

# USER MANUAL

Monorail emulator

## ABSTRACT

This manual contains the basic information that any user needs to know before he starts using the emulator

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## 1. Wiring

Port Group	Pin	Port Group	Pin
PORT F	PF0	LCD DATA	D0
PORT F	PF1	LCD DATA	D1
PORT F	PF2	LCD DATA	D2
PORT F	PF3	LCD DATA	D3
PORT F	PF4	LCD DATA	D4
PORT F	PF5	LCD DATA	D5
PORT F	PF6	LCD DATA	D6
PORT F	PF7	LCD DATA	D7
PORT E	PE4	LCD CTRL	BL
PORT E	PE2	POT	JP91
PORT D	TDX2	MOTOR	OpO
PORT D	RDX3	INPUTS	PB1
PORT D	RDX4	INPUTS	PB0
PORT A	PA4	LCD CTRL	BE
PORT A	PA5	LCD CTRL	RW
PORT A	PA6	LCD CTRL	E
PORT A	PA7	LCD CTRL	RS
PORT C	PC0	LED BAR	LED2
PORT C	PC1	LED BAR	LED3
PORT C	PC2	LED BAR	LED4
PORT C	PC3	LED BAR	LED5
PORT C	PC4	LED BAR	LED6
PORT C	PC5	LED BAR	LED7
PORT C	PC6	LED BAR	LED8
PORT C	PC7	LED BAR	LED9
PORT L	PL0	KEYPAD	C3
PORT L	PL1	KEYPAD	C2
PORT L	PL2	KEYPAD	C1
PORT L	PL3	KEYPAD	C0
PORT L	PL4	KEYPAD	R3
PORT L	PL5	KEYPAD	R2
PORT L	PL6	KEYPAD	R1
PORT L	PL7	KEYPAD	R0
P11	+5V (any)	MOTOR	OpE
MOTOR	Mot	INPUTS	POT

## 2. Emulator set-up

In order to generate all the characters needed to run the emulator, the user has to make use of the following keypad:

1 A B C	2 D E F	3 G H I	SPACE
4 J K L	5 M N O	6 P Q R	ENTER
7 S T U	8 V W X	9 Y Z	
	10		

However, numbers and letters are never going to be introduced at the same time, so the keypad is going to work differently in the different steps of the set up.

### Step one

The display is going to show this message:

Maximum number of stations:

The user is going to be asked to introduce the number of stations that the emulator will have. The stations have to be between 1 and 10. To do so, this is going to be the scheme.

1	2	3	
4	5	6	
7	8	9	
	10		

As it can be seen, the user can introduce the numbers between 1 and 10, and the other keys are set as error. As soon as the user enters the number, the program jumps to the next step, as there is no possibility of pressing two or more keys.

In the case that one incorrect key is pressed the following message is displayed:

*Incorrect! Try again:*

The user will be required to introduce the number again now.

### **Step two**

The display is going to display this message:

*Name station #:*

Where # is the number of the station for which the name is introduced. This number is going to be between 0 and the maximum number that the user has introduced. Being the Station 0 the station where the train departs from.

The station names are formed by a maximum of 10 capital letters from A to Z and space. In order to implement that the keypad looks like this:

A B C	D E F	G H I	SPACE
J K L	M N O	P Q R	ENTER
S T U	V W X	Y Z	

In order to introduce the three different characters in the same key, the user is required to press the key several times. For example, in the first key the letters A,B and C are present. If the user presses the key once, the letter A will be displayed; twice, the letter B; three times, the letter C and if pressed again it will start with the A again, and do the same.

It is important to remark that the key has to be pressed before a second has passed since the key was pressed last time.

When a key is not pressed after a second has passed since the last key was pressed, the keypad interprets that the user has ended introducing that letter, therefore if pressed again after a second, it will generate a new letter.

The action will end when enter is pressed or when the user tries to introduce the 11th letter, saving the previous 10 characters in the latter case. This process will be performed until the last station name is introduced.

In case an incorrect key is pressed, the message:

*Incorrect! Try again:*

will be displayed, but this time it will be just for a second, and then it will return to the same display as before. This is done in order to the user be able to remember the name of which station was entering.

### **Step three**

The display will show:

Enter time #:

Where # is the number of the station from which the train will depart. Here we have to introduce the time that the train will need to reach the next station. The value has to be between 1 and 10, so the keypad will be configured as follows:

1	2	3	
4	5	6	
7	8	9	
	10		

As only 1 key has to be pressed, it will jump to the introduction of the time for the next station, or in case it is the last station to the next step.

The error handler will be the same as before. It will show the message

Incorrect! Try again:

and after a second it will return to the previous display, where the user can see the which are the stations between he/she is entering the names for.

#### **Step four**

The following message will be displayed in the LCD:

Enter stop time:

Here the user has to introduce the time the train will be stopped in each station. This time has to be between 2 and 5, so the other keys will produce an error if they are pressed. The keyboard would look like this:

	2	3	
4	5		

Here, again, only one key has to be pressed, so if the correct key is pressed it will jump to the emulation directly.

In case an incorrect key is pressed, the following error message is displayed in the LCD:

*Incorrect! Try Again:*

After a second it will jump to the message at the beginning of this step.

### **3. Emulator**

Once all the data is introduced the emulator starts to run. At first it is stopped in the first station (Station 0), and waits the time the user introduced the train has to be in each station. Then it starts to go from station to station without stopping. The user can do two things to stop the train.

-Press PB0 or PB1. When PB0 is pressed it means that a passenger wants to get off the train in the next station, and PB1 indicates that a passenger wants to get on the train in the next station. This means that if either one of those buttons or the two of them are pressed, the train will stop in the next station. When PB0 is pressed, the lower 4 leds are set on, and when PB1 is pressed, the higher 4 leds are set on.

PB0 and PB1 are two interrupts, so when they are pressed, this will trigger the interrupt handler of the interrupts in any part of the program.

-Press the key #. The key # is used as an emergency button. when the user presses this key, the train will stop until the key is pressed again. This stop will cause the time to stop, so if the train was waiting in the station when the # key was pressed, it will wait the remaining time after the key is pressed again.

The # key is not an interrupt; thus, it is placed within the loops of the main program of the emulator.