NCD57253 Evaluation Board User Manual

NCD57253GEVB

INTRODUCTION

The NCD57253 Evaluation driver board is designed for evaluation of the NCD57253.

The NCD57253 is a high current two channel gate driver. It can directly drive two independent MOFETs in any configuration.

The driver provides 5 kVrms internal galvanic isolation from input to each output and functional isolation between the two output channels. The device accepts 3.3 V to 20 V bias voltage and signal levels on the input side and up to 32 V bias voltage on the output side. The device accepts complementary inputs and offers separate pins for Disable and Dead Time control for system design convenience. NCD57253 is available in wide body SOIC−16 package.

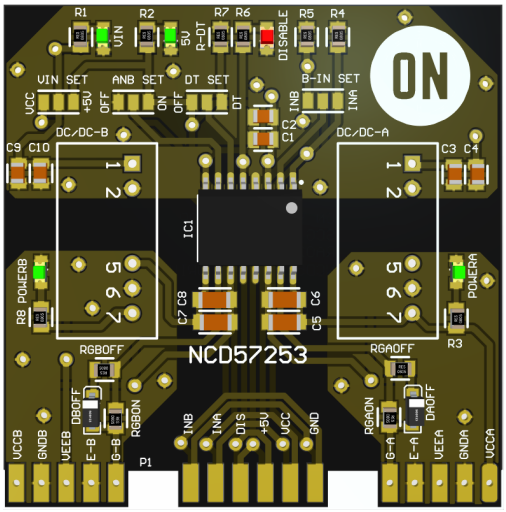


Figure 1. Evaluation Board TOP View

DESCRIPTION

The board was created for the ability to verify and test the datasheet parameters. The board can be externally connected to a power device to verify real parameters in the system. It contains all the necessary peripheral components for direct connection to the power devices. The input bias is configured so the VDDA and VDDB can be powered by using many types of integrated dc−dc power supplies or can be powered directly from external power source. The PCB design is optimized to reduce loop areas and provide clear and simple measurement of all signals. All the parts (except optional dc−dc sources) are TOP mounted which allows easy replacement and can serve as an ideal reference design for future use.

Features

- High Peak Output Current (+8 A/−8 A)
- Configurable as a Dual Low−Side or Dual High−Side or Half−Bridge Driver
- Programmable Overlap or Dead Time control
- Disable Pin to Turn Off Outputs for Power Sequencing
- ANB Function to Offer Flexibility to Set up the Driver as Half−bridge Driver Operating with a Single Input Signal
- MOSFET Gate Clamping during Short Circuit
- Short Propagation Delays with Accurate Matching
- Tight UVLO Thresholds on all Power Supplies
- 3.3 V, 5 V, and 15 V Logic Input
- 5 kVrms Galvanic Isolation from Input to each Output and 1.5 kV Peak Differential Voltage between Output Channels
- 1200 V Working Voltage (per VDE0884−11 Requirements)
- High Common Mode Transient Immunity
- High Electromagnetic Immunity
- This Device is Pb−Free, Halogen Free/BFR Free and is RoHS Compliant
- Non−inverting Output Signals
- PCB layout optimized for power supply bypassing capacitor, gate−driver loop
- Allows quick verification of most of the data sheet parameters

PIN Description

Table 1. EVALUATION BOARD PIN DESCRIPTION

Pin Name	Pin Number	Description
INA	17, 24	Channel A input signal
INB	15, 26	Channel B input signal
DIS	19, 22	Disable signal input (active High)
+5V	21, 20	Driver primary side power supply
VCC	23, 18	DC/DC sources alternative power supply (optional)
GND	25, 16	Primary side power/signal ground
VCCA	39, 40	A channel positive power supply
GNDA	37, 38	A channel Ground
VEEA	35, 36	A channel negative power supply
E−A	33, 34	Source connection of A channel − connected to GNDA
G−A	31, 32	Gate connector of A channel
VCCB	1, 2	B channel positive power supply
GNDB	3, 4	B channel Ground
VEEB	5, 6	B channel negative power supply
E−B	7, 8	Source connection of B channel − connected to GNDB
G−B	9, 10	Gate connection of B channel

ON−BOARD Jumpers Functional Table

Table 2. NCD57253 JUMPERS FUNCTIONAL TABLE

Jumper Name	Setup	Description
VIN SET	OPEN	When using external power supplies for VCCA / VCCB Power supplies need to be connected to the VCCA, VCCB pins on P1
	+5V	When using dc−dc converter powered by the same voltage as the primary side of the driver VCC pin on P1 can be unconnected
	VCC	When using dc−dc converter powered by different voltage as the primary side of the driver Power supply for dc−dc converter need to be connected to the VCC pin on P1
ANB SET	ON	When complementary output signals need to be generated from a single input signal
	OFF	Output signals are in phase with input signals
DT SET	DT	Dead time and interlocking logic between INA and INB is defined by the value of the external resistor (R7)
	OFF	Interlocking logic disabled, no dead time applied
	FLOAT	Dead time and interlocking logic between INA and INB are set internally to the minimum value (see the datasheet)
B−IN SET	INA	When ANB SET is ON − both inputs are connected together
	INB	When ANB SET is OFF

Electrical Specification

Table 3. NCD57253 ELECTRICAL SPECIFICATION

Description		Min	Typ	Max	Unit
VCCA/VCCB	Output positive bias power supply (VCC−VEE max)	13	–	36	V
VEE	Output negative bias power supply	0	–	−20	V
GNDA / GNDB	Output bias ground – connected to the MOSFET source	–	–	–	
+5V	Input bias power supply (VDDI)	3.3	–	22	V
GND	Input bias signal and power ground	–	–	–	
DIS	Disable signal input	0	–	VDDI	V
VCC	DC−DC sources optional power supply (depended on dc−dc)	0	–	–	V
T_J	Operating junction temperature range	−40	–	125	°C

FUNCTIONAL DESCRIPTION

Power Supply (VCC, +5V, VCCA, VCCB)

NCD57253 is designed to support unipolar power supply on both individual channels.

The evaluation driver board supports two types of output side power supply:

- On board dc−dc converter.
  - Powered by a common source as the input side of NCD57253.
  - Powered from external power pin VCC.
- External power supply.

The evaluation driver board is designed to support bipolar power supply, this is achieved by creating a virtual ground connected to the MOSFET source. If bipolar power supply is not required, VEEA / VEEB pin should be connected to the GNDA / GNDB.

For more detailed settings see the Table 2.

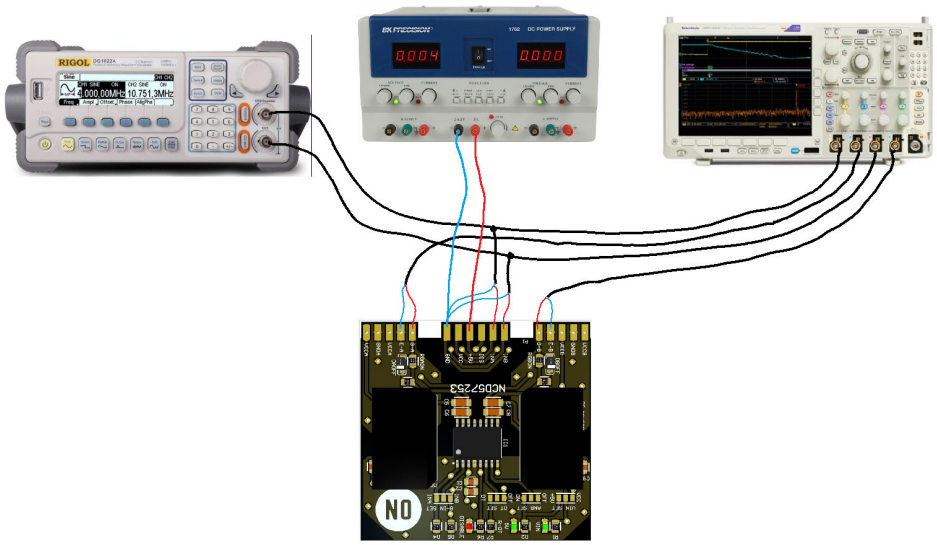


Figure 2. On Board DC−DC Power Converter Powered by a Common Power Source as the Input Side of the Driver

