PROGRAMMABLE CALCULATOR

PX41CX

User Manual

The **PX41CX** programmable calculator is a calculator that incorporates the functionalities and language of the HP-41CX calculator thanks to an emulation running on an AVR128DA microcontroller.

This manual is not intended to document the use of these features nor to present the programming language of the 41CX which are documented in manuals in PDF format on

http://literature.hpcalc.org/#model:41CX

and in particular:

- HP-41CX Owner's Manual Volume 1: Basic Operation
  (http://literature.hpcalc.org/items/909)
- HP-41CX Owner's Manual Volume 2: Operation in Detail
  (http://literature.hpcalc.org/items/913)

This manual therefore presents the particular functionalities of the **PX41CX**:

- calculator menu and settings,
- **PX41CX** firmware update,
- exchange of programs and data between **PX41CX** and PC
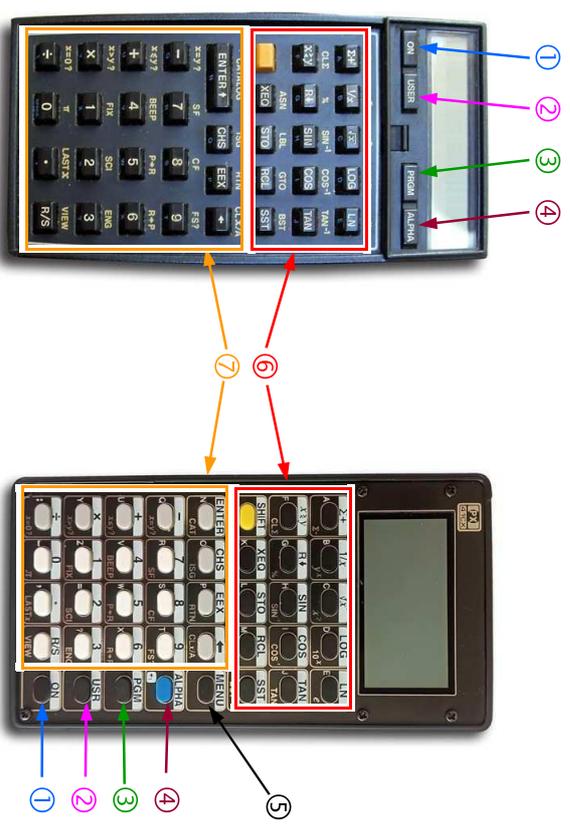
Version 0.900 Build 2024.06.27

Table of Contents

1- The keyboard

The keyboard of the **PX41CX** calculator (40 keys) differs little from that of the HP-41CX (39 keys) since apart from the arrangement of the ON①, USER②, PRGM③, ALPHA④ keys and the addition of the MENU⑤ key, the other keys ⑥⑦ remain identical in title and positioning.

2 - Menu

The MENU key of the **PX41CX** calculator provides access either to calculator setting options or to information on its internal contents.

By pressing this key the ordinary calculator screen

is replaced by a screen called "MENU" offering 5 choices:

- **DISP** allows you to choose the display mode on 1, 2 or 4 lines,

- **VIEW** to display either all registers or all flags,

- **COM** to exchange memory contents with a PC in the form of dump,

- **MORE** to access an additional MENU screen,

- **EXIT** to exit MENU mode.

In all screens of MENU mode, pressing the ON key or the MENU key returns to the standard calculator screen.

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1) **DISP** offers 4 display modes :

X to display only the X register on a line of the screen,

XY to display the X and Y registers on two lines of the screen,

XA to display the X register and the ALPHA register on two lines of the screen,
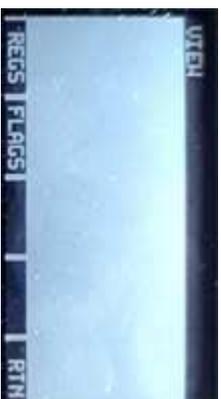
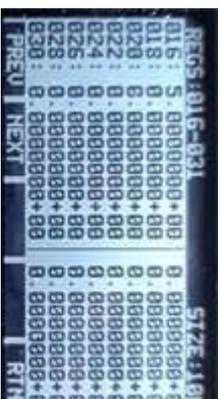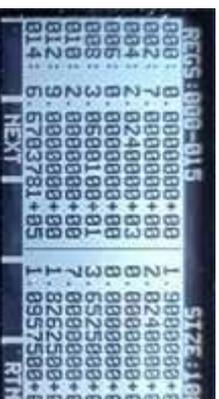**XYZT** to display the stack (X, Y, Z and T registers) on four lines of the screen.

