Primary System Power Channel
Group1

Pack 1
Nominal
28V to 14V

J1
TE/0.156/3x1
3 GND
2 PACK1-IN
1 GND

Pack ORing diodes
380mV@2A, 465mV@10A
-30uA@-30V at 25C

D1, D3
SBR10U45SP5-13/PowerDI5

Battery Disconnect
With Turn-On Delay
4.5V full disconnect
6V full connect

R57
4.02M/0603

C1
6.8uF/50V/1206

D2
BZT52C10-7-F/SOD-123

Q1
SUM110P04-05/D2Pak
5mOhm Rds(on)

R2
2M/0603

D4
SMBJ28A/SMB
Leakage
1uA max
at 28V

C12
10000uF/35V/22Dx50L

Cap discharge

V-CAP-SYS
TP1
V-CAP-SYS

J2
Molex/0.1/2x1

R1
1k/2010

R55
1k/2010

D5
LTST-C150AKT/1206

C2
4.7uF/50V/1206

Switching power supply 3.3V, 500mA
Group3

12uA Quiescent current
Efficiency:
81% at 1mA, 87mA at 10mA,
88% at 100mA; 87% a500mA

U1
LTC3630/MSE16
VIN
RUN
FBO
GND8
GND14
GND16
GND17
SW
VFB
ISET
SS
VPRG1
VPRG2

L1 68uH/12.5x12.5
SW-L

C9
220pF/0805

R3
220k/0603

+3.3CONVERTER

C13 100uF/10V/1206
C14 100uF/10V/1206
C7 100uF/10V/1206
C10 100uF/10V/1206
C5 100uF/10V/1206

3.3V Digital
Group4

TP2
+3.3V/RED
+3.3V

L2
125ohm/8A/1812
10mOhm max

C15 100uF/10V/1206
C8 10uF/25V/1206
C6 1.0uF/0805
C3 0.1uF/0805

GND
TP4
GND/Black

3.3V Digital Quiet
Group5

TP3
+3.3VDQ/RED
+3.3VDQ

L3
120ohm/200mA/0805
190 mOhm max

L4
1000uH/85mA/2220
12 Ohm max

C4 1.0uF/0805
C11 100uF/10V/1206
C16 10uF/25V/1206

L5
120ohm/200mA/0805
190 mOhm max

TP5
AGND/Black
AGND

Modem Power Channel
Group2

Pack 2
Nominal
28V to 14V

J3
TE/0.156/3x1
3 GND
2 PACK2-IN
1 GND

Pack ORing diodes
380mV@2A, 465mV@10A
-30uA@-30V at 25C

D6, D9
SBR10U45SP5-13/PowerDI5

Battery Disconnect
With Turn-On Delay
4.5V full disconnect
6V full connect

R58
4.02M/0603

C17
6.8uF/50V/1206

D7
BZT52C10-7-F/SOD-123

Q2
SUM110P04-05/D2Pak
5mOhm Rds(on)

R12
2M/0603

D10
SMBJ28A/SMB
Leakage
1uA max
at 28V

C21
10000uF/35V/22Dx50L

Cap discharge

V-CAP-MODEM
TP6
V-CAP-MODEM

J4
Molex/0.1/2x1

R8
1k/2010

R56
1k/2010

D11
LTST-C150AKT/1206

D8
BZT52C10-7-F/SOD-123

R4
2M/0603

R7 1M/0603

Q3
SUM110P04-05/D2Pak
5mOhm Rds(on)

R14
1M/0603

Q4
BSS138-7-F/SOT-23

Modem Power
J5
TE/0.156/2x1
2:PWR
1:GND

TP18
GND/Black

MODEM-ENBL
R15 1k/0603

Power Enable Modem
Group6

Modem-Min Voltage Tracker
Time constantants: 20ms down, 40s up,
130us LPF;
Voltage divider 2180/180 = 12.11
Full scale 30V/ 12.11 = 2.47V

