## EQuation ${ }^{\text {mpert }}$

For the HP48 Calculator Series

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#### Abstract

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## Intro to EQuation Xpert

VectorSoft proudly presents EQuation Xpert, the most complete solution to equation management ever offered!

EQuation Xpert provides HP48 users a highly effective graphical user interface to make locating and using equations easier than ever before.

Designed for engineers, students and virtually anyone keeping a large number of equations stored in the HP48, EQuation Xpert uses the equations you provide, making them more useful and manageable.

EQuation Xpert allows you to create your own personal equation library, eliminating the need for purchasing costly topic-specific equation cards that may not contain the equations you really need.

Once you take a look at all of the features EQuation Xpert has to offer, you'll wonder how you ever got along without it...

- Scrollable windows allow viewing the equation list, the equation and related information on the screen at one time
- Selection of equations by descriptive name
- Choose equation categories within classifications
- Exit \& drop equation to solver mode or stack
- View user defined picture for any equation
- View equation in command line or textbook format
- User defined equation information at the press of a key
- Simple one \& two-keystroke selection commands
- Exclusive AutoVARS ${ }^{T M}$ feature


## Program Registration

We encourage you to register this copy of EQuation Xpert.
By doing so, you will be informed of new product releases, updates and future discounts. Just fill out and mail the slip located in the back of this manual. Its that simple!

## Program Requirements

This program is compatible with the following HP scientific calculators: HP-48S, 48SX, 48G, 48GX.

If you purchased the disk-based version of EQuation Xpert, you will need the following:
$\checkmark$ Computer to HP senial cable
$\checkmark$ Kermit file-transfer software on your computer
$\checkmark$ Approximately 13K free RAM
$\checkmark$ Additional free RAM for equation storage

If you purchased the ROM-card version, you will need:
$\checkmark$ HP-48SX or HP-48GX
$\checkmark$ One available RAM/ROM card port
$\checkmark$ Additional free RAM for equation storage

## Installation Procedure

## Disk-based version:

1. Insert the EQuation Xpert disk into the computer disk drive.
2. Connect the PC-to-HP cable to an available serial port on your computer.
3. Change to the directory containing your copy of kermit.exe or mskermit.exe.
4. On the HP, change to the $\{$ home $\}$ directory (RIGHT-SHIFT, HOME).
5. Enter the I/O setup menu.

HP48S / SX: (LEFT-SHIFT, I/O) and press the SETUP key. HP48G / GX: (LEFT-SHIFT, I/O) and press the IOPAR key.
6. Choose WIRE as the means of data transmission.
7. Select a BAUD rate of 9600 .
8. Enter server mode by typing SERVER or entering (RIGHTSHIFT, I/O) on the 48S / SX. (on the 48G / GX select Start Server from the menu after entering RIGHT-SHIFT, I/O.)
9. On the PC, enter the kermit program by entering KERMIT at the prompt.
10. Enter SET BAUD 9600.
11. Enter SET PORT n (where n is the serial port number that you have attached the cable to.)
12. Enter SEND d:IEQX.LIB (d is the program drive.)
13. On the HP, press ON, VAR and the menu key labeled 'EQX.L' to recall the program to the stack.
14. You may now delete the file you transferred to the HP. Enter 'EQX.L!B' PURGE

## Installation Procedure (cont'd)

15. Type the following on the HP: $: \mathrm{n}: 1599$ STO (where n is 0,1 or 2 ). If you have a free RAM card in port 1 or 2 , use the corresponding port number. If you do not have add-in RAM cards or have them merged with user memory, replace the $n$ with a 0 .
16. Turn the HP off and then back on. You should see the following message briefly flash on the screen:


The disk-based installation procedure is complete.

## ROM card version (48SX \& GX only):

1. Turn the HP off, remove the port cover on the back and find a free card slot to use.
2. With the calculator face down, insert the EQuation Xpert ROM card into a slot so that the label is facing up.
3. Replace the port cover and turn the HP off and then on. You should also see the above screen momentarily displayed.

The ROM card installation is complete.

## Equation Organization

EQuation Xpert requires that you setup your equations in a specific manner to operate correctly.

While the following directory tree may look somewhat complicated, it provides for a very organized way in which to order and manage your equations.

Shown here is a typical directory tree containing three equation groups with a breakdown of the physics equation directory and the sub-directory of light related equations:


This structure is explained in detail on the following pages...

## Equation Organization (cont'd)



Within the HOME directory, a subdirectory titled 'X.EQS' is required to store all user defined equations in order to be located by EQuation Xpert.

