BTN9990LV/BTN9970LV

Typical application waveforms

About this document

Scope and purpose

This application note provides information about typical application waveforms to help engineers to understand the function of the devices BTN9970LV and BTN9990LV. The BTN99xx NovalithIC™ + devices are part of an integrated half-bridge family, suitable for driving DC motors and solenoids.

This document must be used in conjunction with the device datasheet.

Intended audience

Developers and system designers evaluating the BTN99xx NovalithIC™ + devices.

Table of contents

1 Measurement setup information

The measurements have been performed with the BTN9970/BTN9990 Motor control shield V1.2 and an Arduino Uno (REV3) Controller board, as shown in **Figure 5**. The BTN9970/BTN9990 Motor control shield V1.2 is on top of the Arduino Uno controller board.

Simplified schematics for the measurement setups are shown in **Figure 1**, **Figure 2**, **Figure 3**, and **Figure 4**. For more detailed schematic and layout information of the BTN9970/BTN9990 Motor control shield V1.2, refer to its user manual.

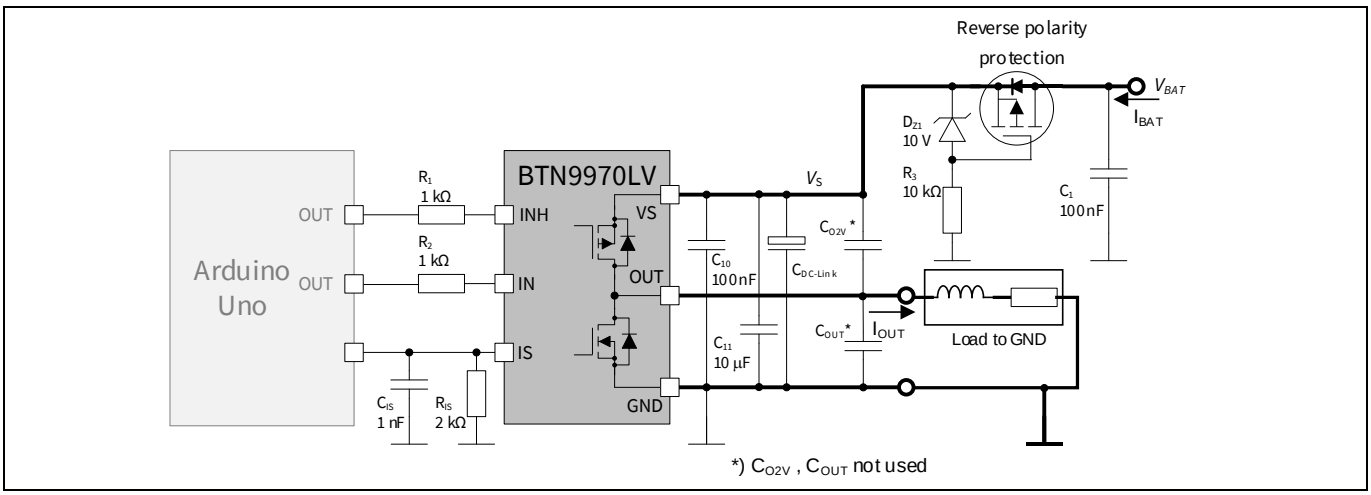


Figure 1 Simplified application schematic of BTN9970LV with load to GND

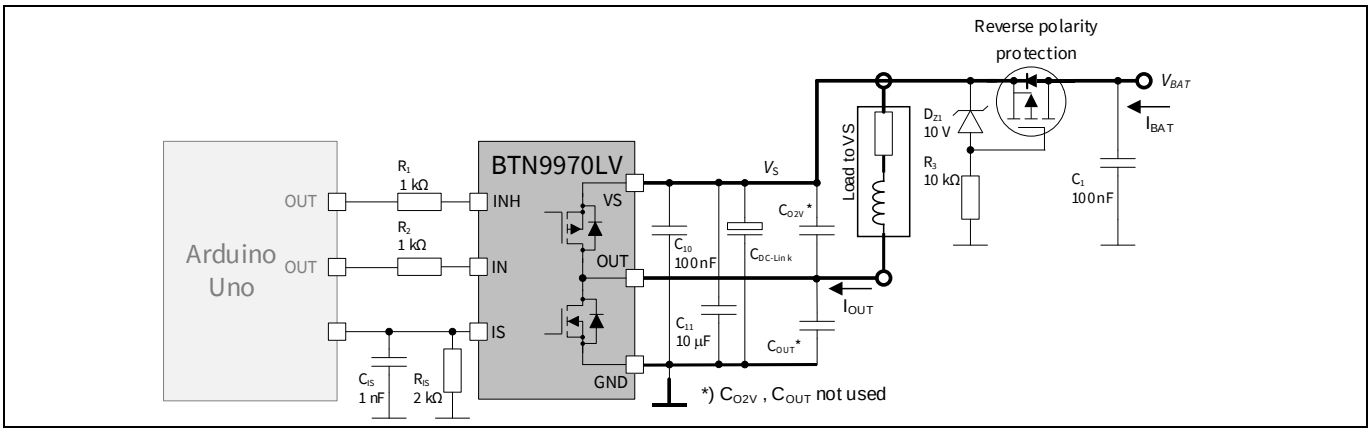


Figure 2 Simplified application schematic of BTN9970LV with load to V_S

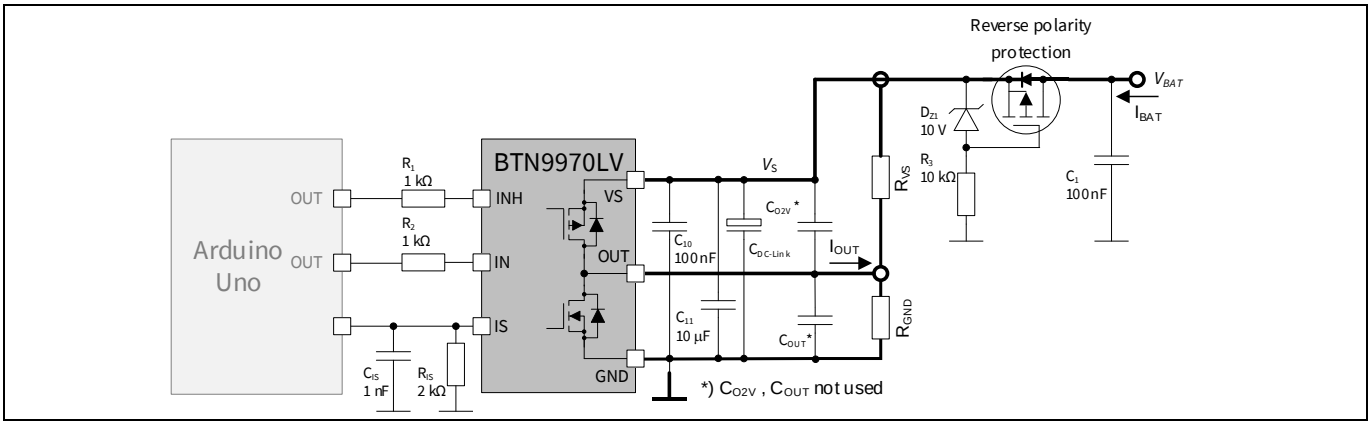


Figure 3 Simplified measurement setup with resistor biased output

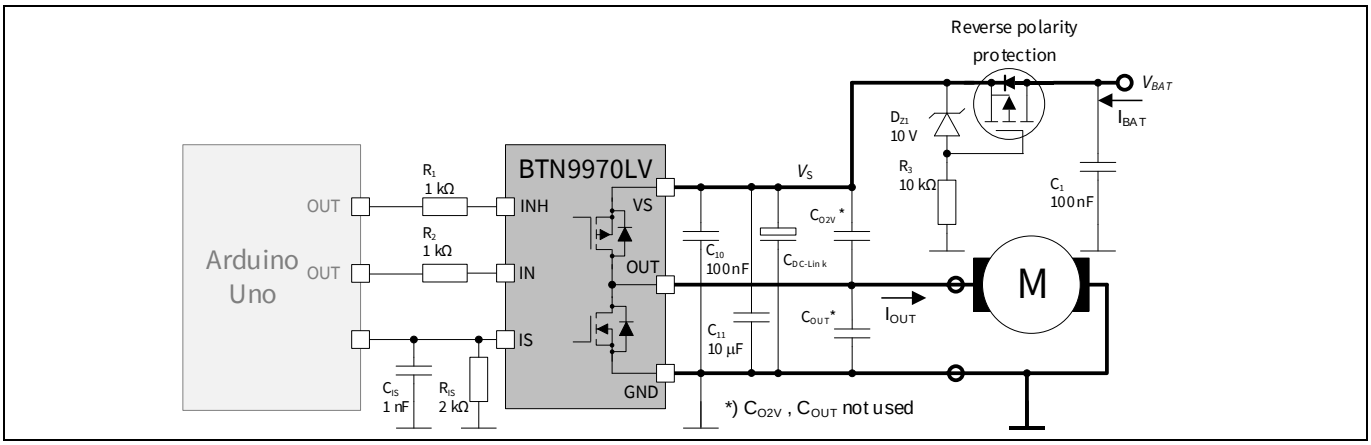


Figure 4 Simplified application schematic of BTN9970LV with DC brushed motor to GND

