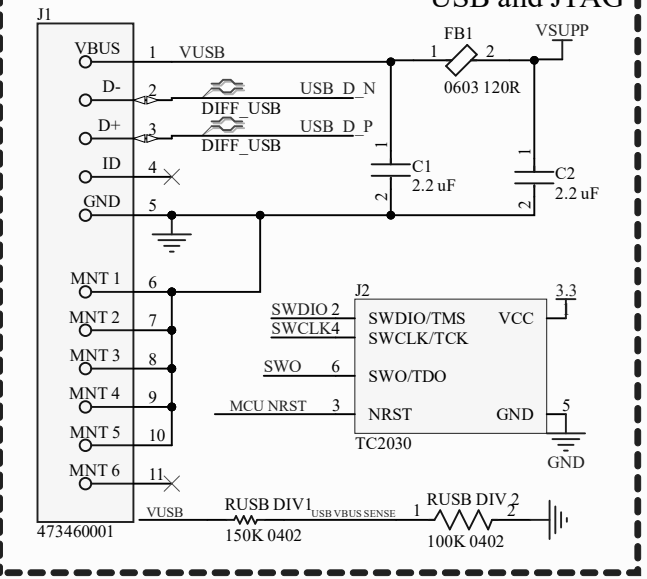
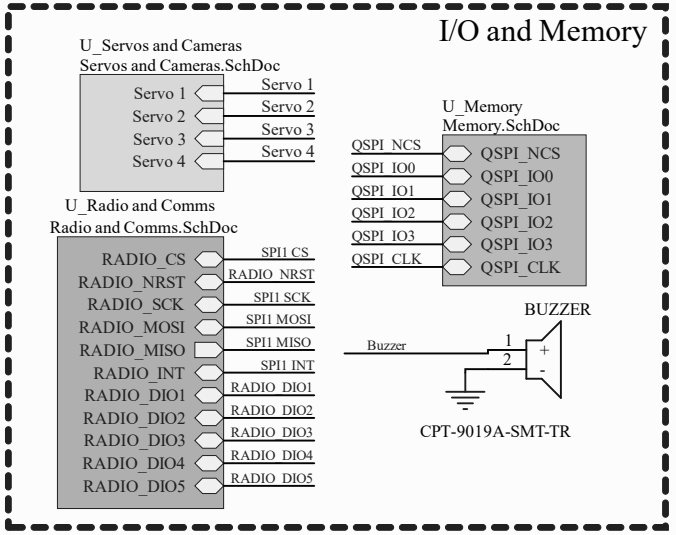
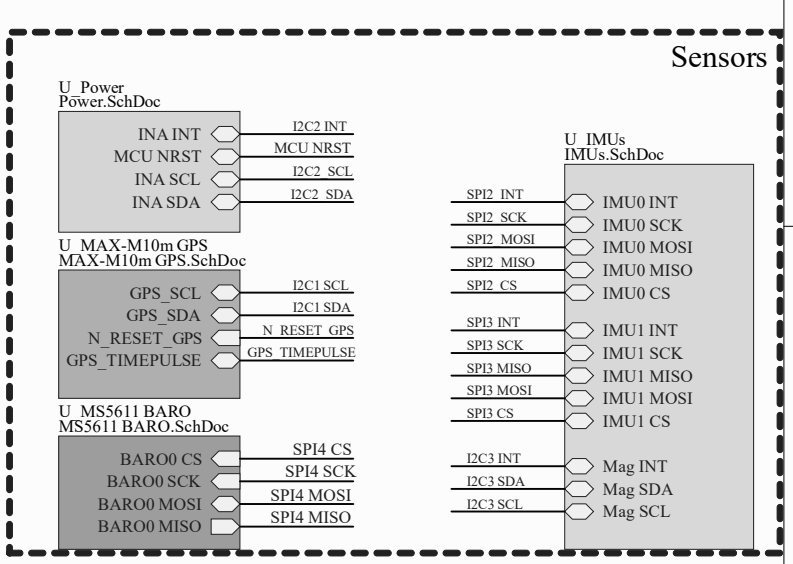
