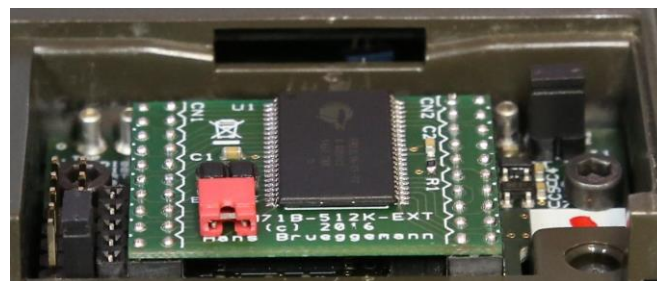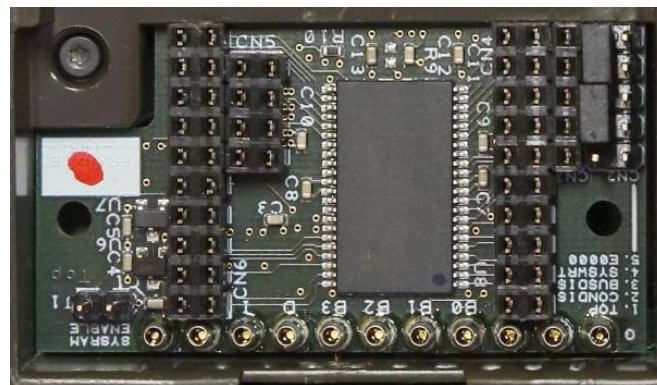# FRAM71B

"Denver 2016"

Now you can cram even more RAM,
with FRAM

Bob Prosperi

Overview

- Recap Classic FRAM71
- New FRAM71B Features
- What was lost?
- Classic FRAM71 Model
- FRAM71B Model
- Sample Configuration
- Tips
- Pricing and Availability
- Related 71B & HP-IL news

Classic FRAM71 Review

- Designed and built by Hans Brueggemann
- 512Kb Model sold (few field upgrades => 1024)
- NV-RAM to fill 71B address space as ROM/RAM
- Holds ROM images (Incl. FORTH or 41Trans ROMs)
- Supports alternate OS & Takeover ROM (Diags)
- Easily configurable w/o programming
- Supports 2 separate HP-71 Configurations (w/1024)
  - BOT(TOM) (initial 512KB) & TOP (upgrade chip)
- Toolkit w/"How to" for loading ROMs using PIL-Box
  - By D. Frederickson, here:
    http://www.hpmuseum.org/forum/thread-4844.html

Special Features – HC ROMs

- FORTH/Assembler ROM and HP-41 Translator ROM
  - Each has 2 ROM Components, Hard & Soft Configured
- Configure FRAM Chip_0 for special ROMs with fixed address (Hard Configured) ROM image
- Hard-Configured ROM (32KB) permanently mapped to E0000-EFFFF (Can't install FTH & T41 together!)
- Both ROMs also have a normal (Soft-Configured) 16KB ROM as well (FORTHROM and other LEX files)
- Config F-Block, write 32KB HC ROM image, set jumper, pwr-cycle, then load SC ROM like any other

Why isn't there 512KB of RAM?

Address Block (32KB)	Use
00000	71B OS
10000	71B OS
20000	Video Ram, System RAM values, FRAM Config
30000	Avail
40000	Avail
50000	Avail
60000	Avail
70000	Avail
80000	Avail
90000 – D0000	Avail (5 banks of 32)
E0000	HC ROMs
F0000-FFBFF	N/A if HC ROM present (Reserved for Debugger)
FFC00-FFFFF	System Config Area

Address Block (32KB)	512KB Total
00000	- 32
10000	- 32
20000	- 32
X0000	- 16KB HP-IL
Y0000	- 16KB FORTH SC ROM
50000	Avail
60000	Avail
70000	Avail
80000	Avail
90000 – D0000	Avail (5 banks of 32)
E0000	- 32
F0000	- 32
Total Available RAM:	320KB (384 w/no ROMs)