Group7

+3.3VDQ

U3
LT6003/TSOT23-5
R5 2M/0603
R10 180k/0603
C20 68pF/0805

R9 2M/0603
R11 1k/0603
D12 BAT43W/SOD-123
R59 180k/0603
C19 33uF/6.3V/1206

U20
LT6003/TSOT23-5
R54 1k/0603

V-MODEM-MIN

System Voltage Monitor
with 100ms LPF

Group8

C18
0.1uF/0805

U2
LT6003/TSOT23-5
R6 2M/0603
C22 0.047uF/0805
R13 180k/0603

AGND
V-SYS

J12
TE/0.1/3x1
Power Test
3: PACK1
2: GND
1: PACK2

MH1 MTHOLE0.129
MH2 MTHOLE0.129
MH3 MTHOLE0.129
MH4 MTHOLE0.129
MH5 MTHOLE0.129
MH6 MTHOLE0.129

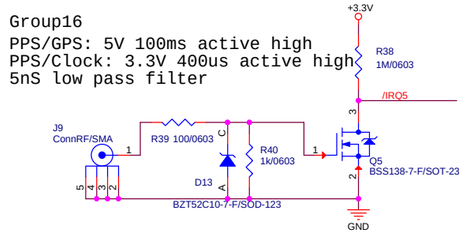
MOB1 to MOB2 revision:
R55: 1k/2010 added
R56: 1k/2010 added
R57: 4.02M/0603 added
R58: 4.02M/0603 added
R59: 180k/0603 added
J12: Molex C-grid 3x1 added

Rev0(01/24/2013): Initial Release
Rev1(05/07/2013): C1,C17(2.2uF to 6.8uF+4M), R2,R12(1M to 2M), R55,R56(1k, added), L3(1k to 120ohm), L5(600ohm to 120ohm), C11(10uF to 100uF), C19(10uF to 33uF), cont. Page2

Monterey Bay Aquarium Research Institute 7700 Sandholdt Rd, Moss landing CA 95076			
Engineer Klimov 831-775-1914	Page Title **BEDS Mother Board/ Power**		Project: 901006
Size B	Doc. or Part Number <Doc>	File Name (auto) *10020895-MOB3*	Rev 0
Page Modify Date (auto): Design Modify Date (auto):	*Friday, February 16, 2018* *Friday, February 16, 2018*	Sheet: 1 of 4	
Full path (auto): *U:\ORCAD PROJECTS\BEDS\10020895-MOB3\10020895-MOB3.DSN*			

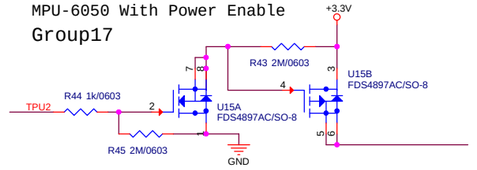
Group16

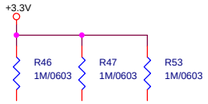
PPS/GPS: 5V 100ms active high
PPS/Clock: 3.3V 400us active high
5nS low pass filter



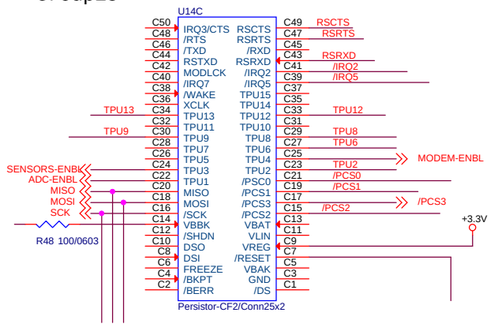
MPU-6050 With Power Enable

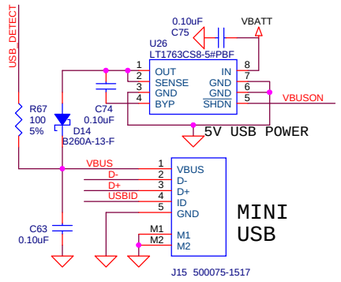
Group17

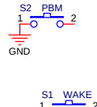


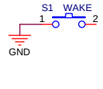


Group15 Persistor Board









MOB1 to MOB2 revision:
J11: BU2032-1-ND-G added
R60: 100/0603 added
J13: TE 0.1/3x1 added
J14, R61,R62,R63,R64,R65,U21 added

Rev2 (cont. from Page2): Install J11 (BU2032) instean of J10 (Keystone/3003)

