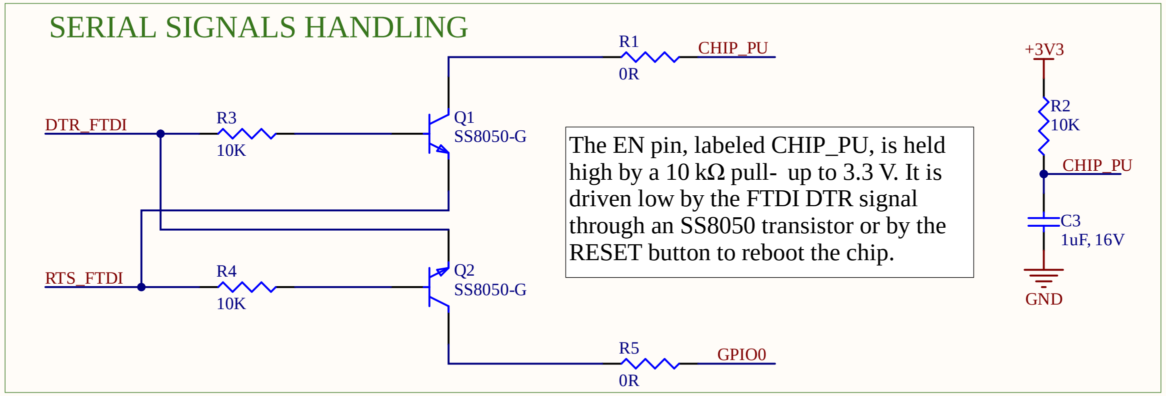
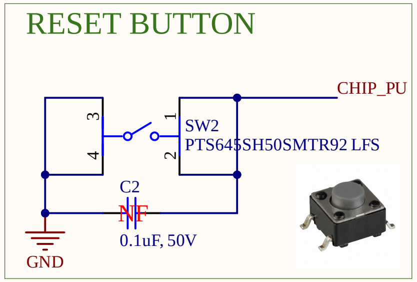
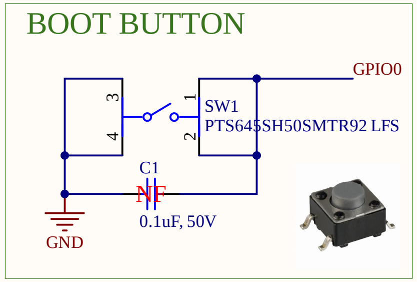


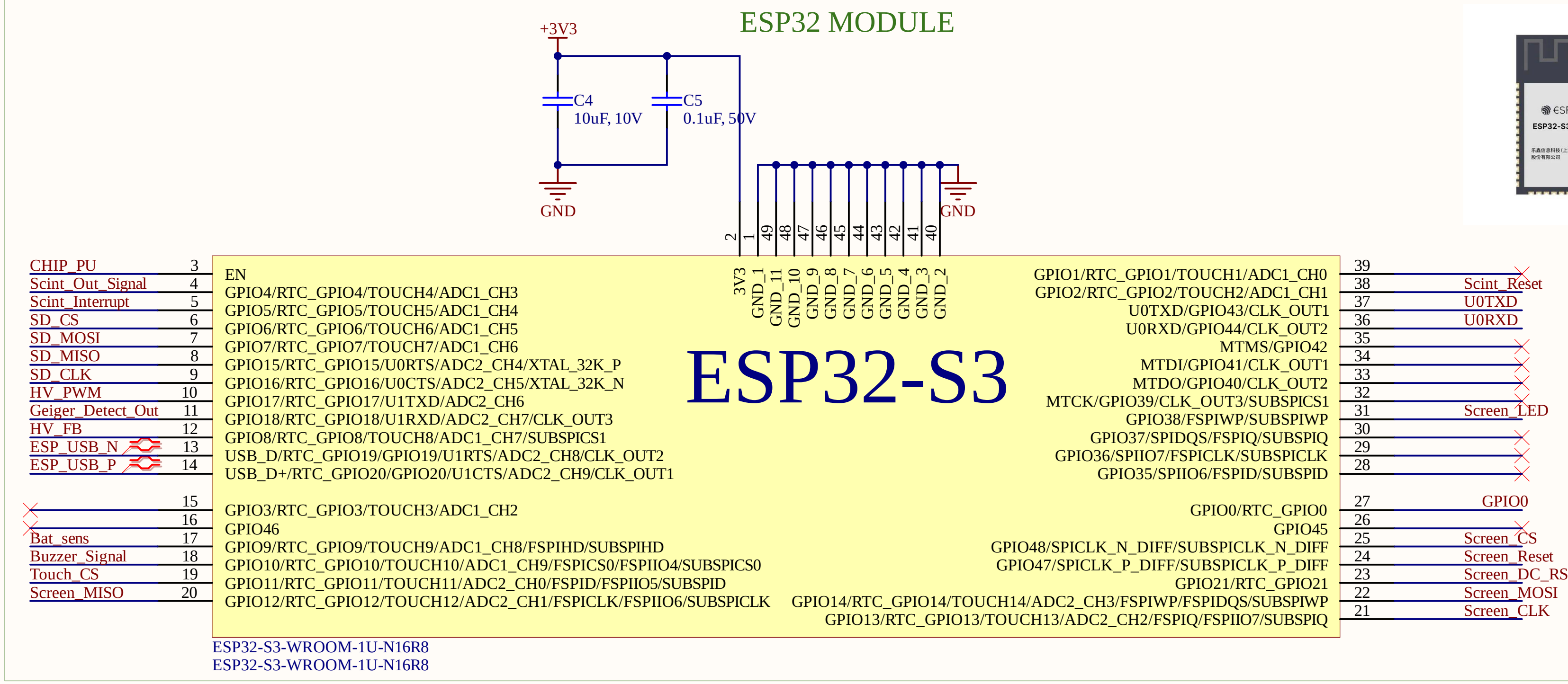
The EN pin, labeled CHIP_PU, is held high by a 10 kΩ pull- up to 3.3 V. It is driven low by the FTDI DTR signal through an SS8050 transistor or by the RESET button to reboot the chip.



