

NCD57200 Evaluation Board



ON Semiconductor®

www.onsemi.com

EVAL BOARD USER'S MANUAL

Introduction

The NCD57200 Evaluation module is designed for evaluation of the NCD57200 IGBT Half-Bridge driver products family.

The NCD57200 is a high voltage gate driver with one non-isolated low side gate driver and one galvanic isolated high or low side gate driver. It can directly drive two IGBTs in a half bridge configuration. Bootstrap technique can be used for powering up the isolated high side gate driver for easy use.

The galvanic isolation for the high side gate driver guarantees reliable switching in high power applications for IGBTs that operate up to 900 V, at high dv/dt . The optimized output stages provide a mean of reducing IGBT losses. Its features include two independent inputs with accurate asymmetric UVLOs, and short and matched propagation delays. The NCD57200 operates with its V_{DD}/V_B up to 25 V.

Description

The board was created for the ability to verify and test the datasheet parameters or to be externally connected to power devices. It contains all the necessary peripheral components for direct connection to the power device. All connections are made by surface-mount test point loops allow easy probe connection. The input bias is configured so the V_B high-side bias can be sourced from V_{DD} , or an external additional bias can be added to provide V_B directly. The high-side and low-side returns are separated on V_S and GND to allow evaluation of the NCD57200 high-side negative voltage capabilities. The PCB design is optimized to reduce loop areas and provide clear and simple measurement of all signals. All the parts are TOP mounted which allows easy replacement and can serve as an ideal reference design for future use.

Features

- High Peak Output Current (+1.9 A/-2.3 A)
- Low Output Voltage Drop for Enhanced IGBT Conduction
- Secured Output Low State without V_{DD}/V_B
- Floating Channel for Bootstrap Operation up to +900 V
- $CMTI$ up to 50 kV/ μs
- Reliable Operation for V_S Negative Swing To -900 V
- V_{DD} & V_{BS} Supply Range up to 25 V
- 3.3 V, 5 V, and 15 V Logic Input
- Asymmetric Under Voltage Lockout Thresholds for High Side and Low Side
- Matched Propagation Delay 110 ns
- Built-in 20 ns Input Noise Filter
- Built-in 300 ns Dead-Time and High and Low Inputs Interlock
- Output in Phase with Input Signal
- PCB Layout Optimized for Power Supply Bypassing Capacitor, Gate-driver Loop
- Capacitive Load with Separated External Gate-drive Resistors ($R_{G_{ON}}$, $R_{G_{OFF}}$)
- Allows Quick Verification of most of the Data Sheet Parameters
- Test Points Allow Probing all the Key Pins of the NCD57200

EVBUM2663

PIN Description

Table 1. EVALUATION BOARD PIN DESCRIPTION

Pins Name	Pins Number	Description
VDD	TP1	VDD positive input of NCD57200, Powers the driver on primary side
VB	TP2	VB power input, Powers the driver on secondary side through Current limiting resistor
VCC	TP3	VCC power input of evaluation board, Powers the driver on primary side through Current limiting resistor
HO	TP5	High-side output pin
HIN	TP6	High-side input pin
HS-LD	TP7	High-side output at capacitive load
PWMIN-H	TP8	High-side signal input
LO-LD	TP12	Low-side output at capacitive load
LO	TP13	Low-side output pin
LIN	TP17	Low-side input pin
PWMIN-L	TP18	Low-side signal input
VS	TP9, TP10, TP21	Multiple test point – Negative VB input, high-side power ground
GND	TP4, TP11, TP14, TP15, TP16, TP19, TP20, TP22	Multiple test point – Negative VDD input, primary ground of DR1

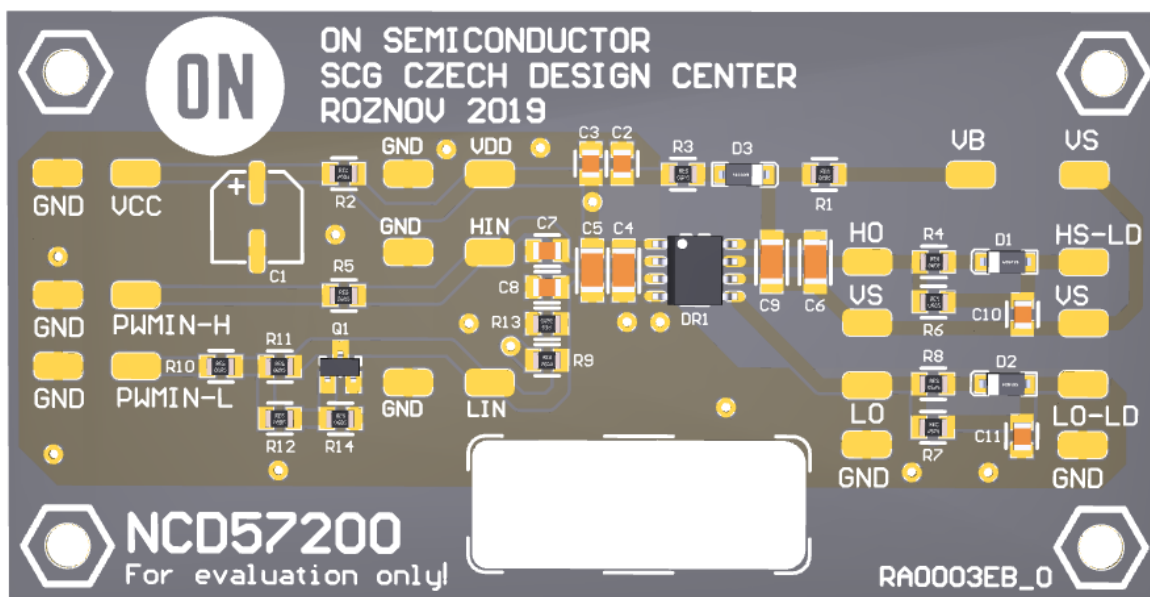


Figure 1. PCB TOP View

Electrical Specification

Table 2. NCD57200 ELECTRICAL SPECIFICATION

Description		MIN	TYP	MAX	Unit
V _{DD}	Input bias power supply	13		25	V
V _B	High-Side power supply (ready for bootstrap power supply)	12		25	V
PWMIN-X	Input signal switching frequency	0		500	kHz
T _J	Operating junction temperature range	-40		125	°C

TEST SPECIFICATION

This section provides details how to configure the NCD57200 Evaluation board. Basic laboratory equipment will be required to perform the tests.

