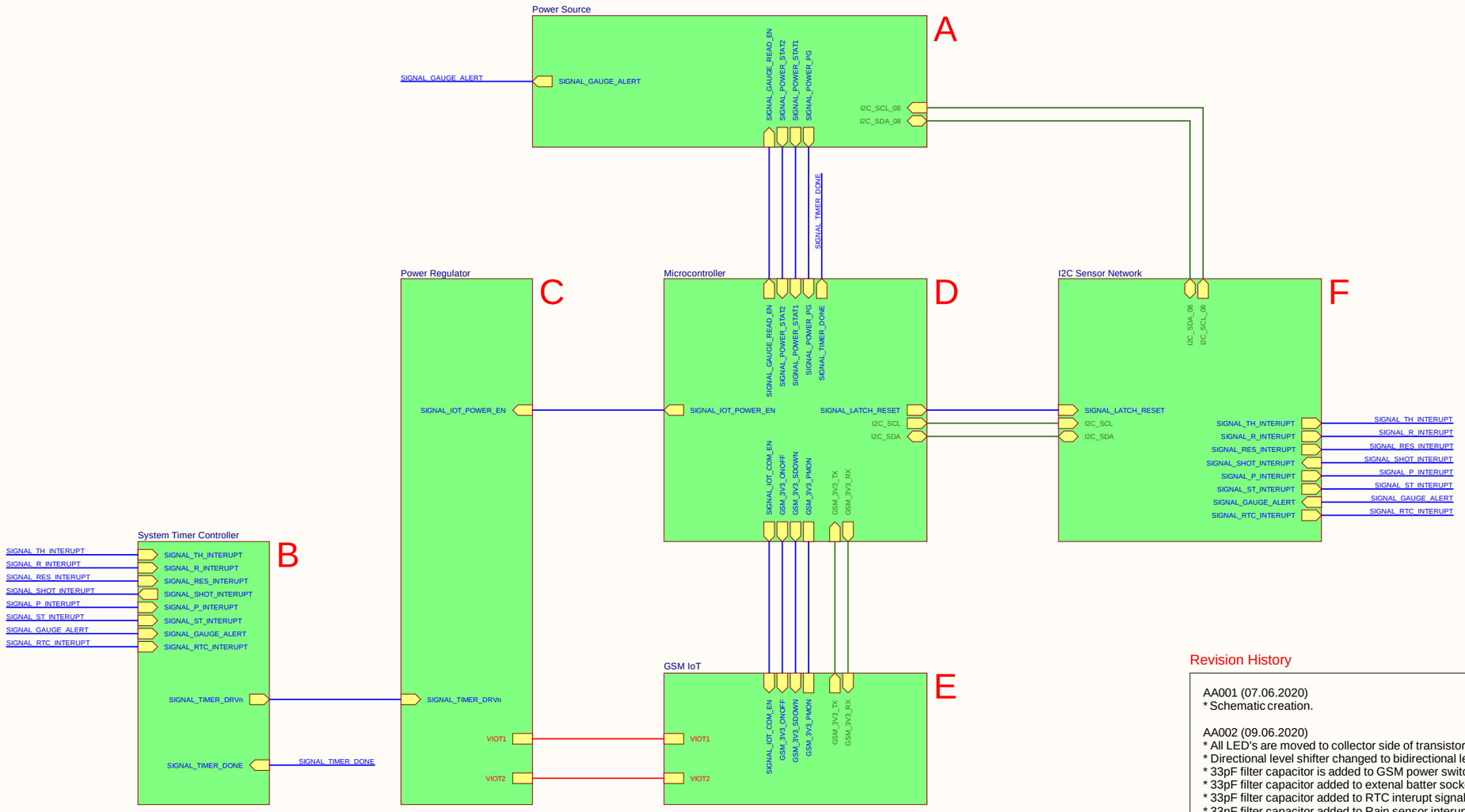
B106 - Weather Station IoT Module



Revision History

AA001 (07.06.2020)
* Schematic creation.

AA002 (09.06.2020)
* All LED's are moved to collector side of transistors.
* Directional level shifter changed to bidirectional level shifter.
* 33pF filter capacitor is added to GSM power switch in and out.
* 33pF filter capacitor added to extenal batter socket in (BAT+).
* 33pF filter capacitor added to RTC interupt signal.
* 33pF filter capacitor added to Rain sensor interupt signal.
* 33pF filter capacitor added to Pressure sensor interupt signal.

Title	Weather Station Block Diagram		
Size: A3	**Number:** AA002	**Revision:** B106AA	*Ovoo Electronics* Küçük İhsaniye Mah. Mızraklı Sok. No:15 Meram / Konya Turkiye
Date: 9.06.2020	**Time:** 19:04:00	**Sheet** 1 of 37	
File: C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\B106AA Block Diagram.SchDoc			

Li-Ion Battery
2 x 2500 mAh

Solar Panel Socket

Bat- Pack-

Pack- GND

Battery Socket & Portection

A1

Battery Measurement

I2C_SCL_08
I2C_SDA_08
SIGNAL_GAUGE_ALERT
SIGNAL_GAUGE_READ_EN

A2

Vbat = 2V8-4V3
BAT+
BAT-

Vpack = 3V-4V2
BAT+
PACK-

BAT+
GND

Battery Charger

SIGNAL_POWER_PG
SIGNAL_POWER_STAT1
SIGNAL_POWER_STAT2

A3

Vsolar = Max 6V
Vsolar
GND

Vcc = 3V-6V
VCC
GND

Buck Boost Converter

VCC 3V8

A4

3V8
3V8
GND

Title	**Power Source & Charger**		
Size: A4	**Number:** AA002	**Revision:** B106AA	
Date: 9.06.2020	**Time:** 19:04:00	**Sheet** 2 of 37	
File:	C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\Power Source.SchDoc		

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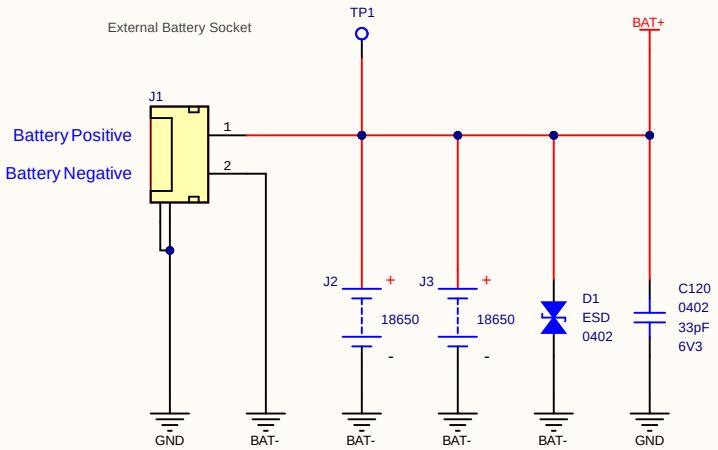
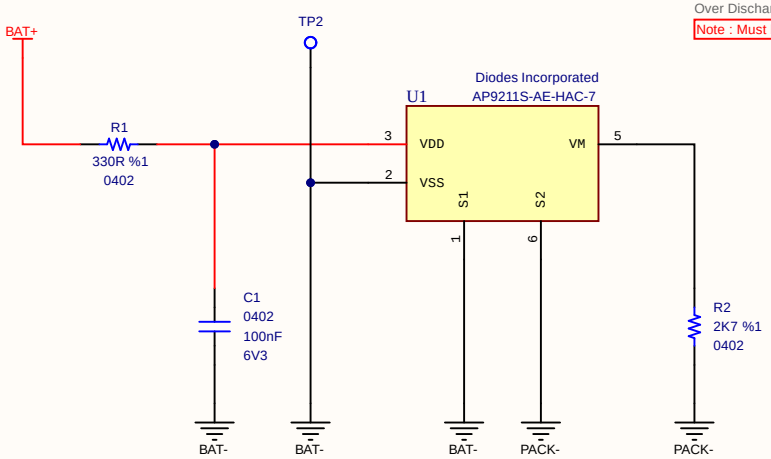


B106AA module have a battery holder for 18650 Lilon battery. System have 2 parallel connected battery system.

Advice : 2x2500mAh VTC6

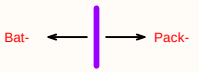


Quiescent Current : 3.0µA

P/N : AP9211XX-AE-HAC-7

Over Charge Detection Voltage (Vcu): 4V2
Over Charge Relase Voltage (Vcl) : 4V1
Over Discharge Detection Voltage (Vdl) : 2V5
Over Discharge Relase Voltage (Vdu) : 3V

Note : Must be plug charge on first run.



Battery ground isolation for protection.

Vbat = 2V8-4V3

Vpack = 3V-4V2

Title	**System Battery Feed and Battery Socket**		
Size: A4	**Number:** AA002	**Revision:** B106AA	
Date: 9.06.2020	**Time:** 19:04:00	**Sheet** 3 of 37	
File: C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\Battery Feed and Socket.SchDoc			

A1

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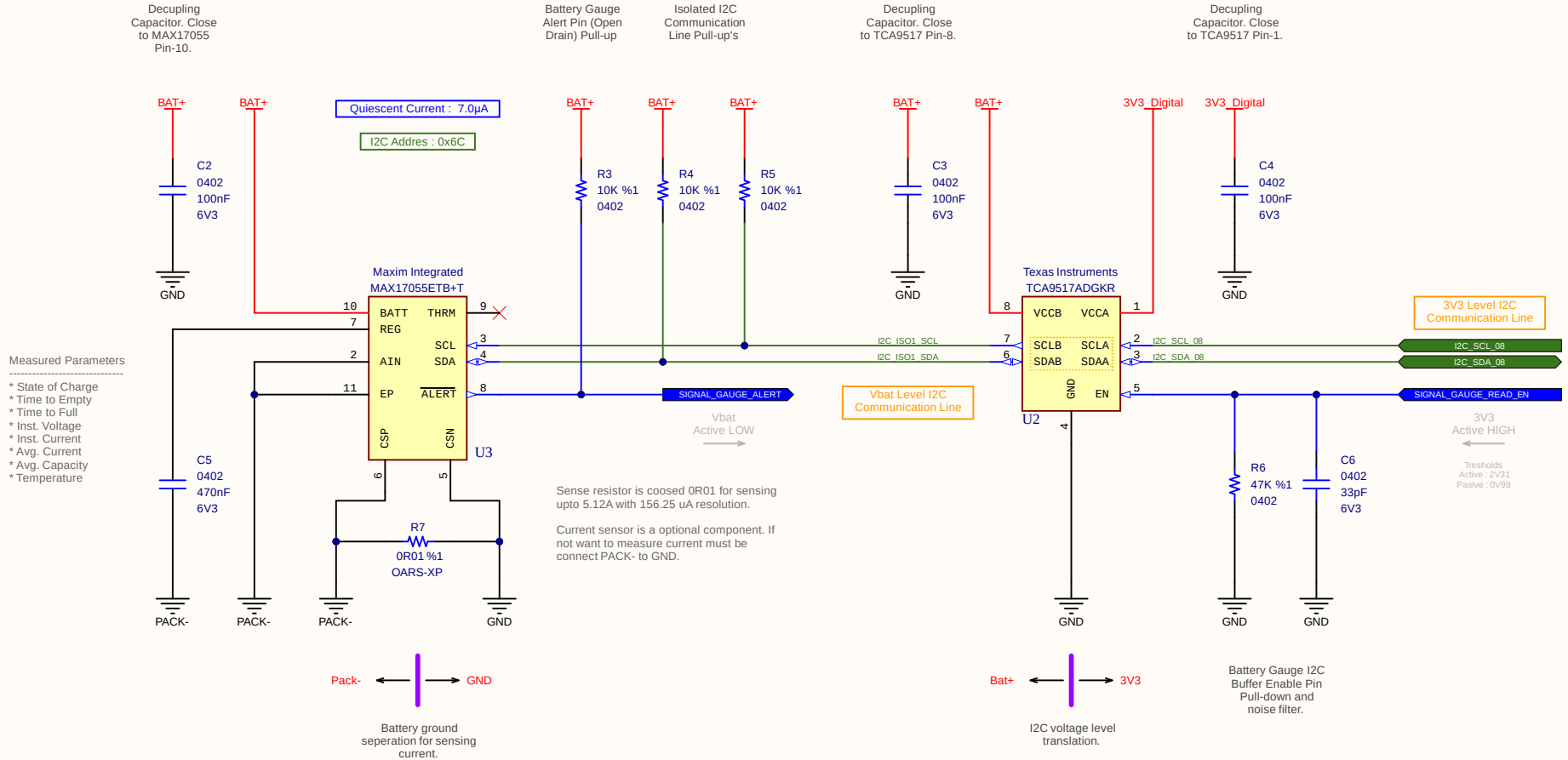
Battery Measurement

I2C Buffer



Title	Battery Measurement With I2C Isolation		
Size: A4	**Number:** AA002	**Revision:** B106AA	
Date: 9.06.2020	**Time:** 19:04:00	**Sheet** 4 of 37	
File:	C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\Battery Measurement.SchDoc		

A2

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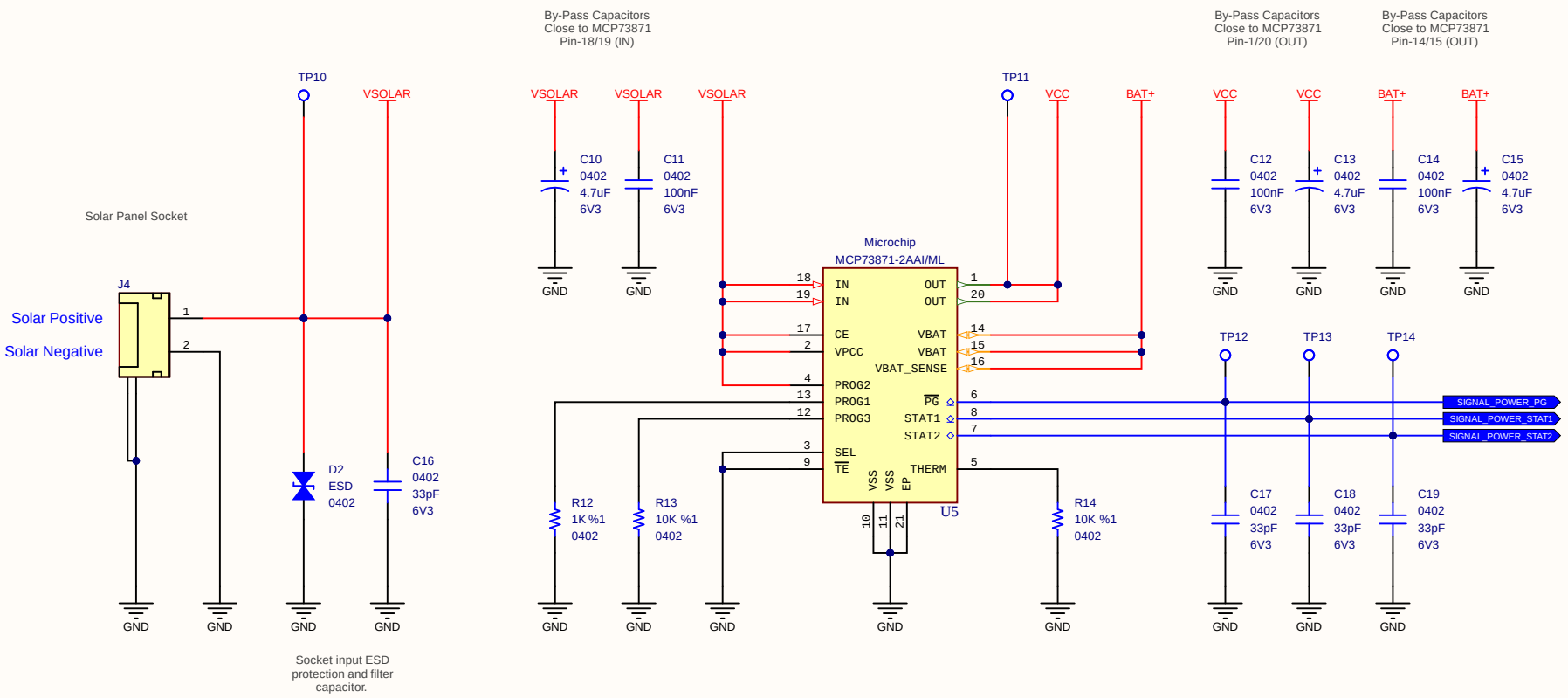

SEL Pin : Input type selection (Low for USB port, High for other type of power source)

TE Pin : Enables Safety Timer when active Low.

