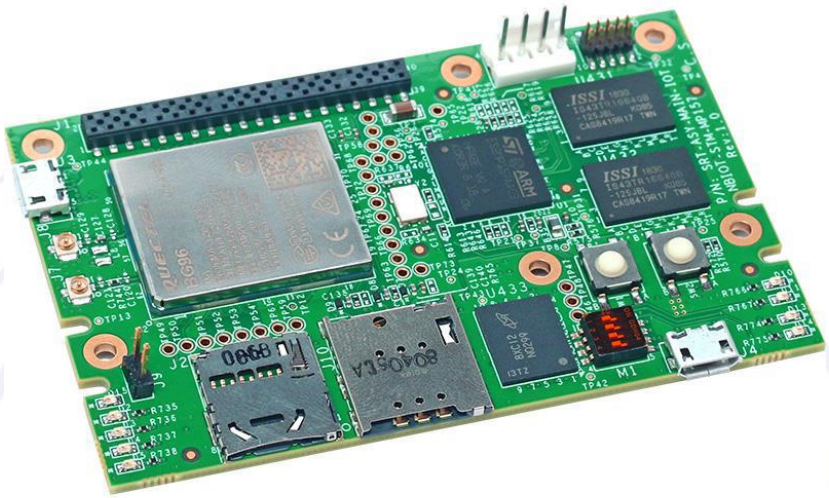
Stinger96

Hardware User Manual Rev1.0



Document Revision History

Revision	Date	Author	Status and Description
0.13	22/07/2019	Ori Makover	Pre-Initial version
1.0	01/05/2020	Guy Zohar	First release

INDEX

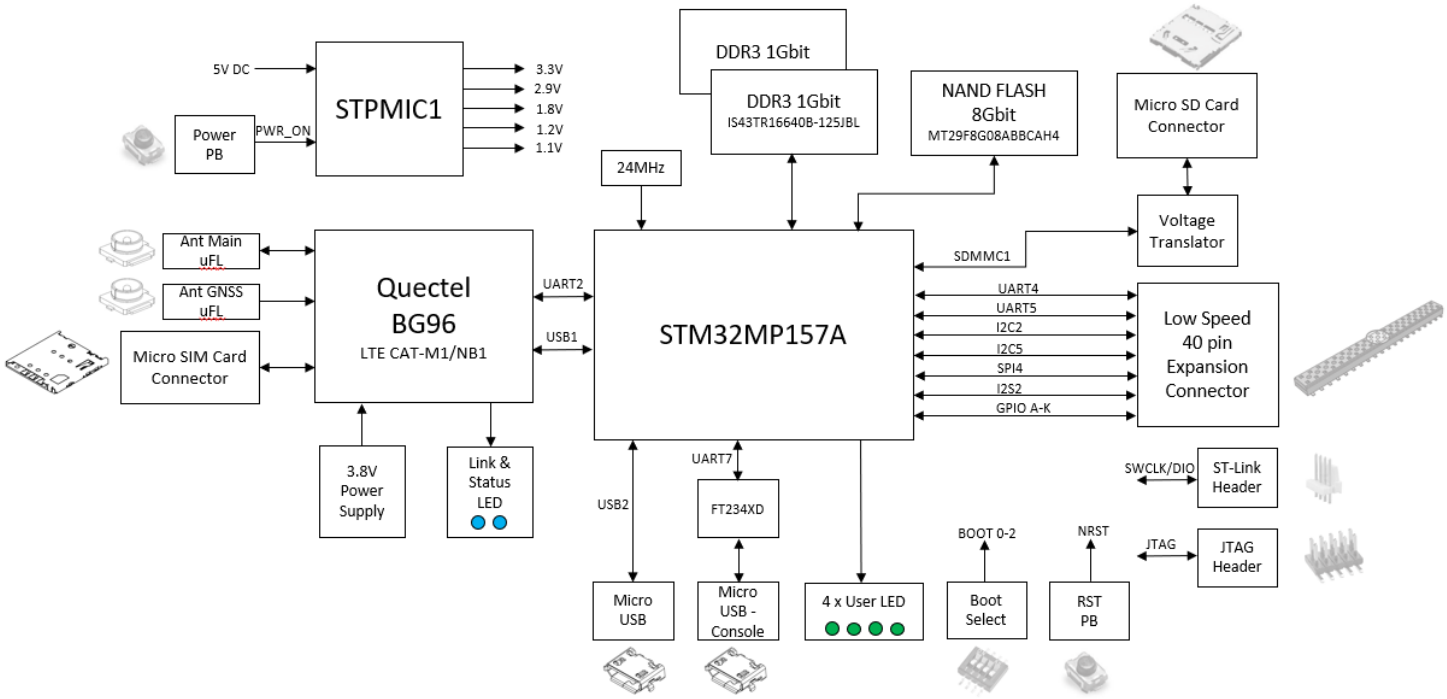
1. Introduction

STINGER96 is a 96Boards IoT Edition compatible (IE extended) base board from Shiratech. The board provides full support for 96Boards IoT Edition (IE) mezzanines via the Low Speed expansion connector, and features LTE connectivity using the Quectel BG96 NB-IoT modem.

The board incorporates the following key elements:

- STM32MP157 microprocessor with dual Arm® Cortex®-A7 and Cortex®-M4 Cores, a very energy-efficient, performance rich SoC, highly suitable for low-power embedded and consumer applications.
- Quectel BG96 LTE, an ultra-low power consumption LTE Cat-M1/NB1/EGPRS module delivering 375Kbps downlink and 375Kbps uplink data rates. Also provides pin-to-pin compatibility with Quectel LTE module EG91/EG95, Cat NB1 (NB-IoT) module BC95, UMTS/HSPA module UG95/UG96 and GSM/GPRS module M95.
- Running Yocto – A Linux distribution aimed for embedded and IoT software.
- 96Boards Low Speed expansion connector, allowing the connection of additional 96Boards mezzanines as needed.
- 2 micro USB connectors (USB and monitor), a micro SD card connector and a micro SIM connector.