Pressing the RESET button grounds EN (CHIP_PU), forcing the ESP32- S3 to restart.



Pressing the BOOT button grounds GPIO0 through the 0.1 µF capacitor, placing the ESP32- S3 into the serial- bootloader on the next reset.



The design uses an Espressif ESP32- S3- WROOM- 1U modul which integrates a dual- core 32- b Xtensa® LX7 CPU running up to 240 MHz, 512 KB of SRAM, onboard QSPI flash and PSRAM, 2.4 GHz Wi- Fi (802.11 b/g/n) and Bluetooth 5 LE radios, USB OTG support, 43 GPIOs (with ADC, SPI, I²C, UART, I²S, RMT, PWM and capacitive- touch interfaces), and hardware cryptographic accelerators (AES, SHA).

ESP32-S3 microcontroler unit

ESP32-S3: Dual-core Xtensa® LX7 MCU with 2.4 GHz Wi-Fi & Bluetooth 5 LE.

Sheet title: Microcontroller_Unit.SchDoc	
Project title: RadiationDetector.PrjPcb	
Author: Pablo Morán Peña	**Size:** A4
Date: 24/08/2025 Revision: 1	**Sheet:** 1 of 6

Supervisor: Sr. Andrés Roldán
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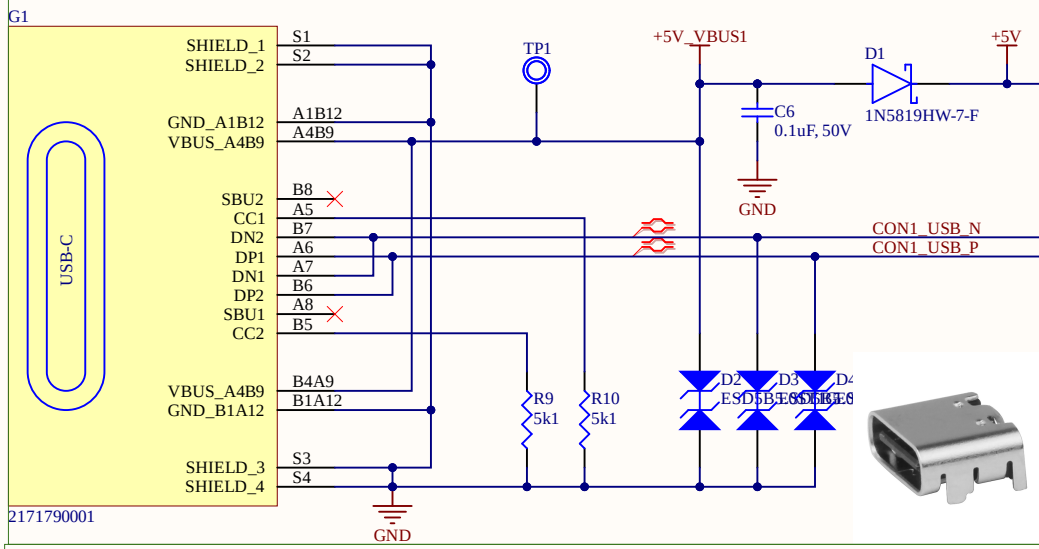
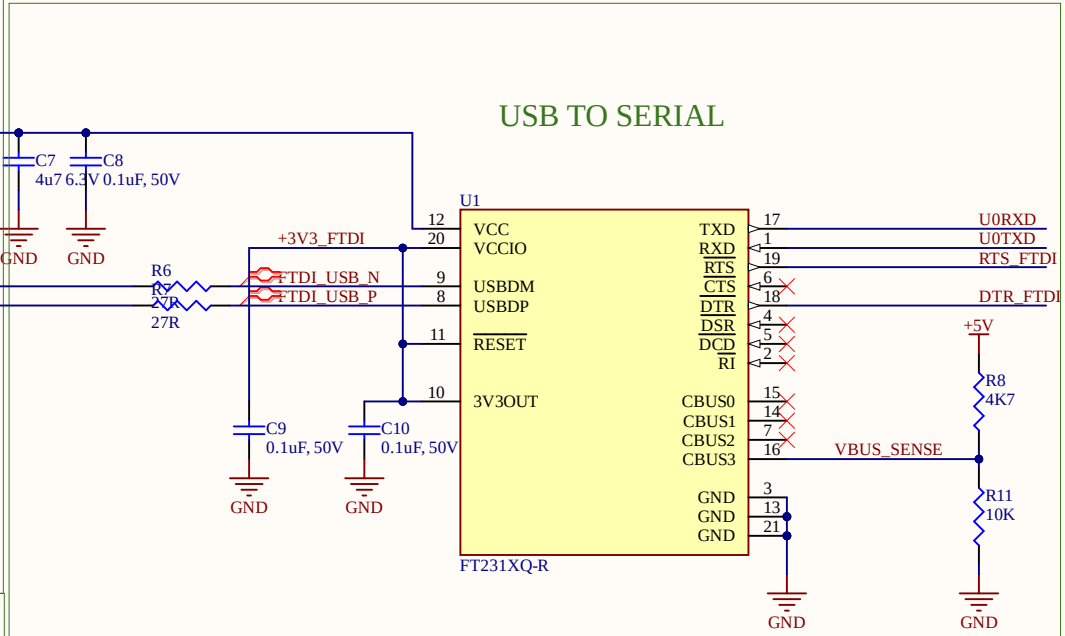
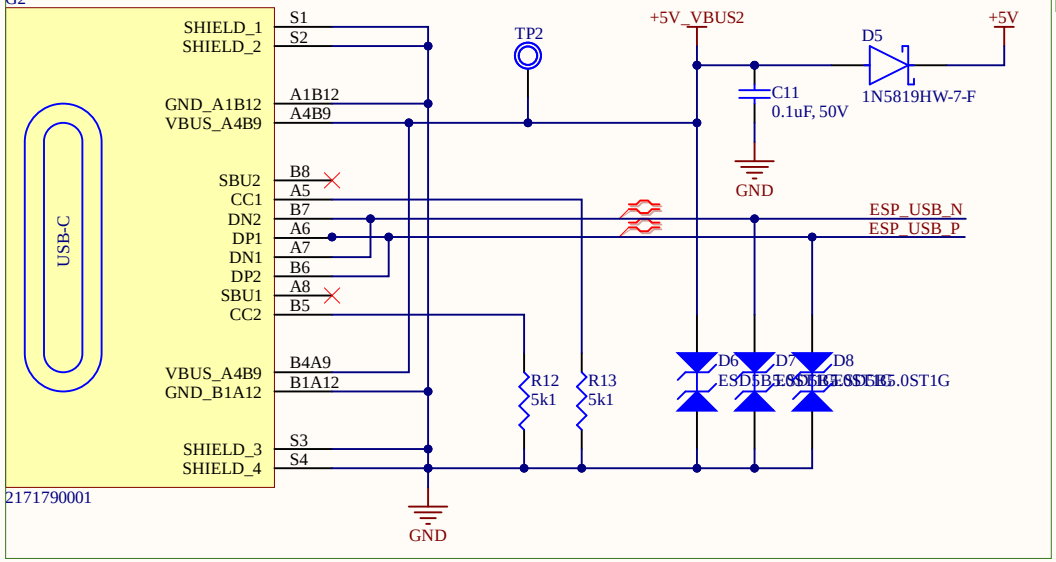
USB-C CONNECTOR 1



