SAM Board v3 – User Manual

Presentation

The SAMboard is a specific electronic boards developed by ESIGELEC especially for building a small differential robots based on the Pololu rrc04a chassis. It accepts a Texas Instruments Launchpad as a daughter board to be the brain of this robot.

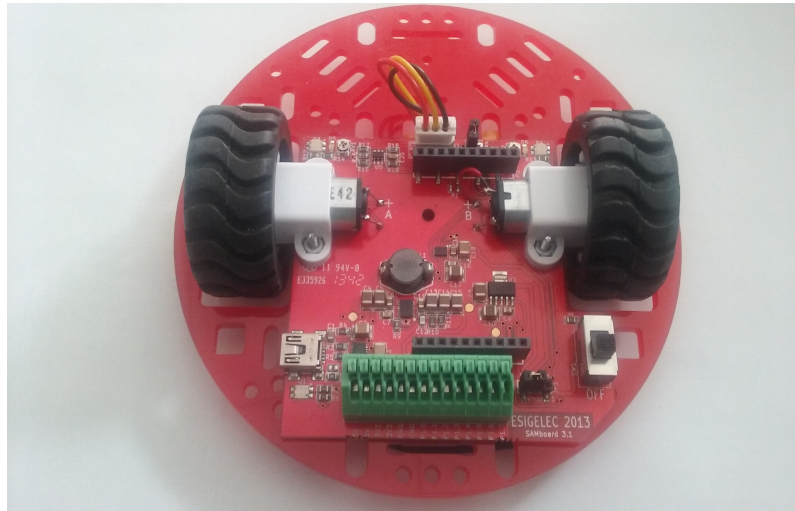This manual presents usage and setup of this board.

Figure 1: SAMboard v3 assembled on Pololu chassis

Functionalities

The SAMboard bring many functionalities to have a fully-functional robot :

- Battery management : charging and supervision of a single cell 3.7V LiPo battery
- Power management : voltage conversion from the battery to 5V and 3.3V
- DC motor control with a dual H bridge (TI DRV8835) and two optical incremental encoders (sensitivity can be tuned using RV1 and RV2)
- Female SIL connectors to plug a Launchpad board (the connectors on a stock Launchpad needs to be modified)
- A quick connector for easy sensor connection

Jumpers configuration

Jumper	Description	Default Configuration	Other Configuration
JP1	DC motors power supply	1-2 : From battery (about 3.7V) *Slower robot, but stronger immunity to sudden changes in speed*	2-3 : From 5V DC/DC converter *Faster robot, but acceleration and decelerations ramps must be used to avoid overload of DC/DC converter and Launchpad reboot*
JP2	Optical incremental encoders	Jumper present : encoders ON, D3 and D4 shows the status	Jumper removed: encoders OFF, D3 et D4 can be controlled by the Launchpad

Connectors

K1 : 3 points connector, 2.54mm step; for 3.7V LiPo battery with embedded NTC.

K2 : 3 points, 2mm step, for 3.7V LiPo battery without embedded NTC. Located under K1 which needs to be removed in order to use K2.

J1 : mini-USB B type connector. Use it to power the system (5V only) and charge the battery.

P1, P3 : female connectors to plug a Launchpad board with MSP430G2553 micro-controller. On the launchpad, all the jumpers should be on their default positions. The signals between the SAMboard and the Launchpad are described in the following tabular :

Launchpad Pin Number	SAMboard function	Direction (from the Launchpad perspective)
P1.0-P1.7	Connected on the extension connector (green)	Input or Output
P 2.0	Motor A optical encoder	Input
P 2.1	Motor A direction	Output
P 2.2	Motor A speed control : PWM [0..100%] duty cycle , 250 KHz maximum frequency	Output
P 2.3	Motor B optical encoder	Input
P 2.4	Motor B speed control : PWM [0..100%] duty cycle , 250 KHz maximum frequency	Output
P 2.5	Motor B direction	Output

P2 : Green quick connector, gives access to all MSP430 signal which are not used by SAMboard functions as well as 3.3V and 5V voltages. See the silkscreen printed on the board.

Indicators

D1   Green : ON = a power supply is connected on J1.

Orange : ON = the battery is charging, OFF = battery fully charged (or disconnected).

D2 : ON = the system is operating.
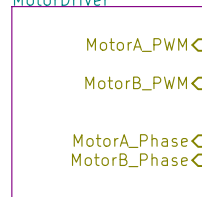
D2, D3 : Shows the rotation direction of each DC motor.

