Entertainment Cabinet Cooling Fan Project rev 8/1/08

Goal: To provide a system which will satisfactorily cool an entertainment cabinet while minimizing fan noise levels.

Strategy: First, use a fan which has integral temperature versus speed capability. This will minimize the noise by having the fan start at its slowest speed, and then ramping up as necessary. Selected a temperature controlled case fan-

Model: VANTEC TF12025
120mm x 120mm x 25mm
Rated Voltage: 12VDC
Power Input: 2.04 – 3.36 W (0.2 - .28 A)
Fan Speed: 1300 – 2200 RPM
Air Delivery: 54.3 – 92 CFM
Noise Level: 29 – 39 dB(A)
Bearing Type: Double ball bearing
Ordered From: TigerDirect.com

Performance Curves: Speed constant at 1300 RPM until 25C(77F) exceeded, then linearly ramps up speed with increasing temperature until temperature reaches 50C(122F) then stays constant at 2200 RPM.

Second, turn the fan off when the low temperature threshold is reached. This reduces noise and power consumption. The output pin of the DS1620 will connect to a solid state switch which will connect or disconnect power (12VDC) to turn on or turn off the fan. The speed of the fan is controlled by its own internal circuitry. See Appendix 1.

To do this a Dallas DS1620 programmable temperature sensor/thermostat chip was programmed to act as a thermostat using a Parallax BS2 PIC microcontroller.

The DS1620's upper threshold will be set to +29C(85F).

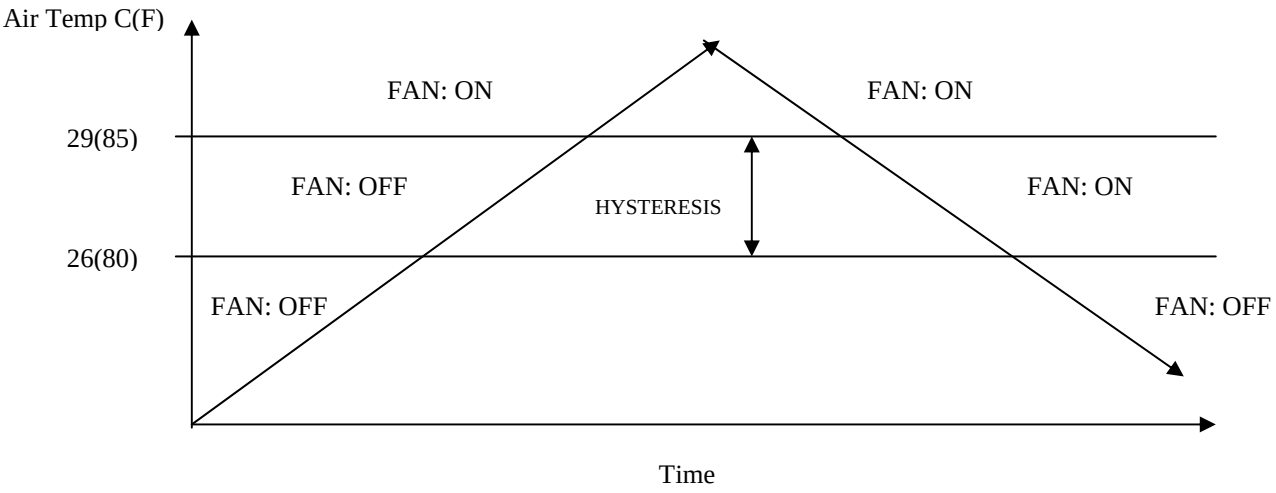
The DS1620's lower threshold will be set to +26C(80F).

Procedure-

1. Attach the PC to the BS2 and verify it is connected properly by opening the STAMP editor and verifying the editor recognizes the attached BS2.
2. Attach the DS1620 to the BS2 as shown in Appendix 2.
3. Copy the code located in Appendix 3 into the STAMP editor.
4. Run the code in the STAMP editor.
5. Turn off power and remove the DS1620 from the programming circuit and install it in the application circuit.
6. Verify the application circuit works as expected
7. End of procedure.

