RC Helicopter Downlink Telemetry Module

Contest Entry FZ1598

Submitted design implements on-board telemetry module, which collects vital information about characteristics of the RC aircraft such as helicopter or airplane. The module sends this information via wireless ZigBee Link to ground station consisting of a laptop computer and ZigBee receiver.

There are several potential applications of this telemetry module.

One possible application of this design may enhance the use of RC aircraft for aerial photography. In this application utilizing this telemetry module may improve the control over the position and the stability of the RC aircraft or the video or digital camera carried on this aircraft.

The second application of this design could allow the Radio Control Pilot to monitor attitude position and pilot the RC aircraft when this aircraft is not directly visible.

This application could find potential use in law enforcement, firefighting and military areas.

Description Of The Design

The on-board telemetry module collects the following information:

1. RC aircraft roll attitude. X-channel of MMA6161Q XY –Axis acceleration sensor is used to collect and process this information
2. RC aircraft pitch attitude. Y-channel of MMA6161Q XY Axis acceleration sensor is used to collect and process this information.
3. RC aircraft inverted attitude. MMA1260D – Z Axis acceleration sensor is used to collect and process this information.
4. RC aircraft receiver battery charge status. One of ADC of MC9S08GT60 and a simple voltage follower and resistor divider circuit are used for processing of this information
5. Downlink signal strength indication. This information is obtained by reading appropriate registers of MC13192 transceiver

The on-board telemetry module is implemented using 1392-SARD demo board with the following modifications: a voltage follower built with LM2904 OpAmp and a simple resistor divider were wired to channel 2 of ADC of MC9S08GT60

The ground receiver is implemented using 13192-EVB-demo board. In order to improve the sensitivity of the received signal the board was modified by populating two 10pf capacitors C128 and C134 to enable Low Noise Amplifier circuit.

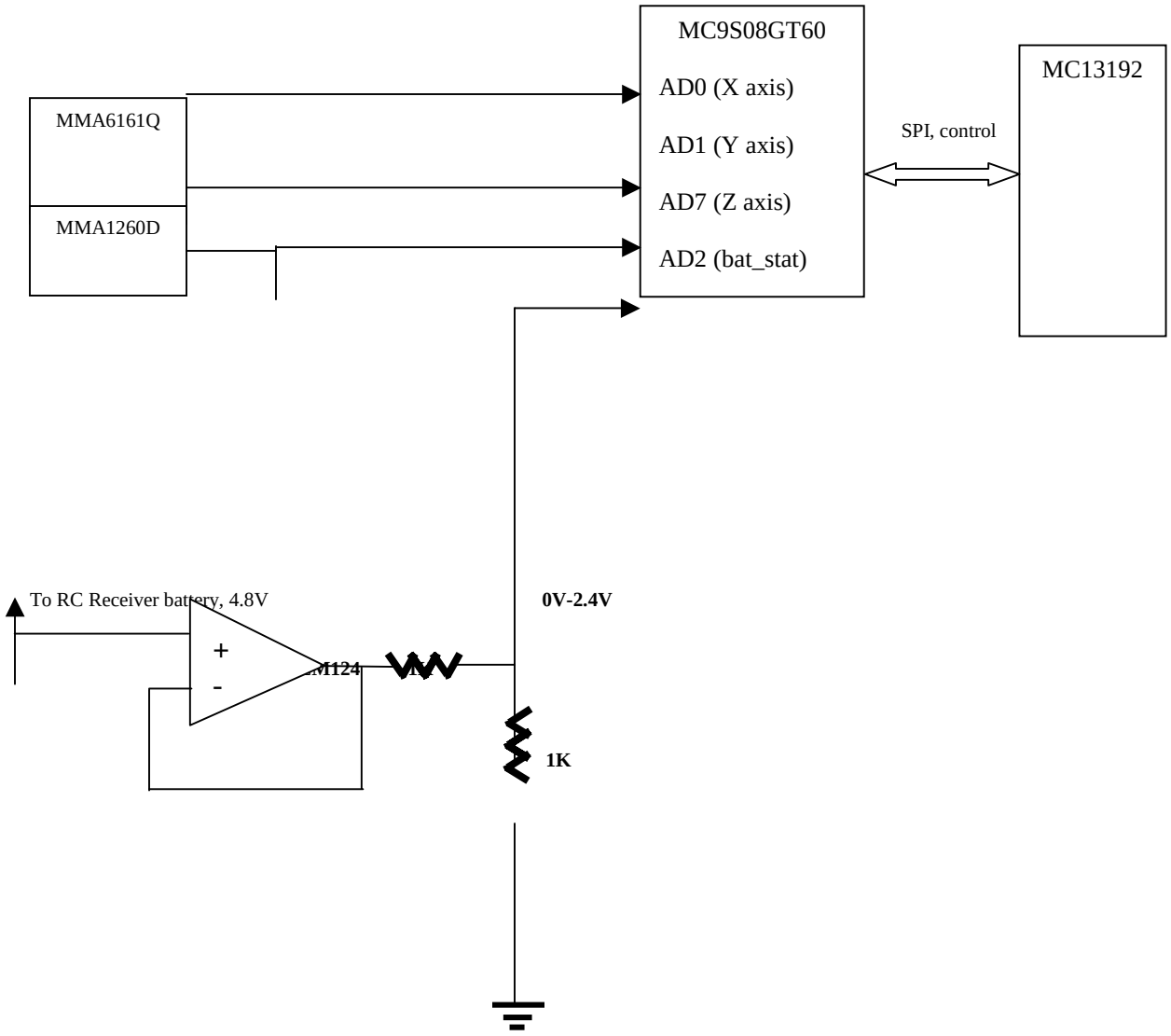
The Telemetry system design is easily expandable to support additional features such as monitoring of engine RPM as well as altitude and airspeed of the model aircraft.

MPXM2010 Compensated Pressure Sensors will be used in the future to measure altitude and airspeed and MC33794 E-Field sensor will be used to monitor engine RPM.

The ground receiver is connected to the laptop computer via serial port running at 38400bps. The telemetry processing software was written in TCL/Tk scripting language.

The software displays information in form of “digital cockpit” which shows telemetry data using “dial-type” widgets.

The telemetry system was built and test flown on Raptor 30 Model helicopter.



Block Diagram of On-Board Telemetry Module

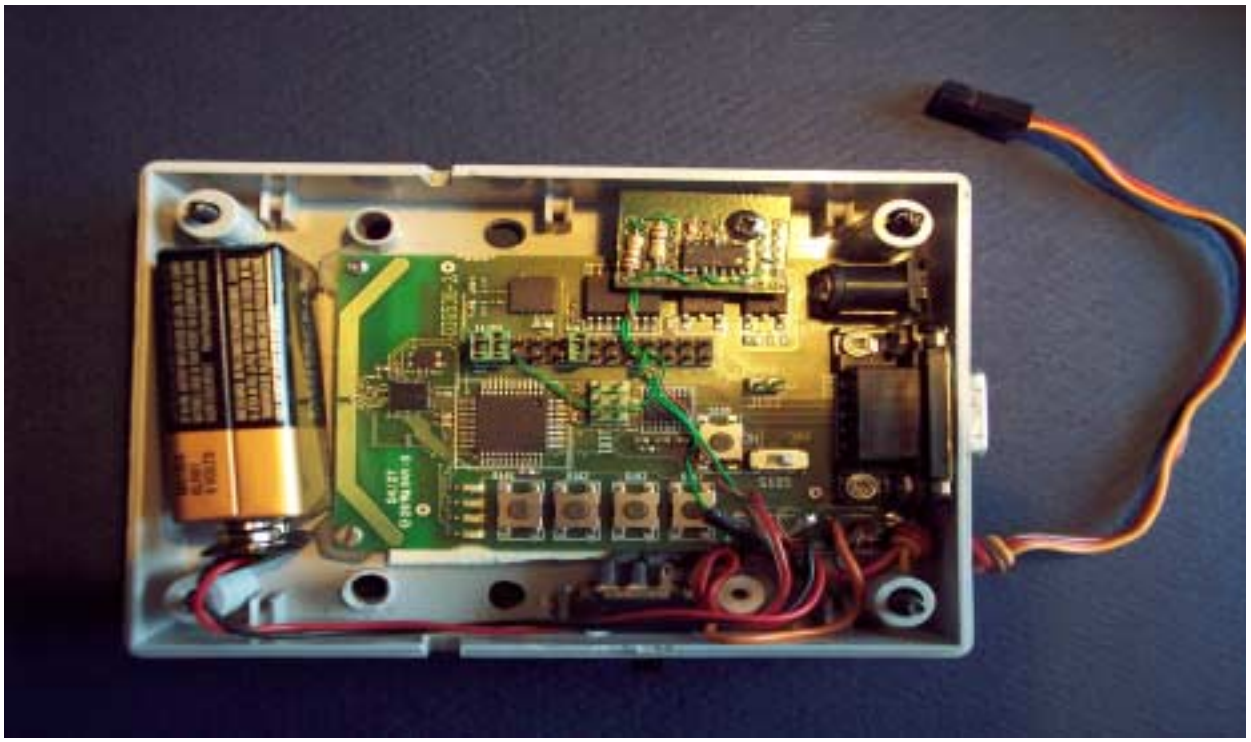
As illustrated in the sample of the C-code below, the software assembles 10-bytes packet consisting of data captured from each of three channels of analog-to-digital converter delimited by known hexadecimal values.

```
/*****************************************************************
 *          TX_accel main loop
 *****************************************************************/
for (;;)
{
            ATD1SC = 0x01;//read X channel
            while((ATD1SC & 0x80) != 0x80){}
            tx_data_buffer[1] = ATD1RH;
            ATD1SC = 0x00;//read Y channel
            while((ATD1SC & 0x80) != 0x80){}
            tx_data_buffer[3] = ATD1RH;
            ATD1SC = 0x07;//read Z channel
            while((ATD1SC & 0x80) != 0x80){}
            tx_data_buffer[5] = ATD1RH;
            ATD1SC = 0x02;//read charge stat channel
            while((ATD1SC & 0x80) != 0x80){}

            tx_data_buffer[7] = ATD1RH;
            tx_data_buffer[0] = 0x78;//send x
            tx_data_buffer[2] = 0x79;//send y
            tx_data_buffer[4] = 0x7A;//send z
            tx_data_buffer[6] = 0x7b;//send charge stat
            tx_packet.dataLength = 10;

            MCPS_data_request(&tx_packet); // transmit data
            LED4 ^= 1;  /* Toggle LED1 */
            LED3 ^= 1;  /* Toggle LED1 */
             delay(0x0FFF);
            delay(0x0FFF);
            delay(0x0FFF);
}//end for
```

The data packet has the following structure:

0x78,
xy_accelerator sample- x axis,
0x79,
xy_accelerator sample- y axis,
0x7a,
z-accelerator sample,
0x7b,
battery charge data sample,
0x7c,
data holder

Note: The data holder byte was necessary because the software running on the ground station board passes the packet to the laptop. The ground station overwrites the data holder byte with link_quality byte as described in section **Error! Reference source not found.**.



On-Board Telemetry Module

Test Flying Of Raptor 30 Equipped with the Telemetry Module