

# B31DG – Assignment 1

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## Table of Contents

Revision History .....	1
Calculation of Parameters .....	2
Output Timing Parameters .....	2
Alternative Behaviour .....	2
Oscilloscope Screenshots .....	3
Original Waveform.....	3
Alternative Waveform .....	5
Hardware Setup .....	6
Program Flowchart.....	7

## Revision History

Revision	Date	Author	Notes
1.0	01/03/2025	Alex Ferguson	Initial Version

## Calculation of Parameters

The timing parameters were calculated as specified in the assignment documentation with the surname 'Ferguson'.

## Output Timing Parameters

*Table 1: Output Timing Parameter Calculations*

Parameter	Letter	Numerical Mapping	Description	Calculation
a	'F'	6	Ton	$6 * 100 = 600\text{us}$
b	'E'	5	dataOff	$5 * 100 = 500\text{us}$
c	'R'	9	pulseCount	$9 + 4 = 13$
d	'G'	7	idleTime	$7 * 500 = 3500\text{us}$

## Alternative Behaviour

Based on the calculations in Table 2 below, the alternative waveform for this program was determined to be the original waveform generated in reverse i.e. from the largest pulse to the smallest pulse.

*Table 2: Alternative Behaviour Calculation*

Letter	Numerical Mapping	Calculation
'U'	6	$(6\%4) = 2$

# Oscilloscope Screenshots

Shown in the following section are the oscilloscope outputs from the data and sync pins for the original and alternative waveforms. The oscilloscope was set to trigger on the rising edge of the sync waveform. Also included are the measurements of the pulse timings for both waveforms.