PROG1 Pin : Fast charge current regulation setting with PROG1 = High. Preconditioning set point for both USB port and other type of power source. 1K = 1A charge current limit.

PROG2 Pin : USB port input current limit selection when PROG2 = HIGH. (Low = 100 mA, High = 500 mA)

PROG3 Pin : Termination set point for power source and USB port. Minimum charge current. 10K = 100 mA.

A3

Title	**Battery Charger**		
Size: A4	**Number:** AA002	**Revision:** B106AA	
Date: 9.06.2020	**Time:** 19:04:00	**Sheet** 5 of 37	
File: C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\Battery Charger.SchDoc			

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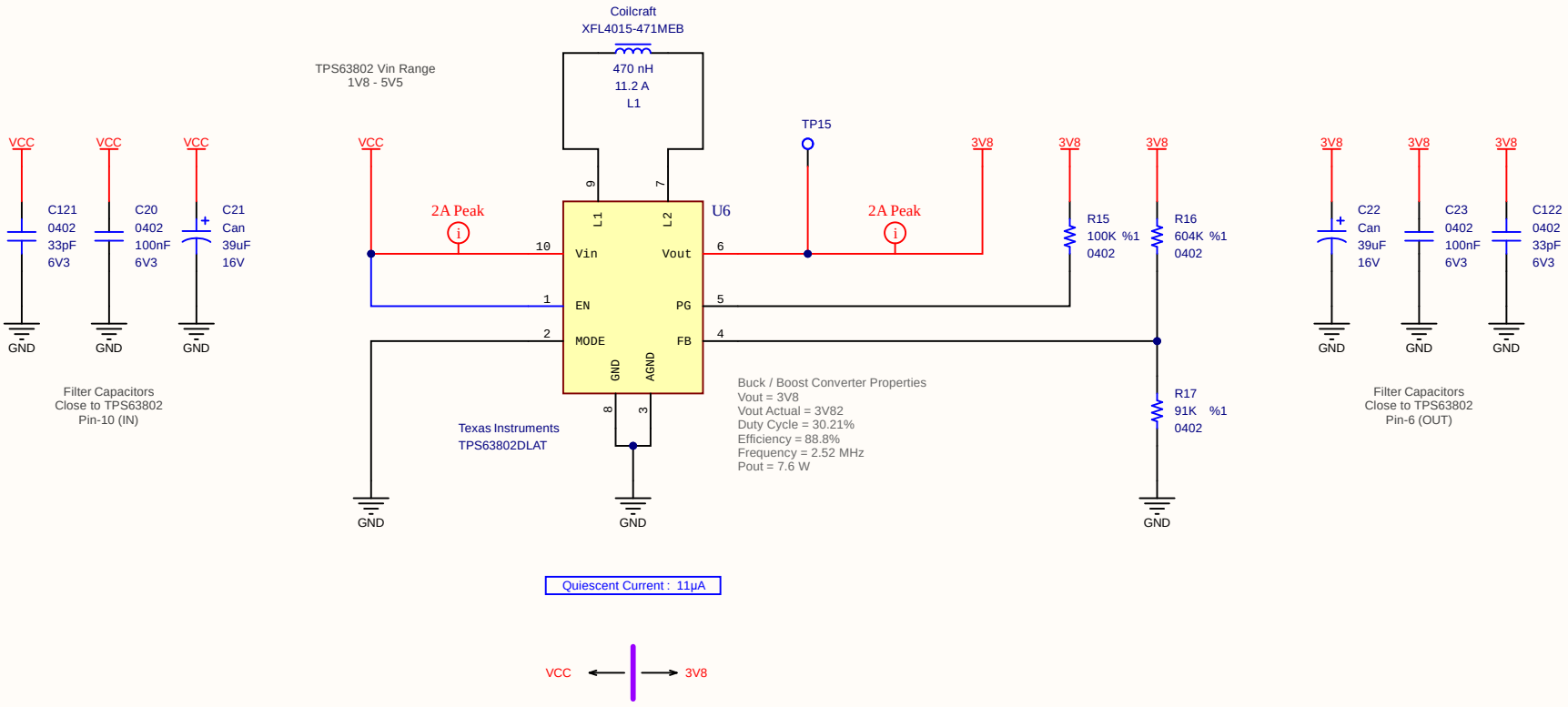

Title	Buck Boost Converter		
Size: A4	Number: AA002	Revision: B106AA	
Date: 9.06.2020	Time: 19:04:01	Sheet 6 of 37	
File: C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\Buck Boost Converter.SchDoc			

A4

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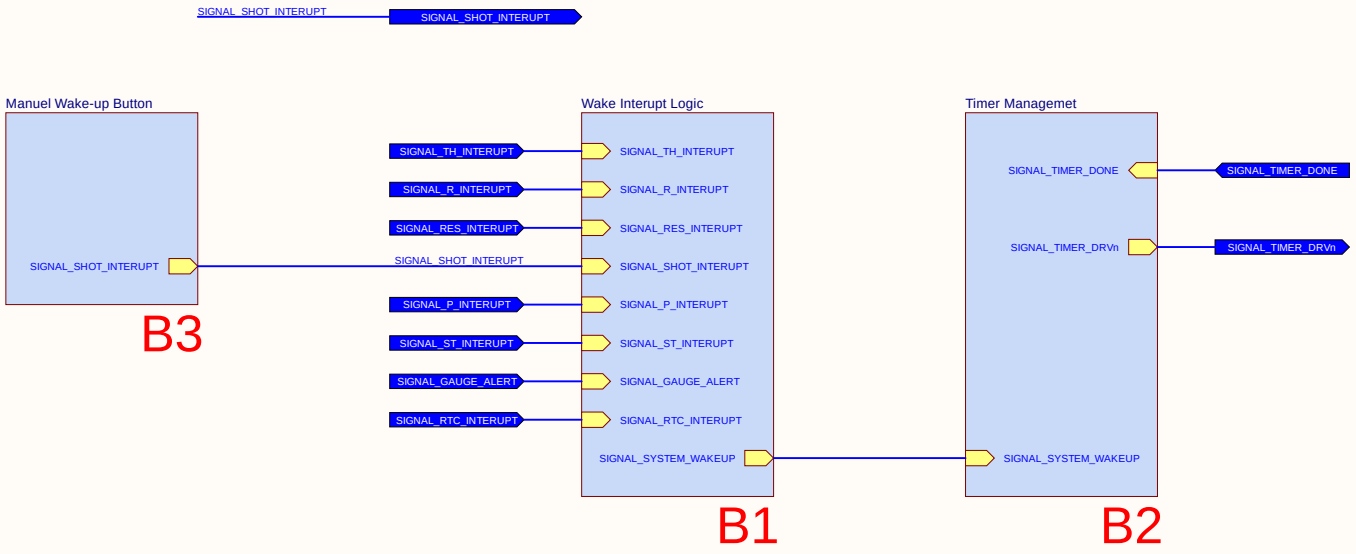
Turkiye



Title	**System Timer Controller**		
Size: A4	**Number:** AA002	**Revision:** B106AA	
Date: 9.06.2020	**Time:** 19:04:01	**Sheet** 7 of 37	
File: C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\System Timer.SchDoc			

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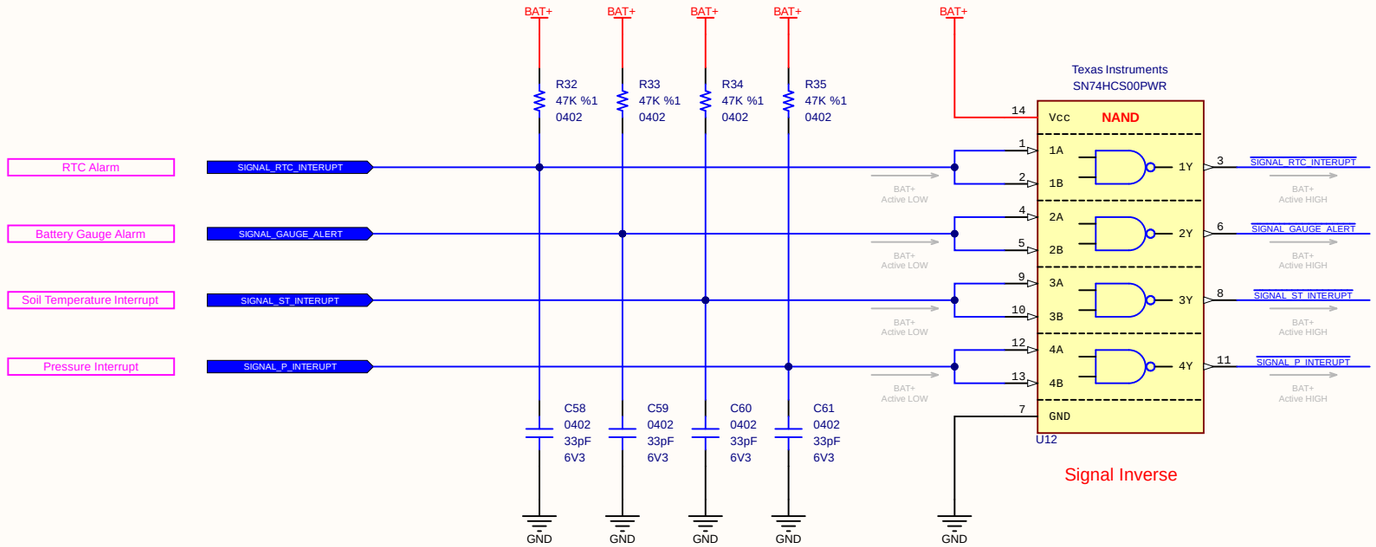
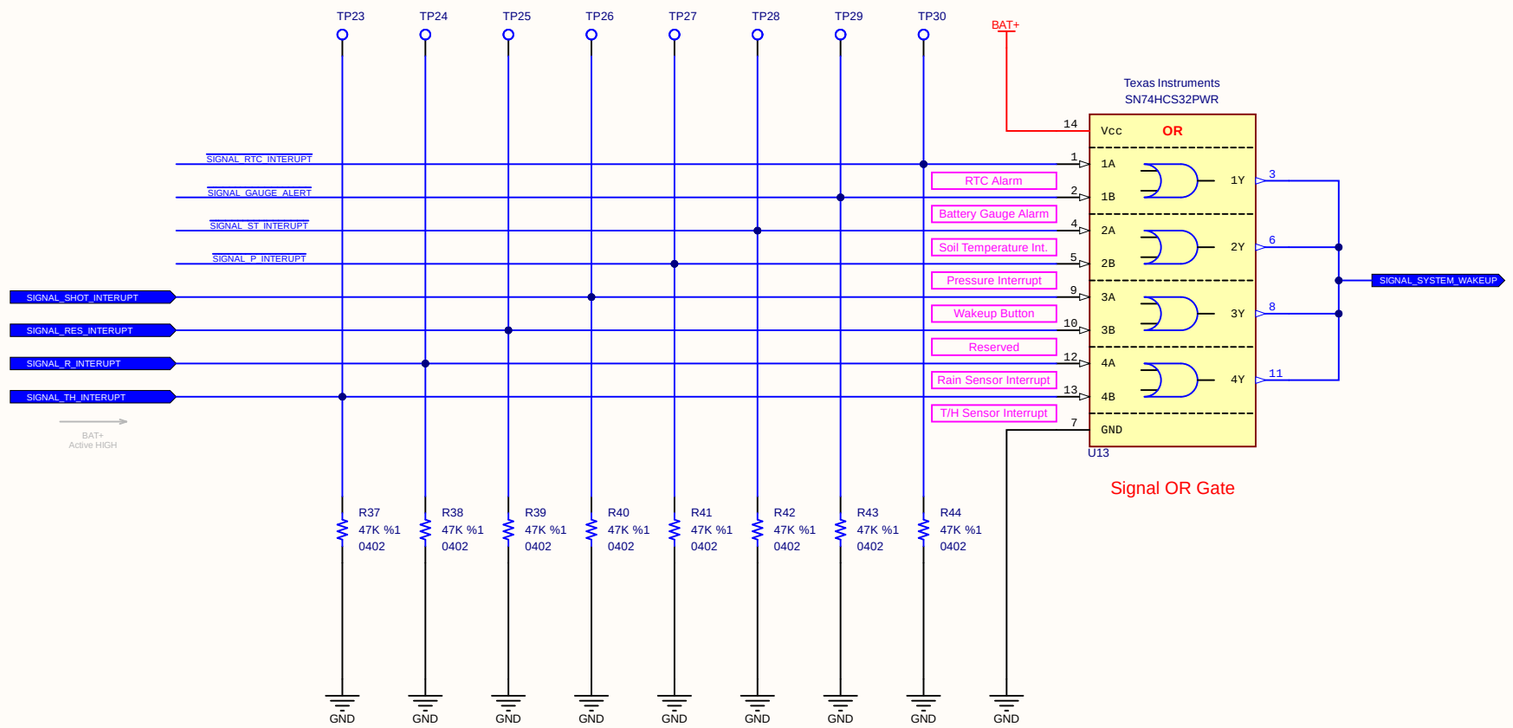
Turkiye





B1

Title	System Wake up Resources Logic Gates		
Size: A3	**Number:** AA002	**Revision:** B106AA	
Date: 9.06.2020	**Time:** 19:04:01	**Sheet** 8 of 37	
File:	C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\System Wake Interupt Logic.SchDoc		

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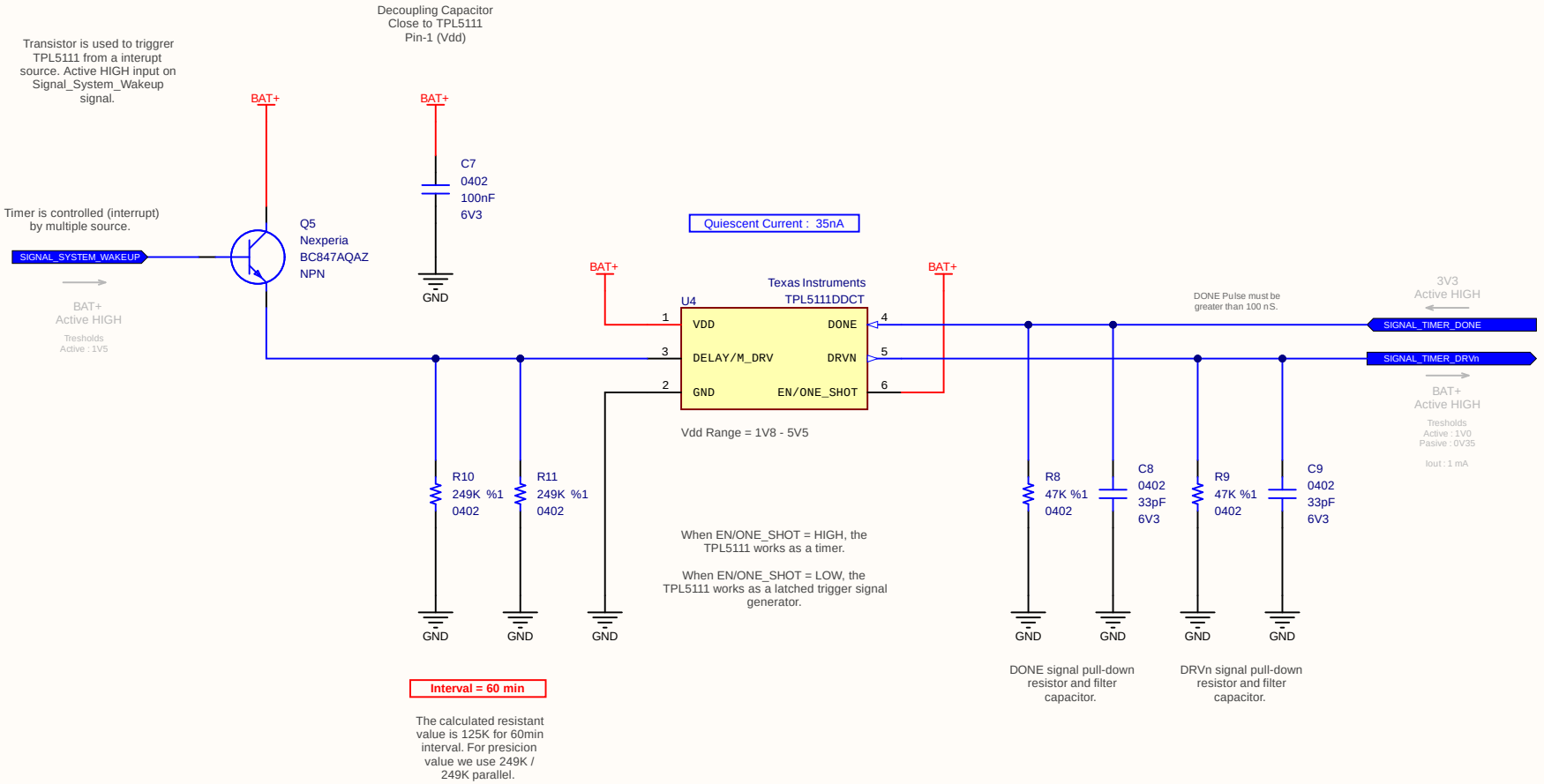

