



COMPUTER CONTROL DIVISION (EUROPE)

PROGRAM DOCUMENTATION

* 0078-001-H908 (O\$XP)

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* COMPUTER: H316, DDP-516

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* PROGRAM CATEGORY: INPUT/OUTPUT

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* PROGRAM TITLE: O\$XP

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CONTROL THE MOTION OF THE DIGITAL PLOTTER EOM 2113

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APPROVAL

DATE

PROG-----

*P. G. Whone**21 JAN 70*

SUPR-----

*W. G. Depledge**9 MAR 70*

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*W. G. Depledge**9 MAR 70*

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0038 *
0039 *
0040 * AUTHOR
0041 *
0042 *   HONEYWELL - COMPUTER CONTROL DIVISION (EUROPE)
0043 *
0044 *
0045 * PURPOSE
0046 *
0047 *   TO CONTROL THE MOTION OF THE DIGITAL PLOTTER EOM 2113
0048 *
0049 *
0050 * RESTRICTIONS
0051 *
0052 *   THE PROGRAM WILL OPERATE ON AN H316 OR DDP-516 COMPUTER WITH A
0053 *   DIGITAL PLOTTER EOM 2113
0054 *
0055 *
0056 * STORAGE
0057 *
0058 *   542   (OCTAL)
0059 *   354   (DECIMAL)
0060 *
0061 *
0062 * USE
0063 *
0064 *   PLOT A LINE
0065 *
0066 *       CALL O$XP (X,Y,IC)
0067 *
0068 *       OR
0069 *
0070 *       CALL  O$XP      PLOT A LINE
0071 *       DAC    X        PEN POSITION, X CO-ORDINATE
0072 *       DAC    Y        PEN POSITION, Y CO-ORDINATE
0073 *       DAC    IC       PEN POSITION INDICATOR
0074 *       OCT    0        END OF PARAMETER LIST
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0075      *                               NORMAL RETURN
0076      *
0077      *           PLOT IS AN IDENTICAL ENTRY TO O$XP
0078      *
0079      *   PROVIDE OFFSET DISTANCES AND SCALE FACTORS
0080      *
0081      *           CALL O$XO (XMIN,XFAC,YMIN,YFAC)
0082      *
0083      *           OR
0084      *
0085      *           CALL  O$XO           PROVIDE OFFSET DISTANCES AND SCALE FACTORS
0086      *           DAC   XMIN           DISTANCE TO TRANSLATE ORIGIN ALONG X AXIS
0087      *           DAC   XFAC           SCALE VALUE FOR X AXIS
0088      *           DAC   YMIN          DISTANCE TO TRANSLATE ORIGIN ALONG Y AXIS
0089      *           DAC   YFAC          SCALE VALUE FOR Y AXIS
0090      *           OCT   0              END OF PARAMETER LIST
0091      *                               NORMAL RETURN
0092      *
0093      *           OFFSET IS AN IDENTICAL ENTRY TO O$XO
0094      *
0095      *   PROVIDE THE SCALE VALUE FOR BOTH AXES
0096      *
0097      *           CALL O$XF (FACT)
0098      *
0099      *           OR
0100      *
0101      *           CALL  O$XF           PROVIDE THE SCALE VALUE FOR BOTH AXES
0102      *           DAC   FACT           SCALE VALUE
0103      *                               NORMAL RETURN
0104      *
0105      *           FACTOR IS AN IDENTICAL ENTRY TO O$XF
0106      *
0107      *   REQUEST PRESENT PEN POSITION AND SCALE VALUE
0108      *
0109      *           CALL O$XW (X,Y,FACT)
0110      *
0111      *           OR
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0112      *
0113      *      CALL  O$XW      PRESENT PEN POSITION AND SCALE VALUE
0114      *      DAC   X        PRESENT PEN POSITION, X CO-ORDINATE
0115      *      DAC   Y        PRESENT PEN POSITION, Y CO-ORDINATE
0116      *      DAC   FACT     CURRENT SCALE VALUE
0117      *      OCT    0        END OF PARAMETER LIST
0118      *      NORMAL RETURN
0119      *
0120      *      WHERE IS AN IDENTICAL ENTRY TO O$XW
0121      *
0122      *      SET PEN AT ORIGIN
0123      *
0124      *      CALL O$XG
0125      *
0126      *      OR
0127      *
0128      *      CALL  O$XG      SET PEN AT ORIGIN
0129      *      NORMAL RETURN