## Original Waveform

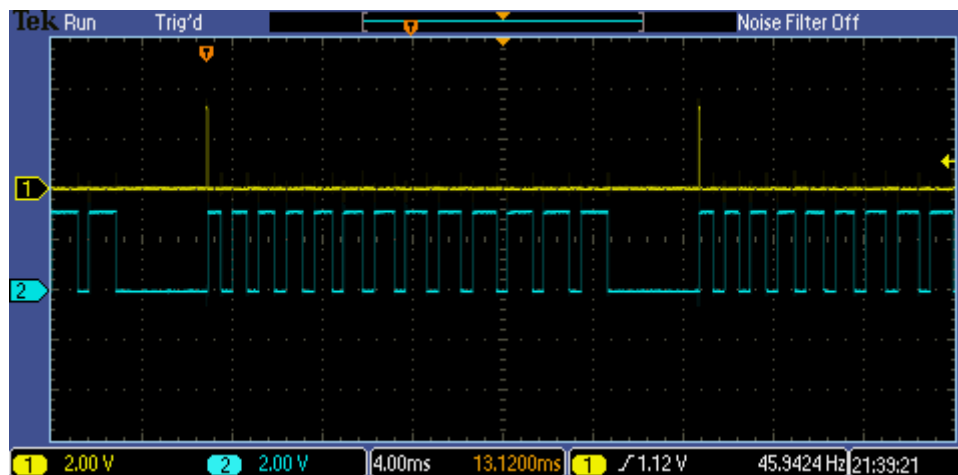


Figure 1: Waveform Oscilloscope Output

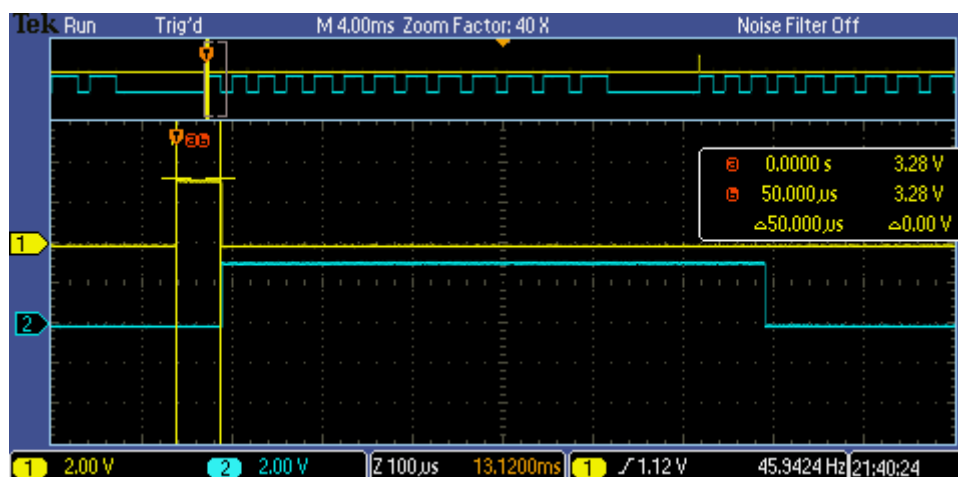


Figure 2: Sync Pulse Timing

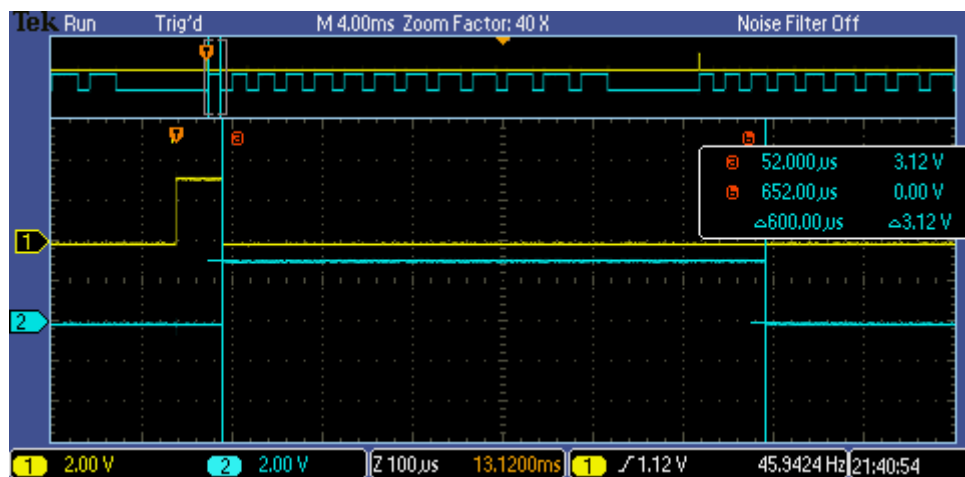


Figure 3: Original Waveform First Pulse Timing

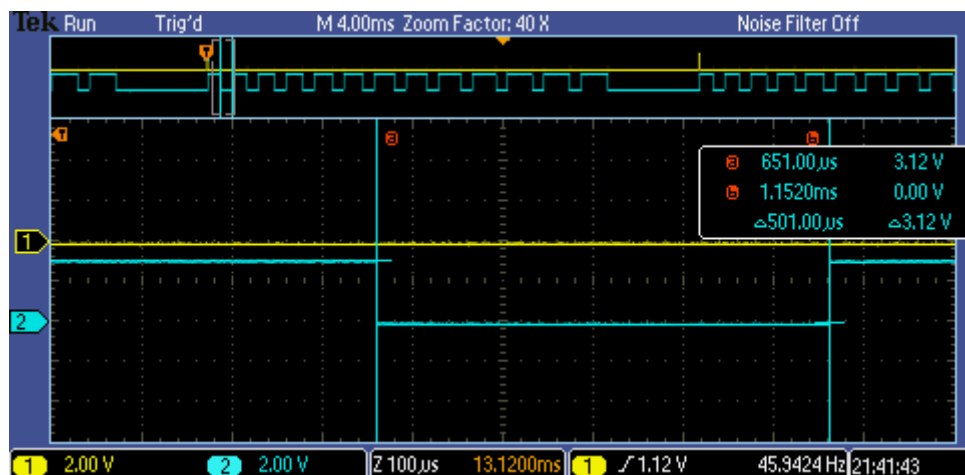


Figure 4: Data Off Timing

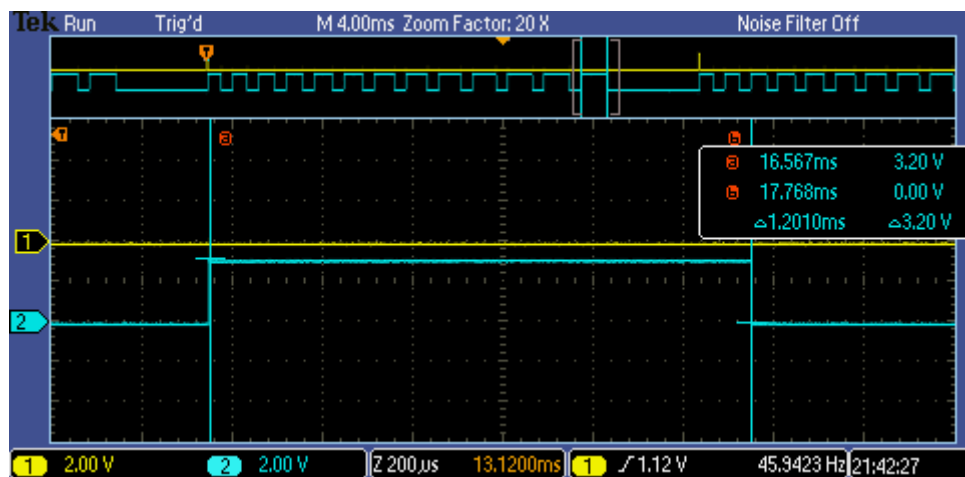


