

# OpenROV Controller 2.7

## Digital I/O Channels

0	BB UART	28	User J3-4
1	BB UART	29	User J3-2
2	User J3-11	30	User J2-16
3	User J3-9	31	User J2-14
4	User J3-7	32	User J2-12
5	User J3-5	33	User J2-10
6	Servo1 J8-1	34	User J2-8
7	Servo2 J8-4	35	User J2-6
8	Servo3 J8-7	36	User J2-4
9	Servo4 J8-10	37	User J2-2
10	Servo5 J8-13	38	N/C
11	Servo6 J8-16	39	N/C
12	PWM4 J1-7/8	40	N/C
13	LED	41	N/C
14	User J2-11	42	N/C
15	User J2-9	43	N/C
16	ESC Power Switch	44	PWM1 J1-1/2
17	N/C	45	PWM2 J1-3/4
18	User J2-7	46	PWM3 J1-5/6
19	User J2-5	47	N/C
20	I2C SDA J1-14	48	N/C
21	I2C SCL J1-12	49	LED
22	User J3-16	50	SPI MISO to BB and ICSP Header
23	User J3-14	51	SPI MOSI to BB and ICSP Header
24	User J3-12	52	SPI SCK to BB and ICSP Header
25	User J3-10	53	SPI SS to BB
26	User J3-8		
27	User J3-6		

## Analog I/O Channels

0	Controller and BB Battery Current
1	ESC 3 Current
2	ESC 2 Current
3	ESC 1 Current
4	Battery Voltage (after protection diodes)
5	Battery 2 Current
6	Battery 1 Current
7	Humidity (optionally populated)
8	Board Temperature
9	User J4-14
10	User J4-12
11	User J4-10
12	User J4-8
13	User J4-6
14	User J4-4
15	User J4-2

## Revision History

Rev	Date	Engr	Changes
2.5	13 Aug 2013	RWH	Initial Prototype
2.5 Rev A	20 Aug 2013	RWH	Prototype Batch. Revised J6 connector orientation. Changed BB node names. Revised C11, C15, and U5 and added C34 to avoid +5V and +3.3V brownout when switching ESCs on. Revised ESC mounting holes. Revised LED colors. Revised silkscreen. Added weak Arduino reset pullup for standalone operation. Added cap slot C35 to hold vehicle on if noisy tether connection. Added bypass points J17 for ESC power switch. Arduino reset function moved from BB pin 13 to BB pin 11.
2.5 Rev B	2 Sep 2013	RWH	First production batch. J6 changed from socket to male board stacker. 4th mounting hole added to board. Revised fiducial locations. Inverted logical case of UART LEDs. BB TX LED moved from Arduino space to BB space. Board ID EEPROM circuitry DNP.
2.6	12 Nov 2013	RWH	Layout changes to accept V2.0 Tenda/MediaLink Homeplug adapter. Additional sockets added to accept V2.0 pin configuration. LEDs added to display Homeplug adapter status. Board ID circuitry modified. Servo output connector split into two. Filters added to ESC current monitors. Test points updated. Silkscreen updated.
2.7	18 Aug 2014	RWH	Revised ESC mounting pads to fit Afro 12A and 20A ESCs. New +5V switching power supply with 3A output vs. 1.6A on Controller 2.6. Resized programming resistors on power PWM outputs to handle 2A output vs 1A. Heavier traces on TP20-TP25. Revised ROV and ESC power switching. Additional +3.3V supply added to isolate homeplug adapter from +3.3V instrumentation

## Sheet Finder

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6	PWM and Environment Sensors
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8	Motor Current Sensing and ESC Connections

