



HP-41 MAXX

MODULE CREATOR
MONTE J. DALRYMPLE

PROJECT UPDATE

PRESENTATION
SYLVAIN CÔTÉ

HHC 2023

Thanks to ...

- * Monte J. Dalrymple for ...
 - * his great hardware creations. (41CL, MAXX, etc.)
 - * his support and patience.
 - * his graphics used in this presentation.
 - * releasing a ROM archive update every month.
- * Ángel Martin for ...
 - * creating mind-blowing ROMs.
 - * his support and patience.
 - * his graphics used in this presentation.
- * Robert Prosperi for ...
 - * his support and patience.

INTRODUCTION

HP-41 MAXX

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Introduction

- * The HP-41 MAXX module is designed to expand an HP-41C, CV or CX calculator to the maximum capabilities envisioned for an HP-41 system.
- * The HP-41 MAXX module implements all of these 41C modules in a single physical module:
 - * Four Memory modules (82106A)
 - * One X-Functions/Memory module (82180A)
 - * Two X-Memory modules (82181A)
 - * One Time module (82182A)
- * The HP-41 MAXX module also adds these advanced features that were never part of the original HP-41 ecosystem:
 - * Three pages (each containing 1024 registers) of Expanded memory
 - * Twelve pages (each containing 4Kx10 bits) of RAM for instruction memory

Note: the above introduction is an excerpt from the HP-41 MAXX Module Manual (4C) by Monte Dalrymple.

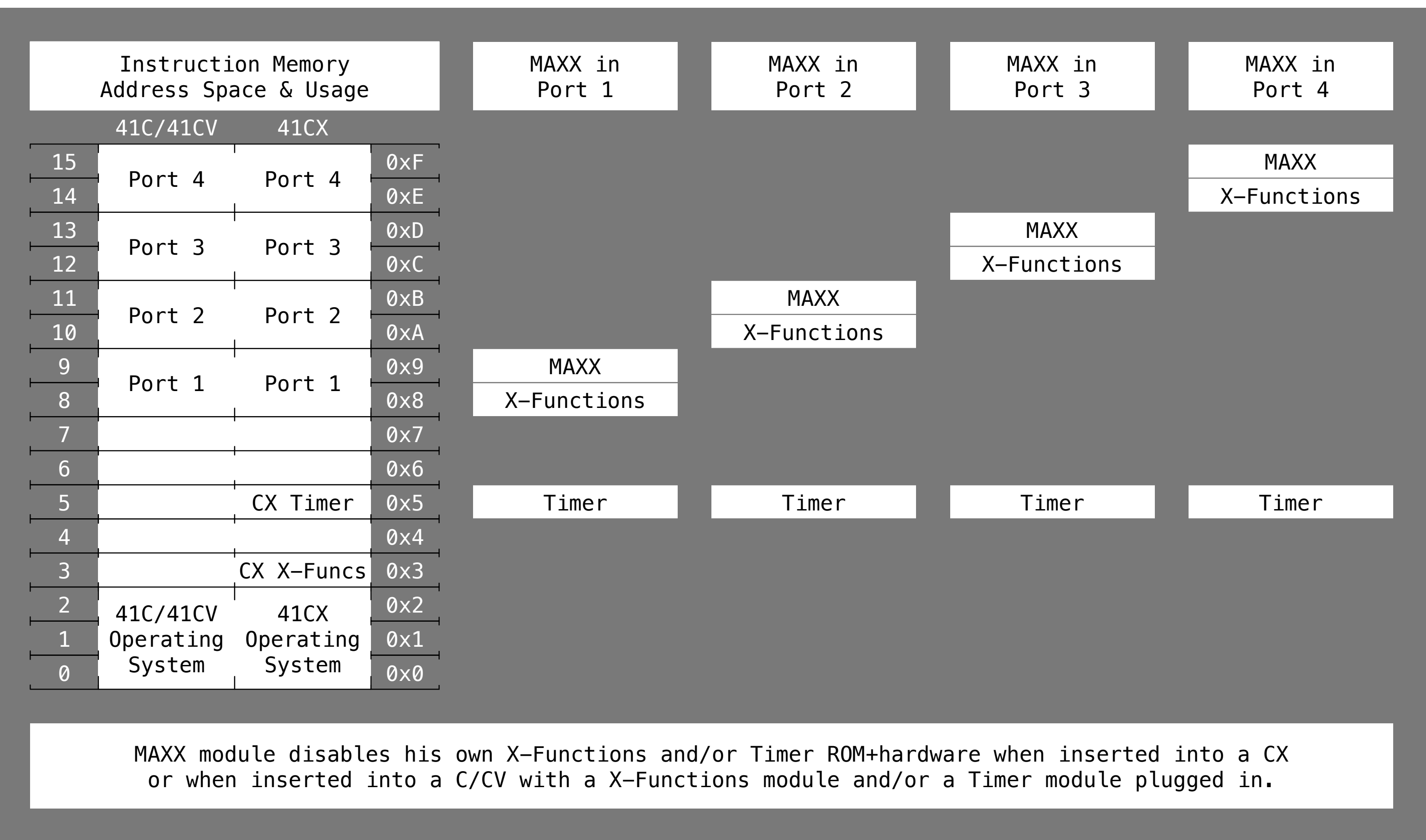
Summary

Feature	Target
* Adds 4 x 82106A memory modules, if missing.	C
* Adds 1 x 82180A X-Functions/Memory module, if missing.	CV : C
* Adds 2 x 82181A X-Memory modules, if missing.	CX : CV : C
* Adds 1 x 82182A Time module, if missing.	CV : C
* Adds 3 x 1K Y-Memory RAM registers.	CX : CV : C
* Adds 12 x 4K bank capable Q-ROM pages.	CX : CV : C
* Adds 1 x 4K MAXX ROM.	CX : CV : C

AUTOMATIC MODULES MAPPING

ROM IMAGES, MAIN MEMORY & EXTENDED MEMORY

ROM Images



In addition to its own MAXX ROM image, the HP-41 MAXX module, when inserted into a 41C or 41CV, adds the Extended Functions ROM image and the Time ROM image.

If the 41C/CV already has the X-F/M and/or Time ROM plugged in, the MAXX module will automatically deactivate the conflicting ROM images.

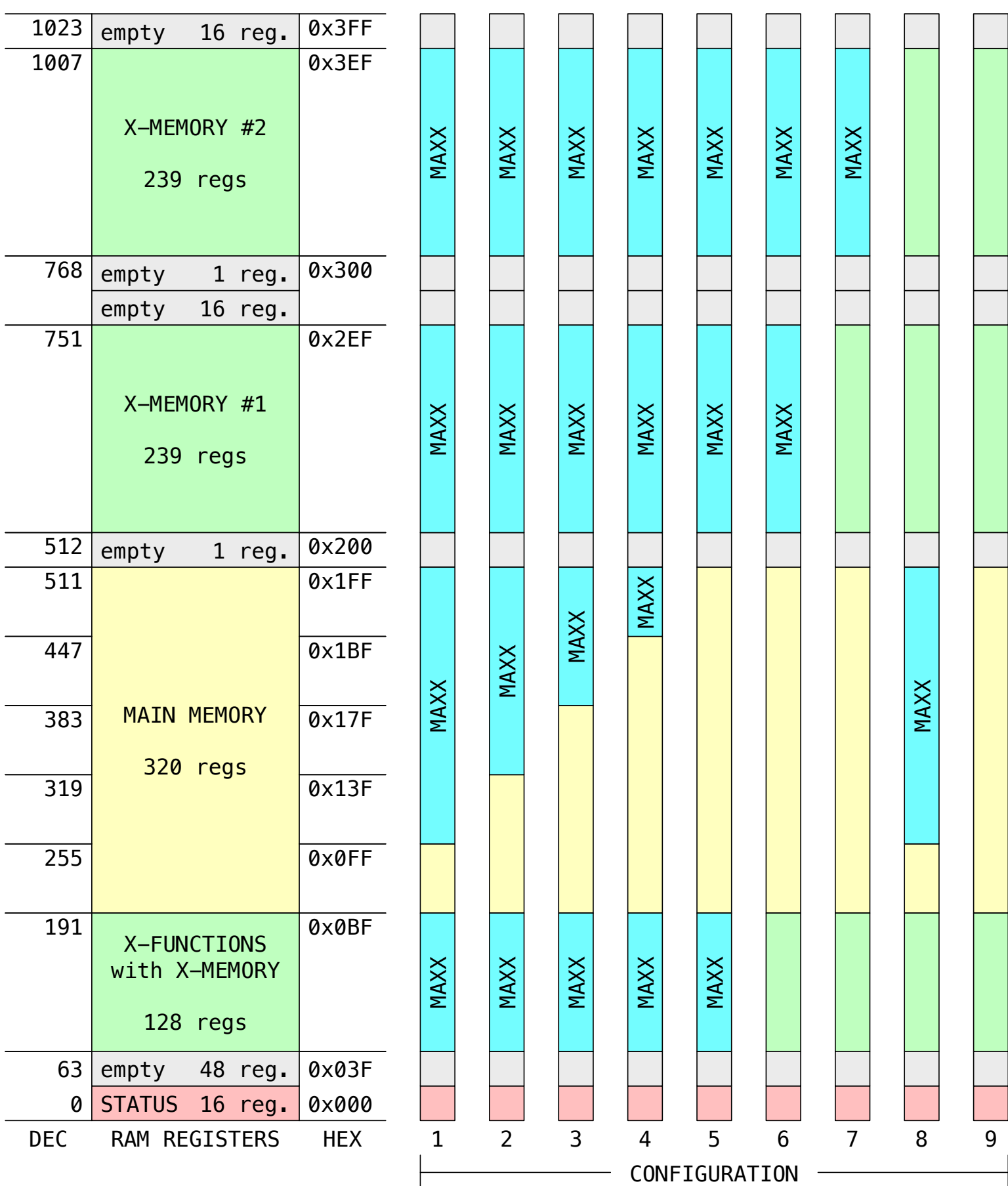
RAM Registers

Configurations with modules who has RAM registers

CFG CALC + PLUGGED IN MODULES

1	41C			+ MAXX
2	41C	+ SM		+ MAXX
3	41C	+ SM x2		+ MAXX
4	41C	+ SM x3		+ MAXX
5	41C + QM 41CV			+ MAXX + MAXX
6	41C + QM 41CV 41CX	+ XFM + XFM		+ MAXX + MAXX + MAXX
7	41C + QM 41CV 41CX	+ XFM + XM + XFM + XM + XM		+ MAXX + MAXX + MAXX
8	41C	+ XFM + XM x2		+ MAXX
9	41CV 41CX	+ XFM + XM x2 + XM x2		+ MAXX + MAXX

SM = 82106A Single Main Memory module
 QM = 82170A Quad Main Memory module
 XFM = 82180A X Functions/X Memory module
 XM = 82181A X Memory module
 MAXX = MAXX ROM/QRROM/M+X+Y Memory module



One of the HP-41 MAXX module features is to fill up missing RAM registers in the calculator.

The HP-41C benefits the most from this feature because it is the model that has the least built-in memory; conversely the HP-41CX is the one that benefits the least, leaving the HP-41CV somewhere in between.

ROM & RAM Mapping Status

MXST?	description	status
-----	-----	-----
T:X:M-S:SSS:SSSS		
* *	Time module	Disabled or Enabled
* *	2nd X Memory module	Disabled or Enabled
* *	1st X Memory module	Disabled or Enabled
* *	X Functions/X Memory module	Disabled or Enabled
* *	4th Main Memory module	Disabled or Enabled
* *	3rd Main Memory module	Disabled or Enabled
* *	2nd Main Memory module	Disabled or Enabled
* *	1st Main Memory module	Disabled or Enabled
T:X:M-E:EEE:EEEE	HP-41 MAXX module in an HP-41C	without other modules
T:X:M-E:EEE:DDDD	HP-41 MAXX module in an HP-41CV	without other modules
T:X:M-D:EED:DDDD	HP-41 MAXX module in an HP-41CX	without other modules

MAXX Module Initialization

- * Power OFF
- * Remove all modules
- * Insert MAXX module
- * Power ON (*)
- * QRINI
- * Loop until MAXX Status valid (*)
 - * Power OFF
 - * Power ON
 - * MXST?

C

→

T:X:M-E:EEE:EEEE

CV

→

T:X:M-E:EEE:DDDD

CX

→

T:X:M-D:EED:DDDD

(*) In some cases, a system reset may be needed.

- * QROM Status
 - * 0
 - * QRST?