RTN returns to the MENU screen
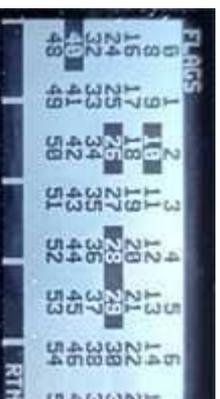
2) **VIEW** offers 2 choices :

- **REGS** to view registers on one or more pages (depending on the SIZE option).
- **FLAGS** to view the flags

REGS displays 16 registers per page with PREV and NEXT choices if necessary.

FLAGS displays the flags. (on a black background if "up")

RTN returns to the higher level screen

3) **COM** offers 2 choices :

- **DUMP** to send a memory dump from the **PX41CX** to PC
- **LOAD** to receive a memory dump from a PC.

(see "Program and data exchange" page 17)

RTN returns to the higher level screen

4) **MORE** displays the rest of the MENU entitled MENU2 offering 5 choices :

- **BEEP** to choose whether a sound should be assigned to the keys or not,
- **SLEEP** to choose the delay before automatic shutdown of the **PX41CX**,
- **SPEED** to choose the processor speed (cadence in MHZ),
- **INFO** to access information regarding the **PX41CX**,
- **RTN** to return to the first MENU.

5) **BEEP** offers 2 choices :

- **OFF** = no sound when pressing a key,
- **ON** = sound emitted when pressing a key

6) **SLEEP** offers 4 options for automatic shutdown :

- **1MIN**,
- **2MIN**,
- **4MIN**,
- or **NEVER**
  (no automatic shutdown)

7) **SPEED** offers 4 frequencies for speed of **PX41CX** :

- **8MHZ**,
- **16MHZ**,
- **24MHZ**,
- **32MHZ**

RTN returns to the higher level screen

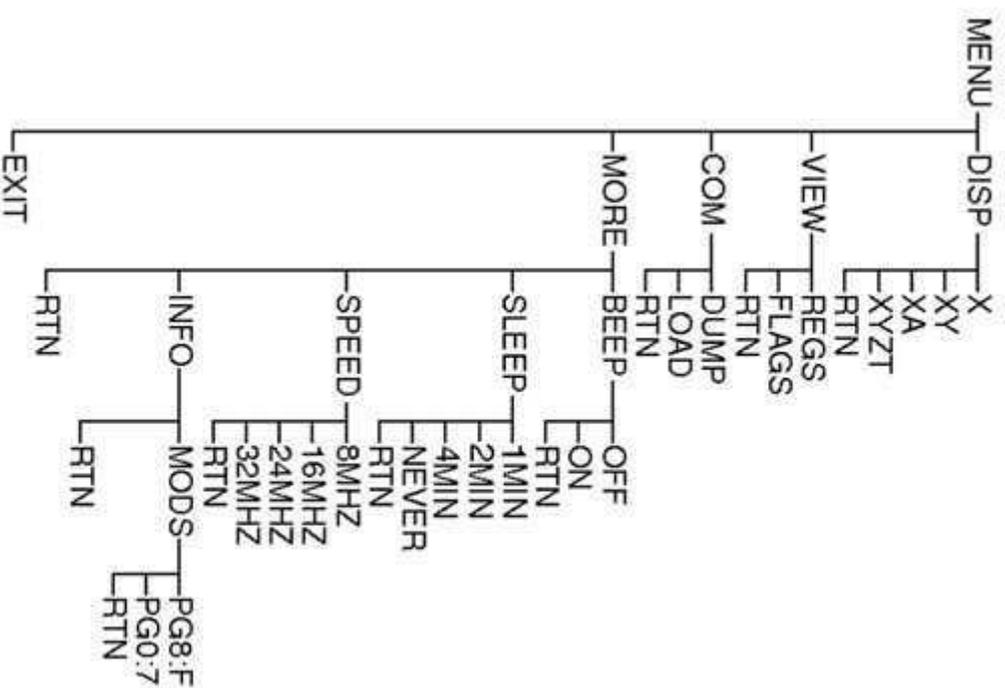8) **INFO** displays battery status and firmware version and date.
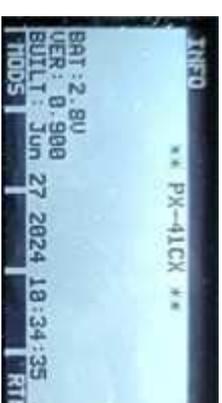
9) **MODS** allows you to consult the list of modules loaded internally.

