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Student
Ballooning
Course

MegaSat Development Board

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What is the MegaSat?

The MegaSat is a microprocessor developmental board designed to assist students in learning electronic instrumentation and programming using the Arduino Mega.

It was developed by the Louisiana Space Grant Consortium as a replacement for the BalloonSat developmental board.

Development Background

- CanSat was a project conceived by Professor Bob Twiggs at Stanford University's Space Science Development Laboratory in the late 1990s.
- CanSat was designed to be accommodated within a soda can-sized satellite enclosure.
- BalloonSat was developed in the early 2000s at LSU by S.B. Ellison and Jim Giammanco as an adaptation of the CanSat.
- ACES needed a more convenient way to expand the payload with external devices and wanted the convenience of having on-board components not offered by CanSat. This led to the creation of BalloonSat.
- After many years of service, the hardware on the BalloonSat became outdated. The MegaSat was designed to update the hardware.

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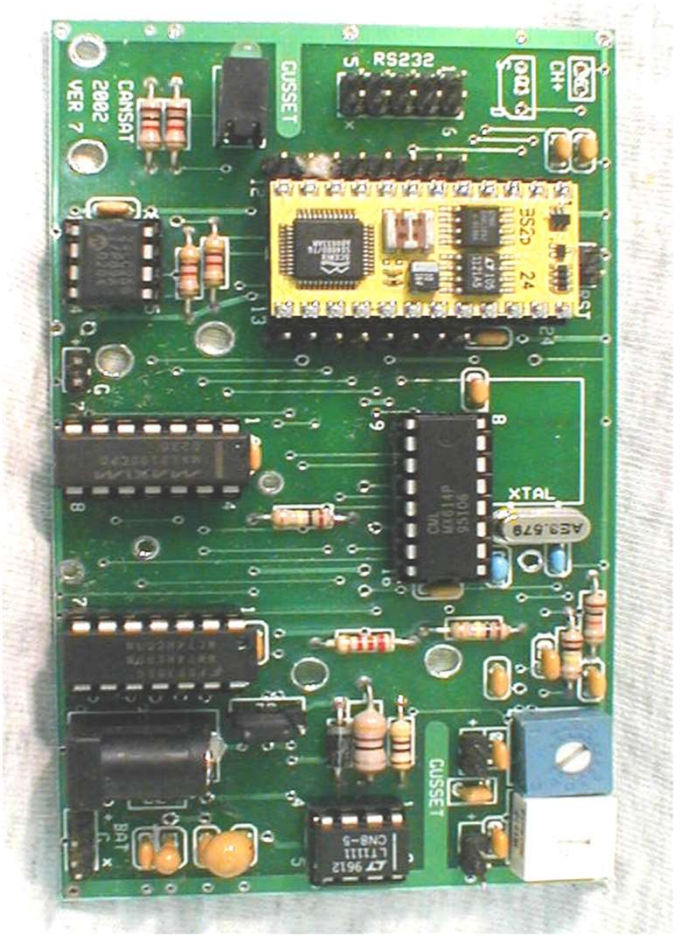
From CanSat to BalloonSat

- CanSat featured a BASIC Stamp microcontroller, an additional memory chip for data storage and a modem for connecting to an external radio transmitter/receiver.

- ACES payloads did not need the modem of CanSat so this was eliminated, but a number of enhancements were added to better accommodate payloads and allow for easier external expansion for students who wanted to go beyond the baseline features.



