SERVOS						
	SCHEMATICS		PARTS LOCATION			
	MM	SM	MM	SM	PARTS LIST	WAVE FORMS
LOG I (64 - 65)						
LOG II (65-67)						
LOG III (68 - 70)						
DIGI - GHOST (68)	A-017					
XL III (68)	A-021					
PRO SERIES (69)	A-021					
PRO SERIES (70 - 71)	A-066		B-625		PL-B-625	W-A-066
LOGICTROL (70)	A-062		B-626		PL-B-626	
CHAMPION (70)	A-062		B-626		PL-B-626	
LOGICTROL (71)	A-090 A-092	A-091	B-621	B-620	PL-B-621 PL-B-620	
CHAMPION (71)	A-090	A-093	B-617	B-617	PL-B-617	
LRB 2 - 3 (71 - 73)	A-090	A-090 A-093 A-126	B-621	B-620	PL-B-621 PL-B-620	
Hobby Lobby	A-090	A-090	B-631	B-619		
CHAMPION (72)	A-126	A-126	B-631	B-619	PL-B-631 PL-B-619	W-A-126
SUPER PRO (72)	A-126	A-126	B-631	B-619	PL-B-631 PL-B-619	W-A-126
CHAMPION (73)	A-126	A-126	B-631	B-619	PL-B-631 PL-B-619	W-A-126
SUPER PRO (73)	A-126	A-126	B-631	B-619	PL-B-631 PL-B-619	W-A-126
LRB 3 - 4 (74 - 75)	A-126	A-126	B-631	B-619	PL-B-631 PL-B-619	W-A-126
CHAMPION (74 - 75)	A-126	A-126	B-631	B-619	PL-B-631 PL-B-619	W-A-126
SUPER PRO (74 - 75)	A-126	A-126	B-631	B-619	PL-B-619 PL-B-619	W-A-126
LRB 3 - 5 (75)	A-126	A-126	B-631	B-619 B-670	PL-B-631 PL-B-619 PL-B-670	W-A-126
RANGER (75)	A-126	A-126	B-631	B-619	PL-B-631 PL-B-619	W-A-126
LRB 3 - 5 (76 - 77)	A-126	A-126	B-631	B-619 B-686	PL-B-631 PL-B-619 PL-B-686	W-A-126
RANGER (76 - 77)	A-126	A-126	B-631	B-619	PL-B-619	W-A-126
CHAMPION (76 - 77)	A-126	A-126	B-631	B-619	PL-B-619	W-A-126
SUPER PRO (76 - 77)	A-126	A-126	B-631	B-619	PL-B-619	W-A-126
NIMBUS 4 (77)	A-126	A-126	B-631	B-619	PL-B-619	W-A-126

Red = Do not have

Orange = Poor copy

Green = Good copy

EK-logictrol

Reliable radio control systems

EK CUSTOMER SERVICE BULLETIN

DATE: October 17, 1977
SUBJECT: Servo Motor Failures
TO: All EK Service Centers

Recently Chamberlin Electronics, Whiting, N.J., and Deville Hobby Mart, Bethany, Ok., have reported cases of motor failures. Apparently, though not totally confirmed by this Service Center, the problem is found only in more recently purchased Mitsumi motors which have the brush end cap crimped rather than with screws as in the past. The crimped cap apparently becomes loose in the motors main case allowing rotation between them resulting in a change in motor timing and resulting power loss to a complete reversal or short of the motor. The results are disastrous. We suspect that heavy vibration contributes to this type of failure.

To correct this problem our production staff are currently gluing (contact type) the motor main case to the mid section of the servo case and checking to make sure that the strain-vibration relief glue is on the motor cap leads and capacitors. This prevents both the brush cap and main case from rotating. This type of failure does not show up in normal production checkout to any degree; the problem does not show up until the servo has been in use for awhile. Please let us know of any other repeating problems you encounter.

Thank you,

Don Downing

Don Downing
Service Manager

Steve Grogg

Steve Grogg
Asst. Service Manager

3322 Stovall St. / Irving, Texas 75061 / (214) 252-8680

CUSTOMER SERVICE BULLETIN

DATE: June 1, 1975
SUBJECT: Servos
- A. Changes
  - 1. Feedback potentiometer and wiper
  - 2. Case and gear
    - a. MM
    - b. SM
- B. Standards
  - 1. Centering
  - 2. Travel and linearity
  - 3. Dead zone

TO: ALL EK CUSTOMER SERVICE CENTERS

Effective February, 1975, EK Products, Inc. changed to the clarostat pots and wipers on new production servos. These offer a greater reliability in multiple contact wipers, a much harder resistance element surface with up to three times the life expectancy and much less pot. maintenance (cleaning). The clarostat pots. are to be available only in the 4K value, therefore many older (prior to 1972) discrete servo amplifiers using 1.5K feedback (1.0 and 1.5K pots) can not be converted to the clarostat pots. without changes in the throw adjustment resistor and other possible circuit changes. The pots. may be used with all EK I/C servo amplifiers. If the I/C servo amplifier previously used a 1.5K feedback pot., the 270ohm series resistor with the feedback pot should be changed to 470ohm so that the voltage rating of the filter capacitor (47ufd, 33ufd, and 22ufd) is not exceeded. Also the throw resistor may require adjustment for proper travel. The clarostat pots. do not use any lubrication film on the element surface or wiper, first shipments of servos with these pots. did have a heavy layer of silicone grease which should be wiped clean.

The change to the clarostat pot. necessitated a change in the Mini-Mite(mm) servo pot, wiper axle, this coincided with changing the case material to nylon rather then polycarbonate. The new case material should nearly eliminate stress cracking of the mid-section screw bosses and bottom section mounting lugs. See the accompanying drawing for new parts numbers and the chart for parts, prices and suggested conversion cost.

The new mid-section can be obtained with the old style pot axle and wiper preassembled as part number S-082 as in the past. On parts orders be sure to specify the correct part number and description, if inadequate information is supplied, our stockroom personnel are instructed to ship the assembled mid-section set up for use with the clarostat pot. and wipers, part number S-082B. The mid-section is designed for the clarostat pot., when using the CTS pots., care must be exercised in positioning the pot. properly due to a slightly looser fit than the older mid-section.

The Super Mini (sm) servos required a new and now additionally strengthened mid-section, pot. axle, and output gear for use with the clarostat pots. and wipers.

The change now allows external centering of the servo through the screwhole in the output shaft. The centering tool is easily made from 1/16 inch piano wire, the tool needs to be ground or filed to .045 inch square and the section that engages the pot. shaft needs to be at least .2 inches long. See the accompanying drawing for new part numbers and the chart for part prices and suggested conversion cost.

The new mid-section for the SM servo can also be used with the original pot. axle and wiper assembly, S-009A for use with CTS pots. and output gear, S-008.

Both the Mini Mite and Super Mini servos should be mechanically centered with an input pulse of 1.38 ms. The MM servo is centered through the pot axle hole with a .058" square tool until the output rack gears (S-043) are centered in the top case slots to allow equal movement of the racks. The RMM servo should also be centered through the pot. axle until the output arm is parallel to the case sides. SM servos using the pot. axle assembly (S-009A) for CTS pots must be centered by loosening the pot retainer screws (S-003) and rotating the pot. element (S-131/S-149/CS-023) until the output arm is parallel to the case sides. SM servos using the pot. axle (S-267) for the Clarostat pots may be centered externally as previously described until the output arm is parallel to the case sides. The correct pulse width for centering may be provided by either a suitable servo tester, a transmitter, or another form of pulse generator. The servo tester should be calibrated to 1.38 ms center position. A transmitter can also be used as a pulse source if it has been calibrated using either an oscilloscope or a frequency counter which has the capability to measure time interval or a calibrated test servo. The present acceptance for servos is to center within one quarter of the transmitter trim lever travel which with twenty per cent (20%) trim represents five percent (5%) of the total servo travel.

The total travel of the linear MM servos should be 7/16 inch with an input pulse of 0.90 ms to 1.86 ms. Standard travel RMM and SM servos should be 90° and flap-retract versions should travel 180° with the additional $\pm$ 0.1 ms trim for a total pulse width change of 0.8 ms to 1.96 ms.

Due to servo pot. non-linearity, tolerance variation and improper throw resistor value may result in non-linear travel. You should check to see if your pulse generator (transmitter or servo tester) is linear. The pulse generator should be set to 1.38 ms center with normal travel $\pm$ 0.48 ms and trim is an additional $\pm$ 0.1 ms (20%). Next, the pot. resistance value should be checked to see if it is within tolerance, if so, then check the total travel. If the total travel is excessive, adjusting the throw resistor value for slightly lesser travel may result in improved linearity. The pot. resistance value being out of tolerance or non-linear can be corrected by replacing the pot. with a good one or low value end resistors may be added to either end of the pot element so that the unbalanced travel may be offset. The throw resistor may then need adjusting for proper total travel.

The servo response in determining the dead zone may be checked by two means, first is to connect an oscilloscope across the positive and negative power supply of the servo amplifier, set input to AC, set the vertical gain to approximately 50 mv/div. and the horizontal sweep to 2 ms/div. When one side or the other of the amplifier is turned on to drive the motor, the voltage level change can be observed as well as the motor noise spikes. The alternate means is by grasping the servo under test near the motor, the slightest of motor movement may be detected as vibrations.

The static dead zone is termed as the minimum change in the signal pulse width necessary to produce a detectable output to the motor. This may be checked

with either a servo tester or a transmitter trim lever. Our servo test stand has a 100 ohm, 270° rotation pot. with a 360° Dial Scale in series with the main control pot. (5K). The dial, available from Radio Shack/Allied No. PKS-1105B-10, has ten large increments of 36° each which are divided into five subdivisions, each major division represents 1.33% of the total pulse width change (0.9 ms - 1.86 ms). The standards when using a servo tester as established in our production department are:

MODEL OF SERVO	DIAL READING	PERCENT OF TRAVEL
SUPER PRO	0.6 - 1.0	0.8 - 1.33%
CHAMPION and all past three wire systems	1.0 - 1.4	1.33 - 1.86%
LRB & RANGER and all past four and five wire systems	1.4 - 2.0	1.86 - 2.66%

Since 1973, the transmitter trim lever movement on EK radios are 20% of the total travel. Therefore one percent of the total pulse width change is equivalent to a movement of 0.050 inches of the trim lever movement. When using a transmitter for checking servo dead zone, the standards are:

