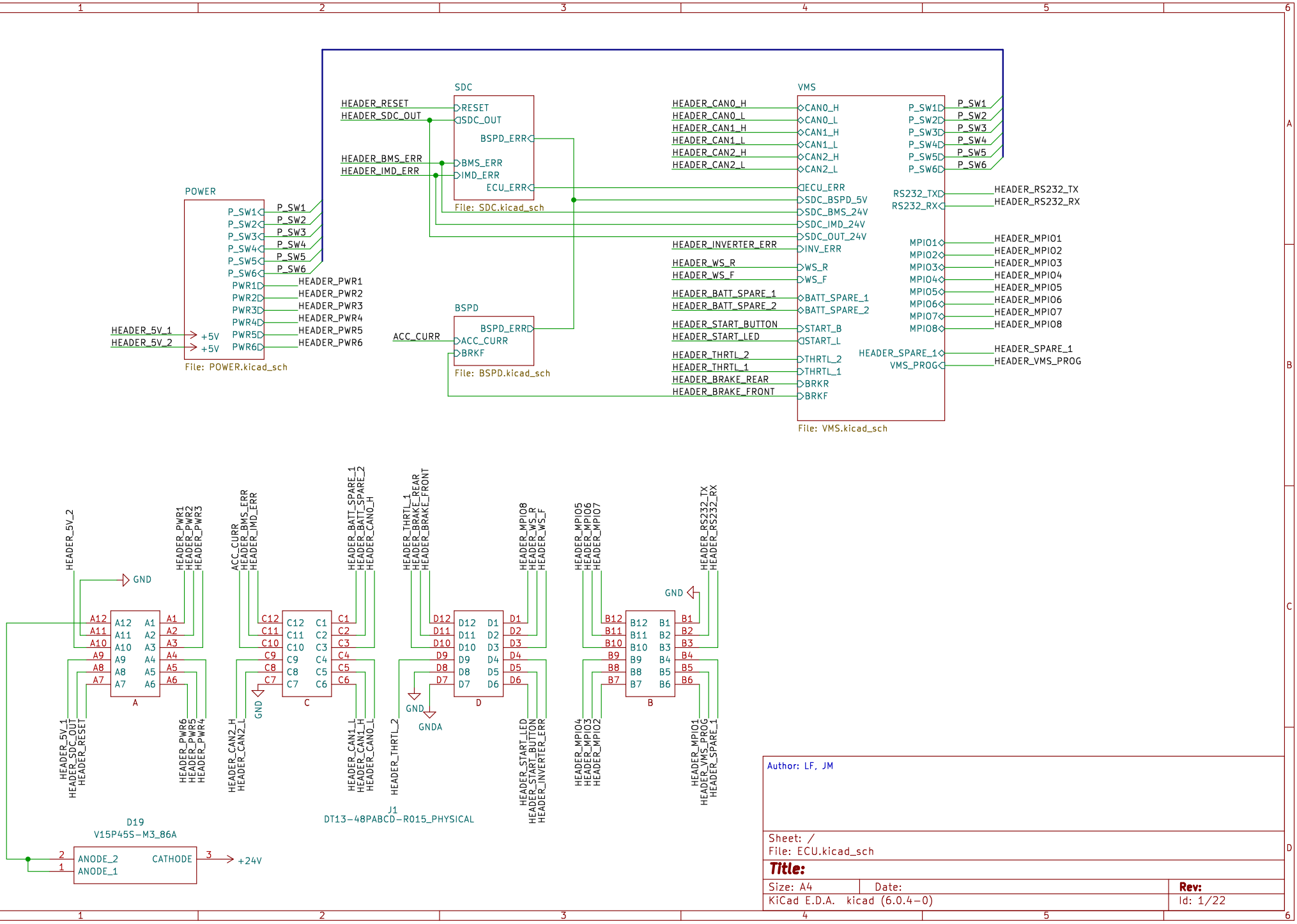
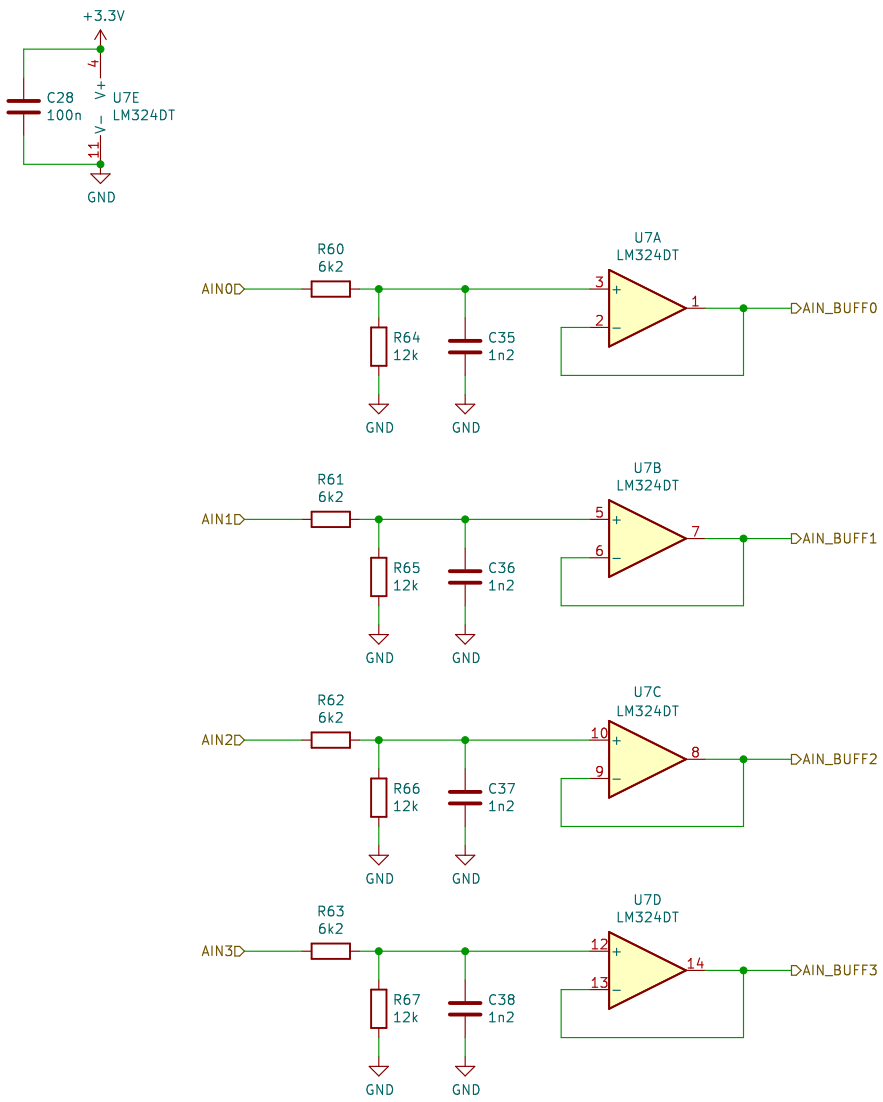

