MICROCHIP LX7730-SAMRH71F20 Sensors Demo User Guide

Contents

MICROCHIP LX7730-SAMRH71F20 Sensors Demo

Product Information:

The LX7730-SAMRH71F20 Sensors Demo is a demonstration of the LX7730 spacecraft telemetry manager being controlled by an SAMRH71F20 MCU. It includes various sensors such as pressure, light, accelerometer, temperature, and magnetic flux sensors. The demo board requires the NI Labview Run-Time Engine Installer to be installed on the computer.

The LX7730-SAMRH71F20 Sensors Demo User Guide provides instructions on installing the software, setting up the hardware, and operating the demo board.

Product Usage Instructions

Installing the Software:

1. Check if you have the NI Labview Run-Time Engine Installer installed on your computer. If not, install it.
2. If you're unsure whether the drivers are already installed, run LX7730_Demo.exe. If you see an error message, it means the drivers are not installed and you need to install them.

Hardware Setup Procedure:

To set up the hardware for the LX7730-SAMRH71F20 Sensors Demo, follow these steps:

1. Connect the LX7730 Daughter Board to the SAMRH71F20-EK Evaluation Kit using the LX7730-DB to SAMRH71F20-EK linker board.
2. Program the SAMRH71F20-EK with the Sensor Interface binary.
3. Connect the FTDI TTL-232R-3V3 USB-to-RS232 adapter cable.

Operation:

To operate the LX7730-SAMRH71F20 Sensors Demo, follow these steps:

1. Power up the SAMRH71F20-EK.
2. Run the LX7730_Demo.exe GUI on the connected computer.
3. Select the COM port corresponding to the SAMRH71F20-EK from the drop-down menu and click connect.
4. The GUI interface will display results for temperature, force, distance, magnetic field (flux), and light.
5. Use the GUI interface to experiment with different sensors:

- **Temperature Sensor:** Follow the instructions provided in section 3.1 of the user guide.
- **Pressure Sensor:** Apply force to the pressure sensor and observe the output voltage in the GUI interface (section 3.2).
- **Distance Sensor:** Move objects closer or farther from the distance sensor and check the sensed distance value in the GUI (section 3.3).
- **Magnetic Flux Sensor:** Move a magnet closer or farther from the magnetic sensor and observe the sensed flux value in the GUI (section 3.4).
- **Light Sensor:** Adjust the brightness of light around the sensor and check the sensed light value in the GUI (section 3.5).

Introduction

The LX7730-SAMRH71F20 Sensors Demo demonstrates the LX7730 spacecraft telemetry manager being controlled by an SAMRH71F20 (200 DMips Cortex M7 with 100krad TID capability) MCU.

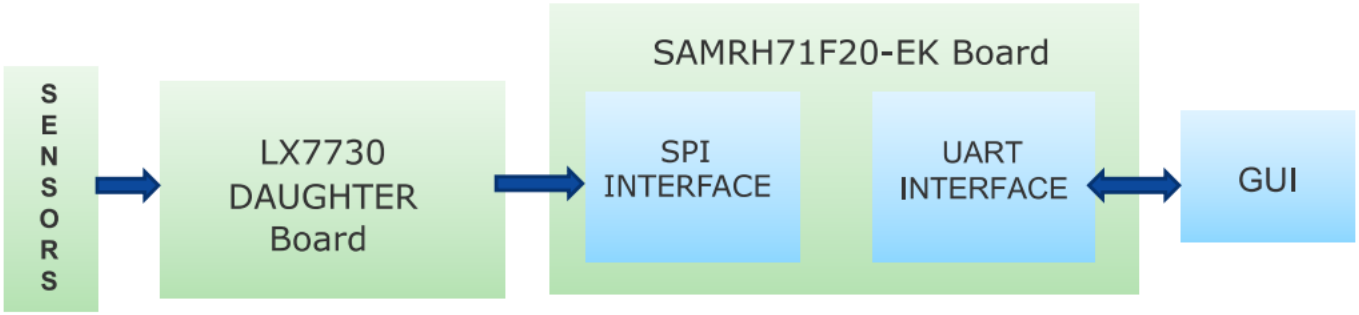


Figure 1. LX7730-SAMRH71F20 Sensors Demo System Diagram

The LX7730 is a spacecraft telemetry manager that contains a 64 universal input multiplexer that can be configured as a mix of differential- or single-ended sensor inputs. There is also a programmable current source that can be directed to any of the 64 universal inputs. The universal inputs can be sampled with a 12-bit ADC, and also feed bi-level inputs with the threshold set by an internal 8-bit DAC. There is an additional 10-bit current DAC with complementary outputs. Finally, there are 8 fixed threshold bi-level inputs.
The demo comprises a small PCB containing 5 different sensors (Figure 2 below) that plugs into LX7730 Daughter Board, The daughter board in turn connects to a SAMRH71F20-EK Evaluation Kit via a linker board. The demo reads data from the sensors (temperature, pressure, magnetic field strength, distance, and 3-axis acceleration), and displays them on a GUI running on a Windows PC.

