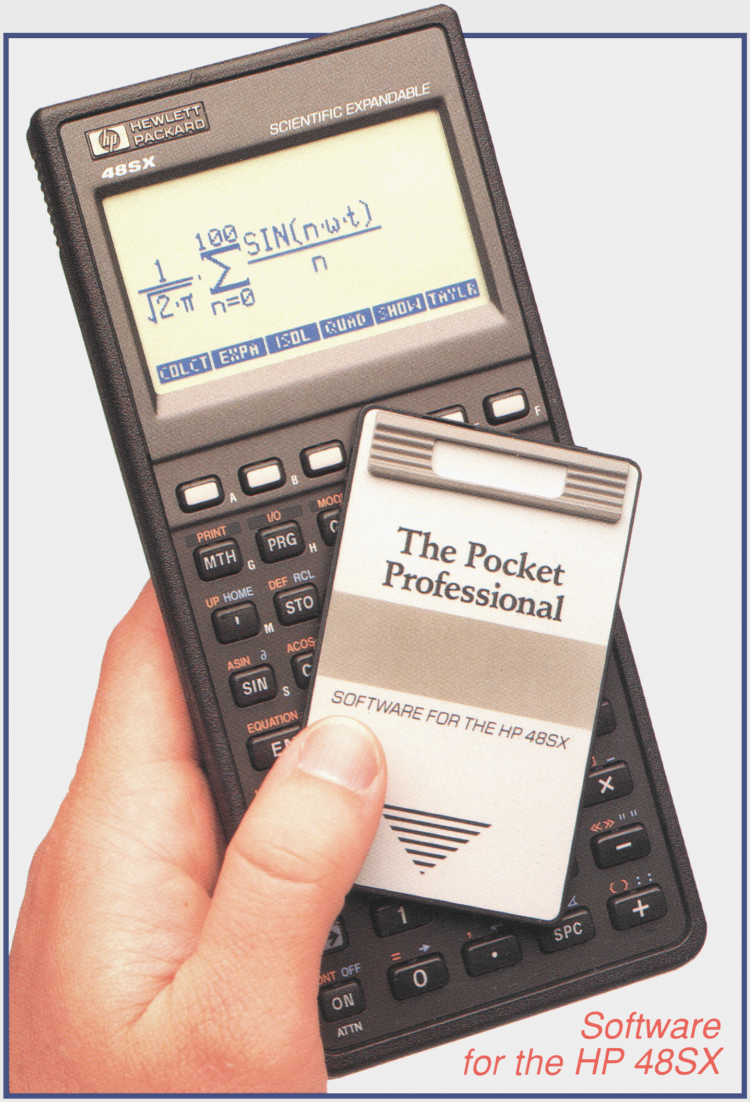
Sparcom

Pocket Professional™

OWNERS MANUAL



Software for the HP 48SX

The Pocket Professional™

Electrical Engineering Reference Pac

Owner's Manual

SPARCOM®

Edition 2 August 1991

Manual Reorder No. 11061-A Software Reorder No. 10061-1A

Notice

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Acknowledgements

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Electrical Engineering Reference Pac Changes

The following changes were made to the Electrical Engineering Reference Pac for version 2.5:

✔ Browser: Cursor movement and scrolling speed have been increased.

✔ Constant Library: Constants have been updated to conform to latest accepted values.

HP 48GX USERS ONLY: You should install the application card in Port 1 for two reasons:

1. Application cards installed in Port 1 will execute ~ 20% faster than those installed in Port 2.

2. Application cards installed in Port 2 may experience long pauses (~ 5-10 seconds or more) intermittently during operation. This is not a software defect. It is caused by the new memory architecture of the extended HP 48GX Port 2, which is different from the HP 48SX Port 2. Such pauses will not occur if the application card is operated from Port 1 of the HP 48GX or if it is operated from either port of the HP 48SX.

Electrical Engineering Reference Pac Manual Changes

These changes apply to the Electrical Engineering Reference Pac Manual, Edition 2, August 1991.

Changes for the HP 48GX

General: To display all libraries on the HP 48GX, press [→] [LIBRARY] instead of [←] [LIBRARY].

General: On the HP 48GX, the [ATTN] key has been replaced by CANCEL.

General: To perform a screen dump on the HP 48GX, press [ON]–[I/O] instead of [ON]–[MTH].

General: To display an item too wide for the display on the HP 48GX, press [→] [CMD] instead of [→] [VISIT].

Changes for Version 2.5

Page 1-8: Using the Search Mode: The search mode is now case-insensitive.

Page 5-7: Decibel Conversions: 2nd picture should display -10.4575749056.

Page 9-4: Constants Library: 2nd picture should include, "h (Planck)," with an updated value of 6.6260755E-34_J*s.

Page 9-5: Standard Prefixes: Picture should indicate prefixes as 1E18, 1E15, ...

Table of Contents

Chapter 5: Electrical Properties

Chapter 6: Dielectric Properties

Chapter 7: Magnetic Properties

Chapter 8: Mechanical and Thermal Properties

Chapter 9: Miscellaneous

Appendix A: Warranty and Service

Appendix B: References

Appendix C: Menu Structure

Appendix D: Questions and Answers

Chapter 1
Getting Started

In This Chapter

Welcome

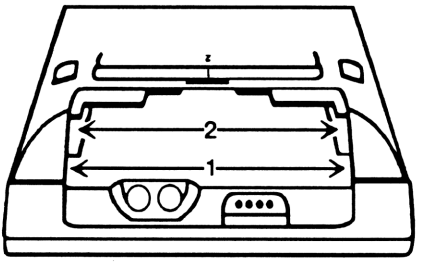
Sparcom's Pocket Professional software is the first of its kind, developed to provide speed, efficiency and portability to students and professionals in the technical fields. The Pocket Professional™ Electrical Engineering Reference Pac instantly transforms the HP 48SX calculator into an electronic handbook, containing over 100 tables of data commonly used by electrical and electronics engineers. The information is organized into an seven-category menu tree with topics and subtopics listed in an easy-to-use "browser" menu format.

Installing and Removing the Pocket Professional

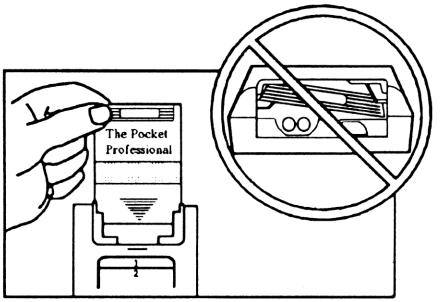
The HP 48SX has two ports for installing plug-in cards. You can install your Electrical Engineering Reference Pac in either port. Be sure to **turn off the calculator** while installing or removing the card. Otherwise, user memory may be erased.

To Install the Card

1. Turn off the calculator. Do not press ON until you have completed the installation procedure.
2. Remove the port cover. Press against the grip lines and push forward. Lift the cover to expose the two plug-in ports.



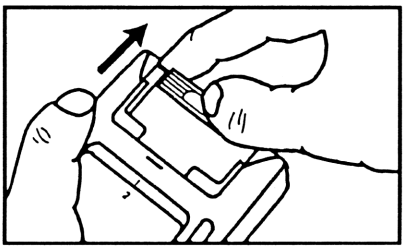
3. Select either empty port for the Pocket Professional card.
4. Position the card just outside the slot. Point the triangular arrow on the card toward the calculator port opening, as shown below.
5. Slide the card firmly into the slot. After you first feel resistance, push the card about 1/4 inch further, until it is fully seated.



6. Replace the port cover.

To Remove the Card

1. Turn the calculator off. Do not press [ON] until you have completed the procedure.
2. Remove the port cover. Press against the card's grip and slide the card out of the port.

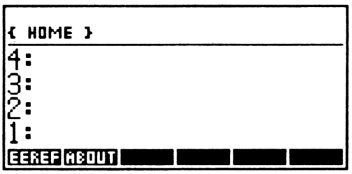


3. Replace the port cover.

To Access the Reference Pac

After you turn your calculator [ON], there are three ways to access the Electrical Engineering Reference Pac.

First Method: Press [↩] [LIBRARY] to display all libraries available to the HP 48SX. Press the **EEREF** "softkey" (the corresponding blank menu key on the top row of the HP 48SX keyboard) to start the Electrical Engineering Reference Pac.



Pressing the second softkey available at this level, **ABOUT**, displays the revision number of the software. Pressing the [ATTN] key exits the revision screen and returns you to the screen shown above.

