



REFERENCE
DOCUMENT

AEROTECH
Instruction Manual
10KR High Speed Ramper With
Local Controls and Home
D-690-1089

Rev. 12/6/79

101 Zeta Drive, Pittsburgh, Pennsylvania 15238 • Telephone 412-963-7470

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1.0 GENERAL DESCRIPTION

The 10KR High Speed Ramper provides a frequency-ramped pulse train to smoothly accelerate and decelerate a stepping motor drive system. It can be commanded by a remotely generated pulse train or by an on-card command generator. The 10KR also incorporates circuitry that, when used with external position sensors will command the motor to return to a fixed reference position ("home"). Total CMOS logic provides excellent noise immunity, and is compatible with TTL logic levels.

In the remote mode the 10KR will accept an input constant frequency pulse train up to 10KC, and it will output a frequency-ramped pulse train that begins at an adjustable start/stop frequency. The frequency then increases, exponentially approaching the input frequency. When the input pulse train stops, the output pulse train frequency exponentially decays back to the start/stop frequency and stops. The number of pulses inputted will equal the number of pulses outputted. If another pulse train begins before the output pulse train ends, the output pulse train frequency will increase again without losing count of any pulses. Also in remote mode, a direction command (Hi = Motor CW rotation) is passed through from the remote input to the output. It is not recommended that direction be changed while the output frequency is above the start/stop frequency.

In Local mode the remote inputs are ignored, and an on-card

pulse generator commands the system. The pulse generator consists of two parts; a single-step debounce latch that uses an SPDT switch for advancing the motor one step at a time, and an externally gated slew oscillator. The slew oscillator frequency can be adjusted from approximately 600 steps/sec to over 10,000 steps/sec. In local mode the remote direction input is also ignored, while the local direction input is passed through to the output.

The home portion of the circuit takes control of the card when a home cycle is initiated. When "go home" is commanded, the home circuit commands the card to output a pulse train at the start/stop frequency. The direction output is commanded so that the motor drives its load toward a limit switch. When the limit switch closes, the home circuit commands a change of direction, and the motor backs the load away from the limit switch. When the limit switch opens, the home circuit begins looking for another signal, called "M" or "Marker". This signal should come from a once-per-revolution motor shaft position sensor. When the marker signal appears, the motor is in the home position. The pulse train stops, the home circuit gives up control of the system, and an "At Home" signal is generated. The card can be re-configured so that the home cycle terminates when the limit switch closes.

2.0 SPECIFICATIONS

2.1 Maximum Ratings

Power Supply (+40V)	25 to 45 V
Operating temperature	0° to 70°C ambient
Storage Temperature	-55°C to +125°C
+5V Supply current avail.	50 ma

2.2 Mechanical Characteristics

Dimensions	6" x 7 1/2" x 11/16"
Mounting	6 3/4" x 5", 5 5/16", or 5 5/8" (1/8" Req'd below bottom board surface)

2.3 Electrical Characteristics

Logic input impedance	100 K-ohm
M and \bar{M} input impedance	10 K-ohm (nominal)
Digital output current	- .12 ma (source) .36 ma (sink)
Clock out pulse width	5 u-sec to 10 u-sec
Local slew oscillator freq.	600 Hz to 10K Hz.
Start/Stop Frequency	15 Hz to 1000 Hz
Accel/Decel time Constant	25 m-sec to 225 m-sec
Max. Output frequency	10 KHz
CZ ' delay	8 m-sec to 27 m-sec

3.0 INSTALLATION

3.1 I/O Connections

3.1.1 J1 Remote Inputs/Outputs

J1-1 + 40V This line is connected to J3-1, and is for routing power to circuits attached to the remote input connector.

J1-2 COM This is signal and power ground for the card.

J1-3 CL This is the command pulse train input. The 10KR card recognizes the rising edges of command pulses. This input is only effective in remote mode.

J1-4 DIR This is the direction input that is effective in remote mode. A Hi is understood to mean CW motor rotation when looking toward the faceplate of the motor.

J1-5 Reset This input, when pulled Lo, terminates the home cycle, stops the output clock pulses, and causes J3-5 to go Lo.

