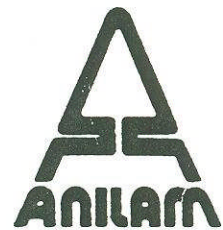


TIM



Anilam Electronics Corporation

FORMAT SPECIFICATION
FOR DATA COMMUNICATION
USING THE RS 232 C PORT.

Part No. 700-039 B

RS 232 C SPECIFICATION

In order to use RS-232-C compatible hardware with the Anilam Crusader, the following characteristics must be known about the hardware being used. This information must be obtained from the hardware manufacturer. The information needed is:

- 1) Baud rate at which the device sends or receives data.
- 2) Parity requirement - Odd, Even, or No Parity.
- 3) The number of bits per character which the device uses.
- 4) Handshaking requirements. If handshaking is required, which type-hardware or software.

If a paper tape reader is being used, the tape format must be the ASCII code format as shown on the tape format code page in this document. The code format is EIA Standard RS-358.

This document contains the information needed to format a program which can be input thru the RS 232 C port of the Anilam Crusader. This data can be used to develop a post processor.

The format detail which conforms to EIA Standard RS-274-D is:

(Inch)	N4 G2 X \pm 3.4 Y \pm 3.4 Z \pm 3.4 I \pm 3.4 J \pm 3.4 K \pm 3.4 F2.1 S4 M4 T4 EOB
(MM)	N4 G2 X \pm 5.2 Y \pm 5.2 Z \pm 5.2 I \pm 5.2 J \pm 5.2 K \pm 5.2 F4. S4 M4 T4 EOB

This format means that a block of information can have an N and up to 4 digits (N4) N0000 to N9999, a G and 2 digits (G2), an X dimension using + or - with 3 digits to the left of the decimal point and aa4 digits to the right of the decimal point, etc. for each character listed. Any character not listed is illegal and will cause a dwell in the program. Spaces are ignored by the control.

DECIMAL POINTS

Decimal points are required for all dimensional input. An input of X375 inches will be interpreted as X 375. inches.

ALGEBRAIC SIGNS

A plus sign does not need to be programmed as the control assumes a positive number. Minus signs must be input when required for dimensional data and must not be used for non-dimensional data such as N, G, F, S, or M.

LEADING AND TRAILING ZEROS

Leading and trailing zeros are not needed and may be left out. X1.5 will be interpreted as X001.5000 and G3 will be interpreted as G03, M02 will be M2, etc.

TRANSFER DATA TO THE CONTROL

A program is first written off line using the format examples that follow. The program must be complete and ready to send from an RS-232-C compatible device.

Before transferring data to the control, one or more of the following codes must be activated at the control. To activate a code, press emergency stop then pull out emergency stop, press manual, the code required (see codes below), start, next code if required, start, next code if required, start.

AUX	2780	- SET BAUD RATE TO 110 BITS/SECOND
	2781	- SET BAUD RATE TO 150 BITS/SECOND
GROUP	2782	- SET BAUD RATE TO 300 BITS/SECOND
1	2783	- SET BAUD RATE TO 600 BITS/SECOND
	2784	- SET BAUD RATE TO 1200 BITS/SECOND
	2785	- SET BAUD RATE TO 1800 BITS/SECOND
	2786	- SET BAUD RATE TO 2400 BITS/SECOND
	2787	- SET BAUD RATE TO 4800 BITS/SECOND
	2788	- SET BAUD RATE TO 9600 BITS/SECOND
	2789	- SET BAUD RATE TO 19200 BITS/SECOND

Aux 2754 - CIA CH. 14-15
2757 - ACC. 1-11-15

Any speed higher than 1200 Bits/Second will transfer data in bursts. (Must use handshake)

AUX	2790	- SET NO HANDSHAKE
GROUP	2791	- SET SOFTWARE HANDSHAKE (X ON, X OFF)
2	2792	- SET HARDWARE HANDSHAKE (DTR, DSR)
AUX	2765	- SET 5 BITS PER CHARACTER
GROUP	2766	- SET 6 BITS PER CHARACTER
3	2767	- SET 7 BITS PER CHARACTER
	2768	- SET 8 BITS PER CHARACTER
AUX:	2770	- SET TO NO PARITY
GROUP	2771	- SET TO ODD PARITY
4	2772	- SET TO EVEN PARITY
AUX	2700	- WRITE TO RS-232-C DEVICE IN RS 274 FORMAT
GROUP	2701	- READ FROM RS-232-C DEVICE IN RS 274 FORMAT
5	2702	- WRITE TO RS-232-C DEVICE IN ANILAM FORMAT

GCODE

After a selection from Group 1, 2,, 3 and 4 are activated, they will stay active and will only need to be entered if power is turned off or if they need to be changed. When a selection from Group 5 is acativated, the control keyboard will become inactive and will wait for information to be transferred thru the RS232 port. At this time, initiate the transmission of data from the external device you are using. The control will be released from the RS 232 by a finish code discussd later. Alternately, pressing the hold button will suspend transmission of data, pressing start will re-start transmission from the point of interruption and pressing the emergency stop will abort the transmission and release the control.

