VC24+

VC23+

VC22+

VC21+

VC20+

VC19+

VC18+

D28 5.1V
D27 5.1V
D26 5.1V
D25 5.1V
D24 5.1V
D23 5.1V

C43 0.1 uF 50V
C44 0.1 uF 50V
C45 0.1 uF 50V
C46 0.1 uF 50V
C47 0.1 uF 50V
C48 0.1 uF 50V

1k R5
1k R4
1k R14
1k R16
1k R17
1k R18

C37 0.1 uF 50V
C38 0.1 uF 50V
C39 0.1 uF 50V
C40 0.1 uF 50V
C41 0.1 uF 50V
C42 0.1 uF 50V

IC4CELLIF
BQ76PL536

1	VC6+
3	VC5+
5	VC4+
7	VC3+
9	VC2+
11	VC1+
13	VC0

IC4BALANCEIF
BQ76PL536

2	CB6
4	CB5
6	CB4
8	CB3
10	CB2
12	CB1

IC4THERM/GPAI/GPIO
BQ76PL536

TS1+	20
TS1-	19
TS2+	61
TS2-	60
GPAI+	48
GPAI-	47
GPIO	45
AUX	31

R87 1.47k — TS7-
R86 1.82k
R89 1.47k — TS8-
R88 1.82k
4-REG50
LED5
R161 10k
R90 1.47k
Q41
VC18+

Device #4 cell interface, balancing, thermistors, GPIO

RELEASE
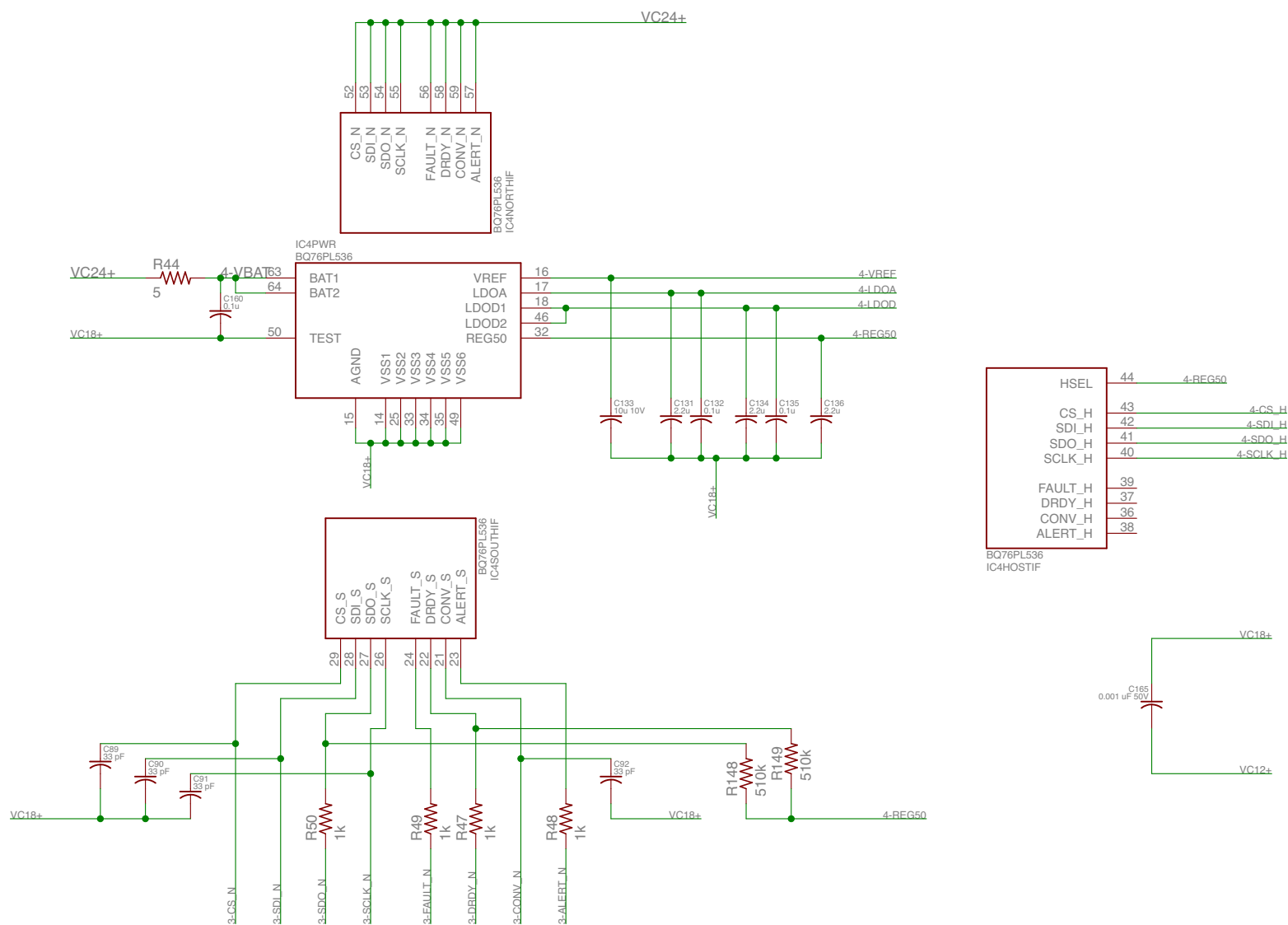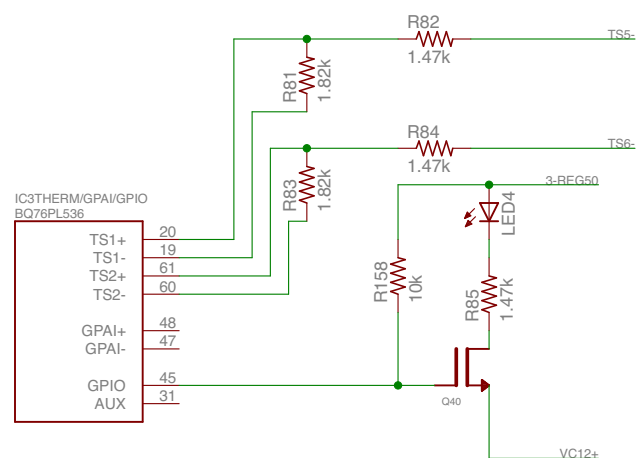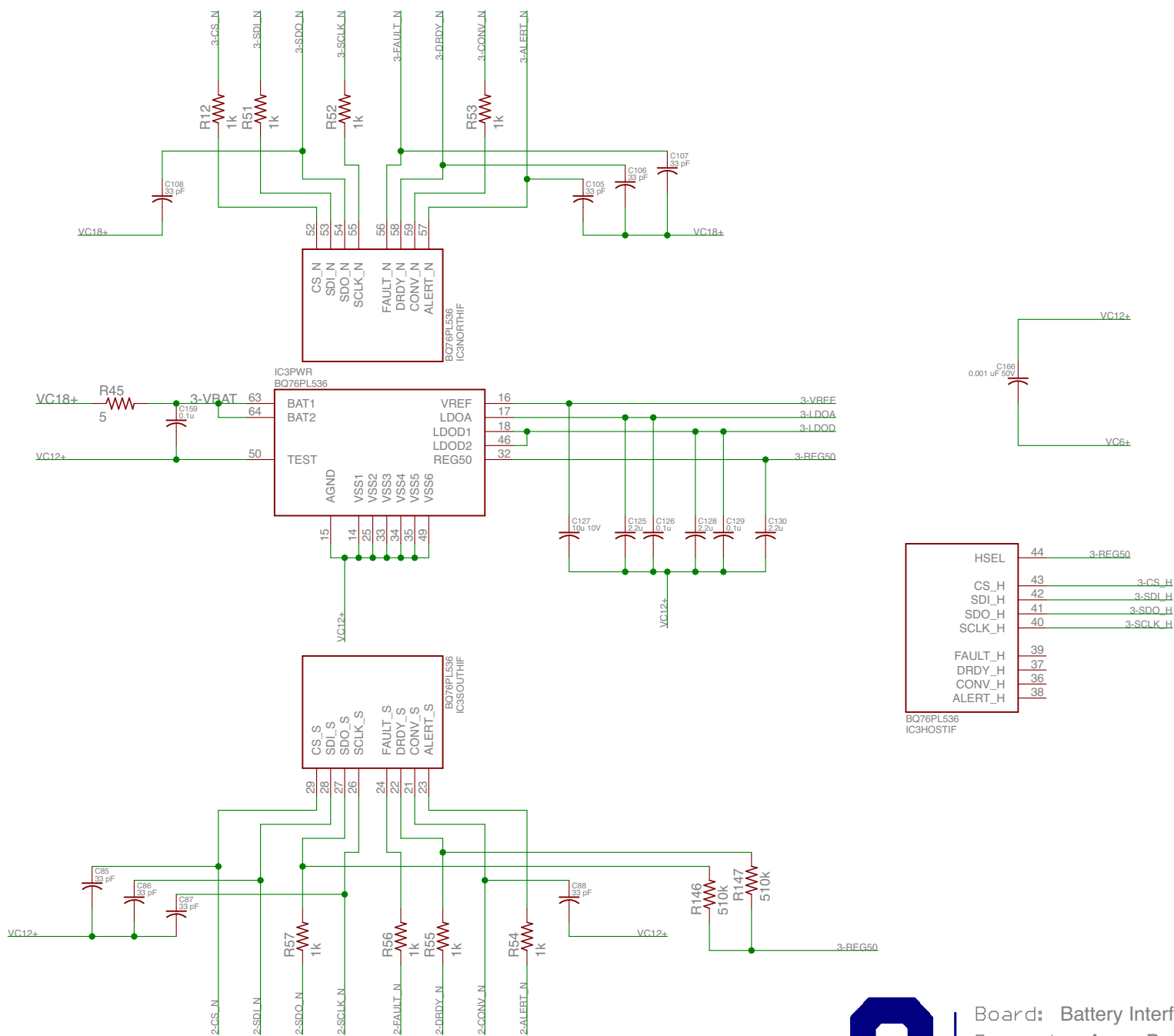
Board: Battery Interface Module
Drawn by Aaron Bonnell-Kangas
Revision date: v2.0.1 - 2015-04-01
Last modified date: 4/1/15 2:38 PM

