

FAST GRAPHICS ROMPACK PRIMER (MICHEAL CRANFORD)

65 HIGH LEVEL GRAPHICS COMMANDS.
MORE THAN 10 TIMES FASTER THAN BASIC.
CROSS-HAIR (4010 STYLE) JOYSTICK CURSOR.
8 TIMES THE PACKING DENSITY (>10,000 VECTORS).
SEVERAL COMMANDS ADD CAPABILITY NOT POSSIBLE IN BASIC.

BENCHMARKS FROM 13.7X FASTER TO 127X FASTER THAN A 4051.
(BENCHMARKS FROM 4.5X FASTER TO 61X FASTER THAN A 4052.)

OVERVIEW :

THE MAIN FUNCTION OF FAST GRAPHICS IS TO SUPPLEMENT THE INTERACTIVE GRAPHICS CAPABILITY OF THE 4051. THIS INCLUDES SEVERAL COMMANDS FOR IMAGE MANIPULATION, WRITE-THRU (NON-STORE), AND PROGRAMMABLE SOUND GENERATION. SEVERAL 4051 BASIC DEFICIENCIES HAVE BEEN CORRECTED AS WELL.

IN ORDER TO IMPROVE THE SPEED AND STORAGE DENSITY OF GRAPHICS, FAST GRAPHICS PACKS IMAGES INTO VALID ASCII CHARACTER STRINGS. THIS RESULTS IN ABOUT EIGHT TIMES THE STORAGE CAPACITY FOR ANY COMPLEX IMAGES. THE NEW FORMAT TAKES 3 BYTES/VECTOR (1 BIT MOVE FLAG 10 BITS X & 10 BITS Y) INSTEAD OF 24 BYTES/VECTOR (X,Y,Z). IMAGES CAN BE CONVERTED FROM FLOATING POINT TO STRING FORMAT OR FROM STRING TO FLOATING POINT FORMAT WITH EASE. IMAGES CAN BE MANIPULATED & SAVED OR READ FROM MAG TAPE FILES IN STRING FORM. NOTE THAT A FREE ADVANTAGE OCCURS WHEN IMAGES ARE IN THE STRING FORMAT - ALL OF THE 4051 BASIC STRING FUNCTIONS CAN BE USED.

POWERFULL IMAGE MANIPULATION COMMANDS SUPPORT THE STRING FORMAT AND GIVE THE 4051 INCREDIBLE SPEED WHEN COMPARED TO STANDARD 4051 (AND 4052) BASIC GRAPHICS COMMANDS.

ALL IMAGE DISPLAY COMMANDS RESTORE THE GRAPHIC CURSOR TO THE POSITION IT HAD BEFORE THE CALL WAS EXECUTED. THUS THE GRAPHIC CURSOR AND THE JOYSTICK CURSOR ARE INDEPENDANTLY MAINTAINED.

NOTE THAT EXTENSIVE ERROR CHECKING EXISTS WITHIN FAST GRAPHICS.

COMMANDS :

THERE ARE FOUR DIFFERENT CATAGORIES OF FAST GRAPHICS COMMANDS. THESE CATAGORIES ARE :

1. LOCATION : USED TO LOCATE THE GRAPHICS CURSOR OR THE JOYSTICK CURSOR OR ANY POINT OR POINTS IN ANY IMAGE.
2. DISPLAY : USED TO DISPLAY CURSORS OR IMAGES OR TEXT.
3. CREATE/MODIFY : USED TO CREATE IMAGES OR MODIFY IMAGES.
4. CHARACTER : USED TO CREATE OR PRINT OR PLAY (SOUND) SPECIAL CHARACTER STRINGS.

NOTE THAT ALL OF THE STANDARD 4051 STRING FUNCTIONS CAN BE USED TO LOCATE A VECTOR OR TO REPLACE PART OF AN IMAGE OR TO EXTRACT PART OF AN IMAGE OR TO CONCATINATE IMAGES ETC.

COMMAND FORMS :

MOST OF THE COMMANDS HAVE FOUR DIFFERENT FORMS. THE DIFFERENT

FORMS HAVE DIFFERENT PREFIXES WITH IDENTICAL SUFFIXES.
THE DIFFERENT PREFIXES ARE :

A : DISPLAY SCREEN "ABSOLUTE"
R : DISPLAY SCREEN "RELATIVE"
G : "GRAPHICS" CURSOR RELATIVE
J : "JOYSTICK" CURSOR ABSOLUTE

NOTE THAT THE COMMAND CALL SYNTAX IS CONSISTANT AMONG THE
DIFFERENT FORMS. I.E. THE JOYSTICK ABSOLUTE FORM SYNTAX IS
IDENTICAL TO THE ABSOLUTE FORM SYNTAX WITH AN ADDITIONAL
REFRESH COUNT PARAMETER AND KEYBOARD KEY PARAMETER.

AN ADDITIONAL FORM EXISTS FOR COMMANDS THAT DO NOT FOLLOW THE
ABOVE RULES. THIS IS THE "SPECIAL" FORM.

