



The HP-41 EEE^(*) Experience

Teaching New Tricks to an Ol'Dog

Ángel M. Martin – May 2021



(*) *Extended, Expanded, Enhanced... premium unleaded*

Acknowledgements (a.k.a. the usual suspects...)

“Standing on the Shoulders of Giants”

- Obviously to HP “of yore”, for the HP-41 System and its phenomenal OS MCODE
 - W&W GmbH, VM Electronics, Redshift s/w – publishers of CCD Module, HEPAX & AECROM
 - Wilson “Bill” Holes and Nelson F. Crowle, head & heart of the AECROM – “*Viva Las Vegas!*”
 - Doug Wilder, author of ROMED, Jump Distances and GOSUB/GOTO Decoders
 - Håkan Thörngren, author of RAMED & several XM-Utils. *Takk!*
 - Greg McClure co-authored the 16C Emulator and Formula Evaluation Modules, true “*partner-in-crime*” for numerous MCODE projects and explorations
-
- David Ingebretsen, program Sponsor and advisor
 - Jean-Marc Baillard provided inextinguishable Math expertise and co-authored Math ROMs
 - Mark Fleming authored the Equation Library (Formula-Eval version)
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 - Sylvain Côté, always glad to share his encyclopedic knowledge
 - Poul Kaarup, author of the PK-Collection w/ innovative apps
 - ... *and many, many others that would take too long to include!*



Presentation ~~Agenda~~ Sketches:

- Library#4 Concept and Reach
 - Auxiliary FATs and Banked FATs
 - Sub-functions, Launchers and Last-Function
 - Auto-Complete XEQ+, Universal Execute XEQ\$
 - Loading and Interrogating the I/O Bus
-
- Advanced Modules Summary
 - OS/X and Utilities ROMS
 - System Extension Modules
 - Emulators and Informatics ROMS
 - Math Extension Modules
 - Science & Engineering ROMS
 - From Solve to Solver: Equation Libraries
 - Rest & Relaxation
 - Adapted Books and Literature
 - Acknowledgments
-
- Appendix: System Memory and MLDL Modules

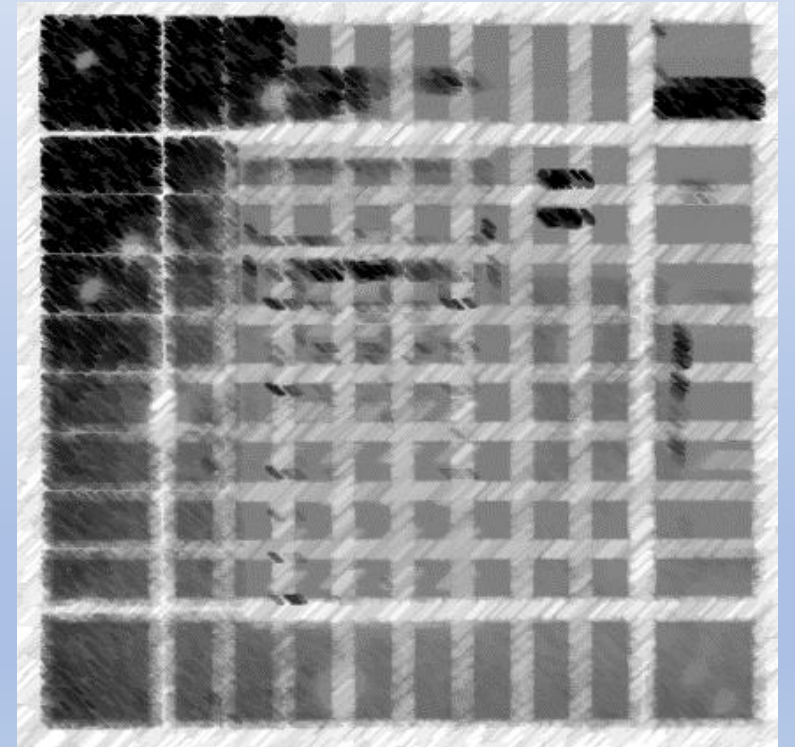


Next-Gen Module Design

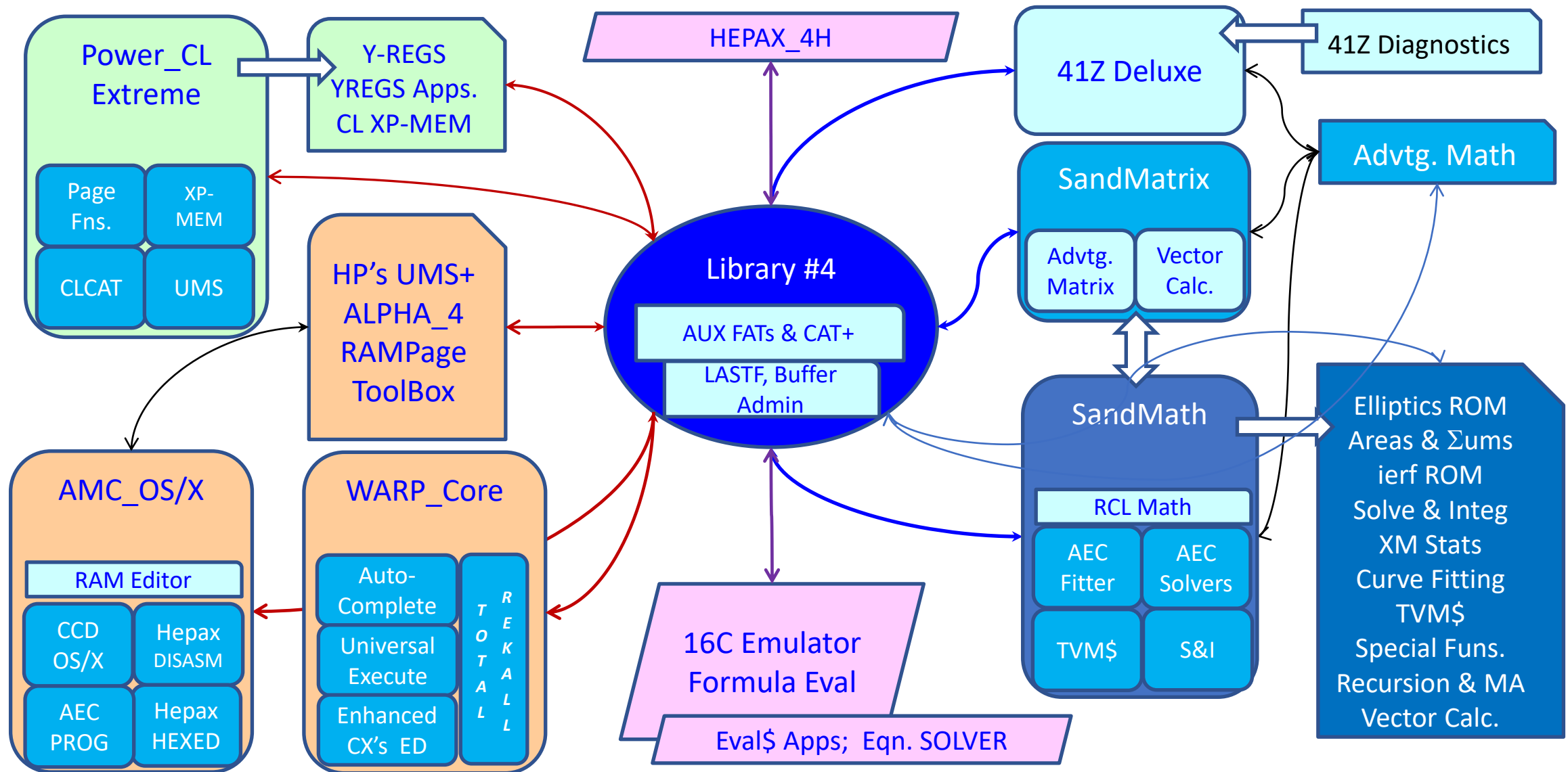
Library#4

Sub-Functions and Auxiliary FATs

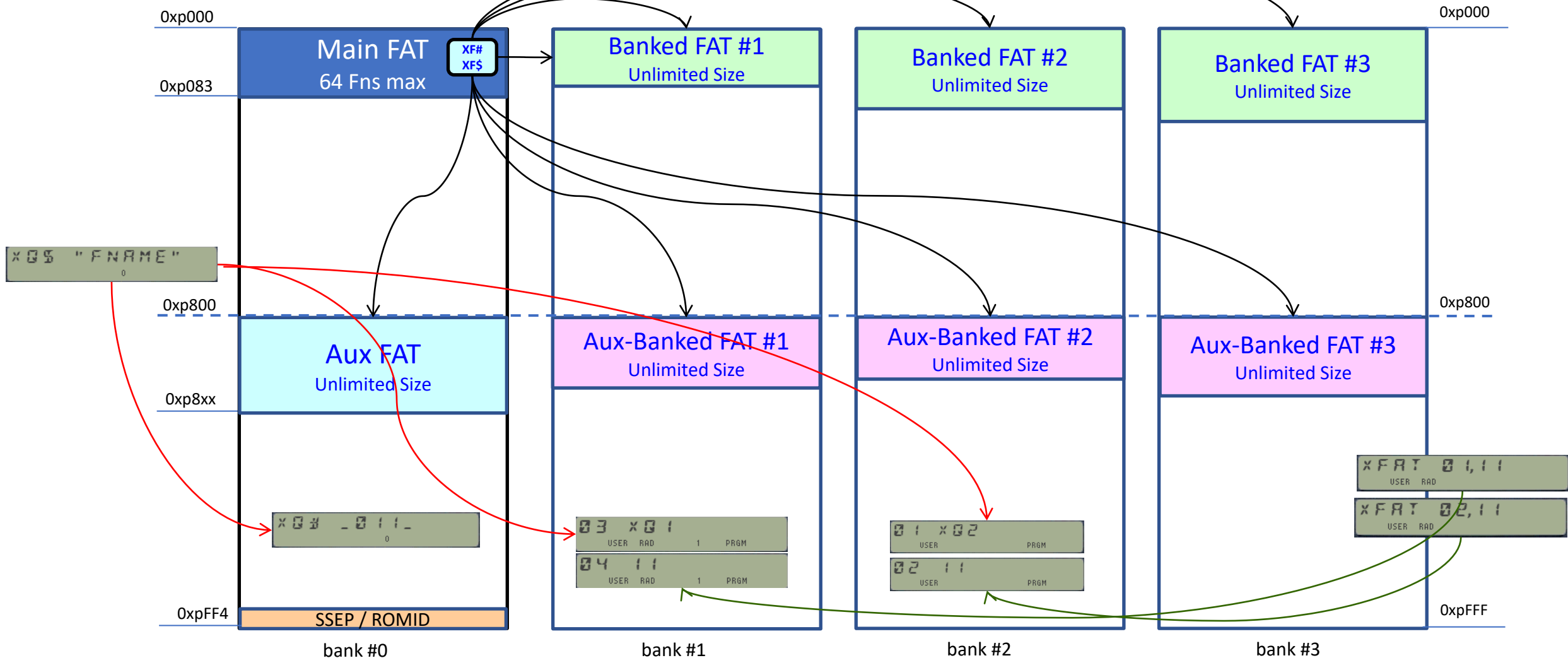
Last-Function facility



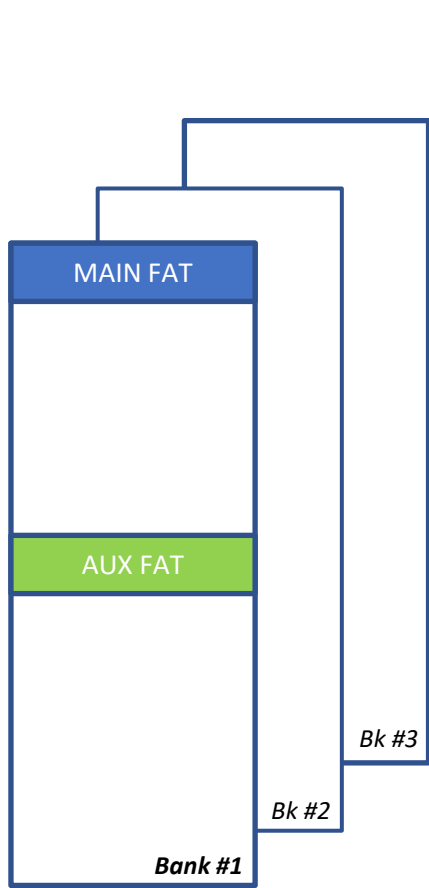
[4LIB] *Library#4: A sorta MindMap*



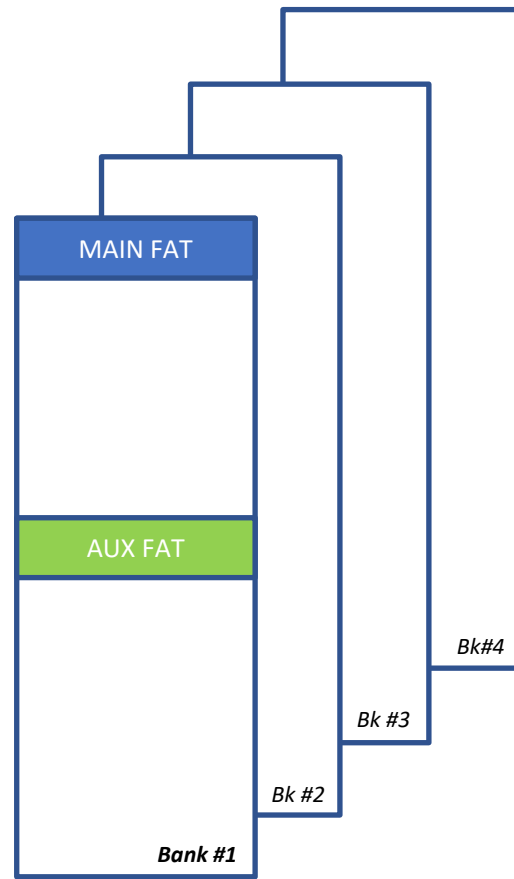
Auxiliary & Banked FAT Concept



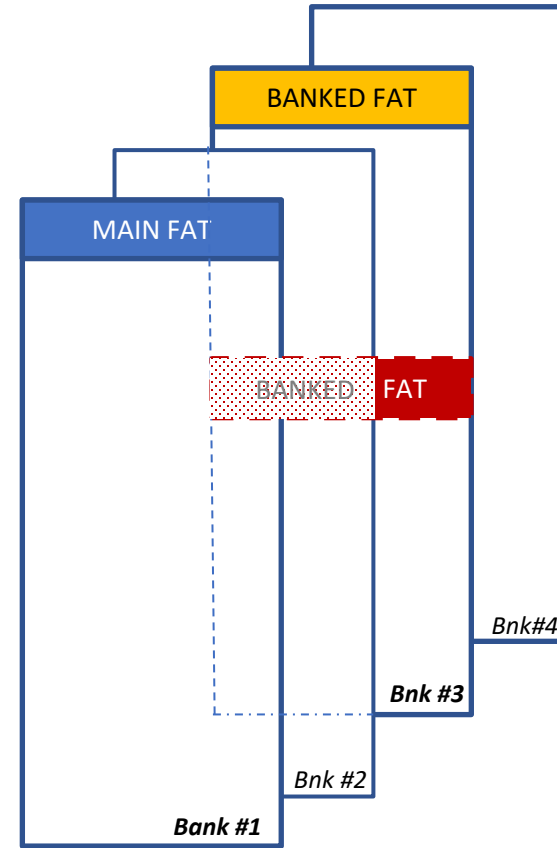
Real-life Examples (1)



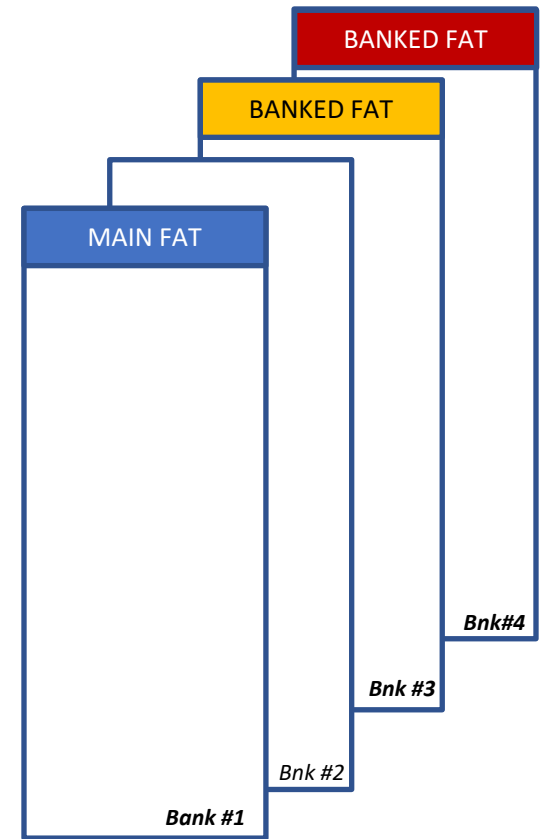
WARP Core
1x3, 2 FATs



**AMC OS/X,
16C Simulator:**
1x4, 2 FATs

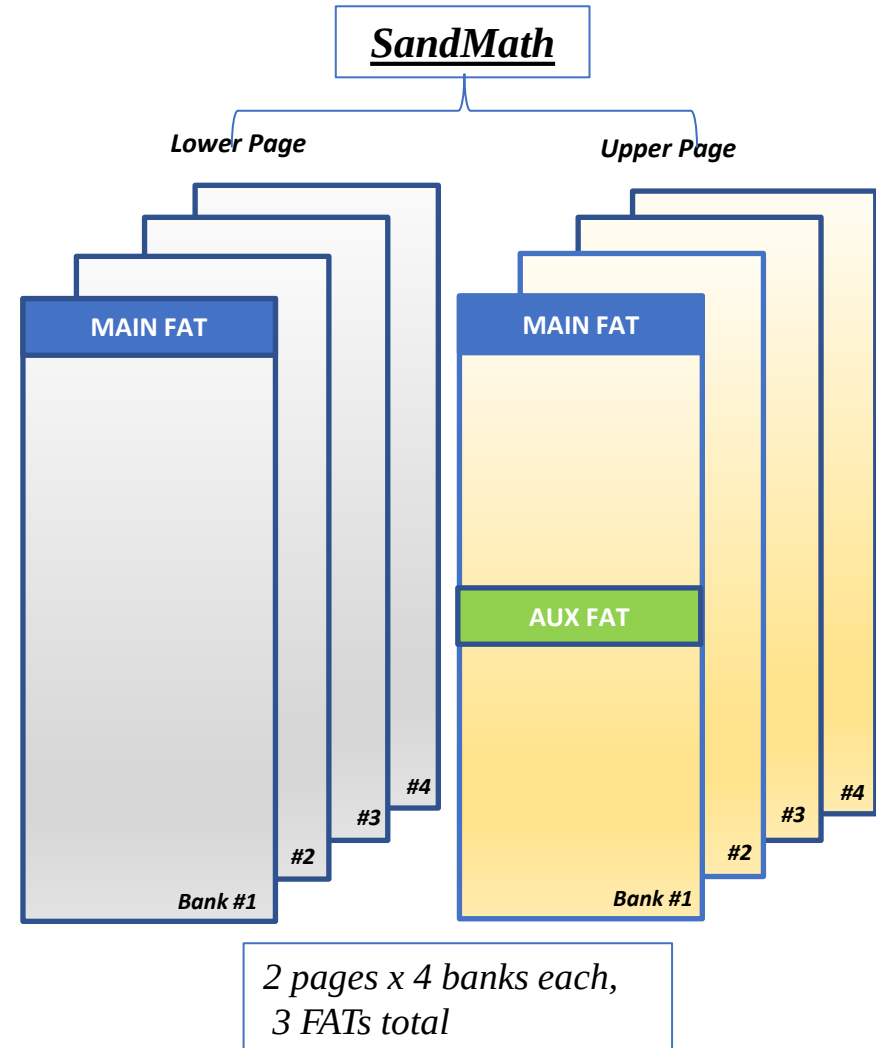
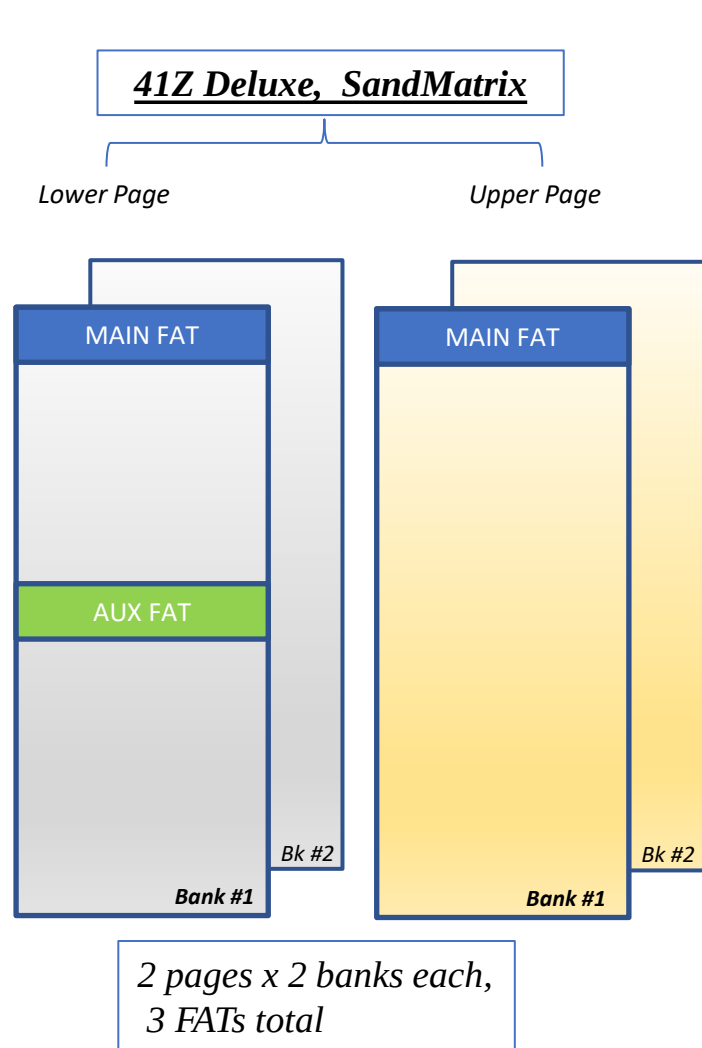


HEPAX 4H:
1x4, 3 FATs



POWER CL:
1x4, 3 FATs

Real-life Examples (2)



Advanced Modules Vital Signs

Original Advanced Modules Architectural Details						
IMDB / Module Name		XROM#	Lib#4	Sub-Fncs	Banked	SVC_IO Buffers
AEC3	AECROM	18	-	-	-	✓ -
ZENR	ZENROM	05	-	-	-	✓ -
ZEPM	ZEPROM	<nn>	-	-	✓+	? ?
HEPX	HEPAX 1D	06	-	✓	✓	- -
CCDR	CCD Module	09, 11	-	-	-	✓ #5
41AD	41 Advantage	22, 24	-	-	✓	✓ #5, #14

Buffer id#	Size	Type	Purpose
05	<= 3	Auto	Word Size – Matrix Name – Seed/RNG
06	16	Auto	Formula Evaluation (Operators & Factors)
07	6	Man	Shadow Stack Emergency Storage; RTN Stack backup
08	12	Auto	Complex Stack
09	6	Auto	LAST Function (5x Single entries) LAST 5-Functions (1x 5 entries)
11	24	Auto	16C Stack (64-bit Words)
14	14/32	Auto	Data for FROOT – FINTG

Next-Gen Advanced Modules Architectural Details							
IMDB	Module Name	XROM#	Lib#4	Sub-Fncs	Banked	SVC_IO	Buffers
16CS	16C Emulator	16	✓	✓	✓	-	#9; #11
Z4DL	41Z Deluxe	01, 04	✓	✓	✓	-	#8; #9
441Z	41Z Standard	01,04	✓	-	-	-	#8; #9
4ALP	ALPHA_44	06	✓	-	-	-	-
OSXB3	AMC_OS/X_XL	05	✓	✓	✓	✓	#5, #9
AOSX	AMC_OS/X	05	✓	-	✓	✓	#5
XPMM	CL_XMEM (Y-Regs)	20	✓	✓	-	-	#9
CRT0	Cryptography	10	✓	-	-	-	#9
EPTC	Elliptics ROM	17	✓	-	-	-	-
FRML	Formula Eval	31	✓	✓	✓	-	#6, #7, #9
HPX2	HEPAX 4H	06	✓	✓	✓	-	#9
METX	Metro Paths	30	✓	-	-	-	-
PWCL	PowerCL	12	✓	✓	✓	-	#9
PWRX	PowerCL_Extreme	12	✓	✓	✓	-	#9
4RAM	RAMPage	17	✓	-	-	-	-
SM44	SandMath	02, 03	✓	✓	✓	✓	#5; #9; #14
4MTI	SandMatrix & Vector Calc	22, 24	✓	✓	✓	-	#5; #9
SERI	Series & Sums	18	✓	-	-	-	-
4TBX	ToolBox	13	✓	-	-	-	-
TRKL	TotalRekall / DTC	21	✓	✓	-	✓	#7; #9
TRKL	TotalRekall / UMS	21	✓	-	-	✓	-
UNIT	Unit Conversion ROM	10	✓	-	-	-	-
WARP	WARP_Core	30	✓	✓	✓	✓	#7, #9
ROMX	XROM ROM	31	✓	-	-	-	-

The Last-(Sub)Function Storage

Beware of double-duty buffers !

LASTF from individual Launchers (*)

Buffer id#	Buffer Reg	Type	Used by:
09	b5	ID# or Name\$	CL-Xmem / WarpCore / GJM ROM
	b4	ID# or Name\$	SandMatrix
	b3	ID# or Name\$	SandMath
	b2	ID# or Name\$	PowerCL / AMC_OS/X
	b1	ID# or Name\$	41Z Deluxe / 16C Emulator
	b0	ID#	Header – Standard 41Z Module

(*) See tables in next slides

Shadow Stack / Evaluation Vars

Buffer id#	Buffer Reg	Type	Used for:
07	b5	BCD value	L-Reg / “e”
	b4	BCD value	T-Reg / “d”
	b3	BCD value	Z-Reg / “c”
	b2	BCD value	Y-Reg / “b”
	b1	BCD value	X-Reg / “a”
	b0	admin	Header

LAST5 from XEQ+ / XEQ\$ -- “LIFO”

Buffer id#	Buffer Reg	Type	Used for:
09	b5	ID# & addr	Fifth function
	b4	ID# & addr	Fourth function
	b3	ID# & addr	Third function
	b2	ID# & addr	Second function
	b1	ID# & addr	First function
	b0	admin	Header

Emergency Storage – RTN Stack

Buffer id#	Buffer Reg	Type	Used for:
07	b5	bR5 value	-
	b4	bR4 value	-
	b3	bR3 value	-
	b2	bR2 value	reg 10(a)
	b1	bR1 value	reg 11(b)
	b0	SEL# pointer	-

Loading up the I/O Bus

- EEE I/O Bus layout w/ multiple banks

Block	Addresses		
F	F000-FFFF	Port 4, upper	
E	E000-EFFF	Port 4, lower	
D	D000-DFFF	Port 3, upper	
C	C000-CFFF	Port 3, lower	
B	B000-BFFF	Port 2, upper	
A	A000-AFFF	Port 2, lower	
9	9000-9FFF	Port 1, upper	
8	8000-8FFF	Port 1, lower	
7	7000-7FFF	HP-IL module	
6	6F00-6FFF	Printer	IR printer
5	5000-5FFF	TIME	CX system
4	4000-4FFF	Take-over ROM	
3	3000-3FFF	Unused/CX	
2	2000-2FFF	System ROM 2	
1	1000-1FFF	System ROM 1	
0	0000-0FFF	System ROM 0	
		Primary bank	Secondary bank

- Standard I/O Bus layout

Port	Page	Addresses	Primary Bank	Secondary Bank	Bank #3	Bank #4	Comments
4	F	FFFF	HP-16C Emulator	HP-16C Emulator	HP-16C Emulator	HP-16C Emulator	2 FATs
		F000					
	E	EFFF	HEPAX_1G- b1	HEPAX_1G- b2	HEPAX_1G- b3	HEPAX_1G- b4	3 FATs
		E000					
3	D	DFFF	ADV Matrix - B1	ADV Matrix - B2			
		D000					
	C	CFFF	SandMatrix - B1	Vector Calc- B2			2 FATs
		C000					
2	B	BFFF	HL_Math - B1	HL_Math - B2	Solve & Integ	AEC PROG	2 FATs
		B000					
	A	AFFF	SandMath - B1	SandMath - B2	GM Solvers / TVM	Deriv, Means, etc.	
		A000					
1	9	9FFF	PWERXT-B1	PWERXT-B2	PWERXT-B3	PWERXT-B4	3 FATs
		9000					
	8	8FFF	YFNX_2B	YMM_1C			
		8000					
hpil	7	7FFF	AMCOSX-4	AMCOSX4 - B2	AEC PROG	HEXED /DSM	
		7000					
	6	6FFF	PRINTER	IR Printer - B2			
		6000					
	5	5FFF	TIMER	CX FNS - Bank 2			
		5000					
	4	4FFF	Library #4	CL Y-Library			
		4000					
	3	3FFF	CX FNS- Bank 1				
		3000					
	2	2FFF	OS - ROM 2				
		2000					
	1	1FFF	OS - ROM 1				
		1000					
	0	0FFF	OS - ROM 0				
		0000					

State-of-the-Art: 16+24 pages = 160 kB
Standard OS Limit: 18 + 30 pg. = 192 kB
Theoretical Limit: 4 x 16 pgs. = 256 kB

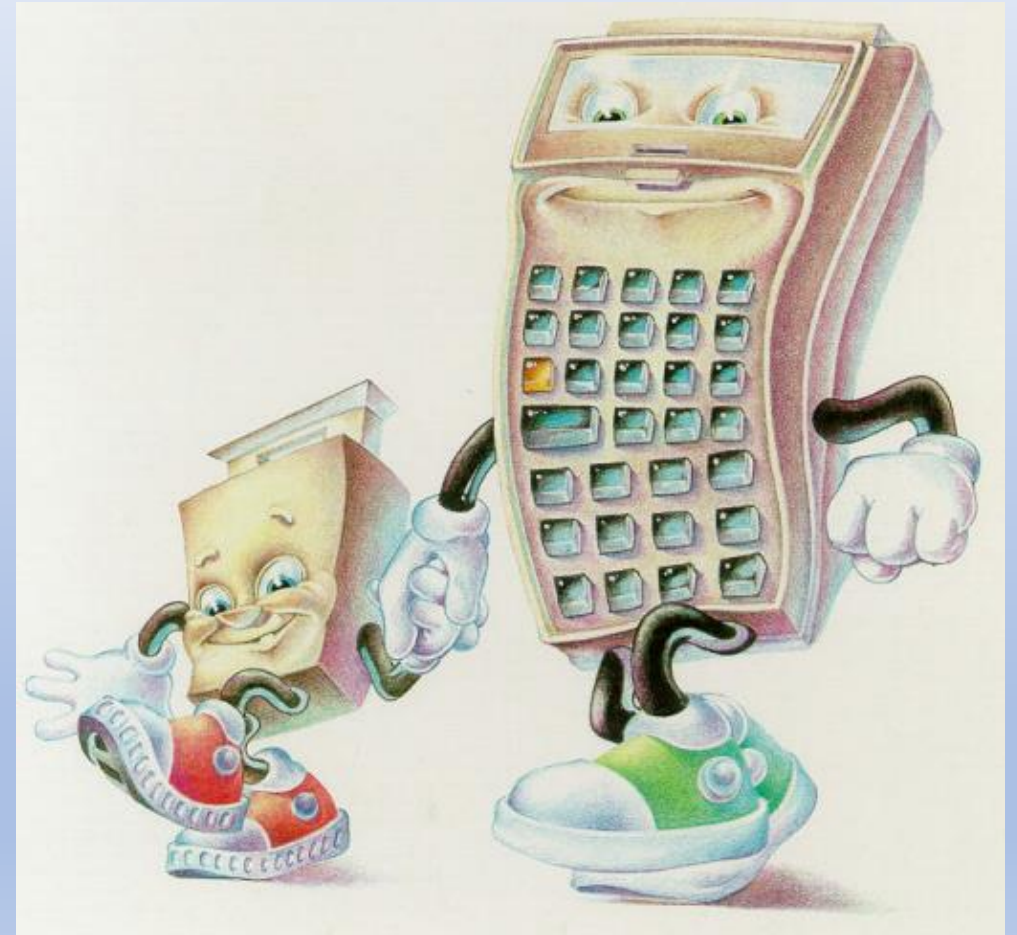
Power User Modules

AMC_OS/X

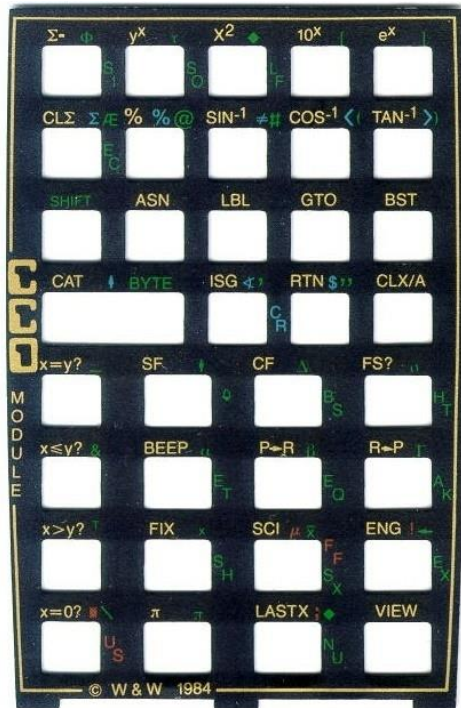
RAMPage & ToolBox

ALPHA ROM

XROM ROM



W&W SOFTWARE PRODUCTS GMBH



File type	CAT'4 Mnemonic	File Type Id#
Program	"P"	01
Data	"D"	02
ASCII	"A"	03
Matrix	"M"	04
Buffers	"B"	05
Key Assignments	"K"	06
Status Registers	"T"	07
Complex Stack	"Z"	08
LIFO Stack	"L"	09
FORTH code	"F"	10
HEPAX Data	"H"	11

- Special Char\$ Keyboard

- 
- PG# ADDR: HEX
USER
- PG# ADDR: 000
USER
- 05 CC-00: 000
USER
- 05 CC-00: 000
USER

AMC_OS/X Highlights (Con't)

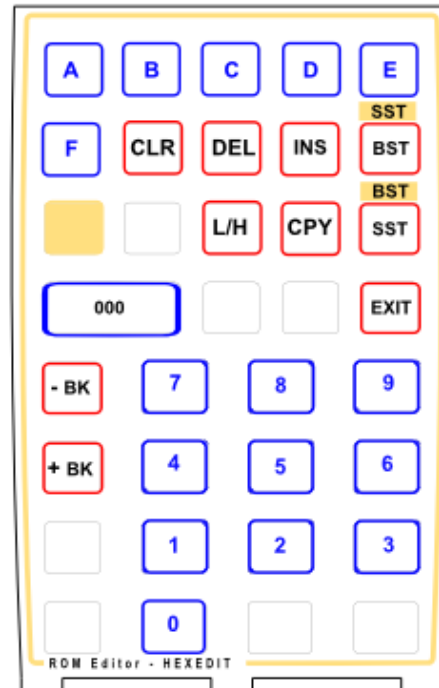


- AECROM's Program Generator
- HEPAX' Disassembler & HEXEDIT
- Håkan's RAM Editor
- Read/Write XMem to IL-Drive
- Buffer Catalog (w/ View & Deletion)
- 22 Sub-functions & LastF support