B2

Title	**Sleep Management (Timer)**		
Size: A4	**Number:** AA002	**Revision:** B106AA	
Date: 9.06.2020	**Time:** 19:04:01	**Sheet** 9 of 37	
File:	C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\Time Management.SchDoc		

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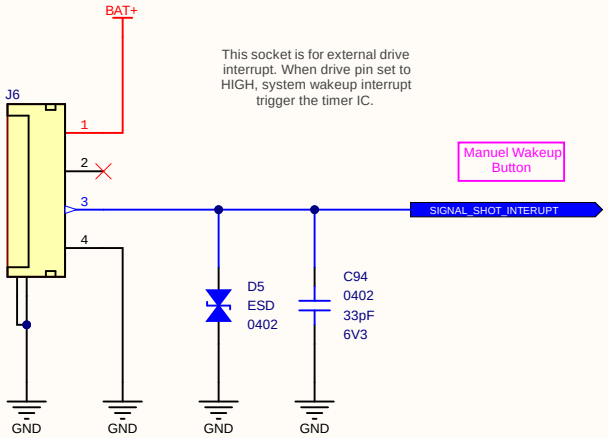
External Wakeup Socket



Socket input ESD protection.

B3

Title	**Manuel Wake-up Button**		
Size: A4	**Number:** AA002	**Revision:** B106AA	
Date: 9.06.2020	**Time:** 19:04:01	**Sheet** 10 of 37	
File:	C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\Manuel Wake-up and Latch.SchDoc		

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Turkiye

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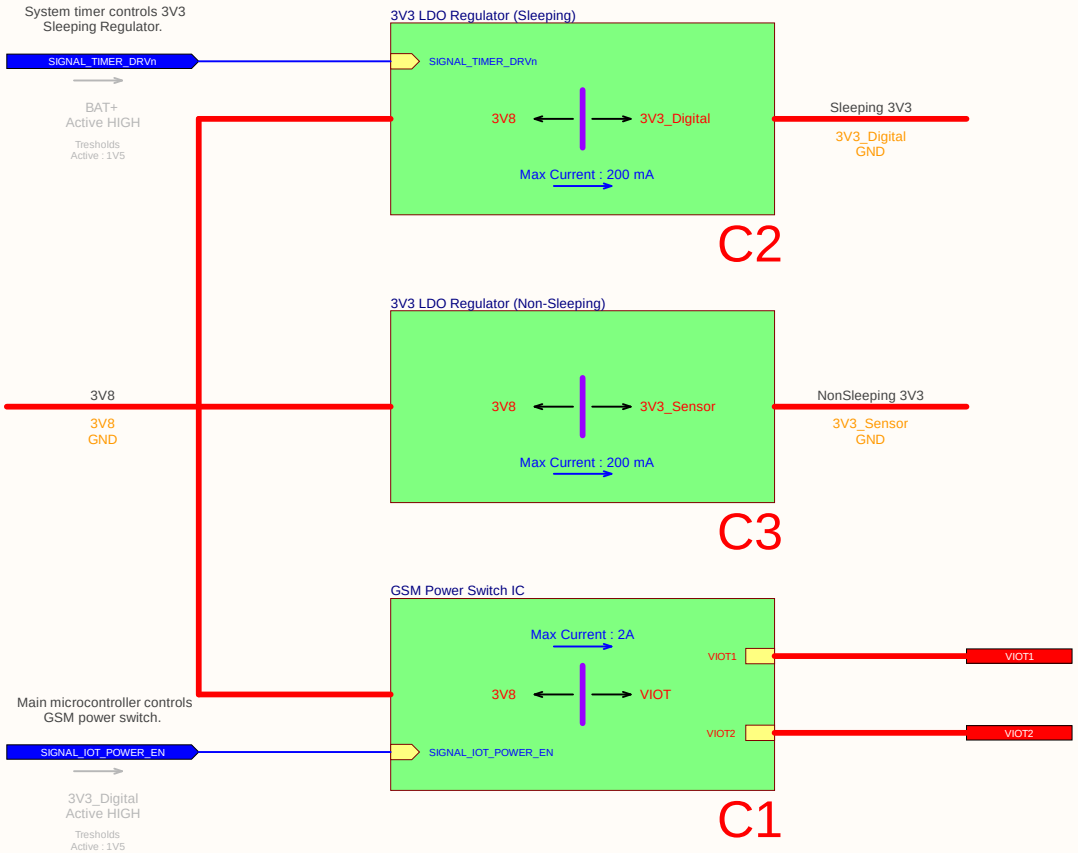

Title	System Power Regulators & GSM IoT Power Switch		
Size: A4	**Number:** AA002	**Revision:** B106AA	
Date: 9.06.2020	**Time:** 19:04:01	**Sheet** 11 of 37	
File:	C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\Power Regulator.SchDoc		

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GSM Modem Power Switch

TPS22917 PFET IC
prefered Vin range :
1V - 5V5

Max Current : 2A

PFET is controlled by
MCU digital pin. Line is
active high.

SIGNAL_IOT_POWER_EN

3V3
Active HIGH

Tresholds
Active : 1V0
Pasive : 0V35

Iout : 1 mA

TP32

3V8

2A Peak

U7

Texas Instruments
TPS22917DBVR

1	VIN	VOUT	6
3	ON/OFF	QOD	5
2	GND	CT	4

Internal ESD
Protection

SIGNAL_IOT_POWER_EN

R19
47K %1
0402

C26
0402
33pF
6V3

GND

PFET enable signal
pull-down resistor and
filter capacitor.

Quiescent Current : 0.1 µA

3V8 → VIOT

The input of the PFET
(power switch) is 3V8. The
output of PFET is VIOT.

VIOT

R18
330R %1
0402

C118
0402
33pF
6V3

C25
0402
100nF
6V3

TP31

By-Pass Capacitor
Close to TPS22917
Pin-6 (Vout)

By-Pass Capacitor
Close to TPS22917
Pin-1 (Vin)

C24
0402
100nF
6V3

C119
0402
33pF
6V3

GSM Module Power Filter

Width Constraint [Pref Width = 20mil Min Width = 20mil Max Width = 30mil]

2A Peak

FB1

Murata Electronics
BLM18EG101TZ1D
0603
2A

C35
0603
10uF
6V3

C36
0402
1uF
6V3

C37
0402
33pF
6V3

VIOT1

VIOT1 : Main Power
Supply for GE910QUAD
(Baseband)

Tantalium Capacitor

FB2

Murata Electronics
BLM18EG101TZ1D
0603
2A

C38
0603
47uF
6V3

C39
0402
1uF
6V3

C40
0402
33pF
6V3

VIOT2

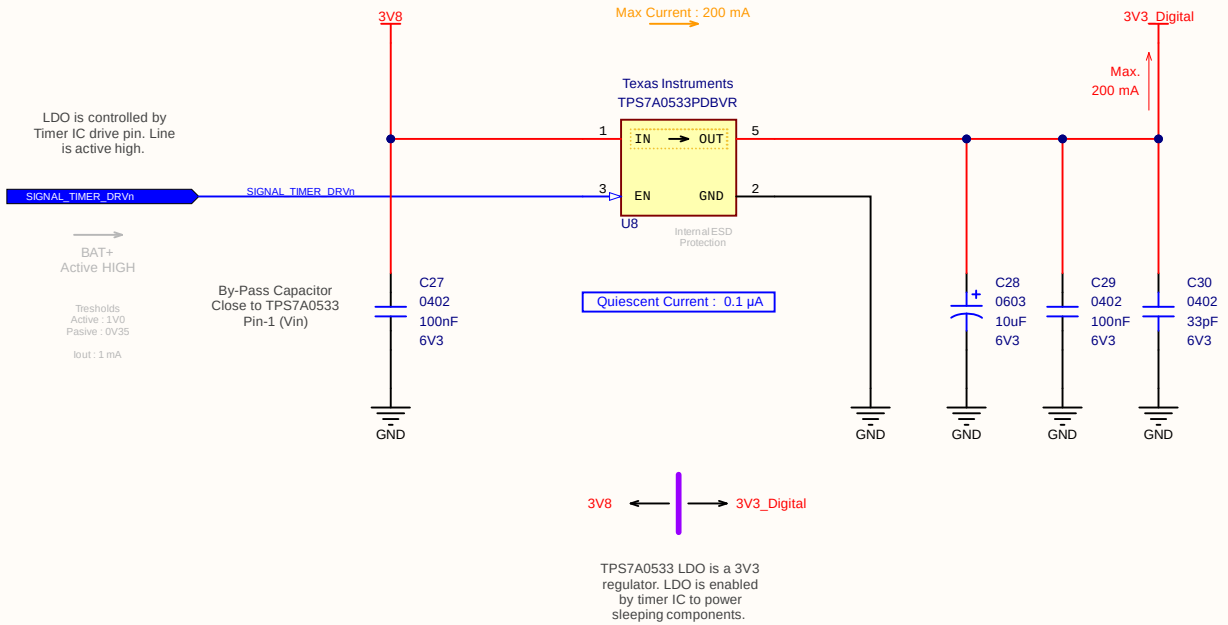
VIOT2 : Main Power
Supply for GE910QUAD
(Radio PA)

Tantalium Capacitor

C1

Title	GSM Module Power On/Off Switch IC & IoT Power Filter		
Size: A4	**Number:** AA002	**Revision:** B106AA	
Date: 9.06.2020	**Time:** 19:04:01	**Sheet** 12 of 37	
File: C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\GSM Power On-Off Switch IC.SchDoc			

Ovoo Electronics
Küçük İhsaniye Mah.
Mızraklı Sok. No:15
Meram / Konya
Turkiye



C2

Title	3V3 LDO Voltage Regulator (Sleeping)		
Size: A4	**Number:** AA002	**Revision:** B106AA	
Date: 9.06.2020	**Time:** 19:04:01	**Sheet** 13 of 37	
File: C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\3V3 LDO Regulator (Sleeping).SchDoc			

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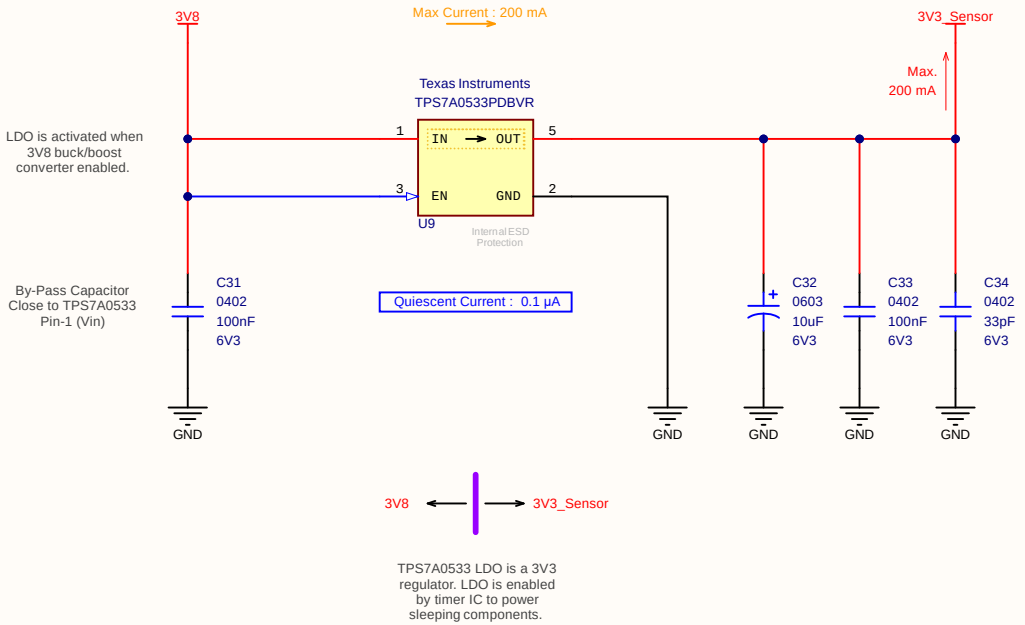
Turkiye



C3

Title	3V3 LDO Voltage Regulator (NonSleeping)		
Size: A4	**Number:** AA002	**Revision:** B106AA	
Date: 9.06.2020	**Time:** 19:04:01	**Sheet** 14 of 37	
File:	C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\3V3 LDO Regulator (NonSleeping).SchDoc		

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Mızraklı Sok. No:15
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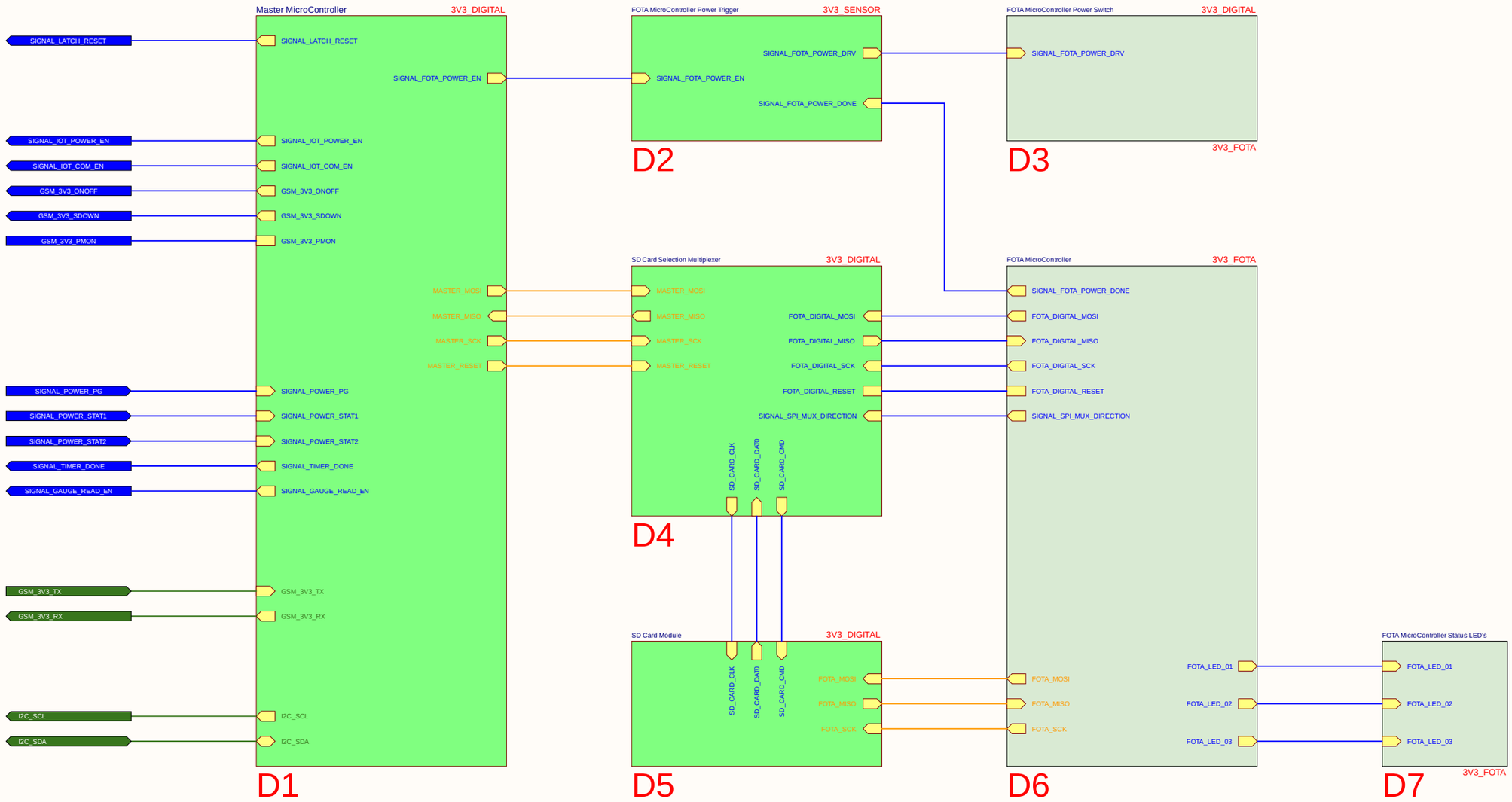
Turkiye