D5, D6 : Shows the optical encoder states. The sensitivity of the encoders can be ajusted with RV1 and RV2 to have 50% duty cycle. If JP2 is removed, these leds can be used as indicators.

PowerSupply
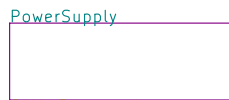
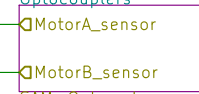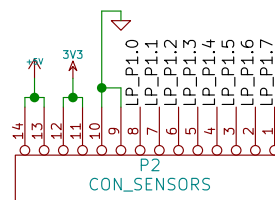SAM-Power.sch

MotorDriver

MotorA_PWM — LP_P2.2 TA1.1 (pour output compare => PWM)

MotorB_PWM — LP_P2.4 TA1.2 (pour output compare => PWM)

MotorA_Phase — LP_P2.1
MotorB_Phase — LP_P2.5

SAM-Motor.sch

Optocouplers

LP_P2.0 — MotorA_sensor

LP_P2.3 — MotorB_sensor

SAM-Opto.sch

USB

Emulator

WARNING
VCC and RESET jumpers must be present on JP3

J3

3V3

MSP430G2553

P1 CON_LAUNCHPAD_LEFT_1-10

3V3

1
LP_P1.0   2
LP_P1.1   3
LP_P1.2   4
LP_P1.3   5
LP_P1.4   6
LP_P1.5   7
LP_P2.0   8
LP_P2.1   9
LP_P2.2   10

P3 CON_LAUNCHPAD_RIGHT_1-10

10
LP_XIN   9
LP_XOUT   8
LP_TEST   7
LP_RST   6
LP_P1.7   5
LP_P1.6   4
LP_P2.5   3
LP_P2.4   2
LP_P2.3   1

3V3

NC R1

Launchpad connectors
SAMTEC SSQ-110-03-x-S soldered on Launchpad
SAMTEC SSM-11-L-SV soldered on SAM board