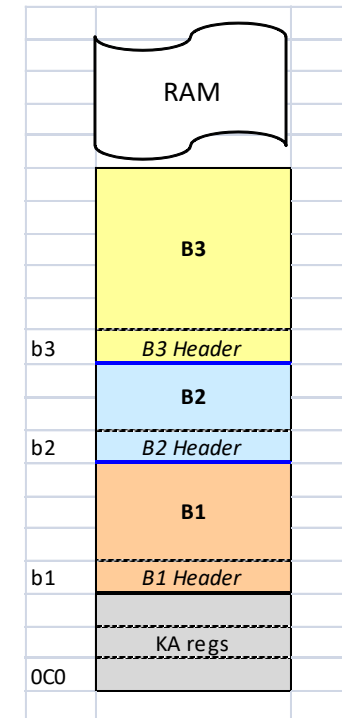
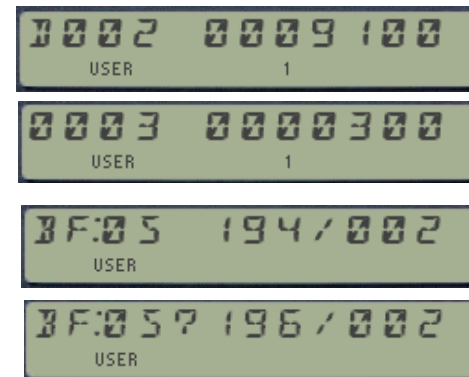
Module	Launchers	Fnc. Id#	LASTF Method
AMC_OS/X Revision XL	-CAT1	n/a	
	XQS _	A1:52	Captures (sub)fnc NAME
	XQ# _ _ _	A1:51	Captures (sub)fnc id#
	CAT+ (XEQ')	#017	Captures (sub)fnc id#



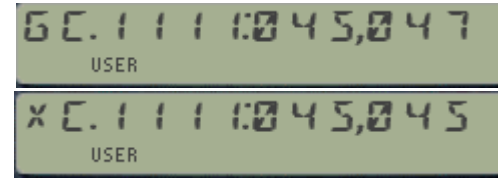
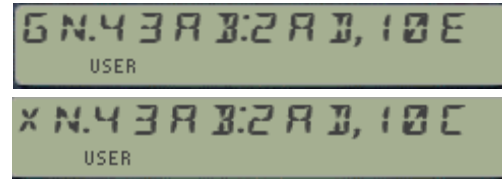
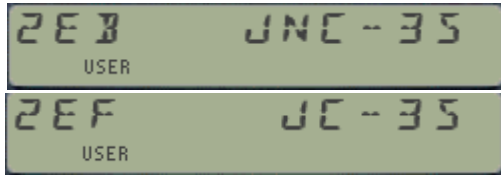
ROMED - Wrom



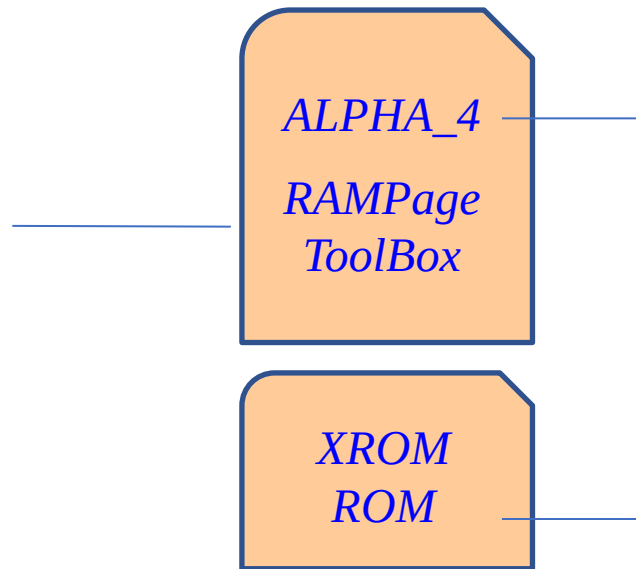
HEXEDIT - Hepax



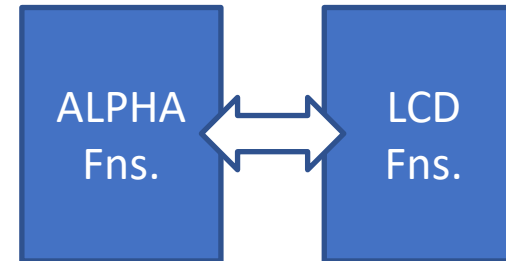
Other Utility Modules



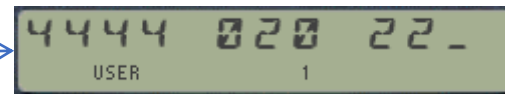
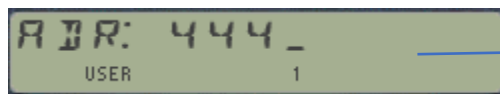
- Buffer Management Fns.
- X-Mem Management Fns.
- Hacker's Lab
- Jump's Calculator
- GOSUB/GOTO Decoder
- BCDBIN, BINBCD
- Håkan's RAMEdit
- ZENROM's RAMEd
- BLDROM's ROMEd
- VASM <> HEX Decoder



- ALPHA Utilities Galore
- "Dr. Jekyll's & Mr. Hyde" FAT



- Byte Jumpers
- Direct Byte Loading
- Multi-Digit Prompts
- HEX <> XROM
- Other (Weird & Obscure)



RAMEdit - GetKey



ROMEd - Wrom

XROM NO.=6	ROM ID number
42 FUNCTIONS	number of functions
FCT: -ALPHA 44	XROM 06,00
FCT: ALENG?	XROM 06,01
FCT: ALENGX	XROM 06,02
FCT: ALENGXY	XROM 06,03
FCT: ANUMI	XROM 06,04
FCT: ANUMDEL	XROM 06,05
FCT: ARCLCHR	XROM 06,06
FCT: AREV	XROM 06,07
FCT: AROTX	XROM 06,08
FCT: ASCII	XROM 06,09
FCT: ASHFX	XROM 06,10
FCT: ASTOXX	XROM 06,11
FCT: ASUB	XROM 06,12
FCT: ASWAP	XROM 06,13
FCT: AXEQ?	XROM 06,14
FCT: CLA?	XROM 06,15
FCT: CLAC	XROM 06,16
FCT: LADEL	XROM 06,17
FCT: LADELX	XROM 06,18
FCT: LATOX	XROM 06,19
FCT: LEFT\$	XROM 06,20
FCT: LOW\$	XROM 06,21
FCT: MID\$	XROM 06,22
FCT: PMTA	XROM 06,23
FCT: POSAX	XROM 06,24
FCT: POSTFX	XROM 06,25
FCT: POSTSP	XROM 06,26
FCT: PREFX	XROM 06,27
FCT: PRESP	XROM 06,28
FCT: RADEL	XROM 06,29
FCT: RATOX	XROM 06,30
FCT: REMZER	XROM 06,31
FCT: RIGHT\$	XROM 06,32
FCT: TOGLC	XROM 06,33
FCT: UPR\$	XROM 06,34
FCT: XATOX	XROM 06,35
FCT: XTOAI	XROM 06,36
FCT: XTOAL	XROM 06,37
FCT: XTOAR	XROM 06,38
FCT: YTOAX	XROM 06,39
FCT: MRHYDE	XROM 06,40
End of FAT	

Dr. Jekyll & Mr. Hyde

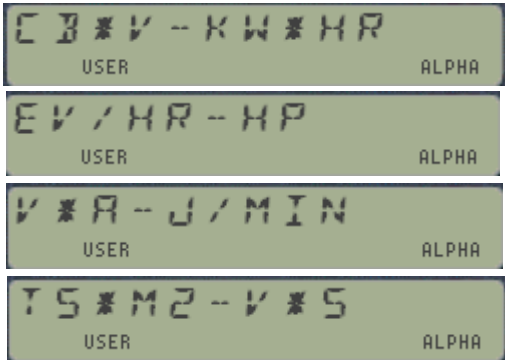
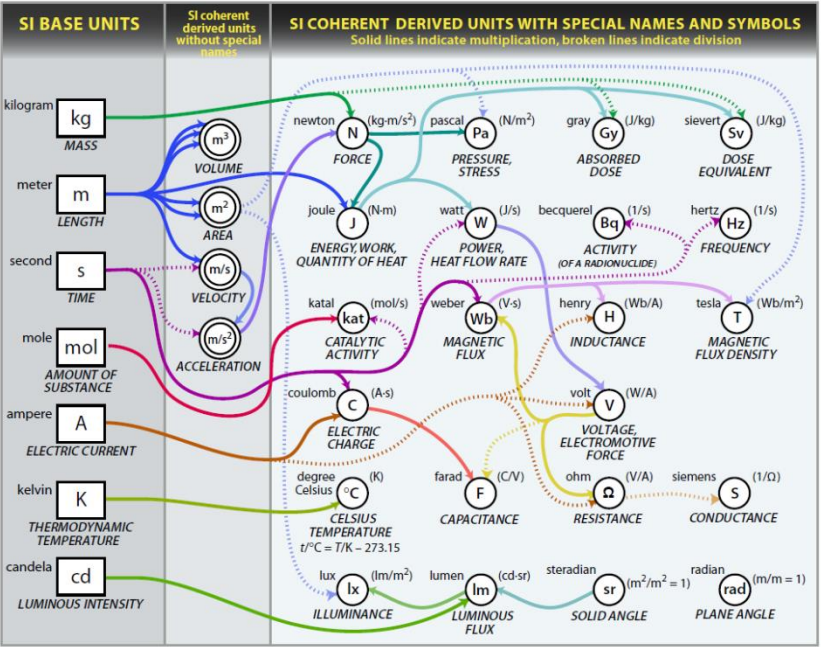
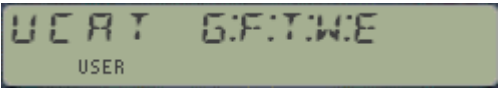
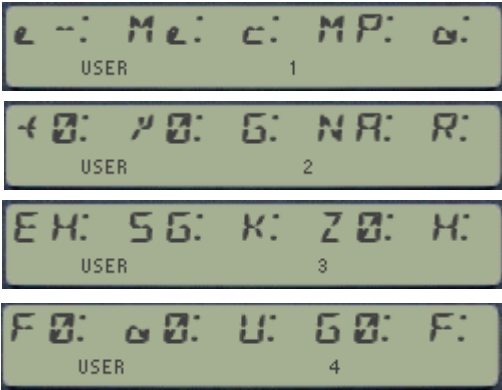
Header	A05C	08C	"L"	
Header	A05D	019	"Y"	
Header	A05E	00B	"K"	
Header	A05F	005	"E"	
Header	A060	00A	"J"	
Header	A061	004	"D"	
DJEKYL	A062	35D	PNC XQ	Refresh C[3,6]
	A063	000	-->00D7	PCTOC
	A064	09C	PT= 5	
	A065	04A	C=0 R<-	clear rest of ADR field
	A066	0FA	C<>B M	Write-To adr in B[M]
	A067	0DA	C=B M	keep it in C[ADR]
	A068	3D0	LD@PT- F	
	A069	090	LD@PT- 2	"pF29"
	A06A	250	LD@PT- 9	address of FAT-B table
	A06B	083	JNC +16d	
Header	A06C	085	"E"	
Header	A06D	004	"D"	
Header	A06E	019	"Y"	
Header	A06F	008	"H"	
Header	A070	012	"R"	
Header	A071	00D	"M"	
MRHYDE	A072	35D	PNC XQ	Refresh C[3,6]
	A073	000	-->00D7	PCTOC
	A074	09C	PT= 5	
	A075	04A	C=0 R<-	clear rest of ADR field
	A076	0FA	C<>B M	Write-To adr
	A077	0DA	C=B M	keep it in C[ADR]
	A078	390	LD@PT- E	
	A079	390	LD@PT- E	"pEE8"
	A07A	210	LD@PT- 8	address of FAT-A table
	A07B	330	FETCH S&X	read source word
	A07C	0FA	C<>B M	swap addresses
	A07D	040	WROM	write word to target
	A07E	23A	C=C+1 M	increase target adr
	A07F	0FA	C<>B M	recall source adr
	A080	23A	C=C+1 M	increase source adr
	A081	2F6	?C#0 XS	end of table?
	A082	3CB	JNC -07	no, loop back
	A083	3E0	RTN	yes, done.

XROM NO.=6	ROM ID number
30 FUNCTIONS	number of functions
FCT: -DISPLAY	XROM 06,00
FCT: aVIEW	XROM 06,01
FCT: CHRSET	XROM 06,02
FCT: DCNT	XROM 06,03
FCT: DCNT?	XROM 06,04
FCT: DCNT+	XROM 06,05
FCT: DCNT-	XROM 06,06
FCT: DISPLAY	XROM 06,07
FCT: DSP?	XROM 06,08
FCT: DTEST	XROM 06,09
FCT: DTOA	XROM 06,10
FCT: VIEWA	XROM 06,11
FCT: ZAVIEW	XROM 06,12
FCT: -ALPHA RG	XROM 06,13
FCT: A<>RG	XROM 06,14
FCT: A<>ST	XROM 06,15
FCT: A>RG	XROM 06,16
FCT: A>ST	XROM 06,17
FCT: AINT	XROM 06,18
FCT: ARCIP	XROM 06,19
FCT: M<>N	XROM 06,20
FCT: M<>O	XROM 06,21
FCT: M<>P	XROM 06,22
FCT: N<>O	XROM 06,23
FCT: N<>P	XROM 06,24
FCT: O<>P	XROM 06,25
FCT: RG>A	XROM 06,26
FCT: ST>A	XROM 06,27
FCT: DJEKYL	XROM 06,28
End of FAT	

Enhanced Unit Management System (UMS+)

- Adds two more base Dimensions (primes!)
- Adds 12 Electricity & Light Magnitudes
- Adds 29 new units to the Tables
- Features Unit Catalog(s) (by groups)
- New 20-Constant Library (values & units!)
- INPUT/OPUTPUT Routines

HP's UMS+
w/ KLIB, UCAT

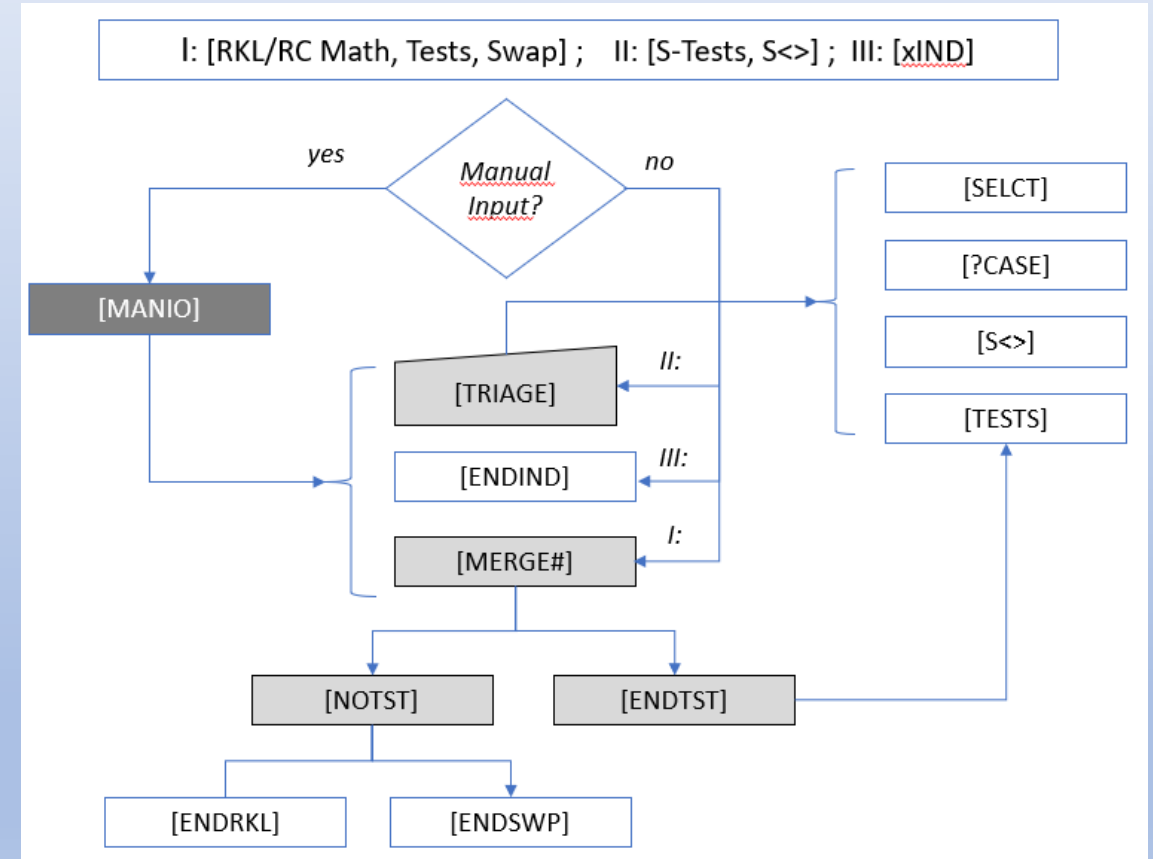
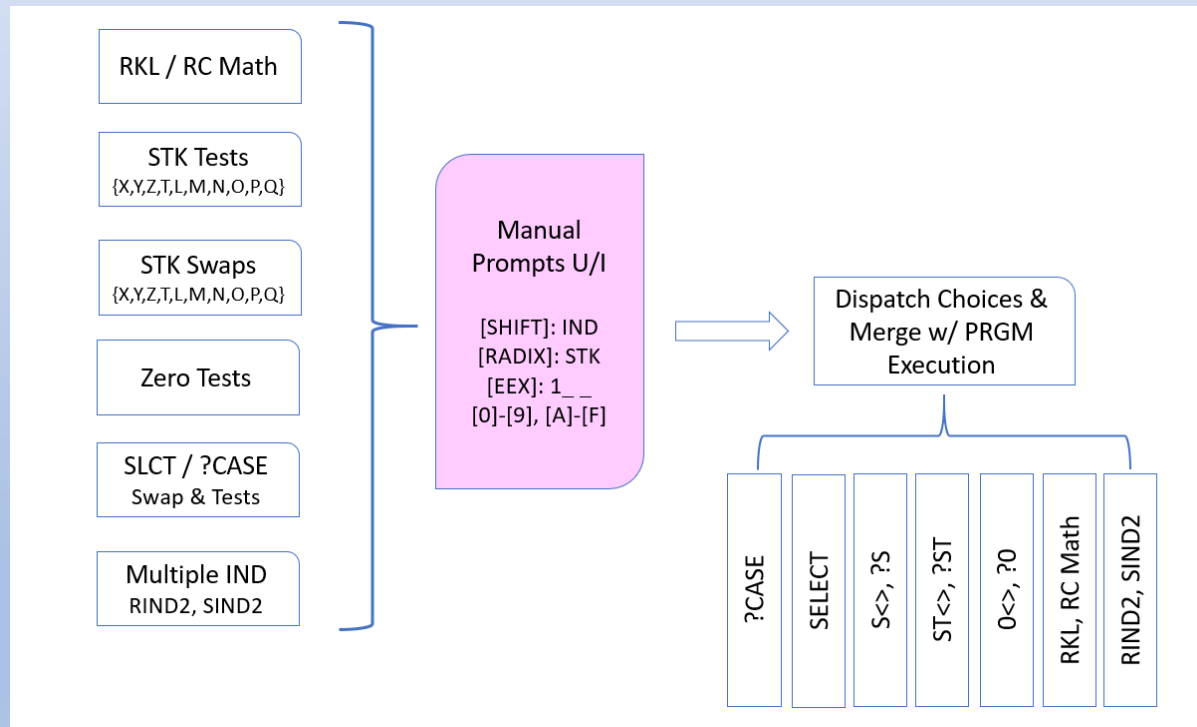


#	Name	Description	Value	Units
1	e-	Electron Charge	-1,6021764 E-19	CB
2	Me	Electron Mass	9,1093821 E-31	KG
3	c	Speed of Light	2,9979245 E 08	M/S
4	MP	Proton's Mass	1,6726216 E-27	KG
5	a	Free-fall Acceleration	9,8066500 E 00	M/S2
6	e0	Vacuum Permittivity	8,8541878 E-12	FD/M
7	u0	Vacuum Permeability	1,2566370 E-06	N/A2
8	G	Gravity Constant	6,6742800 E-11	N*M2/KG
9	NA	Avogadro's Number	6,0221417 E 23	1/MOL
10	R	Gas Constant	8,314472150	J/K*MOL
11	EH	Hartree Energy	4,359748226 E-18	J
12	SG	Stefan-Boltzmann	5,6705119 E-8	W/M2*K4
13	K	Boltzmann's Constant	1,3806504 E-23	J/K
14	ZO	vacuum impedance	376,7303134	OHM
15	H	Planck's h constant	6,6260689 E-34	J*S
16	FO	magnetic flux quantum	2,0678336-15	WB
17	a0	Bohr Radius	5,2917720-11	M
18	U	atomic mass unit	1,6605387-27	KG
19	GO	conductance quantum	77,480916-06	1/OHM
20	F	Faraday constant	96.485,34	CB/MOL

WARP_Core Module

Dare 2 Compare

Total_Rekall



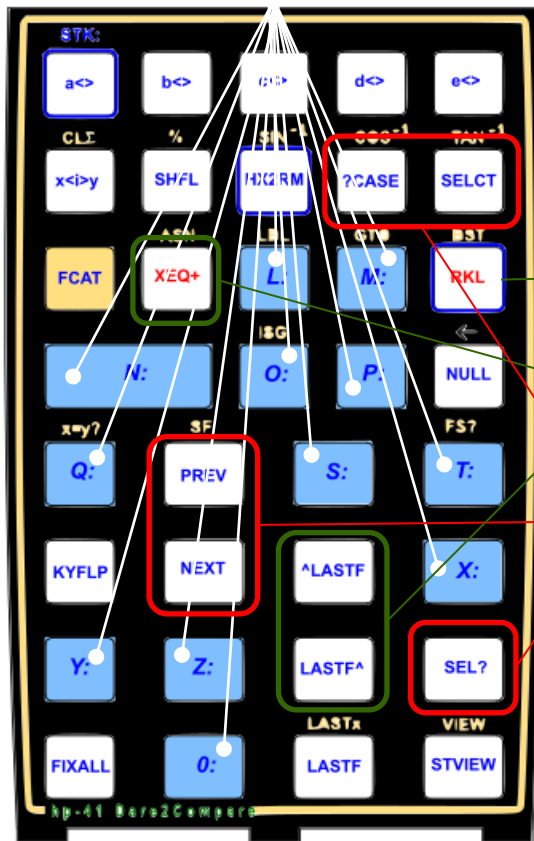
The “Total Rekall” Schema

REV: 18,08,2018
USER 1

<https://www.imdb.com/title/tt0159920/>

- Round about and back throughout...
- RCL Math (not using IO_SVC polling point)
- 92 Sub-functions & LastF support

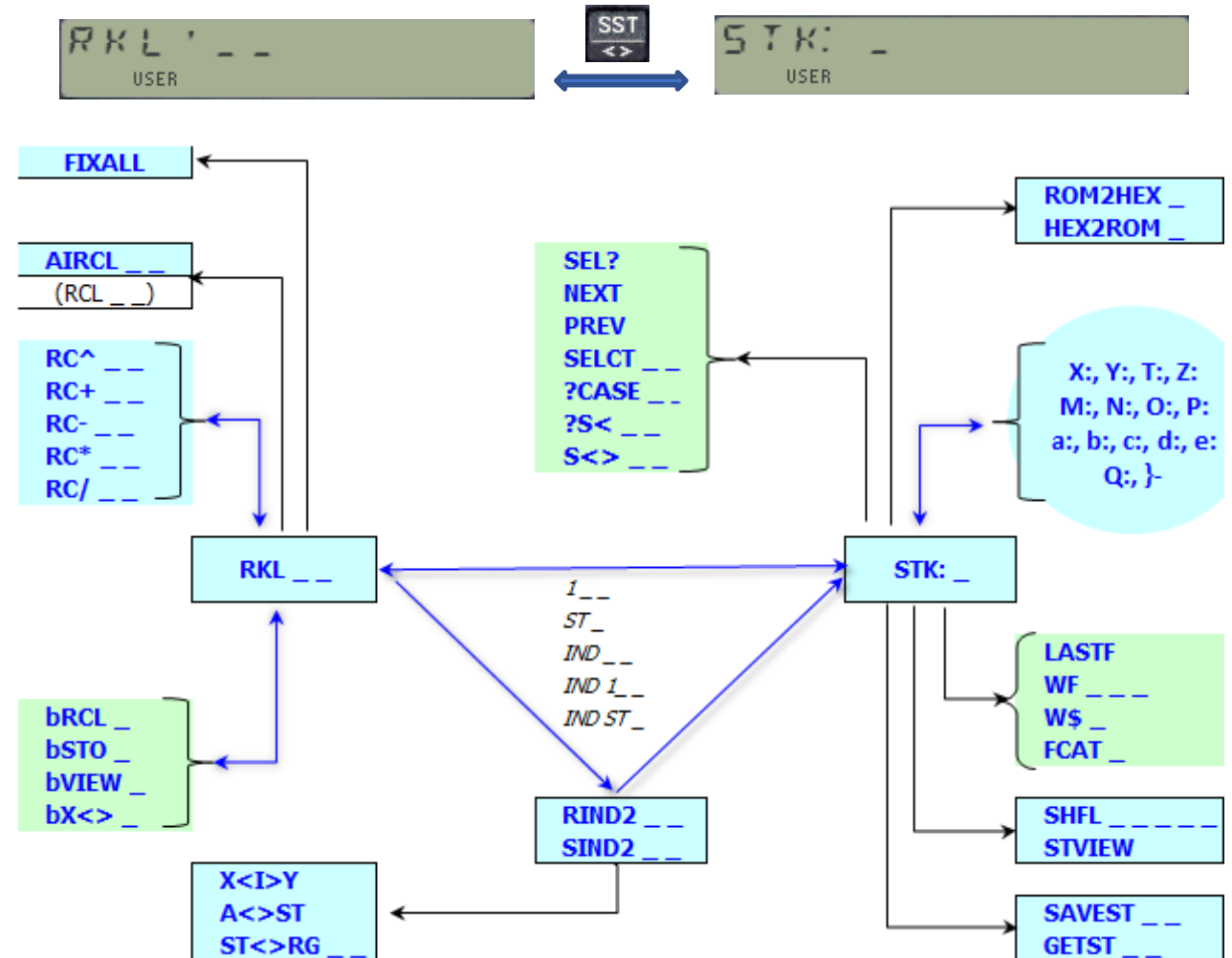
-STK_Tests Launcher



Rekall Math

AutoComplete

Select/Case



Two Decoder Ring(s)

- TRK / DTC functionality

RCL Math (includes RC^)

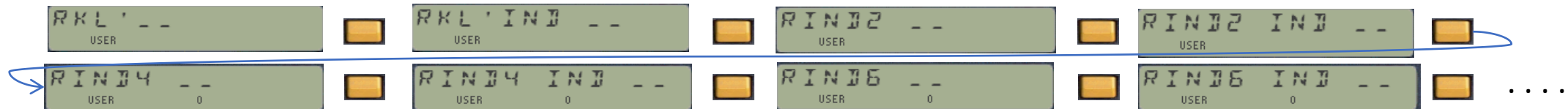
SLCT Variable for integer CASE?

Square² IND (X<I>Y, ?S# IND __)

Multiple IND (RIND/SIND) – up to 10 levels

Register	Exchange	Tests
X	Main	Main
Y	Main	Main
Z	Main	Main
T	Main	Main
L	Main	Main
M	Main	Sub-fcn
N	Main	Sub-fcn
O	Main	Sub-fcn
P	Main	Sub-fcn

Register	Exchange	Tests
Q	Main	Sub-fcn
I-	Sub-fcn	Indirect
a	Sub-fcn	Indirect
b	Sub-fcn	Indirect
c	Sub-fcn	Indirect
d	Sub-fcn	Indirect
e	Sub-fcn	Indirect
"0"	n/a	Main
Rnn	Main	Indirect



- Register Index Mapping

Arguments above "99" (dec)

Partially occupied by STK regs

Falls into IND scheme over "127"

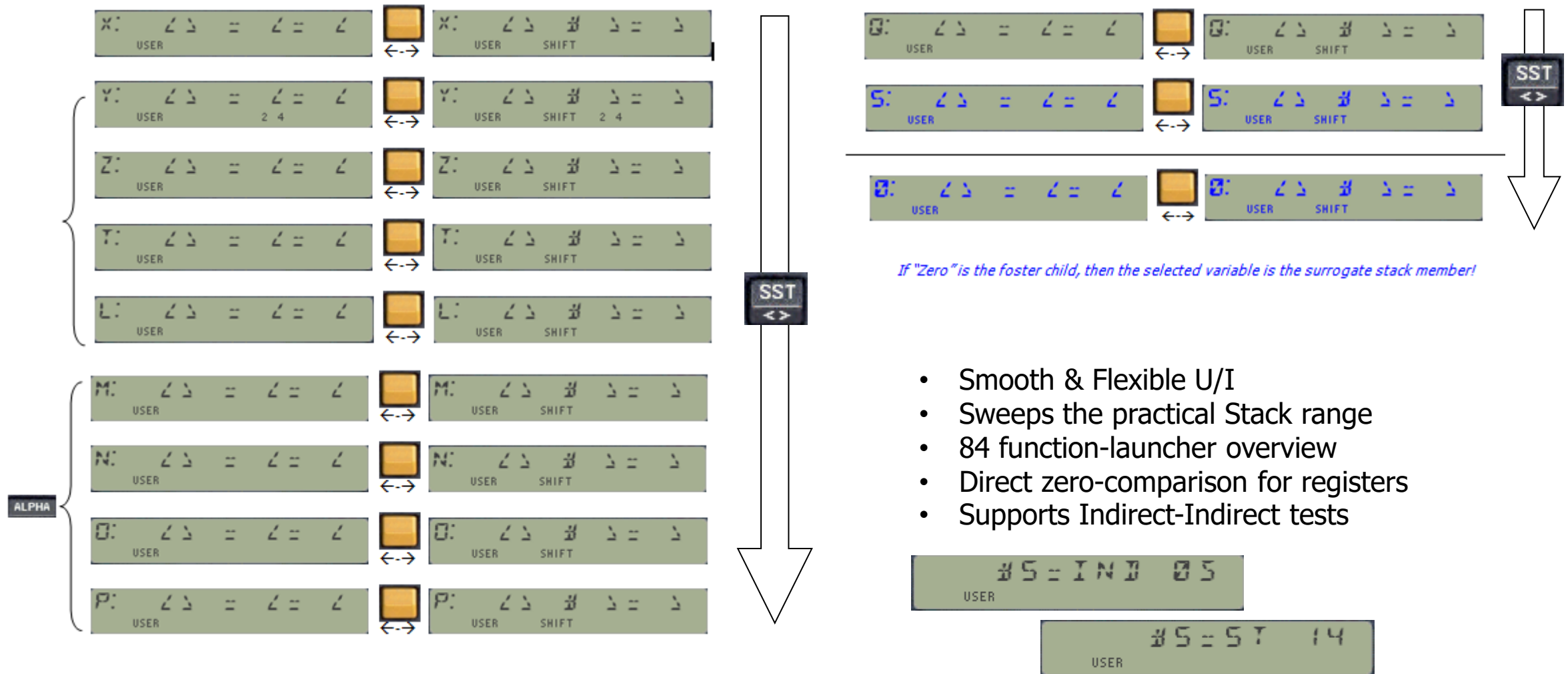
Warps around over "199" (IND 71)

Argument	Shown as:
100	00
101	01
102	A
103	B
104	C
105	D
106	E
107	F
108	G
109	H
110	I
111	J

Argument	Shown as:
112	T
113	Z
114	Y
115	X
116	L
117	M
118	N
119	O
120	P
121	Q
122	I-
123	a

Argument	Shown as:
124	b
125	c
126	d
127	e
128	IND 00
129	IND 01
130	IND 02
131	IND 03
132	IND 04
133	IND 05
134	IND 06
135	IND 07

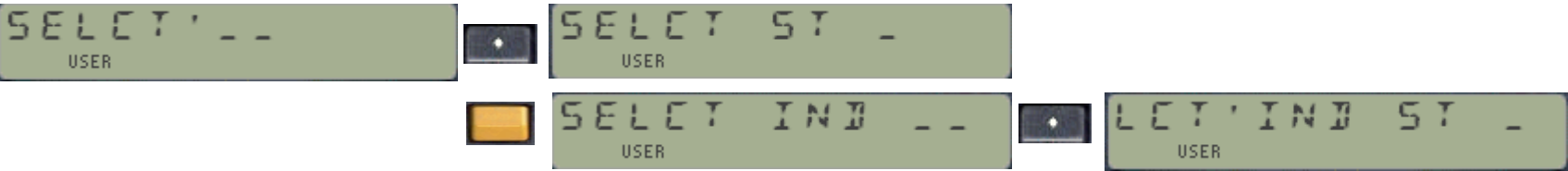
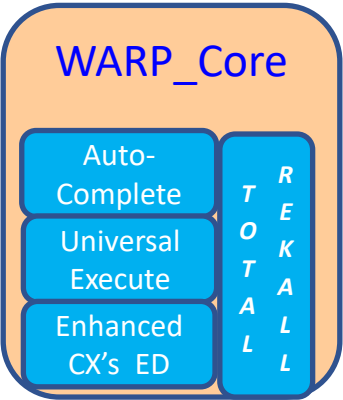
Dare to Compare Interconnectivity



SELECT your Weapon !

The Many ways to skin this cat

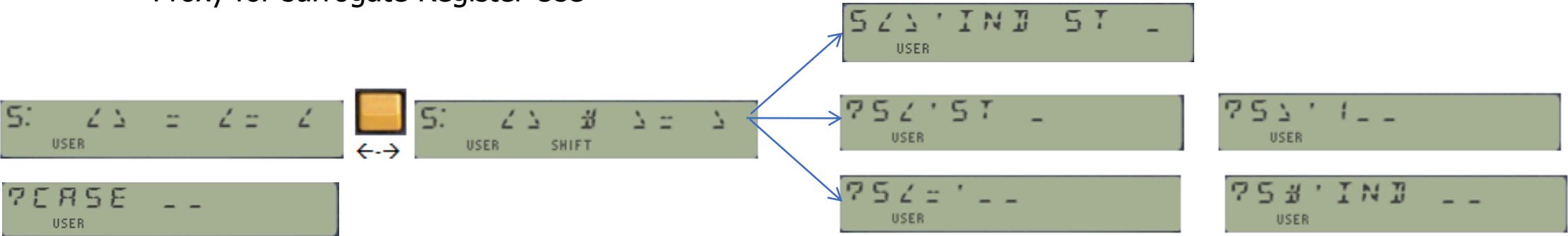
- 1. ready (Define)...
- 2. aim (Store, Recall, Swap)...
- 3. fire (Compare)!



