

Motor Control Shield

For Arduino

User Manual

V0.9 2015-03

Automotive Power



Table of Contents

Table of Contents

1

2	About t	this document	
3		and purpose	
4		ed audience	
5		l information	
6	1	Motor Control Shield Introduction	4
7	1.1	Motor Control Shield overview	4
8	1.2	Key Features	4
9	1.3	Block Diagram of a bi-directional Motor Control	6
10	2	Motor Control Shield Board Description	7
11	2.1	Schematics	
12	2.2	Layout	8
13	2.3	Important design and layout rules:	9
14	2.4	Pin Assignment	
15	2.5	Pin Definitions and Functions	
16	3	BTN8982TA Overview	
17	3.1	Key Features of the BTN8982TA NovalithIC [™]	
18	3.2	Block Diagram	
19	3.3	Pin Assignment	14
20	3.4	Pin Definitions and Functions	
21	4	Getting Started	15
22	4.1	Target Applications	15
23	4.2	Typical target Application	15
24	4.2.1	Getting Started: Shield	15
25	4.2.2	Getting Started: Software	16
26	4.2.3	Software hints	19
27			



1 About this document

2 Scope and purpose

3 This document describes how to use the Motor Control Shield with BTN8982TA for Arduino.

4 Intended audience

5 Engineers, hobbyists and students who want to add a powerful Motor Control to Arduino projects.

6 **Related information**

7 Table 1 Supplementary links and document references

Reference	Description
BTN8982TA Reference Manuals	Product page which contains reference information for the half-bridge BTN8982TA
Arduino Home Page	All information on Arduino
Arduino Uno Product Page	Arduino Uno R3 description
DAVE [™] Development Platform	All details on DAVE™ IDE
XMC1100 Boot Kit	Product page which contains reference information for the XMC1100 Boot Kit



1 1 Motor Control Shield introduction

2 **1.1** Motor Control Shield overview

The Motor Control Shield adds powerful motor control to the Arduino projects. The shield can be controlled with the general logic IO-Ports of a microcontroller. Either an Arduino Uno R3 or the XMC1100 Boot Kit from Infineon can be used as the master.

- On board of the Motor Control Shield are two BTN8982TA NovalithIC[™]. Each is featuring one P-channel high
 side MOSFET and one N-channel low side MOSFET with an integrated driver IC in one package. Due to the P-
- 8 channel high side switch a charge pump is not needed.
- 9 The BTN8982TA half-bridge is easy to control by applying logic level signals to the IN and INH pin. When
- applying a PWM to the IN pin the current provided to the motor can be controlled with the duty cycle of the
- PWM. With an external resistor connected between the SR pin and GND the slew rate of the power switchescan be adjusted.
- 13 The Motor Control Shield can be easily connected to any Arduino board or the XMC1100 Boot Kit via
- 14 headers.

15 16

<complex-block><image>

17 Figure 1 Motor Control Shield photo

18 **1.2** Key features

- 19 The Motor Control Shield has the following features:
- An Arduino Uno R3, XMC1100 Boot Kit, or similar board connected to the shield can control the two half bridges via the general IO pins.



- Brushed DC Motor Control up to 250 W continuous load
 - 8-18 V nominal input voltage (max. 6 40 V)
 - Average motor current 30 A restricted due to the limited power dissipation of the PCB (BTN8982TA current limitation @ 55 A min.)
- 5 Drives either one brushed bi-directional DC motor or two uni-directional DC motors.
- 6 Capable of high frequency PWM, e.g. 30 kHz
- 7 Adjustable slew rates for optimized EMI by changing external resistor
- 8 Driver circuit with logic level inputs
- 9 Status flag diagnosis with current sense capability
- 10 Protection e.g. against overtemperature and overcurrent
- Reverse polarity protection with IPD90P04P4L
- Further comments:

2

3

4

13

14

15

16

17

18 19

20

21 22

- To keep the costs as low as possible the pin headers and connectors are not attached to the shield. The user can solder them by himself. The pin headers are not expensive, but the through whole soldering is a not insignificant cost factor.
 - The size of the DC-link capacity (C4 in the schematics and C10 in the application circuit.) with 1000µF is for most applications oversized. It is a worst case scenario if a 500W motor is connected to the shield. The capacity can be replaced by smaller capacities when using less powerful motors. Equation 10 in the <u>BTN8960 /62 /80 /82 High Current PN Half Bridge</u> <u>NovalithIC[™]</u> (Rev. 0.3, 2014-09-11) Application Note should be used to calculate the value of the DC-link capacity.



