600953 XS4F 内外モデル
SPECIFICATION FOR SUPPLIER

CONTENTS

Tables:

Figures:

REFERENCE ELECTRICAL COMPONENTS

RS485 INTERFACE CHIP

TEXAS INSTRUMENTS THVD1426DR

- **Product homepage:** https://www.ti.com/product/THVD1426/part-details/THVD1426DR
- **Datasheet:** https://www.ti.com/lit/ds/symlink/thvd1426.pdf?ts=1727146185066&ref_url=https%253A%252F%252Fwww.mouser.jp%252F

CHECK DATASHEET, in this document the contains only pinout, typical application and packaging info ONLY.

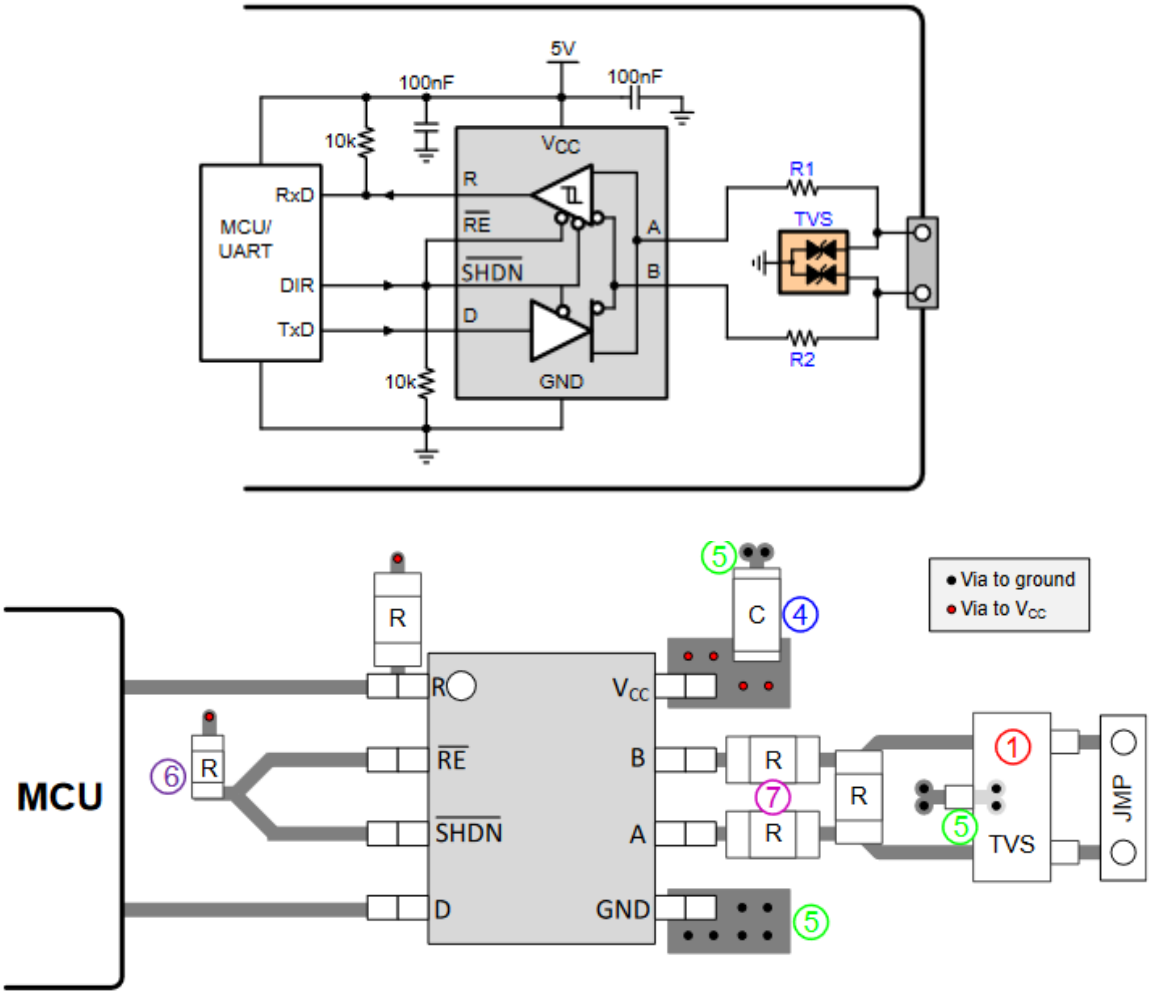
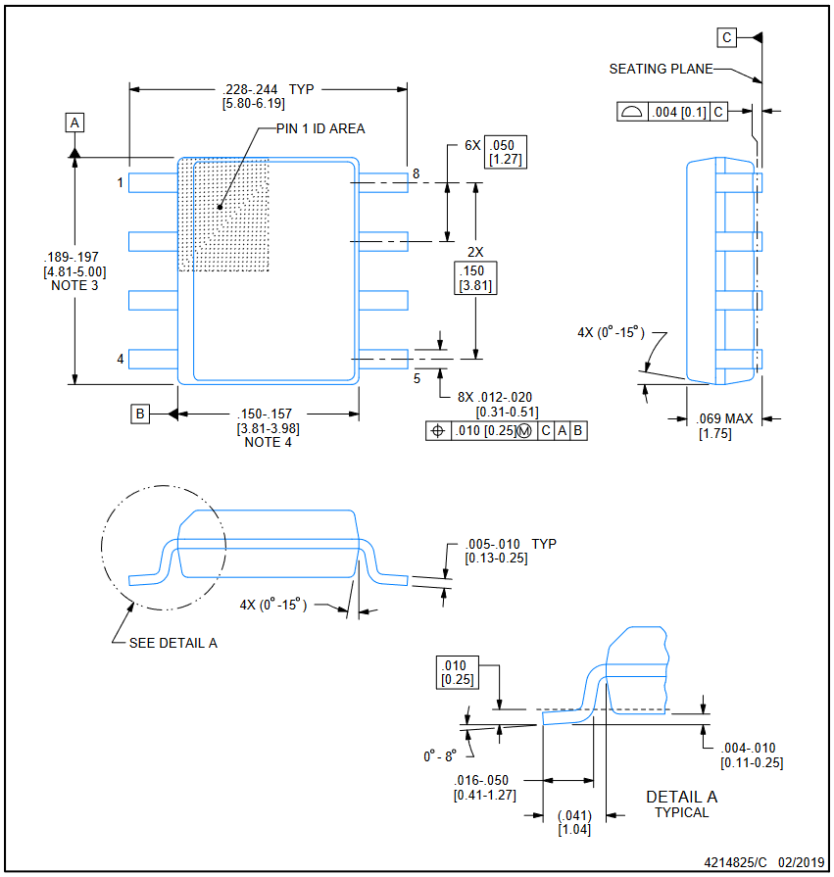


Figure 11-1. Layout Example

Packaging:



CAN INTERFACE CHIP

MICROCHIP MCP2542FDT-E/SN

- **Product homepage:** https://www.microchip.com/en-us/product/mcp2542fd
- **Datasheet:** https://ww1.microchip.com/downloads/aemDocuments/documents/APID/ProductDocuments/DataSheets/MCP2542FD-MCP2542WFD-4WFD-Data-Sheet-DS20005514C.pdf

CHECK DATASHEET, in this document the contains only pinout, typical application and packaging info ONLY.

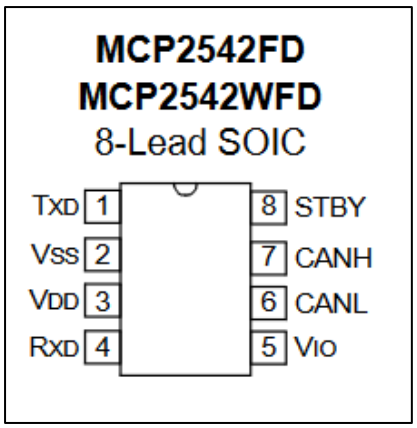
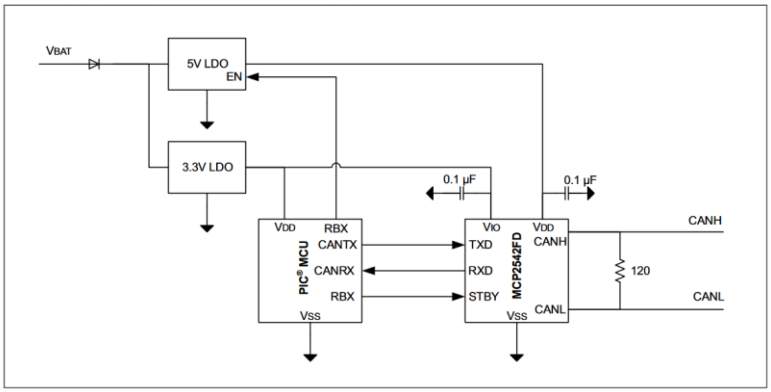


FIGURE 1-4: MCP2542FD WITH VIO PIN

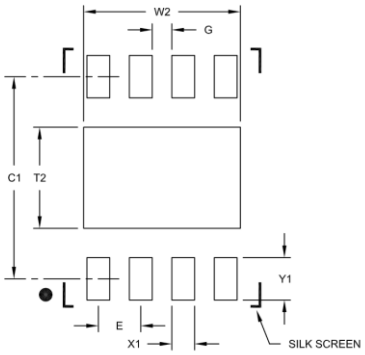


Packaging:

MCP2542FD/4FD, MCP2542WFD/4WFD

8-Lead Plastic Dual Flat, No Lead Package (MF) - 3x3x0.9mm Body [DFN]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



RECOMMENDED LAND PATTERN

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E		0.65 BSC	
Optional Center Pad Width	W2			2.40
Optional Center Pad Length	T2			1.55
Contact Pad Spacing	C1		3.10	
Contact Pad Width (X8)	X1			0.35
Contact Pad Length (X8)	Y1			0.65
Distance Between Pads	G	0.30		

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

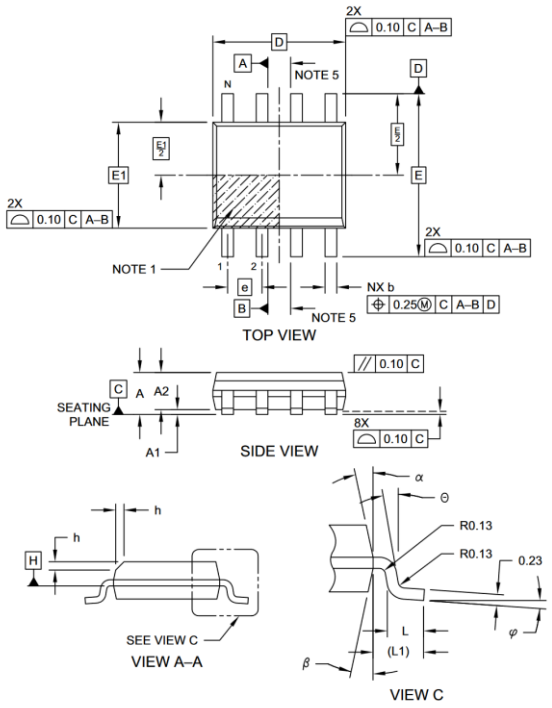
BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing No. C04-2062B

MCP2542FD/4FD, MCP2542WFD/4WFD

8-Lead Plastic Small Outline (SN) - Narrow, 3.90 mm (.150 In.) Body [SOIC]

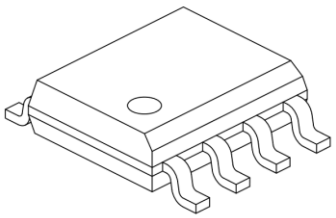
Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



MCP2542FD/4FD, MCP2542WFD/4WFD

8-Lead Plastic Small Outline (SN) - Narrow, 3.90 mm (.150 In.) Body [SOIC]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Pins	N		8	
Pitch	e		1.27 BSC	
Overall Height	A	-	-	1.75
Molded Package Thickness	A2	1.25	-	-
Standoff §	A1	0.10	-	0.25
Overall Width	E		6.00 BSC	
Molded Package Width	E1		3.90 BSC	
Overall Length	D		4.90 BSC	
Chamfer (Optional)	h	0.25	-	0.50
Foot Length	L	0.40	-	1.27
Footprint	L1		1.04 REF	
Foot Angle	φ	0°	-	8°
Lead Thickness	c	0.17	-	0.25
Lead Width	b	0.31	-	0.51
Mold Draft Angle Top	α	5°	-	15°
Mold Draft Angle Bottom	β	5°	-	15°

Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. § Significant Characteristic
3. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15mm per side.
4. Dimensioning and tolerancing per ASME Y14.5M
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.
   REF: Reference Dimension, usually without tolerance, for information purposes only.
5. Datums A & B to be determined at Datum H.