- Wildcard variable selection & management

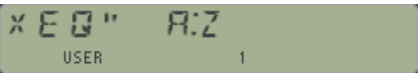


- Interwoven functional areas
- Proxy for surrogate Register Use



Auto-Complete XEQ+ (a.k.a Bus Navigator)

Auto-Complete



PRGM

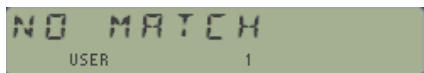
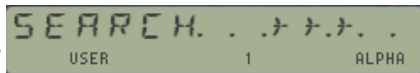


Native's XEQ

ALPHA

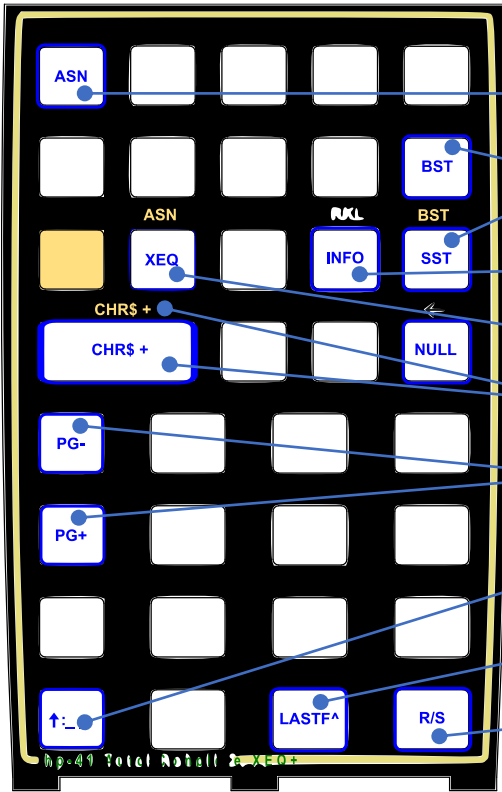


Universal Execute



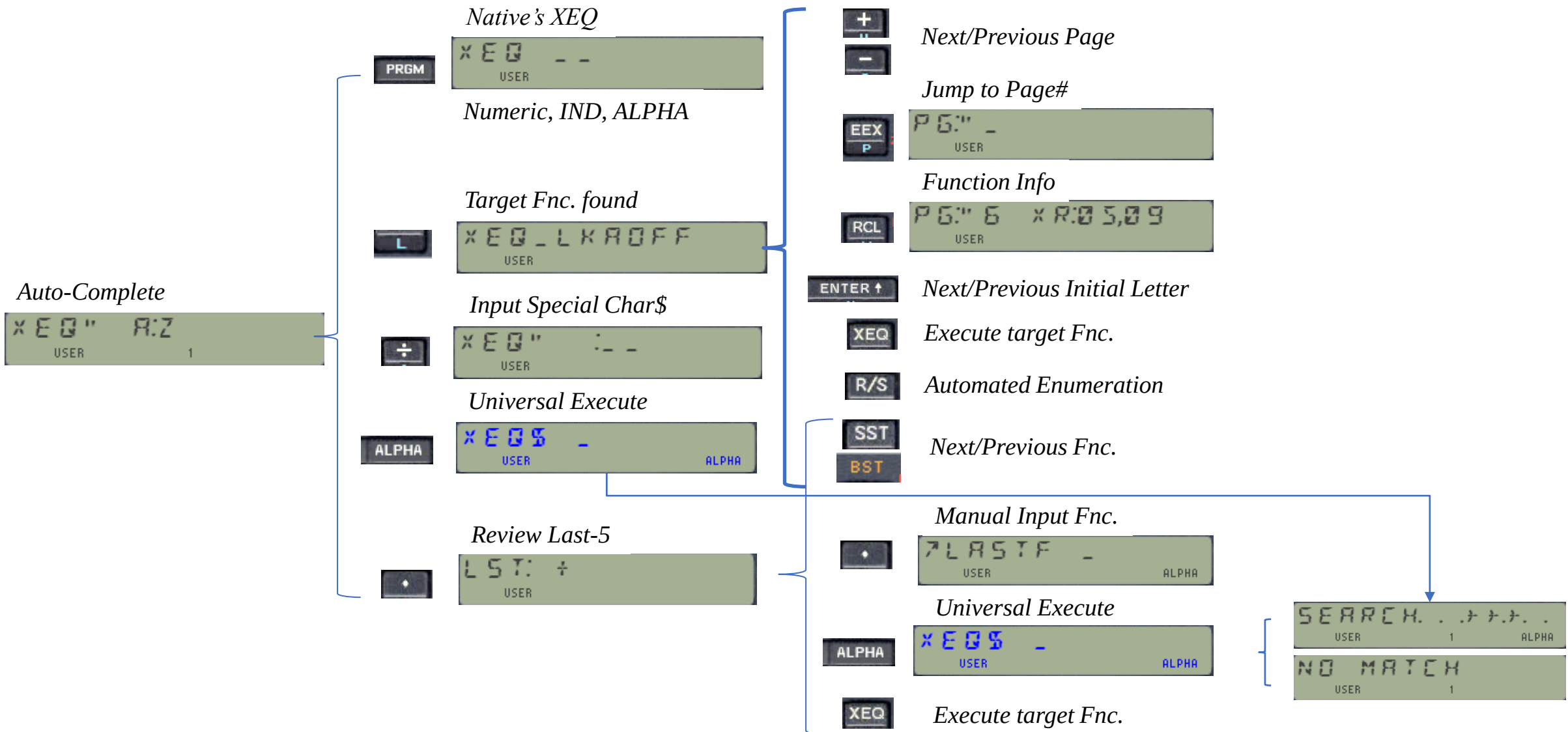
Module	Launchers	LASTF Method
Dare2Compare	-STKT _	Captures (sub)fnc id#
	RKL _	Captures (sub)fnc id#
	WF\$ _	Captures fnc NAME
	WF# _	Captures (sub)fnc id#
	CAT+ (XEQ')	Captures (sub)fnc id#

- WARP_Core Launchers & LastF



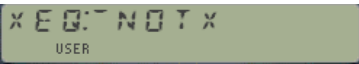
- Assign Main Fnc
- Next / Previous Func.
- Show Info
- Execute (Sub)Function
- Next / Previous Character
- Next / previous Page
- Custom Char\$ _ _
- Last5 Funs.
- Auto Enumeration !

Module	Aux/Banked FAT Location	Launchers	# Sub-Fncts
41Z Deluxe	Middle of Lower page	ZF\$, ZF#	62
AMC_OS/X	Middle of page	XF\$, XF#	22
CL X-Mem Manager	Middle of page	YF\$, YF#	22
Formula Evaluation	Middle of page	SF\$, SF#	24
GJM ROM	Middle of page	GJM\$, GJM#	24
HEPAX_4H	Top of Bank-3, Middle of bank-3	HEPX\$, XF#, XF\$	21 + 25
HP-16C Emulator	Middle of page	16\$, 16#	62
PowerCL Extreme	Top of Bank-3, Top of bank-4	XQ1\$, XQ2\$	89 + 89
SandMath 4x4	Middle of Upper page	ΣF\$, ΣF#	117
SandMatrix	Middle of Lower page	ΣM\$, ΣM#	63
WARP_Core	Middle of page	WF\$, WF#	92
Entire System	Indistinct	XEQ\$	688



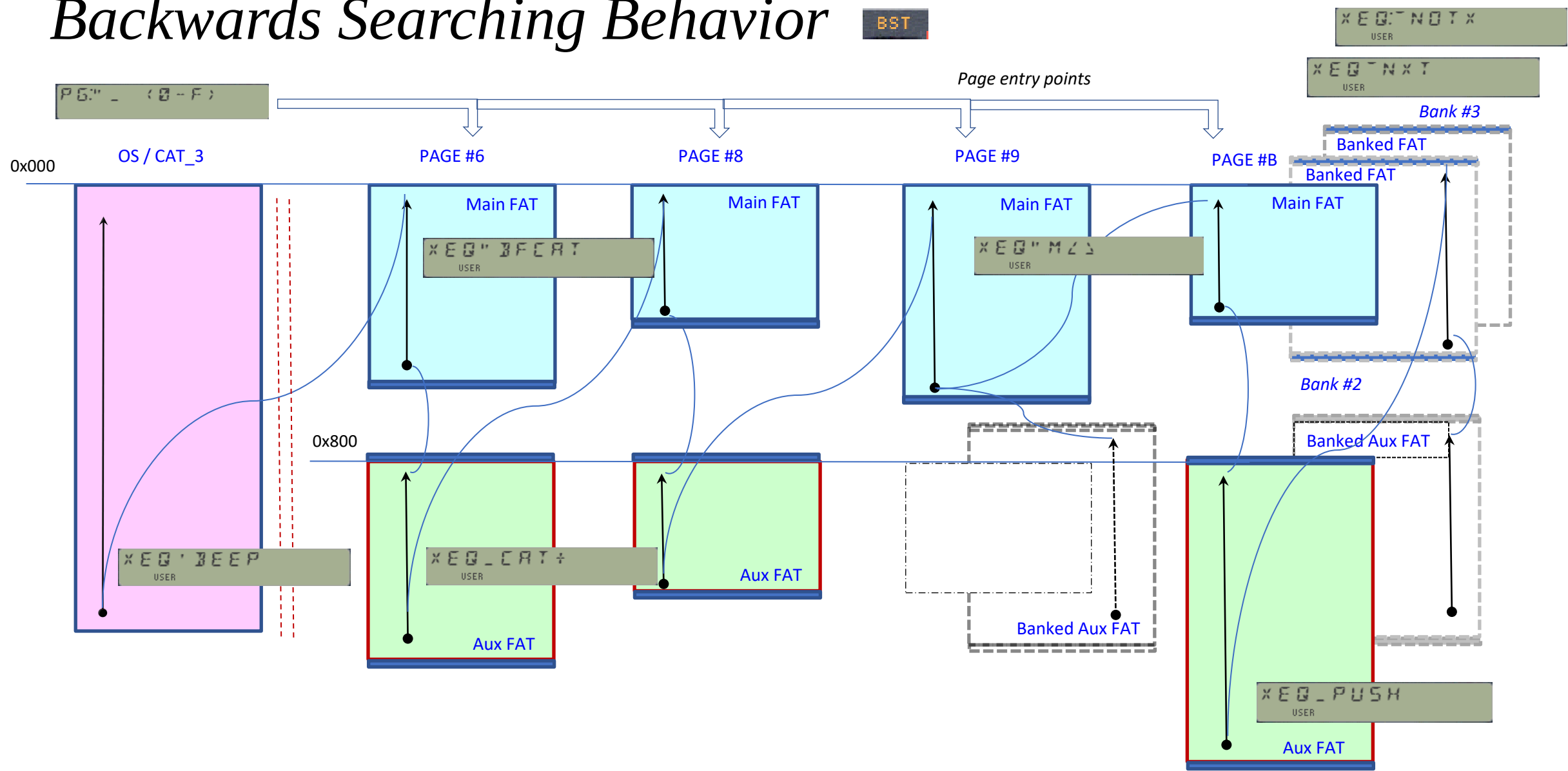
XEQ+ Navigation

SST / R/S



Backwards Searching Behavior

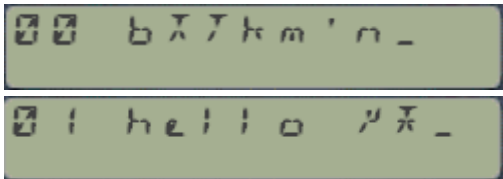
BST



Other Noteworthy WARP Components

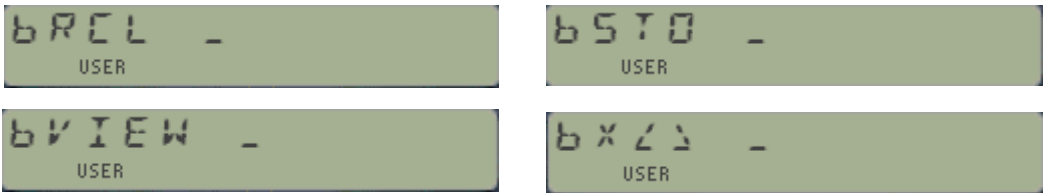
Enhanced CX's ED+ (ASCII Files)

- Adds Lower-Case and Special Character support
- ALPHA key toggles standard <> enhanced modes
- LCD Readable Lower-Case requires Half-Nut display
- Fully utilized by the XM Scripts in the Formula-Eval Module & Equation Libs.



Shadow Buffer Registers Storage

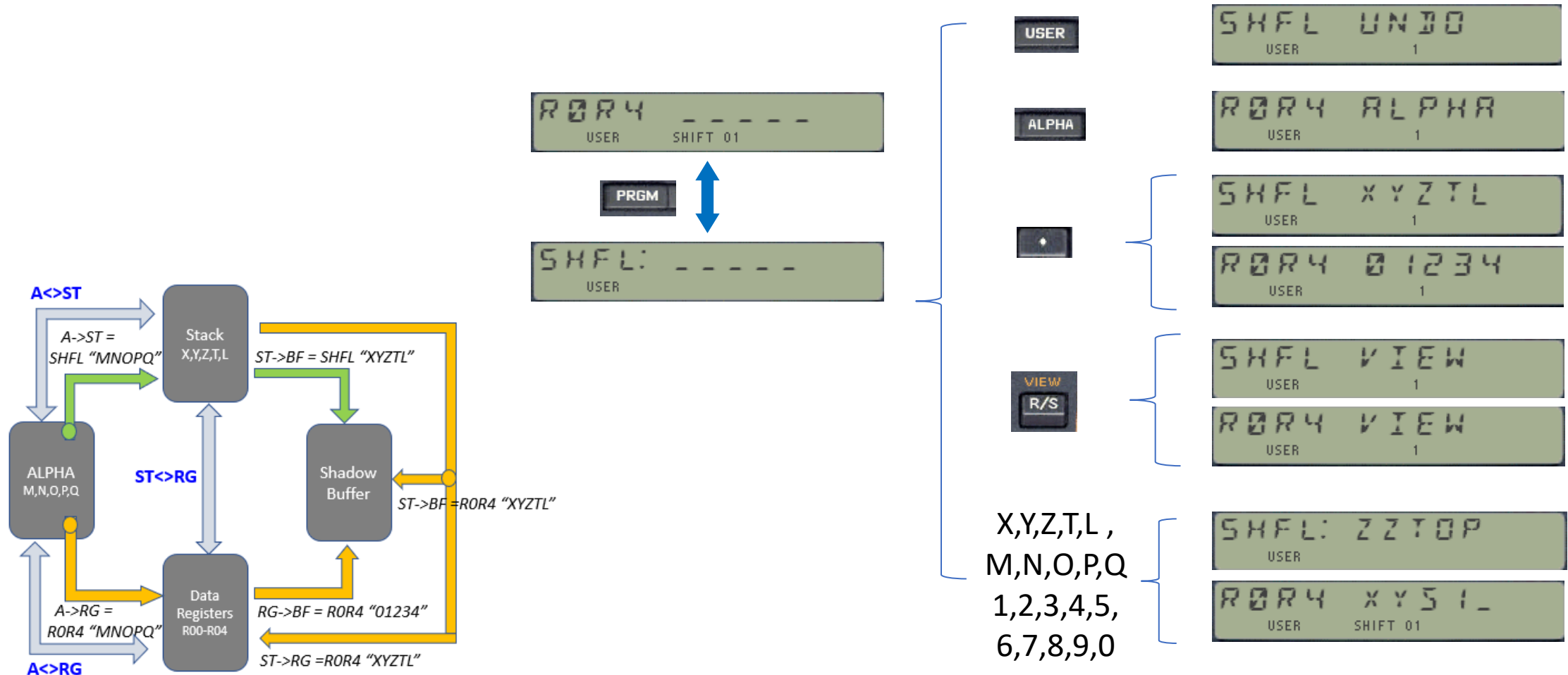
- Holds Custom Variables in Formula-Eval ROM
- Holds Stack Registers for Shuffle functionality
- Provides Back-up for RTN Stack addresses
- Proxy shortcut for SElected variable (bR0)



Register #	Storage	RTN Stack	Shadow Stack	Eval\$ Vars
fifth	bR5	-	Shadow-X	e
fourth:	bR4	-	Shadow-Y	d
third:	bR3	-	Shadow-Z	c
second:	bR3	reg 10(a)	Shadow-T	b
first:	bR1	reg 11(b)	Shadow-L	a
header:	SEL# pointer	-	-	

Shuffle Away !

Sorting, Editing and Review for Stack and {R0-R4} Data Registers



Interrogating the I/O Bus

- System Bus Conflict Check "CHKSYS" automated upon "CALC_ON" event
- Wholesale: I/O Bus Summary PGCAT, ROMLST
- Detail: Free, Used, Banked Report FREE? , USED? , BANKED?, OSREV
- Targeted: Auxiliary FATS anywhere? AUXFAT , SFLNCH _

CONFIG OK
USER

DUP XROM 05
USER

CONFIG BAD
USER

25:35:26:05:12:15
USER

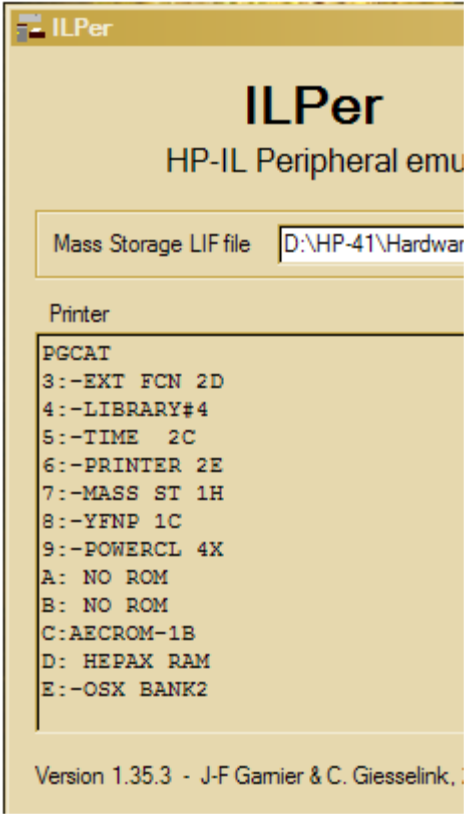
ROM 0:N 1:F 2:L
USER

9:A
USER

SFLNCH _
USER

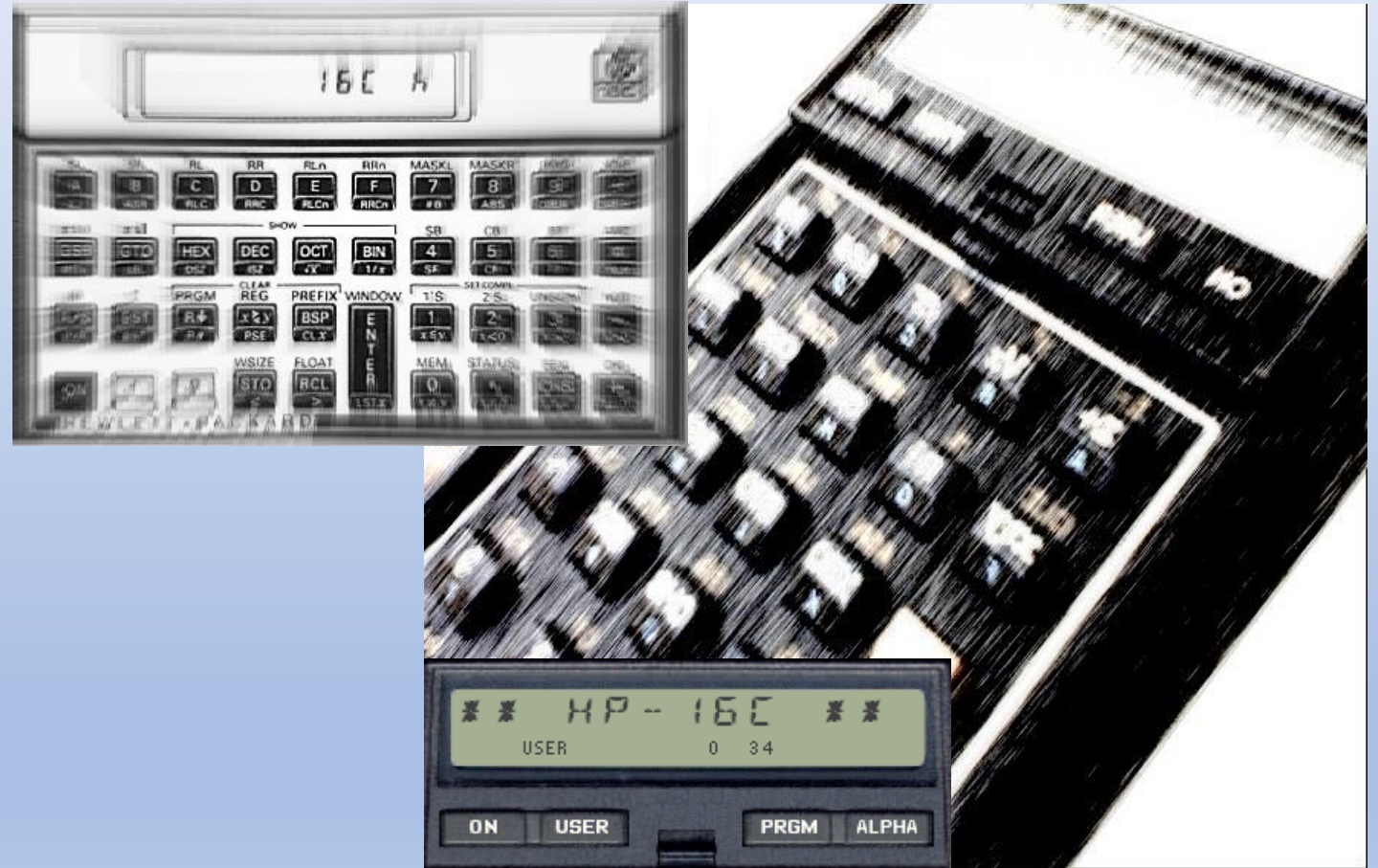
WFS _
USER ALPHA

NO MATCH
USER



Action	OS/X	WARP	PowerCL
Auto Check	✓		
Manual Chk	✓	✓	✓
Wholesale	✓	✓	✓
Detail	✓		✓
Targeted		✓	

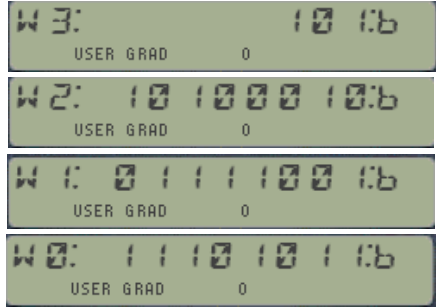
HP-16C Emulator Module



HP-16C Emulator Module [16CS]

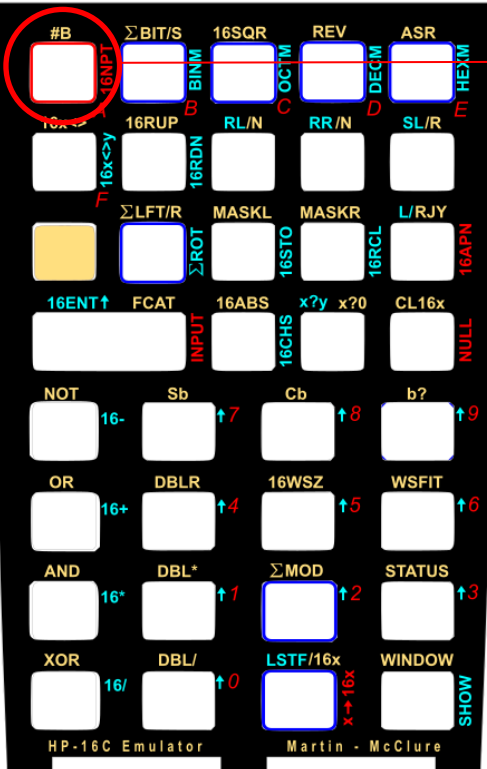


- Automated Base Conversions

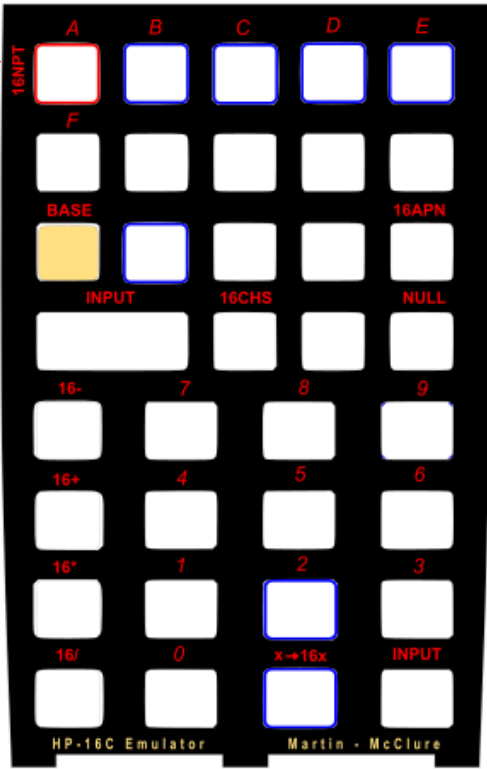


16C Register	Lower Bits	+	Upper Bits
16X	X		b13
16Y	Y		b12
16Z	Z		b11
16T	T		b10
16L	L		b14

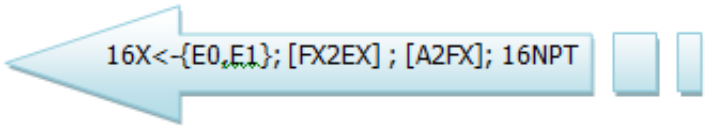
- ALPHA-based Data Input
- 64-bit full support
- Superset of original HP-16C
- Set of 24 Fns. enhanced
- Set of 52 new Fns. Added
- 4k footprint, 4 banks



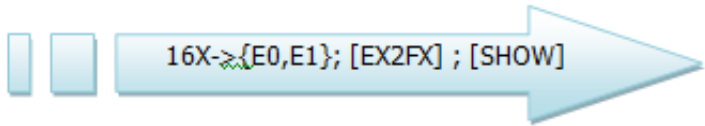
HP-16C Emulator



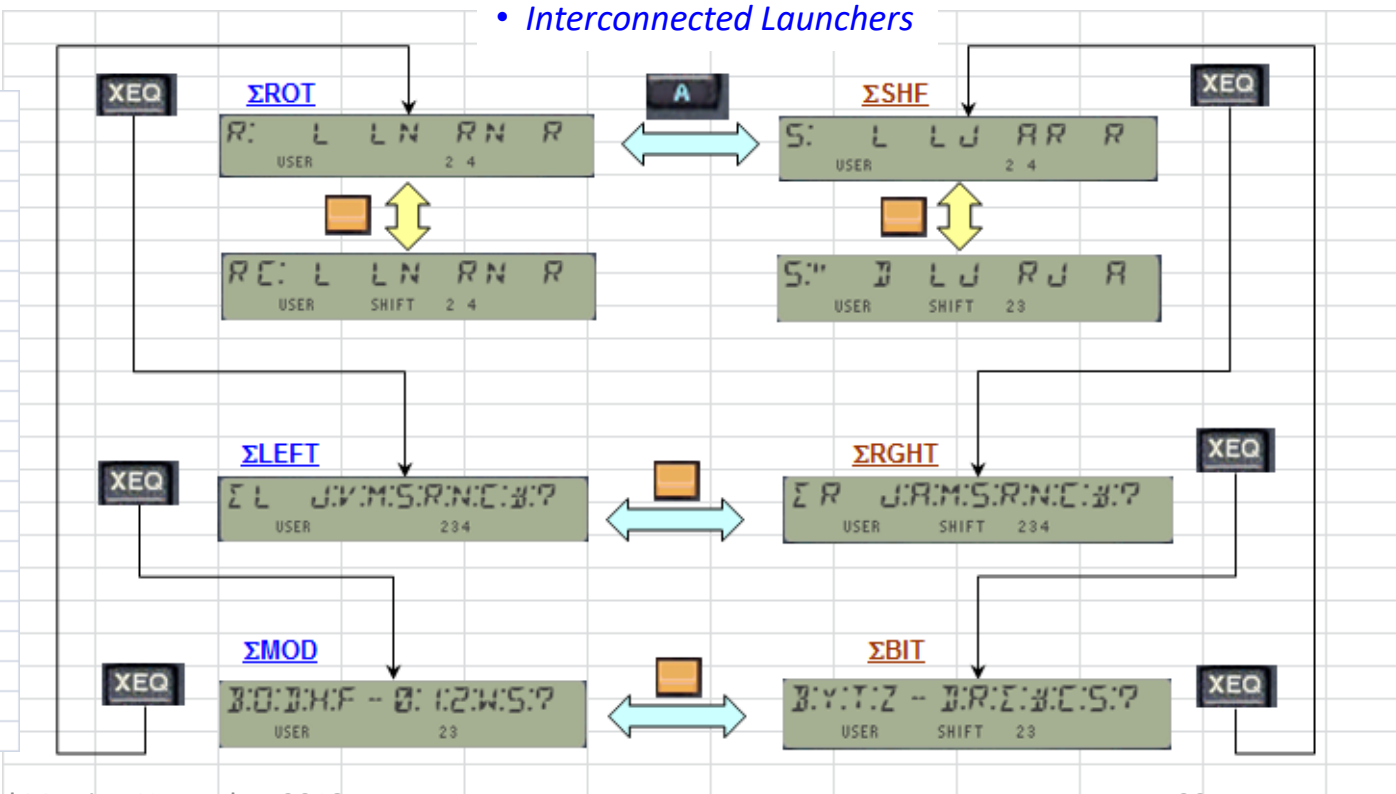
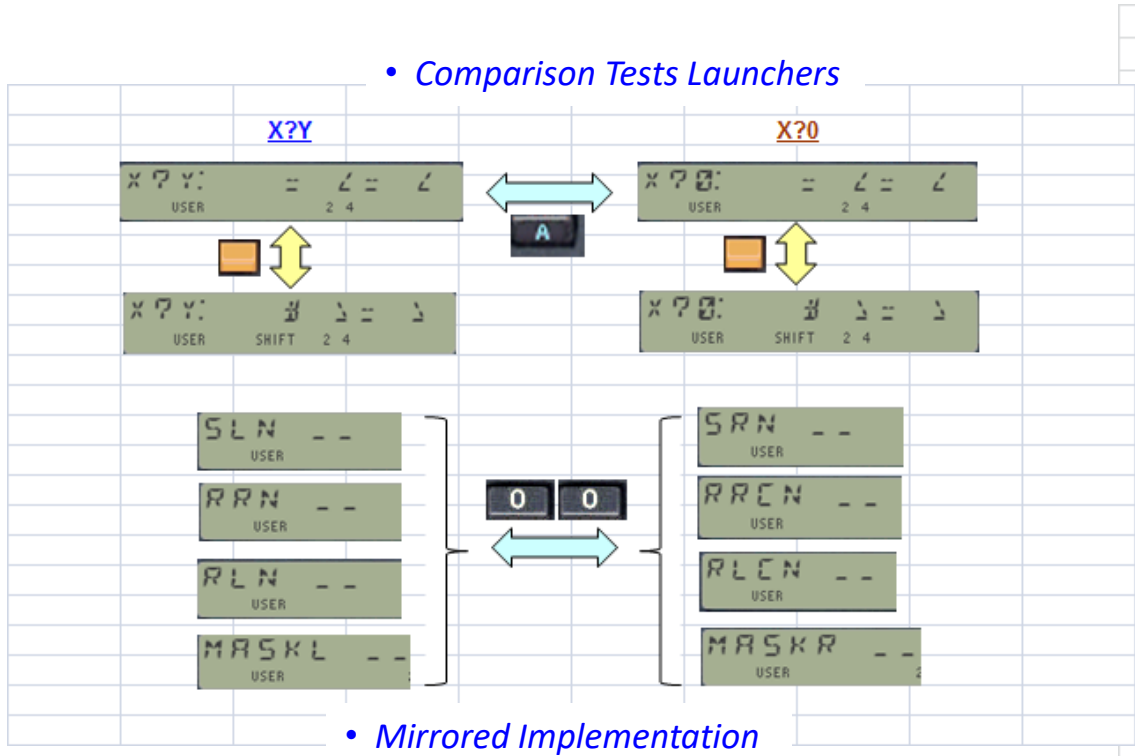
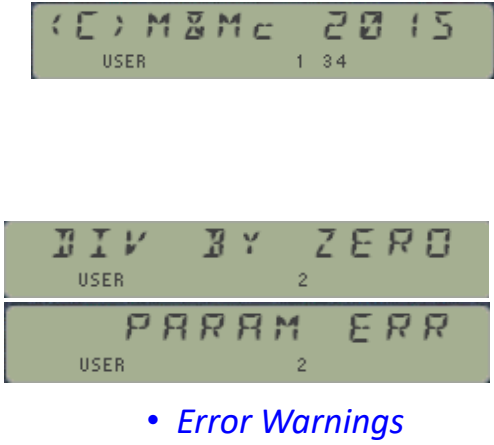
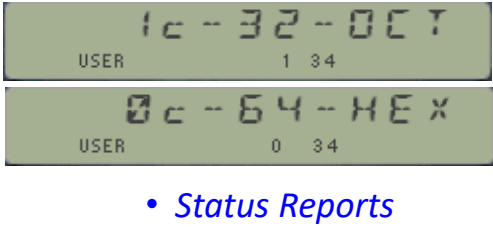
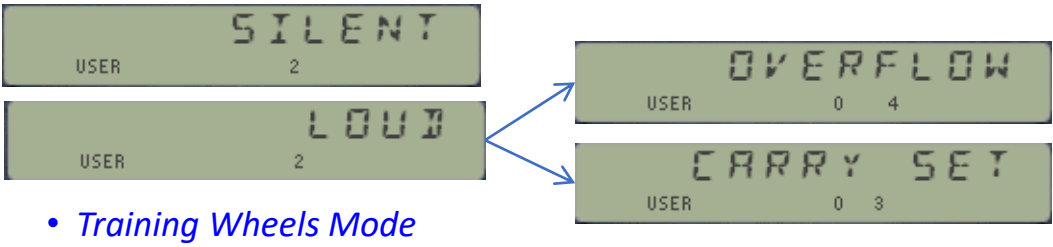
16NPT Hot keys



16T	16Z	16Z	16X	EX, Binary (NNN)	FX, ASCII	ALPHA
upper bits, Binary (NNN)				E4	F7	
				E3	F6	
				E2	F5	
				E1	F4	
					F3	
b10 T	b11 Z	b12 Y	b13 X		F2	
lower bits, Decimal (BCD)					F1	
					F0	



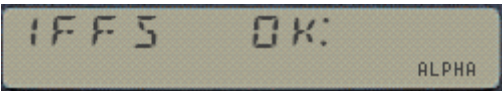
HP-16C Emulator Navigation Tips



Resurrecting FORTH-41 [FRTH]