23 Figure 2 Motor Control Shield driving an engine cooling fan



1 1.3 Block diagram of a bi-directional Motor Control

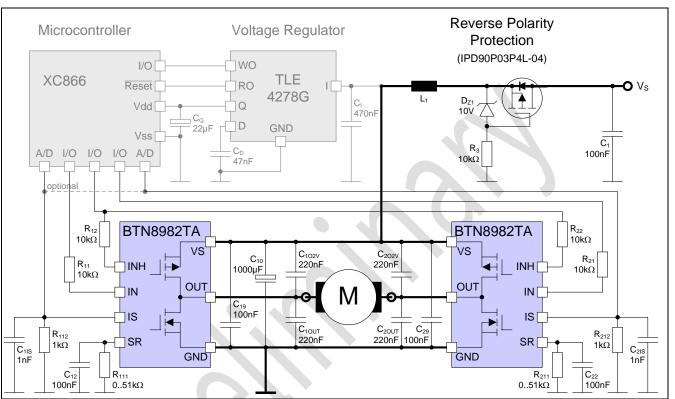
2 As a starting point for the Motor Control Shield, the application block diagram shown in Figure 3 was used.

3 For simplicity reasons the conductivity L_1 was removed in the Shield schematics. In the application block

diagram the INH pins of both half-bridges are connected to one IO-port of the microcontroller. To be more

5 flexible in the usage of the Motor Control Shield each INH of the two half-bridges is connected to a separate

- 6 IO pin.
- 7



8 Figure 3 Application circuit for a bi-directional motor control with BTN8982TA



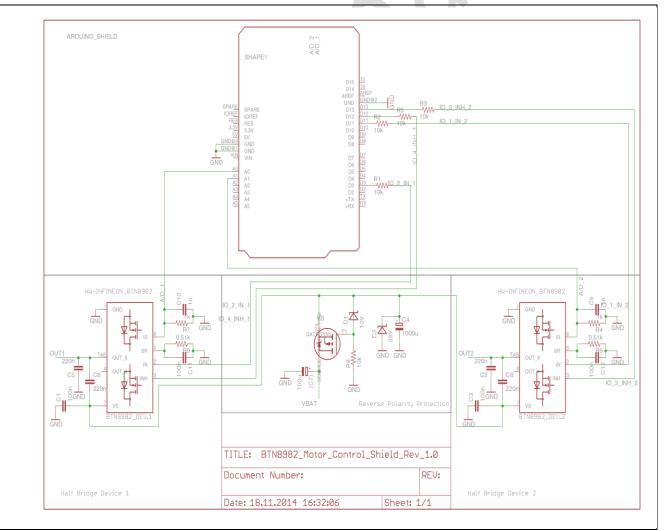
1 2 Motor Control Shield board description

- 2 For a safe and sufficient motor control design, discrete components are needed. Some of them must be
- 3 dedicated to the motor application and some to the NovalithIC[™].
- Figure 4, Figure 5 and Figure 6 show the schematics plus the corresponding layout of the Motor Control
 Shield.
- 6 Due to the possibility of using the Shield with loads which can draw a current of up to 55 A the connectors
- 7 Vbat, GND, OUT1 and OUT2 are designed as solid 4mm through whole connectors. This provides the
- 8 possibility to connect plugs which are capable of such high currents. Nevertheless the thermal performance
- 9 of the Shield itself limits the possible current which should be applied to the Motor Control Shield to 30 A. To
- 10 reach the best performance in terms of parasitic inductance and EMC a GND plane, with maximal size was
- 11 designed.

12 2.1 Schematics

13 In Figure 4 the schematics of the Motor Control Shield is shown. The schematics are based on the

- 14 application circuit in the <u>BTN8982TA Data Sheet</u>.
- 15



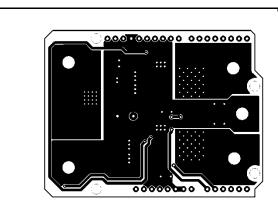




1 **2.2** Layout

Figure 5 and Figure 6 show the layout of the Motor Control Shield. The layout follows the design rules in the
 BTN8960 /62 /80 /82 High Current PN Half Bridge NovalithIC[™] Application Note (also see Chapter 2.3).