COMMAND LIST :

LOCATION :

SPECIAL : BOUNDS LOCATE
ABSOLUTE : AGIN APOINT
RELATIVE : RGIN RPOINT
GRAPHICS : GGIN GPOINT
JOYSTICK : JGIN JPOINT

DISPLAY :

SPECIAL : DASHED DOTTED KABOOM RUBBER VERTEX
ABSOLUTE : ACROSS ADRAW ADOTS APRINT AINPUT
RELATIVE : RCROSS RCRAW ROOTS RPRINT RINPUT
GRAPHICS : GCROSS GDRAW GDOTS GPRINT GINPUT
JOYSTICK : JCROSS JERAW JDOTS JPRINT JINPUT

CREATE/MODIFY :

SPECIAL : IMAGES CHANGE DEFINE POINTS TOGGLE
ABSOLUTE : AMOVE ASCALE ASHEAR ATAPER AROTATE
RELATIVE : RMOVE RSCALE RSHEAR RTAPER RROTATE
GRAPHICS : GMCVE GSCALE GSHEAR GTAPER GROTATE
JOYSTICK : JMOVE JSCALE JSHEAR JTAPER JROTATE

CHARACTER :

SPECIAL : PRINTS INPUTS STRING SOUNDS MUZAKT

COMMAND CONDITIONS :

COMMAND LIMITATIONS :

ALL X,Y POSITIONS ARE IN GDU'S.
COORDINATES ARE LIMITED TO DEFAULT SCREEN.

COMMANDS ASSUME DEFAULT WINDOW & VIEWPORT CONDITIONS.
ALL GRAPHIC DISPLAY COMMANDS RESTORE THE GRAPHIC CURSOR.
RELATIVE IMAGE COMMANDS ARE RELATIVE TO FIRST IMAGE VECTOR.
ANY VECTORS THAT ARE BEYOND THE DEFAULT SCREEN BOUNDARY WILL
BE LIMITED TO THE DEFAULT SCREEN BOUNDARY.
UNDEFINED NUMERIC AND UNDEFINED STRING PARAMETERS ARE ALLOWED
IN MANY OF THE COMMANDS. ANY UNDEFINED STRING VARIABLES WILL
BE DIMENSIONED TO THE 4051 BASIC DEFAULT OF 72 CHARACTERS.
ALL DEFINED IMAGE STRINGS MUST HAVE A LENGTH OF 0 MOD 3. THUS
NO PARTIAL (LESS THAN 3 BYTE) VECTORS ARE ALLOWED. ALSO ALL
DEFINED ARGUMENT STRINGS MUST HAVE A LENGTH > 0. THUS NO NULL
ARGUMENT STRINGS ARE ALLOWED.

DISPLAY COUNT :

C >= +0.5 DRAW IMAGE ABS(C) TIMES IN STORAGE MODE.
C = 0.0 DRAW IMAGE ABS(C) TIMES IN NOTEVER MODE.
C <= -0.5 DRAW IMAGE ABS(C) TIMES IN REFRESH MODE.

JOYSTICK COMMANDS :

EXAMPLE : CALL "JCROSS",C,X,Y,K\$

CROSS-HAIR JOYSTICK CURSOR WILL BE DRAWN C TIMES OR
UNTIL A KEYBOARD KEY IS PRESSED WHICHEVER OCCURS FIRST.
AFTER JOYSTICK COMMAND EXIT : C = ACTUAL DISPLAY COUNT.
X AND Y ARE UPDATED TO THE CURRENT JOYSTICK POSITION.
ANY PENDING KEYBOARD KEYS ARE SAVED IN K\$.

INPUT COMMANDS :

EXAMPLE : CALL "AINPUT",S\$,C,X,Y,K\$

PRINT STRING S\$ AND ANY KEYBOARD CHARACTERS C TIMES OR
UNTIL CARRIAGE RETURN IS PRESSED WHICHEVER OCCURS FIRST.
IF MORE THAN 28 CHAFACTERS ARE ENTERED THEN BEEP BELL.
AFTER INPUT COMMAND EXIT : C = ACTUAL DISPLAY COUNT.
PRINT CHARACTER STRINGS STARTING AT LOCATION X,Y
ANY PENDING KEYBOARD KEYS ARE SAVED IN K\$.

POINT COMMANDS :

EXAMPLE : CALL "APOINT",I\$,N,X,Y

FIND IMAGE I\$ POINT N & X,Y POSITION NEAREST POSITION X,Y.
AT CALL ENTRY N = BEGINNING VECTOR NUMBER TO START SEARCH AT.
AT CALL EXIT SIGN(N) INDICATES IF VECTOR IS A MOVE OR A DRAW.

SCALE COMMANDS :

NEGATIVE VALUES FOR H AND/OR V RESULT IN A MIRROR IMAGE.
-65.535 <= SCALE FACTOR RANGE =< +65.535 (17 BIT RESOLUTION).

SHEAR COMMANDS :

ALL ANGLES ARE MEASURED COUNTER CLOCK-WISE.
ALL ANGLES ARE IN CURRENT TRIGONOMETRIC UNITS.

TAPER COMMANDS :

NEGATIVE VALUES FOR H AND/OR V RESULT IN A MIRROR TAPER.
-65.535 <= TAPER FACTOR RANGE =< +65.535 (17 BIT RESOLUTION).

ROTATE COMMANDS :

ALL ANGLES ARE MEASURED COUNTER CLOCK-WISE.
ALL ANGLES ARE IN CURRENT TRIGONOMETRIC UNITS.

SYNTAX ABBREVIATIONS :

THE FOLLOWING ABBREVIATIONS ARE USED TO DESCRIBE THE
SYNTAX OF ALL FAST GRAPHICS COMMANDS.

