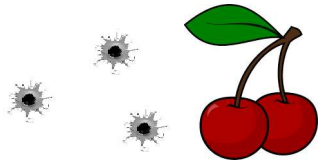
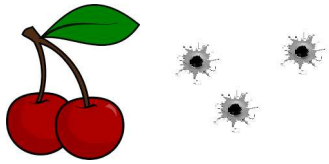


CERISE

BMS Eval Board for BQ79606A



BMS Specs:
3S-6S or 8S-12S battery monitor
12.6V - 25.2V or 33.6V - 50.4V
150mA passive balancing current
10A output circuitry
Max 500W output

Key for Component Names:
Eg: CYXX (X being iterative number).
Y numbers:
1: MCU components
2: BMS South
3: BMS North
4: Input Circuitry
5: Cell tap connectors

Sheet: INPUT_OUTPUT

BATT INPUT, OUTPUT CONTROL CIRCUITRY + CONNECTORS

BUS_NORTH_CELL_CONN
BUS_SOUTH_CELL_CONN
STM_32_IO_CTL

File: INPUT_OUTPUT.sch

Sheet: NORTH_BQ

NORTH (SLAVE) BQ79606

BUS_NORTH_CELL_CONN
BUS_NORTH_COMH
BUS_SOUTH_COMH

File: NORTH_BQS.sch

Sheet: South(Master)_BQ

SOUTH (MASTER) BQ79606

BUS_SOUTH_COMH
BUS_NORTH_COMH
BUS_SOUTH_CELL_CONN
STM32_COMMS

File: South(Master)_BQ.sch

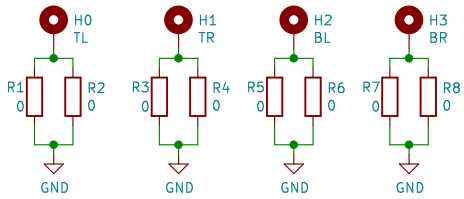
Sheet: MCU

MCU + COMMS + CONNECTORS

STM32_COMMS
STM_32_IO_CTL

File: MCU.sch

Population options for chassis grounding



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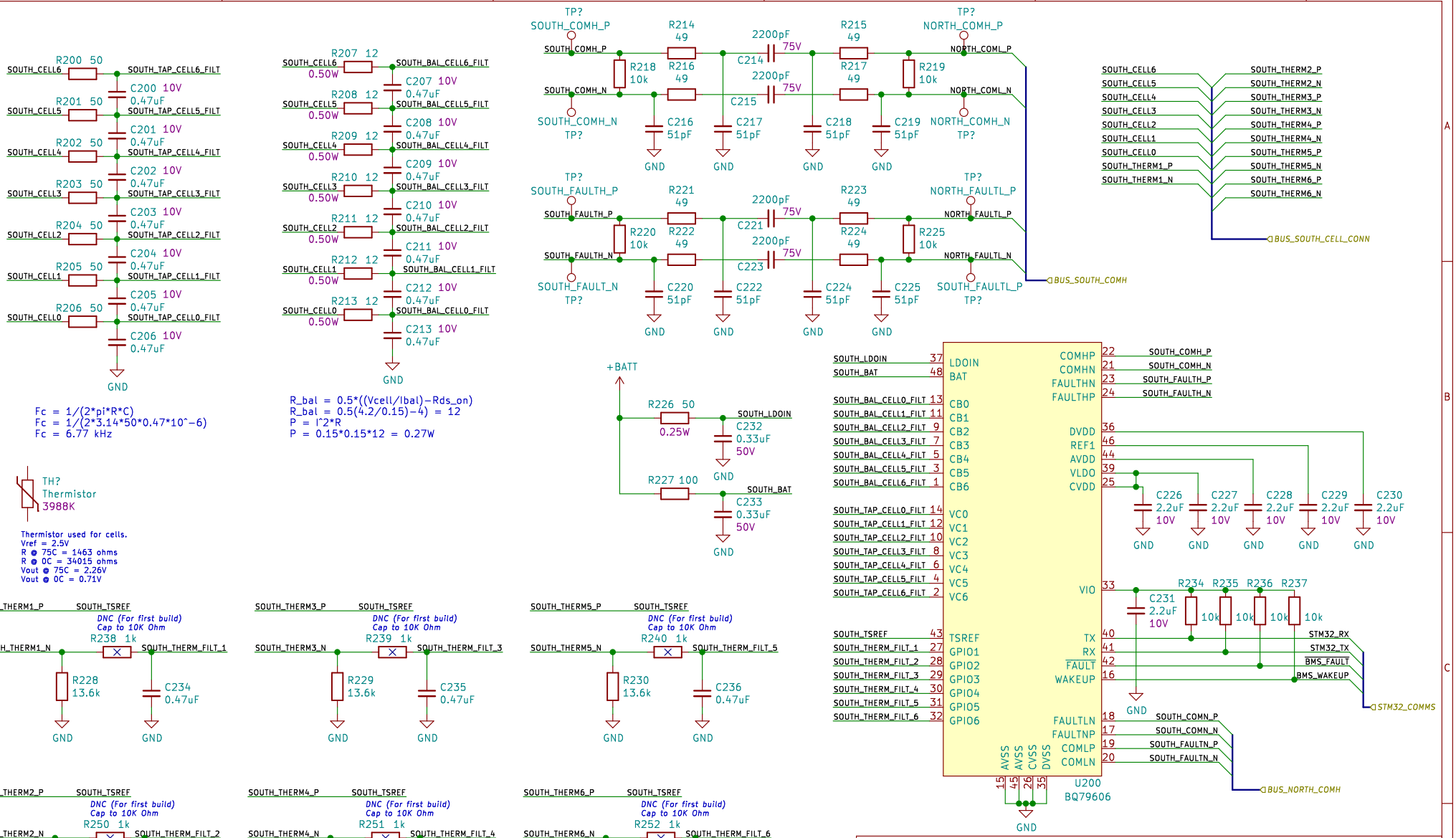
BQ79606A EVAL BOARD
PARADIGM HYPERLOOP