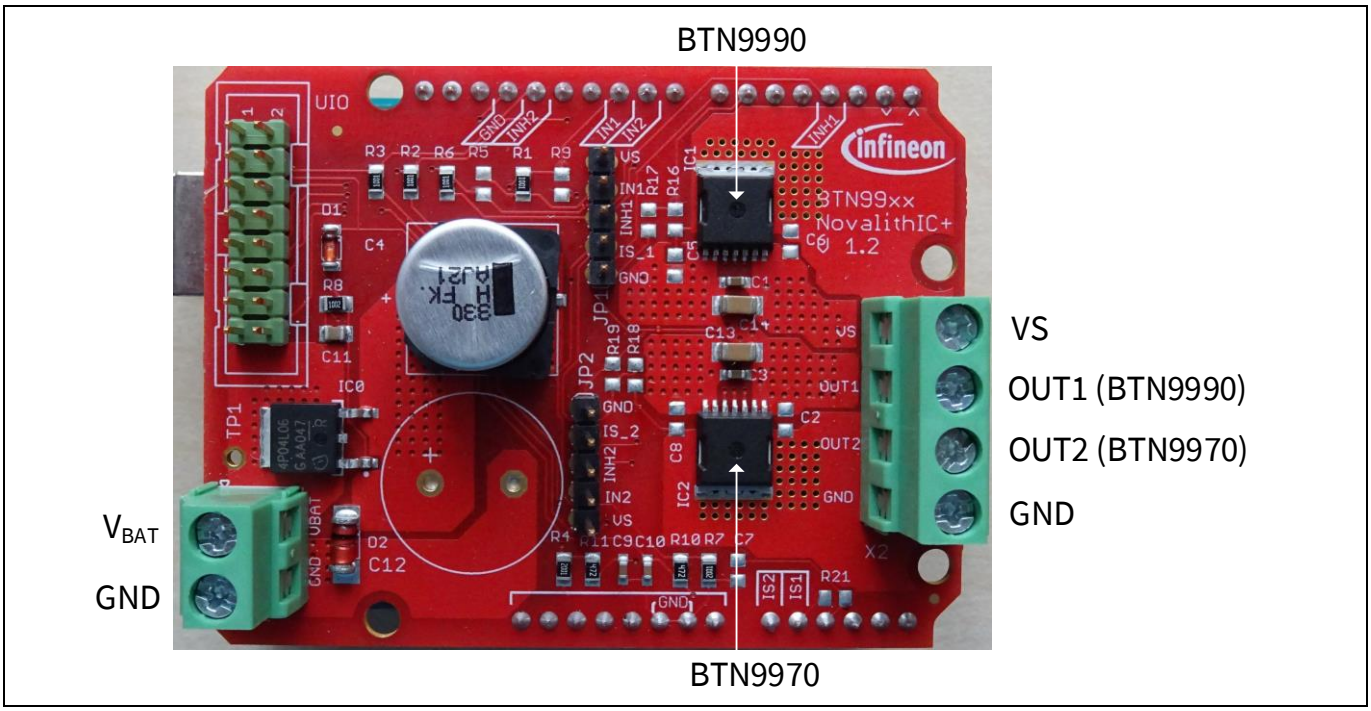


Figure 5 BTN9970 / BTN9990 Motor control shield V1.2

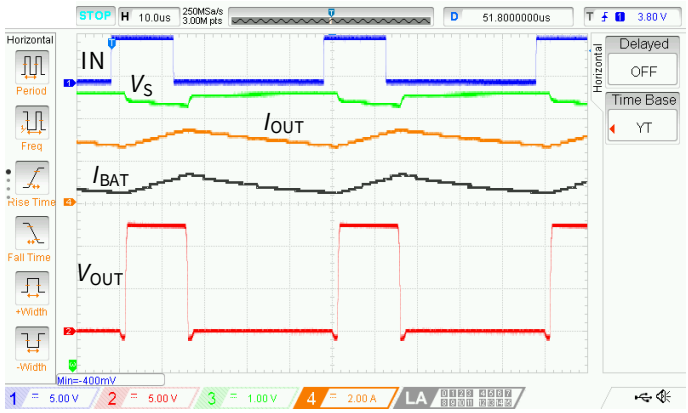
Typical application waveforms

2 Typical application waveforms

The information in this section is not part of the device datasheet. There is no warranty for accuracy or completeness. The user needs to validate and test his design to confirm functionality and meet application requirements. It is in the responsibility of the customer to select suitable components meeting the application requirements.

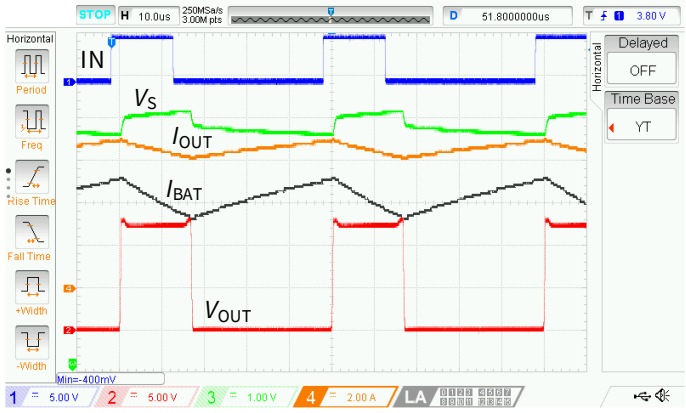
The measurements were performed at T_A = 25°C room temperature and show the typical operation performance of the device.

2.1 PWM operation with load to GND/load to V_S



BTN9970, half-bridge
V_{BAT} = 12 V
INH = 5 V
f_{PWM} = 20 kHz
D = 30%
Slew rate = SR0
Load to GND
Load 150 µH + 1 Ω
C_{DC_Link} = 330 µF

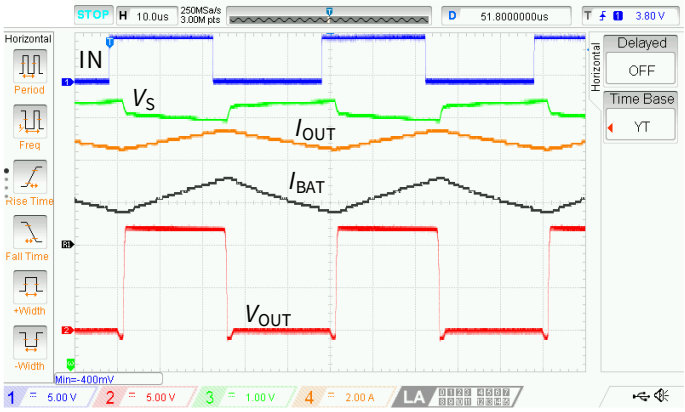
Figure 6 BTN9970 PWM operation in half bridge configuration with D=30%, f_{PWM} 20 kHz, load to GND (see also Figure 1)



BTN9970, half-bridge
V_{BAT} = 12 V
INH = 5 V
f_{PWM} = 20 kHz
D = 30%
Slew rate = SR0
Load to V_S
Load 150 µH + 1 Ω
C_{DC_Link} = 330 µF

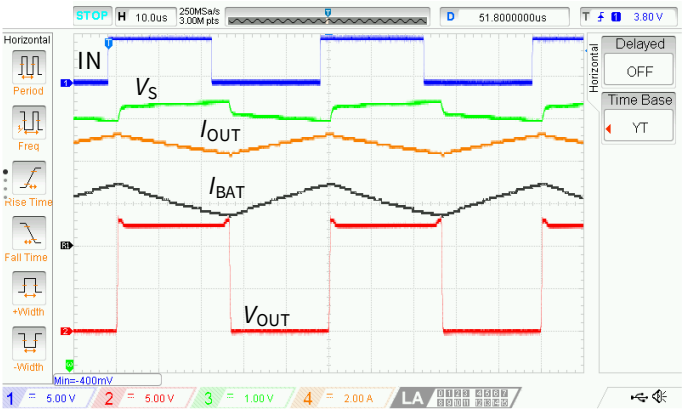
Figure 7 BTN9970 PWM operation in half bridge configuration with D=30%, f_{PWM} 20 kHz, load to V_S (see also Figure 2)