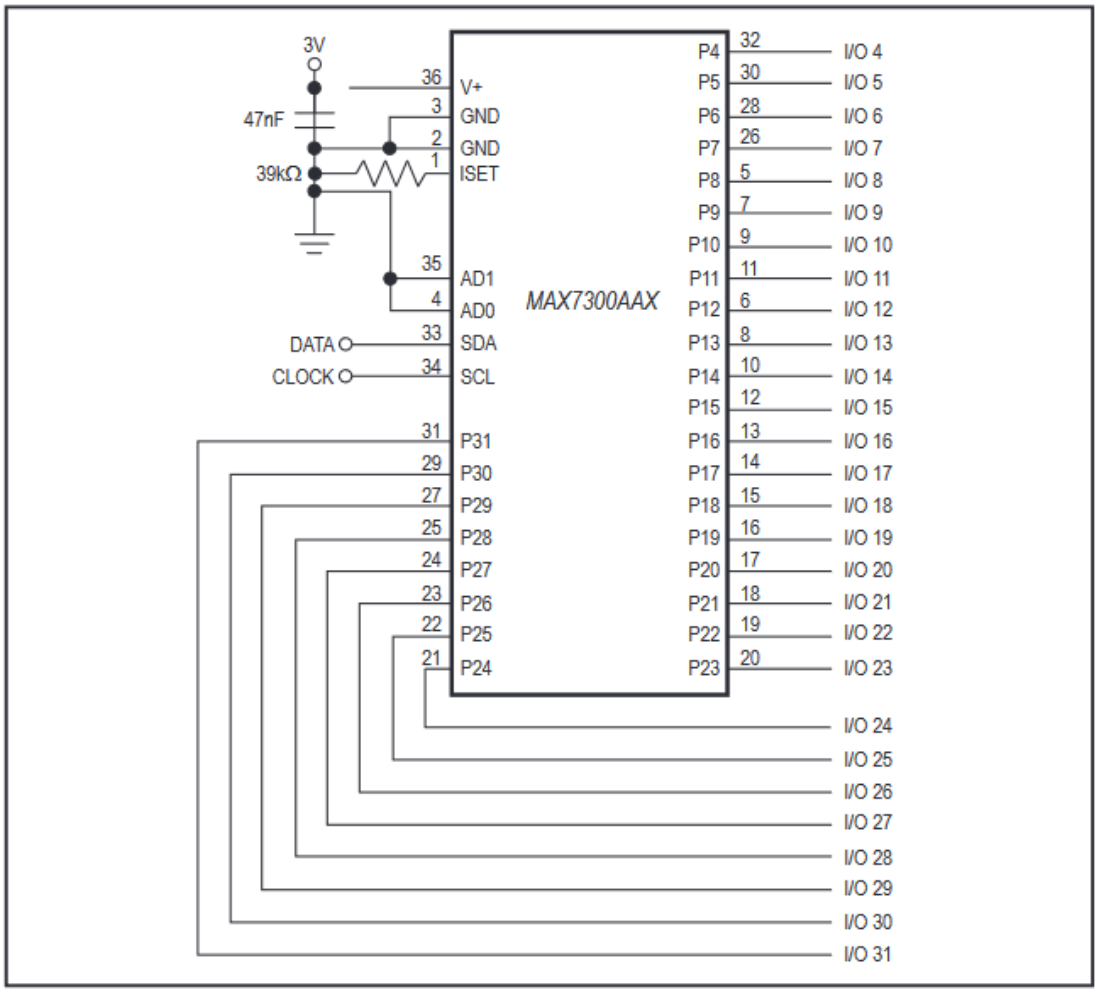
GPIO EXPANDER CHIP

ANALOG DEVICES MAX7300AAX+

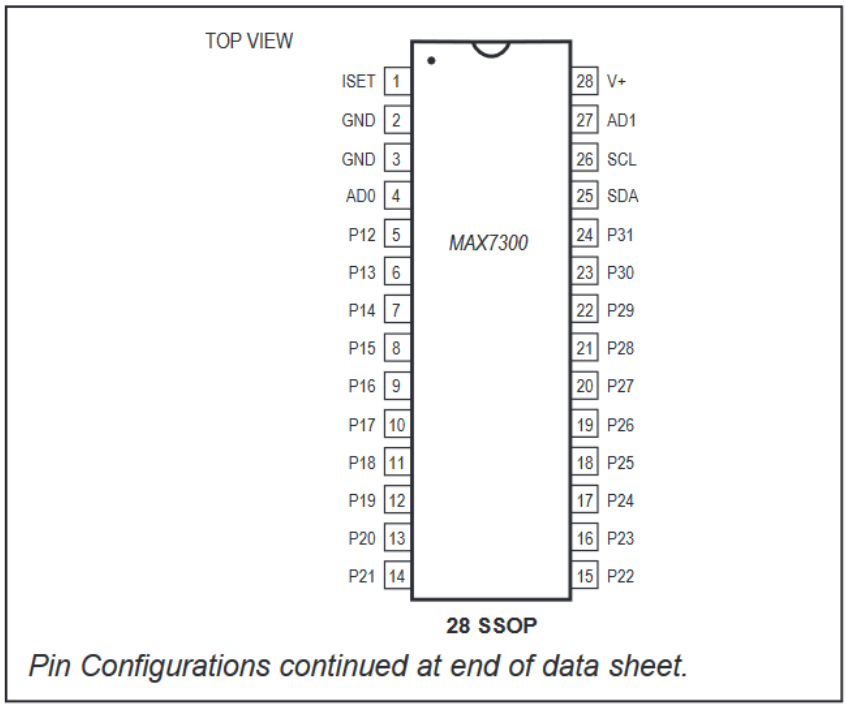
- **Product homepage:** https://www.analog.com/en/products/max7300.html
- **Datasheet:** https://www.analog.com/media/en/technical-documentation/data-sheets/MAX7300.pdf

CHECK DATASHEET, in this document the contains only pinout, typical application and packaging info ONLY.

Typical Operating Circuit

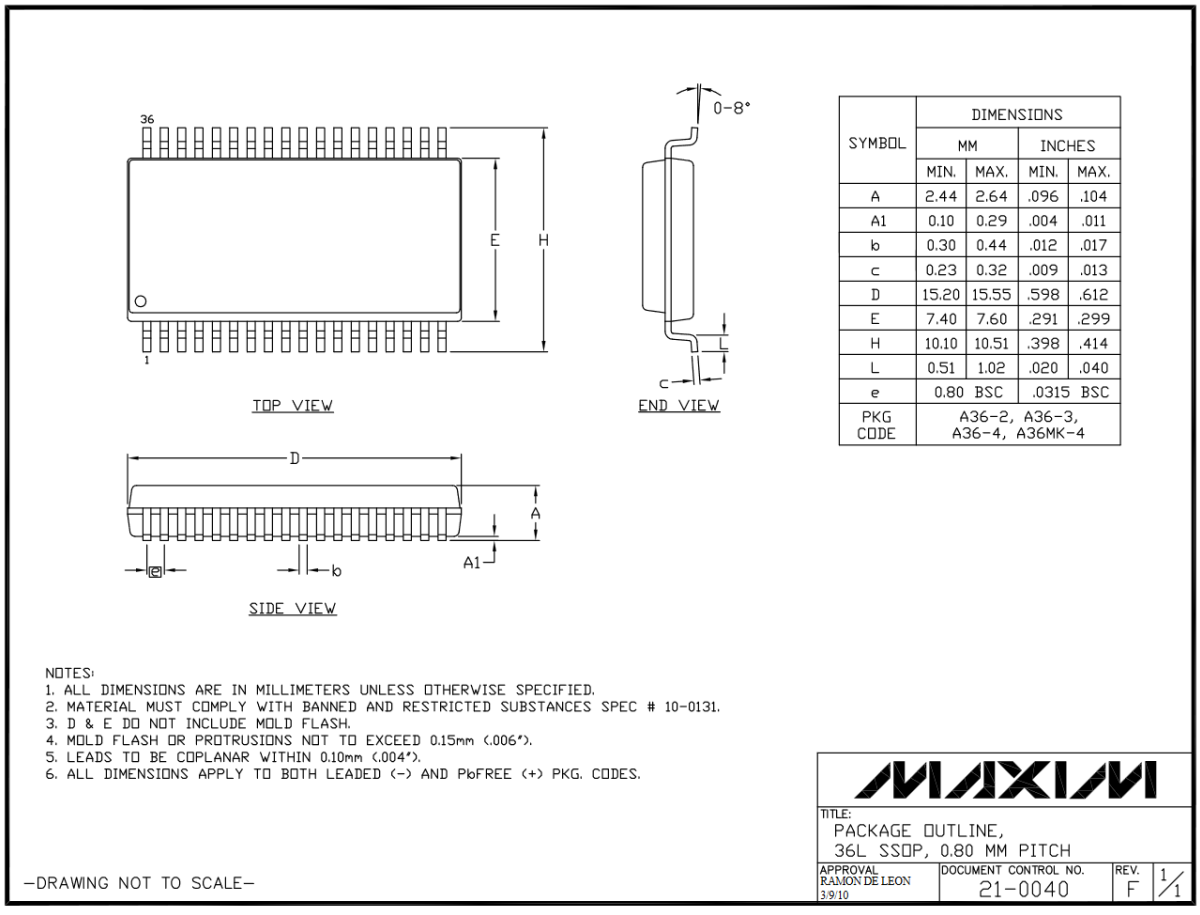


Pin Configurations

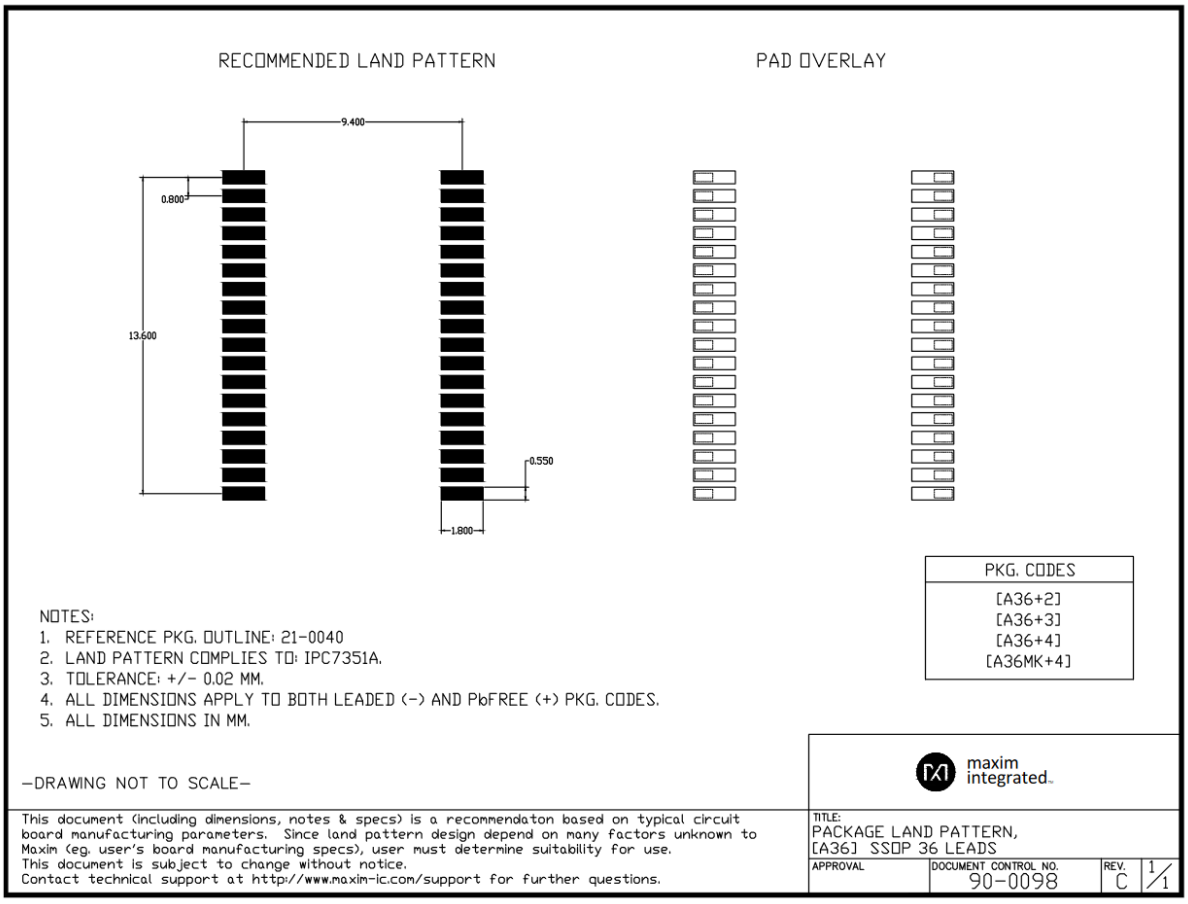


Pin Configurations continued at end of data sheet.

Packaging:



SYMBOL	DIMENSIONS			
	MM		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	2.44	2.64	.096	.104
A1	0.10	0.29	.004	.011
b	0.30	0.44	.012	.017
c	0.23	0.32	.009	.013
D	15.20	15.55	.598	.612
E	7.40	7.60	.291	.299
H	10.10	10.51	.398	.414
L	0.51	1.02	.020	.040
e	0.80 BSC		.0315 BSC	
PKG CODE	A36-2, A36-3, A36-4, A36MK-4			



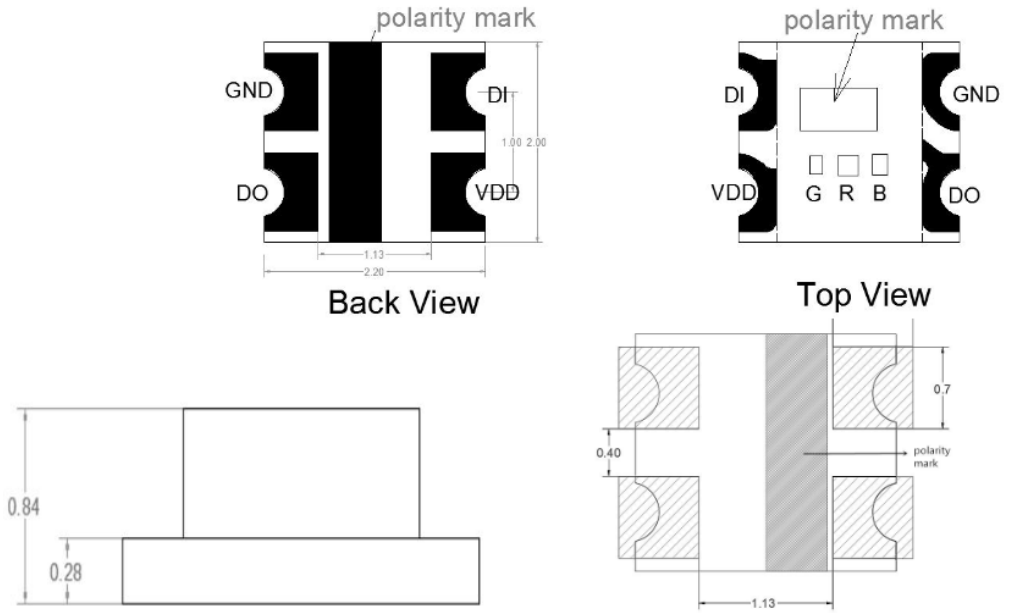
STEERING LED(S)

NEOPIXEL 2020 (RGB) – WS2812C

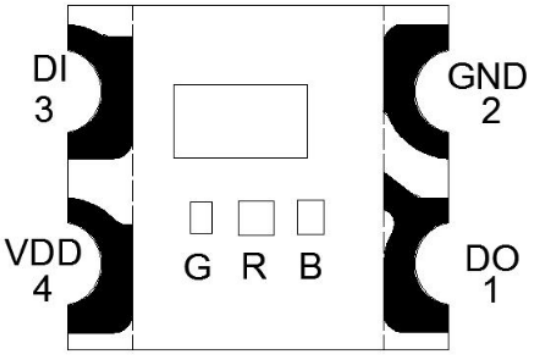
- **Product homepage:** https://akizukidenshi.com/catalog/g/g115068/
- **Datasheet:** https://akizukidenshi.com/goodsaffix/ws2812c-2020.pdf

CHECK DATASHEET, in this document the contains only pinout, typical application and packaging info ONLY.