Q-ROM Status		Description			
1	P:B:M-15:0:D	block	1,	page 15,	not banked, disabled
2	P:B:M-15:0:D	block	2,	page 15,	not banked, disabled
3	P:B:M-15:0:D	block	3,	page 15,	not banked, disabled
4	P:B:M-15:0:D	block	4,	page 15,	not banked, disabled
5	P:B:M-15:0:D	block	5,	page 15,	not banked, disabled
6	P:B:M-15:0:D	block	6,	page 15,	not banked, disabled
7	P:B:M-15:0:D	block	7,	page 15,	not banked, disabled
8	P:B:M-15:0:D	block	8,	page 15,	not banked, disabled
9	P:B:M-15:0:D	block	9,	page 15,	not banked, disabled
10	P:B:M-15:0:D	block	10,	page 15,	not banked, disabled
11	P:B:M-15:0:D	block	11,	page 15,	not banked, disabled
12	P:B:M-15:0:D	block	12,	page 15,	not banked, disabled

- * Last steps ...
 - * OFF ; re-insert modules ; ON

EXPANDED MEMORY

Y-MEMORY

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Y-Memory Overview

YM block 0			YM block 1		YM block 2		YM block 3	
1023	empty 16 reg.	0x3FF	2047	0x7FF	3071	0xBFF	4095	0xFFF
1007		0x3EF						
	X-MEMORY #2							
	239 registers							
768	empty 1 reg.	0x300						
	empty 16 reg.							
751		0x2EF						
	X-MEMORY #1							
	239 registers							
512	empty 1 reg.	0x200						
511		0x1FF						
447		0x1BF						
383	MAIN MEMORY	0x17F	EXPANDED MEMORY		EXPANDED MEMORY		EXPANDED MEMORY	
319	320 registers	0x13F	1024 registers		1024 registers		1024 registers	
			YM block 1		YM block 2		YM block 3	
255		0x0FF						
191	X-FUNCTIONS with X-MEMORY	0x0BF						
	128 registers							
63	empty 48 reg.	0x03F						
0	STATUS 16 reg.	0x000	1024	0x400	2048	0x800	3072	0xC00
DEC	RAM REGISTERS	HEX	DEC	HEX	DEC	HEX	DEC	HEX

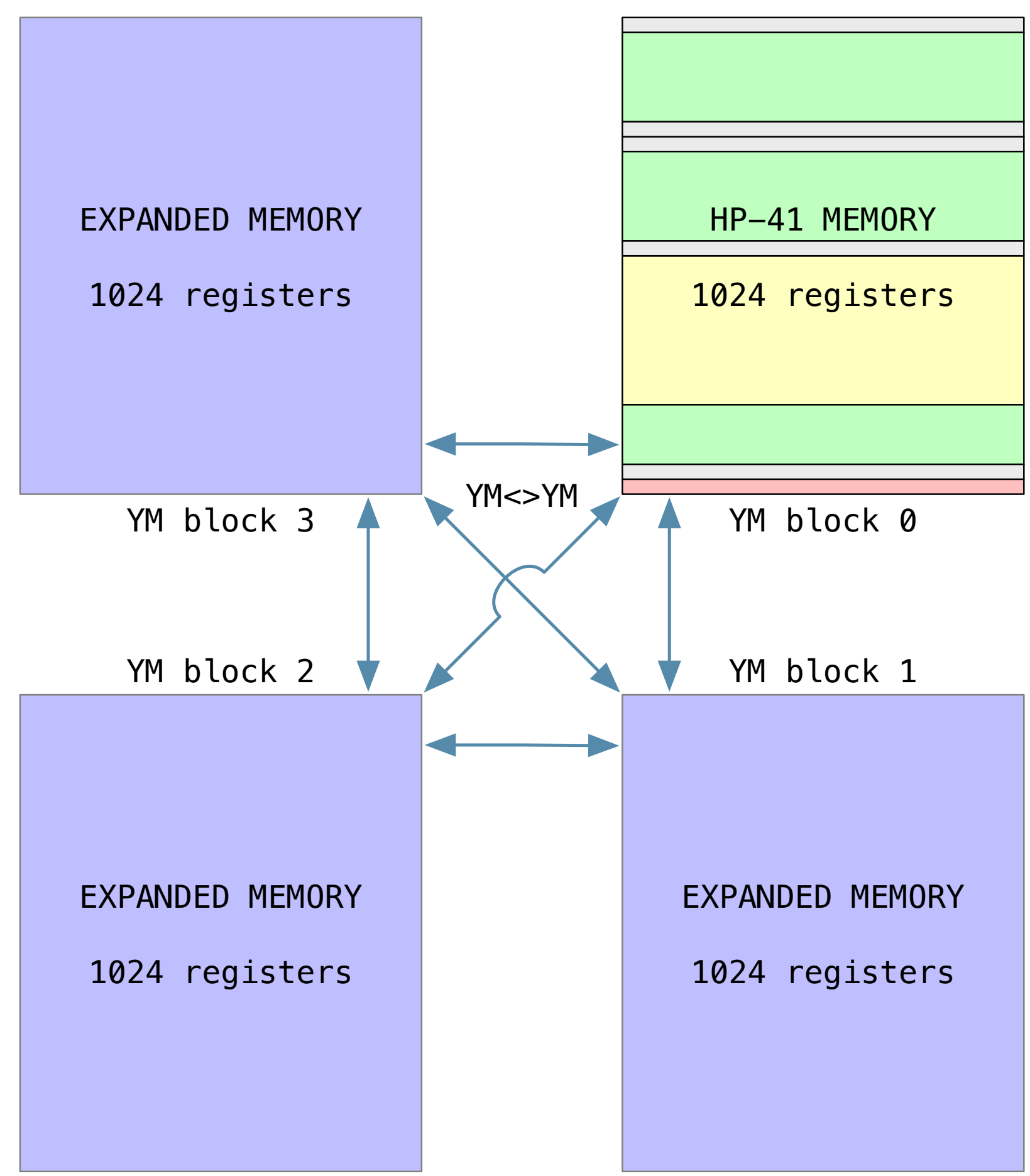
From the beginning, the 41C had the capability to address 4096 RAM registers for a total of 28672 bytes.

Unfortunately, only 1024 RAM registers could be used by the 41OS and its extension modules.

The HP-41 MAXX module fills that void by adding the extra 3072 RAM registers and through the MAXX ROM a way to use that new memory. This new memory is named **Expanded Memory** or **Y Memory**.

The first block (YM block 1) of this extra RAM can be used as additional data registers and all of them can be used as backup or as an alternate configuration. The following slides will explore these new capabilities.

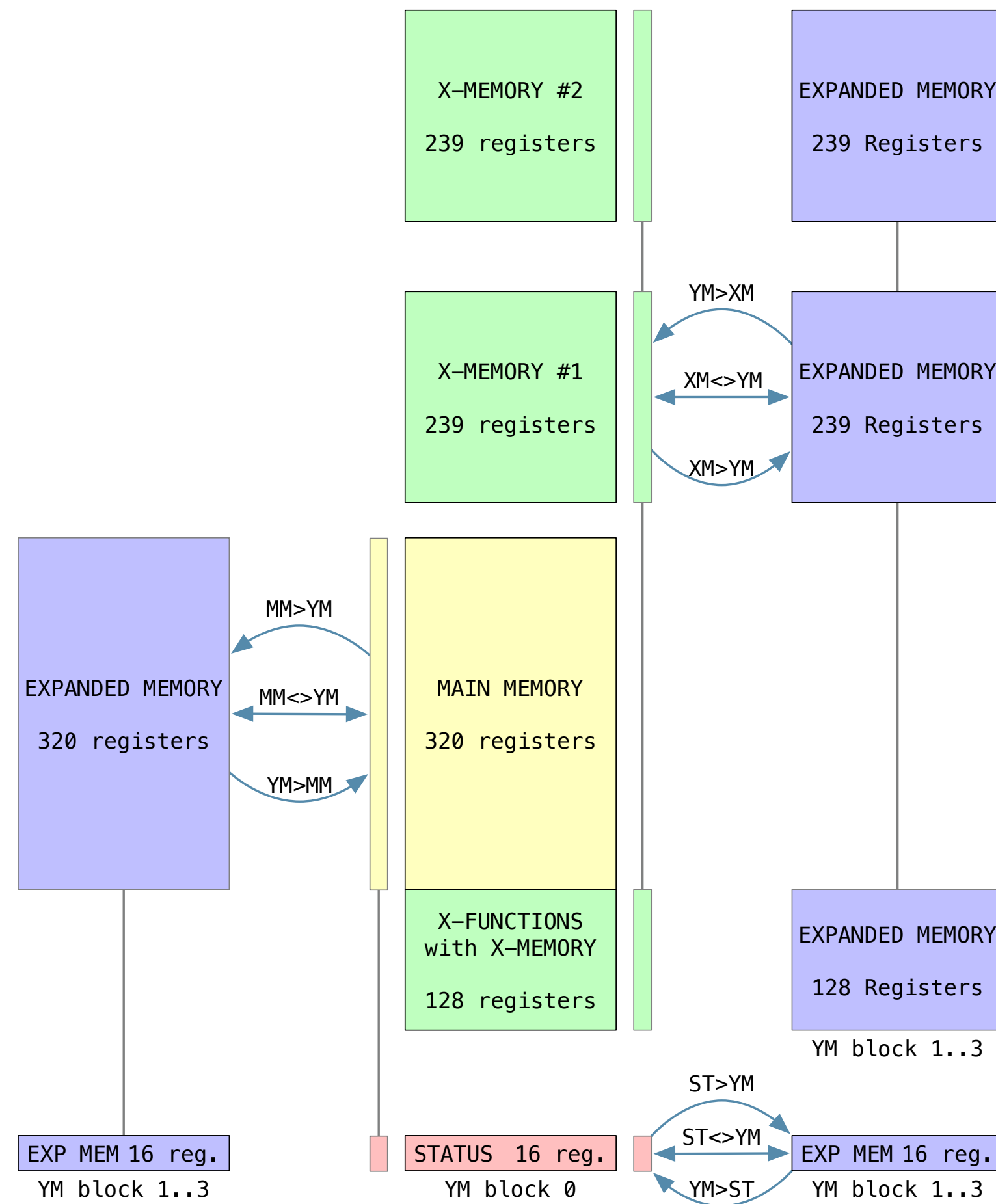
Y-Memory Block Operations



Function	Description
YMCLR	Clear expanded memory
YM<>YM	Exchange expanded memory blocks (*)

(*) Because this function can easily create a "Memory Lost" condition, when X or Y contains 0, the function will do nothing unless ALPHA contains "OK".

Y-Memory Sub-Block Operations



Function	Description
ST>YM	Copy status memory to expanded memory
ST<>YM	Exchange status memory with expanded memory (*)
YM>ST	Copy expanded memory to status memory (*)
MM>YM	Copy main and status memory to expanded memory
MM<>YM	Exchange main and status memory with exp. mem. (*)
YM>MM	Copy expanded memory to main and status memory (*)
XM>YM	Copy extended memory to expanded memory
XM<>YM	Exchange extended memory with expanded memory
YM>XM	Copy expanded memory to extended memory

(*) Because this function can easily create a "Memory Lost" condition, the function will do nothing unless ALPHA contains "OK".

Y-Memory Block Examples

Program	Description
01 LBL "BY3" 02 3	Backup to Y-Memory Block #3 Destination YM block #
03 XM>YM	Backup extended memory to YM block #3
04 MM>YM 05 END	Backup main and status memory to YM blk #3 End program or return to caller program

Program	Description
01 LBL "S0Y3" 02 "OK" 03 0 04 3 05 YM<>YM 06 END	Swap Y-Memory block #0 with block #3 Needed to override YM block #0 First YM block # Second YM block # Swap YM block #0 with YM block #3 End program

Program	Description
01 LBL "RY3" 02 3 03 "OK" 04 YM>XM 05 "OK" 06 YM>MM 07 END	Restore from Y-Memory Block #3 Source YM block # Required for YM>ST Restore extended memory from YM block #3 Required for YM>ST Restore main and status mem. from YM blk #3 End program

Program	Description
01 LBL "S1Y2" 02 1 03 2 04 YM<>YM 05 END	Swap Y-Memory block #1 with block #2 First YM block # Second YM block # Swap YM block #1 with YM block #2 End program

Note: with the exception of YM<>YM who always takes its block numbers from the stack, a Y-Memory block function either prompt to get its block number in run mode (interactive) or takes its block number from the stack in program mode (running or single stepping).

EXPANDED MEMORY

Y-MEMORY DATA REGISTERS

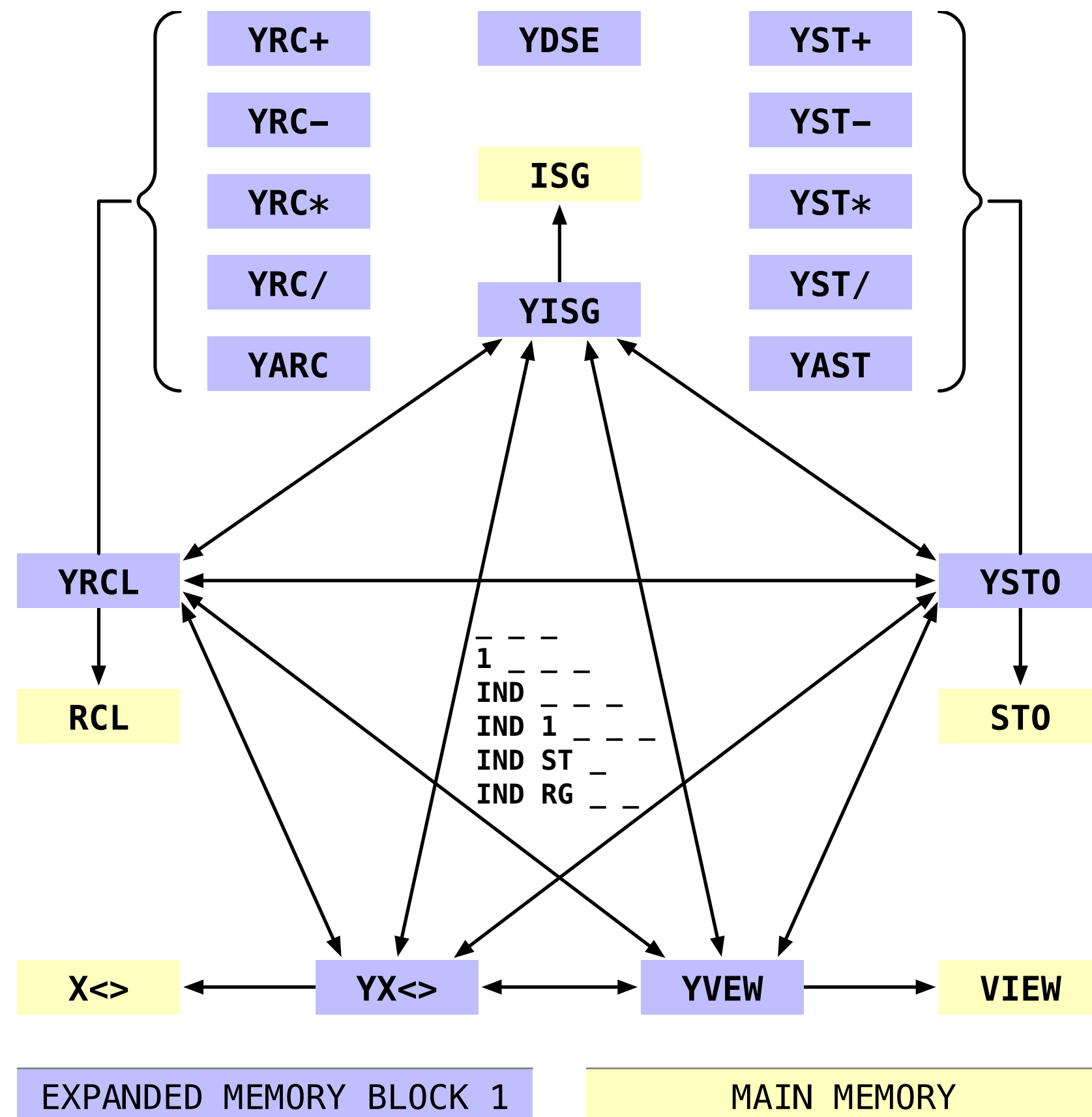
YM Data Registers Function List 1

YM data reg 1023
...
YM data reg 999
...
YM data reg 3
YM data reg 2
YM data reg 1
YM data reg 0

