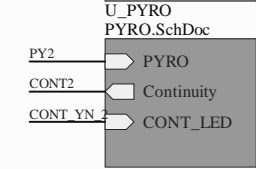
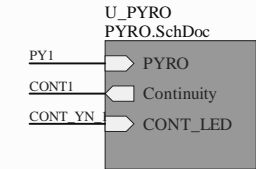
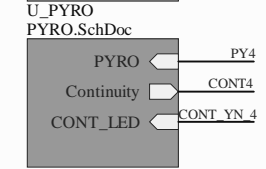
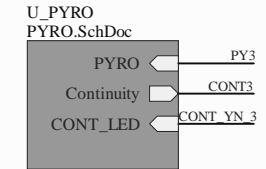
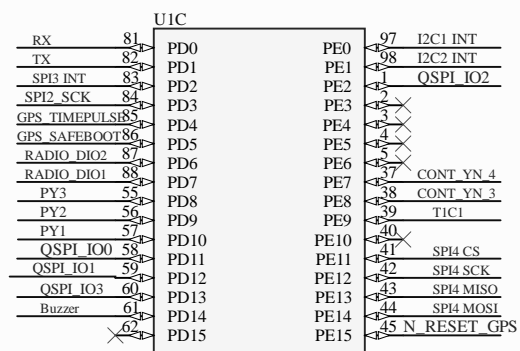
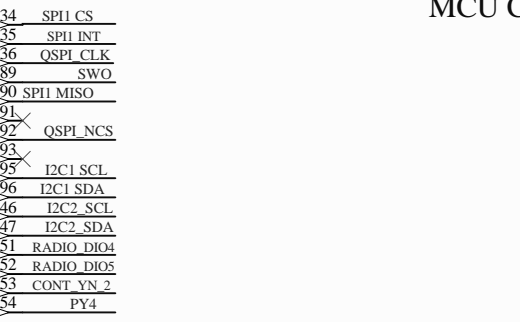
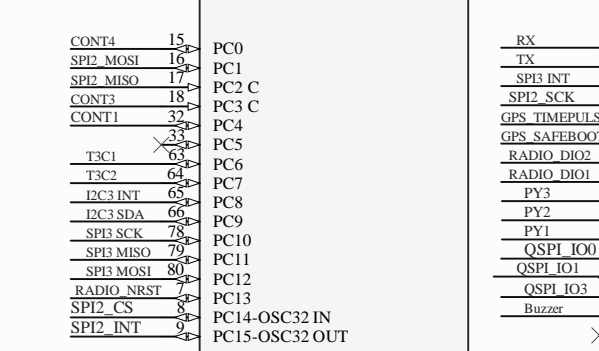
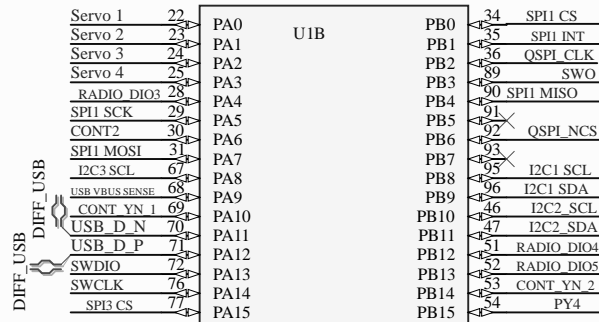
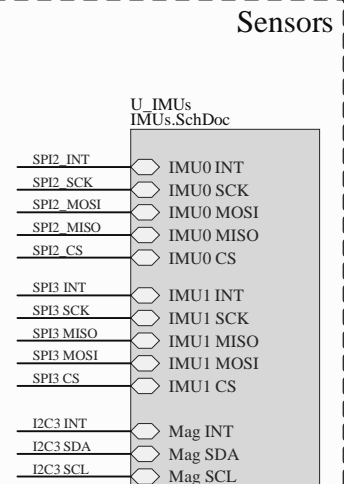
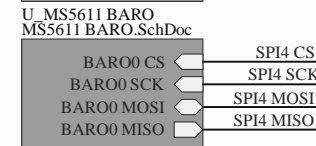