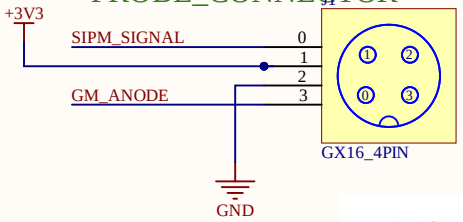
USB TO SERIAL



USB-C CONNECTOR 2



PROBE_CONNECTOR



The 4- pin GX16 probe connector brings the detector signals and power off- board:
- Pin 0: SiPM_SIGNAL (preamp output)
- Pin 1: +3V3
- Pin 2: GM_ANODE (high- voltage coupled pulse)
- Pin 4: GND

Input Output Ports

It includes two USB-C connectors, one for USB-to-UART and the other for native USB, and a 5-pin GX16 connector for interfacing with probes.

Sheet title: IO_Ports.SchDoc		
Project title: RadiationDetector.PrjPcb		
Author: Pablo Morán Peña		**Size:** A4
Date: 24/08/2025	Revision: **1**	**Sheet:** 2 of 6

Supervisor: Sr. Andrés Roldán

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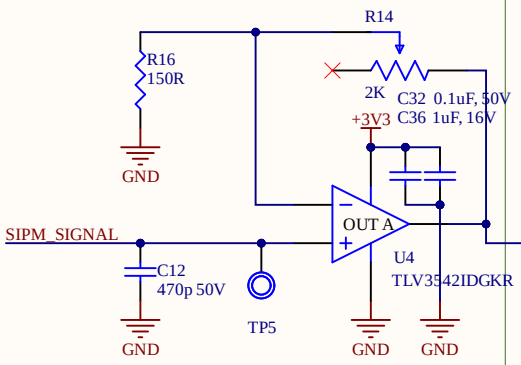
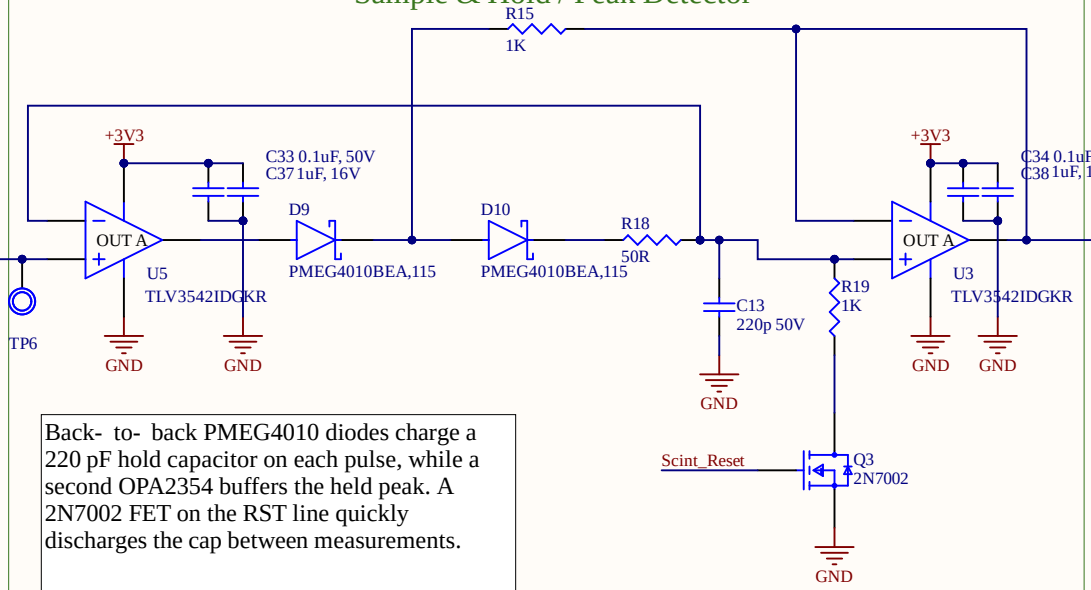
Preamplifier



