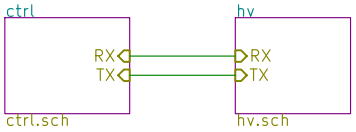

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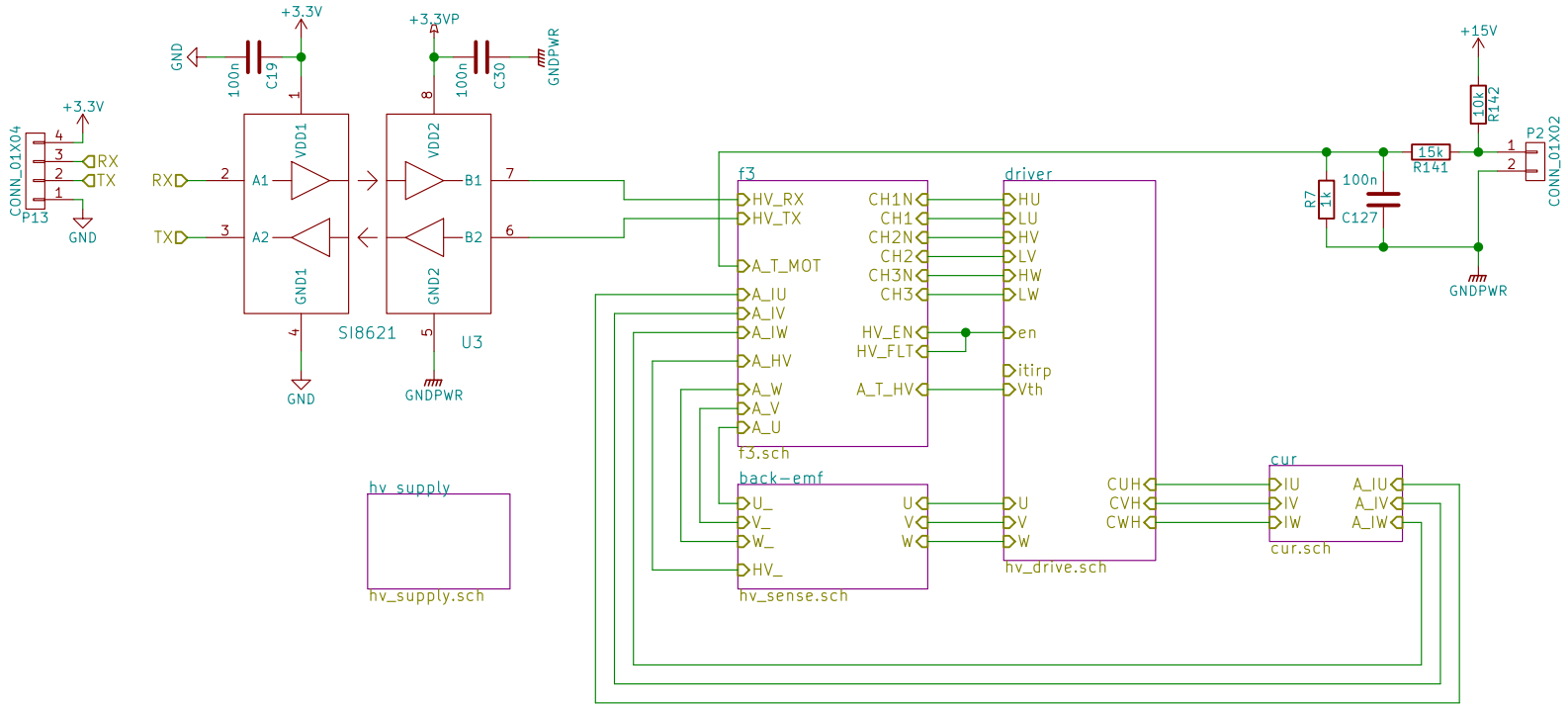
Size: A4	Date:	**Rev:**
KiCad E.D.A. kicad (2016-09-11 revision 6dfe58f)-master		Id: 1/14



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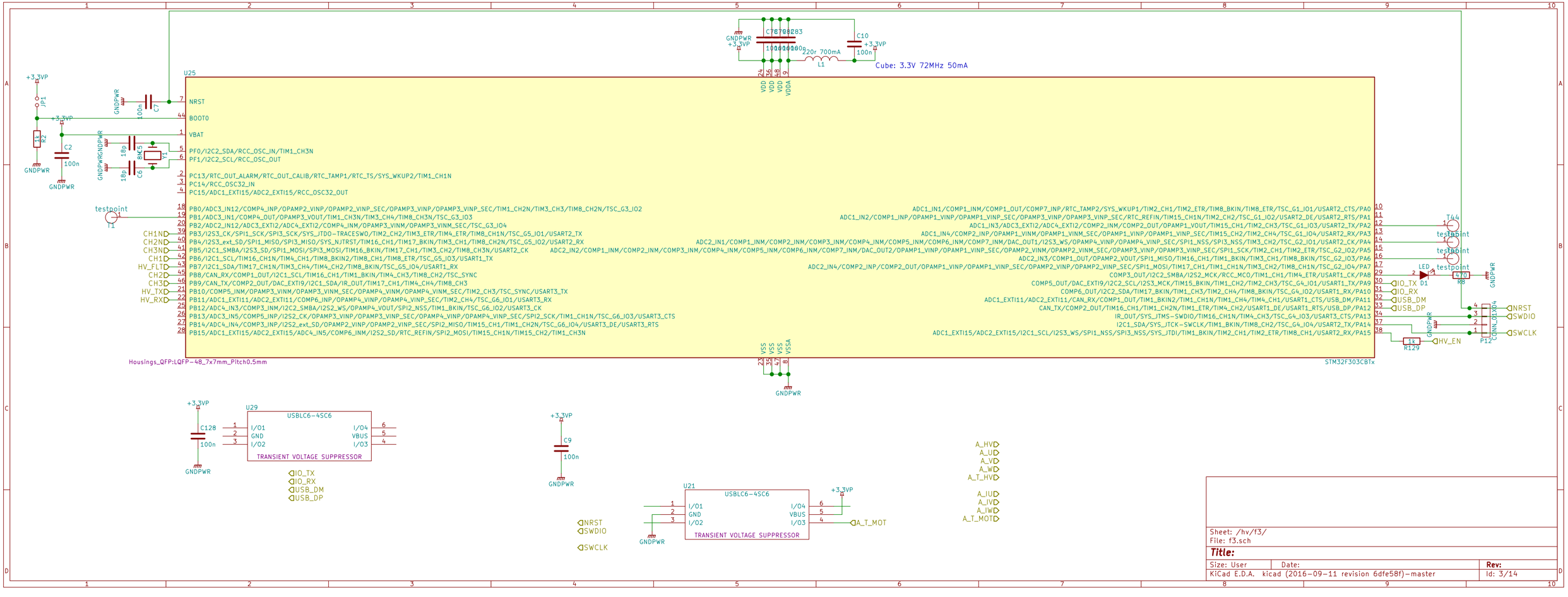
Size: A4	Date:	**Rev:**
KiCad E.D.A. kicad (2016-09-11 revision 6dfe58f)-master		Id: 2/14


