

## The Elegant Assembly System for the 205 ("EASY")

This assembly program is a "quick-and-dirty" routine for the Datatron 205 which still provides a convenient assembly language. It was thrown together in a hurry in order to enable the user to throw his programs together in a hurry. The rules for its use are as follows:

1. There are eleven fields on the input cards.
  - a. Program point location (column 5)
  - b. Symbolic location (cols. 7-11)
  - c. Numeric word (cols. 13-23)
    - (1) sign (column 13)
    - (2) control digits (cols. 14-17)
    - (3) numeric operation (cols. 18-19)
    - (4) numeric address (cols. 20-23)
  - d. Symbolic operation (cols. 25-29)
  - e. Symbolic address (cols. 31-35)
  - f. Program point address (cols. 37-38)
  - g. High-speed-loop tag (column 40)
  - h. Remarks (cols. 42-56)

Column 1 must contain a "1"; all other columns are ignored on input.

2. If the symbolic operation field is blank, the numeric operation field becomes the assembled operation code. If the symbolic operation field is a 205-mnemonic operation, this number supercedes the numeric operation field. If the symbolic op is START or END, special assembly operation occurs, as described later.

3. If the symbolic address field is non-blank, this symbol must occur exactly once in the symbolic location field somewhere in the input program; and the symbol then represents the location of that line.

The program point address field is relevant if it is non-blank and if the symbolic address is blank. This field can have the forms:

- a.  $n+$   $n=0,1,\dots,9$ ; meaning current location plus  $n$ .
- b.  $n-$   $n=0,1,\dots,9$ ; meaning current location minus  $n$ .
- c.  $nF$   $n=1,2,\dots,9$ ; meaning the next location of the program which has  $n$  in the program point location field.
- d.  $nB$   $n=1,2,\dots,9$ ; meaning the previous location of the program which has  $n$  in the program point location field.

The addresses of forward program points and "forward" symbols (i.e. those symbols which occur later in the location field) are eventually assembled as their corresponding equivalents; the addresses of backward program points, of  $n+$  and  $n-$  addresses, and of "backward" symbols (i.e. symbols which have occurred previously in the location field) are assembled as their corresponding equivalents plus the numeric address field (mod 10000), allowing the use of so-called "regional addresses."

Restriction: On all forward symbols and program points the high-order control digit (column 14) must be zero. This is necessary to the loading routine which adjusts the assembled instructions wherever forward references were made and which finds the high-speed-loop tag there.

4. If the high-speed-loop tag is non-zero this digit is inserted into the high-order digit of the assembled address. This is used for programs that have been blocked to a loop and the loop address is sought.

5. A symbolic location is specified by punching the symbol in the appropriate field. The location will be one greater than the previous location if the previous card was not a START card, and will be the location specified by the START card otherwise.

A program point location is specified by punching the number into column 5.

6. START and END are pseudo-operations which do not result in an assembled instruction. On both of these operations an address is specified in the numeric address field and/or symbolic or program point field. (Only non-forward symbols and program points are meaningful here.)

a. START sets the location counter to this address. (Examples:

1000 START causes the next line to have location 1000.

START 2+ causes the assembled coding to skip two lines.

b. END is used exactly once in every assembled program, as the last card. This causes a loading routine to be punched starting at the address you specify on the END card. The loading routine uses (33 plus the number of locations which were used for forward references) memory cells.

7. For best results do not assemble any instructions into location 0000. This simple-minded assembler gets very confused with this location!

8. The output of EASY is immediately reloadable as a one-per-card deck, provided you set the Cardatron control panel to take the format band from column 2. The output is also reloadable for another assembly if the Cardatron control panel is set to take the format band from column 1.

9. Operating instructions! Load EASY deck followed by your input cards into input unit one. Put blank cards into output punch unit one. Let the program take off. There are three programmed stops:

08 8421, improper symbolic operation code. Hit Continuous to read in and process the next card. (rA=erroneous op)

08 9669, symbol occurs in location address twice. (rA=symbol)  
Hit Continuous to read in and process the next card.

08 1111, end of assembly. Unrestartable.

10. Operation Codes! The symbolic operation codes chosen were designed for a man who wants to use both the 205 and the 220 and not be confused. These codes can, however, be easily modified if desired.