FRAM71B New Features

- Both OS configurations can access FRAM blocks from both TOP and BOT banks simultaneously

- Bank-Switching (BS) of active chips under program control
  - Useful for BASIC program to automate building your configuration

- "On-The-Fly" BS (swap active ROMs in real time) is dangerous
  - File chain and LEX chain not restored until off/on, so crash is likely
  - Techniques to automate OTF changes via program control under study

- Entire TOP FRAM can be write-protected (lock the library)

- Simplified SYSRAM control – 1 jumper changes personality

- Much lower power use in sleep mode (46 µA vs 146 µA)

- Field upgradeable 512KB => 1024KB with 2nd FRAM module
  - Simple plug-in daughterboard – no h/w skills needed

FRAM71 Classic Features Lost

- Minor features lost in order to retain simple config process
  - Bits of config string repurposed for new features
- UART removed (experimental in FRAM71)
  - No interest from user base
- 8 KB chips no longer supported
  - No known ROMs, 8KB RAM insignificant in big picture
- 16 KB chips restricted to BOT FRAM blocks
  - Finance, Survey, TextEdit, Datacom, and AC Circuits ROMs are 16KB
  - Can't use TOP FRAM blocks for 16 KB chips, but BOT blocks OK
  - Can also store 16KB ROM images into 32KB chips in TOP
- Effectively no loss of any useful features

FRAM Configuration

- Config easily done via simple POKE command (then pwr-cycle)
- Config "string" comprised of 1 byte (nibble pair) for each FRAM chip used to construct virtual "memory modules" (MM)
- Example looks like POKE "2C000","*14159*6"
- Each pair of Nibbles specifies
  - Size and type (RAM or ROM) of chip
  - One of several chips, or the Last Chip In Module (LCIM)
  - FRAM Block/chip to use (0-F in TOP or BOT)
- In above example:
  - Each *1* means 1 x 32KB RAM Chip in BOT FRAM; *9* is same, but LCIM
  - 4, 5 and 6 mean 4th, 5th and 6th FRAM Blocks
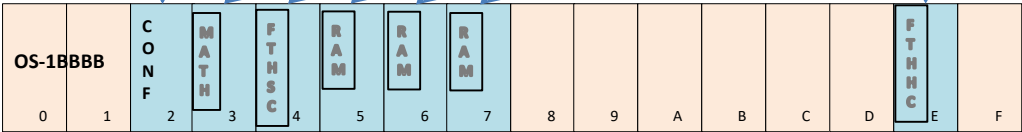 - So, ex. string means allocate 3 x 32KB chips, from BOT into 1 x 96KB MM
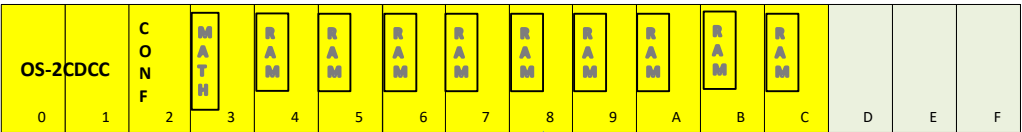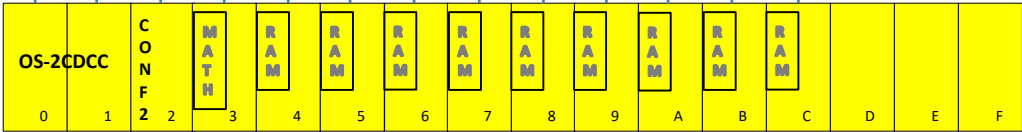
Classic FRAM71 Model
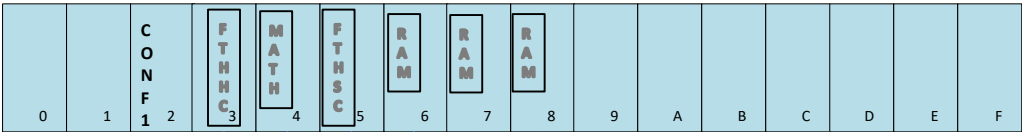
POKE "2C000","D3D4D5161798" w/HC FORTH in E0000
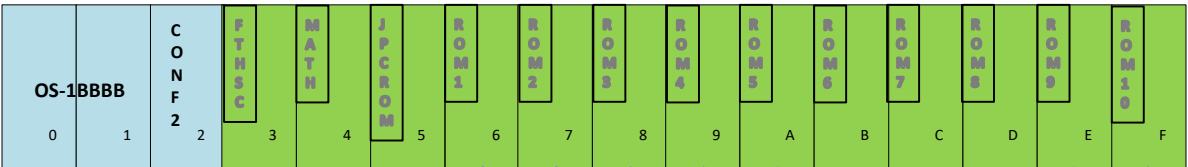FORTH ROM, MATH ROM, 96KB RAM, native OS