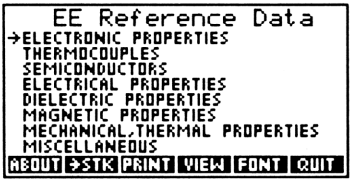
Second Method: Type in the letters EEREF (using alpha entry mode, as described in the *HP 48SX Owner's Manual*) and press [ENTER].

Third Method: Add the command EEREF to the CST (custom) menu (for more information, refer to Chapter 15 of the *HP-48SX Owner's Manual,* "Customizing the Calculator"). After the command has been added, press

CST, then press EEREF to start the Electrical Engineering Reference application.

Using the Main Menu

After you start the Electrical Engineering Reference Pac, the main menu screen appears:



The main menu lists the main categories of the entire electrical engineering reference database in a "browser" menu format. "Browser" refers to the ability to use the cursor keys (▲, ▼) to move the pointer to the menu item you wish to select and to press ENTER to call that menu item to the screen. The row of "softkeys" along the bottom of the screen may give you options that relate to the information displayed on any given screen.

Because the size of the calculator screen is limited, the names of constants and properties are usually abbreviated throughout the reference pac. This manual includes "translations" of these abbreviations where appropriate.

The items in the main menu are described below:

Electronic Properties	Properties of electronic materials and devices
Thermocouples	Temperature vs. Voltage computation of E, J, K, T, and S type thermocouples

Semiconductors	Properties of selected semiconductors such as Silicon, GaAs, III-V, and II-VI compounds
Electrical Properties	Selected properties of general electrical engineering materials
Dielectric Properties	Selected properties of dielectric materials
Magnetic Properties	Selected properties of magnetic materials
Mechanical, Thermal Properties	Mechanical and thermal properties of selected materials
Miscellaneous	Contains ASCII table, Constants library, common Prefixes and Greek Alphabet

Each main category of the reference pac contains several topics and subtopics. They are described in detail in Chapter 2. The information contained in each topic is based on data extracted from the sources listed in Appendix B. Values given in the Electrical Engineering Reference Pac may vary slightly from values listed by sources not documented in this manual.

Moving Around the Screen

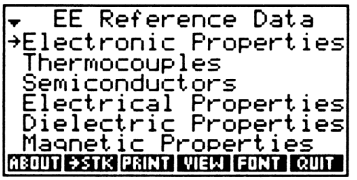
Use the ▲ and ▼ keys to move the pointer up and down in the menu list. Pressing ↩ ▼ moves the pointer to the bottom of the screen, or pages down if the pointer is already at the bottom of the screen. Pressing ↩ ▲ moves to the top of the screen or pages up if the pointer is already at the top of the screen. Pressing ↪ ▼ moves the pointer to the bottom of the list or ↪ ▲ moves to the top of the list.

Viewing Items Too Wide for the Display

If the text of a topic or subtopic is too wide to fit within the display, an ellipsis (...) appears at the end of the line. Press ↪ VISIT to display the rest of the text. Press ATTN or ENTER to return the display to the beginning of the line.

Changing the Font Size

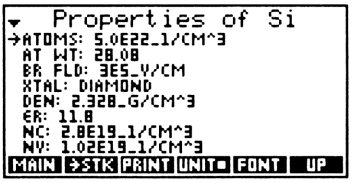
The default font for the Electrical Engineering Reference Pac displays information in condensed, uppercase letters only. Pressing **FONT** displays the information in a larger font, which is case-sensitive. The font size stays large until you press **FONT** again:



Example: Using the Reference Pac

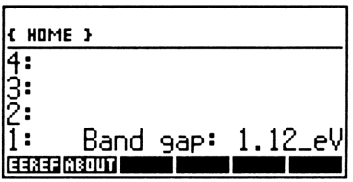
Suppose you need the bandgap of silicon in order to calculate doping concentrations for a new device you are designing. At the main menu, move the pointer to SEMICONDUCTORS and press ENTER. The list of topics filed under the semiconductors category appears:

Move the pointer to PROPERTIES OF SI and press ENTER. This topic contains 28 properties of silicon (in this case there is no subtopic level). Eight properties appear on the screen at a time:



Use the ▼ key to scroll down the list to BANDGAP (item number 14). The following screen shows that the bandgap of silicon is 1.12_eV.

To put the silicon bandgap on the calculator stack, press →STK (For a summary of the softkeys used throughout the Electrical Engineering Reference Pac, see the end of this chapter.) After you have exited the Electrical Engineering Reference Pac by pressing ATTN, the following stack view appears:



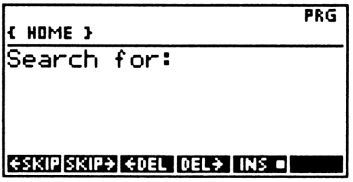
Use the "DTAG" or UVAL command of the HP 48SX to remove the "Band gap" label (See the *HP 48SX* manual for an explanation of units). You may proceed with your calculation or press EEREF to re-enter the Electrical Engineering Reference Pac.

Managing Units

You can choose whether you want the Electrical Engineering Reference Pac to display units on the screen or not by pressing the UNITS softkey. This softkey toggles between the unit and non-unit modes. UNIT■ indicates that units will be displayed with all entries. When units are displayed, pressing ENTER places the entry onto the stack **with** units. When units are not displayed on the screen, units are not included when ENTER is pressed. Note that values in the constants library will be displayed with units whether units are toggled on or off. The Pocket Professional uses standard international (SI) units, customarily used in electrical engineering. Be aware that **using units usually increases the processing time for display**.

Using the Search Mode

When data lists are long, it may be faster to locate an item using the search mode. To initiate a search, press the [α] key. The following screen is displayed:



The calculator is now in *alpha* entry mode, as indicated by the alpha (α) annunciator at the very top of the screen. Alpha entry mode overrides the function of the standard keyboard. This means that each key that has a white capital letter printed to its lower right loses its original function and types that letter onto the command line when pressed. (See the *HP 48SX Owner's Manual*, "The Keyboard and Display", for a complete description of how the alpha mode operates). Type the first letter or letters of the name you want to search for, to create the *search string*, and press [ENTER]. The search function is case-sensitive.

The search mode softkeys (**←SKIP** **←DEL** **INS**) along the bottom of the screen are command line editing keys which allow you to edit the search string. Their functions are summarized at the end of this chapter.

Summary of Functions

FONT Toggles the display font between condensed and large sizes.

QUIT Exits the Electrical Engineering Reference Pac.

UP Moves up one level in the menus.

MAIN Moves to the main menu of the Electrical Engineering Reference Pac.

PICT In a few cases, a picture is available to help explain the data item. Pressing this softkey displays the figure on the screen.

PRINT	Allows you to print a data field or the entire list of data to an IR printer.
ALL	Sends all the data in a list to an IR printer.
ONE	Sends the data in the field selected by the pointer to an IR printer.
UNITS	Toggles between unit and non-unit modes. The Pocket Professional uses standard international (SI) units customarily used in electrical engineering.
←SKIP	Moves the cursor from its current position to the beginning of the word (left).
SKIP→	Moves the cursor to the beginning of the next word (right).
←DEL	Deletes all the characters from the cursor's position to the beginning of the word (left).
DEL →	Deletes all the characters from the cursor's position to the first character of the next word (right).
INS	Toggles between insert and typeover modes.
VIEW	Displays the entire text of an item too wide to fit on the screen up to an entire screen size. If an item fits on the screen this key is non-functional.
ENTER	Moves to the category, topic, or sub-topic indicated by the pointer.
ATTN	Exits the Electrical Engineering Reference Pac.
α	Initiates a case sensitive search for a specific entry.
↩ ▼	Moves to the bottom of the screen or pages down.
↩ ▲	Moves to the top of the screen or pages up.
↪ ▲	Moves the pointer to the top of the list.
↪ ▼	Moves the pointer to the bottom of the list.
↪ VISIT	Displays remaining data (a screen width at a time) on the screen for entries too wide for the screen. If the topic is too long to fit within the display, an ellipsis (...) is displayed on the right of the screen.