4



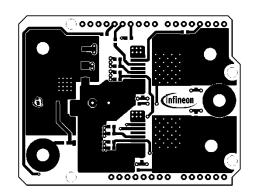


Figure 5 Motor Control Shield – Bottom and top layers

6





Figure 6 Motor Control Shield for Arduino with BTN8982TA – Layout



	С	D	E	F	G	Н	1	J	М
1									
						Place_	Provided _by_cust omer		
2	Device	Package	Description	Descrip	Qty	YES/NO	_YES/NO	Distributor	Remarks_customer
3 4	CAP0603-CAP	0603-CAP	Capacitor			ves			Standard device
	CAP0603-CAP	0603-CAP	Capacitor			yes			Standard device
<u> </u>	CAPUUUS-CAP	UUUS-CAP	Сарасної		4	yes		Farnell Order Code: 2069026 or	Standard device
6	RCL_CPOL-EUE5-13	RCL_E5-13	POLARIZED CAPACI	TOR,	1	yes		1834156	Capaciator Radial
7	CPOL-EUD	PANASONIC_D	POLARIZED CAPACI	TOR,	1	no			
8	CAP0603-CAP	0603-CAP	Capacitor		2	yes			Standard device
9	DIODE ZENER	SMD-PACKAGES_SOD80	Diode		1	yes		Order Code: 1081361RL Farnell	NXP - BZV55-C10 - DIODE ZENER,10V,500MW VISHAY
10	DIODE ZENER	SMD-PACKAGES_MELF-D	Diode		1	yes		Order Code: 1617744	SEMICONDUCTOR - ZMY33-GS08 - DIODE ZENER,1W,33V
11	HW_INFINEON_IPD90P04P4L-04	TO-252-3-313-L	MOSFET		1	yes	yes		
12	HW-INFINEON_BTN8982TA	TO263-7-1	IC		1	yes	yes		
13	HW-INFINEON_BTN8982TA	TO263-7-1	IC		1	yes	yes		
14	RESISTOR0603-RES	0603-RES	Resistor		5	yes			Standard device
15	RESISTOR0603-RES	0603-RES	Resistor		2	yes			Standard device
16	RESISTOR0603-RES	0603-RES	Resistor		1	yes		Farnell Order Code: 1469826	VISHAY DRALORIC - CRCW0603510RFKEA - RESISTOR, 0603, 510R, 1%
17	RESISTOR0603-RES	0603-RES	Resistor		1	yes		Farnell Order Code: 1469826	VISHAY DRALORIC - CRCW0603510RFKEA - RESISTOR, 0603, 510R , 1%

1

Figure 7 Motor Control Shield for Arduino with BTN8982TA – Bill of Material (BOM)

2

7

3 2.3 Important design and layout rules:

The basis for the following design and layout recommendations is the parasitic inductance of electrical
 wires and design guidelines as described in Chapter three and four of the Application Note <u>BTN8960 /62 /80</u>
 <u>/82 High Current PN Half Bridge NovalithIC[™]</u> (Rev. 0.3, 2014-09-11).

8 • C4, so called DC-link capacitor: This electrolytic capacitor is required to keep the voltage ripple at the Vspin of the NovalithIC[™] low during switching operation (the applied measurement procedure for the 9 supply voltage is described in Chapter 3.1 of the Application Note). It is strongly recommended that the 10 voltage ripple at the NovalithIC[™] Vs-pin to the GND-pin is kept below 1 V peak to peak. The value of C4 11 must be aligned accordingly. See therefore Equation (10) in the Application Note. Most electrolytic 12 13 capacitors are less effective at cold temperatures. It must be assured that C4 is also effective under the worst case conditions of the application. The layout is very important too. As shown in Figure 6, the 14 capacitor C4 must be positioned with very short wiring close to the NovalithIC[™]. This must be done to 15 keep the parasitic inductors of the PCB-wires as small as possible. 16



- C1/C3: This ceramic capacitors support C4 to keep the supply voltage ripple low and cover the fast transients between the Vs-pin and the GND-pin. The value of these ceramic capacitors must be chosen so that fast Vs-ripples at the NovalithIC[™] do not exceed 1V peak to peak. The layout wiring for C1/C3 must be shorter than for C4 to the NovalithIC[™] to keep the parasitic PCB-wire inductance as small as possible. In addition the parasitic inductance could be kept low by placing at least two vias for the connection to the GND-layer.
- C6/C8: These ceramic capacitors are important for EMI in order to avoid entering RF into the NovalithIC[™]
 as much as possible. Good results have been achieved with a value of 220 nF. In terms of layout, it is
 important to place these capacitors between "OUT" and "Vs" without significant additional wiring from
 C6/C8 to the Vs- and OUT-line.
- C5/C2: These ceramic capacitor help to improve the EMC immunity and the ESD performance of the
 application. Good results have been achieved with a value of 220 nF. To keep the EMC and ESD out of the
 board, the capacitor is most effective when positioned directly next to the board connector. In addition,
 the parasitic inductance could be kept low by placing at least two vias for the connection to the GND layer.