TRANSFER OF DATA FROM THE CONTROL

Data can be transferred from the control in either an RS-274-D format with N numbers, G codes, etc. so that the program can be saved and input back thru the RS-232-C port, or in an Anilam format which will give a hard copy of the program with ARC CW, DWELL, etc. After one of the codes are activated from Group 1, 2, 3 and 4 above, a code from Group 5 must be activated. The external RS232 device must be on and waiting for data because transmission of data will be started immediately. The program will be output from the event current.

START AND FINISH CODES

When transferring data into the control, a % sign must be the first character received by the control. To release the control, a second % sign after the program must be received by the control. A line feed and/or carriage return must be used as an end of block character.

INPUT CHARACTER FORMAT

This specification deals with spindle commands, coolant commands, feedrate, etc. If your control is not equipped with these options, do not use the codes.

Programming instructions for the control require both letters and numbers which make up a program word. One or more words make up a program block. Examples of program words and blocks are shown as a format guideline. The format for each word must be followed exactly in order to be accepted by the control. Upper or lower case can be used.

The first character the control will recognize is a % sign. This signifies the start of the program. The % sign should be the only character in the first program block. Each program block is terminated with a line feed and/or carriage return.

N - SEQUENCE NUMBER

N followed by up to 4 digits (N0-N9999) is used only to identify a new block of information and to keep a logical sequence will programming. It has no function other than acting as a line counter when preparing a program. This is not the event number which the block of data will be stored at after it is transferred to the control. All blocks between the start % sign and finish % sign must begin with an N and sequence number. Only one sequence number is allowed per block.

G - PREPARATORY COMMAND

G followed by one or two digits (G0-G91) is used to change or set a programmed condition. More than one G code can be programmed in a block, however, if one G code deactivates a previous G code, the last G code programmed will be active. For example:

N50G0G90 G1 X3. F20. - will be interpreted as a feed (G1) move because G1 deactivates G0 (rapid).

The following is a list of valid G codes and a description of each.

G0 - RAPID POSITIONING

This code will cause the block programmed to be executed at rapid speed. If 2 or more axes are programmed, the control will move in a straight line from the present position to the programmed point.

N35 G0G90 X2. Y1. Z.5

This block of data will cause a rapid move to the XYZ coordinate programmed. The order of the words in the block after the sequence number is not important. G0 is modal and will stay active unless deactivated by G1, G2, G3.

G1 - LINEAR FEED

This code will cause the block programmed to be executed at a defined feedrate. If 2 or more axes are programmed, the control will move in a straight line from the present position to the programmed position and the vector velocity will be at the active feedrate.

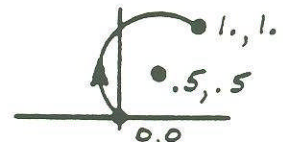
N15 G1G90 X3. Y1. F20.

This block will cause a feed move at 20 I.P.M. to X3. Y1. G1 is modal and deactivated by G0, G2, or G3.

G2 - CIRCULAR MOTION CLOCKWISE

G2 will cause a clockwise arc to be executed. The start point of the arc will be the present position after execution of the previous block, the center will be described by an I, J, an I, K or J, K dimension and the end point will be an X and Y, a Y and Z, or an X and Z dimension.

N30 G1G90 X0 Y0 Z0 F20.
N35 G2 X1. Y1. I.5 J.5



These blocks will perform the example arc shown. G2 is modal and deactivated by G0, G1, G3. Circular motion up to 360° is possible in one block.

G3 - CIRCULAR MOTION COUNTERCLOCKWISE

G3 works and is programmed the same as G2 except the motion generated is counterclockwise. G3 is deactivated by G0, G1, G2.

G4 - PROGRAM STOP

G4 causes a dwell in the program. When executed, the operator must press the start button to continue.

N5 G4

No other data should be programmed in this block. G4 is a one time command and is active for that block only.

G10 - POLAR MOVE FROM CENTER IN RAPID

G10 works as described in the Crusader Programming Manual. It is programmed as follows:

N30 G29 LV14 = 1.125 V15 = 30.
N35 G10

The above program will move from Point A to Point B. G10 is a one time command (non modal) and must be programmed each time it is used.