2. Functional Block Diagram

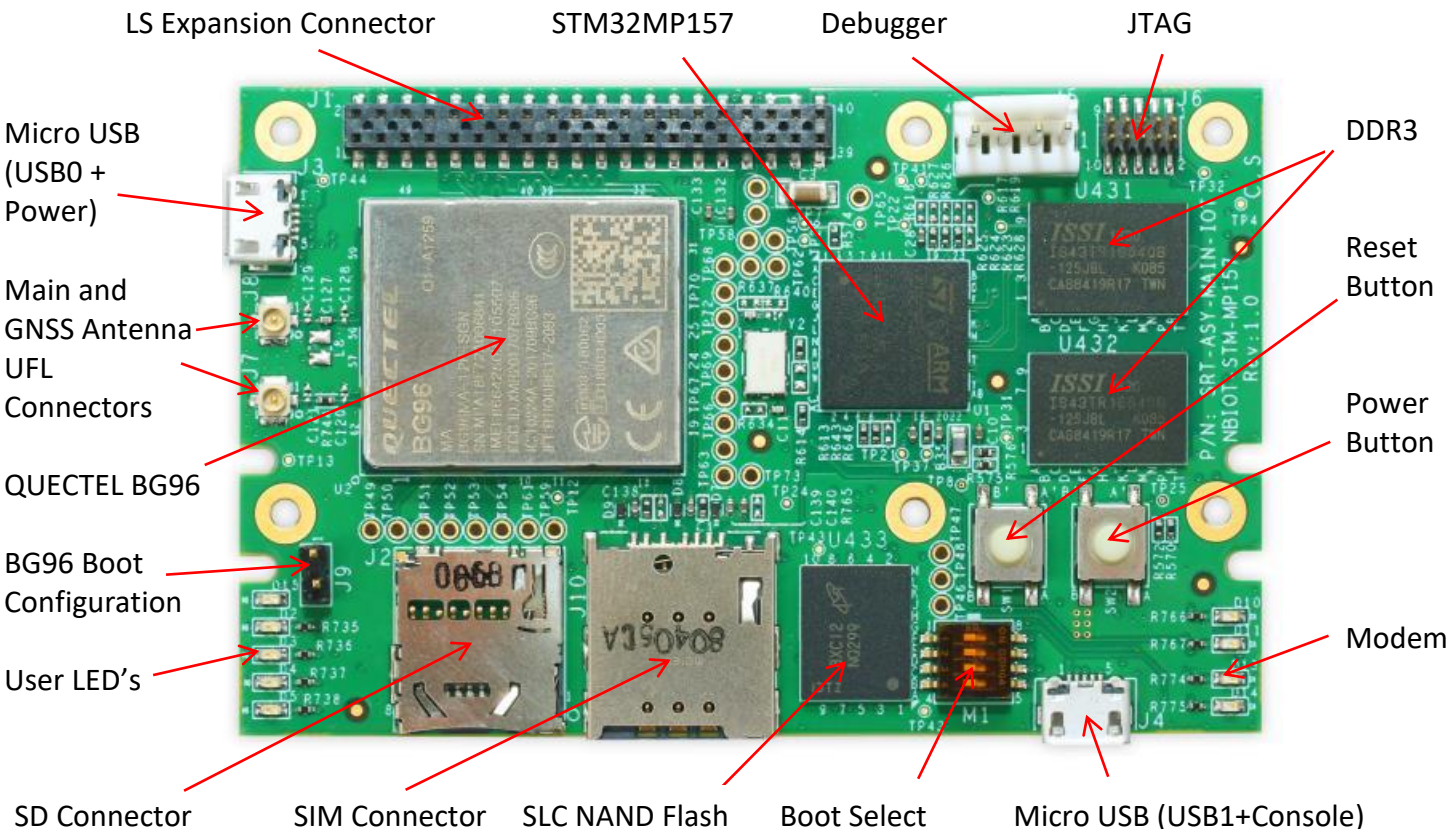


Stinger96 incorporates the following key elements:

- Mezzanine board connection is enabled via Low Speed Connectors, including 2 UART lines, 2 I2C lines, GPIO A-L, SPI0 and PCM.
- The board is connected to a 5V power feed. The STPMIC1 provides additional 3.3V, 2.8V and 1.8V to the various components.
- Quectel BG96 CAT -M1/NB1/GPRS Module:
    - The module is powered by 3.8V
    - Connected to the CPU via UART and USB
    - Connected to a micro SIM connector
    - Connected to two RF antenna UFL jacks: Main and GNSS.
- 8 Gbit NAND Flash MT29F8G08ABBCAH4-ITC, powered by 1.8V, and connected to the CPU via a 32-bit bus.
- Two DDR-3 memories IS43TR16640B-125JBL, are powered by 1.1V, and are connected to the CPU via a 32-bit bus.
- Micro SD-Card connector, connected to a 2.9V power supply. Connected to the CPU by SDIO.
- Micro USB – 5V power supply and UART debug port
- Micro USB – Direct to CPU

- FT234XD-R USB to serial UART interface, powered by the 5V supply from the USB port, and provides UART communication with the CPU.

3. Overview

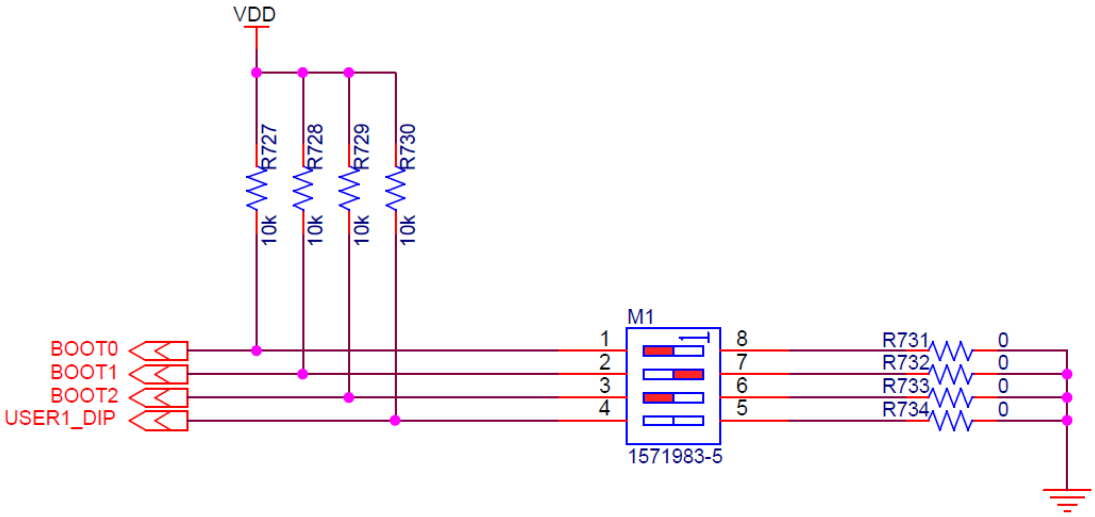


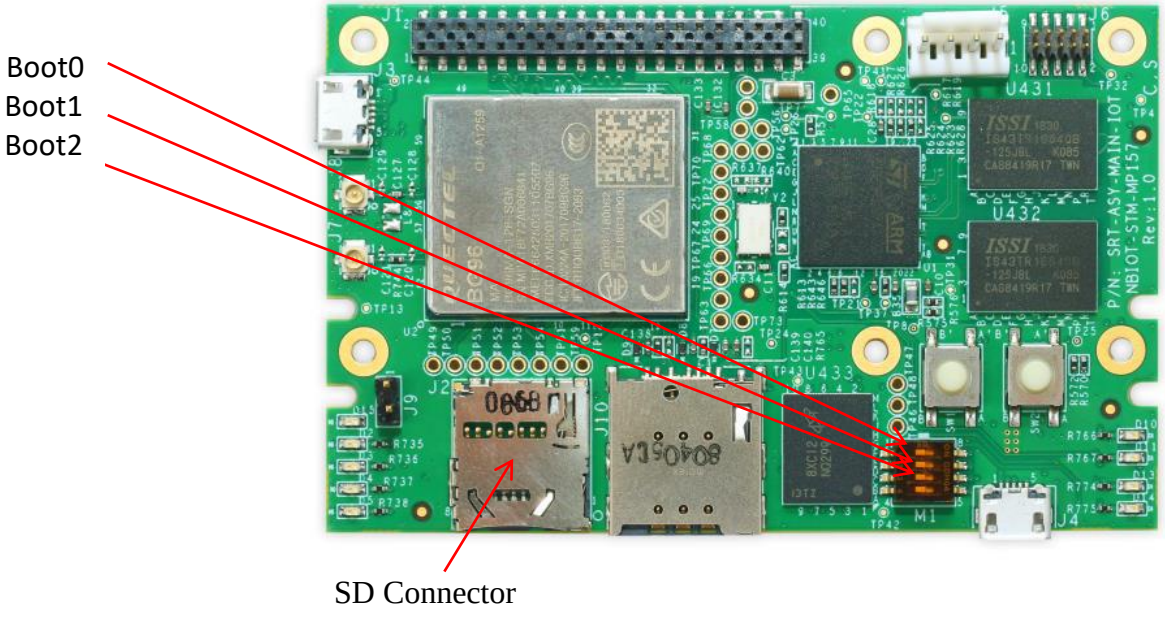
4. Additional Information

SoC:	ST Microelectronics STM32MP157
CPU:	32 bit dual-core Arm® Cortex®-A7 and 32 bit Cortex®-M4 with FPU/MPU
GPU:	Vivante® - OpenGL® ES 2.0
PMIC:	STPMIC1
RAM:	DDR3 – 64M x 32bit (2Gbit/256MB)
Storage:	SLC NAND FLASH – 1G x 8bit (8Gbit/1GB) + micro SD connector.
Communication:	Quectel BG96 LTE modem.
USB:	2 micro USB connectors
Expansion Interface:	40 pin low speed expansion connector: +1.8V, +5V, SYS_DCIN, GND, UART, I2C, SPI, PCM, PWM,GPIO x12
LED:	4 x User LEDs and 2 x modem LEDs
Buttons:	Power button and Reset button
Power Source:	Micro USB Connector
OS Support:	Yocto Linux distribution
Size:	85mm x 54mm x 12mm

5. Running The Board For The First Time

1. Download the image file from the downloads at: https://www.shiratech-solutions.com/products/stinger96/
2. Insert a clean SD card to your PC, then burn the .img file to the SD card using a suitable tool (Win32 Disk Imager for example).
3. Do not connect the board to the power supply yet.
4. To boot from SD card, change the boot select to 1 0 1. The boot select pins are ordered as follows, top to bottom: Boot0, Boot1, Boot2. Please refer to the pin statuses highlighted in red in the schematic below. (The photo is only intended to show the boot select pins location, ignore their status in the photo).

