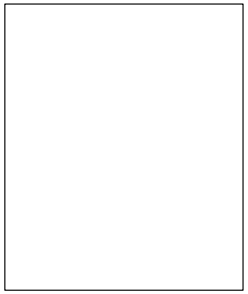
MODULAR MULTI PROTOCOL HUB

Architecture based on interchangeable RF modules sharing a common 20−pin interface.
Each module features local power regulation, ID detection, and independent enable control,
ensuring low RF interference and maximum flexibility for multi−radio systems.

Main Board

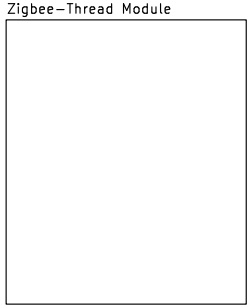


File: main.kicad_sch

Main Board (ESP32−S3 + Power System)

Central controller of the entire platform.
Includes power conversion (12V → 5V → 3.3V),
smart battery system, GPIO expansion,
and the main ESP32−S3 processor.
All RF modules connect through a unified 20−pin
expansion header carrying SPI, I²C, UART, IRQ, and power rails.
Each RF module is power−gated (EN_LDO) from the Main Board
to reduce interference and optimize energy consumption.

Zigbee−Thread Module

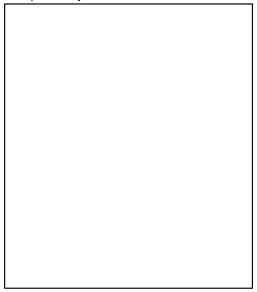


File: zigbee/thread.kicad_sch

Zigbee/Thread Module (EFR32MG24)

Dedicated IEEE 802.15.4 module supporting Zigbee,
Thread, and Matter.
Includes local LDO, RF matching network,
antenna options,Ç mandatory decoupling and
an ID−EEPROM for automatic module detection.
Communicates with the Main Board using
SPI + IRQ and is fully power−controlled
through the expansion header.
Designed for low−power mesh networks,
smart−home devices, and sensor applications.

Proprietary Communication Module



File: propietary.kicad_sch

Proprietary RF Module (nRF24L01+)

Module for proprietary 2.4 GHz communication,
ideal for point−to−point links and low−latency
data transmission.
Based on the nRF24L01+ with its own LDO,
matching network, antenna, and ESD protection.
Reuses the same 20−pin expansion interface as
the Zigbee module (shared SPI, IRQ, I²C).
Additional CE line controlled from the Main Board.
Includes an identification EEPROM for automatic
detection and configuration.