Typical application waveforms



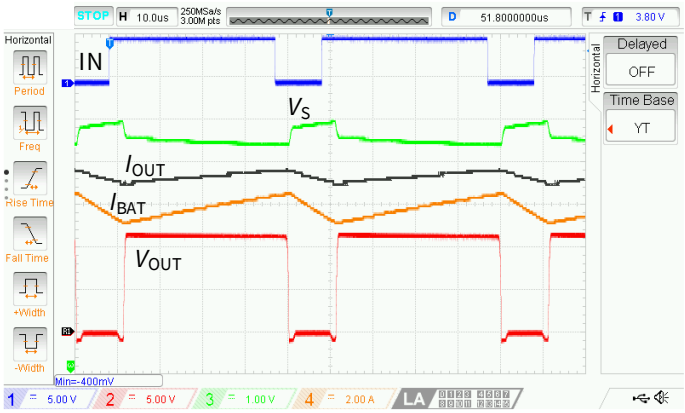
BTN9970, half-bridge
V_{BAT} = 12 V
INH = 5V
f_{PWM} = 20 kHz
D = 50%
Slew rate = SR0
Load to GND
Load 150 µH + 1 Ω
C_{DC_Link} = 330 µF

Figure 8 BTN9970 PWM operation in half bridge configuration with D=50%, f_{PWM} 20 kHz, load to GND (see also Figure 1)



BTN9970, half-bridge
V_{BAT} = 12 V
INH = 5 V
f_{PWM} = 20 kHz
D = 50%
Slew rate = SR0
Load to V_S
Load 150 µH + 1 Ω
C_{DC_Link} = 330 µF

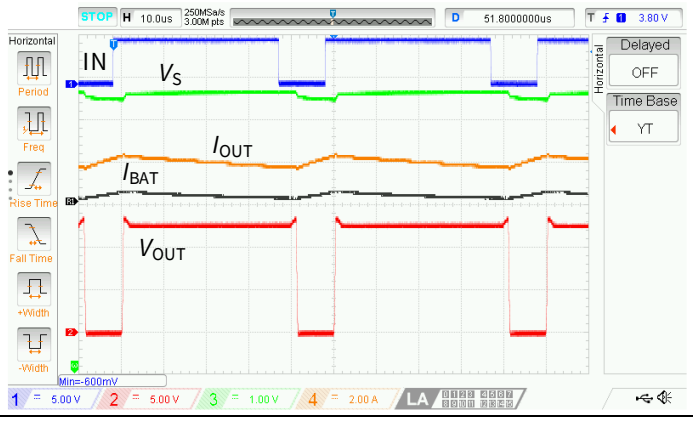
Figure 9 BTN9970 PWM operation in half bridge configuration with D=50%, f_{PWM} 20 kHz, load to V_S (see also Figure 2)



BTN9970, half-bridge
V_{BAT} = 12 V
INH = 5 V
f_{PWM} = 20 kHz
D = 80%
Slew rate = SR0
Load to GND
Load 150 µH + 1 Ω
C_{DC_Link} = 330 µF

Figure 10 BTN9970 PWM operation in half bridge configuration with D=80%, f_{PWM} 20 kHz, load to GND (see also Figure 1)

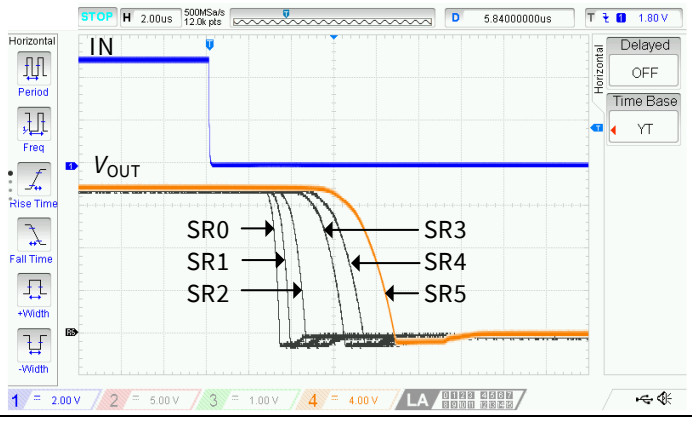
Typical application waveforms



BTN9970, half-bridge
V_{BAT} = 12 V
INH = 5 V
f_{PWM} = 20 kHz
D = 80%
Slew rate = SR0
Load to V_S
Load 150 µH + 1 Ω
C_{DC_Link} = 330 µF

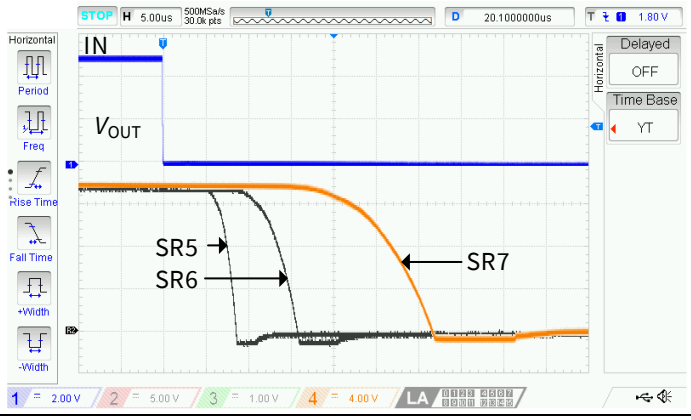
Figure 11 BTN9970 PWM operation in half bridge configuration with D=80%, f_{PWM} 20 kHz, load to V_S (see also Figure 2)

