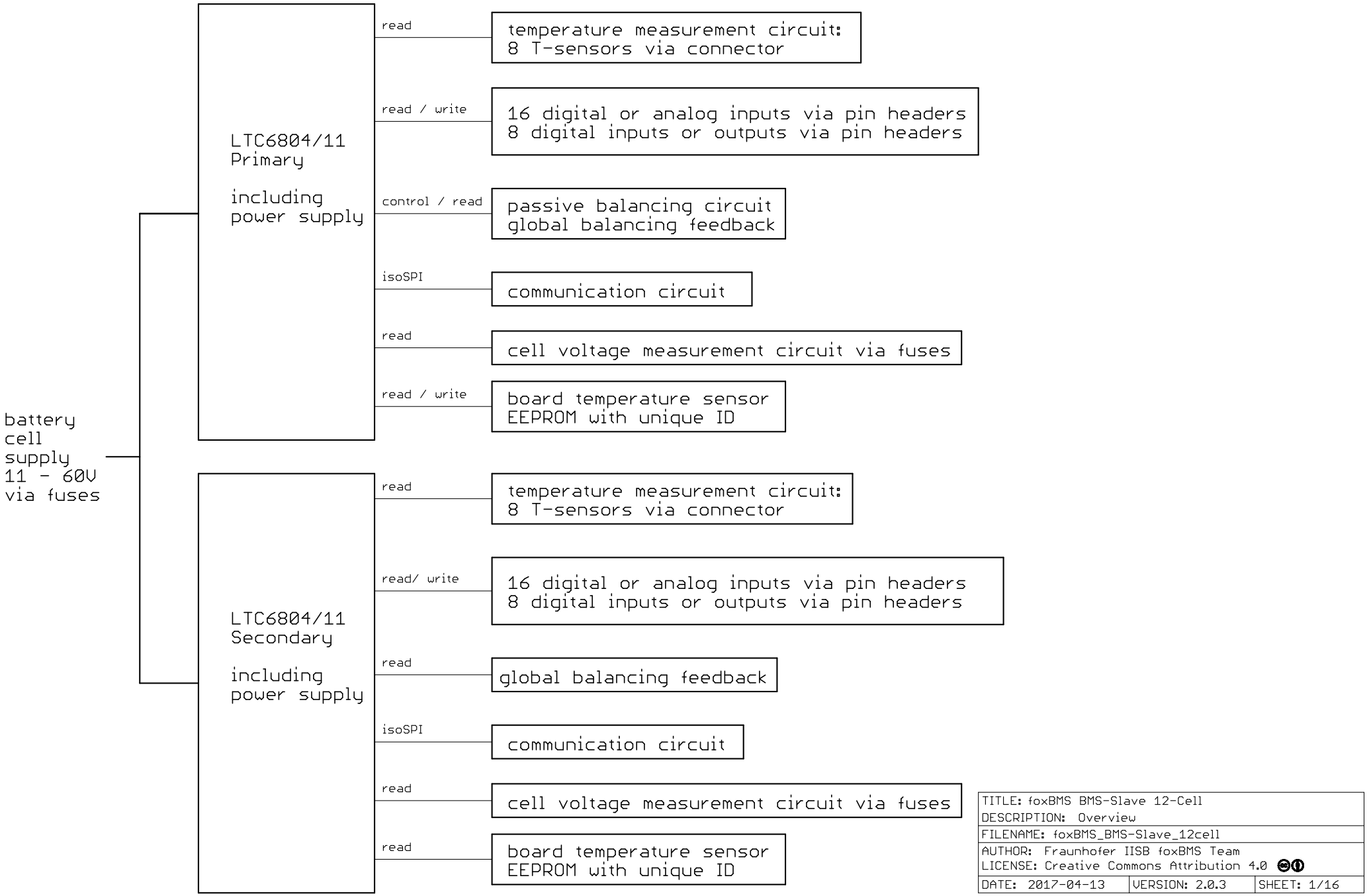
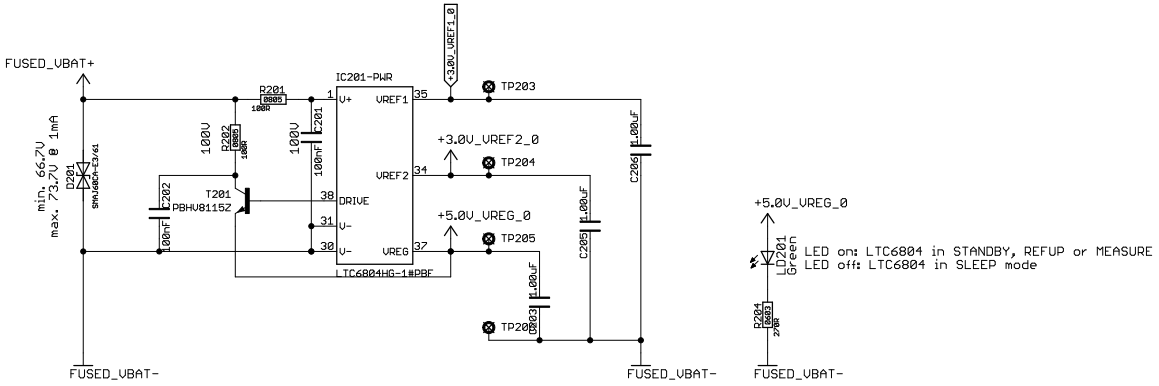
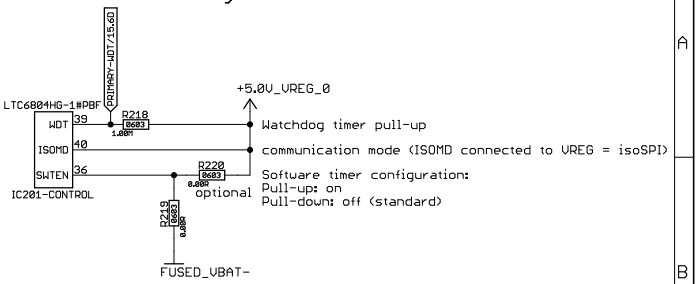


TITLE: foxBMS BMS-Slave 12-Cell		
DESCRIPTION: Overview		
FILENAME: foxBMS_BMS-Slave_12cell		
AUTHOR: Fraunhofer IISB foxBMS Team		
LICENSE: Creative Commons Attribution 4.0		
DATE: 2017-04-13	VERSION: 2.0.3	SHEET: 1/16