17 Other components:

- 18 IC0, D1 and R8: Reverse polarity protection. See Chapter 4.4 of the Applikation Note.
- R9/R6: Slew rate resistors according to data sheet.
- C11/C12: Stabilization for slew rate resistors (R9/R6).
- R7/R4: Resistors to generate a current sensing voltage from the IS current.
- C10/C9: Ceramic capacitors for EMC immunity improvement. GND connection with at least two GND vias. A good value is 1nF. In case the current should be measured during the PWM-phase this capacitor
 must be adapted to the ON-time inside the PWM-phase.
- R1, R2, R3 and R5: Device protection in case of microcontroller pins shorted to Vs.

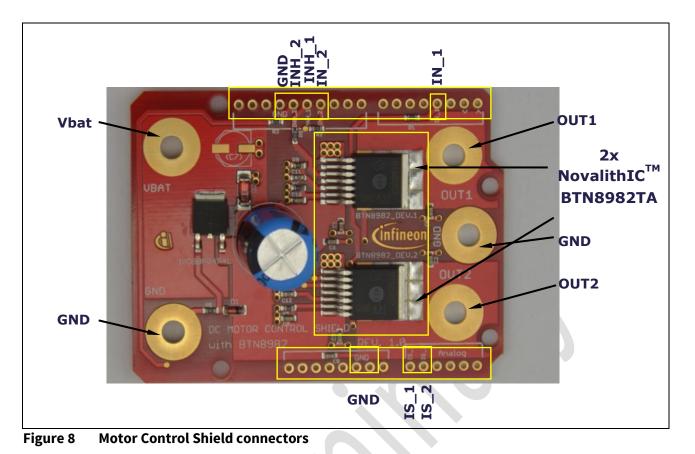
26 **2.4 Pin assignment**

To use the Motor Control Shield the necessary control signals can be applied directly at the Arduino[™]
connectors. There is no need to use an Arduino or XMC 1100 Boot Kit to get the Motor Control Shield into an

application. The control pins are logic level inputs which can be driven by any other microcontroller or with

- logic level signals. Besides the supply voltage Vbat has to be provided to the Vbat connector. Figure 8 shows
 the pinout/connectors of the Motor Control Shield.
- 32





1

2

3

2.5 Pin definitions and functions

Pin	Symbol	1/0	Function
GND	GND	-	Ground
D3	IN_1	1	Input bridge 1
			Defines whether high- or low side switch is activated
D11	IN_2	I	Input bridge 2
			Defines whether high- or low side switch is activated
D12	INH_1	I	Inhibit bridge 1
			When set to low device goes in sleep mode
D13	INH_2	I	Inhibit bridge 2
			When set to low device goes in sleep mode
OUT_1	OUT_1	0	Power output of the bridge 1
OUT_2	OUT_2	0	Power output of the bridge 2
A0	IS_1	0	Current Sense and Diagnostics of half-bridge 1
A1	IS_2	0	Current Sense and Diagnostics of half-bridge 2
Vbat	Vbat	-	Supply (Vs after the reverse polarity protection)



3 BTN8982TA overview

The BTN8982TA used in the Motor Control Shield is an integrated high current half-bridge for motor drive applications. It is part of the NovalithIC[™] family containing one p-channel high side MOSFET and one nchannel low side MOSFET with an integrated driver IC in one package. Due to the p-channel high side switch the need for a charge pump is eliminated thus minimizing EMI. Interfacing to a microcontroller is made easy by the integrated driver IC which features logic level inputs, diagnosis with current sense, slew rate adjustment, dead time generation and protection against overtemperature, undervoltage, overcurrent and short circuit.

- 9 The BTN8982TA provides a cost optimized solution for protected high current PWM motor drives with very
- 10 low board space consumption.

