



UNIVERSITY OF
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G49 - Users Manual

Microprocessors (ENEE440)

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1 Introduction

The purpose of the Users Manual is to ease the transition into using the system for a new user, and to provide current users with an easy lookup manual.

The system currently has three built-in Devices, which include:

- **Digital to Analog Converter:** Device outputs an analog voltage to the userLED pin, PA5.
- **Timer:** Device provides outputting a consistent digital signal to the userLED pin, PA5.
- **Serial Peripheral Interface:** Device provides communication for the W25Q128 flash memory module.

Each command is run once when it's command string has been transmitted to the system.

All Devices have a commands that makes the Device stop anything it's doing.¹ This is the skip command.

¹Except for the SPI Device.

2 Devices

2.1 Digital to Analog Converter (DAC)

The DAC Device is used to output an analog signal to the userLED. If any other pin is needed, a developer whom has read the `Maintainers Manual` should be consulted.

2.1.1 Usage

To **initialize** the Device, command 0 is used. This has the command string `:0100FF`. This *must* be done before using the Device.

If you wish to output a **constant** analog signal, command 1 is used. This command takes one (1) input: a 12-bit digital value. This value represents the analog voltage output. If you wish to output $1.1V$ the input argument should be $0555_{16} = 1365_{10}$. The output voltage is the calculated as

$$V_{out} = 3.3V \cdot \frac{input}{4095}$$

A command string using this input would be:

`:01015505A4`

The Device also has the functionality to output a **pulse**.

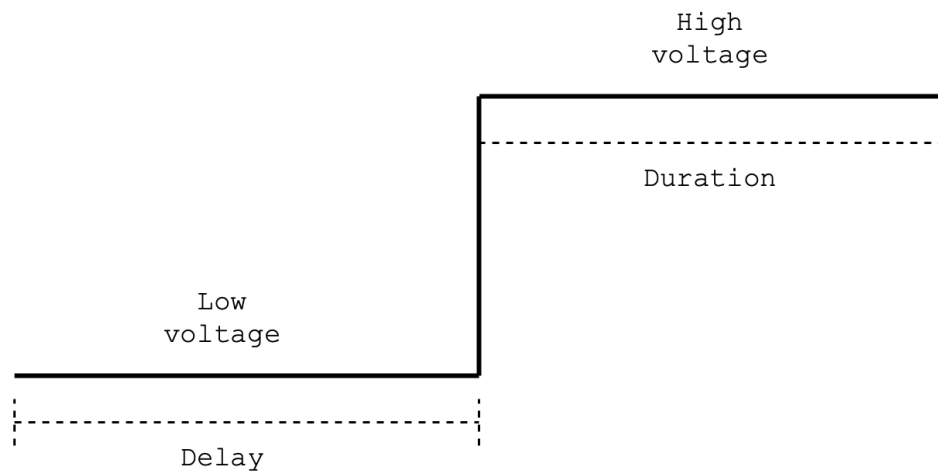


Figure 1: Visual of a DAC pulse

Figure 1 shows a visual of the output of the pulse command; command 2. The command takes four inputs: 16-bit delay, 16-bit duration, 12-bit voltage, 12-bit voltage. The delay and duration should be given in milliseconds. The two voltages work the same for this command as for the constant analog signal command. To output a pulse with $1.1V$ for 0.5 seconds and $3.3V$ for 2 seconds, the following command string can be used:

`:0102F401D0075505FF0FC9`

The Device can also output a repeating sine wave; command 3. It takes two inputs: a 16-bit frequency and 12-bit amplitude. However, this command should *not* be used for something requiring perfect precision, as the used method is flawed and can be off about 2% at higher frequencies. The tested, and therefore officially supported, frequencies are between $10Hz$ and $3000Hz$. To output a sine wave of frequency $10Hz$ and amplitude $3.3V$, the following command string can be used:

:01030A00FF0FE4

If a sine wave is already being produced, using the above command will *pause* it. To *stop* the wave, the **skip** command should be used followed by the **constant** command with an argument of 0000_{16} .