InGnia Technology

Sheet: /
File: Hub.kicad_sch

Title: Modular Multi−Protocol Hub

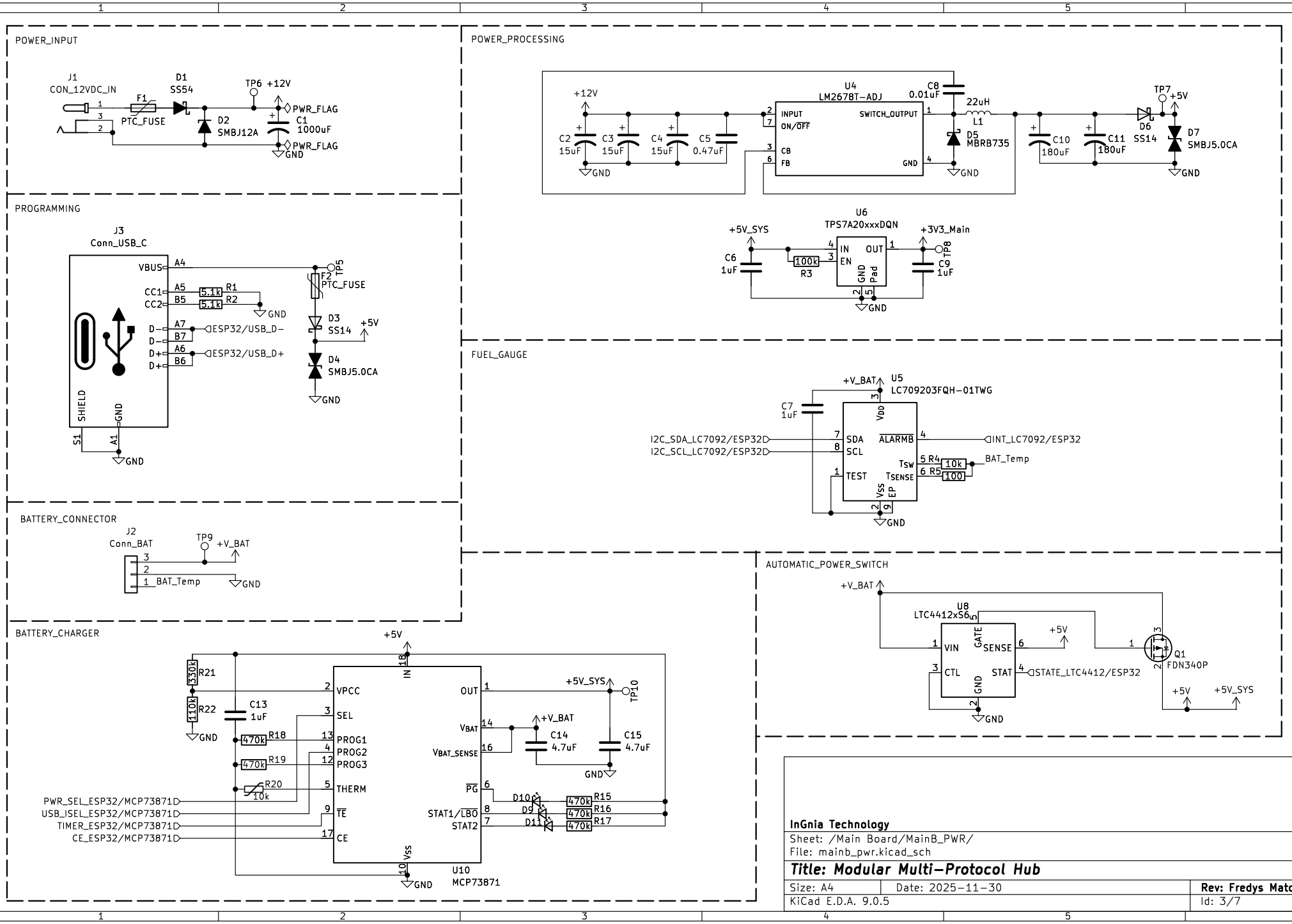
Size: A4	Date: 2025−11−30	**Rev: Fredys Matos**
KiCad E.D.A. 9.0.5		Id: 1/7

