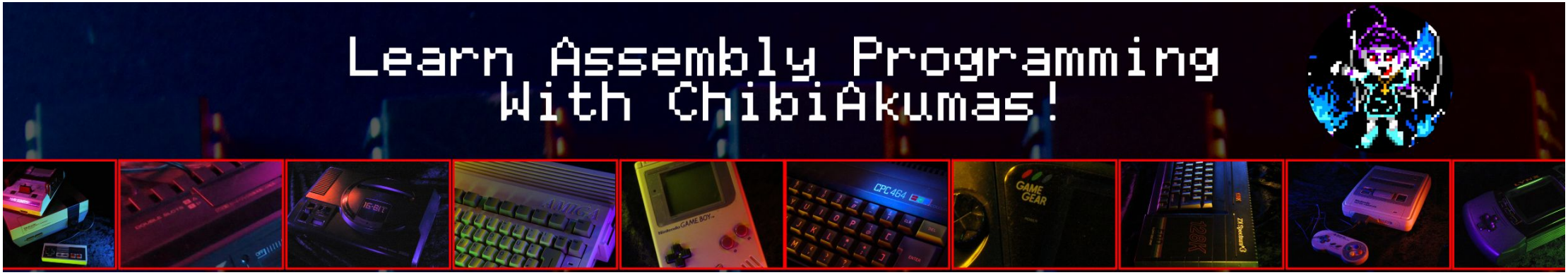

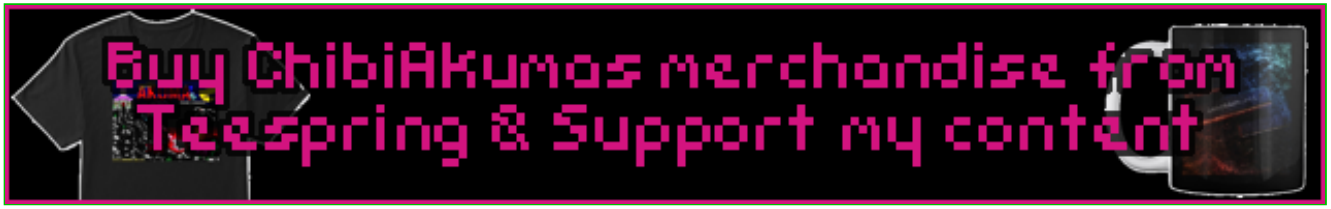

6809 Assembly programming for the Fujitsu FM-7

The FM-7 is one of a series of Fujitsu computers released in Japan

With a pair of 6809 CPU's it was widely popular in Japan, and is one of the few 6809 computers released.

In these tutorials we'll learn the about the FM7, and write some simple programs for it

	FM-7
Cpu	Main: 2mhz 6809 Sub: 2mhz 6809 for GPU
Ram	64k Ram 48k VRam
Sound	AY-3-8912 optional FM2203 add on
Max Resolution	640 x 200 @ 8 colors (RGB CMY BW)

View Options

Default Dark

Simple (Hide this menu)

Print Mode (white background)

Top Menu

Main Menu

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Dec/Bin/Hex/Oct/Ascii Table

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Hello World

Advanced Series

Multiplatform Series

Platform Specific Series

ChibiAkumas Series

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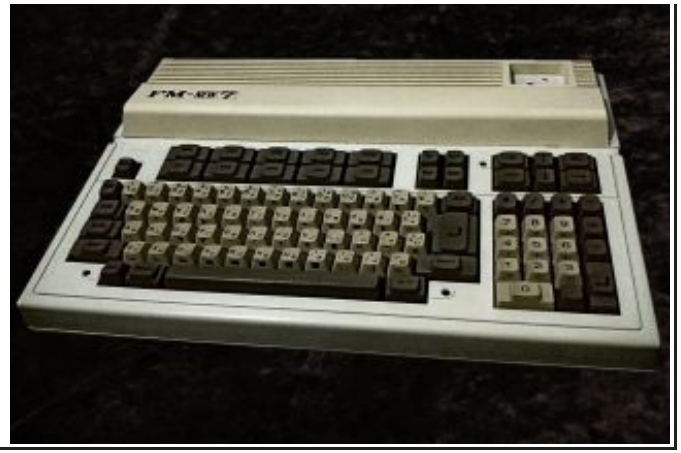
DevTools kit



Hello World Example

Here is a sample file...