SDC
HEADER_RESET
HEADER_SDC_OUT
HEADER_BMS_ERR
HEADER_IMD_ERR
RESET
SDC_OUT
BSPD_ERR
BMS_ERR
IMD_ERR
ECU_ERR
File: SDC.kicad_sch
POWER
P_SW1
P_SW2
P_SW3
P_SW4
P_SW5
P_SW6
PWR1
PWR2
PWR3
PWR4
PWR5
PWR6
HEADER_PWR1
HEADER_PWR2
HEADER_PWR3
HEADER_PWR4
HEADER_PWR5
HEADER_PWR6
HEADER_5V_1
HEADER_5V_2
+5V
+5V
File: POWER.kicad_sch
BSPD
ACC_CURR
BSPD_ERR
ACC_CURR
BRKF
File: BSPD.kicad_sch
VMS
HEADER_CAN0_H
HEADER_CAN0_L
HEADER_CAN1_H
HEADER_CAN1_L
HEADER_CAN2_H
HEADER_CAN2_L
CAN0_H
CAN0_L
CAN1_H
CAN1_L
CAN2_H
CAN2_L
ECU_ERR
SDC_BSPD_5V
SDC_BMS_24V
SDC_IMD_24V
SDC_OUT_24V
HEADER_INVERTER_ERR
INV_ERR
HEADER_WS_R
HEADER_WS_F
WS_R
WS_F
HEADER_BATT_SPARE_1
HEADER_BATT_SPARE_2
BATT_SPARE_1
BATT_SPARE_2
HEADER_START_BUTTON
HEADER_START_LED
START_B
START_L
HEADER_THRTL_2
HEADER_THRTL_1
HEADER_BRAKE_REAR
HEADER_BRAKE_FRONT
THRTL_2
THRTL_1
BRKR
BRKF
P_SW1
P_SW2
P_SW3
P_SW4
P_SW5
P_SW6
RS232_TX
RS232_RX
HEADER_RS232_TX
HEADER_RS232_RX
MPIO1
MPIO2
MPIO3
MPIO4
MPIO5
MPIO6
MPIO7
MPIO8
HEADER_MPIO1
HEADER_MPIO2
HEADER_MPIO3
HEADER_MPIO4
HEADER_MPIO5
HEADER_MPIO6
HEADER_MPIO7
HEADER_MPIO8
HEADER_SPARE_1
VMS_PROG
HEADER_SPARE_1
HEADER_VMS_PROG
File: VMS.kicad_sch
HEADER_5V_2
GND
HEADER_PWR1
HEADER_PWR2
HEADER_PWR3
A
HEADER_5V_1
HEADER_SDC_OUT
HEADER_RESET
HEADER_PWR6
HEADER_PWR5
HEADER_PWR4
ACC_CURR
HEADER_BMS_ERR
HEADER_IMD_ERR
HEADER_BATT_SPARE_1
HEADER_BATT_SPARE_2
HEADER_CAN0_H
C
GND
HEADER_CAN2_H
HEADER_CAN2_L
HEADER_CAN1_L
HEADER_CAN1_H
HEADER_CAN0_L
HEADER_THRTL_1
HEADER_BRAKE_REAR
HEADER_BRAKE_FRONT
D
GND
GNDA
HEADER_THRTL_2
HEADER_MPIO8
HEADER_WS_R
HEADER_WS_F
HEADER_START_LED
HEADER_START_BUTTON
HEADER_INVERTER_ERR
HEADER_MPIO5
HEADER_MPIO6
HEADER_MPIO7
GND
B
HEADER_MPIO4
HEADER_MPIO3
HEADER_MPIO2
HEADER_RS232_TX
HEADER_RS232_RX
HEADER_MPIO1
HEADER_VMS_PROG
HEADER_SPARE_1
J1
DT13-48PABCD-R015_PHYSICAL
D19
V15P45S-M3_86A
ANODE_2
ANODE_1
CATHODE
+24V
Author: LF, JM
Sheet: /
File: ECU.kicad_sch
Title:
Size: A4
Date:
Rev:
KiCad E.D.A. kicad (6.0.4-0)
Id: 1/22

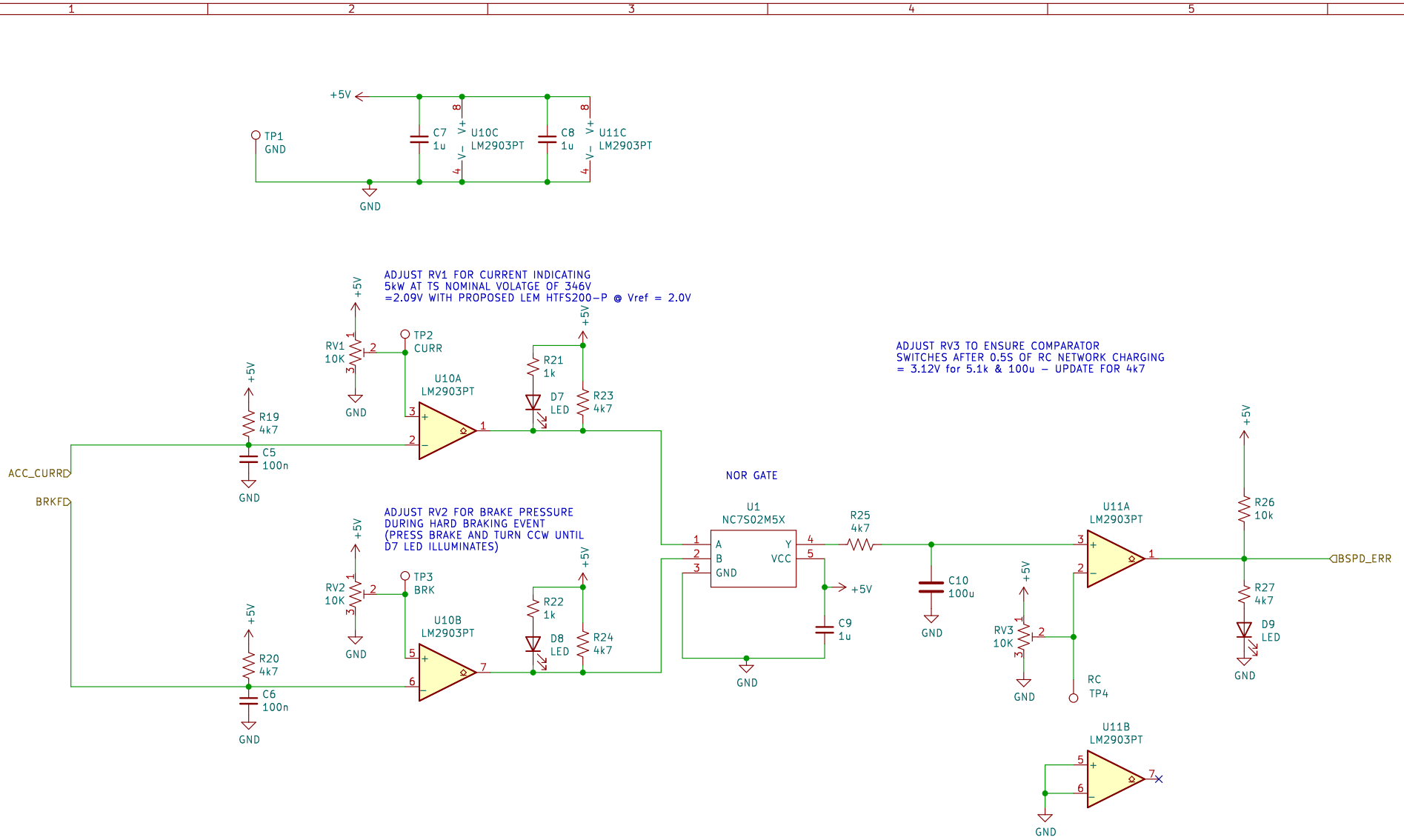



0-5V to 0-3.3V (0.66G ideally) and pulled down on input

6k2 & 12k => 0.659G (5V -> 3.297V)

1n2 gives F_c at 20kHz

| | | |
|---|---|---|
| Author: LF | | |
| Sheet: /VMS/AIN/<br>File: VMS_AIN.kicad_sch | | |
| **Title:** | | |
| Size: A4 | Date: | **Rev:** |
| KiCad E.D.A. kicad (6.0.4-0) | | Id: 2/22 |

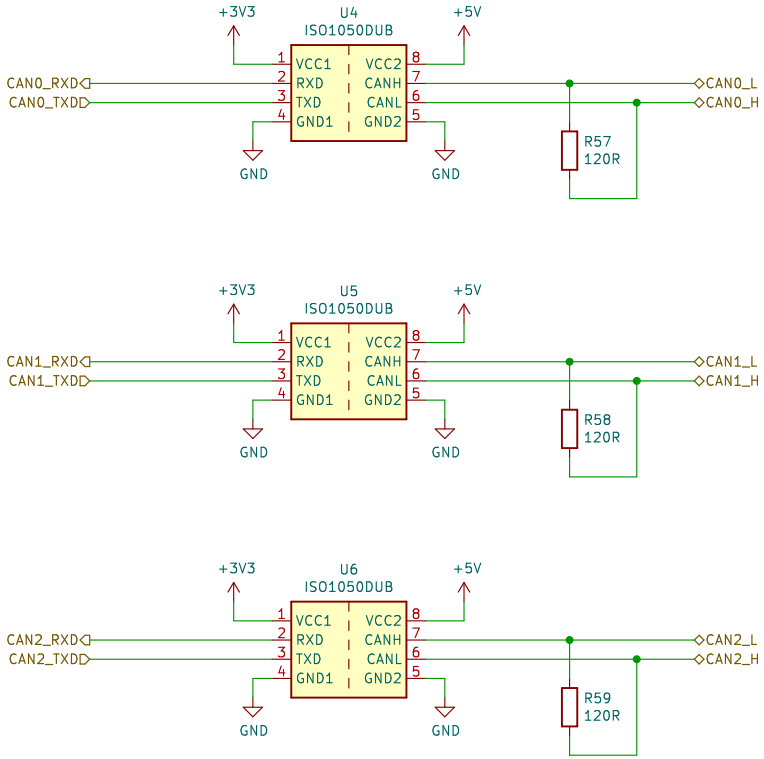



Author: JM

Sheet: /BSPD/
File: BSPD.kicad_sch

**Title:**

Size: A4 | Date: | **Rev:**
KiCad E.D.A. kicad (6.0.4-0) | Id: 3/22

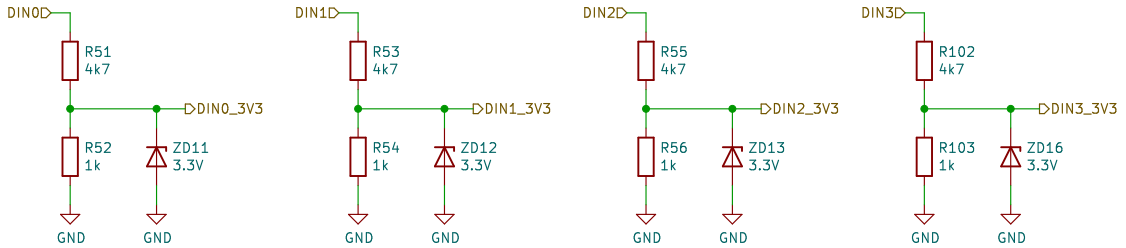



Author: LF

Sheet: /VMS/CAN/
File: VMS_CAN.kicad_sch

**Title:**

| Size: A4 | Date: | **Rev:** |
|---|---|---|
| KiCad E.D.A. kicad (6.0.4-0) | | Id: 4/22 |