Notes:

Chapter 2
Electronic Properties

In This Chapter

This section covers electronic reference data for the following categories:

- Digital Specifications
- Frequency Bands
- Piezoelectric Properties
- Laser Materials
- Electro-Acoustics
- μ-wave Materials
- Superconductors, Critical Temperature
- Thermionic Emission

Digital Specifications

This topic contains general specifications of digital circuits. Specifications covered include operating range for logic inputs, switching parameters (such as gate delays), rise time for a typical load, operating and storage temperature ranges, and maximum clock rates. Data is presented for four technologies:

- ☐ NMOS Technology
- ☐ CMOS Technology
- ☐ TTL Technology
- ☐ ECL Technology

The following table lists the properties included for NMOS, CMOS and TTL technologies:

Vdd (typ),	Typical supply voltage
Vdd (max),	Maximum supply voltage
Vdd (min),	Minimum supply voltage
Top (min),	Minimum operating temperature
Top (max),	Maximum operating temperature
Storage T ,	Minimum storage temperature
Storage T,	Maximum storage temperature
ViL (max),	Input low voltage
ViH (min),	Input high voltage
VoL (max),	Output low voltage

VoH (min),	Output high voltage
Iilkg (min),	Minimum input leakage current
Iilkg (max),	Maximum input leakage current
IolkG (min),	Minimum output leakage current
IolkG (max),	Maximum output leakage current
Cin,	Capacitance for an input pin
Cin (I/O) ,	Capacitance of an I/O pin
prop delay,	Typical propagation delay
toggle f ,	Toggle frequency in MHz
Noise immunity,	Voltage
Fan out ,	Fanout

The following list of properties included for ECL Technology varies slightly from the data given in the table above:

VEE (typ),	Typical supply voltage
VEE (max),	Maximum supply voltage
VEE (min),	Minimum supply voltage
Top (min),	Minmum operating temperature
Top (max),	Maximum operating temperature
Storage T,	Minimum storage temperature
Storage T,	Maximum storage temperature
ViL (max),	Input low voltage
ViH (min),	Input high voltage
VoL (max),	Output low voltage
VoH (min),	Output high voltage
IilkG (max),	Maximum input leakage current
Cin,	Capacitance of an input pin
Cout,	Capacitance of an output pin
prop delay,	Typical propagation delay
toggle f,	Toggle frequency in MHz
Noise immunity,	Voltage
Fan out,	Fanout

Frequency Bands

Microwave frequencies are generally grouped into different frequency bands. The bands and the corresponding frequency ranges are included under the two subtopics below:

New Frequency Bands
Millimeter and Submillimeter Bands

New Frequency Bands

In 1970, a new band designation scheme was adopted. This new designation categorizes frequency bands as follows:

Band A through M
Millimeter bands
Submillimeter bands
Frequency ranges for each band are presented.

Millimeter and Submillimeter Bands

Traditional definitions of microwave bands and waveguide sizes are included for the following bands:

Band L
Band S
Band G
Band C
Band J
Band H
Band X
Band M
Band P
Band N
Band Ku
Band K
Band R
Millimeter Band
Submillimeter Band

Data available for each band include waveguide size and frequency ranges.

Piezoelectric Properties

This subtopic covers two aspects of piezoelectric materials:

Piezoelectric Constants
Piezoelectric, Pyroelectric and Ferroelectric Properties

Piezoelectric Constants

In this subtopic, physical properties of piezoelectric materials, such as quartz, lithium sulfate, barium titanate, PZT-4, PZT-5 and lead niobate, are included. The properties and definitions listed for each material are shown below:

Density	Density
Acous	Acoustic impedance
F*t	Frequency thickness constant
Max T	Maximum operating temperature
εr	Dielectric constant
k33	Electromechanical coupling factor for thickness mode
kp	Electromechanical coupling for radial mode
Elastic Q	Elastic quality factor
d33	Piezoelectric modulus
q33	Piezoelectric pressure constant
ρ	Electrical resistivity
Curie T	Curie temperature
Young M	Young's modulus
Tensile str	Tensile strength

Piezo/Pyro/Ferro Properties

Piezoelectric and pyroelectric materials are non-centrosymmetric. The properties of the following common materials are included in this subtopic:

$NaK_4H_4O_6 \cdot H_2O$
Rochelle salt
KH_2PO_4
$Pb_2KNb_5O_{15}$
$BaTiO_3$
$Bi_4Ti_3O_{12}$
$LiNbO_3$
DOBAMBC - Smectic liquid crystal
PVDF - Polyvinylidene fluoride

For each material, the following properties are listed:

Tcrit	Critical temperature
Spont. Polar.	Spontaneous polarization
Temp	Spontaneous polarization temperature
Piezoelec η	Piezoelectric efficiency
Pyroelec coeff	Pyroelectric coefficient

Laser Materials

In this topic, properties of semiconductor lasers, pulsed lasers, common continuous wave (CW) lasers and commercial CW lasers are included.

Semiconductor Laser

Key properties of various semiconductor lasers using III-V and II-VI compounds are listed by their active layer in this sub-topic. The lasers described in this subtopic included the following materials:

$Ga_{(1-x)}Al_{(x)}As/Ga_{(1-y)}Al_{(y)}As$
(GaIn)P/-
Ga(AsP)/(GaIn)P
(GaIn)(AsP)/InP
Ga(AsSb)/(GaAl)(AsSb)
(GaAl)Sb)/(GaAl)(AsSb)
(GaIn)(AsSb)/(GaAl)(AsSb)
(PbSn)Te/-
(PbSn)Se/-
(PbSn)Te/PbTe
Pb(SSe)/PbSe
(PbSn)Se/PbSe

For each laser type above, the following properties are included:

Passive layer
Substrate
Lattice match
Laser type
Wavelength (range), λ
Current density, J_{th}

Pulsed Lasers

Some common high-powered pulsed lasers in the wavelength range from 157 nm to 496 μm, such as Fe, ArF and XeCl, are included in this subtopic. Properties covered include:

Active atomic or molecular species
State of material
Pulse width
Energy/pulse
Rate in pulses per second

Common CW Lasers

Common CW lasers in the wavelength range from 325 nm to 496 μm forms the basis of this subtopic. The properties covered include:

Atom or molecule
Material
Power

Commercial CW Lasers

Characteristics of commercial continuous wave lasers, such as Argon, Krypton, and Dye, are covered in this subtopic. Properties listed include the following:

Type	Type of laser
Wavelength	Wavelength
Pwr TEM	Power in TEM_{00} mode (range)
Pwr mult	Power in multimode (range)
Beam dia	Beam diameter (range)
Beam div	Beam divergence (range)

Electro-Acoustics

Electro-acoustics data defines the relationship between sound and its electrical analogs. The Electrical Engineering Reference Pac covers four subtopics in electro-acoustics:

Sound Intensity Equations (simplified)
Sound Velocity in Liquids
Sound Velocity in Metals
Sound Velocity in Miscellaneous Materials

Sound Intensity Equations (simplified)

In this subtopic, the simplified equations for sound intensity for quartz, ammonium dihydrogen phosphate (ADP), Rochelle salt (0°C), and barium titanate (40°C) are tabulated. The properties listed for each material are:

Mode	Modes of vibration
Xtal cut	Crystal cut
Piezo mod	Effective piezoelectric modulus

velocity	Sound velocity
ρ	Density
Sound inten	Sound intensity equation in water (for an air backed transducer). In these equations, the following definitions apply: fo = frequency in MHz, V = Voltage in kV, E = Electric field in kV/cm. *

Note that E appears in some equations for Electric field. In some equations, 1E4 (= 10,000) is used as a conversion factor.

Sound Velocity in Liquids

In liquids, sound velocity is determined by the liquid's compressibility and density. In this subtopic, the sound velocities of water, mercury and many organic solvents at specified temperatures are tabulated.

Sound Velocity in Metals

In this subtopic, electro-acoustic properties of common metals, such as aluminum, berylium, zinc, and zirconium, are listed:

Vel bulk	Longitudinal bulk velocity (in m/s and in/s)
Vel bar	Longitudinal bar velocity (in m/s and in/s)
Vel shear	Shear velocity (in m/s and in/s)
Density	Density
Char imp	Characteristic impedance

Sound Velocity in Miscellaneous Materials

In this subtopic electro-acoustic properties of many common materials, such as crown glass, granite, ice and nylon, are included . The properties are the same as those listed above for sound velocity in metals.

μ-wave Materials

This subtopic lists key properties of commercially available microwave garnets and a variety of rare earth compounds. The properties covered include:

Comp	Composition
Sat magzn	Saturation magnetization
Curie temp	Curie temperature
Resn In wid	Resonance line width
Lande g fac	Lande g factor
Coercive f	Coercive force
εr	Dielectric constant
tan (δ)	Dielectric loss factor
Remanent ind	Remanent induction

Superconductors, Critical Temperature

This subtopic lists the critical temperature for over 40 superconducting metals, alloys, and compounds.