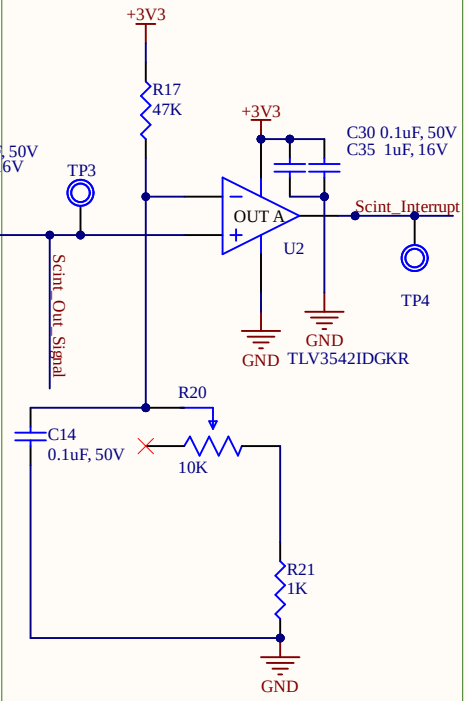
An OPA2354 configured as a low- noise non- inverting amp boosts the SiPM pulses. A 2 kΩ feedback potentiometer with a 150 Ω resistor to ground sets the gain, and a 47 pF input cap ensures stability and bandwidth limiting.

Sample & Hold / Peak Detector

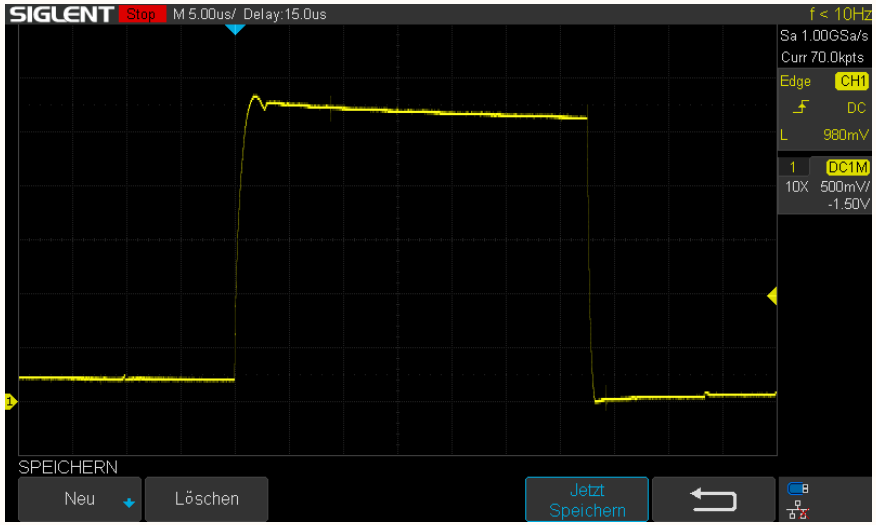


Back- to- back PMEG4010 diodes charge a 220 pF hold capacitor on each pulse, while a second OPA2354 buffers the held peak. A 2N7002 FET on the RST line quickly discharges the cap between measurements.

Pulse Discriminator



The OPA2354 is configured as a comparator: its non- inverting input is tied to the buffered signal, and its inverting input is set by a 10 kΩ/1 kΩ divider with a 0.1 µF filter. A 47 kΩ pull- up on the output drives GPIO5, generating a clean interrupt to trigger the ADC measurement.



Credit: mkgeiger / gamma- spectroscopy (MIT License)

Scintillator signal conditioning circuit

It amplifies the SiPM signal, holds its value, and generates an interrupt so the ADC can sample it.

Sheet title: Scintillator_Circuit.SchDoc		
Project title: RadiationDetector.PrjPcb		
Author: Pablo Morán Peña		**Size:** A4
Date: 24/08/2025	Revision: **1**	**Sheet:** 3 of 6

