Vima Rev Electronics Circuit Design Description

8/28/2017

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Overview

The Vima Rev Goggles are a sport training device intended to facilitate eye-target tracking for Sports or Tactical applications. The Sports model and the Tactical model are the same except for:

1. The color tint of the polycarbonate lens (grey for Sport, amber for Tactical)
2. The plastic surface finish (gloss for Sport, matte for Tactical)
3. The "VQ" or Vision Quotient flicker modes have slightly different timing
4. The Sport model is fitted with a head strap while Tactical model is fitted with ear stems.

Both models work by denying 100% vision of the target to the trainee forcing them to mentally and physically focus on the target to a greater degree than when 100% vision (the norm) is available.

This deliberate denial of vision is achieved when one or both lenses are made to be translucent rather than transparent. The VQ refers to a mix of the temporal ratio of translucent to transparent and the rate at which the lenses toggle between the two states. The higher the VQ the greater the difficulty.

The lenses are physically comprised of a polycarbonate support substrate, an LCD film and an adhesive layer that bonds the two together. The LCD film is electrically subdivided into two parts, one for each lens, so that each lens can be controlled independently of the other. Each lens of the LCD film can be driven into a substantially transparent state or a substantially translucent state under control of the electronics.

Trainees perform prescribed exercises under increasing VQ settings. Later, when the trainee removes the googles, he is able to see the target more clearly and completely as he has been trained to make the most out of minimal information.

The goggles are internally powered by a small Li-ion battery rechargeable via a (micro) USB power source.

The VQ setting and the "Mode" are controllable via a two button interface and also via BLE (Bluetooth, Low Energy). Modes include both lens flickering in or out of phase, one lens flickering while the other is held translucent, etc.

Circuit Boards

There are two circuit boards each designed to fit into the stems of the goggles.

The Power Board, which fits into the left temple stem, implements the battery interface, the micro USB connector, the battery charge circuit, the battery fuel gauge circuit and the step-up voltage circuit.

1. The battery interface is a two pin header. The battery is a custom 3.6v, 60mAh rechargeable single cell Li-ion.

2. The micro USB connector is used to deliver power to the goggles (and, not implemented as of this writing, for engineering debug communications.) This nominal 5V power charges the battery (if the battery is not fully charged already).
    a. The goggles will “wake up” when power is sensed on the USB connector in order to display the state-of-charge on the 2 digit LCD display.
    b. The user can operate the goggles in all modes while the charger is attached or not except that the program update function requires that the charger is attached and providing power to the goggles.
3. The charge controller is set to deliver a C/2 charge to the battery.
4. The battery fuel gauge measures the state of charge of the battery and makes that value available to the CPU via a two wire serial interface.
5. The step-up voltage circuit generates nominal 40V DC from the battery voltage. The 40V is used to drive the LCD lenses.
6. There is a 10 pin ZIF connector to connect to the Power board to the CPU board via a flex circuit.

The CPU Board, which fits into the right temple stem, is comprised of the PSoC (see 7 below), the high voltage drivers which operate the LCD lenses, a 3 volt regulator, the two push buttons and two digit LCD display user interface.

7. The Cypress PCoC (Programmable System on Chip) implements a computing element, flash program storage containing all the code required to run the BLE (supplied by Cypress) , RAM, the Bluetooth radio in its entirety (save the external antenna and two external crystal oscillators), the LCD drive (for the two digit LCD display) , and the timing generator for the lens drivers.
    a. There are two external crystals connected to the PSoC:
        i. 32.768 KHz crystal (provides timing for the radio between connections).
        ii. 24MHz crystal (provides the radio transmit and receive frequencies via a PLL).
8. Three high voltage drivers provide independent drive to the two LCD lenses via a common connection and two dedicated connections, one for each lens. When the dedicated connection for a lens is in phase with the common connection, that LCD lens will be translucent (not driven). When the dedicated connection for a lens is out of phase with the common connection, that lens will be transparent (driven).
    a. A 3 pin connector on the CPU board connects the drivers to the lens assembly.
9. A linear voltage regulator generates 3.0V from the battery voltage or external USB power supply if connected.
    a. This 3.0V is used to power the PSoC.
10. The two push buttons operate two SPST NO switches that are readable by the PSoC. One of these switches (the Mode button) also turns the 3v regulator on.
    a. The two digit LCD display is driven directly by the PSoC and is used to display the firmware revision, the battery state of charge, whether the battery is charging, the mode, rate, BLE pairing progress and software update status.
11. There is a 10 pin ZIF connector to connect the CPU board to the Power board via a flex circuit. In a possible future modification, the flex circuit will also connect the drivers on the CPU board to the lenses, eliminating the separate connector and harness currently used for that purpose.

12. The BLE radio is used to control the flicker mode and rate of the goggles via a proprietary app. BLE is also used to monitor and log certain aspects of the goggles operation and can be used to update the control software.