De Re BASIC!

Version 1.88

August 16, 2015

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Changes in this Version

- Clarifications and additional explanations:
    - Editor menu options ***Load*** and ***Save***.
    - Exiting your program if you trap the BACK key with **OnBackKey:**.
    - Parentheses around variables from mid-line keywords, like **TO** in a **FOR** loop.
    - Commas in continuation lines of **Array.load** and **List.add**.
    - "Buffer strings", one byte per character, from **Byte.read.buffer**, **BT.read**, **ENCODE$()**.
    - **Socket.client.write.file** sends a file to the Server, not the Client.
    - **GR** commands that create bitmaps do not create graphical objects.
    - **Audio.load** returns index 0 if file does not exist. It does not get a run-time error.
    - First GPS status report may be stale.
- Corrected errors:
    - Since v01.86, labels are not required to stand alone on a line.
    - Omission: **TRIM$()**, **LTRIM$()**, and **RTRIM$()** were added to BASIC! in v01.86.
    - Omission: **GR_COLLISION()** has worked with **GR.point** objects since v01.86.
    - Error in description of the **GR.group.list** list pointer parameter.
    - **GR.modify** value parameters are expressions, not necessarily simple variables.
    - Error in the description of the **TimeZone.list** command.
    - Errors in the description of the dialog controls in the **Debug.show.*** commands.
- New BASIC! functions and commands:
    - **ENCODE$()** and **DECODE$()** functions for encrypting, encoding, and converting strings.
    - **GR.bitmap.fill** fills a region of a bitmap with the current drawing color.
    - **KB.showing** command reports if soft keyboard is showing or hidden.
    - **OnKBChange:** interrupt and corresponding command **KB.resume**.
- Other changes in BASIC!:
    - New option on the Preferences screen to enable hardware-accelerated graphics.
    - New option to set color of empty (unwritten) console lines to background or line color.
    - New options on the Preferences screen to move Editor menu items to the Action Bar.
    - Editor menu option ***Save*** uses the default file name **default.bas** if no name is provided.
    - Editor menu option ***Save and Run*** saves without a Save Dialog, if possible.
    - The end-of-program broken-loop checks are done only if debug mode is turned on.
    - Grouped most of the Console options, grouped most of the Editor options.
    - **Debug.?** is an alias for **Debug.print**, as **?** is an alias for **Print**.
    - A single **GR.get.value** command can get the values of multiple parameters.
    - **GR** commands that create bitmaps return -1 if creation fails; do not get run-time errors.
    - **KB.toggle** really toggles, restored **KB.show**.
    - **SST.listen**: added optional prompt parameter.
    - **SST.listen**: list pointer expression can specify a reusable list or a variable for a new list.

About the Title, De Re BASIC!

"De Re" is Latin for "of the thing" or "about".

About the Cover Art

Thanks to BASIC! collaborator Nicolas Mougin. The images are screenshots from real BASIC! programs available from the Google Play™ store, or from the excellent collection of shared BASIC! programs available at http://laughton.com/basic/programs.

You can find more information on the BASIC! user forum at http://rfobasic.freeforums.org/shared-basic-programs-f6.html.

Technical Editor

Thanks to Paul Laughton, the original creator of BASIC! and of this document. Thanks also to Mike Leavitt of Lansdowne, VA, USA, for his many contributions and long-time support.

The current editor of this manual monitors https://github.com/RFO-BASIC/De-Re-Basic/issues and the BASIC! user forum at http://rfobasic.freeforums.org/suggestions-for-improving-the-manual-f9.html for corrections and suggestions.

Getting BASIC!

You can get BASIC! for your Android device from the **Google Play™** store.

If you prefer to download the installation file (Basic.apk) yourself, or to get previous versions, get it from **Bintray** at https://bintray.com/rfo-basic/android/RFO-BASIC/

This manual is also available from Bintray, in PDF format. BASIC! collaborator Nicolas Mougin keeps the manual in HTML format on his BASIC! website: http://rfo-basic.com/manual

BASIC! Forum

Join the community of BASIC! users at http://rfobasic.freeforums.org, where you are always welcome.

BASIC! Tutorial

A BASIC! user, Nick Antonaccio, has written a very nice tutorial for BASIC! You can find it at http://rfobasic.com .

BASIC! Operation

Permissions

This application requests many permissions, permissions such as sending and receiving SMS messages, making phone calls, record audio, etc. BASIC! does not exercise any of these permissions (except writing to the SD card) on its own. These permissions get exercised by the BASIC! programmer, you. You and only you. You exercise these permissions by means of the programs that you write.

If you write a program that uses the sms.send command then BASIC! will attempt to send an SMS message. BASIC! must have permission to send SMS messages for this command to work. If you never use the sms.send command then BASIC! will never send an SMS message. You are in control.

The source code for BASIC! is available from the BASIC! web site (http://laughton.com/basic/) and the BASIC! GitHub repository (https://github.com/RFO-BASIC/Basic). Please feel free to examine this source code if you have any doubt about the use of these permissions.

Editor

Editing the Program

The Editor is where BASIC! programs are written and edited. The operation of the Editor is fairly simple. Tap the screen at the point where you want to edit the program. A cursor will appear. Use the keyboard to edit at the cursor location.

When the Enter key is tapped, the new line will automatically indent to the indent level of the previous line. This feature will not work if the Preference, "Editor AutoIndent," is not checked. This feature also may not work if you are using a software keyboard.

If the program that you are editing has been given a name via Save or Load then that program name will be shown in the title bar.

Some Android devices are shipped with "Settings/Developer Option/Destroy Activities" checked and/or "Settings/Energy/Quick Restart" checked. Both of these setting create problems with loading files into the Editor. It appears as if you have gone through the process of loading the file but nothing appears in the editor. The solution to the problem is to uncheck both of these options. Even better, completely turn off Developer Options unless you know that you have a legitimate development need.

If your Android device does not have a physical keyboard, you will see a virtual keyboard. If you see the virtual keyboard, then you will see different things depending upon the way you are holding the device. If the device is in landscape mode then you will see a dialog box with a chunk of the program in a small text input area. You can scroll the small chunk of text up and down in this area but you will not be able to see very much of the program at any one time. It is probably best not to try to edit a program in landscape mode; hold your device in portrait mode while editing.

On some devices, if you do a long touch on the screen, a dialog box will appear. You can use the selections in the box for selecting, copying, cutting and pasting of text, among other things. Other devices have different procedures for invoking the cut and paste functions.

Multiple Commands on a Line

More than one BASIC! source code statement may be written on one physical line. Separate commands with a colon character "**:**".

For example, the following line uses three separate commands to initialize some variables:

```
name$="BASIC!" : ver=1.86 : array.load reviews$[], "Great!", "Wow!", "Fantastic!"
```

Line Continuation

A BASIC! source code statement may be written on more than one physical line using the line continuation character "~". If "~" is the last thing on a line, except for optional spaces, tabs, or a '%' comment, the line will be merged with the next line. This behavior is slightly different in the **Array.load** and **List.add** commands; see the descriptions of those commands for details.

Note: this operation is implemented by a pre-processor that merges the source code lines with continuation characters before the source code is executed. If you have a syntax error in the merged line, it will show as one line in the error message, but it will still be multiple lines in the editor. Only the first physical line will be highlighted, regardless of which line the error is in.

For example, the code line:

```
s$ = "The quick brown fox " + verb$ + " over " + count$ + " lazy dogs"
```

could be written as:

```
s$ = "The quick brown fox " +~
       verb$ +     ~       % what the fox did
       " over " +  ~
       count$ +    ~       % how many lazy dogs
       " lazy dogs"
```

# - Format Line

If a line has the # character at the end of the line, the key words in that line will be capitalized and the # will be removed.

This feature may not work if you are using a virtual keyboard.

This feature will not work if the Preference, "Editor AutoIndent," is not checked.

Menus

Press the MENU key or touch the Menu icon to access the following menus. On some versions of Android, you will not see all of the menu options. Instead, you will see the first five options and a ***More*** options. Select the ***More*** option to see all of the options listed.

Run

Runs the current program.

If the program has been changed since it was last saved, you will be given an opportunity to save the program before the run is started.

If a run-time error occurs then the offending line will be shown as selected in the editor.

Load

Load is used to load a program file into the editor. Programs must be in the directory, **rfo-basic/source/** or one of its subdirectories. (See **Paths Explained**, later in this manual.) Program files must have the extension **.bas**.

BASIC! checks to see if the current program in the Editor has been changed when ***Load*** is tapped. You will be offered the opportunity to save the program if it has been changed. ***Load*** will be restarted after the save is done if you choose to save the program.

The "BASIC! Load File" screen shows a sorted list of .bas files and directories. Directories are denoted by the **(d)** appended to the directory name. Directory entries are at the top of the list. BASIC! programs will be shown with the .bas extension. If there are files in the **source/** directory (or subdirectories) that do not have the **.bas** extension, they will not appear in the list.

Tap on a **.bas** file to load it into the Editor.

Tap on a directory to display the contents of that directory.

Tap on the "**..**" at the top of list to back up one directory level. The tap will be ignored if the current directory is the **source/** directory.

If you accidentally tap the ***Load*** option, you can back out of ***Load*** by tapping the BACK key.

You can load program from subdirectories of the source/ directory. BASIC! remembers the path to the subdirectory you are in when you exit. Next time you select Load, it starts in that subdirectory. If you select Save, the file is saved in the remembered subdirectory (unless it is Sample_Programs).Save

Saves the program currently in the editor.

A text input dialog box will appear. Type in the name you want the file saved as and tap OK. The extension .bas will be added to file name if is not already there. If the current program has a name because it was previously loaded or saved then that name will be in the text input area.

If you do not enter a file name, BASIC! uses a default filename, **default.bas**.

BASIC! remembers the path to the subdirectory of **source/** you were in when you last exited ***Load***. When you ***Save***, the file name you type is saved in the remembered subdirectory. If the name you type includes subdirectories, BASIC! remembers the new path. To clear the remembered path, select ***Load*** and tap the "**..**" until you reach the top (**source/**), then exit ***Load*** without selecting anything.

You cannot write programs in the sample program directory **source/Sample_Programs**. If you load a program from **source/Sample_Programs**, change it, and ***Save*** it, the program is saved in **source/**.

You can back out of ***Save*** by tapping the BACK key.

Clear

The current program in the Editor is cleared. You will be offered the opportunity to save the current program if it has been changed.

Search

Search for strings in the program being edited. Found strings may be replaced with a different string.

The Search view shows a Text Window with the text from the Editor, a **Search For** field and a **Replace With** field.

If there is a block of text currently selected in the Editor, then that text will be placed into the **Search For** field.

The initial location of the search cursor will be at the start of the text regardless of where the cursor was in the Editor text.

Note: The search ignores case. For example, searching for "basic" will find "BASIC" This is because BASIC! converts the whole program to lower case (except characters within quotes) when the program is run.

Next Button

Start the search for the string in the **Search For** field. The search is started at the current cursor location. If the string is found then it will be selected in **Text Window**.

If the **Done** button is tapped at this point then the Editor will returned to with the found text selected.

If the **Replace** button is tapped then the selected text will be replaced.

Pressing the **Next** button again will start a new search starting at the end of the selected or replaced text.

If no matching text is found then a "string not found" message is shown. Tapping the **Done** button returns to the Editor with the cursor at the end of the program. Alternatively, you could change the **Search For** text and start a new search.

Replace Button

If **Next** has found and selected some text then that text is replaced by the contents of the **Replace With** field.

If no text has been found then the message, "Nothing found to replace" will be shown.

Replace All Button
All occurrences of the **Search For** text are replaced with the **Replace With** text. **Replace All** always starts at the start of the text. The last replaced item will be shown selected in the **Text Window**. The number of items replaced will be shown in a message.

Done Button
Returns to the Editor with the changed text. If there is selected text in the **Text Window** then that text will be shown selected in the Editor.

BACK Key
Returns to the Editor with the original text unchanged. All changes made during the Search will be undone. Think of the BACK key as UNDO ALL.

Load and Run
Selecting this option is exactly the same as first selecting ***Load*** and then selecting ***Run***. The selected program is loaded into the Editor and is run immediately.

Save and Run
Selecting this option is a fast way to save and then run. Any changes you have made are saved, overwriting your file, and your program is run immediately. A brief popup notifies you that your file has been changed. If the program you are editing has no name (not previously loaded or saved), the Editor will ask you what name to use.

Format
Formats the program currently in the Editor. The keywords are capitalized. Program lines are indented as appropriate for the program structure. Left- and right-double quotation marks (**“** and **”**) are replaced by simple ASCII quotation marks (**"**).

When copying program text from the Forum or another web site, "non-breaking space" characters, designated **&nbsp** in HTML, may be inserted into the program text. Except when they are enclosed in quoted strings, **Format** converts these characters to simple ASCII spaces.

Delete
The ***Delete*** option is used to delete files and directories. The command should be used for maintaining files and directories that are used in BASIC! but it can also be used to delete any file or directory on the SD card.

Tapping ***Delete*** presents the "BASIC! Delete File" screen. The screen has a sorted list of files and directories. Directories are marked with **(d)** appended to the name and will appear at the top of the list.

Tapping a file name will cause the "Confirm Delete" dialog box to be shown. Tap the **Delete** button to delete the file. Tap the **No** button to dismiss the dialog box and not delete the file.

When a directory name is tapped, the contents of directory are displayed. If the directory is empty the "Confirm Delete" dialog box will be shown. Tap the **Delete** button to delete the directory. Tap the **No** button to dismiss to dismiss the dialog box and not delete the directory.

Tapping the "**..**" at the top of the screen moves up one directory level. Tapping the "**..**" will have no effect if you are in the root directory.

When BASIC! is first started after installing or re-started after an Exit, the directory listed will be the "<pref base drive>/rfo-basic" directory. If you have changed directories in previous ***Delete*** operations then the directory shown will be last directory that you were in.

Exit ***Delete*** by tapping the BACK key.

Preferences

Screen Colors

Opens a sub-menu with options for setting the colors of the various screens in BASIC!

Color Scheme

Sets the color scheme of the screens. The schemes are identified by their appearance with the default colors. Choose Black text on a White background, White text on a Black background or White text on a Blue background.

Custom Colors

Check the box to override the Color Scheme setting, allowing you to set your own colors. You can set the Text (foreground) Color, the Background Color, the Line Color, and the Highlight Color. Each color is specified as a single number with 16 hexadecimal digits: four fields of four digits each for Alpha (opacity), Red, Green, and Blue components.

Console Settings

Opens a sub-menu with options for settings of the Console and various others screens in BASIC!

Font Size

Sets the font size (Small, Medium, or Large) to be used with the various screens in BASIC!.

Typeface

Choose the typeface to be used on the Output Console and some other screens:
Monospace, Sans Serif, or Serif.

Console Menu

Check the box if the Menu should be visible in the Output Console and TGet screen.

Console Lines

Check the box if the text lines in the Output Console should be underlined.

Empty Console Color
Choose the background color of the part of the Output Console that has not yet been written. It can match the background color of the text or the color of the lines separating text lines.

Editor Settings
Opens a sub-menu with options for setting properties and features of the Program Editor.

Editor Lines
Check the box if the text lines in the Editor should be underlined.

Editor Line Wrap
Check the box if long text lines in the Editor should wrap at the edge of the screen. If unchecked, long lines are not wrapped, and the Editor screen may be scrolled horizontally.

Editor AutoIndent
Check the box if you want the Editor to do auto indentation. Enabling auto indentation also enables the formatting of a line that ends with the "#" character.

Some devices are not able to do auto indenting properly. In some of those devices the AutoIndent feature may cause the Editor to be unusable. If that happens, turn off AutoIndent.

Menu Items on Action Bar
Opens a sub-menu with options for moving some of the Editor menu items to the Action Bar, if there is room for them there. You can select as many as you like, but the number of items moved depends on the device and orientation. These options have no effect on Android devices before Honeycomb (3.0).

RUN on action bar
If checked, Android will attempt to move the Run item from the Editor Menu to the Action Bar.

LOAD on action bar
If checked, Android will attempt to move the Load item from the Editor Menu to the Action Bar.

SAVE on action bar
If checked, Android will attempt to move the Save item from the Editor Menu to the Action Bar.

EXIT on action bar
If checked, Android will attempt to move the Exit item from the Editor Menu to the Action Bar.

Screen Orientation
Choose to allow the Sensors to determine the orientation of the screens or to set a fixed orientation without regard to the Sensors.

Note: The reverse orientations apply to Android 2.3 or newer.

Graphic Acceleration
Check this box to enable GPU-assisted graphics acceleration on devices since 3.0 (Honeycomb) that support it. It is disabled by default. If you enable this option, test your program carefully. Hardware acceleration can make some of BASIC!'s graphical operations fail.

Base Drive

Some Android devices have several external storage devices (and some have no physical external storage devices). BASIC! will use the system-suggested device as its base drive. The *base drive* is the device where the BASIC! "rfo-basic" directory (base directory) is located. The *base directory* is where BASIC!'s programs and data are stored. (See "Paths Explained", later in this manual.)

If your device does have more than one external storage device they will be listed here. If your device has no external storage devices, your one and only choice will be "No external storage". Tap the device you want to use as the base drive and press the BACK key. You will then be given the choice of either immediately restarting BASIC! with the new base drive or waiting and doing the restart yourself.

In this manual, <pref base drive> means the base drive you selected when you set the Base Drive here. In many devices, the system-suggested drive is "/sdcard".

Note: If you have created a Launcher Shortcut (see Appendix C) with files in one base directory but try to execute that shortcut while using a different base directory, the shortcut will fail to execute. You will get an error message.

Commands

The Commands command presents the list of the BASIC! commands and functions as copied from Appendix A of this document.

Tapping an alpha key will cause the command list to scroll to commands that start with that character. There will be no scrolling if there is no command that starts with that character.

Note: You can hide the virtual keyboard with the BACK key. If you do that, you will not be able to get it back until you invoke the ***Commands*** option again.

Tapping on a particular command causes that command to be copied to the clipboard (not including the page number) and returning to the Editor. You can then paste the command into your BASIC! program.

About

The ***About*** option displays the Bintray page for the release of BASIC! that corresponds to the release of the BASIC! that you are using. Make sure that you have a connection to the Internet before selecting ***About***.

Exit

The only way to cleanly exit BASIC! is to use the ***Exit*** option.

Pressing the HOME key while in BASIC! leaves BASIC! in exactly the same state it was in when the HOME key was tapped. If a program was running, it will still be running when BASIC! is re-entered. If you were in the process of deleting, the Delete screen will be shown when BASIC! is re-entered.

Run

Selecting ***Run*** from the Editor's menu starts the program running. However, if the source in the Editor has been changed, then the Save dialog will be displayed. You may choose to save the changed source or continue without saving.

The BASIC! Output Console will be presented as soon as the program starts to run. You will not see anything on this screen unless one of the following situations occur:

- the program prints something
- the **END** statement is executed
- you are in Echo mode
- there is a run-time error

If the program does not print anything then the only indication you would get that the program has finished is if the program ends with an **End** statement.

If the program does not contain any executable statements then the message, "Nothing to execute" will be displayed.

Tapping the BACK key will stop a running program. Tapping the BACK key when the program run has ended will restart the Editor.

If the program ended with a run-time error, the line where the error occurred will be shown selected in the Editor. If the error occurred in an **INCLUDE** file then the **INCLUDE** statement will be shown selected. While this text is selected the Editor "fling scrolling" will not work. Unselect the text to restore the fling scroller.

The Editor cursor will remain where it was when the ***Run*** was started if no run-time error occurred.

Menu

Pressing the MENU key or touching the Menu icon while a program is running or after the program is stopped will cause the Run Menu to be displayed. (Except when Graphics is running. See the Graphics section for details.)

Stop

If a program is running, the ***Stop*** menu item will be enabled. Tapping ***Stop*** will stop the running program. ***Stop*** will not be enabled if a program is not running.

Editor

Editor will not be enabled if a program is running. If the program has stopped and ***Editor*** is thus enabled then selecting ***Editor*** will cause the Editor to be re-entered. You could also use the BACK key to do this.

Crashes

BASIC! is a very large and complex program that is constantly under development. From time to time, it will crash. Previous versions of BASIC! supported automatic crash reporting. This feature has been temporarily disabled while we work on an implementation that is more compatible with Android versions 4.2 and later. We apologize for the inconvenience.

A BASIC! Program

A BASIC! program is made up of lines of text. With a few exceptions that will be explained later, each line of text is one or more **statements**. If a line has more than one statement they are separated by colon (":") characters.

A statement always consists of a single command, usually followed by one or more parameters that are separated by commas. Here is a simple BASIC! program:

```
PRINT "Hello, World!"
```

This program has one statement. The command is **PRINT**. It has one parameter, the string constant **"Hello, World!"**. (A string constant, or string literal, is a set of characters enclosed in double quotation marks. This, too, will be explained later.)

If you start the BASIC! app, so you are in the Editor, you can type in this one-line program. Then you can select **Run** from the Editor's menu. BASIC! will run your program. When the program is done running, you see the **Console**, BASIC!'s, output screen, with **Hello, World!** printed at the top.

Command Description Syntax

Upper and Lower Case

Commands are described using both upper and lower case for ease of reading. BASIC! converts every character (except those between double quotation marks) to lower case when the program is run.

<nexp>, <sexp> and <lexp>

These notations denote a numeric expression (<nexp>), a string expression (<sexp>), and a logical expression (<lexp>). An expression can be a variable, a number, a quoted string or a full expression such as (a*x^2 + bx + c).

<nvar>, <svar> and <lvar>

This notation is used when a variable, not an expression, must be used in the command. Arrays with indices (such as n[1,2] or s$[3,4]) are considered to be the same as <nvar>, <svar> and <lvar>.

Array[] and Array$[]

This notation implies that an array name without indices must be used.

Array[{<start>,<length>}] and Array$[{<start>,<length>}]

In most contexts, numeric expressions inside the brackets are indices specifying a single array element. In some commands, a pair of numeric expressions specifies a segment of the array. Both the start index and length are numeric expressions, and both are optional. This notation is shorthand for:

```
Array [ { {<start_nexp>} , {<length_nexp>} } ]  or
Array$ [ { {<start_nexp>} , {<length_nexp>} } ]
```

{something}

Indicates something optional.

{ A | B |C }

This notation suggests that a choice of either A, B, or C, must be made. For example:

```
Text.open {r|w|a}, fn…
```

Indicate that either "r" or "w" or "a" must be chosen:

```
Text.open r, fn…
Text.open w, fn…
Text.open a, fn…
```

X, ...

Indicates a variable-sized list of items separated by commas. At least one item is required.

{,n} ...

Indicates an optional list of items with zero or more items separated by commas.

<statement>

Indicate an executable BASIC! statement. A <statement> is usually a line of code but may occur within other commands such as: **IF** <lexp> **THEN** <statement>.

Numbers

Numbers in BASIC! are double-precision floating point (64-bit IEEE 754). This means:

- A printed number will always have decimal point. For example, 99 will print as "99.0".You can print numbers without decimal points by using the INT$() or FORMAT$() functions. For example, either INT$(99) or FORMAT$("##",99) will print as "99".
- A number with more than 7 significant digits will be printed in floating point format. For example, the number 12345678 will be printed as 1.2345678E7. INT$() or FORMAT$() can be used to print large numbers in other than floating point format.

- Mathematical operations on decimal values are imprecise. If you are working with currency you should multiply the number by 100 until you need to print it out. When you print it, you can divide by 100.

You must type decimal numbers with a leading zero. Using .15 will create a syntax error. Using 0.15 will not generate a syntax error.

A logical value (false = 0, true <> 0) is a kind of number.

You can use string functions to convert numbers to strings. STR$(), INT$(), HEX$() and a few others do simple conversions. FORMAT$() and USING$() can do more complex formatting.

For the purposes of this documentation, numbers that appear in a BASIC! program are called Numeric Constants.

Strings

Strings in BASIC! are enclosed in quote (") characters. The quote characters are not part of the string. For example, **"This is a string"** is a string of 16 characters.

To include the quote character in a string, you must escape it with a backslash: **\"**. For example:

```
Print "His name is \"Jimbo\" Jim Giudice."
```

prints: His name is "Jimbo" Jim Giudice.

Newline characters (a CR/LF, or carriage return/line feed, combination) may be inserted into a string with the escape sequence **\n**:

```
Print "Jim\nGiudice"
```

prints:

```
Jim
Giudice
```

You can use another escape sequence, **\t**, to put a TAB character into a string. To embed a backslash, escape it with another backslash: \\. Other special characters can be inserted using the **CHR$()** function.

Strings with numerical characters can be converted to BASIC! numbers using the **VAL(<sexp>)** function.

For the purposes of this documentation, strings that appear within a BASIC! program are called String Constants.

Variables

A BASIC! variable is a container for some numeric or string value.

Variable Names

Variable names must start with the characters "a" through "z", "#", "@", or "_". The remaining characters in the variable name may also include the numbers 0 through 9.

A variable name may be as long as needed.

Upper case characters can be used in variable names but they will be converted to lower case characters when the program is run. The variable name "gLoP" is the same as the name "glop" to BASIC!

BASIC! command keywords should not be used to start the name of a variable. For example, **Donut = 5** is interpreted as **Do Nut=5**. BASIC! thus expects this **Do** statement to be followed by an **Until** statement somewhere before the program ends. A list of BASIC! commands can be found in **Appendix A**.

BASIC! statement labels and the names of user-defined functions, both described later in this manual, follow the same naming rules as BASIC! variables.

Variable Types

There are two types of variables: Variables that hold numbers and variables that hold strings. Variables that hold strings end with the character "$". Variables that hold numbers do not end in "$".

"Age", "amount" and "height" are all numeric variable names.

"First_Name$", "Street$" and "A$" are all string variable names.

If you use a numeric variable without assigning it a value, it has the value 0.0. If you use a string variable without assigning it a value, its value is the empty string, "".

Scalar and Array Variables

There are two classes of variables: Scalars and Arrays.

Scalars

A scalar is a variable that can hold only one value. When a scalar is created it is assigned a default value. Numeric scalars are initialized to 0.0. String scalars are initialized to an empty, zero-length string, "".

You create a scalar variable just by using its name. You do not need to predeclare scalars.

Arrays

An array is variable that can hold many values organized in a systematically arranged way. The simplest array is the linear array. It can be thought of as a list of values. The array A[index] is a linear array. It can hold values that can accessed as A[1], A[2],...,A[n]. The number (variable or constant) inside the square brackets is called the index.

If you wanted to keep a list of ten animals, you could use an array called Animals$[] that can be accessed with an index of 1 to 10. For example: Animals$[5] = "Cat"

Arrays can have more than one index or dimension. An array with two dimensions can be thought of as a list of lists. Let's assume that we wanted to assign a list of three traits to every animal in the list of animals. Such a list for a "Cat" might be "Purrs", "Has four legs" and "Has Tail". We could set up the Traits array to have two dimensions such that Traits$[5,2] = "Has four legs". If someone asked what are the traits of cat, search Animals$[index] until "Cat" is found at index =5. Index=5 can then be used to access Traits[index,[{1|2|3}].

BASIC! arrays can have any number of dimensions of any size.

BASIC! arrays are "one-based". This means that the first element of an array has an index of "1". Attempting to access an array with an index of "0" (or less than 0) will generate a run-time error.

Before an array can be used, it must be dimensioned using the **DIM** command. The **DIM** command tells BASIC! how many indices are going to be used and the sizes of the indices. Some BASIC! Commands automatically create a one-dimensional array. Auto-dimensioned array details will be seen in the description of those commands.

Note: It is recommended that the List commands (see below) be used in place of one-dimensional arrays. The List commands provide more versatility than the Array commands.

Array Segments

Some BASIC! Commands take an array as an input parameter. If the array is specified with nothing in the brackets (for example, "Animals$[]"), then the command reads the entire array.

Most of these commands allow you to limit their operation to a segment of the array, using the notation "Array[start, length]", where both "start" and "length" are numeric expressions.

For example, you can write "Animals$[2,3]". Usually that means "the animal at row 2 and column 3 of a two dimensional array called Animals$". When used to specify an array segment, it has a different meaning: "read only the segment of the Animals$ array that starts at index 2 and includes 3 items". Notice that this notation applies only to one-dimensional arrays. In fact, it treats all arrays as one-dimensional, regardless of how they are declared.

Both of the expressions in the "[start, length]" pair are optional. If the "start" value is omitted, the default starting index is 1. If the "length" value is omitted, the default is the length from the starting index to the end of the array. If both are omitted, the default is to use the entire array.

Array Commands

These commands all operate on Arrays. Commands operate on both numeric and string arrays, unless otherwise indicated.

Dim Array[<nexp>{, <nexp> } ...] {, Array[<nexp>{, <nexp> } ...] } ...

The **Dim** command tells BASIC! how many dimensions an array will have and how big those dimensions are. Multiple arrays can be dimensioned with one **Dim** statement. String and numeric arrays can be dimensioned in a single **Dim** command. Examples:

```
        DIM A[15]
        DIM B$[2,6,8], C[3,1,7,3], D[8]
```

UnDim Array[]{, Array[] } ...

Un-dimensions an array. The command allows the array to be dimensioned again with different dimensions. Multiple arrays can be un-dimensioned with one **UnDim** statement. The command is very useful when in a loop using commands that automatically dimension an array. Array[] is specified without any index. The command is exactly the same as Array.delete.

Array.average <Average_nvar>, Array[{<start>,<length>}]

Finds the average of the values in a numeric array (Array[]) or array segment (Array[start,length]), and places the result into <Average_nvar>.

Array.copy SourceArray[{<start>,<length>}], DestinationArray[{{-}<extras>}]

The previously Dimensioned or Loaded SourceArray will be copied to the DestinationArray. If the Destination Array does not exist, a new array is created. If the Destination Array already exists, some or all of the existing array will be overwritten. The arrays may be either numeric or string arrays but they must both be of the same type.

You may copy an entire array (SourceArray[]) or an array segment (SourceArray[start,length]).

If <start> is <= 1 or <start> is not present then the copy will begin with the first element of the SourceArray. If <length> is not present or if <start>+<length> exceeds the number of elements in the SourceArray then the entire array or segment from <start> to the end of the array will be copied.

If the Destination Array does not exist, the optional <extras> parameter specifies that <extras> empty elements are to be added to the new Destination Array before or after the copy. These elements will be added to the start of the array if the optional minus(-) sign is present. If minus is not present then these elements will be added to end of the array.

The extra elements for a new numeric array will be initialized to zero. The extra elements for a new string array will be the empty string, "".

If the Destination Array already exists, the optional <extras> parameter specifies a starting index into the Destination Array. If the remaining length of the Destination Array starting at the <extras> index is less than the number of elements to be copied from the Source Array, anything that would not fit is not copied.

See the Sample Program file, f26_array_copy.bas, for working examples of this command.

Array.delete Array[]{, Array[]} ...

Does the same thing as **UnDim** Array[].

Array.length <length_nvar>, Array[{<start>,<length>}]

Places the number of elements in an entire array (Array[] or Array$[]) or an array segment (Array[start,length] or Array$[start,length]) into <Length_nvar>.

Array.load Array[], <exp>, …

Loads a numeric array Array[] with the list of numeric values <nexp>{,<nexp>..,<nexp>}, or loads a string array Array$[] with the list of string values <sexp>{,<sexp>..,<sexp>}. The Array[] or Array$[] will have a single dimension of the size of the number of values in the list.

The array is specified without an index and must not have been previously dimensioned.

The list of <exp>s may be continued onto the next line by ending the line with the "~" character. The "~" character may be used between <nexp> parameters, where a comma would normally appear. The "~" itself separates the parameters; the comma is optional.

The "~" character may not be used to split a parameter across multiple lines.

Examples:

```
Array.load Numbers[], 2, 4, 8 , n^2, 32
Array.load Hours[], 3, 4,7,0, 99, 3, 66~   % comma not required before ~
37, 66, 43, 83,~                           % comma is allowed before ~
83, n*5, q/2 +j
Array.load Letters$[], "a", "b","c",d$,"e"
```

Array.max <Max_nvar> Array[{<start>,<length>}]

Finds the maximum value in a numeric array (Array[]) or array segment (Array[start,length]), and places the result into the numeric variable <max_nvar>.

Array.min <Min_nvar>, Array[{<start>,<length>}]

Finds the minimum value in a numeric array (Array[]) or array segment (Array[start,length]), and places the result into the numeric variable <min_nvar>.

Array.reverse Array[{<start>,<length>}]

Reverses the order of values in a numeric or string array (Array[] or Array$[]) or array segement (Array[start,length] or Array$[start,length]).

Array.search Array[{<start>,<length>}], <value_exp>, <result_nvar>{,<start_nexp>}

Searches in the numeric or string array (Array[] or Array$[]) or array segment (Array[start,length] or Array$[start,length]) for the specified numeric or string value, which may be an expression. If the value is found in the array, its position will be returned in the result numeric variable <result_nvar>. If the value is not found the result will be zero.

If the optional start expression parameter is present, the search will start at the specified element. The default value is 1.

Array.shuffle Array[{<start>,<length>}]}

Randomly shuffles the values of the specified array (Array[] or Array$[]) or array segment (Array[start,length] or Array$[start,length]).

Array.sort Array[{<start>,<length>}]}

Sorts the values of the specified array (Array[] or Array$[]) or array segment (Array[start,length] or Array$[start,length]) in ascending order.

Array.std_dev <sd_nvar>, Array[{<start>,<length>}]}

Finds the standard deviation of the values in a numeric array (Array[]) or array segment (Array[start,length]), and places the result into the numeric variable <sd_nvar>.

Array.sum <sum_nvar>, Array[{<start>,<length>}]

Finds the sum of the values in a numeric array (Array[]) or array segment (Array[start,length]), and then places the result into the numeric variable <sum_nvar>.

Array.variance <v_nvar>, Array[{<start>,<length>}]

Finds the variance of the values in a numeric array (Array[]) or array segment (Array[start,length]), and places the result into the numeric variable <v_nvar>.

Data Structures and Pointers in BASIC!

BASIC! offers commands that facilitate working with Data Structures in ways that are not possible with traditional Basic implementations. These commands provide for the implementation of Lists, Bundles, Stacks and Queues.

What is a Pointer

The central concept behind the implementation of these commands (and many other BASIC! commands) is the *pointer*. A pointer is a numeric value that is an index into a list or table of things.

Do not confuse the pointer with the thing it points to. A pointer to a List is not a List; a pointer to a bitmap is not a bitmap. A pointer is just a number that represents something else.

As an example of pointers think of a file cabinet drawer with folders in it. That file cabinet is maintained by your administrative assistant. You never see the file drawer itself. In the course of your work you will create a new folder into which you put some information. You then give the folder to your assistant to be place into the drawer. The assistant puts a unique number on the folder and gives you a slip of paper with that unique number on it. You can later retrieve that folder by asking your assistant to bring you the folder with that particular number on it.

In BASIC! you create an information object (folder). You then give that information object to BASIC! to put into a virtual drawer. BASIC! will give you a unique number—a pointer—for that information object. You then use that pointer to retrieve that particular information object.

Continuing with the folder analogy, let’s assume that you have folders that contain information about customers. This information could be things such as name, address and phone number. The number that your assistant will give you when filing the folder will become the customer’s customer number. You can retrieve this information about any customer by asking the assistant to bring you the folder with the unique customer number. In BASIC! you would use a Bundle to create that customer information object (folder). The pointer that BASIC! returns when you create the customer Bundle becomes the customer number.

Now let’s assume that a customer orders something. You will want to create a Bundle that contains all the order information. Such bundles are used by the order fulfillment department, the billing department and perhaps even the marketing department (to SPAM the customer about similar products). Each Bundle could contain the item ordered, the price, etc. The Bundle will also need to contain information about the customer. Rather than replicate the customer information you will just create a customer number field that contains the customer number (pointer). The pointer that gets returned when you create the order bundle becomes the Order Number. You can create different lists of bundles for use by different departments.

It would also be nice to have a list of all orders made by a customer in the customer Bundle. You would do this by creating a List of all order numbers for that customer. When you create the customer bundle, you would ask BASIC! to create an empty List. BASIC! will return a pointer to this empty List. You would then place this pointer into the customer record. Later when the customer places an order, you will retrieve that list pointer and add the order number to the List.

You may also want to create several other Lists of order Bundles for other purposes. You may, for example, have one List of orders to be filled, another List of filled orders, another List of returned orders, another List for billing, etc. All of these Lists would simply be lists of order numbers. Each order number would point to the order Bundle which would point to the Customer Bundle.

If you were to actually create such a database in BASIC!, you would probably want to save all these Bundles and Lists onto external storage. Getting that information from the internal data structures to external storage is an exercise left to the user for now.

There are things besides List, Bundle, and Stack data structures that are accessed through pointers. These include bitmaps and graphical objects, described below in the **Graphics** section, audio clips, described in **SoundPool**, and other things.

Lists

A List is similar to a single-dimension array. The difference is in the way a List is built and used. An array must be dimensioned before being used. The number of elements to be placed in the array must be predetermined. A List starts out empty and grows as needed. Elements can be removed, replaced and inserted anywhere within the list.

There is no fixed limit on the size or number of lists. You are limited only by the memory of your device.

Another important difference is that a List is not a variable type. A numeric pointer is returned when a list is created. All further access to the List is by means of that numeric pointer. One implication of this is that it is easy to make a List of Lists. A List of Lists is nothing more than a numeric list containing numeric pointers to other lists.

Lists may be copied into new Arrays. Arrays may be added to Lists.

All of the List commands are demonstrated in the Sample Program file, f27_list.bas.

List Commands

List.create N|S, <pointer_nvar>

Creates a new, empty list of the type specified by the N or S parameter. A list of strings will be created if the parameter is **S**. A list of numbers will be created if the parameter is **N**. Do not put quotation marks around the N or S.

The pointer to the new list will be returned in the <pointer_nvar> variable.

The newly created list is empty. The size returned for a newly created list is zero.

List.add <pointer_nexp>{, <exp>}...

Adds the values of the expressions <exp>... to specified list. The expressions must all be the same type (numeric or string) as the list.

The list of <exp>s may be continued onto the next line by ending the line with the "~" character. The "~" character may be used between <exp> parameters, where a comma would normally appear. The "~" itself separates the parameters; the comma is optional.

The "~" character may not be used to split a parameter across multiple lines.

Examples:

```
List.add Nlist, 2, 4, 8 , n^2, 32

List.add Hours, 3, 4,7,0, 99, 3, 66~       % comma not required before ~
37, 66, 43, 83,~                           % comma is allowed before ~
83, n*5, q/2 +j

List.add Name~
"Bill", "Jones"~
"James", "Barnes"~
"Jill", "Hanson"
```

List.add.list <destination_list_pointer_nexp>, <source_list_pointer_nexp>

The elements in the source list will be added to the end of the destination list.

The two lists must be of the same type (string or numeric).

List.add.array <list_pointer_nexp>, Array[{<start>,<length>}]

The elements of the specified array (Array[]) or array segment (Array[start,length]) will be added to the end of the list.

The Array type must be the same as the list type.

List.replace <pointer_nexp>,<index_nexp>, <sexp>|<nexp>

The List element specified by <index_nexp> in the list pointed to by <pointer_nexp> will be replaced by the string or numeric expression.

The index is one-based. The first element of the list is 1.

The replacement expression type (string or numeric) must match the list creation type.

List.insert <pointer_nexp>, <index_nexp>, <sexp>|<nexp>

The <sexp> or <nexp> value will be inserted into the list pointed to by <pointer_nexp>. The element will inserted at the index point, <index_nexp>. If the value of the index point is equal to one more than the current size of the list, a new item is inserted at the end of the list.

The index is ones based. The first element of the list is 1.

The inserted element expression type must match the type (string or numeric) used in the creation of the list.

List.remove <pointer_nexp>,<index_nexp>

The list element specified by <index_nexp> in the list pointed to by <pointer_nexp> will be removed from the list.

The index is ones based. The first element of the list is 1.

List.get <pointer_nexp>,<index_nexp>, <svar>|<nvar>

The list element specified by <index_nexp> in the list pointed to by <pointer_nexp> will be returned in the specified string or numeric variable.

The index is one-based. The first element of the list is 1.

The return element variable type must match the type (string or numeric) used in the creation of the list.

List.type <pointer_nexp>, <svar>

The type of list pointed to by the list pointer will be returned in the String variable.

The upper case character "S" will be returned if the List is a list of strings.

The upper case character "N" will be returned if the list is a list of numbers.

List.size <pointer_nexp>, <nvar>

The size of the list pointed to by the list pointer will be returned in the numeric variable.

List.clear <pointer_nexp>

The list pointed to by the list pointer will be cleared. The list's size will be set to zero.

List.search <pointer_nexp>, value|value$, <result_nvar>{,<start_nexp>}

The list pointed to by the list pointer will be searched for the specified string or numeric value. The position of the found value in the list will be returned in result numeric variable. If the value is not found in the list the result numeric variable value will be zero.

If the optional start expression parameter is present, the search will start at the specified element. The default value is 1.

List.toArray <pointer_nexp>, Array$[] | Array[]

The list pointed to by the list pointer will be copied into the new, previously non-dimensioned array. The specified array type (string or numeric) must be the same type as the list.

Bundles

A Bundle is a group of values collected together into a single object. A bundle object may contain any number of string and numeric values. There is no fixed limit on the size or number of bundles. You are limited only by the memory of your device.

The values are set and accessed by keys. A key is string that identifies the value. For example, a bundle might contain a person's first name and last name. The keys for accessing those name strings could be "first_name" and "last_name". An age numeric value could also be placed in the Bundle using an "age" key.

A new, empty bundle is created by using the **Bundle.create** command. The command returns a pointer to the empty bundle. Because the bundle is represented by a pointer, bundles can be placed in lists and arrays. Bundles can also be contained in other bundles. This means that the combination of lists and bundles can be used to create arbitrarily complex data structures.

After a bundle is created, keys and values can be added to the bundle using the **Bundle.put** command. Those values can be retrieved using the keys in the **Bundle.get** command. There are other bundle commands to facilitate the use of bundles.

Bundle Auto-Create

Every bundle command except **Bundle.create** has a parameter, the <pointer_nexp>, which can point to a bundle. If the expression value points to a bundle, the existing bundle is used. If it does not, and the expression consists only of a single numeric variable, then a new, empty bundle is created, and the variable value is set to point to the new bundle.

That may seem complex, but it isn't, really. If there is a bundle, use it. If there is not, try to create a new one – but BASIC! can't create a new bundle if you don't give it a variable name. BASIC! uses the variable to tell you how to find the new bundle.

```
BUNDLE.PUT b,"key1", 1.2            % try to put a value in the bundle pointed to by b
BUNDLE.PUT 10, key2$, value2        % try to put a value in the 10th bundle created
BUNDLE.REMOVE c + d, key$[3],       % try to remove a key/value pair from a bundle
                                    % pointed to by c + d
```

In the first example, if the value of **b** points to a bundle, the **Bundle.put** puts **"key1"** and the value 1.2 into that bundle. If **b** is a new variable, its value is 0.0, so it does not point to a bundle. In that case, the **Bundle.put** creates a new bundle, puts **"key1"** and the value 1.2 into the new bundle, and sets **b** to point to the new bundle.