J1-7 CZ' This signal, called count zero, delayed, goes high approx. 15 m sec after the 10 KR card outputs its last pulse. It signifies that the 10KR card has outputted the same number of pulses as it has been commanded. The delay is there to give time for the motor to settle in position. There is no delay, however, when this line goes lo. It will go lo within 5 u-sec of an input clock command. This signal, on J3-7, commands the Lo current/Hi current command input of Aerotech chopper translators so that standby motor current is reduced from the running current level.

J1-8 Limit This signal is not connected to the 10KR circuits. It comes in from the translator on J3-8 and goes out on J1-8. This signal goes low when a limit switch is activated. This signal line is also normally connected to J2-1.

J1-9 Go Home A falling edge on this input initiates a home cycle. This input is also connected to J2-3.

J1-10 At Home This output goes hi when the home cycle is completed and the motor is in the home position. It goes low again when the first output pulse is generated after reaching the home position. This output is also connected to J2-8.

3.1.2 J2 Front Panel Interface

J2-1 Limit This pin is normally connected to J1-8 and duplicates it. However, a trace can be cut and a jumper inserted that will connect this pin to J1-4, remote direction input instead.

J2-2 Reset This duplicates J1-5 and is tied to it.

J2-3 Go Home This is a duplication of the input at J1-9.

J2-4 Step NC This is one of the inputs to the single step debounce latch. It works in conjunction with J2-12, Step NO. If an SPDT switch (momentary) is connected to these inputs with the wiper to ground, a single pulse will be outputted each time the switch is depressed and then released. The step signals are only effective in local mode.

J2-5 Slew When this signal goes lo, an oscillator on the card is turned on. In local mode, the output of this oscillator becomes the input command pulse train.

J2-6 Spare Not Connected.

J2-7 Rem CL This is a duplication of the Remote Clock input J1-3.

J2-8 At Home This signal output goes hi at the end of the home cycle when the motor has reached the home position. It goes lo again when the first pulse is outputted after getting to the home position.

J2-9 CZ' This is a duplication of the output at J1-7.

J2-10 Spare Not connected.

J2-11 Direction This is the direction input that is effective in local mode. A Hi commands CW Rotation. This input is disabled in remote mode.

J2-12 Step NO This is meant to connect to the normally open terminal of an SPDT switch for single step commands. See J2-4, above.

J2-13 COM This is signal and power ground for the 10KR Card.

J2-14 +V This is the Logic operating voltage for the 10KR Card.

J2-15 Spare Not connected.

J2-16 LCL/REM This is the control input that determines whether the card is in remote or local mode. A high on J2-16 puts the card in local mode, the step and slew commands on J2 are effective, and J2-11 Direction is patched to the output. In local mode Remote CL, (J1-3; J2-7) and Remote Direction, (J1-4; J2-1) are ignored. When J2-16 is LO, the remote inputs are enabled while the local inputs are disabled.

3.1.3 J3 Drive Interface

J3-1 +40V This is the power input for the 10KR Card. The voltage at this point is reduced and regulated to develop the

+V operating voltage.

J3-2 COM This is signal and power ground for the 10KR Card.

J3-3 CL This is the output for the frequency ramped pulse train generated by the 10KR Card and the constant frequency pulse train generated during the home cycle.

J3-4 DIR This is the direction output from the 10KR Card. The selected direction goes out on this line.

J3-5 Reset This line goes low when the reset inputs J1-5 & J2-2 go lo. Also, this line goes lo for approx. 10 m-sec after power is applied, and for approx. .6 m-sec after completion of a home cycle, to reset optional readouts.

J3-7 CZ' This signal is the same signal that goes out on J2-9 and J1-7. See J1-6, above.

J3-8 Limit This pin is the input for the signal that goes out on J1-8.

J3-9 Spare Not connected.

J3-10 Spare Not connected.