RTN returns to the higher level screen

MENU Summary

```
MENU ─┬─ DISP ─┬─ X
      │         ├─ XY
      │         ├─ XA
      │         ├─ XYZT
      │         └─ RTN
      ├─ VIEW ─┬─ REGS
      │         ├─ FLAGS
      │         └─ RTN
      ├─ COM ──┬─ DUMP
      │         ├─ LOAD
      │         └─ RTN
      ├─ MORE ─┬─ BEEP ──┬─ OFF
      │         │          ├─ ON
      │         │          └─ RTN
      │         ├─ SLEEP ─┬─ NEVER
      │         │          ├─ 1MIN
      │         │          ├─ 2MIN
      │         │          ├─ 4MIN
      │         │          └─ RTN
      │         ├─ SPEED ─┬─ 8MHZ
      │         │          ├─ 16MHZ
      │         │          ├─ 24MHZ
      │         │          ├─ 32MHZ
      │         │          └─ RTN
      │         └─ INFO ──┬─ MODS ─┬─ PG8:F
      │                    │         ├─ PG0:7
      │                    │         └─ RTN
      │                    └─ RTN
      └─ EXIT ─── RTN
```

3- Firmware update

To update the firmware of the **PX41CX** several elements are essential :

- a USB Serial cable: USB A socket on the PC side, mini USB on the calculator side
  For Windows you will need to install the corresponding driver (Prolific USB-to-Serial Comm Port)

- **python 3**
  python3-3.7.2.post1-embed-win32v2a.zip

- python tools for the **SerialUPDI** interface (prog.py et libs)
  https://github.com/SpenceKonde/DxCore/tree/master/megaavr/tools
  (.../DxCore/blob/master/megaavr/tools/ManualPython.md)

For Windows :

1) Install Python in c:\python3

2) Install the interface tools (prog.py and libs) in c:\python3\tools

3) Create a directory to receive updates for **PX41CX**
for example : c:\python3\PX41CX_V2

To make updates easier, create a command file such as :

in this last directory you can keep the different firmware versions by numbering them.

```
@echo off
CD..
cls
@echo +===================================+
@echo !  P X 4 1 C X  :  F I R M W A R E  U P D A T E !
@echo +===================================+
SET /P numv=Version (01, 02, 03,...) ?
python -u tools/prog.py -t uart -u COM8 -b 38400 -d avr128da28 --fuses
5:0b11001001 6:0x04 7:0x00 8:0x00 -f PX41CX_V2/main%numv%.hex -a write -v
```

and save it as UPD_PX41CX.bat

---

it will be necessary to adapt this command file to the parameters of the COM port used.
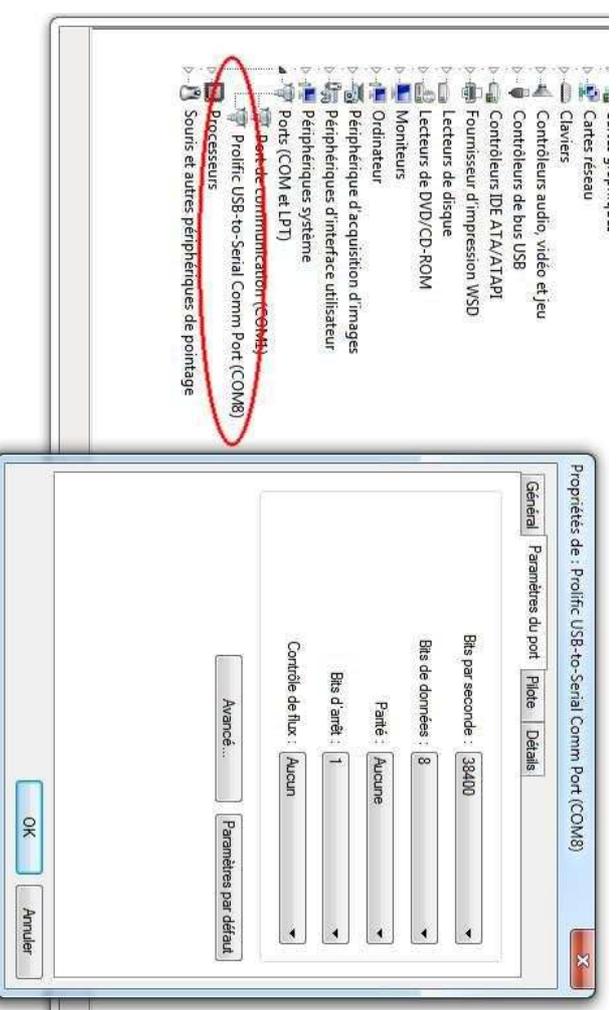
then before launching an update it is imperative to move the switch of the **PX41CX** to the right :