Within this directory, the following entries are required:


- INFO.. a list of the current group class directories i.e. \{ PHY MECH ELEC \}
- TITLE a list of descriptive names of the above class directories (in the same order as above.)
i.e. \{ "PHYSICS" "MECH ENG" "ELECTRONICS" \}

At your option, you may have a list titled 'SOLVER'. This list, if found by EQuation Xpert, will be used to locate your directory for storing equations that are dropped into the HP solver mode.

A typical 'SOLVER' list would be the following:
\{ HOME SOLVDIR \}
EQuation Xpert will then switch to the directory SOLVDIR found in the HOME directory when using the solver mode.

If no such list exists, the HOME directory will be utilized for storing and solving equations.

## Equation Organization (cont'd)

Note: should you specify a solver mode directory that does not exist, you risk the chance of program malfunction.

Within the X.EQS directory are the user defined group/class, equation directories.


In the above directory tree, there are three main directories for the following equation classifications: physics, mechanical engineering, and electronics.

While only three directories are shown here, you may have any number you desire. The only limitation to the number of equations/directories is the amount of memory you have available.

The above equation directories hold topic/category specific directories under the main classifications. The physics directory is detailed below:


Located in the physics directory are the topical directories where all related equations are stored.

It is to your benefit to give these particular directories descriptive names, as they will be used for category selections in EQuation Xpert.

For efficient on-screen readability, it is recommended that the length of these directory names be 15 characters or less.

## Equation Organization (cont'd)

The equations defined by the user are located in the topic directory for each particular class.

Shown below is a typical directory containing five physics equations related to light:


Each of these equation variables are lists of the following format:


As you will come to notice, there is no correlation between the name of the equation variable and the descriptive name you provide it in the above list.

EQuation Xpert does not rely on your variable names, but allows you the freedom of providing more informative equation descriptions than could otherwise be done using the restrictive HP variable naming conventions.

On the following page we will take a look at the 'BRAGGS' variable in the above directory and detail the elements that make up user equation variables.

## Equation Setup

## Elements of a user equation variable:

## Element \#1: Text String (required)

This text string describes your equation. While this string may be as long or short as you like, it will be truncated to approximately 15 characters for display purposes

## Element \#2: Equation (required)

The second element is your equation. Any valid equation can be placed in the list.

## Element \#3: List of strings (optional *)

This list contains textual information related to your equation such as variable definitions, equation usage, notes, etc. Although there is no limit to the amount of information you can provide in this list, it is suggested that you keep the line lengths reasonable to aid on-screen readability.

* Note: if you decide to omit the informational strings, it is necessary to insert an empty list \{ \} as element \#3.

Element \#4: User Graphic (optional **) EQuation Xpert gives you the ability to include a custom graphic to aid in problem solving. The graphic you add to this list may be any size, up to the maximum PICT size of $131 \times 64$ pixels.

Element \#5: AutoVARS (optional **)
Only EQuation Xpert brings you AutoVARS. AutoVARS let you assign values to variables in the equation that normally remain constant. This allows you to view the equation as it would normally appear with all variable letters/names intact.
Upon dropping the equation to solver mode, the values you provide are automatically assigned to the specified variables.

[^0]
## Equation Setup (cont'd)

If you decide to omit one or both of the User Graphic or AutoVARS features, there is no requirement to fill the space in the list.

Using a common physics relationship, Bragg's Law, for finding the path difference between two x-ray beams incident on a crystalline structure, provides an example of a user equation variable utilizing all of the list elements available.

Shown below is the 'BRAGGS' equation variable from the example physics / light equation category:


This list means:
"upon solving this equation, set $m$ to 1 , set $\theta$ to 60 "
Now that the structures of EQuation Xpert directories and equations have been defined, you can get started creating your own personal equation library...

## Getting Started

## Creating your own equation library / Initial setup

1. Change to the \{ home \} directory ( RIGHT-SHIFT, HOME ) or enter HOME.
2. Create the main equation directory 'X.EQS' by entering 'X.EQS' CRDIR.
3. At your option, create a directory for solving equations with EQuation Xpert. Enter 'dirname' (where dirname is the name you choose), CRDIR.
4. Change to the 'X.EQS' directory by pressing VAR X.EQS.
5. If you created a solver directory in step 3, enter the following list on the stack: \{ HOME dirname \} where dirname is the same name used in step 3. Enter 'SOLVER' STO.
6. Create the templates for the 'INFO..' and 'TITLE' variables: Enter two empty lists on the stack: \{\} ENTER ENTER ' INFO.. ' (note 6 characters) STO 'TITLE' STO.