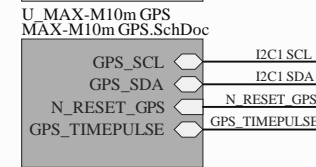
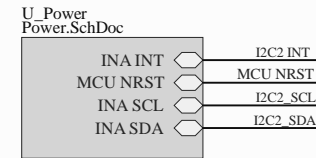
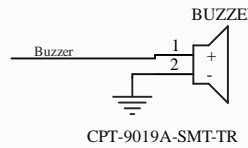
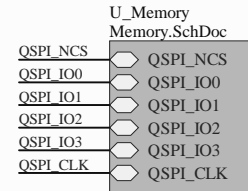
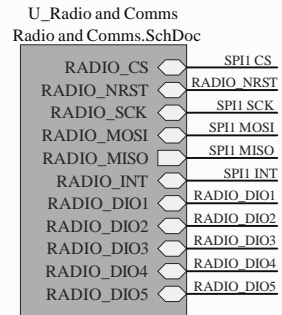
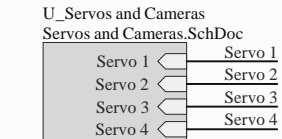
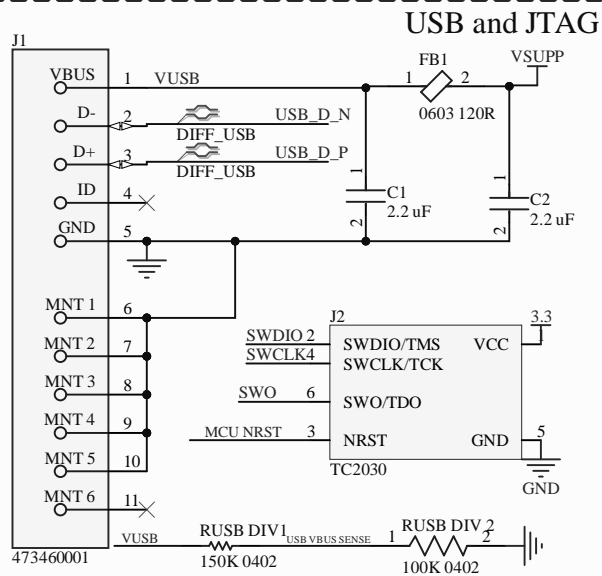
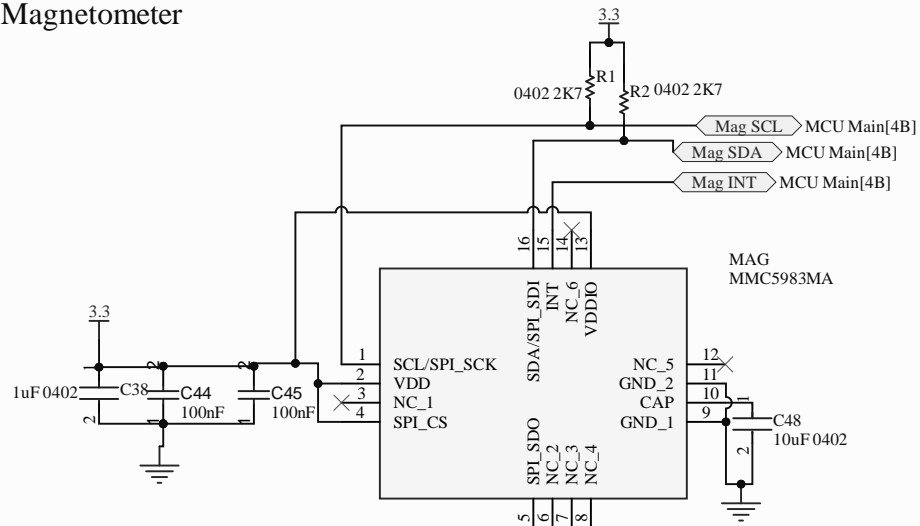
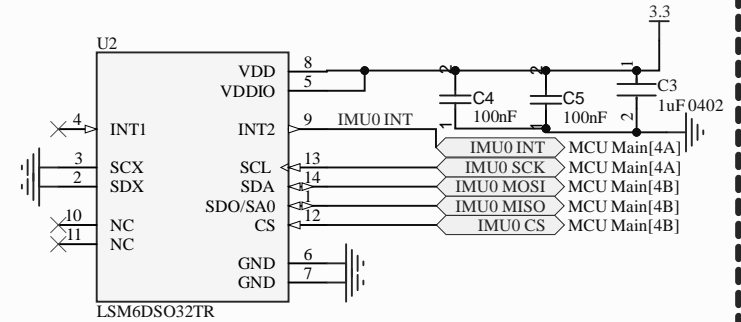
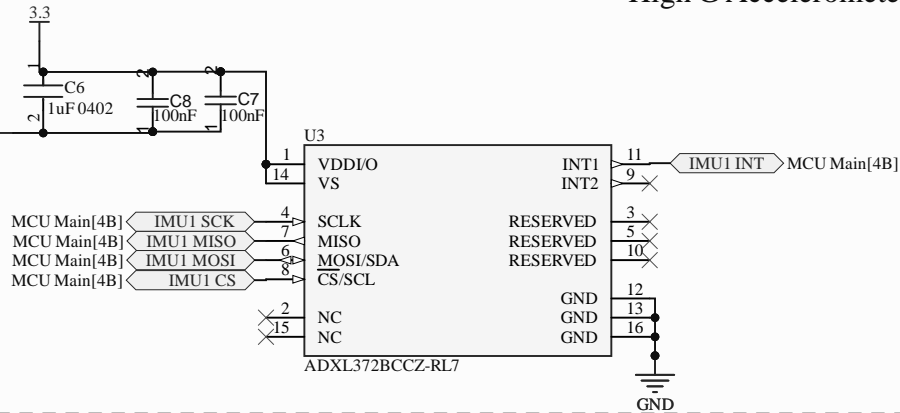