G11 THRU G13 - POLAR MOTION

These polar commands work as described in the Crusader Programming Manual. As many variables as necessary may be entered after the G29 word command. They are non modal, active for one block only.

G29 - SPECIAL FUNCTIONS

1) V Registers

G29 is used for several different functions. When V registers are being set for use in canned cycles in the Crusader, G29 is used to load V registers.

N65 G29 LV20 = 10. V21 = .1
N G0 G90G81 X1. Y2. Z-.5 F15.

In this example, G29 is used to load (L) variable (V) 20 equal to 10. and variable (V) 21 equal to .1. These variables are then used by the control as the feedrate and depth for drilling (G81) as described by the Crusader Programming Manual.

2) DO Loop

A DO Loop is activated using G29 as follows:

N25 G29 D15

This command will be interpreted as DO 15.

3) CALL A Subroutine

To call a user defined subroutine:

N45 G29 C3

This command will CALL 3. (Call subroutine labelled 3.)

4) SUBROUTINE Identifier

To identify a subroutine:

N30 G29 S6

This command will identify SUBR 6. Subroutines must be input after the end of the main program.

5) END of DO Loop, Subroutine or Main Program

To output an end:

N85 G29 E

This will cause an end to be inserted in the program. There must be an end statement at the end of the program before the % sign which signifies the end of program.

6) HELICAL INTERPOLATION is programmed as follows:

N50 G29 LV42=3.

N55 G29 G3 X.5 Y0 Z1. I.25 J0

G40-G42 CUTTER DIAMETER COMPENSATION

G40 - Deactivates Cutter Diameter Compensation.
G41 - Activates Cutter Diameter Compensation Left.
G42 - Activates Cutter Diameter Compensation Right.

G51-G52 POLAR ROTATION

G51 causes polar rotation to take place as described in the Crusader Programming Manual. G29 is used to load the appropriate V registers.

G52 deactivates polar rotation.

G53-G54 SCALING

G53 causes the program to be scaled as described in the Crusader Programming Manual. G29 is used to load the appropriate V registers.

G54 deactivates scaling.

G70 - INCH INPUT

This sets the control to accept inch input. Dimensional data and feedrates will be interpreted as inch data. G70 is modal and deactivated by G71.

G71 - METRIC INCH

This sets the control to accept metric input. Dimensional data and feedrates will be interpreted as millimeters. G71 is modal and deactivated by G70.

G76-G79 CANNED CYCLES

These are one time comomands and active for that block only. They are executed as described in the Crusader Programming Manual. G29 is used to input the appropriate V registers. After the block containing G29 and the V codes needed, the canned cycle is activated by:

N65 G79

This should be the only word in that program block.

G80-G89 CANNED CYCLES

These standard canned drilling cycles are modal. G80 deactivates G81 thru G89. The V codes are loaded using a G29 block. The appropriate drilling code, first XY coordinate and Z depth are then programmed:

```
N40 G29 LV20 = 5. V21 = .1 V23 = .15
N45 G83 X1.5 Y2. Z-1.75
```

The N40 block would set the feedrate (V20) at 5 IPM, the starting height (V21) at .1, and the max peck (V23) at .15.

G90 ABSOLUTE INPUT

This command sets the control to accept the dimensional input data as absolute co-ordinates from chosen absolute zero. G90 is modal and stays active until cancelled by G91.

G91 INCREMENTAL INPUT

This command sets the control to accept the dimensional input data as incremental measurement. Incremental motion is measured from the present tool position. G91 is modal and deactivated by G90.

DIMENSIONAL DATA INPUT

Leading and trailing zeros can be omitted on all dimensional data. Decimal points are required for all dimensional data. Dimensional axis commands are assumed positive unless preceded by a minus sign. Plus signs are not needed. This information applies to X, Y, Z, I, J and K.

I J K - ARC CENTER DATA

When using circular interpolation (G2 or G3), the arc centers are input as I, J, and/or K data. I is the dimension of the center in the X axis, J is the dimension of the center in the Y axis, and K is the center of the arc in the Z axis. Circular interpolation is only possible in any 2 of the 3 controlled axes, therefore I, J and K would never all appear in the same program block. I, J, and K dimensions must be entered even if equal to zero.

I, J, and K can be incremental or absolute coordinates. If incremental, I, J, and K are measured from the starting point of

the arc.

If an F, S, M, or T data word is programmed in a block containing motion, the F, S, M, or T command will be executed before the motion. The F, S, M, or T commands will be executed in the order in which they have been programmed.

F - FEEDRATES

Programmed feedrates are defined by an F word. The feedrate will become active for the block it is programmed in and the feedrate does not have to be restated unless it is changed. The feedrate during circular moves is the feedrate of the center of the cutter. Feedrates are programmable from .1 to 40.0 inches per minute (1-1000 mm/min.).