VC24+

52 53 54 55 56 58 59 57

CS_N
SDI_N
SDO_N
SCLK_N
FAULT_N
DRDY_N
CONV_N
ALERT_N

BQ76PL536
IC4NORTHIF

IC4PWR
BQ76PL536

VC24+ — R44 — 4-VBAT 63 BAT1 — VREF 16 — 4-VREF
5 64 BAT2 — LDOA 17 — 4-LDOA
— LDOD1 18 — 4-LDOD
C160 — LDOD2 46
0.1u
VC18+ — 50 TEST — REG50 32 — 4-REG50

AGND VSS1 VSS2 VSS3 VSS4 VSS5 VSS6

15 14 25 33 34 35 49

VC18+

C133 C131 C132 C134 C135 C136
10u 10V 2.2u 0.1u 2.2u 0.1u 2.2u

VC18+

44 HSEL — 4-REG50
43 CS_H — 4-CS_H
42 SDI_H — 4-SDI_H
41 SDO_H — 4-SDO_H
40 SCLK_H — 4-SCLK_H
39 FAULT_H
37 DRDY_H
36 CONV_H
38 ALERT_H

BQ76PL536
IC4HOSTIF

BQ76PL536
IC4SOUTHIF

CS_S
SDI_S
SDO_S
SCLK_S
FAULT_S
DRDY_S
CONV_S
ALERT_S

29 28 27 26 24 22 21 23

VC18+

VC12+

C165
0.001 uF 50V

C89
33 pF
C90
33 pF
C91
33 pF

R50 R49 R47 R48
1k 1k 1k 1k

C92
33 pF

R148 R149
510k 510k

VC18+

VC18+ 4-REG50

3-CS_N
3-SDI_N
3-SDO_N
3-SCLK_N
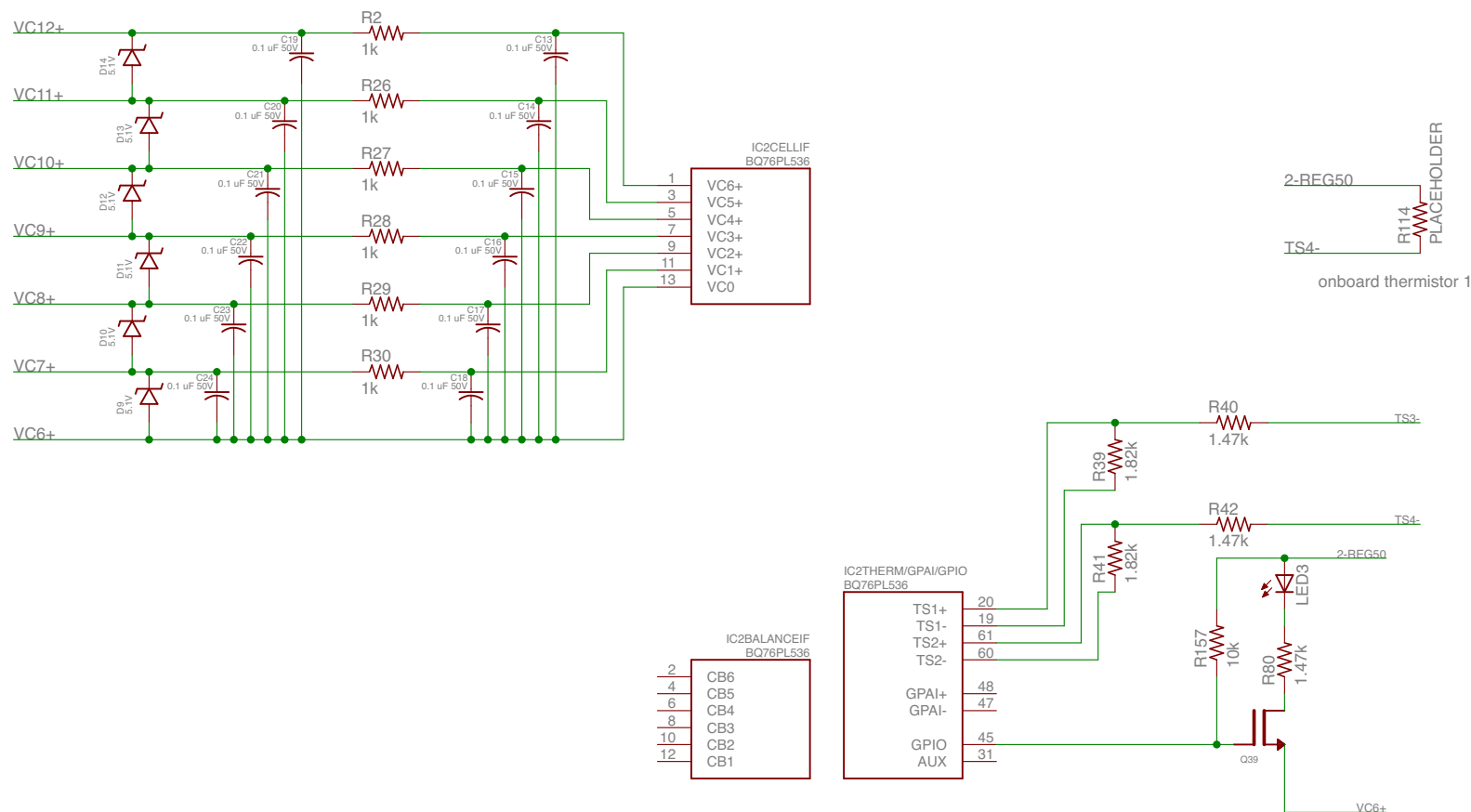3-FAULT_N
3-DRDY_N
3-CONV_N
3-ALERT_N

