

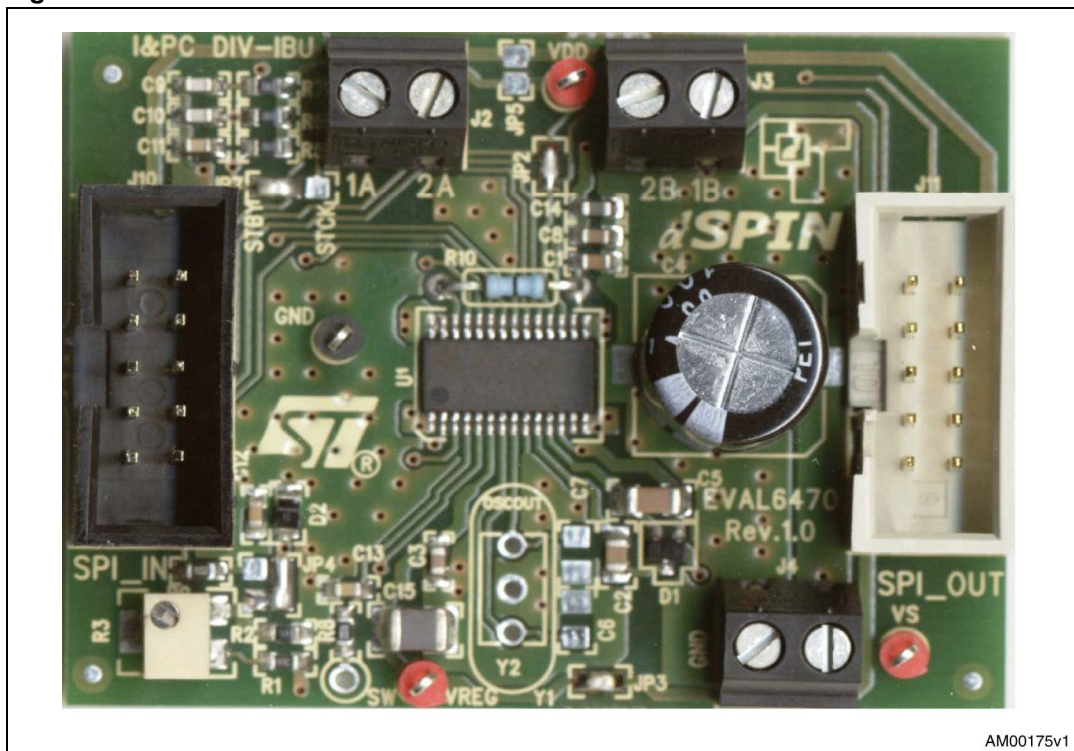
### Fully integrated microstepping motor driver using the L6470

#### Introduction

This application note describes the demonstration board for the fully integrated microstepping motor driver L6470.

The board is designed to be used with IBU universal interface (IBU-UI) or universal USB-to-serial communication interface (UUSCI) board and the dSPIN Evaluation tool software.