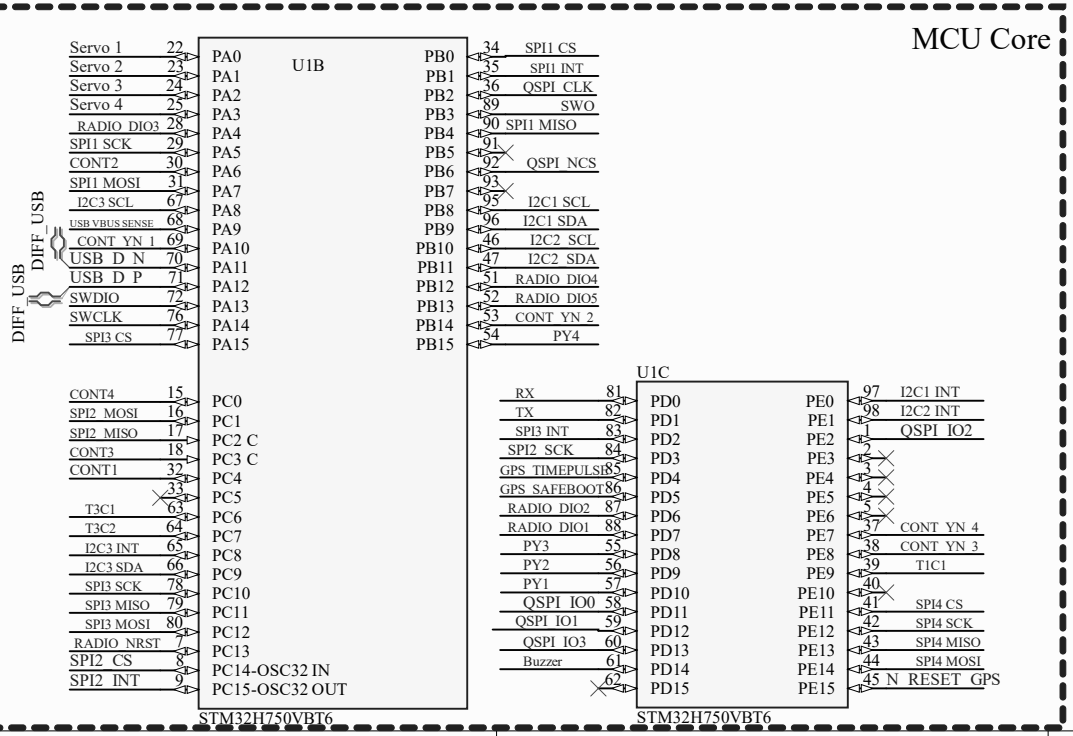
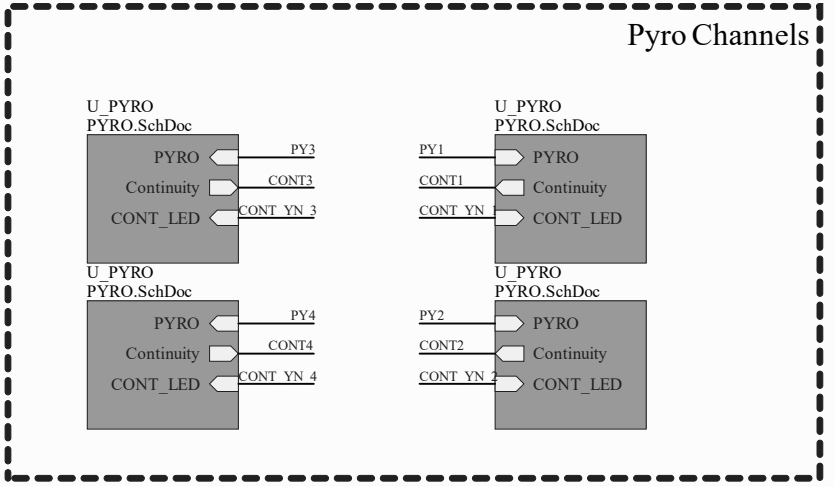
MCU Overview and Peripherals





