Product Test Plan

Swim Team Scoreboard Project

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The Event and Heat Display Board is nearing completion in the final stages of testing. The individual component testing is completed and system testing has begun. This report will describe the methods used for testing, verifying and validating the system.

This report is organized into three parts. First, the individual components will be listed and described. Second, the procedures used to verify and test the components will be described. Lastly, the validation procedures will be described, i.e. the difference between a successful test and an unsuccessful test.

1. Component Description

1.1. Data Interceptor and Decoder.

A. Component Description.

The data interceptor and decoder is the component that will intercept the data coming from the timing computer and then extract the event and heat numbers from the data stream. This component consists of a connection to the data stream coming from the timing computer as well as software for the Rabbit microprocessor.

B. Interactivity

The data interceptor and decoder connects directly to the data stream from the timing computer via a serial connection that is physically plugged into the existing scoreboard. The existing scoreboard has a data out terminal that routs incoming data from the timing computer directly through to the next scoreboard in line. Our data interceptor will connect at this point. After extracting the appropriate event and heat number from this data stream it will send these numbers to the next component in line, the Send Data to Display Driver component.
C. Goal Objectives

This component will achieve the objectives of intercepting the data stream coming from the timing computer and extracting the event and heat information from that data.

1.2 Timing Computer Simulator

A. Component Description

The Timing Computer Simulator component handles the task of simulating the output data stream of the timing computer for testing purposes. This component became necessary when the timing computer that was being used stopped working. This component consists of a separate microcontroller with a serial output port, and a piece of software that outputs hex values on the serial port.

B. Interactivity

The Timing Computer Simulator is only used for testing purposes. This component generates its own data. It connects directly to the Data Interceptor and Decoder in place of the actual timing computer.

C. Goal Objectives

This component’s objectives are to effectively simulate the output hex values of the timing computer. To match the actual operation of the timing computer more fully, this component will send the event and heat channel number, along with several initial pieces of event and heat information, and then it will interrupt that channel and begin a new channel.
1.3. **Send Data to Maxim Driver.**

**A. Component Description.**

The Send Data to Maxim Driver is the component that will send the data from the Rabbit microprocessor to Maxim driver. The Rabbit processor receives the event and heat number from the Interpreter and Decoder component. This Send Data to Maxim Driver component converts event and heat number to Maxim diver format and sends 10 bit serial data which contain register address and actual data.

**B. Interactivity**

The Maxim display driver interfaces the Rabbit microprocessor to a 5 digit 7 segment display. The Rabbit microprocessor sends converted data which contain control registers, register address, and actual data to Maxim driver. Converted data is for single digit update mode which allows one digit to be changed without updating the entire display. The each event and heat number is sent to maxim driver whenever event and heat number is updated from timing computer. In single digit update mode, first the control register is updated with MODE high, WRITE low, DATA COMING low, the desired data format, and the address of the digit to be updated on data lines. A second write to the Maxim driver, this time with MODE low, transfers the actual data into selected digit's RAM location. Whenever event and heat number is updated, single digit update occur five times for 3 digit event number and 2 digit heat number. After sending data, Maxim driver will drive 5 7-segment displays.
C. Goal Objectives

This components objective is to send data which contain control registers, register address, and actual data to Maxim driver. To send data to Maxim driver, the data from timing computer should be converted to Maxim display format.

1.4 Transistor Switch Circuit

A. Component Description.

The transistor switch circuit handles the task of taking the 5-volt output control signal from the Maxim display driver and switches the 24-volt power supply to the 7-segment displays. This is necessary because the output of the Maxim is only 5 volts, which is much less than the voltage that the displays run at. This component consists of a NPN bipolar transistor and a 24-volt power supply.

B. Interactivity

The common anode of the 7-segment display is connected to the positive 24-volt supply and each segment is connected to the collector of each transistor. The emitter is connected to the negative of the voltage supply. The control voltage from the Maxim display driver is connected across the base and emitter. When the control signal from the display driver is sent to the transistor it send current through the base emitter and the transistor acts as a switch to connect the 24 volts to the 7-segment display.

C. Goal Objectives

This components objective is to act as a switch to supply the necessary voltage to the 7-segment displays using the low voltage control signal from the display driver.
1.5 Seven Segment LED Displays.

A. Component Description.

The 7-segment displays are used to display the event and heat numbers that are generated from the timing computer. The displays are made up of 7-segments and each segment consists of 10 LED’s that are in series. Due to the internal circuitry of the LED’s each display needs 18 volts to bring the display to its brightest state. This supply voltage is high because the voltage drop across each diode is .7 volts and each LED needs about 1 volt to bring it to its brightest state.

B. Interactivity

Each display digit is connected to its respective transistor switch circuit depending on which digit it is. There are three digits used to display the event and two digits to display the heat. The common anode of each digit is connected to the positive voltage from the power supply and each segment is connected to the collector of each transistor. The circuit is then completed when the display driver sends the control signal to its respective digit, therefore displaying the correct event and heat numbers for the meet.

C. Goal Objectives

This component’s objective is to display the event and heat numbers that are generated from the timing computer. These displays must be bright enough to be read from about 100 feet so all the viewers can see them.
2. Testing and Verification Procedures

2.1 Data Interceptor and Decoder

To test the data interceptor and decoder component, the timing computer was going to be used to set up a practice swim event and change event and heat numbers. The data stream would be connected to the component and the data interceptor and decoder would work its magic. Unfortunately, the timing computer that was going to be used for testing broke, and with the main timing computer being used for swim meets, this was no longer a viable option.