0130      *
0131      *      ORIGIN IS AN IDENTICAL ENTRY TO O$XG
0132      *
0133      *
0134      * METHOD
0135      *
0136      *      A CALL ON THE O$XP ROUTINE WILL MOVE THE PEN FROM ITS PRESENT
0137      *      POSITION (GIVEN BY THE O$XW ROUTINE) TO THE POINT SPECIFIED IN THE
0138      *      CALL.  THE MOVE WILL BE MADE WITH THE PEN DOWN IF IC=2 OR UP IF
0139      *      IC=3.  IF IC IS NEGATIVE THE PLOT WILL BE ENDED AFTER THE MOVE IS
0140      *      MADE AND CONTROL RETURNED TO THE CALLING PROGRAM.  IF IC=12 OR 13
0141      *      THE INPUTS FROM THE O$XO ENTRANCE WILL BE USED.
0142      *
0143      *      A CALL ON THE O$XO ROUTINE WILL CAUSE THE ORIGIN AND ITS AXES TO BE
0144      *      OFFSET TO THE POINT CALLED, WITH SCALES AS SPECIFIED.  SUBSEQUENT
0145      *      PLOTS WILL REFER TO THIS NEW ORIGIN.
0146      *
0147      *      THE O$XF ROUTINE PROVIDES THE SCALE FOR BOTH AXES, WHETHER OFFSET
0148      *      OR BASED ON THE ORIGIN.
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*
* THE O$XG ROUTINE MOVES THE PEN WEST 360 MILLIMETRES AND BACK EAST
* TO WITHIN 10 MILLIMETRES OF THE EDGE OF THE PAPER. THIS IS TAKEN
* AS THE ORIGIN (0,0).
*
* THESE ROUTINES ALSO CALL THE FOLLOWING MATH LIBRARY ROUTINES: S$22,
* D$22, M$22, C$21 AND H$22.
*
*****
*
*
* SUBR O$XP PLOT A LINE
* SUBR PLOT,O$XP PLOT A LINE
* SUBR O$X0 PROVIDE OFFSET DISTANCES AND SCALE FACTORS
* SUBR OFFSET,O$X0 PROVIDE OFFSET DISTANCES AND SCALE FACTORS
* SUBR O$XF PROVIDE SCALE VALUE FOR BOTH AXES
* SUBR FACTOR,O$XF PROVIDE SCALE VALUE FOR BOTH AXES
* SUBR O$XW REQUEST PRESENT PEN POSITION
* SUBR WHERE,O$XW REQUEST PRESENT PEN POSITION
* SUBR O$XG SET PEN AT ORIGIN
* SUBR ORIGIN,O$XG SET PEN AT ORIGIN
*
*
* CF5 H316 OR DDP-516
* REL RELOCATABLE
*
* PLOTTER DEVICE CODES
*
* OCP
000027 DADP EQU '0027 DEVICE ADDRESS OF DIGITAL PLOTTER
001427 PNDN EQU DADP+'1400 PUT PEN DOWN
001627 PNUP EQU DADP+'1600 PUT PEN UP
*
* SKS
000127 SKNB EQU DADP+'100 SKIP IF NOT BUSY
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0186	000227	SKLM EQU	DADP+'200	SKIP IF LIMIT OF TRAVEL NOT REACHED
0187		*		
0188		*		
0189		* PLOT A LINE		
0190		*		
0191	00000	0 000000	O\$XP DAC **	PLOT A LINE
0192	00001	0 15 00437	STX SAVE	SAVE INDEX
0193	00002	-0 02 00000	LDA* O\$XP	ADDRESS OF X
0194	00003	0 12 00000	IRS O\$XP	ADDRESS OF NEXT PARAMETER
0195	00004	0 10 00421	JST PCUP	PICK UP X
0196	00005	0 04 00444	STA XFLT	FLOATING POINT X VALUE - WORD A
0197	00006	0 04 00452	STA XFX	FLOATING POINT X POSITION - WORD A
0198	00007	000201	IAB	
0199	00010	0 04 00445	STA XFLT+1	FLOATING POINT X VALUE - WORD B
0200	00011	0 04 00453	STA XFX+1	FLOATING POINT X POSITION - WORD B
0201		*		
0202	00012	-0 02 00000	LDA* O\$XP	ADDRESS OF Y
0203	00013	0 12 00000	IRS O\$XP	ADDRESS OF NEXT PARAMETER
0204	00014	0 10 00421	JST PCUP	PICK UP Y
0205	00015	0 04 00446	STA YFLT	FLOATING POINT Y VALUE - WORD A
0206	00016	0 04 00454	STA YFY	FLOATING POINT Y POSITION - WORD A
0207	00017	000201	IAB	
0208	00020	0 04 00447	STA YFLT+1	FLOATING POINT Y VALUE - WORD B
0209	00021	0 04 00455	STA YFY+1	FLOATING POINT Y POSITION - WORD B
0210		*		
0211	00022	-0 02 00000	LDA* O\$XP	ADDRESS OF PEN POSITION INDICATOR
0212	00023	0 10 00421	JST PCUP	PICK UP INDICATOR
0213	00024	0 04 00456	PLTA STA IC	PEN POSITION INDICATOR PARAMETER
0214	00025	100400	SPL	IS IT POSITIVE?
0215	00026	140407	TCA	NO, NEGATE IT
0216	00027	0 07 00540	SUB =10	YES, SUBTRACT 10
0217	00030	100400	SPL	IS IC>10?
0218	00031	0 06 00540	ADD =10	RESTORE PEN POSITION INDICATOR
0219	00032	0 04 00457	STA IP	NO, RESTORE TO PREVIOUS VALUE
0220	00033	0 11 00537	CAS =3	IS IC=3?
0221	00034	0 01 00041	JMP ERPN	IC>3, PEN CONTROL ERROR
0222	00035	0 01 00053	JMP PEN3	IC=3, GO AND PUT PEN UP