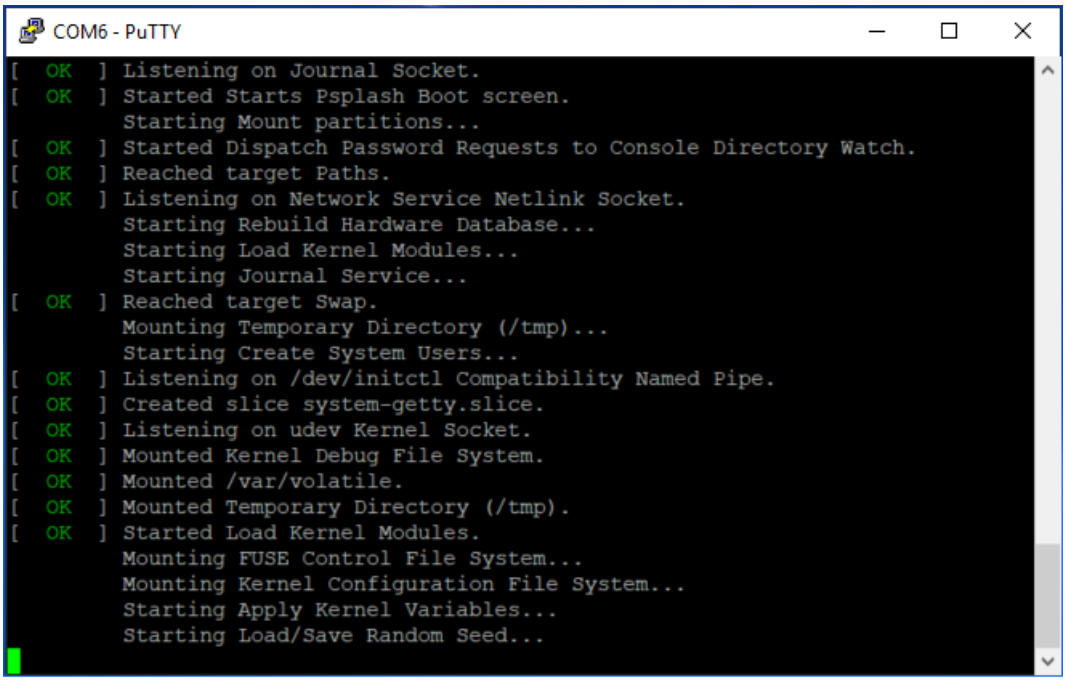




5. For other boot options, please refer to the STM32MP157 boot modes table:

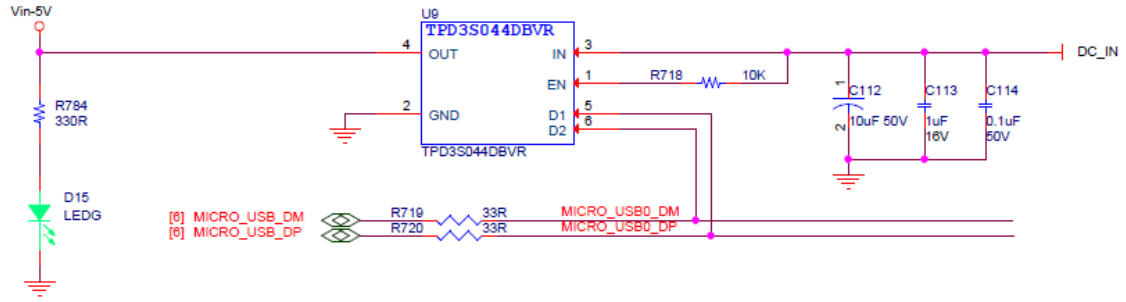
BOOT2	BOOT1	BOOT0	Mode
0	0	0	UART and USB
0	0	1	Serial NOR Flash
0	1	0	e-MMC
0	1	1	NAND Flash
1	0	0	Reserved (NoBoot)
1	0	1	SD Card
1	1	0	UART and USB
1	1	1	Serial NAND Flash

6. Insert the SD card containing the image file to the SD card connector.
7. Connect the board to the PC using the micro USB connector. Make sure you connect using USB1 + Console (the one next to the boot select pins).
8. Your board should now boot from the SD card. Open your device manager. The board should appear under 'Ports (COM & LPT)'.
9. Connect to the board through a serial connection using a suitable tool (PuTTY, for example). Make sure you have picked the correct COM port (the one you see in the device manager), and that you use the correct baud rate – 115200.

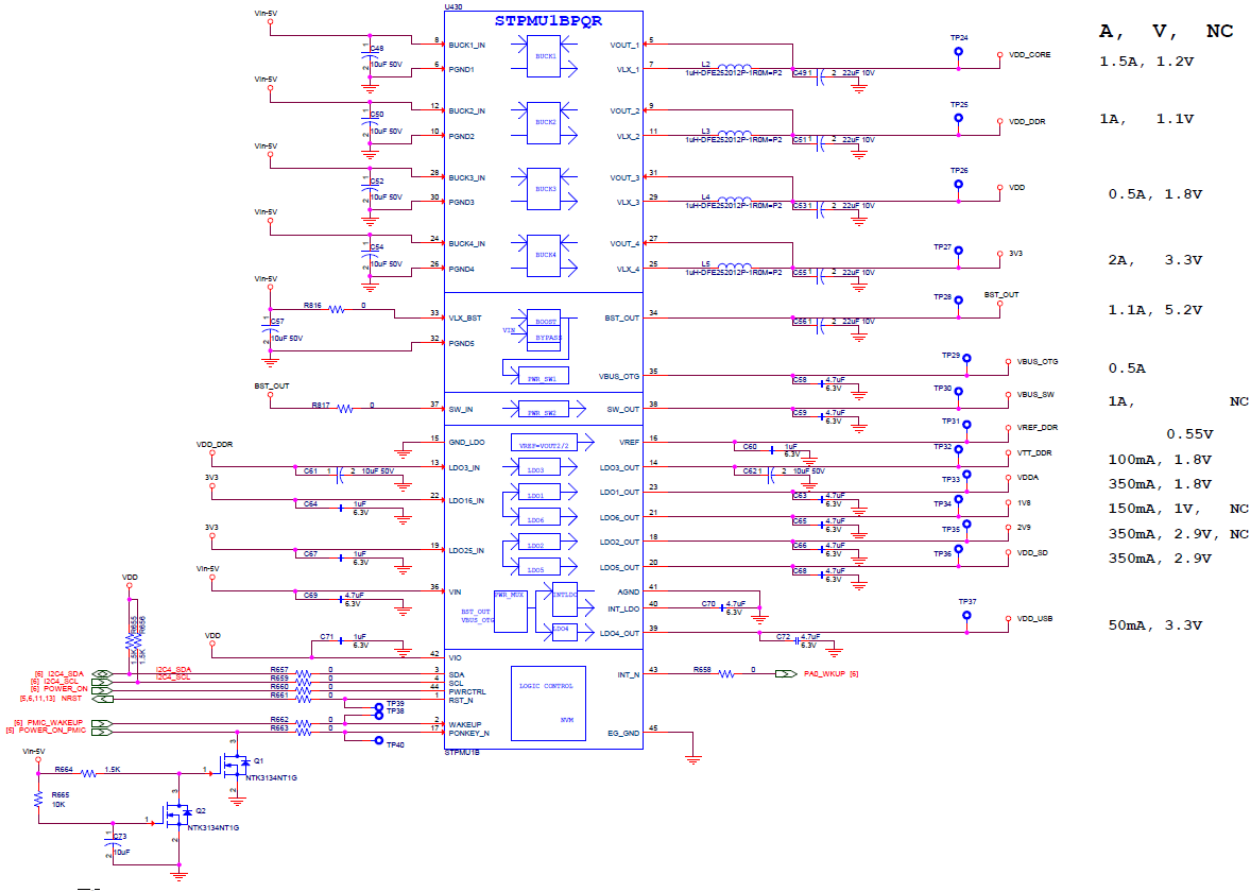


6. Power Supply

The board draws 5V from the micro USB connectors. The green LED (D15) turns on when the board is powered up.



The STPMIC accepts a 5V input voltage, and provides 1.1V, 1.2V, 1.8V, 2.9V and 3.3V voltages to power the various components. It also features I2C and digital IO control interface, and a user programmable non-volatile memory (NVM), enabling scalability to support a wide range of applications.