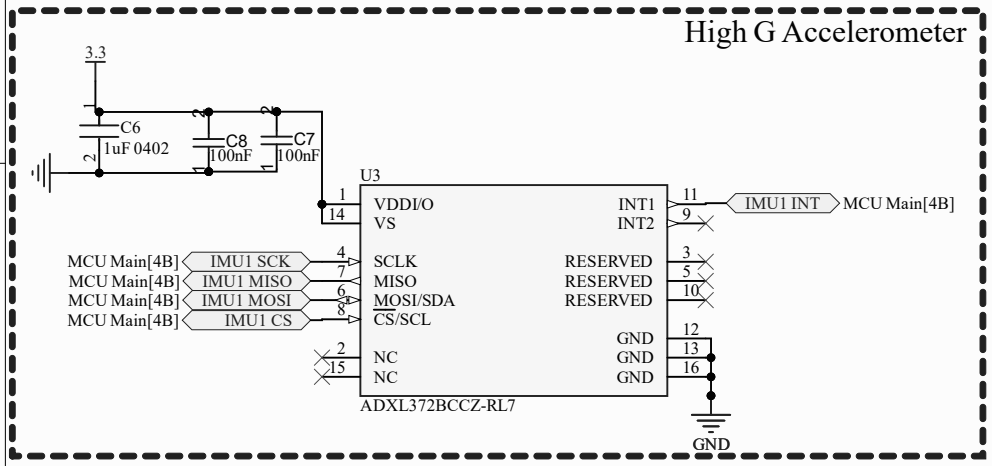


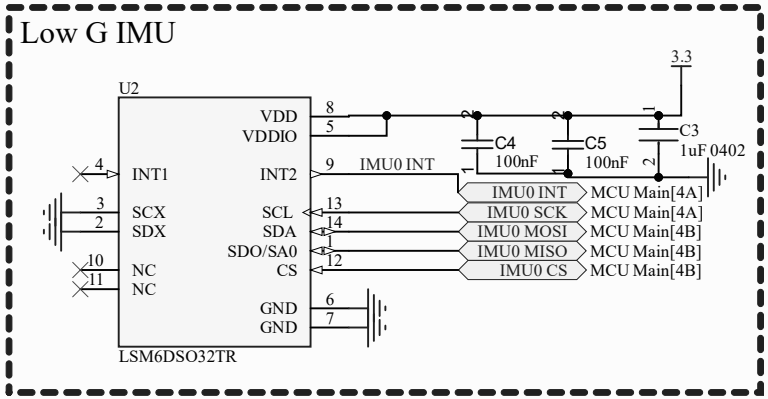


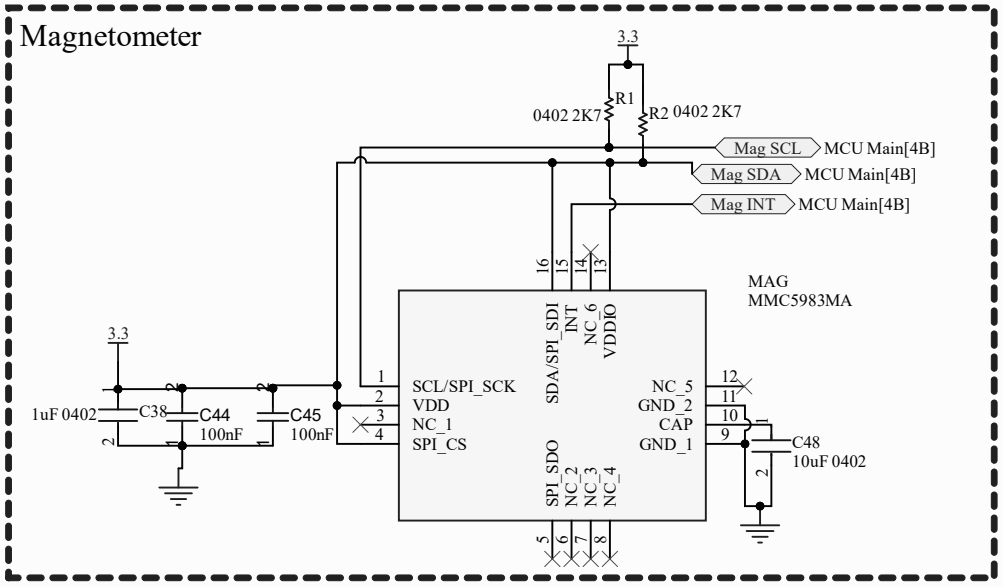


Title: MCU Overview and Peripherals		
Size: A4	Number: 1	Revision: Final
Date: 11/03/2025		Sheet 1 of 9
File: C:\Users\..\MCU Main.SchDoc		Drawn By: Ashwin Vishwanath