Supervisor: Sr. Andrés Roldán

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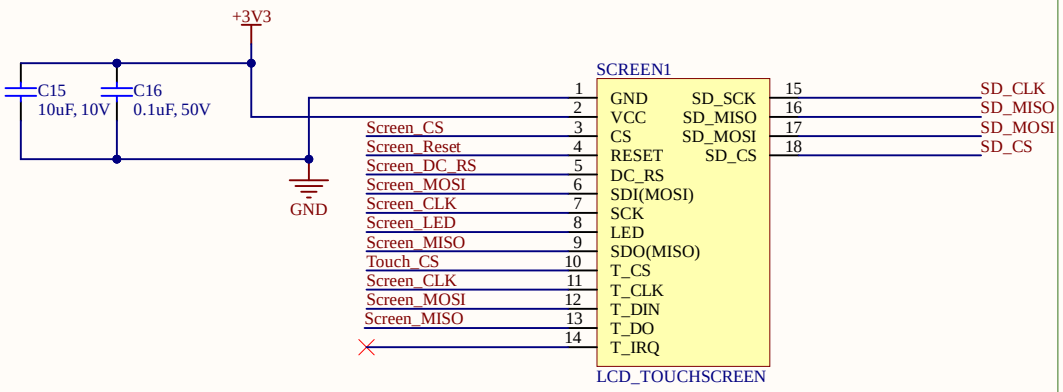
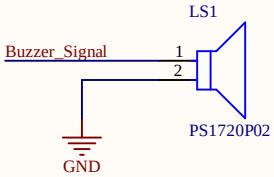
Touch Screen & SD Card

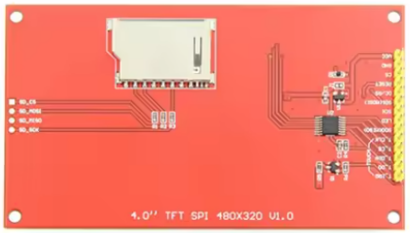


Buzzer



A PS1720P02 piezo buzzer is driven directly from GPIO38, with its other terminal tied to GND for simple audible notifications.

TOP



Bottom

The project uses a 4 " 480 × 320- pixel color TFT module driven by an ST7796S over SPI at 40MHz. It runs from a single 3.3 V rail (with 10 µF + 0.1 µF decoupling. Touch input is handled by an XPT2046 resistive- touch controller Sharing the same SPI interface as the screen. SD Card access is managed via a different SPI interface

Peripherals

SPI Touch Screen, SPI SD Card and buzzer

Sheet title: Peripherals.SchDoc			**Supervisor:** Sr. Andrés Roldán
Project title: RadiationDetector.PrjPcb			**Adress:** Avda. Madrid 28, Edif. I+D Josefina Castro Vizoso, 2ª planta 18012 - GRANADA, SPAIN
Author: Pablo Morán Peña		**Size:** A4	
Date: 24/08/2025	Revision: **1**	**Sheet:** 4 of 6	

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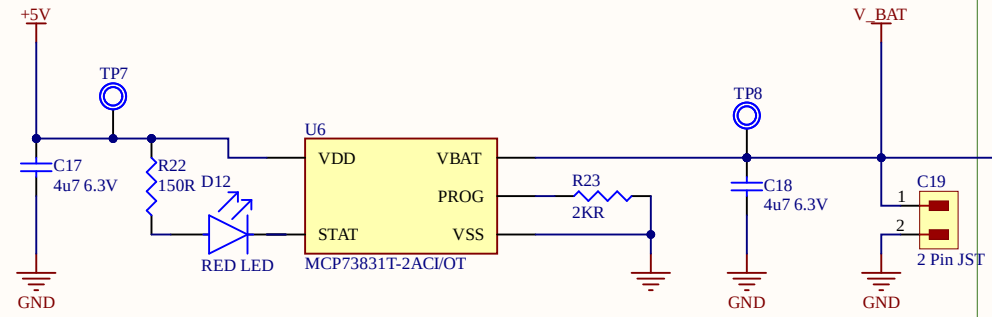
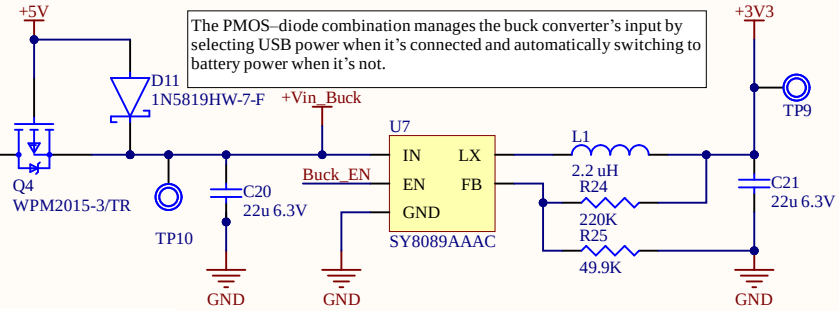
Battery Charging Circuit



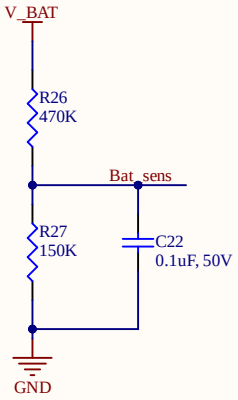
The MCP73831T- 2ACI/OT is a battery- charging IC from Microchip that provides a constant charge current set by the RPROG resistor; here, a 2 kΩ resistor programs the charging current to 500 mA.

3.3V Generation

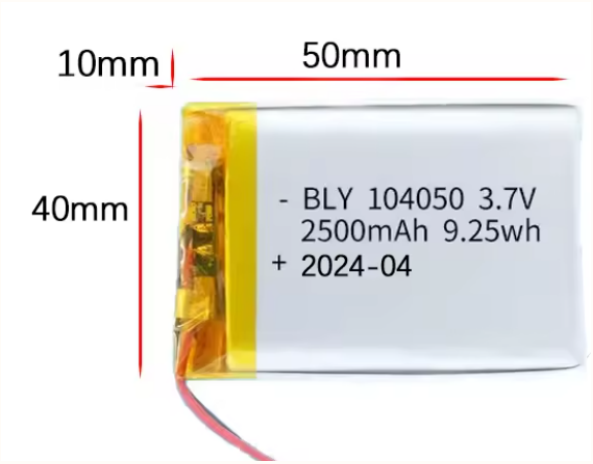


The SY8089AAAC is a synchronous buck converter IC from Silergy that delivers up to 1 A of load current at 1.5 MHz switching frequency, with input undervoltage lock- out and thermal- shutdown protection; the output voltage is set by an external resistor divider—e.g. a 220 kΩ/49.9 kΩ feedback network programs V_{out} to about 3.3 V.