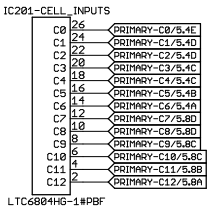
Power Supply



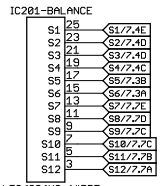
Setting Pins



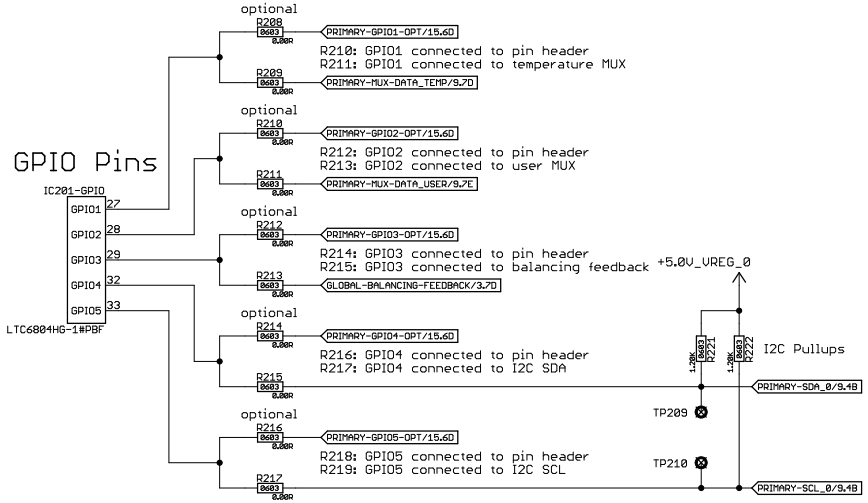
Cell voltage sense inputs



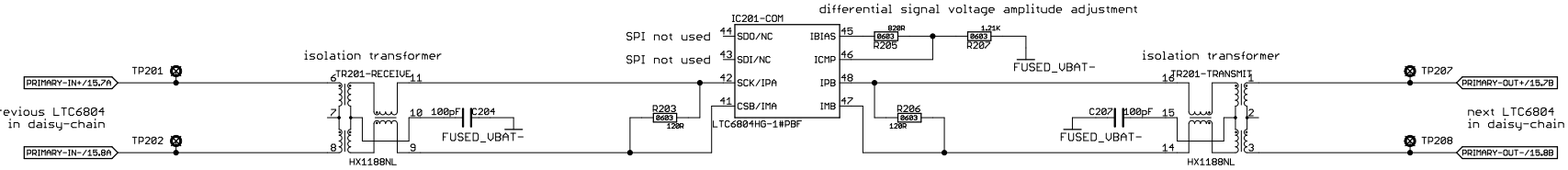
Cell balancing control



GPIO Pins



Communication Circuit

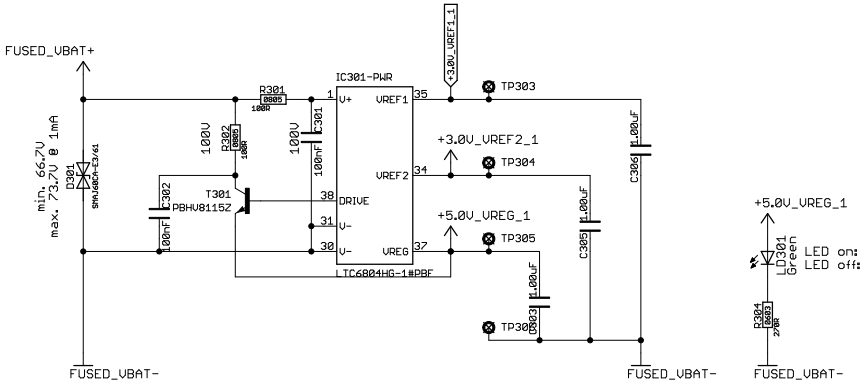


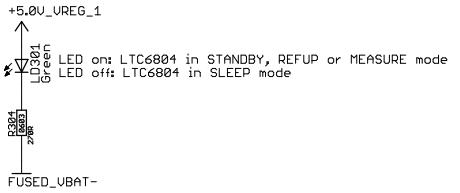
Layout:

- The transformer should be placed as close to the isoSPI cable connector as possible.
  The distance should be kept less than 2cm.
- The LTC6804 should be placed at least 1cm to 2cm away from the transformer.
- On the top component layer, no ground plane should be placed under the transformer,
  the isoSPI connector, or in between the transformer and the connector.
- The isoSPI signal traces should be isolated from surrounding circuits and traces by ground metal or space.
  No traces should cross the isoSPI signal lines, unless separated by a ground plane on an inner layer.

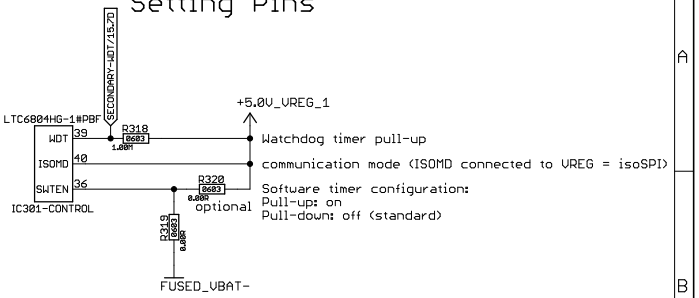
TITLE: foxBMS BMS-Slave 12-Cell		
DESCRIPTION: Primary LTC6804/11		
FILENAME: foxBMS_BMS-Slave_12cell		
AUTHOR: Fraunhofer IISB foxBMS Team LICENSE: Creative Commons Attribution 4.0		
DATE: 2017-04-13	VERSION: 2.0.3	SHEET: 2/16