We've provided a **Header**, containing the Length and destination load address...

There is also an **Exec address** in the footer, however this does not actually have any effect!

The **hello world example** uses the PrintChar routine in the basic rom at $D08E of the FM-7 OS

Z80 Platforms
Amstrad CPC
Elan Enterprise
Gameboy & Gameboy Color
Master System & GameGear
MSX & MSX2
Sam Coupe
TI-83
ZX Spectrum
Spectrum NEXT
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Atari Lynx
BBC Micro
Commodore 64
Commander x16
Super Nintendo (SNES)
Nintendo NES / Famicom
PC Engine (Turbografx-16)
Vic 20

68000 Content

```
printchar equ $D08E

    PADDING off

    ORG     $2000-21
    DC.B $50,$52,$4f,$47,$00,$00,$00,$00    ;FileName
    dc.b $00,$00,$02,$00,$00
    dc.b $58,$4d,$37                        ;XM7
    dc.b 0
    DC.W ProgramEnd-ProgramStart            ;Size
    DC.W ProgramStart                       ;Load Addr

ProgramStart:
    ldy #Hello
    jsr PrintString

InfLoop:
    jmp InfLoop

PrintString:
    lda ,Y+
    cmpa #255
    beq PrintStringDone
    jsr printchar
    jmp PrintString
PrintStringDone:
    rts

Hello:
    dc.b "Hello WORLD!!",255

ProgramEnd:
    dc.w ProgramStart                       ;exec address
    dc.b $1a                                ;EOF
```

StartUp File

To make our disk automatically start, we need a basic launcher.

Here we've written a BAS file, it will load machine code program "PROG" (which has a built in destination address of &H2000)

Next we execute it with an EXEC command

We need to save this as "STARTUP" (Case Sensitive)

```
10 LOADM "PROG"
20 EXEC &H2000

Ready
Save "STARTUP
```

Building our program to the disk

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DevTools kit

We need to create a binary file (with a 2b0 extension)

We use **ASW** to compile the program, and P2Bin to convert it to a binary.

To add a file to a disk we'll need the **Ftools kit**

We'll use a template disk (with our STARTUP bas) and attach the 2b0 file to it

```
rem Compile program
\Utils\Asw\bin\asw %1 -CPU 6809  -L -olist \BldFM7\Listing.txt  -D BuildFM7 -o \BldFM7\prog.bld
if not "%errorlevel%"=="0" goto Abandon

rem Create Binary
\Utils\Asw\bin\p2bin \BldFM7\prog.bld \BldFM7\PROG.2B0 -l 0
if not "%errorlevel%"=="0" goto Abandon

rem Copy Template Disk
cd \BldFM7\
copy Startup_Template.D77 Startup.D77

rem Add program to disk
\Utils\ftools_00\fmwrite startup.d77 PROG.2b0

rem Launch Emulator
cd \Emu\Xm7\Win32\
\Emu\Xm7\Win32\XM7.exe \BldFM7\startup.d77
```

Sending Data to the Sub CPU

The Sub CPU handles graphics drawing and key input - it's a second 6809

To control it we have to send data to it via a 128 byte shared memory block, between $FC80-FCFF ($D380-D3FF on the Sub CPU side)

To do this, we have to:
1. Wait for the Sub Cpu to not be busy (wait for Bit7 in $FD05 to equal 0)
2. Halt the Sub Cpu (set Bit 7 of $FD05 to 1)
3. Copy command data to $FC80-FCFF
4. Resume the Sub CPU (write 0 to $FD05)

The command will then be processed by the sub CPU

```
SubCpu_Halt:              ;Halt the SubCPU
    LDA $FD05
    BMI SubCpu_Halt       ;Wait for Not Busy
    LDA #$80
    STA $FD05             ;Set Halt
SubCpu_HaltWait
    LDA $FD05
    BPL SubCpu_HaltWait ;Wait For Busy (halt to happen)
    RTS

SubCpu_Release:
    PSHS A
    LDA #0
    STA $FD05             ;Release the SubCpu
    PULS A,PC

SubCpu_Wait:
    PSHS    A
SubCpu_Wait2:
    LDA $FD05             ;Wait for SubCpu to be ready
    BMI SubCpu_Wait2
    PULS A,PC
```

if we HALT and RESUME the sub cpu but don't set a command there WILL be trouble!