Thermionic Emission

This subtopic includes two thermionic properties, the work function and Richardson's constant of cathodes made of the following materials:

Materials, Examples

Metals,	Tungsten,, zirconium,, cesium,, barium
Metallic films,	Tungsten-cesium,, tantalum-thorium
Oxide films,	BaO and thoria
Compounds,	TiC and Th02

Notes:

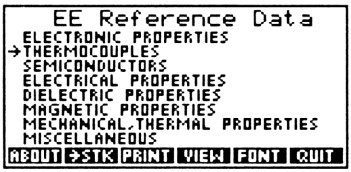
Chapter 3
Thermocouples

In This Chapter

Thermocouple analysis is used to convert measured voltage to temperature and vice versa. This chapter covers:

- E Type
- J Type
- K Type
- S Type
- T Type

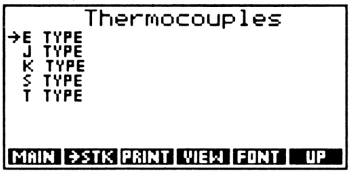
Thermocouples



This analysis tool is designed to convert a temperature to a thermocouple output in millivolts and vice versa. The software has the ability to handle T, E, J, K and S type thermocouples. The implied assumption for a reference temperature is 0_°C. The thermocouple computations are based on the IPTS-68 standards.

Using the Thermocouples Function

Select THERMOCOUPLES at the main menu. The first screen lists the five types of thermocouple values supported by the software.

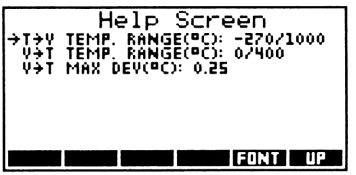


As an example, suppose you want to find the corresponding temperature of an E type thermocouple showing a 22.13 millivolt reading. First, move the pointer to TYPE E and press ENTER to display the following screeen:

At the voltage prompt press ENTER and type 22.13 and press ENTER again.

The screen displays this value as voltage in millivolts. Next, press the V→T softkey to initiate the voltage-to-temperature conversion calculation (314.059_°C):

The Help screen contains limits on voltages and temperatures for each type of thermocouple. Simply press the HELP softkey to view the Help screen.



Basis for Temperature/Voltage Conversions

The temperature-to-voltage conversion is based on a 12th to 14th order polynomial, ensuring very precise calculations. The voltage-to-temperature

conversion is based on a 5th or 6th order polynomial. A maximum deviation listing or applicable temperature ranges are displayed on each screen.

Summary of Softkeys

FONT	Toggles between small and large display fonts.
→STK	Copies selected entry to calculator stack.
QUIT	Moves up one level in the menu structure.
T→V	Converts temperature specified in °C to voltage in mV.
V→T	Converts voltage specified in mV to temperature in °C.

Chapter 4
Semiconductors

In This Chapter

In this topic, semiconductor properties are classified into seven subtopics:

- Properties of Silicon
- Properties of GaAs
- Donors in Silicon
- Acceptors in Silicon
- III-V Compounds
- II-VI Compounds
- Optical Properties

Properties of Silicon

Selected electronic properties of silicon are listed in this subtopic:

Atoms	Atoms/cm^3
At wt	Atomic weight
Br fld	Breakdown field
xtal	Crystal structure
Den	Density
εr	Dielectric constant
Nc	Effective density of states (Conduction band)
Nv	Effective density of states (Valence band)
mle	Effective mass of electrons
mte	Transverse effective mass of electrons
mth	Effective mass of holes
mhh	Transverse effective mass of holes
El affinity	Electron affinity
Band gap	Bandgap
ni	Intrinsic carrier concentration
Lattice a	Lattice constant
αth	Coefficient of thermal expansion
M pt	Melting point
τ	Minority-carrier lifetime
μn	Mobility of electrons
μp	Mobility of holes
Raman E	Raman phonon energy
Sp ht	Specific heat
Th cond	Thermal conductivity at 300 °C
Diff con	Thermal diffusivity
Vapor pr	Vapor pressure at 1600 °C
Vapor pr	Vapor pressure at 930 °C

Work fn	Work function, V

Properties of GaAs

The properties of GaAs are given in the same order as the properties of silicon, listed above.

Donors in Silicon

In this subtopic, the activation energy levels of many known donors in silicon are listed. By convention, the energy levels given are referenced to the conduction band. For deep donors, such as silver, energy levels are referenced to the valence band (VB).

Acceptors in Silicon

Most known acceptor levels in silicon are listed in this subtopic. By convention, the energy levels given are referenced to valence band. For deep acceptor levels, such as for magnesium, energy levels are referenced to the conduction band (CB).

III-V Compounds

This subtopic includes the following III-V compounds:

GaP
GaSb
InAs
InP
InSb

For each of these compounds, the following properties are listed:

Eg	Energy gap
μn	Electron mobility
μp	Hole mobility
mn/mo	Effective energy mass
mp/mo	Effective hole mass
a	Lattice constant
MP	Melting point
εr	Dielectric constant
density	Density

II-VI Compounds

This subtopic includes properties for the following II-VI compounds:

CdS
CdSe

CdTe
ZnS
ZnSe
ZnTe

The properties listed in this subtopic are the same as those listed for III-V compounds.

Optical Properties

The Electrical Engineering Reference Pac covers two subtopics under this heading:

Refractive Index
Light Guide System Sensitivity

Refractive Index

This subtopic lists free space, refractive indices and material wavelengths for three types of glass, for GaAlAs, and for plastic commonly used by electrical engineers.

Light Guide System Sensitivity

This subtopic lists sensitivities of state-of-the-art receivers in the wavelength range from 1300 and 1550 nm. Materials covered are:

InGaAs PINFET (-40.4)
Ge APD (-33.1)
Ge APD (-37.1)
Ge APD (-20.5)
InGaAs/InP APD (-46.5)
InGaAs SAGM APD (-45.2)
InGaAs SAGM APD (-44.5)
InGaAs PINFET (-38.0)
Ge APD (-35.5)
InGaAs PINFET (-34.0)
InGaAs SAGM APD (-36.6)
InGaAs SAGM APD (-28.2)
InGaAs SAGM APD (30.6)

Wavelength, sensitivity, BER and line rate are included for each receiver. Numbers in parenthesis are sensitivities in dBm.

Notes:

Chapter 5
Electrical Properties

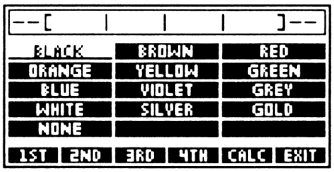
In This Chapter

In this broad category, eight subtopics are included:

- Resistor Color Chart
- Standard Component Values
- Wire Gauge
- VSWR Calculations
- Decibel Conversion
- Battery Characteristics
- Solders and Brazes
- Film Electrical Properties

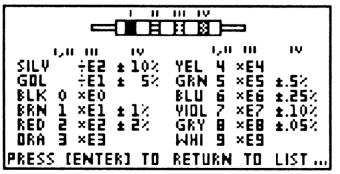
Resistor Color Chart

Upon choosing Resistor Color Chart from the Electrical Properties menu, the following screen appears:



The calculator computes the resistor value for a resistor that has 4 color bands specified. The input screen has three distinct areas; top row that is updated with color choices made; the middle area specifying colors; the softkey row with keys labelled **1ST**, **2ND**, **3RD**, **4TH**, **CALC** and **EXIT**. To select a color, use the cursor keys to match the desired color and press the softkeys **1ST**, **2ND**, **3RD** or **4TH**. Once the four color bands have been specified, press **CALC** to compute the resistance and display the result. Pressing **EXIT** key will return to the previous menu level.

Pressing [ENTER] will display the color band definitions as shown below:



Example: Find the resistance of a 4 band resistor with the following colors: BROWN, BLACK, YELLOW, GOLD.

Move the cursor to BROWN and press **1ST**

Move the cursor to BLACK and press **2ND**

Move the cursor to YELLOW and press **3RD**

Move the cursor to GOLD and press **4TH**, the screen should look as follows:

Pressing **CALC** displays the following screen:

Press [STO] to save the result to the stack, or [ENTER] or [ATTN] to return to the Electrical properties menu without saving the result on the stack.

Standard Component Values

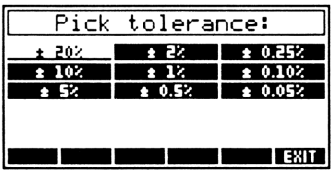
The Electrical Engineering Reference Pac computes the closest standard component value available for a specified tolerance value. Upon selecting this function, the following screen appears:

When entering a component value, a row of softkeys PICO, NANO, MICRO, MILLI, KILO, MEGA, FEMT, GIGA enhance data entry by adding appropriate multipliers.