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0223	00036	0 11 00536	CAS	=2	IS IC=2?
0224	00037	0 01 00041	JMP	ERP	NO, PEN CONTROL ERROR
0225	00040	0 01 00043	JMP	PEN2	IC=2, GO AND PUT PEN DOWN
0226		*			
0227	00041	0 02 00507	ERP LDA	PNER	PEN CONTROL ERROR
0228	00042	0 01 00024	JMP	PLTA	PEN NOW DOWN
0229		*			
0230		* PUT PEN DOWN ROUTINE			
0231	00043	0 02 00460	PEN2 LDA	PENP	PEN POSITION INDICATOR
0232	00044	100040	SZE		IS IT ZERO?
0233	00045	0 01 00063	JMP	CFOF	NO, GO GET INDICATOR PARAMETER
0234	00046	34 0127	SKS	SKNB	SKIP IF NOT BUSY
0235	00047	0 01 00046	JMP	*-1	WAIT UNTIL NOT BUSY
0236	00050	14 1427	OCP	PNDN	PUT PEN DOWN
0237	00051	0 02 00535	LDA	=-1	INDICATE PEN DOWN
0238	00052	0 01 00062	JMP	PENC	SET PEN POSITION INDICATOR
0239		*			
0240		* PUT PEN UP ROUTINE			
0241	00053	0 02 00460	PEN3 LDA	PENP	PEN POSITION INDICATOR
0242	00054	101040	SNZ		IS IT ZERO?
0243	00055	0 01 00063	JMP	CFOF	YES, GO GET INDICATOR PARAMETER
0244	00056	34 0127	SKS	SKNB	BUSY
0245	00057	0 01 00056	JMP	*-1	WAIT UNTIL NOT BUSY
0246	00060	14 1627	OCP	PNU	PUT PEN UP
0247	00061	140040	CRA		INDICATE PEN UP
0248	00062	0 04 00460	PENC STA	PENP	SET PEN POSITION INDICATOR
0249		*			
0250	00063	0 02 00456	CFOF LDA	IC	PEN POSITION INDICATOR PARAMETER
0251	00064	100400	SPL		IS IT NEGATIVE?
0252	00065	140407	TCA		YES, MAKE IT POSITIVE
0253	00066	0 07 00540	SUB	=10	
0254	00067	100400	SPL		IS IC>10?
0255	00070	0 01 00115	JMP	NOFF	NO, NO OFFSET
0256		*			
0257		* OFFSET ROUTINE			
0258		* OFFSET X $X=(X-XMIN)/XFAC$			
0259	00071	0 02 00445	OFST LDA	XFLT+1	FLOATING POINT X VALUE - WORD B



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0260	00072	000201	IAB		
0261	00073	0 02 00444	LDA	XFLT	FLOATING POINT X VALUE - WORD A
0262	00074	0 10 00000	CALL	S\$22	FLOATING POINT SUBTRACT
0263	00075	0 000461	DAC	XMIN	X FROM OFFSET ENTRY
0264	00076	0 10 00000	CALL	D\$22	FLOATING POINT DIVIDE
0265	00077	0 000465	DAC	XFAC	X SCALE FACTOR
0266	00100	0 04 00444	STA	XFLT	VALUE OF OFFSET X - WORD A
0267	00101	000201	IAB		
0268	00102	0 04 00445	STA	XFLT+1	VALUE OF OFFSET X - WORD B
0269					
0270			*		
0271	00103	0 02 00447	LDA	YFLT+1	FLOATING POINT Y VALUE - WORD B
0272	00104	000201	IAB		
0273	00105	0 02 00446	LDA	YFLT	FLOATING POINT Y VALUE - WORD A
0274	00106	0 10 00000	CALL	S\$22	FLOATING POINT SUBTRACT
0275	00107	0 000463	DAC	YMIN	Y FROM OFFSET ENTRY
0276	00110	0 10 00000	CALL	D\$22	FLOATING POINT DIVIDE
0277	00111	0 000467	DAC	YFAC	Y SCALE FACTOR
0278	00112	0 04 00446	STA	YFLT	VALUE OF OFFSET Y - WORD A
0279	00113	000201	IAB		
0280	00114	0 04 00447	STA	YFLT+1	VALUE OF OFFSET Y - WORD B
0281			*		
0282			* NO OFFSET ACTION		
0283			* CONVERT X TO FIXED POINT VALUE	IX=X*SFCT	
0284	00115	0 02 00445	NOFF LDA	XFLT+1	FLOATING POINT X VALUE - WORD B
0285	00116	000201	IAB		
0286	00117	0 02 00444	LDA	XFLT	FLOATING POINT X VALUE - WORD A
0287	00120	0 10 00000	CALL	M\$22	FLOATING POINT MULTIPLY
0288	00121	0 000512	DAC	SFCT	SCALE FACTOR
0289	00122	0 10 00000	CALL	C\$21	FLOATING POINT TO FIXED POINT
0290	00123	0 04 00471	STA	IX	FIXED POINT VALUE OF X
0291			*		
0292			* CONVERT Y TO FIXED POINT VALUE	IY=Y*SFCT	
0293	00124	0 02 00447	LDA	YFLT+1	FLOATING POINT Y VALUE - WORD B
0294	00125	000201	IAB		
0295	00126	0 02 00446	LDA	YFLT	FLOATING POINT Y VALUE - WORD A
0296	00127	0 10 00000	CALL	M\$22	FLOATING POINT MULTIPLY