When we do this we need to set the 'request ready' bit (Bit 7 of $F780) - this will stop the SUB CPU trying to process a command and getting confused.

ARM Platforms
Gameboy Advance
Nintendo DS
Risc Os

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6809 Platforms

```
DoTest_Inkey:   ;Wait for a key from the cursor
    ldx #TestInkey                      ;Source
    LDB #(TestInkey_End-TestInkey)/2    ;length (Words)
    jsr SubCpu_DoCmd                    ;Send it to $FC82

    jsr SubCpu_Halt     ;Stop the Sub CPU so we can read ram
    lda $FC83           ;Key code
    ldb $FC84           ;Key read? (1=yes)
    pshs d
        lda #%10000000
        sta $FC80       ;Ready Request
;(Ready Request FC80 Bit7=1 Stops CPU locking when no command sent)

    puls d
    jsr SubCpu_Release
    jsr monitor         ;A=Ascii   B=Key Read?

    jmp DoTest_Inkey

TestInkey:
    dc.b $29    ;$29=INKEY
    dc.b $3     ;(Bit0=Wait,Bit1=Reset buffer)
TestInkey_End:
```

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RAM Main CPU

From	To	Use
$0000	$7FFF	Ram
$8000	$FBFF	Basic Rom / Ram **
$FC00	$FC7F	Ram
$FC80	$FCFF	Shared Ram (With SUB CPU $D380)
$FD00	$FDFF	IO area
$FE00	$FEEF	Boot Rom
$FFF0	$FFFF	Vectors

** $FD0F Enable/Disable Basic ROM 8000-FC00 (Write=Disable... Read= Enable)

RAM Sub CPU

From	To	Use
$0000	$3FFF	VRAM (BLUE)
$4000	$7FFF	VRAM (RED)
$8000	$BFFF	VRAM (GREEN)

$C000	$CFFF	Console Buffer Ram
$D000	$D37F	Work Ram
$D380	$D3FF	Shared Ram (With MAIN CPU $FC80)
$D400	$D7FF	IO area
$D800	$DFFF	Character Rom
$E000	$FFFF	CRT Monitor Rom

Ports Main CPU

Address	Read Bits	Read Purpose	Write Bits	Write Purpose
$FD00	D-------M	Key Clock D8	Ss-------Ao	Audio Casette / Printer
$FD01	DDDDDDDD	Key Data	DDDDDDDD	Printer Data
$FD02	A-PPPPPP	Audio Casette / Printer	RRRR-TPK	IRQ
$FD03	----ETPK	IRQ	CK-----S	Buzzer
$FD04	------BA	SubCpu Brk / Attention		
$FD05	B------E	SubCPU Busy / Extdet	HC-----Z	Halt / Cancel / Z80
$FD06	DDDDDDDD	RS232 Data	DDDDDDDD	RS232 Data
$FD07	SSSSSSSS	RS232 Status	CCCCCCCC	RS232 Comand
$FD0D			RRRRRRRR	PSG AY Register (need to write zero after reg num?)
$FD0E	DDDDDDDD	PSG AY Data	DDDDDDDD	PSG AY Data
$FD0F	BBBBBBBB	ROM Bank	BBBBBBBB	Ram Bank
$FD18	SSSSSSSS	Floppy Status	CCCCCCCC	Floppy Command
$FD19	DDDDDDDD	Floppy Track Register	DDDDDDDD	Floppy Track Register
$FD1A	DDDDDDDD	Floppy Sector Register	DDDDDDDD	Floppy Sector Register
$FD1B	DDDDDDDD	Floppy Sector Register	DDDDDDDD	Floppy Sector Register
$FD1C	DDDDDDDD	Floppy	DDDDDDDD	Floppy
$FD1D	DDDDDDDD	Floppy	DDDDDDDD	Floppy
$FD1E	DDDDDDDD	Floppy	DDDDDDDD	Floppy
$FD1F	DI------	Floppy		Floppy
$FD20		Kanji Rom 1	DDDDDDDD	Kanji Rom 1
$FD21		Kanji Rom 1	DDDDDDDD	Kanji Rom 1
$FD22	DDDDDDDD	Kanji Rom 1		Kanji Rom 1
$FD23	DDDDDDDD	Kanji Rom 1		Kanji Rom 1
$FD2C		Kanji Rom 2		Kanji Rom 2
$FD2D		Kanji Rom 2		Kanji Rom 2