Appendix 1

LOGIC DIAGRAM



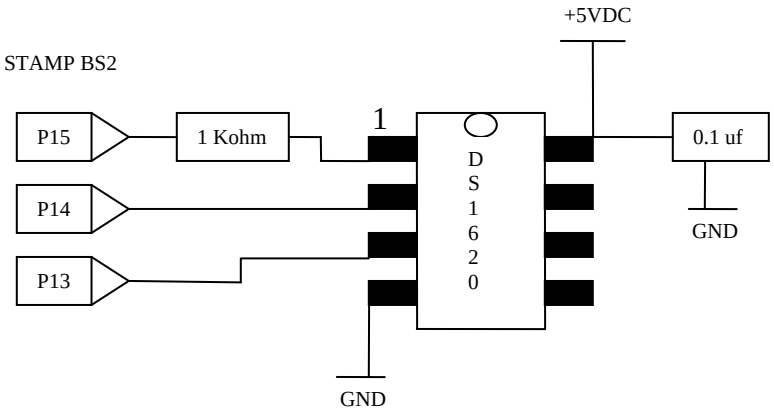
Fan is ON When DS1620's Tcom Pin is HIGH And IRL520 Is Conducting.

Fan is OFF When DS1620's Tcom Pin is LOW And IRL520 Is NOT Conducting.

Appendix 2

Parallax STAMP BS2 / DS1620 Programming Schematic (Stand-Alone Thermostat Mode)

After Being Programmed, The DS1620 Is Removed From The Programming Circuit And Placed Into The Application Circuit.



P15 serial SPI data in and out TO 1kohm resistor TO DS1620 PIN 1 (DQ)
P14 serial data clock TO DS1620 PIN 2 (CLK)
P13 chip select TO DS1620 PIN 3 (RST)
DS1620 PIN4 (GND) TO Vss (GND)
DS1620 PIN8 (Vdd) TO Vdd (+5VDC)
DS1620 PIN8 (Vdd) TO 0.1uf polarized cap TO Vss (GND)
Rev 5/28/07

