UM1984
User manual

SPC5-EV-ADIS

Introduction

SPC5-EV-ADIS adapter board allows to connect a large variety of high-side drivers and H-Bridges easy boards to SPC56B-DIS Discovery board as part of ADE (Automotive Discovery Ecosystem). For further information see *www.st.com*.

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1.1 Getting started by configuring the high-side driver

The sequence to configure the system and launch the application is:

1. Check jumper position in the SPC560B-DIS board:
   - J14,J13,J12,J11,J7,J6 removed
   - S1, S2, J10,J9,J1,J3 inserted
2. Connect the SPC560B-DIS board to a PC with a USB cable ‘type A to mini-B’
3. Download firmware STSW-SPC5EV-ADIS available on *www.st.com* and program the board as described
4. Disconnect USB cable
5. Plug Adapter Discovery board SPC5EV-ADIS
6. Install GUI for HSD on your PC as described in the document on *www.st.com*
7. Connect M07 easy board and loads to the outputs
8. Connect battery voltage to J3 connector of adapter discovery board SPC5EV-ADIS
9. Connect USB cable to PC
10. Execute GUI and check its user manual (*www.st.com*)

1.2 Getting started by configuring the H-Bridge

The sequence to configure the system and launch the application is:

1. Check jumper position in the SPC560B-DIS board:
   - J14,J13,J12,J11, J7, J6 removed
   - S1,S2,J10,J9,J1,J3 inserted
2. Connect the SPC560B-DIS board to a PC with a USB cable ‘type A to mini-B’
3. Download firmware STW-SPC5EV-ADIS available for H-Bridge and program the board as described in the document on *www.st.com*
4. Disconnect USB cable
5. Plug Adapter Discovery board
6. Install GUI on your PC as described on *www.st.com*
7. Connect H-Bridge easy board and loads to the outputs
8. Connect battery voltage to J3 connector of adapter discovery board SPC5EV-ADIS
9. Connect USB cable to PC
10. Execute GUI and check its user manual