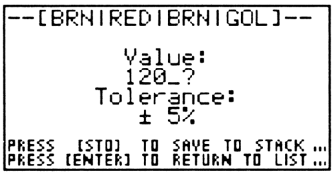
This analysis section computes the closest standard resistance value to the one specified using the selected tolerance.

Example: Find the closest standard value for a 123 Ω resistor and 5% tolerance.

Type 123 and press ENTER. The program prompts for input of tolerance level as shown by the screen below:



Use the cursor to pick the appropriate tolerance value of 5% and press ENTER. The result of the computation is displayed as follows:



The result is presented as a 120_?, along with tolerance value, the color scheme for a standard resistor. The standard values work with capacitors and inductors in addition to resistors.

Press [STO] to save the result to the stack, or [ENTER] or [ATTN] to return to the Electrical properties menu without saving the result on the stack.

Wire Gauge

This topic provides gauge comparisons for a variety of conductors in the following areas:

- ☐ Solid Copper
- ☐ Annealed Copper
- ☐ Hard Drawn Copper
- ☐ Copper Wire Table
- ☐ Stranded Conductors
- ☐ Maximum Current Capacity
- ☐ Fusing Current

Solid Copper

In this subtopic, properties of various wire gauges from numbers 0 through 21 are listed. Wire classifications by American (B&S), Birmingham (Stubs) and British standard (NBS) are included. The properties listed for each entry are diameter, area, and weight.

Annealed Copper

In this subtopic, properties of annealed wire gauges from number AWG (B&S) 0000 through 40 are listed. The properties for each entry are:

Dia	Diameter
Area	Cross sectional area
Res/1kft	Resistance per 1000 ft at 20 °C
Wt/1kft	Weight per 1000 ft
Length/lb	Length per pound
Length/Ω	Length per Ω at 20 °C
Res/lb	Resistance per pound at 20 °C

Hard Drawn Copper

In this subtopic, properties of hard drawn copper wire with AWG (B&S) gauges 4/0 to 18 are listed. The properties for each entry are:

Wire Dia	Wire diameter
Brk load	Breaking load
Tnsle St	Tensile strength
Wt/1kft	Weight per 1000 ft.
Wt/mile	Weight per mile
Res/1kft	Maximum resistance per 1000 ft at 20 °C
Area	Cross sectional area

Copper Wire Table

The Electrical Engineering Reference Pac lists the following properties of stranded copper wire with AWG (B&S) gauges 4/0 to 20:

# wires	Number of wires
Ind wire dia	Individual wire diameter in inches
Cable dia	Cable diameter in inches
Area	Area in square inches
Wt/kft	Weight per 1000 ft.
Wt/mile	Weight per mile
R/kft	Resistance per 1000 ft at 20 °C

Stranded Conductors

In this subtopic, physical properties of stranded copper conductors with AWG (B&S) gauges 0 to 30 are listed:

# strands	Number of strands
# msng strands	Allowable number of missing strands
dia strand	Nominal diameter of individual strands
Max dia strand	Maximum diameter of stranded conductor
Res (Sn coat)	Resistance per 1000 ft. at 20 °C (tin coated)
Res (Ag plate)	Resistance per 1000 ft at 20 °C (silver plated)
Res (Ni plate)	Resistance per 1000 ft. at 20 °C (nickel plated)
Res (hi str cu)	Resistance per 1000 ft at 20 °C (silver plated/copper alloy)

Maximum Current Capacity

The Electrical Engineering Reference Pac lists the maximum current capacity of copper and aluminum conductors for sizes 30 through 0000. The data for each size include the following:

Sngl Cu wire	Single wire (copper)
Bndld Cu wire	Bundled wire (copper)
Sngl Al wire	Single wire (aluminum)
Bndld Al wire	Bundled wire (aluminum)
Natl Ele code	Maximum current - National Electric code
UL at 60_°C	Maximum current - Underwriters Laboratory (at 60 °C)
UL at 80_°C	Maximum current -Underwriters Laboratory (at 80 °C)
Am Insurance	Maximum current - American Insurance Association Standards
500 c mils	Current for 500 circular mils area

Fusing Current

This subtopic covers the fusing currents for AWG wire sizes 40 through 6 for the following materials:

Al - aluminum
Cu - copper
GS - German silver
Fe - iron
Sn - tin

The fusing current can be predicted using the empirical relationship:

$$I = K.d^{3/2}$$

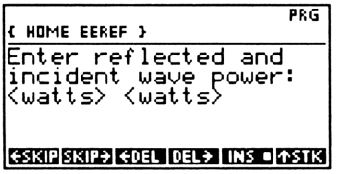
where I is the fusing constant, K is a constant, and d is the wire diameter. The constant K is indicated for each material.

Voltage Standing Wave Ratio Calculations

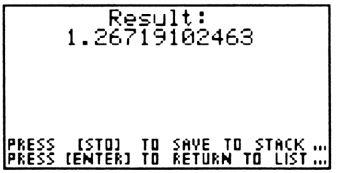
This section allow Ham and CB operators as well as communications engineers to compute the VSWR of their antenna feed lines. The VSWR is the ratio of maximum voltage to the minimum voltage along the line. It is the measure of the mismath between the line and its load. When the line and the load are perfectly matched, the VSWR is equal to 1. For mismath conditions the VSWR increases, limiting the amount of power radiated by the transmitter. In order to calculated the VSWR, the incident power and the reflected power of the line must be entered.

Example: Suppose the reflected wave power is 2.5 Watts, and the incident wave power is 180 Watts, compute the VSWR.

After selecting the VSWR calculations item from the Electrical Properties menu, the following screen is displayed:



Type 2.5 [SPC] 180 [ENTER]. The result is displayed in the following screen:



Press [STO] to save the result to the stack, or [ENTER] or [ATN] to return to the Electrical properties menu without saving the result on the stack.

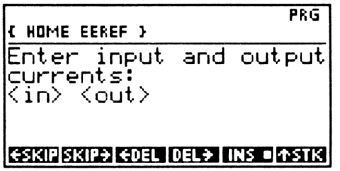
Decibel Conversions

This section allows the conversion of Current, Voltage, and Power ratio's to decibels (dB).

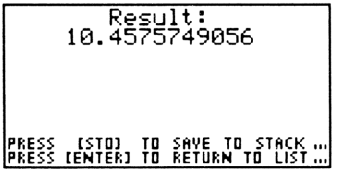
- ☐ Voltage
- ☐ Current
- ☐ Power

Example: Convert the Output current of 3 milliamps to Input current of 10 milliamps to decibels.

After selecting the Current item from the Decibel Conversions menu, the following screen is displayed:



Type 10 [SPC] 3 [ENTER]. The result is displayed in the following screen:



Press [STO] to save the result to the stack, or [ENTER] or [ATTN] to return to the Electrical properties menu without saving the result on the stack.

Battery Characteristics

This subtopic lists characteristics of the following major battery systems:

Leclanche
Magnesium
Alkaline-MnO_2
Mercury
Mercad
Silver oxide
Zinc-air
Li-SO_2

Li-MnO_2
Cuprous chloride
Zinc-silver-oxide
Lead-acid
Edison
Nickel-cadmium
Silver-zinc
Nickel-zinc
Nickel-hydrogen
Silver-cadmium
Zinc-chlorine
High temperature (Li/FeS)
High temperature (Na/S)

The data presented for each battery include anode and cathode materials, theoretical voltages and capacity, and typical voltage and capacity.

Solders and Brazes

The Electrical Engineering Reference Pac lists solders and brazes from Dupont and ESL by melting point. The reference data include the following:

No.	Manufacturer's ID number
Comp	Composition
MP	Melting point

Film Electrical Properties

This subtopic covers the following properties for both thin and thick films.