Mechanical Dimensions（Unit: mm）



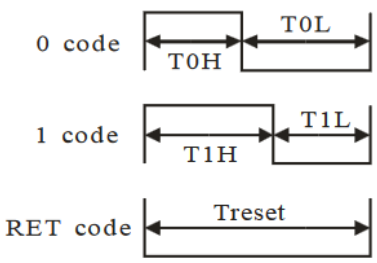
PIN Configuration



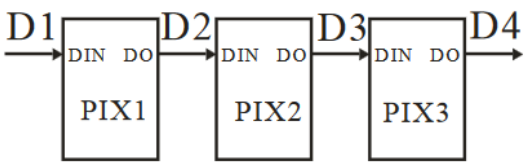
Data Transfer Time

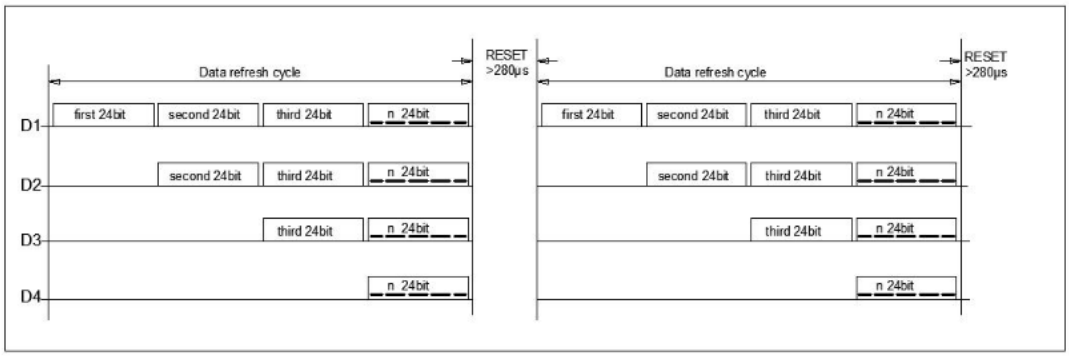
T0H	0 code, high voltage time	220ns~380ns
T1H	1 code, high voltage time	580ns~1μs
T0L	0 code, low voltage time	580ns~1μs
T1L	1 code, low voltage time	580ns~1μs
RES	Frame unit, low voltage time	>280μs

Sequence Chart



Cascade Method





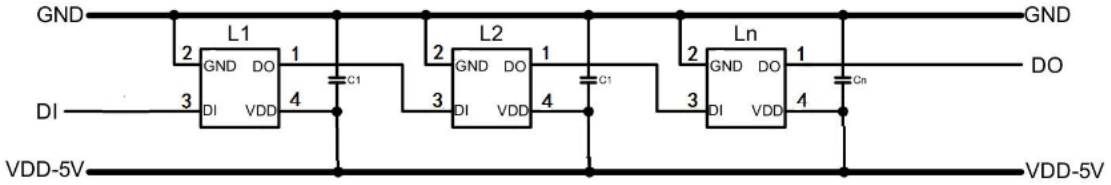
Note: The data of D1 is send by MCU, and D2, D3, D4 through pixel internal reshaping amplification to transmit.

Composition of 24bit Data

G7	G6	G5	G4	G3	G2	G1	G0	R7	R6	R5	R4	R3	R2	R1	R0	B7	B6	B5	B4	B3	B2	B1	B0

Note: Data transmit in order of GRB, high bit data at first.

Typical Application Circuit



Remarks: C1 is the filter capacitor for VDD, its value of 100nF.

MICROCONTROLLER(S)

STM32 NUCLEO F446RE – CLOSURE MCU

- **Product homepage:** https://www.st.com/en/evaluation-tools/nucleo-f446re.html#documentation
- **Datasheet:** file:///C:/Users/bacsi/Downloads/um1724-stm32-nucleo64-boards-mb1136-stmicroelectronics.pdf
- **Schematic:** https://www.carminenoviello.com/wp-content/uploads/2015/01/MB1136.pdf

CHECK DATASHEET, in this document the contains only features list, pinout, powering information and schematic.

Microcontroller features:

- Common features
  - STM32 microcontroller in an LQFP64 or LQFP48 package
  - 1 user LED shared with ARDUINO®
  - 1 user and 1 reset push-buttons
  - 32.768 kHz crystal oscillator
  - Board connectors:
    - ARDUINO® Uno V3 expansion connector
    - ST morpho extension pin headers for full access to all STM32 I/Os
  - Flexible power-supply options: ST-LINK USB V_{BUS} or external sources
  - Comprehensive free software libraries and examples available with the STM32Cube MCU Package

  - Support of a wide choice of Integrated Development Environments (IDEs) including IAR Embedded Workbench®, MDK-ARM, and STM32CubeIDE
- Features specific to some of the boards
  - Second user LED: NUCLEO-C071RB
  - External or internal SMPS to generate V_{core} logic supply: NUCLEO-L412RB-P, NUCLEO-L433RC-P, NUCLEO-L452RE-P, and NUCLEO-U545RE-Q
  - 24 MHz or 48 MHz HSE: NUCLEO-C031C6, NUCLEO-C071RB, NUCLEO-G431RB, NUCLEO-G474RE, and NUCLEO-G491RE
  - User USB Device full speed, or USB SNK/UFP full speed: NUCLEO-C071RB, NUCLEO-H503RB, NUCLEO-H533RE, and NUCLEO-U545RE-Q
  - Cryptography: NUCLEO-H533RE, NUCLEO-U083RC, and NUCLEO-U545RE-Q
  - Board connectors:
    - External SMPS experimentation dedicated connector: NUCLEO-L412RB-P, NUCLEO-L433RC-P, NUCLEO-L452RE-P, and NUCLEO-U545RE-Q
    - USB Type-C®, Micro-B, or Mini-B connector for the ST-LINK
    - USB Type-C® user connector: NUCLEO-C071RB, NUCLEO-H503RB, NUCLEO-H533RE, and NUCLEO-U545RE-Q
    - MIPI® debug connector: NUCLEO-C071RB, NUCLEO-G431RB, NUCLEO-G474RE, NUCLEO-G491RE, NUCLEO-H503RB, NUCLEO-H533RE, NUCLEO-U031R8, and NUCLEO-U083RC
  - On-board ST-LINK (STLINK/V2-1, STLINK-V3E, STLINK-V2EC, or STLINK-V3EC) debugger/programmer with USB re-enumeration capability: mass storage, Virtual COM port, and debug port

Powering:

6.5 Power supply and power selection

6.5.1 External power supply input

The STM32 NUCLEO-G070RB or NUCLEO-G071RB board is designed to be powered by several DC power supply. It is possible to supply the STM32 NUCLEO-G070RB or NUCLEO-G071RB board with any of the following sources:

- 5V_USB_STLK from ST-LINK USB connector
- VIN (7 V - 12 V) from Arduino connector or ST morpho connector
- E5V from ST morpho connector
- 5V_USB_CHG from ST-LINK USB
- 3.3 V on Arduino connector or ST morpho connector

Note: If an external 5 V DC power source is used, the Nucleo board must be powered by a power supply unit or by an auxiliary equipment complying with the standard EN-60950-1: 2006+A11/2009 and must be safety extra low voltage (SELV) with limited power capability.

The power supply capabilities are showed in *Table 7*.

Table 7. Power supply capabilities

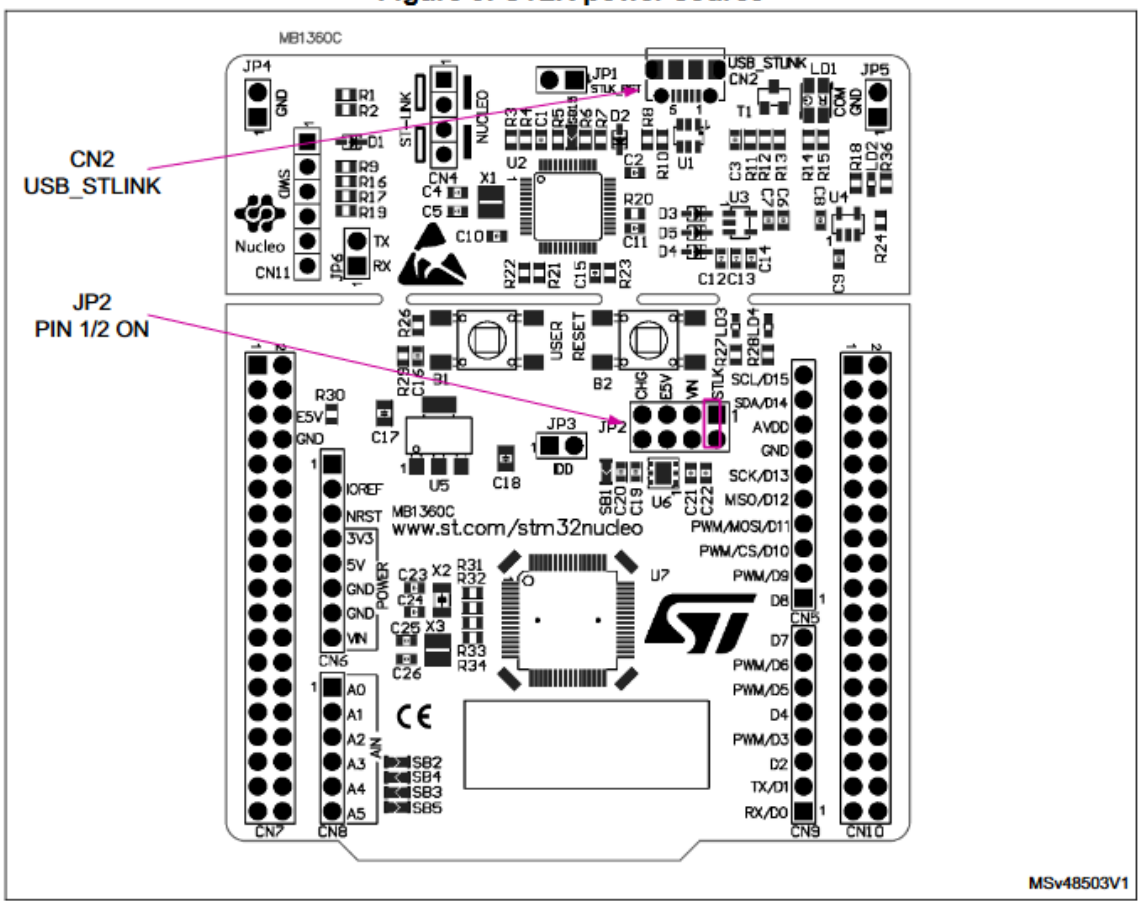
Input power	Connector pins	Voltage range	Max current	Limitation
5V_USB_STLK	CN2 PIN1	4.75 V to 5.25 V	500 mA	Max current depends on the USB enumeration: – 100 mA without enumeration – 500 mA with enumeration OK
VIN	CN6 pin 8 CN7 pin 24	7 V to 12 V	800 mA	From 7 V to 12 V only and input current capability is linked to input voltage: – 800 mA input current when VIN=7 V – 450 mA input current when 7 V<VIN<9 V – 300 mA input current when 10 V>VIN>9 V – less than 300 mA input current when VIN>10 V
E5V	CN7 pin 6	4.75 V to 5.25 V	500 mA	
5V_USB_CHG	CN2 pin 1	4.75 V to 5.25 V	500 mA	Max current depends on the USB wall charger used to powered the Nucleo board
3V3	CN6 pin 4 CN7 pin 16 JP3 pin 1	3 V to 3.6 V	-	Used when ST-LINK part of PCB not used or remove SB1 and SB19

5V_ST_LINK is a DC power with limitation from ST-LINK USB connector (USB type Micro-B connector of ST-LINK/V2-1). In this case JP2 jumper must be on pins 1 and 2 to select STLK power source on silkscreen of JP2. This is the default setting. If the USB enumeration succeeds, the STLK power is enabled, by asserting the PWR_ENn signal (from STM32F103CBT6). This pin is connected to a power switch STMPS2141STR, which Powers the board. This power switch also features a current limitation to protect the PC in case of a short-circuit on board (more than 750 mA).

The STM32 NUCLEO-G070RB or NUCLEO-G071RB board and its shield is powerable from the ST-LINK USB connector CN2, but only ST-LINK circuit is powered before USB enumeration, because the host PC only provides 100 mA to the board at that time. During the USB enumeration, the STM32 NUCLEO-G070RB or NUCLEO-G071RB board requires 500 mA of current from the host PC. If the host is able to provide the required power, the enumeration ends by a ‘SetConfiguration’ command and then, the power transistor STMPS2141STR is switched ON, the green LED LD3 is turned ON, thus the STM32 NUCLEO-G070RB or NUCLEO-G071RB board and its shield request no more than 500 mA current. If the host is not able to provide the required current, the enumeration fails. Therefore the power switch STMPS2141STR stays OFF and the MCU part including the extension board is not powered. As a consequence the green LED LD3 stays turned OFF. In this case it is mandatory to use an external power supply.

USB power: STLK configuration: jumper JP2 [1-2] must be connected as showed in *Figure 9*.

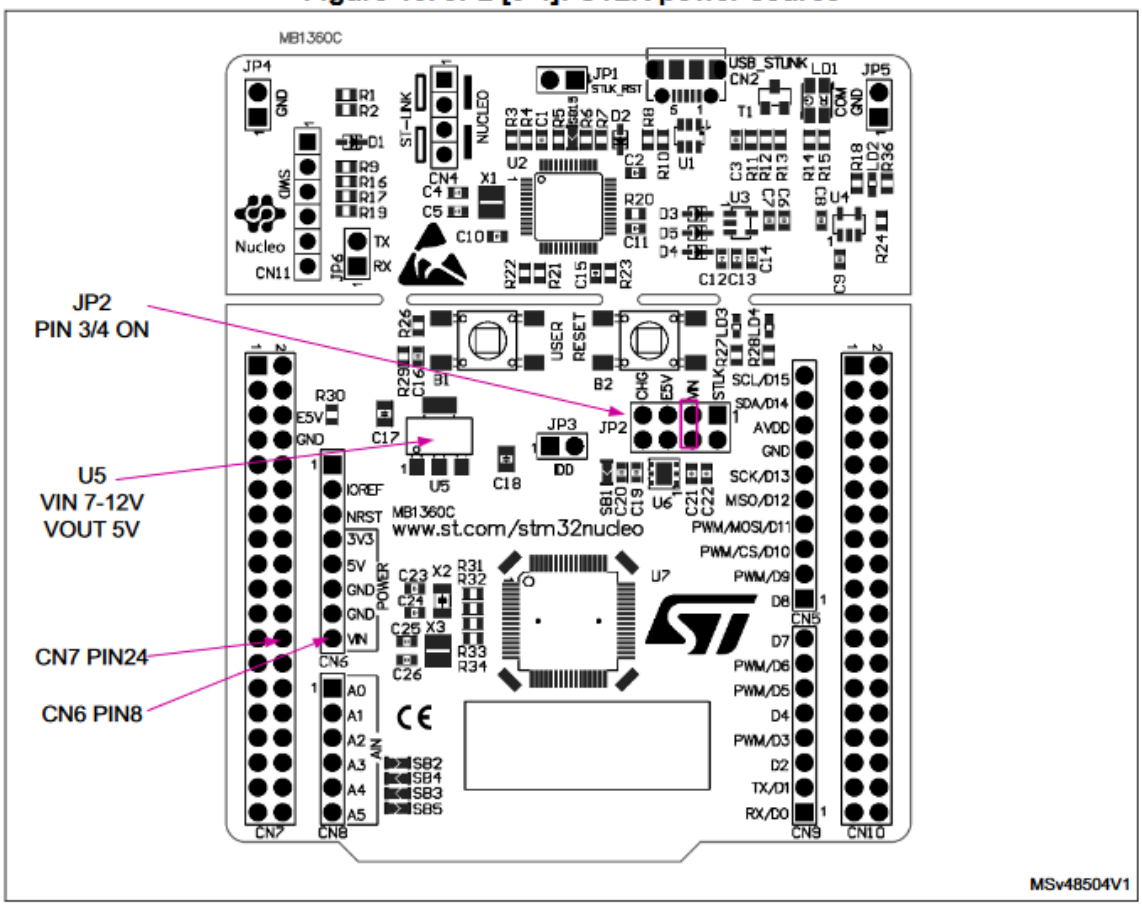
Figure 9. STLK power source



VIN is the 7 V to 12 V DC power from Arduino CN6 pin 8 named VIN on Arduino connector silkscreen or from ST morpho connector CN7 pin 24. In this case JP2 jumper must be on pins 3 and 4 to select VIN power source on silkscreen of JP2. In that case the DC power comes from the power supply through the Arduino Uno V3 battery shield (compatible with Adafruit PowerBoost 500 shield).