Device #4 stack comms + power
RELEASE
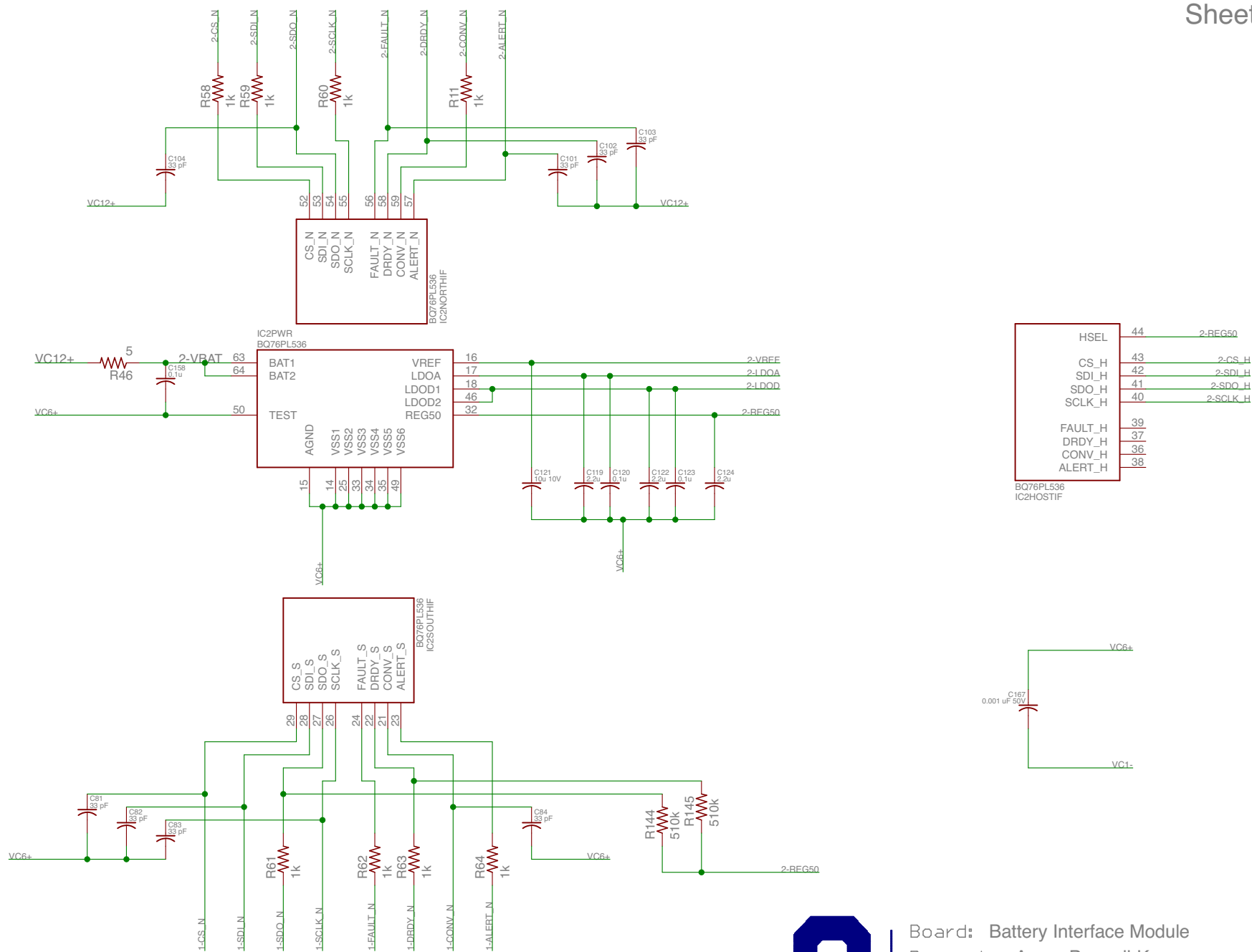
Board: Battery Interface Module
Drawn by Aaron Bonnell-Kangas
Revision date: v2.0.1 - 2015-04-01
Last modified date: 4/1/15 2:38 PM

VC18+

D22
5.1V

C31
0.1 uF 50V

R3
1k

C25
0.1 uF 50V

VC17+

D21
5.1V

C32
0.1 uF 50V

R20
1k

C26
0.1 uF 50V

VC16+

D20
5.1V

C33
0.1 uF 50V

R21
1k

C27
0.1 uF 50V

VC15+

D19
5.1V

C34
0.1 uF 50V

R22
1k

C28
0.1 uF 50V

VC14+

D16
5.1V

C35
0.1 uF 50V

R23
1k

C29
0.1 uF 50V

VC13+

D15
5.1V

C36
0.1 uF 50V

R24
1k

C30
0.1 uF 50V

VC12+

IC3CELLIF
BQ76PL536

1	VC6+
3	VC5+
5	VC4+
7	VC3+
9	VC2+
11	VC1+
13	VC0

IC3BALANCEIF
BQ76PL536

2	CB6
4	CB5
6	CB4
8	CB3
10	CB2
12	CB1

R81
1.82k

R82
1.47k

TS5-

R83
1.82k

R84
1.47k

TS6-

3-REG50

LED4

R158
10k

R85
1.47k

IC3THERM/GPAI/GPIO
BQ76PL536

TS1+	20
TS1-	19
TS2+	61
TS2-	60
GPAI+	48
GPAI-	47
GPIO	45
AUX	31

Q40

VC12+

Device #3 cell interface, balancing, thermistors, GPIO
RELEASE

3-CS_N 3-SDI_N 3-SDO_N 3-SCLK_N 3-FAULT_N 3-DRDY_N 3-CONV_N 3-ALERT_N

R12 1k R51 1k R52 1k R53 1k

C108 33 pF C107 33 pF C106 33 pF C105 33 pF

VC18+   VC18+

52 53 54 55 56 58 59 57

CS_N SDI_N SDO_N SCLK_N FAULT_N DRDY_N CONV_N ALERT_N

BQ76PL536
IC3NORTHIF

IC3PWR
BQ76PL536

VC18+ R45 5 3-VBAT 63 BAT1 VREF 16 3-VREF
C159 0.1u 64 BAT2 LDOA 17 3-LDOA
LDOD1 18 3-LDOD
VC12+ 50 TEST LDOD2 46
REG50 32 3-REG50