00 PTR	10 DAD	20 BUN	31 CUBR	44 CRD	60 MUL	72 LDB	82 FMU
01 CIRA	11 BA	21 CUR	32 IB	45 CRI	61 DIV	73 OSD	83 FDV
02 STC	12 STA	22 DBB	33 CLR	48 CRF	63 EXT	74 ADD	
03 PTW	13 SRT	23 RND	34-7 BT4-7	50 MOW	64 CAD	75 SUB	
04 CNZ	14 SLT	24-7 BF4-7	38 CCB	52 MRV	65 CSU	76 ADA	
06 UA	15 NOR	28 BOF	39 CCER	54 CWR	66 CAA	77 SUA	
07 PTWF	16 ASC	29 CCR	40 MRD	55 CWI	67 CSA	80 FAD	
08 HLT	17 SSC	30 CUB	42 MTS	58 CWF	70 MRO	81 FSU	

11. Listing of EASY program. This listing is an illustration of most of the rules given here and it also is the final authority on EASY operation. The listing is not as it would come out of an assembly, but as an edited listing showing all the forward references as they would appear after the loading routine went to work.

①

		1000	START		EASY ASSEMBLER.				1000
PROC	10	6005	CRD		READ INPUT CARD	1000	0	0010	44 6005
		1600	BF6		MAKE TWO COPIES	1001	0	0000	26 1600
		6012	CAD		IS THE OP CODE	1002	0	0000	64 6012
			CNZ	OP	SYMBOLIC.	1003	0	0000	04 1024
ADDR		6011	CAD		IS THE ADDRESS	1004	0	0000	64 6011
			CNZ	SYMBL	SYMBOLIC.	1005	0	0000	04 1048
		6009	CAD		IS THE ADDRESS	1006	0	0000	64 6009
			CNZ	NUMAD	N+ N- NF OR NB.	1007	0	0000	04 5006
FLAG			SRT			1008	0	0000	13 0000
LOCAT		6017	CAD		IS THE LOCATION	1009	0	0000	64 6017
			CNZ	SLOC	SYMBOLIC.	1010	0	0000	04 1056
		6018	CAD		IS THE LOCATION	1011	0	0000	64 6018
			CNZ	NLOC	A PROGRAM POINT	1012	0	0000	04 1070
FINIS		1613	CAA			1013	0	0000	66 1613
		4	SRT		SYNTHESIZE	1014	0	0000	13 0004
		1608	CAD		INSTRUCTION.	1015	0	0000	64 1608
			CNZ	1F	CHECK HSL TAG	1016	0	0000	04 1020
2		1614	CAD		TACK ON	1017	0	0000	64 1614
		2	SRT		OPERATION CODE.	1018	0	0000	13 0002
			BUN	HSLF		1019	0	0000	20 7010
1		1	SLT		INSERT	1020	0	0000	14 0001
		6008	CAD		HSL TAG DIGIT	1021	0	0000	64 6008
		1	SRT			1022	0	0000	13 0001
			BUN	2B		1023	0	0000	20 1017
OP			ADD	SEVEN	LOOK UP	1024	0	0000	74 5008
			CUR	TABLE	SYMBOLIC OPCODE	1025	0	0000	21 4000
		8421	HLT		HALT IF	1026	0	0000	08 8421
			BUN	PROC	UNDEFINED,	1027	0	0000	20 1000
		1614	STA		BUT IF DEFINED	1028	0	0000	12 1614
		2	SRT		CHECK FOR	1029	0	0000	13 0002
		1614	CNZ		PSUDO OPERATION	1030	0	0000	04 1614
			BUN	ADDR		1031	0	0000	20 1004
END			CAD	3F	SET UP	1032	0	0000	64 1046
			STA	PROC	TO FINISH OFF.	1033	0	0000	12 1000
START			CAD	2F	CALCULATE	1034	0	0000	64 1047
			STC	FLAG	ADDRESS	1035	0	0000	02 1008
			BUN	ADDR	EQUIVALENT.	1036	0	0000	20 1004
5			CAD	1F		1037	0	0000	64 1045
			STA	FLAG		1038	0	0000	12 1008