CanSat

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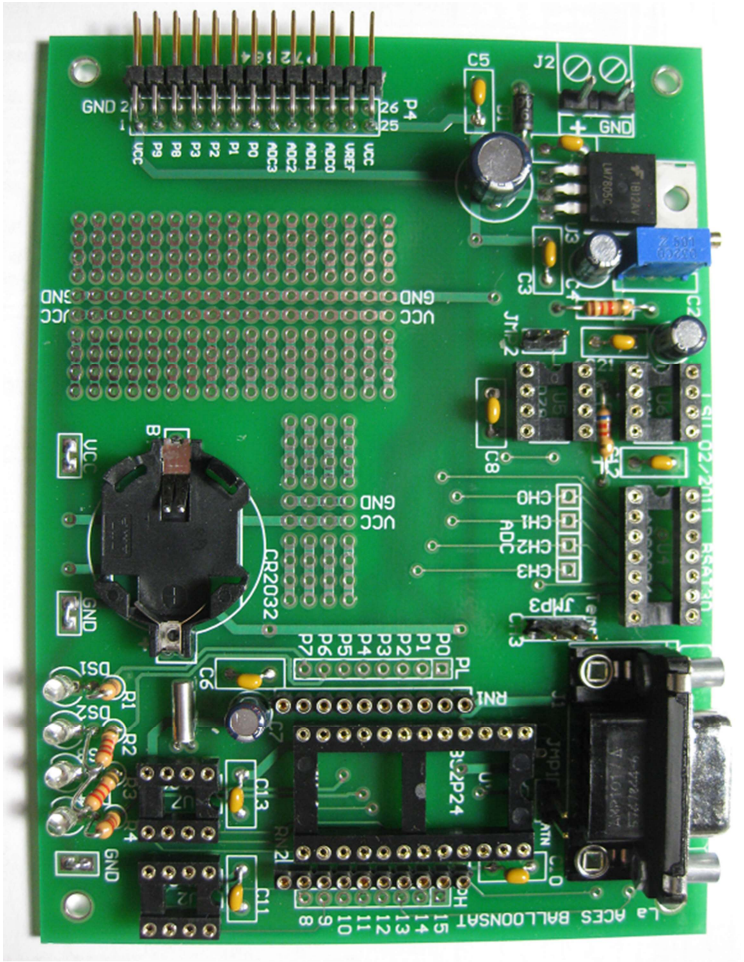
From BalloonSat to MegaSat

- The BalloonSat featured a Basic Stamp microcontroller, an external EEPROM, a 4-channel analog-to-digital converter, a voltage reference, a temperature sensor, a real time clock with a battery backup, and 4 on-board LEDs for use as visual indicators

- The BalloonSat was used by the ACES program for over ten years before the MegaSat was created to update the hardware.



BalloonSat

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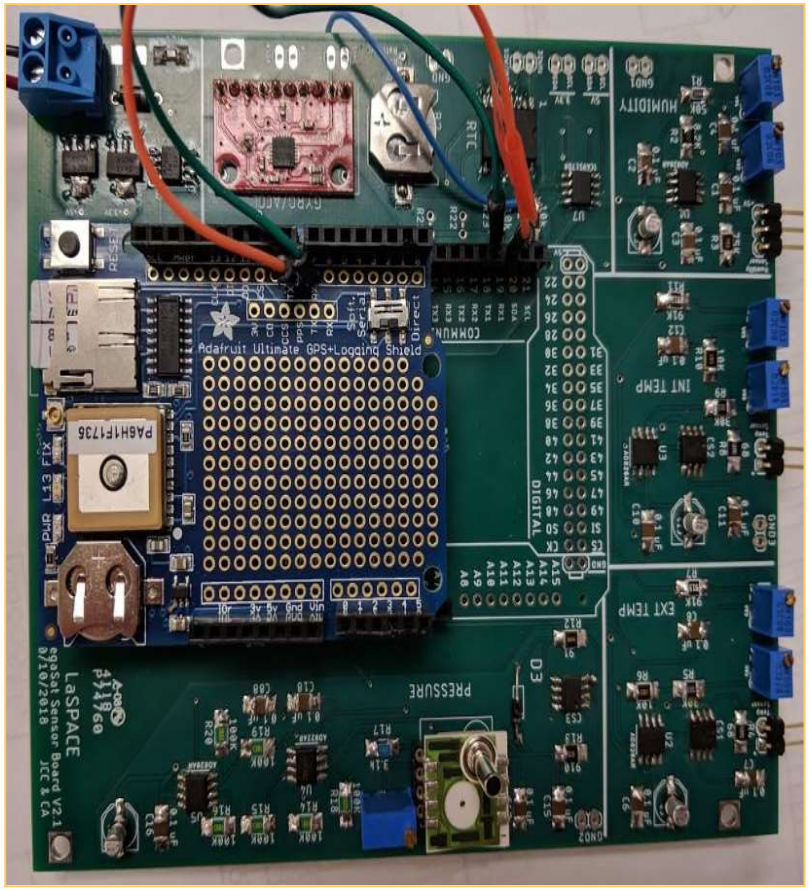
MegaSat Components

The MegaSat included several components for students to utilize:

- Arduino Mega Interface
- Real Time Clock
- Gyroscope / Accelerometer
- 2x temperature sensors and sensor interfaces
- Humidity sensor and sensor interface
- Pressure sensor and sensor interface