POKE "2C000","D31415161718191A1B9C" w/jumpers set for OS takeover
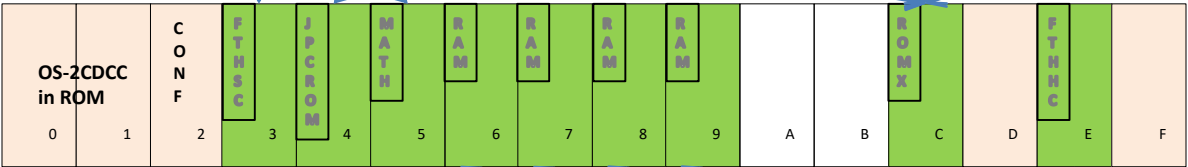MATH ROM, 288KB RAM, OS upgraded to ver. 2CDCC
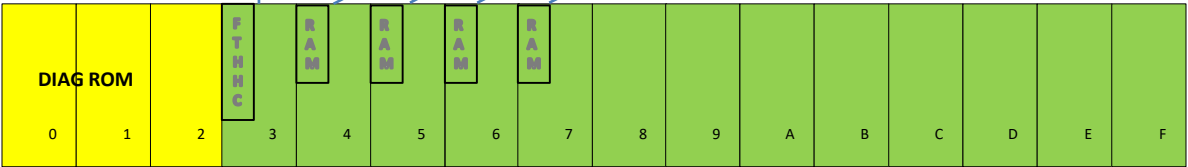
FRAM71B Model

TOP FRAM

71 Personality-1

BOT FRAM

POKE "2C000","F3F5F4141516171899F6*" w/HC FORTH in E0000
FORTH ROM, JPC ROM, MATH ROM, 128KB RAM, + 1 more Appl ROM
Can easily switch to OS 1BBBB or DIAG ROM via jumpers
* - Can select any one of 10 installed ROM images using nibble 6 - F

Sample FRAM71B Configuration

- I want my HP-71B w/FRAM71B setup like this:
  - 128KB RAM
  - A 32KB IRAM for storing LEX files & Utilities
  - FORTH, JPC-ROM, and MATH ROMs always avail
  - Use other Appl. ROMs, one at-a-time – "Guest ROM"
- Other design choices: (can vary, but need to choose)
  - Will use BOT for RAM, TOP for ROM (write-prot. my library)
  - RAM in PORT(5.00)
  - IRAM in PORT(5.01)
  - Permanent ROMs in PORT(5.02,5.03,5.04)
  - Guest ROM in PORT(5.05)

Steps to Create Example Config-1

1. Load FORTH HC ROM (Man & Toolkit describe exactly) & Jumper

2. POKE "2C000", "B31415169799B4B5B6B7"
   a) allocates FRAM Blocks of the size and type needed. Off/On to activate
   b) Check mem to see ~305KB free (128KB + built-in 17KB + 5x32KB)