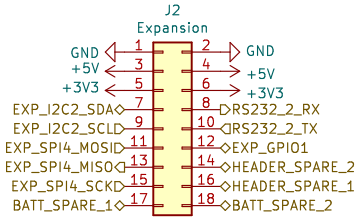

0-24V level digital input => 0-3.3V digital output

Author: LF

Sheet: /VMS/DIN/
File: VMS_DIN.kicad_sch

**Title:**

| Size: A4 | Date: | **Rev:** |
|---|---|---|
| KiCad E.D.A. kicad (6.0.4-0) | | Id: 5/22 |





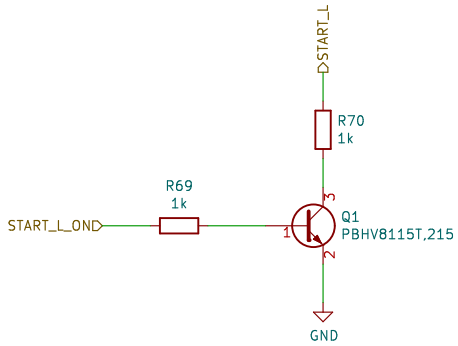
Author: LF

Sheet: /VMS/ExpansionHeaders/
File: VMS_Expansion.kicad_sch

**Title:**

| Size: A4 | Date: | **Rev:** |
|---|---|---|
| KiCad E.D.A. kicad (6.0.4-0) | | Id: 6/22 |

STARTL_ON is a 3V3 signal from MCU
STARTL is the output to be in series with the LED on dash

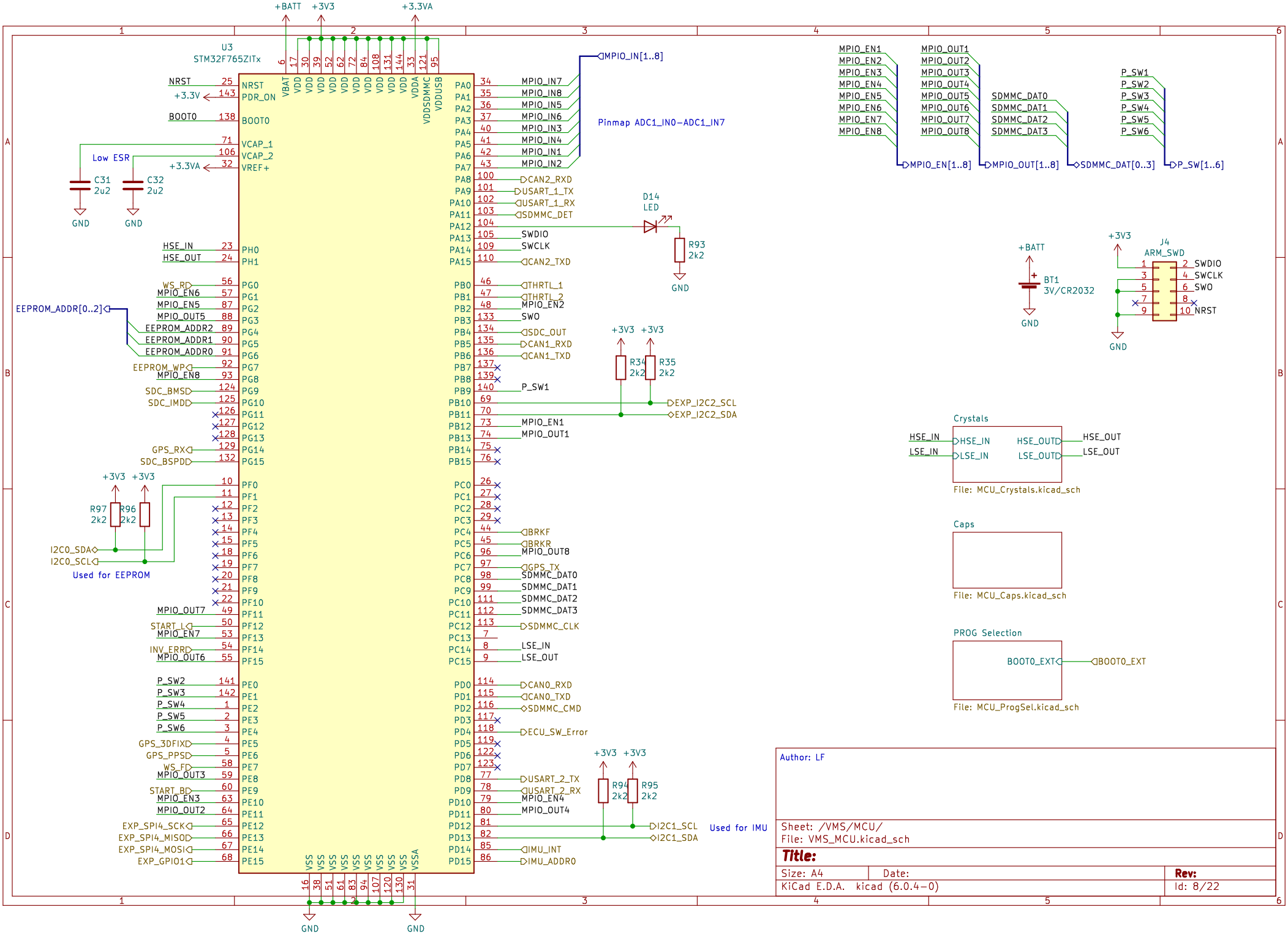



TODO
* Resistor sizing
* Test
* Is this BJT part ok? Change to something JLC has?

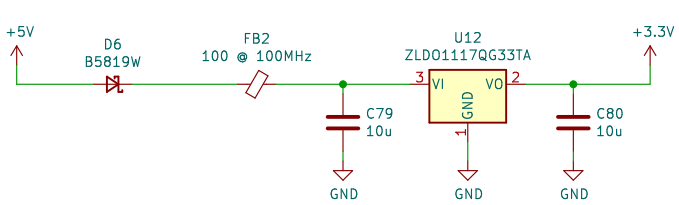
Sheet: /VMS/LEDDriver/
File: VMS_LEDDriver.kicad_sch

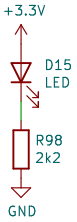
**Title:**

| Size: A4 | Date: | **Rev:** |
|---|---|---|
| KiCad E.D.A. kicad (6.0.4-0) | | Id: 7/22 |