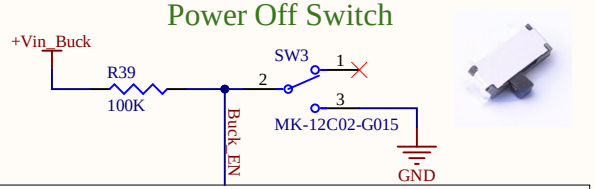
V_BAT Sampling



The 470 kΩ/150 kΩ resistor divider scales V_BAT down to ~0.24 × V_BAT for ADC sensing, while the 0.1 µF cap provides high- frequency noise filtering.



Power Off Switch



A switch sets the buck enable pin to ground, thus turning off the 3v3 generation and the device

The project uses a BLY 104050 single- cell Li- Po pouc battery rated 3.7 V nominal and 2500 mAh (≈9.25 Wh). It measures 50 × 40 × 10 mm, weighs about 50 g, and has no built- in protection, so we pair it with an external MCP73831- based charger. The manufacturer recommends charging it at 0.2–0.5 C (500–1250 mA) up to 4.20 V and avoiding discharge below 3.0 V to maximize life and safety.

Power Management

Battery charging circuitry, and 3v3 generation

Sheet title: Power.SchDoc			**Supervisor:** Sr. Andrés Roldán
Project title: RadiationDetector.PrjPcb			**Adress:** Avda. Madrid 28, Edif. I+D Josefina Castro Vizoso, 2ª planta 18012 - GRANADA, SPAIN
Author: Pablo Morán Peña		**Size:** A4	
Date: 24/08/2025	Revision: **1**	**Sheet:** 5 of 6	

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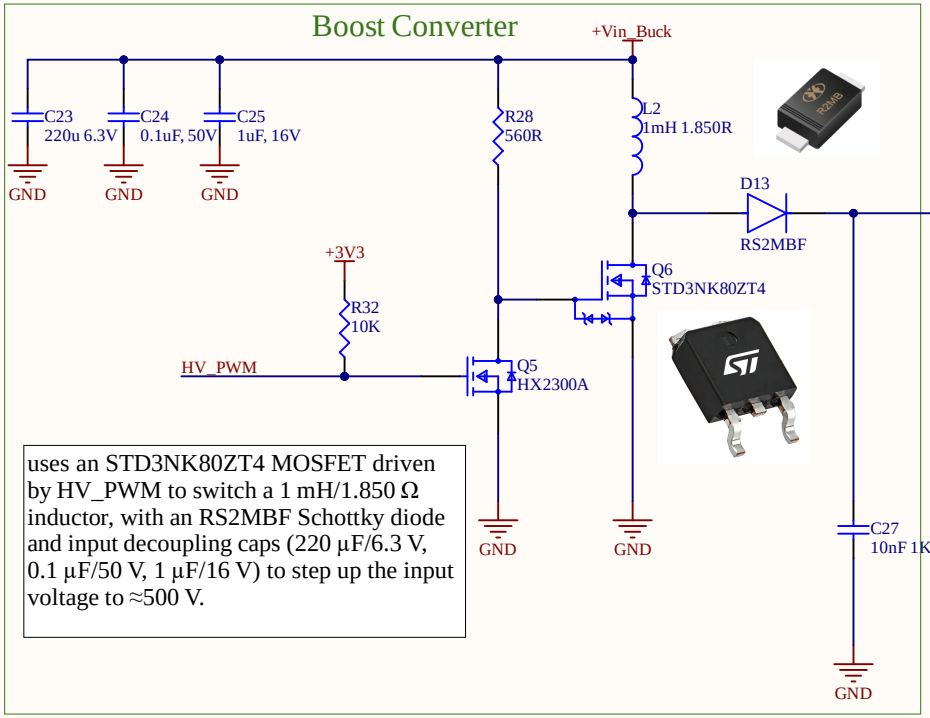
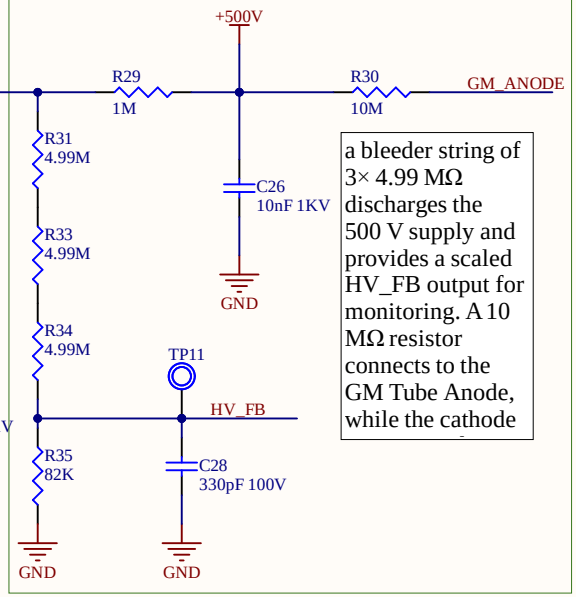
Boost Converter