OVOO



Title	Main Microcontroller & FOTA Microcontroller		
Size: A3	**Number:** AA002	**Revision:** B106AA	
Date: 9.06.2020	**Time:** 19:04:01	**Sheet** 15 of 37	
File:	C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\Microcontroller.SchDoc		

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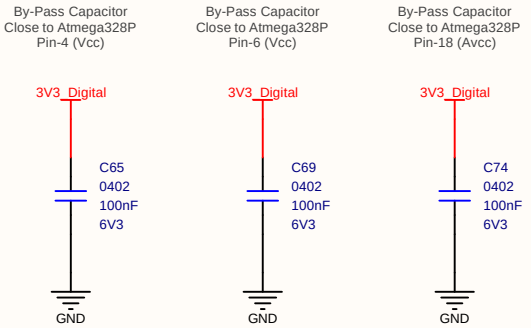
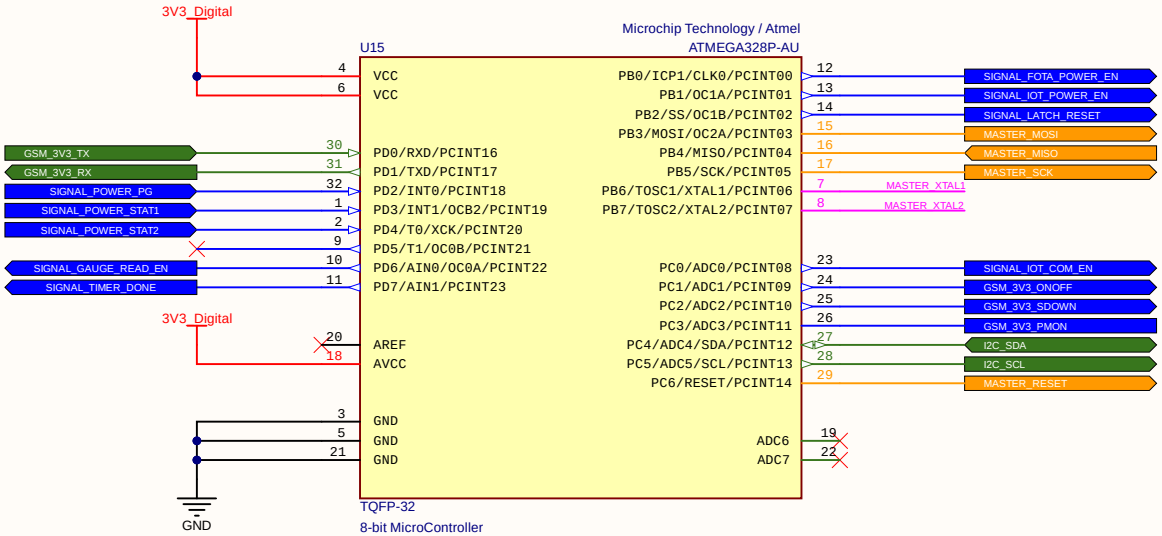
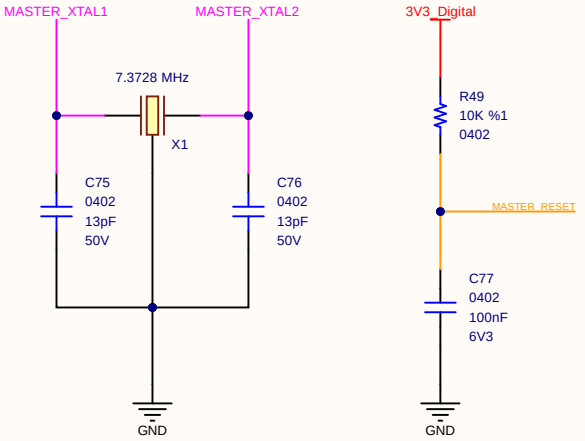
B106AA Module have two on-board MCU.

One is master microcontroller for sensor measurement, handling data and communicate with GSM modem (UART). We use ATMEGA328P-AU as master MCU with 7.3728 Mhz external crystal and 3V3 voltage level.







Master MCU is working at 7.3728 Mhz for minimise UART communication errors.

Master MCU Reset Line. Pull-up.

D1

Title	Master MicroController		
Size: A4	Number: AA002	Revision: B106AA	
Date: 9.06.2020	Time: 19:04:01	Sheet 16 of 37	
File: C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\Master MicroController.SchDoc			

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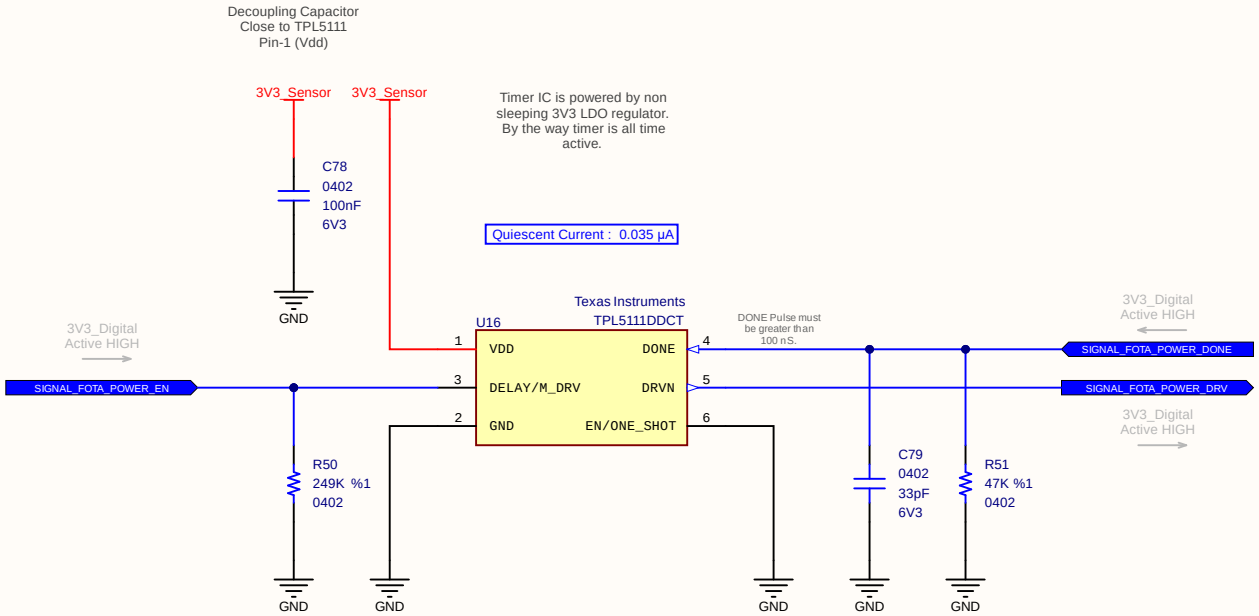

D2

Title	FOTA MicroController Latched Power Trigger		
Size: A4	**Number:** AA002	**Revision:** B106AA	
Date: 9.06.2020	**Time:** 19:04:01	**Sheet** 17 of 37	
File:	C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\FOTA MicroController Power Trigger.SchDoc		

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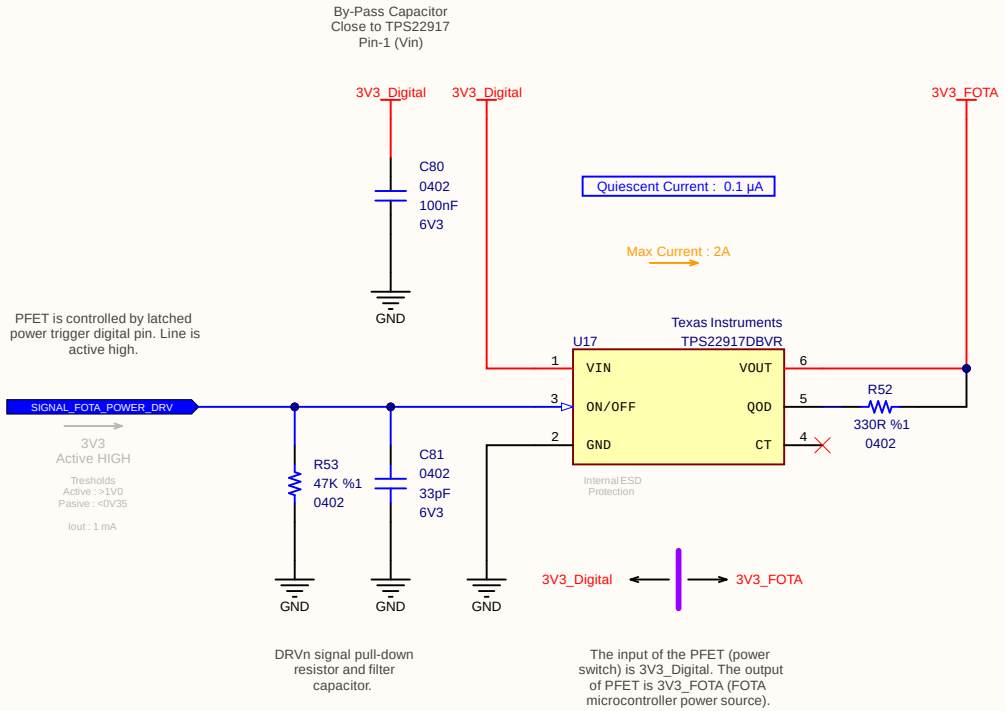
Turkiye

OVOO



D3

Title	FOTA MicroController Power Switch		
Size: A4	**Number:** AA002	**Revision:** B106AA	
Date: 9.06.2020	**Time:** 19:04:01	**Sheet** 18 of 37	
File:	C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\FOTA MicroController Power Switch.SchDoc		

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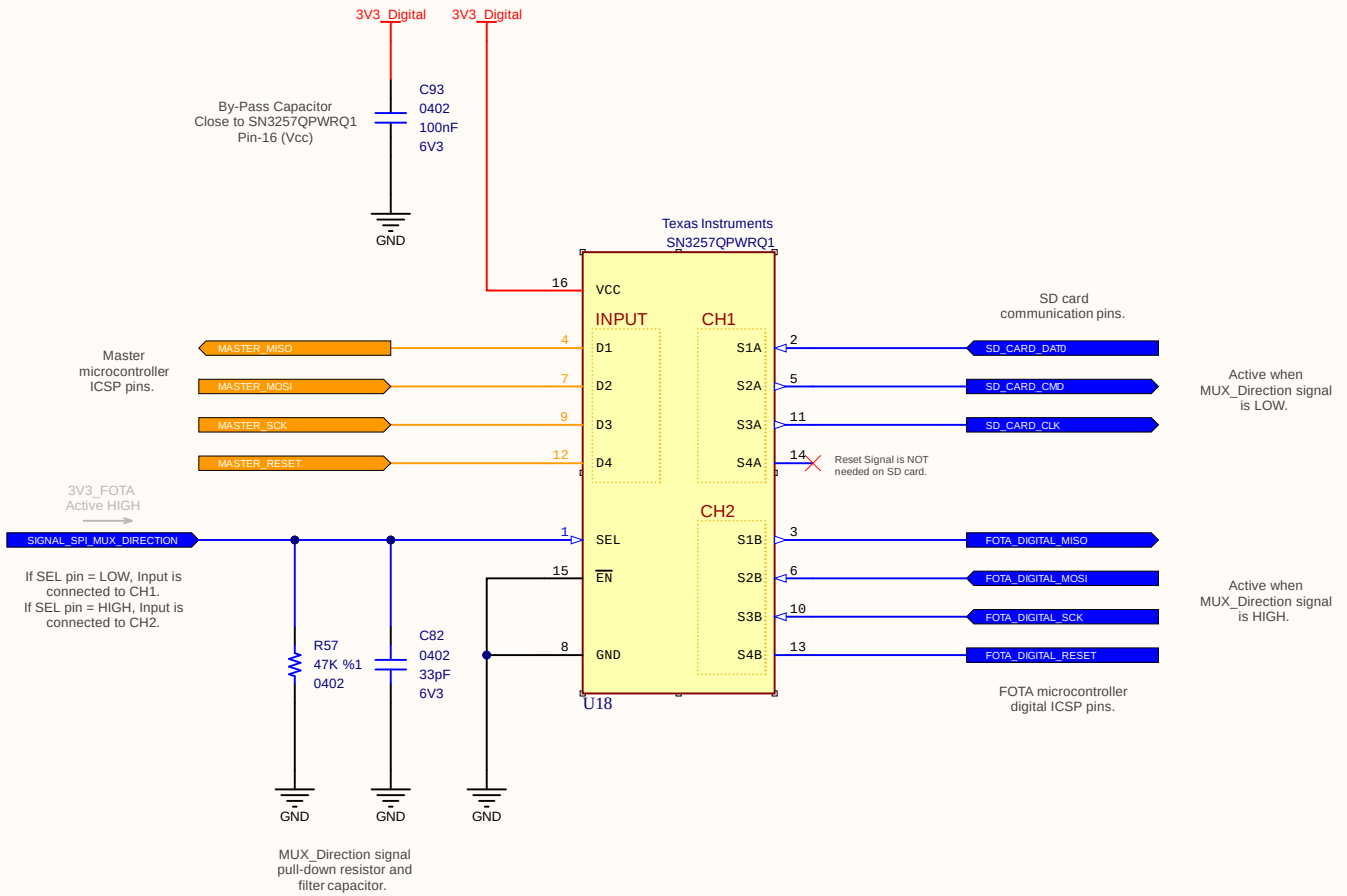
Turkiye

OVOO



D4

Title	SD/ICSP Selection Multiplexer		
Size: A4	**Number:** AA002	**Revision:** B106AA	
Date: 9.06.2020	**Time:** 19:04:01	**Sheet** 19 of 37	
File:	C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\SD Card Selection Multiplexer.SchDoc		