PARADIGM HYPERLOOP

Sheet: /
File: Milpitas_BMS.sch

Title: CERISE BMS Eval Board for BQ79606A

Size: A4	Date: 2020-03-29	**Rev: 0**
KiCad E.D.A. kicad (5.1.5)-3		Id: 1/6


R200 50
SOUTH_CELL6
SOUTH_TAP_CELL6_FILT
C200 10V 0.47uF
R201 50
SOUTH_CELL5
SOUTH_TAP_CELL5_FILT
C201 10V 0.47uF
R202 50
SOUTH_CELL4
SOUTH_TAP_CELL4_FILT
C202 10V 0.47uF
R203 50
SOUTH_CELL3
SOUTH_TAP_CELL3_FILT
C203 10V 0.47uF
R204 50
SOUTH_CELL2
SOUTH_TAP_CELL2_FILT
C204 10V 0.47uF
R205 50
SOUTH_CELL1
SOUTH_TAP_CELL1_FILT
C205 10V 0.47uF
R206 50
SOUTH_CELL0
SOUTH_TAP_CELL0_FILT
C206 10V 0.47uF
GND
Fc = 1/(2*pi*R*C)
Fc = 1/(2*3.14*50*0.47*10^-6)
Fc = 6.77 kHz
R207 12
SOUTH_CELL6
0.50W
SOUTH_BAL_CELL6_FILT
C207 10V 0.47uF
R208 12
SOUTH_CELL5
0.50W
SOUTH_BAL_CELL5_FILT
C208 10V 0.47uF
R209 12
SOUTH_CELL4
0.50W
SOUTH_BAL_CELL4_FILT
C209 10V 0.47uF
R210 12
SOUTH_CELL3
0.50W
SOUTH_BAL_CELL3_FILT
C210 10V 0.47uF
R211 12
SOUTH_CELL2
0.50W
SOUTH_BAL_CELL2_FILT
C211 10V 0.47uF
R212 12
SOUTH_CELL1
0.50W
SOUTH_BAL_CELL1_FILT
C212 10V 0.47uF
R213 12
SOUTH_CELL0
0.50W
SOUTH_BAL_CELL0_FILT
C213 10V 0.47uF
GND
R_bal = 0.5*((Vcell/Ibal)-Rds_on)
R_bal = 0.5(4.2/0.15)-4) = 12
P = I^2*R
P = 0.15*0.15*12 = 0.27W
TP?
SOUTH_COMH_P
R214 49
2200pF 75V
R215 49
TP?
NORTH_COMH_P
SOUTH_COMH_P
R218 10k
R216 49
C214
R217 49
R219 10k
NORTH_COML_P
SOUTH_COMH_N
C215
NORTH_COML_N
SOUTH_COMH_N
TP?
C216 51pF
C217 51pF
C218 51pF
C219 51pF
NORTH_COMH_N
TP?
GND
TP?
SOUTH_FAULTH_P
R221 49
2200pF 75V
R223 49
TP?