AFY:ARG = A COMPLETELY DEFINED NUMERIC ARRAY
NUM:ARG = A NUMERIC EXPRESSION OR A DEFINED SIMPLE NUMERIC
IMG:ARG = A DEFINED IMAGE STRING (LENGTH > 0 & = 0 MOD 3)
STR:ARG = A LITERAL OR A DEFINED STRING (LENGTH > 0)
ARY:RES = A DIMENSIONED NUMERIC ARRAY (MAY BE UNDEFINED)
NUM:RES = A SIMPLE NUMERIC RESULT (MAY BE UNDEFINED)
IMG:RES = A IMAGE STRING RESULT (MAY BE UNDEFINED)
STR:RES = A STRING RESULT (MAY BE UNDEFINED)
ARY:ARG&RES = A COMPLETELY DEFINED NUMERIC ARRAY
NUM:ARG&RES = A DEFINED SIMPLE NUMERIC RESULT
IMG:ARG&RES = A DEFINED IMAGE STRING (LENGTH > 0 & = 0 MOD 3)
STR:ARG&RES = A DEFINED STRING RESULT (LENGTH > 0)

IMAGE BOUNDS :

CALL "BOUNDS",I\$,H,V,X,Y

CALL "BOUNDS",IMG:ARG,NUM:RES,NUM:RES,NUM:RES,NUM:RES

FIND IMAGE I\$ MIN X, MIN Y, MAX X, & MAX Y BOUNDS

JOYSTICK LOCATION :

CALL "LOCATE",C,X,Y,K\$

CALL "LOCATE",NUM:ARG&RES,NUM:RES,NUM:RES,STR:RES

PRINT JOYSTICK CURSOR LOCATION AT GRAPHIC CURSOR POSITION
SEE "JOYSTICK COMMANDS :"

ABSOLUTE GIN :

CALL "AGIN",X,Y

CALL "AGIN",NUM:RES,NUM:RES

FIND GRAPHIC CURSOR X,Y POSITION

RELATIVE GIN :

CALL "RGIN",X,Y

CALL "RGIN",NUM:ARG&RES,NUM:ARG&RES

FIND GRAPHIC CURSOR X,Y POSITION RELATIVE TO X,Y

GRAPHICS GIN :

CALL "GGIN",X,Y

CALL "GGIN",NUM:ARG&RES,NUM:ARG&RES

FIND X,Y POSITION AT X,Y RELATIVE TO GRAPHIC CURSOR

JOYSTICK GIN :

CALL "JGIN",T,X,Y,K\$

CALL "JGIN",NUM:ARG&RES,NUM:RES,NUM:RES,STR:RES

WAIT A MAXIMUM OF T MILLISECONDS FOR KEYBOARD KEY
FIND JOYSTICK CURSOR X,Y POSITION & KEYBOARD KEYS K\$
SEE "JOYSTICK COMMANDS :"

ABSOLUTE POINT :

CALL "APOINT",I\$,N,X,Y

CALL "APOINT",IMG:ARG,NUM:ARG&RES,NUM:ARG&RES,NUM:ARG&RES

FIND IMAGE I\$ POINT N & X,Y NEAREST ABSOLUTE POSITION X,Y
SEE "POINT COMMANDS :"

RELATIVE POINT :

CALL "RPOINT",I\$,N,X,Y

CALL "RPOINT",IMG:ARG,NUM:ARG&RES,NUM:ARG&RES,NUM:ARG&RES

FIND IMAGE I\$ POINT N & X,Y NEAREST RELATIVE POSITION X,Y
SEE "POINT COMMANDS :"

GRAPHICS POINT :

CALL "GPOINT",I\$,N,X,Y

CALL "GPOINT",IMG:ARG,NUM:ARG&RES,NUM:ARG&RES,NUM:ARG&RES

FIND IMAGE I\$ POINT N & X,Y NEAREST X,Y RELATIVE GRAPHIC CURSOR
SEE "POINT COMMANDS :"

JOYSTICK POINT :

CALL "JPOINT",I\$,C,N,X,Y,K\$

CALL "JPOINT",IMG:ARG,NUM:ARG&RES,NUM:ARG&RES,NUM:RES,NUM:RES,STR:RES

FIND IMAGE I\$ POINT N & X,Y POSITION NEAREST JOYSTICK CURSOR
SEE "JOYSTICK COMMANDS :"
SEE "POINT COMMANDS :"

DASHED GRID :

CALL "DASHED",H,V,X0,Y0,X1,Y1

CALL "DASHED",NUM:ARG,NUM:ARG,NUM:ARG,NUM:ARG,NUM:ARG,NUM:ARG

DRAW DASHED GRID WITH HORIZONTAL PITCH H AND VERTICAL PITCH V
THE DASHED GRID STARTS AT X0,Y0 AND ENDS AT X1,Y1 (OR BEFORE)

DOTTED GRID :

CALL "DOTTED",H,V,X0,Y0,X1,Y1

CALL "DOTTED",NUM:ARG,NUM:ARG,NUM:ARG,NUM:ARG,NUM:ARG,NUM:ARG

DRAW DOTTED GRID WITH HORIZONTAL PITCH H AND VERTICAL PITCH V
THE DOTTED GRID STARTS AT X0,Y0 AND ENDS AT X1,Y1 (OR BEFORE)

KABOOM :

CALL "KABOOM",C,X,Y

CALL "KABOOM",NUM:ARG,NUM:ARG,NUM:ARG

DRAW EXPLOSION C TIMES AT POSITION X,Y

RUBBER BAND LINE :

CALL "RUBBER",C,X,Y,K\$

CALL "RUBBER",NUM:ARG&RES,NUM:RES,NUM:RES,STR:RES

DRAW RUBBER BAND LINE FROM JOYSTICK CURSOR TO GRAPHIC CURSOR
SEE "JOYSTICK COMMANDS :"

VERTEX :

CALL "VERTEX",I\$,C,X,Y,K\$

CALL "VERTEX",IMG:ARG,NUM:ARG&RES,NUM:RES,NUM:RES,STR:RES

DRAW RUBBER BAND LINES FROM JOYSTICK CURSOR TO IMAGE I\$ POINTS
SEE "JOYSTICK COMMANDS :"