MCU Overview and Peripherals

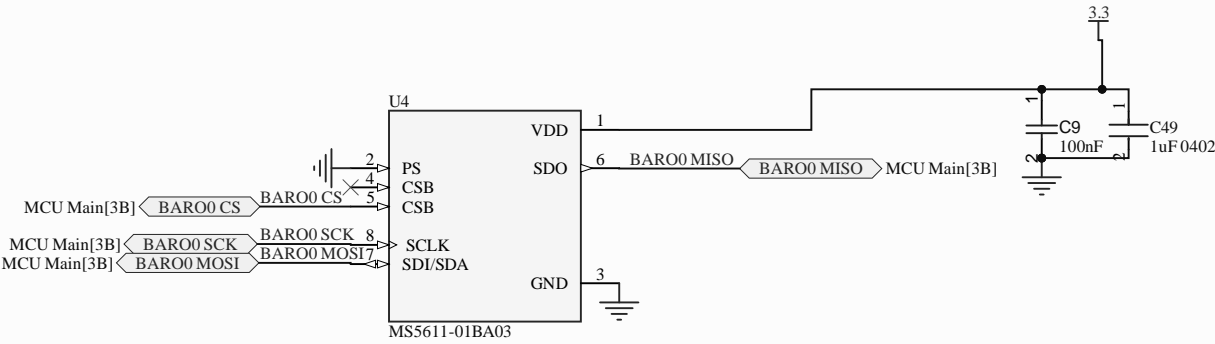


Title MCU Overview and Peripherals		
Size A4	Number 1	Revision Final
Date: 11/17/2025	Sheet 1 of 9	
File: C:\Users\...\MCU Main.Sch.Doc	Drawn By: Ashwin Vishwanath	



Title IMU Circuitry			
Size A4	Number 2		Revision Final
Date:	11/17/2025	Sheet 2 of	9
File:	C:\Users\...IMUs.SchDoc	Drawn By: Ashwin Vishwanath	