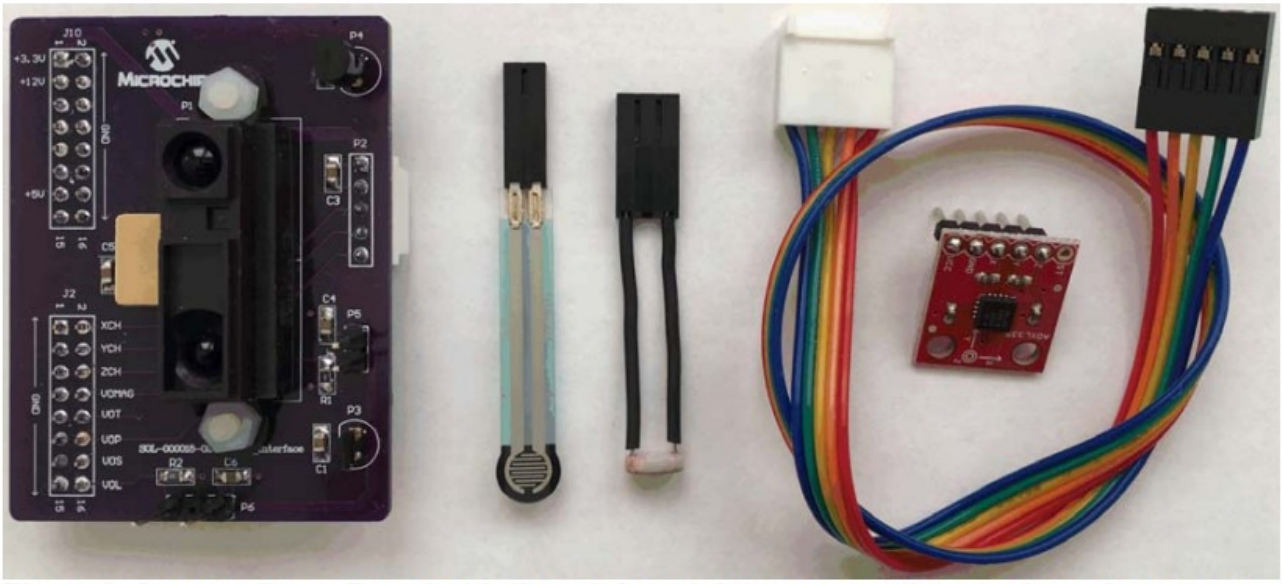


Figure 2. Sensors Demo Board with (from left to right) pressure, light, and accelerometer sensors

Installing the Software

Install the NI Labview Run-Time Engine Installer if not already present on your computer. If you're not sure whether you have the drivers installed already, then try running LX7730_Demo.exe. If an error message appears as below, then you don't have the drivers installed and need to do so.

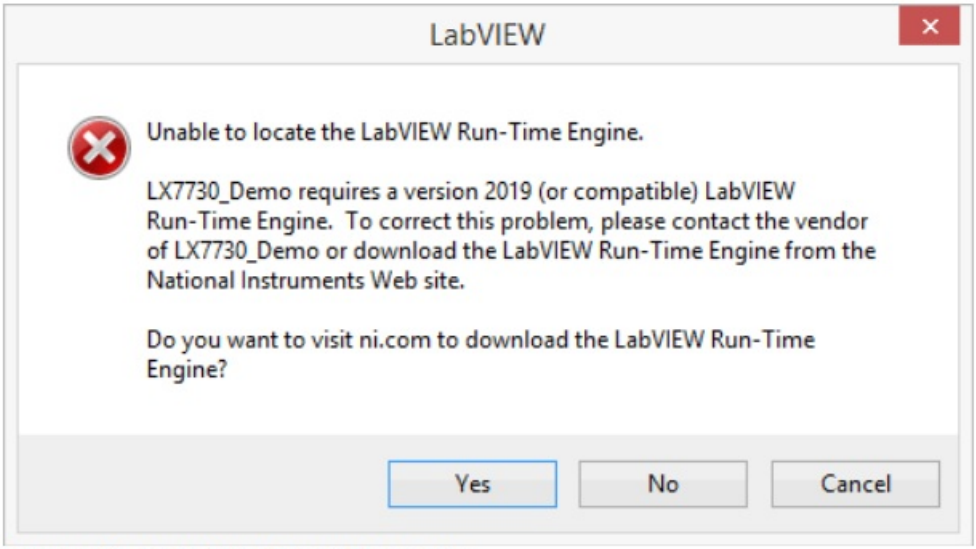


Figure 3. Labview Error Message

Power up and program the SAMRH71F20-EK with the SAMRH71F20 Sensor Interface MPLAB binary, then power it down again.