InGnia Technology

Sheet: /Main Board/
File: main.kicad_sch

Title: Modular Multi-Protocol Hub

Size: A4	Date: 2025-11-30	**Rev: Fredys Matos**
KiCad E.D.A. 9.0.5		Id: 2/7



InGnia Technology		
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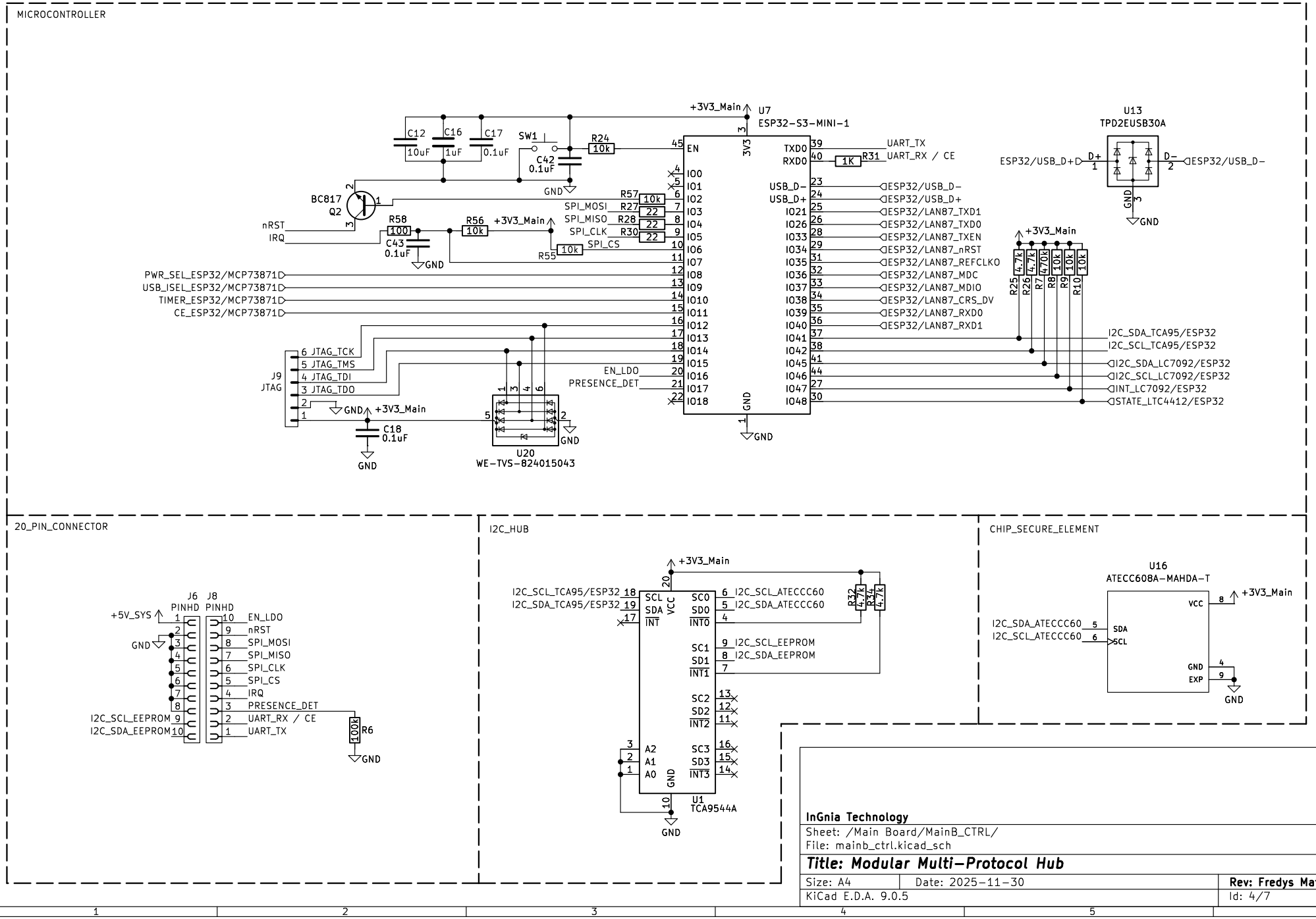
File: mainb_pwr.kicad_sch		
Title: Modular Multi-Protocol Hub		
Size: A4	Date: 2025-11-30	**Rev: Fredys Matos**
KiCad E.D.A. 9.0.5		Id: 3/7