## Adding main equation groups / classes

1. Change to the \{ home \} directory ( RIGHT-SHIFT, HOME ) or enter HOME.
2. Change to the 'X.EQS' directory by pressing VAR X.EQS.
3. Choose a name for your new equation group or class (i.e. 'PHY') and create the directory. Example: 'PHY' CRDIR.
4. Add this directory name to the 'INFO..' list: Press INFO.. the apostrophe ('), the menu key labeled with the new class directory, ENTER then + . Now press ('), the menu key INFO.. STO.
5. Update the 'TITLE' list: Press TITLE. For the directory just created, enter a text string title or description for the group/class (i.e. "Physics" ). Press +, then ('), the menu key TITLE STO.

## Getting Started (cont'd)

Note: Both the 'INFO..' and 'TITLE' lists must have group/ class information in the same order for EQuation Xpert to operate properly.

## Example: INFO.. \{ PHY ELEC MECH \} TITLE \{ "Physics" "Electronics" "Mech Eng II" \}

## Adding categories to the main equation groups

(Refer at any time to page 5 for a typical directory layout.)

1. Change to the group/class directory that you wish to add an equation category/subject to.
2. Select a name for the new category (i.e. 'LIGHT') and create the directory. Example: 'LIGHT' CRDIR.

You may continue to add new groups/classes and categories as desired or begin to add your own personal equation variables.

## User Equations

Adding your own equation variables to your personal EQuation Xpert library is an easy straightforward procedure.

If you have not yet setup the necessary directories in your HP, please refer to Getting Started, pages 11-12.

## Creating user equation variables

Note that there is no limit to the number of user equation variables you may have.

Change to the desired category directory under a main equation group directory.

In the upper left corner of your HP, your path should contain four names. If not all are visible, you may turn the clock off in order to view them.
An example path may be: \{ HOME X.EQS PHY LIGHT \}.
The first two names in the path; HOME and X.EQS should appear as shown above. If different, correct your path selection or refer to page 5 for an example directory layout.

1. Create an empty list: Enter \{ \}.
2. Enter a text string description or name of the new equation. i.e. "MIRROR EQN"
3. Add the name to the list. Press + .
4. Enter the equation. You may use the equation writer if desired to create the equation.

$$
\text { i.e. } \cdot 1 / o+1 / i=1 / f^{\prime}
$$

5. Add the equation to the list. Press +.
6. Place an empty list inside another on the stack: \{ \{ \} \}.
7. If you do not want to add textual information to the equation, add this empty list to the current list. Press + and skip to step 10.

## User Equations (cont'd)

8. If you wish to add textual information to the equation variable, press the down arrow to edit the empty list and add any number of strings inside the inner list brackets.
Example:
\{ \{ "f = focal length"
" $f=R / 2$ where $R$ is" "the radius of curvature" "o = object dist" " $i=$ image dist" \}\}
9. Add the text list to the current equation variable list. Press + .
10. To add a user defined graphic/picture (GROB) to the equation, either create a graphic using the HP graphics commands and place it on the stack or recall a previously created picture.
11. You should see something similar to the following on the stack: Graphic $131 \times 64$. Add the graphic to the list. Press + .
12. If you wish to use the AutoVARS feature, follow steps 13-15, otherwise proceed to step 16.
13. Place an empty list inside another on the stack: $\{$ \{ \} \}.
14. For every variable in the current equation that you would like to assign a value to upon solving, enter the variable letters/names followed by the values inside the inner list brackets. Example:
\{ \{ f 10 \} \} (This will automatically set f to 10 upon placing this equation in solver mode.)
15. Add the above list to your equation variable list. Press +.
16. Store this equation variable with any name of your choice. i.e. 'EQN.I' STO.

Your equation is now ready for use with EQuation Xpert!
NOTEIl It is imperative that only equation variables exist in your equation category directories. Be sure to purge any nonequation variables including PPAR, EQ, IDAT, etc . . .

## Running EQuation Xpert

To run EQuation Xpert, it is necessary to have setup at least one group/class containing one or more equations in a category directory.

To display the commands to run EQuation Xpert, press the following key combinations:

> (on the HP-48S / 48SX) LEFT-SHIFT, LIBRARY. (on the HP-48G / 48GX) RIGHT-SHIFT, LIBRARY.

## Press the menu key labeled EQX...

Your display should now resemble the following:


The menu keys shown here operate EQuation Xpert as follows:
EQX (fastest access): Requires a number* on the stack indicating the class for which you wish to view equations.