IMU Circuitry

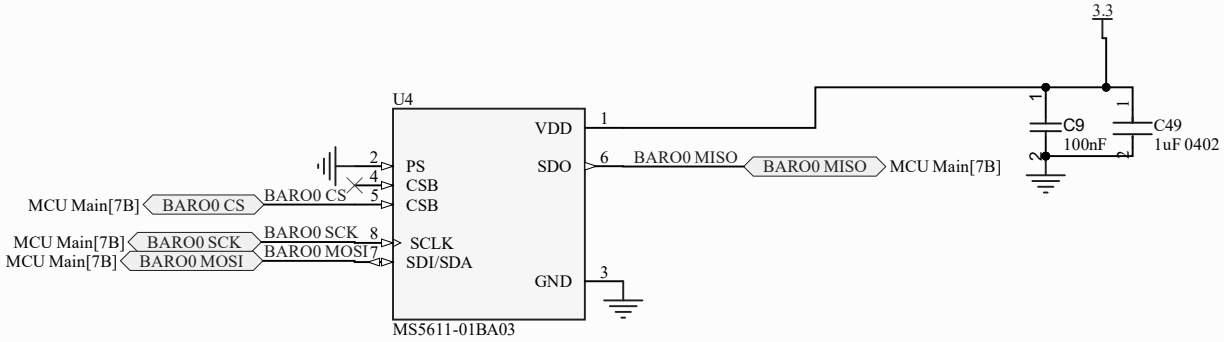






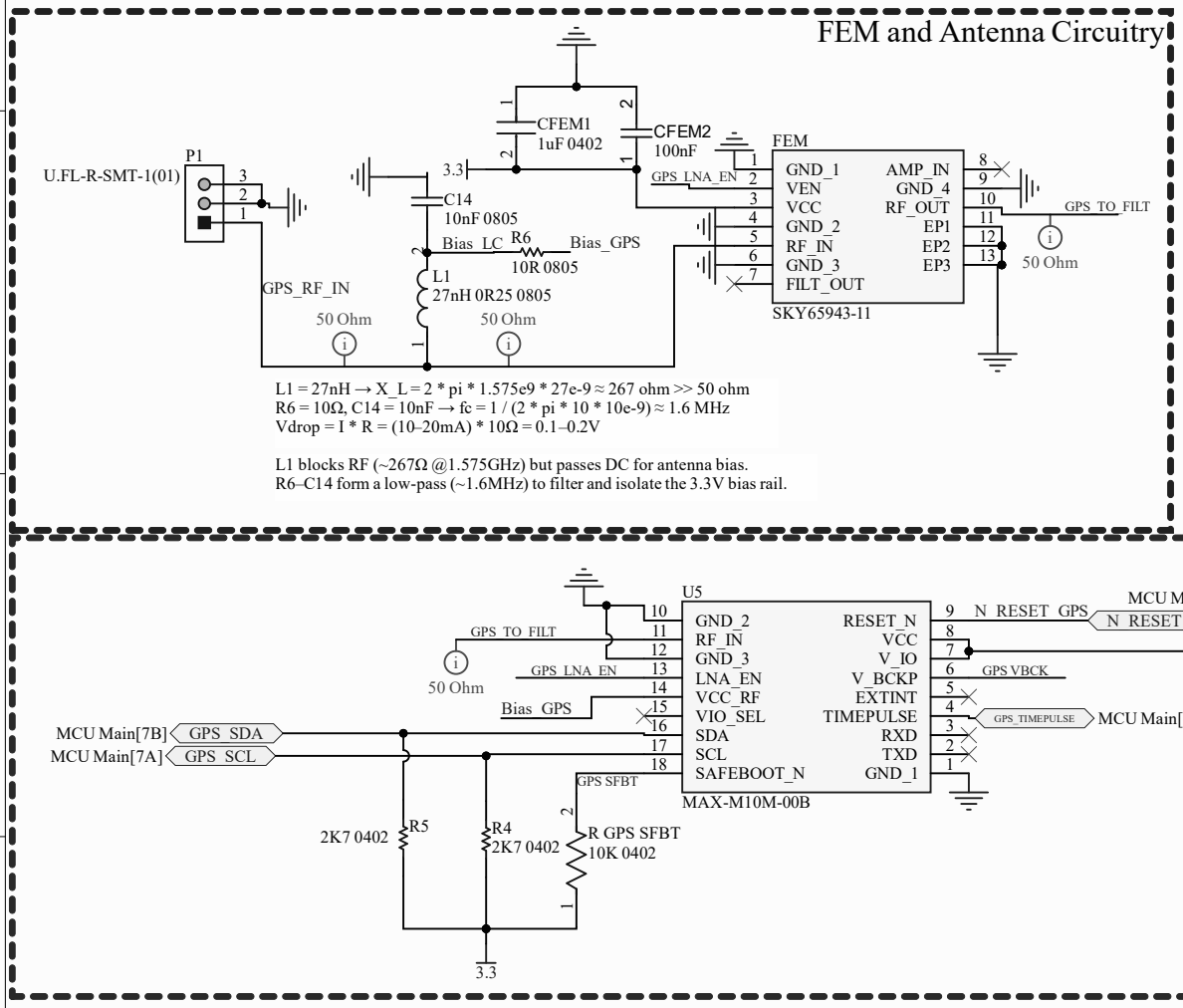
Title: IMU Circuitry		
Size: A4	Number: 2	Revision: Final
Date: 11/03/2025		Sheet 2 of 9
File: C:\Users\..\IMUs.SchDoc		Drawn By: Ashwin Vishwanath