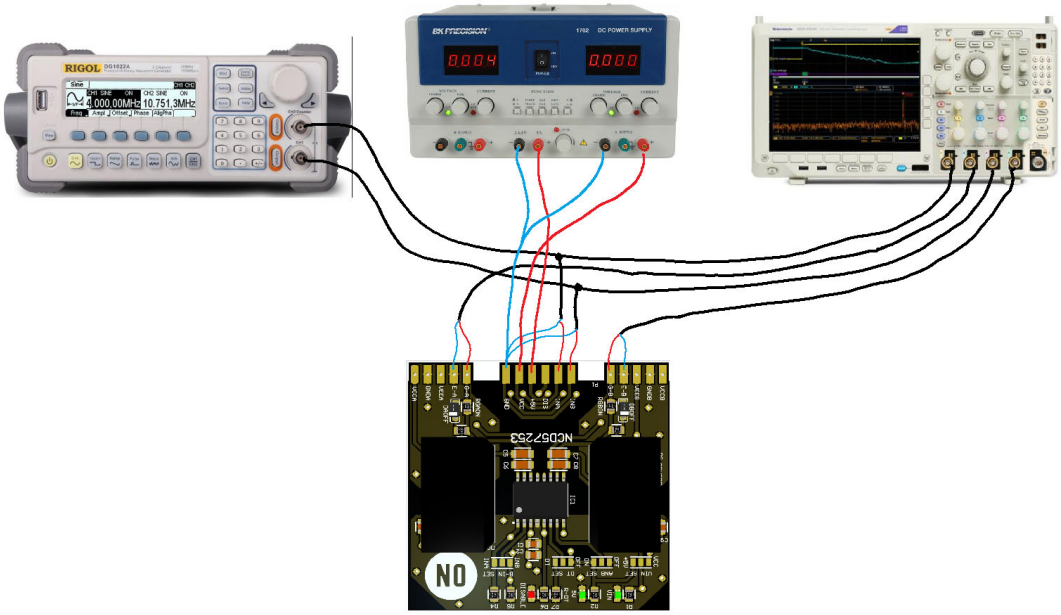


Figure 3. On Board DC−DC Power Converter Powered by a Different Power Source from the VCC Pin

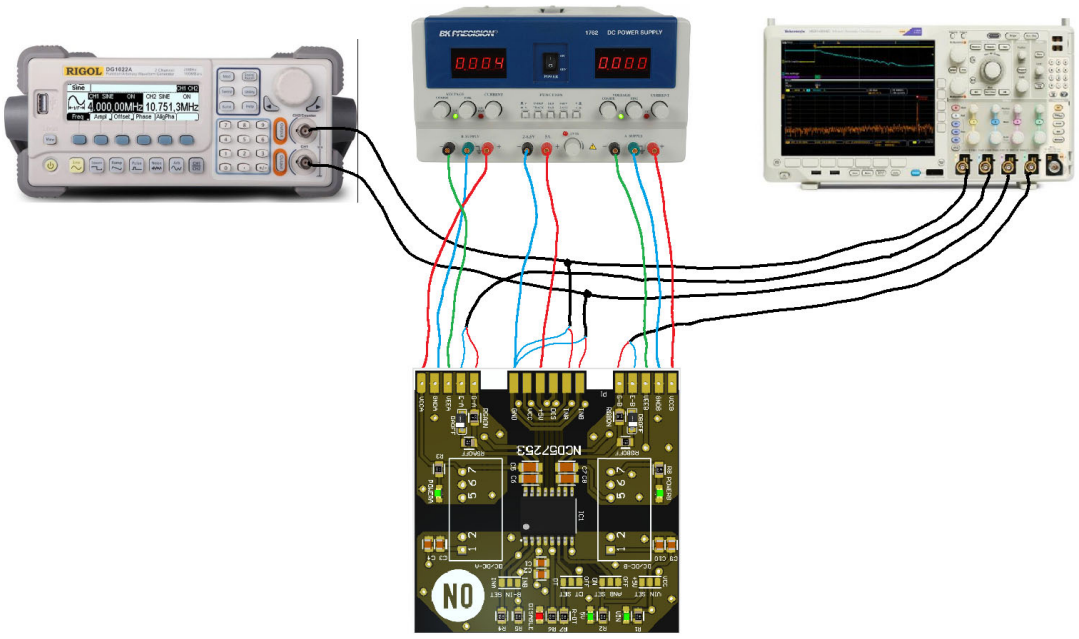


Figure 4. External Power Supply (No On Board DC−DC Converters)

Signal Inputs (INA, INB)

To prevent output pulse trimming, NCD57253 is equipped by resettable input functionality.

This function is active when the UVLO or the DISABLE function is detected.

OUTx will stay LOW until rising edge is detected on the INx.

Signal Inputs Setup (ANB SET, DT SET)

Complementary Output Setup (ANB)

This function provides complementary signal output from one PWM input signal on INA.

- Set ANB SET jumper to ON to activate the function, B−IN jumper should be set to the INA to ensure proper input signal rising edge reset after UVLO conditions have disappeared or DISABLE has been deactivated.
- ANB SET should be set to OFF when G−A and G−B are controlled individually by INA and INB (along with DISABLE and DT).

Deadtime (DT)

The function provides complementary output signals with defined deadtime based on the value of the external resistor R7 (connected between DT pin and GND). The deadtime can be estimated as t_{DT} (ns) ≈ 10 x R_{DT} (kΩ).

If minimum dead time is required, DT SET should remain float (see Table 2).

- If DT SET is set to OFF, the deadtime control is disabled. Outputs are controlled by inputs with respect to other settings such as ANB SET, IN−B.
- If DT SET is set to DT, the deadtime control is active. Outputs are controlled by inputs with added deadtime.

TEST SPECIFICATION

This section provides details how to configure the NCD57253 Evaluation board. Basic laboratory equipment will be required to perform the tests.

Equipment

- Power supplies
  - 3 pcs of DC power supplies providing minimally 25 V/1 A. (or 1 DC power supply + 2 pcs of dc−dc converters).
- Function generator
  - Two channel functional generator providing the required testing frequency.
- Oscilloscope
  - Oscilloscope 2 channel (4 channel optional)
    - Passive probes

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 function generator to the INA and INB signal inputs and GND
- Connect power supply positive lead to the +5 V
- Connect power supply negative lead to the GND
- Connect power supplies positive lead to the VCCA / VCCB
- Connect power supply negative lead to the VEEA / VEEB
- (VEEA/VEEB shorted to the GNDA/GNDB if not used)
- Connect power supply ground lead to the GNDA / GNDB
- Connect oscilloscope probes to G−A, G−B output pins