ABSOLUTE CROSS :

CALL "ACROSS",C,X,Y

CALL "ACROSS",NUM:ARG,NUM:ARG,NUM:ARG

DRAW CROSSHAIR CURSOR C TIMES AT POSITION X,Y

RELATIVE CROSS :

CALL "RCROSS",C,X,Y

CALL "RCROSS",NUM:ARG,NUM:ARG,NUM:ARG

DRAW CROSSHAIR CURSOR C TIMES AT X,Y RELATIVE TO CENTER SCREEN

GRAPHICS CROSS :

CALL "GCROSS",C,X,Y

CALL "GCROSS",NUM:ARG,NUM:ARG,NUM:ARG

DRAW CROSSHAIR CURSOR C TIMES AT X,Y RELATIVE TO GRAPHIC CURSOR

JOYSTICK CROSS :

CALL "JCROSS",C,X,Y,K\$

CALL "JCROSS",NUM:ARG&RES,NUM:RES,NUM:RES,STR:RES

SEE "JOYSTICK COMMANDS :"

ABSOLUTE DRAW :

CALL "ADRAW",I\$,C,X,Y

CALL "ADRAW",IMG:ARG,NUM:ARG,NUM:ARG,NUM:ARG

DRAW IMAGE I\$ C TIMES AT POSITION X,Y

RELATIVE DRAW :

CALL "RDRAW",I\$,C,X,Y

CALL "RDRAW",IMG:ARG,NUM:ARG,NUM:ARG,NUM:ARG

DRAW IMAGE I\$ C TIMES AT RELATIVE POSITION X,Y

GRAPHICS DRAW :

CALL "GDRAW",I\$,C,X,Y

CALL "GDRAW",IMG:ARG,NUM:ARG,NUM:ARG,NUM:ARG

DRAW IMAGE I\$ C TIMES AT X,Y RELATIVE TO GRAPHIC CURSOR

JOYSTICK DRAW :

CALL "JDRAW",I\$,C,X,Y,K\$

CALL "JDRAW",IMG:ARG,NUM:ARG&RES,NUM:RES,NUM:RES,STR:RES

DRAW IMAGE I\$ C TIMES AT JOYSTICK CURSOR

SEE "JOYSTICK COMMANDS :"

ABSOLUTE DOTS :

CALL "ADOTS",I\$,C,X,Y

CALL "ADOTS",IMG:ARG,NUM:ARG,NUM:ARG,NUM:ARG

DRAW IMAGE I\$ DOTS C TIMES AT POSITION X,Y

RELATIVE DOTS :

CALL "RDOTS",I\$,C,X,Y

CALL "RDOTS",IMG:ARG,NUM:ARG,NUM:ARG,NUM:ARG

DRAW IMAGE I\$ DOTS C TIMES AT RELATIVE POSITION X,Y

GRAPHICS DOTS :

CALL "GDOTS",I\$,C,X,Y

CALL "GDOTS",IMG:ARG,NUM:ARG,NUM:ARG,NUM:ARG

DRAW IMAGE I\$ DOTS C TIMES AT X,Y RELATIVE TO GRAPHIC CURSOR

JOYSTICK DOTS :

CALL "JDOTS",I\$,C,X,Y,K\$

CALL "JDOTS",IMG:ARG,NUM:ARG&RES,NUM:RES,NUM:RES,STR:RES

DRAW IMAGE I\$ DOTS C TIMES AT JOYSTICK CURSOR

SEE "JOYSTICK COMMANDS :"

ABSOLUTE PRINT :

CALL "APRINT",C\$,C,X,Y

CALL "APRINT",STR:ARG,NUM:ARG,NUM:ARG,NUM:ARG

PRINT CHARACTERS C\$ C TIMES AT POSITION X,Y

RELATIVE PRINT :

CALL "RPRINT",C\$,C,X,Y

CALL "RPRINT",STR:ARG,NUM:ARG,NUM:ARG,NUM:ARG

PRINT CHARACTERS C\$ C TIMES AT X,Y RELATIVE TO CENTER SCREEN

GRAPHICS PRINT :

CALL "GPRINT",C\$,C,X,Y

CALL "GPRINT",STR:ARG,NUM:ARG,NUM:ARG,NUM:ARG

PRINT CHARACTERS C\$ C TIMES AT X,Y RELATIVE TO GRAPHIC CURSOR

JOYSTICK PRINT :

CALL "JPRINT",C\$,C,X,Y,K\$

CALL "JPRINT",STR:ARG,NUM:ARG&RES,NUM:RES,NUM:RES,STR:RES

PRINT STRING C\$ C TIMES AT JOYSTICK CURSOR
SEE "JOYSTICK COMMANDS :"

ABSOLUTE INPUT :

CALL "AINPUT",C\$,C,X,Y,K\$

CALL "AINPUT",STR:ARG,NUM:ARG&RES,NUM:ARG,NUM:ARG,STR:RES

PRINT STRING C\$ AND ANY KEYBOARD KEYS C TIMES AT POSITION X,Y
SEE "INPUT COMMANDS :"

RELATIVE INPUT :

CALL "RINPUT",C\$,C,X,Y,K\$

CALL "RINPUT",STR:ARG,NUM:ARG&RES,NUM:ARG,NUM:ARG,STR:RES

PRINT STRING C\$ AND ANY KEYBOARD KEYS C TIMES AT X,Y RELATIVE TO CENTER SCREEN
SEE "INPUT COMMANDS :"

GRAPHICS INPUT :