ADC-ENBL
TXD2
/PCS4
TXD3

Title: <Title>		
Size: C	Document Number: <Doc>	Rev: <RevCode>
Date: Friday, February 16, 2018	Sheet 1 of 1	

+5 Analog with Sensor Power Enable

Group9

Reference 5V / 2= 2.5V
Low-pass filter 5ms

Group10

External 3-wire Pressure Sensor Interface
0-70 BAR ABsolute, Ratiometric, 0.5-4.5V Output
Power 5V, 3mA. Output resistance 100 Ohm
US331-000004-070BA

Group11

~560mV @ 1 BAR nominal

Internal 3-wire Pressure Sensor Interface
100PSI Absolute, Ratiometric, 0.5-4.5V Output
Power 5V, 2.5mA, 5k minimum load

Group12

Low-pass filter 5ms

~1.100V @ 15 PSIA nominal

V-CAP-SYS
L6
120ohm/200mA/0805
190 mOhm max
L7
100uH/250mA/2220
1.6 Ohm max
U4 LT3010/8-MSOP
IN OUT /SHDN Sense GND9 GND4
+5V
TP7 +5V/RED
C25 2.2uF/50V/1206
C28 2.2uF/50V/1206
C26 2.2uF/50V/1206
R18 1M/0603
R20 1k/0603
SENSORS-ENBL
AGND
R16 50k/50k/0.035%/SOT23
R1
R2
C31 0.1uF/0805
U7 LT6003/TSOT23-5
C23 0.1uF/0805
J6
MOLEX/C-GRID/4X1
R17 50k/50k/0.035%/SOT23
U5 LT6003/TSOT23-5
C24 0.1uF/0805
C29 0.1uF/0805
U6 Pressure
NC5 NC6 NC7 NC8 Vsup Vout GND NC4
ASDXACX100PAAA5/DIP-8
R66 4.99k/0603
R19 50k/50k/0.035%/SOT23
U8 LT6003/TSOT23-5
C27 0.1uF/0805
C30 0.1uF/0805
~550mV @ 15 PSIA nominal
~280mV @ 1 BAR

Group13

+3.3V Analog

Temperature Sensor
500mV + 10mV/C
+/- 0.5C Nominal
35uA

Humidity Sensor
0.5 - 2.5V Output
+/-3% Accuracy
5s 1/e Responce Time
200uA

Low-pass filters 0.1ms

Group14

8-channel ADC, single-ended config.
3.3V Digital, 2.5V Reference
1.2mA

inp leakage +/- 1uA

V-SYS TP8
Vmodem TP9
Pext TP10
Pint TP11
V-SYS
V-MODEM-MIN
PR-EXT
PR-INT
TEMP
RH
R22 4.99k/0603
R23 4.99k/0603
R24 4.99k/0603
R27 4.99k/0603
R29 4.99k/0603
R30 4.99k/0603
R32 4.99k/0603
R33 4.99k/0603
U9
CH0 CH1 CH2 CH3 CH4 CH5 CH6 CH7 COM /SHDN
Vcc1 DCLK /CS Din BUSY Dout GND1 GND2 Vcc2 Vref
ADS8344/SSOP-20
+3.3VDQ
R21 1M/0603
SCK2 /ADC-CS
MOSI2
MISO2
V-REF
R31 4.99k/0603
C32 1.0uF/0805
C35 0.1uF/0805
C42 0.1uF/0805
C51 10uF/25V/1206
R36 1M/0603
C36 1.0uF/0805
C37 1.0uF/0805
C38 1.0uF/0805
C39 1.0uF/0805
C40 1.0uF/0805
C41 1.0uF/0805
C43 1.0uF/0805
C44 1.0uF/0805
TP12 CH7
TP13 CH6
TP14 RH
TP15 TEMP
TP16 AGND/Black
ADC-ENBL
AGND
TP19 V-REF

R28 49.9k/0603
U12 LT6003/TSOT23-5
R34 100k/0603
U10 Tempr 10mV/C +500mV
VDD VOUT VSS
TC1047AVNBTR/SOT-23
R25 1k/0603
C33 330pF/0805
U11 RH%
+VE NC OUT -VE RH%
HIH-5030-001
R26 100/0603
C34 330pF/0805
R35 49.9k/0603