**Figure 1. EVAL6470 demonstration board**



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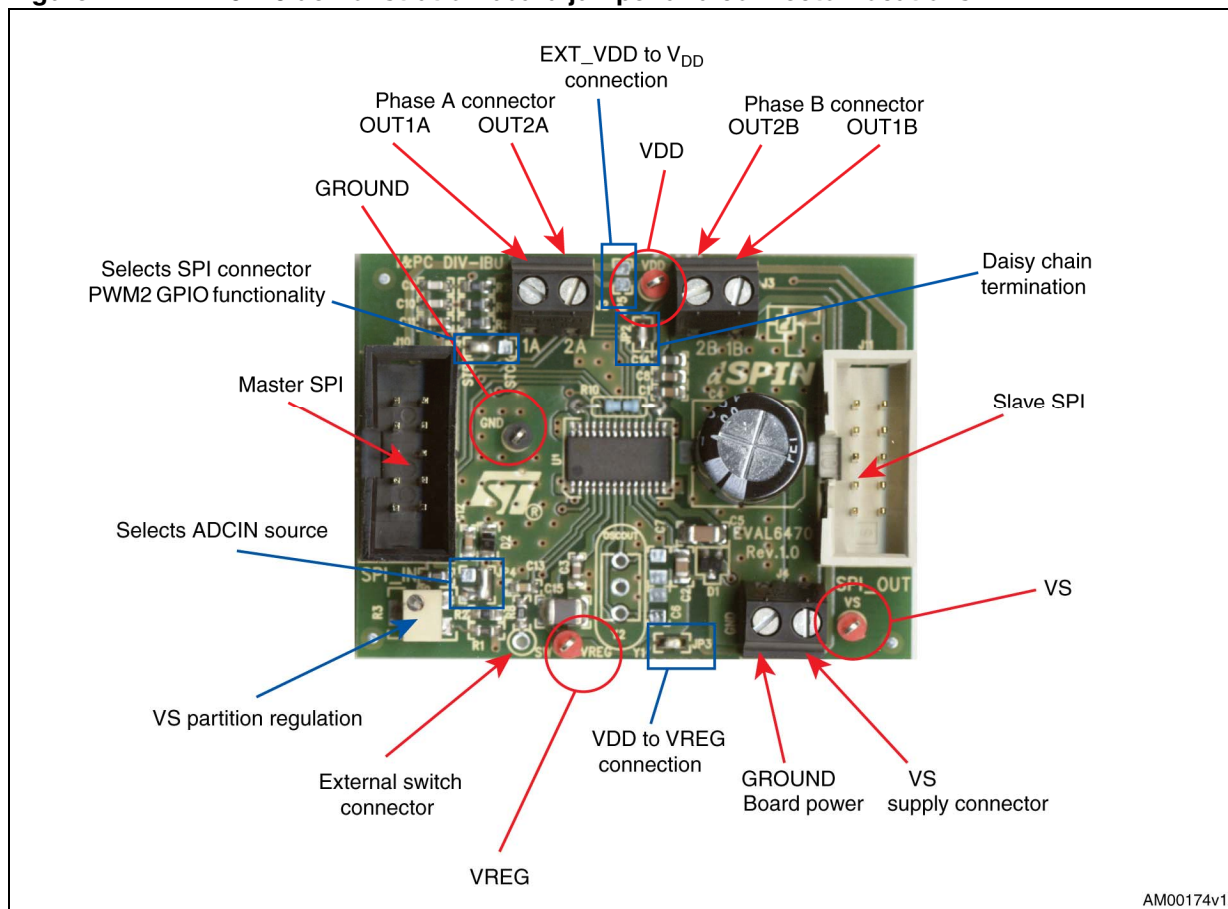
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# 1 Board description

**Figure 2. EVAL6470 demonstration board jumper and connector locations**



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**Table 1. EVAL6470: jumper and connector description**

Name	Type	Function
J4	Power supply	Board power supply
J2	Power outputs	Bridge A outputs
J3	Power outputs	Bridge B outputs
J10	SPI connector	Master SPI connector
J11	SPI connector	Slave SPI connector
SW	NM test point	External switch connector
VS	Test point	Motor supply voltage
V <sub>REG</sub>	Test point	Internal 3 V regulator output
V <sub>DD</sub>	Test point	Logic interface voltage
GND	Test point	Ground
JP7	Jumper	Selects SPI connector PWM2 GPIO functionality

**Table 1. EVAL6470: jumper and connector description (continued)**

Name	Type	Function
JP2	Jumper	Daisy chain termination
JP5	Jumper	EXT_VDD (SPI connector) to V <sub>DD</sub> connection
JP3	Jumper	V <sub>DD</sub> to V <sub>REG</sub> connection
JP4	Jumper	Selects ADCIN source

**Table 2. EVAL6470: master SPI connector pinout (J10)**

Pin number	Description
1	L6470 BUSY open drain output
2	L6470 FLAG open drain output
3	Ground
4	EXT_VDD (can be used as external logic power supply)
5	SPI <i>master in, slave out</i> signal (connected to L6470 SDO output through daisy chain termination jumper JP2)
6	SPI serial clock signal (connected to L6470 CK input)
7	SPI <i>master out, slave in</i> signal (connected to L6470 SDI input)
8	SPI slave select signal (connected to L6470 CS input)
9	PWM1 input
10	PWM2 input