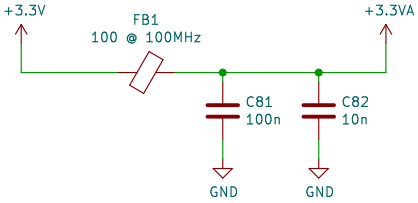

+BATT
+3V3
+3.3VA
U3
STM32F765ZITx
NRST
BOOT0
VCAP_1
VCAP_2
VREF+
Low ESR
C31
2u2
C32
2u2
GND
HSE_IN
HSE_OUT
EEPROM_ADDR[0..2]
EEPROM_ADDR2
EEPROM_ADDR1
EEPROM_ADDR0
EEPROM_WP
SDC_BMS
SDC_IMD
GPS_RX
SDC_BSPD
R97
2k2
R96
2k2
I2C0_SDA
I2C0_SCL
Used for EEPROM
MPIO_OUT7
START_L
INV_ERR
P_SW2
P_SW3
P_SW4
P_SW5
P_SW6
GPS_3DFIX
GPS_PPS
WS_FD
START_B
EXP_SPI4_SCK
EXP_SPI4_MISO
EXP_SPI4_MOSI
EXP_GPIO1
MPIO_IN[1..8]
Pinmap ADC1_IN0-ADC1_IN7
CAN2_RXD
USART_1_TX
USART_1_RX
SDMMC_DET
D14
LED
R93
2k2
SWDIO
SWCLK
CAN2_TXD
THRTL_1
THRTL_2
SWO
SDC_OUT
CAN1_RXD
CAN1_TXD
R34
2k2
R35
2k2
P_SW1
EXP_I2C2_SCL
EXP_I2C2_SDA
BRKF
BRKR
SDMMC_DAT0
SDMMC_DAT1
SDMMC_DAT2
SDMMC_DAT3
SDMMC_CLK
LSE_IN
LSE_OUT
CAN0_RXD
CAN0_TXD
SDMMC_CMD
ECU_SW_Error
USART_2_TX
USART_2_RX
R94
2k2
R95
2k2
I2C1_SCL
I2C1_SDA
Used for IMU
IMU_INT
IMU_ADDR0
MPIO_EN1
MPIO_EN2
MPIO_EN3
MPIO_EN4
MPIO_EN5
MPIO_EN6
MPIO_EN7
MPIO_EN8
MPIO_EN[1..8]
MPIO_OUT1
MPIO_OUT2
MPIO_OUT3
MPIO_OUT4
MPIO_OUT5
MPIO_OUT6
MPIO_OUT7
MPIO_OUT8
MPIO_OUT[1..8]
SDMMC_DAT0
SDMMC_DAT1
SDMMC_DAT2
SDMMC_DAT3
SDMMC_DAT[0..3]
P_SW1
P_SW2
P_SW3
P_SW4
P_SW5
P_SW6
P_SW[1..6]
BT1
3V/CR2032
J4
ARM_SWD
SWDIO
SWCLK
SWO
NRST
Crystals
HSE_IN
LSE_IN
HSE_OUT
LSE_OUT
File: MCU_Crystals.kicad_sch
Caps
File: MCU_Caps.kicad_sch
PROG Selection
BOOT0_EXT
File: MCU_ProgSel.kicad_sch
Author: LF
Sheet: /VMS/MCU/
File: VMS_MCU.kicad_sch
Title:
Size: A4
Date:
Rev:
KiCad E.D.A. kicad (6.0.4-0)
Id: 8/22

3v3 regulator



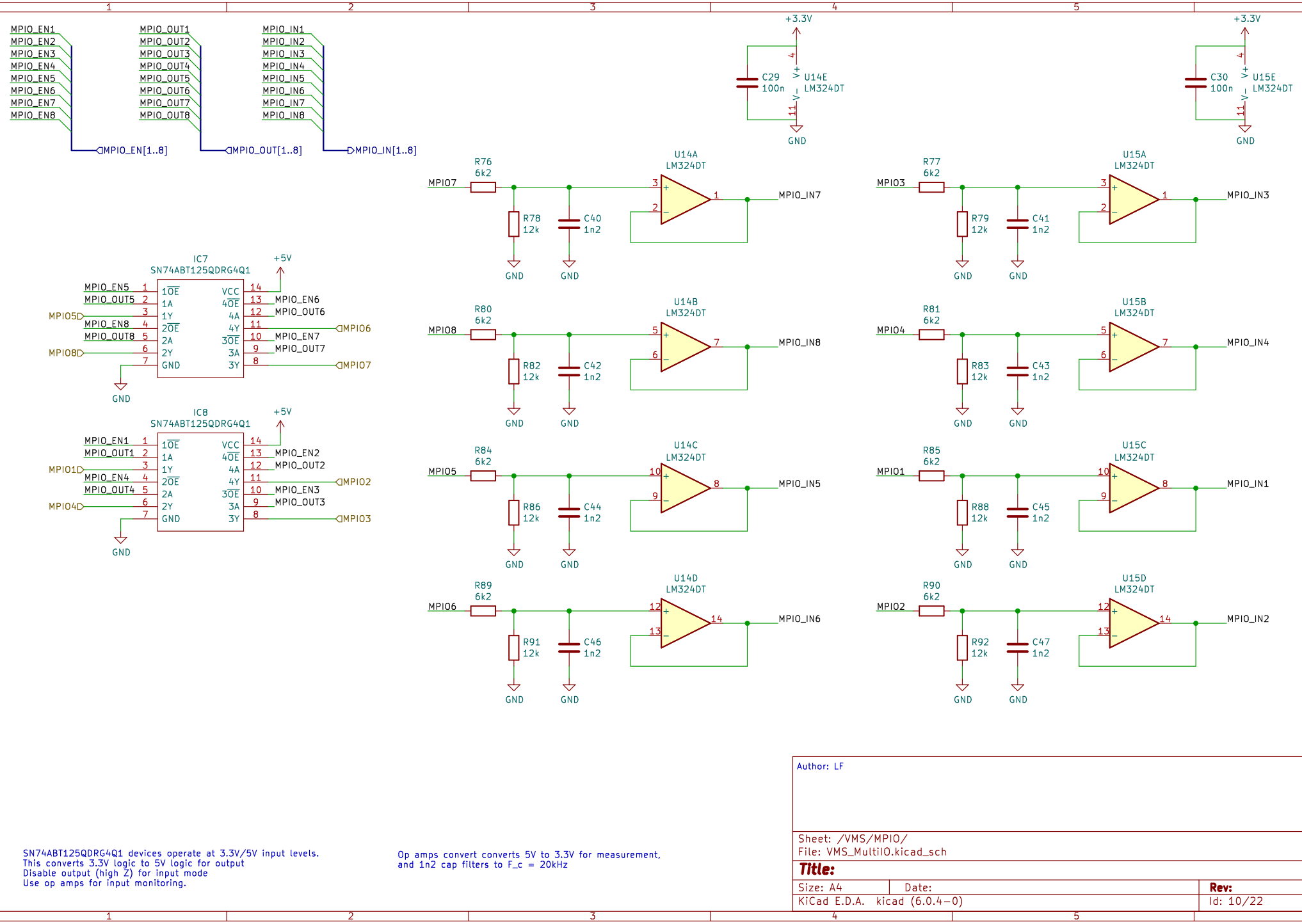




Analog reference voltage

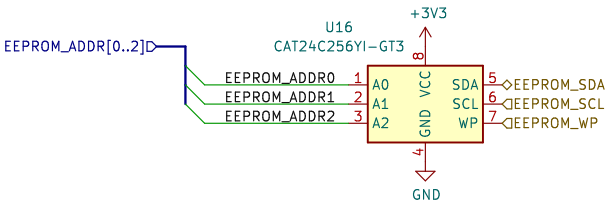



2022-10-16: Changed U12 from LM1117MPX-33NOPB (https://www.ti.com/lit/ds/symlink/lm1117.pdf) to ZLDO1117QG33TA as a equivalent part due to availablity issues.

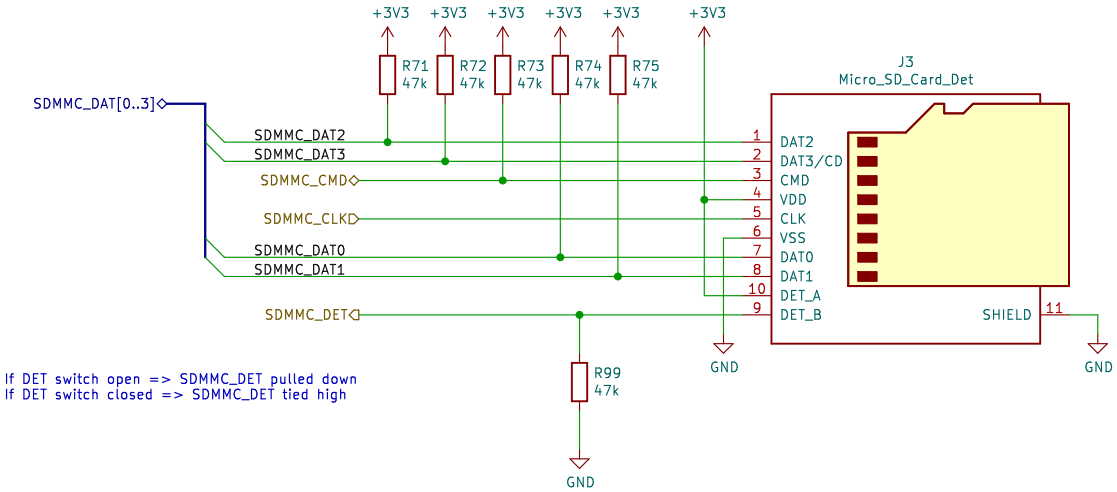
| | | |
|---|---|---|
| Author: LF | | |
| Sheet: /VMS/MCUPower/<br>File: VMS_Power.kicad_sch | | |
| **Title:** | | |
| Size: A4 | Date: | **Rev:** |
| KiCad E.D.A. kicad (6.0.4-0) | | Id: 9/22 |