S - SPINDLE SPEED

S followed by up to 4 digits is a spindle speed command. If spindle speed commands are programmable on your machine, the corresponding S code would be input to achieve the desired spindle speed.

M - MISCELLANEOUS COMMANDS

M followed by up to 4 digits will be translated by the control to an AUX code. M30 will be output as AUX 30. M codes will be activated before the block it is programmed in is executed.

T - TOOL COMMANDS

To list offsets in the program a G29 block is used;

```
N10 G29 T1002 X.5 Z-1.123
```

This block would set tool 2's offsets to .5 for cutter diameter compensation and -1.123 for tool length compensation.

To activate a tool offset:

```
N40 G0 G90 G70 T3
```

This block would activate Tool 3's offsets. The tool length offset will be incorporated in the next Z absolute move and the cutter diameter offset will be activated on the next G41 or G42 block.

DEFAULTS

When the control is first turned on, the default conditions are: G0, G40, G52, G70, G80, G90.

EXAMPLE PART PROGRAM

This example program demonstrates most of the features of the Crusader as programmed thru RS-232-C port.

The part is programmed as follows:

- 1) Absolute zero is at the top left corner of the part. The part is .500 thick.
- 2) Tool change position is at point 1. Tool 1 is a .250 drill, tool 2 is a .250 endmill.
- 3) The machine sequence will be:
 - a) Drill the two patterns of 5 holes to demonstrate drilling cycles and subroutines.
 - b) Drill 6 equally spaced holes to demonstrate DO Loops.
 - c) Drill hole measured 30° polar from last hole to demonstrate polar motion.
 - d) Drill holes labeled A-E in a subroutine then rotate the subroutine to show rotation.
 - e) Drill bolt hole circle to show canned cycle G79.
 - f) Drill one counter bored hole.
 - g) Change tools at point 1.
 - h) Use cutter diameter compensation and program the tool to move from Pt 1, 2, 3...10. Because cutter diameter compensation is active, the tool will move from Pt 2A, 3A,...10A.
 - i) Counter bore hole using G76 canned cycle.
 - j) Mill circular pocket using G77 canned cycle.

- k) Mill rectangular pocket using G78 canned cycle.
- l) Mill 2 triangles using scaling.
- m) End program.