**Table 3. EVAL6470: slave SPI connector pinout (J11)**

Pin number	Description
1	L6470 BUSY open drain output
2	L6470 FLAG open drain output
3	Ground
4	EXT_VDD (can be used as external logic power supply)
5	SPI <i>master in, slave out</i> signal (connected to pin 5 of J10)
6	SPI serial clock signal (connected to L6470 CK input)
7	SPI <i>master out, slave in</i> signal (connected to L6470 SDO output)
8	SPI slave select signal (connected to L6470 CS input)
9	PWM1 input
10	PWM2 input

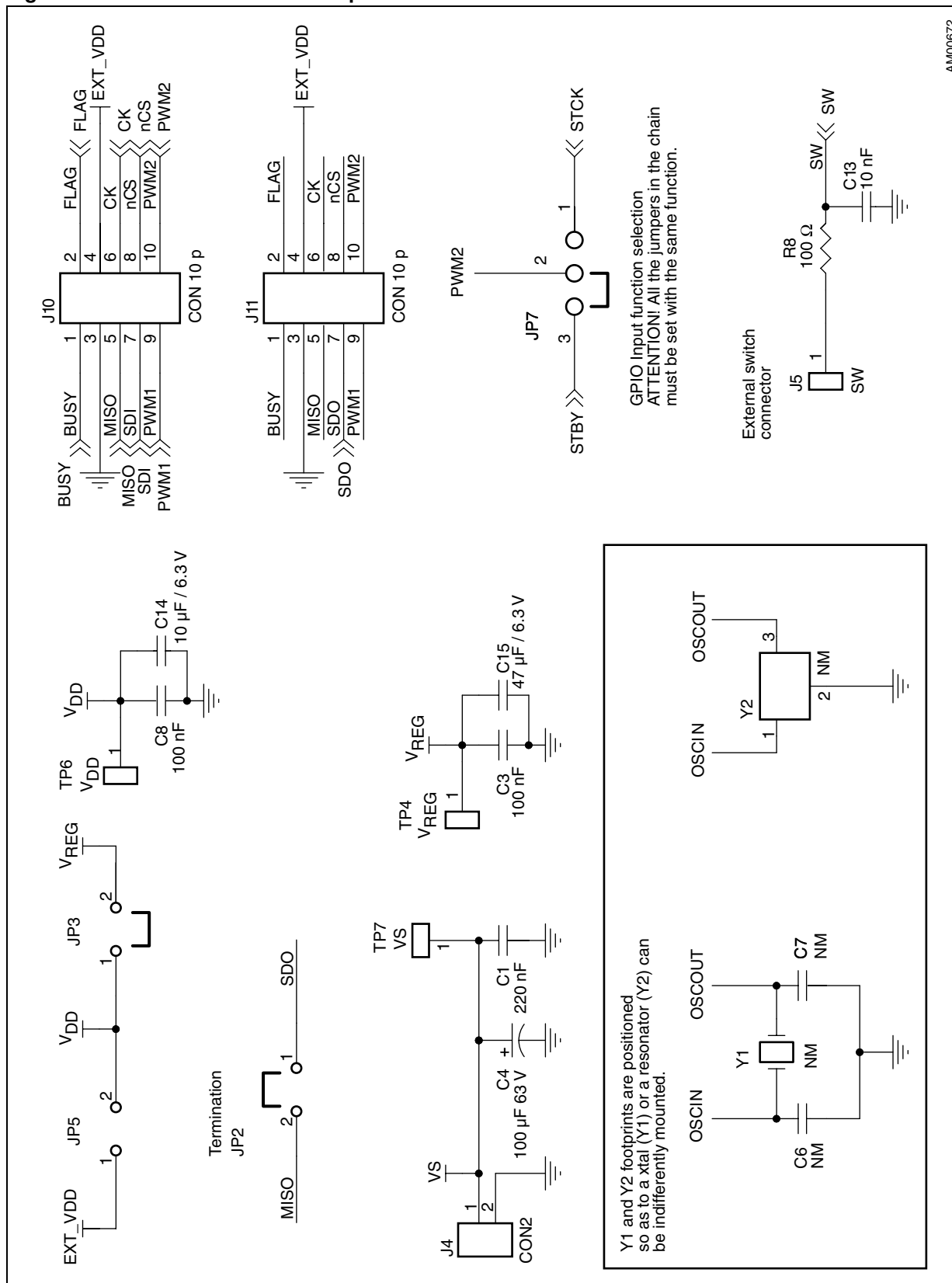
**Table 4. EVAL6470: electrical specification (recommended values)**