Additionally, the MegaSat powers all components on the board from an a +12V supplied externally to the board



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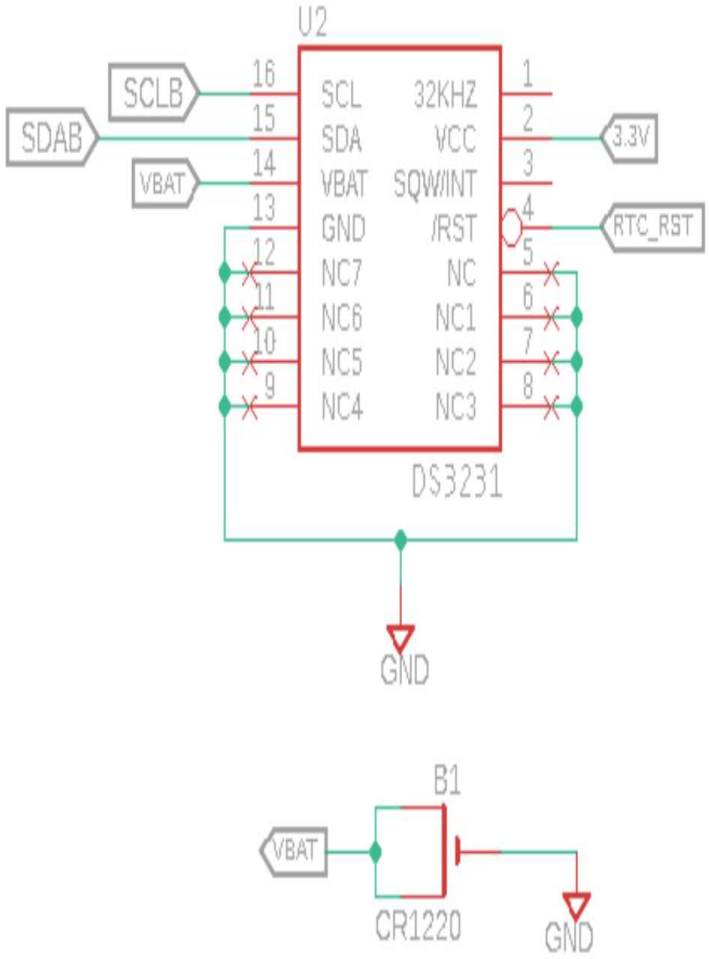
Real-Time Clock

- Maxim Integrated DS3231 RTC
- Fast (400kHz) serial I2C interface
- Precision temperature-compensated voltage reference to enhance accuracy and a comparator circuit that monitors for power failure
- Digital Temp Sensor Output: ±3°C Accuracy
- Backup battery
- Registers for year, month, day, hour, minute, second
- Operating temperature from -40°C to +85°C
- Accuracy ±3.5ppm from -40°C to +85°C



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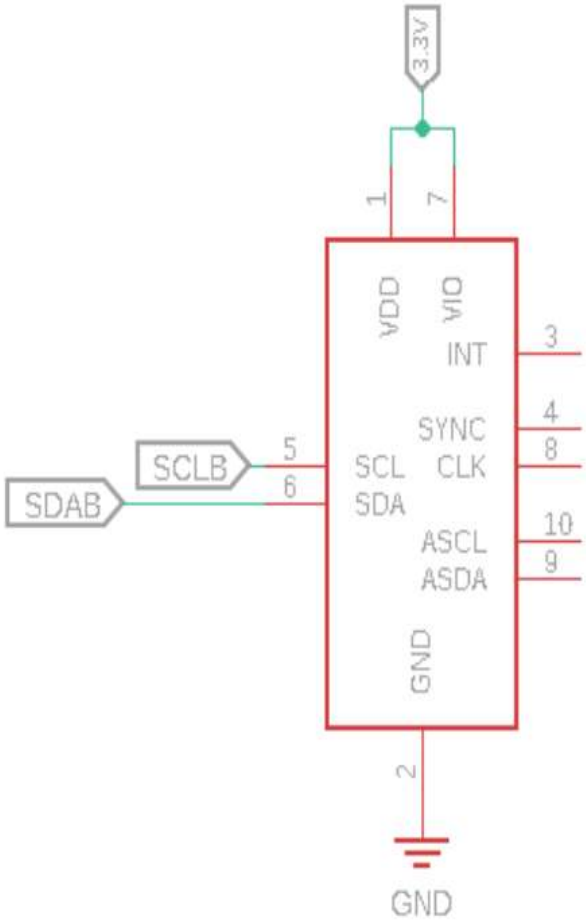
Gyroscope/Accelerometer