	1613	CAD		CHANGE LOCATION	1039	0	0000	64	1613
	6002	STA		COUNTER	1040	0	0000	12	6002
	6003	ADD		AND INSERT	1041	0	0000	74	6003
	6000	STA		TRANSFER	1042	0	0000	12	6000
	6004	CAD		INSTRUCTION.	1043	0	0000	64	6004
		BUN	PUNCH		1044	0	0000	20	7017
1		SRT			1045	0	0000	13	0000
3		CUB	PLOAD		1046	0	0000	30	1708
2		BUN		5B	1047	0	0000	20	1037
	SYMBL	CUR	TABLE	LOOK SYMBOL UP.	1048	0	0000	21	4000
	1	1900	STC	IF UNDEFINED,	1049	1	0000	02	1900
			BUN	LOOP7	1050	0	0000	20	7000
			OSD	7+	1051	0	0000	73	1058
			BOF	LOOP7	1052	0	0000	28	7000
	EQ	6013	ADD	FORWARD GO TO	1053	0	0000	74	6013
		1613	STA	SPECIAL ROUTINE	1054	0	0000	12	1613
			BUN	OTHERWISE SET	1055	0	0000	20	1008
			CUR	EQUIVALENT.	1056	0	0000	21	4000
		1900	STC	LOOK FOR SYMBOL	1057	1	0000	02	1900
			BUN	A3	1058	0	0000	20	1064
			OSD	7-	1059	0	0000	73	1052
			BOF	A3	1060	0	0000	28	1064
		6017	CAD	DEFINED LOC.	1061	0	0000	64	6017
		9669	HLT	HALT IF SYMBL	1062	0	0000	08	9669
			BUN	OCCURS TWICE	1063	0	0000	20	1000
			STA	IN LOCATION	1064	0	0000	12	4019
	A3	6002	CAD	IF FORWARD	1065	0	0000	64	6002
		1	2900	REFERENCE WAS	1066	1	0000	12	2900
			CAD	MADE, MAKE	1067	0	0000	64	4019
			CNZ	NEW TABLE ENTRY	1068	0	0000	04	5011
			BUN	FINIS	1069	0	0000	20	1013
		6018	LDB	PROGRAM POINT	1070	0	0000	72	6018
		1	3950	LOCATION.	1071	1	0000	64	3950
			STA	UNDEFINE	1072	0	0000	12	4019
		6002	CAD	FORWARD P.P.	1073	0	0000	64	6002
		1	3900	DEFINE BACKWARD	1074	1	0000	02	3900
		1	3950		1075	1	0000	12	3950
			BUN	A2	1076	0	0000	20	1067
			CAD	TRANS	1077	0	0000	64	1723
		7006	STA	PUNCH FINAL	1078	0	0000	12	7006
		210	7000	CARD AND	1079	0	0000	54	7000
			1111	STOP	1080	0	0000	08	1111
			HLT	UNCONDITIONALLY	1081	0	0000	20	1080
			BUN	1-					1810
		1810	START						1810
		6002	CAD	N+	1810	0	0000	64	6002
		6010	ADD		1811	0	0000	74	6010

