

A Mini-Disassembler for the 2650

Software development in machine language is a difficult task. A substantial part of the frustration can be traced to the difficulties of debugging a program when one must work from a printout that has no flow, no mnemonics, and bears little resemblance to any real world logic system. A disassembler can save the programmer countless headaches by correcting these deficiencies. This particular disassembler was constructed to aid in the development of software for a dedicated controller for an amateur radio repeater.

The basic requirements for our disassembler are that it use a small amount of memory (this version uses less than 750 bytes of memory, satisfying our definition of small), and that it provide a readable listing that includes mnemonics. The only restriction of this version is that it will print a maximum of only

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hexadecimal FF addresses (eg: hexadecimal 0400 to 04FF) without being restarted.

Using the Disassembler

The disassembler is employed in a straightforward manner:

1. Load the program from the listing.
2. Using the Signetics PIPBUG monitor, GOTO the initial address of the disassembler.
3. Input a 4 digit address for the program to be listed (include leading zeroes).
4. Input a 2 digit stop address.

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Listing 1: A 2650 disassembler. Technically, this listing is a disassembled assembly listing of a disassembler. The program is designed to take Signetics 2650 machine language code and transform it into an assembler-like listing.

Address	Hexadecimal Code	Operator	Operand	Address	Hexadecimal Code	Operator	Operand
0440	76 40	PPU		0490	06 FC	LODI	2
0442	77 02	PPL		0492	0E 63 F7	LODA	2
0444	06 FD	LODI	2	0495	E1	COMZ	1
0446	3F 02 24	BSTA	3	0496	98 09	BCFR	0
0449	01	LODZ	1	0498	CF 04 F9	STRA	3
044A	CE 64 00	STRA	2	049B	3F 05 E4	BSTA	3
044D	DA 77	BIRR	2	049E	1F 04 D0	BCTA	3
044F	06 FE	LODI	2	04A1	87 03	ADDI	3
0451	0E 63 FF	LODA	2	04A3	DA 6D	BIRR	2
0454	C1	STRZ	1	04A5	F5 10	TMII	1
0455	3F 02 69	BSTA	3	04A7	18 03	BCTR	0
0458	DA 77	BIRR	2	04A9	1F 05 15	BCTA	3
045A	3F 03 5B	BSTA	3	04AC	F5 08	TMII	1
045D	04 02	LODI	0	04AE	1C 05 00	BCTA	0
045F	CC 04 FC	STRA	0	04B1	07 AB	LODI	3
0462	0D 84 FD	LODA	1	04B3	04 14	LODI	0
0465	06 F8	LODI	2	04B5	06 02	LODI	2
0467	04 03	LODI	0	04B7	E1	COMZ	1
0469	07 DB	LODI	3	04B8	99 09	BCFR	1
046B	CC 04 FB	STRA	0	04BA	CF 04 F9	STRA	3
046E	0E 63 F3	LODA	2	04BD	3F 05 28	BSTA	3
0471	E1	COMZ	1	04C0	1F 05 D2	BCTA	3
0472	98 0E	BCFR	0	04C3	84 04	ADDI	0
0474	CF 04 F9	STRA	3	04C5	87 0C	ADDI	3
0477	04 09	LODI	0	04C7	FA 6E	BDRR	2
0479	CC 04 FA	STRA	0	04C9	84 17	ADDI	0
047C	3F 05 E4	BSTA	3	04CB	D8 68	BIRR	0
047F	1F 04 D0	BCTA	3	04CD	1F 00 00	BCTA	3
0482	87 03	ADDI	3	04D0	3F 00 8A	BSTA	3
0484	DA 68	BIRR	2	04D3	0C 04 FE	LODA	0
0486	04 01	LODI	0	04D6	E4 01	COMI	0
0488	CC 04 FC	STRA	0	04D8	1E 00 00	BCTA	2
048B	04 0C	LODI	0	04DB	0D 04 FF	LODA	1
048D	CC 04 FA	STRA	0	04DE	E1	COMZ	1