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0297 00130 0 000512 DAC SFCT SCALE FACTOR
0298 00131 0 10 00000 CALL C$21 FLOATING POINT TO FIXED POINT
0299 00132 0 04 00472 STA IY FIXED POINT VALUE OF Y
0300
0301 *
0302 * CALCULATE CHANGE IN PEN POSITION FROM PREVIOUS POSITION
0303 00133 0 02 00471 LDA IX IDLX=ABS(IX-IPNX)
0304 00134 0 07 00450 SUB IPNX FIXED POINT VALUE OF X
0305 00135 0 04 00474 STA DLTx PREVIOUS PEN POSITION
0306 00136 100400 SPL DELTA X
0307 00137 140407 TCA IS IT NEGATIVE?
0308 00140 0 04 00476 STA IDLX YES, MAKE IT POSITIVE
0309 ABSOLUTE DELTA X
0310 *
0311 00141 0 02 00472 LDA IY IDLY=ABS(IY-IPNY)
0312 00142 0 07 00451 SUB IPNY FIXED POINT VALUE OF Y
0313 00143 0 04 00475 STA DLTy PREVIOUS PEN POSITION
0314 00144 100400 SPL DELTA Y
0315 00145 140407 TCA IS IT NEGATIVE?
0316 00146 0 04 00477 STA IDLY YES, MAKE IT POSITIVE
0317 ABSOLUTE DELTA Y
0318 *
0319 * TEST FOR DIRECTION AND METHOD OF PEN MOTION
0320 00147 0 02 00474 LDA DLTx
0321 00150 101040 SNZ
0322 00151 0 01 00156 JMP XPL3
0323 00152 101400 SMI
0324 00153 0 01 00160 JMP XPL2
0325 00154 0 02 00534 LDA ='200
0326 00155 0 01 00161 JMP XPLX
0327 00156 140040 XPL3 CRA
0328 00157 0 01 00161 JMP XPLX
0329 00160 0 02 00533 XPL2 LDA ='100
0330 00161 0 04 00500 XPLX STA XPLT
0331 *
0332 * IS THERE MOTION IN THE Y DIRECTION?
0333 00162 0 02 00475 XPLA LDA DLTy
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0334	00163	101040	SNZ		IS IT ZERO?	
0335	00164	0 01 00171	JMP	YPL3	YES, GO STORE Y DIRECTION	
0336	00165	101400	SMI		NO, IS IT NEGATIVE	
0337	00166	0 01 00173	JMP	YPL1	NO, MUST BE POSITIVE	
0338	00167	0 02 00532	LDA	= '1000	YES, NEGATIVE Y MOTION	
0339	00170	0 01 00174	JMP	YPLY	GO STORE Y DIRECTION	
0340	00171	140040	YPL3 CRA		NO Y MOTION	
0341	00172	0 01 00174	JMP	YPLY	GO STORE Y DIRECTION	
0342	00173	0 02 00531	YPL1 LDA	= '400	POSITIVE Y MOTION	
0343	00174	0 04 00501	YPLY STA	YPLT	STORE Y DIRECTION	
0344						
0345			*			
			* TEST FOR A COMBINATION MOVE	YPLT+XPLT=XYPL		
0346	00175	0 06 00500	YPLA ADD	XPLT	X DIRECTION	
0347	00176	0 04 00502	STA	XYPL	COMBINATION MOVE	
0348	00177	101040	SNZ		IS IT ZERO	
	0349	00200	0 01 00261	JMP	EXIT	YES, NO MOTION
	0350	00201	0 02 00476	LDA	IDLX	ABSOLUTE DELTA X
	0351	00202	0 11 00477	CAS	IDLY	COMPARE WITH ABSOLUTE DELTA Y
	0352	00203	101000	NOP		IDLX>IDLY, NO ACTION
	0353	00204	0 01 00214	JMP	NORM	IDLX=IDLY
	0354	00205	000201	IAB		IDLX<IDLY, PUT X VALUE IN B-REGISTER
	0355			*		
	0356			* MAKE DECISION ON TYPE OF MOVE		
	0357			* SWAP X AND Y VALUES WITH EACH OTHER		
	0358	00206	0 02 00477	LDA	IDLY	DELTA Y
	0359	00207	0 04 00476	STA	IDLX	PUT Y VALUE IN PLACE OF X VALUE
	0360	00210	000201	IAB		BRING BACK X VALUE
	0361	00211	0 04 00477	STA	IDLY	PUT IT IN PLACE OF Y VALUE
	0362	00212	0 02 00501	LDA	YPLT	Y DIRECTION
	0363	00213	0 04 00500	STA	XPLT	PUT IT IN PLACE OF X DIRECTION
	0364			*		
	0365			* EQUAL X AND Y MOVE		
	0366	00214	0 02 00476	NORM LDA	IDLX	ABSOLUTE DELTA X
	0367	00215	0415 77	ALS	1	MULTIPLY BY TWO
	0368	00216	0 04 00503	STA	TDX	TDX=IDLX*2
	0369	00217	0 02 00477	LDA	IDLY	ABSOLUTE DELTA Y
	0370	00220	0415 77	ALS	1	MULTIPLY BY TWO