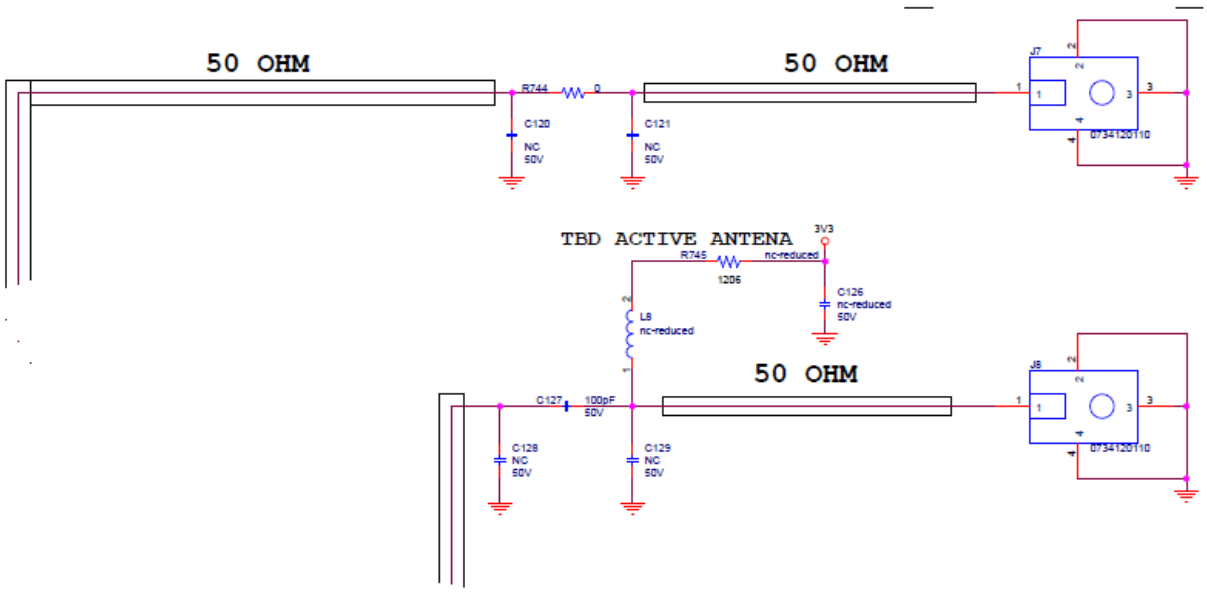
7. LTE BG96 Cat-M1/NB1 & EGPRS Module

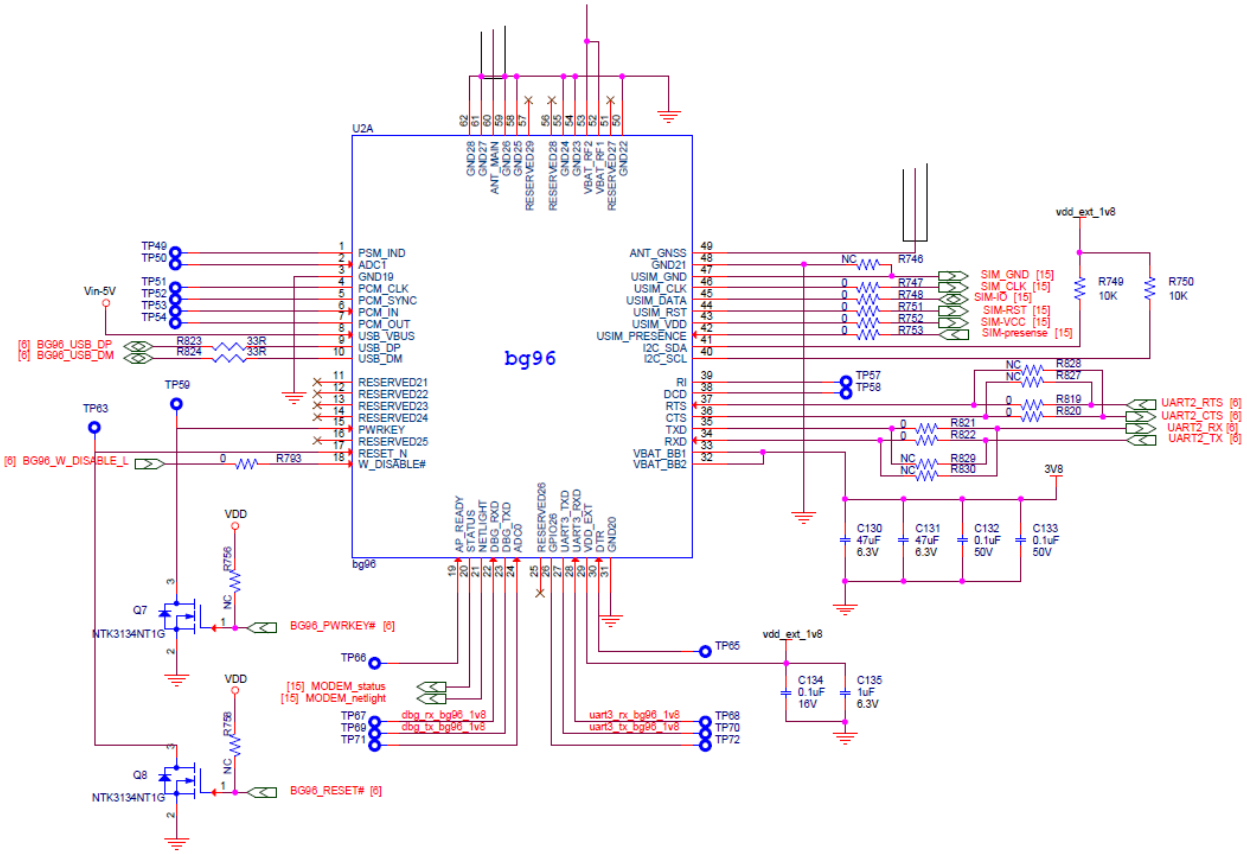
BG96 is a series of LTE Cat-M1/NB1/EGPRS module offering a maximum data rate of 375Kbps downlink and 375Kbps uplink. It features ultra-low power consumption, and provides pin-to-pin compatibility with Quectel LTE module EG91/EG95, Cat NB1 (NB-IoT) module BC95, UMTS/HSPA module UG95/UG96 and GSM/GPRS module M95.

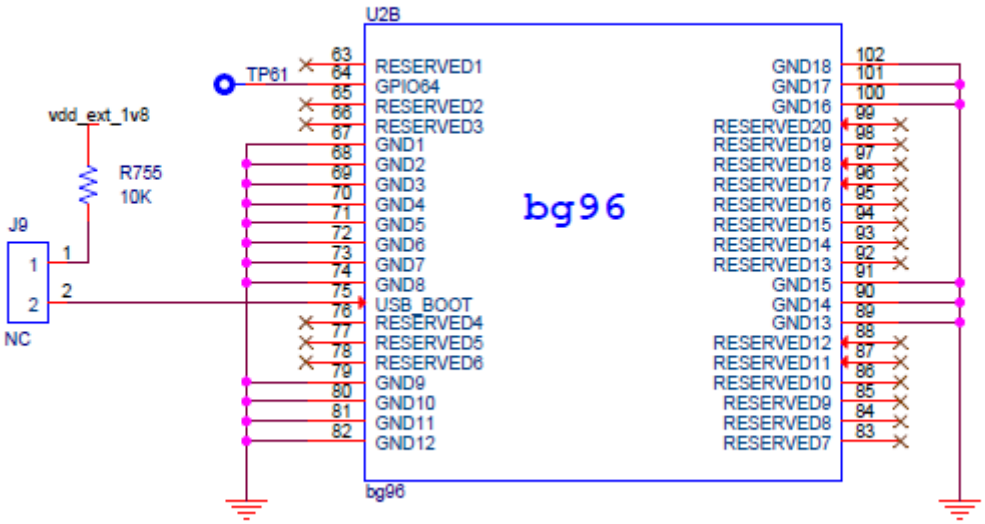
With a cost-effective SMT form factor of 26.5mm × 22.5mm × 2.3mm and high integration level, BG96 enables integrators and developers to easily design their applications and take advantage from the module's low power consumption and mechanical intensity. Its advanced LGA package allows fully automated manufacturing for high-volume applications.

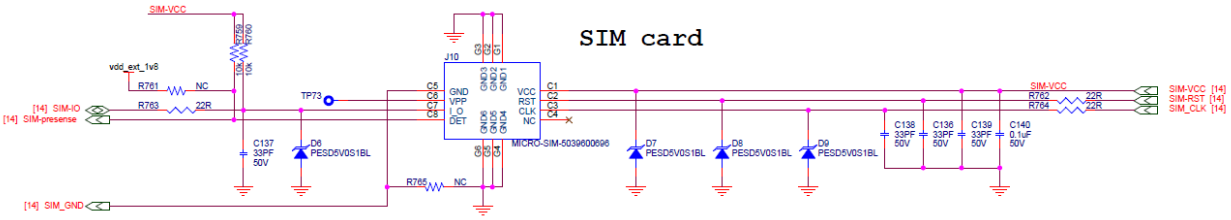
A rich set of Internet protocols, industry-standard interfaces (USB/UART/I2C/Status Indicator) and abundant functionalities (USB drivers for Windows 7/8/8.1/10, Linux and Android) extend the applicability of the module to a wide range of M2M applications such as wireless POS, smart metering, tracking, etc.