- InvenSense MPU-6050 gyroscope/accelerometer
- I2C digital-output of 6 or 9-axis MotionFusion data in rotation matrix, quaternion, Euler Angle, or raw data format with on-board ADC
- Programmable tri-axis angular rate sensor (gyro) with sensitivity up to 131 LSBs/dps, and a full-scale range of ±250, ±500, ±1000, and ±2000 dps
- Programmable tri-axis accelerometer with a full scale range of ±2g, ±4g, ±8g and ±16g
- Digital Motion Processing™ engine offloads complex MotionFusion, sensor timing synchronization and gesture detection



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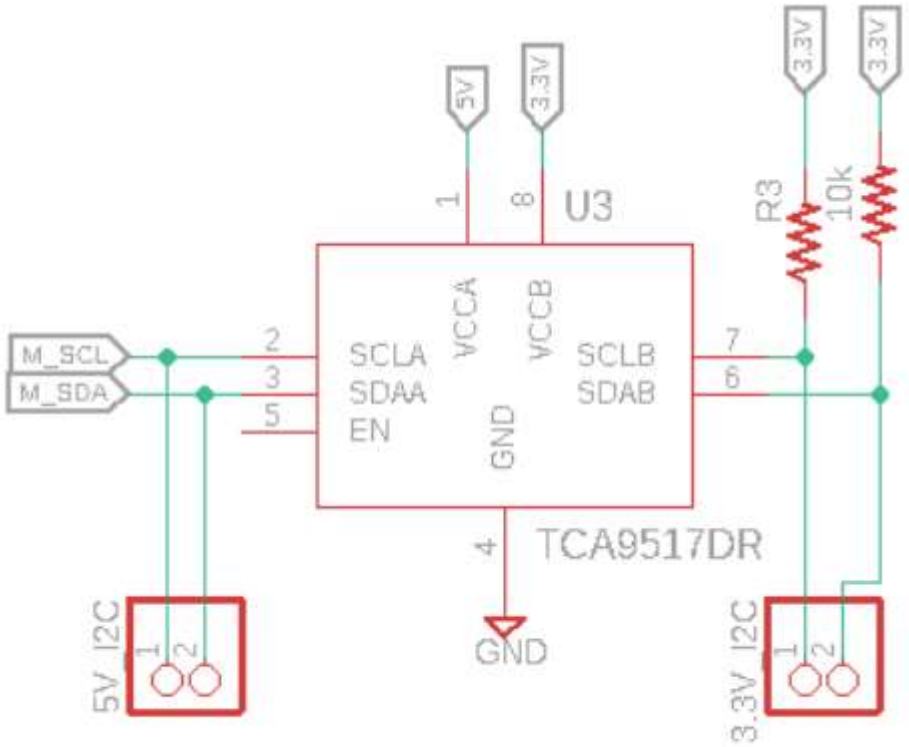
Logic-Level Shifter

- Texas Instrument TCA9517 Level-Shifting I2C Bus Repeater
- Two-channel bidirectional buffer with level shifting capabilities for I2C
- Buffers both serial data (SDA) and the serial clock (SCL) signals on the I2C bus
- Bidirectional voltage-level translation between low and high voltages
- Accommodates Standard Mode and Fast Mode I2C Devices and Multiple Masters