MICROCONTROLLER
U7
ESP32-S3-MINI-1
+3V3_Main
C12
10uF
C16
1uF
C17
0.1uF
SW1
C42
0.1uF
R24
10k
GND
BC817
Q2
R58
100
C43
0.1uF
R56
10k
R57
10k
R27
22
R28
22
R30
22
R55
10k
SPI_MOSI
SPI_MISO
SPI_CLK
SPI_CS
nRST
IRQ
PWR_SEL_ESP32/MCP73871
USB_ISEL_ESP32/MCP73871
TIMER_ESP32/MCP73871
CE_ESP32/MCP73871
J9
JTAG
6 JTAG_TCK
5 JTAG_TMS
4 JTAG_TDI
3 JTAG_TDO
2
1
C18
0.1uF
U20
WE-TVS-824015043
EN_LDO
PRESENCE_DET
TXD0
RXD0
1K
R31
UART_TX
UART_RX / CE
USB_D-
USB_D+
ESP32/USB_D-
ESP32/USB_D+
ESP32/LAN87_TXD1
ESP32/LAN87_TXD0
ESP32/LAN87_TXEN
ESP32/LAN87_nRST
ESP32/LAN87_REFCLKO
ESP32/LAN87_MDC
ESP32/LAN87_MDIO
ESP32/LAN87_CRS_DV
ESP32/LAN87_RXD0
ESP32/LAN87_RXD1
U13
TPD2EUSB30A
ESP32/USB_D+
ESP32/USB_D-
R25
4.7k
R26
4.7k
R7
470k
R8
10k
R9
10k
R10
10k
I2C_SDA_TCA95/ESP32
I2C_SCL_TCA95/ESP32
