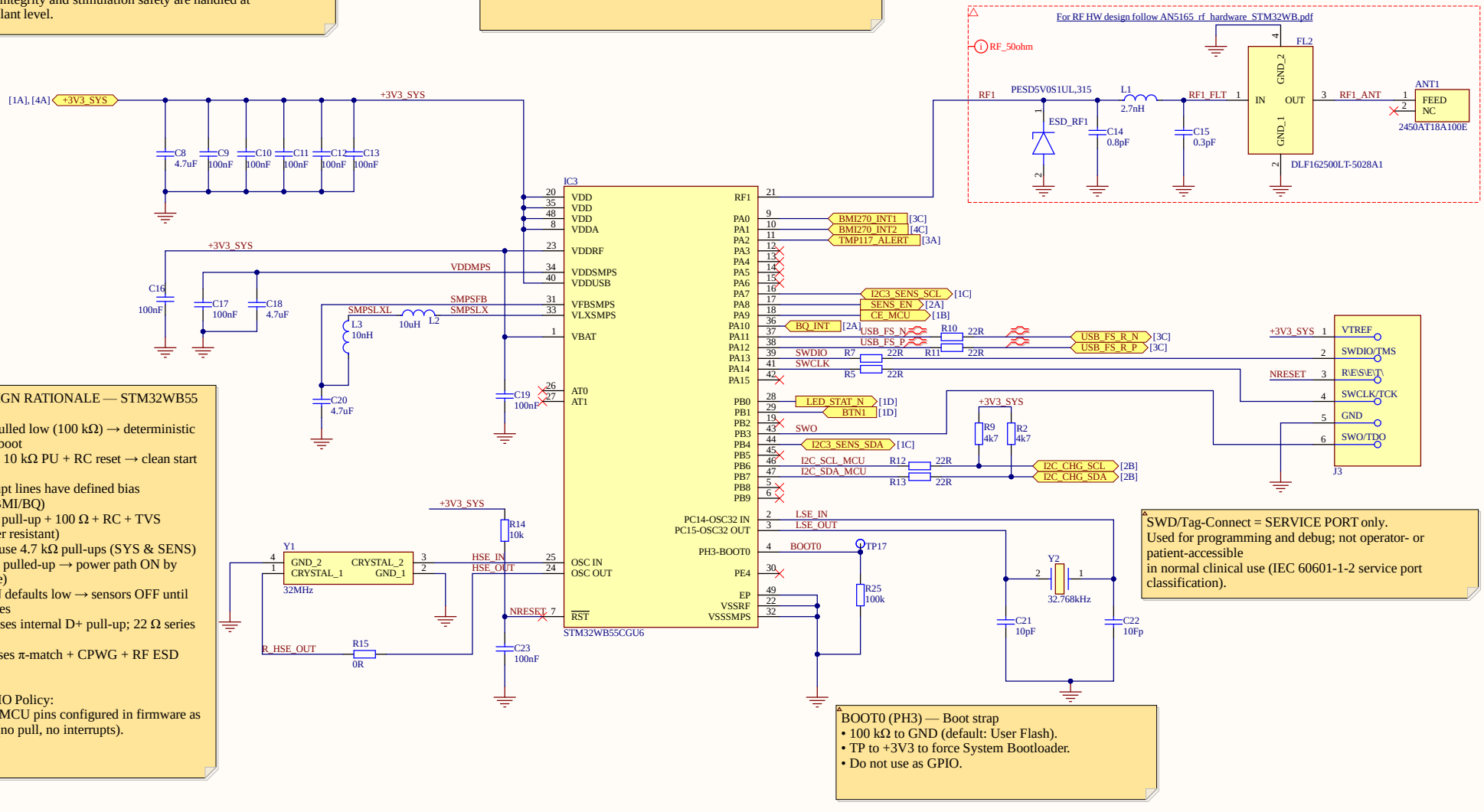
MCU (STM32WB55), SWD Debug & RF (BLE) — BLEC-SCH-0002

Essential performance (controller role):
• Board provides BLE command/control only; no direct patient-applied parts.
• All MCU I/Os are SELV and default to safe states on reset (pull-ups/-downs and series resistors as shown).
• BLE link integrity and stimulation safety are handled at system/implant level.