In the second example, if there are at least ten bundles, then the **Bundle.put** tries to put the key named in the variable **key2$** and the value of the variable **value2** into bundle 10. If there is no bundle 10, then the command does nothing. It can't create a new variable because you did not provide a variable to return the bundle pointer.

In the third example, the bundle pointer is the value of the expression **c + d**. If there is no such bundle, the command does nothing. To create a new bundle, the bundle pointer expression must be a single numeric variable.

Bundle Commands

Bundle.create <pointer_nvar>

A new, empty bundle is created. The bundle pointer is returned in <pointer_nvar>.

Example:

```
BUNDLE.CREATE bptr
```

Bundle.put <pointer_nexp>, <key_sexp>, <value_nexp>|<value_sexp>

The value expression will be placed into the specified bundle using the specified key. If the bundle does not exist, a new one may be created.

The type of the value will be determined by the type of the value expression.

Example:

```
BUNDLE.PUT bptr, "first_name", "Frank"
BUNDLE.PUT bptr,"age", 44
```

Bundle.get <pointer_nexp>, <key_sexp>, <nvar>|<svar>

Places the value specified by the key string expression into the specified numeric or string variable. The type (string or numeric) of the destination variable must match the type stored with the key. If the bundle does not exist or does not contain the requested key, the command generates a run-time error.

Example:

```
BUNDLE.GET bptr,"first_name", first_name$
BUNDLE.GET bptr,"age", age
```

Bundle.keys <bundle_ptr_nexp>, <list_ptr_nexp>

Returns a list of the keys currently in the specified bundle.

The bundle pointer parameter <bundle_ptr_nexp> specifies the bundle from which to get the keys. If the bundle does not exist, a new one may be created.

The list pointer parameter <list_ptr_next> specifies the list into which to write the keys. The previous contents of the list are discarded. If the parameter does not specify a valid string list to reuse, and the parameter is a string variable, a new list is created and a pointer to the list is written to the variable.

The key names in the returned list may be extracted using the various list commands.

Example:

```
BUNDLE.KEYS bptr, list
LIST.SIZE list, size
FOR i = 1 TO size
       LIST.GET list, i, key$
       BUNDLE.TYPE bptr, key$, type$
       IF type$ = "S"
              BUNDLE.GET bptr, key$, value$
              PRINT key$, value$
       ELSE
              BUNDLE.GET bptr, key$, value
              PRINT key$, value
       ENDIF
NEXT i
```

Bundle.contain <pointer_nexp>, <key_sexp> , <contains_nvar>

If the key specified in the key string expression is contained in the bundle's keys then the "contains" numeric variable will be returned with a non-zero value. The value returned will be zero if the key is not in the bundle. If the bundle does not exist, a new one may be created.

Bundle.type <pointer_nexp>, <key_sexp>, <type_svar>

Returns the value type (string or numeric) of the specified key in the specified string variable. The <type_svar> will contain an uppercase "N" if the type is numeric. The <type_svar> will contain an uppercase "S" if the type is a string. If the bundle does not exist or does not contain the requested key, the command generates a run-time error.

Example:

```
BUNDLE.TYPE bptr, "age", type$
PRINT type$   % will print N
```

Bundle.remove <pointer_nexp>, <key_sexp>

Removes the key named by the string expression <key_sexp>, along with the associated value, from the bundle pointed to by the numeric expression <pointer_nexp>. If the bundle does not contain the key, nothing happens. If the bundle does not exist, a new one may be created.

Bundle.clear <pointer_nexp>

The bundle pointed to by <pointer_nexp> will be cleared of all tags. It will become an empty bundle. If the bundle does not exist, a new one may be created.

Stacks

Stacks are like a magazine for a gun.

The last bullet into the magazine is the first bullet out of the magazine. This is also what is true about stacks. The last object placed into the stack is the first object out of the stack. This is called LIFO (Last In First Out).

An example of the use of a stack is the BASIC! Gosub command. When a Gosub command is executed the line number to return to is "pushed" onto a stack. When a return is executed the return line number is "popped" off of the stack. This methodology allows Gosubs to be nested to any level. Any return statement will always return to the line after the last Gosub executed.

A running example of Stacks can be found in the Sample Program file, f29_stack.bas.

There is no fixed limit on the size or number of stacks. You are limited only by the memory of your device.

Stack Commands

Stack.create N|S, <ptr_nvar>

Creates a new stack of the designated type (N=Number, S=String). The stack pointer is in <ptr_nvar>.

Stack.push <ptr_nexp>, <nexp>|<sexp>

Pushes the <nexp> or <sexp> onto the top of the stack designated by <ptr_nexp>.

The type of value expression pushed must match the type of the created stack.

Stack.pop <ptr_nexp>, <nvar>|<svar>

Pops the top-of-the-stack value designated by <ptr_nexp> and places it into the <nvar> or <svar>.

The type of the value variable must match the type of the created stack.

Stack.peek <ptr_nexp>, <nvar>|<svar>

Returns the top-of-stack value of the stack designated by <ptr_nexp> into the <nvar> or <svar>. The value will remain on the top of the stack.

The type of the value variable must match the type of the created stack.

Stack.type <ptr_nexp>, <svar>

The type (numeric or string) of the stack designated by <ptr_nexp> will be returned in <svar>. If the stack is numeric, the upper case character "N" will be returned. If the stack is a string stack, the upper case character "S" will be returned.

Stack.isEmpty <ptr_nexp>, <nvar>

If the stack designated by <ptr_nexp> is empty the value returned in <nvar> will be 1. If the stack is not empty the value will be 0.

Stack.clear <ptr_nexp>

The stack designated by <ptr_nexp> will be cleared.

Queues

A Queue is like the line that forms at your bank. When you arrive, you get in the back of the line or queue. When a teller becomes available the person at the head of the line or queue is removed from the queue to be serviced by the teller. The whole line moves forward by one person. Eventually, you get to the head of the line and will be serviced by the next available teller. A queue is something like a stack except the processing order is First In First Out (FIFO) rather than LIFO.

Using our customer order processing analogy, you could create a queue of order bundles for the order processing department. New order bundles would be placed at the end of the queue. The top-of-the-queue bundle would be removed by the order processing department when it was ready to service a new order.

There are no special commands in BASIC! for Queue operations. If you want to make a queue, create a list.

Use **List.add** to add new elements to the end of the queue.

Use **List.get** to get the element at the top of the queue and use **List.remove** to remove that top of queue element. You should, of course, use **List.size** before using **List.get** to ensure that there is a queued element remaining

Comments

! - Single Line Comment

If the first character in a line is the "!" character, BASIC! considers the entire line a comment and ignores it. If the "!" appears elsewhere in the line it does not indicate a comment.

Rem - Single Line Comment (legacy)

If the first three characters in a line are "Rem", "REM", or even "rEm", BASIC! considers the entire line a comment and ignores it. If "Rem" appears elsewhere in the line it does not indicate a comment.

!! - Block Comment

When a line begins with the "!!" characters, all lines that follow are considered comments and are ignored by BASIC! The Block Comment section ends at the next line that starts with "!!"

% - Middle of Line Comment

If the "%" character appears in a line (except within a quoted string) then rest of the line is a comment.

Expressions

Numeric Expression <nexp>

<nexp> := {<numeric variable>|<numeric constant} {<noperator> <nexp>|<end of line>}

Numeric Operators <noperator>

The numeric operators are listed by precedence. Higher precedence operators are executed before lower precedence operators. Precedence can be changed by using parentheses.

1. Unary +, Unary –
2. Exponent ^
3. Multiply *, Divide /
4. Add +, Subtract –

Numeric Expression Examples

```
a
a*b + 4/d – 2*(d^2)
a + b + d + RND()
b + CEIL(d/25) + 5
```

Pre- and Post-Increment Operators

++x	Increments the value of x by 1 before the x value is used
--y	Decrements the value of y by 1 before the y value is used
x++	Increments the value of x by 1 after the x value is used
y--	Decrements the value of y by 1 after the y value is used

```
a = 5          % creates the variable a and sets it to 5
PRINT --a      % sets a to 4 and prints 4
PRINT a--      % prints 4 and sets a to 3
```

These operations work only on numeric variables. Their action is performed as part of evaluating the variable, so they do not follow normal precedence rules.

Using these operators on a variable makes the variable unavailable for other operations that require a variable. For example, you cannot pass a variable by reference (see **User-Defined functions**) if you pre- or post-increment or -decrement it, because you cannot pass an expression by reference. An exception is made to allow implicit assignment (actual or implied **LET**).

String Expression <sexp>

<sexp> := {<string variable>|<string constant>} { + <sexp> | <end of line>}

There is only one string operator: +. This is the concatenation operator. It is used to join two strings:

```
PRINT "abc" + "def"   % prints abcdef
```

Logical Expression <lexp>

Logical expressions, or Boolean expressions, produce only two results: false or true. False is represented in BASIC! by the numeric value of zero. Anything that is not zero is true. False = 0. True = not 0.

There are two types of logical expressions: Numeric logical expressions and string logical expressions. Both types produce a numerically-represented values of true or false.

<slexp> := {<string variable>|<string constant>} <logical operator> {<string variable>|<string constant>}

<nlexp> := {<numeric variable>|<numeric constant>} <logical operator> {<numeric variable>|<numeric constant>}

There is also the unique unary NOT (!) operator. NOT inverts the truth of a logical expression.

Logical Operators

Most of the logical operators are used for comparison. You can compare strings or numbers (<, =, etc.). You can use the other Boolean operators (!, &, |) on numbers but not on strings.

This table shows all of the Logical operators. They are listed by precedence with the highest precedence first. Precedence may be modified by using parenthesis.

Precedence	Operator	Meaning	Operands
1	!	Unary Not	One <nlexp> only

2	< > <= >=	Less Than Greater Than Less Than or Equal Greater Than or Equal	Two <nlexp> or two <slexp>
3	= <>	Equal Not Equal	Two <nlexp> or two <slexp>
4	& |	And Or	Two <nlexp> only

Examples of Logical Expressions

```
1 < 2 (true)
3 <> 4 (true)
"a" < "bcd" (true)
1 & 0 (false)
!(1 & 0) (true)
```

Parentheses

Parentheses can be used to override operator precendence.

```
a = b * c + d        % the multiplication is done first
a = b * (c + d)      % the addition is done first
```

Parentheses can also be placed around a variable, anywhere except to the left of an = sign. This can be useful in places where the interpreter may mistake part of a variable for a special keyword. For an example, see **Program Control Commands – For - To - Step / Next**, below.

Assignment Operations

Variables get values by means of assignment statements. Simple assignment statements are of the form:

```
<nvar> = <nexp>
<svar> = <sexp>
```

The special form of the statement allows BASIC! to infer the command. The implied command is **LET**.

Let

The original Basic language used the command, **LET**, to denote an assignment operation as in:

```
LET <nvar> = <nexp>
```

BASIC! also has the **LET** command but it is optional. If you use other programming languages, it may look strange to you, but there are two reasons you might use **LET**.

First, you must use **LET** if you want to have a variable name start with a BASIC! keyword. Such keywords may not appear at the beginning of a new line. The statement:

```
Letter$ = "B"
```

is seen by BASIC! as

```
LET ter$ = "B"
```

If you really want to use Letter$ as a variable, you can safely use it by putting it in a **LET** statement:

```
LET Letter$ = "B"
```

If you do the assignment in a single-line **IF** statement, you must also use the **LET** command:

```
IF 1 < 2 THEN LET letter$ = "B"
```

Second, assignment is faster with the **LET** command than without it.

LET, either explicit or implied, may be used without the equals sign and the expression that follows it. This is especially useful if you want to use the increment or decrement operators alone on a line:

```
++a    % same as LET a = a + 1
b--    % same as LET b = b - 1
```

OpEqual Assignment Operations

All of the binary arithmetic and logical operators (+, -, *, /, ^, &, |) may be used with the equals sign (=) to make a single "OpEqual" operator. The combined operator works like this:

```
var op= expression  is the same as  var = var op (expression)
```

Here are some examples:

```
a += 1                 is the same as      a = a + 1
a$ += "xyz"            is the same as      a$ = a$ + "xyz"
b /= 5 + 3             is the same as      b = b / (5 + 3)
c ^= log(37) + 1       is the same as      c = c ^ (log(37) + 1)
d *= --d + d--         is the same as      d = d * (--d + d--)
m &= (x$ = y$) | (x$ != z$) is the same as m = m & ((x$ = y$) | (x$ != z$))
```

Math Functions

Math functions act like numeric variables in a <nexp> (or <lexp>).

BOR(<nexp1>, <nexp2>)

Returns the logical bitwise value of <nexp1> OR <nexp2>. The double-precision floating-point values are converted to 64-bit integers before the operation.

```
BOR(1,2) is 3
```

BAND(<nexp1>, <nexp2>)

Returns the logical bitwise value of <nexp1> AND <nexp2>. The double-precision floating-point values are converted to 64-bit integers before the operation.

```
        BAND(3,1) is 1
```

BXOR(<nexp1>, <nexp2>)

Returns the logical bitwise value of <nexp1> XOR <nexp2>. The double-precision floating-point values are converted to 64-bit integers before the operation.

```
        BXOR(7,1) is 6
```

BNOT(<nexp>)

Returns the bitwise complement value of <nexp>. The double-precision floating-point value is converted to a 64-bit integer before the operation.

```
        BNOT(7) is -8
        HEX$(BNOT(HEX("1234"))) is ffffffffffffedcb
```

ABS(<nexp>)

Returns the absolute value of <nexp>.

SGN(<nexp>)

Returns the signum function of the numerical value of <nexp>, representing its sign.

When the value is:	Return:
> 0	1
= 0	0
< 0	-1

RANDOMIZE(<nexp>)

Creates a pseudorandom number generator for use with the RND() function.

The RANDOMIZE() function always returns zero.

If no RANDOMIZE() has been executed or if RANDOMIZE(0) is executed then the seed will be based upon the time of day in milliseconds since January 1, 1970 00:00:00 UTC.

If the numeric expression <> 0 then the generator will be created using the expression value as the seed. A non-zero seed will always generate the same sequence of pseudorandom numbers.

RND()

Returns a random number generated by the pseudorandom number generator. If a RANDOMIZE() has not been previously executed then a new random generator will be created using "RANDOMIZE(0)".

The random number will be greater than or equal to zero and less than one. (0 <= n < 1).

```
        d = FLOOR(6 * RND() + 1)            % roll a six-sided die
```

MAX(<nexp>, <nexp>)

Returns the maximum of two numbers as an <nvar>.

MIN(<nexp>, <nexp>)

Returns the minimum of two numbers as an <nvar>.

CEIL(<nexp>)

Rounds up towards positive infinity. 3.X becomes 4 and -3.X becomes -3.

FLOOR(<nexp>)

Rounds down towards negative infinity. 3.X becomes 3 and -3.X becomes -4.

INT(<nexp>)

Returns the integer part of <nexp>. 3.X becomes 3 and -3.X becomes -3. This operation may also be called truncation, rounding down, or rounding toward zero.

FRAC(<nexp>)

Returns the fractional part of <nexp>. 3.4 becomes 0.4 and -3.4 becomes -0.4.

FRAC(n) is equivalent to "n – INT(n)".

MOD(<nexp1>, <nexp2>)

Returns the remainder of <nexp1> divided by <nexp2>.

ROUND(<value_nexp>{, <count_nexp>{, <mode_sexp>}})

In it simplest form, ROUND(<value_nexp>), this function returns the closest whole number to <nexp>. You can use the optional parameters to specify more complex operations.

The <count_nexp> is an optional decimal place count. It sets the number of places to the right of the decimal point. The last digit is rounded. The decimal place count must be >= 0. Omitting the parameter is the same as setting it to zero.

The <mode_sexp> is an optional rounding mode. It is a one- or two-character mnemonic code that tells ROUND() what kind of rounding to do. It is not case-sensitive. There are seven rounding modes:

Mode:	Meaning:	-3.8	-3.5	-3.1	3.1	3.5	3.8
"HD"	Half-down	-4.0	-3.0	-3.0	3.0	3.0	4.0
"HE"	Half-even	-4.0	-4.0	-3.0	3.0	4.0	4.0
"HU"	Half-up	-4.0	-4.0	-3.0	3.0	4.0	4.0
"D"	Down	-3.0	-3.0	-3.0	3.0	3.0	3.0
"U"	Up	-4.0	-4.0	-4.0	4.0	4.0	4.0
"F"	Floor	-4.0	-4.0	-4.0	3.0	3.0	3.0
"C"	Ceiling	-3.0	-3.0	-3.0	4.0	4.0	4.0

In this table, "down" means "toward zero" and "up" means "away from zero" (toward ±∞)

"Half" refers to behavior when a value is half-way between rounding up and rounding down(x.5 or -x.5). "Half-down" rounds x.5 towards zero and "half-up" rounds x.5 away from zero.

"Half-even" is either "half-down" or "half-up", whichever would make the result **even**. 4.5 and 3.5 both round to 4.0. "Half-even" is also called "banker's rounding", because it tends to average out rounding errors.

If you do not provide a <mode_sexp>, ROUND() adds +0.5 and rounds down (toward zero). This is legacy behavior, copied from earlier versions of BASIC!. ROUND(n) is NOT the same as ROUND(n, 0).

Examples:

```
pi = ROUND(3.14159)                 % pi is 3.0
pi = ROUND(3.14159, 2)              % pi is 3.14
pi = ROUND(3.14159, , "U")          % pi is 4.0
pi = ROUND(3.14159, 4, "F")         % pi is 3.1415
negpi = ROUND(-3.14159, 4, "D")     % negpi is -3.1416
```

Note that FLOOR(n) is exactly the same as ROUND(n, 0, "F"), but FLOOR(n) is a little faster. In the same way, CEIL(n) is the same as ROUND(n, 0, "C"), and INT(n) is the same as ROUND(n, 0, "D").

SQR(<nexp>)

Returns the closest double-precision floating-point approximation of the positive square root of <nexp>.

CBRT(<nexp>)

Returns the closest double-precision floating-point approximation of the cube root of <nexp>.

LOG(<nexp>)

Returns the natural logarithm (base e) of <nexp>.

LOG10(<nexp>)

Returns the base 10 logarithm of the <nexp>.

EXP(<nexp>)

Returns e raised to the <nexp> power.

POW(<nexp1>, <nexp2>)

Returns <nexp1> raised to the <nexp2> power.

HYPOT(<nexp_x>, <nexp_y)

Returns SQR(x^2+y^2) without intermediate overflow or underflow.

PI()

Returns the double-precision floating-point value closest to pi.

SIN(<nexp>)

Returns the trigonometric sine of angle <nexp>. The units of the angle are radians.

COS(<nexp>)

Returns the trigonometric cosine of angle <nexp>. The units of the angle are radians.

TAN(<nexp>)

Returns the trigonometric tangent of angle <nexp>. The units of the angle are radians.

SINH(<nexp>)

Returns the trigonometric hyperbolic sine of angle <nexp>. The units of the angle are radians.

COSH(<nexp>)

Returns the trigonometric hyperbolic cosine of angle <nexp>. The units of the angle are radians.

ASIN(<nexp>)

Returns the arc sine of the angle <nexp>, in the range of -pi/2 through pi/2. The units of the angle are radians.

ACOS(<nexp>)

Returns the arc cosine of the angle <nexp>, in the range of 0.0 through pi.The units of the angle are radians.

ATAN(<nexp>)

Returns the arc tangent of the angle <nexp>, in the range of -pi/2 through pi/2. The units of the angle are radians.

ATAN2(<nexp_y>, <nexp_x>)

Returns the angle *theta* from the conversion of rectangular coordinates (`x`, `y`) to polar coordinates (r,*theta*). (Please note the order of the parameters in this function.)

TODEGREES(<nexp>)

Converts <nexp> angle measured in radians to an approximately equivalent angle measured in degrees.

TORADIANS(<nexp>)

Converts <nexp> angle measured in degrees to an approximately equivalent angle measured in radians.

VAL(<sexp>)

Returns the numerical value of the string expression <sexp> interpreted as a signed decimal number.

LEN(<sexp>)

Returns the length of the <sexp>.

HEX(<sexp>)

Returns the numerical value of the string expression <sexp> interpreted as a hexadecimal integer.

OCT(<sexp>)

Returns the numerical value of the string expression <sexp> interpreted as an octal integer.

BIN(<sexp>)

Returns the numerical value of the string expression <sexp> interpreted as a binary integer.

SHIFT(<value_nexp>, <bits_nexp>)

Shifts the value <value_nexp> by the bit count <bits_nexp>. If the bit count is < 0, the value will be shifted left. If the bit count is > 0, the bits will be shifted right. The right shift will replicate the sign bit. The double-precision floating-point value are truncated to 64-bit integers before the operation.

ASCII(<sexp>{, <index_nexp>})

Returns the ASCII value of one character of <sexp>. By default, it is the value of the first character. You can use the optional <index_nexp> to select any character. The index of the first character is 1.

A valid ASCII value is between 0 and 255. If <sexp> is an empty string ("") the value returned will be 256 (one more than the largest 8-bit ASCII value). For non-ASCII Unicode characters, ASCII() returns invalid values; use UCODE() instead.

UCODE(<sexp>{, <index_nexp>})

Returns the Unicode value of one character of <sexp>. By default, it is the value of the first character. You can use the optional <index_nexp> to select any character. The index of the first character is 1.

If <sexp> is an empty string ("") the value returned will be 65536 (one more than the largest 16-bit Unicode value). If the selected character of <sexp> is a valid ASCII character, this function returns the same value as ASCII().

IS_IN(<sub_sexp>, <base_sexp>{, <start_nexp>})

Returns the position of an occurrence of the substring <sub_sexp> in the base string <base_sexp>.

If the optional start parameter <start_nexp> is not present then the function starts at the first character and searches forward.

If the start parameter is >= 0, then it is the starting position of a forward (left-to-right) search. The left-most character is position 1. If the parameter is negative, it is the starting position of a reverse (right-to-left) search. The right-most character is position -1.

If the substring is not in the base string, the function returns 0. It can not return a value larger than the length of the base string.

STARTS_WITH(<sub_sexp>, <base_sexp>{, <start_nexp>})

Determines if the substring <sub_sexp> exactly matches the part of the base string <base_sexp> that starts at the position <start_nexp>. The <start_nexp> parameter is optional; if it is not present then the default starting position is 1, the first character, so the base string must start with the substring. If present, <start_nexp> must be >= 1.

The function returns the length of the matching substring. If no match is found, the function returns 0.

ENDS_WITH(<sub_sexp>, <base_sexp>)

Determines if the substring <sub_sexp> exactly matches the end of the base string <base_sexp>.

If the base string ends with the substring, the function returns the index into the base string where the substring starts. The value will always be >= 1. If no match is found, the function returns 0.

GR_COLLISION(<object_1_nvar>, <object_2_nvar>)

The variables <object_1_nvar> and <object_2_nvar> are the object pointers returned when the objects were created.

If the boundary boxes of the two objects overlap then the function will return true (not zero). If they do not overlap then the function will return false (zero).

Objects that may be tested for collision are: point, rectangle, bitmap, circle, arc, oval, and text. In the case of a circle, an arc, an oval, or text, the object's rectangular boundary box is used for collision testing, not the actual drawn object.

BACKGROUND()

A running BASIC! program continues to run when the HOME key is tapped. This is called running in the Background. When not in the Background mode, BASIC! is in the Foreground mode. BASIC! exits the Background mode and enters the Foreground mode when the BASIC! icon on the home screen is tapped.

Sometimes a BASIC! programmer wants to know if the program is running in the Background. One reason for this might be to stop music playing while in the Background mode.

The **BACKGROUND()** function returns true (1) if the program is running in the background. It returns false (0) if the program is not running in the background.

If you want to be able to detect Background mode while Graphics is open, you must not call **Gr.render** while in the Background mode. Doing so will cause the program to stop running until the Foreground mode is re-entered. Use the following code line for all **Gr.render** commands:

```
IF !BACKGROUND() THEN GR.RENDER
```

Time Functions

CLOCK()

Returns the time in milliseconds since the last boot.

TIME()

Returns the time in milliseconds since 12:00:00 AM, January 1, 1970, UTC (the "epoch"). The time interval is the same everywhere in the world, so the value is not affected by the **TimeZone** command.

TIME(<year_exp>, <month_exp>, <day_exp>, <hour_exp>, <minute_exp>, <second_exp>)

Like **TIME()**, except the parameters specify a moment in time. The specification is not complete, as it does not include the timezone. You may specify a timezone with the **TimeZone** command. If you do not specify a timezone, your local timezone is used.

The parameter expressions may be either numeric expressions or string expressions. This is an unusual aspect as it isn't allowed anywhere else in BASIC!. If a parameter is a string, then it must evaluate to a number: digits only, one optional decimal point somewhere, optional leading sign, no embedded spaces. If the string parameter does not follow the rules, BASIC! reports a syntax error, like using a string in a place that expects a numeric expression.

TIME(…) (the function) and **Time** (the command) are inverse operations. **TIME(…)** can take the first six return parameters of the **Time** command directly as input parameters.

With the **USING$()** or **FORMAT_USING$()** functions, you can express a moment in time as a string in many different ways, formatted for your locale.

String Functions

GETERROR$()

Return the error message that was not printed due to an "onError" intercept.

This function can also be used to get an error message when **Text.open**, **Byte.open**, or **GPS.OPEN** fails.

CHR$(<nexp>, ...)

Return the character string represented by the values of list of numerical expressions. Each <nexp> is converted to a character. The expressions may have values greater than 255 and thus can be used to generate Unicode characters.

```
PRINT CHR$(16*4 + 3)        % Hexadecimal 43 is the character "C". This prints: C
PRINT CHR$(945, 946)        % Decimal for the characters alpha and beta: Prints: αβ
```

LEFT$(<sexp>, <count_nexp>)

Return the left-most characters of the string <sexp>. The number of characters to return is set by the count parameter, <count_nexp>.

- If the count is greater than 0, return <count_nexp> characters, counting from the left.
- If the count is less than 0, return all but <count_nexp> characters. The number to return is the string length reduced by <count_nexp>: **LEFT$(a$, -2)** is the same as **LEFT$(a$, LEN(a$) - 2)**.
- If the count is 0, return an empty string ("").
- If the count is greater than the length of the string, return the entire string.

MID$(<sexp>, <start_nexp>{, <count_nexp>})

Return a substring of the string <sexp>, beginning or ending at the start position <start_nexp>. The first character of the string is at position 1. If the start position is 0 or negative, it is set to 1.

The count parameter is optional. If it is omitted, return all of the characters from the start position to the end of the string.

```
a$ = MID$("dinner", 2)            % a$ is "inner"
```

Otherwise, the absolute value of the count specifies the length of the returned substring:

- If the count is greater than 0, begin at <start_nexp> and count characters to the **right**.
  That is, return the substring that **begins** at the start position.
  If the start position is greater than the length of the string, return an empty string ("").

- If the count is less than 0, begin at <start_nexp> and count characters to the **left**.
  That is, return the substring that **ends** at the start position.
  If the start position is greater than the length of the string, it is set to the end of the string.
- If the count is 0, return an empty string ("").

```
a$ = MID$("dinner", 2, 3)          % a$ is "inn"
a$ = MID$("dinner", 4, -3)         % a$ is "inn"
a$ = MID$("dinner", 3, 0)          % a$ is ""
```

RIGHT$(<sexp>, <count_nexp>)

Return the right-most characters of the string <sexp>. The number of characters to return is set by the count parameter, <count_nexp>.

- If the count is greater than 0, return <count_nexp> characters, counting from the right.
- If the count is less than 0, return all but <count_nexp> characters. The number to return is the string length reduced by <count_nexp>: **RIGHT$(a$, -2)** is the same as **RIGHT$(a$, LEN(a$) - 2)**.
- If the count is 0, return an empty string ("").
- If the count is greater than the length of the string, return the entire string.

REPLACE$(<sexp>, <argument_sexp>, <replace_sexp>)

Returns <sexp> with all instances of <argument_sexp> replaced with <replace_sexp>.

TRIM$(<sexp>{, <test_sexp>})

Returns <sexp> with leading and trailing occurrences of <test_sexp> removed.

The expression to trim off, <test_sexp>, is optional. If omitted, all leading and trailing whitespace is removed. That is, the default <test_sexp> is the regular expression "\s+", which means "all whitespace". To use this regular expression in a BASIC! string, you must write it "\\s+" (escape the backslash).

As with the **WORD$()** function and the **SPLIT** command, the <test_exp> is a regular expression. See **Split** for a note about Regular Expressions.

LTRIM$(<sexp>{, <test_sexp>})

RTRIM$(<sexp>{, <test_sexp>})

Exactly like **TRIM$()**, except that **LTRIM$()** trims only the left end of the source string <sexp>, while **RTRIM$()** trims only the right end.

WORD$(<source_sexp>, <n_nexp> {, <test_sexp>})

This function returns a word from a string. The <source_sexp> string is split into substrings at each location where <test_sexp> occurs. The <n_nexp> parameter specifies which substring to return; numbering starts at 1. The <test_sexp> is removed from the result. The <test_sexp> parameter is an optional Regular Expression; if it is not given, the source string is split on whitespace. Specifically, the default <test_sexp> is "\s+".

Leading and trailing occurrences of <test_sexp> are stripped from <source_sexp> before it is split. If <n_nexp> is less than 1 or greater than the number of substrings found in <source_sexp>, then an empty string ("") is returned. Two adjacent occurrences of <test_sexp> in <source_sexp> result in an empty string; <n_nexp> may select this empty string as the return value.

Examples:
```
        string$ = "The quick brown fox"
        result$ = WORD$(string$, 2);                          % result$ is "quick"

        string$ = ":a:b:c:d"
        delimiter$ = ":"
        SPLIT array$[], string$, delimiter$                  % array$[1] is ""
        result$ = WORD$(string$, 1, delimiter$)      % result$ is "a", not ""
```

This function is similar to the **Split** command. See **Split** for a note about Regular Expressions.

ENCODE$(<type_sexp>, {<qualifier_sexp>}, <source_sexp>)

Returns the string <source_sexp> encoded in one of several ways, as specified by the <type_sexp>. The <qualifier_sexp> usage depends on the type:

Type	Qualifier	Default	Result
"ENCRYPT"	password	"" (empty)	Encrypts the source string using the password parameter. The encryption algorithm is "PBEWithMD5AndDES". This usage of **ENCODE$()** works the same was as the **ENCRYPT** command.
"DECRYPT"	password	""	Same as type "ENCRYPT".
"URL"	charset	"UTF-8"	Encodes the source string using the format required by HTML `application/x-www-form-urlencoded`. You should omit the charset parameter.
"BASE64"	charset	"UTF-8"	Encodes the source string into the Base64 representation of binary data. See RFCs 2045 and 3548. The simplest way to use this function is to omit the charset parameter.

The type is required, but see below for the two-parameter form of **ENCODE$()** and **DECODE$()**.
The type IS NOT case-sensitive: "BASE64", "base64", and "Base64" are all the same.
The qualifier is optional, but its comma is required.
If you supply the qualifier, whether password or charset, it IS case-sensitive.

"ENCRYPT", "DECRYPT", and "URL" can be used on any BASIC! string. The string is converted to a byte stream, then the byte stream is encrypted or URL-encoded. For encryption, the byte stream is always converted using UTF-8. Users of URL-encoded strings generally expect UTF-8, too, so that is the default behavior if you omit the optional charset parameter, but you can specify a different character encoding.

"BASE64" also converts its string to a byte-stream before encoding it to Base64. The default conversion, using UTF-8, works with any BASIC! string; specifying another character set encoding may corrupt data.

Normally, you would use "BASE64" on binary data in a buffer string. This is the format returned by the **Byte.read.buffer** command, for example. A buffer string is a special use of the BASIC! string in which each 16-bit character consists of one byte of 0 and one byte of data. In this case, you may specify any valid charset with no data corruption. The encoding string will change, but it can always be decoded using the same charset.

See the two-parameter form of **ENCODE$()**, below, for a partial list of valid charsets.

DECODE$(<type_sexp>, {<qualifier_sexp>}, <source_sexp>)

Returns the result of decoding the string <source_sexp> that was encoded in one of several ways, as specified by the <type_sexp>. The <qualifier_sexp> usage depends on the type. The type and qualifier parameters describe how the string was encoded. You must use the same type and qualifier that were used to encode the source string, or you may get unpredictable results.

Type	Qualifier	Default	Result
"ENCRYPT"	password	"" (empty)	Decrypts the source string using the password parameter. The encryption algorithm is "PBEWithMD5AndDES". This usage of **DECODE$()** works the same way as the **DECRYPT** command.
"DECRYPT"	password	""	Same as type "ENCRYPT".
"URL"	charset	"UTF-8"	Decodes the source string assumed to be in the format required by HTML `application/x-www-form-urlencoded`. You should omit the charset parameter.
"BASE64"	charset	"UTF-8"	Decodes the source string holding the Base64 representation of binary data. See RFCs 2045 and 3548.

The type is required, but see below for the two-parameter form of **ENCODE$()** and **DECODE$()**.
The type IS NOT case-sensitive: "BASE64", "base64", and "Base64" are all the same.
The qualifier is optional, but its comma is required.
If you supply the qualifier, whether password or charset, it IS case-sensitive.

The source string is decoded to a byte stream according to the type. Then the byte stream is converted to a BASIC! string (UTF-16) according to the character encoding (the charset parameter), which describes how to interpret the byte stream. The charset is always UTF-8 for decryption, and defaults to UTF-8 for the other types. The most common usage of this function is to omit the charset.

If a Base64 string was encoded from binary data, the resulting BASIC! string will be a buffer string. When a string is used as a buffer, one byte of data is written into the lower 8 bits of each 16-bit character, and the upper 8 bits are 0. You can extract the binary data from the string, one byte at a time, using the **ASCII$()** or **UCODE$()** functions.

See the two-parameter form of **ENCODE$()**, below, for a partial list of valid charsets.

ENCODE$(<charset_sexp>, <source_sexp>)

Encodes the string <source_sexp> using the character encoding of the <charset_sexp> and returns the result in a buffer string. When a string is used as a buffer, one byte of data is written into the lower 8 bits of each 16-bit character, and the upper 8 bits are 0.

The charset specifies the rules used to convert the source string into a byte stream. The stream is written to a buffer string, one byte per character. The bytes are not reassembled into 16-bit characters.

The charsets "UTF-8", "UTF-16", "UTF-16BE", "UTF-16LE", "US-ASCII", and "ISO-8859-1" are always available. Your device may have additional charsets. The charset names are case-sensitive, but the standard charsets have aliases for convenience. For example, "utf8" is valid.

If you create a buffer string with **ENCODE$()**, you can write the bytes to a file with **Byte.write.buffer**.

For encryption and URL- or Base64-encoding, see the three-parameter form of **ENCODE$()**, above.

DECODE$(<charset_sexp>, <buffer_sexp>)

Decodes the buffer string <buffer_sexp> that was encoded using the <charset_sexp> and returns the result in a standard BASIC! string. A buffer string is a special use of the BASIC! string in which each 16-bit character consists of one byte of 0 and one byte of data.

If you attempt to **DECODE$()** a string that is not a buffer string, you may get unexpected results. Besides the function **ENCODE$()**, the commands **Byte.read.buffer** and **BT.read.bytes** can write buffer strings. Your program can also build such strings directly, character-by-character.

If you read data from a file with **Byte.read.buffer**, you can use **DECODE$()** to reassemble the bytes into BASIC! (UTF-16) strings. The charset specifies how the original string was encoded when it was written as bytes to the file.

For example, a binary file may have embedded text strings for names or titles. In order to allow Unicode, the text may be encoded. Let's say you read 32 bytes of binary data, consisting of 8 bytes of binary and 24 bytes of UTF-8-encoded text:

```
BYTE.READ.BUFFER file, 32, bfr$
namebfr$ = MID$(bfr$, 9)
name$ = DECODE$("UTF-8", namebfr$)
```

For encryption and URL- or Base64-decoding, see the three-parameter form of **DECODE$()**, above.

STR$(<nexp>)

Returns the string representation of <nexp>.

LOWER$(<sexp>)

Returns <sexp> in all lower case characters.

UPPER$(<sexp>)

Returns <nexp> in all upper case characters.

VERSION$()

Returns the version number of BASIC! as a string.

INT$(<nexp>)

Returns a string representing the integer part of the numeric expression.

HEX$(<nexp>)

Returns a string representing the hexadecimal representation of the numeric expression.

OCT$(<nexp>)

Returns a string representing the octal representation of the numeric expression.

BIN$(<nexp>)

Returns a string representing the binary representation of the numeric expression.

USING$({<locale_sexp>} , <format_sexp> { , <exp>}...)

Returns a string, using the locale and format expressions to format the expression list.

This function gives BASIC! programs access to the Formatter class of the Android platform. You can find full documentation here: http://developer.android.com/reference/java/util/Formatter.html.

The <locale_sexp> is a string that tells the formatter to use the formatting conventions of a specific language and region or country. For example, "en_US" specifies American English conventions.

The <format_sexp> is a string that contains *format specifiers*, like "%d" or "%7.2f," that tell the formatter what to do with the expressions that follow.

The format string is followed by a list of zero or more expressions. Most format specifiers take one argument from the list, in order. If you don't provide as many arguments as your format string needs, you will get a detailed Java error message.

Each expression must also match the type of the corresponding format specifier. If you try to apply a string format specifier, like "%-7s", to a number, or a floating point specifier, like "%5.2f" to a string, you will get a Java error message.

Locale expression

The **USING$()** function can localize the output string based on language and region. The locale specifies the language and region with standardized codes. The <locale_sexp> is a string containing zero or more codes separated by underscores.

The function accepts up to three codes. The first must be a language code, such as "en", "de", or "ja". The second must be a region or country code, such as "FR", "US", or "IN". Some language and country combinations can accept a third code, called the "variant code".

The function also accepts the standard three-letter codes and numeric codes for country or region. For example, "fr_FR", "fr_FRA", and "fr_250" are all equivalent.

If you want to use the default locale of your Android device, make the <locale_exp> an empty string (""), or leave it out altogether. If you leave it out, you must keep the comma: **USING$(, "%f", x)**

If you make a mistake in the <locale_sexp>, you may get an obscure Java error message, but more likely your locale will be ignored, and your string will be formatted using the default locale of your device.

Android devices do not support all possible locales. If you specify a valid locale that your device does not understand, your string will be formatted using the default locale.

Format expression

If you are familiar with the *printf* functions of C/C++, Perl, or other languages, you will recognize most of format specifiers of this function. The format expression is exactly the same as format string of the Java *Formatter* class, or the *format(String, Object…)* method of the Java *String*, with two exceptions: Boolean format specifiers are not supported, and hex hash specifiers are limited to numeric and string types.

If you have not programmed in one of those other languages, this will be your introduction to a powerful tool for formatting text.

A format expression is a string with embedded format specifiers. Anything that is not a format specifier is copied literally to the function output string. Each embedded format specifier is replaced with the value of an expression from the list, formatted according to the specifier. For example:

```
PRINT USING$("","Pi is approximately %f.", PI())  ← function call
Pi is approximately 3.141593.                     ← printed output for English locale
```

The <locale_exp> is "", meaning "use my default locale".
The <format_exp>, "Pi is approximately %f", has one format specifier, "%f".
"%f" means, "use the default decimal floating point output format".
The expression list has one item, the math function **PI()**.
In the output, "%f" is replaced by the value of the the **PI()** function.
Your output may be different if your locale language is not English.

Format Specifiers

Here is a brief summary of the available format specifiers:

For this type of data	Use these formats	Comments
String	%s %S	%S forces output to upper-case
Number	%f %e %E %g %G %a %A	Standard BASIC! numbers are floating point Use %f for decimal output: "1234.567"

		Use %e or %E for exponential notation: "1.234e+03" %E writes upper-case: "1.234E+03" %g (%G) lets the system choose %f or %e (%E) %a and %A are "hexadecimal floating point"
Integer	%d %o %x %X	USING$ can use some math functions as integers Use %d for decimal, %o for octal, %x %X for hex %x writes lower-case abcdef, %X writes upper-case
Special integer	%c %C %t	These specifiers can operate on an integer %c %C output a character, %C writes upper-case %t represents a family of time format specifiers
None	%% %n	These specifiers do not read the expression list %% writes a single "%" to the output %n writes a newline, exactly the same as \n

For more information about %a and %A, see the Android documentation linked above.
Android's %b and %B are not supported because BASIC! has no Boolean type.
Android's %h and %H hash code specifiers are limited to strings and numbers in BASIC!.
For an explanation of **USING$()** with integer format specifiers, see below.

There is a whole family of time format specifiers: **%t<x>** where **<x>** is another letter. They operate on an integer, which they interpret as the number of milliseconds since the beginning of January 1, 1970, UTC (the "epoch"). You can apply time format specifiers to the output of the **TIME()** functions. Note, however, that the **%t** time specifiers use your local timezone, not the **TimeZone.set** value.

There are more than 30 time format specifiers. A few examples appear below, but to get the full list you should read the Android documentation linked above.

```
PRINT USING$("", "The time is: %tI:%<tM:%<tS %<Tp", time())     % the hard way
PRINT USING$("", "The time is: %tr", time())                    % same thing!
02:27:16 PM                                                ← example of printed output

t = TIME(2001, 2, 3, 4, 5, 6)            % set 2001/02/03 04:05:06, local timezone
PRINT USING$("sv", "%tA", int(t))        % day in Swedish, prints "lördag"
PRINT USING$("es", "%tB", int(t))        % month in Spanish, prints "febrero"
PRINT USING$("", "%tY/%tm/%td", int(t) , int(t), int(t)) % prints "2001/02/03"
PRINT USING$( , "%tY/%<tm/%<td", int(t))                 % prints "2001/02/03"
PRINT USING$("en_GB", "%tH:%<tM:%<tS", int(t))           % prints "04:05:06"
PRINT USING$("in_IN", "%tT", int(t))                     % prints "04:05:06"
```

Note: Date and time are printed for your local timezone, regardless of either the TIMEZONE.SET setting or the locale parameter. Try the same set of examples with **TIMEZONE.SET "UTC"**. Unless that is your local timezone, a different hour and perhaps even a different day will be displayed.

Optional Modifiers

The format specifiers can be used exactly as shown in the table. They have default settings that control how they behave. You can control the settings yourself, fine-tuning the behavior to suit your needs.

You can modify the format specifiers with *index*, *flags*, *width*, and *precision*, as shown in this example:

"%3$-,15.4f"							
"%	3$	-,	15	.	4	f	"
	<index>	<flags>	<width>		<precision>	<specifier>	

Index

Normally the format specifiers are applied to the arguments in order. You can change the order with an argument index. An index a number followed by a **$** character. The argument index **3$** specifies the third argument in the list.

```
PRINT USING$("", "%3$s %s %s", "a", "b", "c")     % prints "c a b"
```

The special argument index "<" lets you reuse an argument.

```
PRINT USING$("", "%o %<d %<h", int(64) )          % prints "100 64 40"
```

In the last example, there is only one argument, but three format specifiers. This is not an error because the argument is reused.

