SRV-1_Expansion_Board

This is an expansion board for the “SRV-1 Blackfin” module by Surveyor Corp. It features the following:

- 16 general I/O pins
- 8 direct in pins
- 20 servo out pins
- 8 analog in pins
- 1 i2c connector
- 1 microSD slot
- 2 S-32 bus connectors for connecting the SRV-1 Blackfin and additional module(s).

All the above mentioned ports operate at 5V logic (0-5V analog in, respectively) except of the S-32 bus which operates at 3.3V.

General description

The board connects to the SRV-1 Blackfin module using its S-32 bus. Most input/output pins can be managed from the Blackfin processor via the i2c (TWI) bus except the direct in pins which are connected directly to the S-32 bus signals S25 to S32 and the microSD card which uses signals S9 to S12.
All input/output connectors share the same layout – ground, 5V power, data (from the PCB edge towards the center).

Power

The board is powered by a single power-in connector. Input voltage shall range between 5.5V and 18V as per the LF50/LF33 specification. Power dispatch features separate stabilizers for powering the board itself (5V), the SRV-1 (3.3V) and the servos (5V) separately with the maximum draw of 1A at each branch. Servo branch is partially guarded by a polyswitch.
Warning: there is NO protection against wrongly connected power. If the power is connected reversely, the board will be seriously damaged.

Connectivity options

General I/O

There are 16 pins connected to the Microchip MCP23017 – “16-Bit I/O Expander”. The pins may be individually set for input or output and may be used as two 8-bit ports or one 16-bit port; for more details, consult the MCP23017 datasheet and/or application notes by Microchip. Maximum output current sunk/sourced for each pin is 25mA.
The General I/O module i2c address is 0x4E (0100 111).

Direct in

There are 8 pins connected to 74LVC245 – “Octal bus transceiver with direction pin with 5-volt tolerant inputs/outputs (3-State)”. Outputs of the 74LVC245 are connected directly to the S-32 bus (signals 25-32) which are connected at the SRV-1 module to Blackfin port PH8-PH15. The 74LVC245 direction is configured for input, i.e. data flow is from the outside world towards Blackfin.

Servo out

The expansion board hosts the SD20 – "20 Channel I2C to Servo Driver Chip". All channels may be individually positioned or disconnected but share the signal range (default range set at 1 to 2ms). For more information, consult the S20 documentation and/or the chip documentation (the SD20 is a pre-programmed Microchip PIC16F872).
The Servo module i2c address is 0xC2 (1100 001).

Analog in

The Analog in module is implemented using Analog Devices AD7998-0 – "8-Channel, 12-Bit ADC with I2C Compatible Interface".
The Analog module i2c address is 0x44 (0100 010).

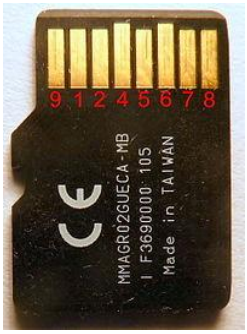
I2c

I2c connector on the board is at 5V levels with i2c specification-recommended pinout (SCL/GND/+5V/SCA from the PCB edge towards the center). Connectivity with S-32 i2c/TWI (which runs at 3.3V levels) is implemented using BSN20 MOS-FETs as suggested by Philips Application Note AN97055 "Bi-directional level shifter for I²C-bus and other systems". There are 2k2 pull-ups at both 3.3V and 5V branches.

microSD

The board is equipped with one microSD hinged slot. The card is connected to the S-32 bus for operation in SPI mode as follows:

microSD pin	signal name	S-32 bus signal	Blackfin pin
1	CS *	12	PJ10/PF14† SPI_SEL
2	DI *	9	PF11 SPI_MOSI
4	Vdd	1	
5	SCLK *	11	PF13 SPI_SCK
6	GND	2	
7	DO *	10	PF12 SPI_MISO
8	(not used in SPI mode)	(not connected)	
9	(not used in SPI mode)	(not connected)	