I2C_SDA_LC7092/ESP32
I2C_SCL_LC7092/ESP32
INT_LC7092/ESP32
STATE_LTC4412/ESP32
20_PIN_CONNECTOR
J6
PINHD
J8
PINHD
+5V_SYS
GND
EN_LDO
nRST
SPI_MOSI
SPI_MISO
SPI_CLK
SPI_CS
IRQ
PRESENCE_DET
UART_RX / CE
UART_TX
I2C_SCL_EEPROM
I2C_SDA_EEPROM
R6
100k
I2C_HUB
I2C_SCL_TCA95/ESP32
I2C_SDA_TCA95/ESP32
SCL
SDA
VCC
INT
A2
A1
A0
SC0
SD0
INT0
SC1
SD1
INT1
SC2
SD2
INT2
SC3
SD3
INT3
I2C_SCL_ATECCC60
I2C_SDA_ATECCC60
I2C_SCL_EEPROM
I2C_SDA_EEPROM
R32
4.7k
R34
4.7k
U1
TCA9544A
CHIP_SECURE_ELEMENT
U16
ATECC608A-MAHDA-T
VCC
SDA
SCL
GND
EXP
InGnia Technology
Sheet: /Main Board/MainB_CTRL/
File: mainb_ctrl.kicad_sch
Title: Modular Multi-Protocol Hub
Size: A4
Date: 2025-11-30
Rev: Fredys Matos
KiCad E.D.A. 9.0.5
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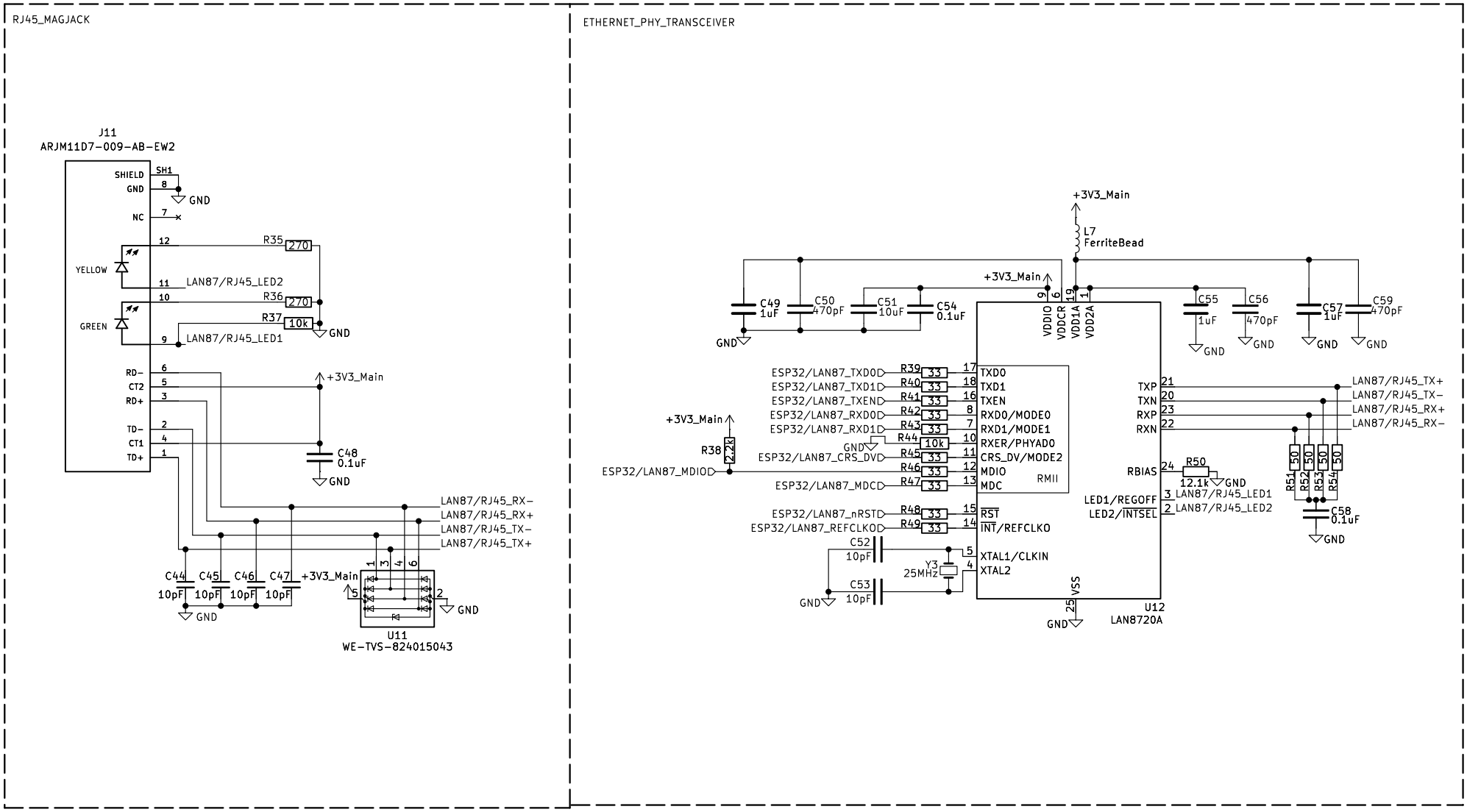