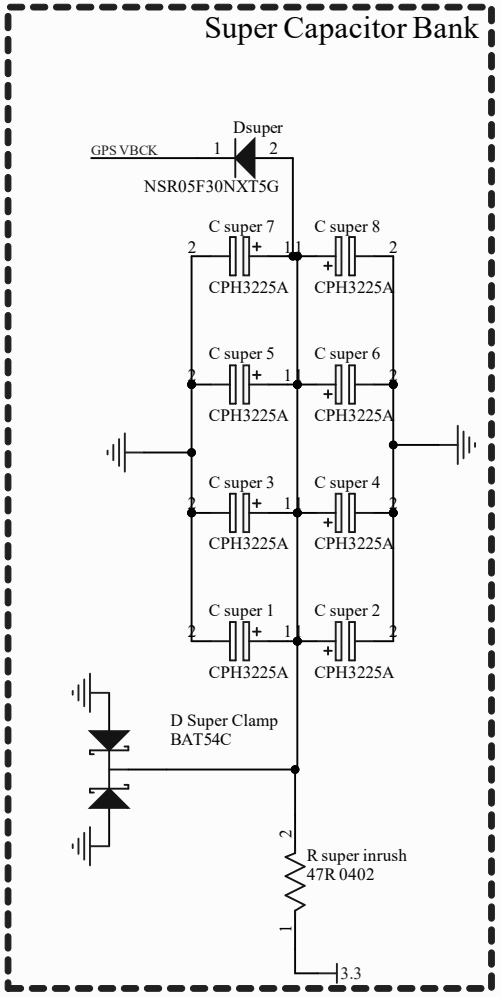
MS5611 Barometer Circuitry



Title: MS5611 Barometer Circuitry		
Size: A4	Number: 3	Revision: Final
Date: 11/03/2025		Sheet 3 of 9
File: C:\Users\..\MS5611 BARO.SchDoc		Drawn By: Ashwin Vishwanath

GPS MAX M10M Circuitry

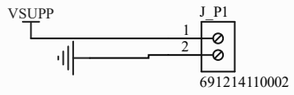




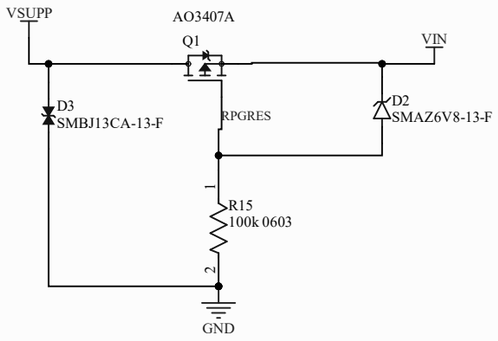
Title	GPS MAX M10M circuitry	
Size: A4	Number: 4	Revision: Final
Date: 11/03/2025		Sheet 4 of 9
File: C:\Users\..\MAX-M10m GPS.SchDoc		Drawn By: Ashwin Vishwanath

Power Distribuition Circuitry

Input and Protection

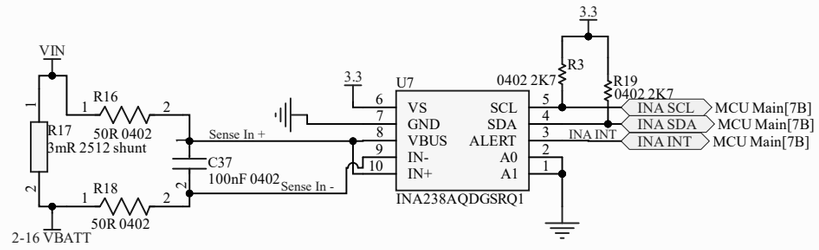


Reverse-polarity and surge protection circuit.
Q1 (P-MOSFET) allows current flow when VIN is positive but blocks reverse current if VIN is inverted.
D3 absorbs input transients, D2 clamps the gate to protect Vgs, and R15 provides gate discharge for smooth startup.



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.

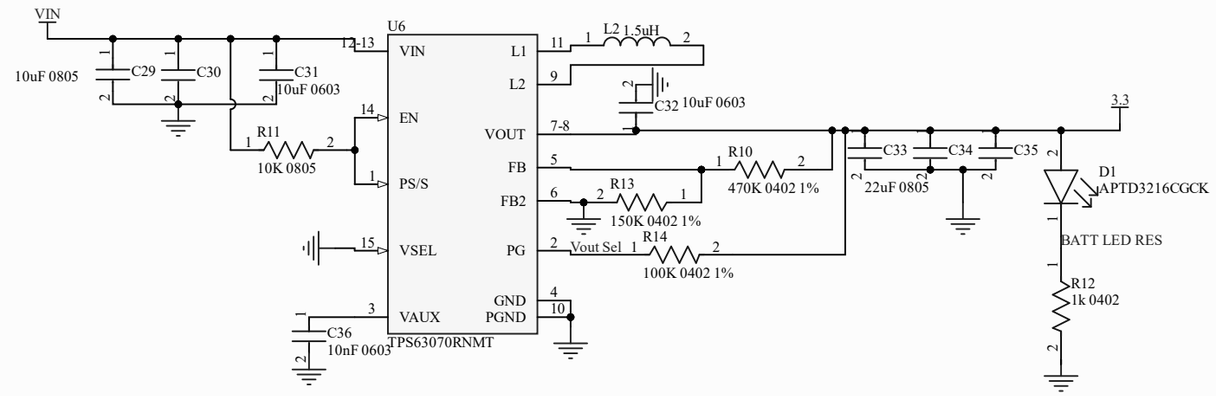


R17 (3mΩ 2512 Kelvin shunt):
Selected for accurate high-current measurement of all system loads (servos, pyro channels, radio, sensors) while staying within the INA238's ±163mV full-scale range.
At 20A peak:
Vshunt = I * R = 20A * 0.003Ω = 60mV (<163mV limit)
Pdiss = I^2 * R = (20A)^2 * 0.003Ω = 1.2W
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.
fc = 1 / (2 * π * R * C)
= 1 / (2 * π * 50Ω * 100nF)
≈ 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.