CALL "GINPUT",C\$,C,X,Y,K\$

CALL "GINPUT",STR:ARG,NUM:ARG&RES,NUM:ARG,NUM:ARG,STR:RES

PRINT STRING C\$ AND ANY KEYBOARD KEYS C TIMES AT X,Y RELATIVE TO GRAPHIC CURSOR
SEE "INPUT COMMANDS :"

JOYSTICK INPUT :

CALL "JINPUT",C\$,C,X,Y,K\$

CALL "JINPUT",STR:ARG,NUM:ARG&RES,NUM:RES,NUM:RES,STR:RES

PRINT STRING C\$ AND ANY KEYBOARD KEYS C TIMES AT JOYSTICK CURSOR
SEE "JOYSTICK COMMANDS :"

SEE "INPUT COMMANDS :"

IMAGES :

CALL "IMAGES",I\$

CALL "IMAGES",IMG:RES

INPUT MAG TAPE ASCII FILE INTO IMAGE STRING I\$
EXIT OCCURS WHEN EOF IS ENCOUNTERED OR IMAGE STRING IS FULL
NO CHARACTERS ARE LOST IF STRING IS FULL AND CALL IS REPEATED

CHANGE :

CALL "CHANGE",F,S\$

CALL "CHANGE",ARY:ARG,IMG:RES

CHANGE FLOATING POINT IMAGE ARRAY F INTO IMAGE STRING S\$
NEGATIVE VALUES IN ARRAY F INDICATE MOVES

CALL "CHANGE",S\$,F

CALL "CHANGE",IMG:ARG,ARY:RES

CHANGE IMAGE STRING S\$ INTO FLOATING POINT IMAGE ARRAY F
NEGATIVE VALUES IN ARRAY F INDICATE MOVES

DEFINE POINT :

CALL "DEFINE",I\$,N,X,Y

CALL "DEFINE",IMG:ARG&RES,NUM:ARG&RES,NUM:ARG,NUM:ARG

DEFINE IMAGE I\$ POINT N X,Y POSITION
IMAGE I\$ POINT N MUST EXIST PRIOR TO THE CALL
SIGN(N) INDICATES IF VECTOR IS A MOVE OR A DRAW.

LOCATE POINTS :

CALL "POINTS",I\$,N,X,Y

CALL "POINTS",IMG:ARG,NUM:ARG&RES,NUM:RES,NUM:RES

FIND IMAGE I\$ POINT N X,Y POSITION
SIGN(N) INDICATES IF VECTOR IS A MOVE OR A DRAW.

TOGGLE MOVE FLAG :

CALL "TOGGLE",I\$,N

CALL "TOGGLE",IMG:ARG&RES,NUM:ARG&RES

TOGGLE IMAGE STRING I\$ POINT N MOVE FLAG
SIGN(N) INDICATES IF VECTOR IS A MOVE OR A DRAW.
A DRAW IS CHANGED TO A MOVE AND A MOVE IS CHANGED TO A DRAW

ABSOLUTE MOVE :

CALL "AMOVE",I\$,X,Y

CALL "AMOVE",IMG:ARG&RES,NUM:ARG,NUM:ARG

MOVE IMAGE I\$ TO POSITION X,Y

RELATIVE MOVE :

CALL "RMOVE",I\$,X,Y

CALL "RMOVE",IMG:ARG&RES,NUM:ARG,NUM:ARG

MOVE IMAGE I\$ TO RELATIVE POSITION X,Y

GRAPHICS MOVE :

CALL "GMOVE",I\$,X,Y

CALL "GMOVE",IMG:ARG&RES,NUM:ARG,NUM:ARG

MOVE IMAGE I\$ TO X,Y RELATIVE TO GRAPHIC CURSOR

JOYSTICK MOVE :

CALL "JMOVE",I\$,C,X,Y,K\$

CALL "JMOVE",IMG:ARG&RES,NUM:ARG&RES,NUM:RES,NUM:RES,STR:RES

MOVE IMAGE I\$ TO JOYSTICK CURSOR
SEE "JOYSTICK COMMANDS :"

ABSOLUTE SCALE :

CALL "ASCALE",I\$,H,V,X,Y

CALL "ASCALE",IMG:ARG&RES,NUM:ARG,NUM:ARG,NUM:ARG,NUM:ARG

SCALE IMAGE I\$ BY FACTORS H,V AROUND POSITION X,Y

RELATIVE SCALE :

CALL "RSCALE" I\$,H,V,X,Y

CALL "RSCALE",IMG:ARG&RES,NUM:ARG,NUM:ARG,NUM:ARG,NUM:ARG

SCALE IMAGE I\$ BY FACTORS H,V AROUND RELATIVE POSITION X,Y

GRAPHICS SCALE :

CALL "GSCALE" I\$,H,V,X,Y

CALL "GSCALE",IMG:ARG&RES,NUM:ARG,NUM:ARG,NUM:ARG,NUM:ARG

SCALE IMAGE I\$ BY FACTORS H,V AROUND X,Y RELATIVE TO GRAPHIC CURSOR

JOYSTICK SCALE :

CALL "JSCALE" I\$,C,H,V,X,Y,K\$

CALL "JSCALE",IMG:ARG&RES,NUM:ARG&RES,NUM:ARG,NUM:ARG,NUM:RES,NUM:RES,STR:RES

SCALE IMAGE I\$ BY FACTORS H,V AROUND JOYSTICK CURSOR
SEE "JOYSTICK COMMANDS :"

ABSOLUTE SHEAR :