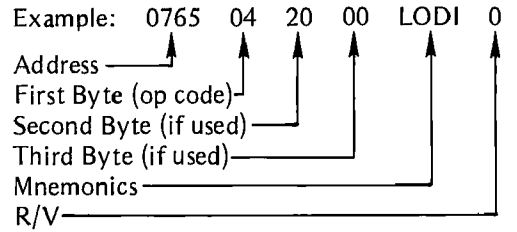
Listing 1 continued:

04DF	9E	00	00	BCFA	2
04E2	1F	04	4F	BCTA	3
04E5	00			LODZ	0
04E6	00			LODZ	0
04E7	00			LODZ	0
04E8	00			LODZ	0
04E9	00			LODZ	0
04EA	00			LODZ	0
04EB	12	13		SPU	
04ED	74	75		CPU	
04EF	76	77		PPU	
04F1	B4	B5		TPU	
04F3	40			HLT	
04F4	92			LPU	
04F5	93			LPL	
04F6	C0			NOP	
04F7	00			LODZ	0
04F8	30			RDCZ	0
04F9	EA	09		PPL	
04FB	03			LODZ	3
04FC	01			LODZ	2
04FD	04	FE		LODI	0
04FF	12				
*					
0500	04	20		LODI	0
0502	07	93		LODI	3
0504	E1			COMZ	1
0505	99	06		BCFR	1
0507	CF	04	F9	STRA	3
050A	1F	05	28	BCTA	3
050D	87	03		ADDI	3
050F	84	1F		ADDI	0
0511	D8	71		BIRR	0
0513	1B	72		BCTR	3
0515	04	10		LODI	0
0517	07	7B		LODI	3
0519	E1			COMZ	1
051A	99	06		BCFR	1
051C	CF	04	F9	STRA	3
051F	1F	05	28	BCTA	3
0522	87	03		ADDI	3
0524	84	1F		ADDI	0
0526	D8	71		BIRR	0
0528	F5	0C		TMII	1
052A	C0			NOP	
052B	98	0F		BCFR	0
052D	04	03		LODI	0
052F	CC	04	FC	STRA	0
0532	CC	04	F7	STRA	0
0535	04	06		LODI	0
0537	CC	04	FA	STRA	0
053A	1B	37		BCTR	3
053C	F5	08		TMII	1
053E	98	0F		BCFR	0
0540	04	02		LODI	0
0542	CC	04	FC	STRA	0
0545	CC	04	F7	STRA	0
0548	04	09		LODI	0
054A	CC	04	FA	STRA	0
054D	1B	24		BCTR	3
054F	F5	04		TMII	1
0551	98	11		BCFR	0
0553	04	02		LODI	0
0555	CC	04	FC	STRA	0
0558	04	01		LODI	0
055A	CC	04	F7	STRA	0
055D	04	09		LODI	0
055F	CC	04	FA	STRA	0
0562	1B	0F		BCTR	3
0564	04	01		LODI	0
0566	CC	04	FC	STRA	0
0569	04	00		LODI	0
056B	CC	04	F7	STRA	0
056E	04	0C		LODI	0
0570	CC	04	FA	STRA	0
0573	3F	05	8A	BSTA	3
0576	04	01		LODI	0
0578	CC	04	FB	STRA	0
057B	07	77		LODI	3
057D	0C	04	F7	LODA	0
0580	83			ADDZ	3
0581	CC	04	F9	STRA	0
0584	3F	06	02	BSTA	3
0587	1F	05	D2	BCTA	3

Listing 1 continued on page 236

Text continued from page 233:

The Listing Format



Listing 1 continued:

Address	Hexadecimal Code	Operator	Operand
058A	06 0C	LODI	2
058C	0E 65 9B	LODA	2
058F	E1	COMZ	1
0590	98 05	BCFR	0
0592	04 01	LODI	0
0594	CC 04 FC	STRA	0
0597	FA 73	BDRR	2
0599	1F 05 A9	BCTA	3
059C	14	RTCI	0
059D	15	RTCI	1
059E	16	RTCI	2
059F	17	RTCI	3
05A0	34	RTEI	0
05A1	35	RTEI	1
05A2	36	RTEI	2
05A3	37	RTEI	3
05A4	94	DARI	0
05A5	95	DARI	1
05A6	96	DARI	2
05A7	97	DARI	3
05A8	00	LODZ	0
05A9	F5 03	TMII	1
05AB	98 07	BCFR	0
05AD	04 33	LODI	0
05AF	CC 04 F8	STRA	0
05B2	1B 1B	BCTR	3
05B4	F5 02	TMII	1
05B6	98 07	BCFR	0
05B8	04 32	LODI	0
05BA	CC 04 F8	STRA	0
05BD	1B 10	BCTR	3
05BF	F5 01	TMII	1
05C1	98 07	BCFR	0
05C3	04 31	LODI	0
05C5	CC 04 F8	STRA	0
05C8	1B 05	BCTR	3
05CA	04 30	LODI	0
05CC	CC 04 F8	STRA	0
05CF	1F 05 E4	BCTA	3
05D2	C0	NOP	
05D3	07 01	LODI	3
05D5	3F 03 5D	BSTA	3
05D8	0C 04 F8	LODA	0
05DB	3F 02 B4	BSTA	3
05DE	3F 00 8A	BSTA	3
05E1	1F 04 D3	BCTA	3
05E4	0E 04 FC	LODA	2
05E7	0D 84 FD	LODA	1
05EA	3F 02 69	BSTA	3
05ED	07 01	LODI	3
05EF	3F 03 5D	BSTA	3
05F2	0D 04 FE	LODA	1
05F5	85 01	ADDI	1
05F7	CD 04 FE	STRA	1
05FA	FA 6B	BDRR	2
05FC	0F 04 FA	LODA	3
05FF,	3F 03 5D	BSTA	3
*			
0602	0E 04 FB	LODA	2
0605	0D 04 F9	LODA	1
0608	0D 25 9B	LODA	1
060B	3F 02 B4	BSTA	3
060E	FA 78	BDRR	2
0610	07 01	LODI	3
0612	17	RTCI	3
*			

Listing 1 continued:

```
0613 -5A -49 -52 -41 -4C -4F -44 -45 -4F -52 -41 -4E -44 -49 -4F -52
0623 -41 -44 -44 -53 -55 -42 -53 -54 -52 -43 -4F -4D -42 -43 -54 -42
0633 -53 -54 -42 -52 -4E -42 -53 -4E -42 -43 -46 -42 -53 -46 -42 -49
0643 -52 -42 -44 -52 -00 -00 -00 -52 -54 -43 -52 -44 -43 -52 -54 -45
0653 -52 -52 -52 -52 -44 -45 -52 -44 -44 -00 -00 -00 -00 -00 -00 -44
0663 -41 -52 -57 -52 -43 -00 -00 -00 -52 -52 -4C -57 -52 -45 -57 -52
0673 -44 -54 -4D -49 -00 -00 -55 -53 -50 -4C -43 -50 -55 -43 -50 -4C
0683 -50 -50 -55 -50 -50 -4C -54 -50 -55 -54 -50 -4C -48 -4C -54 -4C
0693 -50 -55 -4C -50 -4C -4E -4F -50 -0E -0E -0C -8E -0C -8B -4B -2D
```

*

In any command dealing with registers, the R/V column represents the register number. In all other cases the R/V column represents the V (value or condition) field.

The total memory used in this listing is from hexadecimal 0440 to 069A. Areas 04EB to 04F2 and 04F3 to 04F6 are used as tables of unique codes. 04F7 to 04FF is a scratch pad storage area (eg: STOP, START addresses). The area from hexadecimal 059C to 05A7 contains a table of op codes that are one byte long but which have a format of two bytes. Hexadecimal 0613 to 069A is used for storage of ASCII characters which are used for mnemonics.

Storage Area Definitions

04F7 = Address mode 00=Z, 01=I, 02=R,
03=A

04F8 = R/V of op code
04F9 = Indexing for mnemonics print
04FA = Number of spaces between data and
mnemonic
04FB = Number of letters in mnemonic
04FC = Number of bytes in command
04FD = High order start address
04FE = Low order start address
04FF = Stop address

This is not a refined program by any means: with some work it could reside in less memory and perhaps be more efficient. Its only intent is to be a development tool, and it does this well. It has helped make software development for our controller more like higher level language programming. ■

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