MPIO_EN1
MPIO_EN2
MPIO_EN3
MPIO_EN4
MPIO_EN5
MPIO_EN6
MPIO_EN7
MPIO_EN8
MPIO_EN[1..8]
MPIO_OUT1
MPIO_OUT2
MPIO_OUT3
MPIO_OUT4
MPIO_OUT5
MPIO_OUT6
MPIO_OUT7
MPIO_OUT8
MPIO_OUT[1..8]
MPIO_IN1
MPIO_IN2
MPIO_IN3
MPIO_IN4
MPIO_IN5
MPIO_IN6
MPIO_IN7
MPIO_IN8
MPIO_IN[1..8]
+3.3V
C29
100n
U14E
LM324DT
GND
+3.3V
C30
100n
U15E
LM324DT
GND
IC7
SN74ABT125QDRG4Q1
+5V
MPIO_EN5
MPIO_OUT5
MPIO5
MPIO_EN8
MPIO_OUT8
MPIO8
GND
MPIO_EN6
MPIO_OUT6
MPIO6
MPIO_EN7
MPIO_OUT7
MPIO7
IC8
SN74ABT125QDRG4Q1
+5V
MPIO_EN1
MPIO_OUT1
MPIO1
MPIO_EN4
MPIO_OUT4
MPIO4
GND
MPIO_EN2
MPIO_OUT2
MPIO2
MPIO_EN3
MPIO_OUT3
MPIO3
R76
6k2
U14A
LM324DT
MPIO7
R78
12k
C40
1n2
GND
GND
MPIO_IN7
R77
6k2
U15A
LM324DT
MPIO3
R79
12k
C41
1n2
GND
GND
MPIO_IN3
R80
6k2
U14B
LM324DT
MPIO8
R82
12k
C42
1n2
GND
GND
MPIO_IN8
R81
6k2
U15B
LM324DT
MPIO4
R83
12k
C43
1n2
GND
GND
MPIO_IN4
R84
6k2
U14C
LM324DT
MPIO5
R86
12k
C44
1n2
GND
GND
MPIO_IN5
R85
6k2
U15C
LM324DT
MPIO1
R88
12k
C45
1n2
GND
GND
MPIO_IN1
R89
6k2
U14D
LM324DT
MPIO6
R91
12k
C46
1n2
GND
GND
MPIO_IN6
R90
6k2
U15D
LM324DT
MPIO2
R92
12k
C47
1n2
GND
GND
MPIO_IN2
SN74ABT125QDRG4Q1 devices operate at 3.3V/5V input levels.
This converts 3.3V logic to 5V logic for output
Disable output (high Z) for input mode
Use op amps for input monitoring.
Op amps convert converts 5V to 3.3V for measurement,
and 1n2 cap filters to F_c = 20kHz
Author: LF
Sheet: /VMS/MPIO/
File: VMS_MultiIO.kicad_sch
Title:
Size: A4
Date:
Rev:
KiCad E.D.A. kicad (6.0.4-0)
Id: 10/22

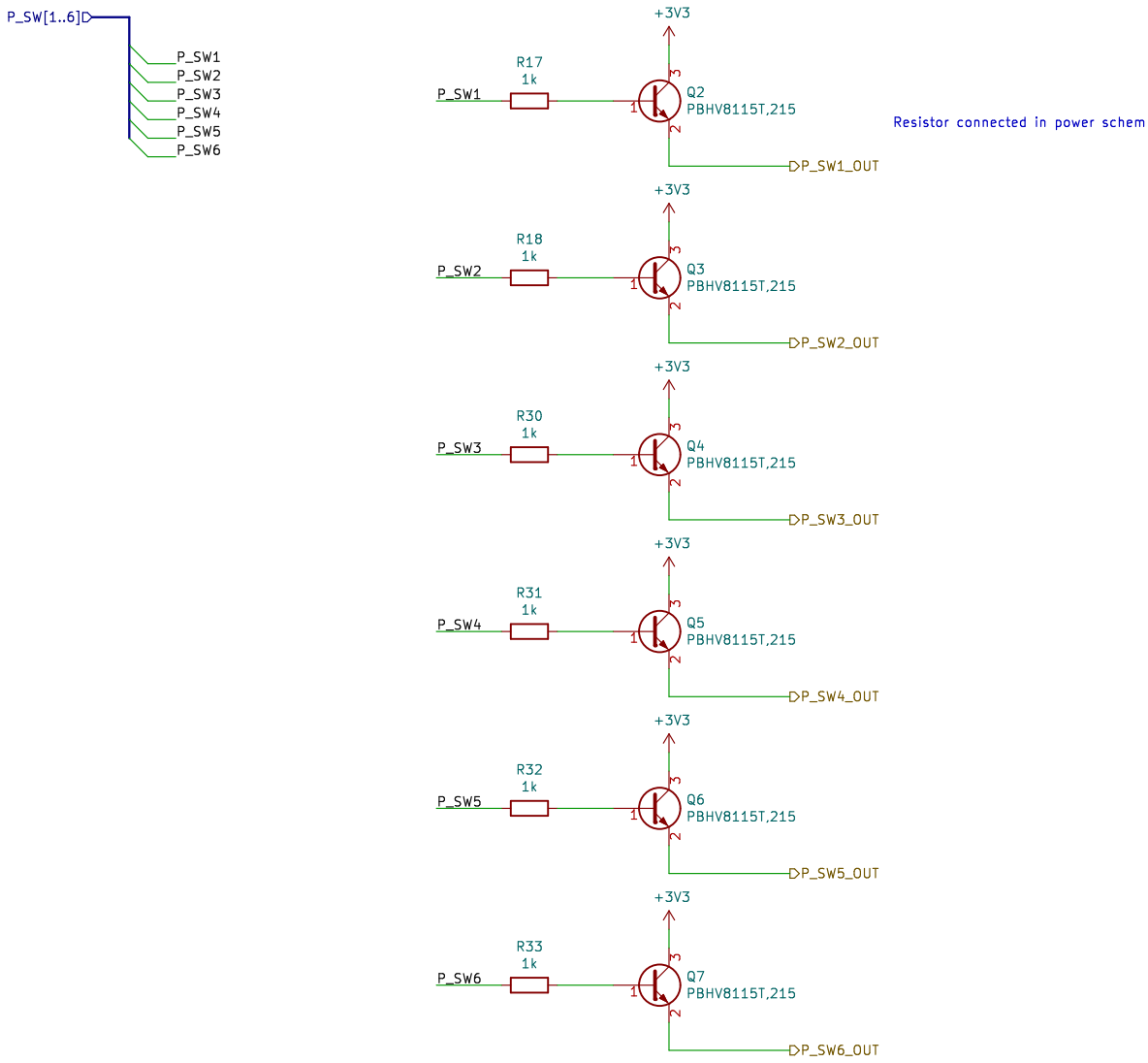
EEPROM (config data)




SD card




| | | |
|---|---|---|
| Author: LF | | |
| Sheet: /VMS/Memory/<br>File: VMS_Memory.kicad_sch | | |
| **Title:** | | |
| Size: A4 | Date: | **Rev:** |
| KiCad E.D.A. kicad (6.0.4-0) | | Id: 11/22 |