InGnia Technology		
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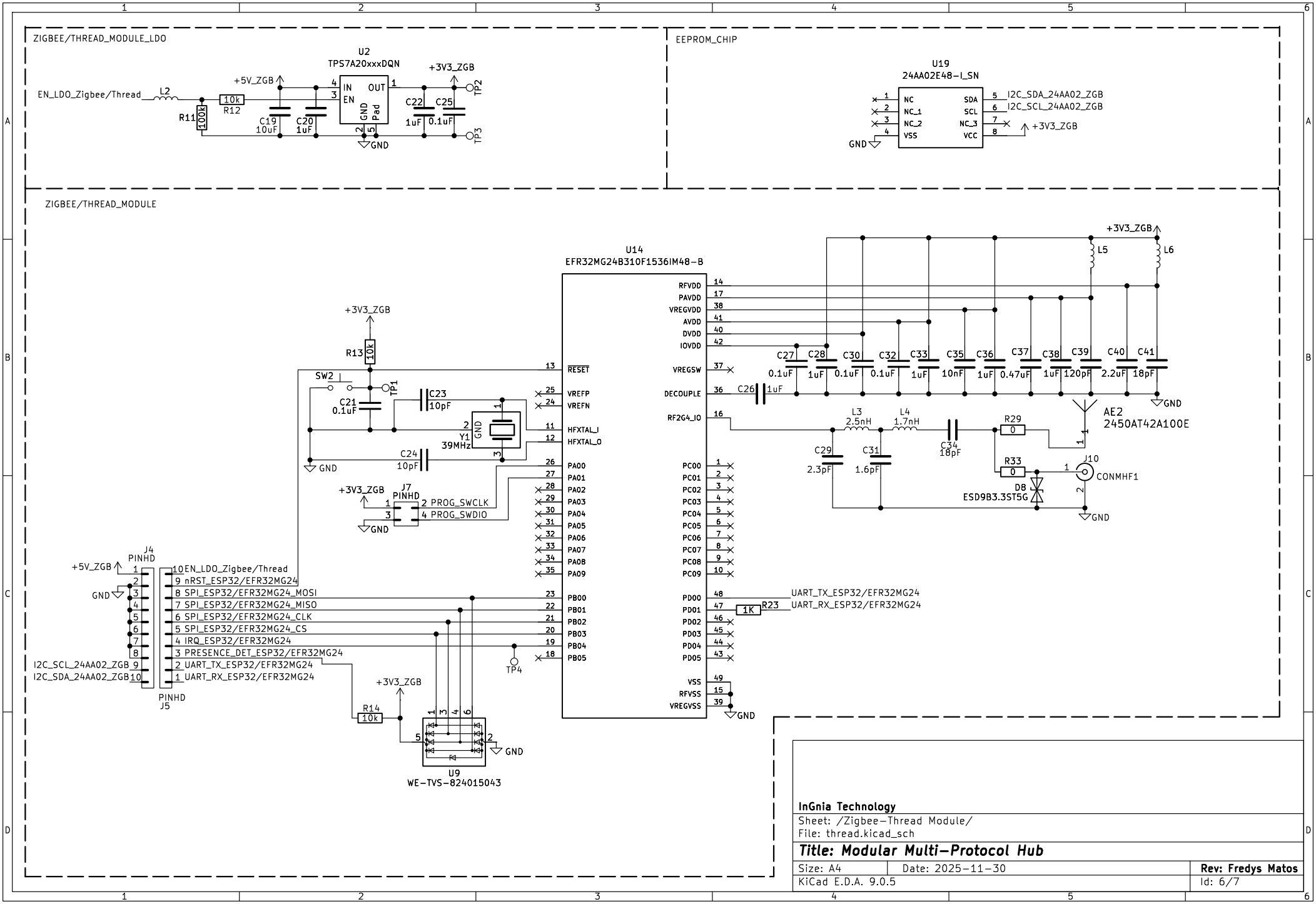
Size: A4	Date: 2025-11-30	**Rev: Fredys Matos**
KiCad E.D.A. 9.0.5		Id: 5/7