- 135-Word Dictionary
 - Access to all HP-41 functions
 - 16-bit Integers only
 - 24-char command line input
 - FORTH Files stored in and loaded from X-Mem
 - Built-in Text File Editor ("EDA")
 - Terminal Console mode (SF 18)
- DEPTH indication in Command Line



Register		6		5		4		3		2		1		0	
DEC	HEX	D	C	B	A	9	8	7	6	5	4	3	2	1	0
208	0D0	"B"	"E"	0000 - CTL:3				0000 - CTL:2				0000 - CTL:1			
209	0D1	C	2	0200 - NPC:X				80ED - PNT:S				C0DB - PNT:R			
210	0D2	2109 - TOP:D				80ED - TOP:S				80DB - TOP:R				0	0
211	0D3	D	0	A0ED - INPT START				A0FF - INPT END				A0FF - INPUT			
212	0D4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
213	0D5	0	0	810B - CURRENT				810B - CONTEXT				0010 - BASE			
214	0D6	01BF -				01BF -				610C - HERE				0100 --	
215	0D7	- PAD		0	0	0	0	0	0	0	0	0	0	0	0
216	0D8	40ED -				614E -				41B4 -				0	0
217	0D9	0	0	0	0	0	0	0	0	0	0	0	0	0	0
218	0DA	O/F RTN:3				O/F RTN:4									
219	0DB	0	0	0	0	O/F RTN:1				O/F RTN:2					

T
Z
Y
X
L
M
N
O
P
Q
|
a

Control Regs

RTN Stack

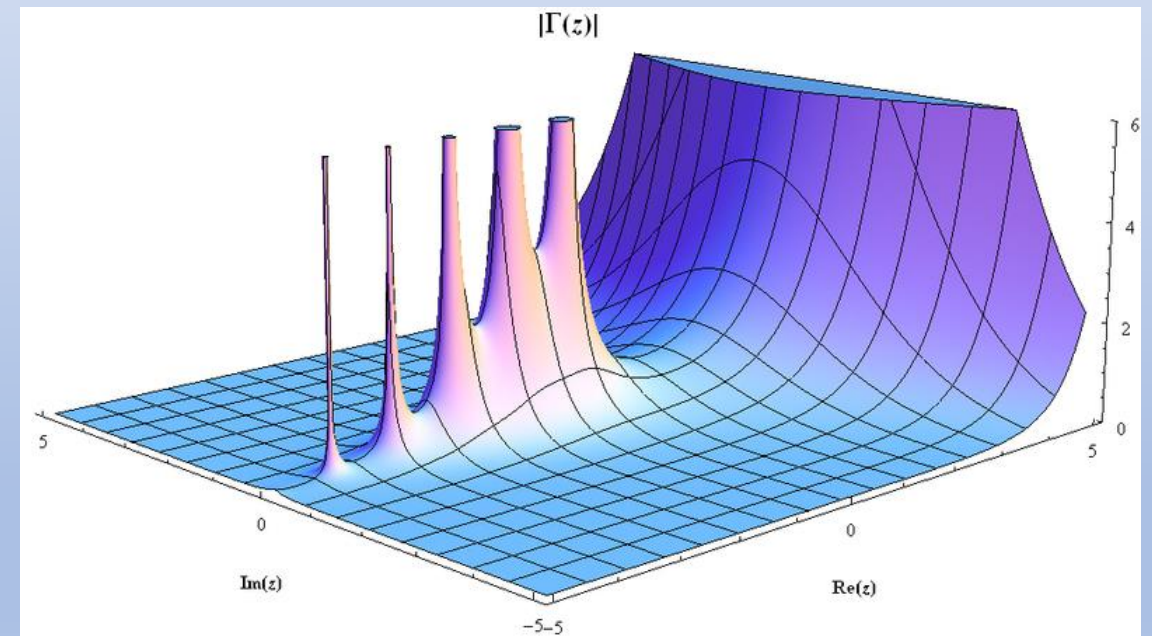
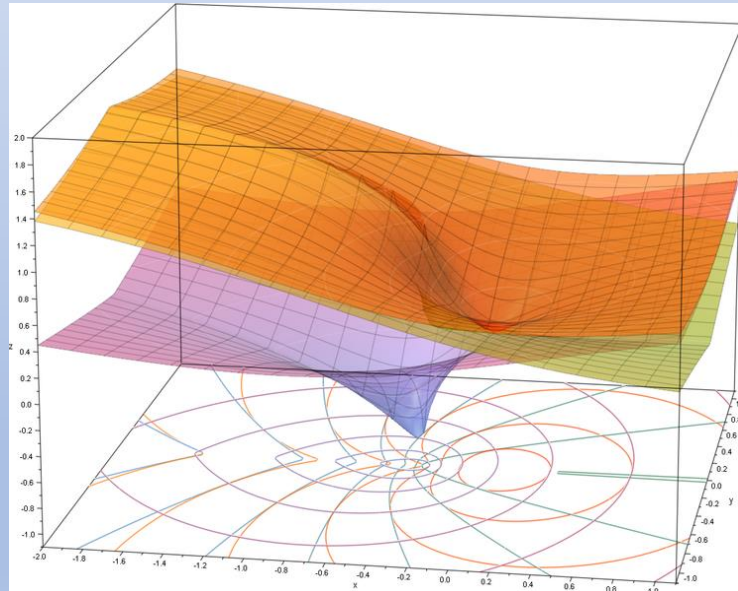


Advanced Math Modules

SandMath

SandMatrix

41Z_Deluxe



41Z Deluxe: The Complex Leviathan

- Launchers, Drivers & Interactive U/I
- Integer/Common factor display
- Polar & Rectangular Modes
- Natural Data Entry (real part first)

9 + j5 USER 0	9.00 + j5.00 USER 0
-5 (1 + j) USER 0	3.14 (1 + j) USER 0
7,074 135 USER	7,074 2,36 USER RAD

- Sub-functions and LASTF support
- Two pages, two banks each

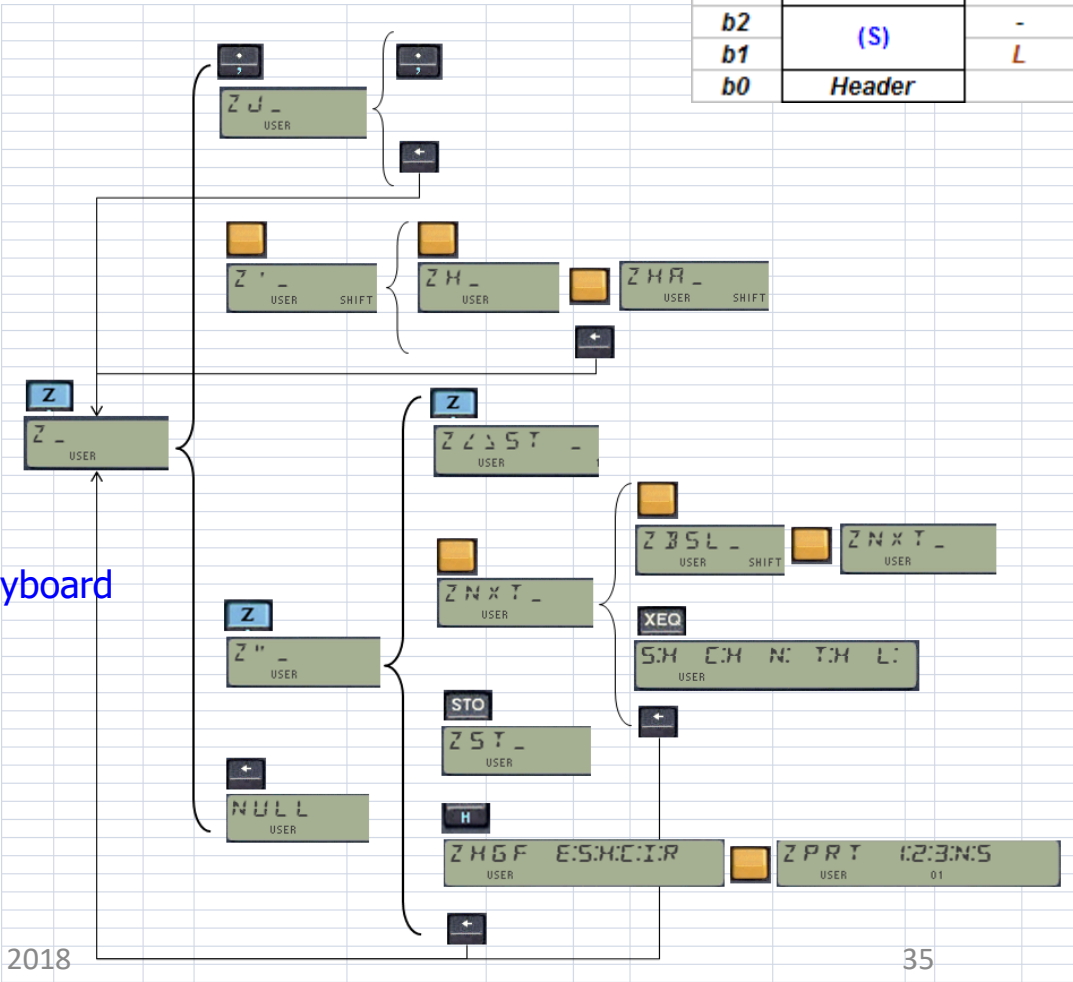
Page	Bank-1	Bank-2
Upper Page XROM #04	Main FAT w/ High-Level Math, Zvectors,	Function Tables and Launcher M-Code
Lower Page XROM #01	Main and Aux-FATs, Z-stack	Lower-level Math Routines. M-Code.

Module	Launchers	LASTF Method
41Z Deluxe	ZKBRD _	Captures (sub)fnc id#
	ZHGF, ZPRT, ZNEXT, ZBSL, ZHYP	Captures (sub)fnc id#
	ZF\$ _	Captures fnc NAME
	ZF# _ _ _	Captures (sub)fnc id#
	ZCAT (XEQ ')	Captures (sub)fnc id#

- Automated 4-Level Complex Stack (buffer #8)
- X-Mem Backup/Restore (file id #8)
- ZSTO & ZRCL Math , Stack Functions

41Z Complex Stack		
b11	non-zero	
b10	U	-
b9		-
b8	V	-
b7		-
b6	W	T ↔ Z
b5		
b4	Z	Y ↔ X
b3		
b2	(S)	-
b1		L
b0	Header	

- ZKBRD
 - Z-pad
 - Z-Keys
- Complex Keyboard



The 41Z Deluxe Leviathan

- Complex Arithmetic
- Elementary Functions
- Complex Logarithms
- 2D-Vector Analogy
- Trigonometry & Hyperbolics
- Multi-valued functions Driver
- Dual Means (AGM, GHM)
- Arithmetic, Harmonic & Geometric Means
- Polynomial Evaluation & Derivatives
- Quadratic & Cubic Equation Roots

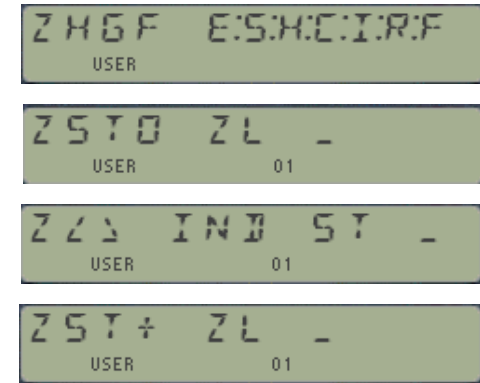
41Z Deluxe

41Z Diagnostics

- Must be in next page
- Admin and Troubleshooting

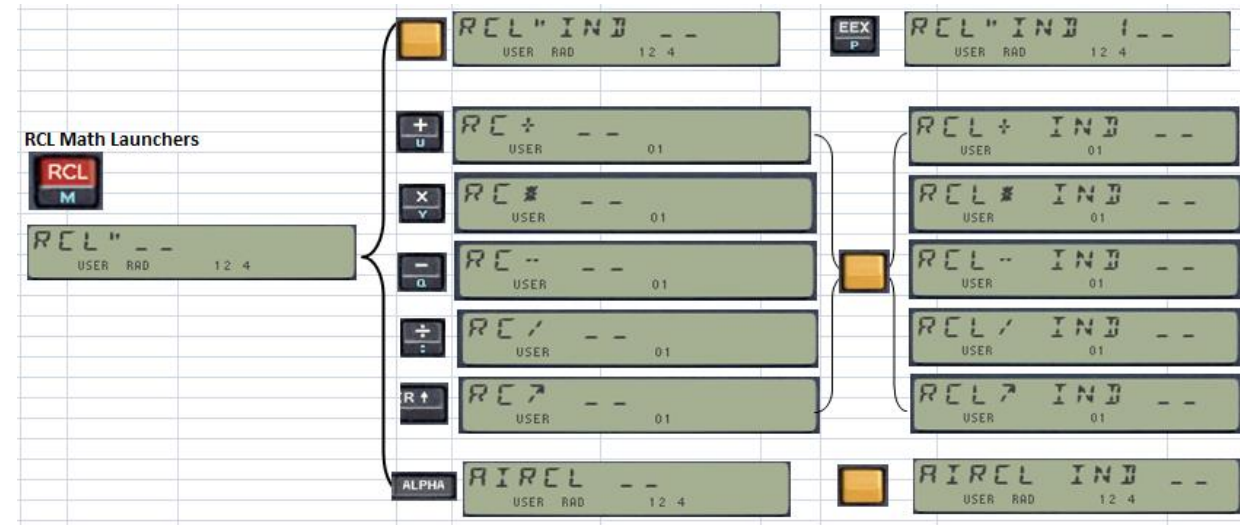
High-Level Math

- Gamma, Digamma (Psi), LNGamma
- ZETA, Lambert, InvGamma
- Bessel 1st & 2nd kinds (!)
- Sine, Cosine Integrals; error function (via ZHGF)
- Many more Special functions (PolyLog, Lerch)
- Complex Derivatives (ZDRV)
- Complex Continued Fractions (ZCF2V)
- Discrete Fourier Transform (DFT)
- Solution to $f(z)=0$ (Secant, Newton, Halley)
- Polynomial Roots - using ZDRV
- Carlson & Elliptic Integrals



- SN 00000000 44
USER 012 4

-
- Figure 10 shows five screenshots of the TI-84 Plus calculator screen, illustrating the steps to solve for X in the equation $Y = -0.50 * X + 2.50$.
- Screenshot 1:** The equation $Y = -0.50 * X + 2.50$ is entered. The screen shows "USER RAD 012 4".
 - Screenshot 2:** The equation $Y = -0.50 * X + 2.50$ is entered. The screen shows "USER RAD 012 4".
 - Screenshot 3:** The equation $Y = -0.50 * X + 2.50$ is entered. The screen shows "USER RAD 012 4".
 - Screenshot 4:** The equation $Y = -0.50 * X + 2.50$ is entered. The screen shows "USER RAD 012 4".
 - Screenshot 5:** The equation $Y = -0.50 * X + 2.50$ is entered. The screen shows "USER RAD 012 4".



The SandMath Juggernaut (Con't)

- Fractions, Quadratic & Cubic Equations
- Linear Regression, GCD, LCM
- Hyperbolic Functions
- Advantage's Number Base conversions
- Polynomial Evaluation & Derivatives
- Orthogonal polynomials

- Special Functions (Gamma, Bessel, Zeta)
- Many, many more Special functions !
- Carlson & Elliptic Integrals, AGM
- Function 1st & 2nd Derivatives
- Continued Fractions

- RCL Math, FIX ALL Mode

- AECROM Curve Fitting

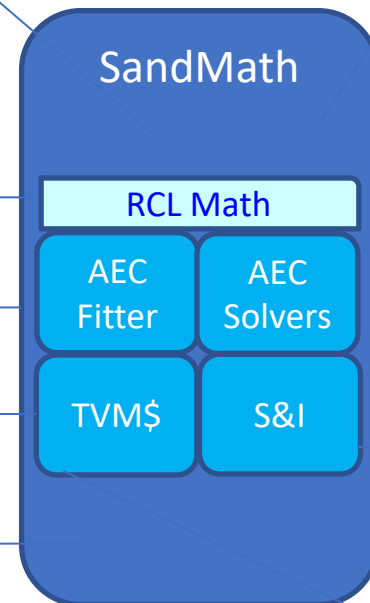
- Time Value of Money

- Triangle, Circle, SARR Solvers

- Advantage's Solve & Integrate

- Combinations & Permutations
- Density & Cumulative Probability
- Time-based Seed, Random numbers
- Primes, Prime Factors, error function
- Factorials, Primorials, Pochhammer, Apery, Kaprekar...

- Taylor Coefficients & approximation
- Chebyshev's approximation
- Fourier Series Coeffs. & Evaluation
- Discrete Hartley (Symmetrical) Transform
- Hypergeometric Functions galore

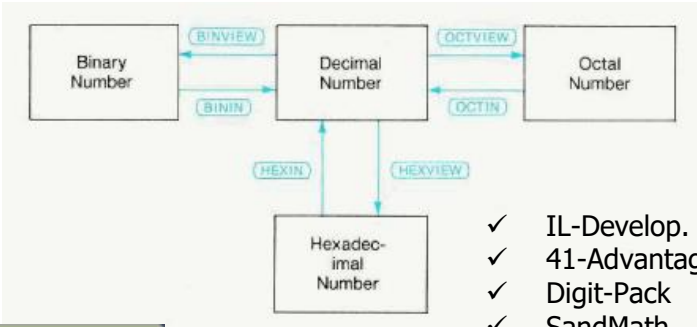


SandMath's Base Conversions

- Advantage's HEX/OCT/BIN -In & -View
- Ken Emery's T>BS, Dedicated H<>D Utils
- Automatic function selection depending on valid ranges

Base	Function	Description	Author
	BS>D _ _	Base to Decimal, prompting version	Ángel Martin
02	BININ	"02" in prompt, then enter binary number	HP Co.
08	OCTIN	"08" in prompt, then enter octal number	HP Co.
16	HEXIN	"16" in prompt, then enter hex number	HP Co.
nn	BT	Any other, base in X and string in Alpha	George Eldridge
16	D>H	Value in X	William Graham
16	H>D	Hex String in Alpha	William Graham
	D>BS _ _	Decimal to Base, prompting version.	Ángel Martin
02	BINVIEW	Value in X, "02" in prompt	HP Co.
08	OCTVIEW	Value in X, "08" in prompt	HP Co.
16	HEXVIEW	Value in X, "16" in prompt	HP Co.
nn	T>BS _ _	Value in X, base in prompt	Ken Emery
-nn	TB	Base in Y, value in X (with negative sign)	George Eldridge

Page	Bank-1	Bank-2	Bank-3	Bank-4
Upper	High-Level Math, Stats	Function Launchers, Curve Fitting	HP Advantage Solve & Integrate	AEC Program Generator
Lower	SandMath_44	FRC, HYP, RCL# Math	TVM\$, AECROM Geometry Solvers	Derivatives, Base Conversions



- ✓ IL-Develop.
- ✓ 41-Advantage
- ✓ Digit-Pack
- ✓ SandMath
- ✓ 16C Emulator

02 05 --
USER

111,1011 3
USER 1

173 0
USER 1

73 H
USER 1

A3
USER 1

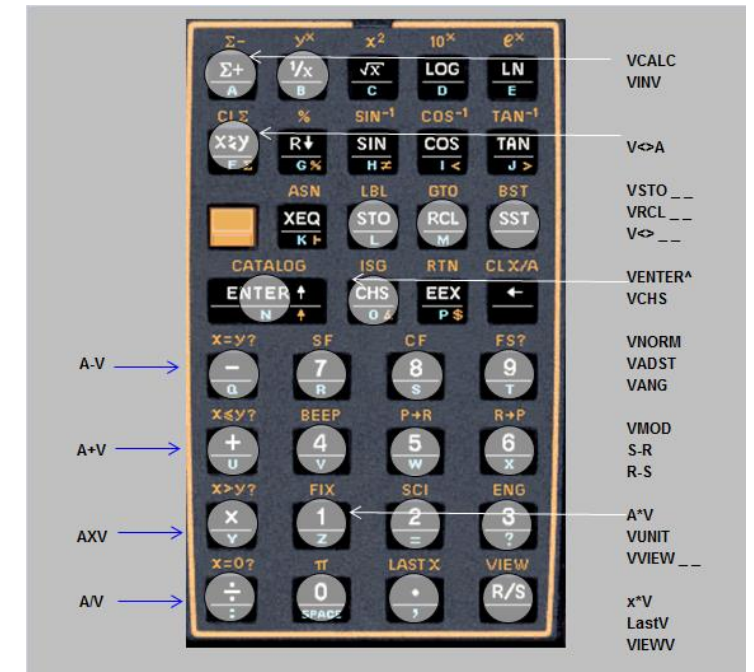
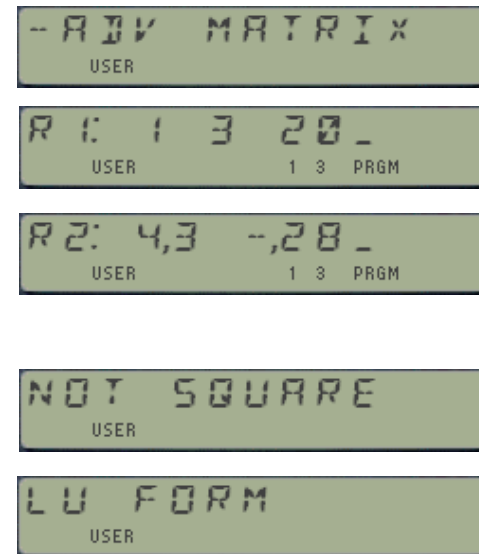
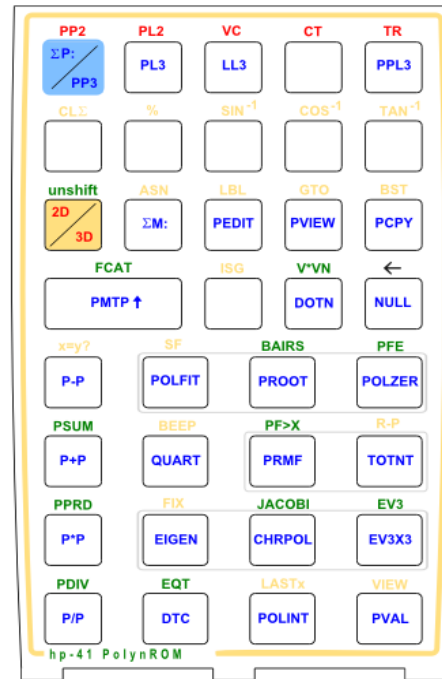
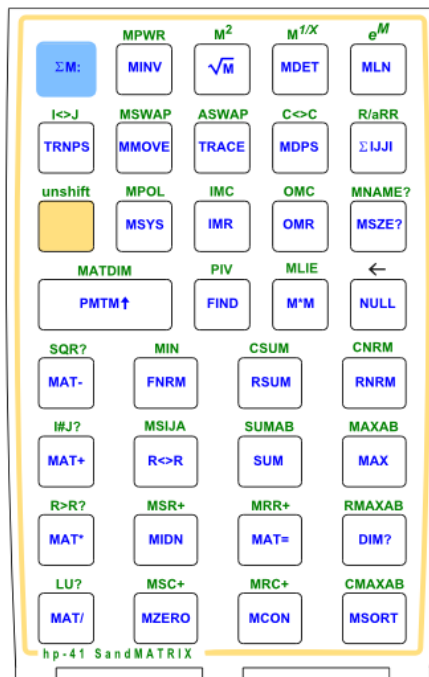
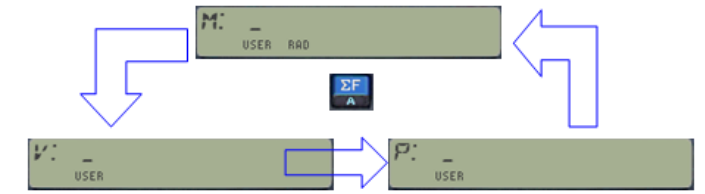
05 05 --
USER

BASE 36
USER RAD 012 4

Base	IN/VIEW	D>H	T>BS
BIN	1,023 1,111,111,111	n/a	4,095 111,111,111,111
OCT	1,073,741,823 7,777,777,777	n/a	8,589,934,587 77,777,777,777
HEX	4,294,967,295 FF,FFF,FFF	9,999,999,999 254,0bE,3FF	9 E10 1,4F4,6b0,400

The SandMatrix Behemoth

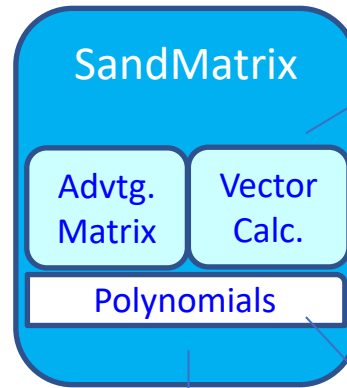
- Picks-up where the SandMath left things off:
 - Includes ALL functionality from Advantage Matrix
 - Adds new MCODE utilities (TRACE, MIDN, MZERO)
 - Adds Complex Matrix Transpose, Determinant, Minors
 - Features a Triple-Launcher: Matrix / Vectors / Polynomials
 - Plus a combined PolyRoots / Distances Launcher
 - **New Matrix Editor (by rows)**



The SandMatrix Behemoth (Con't)

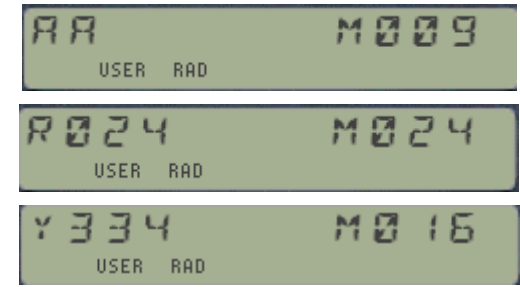
- CCD Array Functions
- Advantage's Major Matrix Fns
- Enhanced Matrix Editors
- Real & Complex Matrix Minors
- Complex Matrix Determinant ($N \leq 5$)
- Complex Matrix Transpose
- Matrix Pseudo-Inverse
- **Matrix Trace & Identity**
- Integer Powers and Roots
- Matrix Exponential & Logarithm
- Lie Product, Matrix Square Root
- Pascal & Random Matrices

Ra11	-Ia11	Ra12	-Ia12	Ra13	-Ia13
Ia11	Ra11	Ia12	Ra12	Ia13	Ra13
Ra21	-Ia21	Ra22	-Ia22	Ra23	-Ia23
Ia21	Ra21	Ia22	Ra22	Ia23	Ra23
Ra31	-Ia31	Ra32	-Ia32	Ra33	-Ia33
Ia31	Ra31	Ia32	Ra32	Ia33	Ra33



- Eigenvalues & Eigenvectors
- Characteristic polynomial
- Jacobi Method for Symmetrical Matrices
- Prime Factors (Con't)

- CL Y-Registers Support
- Up to 50x50 Linear Sys
- **Main- and CL-Mem Matrix Catalogs**
- **Vector Calculator Functions**
- Major Vector Operations Driver
- Coordinate Transformations
- **Polynomial and Derivatives Evaluation**
- Polynomial Arithmetic
- Polynomial Roots, **Quartic Equation**
- Orthogonal polynomials (Con't)
- Polynomial Fitting
- Partial Fraction Expansion



Stand-alone Math ROMs

Time Value of Money

Extended Stats & Curve Fitting

Elliptic Functions

Sums & Areas ROM

Solve & Integrate ROM

Advanced Math

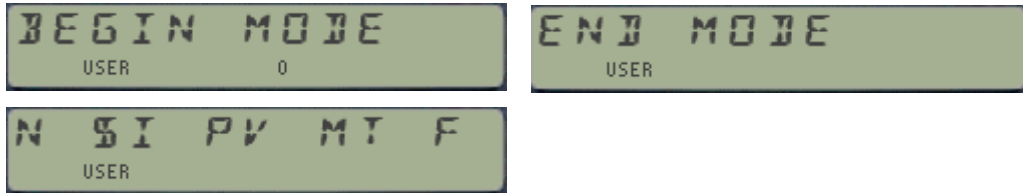
Complex Matrix ROM

Non-linear Systems ROM



Time Value of Money TVM\$ [TMVY]

➤ From-the-scratch, MCODE, HP-12C Equivalent



- ✓ Direct Formula-driven variables for N, PV, FV, PMT (13-digit math)
- ✓ Includes Advantage's and PPC's TVM Programs

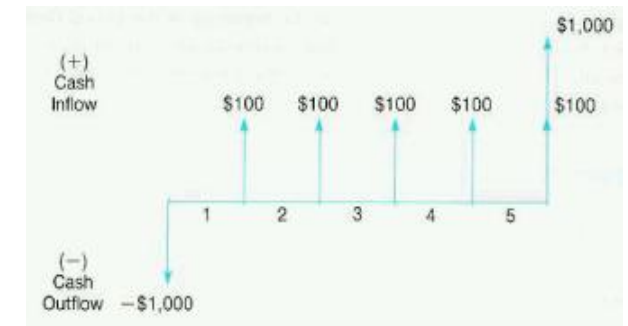
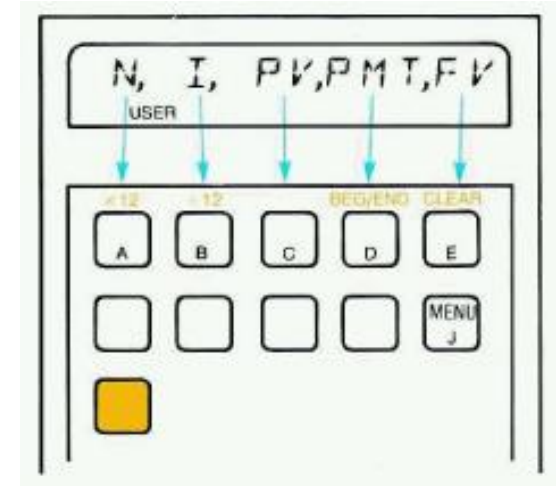
$$0 = PV + (1 + ip) PMT \left[\frac{1 - (1 + i)^{-N}}{i} \right] + FV (1 + i)^{-N}$$

- ✓ Newton's Method for interest rate I\$ (13-digit math)



$$f'(i) = (PMT / i^2) * [(1+i)^{-n} - 1] + n * [PMT (1 + ip)/i - FV] * (1+i)^{-(n+1)}$$

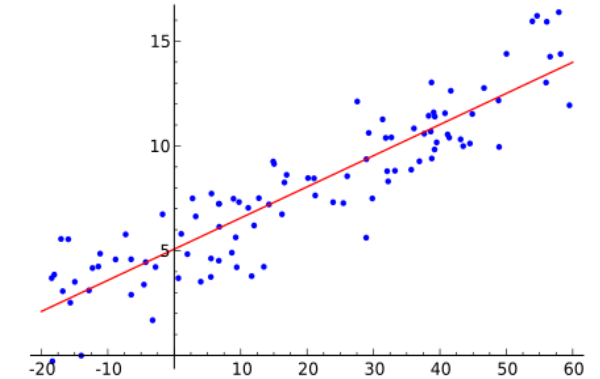
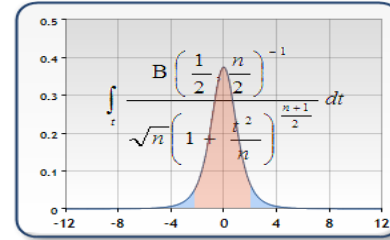
$$i0 = [\text{abs}(PV + n * PMT + FV)]^{1/n}$$



Extended Stats & Curve Fitting ROMS [XTAT, CURV]

➤ Rounds-up SandMath functionality in stand-alone format:

- Linear Regression functions
- Primality Tests, Next Prime,
- Combinations/Permutations
- Summation Functions (Faulhaber's *et al*)
- Single and Duplex Means (AGM,...)
- Ratios, GCD, LCM
- Most popular Statistical Distributions
- Probability Density Functions
- Cumulative Probability



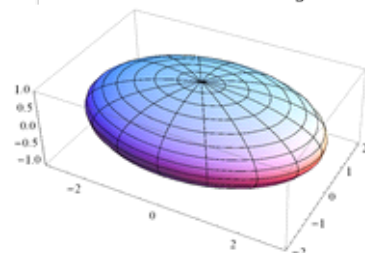
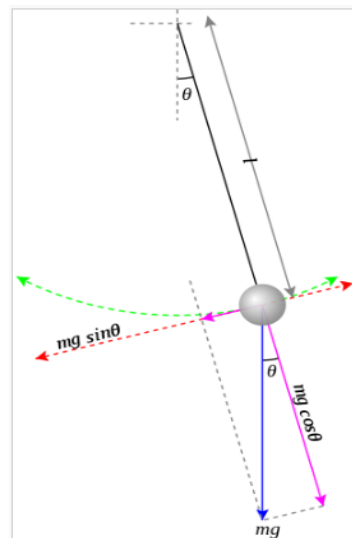
➤ Stand-alone Curve Fitting Compendium:

- AECROM Fitter
- Advantage's CFIT
- Standard HP-41 / PPC's "CV"
- W. Kolb's MCF
- Polynomial Interpolation:
- Aitken's / Lagrange Methods
- General Polynomial Best Fit
- Linear Exponential Curve Fitting
- Orthogonal Polynomials Fitting

Distribution	Density Function	Cumulative Probability	Driver
Normal	NRDF	NRCP	--
T-Student	TSDF	TSCP	TDIST
F-Snedecor	FSDF	FSCP	FDIST
Chi-Squared	C2DF	C2CP	CHI2
Poisson	PSDF	--	POIS
Binomial	BNP	BNP+	BIN

Elliptics and Orthogonal Pols ROM [EPTC]

XROM	Function	Description	Author
30,00	-ELLIPTICS	Section Header	n/a
30,01	AGM2	Arithmetic-Geometric Mean	Ángel Martin
30,02	AGM2	Arithmetic-Geometric Mean	Ángel Martin
30,03	"CEI"	Complete Elliptic Integrals	JM Baillard
30,04	CRF	Carlson Integral 1st. Kind	JM Baillard
30,05	CRFZ	CRF for complex arguments	JM Baillard
30,06	"CRG"	Carlson integral 2nd. Kind	JM Baillard
30,07	CRJ	Carlson Integral 3rd. Kind	JM Baillard
30,08	CRJZ	CRJ for complex arguments	JM Baillard
30,09	"EK"	Elliptic Int. 2nd. Order	Ángel Martin
30,10	"ELI"	Incomplete Elliptic Integrals	JM Baillard
30,11	ELIPE	Complete Elliptic Int. 2nd. Order	Ángel Martin
30,12	ELIPF	Incomplete Elliptic Int. 1st. Order	Ángel Martin
30,13	ELIPK	Complete Elliptic Int. 1st. Order	Ángel Martin
30,14	GHM	Geometric-Harmonic Mean	Greg McClure
30,15	"JEF"	Jacobi Elliptic Functions	JM Baillard
30,16	"KK"	Elliptic Int. 1st. Order	Ángel Martin
30,17	"LEI1"	Legendre Integral 1st. Kind	JM Baillard
30,18	"LEI2"	Legendre Integral 2nd. Kind	JM Baillard
30,19	"LEI3"	Legendre Integral 3rd. Kind	JM Baillard
30,20	-EXAMPLES	Section Header	n/a
30,21	-/+	Calculates (y-x)/(y+x)	Ángel Martin
30,22	ECC	Eccentricity	Ángel Martin
30,23	ELP	Perimeter of Ellipse	Ángel Martin
30,24	"MIND"	Mutual Inductance	Ángel Martin
30,25	"SAE"	Surface Area of Ellipsoide	JM Baillard
30,26	"PEND"	Pendulum period	Ángel Martin
30,27	-JACOBIAN	Section Header	Ángel Martin
30,28	ACOSH	Arc Hyperbolic Sine	Ángel Martin
30,29	AJF	auxiliary for JEF	JM Baillard
30,30	ASINH	Arc Hyperbolic Sine	Ángel Martin
30,31	ATANH	Arc Hyperbolic Tangent	JM Baillard
30,32	CBRT	Cubic Root	Ángel Martin
30,33	COSH	Hyperbolic Cosine	Ángel Martin
30,34	"P2"	Quadratic Equation	JM Baillard
30,35	"P3"	Cubic Equation	JM Baillard
30,36	SINH	Htyperbolic Sine	Ángel Martin
30,37	TANH	Hyperbolic Tangent	JM Baillard
30,38	THETA	Theta Functions	Ángel Martin
30,39	"WEF"	Weierstrass Elliptic Function	Ángel Martin
30,40	"WHIW"	Whittaker "W" function	Ángel Martin