Hardware Setup Procedure

You will need an LX7730 Daughter Board, a LX7730-DB to SAMRH71F20-EK linker board , a SAMRH71F20-EK Evaluation Kit programmed with the Sensor Interface binary, and an FTDI TTL-232R-3V3 USB-to-RS232 adapter cable in addition to the Sensors Demo board. Figure 4 below shows a LX7730-DB connected to a SAMRH71F20-EK with a linker board.

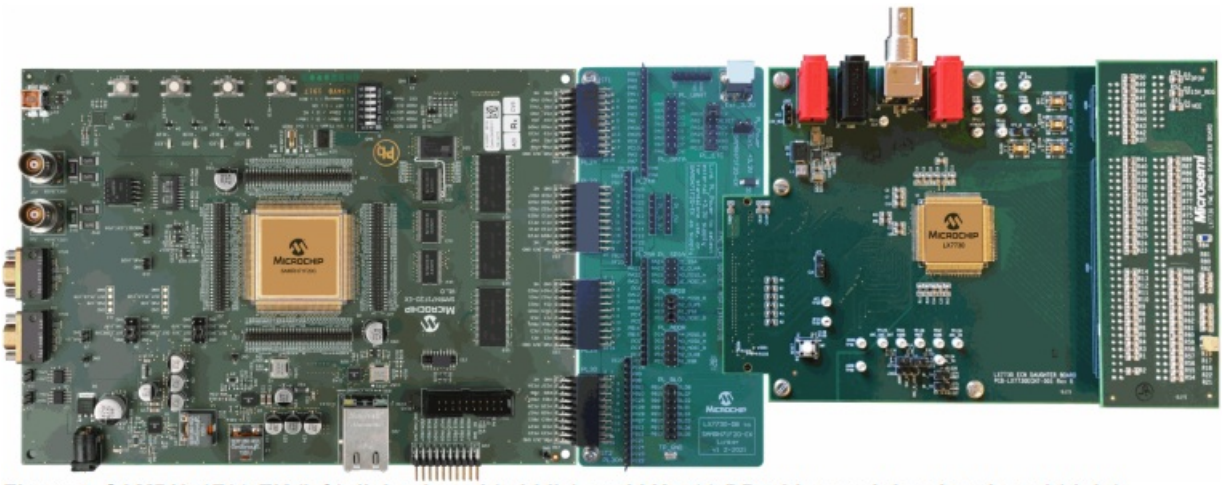


Figure 4. SAMRH71F20-EK (left), linker board (middle), and LX7730-DB with grand-daughter board (right)

The hardware setup procedure is:

- Start with the three boards unplugged from each other
- On the LX7730-DB, set the SPI_B slide switch SW4 to the left (LOW), and set the SPI_A slide switch SW3 to the right (HIGH) to select the SPIB serial interface. Ensure that the jumpers on the LX7730-DB are set to the

defaults shown in the LX7730-DB user guide

- Fit the Sensors Demo board to the LX7730-DB, removing the grand-daughter board first (if fitted). Demo board connector J10 plugs into LX7730-DB connector J376, and J2 fits in the top 8 rows of connector J359 (Figure 5 below)
- Ensure that these are the only jumpers fitted on the linker board:
  - All 4 jumpers on header PL_SPIB. This routes the SPI interface from SAMRH71F20-EK to LX7730-DB
  - The PA10:CLK jumper on header PL_ETC. This routes a 500kHz clock from SAMRH71F20-EK to LX7730-DB
  - The PA9:RESET jumper on header PL_ETC. This routes a reset signal from SAMRH71F20-EK to LX7730-DB
  - Pins 2:3 (the left pair) on single-row header PL_Power. This selects the SAMRH71F20-EK as the source of 3.3V power to LX7730-DB, so the DC power connector on the linker board is not used
- Plug the FTDI TTL-232R-3V3 USB-to-RS232 adapter cable onto the single-row header PL_UART on the linker board. Pin 1 (0V) takes the black lead (Figure 6 below). Only the GND, TXD, and RXD signals are used from the FTDI TTL-232R-3V3 adapter
- Plug the linker board into the SAMRH71F20-EK using the 4 horizontal connectors
- Plug the linker board into the LX7730-DB using the FMC-LPC connector
- Connect the FTDI TTL-232R-3V3 USB-to-RS232 adapter to your PC via USB

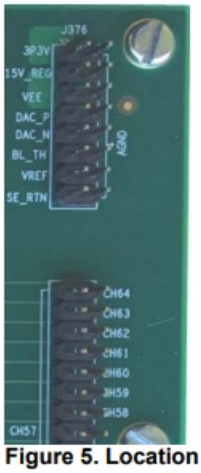


Figure 5. Location of Mating Connectors J376, J359 on the LX7730 Daughter Board for the Sensors Demo board