Supply voltage range (VS)	8 to 45 V
Output current rating	Up to 3 A <sub>rms</sub>
Logic supply voltage (V <sub>REG</sub> )	3.3 V (when externally supplied)
Logic interface voltage (V <sub>DD</sub> )	3.3 V or 5 V (when externally supplied)
Logic inputs voltage range	0 to +5 V
Operating temperature range	-25 to +125 °C
L6470H thermal resistance junction-to-ambient	TBD °C/W





Figure 4. EVAL6470 schematic - part 2



AM00672

Table 5. EVAL6470: component list

Part reference	Part value	Part description
C1	100 nF	50 V ceramic capacitor
C2	10 nF	63 V ceramic capacitor
C3, C8	100 nF	Ceramic capacitor
C4	100 $\mu$ F	63 V electrolytic capacitor
C5	220 nF	16 V ceramic capacitor
C6, C7	NM	Ceramic capacitor
C9, C10	100 pF	Ceramic capacitor
C11	1 nF	Ceramic capacitor
C12	3.3 nF	Ceramic capacitor
C13	10 nF	Ceramic capacitor
C14	10 $\mu$ F	6.3 V ceramic capacitor
C15	47 $\mu$ F	6.3 V ceramic capacitor
D1	BAT46SW	Low drop diode couple
D2	BZX284C3V6	3.6 V Zener diode
JP2, JP3		Jumper 2 x 1
JP5		Jumper 2 x 1
JP4		Jumper 3 x 1
JP7		Jumper 3 x 1
J2, J3, J4		Connector
J5	NM	Strip pin
J10		Vertical 5 x 2 male connector
J11		Vertical 5 x 2 male connector
R1	31.6 k $\Omega$	Resistor 1%
R2	8.2 k $\Omega$	Resistor 1%
R5, R6, R7	39 k $\Omega$	Resistor 1%
R9	10 k $\Omega$	Resistor 1%
R3	200 k $\Omega$	Trimmer
R8	100 $\Omega$	Resistor 1%
R10	0 $\Omega$	Resistor 1/8 W
TP5		Test point
TP4, TP6		Test point
U1	L6470H	L6470 dSPIN
Y1	NM	Crystal
Y2	NM	Ceramic resonator

Figure 5. EVAL6470 layout (top layer)