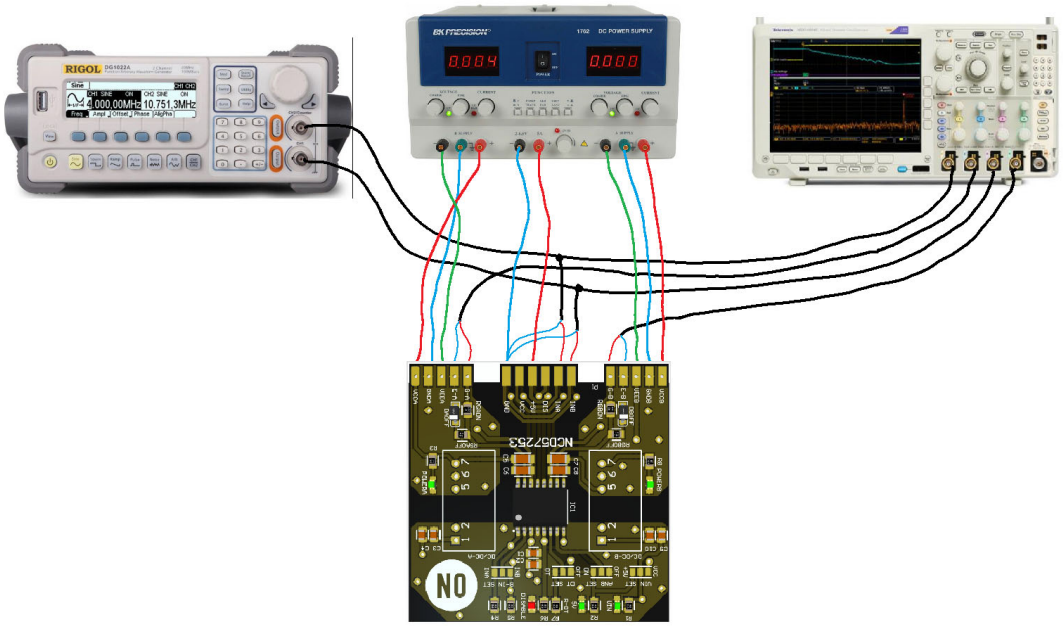


Figure 5. Test Setup Diagram

Power Up

1. Before the power−up, verify the correct connection of all signals and power leads
2. Enable power supply. Current consumption depends on the chosen solution of the secondary side power supply. When 5 V to +20 V/−5 V dc−dc converters are used, the current consumption can be up to 300 mA
3. Enable function generator outputs
4. Check the signals at each outputs

Power Down

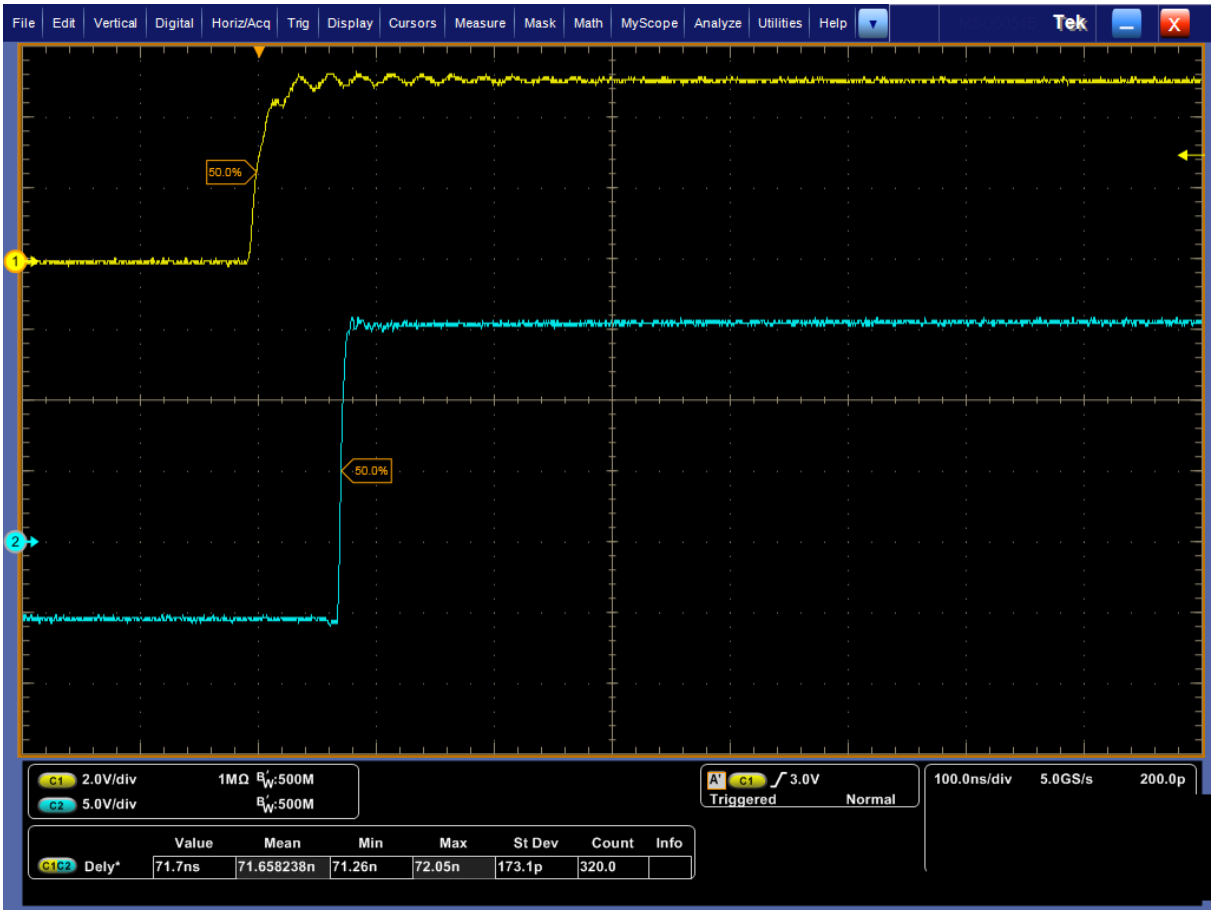
1. Disable functional generator outputs
2. Disable power supply
3. Disconnect equipment

Test 1 – Typical Performance Waveforms – Propagation Delay

To set the board, use this setup as a reference.

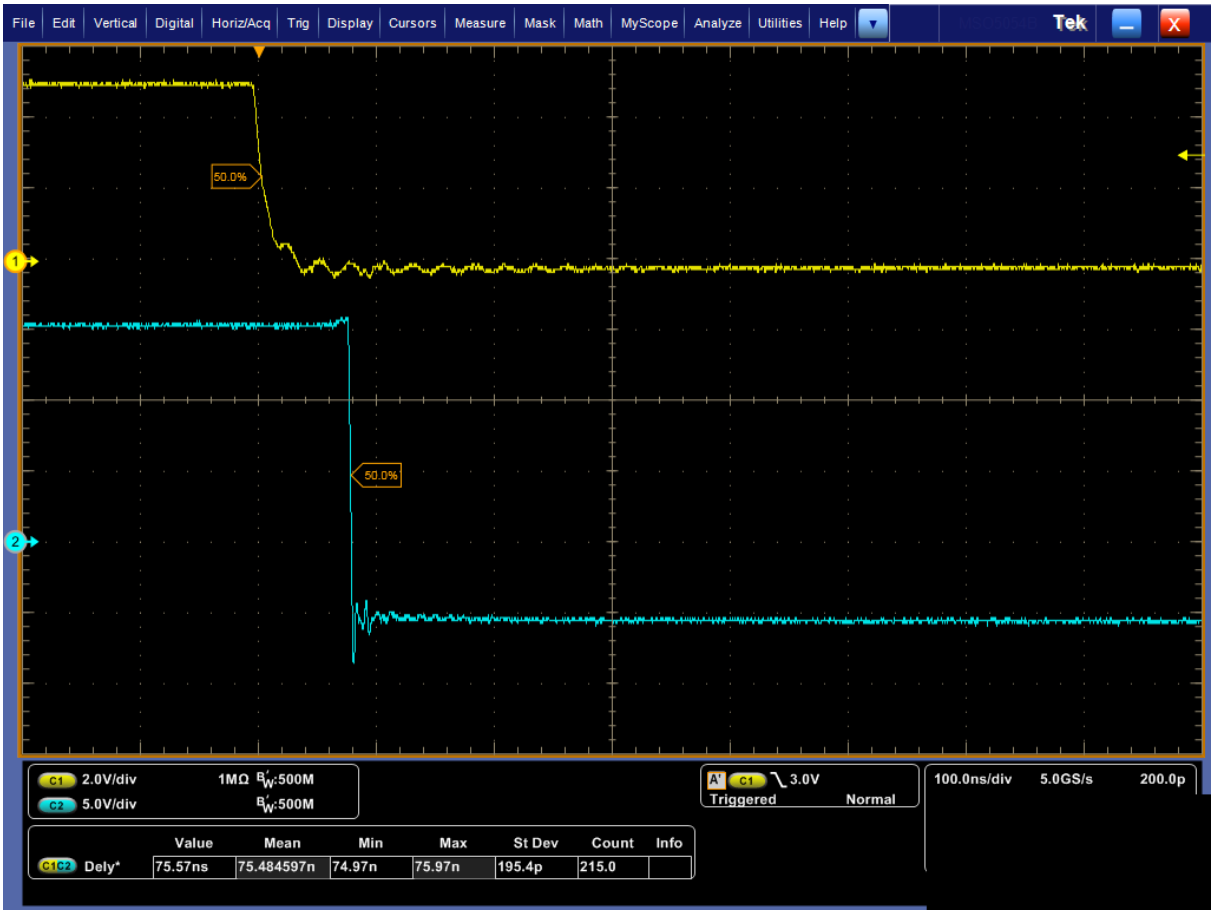
Make sure the power supplies & outputs of signal generators are powered off / disabled channel