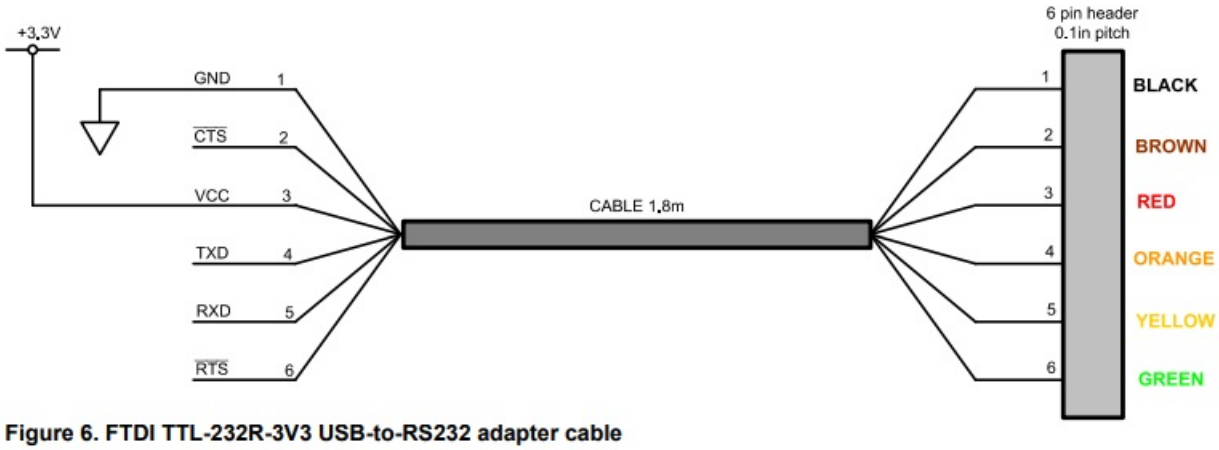


Figure 6. FTDI TTL-232R-3V3 USB-to-RS232 adapter cable

Operation

Power up the SAMRH71F20-EK. The LX7730-DB gets its power from the SAMRH71F20-EK. Run the LX7730_Demo.exe GUI on the connected computer. Select the COM port corresponding to the SAMRH71F20-EK from the drop down menu and click connect. The first page of GUI interface shows results for temperature, force,

distance, magnetic field (flux), and light. The second page of the GUI interface shows results from the 3-axis accelerometer (Figure 7 below).