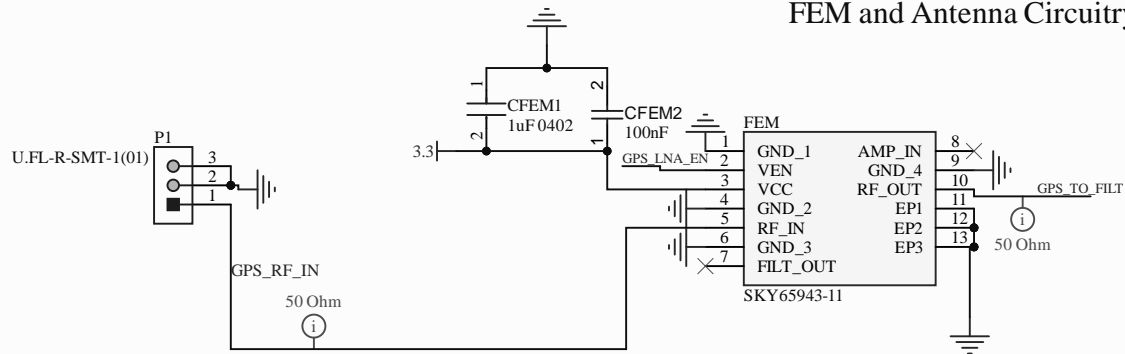
MS5611 Barometer Circuitry



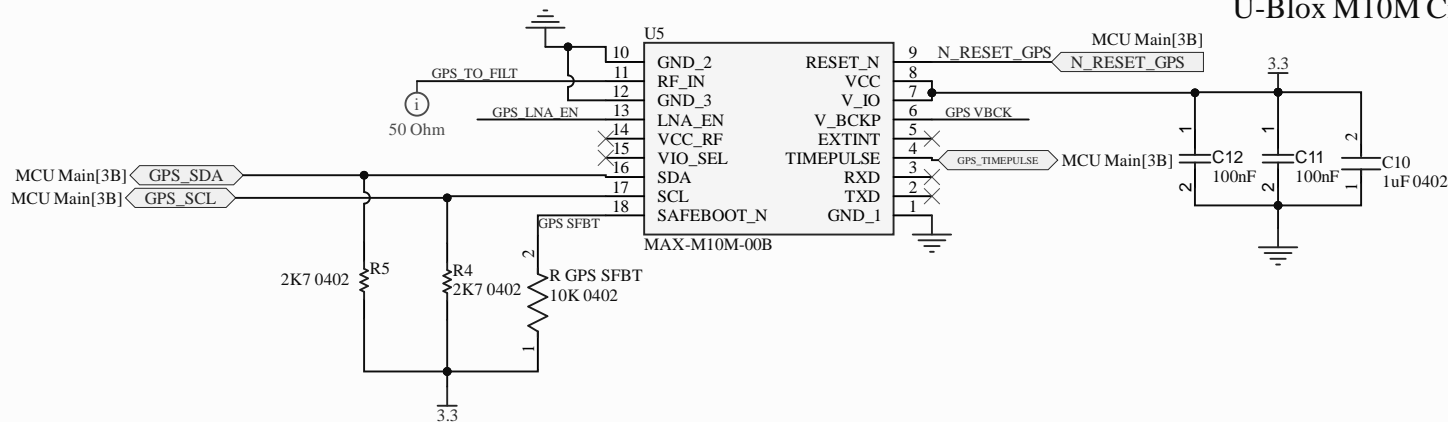
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Size	Number	Revision					
A4	3	Final					
Date:	11/17/2025					Sheet 3 of 9	
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GPS MAX M10M Circuitry