CRUSADER EXAMPLE PART FORMAT

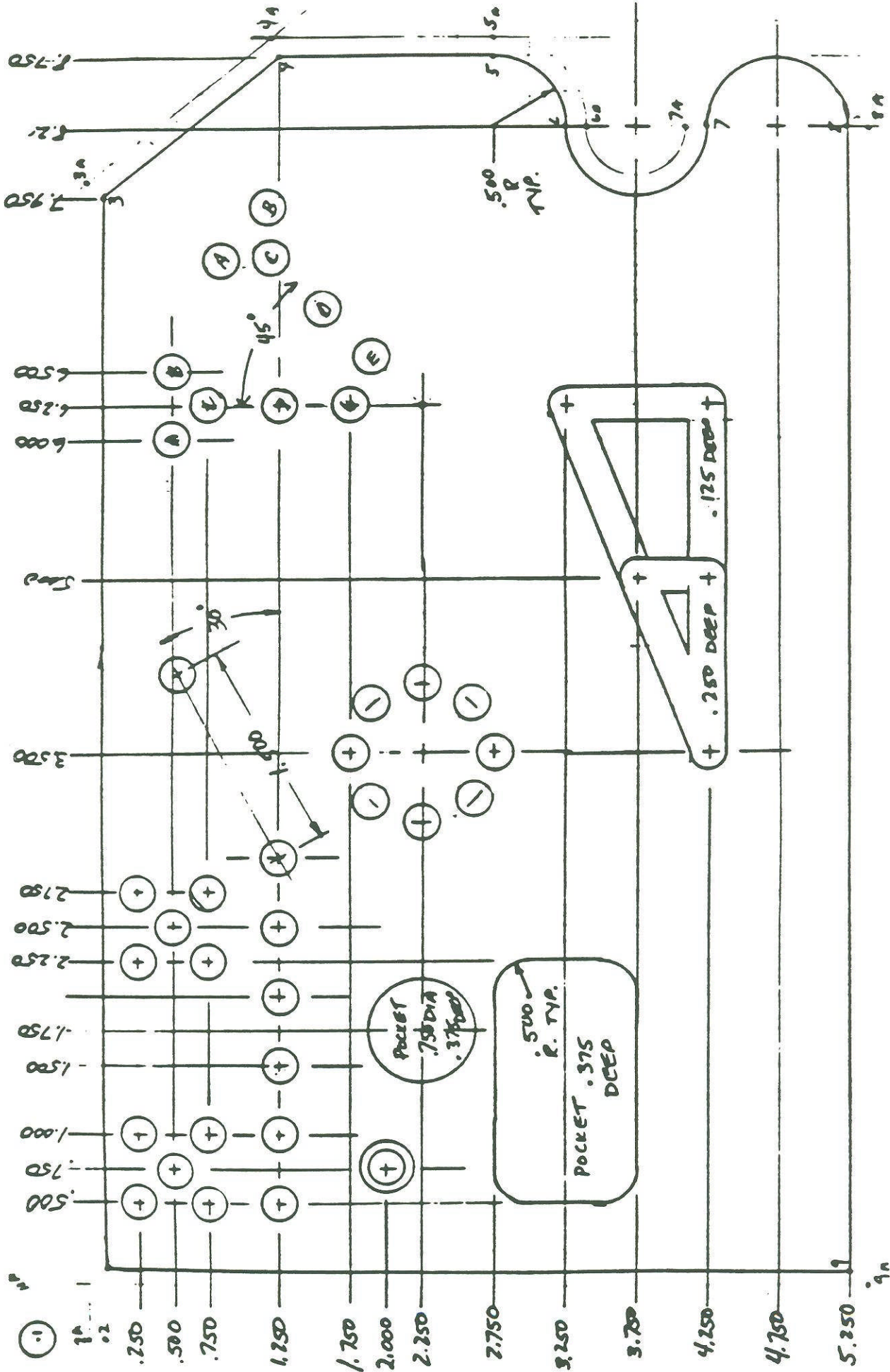
&	(Start Character)
N5 G0 G40 G52 G70 G80 G90	(Sets default conditions)
N10 G29 T1001 Z-1.123	(Sets tool 1's tool length offset)
N15 G29 T1002 X.25 Z-2.234	(Sets tool 2's diameter and length)
N20 Z0 T0	(Retracts quill, G0, G90 active)
N25 X-.5 Y.5	(Move to Pt. 1)
N30 T1	(Activates Tool 1 offset, tool change)
N35 G29 LV20=10. V21=.1 V23=.15	(Loads feedrate V20=10. starting height V21=.1, maxpeck V23=.15)
N40 G83 X.5 Y-.25 Z-.6	(Activates peck drilling G83, lists first X, Y coordinate and Z depth)
N45 G29 C1	(Calls Sub 1 which lists remaining holes in 5 hole pattern incrementally. G83 remains active and drills holes)
N50 G90 X2.25 Y-.25	(Drills first hole in second 5 hole pattern)
N55 G29 C1	(Calls Sub 1 to drill second pattern)
N60 G90 X.5 Y-1.25	(Drills first hole in row of

N65	G29 D5	6 equally spaced holes) (Activates DO Loop to be repeated 5 times)
N70	G91 X.5	(Incremental distance between holes)
N75	G29 Z	(End of DO Loop)
N80	G29 LV14=1.5 V15=30.	(Loads radius V14=1.5, loads angle V15=30.)
N85	G10	(Executes polar rapid move using V14 and V15 and drills hole)
N90	G29 C2	(Calls Sub 2 which drills holes A-E)
N95	G29 LV11=6.25 V12=2.25 V13=0 V15=45.	(Loads appropriate V registers for rotation)
N100	G51	(Activates rotation)
N105	G29 C2	(Calls Sub 2 which drills holes A-E in rotated position)
N110	G52	(Deactivates rotation)
N115	G29 LV11=3.5 V12=2.25 V13=0 V15=0 V16=-45. V17=8 V18=1.	(Loads V registers for bolt circle)
N120	G79	(Activates bolt circle canned cycle)
N125	G90 X.75 Y=2.	(Drills counter bored hole)
N130	G80	(Deactivates drilling)
N140	G0 Z0 T0	(Retracts quill)
N145	X=.5 Y.5	(Rapids to tool change position)

N150 T2	(Activates Tool 2 offset, tool change)
N155 G41 Y0	(Activates Cutter Diameter Compensation to the left. The tool moves to Point A in rapid)
N160 Z-.5	(Tool rapids - .5 below top of part)
N165 G1 X7.75 F20.	(Tool feeds to Point 3A at 20 IPM)
G170 X8.75 Y-1.25	(Tool feeds to Point 4A)
N175 Y-2.75	(Tool feeds to Point 5A)
N180 G2 X8.25 Y-3.25 I8.25 J-2.75	(Tool feeds to Point 6A)
N190 G3 X8.25 Y-4.25 I8.25 J-3.75	(Tool feeds to Point 7A)
N195 G2 G91 X0 Y-1. I0 J-.5	(Tool feeds to Point 8A)
N200 G1 G90 X0	(Tool feeds to Point 9A)
N205 Y.5	(Tool feeds to Point 10A)
N210 G40 G0 Z.1	(Deactivates Cutter Diameter Compensation and rapids tool to .1 above part)
N215 X.75 Y-2.	(Tool rapids to counter bored hole)
N220 G1 Z-.25 F10.	(Feeds Z into hole at 10 IPM)
N225 G29 LV18=.375 V49=.25	(Loads V registers for G76 canned cycle)
N230 G76	(Activates G76 canned cycle)
N235 G0 Z.1	(Rapids Tool .1 above part)

