Ormerod sensor board circuit description

[Version 1, 2014-03-16]

Refer to the schematic. The board is designed to be populated in several different ways:

1. Modulated IR sensor, with modulation controlled by the Duet. The components fitted are:

U1 Q1 C1 C5 R2 R3 R4 R5 R13 L1 X5

The modulation signal from the Duet arrives via X5-1 and switches transistor Q2 via resistor R13. Q2 controls current flow through the IR emitter inside U1 via R5 to give a current of about 40mA when the modulation signal is high. R4 provides a base level of IR illumination even when the modulation signal is off, in order to bias the phototransistor in U1 into its linear region and reduce the effect of ambient IR. The phototransistor current causes a voltage drop across R2. C1 reduces capacitive pickup of noise from other wires in the loom. L1 and C5 decouple the incoming 3.3V supply. L1 is probably not needed n this configuration, so it could be replaced by a 0 ohm resistor.

1a. Modulated IR sensor + lighting. This is as option 1 plus the following components:

U3 D1 D2 D3 R14 X1 X2 X3 X6

In this configuration, all the hot end connectors are brought on to the board, replacing the function of the original 6-way connector. R14 completes the fan circuit. U3 provides a 20mA constant current source for LEDs D1 D2 D3. Optional resistor R1 can be added to increase the LED current, subject to keeping the current and power dissipation in U3 within its ratings.

2. Modulated IR sensor + fan control. The components populated are:

U1 U2 Q1 D4 C1 C2 C3 R2 R4 R5 R7 R10 R11 R12 L1 X1 X2 X3 X5 X6

In this mode, the modulation is controlled by the microcontroller U2, so the modulation control wire from the Duet is not needed. The microcontroller modulates the IR via R12 and Q2 (note that R13 is not fitted in this configuration). The signal appearing across R2 is fed to U2 pin 12 (ADC1) for synchronous detection. The mcu generates PWM signals at pins 6 and 8, which are combined by R7 and R10 and smoothed by C3 to provide an analog output. The mcu also controls the fan via R11 and Q1. D4 is a flyback diode for the fan, in case the fan presents an inductive load. The hot end thermistor is monitored via pin 10 of U2.

2a. Modulated IR sensor + fan + lighting. As option 2 plus U3 D1 D2 D3 and optionally R1.

3. Ultrasonic option. This is option 2 or 2a with the following additional components populated:

XT1 L2 C4 R6 R8 R9

The microcontroller U2 produces a square wave at the appropriate frequency (41.67kHz) on pin 7. This is fed to the transducer connected at X4 via R6 and L2, with C4 completing the circuit while avoiding a DC bias across the transducer. R8 and R9 reduce the peak signal to remain in the range 0 to +3.3V and feed this signal to pin 11 (ADC2) of U2. U2 performs synchronous detection of the signal on this pin.

The mcu operates in IR mode when the signal at X5-1 is high or not connected, and in ultrasonic mode when the signal at X5-1 is low. A ceramic resonator is used instead of the built-in RC oscillator, in order to maintain an accurate frequency for the transducer.