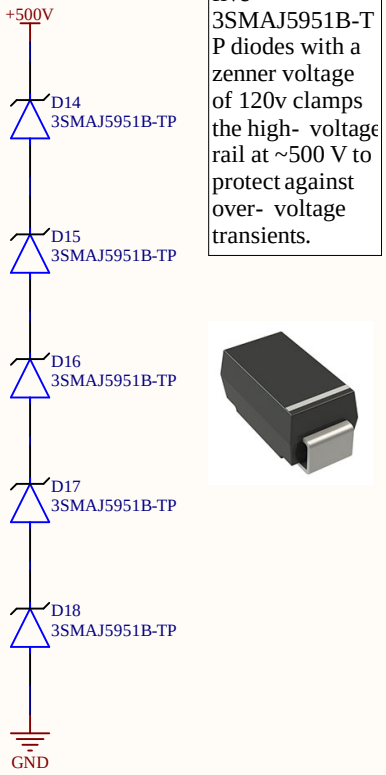
uses an STD3NK80ZT4 MOSFET driven by HV_PWM to switch a 1 mH/1.850 Ω inductor, with an RS2MBF Schottky diode and input decoupling caps (220 µF/6.3 V, 0.1 µF/50 V, 1 µF/16 V) to step up the input voltage to ≈500 V.

Bleeder + Feedback



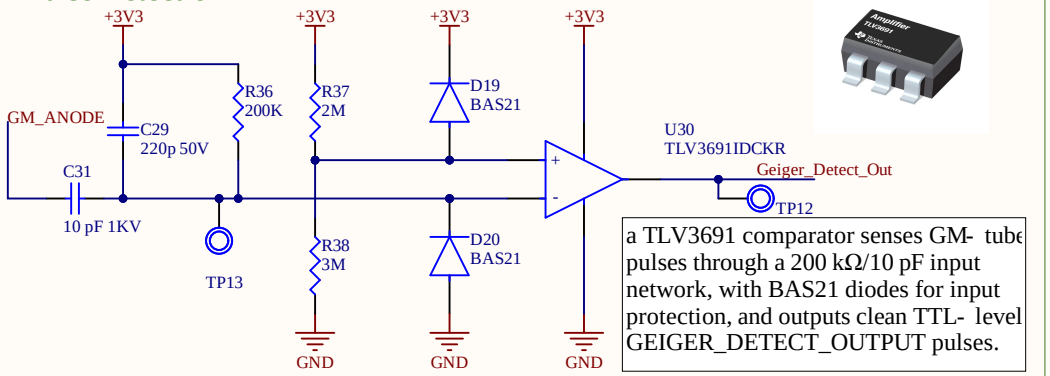
a bleeder string of 3× 4.99 MΩ discharges the 500 V supply and provides a scaled HV_FB output for monitoring. A 10 MΩ resistor connects to the GM Tube Anode, while the cathode

HV Clamp



a series chain of five 3SMAJ5951B-TP diodes with a zenner voltage of 120v clamps the high- voltage rail at ~500 V to protect against over- voltage transients.

Pulse Detection



a TLV3691 comparator senses GM- tube pulses through a 200 kΩ/10 pF input network, with BAS21 diodes for input protection, and outputs clean TTL- level GEIGER_DETECT_OUTPUT pulses.

The tube's anode is held at +500 V through a high- value bleeder resistor, and a coupling capacitor (e.g. 10 nF/1 kV) blocks that DC while passing the fast voltage drop when the tube fires to the pulse- detector input.
The project uses a Philips 18504 Geiger–Müller tube.

GM Tube conditioning circuit

It generates the required 500 V for the GM tube and includes a simple pulse-generating circuit.

Sheet title: Geiger_Circuit.SchDoc			**Supervisor:** Sr. Andrés Roldán
Project title: RadiationDetector.PrjPcb			**Adress:** Avda. Madrid 28, Edif. I+D Josefina Castro Vizoso, 2ª planta 18012 - GRANADA, SPAIN
Author: Pablo Morán Peña		**Size:** A4	
Date: 24/08/2025	Revision: **1**	**Sheet:** 6 of 6	