Power Supply

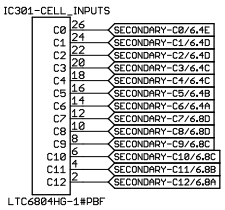




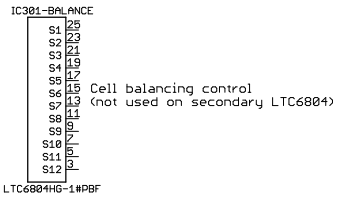
Setting Pins



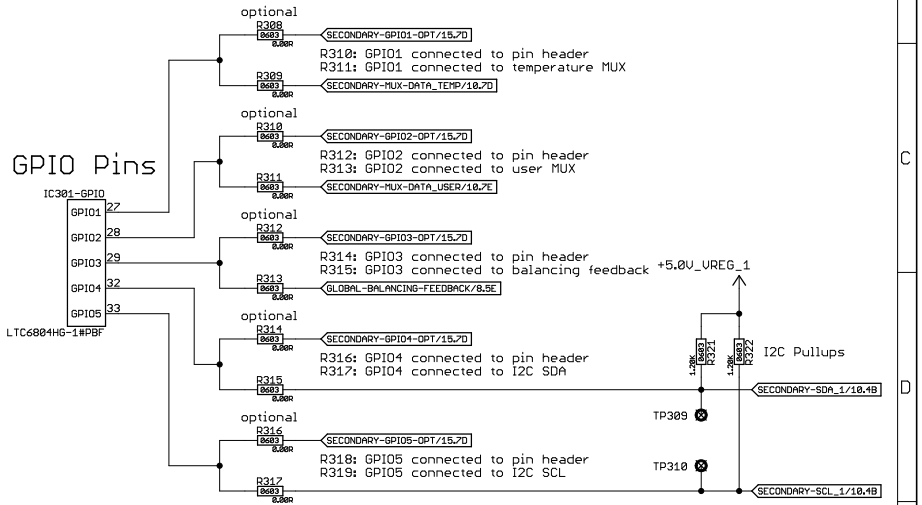
Cell voltage sense inputs



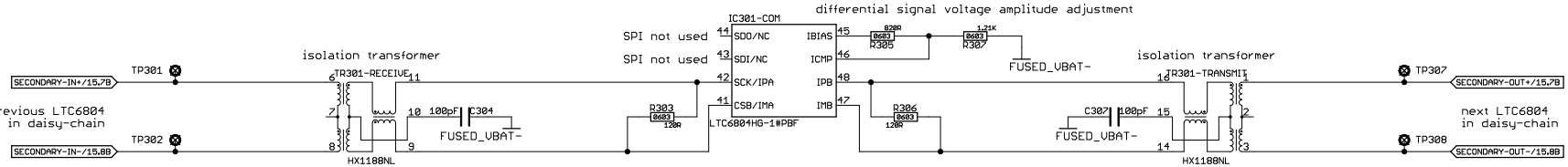
Cell balancing control



GPIO Pins



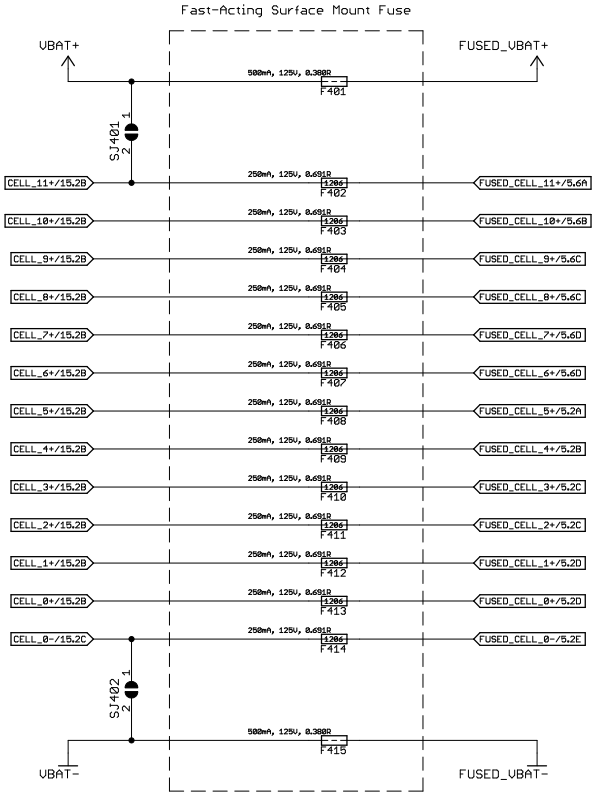
Communication Circuit



Layout:

- The transformer should be placed as close to the isoSPI cable connector as possible.
  The distance should be kept less than 2cm.
- The LTC6804 should be placed at least 1cm to 2cm away from the transformer.
- On the top component layer, no ground plane should be placed under the transformer,
  the isoSPI connector, or in between the transformer and the connector.
- The isoSPI signal traces should be isolated from surrounding circuits and traces by ground metal or space.
  No traces should cross the isoSPI signal lines, unless separated by a ground plane on an inner layer.

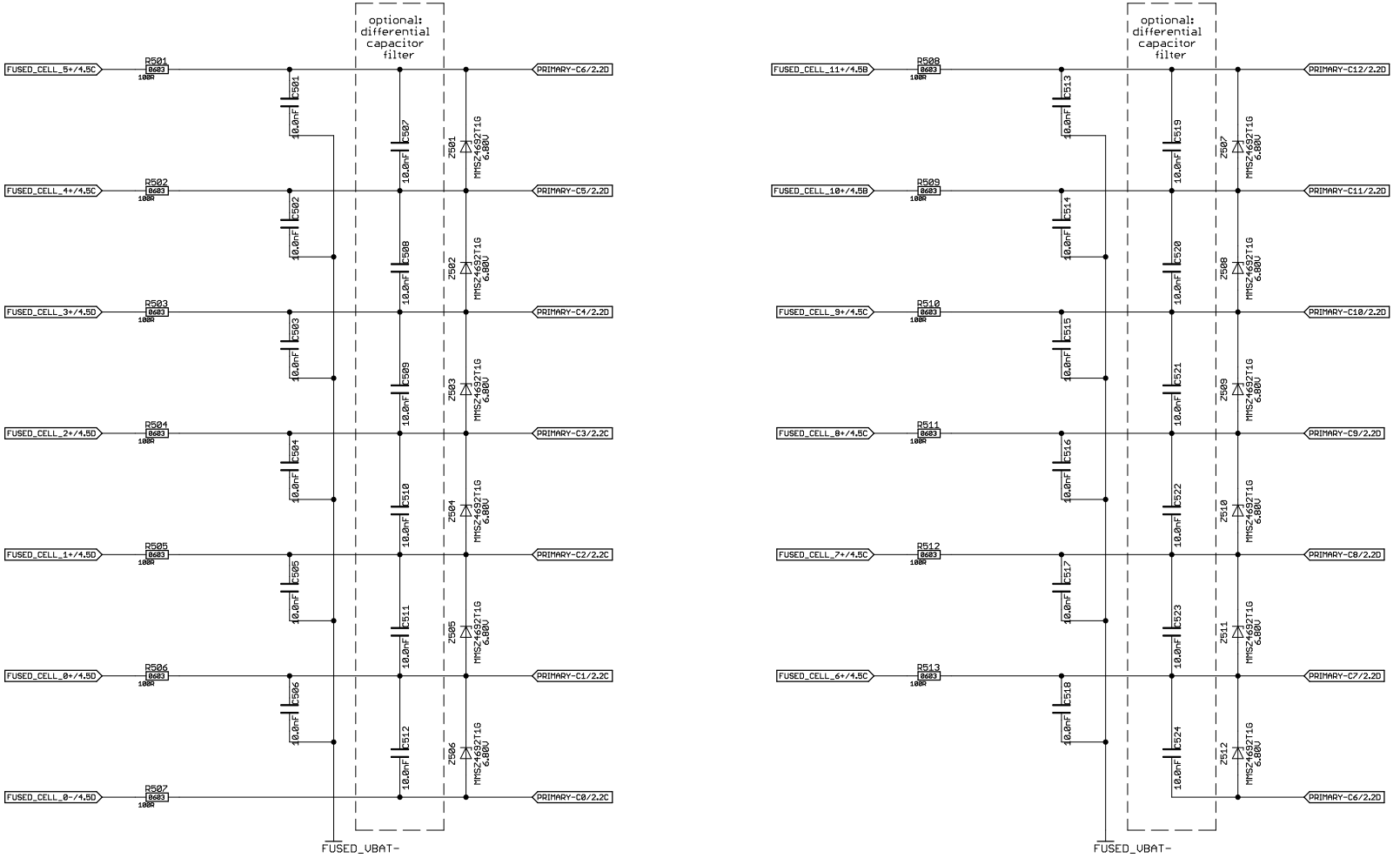
TITLE: foxBMS BMS-Slave 12-Cell		
DESCRIPTION: Secondary LTC6804/11		
FILENAME: foxBMS_BMS-Slave_12cell		
AUTHOR: Fraunhofer IISB foxBMS Team LICENSE: Creative Commons Attribution 4.0		
DATE: 2017-04-13	VERSION: 2.0.3	SHEET: 3/16



For Cell Balancing/ Measuring Inputs: Max. 0.250A Balancing Current
Reaction Time:
200% Load (0.500A) = ca. 20ms
300% Load (0.750A) = <10ms