## OpenROV

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## Cover Page

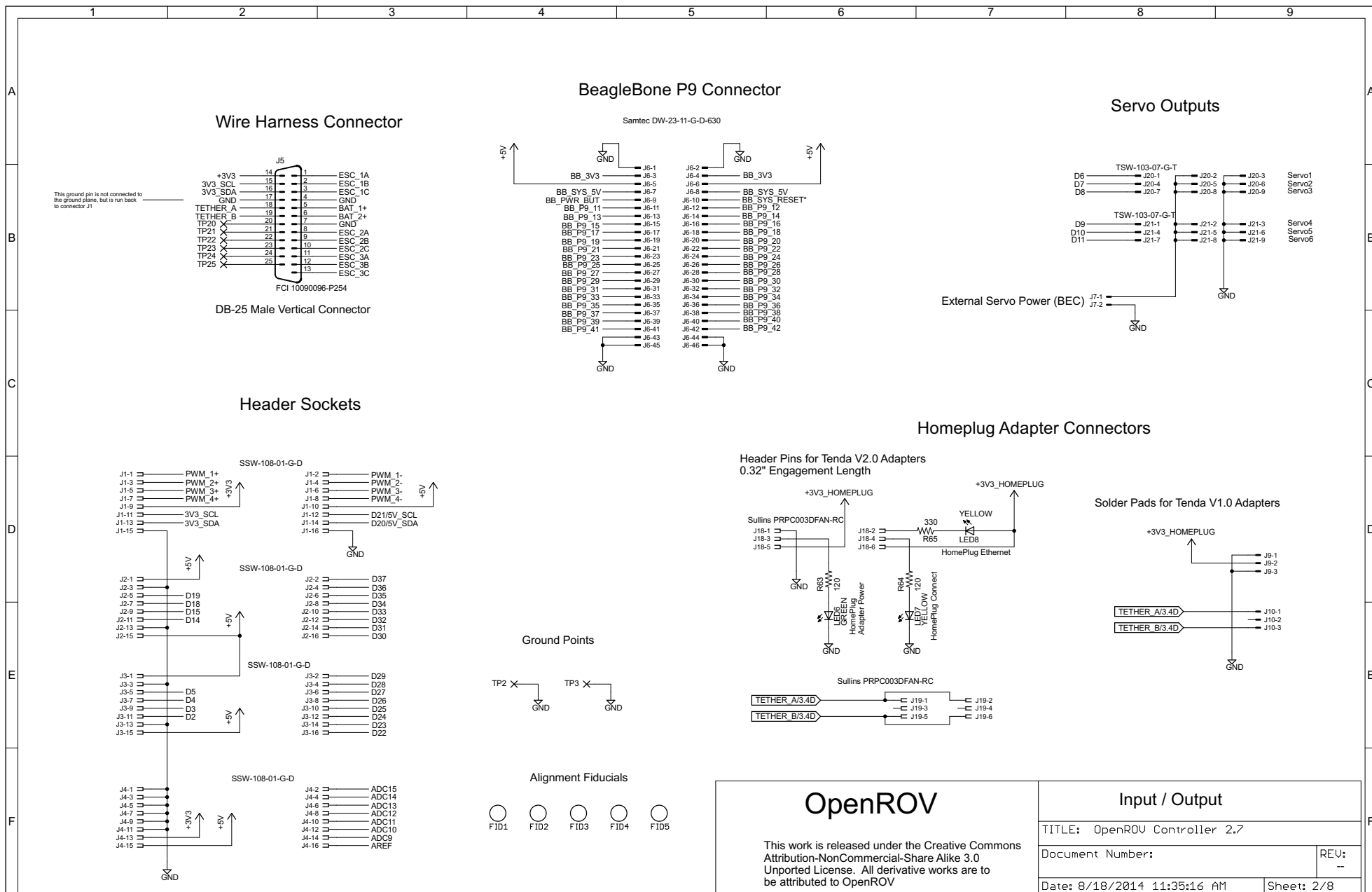
TITLE: OpenROV Controller 2.7

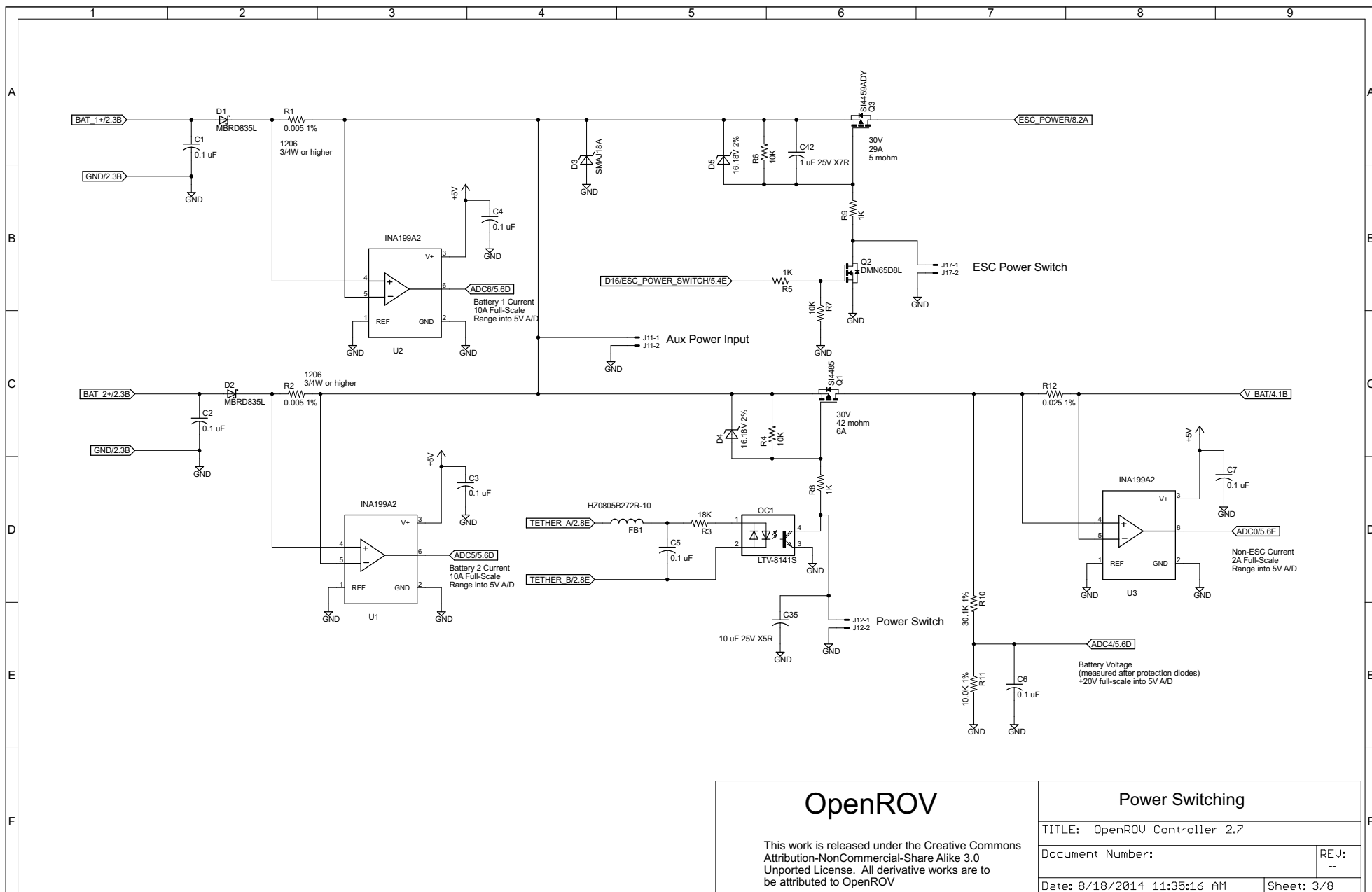