MODEL OF SERVO	TRIM LEVER MOVEMENT IN INCHES
SUPER PRO	0.040 - 0.067
CHAMPION	0.067 - 0.093
LRB & RANGER	0.093 - 0.133

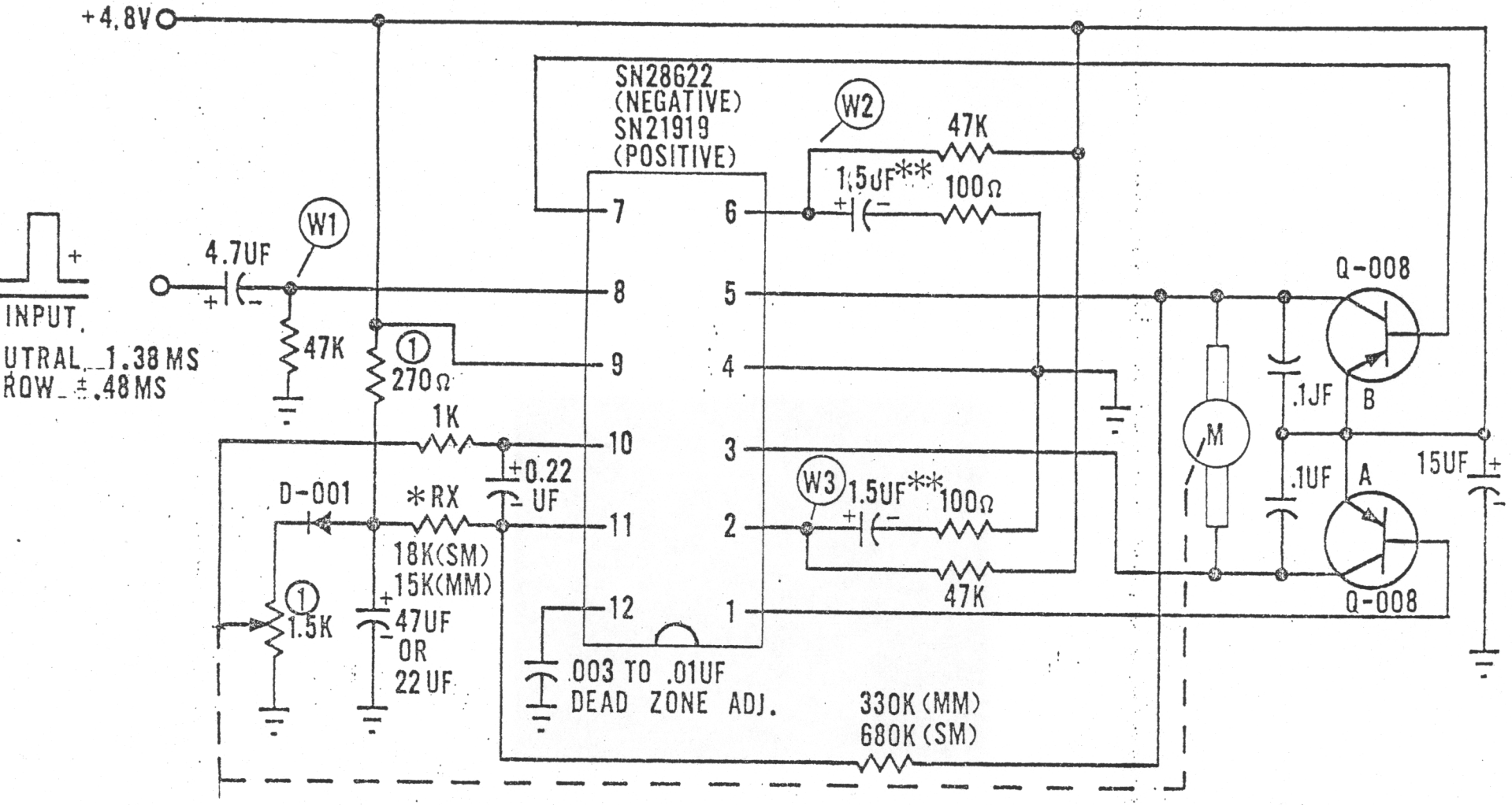
On pre 1973 systems which have 10% trims, double the trim lever movement distance for the same percentage change.

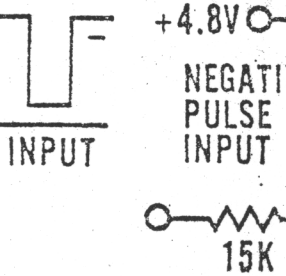
Dynamic dead zone is termed as the ability of the servo to stop at a new position. This is determined by several factors, first are the dynamic characteristics of the servo motor and gear train; their inertia and momentum vary for each combination due to tolerance build up. The amplifier can be adjusted to some extent to prevent either an under or an over dampened condition.

The under dampened servo is characterized by tending to overshoot the new position and to oscillate either continuously or momentarily. It may be corrected by lessening the amount of positive feedback. On both descrete servo amplifiers of the three wire and four wire variety and the I/C amplifiers, this may be accomplished by decreasing the value of the feed back resistor which decreases the amount of positive feedback. This resistor is generally located from one of the outputs of the motor to the reference pulse generator. In extreme cases, one or both of the pulse stretcher capacitors may require replacement because of capacity loss due to aging or a change to a larger value may be necessary on one or both capacitors to insure proper turn-on of the output stages (time constant adjustment).

An over dampened servo is characterized by tending to lag behind a change to a new position such that it creeps to the final stopping point. This may be corrected by increasing the amount of positive feedback from the motor output to the reference pulse generator by increasing the value of the feedback resistor.

Mini-Mite linear (MM) Case: (nylon material of 2-15-75)	Part.No.	Price
Top	S-048	1.00
Mid-section	S-049	1.20
Bottom	S-050	1.50
Deck	S-051	.50
Gears and Axles:		
pinion gear - motor	S-058	.50
#1 and #2 gear	S-060	.50
#3 gear	S-041	.50
*#4 gear	S-042	.50
rack (output) gear	S-043	.50
gear axle - long	S-046	.20
gear axle - short	S-047	.20
*Pot. axle with CTS wiper installed	S-045	.75
*Pot. axle for CLR wiper	CS-062	.50
Rotary Mini-Mite (RMM) Case:		
Top	S-122	1.00
*Mid-section	S-049	1.20
Bottom	S-050	1.50
Gears and Axles:		
pinion gear - motor	S-058	.50
#1 gear	S-060	.50
#2 gear	S-098	.50
#3 gear	S-097	.50
*#4 gear	S-042	.50
gear axle - long	S-046	.20
gear axle - short	S-062	.20
*Pot. axle with CTS wipers installed	S-045	.50
*Pot. axle for CLR wiper	CS-062	.50
Pots. and Wipers for MM and RMM)		
1.5K - CTS brown	S-131	2.00
4.0K - CTS brown	CS-023	2.00
1.5K - CTS white	S-149	2.50
4.0K - CTS white	CS-059	2.50
4.0K - CLR black	S-264	3.00
*Wiper - CTS (comes assembled as S-045)	S-052	1.00
Wiper - CLR	S-265	1.00
Screws: (For MM and RMM)		
#2 x 3/16 - retain pot.	P-009	.05
#2-56 x 1/4 flat - retain bottom	P-020	.05





*RX ADJUST FOR PROPER THROW. ALL RESISTORS ON SM SERVO ARE R10-____
NOMINAL: 18K-SM
15K-MM

**ADJUST FOR RESOLUTION
(1.2UF TO 1.5UF)

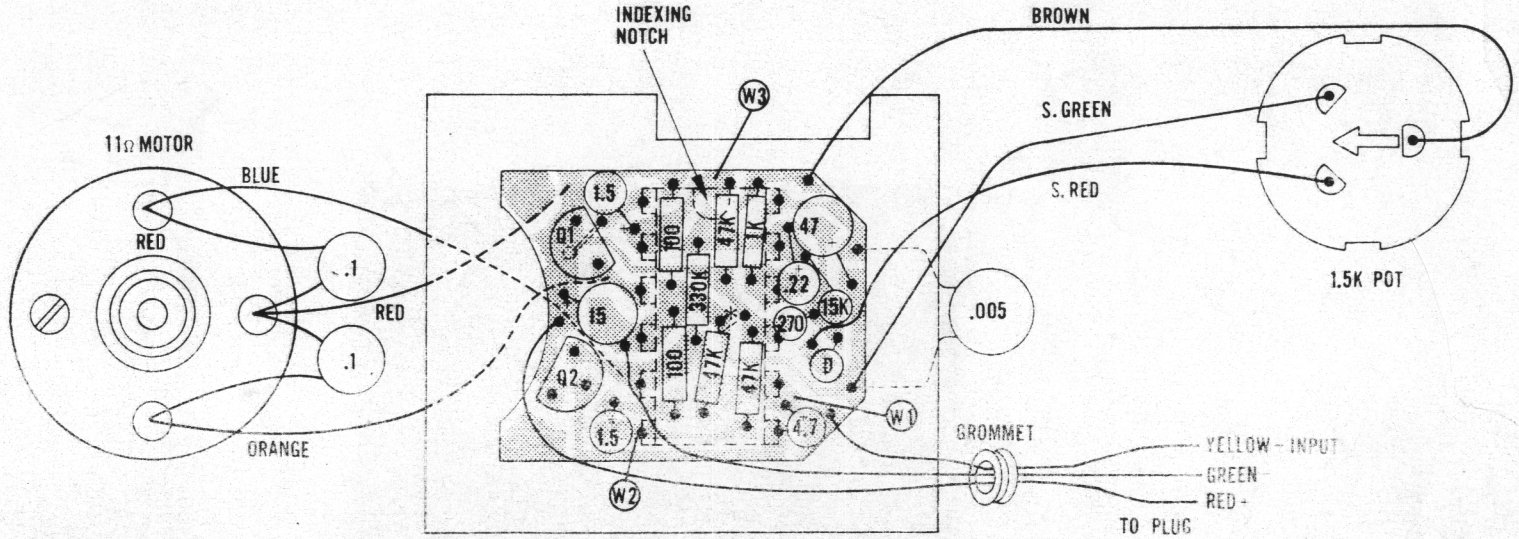
① LATER VERSION: 1.5K FEED BACK POT CHANGED TO 4K
AND 270Ω TO 470Ω

E K PRODUCTS, INC.
3233 W. EULESS BLVD., HURST, TEXAS 76053

	REVISIONS	BY	DATE
SCALE NONE	Neutral Throw 1.38MS ±.48MS	LD	11-10-73
DATE 8-14-73	Rx-Adjust for Proper Throw Nom.	LD	11-10-73
DR'N MWP CKD	Dead zone adjustment	LD	11-10-73
AP'VD	Adjust for resolution & Tube Version	LD	11-13-73

TITLE
CIRCUIT DIAGRAM — I.C. SERVO
AMP. CONNECTIONS

NO.
A — 126



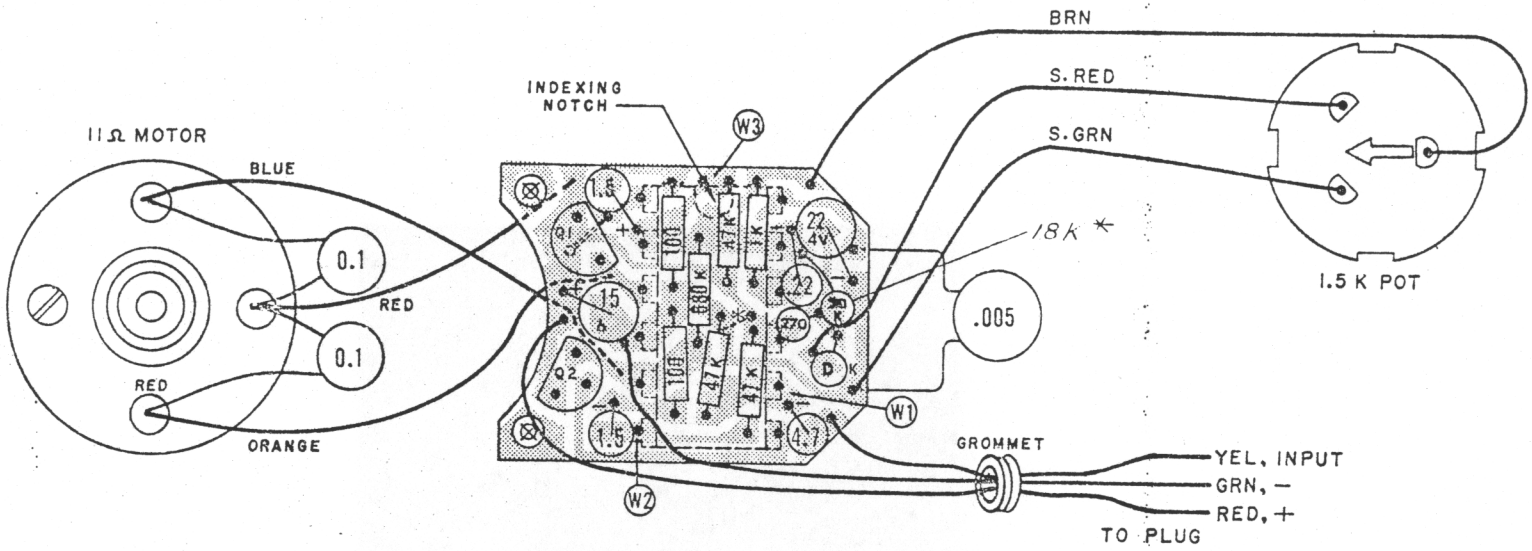
*DOTTED LINE REPRESENTS RESISTOR LEAD CHANGE ON THE NEGATIVE PULSE VERSION

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   ALL CAPACITANCE VALUES ARE IN MICROFARADS.
   ALL RESISTANCE VALUES ARE IN OHMS.
2. TRANSISTORS: Q1 AND Q2 ARE X34E1448 (Q-008).
3. D=DIODE DA2208 (D-001).