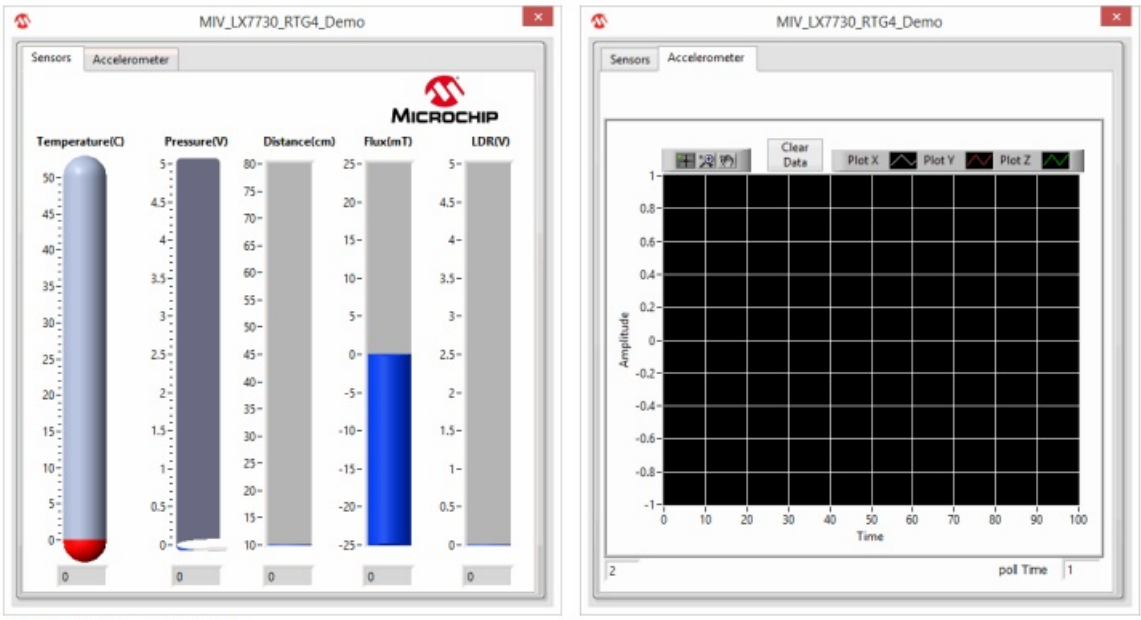


Figure 7. GUI interface

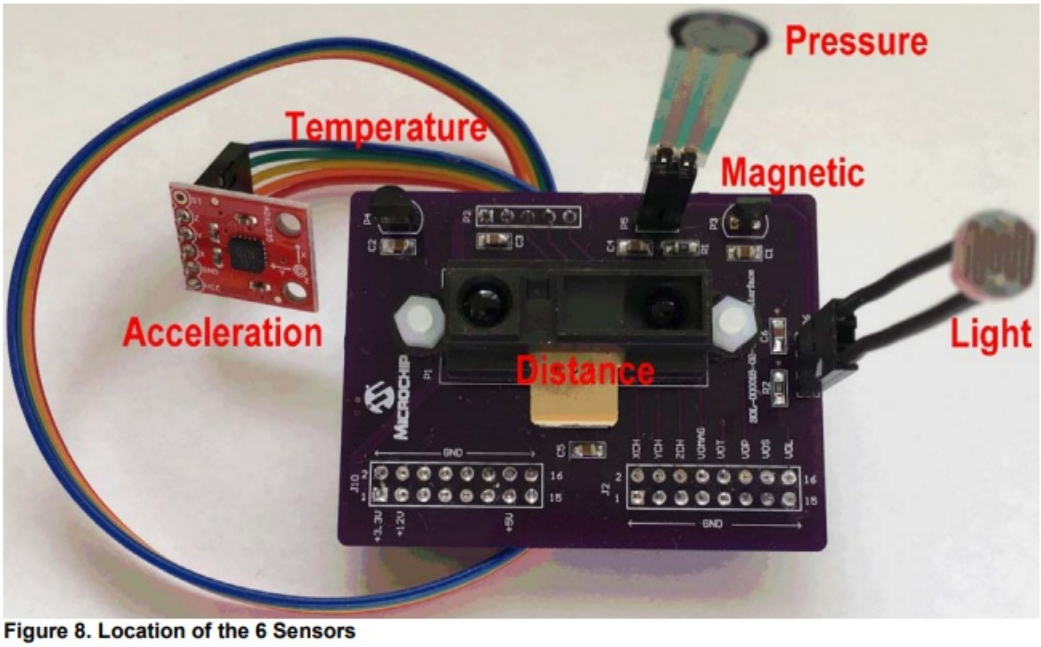


Figure 8. Location of the 6 Sensors

Experimenting with the Temperature Sensor:
Change the temperature in the range 0°C to +50°C around this sensor. The sensed temperature value will be shown in the GUI.

Experimenting with the Pressure Sensor
Press the round tip of the pressure sensor to apply a force. The GUI will show the resultant output voltage, per Figure 9 below for RM = 10kΩ load.

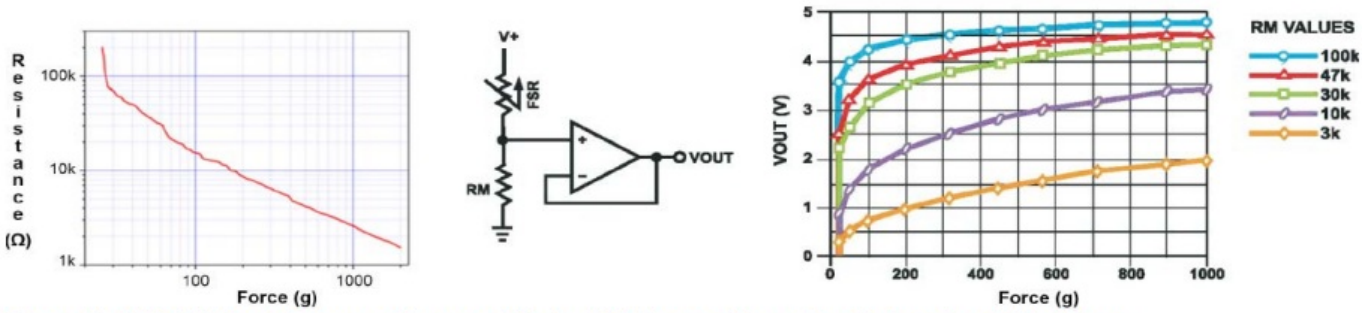


Figure 9. FSR 400 Resistance vs Force and Output Voltage vs Force for Various Load Resistors

Experimenting with the Distance Sensor
Move objects away or close (10cm to 80cm) to the top of the distance sensor. The sensed distance value will be shown in the GUI.

Experimenting with the Magnetic Flux Sensor
Move a magnet away or close to the magnetic sensor. The sensed flux value will be shown in the GUI in the range -25mT to 25mT.

Experimenting with the Light Sensor
Change the brightness of light around the sensor. The sensed light value will be shown in the GUI. The output voltage VOUT range is 0 to 5V (Table 1 below) following Equation 1.

$$V_{OUT} = 5 \times \frac{10000}{10000 + R_d} V$$

Equation 1. Light Sensor Lux to Voltage Characteristic

Table 1. Light Sensor

Lux	Dark Resistance R_d(kW)	VOUT
0.1	900	0.05
1	100	0.45
10	30	1.25
100	6	3.125
1000	0.8	4.625
10,000	0.1	4.95

Experimenting with the Acceleration Sensor
The 3-axis accelerometer data is displayed in the GUI as cm/s², where 1g = 981 cm/s².

