QUECTEL®
Build a Smarter World

LPWAN Design & Test Methods

eMTC & NB-IoT

January, 2018

Quectel LPWAN Modules

QUECTEL
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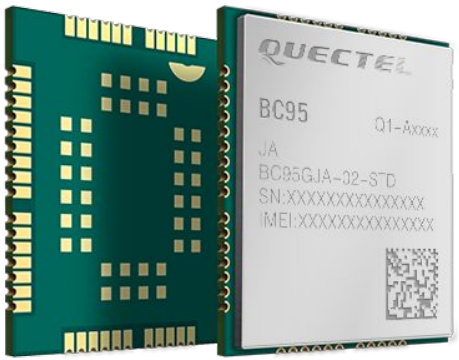
LTE Cat NB1



HUAWEI | HISILICON

LTE Cat NB1 & M1 + EGPRS

QUALCOMM®

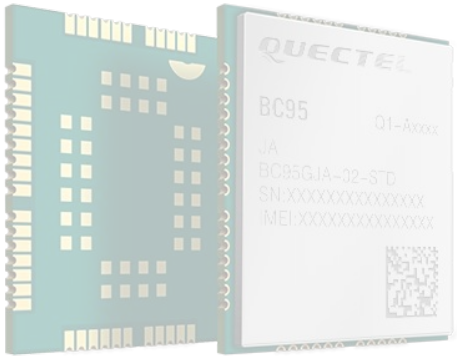
LTE Cat NB1

MEDIATEK

Quectel LPWAN Modules

Build a Smarter World

LTE Cat NB1



HUAWEI | HISILICON

LTE Cat NB1 & M1 + EGPRS

QUALCOMM®

LTE Cat NB1

MEDIATEK

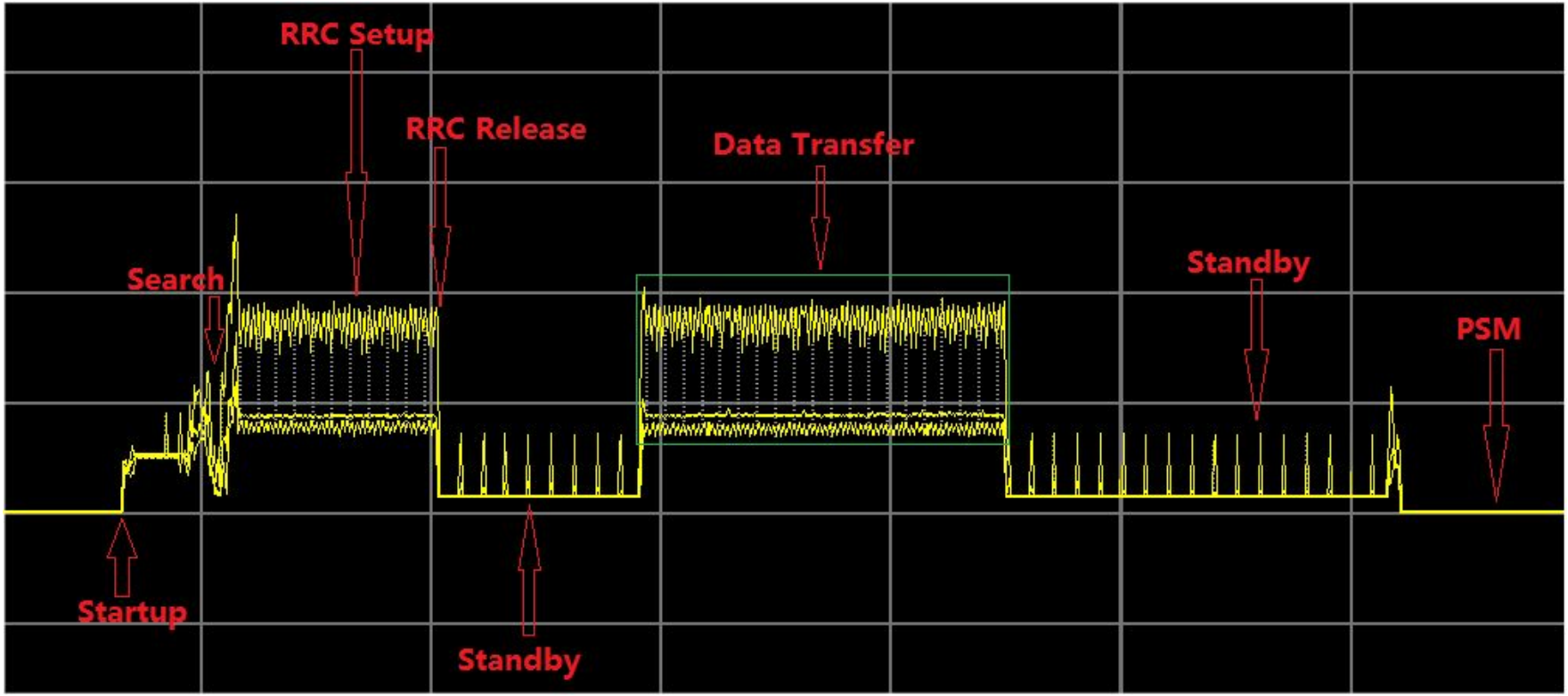
BG96 module overview

- LTE Cat M1 & Cat NB1 + EGPRS
- Multiband: B1/ B2/ B3/ B4/ B5/ B8/ B12/ B13/ B18/ B19/ B20/ B26/ B28
- IP/UDP/TCP
- ThreadX/QAPI/LwM2M/MQTT
- Integrated GNSS with LNA
- Qualcomm MDM9206 chip inside
- Temperature range: -40°C.. +85°C
- LGA package
- Dimensions: 19.9 x 23.6 x 2.2 mm