ZIGBEE/THREAD_MODULE_LDO
U2
TPS7A20xxxDQN
+5V_ZGB
+3V3_ZGB
EN_LDO_Zigbee/Thread
L2
10k
R12
100k
R11
C19
10uF
C20
1uF
C22
1uF
C25
0.1uF
TP2
TP3
GND
EEPROM_CHIP
U19
24AA02E48-I_SN
NC
NC_1
NC_2
VSS
SDA
SCL
NC_3
VCC
I2C_SDA_24AA02_ZGB
I2C_SCL_24AA02_ZGB
ZIGBEE/THREAD_MODULE
U14
EFR32MG24B310F1536IM48-B
RFVDD
PAVDD
VREGVDD
AVDD
DVDD
IOVDD
VREGSW
DECOUPLE
RF2G4_IO
RESET
VREFP
VREFN
HFXTAL_I
HFXTAL_O
PA00
PA01
PA02
PA03
PA04
PA05
PA06
PA07
PA08
PA09
PB00
PB01
PB02
PB03
PB04
PB05
PC00
PC01
PC02
PC03
PC04
PC05
PC06
PC07
PC08
PC09
PD00
PD01
PD02
PD03
PD04
PD05
VSS
RFVSS
VREGSS
C27
0.1uF
C28
1uF
C30
0.1uF
C32
0.1uF
C33
1uF
C35
10nF
C36
1uF
C37
0.47uF
C38
1uF
C39
120pF
C40
2.2uF
C41
18pF
C26
1uF
L5
L6
L3
2.5nH
L4
1.7nH
C34
18pF
C29
2.3pF
C31
1.6pF
R29
0
R33
0
D8
ESD9B3.3ST5G
J10
CONMHF1
AE2
2450AT42A100E
R13
10k
SW2
TP1
C21
0.1uF
C23
10pF
Y1
39MHz
C24
10pF
J7
PINHD
PROG_SWCLK
PROG_SWDIO
J4
PINHD
J5
PINHD
10 EN_LDO_Zigbee/Thread
9 nRST_ESP32/EFR32MG24
8 SPI_ESP32/EFR32MG24_MOSI
7 SPI_ESP32/EFR32MG24_MISO
6 SPI_ESP32/EFR32MG24_CLK
5 SPI_ESP32/EFR32MG24_CS
4 IRQ_ESP32/EFR32MG24
3 PRESENCE_DET_ESP32/EFR32MG24
2 UART_TX_ESP32/EFR32MG24
1 UART_RX_ESP32/EFR32MG24
I2C_SCL_24AA02_ZGB
I2C_SDA_24AA02_ZGB
UART_TX_ESP32/EFR32MG24
UART_RX_ESP32/EFR32MG24
1K
R23
TP4
R14
10k
U9
WE-TVS-824015043
InGnia Technology
Sheet: /Zigbee-Thread Module/
File: thread.kicad_sch
