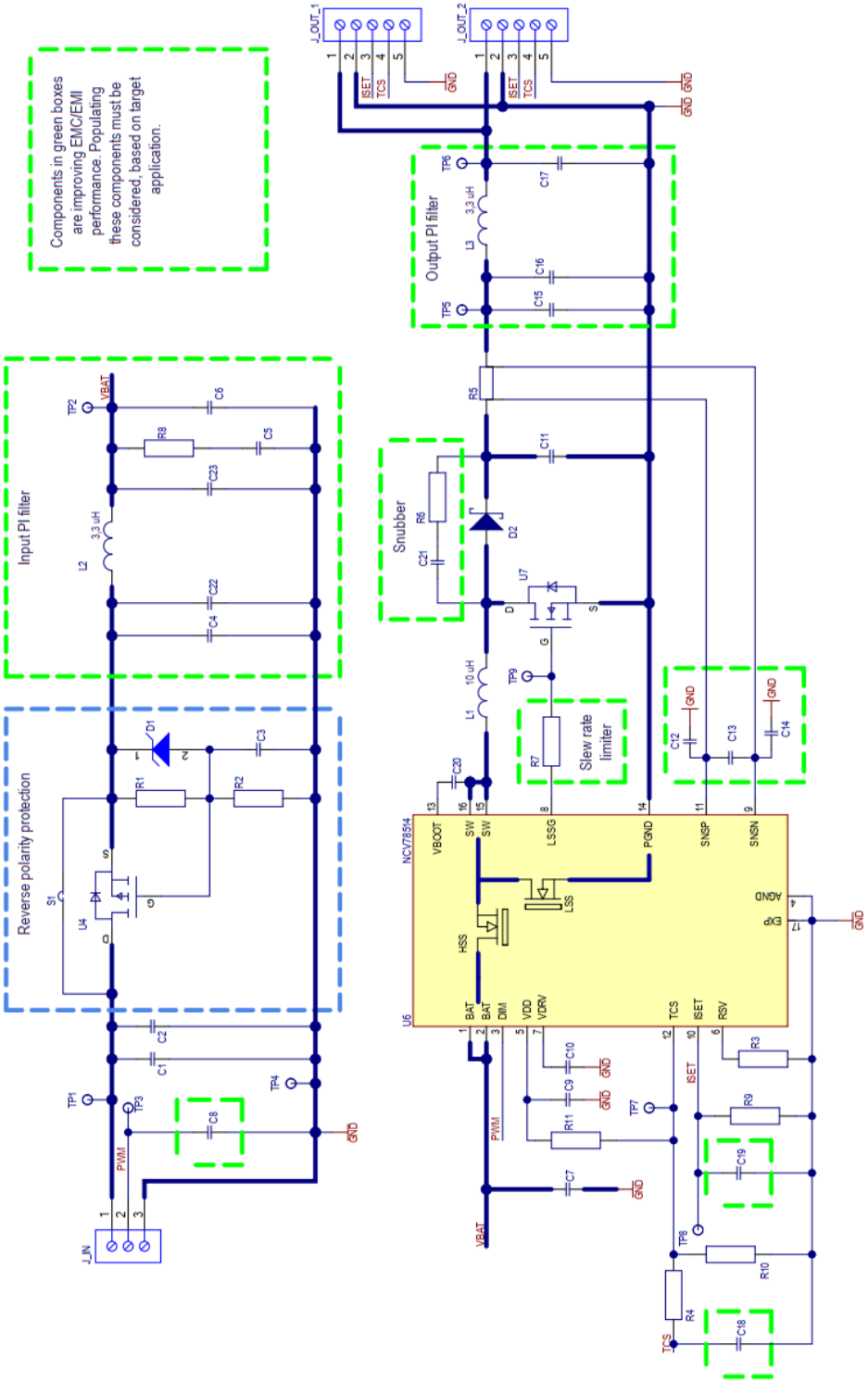


Figure 1: Photo of evaluation module PCB

Schematic


Components in green boxes are improving EMC/EMI performance. Populating these components must be considered, based on target application.
J_OUT_1
J_OUT_2
ISET
TCS
GND
Output PI filter
TP6
TP5
L3
3.3 uH
C17
C16
C15
R5
C11
Snubber
R6
C21
D2
U7
TP9
L1
10 uH
R7
Slew rate limiter
C12
C13
C14
C20
NCV78514
VBOOT
SW
LSSG
PGND
SNSP
SNSN
AGND
EXP
LSS
HSS
BAT
DIM
VDD
VDRV
TCS
ISET
RSV
U6
R3
R9
C19
R10
R4
C18
C10
C9
R11
C7
TP7
TP8
PWM
VBAT
Input PI filter
TP2
R8
C6
C5
C23
L2
3.3 uH
C22
C4
Reverse polarity protection
D1
C3
R1
R2
S1
U4
C2
C1
TP1
TP3
TP4
C8
J_IN

Pinout – connector J_IN

pin	function	Note
1	VBAT	Input voltage
2	PWM	PWM in
3	GND	Ground connection

Pinout – connectors J_OUT_1 & J_OUT_2

pin	function	Note
1	LED Anode	LED string anode
2	LED Cathode	LED string cathode
3	ISET	Connection for current setting resistor
4	TCS	Connection for temperature sensing thermistor
5	GND	Signal ground connection

P Pinout – connectors J_OUT_1 & J_OUT_2

pin	function	Note
1	LED Anode	LED string anode
2	LED Cathode	LED string cathode
3	ISET	Connection for current setting resistor
4	TCS	Connection for temperature sensing thermistor
5	GND	Signal ground connection

EVK board description

The evaluation board is designed to showcase the features of the NCV78514. The input is protected by reverse polarity protection, followed by an input PI filter. Electrical current then flows through a DC/DC converter and an output PI filter. The output current is defined by a resistor attached to the ISET pin. The chip constantly evaluates the resistance to ensure a good electrical connection and to verify that the current-setting resistor is functioning correctly. The measured resistance must remain stable during operation. During the startup sequence, the resistance is evaluated, and the corresponding output current is calculated. The output current can also be modulated by a PWM signal applied to the DIM pin. The integrated circuit senses the applied PWM signal and measures its duty cycle. The output current is then pulse-width modulated at a frequency of 400 Hz, with the duty cycle matching the input PWM signal.

The current defined by the resistor sets the target output current, which is applied when no derating mechanisms are active. There are three derating mechanisms that can influence the output current: input voltage drop, integrated circuit overtemperature, and LED string overtemperature. The output current is governed by the derating mechanism that imposes the greatest reduction. This ensures that the system operates safely and efficiently under varying conditions.

The temperature of the LED module is measured using an NTC (Negative Temperature Coefficient) thermistor placed within the module. As the temperature of the LED module changes, the resistance of the thermistor also changes. A VCC voltage is applied to a pull-

up resistor, with the NTC thermistor connected between this pull-up resistor and ground. As the resistance of the NTC thermistor changes, the voltage drop across it changes as well. This voltage drop is sensed by the ADC (Analog-to-Digital Converter) of the integrated circuit, allowing it to accurately measure the temperature of the LED module.