Film sheet res	Film sheet resistivity
Res range	Resistivity range
Init Tolerance %	Resistance tolerance, initial
with trimming %	Resistance tolerance with trimming
Temp coeff	Temperature coefficient of resistance
Matching	Matching temperature coefficient
Power	Power dissipation
Stability	Stability per year
Sht resistance	Metal sheet resistance
Line resolutin	Line resolution
εr	Dielectric constant
Capacitance	Capacitance per area
Range (min)	Minimum range of data
Range (max)	Maximum range of data
Temp coeff	Temperature coefficient of capacitance
Allowed stress	Allowable stress
Operating V	Operating voltage

Chapter 6
Dielectric Properties

In This Chapter

In this topic, various properties of dielectric materials are classified into five categories:

- Insulating Materials
- Dielectric Constants
- Insulator Resistance
- Insulating Films
- Insulating Liquids

Insulating Materials

This subtopic lists characteristics of a wide range of insulating materials:

Types of Insulating Materials	Examples
Ceramics	A l_2O_3, MgO, Porcelain, TiO_2
Glass	Iron-sealing glass, soda-borosilicate
Plastic	Alkyd resin, cross linked polystyrene, polyvinyl
Organic liquids	Benzene, ethyl alcohol, Vaseline, jet fuel
Waxes	Beeswax, polybutene, dichloronapthalene
Rubbers	Butyl rubber, neoprene rubber
Wood	Douglas fir, balsa, birch
Miscellaneous	Amber, paper, mica

For each material, properties include (if available):

Temp	Temperature °C
εr at 1kHz	Dielectric constant at 1_kHz
εr at 1MHz	Dielectric constant at 1_MHz
εr at .1GHz	Dielectric constant at .1_GHz
εr at 3 GHz	Dielectric constant at 3_GHz
tan (δ) 1kHz	Dissipation factor at 1_kHz
tan (δ) 1MHz	Dissipation factor at 1_MHz

tan (δ) .1GHz	Dissipation factor at .1_GHz
tan (δ) 3GHz	Dissipation factor at 3_GHz
Dielctric st	Dielectric strength (at 25 °C)
ρ at 25 °C	Resistivity (at 25 °C)
Therm expn	Thermal expansion
Softening pt	Softening point
Moisture abs	Moisture absorption

Dielectric Constants

Lists approximate dielectric constants at 20 °C and at a pressure of 1 atmosphere for 40 materials.

Insulator Resistance

This subtopic lists dielectric constant and loss factors at 1 MHz for 21 insulating materials, such as:

Cellulose acetate
Polypropylene
Polystyrene, foam
Hard rubber
Forsterile
Alumina
Fused quartz
Boron nitride

Insulating Films

This subtopic lists properties for 18 different insulating films, such as:

Cellulose acetate
Polyurethane elastomer
Polyethylene
Polyimide
Fluorohalocarbon
TFE-tetrafluoroethylene
Cellulose triacetate
FFP-fluorocarbon
Polyvinyl chloride
Polyimide

Properties include:

Processing
Forms
Thickness
Maximum width
Area factor
Specific gravity
Tensile strength

Elongation	
Burst strength	
Tear strength	
Endurance	
H2O absorption	
εr, 1kHz	Dielectric constant at 1_kHz
εr, 1MHz	Dielectric constant at 1_MH
εr, 1GHz	Dielectric constant at 1_GHz
δ, 1kHz	Dissipation factor δ at 1_kHz
δ, 1MHz	Dissipation factor δ at 1_MHz
δ, 1GHz	Dissipation factor δ at 1_GHz
Dielec st	Dielectric strength
Resistivity	Resistivity
Orientation	Orientation

Insulating Liquids

This subtopic lists properties of transformer oil, cable and capacitor oil, solid cable oil, and transformer Askerel:

Sp gr	Specific gravity
Saybolt VICS	Saybolt viscosity
Flash pt	Flash point
Fire pt	Fire point
Pour pt	Pour point
Sp ht	Specific heat
Coef expan	Coefficient of expansion
Th cond	Thermal conductivity
dielec st	Dielectric strength
εr	Dielectric constant
ρ	Resistivity

Notes:

Chapter 7
Magnetic Properties

In This Chapter

The properties of magnetic materials listed in the Electrical Engineering Reference Pac are classified into six categories:

- High Permeability Materials
- High Remanance Materials
- Laminated Cores
- Soft Magnetic Materials
- Laminated/Wound Cores of Silicon Steel
- Ferrites

High Permeability Materials

This subtopic lists magnetic properties for 15 different high permeability materials, such as iron, mumetal, supermalloy and ferroxcubes:

comp	Composition
Init μ	Initial permeability
Max μ	Maximum permeability
Coercivity	Coercivity
Retentivity	Retentivity
B max	B maximum
ρ	Resistivity

High Remanance

This subtopic lists the following magnetic properties of 23 different high remanant materials, such as carbon steel, tungsten steel, and Alnico:

Comp	Composition
Hmax	H maximum
Bmax	B maximum
Br	Retentivity
Hc	Coercivity
BdHd	External energy
Form	Typical form
ρ	Resistivity

Laminated Cores

This subtopic covers properties for the following high permeability materials: silectron cores and laminations, mumetal, molybdenum permalloy, deltamax, and supermalloy. The properties are:

- Moly %
- Silicon %
- Nickel%
- μmax
- B at μmax
- μmax at 40B
- μmax at 100B
- AC permeability
- μ at 200B
- μ at 2000B
- Saturation induction
- Specific gravity
- Resistivity

Soft Magnetic Materials

This subtopic lists properties of soft magnetic alloys for 21 materials such as purified iron, alfer, supermalloy, mumetal, hipernik, and permendur. The properties include:

Composition	Composition
Crit tem	Critical temperature
μa	Average permeability
Max μa	Maximum permeability
Hc	Coercive force
Is	Flux density
Θ	Curie temperature
ρ	Resisitivity
σ	Density

Laminated/Wound Cores of Silicon Steel

Laminated cores of steel are used in such applications as transformers, large rotating machines, and high efficiency motors and generators. The properties listed in this subtopic are for the grades M-6, M-7, M-19, M-22, M-27, M-36, and M-43 silicon steels:

- Nominal silicon content
- Saturation induction
- Specific gravity
- Resistivity
- Maximum core loss at 60 hz for a variety of thicknesses at 1 Tesla and 1.5 Tesla.

Ferrites

In this subtopic, properties of ferrites are classified under four categories:

Ferrite properties
Ferro, piezo and pyroelectric properties
Pressed powder materials
Garnets

Ferrite Properties

This subtopic lists the following properties for 17 common ferrites, such as $NiFe_2O_4$ and $MnFe_2O_4$:

Saturation moment (Tesla)
Curie temperature
X-ray density
Lattice constant
First order anisotropy constant
Saturation magnetostriction
Saturation Moment (Bohr Magnetons)

Ferroelectric, Piezoelectric and Pyroelectric Properties

Ferroelectric, piezoelectric and pyroelectric materials are non-centrosymmetric. The following common materials are covered:

$NaK_4H_4O_6 \cdot H_2O$
Rochelle salt
KH_2PO_4
$Pb_2KNb_5O_{15}$
$BaTiO_3$
$Bi_4Ti_3O_{12}$
$LiNbO_3$
DOBAMBC - Smectic liquid crystal
PVDF - Polyvinylidene fluoride

The properties listed for each material include:

Tcrit.	Critical temperature
Spont.	Spontaneous polarization
Temp	Spontaneous polarization temperature
Piezoelec η	Piezoelectric efficiency
Pyroelec coeff	Pyroelectric coefficient

Pressed Powder Materials

This subtopic includes the following properties of nine pressed powder and ferrite core materials:

Comp	Composition
Treatment	Treatment
μa	Average permeability
Hc	Coercive force
Is	Flux density
Curie tem	Curie temperature
Res	Resistivity

Garnets

Characteristics of 29 commercially available microwave garnets and ferrites are listed in this subtopic:

Comp	Composition
Sat magzn	Saturation magnitization
Curie temp	Curie temperature
Resn In wid	Resonance line width
Lande g fac	Lande g factor
Coercive f	Coercive force
εr	Dielectric constant
tan (δ) * 1000	Dielectric loss factor
Remanent	Remanent induction

Chapter 8
Mechanical and Thermal Properties

In This Chapter

Mechanical and thermal properties are classified into the following seven categories:

- Properties of Metals and Films
- Plastics, Thermosetting Materials
- Thermal Conductivity
- Critical Points of Gases
- Elastic Constants of Metals
- Planetary Data
- Phase Transition Data

Properties of Metals and Films

Mechanical properties are listed in this subtopic for three types of materials:

Copper alloys
Aluminum alloys
Thick films

Copper Alloys

In this subtopic, electrical conductivity (σ), electrical resistivity (ρ) and the temperature coefficient of resistivity (α) are listed for the following materials:

Pure copper
Electrolytic copper
Oxygen-free copper
Free-machining copper
Gilding metal
Red brass
Cartridge brass
Yellow brass
Phosphor bronze
Cupro nickel
Beryllium copper

Aluminum Alloys

This subtopic covers composition, electrical conductivity (σ), and electrical resistivity (ρ) for the following materials:

Aluminum
EC (O & H 19)
1100 (0)
2011 (T3)
3003 (0)
5056 (H38)
6061 (T4 & T6)
7075T6

Thick Films

The Electrical Engineering Reference Pac lists data for the following materials:

Ag film
Pd-Ag film
Pt-Pd-Ag film
Cu film
Au film
Pt-Pd-Au film
Pt-Ag film
Pt-Au film
In203-Sn02 film

The data include:

Mfr	Manufacturer
No.	Number
ρs	Sheet resistivity
Adhesion	Adhesion
Min thickness	Recommended thickness

Plastics,Thermosetting Materials

This subtopic covers 14 thermosetting molding plastic products, such as epoxy and mellamine. The following properties are listed for each product:

ρVolume resistivity
Br fld(short)
Dielectric strength, short-time
Br fld(step)
Dielectric strength, step-by-step
εr
Dielectric constant
Diss fact
Dissipation factor
Arc resistances
Specific gravity
Specific volume
Tensile strength
Elongation

Tensile modulus
Compressive strength
Flexural strength
Impact strength
Rockwell hardness
Thermal conductivity
Thermal expansion
Maximum use temperature
Heat distortion temperature
Water absorption
Effect of weak acids
Effect of strong acids
Effect of weak alkali
Effect of strong alkali
Effect of organic solvents

Thermal Conductivity

In this subtopic thermal conductivity is listed for solids and high temperature insulators.