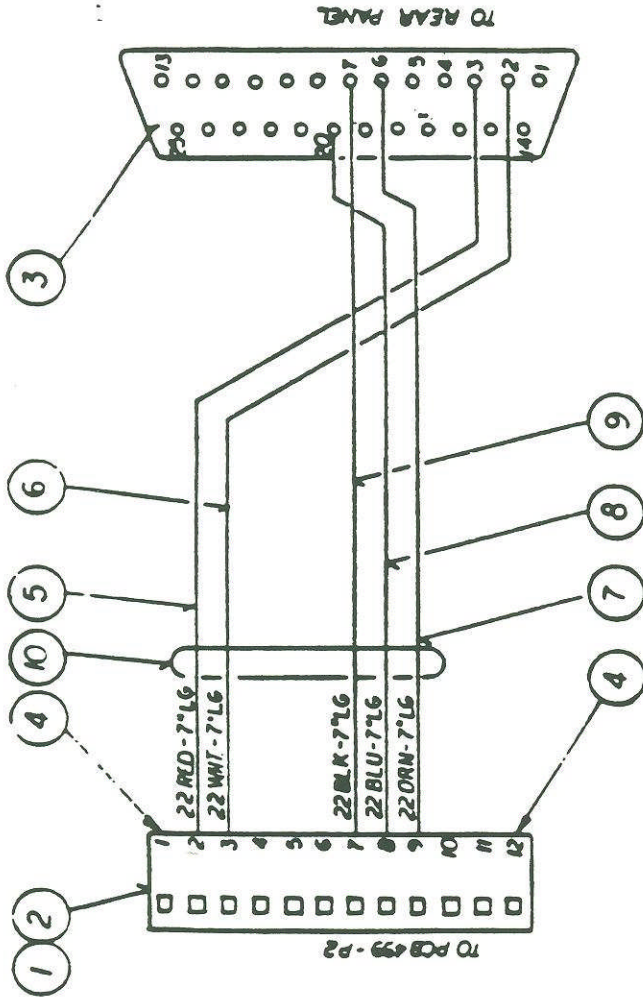
N240	G29 LV40=.1 V41=1.75 V42=2.25 V43=-.375 V44=.75 V45=.15 V46=.125 V47=.01 V48=15. V49=.25	(Loads V registers for G77 canned cycle)
N245	G77	(Activates canned cycle)
N250	X.5 Y-3.75 F10.	(Rapids to corner of pocket and sets feedrate to 10. IPM)
N255	G29 LV40=.1 V41=1.75 V42=1. V43=-.375 V44=.5 V45=.15 V46=.125 V47=.01 V48=15. V49=.25	(Set V registers for G78 canned cycle)
N260	G78	(Activates canned cycle)
N265	X3.5 Y-4.25	(Rapids to corner of triangle)
N270	G1 Z-.125 F10	(Feeds to -.125)
N275	G29 C3	(Calls Sub 3 which mills larger triangle)
N280	Z-.25	(Feeds to -.25)
N285	G29 LV11=3.5 V12=4.25 V13=0 V16=.5 V17=.5 V18=1.	(Sets V registers for scaling)
N290	G53	(Activate scaling)
N295	G29 C3	(Calls Subroutine 3 with scaling active)
N300	G54	(Deactivate scaling)
N305	G0 Z0 T0	(Retracts quill in rapid)
N310	X-.5 Y.5	(Rapids to tool change position)
N315	G29 E	(Ends program)
N320	G29 S1	(Starts definition of Subroutine 1)

N325 G0 G91 X.5	(Incremental moves to remaining holes in 5 hole pattern)
N330 Y-.5	
N335 X-.5	
N340 X.25 Y.25	
N345 G29 E	(End of Subroutine 1)
N350 G29 S2	(Starts definition of Subroutine 2)
N355 G90 X6. Y-.5	(Holes A-E locations)
N360 X6.5	
N365 X6.25 Y-.75	
N370 Y-1.25	
N375 Y-1.75	
N380 G29 E	(End of Subroutine 2 definition)
N385 G29 S3	(Start of Subroutine 3 definition)
N390 G1 G90 X6.25	(Dimensions of larger triangle)
N395 Y-3.25	
N400 X3.5 Y-4.25	
N405 G29 E	(End of Subroutine 3 definition)
*	(End of transmission character)