NORTH_FAULTL_P
SOUTH_FAULTH_P
R220 10k
R222 49
C221
R224 49
R225 10k
NORTH_FAULTL_P
SOUTH_FAULTH_N
C223
NORTH_FAULTL_N
SOUTH_FAULT_N
TP?
C220 51pF
C222 51pF
C224 51pF
C225 51pF
SOUTH_FAULTL_P
TP?
GND
BUS_SOUTH_COMH
SOUTH_CELL6
SOUTH_CELL5
SOUTH_CELL4
SOUTH_CELL3
SOUTH_CELL2
SOUTH_CELL1
SOUTH_CELL0
SOUTH_THERM1_P
SOUTH_THERM1_N
SOUTH_THERM2_P
SOUTH_THERM2_N
SOUTH_THERM3_P
SOUTH_THERM3_N
SOUTH_THERM4_P
SOUTH_THERM4_N
SOUTH_THERM5_P
SOUTH_THERM5_N
SOUTH_THERM6_P
SOUTH_THERM6_N
BUS_SOUTH_CELL_CONN
+BATT
R226 50
0.25W
SOUTH_LDOIN
C232 0.33uF 50V
GND
R227 100
SOUTH_BAT
C233 0.33uF 50V
GND
TH?
Thermistor
3988K
Thermistor used for cells.
Vref = 2.5V
R @ 75C = 1463 ohms
R @ 0C = 34015 ohms
Vout @ 75C = 2.26V
Vout @ 0C = 0.71V
SOUTH_LDOIN 37
SOUTH_BAT 48
SOUTH_BAL_CELL0_FILT 13
SOUTH_BAL_CELL1_FILT 11
SOUTH_BAL_CELL2_FILT 9
SOUTH_BAL_CELL3_FILT 7
SOUTH_BAL_CELL4_FILT 5
SOUTH_BAL_CELL5_FILT 3
SOUTH_BAL_CELL6_FILT 1
SOUTH_TAP_CELL0_FILT 14
SOUTH_TAP_CELL1_FILT 12
SOUTH_TAP_CELL2_FILT 10
SOUTH_TAP_CELL3_FILT 8
SOUTH_TAP_CELL4_FILT 6
SOUTH_TAP_CELL5_FILT 4
SOUTH_TAP_CELL6_FILT 2
SOUTH_TSREF 43
SOUTH_THERM_FILT_1 27
SOUTH_THERM_FILT_2 28
SOUTH_THERM_FILT_3 29
SOUTH_THERM_FILT_4 30
SOUTH_THERM_FILT_5 31
SOUTH_THERM_FILT_6 32
LDOIN
BAT
CB0
CB1
CB2
CB3
CB4
CB5
CB6
VC0
VC1
VC2
VC3
VC4
VC5
VC6
TSREF
GPIO1
GPIO2
GPIO3
GPIO4
GPIO5
GPIO6
AVSS
AVSS
CVSS
DVSS
15
45
26
35
GND
COMHP 22
COMHN 21
FAULTHN 23
FAULTHP 24
SOUTH_COMH_P
SOUTH_COMH_N
SOUTH_FAULTH_P
SOUTH_FAULTH_N
DVDD 36