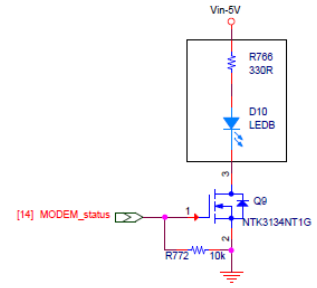
The Quectel BG96 CAT M1/Cat NB1/GPRS module is powered by 3.8V.
Connected to a micro SIM connector.
RF lines connected to two RF antenna UFL jacks: Main and GNSS.
Two LEDs are used to indicate modem status.




U2A
bg96
PSM_IND
ADC1
GND19
PCM_CLK
PCM_SYNC
PCM_IN
PCM_OUT
USB_VBUS
USB_DP
USB_DM
RESERVED21
RESERVED22
RESERVED23
RESERVED24
PWRKEY
RESERVED25
RESET_N
W_DISABLE#
ANT_GNSS
GND21
USIM_GND
USIM_CLK
USIM_DATA
USIM_RST
USIM_VDD
USIM_PRESENCE
I2C_SDA
I2C_SCL
RI
DCD
RTS
CTS
TXD
RXD
VBAT_BB1
VBAT_BB2
AP_READY
STATUS
NETLIGHT
DBG_RXD
DBG_TXD
ADC0
RESERVED26
GPIO26
UART3_TXD
UART3_RXD
VDD_EXT
GND20
TP49
TP50
TP51
TP52
TP53
TP54
TP59
TP63
TP57
TP58
TP65
TP66
TP67
TP69
TP71
TP68
TP70
TP72
Vin-5V
R823
R824
33R
R793
R746
R747
R748
R751
R752
R753
R749
R750
10K
R828
R827
R819
R820
R821
R822
R829
R830
C130
C131
C132
C133
47uF
6.3V
0.1uF
50V
C134
C135
1uF
16V
3V8
vdd_ext_1v8
VDD
Q7
Q8
NTK3134NT1G
R756
R795
BG96_PWRKEY# [6]
BG96_RESET# [6]
[6] BG96_USB_DP
[6] BG96_USB_DM
[6] BG96_W_DISABLE_L
SIM_GND [15]
SIM_CLK [15]
SIM-IO [15]
SIM-RST [15]
SIM-VCC [15]
SIM-presense [15]
UART2_RTS [6]
UART2_CTS [6]
UART2_RX [6]
UART2_TX [6]
[15] MODEM_status
[15] MODEM_netlight
dbg_rx_bg96_1v8
dbg_tx_bg96_1v8
uart3_rx_bg96_1v8
uart3_tx_bg96_1v8


U2B
bg96
TP61
RESERVED1
GPIO64
RESERVED2
RESERVED3
GND1
GND2
GND3
GND4
GND5
GND6
GND7
GND8
USB_BOOT
RESERVED4
RESERVED5
RESERVED6
GND9
GND10
GND11
GND12
GND18
GND17
GND16
RESERVED20
RESERVED19
RESERVED18
RESERVED17
RESERVED16
RESERVED15
RESERVED14
RESERVED13
GND15
GND14
GND13
RESERVED12
RESERVED11
RESERVED10
RESERVED9
RESERVED8
RESERVED7
vdd_ext_1v8
R755
10K
J9
NC


SIM card
SIM-VCC
R759
10K
R760
10K
vdd_ext_1v8
R761
NC
[14] SIM-IO
[14] SIM-presense
R763
22R
TP73
C137
33PF
50V
D6
PESD5V0S1BL
J10
C5
C6
C7
C8
GND
VPP
I_O
DET
G3
G2
G1
GND3
GND2
GND1
GND6
GND5
GND4
G6
G5
G4
VCC
RST
CLK
NC
C1
C2
C3
C4
MICRO-SIM-5039600696
R765
NC
[14] SIM_GND
D7
PESD5V0S1BL
D8
PESD5V0S1BL
D9
PESD5V0S1BL
C138
33PF
50V
C136
33PF
50V
C139
33PF
50V
C140
0.1uF
50V
SIM-VCC
R762
22R
R764
22R
SIM-VCC [14]
SIM-RST [14]
SIM_CLK [14]


Vin-5V
R766
330R
D10
LEDB
[14] MODEM_status
Q9
NTK3134NT1G
R772
10k
Vin-5V
R774
330R
D13
LEDB
[14] MODEM_netlight
Q11
NTK3134NT1G
R776
10k

8. STM32MP157A

The STM32MP157A devices are based on the high-performance dual-core Arm® Cortex®-A7 32-bit RISC core operating at up to 650 MHz. The Cortex-A7 processor includes a 32-Kbyte L1 instruction cache for each CPU, a 32-Kbyte L1 data cache for each CPU and a 256-Kbyte level2 cache. The Cortex-A7 processor is a very energy-efficient application processor designed to provide rich performance in high-end wearables, and other low-power embedded and consumer applications. It provides up to 20% more single thread performance than the Cortex-A5 and provides similar performance than the Cortex-A9.

The Cortex-A7 incorporates all features of the high-performance Cortex-A15 and Cortex-A17 processors, including virtualization support in hardware, NEON™, and 128-bit AMBA®4 AXI bus interface.

The STM32MP157A devices also embed a Cortex® -M4 32-bit RISC core operating at up to 209 MHz frequency. Cortex-M4 core features a floating point unit (FPU) single precision which supports Arm® single-precision data-processing instructions and data types. The Cortex® -M4 supports a full set of DSP instructions and a memory protection unit (MPU) which enhances application security.

The STM32MP157A devices also embed a 3D graphic processing unit (Vivante® - OpenGL® ES 2.0) running at up to 533 MHz, with performances up to 26 Mtriangle/s, 133 Mpixel/s.

The STM32MP157A devices provide an external SDRAM interface supporting external memories up to 8-Gbit density (1 Gbyte), 16 or 32-bit LPDDR2/LPDDR3 or DDR3/DDR3L up to 533 MHz.

The STM32MP157A devices incorporate high-speed embedded memories with 708 Kbytes of Internal SRAM (including 256 Kbytes of AXI SYSRAM, 3 banks of 128 Kbytes each of AHB SRAM, 64 Kbytes of AHB SRAM in backup domain and 4 Kbytes of SRAM in backup domain), as well as an extensive range of enhanced I/Os and peripherals connected to APB buses, AHB buses, a 32-bit multi-AHB bus matrix and a 64-bit multi layer AXI interconnect supporting internal and external memories access.

All the devices offer two ADCs, two DACs, a low-power RTC, 12 general-purpose 16-bit timers, two PWM timers for motor control, five low-power timers, a true random number generator (RNG). The devices support six digital filters for external sigma delta modulators (DFSDM). They also feature standard and advanced communication interfaces.

Stinger96 base board has two 1Gbit S43TR16640B-125JBL DDR memories, connected to the CPU module via a 32-bit bus, and a single MT29F8G08ABBCAH4-ITC 8 Gbit NAND Flash memory, connected to the CPU module via 32-bit bus.