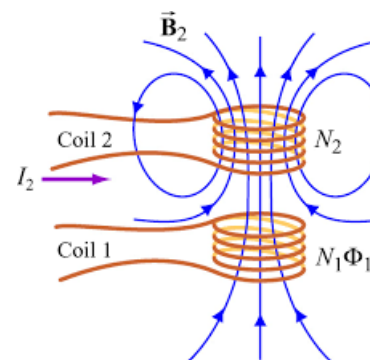
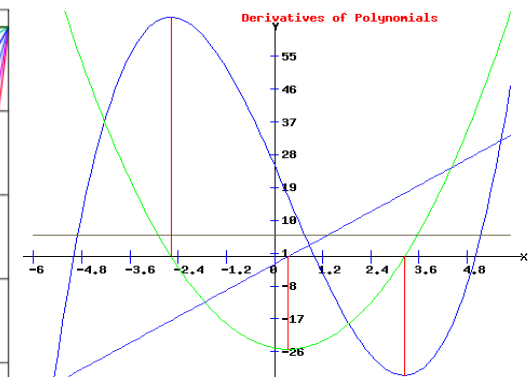
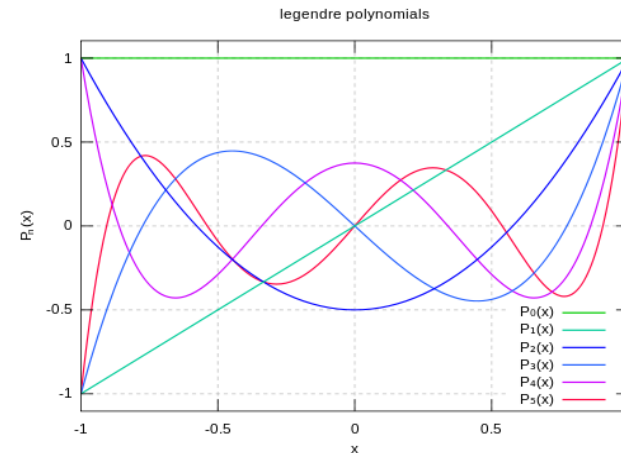


Complete Integrals	FOCAL Routine	MCODE Function
First kind	"KK"	ELIPK
Second kind	"EK"	ELIPE
Third kind	n/a	n/a
All at once	"CEI"	

$$E(k) = \int_0^{\pi/2} \sqrt{1 - k^2 \sin^2 \theta} d\theta = \int_0^1 \frac{\sqrt{1 - k^2 t^2}}{\sqrt{1 - t^2}} dt$$

$$K(k) = \int_0^{\pi/2} \frac{d\theta}{\sqrt{1 - k^2 \sin^2 \theta}} = \int_0^1 \frac{dt}{\sqrt{(1 - t^2)(1 - k^2 t^2)}}$$

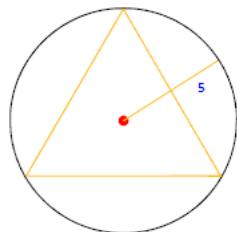
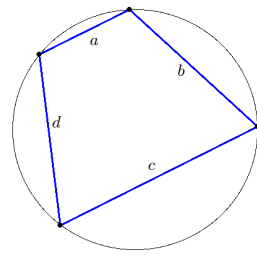
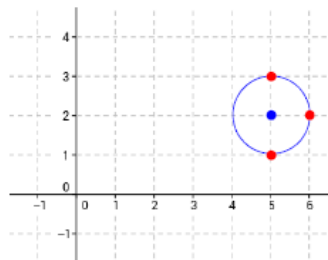
(c) Ángel Martin - November 2018



XROM	Function	Description	Author
30,41	-ORTHOPOL	Section Header	n/a
30,42	"BELL"	Bell Polynomials	JM Baillard
30,43	"BSSL"	Bessel Polynomials	JM Baillard
30,44	CHBT	Chebyshev T(x)	Ángel Martin
30,45	CHBU	Chebyshev U(x)	Ángel Martin
30,46	"FIB"	Fibonacci Polynomials	Ángel Martin
30,47	HMT	Hermite Polynomials	Ángel Martin
30,48	LAG	Lagrange Polynomials	Ángel Martin
30,49	LANX	Generalized Lagrange Polyn	Ángel Martin
30,50	LEG	Legendre Polynomials	Ángel Martin
30,51	"CBT+"	Chebyshev T(x) Coefficients	JM Baillard
30,51	"CBU+"	Chebyshev U(x) Coefficients	JM Baillard
30,53	"HMT+"	Hermite Polynomials Coeffs.	JM Baillard
30,54	"JCP+"	Jacobi Polyn. Coefficients	JM Baillard
30,55	"LANX+"	Generalized Lagrange Polyn	JM Baillard
30,56	"LEG+"	Legendre Polyn. Coefficients	JM Baillard
30,57	"USP+"	Ultra-Spherical Polyn Coeffs.	JM Baillard
30,58	dPL	1st. Derivative polynomial	Ángel Martin
30,59	d2PL	2nd. Derivative Polynomial	Ángel Martin
30,60	DTC	Delete Tiny Coeffs	Ángel Martin
30,61	ITPL	Integral of Polynomial	Ángel Martin
30,62	PDEG	Polyn Degree	Ángel Martin
30,63	PVAL	Polyn Evaluation	Ángel Martin

Sums & Areas ROM [SERI]

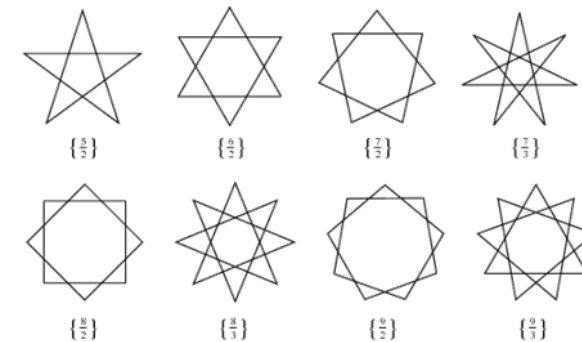
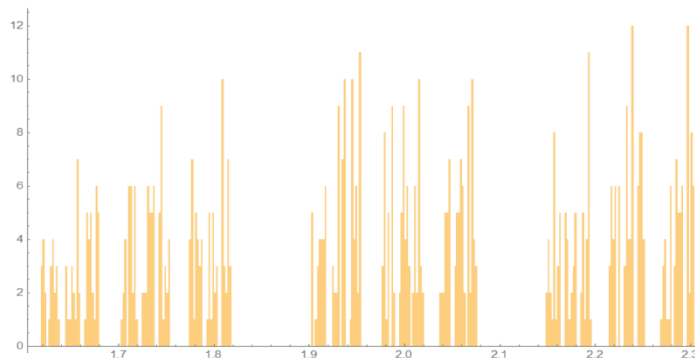
XROM	Function	Description	Author
18,00	-SERIES 1A	Section header	Ángel Martin
18,01	CHSYX	Sign Change of Y by X: $Y*(-1)^X$	Ángel Martin
18,02	NCK	Combinations of N in sets of K	Ángel Martin
18,03	NPK	Permutations of N in sets of K	Ángel Martin
18,04	Σ0	Sum of mantissa digits	PoulKaarup
18,05	Σ1	Sum of first N integers	PoulKaarup
18,06	Σ1/N	Harmonic Numbers	Ángel Martin
18,07	Σ2	Sum of Squares of Numbers	PoulKaarup
18,08	Σ3	Sum of Cubes of Numbers	PoulKaarup
18,09	ΣN^X	Generalized Faulhaber's Sum	Ángel Martin
18,10	ΣUM	Single Series Sum (Explicit)	Ángel Martin
18,11	ΣΣUM	Double Series Sum (Explicit)	Ángel Martin
18,12	ΣΣΣUM	Triple Series Sum (Explicit)	Ángel Martin
18,13	"ΣUME"	Euler Transformation	JM Baillard
18,14	"ΣUMR"	Single Series Sum (Iterative)	JM Baillard
18,15	"NΣUM0"	Multiple Series Sum (Explicit)	JM Baillard
18,16	FNRM	Finite Nested Radical order m	Ángel Martin
18,17	INRM	Infinite Nested Radical order m	Ángel Martin
18,18	PRODX	Infinite Product w. argument	Ángel Martin
18,19	XQRTN	XQ Return to MCODE	Martin-McClure
18,20	X#YR?	Compares rounded X and Y	Ángel Martin
18,21	"NS"	Example for NΣUM0	Martin-Baillard
18,22	"S"	Example for ΣUM	Martin-Baillard
18,23	"SE"	Example for ΣUME	Martin-Baillard
18,24	"SR"	Example for ΣUMR	Martin-Baillard
18,25	"SS"	Example for ΣΣUM	Martin-Baillard
18,26	"SSS"	Example for ΣΣΣUM	Martin-Baillard
18,27	"SIG1"	Single Series Sum (Explicit)	JM Baillard
18,28	"SIG2"	Double Series Sum (Explicit)	JM Baillard
18,29	"SIG3"	Triple Series Sum (Explicit)	JM Baillard
18,30	STK>PT	Stack to Pointers	Ángel Martin
18,31	PT>STK	Pointers to Stack	Ángel Martin



$$\Gamma(z) = \frac{e^{-\gamma z}}{z} \prod_{n=1}^{\infty} \left(1 + \frac{z}{n}\right)^{-1} e^{\frac{z}{n}}$$

$$\frac{\pi}{2} = \frac{2}{1} \cdot \frac{2}{3} \cdot \frac{4}{3} \cdot \frac{4}{5} \cdot \frac{6}{5} \cdot \frac{6}{7} \cdot \frac{8}{7} \cdot \frac{8}{9} \cdots = \prod_{n=1}^{\infty} \left(\frac{4 \cdot n^2}{4 \cdot n^2 - 1} \right)$$

$$\sqrt{n + \sqrt{n + \sqrt{n + \sqrt{n + \cdots}}}} = \frac{1}{2} (1 + \sqrt{1 + 4n})$$



XROM	Function	Description	Author
18.32	-AREAS 1B	Section Header	Ángel Martin
18.33	AINT	ALPHA Integer Part	Fritz Ferwerda
18.34	BRHM	Brhmagupta formula	Ángel Martin
18.35	CIRCLE	Circle through three points	Ángel Martin
18.36	DIAG	Diagonal formula	JM Baillard
18.37	HERON	Heron formula	Ángel Martin
18.38	RPG1	Regular Polygon from sides	PoulKaarup
18.39	RPG2	Regular polygon from circle	PoulKaarup
18.40	"3PNTS"	Driver for CIRCLE/Areas	Ángel Martin
18.41	"CCPA"	Complex Cyclic Polygon Area	JM Baillard
18.42	"CCPA+"	Driver for CCPA	Ángel Martin
18.43	"CPLA"	Complex Cyclic Polygon Area	JM Baillard
18.44	"CPLA+"	Driver for CPLA	Ángel Martin
18.45	"CPLD"	Complex Cyclic Polyg. Diagonals	JM Baillard
3.46	"CPLD+"	Driver for CPLD	Ángel Martin
3.47	"PGA"	Polygon Areas	PoulKaarup
3.48	"STLA"	Star Polygon Area	JM Baillard
3.49	"STLA+"	Driver for STLA	Ángel Martin
3.50	"#"	Auxiliary for SOLVE	Ángel Martin
3.51	"TRIA"	Driver for ABC	Ángel Martin
3.51	"ABC"	Triangle Solver	JM Baillard
3.53	"TRIH"	Driver for HABC	Ángel Martin
3.54	"HABC"	Hyperbolic Triangles	JM Baillard
3.55	"TRIS"	Driver for SABC	Ángel Martin
3.56	"SABC"	Spherical Triangles	JM Baillard
3.57	"OUT"	Output Registers	Ángel Martin
3.58	SINH	Hyperbolic Sine	Ángel Martin
3.59	COSH	Hyperbolic Cosine	Ángel Martin
18.60	TANH	Hyperbolic Tangent	Ángel Martin
18.61	ASINH	Hyperbolic ASIN	Ángel Martin
18.62	ACOSH	Hyperbolic ACOS	Ángel Martin
18.63	ATANH	Hyperbolic ATAN	Ángel Martin

$$F(x, v) = \sum_{k=0}^n \sum_{m1=0}^k \sum_{m2=0}^k \alpha_{m1, m2, k} R^k y^{k-m1} (1-y)^{m1} z^{k-m2} (1-z)^{m2}$$

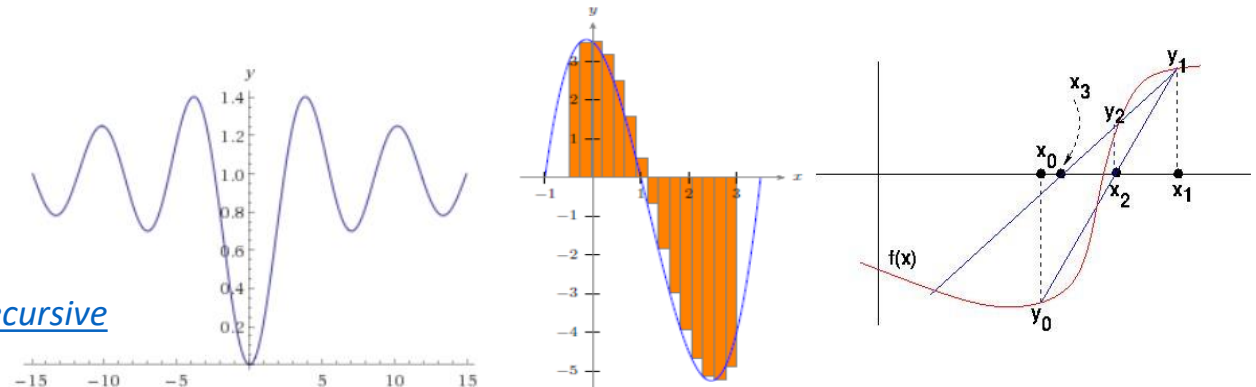
Advantage Math and Solve & Integrate ROMS

[ADVG, SIHP]

- Matrix Minors & Cofactors
- Determinants via Minors
- Matrix Scrolling & Rotations
- Colum Data Sort
- Least Squares 2nd Order
- Complex Step Real-Derivative (ZNWT)
- Newton's & Halley's Method using **DERV**
- Bessel J via Continued Fractions (large arguments)
- Cubic Spline Interpolation
- Curve Fitting w/ Akima's Method
- Harmonic Determinants
- Anti-Identity Matrices
- Over-Conditioned Systems
- Non-Linear Equation Systems
- 2D Integration (*Recursive* **INTEG**)
- 2-Non-Linear Equation System (*Recursive* **SOLVE**)

Example	Description	Using Program	Application Type	Dimension
2DF1	Integrand example1	2DITG	2D Integration	Simple
2DF2	Integrand example2	2DITG	2D Integration	Simple
2DF3	Integrand example3	2DITG	2D Integration	Simple
F1XY	Integrand example1	FITG2	2D Integration	Recursive
F2XY	Integrand example2	FITG2	2D Integration	Recursive
F1, F2	Operands example1	FRT2	2-equation System,	Recursive
G1, G2	Operands example2	FRT2	2-equation System	Recursive
CI	Cosine Integral	FINTG	Single Integration	Simple
SI	Sine Integral	FINTG	Single Integration	Simple
ERF	Error Function	FINTG	Single Integration	Simple
FOURN	Fourier Coeffs.	FINTG	Single Integration	Simple
Q-1	Inverse Probability	FROOT, FINTG	Roots of integral	Nested
JNX	Bessel Function J	FINTG	Single Integration	Simple
JITX	Integral Bessel J	FITG2	2D Integration	Recursive
JZRN	Zeros Bessel J	FROOT, FINTG	Roots of integral	Nested

<http://www.hpmuseum.org/forum/thread-6311.html?highlight=recursive>

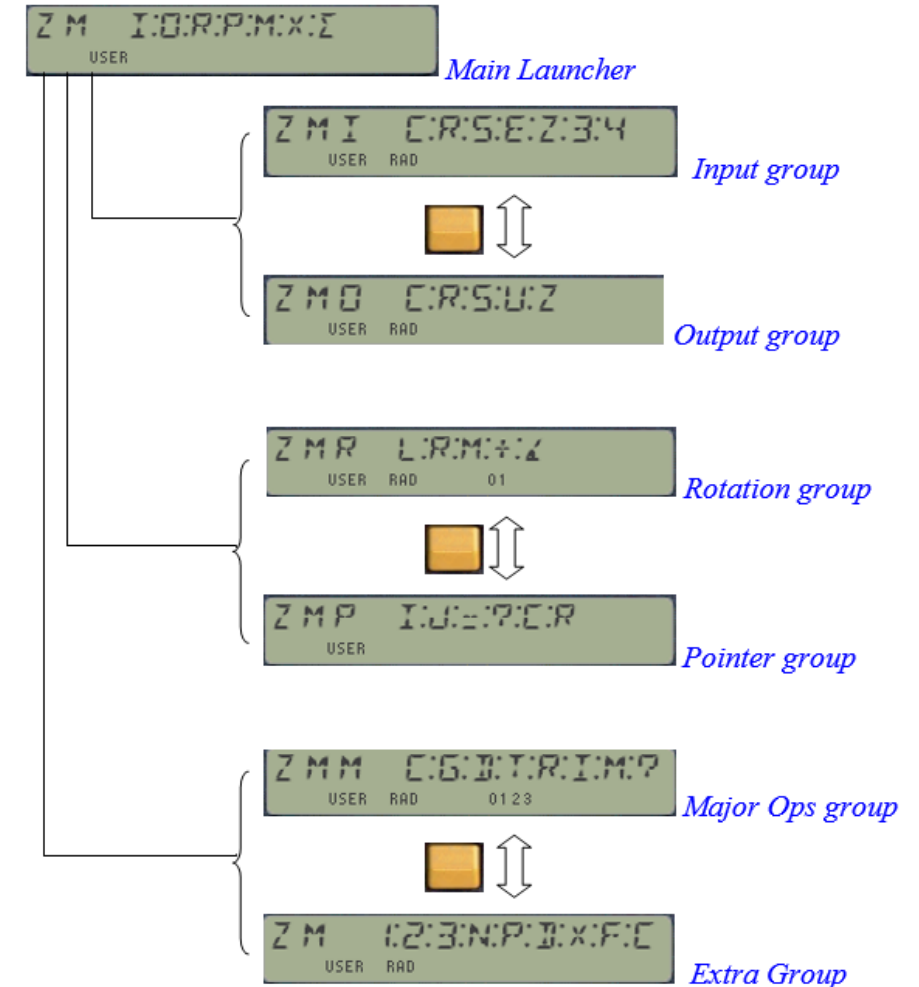
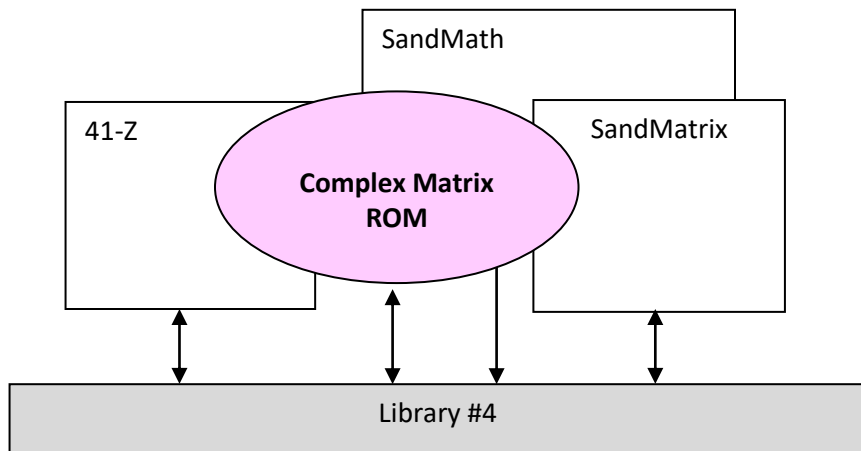


Complex Matrix ROM [ZMAT]



Ra11	-la11	Ra12	-la12	Ra13	-la13
la11	Ra11	la12	Ra12	la13	Ra13
Ra21	-la21	Ra22	-la22	Ra23	-la23
la21	Ra21	la22	Ra22	la23	Ra23
Ra31	-la31	Ra32	-la32	Ra33	-la33
la31	Ra231	la32	Ra32	la33	Ra33

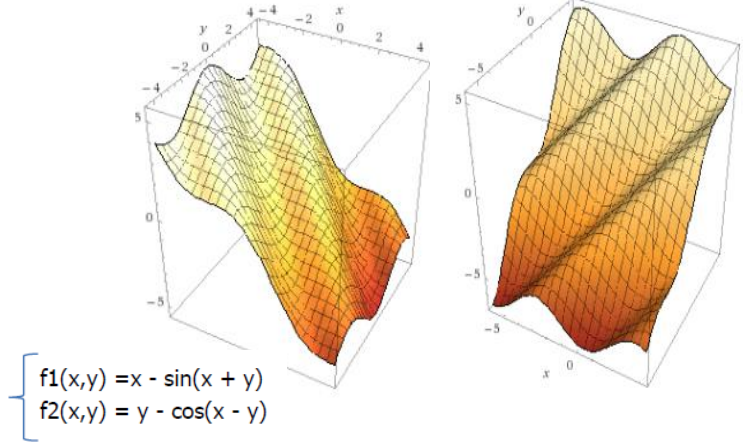
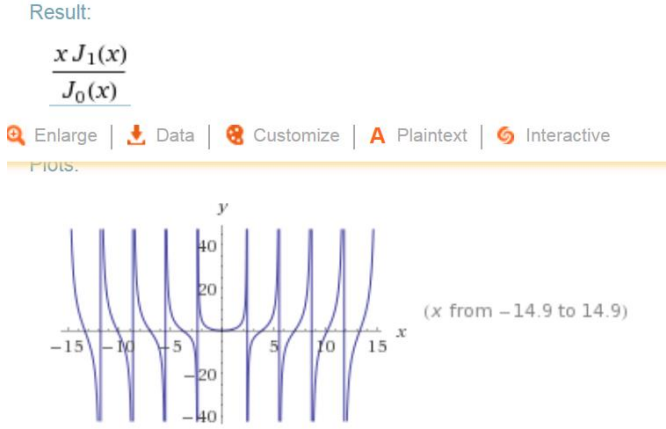
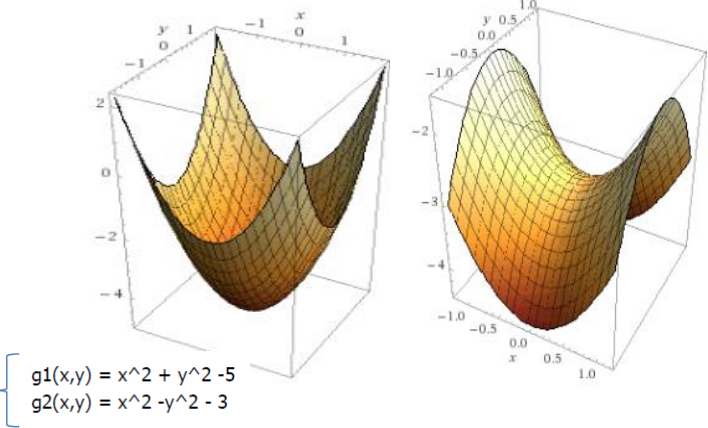
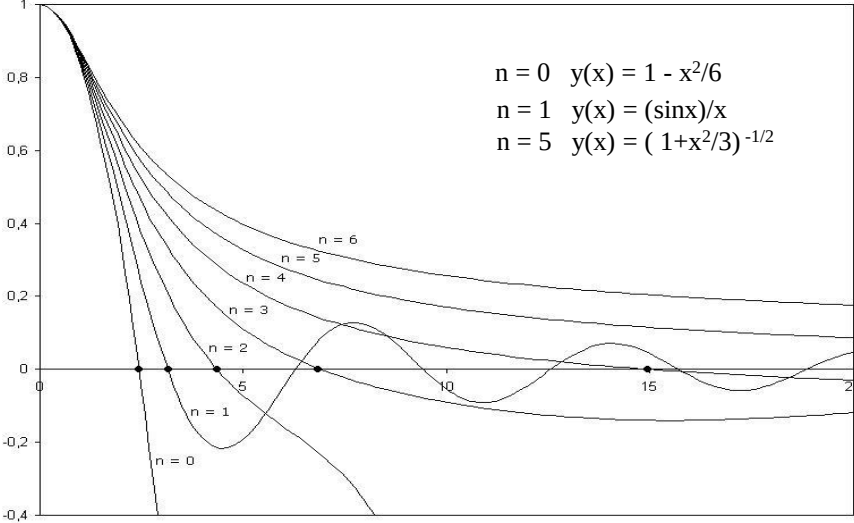
- Complex Matrix Input/Output
- Complex Matrix Minors & Cofactors
- Complex Determinants via Minors
- Complex Matrix Determinants & Inverse
- Complex Matrix Trace
- Complex Matrix Transpose
- Complex Matrix CharPol & Eigenvalues
- Complex Matrix Mappings:
 - Element Scrolling
 - Layer Rotation
 - Reflection and Spiraling



Non-linear Systems ROM [NONL]



01	Non-Linear Systems	Driver Prog	Math Routine	Aux Routines	Examples
	2 Equations	2NLS+	2NL	n/a	FG
	3 Equations	3NLS+	3NL	n/a	FGH
	n-Equations	NNLS+	NLS, LS	FIN, XIN, XOUT	F1, F2, F3
	n-Equations (Advtg)	NLSYS	MSYS	FIN, XIN, XOUT	F1, F2, F3
02	Numerical Analysis	Driver Prog	Math Routine	Examples	
	Laplace Eq.	LAP+	LAP	VLX, VX0, CLX	
	Poisson Eq.	POIS+	POIS	UX0, UY0, UXL, ULY, FXY	
	Diffusion Eq.	DFSN+	DFSN	aXT, bXT, cXT, FX0, FOT, FLT	
03	Differential Equations	Driver Prog	Math Routine	Examples	
	Second Order	2DFEQ	2RGK	d2/dX2 (Lane-Emden)	
	Third Order	3DFEQ	3RGK	d3/dX3	
	Nth. Order	4DFEQ	NRGK	d5/dX5	
04	Successive Approx.	Driver Prog	Math Routine	Examples	
	Real	XSAM	FXN	X=, Y=, Z=	
	Complex	ZSAM	FZN	Z1=, Z2=	



Formula Evaluation & Equation Solver ROMs



$$\begin{aligned} \rho(x) &= -G(-x^2)/[xH(-x^2)]. \\ G(u) &= \prod_{k=1}^n (u + u_k) G_0(u), \\ \rho^p &> \sum_{j=0, j \neq p}^n A_j \rho^j, \\ p &= 2\psi_0 + (1/2)[\text{sg } A_1 - \text{sg } (A_{n-1}A_n)] \\ f(z) &= (\pi/2)(S_1 + S_2) \end{aligned}$$

$$\begin{aligned} \sin^2 \alpha + \cos^2 \alpha &= 1 \\ \tan \alpha \cot \alpha &= 1 \\ \frac{a}{\sin \alpha} = \frac{b}{\sin \beta} = \frac{c}{\sin \gamma} &= 2R \\ \tan(\alpha - \beta) &= \frac{\tan \alpha - \tan \beta}{1 + \tan \alpha \tan \beta} \\ \sin x &= a; x = (-1)^n \arcsin a \end{aligned}$$

Formula Evaluation Module [FRML]

a.k.a “Giving TI a run for its money”

- Formula Editor in ALPHA (24-char limit)
 - Uses Buffer #6 (LIFO, 16-Registers in size)
- Extended via Chained Evaluation
- Can also use ASCII Files in Script Language
 - GTO\$, XEQ\$, DO/WHILE\$, FOR/NEXT\$
- Rich, 13-digit Math function library
- Direct Stack-Registers, π and Custom Variables
- Utility Fns. for data register transfer
 - STO\$, X<>RG, SHFL "XYZTL"

- Full-expression Comparison Tests
- Sums, Series & Products Evaluation
- Stack Shuffle w/ Selective Clear
- Includes ALPHA registers {M, N, O, P}
- Can also clear them on the fly

SHFL - - - -

USER RAD

SHFL ZZTOP

USER RAD

SHFL Y0Z00

USER

AS (AC (AT (N (E (S (X)))))))

USER RAD

LN (E (1))

USER RAD

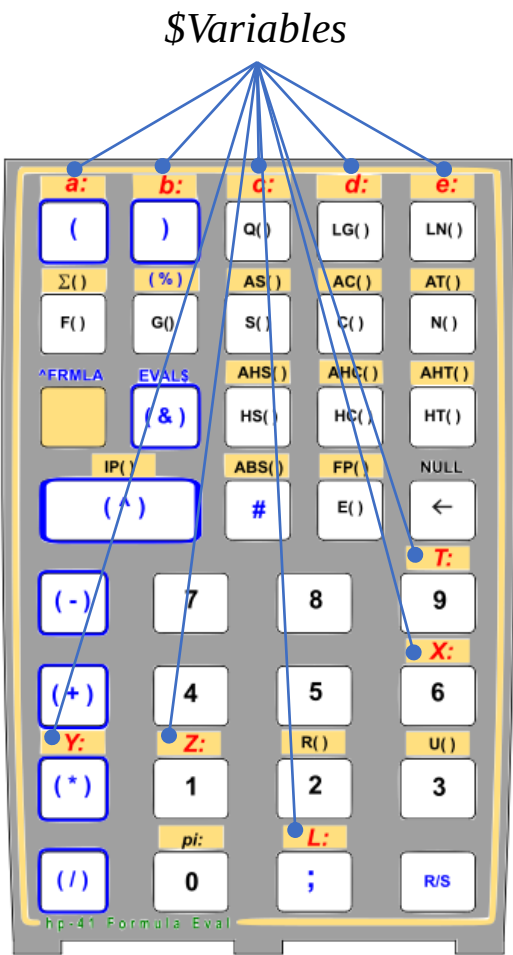
LG (Y / 2 + π 73)

USER RAD

(0 (6 7 2 - 4 * 0 * c) - b) / 2 / 0

USER USER

Buffer id#	Buffer Reg	Type	Used for:
06	b7	Hex code	Operator-3
	B6	BCD value	4 th argument
	b5	Hex code	Operator-2
	b4	BCD value	3 rd argument
	b3	Hex code	Operator-1
	b2	BCD value	2 nd argument
	b1	BCD value	1 st argument
	b0	admin	Header

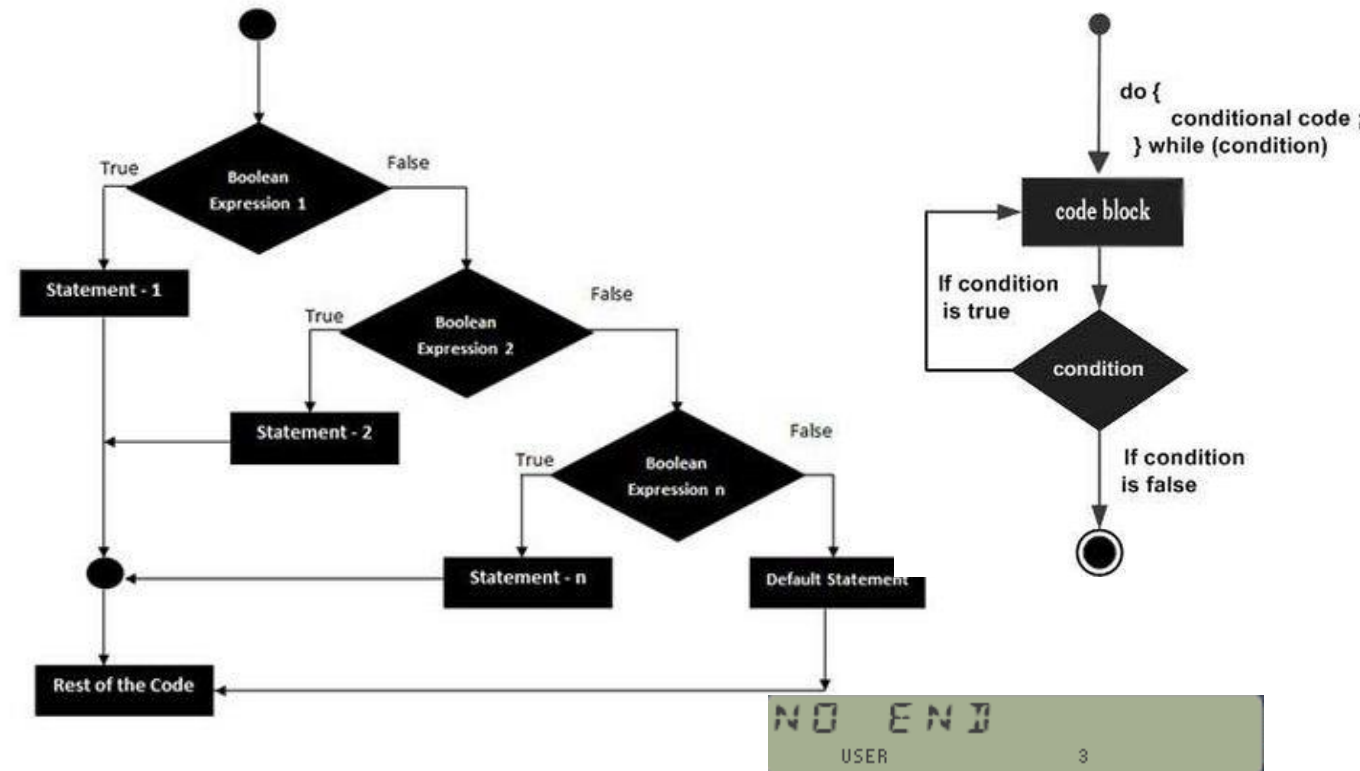


Formula Evaluation Module (Con't)