3. FREE PORT(5.00), FREE PORT(5.01), ... PORT(5.05)
   a) Check MEM to see ~145KB free (5x32KB no longer RAM, now IRAMs)

4. Load ports with desired contents
   a) Copy Lex1 to :PORT(5.01), COPY Lex2 to :PORT(5.01), etc.
   b) ROMCOPY FORTHSC to :PORT(5.02), ROMCOPY JPC to :PORT(5.03), ROMPCOPY MATHROM to :PORT(5.04) -
   c) ROMCOPY AMPISTAT to :PORT(5.05) – 1st Guest ROM I want to use

Steps to Create Example Config-2

5. POKE "2C000","F31415169799F4F5F6F7" (Optional)
   a) Changing the B's to F's means RAM-> ROM. Off/On to activate
   b) Confirm memory configuration with SHOW PORT and MEMBUF

```
>SHOWPORT                >RUN MEMBUF
                         Port Dev Seq  Size Addr   Type
0.05   16384  2           0    0   0     4  70000   0
5.01   32768  1           0    1   0     4  72000   0
5.02   32768  2           0    2   0     4  74000   0
5.03   32768  2           0    3   0     4  76000   0
5.04   32768  2           5    0   0   128  30000   0
5.05   32768  2           0    5   0    16  80000   2
0       4096  0           5    1   0    32  D0000   1
0.01    4096  0           5    2   0    32  C0000   2
0.02    4096  0           5    3   0    32  B0000   2
0.03    4096  0           5    4   0    32  A0000   2
5     131072  0           5    5   0    32  90000   2
```

Steps to Create Example Config-3

6. Now to switch to my next guest ROM, safely

    a) POKE "2C000", "B31415169799B4B5B6<u>00</u>" Off/On

    b) "00" Removes Guest ROM from config

    c) POKE "2C000", "B31415169799B4B5B6B<u>8</u>"

    d) Change last config byte (was B7) to point to new FRAM block. Off/On

    e) ROMCOPY CURVEFIT to :PORT(5.05) – 2nd Guest ROM I want to use

    f)   POKE "2C000", "B31415169799B4B5B6<u>F</u>8" Off/On

    g) Again convert RAM -> ROM (Optional. Can be left as RAM if desired)

    h) Going forward, I can swap ROMs by just doing POKE commands, since all blocks have now been loaded with ROM images (only done once)

- Goal is automate the ROM swapping under program control
   - Under study… will publish solution at MoHPC Forum when available

Tips & Tricks

- On Power Loss or MEM LOST, FRAM71B has lost it's config, but it's saved in FRAM's 0x20000 blocks, so you can restore the config by doing:
  - POKE "2C000",PEEK$("2C000",32)
  - Either TOP or BOT config can be used, assuming they were intact/stable when MEM LOST occurred

Community Parts Compatibility 100%

- FRAM71 Custom bezels
  - >20 Colors & materials, more coming
- OD Module Port Covers
  - 24 AWG wire in Port Cover with precise holes; custom labels
- Avail @ http://www.shapeways.com/shops/hpparts
- By Nate Martin (CAD) and Dave Frederickson (Store)
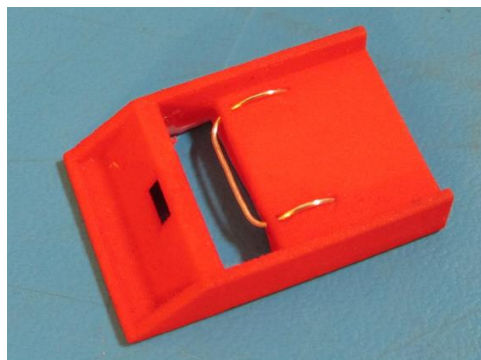
FRAM71 Community Participation

- 3/14 First beta unit (FRAM71) to users
- 4/14 Initial threads in Forum w/specs, features, etc.
- 10/14 Initial FRAM71 sales through Forum
- 3/15 1st Field upgrade FRAM71 to 1024KB (D. Frederickson)
- 4/15 2nd batch sales begin, some w/1024KB
- 9/15 HHC FRAM71 Presentation
- 1/16 FRAM71B Poll and orders announced on Forum
- 5/16 Batch of 30 units pre-order completed
- 9/16 FRAM71B units ship & HHC FRAM71B Presentation
- 7/17 DIY Projects available