VIN configuration: jumper JP2 [3-4] must be connected as showed in *Figure 10*.

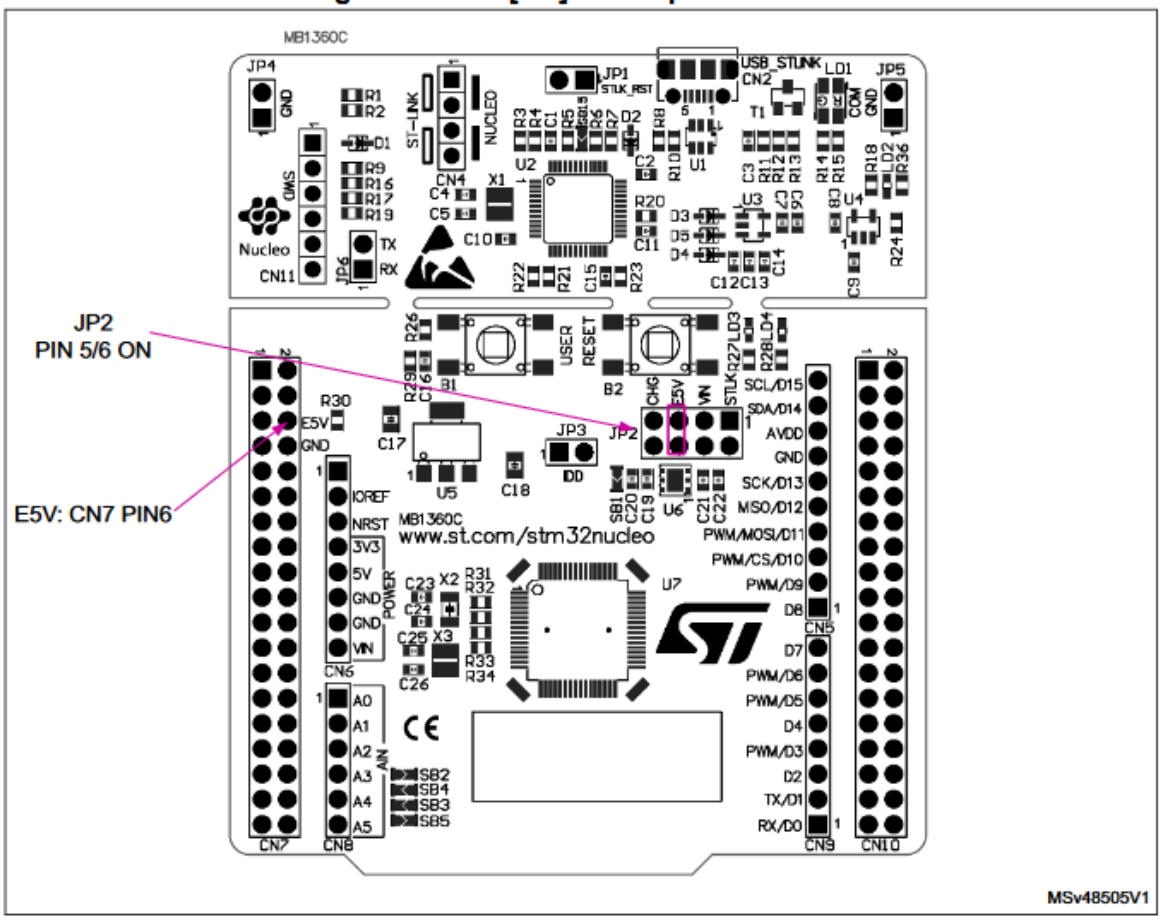
Figure 10. JP2 [3-4]: STLK power source



E5V is the DC power coming from external (5V DC power from ST morpho connector CN7 pin 6). In this case JP2 jumper must be on pins 5 and 6 to select E5V power source on silkscreen of JP2.

E5V configuration: Jumper JP2 [5-6] must be connected as showed in *Figure 11*.

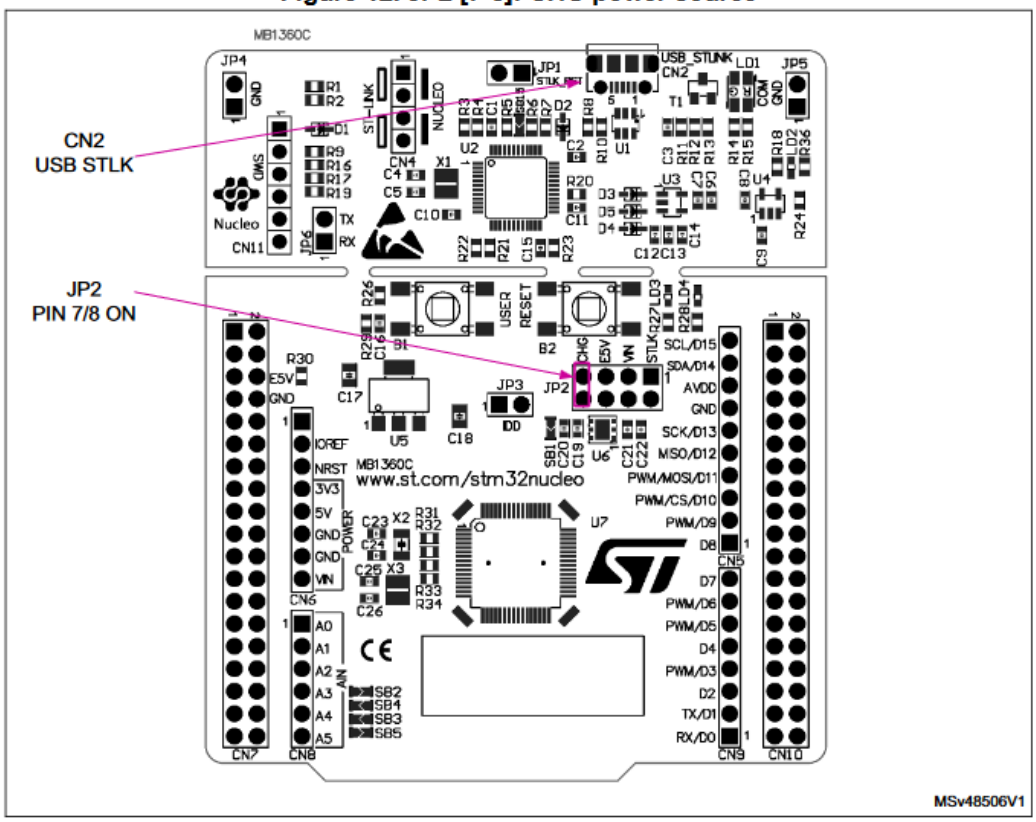
Figure 11. JP2 [5-6]: STLK power source



5V_USB_CHARGER is the DC power charger connected to USB ST-LINK (CN2). To select the CHG power source on silkscreen of JP2, the jumper of JP2 must be on pins 7 and 8. In this case, if the STM32 NUCLEO-G070RB or NUCLEO-G071RB board is powered by an external USB charger the debug is not available. If the PC is connected instead of the charger, the limitation is no more effective, in this case the PC could be damaged.

CHG configuration: jumper JP2 [7-8] must be connected as showed in *Figure 12*.

Figure 12. JP2 [7-8]: CHG power source



6.5.2 External power supply output:

- 5V: The 5V (CN6 pin 5 or CN7 pin 18) is usable as output power supply for an Arduino shield or an extension board, when the NUCLEO-G070RB or NUCLEO-G071RB board is powered by USB, VIN or E5V. In this case the maximum current allowed is showed in *Table 7*.
- 3.3V: on CN6 pin 4 or CN7 pin 16 is usable as power supply output. The current is limited by the maximum current capability of the regulator U6 (LDL112PV33R from STMicroelectronics). In this condition the maximum consumption of the STM32 NUCLEO-G070RB or NUCLEO-G071RB board and the connected shield must be less than 500 mA.

Pinout:

Pins Legend

Labels usable in code

PX_Y	MCU pin without conflict	XXX	Arduino connector names (A0, D1, ...)
PX_Y	MCU pin connected to other components See **PeripheralPins.c** (link below) for more information	XXX	LEDs and Buttons (LED_1, USER_BUTTON, ...)

Labels not usable in code (for information only)

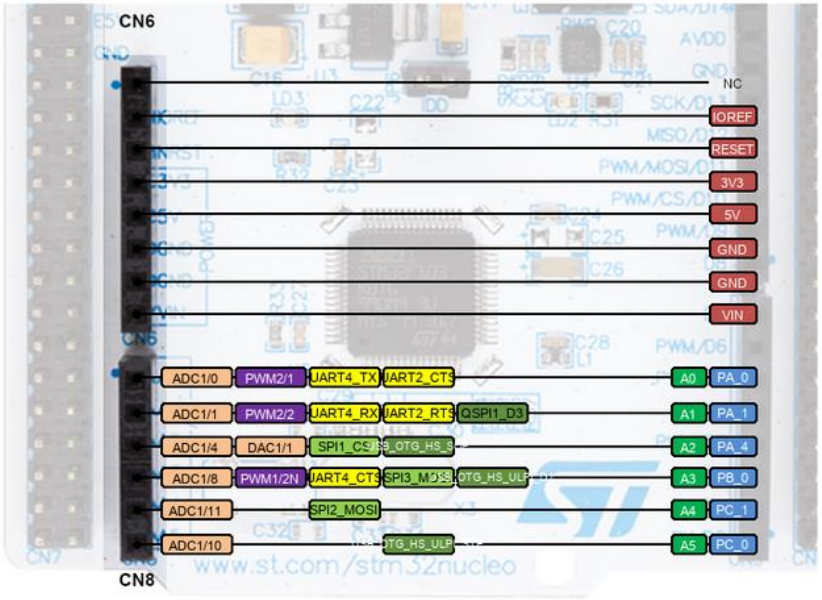
XXX	Serial pins (USART/UART)	XXX	AnalogIn (ADC) and AnalogOut pins (DAC)
XXX	SPI pins	XXX	CAN pins
XXX	I2C pins		
XXX	PWMOut pins (TIMER n/c[N]) n = Timer number c = Channel N = Inverted channel	XXX	Power and control pins (3V3, GND, RESET, ...)

life.augmented

NUCLEO-F446RE

ARDUINO HEADER

(top left side)