YM block 1 only

Function	Description
YDSE	Expanded data register decrement, skip if equal.
YISG	Expanded data register increment, skip if greater.
YRCL	Expanded data register recall.
YRC+	Expanded data register recall and add.
YRC-	Expanded data register recall and subtract.
YRC*	Expanded data register recall and multiply.
YRC/	Expanded data register recall and divide.
YARC	Expanded data register alpha recall.
YSTO	Expanded data register store.
YST+	Expanded data register store with add.
YST-	Expanded data register store with subtract.
YST*	Expanded data register store with multiply.
YST/	Expanded data register store with divide.
YAST	Expanded data register alpha store.
YVEW	Expanded data register view.
YX<>	Expanded data register exchange with X-register.

YM Data Registers Interactive Keys



* Main function keys

- * **STO** YSTO ---
- * **RCL** YRCL ---
- * **SST** YX<> ---
- * **R/S** YVEW ---
- * **CHS** YISG ---

* Parameter modifier keys

- * **EEX** adds one to prompt
- * **SHIFT** adds IND to prompt
- * **RADIX** adds ST to prompt
- * **RADIX** toggle ST and RG

* Special key

- * ← remove all modifiers or quit

* STO alternate function keys

- * **ALPHA** YAST ---
- * **STO** STO --

* STO modifier keys

- * **+** YST+ ---
- * **-** YST- ---
- * **x** YST* ---
- * **÷** YST/ ---

* RCL alternate function keys

- * **ALPHA** YARC ---
- * **RCL** RCL --

* RCL modifier keys

- * **+** YRC+ ---
- * **-** YRC- ---
- * **x** YRC* ---
- * **÷** YRC/ ---

Source: 41CL Expanded Memory Module Manual (2G+), Ángel Martín

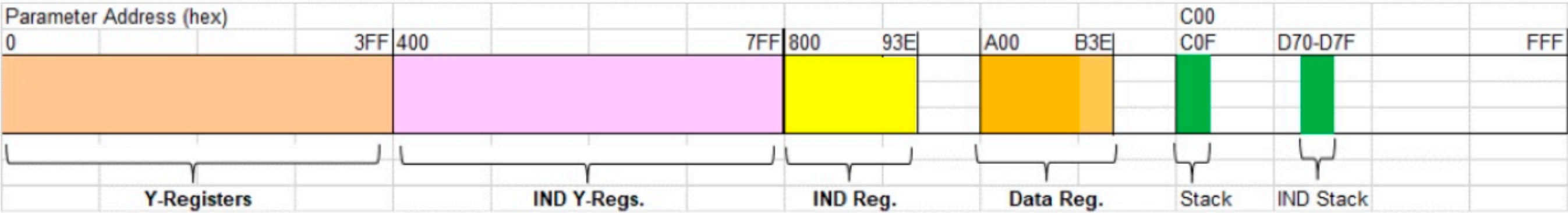
YM Data Registers Access Table

Y-Memory	Indirect Y-Memory	Data Register	Indirect Data Register	Stack	Indirect Stack
YST0 nnn	YST0 IND nnn	ST0 nn	YST0 IND RG nn	ST0 ST _	YST0 IND ST _
YST+ nnn	YST+ IND nnn	ST+ nn	YST+ IND RG nn	ST+ ST _	YST+ IND ST _
YST- nnn	YST- IND nnn	ST- nn	YST- IND RG nn	ST- ST _	YST- IND ST _
YST* nnn	YST* IND nnn	ST* nn	YST* IND RG nn	ST* ST _	YST* IND ST _
YST/ nnn	YST/ IND nnn	ST/ nn	YST/ IND RG nn	ST/ ST _	YST/ IND ST _
YRCL nnn	YRCL IND nnn	RCL nn	YRCL IND RG nn	RCL ST _	YRCL IND ST _
YRC+ nnn	YRC+ IND nnn	YRC+ RG nn	YRC+ IND RG nn	YRC+ ST _	YRC+ IND ST _
YRC- nnn	YRC- IND nnn	YRC- RG nn	YRC- IND RG nn	YRC- ST _	YRC- IND ST _
YRC* nnn	YRC* IND nnn	YRC* RG nn	YRC* IND RG nn	YRC* ST _	YRC* IND ST _
YRC/ nnn	YRC/ IND nnn	YRC/ RG nn	YRC/ IND RG nn	YRC/ ST _	YRC/ IND ST _
YDSE nnn	YDSE IND nnn	DSE nn	YDSE IND RG nn	DSE ST _	YDSE IND ST _
YISG nnn	YISG IND nnn	ISG nn	YISG IND RG nn	ISG ST _	YISG IND ST _
YX<> nnn	YX<> IND nnn	X<> nn	YX<> IND RG nn	X<> ST _	YX<> IND ST _
YVEW nnn	YVEW IND nnn	VIEW nn	YVEW IND RG nn	VIEW ST _	YVEW IND ST _

Source: HP-41 MAXX Module Manual (4C), Monte Dalrymple

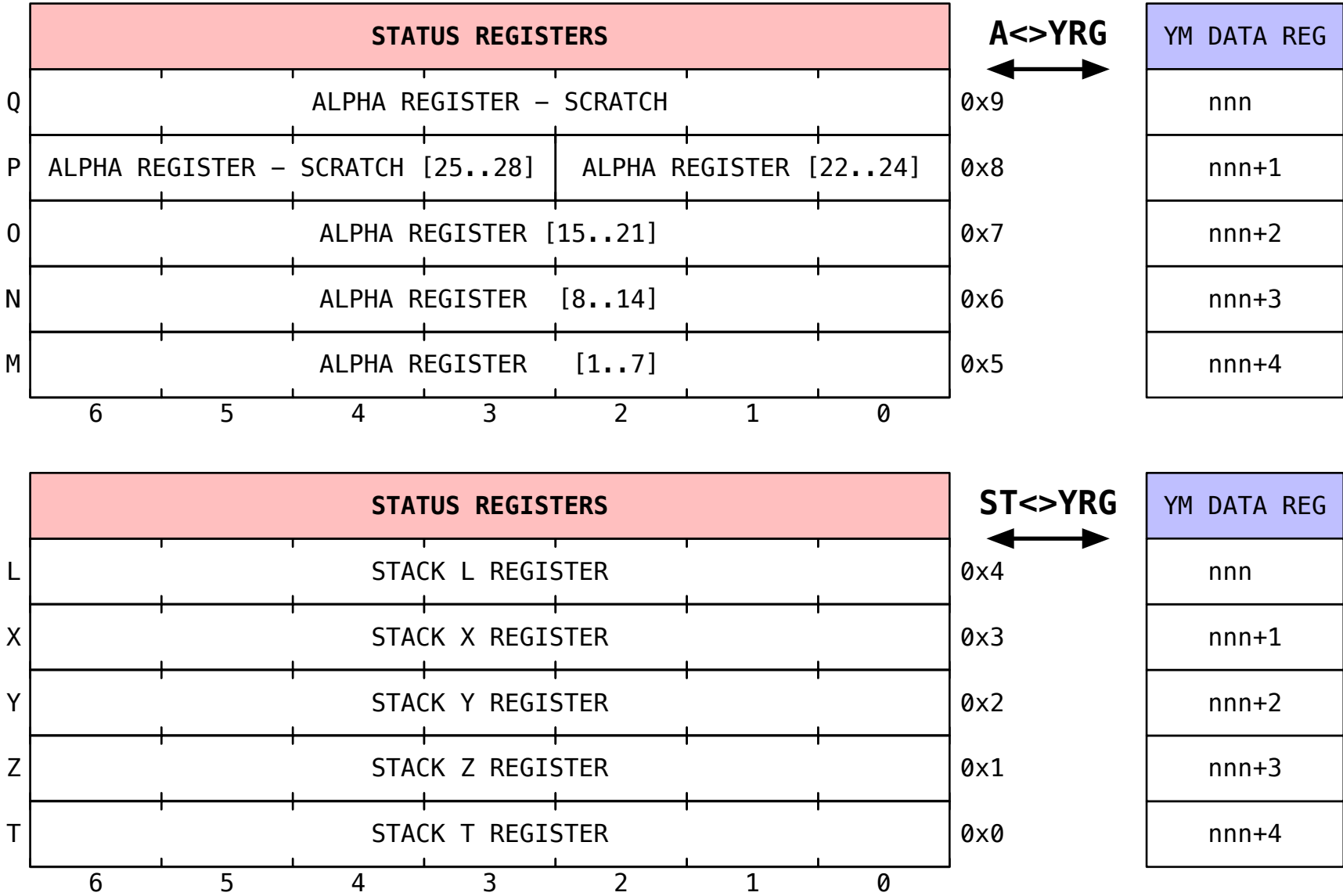
YM Data Registers Program Mode

Func.	adds 0x400		adds 0xA00	adds 0x800	adds 0xD70	adds 0xC00
	Y-Reg nnn	IND Y-reg nnn	Data Reg nn	IND Data Reg nn	STK nn	IND STK nn
YSTO	nnn	nnn+1024	STO nn	nn+2048	STO ST(nn)	nn+3072
YST+	nnn	nnn+1024	ST+ nn	nn+2048	ST+ ST(nn)	nn+3072
YST-	nnn	nnn+1024	ST- nn	nn+2048	ST- ST(nn)	nn+3072
YST*	nnn	nnn+1024	ST* nn	nn+2048	ST* ST(nn)	nn+3072
YST/	nnn	nnn+1024	ST/ nn	nn+2048	ST/ ST(nn)	nn+3072
YRCL	nnn	nnn+1024	RCL nn	nn+2048	RCL ST(nn)	nn+3072
YRC+	nnn	nnn+1024	nn+2560	nn+2048	nn+3440	nn+3072
YRC-	nnn	nnn+1024	nn+2560	nn+2048	nn+3440	(nn+3072)
YRC*	nnn	nnn+1024	nn+2560	nn+2048	nn+3440	nn+3072
YRC/	nnn	nnn+1024	nn+2560	nn+2048	nn+3440	nn+3072
YDSE	nnn	nnn+1024	DSE nn	nn+2048	DSE ST(nn)	nn+3072
YISG	nnn	nnn+1024	ISG nn	nn+2048	ISG ST(nn)	nn+3072
YX<>	nnn	nnn+1024	X<> nn	nn+2048	X<> ST(nn)	nn+3072
YVEW	nnn	nnn+1024	VIEW nn	nn+2048	VIEW ST(nn)	nn+3072
YARC	nnn	nmn+1024	ARCL nn	nn+2048	ARCL ST(nn)	nn+3072
YAST	nnn	mnn+1024	ASTO nn	nn+2048	ASTO ST(nn)	nn+3072