U25
Housings_QFP:LQFP-48_7x7mm_Pitch0.5mm
STM32F303CBTx
NRST
BOOT0
VBAT
PF0/I2C2_SDA/RCC_OSC_IN/TIM1_CH3N
PF1/I2C2_SCL/RCC_OSC_OUT
PC13/RTC_OUT_ALARM/RTC_OUT_CALIB/RTC_TAMP1/RTC_TS/SYS_WKUP2/TIM1_CH1N
PC14/RCC_OSC32_IN
PC15/ADC1_EXTI15/ADC2_EXTI15/RCC_OSC32_OUT
PB0/ADC3_IN12/COMP4_INP/OPAMP2_VINP/OPAMP2_VINP_SEC/OPAMP3_VINP/OPAMP3_VINP_SEC/TIM1_CH2N/TIM3_CH3/TIM8_CH2N/TSC_G3_IO2
PB1/ADC3_IN1/COMP4_OUT/OPAMP3_VOUT/TIM1_CH3N/TIM3_CH4/TIM8_CH3N/TSC_G3_IO3
PB2/ADC2_IN12/ADC3_EXTI2/ADC4_EXTI2/COMP4_INM/OPAMP3_VINM/OPAMP3_VINM_SEC/TSC_G3_IO4
PB3/I2S3_CK/SPI1_SCK/SPI3_SCK/SYS_JTDO-TRACESWO/TIM2_CH2/TIM3_ETR/TIM4_ETR/TIM8_CH1N/TSC_G5_IO1/USART2_TX
PB4/I2S3_ext_SD/SPI1_MISO/SPI3_MISO/SYS_NJTRST/TIM16_CH1/TIM17_BKIN/TIM3_CH1/TIM8_CH2N/TSC_G5_IO2/USART2_RX
PB5/I2C1_SMBA/I2S3_SD/SPI1_MOSI/SPI3_MOSI/TIM16_BKIN/TIM17_CH1/TIM3_CH2/TIM8_CH3N/USART2_CK
PB6/I2C1_SCL/TIM16_CH1N/TIM4_CH1/TIM8_BKIN2/TIM8_CH1/TIM8_ETR/TSC_G5_IO3/USART1_TX
PB7/I2C1_SDA/TIM17_CH1N/TIM3_CH4/TIM4_CH2/TIM8_BKIN/TSC_G5_IO4/USART1_RX
PB8/CAN_RX/COMP1_OUT/I2C1_SCL/TIM16_CH1/TIM1_BKIN/TIM4_CH3/TIM8_CH2/TSC_SYNC
PB9/CAN_TX/COMP2_OUT/DAC_EXTI9/I2C1_SDA/IR_OUT/TIM17_CH1/TIM4_CH4/TIM8_CH3
PB10/COMP5_INM/OPAMP3_VINM/OPAMP3_VINM_SEC/OPAMP4_VINM/OPAMP4_VINM_SEC/TIM2_CH3/TSC_SYNC/USART3_TX
PB11/ADC1_EXTI11/ADC2_EXTI11/COMP6_INP/OPAMP4_VINP/OPAMP4_VINP_SEC/TIM2_CH4/TSC_G6_IO1/USART3_RX
PB12/ADC4_IN3/COMP3_INM/I2C2_SMBA/I2S2_WS/OPAMP4_VOUT/SPI2_NSS/TIM1_BKIN/TSC_G6_IO2/USART3_CK
PB13/ADC3_IN5/COMP5_INP/I2S2_CK/OPAMP3_VINP/OPAMP3_VINP_SEC/OPAMP4_VINP/OPAMP4_VINP_SEC/SPI2_SCK/TIM1_CH1N/TSC_G6_IO3/USART3_CTS
PB14/ADC4_IN4/COMP3_INP/I2S2_ext_SD/OPAMP2_VINP/OPAMP2_VINP_SEC/SPI2_MISO/TIM15_CH1/TIM1_CH2N/TSC_G6_IO4/USART3_DE/USART3_RTS
PB15/ADC1_EXTI15/ADC2_EXTI15/ADC4_IN5/COMP6_INM/I2S2_SD/RTC_REFIN/SPI2_MOSI/TIM15_CH1N/TIM15_CH2/TIM1_CH3N
ADC1_IN1/COMP1_INM/COMP1_OUT/COMP7_INP/RTC_TAMP2/SYS_WKUP1/TIM2_CH1/TIM2_ETR/TIM8_BKIN/TIM8_ETR/TSC_G1_IO1/USART2_CTS/PA0
ADC1_IN2/COMP1_INP/OPAMP1_VINP/OPAMP1_VINP_SEC/OPAMP3_VINP/OPAMP3_VINP_SEC/RTC_REFIN/TIM15_CH1N/TIM2_CH2/TSC_G1_IO2/USART2_DE/USART2_RTS/PA1
ADC1_IN3/ADC3_EXTI2/ADC4_EXTI2/COMP2_INM/COMP2_OUT/OPAMP1_VOUT/TIM15_CH1/TIM2_CH3/TSC_G1_IO3/USART2_TX/PA2
ADC1_IN4/COMP2_INP/OPAMP1_VINM/OPAMP1_VINM_SEC/OPAMP1_VINP/OPAMP1_VINP_SEC/TIM15_CH2/TIM2_CH4/TSC_G1_IO4/USART2_RX/PA3
ADC2_IN1/COMP1_INM/COMP2_INM/COMP3_INM/COMP4_INM/COMP5_INM/COMP6_INM/COMP7_INM/DAC_OUT1/I2S3_WS/OPAMP4_VINP/OPAMP4_VINP_SEC/SPI1_NSS/SPI3_NSS/TIM3_CH2/TSC_G2_IO1/USART2_CK/PA4
ADC2_IN2/COMP1_INM/COMP2_INM/COMP3_INM/COMP4_INM/COMP5_INM/COMP6_INM/COMP7_INM/DAC_OUT2/OPAMP1_VINP/OPAMP1_VINP_SEC/OPAMP2_VINM/OPAMP2_VINM_SEC/OPAMP3_VINP/OPAMP3_VINP_SEC/SPI1_SCK/TIM2_CH1/TIM2_ETR/TSC_G2_IO2/PA5
ADC2_IN3/COMP1_OUT/OPAMP2_VOUT/SPI1_MISO/TIM16_CH1/TIM1_BKIN/TIM3_CH1/TIM8_BKIN/TSC_G2_IO3/PA6
ADC2_IN4/COMP2_INP/COMP2_OUT/OPAMP1_VINP/OPAMP1_VINP_SEC/OPAMP2_VINP/OPAMP2_VINP_SEC/SPI1_MOSI/TIM17_CH1/TIM1_CH1N/TIM3_CH2/TIM8_CH1N/TSC_G2_IO4/PA7
COMP3_OUT/I2C2_SMBA/I2S2_MCK/RCC_MCO/TIM1_CH1/TIM4_ETR/USART1_CK/PA8
COMP5_OUT/DAC_EXTI9/I2C2_SCL/I2S3_MCK/TIM15_BKIN/TIM1_CH2/TIM2_CH3/TSC_G4_IO1/USART1_TX/PA9
COMP6_OUT/I2C2_SDA/TIM17_BKIN/TIM1_CH3/TIM2_CH4/TIM8_BKIN/TSC_G4_IO2/USART1_RX/PA10
ADC1_EXTI11/ADC2_EXTI11/CAN_RX/COMP1_OUT/TIM1_BKIN2/TIM1_CH1N/TIM1_CH4/TIM4_CH1/USART1_CTS/USB_DM/PA11
CAN_TX/COMP2_OUT/TIM16_CH1/TIM1_CH2N/TIM1_ETR/TIM4_CH2/USART1_DE/USART1_RTS/USB_DP/PA12
IR_OUT/SYS_JTMS-SWDIO/TIM16_CH1N/TIM4_CH3/TSC_G4_IO3/USART3_CTS/PA13
I2C1_SDA/SYS_JTCK-SWCLK/TIM1_BKIN/TIM8_CH2/TSC_G4_IO4/USART2_TX/PA14
ADC1_EXTI15/ADC2_EXTI15/I2C1_SCL/I2S3_WS/SPI1_NSS/SPI3_NSS/SYS_JTDI/TIM1_BKIN/TIM2_CH1/TIM2_ETR/TIM8_CH1/USART2_RX/PA15
VDD
VDD
VDD
VDDA
VSS
VSS
VSS
VSSA
GNDPWR
+3.3VP
C78708283
100n
C10
100n
220r 700mA
L1
Cube: 3.3V 72MHz 50mA
JP1
R1
R2
C2
100n
C7
100n
C6
18p
18p
8MS5
Y1
testpoint
T1
CH1N
CH2N
CH3N
CH1
HV_FLT
CH2
CH3
HV_TX
HV_RX
T44
testpoint
testpoint
LED
testpoint
470
R8
D1
IO_TX
IO_RX
USB_DM
USB_DP
NRST
SWDIO
SWCLK
R129
1k
HV_EN
P12
CONN_01X04
U29
USBLC6-4SC6
TRANSIENT VOLTAGE SUPPRESSOR
I/O1
GND
I/O2
I/O4
VBUS
I/O3
C128
100n
C9
100n
U21
USBLC6-4SC6
TRANSIENT VOLTAGE SUPPRESSOR
A_T_MOT
A_HV
A_U
A_V
A_W
A_T_HV
A_IU
A_IV
A_IW
A_T_MOT
Sheet: /hv/f3/
File: f3.sch
Title:
Size: User
Date:
Rev:
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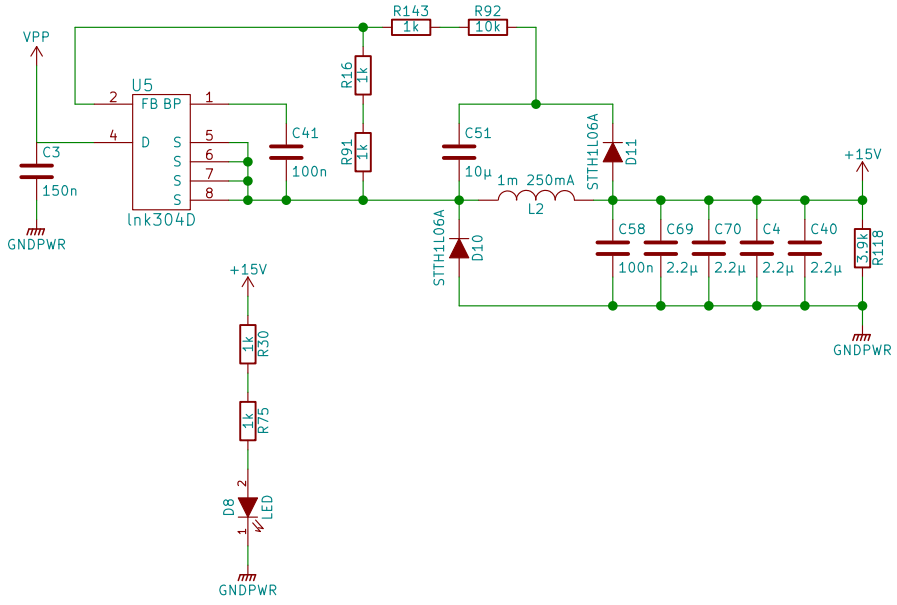
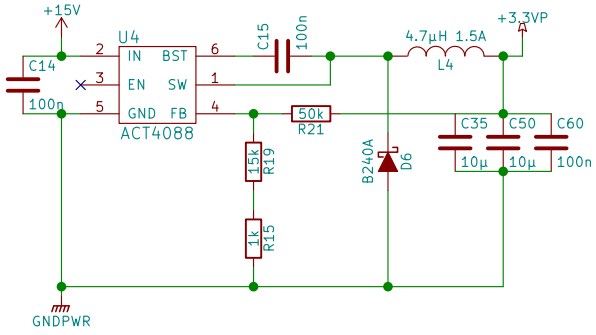
1.65V * (15k + 1k + 1k + 1k)/(1k + 1k) = 14.85V