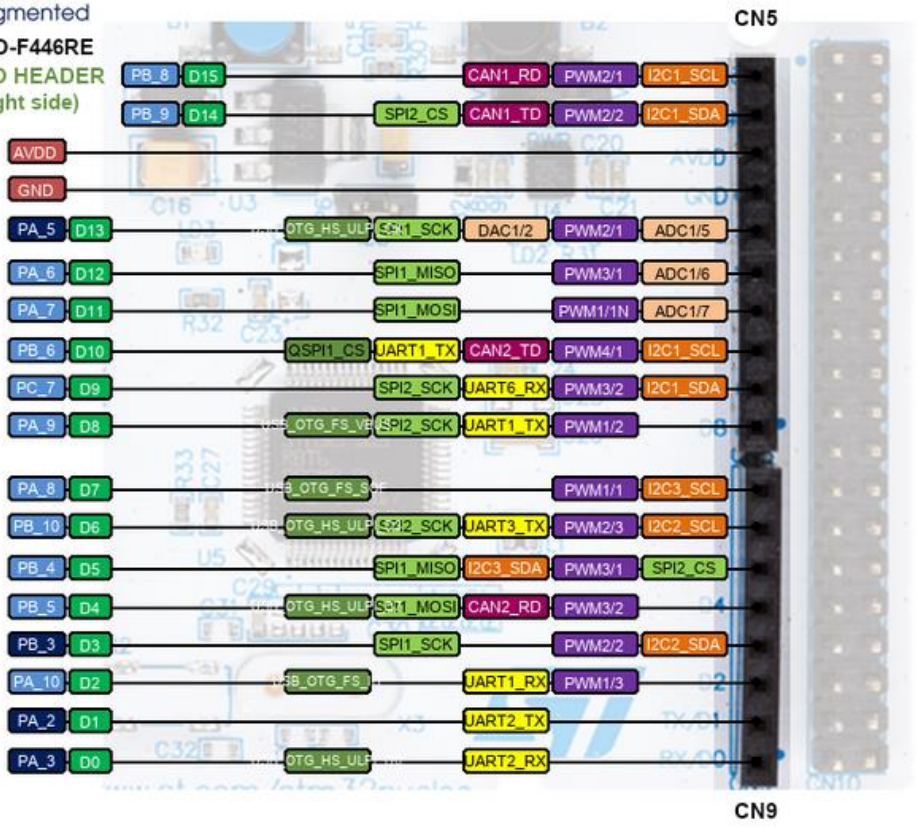


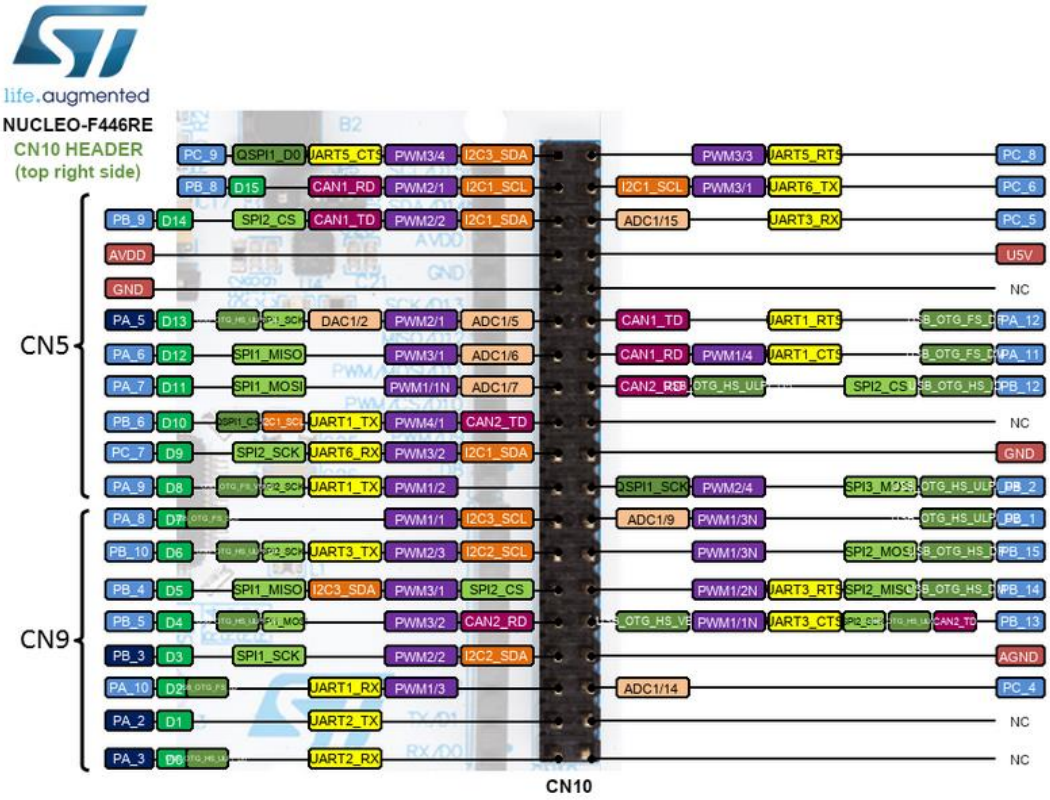
life.augmented

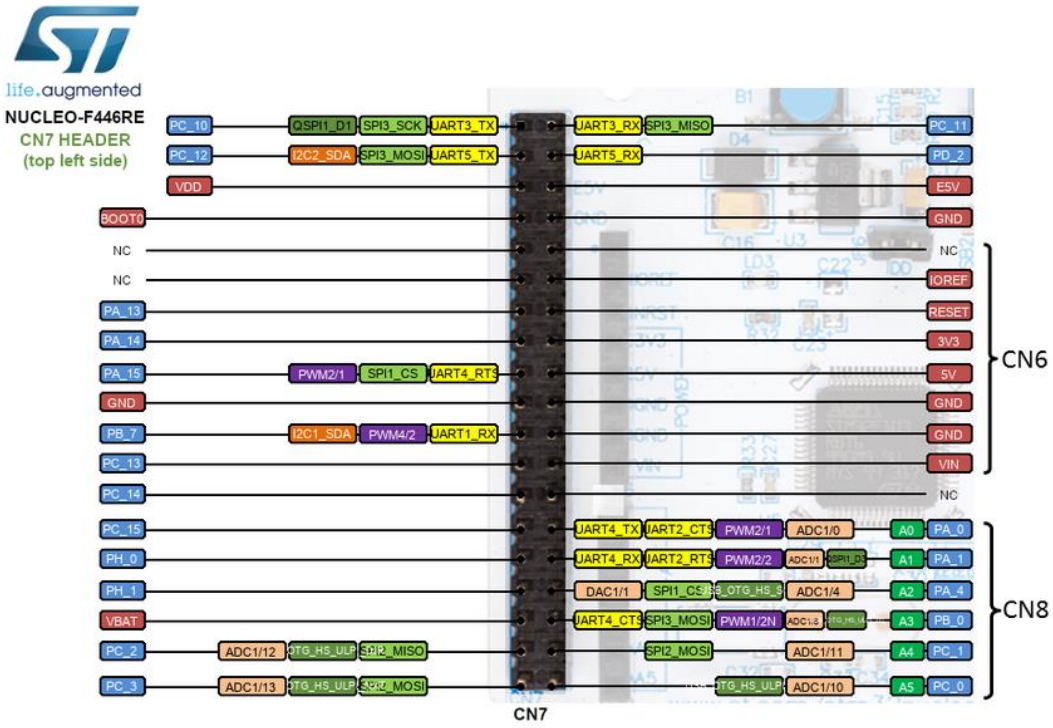
NUCLEO-F446RE

ARDUINO HEADER

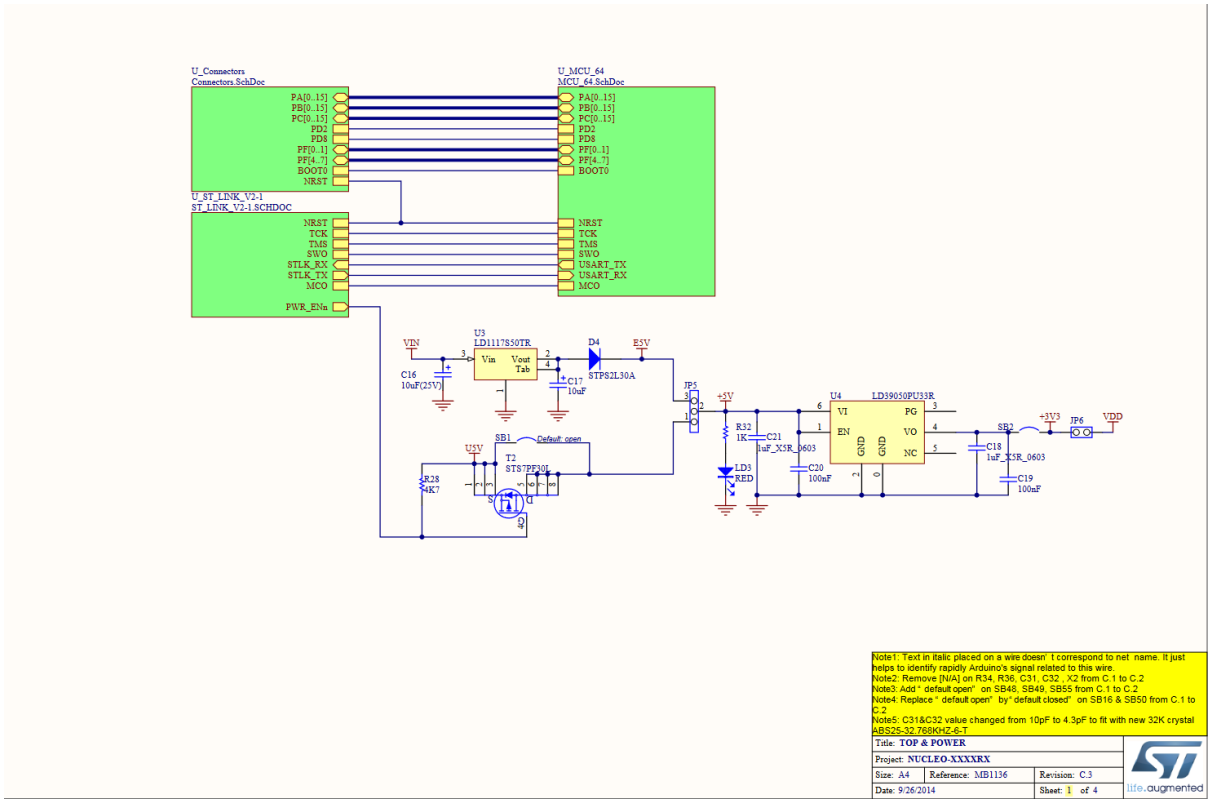
(top right side)

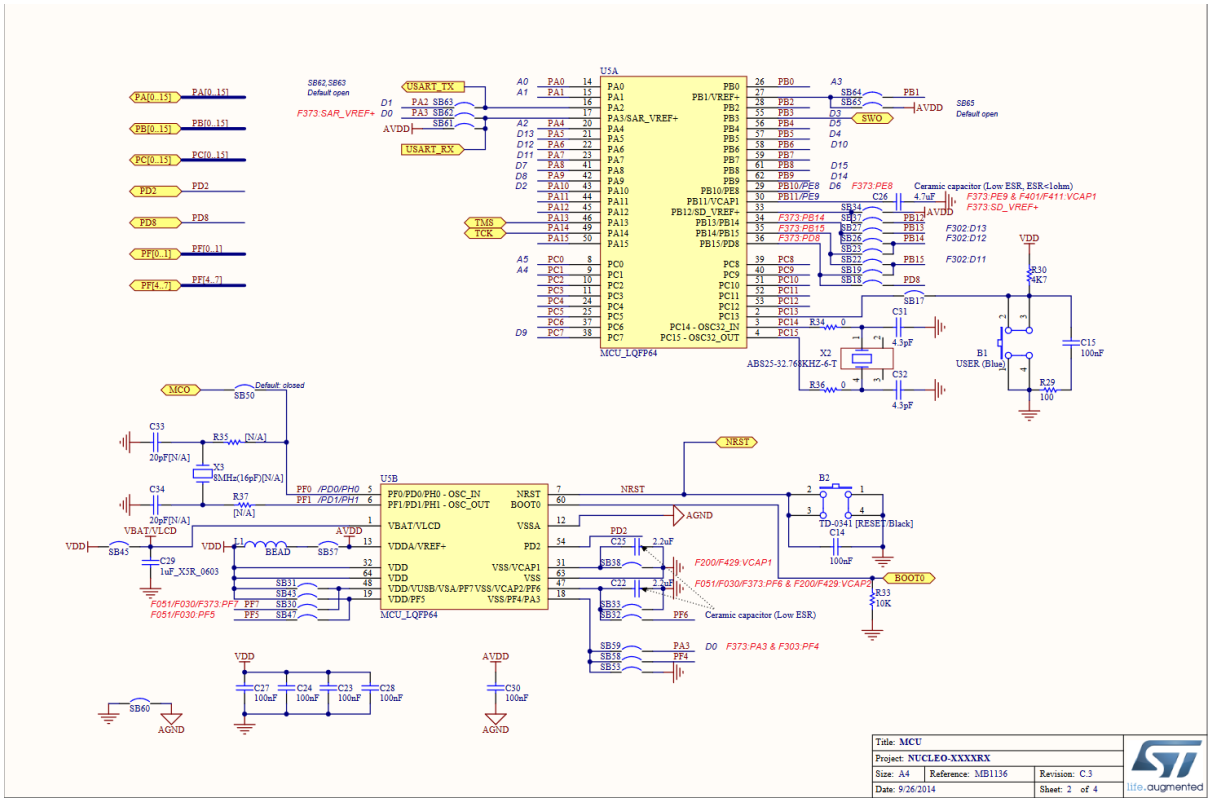


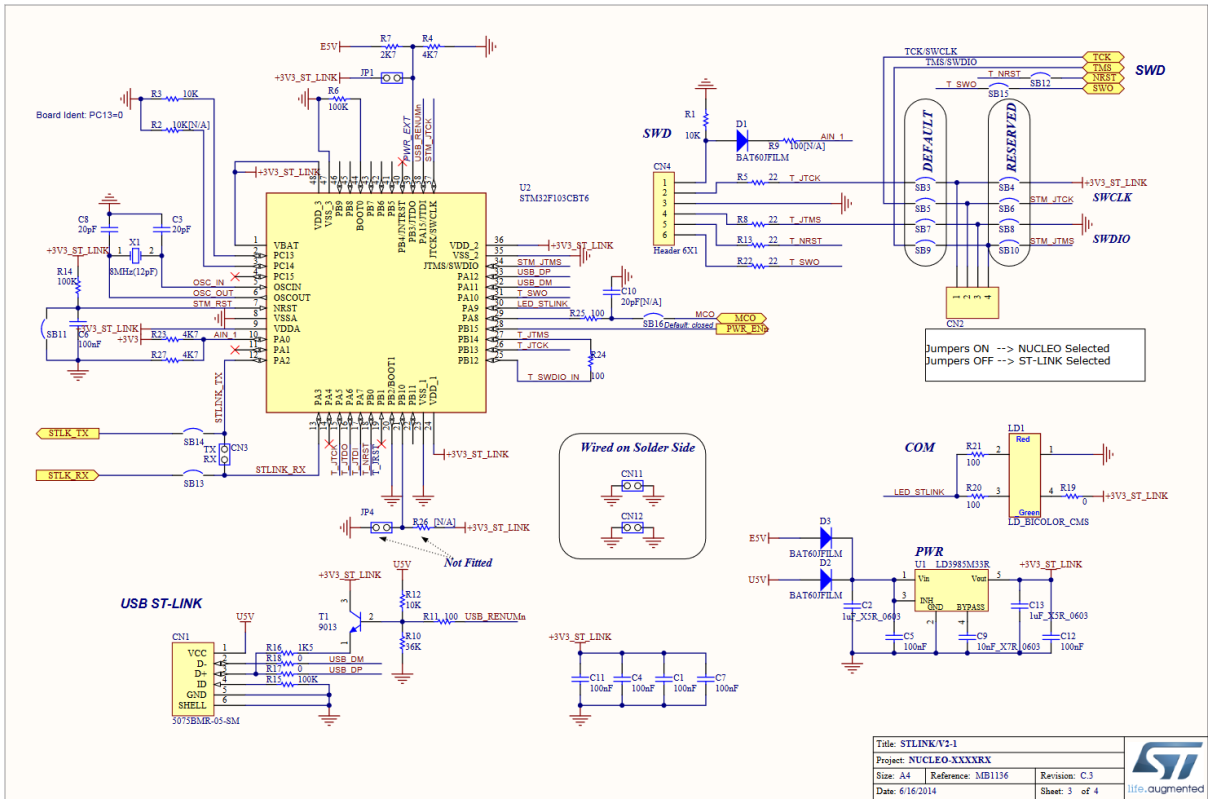

life.augmented
NUCLEO-F446RE
CN10 HEADER
(top right side)
CN5
CN9
CN10
PC_9 QSPI1_D0 UART5_CTS PWM3/4 I2C3_SDA
PB_8 D15 CAN1_RD PWM2/1 I2C1_SCL
PB_9 D14 SPI2_CS CAN1_TD PWM2/2 I2C1_SDA
AVDD
GND
PA_5 D13 DAC1/2 PWM2/1 ADC1/5
PA_6 D12 SPI1_MISO PWM3/1 ADC1/6
PA_7 D11 SPI1_MOSI PWM1/1N ADC1/7
PB_6 D10 UART1_TX PWM4/1 CAN2_TD
PC_7 D9 SPI2_SCK UART6_RX PWM3/2 I2C1_SDA
PA_9 D8 UART1_TX PWM1/2
PA_8 D7 PWM1/1 I2C3_SCL
PB_10 D6 UART3_TX PWM2/3 I2C2_SCL
PB_4 D5 SPI1_MISO I2C3_SDA PWM3/1 SPI2_CS
PB_5 D4 PWM3/2 CAN2_RD
PB_3 D3 SPI1_SCK PWM2/2 I2C2_SDA
PA_10 D2 UART1_RX PWM1/3
PA_2 D1 UART2_TX
PA_3 D0 UART2_RX
PWM3/3 UART5_RTS PC_8
I2C1_SCL PWM3/1 UART6_TX PC_6
ADC1/15 UART3_RX PC_5
U5V
NC
CAN1_TD UART1_RTS PA_12
CAN1_RD PWM1/4 UART1_CTS PA_11
SPI2_CS PB_12
NC
GND
QSPI1_SCK PWM2/4 PB_2
ADC1/9 PWM1/3N PB_1
PWM1/3N PB_15
PWM1/2N UART3_RTS PB_14
PWM1/1N UART3_CTS PB_13
AGND
ADC1/14 PC_4
NC
NC