"firmware update" position

Start the update by double clicking on UPD_PX41CX.bat

then choose the file number to load

and the update runs…

until loading is complete…

it will then absolutely be necessary to re-position the **PX41CX** switch to the left :

"calculator mode" position

Attention !
Each time the calculator firmware is updated, all data and programs are lost!
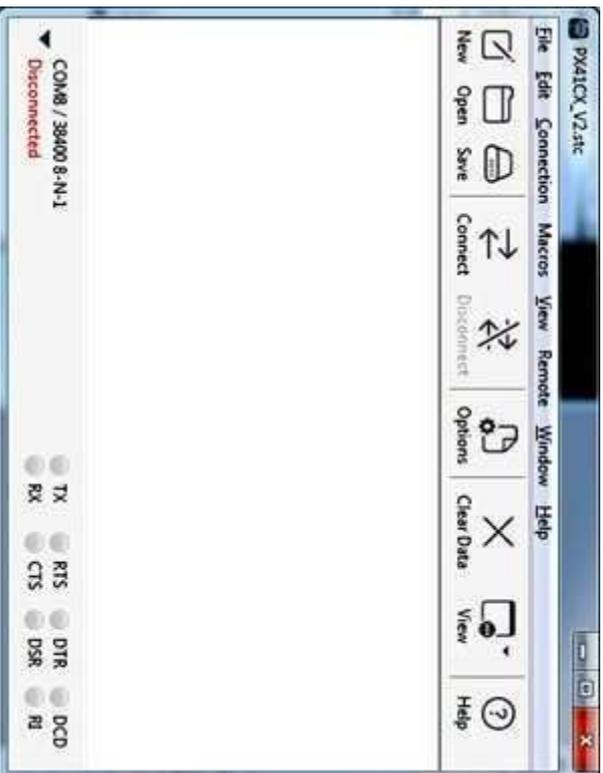Update is a complete reset.

4- Program and data exchange

For the exchange between the PX41CX and a PC the cable is the same as that used for updating the firmware.

But for the "software" part you need :

- "Terminal" transfer software : **CoolTerm** from Roger Meier is most suitable (http://freeware.the-meiers.org/)

- DUMP decoding software (in case of DUMP from **PX41CX**)

- HP-41 program coding software (in case of sending DUMP to **PX41CX**)

DUMP

To extract a DUMP from the PX41CX and send it to the PC, you must :
1) on the calculator press:

to display the MENU screen

to display the COM screen

2) connect the SerialUSB cable between the calculator and the PC,
3) then on PC launch the CoolTerm program and connect to the COM port corresponding to your SerialUSB
4) on the calculator press

corresponding to the DUMP choice to start the transfer

the transfer result is displayed in CoolTerm :

this DUMP can be selected and copied to then be pasted either into a TXT file for backup or into a decoding tool.