ISO code									
Character	8	7	6	5	4	3	2	1	
0			0	0		.			
1	0		0	0		.		0	
2	0		0	0		.	0		
3			0	0		.	0	0	
4	0		0	0		.	0		
5			0	0		.	0	0	
6			0	0		.	0	0	
7	0		0	0		.	0	0	0
8	0		0	0	0	.			
9			0	0	0	.		0	
A		0				.		0	
B		0				.	0		
C	0	0				.	0	0	
D		0				.	0		
E	0	0				.	0	0	
F	0	0				.	0	0	
G		0				.	0	0	0
H		0			0	.			
I	0	0			0	.		0	
J	0	0			0	.	0		
K		0			0	.	0	0	
L	0	0			0	.	0		
M		0			0	.	0	0	
N		0			0	.	0	0	.
O	0	0			0	.	0	0	0
P		0		0	.				
Q	0	0	-	0	.			0	
R	0	0		0	.		0		
S		0		0	.		0	0	
T	0	0		0	.	0			
U		0		0	.	0		0	
V		0		0	.	0	0		
W	0	0		0	.	0	0	0	
X	0	0		0	0	.			
Y		0		0	0	.		0	
Z		0		0	0	.	0		
DEL	0	0	0	0	0	.	0	0	0
NUL					.				
BS	0				0	.			
HT					0	.		0	
LF or NL					0	.	0		
CR	0				0	.	0	0	
SP	0		0		.				
%	0		0		.	0		0	
(0		0	.			
)	0		0		0	.		0	
♦			0		0	.		0	0
-			0		0	.	0		0
:			0	0	0	.		0	
/	0		0		0	.	0	0	0
.			0		0	.	0	0	
#	0		0		.		0	0	
\$			0		.	0			
&	0		0		.	0	0		
'			0		.	0	0	0	
•	0		0		0	.		0	
,	0		0		0	.	0		
:	0		0	0	0	.		0	0
<			0	0	0	.	0		
=	0		0	0	0	.	0		0
>	0		0	0	0	.	0	0	
?			0	0	0	.	0	0	
@	0	0			.				
~			0		.		0		
	0	0		0	0	.		0	0
	0	0		0	0	.	0		0

GENERAL NOTES

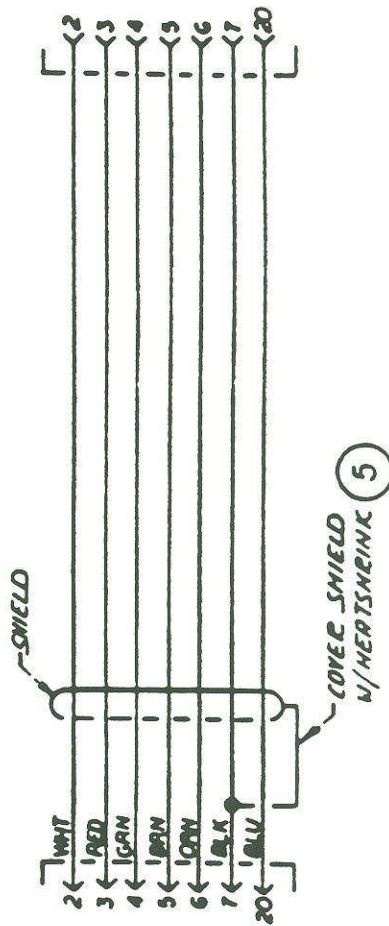
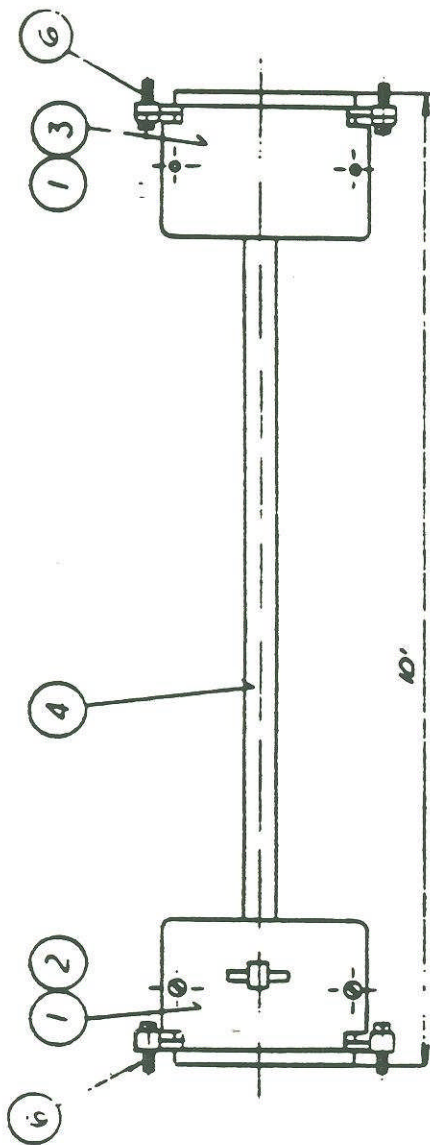