BG96 power consumption

KEYSIGHT
DC Power Analyzer N6705C

BG96 power consumption - Cat M1

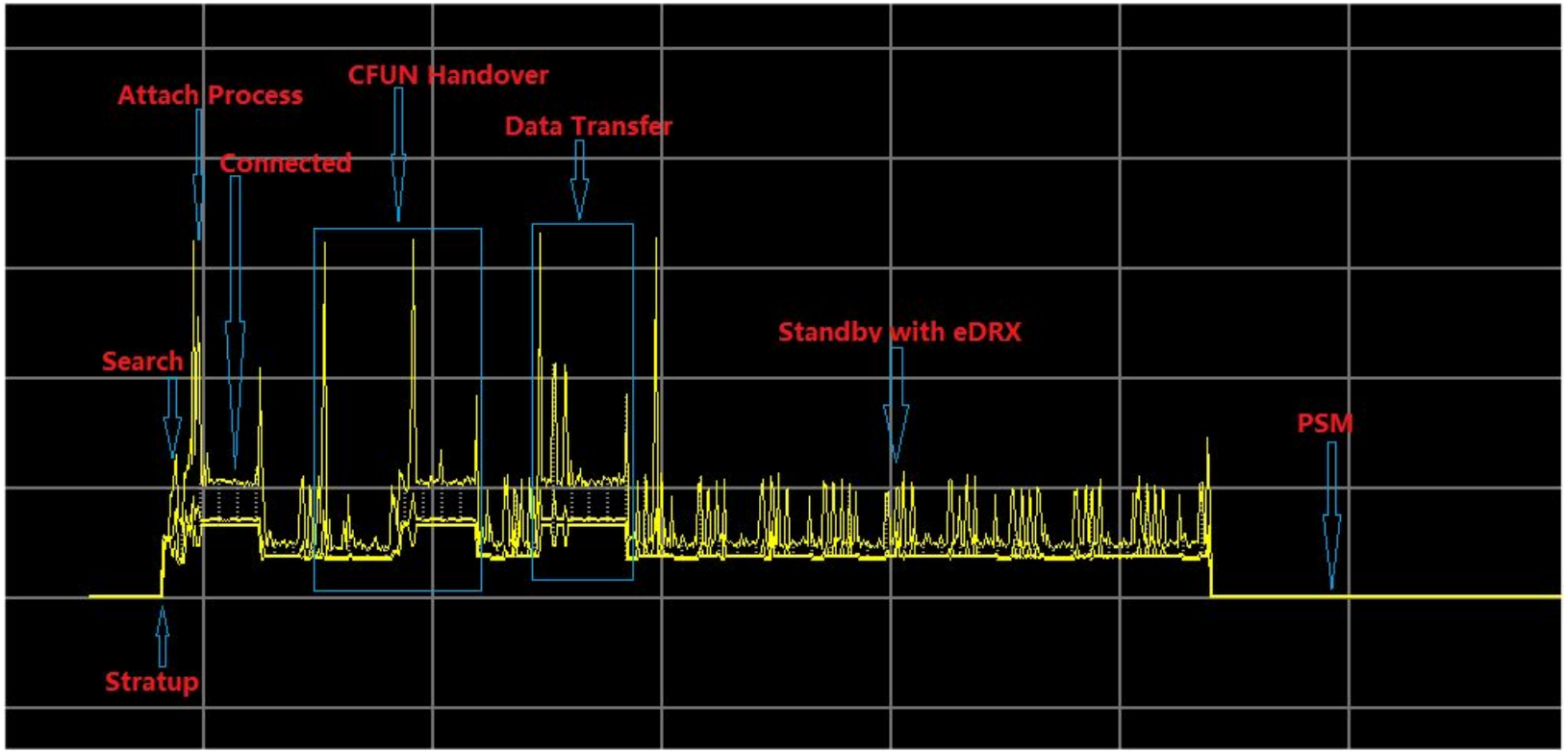


BG96 power consumption - Cat M1

Description	Conditions	Typical	Max	Unit
Power Saving Mode	PSM	10		uA
Standby	DRX=1.28s	1.9* / 16		mA
	eDRX=20.48s	1.3* / 15		mA
Active	23dBm @Instrument	190	447	mA
	10dBm @Instrument	130		mA
	0dBm @Instrument	124		mA
	DataTransfer @RealNetwork	95		mA

*Standby state with both USB and UART disconnected

BG96 power consumption - Cat NB1



BG96 power consumption - Cat NB1

Description	Conditions	Typical	Max	Unit
Power Saving Mode	PSM	10		uA
Standby	DRX=1.28s	2.3* / 16		mA
	eDRX=20.48s	1.9* / 15		mA
Active	23dBm @Instrument	78	400	mA
	10dBm @Instrument	66	221	mA
	0dBm @Instrument	65	209	mA
	DataTransfer @RealNetwork	47	203	mA