Flags

There are six flags:

-	left-justify; if no flag, right-justify
+	always show sign; if no flag, show "-" but do not show "+"
0	pad numbers with leading zeros; if no flag pad with spaces
,	use grouping separators for large numbers
(	put parentheses around negative values
#	alternate notation (leading 0 for octal, leading 0x for hexadecimal)

Width

The **width** control sets the minimum number of characters to print. If the value to format is longer than the width setting, the entire value is printed (unless it would exceed the **precision** setting). If the value to format is shorter than the **width** setting, it is padded to fill the width. By default, it is padded with spaces on the left, but you change this with the "-" and "0" flags.

Precision

The **precision** control means different things to different data types.

For floating point numbers, **precision** specifies the number of characters to print after the decimal point, padding with trailing zeros if needed.

For string values, it specifies the maximum number of characters to print. If **precision** is less than **width**, only **precision** characters are printed.

```
"%4s", "foo"   → " foo"
"%-4s", "foo"  → "foo "
"%4.2s", "foo" → "fo"
```

The **precision** control is not valid for other types.

In the example above, **%-,15.4f**:

> The **flags** "-" and "," mean "left-justify the output" and "use a thousands separator".
> The **width** is 15, meaning the output is to be at least 15 characters wide.
> The **precision** is 4, so there will be exactly four digits after the decimal point.

The whole format specifier means, "format a floating point number (%f) left-justified ("-") in a space 15 characters wide, with 4 characters after the decimal point, with a thousands separator (",")".

The characters used for the decimal point and the thousands separator depend on the locale:

```
    "1,234.5678     " for locale "en"
    "1 234,5678     " for locale "fr"
    "1.234,5678     " for locale "it"
```

Integer values

BASIC! has only double-precision floating point numbers. It does not have an integer type. The **USING$()** function supports format specifiers ("%d", "%t", "%x") that apply only to integer values.

USING$() has a special relationship with the math functions that intrinsically produce integer results. BASIC! converts the output of these functions to floating point, for storage in numeric variables, but **USING$()** can get the original integer values. For example:

```
    PRINT USING$("", "%d", 123)         % ERROR!
    PRINT USING$("", "%d", INT(123))    % No error
```

The functions that can produce integer values for **USING$()** are:

```
    INT()    BIN()    OCT()    HEX()
    CEIL()   FLOOR()
    ASCII()  UCODE()
    BAND()   BOR()    BXOR()
    SHIFT()  TIME()
```

FORMAT_USING$(<locale_sexp>, <format_sexp> { , <exp>}...)

Alias for **USING$()**. You can use the two equivalent functions to make your code easier to read. For example:

```
    string$ = FORMAT_USING("", "pi is not %d", int(pi()))
    Print USING$("en_US", "Balance: $%8.2f", balance)
```

FORMAT$(<pattern_sexp>, <nexp>)

Returns a string with <nexp> formatted by the pattern <pattern_sexp>.

Leading Sign	A negative (-) character for numbers < 0 or a space for numbers >= 0. The Sign and the Floating Character together form the **Floating Field**.

Floating Character	If the first character of the pattern is not "#" or "." or "-" then that character becomes a "floating" character. This pattern character is typically a "$". If no floating character is provided then a space character is used. See also **Overflow**, below.
Decimal Point	The pattern may have one optional decimal point character ("."). If the pattern has no decimal point, then only the whole number is ouput. Any digits that would otherwise appear after the decimal point are not output.
# Character (before decimal, or no decimal)	Each "#" is replaced by a digit from the number. If there are more "#" characters than digits, then the leading "#" character(s) are replaced by **space**(s).
# Character (after decimal point)	Each "#" is replaced by a digit from the number. If there are more "#" characters than significant digits, then the trailing "#" character(s) are replaced by **zero**(s). The number of "#" characters after the pattern decimal point specifies the number of decimal digits that will be output.
% Character (before decimal, or no decimal)	Each "%" is replaced by a digit from the number. If there are more "%" characters than digits, then the leading "%" character(s) are replaced by **zero**(s).
% Character (after decimal)	The "%" character is not allowed after the decimal point. This is a syntax error.
Non-pattern Characters	If any pattern character (other than the first) is not # or %, then that character is copied directly into the output. If the character would appear before the first digit of the number, it is replaced by a space. This feature is usually used for commas.
Overflow	If the number of digits exceeds the number of # and % characters, then the output has the ** characters inserted in place of the Floating Field.
Output Size	The number of characters output is always the number of characters in the pattern plus one for the sign plus one more for the space if the pattern has no Floating Character.

Notes

The sign and the floating character together form a **Floating Field** two characters wide that always appears just before the first digit of the formatted output. If there are any leading spaces in the formatted output, they are placed before the floating field.

The "#" character generates leading spaces, not leading zeros. "##.###" formats 0.123 as ".123". If you want a leading zero, use a "%". For example "%.###", "#%.###", or "##%" all assure a leading zero.

Be careful mixing # and % characters. Doing so except as just shown can produce unexpected results.

The number of characters output is always the number of characters in the pattern plus the two floating characters.

Examples

Function Call	Output	Width
Format$("##,###,###", 1234567)	`   1,234,567`	12 characters
Format$("%%,%%%,%%%.#", 1234567.89)	`  01,234,567.8`	14 characters
Format$("$###,###", 123456)	`$123,456`	9 characters
Format$("$###,###", -1234)	`  -$1,234`	9 characters

Format$("$###,###", 12)	`      $12`	9 characters
Format$("$%%%,%%%", -12)	`-$000,012`	9 characters
Format$("##.#", 0)	`    .0`	6 characters
Format$("#%.#", 0)	`   0.0`	6 characters
Format$("$###.##", -1234.5)	`**234.50`	8 characters

User-Defined Functions

User-Defined Functions are BASIC! functions like ABS(n), MOD(a,b) and LEFT$(a$,n) except that the operation of the function is defined by the user. User functions should generally be defined at the start of the program and in particular, they should appear before the places where they are called.

User-Defined Functions may call other User-Defined Functions. A function can even recursively call itself.

Each time a function is called from another function a certain amount of memory is used for the execution stack. The depth of these nested calls is limited only by the amount of memory that your particular Android device allocates to applications.

Variable Scope

All variables created while running a User-Defined Function are private to the function. A variable named v$ in the main program is not the same as variable v$ within a function. Furthermore, a variable named v$ in a recursively called function is not the same v$ in the calling function.

A function cannot access variables created outside of the function, except as parameters passed by reference. (See **Fn.def**, below, for an explanation of parameters passed by value and by reference.)

All variables created while running a User-Defined Function are destroyed when the function returns. When an array variable is destroyed, its storage is reclaimed. However, when a data structure pointer is destroyed, the data structure is not destroyed (see next section).

Data Structures in User-Defined Functions

Data structures (List, Stack, Bundle, bitmap, graphical object – anything referenced through a pointer) are global in scope. That is, if a variable is used as a pointer to a data structure, it points to the same data structure whether it is used inside or outside of a function. The data structure may have been created in the main program, the same user-defined function, or some other user-defined function.

This means that if you pass a pointer to a bundle, for example, and modify that bundle inside the function, the changes will be retained when the function returns. It also means that a function can modify graphical objects created outside of the function.

Data structures (List, Stack, Bundle, or graphical object) created while running a User-Defined Function are not destroyed when the function returns. Local variables that point to the data structures are lost, but you can return a data structure pointer as the function's return value or through a parameter passed by reference.

Commands

Fn.def name|name$({nvar}|{svar}|Array[]|Array$[], ... {nvar}|{svar}|Array[]|Array$[])

Begins the definition of a function. This command names the function and lists the parameters, if any. Your program must execute **Fn.def** before it tries to call the named function. Your program must not execute more than one **Fn.def** for the same function name, or the same **Fn.def** more than once.

If the function name ends with the $ character then the function will return a string otherwise it will return a number.

The parameter list can contain as many parameters as needed, or none at all. The parameters may be numeric or string, scalar or array.

The following are all valid:

```
fn.def pi()
fn.def cut$(a$, left, right)
fn.def sum(a, b, b, d, e, f, g, h, i, j)
fn.def sort(v$[], direction)
```

There are two types of parameters: call by reference and call by value. Call by value means that the calling variable value (or expression) will be copied into the called variable. Changes made to the called variable within the function will not affect the value of the calling variable. Call by reference means that the calling variable value will be changed if the called variable value is changed within the function.

Scalar (non-array) function variables can be either call by value or call by reference. Which type the variable will be depends upon how it is called. If the calling variable has the "&" character in front of it, then the variable will be call by reference. If there is no "&" in front of the calling variable name then the variable will be call by value.

```
Fn.def test(a)
a = 9
fn.rtn a
fn.end

a =1
print test(a), a  %will print: 9, 1
print test(&a), a %will print: 9, 9
```

Array parameters are of always call by reference.

```
Fn.def test(a[])
a[1] = 9
fn.rtn a[1]
fn.end

dim a[1]
```

```
        a[1] = 1
        print test(a[]), a[1]  %will print: 9, 9
```

Along with the function's return value, you can use parameters passed by reference to return information to a function's caller.

Fn.rtn <sexp>|<nexp>

Causes the function to terminate execution and return the value of the return expression <sexp>|<nexp>. The return expression type, string or number, must match the type of the function name. **Fn.rtn** statements may appear anywhere in the program that they are needed.

A function can return only a single scalar value. It cannot return an array. It cannot return a data structure (List, Stack, Bundle, or graphical object), but it can return a pointer to a data structure.

Note: You can also return information to a function's caller through parameters passed by reference.

Fn.end

Ends the definition of a user-defined function. Every function definition must end with **Fn.end**.

When your function is running, executing the **Fn.end** statement causes the function to terminate and return a default value. If the function type is numeric then the default return value is 0.0. A string function returns the empty string ("").

Call <user_defined_function>

Executes the user-defined function. Any value returned by the function will be discarded.

The **CALL** command keyword is optional. Just as BASIC! can infer the **LET** command from a line that starts with a variable, it can infer the **CALL** command from a line that starts with a function name.

For example, if you have defined a function like this:

```
        FN.DEF MyFunction(x, y$, z)
        < your code here >
        FN.END
```

You can execute the function, ignoring its return value, with either of these statements:

```
        CALL MyFunction(a, b$, c)
        MyFunction(a, b$, c)
```

As with **LET**, you must use **CALL** if your function name starts with a BASIC! command keyword. It is also a little faster to execute a function with **CALL** than to make BASIC! infer the command. See **LET**, above, for details.

Program Control Commands

If / Then / Else / Elseif / Endif

The **If** commands provide for the conditional execution of blocks of statements. (Note: the braces { } are not part of the command syntax. They are used only to show parts that are optional.)

```
IF <condition> { THEN }
    <statement>
    <statement>
...
    <statement>
{ ELSEIF<condition> { THEN }
    <statement>
    <statement>
...
    <statement> }
{ ELSE
    <statement>
    <statement>
...
    <statement> }
ENDIF
```

If commands may be nested to any depth. That is, any <statement> in a block may be a full **If** command with all of its own <statement> blocks.

See the Sample Program file, F04_if_else.bas, for working examples of the **If** command.

If / Then / Else

If your conditional block(s) contain(s) only one statement, you may use a simpler form of the **If** command, all one line:

```
IF <condition> THEN <statement> { ELSE <statement> }
```

In this form, **Then** is required, and there is no **ElseIf** or **EndIf**.

This form does not nest: neither <statement> may be an **If** command.

Because the single statements are not treated as blocks, this is the preferred form if either of the embedded statements is a **Break**, **Continue**, or **GoTo**.

You may replace either <statement> with multiple statements separated by colon (":") characters. If you do this, the set of multiple statements is treated as a block, and the single-line **If/Then/Else** becomes an **If/Then/Else/Endif**. These two lines are exactly equivalent:

```
IF (x > y) THEN x = y : PRINT a$ ELSE y = x : PRINT b$
IF (x > y) : x = y : PRINT a$ : ELSE : y = x : PRINT b$ : ENDIF
```

Please note, if you wish to use colon-separated statements in this form of **If/Then/Else**, then you must be careful to put spaces around the keywords **Then** and **Else**. Spaces are not significant to the BASIC! interpreter, but they are needed by the pre-processor that converts the single-line **If** with multi-statement blocks into a multi-line **If** with an **EndIf**.

For - To - Step / Next

```
FOR <nvar> = <nexp_1> TO <nexp_2> {STEP <nexp_3>}
        <statement>
        ...
        <statement>
NEXT {<nvar>}
```

{STEP <nexp_3>} is optional and may be omitted. If omitted then the **Step** value will be 1. <nvar> will be assigned the value of <nexp_1>. <nvar> will be compared to <nexp_2>.

If <nexp_3> is positive then
    if <nvar> <= <nexp_2> then
        the statements between the **For** and **Next** will be executed.

If <nexp_3> is negative then
    if <nvar> >= <nexp_2> then
        the statements between the **For** and **Next** will be executed.

When the **Next** statement is executed, <nvar> will be incremented or decremented by the **Step** value and the test will be repeated. The <statement>s will be executed as long as the test is true.

Because the keywords **To** and **Step** are in the middle of the line with expressions that may include variables, it is possible to confuse the interpreter. Remember that the interpreter does not see any spaces you put between variables and keywords. **FOR a TO m** is seen as **foratom**. If there is any possibility of confusion, use parentheses to tell the interpreter that a name is a variable:

```
FOR WinTop TO WinBot        % ERROR: interpreted as "FOR win TO ptowinbot"
FOR (WinTop) TO WinBot      % interpreted as intended
```

For-Next loops can be nested to any level. When **For-Next** loops are nested, any executed **Next** statement will apply to the currently executing **For** statement. This is true no matter what the <nvar> coded with the **Next** is. For all practical purposes, the <nvar> coded with the **Next** should be considered to be nothing more than a comment.

You can exit a **For** loop without **Next** or **F_N.break**. However, this can create subtle logic errors that are hard to debug. If you set debug mode (see the **Debug.on** command), then BASIC! can help you find these bugs. When your program ends and debug is on, if your program entered a **For** loop and did not leave it cleanly, BASIC! shows a run-time error: "Program ended with FOR without NEXT".

F_N.continue

If this statement is executed within a **For-Next** loop, the rest of the current pass of the loop is skipped. The **Next** statement executes immediately.

F_N.break

If this statement is executed within a **For-Next** loop, the rest of the current pass of the loop is skipped and the loop is terminated. The statement immediately following the **Next** will be executed.

While <lexp> / Repeat

```
While <lexp>
       <statement>
       …
       <statement>
Repeat
```

The <statement>s between the **While** and **Repeat** will be executed as long as <lexp> evaluates as true. The <statements>s will not be executed at all if <lexp> starts off false.

While-Repeat loops may be nested to any level. When **While-Repeat** are nested, any executed **Repeat** statement will apply to inner most **While** loop.

W_R.continue

If this statement is executed within a **While-Repeat** loop, the rest of the current pass of the loop is skipped. The **Repeat** statement executes immediately.

You can exit a **While** loop without **Repeat** or **W_R.break**. As with **For-Next** loops, this can create subtle bugs, and BASIC! can help you find them. If debug is on, and your program is still in a **While** loop when it ends, BASIC! shows a run-time error: "Program ended with WHILE without REPEAT".

W_R.break

If this statement is executed within a **While-Repeat** loop, the rest of the current pass of the loop is skipped and the loop is terminated. The statement immediately following the **Repeat** will be executed.

Do / Until <lexp>

```
Do
       <statement>
       …
       <statement>
Until <lexp>
```

The statements between **Do** and **Until** will be executed until <lexp> is true. The <statement>s will always be executed at least once.

Do-Until loops may be nested to any level. Any encountered **Until** statement will apply to the last executed **DO** statement.

You can exit a **Do** loop without **Until** or **D_U.break**. As with **For-Next** loops, this can create subtle bugs, and BASIC! can help you find them. If debug is on, and your program is still in a **Do** loop when it ends, BASIC! shows a run-time error: "Program ended with DO without UNTIL".

D_U.continue

If this statement is executed within a **Do-Until** loop, the rest of the current pass of the loop is skipped. The **Until** statement executes immediately.

D_U.break

If this statement is executed within a **Do-Until** loop, the rest of the current pass of the loop is skipped and the loop is terminated. The statement immediately following the **Until** will be executed.

Labels, GOTO, GOSUB, and RETURN: Traditional BASIC

Before computer scientists invented the looping structures and user-defined functions described above, program flow was controlled by **GOTO**, **GOSUB**, and **RETURN** statements. These statements are present in BASIC!, too, mainly for compatibility with old BASIC dialects.

A **GoTo** statement is a one-way jump to another place in your program, identified by a **Label**. The program goes to the **Label** and continues execution there.

A **GoSub** is similar, except that the **Label** is the beginning of a "Subroutine". The proram goes to the **Label**, and executes there until it reaches a **Return** statement. Then it "returns", going back to where it came from: the line after the **GoSub** statement.

Extensive use of the **GoTo** command in your program should be generally avoided. It can make code hard to read and harder to debug. Instead, you should use structured elements like **Do…Until**, **While…Repeat**, etc. in conjunction with the **Break** and **Continue** statements.

It is especially serious to use **GoTo** commands inside an **If…Else…Endif**, **For…Next**, or other structured block, jumping to code outside of the block. Doing this consumes system resources and may corrupt BASIC!'s internal data structures. This practice may lead your program to a run-time error:

```
Stack overflow. See manual about use of GOTO.
```

Label

A label is a word followed by the colon ":", character. A label must not begin with any BASIC! keyword.

You may put a label on a line with other commands. Use two colons: one to signify that the word is a label, and a second to separate the label from the other command(s) on the line.

```
Here: : IF ++a < 5 THEN GOTO here ELSE PRINT a
```

This program prints `5.0` and then stops.

The colon signifies that the word is a label, but it is not part of the label. Use the colon where the label is defined. Do not use it in the **GoTo** or **GoSub** that jumps to the label.

For example:

```
This_is_a_Label:
@Label#3:
Loop:         % The command "GoTo Loop" jumps to this line
       <statement>
       …
       <statement>
       GoTo Loop
```

GoTo <label>
The next statement that will be executed will be the statement following <label>.

GoTo <index_nexp>, <label>...
A "computed GOTO". The index expression is evaluated, rounded to the nearest integer, and used as an index into the list of labels. The program jumps to the statement after the indexed label. If the index does not select any label, the program continues at the statement after the **GoTo**.

For examples, see **GoSub**.

GoSub <label> / Return
The next statement that will be executed will be the statement following <label>.

The statements following the line beginning with <label> will continue to be executed until a **Return** statement is encountered. Execution will then continue at the statement following the **GoSub** statement.

Example:

```
Message$ = "Have a good day"
GOSUB xPrint
PRINT "Thank you"
<statement>
…
<statement>
END
xPrint:
PRINT Message$
RETURN
```

This will print:

```
Have a good day
Thank you
```

GoSub <index_nexp>, <label>... / Return

A "computed GOSUB". The index expression is evaluated, rounded to the nearest integer, and used as an index into the list of labels. The program jumps to the statement after the indexed label. When the next **Return** instruction executes, the program returns to the statement after this **GoSub**.

If the index does not select any label, the program continues to the statement after the **GoSub**. No subroutine is executed, and no **Return** statement is expected.

Example:

```
d = FLOOR(6 * RND() + 1)           % roll a six-sided die
GOSUB d, Side1, Side2, Side3, Side4, Side5, Side6
PRINT "Welcome back!"
END
Side1:
<subroutine for side 1>
RETURN
…
Side6:
<subroutine for side 1>
RETURN
```

Using Source Code from Multiple Files

Include FilePath

Before the program is run, the BASIC! pre-processor replaces any **Include** statements with the text from the named file. You can use this to insert another BASIC! program file into your program at this point. The program is not yet running, therefore the File Path cannot be a string expression.

```
INCLUDE functions/DrawGraph.bas
```

inserts the code from the file "<pref base drive>/rfo-basic/source/functions/DrawGraph.bas" into the program.

The File Path may be written without quotation marks, as in the example above, or with quotes:

```
INCLUDE "functions/DrawGraph.bas"
```

If present, the quotes prevent the pre-processor from forcing the File Path to lower-case. Normally, this does not change how BASIC! behaves, because the file system on the SD card is case-insensitive. **DrawGraph.bas** and **drawgraph.bas** both refer to the same file.

However, if you build your program into a standalone Android application (see **Appendix D**), you can use virtual files in the Android **assets** file system. File names in **assets** are case-sensitive, so you may need to use quotes with the **Include** File Path.

Run <filename_sexp> {, <data_sexp>}

This command will terminate the running of the current program and then load and run the BASIC! program named in the filename string expression. The filename is relative to BASIC's "source/" directory. If the filename is "program.bas" and your <pref base drive> is "/sdcard" (the default), then the file "/sdcard/rfo-basic/source/program.bas" will be executed.

The optional data string expression provides for the passing of data to the next program. The passed data can be accessed in the next program by referencing the special variable, **##$**.

Run programs can be chained. A program loaded and run by means of the **Run** command can also run another program file. This chain can be a long as needed.

When the last program in a **Run** chain ends, tapping the BACK key will display the original program in the BASIC! Editor.

When a program ends with an error, the Editor tries to highlight the line where the error occurred. If the program with the error was started by a **Run** command, the Editor does not have that program loaded. Any highlighting that may be displayed is meaningless.

Switch Commands

The Switch commands may be used to replace nested if-then-else operations.

```
SW.BEGIN a
SW.CASE 1
       <statement1>
       …
       <statement2>
       SW.BREAK
SW.CASE 2
       <statement3>
       …
       <statement4>
       SW.BREAK
SW.CASE 3
       <statement5>
       …
       <statement6>
       SW.BREAK
SW.DEFAULT
       <statement7>
SW.END
```

Nesting Switch Operations

Switch operation can NOT be nested. Do not program switch operations within other switch operations.

Sw.begin <nexp>|<sexp>

Begins a switch operation.

The <nexp> or <sexp> will be evaluated. The results will then be compared the <nexp> or <sexp> in the **Sw.case** statements.

If <begin_nexp> = <case_nexp> or if <begin_sexp> = <case_sexp> then the statement following the **Sw.case** will be executed.

Sw.case <nexp>|<sexp>

The type of parameter, numeric or string, in **Sw.case** must match the expression type of the **Sw.begin** statement.

If multiple **Sw.case** statements have the same parameter, only the first **Sw.case** with the matching parameter will be executed.

Sw.break

Once a matching **Sw.case** has been found then the statements following the **Sw.case** will be executed until a **Sw.break** is encountered.

When the **Sw.break** is encountered then BASIC! looks for the **Sw.end** statement. Execution will then resume with the statement following the **Sw.end**.

If no **Sw.break** is present in a particular **Sw.case** then subsequent **Sw.case**s will be executed until a **Sw.break** is encountered.

Sw.default

If no matching **Sw.case** is found then the **Sw.default**, if present, will be executed. The **Sw.default** must be placed after all the **Sw.case** statements

Sw.end

The **Sw.end** terminates a switch operation. **Sw.end** must eventually follow a **Sw.begin**.

OnError:

If an **OnError:** label is in a BASIC! program then control will pass to the statement following the **OnError:** label whenever a run-time error occurs.

The error message that would have been printed will not be printed. That error message can be retrieved by the **getError$()** function.

Be careful. An infinite loop will occur if a run-time error occurs within the **OnError:** code.You should not place an **OnError:** label into your program until the program is fully debugged. Premature use of **OnError:** will make the program difficult to debug.

OnConsoleTouch:

Tapping on any line on the output Console that has text on it will cause control to be transferred to this label. Note that the touch must be any printed line of text. It cannot be an empty area of the screen.

After a Console touch interrupt has occurred, you may use the **Console.Line.Touched** command to determine what line of text was touched.

This interrupt allows the user to asynchronously interrupt an executing BASIC! program (not in graphics mode). A common reason for such an interrupt would be to have the program request input via an **INPUT** statement. See the Sample File, **f35_bluetooth.bas**, for an example of this.

For detecting screen touches while in graphics mode, use **OnGrTouch:**.

ConsoleTouch.resume

Resumes execution at the point in the BASIC! program where the touch occurred.

OnBackKey:

Pressing the BACK key normally halts program execution. The **OnBackKey:** label will intercept the BACK key event and transfer control to the statement following **OnBackKey:**.

If you trap the BACK key with **OnBackKey:**, the BACK key does not stop your program. You should either terminate the run in the **OnBackKey:** code or provide another way for the user to tell your program to stop, especially if the program is in Graphics mode where there is no menu. If you do not then there will be no stopping the program (other than using a task killer application).

Back.resume

If a BACK key tap has been trapped by **OnBackKey:** then the **Back.resume** will cause the program to resume at the point where the BACK key was tapped.

OnMenuKey:

If this label is in the program and the user taps the MENU key, the currently running program will be interrupted. The statements following this label will be executed.

MenuKey.resume

If a MENU key tap has been trapped by **OnMenuKey:** then **MenuKey.resume** will cause the program to resume at the point where the MENU key was tapped.

OnKeyPress:

If this label is in the program and the user taps any key, the currently running program will be interrupted. The statements following this label will be executed.

Key.resume

If a key tap has been trapped by **OnKeyPress:** then **Key.resume** will cause the program to resume at the point where the key was tapped.

End{ <msg_sexp>}

Prints a message and stops the execution of the program. You can use the optional <msg_sexp> argument to specify the message. If you don't, the default message is "END". The empty string ("") prints nothing, not even a blank line. The **End** statement always stops execution, even if the statement has an error.

End statements may be placed anywhere in the program.

Exit

Causes BASIC! to stop running and exit to the Android home screen.

READ – DATA – RESTORE Commands

These commands approximate the **READ**, **DATA** and **RESTORE** commands of Dartmouth Basic.

Read.data <number>|<string>{,<number>|<string>...,<number>|<string>}

Provides the data value(s) to be read with **Read.next**.

Read.data statements may appear anywhere in the program. You may have as many **Read.data** statements as you need.

Example:

```
Read.data 1,2,3,"a","b","c"
```

Read.data is equivalent to the **DATA** statement in Dartmouth Basic.

Read.next <var>, ...

Reads the data pointed to by the internal NEXT pointer into the next variables. The NEXT pointer is initialized to "1" and is incremented by one each time a new value is read. Data values are read in the sequence in which they appeared in the program **Read.data** statement(s).

The data type (number or string) of the variable must match the data type pointed by the NEXT pointer.

Example:

```
Read.next a,b,c,c$
Read.next d$,e$
```

Read.next is equivalent to the **READ** statement in Dartmouth Basic

Read.from <nexp>

Sets the internal NEXT pointer to the value of the expression. This command can be set to randomly access the data.

The command **Read.from 1** is equivalent to the **RESTORE** command in Dartmouth Basic.

Debug Commands

The debug commands help you debug your program. The **Debug.on** command controls execution of all the debug commands. The debug commands are ignored unless the **Debug.on** command has been previously executed. This means that you can leave all your debug commands in your program and be assured that they will not execute unless you turn debugging on with **Debug.on**.

Debug.on

Turns on debug mode. All debug commands will be executed when in the debug mode.

Debug.on also enables a simple debugging aid built into BASIC!. If debug is on, and your program entered a loop but did not exit the loop cleanly, you will get a run-time error. See the looping commands (**For**, **While**, and **Do**) for details.

Debug.off

Turns off debug mode. All debug commands (except **Debug.on**) will be ignored. When your program exits, the broken-loop checks are not performed.

Debug.echo.on

Turns on Echo mode. Each line of the running BASIC! program is printed before it is executed. This can be of great help in debugging. The last few lines executed are usually the cause of program problems. The Echo mode is turned off by either the **Debug.echo.off** or the **Debug.off** commands.

Debug.echo.off

Turns off the Echo mode.

Debug.print

This command is exactly the same as the **Print** command except that the print will occur only while in the debug mode.

Debug.dump.scalars

Prints a list of all the Scalar variable names and values. Scalar variables are the variable names that are not Arrays or Functions. Among other things, this command will help expose misspelled variable names.

Debug.dump.array Array[]

Dumps the contents of the specified array. If the array is multidimensional the entire array will be dumped in a linear fashion.

Debug.dump.bundle <bundlePtr_nexp>

Dumps the Bundle pointed to by the Bundle Pointer numeric expression.

Debug.dump.list <listPtr_nexp>

Dumps the List pointed to by the List Pointer numeric expression.

Debug.dump.stack <stackPtr_nexp>

Dumps the Stack pointed to by the Stack Pointer numeric expression.

Debug.show.scalars

Pauses the execution of the program and displays a dialog box. The dialog box prints a list of all the Scalar variable names and values, the line number of the program line just executed and the text of that line. Scalar variables are the variable names that are not Arrays or Functions. Among other things, this command will help expose misspelled variable names.

For a description of the dialog box controls, see the **Debug.show** command, below.

Debug.show.array Array[]

Pauses the execution of the program and displays a dialog box. The dialog box prints the contents of the specified array, the line number of the program line just executed and the text of that line. If the array is multidimensional the entire array will be displayed in a linear fashion.

For a description of the dialog box controls, see the **Debug.show** command, below.

Debug.show.bundle <bundlePtr_nexp>

Pauses the execution of the program and displays a dialog box. The dialog box prints the Bundle pointed to by the Bundle Pointer numeric expression, the line number of the program line just executed and the text of that line.

For a description of the dialog box controls, see the **Debug.show** command, below.

Debug.show.list <listPtr_nexp>

Pauses the execution of the program and displays a dialog box. The dialog box prints the List pointed to by the List Pointer numeric expression, the line number of the program line just executed and the text of that line.

For a description of the dialog box controls, see the **Debug.show** command, below.

Debug.show.stack <stackPtr_nexp>

Pauses the execution of the program and displays a dialog box. The dialog box prints the Stack pointed to by the Stack Pointer numeric expression, the line number of the program line just executed and the text of that line.

For a description of the dialog box controls, see the **Debug.show** command, below.

Debug.watch var, ...

Gives a list of Scalar variables (not arrays) to be watched. The values of these variables will be shown when the Debug.show.watch command is executed. This command is accumulative, meaning that subsequent calls will add new variables into the watch list.

Debug.show.watch

Pauses the execution of the program and displays a dialog box. The dialog box lists the values of the variables being watched, the line number of the program line just executed and the text of that line.

For a description of the dialog box controls, see the **Debug.show** command, below.

Debug.show.program

Pauses the execution of the program and displays a dialog box. The dialog box shows the entire program, with line numbers, as well as a marker pointing to the last line that was executed.

Note: the debugger does not stop on a function call. The first line of the function is executed and the marker points to that line. When a **Fn.rtn** or **Fn.end** executes, the marker points to the function call.

For a description of the dialog box controls, see the **Debug.show** command, below.

Debug.show

Pauses the execution of the program and displays a dialog box. The dialog box will contain the result of the last **Debug.show.<command>** used or by default **Debug.show.program**.

There are three buttons in the dialog:

Resume: Resumes execution.
Step: Executes the next line while continuing to display the dialog box.
View Swap: Opens a new dialog that allows you to choose a different Debug View.

The BACK key closes the debug dialog and stops your program.

Fonts

Your program can use fonts loaded from files. If compiled into a standalone APK, a program can use fonts loaded from assets or resources contained in the APK. This is a new feature of BASIC! that is not yet fully developed. New ways to use these fonts will be coming soon.

At present, the only way to use a loaded font is with the **Gr.Text.SetFont** command.

Font.load <font_ptr_nvar>, <filename_sexp>

Loads a font from the file named by the <filename_sexp>. Returns a pointer to the font in the variable <font_ptr_nvar>. This pointer can be used to refer to the loaded font, for example, in a **Gr.Text.SetFont** command.

Font.delete {<font_ptr_nexp>}

Deletes the previously loaded font specified by the font pointer parameter <font_ptr_nexp>. Any variable that points to the deleted font becomes an invalid font pointer. An attempt to use the deleted font is an error. It is not an error to delete the same font again.

If the font pointer is omitted, the command deletes the most-recently loaded font that has not already been deleted. Repeating this operation deletes loaded fonts in last-to-first order. It is not an error to do this when there are no fonts loaded.

Font.clear

Clears the font list, deleting all previously loaded fonts. Any variable that points to a font becomes an invalid font pointer. An attempt to use any of the deleted fonts is an error.

Note: Font.delete leaves a marker in the font list, so pointers to other fonts will not be affected. That is why you can **Font.delete** the same font more than once. **Font.clear** clears the entire list, making all font pointer variables invalid. After executing **Font.clear**, you can't **Font.delete** any of the cleared fonts.

Console I/O

Output Console

BASIC! has two types of output screens: The Output Console and the Graphics Screen. This section deals with the Output Console. See the section on Graphics for information about the Graphics Screen.

Information is printed to screen using the Print command. BASIC! Run-time error messages are also displayed on this screen.

There is no random access to locations on this screen. Lines are printed one line after the other.

Although no line numbers are displayed, lines are numbered sequentially as they are printed, starting with 1. These line numbers refer to lines of text output, not to locations on the screen.

Console.title { <title_sexp>}

Changes the title of the console window. If the <title_sexp> parameter is omitted, the title is changed to the default title, "BASIC! Program Output".

Cls

Clears the Output Console screen.

Print {<exp> {,|;}} ...
? {<exp> {,|;}} ...

Evaluates the expression(s) <exp> and prints the result(s) to the Output Console. You can use a question mark (**?**) in place of the command keyword **Print**.

If the comma (**,**) separator follows an expression then a comma and a space will be printed after the value of the expression.

If the semicolon (**;**) separator is used then nothing will separate the values of the expressions.

If the semicolon is at the end of the line, the output will not be printed until a **Print** command without a semicolon at the end is executed.

Print with no parameters prints a newline.

Examples:

```
PRINT "New", "Message"              % Prints: New, Message
PRINT "New";" Message"              % Prints: New Message
PRINT "New" + " Message"            % Prints: New Message

? 100-1; " Luftballons"             % Prints: 99.0 Luftballons
? FORMAT$("##", 99); " Luftballons" % Prints:   99 Luftballons

PRINT "A";"B";"C";                  % Prints: nothing
PRINT "D";"E";"F"                   % Prints: ABCDEF
```

Print with User-Defined Functions

Note: Some commands, such as **Print**, can operate on either strings or numbers. Sometimes it has to try both ways before it knows what to do. First it will try to evaluate an expression as a number. If that fails, it will try to evaluate the same expression as a string.

If this happens, and the expression includes a function, the function will be called twice. If the function has side-effects, such as printing to the console, writing to a file, or changing a global parameter, the side-effect action will also happen twice.

Eventually this problem should be fixed in BASIC!, but until then you should be careful not to call a function, especially a user-defined function, as part of a **Print** command. Instead, assign the return value of the function to a variable, and then **Print** the variable. An assignment statement always knows what type of expression to evaluate, so it never evaluates twice.

```
! Do this:
y = MyFunction(x)
Print y
! NOT this:
```

```
Print MyFunction(x)
```

Console.line.count <count_nvar>

Sets the return variable <count_nvar> to the number of lines written to the Console. This command waits for any pending Console writes to complete before reporting the count.

Console.line.text <line_nexp>, <text_svar>

The text of the specified line number of the Console is copied to the <text_svar>.

Console.line.touched <line_nvar> {, <press_lvar>}

After an **OnConsoleTouch** interrupt indicates the user has touched the console, this command returns information about the touch.

The number of the line that the user touched is returned in the <line_nvar>.

If the optional <press_lvar> is present, the type of user touch – a short tap or a long press – is returned in the <press_lvar>. Its value will be 0 (false) if the touch was a short tap. Its value will be 1 (true) if the touch was a long press.

Console.save <filename_sexp>

The current contents of the Console is saved to the text file specified by the filename string expression.

User Input and Interaction

This set of commands lets you interact with your programs.

At the lowest level, you can use **Inkey$** to read raw keystrokes. You control display of the virtual keyboard with **Kb.hide**, **Kb.show**, and **Kb.toggle**.

With the **Select** command you present information in a list format that looks very much like the Output Console. If you prefer, you can use **Dialog.Select** to present the same information in a new dialog window. Either way, when your program runs, you select an item from the list by tapping a line.

The other commands in this group all pop up new windows.

Input lets you type a number or a line of text as input to your program. **Dialog.message** presents a message with a set of buttons to let you tell your program what to do next.

Popup is different. It presents information in a small, temporary display. It is not interactive and requires no management in your program. You pop it up and forget it.

The last two commands in this group present another kind of dialog window. The **Text.input** command operates on larger blocks of text, and **TGet** simulates terminal I/O.

Dialog.message {<title_sexp>}, {<message_sexp>}, <selection_nvar> {, <button1_sexp>{, <button2_sexp>{, <button3_sexp>}}}

Generates a dialog box with a title, a message, and up to three buttons. When the user taps a button, the number of the button is returned in <selection_nvar>. If the user taps the screen outside of the message dialog or presses the BACK key, then the returned value is 0.

The string <title_sexp> becomes the title of the dialog box. The string <message_sexp> is displayed in the body of the dialog, above the buttons. The strings <button1_sexp>, <button2_sexp>, and <button3_sexp> provide the labels on the buttons.

You may have 0, 1, 2, or 3 buttons. The buttons are numbered from right-to-left, because Android style guides recommend the positive action on the right and the negative action on the left. Therefore tapping the right-most button always returns 1.

All of the parameters except the <selection_nvar> are optional. If you omit either or both of the first two parameters, you must still use the commas as place-holders for the omitted parameters. If any parameter is omitted, the corresponding part of the message dialog is not displayed.

Examples:

```
Dialog.Message "Hey, you!", "Is this ok?", ok, "Sure thing!", "Don't care", "No way!"
Dialog.Message "Continue?", , go, "YES", "NO"
Dialog.Message  , "Continue?", go, "YES", "NO"
Dialog.Message  , , b
```

The first command displays a full dialog with a title, a message, and three buttons.

The second command displays a box with a title and two buttons – note that the **YES** button will be on the right and the **NO** button on the left. The third displays the same information, but it looks a little different because the text is displayed as the message and not as the title. Note the commas.

The fourth command displays nothing at all. The screen dims and your program waits for a tap or the BACK key with no feedback to tell the user what to do.

Dialog.select <selection_nvar>, <Array$[]>|<list_nexp> {,<title_sexp>}

Generates a dialog box with a list of choices for the user. When the user taps a list item, the index of that line is returned in the <selection_nvar>. If the user taps the screen outside of the selection dialog or presses the BACK key, then the returned value is 0.

<Array$[]> is a string array that holds the list of items to be selected. The array is specified without an index but must have been previously dimensioned or loaded via Array.load.

As an alternative to an array, a string-type list may be specified in the <list_nexp>.

The <title_sexp> is an optional string expression that will be displayed at the top of the selection dialog. If the parameter is not present, or the expression evaluates to an empty string (""), the dialog box will be displayed with no title.

This command also accepts optional <message_sexp> and <press_lvar> parameters like those described in the **Select** command, but they should not be used. The <message_sexp> is ignored and the <press_lvar> will always be set to 0.

Input {<prompt_sexp>}, <result_var>{, {<default_exp>}{, <canceled_nvar>}}

Generates a dialog box with an input area and an **OK** button. When the user taps the button, the value in the input area is written to the variable <result_var>.

The <prompt_sexp> will become the dialog box title. If the prompt expression is empty ("") or omitted, the dialog box will be drawn without a title area.

If the return variable <result_var> is numeric, the input must be numeric, so the only key taps that will be accepted are 0-9, "+", "-" and ".". If <result_var> is a string variable, the input may be any string.

If a <default_exp> is given then its value will be placed into the input area of the dialog box. The default expression type must match the <result_var> type.

The variable <canceled_nvar> controls what happens if the user cancels the dialog, either by tapping the BACK key or by touching anywhere outside of the dialog box.

If you provide a <canceled_nvar>, its value is set to **false** (0) if the user taps the **OK** button, and **true** (1) if the users cancels the dialog.

If you do not provide a <canceled_nvar>, a canceled dialog is reported as an error. Unless there is an "OnError:" the user will see the messages:

```
Input dialog cancelled
Execution halted
```

If there is an "OnError:" label, execution will resume at the statement following the label.

The <result_var> parameter is required. All others are optional, but positional. These are all valid:

```
INPUT "prompt", result$, "default", isCanceled
INPUT , result$, "default"
INPUT "prompt", result$, , isCanceled
INPUT "prompt", result$
INPUT , result$
```

Note the use of commas as parameter placeholders.

Inkey$ <svar>

Reports key taps for the a-z, 0-9, Space and the D-Pad keys. The key value is returned in <svar>.

The D-Pad keys are reported as "up", "down", "left", "right" and "go". If any key other than those have been tapped, the string "key nn" will be returned. Where nn will be the Android key code for that key.

If no key has been tapped, the "@" character is returned in <svar>.

Rapid key taps are buffered in case they come faster than the BASIC! program can handle them.

Popup <message_sexp> {{, <x_nexp>}{, <y_nexp>}{, <duration_lexp>}}

Pops up a small message for a limited duration. The message is <message_sexp>.

All of the parameters except the message are optional but positional: you may omit any of them, but you must have the correct number of commas before any parameter you want to you. If omitted, their default values are 0.

The simplest form of the **Popup** command, **Popup "Hello!"**, displays the message in the center of the screen for two seconds.

The default location for the Popup is the center of the screen. The optional <x_nexp> and <y_nexp> parameters give a displacement from the center. The values may be negative.

Select the duration of the Popup, either 2 seconds or 4 seconds, with the optional <duration_lexp> "long flag". If the flag is false (the expression evaluates to 0) the message is visible for 2 seconds. If the flag is true (non-zero) the message is visible for 4 seconds. If the flag is omitted the duration is short.

Select <selection_nvar>, <Array$[]>|<list_nexp> {,<title_sexp> {, <message_sexp> } } {,<press_lvar> }

The Select command generates a new screen with a list of choices for the user. When the user taps a screen line, the index of that line is returned in the <selection_nvar>. If the user presses the BACK key, then the returned value is 0.

<Array$[]> is a string array that holds the list of items to be selected. The array is specified without an index but must have been previously dimensioned, loaded via Array.load, or created by another command.

As an alternative to an array, a string-type list may be specified in the <list_nexp>.

The <title_sexp> is an optional string expression that is placed into the title bar at the top of the selection screen. If the parameter is not present, the screen displays a default title. If the expression evaluates to an empty string ("") the title is blank.

The <message_sexp> is an optional string expression that is displayed in a short Popup message. If the message is an empty string ("") there is no Popup. If the parameter is absent, the <title_sexp> string is used instead, but if the <title_sexp> is also missing or empty, there is no Popup.

If you want a message but no title, make the <title_sexp> an empty string, or omit the <title_sexp> but keep the following comma.

The <press_lvar> is optional. If present, the type of user tap—long or short—is returned in <press_lvar>. The value returned is 0 (false) if the user selected the item with a short tap. The value returned is 1 (true) if the user selected the item with a long press.