11 3.1 Key features of the BTN8982TA NovalithIC[™]

- Path resistance of max. 20.4 m Ω @ 150 °C (typ. 10.0 m Ω @ 25 °C)
- 13 High side: max. 10.5 mΩ @ 150 °C (typ. 5.3 mΩ @ 25 °C)
- 14 Low side: max. 9.9 mΩ @ 150 °C (typ. 4.7 mΩ @ 25 °C)
- Enhanced switching speed for reduced switching losses
- Capable for high PWM frequency combined with active freewheeling
- 17 Low quiescent current of typ. 7 μA @ 25 °C
- Switched mode current limitation for reduced power dissipation in overcurrent
- 19 Current limitation level of 55 A min.
- 20 Status flag diagnosis with current sense capability
- Overtemperature shut down with latch behavior
- Undervoltage shut down
- 23 Driver circuit with logic level inputs
- Adjustable slew rates for optimized EMI
- Operation up to 40 V
- Green Product (RoHS compliant)
- AEC Qualified in PG-TO263-7-1 package
- 28



Figure 9 PG-TO263-7-1



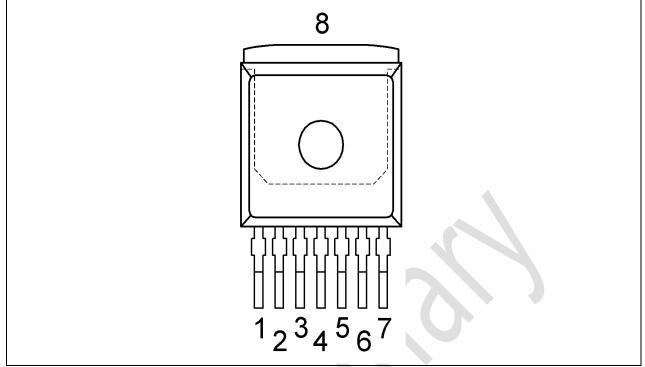
3.2 Block diagram

- 2 The BTN8982TA is part of the NovalithIC[™] family containing three separate chips in one package: One p-
- 3 channel high side MOSFET and one n-channel low side MOSFET together with a driver IC, forming an
- 4 integrated high current half-bridge. All three chips are mounted on one common lead frame, using the chip
- 5 on chip and chip by chip technology. The power switches utilize vertical MOS technologies to ensure
- 6 optimum on state resistance.

- 7 Due to the p-channel high side switch the need for a charge pump is eliminated thus minimizing EMI.
- 8 Interfacing to a microcontroller is made easy by the integrated driver IC which features logic level inputs,
- 9 diagnosis with current sense, slew rate adjustment, dead time generation and protection against
- 10 overtemperature, undervoltage, overcurrent and short circuit. The BTN8982TA can be combined with other
- 11 BTN8982TA to form H-bridge and 3-phase drive configurations.
 - vs Undervolt. Current detection Sense Current Limitation HS Overtemp. detection Gate Driver HS IS OUT **Digital Logic** LS off HS off П IN Gate Driver LS INH ╓ Current Limitation Slewrate SR Adjustment LS GND
- 13 Figure 10 Block diagram BTN8982TA



1 3.3 Pin assignment



2 Figure 11 Pin assignment BTN8982TA (top view)

3

4

3.4 Pin definitions and functions BTN8982TA

5 Table 2

Pin	Symbol	I/O	Function
1	GND	N- N	Ground
2	IN	1	Input
			Defines whether high- or low side switch is activated
3	INH	1	Inhibit
			When set to low device goes in sleep mode
4, 8	OUT	0	Power output of the bridge
5	SR	I	Slew Rate
			The slew rate of the power switches can be adjusted by connecting a resistor between SR and GND
6	IS	0	Current Sense and Diagnostics
7	Vs	-	Supply (Vbat at the Shield connector)



1 4 Getting Started

2 **4.1** Target applications

The application targeted by the BTN89xx devices is brushed DC Motor Control. Besides Motor Control any other inductive, resistive and capacitive load within the electrical characteristics of the NovalithIC[™] can be

5 driven by the BTN89xx. In the Motor Control Shield two BTN8982TA are used. Each is capable of driving up to

⁶ 50 A. The limited thermal performance of the Shield PCB limits the recommended maximum current to 30 A.

7 4.2 Typical target application

8 With the Motor Control Shield either two mid power uni-directional DC-brushed motors or one bi-directional 9 brushed motor (with the two half-bridges used in H-bridge configuration) can be driven. The half-bridges 10 are controlled via the IN (Input) and INH (Inhibit) pins. The slew rate of the high frequency PWM can be 11 adjusted by connecting an external resistor between the SR pin and GND. The BTM8982TA also provides a 12 sense current at the IS pin. The Power Shield provides a fast and easy access to brushed DC motor solutions 13 of up to 300 W.