LOAD

To load a DUMP into the **PX41CX**, you must :

1) on the calculator press :
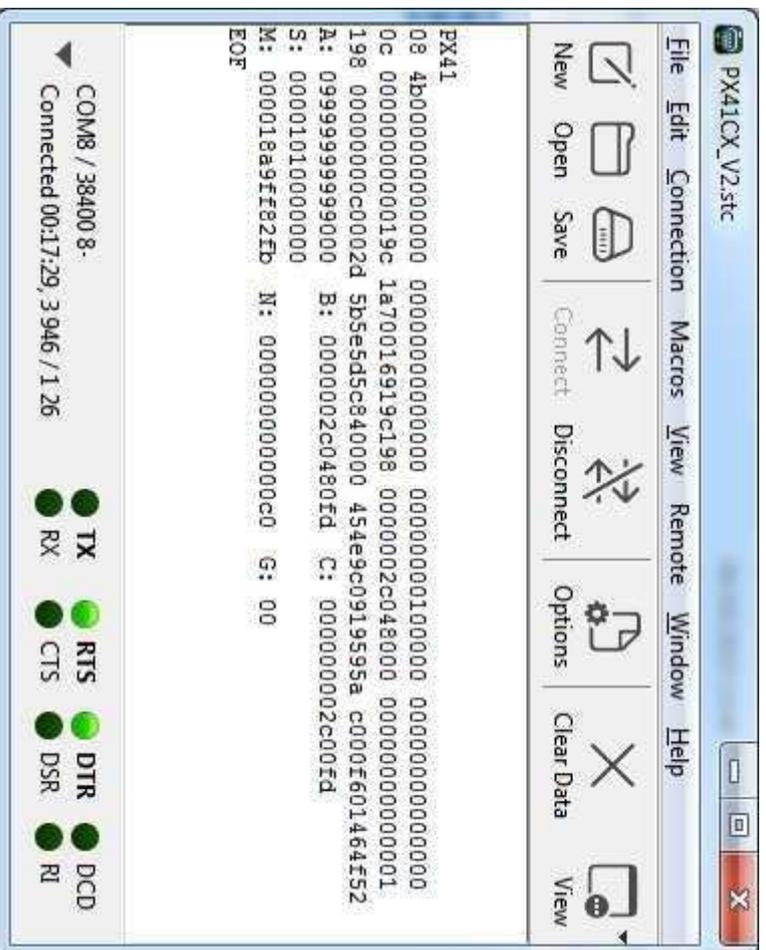

to display the MENU screen

to display the COM screen

2) connect the SerialUSB cable between the calculator and the PC,

3) then on PC launch the CoolTerm program and connect to the COM port corresponding to your SerialUSB

4) either from a text editor (Notepad type) or from HP-41 program coding software, copy the DUMP (CTRL + C)

Microsoft Excel - PX41CX_Interface.xls

PX41CX interface

PX41 calculator dump

```
foren.d41
PX41
08  00000000000000  0000000000100000  00000000000000
0c  0000000000019c  1a70016919c198   0000002c048000  00000000000001
198 00000000c0002f  5b5e5d5c840000   454e9c0919595a  c000f601464f52
A: 00000000000000  B: 00000000000000  C: 00000000000000
M: 00000000000000  N: 00000000000000  G: 00
```

Copy Clear Load Save

5) on the **PX41CX**, press
corresponding to the LOAD choice
to wait for the transfer

restoring....

6) in CoolTerm, right-click to get the context menu to paste the DUMP to send to the **PX41CX**

PX41CX_V2.stc
File Edit Connection Macros View Remote Window Help
New Open Save Connect Disconnect Options Clear Data View

Copy
Paste
Font Settings...