AGND VSS1 VSS2 VSS3 VSS4 VSS5 VSS6

15 14 25 33 34 35 49

VC12+

C127 10u 10V C125 2.2u C126 0.1u C128 2.2u C129 0.1u C130 2.2u

VC12+

VC12+ C166 0.001 uF 50V VC6+

HSEL 44 3-REG50
CS_H 43 3-CS_H
SDI_H 42 3-SDI_H
SDO_H 41 3-SDO_H
SCLK_H 40 3-SCLK_H
FAULT_H 39
DRDY_H 37
CONV_H 36
ALERT_H 38

BQ76PL536
IC3HOSTIF

BQ76PL536
IC3SOUTHIF

CS_S SDI_S SDO_S SCLK_S FAULT_S DRDY_S CONV_S ALERT_S

29 28 27 26 24 22 21 23

C85 33 pF C86 33 pF C87 33 pF C88 33 pF

VC12+

R57 1k R56 1k R55 1k R54 1k R146 510k R147 510k

VC12+

3-REG50

2-CS_N 2-SDI_N 2-SDO_N 2-SCLK_N 2-FAULT_N 2-DRDY_N 2-CONV_N 2-ALERT_N

Device #3 stack comms + power
RELEASE

VC12+

R2
1k
C19
0.1 uF 50V
C13
0.1 uF 50V
D14
5.1V

VC11+

R26
1k
C20
0.1 uF 50V
C14
0.1 uF 50V
D13
5.1V

VC10+

R27
1k
C21
0.1 uF 50V
C15
0.1 uF 50V
D12
5.1V

VC9+

R28
1k
C22
0.1 uF 50V
C16
0.1 uF 50V
D11
5.1V

VC8+

R29
1k
C23
0.1 uF 50V
C17
0.1 uF 50V
D10
5.1V

VC7+

R30
1k
C24
0.1 uF 50V
C18
0.1 uF 50V
D9
5.1V

VC6+

IC2CELLIF
BQ76PL536

1	VC6+
3	VC5+
5	VC4+
7	VC3+
9	VC2+
11	VC1+
13	VC0

2-REG50

R114

PLACEHOLDER

TS4-

onboard thermistor 1

IC2BALANCEIF
BQ76PL536

2	CB6
4	CB5
6	CB4
8	CB3
10	CB2
12	CB1

IC2THERM/GPAI/GPIO
BQ76PL536

TS1+	20
TS1-	19
TS2+	61
TS2-	60
GPAI+	48
GPAI-	47
GPIO	45
AUX	31

R39
1.82k

R40
1.47k
TS3-

R41
1.82k

R42
1.47k
TS4-

2-REG50

LED3

R157
10k

R80
1.47k

Q39

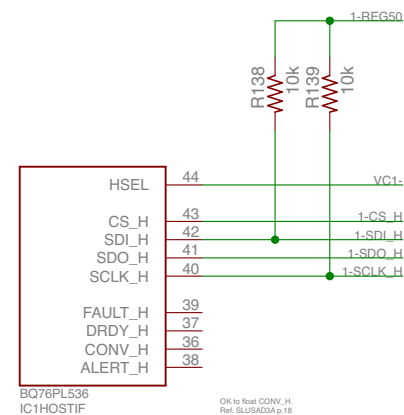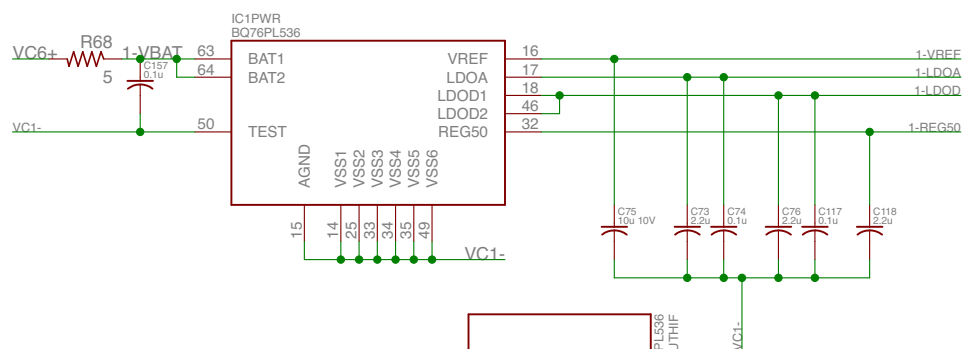VC6+

Device #2 cell interface, balancing, thermistors, GPIO
RELEASE
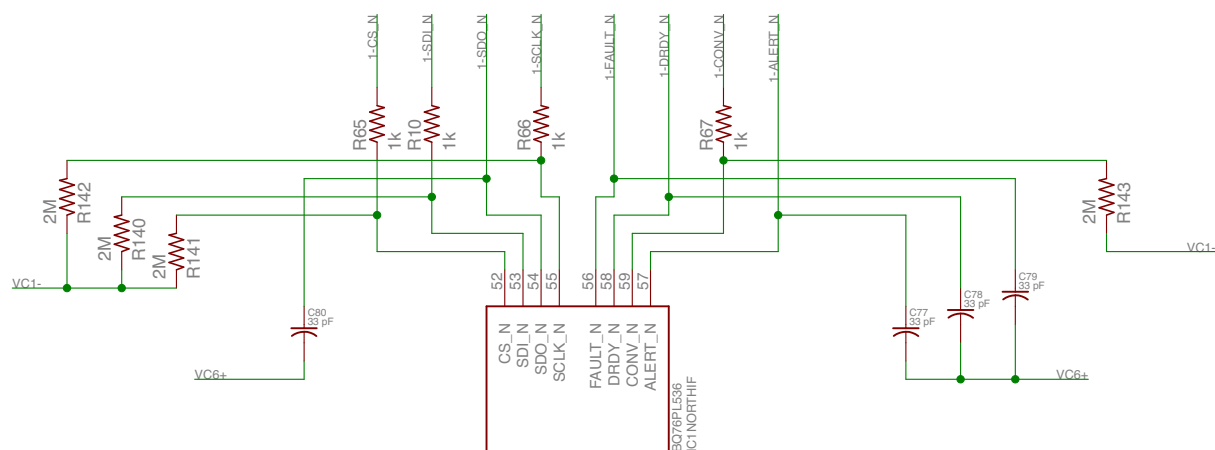
Board: Battery Interface Module
Drawn by Aaron Bonnell-Kangas
Revision date: v2.0.1 - 2015-04-01
Last modified date: 4/1/15 2:38 PM