0.81V * (50k + 15k + 1k) / (15k + 1k) = 3.34V

Sheet: /hv/hv supply/ File: hv_supply.sch		
Title:		
Size: A4	Date:	**Rev:**
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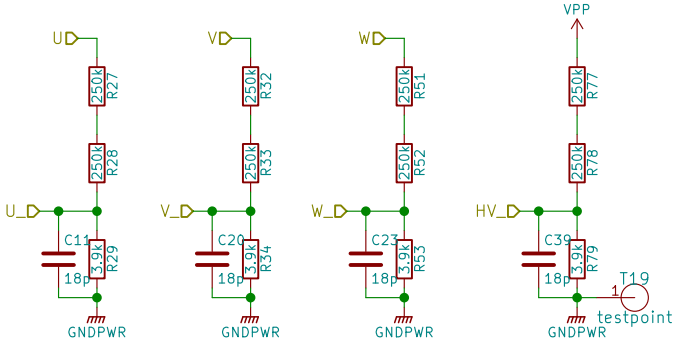
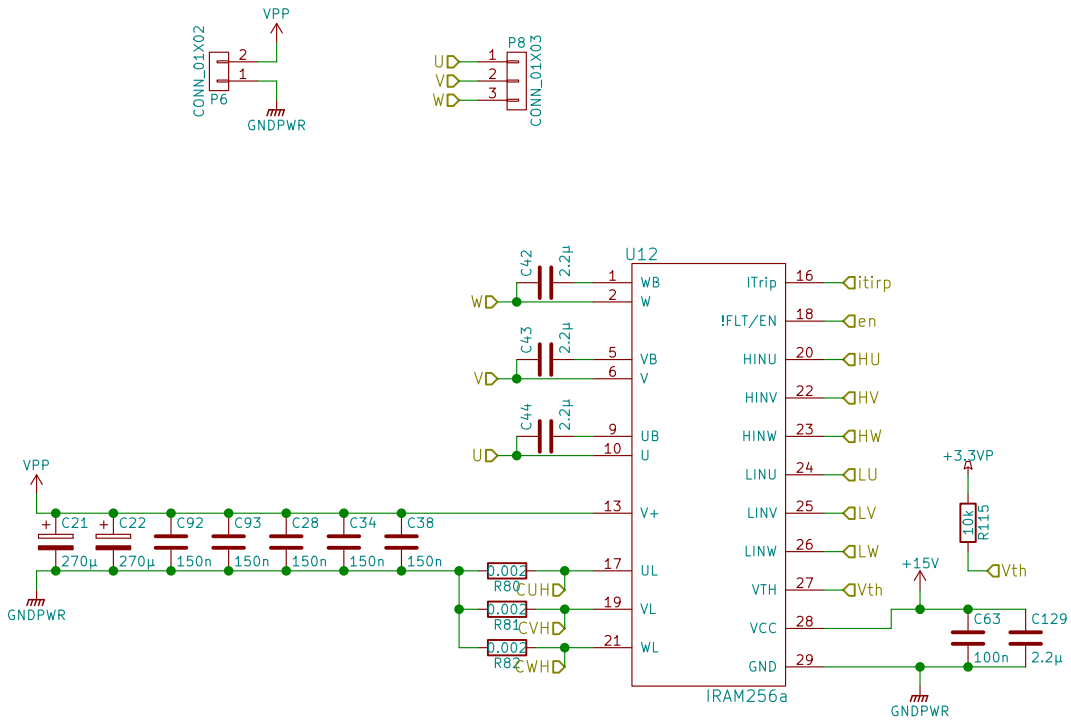
3.3V * (250k + 250k + 3.9k) / 3.9k = 426V