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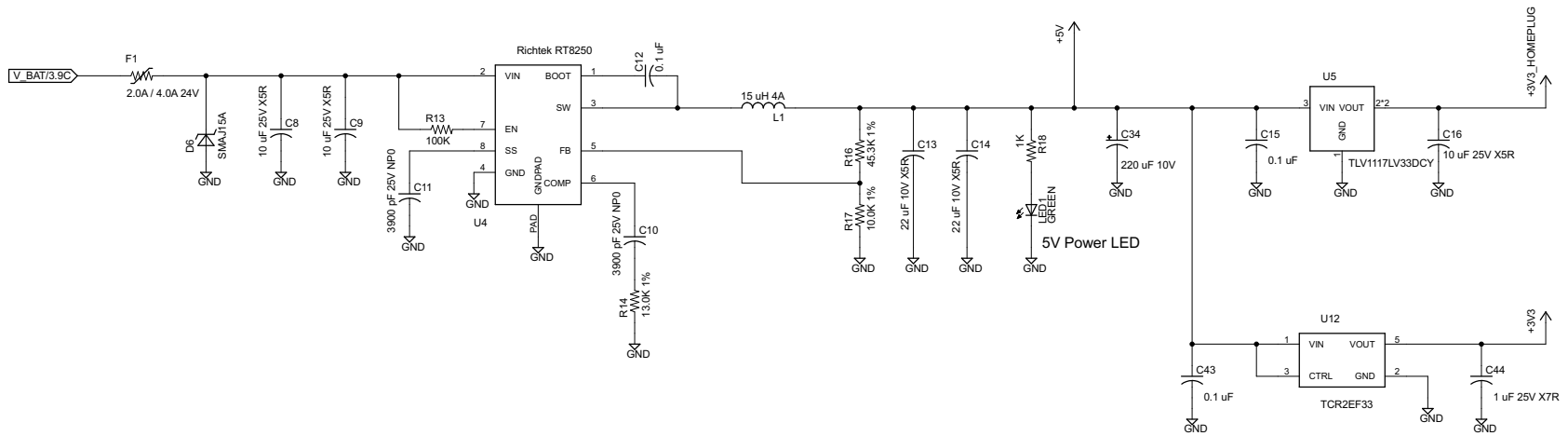
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## 5V and 3.3V Power