Appendix 3

Parallax STAMP BS2 Program Code

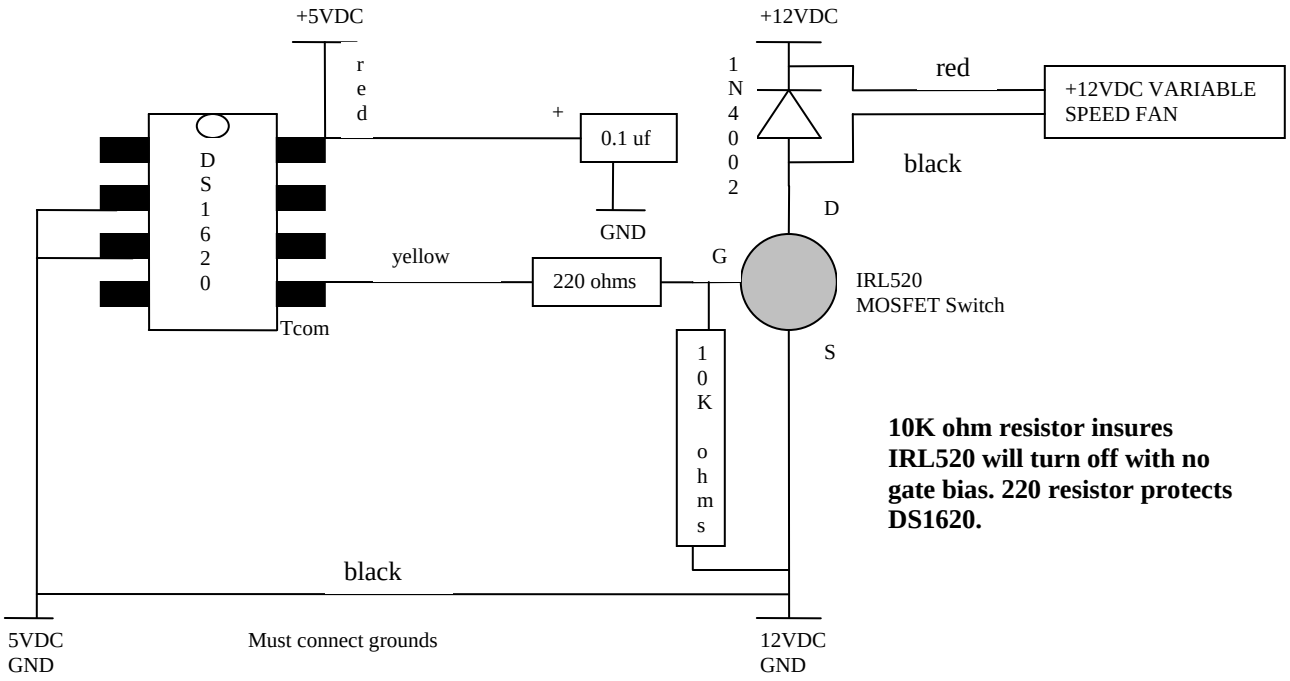
```
' {$STAMP BS2}
' Routine to put the DS1620 in standalone thermostat mode
' and to set the lower and upper threshold registers
' to 26C(80F) and 29C(85F). John Goglick Apr 22 2007
' The purpose of the DS1620 is to simply apply 12vdc when the upper threshold is exceeded and turn off power to the fan
' when the air temp falls below the lower threshold set point (note the hysteresis on the Tcom pin).
' The fan has internal circuitry to ramp its speed based upon air temp.
' The fan starts increasing speed at 25C=77F, max speed reached at 50C=122F
' Fan: Vantec model TF12025 purchased from TigerDirect.com
'-----------------------------------
' P13=chip select TO DS1620 PIN 3 (RST)
' high activates the DS1620 to receive data
' P14=serial data clock TO DS1620 PIN 2 (CLK)
' P15=serial SPI data in and out  TO 1kohm resistor TO DS1620 PIN 1 (DQ)
' DS1620 PIN4 (GND) TO Vss (GND)
' DS1620 PIN8 (Vdd) TO Vdd (+5VDC)
' DS1620 PIN8 (Vdd) TO 0.1uf polarized cap TO Vss (GND)
' DS1620 PIN5 (Tcom) TO  switch. Tcom goes high when upper threshold exceeded, goes low
' when temp falls below lower threshold (note hysteresis in between).
' Can also connect LEDS to Thigh and Tlow pins on 1620 to indicate state(use transistor switch)
' ---------------------------------
' configure DS1620 for standalone thermostat mode
HIGH 13
  SHIFTOUT 15,14,LSBFIRST,[12,0]
LOW 13
PAUSE 100  ' let it write (be sure to allow time!)
' ---------------------------------
' set the lower threshold= +26C(80F)
'NOTE: Double your set temp in C and enter this value in SHIFTOUT
'Must send the DS1620 twice the desired temperature value.
'If reading the DS1620, it sends twice the actual temp, so devide it by 2
HIGH 13
  SHIFTOUT 15,14,LSBFIRST,[2,52\9]  ' lower threshold=-52/2=26C(80F)
            '  the twos complement number is sent correctly as 9 bits
LOW 13
PAUSE 100  ' let it write
' ---------------------------------
' set the upper threshold= +29C(85F)
HIGH 13
  SHIFTOUT 15,14,LSBFIRST,[1,58\9]  ' upper threshold=58/2=29C(85F)
LOW 13
PAUSE 100

' ---------------------------------
' At this point you can turn off the DS1620
```

Appendix 3, continued

Parallax STAMP BS2 Program Code

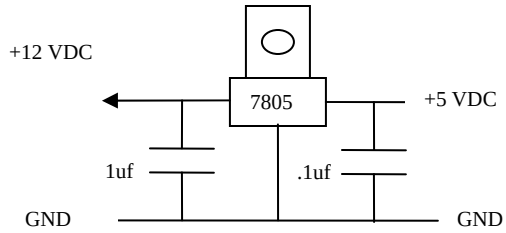
```
' and move it to another circuit.
' The configuration and settings are fixed in eeprom
' you only need to program the eeprom once.
' (until you want to change the configuration or thresholds!)
' DS1620 pins 2 & 3 should be tied low in the application circuit.
' DS1620 pin 7 is high for temperature >= 29
' DS1620 pin 6 is high for temperature <= 26
' DS1620 pin 5 is high >=26, low <=29, hysteresis in between
' -------
```

Appendix 4
Application Schematic

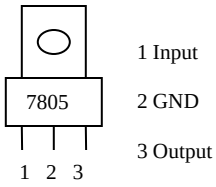


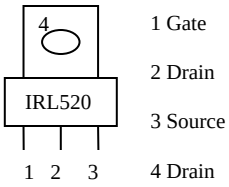
NOTE HYSTERISIS (see Appendix 1)