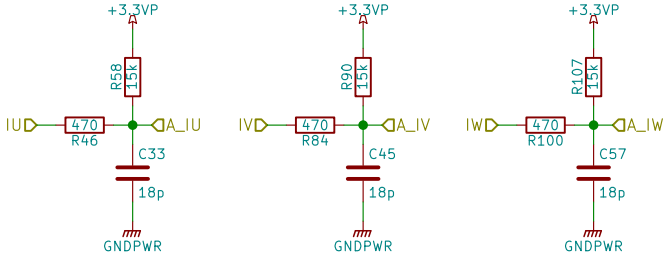


Sheet: /hv/back-emf/ File: hv_sense.sch		
Title:		
Size: A4	Date:	**Rev:**
KiCad E.D.A. kicad (2016-09-11 revision 6dfe58f)-master		Id: 5/14



Sheet: /hv/driver/		
File: hv_drive.sch		
Title:		
Size: A4	Date:	**Rev:**
KiCad E.D.A. kicad (2016-09-11 revision 6dfe58f)-master		Id: 6/14

+-30A = 0.04V - 0.16V



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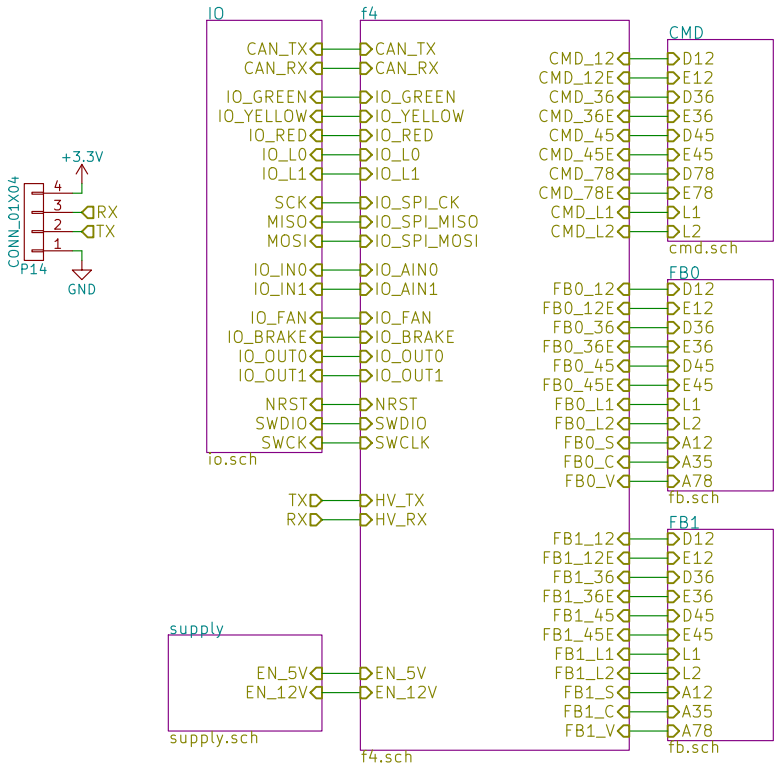
KiCad E.D.A. kicad (2016-09-11 revision 6dfe58f)-master		Id: 7/14



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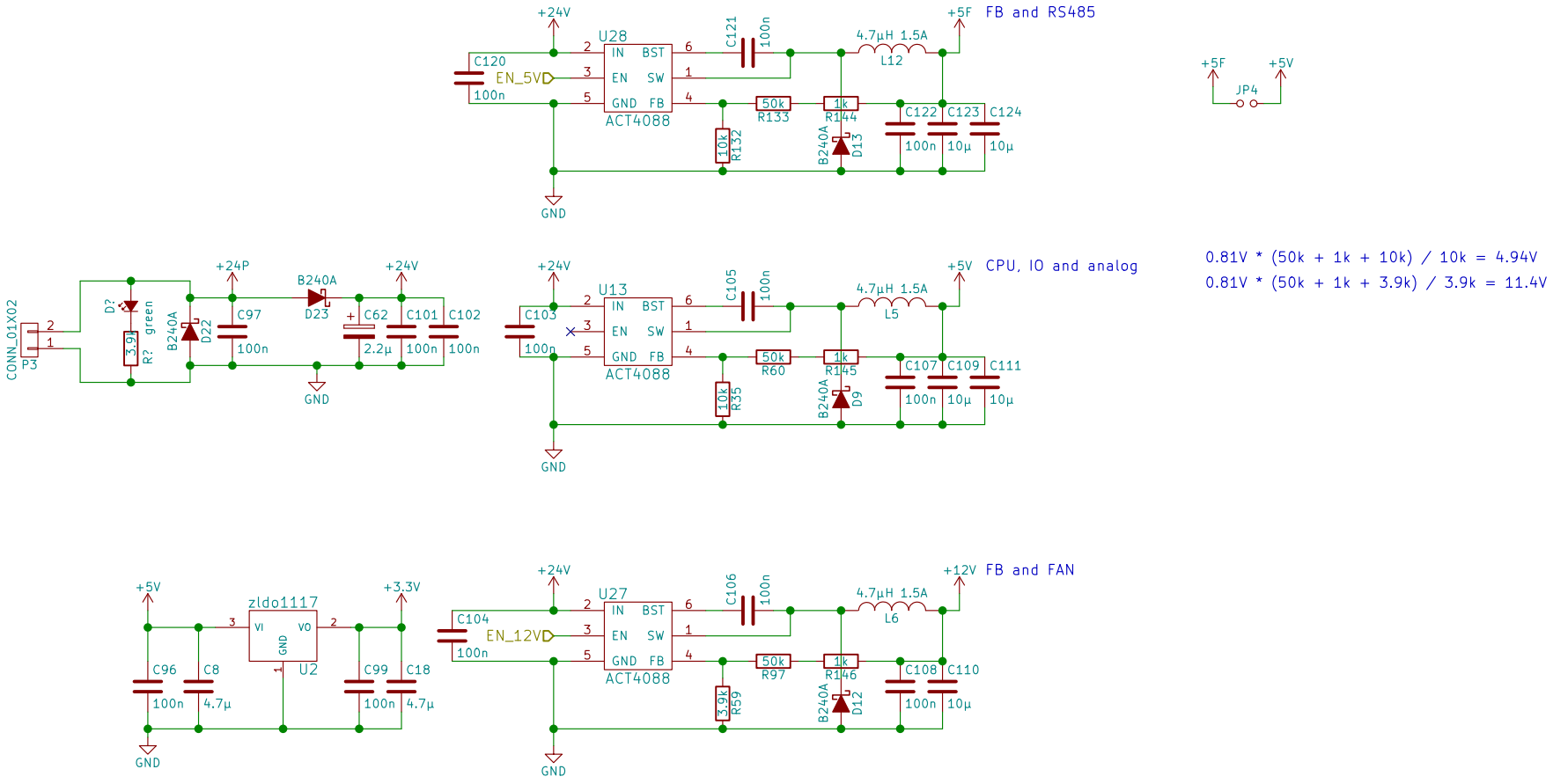
KiCad E.D.A. kicad (2016-09-11 revision 6dfe58f)-master		Id: 8/14