- ✓ **ΣEVAL** and **PEVAL** integrated into **EVAL\$**
- ✓ Generalized Comparison Tests with **EVAL?**
 - ✓ {formula1} <, =, >, # {formula2}
 - ✓ Full MCODE implementation
- ✓ Approaching a High-Level Language:
 - ✓ **SELECT / CASE** (in [WARP] ROM)
 - ✓ **LET / GET / SHOW** (buffer vars)
 - ✓ **IF / ELSE / THEN**
 - ✓ Generalized formula comparison
 - ✓ Up to Three nested structures (*)
 - ✓ **DO ... WHILE**
 - ✓ Generalized formula comparison
 - ✓ Up to Three nested loops

$X \div Y \div = Y \uparrow 2$
 USER RAD 0
 $T * X \leq 5 (Y)$
 RAD 0

$b \uparrow 2 - 4 * a * c \div = 0$
 USER RAD 34



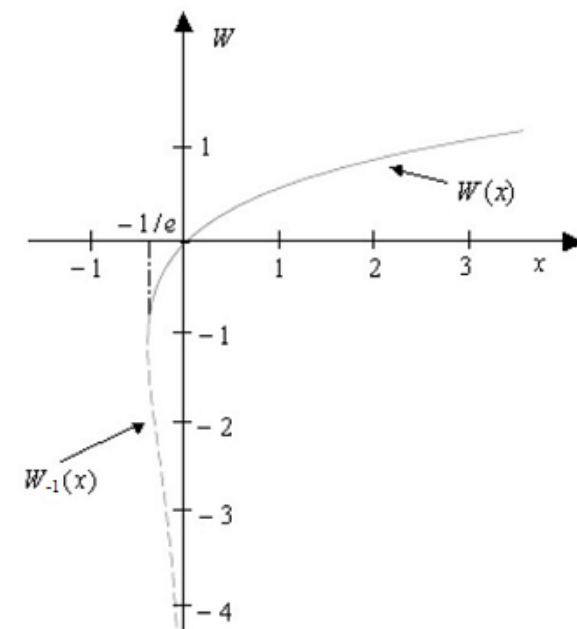
(*) Some restrictions apply

Formula Evaluation Applications [FRMX]

- ✓ Built-in Library of Applications (Upper 4k)
- ✓ Accuracy holds to 8th/9th decimal point
- ✓ Comparable runtimes to "RPN" approach

- SV\$, ITG\$ - Solve & Integrate
- AGM\$ - Arithmetic-Geometric Mean
- 2D & 3D Distances; Dot-Products
- CL\$, FL\$ - Ceiling & Floor Functions
- QRT\$ - Quadratic Equation Roots
- LINE\$ - Line equation thru 3 points
- P4\$ - Polynomial Evaluation (n<=4)
- NFD\$ - Normal Density Function
- Rectangular <> Spherical
- Julian <> Calendar Dates
- Exponential function
- Erdos-Borwein constant

- GAM\$ - Gamma Function
- PSI\$ - Digamma Function
- LNG\$ - LogGamma function
- WL\$ - Lambert function
- Elliptic Integral 1st. Kind
- Combinations & Permutations
- Legendre Polynomials
- Hermite's Polynomials
- Chebyshev's Polyn. 1st & 2nd. Kind
- Sine & Cosine Integral
- Error Function
- Bessel J integer order
- Harmonic Number
- Generalized Faulhaber's Sum



$$E = \sum_{n=1}^{\infty} \frac{1}{2^{n^2}} \frac{2^n + 1}{2^n - 1}$$

$$E = \sum_{m=1}^{\infty} \sum_{n=1}^{\infty} \frac{1}{2^{mn}}$$

$$w_{j+1} = w_j - \frac{w_j e^{w_j} - z}{e^{w_j} + w_j e^{w_j}}$$

$$z = W(z) e^{W(z)}$$

$$\Gamma(z) = \frac{\sum_{n=0}^N q_n z^n}{\prod_{n=0}^N (z+n)} (z+5.5)^{z+0.5} e^{-(z+5.5)}$$

$$\Psi(x) = \log(x) - \frac{1}{2x} - \frac{1}{12x^2} + \frac{1}{120x^4} - \frac{1}{252x^6} + O\left(\frac{1}{x^8}\right)$$

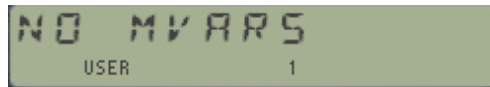
Equation Solver Module

[SLVF]

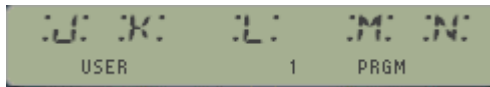


- ✓ Equations are interpreted using the Formula Evaluation Module.
- ✓ Long equations may be chained in two parts (using SLV+)

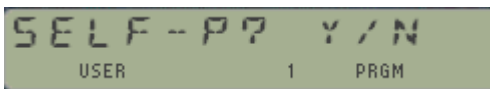
- ✓ Variables are declared with **MVARS**; resolved via **SOLVER**



- ✓ Two SOLVER sets are available: 5-Vars (Custom) or 6-Vars (A-F)

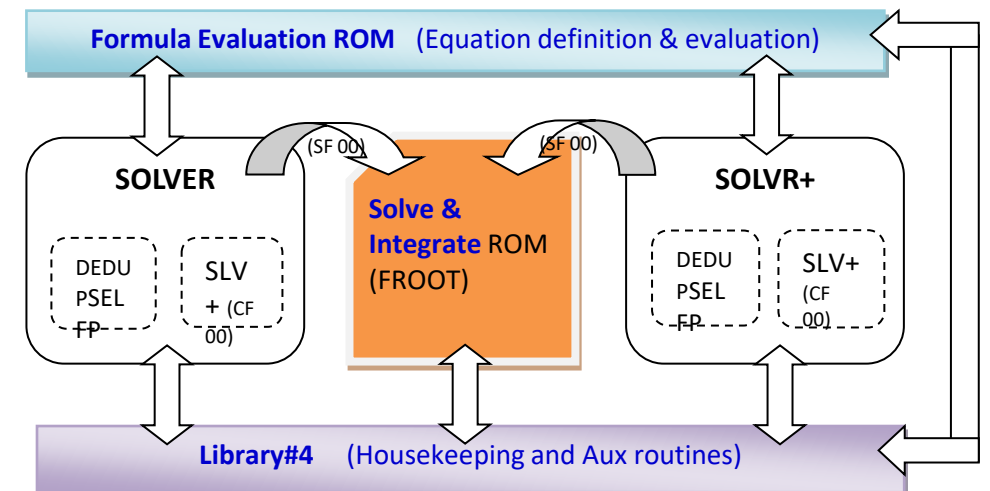
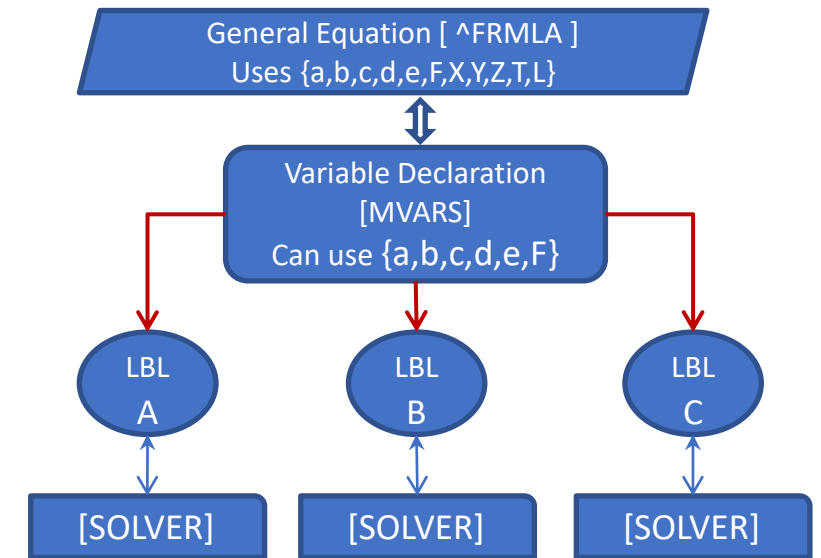


- ✓ *Self-programming* feature completes the FOCAL Solver code



- ✓ Mini-Library with 13 example equations is included

- ✓ Two options of SOLVE engines: built-in **SLV+** (CF 00) or **FROOT** (SF 00) in Solve & Integrate ROM.



From SOLVE to Solver: Equation Libraries

From: $f(x)=0$ to: $f(a,b,c,d,e)=0$

- Up to five variables to solve for. (at least 3)
- Mapped to local Labels [A]-[E] - and {R01–R05}
- FOCAL driver I/O, UF-22 controlled known/unknown
- Other Constants prompted separately
 - Two versions available:
 - ✓ [ISOL] “Interchangeable Solutions”, uses **FROOT**

EQ NAME: _
USER 01 4 PRGM ALPHA

NAME: ORBIT_
USER 01 4 ALPHA

- ✓ [EQLB] “Formula-Evaluation” based, uses “**SLV\$**”
- ✓ ASCII File includes all information. Navigation keys: PREV, NEXT, S&R
- ✓ *User can add own custom equations*

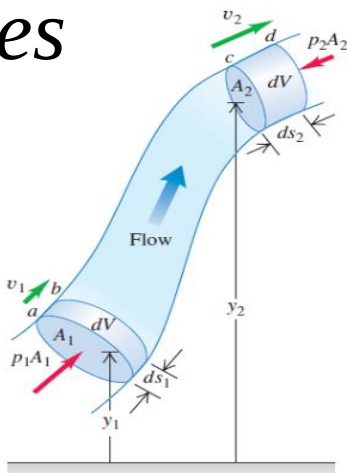
QUADRATIC
USER 0

$Y = AX^2 + BX + C$
USER 0

A B C X Y
USER 0

$$x_{1,2} = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Equation Name	POSROOT	NEGROOT
Equation Expression	$X1 = -B + \text{SQRT}(B^2 - 4AC) / 2A$	$X2 = -B - \text{SQRT}(B^2 - 4AC) / 2A$
Equation Formula	$(\#b + Q(b^2 - 4*a*c)) / 2/a - d$	$(\#b - Q(b^2 - 4*a*c)) / 2/a - d$
Equation Menu	A B C X1	A B C X2



N I P V M F V
USER RAD 2 4

P V Z N T
USER RAD 2 4

F M I M2 R
USER RAD 2 4

Σ R R 1-2-R3
USER RAD 0 2 4

dP dY V R 1-2
USER RAD 12 4

dP dY V 1-2 R
USER RAD 12 4



Equation Libraries in Detail

#	Eq. NAME	Description	CF00 <- Options -> SF00
1	"<)RLC	Delay angle RLC	Serial RLC / Parallel RLC
2	"BERN-A	Bernoulli w/Areas	
3	"BERN-V	Bernoulli w/Velocities	
4	"CATNRY	Catenary Equation	$d = H.[1 - (1/\cosh(V/2a))]$
5	"F=Ma	Force Equation	
6	"F=MM/R2	Gravitation	
7	"HEATX	Heat Exchangers	Counterflow / Parallel Flow
8	"HERON	Heron Formula	
9	"ISENT	Isentropic Flow	
10	"KEPLR	Kepler Equation	
11	"MPAD	Michell Pad	
12	"MVT	Linear Movement	$x = x0 + v.t + 1/2 a.t^2$
13	"ORBIT	Orbital Trajectory	$e = \sqrt{1 + [Vo^2 - 2g(Ro^2/r)][r.Vo.\cos a / g.Ro]^2}$
14	"PRJT-D	Projectile Displacement	X-Coordinate / Y-Coordinate
15	"PRJT-V	Projectile Velocity	X-Coordinate / Y-Coordinate
16	"PV=ZNT	Ideal Gas EOS	
17	"R1+R2	Parallel Resistors	
18	"REDLCH	Redlich-Kwong EOS	
19	"RFLC	Resonance Frequency RLC	
20	"RPM=TP	Torque Equation	
21	"SRL-AC	Serial RL AC Control	
22	"TVM	Time Value of Money	Begin mode / End mode
23	"V=IR	Ohm's Law	
24	"VMOD	Vector Module	
25	"VWAALS	Van-der Waals EOS	
26	"Y=aX+b	Linear Equation	$P1 = a.x + b$
27	"Y=PX2	Quadratic Equation	$P2 = a0 + a1.x + a2.x^2$
28	"Y=PX3	Cubic Equation	$P3 = 1 + a1.x + a2.x^2 + a3.x^3$

FROOT Based:

#	NAME	Description	Equation
1	LINEAR	Line Equation	$Y = Ax + B$
2	QUADRATIC	Quadratic Equation	$Y = A.x^2 + .Bx + C$
3	CUBIC	Cubic Equation	$Y = A.x^3 + B.X^2 + C.x + D$
4	4TH ORDER	Quartic Equation	
5	POSROOT	Positive Root	$x1 = (-B + \sqrt{B^2 - 4A.C}) / 2A$
6	NEGROOT	Negative Root	$x2 = (-B - \sqrt{B^2 - 4A.C}) / 2A$
7	OHMS LAW	Ohm's Law	$E = I.R$
8	PARALLEL R	Parallel Resistors	$1/R1 = 1/R1 + 1/R2$
9	RLC FREQ	RLC Oscillator	$F0 = 1/\sqrt{L.C}$
10	GAS EQUATION	Perfect Gas Equation	$P.V = N.R.T$
11	LIN. MOTION	Linear Motion	$X = V.T + 1/2 A.T^2$
12	NEWTONS LAW	Newton's Law	$F = G. M1.M2/R^2$
13	INTEREST	Compound Interest	
14	+TVM END MODE	Extended version-1	
15	+TVM BEGIN MODE	Extended version-2	
16	...add your own equations here...		

Formula-Eval Based:

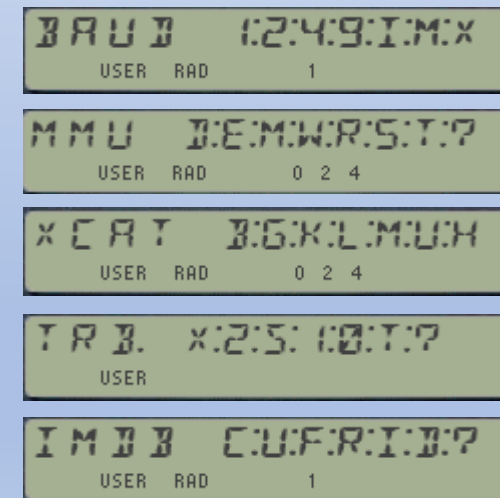
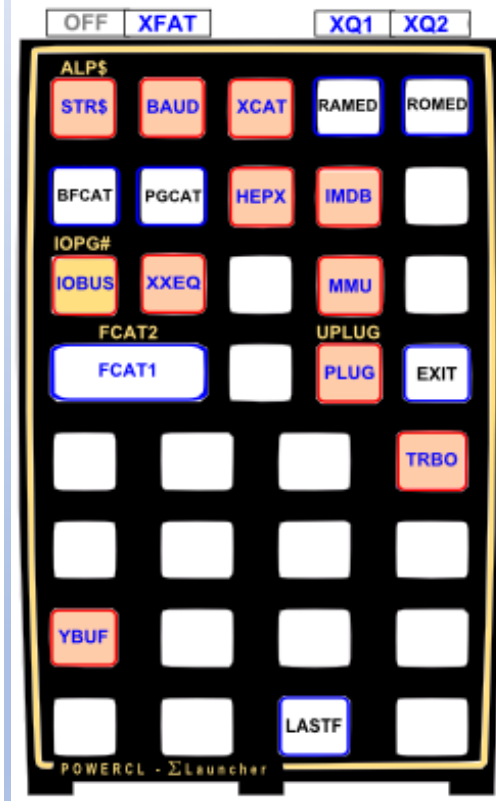
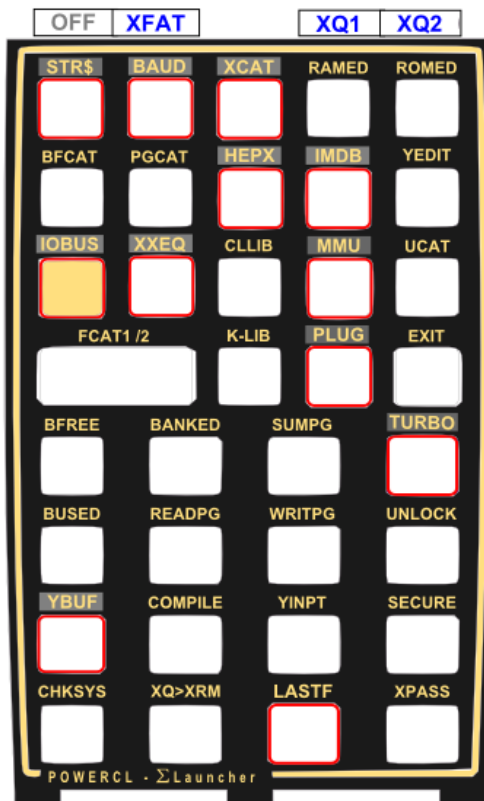
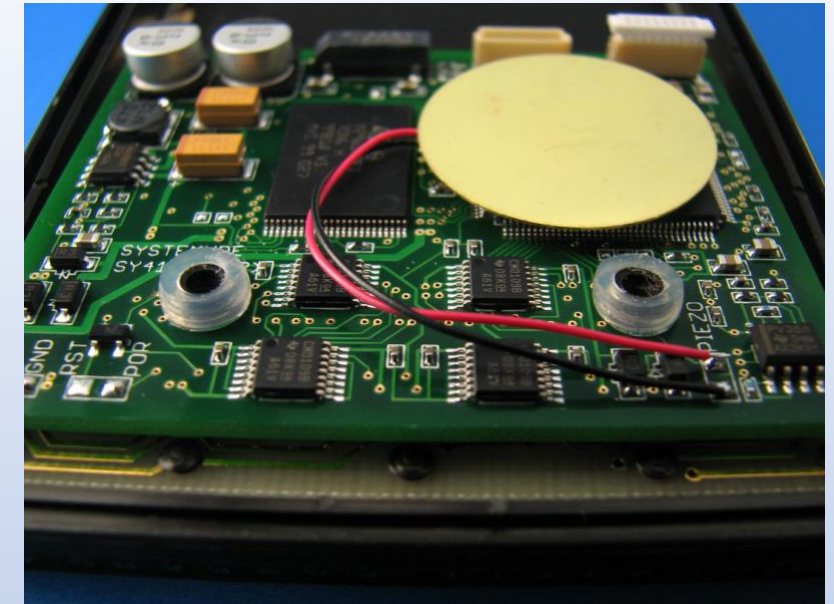
1	LBL "ESLV"	1	LBL "ELSV+" ←
2	STOS 07	2	LBL 00 ←
3	LBL 00 ←	3	RCL\$ 07
4	EVALZ	4	EVALT
5	X<>Y	5	RCL\$ 11
6	EVALT	6	EVALT
7	Z=T?	7	R^
8	RTN	8	STO T(0)
9	"Y-Z*(Y-X)/(Z-T)"	9	RDN
10	EVAL\$	10	X<>Y
11	FS? 10	11	RCL\$ 07
12	VIEW X(3)	12	EVALT
13	RCL\$ 07	13	Z=T?
14	X#Y?	14	RTN
15	GTO 00 ←	15	"Y-Z*(Y-X)/(Z-T)"
16	END	16	EVAL\$
		17	FS? 10
		18	VIEW X(3)
		19	X#Y?
		20	GTO 00 ←
		21	END

SY-41CL Specials



SYSTEMYDE INTERNATIONAL

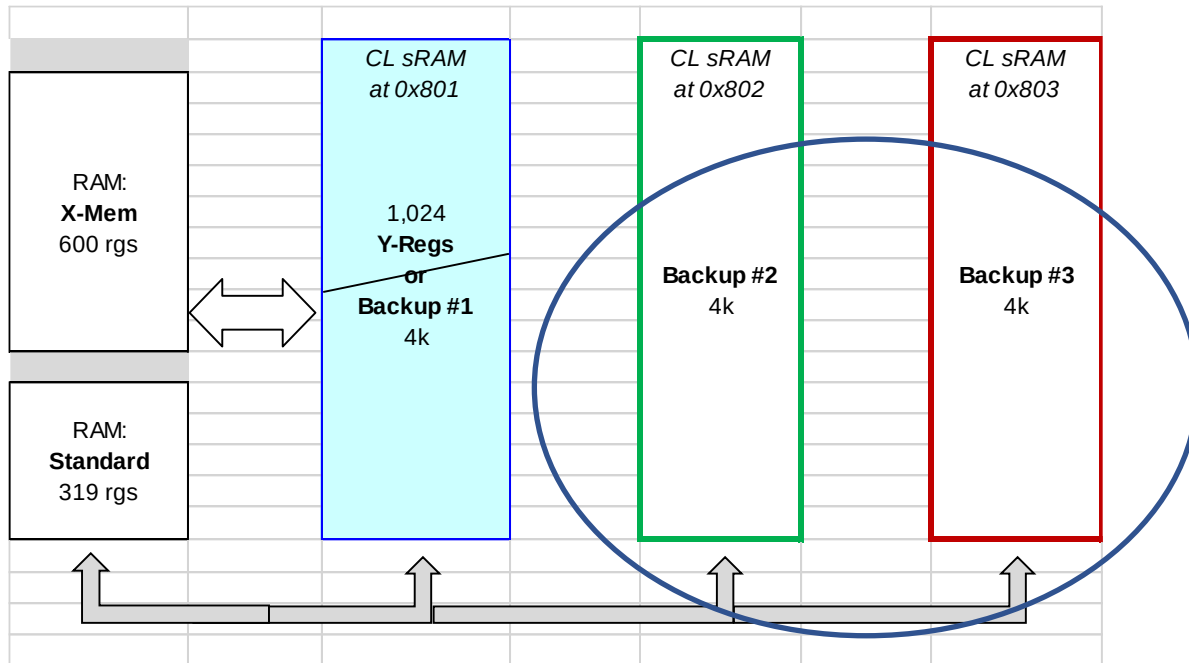
41CL



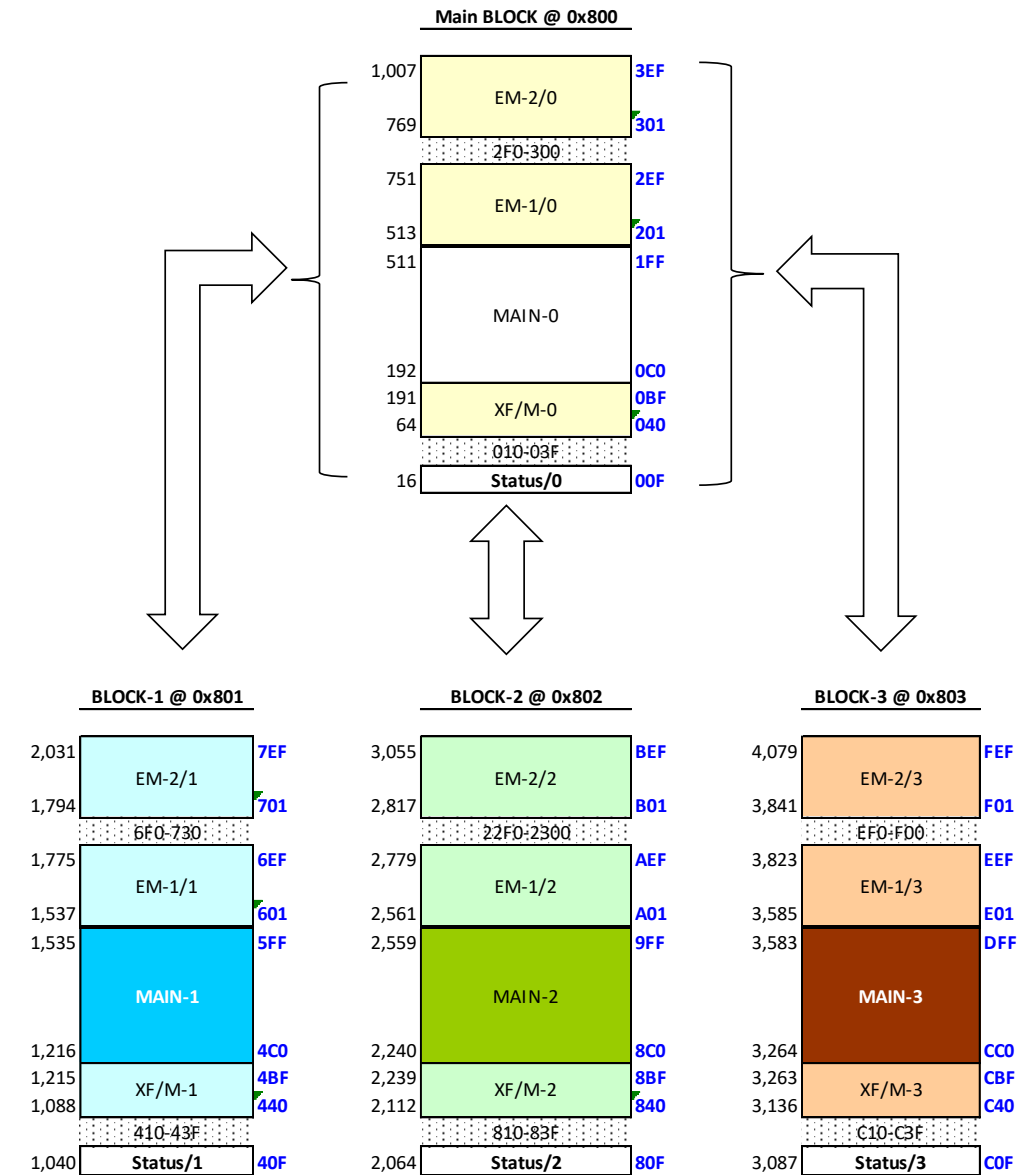
Hyper-spacing sRAM (CL only)

SY SYSTEMYDE INTERNATIONAL 41CL

- Conceptual scheme of the different CL sRAM blocks
- Uses can be: (1) Back-up or (2) direct Access



- *Can also be used by SandMatrix functions (up to 50x50 Linear Systems)*



Expanded Y-Registers (CL only)

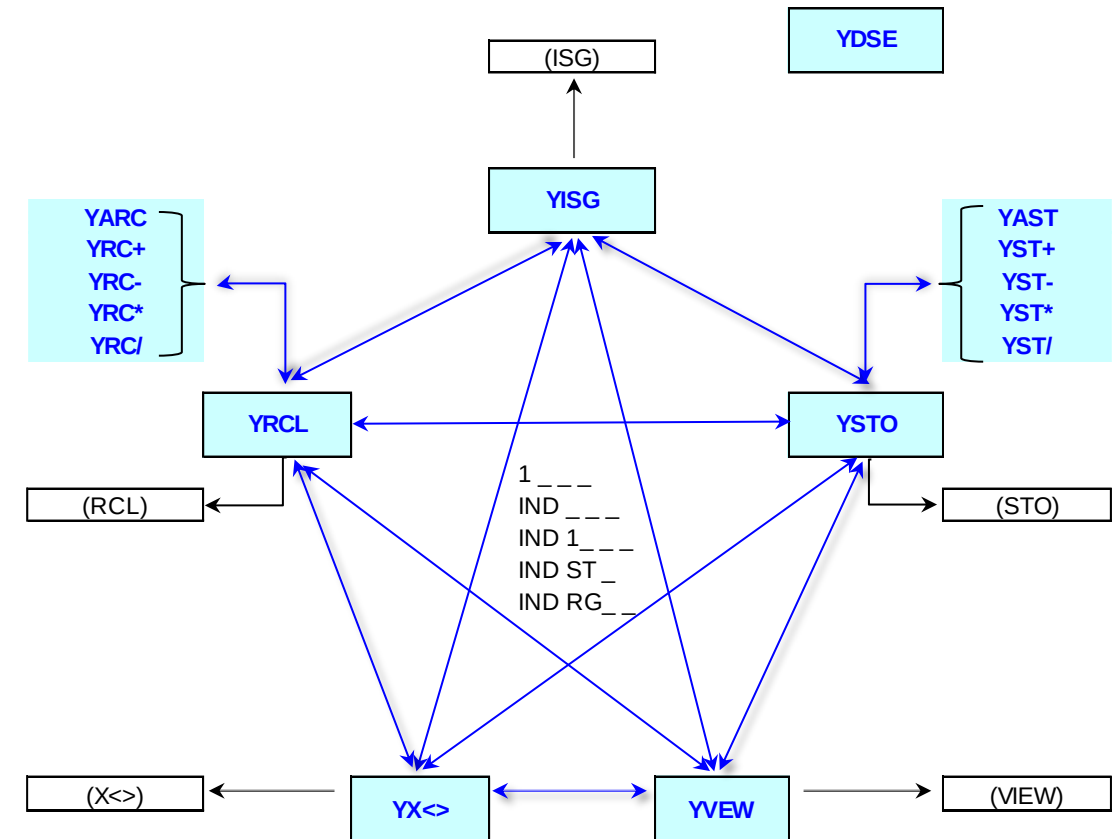
SY SYSTEMYDE INTERNATIONAL **41CL** [XPMM]

- 1,024 Directly accessible Y-Regs (!)
- 3,072 available for Matrix Functions (!!)
- STO/RCL Math, ISG/DSE, ALPHA, etc...
- Supports IND, ST, RG, and combinations
- *All Programmable but not all meant for PRGM use*



- *Can you spot something different?*

Extended Regs	Store	Recall	Other	X-Blocks
Y-Register : From 0 to 1,023. Use EEX for the Fourth digit field.	YSTO ____	YRCL ____	YX<> ____	CLYRG
	YST+ ____	YRC+ ____	YVEW ____	CLYRGX
	YST- ____	YRC- ____	YDSE ____	YRGMOV
	YST* ____	YRC* ____	YISG ____	YRGSWP
	YST/ ____	YRC/ ____	YFINDX	ST<>YRG ____
ALPHA	YAST ____	YARC ____		A<>YRG ____



Y-Registers Applications ROM

- YDUMP, YSHFT – Complete & Selective Reg. Copy
- YINPT, YOUPT – Y-Reg. Input/Output driver
- YRAN, YSORT – Random and Sorted Y-Reg. Block
- YM<>RM – Matrix Formats Exchange (JMB/ADV)
- Y-REG versions of PPC Matrix & Block Routines
- Y-REG versions of JMB_Matrix Programs

Function	Description	Dependency	Type	Author	#
-YJMB_MTRX	Section Header	n/a	MCODE	Ángel Martin	021.38
"CRYMAT	Create Matrix from function	XPMM	FOCAL	JM Baillard	021.39
M*M	Matrix Product	CL, Lib#4	MCODE	Martin-Baillard	021.40
MNORM	Matrix Norm	CL, Lib#4	MCODE	Martin-Baillard	021.41
TRACE	Matrix Trace	CL, Lib#4	MCODE	Martin-Baillard	021.42
"YDET	Determinant	XPMM	FOCAL	JM Baillard	021.43
"YLS	Linear Systems	XPMM	FOCAL	JM Baillard	021.44
"YLS1	Linear Systems (variant)	XPMM	FOCAL	JM Baillard	021.45
"YM-	Matrix Subtraction	XPMM	FOCAL	JM Baillard	021.46
"YM+	Matrix Addition	XPMM	FOCAL	JM Baillard	021.47
"YM*	Matrix Product	XPMM	FOCAL	JM Baillard	021.48
"YMC0	Matrix Copy	XPMM	FOCAL	JM Baillard	021.49
"YMINV	Inverse Matrix	XPMM	FOCAL	JM Baillard	021.50
"YMNORM	Matrix Norm	XPMM	FOCAL	JM Baillard	021.51
"YMPL	Matrix Polynomial	XPMM	FOCAL	JM Baillard	021.52
"YMRCL	Recall Matrix	XPMM, OSX3	FOCAL	Ángel Martin	021.53
"YMSTO	Store Matrix	XPMM, OSX3	FOCAL	Ángel Martin	021.54
"YRANM	Random (integers) Matrix	XPMM, TIMER	FOCAL	JM Baillard	021.55
"YRNSYM	Symmetric RANM	XPMM, TIMER	FOCAL	JM Baillard	021.56
"YTRACE	Matrix Trace	XPMM	FOCAL	JM Baillard	021.57
"YTRN	Transpose Matrix	XPMM	FOCAL	JM Baillard	021.58
"YTRN2	Symmetric TRN	XPMM	FOCAL	JM Baillard	021.59

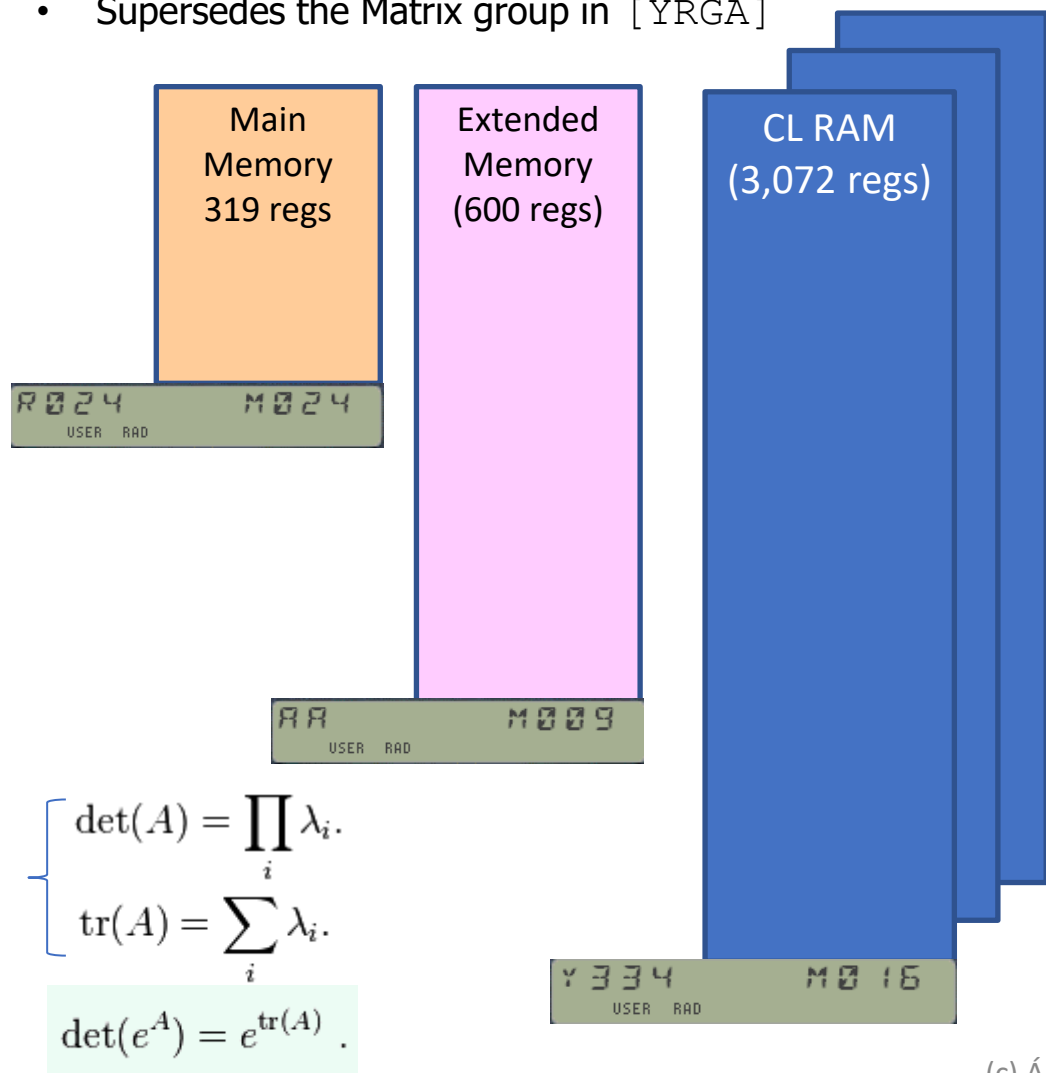
[YRGA]