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Line #	Name	Description	Designator	Quantity	Manufacturer 1	Manufacturer Part Number 1	Manufacturer Lifecycle 1	Supplier 1	Supplier Part Number 1	Supplier Unit Price 1	Supplier Subtotal 1
	1uF, 16V	CAP CER 1UF 16V X5R 0402	C1, C24, C25, C36, C37, C38	6							
	10uF, 10V	CAP CER 10UF 10V X5R 0402	C4, C15	2							
	0.1uF, 50V	CAP CER 0.1UF 50V X7R 0402	C5, C6, C8, C9, C10, C11, C14, C16, C22, C24, C30, C32, C33, C34	14							
	4u7 6.3V	CAP CER 4.7UF 6.3V X5R 0402	C7, C17, C18	3							
	470p 50V	CAP CER 470PF 50V X7R 0402	C12	1							
	220p 50V	CAP CER 220PF 50V X7R 0402	C13, C29	2							
	2 Pin JST	Board Connector, 2 Contact(s), 1 Row(s), Male, Straight, 0.079 inch Pitch, Solder Terminal, Locking, Natural Insulator	C19	1							
	22u 6.3V	CAP CER 22UF 6.3V X5R 0603	C20, C21	2							
	220u 6.3V	CAP CER 220UF 6.3V X5R 1210	C23	1							
	10nF 1kV	CAP CER 10000PF 1kV X7R 1206	C26, C27	2							
	330pF 100V	CAP CER 330PF 100V C0G/NPO 0805	C28	1							
	10 pF 1kV	CAP CER 10PF 1kV C0G/NPO 1206	C31	1							
	1N5819HW-7-F	DIODE SCHOTTKY 40V 1A SOD123	D1, D5, D11	3							
	ESD5B5.0ST1G	TVS DIODE 5VWM SOD523	D2, D3, D4, D6, D7, D8	6							
	PMEG4010BEA,115	DIODE SCHOTTKY 40V 1A SOD323	D9, D10	2							
	RED LED	LED RED CLEAR SMD	D12	1							
	RS2MBF	2A 1000V 1.3V SMB FL Diodes - General Purpose ROHS	D13	1							
	SMAJ5951B-TP	DIODE ZENER 120V 3W DO214AC	D14, D15, D16, D17, D18	5							
	BAS21	DIODE SWITCHING 250V 200MA SOT223	D19, D20	2							
	ESP32-S3-WROOM-1U-N16R8	SMD Modules, ESP32-S3R8 With 8 MB	ESP32-S3-WROOM-1U-N16R8	1							
	2171760001	CONN RCP USB2.0 TYP C 24P SMD R/A	G1, G2	2							
	GX16 4PIN	GX16 4PIN	J1	1							
	2.2uH	1.35A 2.2uH ±20% 1.35A SMD, 5x5mm Power Inductors ROHS	L1	1							
	1mH 1.85OR	FIXED IND 1MH 520MA 1.85 OHM SMD	L2	1							
	PS2720P02	Data Line Filter, 1 Function(s)	LS1	1							
	S8050-G	Transistores - Bipolar (BJT) - Single NPN 25 V 1.5 A 100MHz 300 mW Montaje en superficial SOT-23-3	Q1, Q2	2							
	2N7002	MOSFET SOT23 N-60V 5OHM 1SOC	Q3	1							
	WPM3015-3/TR	20V 2.4A 110mΩ@4.5V,2.7A 1.1W 1V@250uA 1 P-Channel SOT-23-1 MOSFETs ROHS	Q4	1							
	HX2300A	20V 2.5A 46mΩ@4.5V,2.5A 850mV 1 N-channel SOT-23 MOSFETs ROHS	Q5	1							
	SIS318NKB0ZS4	MOSFET N-CH 800V 2.5ADPAK	Q6	1							
	0R	RES 0 OHM JUMPER 1/16W 0402	R1, R5	2							
	10K	RES SMD 10K OHM 1% 1/16W 0402	R2, R3, R4, R11, R12	5							
	27R	RES SMD 27 OHM 1% 1/16W 0402	R6, R7	2							
	4K7	RES SMD 4.7K OHM 1% 1/16W 0402	R8	1							
	5k1	RES SMD 5.1K OHM 1% 1/16W 0402	R9, R10, R12, R13	4							
	2K	TRIMMER 2K OHM 0.25W JLEAD TOP	R14	1							
	1K	RES SMD 1K OHM 5% 1/16W 0402	R15, R19, R21	3							
	150R	RES SMD 150 OHM 1% 1/16W 0402	R16, R22	2							
	47K	RES SMD 47K OHM 1% 1/16W 0402	R17	1							
	50R	RES SMD 50 OHM 0.1% 1/16W 0402	R18	1							
	10K	TRIMMER 10K OHM 0.25W SMT TOP ADJ	R20	1							
	2KR	RES 2K OHM 1% 1/16W 0402	R23	1							
	220K	RES 220K OHM 5% 1/16W 0402	R24	1							
	49.9K	RES 49.9K OHM 1% 1/16W 0402	R25	1							
	470K	RES 470K OHM 5% 1/16W 0402	R26	1							
	150K	RES 150K OHM 5% 1/16W 0402	R27	1							
	560R	RES SMD 560 OHM 1% 1/16W 0402	R28	1							
	3M	RES SMD 3M OHM 1% 1/16W 0402	R29	1							
	10M	RES SMD 10M OHM 1% 1/16W 0402	R30	1							
	4.99M	RES 4.99M OHM 1% 1/4W 1206	R31, R33, R34	3							
	82K	RES SMD 82K OHM 1% 1/16W 0402	R35	1							
	200K	RES SMD 200K OHM 1% 1/16W 0402	R36	1							
	2M	RES SMD 2M OHM 1% 1/16W 0402	R37	1							
	3M	RES SMD 3M OHM 5% 1/16W 0402	R38	1							
	100K	RES SMD 100K OHM 1% 1/16W 0402	R39	1							
	LCD_TOUCHSCREEN_	Data Line Filter, 1 Function(s)	SCREEN1	1							
	PTS645SH50SMTR92 LFS	SWITCH TACTILE SPST-NO 0.05A 12V	SW1, SW2	2							
	MK-12C02-G015	Surface Mount, Right Angle 1A SPDT 5V Back 10,000 Cycles SMD Slide Switches ROHS	SW3	1							
	FT231XQR	IC USB SERIAL FULL UART 20QFN	U1	1							
	TLV9542IDGKR	200MHz Rail-to-Rail I/O, CMOS Operational Amplifier for Cost-Sensitive Systems	U2, U3, U4, U5	4							
	MCP73831T-2ACI/OT	Power Supply Support Circuit, Adjustable, 1 Channel, PDSO5	U6	1							
	SY8089AAAC	Buck Adjustable 2A 2.7V~5.5V SOT-23-5 DC-DC Converters ROHS	U7	1							
	TLV6691IDCNR	IC COMPARATOR1 GEN PURPOSE 70-5	U10	1							