HIH-5030-001 calc humidity calc:
Vout=Vsup*(0.00636*RH+0.1515)
RH=(Vout/Vsup-0.1515)/0.00636

MOB1 to MOB2 revision:
C51: 10uF/25V/1206 added
TP19: V-REF added
R66: 4.99k/0603 added

Rev2 (cont. from Page1): L6(1k/200mA to 120oHm/200mA), R25(100 to 1k), C33,C34(0.1uF to 330pF), R22-R33(1k to 5k), C37-C41,C43,C44(0.1uF to 1.0uF), C42(0.1uF to 0.1uF+10uF), R31(1k to 5k), cont. to Page3

MBARI	Monterey Bay Aquarium Research Institute 7700 Sandholdt Rd, Moss landing CA 95076		
Engineer: Klimov 831-775-1914	Page Title: BEDS Mother Board/ Sensors	Project: see page 1	
Size: B	Document Number: see page 1	File Name (auto): 10020895-MOB3	Rev: see page 1
Page Modify Date (auto): Friday, February 16, 2018		Sheet: 2 of 4	
Design Modify Date (auto): Friday, February 16, 2018			
Full path (auto): U:\ORCAD PROJECTS\BEDS\10020895-MOB3\10020895-MOB3.DSN			

Test Points
J??
TEST_3 5
TEST_2 4
TEST_1 3
TEST_0 2
GND 1
MOLEX/C-GRID/5X1

Test Points
J??
TEST_7 5
TEST_6 4
TEST_5 3
TEST_4 2
GND 1
MOLEX/C-GRID/5X1

NEEDS TO BE LOW ESR

C??
10uF/16V/1206
GND

IMU_ENBL
IMU_CS
IMU_INT

+3.3V
C??
0.1uF/0805
GND

+3.3V
C??
0.1uF/0805
C??
0.1uF/0805
GND

TEST_4 TEST_3 TEST_2 TEST_1 TEST_0

PIC32MX470F512L-I/PF
U28

RG15 1
VDD 2
AN22/RPE5/PMD5/RE5 3
AN23/PMD6/RE6 4
AN27/PMD7/RE7 5
RPC1/RC1 6
RPC2/RC2 7
RPC3/RC3 8
RPC4/CTED7/RC4 9
AN16/C1IND/RPG6/SCK2/PMA5/RG6 10
AN17/C1INC/RPG7/PMA4/RG7 11
AN18/C2IND/RPG8/PMA3/RG8 12
MCLR 13
AN19/C2INC/RPG9/PMA2/RG9 14
VSS 15
VDD 16
TMS/CTED1/RA0 17
RPE8/RE8 18
RPE9/RE9 19
AN5/C1INA/RPB5/VBUSON/RB5 20
AN4/C1INB/RB4 21
PGED3/AN3/C2INA/RPB3/RB3 22
PGEC3/AN2/C2INB/RPB2/CTED13/RB2 23
PGEC1/AN1/RPB1/CTED12/RB1 24
PGED1/AN0/RPB0/RB0 25

AN21/PMD4/RE4 AN20/PMD2/RE2 TRD0/RG13 TRD1/RG12 TRD2/RG14 PMD1/RE1 PMD0/RE0 TRD3/CTED8/RA7 TRCLK/RA6 RPG0/PMD8/RG0 RPG1/PMD9/RG1 RPF1/PMD10/RF1 RPF0/PMD11/RF0 VDD VCAP PMD15/RD7 PMD14/RD6 RPD5/PMRD/RD5 RPD4/PMWR/RD4 PMD13/RD13 RPD12/PMD12/RD12 AN26/RPD3/RD3 AN25/RPD2/RD2 AN24/RPD1/RD1

VSS 75
SOSCO/RPC14/T1CK/RC14 74
SOSCI/RPC13/RC13 73
RPD0/INT0/RD0 72
RPD11/PMCS1/RD11 71
RPD10/PMCS2/RD10 70
RPD9/RD9 69
RPD8/RTCC/RD8 68
SDA1/RPA15/RA15 67
SCL1/RPA14/RA14 66
VSS 65
OSC2/CLKO/RC15 64
OSC1/CLKI/RC12 63
VDD 62
TDO/RA5 61
TDI/CTED9/RA4 60
SDA2/RA3 59
SCL2/RA2 58
D+ 57
D- 56
VUSB3V3 55
VBUS 54
RPF8/RF8 53
RPF2/RF2 52
USBID/RPF3/RF3 51