Figure 5: Original Waveform Final Pulse Timing

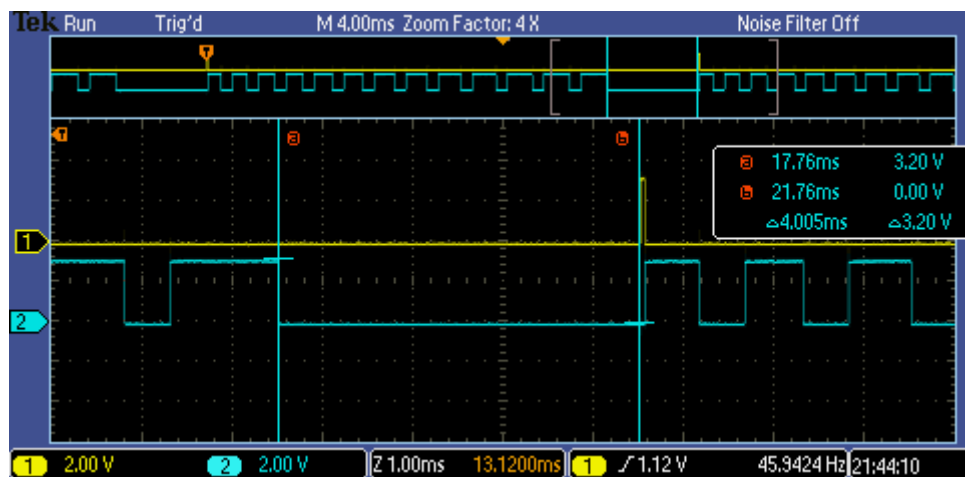


Figure 6: Idle Time Timing

## Alternative Waveform

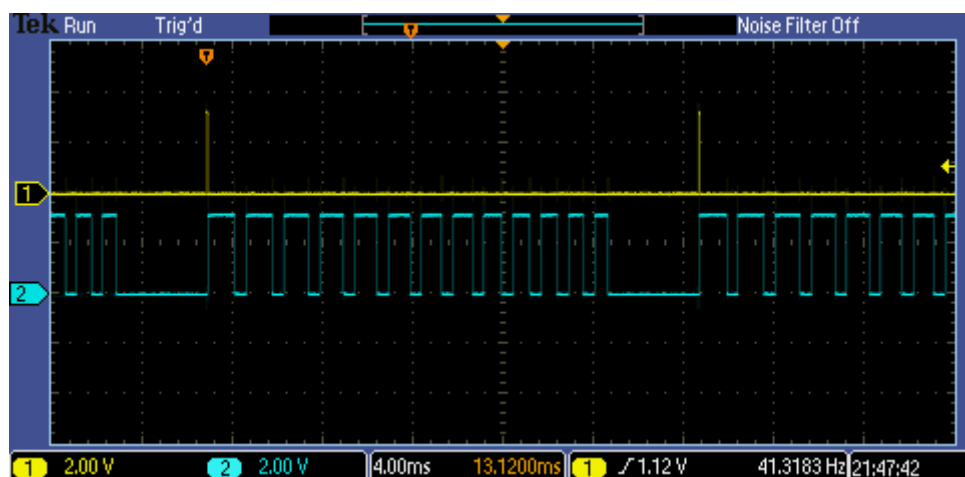


Figure 7: Alternative Data Waveform

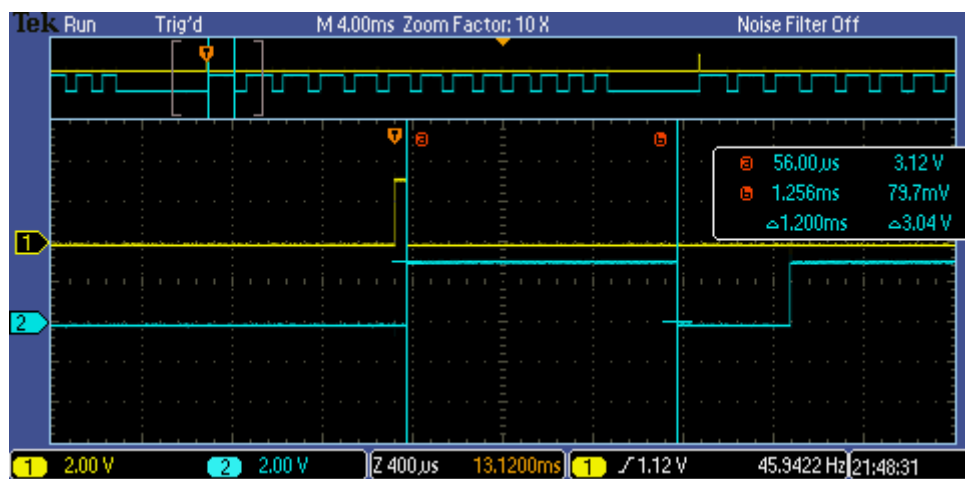


Figure 8: Alternative Waveform First Pulse Timing

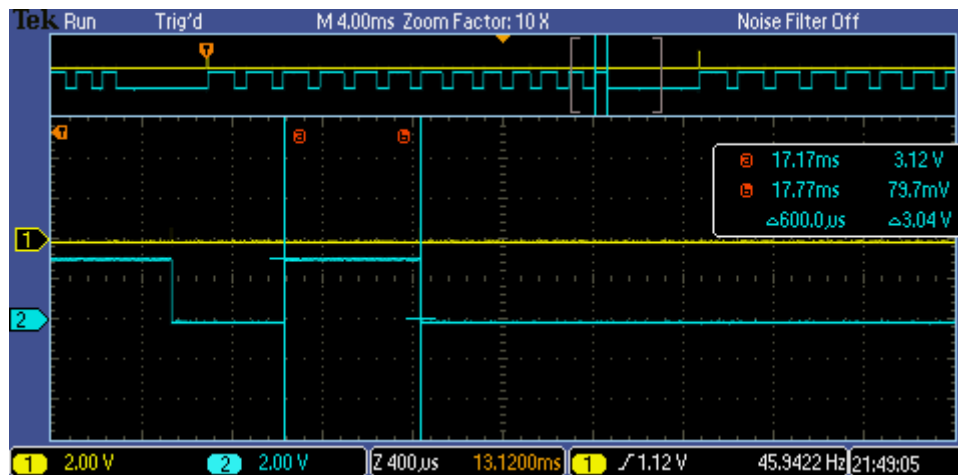


Figure 9: Alternative Waveform Final Pulse Timing

## Hardware Setup

The ESP32 was set up on a breadboard as shown in Figure 10 below. Two LEDs were connected to GPIO pins 25 and 26 with a 330Ω resistor in series to allow for visual debugging of the program when using debug timing. Two push buttons were also connected to GPIO pins 12 and 14 with a 1kΩ pull-down resistor to allow the output to be toggled on and off, and to select the waveform to be generated.