2.2 Power stage behavior for different slew rates



BTN9970, half-bridge
V_{BAT} = 13.5 V
INH = 5 V
Load to GND
Load 150 µH + 1.65 Ω
C_{DC_Link} = 330 µF

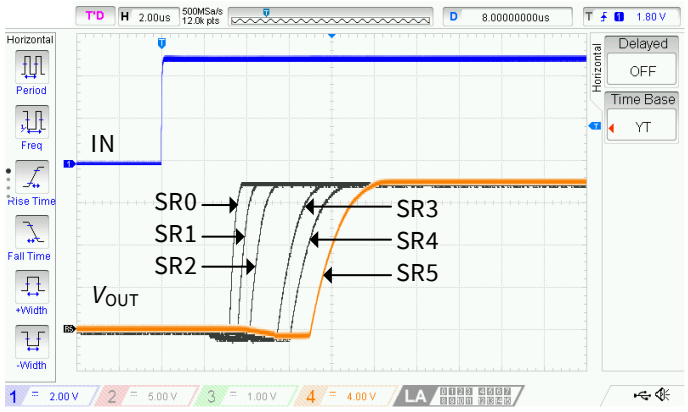
Figure 12 BTN9970 high-side switch turn off delay and fall timing for SR0 – SR5, load to GND (see also Figure 1)



BTN9970, half-bridge
V_{BAT} = 13.5 V
INH = 5 V
Load to GND
Load 150 µH + 1.65 Ω
C_{DC_Link} = 330 µF

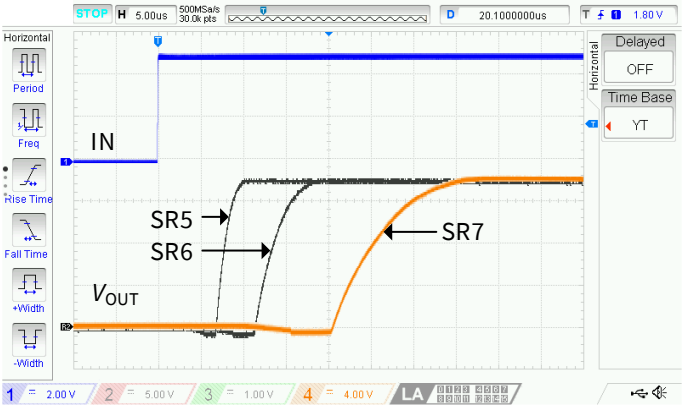
Figure 13 BTN9970 high-side switch turn off delay and fall timing for SR5 – SR7, load to GND (see also Figure 1)

Typical application waveforms



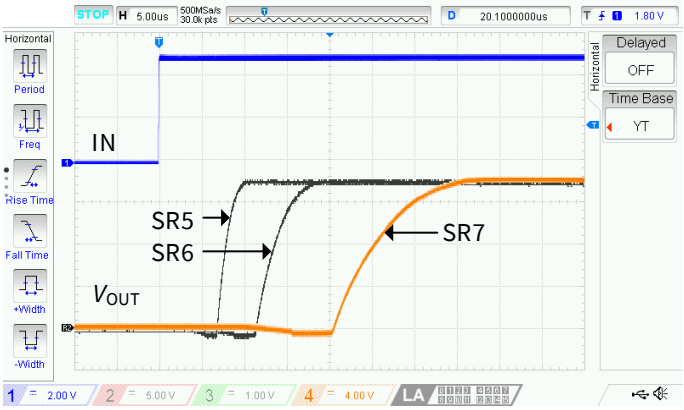
BTN9970, half-bridge
V_{BAT} = 13.5 V
INH = 5 V
Load to GND
Load 150 µ H + 1.65 Ω
C_{DC_Link} = 330 uF

Figure 14 BTN9970 high-side switch turn on delay and rise timing for SR0 – SR5, load to GND (see also Figure 1)



BTN9970, half-bridge
V_{BAT} = 13.5 V
INH = 5 V
Load to GND
Load 150 µ H + 1.65 Ω
C_{DC_Link} = 330 uF

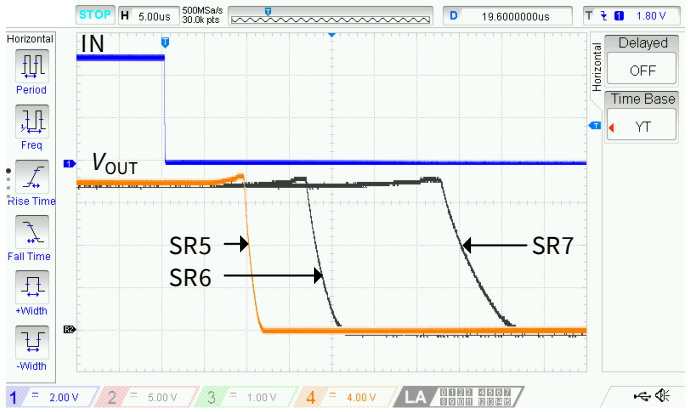
Figure 15 BTN9970 high-side switch turn on delay and rise timing for SR5 – SR7, load to GND (see also Figure 1)



BTN9970, half-bridge
V_{BAT} = 13.5 V
INH = 5 V
Load to GND
Load 150 µ H + 1.65 Ω
C_{DC_Link} = 330 uF