> *The class numbers correspond to the position that the class directory appears in your 'INFO..' list variable. (see p.19)

EQXS (select mode): This menu key introduces a selection list of all the available equation groups/ classes that you have defined.

This selection does not require any stack arguments.

## Running EQuation Xpert (cont'd)

## EQXS Usage Example:

Simply press the EQXS key, or enter EQXS from the command line.

You will now see the intro screen briefly displayed on the screen...

followed by the equation group selection screen displaying the groups you have defined.


Use the arrow keys to scroll through the list, then select your desired equation group by pressing ENTER.

Once a main equation group has been selected, you must rerun EQuation Xpert to view any other of your groups.

## Running EQuation Xpert (cont'd)

Now displayed on the screen should be the EQuation Xpert user interface.

An example screen is shown below which details the EQuation Xpert environment:


The EQuation Xpert control key functions operate as follows:

## WII CHANGE CURRENT WINDOW:

Pressing this key changes the current window, updating the user equation information, displaying the equation, or choosing the select-by-description window.

## -5Th PLACE CURRENT EQUATION ON STACK:

This key will place the equation pointed to by the arrow on the stack.

FIIT PLACE EQUATION IN SOLVER MODE \& EXIT:
This selection changes to the equation directory specified in your 'SOLVER' list, stores the equation in 'EQ', assigns values to AutoVARS (if they exist) and exits to the HP solver mode.

## Running EQuation Xpert (cont'd)

## FILL DISPLAY FULL SCREEN:

This function will display the user equation full-screen if the currently selected window is the select-by-description or user information window. If the equation window is selected, EQuation Xpert will display the equation in equation writer/textbook format.
Screen scrolling is allowed if either the equation or user information extend beyond the screen limits.

PICT VIEW USER GRAPHIC:
If you have created a graphic for the current equation, this key will display the graphic (up to a maximum size of $131 \times 64$ ) in the upper left corner of the display.

CHANGE EQUATION CATEGORY:
To select a different equation category, press this to display a category selection window. Use the arrow keys and press ENTER to make your new selection.

An example equation category selection screen is shown below:


## Running EQuation Xpert (cont'd)

The remaining keys necessary to operate EQuation Xpert are:
ARROW KEYS (up, down, left, right)
Depending on which window is currently selected, the arrow keys allow scrolling through user information, the equation, or selecting equations by description.
Scrolling in windows on the main screen requires multiple arrow presses, while full-screen displays may be scrolled by pressing the desired key and holding it down.

## BACKSPACE/DROP

Pressing the backspace key exits EQuation Xpert, returning you to the directory from which it was run.

## ENTER

The enter key displays the EQuation Xpert intro screen and program credits.

## Quick method of running EQuation Xpert:

Explained on page 16 was the use of EQXS to run EQuation Xpert.

A faster way of entering EQuation Xpert is to bypass the equation group selection screen by placing the group number on the stack and pressing EQX , or entering EQX from the command line.

The equation groups that you have created can be specified by a number which corresponds to the position of the group directory in your 'INFO..' list located in the 'X.EQS' directory.

If, for example your 'INFO..' file is the following:
\{ PHY MECH ELEC \}
and you enter a 2 on the stack and press EQX, you will bypass the group selection screen and EQuation Xpert will immediately display the mechanical engineering equation group.

## Running EQuation Xpert (cont'd)

## Alternate methods of running EQuation Xpert

In addition to using the library menu keys, entering EQX or EQXS from the command line, you may also define user keys on your HP to automatically call up EQuation Xpert with the desired equation group/class already selected.

The steps to assign a user key to run EQuation Xpert are very simple:

On the stack enter the following program with the equation group number in place of the n :

## «nEQX»

Now enter a three-digit location number for the key you wish to define, then assign the program to the key.

## i.e. 64.2 ASN

In the above example the three-digit number defines the key as follows:


Plane of key:
(key required to activate)
0,1: no-shift
2: left-shifted
As shown above, 64.2
3: right-shifted would cause a left-shifted 9 4: alpha to run EQuation Xpert with the equation group

5: alpha-left-shifted
6: alpha-right-shifted number you have specified when in user key mode*.

[^1]
## Removing EQuation Xpert

In order to remove the EQuation Xpert library from your calculator, follow the steps outlined below:

## Removal of disk-based installations:

1. Change to the \{ home \} directory ( RIGHT-SHIFT, HOME ) or enter HOME.
2. Enter the following: :n: 1599 DETACH (where n is the port number in which you installed the program.)
3. Enter: :n:I599 PURGE. You may see the screen flicker. (this is normal behavior.) EQuation Xpert has now been removed from your calculator.