LED MODULE v2.0

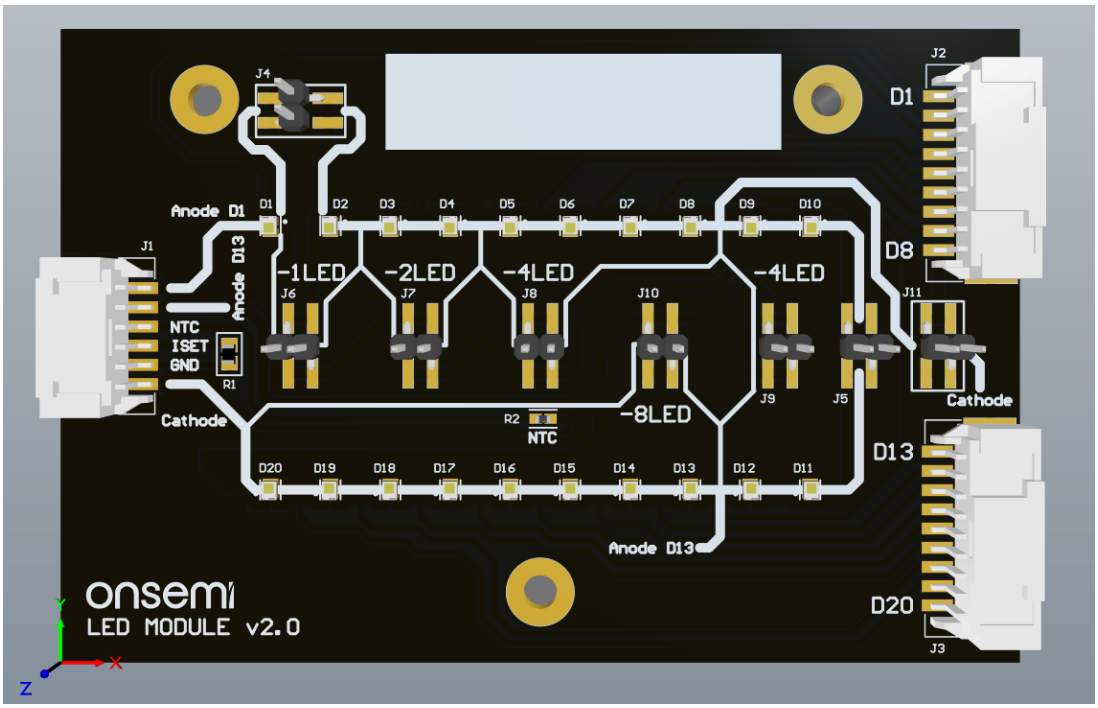


Figure 2: Photo of LED module

Schematic

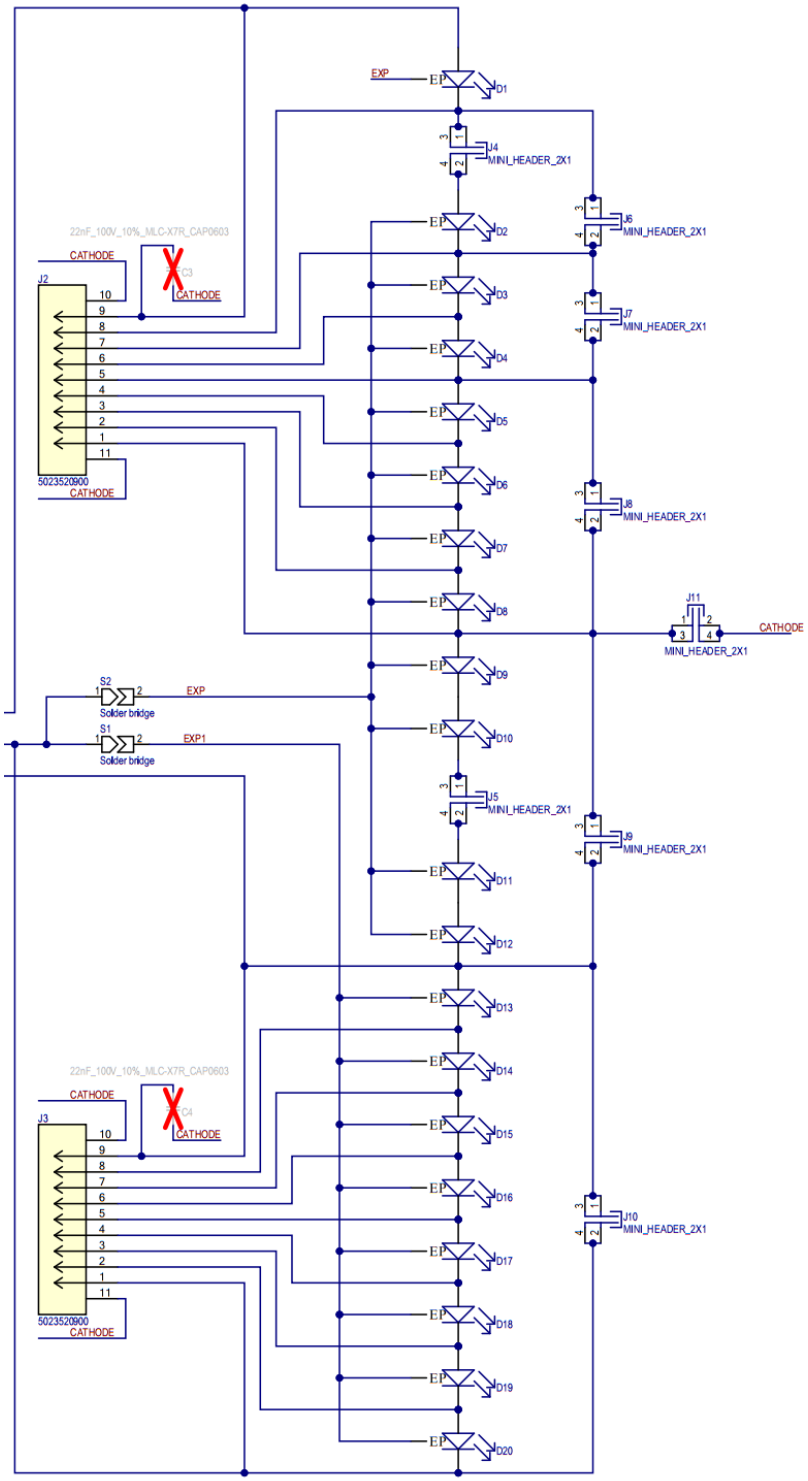


Figure 3:LED MODULE v2.0 schematic part I.

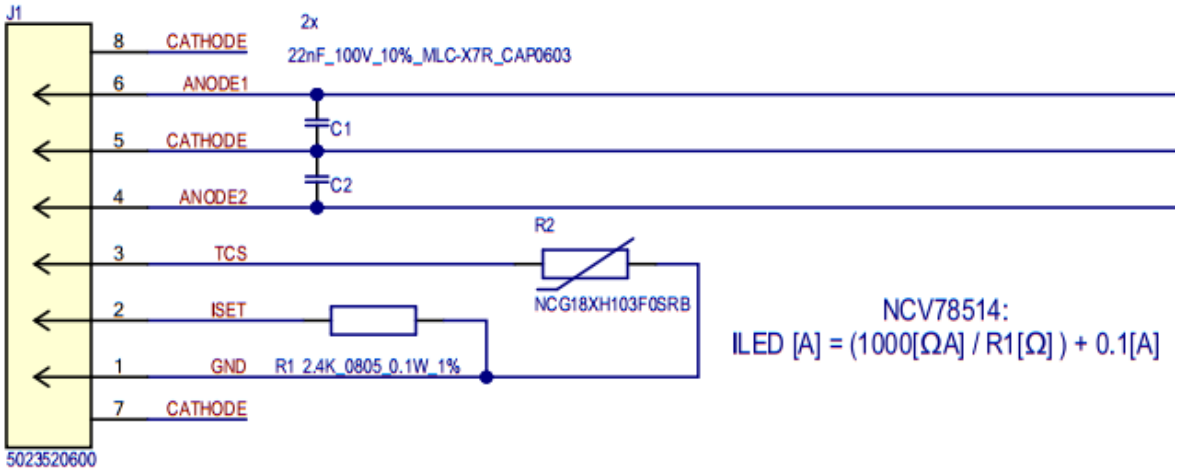


Figure 4:LED MODULE v2.0 schematic part II.

Pinout – connector J1

pin	function	Note
1	GND	Gnd for pins 2,3
2	ISET	Connection for ISET resistor
3	TCS	Connection for temperature sensor
4	ANODE2	Anode D13
5	CATHODE	Common LED string Cathode
6	ANODE1	Anode D1
7,8	Mechanical	Mechanical pads no electric function

Pinout – connector J2 & J3

Pin	Function J2	Function J3
1	Cathode D8	Cathode D20
2	Anode D8	Anode D20
3	Anode D7	Anode D19
4	Anode D6	Anode D18
5	Anode D5	Anode D17
6	Anode D4	Anode D16
7	Anode D3	Anode D15
8	Anode D2	Anode D14
9	Anode D1	Anode D13
10, 11	Mechanical pads no electric function	Mechanical pads no electric function