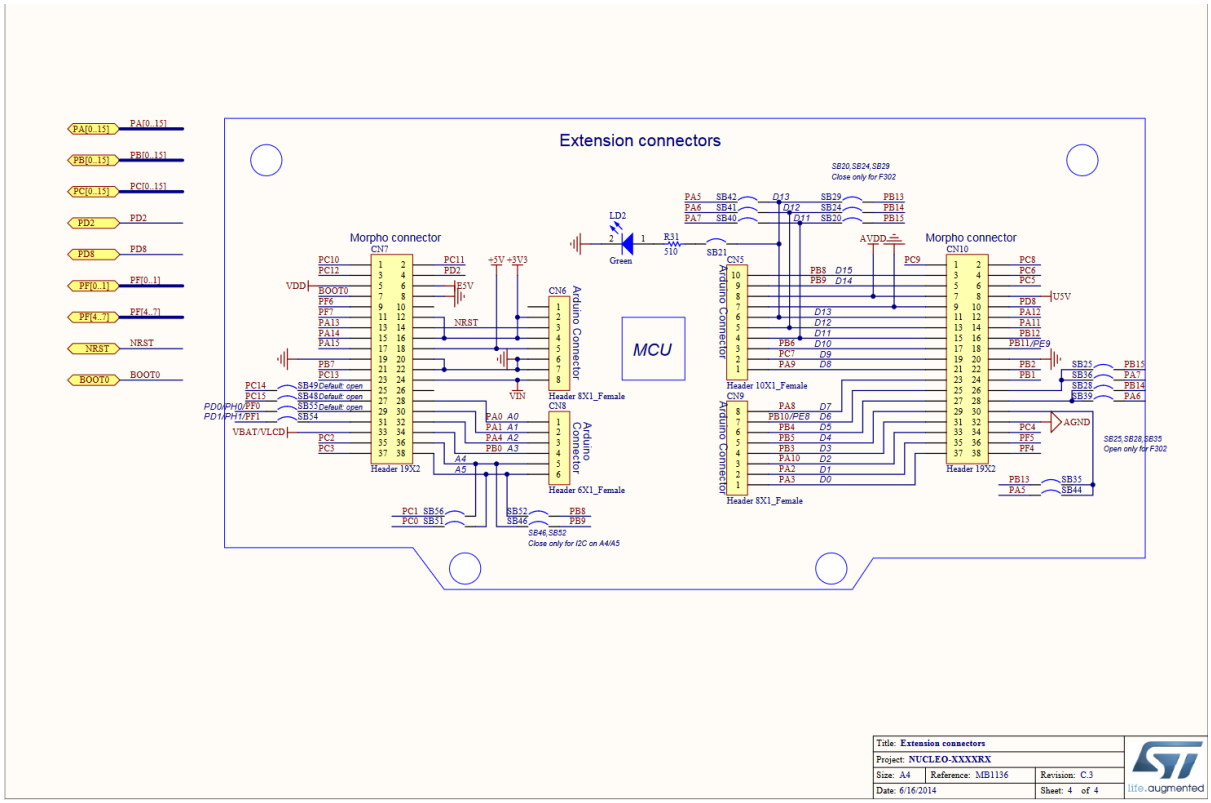

life.augmented
NUCLEO-F446RE
CN7 HEADER
(top left side)
CN6
CN8
CN7
PC_10 QSPI1_D1 SPI3_SCK UART3_TX
PC_12 I2C2_SDA SPI3_MOSI UART5_TX
VDD
BOOT0
NC
NC
PA_13
PA_14
PA_15 PWM2/1 SPI1_CS UART4_RTS
GND
PB_7 I2C1_SDA PWM4/2 UART1_RX
PC_13
PC_14
PC_15
PH_0
PH_1
VBAT
PC_2 ADC1/12 SPI2_MISO
PC_3 ADC1/13 SPI2_MOSI
UART3_RX SPI3_MISO PC_11
UART5_RX PD_2
E5V
GND
NC
IOREF
RESET
3V3
5V
GND
GND
VIN
NC
UART4_TX UART2_CTS PWM2/1 ADC1/0 A0 PA_0
UART4_RX UART2_RTS PWM2/2 A1 PA_1
DAC1/1 SPI1_CS ADC1/4 A2 PA_4
UART4_CTS SPI3_MOSI PWM1/2N A3 PB_0
SPI2_MOSI ADC1/11 A4 PC_1
ADC1/10 A5 PC_0

Schematic:


U_Connectors
Connectors.SchDoc
U_MCU_64
MCU_64.SchDoc
U_ST_LINK_V2-1
ST_LINK_V2-1.SCHDOC
U3
LD1117S50TR
D4
STPS2L30A
U4
LD39050PU33R
JP5
JP6
SB1
Default: open
SB2
SB3
U5V
T2
STS7PF30L
R28
4K7
R32
1K
C21
1uF_X5R_0603
C20
100nF
LD3
RED
C16
10uF(25V)
C17
10uF
C18
1uF_X5R_0603
C19
100nF
Note1: Text in italic placed on a wire doesn't correspond to net name. It just helps to identify rapidly Arduino's signal related to this wire.
Note2: Remove [N/A] on R34, R36, C31, C32 , X2 from C.1 to C.2
Note3: Add " default open" on SB48, SB49, SB55 from C.1 to C.2
Note4: Replace " default open" by" default closed" on SB16 & SB50 from C.1 to C.2
Note5: C31&C32 value changed from 10pF to 4.3pF to fit with new 32K crystal ABS25-32.768KHZ-6-T
Title: TOP & POWER
Project: NUCLEO-XXXXRX
Size: A4
Reference: MB1136
Revision: C.3
Date: 9/26/2014
Sheet: 1 of 4
life.augmented


U5A
MCU_LQFP64
U5B
MCU_LQFP64
X2
ABS25-32.768KHZ-6-T
X3
8MHz(16pF)[N/A]
B1
USER (Blue)
B2
TD-0341 [RESET/Black]
SB50
Default: closed
SB45
SB57
SB60
SB65
Default: open
SB62,SB63
Default: open
C26
4.7uF
C31
4.3pF
C32
4.3pF
C33
20pF[N/A]
C34
20pF[N/A]
C29
1uF_X5R_0603
C14
100nF
C15
100nF
C22
2.2uF
C23
2.2uF
C24
100nF
C27
100nF
C28
100nF
C30
100nF
R30
4K7
R29
100
R33
10K
R34
0
R36
0
R35
[N/A]
R37
[N/A]
L1
BEAD
Ceramic capacitor (Low ESR, ESR<1ohm)
Ceramic capacitor (Low ESR)
F373:PE9 & F401/F411:VCAP1
F373:SD_VREF+
F373:SAR_VREF+
F373:PB14
F373:PB15
F373:PD8
F373:PE8
F373:PA3 & F303:PF4
F200/F429:VCAP1
F051/F030/F373:PF6 & F200/F429:VCAP2
F051/F030/F373:PF7
F051/F030:PF5
F302:D13
F302:D12
F302:D11
Title: MCU
Project: NUCLEO-XXXXRX
Size: A4
Reference: MB1136
Revision: C.3
Date: 9/26/2014
Sheet: 2 of 4
life.augmented


Board Ident: PC13=0
U2
STM32F103CBT6
SWD
SWCLK
SWDIO
DEFAULT
RESERVED
Jumpers ON --> NUCLEO Selected
Jumpers OFF --> ST-LINK Selected
Wired on Solder Side
Not Fitted
USB ST-LINK
COM
PWR
Title: STLINK/V2-1
Project: NUCLEO-XXXXRX
Size: A4
Reference: MB1136
Revision: C.3
Date: 6/16/2014
Sheet: 3 of 4


Extension connectors
Morpho connector
MCU
Arduino Connector
Header 19X2
Header 10X1_Female
Header 8X1_Female
Header 6X1_Female
Title: Extension connectors
Project: NUCLEO-XXXXRX
Size: A4
Reference: MB1136
Revision: C.3
Date: 6/16/2014
Sheet: 4 of 4

STM32 BLUE PILL F103C8T6 – STRG MCU

- **Product homepage:** https://stm32-base.org/boards/STM32F103C8T6-Blue-Pill.html
- **Datasheet:** file:///C:/Users/bacsi/Downloads/stm32f103c8.pdf [Chip only]
- **Schematic:** https://stm32-base.org/assets/pdf/boards/original-schematic-STM32F103C8T6-Blue_Pill.pdf

CHECK DATASHEET, in this document the contains only features list, pinout, powering information and schematic.

Microcontroller features:

- Arm® 32-bit Cortex®-M3 CPU core
  - 72 MHz maximum frequency, 1.25 DMIPS/MHz (Dhrystone 2.1) performance at 0 wait state memory access
  - Single-cycle multiplication and hardware division
- Memories
  - 64 or 128 Kbytes of Flash memory
  - 20 Kbytes of SRAM
- Clock, reset and supply management
  - 2.0 to 3.6 V application supply and I/Os
  - POR, PDR, and programmable voltage detector (PVD)
  - 4 to 16 MHz crystal oscillator
  - Internal 8 MHz factory-trimmed RC
  - Internal 40 kHz RC
  - PLL for CPU clock
  - 32 kHz oscillator for RTC with calibration
- Low-power
  - Sleep, Stop and Standby modes
  - V_{BAT} supply for RTC and backup registers
- 2x 12-bit, 1 µs A/D converters (up to 16 channels)
  - Conversion range: 0 to 3.6 V
  - Dual-sample and hold capability
  - Temperature sensor
- DMA
  - 7-channel DMA controller
  - Peripherals supported: timers, ADC, SPIs, I^2Cs and USARTs
- Up to 80 fast I/O ports
  - 26/37/51/80 I/Os, all mappable on 16 external interrupt vectors and almost all 5 V-tolerant
- Debug mode:
  - Serial wire debug (SWD) and JTAG interfaces
- Seven timers
  - Three 16-bit timers, each with up to 4 IC/OC/PWM or pulse counter and quadrature (incremental) encoder input
  - 16-bit, motor control PWM timer with dead-time generation and emergency stop
  - Two watchdog timers (independent and window)
  - SysTick timer 24-bit downcounter
- Up to nine communication interfaces
  - Up to two I^2C interfaces (SMBus/PMBus®)
  - Up to three USARTs (ISO 7816 interface, LIN, IrDA capability, modem control)
  - Up to two SPIs (18 Mbit/s)
  - CAN interface (2.0B Active)
  - USB 2.0 full-speed interface
- CRC calculation unit, 96-bit unique ID
- Packages are ECOPACK®
-

Powering: Use [5V] pin and [G] pin to connect power for the blue pill board.

Pinout:

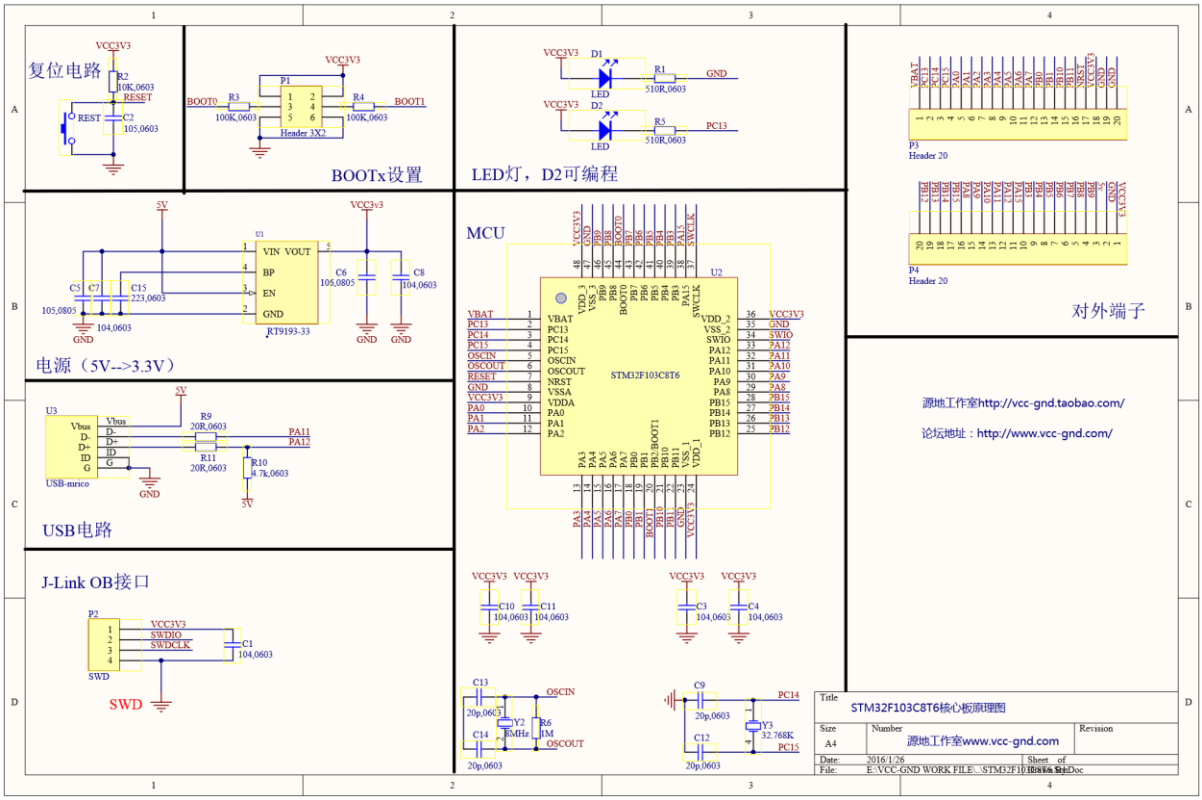
⇄ Header 1 pins

#	Name	Function	Connected to
1	VB	-	V_{BAT}
2	C13	-	PC13
3	C14	-	PC14
4	C15	-	PC15
5	A0	-	PA0
6	A1	-	PA1
7	A2	-	PA2
8	A3	-	PA3
9	A4	-	PA4
10	A5	-	PA5
11	A6	-	PA6
12	A7	-	PA7
13	B0	-	PB0
14	B1	-	PB1
15	B10	-	PB10
16	B11	-	PB11
17	R	-	$\overline{\text{NRST}}$
18	3.3	-	+3.3V rail
19	G	-	Ground plane
20	G	-	Ground plane