REF1 46
AVDD 44
VLDO 39
CVDD 25
C226 2.2uF 10V
C227 2.2uF 10V
C228 2.2uF 10V
C229 2.2uF 10V
C230 2.2uF 10V
GND
VIO 33
C231 2.2uF 10V
R234 10k
R235 10k
R236 10k
R237 10k
TX 40
RX 41
FAULT 42
WAKEUP 16
STM32_RX
STM32_TX
BMS_FAULT
BMS_WAKEUP
STM32_COMMS
GND
FAULTLN 18
FAULTNP 17
COMLP 19
COMLN 20
SOUTH_COMN_P
SOUTH_COMN_N
SOUTH_FAULTN_P
SOUTH_FAULTN_N
BUS_NORTH_COMH
U200
BQ79606
SOUTH_THERM1_P
SOUTH_TSREF
DNC (For first build)
Cap to 10K Ohm
R238 1k
SOUTH_THERM1_N
SOUTH_THERM_FILT_1
R228 13.6k
C234 0.47uF
GND
SOUTH_THERM3_P
SOUTH_TSREF
DNC (For first build)
Cap to 10K Ohm
R239 1k
SOUTH_THERM3_N
SOUTH_THERM_FILT_3
R229 13.6k
C235 0.47uF
GND
SOUTH_THERM5_P
SOUTH_TSREF
DNC (For first build)
Cap to 10K Ohm
R240 1k
SOUTH_THERM5_N
SOUTH_THERM_FILT_5
R230 13.6k
C236 0.47uF
GND
SOUTH_THERM2_P
SOUTH_TSREF
DNC (For first build)
Cap to 10K Ohm
R250 1k
SOUTH_THERM2_N
SOUTH_THERM_FILT_2
R231 13.6k
C237 0.47uF
GND
SOUTH_THERM4_P
SOUTH_TSREF
DNC (For first build)
Cap to 10K Ohm
R251 1k
SOUTH_THERM4_N
SOUTH_THERM_FILT_4
R232 13.6k
C238 0.47uF
GND
SOUTH_THERM6_P
SOUTH_TSREF
DNC (For first build)
Cap to 10K Ohm
R252 1k
SOUTH_THERM6_N
SOUTH_THERM_FILT_6
R233 13.6k
C239 0.47uF
GND
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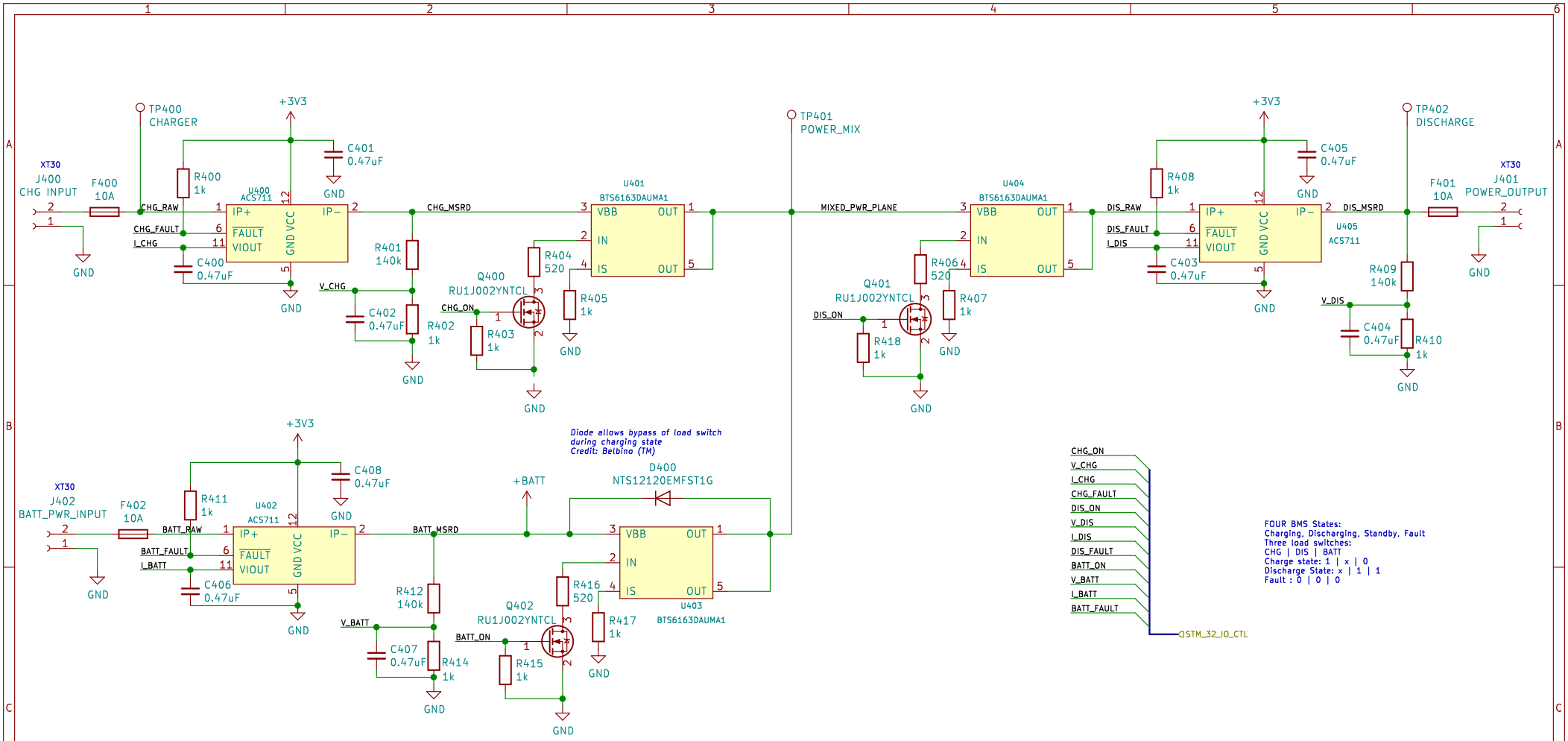
BQ79606A EVAL BOARD
PARADIGM HYPERLOOP
Sheet: /South(Master)_BQ/
File: South(Master)_BQ.sch
Title: CERISE
Size: A4
Date: 2020-03-29
Rev: 0
KiCad E.D.A. kicad (5.1.5)-3
Id: 2/6
PARADIGM
HYPERLOOP