Function	Description	Dependency	Type	Author	#
-Y-RGS_1B	Shows 'RUNNING...' msg.	Lib#4	MCode	Ángel Martin	021.00
STVIEW	Stack View	Lib#4	MCODE	Ángel Martin	021.01
YCRYPT	Encrypts Page	CL, OSX3	Hybrid	Ángel Martin	021.02
"YDUMP	Dumps Standard Regs into Y-	XPMM, OSX	FOCAL	Ángel Martin	021.03
"YINP	Inputs Y-Regs	XPMM, OSX	FOCAL	Ángel Martin	021.04
"YOUT	Outputs Y-Regs	XPMM, OSX	FOCAL	Ángel Martin	021.05
"YRAN	Enters Random values	XPMM, OSX	FOCAL	Ángel Martin	021.06
"YSHFT	Selective Std, Reg copy	XPMM, OSX	FOCAL	Ángel Martin	021.07
"YSORT	Sorts Y-Regs	XPMM	FOCAL	JM Baillard	021.08
"YM>RM	Moves matrix to Standard Regs	XPMM, ADVTG	FOCAL	Ángel Martin	021.09
"RM>YM	Moves matrix to Y-Regs	XPMM, ADVTG	FOCAL	Ángel Martin	021.10
-YPPC_MTRX	Section Header	n/a	MCODE	Ángel Martin	021.11
"QR	Quotient / Remainder	none	FOCAL	PPC	021.12
"YMIO	Matrix I/O	XPMM	FOCAL	PPC	021.13
"YRRM	Row Reduction Matrix	XPMM	FOCAL	PPC	021.14
"YM1	Interchange two rows	XPMM	FOCAL	PPC	021.15
"YM2	Multiply row by constant	XPMM	FOCAL	PPC	021.16
"YM3	Add multiple of row to another	XPMM	FOCAL	PPC	021.17
"YM4	Register address to (i, j)	XPMM	FOCAL	PPC	021.18
"YM5	(i, j) to Register address	XPMM	FOCAL	PPC	021.19
"YS1	Stack Sort	XPMM	FOCAL	PPC	021.20
"YS2	Small Register Sort	XPMM	FOCAL	PPC	021.21
"YS3	Large Register Sort	XPMM	FOCAL	PPC	021.22
-YPPC_BLK	Section Header	n/a	MCODE	Ángel Martin	021.23
"YBC	Block Clear	XPMM	FOCAL	PPC	021.24
"YBE	Block Exchange	XPMM	FOCAL	PPC	021.25
"YBI	Block Increment	XPMM	FOCAL	PPC	021.26
"YBM	Block Move	XPMM	FOCAL	PPC	021.27
"YBR	Block Rotate	XPMM	FOCAL	PPC	021.28
"YBV	Block View	XPMM	FOCAL	PPC	021.29
"YBX	Block Extrema	XPMM	FOCAL	PPC	021.30
"YB?	Block Statistics	XPMM	FOCAL	PPC	021.31
"YDR	Delete Record	XPMM	FOCAL	PPC	021.32
"YIR	Insert Record	XPMM	FOCAL	PPC	021.33
"YMS	Memory to Stack	XPMM	FOCAL	PPC	021.34
"YPR	Pack Registers	XPMM	FOCAL	PPC	021.35
"YSM	Stack to Memory	XPMM	FOCAL	PPC	021.36
"YUR	Unpack Registers	XPMM	FOCAL	PPC	021.37

The SandMatrix on CL-steroids

SY SYSTEMYDE INTERNATIONAL **41CL**

- Supersedes the Matrix group in [YRGA]



13	12	11	10	9	8	7	6	5	4	3	2	1	0
"4"	File Addr	LU?	# of Columns	Active ij			File Size						

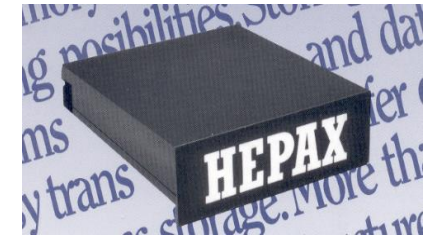
$$S_{ij} = \binom{n}{r} = \frac{n!}{r!(n-r)!}, \quad \operatorname{tr}(S_n) = \sum_{i=1}^n \frac{[2(i-1)]!}{[(i-1)!]^2} = \sum_{k=0}^{n-1} \frac{(2k)!}{(k!)^2}$$

$$i=1 \quad \begin{matrix} j=1 \\ \begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix} \end{matrix} \quad \begin{matrix} j=2 \\ \begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix} \end{matrix} \quad \begin{matrix} j=3 \\ \begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix} \end{matrix}$$

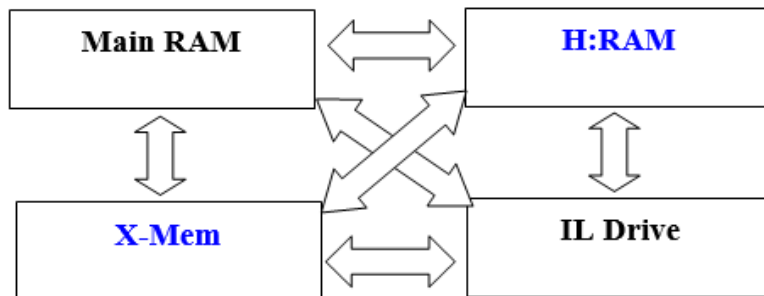
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
6	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
7	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
8	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
9	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
10	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
11	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
12	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
13	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
14	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
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19	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
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21	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1
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29	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
30	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0

HEPAX Revisited & Enhanced

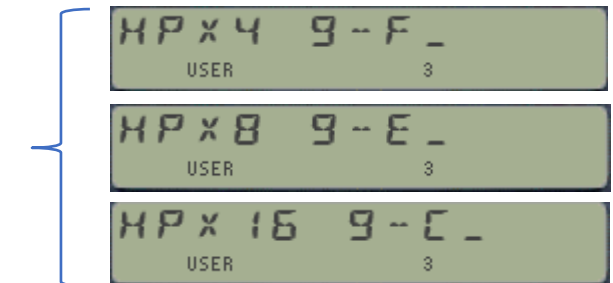
SY SYSTEMYDE INTERNATIONAL 41CL



- Dedicated HEPAX Launcher Group
- Choice of 4k, 8k, and 16k H:RAM setups
- Automated H:FileSys setup (HEPINI)
- Manual H:RAM Chain configuration
- Sub-function Catalogs and LastF support
- Added 18 Sub/functions
- ASCII H:RAM File Editor
- H:RAM <-> X-Mem File Conversion



- E: Exit the Editor
- R: Resize File
- G: Goto (and show) Record
- I: Insert Record at current pointer
- A: Append Record at end of File
- M: Move record (From: -> To:)
- C: Copy record (From: -> To:)
- S: Search for Text



Science & Engineering Modules (just my fav's)

ETSII Collection

[ETS3, ETS4, ETS5]

Dynamic Balancing
Holzer Method
Heat Transfer
Heat Exchangers
Binary Mixes

Liquefaction Cycles
Refrigerant Gases
Psychrometric Props.
Water Hammer
Joukowski Airfoils
Pump Association
Pipe Network Analysis

ETSII Collection –

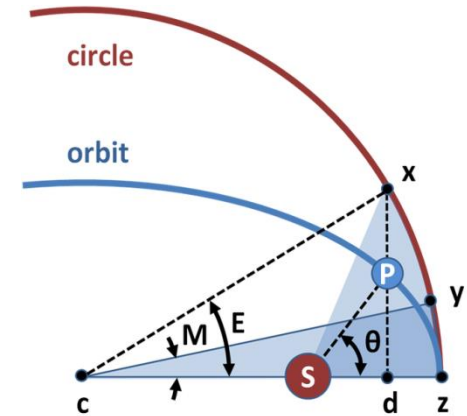
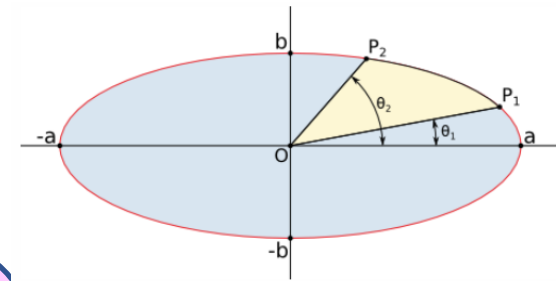
Con't [ETS9, FFE]

Two-Port Networks
Swing Equation
Power-Flow Equations
AC Regulator Design

Electric Circuits
Backwards LAP
Logical Networks
Frequency Response
Transfer Functions

Physics & Earth:

ELIX **Orbital Mechanics**
GRVI Gravity & Time
NBOD N-Body Problem
TIDW Tides ROM
PRTW US Ports
NONL Non-Linear ROM
EEFD EE Filters Design
LPLC Laplace Transforms
ISOL Interch. Solutions
INDO Indoor Lighting
LTLN Geodetics ROM
STEQ Steam Properties

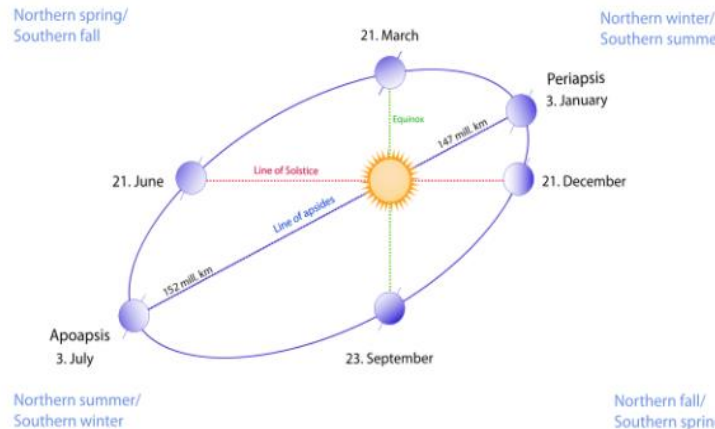
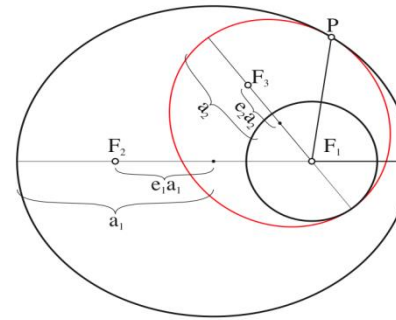
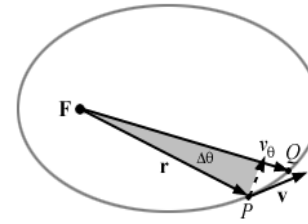


NOAA

NATIONAL OCEANIC AND
ATMOSPHERIC ADMINISTRATION
UNITED STATES DEPARTMENT OF COMMERCE

Orbital Mechanics 101

- Ellipse Central and Focal Sector Areas and Arc Lengths
- Elliptic Integrals and other Geometry Utils
- Orbital Position Determination & Time of Flight
 - *Kepler Equation and Direct approaches.*
- Orbital Velocity Determination:
 - *Conservation of Energy, Angular Momentum*
- Solar System Orbits & Gravitational parameters
- Delta-V orbit Simulator (HP Solution Book)
- Orbit Phasing, Co-Orbital & Co-Planar *rendez-vous*



-SOLAR SYS	Section Header	Doubles as ZOUT
EARTH	Planet orbital data	Puts data in R00-R02 & R06
JUPITER	Planet orbital data	Puts data in R00-R02 & R06
MARS	Planet orbital data	Puts data in R00-R02 & R06
MERCURY	Planet orbital data	Puts data in R00-R02 & R06
MOON	Satellite orbital data	Puts data in R00-R02 & R06
NEPTUNE	Planet orbital data	Puts data in R00-R02 & R06
PLUTO	Planet orbital data	Puts data in R00-R02 & R06
SATURN	Planet orbital data	Puts data in R00-R02 & R06
URANUS	Planet orbital data	Puts data in R00-R02 & R06
VENUS	Planet orbital data	Puts data in R00-R02 & R06
+VH12	Hohmann Transfers v1 & v2	M, R1, R2 in {Z,Y,X}
+VB123	Bi-Elliptic Transfer V1, V2, V3	(M, r1, r2, rb) in {T,Z,Y,X}
+VEa12	Elliptic Apogee Transfers V12	(r1, r2, r3, r4,M) in Stack & LastX
+VEb12	Elliptic Perigee Transfers V12	(r1, r2, r3, r4,M) in Stack & LastX
"CORV"	Co-Orbital Rendezvous	Prompts for Data
"CPRV"	Co-Planar Rendezvous	Prompts for Data

Function	Description	Input / Output
-ELLIP APPS	Section Header	n/a
BRHM	Area of Cyclic Quadrilateral	Data in R01-R04
CIRCLE	Circle through three points	P1, P2, P3 in Registers R01-R06
"ECS+"	Driver for ECS	Prompts for values
ECS	Elliptical Central Sector	{a,b,e} in R00-R02, a in X
EFS-	Elliptical Left Focal Sector	{a,b,e} in R00-R02, a,b in R03-04
"EFS+"	Elliptical Right Focal Sector	{a,b,e} in R00-R02, a,b in R03-04
HERON	Area of Triangle from sides	Data in X,Y,Z
"K2-"	Kepler 2nd. Law – Left Sector	Prompts for values
"K2+"	Kepler 2nd. Law – Right Sector	Prompts for values
"LCS"	Central sector Arc Length	Prompts for values
"LF+"	Right Focal sector Arc Length	Prompts for values
RAMA2	Ramanujan's 2nd. Approx.	a,b, in Y,X
TOF	Time of Flight	(T, e, q) in {Z,Y,X}
ZELIP1	Complex Elliptic Intg. 1st. kind	z in (Z,Y), m in X
ZELIP2	Complex Elliptic Intg. 2nd. kind	z in (Z,Y), m in X
-ORBITS 101	Section Header	n/a
E>M	Eccentric to Mean anomaly	(e, E) in Y,X
E>T	Eccentric to True Anomaly	(e, E) in Y, X
M>E	Mean to Eccentric anomaly	(e, M) in Y,X
T>E	True to Eccentric Anomaly	(e, T) in Y,X
"ORBIT"	Delta-V Orbit Simulator	Under program control
"TA<T>"	True Anomaly via Kepler	New Position w/Kepler equation
"TA+"	True Anomaly Direct Mode (+)	New Position using Right sectors
"TA-"	True Anomaly Direct Mode (-)	New Position using Left sectors
"<T"	Subroutine for Solve	Under program control
"V<R>"	Velocity "Vis Vivas"	Velocity at distance – Left focus
"VR+"	Velocity at Position R+	Velocity at distance - right focus
"VR-"	Velocity at Position R-	Velocity at distance - Left focus
T(μ)	Period from Gravitational data	Mass in Y, semi-major axis in X
μ1/2	Gravitational Parameter	Period in Y, semi-major in X
-AUX FNS	Section Header	Doubles as QROUT
<)C-R	Central angle to Radius	{a,b,e} in R00-R02, a in X
<)C-XY	Central angle to coordinates	{a,b,e} in R00-R02, a in X
<)C0+	Central angle for Focal 90°	{a,b,e} in R00-R02. Lifts stack
<)C>F	Central to Focal angle	{a,b,e} in R00-R02, a in X
<)F>C	Focal to Central angle	{a,b,e} in R00-R02, a in X
<)F0+	Right focal angle at x=0	{a,b,e} in R00-R02. Lifts stack
<)F0-	Left Focal angle at x=0	{a,b,e} in R00-R02. Lifts stack
<)F>R-	Left Focal angle to radius	{a,b,e} in R00-R02, a in X
<)F>R+	Right focal angle to radius	{a,b,e} in R00-R02, a in X
"?ab"	Prompts for semi-axis	New value or R/S for current
"?<-"	Prompts for left-angles	New value or R/S for current
"?<)+"	Prompts for right-angles	New value or R/S for current
"?P"	Prompts for Period	New value or R/S for current
QROOT	Quadratic Eqn. Roots	c2, c1, c0 in Z,Y,X
V(X)	Velocity at abscissa X	Period in Y, abscissa in X

Odd Balls and Nerdies (gotta love them!)

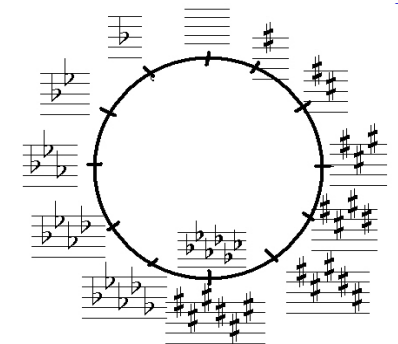
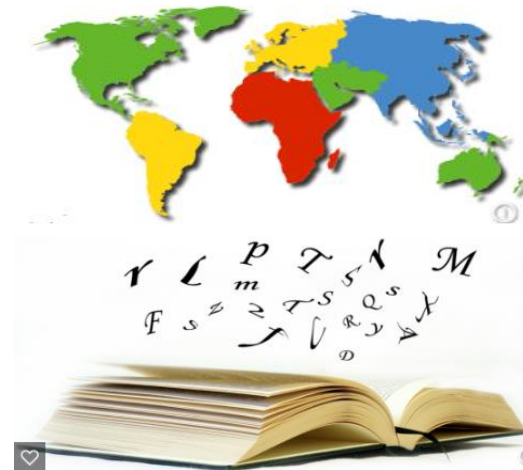
Path-finding in Metro Networks [METX]

5MAD Metro Madrid
5PAR Paris Metro
5LON London Tube
5UBH Berlin U-Bahn
NYSB NYC Subway



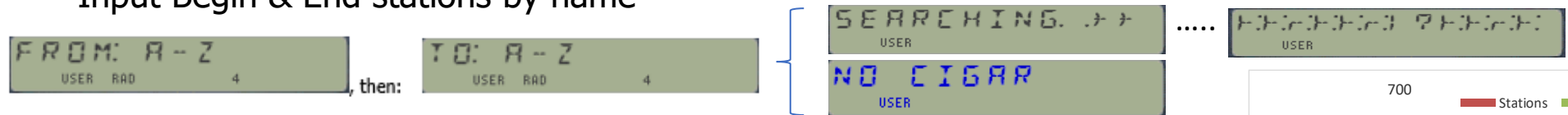
Three Originals:

SUD1 Sudoku & Sounds
CITY Country Capitals
WORD Dictionary
English<>Spanish

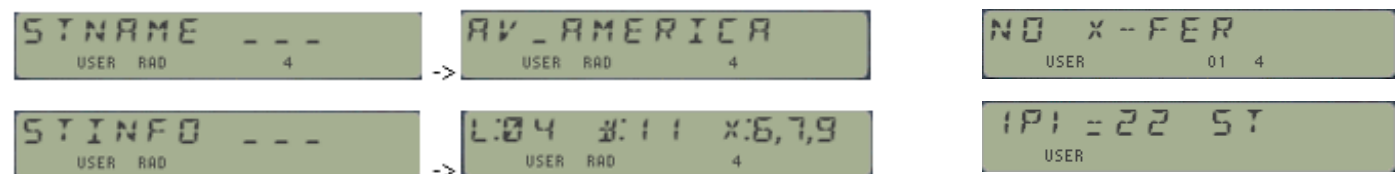


Path-finding in Subway Networks

- Input Begin & End stations by name



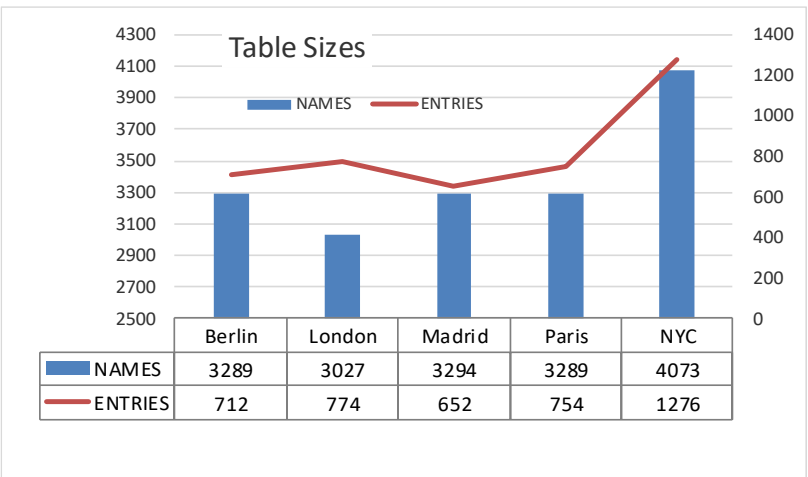
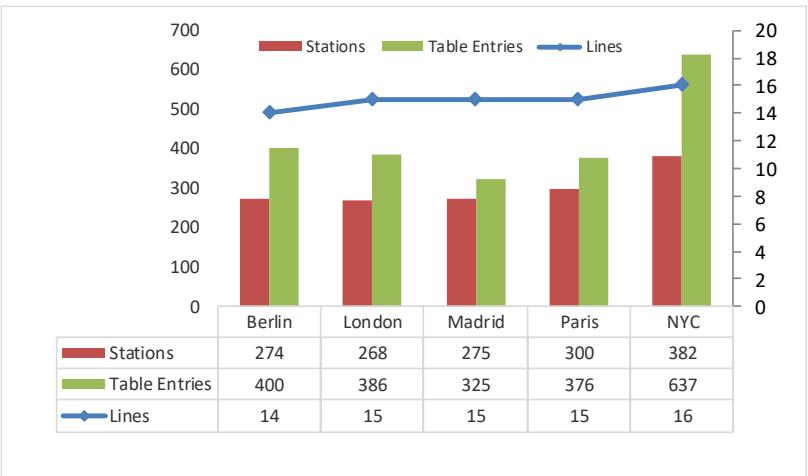
- Individual Station details and From/To Transfer Info



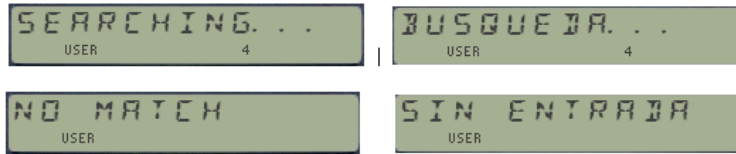
- Consolidated function launchers (connected)



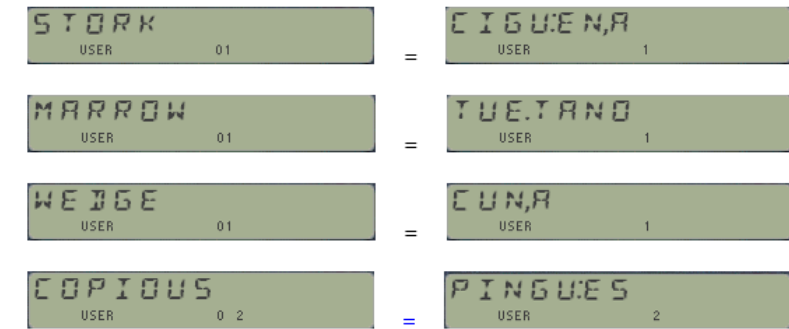
Key	LEVEL 0:1:2:3:X:~	Key	XFER +:-:~:~:~:~:~:~
[0]	LEVEL0	[+]	NEXTX
[1]	LEVEL1	[-]	PREVX
[2]	LEVEL2	[*]	NEARX
[3]	LEVEL3	[C]	CHANGE
[X]	XPLORE	[H]	LHEAD
[ENTER]	^PATH	[T]	LTAIL
[?]	XPLORE	[?]	?MAP
[SHIFT]	XFER _	[SHIFT]	LEVEL _
[ALPHA]	STNAME	[ALPHA]	STNAME
[PRGM]	STINFO	[PRGM]	STINFO



Words and Cities in detail



- Enumeration by types & kinds
- Tilde & special chars on LCD
- *"I'm feeling Lucky"* selection



Function	Description	Input
-ENGL>SPAN	Section Header	n/a
SPANISH	Translates Word to Spanish	English word in ALPHA
NOUNS	Enumerates English Nouns	none
VERBS	Enumerates English Verbs	none
OTHER	Enumerates other English words	none
CHANCE	Retrieves one word at random	(time from Time Module)
WORD _ _ _	Retrieves a word by its index	Index# in Prompt
"WLIST"	Lists ALL English words	none
-ESPA>INGL	Section Header	n/a
INGLES	Translates Word to English	Spanish word in ALPHA
NOMBRES	Enumerates Spanish Nouns	None
VERBOS	Enumerates Spanish Verbs	None
RESTO	Retrieves other Spanish words	None
PALABRA _ _ _	Retrieves a word by its index	Index# in prompt
AZAR	Retrieves one word at random	(time from Time Module)
"LISTAP"	Lists ALL Spanish words	none
-DC TOOLS	Section Header	n/a
CLWAIT	Like PAUSE for the CL model	none
DTOA	Utility to write LCD to ALPHA	Text in LCD
"HANGM"	Hangman word-guessing game	Word in Alpha
INDICE	Gets index# in Spanish Table	Spanish word in ALPHA
RNG	Random Number Generator	Time from Time Module
WINDEX	Gets index# in English Table	English word in Alpha



Function	Description	Input
-COUNTRIES	Section Header	n/a
COUNTRY	Finds Country for Capital	City name in ALPHA
NEWORLD	New World Countries	none
EUROPE	European Countries	none
RESTOW	"Rest of the World" Countries	none
ANYLND	Retrieves one country at random	(time from Time Module)
LAND _ _ _	Retrieves a country by its index	Index# in Prompt
"RLIST"	Lists ALL Countries	none
AREV	Utility to Reverse ALPHA strings	Text in ALPHA
-CAPITALS	Section Header	n/a
CAPITAL	Finds Capital for Country	Country Name in ALPHA
AMERY	Enumerates New World Cities	None
EUROY	Enumerates European Cities	None
OTHER	Lists "Rest of World" Cities	None
CITY _ _ _	Retrieves capital by its index	Index# in prompt
ANYCTY	Retrieves capital at random	(time from Time Module)
"LISTAP"	Lists ALL capital cities	none
RNG	Random Number Generator	Time from Time Module

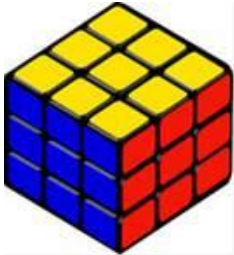
R&R: Fun Stuff & Playground

- Ain't such a thing as too much fun

CHES CH136 Chess
QUEN Queens NxN
RUBK Rubik's Cube
MAZZ Mazes
PPOK Poker ROM
FUNS Fun_Stuff
AGAM Action Games
GRMK Sammlung Book
GSPW Swap_Games
RGME Raw_Games
4WIN Connect Four
ZONE Game_Zone
MONO Monopoly
HORO Horoscope
MAHJ Mah-Jong Score

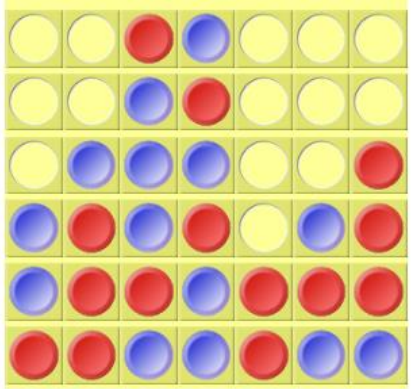
Adventure Games:
TREK/GAMX/ADV1

Trekkies
Dungeon
Explore
The Caves
Ghost Town
Black Tower
Tower of Skelos
Swords & Sorcery
Dungeon of Death
Terror Dam
Treasure Quest
French Adventure



CC POKER	
HAND RANKINGS	
ROYAL FLUSH	STRAIGHT
STRAIGHT FLUSH	THREE OF A KIND
FOUR OF A KIND	TWO PAIR
FULL HOUSE	ONE PAIR
FLUSH	HIGH CARD

HP-41	Casino	0	00	
1to18	1st12	1	2	3
		4	5	6
EVEN		7	8	9
		10	11	12
RED	2nd12	13	14	15
		16	17	18
BLACK		19	20	21
		22	23	24
ODD	3rd12	25	26	27
		28	29	30
19to36		31	32	33
		34	35	36
HP-41	Casino	2to1	2to1	2to1



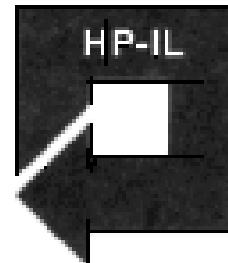
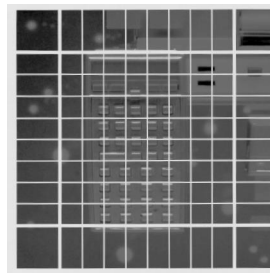
Move	Turns	Move	Turns
01	F:RDFD,D:FD:U:R:RU:	06	B,U,R,U,RF,LFL,U,L,U
02	R,FU:F,U:LUL,BU:B,U,	07	LUDFD,F,DFD,F,U,D
03	BUB, - stage2	08	FD,F,DFD,F,U,DFD,F,
04	F,U,FURUR,L,U,LUF	09	DFD,F,U:F,U:FRBLU:
05	UF,UB,U,BULUL,BU	10	L,B,R,F:ULR,F:RL,UF:

Office Informatics & Other Miscellaneous

SHTZ Spreadsheet / PAM
RCSN Recursion & MODMath
BASI BASIC & FIFTH
PSDB PASCAL & DataBanks
CRTO Cryptography
UCLN User Calendar
PPC9 PPC Statistics
GRAW PPC RAW Collection
TEDR Text Editors
DIGT Digit-Pack

From Swap Disks:

FSSY Focal Disassembly
SWP2 Swap Disks Routines
SWP3 Swap Math
GSWP Swap Games



AECROM Derivatives:

AEC3 13-digit AECROM
PROG Program Generation
GSLV Geometric Solvers

HEPAX Derivatives:

HEP2 CL Extended HEPAX
HEP3 HEPAX Applications
HDIS HEPAX Disassembler
HTAB Periodic Table

HP-IL Related:

DEV2 HPIL-Development+
ILBF IL-Buffer ROM
MASS Extended Mass Storage
GRF1 Grafik m.d. HP41 Plotter

Adapted Books & Literature

- The FOCAL Factory never sleeps...