IEC 60601 Compliance:
USB-C = AC/DC SELV Input Port.
PPTC + TVS + ESD + CMC provide protection for IEC 61000-4-2/4-4/4-5.
All voltages SELV; battery safety provided by charger + pack.

RF port (intentional radiator):
2.4 GHz BLE antenna with π-match (C-L-C) and RF ESD footprint.
CPWG, via fence and π-match used to meet radiated emission/immunity requirements (IEC 60601-1-2).



MCU DESIGN RATIONALE — STM32WB55

• BOOT0 pulled low (100 kΩ) → deterministic User Flash boot
• NRST has 10 kΩ PU + RC reset → clean start under EMC
• All interrupt lines have defined bias (TMP117/BMI/BQ)
• BTN1 has pull-up + 100 Ω + RC + TVS (false-trigger resistant)
• I²C buses use 4.7 kΩ pull-ups (SYS & SENS)
• CE_MCU pulled-up → power path ON by default (safe)
• SENS_EN defaults low → sensors OFF until MCU enables
• USB FS uses internal D+ pull-up; 22 Ω series resistors
• RF path uses π-match + CPWG + RF ESD footprint

Unused GPIO Policy:
All unused MCU pins configured in firmware as ANALOG (no pull, no interrupts).

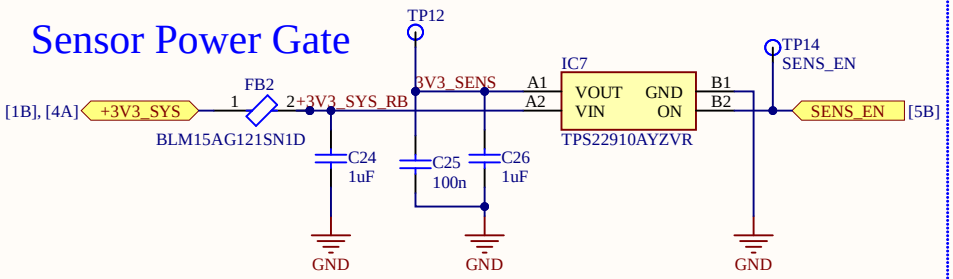
SWD/Tag-Connect = SERVICE PORT only.
Used for programming and debug; not operator- or patient-accessible in normal clinical use (IEC 60601-1-2 service port classification).

BOOT0 (PH3) — Boot strap
• 100 kΩ to GND (default: User Flash).
• TP to +3V3 to force System Bootloader.
• Do not use as GPIO.

Title	BLE-Control Wearable — Schematic Set (AD25)	
Size: A3	Number: BLEC-SCH-0002	Revision: A0 (EVT)
Date: 11/18/2025	Sheet of: 2 of 3	
File: C:\Users\..\MCU_RF.SchDoc	Drawn By: Caoilte Donohoe	

Sensors/IO: TPS22910A 3V3_SENS, Button, LEDs, I²C — BLEC-SCH-0003

Sensor Power Gate

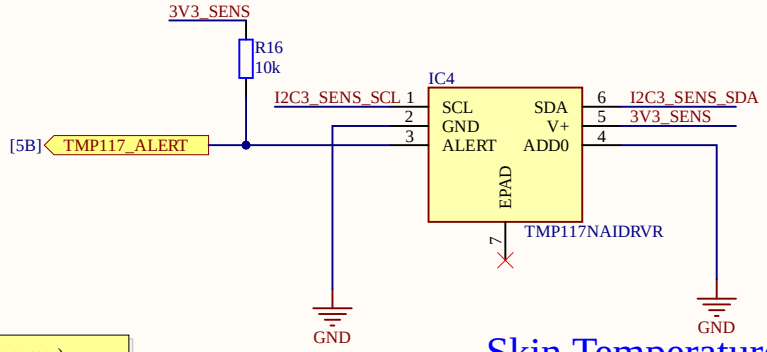


3V3_SENS (sensor rail):
- Generated from +3V3_SYS via TPS22910A and ferrite bead.
- SENS_EN used to disable sensor rail during faults or EMC test modes, improving tolerance to IEC 60601-1-2 disturbances.