3.1.4 J4 Home Interface

J4-1 CCW $\overline{\text{LMT}}$ The 10KR Card is normally set up so that, at the start of the home cycle, the direction output goes LO (CCW). Therefore, it is desired to change directions at the CCW limit of travel. This input will cause the home circuit to change directions when it goes lo. The Home circuit can be set up, however, to start the home cycle going CW (Dir HI). If that is the case, then the CW limit instead of the CCW Limit should be connected to this connector. Once direction is changed, further LO's have no effect. If limit switch home is used, the

motor changes directions when J4-1 goes lo, and the home cycle is complete.

J4-2 Spare Not connected.

J4-3 GO HOME This input is connected to J1-9, $\overline{go\ home}$. A falling edge on this input initiates the home cycle.

J4-4 At Home This is the same output as is found on J1-10. See J1-10 Above.

J4-5 and J4-6 are \overline{M} and M, respectively. These two signals constitute a differential pair that is fed to a comparator. When M is more positive than \overline{M} , a "Marker" is recognized. During the home cycle, after the motor changes directions, and the input at J4-1 goes Hi, the presence of the marker signal stops the output clock pulses, generates an "At Home" signal, and terminates the home cycle.

3.2 Jumper Options

Numbered pads on the PC Card are available for insertion of jumper wires and some traces between numbered pads are designed to be cut, if needed. These changeable connections are made available to allow for re-configuring the operation of the card.

3.2.1 Hardwired Remote Mode (Pads 1 & 2)

If use of local mode is not anticipated and connector J2 will not be used, a jumper can be wired in between pads 1 and 2. This puts gnd on the LCL/REM input and hardwires the card into remote mode.

3.2.2 Home Cycle Directions (Pads 3, 4, & 5)

When in the home cycle, the motor turns CCW until the limit switch closes, then CW. If it is desired to turn the motor

CW, and then CCW after limit switch closure, the run between pads 4 and 5 must be cut and a jumper inserted between pads 3 and 4.

3.2.3 Limit Switch Home/Marker Home (Pads 6 thru 9, 13)

Normally, the home cycle is terminated when a marker pulse is recognized, but a marker pulse need not be present to terminate the home cycle. If the trace between pads 7 and 8 is cut, a jumper inserted between pads 9 and 13, a home cycle will terminate when a LO appears at J4-1. The repeatability of the limit switch closure.

Be sure that R22 is not turned full CW.

3.2.4 M Loading (Pads 9 & 10)

Some shaft position sensors (encoders) have NPN open emitter outputs and are designed to operate into a resistance to ground. Other sensors can operate into the wiper of a balance pot between ground and +V. If an NPN open emitter type of sensor is used, the trace between Pads 9 and 10 should be cut.

3.2.5 +V Operating Voltage (Pads 11 & 12)

3.2.6 J2-1 Dedication (Pads 14, 15 and 16)

J2-1 is normally connected to J1-8 (Limit) To simplify wiring in some systems it can be patched to J1-4 (Remote Direction.) To do this, cut trace between pads 14 & 16.

4.0 ADJUSTMENTS

4.1 Variable Resistors (Pots)

4.1.1 Slew Speed (R8)

In local mode the frequency of the command pulse train is adjusted at R8. CW rotation increases the frequency.

4.1.2 Marker Balance (R22)

The difference between the M and \bar{M} signals determines whether a marker pulse is recognized. What that difference needs to be can be set by R22. CCW Rotation increases the level needed at the M input to recognize a marker.

Be sure that R22 is not turned full CW.

4.1.3 Accel/Decel (R29)

The exponential rise and exponential fall of frequency have the same time constant. This time constant is set at R29.

CW Rotation shortens the time constant.

4.1.4 Start/Stop (R34)

The frequency at the start of the ramp up and at the end of the ramp down is the Start/Stop frequency. It is also the frequency during a home cycle. This frequency can be adjusted at R34. CW Rotation increases frequency.

4.2 Changeable Component (R7)

R7 has been mounted on standoffs. This resistor sets the Maximum frequency the local slew oscillator can reach. Doubling it will approximately halve the maximum slew frequency. It is not recommended that this value be reduced

since this allows the slew oscillator to run faster than the maximum output frequency and erratic operation will occur.