CPU Speed	650 MHz
DDR Memory Capacity	1Gbit
DDR Memory Maximum Speed	1066 MHz
Flash Memory Capacity	8Gbit
USB0	Power (OTG)
USB1	Console (UART7)

The Low-Speed connector deploys:

- 2 UART communication lines
- 2 I2c lines
- PCM
- SP10
- GPIO A-L

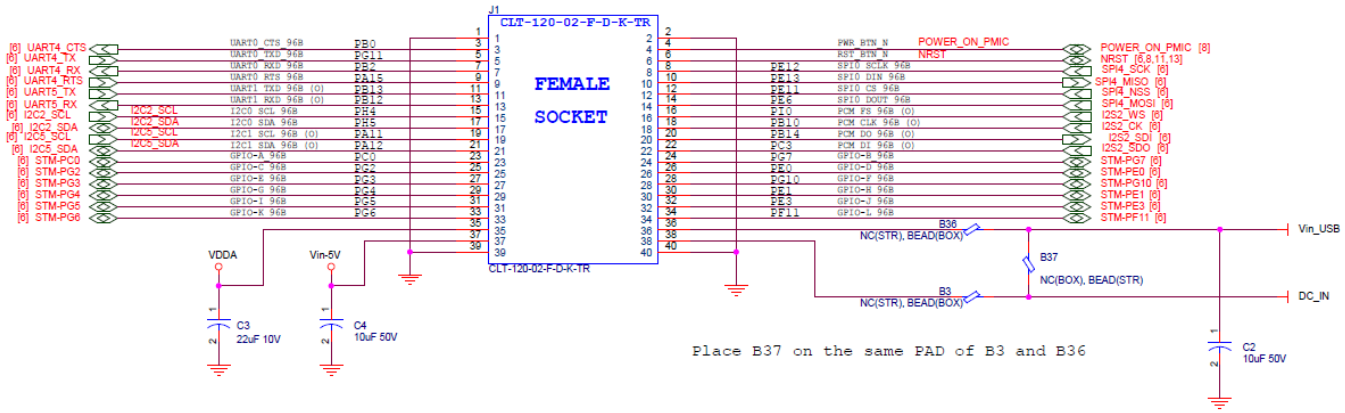
9. Low-Speed Connector

Stinger96 supports a standard 96Boards 40 pin Low-Speed expansion connector with 1.8V logic levels. The connector contains the following interfaces:

- UART0
- UART1
- 2 x I2C
- I2S
- 12 x GPIO
- Reset button
- Power button

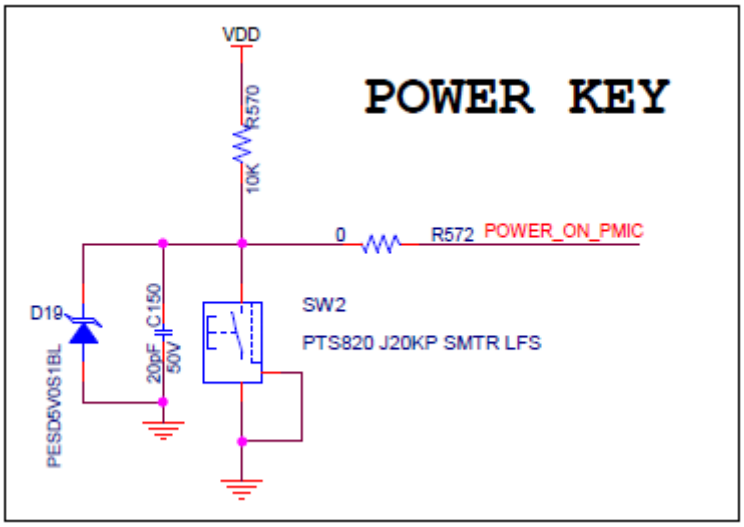
Connects to	Description	Pin #
GND	GND	1
UART4_CTS	UART0_CTS	3
UART4_TX	UART0_TxD	5
UART4_RX	UART0_RxD	7
UART4_RTS	UART0_RTS	9
UART5_TX	UART1_txD (O)	11
UART5_RX	UART1_RxD (O)	13
I2C2_SCL	I2C0_SCL	15
I2C2_SDA	I2C0_SDA	17
I2C5_SCL	I2C1_SCL (O)	19
I2C5_SDA	I2C1_SDA (O)	21
STM-PG0	GPIO-A	23
STM-PG2	GPIO-C	25
STM-PG3	GPIO-E	27
STM-PG4	GPIO-G	29
STM-PG5	GPIO-I	31
STM-PG6	GPIO-K	33
VDD	+1.8V	35
Vin-5V	+5V	37
GND	GND	39

Pin #	Description	Connects to
2	GND	GND
4	PWR_BTN_N	POWER_ON_PMIC
6	RST_BTN_N	NRST
8	SPI0_SCLK	SPI1_SCK
10	SPI0_DIN	SPI1_MISO
12	SPI0_CS	SPI1_NSS
14	SPI0_DOUT	SPI1_MOSI
16	PCM_FS (O)	I2S2_WS
18	PCM_CLK (O)	I2S2_CK
20	PCM_DO (O)	I2S2_SDI
22	PCM_DI (O)	O2S2_SDO
24	GPIO-B	STM-PG7
26	GPIO-D	STM-PG8
28	GPIO-F	STM-PG10
30	GPIO-H	STM-PG12
32	GPIO-J	
34	GPIO-L	
36	NC	Vin_USB
38	NC	Vin_USB
40	GND	GND

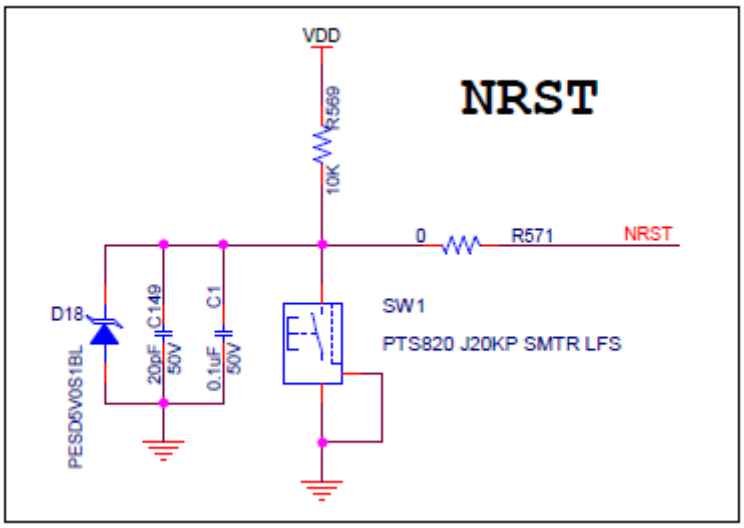

J1
CLT-120-02-F-D-K-TR
FEMALE
SOCKET
CLT-120-02-F-D-K-TR
[6] UART4_CTS
[6] UART4_TX
[6] UART4_RX
[6] UART4_RTS
[6] UART5_TX
[6] UART5_RX
[6] I2C2_SCL
[6] I2C2_SDA
[6] I2C5_SCL
[6] I2C5_SDA
[6] STM-PC0
[6] STM-PG2
[6] STM-PG3
[6] STM-PG4
[6] STM-PG5
[6] STM-PG6
UART0_CTS_96B
UART0_TXD_96B
UART0_RXD_96B
UART0_RTS_96B
UART1_TXD_96B (O)
UART1_RXD_96B (O)
I2C0_SCL_96B
I2C0_SDA_96B
I2C1_SCL_96B (O)
I2C1_SDA_96B (O)
GPIO-A_96B
GPIO-C_96B
GPIO-E_96B
GPIO-G_96B
GPIO-I_96B
GPIO-K_96B
PB0
PG11
PB2
PA15
PB13
PB12
PH4
PH5
PA11
PA12
PC0
PG2
PG3
PG4
PG5
PG6
I2C2_SCL
I2C2_SDA
I2C5_SCL
I2C5_SDA
PWR_BTN_N
RST_BTN_N
POWER_ON_PMIC
NRST
PE12
PE13
PE11
PE6
PI0
PB10
PB14
PC3
PG9
PE0
PG10
PE1
PE3
PF11
SPI0_SCLK_96B
SPI0_DIN_96B
SPI0_CS_96B
SPI0_DOUT_96B
PCM_FS_96B (O)
PCM_CLK_96B (O)
PCM_DO_96B (O)
PCM_DI_96B (O)
GPIO-B_96B
GPIO-D_96B
GPIO-F_96B
GPIO-H_96B
GPIO-J_96B
GPIO-L_96B
POWER_ON_PMIC [8]
NRST [5,8,11,13]
SPI4_SCK [6]
SPI4_MISO [6]
SPI4_NSS [6]
SPI4_MOSI [6]
I2S2_WS [6]
I2S2_CK [6]
I2S2_SDI [6]
I2S2_SDO [6]
STM-PG7 [6]
STM-PE0 [6]
STM-PG10 [6]
STM-PE1 [6]
STM-PE3 [6]
STM-PF11 [6]
B36
NC(STR), BEAD(BOX)
B37
NC(BOX), BEAD(STR)
B3
NC(STR), BEAD(BOX)
Vin_USB
DC_IN
VDDA
Vin-5V
C3
22uF 10V
C4
10uF 50V
C2
10uF 50V
Place B37 on the same PAD of B3 and B36

10. Power and Reset Buttons

Pressing the Power button generates low level signal that initiates the PMIC voltage shutdown sequence, followed by the voltage power up sequence (when released).