14 4.2.1 Getting started: Shield

15

16

17

18

19

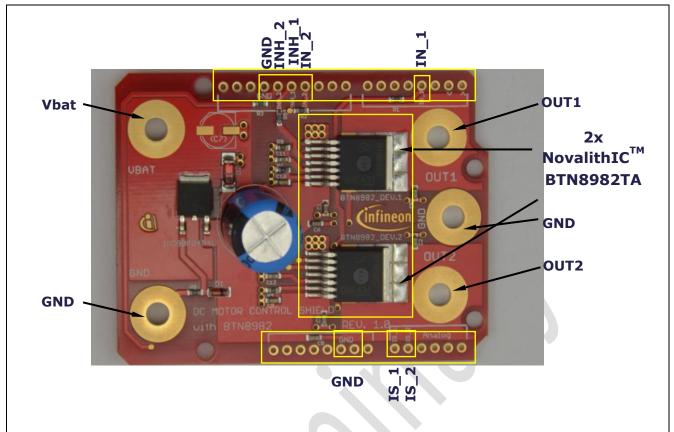
20

21

22

- Choose a mid-power, brushed DC motor.
- Choose a DC adapter. The nominal input of the Power Shield is 8 18 V DC. Maximum Voltage is 40 V
- Select pin headers and connectors of your choice and solder to the Power Shield. Due to cost reduction, the pin headers and connectors are not attached.
- Connect the Power Shield to Arduino Uno R3 or XMC 1100 Boot Kit.
- Connect power supply (5 V) to the Arduino Uno R3 or XMC 1100 Boot Kit (Micro USB). For the XMC Boot Kit a standard mobile phone charger can be used.
- Program the controller board with the motor control software (see 4.2.2).
- Connect the motor to OUT1 and OUT2 (H-bridge). For bi-directional applications connect the motor to OUT1 and OUT2 (H-bridge). For uni-directional use, the motor can be placed between an output OUT1/OUT2 and either GND or Vbat (half-bridge).
 - Connect the DC adapter to the Power Shield (Vbat, GND).
 - Turn on the power.





1 Figure 12 Motor Control Shield connectors

4.2.2 Getting started: Software

A simple example software for the XMC1100 Boot Kit is provided (H-bridge).

- Connect the XMC 1100 Boot Kit with a micro USB cable to the USB port of your PC.
- Download and install the DAVE[™] Free Development Platform for Code Generation from the Infineon website <u>DAVE[™]</u>.
- Start DAVE[™] and import project file H-bridge:

1	2
1	3
-	



1 1: Select File \rightarrow Import

<u>F</u> ile	<u>E</u> dit <u>S</u>	Source	Refactor	<u>N</u> avigate	Se <u>a</u> rch	<u>R</u> un	<u>P</u> roject
	New					Alt+S	Shift+N ▶
	Open Fi	ile					
	Close					(Ctrl+W
	Close A	Ш				Ctrl+S	hift+W
	Save						Ctrl+S
	Save As						
R	Save All					Ctrl+	Shift+S
	Revert						
	Move						
	Rename	2					
8	Refresh						
	Convert	t Line D	elimiters To	0			×
₽	Print						Ctrl+P
	Switch \	Workspa	ace				×
	Restart						
2	Import.						
4	Export						
	Properti	ies				Alt	+Enter
	1 Main.	c [H-Br	idge]				
	2 startu	p_XMC1	L100.s [H-E	Bridge/Startu	.p]		
	3 IO004	_1.uimo	del [Users	/rabensta/]		
	4 IO004	_0.uimo	del [Users	/rabensta/]		
	Exit						

2 3 4 5

6

2: Choose Infineon DAVE project

😻 Import	
Select	Ľ
Select an import source:	
type filter text	
👂 🗁 General	
⊳ 🗁 C/C++	
🔺 🗁 Infineon	
Build Settings	
😭 DAVE Project	
😭 DAVE Project From Local Library Store	
👂 🗁 Install	
👂 🗁 Run/Debug	
👂 🗁 Team	



1 3: Select archive file \rightarrow Browse for the file \rightarrow Select the project \rightarrow Click finish

Import DAVE Projects				
Import DAVE projects Import Existing DAVE Pro				
				L .
Select Root Directory			Browse	9
Select Archive File	C:\Users\rabensta\My Work	\Baustein\XE1000\4	Browse	
Project List:				
H-Bridge(H-Brid	ge)		Select All	
			DeSelect All	
			Refresh	
				ľ
✓ Copy Projects Into W	orkspace			
				ļ.
?	< Back Next >	Finish	Cancel	ł
	- Duck			
DAVE CE - DAVE 3				
DAVE CE - DAVE 3				
DAVE CE - DAVE 3				
DAVE CE - DAVE 3				
DAVE CE - DAVE 3				
DAVE CE - DAVE 3 iile Edit Source Re				
ile Edit Source Re				
DAVE CE - DAVE 3 File Edit Source Re				
DAVE CE - DAVE 3 File Edit Source Re				