Equipment

- Power supplies
 - ◆ A DC power supply providing minimally 25 V/1 A
- Function generator
 - ◆ Two channel functional generator providing the required testing frequency
- Oscilloscope
 - ◆ Oscilloscope 2 channel (4 channel optional)
 - ◆ Passive probes
 - ◆ Current probe (optional)
- Digital multimeter
 - ◆ Allows DC current measurement

Bench Test setup

The bench test setup shows the equipment connections. Use basic setup procedure as a reference:

- Make sure the power supplies & outputs of signal generators are powered off / disabled

- Connect functional generator to the PWMIN–H and PWMIN–L signal inputs and GND
- Connect power supply positive lead to the VCC (use digital multimeter to measure input current)
- Connect power supply negative lead to the GND
- Connect oscilloscope probes to HO–LD and LO–LD test points

Power Up

1. Before the power–up, verify the correct connection of all signals and power leads
2. Enable power supply and check the current consumption on the digital multimeter. If is less than 1 mA, everything is set correctly
3. Enable function generator outputs
4. Check the signals at each outputs

Power Down

1. Disable functional generator outputs
2. Disable power supply
3. Disconnect equipment

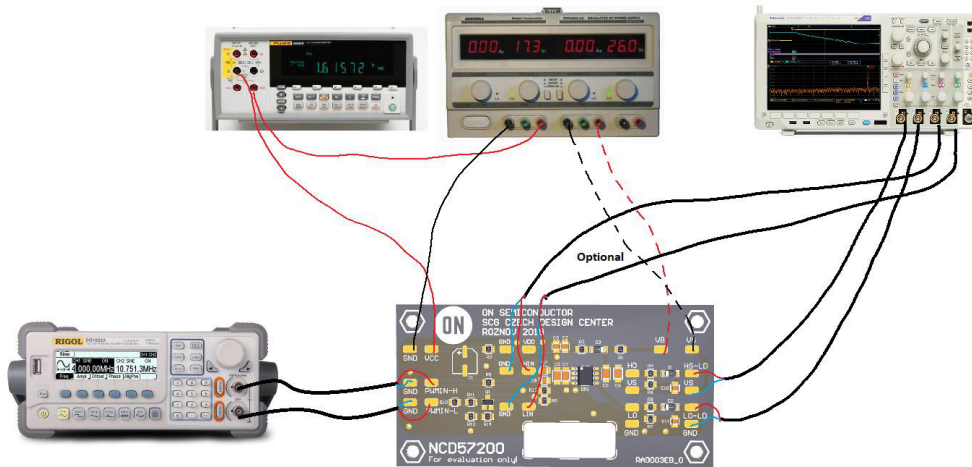


Figure 2. Test 1–2 Setup Diagram

Test 1: Current Consumption

To evaluate the Driver at

- (A) no switching current consumption and
- (B) current consumption at different signal frequencies
 - A. Power up the setup, turn off the signal generator outputs
 - ◆ Digital multimeter displays the standby current under 1 mA
 - B. Power up the setup, gradually set the output frequency ($R_{G-ON/OFF} = 0 \Omega$, $C_{LOAD} = 1 \text{ nF}$)
 - ◆ Digital multimeter displays the current dependent on input signal frequency

Table 3. NCD57200 CURRENT CONSUMPTION

PWMIN Frequency (kHz)	IDD (mA)
0	0.6
10	2.2
50	4
100	6
200	11
500	23

Test 2 – Typical Performance Waveforms

To evaluate propagation delay, the input signals must have dead time greater than the internal dead time. (Depend on the driver version – see the specific values in the datasheet).