Text.input <svar>{, { <text_sexp>} , <title_sexp> }

This command is similar to "Input" except that it is used to input and/or edit a large quantity of text. It opens a new window with scroll bars and full text editing capabilities. You may set the title of the new window with the optional <title_sexp> parameter.

If the optional <text_sexp> is present then that text is loaded into the text input window for editing. If <text_sexp> is not present then the text.input text area will be empty. If <title_sexp> is needed but text.input text area is to be initially empty, use two commas to indicate the <sexp> specifies the title and not the initial text.

When done editing, tap the Finish button. The edited text is returned in <svar>.

If you tap the BACK key then all text editing is discarded. <svar> returns the original <sexp> text.

The following example grabs the Sample Program file, **f01_commands.bas**, to string s$. It then sends s$ to text.input for editing. The result of the edit is returned in string r$. r$ is then printed to console.

```
grabfile s$, "../source/ Sample_Programs/f01_commands.bas"
text.input r$,s$
print r$
end
```

TGet <result_svar>, <prompt_sexp> {, <title_sexp>}

Simulates a terminal. The current contents of the Output Console is displayed in a new window. The last line displayed starts with the prompt string followed by the cursor. The user types in the input and taps enter. The characters that the user typed in is returned in <result_svar>. The prompt and response are displayed on the Output Console.

You may set the title of the text input window with the optional <title_sexp> parameter.

Kb.hide

Hides the soft keyboard.

If the keyboard is showing, and you have an **OnKbChange:** interrupt label, BASIC! will jump to your interrupt label when the keyboard closes.

The soft keyboard is always hidden when your program starts running, regardless of whether it is showing in the Editor.

Note: BASIC! automatically hides the soft keyboard when you change screens. For example, if the keyboard is showing over the Output Console, and you execute **GR.open** to start Graphics Mode, the keyboard is hidden. The keyboard will not be showing when you exit Graphics Mode and return to the

Console. Similarly, if you show the keyboard over your Graphics screen and you execute **GR.close** to return to the Console, the keyboard is hidden.

If you have an **OnKbChange:** interrupt label, automatically hiding the keyboard does **not** trigger a jump to the interrupt label.

Kb.show

Shows the soft keyboard.

If the keyboard is not showing, and you have an **OnKbChange:** interrupt label, BASIC! will jump to your interrupt label when the keyboard opens.

When the soft keyboard is showing, its keys may be read using the **Inkey$** command. The command may not work in devices with hard or slide-out keyboards.

You cannot show the soft keyboard over the Output Console unless you first **Print** to the Console.

Kb.toggle

Toggles the showing or hiding of the soft keyboard. If the keyboard is being shown, it will be hidden. If it is hidden, it will be shown.

Kb.showing <lvar>

Reports the visibility of the soft keyboard. If the keyboard is showing, the <lvar> is set to 1.0 (true), otherwise the <lvar> is set to 0.0 (false).

This command reports only the status of the keyboard shown by **Kb.show**. For example, the keyboard attached to the **Input** command dialog box cannot be controlled by **Kb.show** or **Kb.hide** and its status is not reported by **Kb.showing**.

OnKbChange:

If you show a soft keyboard with **Kb.show**, or close that same keyboard with **Kb.hide** or by tapping the BACK key, the change takes some time. The keyboard may open or close a few hundred milliseconds after it is requested. **Kb.show** and **Kb.hide** block until the change is complete, but your program does not know when you tap the BACK key.

If you have an **OnKbChange:** interrupt label in your program, then when the keyboard changes as just described BASIC! interrupts the execution of your program and transfers control to the command after the interrupt label.

To return control to where the interrupt occurred, execute **Kb.resume** in your interrupt handler.

This interrupt occurs only for keyboards you show with **Kb.show**. Keyboards attached to other screens, such as **TGet** or the **Input** dialog box, do not cause **OnKbChange:** interrupts.

Kb.resume

Resume program execution at the point where the **OnKbChange:** interrupt occurred.

When an interrupt occurs, no other interrupt can occur (except **OnError:**) until the corresponding **resume** executes.

The Soft Keyboard and the BACK Key

If you show a soft keyboard with **Kb.show**, and you tap the BACK key, the keyboard closes. The current screen (Console or Graphics screen) does not close. BASIC! does not trap the keypress with either **OnBackKey:** or **OnKeyPress:**. You can use the **OnKbChange:** interrupt label to be notified that the keyboard closed.

Working with Files

Files on Android devices are stored on more or more storage devices. BASIC! uses one of these devices as its *base drive*. In most cases, the *base drive* is the SD card, seen on most Android devices as the directory "/sdcard". You can select a different base drive in the *Menu->Preferences* item BASE DRIVE. In this manual, the notation <pref base drive> refers to the base drive you selected in Preferences.

BASIC! can work with files anywhere on the base drive, but most file operations are done in BASIC!'s *base directory*. Except when the user creates a standalone apk file (see Appendix D), the base directory is <pref base drive>/rfo-basic. All filenames (but not URLs) are relative to a subdirectory of the base drive.

Paths Explained

A path describes where a file or directory is located relative to some other file or directory.

BASIC! files are stored in subdirectories of the base directory, "<pref base drive>/rfo-basic/". Files are grouped by type, as follows:

BASIC! program files are in: "rfo-basic/source/"
BASIC! data files are in:"rfo-basic/data/"
BASIC! SQLite databases are in:"rfo-basic/databases/"

All of the BASIC! file I/O commands assume a certain default path. The default path depends on the type of file each command expects to handle. The INCLUDE and RUN commands expect to load program files, so they look in "rfo-basic/source/". SQLite operations look for database files in "rfo-basic/databases/". All other file operations look for data files in "rfo-basic/data/".

If you give a filename to a file command, it looks for that file in the default directory for commands of that type. If you want to work with a file that is not in that directory, you will have to specify a path to the appropriate directory.

The "../" path notation means to back up from the current directory by one level. The default path for data files is "<pref base drive>/rfo-basic/data/". The path "../source/" tells BASIC! to back up to the "<pref base drive>/rfo-basic/" directory and look into the "source/" directory.

The default <pref base drive> is the SD card, "/sdcard". If you want to work with a file in the root directory of the SD card, the path from the default path is would be: "../../" This tells BASIC! to back up two levels from "/sdcard/rfo-basic/data/" to "/sdcard/". On most Android devices "sdcard" is a symbolic link (shortcut) to a longer path name, such as "/mnt/sdcard" or "/storage/sdcard0". If you want to work with a file in the root directory of the Android device, "/", you can use the FILE.ROOT command to get the full path of the <pref base drive>.

All of these paths get you to a directory where you want to read, write, or create a file. To access that specific file, you add the filename to the path.

- In order to read the file "names.txt" in "/sdcard/rfo-basic/data/", the path would be "names.txt".
- In order to read the program file "sines.bas" in "/sdcard/rfo-basic/source", the path would be "../source/sines.bas".
- In order to access the music file "rain.mp3" in "/sdcard/music/", the path would be "../../music/rain.mp3".

Paths and Case-sensitivity

While the Android file system is normally case-sensitive. However, the FAT file system, often used on SD cards, memory sticks, etc., is case-insensitive. When handling files on these devices, Android – and therefore BASIC! – can not differentiate between names that differ only in case. In your BASIC! program, the two paths "../../music/rain.mp3" and "../../MUSIC/Rain.MP3" will both access the same file.

The rules change if you compile the same BASIC! program into a stand-alone apk (see Appendix D). The file system inside the apk is case-sensitive. The paths "../../music/rain.mp3" and"../../MUSIC/Rain.MP3" access different files. If the actual path in your build project is "Assets/<project>/MUSIC/Rain.MP3", then using the second path would succeed, but the first path would fail.

To prevent any error, it is good practice to match case exactly in file paths and names.

Mark and Mark Limit

Note: This is an advanced file management technique that you will rarely need to use. However see the note below about Out of Memory errors when reading very large files.

Every file has a mark and a mark limit. The mark is a position, and the mark limit is a size. As you read a file, its data is copied into a buffer. The buffer starts at the mark, and its length is the mark limit. BASIC! uses the buffer to allow you to reposition within the file. You are really repositioning within the buffer.

If you do not mark a file, then the first time you read it or set a position in it, the mark is set at position 1 and the mark limit is set to the size of the file. This allows you to position and read anywhere in the file.

The **Text.position.mark** and **Byte.position.mark** commands override the default mark and mark limit. You can change the mark and mark limit as often as you like, but there is only one mark in a file.

You cannot set a position before the mark. If you try, the file will be positioned at the mark. You will not be notified that the current position is different from what you requested, but you can use **Text/Byte.position.get** to determine the real position. Since the default mark position is 1, you can position anywhere if you never set a mark.

You cannot make the buffer smaller. If you want the buffer to be smaller than the file, you must execute **Text/Byte.position.mark** before reading the file or setting a position. The smallest buffer size available is 8096 bytes, but it is not an error to specify a smaller number. Since the default mark limit is the file size, you can position anywhere if you never set a mark limit.

If you read or position past the end of the buffer (more than **marklimit** bytes beyond the the mark), the mark is invalid. It is an error to try to move the position backward when the mark is invalid. You will see the error message "**Invalid mark**". Since the default buffer is the whole file, you will never see this error if you never set a mark.

There is only one condition that requires you to use this command. **If you open a very large file, the default buffer size may be too large.** Reading or positioning to the end of the file may cause an **Out Of Memory** error. To avoid this error, your must use **Text.position.mark** to reduce the buffer size.

File Commands

File.delete <lvar>, <path_sexp>

The file or directory at <path_sexp> will be deleted, if it exists. If the file or directory did not exist before the Delete, the <lvar> will contain zero. If the file or directory did exist and was deleted, the <lvar> will be returned as not zero.

The default path is "<pref base drive>/rfo-basic/data/".

File.dir <path_sexp>, Array$[] {,<dirmark_sexp>}

This command returns the names of the files and directories in the path specified by <path_sexp>. The path is relative to "<pref base drive>/rfo-basic/data/".

The names are placed into Array$[], which must not already exist. The array is sorted alphabetically with the directories at the top of the list.

A directory is identified by a marker appended to its name. The default marker is the string "(d)". You can change the marker with the optional directory mark parameter <dirmark_sexp>. If you do not want directories to be marked, set <dirmark_sexp> to an empty string, "".

File.exists <lvar>, <path_sexp>

This command reports if the <path_sexp> directory or file exists. If the directory or file does not exist, the <lvar> will contain zero. If the file or directory does exist, the <lvar> will be returned as not zero.

The default path is "<pref base drive>/rfo-basic/data/".

File.mkdir <path_sexp>

Before you can use a directory, the directory must exist. The Mkdir command is used to create directories.

The default path is "<pref base drive>/rfo-basic/data/".

The path to create a new directory, "homes", in "<pref base drive>/rfo_basic/data/" would be "homes/", or simply "homes".

The path to create a new directory, "icons", in the root directory of the SD card would be "../../icons".

File.rename <old_path_sexp>, <new_path_sexp>

The file or directory at old_path is renamed to new_path. If there is already a file present named <new_path_sexp>, it is silently replaced.

The default path is "<pref base drive>/rfo-basic/data/".

The Rename operation can not only change the name of a file or a directory, it can also move the file or directory to another directory.

For example:

```
    Rename "../../testfile.txt", "testfile1.txt"
```

removes the file, testfile.txt, from "<pref base drive>/", places it into "sdcard/rfo-basic/data/" and also renames it to testfile1.txt.

File.root <svar>

Returns the canonical path from the file system root to "<pref base drive>/rfo-basic/data", the default data directory, in <svar>. The <pref_base_drive> is expanded to the full absolute path from the file system root, "/".

File.size <size_nvar>, <path_sexp>

The size, in bytes, of the file at <path_sexp> will be returned in <size_nvar>. If there is no file at <path_sexp>, the system will generate a run-time error.

The default path is "<pref base drive>/rfo-basic/data/".

File.type <type_svar>, <path_sexp>

Returns a one-character type indicator in <type_svar> for the file at <path_sexp>. The <path_sexp> is appended to the default data path, "<pref base drive>/rfo-basic/data/". The type indicator values are:

Indicator:	Meaning:
"d"	"directory" – path names a directory
"f"	"file" – path names a regular file
"o"	"other" – path names a special file
"x"	file does not exist

Text File I/O

The text file I/O commands are to be exclusively used for text (.txt) files. Text files are made up of lines of characters that end in CR (Carriage Return) and/or NL (New Line). The text file input and output commands read and write entire lines.

The default path is "<pref base drive>/rfo-basic/data/"

Text.open {r|w|a}, <file_table_nvar>, <path_sexp>

The file specified by the path string expression <path_sexp> is opened. The default path is "<pref base drive>/rfo-basic/data/". The <path_sexp> string is appended to the default path.

The first parameter is a single character that sets the I/O mode for this file:

Parameter	Mode	Notes
r	read	
w	write	Write from the start of the file. Writes over any existing data.
a	append	Writing starts after the last line in the file.

A file table number is placed into the numeric variable <file_table_nvar>. This value is for use in subsequent **Text.readln**, **Text.writeln**, **Text.eof**, **Text.position.***, or **Text.close** commands.

If a file being opened for read does not exist then the <file_table_nvar> will be set to -1. The BASIC! programmer can check for this and either create the file or report the error to the user. Information about the error is available from the **GetError$()** function.

Opening a file for append that does not exist creates an empty file. Finally, opening a file for write that already exists deletes the contents of the file; that is, it replaces the existing file with a new, empty one.

Text.close <file_table_nexp>

The previously opened file represented by <file_table_nexp> will be closed.

Note: It is essential to close an output file if you have written over 8k bytes to it. If you do not close the file then the file will only contain the first 8k bytes.

Text.readln <file_table_nexp>, <line_svar>

Read the next line from the specified, previously opened file is and write it into <line_svar>. If <file_table_nexp> is -1, indicating **Text.open** failed, or if it is not a valid file table number, then a run-time error is thrown.

If this command is executed after the last line in the file has been read, the characters "EOF" are placed into <line_svar>. This is indistinguishable from the string "EOF" read as actual data, except that the result of the **Text.eof** command will be false for real data and true for end-of-file.

This example reads an entire file and prints each line.

```
TEXT.OPEN r, file_number, "testfile.txt"
DO
  TEXT.READLN file_number, line$
  PRINT line$
UNTIL line$ = "EOF"
TEXT.CLOSE file_number
```

The file will not automatically be closed when the end-of-file is read. Subsequent reads from the file will continue to return "EOF".

When you are done reading a file, the **Text.close** command should be used to close the file.

Text.writeln <file_table_nexp>, <parms same as Print>

The parameters that follow the file table pointer are parsed and processed exactly the same as the **Print** command parameters. This command is essentially a **Print** to a file.

If a parameter line ends with a semicolon, the data is not written to the file. It is stored in a temporary buffer until the next **Text.writeln** command that does not end in a semicolon. There is only one temporary buffer no matter how many files you have open. If you want to build partial print lines for more than one file at a time, do not use **Text.writeln** commands ending with semicolons. Instead use string variables to store the temporary results.

After the last line has been written to the file, the **Text.close** command should be used to close the file.

Text.writeln with no parameters writes a newline.

Text.eof <file_table_nexp>, <lvar>

Report an opened file’s end-of-file status. If the file is at EOF, the <lvar> is set true (non-zero). If the file or directory is not at EOF, the <lvar> is set false (zero).

A file opened for write or append is always at EOF. A file opened for read is not at EOF until all of the data has been read and then one more read is attempted. That read will have returned the string "EOF". **Text.position.set** may also position the file at EOF.

Text.position.get <file_table_nexp>, <position_nvar>

Get the position of the next line to be read or written to the file. The position of the first line in the file is 1. The position is incremented by one for each line read or written. The position information can be used for setting up random file data access.

Note: If a file is opened for append, the position returned will be relative to the end of the file. The position returned for the first line to be written after a file is opened for append will be 1. You will have to add these new positions to the known position of the end of the file when building your random access table.

Text.position.set <file_table_nexp>, <position_nexp>

Sets the position of the next line to read. A position value of 1 will read the first line in the file.

Text.position.set can only be used for files open for text reading.

If the position value is greater than the number of lines in the file, the file will be positioned at the end of file. The position returned for Text.position.get at the EOF will be number of lines plus one in the file.

If you have marked a position in the file, you cannot set a position before the mark. You will not be notified that the position is different from what you requested. See **Text.position.mark** for more information.

Text.position.mark {{<file_table_nexp>}{, <marklimit_nexp>}}

Marks the current line of the file, and sets the mark limit to <marklimit_nexp> bytes.

Both parameters are optional. If the file table index <file_table_nexp> is omitted, the default file is the last file opened; you must ensure that the last file opened was a **Text** file opened for reading. If the mark limit <marklimit_exp> is omitted, the default value is the file's current mark limit.

Please read **Working with Files → Mark and Mark Limit**, above.

GrabURL <result_svar>, <url_sexp>{, <timeout_nexp>}

The entire source text of the Internet URL <url_sexp> is copied to the <result_svar> string. The **Split** command can then be used to split the <result_svar> into an array of lines.

If the optional <timeout_nexp> parameter is non-zero, it specifies a timeout in milliseconds. This is meaningful only if the URL names a file on a remote host. If the timeout time elapses and host does not connect or does not return any data, **GrabURL** reports a socket timeout run-time error.

GrabFile <result_svar>, <path_sexp>{, <unicode_flag_lexp>}

The entire contents of the file at <path_sexp> will be copied to the <result_svar> string. By default, **GrabFile** assumes that the file contains binary bytes or ASCII characters. If the optional <unicode_flag_lexp> evaluates to true (a non-zero numeric value), **GrabFile** can read Unicode text. For text files, either ASCII or Unicode, the **Split** command can then be used to split the <result_svar> into an array of lines.

The command could be used grab the contents of a text file for direct use with **Text.input**:

```
GrabFile text$, "MyJournal.txt"
Text.input EditedText$, text$
```

Byte File I/O

Byte file I/O can be used to read and write any type of file (.txt, .jpg, .pdf, .mp3, etc.). The data is read and written one byte at a time.

Byte.open {r|w|a}, <file_table_nvar>, <path_sexp>

The file specified by the path string expression <path_sexp> is opened. If the path is a URL starting with "http…" then an Internet file is opened. Otherwise, the <path_sexp> string is appended to the default path "<pref base drive>/rfo-basic/data/".

The first parameter is a single character that sets the I/O mode for this file:

Parameter	Mode	Notes
r	read	
w	write	Write from the start of the file. Writes over any existing data.
a	append	Writing starts after the last line in the file.

A file table number is placed into the numeric variable <file_table_nvar>. This value is for use in subsequent **Byte.read.***, **Byte.write**.*, **Byte.eof**, **Byte.position.***, **Byte.truncate**, **Byte.copy**, or **Byte.close** commands.

If a file being opened for read does not exist then the <file_table_nvar> will be set to -1. The BASIC! programmer can check for this and either create the file or report the error to the user. Information about the error is available from the **GetError$()** function.

Opening a file for append that does not exist creates an empty file. Finally, opening a file for write that already exists deletes the contents of the file; that is, it replaces the existing file with a new, empty one.

Byte.close <file_table_nexp>

Closes the previously opened file.

Byte.read.byte <file_table_nexp>, <byte_nvar>

If <file_table_nexp> = -1 then a run-time error will be thrown.

A single byte is read from the file and placed into <byte_nvar>. After the last byte in the file has been read, further attempts to read from the file return the value -1. This is indistinguishable from -1 read as actual data, except that the result of the **Byte.eof** command will be false for real data and true for EOF.

This example reads a file and prints each byte, and prints "-1" at the end to show that the entire file has been read.

```
BYTE.OPEN r, file_number, "testfile.jpg"
```

```
DO
    BYTE.READ.BYTE file_number, Byte
    PRINT Byte
UNTIL Byte < 0
BYTE.CLOSE file_number
```

Byte.write.byte <file_table_nexp>, <byte_nexp>|<sexp>

If the second parameter is a numeric expression then the low order 8 bits of the value will be written to the file as a single byte.

If the second parameter is a string expression then the entire string will be written to the file as 8 bit bytes.

Byte.read.buffer <file_table_nexp>, <count_nexp>, <buffer_svar>

Reads the specified count of bytes (<count_nexp>) into the buffer string variable (<buffer_svar>) from the file. If the end of file has been reached, the string length (len(<buffer_svar>) will be zero.

A buffer string is a special use of the BASIC! string. Each character of a string is 16 bits. When used as a buffer, one byte of data is written into the lower 8 bits of each 16-bit character. The upper 8 bits are 0. Extract the binary data from the string, one byte at a time, with the **ASCII$()** or **UCODE$()** functions.

Byte.write.buffer <file_table_nexp>, <buffer_sexp>

Writes the entire contents of the string expression to the file. The string is assumed to be a buffer string holding binary data, as described in **Byte.read.buffer**. The writer discards the upper 8 bits of each 16-bit character, writing one byte to the file for each character in the string.

Byte.eof <file_table_nexp>, <lvar>

Reports an opened file's end-of-file status. If the file is at EOF, the <lvar> is set true (non-zero). If the file or directory is not at EOF, the <lvar> is set false (zero).

A file opened for write or append is always at EOF. A file opened for read is not at EOF until all of the data has been read and then one more read is attempted. That read will have returned the value -1. **Byte.position.set** may also position the file at EOF.

Byte.position.get <file_table_nexp>, <position_nvar>

Gets the position of the next byte to be read or written. The position of the first byte is 1. The position value will be incremented by 1 for each byte read or written.

The position information can be used for setting up random file data access.

If the file is opened for append, the position returned will be the length of the file plus one.

Byte.position.set <file_table_nexp>, <position_nexp>

Sets the position of the next by to be read from the file. If the position value is greater than the position of the last byte of the file, the position will point to the end of file.

This command can only be used on files open for byte read.

Byte.position.mark {{<file_table_nexp>}{, <marklimit_nexp>}}

Marks the current position in the file, and sets the mark limit to <marklimit_nexp> bytes.

Both parameters are optional. If the file table index <file_table_nexp> is omitted, the default file is the last file opened; you must ensure that the last file opened was a **Byte** file opened for reading. If the mark limit <marklimit_exp> is omitted, the default value is the file's current mark limit.

Please read **Working with Files → Mark and Mark Limit**, above.

Byte.truncate <file_table_nexp>,<length_nexp>

Truncates the file to <length_nexp> bytes and closes the file. Setting the truncate length <length_nexp> larger than the current length (current write position - 1) has no effect.

This command can only be used on files open for byte write or append.

Byte.copy <file_table_nexp>,<output_file_sexp>

Copies the previously open input file represented by <file_table_nexp> to the file whose path is specified by <output_file_sexp>. The default path is "<pref base drive>/rfo-basic/data/".

If <file_table_nexp> = -1 then a run-time error will be thrown.

The input file will be completely copied to the to the output file. Both files will then be closed.

You should use **Byte.copy** if you are using Byte I/O for the sole purpose of copying. It is thousands (literally) of times faster than using **Byte.read**/**Byte.write**.

HTML

Introduction

The BASIC! HTML package is designed to allow the BASIC! programmer to create user interfaces using HTML and JavaScript. The interface provides for interaction between the HTML engine and BASIC!. The HTML programmer can use JavaScript to send messages to BASIC!. The HTML engine will also report user events such as the BACK key, hyperlink transfers, downloads, form data and errors.

The demo program, **f37_html_demo.bas**, combined with the HTML demo files, **htmlDemo1.html** and **htmlDemo2.html**, illustrate the various commands and possibilities. The content of all three files are listed in the **Appendix B** of this document. They are also delivered with the BASIC! apk. It is highly recommended that all three files be carefully studied to fully understand this interface.

Another demo program, **f38_html_edit.bas**, can be used to edit html files. To use the program, run it and enter the html file name without the html extension. The program will add the extension ".html".

Caution: Forum users have reported problems in HTML mode with commands that use a new window or screen to interact with the user (**Input**, **Select** and others), or when using the BACK key to try to control actions outside of the HTML WebView.

HTML Commands

Html.open {<ShowStatusBar_lexp> {, <Orientation_nexp>}}

This command must be executed before using the HTML interface.

The Status Bar will be shown on the Web Screen if the <ShowStatusBar_lexp> is true (not zero). If the <ShowStatusBar_lexp> is not present, the Status Bar will not be shown.

The orientation upon opening the HTML screen will be determined by the <Orientation_nexp> value. <Orientation_nexp> values are the same as values for the Html.orientation command (see below). If the <Orientation_nexp> is not present, the default orientation is determined by the orientation of the device.

Both <ShowStatusBar_lexp> and <Orientation_nexp> are optional; however, a <ShowStatusBar_lexp> must be present in order to specify an <Orientation_nexp>.

Executing a second HTML.OPEN before executing HTML.CLOSE will generate a run-time error.

Html.orientation <nexp>

The value of the <nexp> sets the orientation of screen as follows:

-1 = Orientation depends upon the sensors.
 0 = Orientation is forced to Landscape.
 1 = Orientation is forced to Portrait.

Html.load.url <file_sexp>

Loads and displays the file specified in the string <file_sexp>. The file may reside on the Internet or on your android device. In either case, the entire URL must be specified.

The command:

```
html.load.url "http://laughton.com/basic/"
```

will load and display the BASIC! home page.

The command:

```
html.load.url "htmlDemo1.html"
```

will load and display the html file "htmlDemo1.html" residing in BASIC!'s default "data" directory, as set by your "Base Drive" preference. You may also use a fully-qualified pathname. With the default "Base Drive" setting, this command loads the same file:

```
html.load.url "file:///sdcard/rfo-basic/data/htmlDemo1.html"
```

When you tap the BACK key on the originally-loaded page, the HTML viewer will be closed and the BASIC! output console will be displayed. If the page that was originally loaded links to another page and then the BACK key is tapped, it will be up to the BASIC! programmer to decide what to do.

Html.load.string <html_sexp>

Loads and displays the HTML contained in the string expression. The base page for this HTML will be:

<pref base drive>/rfo-basic/data/

Html.post <url_sexp>, <list_nexp>

Execute a Post command to an Internet location.

<url_sexp> is a string expression giving the url that will accept the Post.

<list_nexp> is a pointer to a string list which contains the Name/Value pairs needed for the Post.

Html.get.datalink <data_svar>

A datalink provides a method for sending a message from an HTML program to the BASIC! programmer. There are two parts to a datalink in an HTML file: 1) the JavaScript that defines the datalink function, and 2) the HTML code that calls the datalink function. The BASIC! Program requires a mechanism for communicating with a website's HTML code.

Html.get.datalink gets the next datalink string from the datalink buffer. If there is no datalinked data available then the returned data will be an empty string (""). You should program a loop waiting for data:

```
do
 html.get.datalink data$
 until data$ <> ""
```

The returned data string will always start with a specific set of four characters—three alphabetic characters followed by a colon (":"). These four characters identify the return datalink data type. Most of the type codes are followed by some sort of data. The codes are:

BAK: The user has tapped the BACK key. The data is either "1" or "0".

If the data is "0" then the user tapped BACK in the start screen. Going back is not possible therefore html has been closed.

If the data is "1" then going back is possible. The BASIC! programmer should issue the command html.go.back if going back is desired.

LNK: The user has tapped a hyperlink. The linked-to url is returned. The transfer to the new url has not been done. The BASIC! programmer must execute an "html.load.url" with the returned url (or some other url) for a transfer to occur.

ERR: Some sort of fatal error has occurred. The error condition will be returned. This error code always closes the html engine. The BASIC! output console will be displayed.

FOR: The user has tapped the Submit button on a form with action='FORM' The form name/value pairs are returned.

DNL: The user has clicked a link that requires a download. The download url is supplied. It is up to the BASIC! programmer to do the download.

DAT: The user has performed some action that has caused some JavaScript code to send data to BASIC! by means of the datalink. The JavaScript function for sending the data is:

```
<script type="text/javascript">
    function doDataLink(data) {
        Android.dataLink(data);
    }
</script>
```

Html.go.back
Go back one HTML screen, if possible.

Html.go.forward
Go forward one HTML screen, if possible.

Html.close
Closes the HTML engine and display.

Html.clear.cache
Clears the HTML cache.

Html.clear.history
Clears the HTML history.

Related Commands

Browse <url_sexp>
If <url_sexp> starts with "http…" then the internet site specified by <url_sexp> will be opened and displayed.

If <url_sexp> starts with "file:///sdcard/... " then the file will be open be opened by the application, ThinkFree Mobile. The file types that the free version of ThinkFree Mobile can open are ".txt, .doc, .xls, .rtf".

If your Android device does not already have ThinkFree Mobile Viewer on it, you can find it in the apps section of the Google Play Store. There is also a paid "pro" version that manages additional file types.

Note: You can also use the HTML commands to display (and interact with) web pages located on your device or on the web.

Http.post <url_sexp>, <list_nexp>, <result_svar>

Execute a Post command to an Internet location.

<url_sexp> contains the url ("http://....") that will accept the Post.

<list_nexp> is a pointer to a string list which contains the Name/Value pairs needed for the Post.

<result_svar> is where the Post response will be placed.

TCP/IP Sockets

TCP/IP Sockets provide for the transfer of information from one point on the Internet to another. There are two genders of TCP/IP Sockets: Servers and Clients. Clients must talk to Servers. Servers must talk to Clients. Clients cannot talk to Clients. Servers cannot talk to Servers.

Every Client and Server pair have an agreed-upon protocol. This protocol determines who speaks first and the meaning and sequence of the messages that flow between them.

Most people who use a TCP/IP Socket will use a Client Socket to exchange messages with an existing Server with a predefined protocol. One simple example of this is the Sample Program file, **f31_socket_time.bas**. This program uses a TCP/IP client socket to get the current time from one of the many time servers in the USA.

A TCP/IP Server can be set up in BASIC!; however, there are difficulties. The capabilities of individual wireless networks vary. Some wireless networks allow servers. Most do not. Servers can usually be run on WiFi or Ethernet Local Area Networks (LAN).

If you want to set up a Server, the way most likely to work is to establish the Server inside a LAN. You will need to provide Port tunneling (forwarding) from the LAN’s external Internal IP to the device’s LAN IP. You must to be able to program (setup) the LAN router in order to do this.

Clients, whether running inside the Server’s LAN or from the Internet, should connect to the LAN’s external IP address using the pre-established, tunneled Port. This external or WAN IP can be found using:

```
        Graburl ip$, "http://icanhazip.com"
```

This is not the same IP that would be obtained by executing **Socket.myIP** on the server device.

Note: The specified IPs do not have to be in the numeric form. They can be in the name form.

The Sample Program, **f32_tcp_ip_sockets.bas**, demonstrates the socket commands for a Server working in conjunction with a Client. You will need two Android devices to run this program.

TCP/IP Client Socket Commands

Socket.client.connect <server_sexp>, <port_nexp> { , <wait_lexp> }

Create a Client TCP/IP socket and attempt to connect to the Server whose Host Name or IP Address is specified by the Server string expression using the Port specified by Port numeric expression.

The optional "wait" parameter determines if this command waits until a connection is made with the Server. If the parameter is absent or true (non-zero), the command will not return until the connection has been made or an error is detected. If the Server does not respond, the command should time out after a couple of minutes, but this is not certain.

If the parameter is false (zero), the command completes immediately. Use **Socket.server.status** to determine when the connection is made. If you monitor the socket status, you can set your own time-out policy. You must use the **Socket.client.close** command to stop a connection attempt that has not completed.

Socket.client.status <status_nvar>

Get the current client socket connection status and place the value in the numeric variable <status_nvar>.

0 = Nothing going on
2 = Connecting
3 = Connected

Socket.client.server.ip <svar>

Return the IP of the server that this client is connected to in the string variable.

Socket.client.read.line <line_svar>

Read a line from the previously-connected Server and place the line into the line string variable. The command does not return until the Server sends a line. To avoid an infinite delay waiting for the Server to send a line, the **Socket.client.read.ready** command can be repeatedly executed with timeouts.

Socket.client.read.ready <nvar>

If the previously created Client socket has not received a line for reading by **Socket.client.read.line** then set the return variable <nvar> to zero. Otherwise return a non-zero value.

The **Socket.client.read.line command** does not return until a line has been received from the Server. This command can be used to allow your program to time out if a line has not been received within a pre-determined time span. You can be sure that **Socket.client.read.line** will return with a line of data if **Socket.client.read.ready** returns a non-zero value.

Socket.client.read.file <file_nexp>

Read file data transmitted by the Server and write it to a file. The <file_nexp> is the file index of a file opened for write by **Byte.open write** command. For example:

```
Byte.open w, fw, "image.jpg"
Socket.client.read.file fw
Byte.close fw
```

Socket.client.write.line <line_sexp>

Send the string expression <line_sexp> to the previously-connected Server as UTF-16 characters. End of line characters will be added to the end of the line.

Socket.client.write.bytes <sexp>

Send the string expression, <sexp>, to the previously-connected Server as 8-bit bytes. Each character of the string is sent as a single byte. The string is not encoded. No end-of-line characters are added by BASIC!. If you need a CR or LF character, you must make it part of the string. Note that if **Socket.server.read.line** is used to receive these bytes, the **read.line** command will not return until it receives a LF (10, 0x0A) character.

Socket.client.write.file <file_nexp>

Transmit a file to the Server. The <file_nexp> is the file index of a file opened for read by **Byte.open**. Example:

```
Byte.open r, fr, "image.jpg"
Socket.client.write.file fr
Byte.close fr
```

Socket.client.close

Closes an open client side connection.

TCP/IP Server Socket Commands

Socket.myIP <svar>

Return the IP of the device in <svar>.

If the device is on a WiFi or Ethernet LAN then the IP returned is the device's LAN IP.

Note: The external or WAN IP can be found using:

```
Graburl ip$, "http://icanhazip.com"
```

Socket.server.create <port_nexp>

Establish a Server that will listen to the Port specified by the numeric expression, <port_nexp>.

Socket.server.connect {<wait_lexp>}

Direct the previously created Server to accept a connection from the next client in the queue.

The optional "wait" parameter determines if the command waits until a connection is made with a client. If the parameter is absent or true (non-zero), the command waits for the connection. If the parameter is false (zero), the command completes immediately. Use **Socket.server.status** to determine when the connection is made.

In general, it is safer to set the parameter to false (don't wait) and explicitly monitor the connection's status, since it can avoid a problem if the program exits with no connection made. You must use the **Socket.server.close** command to stop a connection attempt that has not completed.

Socket.server.status <status_nvar>

Get the current server socket connection status and place the value in the numeric variable <status_nvar>.

- 1 = Server socket not created
 0 = Nothing going on
 1 = Listening
 3 = Connected

Socket.server.read.line <svar>

Read a line sent from the previously-connected Client and place the line into the string variable <svar>. The command does not return until the Client sends a line. To avoid an infinite delay waiting for the Client to send a line, the **Socket.server.read.ready** command can be repeatedly executed with timeouts.

Socket.server.read.ready <nvar>

If the previously-connected Client socket has not sent a line for reading by **Socket.server.read.line** then set the return variable <nvar> to zero. Otherwise return a non-zero value.

The **Socket.server.read.line** command does not return until a line has been received from the Client. This command can be used to allow your program to time out if a line has not been received within a pre-determined time span. You can be sure that **Socket.server.read.line** will return with a line of data if returns a non-zero value.

Socket.server.write.line <line_sexp>

Send the string expression <line_sexp> to the previously-connected Client as UTF-16 characters. End of line characters will be added to the end of the line.

Socket.server.write.bytes <sexp>

Send the string expression, <sexp>, to the previously-connected Client as 8-bit bytes. Each character of the string is sent as a single byte. The string is not encoded. No end of line characters are added by BASIC!. If you need a CR or LF character, you must make it part of the string. Note that if **Socket.client.read.line** is used to receive these bytes, the **read.line** command will not return until it receives a LF (10, 0x0A) character.

Socket.server.write.file <file_nexp>

Transmit a file to the Client. The <file_nexp> is the file index of a file opened for read by **Byte.open**. Example:

```
Byte.open r, fr, "image.jpg"
Socket.server.write.file fr
Byte.close fr
```

Socket.server.read.file <file_nexp>

Read file data transmitted by the Client and write it to a file. The <file_nexp> is the file index of a file opened for write by **Byte.open**. Example:

```
Byte.open w, fw, "image.jpg"
Socket.server.read.file fw
Byte.close fw
```

Socket.server.disconnect

Close the connection with the previously-connected Client. A new **Socket.server.connect** can then be executed to connect to the next client in the queue.

Socket.server.close

Close the previously created Server. Any currently connected client will be disconnected.

Socket.server.client.ip <nvar>

Return the IP of the Client currently connected to the Server.

FTP Client

These FTP commands implement a FTP Client

Ftp.open <url_sexp>, <port_nexp>, <user_sexp>, <pw_sexp>

Connects to the specified url and port. Logs onto the server using the specified user name and password. For example:

ftp.open "ftp.laughton.com", 21, "basic", "basic"

Ftp.close

Disconnects from the FTP server.

Ftp.put <source_sexp>, <destination_sexp>

Uploads specified source file to the specified destination file on connected ftp server.

The source file is relative to the directory, "<pref base drive>/rfo-basic/data/" If you want to upload a BASIC! source file, the file name string would be: "../source/xxxx.bas".

The destination file is relative to the current working directory on the server. If you want to upload to a subdirectory of the current working directory, specify the path to that directory. For example, if there is a subdirectory named "etc" then the filename, "/etc/name" would upload the file into that subdirectory.

Ftp.get <source_sexp>, <destination_sexp>

The source file on the connected ftp server is downloaded to the specified destination file on the Android device.

You can specify a subdirectory in the server source file string.

The destination file path is relative to "<pref base drive>/rfo-basic/data/" If you want to download a BASIC! source file, the path would be, "../source/xxx.bas".

Ftp.dir <list_nvar> {,<dirmark_sexp>}

Creates a list of the names of the files and directories in the current working directory and places it in a BASIC! List data structure. A pointer to the new List is returned in the variable <list_nvar>.

A directory is identified by a marker appended to its name. The default marker is the string "(d)". You can change the marker with the optional directory mark parameter <dirmark_sexp>. If you do not want directories to be marked, set <dirmark_sexp> to an empty string, "".

The following code can be used to print the file names in that list:

```
ftp.dir file_list
list.size file_list,size

for i = 1 to size
        list.get file_list,i,name$
        print name$
next i
```

Ftp.cd <new_directory_sexp>

Changes the current working directory to the specified new directory.

Ftp.rename <old_filename_sexp>, <new_filename_sexp>

Renames the specified old filename to the specified new file name.

Ftp.delete <filename_sexp>

Deletes the specified file.

Ftp.rmdir <directory_sexp>

Removes (deletes) the specified directory if and only if that directory is empty.

Ftp.mkdir <directory_sexp>

Creates a new directory of the specified name.

Bluetooth

BASIC! implements Bluetooth in a manner which allows the transfer of data bytes between an Android device and some other device (which may or may not be another Android device).

Before attempting to execute any BASIC! Bluetooth commands, you should use the Android "Settings" Application to enable Bluetooth and pair with any device(s) with which you plan to communicate.

When Bluetooth is opened using the **Bt.open** command, the device goes into the Listen Mode. While in this mode it waits for a device to attempt to connect.

For an active attempt to make a Bluetooth connection, you can use the Connect Mode by successfully executing the **Bt.connect** command. Upon executing the **Bt.connect** command the person running the program is given a list of paired Bluetooth devices and asked. When the user selects a device, BASIC! attempts to connect to it.

You should monitor the state of the Bluetooth using the **Bt.status** command. This command will report states of Listening, Connecting and Connected. Once you receive a "Connected" report, you can proceed to read bytes and write bytes to the connected device.

You can write bytes to a connected device using the **Bt.write** command.

Data is read from the connected device using the **Bt.read.bytes** command; however, before executing **Bt.read.bytes**, you need to find out if there is data to be read. You do this using the **Bt.read.ready** command.

Once connected, you should continue to monitor the status (using **Bt.status**) to ensure that the connected device remains connected.

When you are done with a particular connection or with Bluetooth in general, execute **Bt.close**.

The sample program, f35_bluetooth, is a working example of Bluetooth using two Android devices in a "chat" type application.

Bt.open {0|1}

Opens Bluetooth in Listen Mode. If you do not have Bluetooth enabled (using the Android Settings Application) then the person running the program will be asked whether Bluetooth should be enabled. After **Bt.open** is successfully executed, the code will listen for a device that wants to connect.

The optional parameter determines if BT will listen for a secure or insecure connection. If no parameter is given or if the parameter is 1, then a secure connection request will be listened for. Otherwise, an insecure connection will be listened for. It is not possible to listen for either a secure or insecure connection with one **Bt.open** command because the Android API requires declaring a specific secure/insecure open.

If **Bt.open** is used in graphics mode (after **Gr.open**), you will need to insert a **Pause 500** statement after the **Bt.open** statement.

Bt.close

Closes any previously opened Bluetooth connection. Bluetooth will automatically be closed when the program execution ends.

Bt.connect {0|1}

Commands BASIC! to connect to a particular device. Executing this command will cause a list of paired devices to be displayed. When one of these devices is selected the **Bt.status** will become "Connecting" until the device has connected.

The optional parameter determines if BT will seek a secure or insecure connection. If no parameter is given or if the parameter is 1, then a secure connection will be requested. Otherwise, an insecure connection will be requested.

Bt.disconnect

Disconnects from the connected Bluetooth device and goes into the Listen status. This avoids having to use **Bt.close** + **Bt.open** to disconnect and wait for a new connection.

Bt.reconnect

This command will attempt to reconnect to a device that was previously connected (during this Run) with **Bt.connect** or a prior **Bt.reconnect**. The command cannot be used to reconnect to a device that was connected following a **Bt.open** or **Bt.disconnect** command (i.e. from the **Listening** status).

You should monitor the Bluetooth status for **Connected** (3) after executing **Bt.reconnect**.

Bt.status {{<connect_var>}{, <name_svar>}{, <address_svar>}}

Gets the current Bluetooth status and places the information in the return variables. The available data are the current connection status (in <connect_var>), and the friendly name and MAC address of your Bluetooth hardware (in <name_svar> and <address_svar>).

All of the parameters are optional but positional: you can omit any parameter, but you must have the correct number of commas before any parameter you want to use.

If the connection status variable <connect_var> is present, it may be either a numeric variable or a string variable. The table shows the possible return values of each type:

Numeric Value	String Value	Meaning
-1	Not enabled	Bluetooth not enabled

0	Idle	Nothing going on
1	Listening	Listening for connection
2	Connecting	Connecting to another device
3	Connected	Connected to another device

If the device name string variable <name_svar> is present, it is set to the friendly device name. If your device has no Bluetooth radio, the string will be empty.

If the address string variable <address_svar> is present, it is set to the MAC address of your Bluetooth hardware, represented as a string of six hex numbers separated by colons: "00:11:22:AA:BB:CC".

Bt.write {<exp> {,|;}} ...

Writes data to the Bluetooth connection.