For Power Supply Inputs: Max. 0.500A Current
Reaction Time:
200% Load (1.000A) = ca. 200ms
300% Load (1.500A) = ca. 70ms

TITLE: foxBMS BMS-Slave 12-Cell DESCRIPTION: Cell Voltage Sense Fuses		
FILENAME: foxBMS_BMS-Slave_12cell		
AUTHOR: Fraunhofer IISB foxBMS Team LICENSE: Creative Commons Attribution 4.0		
DATE: 2017-04-13	VERSION: 2.0.3	SHEET: 4/16

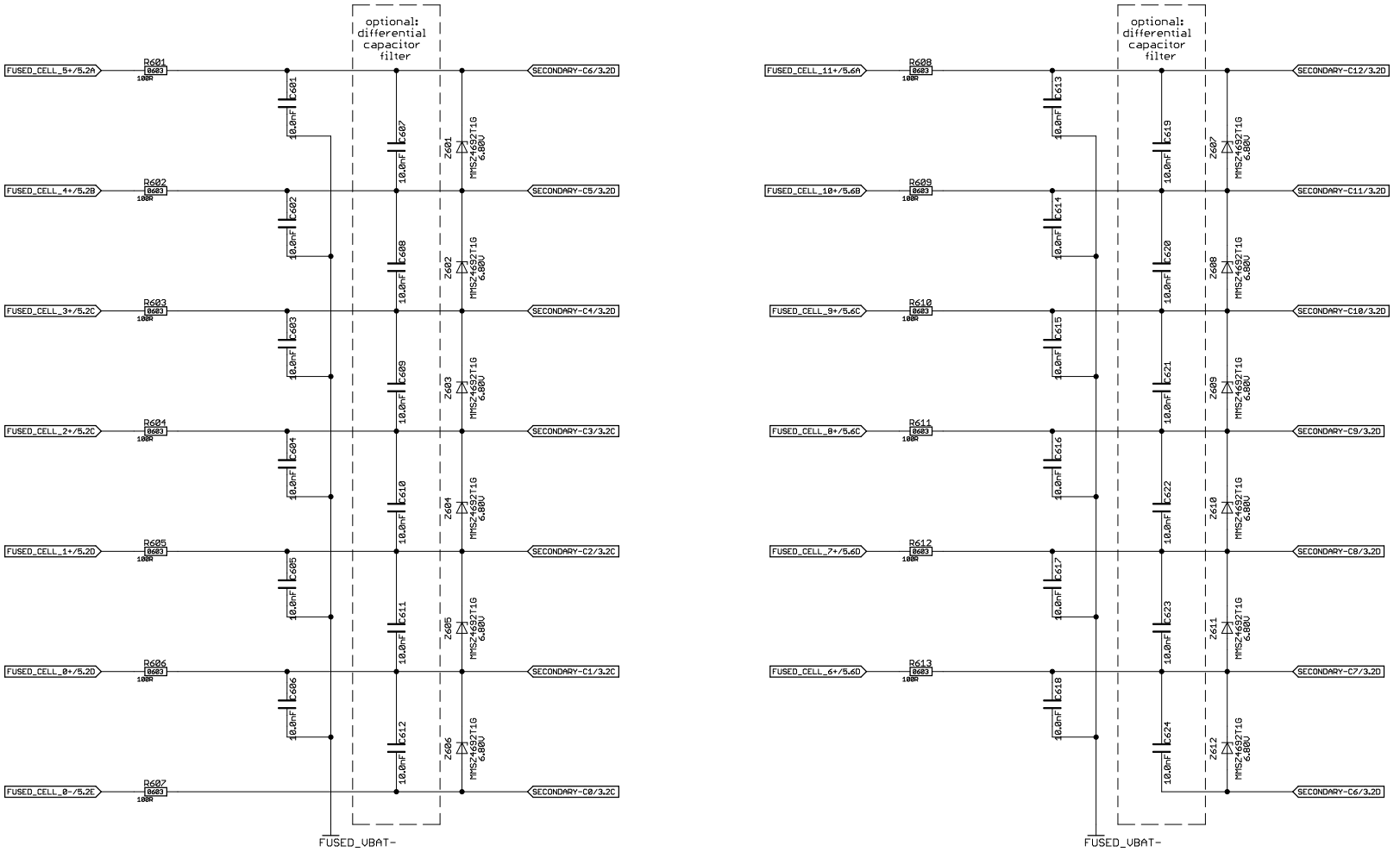


-3dB corner frequency of LTC6804 internal digital low-pass filter:
fast mode: 27kHz
normal mode: 6.8kHz
filtered mode: 26Hz

Grounded capacitor low-pass filter:
C = 100nF -> fg = 16kHz
C = 22nF -> fg = 72kHz
C = 10nF -> fg = 160kHz (recommended)

Differential capacitor low-pass filter (lower cost):
C = 100nF -> fg = 11kHz
C = 22nF -> fg = 50kHz
C = 10nF -> fg = 112kHz

TITLE: foxBMS BMS-Slave 12-Cell		
DESCRIPTION: Primary Voltage Measurement		
FILENAME: foxBMS_BMS-Slave_12cell		
AUTHOR: Fraunhofer IISB foxBMS Team LICENSE: Creative Commons Attribution 4.0		
DATE: 2017-04-13	VERSION: 2.0.3	SHEET: 5/16