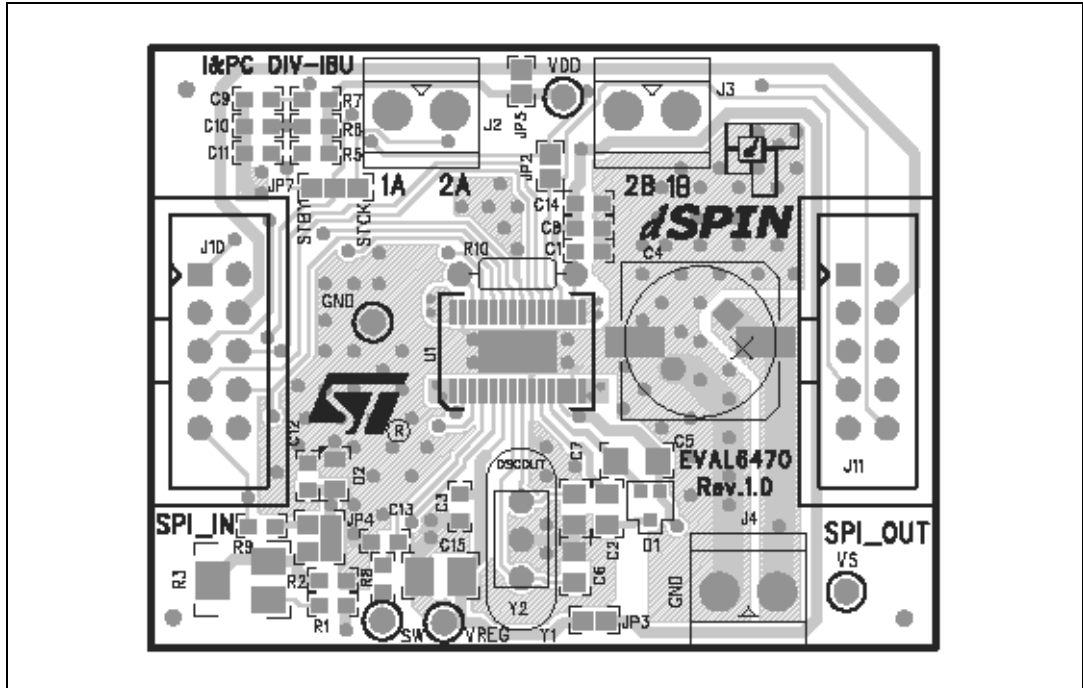
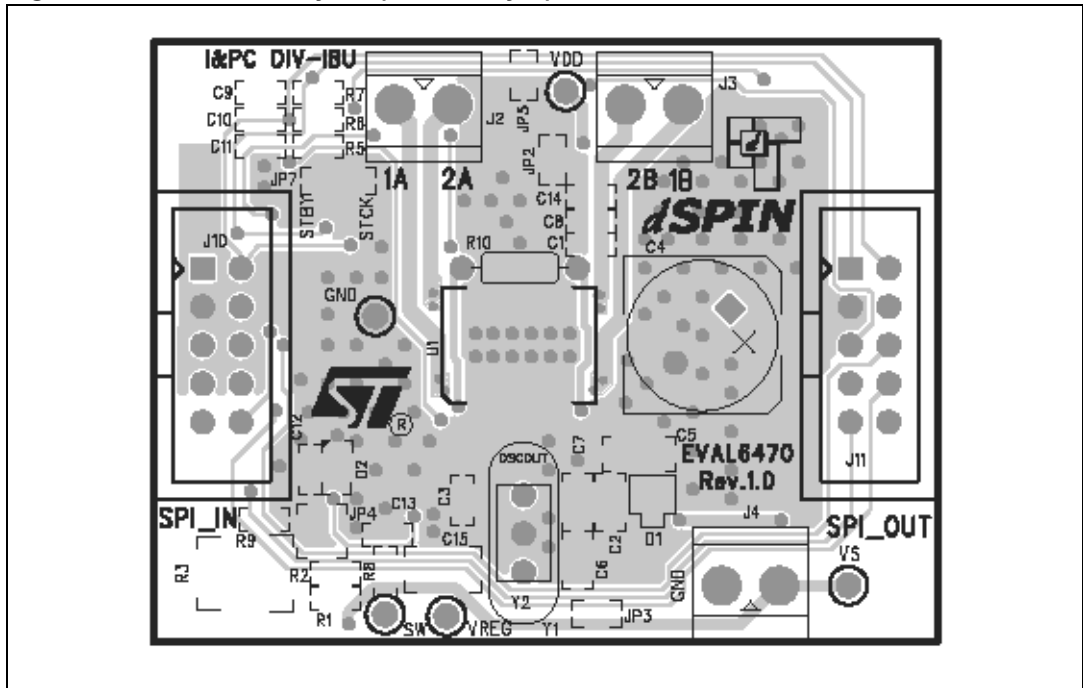


Figure 6. EVAL6470 layout (bottom layer)



## 2 Connection to IBU universal interface board

The EVAL6470 should be connected to the interface board (IBU-UI or UUSCI), and the following steps performed:

1. Connect the interface board to the PC through the USB cable
2. If requested, install interface board drivers
3. Verify interface board operation (check if operation LED diode is turned on)
4. Connect the interface board 10-pin connector to the EVAL6470 J10 connector (master SPI) through the 10-pole flat cable
5. Connect motor phases to the EVAL6470 J2 and J3 connectors
6. Connect the power supply (8 V to 45 V) to the EVAL6470 J4 connector
7. Start the dSPIN Evaluation tool.

### 3 dSPIN Evaluation tool

The dSPIN Evaluation tool allows users to program the L6470 registers and to perform all basic positioning and speed control commands.