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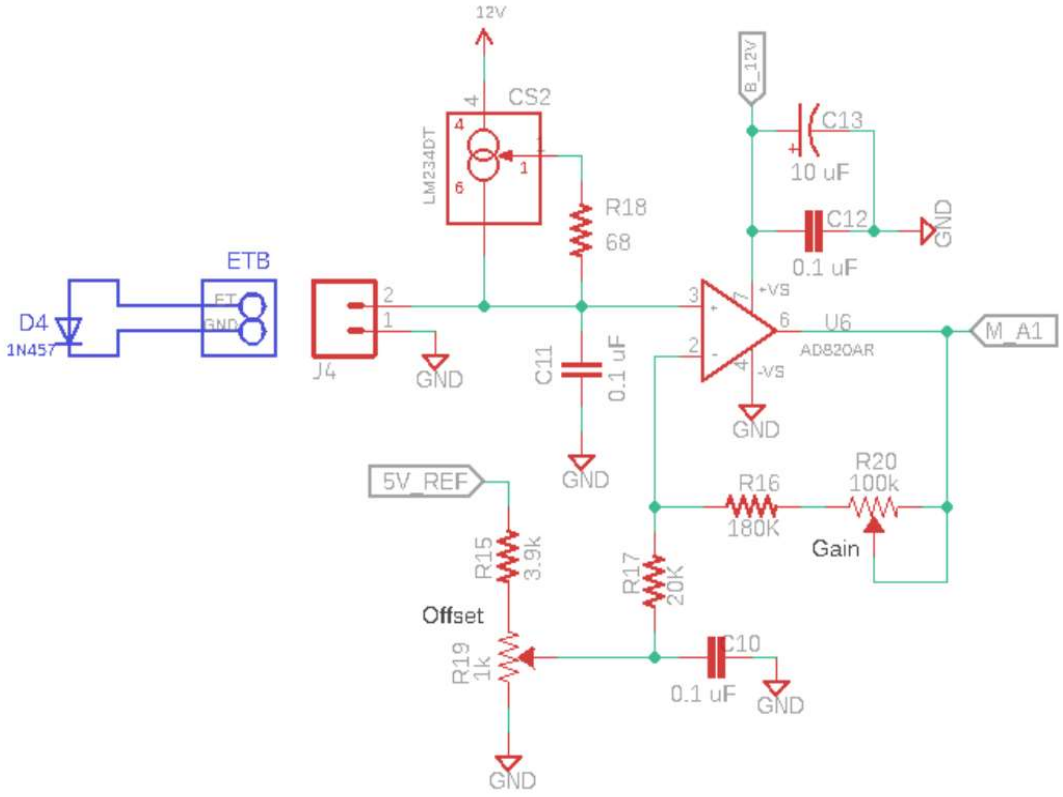
Temperature Sensors

- 1N457 diodes temperature
- Two temperature sensors for both internal and external monitoring



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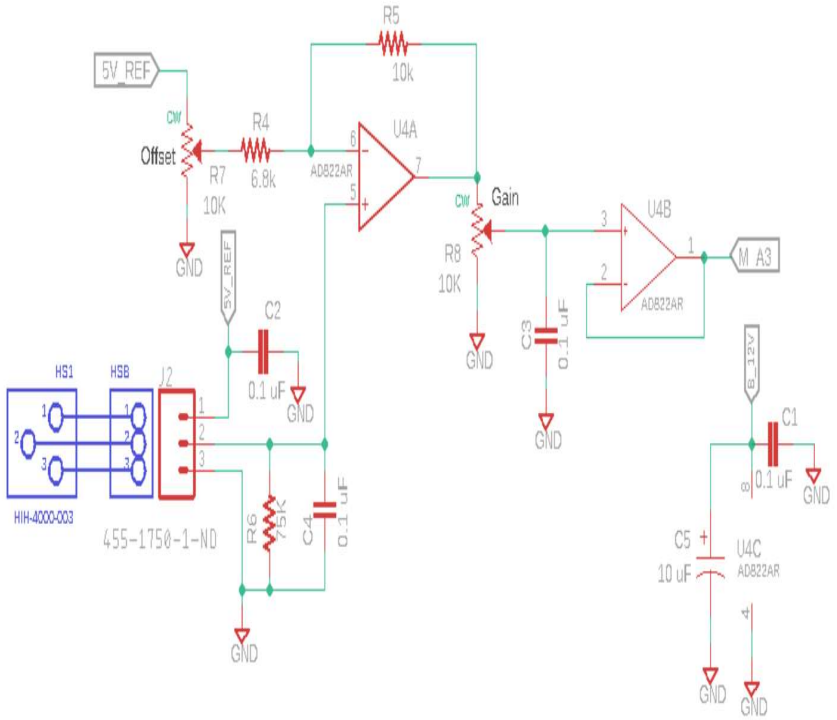
Humidity Sensor

- Honeywell HIH-4000-003
- Near linear voltage output vs percentage of relative humidity
- ± 3.5% accuracy



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Pressure

- TE Connectivity Ultra Stable Pressure Sensor
- Wheatstone bridge configuration
- ±0.1% Non Linearity
- 0-100 mV Output