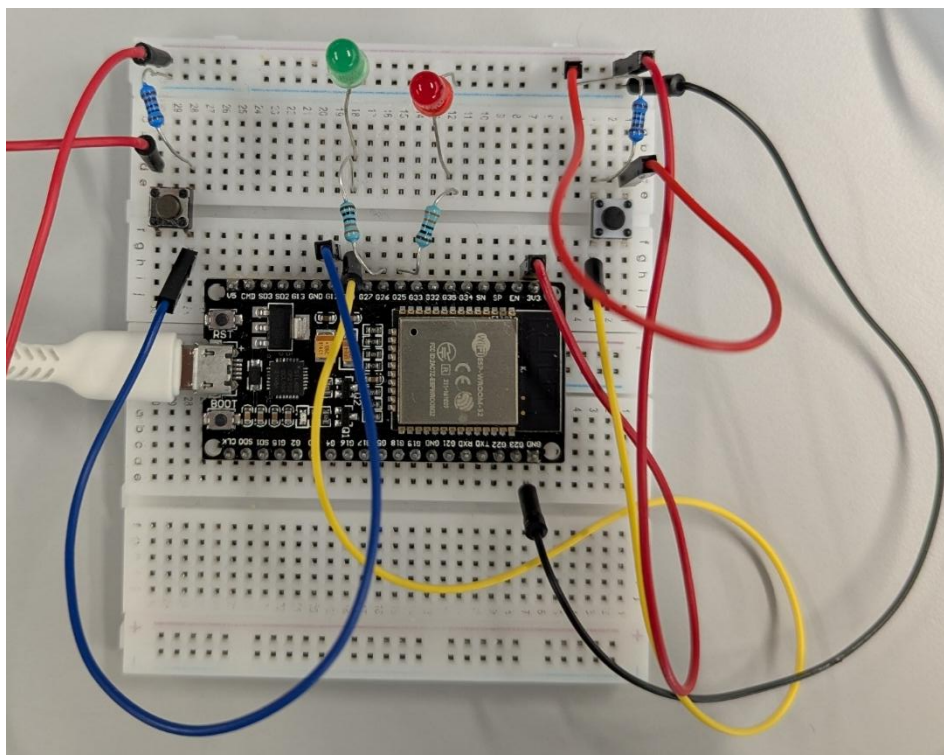


Figure 10: ESP32 and Circuit Assembled on Breadboard

# Program Flowchart