CALL "ASHEAR",I\$,H,V,X,Y

CALL "ASHEAR",IMG:ARG&RES,NUM:ARG,NUM:ARG,NUM:ARG,NUM:ARG

SHEAR IMAGE I\$ BY ANGLES H,V AROUND POSITION X,Y

RELATIVE SHEAR :

CALL "RSHEAR" I\$,H,V,X,Y

CALL "RSHEAR",IMG:ARG&RES,NUM:ARG,NUM:ARG,NUM:ARG,NUM:ARG

SHEAR IMAGE I\$ BY ANGLES H,V AROUND RELATIVE POSITION X,Y

GRAPHICS SHEAR :

CALL "GSHEAR" I\$,H,V,X,Y

CALL "GSHEAR",IMG:ARG&RES,NUM:ARG,NUM:ARG,NUM:ARG,NUM:ARG

SHEAR IMAGE I\$ BY ANGLES H,V AROUND X,Y RELATIVE TO GRAPHIC CURSOR

JOYSTICK SHEAR :

CALL "JSHEAR" I\$,C,H,V,X,Y,K\$

CALL "JSHEAR",IMG:ARG&RES,NUM:ARG&RES,NUM:ARG,NUM:ARG,NUM:RES,NUM:RES,STR:RES

SHEAR IMAGE I\$ BY ANGLES H,V AROUND JOYSTICK CURSOR

SEE "JOYSTICK COMMANDS :"

ABSOLUTE TAPER :

CALL "ATAPER",I\$,H,V,X,Y

CALL "ATAPER",IMG:ARG&RES,NUM:ARG,NUM:ARG,NUM:ARG,NUM:ARG

TAPER IMAGE I\$ BY FACTORS H,V AROUND POSITION X,Y

RELATIVE TAPER :

CALL "RTAPER",I\$,H,V,X,Y

CALL "RTAPER",IMG:ARG&RES,NUM:ARG,NUM:ARG,NUM:ARG,NUM:ARG

TAPER IMAGE I\$ BY FACTORS H,V AROUND RELATIVE POSITION X,Y

GRAPHICS TAPER :

CALL "GTAPER" I\$,H,V,X,Y

CALL "GTAPER",IMG:ARG&RES,NUM:ARG,NUM:ARG,NUM:ARG,NUM:ARG

TAPER IMAGE I\$ BY FACTORS H,V AROUND X,Y RELATIVE TO GRAPHIC CURSOR

JOYSTICK TAPER :

CALL "JTAPER" I\$,C,H,V,X,Y,K\$

CALL "JTAPER",IMG:ARG&RES,NUM:ARG&RES,NUM:ARG,NUM:ARG,NUM:RES,NUM:RES,STR:RES

TAPER IMAGE I\$ BY FACTORS H,V AROUND JOYSTICK CURSOR

SEE "JOYSTICK COMMANDS :"

ABSOLUTE ROTATE :

CALL "AROTATE",I\$,R,X,Y

CALL "AROTATE",IMG:ARG&RES,NUM:ARG,NUM:ARG,NUM:ARG

ROTATE IMAGE I\$ BY ANGLE R AROUND POSITION X,Y

RELATIVE ROTATE :

CALL "RROTATE",I\$,R,X,Y

CALL "RROTATE",IMG:ARG&RES,NUM:ARG,NUM:ARG,NUM:ARG

ROTATE IMAGE I\$ BY ANGLE R AROUND RELATIVE POSITION X,Y

GRAPHICS ROTATE :

CALL "GROTATE",I\$,R,X,Y

CALL "GROTATE",IMG:ARG&RES,NUM:ARG,NUM:ARG,NUM:ARG

ROTATE IMAGE I\$ BY ANGLE R AROUND X,Y RELATIVE TO GRAPHIC CURSOR

JOYSTICK ROTATE :

CALL "JROTATE",I\$,C,P,X,Y,K\$

CALL "JROTATE",IMG:ARG&RES,NUM:ARG&RES,NUM:ARG,NUM:RES,NUM:RES,STR:RES

ROTATE IMAGE I\$ BY ANGLE R AROUND JOYSTICK CURSOR

SEE "JOYSTICK COMMANDS :"

PRINTS :

CALL "PRINTS",S\$

CALL "PRINTS",STR:ARG

PRINT STRING S\$ CHARACTERS (PRINTABLE CONTROL CHARACTERS)

INPUTS :

CALL "INPUTS",S\$

CALL "INPUTS",STR:ARG

INPUT STRING S\$ CHARACTERS INTO KEYBOARD BUFFER (28 CHAR MAX)

STRING :

CALL "STRING",F,S\$

CALL "STRING",ARY:ARG,STR:RES

CHANGE FLOATING POINT ARRAY F INTO ASCII STRING S\$
ASCII STRING WILL BE VALID ASCII CHARACTERS (ASCII 0..127)

CALL "STRING",S\$,F

CALL "STRING",STR:ARG,ARY:RES

CHANGE ASCII STRING S\$ INTO FLOATING POINT ARRAY F
FLOATING POINT ARRAY F WILL BE VALID ASCII CHARACTER CODES

SOUNDS :

CALL "SOUNDS",S\$

CALL "SOUNDS",STR:ARG

OUTPUT ZERO CROSSING PERIODS IN ASCII STRING S\$ TO SPEAKER

SAMPLE PERIOD = (N+1) * 38.4 US
00HEX = 26042 HZ EDGE RATE (FREQ = 13KHZ)
7FHEX = 203.5 HZ EDGE RATE (FREQ = 100HZ)
SAMPLE INTERVAL = 32 CYCLES AT 1.2 US/CYCLE

MUZAKT :