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BQ79606A EVAL BOARD
PARADIGM HYPERLOOP

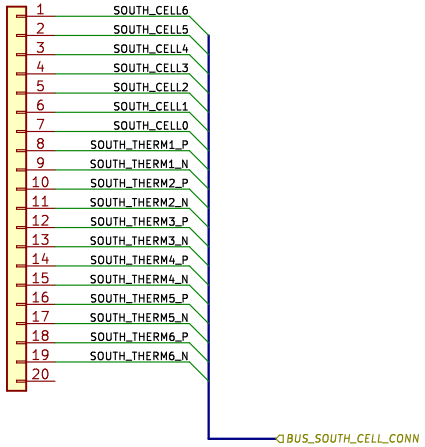
PARADIGM HYPERLOOP

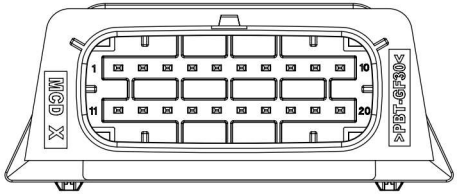
Sheet: /INPUT_OUTPUT/
File: INPUT_OUTPUT.sch

Title: CERISE

Size: A4	Date: 2020-03-29	**Rev: 0**
KiCad E.D.A. kicad (5.1.5)-3		Id: 3/6

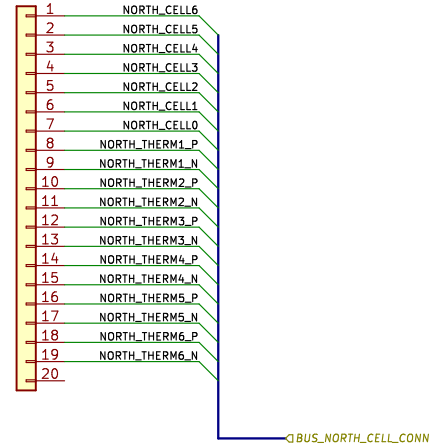
J500
SOUTH CELL CONN

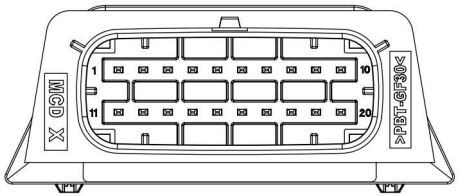




PINOUT TBD UNTIL LAYOUT BEGINS

J501
NORTH CELL CONN





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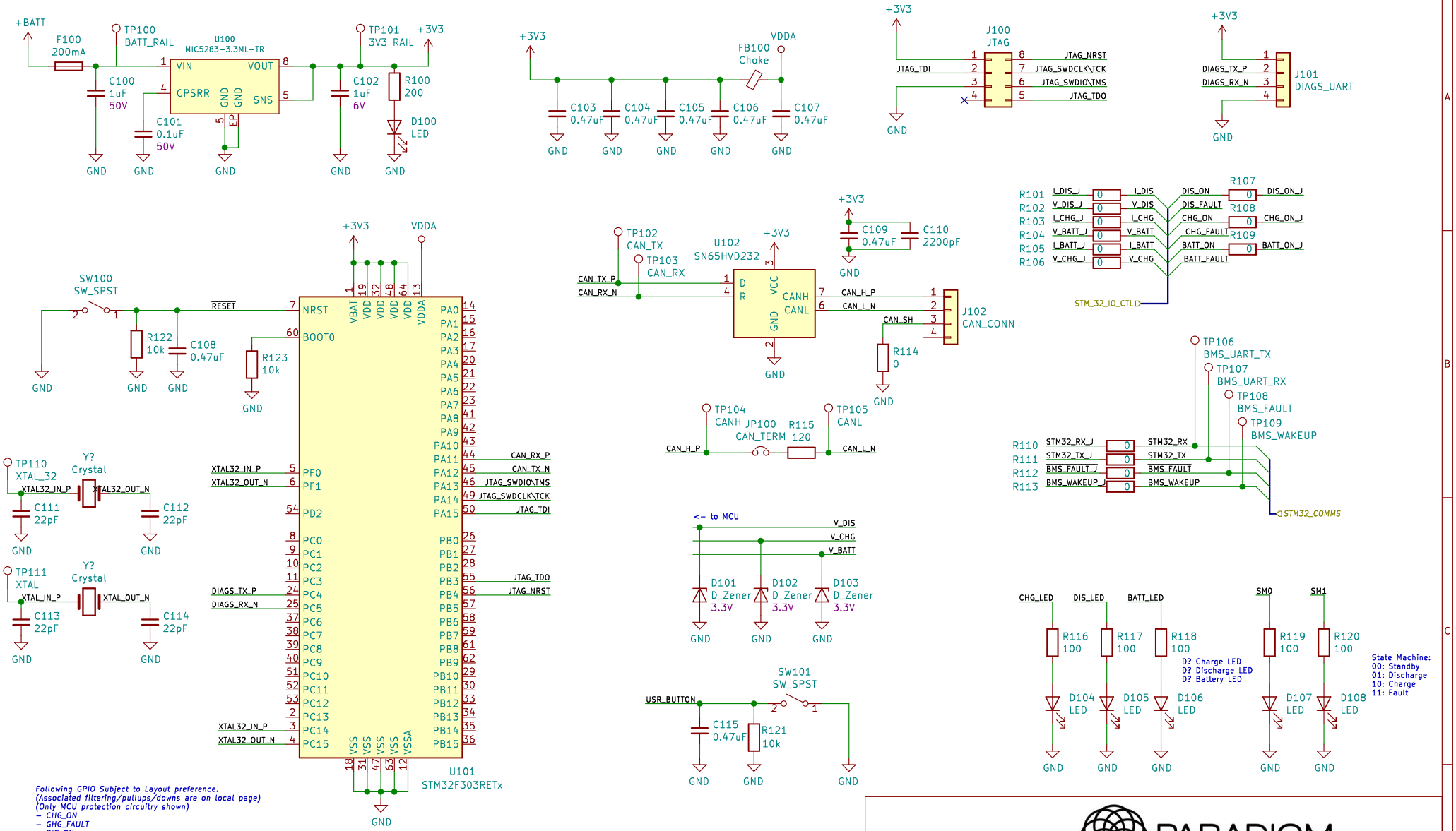
BQ79606A EVAL BOARD
PARADIGM HYPERLOOP