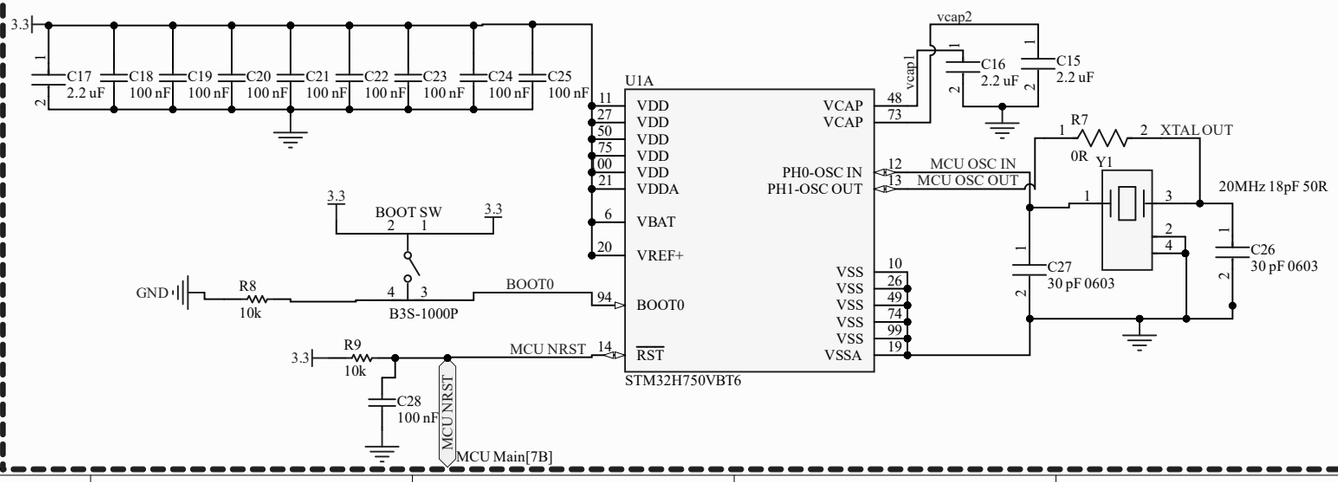
2-16v Buck-Boost Regulator

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.



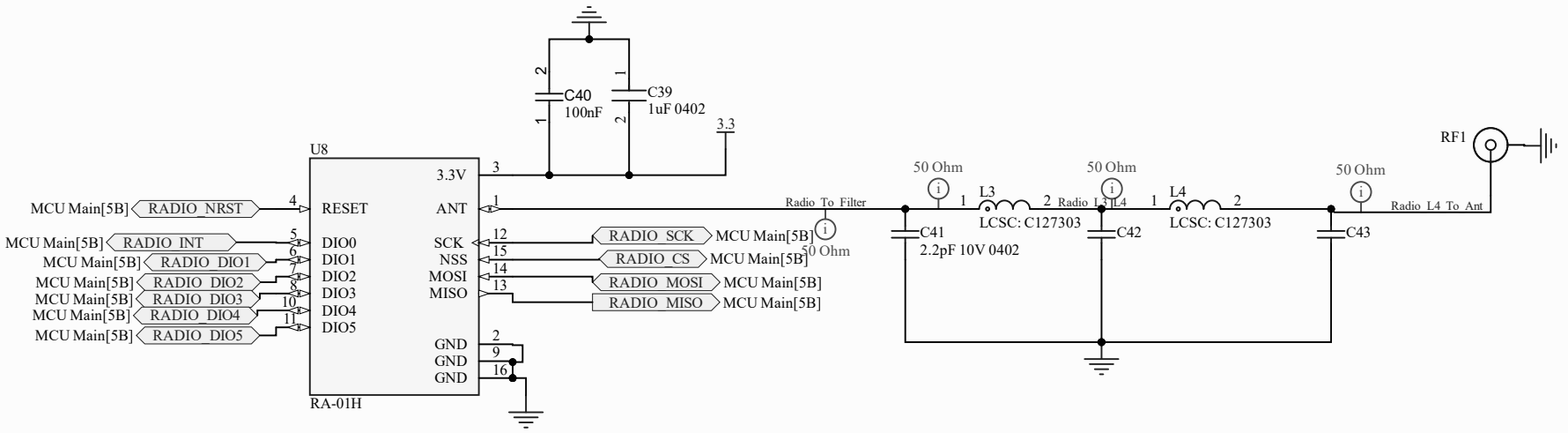
MCU Core

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.