1. VIN SET
   a. For powering outputs by using external power supplies – open jumper
   b. For using 5 V dc−dc converter – Set jumper to 5 V
   c. For using different input voltage dc−dc converter – Set jumper to VCC
      i. External power supplies with appropriate voltage need to be connected to VCC pin
2. ANB SET – Set to OFF
3. DT SET – Set to OFF
4. B−IN SET – Set to INB
5. POWER UP the setup



(Legend: C1 – Input A (INA), C2 – Output A (G–A), C3 – Input B (INB), C4 – Output B (G–B))

Figure 6. INPUT and OUTPUT Rise Propagation Delay Waveforms



(Legend: C1 – Input A (INA), C2 – Output A (G–A), C3 – Input B (INB), C4 – Output B (G–B))

Figure 7. INPUT and OUTPUT Fall Propagation Delay Waveforms

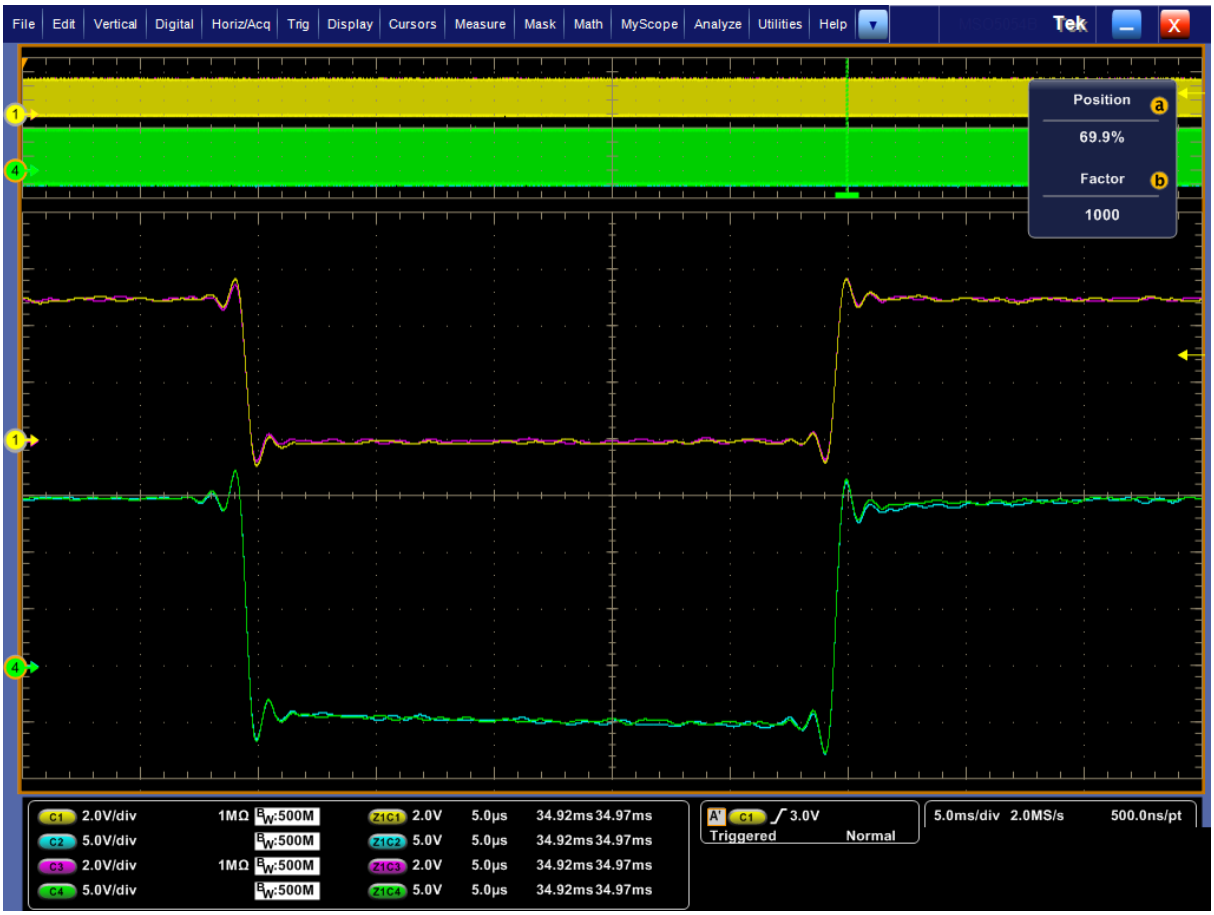
Test 2 – Typical Performance Waveforms – Independent 2 Channels Driver

The NCD57253 can work as 2 independent channel driver.

To set the board as 2 independent channel driver, use this setup as a reference.

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

1. VIN SET
   a. For powering outputs by using external power supplies − open jumper
   b. For using 5 V dc−dc converter – Set jumper to 5 V
   c. For using different input voltage dc−dc converter – Set jumper to VCC
      i. External power supplies with appropriate voltage need to be connected to VCC pin
2. ANB SET – Set to OFF
3. DT SET – Set to OFF
4. B−IN SET – Set to INB
5. POWER UP the setup



(Legend: C1 – Input A (INA), C2 – Output A (G–A), C3 – Input B (INB), C4 – Output B (G–B))

(Input signals from the external signal generator are in phase)

Figure 8. INPUT and OUTPUT Signals

(Legend: C1 – Input A (INA), C2 – Output A (G–A), C3 – Input B (INB), C4 – Output B (G–B))

(Input signals from the external signal generator are complementary)