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		BUN	EQ		1812	0	0000	20	1053	
		1820	START						1820	
		6002	CAD	N-	1820	0	0000	64	6002	(3)
		6010	SUB		1821	0	0000	75	6010	
		BUN	EQ		1822	0	0000	20	1053	
		1842	START						1842	
		6010	LDB	NB	1842	0	0000	72	6010	
1		3900	CAD		1843	1	0000	64	3900	
		BUN	EQ		1844	0	0000	20	1053	
		1846	START						1846	
		6010	CAD	NF	1846	0	0000	64	6010	
		ADD	FUDGE	PROCESS	1847	0	0000	74	5019	
		STA	TEMP	LIKE	1848	0	0000	12	4019	
		LDB	TEMP	SYMBOL	1849	0	0000	72	4019	
1		2900	CAD		1850	1	0000	64	2900	
		BUN	LOOP7		1851	0	0000	20	7000	
		1708	START						1708	
PLOAD	1	6002	CAD	PUNCH LOADING	1708	0	0001	64	6002	
		7000	ADD	ROUTINE.	1709	0	0000	74	7000	
		7000	STA	FIRST CARD	1710	0	0000	12	7000	
		7002	EXT	LOADS B BOX	1711	0	0000	63	7002	
		7002	STA		1712	0	0000	12	7002	
		7006	CSU		1713	0	0000	65	7006	
		7001	STA		1714	0	0000	12	7001	
	21	7000	CWR		1715	0	0210	54	7000	
		CAD		3F 7	1716	0	0000	64	7724	
		ADD	PLACE		1717	0	0000	74	5014	
		4	SRT		1718	0	0000	13	0004	
		BUN		1F	1719	0	0000	20	1728	
		LDB			1720	0	0000	72	0000	
		LDB			1721	0	4000	72	0000	
	4000				1722	0	1111	20	1111	
SIGN6	1111201111			SN CHGED TO 6	1723	0	0000	20	0015	
TRANS		15	BUN		1724	0	0000	00	0023	
3		23			1725	0	0000	00	0000	
					1726	0	0010	44	0000	
	1		CRD		1727	0	7667	00	0005	
	7667000005				1728	0	0000	64	1776	
1			CAD	TOFIX	1729	0	0000	14	0004	
		4	SLT		1730	0	0000	12	1776	
			STA	TOFIX	1731	0	0000	34	1740	
		1740	BT4		1732	0	0000	64	6004	
		6004	CAD		1733	0	0000	00	0000	
			BUN	4F 4						
		1740	START						1740	
3		10	SRT	LOOP TO	1740	0	0000	13	0010	
		7007	LDB	PUNCH THE	1741	0	0000	72	7007	

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			1F 4	LOADING ROUTINE	1742	0	0000	64	4745
	6004	CAD			1743	0	0000	75	6204
		SUB			1744	0	0000	12	4745
		STA	1F 4		1745	1	0000	64	1755
1	1755	CAD			1746	1	0000	12	7000
1	7000	STA			1747	0	0000	22	4745
		DBB	1B 4		1748	0	0000	64	7005
	7005	CAD			1749	0	0000	04	4751
		CNZ	2+ 4		1750	0	0000	20	1077
		BUN	HALT		1751	0	0000	64	7006
	7006	CAD			1752	0	0000	74	6004
	6004	ADD			1753	0	0000	12	7006
	7006	STA			1754	0	0210	54	7000
21	7000	CWR			1755	0	0000	14	0010
	10	SLT		AFTER FIRST	1756	0	0000	75	5005
		SUB	ONE	SIX CARDS,	1757	0	0000	04	4740
		CNZ	3B 4	DUMP FORWARD	1758	0	0000	64	1760
		CAD	8F	REFERENCE TABLE	1759	0	0000	12	4746
		STA	1B 4		1760	1	0000	64	0000
		CAD							1761
	1761	START			1761	1	0000	64	0001
1	0001	CAD		LOADING ROUTINE	1762	2	0000	12	0030
2	30	STA		CLEANS UP	1763	2	0000	63	0029
2	29	EXT		FORWARD	1764	2	0000	75	0031
2	31	SUB		REFERENCES.	1765	0	0000	13	0009
	9	SRT			1766	2	0000	04	0021
2	21	CNZ			1767	0	0000	13	0001
	1	SRT			1768	2	0000	64	0030
2	30	CAD			1769	0	0000	14	0010
	10	SLT			1770	1	0000	02	0001
1	1	STC			1771	2	0000	72	0030
2	30	LDB			1772	2	0000	22	0000
2		DBB			1773	2	0000	64	0015
2	15	CAD			1774	2	0000	75	0028
2	28	SUB			1775	2	0000	12	0015
2	15	STA			1776	2	0000	00	0064
TOFIX	2	64			1777	2	0000	12	0030
	2	30	STA		1778	0	0000	13	0004
		4	SRT		1779	2	0000	12	0031
2	31	STA			1780	2	0000	04	0010
2	10	CNZ			1781	0	0000	08	1221
	1221	HLT			1782	2	0000	02	0032
2	32	STC			1783	0	0000	14	0006
	6	SLT			1784	2	0000	63	0027
2	27	EXT			1785	2	0000	74	0032
2	32	ADD			1786	0	0000	13	0007
	7	SRT							