Pricing and Availability

- 2 Models available to order, beginning *today*!
  - FRAM71B-512KB, 239 EUR ($269)
  - FRAM71B-1024KB, 321 EUR ($361)
- Upgrade daughter board (512KB => 1024KB)
  - FRAM71B-512K-EXT, 103 EUR ($116)
  - User installable, no special h/w skills needed
- Prices include International Shipping
- Email order to Hans Brueggemann (FRAM71B@gmx.net)
  - Order <u>must</u> include ship-to address
- Will ship in 3 weeks max, likely less

Order Procedure

- Initial 30 buyers (from MoHPC thread) have 1st Priority
  - Must order NLT Nov 30th, 2016
  - Limited to 1 piece, for now
- Hans will make 11/30 "Last Call" announcement on MoHPC for any remaining units
  - 1st Priority for 2nd unit to original 30 that ordered > 1 piece
  - New customers may order at this time as well (not before)
- Bare (unpopulated) FRAM71B boards for DIY users
  - July 2017 – Look for announcement at MoHPC Forum

Many Thanks to…

- Hans Brueggemann – creator of FRAM71/71B
- Dave Frederickson and Sylvain Cote
    - Testing, documenting, always pushing to learn more
- Joe Horn for LEX files and *many* 71B answers
- All FRAM71 buyers that made FRAM71B possible
- HHC for a forum to discuss these great tools
- MoHPC Forums and Dave Hicks
   - For a place to discuss and share all these FRAMisms

Related 71B & HP-IL News

- New Firmware (v2.1) for JFG's PIL-Box
  - Doubles USB speed to 230KBPS
  - Simply replace socketed PIC micro chip inside
  - ILPer V2.1+ required to take advantage of speeds
  - Dramatically improves all operations, especially disk
    - Up to 1.8 KBPS throughput on USB 3 ports
    - On some systems, higher speeds possible when PIL-Box is connected to host PC via USB Hub (verified & quite odd)
  - Available for small fee from Jean Francois Garnier
    - Email JFG at jeffcalc@wanadoo.fr

Related 71B & HP-IL News

- ILPer V2.22 Client for PIL-Box
  - Supports new PIL-Box speeds
    - Both new & original f/w
  - Dual Virtual Drives
  - Integrated DOSLink device
    - Saves many cmd-line steps
  - Wider output window
    - Toggles w/HP-Il Scope

- Other Virtual IL Utilities too
  - Video, Scope, ILCtrl, etc.

- From Christoph Giesselink
  - http://hp.giesselink.com/hpil.htm
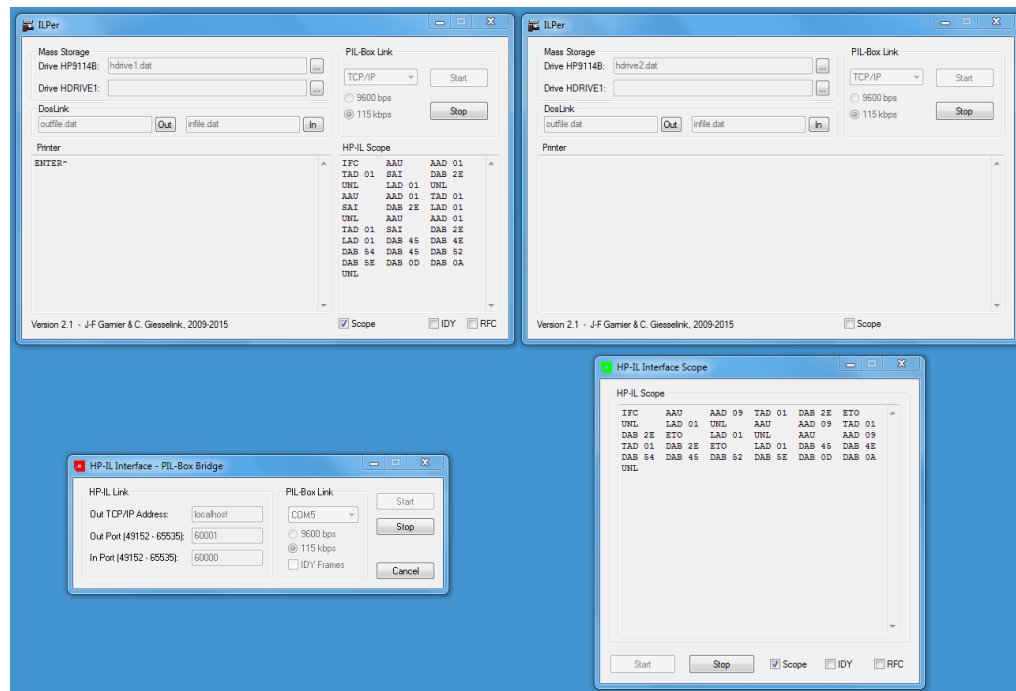
Related 71B & HP-IL News