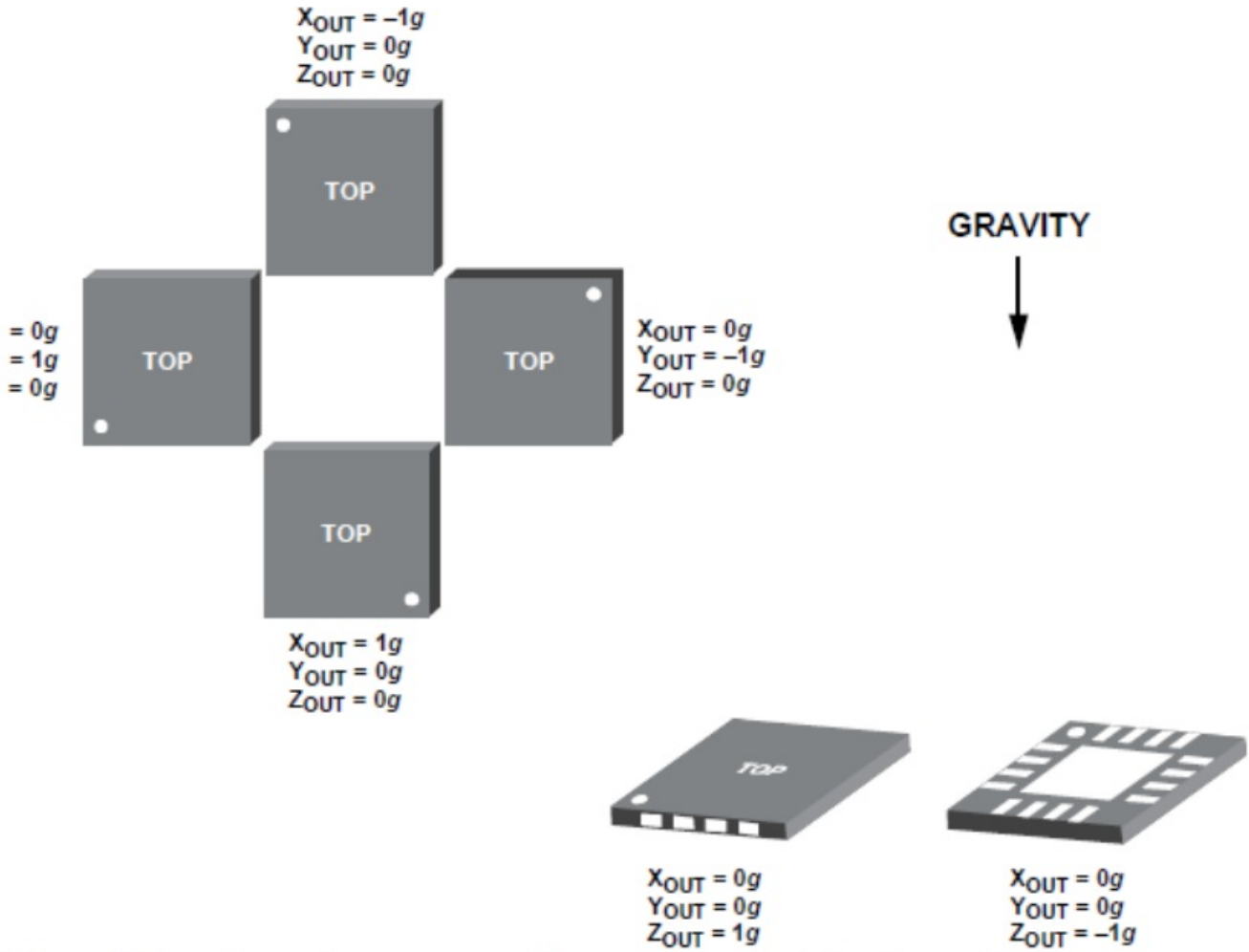


Figure 10. Accelerometer response with respect to orientation to gravity

Schematic

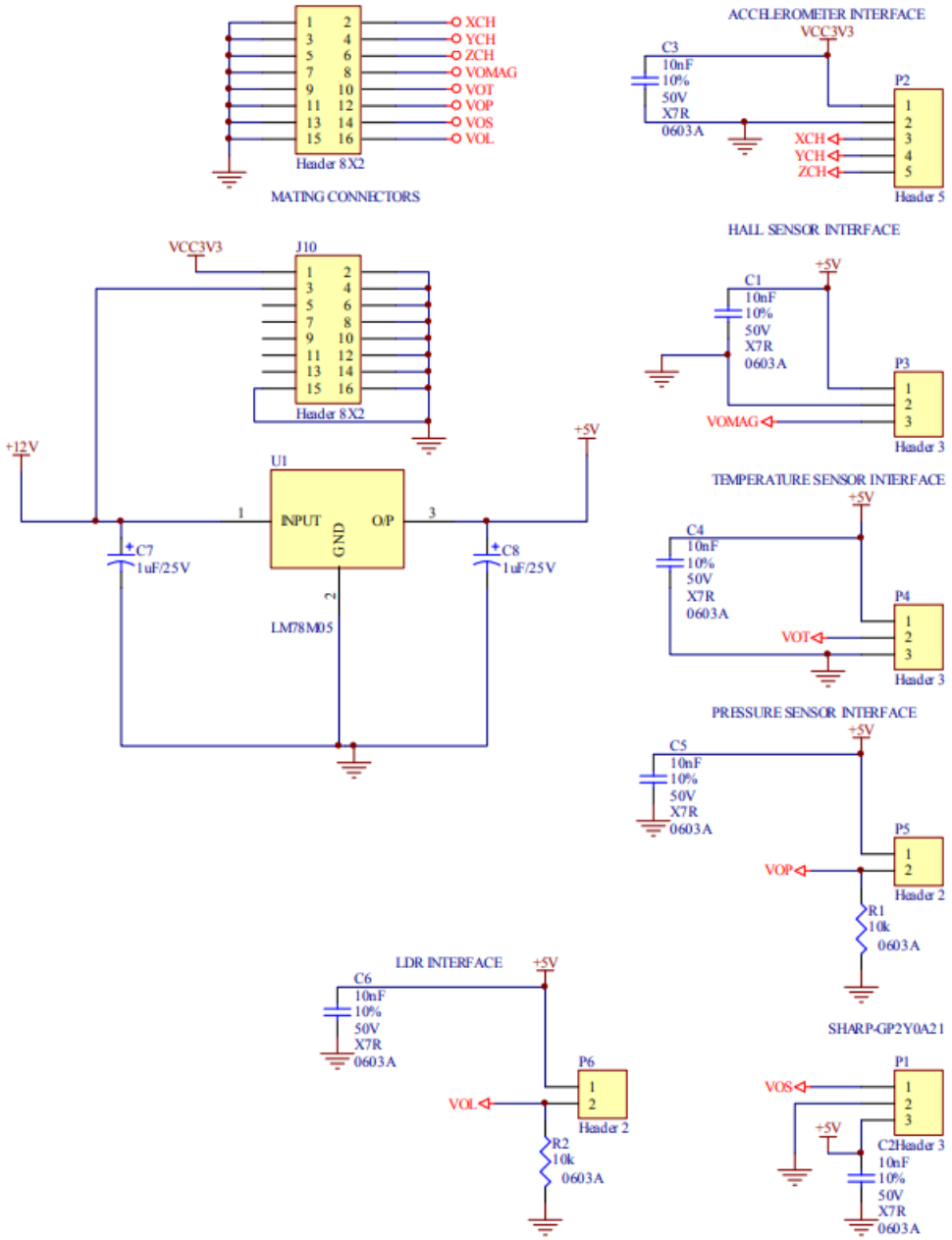


Figure 11. LX7714 Mini Board Full Schematic

PCB Layout

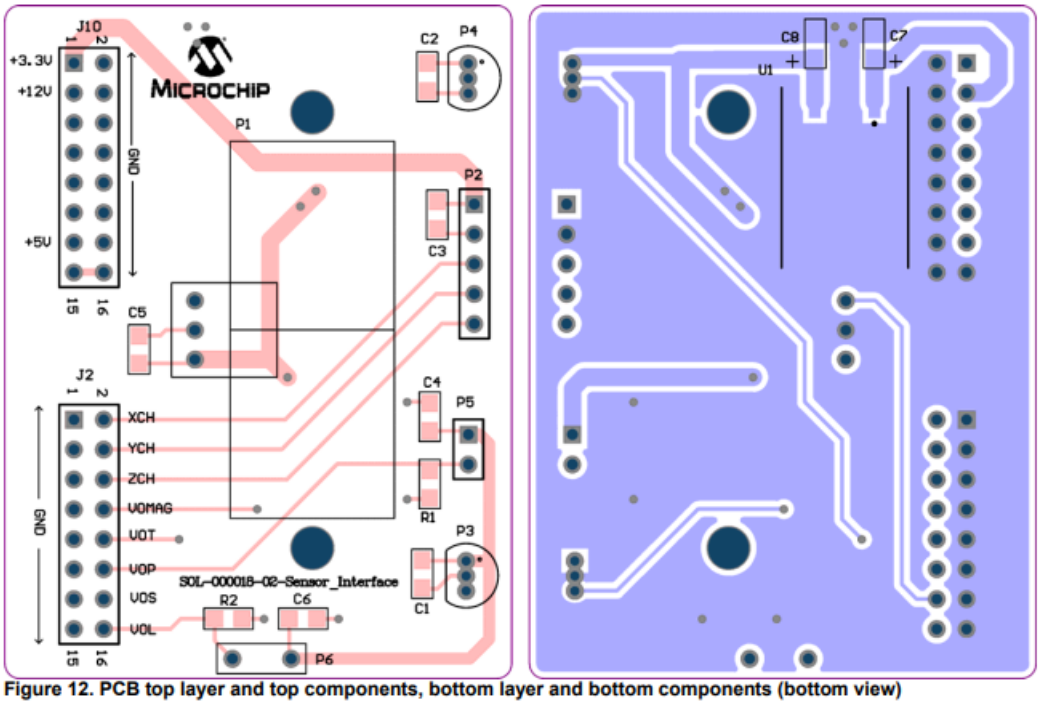


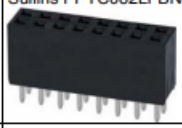
Figure 12. PCB top layer and top components, bottom layer and bottom components (bottom view)

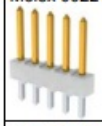
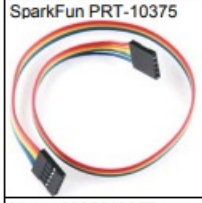
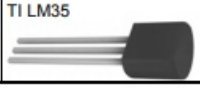
PCB Parts List

Assembly notes are in blue.

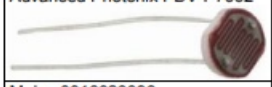
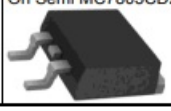
Table 2. Bill of Materials

Table 2. Bill of Materials

Designators	Part	Quantity	Part Type
C1, C2, C3, C4, C5, C6	10nF/50V-0805 (10nF to 1µF acceptable)	6	Capacitor MLCC
C7, C8	1µF/25V-0805 (1µF to 10µF acceptable)	2	Capacitor MLCC
J2, J10	Sullins PPTC082LFBN-RC 	2	16 position header 0.1" These fit to the underside of the PCB
R1, R2	10kΩ	2	Resistor 10kΩ 1% 0805
P1	Sharp GP2Y0A21 	1	Optical Sensor 10 ~ 80cm Analog Output Remove the white 3-pin plug, and solder directly to the PCB with 3 wires