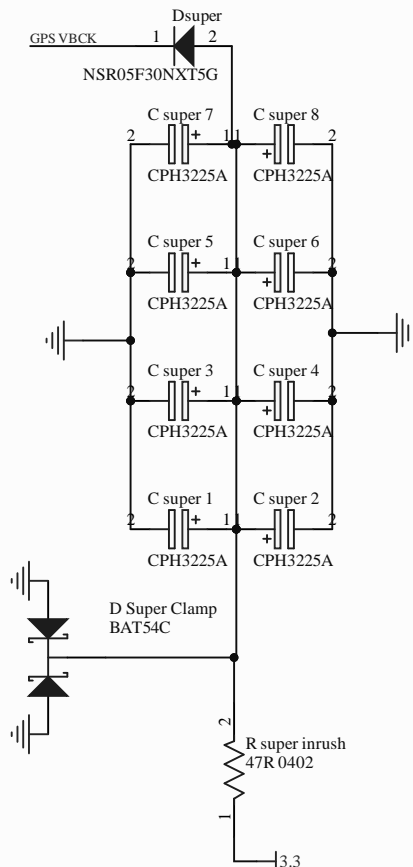
FEM and Antenna Circuitry



U-Blox M10M Circuitry



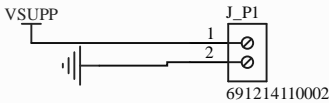
Super Capacitor Bank



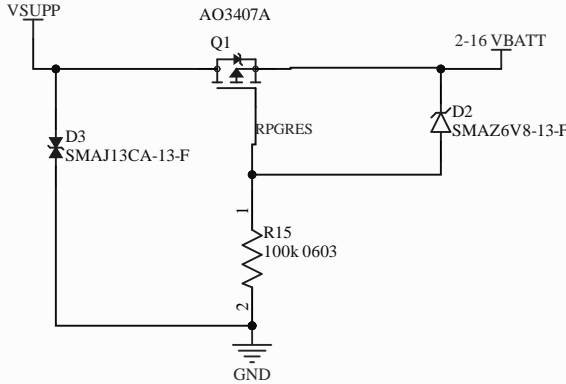
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GPS MAX M10M circuitry		
Size	Number	Revision
A4	4	Final
Date:	11/17/2025	Sheet 4 of 9
File:	C:\Users\...\MAX-M10m GPS.SchDoc	Drawn By: Ashwin Vishwanath

Power Distribution Circuitry

Input and Protection

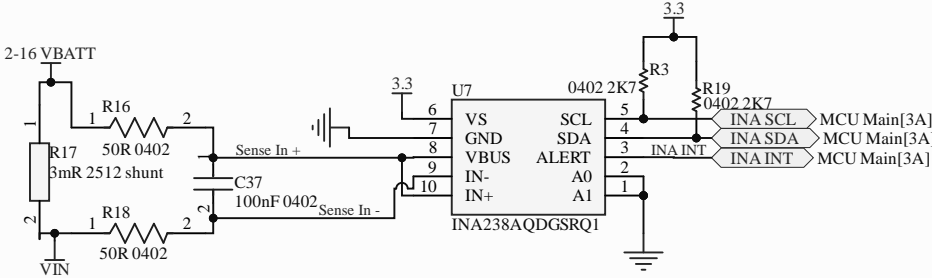


Reverse-polarity and surge protection circuit.
Q1 (P-MOSFET) allows current flow when VIN is positive but blocks reverse current if VIN is inverted.
D3 absorbs input transients, D2 clamps the gate to protect Vgs, and R15 provides gate discharge for smooth startup.



Power Sensing

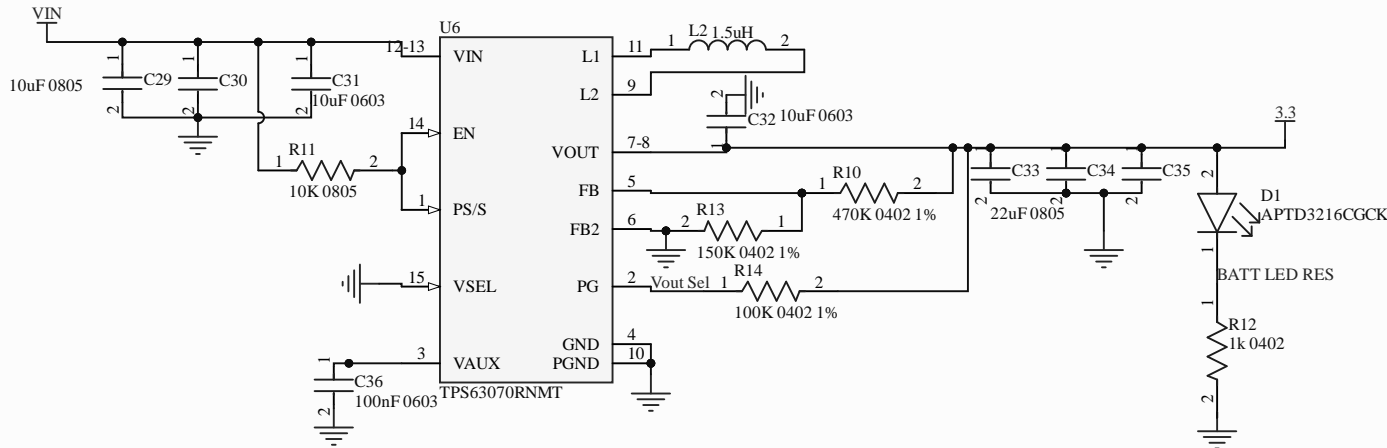
This circuit measures system current and voltage using the INA239 precision current/voltage/power monitor.
A 3 mΩ sense resistor (R17) in series with the supply line develops a small differential voltage proportional to current, filtered by C37.
The INA239 amplifies this signal and reports current, voltage, and power via I2C to the MCU.