If the comma (,) separator is used then a comma will be printed between the values of the expressions.

If the semicolon (;) separator is used then nothing will separate the values of the expressions.

If the semicolon is at the end of the line, the output will be transmitted immediately, with no newline character(s) added.

The parameters are the same as the **Print** parameters. This command is essentially a **Print** to the Bluetooth connection, with two differences:

- Only one byte is transmitted for each character; the upper byte is discarded. Binary data and ASCII text are sent correctly, but Unicode characters may not be.
- A line that ends with a semicolon is sent immediately, with no newline character(s) added.

This command with no parameters sends a newline character to the Bluetooth connection.

Bt.read.ready <nvar>

Reports in the numeric variable the number of messages ready to be read. If the value is greater than zero then the messages should be read until the queue is empty.

OnBtReadReady:

If a Bluetooth received message is ready (**Bt.read.ready** would return a non-zero value) the currently running program will be interrupted and execution will resume at the statement after this label. You can then read and handle the message. When done, you can execute the **Bt.onReadReady.Resume** command to resume the interrupted program.

Bt.onReadReady.resume

Resumes the running of the program at the location where it was interrupted by the Bluetooth Read Ready event.

Bt.read.bytes <svar>

The next available message is placed into the specified string variable. If there is no message then the string variable will be returned with an empty string ("").

Each message byte is placed in one character of the string; the upper byte of each character is 0. This is similar to **Byte.read.buffer**, which reads binary data from a file into a buffer string.

Bt.device.name <svar>

Returns the name of the connected device in the string variable. A run-time error will be generated if no device (Status <> 3) is connected.

Bt.set.UUID <sexp>

A Universally Unique Identifier (UUID) is a standardized 128-bit format for a string ID used to uniquely identify information. The point of a UUID is that it's big enough that you can select any random 128-bit number and it won't clash with any other number selected similarly. In this case, it's used to uniquely identify your application's Bluetooth service. To get a UUID to use with your application, you can use one of the many random UUID generators on the web.

Many devices have common UUIDs for their particular application. The default BASIC! UUID is the standard Serial Port Profile (SPP) UUID: "00001101-0000-1000-8000-00805F9B34FB".

You can change the default UUID using this command.

Some information about 16 bit and 128 bit UUIDs can be found at:

http://farwestab.wordpress.com/2011/02/05/some-tips-on-android-and-bluetooth/

Communication: Phone and Text

Email.send <recipient_sexp>, <subject_sexp>, <body_sexp>

The email message in the Body string expression will be sent to the named recipient with the named subject heading.

MyPhoneNumber <svar>

The phone number of the Android device will be returned in the string variable. If the device is not connected to a cellular network, the returned value will be uncertain.

Phone.call <sexp>

The phone number contained in the string expression will be called. Your device must be connected to a cellular network to make phone calls.

Phone.dial <sexp>

Open the phone dialer app. The phone number contained in the string expression will be displayed in the dialer. Alphabetic characters in the string will be converted to digits, as if the corresponding key of a phone pad had been touched.

Phone.rcv.init

Prepare to detect phone calls using phone.rcv.next.

Phone.rcv.next <state_nvar>, <number_svar>

The state of the phone will be returned in the state numeric value. A phone number may be returned in the string variable.

State = 0. The phone is idle. The phone number will be an empty string.

State = 1. The phone is ringing. The phone number will be in the string.

State = 2. The phone is off hook. If there is no phone number (an empty string) then an outgoing call is being made. If there is a phone number then an incoming phone call is in progress.

States 1 and 2 will be continuously reported as long the phone is ringing or the phone remains off hook.

Sms.send <number_sexp>, <message_sexp>

The SMS message in the string expression <message_sexp> will be sent to number in the string expression <number_sexp>. This command does not provide any feedback about the sending of the message. The device must be connected to a cellular network to send an SMS message.

Sms.rcv.init

Prepare to intercept received SMS using the sms.rcv.next command.

Sms.rcv.next <svar>

Read the next received SMS message from received SMS message queue in the string variable.

The returned string will contain "@" if there is no SMS message in the queue.

The sms.rcv.init command must be called before the first sms.rcv.next command is executed.

Example:

```
SMS.RCV.INIT
DO
       DO % Loop until SMS received
         PAUSE 5000 % Sleep of 5 seconds
         SMS.RCV.NEXT m$ % Try to get a new message
       UNTIL m$ <> "@" % "@" indicates no new message
```

```
        PRINT m$ % Print the new message
    UNTIL 0   % Loop forever
```

Time and Timers

Time and TimeZone Commands

The **TimeZone** commands allow you to manage the timezone used by the **Time** command and the **TIME(…)** function. They do not affect the no-parameter **TIME()** function. They affect only your BASIC! program, not any other time-related operation on your device.

See also the time functions **CLOCK()** and **TIME()**.

Time {<time_nexp>,} Year$, Month$, Day$, Hour$, Minute$, Second$, WeekDay, isDST

Returns the current (default) or specified date, time, weekday, and Daylight Saving Time flag in the variables.

You can use the optional first parameter (<time_nexp>) to specify what time to return in the variables. It is a numeric expression number of milliseconds from 12:00:00 AM, January 1, 1970, UTC, as returned by the **TIME()** functions. It may be negative, indicating a time before that date.

The day/date and time are returned as two-digit numeric strings with a leading zero when needed, except Year$ which is four characters.

The WeekDay is a number from 1 to 7, where 1 means Sunday. You can use it to index an array of day names in your language of choice.

The isDST flag is
 1 if the current or specified time is in Daylight Saving Time in the current timezone
 0 if the time is not in Daylight Saving Time (is Standard Time)
-1 if the system can't tell if the time is in DST

The current timezone is your local timezone unless you change it with the **TimeZone** commands.

All of the return variables are optional. That is, you can omit any of them, but if you want to return only some of them, you need to retain their position by including commas for the omitted return variables. For example:

```
t = TIME(2001, 2, 3, 4, 5, 6)
Time t, Y$, M$, D$        % sets only the year, month, and day
Time t, Y$, M$, D$,,,, W  % adds the day of the week (7, Saturday)
```

To do the same with the current time, leave out both the first parameter and its comma:

```
Time ,, day$,,,, wkday    % returns the today's day and weekday
```

TimeZone.set { <tz_sexp> }
Sets the timezone for your program. If you don't specify a timezone, it is set to the default for your device, which is based on where you are. If you specify a timezone your device does not recognize, it is set to "GMT". (In Android, GMT is exactly the same as UTC).

TimeZone.get <tz_svar>
Returns the current timezone in the string variable. This is the default timezone for your device and location, unless you have changed it with TimeZone.set.

TimeZone.list <tz_list_pointer_nexp>
While timezones are defined by international standards, the only ones that matter to your program are those recognized by your device. This command returns all valid timezone strings, putting them in the list that <tz_list_pointer_nexp> points at. The previous contents of the list are discarded. If the pointer does not specify a valid string list, and the expression is a numeric variable, a new list is created and the variable is set to point to the new list.

Timer Interrupt and Commands

You can set a timer that will interrupt the execution of your program at some set time interval. When this interrupt occurs program execution will transfer to the statements following the **onTimer:** label. When you have done whatever you need to do to handle this Timer event, you use the **Timer.Resume** command to resume the execution of the program at the point where the timer interrupt occurred.

The timer cannot interrupt an executing command. When the timer expires, it arms the interrupt. When the current command completes, the timer triggers, transferring control to the timer interrupt code after the **onTimer:** label. If the current command takes a long time to finish, it may appear that your interrupt is late.

The trigger disables the interrupt. Another timer expiration cannot arm the interrupt unless a Timer.Resume first enables the interrupt. The timer interrupt code must exit by running **Timer.Resume**, or the interrupt can occur only once.

Timer.set <interval_nexp>
Sets a timer that will repeatedly interrupt program execution after the specified time interval. The interval time units are milliseconds. The program must contain an **onTimer:** label when this command is executed.

OnTimer:
The label after which the timer interrupt code will be placed.

Timer.resume
Causes program execution to resume at the point where the timer interrupt occurred.

Timer.clear
Clears the repeating timer. No further timer interrupts will occur.

Sample Code

```
n=0
TIMER.SET 2000

DO
UNTIL n=4
TIMER.CLEAR
PRINT "Timer cleared. No further interrupts."
DO
UNTIL 0

ONTIMER:
n = n + 1
PRINT n*2; " seconds"
TIMER.RESUME
```

Miscellaneous Commands

Clipboard

Clipboard.get <svar>

Copies the current contents of the clipboard into <svar>

Clipboard.put <sexp>

Places <sexp> into the clipboard.

Echo.on

Same as debug.echo.on. See debug.echo.on for details.

Echo.off

Same as debug.echo.off. See debug.echo.off for details.

Encryption

Encrypts and decrypts a string using a supplied password. The encryption algorithm used is "PBEWithMD5AndDES".

Encrypt {<pw_sexp>}, <source_sexp>, <encrypted_svar>

Encrypts the string <source_sexp> using the password <pw_sexp>. The result is placed into the variable <encrypted_svar>.

The password parameter is optional, but its comma is required. Omitting the password is the same as using an empty string, "".

This command is the same as **ENCODE$("ENCRYPT", <pw_sexp>, <source_sexp>)**.

Decrypt <pw_sexp>, <encrypted_sexp>, <decrypted_svar>

Decrypts the encrypted string <encrypted_sexp> using the password <pw_sexp>. The result is placed in <decrypted_svar>.

The password parameter is optional, but its comma is required. Omitting the password is the same as using an empty string, "".

This command is the same as **DECODE$("ENCRYPT", <pw_sexp>, <source_sexp>)**.

Ringer

Android devices support three ringtone modes:

Value:	Meaning:	Behavior
0	Silent	Ringer is silent and does not vibrate
1	Vibrate	Ringer is silent but vibrates
2	Normal	Ringer may be audible and may vibrate

"Normal" behavior depends on other device settings set by the user.

Ringer volume is an integer number from zero to a device-dependent maximum. If the volume is zero the ringer is silent.

NOTE: These are system settings. Any change you make persists after your program ends. You may want to record the original settings and change them back when the program exits.

Ringer.get.mode <nvar>

Returns the current ringtone mode in the numeric variable.

Ringer.set.mode <nexp>

Changes the ringtone mode to the specified value. If the value is not a valid mode, the device mode is not changed.

Ringer.get.volume <vol_nvar> { , <max_nvar> }

Returns the ringer volume level in the numeric variable. Returns the maximum volume settting in <max_nvar>, if <max_nvar> is present.

Ringer.set.volume <nexp>

Changes the ringer volume to the specified value. If the value is less than zero, volume is set to zero. If the value is greater than the device-specific maximum, the volume is set to the maximum level.

String Operations

Split and **Join** are complementary operations. **Split** separates a string into parts and put the parts in an array. **Join** builds a string by combining the elements of an array.

See also the various String Functions.

Join <source_array$[]>, <result_svar> {, <separator_sexp>{, <wrapper_sexp}}

Join.all <source_array$[]>, <result_svar> {, <separator_sexp>{, <wrapper_sexp}}

The elements of the <source_array$[]> are joined together as a single string in the <result_svar>. By default, the source elements are joined with nothing between them or around them.

You may specify optional modifiers that add characters to the string. Copies of the separator string <separator_sexp> are written between source elements. Copies of the wrapper string <wrapper_sexp> are placed before and after the rest of the result string.

The **Join** command omits any empty source elements. The **Join.all** command includes all source elements in the result string, even if they are empty. There is no difference between the two commands unless you specify a non-empty separator string. **Join.all** places copies of the separator between all of the elements, including the empty ones.

An example of an operation that uses both separators and wrappers is a CSV string, for "comma-separated values".

```
InnerPlanets$ = "Mercury Venus Earth Mars"
SPLIT IP$[], InnerPlanets$
JOIN IP$[], PlanetsCSV$, "\",\"", "\""
PRINT PlanetsCSV$
```

This prints the string `"Mercury","Venus","Earth","Mars"` (including all of the quotes). The separator puts the `","` between planet names, and the wrapper puts the `"` at the beginning and end of the string.

Split <result_array$[]>, <sexp> {, <test_sexp>}

Split.all <result_array$[]>, <sexp> {, <test_sexp>}

Split the source string <sexp> into multiple strings and place them into <result_array$[]>. The string is split at each location where <test_sexp> occurs. The <test_sexp> occurrences are removed from the result strings. The <text_sexp> parameter is optional; if it is not given, the string is split on whitespace.

The <result_array$[]> is specified without an index. The array must not have been previously dimensioned.

If the beginning of the source string matches the test string, the first element of the result array will be an empty string. This differs from the **WORD$()** function, which strips leading and trailing occurrences of the test string from the source string before splitting.

Two adjacent occurrences of the test expression in the source expression result in an empty element somewhere in the result array. The **Split** command discards these empty strings if they occur at the end of the result array. To keep these trailing empty strings, use the **Split.all** command.

Example:

```
string$ = "a:b:c:d"
delimiter$ = ":"
```

```
SPLIT result$[], string$, delimiter$

ARRAY.LENGTH length, result$[]
FOR i = 1 TO length
PRINT result$[i] + " ";
NEXT i
PRINT ""
```

Prints: `a b c d`

Note: The <test_sexp> is actually a Regular Expression. If you are not getting the results that you expect from the <test_sexp> then you should examine the rules for Regular Expressions at:

http://developer.android.com/reference/java/util/regex/Pattern.html

Text To Speech

Your program can synthesize speech from text, either for immediate playback with the **TTS.speak** command or to create a sound file with **TTS.speak.toFile**.

Your device may come with the text-to-speech engine already enabled and configured, or you may need to set it up yourself in the Android Settings application. The details vary between different devices and versions of Android. Typically, the menu navigation looks like one of these:

Settings → Voice input & output → Text-to-speech settings
Settings → Language & input → Text-to-speech output

Unless you set an output language in the text-to-speech settings, the speech generated will be spoken in the current default language of the device. The menu path for setting the default language usually looks like one of these:

Settings → Language and keyboard → Select language
Settings → Language & input → Language

TTS.init

This command must be executed before speaking.

TTS.speak <sexp> {, <wait_lexp>}

Speaks the string expression. The statement does not return until the string has been fully spoken, unless the optional "wait" parameter is present and evaluates to false (numeric 0). Spoken expressions cannot overlap. A second **TTS.speak** (or a **TTS.speak.toFile**) will wait for the speech from an earlier **TTSts.speak** to finish, even if the "wait" flag was false.

TTS.speak.toFile <sexp> {, <path_sexp>}

Converts the string expression to speech and writes it into a wav file. You can specify the name and location of the file with the optional "path" parameter. The default path is "<pref base drive>/rfo-basic/data/tts.wav". The statement does not return until the speech synthesis is complete, but there is no guarantee the file-write is finished. If a previous **TTS.speak** is still speaking, this statement will not start until that speech completes.

TTS.stop

Waits for any outstanding speech to finish, then releases Android's text-to-speech engine. Following **TTS.stop**, if you want to run **TTS.speak** or **TTS.speak.toFile** again, you will have to run **TTS.init** again.

Speech To Text (Voice Recognition)

The Voice Recognition function on Android uses Google Servers to perform the recognition. This means that you must be connected to the Internet and logged into your Google account for this feature to work.

There are two commands for Speech to Text: **STT.listen** and **STT.results**.

STT.listen starts the voice recognition process with a dialog box. **STT.results** reports the interpretation of the voice with a list of strings.

The Speech to Text procedures are different for Graphics Mode, HTML mode and simple Console Output mode.

STT.listen {<prompt_sexp>}

Start the voice recognize process by displaying a "Speak Now" dialog box. The optional prompt string expression <prompt_sexp> sets the dialog box's prompt. If you do not provide the prompt parameter, the default prompt "BASIC! Speech To Text" is used.

Begin speaking when the dialog box appers.

The recognition will stop when there is a pause in the speaking.

STT.results should be executed next.

Note: **STT.listen** is *not* to be used in HTML mode.

STT.results <string_list_ptr_nexp>

The command must not be executed until after a **STT.listen** is executed (unless in HTML mode).

The recognizer returns several variations of what it thinks it heard as a list of strings. The first string in the list is the best guess.

The strings are written into the list that <string_list_ptr_nexp> points to. The previous contents of the list are discarded. If the pointer does not specify a valid string list, and the expression is a numeric variable, a new list is created and the variable is set to point to the new list.

Console Mode

The following code illustrates the command in Output Console (not HTML mode and not Graphics mode):

```
PRINT "Starting Recognizer"
STT.LISTEN
STT.RESULTS theList
LIST.SIZE theList, theSize
FOR k = 1 TO theSize
       LIST.GET theList, k, theText$
       PRINT theText$
NEXT k
END
```

Graphics Mode

This command sequence is to be used in graphics mode. Graphics mode exists after **Gr.open** and before **Gr.close**. (Note: Graphics mode is temporarily exited after **Gr.front 0**. Use the Console Mode if you have called **Gr.front 0**).

The primary difference is that **Gr.render** *must* be called after **STT.listen** and before **STT.results**.

```
PRINT "Starting Recognizer"
STT.LISTEN
GR.RENDER
STT.RESULTS theList
LIST.SIZE theList, theSize
FOR k =1 TO theSize
       LIST.GET theList, k, theText$
       PRINT theText$
NEXT k
END
```

HTML Mode

This command sequence is used while in HTML mode. HTML mode exists after **HTML.open** and before **HTML.close**.

The primary difference is that the **STT.listen** command is *not* used in HTML mode. The **STT.listen** function is performed by means of an HTML datalink sending back the string "STT". The sending of "STT" by means of the datalink causes the Speak Now dialog box to be displayed.

When the datalink "STT" string is received by the BASIC! program, the **STT.results** command can be executed normally as it will contain the recognized text.

The sample file, f37_html_demo.bas, along with the associated html file, htmlDemo1.html (located in "rfo-basic/data/") demonstrates the use of voice recognition in HTML mode.

Device <svar>

Returns information about your Android device in the string variable. The items returned are:

- The Device Brand, Device Model, Device Type, and OS
- The Language and Locale
- The PhoneType, PhoneNumber, and DeviceID
- The SN, MCC/MNC, and Network Provider stored on the SIM, if there is one.

The items are separated by newline characters; if you **PRINT** the returned string, it is displayed with one item on each line. For the meaning of each item, see **Device <nvar>**, below.

Device <nvar>|<nexp>

Returns information about your Android device in a Bundle. If you provide a variable that is not a valid Bundle pointer, the command creates a new Bundle and returns the Bundle pointer in your variable. Otherwise it writes into the Bundle your variable or expression points to.

The Bundle keys and possible values are in the table below. The Bundle values are all strings.

Key	Values	Meaning	**Example** (from emulator)
Brand	Any string	Brand name assigned by device manufacturer	generic
Model	Any string	Model identifier assigned by device manufacturer	sdk
Device	Any string	Device identifier assigned by device manufacturer	generic
Product	Any string	Product identifier assigned by device manufacturer	sdk
OS	OS Version	Android operating system version number	4.1.2
Language	Language name	Default language of this device	English
Locale	Locale code	Default locale code, typically language and country	en_US
PhoneType	**GSM**, **CDMA**, **SIP**, or **None**	Type of phone radio in this device	GSM
PhoneNumber	String of digits	Phone number registered to this device, if any	15555215554
DeviceID	String of digits	The unique device ID, such as the IMEI	000000000000000
SIM SN	String of digits or **Not available**	Serial number of the SIM card, if one is present and it is accessible	89014103211118510720
SIM MCC/MNC	String of digits or **Not available**	The "numeric name" of the provider of the SIM, if present and accessible	310260
SIM Provider	Name string or **Not available**	The name of the provider of the SIM, if present and accessible	Android

The information returned by the **Device** command is static. To get dynamic information, use the **Phone.Info** command.

Headset <state_nvar>, <type_svar>, <mic_nvar>

<state_nvar>: 1.0 if headset plugged in, -1 if no headset plugged in.

<type_svar>: A string describing the device type.

<mic_nvar>: 1.0 if the headset has a microphone, -1 if the headset does not have microphone.

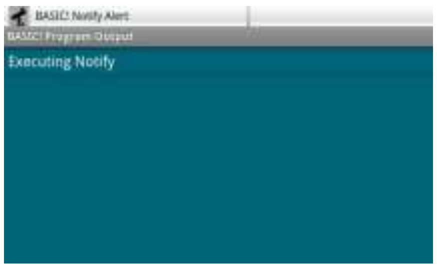
Notify <title_sexp>, <subtitle_sexp>, <alert_sexp>, <wait_lexp>

This command will cause a Notify object to be placed in the Notify (Status) bar.

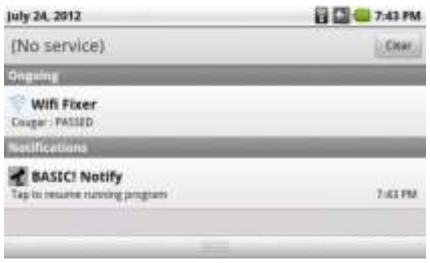
If <wait_lexp> is not zero (true), then the execution of the BASIC! program will be suspended until the user taps the Notify object. If the value is zero (false), the BASIC! program will continue executing.

The Notify object will be removed when the user taps the object.

```
Print "Executing Notify"
Notify "BASIC! Notify", "Tap to resume running program",~
"BASIC! Notify Alert", 1
! Execution is suspended and waiting for user to tap the Notify Object
Print "Notified"
```



Executing Notify



(No service)

Wifi Fixer
Cougar : PASSED

BASIC! Notify
Tap to resume running program 7:43 PM

Note: the icon that appears in the Notify object will be the icon for the application in user-built apk.

Phone.info <nvar>|<nexp>

Returns information about the telephony radio in your Android device, if it has one. The information is placed in a Bundle. If you provide a variable that is not a valid Bundle pointer, the command creates a new Bundle and returns the Bundle pointer in your variable. Otherwise it writes into the Bundle your variable or expression points to.

The Bundle keys and possible values are in the table below. Each entry's type is either N (Numeric) or S (String).

Key	Type	Values	Meaning	Example
PhoneType	S	**GSM**, **CDMA**, **SIP**, or **None**	Type of phone radio in this device	GSM
NetworkType	S	**GPRS**, **EDGE**, **UMTS**, **CDMA**, **EVDOrev0**, **EVDOrevA**, **1xRTT**, **HSDPA**, **HSUPA**, **HSPA**, **iDen**, **EDVOrevB**, **LTE**, **EHRPD**, **HSPAP+**, or **Unknown**	Network type of the current data connection	LTE

The **PhoneType** is the same as that returned by the **Device** command. It is static.

If the **PhoneType** is **GSM** and the phone is registered to a network, the **Phone.info** command also returns the following items in the Bundle:

Key	Type	Values	Meaning	Example
CID	N	A positive number or -1 if CID is unknown	GSM Cell ID	342298497
LAC	N	A positive number or -1 if LAC is unknown	GSM Location Area Code	11090
MCC/MNC	S	String of 5 or 6 decimal digits	The "numeric name" of the registered network operator	310260
Operator	N	A name string	The name of the operator of the registered network	T-Mobile

The "numeric name" is made up of the Mobile Country Code (MCC) and Mobile Network Code (MNC).

If the **PhoneType** is **CDMA** and the phone is registered to a network, the **Phone.info** command also returns the following items in the Bundle:

Key	Type	Values	Meaning
BaseID	N	A positive number or -1 if BaseID is unknown	CDMA base station identification number
NetworkID	N	A positive number or -1 if NetworkID is unknown	CDMA network identification number
SystemID	N	A positive number or -1 if SystemID is unknown	CDMA system identification number

Pause <ticks_nexp>

Stops the execution of the BASIC! program for <ticks_nexp> milliseconds. One millisecond = 1/1000 of a second. Pause 1000 will pause the program for one second.

Swap <nvar_a>|<svar_a>, <nvar_b>|<svar_b>

The values and in "a" and "b" numeric or string variables are swapped.

Tone <frequency_nexp>, <duration_nexp> {, <duration_chk_lexp}

Plays a tone of the specified frequency in hertz (cycles per second) for the specified duration in milliseconds.

The duration produced does not exactly match the specified duration. If you need to get an exact duration, experiment.

Each Android device has a minimum tone duration. By default, if you specify a duration less than this minimum, you get a run-time error message giving the minimum for your device. However, you can suppress the check by setting the optional duration check flag <duration_chk_lexp> to 0 (false). If you do this, the result you get depends on your device. You will not get a run-time error message, but you may or may not get the tone you expect.

Vibrate <pattern_array[{<start>,<length>}]>,<nexp>

The vibrate command causes the device to vibrate in the specified pattern. The pattern is held in a numeric array (pattern_array[]) or array segment (pattern_array[start,length]).

The pattern is of the form: pause-time, on-time, …, pause-time, on-time. The values for pause-time and on-time are durations in milliseconds. The pattern may be of any length. There must be at least two values to get a single buzz because the first value is a pause.

If <nexp> = -1 then the pattern will play once and not repeat.
If <nexp> = 0 then the pattern will continue to play over and over again until the program ends.
If <nexp> > 0 then the pattern play will be cancelled.

See the sample program, **f21_sos.bas**, for an example of **Vibrate**.

WakeLock <code_nexp>

The **WakeLock** command modifies the system screen timeout function. The <code_nexp> may be one of five values. Values 1 through 4 modify the screen timeout in various ways. Code value 5 releases the WakeLock and restores the system screen timeout function.

Code	WakeLock Type	CPU	Screen	Keyboard Light
1	Partial WakeLock	On*	Off	Off
2	Screen Dim	On	Dim	Off
3	Screen Bright	On	Bright	Off
4	Full WakeLock	On	Bright	Bright
5	No WakeLock	Off	Off	Off

** If you hold a partial WakeLock, the CPU will continue to run, regardless of any timers and even after the user taps the power button. In all other WakeLocks, the CPU will run, but the user can still put the device to sleep using the power button.*

Use the WakeLock only when you really need it. Acquiring a WakeLock increases power usage and decreases battery life. The WakeLock is always released when the program stops running.

One of the common uses for **WakeLock** would be in a music player that needs to keep the music playing after the system screen timeout interval. Implementing this requires that BASIC! be kept running. One way to do this is to put BASIC! into an infinite loop:

```
Audio.load n,"B5b.mp3"
Audio.play n
WakeLock 1
Do
  Pause 30000
Until 0
```

The screen will turn off when the system screen timeout expires but the music will continue to play.

WifiLock <code_nexp>

The **WifiLock** command allows your program to keep the WiFi connection awake when a time-out would normally turn it off. The <code_nexp> may be one of four values. Values 1 through 3 acquire a WifiLock, changing the way WiFi behaves when the screen turns off. Code value 4 releases the WifiLock and restores the normal timeout behavior.

Code:	WiFiLock Type	WiFi Operation When Screen is Off
1	Scan Only	WiFi kept active, but only operation is initiating scan and reporting scan results
2	Full	WiFi behaves normally
3	Full High-Performance	WiFi operates at high performance with minimum packet loss and low latency*
4	No WiFiLock	WiFi turns off (may be settable on some devices)

*Full Hi-Perf mode is not available on all Android devices. Devices running Android 3.0.x or earlier, and devices without the necessary hardware, will run in Full mode instead.

Use **WifiLock** only when you really need it. Acquiring a WifiLock increases power usage and decreases battery life. The WifiLock is always released when the program stops running.

WiFi.info {{<SSID_svar>}{, <BSSID_svar>}{, <MAC_svar>}{, <IP_var>}{, <speed_nvar>}}

Gets information about the current Wi-Fi connection and places it in the return variables.

All of the parameters are optional but positional: you can omit any parameter, but you must have the correct number of commas before any parameter you want to use. The table shows the available data:

Variable	Type	Returned Data	Format
SSID	String	SSID of current 802.11 network	"name" or hex digits (see below)
BSSID	String	BSSID of current access point	xx:xx:xx:xx:xx:xx (MAC address)
MAC	String	MAC address of your WiFi	xx:xx:xx:xx:xx:xx
IP	Numeric or String	IP address of your WiFi	Number or octets (see below)
speed	Numeric	Current link speed in Mbps	Number

Format notes:

- SSID: If the network is named, the name is returned, surrounded by double quotes. Otherwise the returned name is a string of hex digits.
- IP: If you provide a numeric variable, your Wi-Fi IP address is returned as a single number. If you provide a string variable, the number is converted to a standard four-octet string. For example, the string format 10.70.13.143 is the same IP address as the number -1887287798 (hex 8f82460a).

Home

The **HOME** command does exactly what tapping the HOME key would do. The Home Screen is displayed while the BASIC! program continues to run in the background.

OnBackGround:

When the Background/Foreground state changes, if this label is present in the program than the currently executing program will be interrupted and the code following the label will be executed. The **Background()** function should be used to determine the new state. The interrupted code should be resumed by executing **Background.Resume**.

Background.resume

Resumes the execution of the program interrupted by a Background/Foreground state change.

SQLITE

Overview

The Android operating system provides the ability to create, maintain and access SQLite databases. SQLite implements a self-contained, serverless, zero-configuration, transactional SQL database engine. SQLite is the most widely deployed SQL database engine in the world. The full details about SQLite can be found at the SQLite Home Page (http://www.sqlite.org/).

An excellent online tutorial on SQL can be found at www.w3schools.com (http://www.w3schools.com/sql/default.asp).

Database files will be created on the base drive (usually the SD card) in the directory, "<pref base drive>/rfo-basic/databases/ ".

SQLITE Commands

Sql.open <DB_pointer_nvar>, <DB_name_sexp>

Opens a database for access. If the database does not exist, it will be created.

<DB_pointer_nvar> is a pointer to the newly opened database. This value will be set by the sql.open command operation. <DB_pointer_nvar> is used in subsequent database commands and should not be altered.

<DB_name_sexp> is the filename used to hold this database. The base reference directory is "<pref base drive>/com.rfo.basic/databases/". If <DB_name_sexp> = ":memory:" then a temporary database will be created in memory.

Note: You may have more than one database opened at same time. Each opened database must have its own, distinct pointer.

Sql.close <DB_pointer_nvar>

Closes a previously opened database. <DB_pointer_nvar> will be set to zero. The variable may then be reused in another sql.open command. You should always close an opened database when you are done with it. Not closing a database can reduce the amount of memory available on your Android device.

Sql.new_table <DB_pointer_nvar>, <table_name_sexp>, C1$, C2$, ...,CN$

A single database may contain many tables. A table is made of rows of data. A row of data consists of columns of values. Each value column has a column name associated with it.

This command creates a new table with the name <table_name_sexp> in the referenced opened database. The column names for that table are defined by the following: C1$, C2$, ..., CN$. At least one column name is required. You may create as many column names as you need.

BASIC! always adds a Row Index Column named "_id" to every table. The value in this Row Index Column is automatically incremented by one for each new row inserted. This gives each row in the table a unique identifier. This identifier can be used to connect information in one table to another table. For example, the _id value for customer information in a customer table can be used to link specific orders to specific customers in an outstanding order database.

Sql.drop_table <DB_pointer_nvar>, <table_name_sexp>

The table named <table_name_sexp> in the opened database pointed to by <DB_pointer_nvar> will be dropped from the database if the table exists.

Sql.insert <DB_pointer_nvar>, <table_name_sexp>, C1$, V1$, C2$, V2$, ..., CN$, VN$

Inserts a new row of data columns and values into a table in a previously opened database.

The <table_name_sexp> is the name of the table into which the data is to be inserted. All newly inserted rows are inserted after the last, existing row of the table.

C1$, V1$, C2$, V2$, ..., CN$, VN$: The column name and value pairs for the new row. These parameters must be in pairs. The column names must match the column names used to create the table. Note that the values are all strings. When you need a numeric value for a column, use the BASIC! STR$(n) to convert the number into a string. You can also use the BASIC! FORMAT$(pattern$, N) to create a formatted number for a value. (The Values-as-strings requirement is a BASIC! SQL Interface requirement, not a SQLite requirement. While SQLite, itself, stores all values as strings, it provides transparent conversions to other data types. I have chosen not to complicate the interface with access to these SQLite conversions since BASIC! provides its own conversion capabilities.)

Sql.query <cursor_nvar>, <DB_pointer_nvar>, <table_name_sexp>, <columns_sexp> {, <where_sexp> {, <order_sexp>} }

Queries a table of a previously-opened database for some specific data. The command will return a Cursor named <Cursor_nvar> to be used in stepping through query results.

The <columns_sexp> is a string expression with a list of the names of the columns to be returned. The column names must be separated by commas. An example is Columns$ = "First_name, Last_name, Sex, Age". If you want to get the automatically incremented Row Index Column then include the "_id" column name in your column list. Columns may be listed in any order. The column order used in the query will be the order in which the rows are returned.

The optional <where_sexp> is an SQL expression string used to select which rows to return. In general, an SQL expression is of the form <Column Name> <operator> <Value>. For example, Where$ = "First_name = 'John' " Note that the Value must be contained in single quotes. Full details about the SQL expressions can be found here. If the Where parameter is omitted, all rows will be returned.

The optional <order_sexp> specifies the order in which the rows are to be returned. It identifies the column upon which the output rows are to be sorted. It also specifies whether the rows are to be sorted in ascending (ASC) or descending (DESC) order. For example, Order$ = "Last_Name ASC" would return the rows sorted by Last_Name from A to Z. If the Order parameter is omitted, the rows are not sorted.

If the Order parameter is present, the Where parameter must be present. If you want to return all rows, just set Where$ = ""

Sql.query.length <length_nvar>, <cursor_nvar>

Report the number of records returned by a previous Query command, Given the Cursor returned by a Query, the command writes the number of records into <length_nvar>. This command cannot be used after all of the data has been read.

Sql.query.position <position_nvar>, <cursor_nvar>

Report the record number most recently read using the Cursor of a Query command. Given the Cursor returned by a Query, the command writes the position of the Cursor into <Position_nvar>. Before the first Next command, the Position is 0. It is incremented by each Next command. A Next command after the last row is read sets its Done variable to true and resets the Cursor to 0. The Cursor can no longer be used, and this command can no longer be used with that Cursor.

Sql.next <done_lvar>, <cursor_nvar>, C1V$, C2V$, ..., CNV$

Using the Cursor generated by a previous Query command, step to the Next row of data returned by the query.

C1V$, C2V$,CNV$ are the values associated with the columns listed in the Query Columns$ string. If any of your values are numeric values that you need to use in arithmetic operations, you can use the BASIC! VAL(str$) function to convert the value to a number.

The <Done_lvar> parameter is a Boolean used to signal that the last row of the Query returned rows has been read. When the last returned row has been read, <Done_lvar> changes from 0 (false) to 1 (true). When <Done_lvar> becomes true, the Cursor variable is reset to zero. It can no longer be used for sql.next operations. It may be used in a subsequent sql.query statement.

You may have more than one Cursor opened at a time. Each opened Cursor would, of course, have a different variable name.

Sql.delete <DB_pointer_nvar>, <table_name_sexp>{,<where_sexp>{,<count_nvar>} }

From the named table of a previously opened database, delete rows selected by the conditions established by the Where string expression. The Count variable reports the number of rows deleted.

The formation of the Where string is exactly the same as described in the sql.query command. Both Where and Count are optional. If the Where string is omitted all rows are deleted, and the Count variable must be omitted, too.

Sql.update <DB_pointer_nvar>, <table_name_sexp>, C1$, V1$, C2$, V2$,...,CN$, VN${: <where_sexp>}

In the named table of a previously opened database, change column values in specific rows selected by the Where$ parameter <where_sexp>. The C$,V$ parameters must be in pairs. The colon character terminates the C$,V$ list and must precede the Where$ in this command. The Where$ parameter and preceding colon are optional.

BASIC! also uses the colon character to separate multiple commands on a single line. The use of colon in this command conflicts with that feature, so you must use caution when using both features together.

If you put a colon on a line after this command, the pre-processor **always** assumes the colon is part of the command and not a command separator. If you are not certain of the outcome, the safest action is to put the **Sql.update** command on a line by itself, or at the end of a multi-command lne.

Sql.exec <DB_pointer_nvar>, <command_sexp>

Execute ANY non-query SQL command string ("CREATE TABLE", "DELETE", "INSERT", etc.) using a previously opened database.

Sql.raw_query <cursor_nvar>, <DB_pointer_nvar>, <query_sexp>

Execute ANY SQL Query command using a previously opened database and return a Cursor for the results.

Graphics

Introduction

The Graphics Screen and Graphics Mode

Graphics are displayed on a new screen that is different from the BASIC! Text Output Screen. The Text Output Screen still exists and can still be written to. You can be returned to the text screen using the BACK key or by having the program execute the **Gr.front** command.

The **Gr.open** command opens the graphics screen and puts BASIC! into the graphics mode. BASIC! must be in graphics mode before any other graphics commands can be executed. Attempting to execute any graphics command when not in the graphics mode will result in a run-time error. The **Gr.**close command closes the graphics screen and turns off graphics mode. The graphics mode automatically turns off when the BACK key or MENU key is tapped. BASIC! will continue to run after the BACK key or MENU key is tapped when in graphics mode but the Output Console will be shown.

The BASIC! Output Console is hidden when the graphics screen is being displayed. No run-time error messages will be observable. A haptic feedback alert signals a run-time error. This haptic feedback will be a distinct, short buzz. Tap the BACK key to close the Graphics Screen upon feeling this alert. The error messages can then read from the BASIC! Output Console.

Use the **Gr.front** command can to swap the front-most screen between the Output Console and the graphics screen.

Commands that use a new window or screen to interact with the user (**Input**, **Select** and others) may be used in graphics mode.

When your program ends, the graphics screen will be closed. If you want to keep the graphics screen showing, use a long pause or an infinite loop to keep the program from ending:

```
! Stay running to keep the graphics screen showing
do
until 0
```

Depending on your application, you may want to add a **Pause** to the loop to conserve battery power. Tap the BACK key to break out of the infinite loop. The BACK key ends your program unless you trap it with the **OnBackKey:** interrupt label.

Display Lists

Each command that draws a graphical object (line, circle, text, etc.) places that object on a list called the Object List. The command returns the object's Object Number. This Object Number, or Object Pointer, is the object’s position in the Object List. This Object Number can be used to change the object on the fly. You can change the parameters of any object in the Object List with the **Gr.modify** command. This feature allows you easily to create animations without the overhead of having to recreate every object in the Object List.

To draw graphical objects on the graphics screen, BASIC! uses a Display List. The Display List contains pointers to graphical objects on the Object List. Each time a graphical object is added to the Object List, its Object Number is also added to the Display List. Objects are drawn on the screen in the order in which they appear in the Display List. The Display List objects are not visible on the screen until the **Gr.render** command is called.

You may optionally use the **Gr.NewDL** command to replace the current Display List with a custom display list array. This custom display list array may contain some or all of the Object Numbers in the Object List.

One use for custom display lists is to change the Z order of the objects. In other words you can use this feature to change which objects will be drawn on top of other objects.

See the Sample Program file, f24_newdl, for a working example of **Gr.NewDL**.

Drawing Coordinates

The size and location of an object drawn on the screen are specified in pixels. The coordinates of the pixel at the upper-left corner of the screen are x = 0 (horizontal position) and y = 0 (vertical position). Coordinate values increase from left to right and from top to bottom of the screen.

Coordinates are measured with respect to the physical screen, not to anything on it. If you choose to show the Android Status Bar, anything you draw at the top of the screen is covered by the Status Bar.

Drawing into Bitmaps

You can draw into bitmaps in addition to drawing directly to the screen. You notify BASIC! that you want to start drawing into a bitmap instead of the screen with the **Gr.bitmap.drawinto.start** command. This puts BASIC! into the draw-into-bitmap mode. All draw commands issued while in this mode will draw directly into the bitmap. The objects drawn in this mode will not be placed into the Object List. The Object Number returned by a draw command while in this mode is invalid and should not be used for any purpose including **Gr.modify**.

The draw-into-bitmap mode is ended by the **Gr.bitmap.drawinto.end** command. Subsequent draw commands will place the objects on the Object List and object numbers in the Display List for rendering on the screen. If you wish to display the drawn-into bitmap on the screen, issue a **Gr.bitmap.draw** command for that bitmap. The drawn-into bitmap may be drawn at any time before, during or after the draw-into process.

Colors

Android colors consist of a mixture of Red, Green and Blue. Each of the colors can have numerical values ranging from 0 to 255. Black occurs when all three values are zero. White occurs when all three values are 255. Solid Red would occur with Red having a value of 255 while Blue and Green are zero.

Colors also have what is called an Alpha Channel. The Alpha Channel describes the level of opaqueness of the color. An Alpha value of 255 is totally opaque. No object of any color can show through an object with an Alpha value of 255. An Alpha value of zero will render the object invisible.

Paints

BASIC! has Paint objects. A Paint object holds drawing information about a graphical object. This includes the color, font size, style and so forth. The last created Paint object is associated with a graphical object when a draw command is executed.

Each command that affects the current Paint (**Gr.color**, **Gr.text.size**, etc.) first copies the current Paint and then modifies it to make a new Paint, which then becomes the current Paint.

You can get a pointer to the current Paint with the **Gr.paint.get** command. You can get a pointer to the Paint associated with any graphical object by using the "paint" tag with **Gr.get.value** command.

Hardware-accelerated Graphics

Many Android devices since 3.0 (Honeycomb) support hardware acceleration of some graphical operations. An app that can use the hardware Graphics Processor (GPU) may run significantly faster than one that cannot use the GPU. Some of BASIC!'s graphical operations do not work with hardware-acceleration, so it is disabled by default. You can turn it on with the **Graphic Acceleration** item of the **Editor->Menu->Preferences** screen.

If you enable accelerated graphics, test your app thoroughly, comparing it to what you see with acceleration off. If you see blurring, missing objects, or other problems, leave acceleration disabled.

Graphics Setup Commands

Gr.open {{alpha}{, red}{, green}{, blue}{, <ShowStatusBar_lexp>}{, <Orientation_nexp>}}

Opens the Graphics Screen and puts BASIC! into Graphics Mode. The color values become the background color of the graphics screen. The default color is opaque white (255,255,255,255).

All of the parameters are optional but positional: you can omit any parameter, but you must have the correct number of commas before any parameter you want to use.

Each of the four color parameters is a numeric expression with a value from 0 through 255. If a value is outside of this range, only the last eight bits of the value are used; for example, 257 and 1025 are the same as 1. If any color parameter is omitted, it is set to 255.

The Status Bar will be shown on the graphics screen if the <ShowStatusBar_lexp> is true (not zero). If the <ShowStatusBar_lexp> is not present, the Status Bar will not be shown.

The orientation upon opening graphics will be determined by the <Orientation_nexp> value. <Orientation_nexp> values are the same as values for the **Gr.orientation** command (see below). If the <Orientation_nexp> is not present, the default orientation is Landscape.

Gr.color {{alpha}{, red}{, green}{, blue}{, style}}

Sets the current color and style for drawing objects. The current color will be used for whatever graphical objects are subsequently drawn until the next color command is executed.

All of the parameters are optional but positional: you can omit any parameter, but you must have the correct number of commas before any parameter you want to use.