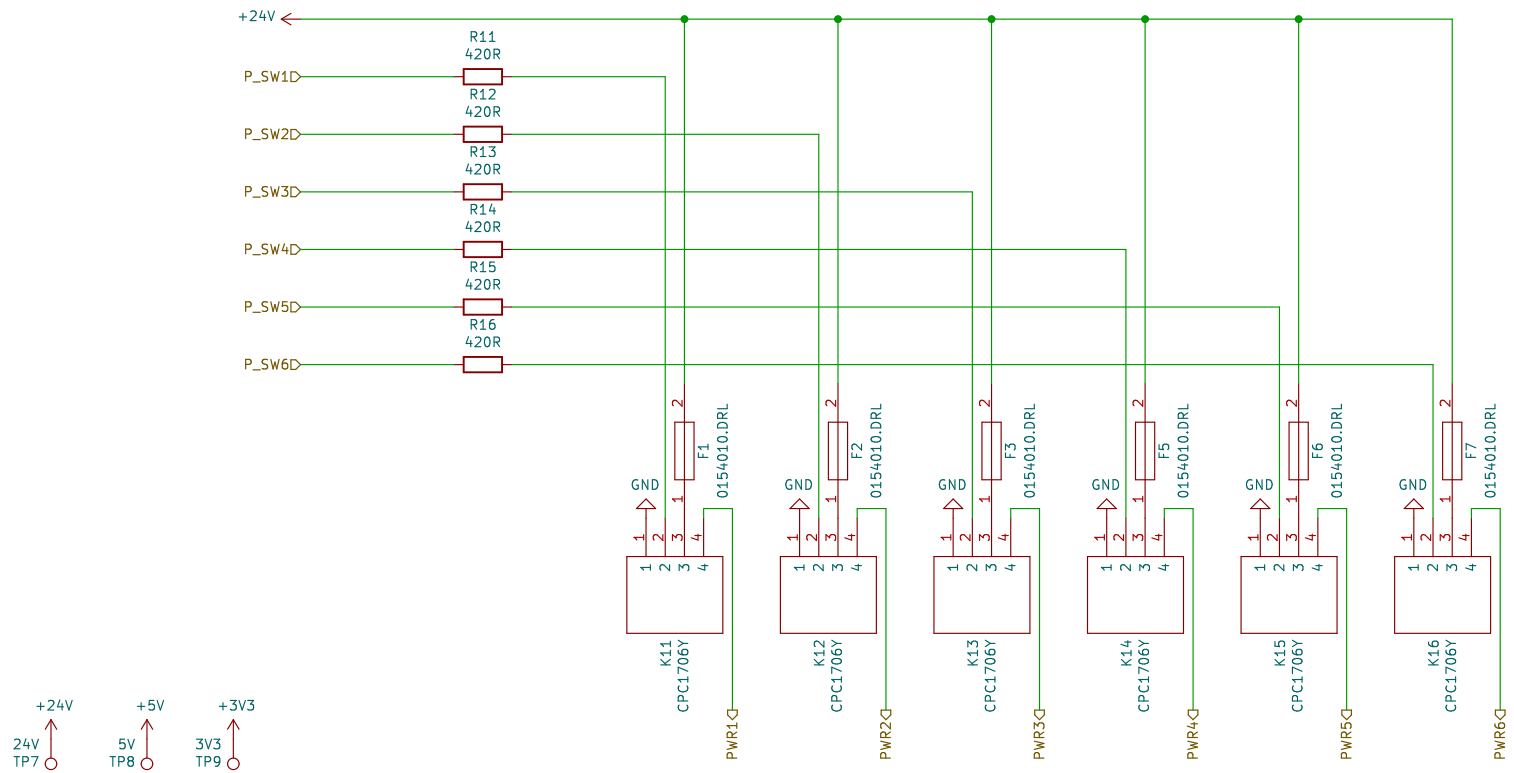



Author: LF

Sheet: /VMS/PDMSwitch/
File: VMS_PDMSwitch.kicad_sch

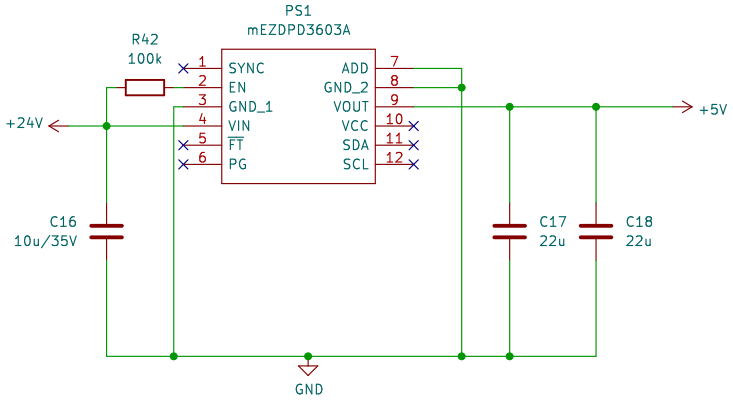
**Title:**

| Size: A4 | Date: | **Rev:** |
|---|---|---|
| KiCad E.D.A. kicad (6.0.4-0) | | Id: 12/22 |







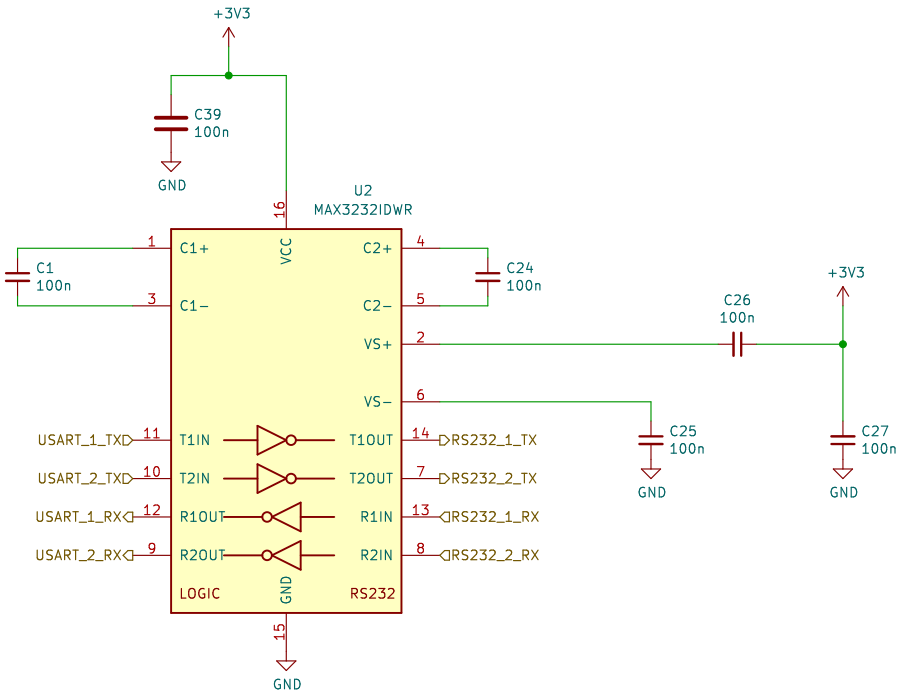



Author: JM

Sheet: /POWER/
File: POWER.kicad_sch

**Title:**

| Size: A4 | Date: | **Rev:** |
|---|---|---|
| KiCad E.D.A. kicad (6.0.4-0) | | Id: 13/22 |

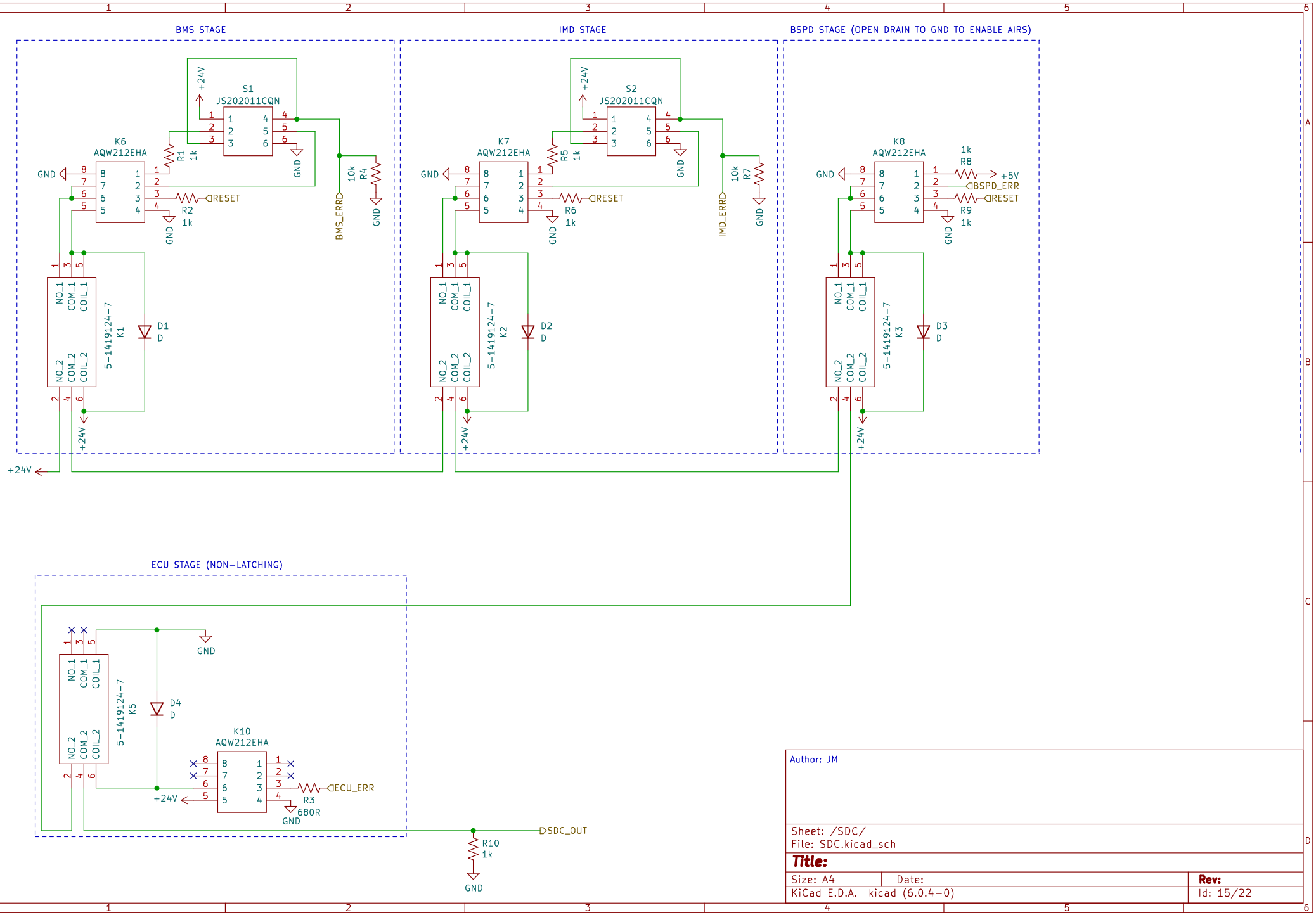



Author: LF

Sheet: /VMS/RS232/
File: VMS_RS232.kicad_sch

**Title:**

| Size: A4 | Date: | **Rev:** |
|---|---|---|
| KiCad E.D.A. kicad (6.0.4-0) | | Id: 14/22 |

