

# Design Requirement

for the Base Station Telephone

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# Design Requirement for the Base Station Telephone

## 1. Hardware

The hardware design has evolved from the Prototype in the following aspects:

- The SIM800L Telephone Module has been changed to be powered from a common 5 Volt Supply and has level shifting circuitry to accommodate the 3V3 Voltage Levels of the ESP32 Microprocessor.
- The Microprocessor was changed to the ESP32 to include the Bluetooth Transmission Protocol.

### a. Power Requirements

The 'Base Station' is to be main's powered. The projected components have the following requirements:

Item	Voltage	Current
LCD Display	5 Volts	< 100 mA
Telephone Module	5 Volts	Peaking up to 2.5Amps as it connects to the network
Microprocessor	Whilst the Microprocessor runs off 3V3, it has a power pin that is 5 Volt compatible	< 100 mA

With a view to using a commercial power supply, the power requirement is set to be powered from a mains voltage of 100 to 260 Volts to provide 5 Volts at 3 Amps to power the internal component.

### b. Enclosure

The 'Base Station' is to be housed in a suitable sized enclosure.

### c. Communications

The 'Base Station' is to communicate with the Microsoft Excel Workbook by either:

- i. USB COM Port with a USB socket available for connection to the Workstation.
- ii. Bluetooth Virtual COM Port.

The communication protocol is to be 9600 Baud; 8 Data Bits; No Parity Bit; 1 Stop Bit for both COM Ports.

### d. Display

The 'Base Station' is to have visible Liquid Crystal Display of 4 lines each of 20 characters. This Component is optional and the Production Sketch will function either with or without a Liquid Crystal Display. This is provided as an alternative to the EXCEL Automation "speaking" the progress messages.

### e. Network Indicator

The 'Base Station' is to have visible "Network Indicator" to show the status of the connection to the Service Provider's Network.

### f. Communication Indicator

The 'Base Station' is to have visible "Communication Indicator" to show when the 'Base Station' has processed a command.

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## g. Internal Communication Busses

There is to be two internal communication busses:

### i. Serial Protocol

Communication between the SIM800L (Type 2) Module and the Microprocessor is to be on a bidirectional Serial Bus. The Microprocessor's Pins function at 3V3 Logic Levels.

### ii. I<sup>2</sup>C Protocol

Communication between the Liquid Crystal Display and the Microprocessor is to be on a bidirectional Inter-Integrated Circuit Bus. The Microprocessor's Pins function at 3V3 Logic Levels.

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## 2. Software

The hardware design has evolved from the Prototype in the following aspects:

- The inclusion of the REPORT() command
- Inclusion of coding to disable the SIM\_LOCK if enabled.
- Turning of the Netlight when the LCD's Backlight is turned off.

### a. Optional fitting of a Display

If there is no Liquid Crystal Display connected to the I<sup>2</sup>C internal Communication Bus, then the Sketch will continue to function correctly.

### b. Backlight Control

If there is now activity for more than 10 minutes, then the display's backlight and the Netlight are to be turned off.

Receipt of the ACK? command is to turn on the display's backlight and restore the Netlight to its saved status.

### c. Communication Response

The 'Base Station' is to respond to the command on the communication stream that the communication was received on.

### d. Commands

#### i. ACK?

Reply with OK (Code Number of the Base Station). The Code Number is to be in the range of 1 to 4. This is to enable several Base Stations to correctly function in different Workbooks on one Workstation. The Code number is to be "hard coded" into the Sketch and the default value is to be '1'.

#### ii. VERIFY()

In response to this command, a check of the SIM Card's Status is to be enumerated.

If the SIM Card is not valid, then the response is to be "NO SIM".

If the SIM\_LOCK is enabled, then send the code to unlock it.

If the SIM Card is valid, then the response is to be:

1. The preamble is to be "CODE="
2. The separator is to be a ','
3. 'status'

The response to the command "AT+CGREG?" (Network Registration Status) is to be analysed and the single integer is to be added to the string that is to be outputted.

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## 4. 'subscriber number'

The response to the command "AT+CNUM" (Subscriber Number) is to be analysed and the Mobile Telephone Number (in the National Format) is to be added to the string that is to be outputted.

## 5. 'battery status'

The response to the command "AT+CBC" (Battery Charge) is to be analysed and the Battery Voltage (in millivolts) is to be added to the string that is to be outputted.

## 6. 'rssi'

The response to the command "AT+CSQ" (Signal Quality Report) is to be analysed and the Received Signal Strength Indicator parameter (expressed as an integer) is to be added to the string that is to be outputted.

## 7. 'ber'

The response to the command "AT+CSQ" (Signal Quality Report) is to be analysed and the Bit Error Rate parameter (expressed as an integer) is to be added to the string that is to be outputted.