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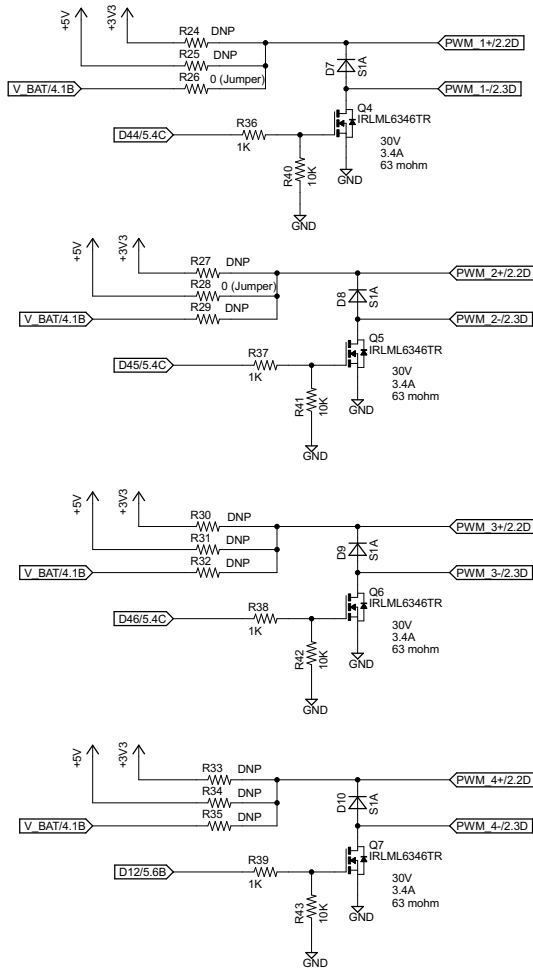
## PWM Outputs

Populate one jumper only for each PWM channel.

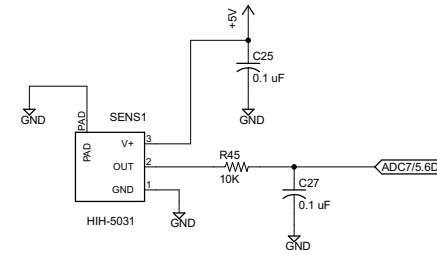
Select from maximum output of 3.3V, 5V, or battery voltage

Default configuration is Battery Voltage on Channel 1 (LED Modules), and 5V on Channel 2 (Scaling Lasers)

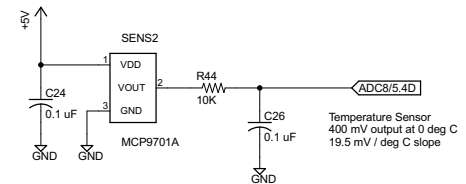
For Battery outputs, 2.0A maximum current on each PWM channel  
For +5V outputs, maximum total PWM current is 1.5A  
For +3.3V outputs, maximum total PWM current is 0.2A



## Humidity Sensor



## Temperature Sensor



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## PWM and Environment Sensors

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**BeagleBone Interface**

The BeagleBone Interface section shows the connection of the BeagleBone Black (BB) to the TXB0108SSOP-20 level shifter. The BB's VCCA and VCCB pins are connected to the TXB's VCC and GND pins, respectively. The BB's TX pin is connected to the TXB's TX pin. The BB's RX pin is connected to the TXB's RX pin. The BB's P9\_11 pin is connected to the TXB's OE pin. The BB's P9\_24, P9\_26, P9\_17, P9\_22, P9\_18, and P9\_21 pins are connected to the TXB's A1, A2, A3, A4, A5, and A6 pins, respectively. The BB's SYS\_RESET\* pin is connected to the TXB's RESET\_N pin. The TXB's TX pin is connected to the BB's TX pin. The TXB's RX pin is connected to the BB's RX pin. The TXB's OE pin is connected to the BB's P9\_11 pin. The TXB's A1, A2, A3, A4, A5, and A6 pins are connected to the BB's P9\_24, P9\_26, P9\_17, P9\_22, P9\_18, and P9\_21 pins, respectively. The TXB's RESET\_N pin is connected to the BB's SYS\_RESET\* pin. The TXB's TX pin is connected to the BB's TX pin. The TXB's RX pin is connected to the BB's RX pin. The TXB's OE pin is connected to the BB's P9\_11 pin. The TXB's A1, A2, A3, A4, A5, and A6 pins are connected to the BB's P9\_24, P9\_26, P9\_17, P9\_22, P9\_18, and P9\_21 pins, respectively. The TXB's RESET\_N pin is connected to the BB's SYS\_RESET\* pin.

**I2C Interface**

The I2C Interface section shows the connection of the I2C bus to the DB-25 connector. The I2C bus is connected to the DB-25 connector pins D21/5V\_SCL/5.6D and D20/5V\_SDA/5.6D. The I2C bus is connected to the DB-25 connector pins +3V3, 3V3\_SCL, and 3V3\_SDA. The I2C bus is connected to the DB-25 connector pins GND. The I2C bus is connected to the DB-25 connector pins +5V, D21/5V\_SCL, D20/5V\_SDA, and GND. The I2C bus is connected to the DB-25 connector pins +3V3, 3V3\_SCL, 3V3\_SDA, and GND. The I2C bus is connected to the DB-25 connector pins GND. The I2C bus is connected to the DB-25 connector pins +5V, D21/5V\_SCL, D20/5V\_SDA, and GND. The I2C bus is connected to the DB-25 connector pins +3V3, 3V3\_SCL, 3V3\_SDA, and GND. The I2C bus is connected to the DB-25 connector pins GND.