COM8 / 38400 8-
Connected 00:17:29, 3 946 / 1 26
TX RX RTS CTS DTR DSR DCD RI
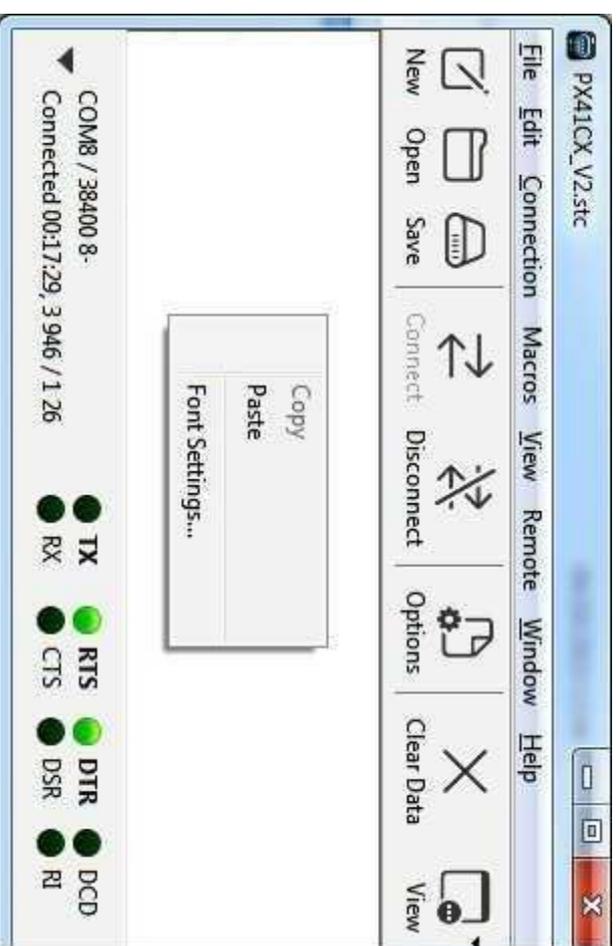
7) Click on "Paste", the DUMP is sent

PX41CX_V2.stc
File Edit Connection Macros View Remote Window Help
New Open Save Connect Disconnect Options Clear Data View

Waiting for data...
OK

COM8 / 38400 8-
Connected 00:17:29, 3 946 / 1 26
TX RX RTS CTS DTR DSR DCD RI
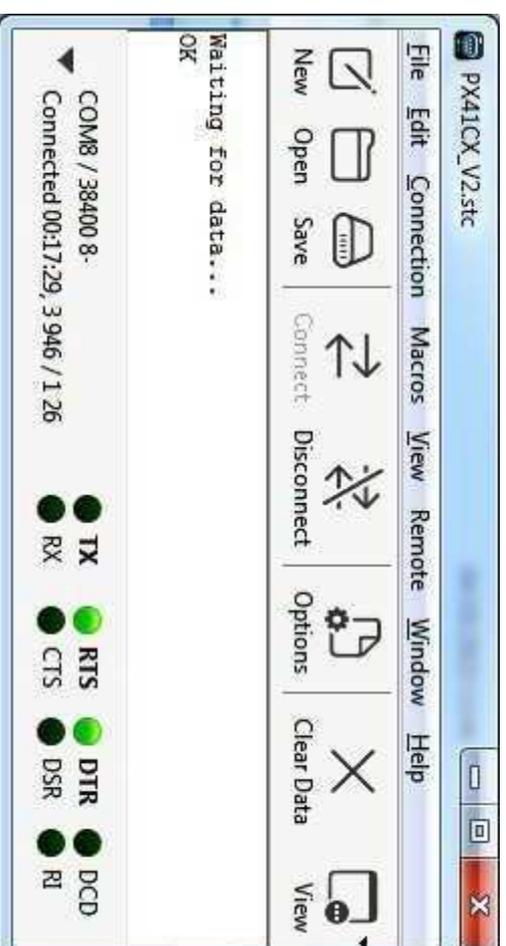
Decoding **PX41CX** dumps :

currently the only tool allowing decoding of dumps is

DM41 programming tool from Swiss Micros.

(https://dm41.swissmicros.com/)

Coding in **PX41CX** dumps :

The **PX41CX** interface allows HP-41 programs to be coded into dumps

PX41CX interface

(https://clones.phweb.me/)