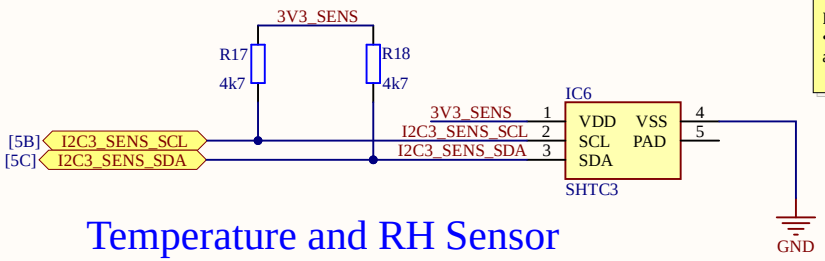
Operator I/O (button + LED + skin sensor):
- Button: TVS at pad + 100R series + RC network for ESD and burst immunity.
- Sensors: on-board only, short I2C, powered via 3V3_SENS gate.
- No direct patient-applied parts on this PCB; temperature is read through enclosure/assembly.

BTN1 default state:
- Pull network ensures defined logic level on reset and under noise.

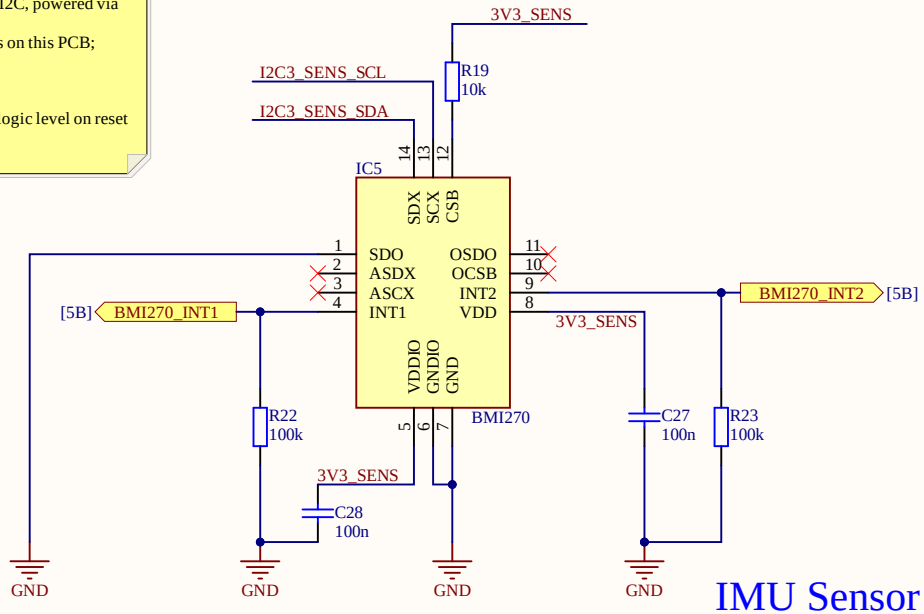
Skin Temperature Sensor



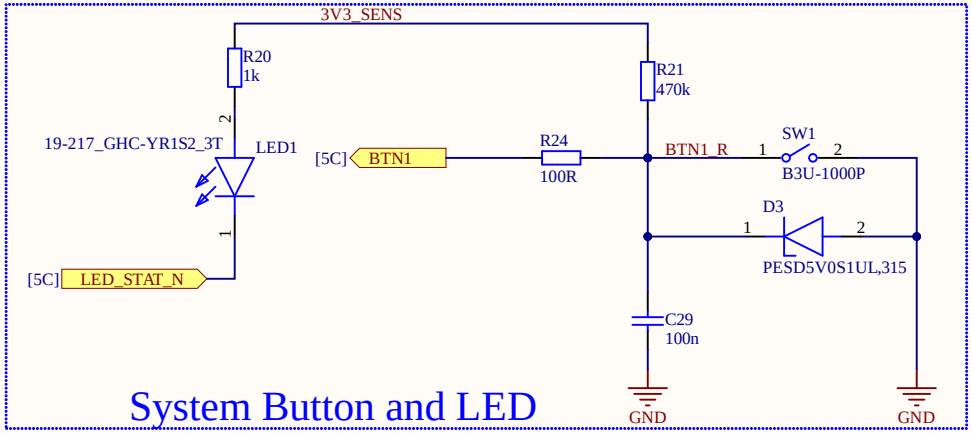
Temperature and RH Sensor



IMU Sensor

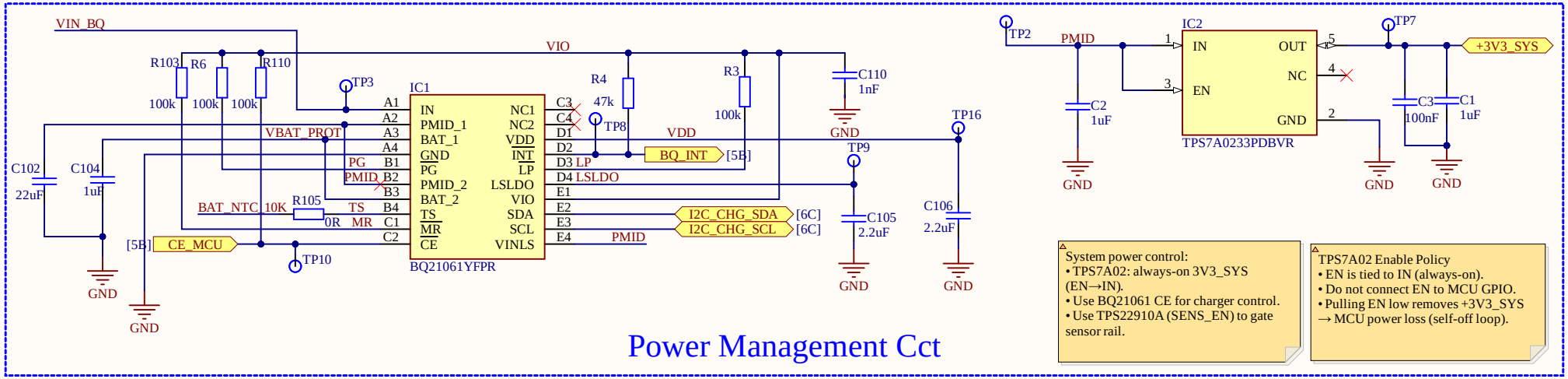


System Button and LED

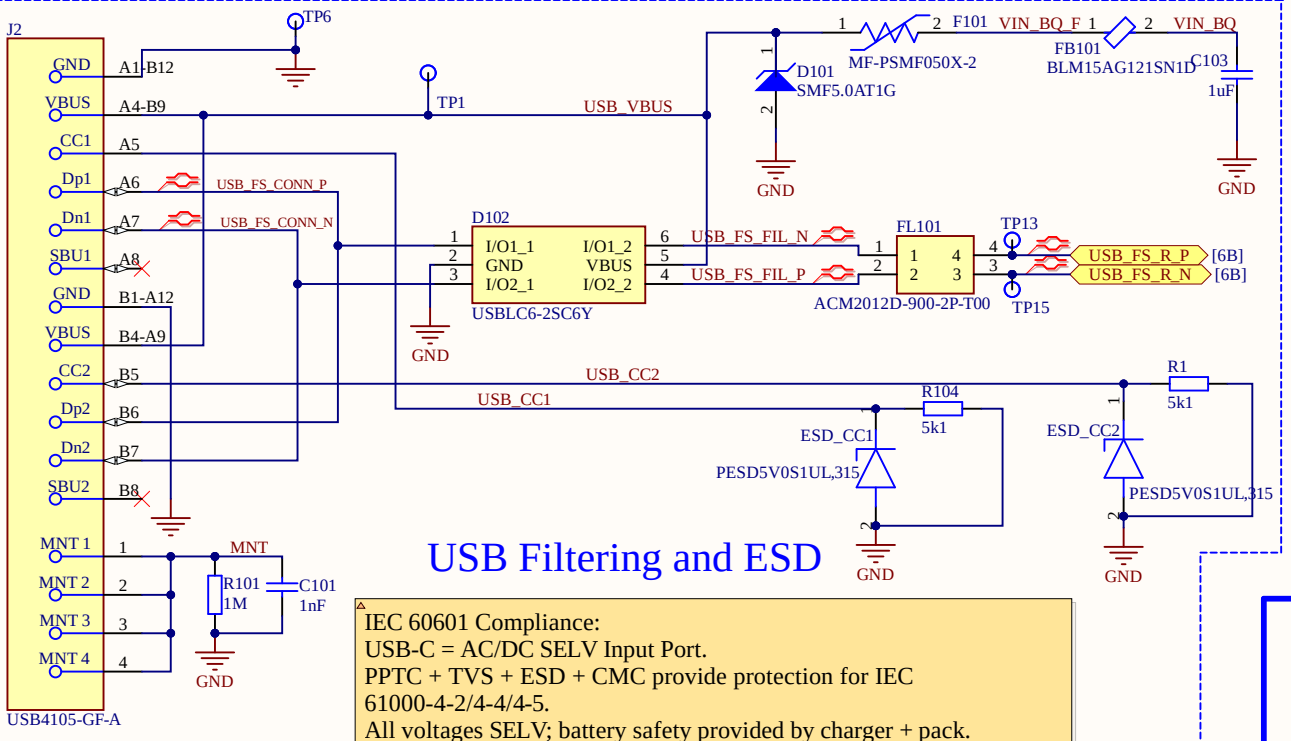


Title: BLE-Control Wearable — Schematic Set (AD25)		
Size: A4	Number: BLEC-SCH-0003	Revision: A0 (EVT)
Date: 11/18/2025	Sheet of: 3 of 3	