Each of the four color parameters is a numeric expression with a value from 0 through 255. If a value is outside of this range, only the last eight bits of the value are used; for example, 257 and 1025 are the same as 1. If any parameter is omitted, that component of the current color is left unchanged. For example, **GR.color ,,0** sets only green to 0, leaving alpha, red, blue, and style as they were.

The style parameter, is a numeric expression that determines the stroking and filling of objects. "Stroking" means only the perimeter of the object is drawn, while leaving interior pixels unchanged. "Filling" means only the interior pixels are colored. The possible values for <style_nexp> are:

> 0: STROKE. Geometry and text drawn with this style will be stroked, respecting the stroke-related fields on the paint.
>
> 1: FILL. Geometry and text drawn with this style will be filled, ignoring all stroke-related settings in the paint.
>
> 2: STROKE_AND_FILL. Geometry and text drawn with this style will be both filled and stroked at the same time, respecting the stroke-related fields on the paint.

You can change the stroke weight with commands such as **Gr.set.stroke** (see below) and the various text style commands. If you never set the style, the default value is 1, FILL.

Gr.set.antialias <lexp>

If <lexp> is false (0), AntiAlias will be turned off. If the value is true (not zero) then AntiAlias will be turned on. AntiAlias should generally be on. It is on by default.

AntiAlias must be off to draw single-pixel pixels and single-pixel-wide horizontal and vertical lines.

Gr.set.stroke <nexp>

Sets the line width of objects drawn after this command is issued. The <nexp> value must be >=0. Zero produces the thinnest line and is the default stroke value.

The thinnest horizontal lines and vertical lines will be two pixels wide if AntiAlias is on. Turn AntiAlias off to draw single-pixel-wide horizontal and vertical lines.

Pixels drawn by the **Gr.set.pixels** command will be drawn as a 2x2 matrix if AntiAlias is on. To draw single-pixel pixels, set AntiAlias off and set the stroke = 0.

Gr.orientation <nexp>

The value of the <nexp> sets the orientation of screen as follows:

> -1 = Orientation depends upon the sensors.
> 0 = Orientation is forced to Landscape.
> 1 = Orientation is forced to Portrait.

You can monitor changes in orientation by reading the screen width and height using the the **Gr.screen** command.

Gr.statusbar {<height_nvar>} {, showing_lvar}

Returns information about the Status Bar. If the **height** variable <height_nvar> is present, it is set to the nominal height of the Status Bar. If the **showing** flag <showing_lvar> is present, it is set to **0** (false, not showing) or **1** (true, showing) based on on how Graphics Mode was opened.

The parameters are both optional but positional. That is, if you omit the first parameter but use the second, you must keep the comma.

Gr.statusbar.show <nexp>

This command has been deprecated. To show the status bar on the graphics screen, use the optional fifth parameter in **Gr.open**.

Gr.render

This command displays all the objects that are listed in the current working Display List. It is not necessary to have a **Pause** command after a **Gr.render**. The **Gr.render** command will not complete until the contents of the Display List have been fully displayed.

If BASIC! is running in the background (see **Background()** function and **Home** command), **Gr.render** will not execute. It will pause your program until you return BASIC! to the foreground.

Gr.screen width, height{, density }

Returns the screen's width and height, and optionally its density, in the numeric variables. The density, in dots per inch (dpi), is a standardized Android density value (usually 120, 160, or 240 dpi), and not necessarily the real physical density of the screen.

This command should be executed after the execution of any **Gr.orientation** command. This is because the **Gr.orientation** command swaps the height and width so the values for height and width will be different if the orientation is changed.

Gr.scale x_factor, y_factor

Scale all drawing commands by the numeric x and y scale factors. This command is provided to allow you to draw in a device-independent manner and then scale the drawing to the actual size of the screen that your program is running on. For example:

```
! Set the device independent sizes
di_height = 480
di_width = 800

! Get the actual width and height
gr.open 255, 255, 255, 255
gr.orientation 0
gr.screen actual_w, actual_h
```

```
        ! Calculate the scale factors
        scale_width = actual_w /di_width
        scale_height = actual_h /di_height

        ! Set the scale
        gr.scale scale_width, scale_height
```

Now, start drawing based upon di_height and di_width. The drawings will be scaled to fit the device running the program.

Gr.cls

Clears the graphics screen. Deletes all previously drawn objects; all existing object references are invalid. Deletes all existing Paints and resets all **Gr.color** or **Gr.text** {size|align|bold|strike|underline|skew} settings. Disposes of the current Object List and Display List and creates a new Initial Display List.

Note: bitmaps are not deleted. They will not be drawn because no graphical objects point to them, but the bitmaps still exist. Variables that point to them remain valid.

The **Gr.render** command must be called to make the cleared screen visible to the user.

Gr.close

Closes the opened graphics mode. The program will continue to run. The graphics screen will be removed. The text output screen will be displayed.

Gr.front flag

Determines whether the graphics screen or the Output Console will be the front-most screen. If flag = 0, the Output Console will be the front-most screen and seen by the user. If flag <>0, the graphics screen will be the front-most screen and seen by the user.

One use for this command is to display the Output Console to the user while in graphics mode. Use **Gr.front 0** to show text output and **Gr.front 1** to switch back to the graphics screen.

Note: When the Output Console is in front of the graphics screen, you can still draw (but not render) onto the graphics screen. The **Gr.front 1** must be executed before any **Gr.render**.

Print commands will continue to print to the Output Console even while the graphic screen is in front.

Gr.brightness <nexp>

Sets the brightness of the graphics screen. The value of the numeric expression should be between 0.01 (darkest) and 1.00 (brightest).

Graphical Object Creation Commands

These commands create graphical objects and add them to the Object List, also adding their Object Numbers to the Display List. You create each object with parameters that describe what to draw and where. Once it is created, you can read back its parameters by name with the **Gr.get.value** command. You can change any parameter with the **Gr.modify** command. The parameters you can modify are listed with each command's description. Along with the parameters listed with each command, every graphical object has two other modifiable parameters, "paint" and "alpha". See the **Gr.modify** and **Gr.paint.get** command descriptions for more details.

There are three commands that create graphical objects that are not in this section: Gr.text.draw, **Gr.bitmap.draw**, and **Gr.clip**.

Gr.point <object_number_nvar>, x, y

Creates a point object. The point will be located at (x,y). The <object_number_nvar> returns the Object List object number for this point. This object will not be visible until the **Gr.render** command is called.

The appearance of the point object is affected by the current stroke weight and the AntiAlias setting. The object is rendered as a square, centered on (x,y) and as big as the current stroke. If AntiAlias is on, it will blur the point, making it larger and dimmer. To color a single pixel, use **Gr.set.stroke 0** and **Gr.set.antialias 0**.

The **Gr.modify** parameters for **Gr.point** are: "x" and "y".

Gr.line <object_number_nvar>, x1, y1, x2, y2

Creates a line object. The line will start at (x1,y1) and end at (x2,y2). The <object_number_nvar> returns the Object List object number for this line. This object will not be visible until the **Gr.render** command is called.

The thinnest horizontal lines and vertical lines are drawn with **Gr.set.stroke 0**. These lines will be two pixels wide if AntiAlias is on. Turn AntiAlias off to draw single-pixel wide horizontal and vertical lines.

The **Gr.modify** parameters for **Gr.line** are: "x1", "y1", "x2" and "y2".

Gr.rect <object_number_nvar>, left, top, right, bottom

Creates a rectangle object. The rectangle will be located within the bounds of the parameters. The rectangle will or will not be filled depending upon the **Gr.color** style parameter. The <object_number_nvar> returns the Object List object number for this rectangle. This object will not be visible until the **Gr.render** command is called.

The **Gr.modify** parameters for **Gr.rect** are: "left", "top", "right" and "bottom".

Gr.oval <object_number_nvar>, left, top, right, bottom

Creates an oval-shaped object. The oval will be located within the bounds of the parameters. The oval will or will not be filled depending upon the **Gr.color** style parameter. The <object_number_nvar> returns the Object List object number for this oval. This object will not be visible until the **Gr.render** command is called.

The **Gr.modify** parameters for **Gr.oval** are: "left", "top", "right" and "bottom".

Gr.arc <object_number_nvar>, left, top, right, bottom, start_angle, sweep_angle, fill_mode

Creates an arc-shaped object. The arc will be created within the rectangle described by the parameters. It will start at the specified start_angle and sweep clockwise through the specified sweep_angle. The angle values are in degrees.

The effect of the fill_mode parameter depends on the **Gr.color** style parameter:

- Style 0, fill_mode false: Only the arc is drawn.
- Style 0, fill_mode true: The arc is drawn with lines connecting each endpoint to the center of the bounding rectangle. The resulting closed figure is not filled.
- Style non-0, fill_mode false: The endpoints of the arc are connected by a single straight line. The resulting figure is filled.
- Style non-0, fill_mode true: The arc is drawn with lines connecting each endpoint to the center of the bounding rectangle. The resulting closed figure is filled.

The <object_number_nvar> returns the Object List object number for this arc. This object will not be visible until the **Gr.render** command is called.

The **Gr.modify** parameters for **Gr.arc** are: "left", "top", "right", "bottom", "start_angle", "sweep_angle" and "fill_mode". The value for "fill_mode" is either false (0) or true (not 0).

Gr.circle <object_number_nvar>, x, y, radius

Creates a circle object. The circle will be created with the given radius around the designated center (x,y) coordinates. The circle will or will not be filled depending upon the **Gr.color** style parameter. The <object_number_nvar> returns the Object List object number for this circle. This object will not be visible until the **Gr.render** command is called.

The **Gr.modify** parameters for **Gr.circle** are "x", "y", and "radius".

Gr.set.pixels <object_number_nvar>, pixels[{<start>,<length>}] {,x,y}

Inserts an array of pixel points into the Object List. The array (pixels[]) or array segment (pixels[start,length]) contains pairs of x and y coordinates for each pixel. The pixels[] array or array segment may be any size but must have an even number of elements.

If the optional x,y expression pair is present, the values will be added to each of the x and y coordinates of the array. This provides the ability to move the pixel array around the screen. The default values for the x,y pair is 0,0. Negative values for the x,y pair are valid.

Pixels will be drawn as 2x2 matrix pixels if AntiAlias is on and the stroke = 0. To draw single-pixel pixels, set AntiAlias off and set the stroke = 0. AntiAlias in on by default.

The <object_number_nvar> returns the Object List object number for the object. The pixels will not be visible until the **Gr.render** command is called.

The **Gr.modify** parameters for this command are "x" and "y".

In addition to modify, the individual elements of the pixel array can be changed on the fly. For example:

```
	Pixels[3] = 120
	Pixels[4] = 200
```

will cause the second pixel to be located at x = 120, y = 200 at the next rendering.

Gr.poly <object_number_nvar>, list_pointer {,x, y}

Creates an object that draws a closed polygon of any number of sides.

The list_pointer is a pointer to a List data structure. The list contains x,y coordinate pairs. The first coordinate pair defines the point at which the polygon drawing start. Each subsequent coordinate pair defines a line drawn from the previous coordinate pair to this coordinate pair.

BASIC! automatically draws the final line from the last given coordinate pair to the first coordinate pair. This is to ensure that the polygon is closed.

The minimum number of coordinate pairs is three pairs (six values). Three pairs define a triangle.

The polygon line width, line color, alpha and fill is determined by previous **Gr.color** and **Gr.set.stroke** commands just like any other drawn object.

If the optional x,y expression pair is present, the values will be added to each of the x and y coordinates of the list. This provides the ability to move the polygon array around the screen. The default values for the x,y pair is 0,0. Negative values for the x,y pair are valid.

The <object_number_nvar> returns the Object List object number for this polygon. This object will not be visible until the **Gr.render** command is called.

The **Gr.modify** parameters are "x", "y" and "list".

See the Sample Program file, f30_poly, for working examples of **Gr.poly**.

Groups

You can put graphical objects into groups. A group is a list of graphical objects. When you perform certain operation on a group, the operation is performed on each object in the group.

You group graphical objects by creating a Group Object on the Display List. You use the group by putting its object number in a graphics command where you would use any other graphical object number.

In this version of BASIC!, you can use a Group Object in these commands:

- **Gr.move**: moves all of the objects by the same x and y amounts
- **Gr.hide**: hides all of the objects
- **Gr.show**: shows (unhides) all of the objects
- **Gr.show.toggle**: any objects that are showing will be hidden, and any objects that are hidden will be shown.

You use graphics commands to act on the objects in the group's list. You use the **List** commands to act on the list: add objects, count the objects, clear the list, and so on.

Gr.group <object_number_nvar>{, <obj_nexp>}...

Creates a group of graphical objects. All of the numeric expressions <obj_nexp> must evaluate to valid graphical object numbers. The object numbers are put in a list and attached to the group.

The <object_number_nvar> returns the Object List object number for the group.

The **Gr.modify** parameter is "list".

Gr.group.list <object_number_nvar>, <list_ptr_nexp>

Creates a group from a list of graphical objects. The List is assumed to contain valid graphical object numbers, but it is not checked. The list is simply attached to the group.

The list pointer parameter <list_ptr_nexp> is optional. If you provide an expression that evaluates to a valid List pointer, the List that the pointer addresses supplies the graphical objects that are put in the group. Otherwise, the group is empty. If you provide a numeric variable that does not already point to a list, the variable is set to point to the group's empty list.

The <object_number_nvar> returns the Object List object number for the group.

The **Gr.modify** parameter is "list".

Gr.group.getDL <object_number_nvar>

Creates a group from the current Display List. The Display List is copied to a new list that is attached to the group.

The <object_number_nvar> returns the Object List object number for the group.

The **Gr.modify** parameter is "list".

Gr.group.newDL <object_number_nvar>

Replaces the existing Display List with a new list read from the specified group.

The <object_number_nvar> returns the Object List object number for the group.

The **Gr.modify** parameter is "list".

Hide and Show Commands

Gr.hide <object_number_nexp>

Hides the object with the specified Object Number. If the Object is a Group, all of the Graphical Objects in the Group are hidden. This change will not be visible until the **Gr.render** command is called.

Gr.show <object_number_nexp>
Shows (unhides) the object with the specified Object Number. If the Object is a Group, all of the Graphical Objects in the Group are shown. This change will not be visible until the **Gr.render** command is called.

Gr.show.toggle <object_number_nexp>
Toggles visibility of the object with the specified Object Number. If it is hidden, it will be shown. If it is shown, it will be hidden. If the Object is a Group, all of the Graphical Objects in the Group are toggled. This change will not be visible until the **Gr.render** command is called.

Touch Query Commands

If the user touches the screen and then moves the finger without lifting the finger from the screen, the motion can be tracked by repeatedly calling on the touch query commands. This will allow you to program the dragging of graphical objects around the screen. The Sample Program, f23_breakout.bas, illustrates this with the code that moves the paddle.

The OnGrTouch: label can be used optionally to interrupt your program when a new touch is detected.

The touch commands report on one- or two-finger touches on the screen. If the two fingers cross each other on the x-axis then touch and touch2 will swap.

Gr.touch touched, x, y
Tests for a touch on the graphics screen. If the screen is being touched, Touched is returned as true (not 0) with the (x,y) coordinates of the touch. If the screen is not currently touched, Touched returns false (0) with the (x,y) coordinates of the last previous touch. If the screen has never been touched, the x and y variables are left unchanged. The command continues to return true as long as the screen remains touched.

If you want to detect a single short tap, after detecting the touch, you should loop until touched is false.
```
do
gr.touch touched, x, y
until touched

~ Touch detected, now wait for
~ finger lifted
do
gr.touch touched, x, y
until !touched.
```

The returned values are relative to the actual screen size. If you have scaled the screen then you need to similarly scale the returned parameters. If the parameters that you used in **Gr.scale** were scale_x and scale_y (**Gr.scale scale_x, scale_y**) then divide the returned x and y by those same values.

```
gr.touch touched, x, y
Xscaled = x / scale_x
Yscaled = y / scale_y
```

Gr.bounded.touch touched, left, top, right, bottom

The Touched parameter will be returned true (not zero) if the user has touched the screen within the rectangle defined by the left, top, right, bottom parameters. If the screen has not been touched or has been touched outside of the bounding rectangle, the touched parameter will be return as false (zero). The command will continue to return true as long as the screen remains touched and the touch is within the bounding rectangle.

The bounding rectangle parameters are for the actual screen size. If you have scaled the screen then you need to similarly scale the bounding rectangle parameters. If the parameters that you used in **Gr.scale** were scale_x and scale_y (**Gr.scale scale_x, scale_y**) then divide left and right by scale_x and divide top and bottom by scale_y.

Gr.touch2 touched, x, y

The same as **Gr.touch** except that it reports on second simultaneous touch of the screen.

Gr.bounded.touch2 touched, left, top, right, bottom

The same as **Gr.bounded.touch** except that it reports on second simultaneous touch of the screen.

OnGrTouch:

If this label is present in the program, the currently running program will be interrupted when the user touches the screen. Execution will then continue at the statement following this label. One of the above **Gr.touch** commands can be executed.

Gr.onGrTouch.resume

Resumes the execution of the program at the point where the touch interrupt occurred.

Text Commands

Gr.text.align type

Align the text relative to the (x,y) coordinates given in the **Gr.text.draw** command.
type values: 1 = Left, 2 = Center, 3 = Right.

Gr.text.size <nexp>

Specifies the size of the text in pixels. The size <nexp> sets the nominal height of the characters. This height is large enough to include the top of characters with ascenders, like "h", and the bottom of characters with descenders, like "y". Character width is scaled proportionately to the height.

Gr.text.height {<height_nvar>} {, <up_nvar>} {, <down_nvar>}

Returns height information for the current font and text size. All of the parameters are optional but positional: you can omit any parameter, but you must have the correct number of commas before any parameter you want to use.

If the **height** variable <height_nvar> is present, it is set to the height in pixels of the space that will be used to print most text in most languages. This is the value you set with **Gr.text.size**. In typeface terminology, it is the "acsent" plus the "descent". The space contains the ascenders of letters like "h" and the descenders of letters like "y".

Some letters, such as the Polish letter "Ż", may not fit in this space. The position of a line high enough to contain all possible characters is returned in the **up** variable <up_nvar>, if it is present.

If the **down** variable <down_nvar> is present, it is set to the "descent" value. This position is low enough to contain the lowest part of all possible characters, such as the tail of a "y".

Gr.text.draw positions text so the the body of the characters sit on a line called the baseline. The **down** and **up** values are reported as offsets from this baseline. The **up** value is negative, because it defines a position above the baseline. The **down** value is positive, because its position is below the baseline. The **height** value is not an offset, so it is always positive. **down** - **up** is always larger than **height**.

Sometimes you want to know the real screen positions of the top and bottom of the area where your text will be drawn, independent of the actual text you will draw there. The bottom of this area is the **y** coordinate of **Gr.text.draw** plus the **down** value of **Gr.text.height**. For most applications, the top of the text area is the bottom position minus the **height** value of **Gr.text.height**, so **y** + **down** - **height**. For some applications (such as a Polish text field), you may need the extra height you get with **y** + **up**.

```
Gr.text.size 40
Gr.text.height ht, up, dn    % ht is 40
Gr.text.draw t, x, y, "Hello, World!"
txtBottom = y + dn
txtTop = txtBottom - ht      % good for most applications
txtTop = y + up              % high enough for all possible text (up is negative)
```

Gr.text.width <nvar>, <sexp>

Returns the pixel width of <sexp> in <nvar>. The width is determined by the latest **Gr.text.size** parameter.

Gr.get.textbounds <sexp>, left, top, right, bottom

Gets the boundary rectangle of the string expression <sexp>. The corners of the rectangle are reported as offsets from the x,y coordinates of the **Gr.text.draw** command.. The value returned for "top" will be a negative number. This is because y coordinate of the **Gr.text.draw** command specifies the baseline of the text. See **Gr.text.draw** and **Gr.text.height** for more explanation of the lines that define where text is drawn.

If this is confusing, try running this example:

```
gr.open 255,255,255,255
gr.color 255,255,0,0,0
gr.text.size 40
gr.text.align 1
s$ = "This is a test"
gr.get.textbounds s$,l,t,r,b
print l,t,r,b
```

```
gr.rect x,l+10,t+50,r+10,b+50
gr.text.draw x,10,50,s$
gr.render
pause 5000
```

Gr.text.setfont {{<font_ptr_nexp>|<font_family_sexp>} {, <style_sexp>}}

Set the text font, specifying typeface and style. Both parameters are optional. This command is similar to the older **Gr.text.typeface**, but it is more flexible.

If the font parameter is a numerical expression <font_ptr_nexp>, it must be a font pointer value returned by the **Font.load** command. You cannot modify the style of a font once it is loaded, so the the style parameter <style_sexp> is ignored.

If the font parameter is a string expression <font_family_sexp>, it must specify one of the font families available on your Android device. If your device does not recognize the string, the font is set to the system default font typeface. On most systems, the default is **"sans serif"**.

The standard font families are **"monospace"**, **"serif"**, and **"sans serif"**. Some more recent versions of Android also support **"sans-serif"**, **"sans-serif-light"**, **"sans-serif-condensed"**, and **"sans-serif-thin"**. The font family names are not case-sensitive: "Serif" or "SERIF" works as well as "serif".

If you omit the font parameter, the command sets the most recently loaded font (see **Font.load**). If you have deleted fonts (see **Font.delete**), the command sets the most recently loaded font that has not been deleted. If you have not loaded any fonts, or if you have cleared them (see **Font.clear**), the command sets the default font family.

If you specify a font family, you can use the style parameter <style_sexp> to change the font's appearance. The parameter value must be one of the style strings shown in the table below. You may use either the full style name or an abbreviation as shown. The parameter is not case-senstive: "BOLD", "bold", "Bold", and "bOlD" are all the same. If you use any other string, or if you omit the style parameter, the style is set to **"NORMAL"**.

Style Name	Abbreviation
"NORMAL"	"N"
"BOLD"	"B"
"ITALIC"	"I"
"BOLD_ITALIC"	"BI"

Notes: The **"monospace"** font family always displays as **"normal"**, regardless of the style parameter. Some devices do not support all of the styles.

Gr.text.typeface {{<font_nexp>} {, <style_nexp>}}

Set the text typeface and style. Both parameters are optional. The default value if you omit either parameter is 1. All valid parameter values and their meanings are shown in this table:

The values for <font_nexp> are:	The values for <style_nexp> are:

1	Default font	1	Normal (not bold or italic)
2	Monospace font	2	Bold
3	Sans-serif font	3	Italic
4	Serif font	4	Bold and italic

This command is similar to the newer **Gr.text.setfont**, except that it is limited to the four typefaces listed in the table. It cannot specify fonts loaded by the **Font.load** command.

Notes: The "Monospace" font (font 2) always displays as "Normal" (style 1), regardless of the style parameter. Some devices do not support all of the styles.

Gr.text.bold <lexp>

Makes the text appear bold if<lexp> is true (<> 0). If the color fill parameter is 0, only the outline of the bold text will be shown. If fill <>0, the text outline will be filled.

This is a "fake bold", simulated by graphical techniques. It may not look the same as text drawn after setting "Bold" style with **Gr.text.setfont** or **Gr.text.typeface**.

Gr.text.skew <nexp>

Skews the text to give an italic effect. Negative values of <nexp> skew the bottom of the text left. This makes the text lean forward. Positive values do the opposite. Traditional italics can be best imitated with <nexp> = -0.25.

Gr.text.underline <lexp>

The drawn text will be underlined if <lexp> is true (<> 0).

Gr.text.strike <lexp>

The text will be drawn with a strike-through line if <lexp> is true (<> 0).

Gr.text.draw <object_number_nvar>, <x_nexp>, <y_nexp>, <text_object_sexp>

Creates and inserts a text object (<text_object_sexp>) into the Display List. The text object will use the latest color and text preparatory commands. The <object_number_nvar> returns the Display List object number for this text. This object will not be visible until the **Gr.render** command is called.

Gr.text.draw positions the text so the the body of the characters sit on a line called the baseline. The tails of letters like "y" hang below the baseline.The **y** value <y_nexp> sets the location of this baseline.

The **Gr.text.height** command tells you the locations of the various lines used to draw text. The **Gr.text.width** command tells you width of the space in which a specific string will be drawn. The **Gr.get.textbounds** command tells you the locations of the left-, top-, right-, and bottom-most pixels actually drawn for a specific text string.

The **Gr.modify** parameters for **Gr.text.draw** are "x", "y", and "text". The value for "text" is a string representing the new text.

Bitmap Commands

When a bitmap is created, it is added to a list of bitmaps. Commands that create bitmaps return a pointer to the bitmap. The pointer is an index into the bitmap list. Your program works with the bitmap through the bitmap pointer.

If you want to draw the bitmap on the screen, you must add a graphical object to the Object List. The **Gr.bitmap.draw** command creates a graphical object that holds a pointer to the bitmap. Do not confuse the bitmap with the graphical object. You cannot use the Object Number to access the bitmap, and you cannot use the bitmap pointer to modify the graphical object.

Android devices limit the amount of memory available to your program. Bitmaps may use large blocks of memory, and so may exceed the application memory limit. If a command that creates a bitmap exceeds the limit, the bitmap is not created, and the command returns -1, an invalid bitmap pointer. Your program should test the bitmap pointer to find out if the bitmap was created. If the bitmap pointer is -1, you can call the **GETERROR$()** function to get information about the error.

If a command exceeds the memory limit, but BASIC! does not catch the out-of-memory condition, your program terminates with an error message displayed on the Console screen. If you return the Editor, a line will be highlighted near the one that exceeded the memory limit. It may not be exactly the right line.

Bitmaps use four bytes of memory for each pixel. The amount of memory used depends only on the width and height of the bitmap. The bitmap is not compressed. When you load a bitmap from a file, the file is usually in a compressed format, so the bitmap will usually be larger than the file.

Gr.bitmap.create <bitmap_ptr_nvar>, width, height

Creates an empty bitmap of the specified width and height. The specified width and height may be greater than the size of the screen, if needed.

Returns a pointer to the created bitmap in the <bitmap_ptr_nvar> variable for use with the other **Gr.bitmap** commands. If there is not enough memory available to create the bitmap, the returned bitmap pointer is -1. Call **GETERROR$()** for information about the failure.

Gr.bitmap.load <bitmap_ptr_nvar>, <file_name_sexp>

Creates a bitmap from the file specified in the file_name string expression. Returns a pointer to the created bitmap for use with other **Gr.bitmap** commands. If there is not enough memory available to create the bitmap, the returned bitmap pointer is -1. Call **GETERROR$()** for information about the failure.

Bitmap image files are assumed to be located in the "<pref base drive>/rfo-basic/data/" directory.

Note: You may include path fields in the file name. For example, "../../Cougar.jpg" would cause BASIC! to look for Cougar.jpg in the top level directory of the base drive, usually the SD card. "images/Kitty.png" would cause BASIC! to look in the images(d) sub-directory of the "/sdcard/rfo-basic/data/" ("/sdcard/rfo-basic/data/images/Kitty.png").

Note: Bitmaps loaded with this command cannot be changed with the **Gr.bitmap.drawinto** command. To draw into an image loaded from a file, first create an empty bitmap then draw the loaded bitmap into the empty bitmap.

Gr.bitmap.size <bitmap_ptr_nexp>, width, height

Return the pixel width and height of the bitmap pointed to by <bitmap_ptr_nexp> into the width and height variables.

Gr.bitmap.scale <new_bitmap_ptr_nvar>, <bitmap_ptr_nexp>, width, height {, <smoothing_lexp>}

Scales a previously loaded bitmap (<bitmap_ptr_nexp>) to the specified width and height and creates a new bitmap <new_bitmap_ptr_nvar>. The old bitmap still exists; it is not deleted. If there is not enough memory available to create the new bitmap, the returned bitmap pointer is -1. Call **GETERROR$()** for information about the failure.

Negative values for width and height will cause the image to be flipped left to right or upside down.

Neither the width value nor the height value may be zero.

Use the optional smoothing logical expression (<smoothing_lexp>) to request that the scaled image not be smoothed. If the expression is false (zero) then the image will not be smoothed. If the optional parameter is true (not zero) or not specified then the image will be smoothed.

Gr.bitmap.delete <bitmap_ptr_nexp>

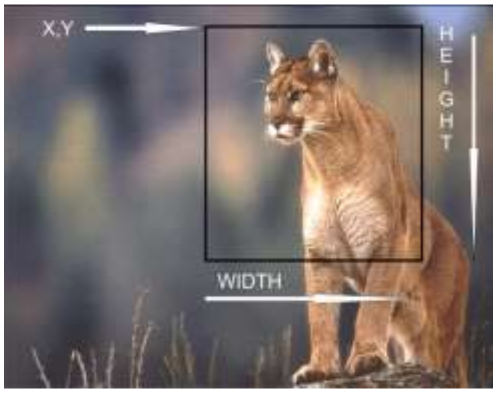
Deletes an existing bitmap. The bitmap's memory is returned to the system.

This does not destroy any graphical object that points to the bitmap. If you do not **Gr.hide** such objects, or remove them from the Display List, you will get a run-time error from the next **Gr.render** command.

Gr.bitmap.crop <new_bitmap_ptr_nvar>, <source_bitmap_ptr_nexp>, <x_nexp>, <y_nexp>, <width_nexp>, <height_nexp>

Creates a cropped copy of an existing source bitmap specified by <source_bitmap_ptr_nexp>. The source bitmap is unaffected; a rectangular section is copied into a new bitmap. A pointer to the new bitmap is returned in <new_bitmap_nvar>. If there is not enough memory available to create the new bitmap, the returned bitmap pointer is -1. Call **GETERROR$()** for information about the failure.

The <x_nexp>, <y_nexp> pair specifies the point within the source bitmap that the crop is to start at. The <width_nexp>, <height_nexp> pair defines the size of the rectangular region to crop.



Gr.bitmap.save <bitmap_ptr_nvar>, <filename_sexp>{, <quality_nexp>}

Saves the specified bitmap to a file. The default path is "<pref base drive>/rfo-basic/data/".

The file will be saved as a JPEG file if the filename ends in ".jpg".

The file will be saved as a PNG file if the filename ends in anything else (including ".png").

Gr.bitmap.draw <object_ptr_nvar>, <bitmap_ptr_nexp>, x , y

Creates a graphical object that contains a bitmap and inserts the object into the Object List. The bitmap is specified by the bitmap pointer <bitmap_ptr_nexp>. The bitmap will be drawn with its upper left corner at the provided (x,y) coordinates. The command returns the Object List object number of the graphical object in the <object_ptr_nvar> variable. This object will not be visible until the **Gr.render** command is called.

The alpha value of the latest **Gr.color** will determine the transparency of the bitmap.

The **Gr.modify** parameters for **Gr.bitmap.draw** are "bitmap", "x" and "y".

Gr.get.bmpixel <bitmap_ptr_nvar>, x, y, alpha, red, green, blue

Return the color data for the pixel of the specified bitmap at the specified x, y coordinate. The x and y values must not exceed the length or width of the bitmap.

Gr.bitmap.fill <bitmap_ptr_nexp>, <x_nexp>, <y_nexp>

Change all of the points in an area of a bitmap to the current drawing color. The bitmap pointer parameter <bitmap_ptr_nexp> must specify an existing bitmap. The x and y parameters <x_nexp> and <y_nexp> must specify a point (x,y) in the bitmap. The area to color is a set of connected pixels all the same color. The area may be any shape, and the point (x,y) may be any point in the area.

This command reads actual bitmap pixel colors, so it is affected by the antialiasing setting. If antialiasing is on, the pixels at the edge of the colored area may not be re-colored correctly.

Gr.bitmap.drawinto.start <bitmap_ptr_nexp>

Put BASIC! into the draw-into-bitmap mode.

All draw commands issued while in this mode draw directly into the bitmap. The objects drawn in this mode are not placed into the display list. The object number returned by the draw commands while in this mode is invalid and should not be used for any purpose including **Gr.modify**.

Note: Bitmaps loaded with the **Gr.bitmap.load** command cannot be changed with **Gr.bitmap.drawinto**. To draw into an image loaded from a file, first create an empty bitmap then draw the loaded bitmap into the empty bitmap.

Gr.bitmap.drawinto.end

End the draw-into-bitmap mode.Subsequent draw commands will place the objects into the display list for rendering on the screen. If you wish to display the drawn-into bitmap on the screen, issue a **Bitmap.draw** command for that bitmap.

Rotate Commands

Gr.rotate.start angle, x, y{,<obj_nvar>}

Any objects drawn between the **Gr.rotate.start** and **Gr.rotate.end** will be rotated at the specified angle around the specified (x,y) point. **Gr.rotate.start** must be eventually followed by **Gr.rotate.end** or you will not get the expected results.

The optional <obj_nvar> will contain the Object list object number of the object to which **Gr.rotate.start** will apply. If you are going to use rotated objects in the array for **Gr.NewDl** then you will need to include the **Gr.rotate.start** and **Gr.rotate.end** objects.

Gr.rotate.end {<obj_nvar>}

Ends the rotated drawing of objects. Objects created after this command will not be rotated.

The optional <obj_nvar> will contain the Object list object number of the object to which **Gr.rotate.end** will apply. If you are going to use rotated objects in the array for **Gr.NewDl** then you will need to include the **Gr.rotate.start** and **Gr.rotate.end** objects.

Camera Commands

There are three ways to use the camera from BASIC!:

1) The device's built in Camera User Interface can be used to capture an image. This method provides access to all the image-capture features that you get when you execute the device's Camera application. The difference is the image bitmap is returned to BASIC! for manipulation by BASIC! The **Gr.camera.shoot** command implements this mode.
2) A picture can be taken automatically when the command is executed. This mode allows for untended, time-sequenced image capture. The command provides for the setting the flash to on, off and auto. The **Gr.camera.autoshoot** command implements this mode.
3) The third mode is the **Gr.camera.manualshoot** command which is much like the autoshoot mode. The difference is that a live preview is provided and the image is not captured until the screen is touched.

All pictures are taken at full camera resolution and stored with 100% jpg quality as "<pref base drive>/rfo-basic/data/image.png".

All of these commands also return pointers to bitmaps. The bitmaps produced are scaled down by a factor of 4. You may end up generating several other bitmaps from these returned bitmaps. For example, you many need to scale the returned bitmap to get it to fit onto your screen. Any bitmaps that you are not going to draw and render should be deleted using **Gr.bitmap.delete** to avoid out-of-memory situations.

The Sample Program, f33_camera.bas, demonstrates all the modes of camera operations. It also provides examples of scaling the returned image to fit the screen, writing text on the image and deleting obsolete bitmaps.

The Sample Program, f34_remote_camera.bas, demonstrates remote image capture using two different Android devices.

Gr.camera.select 1|2

Selects the Back (1) or Front(2) camera in devices with two cameras. The default camera is the back (opposite the screen) camera.

If only one exists camera exists, then the default will be that camera. For example, if the device (such as the Nexus 7) only has a Front Camera then it will be the default camera. If the device does not have any installed camera apps, then there will be a run-time error message, "This device does not have a camera." In addition, a run-time error message will be shown if the device does not have the type of camera (front or back) selected.

Gr.camera.shoot <bm_ptr_nvar>

The command calls the device's built in camera user interface to take a picture. The image is returned to BASIC! as a bitmap pointed to by the bm_ptr numeric variable. If the camera interface does not, for some reason, take a picture, bm_ptr will be returned with a zero value.

Many of the device camera interfaces will also store the captured images somewhere else in memory with a date coded filename. These images can be found with the gallery application. BASIC! is not able to prevent these extraneous files from being created.

Note: Some devices like the Nexus 7 do not come with a built in camera interface. If you have installed an aftermarket camera application then it will be called when executing this command. You can take pictures with the Nexus 7 (or similar devices) using the other commands even if you do not have camera application installed. If the device does not have any installed camera apps, then there will be a run-time error message, "This device does not have a camera."

Gr.camera.autoshoot <bm_ptr_nvar>{, <flash_ mode_nexp> {, focus_mode_nexp} }

An image is captured as soon as the command is executed. No user interaction is required. This command can be used for untended, time-sequence image captures.

The optional flash_mode numeric expression specifies the flash operation:

0	**Auto Flash**
1	**Flash On**
2	**Flash Off**
3	**Torch**
4	**Red-eye**

The default, if no parameter is given, is Auto Flash.

The optional focus_mode numeric expression specifies the camera focus:

0	**Auto Focus**
1	**Fixed Focus**
2	**Focus at Infinity**
3	**Macro Focus (close-up)**

The default, if no parameter is given, is Auto Focus.

If you want to specify a focus mode, you must also specify a flash mode.

The command also stores the captured image into the file, "<pref base drive>/rfo-basic/data/image.png".

Gr.camera.manualShoot <bm_ptr_nvar>{, <flash_ mode_nexp> {, focus_mode_nexp} }

This command is much like **Gr.camera.autoshoot** except that a live preview is shown on the screen. The image will not be captured until the user taps the screen.

Other Graphics Commands

Gr.screen.to_bitmap <bm_ptr_nvar>

The current contents of the screen will be placed into a bitmap. The pointer to the bitmap will be returned in the bm_ptr variable. If there is not enough memory available to create the bitmap, the returned bitmap pointer is -1. Call **GETERROR$()** for information about the failure.

Please note the idiosyncratic underscore in the command.

Gr.get.pixel x, y, alpha, red, green, blue

Returns the color data for the screen pixel at the specified x, y coordinate. The x and y values must not exceed the width and height of the screen and must not be less than zero.

To get a pixel from the screen, BASIC! must first create a bitmap from the screen. If there is not enough memory available to create the bitmap, you will get an "out-of-memory" run-time error.

Gr.save <filename_sexp> {,<quality_nexp>}

Saves the current screen to a file. The default path is "<pref base drive>/rfo-basic/data/".

The file will be saved as a JPEG file if the filename ends in ".jpg".

The file will be saved as a PNG file if the filename ends in anything else (including ".png").

The optional <quality_nexp> is used to specify the quality of a saved JPEG file. The value may range from 0 (bad) to 100 (very good). The default value is 50. The quality parameter has no effect on PNG files which are always saved at the highest quality level.

Note: The size of the JPEG file depends on the quality. Lower quality values produce smaller files.

Gr.get.type <object_ptr_nexp>, <type_svar>

Get the type of the specified display list object. The type is a string that matches the name of the command that created the object: "point", "circle", "rect", etc. For a complete list of types, see the table in **Gr.Modify**.

Gr.get.params <object_ptr_nexp>, <param_array$[]>

Get the modifiable parameters of the specified display list object. The parameter strings are returned in the <param_array$[]> in no particular order. For a complete list of parameters, see the table in **Gr.Modify**.

Gr.get.position <object_ptr_nexp>, x, y

Get the current x,y position of the specified display list object. If the object was specified with rectangle parameters (left, top, right, bottom) then left is returned in x and top is returned in y. For Line objects, the x1 and y1 parameters are returned.

Gr.move <object_ptr_nexp> {{, dx}{, dy}}

Moves the graphics object by the amounts dx and dy. If the object is a group, all of the graphical objects in the group are moved. The dx and dy parameters are optional. If omitted they default to 0.

Gr.get.value <object_ptr_nexp> {, <tag_sexp>, <value_nvar | value_svar>}...

The value of the parameter named <tag_sexp> ("left", "radius", etc.) in the Display List object <object_ptr_nvar> is returned in the variable <value_nvar> or <value_svar>. This command can return values from only one object at a time, but you may list as many tag/variable pairs as you want.

Most parameters are numeric. Only the **Gr.text.draw** "text" parameter is returned in a string var. The parameters for each object are given with descriptions of the commands in this manual. For a complete list of parameters, see the table in **Gr.Modify**.

Gr.modify <object_ptr_nexp> {, <tag_sexp>, <value_nexp | value_sexp>}...

The value of the parameter named <tag_sexp> in the Display List object <object_ptr_nvar> is changed to the value of the expression <value_nexp> or <value_sexp>. This command can change only one object at a time, but you may list as many tag/value pairs as you want.

With this command, you can change any of the parameters of any object in the Display List. The parameters you can change are given with the descriptions of the commands in this manual. In addition there are two general purpose parameters, "paint" and "alpha" (see below for details).You must provide parameter names that are valid for the specified object.

The results of **Gr.modify** commands will not be observed until a **Gr.render** command executes.

	TYPE	POSITION 1 (numeric)		POSITION 2 (numeric)		ANGLE/RADIUS (numeric)	UNIQUE (various)	PAINT (list ptr)	ALPHA (num)
SHAPES and OBJECTS	arc	left	top	right	bottom	start_angle sweep_angle	fill_mode	paint	alpha
	bitmap	x	y				bitmap	paint	alpha
	circle	x	y			radius		paint	alpha
	line	x1	y1	x2	y2			paint	alpha
	oval	left	top	right	bottom			paint	alpha
	pixels	x	y					paint	alpha
	point	x	y					paint	alpha
	poly	x	y				list	paint	alpha
	rect	left	top	right	bottom			paint	alpha
	text	x	y				text	paint	alpha
MODI-FIERS	clip	left	top	right	bottom		RO	paint	alpha
	group						list	paint	alpha
	rotate	x	y			angle		paint	alpha

TABLE NOTES:

- The **TYPE** column shows the string returned by **Gr.get.type** for each graphical object type.
- **Gr.get.position** returns the values in the **POSITION 1** columns.
- All table entries are **Gr.modify** tags (strings). Values of all the tags are numeric except for **"text"**.
- The values of tags in the **UNIQUE** column are either strings (**"text"**) or numbers with special interpretations. **"fill_mode"** is a logical value. **"list"** is a pointer to a list of point coordinates. **"RO"** is a Region Operator as explained in **Gr.clip**.
- **"alpha"** is an integer value from 0 to 256, with 256 interpreted specially. See **General Purpose Parameters**, below.
- You can modify the **Gr.set.pixels** point-coordinates array directly. There is no **Gr.modify** tag.

For example, suppose a bitmap object was created with **Gr.bitmap.draw BM_ptr, galaxy_ptr, 400, 120**.

Executing **gr.modify BM_ptr, "x", 420** would move the bitmap from x =400 to x = 420.
Executing **gr.modify BM_ptr, "y", 200** would move the bitmap from y = 120 to y = 200.
Executing **gr.modify BM_ptr, "x", 420, "y", 200** would change both x and y at the same time.
Executing **gr.modify BM_ptr, "bitmap", Saturn_ptr** would change the bitmap of an image of a (preloaded) Galaxy to the image of a (preloaded) Saturn.

General Purpose Parameters

When you create a graphical object, all the graphics settings (color, stroke, text settings, and so forth) are captured in a Paint object. You can use the "paint" parameter to replace the Paint object, changing any graphics setting you want to. See the **Gr.paint.get** command description (below) for more details.

Normally, graphical objects get their alpha channel value (transparency) from the latest **Gr.color** command. You can change the "alpha" parameter to any value from 0 to 255. Setting alpha to 256 tells BASIC! to use the alpha from the latest color value.