WARRANTY

ALL SYSTEMS ARE WARRANTED FOR 12 CONSECUTIVE MONTHS FROM THE ORIGINAL SHIPMENT DATE. THIS WARRANTY COVERS DEFECTS IN WORKMANSHIP AND MATERIALS. A VOIDED WARRANTY IS DEFINED BY PHYSICAL ABUSE, REMOVAL OF FACTORY APPLIED SERIAL NUMBERS, IMPROPER APPLICATION, OVER-STRESSING EQUIPMENT BEYOND ITS PUBLISHED SPECIFICATIONS, FAILURE TO COMPLY WITH RETURN PROCEDURES DESCRIBED IN THE WARRANTY, ANY CHANGE OF OWNERSHIP FROM ORIGINAL PURCHASER.

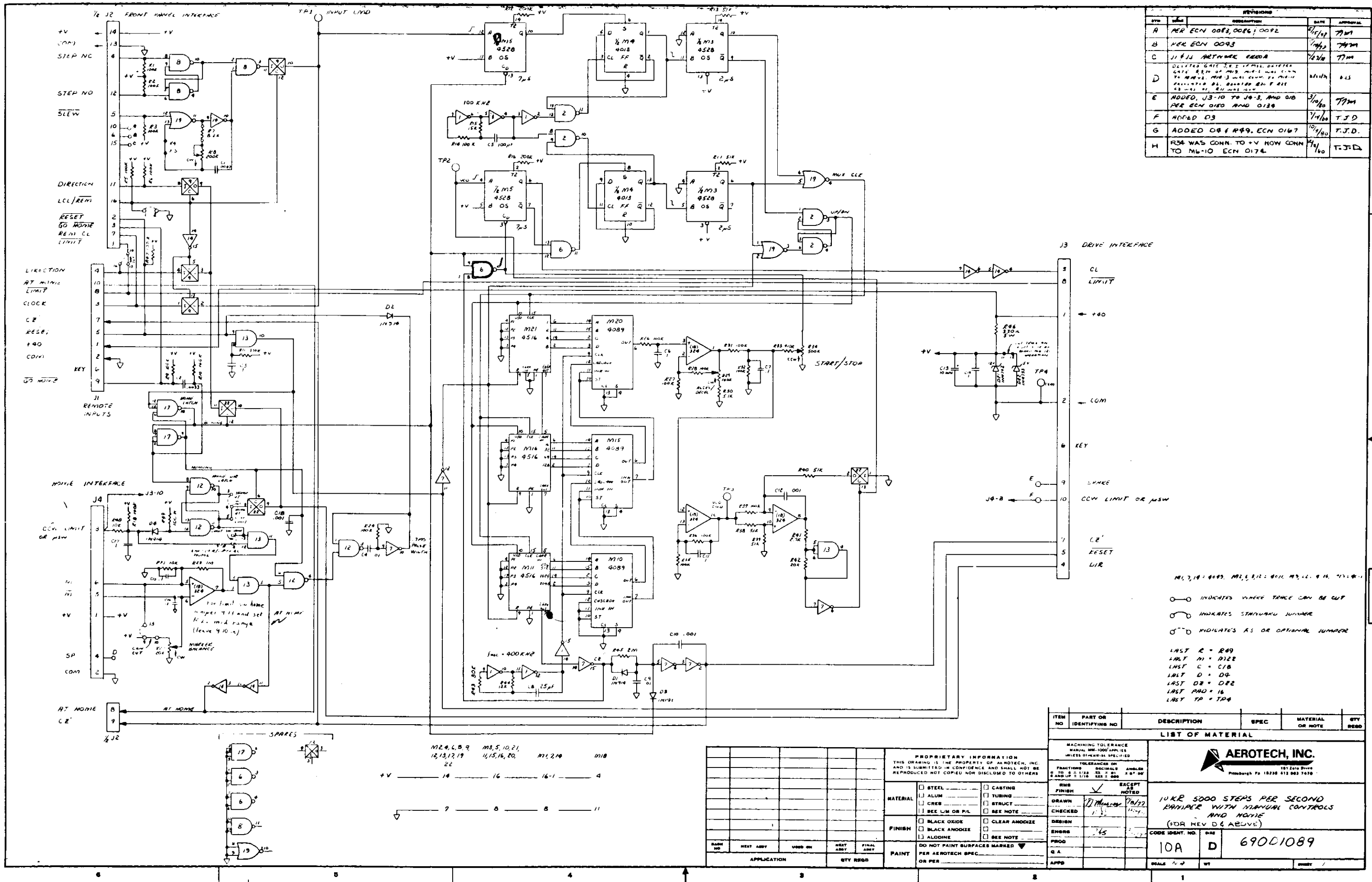
IN THE EVENT A DEFECT OR A MALFUNCTION OCCURS IN YOUR EQUIPMENT, TWO CHOICES ARE AVAILABLE TO THE CUSTOMER. THESE TWO CHOICES ARE:

- A) NOTIFY FACTORY PRIOR TO YOUR PREPAID SHIPMENT TO AEROTECH. ALSO, ENCLOSE A FULLY-DETAILED WRITTEN EXPLANATION OF YOUR DISCREPANCY. THE CUSTOMER WILL BE NOTIFIED UPON RECEIPT OF SHIPMENT IF THE UNIT IS NOT COVERED BY OUR WARRANTY. AT THIS POINT, IF UNIT IS DETERMINED OUT OF WARRANTY, A PURCHASE ORDER MUST BE RECEIVED BEFORE AEROTECH WILL PROCEED WITH THE REPAIR.
- B) IF SENDING THE SYSTEM BACK TO THE FACTORY FOR REPAIR IS IMPOSSIBLE, NOTIFY THE FACOTRY, WITH A PURCHASE ORDER, THAT YOU DESIRE ON-CALL MAINTENANCE. AT THIS TIME THE PREVAILING TRAVEL RATES WILL BE EXPLAINED ALONG WITH A TIME AND PLACE. IN THE EVENT THE SYSTEM HAD A WARRANTY PROBLEM, PARTS WILL BE FREE OF CHARGE.

THIS IS THE FULL EXTENT OF AEROTECH, INC., LIABILITY. AEROTECH IS NOT RESPONSIBLE FOR ANY PHYSICAL OR PROPERTY DAMAGE DUE TO PRODUCT USE OR FAILURE.

7/21/78

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REV	DATE	DESCRIPTION	DATE	APPROVAL
A	11/1/67	PER ECN 0083, 0086, 0092	7/1/68	TJM
B	1/1/68	PER ECN 0093	7/1/68	TJM
C	7/2/68	J1 & J2 NETWORK REWORK	7/1/68	TJM
D	8/1/68	DELETED GATE 301 & 302. GATE 301 & 302 WAS CHANGED TO 74101. GATE 303 WAS CHANGED TO 74101. GATE 304 WAS CHANGED TO 74101. GATE 305 WAS CHANGED TO 74101.	8/1/68	TJM
E	3/1/69	ADDED J3-10 TO J3-3, AND G10 PER ECN 0180 AND 0189	7/1/69	TJM
F	7/1/69	ADDED D3	7/1/69	T.J.D.
G	10/1/69	ADDED D8 & R99. ECN 0167	7/1/69	T.J.D.
H	7/1/69	R34 WAS CONN. TO +V NOW CONN. TO ML-10 ECN 0174	7/1/69	T.J.D.