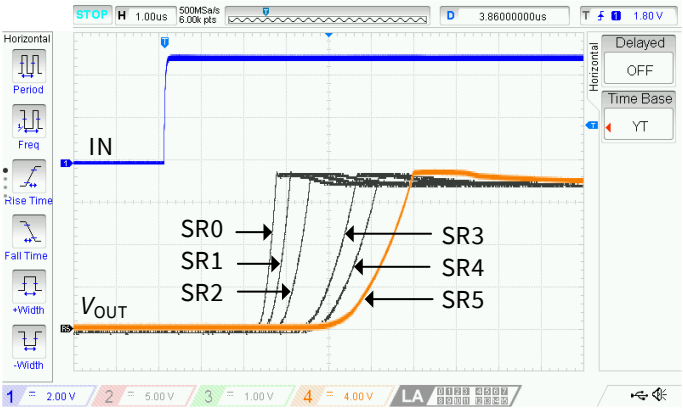
Figure 16 BTN9970 low-side switch turn on delay and fall timing for SR0 – SR5, load to V_s (see also Figure 2)

Typical application waveforms



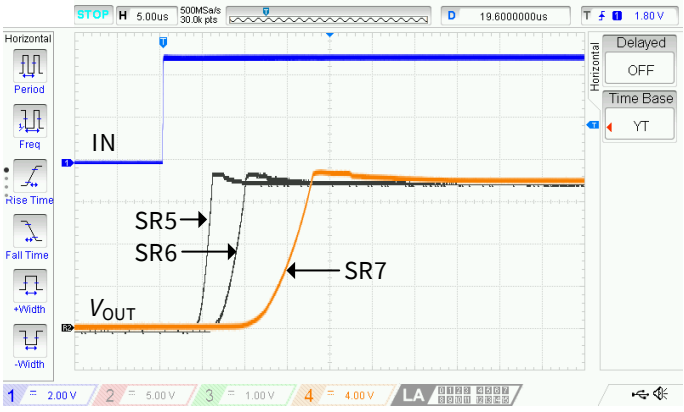
BTN9970, half-bridge
V_{BAT} = 13.5 V
INH = 5 V
Load to VS
Load 150 µH + 1.65 Ω
C_{DC_Link} = 330 µF

Figure 17 BTN9970 low-side switch turn on delay and fall timing for SR5 – SR7, load to V_S (see also Figure 2)



BTN9970, half-bridge
V_{BAT} = 13.5 V
INH = 5 V
Load to VS
Load 150 µ H + 1,65 Ω
C_{DC_Link} = 330 uF

Figure 18 BTN9970 low-side switch turn off delay and rise timing for SR0 – SR5, load to V_S (see also Figure 2)

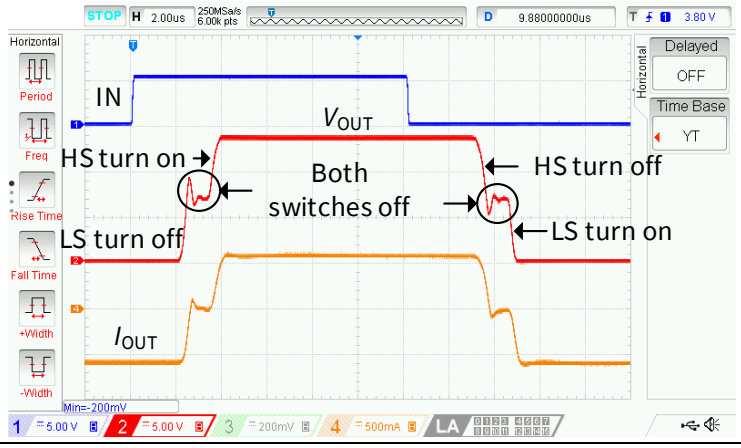


BTN9970, half-bridge
V_{BAT} = 13.5 V
INH = 5 V
Load to VS
Load 150 µ H + 1,65 Ω
C_{DC_Link} = 330 uF

Figure 19 BTN9970 low-side switch turn off delay and rise timing for SR5 – SR7, load to V_S (see also Figure 2)

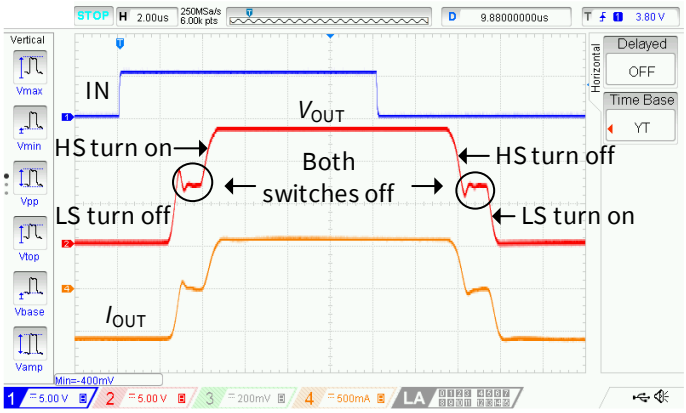
For the following measurements in **Figure 20**, **Figure 21**, **Figure 22**, and **Figure 23** the circuit of **Figure 3** has been used with resistors to GND and V_S to bias the output to V_S/2.