PGEC2/AN6/RPB6/RB6 PGED2/AN7/RPB7/CTED3/RB7 VREF-/CVREF-/PMA7/RA9 VREF+/CVREF+/PMA6/RA10 AVDD AVSS AN8/RPB8/CTED10/RB8 AN9/RPB9/CTED4/RB9 CVREFOUT/AN10/RPB10/CTED11/PMA13/RB10 AN11/PMA12/RB11 VSS VDD TCK/CTED2/RA1 RPF13/RF13 RPF12/RF12 AN12/PMA11/RB12 AN13/PMA10/RB13 AN14/RPB14/CTED5/PMA1/RB14 AN15/RPB15/OCFB/CTED6/PMA0/RB15 VSS VDD RPD14/RD14 RPD15/RD15 RPF4/PMA9/RF4 RPF5/PMA8/RF5

/RTC_CS
/RTC_INT
POWER_ON
MISO1
R78 47 SCLK1
R79 47 MOSI1
IMU_IO2
IMU_IO1
OSC2
OSC1
Y2
24MHz
C85 18pF
C77 18pF
GND
D+
D-
USB_DETECT
TXD0
RXD0
USBID

445C25D24M00000

+3.3V
C??
0.1uF/0805
C??
0.1uF/0805
GND

SENSORS-ENBL
MODEM-ENBL
RXD2
TXD2

+3.3V
C??
0.1uF/0805
C??
0.1uF/0805
C??
0.1uF/0805
GND

Micro SD Card

SHILED15 SHILED14 SHILED13 SHILED12 SHILED11
15 14 13 12 11
GND_10 10
SWITCH 9
D1 8
MISO 7
GND_7 6
CLK 5
VDD 4
MOSI 3
CS 2
D2 1
5031821853
J??

CARD_DET
MISO2
SCK2
MOSI2
SD_CS

+3.3V
L??
120ohm/200mA/0805
190 mOhm max
C??
0.1uF/0805
C??
10uF/16V/1206
GND

18123D106KAT2A

Serial Port Controller 0.3mA; 1uA in shutdown
Group19

+3.3V
R37 1M/0603
R41 1M/0603
R42 1M/0603
GND

U13
DIN1 13
DIN2 12
ROUT1 15
ROUT2 10
C1+ 2
C2+ 5
C2- 6
C1- 4
EN 1
PWRDOWN 20
DOUT1 17
DOUT2 8
RIN1 16
RIN2 9
V- 7
V+ 3
VCC 19
GND 18
NC11 11
NC14 14
MAX3222/20-SOIC