Title: Power Distribuition Circuitry		
Size: A3	Number: 5	Revision: Final
Date: 11/03/2025		Sheet 5 of 9
File: C:\Users\..\Power.SchDoc		Drawn By: Ashwin Vishwanath

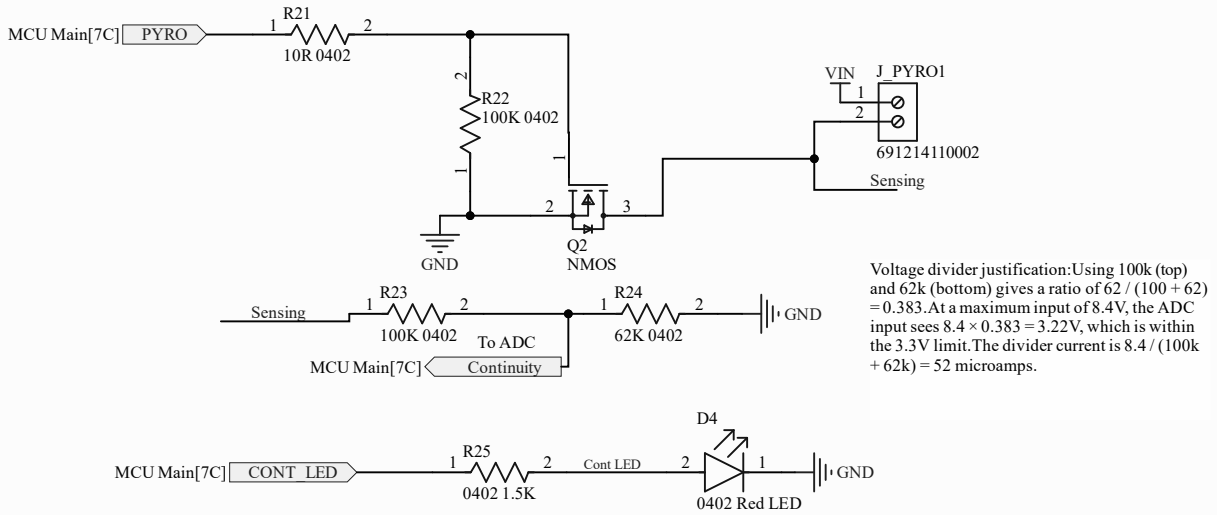
Radio Communications Circuitry



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: A4	Number: 6	Revision: Final
Date: 11/03/2025		Sheet 6 of 9
File: C:\Users\..\Radio and Comms.SchDoc		Drawn By: Ashwin Vishwanath

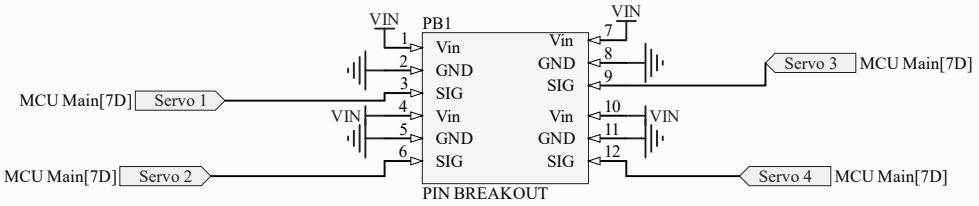
Pyro Channel and Continuity Detection Circuitry



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.

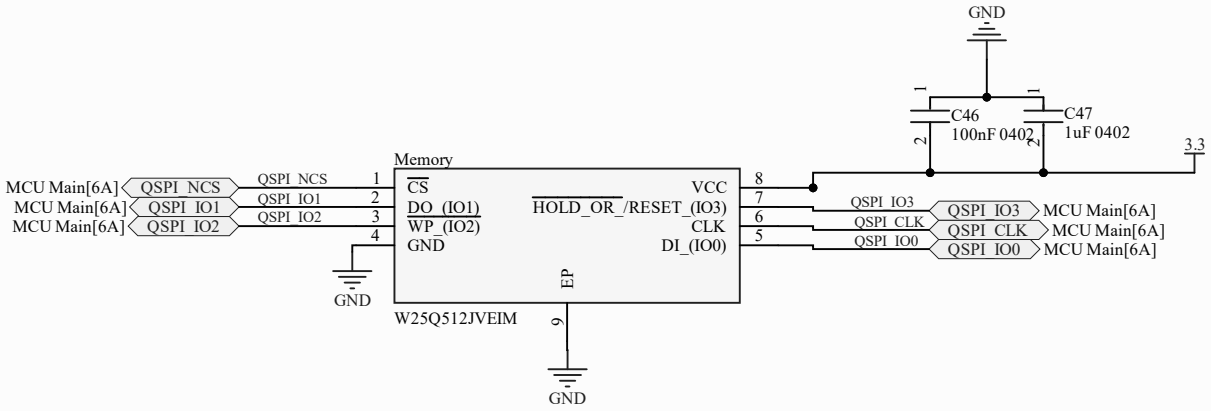
Title: Pyro Channel and Continuity Detection Circuitry		
Size: A4	Number: 7	Revision: Final
Date: 11/03/2025		Sheet 7 of 9
File: C:\Users\..\PYRO.SchDoc		Drawn By: Ashwin Vishwanath