*Standby state with both USB and UART disconnected

Future proof design compatibility

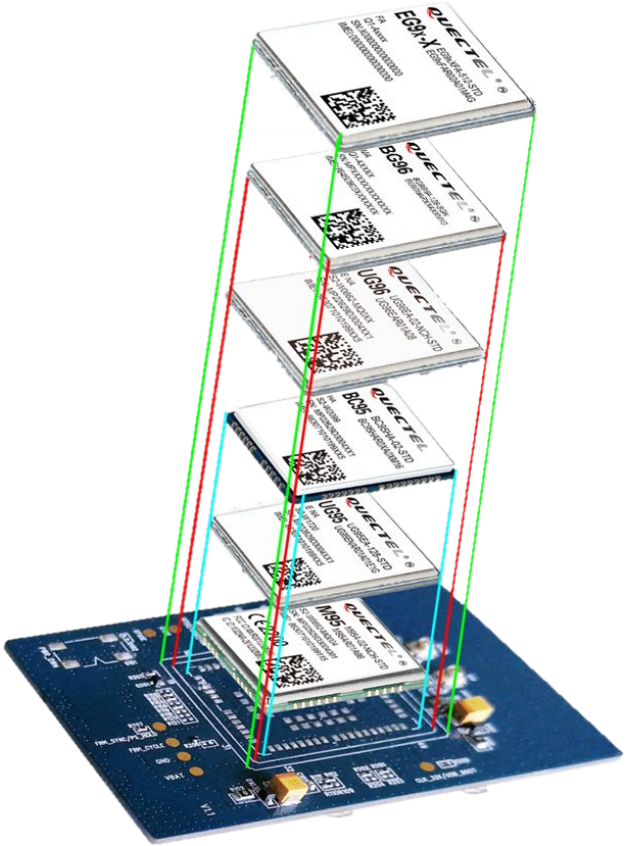
[4G] - **EG91** LTE Cat 1 module

[4G] - **BG96** LTE Cat M1 & NB-IoT

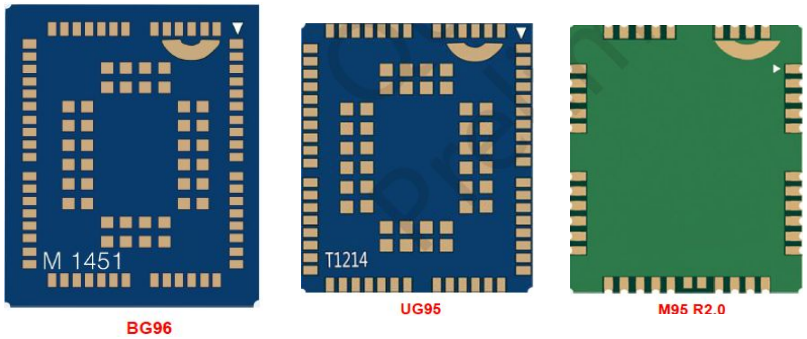
[4G] - **BC95** LTE Cat NB-IoT

[3G] - **UG96** & **UG95** UMTS modules

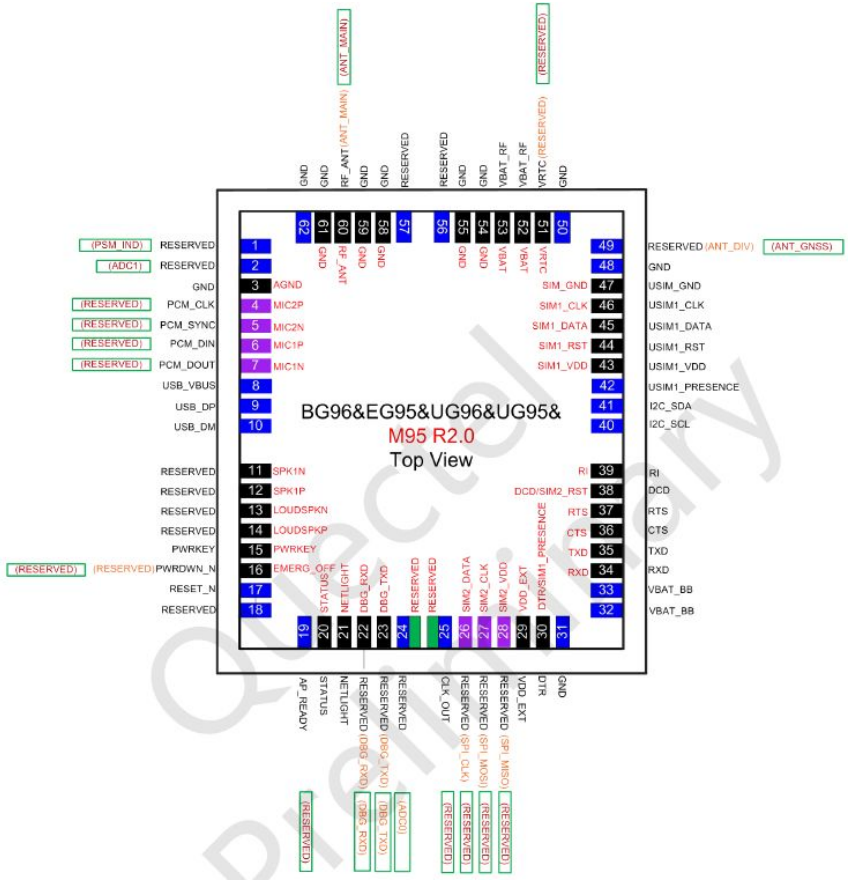
[2G] - **M95** GSM/GPRS module



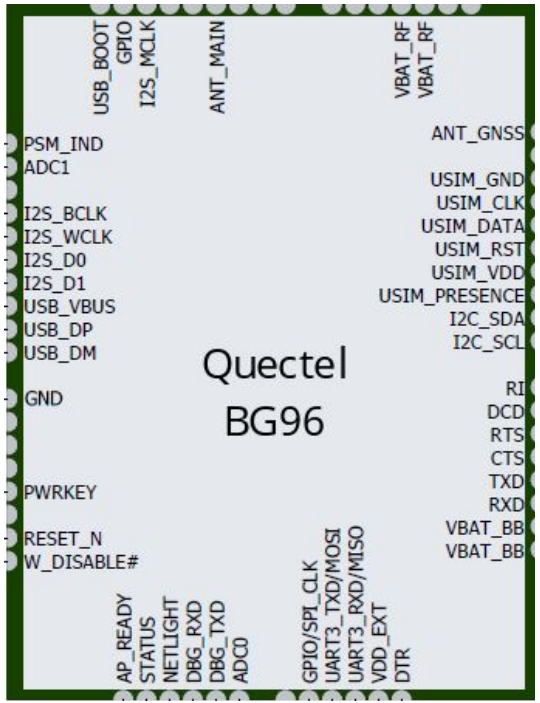
Future proof design compatibility



BG96 UG95 M95 R2.0

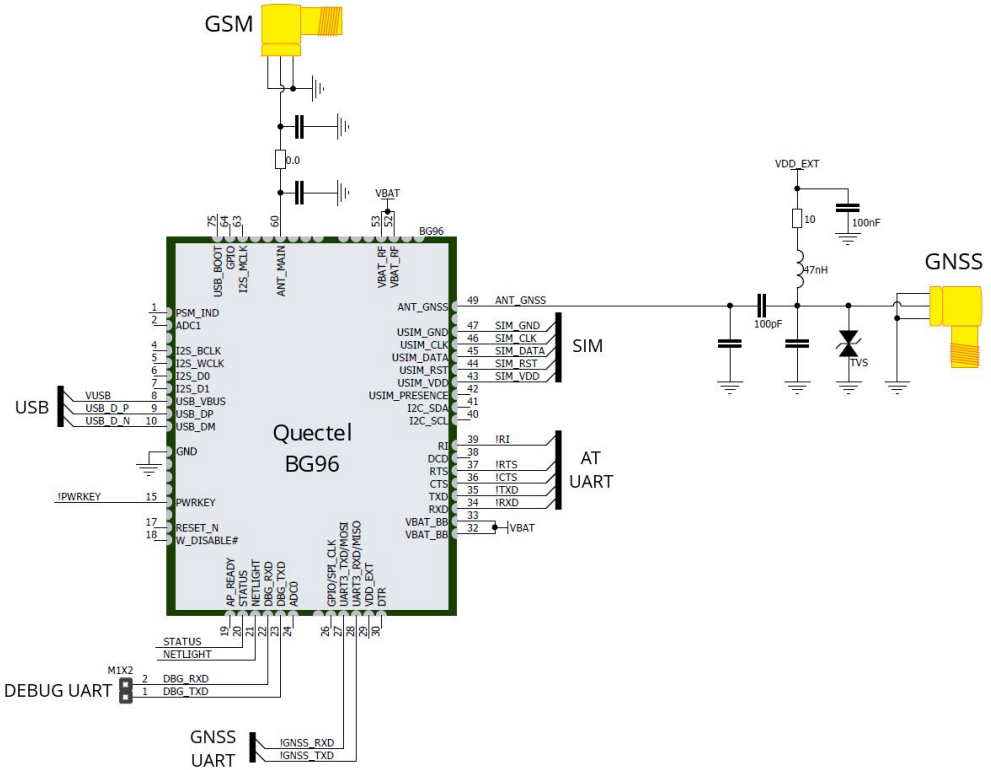


BG96 design example

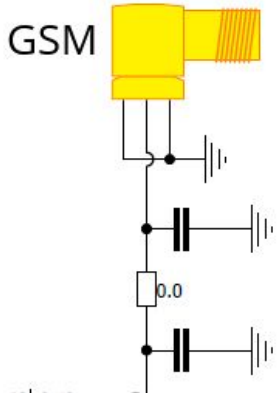


BG96 interfaces

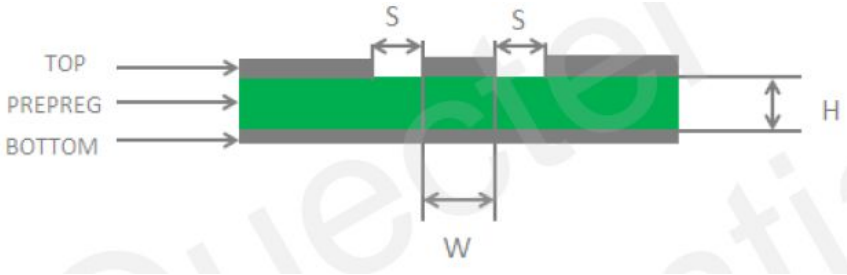
- 1x USB 2.0
- 3x UART
- 1x I2S & I2C for codec
- 2x ADC
- 2x GPIO
- 1x (U)SIM
- NETLIGHT, STATUS
- GSM & GNSS Antenna



BG96 interfaces

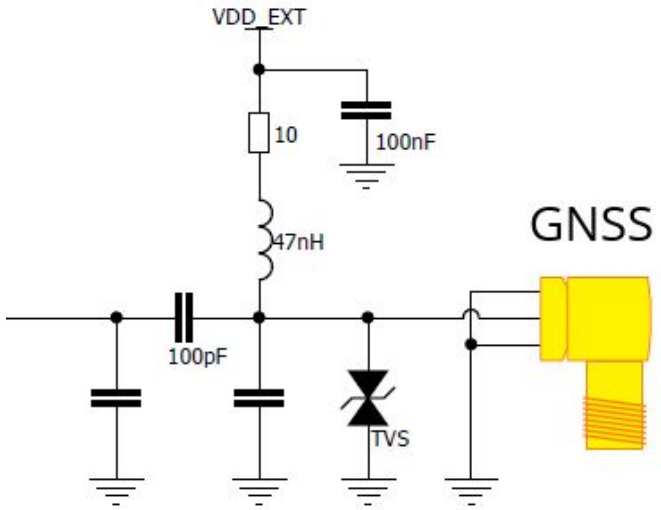


- Reserve PI matching network
- 50 ohms impedance

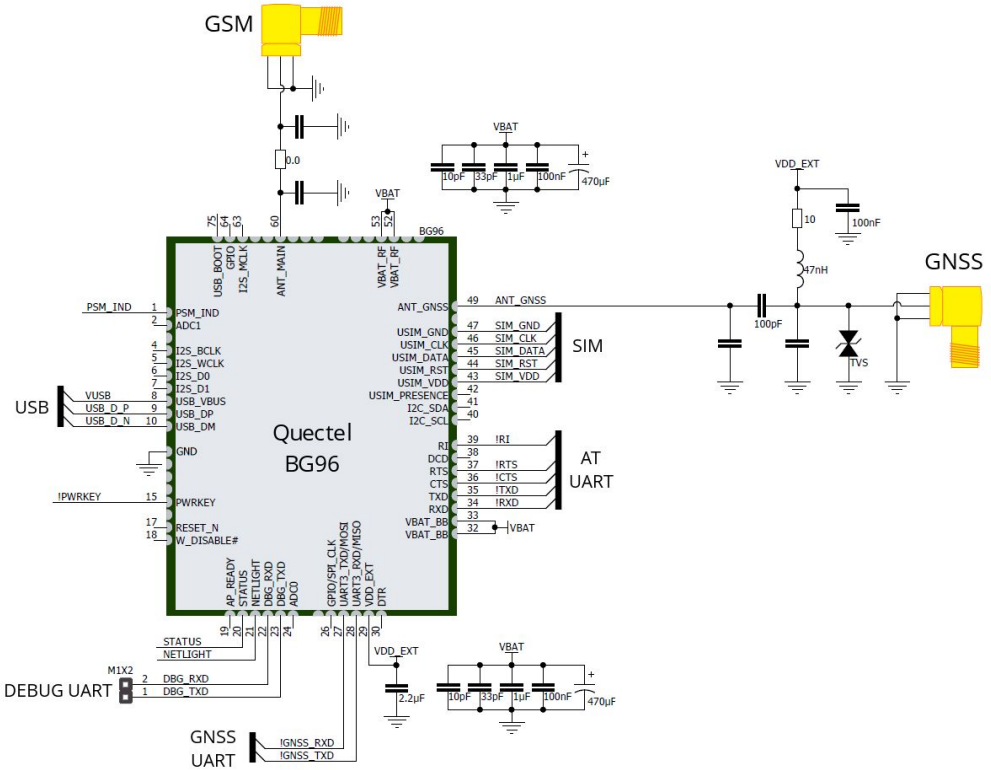


BG96 interfaces

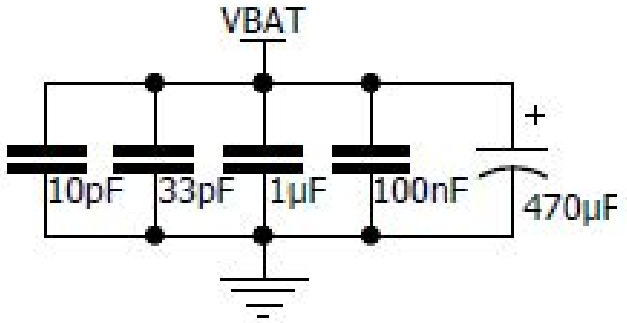
- Active antenna power supply
- TVS protection
- Reserve PI matching network
- 50 ohms impedance