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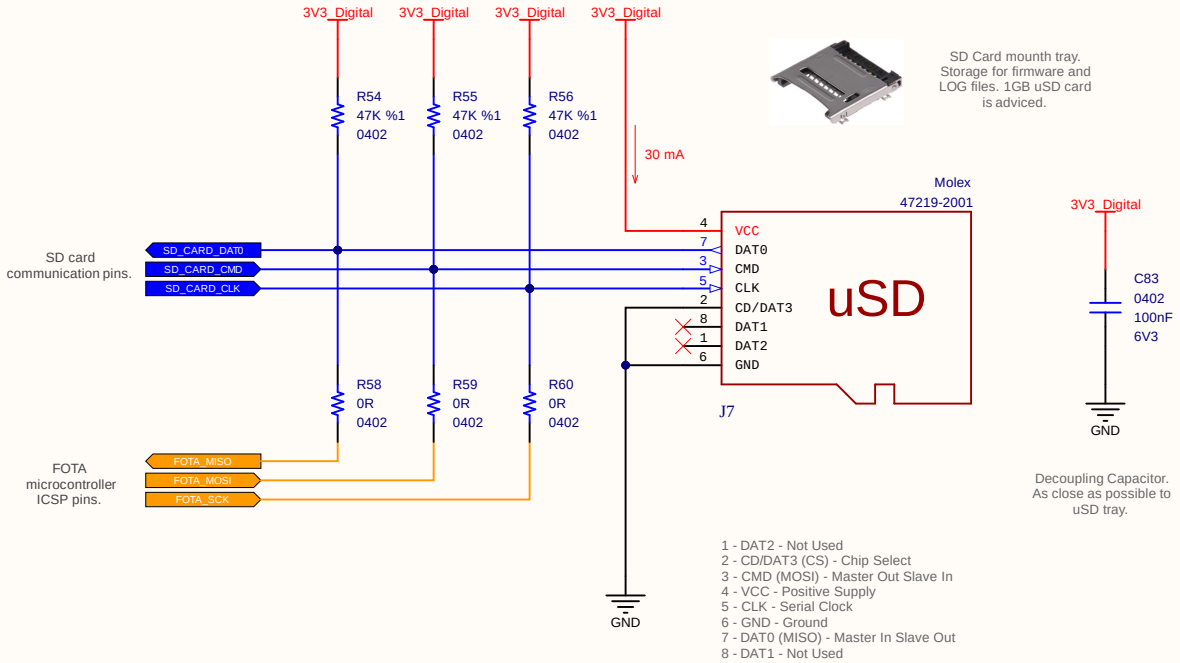
Turkiye

OVOO



D5

Title	**Micro SD Card Module**		
Size: A4	**Number:** AA002	**Revision:** B106AA	
Date: 9.06.2020	**Time:** 19:04:01	**Sheet** 20 of 37	
File: C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\SD Card Module.SchDoc			

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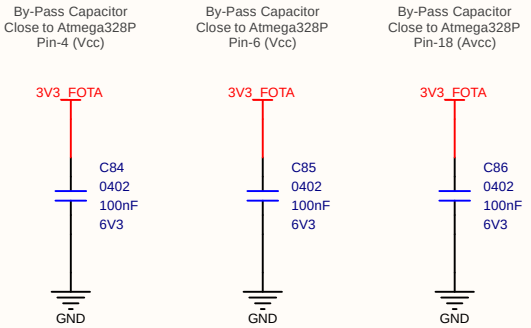
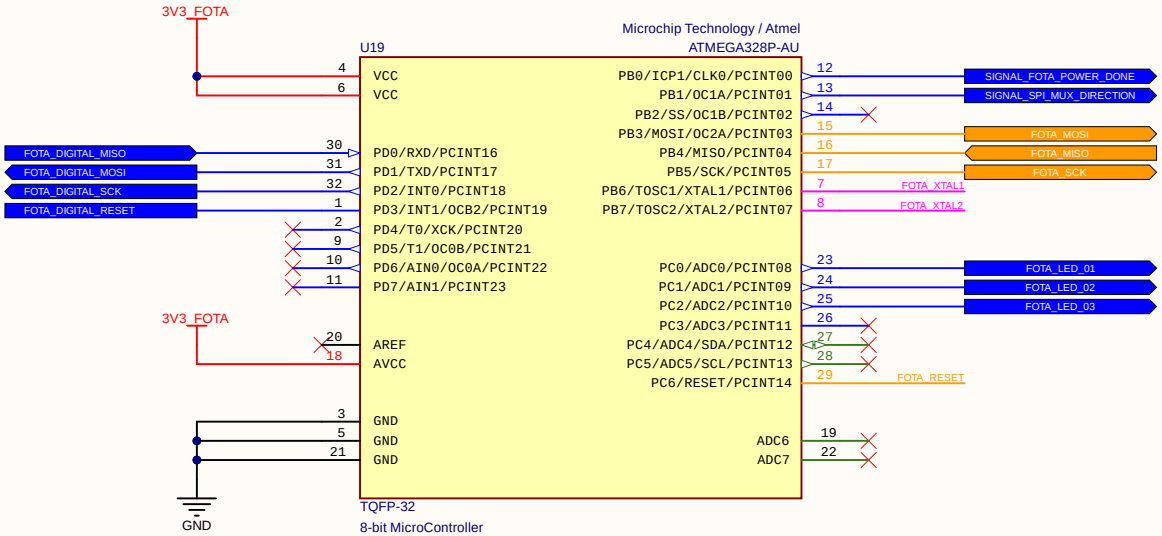
Mızraklı Sok. No:15
Meram / Konya
Turkiye

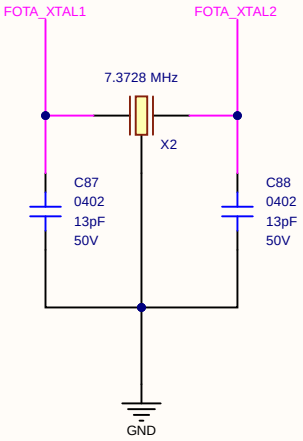
OVOO

B106AA Module have two on-board MCU.

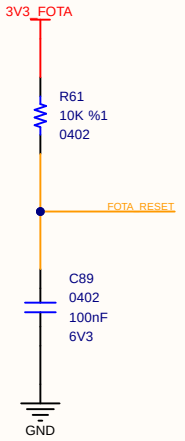
Second microcontroller is a firmware over the air controller. This MCU is burn firmware to the main MCU.







FOTA MCU is working at 7.3728 Mhz.



FOTA MCU Reset Line. Pull-up.

D6

Title	FOTA MicroController		
Size: A4	Number: AA002	Revision: B106AA	
Date: 9.06.2020	Time: 19:04:01	Sheet 21 of 37	
File: C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\FOTA MicroController.SchDoc			

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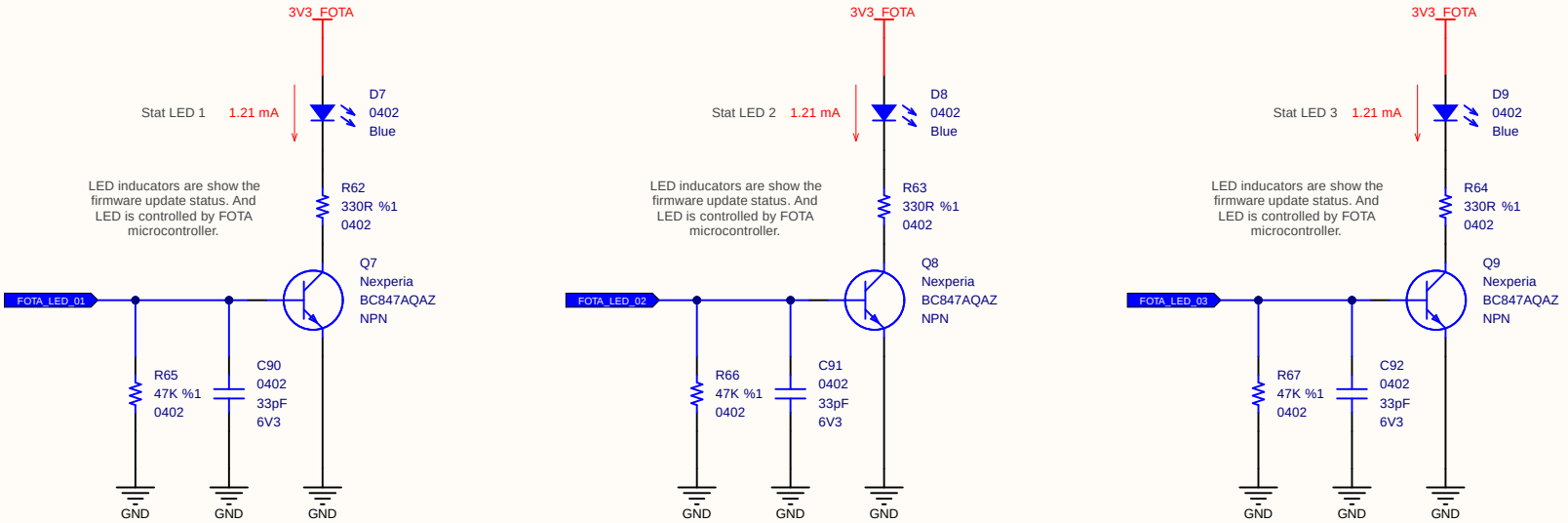

D7

Title	FOTA Microcontroller Status LED's		
Size: A4	**Number:** AA002	**Revision:** B106AA	
Date: 9.06.2020	**Time:** 19:04:01	**Sheet** 22 of 37	
File:	C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\FOTA MicroController Status LEDs.SchDoc		

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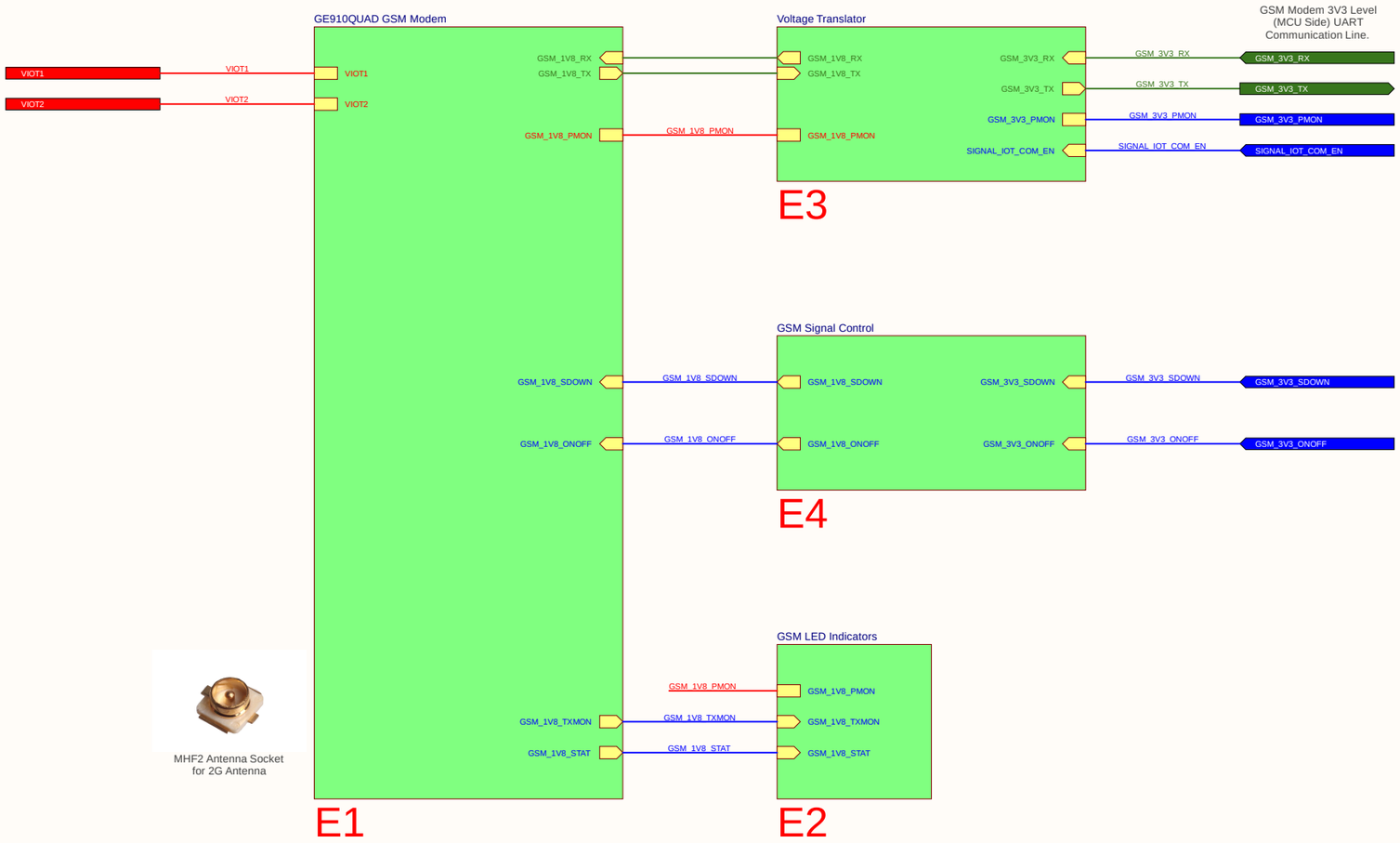
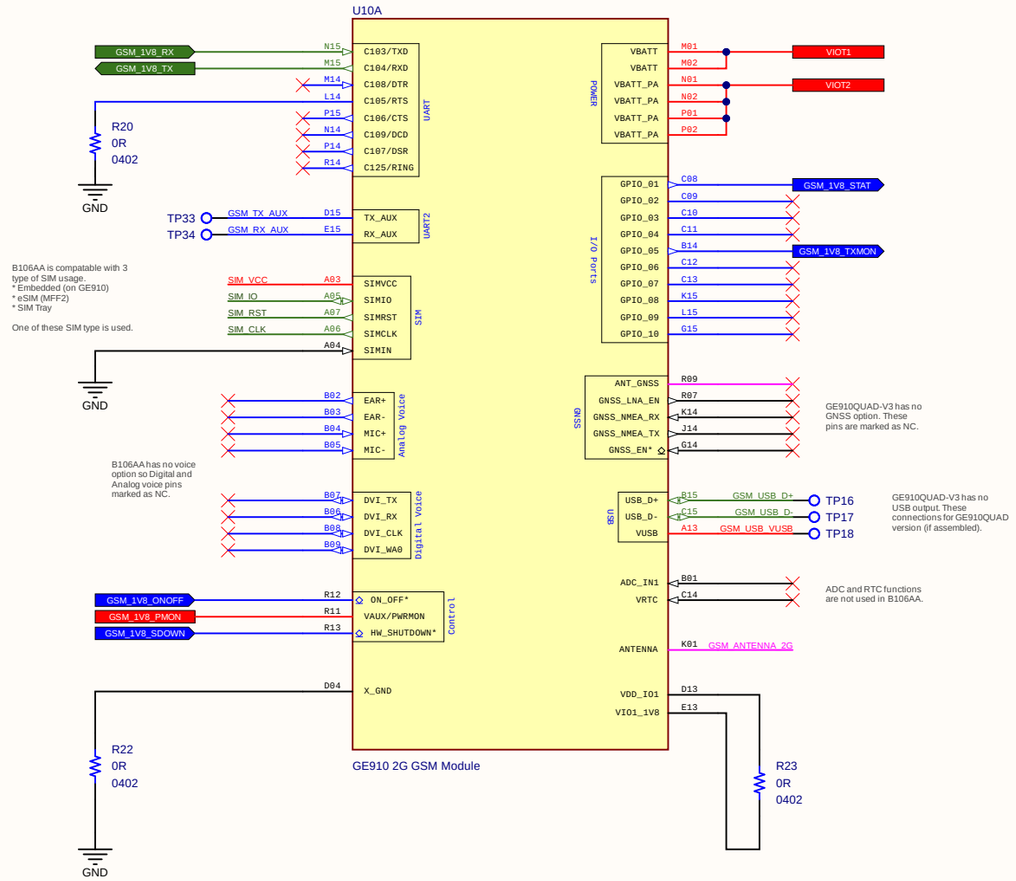
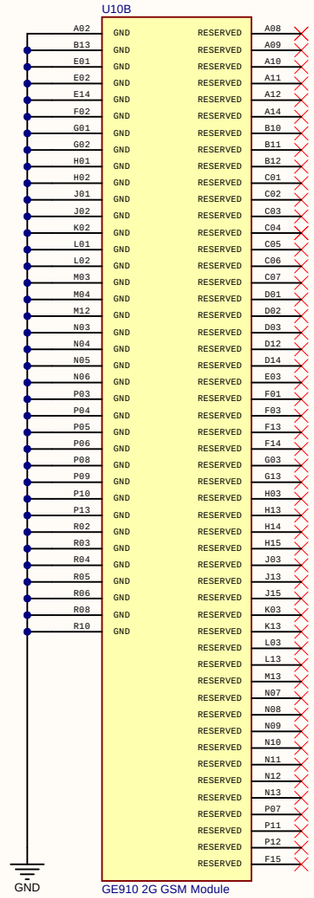
Turkiye