**BeagleBone Cape ID**

The BeagleBone Cape ID section shows the connection of the BeagleBone Cape ID to the TXB0108SSOP-20 level shifter. The Cape ID's VCC pin is connected to the TXB's VCC pin. The Cape ID's GND pin is connected to the TXB's GND pin. The Cape ID's WP pin is connected to the TXB's WP pin. The Cape ID's SCL pin is connected to the TXB's SCL pin. The Cape ID's SDA pin is connected to the TXB's SDA pin. The Cape ID's VSS pin is connected to the TXB's VSS pin. The Cape ID's WP pin is connected to the TXB's WP pin. The Cape ID's SCL pin is connected to the TXB's SCL pin. The Cape ID's SDA pin is connected to the TXB's SDA pin. The Cape ID's VSS pin is connected to the TXB's VSS pin.

**ICSP Header**

The ICSP Header section shows the connection of the ICSP header to the TXB0108SSOP-20 level shifter. The ICSP header's D50/SPI\_MISO pin is connected to the TXB's D50/SPI\_MISO pin. The ICSP header's D52/SPI\_SCK pin is connected to the TXB's D52/SPI\_SCK pin. The ICSP header's RESET\_N pin is connected to the TXB's RESET\_N pin. The ICSP header's D51/SPI\_MOSI pin is connected to the TXB's D51/SPI\_MOSI pin. The ICSP header's D50/SPI\_MISO pin is connected to the TXB's D50/SPI\_MISO pin. The ICSP header's D52/SPI\_SCK pin is connected to the TXB's D52/SPI\_SCK pin. The ICSP header's RESET\_N pin is connected to the TXB's RESET\_N pin. The ICSP header's D51/SPI\_MOSI pin is connected to the TXB's D51/SPI\_MOSI pin.

**BeagleBone Interface**

BB TX LED

U7

TXB0108SSOP-20

BB\_P9\_24, BB\_P9\_26, BB\_P9\_17, BB\_P9\_22, BB\_P9\_18, BB\_P9\_21

BB\_3V3, BB\_P9\_11, BB\_SYS\_RESET\*

R46, R47, R48, R62, R21, R20

C28, C30

BB\_P9\_24, BB\_P9\_26, BB\_P9\_17, BB\_P9\_22, BB\_P9\_18, BB\_P9\_21

A1, A2, A3, A4, A5, A6, A7, A8, A9, A10, A11, A12, A13, A14, A15, A16, A17, A18, A19, A20

B1, B2, B3, B4, B5, B6, B7, B8, B9, B10, B11, B12, B13, B14, B15, B16, B17, B18, B19, B20

D0/UART\_RX, D1/UART\_TX, D2/SPI\_SS, D3/SPI\_SCK, D4/SPI\_MOSI, D5/SPI\_MISO, D6/RESET\_N

OE, GND

**I2C Interface**

5V I2C Bus To Headers

3.3V I2C Bus To Headers

To DB-25 Connector

These wires are run on surface traces, that can be cut if it is desired to repurpose the DB-25 pins. This ground pin is tied to the ground plane at the J1 connector, not at the DB-25 connector

**BeagleBone Cape ID**

CAT24C256W1-G

BB\_3V3/2.5B

BB\_P9\_19/2.4B, BB\_P9\_20/2.5B

R51, R52, R53, R54, R55, R56, R57, R58, R59, R60, R61, R62, R63, R64, R65, R66, R67, R68, R69, R70, R71, R72, R73, R74, R75, R76, R77, R78, R79, R80, R81, R82, R83, R84, R85, R86, R87, R88, R89, R90, R91, R92, R93, R94, R95, R96, R97, R98, R99, R100

C29

**ICSP Header**

J13

D50/SPI\_MISO, D52/SPI\_SCK, RESET\_N, D51/SPI\_MOSI

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**I2C and BeagleBone Interface**

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**BeagleBone Interface**

BB TX LED

U7

TXB0108SSOP-20

BB\_P9\_24, BB\_P9\_26, BB\_P9\_17, BB\_P9\_22, BB\_P9\_18, BB\_P9\_21

BB\_3V3, BB\_P9\_11, BB\_SYS\_RESET\*

R46, R47, R48, R62, R21, R20

C28, C30

BB\_P9\_24, BB\_P9\_26, BB\_P9\_17, BB\_P9\_22, BB\_P9\_18, BB\_P9\_21

A1, A2, A3, A4, A5, A6, A7, A8, A9, A10, A11, A12, A13, A14, A15, A16, A17, A18, A19, A20

B1, B2, B3, B4, B5, B6, B7, B8, B9, B10, B11, B12, B13, B14, B15, B16, B17, B18, B19, B20

D0/UART\_RX, D1/UART\_TX, D2/SPI\_SS, D3/SPI\_SCK, D4/SPI\_MOSI, D5/SPI\_MISO, D6/RESET\_N

OE, GND

**I2C Interface**

5V I2C Bus To Headers

3.3V I2C Bus To Headers

To DB-25 Connector

These wires are run on surface traces, that can be cut if it is desired to repurpose the DB-25 pins. This ground pin is tied to the ground plane at the J1 connector, not at the DB-25 connector