BG96 power supply decoupling

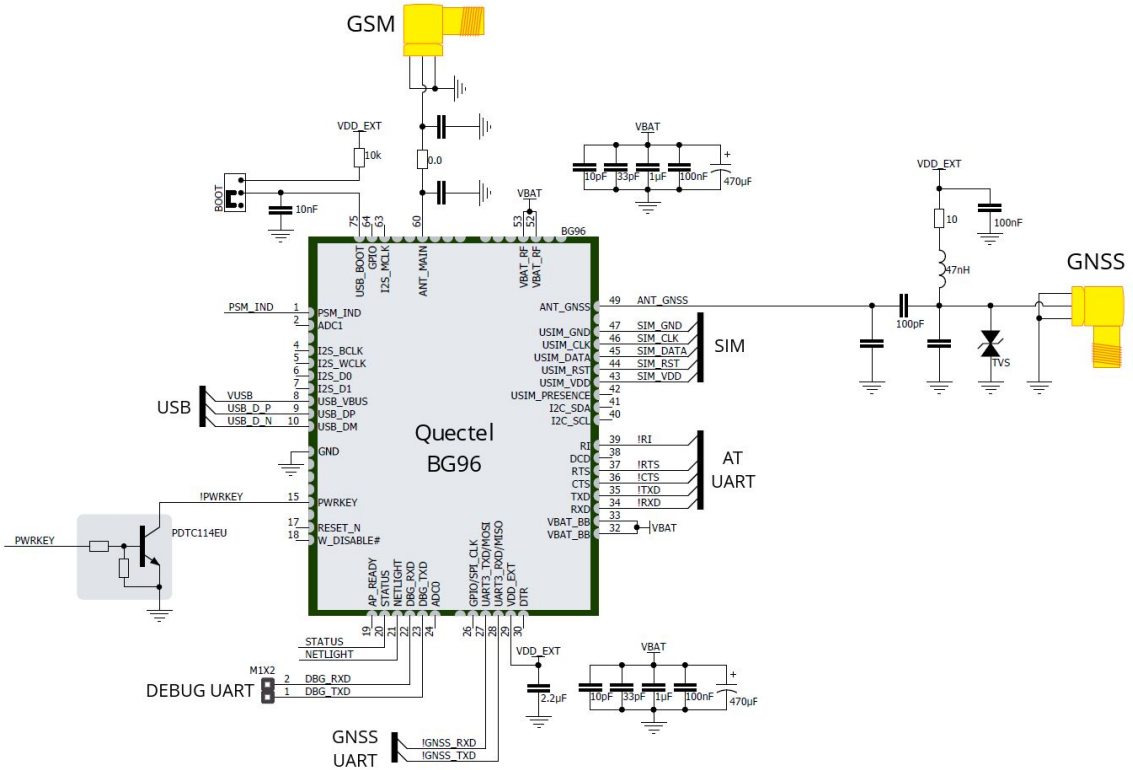


BG96 power supply decoupling



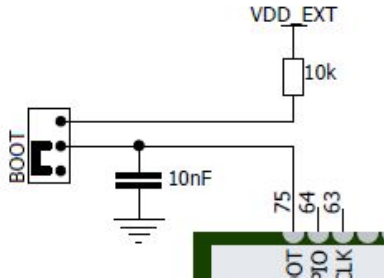
- Star layout for VBAT_BB & VBAT_RF
- Smaller capacitors closer to input pin
- Wide trace or power plane connection

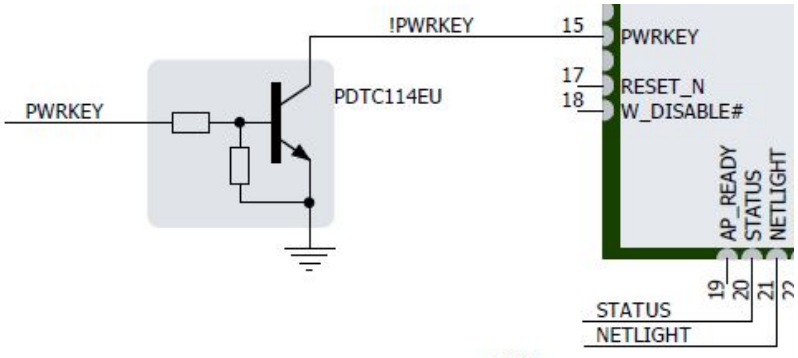
BG96 control & status signals



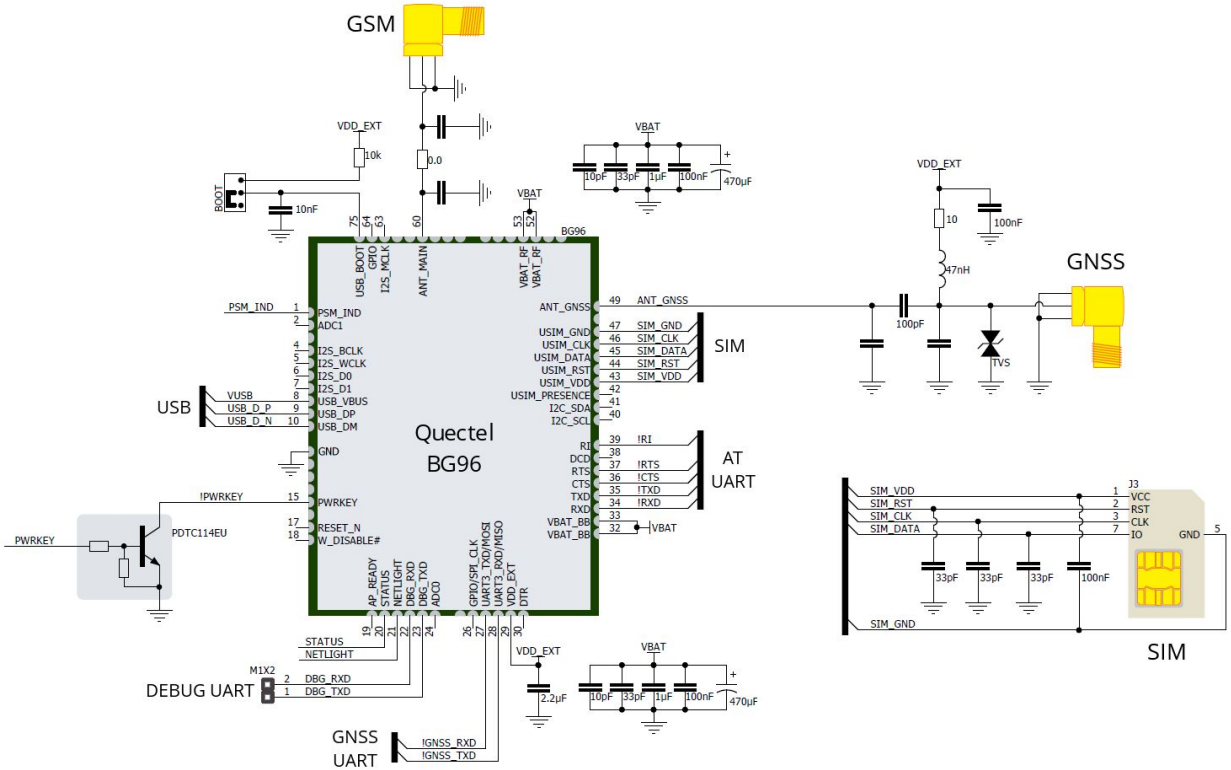
BG96 control & status signals

- PWRKEY for On/Off
- STATUS for power status
- NETLIGHT for network status
- USB_BOOT enable