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0371	00221	0 04 00504	STA	TDY	TDY=IDLY*2
0372	00222	140040	CRA		CLEAR A-REGISTER
0373	00223	0 04 00473	STA	TEMP	TEMPORARY
0374	00224	0 04 00505	STA	N	NUMBER OF STEPS
0375			*		
0376	00225	0 35 00530	TENT	LDX	INDEX REGISTER=-10
0377	00226	0 02 00473	OUTP	LDA	TEMPORARY
0378	00227	0 06 00504		ADD	ADD (2*DELTA Y)
0379	00230	0 11 00476	CAS	IDLX	COMPARE WITH DELTA X
0380	00231	0 01 00234	JMP	L1	DELTA X=TDY <
0381	00232	0 01 00240	JMP	BASE	DELTA X=TDY, USE X DIRECTION
0382	00233	0 01 00240	JMP	BASE	DELTA X=TDY, USE X DIRECTION >
0383	00234	0 07 00503	L1	SUB	SUBTRACT TDX FROM TDY
0384	00235	0 04 00473	STA	TEMP	TEMPORARY
0385	00236	0 02 00502	LDA	XYPL	USE COMBINATION MOVE
0386	00237	0 01 00242	JMP	EXEC	GO EXECUTE COMBINATION MOVE
0387			*		
0388	00240	0 04 00473	BASE	STA	PUT TDY IN TEMPORARY
0389	00241	0 02 00500		LDA	AND PLOT X VALUE
0390			*		
0391			* PLOT THE	MOVE	
0392	00242	0 06 00506	EXEC	ADD	BASIC OCP INSTRUCTION
0393	00243	0 04 00246		STA	COMPUTED OCP
0394	00244	34 0127		SKS	SKIP IF NOT BUSY
0395	00245	0 01 00244		JMP	WAIT UNTIL NOT BUSY
0396	00246	0 00 00000	EXCM	***	COMPUTED OCP
0397	00247	0 12 00505		IRS	TALLY NUMBER OF STEPS
0398	00250	0 02 00505		LDA	NUMBER OF STEPS
0399	00251	0 11 00476		CAS	DELTA X
0400	00252	101000		NOP	N>IDLX, NO ACTION
0401	00253	0 01 00261		JMP	EQUAL, MOVE COMPLETED
0402	00254	0 12 00000		IRS	TALLY INDEX
0403	00255	0 01 00226		JMP	GO FOR NEXT MOVE
0404	00256	34 0227		SKS	SKIP IF LIMIT NOT REACHED
0405	00257	0 01 00261		JMP	LIMIT REACHED, MOVE COMPLETE
0406	00260	0 01 00225		JMP	GO FOR NEXT MOVE
0407			*		