R17 (3mΩ 2512 Kelvin shunt):
Selected for accurate high-current measurement of all system loads (servos, pyro channels, radio, sensors) while staying within the INA238's ±163mV full-scale range.
At 20A peak:
 $V_{shunt} = I * R = 20A * 0.003\Omega = 60mV$ (<163mV limit)
 $P_{diss} = I^2 * R = (20A)^2 * 0.003\Omega = 1.2W$
A 2W 2512 package provides ample thermal margin with low self-heating.
Kelvin (4-terminal) geometry minimizes errors from PCB copper IR drops and maintains stability during high di/dt events.
R16-R18 (50Ω 0402) and C37 (100nF 0402):
Form a differential RC low-pass filter to remove high-frequency switching and servo noise before the INA238 input stage.
 $f_c = 1 / (2 * \pi * R * C)$
 $\approx 1 / (2 * \pi * 50\Omega * 100nF)$
 $\approx 31.8kHz$
This cutoff filters PWM and switching spikes while keeping response fast enough for current transients in the kHz range.
Resistor dissipation is negligible (μA bias current), so 0402 is sufficient.

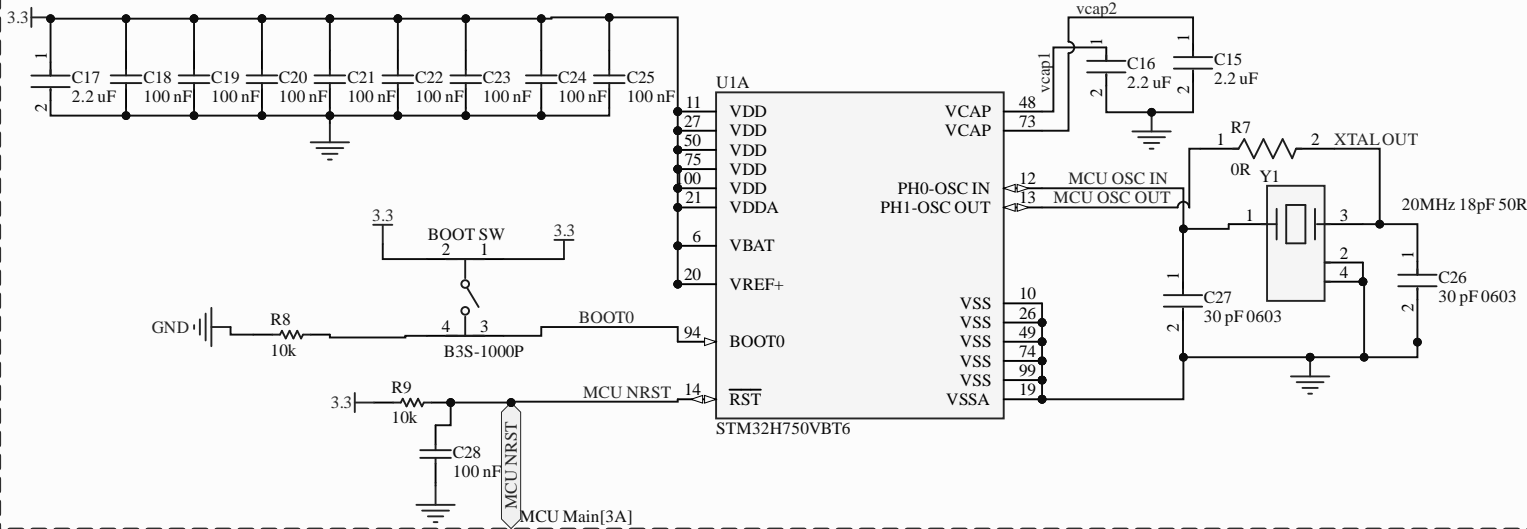
2-16v Buck-Boost Regulator

This circuit implements a buck/boost converter using the TPS63070 to generate a regulated 3.3V rail from a variable input supply.
C29-C32 provide input and output decoupling for noise suppression, while L1 and L2 form the main power inductor pair for energy storage and filtering.
Feedback resistors R12-R13 set the output voltage, and R14-R15 provide current sense or load feedback stabilization.
C33-C35 ensure loop stability and transient response.
D1 and R16 drive a status LED indicating the presence of the regulated 3.3V output.