2-CS_N
2-SDI_N
2-SDO_N
2-SCLK_N
2-FAULT_N
2-DRDY_N
2-CONV_N
2-ALERT_N

R58 1k
R59 1k
R60 1k
R11 1k

C104 33 pF
C103 33 pF
C102 33 pF
C101 33 pF

VC12+
VC12+

52 CS_N
53 SDI_N
54 SDO_N
55 SCLK_N
56 FAULT_N
58 DRDY_N
59 CONV_N
57 ALERT_N

BQ76PL536
IC2NORTHIF

IC2PWR
BQ76PL536

VC12+ 5 R46 2-VBAT 63 BAT1
C158 0.1u
64 BAT2
VC6+ 50 TEST

16 VREF 2-VREF
17 LDOA 2-LDOA
18 LDOD1
46 LDOD2 2-LDOD
32 REG50 2-REG50

AGND VSS1 VSS2 VSS3 VSS4 VSS5 VSS6
15 14 25 33 34 35 49

VC6+

C121 10u 10V
C119 2.2u
C120 0.1u
C122 2.2u
C123 0.1u
C124 2.2u

VC6+

HSEL 44 2-REG50
CS_H 43 2-CS_H
SDI_H 42 2-SDI_H
SDO_H 41 2-SDO_H
SCLK_H 40 2-SCLK_H
FAULT_H 39
DRDY_H 37
CONV_H 36
ALERT_H 38

BQ76PL536
IC2HOSTIF

BQ76PL536
IC2SOUTHIF

CS_S SDI_S SDO_S SCLK_S FAULT_S DRDY_S CONV_S ALERT_S
29 28 27 26 24 22 21 23

C81 33 pF
C82 33 pF
C83 33 pF
C84 33 pF

R61 1k
R62 1k
R63 1k
R64 1k

R144 510k
R145 510k

VC6+
VC6+

2-REG50

1-CS_N
1-SDI_N
1-SDO_N
1-SCLK_N
1-FAULT_N
1-DRDY_N
1-CONV_N
1-ALERT_N

VC6+
C167 0.001 uF 50V
VC1-

Device #2 stack comms + power
RELEASE

VC6+

R1
0.1 uF 50V
C7
C1
0.1 uF 50V
1k

D8
5.1V

VC5+

R32
0.1 uF 50V
C8
C2
0.1 uF 50V
1k

D7
5.1V

VC4+

R33
0.1 uF 50V
C9
C3
0.1 uF 50V
1k

D6
5.1V

VC3+

R34
0.1 uF 50V
C10
C4
0.1 uF 50V
1k

D5
5.1V

VC2+

R35
0.1 uF 50V
C11
C5
0.1 uF 50V
1k

D4
5.1V

VC1+

R36
0.1 uF 50V
C12
C6
0.1 uF 50V
1k

D3
5.1V

VC1-

IC1CELLIF
BQ76PL536

Pin	Signal
1	VC6+
3	VC5+
5	VC4+
7	VC3+
9	VC2+
11	VC1+
13	VC0

IC1BALANCEIF
BQ76PL536

Pin	Signal
2	CB6
4	CB5
6	CB4
8	CB3
10	CB2
12	CB1

R7
1.47k
TS1-

R6
1.82k

R9
1.47k
TS2-

R8
1.82k

1-REG50

LED1

IC1THERM/GPAI/GPIO
BQ76PL536

Pin	Signal
20	TS1+
19	TS1-
61	TS2+
60	TS2-
48	GPAI+
47	GPAI-
45	GPIO
31	AUX

R155
10k

R15
1.47k

Q37

VC1-
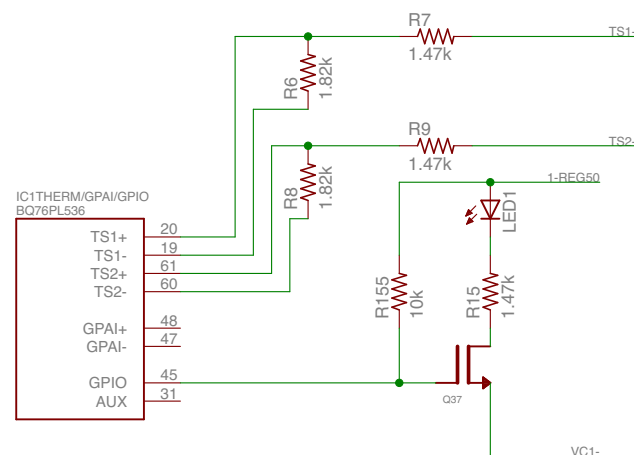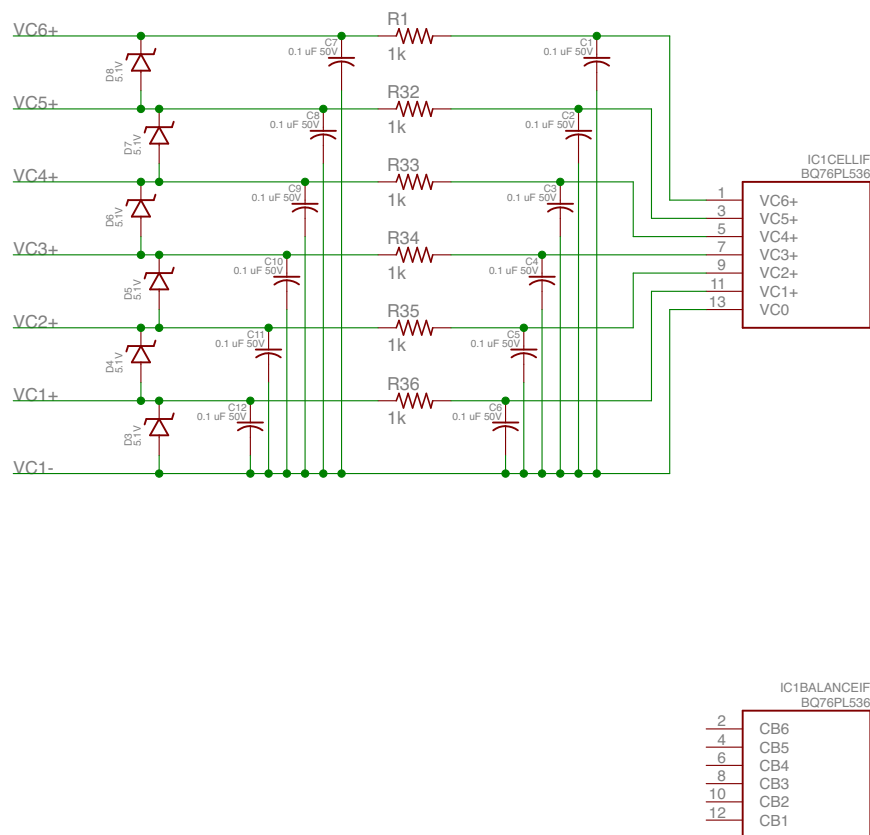
Device #1 cell interface, balancing, thermistors, GPIO
RELEASE