* All data signals are pulled high by a 10k resistor
† Set by jumper on CPU card

S-32 bus

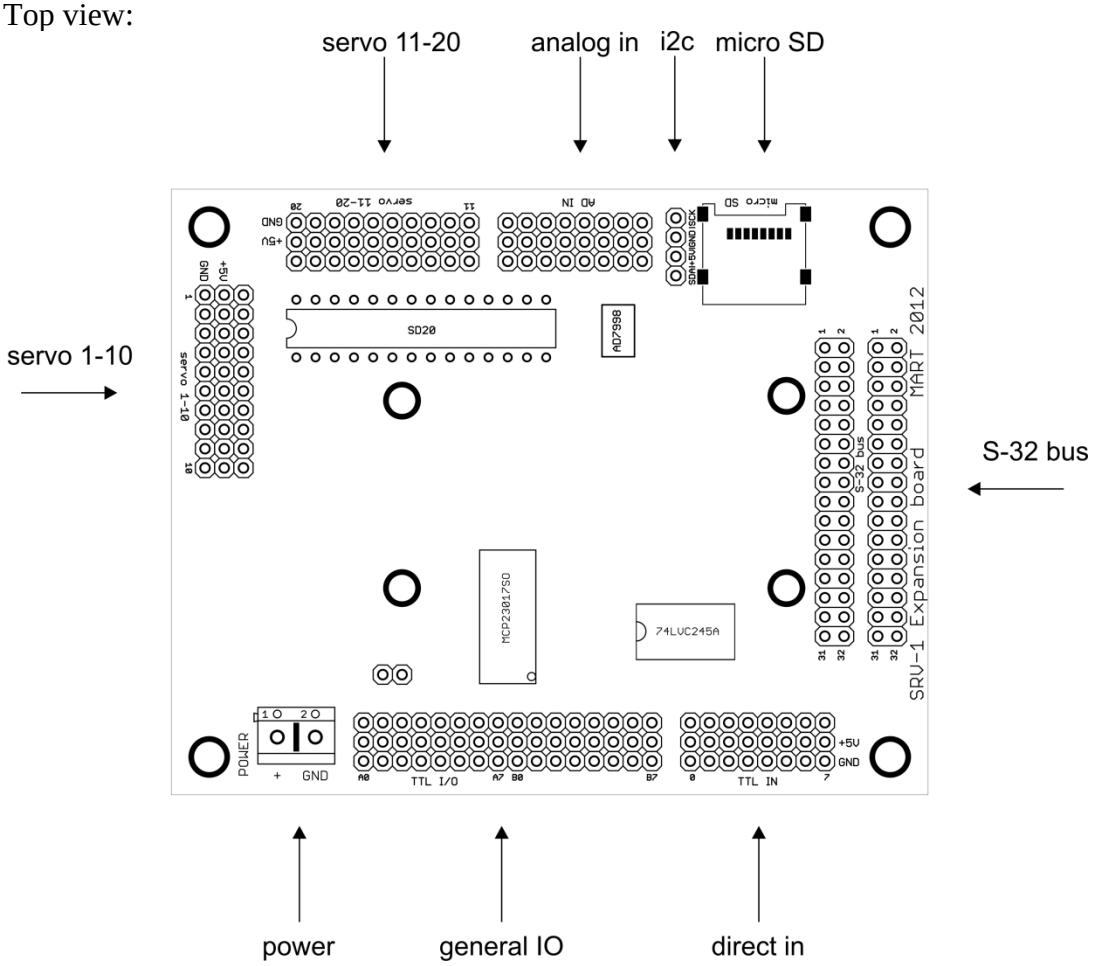
There are two 2x16 headers for S-32 connectivity on the board. The layout is as per the SRV-1 Blackfin specification:

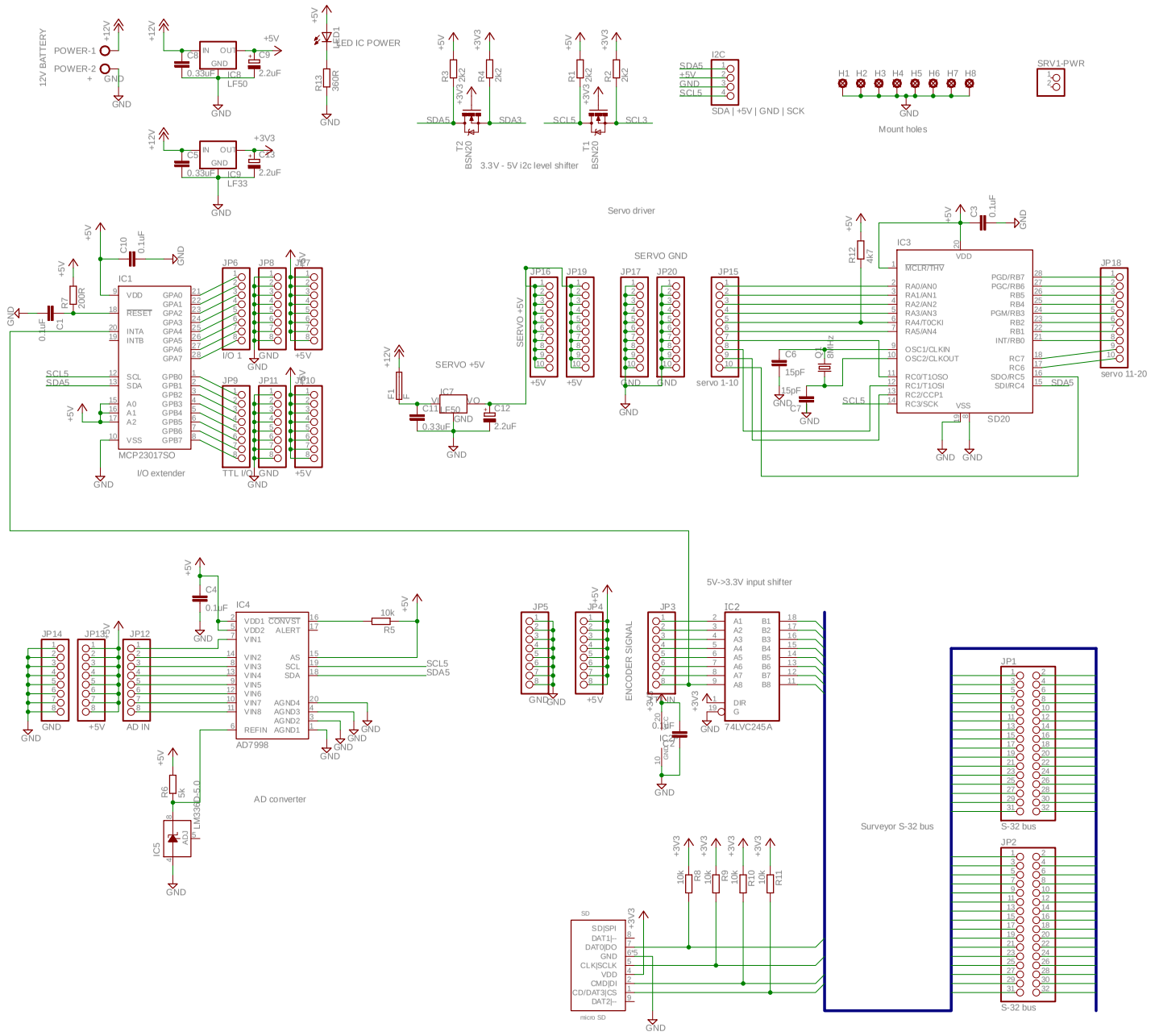
S-32 pin	Blackfin pin	Blackfin Name	Board usage
1		3.3V	3.3V
2		GND	GND
3	PF0	TX0	
4	PF1	RX0	
5	PF2	TX1/TMR6	
6	PF3	RX1/TMR7	
7	PF7	TMR2	
8	PF6	TMR3	
9	PF11	SPI_MOSI	microSD
10	PF12	SPI_MISO	microSD
11	PF13	SPI_SCK	microSD
12	PJ10/PF14	SPI_SEL	microSD
13	PJ11	SPI_SEL2	
14	PJ2	I2C SCL	I2C
15	PJ3	I2C SDA	I2C
16		GND	GND

S-32 pin	Blackfin pin	Blackfin Name	Board usage
17	PH0	GPIO-H0	
18	PH1	GPIO-H1	
19	PH2	GPIO-H2	
20	PH3	GPIO-H3	
21	PH4	GPIO-H4	
22	PH5	GPIO-H5	
23	PH6	GPIO-H6	
24	PH7	GPIO-H7	
25	PH8	GPIO-H8	direct in
26	PH9	GPIO-H9	direct in
27	PH10	GPIO-H10	direct in
28	PH11	GPIO-H11	direct in
29	PH12	GPIO-H12	direct in
30	PH13	GPIO-H13	direct in
31	PH14	GPIO-H14	direct in
32	PH15	GPIO-H15	direct in

Board layout

Top view:




12V BATTERY
POWER-1
POWER-2
LED IC POWER
3.3V - 5V i2c level shifter
I2C
SDA | +5V | GND | SCK
Mount holes
SRV1-PWR
Servo driver
SERVO GND
SERVO +5V
servo 1-10
servo 11-20
I/O extender
MCP23017SO
TTL I/O
SD20
AD converter
AD7998
5V->3.3V input shifter
ENCODER SIGNAL
74LVC245A
Surveyor S-32 bus
S-32 bus
micro SD