HOBBY LOBBY

AMPLIFIED SERVO TOP OVERLAY



NOTES —

1. UNLESS OTHERWISE SPECIFIED:
   ALL CAPACITANCE VALUES ARE IN MICROFARADS.
   ALL RESISTANCE VALUES ARE IN OHMS.
2. TRANSISTORS: Q1 & Q2 ARE X34E1448 (Q-006).
3. D = DIODE IN4154 (D-001).

*DOTTED LINE REPRESENTS RESISTOR LEAD CHANGE ON THE NEGATIVE PULSE VERSION.

* VARIABLE 18K TO 20K

E. K PRODUCTS, INC. 3233 W. EULESS BLVD., HURST, TEXAS 76053			
SCALE	REVISIONS	BY	DATE
DATE 11/8/71	ADDED CHECK POINTS	LD	11/25/71
DR'N TAL / CK'D			
AP'VD			
TITLE PARTS SM-3P & SM-3N LOCATION SERVO AMP.		NO B-619.	

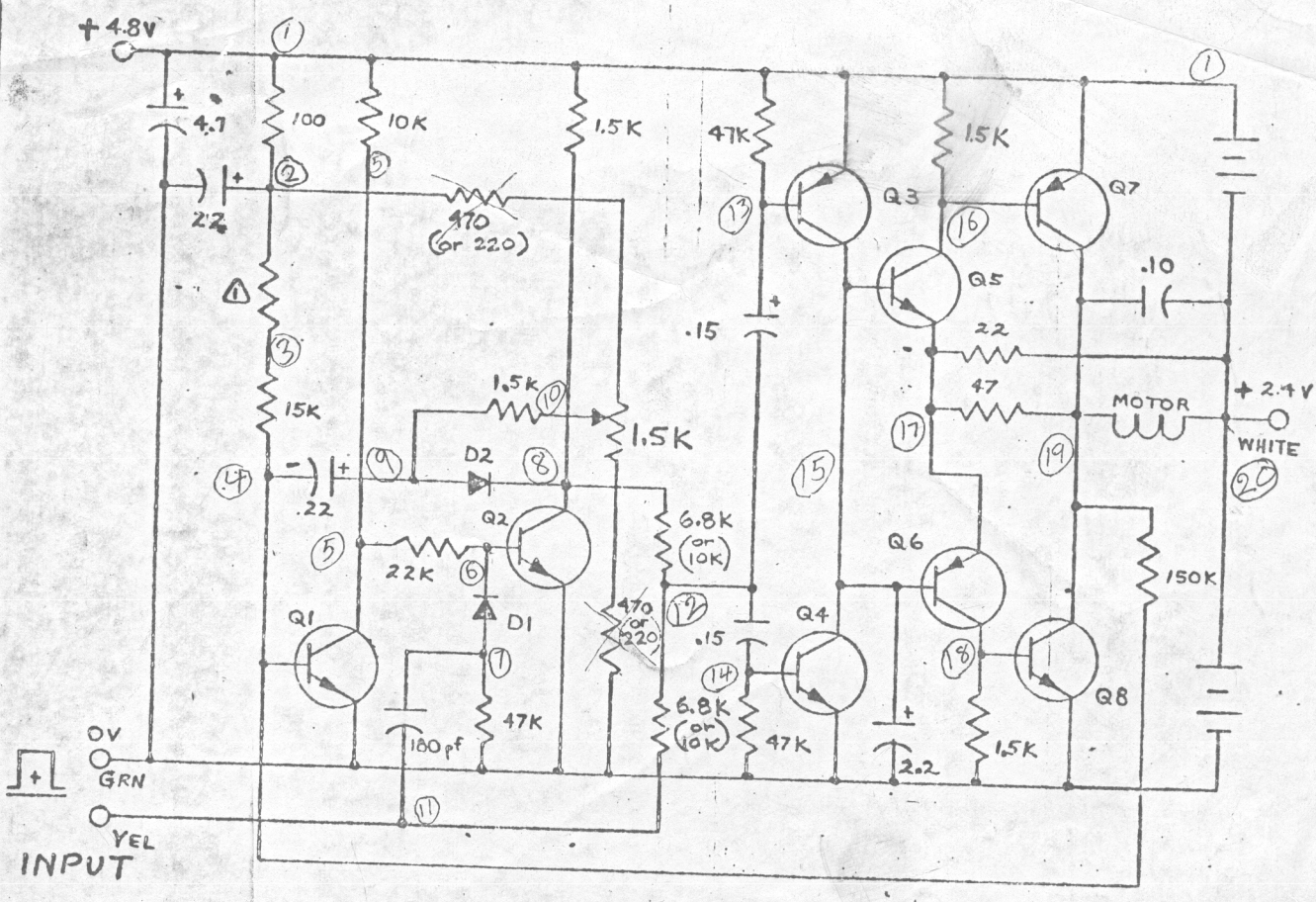
BRUNING 40-105

PARTS LIST FOR SM-3P I/C and SM-3N I/C Servo Amp. | PL- B-619

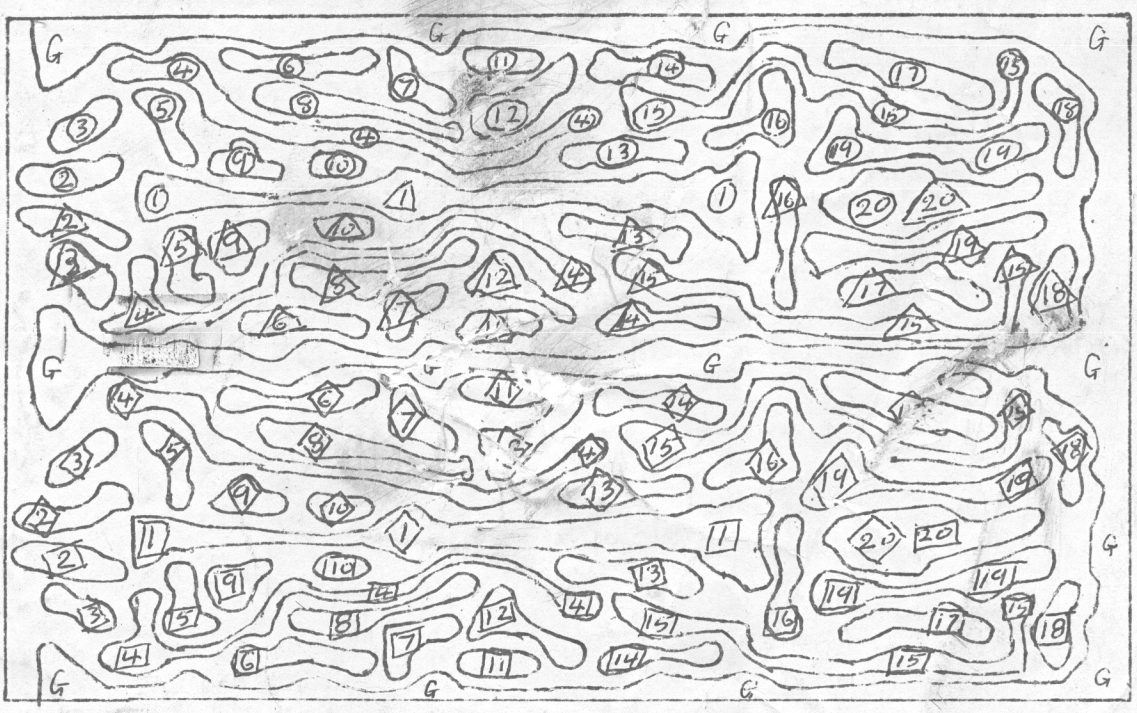
NEXT ASSEMBLY Servo 1972----------

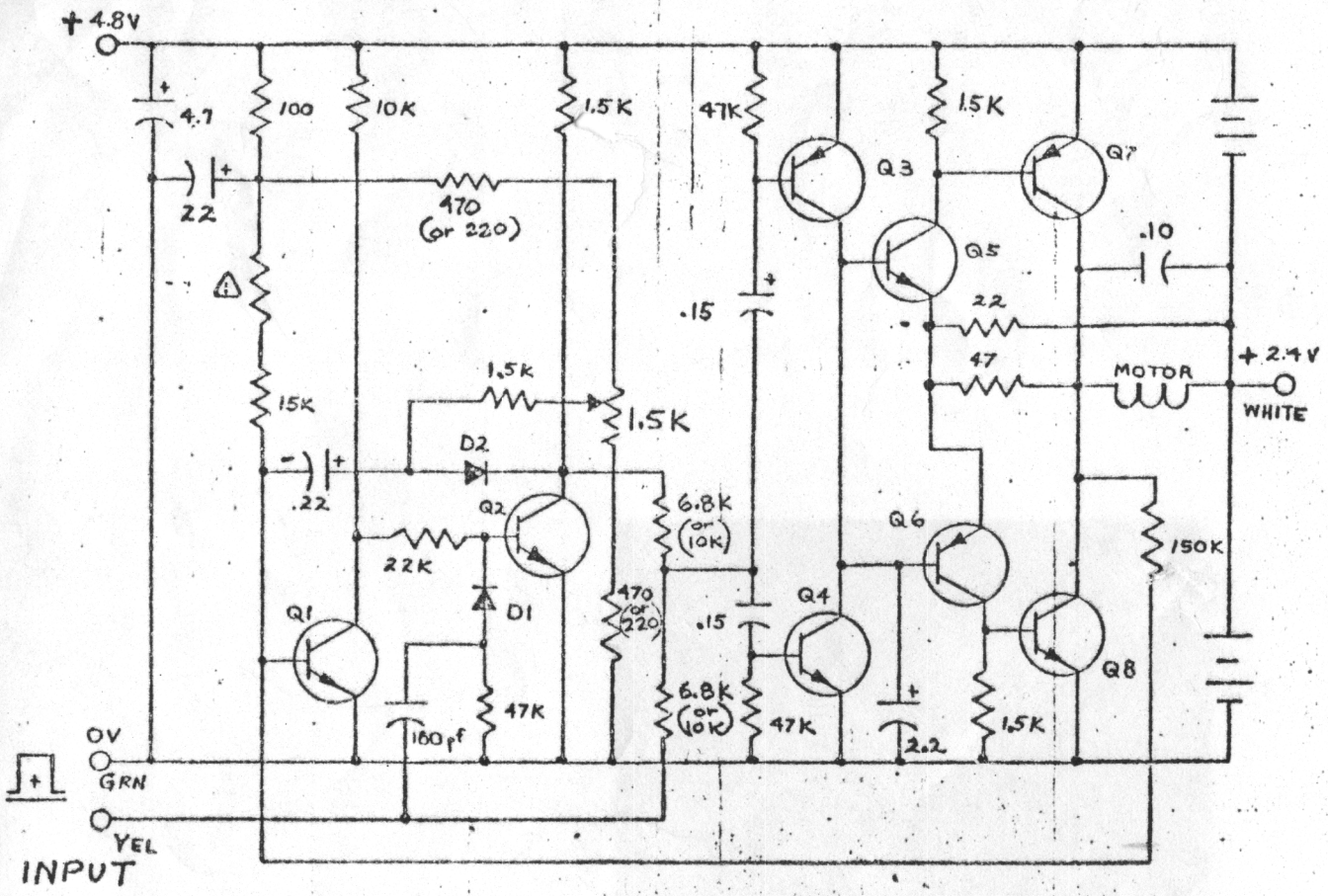
PART NUMBER	DESCRIPTION		ALL"	
C-033	15uf Tant. Cap. - Substitute C-084		1	
C-037	.005uf Disc. Cap.		1	
C-039	.10uf Disc. Cap.		2	
C-055/101	4.7uf Tant. Cap. - Substitute C-087		1	
C-063	22uf Tant. Cap. - No substitute		1	
C-064	.002 uf C.D. Cap. KCK		1	
C-083	.22uf ± 10% Tant. Cap. - No Substitute		1	
C-092	1.5uf ± 20% Tant. Cap. - No Substitute		2	
D-001	Silicon Diode (GP)		1	
Q-008	PNP Transistor		2	
Q-030	IC SN 21919 Positive Pulse		1	
Q031	IC SN 28622 Negative Pulse		1	
R10-1011	100Ω ± 10% 1/10 Watt Carbon Comp. Resistor		2	
R10-1021	1000Ω ± 10%, 1/10 Watt Carbon Comp . Resistor		1	
R10-1530	15K OHM 1/10 Watt Carbon Comp. Resistor		1	
R10-2220-	2.2K OHM 1/10 Watt Carbon Comp Resistor		1	
R10-2711	270Ω ± 10%, 1/10 Watt Carbon Comp. Resistor		1*	
R10-4731	4 7K ±10% Watt Carbon Comp. Resistor		3	
R10-6841	680K ± 10% 1/10 Watt Carbon Comp. Resistor		1	
S-131	1.5K Ceramic Pot ½" Diameter		1	**
S-148	Motor - 11Ω - 16mm Diameter		1	
W-001	Wire - Brown		1	
W-002	Wire - Red		2	
W-003	Wire - Orange		1	
W-004	Wire- Yellow		1	
W-005	Wire - Green		1	
W-006	Wire - Blue		1	
W-092	Wire - S. Red		1	
W-095	Wire - S. Green		1	
PC-XXX	Printed Circuit Board for SM-I/C		1	
R10-4711	470Ω ± 10%	Latest version intro. 74'	1	
CS-059	4K Ceramic pot ½" Dia.		1	