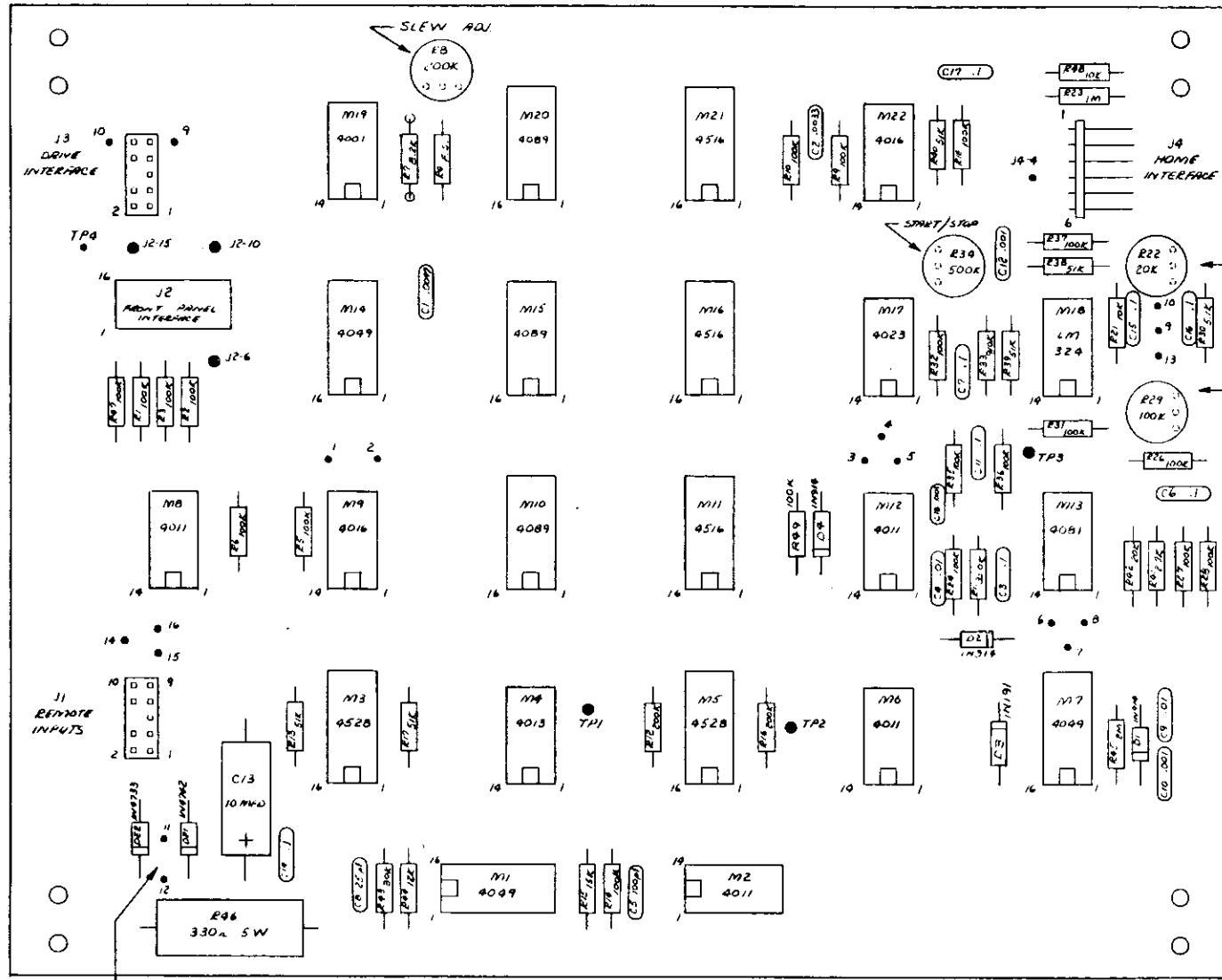
M1, 18 = 9089, M12, 12 = 9011, M13, 12 = 911, M14 = 911
 ○ INDICATES WHERE TRACE CAN BE CUT
 ○ INDICATES STANDARD JUMPER
 ○ INDICATES AS OR OPTIONAL JUMPER
 LAST R = R99
 LAST M = M12
 LAST C = C18
 LAST D = D4
 LAST DR = DR2
 LAST PRO = 16
 LAST TP = TP4

ITEM NO	PART OR IDENTIFYING NO	DESCRIPTION	SPEC	MATERIAL OR NOTE	QTY REQD																		
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SCALE	WT	SHEET																					
1/16"		1																					