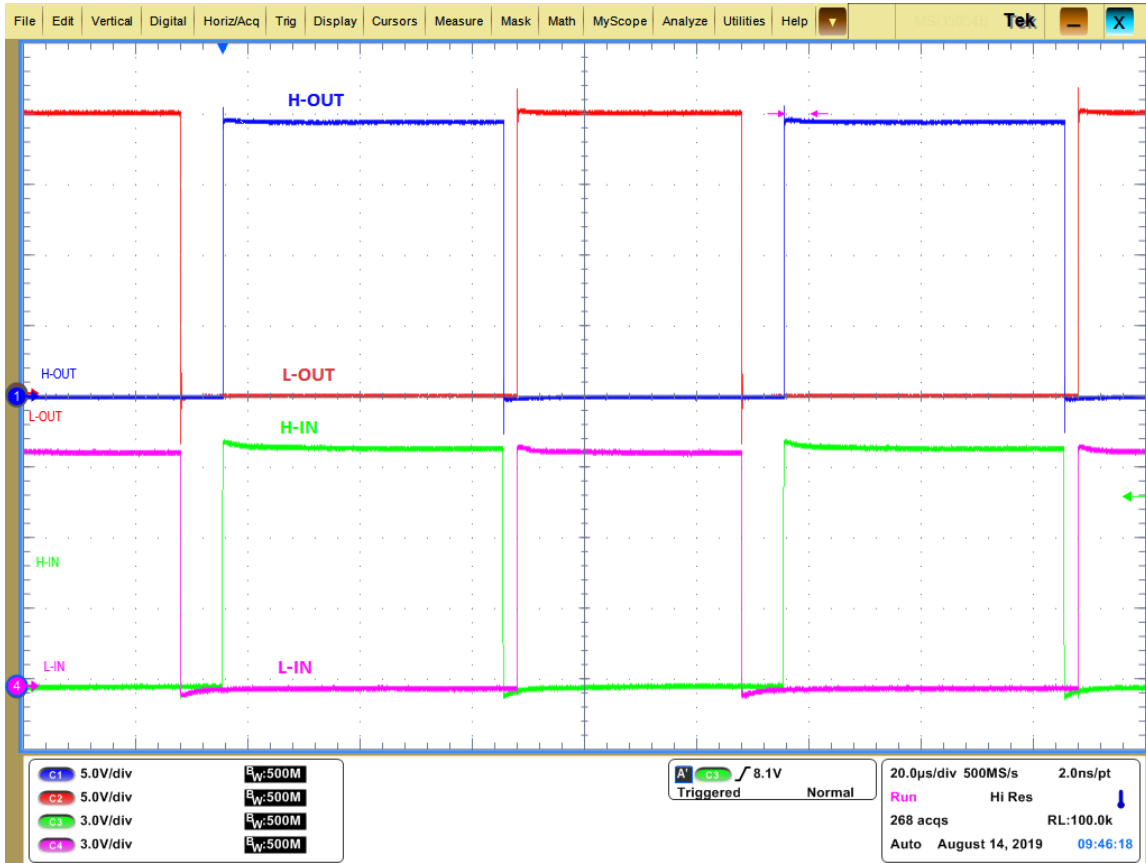


Figure 3. INPUT and OUTPUT Waveforms

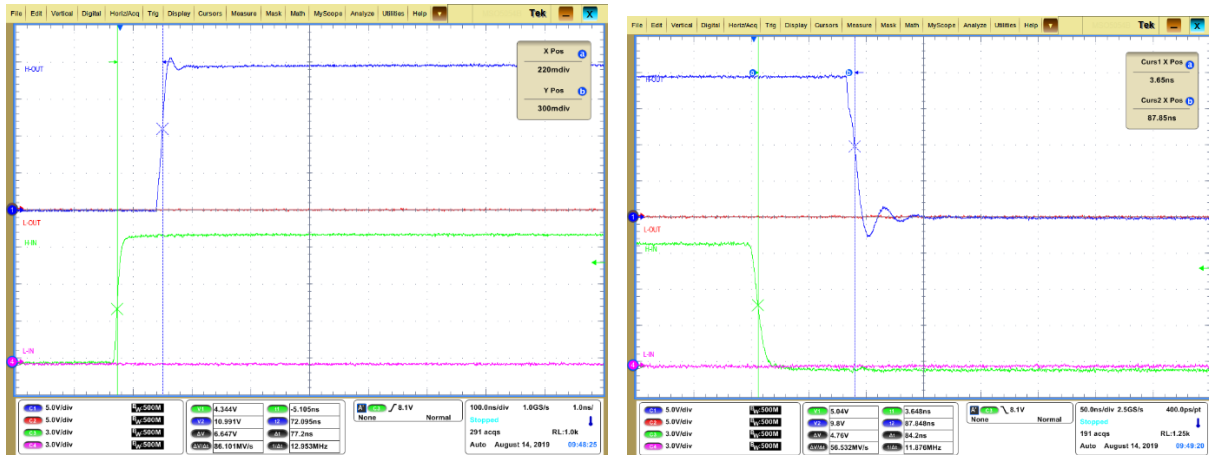


Figure 4. HS-IN and HS-OUT Waveforms

EVBUM2663

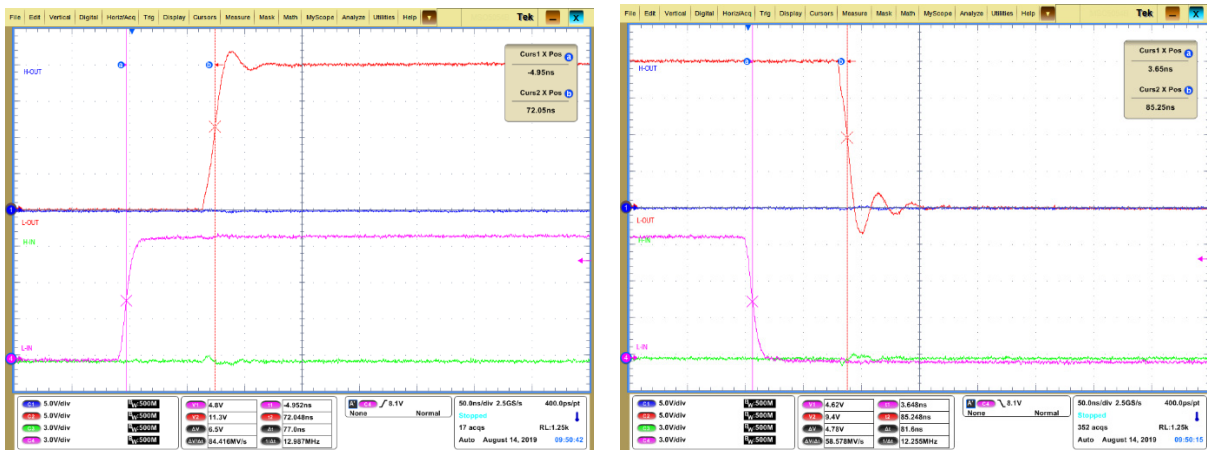


Figure 5. LS-IN and LS-OUT Waveforms

Test 3 – Typical Performance Waveforms – Output Current (Optional Advanced)

To evaluate maximum output peak current, the input signals must have dead time greater than the internal dead time. (Depend on the driver version – see the specific values in the datasheet). Setup need to be adjusted to allow maximum peak current measurement.