SERVO AMPLIFIERS



Channel 1 = ○, 2 = △, 3 = ◇, 4 = □





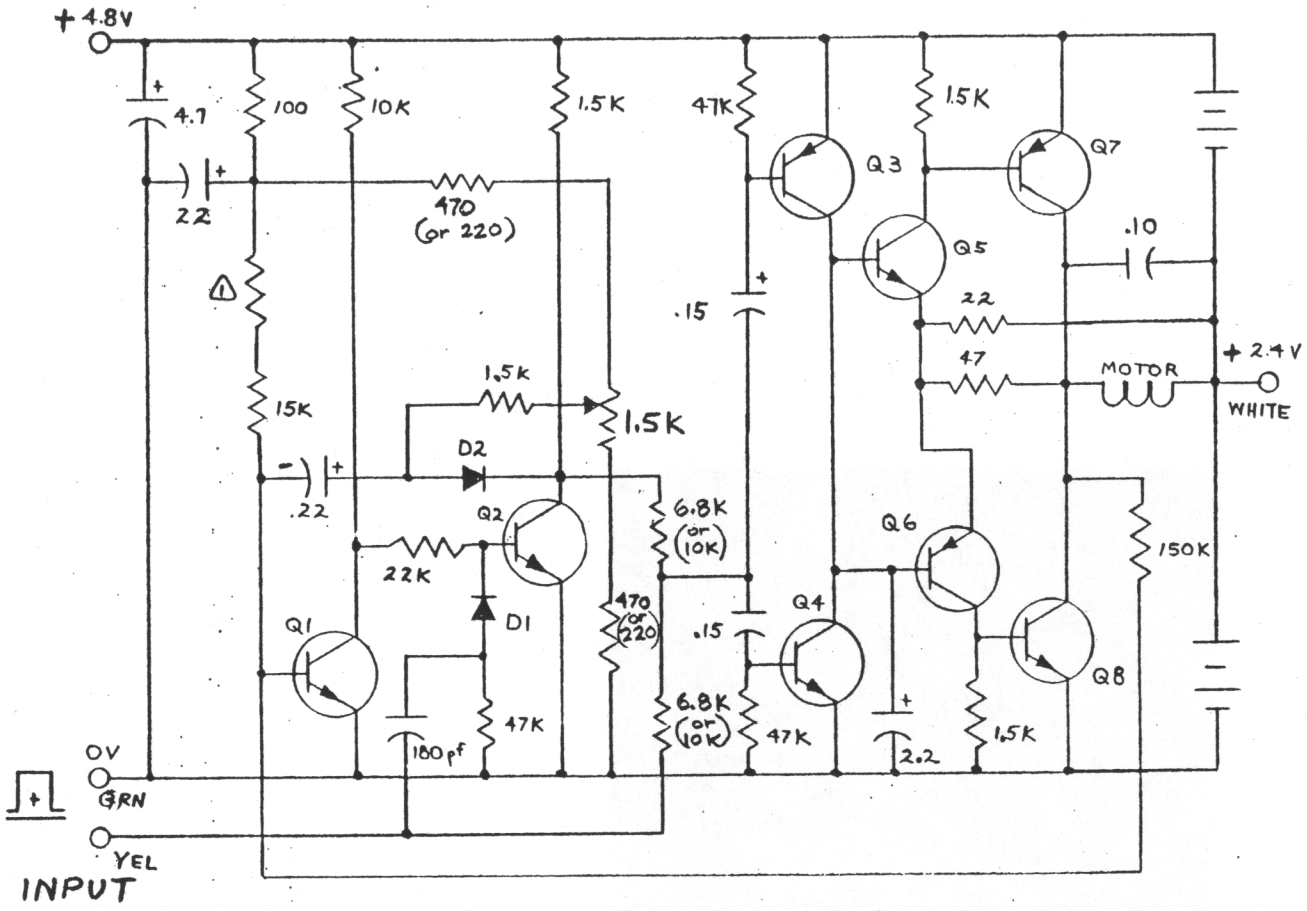
⚠ OPTIONAL VALUE 10Ω - 8.2KΩ

PART NO.	ITEM OR COMPONENT	QTY
R10-220	RESISTOR, 22Ω 1/10W(AB)	1
R8-470	RESISTOR, 47Ω 1/8 W	1
R8-101	RESISTOR, 100Ω 1/8 W	1
R8-152	RESISTOR, 1.5KΩ 1/8 W	4
R8-471	RESISTOR, 470Ω 1/8 W	2
R8-682	RESISTOR, 6.8KΩ 1/8 W	2
R8-153	RESISTOR, 15KΩ 1/8 W	1
R8-223	RESISTOR, 22KΩ 1/8 W	1
R8-473	RESISTOR, 47KΩ 1/8 W	3
R8-154	RESISTOR, 150KΩ 1/8 W	1
R8-⚠	RESISTOR, VALUE OPT.	1
C-039	CAPACITOR, DISC, .10 uf	1
C-057	CAPACITOR, TANT, .15 uf	2
C-052	CAPACITOR, TANT, .22 uf	1
C-063	CAPACITOR, TANT, 22 uf	1
C-003	CAPACITOR, DISC, 180 pf	1
D-001	SILICON DIODE	2
S-131	POTENTIOMETER, 1.5K	1
* Q3 & Q6	TRANSISTOR, X34A1165	2
Q1, Q2, Q4, Q5	TRANSISTOR, X32B4079	4
Q7	X34E1148	1
Q8	X32D4080	1
S-081	MOTOR, 2.4V, 4Ω, 20HM	1
C-055	CAPACITOR, TANT 4.7uf	1
C-004	CAPACITOR, TANT 2.2uf	1

* Q1, Q2, Q4, & Q5 ~ Q-025
Q3 & Q6 ~ Q-026
Q7 ~ Q-008
Q8 ~ Q-027

HOBBY LOBBY

EARLY MODEL SERVO AMPLIFIER



⚠ OPTIONAL VALUE 10Ω - 8.2KΩ

PART NO.	ITEM OR COMPONENT	QTY
R10-220	RESISTOR, 22Ω 1/10W (AB)	1
R8-470	RESISTOR, 47Ω 1/8W	1
R8-101	RESISTOR, 100Ω 1/8W	1
R8-152	RESISTOR, 1.5KΩ 1/8W	4
R8-471	RESISTOR, 470Ω 1/8W	2
R8-682	RESISTOR, 6.8KΩ 1/8W	2
R8-153	RESISTOR, 15KΩ 1/8W	1
R8-223	RESISTOR, 22KΩ 1/8W	1
R8-473	RESISTOR, 47KΩ 1/8W	3
R8-154	RESISTOR, 150KΩ 1/8W	1
R8-⚠	RESISTOR, VALUE OPT.	1
C-039	CAPACITOR, DISC, .10 uf	1
C-057	CAPACITOR, TANT, .15 uf	2
C-052	CAPACITOR, TANT, .22 uf	1
C-063	CAPACITOR, TANT, 22 uf	1
C-003	CAPACITOR, DISC, 180 pf	1
D-001	SILICON DIODE	2
S-131	POTENTIOMETER, 1.5K	1
* Q3 & Q6	TRANSISTOR, X34A1165	2
Q1, Q2, Q4, Q5	TRANSISTOR, X32B4079	4
Q7	X34E1478	1
Q8	X32D4080	1
S-081	MOTOR, 2.4V, 4Ω, 20HM	1
C-055	CAPACITOR, TANT 4.7uf	1
C-004	CAPACITOR, TANT 2.2uf	1

*
Q1, Q2, Q4, & Q5 ~ Q-025
Q3 & Q6 ~ Q-026
Q7 ~ Q-008
Q8 ~ Q-027

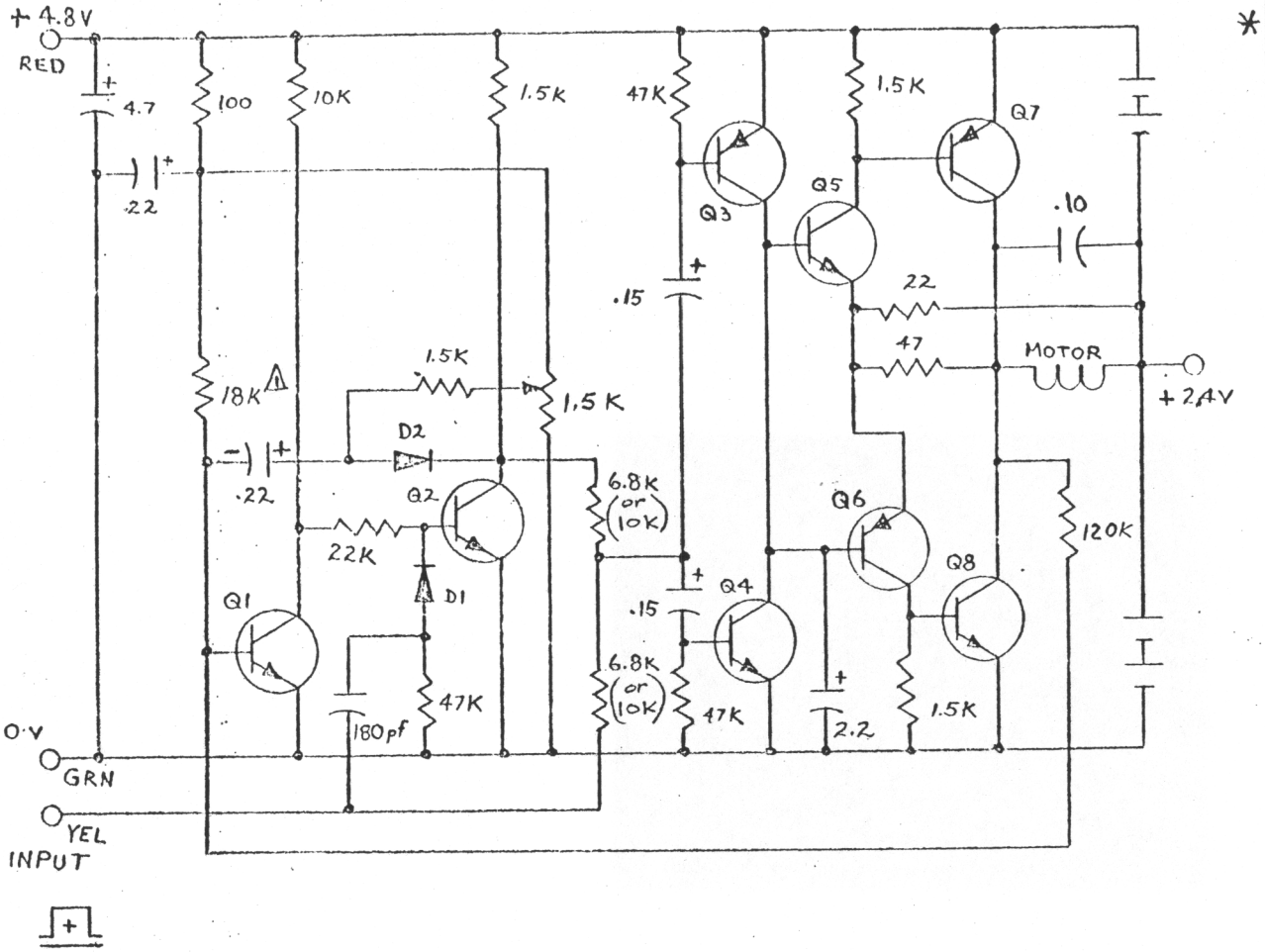
E K PRODUCTS, INC.
3233 W. EULESS BLVD., HURST, TEXAS 76053