AIR TEMP	> UPPER THRESHOLD	< LOWER THRESHOLD
Tcom	HIGH	LOW
FAN	ON	OFF

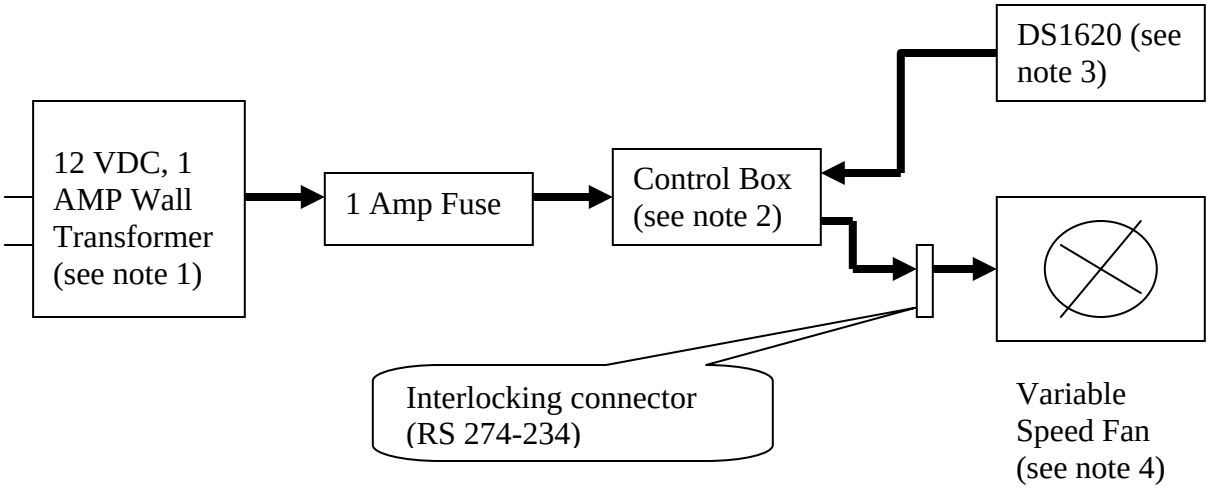


+12VDC from 12VDC 1 Amp wall outlet power supply





Appendix 5
Wiring Connection Diagram



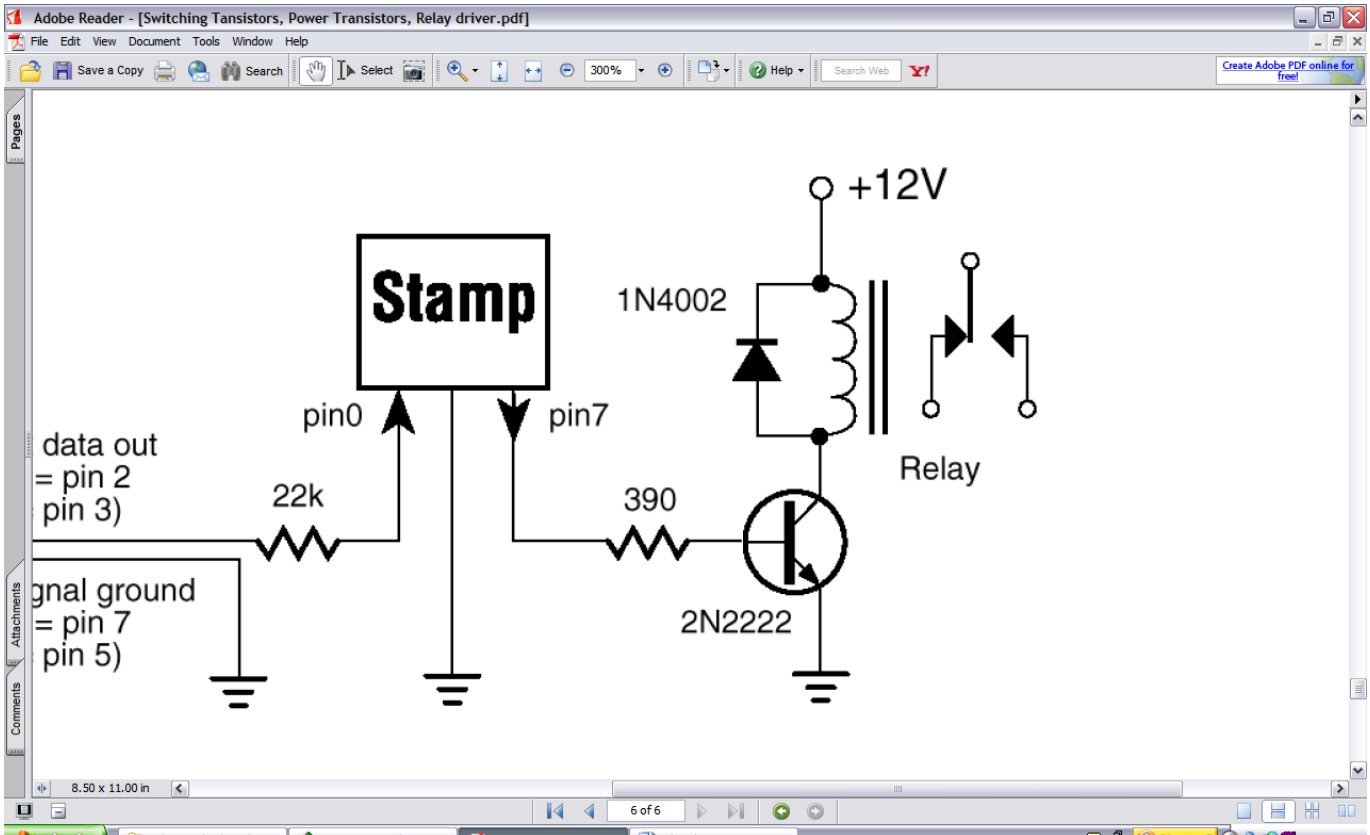
Note 1: The wall transformer may be a switching or regular transformer type. The switching type is smaller and lighter than the transformer type; however, the transformer type will probably have better life expectancy. Switching transformer - SCEPTRE POWER, Model# AMDD-20120-1000, P/N: PX1210AWPL05, INPUT: 100-240 VAC 50/60 Hz 0.5 A, OUTPUT: 12.0 VDC 1 A.