Required Changes:

- Current probes are required
- Place (solder) loading capacitors to the output loading point HS-LD/VS and LS-LD/GND
 - ◆ Typical testing value is 100 nF/50 V
 - ◆ Recommended using leaded package to create a current measuring loop

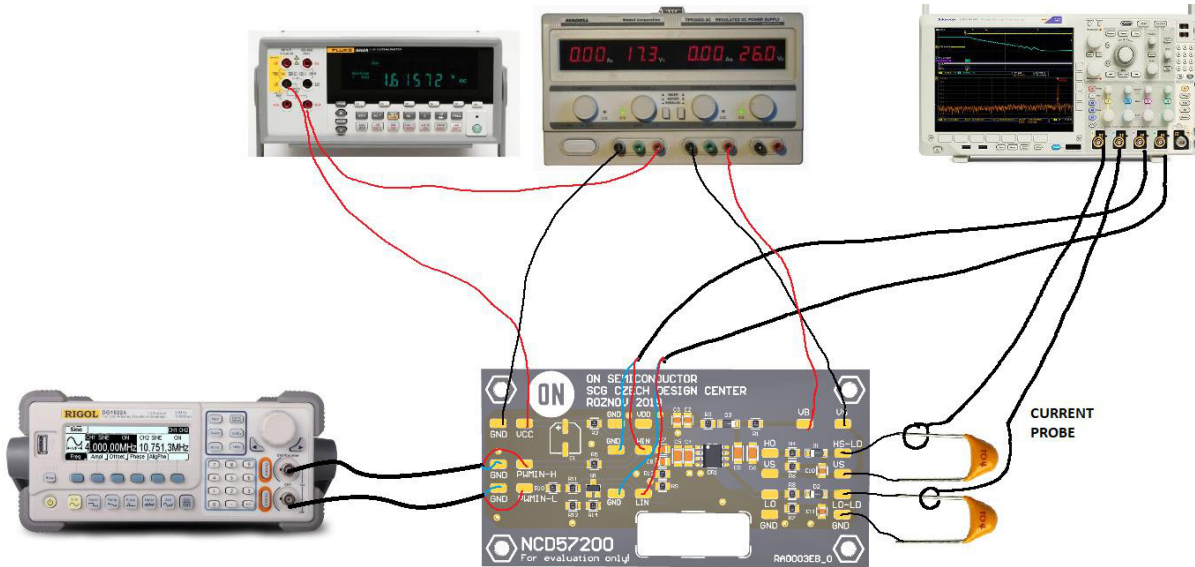


Figure 6. Test 3 Setup Diagram

EVBUM2663

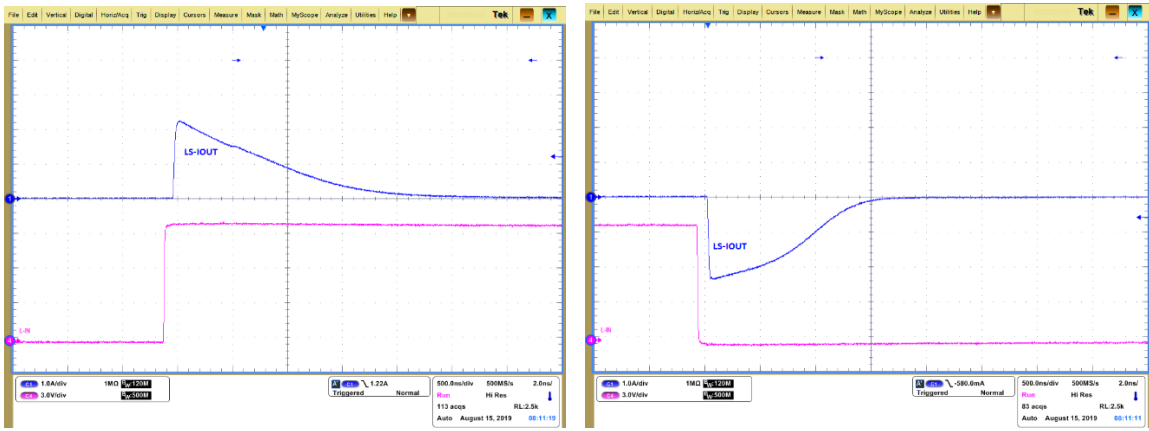


Figure 7. LS Current Waveforms

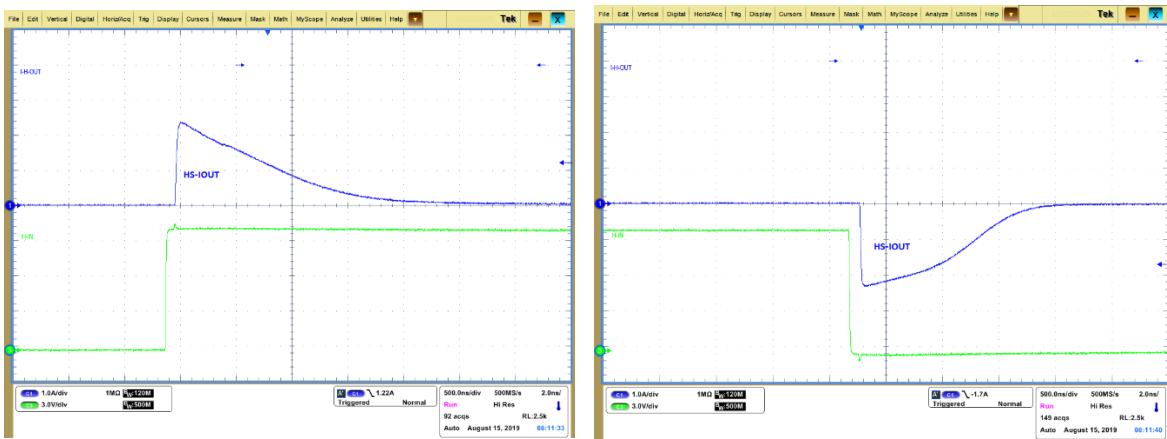


Figure 8. HS Current Waveforms

SCHEMATIC & LAYOUT DIAGRAMS

Schematic Diagram

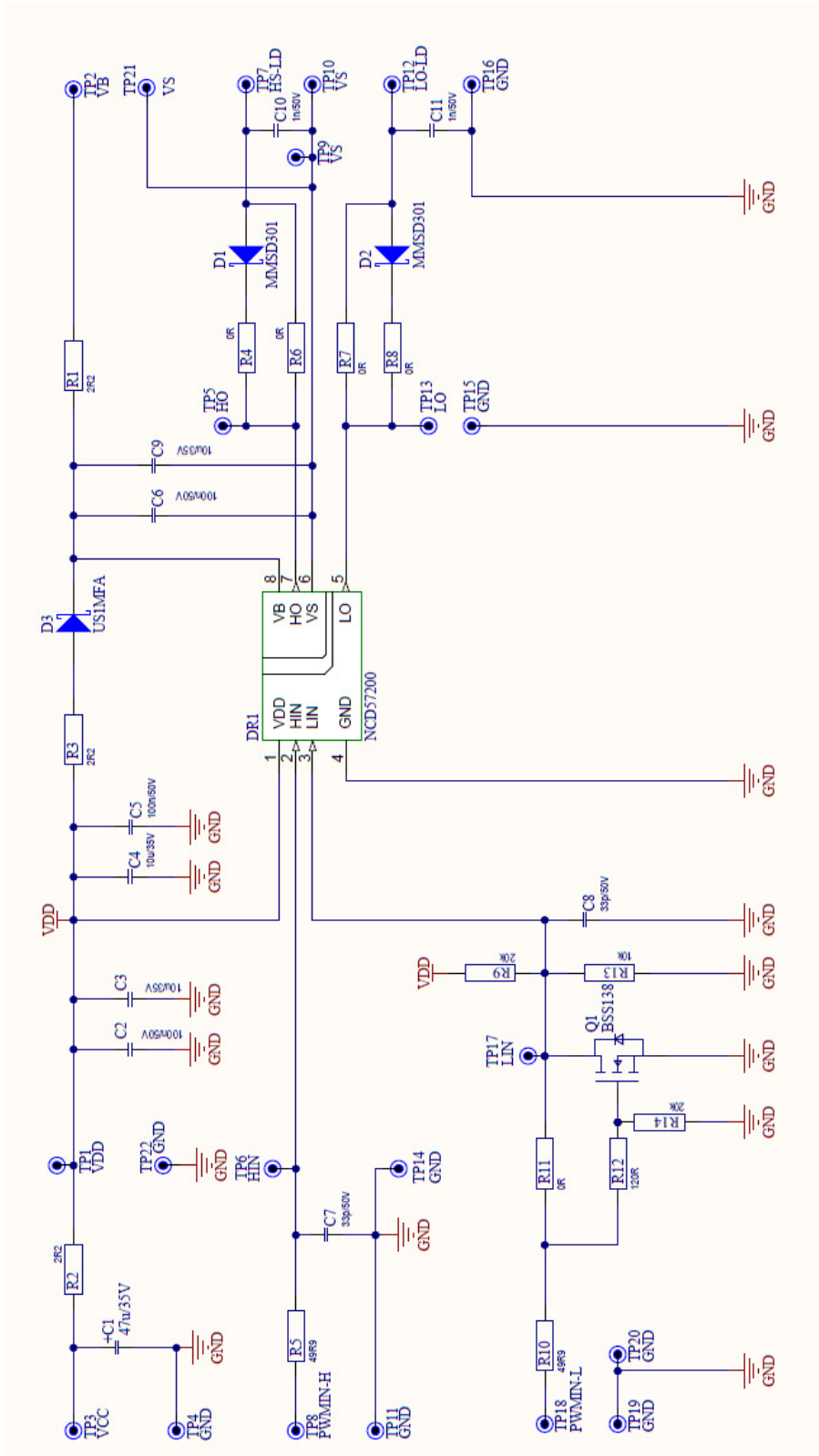


Figure 9. Schematics

Layout Diagrams

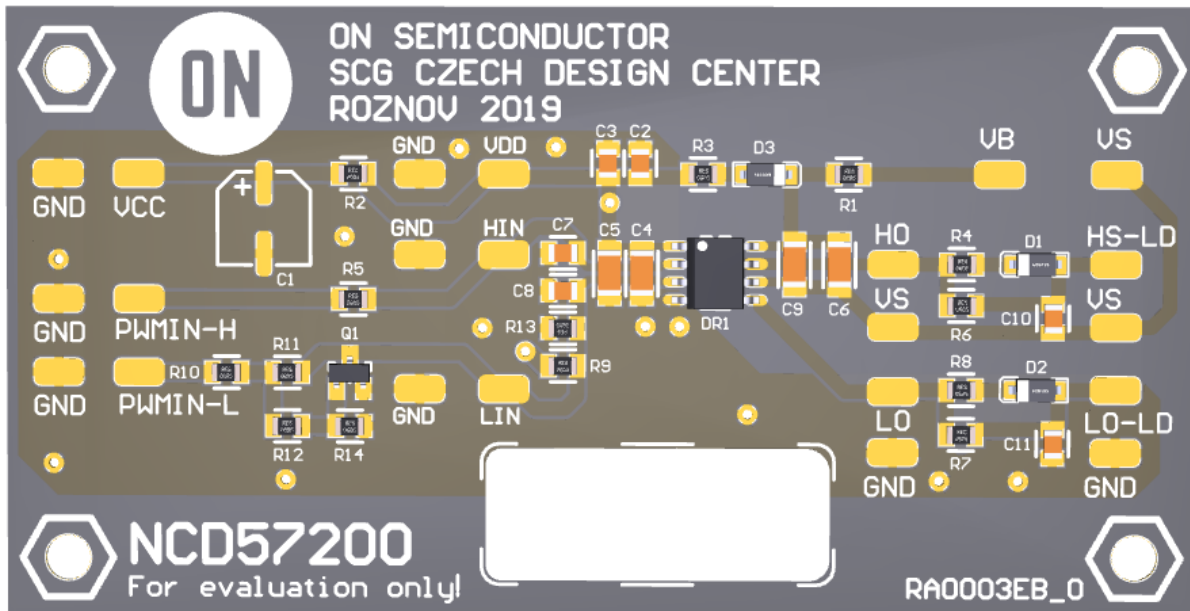


Figure 10. Assembled PCB TOP View

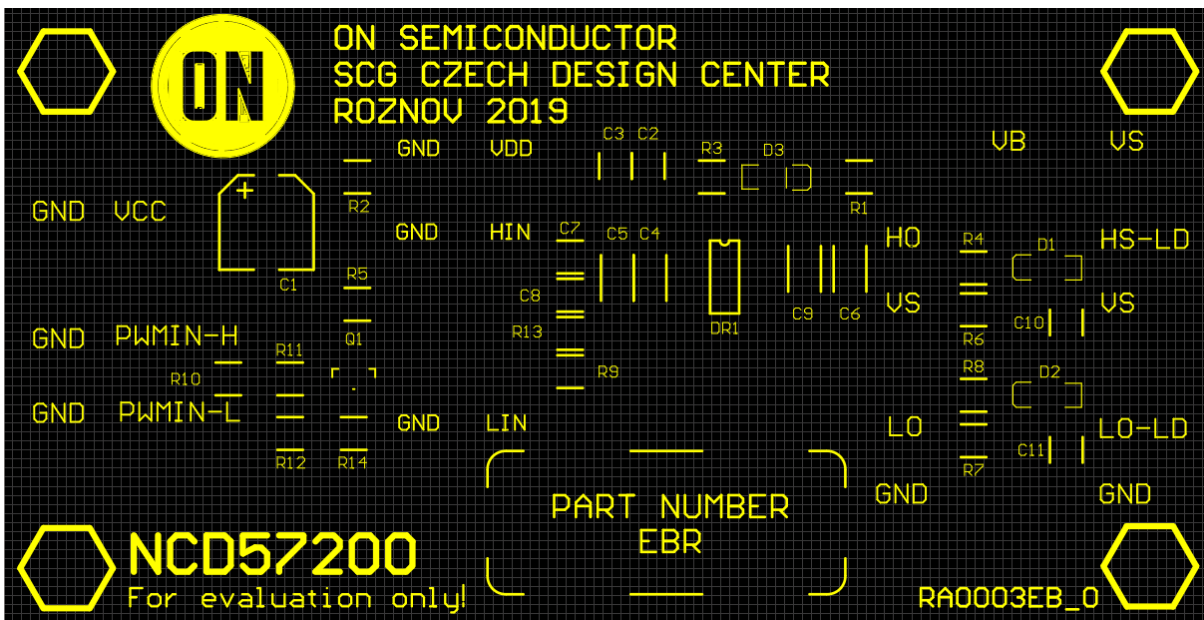


Figure 11. TOP Overlay

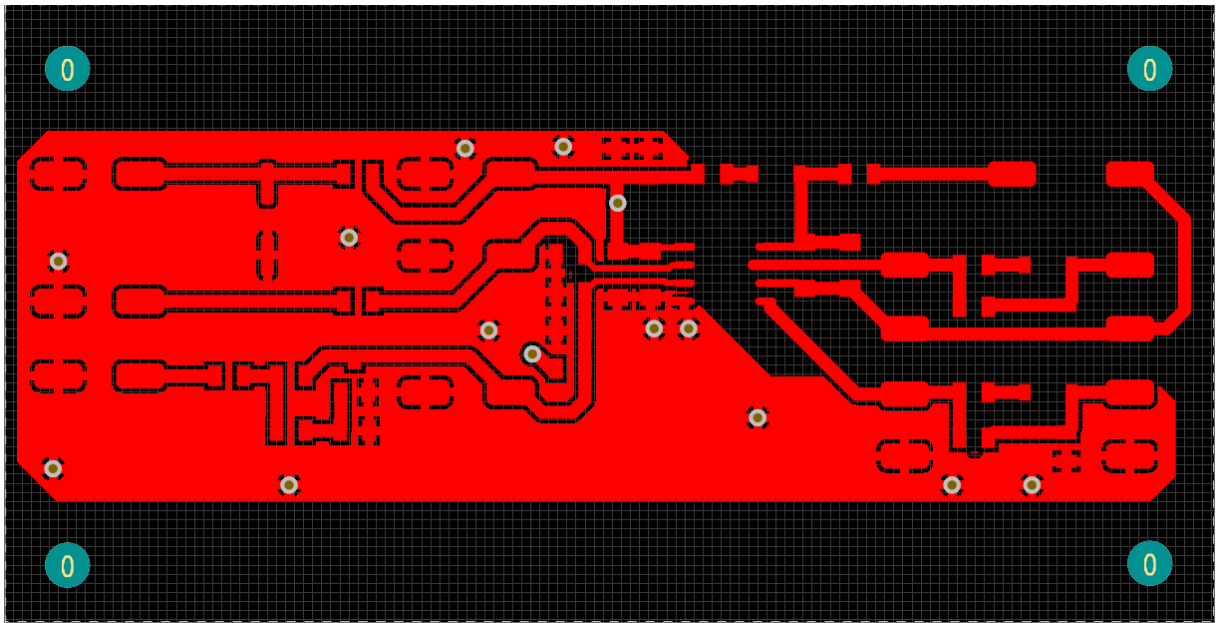


Figure 12. TOP Layer

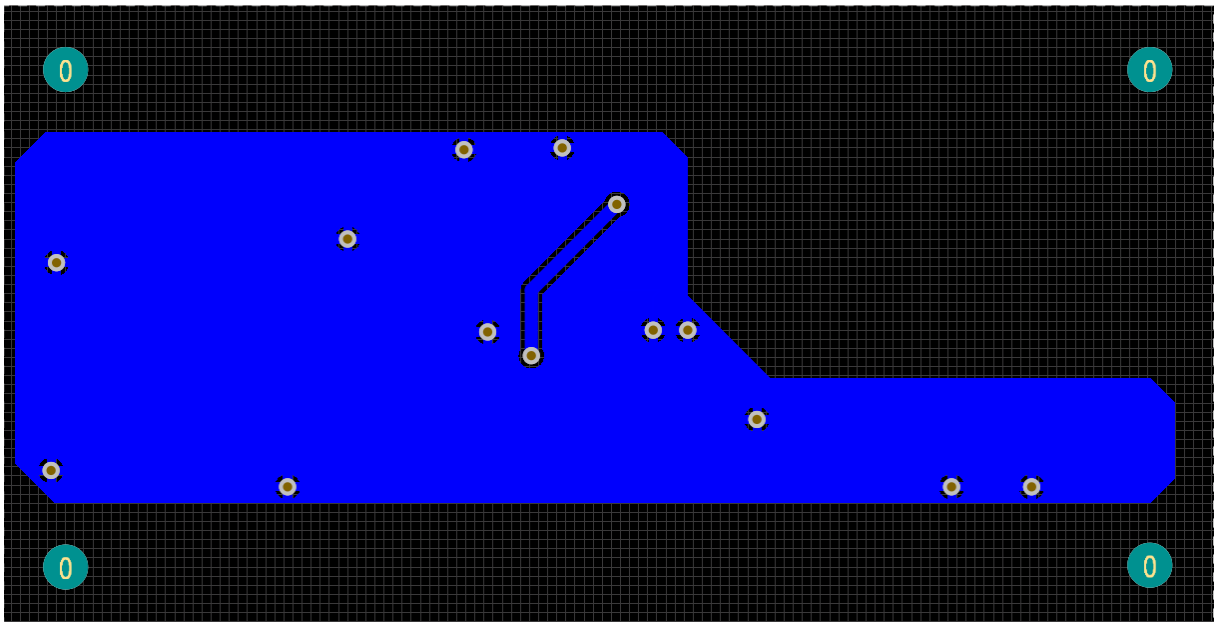


Figure 13. BOT Layer



Figure 14. BOT Overlay

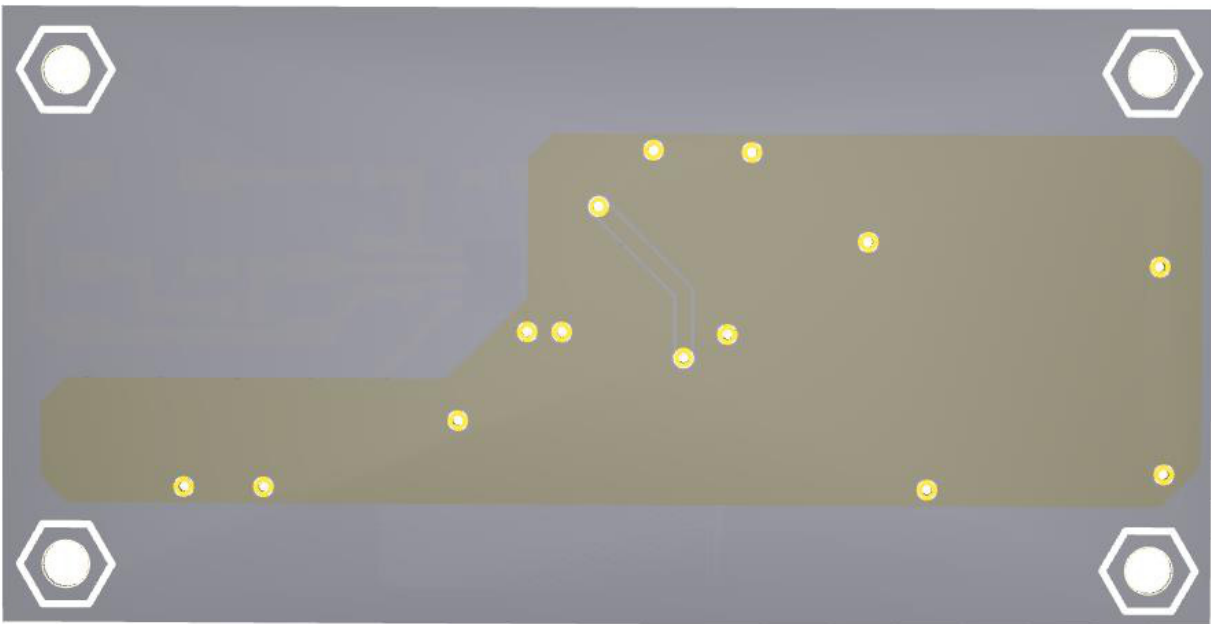


Figure 15. Assembled PCB BOT View

EVBUM2663

BOM

Table 4. BILL OF MATERIAL

Quantity	Assembled	Designator	Value	Description	Package	Manufacturer
1	YES	DR1	NCD57200	IGBT Driver	SOIC-8	ON Semiconductor
2	YES	D1, D2	MMSD301T1G	Schottky diode 30 V	SOD-123	ON Semiconductor
1	YES	D3	US1MFA	Super fast rectifier 1000 V	SOD-123 FL	ON Semiconductor
22	YES	TP1, ..., TP22		SMD test point		Harwin
1	YES	C1	47 μ F / 35 V	Electrolytic capacitor	SMD radial d8x6.2	Panasonic