SCALE:	APPROVED BY: R L Elliott	DRAWN BY JWB
DATE: 3/2/71		REVISED TAL

CIRCUIT DIAGRAM

SA7-MM

DRAWING NUMBER A-090



PART No.	ITEM	QTY
* Q1, Q2, Q4 & Q5	TRANSISTOR, X32B4079	4
Q3 & Q6	TRANSISTOR, X34A1165	2
Q7	TRANSISTOR, X34E1448	1
Q8	TRANSISTOR, X32D4080	1
S-081	MOTOR, 2.4V, 4Ω, 20MM	1
D-001	SILICON DIODE 1N4154	2
S-131	POTENTIOMETER, 1.5K	1
R10-220	RESISTOR, 22Ω 1/10W	1
R8-170	RESISTOR, 47Ω 1/8W	1
R-8-101	RESISTOR, 100Ω 1/8W	1
R-8-152	RESISTOR, 1.5KΩ 1/8W	4
R-8-682	RESISTOR, 6.8KΩ 1/8W	2
R-8-103	RESISTOR, 10KΩ 1/8W	1
R-8-183	RESISTOR, 18KΩ 1/8W	1
R-8-223	RESISTOR, 22KΩ 1/8W	1
R-8-473	RESISTOR, 47KΩ 1/8W	3
R-8-124	RESISTOR, 120KΩ 1/8W	1
C-039	CAPACITOR, DISC, .10 uf	1
C-057	CAPACITOR, TANT, .15 uf	2
C-004	CAPACITOR, TANT. 2.2 uf	1
C-052	CAPACITOR, TANT. .22 uf	1
C-055	CAPACITOR, TANT. 4.7 uf	1
C-063	CAPACITOR, TANT. 22 uf	1
C-003	CAPACITOR, DISC, 180 pf	1

* Q1, Q2, Q4, & Q5 ~ Q-025
Q3 & Q6 ~ Q-026
Q7 ~ Q-008
Q8 ~ Q-027

⚠ MAY BE VARIED FOR PROPER TRAVEL.

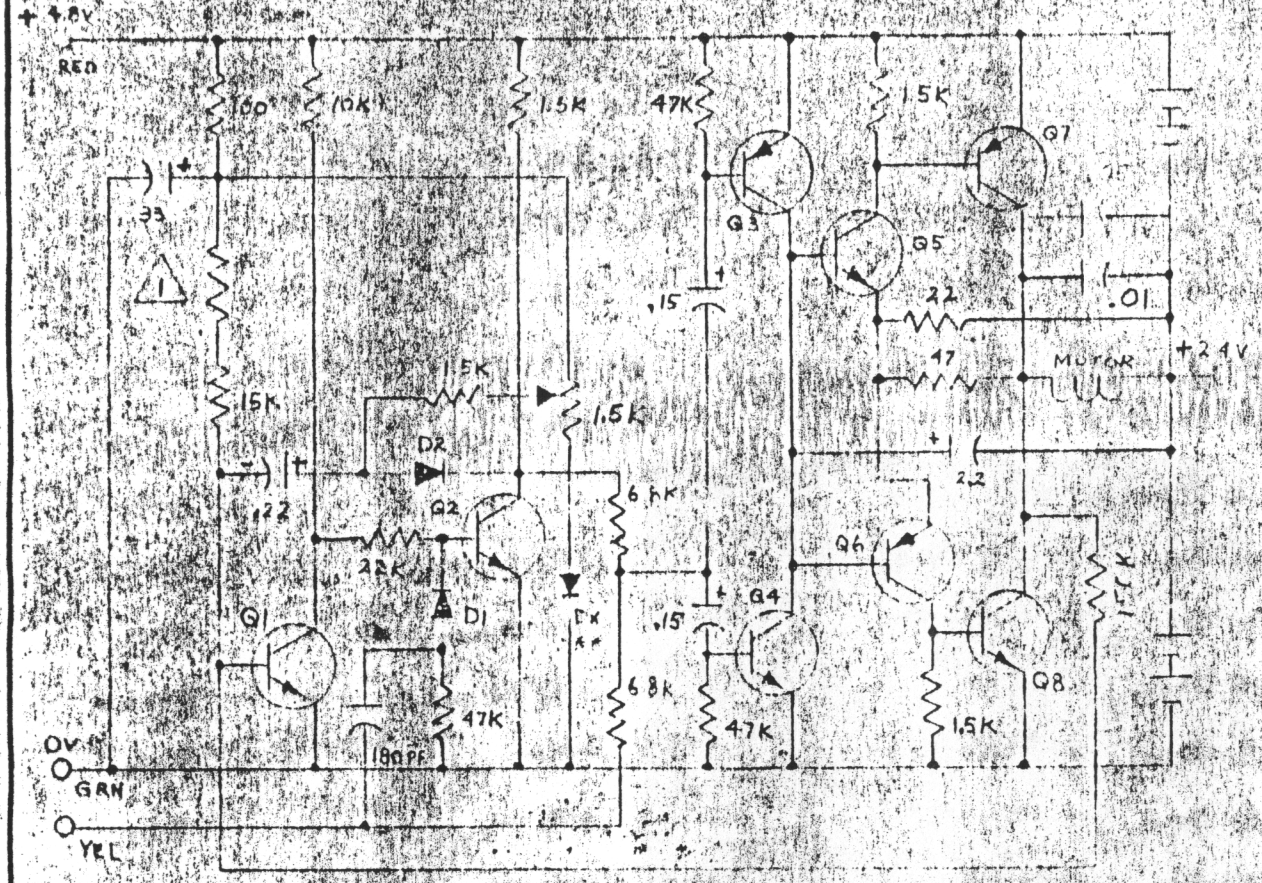
E K PRODUCTS, INC.
3233 W. EULESS BLVD., HURST, TEXAS 76053

SCALE:	APPROVED BY:	DRAWN BY QJB
DATE: 3/2/71		REVISED TAL

CIRCUIT DIAGRAM

SA7-RMM

DRAWING NUMBER A-092



PART NO.	ITEM	QTY
* Q1, Q2, Q4 & Q5	TRANSISTOR, X32B4079	4
Q3 & Q6	TRANSISTOR, X34A1165	2
Q7	TRANSISTOR, X34E1148	1
Q8	TRANSISTOR, X32D4080	1
D-001	SILICON DIODE IN4154	2
S-011	MOTOR, 2.4V, 4Ω, 16MM	1
S-131	POTENTIOMETER, 1.5K	1
R10-220	RESISTOR, 22Ω 1/10W	1
R8-470 (4)	RESISTOR, 47Ω 1/8W	1
R8-101	RESISTOR, 100Ω 1/8W	1
R8-152	RESISTOR, 1.5KΩ 1/8W	4
R8-682	RESISTOR, 6.8KΩ 1/8W	2
R8-103	RESISTOR, 10KΩ 1/8W	1
R8-153	RESISTOR, 15KΩ 1/8W	1
R8-223	RESISTOR, 22KΩ 1/8W	1
R8-473	RESISTOR, 47KΩ 1/8W	3
R8-154	RESISTOR, 150KΩ 1/8W	1
C-001	CAPACITOR, DISC .05uf	1
C-057	CAPACITOR, TANT .15uf	2
C-052	CAPACITOR, TANT .22uf	1
C-004	CAPACITOR, TANT 2.2uf	2
C-049	CAPACITOR, TANT 33uf	1
C-003	CAPACITOR, DISC 180 PF	1
C-010	CAPACITOR, DISC .01uf	1

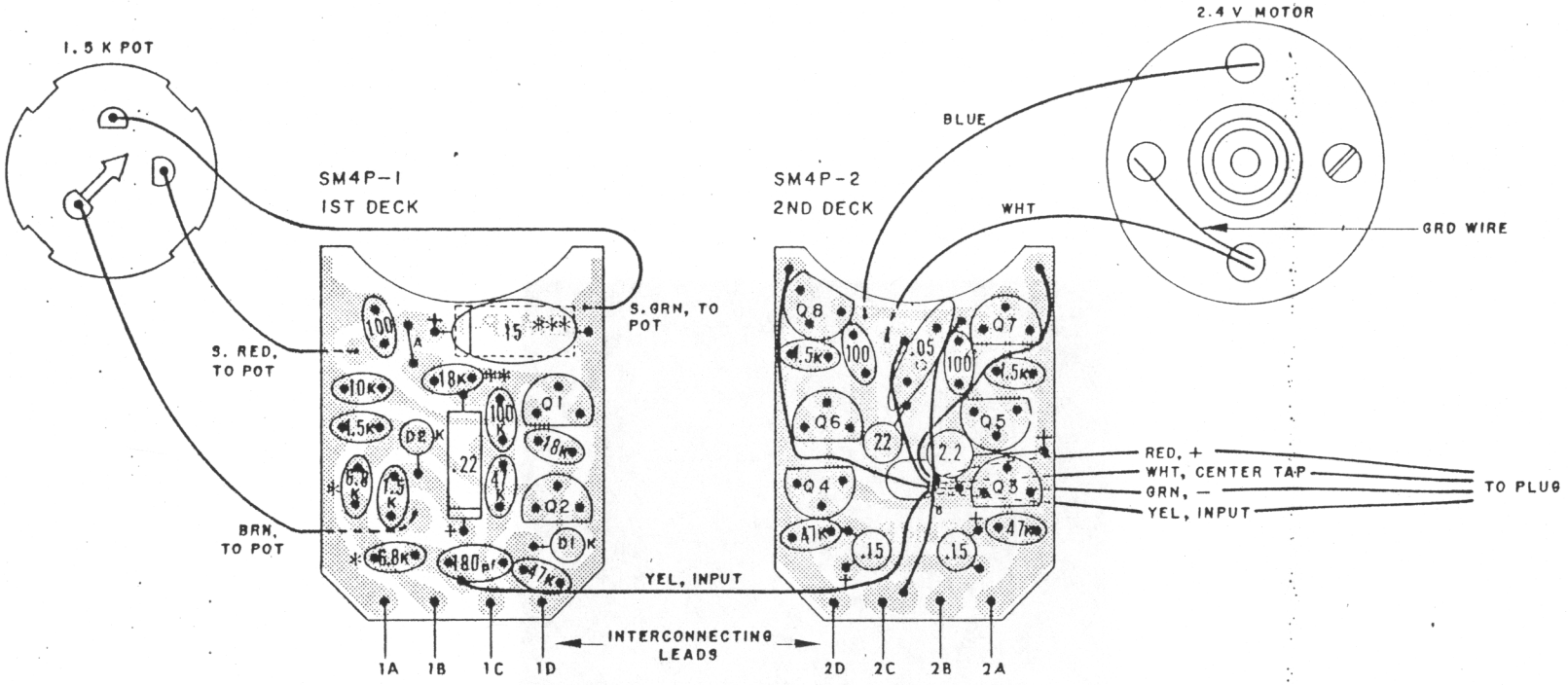
ON LATER MODELS THIS DIODE (D-001) IS ADDED IN SERIES WITH PLUG WIRE, WITH CATHODE TO P.C. BOARD.