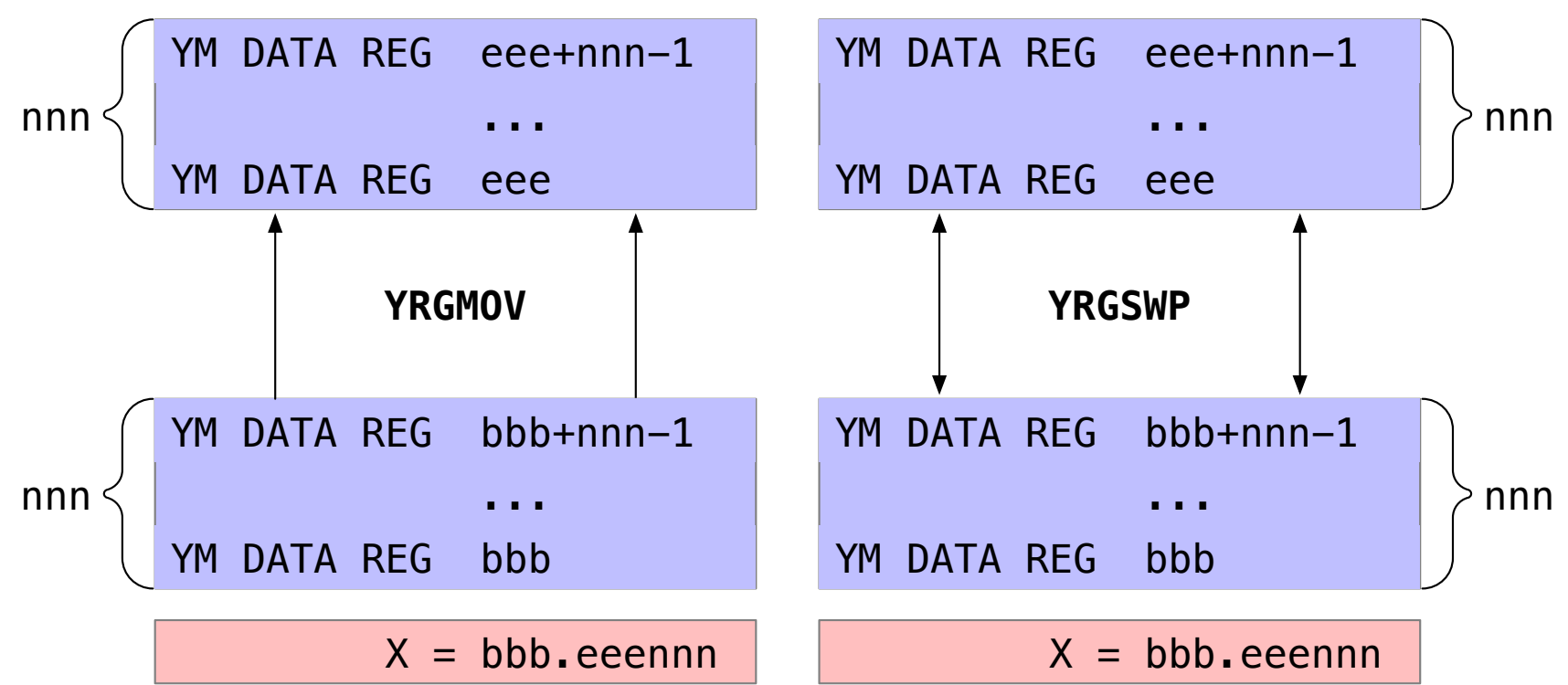


Source: 41CL Expanded Memory Module Manual (2G+), Ángel Martín

YM Data Registers Function List 2



Function	Description
CLYRG CLYRGX	Clear expanded data registers Clear expanded data registers by X
A<->YRG ST<->YRG	Exchange ALPHA with expanded data registers Exchange RPN stack with expanded data registers
YRGMOV YRGSWP	Move expanded data registers Exchange expanded data registers



YM Data Registers Examples

Example #1 Clearing YM data registers

100.200
CLYRGX X = YM data registers address range. (bbb.eee)
Clear YM data registers from 100 to 200

Example #2 Writing and reading a value to a YM data register

25
YSTO 100 X = 25
Store X value to YM data register 100
CLX
Clear X
YRCL 100 Recall YM data register 100 to X

Example #3 Swapping alpha with YM data registers

CLA Clear ALPHA
A<>YRG 110 Swap ALPHA with YM data registers 110 to 114
36
X = 36
"X=" ALPHA = "X="

ARCL X Append "36.0000" to ALPHA
ALPHA has "X=36.0000"

A<>YRG 110 Swap ALPHA with YM data registers 110 to 114
ALPHA is empty

Example #4 Swapping stack with YM data registers

ST<>YRG 130 Swap stack [LXYZT] with YM data reg. 130 to 134

Example #5 Moving YM data registers

123.166010
YRGM0V X = YM data registers (bbb.eeennn)
Copy YM data registers
(copy 10 registers from 123...132 to 166...175)

Example #6 Swapping YM data registers

123.166010
YRGSWP X = YM data registers (bbb.eeennn)
Swap YM data registers
(swap 10 registers 123...132 with 166...175)

Example #7 Swapping YM blocks

1 ENTER Y = YM block 1 (data registers)
2 X = YM block 2 (backup)
YM<>YM Swap YM block 1 with YM block 2
we now have an alternate set of YM data registers

INSTRUCTIONS MEMORY

Q-ROM

41C Microprocessor

- * HP-41C microprocessor is named NUT.
- * The NUT microprocessor (CPU) is a descendant of the 1-bit bus calculator architecture that began with the HP-35 in 1972.
- * Instruction memory is made up of 10-bit memory cells.
- * The CPU program counter is 16-bit wide and can access 64K of 10-bit cells.
- * The 64K address space is divided into 16 pages of 4K.
- * When hardware support it, a 4K page can contains up to 4 banks, but only one bank can be active for a specific page at a given time.

41C Instruction Memory Layout

Instruction Memory Layout						
Port 4					15	0xF
					14	0xE
Port 3					13	0xD
					12	0xC
Port 2					11	0xB
					10	0xA
Port 1					9	0x9
					8	0x8
HP-IL					7	0x7
Printer					6	0x6
Time				← C/CV	5	0x5
	CX TM	CX Ext		← CX		
Special					4	0x4
	not used			← C/CV	3	0x3
	CX XF			← CX		
C/CV OS or CX OS	41 OS				2	0x2
	41 OS				1	0x1
	41 OS				0	0x0
Bank 1		Bank 2	Bank 3	Bank 4	Page	

- * C/CV CAT 2 order
 - * Pages 5 to 15
- * Bank switching operates at page level for system pages. (pages: 0 to 7)
- * Bank switching operates at port level for port pages. (pages: 8 to 15)
 - * Port 1 : pages 8 & 9
 - * Port 2 : pages 10 & 11
 - * Port 3 : pages 12 & 13
 - * Port 4 : pages 14 & 15
- * CX CAT 2 order
 - * Pages 5 to 15 then 3
- * Hard configured pages :
 - * 7 : HP-IL ROM
 - * 6 : Printer ROM
 - * 5 : Time ROM
- * Page 4 is a special page, it is used for:
 - * Takeover ROMs
 - * Service ROMs
 - * Disabled Printer ROM
 - * Libraries

Q-ROM Introduction

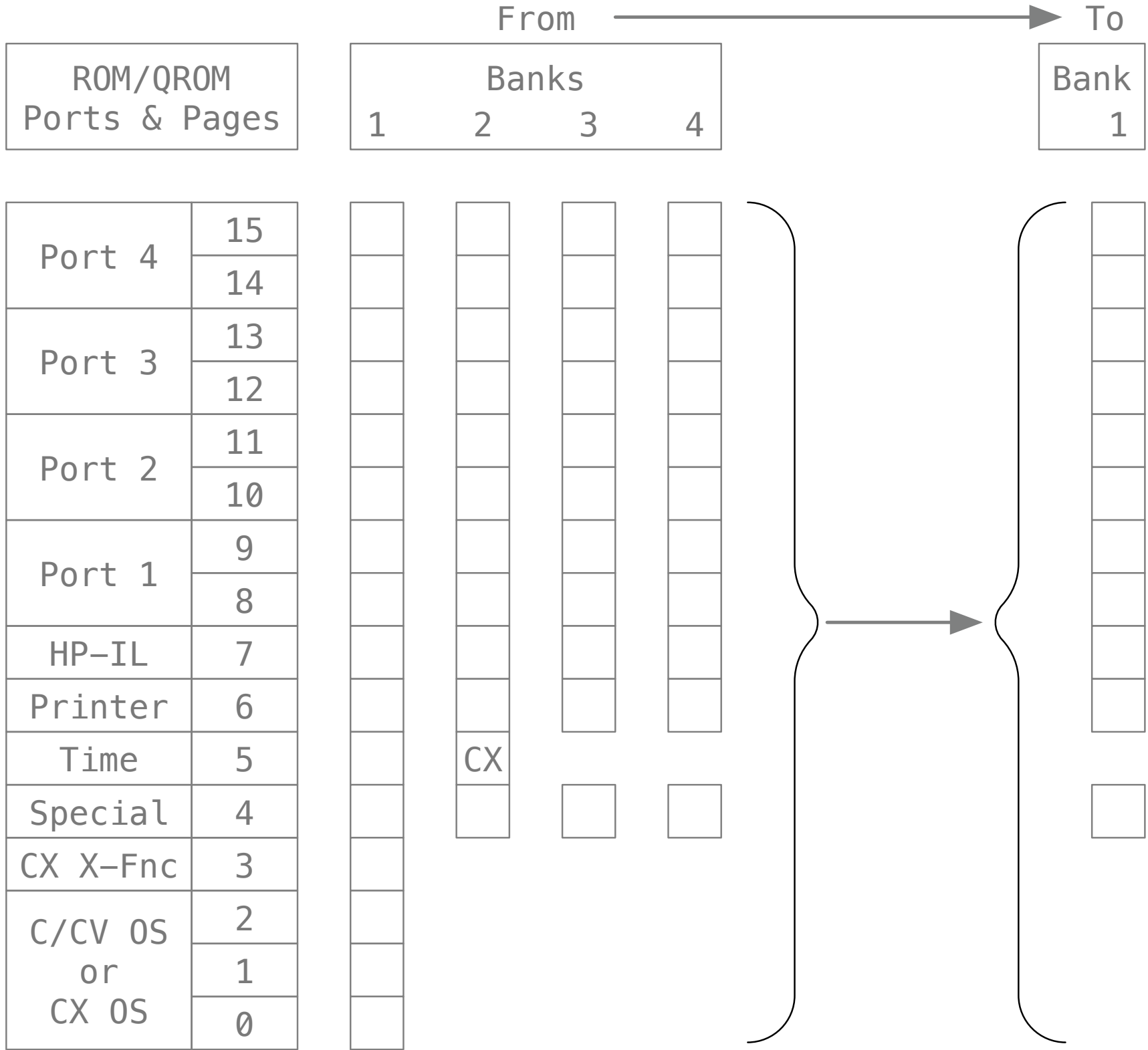
- * The term Q-ROM is an abbreviation of Quasi-ROM.
- * A Quasi-ROM device, is something that simulate 10-bit ROM with RAM.
- * A Quasi-ROM device contains one or multiple 4K block(s) of 10-bit RAM.
- * The MAXX module has twelve Q-ROM blocks of 4K 10-bit RAM.
- * A MAXX Q-ROM block, can be:
 - * mapped to a specific page (4, 6..15) and bank (1..4).
 - * disabled or enabled as: read-only, write-only or read-write.
 - * erased and programmed indefinitely.

Q-ROM Block Operations

Function	Address	Bank	Write	Read	Scope	Function	Description
QRINI	-	-	-	-	-	QRINI	Clear all Q-ROM blocks
QRCLR	-	-	-	-	block	QRCLR	Clear a Q-ROM block
QRABY	set	set	-	-	block	QRABY	Map a Q-ROM block to an HP-41 page and bank
QRRO	-	-	disabled	enabled	block	QRRO	Set Q-ROM block to read only
QRRE	-	-	-	enabled	block	QRRE	Enable Q-ROM block reading
QRRP	-	-	-	disabled	all or block	QRRP	Disable Q-ROM block(s) reading
QRWO	-	-	enabled	disabled	all or block	QRWO	Set Q-ROM block(s) to write only
QRWE	-	-	enabled	-	all or block	QRWE	Enable Q-ROM block(s) writing
QRWP	-	-	disabled	-	all or block	QRWP	Disable Q-ROM block(s) writing
QRRWE	-	-	enabled	enabled	block	QRRWE	Enable Q-ROM block reading and writing
QRRWD	-	-	disabled	disabled	all or block	QRRWD	Disable Q-ROM blk(s) reading and writing
QRST?	-	-	-	-	all or block	QRST?	Display QROM block(s) status

Note: the "all" scope option is only available for functions that cannot create a system lock-up. A system lock-up normally happens when read access is activated on a uninitialized Q-ROM block.