The skip command has number 4. The command string is:

:0104FB

2.2 Timer

The Timer Device is used to output a digital signal to the userLED. If any other pin is needed, a developer whom has read the **Maintainers Manual** should be consulted.

2.2.1 Usage

To **initialize** the Device, command 0 is used. This has the command string :0200FE. This *must* be done before using the Device.

To output a single **pulse**, command 1 is used. This command takes two inputs: 16-bit delay, 16-bit duration. The delay and duration should be given in milliseconds. In practice, it works the exact same way as the DAC pulse output, except there's no control of the voltage. Therefore, for the duration of *delay* the LED is off, and for the duration of *duration* the LED is on. To output a pulse with delay 1 second and duration 3 seconds, the following command string can be used: :0201E803B80B4F

The Device also has the ability to do a **stream of pulses** pulses; command 2. This means, as soon as one pulse is done, a new pulse will begin. This command is identical to the single pulse command, except the pulse repeats. The command string used to make the previously discussed pulse into a stream of pulses, would be: :0202E803B80B4E

Note: The stream does not stop on it's own. If you wish for it to stop, the skip command should be used.

The skip command has number 3. The command string is:

:0203FB

2.3 Serial Peripheral Interface (SPI)

The SPI Device provides communication commands to the external flash module W25Q128JV. If communication with any other slave device is needed, or other W25Q128JV instructions

is wished to be implemented, a developer whom has read the **Maintainers Manual** should be consulted.

2.3.1 Usage

To **initialize** the Device, command 0 is used. This has the command string :0300FD. This *must* be done before using the Device.

To make sure a working connection is established with the W25Q128JV, the command **WHOAMI** can be used; command 1. This command requests the Manufacturer ID from the W25Q128JV, which is 0xEF. If this is not received, the connection is *not* working. The command string for this is:

:0301FC

To **read** a byte from the flash module, command 3 should be used. This command takes three inputs, which consists of a 24-bit address split into three 8-bit inputs. To read the byte at address 0x000000 the following command string should be used:

:0303000000FA

To **write** a byte to the flash module, command 4 should be used. This command takes at least five inputs, which consists of a length, a 24-bit address split into three 8-bit inputs, and 1 to 256 bytes of data. The length input is the amount of data bytes to write. To write two bytes (0xAA and 0xBB at address 0x000000 the following command string should be used:

:030402000000AABB92

However, before writing, it *can* be crucial to make sure to **erase** the memory beforehand. This done using command 2, which takes three inputs, identical to the **read** command. The command erases 64 kB from the given address. That is *one* block of memory. To erase the block starting at address 0x000000 (Block 0), the following command string can be used:

:0302000000FB

The Device also has a command that reports if the W25Q128JV is **busy**; command 5. This is a command used internally in the Device, but, it is also available to *you*. Do note, it's practically useless and irrelevant for you. However, the following command string can be used to invoke the command:

:0305F8

The Device does not come with a skip command.

3 Command Generation

To generate your own commands, the utility software **hex2mot** can be used. Run the software via a terminal with any necessary arguments. To demonstrate the use of the software, here's how to generate a couple of commands:

	Initializer	Device	Command	Input	Checksum
Input		01	03	0096 09B2	
Output	:	01	03	9600 B209	AB

Table 1: Generation of DAC **sine wave** command at a $150Hz$ frequency and with an amplitude of $2.0V$. Result: :01039600B209AB

	Initializer	Device	Command	Input	Checksum
Input		03	04	01 00 00 00 7C	
Output	:	03	04	01 00 00 00 7C	7C

Table 2: Generation of SPI **write** command, with address $0x000000$ and data byte $7C$. Result: :0304010000007C7C

	Initializer	Device	Command	Input	Checksum
Input		02	01	01F4 03E8	
Output	:	02	01	F401 E803	1D

Table 3: Generation of Timer **pulse** command, with a delay of 500 milliseconds a duration of 1000 milliseconds. Result: :0201F401E8031D

4 Conclusion

This concludes the User Manual. If anything is unclear, the Maintainers Manual contains the same information, and more, in much deeper detail.

Additionally, the `testscript.txt` file can be seen for demonstration commands.