$FD2E		Kanji Rom 2		Kanji Rom 2
$FD2F		Kanji Rom 2		Kanji Rom 2
$FD2E?		Dictionary Bank		Dictionary Bank
$FD30				Analog Palette Number
$FD31				Analog Palette Number
$FD32				Analog Palette Blue Level
$FD33				Analog Palette Red Level
$FD34				Analog Palette Green Level
$FD35		Speech Synthesis		Speech Synthesis
$FD37			-GRB-GRB	Multipage (Display / Write Lock)
$FD38	-----GRB	Palette 0 (---)	-----GRB	Palette 0
$FD39	-----GRB	Palette 1 (--B)	-----GRB	Palette 1
$FD3A	-----GRB	Palette 2 (-R-)	-----GRB	Palette 2
$FD3B	-----GRB	Palette 3 (-RB)	-----GRB	Palette 3
$FD3C	-----GRB	Palette 4 (G--)	-----GRB	Palette 4
$FD3D	-----GRB	Palette 5 (G-B)	-----GRB	Palette 5
$FD3E	-----GRB	Palette 6 (GR-)	-----GRB	Palette 6
$FD3F	-----GRB	Palette 7 (GRB)	-----GRB	Palette 7
$FD40		Modem Card		Modem Card
$FD41		Modem Card		Modem Card
$FD42				Modem Card
$FD56		Voice Recognition Card		Voice Recognition Card
$FD57		Voice Recognition Card		Voice Recognition Card
$FD58		Handy Image Scanner		
$FD59				Handy Image Scanner
$FD5A		Handy Image Scanner		
$FD80		Memory Management Register		Memory Management Register
$FD81		Memory Management Register		Memory Management Register
$FD82		Memory Management Register		Memory Management Register
$FD83		Memory Management Register		Memory Management Register
$FD84		Memory Management Register		Memory Management Register
$FD85		Memory Management		Memory Management Register

	Register	
$FD86	Memory Management Register	Memory Management Register
$FD87	Memory Management Register	Memory Management Register
$FD88	Memory Management Register	Memory Management Register
$FD89	Memory Management Register	Memory Management Register
$FD8A	Memory Management Register	Memory Management Register
$FD8B	Memory Management Register	Memory Management Register
$FD8C	Memory Management Register	Memory Management Register
$FD8D	Memory Management Register	Memory Management Register
$FD8E	Memory Management Register	Memory Management Register
$FD8F	Memory Management Register	Memory Management Register
$FD90		MMR Segment Register
$FD92		Window Offset Register
$FD93		Mode Select Register 1
$FD94		CPU Speed
$FD95	Mode Select Switch 2	Mode Select Switch 2
$FD98		DMAC
$FD99	DMAC	DMAC
$FDE0		Mouse
$FDE1	Mouse	Mouse
$FDE2	Mouse	Mouse
$FDE3	Mouse	Mouse
$FDE4	Mouse	Mouse
$FDE5	Mouse	Mouse
$FDE6	Mouse	Mouse
$FDE7	Mouse	Mouse
$FDE8	Mouse	Mouse

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$FDE9			MIDI
$FDEA	MIDI		MIDI
$FDEB	MIDI		MIDI
$FDEC	MIDI		MIDI
$FDED	MIDI		MIDI
$FDEE	MIDI		MIDI
$FDEF			MIDI