Solids

Densities, temperatures and thermal conductivities are listed for 67 materials.

High Temperature Insulators

Bulk densities, maximum operating temperatures, and thermal conductivities at different temperatures are listed for 15 different materials.

Critical Points of Gases

In this subtopic, boiling point, critical pressure, critical temperature, and critical volume are listed for 44 gases.

Elastic Constants of Metals

In this subtopic, the following properties are listed for 20 materials, such as steels, copper, brass, monel and molybdenum:

Young's modulus
Rigidity modulus
Bulk modulus
Poisson's ratio

Planetary Data

This subtopic includes the following data for the nine planets in the solar system:

Equatorial radius
Polar radius
Mass
Mean density
Visual albedo
Rotational period
Inclination

Phase Transition Data

In this subtopic, the following data are included for a variety of materials, such as acetic acid, chlorine, ethyl ether and hydrogen sulfide:

Formula	Formula
M	Mass
Tm	Melting point
Δhfus	Heat of fusion
Tb	Boiling point
Δhvap	Heat of vaporization
Pc	Critical pressure
vc	Critical volume
Tc	Critical temperature
Zc	Compressibility factor

Chapter 9
Miscellaneous

In This Chapter

Miscellaneous contains commonly used mathematical reference data.

This chapter covers:

- ☐ Constants Library
- ☐ Common Prefixes
- ☐ Greek Alphabet
- ☐ ASCII Table

Using Miscellaneous

To get to the Miscellaneous section, follow these steps:

1. Press ◀ LIBRARY to display all libraries available to the HP 48SX.
2. Find and press to enter the Electrical Engineering Reference Pac library directory.
3. Press the first softkey, EEREF, to start the application.
4. At the Main menu, move the arrow to Miscellaneous (by pressing ▲ and ▼) and press ENTER.

Items in the Miscellaneous Menu

Each entry in the Miscellaneous menu is briefly described below and is discussed in detail later in this chapter.

Item	Description
Constants Library	Commonly used mathematical constants. (Universal, Physical, Magnetic, and Mechanical)
Common Prefixes	Commonly used prefixes.
Greek Alphabet	Uppercase and lowercase Greek letters.
ASCII Table	A browser displaying all of HP 48SX characters.

Summary of Operations (Miscellaneous)

Key	Action
FONT	Toggles between the small and large fonts.
MAIN	Returns to the Main menu.
PRINT	Prompts for ONE or ALL to select items, and then sends those items to an IR printer.
→STK	Prompts for ONE or ALL to select items, and then copies those items to the stack. The items are placed in a list if ALL was chosen.
UP	Moves up one level in the menu structure.
VIEW	Displays the entire text of an item too wide to fit on the screen, up to one entire screen size. If the item fits on the screen, this key is non-functional.
ATTN	Quits the EEREF Pac to the HP 48SX stack.
ENTER	Moves down one level in the menu structure.
ON-MTH	Dumps the current screen to an IR printer.

Constants Library

The Constants Library offers you access to 39 constants commonly used in electrical engineering. All constants are listed in SI units and are classified under four categories:

Universal Constants

R	Universal gas constant
NA	Avogadro's number
Vm	Molar volume
StdT	Standard temperature

StdP	Standard pressure
εo	Permittivity
c	Velocity of light
h	Planck
hb	Dirac
k	Boltzmann

Physical Constants

q	Electron charge
me	Electron mass
re	Classic electron radius
mp	Proton mass
μN	Neutron mass
R∞	Rydberg's
α	Fine structure
ao	Bohr radius
μB	Bohr magneton
λ	Wavelength for 1 eV
λc	Compton's wavelength
σ	Stefan-Boltzmann
c1	1st radiation
c2	2nd radiation
c3	Wiens' displacement
Vt	Thermal voltage at 300 K

Magnetic Constants

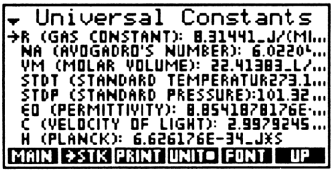
μo	Permeability of free space
ϕo	Magnetic flux quantum
F	Faraday constant
μe	Electron magnetic moment
μp	Proton magnetic moment

Mechanical and Thermal Constants

G	Gravitational constant
g	Acceleration due to gravity

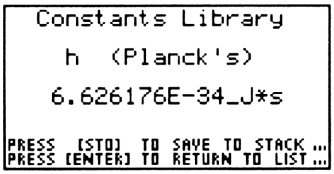
ρH2O	Density of water at 20 °C
λH2O	Refractive index of water at 20°C
CpH2O	Molar heat capacity of water
HfH2O	Heat of fusion of water
HvH2O	Heat of vaporization of water
cH2O	Velocity of sound in water

Upon choosing Universal Constants from the Miscellaneous menu, the following screen appears:



NOTE: The values are unjustified because the small font is proportionally spaced; switching to the large font will align the numerical data in the same column.

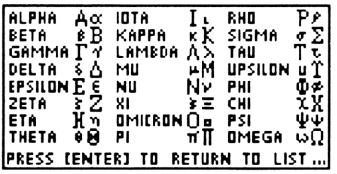
Example: Look up the value of Planck's constant. First, move the arrow down to H by pressing ↩ ▼. Now, press UNITS to turn on units. Finally, although you can see most of the value of H on the display, press ENTER to view the full value of the constant:



Press STO to save the constant to the stack as a tagged object, or ENTER or ATTN to return to the Universal Constants menu without saving the constant on the stack.

Greek Alphabet

Upon choosing Greek Alphabet from the Miscellaneous menu, the following screen appears:

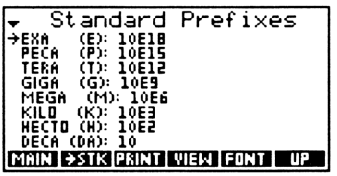


This screen is a picture displaying representations of all of the uppercase and lowercase Greek letters. Many of these characters are available from the HP 48SX keyboard, but not all of them. To get a printed copy of this screen, press [ON]-[MTH] now. Press [ENTER] to return to the Miscellaneous menu.

NOTE: The uppercase and lowercase letters alternate columns, due to limitations of the pixel resolution of the HP 48SX screen.

Standard Prefixes

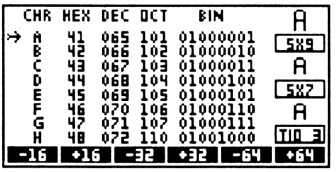
Upon choosing Standard Prefixes from the Miscellaneous menu, the following screen appears:



The only difference in behavior between Standard Prefixes and Constants Library is that units are not relevant to the prefixes, so UNITS has been replaced with VIEW.

ASCII Table

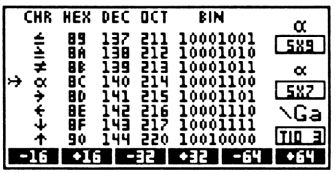
Upon choosing ASCII Table from the Miscellaneous menu, the following screen appears:



This function displays hexadecimal, octal, binary and ASCII equivalents for the decimal numbers 0 through 255.

Example:

Suppose you want to find the binary equivalent of the ASCII α character. Enter the ASCII Table, The first screen displays characters at decimal number 065 (although ASCII characters beginning at decimal 0 are available). Use the ▼ cursor key to scroll down the list until you find the α character (decimal 140). Look under the BIN heading to find the binary equivalent of α.