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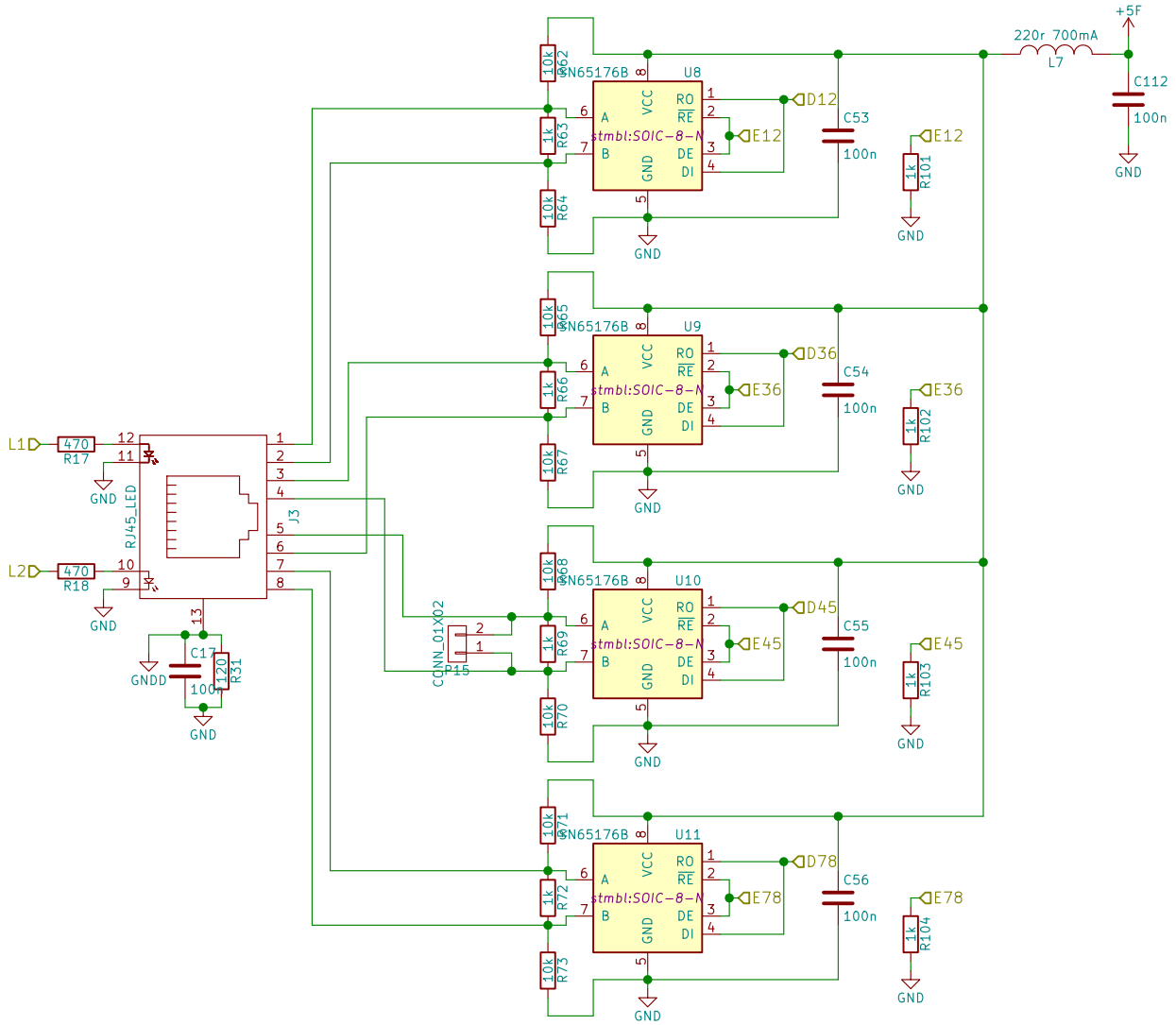
Size: A4	Date:	**Rev:**
KiCad E.D.A. kicad (2016-09-11 revision 6dfe58f)-master		Id: 9/14



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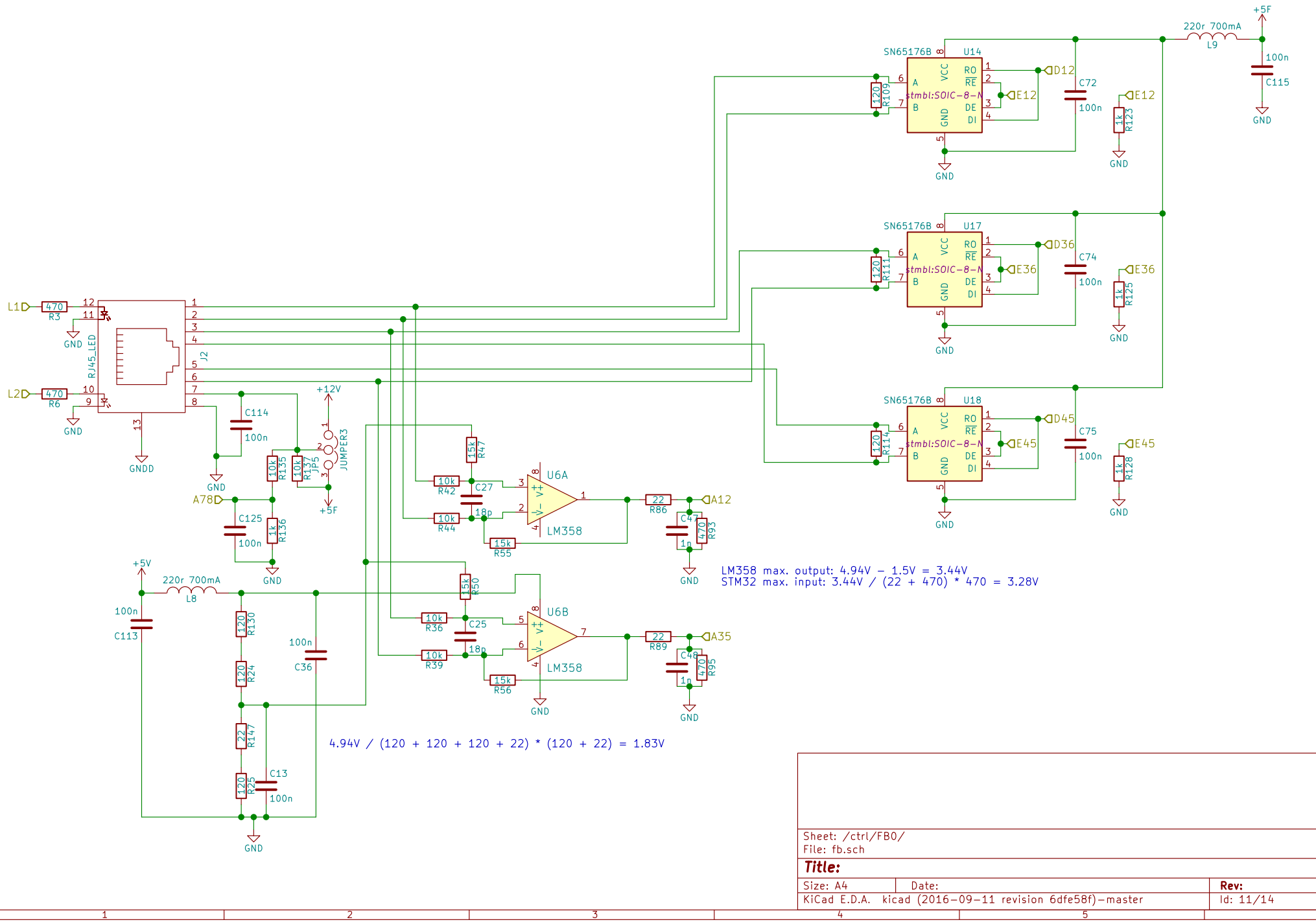
Size: A4	Date:	**Rev:**
KiCad E.D.A. kicad (2016-09-11 revision 6dfe58f)-master		Id: 10/14