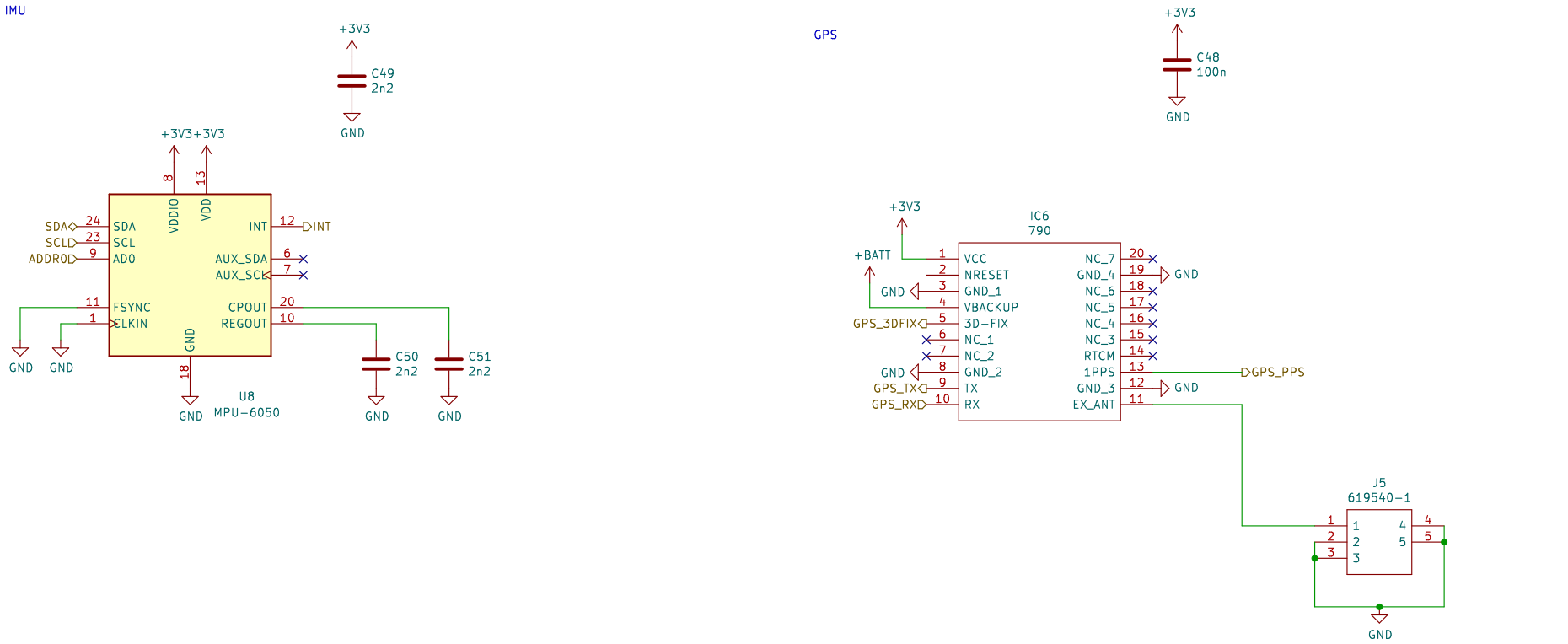


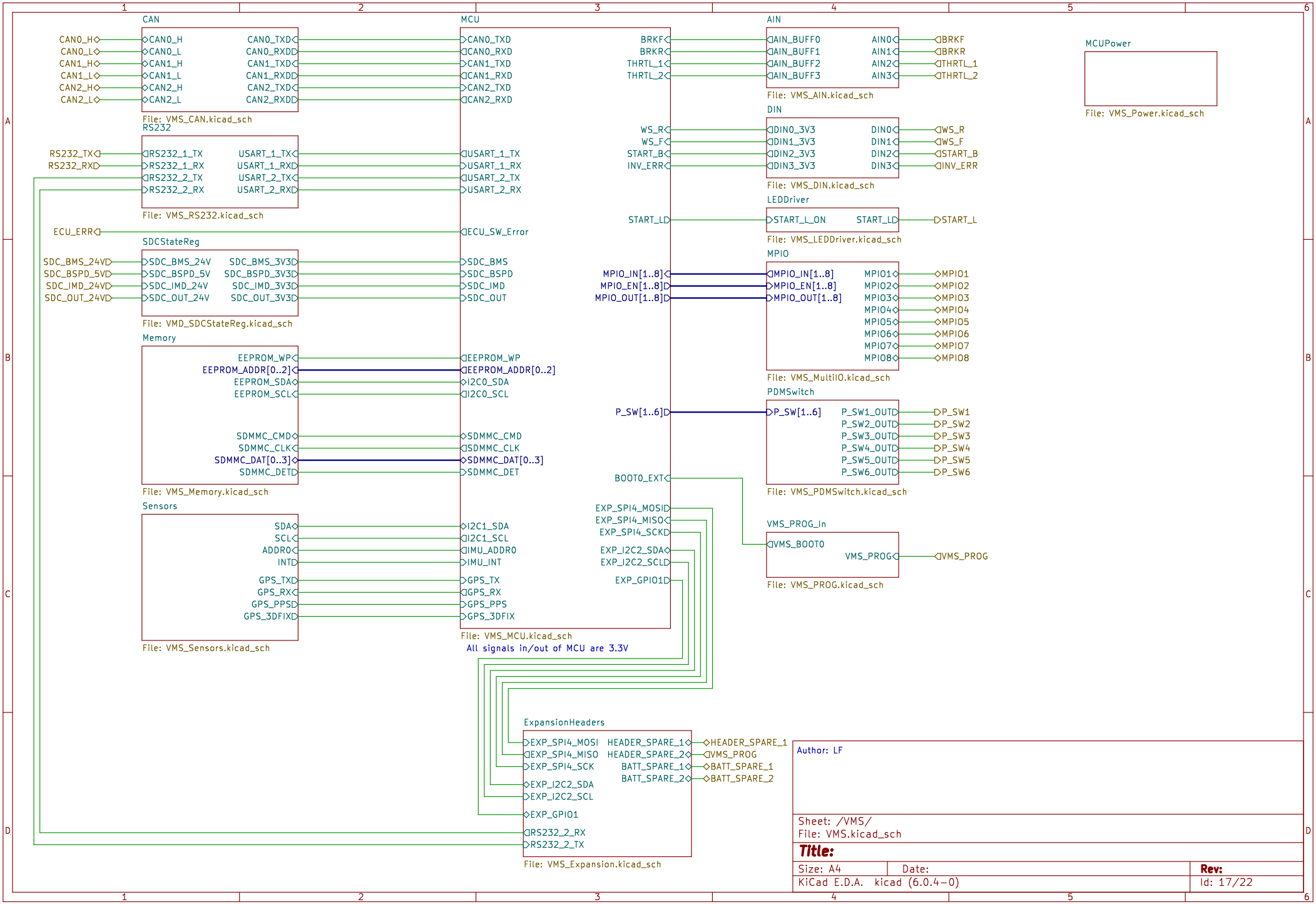

Author: JM

Sheet: /SDC/
File: SDC.kicad_sch

**Title:**

| Size: A4 | Date: | **Rev:** |
|---|---|---|
| KiCad E.D.A. kicad (6.0.4-0) | | Id: 15/22 |


IMU
+3V3
C49
2n2
GND
+3V3+3V3
8
13
VDDIO
VDD
SDA
SCL
ADO
INT
AUX_SDA
AUX_SCL
FSYNC
CLKIN
CPOUT
REGOUT
GND
SDA
SCL
ADDR0
INT
11
1
18
12
6
7
20
10
24
23
9
U8
MPU-6050
C50
2n2
C51
2n2
GND
GND
GND
GND
GND
GPS
+3V3
C48
100n
GND
IC6
790
+3V3
+BATT
GND
GPS_3DFIX
GND
GPS_TX
GPS_RX
VCC
NRESET
GND_1
VBACKUP
3D-FIX
NC_1
NC_2
GND_2
TX
RX
NC_7
GND_4
NC_6
NC_5
NC_4
NC_3
RTCM
1PPS
GND_3
EX_ANT
GND
GPS_PPS
GND
J5
619540-1
GND
Author: LF
Sheet: /VMS/Sensors/
File: VMS_Sensors.kicad_sch
Title:
Size: A4
Date:
Rev:
KiCad E.D.A. kicad (6.0.4-0)
Id: 16/22