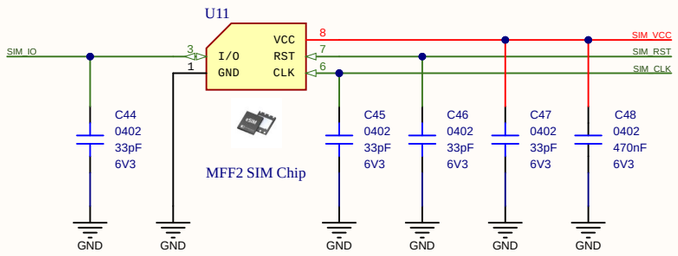
MHF2 Antenna Socket
for 2G Antenna

Title GSM IoT Block Diagram			**Ovoo Electronics** Küçük İhsaniye Mah. Muzaklı Sok. No:15 Meram / Konya Turkiye
Size: A3	**Number:** AA002	**Revision:** B106AA	
Date: 9.06.2020	**Time:** 19:04:02	**Sheet** 23 of 37	
File: C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\GSM IoT.SchDoc			





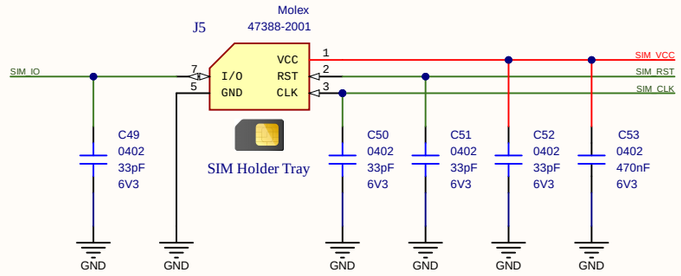
OnBoard eSIM Chip



External SIM (MFF2) is only assembled when GE910QUAD-V3 (not simwise) module is assembled.

SIM_VCC capacitor is chosed according Telit SIM integration guide.

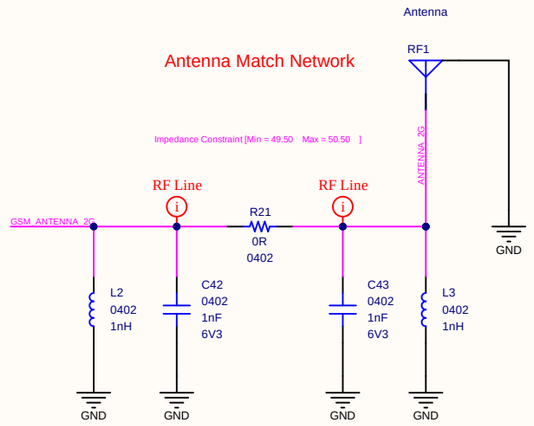
OnBoard Sim Tray



SIM Tray is only assembled when Simwise or E-Sim is not used.

SIM_VCC capacitor is chosed according Telit SIM integration guide.

Antenna Match Network



RF Matching network circuit is not placed on production. Only 0R resistor is placed.

E1

Title	GE910 GSM Modem & SIM		
Size: A3	**Number:** AA002	**Revision:** B106AA	
Date: 9.06.2020	**Time:** 19:04:02	**Sheet** 24 of 37	
File:	C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\GE910QUAD Modem.SchDoc		

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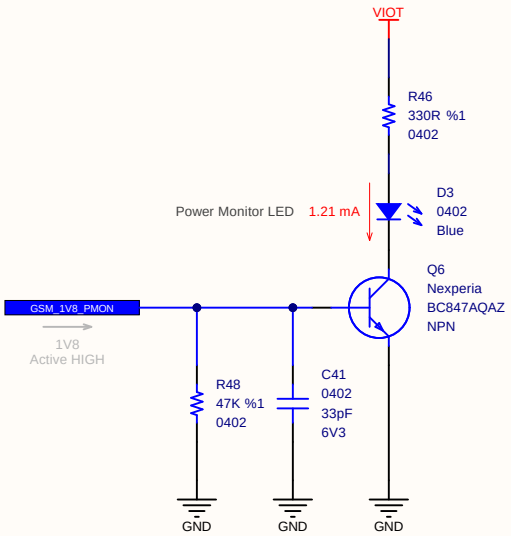
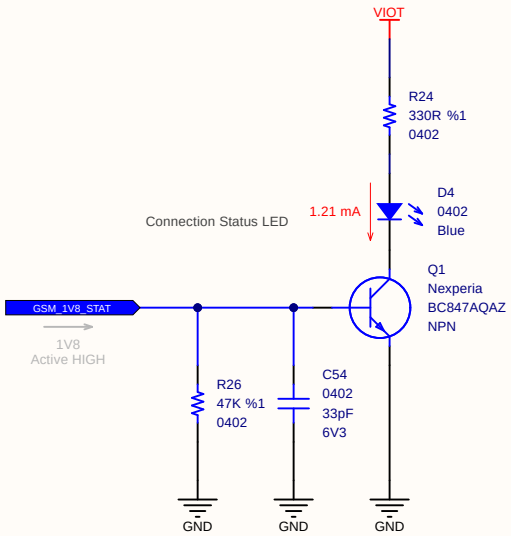
GSM Power Monitor LED



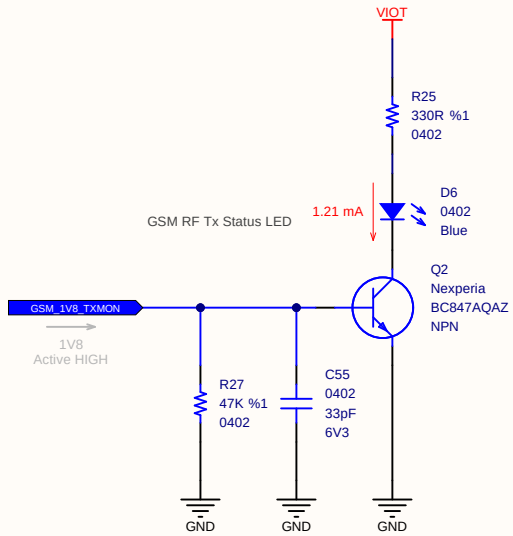
LED activates when GSM modem powered. This LED is a active HIGH inducator.

GSM Connection Status LED



LED activates according to connection. Fast blinking LED is indicates searching GSM connection. Slow blinking LED is indicates GSM connection is established.

RF Tx Monitor LED



LED activates when GSM modem sending data to internet.

E2

Title	**GSM Modem Signal Indicator LED's**		
Size: A4	**Number:** AA002	**Revision:** B106AA	
Date: 9.06.2020	**Time:** 19:04:02	**Sheet** 25 of 37	
File:	C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\GSM LED Indicators.SchDoc		

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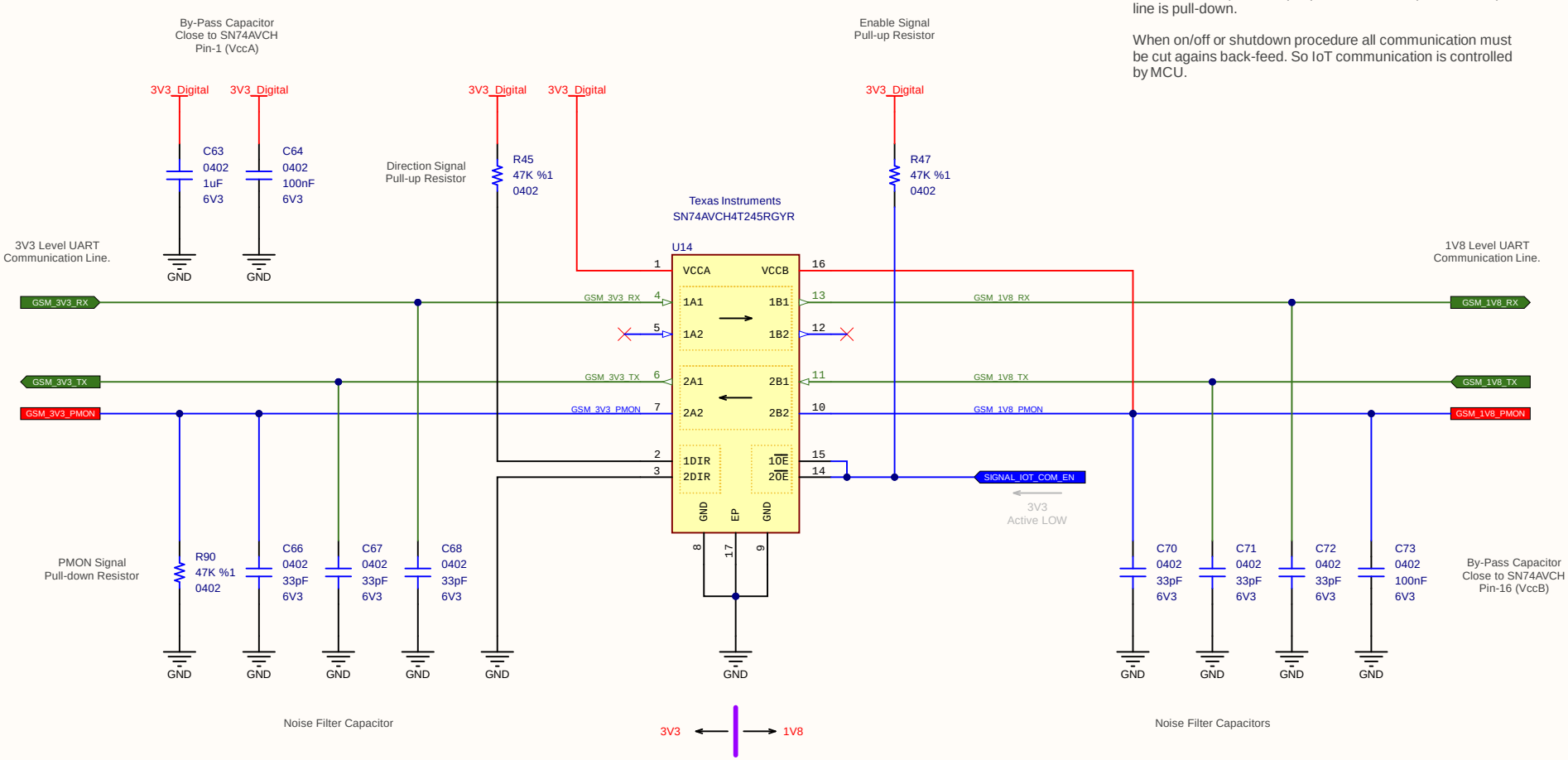
BiDirectional Level Shifter

Telit GE910QUAD GSM Modem communicates at 1V8 voltage level. This level is translated to 3V3 level with this level shifter.

Power Monitor pin is a input pin at MCU side (active HIGH) so line is pull-down.

When on/off or shutdown procedure all communication must be cut agains back-feed. So IoT communication is controlled by MCU.



E3

Title	3V3 - 1V8 Voltage Level Translator		
Size: A4	**Number:** AA002	**Revision:** B106AA	
Date: 9.06.2020	**Time:** 19:04:02	**Sheet** 26 of 37	
File:	C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\Bidirectional Voltage Translator.SchDoc		

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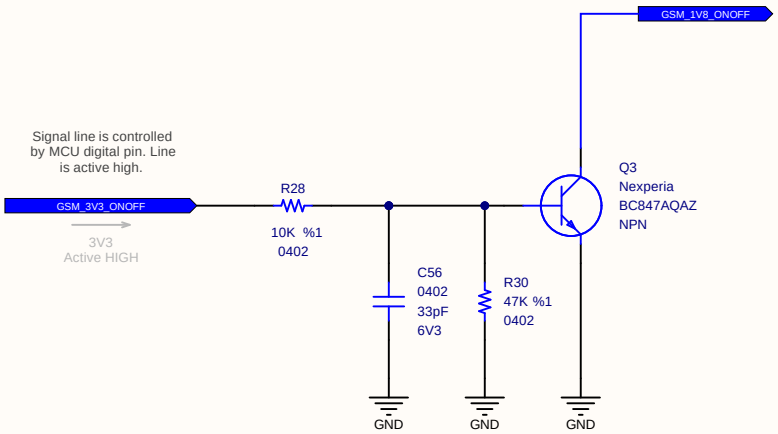
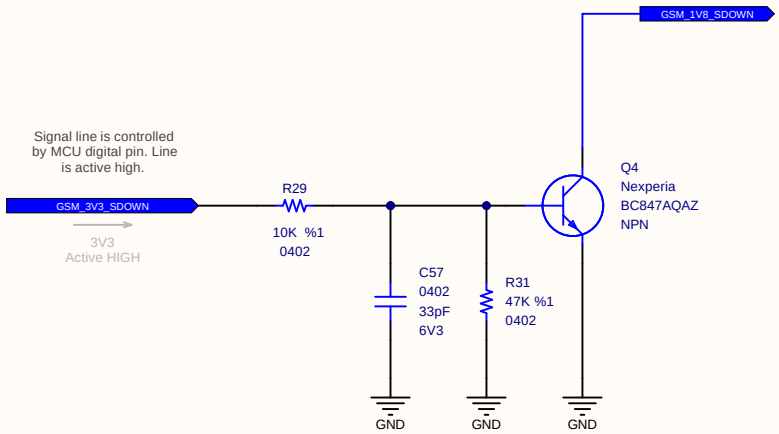
GSM Module On/Off Signal



GSM Module Shut Down Signal



GE910 GSM Modem have an On/Off pin for power on. To turn on the GE910 the pad ON-OFF* must be tied low for at least 5 seconds and then released. The maximum current that can be drained from the ON-OFF* pad is 0.2mA. This pin is a open collector pin so tie this pin to GND via a transistor.

GE910QUAD GSM modem has a "Shut Down" pin for unconditional shut down. The unconditional hardware shutdown must always be implemented on the boards and the software must use it as an emergency exit procedure. To turn off modem tie this pin to GND for 200mS. This pin is a open collector pin so tie this pin to GND via a transistor.