1-CS_N
1-SDI_N
1-SDO_N
1-SCLK_N
1-FAULT_N
1-DRDY_N
1-CONV_N
1-ALERT_N

R65 1k
R10 1k
R66 1k
R67 1k

2M R142
2M R140
2M R141
2M R143

VC1-
VC1-

C80 33 pF
C77 33 pF
C78 33 pF
C79 33 pF

VC6+
VC6+

52 53 54 55 56 58 59 57

CS_N SDI_N SDO_N SCLK_N FAULT_N DRDY_N CONV_N ALERT_N

BQ76PL536
IC1 NORTHIF

1-REG50

R138 10k
R139 10k

VC1-

1-CS_H
1-SDI_H
1-SDO_H
1-SCLK_H

44 HSEL
43 CS_H
42 SDI_H
41 SDO_H
40 SCLK_H
39 FAULT_H
37 DRDY_H
36 CONV_H
38 ALERT_H

BQ76PL536
IC1HOSTIF

OK to float CONV_H.
Ref. SLUSAD3A p.18

VC6+ R68 1-VBAT 63 BAT1
C157 0.1u 64 BAT2
5
VC1- 50 TEST

IC1PWR
BQ76PL536

16 VREF 1-VREF
17 LDOA 1-LDOA
18 LDOD1 1-LDOD
46 LDOD2
32 REG50 1-REG50

AGND VSS1 VSS2 VSS3 VSS4 VSS5 VSS6
15 14 25 33 34 35 49

VC1-

C75 10u 10V
C73 2.2u
C74 0.1u
C76 2.2u
C117 0.1u
C118 2.2u

VC1-

CS_S SDI_S SDO_S SCLK_S FAULT_S DRDY_S CONV_S ALERT_S
29 28 27 26 24 22 21 23

BQ76PL536
IC1SOUTHIF

VC1-

Device #1 stack comms + power
RELEASE

C

X2

10	20

TS8-   4-REG50
TS7-   4-REG50
TS6-   3-REG50
TS5-   3-REG50
VC21+   VC23+
VC17+   VC19+
VC13+   VC15+
VC9+   VC11+
VC5+   VC7+
VC1+   VC3+

1	11

X3

10	20

VC22+   VC24+
VC18+   VC20+
VC14+   VC16+
VC10+   VC12+
VC6+   VC8+
VC2+   VC4+
VC1-
TS3-   2-REG50
TS2-   1-REG50
TS1-   1-REG50

1	11

Cell and thermistor connectors
RELEASE

Board: Battery Interface Module
Drawn by Aaron Bonnell-Kangas
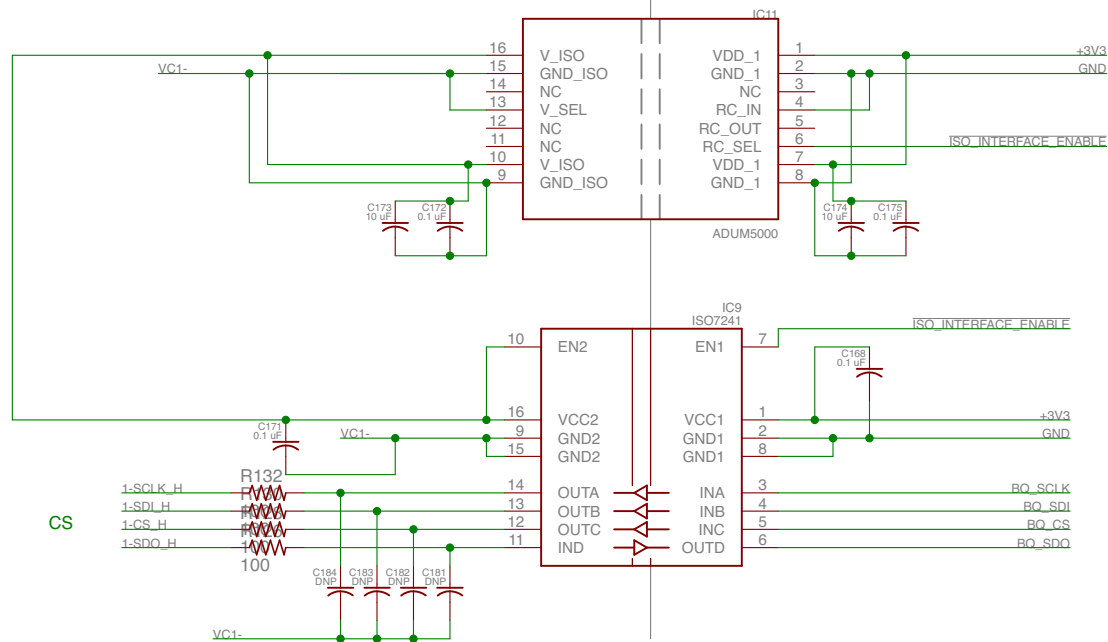Revision date: v2.0.1 - 2015-04-01
Last modified date: 4/1/15 2:38 PM