For example, you can make an object slowly appear and disappear, just by changing its alpha with **Gr.modify**.

```
Do
        For a = 1 to 255 step 10
                gr.modify object,"alpha",a
                gr.render
                pause 250
        next a

        For a = 255 to 1 step -10
                gr.modify object,"alpha",a
                gr.render
                pause 250
        next a
until 0
```

Gr.paint.get <object_ptr_nexp>

Gets a pointer (<object_ptr_nvar>) to the last created Paint object. For information about Paint objects, see the section Graphics → Introduction → Paints, above.

This pointer can be used to change the Paint object associated with a draw object by means of the **Gr.modify** command. The **Gr.modify** parameter is "paint".

If you want to modify any of the paint characteristics of an object then you will need to create a current Paint object with those parameters changed. For example:

```
gr.color 255,0,255,0,0
gr.text.size 20
gr.text.align 2
gr.paint.get the_paint
gr.modify shot, "paint", the_paint
```

changes the current text size and alignment as well as the color.

GR_COLLISION(<object_1_nexp>, <object_2_nexp>)

GR_COLLISION() is a function, not a command. The variables <object_1_nvar> and <object_2_nvar> are the object pointers returned when the objects were created.

If the boundary boxes of the two objects overlap then the function will return true (not zero). If they do not overlap then the function will return false (zero).

Objects that may be tested for collision are: rectangle, bitmap, circle, arc, oval, and text. In the case of a circle, an arc, an oval, or text, the object's rectangular boundary box is used for collision testing, not the actual drawn object.

Gr.clip <object_ptr_nexp>, <left_nexp>, <top_nexp>, <right_nexp>, <bottom_nexp>{, <RO_nexp>}

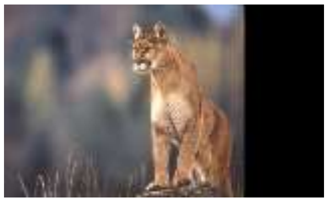
Objects that are drawn after this command is issued will be drawn only within the bounds (clipped) of the clip rectangle specified by the "left, top, right, bottom" numeric expressions.

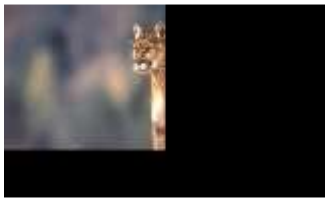
The final parameter is the Region Operator, <RO_nexp>. The Region Operator prescribes how this clip will interact with everything else you are drawing on the screen or bitmap. If you issue more than one **Gr.clip** command, the RO prescribes the interaction between the current **Gr.clip** rectangle and the previous one. The RO values are:

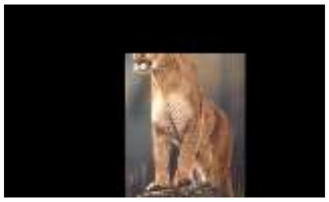
0	**Intersect**
1	**Difference**
2	**Replace**
3	**Reverse Difference**
4	**Union**
5	**XOR**

The Region Operator parameter is optional. If it is omitted, the default action is **Intersect**.

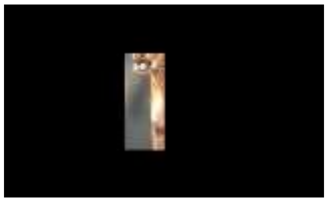
Examples:

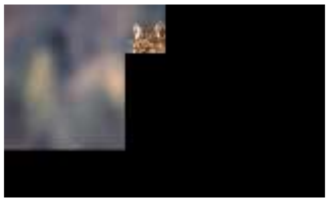

Original

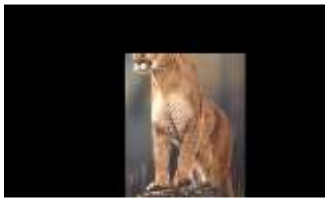

Clip 1

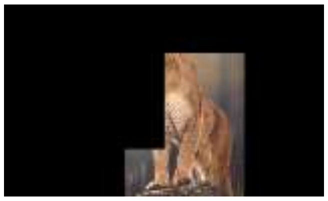

Clip 2

Clip 2 applied to Clip 1 with RO parameter on Clip 2

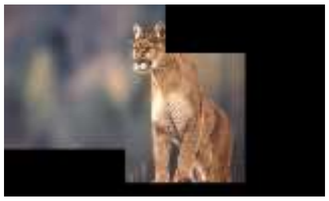

0 = Intersect


1 = Difference

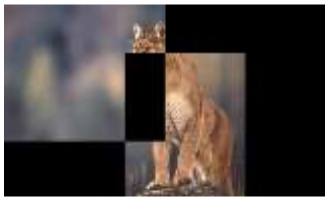

2 = Replace



3 = Reverse Difference



4 = Union



5 = XOR

Gr.clip is a display list object. It can be modified with **Gr.modify**. The modify parameters are "left", "top", "right", "bottom", and "RO".

The **Gr.show** and **Gr.hide** commands can be used with the **Gr.clip** object.

Gr.newDL <dl_array[{<start>,<length>}]>

Replaces the existing display list with a new display list read from a numeric array (dl_array[]) or array segment (dl_array[start,length]) of object numbers. Zero values in the array will be treated as null objects in the display list. Null objects will not be drawn nor will they cause run-time errors.

See the Display List subtopic in this chapter for a complete explanation.

See the Sample Program file, f24_newdl, for a working example of this command.

Gr.getDL <dl_array[]> {, <keep_all_objects_lexp> }

Writes the current Display List into the numeric dl_array[] variable. If the Display List is empty, the array will have one entry that does not display anything.

By default, objects hidden with **Gr.hide** are not included in the returned array. To get all objects, including hidden objects, set the optional keep_all_objects flag to true (any non-zero value).

Audio Interface

Introduction

The Audio Interface

BASIC! uses the Android Media Player interface for playing music files. This interface is not the most stable part of Android. It sometimes gets confused about what it is doing. This can lead to random "Forced Close" events. While these events are rare, they do occur.

Audio File Types

The Music Player is supposed to be able to play WAV, AAC, MP3, WMA, AMR, OGG and MIDI files. I have tried MP3 and WAV files. Your mileage may vary on these other file types.

Commands

Audio files must be loaded into the Audio File Table (AFT) before they can be played. Each audio file in the AFT has a unique index which is returned by the audio.load command.

Audio.load <aft_nvar>, <filename_sexp>

Loads a music file into the Audio File Table. The AFT index is returned in <aft_nvar>. If the file can't be loaded, the <aft_nvar> is set to 0. Your program should test the AFT index to find out if the file was loaded. If the bitmap pointer is 0, you can call the **GETERROR$()** function to get information about the error.If you use index 0 in another **Audio** command you will get a run-time error.

The file must be in the "<pref base drive>/ref-basic/data/" directories or one of its subdirectories.

You can reach outside the "<pref base drive>/ref-basic/data/" by using path fields in the filename. For example, "../../Music/Blue Danube Waltz.mp3" would access "<pref base drive>/Music/Blue Danube Waltz.mp3".

Audio.play <aft_nexp>

Selects the file from the Audio File Table pointed to by <aft_nexp> and begins to play it. There must not be an audio file already playing when this command is executed. If there is a file playing, execute audio.stop first.

The music stops playing when the program stops running. To simply start a music file playing and keep it playing, keep the program running. This infinite loop will accomplish that:

```
Audio.load ptr, "my_music.mp3"
Audio.play ptr
Do
Pause 5000
Until 0
```

Audio.stop

Audio.stop terminates the currently-playing music file. The command will ignored is no file is playing. It is best to precede each audio.play command with an audio.stop command.

Audio.pause

Pause is like stop except that the next audio.play for this file will resume the play at the point where the play was paused.

Audio.loop

When the currently playing file reaches the end of file, the file will restart playing from the beginning of the file. There must be a currently playing file when this command is executed.

Audio.volume <left_nexp>, <right_nexp>

Changes the volume of the left and right stereo channels. There must be a currently playing file when this command is executed.

The values should range between 0.0 (lowest) to 1.0 (highest). The human ear perceives the level of sound changes on a logarithmic scale. The ear perceives a 10db change as twice as loud. A 20db change would be four times as loud.

A 1 db change would be about 0.89. One way to implement a volume control would be set up a volume table with 1db level changes. The following code creates a 16 step table.

```
dim volume[16]
x =1
volume [1] = x
for i = 2 to 16
	x = x * 0.89
	volume [i] = x
next i
```

Your code can select volume values from the table for use in the audio.volume command. The loudest volume would be volume[1].

Audio.position.current <nvar>

The current position in milliseconds of the currently playing file will be returned in <nvar>.

Audio.position.seek <nexp>

Moves the playing position of the currently playing file to <nexp> expressed in milliseconds.

Audio.length <length_nvar>, <aft_nexp>

Returns the total length of the file in the Audio File Table pointed to by <aft_nexp>. The length in milliseconds will be returned in <length_nvar>.

Audio.release <aft_nexp>

Releases the resources used by the file in the Audio File Table pointed to by <aft_nexp>. The file must not be currently playing. The specified file will no longer be able to be played.

Audio.isdone <lvar>

If the current playing file is still playing then <lvar> will be set to zero otherwise it will be set to one. This can be used to determine when to start playing the next file in a play list.

```
Audio.play f[x]
Do
	Audio.isdone isdone
	Pause 1000
Until isdone
```

Audio.record.start <fn_svar>

Start audio recording using the microphone as the audio source. The recording will be saved to the specified file. The file must have the extension .3GP. Recording will continue until the audio.record.stop command is issued.

Audio.record.stop

Stops the previously started audio recording.

SoundPool

Introduction

A SoundPool is a collection of short sound bites that are preloaded and ready for instantaneous play. SoundPool sound bites can be played while other sounds are playing, either while other sound bites are playing or over a currently playing sound file being played my means of Audio.play. In a game, the Audio.play file would be the background music while the SoundPool sound bites would be the game sounds (Bang, Pow, Screech, etc).

A SoundPool is opened using the SoundPool.open command. After the SoundPool is opened, sound bites will be loaded into memory from files using the SoundPool.load command. Loaded sound bites can be played over and over again using the SoundPool.play command.

A playing sound is called a sound stream. Individual sound streams can be paused (SoundPool.pause), individually or as a group, resumed (SoundPool.resume) and stopped (SoundPool.stop). Other stream parameters (priority, volume and rate) can be changed on the fly.

The SoundPool.release command closes the SoundPool. A new SoundPool can then be opened for a different phase of the game. SoundPool.release is automatically called when the program run is terminated.

Commands

Soundpool.open <MaxStreams_nexp>

The MaxStreams expression specifies the number of Soundpool streams that can be played at once. If the number of streams to be played exceeds this value, the lowest priority streams will be terminated.

Note: A stream playing via audio.play is not counted as a Soundpool stream.

Soundpool.load <soundID_nvar>, <file_path_sexp>

The file specified in <file_path_sexp> is loaded. Its sound ID is returned in <soundID_nvar>. The sound ID is used to play the sound and also to unload the sound. The sound ID will be returned as zero if the file was not loaded for some reason.

The default file path is "sdcard/rfo-basic/data/"

Note: It can take a few hundred milliseconds for the sound to be loaded. Insert a "Pause 500" statement after the load if you want to play the sound immediately following the load command.

Soundpool.unload <soundID_nexp>

The specified loaded sound is unloaded.

Soundpool.play <streamID_nvar>, <soundID_nexp>, <rightVolume_nexp>, <leftVolume_nexp>, <priority_nexp>, <loop_nexp>, <rate_nexp>

Starts the specified sound ID playing.

The stream ID is returned in <streamID_nvar>. If the stream was not started, the value returned will be zero. The stream ID is used to pause, resume and stop the stream. It is also used in the stream modification commands (Soundpool.setrate, Soundpool.setvolume, Soundpool.setpriority and Soundpool.setloop).

The left and right volume values must be in the range of 0 to 0.99 with zero being silent.

The priority is a positive value or zero. The lowest priority is zero.

The loop value of -1 will loop the playing stream forever. Values other than -1 specify the number of times the stream will be replayed. A value of 1 will play the stream twice.

The rate value changes the playback rate of the playing stream. The normal rate is 1. The minimum rate (slow) is 0.5. The maximum rate (fast) is 1.85.

Soundpool.setvolume <streamID_nexp>, <leftVolume_nexp>, <rightVolume_nexp>
Changes the volume of a playing stream.

The left and right volume values must be in the range of 0 to 0.99 with zero being silent.

Soundpool.setrate <streamID_nexp>, <rate_nexp>
Changes the playback rate of the playing stream.

The normal rate is 1. The minimum rate (slow) is 0.5. The maximum rate (fast) is 1.85.

Soundpool.setpriority <streamID_nexp>, <priority_nexp>
Changes the priority of a playing stream.

The lowest priority is zero.

Soundpool.pause <streamID_nexp>
Pauses the playing of the specified stream. If the stream ID is zero, all streams will be paused.

Soundpool.resume <streamID_nexp>
Resumes the playing of the specified stream. If the stream ID is zero, all streams will be resumed.

Soundpool.stop <streamID_nexp>
Stops the playing of the specified stream.

Soundpool.release
Closes the SoundPool and releases all resources. Soundpool.open can be called to open a new SoundPool.

GPS

These commands provide access to the raw location data reported by an Android device's GPS hardware. Before attempting to use these commands, make sure that you have GPS turned on in the Android Settings Application.

The Sample Program file, f15_gps.bas is a running example of the use of the GPS commands.

There are two kinds of data reports: GPS status and location data. They are not reported at the same time, so there is no guarantee that overlapping information matches. For example, the location data report includes a count of the satellites used in the most recent location fix. The same information can be derived from the GPS status report. If number of detected satellites changes between reports, the two numbers do not agree.

GPS Control commands

Gps.open {{<status_nvar>},{<time_nexp>},{<distance_nexp>}}

Connects to the GPS hardware and starts it reporting location information. This command must be issued before using any of the other GPS commands.

The three parameters are all optional; use commas to indicate missing parameters. The parameters are available for advanced usage. The most common way to use this command is simply **GPS.open**.

If you provide a status return variable <status_nvar>, it is set to 1.0 (TRUE) if the open succeeds, or 0.0 (FALSE) if the open fails. If the open fails, you may get information about the failure from the **GetError$()** function.

The time interval expression <time_nexp> sets the minimum time between location updates. The time is in milleseconds. If you do not set an interval, it defaults to the minimum value allowed by your Android device. This is typically one second. Note: to reduce battery usage, Android recommends a minimum interval of five minutes.

If you provide a distance parameter <distance_nexp>, it is a numerical expression that sets the minimum distance between location updates, in meters. That is, your program will not be informed of location changes until your device has moved at least as far as the minimum distance setting. If you do not set a distance, any location change that can be detected will be reported.

This command attempts to get an initial "last known location". If the GPS hardware does not report a last known location, BASIC! tries to get one from the network location service. If neither source can provide one, the location information is left empty. If you use GPS commands to get location information before the GPS hardware starts reporting current location information, you will get this "last known location" data. The last known location may be stale, hours or days old, and so may not be useful.

Gps.close

Disconnects from the GPS hardware and stops the location reports. GPS is automatically closed when you stop your BASIC! program. GPS is not turned off if you tap the HOME key while your GPS program is running.

Gps.status {{<status_var>}, {<infix_nvar>},{inview_nvar}, {<sat_list_nexp>}}

Returns the data from a GPS status report. The parameters are all optional; use commas to indicate omitted parameters.

This kind of report contains the type of the last GPS event and a list of the satellites that were detected by the GPS hardware when that event occurred. As a convenience, this command analyzes the satellite list to report how many satellites were detected ("in view") and how many of those were used in the last location fix ("in fix").

The GPS status report is not timestamped, and the first event reported to your program may be stale. Do not rely on the data from the first status report alone to determine when the GPS hardware gets a current location fix..

<status_var>: If provided, this variable returns the type of last GPS event that occurred. If you provide a numeric variable, the event type is reported as a number. If it is a string variable, the event type is reported as an English-language event name.

Event Number	Event Name	Meaning
1	Started	The GPS system has been started, no location fixed yet
2	Stopped	The GPS system has been stopped
3	First Fix	The GPS system has received its first location fix since starting
4	Updated	The GPS system has updated its location data

<infix_nvar>: If provided, this numeric variable returns the number of satellites used in the last location fix. This is the number of satellites in the satellite list describe below whose "infix" value is TRUE (non-zero). If the status report could not get a satellite list the number is unknown, so the variable is set to -1.

<inview_nvar>: If provided, this numeric variable returns the number of satellites detected by the GPS hardware. This is the number of satellites in the satellite list described below that have current data. It is not necessarily the size of the list. If the status report could not get a satellite list the number is unknown, so the variable is set to -1.

<sat_list_nexp>: If provided, the value of this numeric expression is used as a list pointer. If the value is not a valid numeric list pointer, and the numeric expression is a single numeric variable, then a new list is created and the numeric variable is set to point to the new list.

The satellite list is a list of bundle pointers. When the GPS system reports GPS status, it provides data collected from the satellites it can detect. The data from each satellite is put in a bundle. The satellite list has pointers to all of the satellite data bundles. You can use these pointers with any **Bundle** command, just like any other bundle pointer.

If you provide an existing list, any bundles already in the list are cleared, except for the identifying pseudo-random number (PRN). Anything else in the list is discarded. Then the new satellite data is written into the satellite bundle. This is done so that a satellite that is lost and then regained will be remembered in the satellite bundle, but its stale data will not be kept.

The number of satellite bundles with complete data matches the value of the **<inview_var>**. These bundles are listed first. Any cleared bundles for satellites not currently visible are at the end of the list.

Each satellite bundle has five key/value pairs. All values are numeric. The value of "infix" is interpreted as logical (Boolean).

KEY	VALUE
prn	Pseudo-Random Number assigned to the satellite for identification
elevation	Elevation in degrees
azimuth	Azimuth in degrees
snr	Signal-to-noise ratio: a measure of signal strength
infix	TRUE (non-zero) if the satellite's data was used in the last location fix, else FALSE (0.0)

This is the only GPS command that returns information from both kinds of GPS data. The satellite count returned in <count_nvar> comes from the location data report, and the satellite list returned in the satellite list comes from the GPS status report. If nothing changes between reports, the number of satellites with infix set TRUE is the same as the satellite count value, but this condition cannot be guaranteed.

The satellite count value is also returned by the **GPS.location** command. The satellite list is also returned or updated by the **GPS.status** command. This command, **GPS.satellites**, is retained for backward-compatibility and for convenience.

For example, let's say the most recent GPS status report had data from three satellites with PRNs 4, 7, and 29.

```
GPS.OPEN sts
GPS.STATUS , , inView, sats
DEBUG.DUMP.LIST sats              % may print 7.0, 29.0, 4.0
```

Assume appropriate delays after the **GPS.open** and that **DEBUG** is enabled. Another GPS status report may report data from satellites 4, 7, and 8. Then the list dump might show 7.0, 4.0, 8.0, 29.0. The order is unpredictable, except that 29.0 will be last, because it is not currently visible. In both cases, the value of inView is 3.0.

Debug.dump.bundle of the satellite bundle with PRN 4 might show this:

```
Dumping Bundle 11
prn: 4.0
snr: 17.0
infix: 0.0
elevation: 25.0
```

```
        azimuth: 312.0
```

GPS Location commands

These commands report the values returned by the most recent GPS location report, with one exception. The **Gps.satellites** command also returns the list of satellites contained in a GPS status report.

A location report contains:

- the location provider
- the number of satellites used to generate the data in the report
- the time when the data was reported
- an estimate of the accuracty of the location components
- the location components:
  - latitude
  - longitude
  - altitude
  - bearing
  - speed

There are individual commands available to read each element of a location report. If you use separate GPS commands to read different components of the location data, you don't know if the different components came from the same location report. To be certain of consistent data, get all of the location components from a single **Gps.location** command.

Gps.location {{<time_nvar>}, {<prov_svar>}, {<count_nvar}, {<acc_nvar>}, {<lat_nvar>}, {<long_nvar>}, {<alt_nvar>}, {<bear_nvar>}, {<speed_nvar>}}

Returns the data from a single GPS location report. It returns all of the data provided by all of the individual GPS location component commands below, except that it does not return the satellite list of the **Gps.satellites** command.

The parameters are all optional; use commas to indicate missing parameters. All of the parameters are variable names, so if any parameter is not provided, the corresponding data is not returned.

The parameters are:

<time_nvar>: time of the location fix, in milliseconds since the epoch, as reported by **Gps.time**.
<prov_svar>: the location provider, as reported by **Gps.provider**.
<count_nvar>: the number of satellites used to generate the location fix, as reported by **Gps.satellites**.
<acc_nvar>: an estimate of the accuracy of the location fix, in meters, as reported by **Gps.accuracy**.
<lat_nvar>: current latitude, in decimal degrees, as reported by **Gps.latitude**.
<long_nvar>: current longitude, in decimal degrees, as reported by **Gps.longitude**.
<alt_nvar>: current altitude, in meters, as reported by **Gps.altitude**.

<bear_nvar>: current bearing, in compass degrees, as reported by **Gps.bearing**.
<speed_nvar>: current speed, in meters per second, as reported by **Gps.speed**.

Gps.time <nvar>

Returns the time of the last GPS fix in milliseconds since "the epoch", January 1, 1970, UTC.

Gps.provider <svar>

Returns the name of the location provider in <svar>. Normally this is "**gps**". The first time you read location data, you get the last known location, which may come from either the GPS hardware or the network location service. If it came from the network, this command returns "**network**". If neither provider reported a last known location, the provider <svar> is the empty string, "".

Gps.satellites {{<count_nvar>}, {<sat_list_nexp>}}

Returns the number of satellites used for the last GPS fix and a list of the satellites known to the GPS hardware.

Both parameters are optional. If you omit the <count_nvar> but use the <sat_list_nexp>, it must be preceded by a comma.

If you provide a numeric variable <count_nvar>, it is set to the number of satellites used for the most recent location data. If the location report did not provide a satellite count, <count_nvar> is set to -1.

For a description of the satellite list pointer expression <sat_list_nexp>, see the <sat_list_nexp> parameter of the **Gps.status** command, above.

Gps.accuracy <nvar>

Returns the accuracy level in <nvar>. If non-zero, this is an estimate of the uncertainty in the reported location, measured in meters. A value of zero means the location is unknown.

Gps.latitude <nvar>

Returns the latitude in decimal degrees in <nvar>.

Gps.longitude <nvar>

Returns the longitude in decimal degrees in <nvar>.

Gps.altitude <nvar>

Returns the altitude in meters in <nvar>.

Gps.bearing <nvar>

Returns the bearing in compass degrees in <nvar>.

Gps.speed <nvar>

Returns the speed in meters per second in <nvar>.

Sensors

Introduction

Android devices can have several types of Sensors. Currently, Android's pre-defined Sensors are:

Name of Sensor	Type	Notes
Accelerometer	1	As of API 3 (Cupcake)
Magnetic Field	2	As of API 3
Orientation	3	As of API 3, deprecated API 8
Gyroscope	4	As of API 3
Light	5	As of API 3
Pressure	6	As of API 3
Temperature	7	As of API 3, deprecated API 14
Proximity	8	As of API 3
Gravity	9	As of API 9 (Gingerbread)
Linear Acceleration	10	As of API 9
Rotation Vector	11	As of API 9
Relative Humidity	12	As of API 14 (Ice Cream Sandwich)
Ambient Temperature	13	As of API 14
Uncalibrated Magnetic Field	14	As of API 18 (Jellybean MR2)
Game Rotation Vector	15	As of API 18
Uncalibrated Gyroscope	16	As of API 18
Significant Motion	17	As of API 18

Some details about (most) of these sensors can be found at Android's Sensor Event (http://developer.android.com/reference/android/hardware/SensorEvent.html) web page.

Not all Android devices have all of these Sensors. Some Android devices may have none of these sensors. The BASIC! command, sensors.list, can be used to provide an inventory of the sensors available on a particular device.

Some newer devices may have sensors that are not currently supported by BASIC! Those sensors will be reported as "Unknown, Type = NN" where NN is the sensor type number.

Sensor Commands

Sensors.list <sensor_array$[]>

This command provides a list of the sensors available on a particular Android device. The <sensor_array$[]> parameter must be an un-dimensioned array. Information about the available sensors will be returned in this array. The elements will contain the names and types of the available sensors. For example, "Gyroscope, Type = 4". The following program snip can be used to list the elements of sensorarray$[].

```
sensors.list sensorarray$[]
array.length size, sensorarray$[]
```

```
for index = 1 to size
   print sensorarray$[ index ]
next index
end
```

Sensors.open <type_nexp>{:<delay_nexp>}{, <type_nexp>{:<delay_nexp>}, ...}

Opens a list of sensors for reading. The parameter list is the type numbers of the sensors to be opened, followed optionally by a number (0, 1, 2, and 3) that specifies the delay in activating the sensor. 3 is the default (slowest). The delay option is a feature almost nobody should use. The default setting is good for almost everything. The faster settings will burn battery. So unless you know that you really need it, you don't want to use it.

For example, "sensors.open 1, 3", would open the Acceleration and Orientation sensors. This command must be executed before issuing any sensors.read commands. You should only open the sensors that you actually want to read. Each sensor opened drains the battery and increases the background CPU usage.

Sensors.read sensor_type_nexp, p1_nvar, p2_nvar, p3_nvar

This command returns that latest values from the sensors specified by the "sensor_type" parameters. The values are returned are placed into the p1, p2 and p3 parameters. The meaning of these parameters depends upon the sensor being read. Not all sensors return all three parameter values. In those cases, the unused parameter values will be set to zero. See Android's Sensor Event web page for the meaning of these parameters.

Sensors.close

Closes the previously opened sensors. The sensors' hardware will be turned off preventing battery drain. Sensors are automatically closed when the program run is stopped via the BACK key or Menu->Stop.

System

These commands provide for the execution of System commands on non-rooted devices.

Commands

System.open

Opens a shell to execute system commands. The working directory is set to "**rfo-basic**". If the working directory does not exist, it is created. If you open a command shell with either Su.open or System.open, you can't open another one of either type without first closing the open one.

System.write <sexp>

Executes a System command.

System.read.ready <nvar>

Tests for responses from a System.write command. If the result is non-zero, then response lines are available.

Not all System commands return a response. If there is no response returned after a few seconds then it should be assumed that there will be no response.

System.read.line <svar>

Places the next available response line into the string variable.

System.close

Exits the System Shell mode.

Superuser

These commands provide for the execution of Superuser commands on rooted devices. See the Sample Program, f36_superuser.bas, for an example using these commands.

Commands

Su.open

Requests Superuser permission. If granted, opens a shell to execute system commands. The working directory is set to /. If you open a command shell with either Su.open or System.open, you can't open another one of either type without first closing the open one.

Su.write <sexp>

Executes a Superuser command.

Su.read.ready <nvar>

Tests for responses from a Su.write command. If the result is non-zero, then response lines are available.

Not all Superuser commands return a response. If there is no response returned after a few seconds then it should be assumed that there will be no response.

Su.read.line <svar>

Places the next available response line into the string variable.

Su.close

Exits the Superuser mode.

Appendix A – Command List

Appendix B – Sample Programs

The programs are loaded into "<pref base drive>/rfo-basic/source/Sample_Programs" when a new release of BASIC! is installed. You can access them by selecting Menu->Load. Tap the "Sample_Programs" lines. The sample programs will be listed and can be loaded.

If you load and save one of these programs, the program will be saved in "<pref base drive>/rfo-basic/source/" not in "<pref base drive>/rfo-basic/source/Sample_Programs"

You can force BASIC! to re-load these programs by:

- Select Menu->Delete
- Navigate to "rfo-basic/source/Sample_Programs/"
- Delete the "f01_vxx.xx_read_me file"
- Exit BASIC! using Menu->Exit or Menu->More->Exit
- Re-enter BASIC!

Appendix C – Launcher Shortcut Tutorial

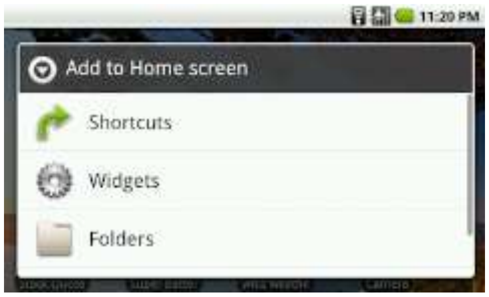
Introduction

This tutorial will "compile" a BASIC! program and create an "application" that resides on your Android device home page. This "application" will have its own Icon and Name. The official Android name for this type of "application" is "Shortcut." The BASIC! application must be installed for this to work.

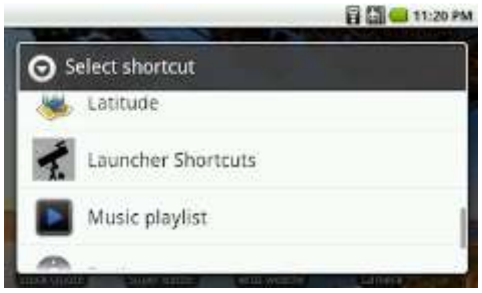
There is also an option to actually build a standalone application .apk file that does not require the BASIC! application to be installed. The process is more difficult but it will result in an application that can be offered on theGoogle Play Store. See Appendix D.

How to Make a Shortcut Application (older versions of Android—prior to Android 4.0)

1. Start BASIC!
2. Select Menu->Exit orMenu->More->Exit to Exit BASIC!
3. Do a long press on the HOME screen.
4. You should see something like the following:

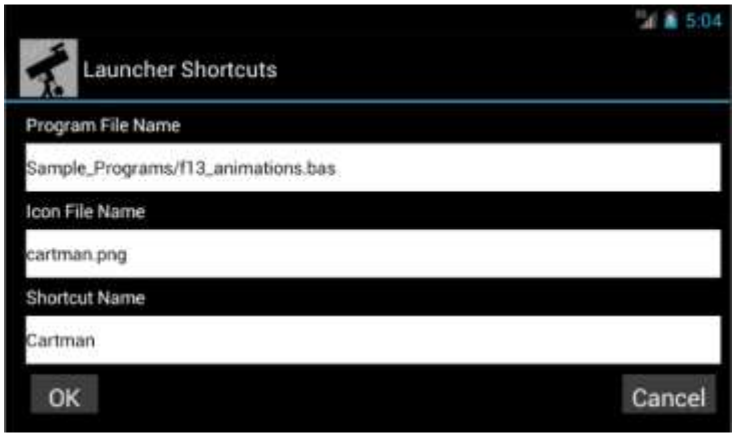


5. Tap Shortcuts.
6. Scroll down the Select Shortcut page until you see the BASIC! icon with the Launcher Shortcuts Label.



7. Tap the BASIC! Icon.

8. This screen will appear:



Program File Name

Sample_Programs/f13_animations.bas

Icon File Name

cartman.png

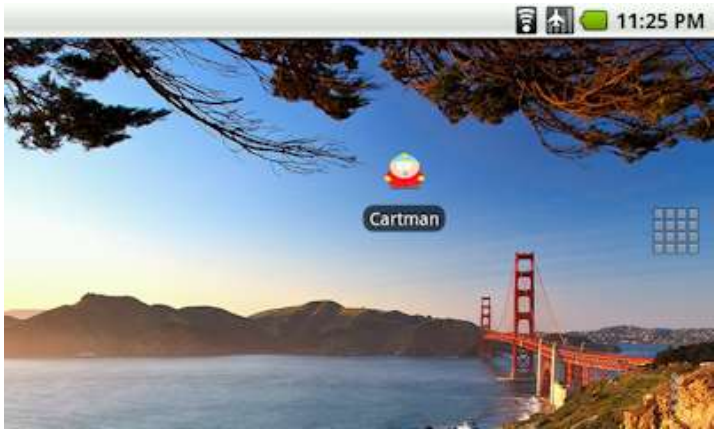
Shortcut Name

Cartman

9. Fill out the Form exactly as shown.

- The Program File Name is Sample_Programs/f13_animations.bas
- The Icon File Name is cartman.png
- The Shortcut Name is Cartman

10. Tap OK.



11. You should see something like this on your HOME screen:
12. Tap the Cartman Shortcut.
13. BASIC! will start and run the Cartman Jumping Demo.

How to Make a Shortcut Application (newer versions of Android—Android 4.0 and later)

1. Select the Apps Page.
2. At the top of the screen, tap Widgets.

3. Scroll horizontally until you see the BASIC! icon that says Launcher Shortcuts.
4. Touch and hold that entry. It will be moved to the Home page.
5. Continue with step 8, above.

What you need to know

- The icon image file must be located in the "<pref base drive>/rfo-basic/data/" directory.
- The program that you are going to run must be in the "source" directory or one of its sub directories. In this example, the file was located in the Sample_Programs(d) subdirectory of the "source(d)" directory.
- The icon should be a .png file. A Google search for "icon" will reveal thousands for free icons. Just copy your icon into "rfo-basic/data" on the SD card.
- Be very careful to correctly spell the names of the program and icon files. BASIC! does not check to see if these files actually exist during the "compile" process. If you enter the name of an icon file that does not exist, your shortcut will have the generic Android icon. If the file name you specified does not exist, when you tap the Shortcut you will see an error message in the form of program file in the Editor.
- The Shortcut name should be nine (9) characters or less. Android will not show more than nine characters.
- You can create as many shortcuts as you home screen(s) can handle.
- Tapping "Cancel" in the Launcher Shortcuts dialog will simply cancel the operation and return to the home screen.
- If you plan to use a BASIC! Launcher Shortcut, you should always exit BASIC! using Exit-Menu or Menu->More->Exit. If a Launched program is running, tapping BACK once or twice will exit BASIC back to the Home Screen.

Appendix D – Building a Standalone Application

Note: BASIC! collaborator Nicolas Mougin, has created a suite of automated tools for generating standalone applications. These tools can be downloaded from this website:

http://rfo-basic.com

Using Mr. Mougin's tools, you avoid having to do all of the following.

If you have any questions or problems with this tool you can contact Mr. Mougin and other users of the tool at the BASIC! forum in this thread:

http://rfobasic.freeforums.org/rfo-basic-app-builder-f20.html

Introduction

This document will demonstrate how to create a standalone application from a BASIC! program. The resulting application does not need to have BASIC! installed to run. It will have its own application name and application icon. It may be distributed in the Google Play Store or elsewhere. The process involves setting up the Android development environment and making some simple, directed changes to the BASIC! Java source code. Since Google changes the Development Environment every so often, this procedure does not necessarily reflect the latest version of the ADT.

License Information

BASIC! is distributed under the terms of the GNU GENERAL PUBLIC LICENSE. The license requires that the source code for "derivative works" be made available to anyone who asks. The author of BASIC! interprets this to mean that the license applies only to derivatives of the BASIC! *source interpreter code*. It does not apply to source code for BASIC! applications, i.e., code that you have written using the BASIC! language.

Before You Start

Run the sample program, **source/my_program.bas**.

We are going to turn this program into a practice APK.

Setting Up the Development Environment

These instructions are based on using the Android Developer Tools (ADT) plug-in for the Eclipse Integrated Development Environment (IDE) to build an Android application.

This is no longer the recommended toolset. Android Studio is now the official IDE for Android. For information about Android Studio, visit Android's Developer Tools page at http://developer.android.com/sdk/index.html.

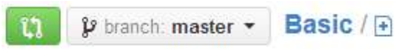
These instructions will be updated for the new tools in a future version of this manual.

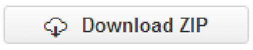
1. Download and install the latest version of the Java Development Kit (JDK). Find this by Googling "java jdk download" and going to the listed oracle.com download site. Do not download from any other site. Note: The JDK download includes the Java Run Time Environment (JRE) which is also needed.
2. Download and install the "Eclipse IDE for Java Developers" from https://eclipse.org/downloads/. The current version is 4.4.1 "Luna". You may prefer to download and install an older version from https://eclipse.org/kepler/ or https://eclipse.org/juno/, because these instructions were written from "Juno".
3. Visit Android's "Installing the Eclipse Plugin" page at http://developer.android.com/sdk/installing/installing-adt.html. From there you can download the Android Developer Tools (ADT) Plugin. Follow the installation instructions found there.

The instructions below have been changed over time for different versions, most recently for Eclipse 4.2 (Juno) and ADT 22.2, and you may find differences in the version you have installed. Please visit the BASIC! users' forum at http://rfobasic.freeforums.org to report any problems you find.

4. BASIC! supports most versions of Android, which can lead to spurious build errors. You may need to change API level checking from Error to Warning:
   a. Select **Window->Preferences->Android->Lint Error Checking**
   b. Find **NewApi** and click on it.
   c. In the dropdown list, change the Severity from Error to Warning.
   d. Click **Apply**

Download the BASIC! Source Code from the GitHub Repository

1. Go to: https://github.com/RFO-BASIC/Basic.
2. Find the branch/tag selection button: 

Click the button and the "Tags" tab to select the tagged release version you want. If you do not select a tag, you will get the source for the latest development build. The latest development source is not guaranteed to be stable.
3. Click the "Download ZIP" button: 

found on the right side of the page. The name of the downloaded ZIP file depends on which tag you selected in the previous step.
4. Put the unzipped source files into a folder. For this exercise, name the folder "Cats". You should use a different folder for each new APK that you create.

– OR –

Download the BASIC! Source Code from the Legacy Archive

1. Go to: http://laughton.com/basic/versions/index.html and select the version number you want. For versions later than v01.77, you must download the source from GitHub.
2. Look for the section heading, "**Download BASIC! Source Code.**" Click on the "**here**" to download "Basic.zip".

3. Older versions of this file contain only the BASIC! source code. More recent versions also contain a copy of the Android-loadable Basic.apk file and a copy of this manual.
4. Put the unzipped source files into a folder. For this exercise, name the folder "Cats". You should use a different folder for each new APK that you create.

Note: In the remainder of this tutorial, we assume our application is about cats, thus we are using the name "Cats". For your own APK, you should choose a name that matches your application.

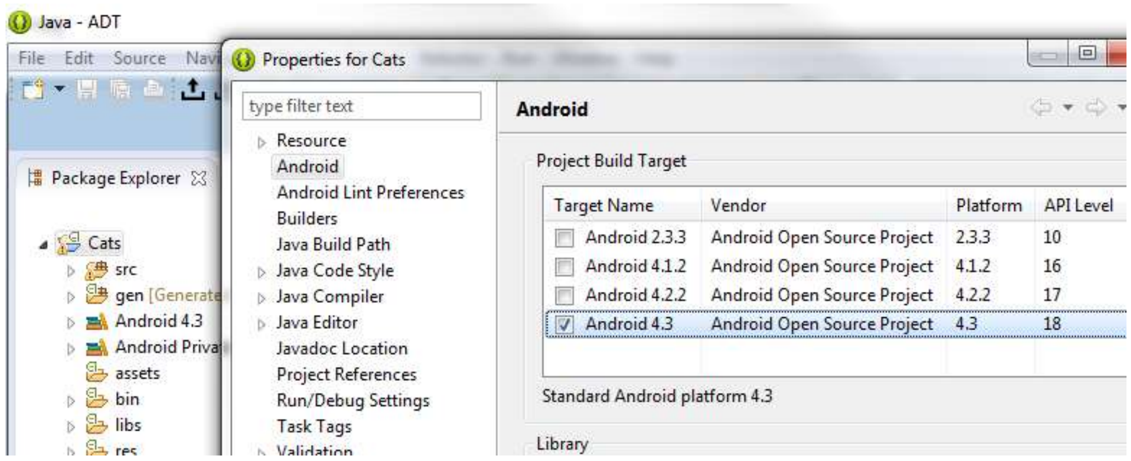
Create a New Project in Eclipse

Note: to simplify later steps, turn off the automatic build feature of Eclipse before creating the new project:

1. On the menu, click **Project**.
2. Uncheck **Build Automatically**.

Now you can create the project.

3. Select: **File -> New -> Project...->Android->Android Project from Existing Code**.
4. In the **Import Projects** dialog box, browse to the folder where you put the BASIC! source files.
5. Under **Projects to Import**, click the project you are importing. Make sure it is checked.
6. Under **New Project Name**, change the project name from "Basic" to "Cats". Click **Finish**.
7. In the **Package Explorer** window on the left, right-click on **Cats** and select **Properties** (near the bottom of the list).
8. In the Properties dialog box, select **Android**:



	Target Name	Vendor	Platform	API Level
☐	Android 2.3.3	Android Open Source Project	2.3.3	10
☐	Android 4.1.2	Android Open Source Project	4.1.2	16
☐	Android 4.2.2	Android Open Source Project	4.2.2	17
✓	Android 4.3	Android Open Source Project	4.3	18

Standard Android platform 4.3

9. Check the highest level of the Android OS available in this list. Do this without regard to the level of OS in your device(s). (Note for KitKat users: BASIC! is currently compiled with API 18. The build works with higher levels, but you may choose to limit the OS level to 4.3, API 18.)
10. Click **Apply** then **OK**.

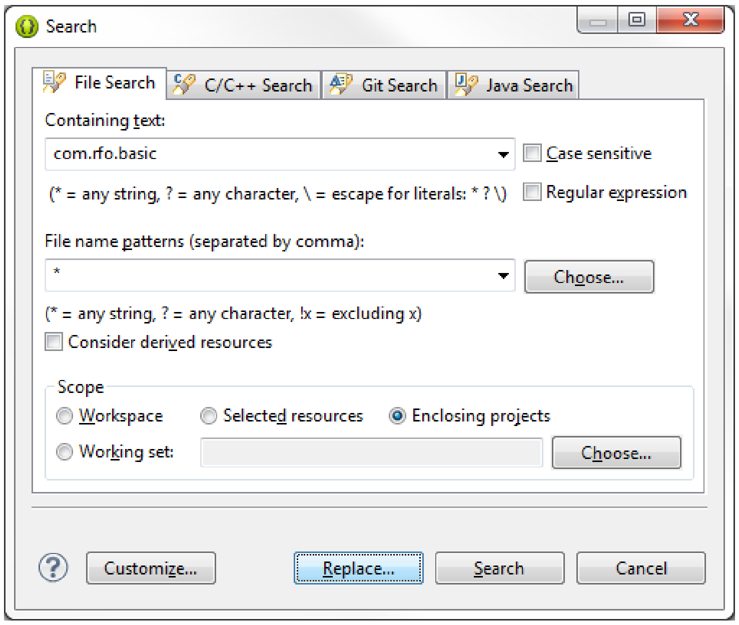
The Basic source is now ready for making an APK.

Rename the Package

The package name is what makes your application different from every other application that runs on Android devices. No matter what you name your application, it is the package name that Android uses to identify your particular application.

First, use the search-and-replace dialog to update references to the package name.