Typical application waveforms



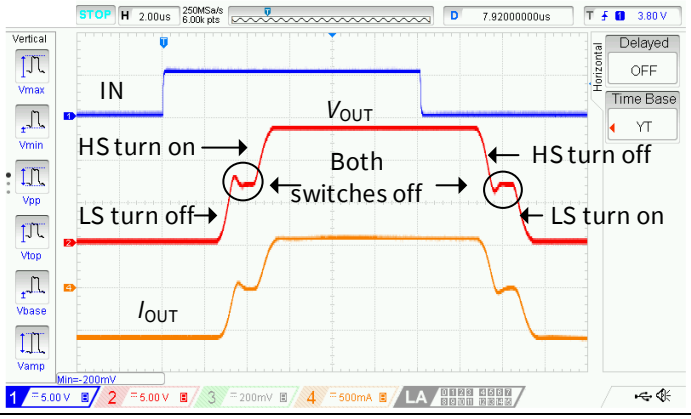
BTN9970, half-bridge
V_{BAT} = 13.5 V
INH = 5V
SR0
Load:
22 Ω to GND + 22 Ω to V_S
C_{DC_Link} = 330 µF

Figure 20 BTN9970 SR0 HS/LS transition (see also Figure 3)



BTN9970, half-bridge
V_{BAT} = 13.5 V
INH = 5 V
SR1
Load:
22 Ω to GND + 22 Ω to V_S
C_{DC_Link} = 330 µF

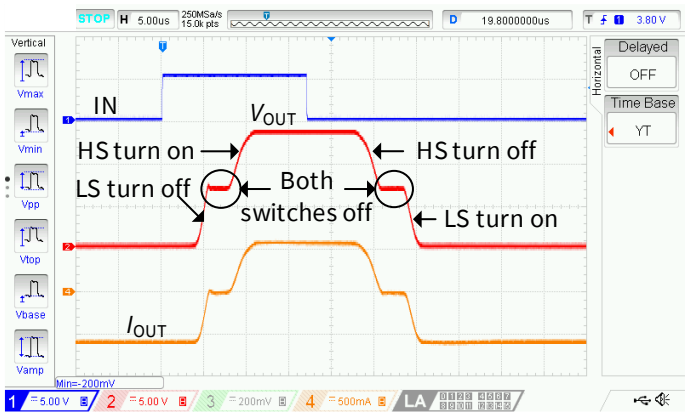
Figure 21 BTN9970 SR1 HS/LS transition (see also Figure 3)



BTN9970, half-bridge
V_{BAT} = 13.5 V
SR2
INH = 5 V
Load:
22 Ω to GND + 22 Ω to V_S
C_{DC_Link} = 330 µF

Figure 22 BTN9970 SR2 HS/LS transition (see also Figure 3)

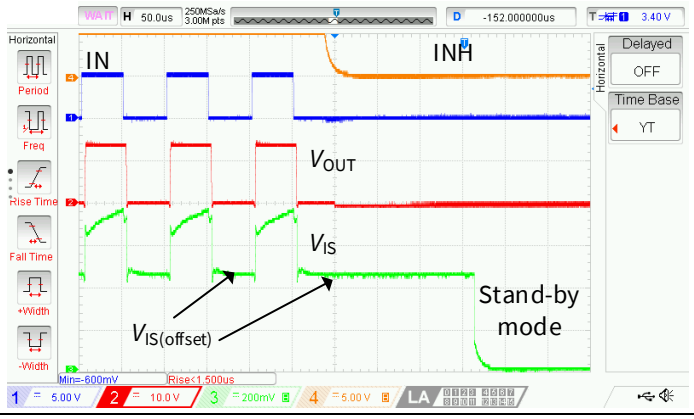
Typical application waveforms



BTN9970, half-bridge
V_{BAT} = 13.5 V
SR5
INH = 5 V
Load:
22 Ω to GND + 22 Ω to V_S
C_{DC_Link} = 330 µF

Figure 23 BTN9970 SR5 HS/LS transition (see also Figure 3)

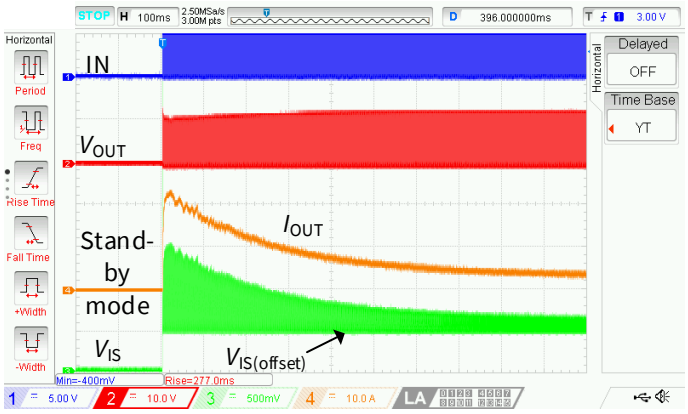
2.3 Enter stand-by mode



BTN9970, half-bridge
V_{BAT} = 13.5 V
SR5
INH = 5 V
Load to GND
Load 150 µH + 1 Ω
C_{DC_Link} = 330 µF

Figure 24 Enter stand-by mode

2.4 Device start-up with motor to GND

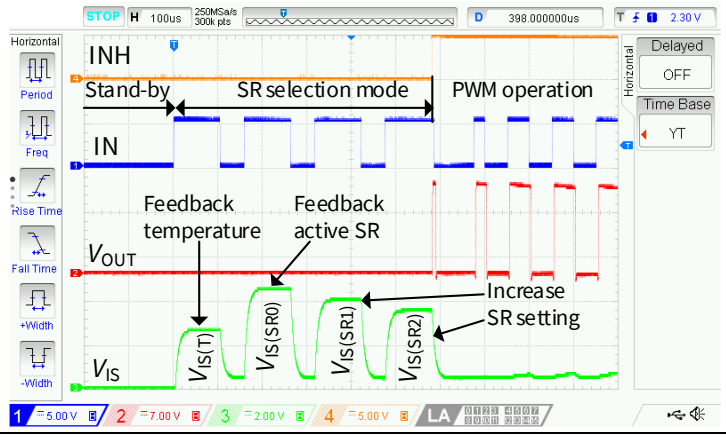


BTN9970, half-bridge
V_{BAT} = 13.5 V
SR0
R_{Sense} = 2 kΩ
Motor to GND

Figure 25 Device start-up with brushed DC motor load (see also Figure 4)