Designators	Part	Quantity	Part Type
P2	SparkFun SEN-09269 	1	ADI ADXL335, ±3g 3 Axis Accelerometer on PCB
	Molex 0022102051 	1	Square pin header 5 position 0.1" Solder to the underside of the accelerometer board, from VCC to Z. The ST hole is unused
	SparkFun PRT-10375 	1	5 way 12" ribbon cable 0.1" Cut off one connector, and replace with five crimped terminals fitted into the polarized 5 position housing. The original, unpolarized housing plugs into the accelerometer board, with the red wire at VCC and blue wire at Z
	Molex 0022013057 	1	Housing polarized 5 position 0.1"
	Molex 0008500113 	5	Crimp connector
	Molex 0022232051 	1	Connector polarized 5 position 0.1" Solder to the underside of the PCB, with orientation such that the red wire will be at the P2 end when the 5 way ribbon cable is fitted
P3	TI DRV5053 	1	Hall Effect Sensor Single Axis TO-92 Fit with flat face facing outward. The PCB 'D' outline is wrong
P4	TI LM35 	1	Temperature Sensor Analog, 0°C ~ 100°C 10mV/°C TO-92 Follow the PCB 'D' outline

Revision History

Designators	Part	Quantity	Part Type
P5	Interlink 30-49649 	1	Force/Pressure Sensor - 0.04-4.5LBS
	Molex 0016020096 	2	Crimp connector Crimp or solder a terminal to each Force/Pressure Sensor wire
	Molex 0050579002 	1	Housing 2 position 0.1" Fit the Force/Pressure Sensor's terminals into the outer two positions
	Molex 0022102021 	1	Square pin header 2 position 0.1" Solder to the topside of the PCB
P6	Advanced Photonix PDV-P7002 	1	Light Dependent Resistor (LDR)
	Molex 0016020096 	2	Crimp connector Crimp or solder a terminal to each LDR wire
	Molex 0050579003 	1	Housing 3 position 0.1" Fit the LDR's terminals into the outer two positions
	Molex 0022102031 	1	Square pin header 3 position 0.1" Remove middle pin. Solder to the topside of the PCB
U1	On Semi MC7805CD2T 	1	5V 1A Linear Voltage Regulator

Revision History

Revision 1 – May 2023

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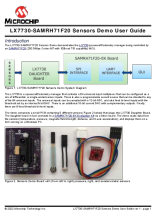	MICROCHIP LX7730-SAMRH71F20 Sensors Demo [pdf] User Guide LX7730-SAMRH71F20 Sensors Demo, LX7730-SAMRH71F20, Sensors Demo, Demo

References

- { 42 ,18 , , AV }
- Microchip Lightning Support
- Empowering Innovation | Microchip Technology
- Product Change Notification | Microchip Technology
- Quality | Microchip Technology