+12V

D18

+12V

C189
1 uF 25V

R136
36k

PWROUT_INT

R137
10k

GND

C192
0.1 uF

C192 value is noncritical >0.15 uF

IC15
LMR14206

5	VIN	CB	1
4	SHDN	SW	6
2	GND	FB	3

L5
18 uH

D17

R134
5.6k
1%

R135
1.02k

C190
22 uF

C191
22 uF

power loss cap

C49
100 uF

C54
100 uF

+5V

GND

OK to pop R135 w/ 1k 1% -abk

ref. WEBENCH design

+5V

IC6
LP38693MP

4	VIN	VOUT	3
1	VEN	GND	
		5	

+3V3

C52
10 uF

C53
10 uF

GND

12V - 5V, 5V-3V3 power
RELEASE

Board: Battery Interface Module
Drawn by Aaron Bonnell-Kangas
Revision date: v2.0.1 - 2015-04-01
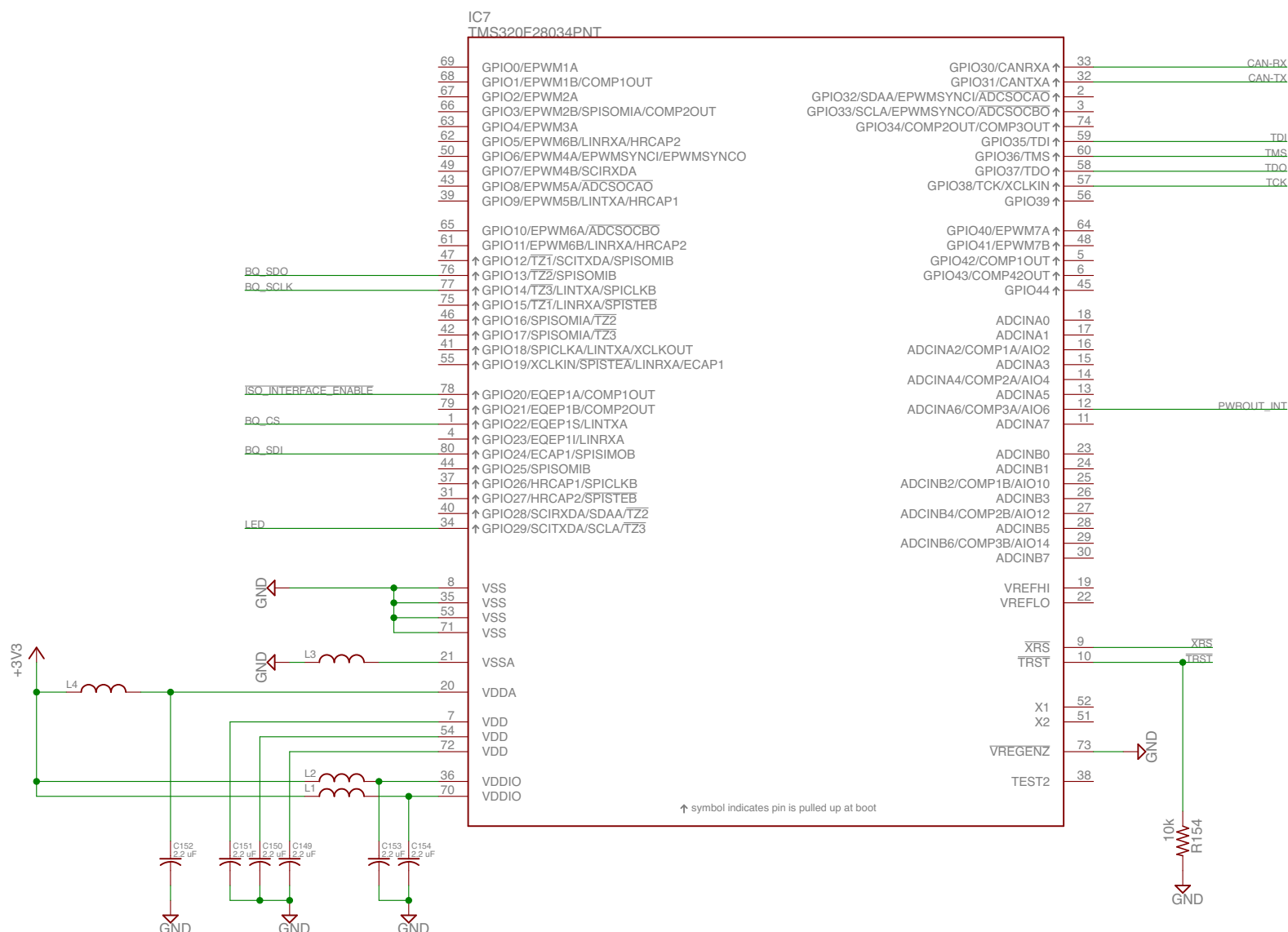Last modified date: 4/1/15 2:38 PM

Battery side   Host side

IC11

16	V_ISO	VDD_1	1	+3V3
15	GND_ISO	GND_1	2	GND
14	NC	NC	3	
13	V_SEL	RC_IN	4	
12	NC	RC_OUT	5	ISO_INTERFACE_ENABLE
11	NC	RC_SEL	6	
10	V_ISO	VDD_1	7	
9	GND_ISO	GND_1	8	

VC1-

C173
10 uF

C172
0.1 uF

C174
10 uF

C175
0.1 uF

ADUM5000

IC9
ISO7241

ISO_INTERFACE_ENABLE

10	EN2	EN1	7	
				C168 0.1 uF
16	VCC2	VCC1	1	+3V3
9	GND2	GND1	2	GND
15	GND2	GND1	8	
14	OUTA	INA	3	BQ_SCLK
13	OUTB	INB	4	BQ_SDI
12	OUTC	INC	5	BQ_CS
11	IND	OUTD	6	BQ_SDO

C171
0.1 uF

VC1-

R132

1-SCLK_H
1-SDI_H
1-CS_H
1-SDO_H

CS

100

C184
DNP

C183
DNP

C182
DNP

C181
DNP

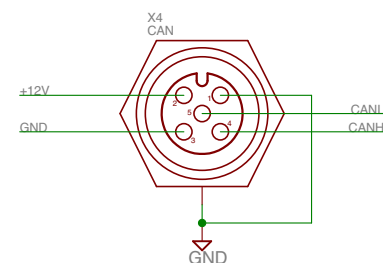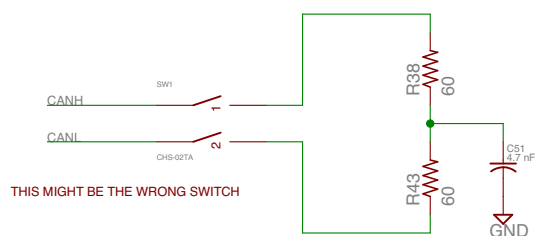VC1-

C181-C188 DNP UNLESS EMERGENCY

Isolated comms interface
RELEASE
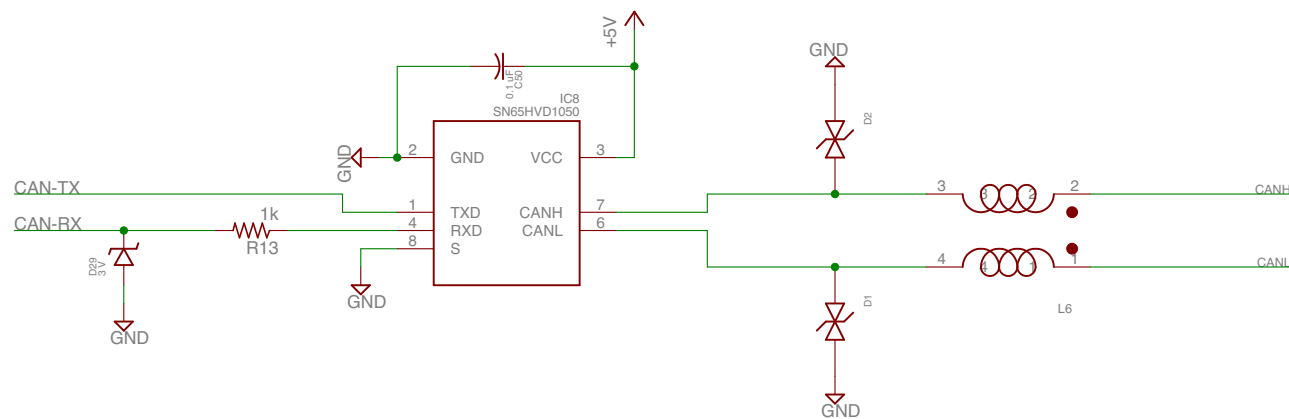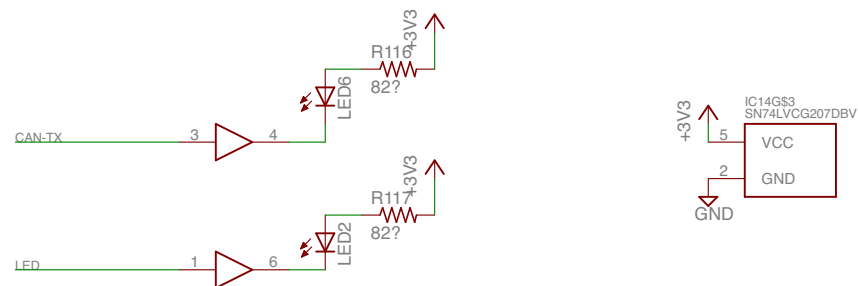
Board: Battery Interface Module
Drawn by Aaron Bonnell-Kangas
Revision date: v2.0.1 - 2015-04-01
Last modified date: 4/1/15 2:38 PM