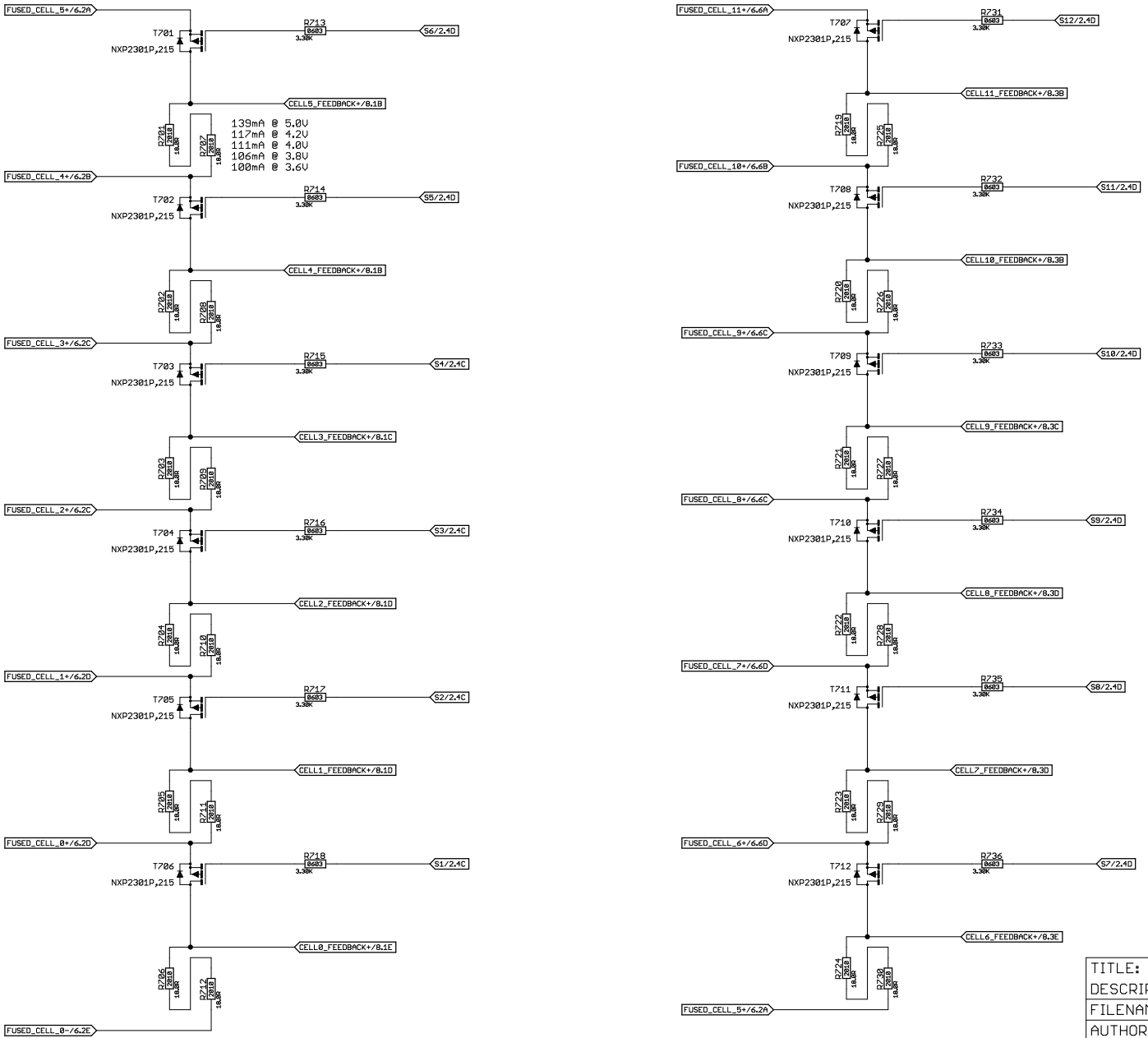


-3dB corner frequency of LTC6804 internal digital low-pass filter:
fast mode: 27kHz
normal mode: 6.8kHz
filtered mode: 26Hz

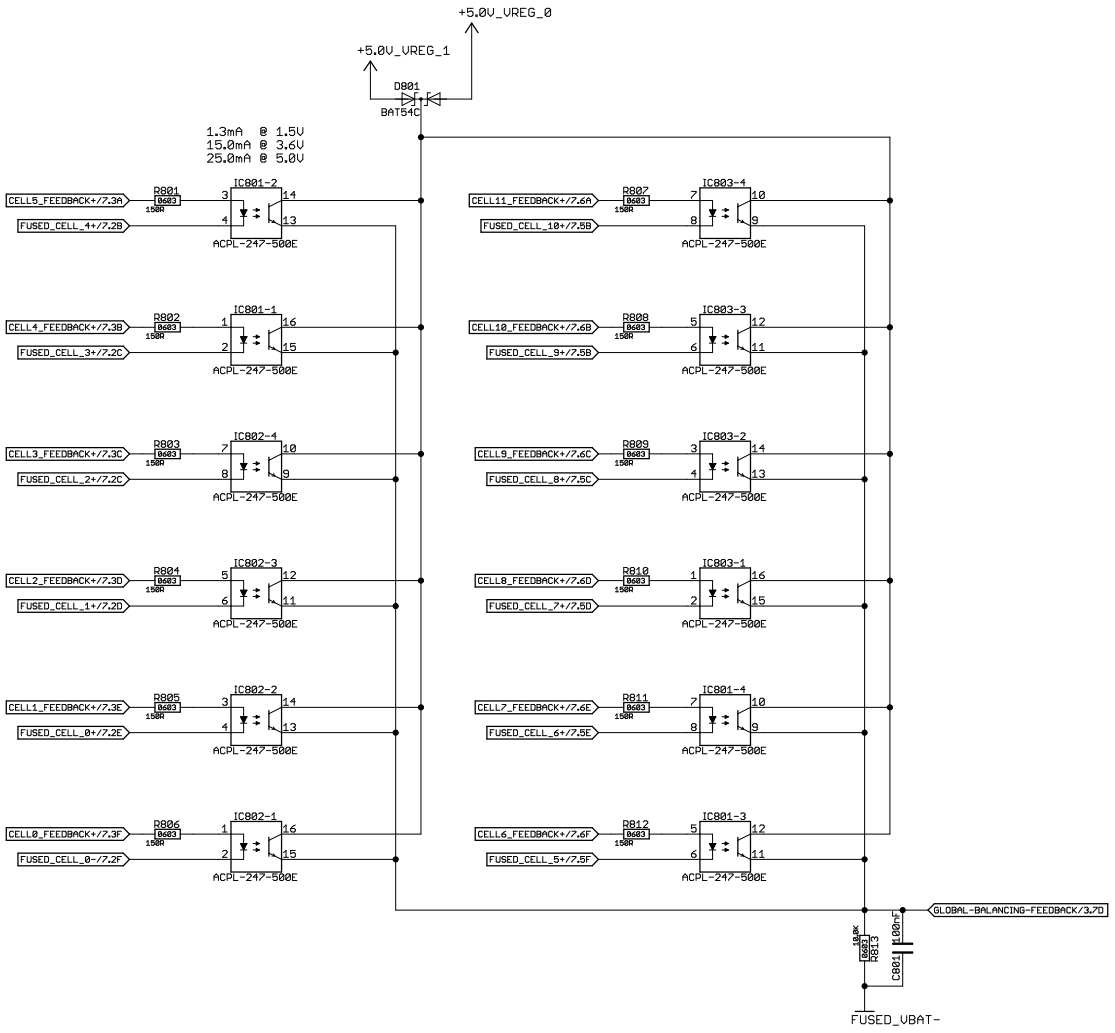
Grounded capacitor low-pass filter:
C = 100nF -> fg = 16kHz
C = 22nF -> fg = 72kHz
C = 10nF -> fg = 160kHz (recommended)

Differential capacitor low-pass filter (lower cost):
C = 100nF -> fg = 11kHz
C = 22nF -> fg = 50kHz
C = 10nF -> fg = 112kHz

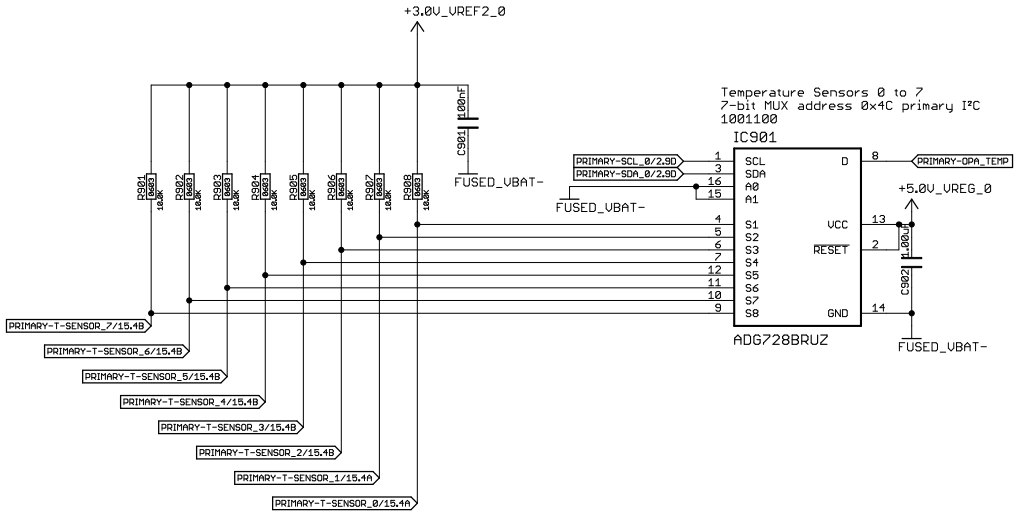
TITLE: foxBMS BMS-Slave 12-Cell		
DESCRIPTION: Secondary Voltage Measurement		
FILENAME: foxBMS_BMS-Slave_12cell		
AUTHOR: Fraunhofer IISB foxBMS Team LICENSE: Creative Commons Attribution 4.0		
DATE: 2017-04-13	VERSION: 2.0.3	SHEET: 6/16