Since the search mode is not available in the ASCII table, you need to use the **-16**, **+16**, **-32**, **+32**, **-64**, **+64** softkeys to jump forward or backward 16, 32, or 64 characters at a time.

The HP48SX Character Set

The top two boxes at the far right of the ASCII listing display the selected character in the HP 48SX small (5X7) and medium (5X9) fonts. The third box displays the I/O character and translate code setting required to download data from a personal computer to the HP 48SX. (See the *HP 48SX Owner's Manual* for complete instructions.)

Summary of Operations (Miscellaneous Sections)

Key	Action
FONT	Toggles between the small and large fonts.
MAIN	Returns to the Main menu.
PRINT	Prompts for ONE or ALL to select items, and then sends those items to an IR printer.
→STK	Prompts for ONE or ALL to select items, and then copies those items to the stack.
UNIT▪	Indicates that units are currently turned on. Pressing this key turns off units, automatically stripping units from all constants.
UNITS	Indicates that units are currently turned off. Pressing this key turns on units, automatically appending units to all constants.
UP	Moves up one level in the menu structure.
VIEW	Displays the entire text of an item too wide to fit on the screen, up to one entire screen size. If the item fits on the screen, this key is non-functional.
ATTN	Quits the EEREF Pac to the HP 48SX stack.
ENTER	For picture data, ENTER displays the picture. For text, ENTER displays the screen title, the item label, and the item, all expanded to one screen.
ON-MTH	Dumps the current screen to an IR printer.

Notes:

Appendix A
Warranty and Service

Pocket Professional Support

You can get answers to your questions about using your Pocket Professional card from Sparcom. If you don't find the information in this manual or in the HP 48SX *Owner's Manual*, contact us in writing, at :

Sparcom Corporation
Attn: Technical Support Dept.
897 NW Grant Avenue, Corvallis, OR 97330, U.S.A. (503) 757-8416

or send E-mail:

from **Internet:**	support@sparcom.com
from **Compuserve:**	>Internet:support@sparcom.com
from **FidoNet:**	To:support@sparcom.com

Limited One-Year Warranty

What Is Covered

The Pocket Professional is warranted by Sparcom Corporation against defects in material and workmanship for one year from the date of original purchase. If you sell your card or give it as a gift, the warranty is automatically transferred to the new owner and remains in effect for the original one-year period. During the warranty period, we will repair or replace (at no charge) a product that proves to be defective, provided you return the product and proof of purchase, shipping prepaid, to Sparcom.

What Is Not Covered

This warranty does not apply if the product has been damaged by accident or misuse or as the result of service or modification by any entity other than Sparcom Corporation.

No other warranty is given. The repair or replacement of a product is your exclusive remedy. ANY OTHER IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS IS LIMITED TO THE ONE-YEAR DURATION OF THIS WRITTEN WARRANTY. IN NO EVENT SHALL SPARCOM CORP. BE LIABLE FOR CONSEQUENTIAL DAMAGES. Products are sold on the basis of specifications applicable at the time of manufacture. Sparcom shall have no obligation to modify or update products, once sold.

If the Card Requires Service

Sparcom will repair a card, or replace it with the same model or one of equal or better functionality, whether it is under warranty or not.

Service Charge

There is a fixed charge for standard out-of-warranty repairs. This charge is subject to the customer's local sales or value-added tax, wherever applicable. Cards damaged by accident or misuse are not covered by fixed charges. These charges are individually determined based on time and material.

Shipping Instructions

If your card requires service, ship it to Sparcom Corporation, 897 NW Grant Avenue, Corvallis, OR 97330, U.S.A.

- Include your return address and a description of the problem.
- Include proof-of-purchase date if the warranty has not expired.
- Include a purchase order, along with a check, or credit card number and expiration date (VISA or MasterCard) to cover the standard repair charge.
- Ship your card, postage prepaid, in adequate protective packaging to prevent damage. Shipping damage is not covered by the warranty, so insuring the shipment is recommended.

Cards are usually serviced and reshipped within five working days.

Environmental Limits

The reliability of the Pocket Professional depends upon the following temperature and humidity limits:

- Operating temperature: 0 to 45 °C (32 to 113 °F).
- Storage temperature: -20 to 60 °C (-4 to 140 °F).
- Operating and storage humidity: 90% relative humidity at 40 °C (104 °F) maximum.

Appendix B
References

Electronic Properties

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"Reference Data for Radio Engineers," Sixth Edition, Howard W. Sams & Co., Inc., NY, 1975

Notes:

Appendix C
Menu Structure

This chapter presents the menu structure format of the Electrical Engr. ref. Pac. The main menu items are shown in bold typeface for clarity.

Electronic Properties

- Digital Specifications
  - NMOS Technology
  - CMOS Technology
  - TTL Technology
  - ECL Technology
- Frequency Bands
  - New frequency bands
  - Mm & Sub Mm Bands
- Piezoelectric Properties
  - Piezoelectric Constants
  - Piezo/pyro/ferro properties
- Properties of Lasers
  - Semiconductor Laser
  - Pulsed Lasers
  - Common Lasers (nm)
  - Commercial CW Lasers
- Electro-Acoustics
  - Sound Intensity Eqns
  - Sound Vel in Liquids
  - Sound Velocity in Metals
  - Sound Vel in Misc. Matls.
- μ-Wave Materials
- Superconductors, Tcrit.
- Thermionic Emission

Thermocouples

- E Type
- J Type
- K Type
- S Type
- T Type

Semiconductors

- Properties of Si
- Properties of GaAs
- Donors in Silicon
- Acceptors in Silicon
- III-V Compounds
- II-VI Compounds
- Optical Properties
  - Refractive Index
  - Light Guide Sys. Sensitivity(_dBm)

Electrical Properties

- Resistor Color Code Interpretation
- Standard Comp Values
- Wire Gauge
  - Solid Copper
  - Annealed Copper
  - Hard Drawn Copper
  - Copper Wire Table
  - Stranded Conductors
  - Max Current Capacity
  - Fusing Current
- Voltage Standing Wave Ratio (VSWR) Calculations
- Decibel Conversions
  - Current
  - Voltage
  - Power
- Battery Characteristics
- Solders, Brazes
- Film Electrical Properties

Dielectric Properties

- Insulating Materials
  - Ceramics
  - Glasses
  - Plastics
  - Organic Liquids
  - Waxes
  - Rubbers
  - Woods
  - Miscellaneous
- Dielectric Constants

Insulator Resistance
Insulating Films
Insulating Liquids

Magnetic Properties

Hi Permeability matl
Hi Remanence
Laminated Cores
Soft Magnetic Matl
Laminated/Wound cores of Si Steel
Ferrites
  Ferrite Properties
  Ferro,Piezo,Pyro Props
  Pressed Powder
  Garnets

Mechanical,Thermal Properties

Properties of Metals/Films
  Copper Alloys
  Al alloys
  Thick Films
Plastics, Thermosetting Matls
Thermal Conductivity
  Solids
  Hi Temp Insulators
Critical Points-Gases
Elastic Constants of Metals
Planetary Data
Phase Transition Data

Miscellaneous

Universal Constants
Physical Constants
Magnetic Constants
Mechanical, Thermal Constants
Greek Alphabet
Standard Prefixes
ASCII Table

Notes:

Appendix D
Questions and Answers

Commonly Asked Questions

Q. I'm not sure whether the Pocket Professional card is malfunctioning or I'm doing something improperly. How can I verify that the card and the calculator are functioning properly.

A. There are several possibilities for this condition to occur.

- check to make sure that the card is properly seated in the calculator port.
- turn the calculator ON and press [LIBRARY]. The calculator checks the reference card when it turns on; if "Invalid Card Data or Port Not Available" message is displayed, then the card may require service. If the library menu does not include the reference name shown in Chapter 1, then the card may require service.
- a third possibility occurs when you remove a merged RAM card incorrectly and install the Pocket Professional card. In this case, the calculator display shows "Recovering Memory".

Q. What do three dots (...) mean at the end of a display line?

A. The three dots indicate that the object is displayed too long to show on one line. To view the complete object, select the object using the [▼] or the [▲] key by moving the pointing arrow to the object to be displayed, press [→] and [VISIT]. Pressing [ENTER] or [ATTN] will return to the browser.

Q. While searching a list of information, I used the alpha key to do the search, but the search did not work. Why?

A. Most likely, the search did not work because of case sensitivity of the alpha search.

Notes:

Index

T

U

W

Sparcom

Sparcom Corporation
897 NW Grant Avenue
Corvallis, OR 97330

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