Servo Header Circuitry

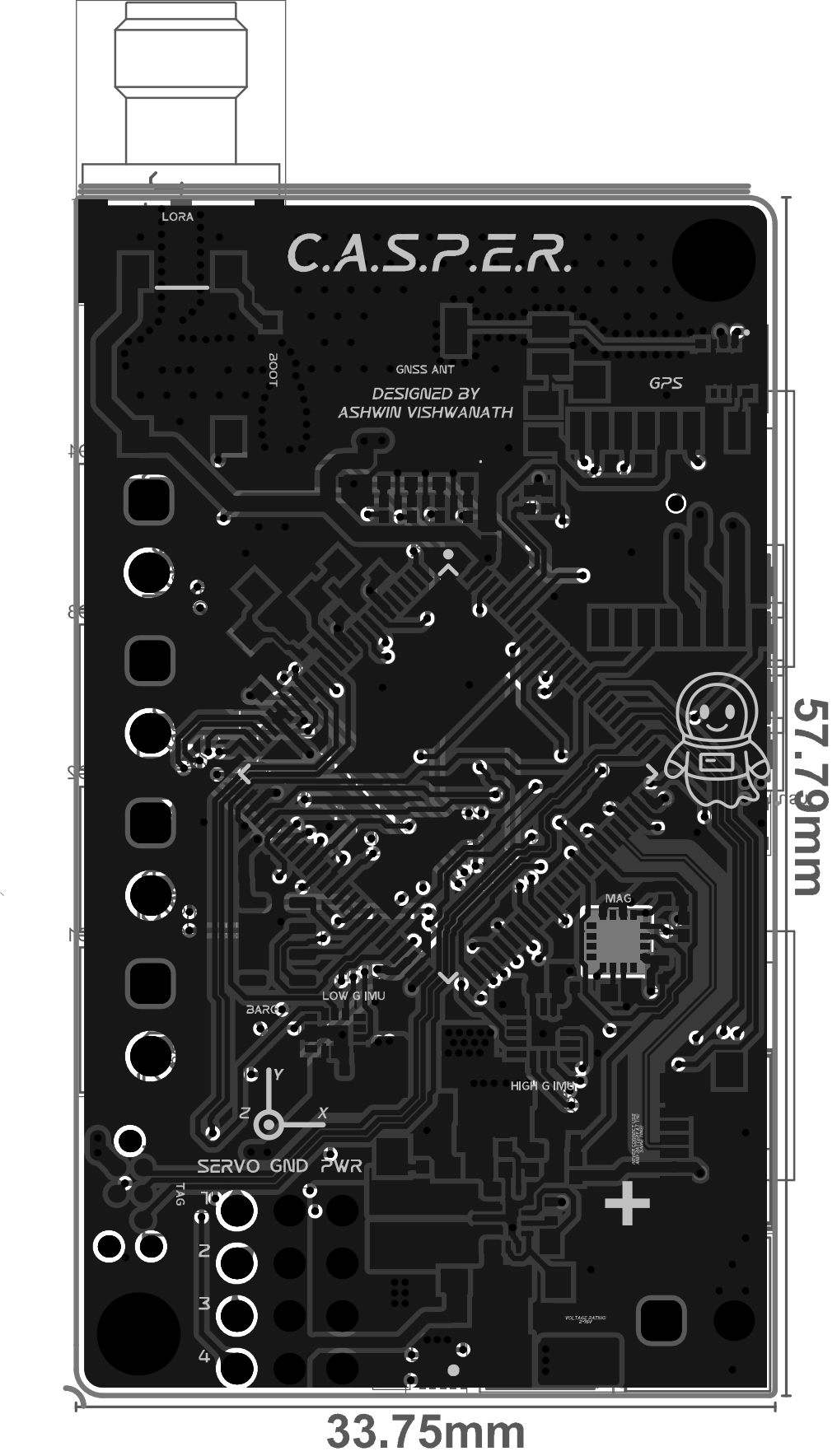


Title	Servo Header Circuitry	
Size: A4	Number: 8	Revision: Final
Date: 11/03/2025	Sheet 8 of 9	
File: C:\Users\..\Servos and Cameras.SchDoc	Drawn By: Ashwin Vishwanath	

Flash Memory Circuitry



Title	Flash Memory Circuitry		
Size: A4	Number: 9	Revision: Final	
Date: 11/03/2025		Sheet 9 of 9	
File: C:\Users\..\Memory.SchDoc		Drawn By: Ashwin Vishwanath	


C.A.S.P.E.R.
LORA
BOOT
GNSS ANT
GPS
DESIGNED BY
ASHWIN VISHWANATH
MAG
LOW G IMU
BARO
HIGH G IMU
SERVO GND PWR
TAG
57.79mm
33.75mm