CAUSES
ERRORS



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0408	00261	0 02 00456	EXIT LDA	IC	PEN POSITION INDICATOR
0409	00262	101400	SMI		SKIP IF END OF PLOT REACHED
0410	00263	0 01 00272	JMP	PLUS	CONTINUE WITH PLOT
0411			*		
0412			* END OF PLOT.	SET ALL PARAMETERS TO ZERO	
0413	00264	140040	TERM CRA		END OF PLOT
0414	00265	0 35 00530	LDX	=-10	INDEX REGISTER=-10
0415	00266	1 04 00456	L2 STA	XFLT+10,1	ZERO IN PARAMETERS
0416	00267	0 12 00000	IRS	0	TALLY INDEX REGISTER
0417	00270	0 01 00266	JMP	L2	RETURN FOR NEXT PARAMETER
0418	00271	0 01 00276	JMP	PLSA	FINISH PLOT ROUTINE
0419			*		
0420			* OBTAIN NEW PEN POSITION COORDINATES		
0421	00272	0 02 00471	PLUS LDA	IX	FIXED POINT VALUE OF X
0422	00273	0 04 00450	STA	IPNX	NEW X POSITION
0423	00274	0 02 00472	LDA	IY	FIXED POINT VALUE OF Y
0424	00275	0 04 00451	STA	IPNY	NEW Y POSITION
0425			*		
0426			* FINISH PLOT ROUTINE		
0427	00276	0 12 00000	PLSA IRS	O\$XP	INCREMENT RETURN ADDRESS
0428	00277	0 12 00000	IRS	O\$XP	INCREMENT RETURN ADDRESS
0429	00300	0 35 00437	LDX	SAVE	RESTORE INDEX
0430	00301	-0 01 00000	JMP*	O\$XP	EXIT
0431			*		
0432			*		
0433			* PROVIDE OFFSET DISTANCES AND SCALE FACTORS		
0434			*		
0435	00302	0 000000	O\$X0 DAC	**	PROVIDE OFFSET DISTANCES AND SCALE FACTORS
0436	00303	0 15 00440	STX	SAV1	SAVE INDEX
0437	00304	-0 02 00302	LDA*	O\$X0	ADDRESS OF XMIN
0438	00305	0 12 00302	IRS	O\$X0	ADDRESS OF NEXT PARAMETER
0439	00306	0 10 00421	JST	PCUP	PICK UP XMIN
0440	00307	0 04 00461	STA	XMIN	X FROM OFFSET ENTRY - WORD A
0441	00310	000201	IAB		
0442	00311	0 04 00462	STA	XMIN+1	X FROM OFFSET ENTRY - WORD B
0443	00312	-0 02 00302	LDA*	O\$X0	ADDRESS OF XFAC
0444	00313	0 12 00302	IRS	O\$X0	ADDRESS OF NEXT PARAMETER



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0445	00314	0 10 00421	JST	PCUP	PICK UP XFAC
0446	00315	0 04 00465	STA	XFAC	SCALE FACTOR FOR X - WORD A
0447	00316	000201	IAB		
0448	00317	0 04 00466	STA	XFAC+1	SCALE FACTOR FOR X - WORD B
0449			*		
0450	00320	-0 02 00302	LDA*	O\$X0	ADDRESS OF YMIN
0451	00321	0 12 00302	IRS	O\$X0	ADDRESS OF NEXT PARAMETER
0452	00322	0 10 00421	JST	PCUP	PICK UP YMIN
0453	00323	0 04 00463	STA	YMIN	Y FROM OFFSET ENTRY - WORD A
0454	00324	000201	IAB		
0455	00325	0 04 00464	STA	YMIN+1	Y FROM OFFSET ENTRY - WORD B
0456	00326	-0 02 00302	LDA*	O\$X0	ADDRESS OF YFAC
0457	00327	0 12 00302	IRS	O\$X0	ADDRESS OF END OF PARAMETER LIST
0458	00330	0 12 00302	IRS	O\$X0	RETURN ADDRESS
0459	00331	0 10 00421	JST	PCUP	PICK UP YFAC
0460	00332	0 04 00467	STA	YFAC	SCALE FACTOR FOR Y - WORD A
0461	00333	000201	IAB		
0462	00334	0 04 00470	STA	YFAC+1	SCALE FACTOR FOR Y - WORD B
0463			*		
0464	00335	0 35 00440	LDX	SAV1	RESTORE INDEX
0465	00336	-0 01 00302	JMP*	O\$X0	EXIT
0466			*		
0467			*		
0468			*	PROVIDE THE SCALE VALUE FOR BOTH AXES	
0469			*		
0470	00337	0 000000	O\$XF	DAC **	PROVIDE SCALE VALUE FOR BOTH AXES
0471	00340	0 15 00441	STX	SAV2	SAVE INDEX
0472	00341	-0 02 00337	LDA*	O\$XF	SCALE FACTOR ADDRESS
0473	00342	0 12 00337	IRS	O\$XF	RETURN ADDRESS
0474	00343	0 10 00421	JST	PCUP	PICK UP SCALE FACTOR
0475	00344	0 04 00510	STA	FACT	FLOATING POINT SCALE FACTOR - WORD A
0476	00345	000201	IAB		
0477	00346	0 04 00511	STA	FACT+1	FLOATING POINT SCALE FACTOR - WORD B
0478	00347	000201	IAB		
0479	00350	0 10 00000	CALL	M\$22	FLOATING POINT MULTIPLY
0480	00351	0 000514	DAC	FFCT	UNITS CONVERSION FACTOR
0481	00352	0 04 00512	STA	SFCT	CONVERTED SCALE FACTOR - WORD A