+5V 3V3

LP_P1.0
LP_P1.1
LP_P1.2
LP_P1.3
LP_P1.4
LP_P1.5
LP_P1.6
LP_P1.7

14 13 12 11 10 9 8 7 6 5 4 3 2 1

P2
CON_SENSORS

External supply and battery charger

Green : 2-3 / Yellow 1-4

VccIN

PWR/CHRG D1

R2 300   R6 300

5mA recommanded

TP1 PWR_IN

VccIN

SW1
1   2
POWER_SW

VCC

VCC

D2 Power ON

R8 300
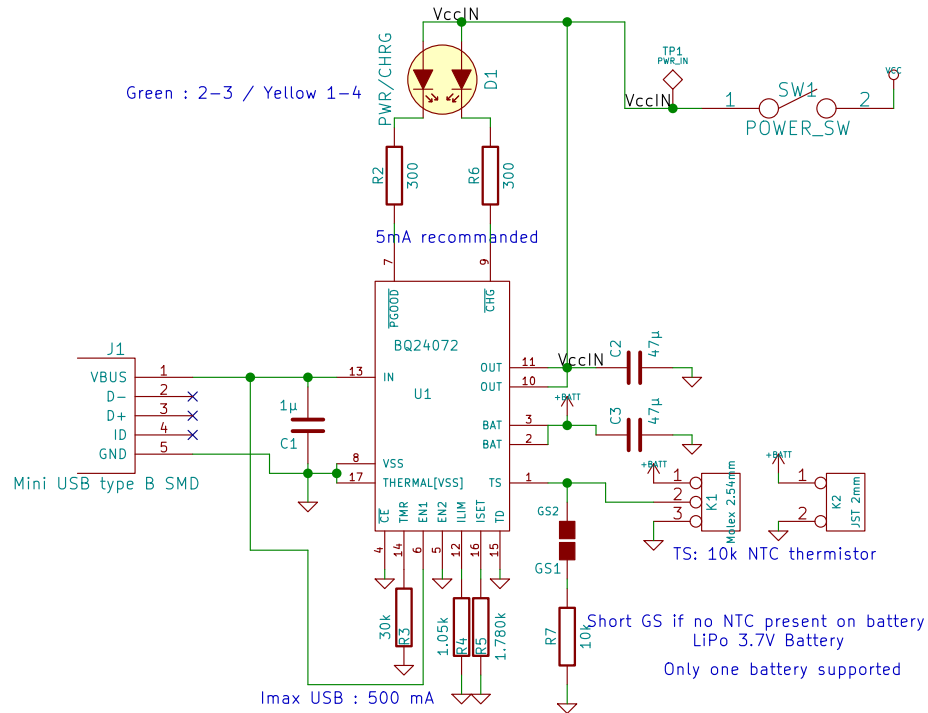
Buck-Boost converter, 5V output

1.5µ
L1

U2
8 L1   L2 6
9 L1   L2 7
10 VIN   VOUT 4
11 VIN   VOUT 3
1 VINA   FB 5
12 EN
13 PS/SYNC PG 14
2 GND   PGND 15
TPS63020

TP2 5V

VCC

C4 22µ   C5 22µ   C6 2.2µ   C7 100nF

R10 1.8M

R11 200K

C11 2.2µ C13 22µ C14 22µ C15 22µ

C12 10p

R9 1M

5V

J1
VBUS 1
D-   2
D+   3
ID   4
GND 5
Mini USB type B SMD

C1 1µ

U1
13 IN   OUT 11   VccIN
           OUT 10
           BAT 3   +BATT
           BAT 2
8 VSS   TS 1
17 THERMAL[VSS]
PGOOD 7
CHRG 9
BQ24072

CE 4   TMR 14   EN1 6   EN2 5   ILIM 12   ISET 16   TD 15

R3 30k   R4 1.05k   R5 1.780k   R7 10k

GS2
GS1

C2 47µ

C3 47µ

+BATT
K1 Molex 2.54mm
1
2
3
TS: 10k NTC thermistor

+BATT
K2 JST 2mm
1
2

Short GS if no NTC present on battery
LiPo 3.7V Battery
Only one battery supported

Imax USB : 500 mA

LDO Regulator 3V3 output

TP3 3V3

3V3

U3
1 Vin   Vout 2
5 EN   NR/FB 4
3 GND   TAB(GND) 6
TPS73733

5V

C8 22µ

C9 10n   C10 22µ

Title: SAMBoard : Launchpad base board for Polulo rrc04a chassis
Size: A4   Date: 26 apr 2013   Rev: 2.0
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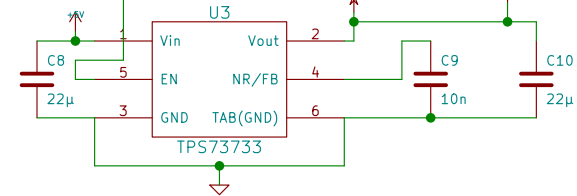
3V3

100nF   C17
C16   22µF

+5V   VCC
3   1
2
JP1

C18   47µ
1µ   C19

P4
+
R12   300
D3
LED_A
Motor Left

VCC   12   VM   1
MotorA_Phase   10   AIN1/APHASE   AOUT1   2
MotorA_PWM   9   AIN2/AENBL   AOUT2   3

Max PWM freq : 250kHz

U4
DRV8835

P5
P6

+
R13   300
LED_B   D4
Motor Right

MotorB_Phase   8   BIN1/BPHASE   BOUT1   4
MotorB_PWM   7   BIN2/BENBL   BOUT2   5

3V3   11   MODE
Mode Phase / Enable (MODE=+3V3)