1.3 Hardware, schematic and layout

Figure 1. SPC5-EV-ADIS Adapter Discovery board schematic

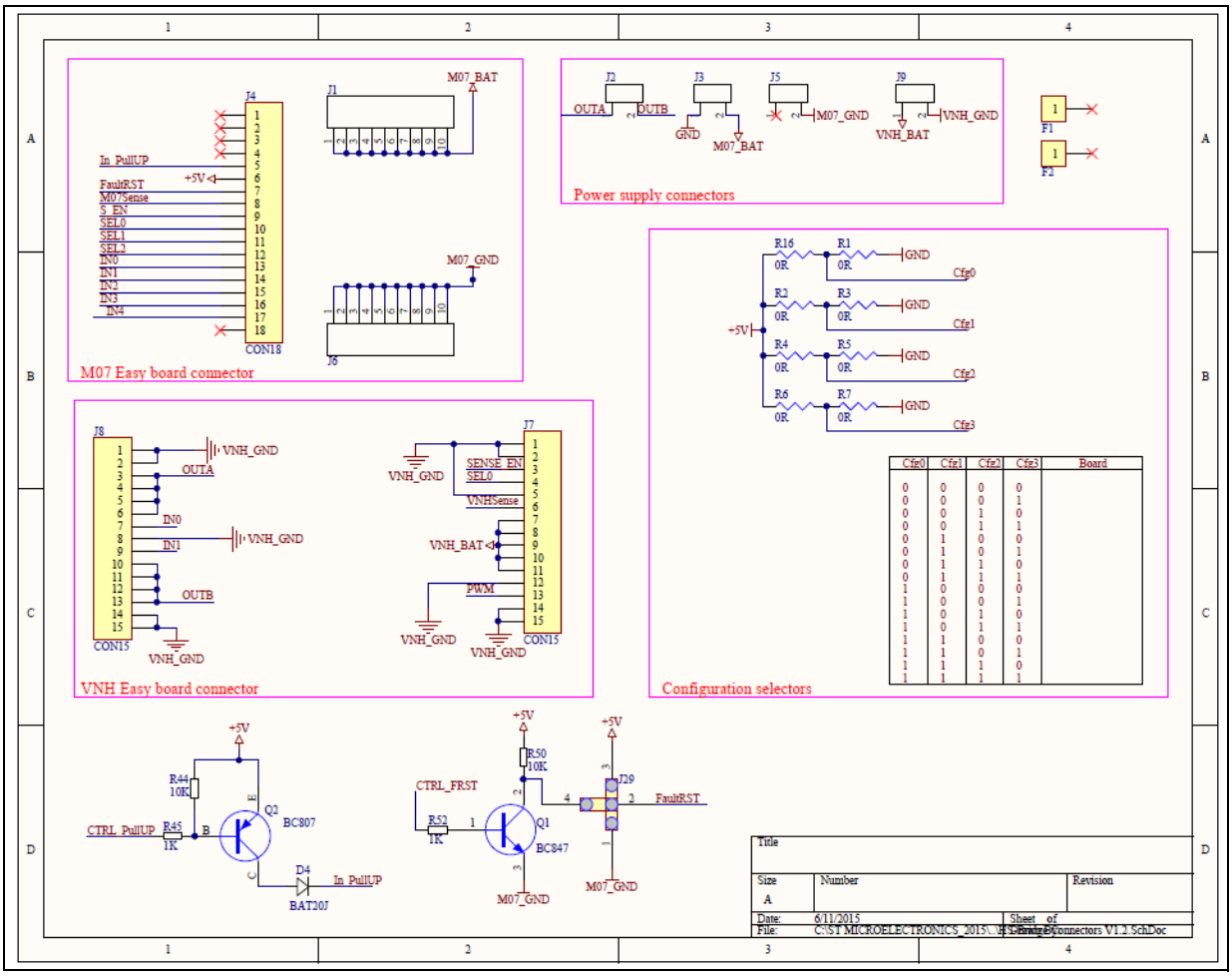
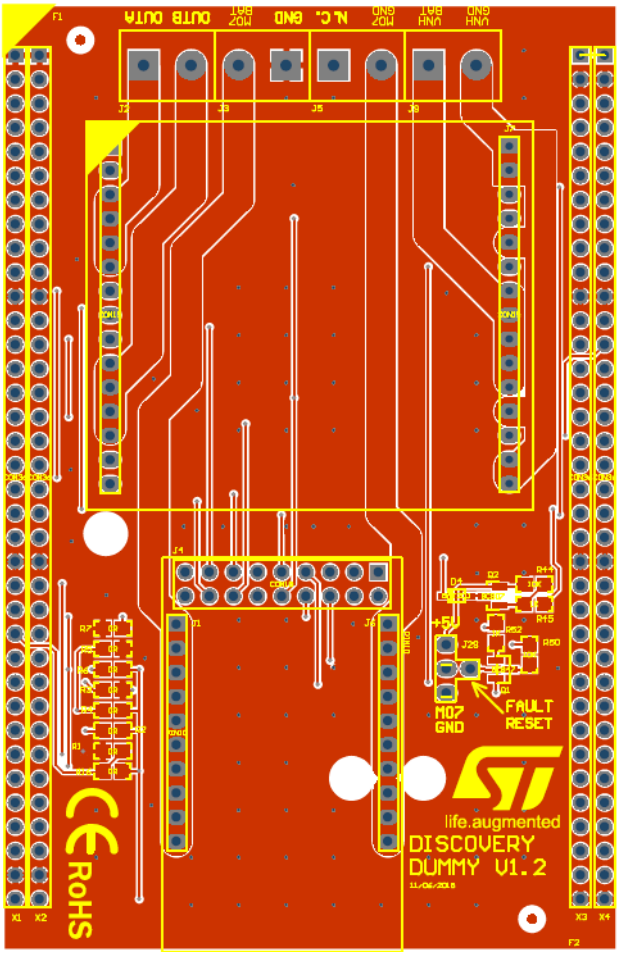


Figure 2. Adapter Discovery board top layer



1.4 M0-7 high-side devices

These devices are manufactured using ST proprietary VIPower M0-7 technology and are designed to drive 12 V automotive grounded loads through a 3 V and 5 V CMOS-compatible interface, providing protection and diagnostics.