## e. FIND(n)

This command has a passed parameter that is used to indicate which of the Message Stores is to be read. The response is to be that the reply string to the command "AT+CMGR" (Read SMS Message) is outputted as sent from the SIM800L Module.

## f. COUNT()

This command is to return the number of used locations in the Message Store Area.

## g. CLEAR(n)

This command has a passed parameter that is used to indicate which of the Message Stores is to be cleared. The response is to be that the reply string to the command "AT+CMGD" (Delete SMS Message) with the <delflag> set to '0' is outputted as sent from the SIM800L Module.

## h. SEND(telNo,text)

This command has two passed parameters that are used to detail the Text to be sent and the Mobile Telephone Number the Text is to be sent too. The response is to confirm that the SMS has been sent or not.

## i. NETLIGHT?

The response is to return to current status of the Netlight. The value of '1' is to be returned if the NETLIGHT is set to "Open to Shining" or '0' if the NETLIGHT is set to "Closed to Shining".

## j. NETLIGHT(n)

This command has a passed parameter that is used to indicate which state the NETLIGHT is to be set to and then that value is to be stored in the non-volatile storage. The value of '1' will set the NETLIGHT to be "Open to Shining" or '0' will set the NETLIGHT to be "Closed to Shining".

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## k. `DISPLAY(line,text)`

This command has two passed parameters that are used to detail the line on which the text is to be displayed and the text to be displayed.

The range of the line is to be checked. If the passed line number is less than '0' then the command will not implement any change to the display and is to return the error message "DISP\_LN\_LO". If the passed line number is greater than '3' then the command will not implement any change to the display and is to return the error message "DISP\_LN\_HI".

The length of the text to be displayed is to be checked. If more than 20 characters are sent, then the Sketch is to return the error message "DISP\_TXT\_TRUN" and truncate the text to 20 characters.

The passed text is to be displayed on the passed line number. The response is to be "DISPLAY\_OK".

## l. `LINE_CLEAR(line)`

The range of the line is to be checked. If the passed line number is less than '0' then the command will not change the display and is to return the error message "DISP\_LN\_LO". If the passed line number is greater than '3' then the command will not change the display and is to return the error message "DISP\_LN\_HI". If the passed line number is in the range 0-3, then this command is to clear that line and is to respond with "CLEARED LINE " and the passed line number.

## m. `ALL_CLEAR()`

This command will clear all four lines of text on the display and the response is to be "DISP\_CLEARED".

## n. `RESET()`

This command is to provide an instruction on the Bluetooth and USB Communication Streams of the need to close and reopen Bluetooth Communication Stream before the Microprocessor is reset.

## o. `REPORT()`

This command is to provide information about the Base Station:

- a) The preamble is to be "This Base Station's parameter's are:"
- b) The delimitator is to be ':'
- c) The Serial Number of the Base Station

To maintain commonality of the installed Sketches, the Base Station Serial Number will not be hard coded into the sketch but read from the non-volatile storage of the Microprocessor; therefore, the Serial Number is attached to the Microprocessor not the Sketch.

The response is to be "Base Station Serial Number" and then the value read.

- d) The CODE Number of the Base Station

The response is to be "Base Station CODE Number" and then the Code Number String as stored in the Sketch.

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e) The Software Version of the Sketch

The response is to be “Software Version” and then the Software Version String as stored in the Sketch.

f) The Bluetooth Broadcast Name

The response is to be “Bluetooth Broadcast Name” and then the Bluetooth Broadcast Name String and then the Code Number String as stored in the Sketch.

g) The Subscriber Telephone Number

This command is to integrate the Telephone Module to confirm that it contains valid SIM Card.

If no valid SIM Card is found, then the response is to be “NO SIM FOUND” and processing of the Network Name and the Signal Quality (RSSI & BER) will be bypassed.

If a valid SIM Card is found, then the response is to be “Subscriber Number” and then the Subscriber Number String as read from the SIM Card.

h) The Network Name

If a valid SIM Card is found, then the response is to be “Network Name” and then the Network Name String as read from the Telephone Module.

i) The Signal Quality (RSSI)

If a valid SIM Card is found, then the response is to be “Signal Quality - RSSI” and then the Received Signal Strength Indicator Integer as read from the Telephone Module.

j) The Signal Quality (BER)

If a valid SIM Card is found, then the response is to be “Signal Quality - BER” and then the BIT Error Rate Integer as read from the Telephone Module.

k) The IMEI Number

The response is to be “IMEI No.” and then the International Mobile Equipment Identifier String as read from the Telephone Module.

l) The Software Version of the SIM800L Module

The response is to be “Software Revision” and then the Software Revision String as read from the Telephone Module.