SN65176B
U14
U17
U18
stmbl:SOIC-8-N
D12
D36
D45
E12
E36
E45
C72
C74
C75
100n
220r 700mA
L9
+5F
C115
GND
R109
R111
R114
120
1k
R123
R125
R128
J2
RJ45_LED
L1
L2
470
R3
R6
C114
C125
R135
R136
R137
JP5
JUMPER3
+12V
A78
GNDD
U6A
U6B
LM358
R42
R44
R47
R55
C27
18p
R86
R93
C47
1n
A12
R50
R36
R39
R56
C25
R89
R95
C48
A35
+5V
L8
C113
C36
R130
R24
R147
R25
C13
LM358 max. output: 4.94V - 1.5V = 3.44V
STM32 max. input: 3.44V / (22 + 470) * 470 = 3.28V
4.94V / (120 + 120 + 120 + 22) * (120 + 22) = 1.83V
Sheet: /ctrl/FB0/
File: fb.sch
Title:
Size: A4
Date:
Rev:
KiCad E.D.A. kicad (2016-09-11 revision 6dfe58f)-master
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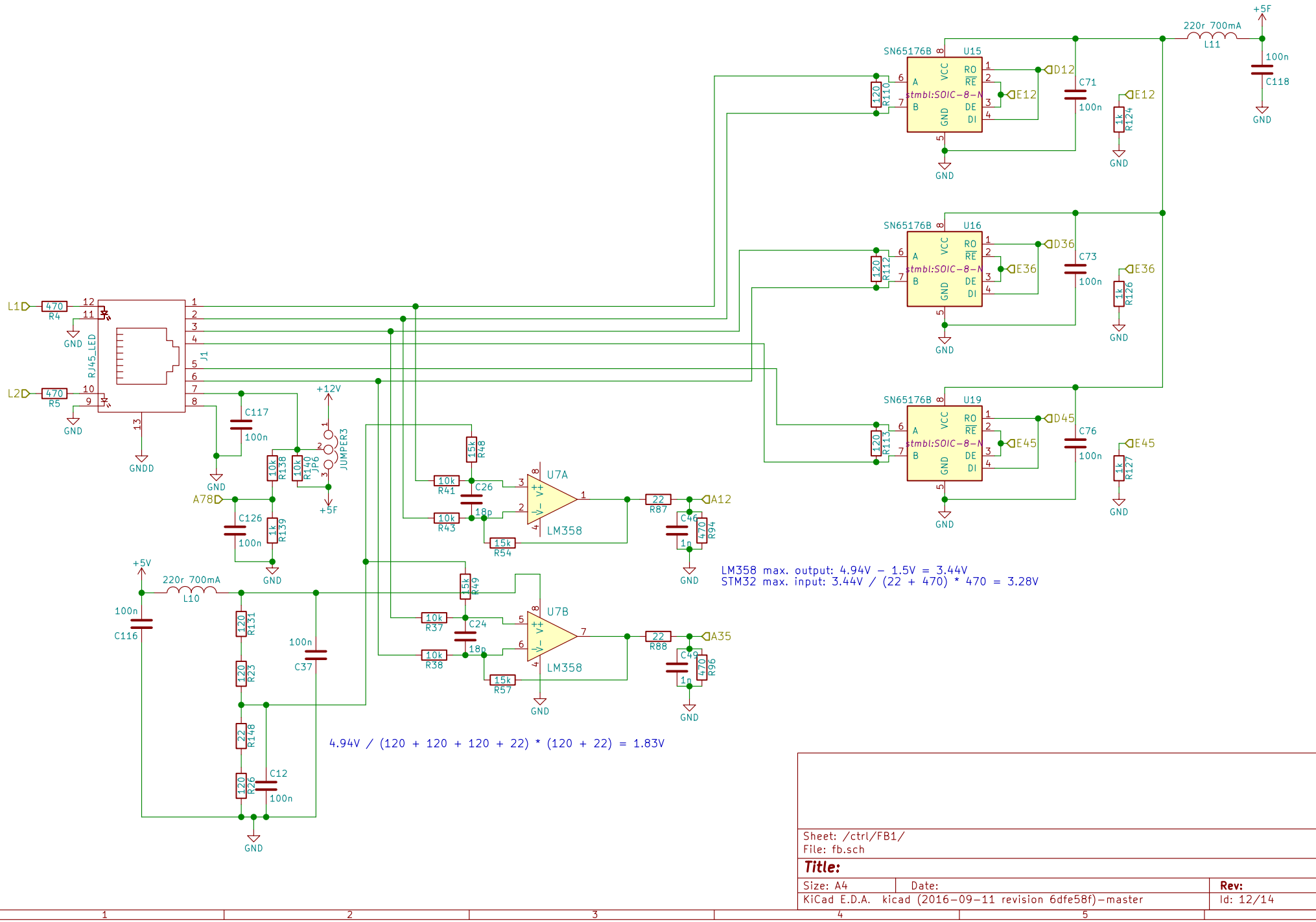

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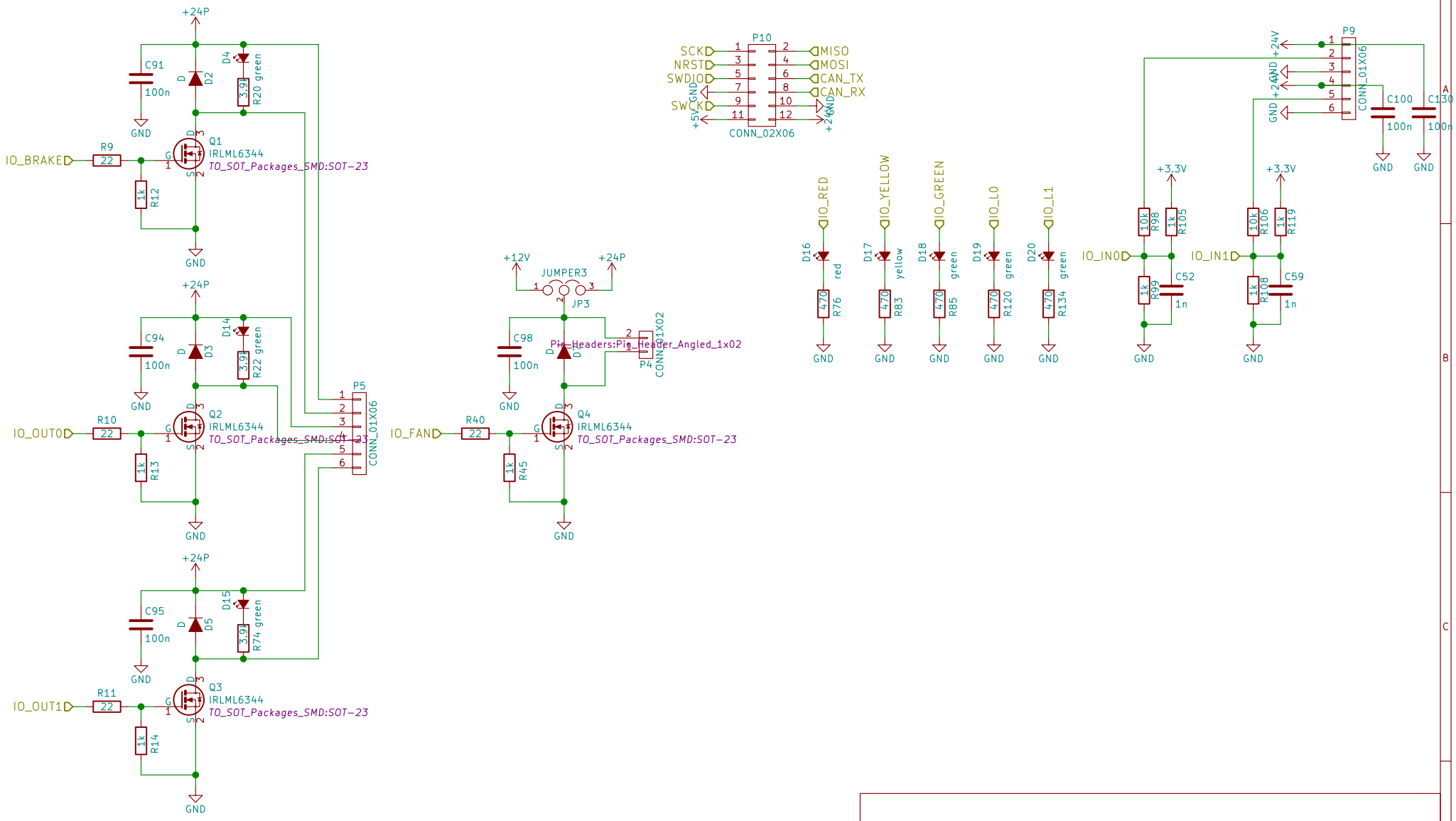
File: fb.sch		
Title:		
Size: A4	Date:	**Rev:**
KiCad E.D.A. kicad (2016-09-11 revision 6dfe58f)-master		Id: 12/14