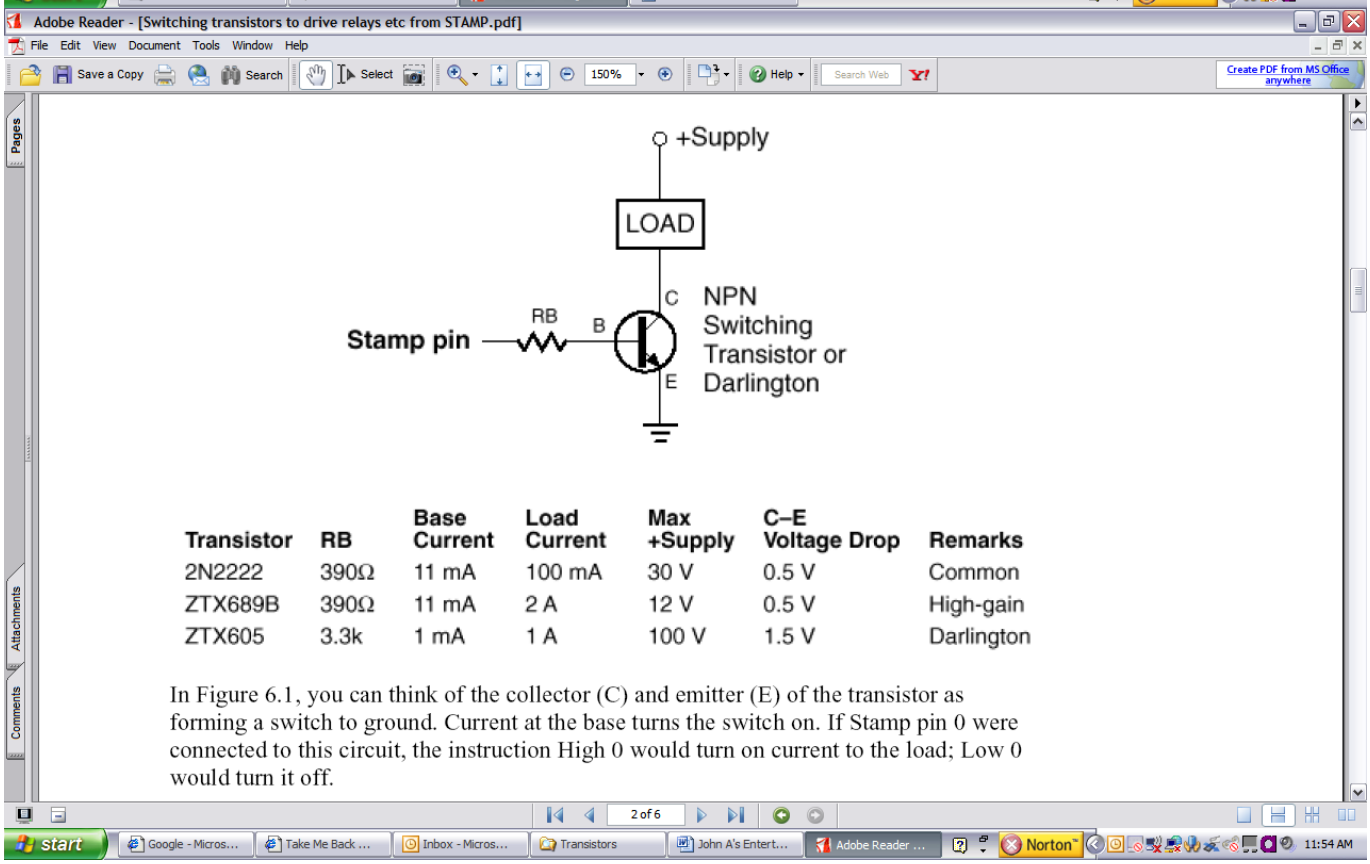
Note 2: The control box contains all of the electronics, is a 3x2x1 inch plastic project box from Radio Shack. Neither of the supplied covers were used. Instead a piece of perfboard was cut to fit to facilitate air flow to cool the electronics. A jack was installed on one end to mate with the plug from the 12VDC power transformer. The fuse was spliced into one side of the transformer's output cable. Two wires exited from the other end- one going to the fan, and the other to the DS1620. Velcro (matching strips) was attached to the bottom of the box (after the bottom was flattened with sandpaper) so that it could be stuck o the cabinet, but removed if necessary later. The control box was mounted close to the fan.