## Removal of ROM card installations:

1. Simply turn the calculator off and remove the EQuation Xpert ROM card. EQuation Xpert is now removed.

## Troubleshooting

If you experience problems with EQuation Xpert, it may be due to the following:
$\checkmark$ Incorrect directory setup
$\checkmark$ Invalid user equation variables
$\checkmark$ Low memory condition
$\checkmark$ Specified SOLVER directory non-existent
$\checkmark$ Variables other than user equations located in equation group/class directories or category directories. i.e. 'PPAR'

If you have a problem, look first through your directories for non-equation variables.

If the problem occurs when placing the equation in solver mode, your AutoVARS may not be properly setup for the particular equation or the specified SOLVER directory may be invalid.

Does a problem arise when changing between windows? It may be due to missing list brackets \{ \} surrounding user information text strings or an invalid equation format.

If a system lock-up should occur, (placing miscellaneous items into equation variables will greatly increase your chances of this happening), pressing ON-C (ON and C) at the same time may revive the calculator. Before attempting to run EQuation Xpert again, be sure to inspect the directories and/or equations to locate the problem.

Please refer back to the instructions in this manual for proper directory and equation setup.

## Error Handling

EQuation Xpert was designed to be a rapid method of viewing and retrieving equations. To do this, the program was required to be as efficient as possible, both in performance and code size.

In many cases an on-screen information box will notify you of error conditions should you attempt to select an empty equation group or category or use a function that operates on an equation list variable element that does not exist.

There may be situations however, when the user will forget to insert one of the required equation list elements, place them out of order, or put an invalid element into the list.

This may cause EQuation Xpert to error. Adding the capability to check the validity of all user equations and directory contents has proven to sacrifice program performance substantially.

By thoroughly reading the manual and understanding the basic directory structure, you will not experience any problems.

As an aid to properly set up directories and equations, you will find a handy reference page located on page 28 of this manual to keep with your calculator.

## Usage Tips

Here are some suggestions to consider when using EQuation Xpert...

- Backup your calculator's memory.

To backup the memory contents, refer to your calculators reference manual.

If you would only like to backup your equation directories, simply copy the 'X.EQS' directory to your PC or store it on a free RAM card for safe keeping.

- Be sure equation variables are of the correct format.

By keeping the Quick Reference Card in your calculator case, you can verify that new equations are setup correctly.

- Store only equation variables in the category directories.

Do not store anything other than equation variables in the equation category or directories.

Also make certain that group/class directories only contain equation category directories.

- Trim user defined graphics/pictures.

When creating your own pictures for your equations, use the SUB function on your HP to trim your drawing to the smallest size possible. This results in less memory used to store graphic 'white space'.

## Ideas...

Here are some ideas that may make EQuation Xpert even more useful to you...

- Create an 'exam' equation category directory.

Tests or exams approaching?
Simply create an 'EXAM' category for the class and copy your most frequently used equations from your other categories into it.

Once you are done with your 'EXAM' directory, go ahead and delete it.

- Share your equation variables/directories.

Share and exchange your equation directories. EQuation Xpert gives you the flexibility to add to your personal equation library by simply transferring equation directories or individual equations between calculators.

- Make use of the options available.

Add your own pictures to your equation variables. It will enhance your understanding of less frequently used equations as well as reduce mistakes.

Use the optional text information. By adding a short description of how the equation is used, or listing the constants and variables, you will never need to guess again.

Use AutoVARS to view equations in their original format while assigning values to normally constant variables.

You view: $\quad W=m \times g \quad$ Actual: $\quad W=m \times 9.80 \mathrm{~m} / \mathrm{s}^{2}$
Only EQuation Xpert has it!

## EQuation Xpert Registration Card

Congratulations on your purchase of EQuation Xpert!
We would appreciate your taking the time to fill out and mail this registration card.

Your comments and suggestions are greatly appreciated and will help us to improve our products to continue meeting your needs.


Notes
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Directory Layout Worksheet



Use this directory template as an aid in designing your own personal EQuation Xpert equation library.


[^0]:    ** Note: If both elements 4 \& 5 appear in the equation variable list, the order of them may be swapped at your discretion. i.e. element \#4 = AutoVARS list, element \#5 = User Graphic

[^1]:    * To enter user key mode for one operation, press LEFT-SHIFT, $\boldsymbol{\alpha}$. To lock user key mode, press this combination twice.