Q-ROM Block Copy



Function

CPYBNK

Example

CPYBNK
CPYBNK
CPYBNK 3" 8 :
CPYBNK 3" 8 :
CPYBNK 3" 8 : F

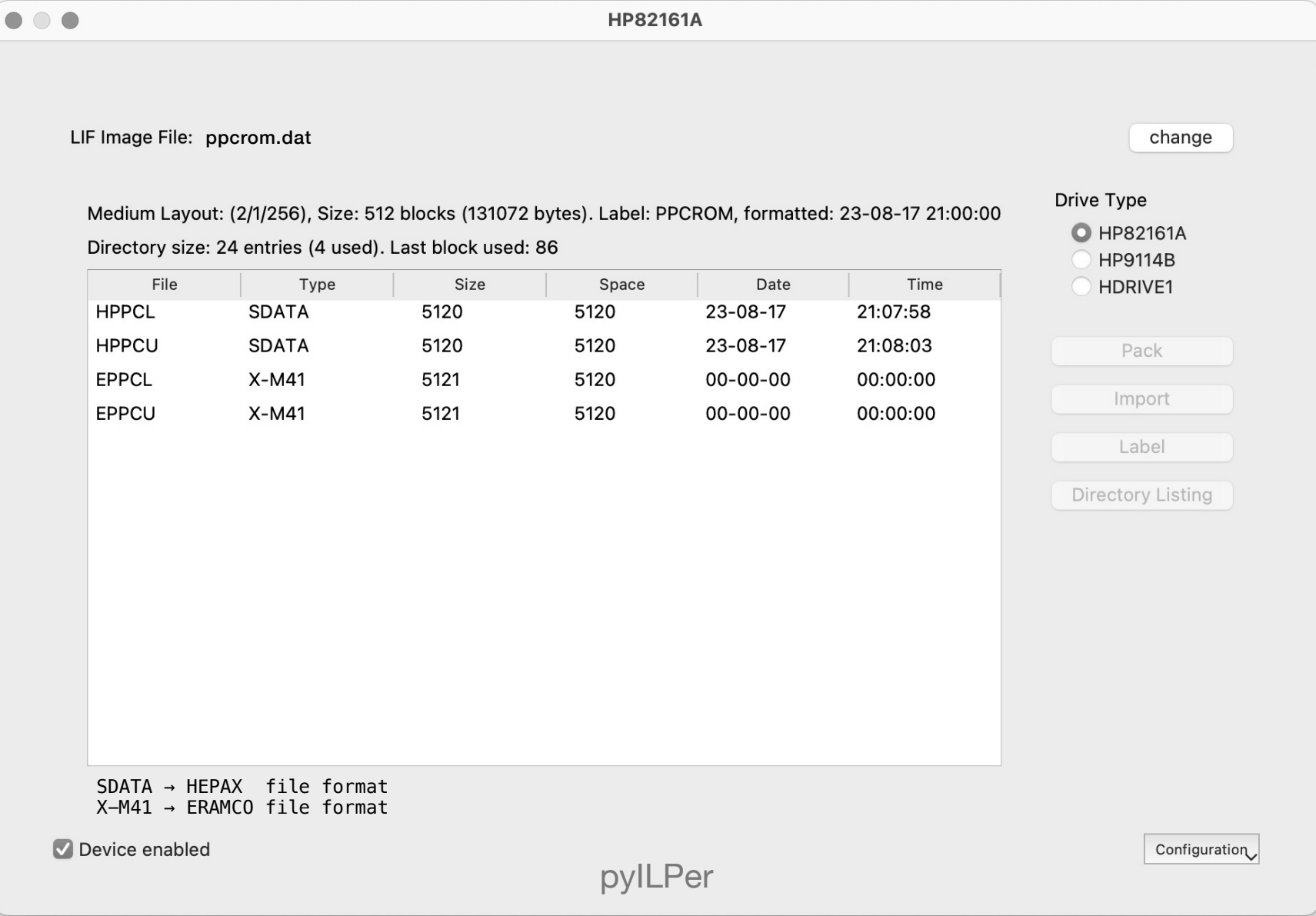
Description

Copy from a page#:bank# to a page#:bank1

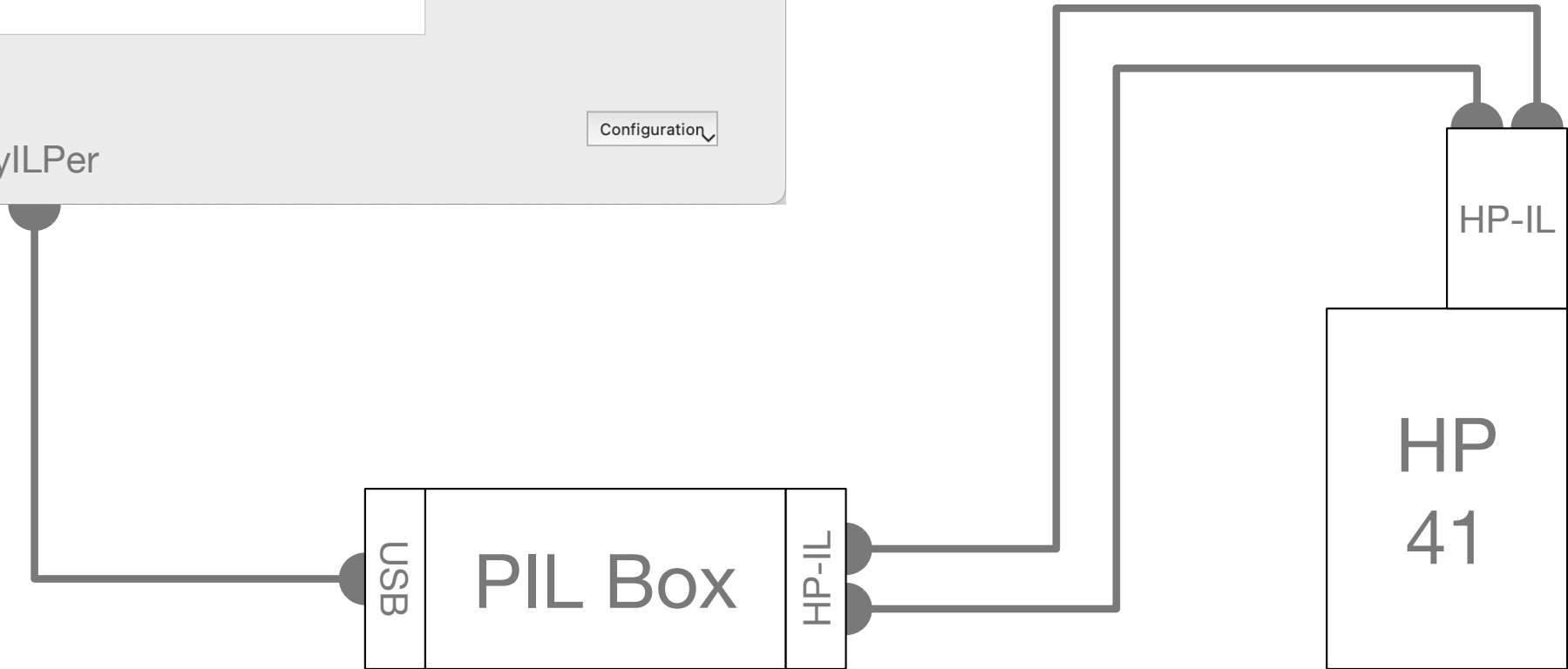
Description

Non-programmable function
1st parameter is the bank to copy from (ex.: 3)
2nd parameter is the page to copy from (ex.: 8)
3rd parameter is the page to copy to (ex.: F)
Copy page 8 bank 3 to page F bank 1

Q-ROM Read/Write Page f/t HP-IL



Function	Description
RDEIL WREIL	Read ROM page from HP-IL Write ROM page to HP-IL (ERAMCO ROM format) (ERAMCO ROM format)
RDHIL WRHIL	Read ROM page from HP-IL Write ROM page to HP-IL (HEPAX ROM format) (HEPAX ROM format)



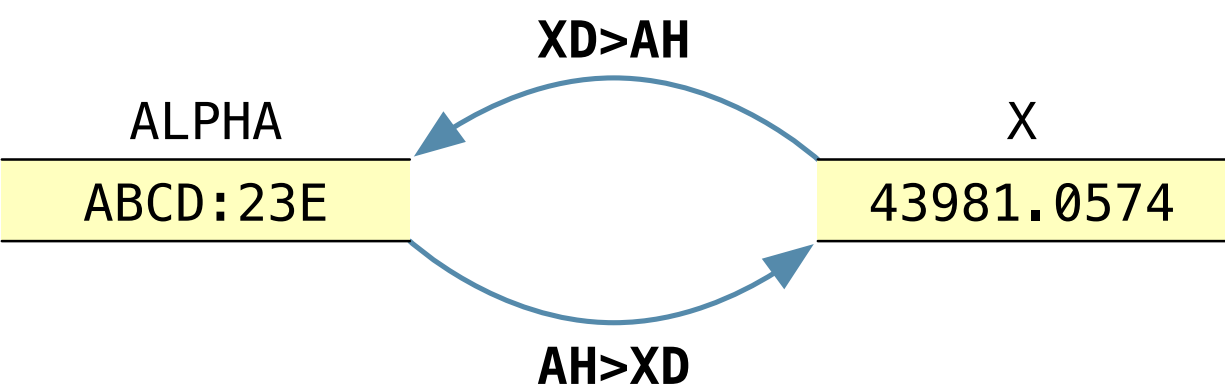
(Virtual) Cassette Content

NAME	TYPE	REGS
HPPCL	DA	640
HPPCU	DA	640
EPPCL	??	640
EPPCU	??	640

ROM/QROM Pages & Ports

15	Port 4
14	
13	Port 3
12	
11	Port 2
10	
9	Port 1
8	
7	HP-IL
6	Printer
5	Time
4	Special
3	CX X-Fnc
2	C/CV 0S or CX 0S
1	
0	

Q-ROM Memory Access



Function	Description
XD>AH AH>XD	Convert a decimal address.data value to an hex address:data string Convert an hex address:data string to a decimal address.data value
AHPEEK AHPOKE	Read a ROM/Q-ROM cell using hex address:data string Change a ROM/Q-ROM cell using hex address:data string
XDPEEK XDPOKE	Read a ROM/Q-ROM cell using decimal address.data value Change a ROM/Q-ROM cell using decimal address.data value

AHPEEK	
addr	data
ABCF	379
ABCE	0FE
ABCD	23E
ABCC	23E
ABCB	23E

before after

ABCD:000	ALPHA	ABCD:23E
----------	-------	----------

AHPOKE	
addr	data
ABCF	379
ABCE	0FE
ABCD	23E
ABCC	23E
ABCB	23E

before after

ALPHA	ABCD:000
-------	----------

XDPEEK	
addr	data
43983	889
43982	254
43981	574
43980	574
43979	574

before after

43981.0000	X	43981.0574
------------	---	------------

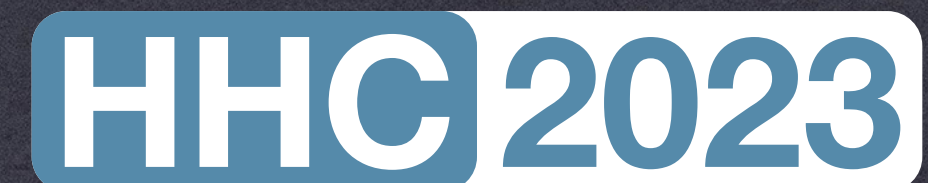
XDPOKE	
addr	data
43983	889
43982	254
43981	574
43980	574
43979	574

before after

X	43981.0000
---	------------

INSTRUCTIONS MEMORY

HP-41C/CV MINI HOW-TO



Q-ROM Blocks Initialization

Program	Description
01 LBL "QRBI"	Q-ROM Blocks Initialization
02 0	X = 0 (select all Q-ROM blocks)
03 QRRWD	Disable read & write for all Q-ROM blocks
04 QRINI	Fills all QROM blocks with all zeros
05 15.0	Page 15, bank switch disable
06 1.012	Loop control value 1..12
07 LBL 00	Map reset loop
08 INT	Extract Q-ROM block number
09 VIEW X	Display Q-ROM block number
10 QRABY	Reset specified Q-ROM block
11 X<> L	Get back loop control value
12 ISG X	Increment loop counter & Test: is loop counter greater than 12 ?
13 GTO 00	No: loop back to LBL 00
14 CLD	Clear display
15 END	Q-ROM blocks are now in their initial state

Command	Description
XEQ "QRBI"	Execute Q-ROM Blocks Initialization program
0	X = 0 (select all Q-ROM blocks)
QRST?	Show Q-ROM status for all Q-ROM blocks

```
CAT 2
-TIME- C
...
-PRINTER 2E
...
-MASS ST 1H
...
-CTL FNS
...
-EXT FCN 1C
...
-MAXX 4C
...
```

Q-ROM Status	Description
1 P:B:M-15:0:D	block 1, page 15, not banked, disabled
2 P:B:M-15:0:D	block 2, page 15, not banked, disabled
3 P:B:M-15:0:D	block 3, page 15, not banked, disabled
4 P:B:M-15:0:D	block 4, page 15, not banked, disabled
5 P:B:M-15:0:D	block 5, page 15, not banked, disabled
6 P:B:M-15:0:D	block 6, page 15, not banked, disabled
7 P:B:M-15:0:D	block 7, page 15, not banked, disabled
8 P:B:M-15:0:D	block 8, page 15, not banked, disabled
9 P:B:M-15:0:D	block 9, page 15, not banked, disabled
10 P:B:M-15:0:D	block 10, page 15, not banked, disabled
11 P:B:M-15:0:D	block 11, page 15, not banked, disabled
12 P:B:M-15:0:D	block 12, page 15, not banked, disabled

Note: on first power up after MAXX module insertion, all Q-ROM blocks are: disabled, mapped to page 15 with bank switching disabled. Since Q-ROM blocks content can be anything on first power up, it is recommended to initialize all Q-ROM blocks content with QRINI.



Virtual tape / LIF Volume

Create a virtual tape (aka LIF volume) : **lifinit -z -m cass qr41cv.dat 64**

Label the tape : **liflabel qr41cv.dat QR41CV**

Show virtual tape content : **lifdir qr41cv.dat**

```
Volume : QR41CV , formatted : 07/09/23 21:00:00
Tracks: 2 Surfaces: 1 Blocks/Track: 256 Total size: 512 Blocks, 131072 Bytes
0 files (64 max), last block used: 0 of 512
```

Linux/macOS users ↓

Add PPC lower ROM image to tape : **cat PPCL.ROM | rom41er PPCL | lifput qr41cv.dat**

Add PPC upper ROM image to tape : **cat PPCU.ROM | rom41er PPCU | lifput qr41cv.dat**

Windows users ↓

Add PPC lower ROM image to tape : **type PPCL.ROM | rom41er PPCL | lifput qr41cv.dat**

Add PPC upper ROM image to tape : **type PPCU.ROM | rom41er PPCU | lifput qr41cv.dat**

Show virtual tape content : **lifdir qr41cv.dat**

```
Volume : QR41CV , formatted : 07/09/23 21:00:00
Tracks: 2 Surfaces: 1 Blocks/Track: 256 Total size: 512 Blocks, 131072 Bytes
PPCL      X-M41      5121/5120 ← lifdir has a display bug for X-M41
PPCU      X-M41      5121/5120
2 files (64 max), last block used: 50 of 512
```



Virtual tape / LIF Volume (cont.)