	2		7	BUN			1787	2	0000	20	0007
		1111111110					1788	0	1111	11	1110
			1				1789	0	0000	00	0001
		1111110000					1790	0	1111	11	0000
		4000		START							4000
TABLE				STC	HOLD		4000	0	0000	02	5010
				CAD		4F	4001	0	0000	64	7012
		4		SLT			4002	0	0000	14	0004
				STA	EXIT		4003	0	0000	12	4013
				CAD	HOLD		4004	0	0000	64	5010
				MUL	10101		4005	0	0000	60	4014
				STC	TEMP		4006	0	0000	02	4019
		3		SLT			4007	0	0000	14	0003
				STA	TEMP		4008	0	0000	12	4019
				LDB	TEMP		4009	0	0000	72	4019
1	1	1900		CAD			4010	1	0000	64	1900
				CNZ		2F	4011	0	0000	04	5000
				CAD	HOLD		4012	0	0000	64	5010
							4013	0	0000	00	0000
EXIT							4014	0	1001	00	1001
10101		1001001001		CAD	EXIT		4015	0	0000	64	4013
				ADD	TWO		4016	0	0000	74	5009
				STA	TEMP		4017	0	0000	12	4019
		1	2900	CAD			4018	1	0000	64	2900
TEMP							4019	0	0000	00	0000
		5000		START							5000
				SUB	HOLD		5000	0	0000	75	5010
				NOR		3B	5001	0	0000	15	4015
				DBB		1B	5002	0	0000	22	4010
				LDB	999		5003	0	0000	72	6019
				BUN		1B	5004	0	0000	20	4010
							5005	0	0000	00	0001
ONE		1					5006	0	0000	72	6009
NUMAD		6009		LDB			5007	1	0000	20	1800
		1	1800	BUN			5008	0	0000	00	0007
SEVEN			7				5009	0	0000	00	0002
TWO			2				5010	0	0000	00	0000
HOLD							5011	0	0000	13	0004
A1		4		SRT			5012	0	0000	65	6002
		6002		CSU			5013	0	0000	14	0004
		4		SLT			5014	0	0000	02	0009
PLACE		9		STA			5015	0	0000	64	5014
				CAD	PLACE		5016	0	0000	74	5005
				ADD	ONE		5017	0	0000	02	5014
				STC	PLACE		5018	0	0000	20	1013
				BUN	FINIS		5019	0	0000	00	1050
FUDGE		1050									

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		6003	START						6003
	81	0000	CRD		CONSTANTS FOR	6003	0 0810	44	0000
		6			PUNCHOUT	6004	0 0000	00	0006
		6019	START						6019
999	16	0999				6019	0 1600	00	0999
		7000	START						7000
LOOP7		1613	STA		SET UP CHAINING	7000	0 0000	12	1613
		6002	CSU		PROCEDURE	7001	0 0000	65	6002
	1	2900	STC		FOR FORWARD	7002	1 0000	02	2900
		6015	CAD		REFERENCES	7003	0 0000	64	6015
		3	SRT			7004	0 0000	13	0003
		6008	CAD			7005	0 0000	64	6008
		3	SLT			7006	0 0000	14	0003
		1615	STC			7007	0 0000	02	1615
		1608	STA			7008	0 0000	12	1608
			BUN	LOCAT		7009	0 0000	20	1009
HSLF		1615	CAD		TACK ON CON-	7010	0 0000	64	1615
		6	SLT		TROL DIGITS	7011	0 0000	14	0006
4		6020	STA			7012	0 0000	12	6020
		6002	CAD		INCREMENT	7013	0 0000	64	6002
			ADD	ONE	LOCATION	7014	0 0000	74	5005
		6002	STC		COUNTER	7015	0 0000	02	6002
		6016	CAD			7016	0 0000	64	6016
PUNCH		6001	STC		SET SIGN	7017	0 0000	02	6001
	1	6000	CWR		PUNCH AND	7018	0 0010	54	6000
			BUN	PROC	RECYCLE	7019	0 0000	20	1000
							0 0000	00	0000

The format bands  
and symbolic op  
table are not  
shown here.

(6)