#### 3.1 Software installation

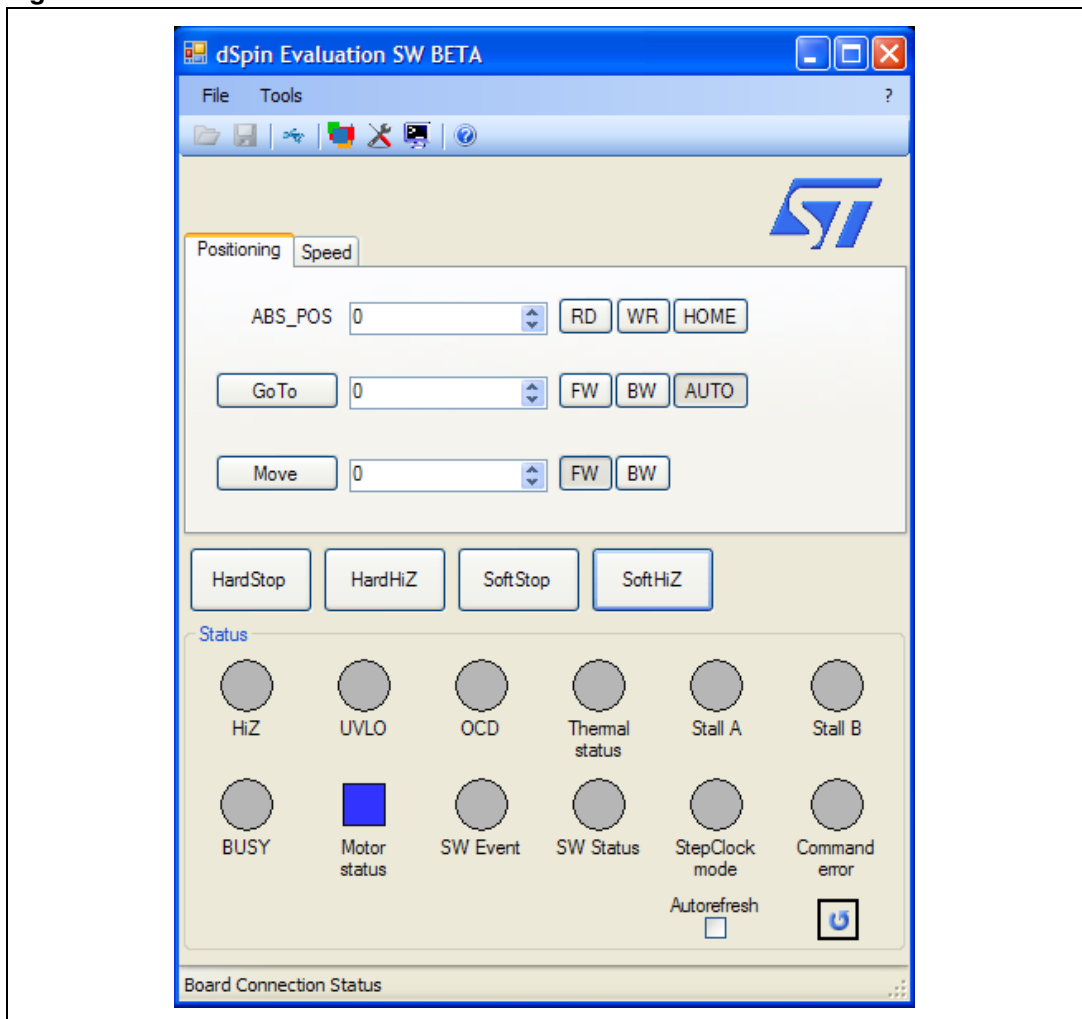
Run the Setup.exe and follow the installation instructions. A link to the application is automatically added to the PC desktop and the Start menu. Microsoft®.NET Framework 3.5 is required.

*Note: If a previous version of the software is already installed, it should be removed.*

#### 3.2 Main form

When the application is started, the main form is displayed.

Figure 7. dSPIN Evaluation tool main form



The main form is composed of the following elements:

- Menu and toolbars
- Positioning commands tab
- Speed commands tab
- HardStop, SoftStop, HardHiZ and SoftHiZ buttons
- Device status panel

### 3.2.1 Menu and toolbars

The menu and toolbars include all the main commands.