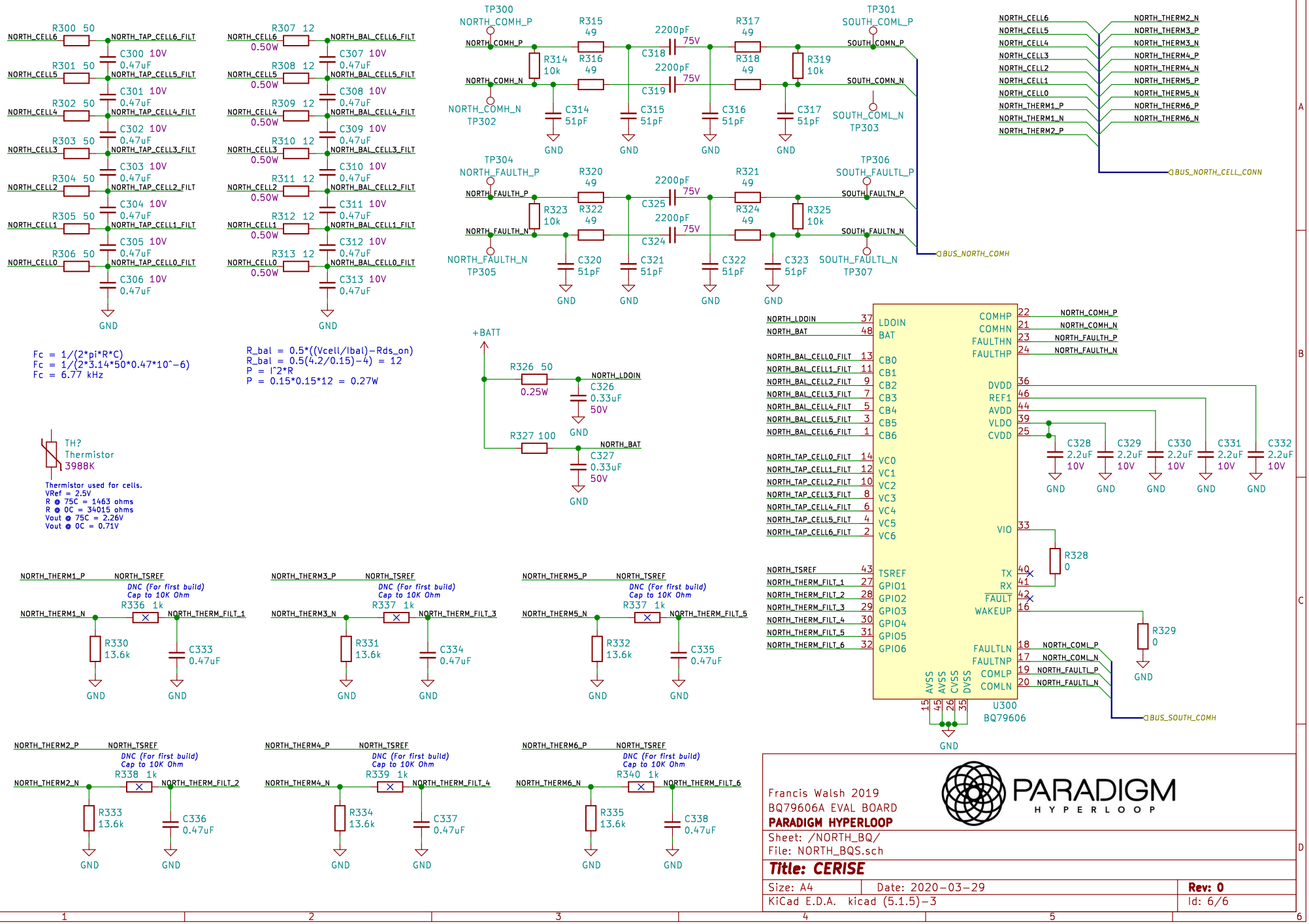
PARADIGM HYPERLOOP

Sheet: /INPUT_OUTPUT/Cell Tap Pinout/
File: Cell_Tap_Pinout.sch

Title: CERISE

Size: A4	Date: 2020-03-29	**Rev: 0**
KiCad E.D.A. kicad (5.1.5)-3		Id: 4/6


+BATT
F100
200mA
TP100
BATT_RAIL
U100
MIC5283-3.3ML-TR
VIN
VOUT
CPSRR
GND
SNS
EP
C100
1uF
50V
C101
0.1uF
50V
TP101
3V3 RAIL
+3V3
C102
1uF
6V
R100
200
D100
LED
C103
0.47uF
C104
0.47uF
C105
0.47uF
C106
0.47uF
C107
0.47uF
FB100
Choke
VDDA
J100
JTAG
JTAG_TDI
JTAG_NRST
JTAG_SWDCLK\TCK
JTAG_SWDIO\TMS
JTAG_TDO
J101
DIAGS_UART
DIAGS_TX_P
DIAGS_RX_N
SW100
SW_SPST
RESET
R122
10k
C108
0.47uF
R123
10k
U101
STM32F303RETx
NRST
BOOT0
VBAT
VDD
VDDA
VSS
VSSA
PF0
PF1
PD2
PC0
PC1
PC2
PC3
PC4
PC5
PC6
PC7
PC8
PC9
PC10
PC11
PC12
PC13
PC14
PC15
PA0
PA1
PA2
PA3
PA4
PA5
PA6
PA7
PA8
PA9
PA10
PA11
PA12
PA13
PA14
PA15
PB0
PB1
PB2
PB3
PB4
PB5
PB6
PB7
PB8
PB9
PB10
PB11
PB12
PB13
PB14
PB15
XTAL32_IN_P
XTAL32_OUT_N
CAN_RX_P
CAN_TX_N
JTAG_SWDIO\TMS
JTAG_SWDCLK\TCK
JTAG_TDI
JTAG_TDO
JTAG_NRST
DIAGS_TX_P
DIAGS_RX_N
TP110
XTAL_32
Y?
Crystal
C111
22pF
C112
22pF
TP111
XTAL
C113
22pF
C114
22pF
TP102
CAN_TX
TP103
CAN_RX
U102
SN65HVD232
D
R
VCC
GND
CANH
CANL
CAN_TX_P
CAN_RX_N
CAN_H_P
CAN_L_N
CAN_SH
J102
CAN_CONN
R114
0
C109
0.47uF
C110
2200pF
TP104
CANH
TP105
CANL
JP100