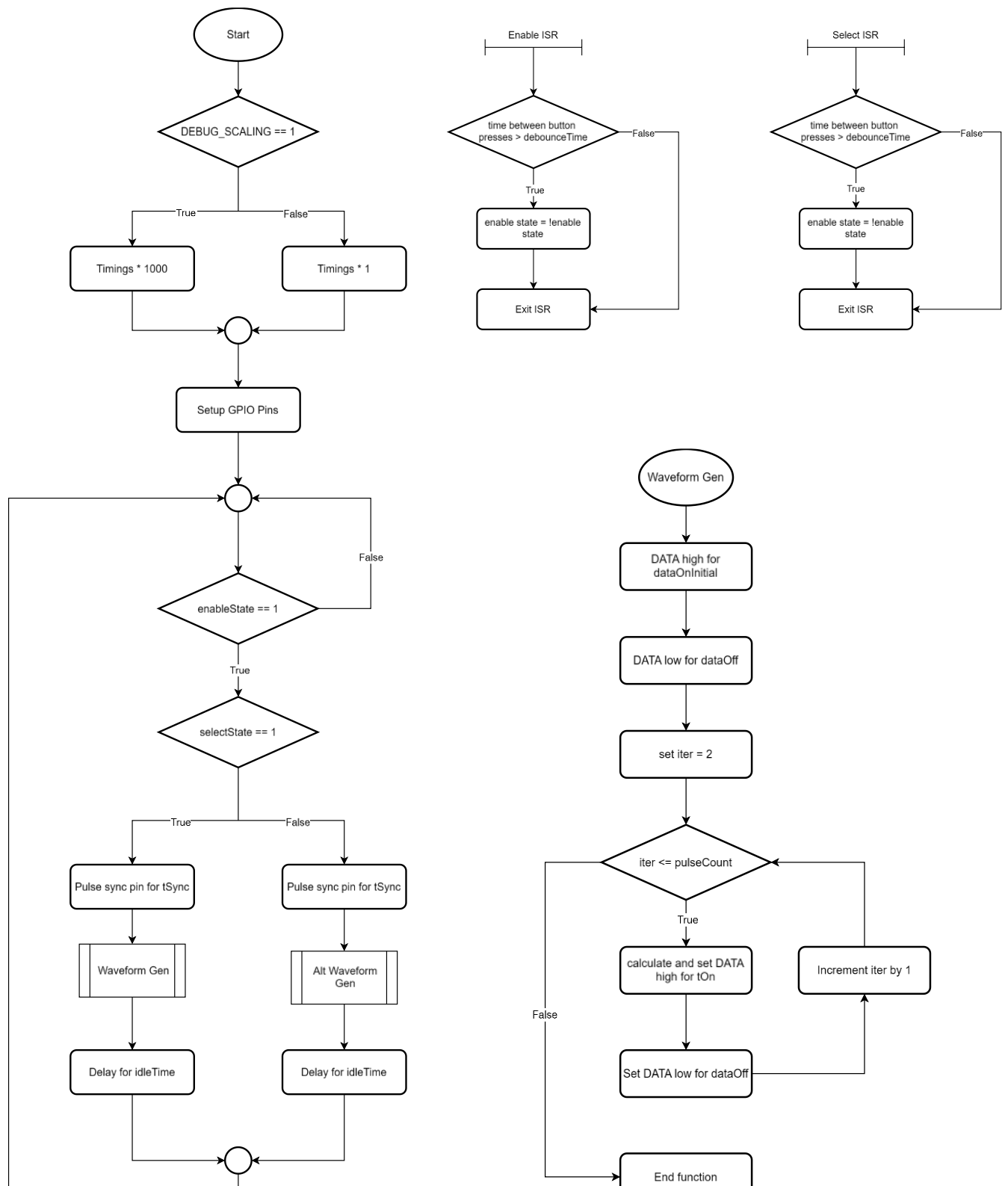


Figure 11: Program Flowchart

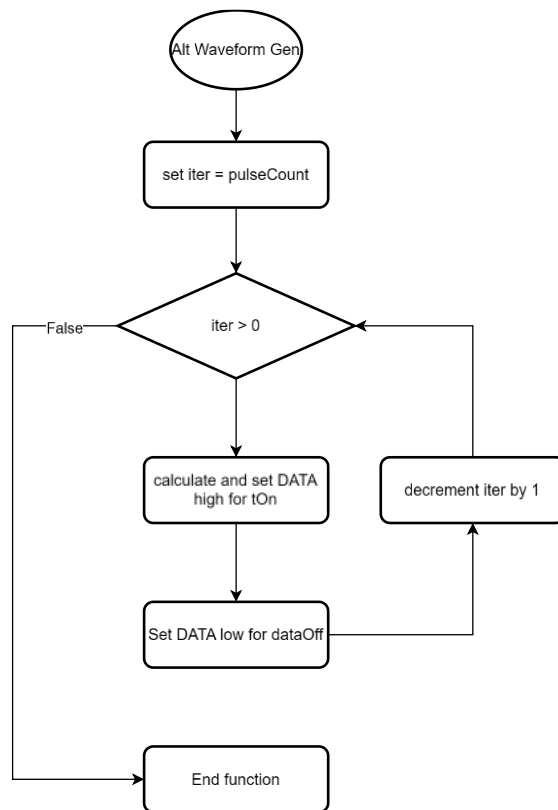


Figure 12: Program Flowchart Continued