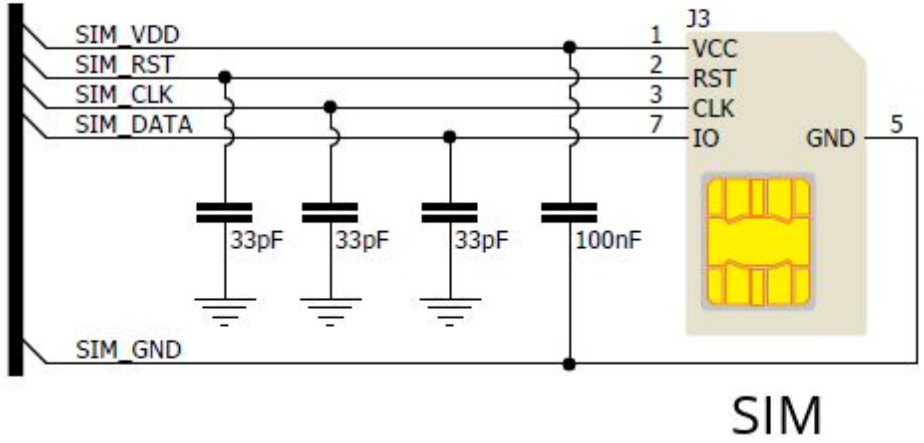


BG96 SIM interface design

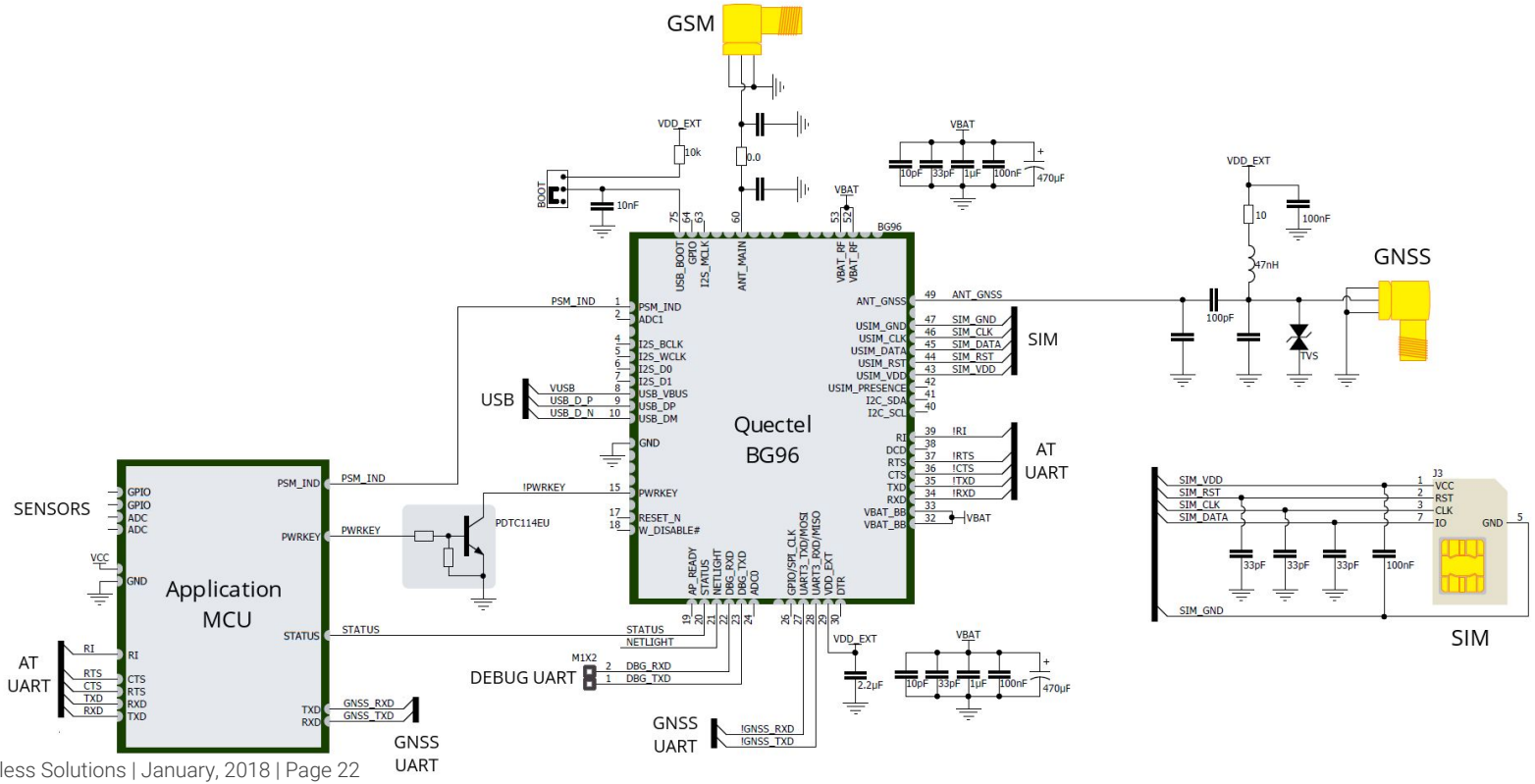


BG96 SIM interface design

- Decoupling capacitor for SIM_VDD
- SIM_CLK/DATA separated by system GND to avoid crosstalk

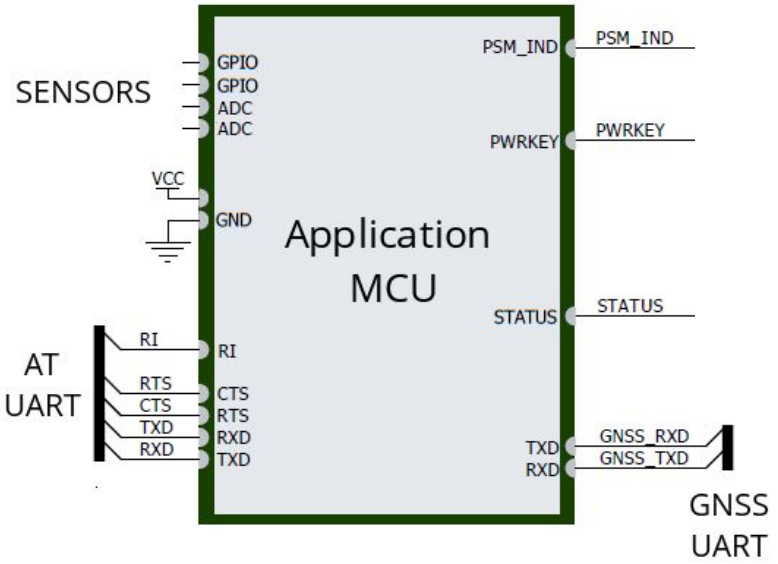


BG96 connection to external MCU

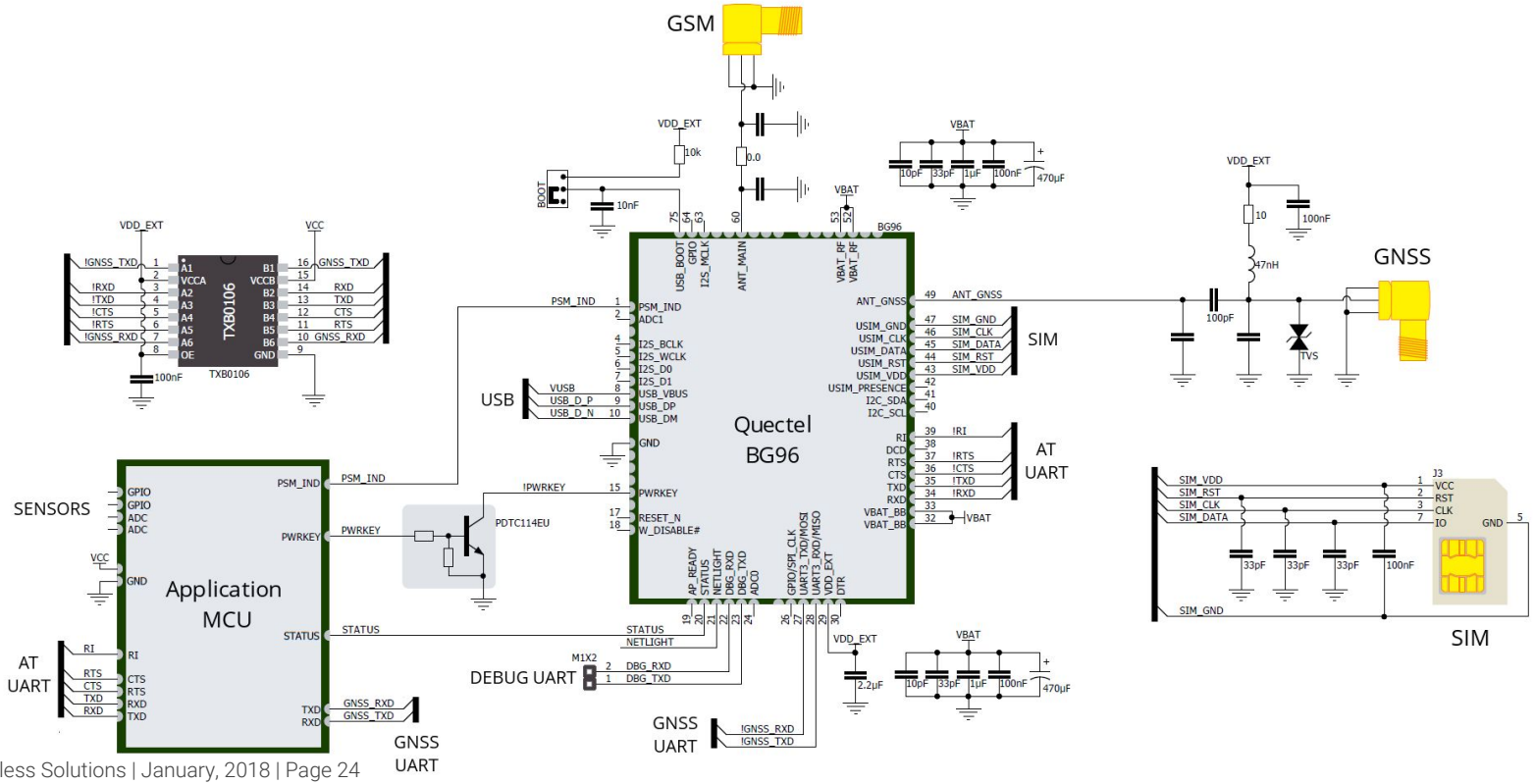


BG96 connection to external MCU

- AT UART
- GNSS UART
- STATUS, PWRKEY, PSM_IND
- Analog & Digital Sensors
- Different Power Domain