The devices integrate advanced protective functions such as load current limitation, overload active management by power limitation and overtemperature shutdown with configurable latch-off.

A dedicated multifunction multiplexed analog output pin delivers sophisticated diagnostic functions including high precision proportional load current sense, supply voltage feedback and chip temperature sense, in addition to the detection of overload and short circuit to ground, short to V_{CC} and off-state open-load.

M0-7 devices most important features are:

- General
  - Smart high-side driver with MultiSense analog feedback
  - Very low standby current
  - Compatible with 3 V and 5 V CMOS outputs
  - Automotive qualified
- MultiSense diagnostic functions
  - Multiplexed analog feedback of: load current with high precision proportional current mirror, V_{CC} supply voltage and T_{CHIP} device temperature
  - Overload and short to ground (power limitation) indication
  - Thermal shutdown indication
  - Off-state open-load detection
  - Output short to V_{CC} detection
  - Sense enable/ disable
- Protections
  - Undervoltage shutdown
  - Overvoltage clamp
  - Load current limitation
  - Self limiting of fast thermal transients
  - Configurable latch-off on overtemperature or power limitation with a dedicated fault reset pin
  - Loss of ground and loss of V_{CC}
  - Reverse battery through self turn-on
  - Electrostatic discharge protection

The discovery adapter board is equipped with an extension header for quick connection to all the M0-7 easy boards.

1.5 H-Bridge devices

The VNHxxx are full bridge motor drivers for a wide range of automotive applications. The devices incorporate a dual monolithic high-side driver and two low-side switches. All switches are designed using a STMicroelectronics VIPower technology that allows to integrate efficiently on the same die a true Power MOSFET with an intelligent signal/protection circuitry. A sense pin is available to monitor the motor current by delivering a current proportional to the motor current value. The input signals (A,B) can directly interface the microcontroller to select the motor direction and the brake condition. The PWM, up to 20KHz, allows to control the speed of the motor in all possible conditions. In all cases, a low level state on the PWM pin turns off both the LS_A and LS_B switches.

VNHxx devices most important features are::

- Automotive qualified
- 3 V CMOS compatible inputs
- Undervoltage shutdown
- Overvoltage clamp
- Thermal shutdown
- Cross-conduction protection
- Current and power limitation
- Very low standby power consumption
- Protection against loss of ground and loss of V_{CC}
- PWM operation up to 20 KHz
- Multisense current proportional to motor current

SPC5-EV-ADIS discovery adapter board is equipped with an extension header for quick connection to H-bridges easy boards.

1.6 Power supply

The power supply is provided through J3 connector (HSD) or J9 connector (H-Bridge) and must be able to provide the required current.

1.7 Jumpers

The high-side driver M0-7 has a FaultRST pin, an active low compatible with 3V and 5V CMOS outputs to unlatch the output in case of fault or to disable the latch-off functionality.

J29 are multi positions and allow three different configurations:

1. Pin 2 connected with pin 1, FaultRST is forced to GND setting the outputs in auto-restart mode
2. Pin 2 connected with pin 3, FaultRST is forced to 5V so unlatches the output in case of fault
3. Pin 2 connected with pin 4, FaultRST is driven by microcontroller output

1.8 Extension connectors

The male headers X1,X2,X3 and X4 are two strip lines connectors of 2x36 each and are used to allow the access to all the SPC560B54L5 MCU pins with exception of JTAG, TCK, TMS, TDI, TDO, XTAL, EXTAL and VDD_LV. The pins used in the adapter board SPC5-EV-ADIS are the following:

Table 1. Extension connectors pins used in the adapter board SPC5-EV-ADIS with H-Bridge