**BeagleBone Cape ID**

CAT24C256W1-G

BB\_3V3/2.5B

BB\_P9\_19/2.4B, BB\_P9\_20/2.5B

R51, R52, R53, R54, R55, R56, R57, R58, R59, R60, R61, R62, R63, R64, R65, R66, R67, R68, R69, R70, R71, R72, R73, R74, R75, R76, R77, R78, R79, R80, R81, R82, R83, R84, R85, R86, R87, R88, R89, R90, R91, R92, R93, R94, R95, R96, R97, R98, R99, R100

C29

**ICSP Header**

J13

D50/SPI\_MISO, D52/SPI\_SCK, RESET\_N, D51/SPI\_MOSI

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**I2C and BeagleBone Interface**

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**BeagleBone Interface**

BB TX LED

U7

TXB0108SSOP-20

BB\_P9\_24, BB\_P9\_26, BB\_P9\_17, BB\_P9\_22, BB\_P9\_18, BB\_P9\_21

BB\_3V3, BB\_P9\_11, BB\_SYS\_RESET\*

R46, R47, R48, R62, R63, R64, R65, R66, R67, R68, R69, R70, R71, R72, R73, R74, R75, R76, R77, R78, R79, R80, R81, R82, R83, R84, R85, R86, R87, R88, R89, R90, R91, R92, R93, R94, R95, R96, R97, R98, R99, R100

C28, C29, C30

0 (Jumper)

**I2C Interface**

5V I2C Bus To Headers

3.3V I2C Bus To Headers

To DB-25 Connector

D21/5V\_SCL/5.6D, D20/5V\_SDA/5.6D

+5V, +3V3, GND

FDV301N

Q8, Q9

R55, R56, R57, R58, R59, R60, R61, R62, R63, R64, R65, R66, R67, R68, R69, R70, R71, R72, R73, R74, R75, R76, R77, R78, R79, R80, R81, R82, R83, R84, R85, R86, R87, R88, R89, R90, R91, R92, R93, R94, R95, R96, R97, R98, R99, R100

C28, C29, C30

0 (Jumper)

**BeagleBone Cape ID**

BB\_3V3/2.5B

U8

CAT24C256W1-G

A0, A1, A2, VSS

VCC, WP, SCL, SDA

R51, R52, R53, R54, R55, R56, R57, R58, R59, R60, R61, R62, R63, R64, R65, R66, R67, R68, R69, R70, R71, R72, R73, R74, R75, R76, R77, R78, R79, R80, R81, R82, R83, R84, R85, R86, R87, R88, R89, R90, R91, R92, R93, R94, R95, R96, R97, R98, R99, R100

C29

0 (Jumper)

**ICSP Header**

J13

D50/SPI\_MISO, D52/SPI\_SCK, RESET\_N

D51/SPI\_MOSI

+5V, GND

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**I2C and BeagleBone Interface**