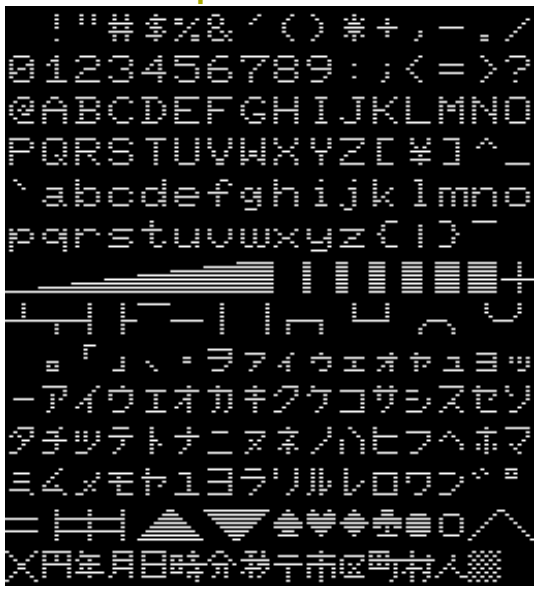
Ports Sub CPU

Address	Read Bits	Read Purpose	Write Bits	Write Purpose
$D400	DDDDDDDD	Key Data		
$D401	-------D	Key Data		
$D402		Cancel IRQ ACK		
$D404		Main CPU Attention IRQ		
$D408		CRT ON		CRT OFF
$D409		Vram Access Set		Vram Access Reset
$D40A		Ready		Busy
$D40D		Ins LED ON		Ins LED OFF
$D40E			--HHHHHH	Vram Address H
$D40F			LLLLLLLL	Vram Address L

Colors

0 1 2 3 4 5 6 7

Char Map



Special Chars

Code		Meaning
$11	SF	Start Field
$12,X,Y	SBA	Set Buffer Address (Locate)
$13,count,Ascii	RC	Repeat Character
$05	EL	Erase Line
$07	BEL	BELL (Beep)
$08	BS	BackSpace
$09	HT	Horizontal TAB
$0A	LF	Line Feed
$0B	HOME	Buffer Address to top of screen
$0C	EA	Erase All (CLS)
$0D	CR	Carrage Return
$1C		Right Cursor
$1D		Left Cursor
$1E		Up Cursor
$1F		Down Cursor

$1B,$23	Lock Keyboard
$1B,$22	Unlock Keyboard
$1B,$39	Erase Key Buffer
$1B,$67	Set Buffered Mode
$1B,$69	Set Unbuffered Mode

Graphics Operations

Code	Op	Details
0	PSET	Set to Color
1	PRESET	Set to background Color
2	OR	Add to
3	AND	Mask
4	XOR	Invert
5	NOT	Flip bits

Commands that can be sent to the Sub CPU

There are a variety of commands that can be sent to the Sub CPU, there are some special 'secret' ones called the YAMAUCHI calls,
These allow data to be direct copied to the SubCPU and allows for execution

Gfx Cmd	Name	Purpose	Data (Load into #$FC80)	Returns
$01	INIT	Init Console	DC.B unused,unused DC.B $01,Background DC.B Widh,Hei (80/40,25/20) DC.B ScrollStart,ScrollEnd DC.B SHowFunctions,ClearScreen,GreenScreen	
$02	ERASE	Clear screen	DC.B unused,unused DC.B $02,Mode (0-3),Color	
$03	PUT	Print Characters	dc.b unused,unused dc.b continue (128=yes) dc.b unused dc.b $03 dc.b Bytecount dc.b StringToSend	

$04	GET		
$05	GETC		
$06	Get Character Block 1		
$07	Put Character Block 1		
$08	Get Character Block 2		
$09	Put Character Block 2		
$0A	Get Buffer Address		
$0B	Tab Set		
$0C	Console Control		
$0D	Erase 2		
$15	Line	Draw Lines, Fill Boxes	dc.b unused,unused dc.b $15,color,operation dc.w StartX,StartY,EndX,EndY dc.b mode (line,square,filled)
$16	Chain	Draw a series of lines	
$17	Point	Draw Dots	dc.b unused,unused dc.b $17,points (1-20) (for each point) dc.w Xpos,Ypos ;(X,Y) dc.b Color,Operation ;Color,Operation
$18	Paint	Fill an area	dc.b $18 dc.w Xpos,Ypos dc.b FillColor dc.b BoundaryCount dc.b BoundaryColor....BoundaryColor
$19	Symbol	Draw text with color, Scale and rotation	dc.b unused,unused dc.b $19,Color,Operation dc.b Rotation (0,90,180,270) dc.b ScaleX,ScaleY (1=normal) dc.w Xpos,Ypos dc.b StringLen dc.b "String"