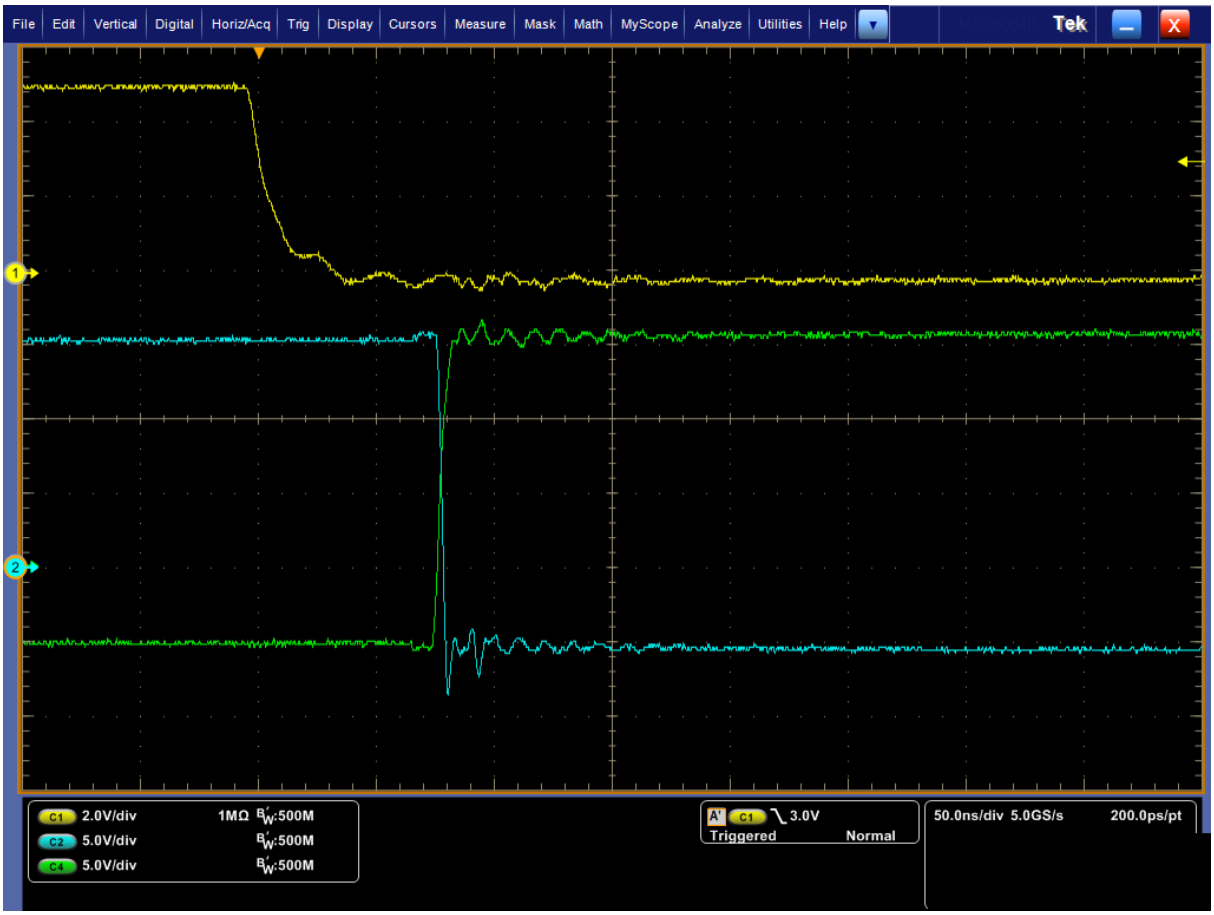
Figure 9. INPUT and OUTPUT Signals

Test 3 – Typical Performance Waveforms –2 Channels Complementary Driver without Added Dead Time

The NCD57253 can work as 2 channel complementary driver with single channel input without affecting the dead time. To set the board as 2 channel driver, use this setup as a reference.

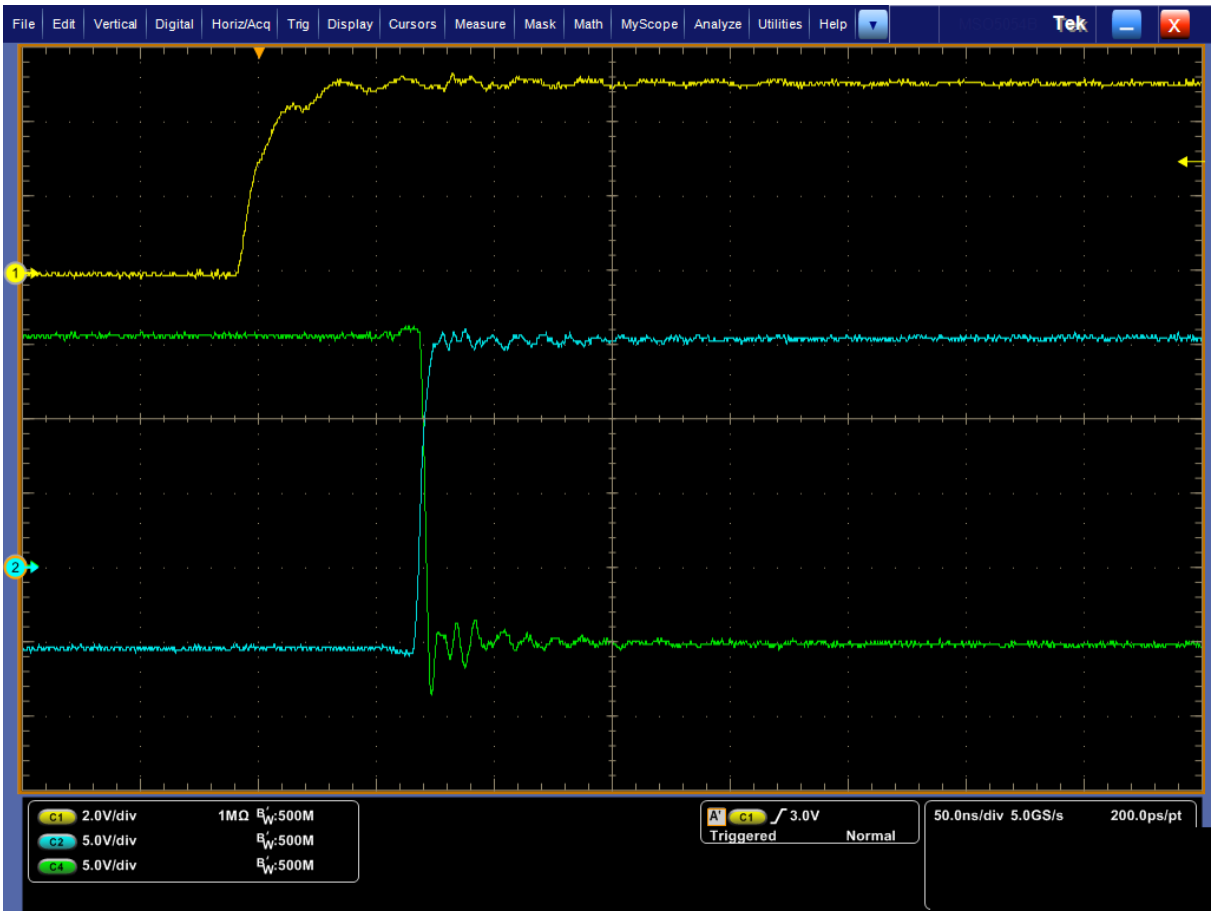
Make sure the power supplies & outputs of signal generators are powered off / disabled channel

1. VIN SET
   a. For powering outputs by using external power supplies − open jumper
   b. For using 5 V dc−dc converter – Set jumper to 5 V
   c. For using different input voltage dc−dc converter – Set jumper to VCC
      i. External power supplies with appropriate voltage need to be connected to VCC pin
2. ANB SET – Set to ON
3. DT SET – Set to OFF
4. B−IN SET – Set to INA
5. POWER UP the setup



(Legend: C1 – Input A (INA), C2 – Output A (G–A), C3 – Input B (INB), C4 – Output B (G–B))