Linux/macOS users ↓

Add Library 4 bank 1 ROM img to tape :	<code>cat XLIB4_B1.ROM</code>	<code> rom41er LIB4B1</code>	<code> lifput qr41cv.dat</code>
Add Library 4 bank 2 ROM img to tape :	<code>cat XLIB4_B2.ROM</code>	<code> rom41er LIB4B2</code>	<code> lifput qr41cv.dat</code>
Add OS/X bank 1 ROM image to tape :	<code>cat XOSX_B1.ROM</code>	<code> rom41er OSXB1</code>	<code> lifput qr41cv.dat</code>
Add OS/X bank 2 ROM image to tape :	<code>cat XOSX_B2.ROM</code>	<code> rom41er OSXB2</code>	<code> lifput qr41cv.dat</code>
Add OS/X bank 3 ROM image to tape :	<code>cat XOSX_B3.ROM</code>	<code> rom41er OSXB3</code>	<code> lifput qr41cv.dat</code>
Add OS/X bank 4 ROM image to tape :	<code>cat XOSX_B4.ROM</code>	<code> rom41er OSXB4</code>	<code> lifput qr41cv.dat</code>

Windows users → Replace **cat** with **type** on the above commands

Show virtual tape content : **lifdir qr41cv.dat**

```
Volume : QR41CV , formatted : 07/09/23 21:00:00
Tracks: 2 Surfaces: 1 Blocks/Track: 256 Total size: 512 Blocks, 131072 Bytes
PPCL      X-M41      5121/5120 ← lifdir has a display bug for X-M41
PPCU      X-M41      5121/5120
LIB4B1     X-M41      5121/5120
LIB4B2     X-M41      5121/5120
OSXB1      X-M41      5121/5120
OSXB2      X-M41      5121/5120
OSXB3      X-M41      5121/5120
OSXB4      X-M41      5121/5120
8 files (64 max), last block used: 176 of 512
```



PPC ROM Loader Program

Setup:

- HP-41C or HP-41CV
- HP-41 MAXX in port #1 (p. 5, 8 & 9)
- 82160A HP-IL in port #4 (p. 6 & 7)
- PIL-Box : HP-IL/USB interface
- HP-IL peripherals simulator (ILPER, pyILPer, etc) with a virtual tape drive loaded with **qr41cv.dat** LIF volume.

Operations:

DIR

NAME	TYPE	REGS
PPCL	??	640
PPCU	??	640
LIB4B1	??	640
LIB4B2	??	640
OSXB1	??	640
OSXB2	??	640
OSXB3	??	640
OSXB4	??	640

PPC ROM lower page file is loaded.
ROM file is in ERAMCO format.
Q-ROM block 11 is used.
41C/CV page 12 is used.
Bank switching is disabled.

01 LBL "LPPC" Load PPC ROM images
02 12.0 Y = [p: 12].[b: 0 none]
03 11 X = QROM block number
04 QRW0 Set QR block to write only
05 QRABY Map QR block to pg.bk
06 X<>Y X = target page
07 "PPCL" ALPHA = ROM filename
08 AVIEW Display ROM filename
09 RDEIL Copy ROM file to QROM
10 X<>Y X = QROM block number
11 QRR0 Set QR block to read only

PPC ROM upper page file is loaded.
ROM file is in ERAMCO format.
Q-ROM block 12 is used.
41C/CV page 13 is used.
Bank switching is disabled.

12 13.0 [p: 13].[b: 0 none]
13 12 X = QROM block number
14 QRW0 Set QR block to write only
15 QRABY Map QR block to pg.bk
16 X<>Y X = target page
17 "PPCU" ALPHA = ROM filename
18 AVIEW Display ROM filename
19 RDEIL Copy ROM file to QROM
20 X<>Y X = QROM block number
21 QRR0 Set QR block to read only
22 CLD Clear display
23 END End of program

Loading PPC ROM & Q-ROM Status

HP-41C/CV Instruction Memory Layout						
Port 4					15	0xF
					14	0xE
Port 3	PPCU	PPCU	PPCU	PPCU	13	0xD
	PPCL	PPCL	PPCL	PPCL	12	0xC
Port 2					11	0xB
					10	0xA
Port 1	MAXX				9	0x9
	MAXX XF				8	0x8
HP-IL	HP-IL				7	0x7
Printer	Printer				6	0x6
Time	MAXX TM				5	0x5
Special					4	0x4
	not used				3	0x3
C/CV OS	41 OS				2	0x2
	41 OS				1	0x1
	41 OS				0	0x0
Bank 1 Bank 2 Bank 3 Bank 4					Page	

Command	Description																										
XEQ "LPPC"	Run PPC ROM loader program																										
0	X = 0 (select all Q-ROM blocks)																										
QRST?	Show Q-ROM status for all Q-ROM blocks																										
CAT 2	<table><tr><th>Q-ROM Status</th><th>Description</th></tr><tr><td>1 P:B:M-15:0:D</td><td>block 1, page 15, not banked, disabled</td></tr><tr><td>2 P:B:M-15:0:D</td><td>block 2, page 15, not banked, disabled</td></tr><tr><td>3 P:B:M-15:0:D</td><td>block 3, page 15, not banked, disabled</td></tr><tr><td>4 P:B:M-15:0:D</td><td>block 4, page 15, not banked, disabled</td></tr><tr><td>5 P:B:M-15:0:D</td><td>block 5, page 15, not banked, disabled</td></tr><tr><td>6 P:B:M-15:0:D</td><td>block 6, page 15, not banked, disabled</td></tr><tr><td>7 P:B:M-15:0:D</td><td>block 7, page 15, not banked, disabled</td></tr><tr><td>8 P:B:M-15:0:D</td><td>block 8, page 15, not banked, disabled</td></tr><tr><td>9 P:B:M-15:0:D</td><td>block 9, page 15, not banked, disabled</td></tr><tr><td>10 P:B:M-15:0:D</td><td>block 10, page 15, not banked, disabled</td></tr><tr><td>11 P:B:M-12:0:R</td><td>block 11, page 12, not banked, read-only, active</td></tr><tr><td>12 P:B:M-13:0:R</td><td>block 12, page 13, not banked, read-only, active</td></tr></table>	Q-ROM Status	Description	1 P:B:M-15:0:D	block 1, page 15, not banked, disabled	2 P:B:M-15:0:D	block 2, page 15, not banked, disabled	3 P:B:M-15:0:D	block 3, page 15, not banked, disabled	4 P:B:M-15:0:D	block 4, page 15, not banked, disabled	5 P:B:M-15:0:D	block 5, page 15, not banked, disabled	6 P:B:M-15:0:D	block 6, page 15, not banked, disabled	7 P:B:M-15:0:D	block 7, page 15, not banked, disabled	8 P:B:M-15:0:D	block 8, page 15, not banked, disabled	9 P:B:M-15:0:D	block 9, page 15, not banked, disabled	10 P:B:M-15:0:D	block 10, page 15, not banked, disabled	11 P:B:M-12:0:R	block 11, page 12, not banked, read-only, active	12 P:B:M-13:0:R	block 12, page 13, not banked, read-only, active
Q-ROM Status	Description																										
1 P:B:M-15:0:D	block 1, page 15, not banked, disabled																										
2 P:B:M-15:0:D	block 2, page 15, not banked, disabled																										
3 P:B:M-15:0:D	block 3, page 15, not banked, disabled																										
4 P:B:M-15:0:D	block 4, page 15, not banked, disabled																										
5 P:B:M-15:0:D	block 5, page 15, not banked, disabled																										
6 P:B:M-15:0:D	block 6, page 15, not banked, disabled																										
7 P:B:M-15:0:D	block 7, page 15, not banked, disabled																										
8 P:B:M-15:0:D	block 8, page 15, not banked, disabled																										
9 P:B:M-15:0:D	block 9, page 15, not banked, disabled																										
10 P:B:M-15:0:D	block 10, page 15, not banked, disabled																										
11 P:B:M-12:0:R	block 11, page 12, not banked, read-only, active																										
12 P:B:M-13:0:R	block 12, page 13, not banked, read-only, active																										

OSX+LIB4 Loader Program

Setup:

- HP-41C or HP-41CV
- HP-41 MAXX in port #1 (p. 5, 8 & 9)
- 82160A HP-IL in port #4 (p. 6 & 7)
- PIL-Box : HP-IL/USB interface
- HP-IL peripherals simulator with a virtual tape drive loaded with **qr41cv.dat**

ROM loading order:

- LIB4B2 → block 2 → page 4 bank 2
- LIB4B1 → block 1 → page 4 bank 1
- OSXB4 → block 6 → page 10 bank 4
- OSXB3 → block 5 → page 10 bank 3
- OSXB2 → block 4 → page 10 bank 2
- OSXB1 → block 3 → page 10 bank 1

Note: in a multi-bank module, to prevent polling point to go astray and crash the unit, always load bank 1 last.

Program:

01	LBL	"LOSX"	Load OSX & LIB4 images
02	"LIB4B2"	ROM image filename	
03	4.2	Destination page.bank	
04	2	MAXX Q-ROM block	
05	XEQ	00	XEQ "Load ROM image"
06	"LIB4B1"	ROM image filename	
07	4.1	Destination page.bank	
08	1	MAXX Q-ROM block	
09	XEQ	00	XEQ "Load ROM image"
10	"OSXB4"	ROM image filename	
11	10.4	Destination page.bank	
12	6	MAXX Q-ROM block	
13	XEQ	00	XEQ "Load ROM image"
14	"OSXB3"	ROM image filename	
15	10.3	Destination page.bank	
16	5	MAXX Q-ROM block	
17	XEQ	00	XEQ "Load ROM image"
18	"OSXB2"	ROM image filename	
19	10.2	Destination page.bank	
20	4	MAXX Q-ROM block	

21	XEQ	00	XEQ "Load ROM image"
22	"OSXB1"	ROM image filename	
23	10.1	Destination page.bank	
24	3	MAXX Q-ROM block	
		Fall thru "Load ROM img"	
		→ X=block ; Y=page.bank ; ALPHA=filename	
25	LBL	00	Load ROM image
26	AVIEW		Display ROM image
27	15.0	Temporary page.bank	
		X=tmp-p.b ; Y=blk ; Z=p.b	
28	X<>Y		Get MAXX block number
		X=blk ; Y=tmp-p.b ; Z=p.b	
29	QRWO		Set block as write-only
30	QRABY		Map block to temp. page
31	X<>Y		Get temporary page
		X=tmp-p.b ; A=filename	
32	RDEIL		Read ERAMCO image
33	RDN		X=block ; Y=page.bank
34	QRABY		Map block to final page
35	QRRO		Set block as read-only
36	CLD		Clear display
37	END		End of sub/program

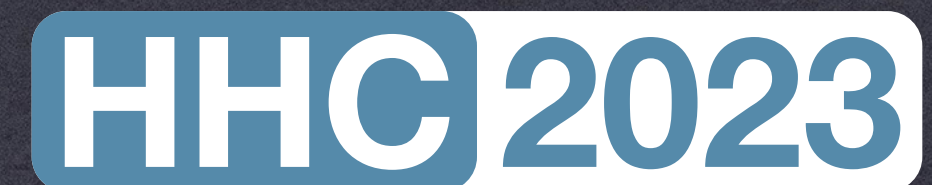
Loading OSX+LIB4 & Q-ROM Status

HP-41C/CV Instruction Memory Layout						
Port 4					15	0xF
					14	0xE
Port 3	PPCU	PPCU	PPCU	PPCU	13	0xD
	PPCL	PPCL	PPCL	PPCL	12	0xC
Port 2					11	0xB
	OSXB1	OSXB2	OSXB3	OSXB4	10	0xA
Port 1	MAXX				9	0x9
	MAXX XF				8	0x8
HP-IL	HP-IL				7	0x7
Printer	Printer				6	0x6
Time	MAXX TM				5	0x5
Special	LIB4B1	LIB4B2			4	0x4
	not used				3	0x3
C/CV OS	41 OS				2	0x2
	41 OS				1	0x1
	41 OS				0	0x0
	Bank 1	Bank 2	Bank 3	Bank 4	Page	

Command	Description
XEQ "LOSX"	Run OSX+LIB4 loader program
0	X = 0 (select all Q-ROM blocks)
QRST?	Show Q-ROM status for all Q-ROM blocks
CAT "2"	
-TIME- C -PRINTER 2E -- -MASS ST 1H -- -CTL FNS -EXT FCN 1C -MAXX 4C -AMC"OS/X -OSX BANK2 C PPC 1981 \SR	
Q-ROM Status	Description
1 P:B:M- 4:1:R	block 1, page 4, bank 1, read-only, active
2 P:B:M- 4:2:R	block 2, page 4, bank 2, read-only, active
3 P:B:M-10:1:R	block 3, page 10, bank 1, read-only, active
4 P:B:M-10:2:R	block 4, page 10, bank 2, read-only, active
5 P:B:M-10:3:R	block 5, page 10, bank 3, read-only, active
6 P:B:M-10:4:R	block 6, page 10, bank 4, read-only, active
7 P:B:M-15:0:D	block 7, page 15, not banked, disabled
8 P:B:M-15:0:D	block 8, page 15, not banked, disabled
9 P:B:M-15:0:D	block 9, page 15, not banked, disabled
10 P:B:M-15:0:D	block 10, page 15, not banked, disabled
11 P:B:M-12:0:R	block 11, page 12, not banked, read-only, active
12 P:B:M-13:0:R	block 12, page 13, not banked, read-only, active

INSTRUCTIONS MEMORY

HP-41CX MINI HOW-TO



Q-ROM Blocks Initialization

Program	Description
01 LBL "QRBI"	Q-ROM Blocks Initialization
02 0	X = 0 (select all Q-ROM blocks)
03 QRRWD	Disable read & write for all Q-ROM blocks
04 QRINI	Fills all QROM blocks with all zeros
05 15.0	Page 15, bank switch disable
06 1.012	Loop control value 1..12
07 LBL 00	Map reset loop
08 INT	Extract Q-ROM block number
09 VIEW X	Display Q-ROM block number
10 QRABY	Reset specified Q-ROM block
11 X<> L	Get back loop control value
12 ISG X	Increment loop counter & Test: is loop counter greater than 12 ?
13 GTO 00	No: loop back to LBL 00
14 CLD	Clear display
15 END	Q-ROM blocks are now in their initial state

Command	Description
XEQ "QRBI"	Execute Q-ROM Blocks Initialization program
0	X = 0 (select all Q-ROM blocks)
QRST?	Show Q-ROM status for all Q-ROM blocks

```
CAT 2
-TIME 2C
-CX TIME
-PRINTER 2E
-MASS ST 1H
-CTL FNS
-MAXX 4C
-EXT FCN 2D
-CX EXT FCN
```

Q-ROM Status	Description
1 P:B:M-15:0:D	block 1, page 15, not banked, disabled
2 P:B:M-15:0:D	block 2, page 15, not banked, disabled
3 P:B:M-15:0:D	block 3, page 15, not banked, disabled
4 P:B:M-15:0:D	block 4, page 15, not banked, disabled
5 P:B:M-15:0:D	block 5, page 15, not banked, disabled
6 P:B:M-15:0:D	block 6, page 15, not banked, disabled
7 P:B:M-15:0:D	block 7, page 15, not banked, disabled
8 P:B:M-15:0:D	block 8, page 15, not banked, disabled
9 P:B:M-15:0:D	block 9, page 15, not banked, disabled
10 P:B:M-15:0:D	block 10, page 15, not banked, disabled
11 P:B:M-15:0:D	block 11, page 15, not banked, disabled
12 P:B:M-15:0:D	block 12, page 15, not banked, disabled

Note: on first power up after MAXX module insertion, all Q-ROM blocks are: disabled, mapped to page 15 with bank switching disabled. Since Q-ROM blocks content can be anything on first power up, it is recommended to initialize all Q-ROM blocks content with QRINI.