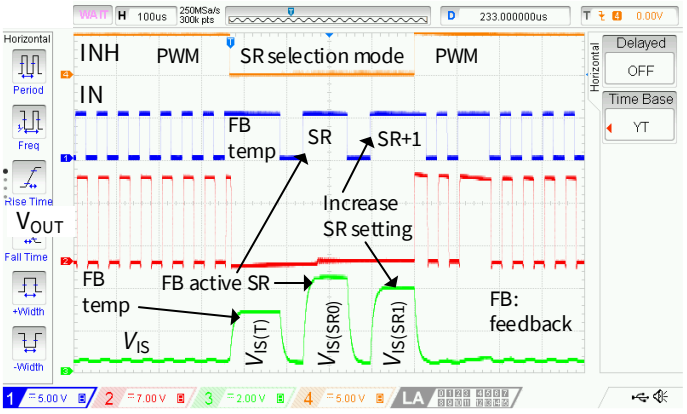
Typical application waveforms

2.5 Slew rate selection mode



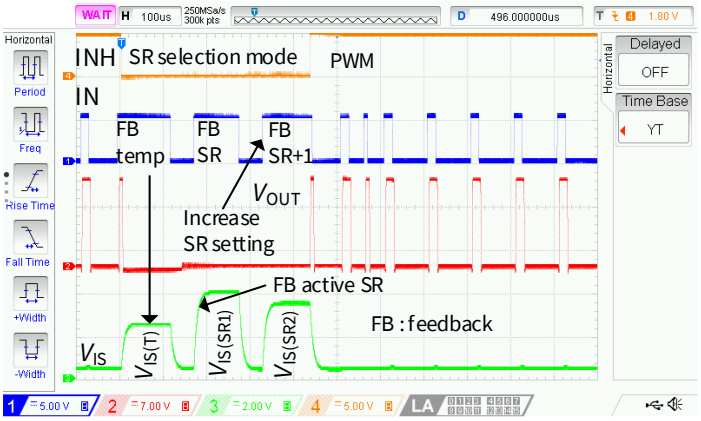
BTN9970, half-bridge
V_{BAT} = 13.5 V
f_{PWM} = 10 kHz
D = 50%
R_{Sense} = 2 kΩ
Load to GND
Load 150 µH + 2 Ω
C_{DC_Link} = 330 µF

Figure 26 Setting slew rate to value SR2 out of stand-by mode



BTN9970, half-bridge
V_{BAT} = 13.5 V
f_{PWM} = 10 kHz
Active SR = SR0
R_{Sense} = 2 kΩ
Load to GND
Load 150 µH + 2 Ω
C_{DC_Link} = 330µF

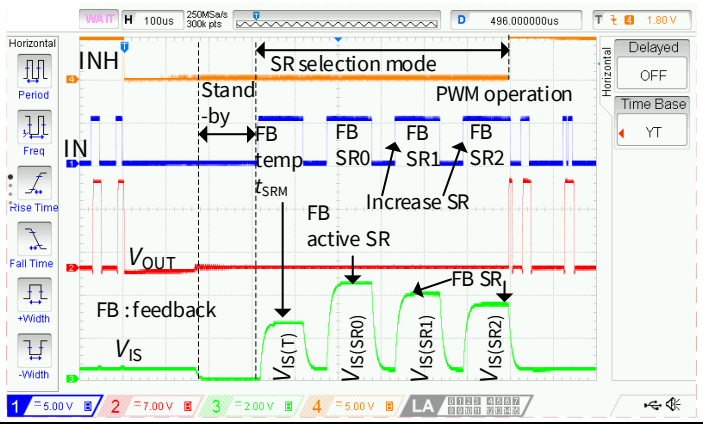
Figure 27 Incrementing slew rate by one step from SR0 to SR1



BTN9970, half-bridge
V_{BAT} = 13.5 V
f_{PWM} = 10 kHz
Active SR = SR1
R_{Sense} = 2 kΩ
Load to GND
Load 150 µH + 2 Ω
C_{DC_Link} = 330uF

Figure 28 Incrementing slew rate by one step from SR1 to SR2

Typical application waveforms



BTN9970, half-bridge
V_{BAT} = 13.5 V
f_{PWM} = 10 kHz
R_{Sense} = 2 kΩ
Load to GND
Load 150 µH + 2 Ω
C_{DC_Link} = 330 µF

Figure 29 Setting SR2 with turning the device into stand-by mode before (starting with SR0)

Typical application waveforms

Revision history

Document version	Date of release	Description of changes
1.00	2021-09-30	Initial document release

Trademarks
All referenced product or service names and trademarks are the property of their respective owners.

Edition 2021-09-30

Published by

Infineon Technologies AG

81726 Munich, Germany

Do you have a question about this document?

Email: erratum@infineon.com

Document reference
Z8F80194599

IMPORTANT NOTICE

The information contained in this application note is given as a hint for the implementation of the product only and shall in no event be regarded as a description or warranty of a certain functionality, condition or quality of the product. Before implementation of the product, the recipient of this application note must verify any function and other technical information given herein in the real application. Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind (including without limitation warranties of non-infringement of intellectual property rights of any third party) with respect to any and all information given in this application note.

The data contained in this document is exclusively intended for technically trained staff. It is the responsibility of customer's technical departments to evaluate the suitability of the product for the intended application and the completeness of the product information given in this document with respect to such application.

For further information on the product, technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies office (**www.infineon.com**).

WARNINGS

Due to technical requirements products may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies office.

Except as otherwise explicitly approved by Infineon Technologies in a written document signed by authorized representatives of Infineon Technologies, Infineon Technologies' products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury.