

Phone PIC

The latest and simplest generation of low cost PIC programmer is reviewed here. Most importantly it needs no additional hardware and no computer or software requirements. This means it can be used in any D&T environment without the need for ICT facilities and consequently, no cables, wires or connections! TEP launched the Phone PIC system at the NEC last November and since then its popularity has grown; the reason behind that of course is its simplicity and accessibility. This ground-breaking resource is set to get mobile phone keypads clicking.



Nick Baldwin takes us on a tour of Phone PIC

All too often we limit student's ability to access to resources in the classroom and present them with unfamiliar and complex methods of working and programming. Phone PIC represents an elegant, simple and intriguing opportunity to engage pupils with ideas, techniques and accessible capability at low cost.

If ever there is a reason for allowing students and pupils to have their mobile phones out in class—this is it. The mobile phone is a superb utility for a range of activities in school, not least to be able to programme PICs directly in class and at home! Pupils are the so called 'text' generation and interpret the use of phone keypads quite naturally and rather more easily than most of us adults. It is more important to focus on the opportunities for integrating this technology into class than objecting to it. For schools that operate a no phone policy it is simply a case of D&T departments acquiring a few stock phones to use specifically in class. As the phones are being used to generate DTMF tones and not radio signals they can be abandoned, donated or discarded phones without SIM cards installed. It is a good idea to acquire the phone chargers too.

What are DTMF tones?

DTMF tones are the audible tones used in tone dialling. These known as: Dual Tone Multi Frequency, tones or touch-tones. DTMF tones are created by adding together two separate sine wave frequencies. Each key on the phone keypad is defined at a row and column. So on a matrix of 12 keys, key 1 is row 1, column 1 and Key 9 is row 3 column 3. Each row and each column generate the sine wave tones so when key 1 is pressed 1209Hz and 697Hz are added together to generate a unique tone 1906Hz and when key 9 is depressed, (852Hz + 1477Hz) 2329Hz is generated.

	1209 Hz	1336 Hz	1477 Hz
697 Hz	1 OO	2 abc	3 def
770 Hz	4 ghi	5 jkl	6 mno
852 Hz	7 pqrs	8 tuv	9 wxyz
941 Hz	* +	0 -	⏏ #

Each key is not only associated with a number or symbol, but the alphabet. This means we can program basic text commands as well as numeric values.

So, we have a really useful keyboard in the guise of a mobile phone that can do all the limited programming we require.

How do I set up a mobile phone for DTMF outputs?

Generally, most mobile phones will allow you to change the sounds being emitted from your keypad touch tone buttons from either silent mode or to DTMF mode. You will need to navigate through your phone menus to 'phone settings' or 'sound settings' menu. There you should find an option to change the Keypad Tone. Select Tone in the option settings. Do not select beep as this will produce the same sound frequency with each keypad pressed. Once selected adjust your phone volume to enable a clear tone output through its internal speaker.

Keypad Options

Silent
DTMF Tones
Beeps

^ Select DTMF Tones

Volume



^ Adjust the volume

How does the programmer work?

TEP's Phone PIC is designed to work with any mobile phone that features DTMF keypad tones. The Phone PIC module is a small programmer board little bigger than a matchbox that hosts the PIC to be programmed inserted into a ZIF socket. The user of course requires a DTMF activated mobile phone and a suitable PIC. At this time there are three suitable PIC formats with more to follow. These are:



16F627, 16F84 and 16F84A

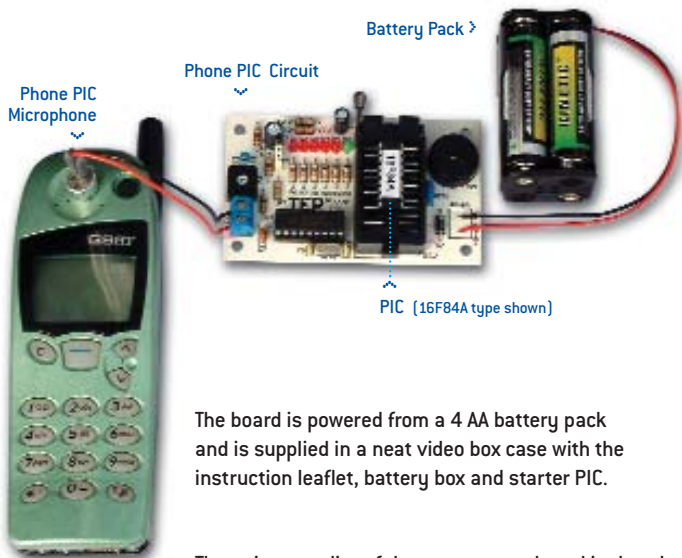
The programming to the board is exclusively via sound DTMF tones from a mobile phone so the input is a miniature electret microphone. The programmer simply interprets and decodes the incoming DTMF tones and directs them into the PIC.



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Phone PIC

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The board is powered from a 4 AA battery pack and is supplied in a neat video box case with the instruction leaflet, battery box and starter PIC.



BEEP! BEEP!

The unique quality of the programmer board is that the true functionality is in-built into the PIC on a 'header' program. That sounds simple but in practice is a highly complex routine that runs as soon as the PIC is placed in the programmer socket. The user is made aware immediately that the PIC is functioning correctly as the board's piezo sounder 'beeps twice and a tell-tale green LED flag lights up.

The pre-programmed PIC still has lots of space (memory) for storing a program and of course has Flash functionality so can be reprogrammed indefinitely. The header programme is non-erasable and is not lost. The PICs can be purchased from Teaching Resources pre-programmed for the same cost as blank PIC's or alternatively more confident users in departments can programme the header themselves using any serial programmer by downloading the header hex files from the TEP website at:

➔ www.tep.org.uk/Phone PIC.html

Basic Commands

Just like the TEP Chipfactory there are a set of basic commands that need to be mastered.

HIGH, LOW, WAIT, GOTO, IF, END, LET and BEEP are all familiar basic commands to many programmers and are abbreviated for ease of keypad use to just two digits so that the command **High** is abbreviated to HI. H is key 4 on the phone keypad and I is also key 4, thus keying in 4 followed by 4 or 44 is the command **High**. The programming board even interacts with the user and Beeps its approval when a correctly recognised command sequence is entered. There are even Red LED tell-tale flags to indicate in binary the input values recognised by the board.

The table below outlines the commands and codes:

Abbreviated Command	Command	Phone KeyCode
High = HI	The command to switch an output high	4 4
Low = LO	The command to switch an output low	5 6
WAIT = WA	The command to create a delay or pause.	9 2
GOTO = GO	To make the program loop to a different line.	4 6
IF = IF	The conditional statement for an input or variable	4 3
LET = LE	The variable maths statement	5 3
END = EN	The last line of program	3 6

It really is that simple. With this reduced set of commands and a mobile phone it is an easy task to take an idea through to program in just a few key strokes. What needs to be considered is that lack of attention can soon lose the user and the accurate sequence required so attention and a little planning are necessary. The mobile phone does not store the keystrokes or allow editing so care is needed at the input stage. However it is so quick even getting it wrong a few times is only a few seconds delay as you will need to restart the PIC header programme again first. A program planning sheet for pupils and students to organise and sequence their program before inputting it will prove useful. You can download a basic planning sheet from the TEP website under PICs downloads.

Using the programmer

Connect the 4 AA battery box to the programmer. Select the pre-programmed PIC into the ZIF socket. Ensure the notch in the PIC is at the top of the socket nearest the lever, so that the top pair of legs is in the top most available slots in the socket. Push the lever down, locking the PIC in place. The green LED will light and the piezo sounder will beep twice. Place the microphone over the earpiece or loudspeaker of the mobile phone and you are ready to input DTMF commands via the phones keypad.

The simplest program to test is to create a pulsing LED and in this case an accompanying 'beep'.

Enter 44 followed by 1	means HI output 1
Enter 92 followed by 010	means WAIT 1 second
Enter 56 followed by 1	means LO output 1
Enter 92 followed by 010	means WAIT 1 second (Note value 1-255)
Enter 23 followed by 200	means BEEP 200 (tone)
Enter 46 followed by 00	means GOTO line 00 (Note line number is 00-99)
Enter 36	means END



This program with just 6 active lines takes just 25 or so seconds to input and demonstrates just how easily and quickly pupils and students can unlock the potential of this resource. Testing a program is easy using any demo board, in our case we are using a PIC18 Demo Board prior to putting the PIC into a project circuit.

IF statements

IF statements, involves a condition to test the program or inputs. This determines what loop to go to in a programme. The inputs tested are 0, 1, 2 or 3 in the case of the PIC and up to two variables within the program, which we will call I and j. (Note: We cannot use a or b as variable terms or x and y as each pair share the same keypad)

IF is the keystrokes 4 followed by 3 or 43 followed by an input number 0,1,2 or 3 or a variable I {4} or j {5}.

If a variable is entered, the Phone PIC system neatly represents the next key press elements as:

Is equal to	with key 3(e)
Is greater than	with key 4(g)
Is less than	with key 5(l)
Is not equal to	with key 6(n)

So IF variable j is greater than value 200 GOTO line 2 is keyed in as: 43 followed by 5 followed by 4 followed by 200 followed by 46 followed by 02 or 43542004602

LET statements

LET statements are used to set the variables I or j with specific values. Once again the LET keycode 5 followed by 3 or 53 followed by the variable name i{4} or j{5} will allow us to complete the LET statement with one of three operations:

LET variable = a value	Key 3(e)	equal to
LET variable = itself plus a value	Key 7(p)	plus
LET variable = itself minus a value	Key 6(m)	minus

For example if we wanted to set a LET statement to define an increase of 1 each time that line is read we would input the following keycode:

LET keys 53 followed by variable {i} key 4 followed by plus key 7 followed by key 1, the value of increment. The coding for that line now reads 53471

Included with the Phone PIC resource is a comprehensive leaflet that takes the user through aspects of using IF statements and Variables and it is worth taking a look at them here as it conveys just how comprehensive the programmer is. The current PIC 'headers' available do not include analogue inputs or the latest 8pin PICs however these are planned as a future release and once again will be free downloads off the TEP website or at no extra cost pre-programmed from Teaching Resources.

Future Proof

What we have found difficult to appreciate in testing and trying out this resource is that it is totally future proofed in that, future PIC releases that emerge on the education market will be catered for by this programmer and users will simply download the latest 'headers' as they become available. This system provides an ideal ultra low cost entry into PIC based activity in school without the usual hassles. As the whole unit is neatly stored in a self contained video style case it can be managed in class and loaned out to reliable students for use overnight and at weekends as it requires no additional PC or software. In due course we hope to feature on the website and in future issues of News and Views, a number of programs as teachers tell us about them.

The initial challenge to thinking and programming in a new way will soon give way to relief that it is less dependent on complex supporting systems and firmware and allows you the freedom to integrate it for little investment.

Providing some exemplar programs on paper and getting students to edit and re-edit them and try 'hands-on' program changes as a useful starting point.

Phone PIC is available now from Teaching Resources for around £25.00



teaching resources

Phone PIC – stock code ELE 070

Nick Baldwin will be pleased to help advise you on using Phone PIC and on some implementation strategies

Contact him at : nickbaldwin@enterprise.net