E4

Title	GSM Control Signal Management		
Size: A4	**Number:** AA002	**Revision:** B106AA	
Date: 9.06.2020	**Time:** 19:04:02	**Sheet** 27 of 37	
File:	C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\GSM Signal Control.SchDoc		

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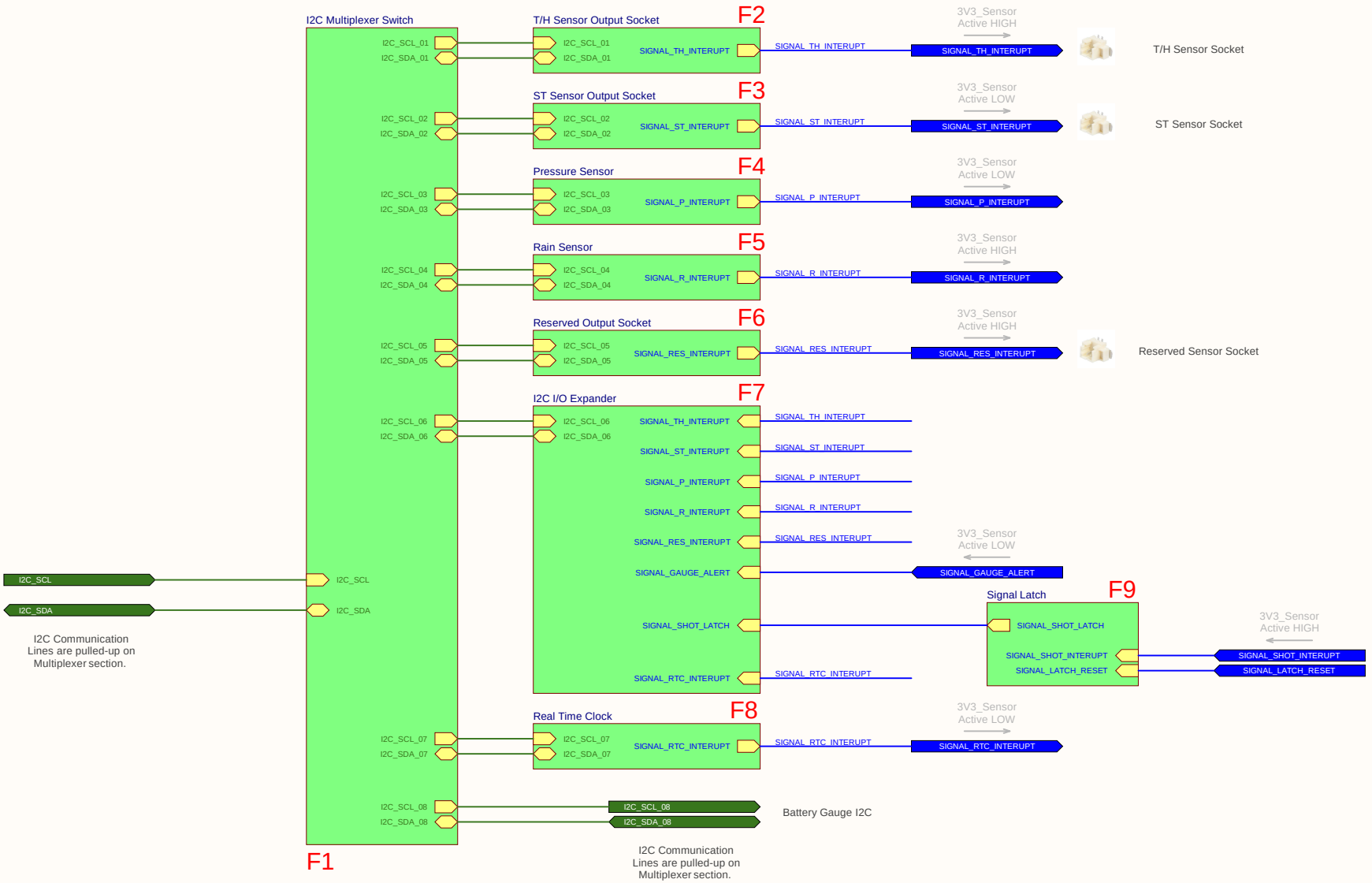
Turkiye



Title	I2C Sensor Network		
Size: A4	**Number:** AA002	**Revision:** B106AA	
Date: 9.06.2020	**Time:** 19:04:02	**Sheet** 28 of 37	
File:	C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\I2C Sensor Network.SchDoc		

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Decoupling Capacitor.
As close as possible to
TCA9547 pin-24.

I2C 3V3 Pull-up
Resistors.

Power Consumption : 15 µA

Texas Instruments
TCA9548APWR

C109
0402
100nF
6V3

R36
10K %1
0402

R68
10K %1
0402

R89
10K %1
0402

C110
0402
100nF
6V3

R69 R70 R71 R72 R73 R74 R75 R76 R77 R78 R79 R80 R81 R82 R83 R84
10K %1
0402

3V3_Digital

GND

I2C_SCL

I2C_SDA

VCC
SCL
SDA
RESET
A0
A1
A2
GND
IN
Adr.

CH0 SCL0 SDA0
CH1 SCL1 SDA1
CH2 SCL2 SDA2
CH3 SCL3 SDA3
CH4 SCL4 SDA4
CH5 SCL5 SDA5
CH6 SCL6 SDA6
CH7 SCL7 SDA7

I2C_SCL_01 I2C_SDA_01 T/H Sensor
I2C_SCL_02 I2C_SDA_02 ST Sensor
I2C_SCL_03 I2C_SDA_03 P Sensor
I2C_SCL_04 I2C_SDA_04 R Sensor
I2C_SCL_05 I2C_SDA_05 RES Sensor
I2C_SCL_06 I2C_SDA_06 I/O Expander
I2C_SCL_07 I2C_SDA_07 RTC
I2C_SCL_08 I2C_SDA_08 Battery Gauge

U20

Vcc Range = 1V65 - 5V5

F1

Title	I2C 8 Channel Multiplexer		
Size: A3	**Number:** AA002	**Revision:** B106AA	
Date: 9.06.2020	**Time:** 19:04:02	**Sheet** 29 of 37	
File:	C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\I2C Multiplexer.SchDoc		

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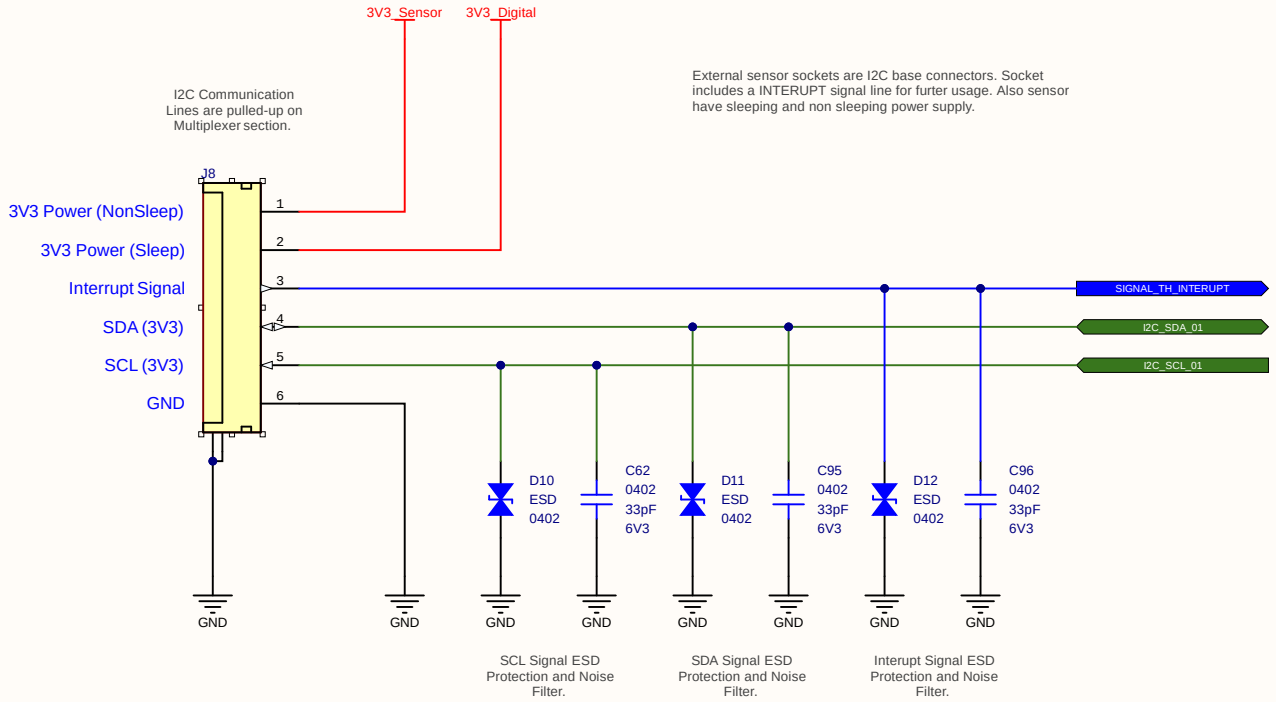
Turkiye



F2

Title	Air Temperature & Air Humidity Sensor Output Socket		
Size: A4	**Number:** AA002	**Revision:** B106AA	
Date: 9.06.2020	**Time:** 19:04:02	**Sheet** 30 of 37	
File:	C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\TH Sensor Output Socket.SchDoc		

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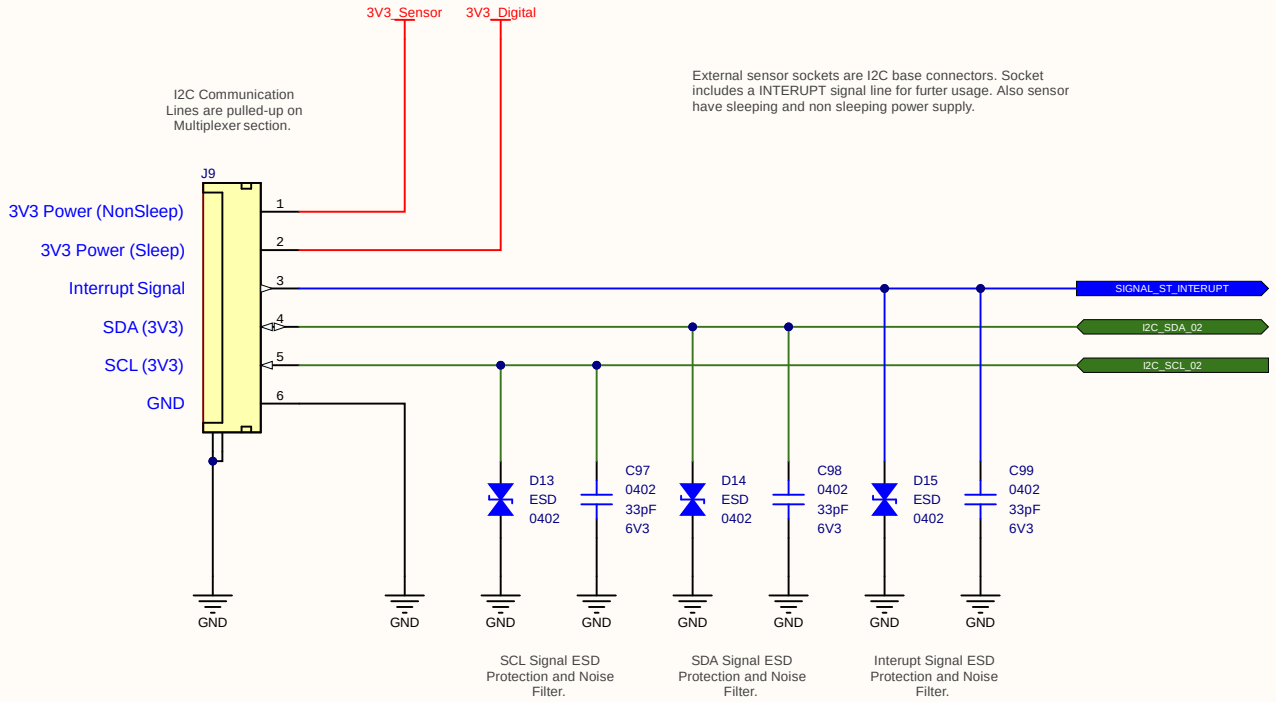
Mızraklı Sok. No:15
Meram / Konya
Turkiye



F3

Title	Soil Temperature Sensor Output Socket		
Size: A4	**Number:** AA002	**Revision:** B106AA	
Date: 9.06.2020	**Time:** 19:04:02	**Sheet** 31 of 37	
File: C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\ST Sensor Output Socket.SchDoc			

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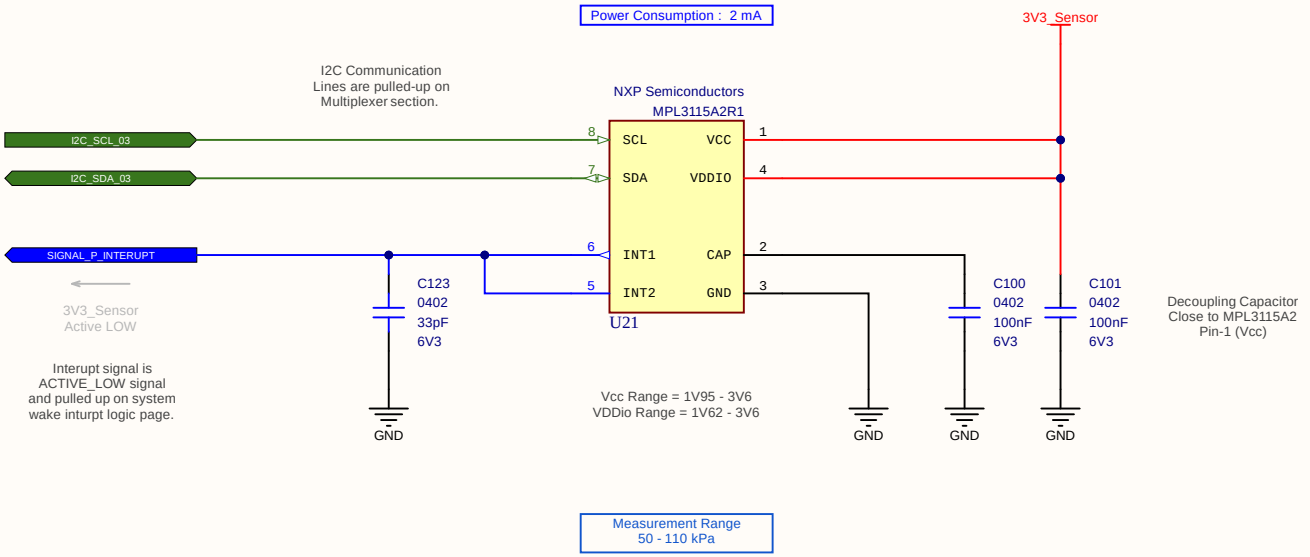
Turkiye

OVOO



F4

Title	**Pressure Sensor**		
Size: A4	**Number:** AA002	**Revision:** B106AA	
Date: 9.06.2020	**Time:** 19:04:02	**Sheet** 32 of 37	
File: C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\Pressure Sensor.SchDoc			