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**BeagleBone Interface**

BB TX LED

BB\_P9\_24, BB\_P9\_26, BB\_P9\_17, BB\_P9\_22, BB\_P9\_18, BB\_P9\_21, BB\_P9\_11, BB\_SYS\_RESET\*

TXB0108SSOP-20

**I2C Interface**

D21/5V\_SCL/5.6D, D20/5V\_SDA/5.6D

BB\_P9\_19/2.4B, BB\_P9\_20/2.5B

**BeagleBone Cape ID**

BB\_3V3/2.5B

CAT24C256W1-G

**ICSP Header**

J13

D50/SPI\_MISO, D52/SPI\_SCK, RESET\_N

D51/SPI\_MOSI

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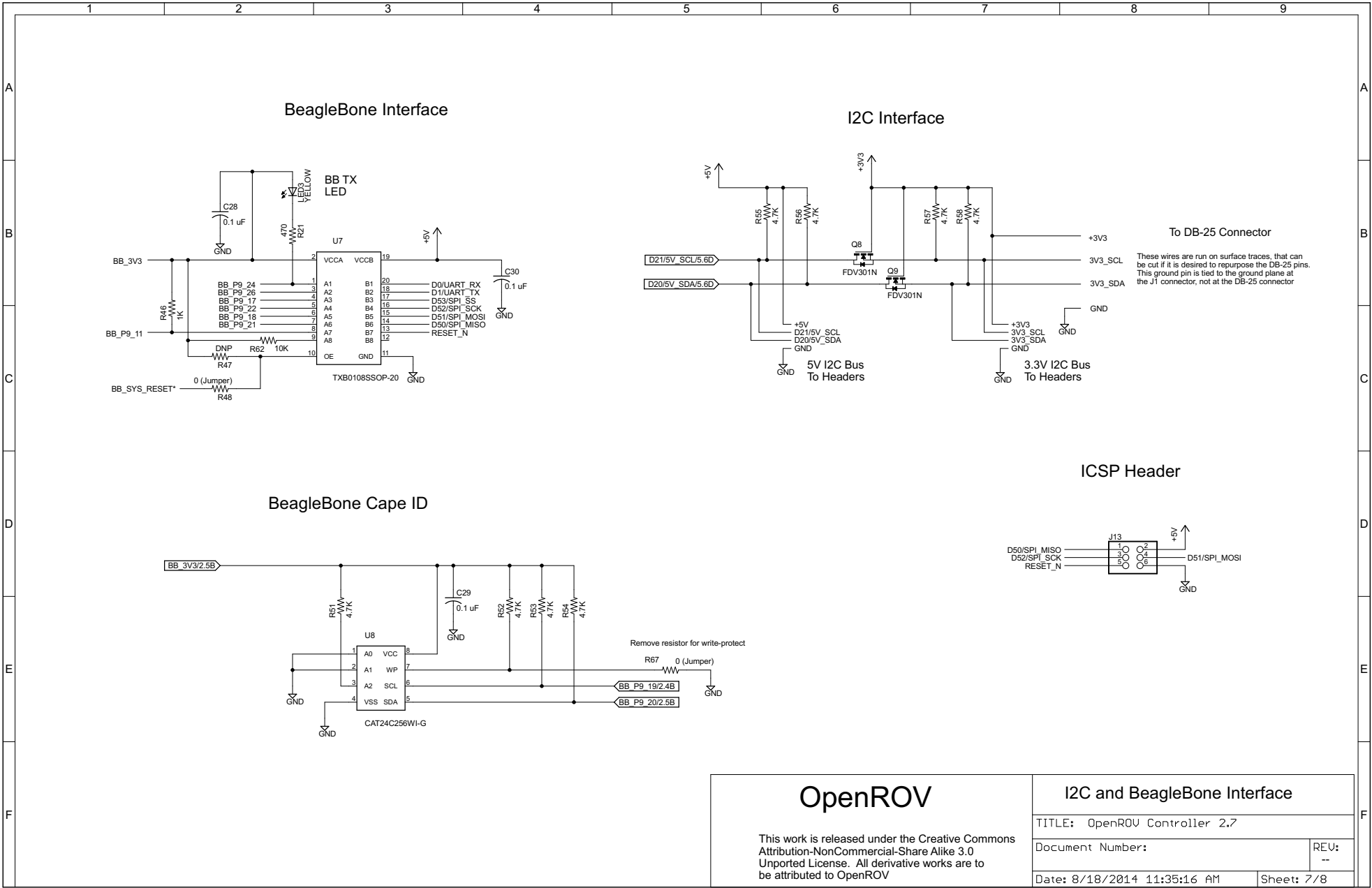
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**I2C and BeagleBone Interface**

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**BeagleBone Interface**

BB TX LED

BB\_P9\_24, BB\_P9\_26, BB\_P9\_17, BB\_P9\_22, BB\_P9\_18, BB\_P9\_21, BB\_P9\_11, BB\_SYS\_RESET\*

TXB0108SSOP-20

**I2C Interface**

D21/5V\_SCL/5.6D, D20/5V\_SDA/5.6D

BB\_P9\_19/2.4B, BB\_P9\_20/2.5B

**BeagleBone Cape ID**

BB\_3V3/2.5B

CAT24C256W1-G

**ICSP Header**

J13

D50/SPI\_MISO, D52/SPI\_SCK, RESET\_N

D51/SPI\_MOSI

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**BeagleBone Interface**

BB TX LED

U7

TXB0108SSOP-20

BB\_3V3

BB\_P9\_11

BB\_P9\_24

BB\_P9\_26

BB\_P9\_17

BB\_P9\_22

BB\_P9\_18

BB\_P9\_21

R46 1K

R62 10K

R47 DNP

R48 0 (Jumper)