CALL "MUZAKT",S\$

CALL "MUZAKT",STR:ARG

OUTPUT MUSICAL NOTES IN ASCII STRING S\$ TO SPEAKER

MUZAKT STRING SYNTAX :

<WORD> ::= <TEMP>
 + <REST>
 + <NOTE>
 + <NOTE><DOT>
 + <NOTE><OCT>
 + <NOTE><OCT><DOT>
 + <NOTE><OCT><LEN>
 + <NOTE><OCT><LEN><DOT>
<NOTE> ::= <A + B + C + D + E + F + G>
 + <A + B + C + D + E + F + G><FLAT>
 + <A + B + C + D + E + F + G><SHRP>
<OCT> ::= <0..7> (ZERO = FIRST OCTAVE ON STANDARD KEYBOARD)
<LEN> ::= <1..99> (RECIPROCAL NOTE LENGTH : 1,2,4,8,16,32,64)
<REST> ::= <R><1..99> (RECIPROCAL REST LENGTH : 1,2,4,8,16,32,64)
<TEMP> ::= <T><0..9> (SEE MUZAKT TEMPO TABLE BELOW)
<DOT> ::= <.> (PERIOD)
<SHRP> ::= <#> (POUNDS)
<FLAT> ::= <@B> (SMALL B)

TO ENTER THIRDS , FIFTHS ... USE THREE , FIVE ... TIMES LENGTH ETC.

TEMPO RATE (BEATS/MINUTE)

0	80
1	90
2	100
3	110
4	120
5	130
6	140
7	150
8	160
9	170

MUZAKT STRING EXAMPLE :

T4E316G332B4EGB5EG58.G516G54F#R

NOTE OCT LEN

TEMP 4
E 3 1/16
C 3 1/32

ANY INVALID WORDS OR CHARACTERS ARE IGNORED

1.500 VECTOR IMAGE :

CHANGE FLOATING POINT TO STRING :	2.8 SECONDS	536
CHANGE STRING TO FLOATING POINT :	28.0 SECONDS	54

VECTORS/SECOND SPEED(X)

BASIC USING "MOVE/DRAW" :	175 SECONDS	18	
BASIC USING "PRINT AT:" :	110 SECONDS	29	
BASIC USING "MOVE/DRAW" :	79.0 SECONDS (4052)	41	
EXTENDED BASIC "QDRAW" :	36.0 SECONDS	89	
FAST GRAPHICS "RORAW" :	12.8 SECONDS	250	13.7 (6.2)
FAST GRAPHICS "RDOTS" :	2.8 SECONDS	1145	125 (55)
FAST GRAPHICS "RMOVE" :	1.9 SECONDS	1684	
FAST GRAPHICS "APPOINT" :	5.9 SECONDS	542	
FAST GRAPHICS "ASCALE" :	7.3 SECONDS	438	
FAST GRAPHICS "BOUNDS" :	1.3 SECONDS	2462	

VECTORS/SECOND SPEED (X)

BASIC USING "MOVE/DRAW" :	185 SECONDS	18	
BASIC USING "PRINT AT:" :	125 SECONDS	26	
BASIC USING "MOVE/DRAW" :	89.4 SECONDS (4052)	37	
EXTENDED BASIC "ODRAW " :	24.5 SECONDS	135	
FAST GRAPHICS "RDRAW " :	12.7 SECONDS	260	14.6 (7.0)
FAST GRAPHICS "RDOTS " :	2.9 SECONDS	1132	127 (61)
FAST GRAPHICS "RMOVE " :	2.0 SECONDS	1650	
FAST GRAPHICS "APPOINT" :	6.1 SECONDS	541	
FAST GRAPHICS "ASCALE" :	7.4 SECONDS	446	
FAST GRAPHICS "BOUNDS" :	1.3 SECONDS	2538	

VECTORS/SECOND SPEED (X)

BASIC USING "MOVE/DRAW"	:	80.0	SECONDS	(4052)	55	
EXTENDED BASIC "QDRAW"	:	26.4	SECONDS		165	
FAST GRAPHICS "RDRAW"	:	17.8	SECONDS		246	(4.5)
FAST GRAPHICS "RDOTS"	:	3.25	SECONDS		1112	(40)

VECTORS/SECOND SPEED (X)

BASIC USING "MOVE/DRAW" :	FOREVER	...
BASIC USING "PRINT AT:" :	FOREVER MINUS A LITTLE	...
EXTENDED BASIC "QDRAW " :	50.0 SECONDS	200
FAST GRAPHICS "RDRAW " :	36.6 SECONDS	273
FAST GRAPHICS "RDOTS " :	3.5 SECONDS	1177
FAST GRAPHICS "RMOVE " :	5.5 SECONDS	1818
FAST GRAPHICS "APOINT" :	18.0 SECONDS	556
FAST GRAPHICS "ASCALE" :	21.5 SECONDS	465

ASCII CHARACTERS (3200 CHARACTERS) :

CHARACTERS/SECOND

CHARACTER PRINTING RATE :	>250
CHANGE ASCII TO CHARACTER : 2.1 SECONDS	1524
CHANGE CHARACTER TO ASCII : 4.1 SECONDS	780

SEVERAL DIFFERENT FAST GRAPHICS DEMO TAPES ARE AVAILABLE FROM
M. D. CRANFORD MS 50-370 X6131 (SEND BLANK TAPES).