Virtual tape / LIF Volume

Create a virtual tape (aka LIF volume) : **lifinit -z -m cass qr41cx.dat 64**

Label the tape : **liflabel qr41cx.dat QR41CX**

Show virtual tape content : **lifdir qr41cx.dat**

```
Volume : QR41CX , formatted : 07/09/23 21:00:00
Tracks: 2 Surfaces: 1 Blocks/Track: 256 Total size: 512 Blocks, 131072 Bytes
0 files (64 max), last block used: 0 of 512
```

Linux/macOS users ↓

Add PPC lower ROM image to tape : **cat PPCL.ROM | rom41er PPCL | lifput qr41cx.dat**

Add PPC upper ROM image to tape : **cat PPCU.ROM | rom41er PPCU | lifput qr41cx.dat**

Windows users ↓

Add PPC lower ROM image to tape : **type PPCL.ROM | rom41er PPCL | lifput qr41cx.dat**

Add PPC upper ROM image to tape : **type PPCU.ROM | rom41er PPCU | lifput qr41cx.dat**

Show virtual tape content : **lifdir qr41cx.dat**

```
Volume : QR41CX , formatted : 07/09/23 21:00:00
Tracks: 2 Surfaces: 1 Blocks/Track: 256 Total size: 512 Blocks, 131072 Bytes
PPCL      X-M41      5121/5120 ← lifdir has a display bug for X-M41
PPCU      X-M41      5121/5120
2 files (64 max), last block used: 50 of 512
```



Virtual tape / LIF Volume (cont.)

Linux/macOS users ↓

Add Library 4 ROM image to tape : `cat LIBRARY4.ROM | rom41er LIB4 | lifput qr41cx.dat`

Add OS/X bank 1 ROM image to tape : `cat OSXB1.ROM | rom41er OSXB1 | lifput qr41cx.dat`

Add OS/X bank 2 ROM image to tape : `cat OSXB2.ROM | rom41er OSXB2 | lifput qr41cx.dat`

Add OS/X bank 3 ROM image to tape : `cat OSXB3.ROM | rom41er OSXB3 | lifput qr41cx.dat`

Add OS/X bank 4 ROM image to tape : `cat OSXB4.ROM | rom41er OSXB4 | lifput qr41cx.dat`

Windows users → Replace **cat** with **type** on the above commands

Show virtual tape content : `lifdir qr41cx.dat`

```
Volume : QR41CX , formatted : 07/09/23 21:00:00
Tracks: 2 Surfaces: 1 Blocks/Track: 256 Total size: 512 Blocks, 131072 Bytes
PPCL      X-M41      5121/5120 ← lifdir has a display bug for X-M41
PPCU      X-M41      5121/5120
LIB4      X-M41      5121/5120
OSXB1     X-M41      5121/5120
OSXB2     X-M41      5121/5120
OSXB3     X-M41      5121/5120
OSXB4     X-M41      5121/5120
7 files (64 max), last block used: 155 of 512
```



PPC ROM Loader Program

Setup:

- HP-41CX
- HP-41 MAXX in port #1 (p. 9)
- 82160A HP-IL in port #4 (p. 6 & 7)
- PIL-Box : HP-IL/USB interface
- HP-IL peripherals simulator (ILPER, pyILPer, etc) with a virtual tape drive loaded with **qr41cx.dat** LIF volume.

Operations:

DIR

NAME	TYPE	REGS
PPCL	??	640
PPCU	??	640
LIB4	??	640
OSXB1	??	640
OSXB2	??	640
OSXB3	??	640
OSXB4	??	640

PPC ROM lower page file is loaded.
ROM file is in ERAMCO format.
Q-ROM block 11 is used.
41CX page 12 is used.
Bank switching is disabled.

01 LBL "LPPC" load PPC ROM images
02 12.0 Y = [p: 12].[b: 0 none]
03 11 X = QROM block number
04 QRW0 Set QR block to write only
05 QRABY Map QR block to pg.bk
06 X<>Y X = target page
07 "PPCL" ALPHA = ROM filename
08 AVIEW Display ROM filename
09 RDEIL Copy ROM file to QROM
10 X<>Y X = QROM block number
11 QRRO Set QR block to read only

PPC ROM upper page file is loaded.
ROM file is in ERAMCO format.
Q-ROM block 12 is used.
41CX page 13 is used.
Bank switching is disabled.

12 13.0 [p: 13].[b: 0 none]
13 12 X = QROM block number
14 QRW0 Set QR block to write only
15 QRABY Map QR block to pg.bk
16 X<>Y X = target page
17 "PPCU" ALPHA = ROM filename
18 AVIEW Display ROM filename
19 RDEIL Copy ROM file to QROM
20 X<>Y X = QROM block number
21 QRRO Set QR block to read only
22 CLD Clear display
23 END End of program

Loading PPC ROM & Q-ROM Status

HP-41CX Instruction Memory Layout						
Port 4					15	0xF
					14	0xE
Port 3	PPCU	PPCU	PPCU	PPCU	13	0xD
	PPCL	PPCL	PPCL	PPCL	12	0xC
Port 2					11	0xB
					10	0xA
Port 1	MAXX				9	0x9
					8	0x8
HP-IL	HP-IL				7	0x7
Printer	Printer				6	0x6
CX Only	CX TM	CX Ext			5	0x5
Special					4	0x4
CX Only	CX XF				3	0x3
	41 OS				2	0x2
CX OS	41 OS				1	0x1
	41 OS				0	0x0
Bank 1		Bank 2	Bank 3	Bank 4	Page	

Command	Description																										
XEQ "LPPC"	Run PPC ROM loader program																										
0	X = 0 (select all Q-ROM blocks)																										
QRST?	Show Q-ROM status for all Q-ROM blocks																										
CAT 2	<table><tr><th>Q-ROM Status</th><th>Description</th></tr><tr><td>1 P:B:M-15:0:D</td><td>block 1, page 15, not banked, disabled</td></tr><tr><td>2 P:B:M-15:0:D</td><td>block 2, page 15, not banked, disabled</td></tr><tr><td>3 P:B:M-15:0:D</td><td>block 3, page 15, not banked, disabled</td></tr><tr><td>4 P:B:M-15:0:D</td><td>block 4, page 15, not banked, disabled</td></tr><tr><td>5 P:B:M-15:0:D</td><td>block 5, page 15, not banked, disabled</td></tr><tr><td>6 P:B:M-15:0:D</td><td>block 6, page 15, not banked, disabled</td></tr><tr><td>7 P:B:M-15:0:D</td><td>block 7, page 15, not banked, disabled</td></tr><tr><td>8 P:B:M-15:0:D</td><td>block 8, page 15, not banked, disabled</td></tr><tr><td>9 P:B:M-15:0:D</td><td>block 9, page 15, not banked, disabled</td></tr><tr><td>10 P:B:M-15:0:D</td><td>block 10, page 15, not banked, disabled</td></tr><tr><td>11 P:B:M-12:0:R</td><td>block 11, page 12, not banked, read-only, active</td></tr><tr><td>12 P:B:M-13:0:R</td><td>block 12, page 13, not banked, read-only, active</td></tr></table>	Q-ROM Status	Description	1 P:B:M-15:0:D	block 1, page 15, not banked, disabled	2 P:B:M-15:0:D	block 2, page 15, not banked, disabled	3 P:B:M-15:0:D	block 3, page 15, not banked, disabled	4 P:B:M-15:0:D	block 4, page 15, not banked, disabled	5 P:B:M-15:0:D	block 5, page 15, not banked, disabled	6 P:B:M-15:0:D	block 6, page 15, not banked, disabled	7 P:B:M-15:0:D	block 7, page 15, not banked, disabled	8 P:B:M-15:0:D	block 8, page 15, not banked, disabled	9 P:B:M-15:0:D	block 9, page 15, not banked, disabled	10 P:B:M-15:0:D	block 10, page 15, not banked, disabled	11 P:B:M-12:0:R	block 11, page 12, not banked, read-only, active	12 P:B:M-13:0:R	block 12, page 13, not banked, read-only, active
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3 P:B:M-15:0:D	block 3, page 15, not banked, disabled																										
4 P:B:M-15:0:D	block 4, page 15, not banked, disabled																										
5 P:B:M-15:0:D	block 5, page 15, not banked, disabled																										
6 P:B:M-15:0:D	block 6, page 15, not banked, disabled																										
7 P:B:M-15:0:D	block 7, page 15, not banked, disabled																										
8 P:B:M-15:0:D	block 8, page 15, not banked, disabled																										
9 P:B:M-15:0:D	block 9, page 15, not banked, disabled																										
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12 P:B:M-13:0:R	block 12, page 13, not banked, read-only, active																										

-TIME 2C
-CX TIME
-PRINTER 2E
-MASS ST 1H
-CTL FNS
-MAXX 4C
C PPC 1981
-EXT FCN 2D
-CX EXT FCN

OSX+LIB4 Loader Program

Setup:

- HP-41CX
- HP-41 MAXX in port #1 (p. 9)
- 82160A HP-IL in port #4 (p. 6 & 7)
- PIL-Box : HP-IL/USB interface
- HP-IL peripherals simulator with a virtual tape drive loaded with **qr41cx.dat**

ROM loading order:

- LIB4 → block 1 → page 4
- OSXB4 → block 6 → page 10 bank 4
- OSXB3 → block 5 → page 10 bank 3
- OSXB2 → block 4 → page 10 bank 2
- OSXB1 → block 3 → page 10 bank 1

Note: in a multi-bank module, to prevent polling point to go astray and crash the unit, always load bank 1 last.

Program:

```
01 LBL "LOSX" Load OSX & LIB4 images
.....
02 "LIB4" ROM image filename
03 4.0 Destination page.bank
04 1 MAXX Q-ROM block
05 XEQ 00 XEQ "Load ROM image"
06 "OSXB4" ROM image filename
07 10.4 Destination page.bank
08 6 MAXX Q-ROM block
09 XEQ 00 XEQ "Load ROM image"
10 "OSXB3" ROM image filename
11 10.3 Destination page.bank
12 5 MAXX Q-ROM block
13 XEQ 00 XEQ "Load ROM image"
14 "OSXB2" ROM image filename
15 10.2 Destination page.bank
16 4 MAXX Q-ROM block
```

```
17 XEQ 00 XEQ "Load ROM image"
18 "OSXB1" ROM image filename
19 10.1 Destination page.bank
20 3 MAXX Q-ROM block
.....
→ X=block ; Y=page.bank ; ALPHA=filename
21 LBL 00 Load ROM image
22 AVIEW Display ROM image
23 15.0 Temporary page.bank
X=tmp-p.b ; Y=blk ; Z=p.b
24 X<>Y Get MAXX block number
X=blk ; Y=tmp-p.b ; Z=p.b
25 QRWO Set block as write-only
26 QRABY Map block to temp. page
27 X<>Y Get temporary page
X=tmp-p.b ; A=filename
28 RDEIL Read ERAMCO image
29 RDN X=block ; Y=page.bank
30 QRABY Map block to final page
31 QRRO Set block as read-only
32 CLD Clear display
33 END End of sub/program
```


Loading OSX+LIB4 & Q-ROM Status

HP-41CX Instruction Memory Layout						
Port 4					15	0xF
					14	0xE
Port 3	PPCU	PPCU	PPCU	PPCU	13	0xD
	PPCL	PPCL	PPCL	PPCL	12	0xC
Port 2					11	0xB
	OSXB1	OSXB2	OSXB3	OSXB4	10	0xA
Port 1	MAXX				9	0x9
					8	0x8
HP-IL	HP-IL				7	0x7
Printer	Printer				6	0x6
CX Only	CX TM	CX Ext			5	0x5
Special	LIB4	LIB4	LIB4	LIB4	4	0x4
CX Only	CX XF				3	0x3
	41 OS				2	0x2
CX OS	41 OS				1	0x1
	41 OS				0	0x0
Bank 1		Bank 2	Bank 3	Bank 4	Page	