PPCU PPC Manual Examples
 UCCD CCD Manual Examples
 CCDA CCD Advanced Apps
 2SWP SWAP Disks Routines
 3SWP SAWP Math Programs
 WWDB Wickes, Wlodeck, Dearing
 JARR Keith Jarret SP / XF
 MCCK Alan McCormak
 KRSS Karl-Heinz Krauss
 KRGM G. Kruse & KH Gossman
 REGU Control Systems
 VIEW HP-41 in der Praxis
 QMTH Prisma-Math
 PAPZ Published Papers
 UPLM UPL(E) Programs
 LUIZ, VONK User's Collections
 * * * * All HP Solution Books

Jean-Marc Baillard's

ASTT ASTRO ROM
 BSSL BESSEL ROM
 DIFF Differential Equations
 FRID Fractional Intgr./Diff.
 GMTY Geometry_11
 INTG Integrator ROM
 HCPL Hyper-Complex ROM
 JMBC JMB_Calendar
 JMAT JMB_Math
 JMTX JMB_Matrix
 NTHY Number Theory
 POLY Polynomial ROM
 QUAT Quaternions
 SPEC Spectral Analysis
 KNGT JMB_Knight's Tour

IMDB	Author	Title
n/a	Ken Emery	MCODE for Beginners
WWDB	Wlodek Mier-J.	Extend your HP-41
WWDB	John Dearing	Calculator Tips and Routines
WWDB	Cary E. Reinstein	HP41/HP-IL System Dictionary
WWDB	William C. Wickes	Synthetic Programming on the HP-41
n/a	HP. Co.	HP-41CX Owners Manual
n/a	W.M & F. Wales	RCL 20
MCCK	Alan McCormack	HP-41 Advanced Programming Tips
n/a	Kane, Harper, Ushijima	The HP-IL System
CURV	William M. Kolb	Curve Fitting for Programmable Calculators
SESA	José A. Mañón	Solutions for Structural Engineering
	Hollo, Holmes & Pais	Reservoir Economics & Engineering Manual
VOI1/3/5	Meehan & Vogel	HP-41 Reservoir Engineering Manual
n/a	William C. Wickes	HP41 / HP48 Transitions
JARR	Keith Jarret	Extended Functions Made Easy
JARR	Keith Jarret	Synthetic Programming Made Easy
n/a	Gary Friedman	Control the World w/ HP-IL
PPCU	PPC Members	PPC ROM User's Handbook
n/a	Depto. Escuela	Programas de Topografía
n/a	Depto. Escuela	Cálculo de Zapatas con la HP-41
n/a	Jean-Daniel Dodin	Au Fond de la HP-41C
n/a	Janick Taillandier	Autour de la Boocle
n/a	PH. Leys	Programmes D'Acoustique sur HP 41
n/a	Socotec	Calculs de Beton Armé sur HP 41
n/a	Various	Best of PRISMA
SHTZ	Herbert Mai	Lineares Optimieren
	Frank Altensen	Dienstprogramme (Tool-Kit)
VIEW	Stefan Fegert	HP-41 in der praxis
PSCL	Harald Schumny	HP-41 Sammlung
CRTO	Frank Altensen	Kryptologie-Programme
	Harald Schumny	HP-41 Hilfen und Anwendungen
KRGM	Gerhard Kruse	Optimales Programmieren m.d. HP-41
SWSW	Michael Gehert	S/W Entwicklung am Beispiel einer Dateiverwaltung
KRGM	Karl-Heinz Gosmann	Anwenderhandbuch
REGU	Peter Martin	Mathematische Verfahren der Regelungstechnik
GRMK / HORO	Fegert - Dalkowski	Eine Programmsammlung für den HP-41
n/a	Konrad Albers	HP-41 Barcodes mit dem HP-IL System
XBFR / XTRS	Alois Kammerl	Matrix Steigkeits Methode für den HP-41
EEFD	Dieter Lange	Algorithmen der Netzwerkanalyse für HP-41C
GRF1/3	Walter Prankel	Grafik mit dem HP-41 Plotter
KRSS	Karlheinz Krauss	Der HP-41 in Handwerk und Industrie
LDSP	Christoph Klug	HP-IL 2000 / HP-41C
UCCD	W&W GmbH	CCD Manual Examples

Appendices

Suggested 41CL Configurations
IMDB References by Category
HP-41 System Memory
MLDL Module Functions

Appendix: Suggested CL Configurations

Pg#	#0: Super User		#1: Math Machine		#2: Scientist's		#3: Informatics		#4: HP-IL	
	IMDB	XROM-Name	IMDB	XROM-Name	IMDB	XROM-Name	IMDB	XROM-Name	IMDB	XROM-Name
0-2	OS41	CX's O/S	OS41	CX's O/S	OS41	CX's O/S	OS41	CX's O/S	OS41	CX's O/S
3	XFN5	[25] CL-X/Functions	XFN5	[25] CL-X/Functions	XFN5	[25] CL-X/Functions	XFN5	[25] CL-X/Functions	XFN5	[25] CL-X/Functions
4	4LIB	Library#4	4LIB	Library#4	4LIB	Library#4	4LIB	Library#4	4LIB	Library#4
5	TMOD	[26] CL-Time Mod.	TMOD	[26] CL-Time Mod.	TMOD	[26] CL-Time Mod.	TMOD	[26] CL-Time Mod.	TMOD	[26] CL-Time Mod.
6	OSX3	[05] AMC_OS/X	OSX3	[05]AMC_OS/X	OSX3	[05] AMC_OS/X	OSX3	[05] AMC_OS/X	HPIL	[29/28] Printer / Mass Storage
7	YFNX	[15] Y-Fncs_Extrm.	YFNX	[15] Y-Fncs_Extrm.	YFNX	[15] Y-Fncs_Extrm.	YFNX	[15] Y-Fncs_Extrm.		
8	PWRX	[12] PwrCL_Extrm.	SM44	[03/02] SandMath	PWRX	[12] PwrCL_Extrm.	16CS	[16]HP16C Simulator	OSX3	[05] AMC_OS/X
9	WARP	[21] WARP Core			ISOL	[11] Equation Library	CRT0	[10] Cryptography	DEV2	[22/24] HP-IL Dev+
A	XPMM	[20] CL XP-Mem	4MTI	[22/24] SandMatrix	NONL	[17]Non-Linear Mod	RCSN	[09] Recursion & MA		
B	4TBX	[13] ToolBox ROM			XTAT	[06]Extended Stats	PWRX	[12] PwrCL_Extrm.	EXTI	[08] Extd IL - Skwid's
C	ROMX	[31] XROM ROM	Z4DL	[01/04] 41Z Deluxe	CURV	[04] Curve Fitting	BASI	[08/11] BASIC & 5 th	EXIO	[23] Extended-I/O
D	YUPS	[31] Y-Update							YFNX	[15] Y-Fncs_Extrm.
E	HPX2	[06] Hepax_4H	SERI	[18] Sums & Areas	EPTC	[17] Elliptic Apps	FRML	[30/31] Formula Evaluation	DACQ	[21/31] HP Data Acq.
F	HEPR	[14] Hepax RAM	ADVG	[12] Advantage's Apps	ELIX	[16] Orbital Mechanics				

Suggested CL Configurations (Con't)

Pg#	#5: Electrical Eng.		#6: Mechanical Eng.		#7: Maps & Words		#8: Playground		#9: Brainy Games	
	IMDB	XROM-Name	IMDB	XROM-Name	IMDB	XROM-Name	IMDB	XROM-Name	IMDB	XROM-Name
0-2	OS41	CX's O/S	OS41	CX's O/S	OS41	CX's O/S	OS41	CX's O/S	OS41	CX's O/S
3	XFN5	25-CL-X/Functions	XFN5	25-CL-X/Functions	XFN5	25-CL-X/Functions	XFN5	25-CL-X/Functions	XFN5	25-CL-X/Functions
4	4LIB	Library#4	4LIB	Library#4	4LIB	Library#4	4LIB	Library#4	4LIB	Library#4
5	TMOD	26-CL-Time Mod.	TMOD	26-CL-Time Mod.	TMOD	26-CL-Time Mod.	TMOD	26-CL-Time Mod.	TMOD	26-CL-Time Mod.
6	OSX3	05-AMC_OS/X	OSX3	05-AMC_OS/X	OSX3	05-AMC_OS/X	OSX3	05-AMC_OS/X	OSX3	05-AMC_OS/X
7	YFNX	15-Y-Fncs_Extm.	YFNX	15-Y-Fncs_Extm.	YFNX	15-Y-Fncs_Extm.	YFNX	15-Y-Fncs_Extm.	YFNX	15-Y-Fncs_Extm.
8	ETI5	10/20 ETSII-5	ETI3	12 ETSII-4	METX	30-Metro Paths	FUNS	10 FUN-Stuff	CHES	08 Chess (CH-36)
9					5MAD	30-Madrid Map				
A	EEFD	17/18 EE Filters	ETI4	08/14 ETSII-5	WORD	31-Dictionary (EN<>SP)			PPOK	10-Poker & BJ
B					CITY	18-Country Cities			MAZZ	16-Mazes & Puzzles
C	UNIT	10-Unit Mng. Sys.	UNIT	10-Unit Mng. Sys.	CLND	12-HP Calendar	RUBK	08-Rubik's Cube	RWGM	18 Raw Games
D	CIRC	06-Circuit Anl.	MCHN	12-Machine Design Pac	SUD1	16-Sudoku & Sounds	4WIN	16-Connect Four		
E	EENG	15-Electrical Eng	MENG	16-Mechanical Eng. SB	CRT0	10-Cryptography	AGAM	13 Action Games	GSWP	09 Swap Games
F	ETI9	16-ETSII-6	NBOD	06-N-Body Problem	TREK	11-Trekkies				

Appendix: IMDB Reference - HP Application Pac

IMDB	XROM	Name	Size	IMDB	XROM	Name	Size
41AD	22/24	Advantage HP41	12k	NAVI	14	Navigation Pac	8k
AUTO	10	Autostart HP	4k	PETR	15/16	Petroleum Fluids	8k
AVIA	19	Aviation Pac	4k	REAL	11	Real State Pac	4k
CIRC	6	Circuit Analysis	4k	SECY	19	Securities Pac	4k
CLIN	19	Clinical Lab & Nuclr.	4k	STAN	5	Standard Apps	4k
FINA	4	Financial Decisions	4k	STAT	2	Statistics Pac	4k
GAME	10	Games Pac	4k	STRE	8	Stress Analysis	4k
HOME	9	Home Management	4k	STRU	7/19	Structural Analysis	8k
MCHN	12	Machine Design	4k	SURV	3	Surveying Pac	4k
MATH	1	Math Pac	4k	THER	13	Thermal & Transport	4k
IPRT	29	IR-Printer	8k	EXIO	23	Extended I/O	4k
RCRD	30	Card Reader	4k	DEVI	22/24	HPIL Development	8k
HIILM	28	HPIL Mass Storage	4k	PLOT	17/18	Plotter ROM	8k

Appendix: IMDB Reference - HP Solution Books

IMDB	XROM	Name	Size	IMDB	XROM	Name	Size
ANTS	16	Antennas	4k	HVAC	16	Heating, Ventilation & AirCon	4k
CNTL	14	Control Systems	4k	BSMS	18	Business, Sales, Mktg. & Stats	4k
EENF	15	Electrical Engineering	4k	LNDL	19	Lending & Lease	4k
MENG	16	Mechanical Engineering	4k	TEST	13	Test Statistics	4k
OPTO	16	Optometry	4k	GEOM	14	Geometry	4k
PHYH	15	Physics	4k	HMAT	12	High-Level Math	4k
FDYN	17	Fluid Dynamics	4k	LENG	14	Solar Engineering	4k
CHEM	20	Chemistry	4k	GSB2	16	Games Solutions Book	8k
CENG	12	Chemical Engineering	4k	CLND	12	HP Calendar	4k
CIVI	16	Civil Engineering	4k	TIME	06	Timer Solution	4k
CIVU	20	Civil Engineering Collection	8k	ISOL	11	Interchangeable Sols / Eqn. Library	4k
SESA	16	Structural Solutions	8k	----	16	HP Structural Design	8k

Appendix: IMDB Reference – Math ROMs

IMDB	XROM	Name	Size
MATH	1	Math Pac 1D	4k
HMAT	12	High-Level Math Sol. Book	4k
GEOM	14	Geometry Sol. Book	4k
4ZDL	1/4	41Z Deluxe	16k
SM44	3/2	SandMath 4x4	32k
4MTI	22/24	SandMatrix	16k
ADVG	12	Advantage Math	4k
VECT	14	Vector Analysis	4k
EPTC	17	Elliptic ROM	4k
SERI	18	Areas, Sums & Series	4k
SIHP	24	Solve & Integrate	4k
IERR	1	ierf ROM	8k
RCSN	9	Recursion & Modular Math	4k
FRID	18	Fractional Integro-Differentiation	4k

IMDB	XROM	Name	Size
POLY	6/9	Polynomials ROM	8k
BESL	2/3	Bessel ROM	8k
INTG	16	Integrator ROM	8k
DIFF	15	Differential Equations	8k
SPEC	8	Spectral Analysis	4k
JMAT	5/6	JMB Math	8k
JMTX	8	JMB Matrix	8k
NONL	17	Non-Linear ROM	4k
GMTH	11	Geometry-11	4k
VONK	16	Coert Vonk Collection	4k
NTHY	16	Number Theory	4k
LPLC	10	Laplace Transform	8k
3SWP	12/13	Swap Math	8k
QMTH	13	PRISMA Math Programs	8k

Appendix: IMDB Reference - Statistics & Finance

IMDB	XROM	Name	Size
STAT	2	Statistics Pac	4k
XTAT	6	Extended Stats ROM	4k
TVMY	22	Time Value of Money	4k
CURV	4	Curve Fitting ROM	8k
TEST	13	Test Statistics	4k
BSMS	18	Business, Sales, Mktg. & Stats	4k
LNDL	19	Lending & Lease Sol. Book	4k
HOME	9	Home Management Pac	4k
FINA	4	Financial Decisions Pac	4k
REAL	11	Real State Pac	4k
SECY	19	Securities Pac	4k
AFIN	21	Auto Financing (GMAC)	4k
GMAT	31	GM Auto Leasing (GMAC2)	4k
GMAT	21/31	GM Auto Leasing (GMAC3)	8k

IMDB	XROM	Name	Size
SMPL	16	Simplex ROM	4k
SHTZ	8	Spreadsheet ROM	4k
BVLU	3	Business Valuation	4k
CMGT	6	Capital Management	4k
FCS1	10	Market Forecaster - 1	4k
HPPA	8/12	Hypothetical Probate Plus	8k
RCTR	21	Beat the Racetrack	4k
DSTY	10	Data & Statistics	4k
BBSC	11-14	Banken Beratung Service	16k
BSHM	31/15/16	Bausparkasse Schwäbisch Hall	12k
PPC9	9/13	PPC Statistics Programs	8k
DMND	31	Diamond Teller	4k
SMCH	21/31	Speed Machine	8k
IMS4	31/21	IMS Media Reach & Frequency	8k

Appendix: IMDB Reference - Mechanical Engineering

IMDB	XROM	Name	Size
MCHN	12	Machine Design Pac	4k
PETR	16/16	Petroleum Fluids Pac	8k
STRE	08	Stress Analysis Pac	4k
THER	13	Thermal & Transport Science Pac	4k
MENG	16	Mechanical Engineering Sols.	4k
FDYN	17	Fluid Dynamics Solutions	4k
HCMP	21	HydraComp	4k
STEQ	12	Steam Properties	4k
ETI3	12	ETSII Collection - 3	8k
ETI4	8/14	ETSII Collection - 4	8k
GASL	1/2/3/4	GasProp-1	16k
GASU	5/6/7/8	GasProp-2	16k
SGSG	21	SGS Gas Module	4k
CVPK	21/31	Cv Pack	8k
FAIR	21/31	Fairfield Gear Design	8k

IMDB	XROM	Name	Size
OILW	21/31	Oil Well	8k
NEA1	21/31	SNEAP 1- Rheofluidics	16k
NEA2	11/10	SNEAP 2- Rheofluidics	16k
NEA3	13/14	SNEAP 3- Rheofluidics	16k
BUD1	10/21	Buderus-1	8k
BUD2	15/16	Buderus-2	8k
BUD3	9	Buderus-3	4k
OTRP	5/6	Oventrop Ventil	8k
MWK3	10	MWK-3	4k
MWK4	21/31	MWK-4	8k
VOI1	9	Reservoir Engineering – 1	8k
VOI3	10	Reservoir Engineering – 2	8k
VOI5	11	Reservoir Engineering - 3	8k
DRPS	31	Drilling Rig Platform	12k
CAB4	21/31	Schenk CAB-41	8k

Appendix: IMDB Reference - Civil /Military Engineering

IMDB	XROM	Name	Size
STRU	7/19	Structural Analysis Pac	8k
CIVI	16	Civil Engineering Solutions	4k
CIVU	20	Civil Engineering Collection	8k
SESA	16	Structural Solutions	8k
MUEC	21/31	Mücke Baustatik Module	8k
XBFR	30	Direct Stiffness Method	8k
XTRS	30	DSM - Trusses	8k
SDMO	31	Sto. Domingo – MOP Spain	4k
RRAP	13	Riprap Engineering	4k
KRMK	26	Kermi NT 2000	4k
TIDW	10	Tides	4k
PRTW	11	US Ports	8k
FFEE	14	AirCon Loads and Waterwell Strata	4k
HVAC	16	Heating, Ventilation & AirCon	4k

IMDB	XROM	Name	Size
MILE	21/31	Military Engineering	8k
AFDE	16/17	Artillery Fire Data Computer - 1	8k
AFDF	18/19	Artillery Fire Data Computer - 2	8k
L119	21/31	AFDC – L119	8k
MDP1	15/16	MDP-1	8k
MDP2	17/18	MDP-2	8k
SEAK	21	Sea King MK5	4k
TGT2	10	AP550 A2 Targeting	4k
TGT3	21/31	AP550 A3 Targeting	8k
TAFB	21/32	Tinker AFB	8k
WPNE	21/31	Weapon Effects	8k
MRTR	31	Mortar Fire	4k
----	21/31	E3A FMS Mod9	8k
----	31/21	120 mm	12k

Appendix: IMDB Reference - Electrical /Med. Engineering

IMDB	XROM	Name	Size
CIRC	6	Circuit Analysis Pac	4k
ANTS	16	Antennas Solutions	4k
CNTL	14	Control Systems Solutions	4k
EENF	15	Electrical Engineering Solutions	4k
ETI5	10/20	ETSII Collection - 5	8k
ETI9	16	ETSII Collection - 6	4k
HNDY	31	Handy Compact	4k
PRIQ	21/31	Portable Process & Device Design	8k
CMT2	4	CMT-200 Data Acquisition	4k
CMT3	9	CMT-300 Multimeter	8k
INDO	10	Philips Indoor Lighting	4k
EEFD	17/18	EE Filter Design	8k
LDSP	10	Loudspeaker Design	4k
REGU	9/10	Control Systems Book	8k

IMDB	XROM	Name	Size
LENG	14	Solar Engineering Solutions	4k
CLIN	19	Clinical Lab & Nuclr. Med. Pac	4k
OPTO	16	Optometry Solutions	4k
PHYH	15	Physics Solutions	4k
IDC1	21	Blood Glucose UG	4k
IDC2	21/22	ML-Insuline Dosage Computer	8k
OBCZ	31	Obstetrician System	4k
RADA	21	Radiation Calculations	4k
BCMW	8	BCMW (Food Industry)	8k
----	1/2	Abrafrac Formulations	8k
PKP2	14/15	Poul Kaarup's Math & Physics	8k
CHEM	20	Chemistry Solutions	4k
CENG	12	Chemical Engineering Solutions	4k
SWP5	12	Swap Engineering	8k

Appendix: IMDB Reference - Surveying / Aviation

IMDB	XROM	Name	Size
SURV	3	Surveying Pac 1B	4k
LAND	1	Land Navigation	4k
SIMM	4-31	Surveyor's Module Inc. CoOp	16k
SUPR	21/31	SUP-R-ROM	8k
USPS	21/31	Delivery Service USPS	8k
TOMS	6	Tom's ROM	4k
DST1	9/8/10	CalTrans Surveying	12k
VERM	27	VermPack 1A	4k
COOQ	31	SunShot CoOp	8k
TDSM	4-30	TDS Surveying - 1	16k
TDSI	5/12	TDS Surveying - 2	8k
TDSP	8/9	TDS Plotter	8k
RDII	31	Rhode Systems II	4k
GEDA	9/10	GeoData 126A	8k

IMDB	XROM	Name	Size
LTLN	9	Geodetics	4k
ENS1	21/31	ENS-41	8k
FSTK	16	Fish Stock Calculations	4k
PAPZ	10/16	Logging & Agricultural Eng.	8k
LOGA	21/32	Log Analysis	8k

AVIA	19	Aviation Pac	4k
B52B	21/31	Boeing B-52	8k
P3BC	9/31/21	P3B/C Aviation Pac 82	12k
AV1Q	31	Aviation 1Q	4k
FACC	10/11	300889 FACC	8k
141B	22/31	C141B FSC	8k
K135	21/31/16	KC135 Weight & Balance	12k
E-6A	21/31/10	E-6A Weight & Balance	16k

Appendix: IMDB Reference - Astronomy / Navigation

IMDB	XROM	Name	Size
ASTT	6/8	Astro-2010	16k
ALGY	31	Astro ROM	4k
NBOD	6	Gravitational N-Body Problem	4k
GRVI	16	Gravity and Time	8k
ELIX	16	Orbital Mechanics	4k
JMBC	17	JMB Calendar	4k
UCLN	18	User Calendar	4k
CLND	12	HP Calendar Solutions	4k
EPTN	23	Trans-Neptunian Planets	4k
PLAN	9	Planets	4k
PLTO	10	Plutoids	4k
1AST	23/24	Astro-10000	8k
BPRN	9	Precession & Nutation	4k
P18E	23/24	Planetary Ephemerides 2018	8k

IMDB	XROM	Name	Size
ASTI	24	Amateur Astronomy	4k
ASTU	31	Astro-1	4k
BEPT	10	Ellipsoidal Refraction	4k
BREF	9	Astronomical Refraction	4k
PKP5	18	Poul Kaarup's Timer Utils	4k
NAVI	14	Navigation Pac	8k
SR1B	11	SLANT-SR 1B	4k
NVCM	14/15	NAVCOM	8k
NPAC	14/15	Navigation Pack	8k
YACH	21/31	Bobby Schenk's Yacht	8k
PKP4	5	Poul Kaarup's Programs	4k

Appendix: IMDB Reference - Games ROMs

IMDB	XROM	Name	Size	IMDB	XROM	Name	Size
GAME	10	Games Pac	4k	ADV1	12	Adventure Games - 1	16k
GSB2	16	Games Solutions Book	8k	ADV2	13	Adventure Games - 2	16k
CHES	8	Chess & Board Games	8k	GAMX	12	Explorer Game	8k
FUNS	10	Fun Stuff Compendium	16k	4WIN	16	Connect Four Game	4k
QUEN	9	N-Queens	4k	GRAW	18	Gene's RAW Files	8k
TREK	11	Start Trek	4k	RUBK	8	Rubik's Cube Solver	4k
KNGT	31	JMB Knight's Tour	4k	MAHJ	10	Mah-Jong Score Keeping	8k
AGAM	13	Action Games	8k	PPOK	10	Poker and BlackJack	4k
MONO	16	Monopoly	8k	HORO	16	Horoscope	4k
SUD1	16	Sudoku & Sounds	4k	MAZZ	16	Mazes and Puzzles	4k
H67G	23	HP-67 Games	4k	ZONE	10	Game Zone	4k
RGME	18	Raw & MCODE Games	8k	DIVN	9	Divination ROM	4k
GSWP	9	Swap Games	8k	BJMX	6	Blackjack MAX 2E	4k
GRMK	10	Sammlung Spiele	8k	VEGS	6	Vegas 1C	4k

Appendix: IMDB Reference - Utilities and Informatics

IMDB	XROM	Name	Size
ZENR	5	ZENROM	4k
ZEPM	9	ZEPROM Programmer	4k
DBUG	3	MCODE Debugger	4k
CCDM	9/11	CCD Module	8k
OSX3	5	AMC_OS/X	16k
AEC3	18	AECROM 13-Digit	8k
PANA	5/9	PANAME ROM	8k
PPCR	10/20	PPC ROM	8k
MELB	12	Melbourne Eprom	4k
PMLB	12	PPC Melbourne	4k
4RAM	17	RAMPage	4k
4TBX	13	ToolBox	4k
WARP	21	WARP Core+	12k
ROMX	31	XROM ROM	4k

IMDB	XROM	Name	Size
FRTH	-	FORTH 41CX	8k
ICOD	19	I-Code ROM	4k
MLTI	3	Multi-Precision Library	4k
BASI	8/11	BASIC and Fifth	8k
APSC	20	Pascal & Data Banks	8k
16CS	16	HP-16C Simulator	16k
LADY	16	Lady Bug	8k
DIGT	24	Digit Pack	4k
FMRL	30/31	Formula Eval / MathApps ROM	8k
SLVF	30/31	Formula Eval / Equation Solver ROM	8k
NCHP	31	NoVo Chap	4k
NEXT	6	Next ROM	4k
SWSW	6	S/W Development Book	8k
ITCP	4	NutIP TCP/IP 1A	4k

Appendix: IMDB Reference - MLDL & MCODE

IMDB	XROM	Name	Size
HEPX	6	Hepax 1D Module	16k
HPX2	6	Hepax 4H Module (CL Version)	16k
ES41	4/6	Eramco ES-41 Database 85	8k
ROSV	4/6	RSU O/S Database 85	8k
ESML	10	Eramco ES MLDL 7B	4k
PRFS	27/31	MW's ProfiSet	8k
PSOF	16	MW's PS-OF	4k
RM32	31	W&W RAMBox 32	4k
WRAM	31	W&W RAMBox 64	4k
PCOD	16	NFC's Proto-Coder 1A	4k
PARI	14	NFC's Proto-Pario	4k
NFCR	17	NFC ROM 1B	4k
MLRM	21	MLDL2k ROM	4k
----	4	RSU Initialization	4k

IMDB	XROM	Name	Size
ASMB	21	Assembler-3	4k
ASM4	21	Assembler-4	4k
EPRH	4	ML Eprom 1H	4k
DAVA	2	David Assembler 2C	4k
MLBL	-	Mainframe Labels	4k
HDIS	9	Hepax Disassembler	4k
DA4C	14	DisAssembler 4C ROM	4k
DASM	15	DisAssembler 4D ROM	4k
LBLS	-	Labels for DisAssm	4k
FSSY	14	Swap's FOCAL DisAssembly	8k
BLDR	17	Build ROM (BLDROM)	4k
EPRM	16	MM EPROM	4k
MTST	3	Mountain Computer's Set EPROM	4k
ROAM	5	ROAM – 0A	4k

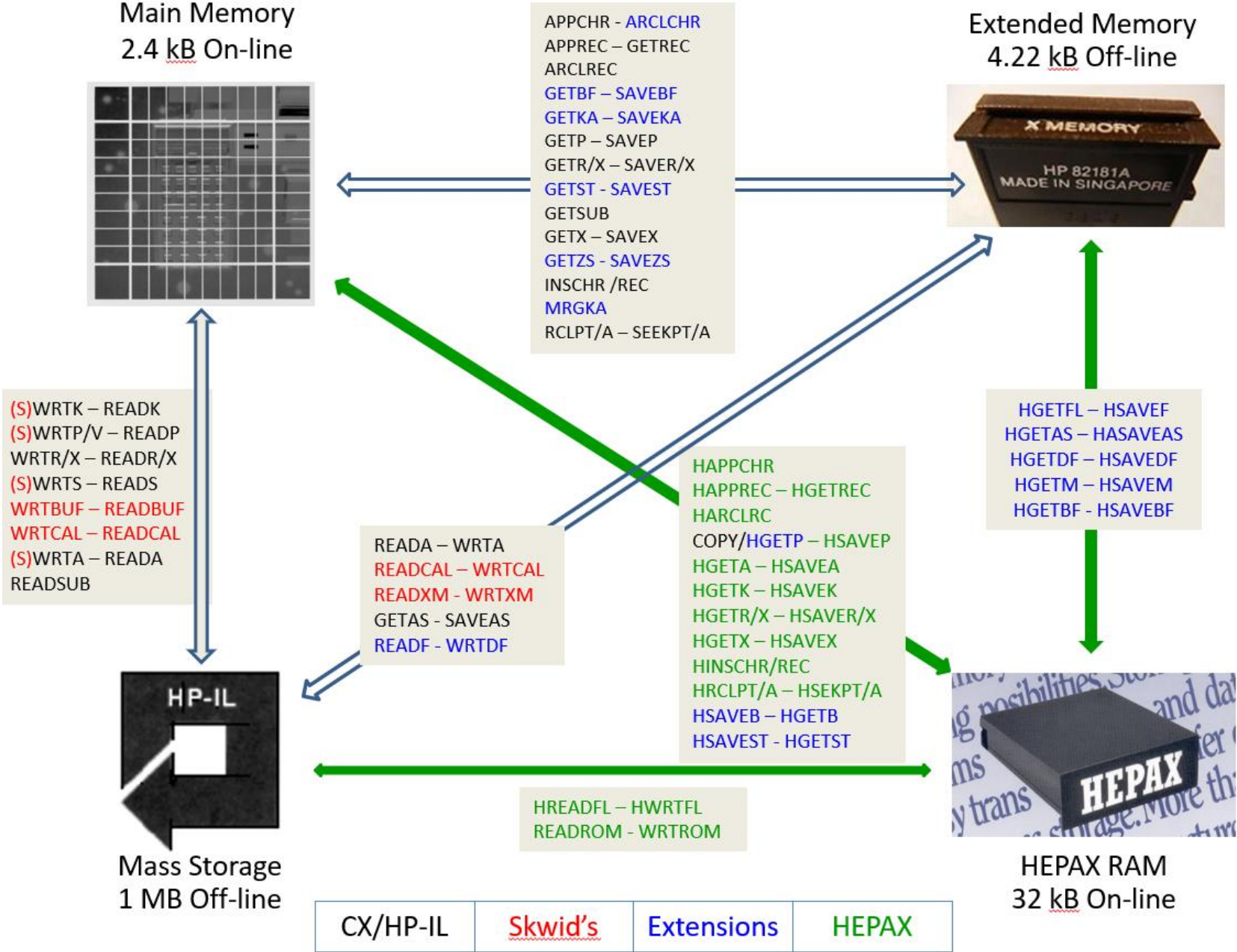
Appendix: IMDB Reference - Peripherals

IMDB	XROM	Name	Size
WPRT	29	HP 82143A Printer	4k
IPRT	29	HP Infrared Printer 3B	8k
RCRD	30	HP Card Reader 1G	4k
HWND	27	HP Barcode Wand 1F	4k
EXIO	23	Extended I/O	4k
DEVI	22/24	HP-IL Development	8k
HILM	28	HP-IL Cntl./Mass Storage 1H	4k
HILN	29	HP-IL Printer 2E	4k
PLOT	17/18	HP Plotter Module	8k
DACQ	21/31	3421 Control Module	8k
DIIL	19	HP-IL Diagnostics	4k
PSRV	-	Printer Service ROM	4k
AUTO	10	Autostart / Duplication ROM	4k
HSRV	-	HP Service 2A	4k

IMDB	XROM	Name	Size
YFNZ	15	Y-Extra Functions	4k
YFNP	15	Y-Extra Functions Plus	4k
YFNX	15	Y-Extra Functions Extreme	4k
YFNM	16	Y-Memory Functions	4k
YUPS	31	Y-Update Functions	4k
YCLN	31	Y-Clone Functions (Host)	4k
IMDB	-	Image Database	4k
FLDB	-	Flash Database	4k
PWRX	12	Power_CL Extreme	16k
XPMM	20	CL Expanded Memory	4k
YRGA	21	Y-Regs Applications	4k
SKWD	8	Skwid's BarCode ROM	4k
EXTI	8	Skwid's Extended IL	4k
EILP	27	Extended IL+	4k

Appendix:

HP-41 System Memory MLDL Modules



Main RAM

7P<>S
 CLMM
 CLP
 CLRAM
 CLRG/X
 CLΣ
 CLST
 CLX
 ENTER^
 PCLPS
 COPY
 LASTX
 NRCLX - NSTOY
 PC>X - X>PC
 PC<>RTN
 PACK
 PEEKR - POKER
 R^ - RDN
 RAMED/EDIT
 REGMOVE/SWAP RCLBM -
 STOBM
 ST>RG - RG>ST
 ST<>RG __
 ST>Σ - Σ>ST
 ST<>Σ
 (A)STO - (A)RCL
 STOFLAG - RCLFLAG
 SWAPR
 (P)SIZE
 X<>
 X<>BM
 X<>F
 X<>Y
 X<I>Y

ALPHA

A<>RG __
 A<>ST
 A>ST/ST>A
 A>RG - RG>A
 ABSP
 AINT /AIP /ARCLI
 ALENG/X/XY
 ANUM/DEL
 AREV
 ASHF/X - AROT/X
 ASWAP / USWAP
 AXEQ?
 (L)ATOX - XTOAL
 CLA/ -/ C/ ?
 LADEL/X
 LEFT\$ - MID\$ - RIGHT\$
 LOW\$ - UPR\$
 M<>N/O/P
 N<>O/P
 O<>P
 POSA
 PRESF/FX - POSTSP/FX
 RATOX - XTOA(R)
 REMZER
 XATOX - ASTOXX
 YTOAX / ASUB

I/O Area

ARCLBF - ASTOBF
 B? / BUF?
 BF>RGX - RGX>BF
 BF>ST - ST>BF
 BFHD
 BHEAD
 BFLNG
 BRFL - BFSTO
 CLB / DELBUF
 CLRBF
 CRBUF
 KACLR
 KALNG
 KAPCK
 REIDBF
 RESZBF

General XM

CLEM/CLXM
 FLCOPY
 RENMFL
 RETPFL
 FLDH
 FLSIZE
 PURFL
 RESZFL
 WORKFL

 GETBF - SAVEBF
 GETKA - SAVEKA
 GETST - SAVEST
 GETZS - SAVEZS
 MRGKA

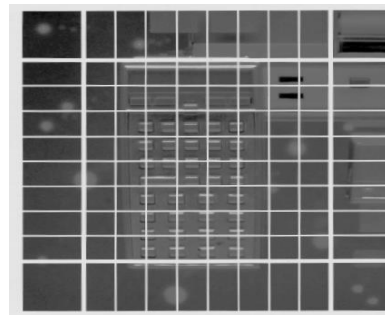
PRGM/DATA/ASCII

GETP - SAVEP
 GETSUB
 RSTCHK
 XQXM

 CRFLD
 CLFL
 GETR/X - SAVER/X
 GETX - SAVEX
 RCLPT/A - SEEKPT/A
 WRTDF - READF

 APPCHR - ARCLCHR
 APPREC - GETREC
 ARCLREC
 ASROOM
 CRFLAS
 DELCHR/REC
 ED / ED+
 GETAS - SAVEAS
 INSCHR /REC
 POSFL
 RCLPT/A - SEEKPT/A

Main Memory
 2.4 kB On-line



Extended Memory
 4.22 kB Off-line



-HEPAX 4H

CLRAM
CODE
COPYROM
DECODE/YX
DISASM
HAPPCHR/REC
HARCLRC
HASROOM
HCLFL
HCRFLAS
HCRFLD
HDELCHR/REC
HEPDIR/X
HEPROOM
HEXEDIT
HFLADR
HFLSIZE
HFLTYP
HGETREC
HINSCHR/REC
HPOSFL
HPROMPT
HPURFL
HRCLPT/A
HRENAME
HSAVEA - HGETA
HSAVEK - HGETK
HSAVEP - HGETP
HSAVER/X - HGETR/X
HSAVEX - HGETX
HSEC
HSEKPT/A
HUNSEC
HWRKFL
HWRTFL - HREADFL
PRIVATE
RAMTOG
READROM - WRTROM
RLSRAM

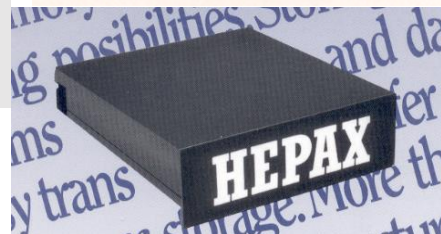
XF(A)

ALENG
ANUM
AROT
ATOX
CLEM
CLKEYS
CLRGX
GETKEY
GEYTKEYX
PASN
PCLPS
POSA
PSIZE
RCLFLAG
REGMOVE
REGSWAP
RTN?
SIZE?
ΣREG?
STOFLAG
X#NN?
X<=NN?
X<>F
X<NN?
X=NN?
X>=NN?
X>NN?
XTOA
XFCAT
XQ>GO
XQXM

HEPAX RAM
32 kB On-line

HEPAX(A)

AND
BCAT
BCD-BIN
BIN-BCD
CHKSYS
CTRAST
DELETE
HPCAT
INSERT
NOT
OR
PGROOM
PGSUM
ROMLST
ROTYX
SHIFTYX
X-\$
X+Y
XOR
Y-X



RAMBOX

BUFLNG?
CLLSTFL
CLPG
CLRFL
COPYPG
CRDIR
CRFLDTA
CRFLBUF
CRFLKEY
ENDPG
FNC?
FRBYT?
INITPG
KEYAS?
LDPGM
LDREG/X - GTREG/X
LDREGXY - GTREGXY LDKEY -
GTKEY
LDBUF - GTBUF
PG<>
PG?
PGSUM
PTCT
PG01/10
SETPRV
UNPTCT
WRTPG - READPG XQ>XR

RAMBOX
16 kB On-line / 16Kb Off-line





Profiset

CLDF
CLEM
CLPR
CLRSU
CLSEC
CRDF
DELFL
DF+ / - /* //
DPTDF
EXALL
EXEM
EXREG/X
EXST
FIND/I
FLDIR
INIDATA
INIPRGM
IPTDF
LOADP
MPTDF
RCLALL
RCLDF/X
RCLEM
RCLIDF
RCLREG/X

RCLST
READRAM
RENFL
RESDF
RLEFT?
RPTDF
RSTDF/X
SETSEC
SPTDF
STOALL
STODF/Y
STOEM
STOREG/X
STOST
SZ?DF
WRTRAM
X<>DF/Y
X=DF?
X<>DF?
X<DF?
X<=DF?
X>DF?
X>=DF?
X=PT?

ACHR/REC
AFLD
ALEN?
ASRM?
A=F? = A<>F?
A<F? – A>F?
A<=F? – A>=F?
CLAF
CRAF
DCHPT
DCHR/REC
DFLD
DRCPT
EDT
FINDPS
FLEN?
GCHR/REC
GFLD
ICHPT/R
IFLD
IRCPT
IREC
MCHPT
MRCPT
NAMA/DF

NFLD?
NREC?
NUMREC
OUTCHR/REC
OUTFLD
RCHPT/R
RESAF
RFLD
RLEN?
RRCPT/REC
RSTAF
SCHPT
SFPT
SRCPT
ST<>DF
SWPREC
SZ?AF
X<>CHR
?EOF

EP=BL?
EP=FF?
EPROM?
PROM
PBL
CLEAR
CLRN
COPYBL
IDBL
INIT
NAMEBL
NEWBL
NEXTBL
PACKBL/KC
REVL
SLCT
SUMBL
ADR>ID
BL? /A? /1A?
BLCAT/X
BLF?
CATF?
CATS?
ID?
LENG?
CHKBL
ID>ADR
REV?
SRV
TYP?
LADEP
PRVBL
PRVP
XROMBL/P
DATE2/5/7/N
DAT12/4/7/9
X>DATY
GETBL - SAVEBL
GETF - SAVEF
CLRS
EPACK
J?
L* / - /=
LADEK
LADES
N?
PKEY
PRM