IC7
TMS320F28034PNT

Pin	Signal		Signal	Pin
69	GPIO0/EPWM1A		GPIO30/CANRXA ↑	33	CAN-RX
68	GPIO1/EPWM1B/COMP1OUT		GPIO31/CANTXA ↑	32	CAN-TX
67	GPIO2/EPWM2A		GPIO32/SDAA/EPWMSYNCI/ADCSOCAO ↑	2
66	GPIO3/EPWM2B/SPISOMIA/COMP2OUT		GPIO33/SCLA/EPWMSYNCO/ADCSOCBO ↑	3
63	GPIO4/EPWM3A		GPIO34/COMP2OUT/COMP3OUT ↑	74
62	GPIO5/EPWM6B/LINRXA/HRCAP2		GPIO35/TDI ↑	59	TDI
50	GPIO6/EPWM4A/EPWMSYNCI/EPWMSYNCO		GPIO36/TMS ↑	60	TMS
49	GPIO7/EPWM4B/SCIRXDA		GPIO37/TDO ↑	58	TDO
43	GPIO8/EPWM5A/ADCSOCAO		GPIO38/TCK/XCLKIN ↑	57	TCK
39	GPIO9/EPWM5B/LINTXA/HRCAP1		GPIO39 ↑	56

65	GPIO10/EPWM6A/ADCSOCBO		GPIO40/EPWM7A ↑	64
61	GPIO11/EPWM6B/LINRXA/HRCAP2		GPIO41/EPWM7B ↑	48
47	↑ GPIO12/TZ1/SCITXDA/SPISOMIB		GPIO42/COMP1OUT ↑	5
76	↑ GPIO13/TZ2/SPISOMIB	BQ_SDO	GPIO43/COMP42OUT ↑	6
77	↑ GPIO14/TZ3/LINTXA/SPICLKB	BQ_SCLK	GPIO44 ↑	45
75	↑ GPIO15/TZ1/LINRXA/SPISTEB			
46	↑ GPIO16/SPISOMIA/TZ2		ADCINA0	18
42	↑ GPIO17/SPISOMIA/TZ3		ADCINA1	17
41	↑ GPIO18/SPICLKA/LINTXA/XCLKOUT		ADCINA2/COMP1A/AIO2	16
55	↑ GPIO19/XCLKIN/SPISTEA/LINRXA/ECAP1		ADCINA3	15
			ADCINA4/COMP2A/AIO4	14
78	↑ GPIO20/EQEP1A/COMP1OUT	ISO_INTERFACE_ENABLE	ADCINA5	13
79	↑ GPIO21/EQEP1B/COMP2OUT		ADCINA6/COMP3A/AIO6	12	PWROUT_INT
1	↑ GPIO22/EQEP1S/LINTXA	BQ_CS	ADCINA7	11
4	↑ GPIO23/EQEP1I/LINRXA			
80	↑ GPIO24/ECAP1/SPISIMOB	BQ_SDI	ADCINB0	23
44	↑ GPIO25/SPISOMIB		ADCINB1	24
37	↑ GPIO26/HRCAP1/SPICLKB		ADCINB2/COMP1B/AIO10	25
31	↑ GPIO27/HRCAP2/SPISTEB		ADCINB3	26
40	↑ GPIO28/SCIRXDA/SDAA/TZ2		ADCINB4/COMP2B/AIO12	27
34	↑ GPIO29/SCITXDA/SCLA/TZ3	LED	ADCINB5	28
			ADCINB6/COMP3B/AIO14	29
			ADCINB7	30

8	VSS		VREFHI	19
35	VSS		VREFLO	22
53	VSS			
71	VSS		XRS	9	XRS
21	VSSA		TRST	10	TRST
20	VDDA			
7	VDD		X1	52
54	VDD		X2	51
72	VDD			
36	VDDIO		VREGENZ	73
70	VDDIO		TEST2	38

↑ symbol indicates pin is pulled up at boot

+3V3

L4
L3
L2
L1

C152 2.2 uF
C151 2.2 uF
C150 2.2 uF
C149 2.2 uF
C153 2.2 uF
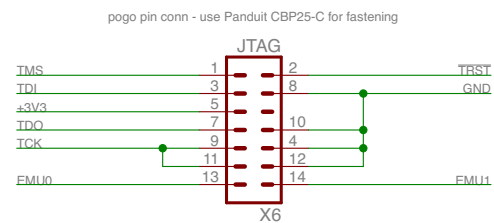C154 2.2 uF

GND

10k R154

GND

F28035 connections
RELEASE

Board: Battery Interface Module
Drawn by Aaron Bonnell-Kangas
Revision date: v2.0.1 - 2015-04-01
Last modified date: 4/1/15 2:38 PM

IC8
SN65HVD1050

CAN-TX
CAN-RX

R13
1k

D29
3V

GND
GND
GND

C50
0.1 uF

+5V

GND

TXD
RXD
S

GND
VCC
CANH
CANL

1
4
8
2
3
7
6

GND

D2

D1

L6

GND

CANH
CANL

SW1

CANH
CANI

CHS-02TA

THIS MIGHT BE THE WRONG SWITCH

R38
60

R43
60

C51
4.7 nF

GND

X4
CAN

+12V
GND

CANI
CANH

GND

CAN interface and termination
RELEASE

Board: **Battery Interface Module**
Drawn by Aaron Bonnell-Kangas
Revision date: v2.0.1 - 2015-04-01
Last modified date: 4/1/15 2:38 PM

pogo pin conn - use Panduit CBP25-C for fastening

JTAG

TMS	1	2	TRST
TDI	3	8	GND
+3V3	5		
TDO	7	10	
TCK	9	4	
	11	12	
EMU0	13	14	EMU1

X6

R116
82?
+3V3

LED6

CAN-TX   3   4

R117
82?
+3V3

LED2

LED   1   6

IC14G$3
SN74LVCG207DBV
+3V3

| 5 | VCC |
| 2 | GND |

GND

JTAG, LEDs
RELEASE

C

Board: Battery Interface Module
Drawn by Aaron Bonnell-Kangas
Revision date: v2.0.1 - 2015-04-01
Last modified date: 4/1/15 2:38 PM

VC24+   TP3

VC12+   TP4

VC6+   TP5

VC1-   TP6

BQ_CS   TP1

BQ_SCLK   TP2

BQ_SDI   TP27

BQ_SDO   TP28

4-REG50   TP7

3-REG50   TP8

2-REG50   TP9

1-REG50   TP10

+3V3   TP29

GND   TP30

+5V   TP31

+12V   TP32

4-CS_H   TP11

4-SDO_H   TP12

4-SDI_H   TP13

4-SCLK_H   TP14

3-CS_H   TP15

3-SDO_H   TP16

3-SDI_H   TP17

3-SCLK_H   TP18

2-CS_H   TP19

2-SDO_H   TP20

2-SDI_H   TP21

2-SCLK_H   TP22

1-CS_H   TP23

1-SDO_H   TP24

1-SDI_H   TP25

1-SCLK_H   TP26

Test points
RELEASE