File: C:\Users\..\Sensor_IO_Buttons_LED.SchDoc	Drawn By: Caoilte Donohoe	

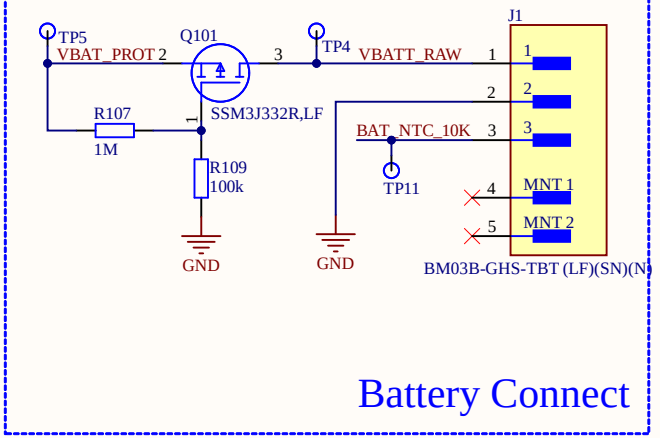
Power, Battery, USB-C & BQ21061 (Main 3V3) — BLEC-SCH-0001



Power Management Cct



USB Filtering and ESD



Battery Connect

Title	BLE-Control Wearable — Schematic Set (AD25)		
Size: A4	Number: BLEC-SCH-0001		Revision: A0 (EVT)
Date: 11/18/2025		Sheet of	1 of 3
File: C:\Users\..\Power_Charge_USB.SchDoc		Drawn By:	Caoilte Donohoe