TXD1
TXD2
RXD1
RXD2
/SER_EN
/SER_SHDN

C45 0.1uF/0805
C46 0.1uF/0805
C47 0.1uF/0805
C48 0.1uF/0805
C49 0.1uF/0805

+3.3V
GND

Modem
J7
RxD 5
TxD 4
GND 3
2
1
MOLEX/C-GRID/5X1

Debug
J8
RSRXD 5
RSTXD 4
GND 3
2
1
MOLEX/C-GRID/5X1

S3 RESET
1 2
GND

R68 10.0K
R77 100
/MCLR
+3.3
+3.3V C67 0.10uF
GND

J18
MCLR 1
vdd 2
GND 3
PGD 4
PGC 5
PGM 6
43743-6001

PGED
PGEC

ICSP CONNECTOR
6 PIN MODULAR

MISO1
MOSI1
SCK1
/IMU_INT
/IMU_CS
/IMU_ENBL
IMU_IO1
IMU_IO2

U18A
A1 Main-SDA-X
A3 COMPASS-RDY
A5
A7
A9 GND
Main-SCL-X A2
MPU-IRQ-X A4
A6
PWR-EN-X A8
PWR A10
MPU-6050/Conn5x2/2x
GND

U18B
B1
B3
B5
B7
B9
B2
B4
B6
B8
B10
MPU-6050/Conn5x2/2x

SPI Bus RTC with Integrated Crystal and SRAM
400uA active, 120uA standby
Group18

TP17
32kHz
+3.3V
/RTC_CS
/RTC_INT
R50 1M/0603
R51 1M/0603
C50 0.1uF/0805
GND

U19
/CS 1
NC2 2
32kHz 3
VCC 4
INT/SQW 5
/RST 6
NC7 7
NC8 8
NC9 9
NC10 10
SCLK2 20
DOUT 19
SCLK1 18
DIN 17
VBAT 16
GND 15
NC14 14
NC13 13
NC12 12
NC11 11
DS3234S/20-SOIC

SCK1
MISO1
MOSI1
R52 100/0603

VBBK
R60 100/0603
TP20
VBBK
J11
BATT1
CR2032/20mm/3V
BU2032-1-HD-G
GND

Reset circuitry using Release Enable
3.3V active, 50mS low pass filter

+3.3V
R65
skip/1k/0603
J14
MOLEX/C-GRID/3X1

Reset Input
3:RELEASE SENSE
2:RELEASE ENABLE
1:GND

R63 skip/1k/0603
R62 49.9k/0603
R64 skip/1k/0603
R61 1k/0603
C52 1.0uF/0805
U21A
FDS4897AC/SO-8
FDS4897AC/SO-8
U21B
GND

ADC-ENBL
TXD2
/PCS4
TXD3
SER_EN
SER_SHDN

Monterey Bay Aquarium Research Institute 7700 Sandholdt Rd, Moss landing CA 95076		
Engineer Klimov 831-775-1914	Page Title BEDS Mother Board/ Persistor	Project: see page 1
Size B	Document Number see page 1	File Name (auto) 10020895-MOB3
		Rev see page 1
Page Modify Date (auto): Design Modify Date (auto): Full path (auto):	Friday, February 16, 2018 Friday, February 16, 2018	Sheet: 3 of 4

U:\ORCAD PROJECTS\BEDS\10020895-MOB3\10020895-MOB3.DSN

Bring-up Checklist
Fully assembled Mother Board, no Persistor Board, no MPU-6050 board. Set power supply to 12V, power up.

0. Connect jumpers to J2 and J4, verify LEDs light up, record PS current with and withoud LEDs running

1. Check voltage level and noise on 3.3V (TP2) with test load on 3.3V, 100mA (33 Ohm) and 200mA (16 Ohm)

2. Check voltage level and noise on 3.3VDQ (TP3) with 100mA (33 Ohm) test load on 3.3V power

3. Check operation of Modem_Enable with 5 Ohm 50W test load in J5 (2.3A).

4. Measure V-CAP-MODEM (TP6), voltage at J5.2, and difference between them (<50mV)

5. Check V-SYS (TP8) and V-MODEM-MIN (TP9) trackers with Modem-ENBL cycling and 5 Ohm 50W test load in J5

6. Check operation of SENSOR-ENBL and measure 5V (TP7) value and noise.

7. Check operation of TPU6 (U14.C27) and voltage on U18.A10

Sensors
8. External pressure sensor. Check voltages on J6.3, J6.2, and TP10

9. Internal Pressure sensor. Check voltages on U6.1, U6.2, TP11

10. Temperature sensor. Check voltage on U10.1 (3.3V) and TP15

11. Humidity sensor. Check voltage on U11.3 (3.3V) and TP14.

Plug test Persistor board and run AD Test.
Record values on channels:

0:

1:

2:

3:

4:

5:

Monterey Bay Aquarium Research Institute
7700 Sandholdt Rd, Moss landing CA 95076

Page Title: BEDS Mother Board / Checklist
Project: see page 1
Engineer: Klimov 831-775-1914
Size: B
Document Number: see page 1
File Name (auto): 10020895-MOB3
Rev: see page 1
Page Modify Date (auto): Friday, February 16, 2018
Design Modify Date (auto): Friday, February 16, 2018
Sheet: 4 of 4
Full path (auto): U:\ORCAD PROJECTS\BEDS\10020895-MOB3\10020895-MOB3.DSN