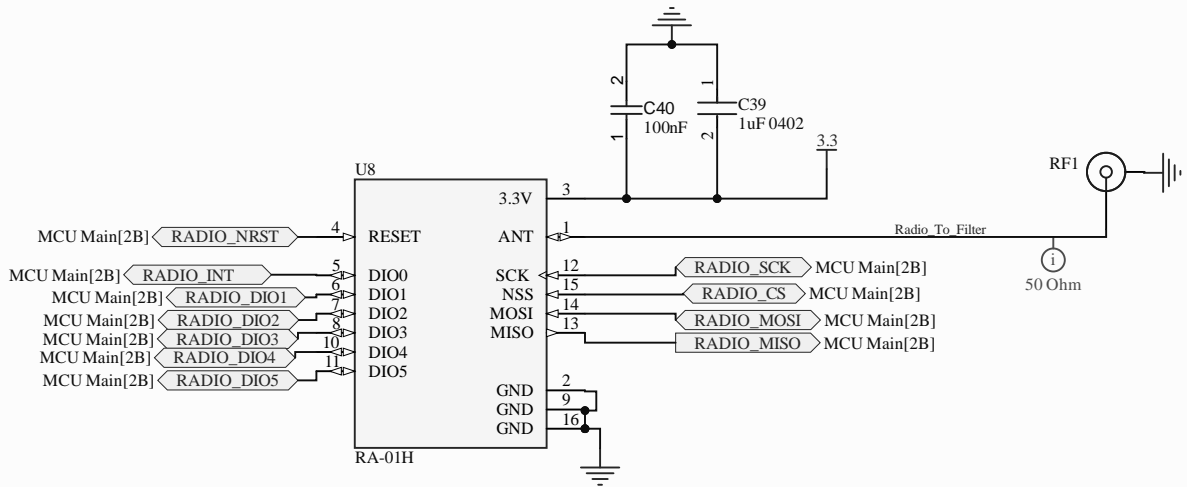


MCU Core

This circuit provides power decoupling, reset control, and clock generation for the MCU core.
C17-C25 form distributed decoupling across all VDD and VDDA pins to ensure stable 3.3V operation.
Boot SW and R8 provide manual BOOT0 selection for firmware flashing, while R9 and C26 form the NRST debounce circuit.
The external crystal oscillator (Y1, C30-C31) establishes the MCU clock reference, and VCAP stabilizes the internal regulator output.
Overall, this section ensures clean supply rails, reliable startup, and accurate clock timing for the microcontroller.



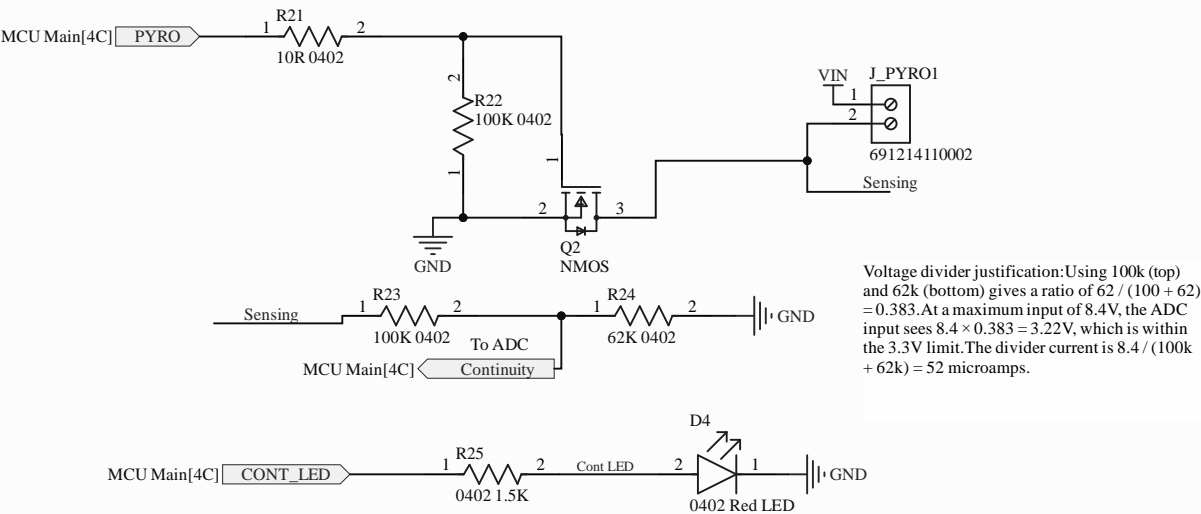
Radio Communications Circuitry



This circuit implements the LoRa radio transceiver interface using the RA-01H module. The MCU communicates with the transceiver via SPI (MOSI, MISO, SCK, CS) and digital control lines (NRST, INT, DIO0-DIO5). C39-C40 provide local power decoupling, while the RF path includes a 50 Ω matching network (C41, L3, L4, C42, C43) to ensure proper impedance matching and minimize signal reflections. The filtered RF output connects to an external antenna through a 50 Ω transmission line, maintaining optimal RF performance and low loss.