CAN
CAN0_H
CAN0_L
CAN1_H
CAN1_L
CAN2_H
CAN2_L
CAN0_TXD
CAN0_RXD
CAN1_TXD
CAN1_RXD
CAN2_TXD
CAN2_RXD
File: VMS_CAN.kicad_sch
RS232
RS232_TX
RS232_RX
RS232_1_TX
RS232_1_RX
RS232_2_TX
RS232_2_RX
USART_1_TX
USART_1_RX
USART_2_TX
USART_2_RX
File: VMS_RS232.kicad_sch
ECU_ERR
ECU_SW_Error
SDCStateReg
SDC_BMS_24V
SDC_BSPD_5V
SDC_IMD_24V
SDC_OUT_24V
SDC_BMS_3V3
SDC_BSPD_3V3
SDC_IMD_3V3
SDC_OUT_3V3
SDC_BMS
SDC_BSPD
SDC_IMD
SDC_OUT
File: VMD_SDCStateReg.kicad_sch
Memory
EEPROM_WP
EEPROM_ADDR[0..2]
EEPROM_SDA
EEPROM_SCL
SDMMC_CMD
SDMMC_CLK
SDMMC_DAT[0..3]
SDMMC_DET
I2C0_SDA
I2C0_SCL
File: VMS_Memory.kicad_sch
Sensors
SDA
SCL
ADDR0
INT
GPS_TX
GPS_RX
GPS_PPS
GPS_3DFIX
I2C1_SDA
I2C1_SCL
IMU_ADDR0
IMU_INT
File: VMS_Sensors.kicad_sch
MCU
File: VMS_MCU.kicad_sch
All signals in/out of MCU are 3.3V
AIN
BRKF
BRKR
THRTL_1
THRTL_2
AIN_BUFF0
AIN_BUFF1
AIN_BUFF2
AIN_BUFF3
AIN0
AIN1
AIN2
AIN3
File: VMS_AIN.kicad_sch
DIN
WS_R
WS_F
START_B
INV_ERR
DIN0_3V3
DIN1_3V3
DIN2_3V3
DIN3_3V3
DIN0
DIN1
DIN2
DIN3
File: VMS_DIN.kicad_sch
LEDDriver
START_LD
START_L_ON
START_L
File: VMS_LEDDriver.kicad_sch
MPIO
MPIO_IN[1..8]
MPIO_EN[1..8]
MPIO_OUT[1..8]
MPIO1
MPIO2
MPIO3
MPIO4
MPIO5
MPIO6
MPIO7
MPIO8
File: VMS_MultiIO.kicad_sch
PDMSwitch
P_SW[1..6]
P_SW1_OUT
P_SW2_OUT
P_SW3_OUT
P_SW4_OUT
P_SW5_OUT
P_SW6_OUT
P_SW1
P_SW2
P_SW3
P_SW4
P_SW5
P_SW6
File: VMS_PDMSwitch.kicad_sch
BOOT0_EXT
VMS_PROG_In
VMS_BOOT0
VMS_PROG
File: VMS_PROG.kicad_sch
EXP_SPI4_MOSI
EXP_SPI4_MISO
EXP_SPI4_SCK
EXP_I2C2_SDA
EXP_I2C2_SCL
EXP_GPIO1
ExpansionHeaders
HEADER_SPARE_1
HEADER_SPARE_2
BATT_SPARE_1
BATT_SPARE_2
File: VMS_Expansion.kicad_sch
MCUPower
File: VMS_Power.kicad_sch
Author: LF
Sheet: /VMS/
File: VMS.kicad_sch
Title:
Size: A4
Date:
Rev:
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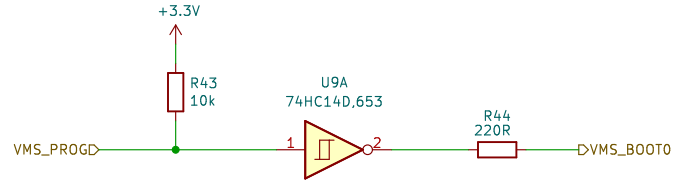
SDC 0-5V/0-24V digital to 0-3.3V

Author: LF

Sheet: /VMS/SDCStateReg/
File: VMD_SDCStateReg.kicad_sch

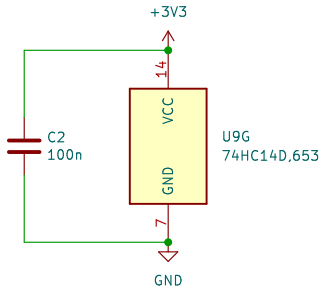
**Title:**

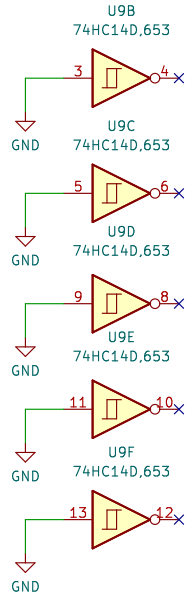
| Size: A4 | Date: | **Rev:** |
|---|---|---|
| KiCad E.D.A. kicad (6.0.4-0) | | Id: 18/22 |




When VMS_PROG pulled down, R43 330uA/1mW.

Leave VMS_PROG open for BOOT0=0V (normal boot mode)
Tie VMS_PROG to GND for BOOT0=3.3V (flash update mode)



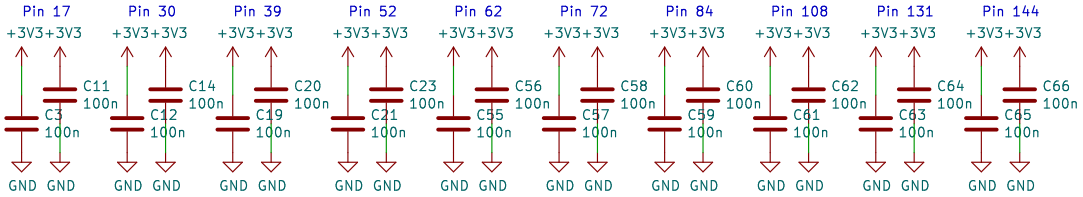

Author: LF

Sheet: /VMS/VMS_PROG_In/
File: VMS_PROG.kicad_sch

**Title:**

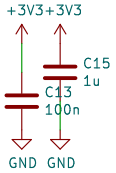
| Size: A4 | Date: | **Rev:** |
|---|---|---|
| KiCad E.D.A. kicad (6.0.4-0) | | Id: 19/22 |

Ceramic bypass caps

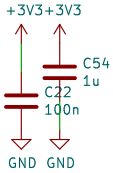



Decoupling cap
close to pkg


VDDSDMMC




VDDUSB

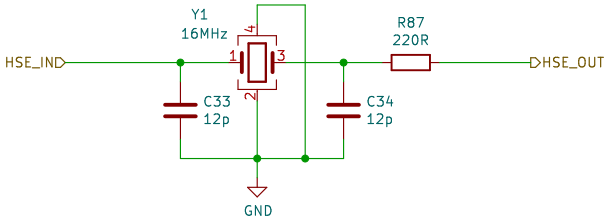



Author: LF

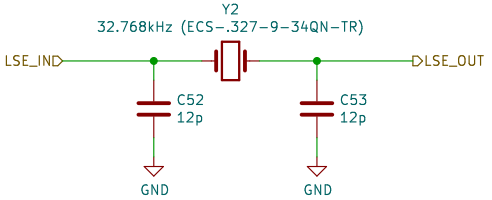
Sheet: /VMS/MCU/Caps/
File: MCU_Caps.kicad_sch

**Title:**

Size: A4 | Date: | **Rev:**
KiCad E.D.A. kicad (6.0.4-0) | Id: 20/22




C_Load = 2*(C_LOAD_CRYSTAL – C_PARASITIC)
= 2 * (9pF – 2pF (or less))  = 14pF (or less)



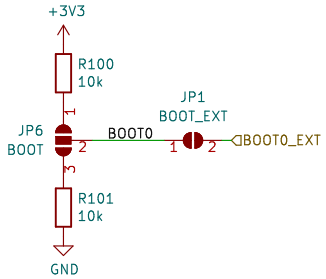

Author: LF

Sheet: /VMS/MCU/Crystals/
File: MCU_Crystals.kicad_sch

**Title:**

| Size: A4 | Date: | **Rev:** |
|---|---|---|
| KiCad E.D.A. kicad (6.0.4-0) | | Id: 21/22 |

BOOT0 (PROG) pin selection




Tie BOOT0 to 3.3v
to program.
0V to boot from
internal flash.
Switch between
hardwired and
configurable.

Author: LF

Sheet: /VMS/MCU/PROG Selection/
File: MCU_ProgSel.kicad_sch

**Title:**

| Size: A4 | Date: | **Rev:** |
|---|---|---|
| KiCad E.D.A. kicad (6.0.4-0) | | Id: 22/22 |