Command	Description
XEQ "LOSX"	Run OSX+LIB4 loader program
0	X = 0 (select all Q-ROM blocks)
QRST?	Show Q-ROM status for all Q-ROM blocks
CAT "2"	-EXT FCN 2D -CX EXT FCN -TIME 2C -CX TIME -PRINTER 2E -- -MASS ST 1H -- -CTL FNS -MAXX 4C -AMC"OS/X -OSX BANK2 C PPC 1981 \SR
Q-ROM Status Description	
1 P:B:M- 4:0:R	block 1, page 4, not banked, read-only, active
2 P:B:M-15:0:D	block 2, page 15, not banked, disabled
3 P:B:M-10:1:R	block 3, page 10, bank 1, read-only, active
4 P:B:M-10:2:R	block 4, page 10, bank 2, read-only, active
5 P:B:M-10:3:R	block 5, page 10, bank 3, read-only, active
6 P:B:M-10:4:R	block 6, page 10, bank 4, read-only, active
7 P:B:M-15:0:D	block 7, page 15, not banked, disabled
8 P:B:M-15:0:D	block 8, page 15, not banked, disabled
9 P:B:M-15:0:D	block 9, page 15, not banked, disabled
10 P:B:M-15:0:D	block 10, page 15, not banked, disabled
11 P:B:M-12:0:R	block 11, page 12, not banked, read-only, active
12 P:B:M-13:0:R	block 12, page 13, not banked, read-only, active

REFERENCES

Presentation LIF Volumes

- pg41cv.dat : C/CV demo programs

```
Volume : PG41CV , formatted : 07/09/23 21:00:00
Tracks: 2 Surfaces: 1 Blocks/Track: 256 Total size: 512 Blocks, 131072 Bytes
QRBI      PGM41      38/256 : Q-ROM Blocks Initialization
LPPC      PGM41      55/256 : Load PPC ROM images
LOSX      PGM41     119/256 : Load OS/X ROM images
BY3       PGM41      16/256 : Backup system to Y-Memory block #3
RY3       PGM41      22/256 : Restore system from Y-Memory block #3
S0Y3      PGM41      20/256 : Swap system with Y-Memory block #3
S1Y2      PGM41      17/256 : Swap Y-Memory block #1 with YM block #2
7 files (64 max), last block used: 16 of 512
```

- pg41cx.dat : CX demo programs

```
Volume : PG41CX , formatted : 07/09/23 21:00:00
Tracks: 2 Surfaces: 1 Blocks/Track: 256 Total size: 512 Blocks, 131072 Bytes
QRBI      PGM41      38/256 : Q-ROM Blocks Initialization
LPPC      PGM41      55/256 : Load PPC ROM images
LOSX      PGM41     102/256 : Load OS/X ROM images
BY3       PGM41      16/256 : Backup system to Y-Memory block #3
RY3       PGM41      22/256 : Restore system from Y-Memory block #3
S0Y3      PGM41      20/256 : Swap system with Y-Memory block #3
S1Y2      PGM41      17/256 : Swap Y-Memory block #1 with YM block #2
7 files (64 max), last block used: 16 of 512
```

- qr41cv.dat : C/CV ROM images

```
Volume : QR41CV , formatted : 07/09/23 21:00:00
Tracks: 2 Surfaces: 1 Blocks/Track: 256 Total size: 512 Blocks, 131072 Bytes
PPCL      X-M41      5121/5120 : PPC ROM (lower page) ROM image
PPCU      X-M41      5121/5120 : PPC ROM (upper page) ROM image
LIB4B1    X-M41      5121/5120 : Library (page 4, bank 1) ROM image
LIB4B2    X-M41      5121/5120 : Library (page 4, bank 2) ROM image
OSXB1     X-M41      5121/5120 : OS/X (bank 1) ROM image
OSXB2     X-M41      5121/5120 : OS/X (bank 2) ROM image
OSXB3     X-M41      5121/5120 : OS/X (bank 3) ROM image
OSXB4     X-M41      5121/5120 : OS/X (bank 4) ROM image
8 files (64 max), last block used: 176 of 512
```

- qr41cx.dat : CX ROM images

```
Volume : QR41CX , formatted : 08/09/23 01:00:00
Tracks: 2 Surfaces: 1 Blocks/Track: 256 Total size: 512 Blocks, 131072 Bytes
PPCL      X-M41      5121/5120 : PPC ROM (lower page) ROM image
PPCU      X-M41      5121/5120 : PPC ROM (upper page) ROM image
LIB4      X-M41      5121/5120 : Library (page 4) ROM image
OSXB1     X-M41      5121/5120 : OS/X (bank 1) ROM image
OSXB2     X-M41      5121/5120 : OS/X (bank 2) ROM image
OSXB3     X-M41      5121/5120 : OS/X (bank 3) ROM image
OSXB4     X-M41      5121/5120 : OS/X (bank 4) ROM image
7 files (64 max), last block used: 155 of 512
```


41CL Version of MAXX Functions

MAXX	ROM ID	FNC
MXST?	Note 2	
QRST?		

MAXX	ROM ID	FNC
ST>YM	XPMM	ST–YBK
ST<>YM	XPMM	STYSWP
YM>ST	XPMM	YBK–ST
MM>YM	XPMM	MM–YBK
MM<>YM	XPMM	MMYSWP
YM>MM	XPMM	YBK–MM
XM>YM	XPMM	XM–YBK
XM<>YM	XPMM	XMYSWP
YM>XM	XPMM	YBK–XM
YM<>YM	XPMM	YMSWAP
YMCLR	YFNZ	YMCLR

MAXX	ROM ID	FNC
YARC	XPMM	YARC
YAST	XPMM	YAST
YDSE	XPMM	YDSE
YISG	XPMM	YISG
YRCL	XPMM	YRCL
YRC+	XPMM	YRC+
YRC–	XPMM	YRC–
YRC*	XPMM	YRC*
YRC/	XPMM	YRC/
YST0	XPMM	YST0
YST+	XPMM	YST+
YST–	XPMM	YST–
YST*	XPMM	YST*
YST/	XPMM	YST/
YVEW	XPMM	YVEW
YX<>	XPMM	YX<>

MAXX	ROM ID	FNC
YRGM0V	XPMM	YRGM0V
YRGSWP	XPMM	YRGSWP
CLYRG	XPMM	CLYRG
CLYRGX	XPMM	CLYRGX
A<>YRG	XPMM	A<>YRG
ST<>YRG	XPMM	ST<>YRG

MAXX	ROM ID	FNC
QRABY	Note 2	
QRCLR		
QRINI		
QRRE		
QRR0		
QRRP		
QRRWE		
QRRWD		
QRWE		
QRW0		
QRWP		

MAXX	ROM ID	FNC
AH>XD	–	–
XD>AH	–	–
AHPEEK	YFNZ	YPEEK
AHPOKE	YFNZ	YPOKE
XDPEEK	–	–
XDPOKE	–	–

MAXX	ROM ID	FNC
CPYBNK	XPMM	CPYBNK

MAXX	ROM ID	FNC
RDEIL	IRSU	GETROM
WREIL	IRSU	SAVEROM
RDHIL	HEPX	READROM
WRHIL	HEPX	WRTROM

Note 1: 41CL functions in blue has a similar behavior as the MAXX function, but has a different implementation or set of parameters.

Note 2: 41CL has a different MMU implementation and has an alternate set of functions to manage it.

Ángel's Library 4 ROMs - 41C/CV

Description	XROM	Page/Bank	Filename
C/CV-compatible Library-4	16	pg 4, bk 1	XLIB4_B1.ROM
C/CV-compatible Library-4		pg 4, bk 2	XLIB4_B2.ROM
HP-16C Emulator -1A		bk 1	X16C_B1.ROM
HP-16C Emulator -1A		bk 2	X16C_B2.ROM
HP-16C Emulator -1A	5	bk 3	HP-16C_3.ROM
HP-16C Emulator -1A		bk 4	X16C_B4.ROM
OS/X		bk 1	XOSX_B1.ROM
OS/X		bk 2	XOSX_B2.ROM
OS/X	3	bk 3	XOSX_B3.ROM
OS/X		bk 4	XOSX_B4.ROM
Sandmath 4x4		lower pg, bk 1	XSMAT_41.ROM
Sandmath 4x4		lower pg, bk 2	XSMAT_42.ROM
Sandmath 4x4	2	lower pg, bk 3	XSMAT_43.ROM
Sandmath 4x4		lower pg, bk 4	XSMAT_44.ROM
Sandmath 4x4		upper pg, bk 1	XHLMT_41.ROM
Sandmath 4x4		upper pg, bk 2	XHLMT_42.ROM
Sandmath 4x4	21	upper pg, bk 3	XHLMT_43.ROM
Sandmath 4x4		upper pg, bk 4	XHLMT_44.ROM
Warp-core		bk 1	XWARP_B1.ROM
Warp-core		bk 2	XWARP_B2.ROM
Warp-core	31	bk 3	XWARP_B3.ROM
XROM			XXROM.ROM
YREG Applications	21		XYRGAPPS.ROM

Description	XROM	Page/Bank	Filename
41Z Deluxe	1	lower pg, bk 1	X41Z_L1.ROM
41Z Deluxe	4	lower pg, bk 2	X41Z_L2.ROM
41Z Deluxe		upper pg, bk 1	X41Z_U1.ROM
41Z Deluxe		upper pg, bk 2	X41Z_U2.ROM
Advantage Math	12		XADVMTH.ROM
Alpha	6		XALPHA44.ROM
Complex Matrices	13		XCPXMTRX.ROM
Dual Numbers and Double Stack	1		XDBLDOWN.ROM
Formula Evaluation	30		XEVAL_VF.ROM
Formula Evaluation Equations	31		XEVAL_EQ.ROM
HEPAX 4H	7	bk 1	HEPX4H_1.ROM
HEPAX 4H		bk 2	XHEPX_B2.ROM
HEPAX 4H		bk 3	HEPX4H_3.ROM
HEPAX 4H		bk 4	HEPX4H_4.ROM
Pi and e ROM	9		XPIE.ROM
RAMpage X	17		XRAMPAGE.ROM
Random Numbers	6		XRANDOM.ROM
Solve & Integrate	27		XSIROM.ROM
Sums & Series	18		XSERIES.ROM
Time Value of Money	22		XTVM.ROM
Toolbox	13		XTBOX4L.ROM
X-mem Extended Functions	17		XXMEMXF.ROM
X-mem TWIN	20		XXMTWIN.ROM

Ángel's Library 4 ROMs - 41CX

Description	XROM	Page/Bank	Filename
CX-compatible Library-4		pg 4, bk 1	LIBRARY4.ROM
HP-16C Emulator -1A	16	bk 1	HP-16C_1.ROM
HP-16C Emulator -1A		bk 2	HP-16C_2.ROM
HP-16C Emulator -1A		bk 3	HP-16C_3.ROM
HP-16C Emulator -1A		bk 4	HP-16C_4.ROM
OS/X	5	bk 1	OSXB1.ROM
OS/X		bk 2	OSXB2.ROM
OS/X		bk 3	OSXB3.ROM
OS/X		bk 4	OSXB4.ROM
Sandmath 4x4	3	lower pg, bk 1	SMAT41.ROM
Sandmath 4x4		lower pg, bk 2	SMAT42.ROM
Sandmath 4x4		lower pg, bk 3	SMAT43.ROM
Sandmath 4x4		lower pg, bk 4	SMAT44.ROM
Sandmath 4x4	2	upper pg, bk 1	HLMAT41.ROM
Sandmath 4x4		upper pg, bk 2	HLMAT42.ROM
Sandmath 4x4		upper pg, bk 3	HLMAT43.ROM
Sandmath 4x4		upper pg, bk 4	HLMAT44.ROM
Warp-core	21	bk 1	WARPB1.ROM
Warp-core		bk 2	WARPB2.ROM
Warp-core		bk 3	WARPB3.ROM
XROM	31		XROM.ROM
YREG Applications	21		YRGAPPS.ROM

Description	XROM	Page/Bank	Filename
41Z Deluxe	1	lower pg, bk 1	41ZL1.ROM
41Z Deluxe		lower pg, bk 2	41ZL2.ROM
41Z Deluxe	4	upper pg, bk 1	41ZU1.ROM
41Z Deluxe		upper pg, bk 2	41ZU2.ROM
Advantage Math	12		ADVTGMTH.ROM
Alpha	6		ALPHA44.ROM
Complex Matrices	13		CPXMTRX.ROM
Dual Numbers and Double Stack	1		DBLDOWN.ROM
Formula Evaluation	30		EVAL_VF.ROM
Formula Evaluation Equations	31		EVAL_EQN.ROM
HEPAX 4H	7	bk 1	HEPX4H_1.ROM
HEPAX 4H		bk 2	HEPX4H_2.ROM
HEPAX 4H		bk 3	HEPX4H_3.ROM
HEPAX 4H		bk 4	HEPX4H_4.ROM
Pi and e ROM	9		PIE_ROM.ROM
RAMpage X	17		RAMPGX4.ROM
Random Numbers	6		RANDOM.ROM
Solve & Integrate	27		SIROM.ROM
Sums & Series	18		SERIES.ROM
Time Value of Money	22		TVM_1G.ROM
Toolbox	13		TBOX4_L4.ROM
X-mem Extended Functions	17		XMEMXF.ROM
X-mem TWIN	20		XMTWIN.ROM

Websites

- * HP-41 MAXX & 41CL Website systemyde.com/hp41/
- * HP-41 MAXX Manual systemyde.com/pdf/maxx-4c_manual.pdf
- * PIL-Box - HP-IL to USB Interface jeffcalc.hp41.eu/hpil/
- * Virtual IL - Virtual IL Peripherals hp.giesselink.com/hpil.htm
- * pyILPER - Virtual IL Peripherals github.com/bug400/pyilper/
- * LIF Utilities github.com/bug400/lifutils/
- * ROM Images systemyde.com/hp41/archive.html
- * HHC Conferences hhuc.us
- * HP-41 Website www.hp41.org/Intro.cfm
- * HP Museum Forum hpmuseum.org/forum/

Price & Availability

- * Price

- * \$135 USD + shipping → with a donor module from the customer.
- * \$155 USD + shipping → without a donor module.

- * Availability

- * As soon as beta testing is done and no critical bug is found.
- * Testing is crucial, the module once programmed cannot be easily updated.
- * Future batches and prices will depend on parts availability and costs.

QUESTIONS ?





HP-41 MAXX

THANK YOU !

HHC 2023