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Size: A4
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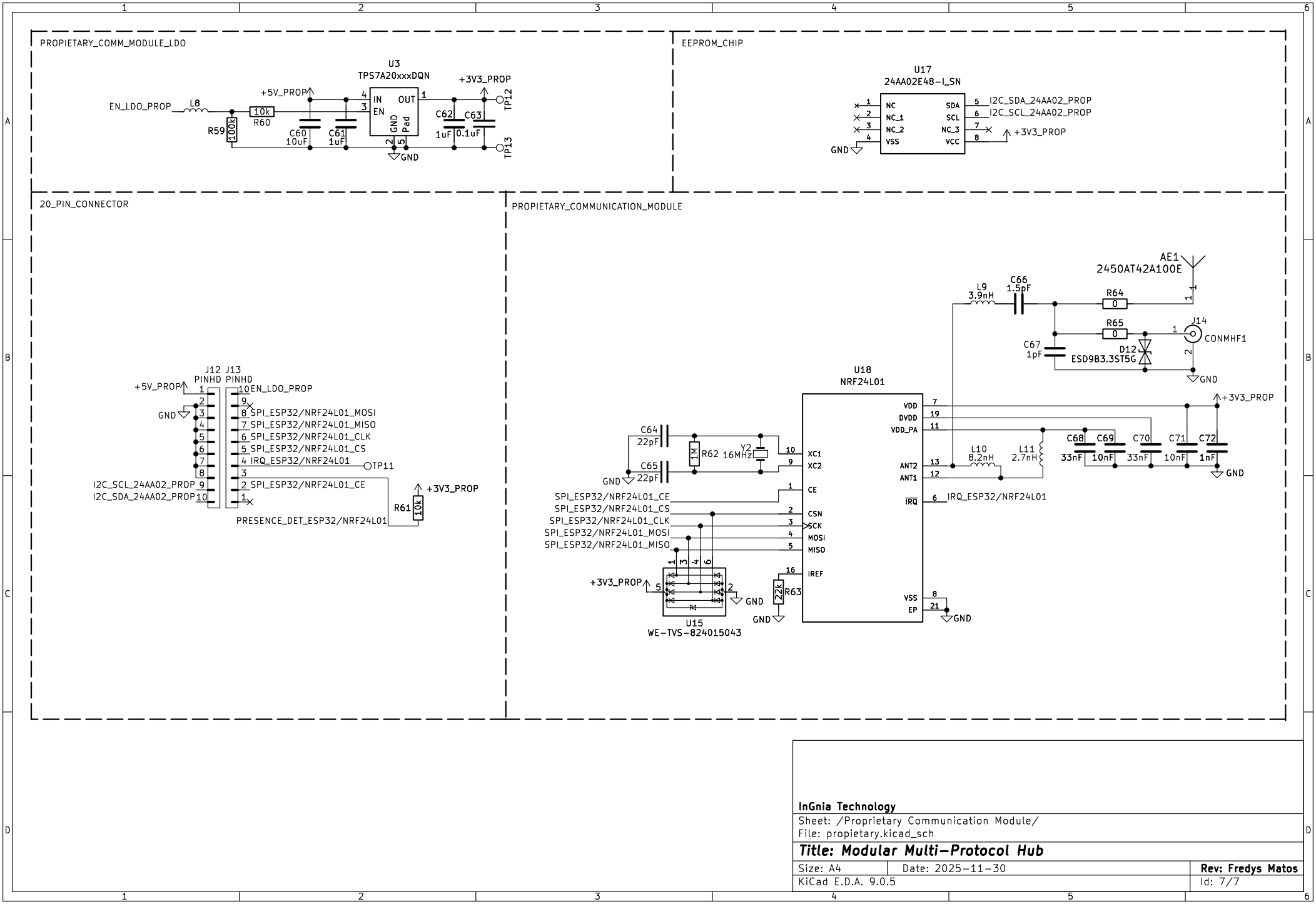
PROPIETARY_COMM_MODULE_LDO
U3
TPS7A20xxxDQN
EN_LDO_PROP
L8
10k
R60
100k
R59
+5V_PROP
C60
10uF
C61
1uF
IN
EN
OUT
GND
Pad
+3V3_PROP
C62
1uF
C63
0.1uF
TP12
TP13
GND
EEPROM_CHIP
U17
24AA02E48-I_SN
NC
NC_1
NC_2
VSS
SDA
SCL
NC_3
VCC
I2C_SDA_24AA02_PROP
I2C_SCL_24AA02_PROP
+3V3_PROP
GND
20_PIN_CONNECTOR
J12 J13
PINHD PINHD
+5V_PROP
GND
EN_LDO_PROP
SPI_ESP32/NRF24L01_MOSI
SPI_ESP32/NRF24L01_MISO
SPI_ESP32/NRF24L01_CLK
SPI_ESP32/NRF24L01_CS
IRQ_ESP32/NRF24L01
TP11
SPI_ESP32/NRF24L01_CE
I2C_SCL_24AA02_PROP
I2C_SDA_24AA02_PROP
+3V3_PROP
R61
10k
PRESENCE_DET_ESP32/NRF24L01
PROPIETARY_COMMUNICATION_MODULE
AE1
2450AT42A100E
L9
3.9nH
C66
1.5pF
R64
0
R65
0
J14
CONMHF1
C67
1pF
D12
ESD9B3.3ST5G
GND
U18
NRF24L01
C64
22pF
C65
22pF
R62 1M
Y2
16MHz
XC1
XC2
CE
CSN
SCK
MOSI
MISO
IREF
SPI_ESP32/NRF24L01_CE
SPI_ESP32/NRF24L01_CS
SPI_ESP32/NRF24L01_CLK
SPI_ESP32/NRF24L01_MOSI
SPI_ESP32/NRF24L01_MISO
U15
WE-TVS-824015043
22k
R63
VDD
DVDD
VDD_PA
ANT2
ANT1
IRQ
VSS
EP
L10
8.2nH
L11
2.7nH
C68
33nF
C69
10nF
C70
33nF
C71
10nF
C72
1nF
IRQ_ESP32/NRF24L01
+3V3_PROP
GND
InGnia Technology
Sheet: /Proprietary Communication Module/
File: propietary.kicad_sch
Title: Modular Multi-Protocol Hub
Size: A4
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