5- Implemented modules

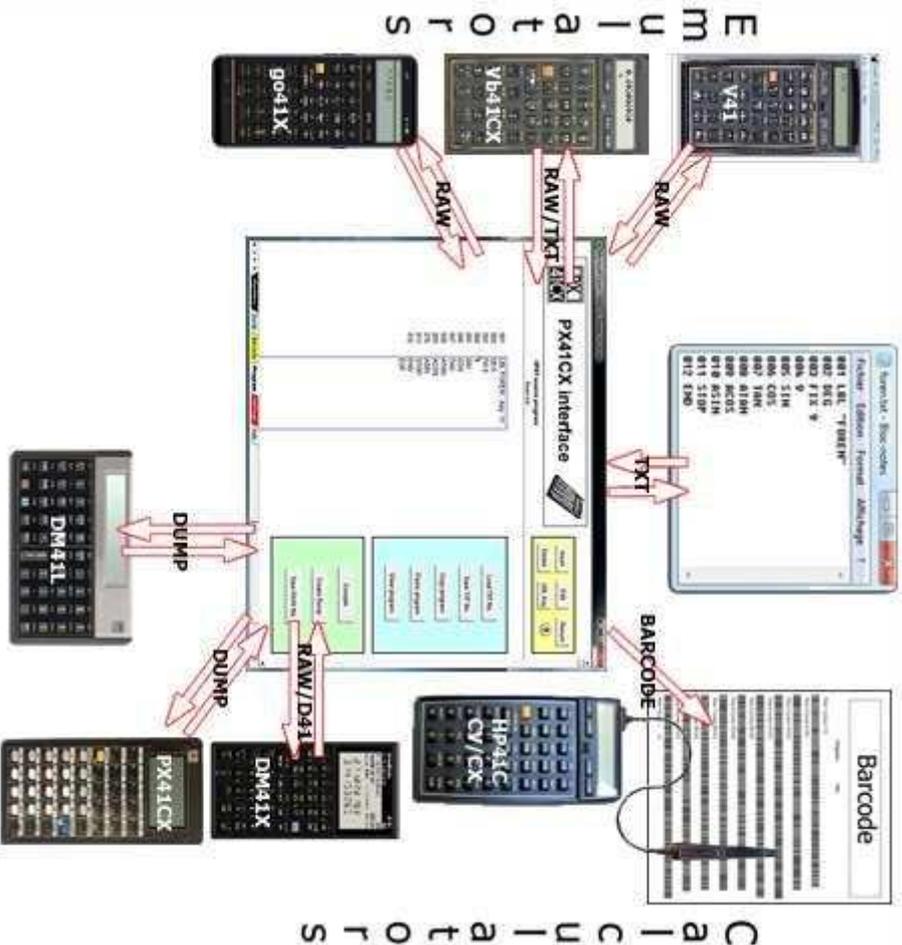| Time (CX)	
TIME 2C	**CX TIME**
ADATE	CLALMA
ALMCAT	CLALMX
ALMNOW	CLRALMS
ATIME	RCLALM
ATIME24	SWPT
CLK12	
CLK24	
CLKT	
CLKTD	
CLOCK	
CORRECT	
DATE	
DATE+	
DDAYS	
DMY	
DOW	
MDY	
RCLAF	
RCLSW	
RUNSW	
SETAF	
SETDATE	
SETIME	
SETSW	
STOPSW	
SW	
T+X	
TIME	
XYZALM	

X Functions (CX)		
EXT FNC 2D		**CX EXT FCN**
ALENG	INSREC	ASROOM
ANUM	PASN	CLRGX
APPCHR	PCLPS	ED
APPREC	POSA	EMDIRX
ARCLREC	POSFL	EMROOM
AROT	PSIZE	GETKEYX
ATOX	PURFL	RESZFL
CLFL	RCLFLAG	?REG?
CLKEYS	RCLPT	X=NN?
CRFLAS	RCLPTA	X?NN?
CRFLD	REGMOVE	X<NN?
DELCHR	REGSWAP	X<=NN?
DELREC	SAVEAS	X>NN?
EMDIR	SAVEP	X>=NN?
FLSIZE	SAVER	
GETAS	SAVERX	
GETKEY	SAVEX	
GETP	SEEKPT	
GETR	SEEKPTA	
GETREC	SIZE?	
GETRX	STOFLAG	
GETSUB	X<>F	
GETX	XTOA	
INSCHR		

ADVANTAGE	ADV CONV B	ADV MTRX	ADV MATH	
BININ	C<>C	MRIJ	SOLVE	D?
BINVIEW	CMAXAB	MRIJA	INTEG	BFIT
OCTIN	CNRM	MRR+	SILOOP	FIT
OCTVIEW	CSUM	MRR-	SIRTN	Y?X
HEXIN	DIM?	MS	Z?N	SZ?
HEXVIEW	FNRM	MSC+	MAGZ	VC
NOT	I+	MSIJ	e?Z	CROSS
AND	I-	MSIJA	LNZ	VS
OR	J+	MSR+	Z?1/N	VR
XOR	J-	MSWAP	SINZ	DOT
ROTXY	M"M	MSYS	COSZ	VE
BIT?	MAT*	PIV	TANZ	V-
	MAT+	R<>R	a?Z	V+
	MAT-	R>R?	LOGZ	VXY
ADV TVM	MAT/	RMAXAB	Z?1/W	UV
TVM	MATDIM	RNRM	Z?W	V?
N	MAX	RSUM	C+	VD
PV	MAXAB	SUM	C-	V*
PMT	MDET	SUMAB	CINV	TR
FV	MIN	TRNPS	C*	CT
*I	MINV	YC+C	C/	AIP
	MMOVE	MEDIT	PLY	
	MNAME?	CMEDIT	RTS	
	MR	MP	DIFEQ	
	MRC+	MATRX	CFIT	
	MRC-	MTR	A?	