CAN_TERM
R115
120
R101
R102
R103
R104
R105
R106
I_DIS_J
V_DIS_J
I_CHG_J
V_BATT_J
I_BATT_J
V_CHG_J
I_DIS
V_DIS
I_CHG
V_BATT
I_BATT
V_CHG
R107
R108
R109
DIS_ON
DIS_FAULT
CHG_ON
CHG_FAULT
BATT_ON
BATT_FAULT
DIS_ON_J
CHG_ON_J
BATT_ON_J
STM_32_IO_CTLD
TP106
BMS_UART_TX
TP107
BMS_UART_RX
TP108
BMS_FAULT
TP109
BMS_WAKEUP
R110
R111
R112
R113
STM32_RX_J
STM32_TX_J
BMS_FAULT_J
BMS_WAKEUP_J
STM32_RX
STM32_TX
BMS_FAULT
BMS_WAKEUP
STM32_COMMS
<-- to MCU
V_DIS
V_CHG
V_BATT
D101
D_Zener
3.3V
D102
D_Zener
3.3V
D103
D_Zener
3.3V
SW101
SW_SPST
USR_BUTTON
C115
0.47uF
R121
10k
CHG_LED
DIS_LED
BATT_LED
R116
100
R117
100
R118
100
D104
LED
D105
LED
D106
LED
D? Charge LED
D? Discharge LED
D? Battery LED
SM0
SM1
R119
100
R120
100
D107
LED
D108
LED
State Machine:
00: Standby
01: Discharge
10: Charge
11: Fault
GND
Following GPIO Subject to Layout preference.
(Associated filtering/pullups/downs are on local page)
(Only MCU protection circuitry shown)
- CHG_ON
- GHG_FAULT
- DIS_ON
- DIS_FAULT
- BATT_ON
- BATT_FAULT
- BMS_FAULT
- BMS_WAKEUP
- CHG_LED
- DIS_LED
- BATT_LED
- SM0
- SM1
- USR_BUTTON
Francis Walsh 2019
BQ79606A EVAL BOARD
PARADIGM HYPERLOOP
PARADIGM
HYPERLOOP
Sheet: /MCU/
File: MCU.sch
Title: CERISE
Size: A4
Date: 2020-03-29
Rev: 0
KiCad E.D.A. kicad (5.1.5)-3
Id: 5/6