$1A	Change Color	Swap colors for other colors	dc.b $1A dc.w StartX,StartY,EndX,EndY dc.b 2 ;SwapCount dc.b 7,6 ;Old Color,New Color dc.b 4,3 ;Old Color,New Color
$1B	Get Block 1		
$1C	Put Block 1	Send Monocrome data	
$1D	Get Block 2		
$1E	Put Block 2	Send Color Data	dc.b unused,Multiblock (128=Y) dc.b $1E dc.w StartX,StartY,EndX,EndY dc.b Unused, Function, Bytes dc.b pixel,pixel,pixel....
$1F	Graphics Cursor		
$20	Character Line		
$29	Inkey		DC.B unused,unused DC.B $29,Option(Bit0=Wait,Bit1=Reset)
$2A	Define String of PF		
$2B	Get String of PF		
$2C	Interrupt Control		
$3D	Set Timer		
$3E	Read Timer		
$3F - 90	YAMAUCHI END	End command sequence	DC.B unused,unused DC.B $3F,YAMAUCHI,$90
$3F - 93	YAMAUCHI CALL	Call program in sub cpu ram	DC.B unused,unused DC.B $3F,YAMAUCHI,$93 DC.W {address} DC.B $90
$3F -	YAMAUCHI	transfer data in sub	DC.B unused,unused

DC.B ErrorCode,Unused,Unused
DC.B,Keycode (ASCII),Keyreturned? (1=yes)

92	MOVE	cpu	DC.B $3F,YAMAUCHI,$91 DC.W {FromAddrInSub} DC.W {ToAddrInSub} DC.W {LengthInBytes} DC.B $90 DC.B unused,unused
$3F - 91	YAMAUCHI JUMP	Jump to an address	DC.B $3F,YAMAUCHI,$91 DC.W {address} DC.B $90
$64	Continue	Send more data (Put Block)	dc.b unused,Multiblock (128=Y) dc.b $64 ;Continue dc.b pixel,pixel,pixel....

The FM8 required $3F to be followed with the 8 byte 'YAMAUCHI' string... but FM7 onwards didn't check it ...

There still needs to be 8 bytes 'there' before $9x commands - but they can be anything.

AY Registers

The procedure for setting and reading **AY-3-8910** registers is not quite direct... the method is shown here	**Select Register:** RegNum -> $FD0E #$03 -> $FD0D #$00 -> $FD0D	**Write Selected Register:** New Value -> $FD0E #$02 -> $FD0D #$00 -> $FD0D	**Read Selected Register:** #$01 -> $FD0D $FD0E -> Result #$00 -> $FDOD

FM Registers

The FM7 later gained a **YM2203** FM card! It's strangely backwards compatible with the AY too.	**Select Register:** RegNum -> $FD16	**Write Selected Register:** New Value -> $FD16	**Read Selected Register:** #$09 -> $FD15

bit modes on the 65816

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ARM Assembly Lesson H3

Lesson P65 - Mouse reading on the Sam Coupe

Mouse Reading in MS-DOS

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This had a built in joystick port we may want to use!	#$03 -> $FD15 #$00 -> $FD15	#$02 -> $FD15 #$00 -> $FD15	$FD16 -> Result #$00 -> $FD15

Joystick Reading

The original FM7 had no joystick... but the later FM card had one as an upgrade.
 	
The Joystick is connected to ports A (Reg14) & B (Reg15) Reg 14 selects which joystick to read (1 or 2)... reg 15 reads in from the joystick.
	;Init Joystick
	  ldb #15 ;RegNum
	  lda #$7F ;Value (Turn off joysticks)
	  jsr FMRegWrite
	
	  ldb #7 ;RegNum
	  lda #%10111111 ;Value (Set Direction B=Out R15 / A= In R14)
	  jsr FMRegWrite
	
	  ldb #15 ;$2F (Joy0) $5F (Joy1)
	  lda #$2F
	  jsr FMRegWrite
	
	  ldb #14
	  jsr FMRegRead ;A= %--21RLDU

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