LED configuration table

# LEDs	J6 (-1LED)	J7 (-2LED)	J8 (-4LED)	J9 (-4LED)	J10 (-8LED)	J4	J5	J11
1	closed	closed	closed	closed	closed	closed	closed	open
2	open	closed	closed	closed	closed	closed	closed	open
3	closed	open	closed	closed	closed	closed	closed	open
4	open	open	closed	closed	closed	closed	closed	open
5	closed	closed	open	closed	closed	closed	closed	open
6	open	closed	open	closed	closed	closed	closed	open
7	closed	open	open	closed	closed	closed	closed	open
8	open	open	open	closed	closed	closed	closed	open
9	closed	closed	open	open	closed	closed	closed	open
10	open	open	open	open	closed	closed	closed	open
11	closed	open	open	open	closed	closed	closed	open
12	open	open	open	open	closed	closed	closed	open
13	closed	closed	closed	open	open	closed	closed	open
14	open	closed	closed	open	open	closed	closed	open
15	closed	closed	closed	closed	closed	closed	closed	open
16	open	open	closed	open	open	closed	closed	open
17	closed	closed	open	open	open	closed	closed	open
18	open	closed	open	open	open	closed	closed	open
19	closed	open	open	open	open	closed	closed	open
20	open	open	open	open	open	closed	closed	open

LED MODULE v2.0 description

The LED MODULE v2.0 is designed to simulate various loads ranging from 1 to 20 LEDs. By shorting specific jumpers, sections of the LED string can be bypassed, effectively reducing the number of active LEDs. This allows for flexible configuration of the LED string length. The module can be divided into two independent strings, with LEDs D1-D8 and D13-D20 individually controlled by a pixel controller.

The LED MODULE v2.0 includes a current-setting resistor (R1) and a temperature-sensing thermistor (R2), which are used by the NCV78514 to adjust the LED string current in case of overheating. These resistors can be placed either on the evaluation kit (EVK) module or the LED module. However, ensure that the resistor and thermistor are not placed on both the LED module and the evaluation module simultaneously. The positions are duplicated to accommodate driving other LED loads that do not have positions for the ISET and TCS components.

To change the LED current, use equation (1) below:

$$ILED\ [A] = \frac{1000\ [\Omega \cdot A]}{RSET\ [\Omega]} + 0.1\ [A] \quad (1)$$

The measured resistance of thermistor (NCG18XH103F0SRB) changes with temperature as (2)

$$ILED\ [A] = \frac{1000\ [\Omega \cdot A]}{RSET\ [\Omega]} + 0.1\ [A] \quad (2)$$

The following table characterizes the thermistor.

Parameter	Value
Resistance @ 25 °C	10 kΩ
Resistance tolerance	± 1%
B-Constant (25/50℃)	3380K
B-Constant (25/50℃) Tolerance	±1%
B-Constant(25/80℃)	3428K
B-Constant(25/85℃)	3434K
B-Constant(25/100℃)	3455K

Temperature estimation can be done by equation 3.

$$T\ [K] = \frac{T_0\ [K] \cdot B\ [K]}{T_0\ [\mathrm{K}] \ln\left(\frac{R[\Omega]}{R_0[\Omega]}\right) + B\ [K]} \quad (3)$$

Setup instructions

1. Carefully unpack the evaluation kit and ensure all components are present. The kit includes wires with banana plugs for connecting to a lab power supply and an LED load module.
2. Locate the wires with banana plugs included in the kit.

3. Connect the banana plugs to the corresponding terminals on your lab power supply.
4. Set your power supply to output 12 V and 1 A.
5. Ensure the LED load module is securely connected to the evaluation board as per the provided diagram.
6. Once all connections are secure, turn on the power supply.

Troubleshooting

- Check PWM Input:
  - Ensure the PWM input is connected. If it is unconnected, the sensed duty cycle will be 0%, resulting in no output current. 100 % Duty cycle can be reached by coupling the PWM and VBAT inputs.
- Verify Voltages:
  - Measure the voltage at the ISET pin. The expected voltage is approximately 1 V.
  - Measure the voltage at the PTC pin. It should be above 0.6 × VCC to operate normally.
- Inspect Connections:
  - Check all connections to ensure they are secure and correctly placed.
- Review Power Supply Settings:
  - Confirm that the power supply and that the banana plugs are properly connected.
- Examine Components:
  - Inspect the current-setting resistor (R1) and the temperature-sensing thermistor (R2) to ensure they are functioning correctly and not placed simultaneously on both the LED module and the evaluation module.

Technical support

In case of any issue with the evaluation kit, please contact:

Martin.Rejthar@onsemi.com

The latest release of datasheet can be found on onsemi.com > LINK