⇄ Header 2 pins

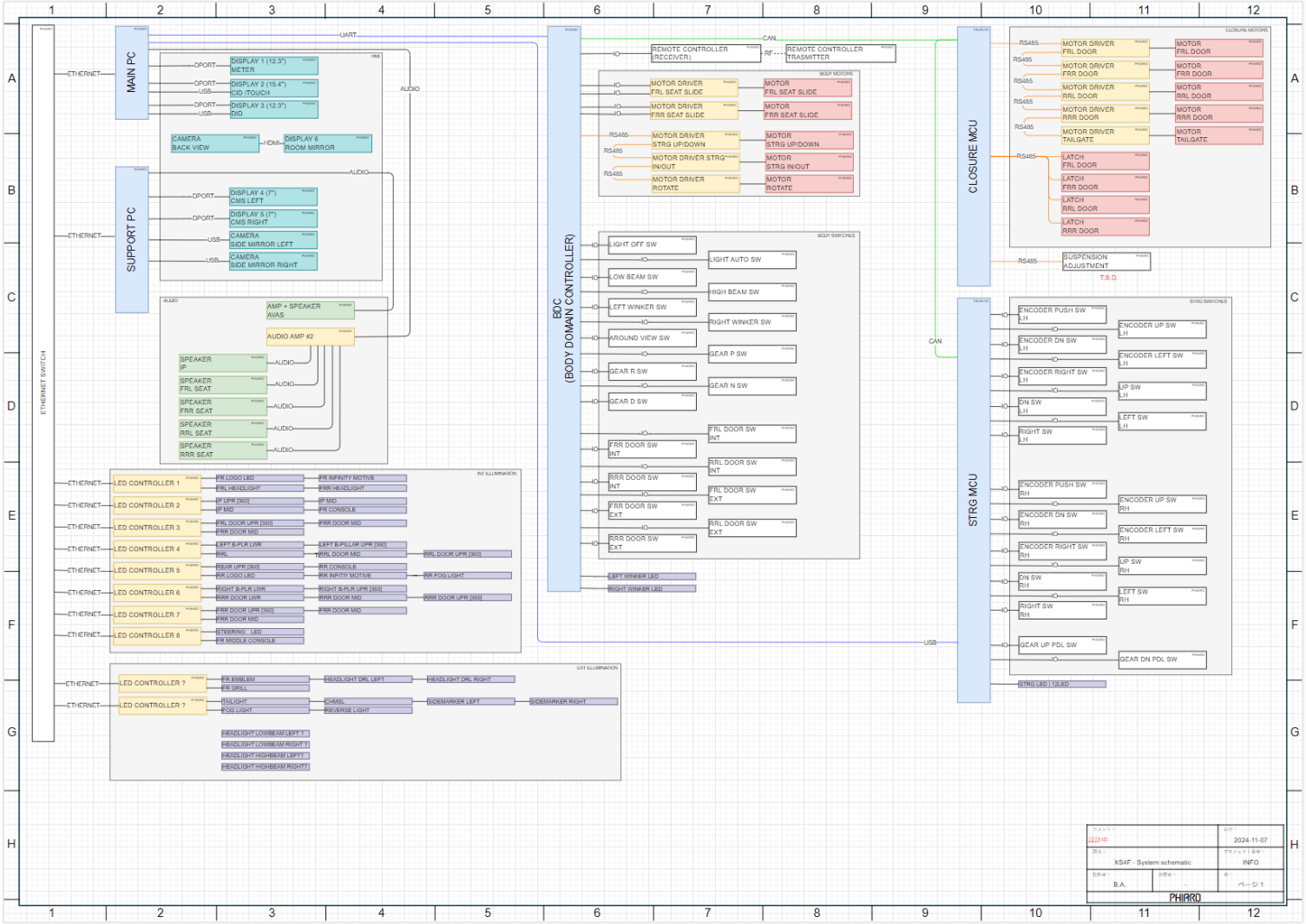
#	Name	Function	Connected to
1	3.3	-	+3.3V rail
2	G	-	Ground plane
3	5V	-	+5V rail
4	B9	-	PB9
5	B8	-	PB8
6	B7	-	PB7
7	B6	-	PB6
8	B5	-	PB5
9	B4	-	PB4
10	B3	-	PB3
11	A15	-	PA15
12	A12	-	PA12
13	A11	-	PA11
14	A10	-	PA10
15	A9	-	PA9
16	A8	-	PA8
17	B15	-	PB15
18	B14	-	PB14
19	B13	-	PB13
20	B12	-	PB12

Schematic:



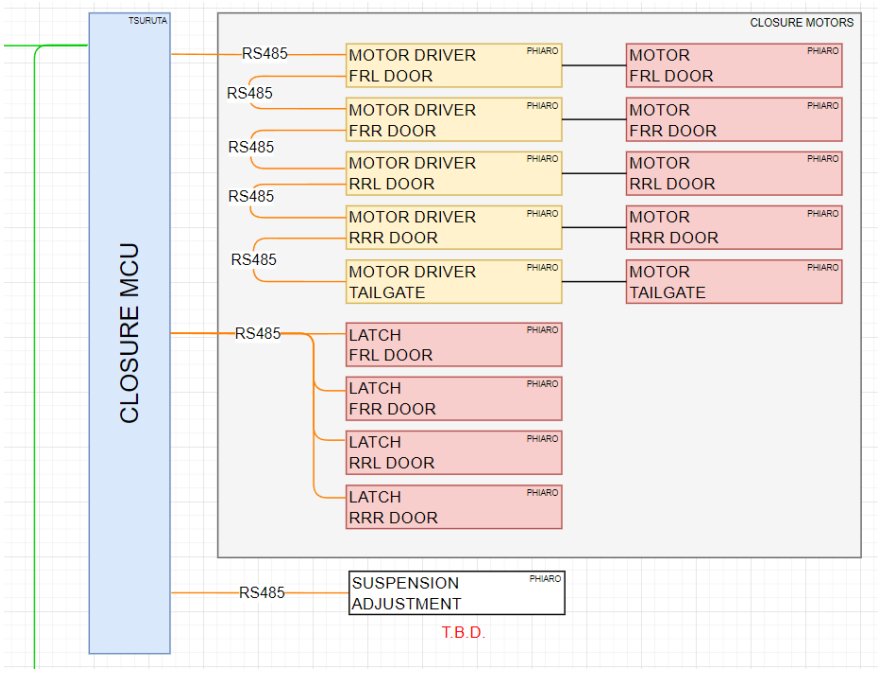
SYSTEM COMPONENTS AND RELATIONS

SYSTEM SCHEMATIC



CLOSURE MCU

BLOCK SCHEMATIC



NECESSARY FUNCTIONS

- Control the suspension adjustment motors based on CAN messages [T.B.D]
  - **<u>This function cannot be detailed at actual status, will be updated as soon as possible</u>**
- Control the door motors and latch motors based on CAN messages
- Door motors and latch motors should be on separate RS485 bus
- The latch and door motors controls should be able to:
  - Door open function:
    - From door closed state: Open latch → Open door fully → Release electical control on latch and door motor (free movement)
  - Door close funciton:
    - From door open state: Close door → Close latch → Release electical control on latch and door motor (free movement)
  - Door pop-up function:
    - From door closed state: Open latch → Open door slightly (pop-up) → Release electical control on latch and door motor (free movement)
  - Report the following state of the motors via CAN messages:
    - 4 latch motor state (open/close)
    - 4 door motor state (closed/openFree/moving)

<u>DOOR MOTOR DRIVERS</u>

Oriental motor AZD-AD series

- **Product page:** https://catalog.orientalmotor.com/item/azd-closed-loop-absolute-type-servo-drivers-ac/azd-absolute-stepper-driver-stored-data/azd-ad
- **Operating manual:** https://www.orientalmotor.com/products/pdfs/opmanuals/HM-60314-5owE.pdf

- **Function manual:** https://www.orientalmotor.com/products/pdfs/opmanuals/HM-60262-9E.pdf

LATCH MOTORS

Dynamixel XM430-W350-R

- **Product page:** https://emanual.robotis.com/docs/en/dxl/x/xm430-w350/
- **Operating manual and function manual is on the product homepage, please check for more information**

COMMUNICATION SPECIFICATION (CAN, RS485)

CAN (5.0V) → RX message: BDC to CLOSURE MCU								
ID	0x50	DLC	2	Baud rate	500kbit/s	Transmission	Tx, periodic	50ms
Bits→ Bytes↓	7	6	5	4	3	2	1	0
0	>RRR_door_req [0] No action [1] Open door [2] Pop-up door [3] Close door		>RRL_door_req [0] No action [1] Open door [2] Pop-up door [3] Close door		>FRR_door_req [0] No action [1] Open door [2] Pop-up door [3] Close door		>FRL_door_req [0] No action [1] Open door [2] Pop-up door [3] Close door	
1	> BDC_to_CLOSURE_MCU_MsgCounter ■ Increase by 1 at every Msg, restarts from 0 at overflow							

Table 1: CAN msg - BDC to CLOSURE MCU

CAN (5.0V) → TX message: CLOSURE MCU to BDC								
ID	0x51	DLC	3	Baud rate	500kbit/s	Transmission	Tx, periodic	50ms
Bits→ Bytes↓	7	6	5	4	3	2	1	0
0	>RRR_latch_sts [0] No action [1] Closed [2] Open [3] N/A		>RRL_latch_sts [0] No action [1] Closed [2] Open [3] N/A		>FRR_latch_sts [0] No action [1] Closed [2] Open [3] N/A		>FRL_latch_sts [0] No action [1] Closed [2] Open [3] N/A	
1	>RRR_door_sts [0] No action [1] Closed [2] OpenFree [3] Moving		>RRL_door_sts [0] No action [1] Closed [2] OpenFree [3] Moving		>FRR_door_sts [0] No action [1] Closed [2] OpenFree [3] Moving		>FRL_door_sts [0] No action [1] Closed [2] OpenFree [3] Moving	
2	> CLOUSRE_MCU_to_BDC_MsgCounter ■ Increase by 1 at every Msg, restarts from 0 at overflow							

Table 2: CAN msg - CLOSURE MCU to BDC

RS485 (5.0V) ⟶ TX message: CLOSURE MCU to DOOR MOTORS								
Baud rate	115200 bit/s			Transmission		Tx, event		-
Bits⟶ Bytes ↓	7	6	5	4	3	2	1	0
0	Please make RS485 communication with door motors based on the Oriental Motor documentation. DOCUMENT LINK p267							
…								
X								

Table 3: RS485 msg - CLOSURE MCU to DOOR MOTORS

RS485 (5.0V) ⟶ TX message: CLOSURE MCU to LATCH MOTORS								
Baud rate	115200 bit/s			Transmission		Tx, event		-
Bits⟶ Bytes ↓	7	6	5	4	3	2	1	0
0	Please make RS485 communication with latch motors based on the Dynamixel product page information. PRODUCT HOMEPAGE							
…								
X								

Table 4: RS485 msg - CLOSURE MCU to LATCH MOTORS

BOARD DESIGN REQUESTS

1. The CLOSURE MCU board will be powered by 12VDC, please use appropriate DC/DC converter to drop it to 5VDC and use the Nucleo board's 5V pin to power the MCU.
   1.1. Recommended DC/DCs
      1.1.1. ROHM BP5293-50: https://akizukidenshi.com/catalog/g/g111188/
      1.1.2. MINMAX M78AR05-1: https://akizukidenshi.com/catalog/g/g113536/
2. Please use Wurth Elektronik WR-MPC3 connectors for the following connections:
   2.1. CN1 (power), 2pin side entry: WR-MPC3 66200221022
   2.2. CN300 (CAN), 4pin side entry: WR-MPC3 66200421022
   2.3. CN450 (latch RS485), 4pin side entry: WR-MPC3 66200421022
   2.4. Please make PIN1 to GND for all connectors, the other pins can se selected freely
3. Please use RJ45 side entry connector for the following connections:
   3.1. CN400 (door RS485): RJE091884111A
   3.2. Please design pin layout based on the oriental motor documentation
4. Add proper GND pouring to the PCB where it is possible, especially at CAN and RS485 routes
5. Please make the design in a way to be able to select on/off 120R terminiting resistor for CAN and RS485 buses
   5.1. Recommended design: Add 3pin header to select 120R resistor
6. Please make the deisng in a way to be able to see CAN and RS485 signal for debugging, even when the connectors are connected.
   6.1. Recommended design: Add 3pin header to see CAN gnd, CAN HIGH, CAN LOW
   6.2. Recommended design: Add 3pin header to see RS485 gnd, RS485 A, RS485 B