10 KR 5000 STEPS PER SECOND
 DRIVER WITH MANUAL CONTROLS
 AND HOME
 (FOR REV D & ABOVE)

CODE IDENT. NO. 10A D
 SIZE D
 PART NO. 69001089



11 REMOTE INPUTS

- 1 +40
- 2 COM
- 3 CLOCK
- 4 DIRECTION
- 5 RESET
- 6 KEY
- 7 CE
- 8 LIMIT
- 9 GO HOME
- 10 AT HOME

12 FRONT PANEL INTERFACE

- 1 REM DIRECTION
- 2 RESET
- 3 GO HOME
- 4 STEP INC
- 5 SLEW
- 6 SPACE
- 7 REM CLOCK
- 8 AT HOME
- 9 CE
- 10 SPACE
- 11 DIRECTION
- 12 STEP INC
- 13 GND
- 14 +V
- 15 SPACE
- 16 LCL/RETN

13 DRIVE INTERFACE

- 1 +40 (INPUT)
- 2 COM
- 3 CLOCK
- 4 DIRECTION
- 5 RESET
- 6 KEY
- 7 CE
- 8 LIMIT
- 9 SPACE
- 10 SPACE

14 HOME INTERFACE

- 1 +V
- 2 COM
- 3 CCW LIMIT OR P.W
- 4 SPACE
- 5 M
- 6 M

REVISIONS				
REV	DATE	DESCRIPTION	DATE	APPROVAL
A	1/19/77	PER ECN 0082, 0084, 0092L	1/19/77	T.J.D.
B	1/19/77	PER ECN 0093	1/19/77	T.J.D.
C	1/19/77	11/12 RETURN NUMBER ERROR	1/19/77	T.J.D.
D	1/19/77	REVISED R13, R15, R16 TO 100K	1/19/77	T.J.D.
E	1/19/77	ADDED R13-10 TO R13, AND C13 PER ECN 0150 AND 0158	1/19/77	T.J.D.
F	1/19/77	ADDED D3	1/19/77	T.J.D.
G	1/19/77	ADDED D4 & R49 ECN 0167	1/19/77	T.J.D.
H	1/19/77	NO CHANGE THIS SHEET	1/19/77	T.J.D.

CUT TRANCE ON CIRCUIT SIDE FOR 12V OPERATION

ITEM NO	PART OR IDENTIFYING NO	DESCRIPTION	SPEC	MATERIAL OR NOTE	QTY	REGR
LIST OF MATERIAL						
<p>MACHINING TOLERANCE DECIMAL: .0001-.001: .0015 UNLESS OTHERWISE SPECIFIED</p> <p>TOLERANCES ON FRACTIONS: 1/16: .0015, 1/8: .0025, 1/4: .0050, 3/8: .0075, 1/2: .0100, 3/4: .0150, 1: .0200</p>						
AEROTECH, INC. 181 Zola Drive, Pittsburgh, Pa. 15228-413 983 7476						
<p>10KR 5000 STEPS PER SECOND RANGE WITH MANUAL CONTROLS AND HOME (ASSEMBLY)</p>						
<p>PROPRIETARY INFORMATION THIS DRAWING IS THE PROPERTY OF AEROTECH, INC. AND IS SUBMITTED IN CONFIDENCE AND SHALL NOT BE REPRODUCED NOR COPIED NOR DISCLOSED TO OTHERS.</p>		<p>FINISH: <input checked="" type="checkbox"/> STEEL, <input type="checkbox"/> ALUM, <input type="checkbox"/> CRP, <input type="checkbox"/> SEE LHM OR P.L.</p> <p>FINISH: <input type="checkbox"/> BLACK OXIDE, <input type="checkbox"/> BLACK ANODIZE, <input type="checkbox"/> ALODINE, <input type="checkbox"/> SEE NOTE</p> <p>PAINT: <input type="checkbox"/> DO NOT PAINT SURFACES MARKED PER AEROTECH SPEC</p>				
<p>DESIGN: [Signature] 1/19/77 CHECKED: [Signature] 1/19/77 ENGR: [Signature] 1/19/77 PROD: [Signature] 1/19/77 G.A. APPD:</p>						
<p>SCALE: 1:1</p>		<p>CODE IDENT. NO. 10A</p>		<p>SIZE: D</p>		<p>690D1089</p>

690/1089