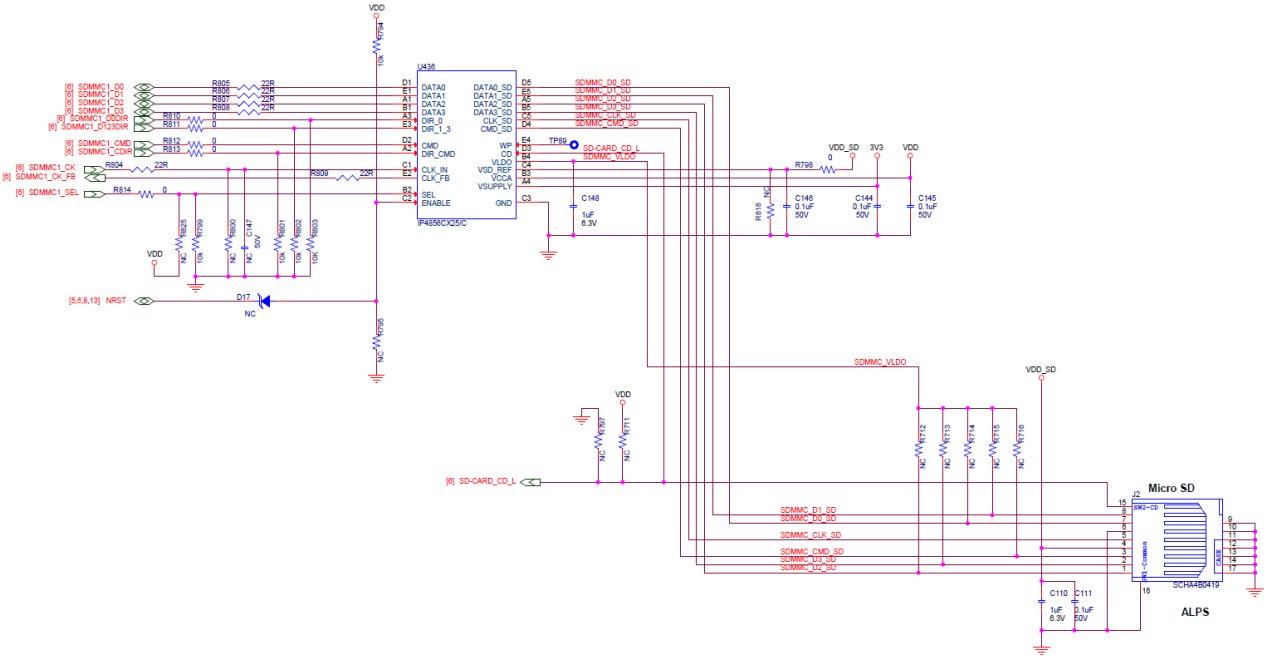


Pressing the Reset button generates low level reset command to the SOC resulting in a soft reset.



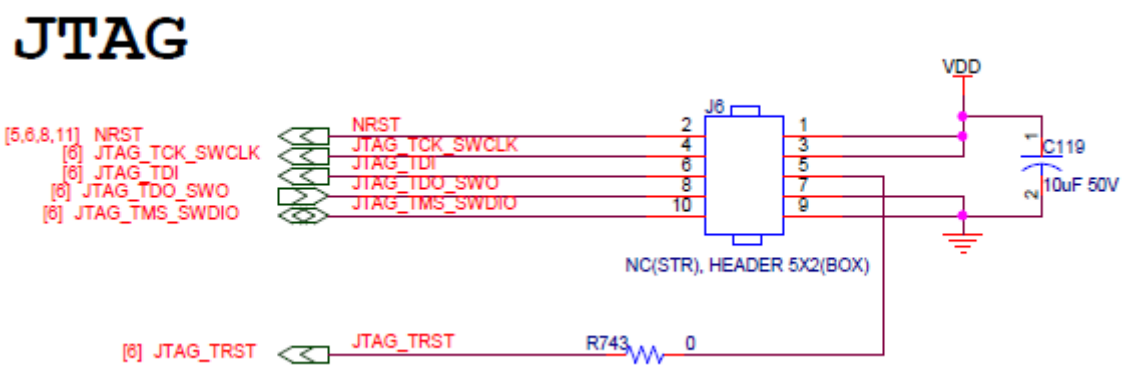
11. Micro SD Card Connector

Powered by 2.9V power supply and connected to the CPU SDIO lines via voltage translator to support low voltage SD card mode.



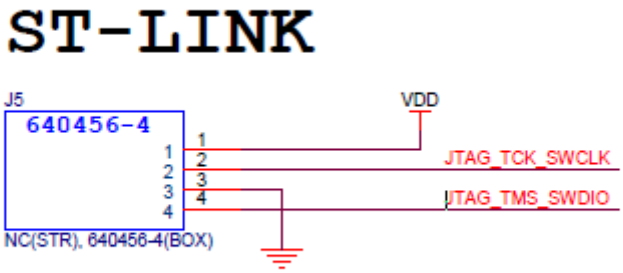
12. JTAG Connector

10 pin JTAG header directly connected to the CPU JTAG lines and 1.8V power supply.



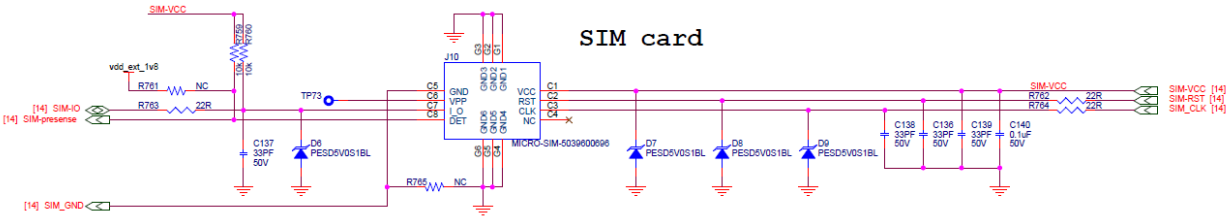
13. ST-Link Connector

4 pin ST-Link header directly connected to the CPU. Connected to a 1.8V power supply.



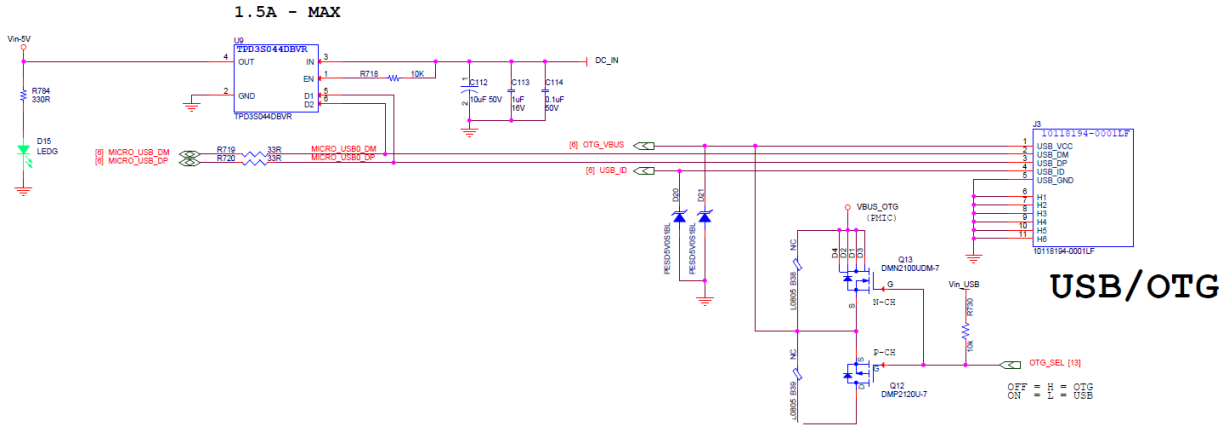
14. SIM Card Connector

Directly connected to SIM interface lines in the BG96. Powered, utilized and managed by the BG96 module.