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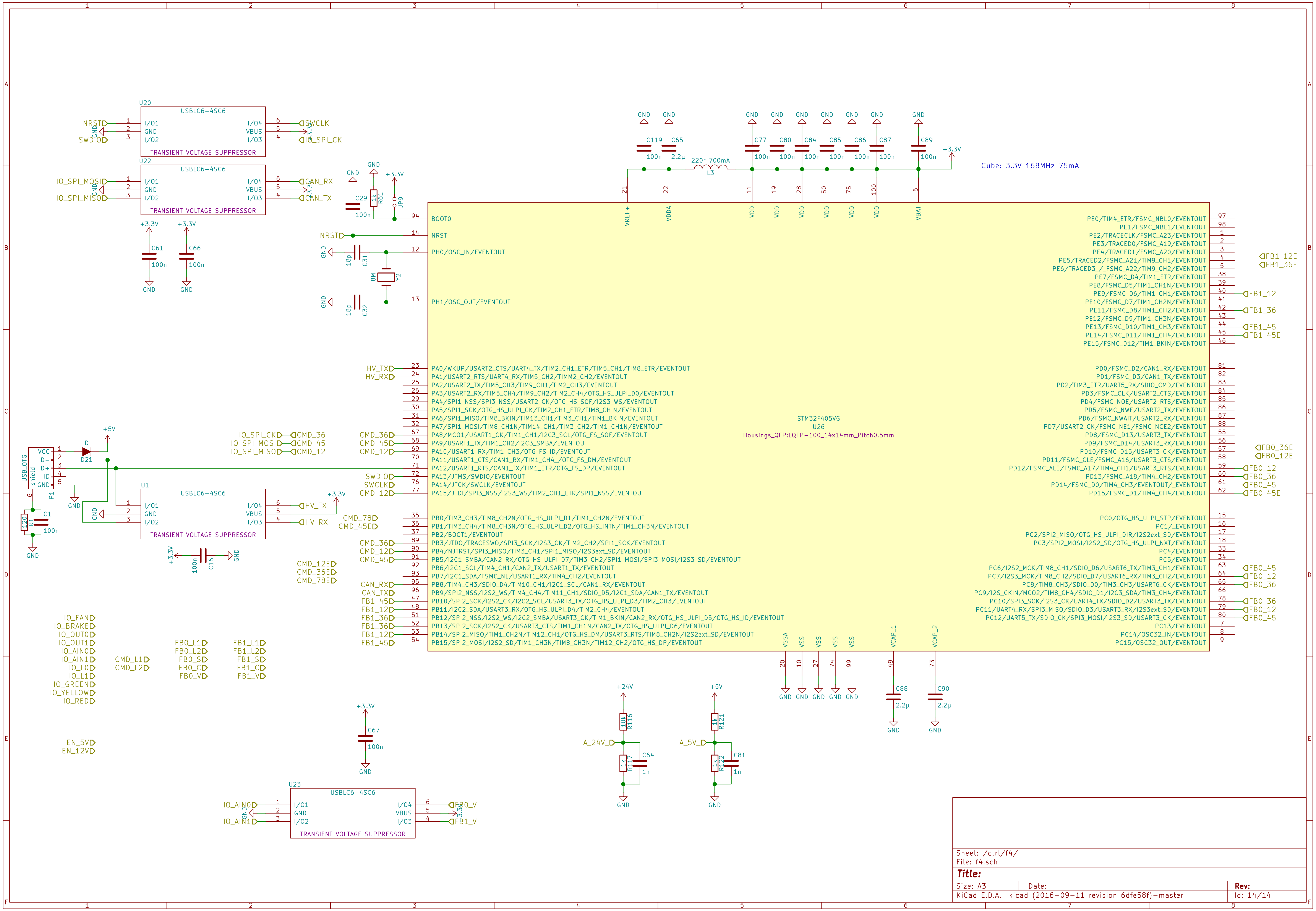
Size: A4	Date:	**Rev:**
KiCad E.D.A. kicad (2016-09-11 revision 6dfe58f)-master		Id: 13/14


