B31DG - Assignment 1

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# Revision History:

|  |  |  |  |
| --- | --- | --- | --- |
| **Version Number** | **Date** | **Author** | **Notes** |
| 0.0 | 24/02 | Fraser Holman | Initial Report Layout |
| 1.0 | 25/02 | Fraser Holman | Calculated Parameters |
| 1.1 | 26/2 | Fraser Holman | Oscilloscope Screenshots |
| 1.2 | 28/02 | Fraser Holman | Flowchart and Hardware Screenshots |
| 1.3 | 28/02 | Fraser Holman | Final Draft and Submission |

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# Calculated Parameters

## LED Resistor Values

Equation 1 can be used to calculate the corresponding resistor values for the LEDs used in this system. Vs represents the supply voltage, which for all LED’s within this system this will be 3.3V as the operating voltage of an ESP32 is 3.3V. Vf represents the forward voltage for each LED which can be found in the appropriate datasheet alongside If, the forward current. And R represents the desired resistor value for the corresponding resistor to each LED.

Equation 1 - Corresponding LED Calculation (RS Components, 2024)

Using Equation 1 the following desired resistor values were calculated as shown in Table 1.

Table 1 - LED Desired Resistors

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **LED Colour** | **Supply Voltage Vs (V)** | **Typical Forward Voltage Vf (V)** | **Forward Current If (mA)** | **Desired Resistor Value (Ω)** |
| Red (Farnell, 2011) | 3.3 | 2 | 20 | 65 |
| Orange (Farnell, 2019) | 3.3 | 2 | 20 | 65 |
| Green (Farnell, 2019) | 3.3 | 3.2 | 20 | 5 |

## Application Parameters

To calculate the application parameters used within this system the surname ‘HOLMAN’ was used. Table 2 demonstrates the final calculations for each parameter used for the signal. The alternate behaviour was calculated as option 2 – this is the reversed data waveform starting at the largest pulse rather than the shortest.

Table 2 - Application Parameters Calculations

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Numerical Mapping** | **Calculation** |
| a | ‘H’ maps to 8 | 8 x 100us = 800us |
| b | ‘O’ maps to 12 | 12 x 100us = 1200us |
| c | ‘L’ maps to 12 | 12 + 4 = 16 |
| d | ‘M’ maps to 13 | 13 x 500us = 6500 |
| Alternative Behaviour | ‘A’ maps to 1 | (1 % 4) + 1 = 2 |
| TON(n) | N/A | 800 + ((n-1) x 50us) for 2 ≤ n |

# Oscilloscope

Figure 1 represents the data waveform output displayed on an oscilloscope. The oscilloscope was setup to be triggered on the rising edge of the sync pulse (in blue). Figure 2 shows the alternate behaviour waveform, similarly triggered on the rising edge of the sync pulse. As stated previously the alternative behaviour was a reverse of the original data waveform, rather than the pulse width increasing, the data signal (in yellow) starts at the widest pulse and decreases.

A screenshot of a computer

AI-generated content may be incorrect.

Figure 1 - Data Waveform Output

A screen shot of a device

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Figure 2 - Alternative Data Waveform Output

# Hardware Circuit

Figure 3 demonstrates the system recreated in a schematic format.

A diagram of a circuit board

AI-generated content may be incorrect.

Figure 3 - System Schematic

Figure 4 demonstrates the wiring diagram used to put together the circuit for this project.

A computer chip on a circuit board

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Figure 4 - Wiring Diagram of System

Figure 5 shows the circuit recreated using an ESP32-WROOM module and with the LEDS, resistors, and buttons as outlined above.

A circuit board with wires and wires

AI-generated content may be incorrect.

Figure 5 - Physical Circuit

# Flowchart

Figure 6 shows the control flow of the main system

A diagram of a computer program

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Figure 6 - Flowchart of Main Control Flow

Figure 7 shows the control flow for button interrupts during the systems operation and the variables they affect to change between waveform behaviours and toggling the data signal on/off.

A diagram of a system

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Figure 7 - Flowchart of Button Interrupts

# Relevant Links

Project GitHub Link:

<https://github.com/fholman/B31DGAssig1>

Demonstration MS Stream Link:

<https://heriotwatt-my.sharepoint.com/personal/fjah2000_hw_ac_uk/_layouts/15/stream.aspx?id=%2Fpersonal%2Ffjah2000%5Fhw%5Fac%5Fuk%2FDocuments%2Fdemonstration%2Emp4&referrer=StreamWebApp%2EWeb&referrerScenario=AddressBarCopied%2Eview%2E39f83abe%2Dadd1%2D43fe%2Dae3d%2Daa873ceb899f&isDarkMode=false>

# References

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Farnell. (2019, February 05). *Green LED - T1*. Retrieved from Farnell: https://www.farnell.com/datasheets/2724776.pdf

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