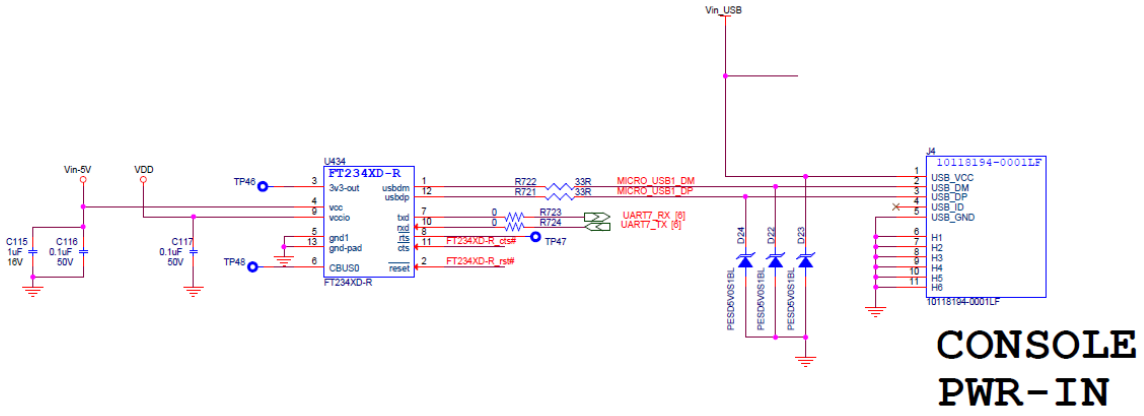
15. USB0 + Power

USB lines connected to the CPU and power lines provide 5V voltage.



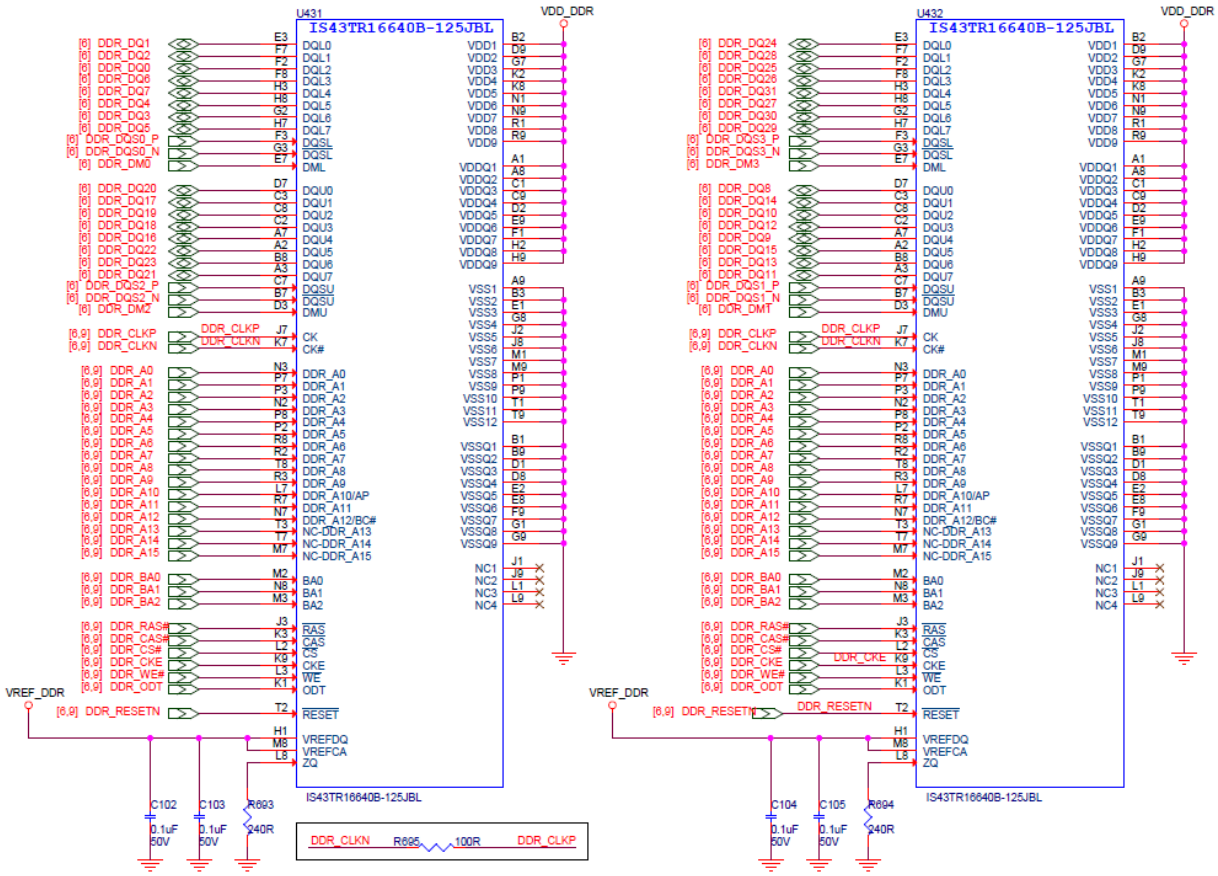
16. USB1 + Console

Connected to the CPU through the FT234XD-R which translates USB to UART (UART7). This connection enables the Linux monitor communication with the board. Provides 5V voltage.



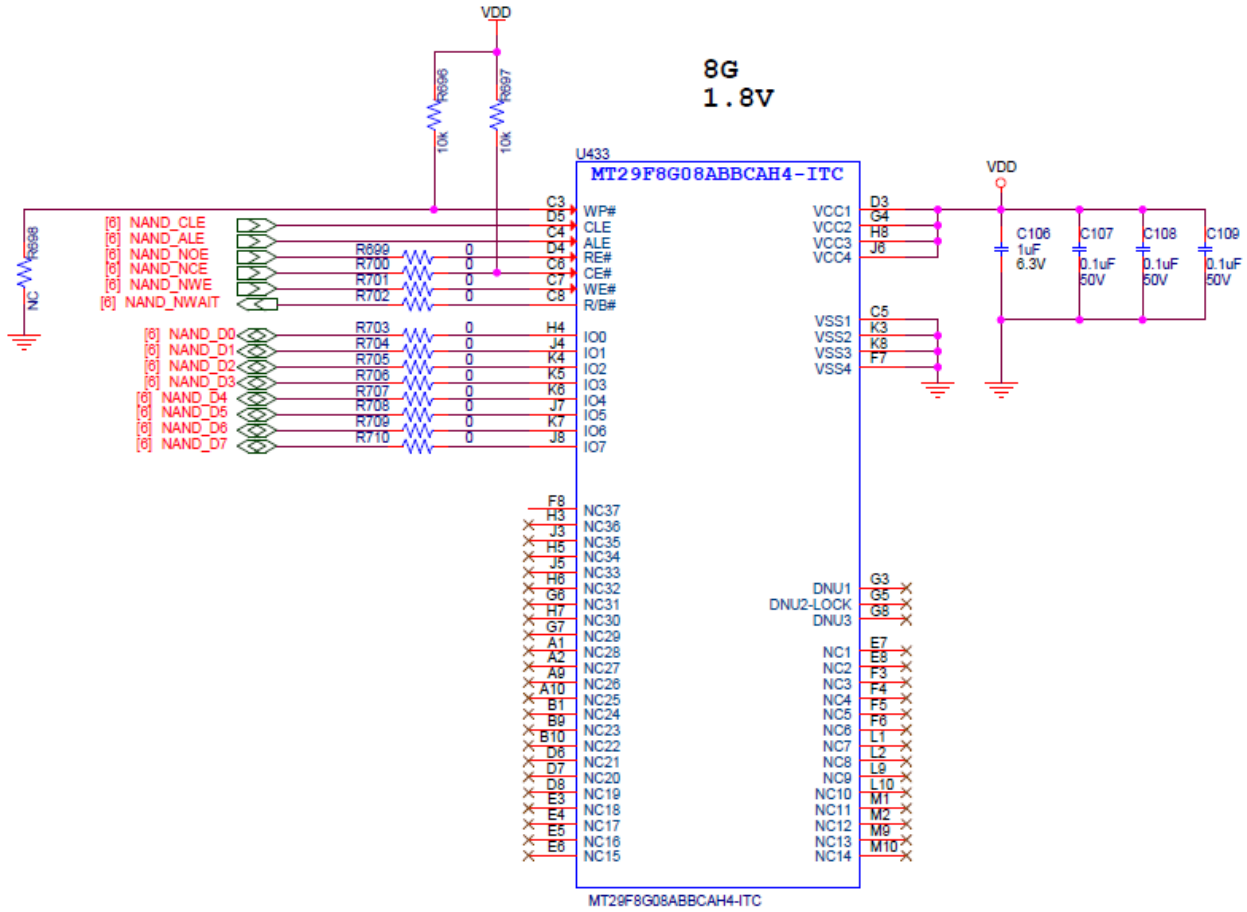
17. IS43TR16640B-125JBL

Two DDR memory components are included, each powered by 1.1V power supply, connected to the CPU module via a 32-bit bus.



18. MT29F8G08ABBCAH4-ITC

8 Gbit NAND Flash memory, powered by 1.8V power supply, connected to the CPU module via a 32-bit bus.



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