- pyILPER Version 1.3.4
  - Python PIL-Box client, like ILPer
    - Win, MAC and Linux supported
  - Requires PIL-Box f/w v1.6+
  - Drive, Printer & IL-Scope Tabs
    - Multiple of each type available
  - Terminal for remote access
    - Run 71B from PC Kbd/Screen
    - Short program to map keys
  - Also integrates author's LIF Utils
    - Manage/repair LIF files
  - From Joachim Siebold
    - https://github.com/bug400/pyilper/releases

- HP-IL Port can accept any ROM/RAM module – address is :PORT(0.05)
  - Rediscovery of old news documented by Valentin Albillo's "Long Live the HP-71B !"


```
>cat :main
  NAME    S TYPE    LEN    DATE     TIME PORT
FORTHRAM    FORTH   6937 03/21/16 21:30
LOOPSPD     BASIC     46 01/01/00 00:00
MEMBUF      BASIC    651 03/21/16 21:31
MEMBUFF     TEXT     768 03/21/16 21:31
EDITFTH     TEXT    1024 03/21/16 21:32
RAMED       TEXT    1536 03/21/16 21:32
FLIB        TEXT    1536 03/21/16 21:37
VCAT        TEXT    1536 03/21/16 21:37
YESNO       TEXT     768 03/21/16 21:41
YESNO2      TEXT     766 03/27/16 16:17
keys        KEY      117 03/27/16 16:18
IDSXREF     BASIC    548 04/06/16 21:14
IDSNAMES    TEXT   11008 04/06/16 21:15
IDSADDRS    TEXT    6400 04/06/16 21:16
README      TEXT    2560 04/06/16 21:23
DIS         BASIC   4224 04/06/16 21:24
workfile    BASIC     19 04/22/16 10:39
XFER71      BASIC    424 04/22/16 15:14
NIBBLDOC    TEXT    2816 04/22/16 18:42
UTILLEXS    TEXT    2816 04/30/16 18:52
PEEKLIST    TEXT   14336 04/30/16 19:03
PEEKASSY    TEXT    4864 04/30/16 19:06
```

Related 71B & HP-IL News

- EMU71/Win w/Application ROM Overlays
  - Scans of overlays for App ROMs can be "installed" so they're visible on 71 keyboard of EMU71/Win (also from Christoph Giesselink)
  - Idea from D. Frederickson, images from HP-Museum (Matthias Wehrli) with some KML tweaking by Christoph
  - Download link in 09.08.2016 note here: http://www.hp-collection.org/

Related 71B & HP-IL News

- HP-71B Compendium, by Sylvain Côté
  - Amazing (really!) collection of information about the HP-71B, including all available related HP accessories, documents and software, including 3rd-party products – 152 pages!
  - This document and the Titan File Collection released last year are almost all you need to learn all about the HP-71B
  - Avail: http://www.hpmuseum.org/forum/thread-5286.html
  - Get it! Even if you never liked the 71B until now, you will
  - Full presentation coming up…