Title		
Radio Communications Circuitry		
Size	Number	Revision
A4	6	Final
Date:	11/17/2025	Sheet 6 of 9
File:	C:\Users\...\Radio and Comms.SchDoc	Drawn By: Ashwin Vishwanath

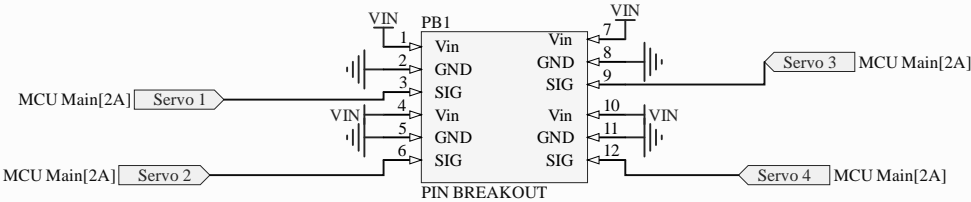
Pyro Channel and Continuity Detection Circuitry



This circuit drives and monitors a pyro channel. Q2 (P-MOSFET) switches current to the igniter when the MCU asserts the PYRO signal, with R21 limiting gate charge current and R22 pulling the gate low to keep the channel off by default. The “Sensing” line provides a high-impedance continuity check through R23–R24, allowing the MCU to verify igniter presence without firing. D4 and R25 form a status LED circuit driven by CONT_LED to indicate continuity or armed state.

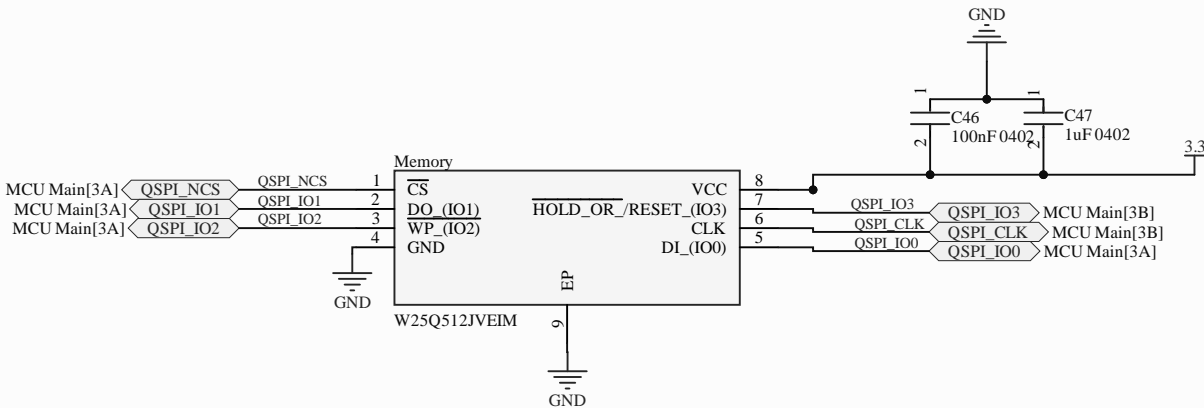
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Size A4	Number 7	Revision Final
Date: 11/17/2025	Sheet 7 of 9	
File: C:\Users\...\PYRO.SchDoc	Drawn By: Ashwin Vishwanath	

Servo Header Circuitry



Title			Servo Header Circuitry	
Size	Number		Revision	
A4	8		Final	
Date:	11/17/2025		Sheet 8 of 9	
File:	C:\Users\...\Servos and Cameras.SchDoc		Drawn By: Ashwin Vishwanath	

Flash Memory Circuitry



Title			Flash Memory Circuitry
Size	Number	Revision	
A4	9	Final	
Date:	11/17/2025	Sheet 9 of	9
File:	C:\Users\...\Memory.SchDoc	Drawn By:	Ashwin Vishwanath