### 3.2.2 Positioning commands tab

This tab is used to:

- read, write and reset (set home position) the L6470 position register (ABS\_POS)
- perform an absolute positioning command using the minimum path algorithm (GoTo command) or to force a direction (GoTo\_DIR command)
- perform a relative positioning command (Move command)

### 3.2.3 Speed command tab

This tab is used to:

- read the L6470 speed register (SPEED)
- perform a constant speed command (Run command)

### 3.2.4 HardStop, SoftStop, HardHiZ and SoftHiZ buttons

Those buttons allow quick sending of the respective L6470 commands.

### 3.2.5 Device status panel

The device status panel is a graphical representation of the status conditions stored in the L6470 STATUS register. When the Autorefresh checkbox is checked, the device STATUS register is periodically read (GetParam command) and its value is shown. Using the refresh button a GetStatus command is sent to the L6470 and the returned value is shown.

## 3.3 Register map

The register map form shows all device registers in a table form. Register values are reported in both hexadecimal and natural format.

Register can be written, read and reset to default values using the WR, RD and DEF buttons, respectively.

Register value can be changed by writing the new hexadecimal value (Hex column) or double-clicking on its natural value (Value column); in the second case a conversion form is opened.

When the value of a register is changed the new value is not immediately written to the device, but only when the WR button is used. In order for the value of a register to be written

as soon as it is changed into the GUI, the respective AWR (Automatic WRite) checkbox should be checked.

Device configuration can be saved or loaded using the toolbar open and save buttons.

**Figure 8. dSPIN Evaluation tool Register Map form**

Name	Address	Description	Value	Hex	Default	AWR	WR	RD	DEF
ABS_POS	01	Current absolute position	0 ustep	0	0	<input type="checkbox"/>	WR	RD	DEF
EL_POS	02	Current electrical position (lstep)	0 step	0	0	<input type="checkbox"/>	WR	RD	DEF
MARK	03	Marked position	0 ustep	0	0	<input type="checkbox"/>	WR	RD	DEF
SPEED	04	Current speed	0 step/s	0	0	<input type="checkbox"/>	WR	RD	DEF
ACC	05	Acceleration	2008.164 step/s <sup>2</sup>	8A	138	<input type="checkbox"/>	WR	RD	DEF
DEC	06	Deceleration	2008.164 step/s <sup>2</sup>	8A	138	<input type="checkbox"/>	WR	RD	DEF
MAX_SPEED	07	Maximum speed	991.821 step/s	41	65	<input type="checkbox"/>	WR	RD	DEF
MIN_SPEED	08	Minimum speed	0 step/s	0	0	<input type="checkbox"/>	WR	RD	DEF
FS_SPEED	15	Full-step speed	595.093 step/s	27	39	<input type="checkbox"/>	WR	RD	DEF
KVAL_HOLD	09	Holding torque	16.016%	29	41	<input type="checkbox"/>	WR	RD	DEF
KVAL_RUN	0A	Run torque	16.016%	29	41	<input type="checkbox"/>	WR	RD	DEF
KVAL_ACC	0B	Acceleration torque	16.016%	29	41	<input type="checkbox"/>	WR	RD	DEF
KVAL_DEC	0C	Deceleration torque	16.016%	29	41	<input type="checkbox"/>	WR	RD	DEF
INT_SPD	0D	Intersect speed - BEMF compensation curve	246.048 step/s	408	1032	<input type="checkbox"/>	WR	RD	DEF
ST_SLP	0E	Starting slope - BEMF compensation curve	0.03815% s/step	19	25	<input type="checkbox"/>	WR	RD	DEF
FN_SLP_ACC	0F	Acceleration final slope - BEMF compensation curve	0.06256% s/step	29	41	<input type="checkbox"/>	WR	RD	DEF
FN_SLP_DEC	10	Deceleration final slope - BEMF compensation curve	0.06256% s/step	29	41	<input type="checkbox"/>	WR	RD	DEF
K_THERM	11	Thermal compensation coefficient	1	0	0	<input type="checkbox"/>	WR	RD	DEF
ADC_OUT	12	Internal ADC conversion result	0x00	0	0	<input type="checkbox"/>	WR	RD	DEF
OCD_TH	13	Overcurrent detection threshold	3.375 A	8	8	<input type="checkbox"/>	WR	RD	DEF
STALL_TH	14	Stall detection threshold	2.031 A	40	64	<input type="checkbox"/>	WR	RD	DEF
STEP_MODE	16	Driving mode and Step mode	VM, 1/128 Step	7	7	<input type="checkbox"/>	WR	RD	DEF
ALARM_EN	17	Alarms sent to FLAG output	Overcurrent, Undervoltage, Thermal warning, Thermal shutdown, Stall detection (A), Stall detection (B), Switch	FF	255	<input type="checkbox"/>	WR	RD	DEF