R300 50
NORTH_CELL6
NORTH_TAP_CELL6_FILT
C300 10V 0.47uF
R301 50
NORTH_CELL5
NORTH_TAP_CELL5_FILT
C301 10V 0.47uF
R302 50
NORTH_CELL4
NORTH_TAP_CELL4_FILT
C302 10V 0.47uF
R303 50
NORTH_CELL3
NORTH_TAP_CELL3_FILT
C303 10V 0.47uF
R304 50
NORTH_CELL2
NORTH_TAP_CELL2_FILT
C304 10V 0.47uF
R305 50
NORTH_CELL1
NORTH_TAP_CELL1_FILT
C305 10V 0.47uF
R306 50
NORTH_CELL0
NORTH_TAP_CELL0_FILT
C306 10V 0.47uF
GND
R307 12
0.50W
NORTH_BAL_CELL6_FILT
C307 10V 0.47uF
R308 12
NORTH_BAL_CELL5_FILT
C308 10V 0.47uF
R309 12
NORTH_BAL_CELL4_FILT
C309 10V 0.47uF
R310 12
NORTH_BAL_CELL3_FILT
C310 10V 0.47uF
R311 12
NORTH_BAL_CELL2_FILT
C311 10V 0.47uF
R312 12
NORTH_BAL_CELL1_FILT
C312 10V 0.47uF
R313 12
NORTH_BAL_CELL0_FILT
C313 10V 0.47uF
Fc = 1/(2*pi*R*C)
Fc = 1/(2*3.14*50*0.47*10^-6)
Fc = 6.77 kHz
R_bal = 0.5*((Vcell/Ibal)-Rds_on)
R_bal = 0.5(4.2/0.15)-4) = 12
P = I^2*R
P = 0.15*0.15*12 = 0.27W
TH?
Thermistor
3988K
Thermistor used for cells.
VRef = 2.5V
R @ 75C = 1463 ohms
R @ 0C = 34015 ohms
Vout @ 75C = 2.26V
Vout @ 0C = 0.71V
TP300
NORTH_COMH_P
R315 49
R316 49
R314 10k
2200pF 75V
C318
C319
R317 49
R318 49
R319 10k
TP301
SOUTH_COML_P
SOUTH_COMN_P
SOUTH_COMN_N
NORTH_COMH_N
TP302
C314 51pF
C315 51pF
C316 51pF
C317 51pF
SOUTH_COML_N
TP303
TP304
NORTH_FAULTH_P
R320 49
R322 49
R323 10k
C325
C324
R321 49
R324 49
R325 10k
TP306
SOUTH_FAULTL_P
SOUTH_FAULTN_P
SOUTH_FAULTN_N
NORTH_FAULTH_N
TP305
C320 51pF
C321 51pF
C322 51pF
C323 51pF
SOUTH_FAULTL_N
TP307
BUS_NORTH_COMH
NORTH_CELL6
NORTH_CELL5
NORTH_CELL4
NORTH_CELL3
NORTH_CELL2
NORTH_CELL1
NORTH_CELL0
NORTH_THERM1_P
NORTH_THERM1_N
NORTH_THERM2_P
NORTH_THERM2_N
NORTH_THERM3_N
NORTH_THERM3_P
NORTH_THERM4_P
NORTH_THERM4_N
NORTH_THERM5_P
NORTH_THERM5_N
NORTH_THERM6_P
NORTH_THERM6_N
BUS_NORTH_CELL_CONN
+BATT
R326 50
0.25W
NORTH_LDOIN
C326 0.33uF 50V
R327 100
NORTH_BAT
C327 0.33uF 50V
LDOIN
BAT
CB0
CB1
CB2
CB3
CB4
CB5
CB6
VC0
VC1
VC2
VC3
VC4
VC5
VC6
TSREF
GPIO1
GPIO2
GPIO3
GPIO4
GPIO5
GPIO6
COMHP
COMHN
FAULTHN
FAULTHP
DVDD
REF1
AVDD
VLDO
CVDD
VIO
TX
RX
FAULT
WAKEUP
FAULTLN
FAULTNP
COMLP
COMLN
AVSS
AVSS
CVSS
DVSS
U300
BQ79606
C328 2.2uF 10V
C329 2.2uF 10V
C330 2.2uF 10V
C331 2.2uF 10V
C332 2.2uF 10V
R328 0
R329 0
BUS_SOUTH_COMH
DNC (For first build)
Cap to 10K Ohm
R336 1k
R330 13.6k
C333 0.47uF
R337 1k
R331 13.6k
C334 0.47uF
R332 13.6k
C335 0.47uF
R338 1k
R333 13.6k
C336 0.47uF
R339 1k
R334 13.6k
C337 0.47uF
R340 1k
R335 13.6k
C338 0.47uF
Francis Walsh 2019
BQ79606A EVAL BOARD
PARADIGM HYPERLOOP
Sheet: /NORTH_BQ/
File: NORTH_BQS.sch
Title: CERISE
Size: A4
Date: 2020-03-29
Rev: 0
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