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0482	00353	000201	IAB		
0483	00354	0 04 00513	STA	SFCT+1	CONVERTED SCALE FACTOR - WORD B
0484	00355	0 35 00441	LDX	SAV2	RESTORE INDEX
0485	00356	-0 01 00337	JMP*	O\$XF	EXIT
0486			*		
0487			*		
0488			*	REQUEST PRESENT PEN POSITION	
0489			*		
0490	00357	0 000000	O\$XW	DAC **	REQUEST PRESENT PEN POSITION
0491	00360	0 15 00442	STX	SAV3	SAVE INDEX
0492	00361	0 02 00453	LDA	XFX+1	X POSITION - WORD B
0493	00362	000201	IAB		
0494	00363	0 02 00452	LDA	XFX	X POSITION - WORD A
0495	00364	0 10 00426	JST	STOR	STORE X POSITION
0496			*		
0497	00365	0 02 00455	LDA	YFY+1	Y POSITION - WORD B
0498	00366	000201	IAB		
0499	00367	0 02 00454	LDA	YFY	Y POSITION - WORD A
0500	00370	0 10 00426	JST	STOR	STORE Y POSITION
0501			*		
0502	00371	0 02 00511	LDA	FACT+1	SCALE VALUE - WORD B
0503	00372	000201	IAB		
0504	00373	0 02 00510	LDA	FACT	SCALE VALUE - WORD A
0505	00374	0 10 00426	JST	STOR	STORE SCALE VALUE
0506	00375	0 35 00442	LDX	SAV3	RESTORE INDEX
0507	00376	0 12 00357	IRS	O\$XW	RETURN ADDRESS
0508	00377	-0 01 00357	JMP*	O\$XW	EXIT
0509			*		
0510			*		
0511			*	SET PEN AT ORIGIN	
0512			*		
0513	00400	0 000000	O\$XG	DAC **	SET PEN AT ORIGIN
0514	00401	140040	CRA		CLEAR A-REGISTER
0515	00402	0 35 00530	LDX	=-10	INDEX REGISTER=-10
0516	00403	1 04 00456	LABL	STA XFLT+10,1	PUT ZERO IN PARAMETER LOCATIONS
0517	00404	0 12 00000	IRS	0	TALLY INDEX REGISTER
0518	00405	0 01 00403	JMP	LABL	RETURN FOR NEXT PARAMETER