2	YES	C7, C8	33 p / 50 V	Ceramic capacitor	0805	Kemet
1	YES	C2	100 n / 50 V	Ceramic capacitor	0805	Kemet
1	YES	C3	10 μ / 35 V	Ceramic capacitor	0805	Murata
2	YES	C4, C9	10 μ / 35 V	Ceramic capacitor	1206	TDK
2	YES	C5, C6	100 n / 50 V	Ceramic capacitor	1206	Kemet
2	YES	C10, C11	1 n / 50 V	Ceramic capacitor	0805	Kemet
2	YES	R5, R10	49R9	Resistor	0805	Vishay
3	YES	R1, R2, R3	2R2	Resistor	0805	Vishay
5	YES	R4, R6, R7, R8, R11	0R	Resistor	0805	Vishay
4	YES	SP1a, SP2a, SP3a, SP4a	M3x10	plastic spacer		Duratool
4	YES	SP1b, SP2b, SP3b, SP4b	M3x10	plastic screw		Duratool
1	YES	Part Number 1	paper sticker 10x25 mm	DR1 part number and EBR specification		
1	YES	PCB	RA0003EB_0	PCB	43x85 mm	any
1	NA	Q1	BSS138	N-mosfet 50 V/220 mA	SOT-23-3	ON Semiconductor
1	NA	R13	10k	Resistor	0805	Vishay
1	NA	R12	120R	Resistor	0805	Vishay
2	NA	R9, R14	20k	Resistor	0805	Vishay

onsemi, **Onsemi**, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

The evaluation board/kit (research and development board/kit) (hereinafter the "board") is not a finished product and is not available for sale to consumers. The board is only intended for research, development, demonstration and evaluation purposes and will only be used in laboratory/development areas by persons with an engineering/technical training and familiar with the risks associated with handling electrical/mechanical components, systems and subsystems. This person assumes full responsibility/liability for proper and safe handling. Any other use, resale or redistribution for any other purpose is strictly prohibited.