STAT 1B
?BSTAT
?BSTG
*BE
?MMTUG
?MMTGD
*MT
*MD
?AOVONE
?AOVTWO
?ANOCOV
?LIN
?EXP
?LOG
?POW
?POLYP
?POLYC
?MLRXY
?MLRXYZ
?PTST
?TSTAT
?XSQEV
?EEFXSQ
?CTKK
?CTKKK
?SPEAR
?NORMD
?CHISQD
*a
*b

MATH 1D	
MATRIX	a^z
SIMEQ	LOGZ
VCOL	Z^1/W
VMAT	Z^W
PVT	C+
DET	C-
INV	CINV
EDIT	C*
SOLVE	C/
SOL	SINH
POLY	COSH
ROOTS	TANH
INTG	ASINH
DIFEQ	ACOSH
FOUR	ATANH
Z?N	SSS
MAGZ	SAA
e?Z	ASA
LNZ	SAS
Z?1/N	SSA
SINZ	TRANS
COSZ	*FN
TANZ	

FINANCE 1D	MONEY	
	IRR	*I
	MIRR	*PV
	NPV	*PMT
	AMORT	*FV
	SL	*IRR
	DB	*MIRR
	SOYD	*NPV
	BOND	*AMORT
	DAYS	*SL
		*DB
		*SOYD
		*PRC
		*YLD
		*DAYS
		*BGN
		*SIZE
		*DATA
		*DATA1
		*OUT
		*TGL
		*TGL1
		*Y/N
		$ENG
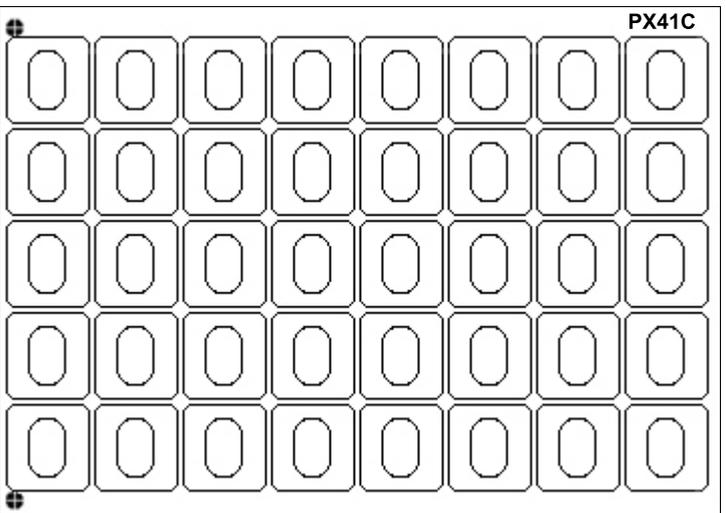
PX41C

Blank overlay for PX41CX

ED

Overlay for ED (CX EXT FCN)

A	B	C	D	E
a	b	c	d	e
F	G	H	I	J
Σ	%	≠	∧	∨
	K	L	M	NEXT
		INSERT	GOTO	PREV
N	O	P	↑	
→	↙	$	DELREC	
Q	R	S	T	1→
_	7	8	9	12↓
U	V	W	X	←1
+	4	5	6	←12
Y	Z	=	?	EXIT
*	1	2	3	+REC↓ +REC→
·	[	,		
/	0	.		

Overlay for SW (TIME 2C)

STOPWATCH   SW

SPLIT   SHIFT

ΔSPLIT   0   1   4   7

REG#   Rnnn   .   2   5   8

CLEAR   EXIT   RCL   R/S   3   6   9

BST   SST