CALL PARAMETER CODES :

80 : NUMERIC ARRAY ARGUMENT
40 : NUMERIC SIMPLE ARGUMENT
20 : NUMERIC CONSTANT ARGUMENT
10 : STRING ARRAY ARGUMENT
08 : NUMERIC ARRAY RESULT
04 : NUMERIC SIMPLE RESULT
02 : STRING CONSTANT ARGUMENT
01 : STRING ARRAY RESULT
00 : NONE (CALL TAG)

CALL SYNTAX FORMS :

CALL PARAMETER TYPES :

CALL "BOUNDS",I\$,X0,Y0,X1,Y1	10 04 04 04 04
CALL "LOCATE",C,X,Y,K\$	44 04 04 01
CALL "AGIN ",X,Y	04 04
CALL "RGIN ",X,Y	44 44
CALL "GGIN ",X,Y	44 44
CALL "JGIN ",T,X,Y,K\$	44 04 04 01
CALL "APOINT",I\$,N,X,Y	10 44 44 44
CALL "RPOINT",I\$,N,X,Y	10 44 44 44
CALL "GPOINT",I\$,N,X,Y	10 44 44 44
CALL "JPOINT",I\$,C,N,X,Y,K\$	10 44 44 04 04 01
CALL "DASHED",H,V,X0,Y0,X1,Y1	60 60 60 60 60 60
CALL "DOTTED",H,V,X0,Y0,X1,Y1	60 60 60 60 60 60
CALL "KABOOM",C,X,Y	60 60 60
CALL "RUBBER",C,X,Y,K\$	44 04 04 01
CALL "VERTEX",I\$,C,X,Y,K\$	10 44 04 04 01
CALL "ACROSS",C,X,Y	60 60 60
CALL "RCROSS",C,X,Y	60 60 60
CALL "GCROSS",C,X,Y	60 60 60
CALL "JCROSS",C,X,Y,K\$	44 04 04 01
CALL "ADRAW ",I\$,C,X,Y	10 60 60 60
CALL "RDRAW ",I\$,C,X,Y	10 60 60 60
CALL "GDRAW ",I\$,C,X,Y	10 60 60 60
CALL "JDRAW ",I\$,C,X,Y,K\$	10 44 04 04 01
CALL "ADOTS ",I\$,C,X,Y	10 60 60 60
CALL "RDOTS ",I\$,C,X,Y	10 60 60 60
CALL "GDOTS ",I\$,C,X,Y	10 60 60 60
CALL "JDOTS ",I\$,C,X,Y,K\$	10 44 04 04 01
CALL "APRINT",C\$,C,X,Y	12 60 60 60
CALL "RPRINT",C\$,C,X,Y	12 60 60 60
CALL "GPRINT",C\$,C,X,Y	12 60 60 60
CALL "JPRINT",C\$,C,X,Y,K\$	12 44 04 04 01
CALL "AINPUT",C\$,C,X,Y,K\$	12 44 60 60 01
CALL "RINPUT",C\$,C,X,Y,K\$	12 44 60 60 01
CALL "GINPUT",C\$,C,X,Y,K\$	12 44 60 60 01
CALL "JINPUT",C\$,C,X,Y,K\$	12 44 04 04 01
CALL "IMAGES",I\$	01
CALL "CHANGE",F,S\$	80 01
CALL "CHANGE",S\$,F	10 08
CALL "DEFINE",I\$,N,X,Y	11 44 60 60

CALL "POINTS",I\$,N,X,Y	10	44	04	04	
CALL "TOGGLE",I\$,N	11	44			
CALL "AMOVE ",I\$,X,Y	11	60	60		
CALL "RMOVE ",I\$,X,Y	11	60	60		
CALL "GMOVE ",I\$,X,Y	11	60	60		
CALL "JMOVE ",I\$,C,X,Y,K\$	11	44	04	04	01
CALL "ASCALE",I\$,H,V,X,Y	11	60	60	60	60
CALL "RSCALE",I\$,H,V,X,Y	11	60	60	60	60
CALL "GSCALE",I\$,H,V,X,Y	11	60	60	60	60
CALL "JSCALE",I\$,C,H,V,X,Y,K\$	11	44	60	60	04 04 01
CALL "ASHEAR",I\$,H,V,X,Y	11	60	60	60	60
CALL "RSHEAR",I\$,H,V,X,Y	11	60	60	60	60
CALL "GSHEAR",I\$,H,V,X,Y	11	60	60	60	60
CALL "JSHEAR",I\$,C,H,V,X,Y,K\$	11	44	60	60	04 04 01
CALL "ATAPER",I\$,H,V,X,Y	11	60	60	60	60
CALL "RTAPER",I\$,H,V,X,Y	11	60	60	60	60
CALL "GTAPER",I\$,H,V,X,Y	11	60	60	60	60
CALL "JTAPER",I\$,C,H,V,X,Y,K\$	11	44	60	60	04 04 01
CALL "AROTATE",I\$,R,X,Y	11	60	60	60	
CALL "RROTATE",I\$,R,X,Y	11	60	60	60	
CALL "GROTATE",I\$,R,X,Y	11	60	60	60	
CALL "JROTATE",I\$,C,R,X,Y,K\$	11	44	60	04	04 01
CALL "PRINTS",S\$	12				
CALL "INPUTS",S\$	12				
CALL "STRING",F,S\$	80	01			
CALL "STRING",S\$,F	10	08			
CALL "SOUNDS",S\$	12				
CALL "MUZAKT",S\$	12				

ACKNOWLEDGEMENTS :

KURT KRUEGER WROTE THE ORIGINAL VERSION OF MUZAKT IN 1978.
THE FAST GRAPHICS VERSION HAS SEVERAL ADDITIONAL FEATURES.

CARL HOVEY DEMONSTRATED THE FEASIBILITY OF 4051 WRITE-THRU
(NON-STORE) GRAPHICS IN A PINBALL GAME IN 1978.

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