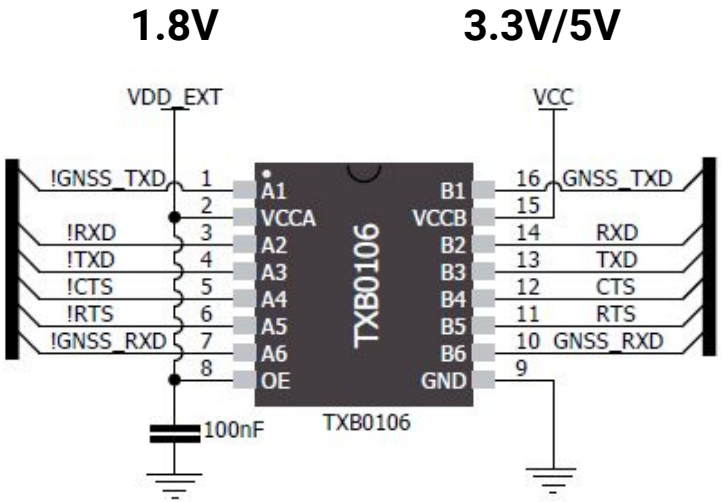


BG96 signal level shifting

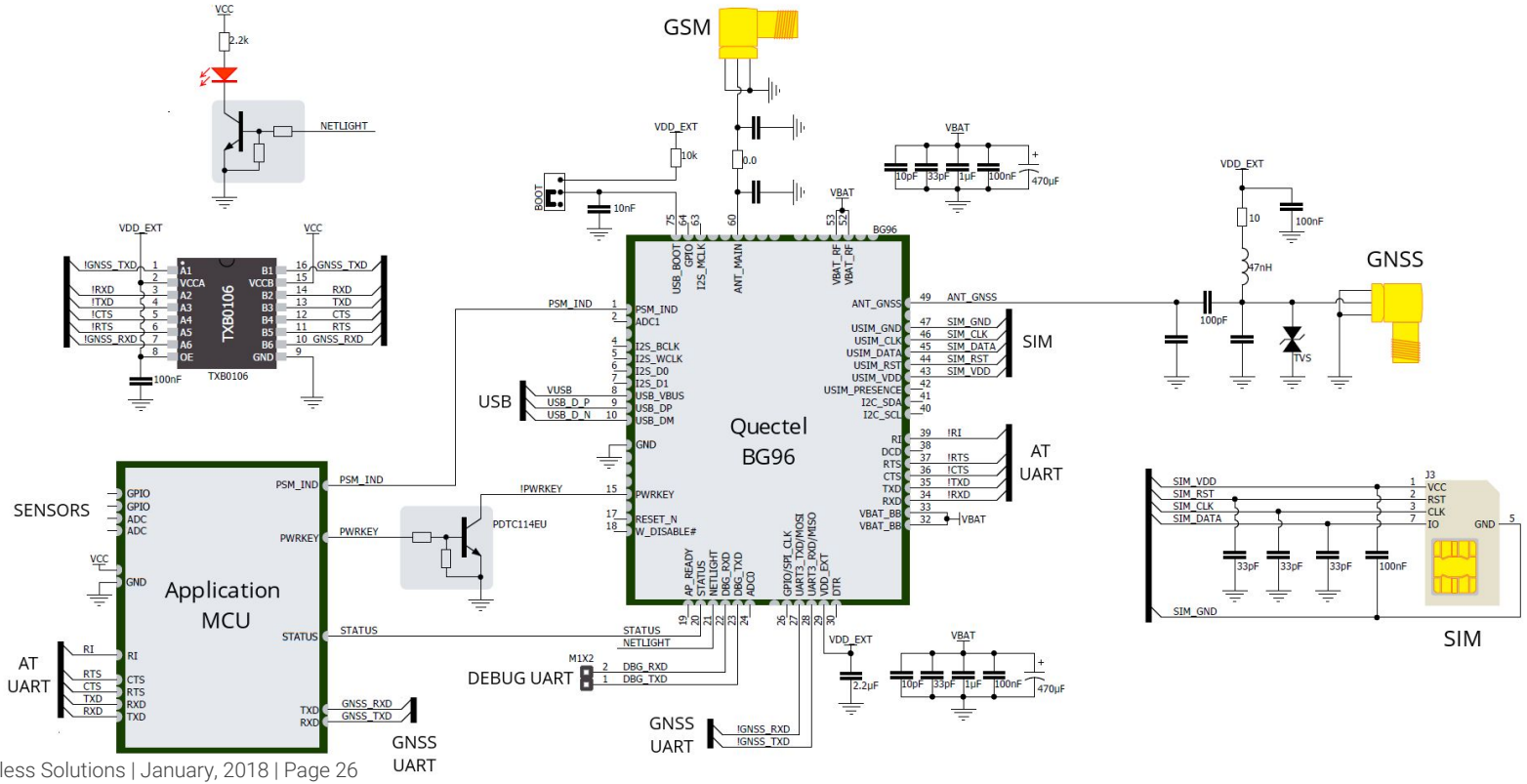


BG96 signal level shifting

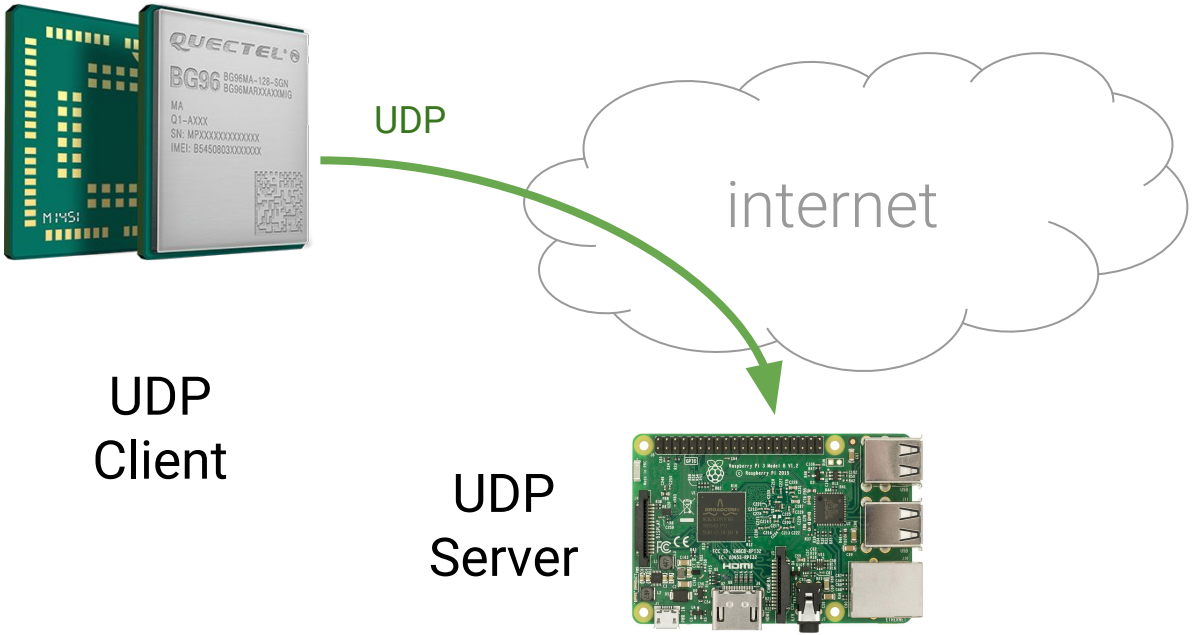
- Different Power Domain (1.8V)