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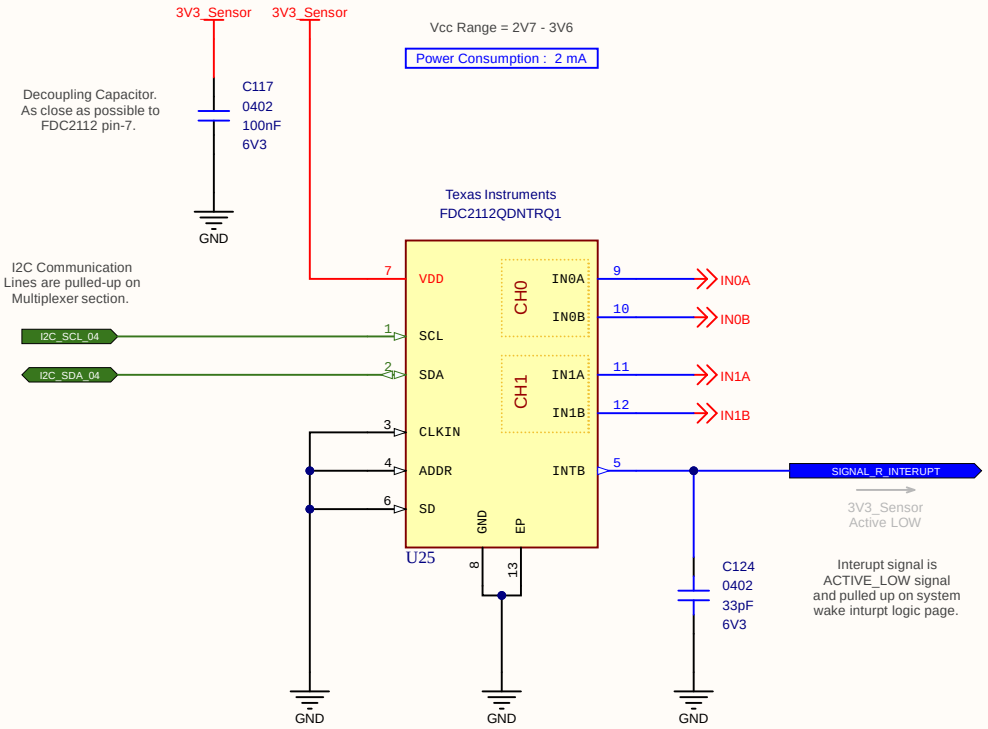
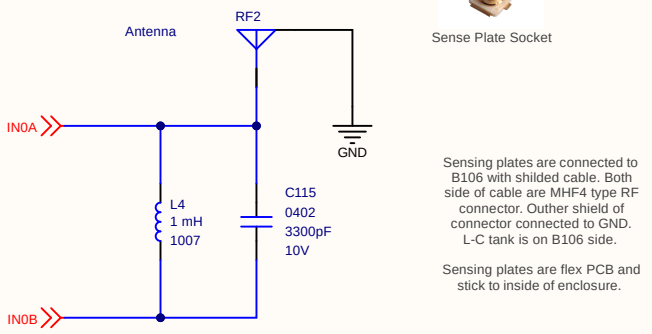
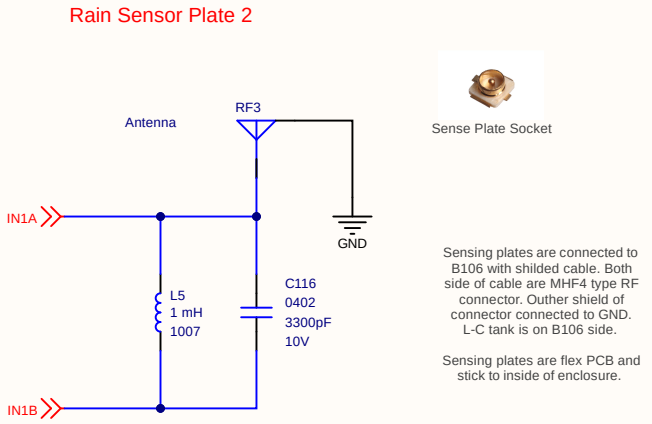
Turkiye







F5

Title	Capacitive Rain Sensor		
Size: A4	**Number:** AA002	**Revision:** B106AA	
Date: 9.06.2020	**Time:** 19:04:02	**Sheet** 33 of 37	
File:	C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\Capacitive Rain Sensor.SchDoc		

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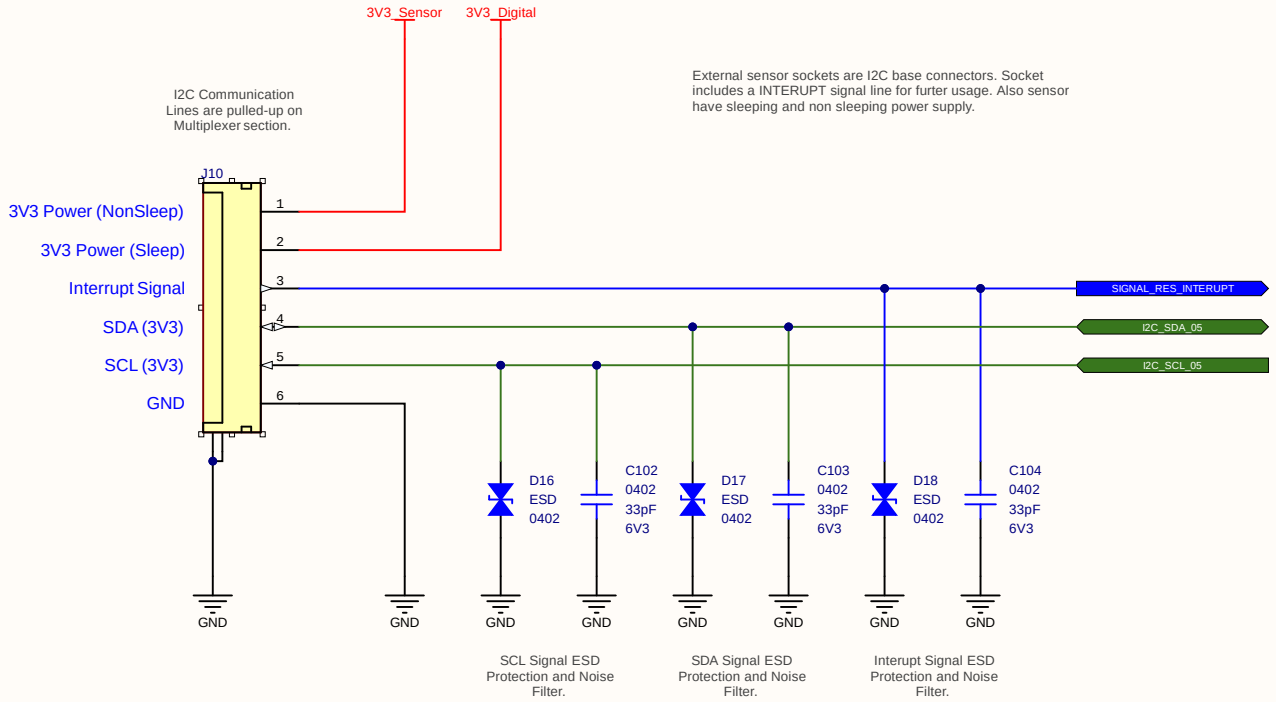
Turkiye



F6

Title	Reserved Sensor Output Socket		
Size: A4	**Number:** AA002	**Revision:** B106AA	
Date: 9.06.2020	**Time:** 19:04:02	**Sheet** 34 of 37	
File: C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\Reserved Sensor Output Socket.SchDoc			

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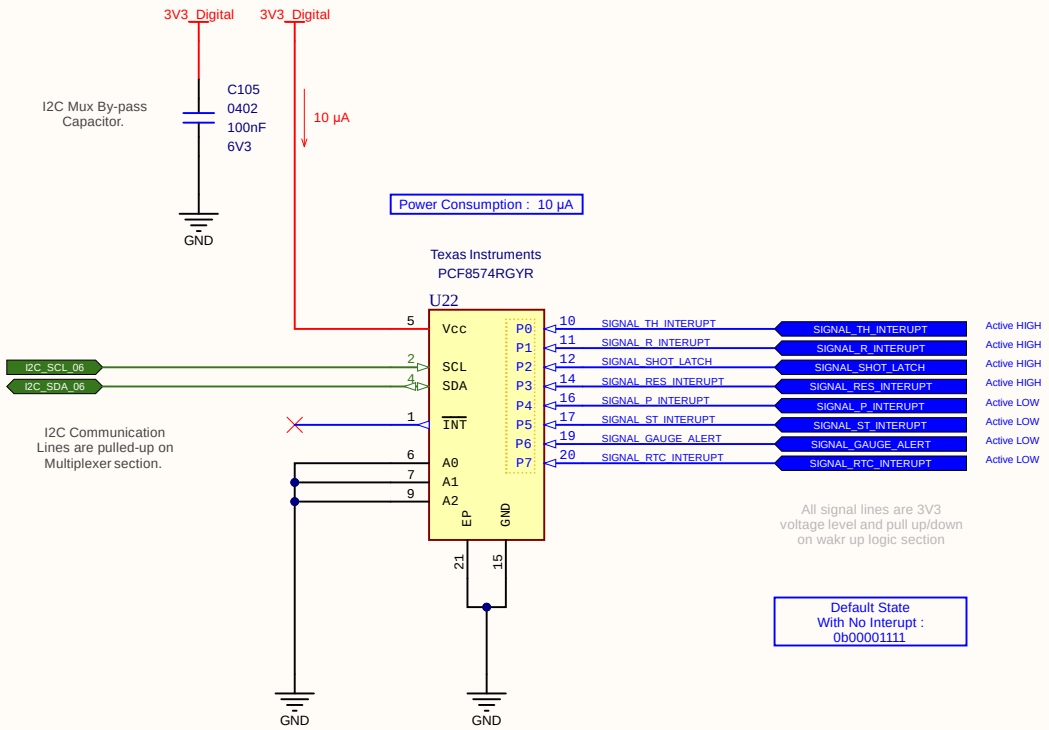
Turkiye

OVOO



F7

Title	I2C I/O Expander for Reading Interrupts		
Size: A4	**Number:** AA002	**Revision:** B106AA	
Date: 9.06.2020	**Time:** 19:04:03	**Sheet** 35 of 37	
File:	C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\I2C IO Expander.SchDoc		

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Mızraklı Sok. No:15
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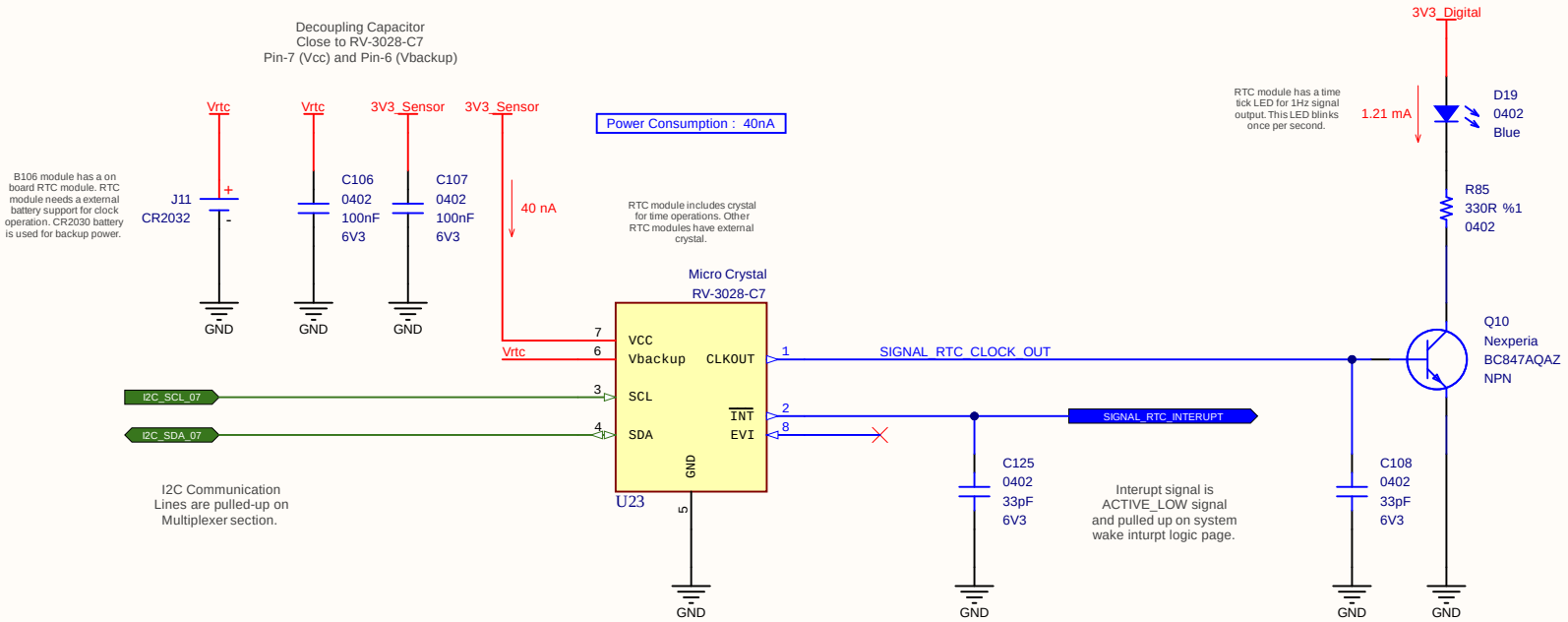
Turkiye



F8

Title	**Real Time Clock**		
Size: A4	**Number:** AA002	**Revision:** B106AA	
Date: 9.06.2020	**Time:** 19:04:03	**Sheet** 36 of 37	
File: C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\Real Time Clock.SchDoc			

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Mızraklı Sok. No:15
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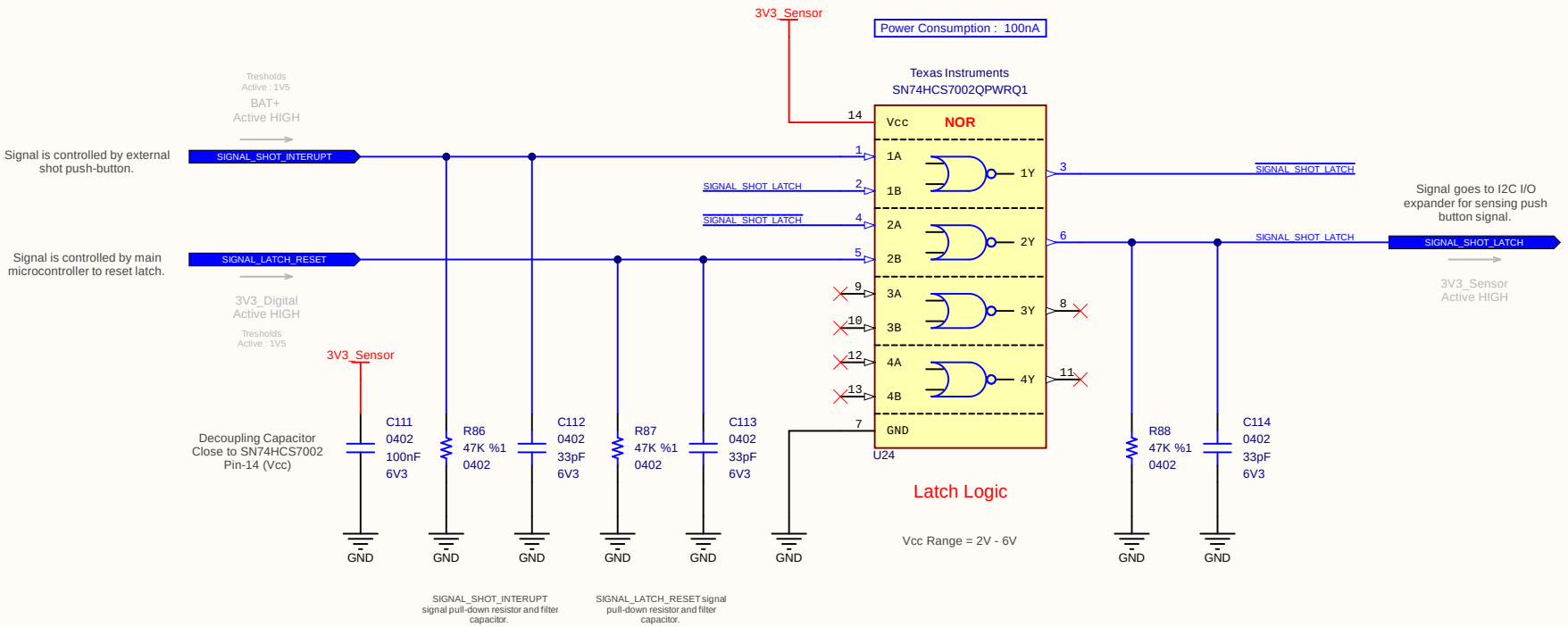
Turkiye

OVOO



System main timer and wake interupt logic includes manuel shot button interupt for wakeup the system. If user pushes the manuel wakeup button system wakes up and send data.

We want to learn wich interupt wakes up the system. All interupt source are latch up until firmware clear the interupt. But shot button is a push button interupt so we need to latch the signal for sensing.

SN74HCS7002 is a 4 channel NOR gate for building "SR Latch flip flop". Latch circuit have 2 input (one is set one is reset) and one output.

If set pin (Signal_Shot_Interupt) goes HIGH output pin (Signal_Shot_Latch) goes HIGH. Output pin latched at HIGH until resep signal is recieved. So all input and output pins are pull-down.

Title	Signal Latch Logic		
Size: A4	**Number:** AA002	**Revision:** B106AA	
Date: 9.06.2020	**Time:** 19:04:03	**Sheet** 37 of 37	
File:	C:\Altium Projects\STF\P102 - Weather Station\Modules\B106AA\Schematic\Signal Latch Logic.SchDoc		

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