2009 BEST
High Octane
IR Communications Subsystem

Introduction

The High Octane game designers set as one of their goals to encourage experimentation with the recently introduced BEST control module, the "BRAIN". The intent was not to preclude play by teams without programming skill but to reward teams for investigating and experimenting with embedded programming. The strategy they chose to provide this encouragement was to implement a system where a team's robot can interact with the playing field via a unidirectional infrared (IR) communications link. This link allows the robot to command the field to respond in ways not possible via the provided mechanical inputs.

Theory of operation

To keep cost low it was decided to leverage technology used in standard consumer IR remote control systems. This hardware is widely available, has low cost and has high false-signal immunity. The system is comprised of an IR emitter that interfaces to the robot's BRAIN and an IR detector/receiver that interfaces to the BRAIN used to operate the field.

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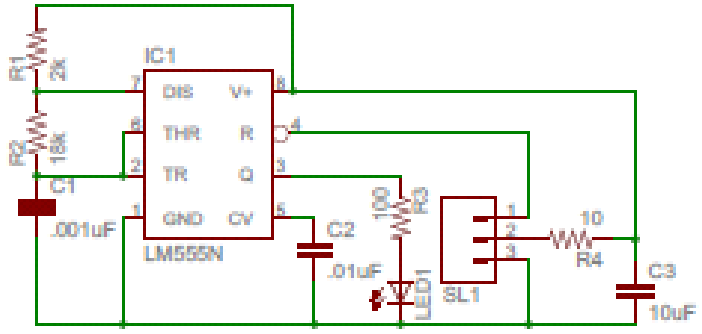
The servo output from the BRAIN is a pulse width signal that is modulated between 0.5 ms and 2 ms. To help with immunity, the pulse width signal is encoded on top of a 56 kHz IR carrier by the IR emitter module.

The detector has a band pass filter to reject spurious signals like florescent lights and Automatic Gain Control (AGC) to help in reception of weak signals. The signal from the detector is routed through the BRAIN Interface board to the Brain radio control (RC) receiver inputs. The RC inputs are internally connected to a timer module within the BRAIN user processor. The field control software reads this data and applies additional debounce and validations routines before declaring a signal a valid command code.

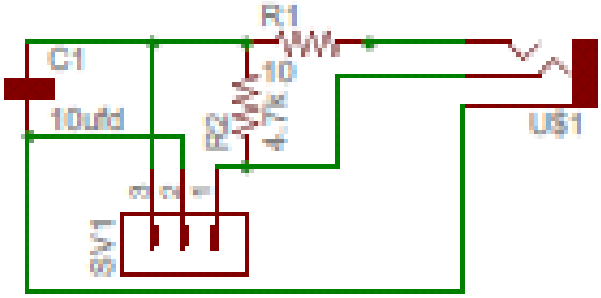
IR Emitter

The IR emitter module interfaces with a BRAIN servo output. A 555 timer is configured in an astable mode that oscillates at a frequency compatible with the receiver pass band. The timer directly drives the Vishay TSAL6200 IR LED. The reset input is used to modulate the 56 kHz carrier by holding the astable output (Q) low when the servo output from the BRAIN is low. When the servo output is high the LED "flashes" at the carrier rate established by R1, R2, and C1. The input power filter R4 and C3 are used to keep the noise from being injected back into the BRAIN circuitry by the high current pulses into the LED.



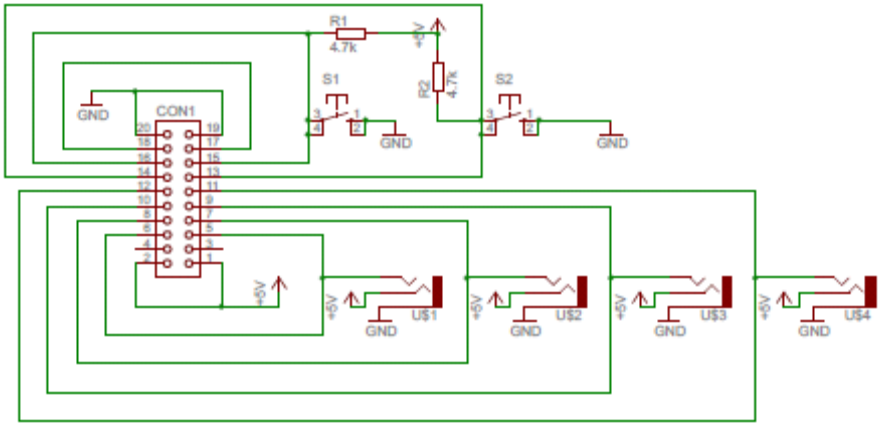
IR Detector

R1 and C1 are used as an input filter to keep noise on the power supply from causing false triggers in the Vishay TSOP 4856 detector (SV1). The detector output only has a weak pull up resistor (33kΩ), so an external resistor R2 is used to augment this. The detector module is connected to the BRAIN interface module with a standard 3.5 mm stereo cable.



BRAIN Interface

The BRAIN interface board is a passive board used to route signals from the IR detector modules to the BRAIN RC receiver inputs and provide pushbutton inputs to the BRAIN used to control field operation.



Appendix

IR Led specifications
http://www.vishay.com/docs/81010/tsal6200.pdf
Mouser order location:
http://www.mouser.com/Search/ProductDetail.aspx?R=TSAL6200virtualkey61370000virtualkey782-TSAL6200

IR Receiver module. We use the TSOP4856 (56Khz Variant)
http://www.vishay.com/docs/82090/tsop48xx.pdf
Mouser order location:
http://www.mouser.com/Search/ProductDetail.aspx?R=TSOP4856virtualkey61370000virtualkey782-TSOP4856