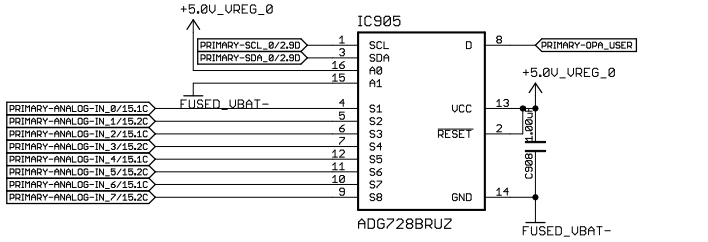


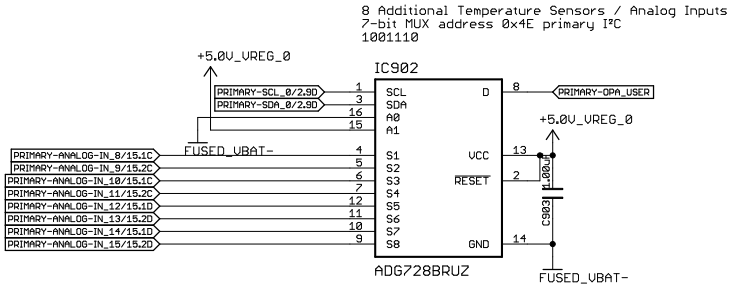
TITLE: foxBMS BMS-Slave 12-Cell DESCRIPTION: Passive Cell Balancing		
FILENAME: foxBMS_BMS-Slave_12cell		
AUTHOR: Fraunhofer IISB foxBMS Team LICENSE: Creative Commons Attribution 4.0		
DATE: 2017-04-13	VERSION: 2.0.3	SHEET: 7/16

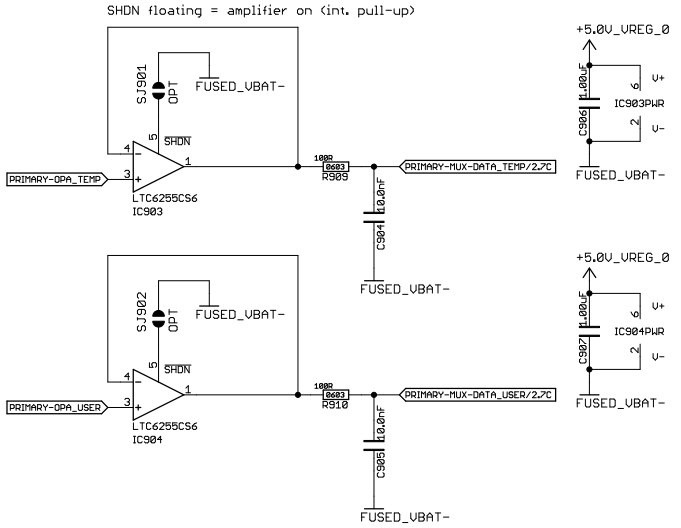


TITLE: foxBMS BMS-Slave 12-Cell		
DESCRIPTION: Passive Balancing Feedback		
FILENAME: foxBMS_BMS-Slave_12cell		
AUTHOR: Fraunhofer IISB foxBMS Team LICENSE: Creative Commons Attribution 4.0		
DATE: 2017-04-13	VERSION: 2.0.3	SHEET: 8/16