Luckily, we were able to obtain sample data from the timing computer. With this sample data, a timing computer simulator was set up on another microcontroller and this would output data in the format of the timing computer. This data stream would be used to test the data interceptor and decoder.

To test the data interceptor and decoder component, the sample data stream coming from the timing computer simulator will be connected to the input of the data interceptor and decoder. The sample data stream will contain known values for the event and heat. Intermixed with these hex values will be hex values for other channels and random information. Also, the event and heat data will start to be sent, and then be interrupted by another channel, in order to see if the data interceptor and decoder can recover the proper event and heat numbers.

2.2 Timing Computer Simulator

In order to test the timing computer simulator, and make sure that it was outputting the appropriate hex values, the actual output of the real timing computer had to be obtained. Luckily, we had about a page of output values from the real timing
computer, as well as the specs on how it operates, 9600 BAUD, even parity, etc. The output of the simulator was connected to a computer running the HyperTerminal program. This program monitors a serial connection and displays any data that it receives.

HyperTerminal tries to display ASCII characters, so it just displays nonsense when you send it random hex values. To view the actual hex data, the input was captured to a text file and then another program, HexEdit, was used to view the captured text as hex values.

2.3 Send Data to Maxim Driver

To test the Send Data to Maxim Driver, The Rabbit microcontroller will be connected to the data interceptor and decoder and receive the current event and heat numbers. The Rabbit microcontroller also will be connected to the Maxim microcontroller. The Rabbit microcontroller needs 10 I/O ports for output. The Maxim driver will receive the data from 10 I/O ports Rabbit microcontroller output. In order to see if the Maxim driver receives the proper event and heat numbers, the Maxim display driver will be connected to 5 digit 7-segment displays and 7-segment displays will display the data in proper numbers and positions.

2.4 Transistor Switch Circuit

To test the transistor switch circuit a series of voltages and current were ran through the collector and the base. These voltages were similar to the ones that are supplied by the display system. To test, an LED was connected from the supply voltage to the collector and a simulated control signal was sent to the base emitter. When the control signal was sent through the base the LED on the collector turned on, which means
the circuit works as planned.

After the circuit performed to its expectations, it was tested for its maximum ratings. The maximum ratings that were used for the testing were way above the circuit’s normal ratings. Therefore there is a huge margin or error if the circuit becomes unstable for some reason.

2.5 Seven Segment LED Displays.

The 7-segment displays were tested by running the rated current through each segment of each digit. This showed that the digits were not defective. The digits then were tested in the transistor switch circuit. As the control signal from the display driver was sent to the digit it would light up each of the corresponding digits. This test showed that the transistor switch circuit could in fact be used to run the digits from the low voltage control signals from the display driver. After this was done there was not much else used to test the digits because a failure test was out of the question.

3. Validation Procedures

3.1 Data Interceptor and Decoder

In order to validate the results achieved from testing the data interceptor and decoder, the output of the function (the extracted event and heat numbers) will be compared with the event and heat numbers that were input. If this component is functioning properly, an incoming event and heat number should produce an identical outgoing event and heat number.

A. Objectives Met?

The objectives for the data interceptor and decoder component were:

-intercepting the data stream coming from the timing computer.
-extracting the event and heat information from that data.

The data interceptor and decoder met the objective of intercepting the data stream coming from the decoder. The data stream is input to the microcontroller via a serial connection at 9600 BAUD and even parity.

The data interceptor and decoder met the objective of extracting the event and heat information from the data stream. Even when the event and heat were interrupted, the component waited until they were fully sent again before updating the internal event and heat numbers.

3.2 Timing Computer Simulator

To determine that the timing computer simulator was operating correctly, the captured output was viewed as hex and compared with the sample of actual timing computer output. It would be considered a success if individual channel numbers were sent, followed by data for that channel, interrupted by another channel and data, and then repeated.

A. Objectives Met?

The objectives for the timing computer simulator were:

- Accurately simulate the output of the timing computer.

This objective was met by the simulator. The output of the simulator accurately mimics the output of the timing computer. The simulator can be used to test the other components of the system.

3.3 Send Data to Maxim Driver

In order to validate the results achieved from testing the Send Data to Maxim Driver, the output of the component (the current event and heat numbers) will be
displayed on 7-segment displays in proper numbers and positions.

A. Objectives Met?

The objectives for the Send Data to Maxim Driver were:

- converting Maxim display format
- sending data to Maxim driver.

The Send Data to Maxim Driver met the objective of converting Maxim display format. The control registers, register address and actual data for Maxim display driver are set.

The Send Data to Maxim Driver met the objective of sending data to Maxim driver. The Rabbit microcontroller needs 10 I/O ports for output. The Maxim driver will receive the data from 10 I/O ports Rabbit microcontroller output.

3.4 Transistor Switch Circuit and Seven Segment LED Displays.

In order to validate the results achieved from transistor switch circuit and the 7-segment displays, the digits must be displaying the correct event and heat numbers. Also to validate the transistor circuit the display must be bright enough to be seen from about 200 feet away.