1. From the Menu Bar, select: **Search->File**.
2. Fill in the dialog like this:



Containing text: com.rfo.basic

[ ] Case sensitive

(* = any string, ? = any character, \ = escape for literals: * ? \)

[ ] Regular expression

File name patterns (separated by comma): *

(* = any string, ? = any character, !x = excluding x)

[ ] Consider derived resources

Scope

Workspace   Selected resources   [✓ Enclosing projects]

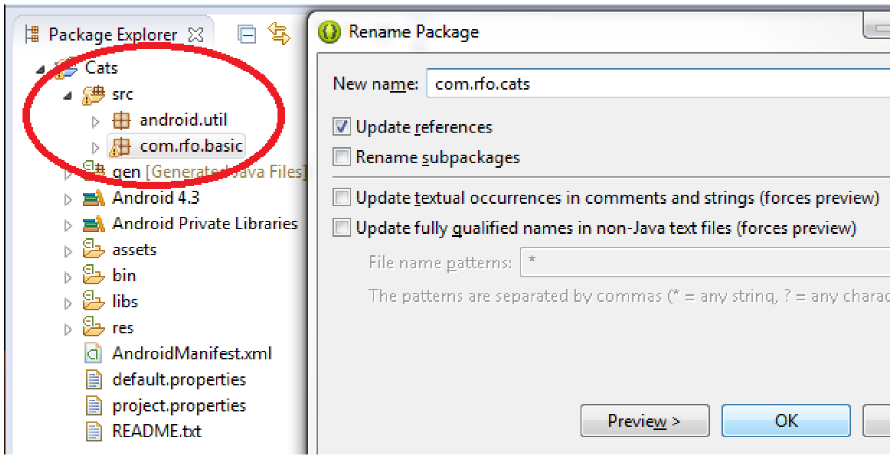
Working set:

3. Click **Replace**. The Replace Text Matches Dialog Box opens.
4. Enter "com.rfo.cats" in the **With:** field, and click **OK**.

Next, tell Eclipse about the package change.

5. In the **Package Explorer**, click and open the **Cats -> src** hierarchy as shown below.
6. Select the **com.rfo.basic** package.
7. From the Menu Bar, select **File->Rename** to open the **Rename Package** dialog.
8. In the **New name:** field, enter "com.rfo.cats".

9. Make sure the **Update references** box is checked and click **OK**.


Package Explorer

- Cats
  - src
    - android.util
    - com.rfo.basic
  - gen [Generated Java Files]
  - Android 4.3
  - Android Private Libraries
  - assets
  - bin
  - libs
  - res
  - AndroidManifest.xml
  - default.properties
  - project.properties
  - README.txt

Rename Package

New name: com.rfo.cats

[✓] Update references

[ ] Rename subpackages

[ ] Update textual occurrences in comments and strings (forces preview)

[ ] Update fully qualified names in non-Java text files (forces preview)

File name patterns: *

The patterns are separated by commas (* = any string, ? = any charac

Your project is ready to build. Restore the automatic build feature of Eclipse:

10. Click **Project->Build Automatically**. Make sure the checkmark appears.

The project should build without errors.

At this point the package has been successfully renamed. Next we will create a practice APK that you then use to make your own APK.

Modifications to setup.xml

You can customize your apk with settings in the resource file **setup.xml**. Some changes are required for any apk.

In the **Package Explorer**, expand **Cats/res/values** and then double-click **setup.xml**. The file opens in the window on the right. There are tabs at the bottom of the window that let you change how the file is displayed. If the **Resources** tab is selected, you see a special Eclipse Resource Editor. This editor does not know how to modify all of the properties in this file. Click on the **setup.xml** tab to display the actual XML text, as shown in the image below. In this view, you can also see the comments describing the values you can change for your application.

Be sure you change only values, not names. Names are shown as blue text in quotes. Values are shown as black text with no quotation marks. If you change a name, Java can not find the item to get its value.

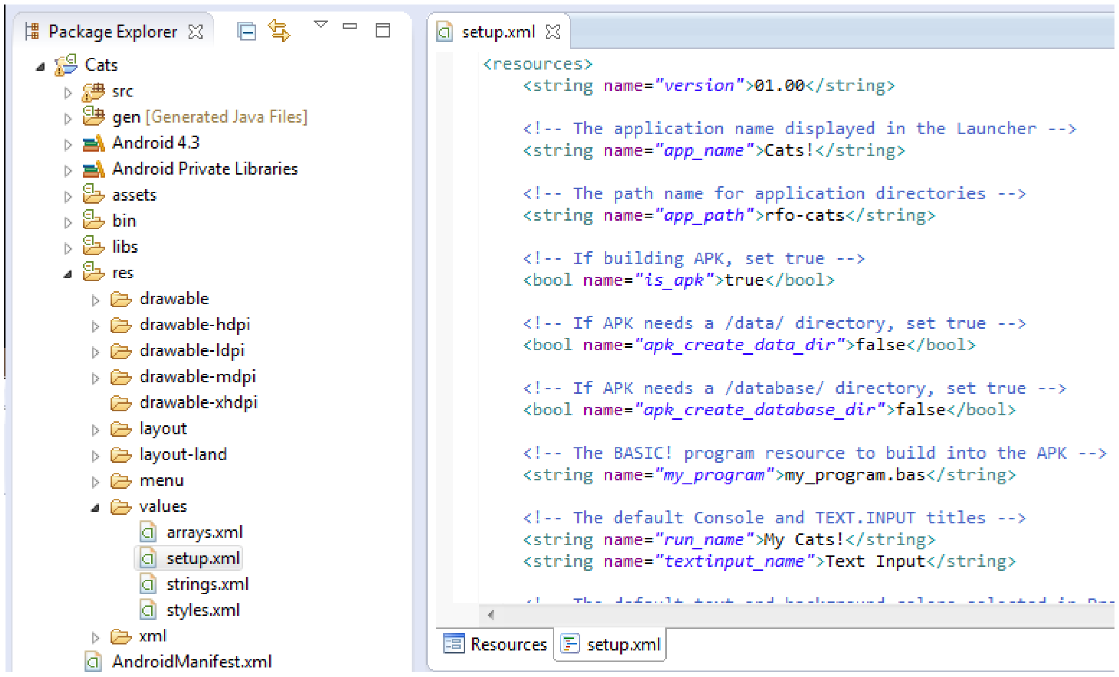
Change the value of **"app_name"** from **BASIC!** to **Cats!**. This is the name of the application as it will appear on your Android device.

Change the value of **"app_path"** to **rfo-cats**. This will be the directory on the SD card where your files are stored, if you choose to have a directory for files for your application. Make this change even if you do not choose to create directories for your application. It has implications in other parts of the code.

Change the value of **"is_apk"** to **true**.

The items **"apk_create_data_dir"** and **"apk_create_database_dir"** are flags that control whether directories are created under **"app_path"** for your application's files. Since this practice application does not need any directories, change the values of both to **false**.

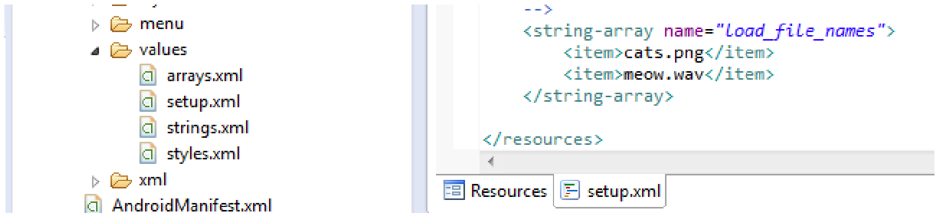
The item **"load_file_names"** is a list of files that you want loaded to the SD card. This practice application uses the sound clip **meow.wav**. Running under standard BASIC!, the program would use the file **rfo-basic/data/meow.wav**. As a standalone application, it can use a file image built into APK. Since the practice application is not using a real file, you can leave the **"load_file_names"** list empty.



```
<resources>
    <string name="version">01.00</string>

    <!-- The application name displayed in the Launcher -->
    <string name="app_name">Cats!</string>

    <!-- The path name for application directories -->
    <string name="app_path">rfo-cats</string>

    <!-- If building APK, set true -->
    <bool name="is_apk">true</bool>

    <!-- If APK needs a /data/ directory, set true -->
    <bool name="apk_create_data_dir">false</bool>

    <!-- If APK needs a /database/ directory, set true -->
    <bool name="apk_create_database_dir">false</bool>

    <!-- The BASIC! program resource to build into the APK -->
    <string name="my_program">my_program.bas</string>

    <!-- The default Console and TEXT.INPUT titles -->
    <string name="run_name">My Cats!</string>
    <string name="textinput_name">Text Input</string>
```

Save the changes to setup.xml.

Note: If you do want to load files to the SD card, you must allow the creation of the data directory (set "**apk_create_data_dir**" to **true**) and put the file names in the "**load_file_names**" list like this:



```
    -->
    <string-array name="load_file_names">
        <item>cats.png</item>
        <item>meow.wav</item>
    </string-array>

</resources>
```

The files will be loaded from the assets folder. This will be explained in the next section.

At this point, you have modified the source files of the BASIC! interpreter so it can be packaged into a standalone application. You can build and run it, if you like, but it will display a blank Console. That's result you get when you build BASIC! into an application but you don't give it a program to run.

Advanced Customization with setup.xml

The **setup.xml** file allows more customization than the minimum required for **Cats**.

The VERSION$() function gets its value from the item named **"version"**. If your application uses VERSION$(), this is where you set the value you want it to return.

The item **"my_program"** is the name of the BASIC! program you want your application to run. This will be explained in the next section.

If the **.bas** program files in the **source** subdirectory of your **assets** are encrypted, you must set the item **"apk_programs_encrypted"** to **true**. This tells the BASIC! interpreter that it must decrypt programs as it loads them.

The item **"run_name"** is the default title of the Console. Your program can set the Console title, but you may want to change the default title here. Similarly, **"select_name"** and **"textinput_name"** set the names of the screens for the **Select**, **Text.Input**, and **TGet** commands.

If your app uses Console output, you can set the text colors here. The mapping of **"color1"**, **"color2"**, and **"color3"** to text foreground, background, and underline depend on your **Screen Colors** setting under **Preferences**.

As mentioned earlier, the **"load_file_names"** is a list of files that you want loaded to the SD card. Any files listed here will be copied from the **assets** directory to the SD card every time your app starts. This may be the internal Android file system or a file system mounted on an external SD card. After that, your app will access the files from the SD card file system, not from **assets**. Any changes your program makes to these files will be overwritten the next time the app starts. To preserve changes, your program must copy or rename the file. The copied/renamed file will not be overwritten when your program runs again.

Several items in **setup.xml** control the splash screen and file-load progress indicator. If you don't change anything, your **Cats** app will display the default BASIC! splash screen briefly. You may not see it because the apk does not load any files.

You can turn off the splash screen by setting **"splash_display"** to **false**.

The splash screen image is the resource file **res/drawable/splash.png**. To customize the splash screen, replace this file in your project with an image of your own. Your image file must be named **splash.jpg**.

If you do not use a splash screen, you may remove this file from your project to make your apk a little smaller. Do not remove the file **res/drawable/blank.jpg**.

You can also customize the file-load progress indicator. Progress is shown in a pop-up over the splash screen. The title comes from the string **"loading_msg"**.Each increment of progress is a copy of the string **"progress_marker "**. The default string is a single period (**.**).

You can turn off the progress indicator by making the **"loading_msg"** an empty string.

The **setup.xml** file is intended to collect the fields you are most likely to want to change all in one place. There are many other strings and values that can be set to customize your app. Another file with fields you may find interesting is **strings.xml**, where default values of many strings are set. For example, you can change the default title string for the Speech-to-Text dialog by editing the string named **sst_prompt**.

Later, we will describe how to change the default values of Preference options in the file **settings.xml**.

Files and Resources

Standard BASIC! loads its sample programs and the data files they need from the **assets** folder of the Eclipse project. Android treats the **assets** folder like a file system. At startup, BASIC! simply copies the entire **assets/rfo-basic** folder to the SD card.

Your application can use the **assets** folder, too. Most of the BASIC! file-handling commands look in the SD card file system first. If the file does not exist on the SD card, your program compiled into an APK can look for the file in **assets**. **FILE.EXISTS** looks only for files on the SD card, but **FILE.TYPE** works with items in **assets** as well. You can use them together to determine where an item is.

Files in **assets** are ***read-only***. Your program can create and modify files on the SD card. It cannot create or modify files in **assets**. If you want BASIC! to copy files from **assets** to the SD card, list them the **"load_file_names"** tag of **setup.xml** as described above in "**Advanced Customization with setup.xml**".

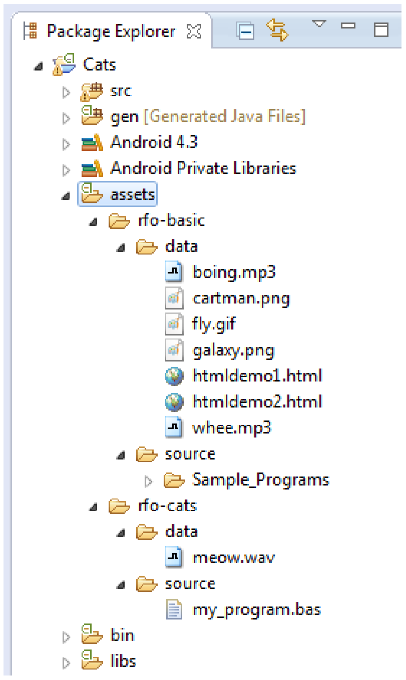
File names in **assets** are ***case-sensitive***. If your program looks for a file on the SD card, the name is not case-sensitive: "meow.wav" and "Meow.WAV" are the same file. However, to find a file in **assets**, your program must name the file exactly as you put it in **assets**. **AUDIO.LOAD aft, "meow.wav"** will **not** find **assets/rfo-cats/data/Meow.WAV**.

For this practice APK, make the following changes:

1. In the **Package Explorer**, expand **Cats/assets/rfo-basic** and its **data** and **source** folders.
2. Right-click **assets** and select **New -> Folder**.
3. In the **Folder name:** field, enter "rfo-cats/data".
4. Click **Finish**.
5. In the same way, create "rfo-cats/source".
6. Drag **assets/rfo-basic/data/meow.wav** to **assets/rfo-cats/data/**.
7. Drag **assets/rfo-basic/source/my_program.bas** to **assets/rfo-cats/source/**.

   Note: the top folder in **assets** must exactly match what you put in the "**app_path**" item in **res/values/setup.xml**. For this practice program, it is **rfo-cats**.

   If you expand your new folders, your **Package Explorer** should look like this:



```
Cats
  src
  gen [Generated Java Files]
  Android 4.3
  Android Private Libraries
  assets
    rfo-basic
      data
        boing.mp3
        cartman.png
        fly.gif
        galaxy.png
        htmldemo1.html
        htmldemo2.html
        whee.mp3
      source
        Sample_Programs
    rfo-cats
      data
        meow.wav
      source
        my_program.bas
  bin
  libs
```

Your APK does not need anything in **assets/rfo-basic**. Delete the entire folder:

8. In the **Package Explorer**, right-click **Cats/assets/rfo-basic** and select **Delete**.
9. In the confirmation window that appears, click **OK**.
10. You are done making changes! It wouldn't hurt to do a **Project->Clean** here.

Testing the APK

We are now ready to test this practice APK.

The first thing you will do is to create a Keystore. The Keystore is used to sign your application. Google Play requires this signing. Android devices will not install unsigned APKs. You will use this one Keystore for all your APKs. Preserve and protect it. You will not be able to update your APK without it.

For more information about the Keystore and signing, see:

http://developer.android.com/tools/publishing/app-signing.html

1. In the **Package Explorer**, right-click **Cats**.
2. Select: **Android Tools -> Export Signed Application Package**.
3. In the **Project Checks** dialog box click **Next**.
4. Select **Create New Keystore**.
    a. Provide a name and location for the Keystore.
    b. Provide a password and confirm it.
    c. Click **Next**.
5. Fill out the **Key Creation** dialog.
    a. Pick any name for an Alias.

   b. Enter 25 for Validity (Years).
   c. Click next.
6. In the **Destination and Key/Certificate Checks** dialog,
   a. Browse to the folder where you want to put the APK.
   b. Name the APK "Cats.apk".
   c. Click next.
7. Now, install and run Cats.apk.

The APK will have the BASIC! icon. The name below the icon on your device will be "Cats!". Double click the icon to run your application.

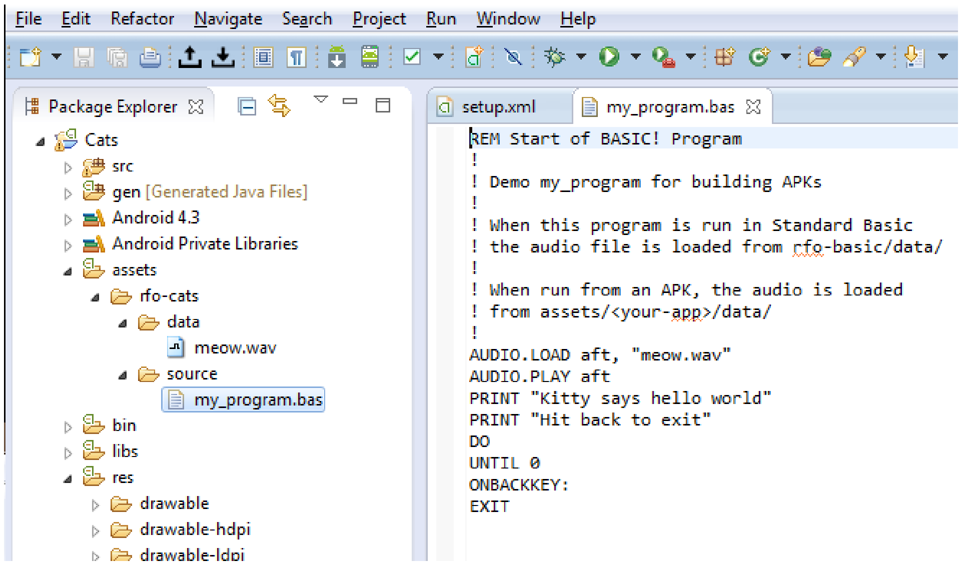
If you have reached this point successfully then you are ready to customize the APK for your application.

Start over with a new copy of Basic.zip but use names and information particular to your application and then continue below.

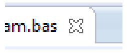
Installing a BASIC! Program into the Application

You must build your BASIC! program into your application my putting it into the **assets** folder, just as you saw in the practice program. One very simple way is to copy your text into **assets/<your-app>/my_program.bas**. **<your-app>** is the path you named in the **setup.xml** item **"app_path"**.

1. In the Eclipse **Package Explorer**, expand the **assets** folder.
2. Double-click **assets/<your-app>/source/my_program.bas**.
3. The file will open in the edit window to the right:



```
REM Start of BASIC! Program
!
! Demo my_program for building APKs
!
! When this program is run in Standard Basic
! the audio file is loaded from rfo-basic/data/
!
! When run from an APK, the audio is loaded
! from assets/<your-app>/data/
!
AUDIO.LOAD aft, "meow.wav"
AUDIO.PLAY aft
PRINT "Kitty says hello world"
PRINT "Hit back to exit"
DO
UNTIL 0
ONBACKKEY:
EXIT
```

Now you can edit the file directly in Eclipse. If you prefer, you can open your program outside of Eclipse, copy its contents to the clipboard, and paste it into the Eclipse editor. When you are finished, select **File->Save** from the menu bar, or just close the file by clicking the **X**  on the file tab and **Yes** in the **Save Resource** dialog box.

For more complex projects, here is another way to do it.

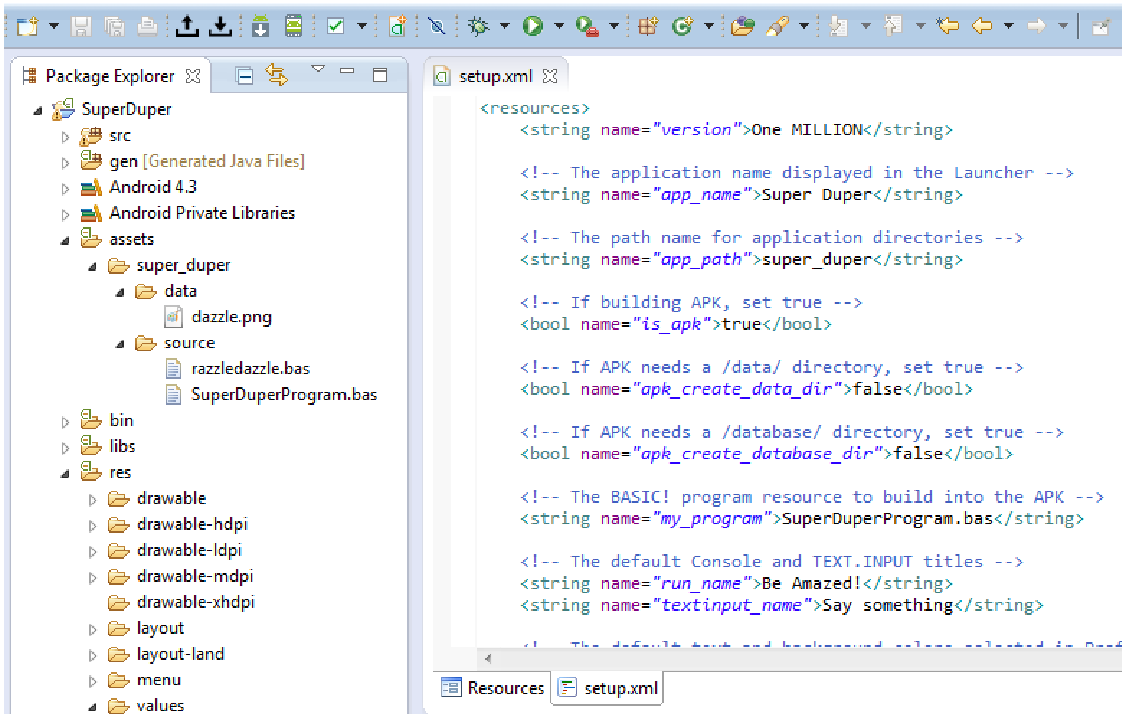
1. In the Eclipse **Package Explorer**, expand your program's **assets** folder.
2. If you have a **my_program.bas** in your **assets** folder, delete it.
3. In a file browser, browse to the file containing your program.
4. Drag your program from your file browser to your **assets/<your-app>/source** folder in Eclipse.
5. If your program uses **INCLUDE** files, drag them to the **source** folder, too.

With either method, you now have a program to run. If your program uses graphics, audio files, or other resources, you must put them in your Android **assets** folder, too.

If your program uses data files, drag them to your **assets/<your-app>/data** folder.

If your program uses data base files with the ".db" extension, create a new folder for them called **assets/<your-app>/databases** and drag your file into the new folder.

The result might look something like this:



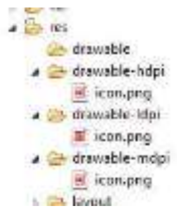
```
<resources>
    <string name="version">One MILLION</string>

    <!-- The application name displayed in the Launcher -->
    <string name="app_name">Super Duper</string>

    <!-- The path name for application directories -->
    <string name="app_path">super_duper</string>

    <!-- If building APK, set true -->
    <bool name="is_apk">true</bool>

    <!-- If APK needs a /data/ directory, set true -->
    <bool name="apk_create_data_dir">false</bool>

    <!-- If APK needs a /database/ directory, set true -->
    <bool name="apk_create_database_dir">false</bool>

    <!-- The BASIC! program resource to build into the APK -->
    <string name="my_program">SuperDuperProgram.bas</string>

    <!-- The default Console and TEXT.INPUT titles -->
    <string name="run_name">Be Amazed!</string>
    <string name="textinput_name">Say something</string>
```

Notice that the top folder in **assets** matches the "**app_path**" value, and there is a program in its **source** folder named the same as the "**my_program**" value.

Application Icons

Android specifies that Application icons must be provided in specific sizes: low dpi (36x36 pixels), medium dpi (48x48 pixels), high dpi (72x72), x-high dpi (96x96), and so on. The icons must be .png files. There are tens of thousands of free icons available on the web. Most image editing programs can be used to re-sample the icons to the proper sizes and to save them as .png files. If you are not going to put your application on the Google Play Store then you do not really need to worry about getting this exactly right.

To get your icon into your application, in res, open drawable-ldpi, drawable-mdpi, drawable-hdpi.



For each of the icon sizes:

1. Outside of Eclipse, copy the icon file
2. In Eclipse, right click on the appropriate **drawable-** for the copied icon's size
3. Select **Paste**
4. Right click on the icon.png file and delete it
5. Select the newly pasted icon and rename it to "icon.png" by selecting **File -> Rename**.

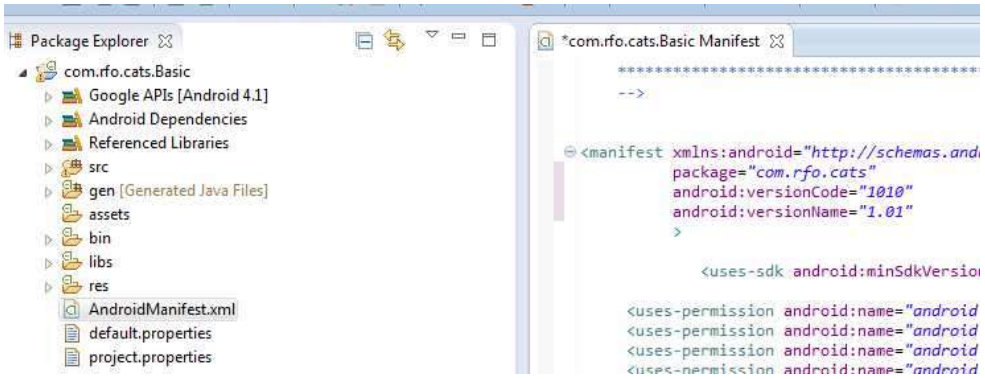
Yes, it is tedious work.

Modifications to the AndroidManifest.xml File

The **AndroidManifest.xml** file defines many aspects of how your application is built, and how it is presented to the Android system. For example, when you changed the package name, Eclipse wrote the change into the Android manifest.

You can build and run your application with no further changes to AndroidManifest.xml. However, the manifest carries information that your application may not need. You should customize it to suit your application.

In the **Package Explorer**, find the **AndroidManifest.xml** file. Double-click to open it:



```
    ****************************************
    -->

<manifest xmlns:android="http://schemas.and
          package="com.rfo.cats"
          android:versionCode="1010"
          android:versionName="1.01"
          >

            <uses-sdk android:minSdkVersio

      <uses-permission android:name="android
      <uses-permission android:name="android
      <uses-permission android:name="android
      <uses-permission android:name="android
```

Eclipse has special editors to display different views of the Manifest. If you don't see the actual XML text as shown here, click on the rightmost tab at the bottom of the window, labeled **AndroidManifest.xml**.

Setting the Version Number and Version Name

If you are going to put the application on the Google Play Store, you will need to change the version number and name for each new release.

Make the appropriate changes to the **android:versionCode** and **android:versionName** items of the **<manifest>** tag at the top of **AndroidManifest.xml**.

If you want to use the BASIC! **VERSION$()** function to have your program read your version number, you will also have to change the version number in **res->values->strings**.

Permissions

BASIC! uses many features about which the APK user is warned and must approve. Your particular APK may not need all or any of these permissions. The permission notifications are contained in the **<uses-permission>** tags of the **AndroidManiest.xml**. They look like this:

```
<uses-permission android:name=" android.permission. … " />
```

Look them over. If you feel that your APK does not need them then delete or comment them out.

If your application uses the SD card, do not comment out:

```
<uses-permission android:name="android.permission.WRITE_EXTERNAL_STORAGE" />
```

If you want your application to run when the device boots (see "Launch at device boot", below), do not comment out:

```
<uses-permission android:name="android.permission.RECEIVE_BOOT_COMPLETED" />
```

Be sure to test your APK after changing permissions.

Disable the Shortcut Launcher

Each Activity screen that BASIC! can present to a user is declared in an **<activity>** tag in the **AndroidManifest.xml** file. Your application may not use every Activity BASIC! offers. You may remove the unsed **<activity>** tags if you wish, but they don't hurt anything if you leave them in.

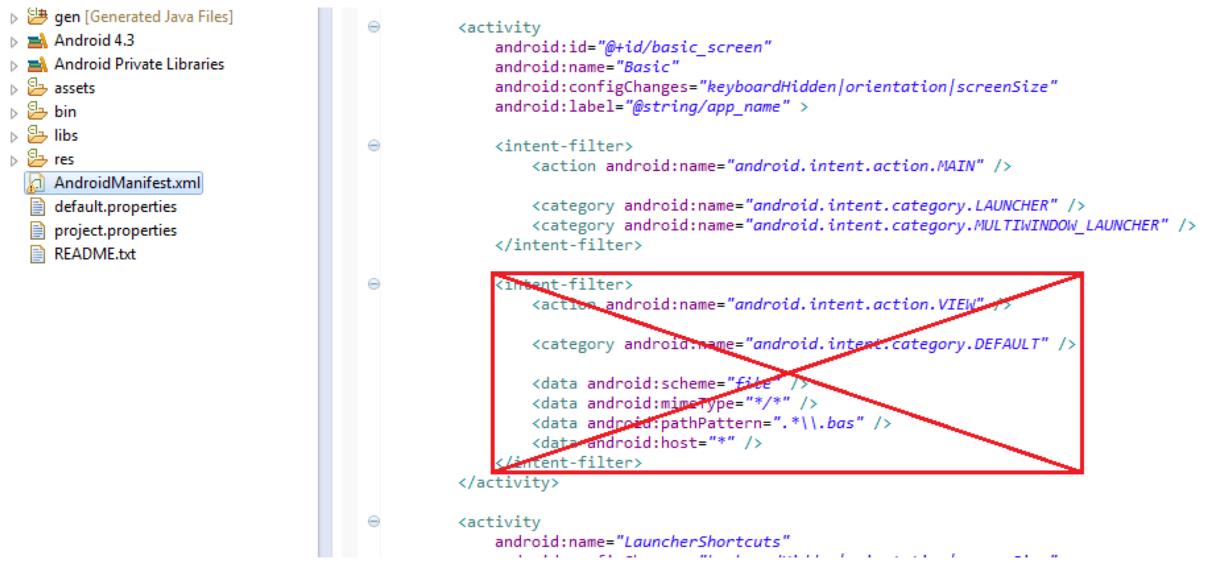
However, the **<activity>** tags also tell the Android system what events should start your application. You probably do not want your application to respond to these two events:

1) A user can launch BASIC! by tapping a file with a ".bas" extension
2) A user can use the Shortcut Launcher to create a shortcut for a BASIC! program

You remove these by deleting their tags from the Manifest:

1) Find the **<activity>** tag that contains **android:name="Basic"**.

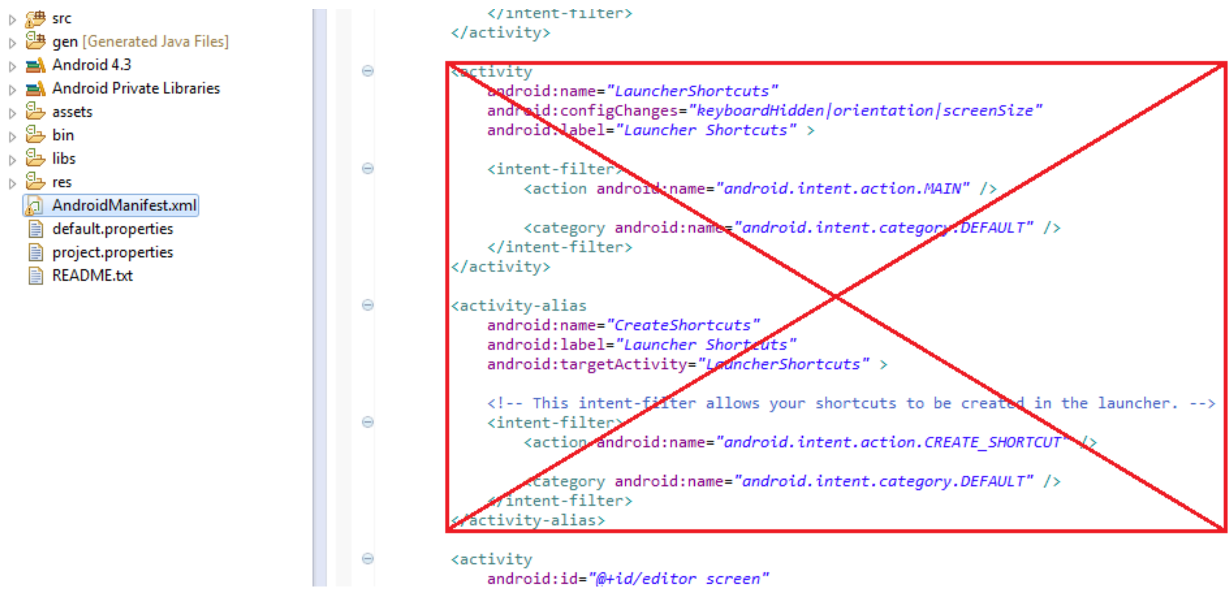
a) In it, find the **<intent-filter>** tag that contains **<data android:pathPattern=".*\\.bas" />**.
b) Remove all of the **<intent-filter>** tag, from **<intent-filter>** to **</intent_filter>**.
Do **not** remove the **<activity>** tag.



gen [Generated Java Files]
Android 4.3
Android Private Libraries
assets
bin
libs
res
AndroidManifest.xml
default.properties
project.properties
README.txt

```
<activity
    android:id="@+id/basic_screen"
    android:name="Basic"
    android:configChanges="keyboardHidden|orientation|screenSize"
    android:label="@string/app_name" >

    <intent-filter>
        <action android:name="android.intent.action.MAIN" />

        <category android:name="android.intent.category.LAUNCHER" />
        <category android:name="android.intent.category.MULTIWINDOW_LAUNCHER" />
    </intent-filter>

    <intent-filter>
        <action android:name="android.intent.action.VIEW" />

        <category android:name="android.intent.category.DEFAULT" />

        <data android:scheme="file" />
        <data android:mimeType="*/*" />
        <data android:pathPattern=".*\\.bas" />
        <data android:host="*" />
    </intent-filter>
</activity>

<activity
    android:name="LauncherShortcuts"
```

2) There are two shortcut tags:
a) Find and remove the **<activity>** tag that contains **android:name="LauncherShortcuts"**.
b) Find and remove the **<activity-alias>** tag that contains **android:name="CreateShortcuts"**.



src
gen [Generated Java Files]
Android 4.3
Android Private Libraries
assets
bin
libs
res
AndroidManifest.xml
default.properties
project.properties
README.txt

```
    </intent-filter>
</activity>

<activity
    android:name="LauncherShortcuts"
    android:configChanges="keyboardHidden|orientation|screenSize"
    android:label="Launcher Shortcuts" >

    <intent-filter>
        <action android:name="android.intent.action.MAIN" />

        <category android:name="android.intent.category.DEFAULT" />
    </intent-filter>
</activity>

<activity-alias
    android:name="CreateShortcuts"
    android:label="Launcher Shortcuts"
    android:targetActivity="LauncherShortcuts" >

    <!-- This intent-filter allows your shortcuts to be created in the launcher. -->
    <intent-filter>
        <action android:name="android.intent.action.CREATE_SHORTCUT" />

        <category android:name="android.intent.category.DEFAULT" />
    </intent-filter>
</activity-alias>

<activity
    android:id="@+id/editor_screen"
```

Launch at device boot

Your APK can be set up to automatically launch just after the Android device has booted. This is accomplished by changing another item in **AndroidManifest.xml**.

Find the **<receiver>** tag with **android:name=".BootUpReceiver".**
Change **android:enabled="false"** to **android:enabled="true"**.

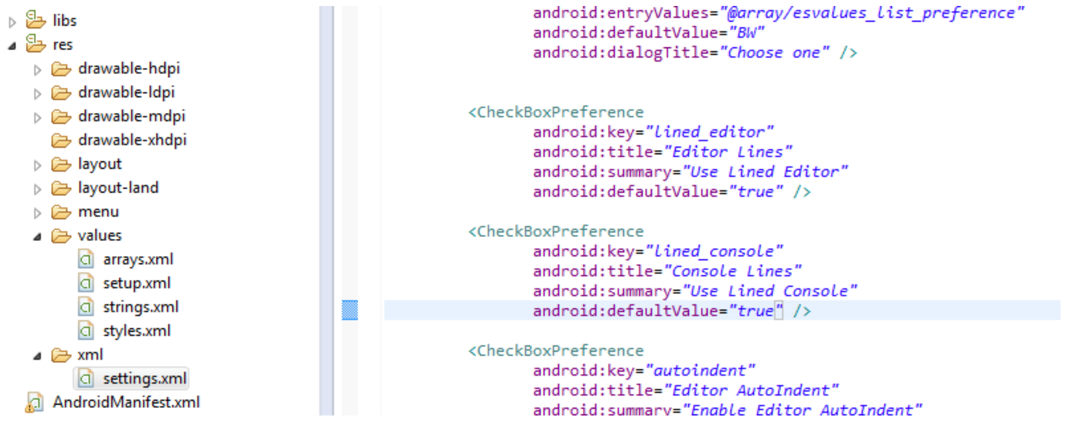
You must also make sure your app has "RECEIVE_BOOT_COMPLETED" permission. See the "Permissions" section, above.

Preferences

There are certain preferences such as screen colors and font sizes that you have set for your application. The preferences that you will get with an APK will be BASIC!’s default preferences. You can change the default preferences if you wish.

Some preferences are simple check boxes. To change these, open the **res/xml** hierarchy and double click on the **settings.xml** file as shown below:

For example, to change the default Console Lines preference from lined console to unlined console, change the value on the indicated line from **"true"** to **"false"**.



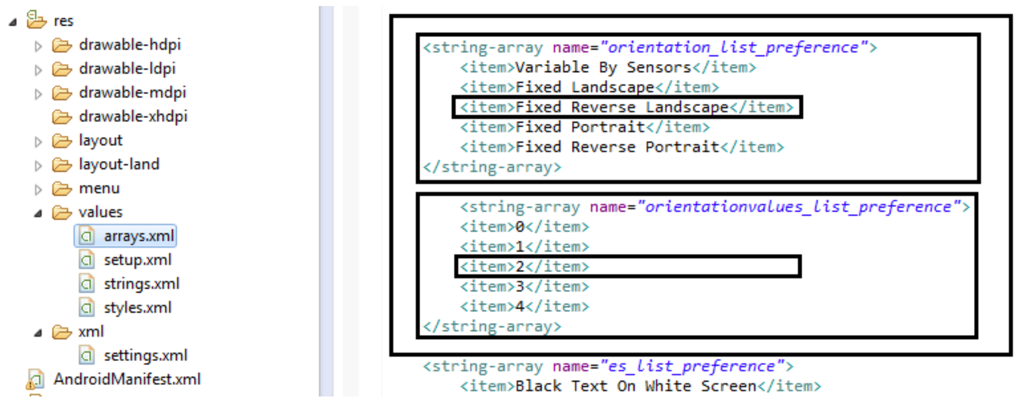
```
libs
res
  drawable-hdpi
  drawable-ldpi
  drawable-mdpi
  drawable-xhdpi
  layout
  layout-land
  menu
  values
    arrays.xml
    setup.xml
    strings.xml
    styles.xml
  xml
    settings.xml
AndroidManifest.xml
```

```
            android:entryValues="@array/esvalues_list_preference"
            android:defaultValue="BW"
            android:dialogTitle="Choose one" />


        <CheckBoxPreference
            android:key="lined_editor"
            android:title="Editor Lines"
            android:summary="Use Lined Editor"
            android:defaultValue="true" />

        <CheckBoxPreference
            android:key="lined_console"
            android:title="Console Lines"
            android:summary="Use Lined Console"
            android:defaultValue="true" />

        <CheckBoxPreference
            android:key="autoindent"
            android:title="Editor AutoIndent"
            android:summary="Enable Editor AutoIndent"
```

If your app uses graphics mode, and you have determined it works correctly with hardware-accelerated graphics, you may want to change the default setting of the CheckBoxPreference named "gr_accel". The default is normally "false", but to enable graphics acceleration in an APK you must change it to "true".

Other preferences are multiple-choice lists. To see the list values, open the **res/values** hierarchy and double click on **arrays.xml**. Each preference has two blocks. The top block lists the words that will be seen on the Android screen. The second block lists the internal names that correspond to the displayed words.

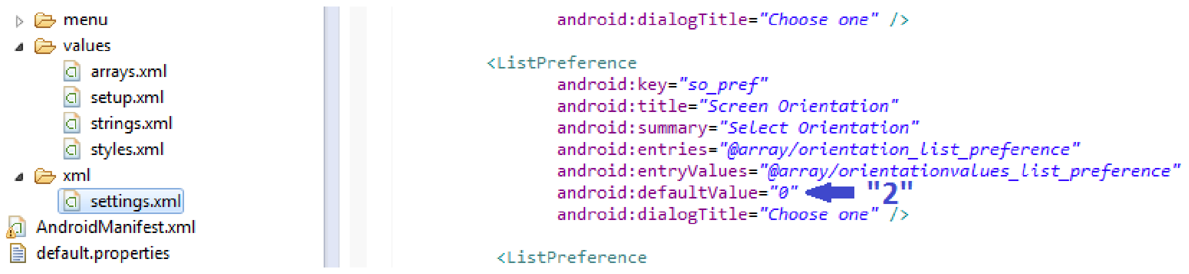
In the image below:



```
<string-array name="orientation_list_preference">
    <item>Variable By Sensors</item>
    <item>Fixed Landscape</item>
    <item>Fixed Reverse Landscape</item>
    <item>Fixed Portrait</item>
    <item>Fixed Reverse Portrait</item>
</string-array>
    <string-array name="orientationvalues_list_preference">
    <item>0</item>
    <item>1</item>
    <item>2</item>
    <item>3</item>
    <item>4</item>
</string-array>
<string-array name="es_list_preference">
    <item>Black Text On White Screen</item>
```

The section marked contains the names and values for the Screen Orientation preference. The top block is the display names. The bottom block is the internal values that correspond to the display name. For example the internal value of **Fixed Reverse Landscape** is **2**.

To set a default value for Screen Orientation, we need to go back to **settings.xml**:



```
        android:dialogTitle="Choose one" />

    <ListPreference
        android:key="so_pref"
        android:title="Screen Orientation"
        android:summary="Select Orientation"
        android:entries="@array/orientation_list_preference"
        android:entryValues="@array/orientationvalues_list_preference"
        android:defaultValue="0"
        android:dialogTitle="Choose one" />

     <ListPreference
```

Find the **<ListPreference>** tag with **android:title"="Screen Orientation"**. The title is the preference name that you see on the Android screen. The default value is in the **android:defaultValue ="0"** line. Here we see the default value for the screen orientation is "0". Looking at the Array.xml file we can see the "0" is the internal name for **Variable By Sensors**. To change the default value to **Fixed Reverse Landscape**, change the **"0"** to **"2"**.

The other list preferences follow the same logic.

Note: Be sure to test your application with your chosen preferences before burning them into an APK.

Finished

Create your finished APK in the same way we created the practice APK.

Now that was not too bad, was it?

Appendix E – BASIC! Distribution License

BASIC! is distributed under the terms of the GNU General Public License which is reproduced here.

Apache Commons

Portions of BASIC! use Apache Commons.