* Q1, Q2, Q4 & Q5 ~ Q-025
Q3 & Q6 ~ Q-026
Q7 ~ Q-008
Q8 ~ Q-027

1/ OPTIONAL VALUE 10Ω TO 8.2KΩ MAY BE VALUED FOR TRIMMER TRAVEL.

2/ 1/4W RESISTORS (R4) MAY BE SUBSTITUTED FOR R8 (1/8 WATT) RESISTORS

SCALE:	APPROVED BY:	DRAWN BY JWB
DATE: 3/2/71		REVISED TAL
(CHAMPION & LRB)		
		DRAWING NUMBER A-093



NOTES—

1. UNLESS OTHERWISE SPECIFIED:
   ALL CAPACITANCE VALUES ARE IN MICROFARADS.
   ALL RESISTANCE VALUES ARE IN OHMS.
2. TRANSISTORS: Q1, Q2, Q4, & Q5 ARE X3284079 (Q-025). Q3, & Q6 ARE X34A1165 (Q-026). Q7 IS X34E1448 (Q-008). Q8 IS X32D4080 (Q-027).
3. DIODES: D1 & D2 ARE IN4154 (D-001).
4. JUMPERS: A & B

*OPTIONAL VALUE: 10K

**MAY BE VARIED FOR PROPER TRAVEL. (18K IS NOMINAL)

***OPTIONAL VALUE: 22uf

SERIES '71

E K PRODUCTS, INC.
3233 W. EULESS BLVD., HURST, TEXAS 76053

SCALE	REVISIONS	BY	DATE
DATE 11/12/71			
DR'N TAL CKD			
APVD			

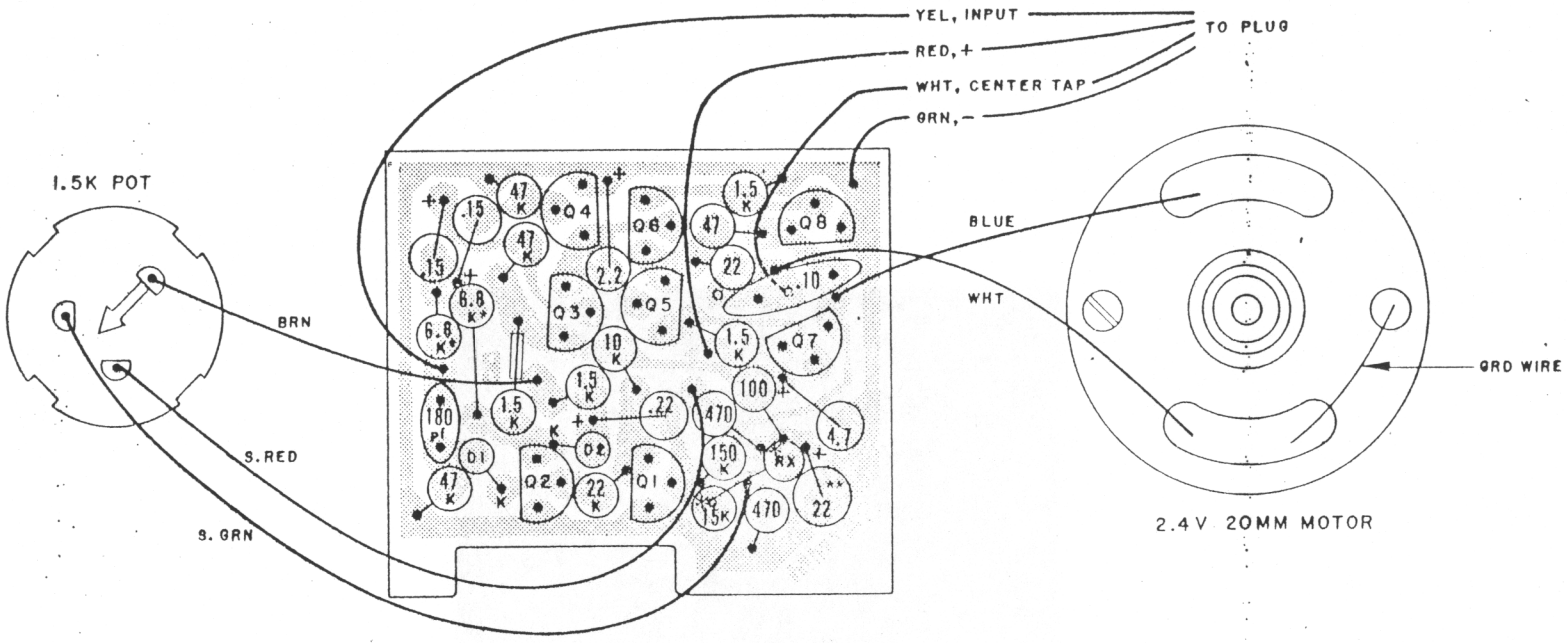
TITLE: PARTS LOCATION SM4P-1 & SM4P-2 SERVO AMP.

NO B-620

PARTS LIST FOR NEXT ASSEMBLY: SERVO - SM4P / 1971 LOGICTROL AND 1971 -1973 LRB

PL- B-620

PART NUMBER	DESCRIPTION	QUANTITY ALL		
	1st DECK			
C-003	180 pf	1	1	1
C-033	15 uf	1	1	1
C-052	.22 uf	1	1	1
D-001	1N4154	3	3	3
PC-019	P.C. BOARD 1st DECK SM4P	1	1	1
Q-025	X32B4079	2	2	2
R16-1010	100Ω	1	1	1
R16-1030	10K	3	3	3
R16-1040	100K	1	1	1
R16-1520	1.5K	2	2	2
R16-1830	18K	2	2	2
W-001	BROWN	1	1	1
W-004	YELLOW	1	1	1
W-092	S. RED	1	1	1
W-095	S. GREEN	1	1	1
	WIRE LEADS (INTERCONNECTING)	4	4	4
	WIRE (JUMPER)	1	1	1
	2nd DECK			
C-001	.05 uf	1	1	1
C-004	2.2 uf	1	1	1
C-057	.15	2	2	2
PC-018	P.C. BOARD 2nd DECK SM4P	1	1	1
Q-008	X34E1448	1	1	1
Q-025	X32B4079	2	2	2
Q-026	X34A1165	2	2	2
Q-027	X32D4080	1	1	1
R10-2200	22 Ω	1	1	1
R16-1010	100 Ω	2	2	2
R16-1520	1.5K	2	2	2
S-011	MOTOR 16mm 2.4V	1	1	1
S-131	1.5K Ω POTENTIOMETER	1	1	1
W-002	RED	1	1	1
W-005	GREEN	1	1	1
W-006	BLUE	1	1	1
W-009	WHITE	3	3	3
	WIRE - GROUND ON MOTOR	1	1	1



NOTES –

1. UNLESS OTHERWISE SPECIFIED:
   ALL CAPACITANCE VALUES ARE IN MICROFARADS.
   ALL RESISTANCE VALUES ARE IN OHMS.
2. TRANSISTORS: Q1, Q2, Q4, & Q5 ARE X32B4079 (Q-025).
   Q3 & Q6 ARE X34A1165 (Q-026). Q7 IS X34E1448 (Q-008). Q8 IS X32D4080 (Q-027).
3. DIODES: D1 & D2 ARE 1N4154 (D-001).
4. RX – OPTIONAL VALUE: 10Ω TO 8.2K VARIED TO OBTAIN PROPER TRAVEL.
5. * FOR THE RMM SERVO — 90° & 180°, THESE RESISTORS MAY BE VARIED FOR PROPER TRAVEL.

* OPTIONAL VALUE: 10K
** OPTIONAL VALUE: 15

SERIES '71

E K PRODUCTS, INC.
3233 W. EULESS BLVD., HURST, TEXAS 76053

	REVISIONS	NO.	DATE
DRAWN TAL			

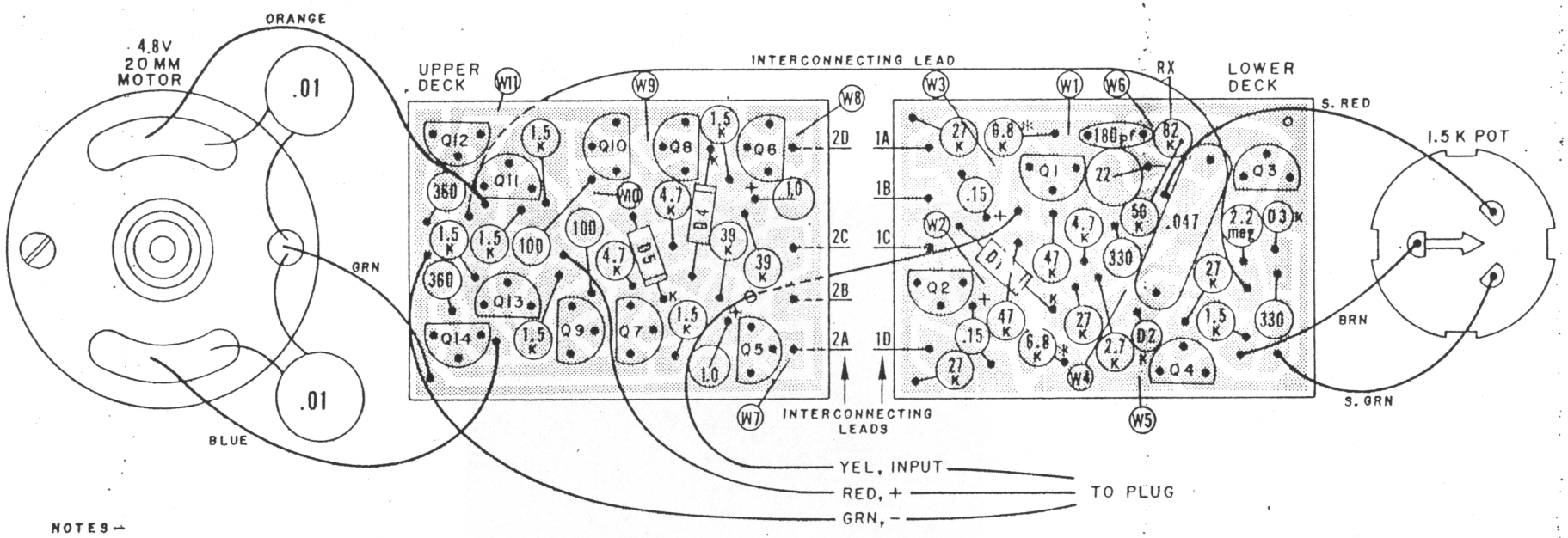
PARTS LOCATION
SA7 – MM SERVO AMP.