Discovery Connector X1		H-Bridge	Discovery Connector X2		H-Bridge	Discovery Connector X3		H-Bridge	Discovery Connector X4		H-Bridge
1	GND		1	GND		1	Batt		1	Batt	
2	PE[2]		2	PE[3]		2	GND		2	GND	
3	PC[5] (CSN)		3	PC[4]		3	TCK		3	TDI	
4	PE[4]		4	PE[5]		4	TDO		4	TMS	
5	PH[4]		5	PH[5]		5	PA[6]		5	PA[5]	
6	PH[6]		6	PH[7]		6	PC[2]		6	PC[3]	
7	PH[8]		7	PE[6]		7	PG[11]		7	PG[10]	
8	PE[7]		8	PC[12]		8	PE[15]		8	PE[14]	
9	PC[13]		9	PB[1] (RxDC)	SENSE_EN	9	PG[15]		9	PG[14]	
10	PB[2]	LIN_TX	10	PB[3]	LIN_RX	10	PE[12]		10	PA[11]	
11	GND		11	GND		11	GND		11	GND	
12	PB[0] (TxDC)		12	PC[14]		12	PA[10]		12	PA[9]	PullUP_OUT1
13	PC[15]		13	PG[5]		13	PA[8]	PullUP_OUT 0	13	PA[7]	PWM
14	PG[4]		14	PG[3]		14	PE[13]		14	PF[14]	
15	PG[2]		15	PA[2]	SEL0	15	PF[15]		15	PG[0]	
16	PE[0]		16	PA[1]	IN1	16	PG[1]		16	PH[3]	
17	PE[1]		17	PE[8]		17	PH[2]		17	PH[1]	
18	PE[9]		18	PE[10]		18	PH[0]		18	PG[12]	
19	PA[0]	IN0	19	PE[11]		19	PG[13]		19	PA[3]	
20	RESET_ASD		20	PG[9]		20	PB[15]		20	PD[15]	
21	PG[8]		21	PC[11]		21	PB[14]		21	PD[14]	
22	GND		22	GND		22	GND		22	GND	
23	PC[10]	SEL1	23	PG[7]		23	PB[13]		23	PD[13]	
24	PG[6]		24	PC[9]		24	PB[12]		24	PD[12]	
25	PC[8]	Cfg0	25	PF[9]		25	PB[11]		25	PD[11]	
26	PF[8]		26	PF[12]		26	PD[10]		26	PD[9]	

Table 1. Extension connectors pins used in the adapter board SPC5-EV-ADIS with H-Bridge

Discovery Connector X1		H-Bridge	Discovery Connector X2		H-Bridge	Discovery Connector X3		H-Bridge	Discovery Connector X4		H-Bridge
27	PC[6] (TxDL)		27	PC[7] (RxDL)	Cfg1	27	PB[7]	VNHSense	27	PB[6]	
28	PF[10]		28	PF[11]		28	PB[5]		28	PB[4]	
29	PA[15]	Cfg2	29	PF[13]		29	PD[8]		29	PD[7]	
30	PA[14] (CLK)	Cfg3	30	PA[4]		30	PD[6]		30	PD[5]	
31	PA[12] (MISO)		31	PA[13] (MOSI)		31	PD[4]		31	PD[3]	
32	PB[9]		32	PB[8]		32	PD[2]		32	PD[1]	
33	PB[10]		33	PF[0]		33	PD[0]		33	PF[7]	
34	PF[1]		34	PF[2]		34	PF[6]		34	PF[5]	
35	GND		35	GND		35	PF[4]		35	PF[3]	
36	5V		36	5V		36	GND		36	GND	

Table 2. Extension connectors pins used in the adapter board SPC5-EV-ADIS with M0-7