1 6: Run the software \rightarrow the motor will spin

🔹 TASKING Debug - XMC11	L00_Blinky_wit	hApps/Ma	in.c - DAVE 3	
File Edit Source Refact	or Navigate	Search	Project Debug	Window Help
📑 - 🛛 🖻 🖨 🖬	蓉	• 🄑 🛛	M 🗐 🗶	COM Por
🏇 Debug 🖾	🍇 🕅 м	టి 🕹 🔲	D 🗉 🖬 🔤	🎝 🔿 🗈 🛼 i

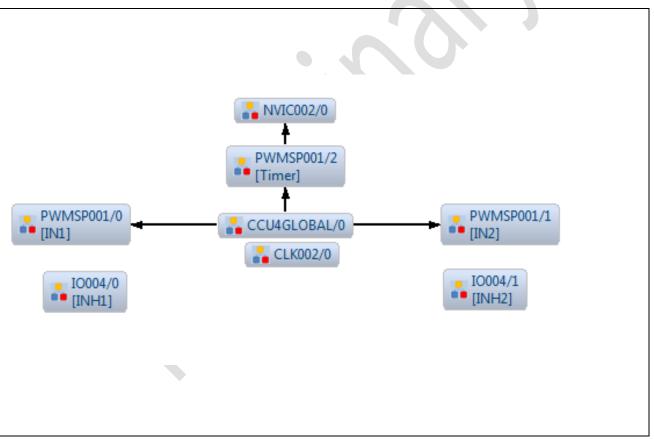
2 3

4 4.2.3 Software hints

For hints, tutorials, software examples, a quick introduction and further information around the DAVE[™] –
 Free Development Platform for Code Generation, visit the DAVE[™] web site.

The DAVE[™] App structure of the software example H-bridge for the Motor Control Shield is shown in
 Figure 13. The output voltage is controlled by the two PWMSP001 Apps. The ramp time is controlled by a
 third PWMSP001 App via interrupts. The inhibit signals are software controlled by the IO004 App.

10



- 11 Figure 13 App structure of the example software H-bridge
- 12 To change the PWM frequency from 25 kHz to a different value the settings of both PWM App instances
- PWMSP001/0 and PWMSP001/0 have to be modified. There, the PWM frequency can be easily set to different
 values.
- 15

16

Users Manual



Counting Mode	Timer Mode		Start		
 Edge-Aligned Mode Center-Aligned Mode 	Enable Single Sho	t Mode	V Start durin	g initialization	
imer Configurations					
CCU4 resolution 1000	nsec 🔻	Resolution 1	000	nsec	$\overline{\mathbf{v}}$
PWM freq 25	Hz 🔻	Period 9	c3f	hex	$\overline{\nabla}$
Duty Cycle 50	% 🔻	Compare 4	e20	hex	$\overline{\nabla}$
Selected Timer mode No timer c	concatenation]			
nterrupts]			
No uner e	Period Match]	External Start		
nterrupts		zation		initialization	
nterrupts Compare Match	Period Match	zation		initialization	

• Figure 14 shows the ramp generator and the parameters which can be set in main.c. The parameter "outputvoltage_max" and "outputvoltage_min" are controlled in the software by adapting the PWM duty cycle. With the duty cycle the motor speed and current consumption in controlled.

		_					pply volt maximum				aling	the duty	cycle
			•				/ minimum	•					
const :	int32	_t f	lat tin	<u>ie</u> = 1	00;/	/ ticks	based or	1 25Hz.	(100 t	ic	(s = 4	seconds)	· · ·
/ 		****				****			: 				:
	1		rator	······ : :			**************************************	· · · · · · · · · · · · · · · · · · ·	*				· · · · · · · · · · · · · · · · · · ·
*		* * * *			****	******			******				:
* max			· · · · · · · · · · · · · · · · · · ·				•	· · · · · · · · · · · · · · · · · · ·	*	r :			· · · · · · · · · · · · · · · · · · ·
*	1	fla	<u>t_time</u>	λ					*	r			:
*	/		· · · · · · · · · · · ·	\ \				/	*	r 			
* 0 -/	/		•				•		*				•
* 0 -/			:		\			/ /	*				•
*			•		N		/	· · · · · · · · · · · · · · · · · · ·	*	r :			· · · · · · · · · · · · · · · · · · ·
* * min					\	<u>flat ti</u>	ime /		* *	r r		•	
*	:		:	· · · · · · · · · · · · · · · · · · ·			· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·	: ******			· · · · · · · · · · · · · · · · · · ·	:
*****	*****	****	******	*****	****	******	*******	******	****/				:





1 Revision History

2 Major changes since the last revision

Page or Reference	Description of change
V0.9, 2015-03	



Trademarks of Infineon Technologies AG

AURIX™, C166[™], CanPAK™, CIPOS[™], CIPURSE[™], CoolGaN[™], CoolMOS[™], CoolSET[™], CoolSiC[™], CORECONTROL[™], CROSSAVE[™], DAVE[™], DI-POL[™], DrBLADE[™], EasyPIM™, EconoBRIDGE[™], EconoDUAL[™], EconoPACK[™], EconoPIM[™], EiceDRIVER[™], eupec[™], FCOS[™], HITFE[™], HybridPACK[™], ISOFACE[™], IsoPACK[™], IsoPACK[™], IsoPACK[™], IsoPACK[™], IsoPACK[™], IsoPACK[™], IsoPACK[™], IsoPACK[™], IsoPACK[™], PrimeSTACK[™], PROFET[™], PRO-SIL[™], REAL3[™], ReverSave[™], SatRIC[™], SIEGE[™], SIPMOS[™], SmartLEWIS[™], SOLID FLASH[™], SPOC[™], TEMPFET[™], thinQ[™], TRENCHSTOP[™], TriCore[™].

Other Trademarks

Advance Design System[™] (ADS) of Agilent Technologies, AMBA[™], ARM[™], MULTI-ICE[™], KEIL[™], PRIMECELL[™], REALVIEW[™], THUMB[™], µVision[™] of ARM Limited, UK. ANSI[™] of American National Standards Institute. AUTOSAR[™] of AUTOSAR development partnership. Bluetooth[™] of Bluetooth SIG Inc. CATiq[™] of DECT Forum. COLOSSUS[™], FirstGPS[™] of Trimble Navigation Ltd. EMV[™] of EMVCo, LLC (Visa Holdings Inc.). EPCOS[™] of Epcos AG. FLEXGO[™] of Microsoft Corporation. HYPERTERMINAL[™] of Hilgraeve Incorporated. MCS[™] of Intel Corp. IEC[™] of Commission Electrotechnique Internationale. IrDA[™] of Infrared Data Association Corporation. ISO[™] of INTERNATIONAL ORGANIZATION FOR STANDARDIZATION. MATLAB[™] of MathWorks, Inc. MAXIM[™] of Maxim Integrated Products, Inc. MICROTEC[™], NUCLEUS[™] of Mentor Graphics Corporation. MIPI[™] of MIPI Alliance, Inc. MIPS[™] of MIPS Technologies, Inc., USA. muRata[™] of MURATA MANUFACTURING CO., MICROWAVE OFFICE[™] (MWO) of Applied Wave Research Inc., OmniVision[™] of OmniVision Technologies, Inc., Inc. Openwave[™] of Openwave Systems Inc. RED HAT[™] of Red Hat, Inc. RFMD[™] of RF Micro Devices, Inc. SIRIUS[™] of Sirius Satellite Radio Inc. SOLARIS[™] of EVA, Inc. TEKTRONIX[™] of Tektronix Inc. TOKO[™] of TOKO KABUSHIKI KAISHA TA, UNIX[™] of X/Open Company Limited. VERILOG[™], PALLADIUM[™] of Cadence Design Systems, Inc. VLYNQ[™] of Texas Instruments Incorporated. VXWORKS[™], WIND RIVER[™] of WIND RIVER SYSTEMS, INC. ZETEX[™] of Diodes Zetex.

Last Trademarks Update 2014-07-17

www.infineon.com

Edition 2015-03 Published by Infineon Technologies AG 81726 Munich, Germany

© 2015 Infineon Technologies AG. All Rights Reserved.

Order Number: B127-10043-V1-7600-EU-EC-P

ifx00000000001

Legal Disclaimer

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics. With respect to any examples or hints given herein, any typical values stated herein and/or any information regarding the application of the device, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation, warranties of noninfringement of intellectual property rights of any third party.

Information

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

Warnings

Due to technical requirements, components may contain dangerous substances. For information on the types in question, please contact the nearest Infineon Technologies Office. Infineon Technologies components may be used in life-support devices or systems only with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support device or system or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.