### 3.4 Device configuration

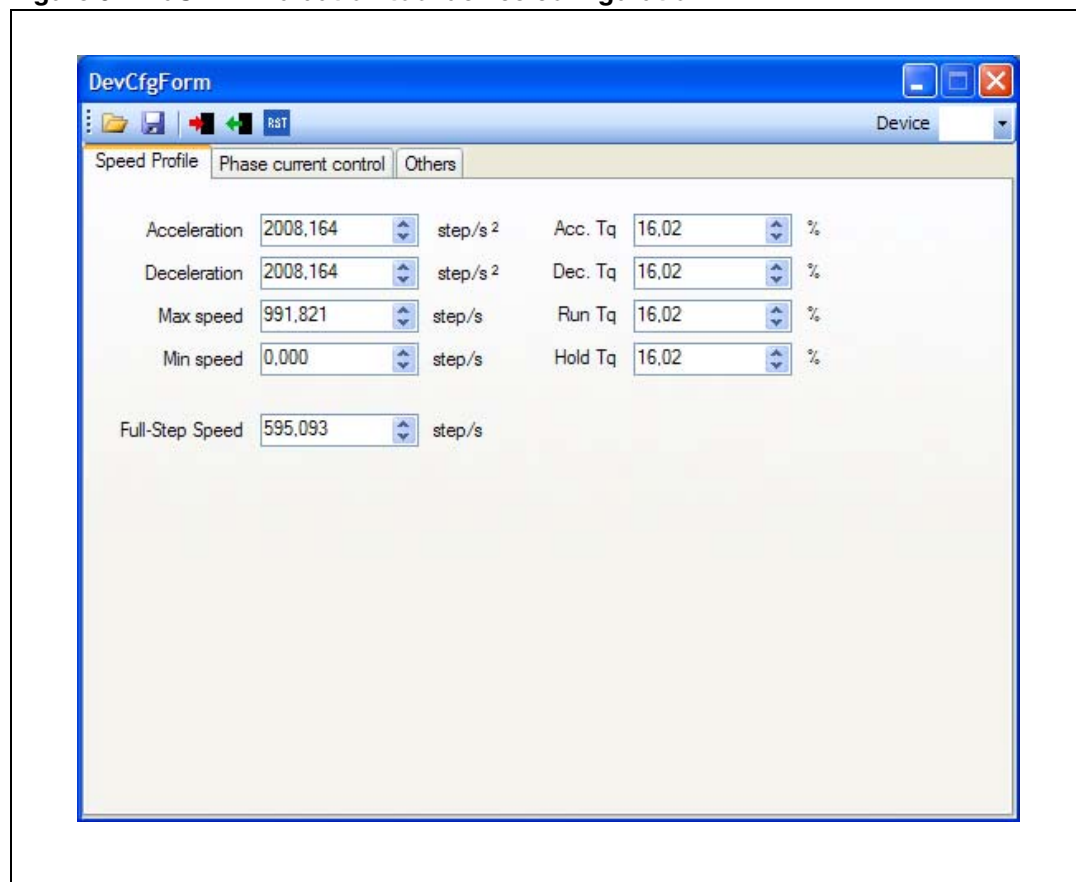
The device configuration form makes it easy to modify the L6470 configuration. All device parameters are grouped into tree tabs and displayed in natural format.

Unlike the register map, no information regarding a single device register is shown, and their values cannot be individually written.

The current configuration can be read and written using respective toolbar buttons.

The device configuration can be saved or loaded using toolbar open and save buttons.

Figure 9. dSPIN Evaluation tool device configuration





## 4 Revision history

**Table 6. Document revision history**

Date	Revision	Changes
01-Mar-2010	1	Initial release.

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