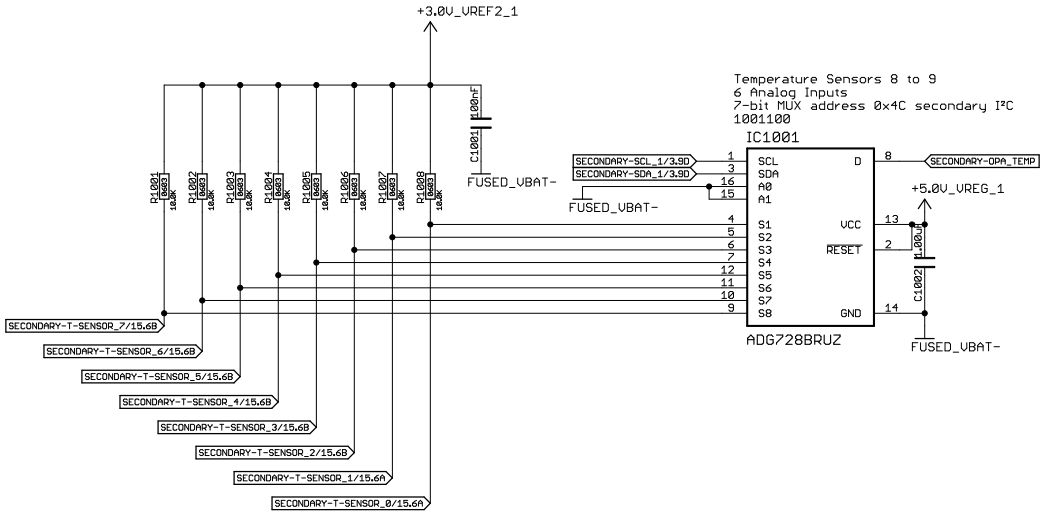


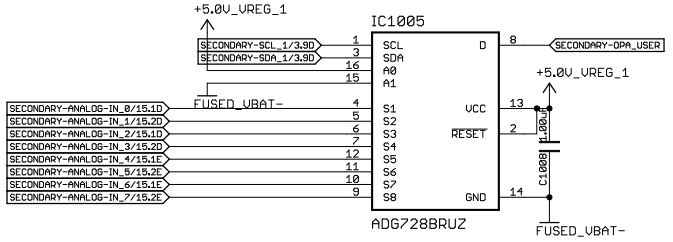


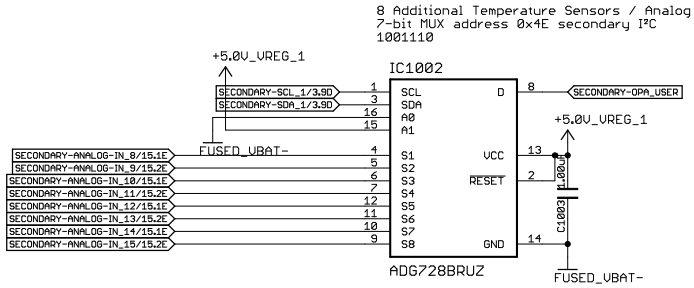


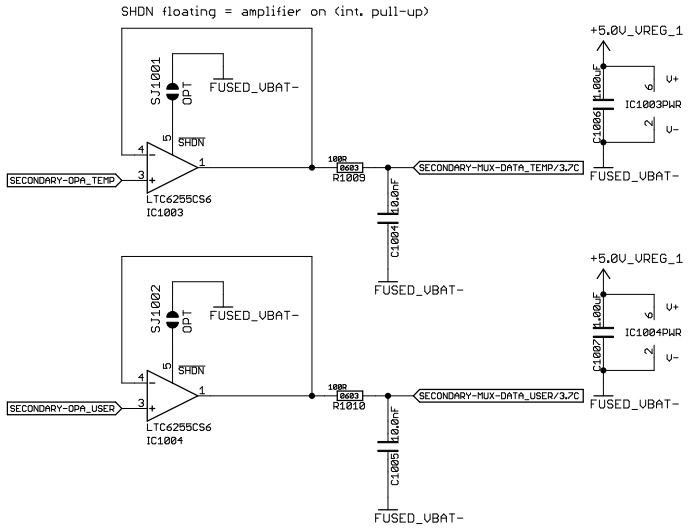


TITLE: foxBMS BMS-Slave 12-Cell DESCRIPTION: Primary Analog Inputs		
FILENAME: foxBMS_BMS-Slave_12cell		
AUTHOR: Fraunhofer IISB foxBMS Team LICENSE: Creative Commons Attribution 4.0		
DATE: 2017-04-13	VERSION: 2.0.3	SHEET: 9/16

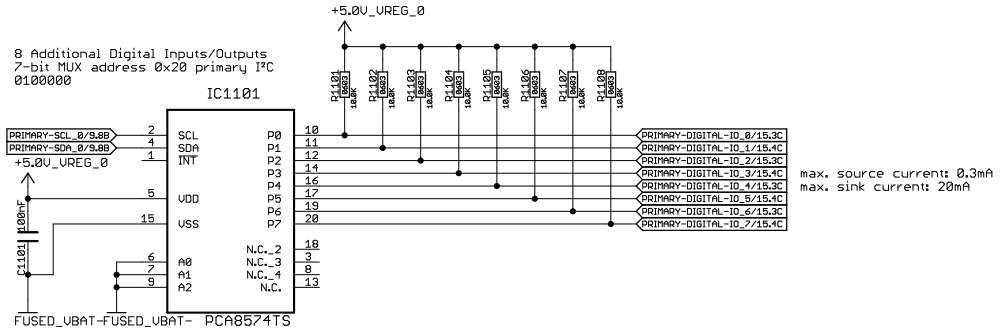




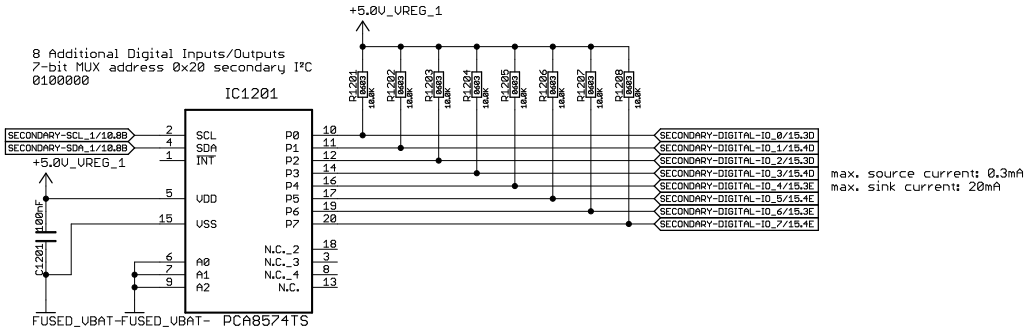




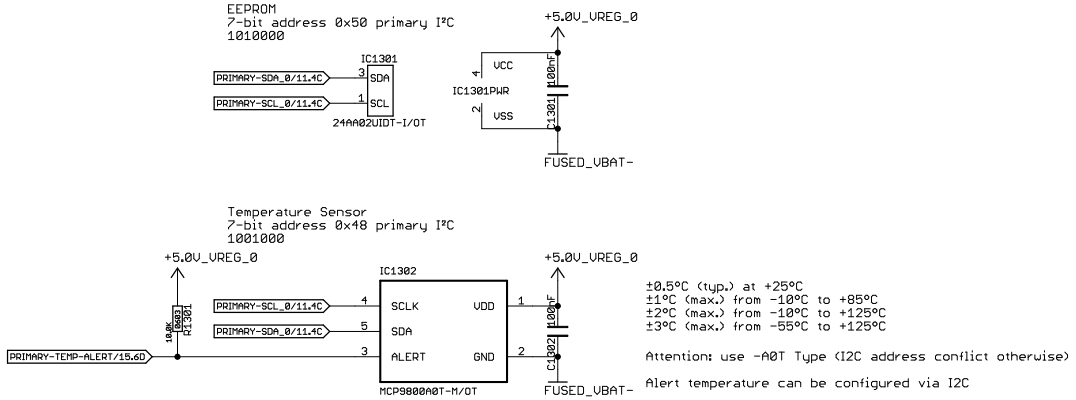
TITLE: foxBMS BMS-Slave 12-Cell		
DESCRIPTION: Secondary Analog Inputs		
FILENAME: foxBMS_BMS-Slave_12cell		
AUTHOR: Fraunhofer IISB foxBMS Team LICENSE: Creative Commons Attribution 4.0		
DATE: 2017-04-13	VERSION: 2.0.3	SHEET: 10/16



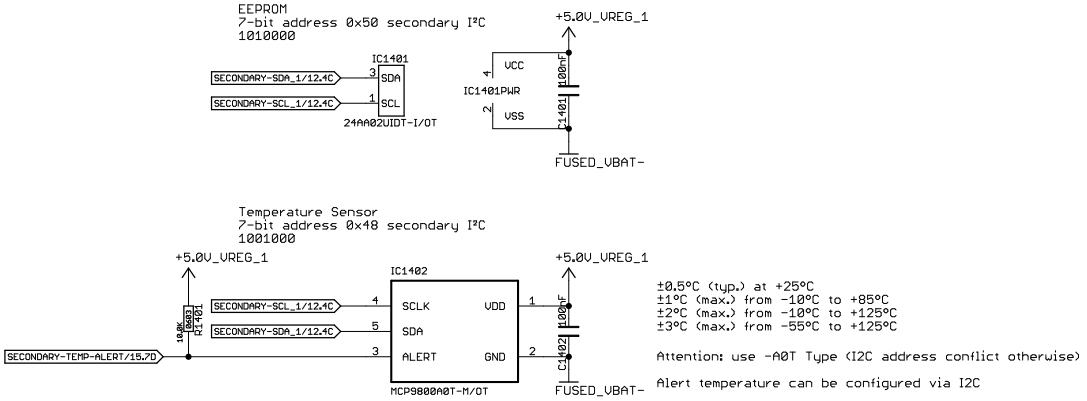
TITLE: foxBMS BMS-Slave 12-Cell		
DESCRIPTION: Primary Digital Inputs/Outputs		
FILENAME: foxBMS_BMS-Slave_12cell		
AUTHOR: Fraunhofer IISB foxBMS Team LICENSE: Creative Commons Attribution 4.0		
DATE: 2017-04-13	VERSION: 2.0.3	SHEET: 11/16