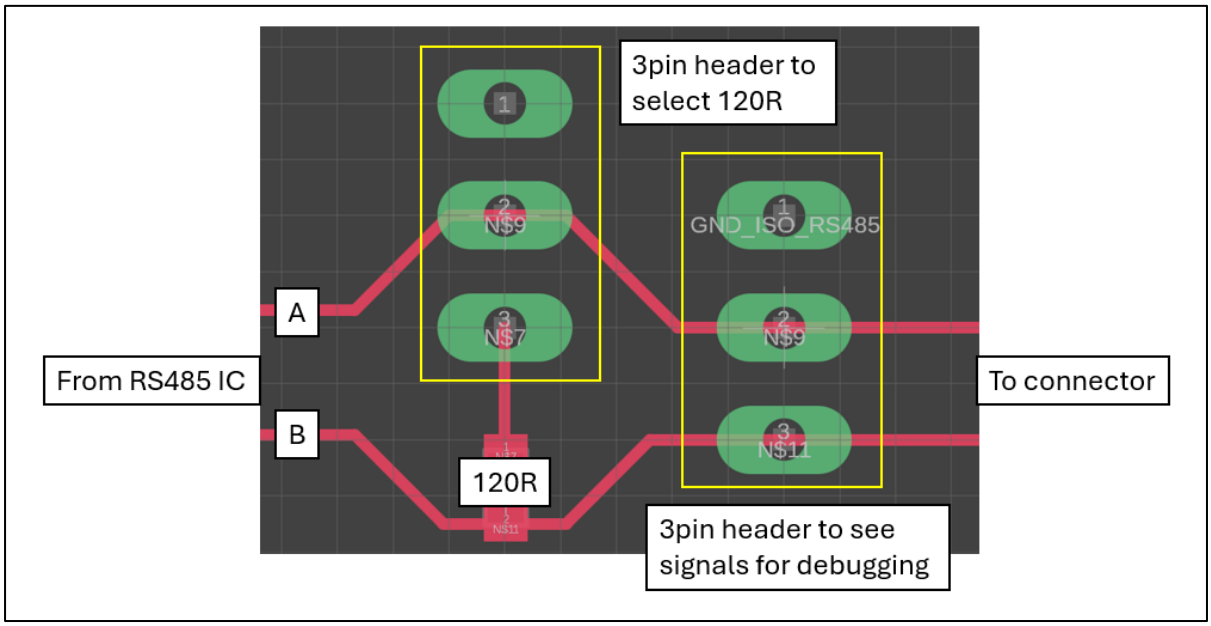
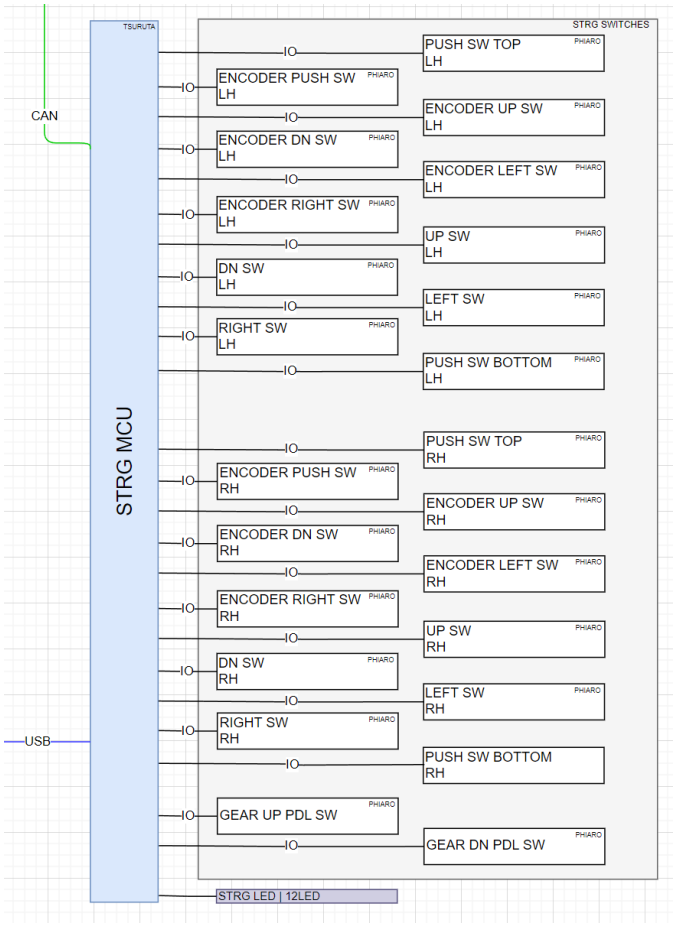


Figure 1: Example of routing for RS485 routes

STRG MCU

BLOCK SCHEMATIC



NECESSARY FUNCTIONS

- Read the button statuses and handle their debouncing phenomena
- Send the button statuses via CAN msg
- Send specified keycode (keyboard USB HID emulation) to PC when specific button pressed

COMMUNICATION SPECIFICATION (CAN, KEYCODE USB)

CAN (5.0V) → RX message: BDC to STRG MCU								
ID	0x60	DLC	4	Baud rate	500kbit/s	Transmission	Tx, periodic	50ms
Bits→ Bytes↓	7	6	5	4	3	2	1	0
0	>STRG_LED_R [0-255]							
1	>STRG_LED_G [0-255]							
2	>STRG_LED_B [0-255]							
3	> BDC_to_STRG_MCU_MsgCounter ■ Increase by 1 at every Msg, restarts from 0 at overflow							

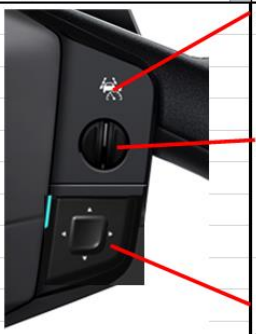
Table 5: CAN msg - BDC to STRG MCU

CAN (5.0V) → TX message: STRG MCU to BDC								
ID	0x61	DLC	4	Baud rate	500kbit/s	Transmission	Tx, periodic	50ms
Bits→ Bytes↓	7	6	5	4	3	2	1	0
0	>LH_DN_sts [0] No action	>LH_UP_sts [0] No action	>LH_ENC_RIGHT_sts	>LH_ENC_LEFT_sts	>LH_ENC_DN_sts	>LH_ENC_UP_sts	>LH_ENC_PUSH_sts	>LH_PUSH_TOP_sts

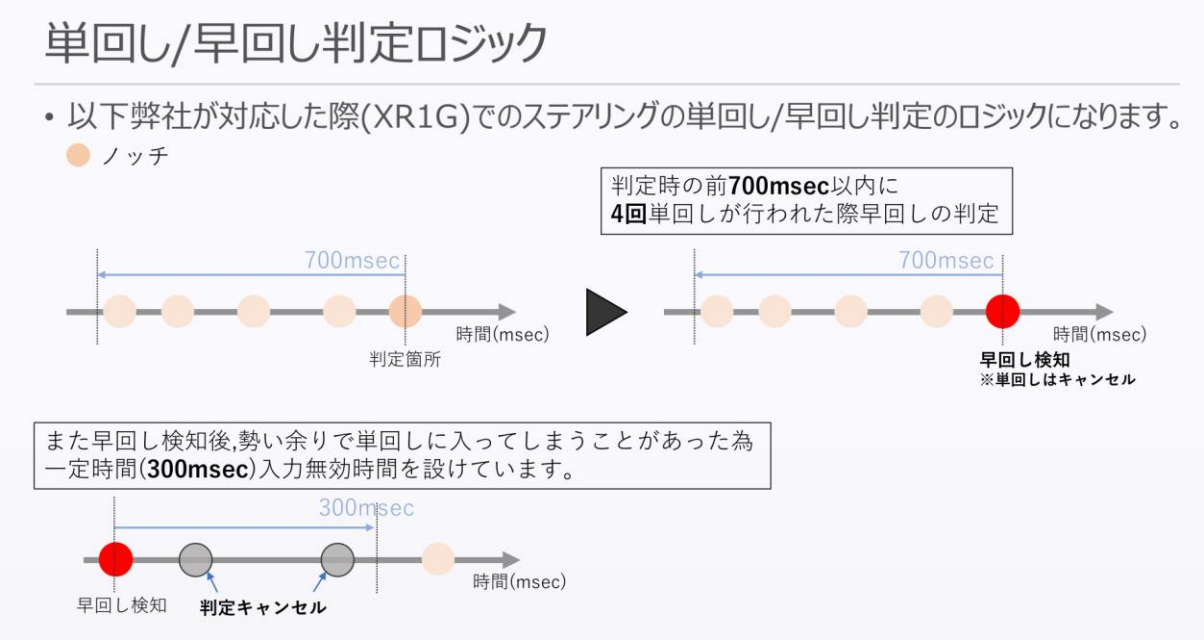
	[1] Pushed	[1] Pushed	[0] No action [1] Pushed	[0] No action [1] Pushed	[0] No action [1] Pushed	[0] No action [1] Pushed	[0] No action [1] Pushed	[0] No action [1] Pushed
1	>RH_ENC_LEFT_sts [0] No action [1] Pushed	>RH_ENC_DN_sts [0] No action [1] Pushed	>RH_ENC_UP_sts [0] No action [1] Pushed	>RH_ENC_PUSH _sts [0] No action [1] Pushed	>RH_PUSH_TOP_sts [0] No action [1] Pushed	>LH_PUSH_BTM_sts [0] No action [1] Pushed	>LH_RIGHT_sts [0] No action [1] Pushed	>LH_LEFT_sts [0] No action [1] Pushed
2	>GEAR_DN_sts [0] No action [1] Pushed	>GEAR_UP_sts [0] No action [1] Pushed	>RH_PUSH_BTM_sts [0] No action [1] Pushed	>RH_RIGHT_sts [0] No action [1] Pushed	>RH_LEFT_sts [0] No action [1] Pushed	>RH_DN_sts [0] No action [1] Pushed	>RH_UP_sts [0] No action [1] Pushed	>RH_ENC_RIGHT_sts [0] No action [1] Pushed
3	> STRG_MCU_to_BDC_MsgCounter ■ Increase by 1 at every Msg, restarts from 0 at overflow							

Table 6: CAN msg - STRG MCU to BDC

Please send the following keycodes once, when the buttons are pressed.

	image	SW	入力	キーアサイ
R側SW		タクトスイッチ	PUSH	P
		ステコマ	UP(1ノッチ)	O
			UP(高速回転時)	I
			DOWN(1ノッチ)	L
			DOWN(高速回転時)	K
			LEFT	U
			RIGHT	Y
			PUSH	M
		十字キー	UP	G
			RIGHT	**9**
			LEFT	**H**
			DOWN	E
			PUSH	**8**
L側SW		タクトスイッチ	PUSH	V
		ステコマ	UP(1ノッチ)	W
			UP(高速回転時)	Q
			DOWN(1ノッチ)	S
			DOWN(高速回転時)	Z
			LEFT	A
			RIGHT	D
			PUSH	X
		十字キー	UP	R
			LEFT	**7**
			RIGHT	**6**
			DOWN	F
			PUSH	**J**
R側パドル		パドル	PUSH	C
L側パドル		パドル	PUSH	**T**

For the encoder there are two separate keycode to send based on the usage, having 1 scroll or multiple scroll in a given time. The logic to this can be seen below:



BOARD DESIGN REQUESTS

1. The STRG MCU board will be powered by 12VDC, please use appropriate DC/DC converter to drop it to 5VDC and use the Nucleo board's 5V pin to power the MCU.
   1.1. Recommended DC/DCs
      1.1.1. ROHM BP5293-50: https://akizukidenshi.com/catalog/g/g111188/
      1.1.2. MINMAX M78AR05-1: https://akizukidenshi.com/catalog/g/g113536/
2. Please use JST XH connectors for the following connections:
   2.1. CN1 (power), 2pin side entry: B2B-XH-A
   2.2. CN300 (CAN), 3pin top entry: B3B-XH-A
   2.3. CN600 (USB), 5pin top entry: B5B-XH-A
   2.4. CN 500 (LED), 3pin top entry: B3B-XH-A
   2.5. J1 (LH BTNS 1), 6pin top entry: B6B-XH-A
   2.6. J2 (LH BTNS 2), 6pin top entry: B6B-XH-A
   2.7. J3 (RH BTNS 1), 6pin top entry: B6B-XH-A
   2.8. J4 (RH BTNS 2), 6pin top entry: B6B-XH-A
   2.9. J5 (LH ENCODER), 4pin top entry: B4B-XH-A
   2.10. J6 (RH ENCODER), 4pin top entry: B4B-XH-A
   2.11. Please make PIN1 to GND for all connectors, the other pins can se selected freely

2.12. For illustration about connection of STRG MCU PCB and STRG BUTTONS PCB please see the figure below

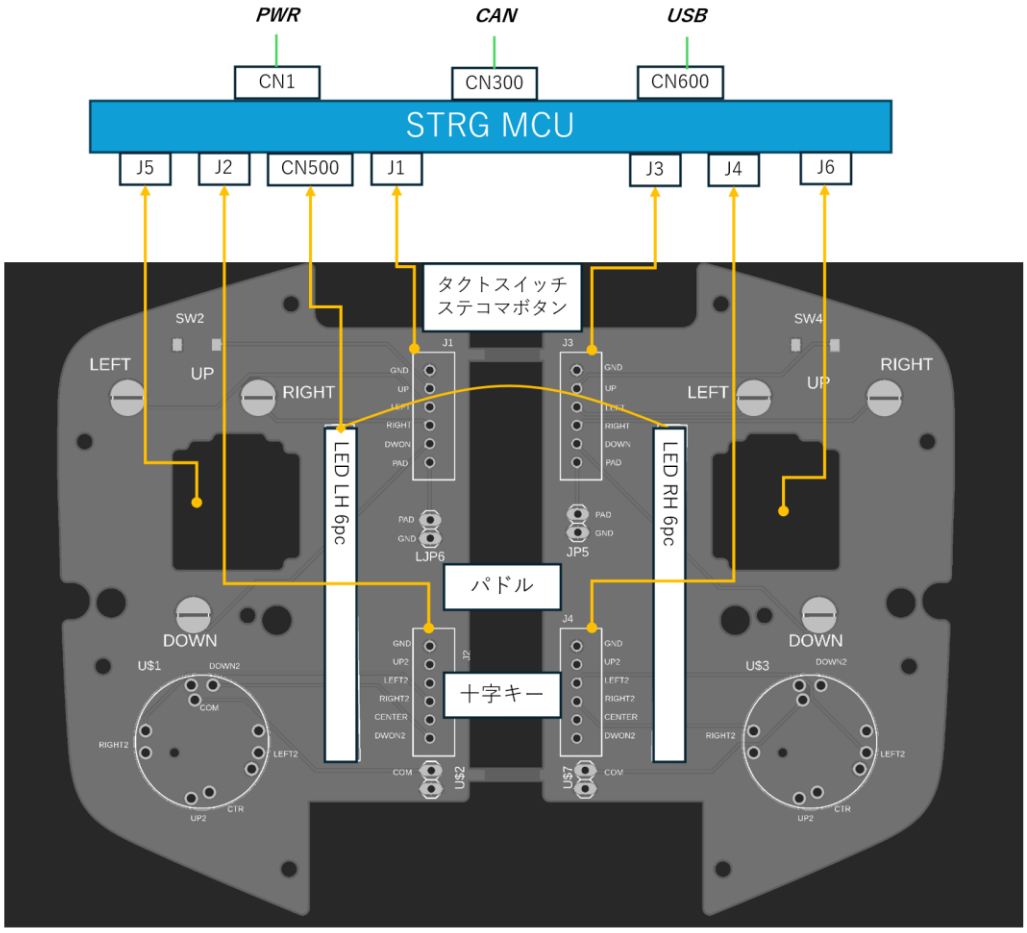


Figure 2: STRG MCU PCB adn STRG BUTTONS PCB connection illustration

3. Add proper GND pouring to the PCB where it is possible, especially at CAN routes
   3.1. Please make the design in a way to be able to select on/off 120R terminiting resistor for CAN
   3.2. Recommended design: Add 3pin header to select 120R resistor
4. Please make the deisng in a way to be able to check CAN signal for debugging, even when the connectors are connected. *(See details at CLOSURE MCU section)*
   4.1. Recommended design: Add 3pin header to see CAN gnd, CAN HIGH, CAN LOW
5. Please design the PCB with the following dimensions