Discovery Connector X1		M0-7	Discovery Connector X2		M0-7	Discovery Connector X3		M0-7	Discovery Connector X4		M0-7
1	GND		1	GND		1	Batt		1	Batt	
2	PE[2]		2	PE[3]		2	GND		2	GND	
3	PC[5] (CSN)		3	PC[4]		3	TCK		3	TDI	
4	PE[4]		4	PE[5]		4	TDO		4	TMS	
5	PH[4]		5	PH[5]		5	PA[6]		5	PA[5]	
6	PH[6]		6	PH[7]		6	PC[2]		6	PC[3]	S_EN
7	PH[8]		7	PE[6]		7	PG[11]		7	PG[10]	
8	PE[7]		8	PC[12]		8	PE[15]		8	PE[14]	
9	PC[13]		9	PB[1] (RxD)		9	PG[15]		9	PG[14]	
10	PB[2]		10	PB[3]		10	PE[12]		10	PA[11]	

Table 2. Extension connectors pins used in the adapter board SPC5-EV-ADIS with M0-7

Discovery Connector X1		M0-7	Discovery Connector X2		M0-7	Discovery Connector X3		M0-7	Discovery Connector X4		M0-7
11	GND		11	GND		11	GND		11	GND	
12	PB[0] (TxDC)	CTRL_PUP	12	PC[14]		12	PA[10]	IN2	12	PA[9]	
13	PC[15]		13	PG[5]		13	PA[8]		13	PA[7]	
14	PG[4]		14	PG[3]		14	PE[13]		14	PF[14]	
15	PG[2]		15	PA[2]	SEL0	15	PF[15]		15	PG[0]	
16	PE[0]		16	PA[1]	IN1	16	PG[1]		16	PH[3]	
17	PE[1]		17	PE[8]		17	PH[2]		17	PH[1]	
18	PE[9]		18	PE[10]		18	PH[0]		18	PG[12]	
19	PA[0]	IN0	19	PE[11]		19	PG[13]		19	PA[3]	IN3
20	RESET_ASD		20	PG[9]		20	PB[15]		20	PD[15]	
21	PG[8]		21	PC[11]		21	PB[14]		21	PD[14]	
22	GND		22	GND		22	GND		22	GND	
23	PC[10]	SEL1	23	PG[7]		23	PB[13]		23	PD[13]	
24	PG[6]		24	PC[9]	CTRL_FRST	24	PB[12]	M0-7Sense	24	PD[12]	
25	PC[8]	SEL2	25	PF[9]		25	PB[11]		25	PD[11]	
26	PF[8]		26	PF[12]		26	PD[10]		26	PD[9]	
27	PC[6] (TxDL)		27	PC[7] (RxDL)		27	PB[7]		27	PB[6]	
28	PF[10]		28	PF[11]		28	PB[5]		28	PB[4]	
29	PA[15]		29	PF[13]		29	PD[8]		29	PD[7]	
30	PA[14] (CLK)		30	PA[4]	IN4	30	PD[6]		30	PD[5]	
31	PA[12] (MISO)		31	PA[13] (MOSI)		31	PD[4]		31	PD[3]	
32	PB[9]		32	PB[8]		32	PD[2]		32	PD[1]	
33	PB[10]		33	PF[0]		33	PD[0]		33	PF[7]	
34	PF[1]		34	PF[2]		34	PF[6]		34	PF[5]	
35	GND		35	GND		35	PF[4]		35	PF[3]	
36	5V		36	5V		36	GND		36	GND	

2 Graphical User Interface

The Graphical User Interface is available on *www.st.com* (STSW-M07-ADIS & STSW-SPC5EV-ADIS).

3 Revision history

Table 3. Document revision history

Date	Revision	Changes
17-Nov-2015	1	Initial release.
15-Apr-2016	2	Updated: - *Introduction* - *Section 1.1: Getting started by configuring the high-side driver* - *Section 1.2: Getting started by configuring the H-Bridge* Changed title in *Figure 1: SPC5-EV-ADIS Adapter Discovery board schematic*. Updated: - *Section 1.4: M0-7 high-side devices* - *Section 1.5: H-Bridge devices* - *Section 1.7: Jumpers* Changed title in *Table 1: Extension connectors pins used in the adapter board SPC5-EV-ADIS with H-Bridge* and in *Table 2: Extension connectors pins used in the adapter board SPC5-EV-ADIS with M0-7* Updated: - *Section 2: Graphical User Interface*