Note 3: A square hole, just big enough so an 8-pin dip socket could be slid through, was cut into a Radio Shack 3x2x1 inch plastic project box's plastic lid . The 8-pin dip socket was inserted from the inside face of the lid until it was slightly proud of the surface and then glued in with "super glue". The 0.1uf capacitor and 220 ohm protection resistor were wired on the back of the dip socket. A hole was drilled in the end of the box and the connection wire inserted and soldered to the dip socket. After the lid was attached, the DS1620 chip was inserted into the socket. This allows the sensor to be outside of the box in direct contact with the air. Velcro (matching strips) was attached to the bottom of the box (after the bottom was flattened with sandpaper) so that it could be stuck o the cabinet, but removed if necessary later. The DS1620 box was mounted to the underside of the top of the cabinet.

Note 4: The variable speed fan was a Vantec, 120mm, temperature controlled case fan, double ball bearing, lifetime warranty, Model TF12025, 12vdc, 1300-2200 RPM, 54.3-92 CFM, 29-39 db(A), draws 0.3A, purchased from TigerDirect.com The rpm speed sensor wire was cut off the fan. The power connectors (for a PC) were cut off and replaced with an interlocking connector (RS 274-234) pair which allowed it to be connected to the control box wire. The fan should be mounted high on the cabinet's back panel with it oriented to expel air from the cabinet. Holes should be drilled in the bottom of the cabinet's back panel to allow cool air to enter.

Appendix 6
Additional Driver Circuits





Transistor	RB	Base Current	Load Current	Max +Supply	C–E Voltage Drop	Remarks
2N2222	390Ω	11 mA	100 mA	30 V	0.5 V	Common
ZTX689B	390Ω	11 mA	2 A	12 V	0.5 V	High-gain
ZTX605	3.3k	1 mA	1 A	100 V	1.5 V	Darlington

In Figure 6.1, you can think of the collector (C) and emitter (E) of the transistor as forming a switch to ground. Current at the base turns the switch on. If Stamp pin 0 were connected to this circuit, the instruction High 0 would turn on current to the load; Low 0 would turn it off.

Appendix 6, continued
Additional Driver Circuits

Driving an LED from logic level output- STAMP, DS1620, etc.