THE BOARD IS PROVIDED BY ONSEMI TO YOU "AS IS" AND WITHOUT ANY REPRESENTATIONS OR WARRANTIES WHATSOEVER. WITHOUT LIMITING THE FOREGOING, ONSEMI (AND ITS LICENSORS/SUPPLIERS) HEREBY DISCLAIMS ANY AND ALL REPRESENTATIONS AND WARRANTIES IN RELATION TO THE BOARD, ANY MODIFICATIONS, OR THIS AGREEMENT, WHETHER EXPRESS, IMPLIED, STATUTORY OR OTHERWISE, INCLUDING WITHOUT LIMITATION ANY AND ALL REPRESENTATIONS AND WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, TITLE, NON-INFRINGEMENT, AND THOSE ARISING FROM A COURSE OF DEALING, TRADE USAGE, TRADE CUSTOM OR TRADE PRACTICE.

onsemi reserves the right to make changes without further notice to any board.

You are responsible for determining whether the board will be suitable for your intended use or application or will achieve your intended results. Prior to using or distributing any systems that have been evaluated, designed or tested using the board, you agree to test and validate your design to confirm the functionality for your application. Any technical, applications or design information or advice, quality characterization, reliability data or other services provided by **onsemi** shall not constitute any representation or warranty by **onsemi**, and no additional obligations or liabilities shall arise from **onsemi** having provided such information or services.