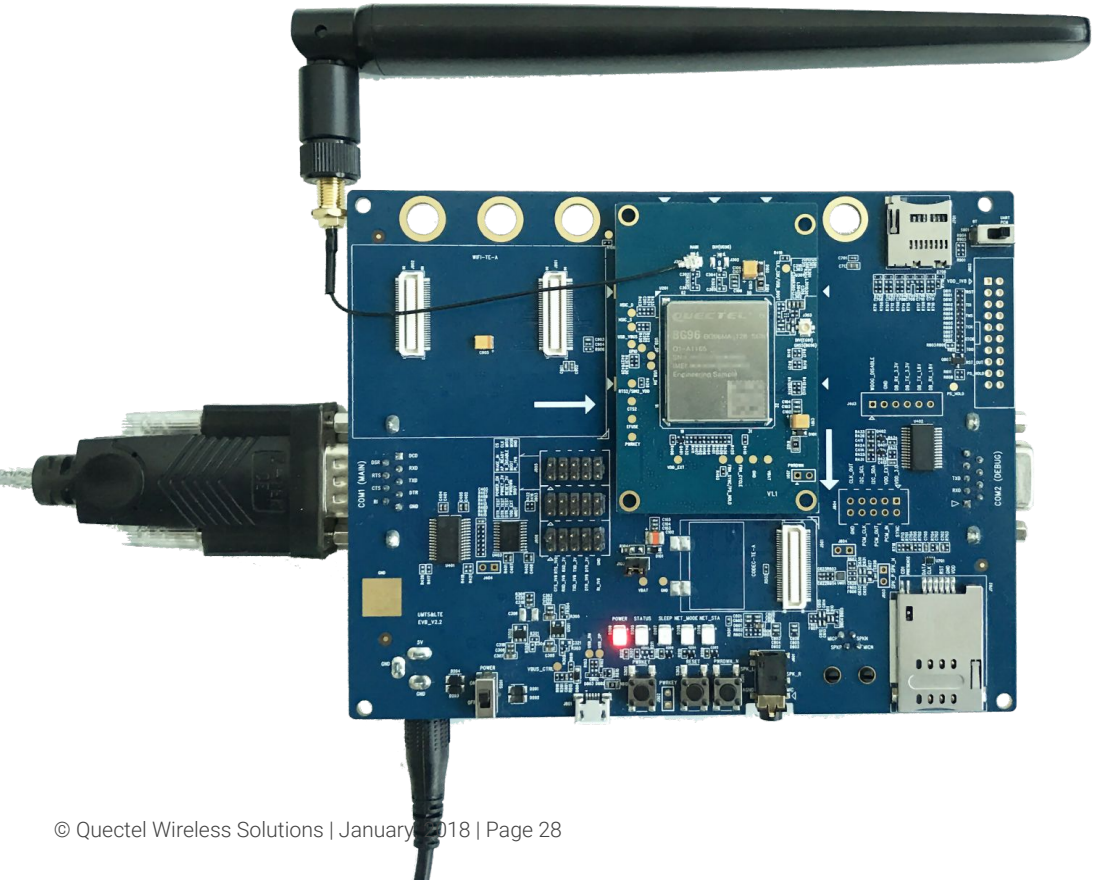
BG96 design example



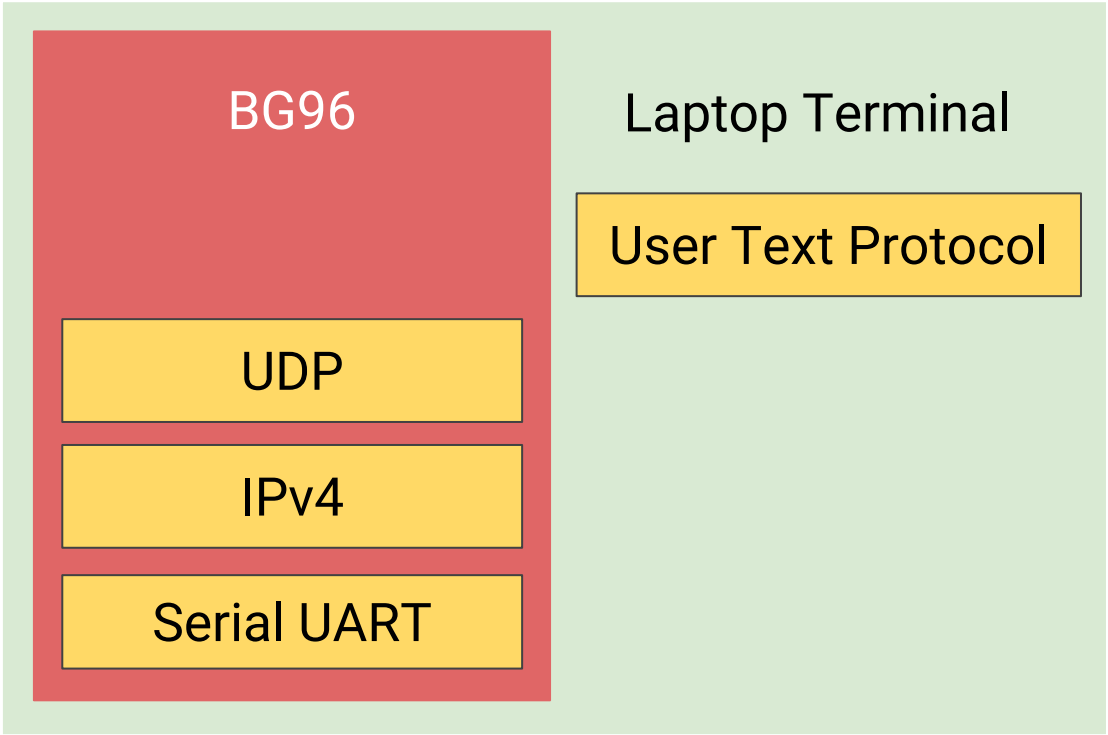
BG96 testing with NB-IoT



BG96 EVB kit



BG96 communication layers

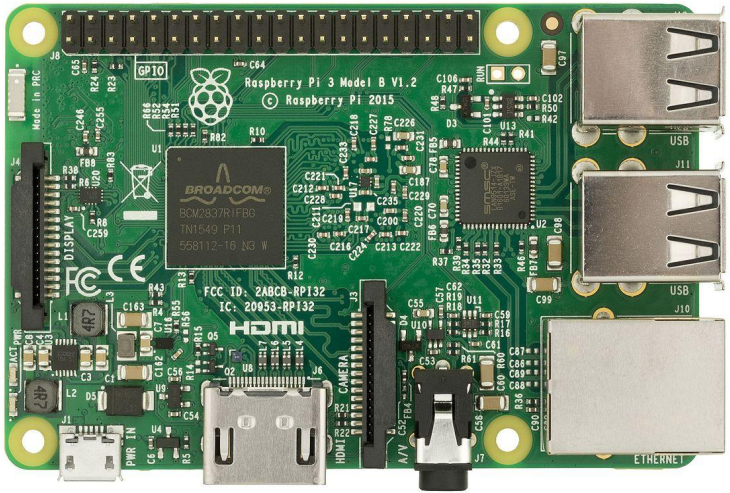


UDP Test Server

web: bit.ly/quectel-udp-server

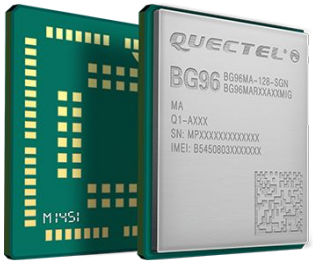
IP: **83.58.228.64***

port: **16666**



* IP is dynamic, check web link for current allocated IP

NB-IoT Test System Architecture

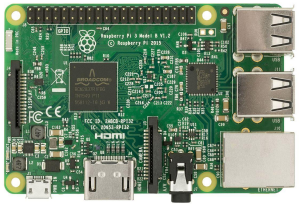


UDP

internet

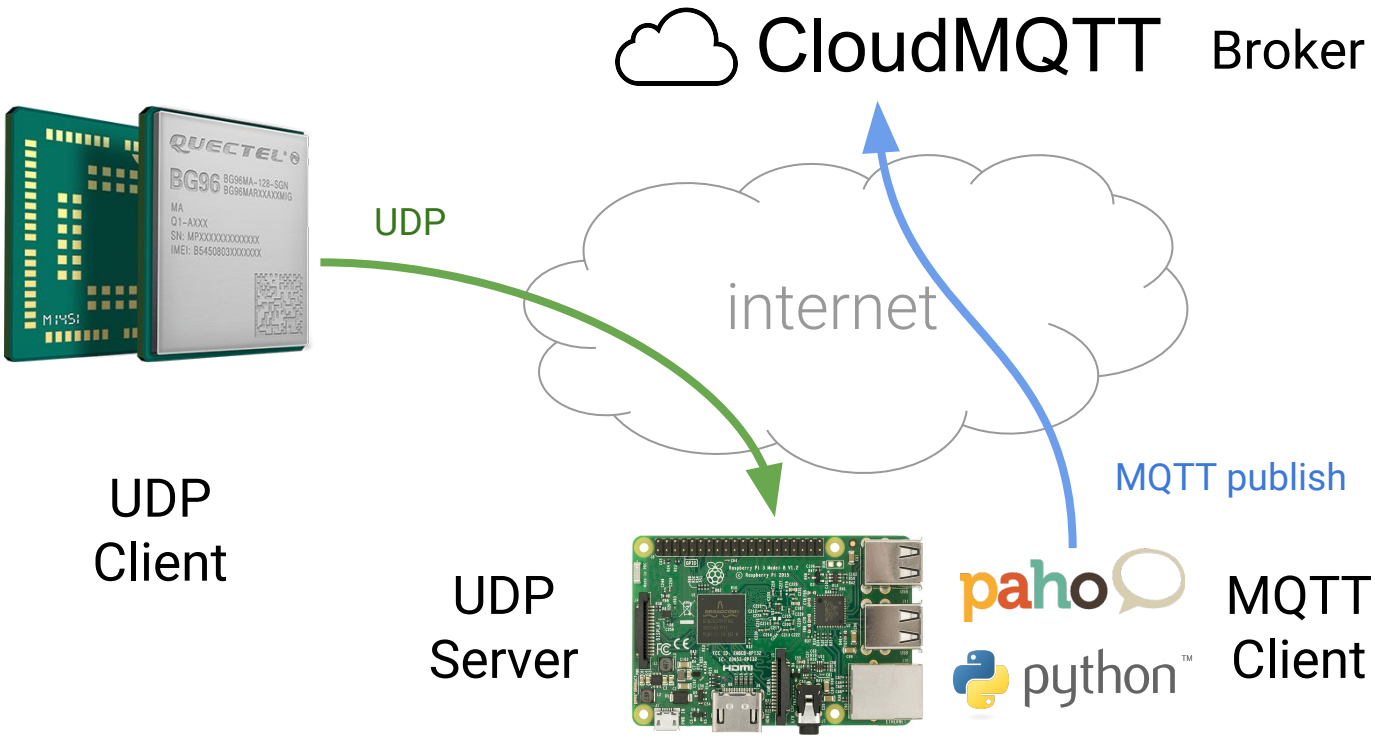
UDP
Client

UDP
Server

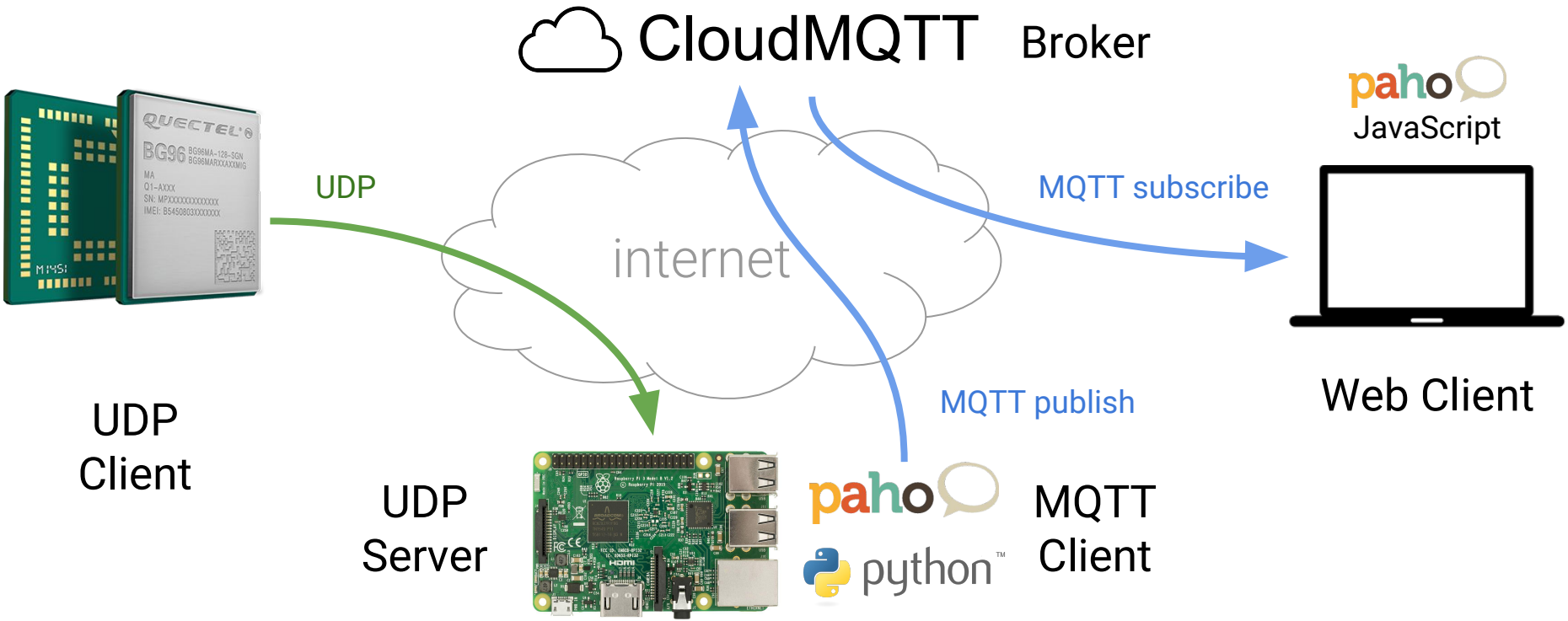


python™

NB-IoT Test System Architecture



NB-IoT Test System Architecture



Visualize UDP Data

bit.ly/quectel-udp-server

Initial Setup & Configuration

1. Enable scrambling, PSM, eDRX
2. Set Band, Network, Mode, APN
3. Manual Operator Selection
4. Check registration/attachment status
5. Send/Receive UDP data

Enable Scrambling, PSM, eDRX

```
//set & store fixed baudrate
AT+IPR=115200;&W
//Enable scrambling, T3412=10min, T3324=2s, eDRX=5.12s
AT+QCFG="nbsibscramble",0
AT+CPSMS=1,,,"00000001","00000001"
AT+CEDRXS=1,5,"0000"
//Reboot the module, power off
AT+QPOWD=1
//then tart module from PWRKEY button
```

Set Band, Network & Mode