Figure 10. INPUT and OUTPUT Signals



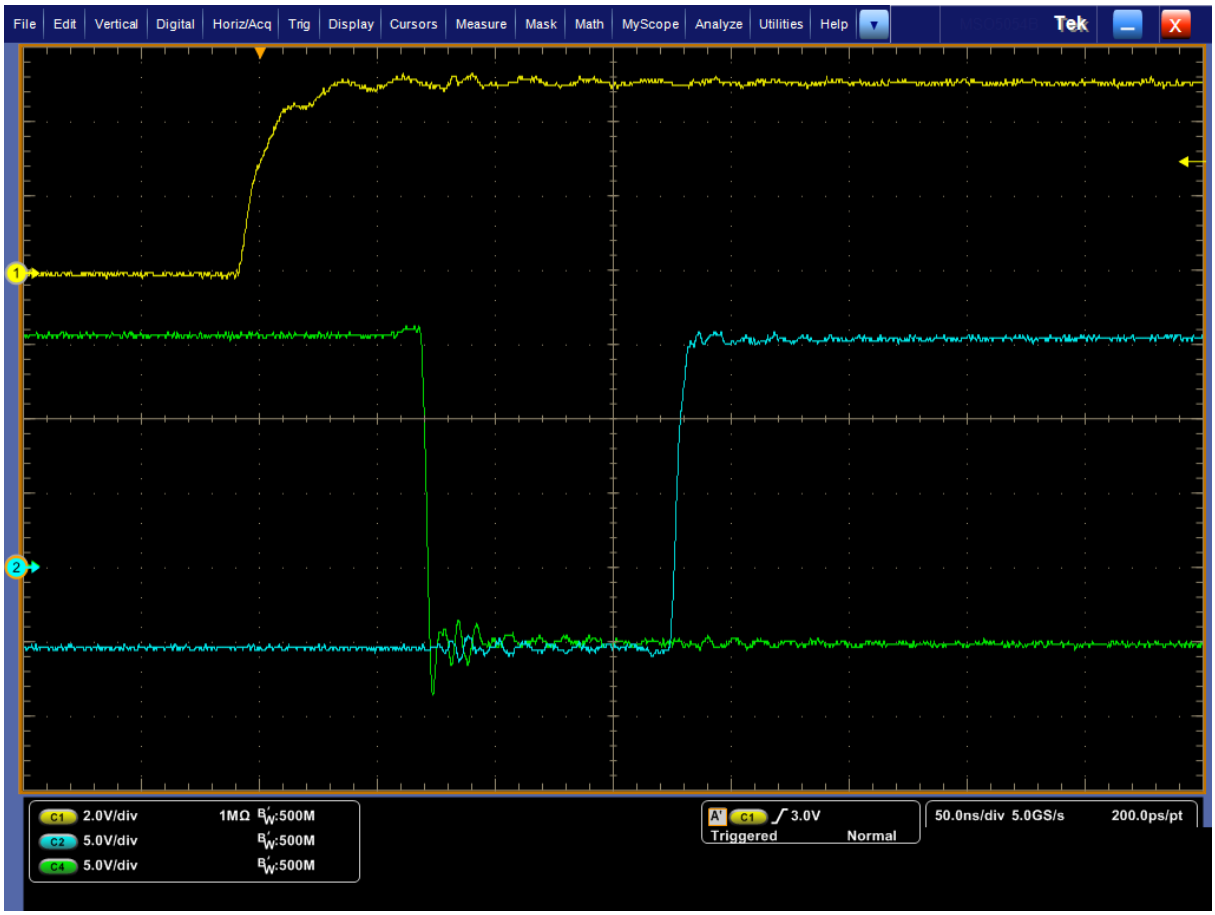
(Legend: C1 – Input A (INA), C2 – Output A (G–A), C3 – Input B (INB), C4 – Output B (G–B))

Figure 11. INPUT and OUTPUT Signals

Test 4 – Typical Performance Waveforms –2 Channels Complementary Driver with Adjustable Dead Time

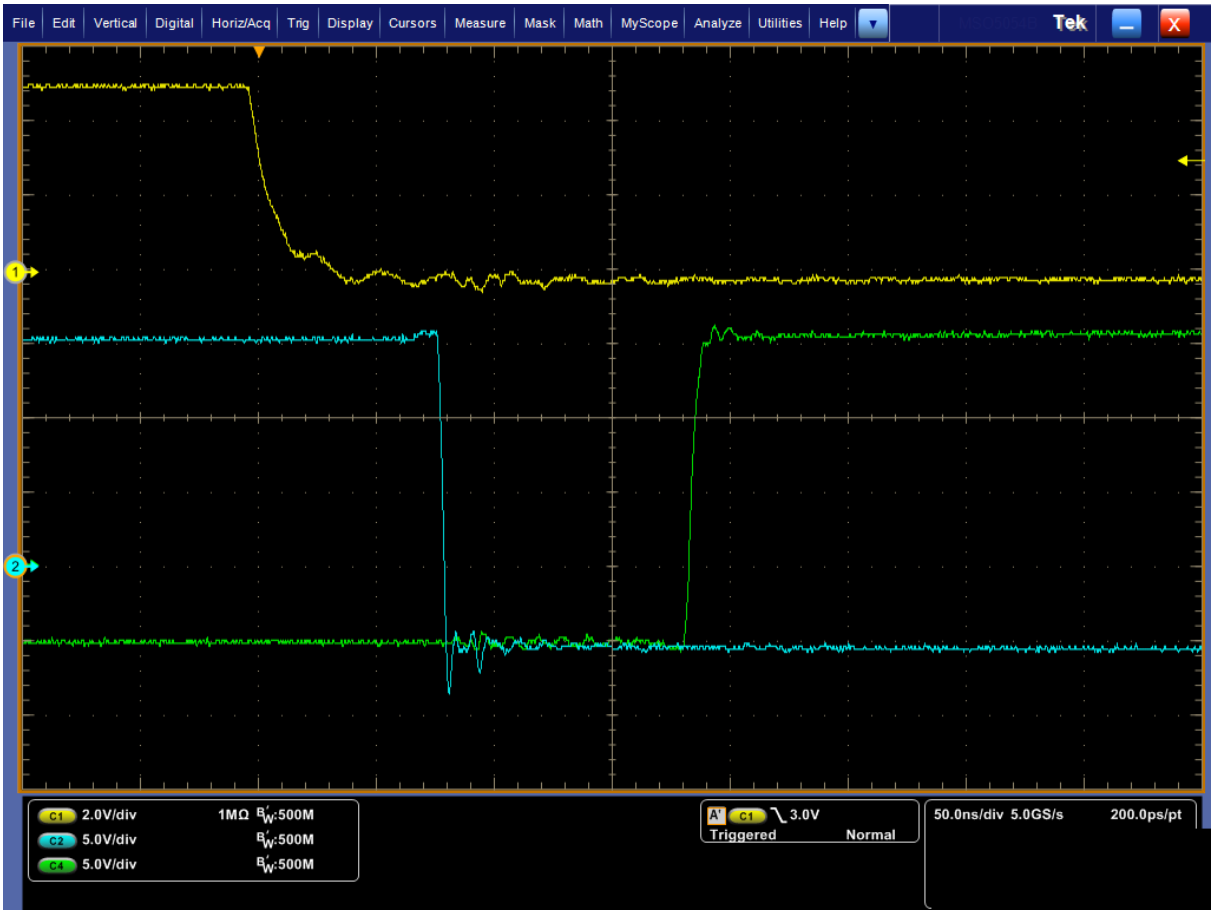
The NCD57253 can work as 2 channel complementary driver with single channel input with adjustable dead time.
To set the board as 2 channel driver, use this setup as a reference.
Make sure the power supplies & outputs of signal generators are powered off / disabled channel

1. VIN SET
   a. For powering outputs by using external power supplies − open jumper
   b. For using 5 V dc−dc converter – Set jumper to 5 V
   c. For using different input voltage dc−dc converter – Set jumper to VCC
      i. External power supplies with appropriate voltage need to be connected to VCC pin
2. ANB SET – Set to ON
3. DT SET – Set to DT (DT value is set by R7 value, see the datasheet)
4. B−IN SET – Set to INA
5. POWER UP the setup



(Legend: C1 – Input A (INA), C2 – Output A (G–A), C3 – Input B (INB), C4 – Output B (G–B))

Figure 12. INPUT and OUTPUT Signals



(Legend: C1 – Input A (INA), C2 – Output A (G–A), C3 – Input B (INB), C4 – Output B (G–B))