BB\_SYS\_RESET\*

C28 0.1 uF

R21 470

LED3 YELLOW

VCCA

VCCB

A1

A2

A3

A4

A5

A6

A7

A8

B1

B2

B3

B4

B5

B6

B7

B8

D0/UART\_RX

D1/UART\_TX

D53/SPI\_SS

D52/SPI\_SCK

D51/SPI\_MOSI

D50/SPI\_MISO

RESET\_N

OE

GND

C30 0.1 uF

+5V

**I2C Interface**

+5V

+3V3

D21/5V\_SCL/5.6D

D20/5V\_SDA/5.6D

R55 4.7K

R56 4.7K

R57 4.7K

R58 4.7K

Q8 FDV301N

Q9 FDV301N

+5V

D21/5V\_SCL

D20/5V\_SDA

GND

5V I2C Bus To Headers

+3V3

3V3\_SCL

3V3\_SDA

GND

3.3V I2C Bus To Headers

To DB-25 Connector

These wires are run on surface traces, that can be cut if it is desired to repurpose the DB-25 pins. This ground pin is tied to the ground plane at the J1 connector, not at the DB-25 connector

**BeagleBone Cape ID**

BB\_3V3/2.5B

R51 4.7K

C29 0.1 uF

R52 4.7K

R53 4.7K

R54 4.7K

U8

CAT24C256W1-G

A0 VCC

A1 WP

A2 SCL

VSS SDA

Remove resistor for write-protect

R67 0 (Jumper)

BB\_P9\_19/2.4B

BB\_P9\_20/2.5B

**ICSP Header**

J13

D50/SPI\_MISO

D52/SPI\_SCK

RESET\_N

D51/SPI\_MOSI

+5V

GND

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**I2C and BeagleBone Interface**

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**BeagleBone Interface**

BB TX LED

BB\_P9\_24, BB\_P9\_26, BB\_P9\_17, BB\_P9\_22, BB\_P9\_18, BB\_P9\_21, BB\_P9\_11, BB\_SYS\_RESET\*

TXB0108SSOP-20

**I2C Interface**

D21/5V\_SCL/5.6D, D20/5V\_SDA/5.6D

BB\_P9\_19/2.4B, BB\_P9\_20/2.5B

**BeagleBone Cape ID**

BB\_3V3/2.5B

CAT24C256W1-G

**ICSP Header**

D50/SPI\_MISO, D52/SPI\_SCK, RESET\_N

J13

D51/SPI\_MOSI

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**I2C and BeagleBone Interface**

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**BeagleBone Interface**

BB TX LED

U7

TXB0108SSOP-20

BB\_P9\_24, BB\_P9\_26, BB\_P9\_17, BB\_P9\_22, BB\_P9\_18, BB\_P9\_21

BB\_3V3, BB\_P9\_11, BB\_SYS\_RESET\*

R46, R47, R48, R62, R21, R22, R23, R24, R25, R26, R27, R28, R29, R30, R31, R32, R33, R34, R35, R36, R37, R38, R39, R40, R41, R42, R43, R44, R45, R46, R47, R48, R49, R50, R51, R52, R53, R54, R55, R56, R57, R58, R59, R60, R61, R62, R63, R64, R65, R66, R67, R68, R69, R70, R71, R72, R73, R74, R75, R76, R77, R78, R79, R80, R81, R82, R83, R84, R85, R86, R87, R88, R89, R90, R91, R92, R93, R94, R95, R96, R97, R98, R99, R100

C28, C29, C30

BB\_P9\_19/2.4B, BB\_P9\_20/2.5B

**I2C Interface**

5V I2C Bus To Headers

3.3V I2C Bus To Headers

To DB-25 Connector

D21/5V\_SCL/5.6D, D20/5V\_SDA/5.6D

Q8, Q9

FDCV301N

BB\_P9\_19/2.4B, BB\_P9\_20/2.5B

**BeagleBone Cape ID**

CAT24C256W1-G

U8

BB\_P9\_19/2.4B, BB\_P9\_20/2.5B

R51, R52, R53, R54, R55, R56, R57, R58, R59, R60, R61, R62, R63, R64, R65, R66, R67, R68, R69, R70, R71, R72, R73, R74, R75, R76, R77, R78, R79, R80, R81, R82, R83, R84, R85, R86, R87, R88, R89, R90, R91, R92, R93, R94, R95, R96, R97, R98, R99, R100

C29

**ICSP Header**

J13

D50/SPI\_MISO, D52/SPI\_SCK, RESET\_N

D51/SPI\_MOSI

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**I2C and BeagleBone Interface**

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**BeagleBone Interface**

BB TX LED

BB\_P9\_24, BB\_P9\_26, BB\_P9\_17, BB\_P9\_22, BB\_P9\_18, BB\_P9\_21, BB\_P9\_11, BB\_SYS\_RESET\*

TXB0108SSOP-20

**I2C Interface**

D21/5V\_SCL/5.6D, D20/5V\_SDA/5.6D

BB\_P9\_19/2.4B, BB\_P9\_20/2.5B

**BeagleBone Cape ID**

BB\_P9\_19/2.4B, BB\_P9\_20/2.5B

**ICSP Header**

J13

D50/SPI\_MISO, D52/SPI\_SCK, RESET\_N, D51/SPI\_MOSI

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