onsemi products including the boards are not designed, intended, or authorized for use in life support systems, or any FDA Class 3 medical devices or medical devices with a similar or equivalent classification in a foreign jurisdiction, or any devices intended for implantation in the human body. You agree to indemnify, defend and hold harmless **onsemi**, its directors, officers, employees, representatives, agents, subsidiaries, affiliates, distributors, and assigns, against any and all liabilities, losses, costs, damages, judgments, and expenses, arising out of any claim, demand, investigation, lawsuit, regulatory action or cause of action arising out of or associated with any unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of any products and/or the board.

This evaluation board/kit does not fall within the scope of the European Union directives regarding electromagnetic compatibility, restricted substances (RoHS), recycling (WEEE), FCC, CE or UL, and may not meet the technical requirements of these or other related directives.

FCC WARNING – This evaluation board/kit is intended for use for engineering development, demonstration, or evaluation purposes only and is not considered by **onsemi** to be a finished end product fit for general consumer use. It may generate, use, or radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment may cause interference with radio communications, in which case the user shall be responsible, at its expense, to take whatever measures may be required to correct this interference.

onsemi does not convey any license under its patent rights nor the rights of others.

LIMITATIONS OF LIABILITY: **onsemi** shall not be liable for any special, consequential, incidental, indirect or punitive damages, including, but not limited to the costs of requalification, delay, loss of profits or goodwill, arising out of or in connection with the board, even if **onsemi** is advised of the possibility of such damages. In no event shall **onsemi**'s aggregate liability from any obligation arising out of or in connection with the board, under any theory of liability, exceed the purchase price paid for the board, if any.

The board is provided to you subject to the license and other terms per **onsemi**'s standard terms and conditions of sale. For more information and documentation, please visit www.onsemi.com.

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:

Technical Library: www.onsemi.com/design/resources/technical-documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support

For additional information, please contact your local Sales Representative at www.onsemi.com/support/sales