NOTES: PINS AT REAR PANEL OF CONSOLE MALE CONNECTOR

- PIN 2 = RECEIVE DATA
- PIN 3 = SEND DATA
- PIN 6 = DATA SET READY
- PIN 7 = COMMON
- PIN 20 = DATA TERMINAL READY

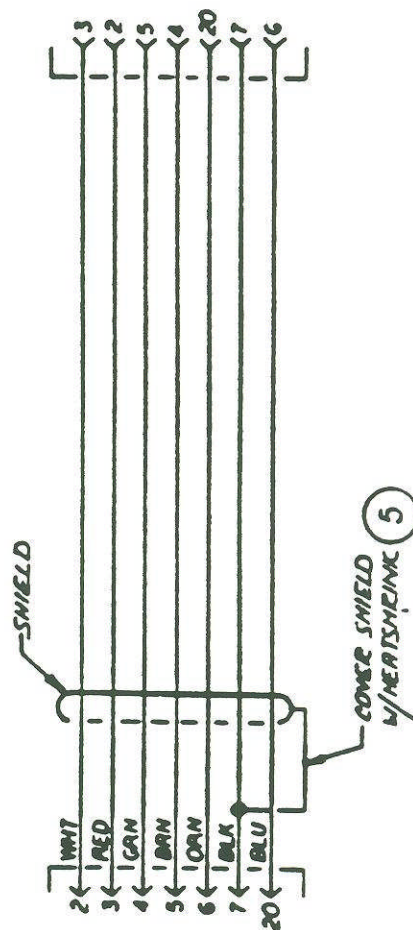
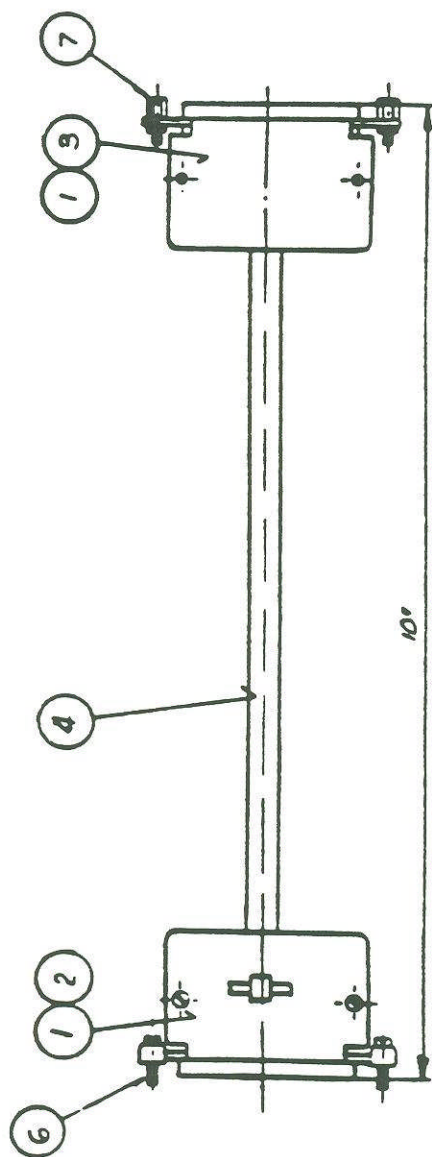
		ANNAM ELECTRONICS ANNAM, MADRAS U.S.A.
HARNESSES		
RS 232C CONN-PC 499 HARN		
DATE: 3/5-550	OF 1	1 OF 1

GENERAL NOTES



0	1/4	NPT:030 REDDUN	HK
ANILAM ELECTRONICS			
MIAMI, FLORIDA 33134			
U.S.A.			
CABLE			
AS 232 INTERFACE CABLE			
360-107			
1 OF 1			

GENERAL NOTES



AMMAN ELECTRONICS 1001 W. 100th St. Olathe, MO 64660		DATE: 10/1/81 DRAWN BY: J. J. J. CHECKED BY: J. J. J. 1 OF 1
CABLE RS 232 HOST PATCH CABLE		