Figure 13. INPUT and OUTPUT Signals

SCHEMATIC & LAYOUT DIAGRAMS

Schematic Diagram

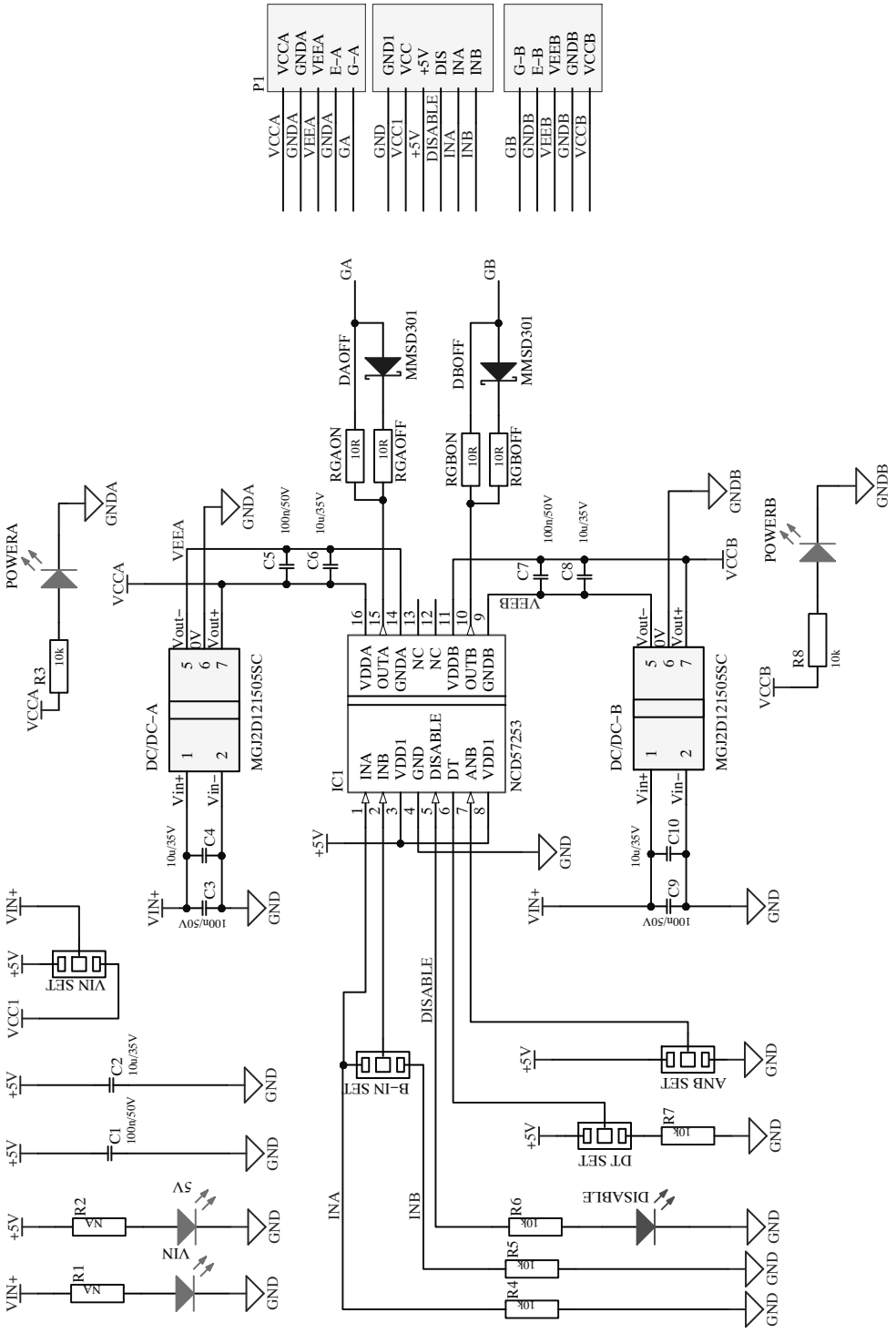


Figure 14. Schematic

Layout Diagrams

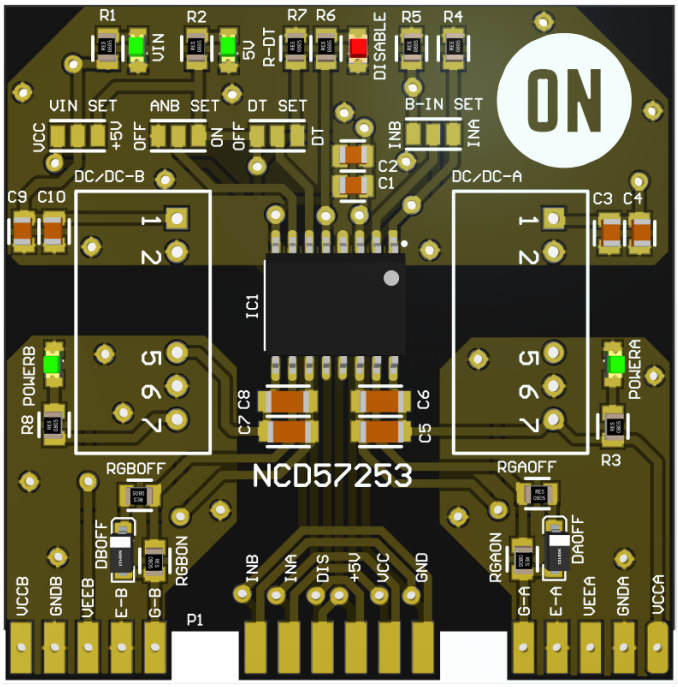


Figure 15. Assembled PCB TOP View

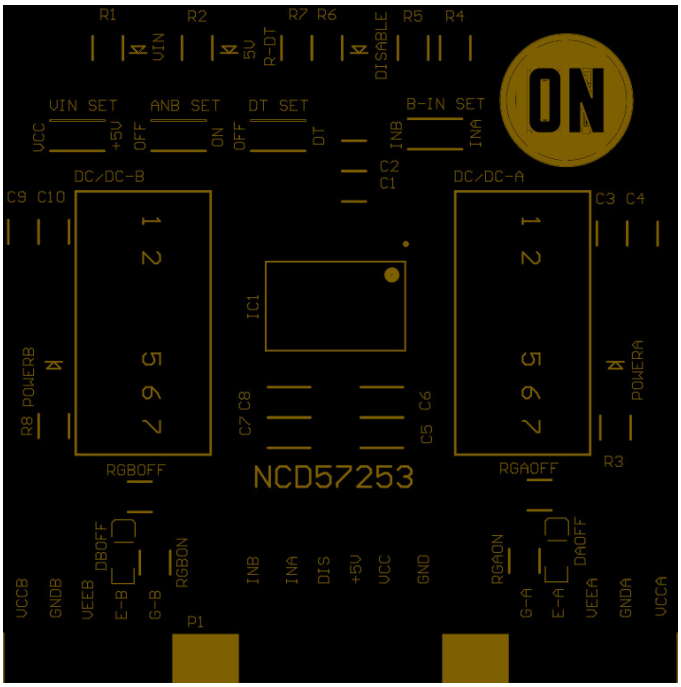


Figure 16. TOP Overlay

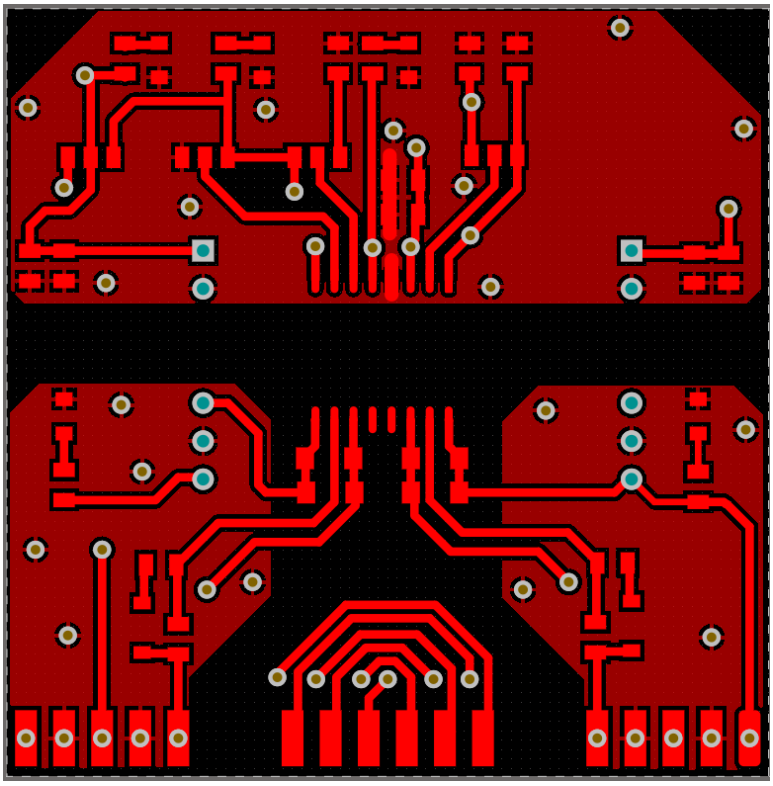


Figure 17. Top Layer

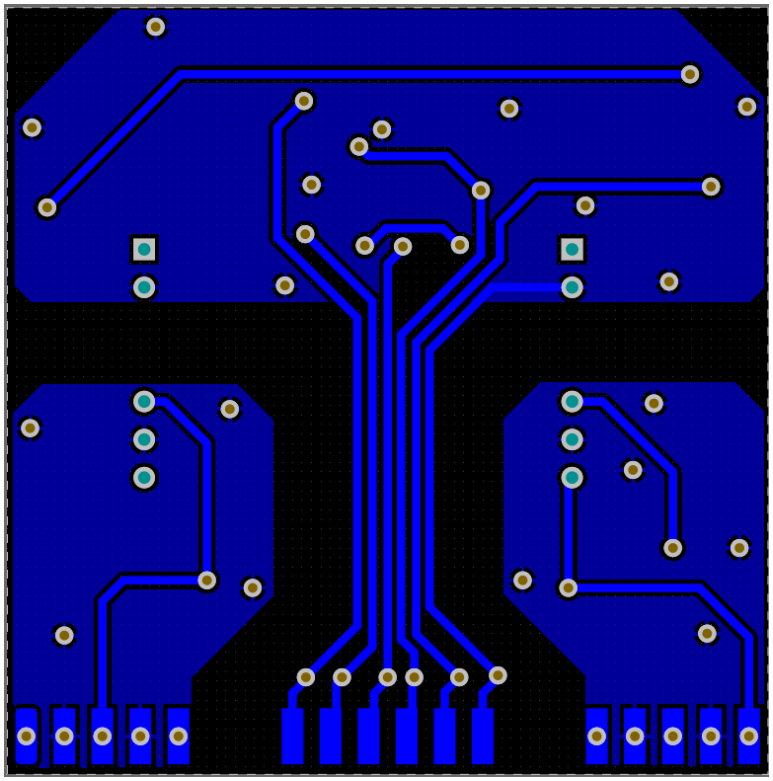


Figure 18. BOT Layer

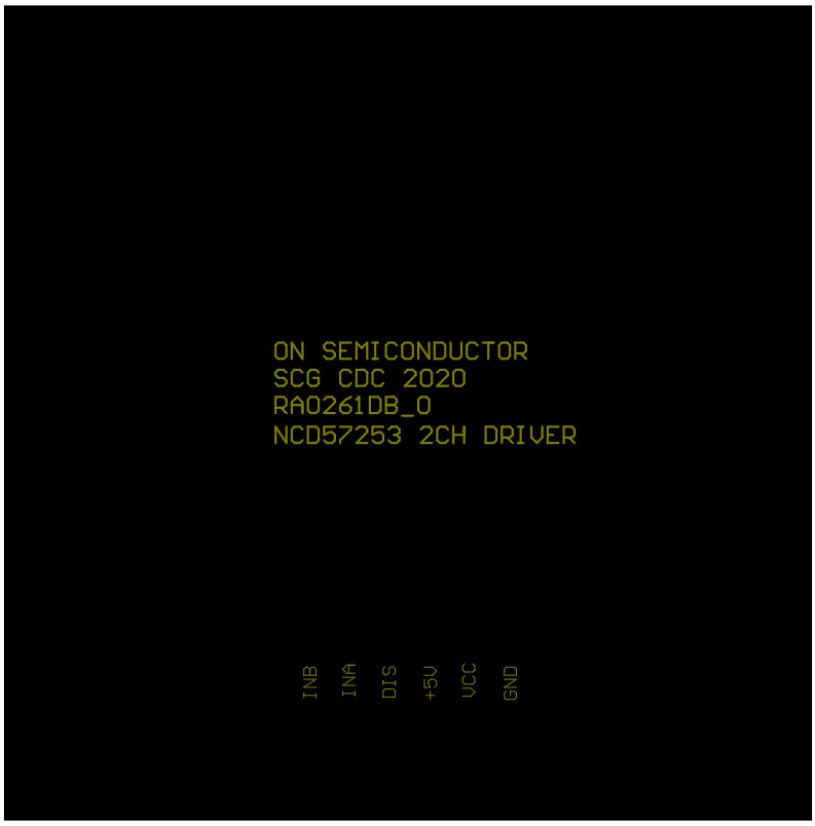


Figure 19. BOT Overlay

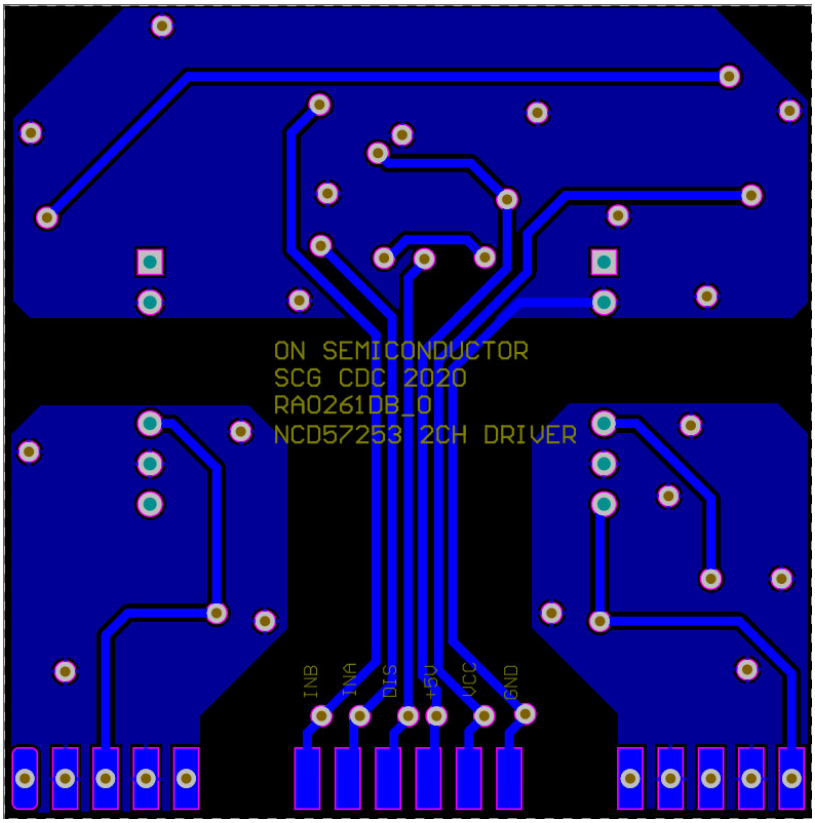


Figure 20. Assembled PCB BOT View

BOM

Table 4. BILL OF MATERIAL

Quantity	Assembled	Designator	Value	Description	Package	Manufacturer
1	YES	IC1	NCD57253	MOSFET Driver	SOIC−16W	**onsemi**
2	YES	DAOFF, DBOFF	MMSD301T1G	Schottky diode 30 V	SOD−123	**onsemi**
4	YES	VIN, +5V, POWERA, POWERB	LED SMD	GREEN	SMD 0805	
1	YES	DISABLE	LED SMD	RED	SMD 0805	
1	YES	C1, C3, C9	100 nF / 50 V	Ceramic capacitor	0805	Kemet
1	YES	C2, C4, C10	10 μF / 35 V	Ceramic capacitor	0805	Kemet
2	YES	C6, C8	10 μF / 35 V	Ceramic capacitor	1206	TDK
2	YES	C5, C7	100 nF / 50 V	Ceramic capacitor	1206	Kemet
7	YES	R1, R2, R3, R4, R5, R6, R8	10 kΩ	Resistor	0805	Vishay
4	YES	RGAON, RGAOFF, RGBON, RGBOFF	10 Ω	Resistor	0805	Vishay
1	YES	R7	100 kΩ (20 kΩ − 500 kΩ)	Resistor	0805	Vishay
1	YES	P1	2x20	PIN header		
1	YES	PCB	RA0261DB_0	PCB	51x51 mm	Any
2	OPTIONAL	dc−dc−A, dc−dc−B	MGJ2D051505SC MGJ2D121505SC MGJ2D052005SC MGJ2D152015SC	dc−dc power source	10x13x20 mm	MURATA

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:
Technical Library: www.onsemi.com/design/resources/technical−documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support
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