NO. B-621

PARTS LIST FOR SA 7 - MM(4P) SERVO AMP
NEXT ASSEMBLY '71 SERIES LOGICTROL & 1971-72 LRB

PL- B-621

PART NUMBER	DESCRIPTION	QUANTITY ALL	ALL	
C-003	180 pf	1	1	1
C-004	2.2 uf	1	1	1
C-039	.10 uf	1	1	1
C-052	.22 uf	1	1	1
C-055	4.7 uf	1	1	1
C-057	.15 uf	2	2	2
C-063	22 uf	1	1	1
D-001	1N4154	2	2	2
PC-020	P.C. BOARD SA7MMP	1	1	1
Q-008	X34E1448	1	1	1
Q-025	X32B4079	4	4	4
Q-026	X34A1165	2	2	2
Q-027	X32D4080	1	1	1
R4-1010	100 Ω	1	1	1
R4-1030	10 K Ω	1	1	1
R4-1520	1.5K Ω	4	4	4
R4-1530	15K	1	1	1
R4-1540	150 K	1	1	1
R4-2230	22K	1	1	1
R4-4700	47 Ω	1	1	1
R4-4710	470 Ω	2	2	2
R4-4730	47 K	3	3	3
R4-6820	6.8K	2	2	2
R4-	OPTIONAL: 10 Ω to 8.2 K	1	1	1
R10-2200	22 Ω	1	1	1
S-081	MOTOR 20mm 2.4V	1	1	1
S-131	1.5K Ω POTENTIOMETER	1	1	1
W-001	BROWN	1	1	1
W-002	RED	1	1	1
W-004	YELLOW	1	1	1
W-005	GREEN	1	1	1
W-006	BLUE	1	1	1
W-009	WHITE	2	2	2
W-092	S. RED	1	1	1
W-095	S. GREEN	1	1	1



NOTES—

1. UNLESS OTHERWISE SPECIFIED:
   ALL CAPACITANCE VALUES ARE IN MICROFARADS.
   ALL RESISTANCE VALUES ARE IN OHMS.
2. TRANSISTORS: Q1 THRU Q10, Q12, & Q14 ARE X32B4079 (Q-025). Q11 & Q13 ARE X34A1165 (Q-026).
3. DIODES: D1 THRU D5 ARE IN4154 (D-001).
4. RX TRIM FOR PROPER THROW

*OPTIONAL VALUE: 10K

SERIES '71

E K PRODUCTS, INC.
3233 W. EULESS BLVD., HURST, TEXAS 76053

SCALE	REVISIONS	BY	DATE
	added note 4	[illegible]	12-6-71
DATE 12/7/71			
DRN TAL CKD ktr			
APVD [illegible]			

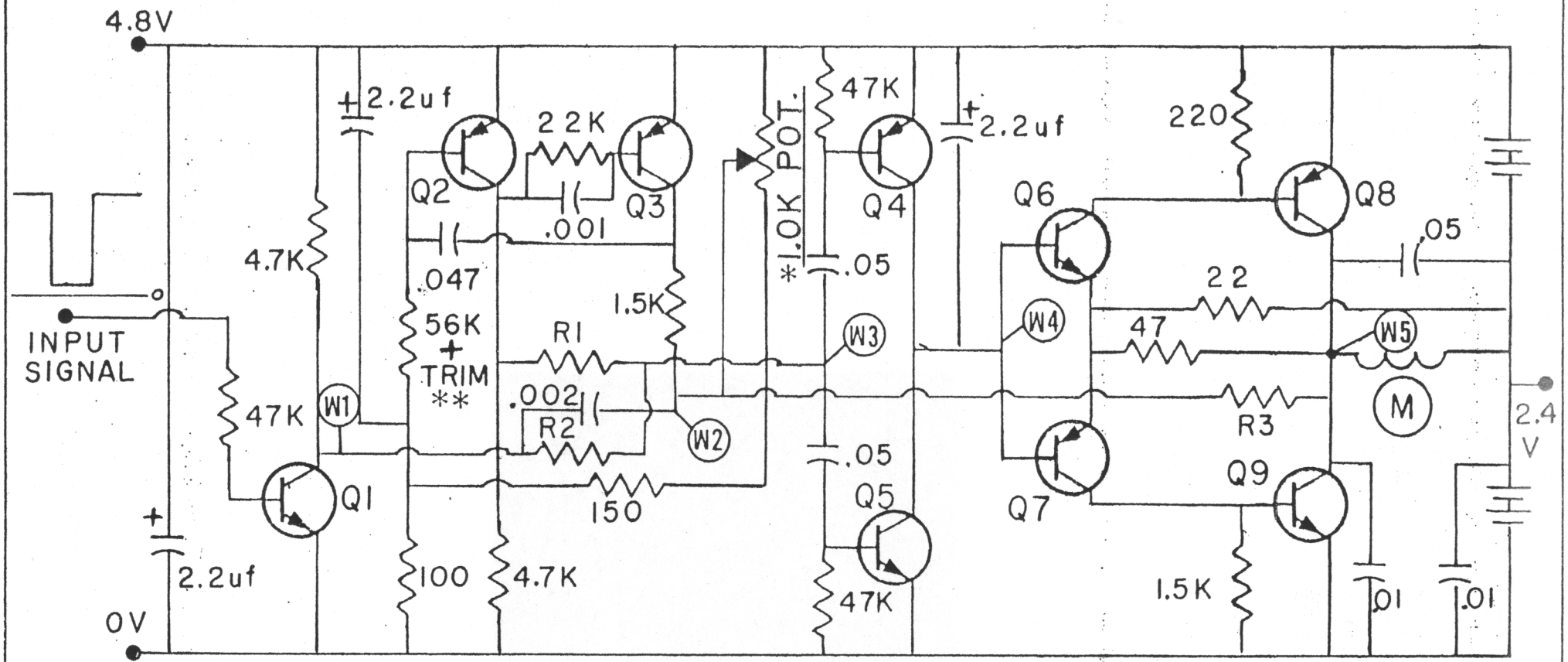
TITLE: PARTS LOCATION
MM3N SERVO AMP.

NO B-625

PARTS LIST FOR NEXT ASSEMBLY: MM3N SERVO AMP

PL- B-625

PART NUMBER	DESCRIPTION		ALL
C-003	180pf Disk Cap		1
C-017	.01 uf Cap		2
C-029	.047 uf Mylar Cap.		1
C-050	1.0uf Cap		2
C-057	.15 uf Tant. Cap.		2
C-063	22uf Tant. Cap.		1
D-001	Silicon Diode (GP)		5
Q-025	X32B4079 Transistor		12
Q-026	X34A1165 Transistor		2
R4-1010	100Ω Resistor		2
R4-1520	1.5K Resistor		7
R4-2250	2.2 Meg. Resistor		1
R4-2720	2.7 K Resistor		1
R4-2730	27 K Resistor		4
R4-3310	330Ω Resistor		2
R4-3615	360Ω Resistor		2
R4-3930	39K Resistor		2
R4-4720	4.7K Resistor		3
R4-4730	47K Resistor		2
R4-5630	56K Resistor		1
R4-6820	6.8K Resistor optional value 10K		2
R4-8230	82K Resistor		1
S-079	Motor - 4.8V - 20MM Diameter		1
S-131	1.5K Cermatic Pot ½" Diameter		1
W-001	Wire - Brown		1
W-002	Wire - Red		1
W-003	Wire - Orange		1
W-004	Wire - Yellow		1
W-005	Wire - Green		2
W-006	Wire - Blue		1
W-092	Wire - S. Red		1
W-095	Wire - S. Green		1
	Wire - Interconnecting Leads		5



	NEW	OLD
Q1,5,6	X32B4079	2N3794
Q2,3,4,7	X34A1165	2N4291
R1,2	10K	4.7K
R3	2.7-3.9K	4.7K

Q8-2N2431

Q9-X32D4080 or D32D4

*MAY ALSO BE 1 5K

**ADJUST FOR PROPER THROW

E K PRODUCTS, INC.

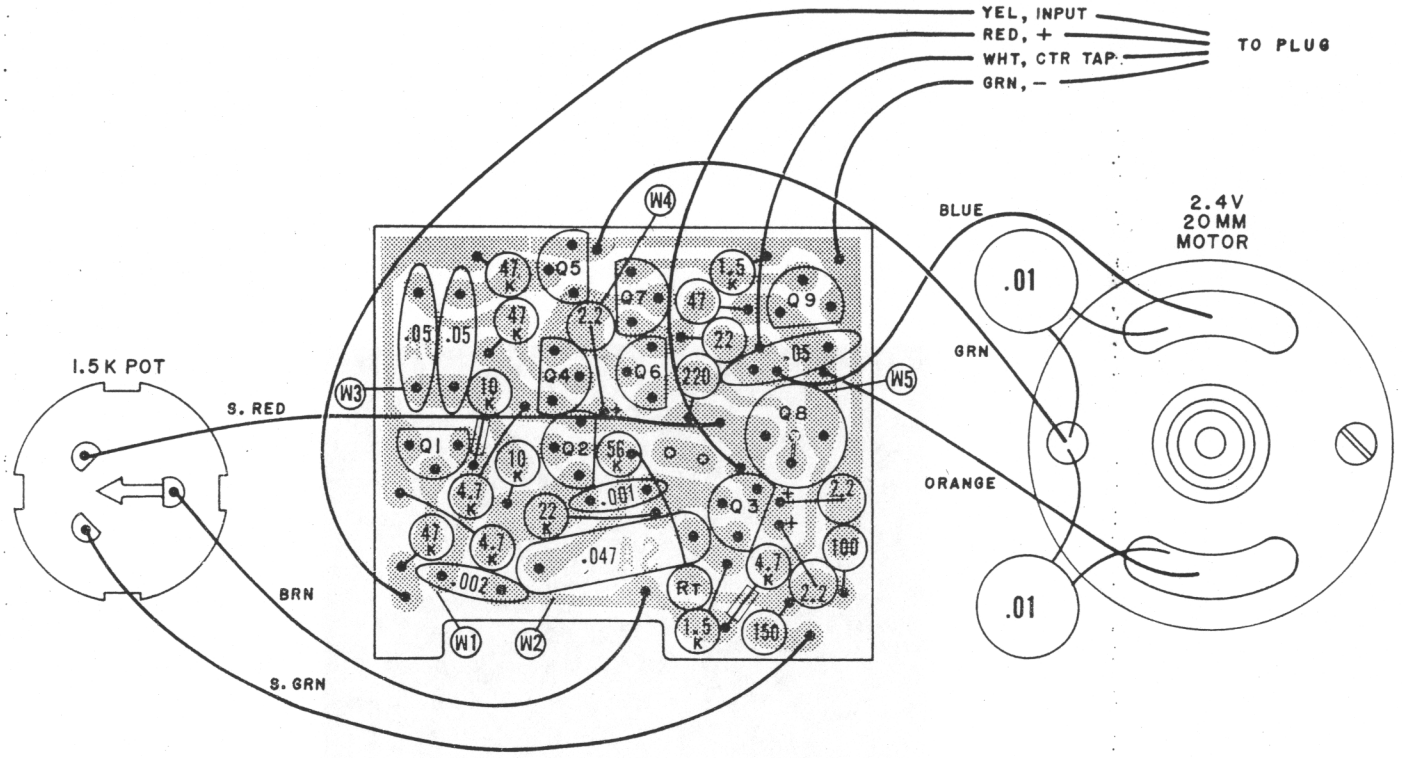
3233 W. LOULESS BLVD. HURST, TEXAS 76053

DRAWN	SCALE	REVISIONS	DATE
CHECKED			
APPROVED			
DATE 12/22/69			

TITLE

SERVO AMP SA-6A

NO. A062



NOTES –

1. UNLESS OTHERWISE SPECIFIED:
   ALL CAPACITANCE VALUES ARE IN MICROFARADS.
   ALL RESISTANCE VALUES ARE IN OHMS.
2. TRANSISTORS: Q1, Q5, & Q6 ARE X32B4079 (Q-025).
   Q2, Q3, Q4, & Q7 ARE X34A1165 (Q-026). Q8 IS
   2N2431 (Q-004). Q9 IS X32D4080 (Q-027).
3. RT – TRIM RESISTOR: 10Ω TO 27K.

E K PRODUCTS, INC.
3233 W. EULESS BLVD., HURST, TEXAS 76053

SCALE	REVISIONS	BY	DATE
DATE 12/10/71			
DR'N. TAL CK'D.			
AP'VD.			

TITLE: PARTS LOCATION MM4N
SA-6A SERVO AMP.