```
//set band 80=B8(900 MHz), 80000=B20(800 MHz),... see manual
AT+QCFG="band",0,0,80,1
//Set LTE only mode and scan sequence LTE NB1 > LTE M1 > GSM
AT+QCFG="nwscanmode",3,1
AT+QCFG="nwscanseq",030201,1
//Set network operating mode as LTE NB1 only
AT+QCFG="iotopmode",1,1
//Set PS only domain
AT+QCFG="servicedomain",1,1
```

Set APN

```
//Enable full functionality
AT+CFUN=1
//Set APN for PDP context, can be empty ("")
AT+CGDCONT=1,"IP","APN_provided_by_operator"
```

Check Network Status

```
//wait 30s for NW registration, then check attachment status
AT+CGATT?
    +CGATT:1
//check EPS network registration status (1=home, 5=roaming)
AT+CEREG?
    +CEREG:1,xxxx,yyyyy,z
//or
    +CEREG:5,xxxx,yyyyy,z
```

Send/Receive UDP Data

```
//activate PDP context and create an UDP socket on IP*/port
AT+QIACT=1
AT+QIOPEN=1,0,"UDP","83.58.228.64",16666

//send UDP message encoded as 2 digit HEX
AT+QISENDEX=0,"48656C6C6F20576F726C6421"
    +QIURC: "recv",0
//read received UDP message
AT+QIRD=1
    +QIRD: 12
    48656C6C6F20576F726C6421
//close socket
AT+QICLOSE=0
```


* update 83.58.228.64 with UDP server IP from web link

Visualize UDP Data

bit.ly/quectel-udp-server

Thank you!

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