GNDP   13   GND   6

P7

Motor Connectors (4*1pins)
Spacing = 6mm
Height = 6mm from board surface

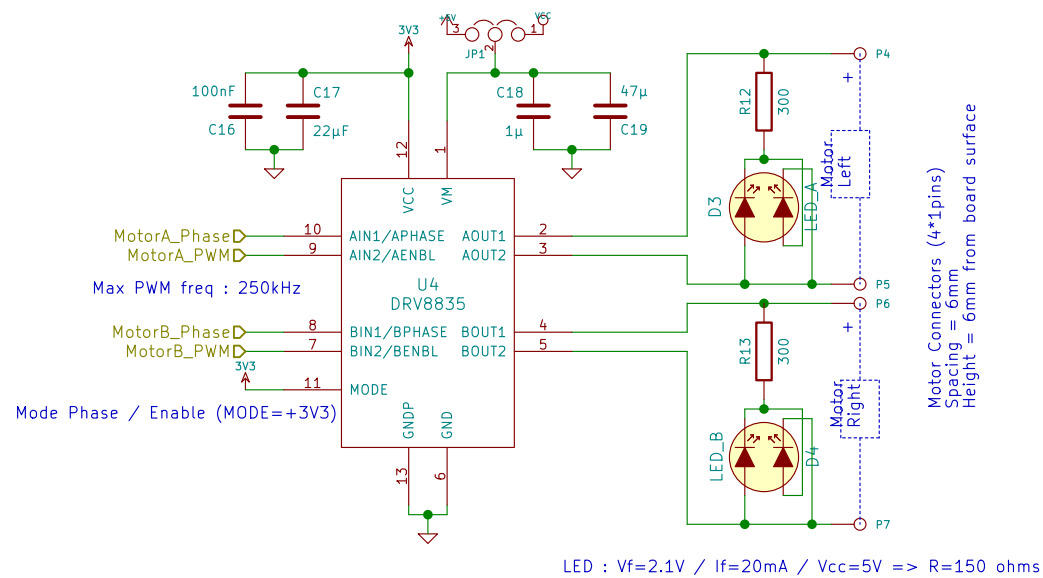LED : Vf=2.1V / If=20mA / Vcc=5V => R=150 ohms

Author : Romain Rossi
ESIGELEC
Sheet: /MotorDriver/
File: SAM-Motor.sch
Title: SAMBoard : Launchpad base board for Polulo rrc04a chassis
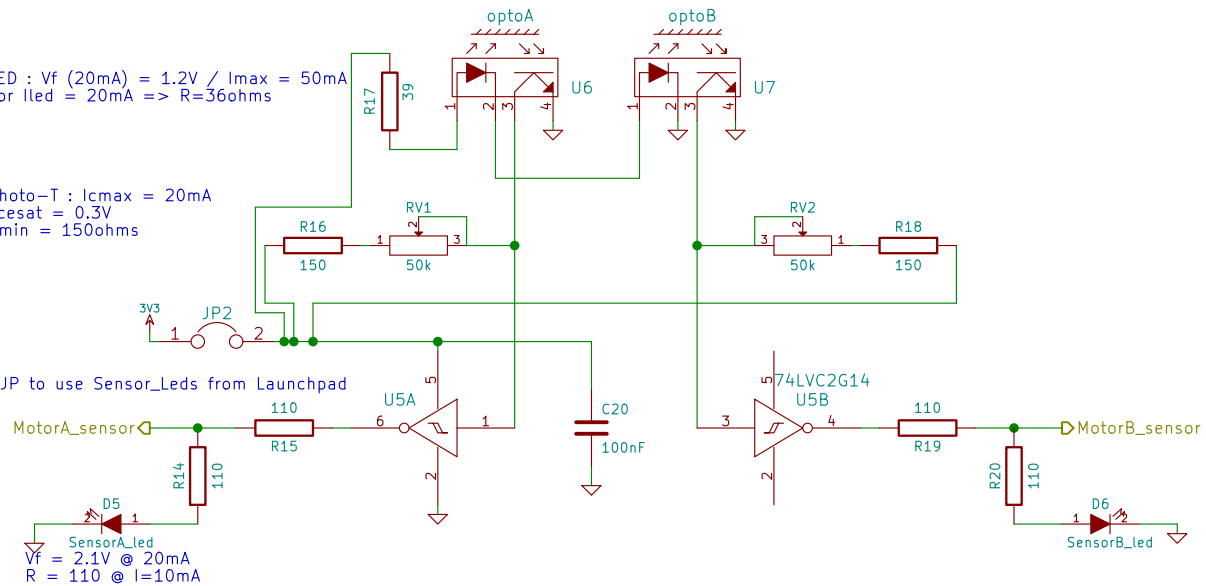Size: A4   Date: 26 apr 2013   Rev: 2.0
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optoA

optoB

LED : Vf (20mA) = 1.2V / Imax = 50mA
For Iled = 20mA => R=36ohms

R17
39

U6

U7

Photo−T : Icmax = 20mA
Vcesat = 0.3V
Rmin = 150ohms

RV1

RV2

R16
150

2
1   3
50k

3   2
1
50k

R18
150

3V3

JP2

1   2

Open JP to use Sensor_Leds from Launchpad

R15
110

U5A

6   1
5
2

C20
100nF

74LVC2G14
U5B

3   4
5
2

R19
110

MotorA_sensor

MotorB_sensor

R14
110

D5

2   1

SensorA_led

R20
110

D6

1   2

SensorB_led

Vf = 2.1V @ 20mA
R = 110 @ I=10mA

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