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0519
0520      *
0521 00406 0 10 00000 JST O$XP      PLOT A LINE
0522 00407 0 000516 DAC XPNW      X CO-ORDINATE FOR MOVE WEST
0523 00410 0 000520 DAC YPNW      Y CO-ORDINATE FOR MOVE WEST
0524 00411 0 000526 DAC THRE      PEN UP
0525 00412 000000 OCT 0          END OF PARAMETER LIST
0526      *
0527      * MOVE PEN EAST TO WITHIN 10 MILLIMETRES OF PAPER EDGE
0528 00413 0 10 00000 JST O$XP      PLOT A LINE
0529 00414 0 000522 DAC XPNE      X CO-ORDINATE FOR MOVE EAST
0530 00415 0 000524 DAC YPNE      Y CO-ORDINATE FOR MOVE EAST
0531 00416 0 000527 DAC MTHR      PEN UP AND TERMINATE PLOT
0532 00417 000000 OCT 0          END OF PARAMETER LIST
0533 00420 -0 01 00400 JMP* O$XG    EXIT
0534      *
0535      *
0536      * SUBROUTINES
0537      *
0538      * PICK UP A VARIABLE
0539 00421 0 000000 PCUP DAC **      PICK UP A VARIABLE
0540 00422 0 04 00424 STA L3        ADDRESS OF VARIABLE
0541 00423 0 10 00000 CALL L$22     SINGLE PRECISION LOAD
0542 00424 0 00 00000 L3 *** **     ADDRESS OF VARIABLE
0543 00425 -0 01 00421 JMP* PCUP    EXIT
0544      *
0545      * STORE A VARIABLE
0546 00426 0 000000 STOR DAC **      STORE A VARIABLE
0547 00427 0 04 00443 STA SAV4      SAVE INDEX
0548 00430 -0 02 00357 LDA* O$XW     ADDRESS OF PEN POSITIONING ENTRY
0549 00431 0 12 00357 IRS O$XW      NEXT PEN POSITIONING ENTRY ADDRESS
0550 00432 0 04 00435 STA L4        STORE ADDRESS
0551 00433 0 02 00443 LDA SAV4      RESTORE INDEX
0552 00434 0 10 00000 CALL H$22     SINGLE PRECISION HOLD
0553 00435 0 00 00000 L4 *** **     PEN POSITIONING ENTRY ADDRESS
0554 00436 -0 01 00426 JMP* STOR    EXIT
0555      *
```



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0556			*		
0557			* VARIABLES		
0558			*		
0559	00437	000000	SAVE BSZ	1	PLOT ROUTINE INDEX
0560	00440	000000	SAV1 BSZ	1	OFFSET ROUTINE INDEX
0561	00441	000000	SAV2 BSZ	1	FACTOR ROUTINE INDEX
0562	00442	000000	SAV3 BSZ	1	POSITIONING ROUTINE INDEX
0563	00443	000000	SAV4 BSZ	1	STORE ROUTINE INDEX
0564			*		
0565	00444	000000	XFLT BSZ	2	FLOATING POINT X VALUE
	00445	000000			
0566	00446	000000	YFLT BSZ	2	FLOATING POINT Y VALUE
	00447	000000			
0567	00450	000000	IPNX BSZ	1	PREVIOUS PEN POSITION
0568	00451	000000	IPNY BSZ	1	PREVIOUS PEN POSITION
0569	00452	000000	XFX BSZ	2	FLOATING POINT X POSITION
	00453	000000			
0570	00454	000000	YFY BSZ	2	FLOATING POINT Y POSITION
	00455	000000			
0571			*		
0572	00456	000000	IC BSZ	1	PEN CONTROL PARAMETER
0573	00457	000000	IP BSZ	1	ABSOLUTE PEN CONTROL PARAMETER
0574	00460	000000	PENP BSZ	1	PEN POSITION INDICATOR
0575			*		
0576	00461	000000	XMIN BSZ	2	X FROM OFFSET ENTRY
	00462	000000			
0577	00463	000000	YMIN BSZ	2	Y FROM OFFSET ENTRY
	00464	000000			
0578	00465	000000	XFAC BSZ	2	FLOATING POINT X SCALE
	00466	000000			
0579	00467	000000	YFAC BSZ	2	FLOATING POINT Y SCALE
	00470	000000			
0580			*		
0581	00471	000000	IX BSZ	1	FIXED POINT X VALUE
0582	00472	000000	IY BSZ	1	FIXED POINT Y VALUE
0583	00473	000000	TEMP BSZ	1	TEMPORARY STORE
0584	00474	000000	DLTX BSZ	1	DELTA X



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0585	00475	000000	DLTY BSZ	1	DELTA Y
0586	00476	000000	IDLX BSZ	1	ABSOLUTE DELTA X
0587	00477	000000	IDLY BSZ	1	ABSOLUTE DELTA Y
0588	00500	000000	XPLT BSZ	1	X DIRECTION
0589	00501	000000	YPLT BSZ	1	Y DIRECTION
0590	00502	000000	XYPL BSZ	1	COMBINATION MOVE
0591	00503	000000	TDX BSZ	1	2*DELTA X
0592	00504	000000	TDY BSZ	1	2*DELTA Y
0593	00505	000000	N BSZ	1	COUNTER
0594			*		
0595			*		
0596			* CONSTANTS		
0597			*		
0598	00506	14 0027	OCP OCP	DADP	BASIC OCP INSTRUCTION
0599	00507	000002	PNER OCT	2	PEN ERROR
0600	00510	040300	FACT DEC	1.0	FLOATING POINT SCALE VALUE
	00511	000000			
0601	00512	041120	SFCT DEC	10.0	STARTING SCALE VALUE
	00513	000000			
0602	00514	041120	FFCT DEC	10.0	UNITS CONVERSION FACTOR
	00515	000000			
0603	00516	135450	XPNW DEC	-350.0	X CO-ORDINATE FOR MOVE PEN WEST
	00517	100000			
0604	00520	000000	YPNW DEC	0.0	Y CO-ORDINATE FOR MOVE WEST
	00521	000000			
0605	00522	135453	XPNE DEC	-340.0	X CO-ORDINATE FOR MOVE PEN EAST
	00523	000000			
0606	00524	000000	YPNE DEC	0.0	Y CO-ORDINATE FOR MOVE EAST
	00525	000000			
0607	00526	000003	THRE OCT	3	PEN UP
0608	00527	177775	MTHR OCT	-3	PEN UP AND TERMINATE PLOT
0609			*		
0610			* LITERALS		
0611	00530	177766	FIN		LITERALS
	00531	000400			
	00532	001000			
	00533	000100			



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00534	000200
00535	177777
00536	000002
00537	000003
00540	000012

0612

*

0613

*

0614

END

NO ERRORS IN ABOVE ASSEMBLY.

DAP-16 INHOUSE 27.1.70 JDC/PJV

END OF O\$XP 21.JAN.70 P.G.WHONE