U20
USBLC6-4SC6
NRST
SWDIO
SWCLK
IO_SPI_CK
TRANSIENT VOLTAGE SUPPRESSOR
U22
IO_SPI_MOSI
IO_SPI_MISO
CAN_RX
CAN_TX
+3.3V
C61 100n
C66 100n
GND
C29 100n
R61 1k
JP9
18p C31
8M Y2
18p C32
C119 100n
C65 2.2µ
220r 700mA L3
C77 100n
C80 100n
C84 100n
C85 100n
C86 100n
C87 100n
C89 100n
Cube: 3.3V 168MHz 75mA
STM32F405VG
U26
Housings_QFP:LQFP-100_14x14mm_Pitch0.5mm
BOOT0
NRST
PH0/OSC_IN/EVENTOUT
PH1/OSC_OUT/EVENTOUT
VREF+
VDDA
VDD
VBAT
PA0/WKUP/USART2_CTS/UART4_TX/TIM2_CH1_ETR/TIM5_CH1/TIM8_ETR/EVENTOUT
PA1/USART2_RTS/UART4_RX/TIM5_CH2/TIMM2_CH2/EVENTOUT
PA2/USART2_TX/TIM5_CH3/TIM9_CH1/TIM2_CH3/EVENTOUT
PA3/USART2_RX/TIM5_CH4/TIM9_CH2/TIM2_CH4/OTG_HS_ULPI_D0/EVENTOUT
PA4/SPI1_NSS/SPI3_NSS/USART2_CK/OTG_HS_SOF/I2S3_WS/EVENTOUT
PA5/SPI1_SCK/OTG_HS_ULPI_CK/TIM2_CH1_ETR/TIM8_CHIN/EVENTOUT
PA6/SPI1_MISO/TIM8_BKIN/TIM13_CH1/TIM3_CH1/TIM1_BKIN/EVENTOUT
PA7/SPI1_MOSI/TIM8_CH1N/TIM14_CH1/TIM3_CH2/TIM1_CH1N/EVENTOUT
PA8/MCO1/USART1_CK/TIM1_CH1/I2C3_SCL/OTG_FS_SOF/EVENTOUT
PA9/USART1_TX/TIM1_CH2/I2C3_SMBA/EVENTOUT
PA10/USART1_RX/TIM1_CH3/OTG_FS_ID/EVENTOUT
PA11/USART1_CTS/CAN1_RX/TIM1_CH4_/OTG_FS_DM/EVENTOUT
PA12/USART1_RTS/CAN1_TX/TIM1_ETR/OTG_FS_DP/EVENTOUT
PA13/JTMS/SWDIO/EVENTOUT
PA14/JTCK/SWCLK/EVENTOUT
PA15/JTDI/SPI3_NSS/I2S3_WS/TIM2_CH1_ETR/SPI1_NSS/EVENTOUT
PB0/TIM3_CH3/TIM8_CH2N/OTG_HS_ULPI_D1/TIM1_CH2N/EVENTOUT
PB1/TIM3_CH4/TIM8_CH3N/OTG_HS_ULPI_D2/OTG_HS_INTN/TIM1_CH3N/EVENTOUT
PB2/BOOT1/EVENTOUT
PB3/JTDO/TRACESWO/SPI3_SCK/I2S3_CK/TIM2_CH2/SPI1_SCK/EVENTOUT
PB4/NJTRST/SPI3_MISO/TIM3_CH1/SPI1_MISO/I2S3ext_SD/EVENTOUT
PB5/I2C1_SMBA/CAN2_RX/OTG_HS_ULPI_D7/TIM3_CH2/SPI1_MOSI/SPI3_MOSI/I2S3_SD/EVENTOUT
PB6/I2C1_SCL/TIM4_CH1/CAN2_TX/USART1_TX/EVENTOUT
PB7/I2C1_SDA/FSMC_NL/USART1_RX/TIM4_CH2/EVENTOUT
PB8/TIM4_CH3/SDIO_D4/TIM10_CH1/I2C1_SCL/CAN1_RX/EVENTOUT
PB9/SPI2_NSS/I2S2_WS/TIM4_CH4/TIM11_CH1/SDIO_D5/I2C1_SDA/CAN1_TX/EVENTOUT
PB10/SPI2_SCK/I2S2_CK/I2C2_SCL/USART3_TX/OTG_HS_ULPI_D3/TIM2_CH3/EVENTOUT
PB11/I2C2_SDA/USART3_RX/OTG_HS_ULPI_D4/TIM2_CH4/EVENTOUT
PB12/SPI2_NSS/I2S2_WS/I2C2_SMBA/USART3_CK/TIM1_BKIN/CAN2_RX/OTG_HS_ULPI_D5/OTG_HS_ID/EVENTOUT
PB13/SPI2_SCK/I2S2_CK/USART3_CTS/TIM1_CH1N/CAN2_TX/OTG_HS_ULPI_D6/EVENTOUT
PB14/SPI2_MISO/TIM1_CH2N/TIM12_CH1/OTG_HS_DM/USART3_RTS/TIM8_CH2N/I2S2ext_SD/EVENTOUT
PB15/SPI2_MOSI/I2S2_SD/TIM1_CH3N/TIM8_CH3N/TIM12_CH2/OTG_HS_DP/EVENTOUT
PE0/TIM4_ETR/FSMC_NBL0/EVENTOUT
PE1/FSMC_NBL1/EVENTOUT
PE2/TRACECLK/FSMC_A23/EVENTOUT
PE3/TRACED0/FSMC_A19/EVENTOUT
PE4/TRACED1/FSMC_A20/EVENTOUT
PE5/TRACED2/FSMC_A21/TIM9_CH1/EVENTOUT
PE6/TRACED3_/_FSMC_A22/TIM9_CH2/EVENTOUT
PE7/FSMC_D4/TIM1_ETR/EVENTOUT
PE8/FSMC_D5/TIM1_CH1N/EVENTOUT
PE9/FSMC_D6/TIM1_CH1/EVENTOUT
PE10/FSMC_D7/TIM1_CH2N/EVENTOUT
PE11/FSMC_D8/TIM1_CH2/EVENTOUT
PE12/FSMC_D9/TIM1_CH3N/EVENTOUT
PE13/FSMC_D10/TIM1_CH3/EVENTOUT
PE14/FSMC_D11/TIM1_CH4/EVENTOUT
PE15/FSMC_D12/TIM1_BKIN/EVENTOUT
PD0/FSMC_D2/CAN1_RX/EVENTOUT
PD1/FSMC_D3/CAN1_TX/EVENTOUT
PD2/TIM3_ETR/UART5_RX/SDIO_CMD/EVENTOUT
PD3/FSMC_CLK/USART2_CTS/EVENTOUT
PD4/FSMC_NOE/USART2_RTS/EVENTOUT
PD5/FSMC_NWE/USART2_TX/EVENTOUT
PD6/FSMC_NWAIT/USART2_RX/EVENTOUT
PD7/USART2_CK/FSMC_NE1/FSMC_NCE2/EVENTOUT
PD8/FSMC_D13/USART3_TX/EVENTOUT
PD9/FSMC_D14/USART3_RX/EVENTOUT
PD10/FSMC_D15/USART3_CK/EVENTOUT
PD11/FSMC_CLE/FSMC_A16/USART3_CTS/EVENTOUT
PD12/FSMC_ALE/FSMC_A17/TIM4_CH1/USART3_RTS/EVENTOUT
PD13/FSMC_A18/TIM4_CH2/EVENTOUT
PD14/FSMC_D0/TIM4_CH3/EVENTOUT/_EVENTOUT
PD15/FSMC_D1/TIM4_CH4/EVENTOUT
PC0/OTG_HS_ULPI_STP/EVENTOUT
PC1/_EVENTOUT
PC2/SPI2_MISO/OTG_HS_ULPI_DIR/I2S2ext_SD/EVENTOUT
PC3/SPI2_MOSI/I2S2_SD/OTG_HS_ULPI_NXT/EVENTOUT
PC4/EVENTOUT
PC5/EVENTOUT
PC6/I2S2_MCK/TIM8_CH1/SDIO_D6/USART6_TX/TIM3_CH1/EVENTOUT
PC7/I2S3_MCK/TIM8_CH2/SDIO_D7/USART6_RX/TIM3_CH2/EVENTOUT
PC8/TIM8_CH3/SDIO_D0/TIM3_CH3/USART6_CK/EVENTOUT
PC9/I2S_CKIN/MCO2/TIM8_CH4/SDIO_D1/I2C3_SDA/TIM3_CH4/EVENTOUT
PC10/SPI3_SCK/I2S3_CK/UART4_TX/SDIO_D2/USART3_TX/EVENTOUT
PC11/UART4_RX/SPI3_MISO/SDIO_D3/USART3_RX/I2S3ext_SD/EVENTOUT
PC12/UART5_TX/SDIO_CK/SPI3_MOSI/I2S3_SD/USART3_CK/EVENTOUT
PC13/EVENTOUT
PC14/OSC32_IN/EVENTOUT
PC15/OSC32_OUT/EVENTOUT
VSSA
VSS
VCAP_1
VCAP_2
C88 2.2µ
C90 2.2µ
HV_TX
HV_RX
CMD_36
CMD_45
CMD_12
CMD_78
CMD_45E
CMD_12E
CMD_36E
CMD_78E
FB1_45
FB1_12
FB1_36
FB1_12E
FB1_36E
FB1_45E
FB0_12
FB0_36
FB0_45
FB0_45E
FB0_36E
FB0_12E
USB_OTG
shield
P1
VCC
D-
D+
ID
D D21
+5V
R1 120
C1 100n
U1
C16 100n
IO_FAN
IO_BRAKE
IO_OUT0
IO_OUT1
IO_AIN0
IO_AIN1
IO_L0
IO_L1
IO_GREEN
IO_YELLOW
IO_RED
CMD_L1
CMD_L2
FB0_L1
FB0_L2
FB0_S
FB0_C
FB0_V
FB1_L1
FB1_L2
FB1_S
FB1_C
FB1_V
EN_5V
EN_12V
C67 100n
U23
+24V
R116 10k
A_24V_
R117 1k
C64 1n
R121 1k
A_5V_
R122 1k
C81 1n
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Size: A3
Date:
Rev:
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