NO. B-626

PARTS LIST FOR MM4N SA-6A SERVO AMP

NEXT ASSEMBLY

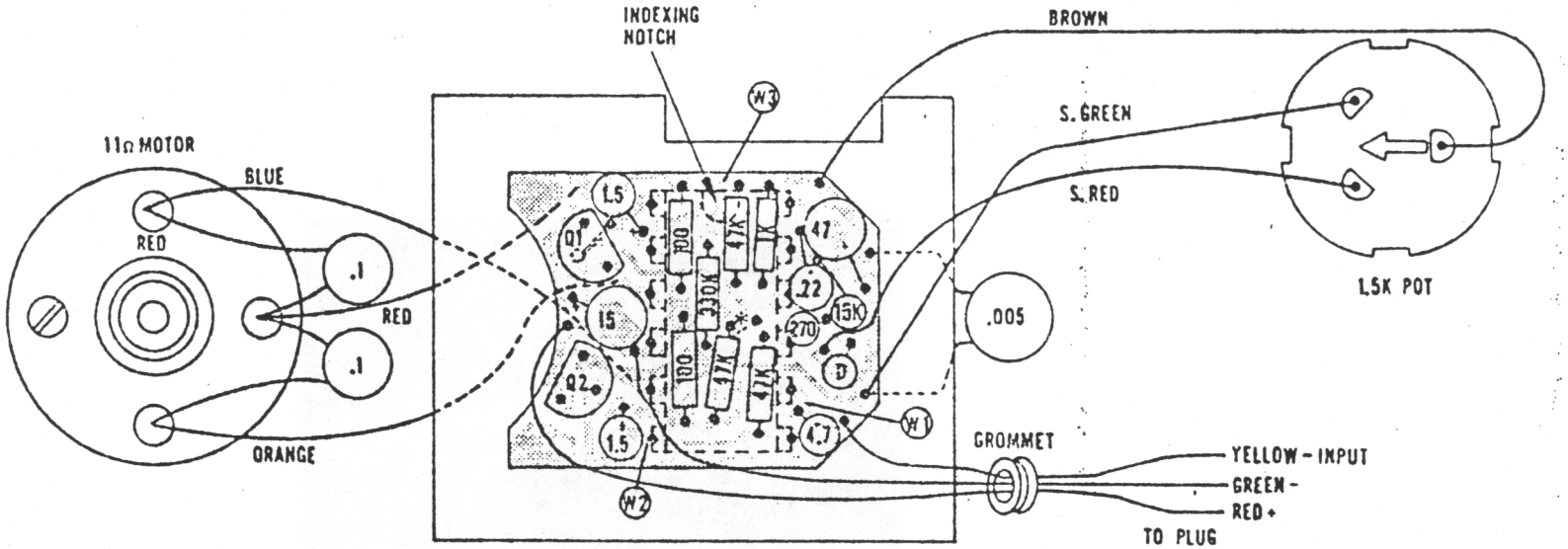
PL- PL-B-626

PART NUMBER	DESCRIPTION	ALL
C-001	.05uf C.D. Cap.	3
C-002	.001uf C.D. Cap.	1
C-004	2.2uf Tant. Cap.	3
C-017	.01uf C.D. Cap.	2
C-029	.047uf Mylar Cap.	1
C-064	.002uf C.D. Cap.	1
Q-004	2N2431 Transistor	1
Q-025	X32B4079 Transistor	3
Q-026	X34A1165 Transistor	4
Q-027	X32D4080 Transistor	1
R4-1010	100Ω Resistor	1
R4-1030	10K Resistor	2
R4-1510	150Ω Resistor	1
R4-1520	1.5K Resistor	2
R4-2200	22Ω Resistor	1
R4-2210	220Ω Resistor	1
R4-2230	22K Resistor	1
R4-4700	47Ω Resistor	1
R4-4720	4.7K Resistor	3
R4-4730	47K Resistor	3
R4-5630	56K Resistor	1
R4-	Rt-Trim Resistor :10Ω to 27K	1
S-081	Motor - 2.4v 20MM	1
S-131	1.5K Ceramic Pot	1
W-001	Wire - Brown	1
W-002	Wire - Red	2
W-003	Wire - Orange	1
W-004	Wire - Yellow	1
W-005	Wire - Green	2
W-006	Wire - Blue	1
W-009	Wire - White	1
W-092	Wire - S. Red	1
W-095	Wire - S. Green	1

PARTS LIST FOR NEXT ASSEMBLY: MM4N SA-6A SERVO AMP

PL- PL-B-626

PART NUMBER	DESCRIPTION	ALL
C-001	.05uf C.D. Cap.	3
C-002	.001uf C.D. Cap.	1
C-004	2.2uf Tant. Cap.	3
C-017	.01uf C.D. Cap.	2
C-029	.047uf Mylar Cap.	1
C-064	.002uf C.D. Cap.	1
Q-004	2N2431 Transistor	1
Q-025	X32B4079 Transistor	3
Q-026	X34A1165 Transistor	4
Q-027	X32D4080 Transistor	1
R4-1010	100Ω Resistor	1
R4-1030	10K Resistor	2
R4-1510	150Ω Resistor	1
R4-1520	1.5K Resistor	2
R4-2200	22Ω Resistor	1
R4-2210	220Ω Resistor	1
R4-2230	22K Resistor	1
R4-4700	47Ω Resistor	1
R4-4720	4.7K Resistor	3
R4-4730	47K Resistor	3
R4-5630	56K Resistor	1
R4-	Rt-Trim Resistor :10Ω to 27K	1
S-081	Motor - 2.4v 20MM	1
S-131	1.5K Ceramic Pot	1
W-001	Wire - Brown	1
W-002	Wire - Red	2
W-003	Wire - Orange	1
W-004	Wire - Yellow	1
W-005	Wire - Green	2
W-006	Wire - Blue	1
W-009	Wire - White	1
W-092	Wire - S. Red	1
W-095	Wire - S. Green	1



*DOTTED LINE REPRESENTS RESISTOR LEAD CHANGE ON THE NEGATIVE PULSE VERSION

NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   ALL CAPACITANCE VALUES ARE IN MICROFARADS.
   ALL RESISTANCE VALUES ARE IN OHMS.
2. TRANSISTORS: Q1 AND Q2 ARE X34E1448 (Q-008).
3. D-DIODE 0A2208 (D-001).

E K PRODUCTS, INC.
3233 W. EULESS BLVD., HURST, TEXAS 76053

1-4-72	CHG. NOTCH LOCATION	RLE	6-11-7
TAL / RLE	REDRAWN	MWP	10-3-7
	ADDED CHAN LINES		

PARTS LOCATION — MM3P AND MM3N I.C. SERVO AMP.

B-631

PARTS LIST FOR MM3P AND MM3N I.C. SERVO AMP. | PL- B-631

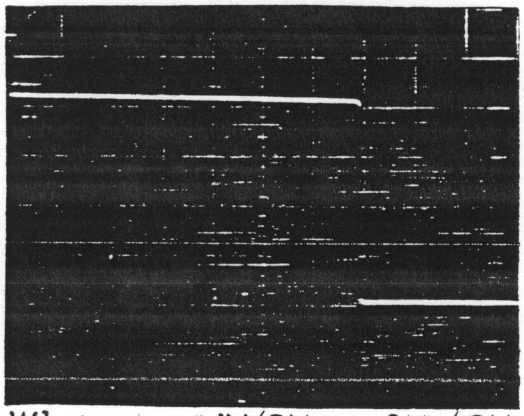
NEXT ASSEMBLY ALL SERVOS 1972 etc.

PART NUMBER	DESCRIPTION	27
C-027	47 uf TANT. CAP.	1
C-033	15 uf TANT. CAP. - SUB C-084	1
C-037	.005 uf DISC. CAP.	1
C-039	.1 uf DISC. CAP.	2
C-055	4.7 uf TANT. CAP. - SUB. C-087	1
C-083	.22 uf ± 10% TANT. CAP.	1
C-092	1.5 uf ± 20% TANT. CAP.	2
D-001	SILICON DIODE (GP)	1
Q-008	PNP TRANSISTOR	2
Q-030	INTERGRATED CIRCUIT SN 21919 - POSITIVE PULSE	1
R10-1011	100 Ω ± 10%	2
R10-1021	1000 Ω ± 10%	1
R10-1535	15K ± 5%	1
R10-2711	270 Ω ± 10%	1
R10-3341	330 K ± 10%	1
R10-4711	470 Ω ± 10%	1
R10-4731	47K ± 10%	3
S-131	1.5K CERAMIC POT ½" DIAMETER	1
S-148	MOTOR - 11Ω - 16 mm DIAMETER	1
W-001	WIRE - BROWN	1
W-002	WIRE - RED	1
W-003	WIRE - ORANGE	1
W-004	WIRE - YELLOW	1
W-005	WIRE - GREEN	1
W-006	WIRE - BLUE	1
W-092	WIRE - S. RED	1
W-093	WIRE - S. GREEN	1
PC-XXX	PRINTED CIRCUIT BOARD	1
Q -031	IC SN 28622 - Negative Pluse	1
	Latest Version intro. 74'	
R10-4711	470Ω ± 10%	1
CS-059	4K Ceramic Pot ½" Dia.	1

W-A-126

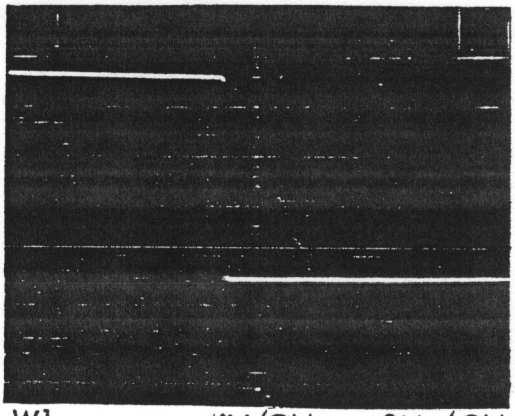
Wave forms

I/C Servo Amplifier Ref. Drawings A-126, B-619, B-631



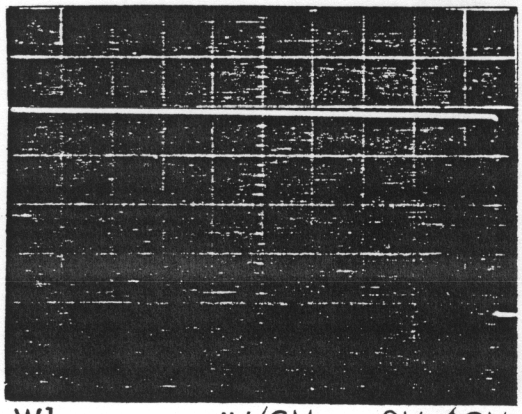
W1 1V/CM .2Ms/CM

Input to IC - Neutralpulse
(1.38 Ms) with motor removed.



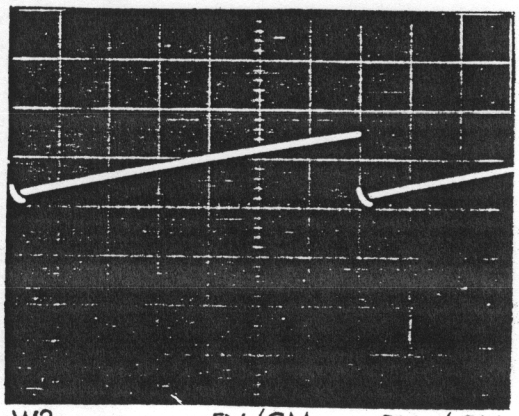
W1 1V/CM .2Ms/CM

Input to IC - Shortpulse
(0.90 Ms) with motor removed.



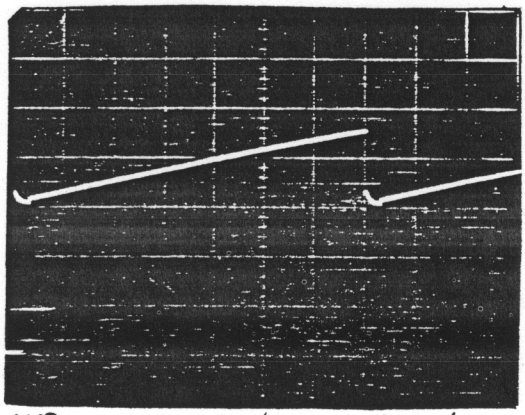
W1 1V/CM .2Ms/CM

Input to IC - Longpulse
(1.86 MS) with motor removed.



W2 .5V/CM 2Ms/CM

Pulse stretcher - Shortpulse
with motor removed.



W3 .5V/CM 2Ms/CM

Pulse stretcher - Longpulse
with motor removed.