TITLE: foxBMS BMS-Slave 12-Cell		
DESCRIPTION: Secondary Digital Inputs/Outputs		
FILENAME: foxBMS_BMS-Slave_12cell		
AUTHOR: Fraunhofer IISB foxBMS Team LICENSE: Creative Commons Attribution 4.0		
DATE: 2017-04-13	VERSION: 2.0.3	SHEET: 12/16



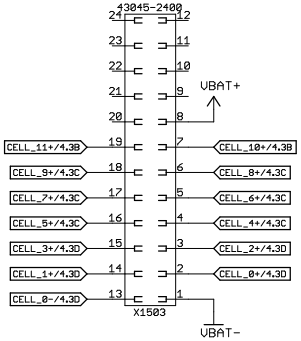
TITLE: foxBMS BMS-Slave 12-Cell DESCRIPTION: Primary EEPROM and Board T-Sensor		
FILENAME: foxBMS_BMS-Slave_12cell		
AUTHOR: Fraunhofer IISB foxBMS Team LICENSE: Creative Commons Attribution 4.0		
DATE: 2017-04-13	VERSION: 2.0.3	SHEET: 13/16



TITLE: foxBMS BMS-Slave 12-Cell DESCRIPTION: Secondary EEPROM and Board T-Sensor		
FILENAME: foxBMS_BMS-Slave_12cell		
AUTHOR: Fraunhofer IISB foxBMS Team LICENSE: Creative Commons Attribution 4.0		
DATE: 2017-04-13	VERSION: 2.0.3	SHEET: 14/16

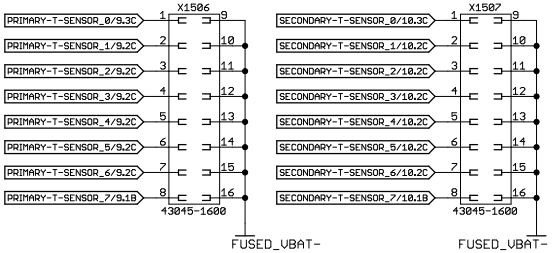
Batterie Cell Voltage Sense Connector

24p connector equal for 12/15/18/20 cell version



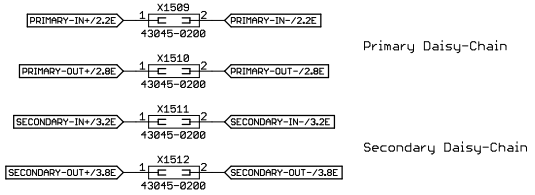
Temperature Sensor Connector

2x 16p connector equal for 12/15/18/20 cell version

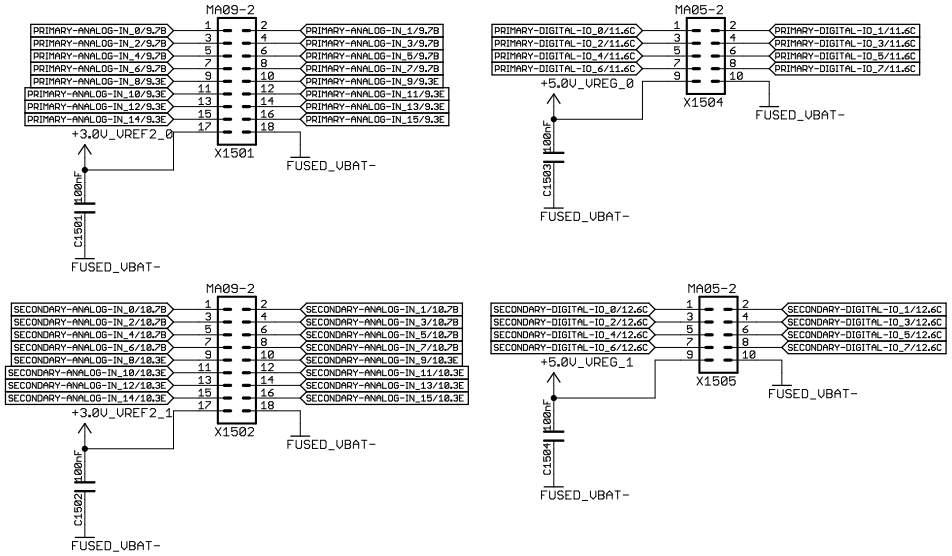


Daisy Chain Connectors

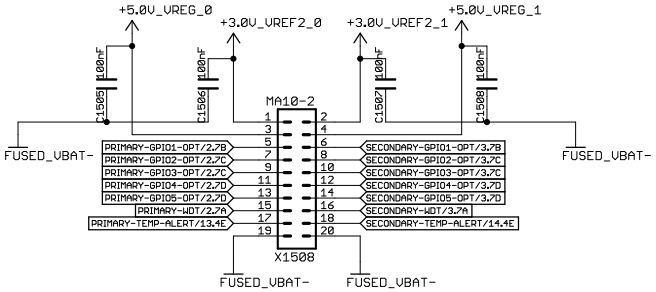
4x 2p connector equal for 12/15/18/20 cell version



Pin-Header for additional analog and digital inputs/outputs



GPIO Extension Connector



TITLE: foxBMS BMS-Slave 12-Cell		
DESCRIPTION: Connectors		
FILENAME: foxBMS_BMS-Slave_12cell		
AUTHOR: Fraunhofer IISB foxBMS Team LICENSE: Creative Commons Attribution 4.0		
DATE: 2017-04-13	VERSION: 2.0.3	SHEET: 15/16

Version	Date	Editor	Comment
2.00	2016-09-29	Sebastian Wacker	Initial Version
2.01	2016-11-15	Sebastian Wacker	Added missing cooling areas on bottom side, adjusted silk screen Enlarged PCB tracks, R201/202/301/302 other package Enlarged T201/301 cooling area Replaced PCF8574 with PCA8574 (400 kHz I2C)
2.02	2016-11-24	Sebastian Wacker	Replaced LTC1380 MUXs with ADG728 (400 kHz I2C) Adjusted connection of 100 ohm resistors for V+ / V_REG supply Reduced value of I2C pullups to 1k2
2.03	2017-04-13	Sebastian Wacker	fixed isoSPI transformer CMC issue

Device	I2C Address (without R/W bit)	max. I2C clock
MUX Temp. Sens. 0-7	0x4C	400 kHz
MUX Analog In 0-7	0x4D	400 kHz
MUX Analog In 8-15	0x4E	400 kHz
Port Expander	0x20	400 kHz
EEPROM	0x50	400 kHz
Board Temp. Sens.	0x48	400 kHz

TITLE: foxBMS BMS-Slave 12-Cell DESCRIPTION: Changelog		
FILENAME: foxBMS_BMS-Slave_12cell		
AUTHOR: Fraunhofer IISB foxBMS Team LICENSE: Creative Commons Attribution 4.0		
DATE: 2017-04-13	VERSION: 2.0.3	SHEET: 16/16