

PRELIMINARY

LOG SHEETS AND PROTOTYPE  
REFERENCE CARTRIDGES MUST  
BE RETURNED TO COLORADO  
UPON REQUEST FROM CSSE

RL01 RL02 ALIGNMENT CARTRIDGE PROCEDURE

Version (Preliminary)

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RL01 RL02 ALIGNMENT CARTRIDGE PROCEDURE

Version (Preliminary)

PRELIMINARY

NOTE: Perform inspection and cleaning of heads, spindle, spindle cone and disk well, prior to performing this procedure.

## 1.0 READ SIGNAL AMPLITUDE CHECK and/or ALIGNMENT

### 1.1 REQUIRED TOOLS

1. Calibrated Oscilloscope with 2 probes
2. - One DIP clip, one pin-to-pin jumper, & one test lead (aligator clip)

OR

- Two (2) DIP clips and two (2) pin-to-pin jumpers.
3. Diagnostic listed in Appendix A or toggle-in programs listed in Appendix B & C. (for head selection)
4. Standard Reference Cartridge ( RL01K-RF or RL02K-RF )

### 1.2 EQUIPMENT SETUP

#### OSCILLOSCOPE

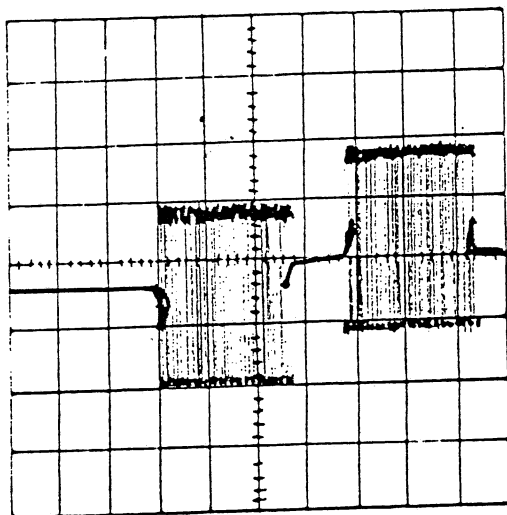
Channel 1 Probe	- Servo Data, R/W Module TP2
Channel 1 Ground	- Signal Gnd, R/W Module TP3
Coupling	- DC
Vertical Mode	- Channel 1
Vertical Gain	- (Outer Cyl) 500mv/div (50mv/div. w/X10 probe)
	- (Inner Cyl) 200mv/div (20mv/div. w/X10 probe)
Ext. Sync Probe	- DLM version 1 , TP9 (sector time)
	- DLM version 2 , TP11 (sector time)
	- DLM version 3 , TP11 (sector time)
Ext. Sync Gnd	- DLM (all) , TP2 (signal gnd)
Trigger Source	- External
Trigger Coupling	- AC
Trigger Slope	- Negative
Sweep time	- 5us/div.
Sweep mode	- Auto or Norm. trigger

## 1.3 PROCEDURE - Amplitude Check/Adjust

1. Remove both top cover assemblies from the RL Drive.
2. Defeat SK TO (Seek Timeout) & Cover Interlock (Appendix D).
3. Place R/W module assembly up and out of the way to expose the carriage assembly.
4. Install Standard Reference Cartridge (RL01K-RF or RL02K-RF).
5. Press WRITE PROT switch to IN.
6. Press LOAD switch to IN and wait for the heads to load onto the cartridge.
7. Set the vertical gain to display a deflection of 500mv/div and observe the S1 Servo waveform similar to the one shown below.

S1

S2



Time = 5us/div.

Figure 1

8. Measure and record the peak-to-peak amplitude of the S1 burst for both heads on this cylinder (Cylinder 0).
9. CAREFULLY move the positioner towards the spindle to the innermost cylinder. Be sure to "CAREFULLY" grab the positioner and NOT the heads themselves. You will feel a slight "detented" resistance when moving the positioner. The resistance will become noticeably greater when you attempt to move beyond the innermost cylinder into the inner guardband. Merely release the positioner and allow it to lock onto the inner cylinder.

## 1.3 PROCEDURE - Amplitude Check/Adjust (continued)

10. Set the vertical gain to display a deflection of 200mv/div and observe the S1 Servo waveform similar to the one shown in Fig 1.
11. Measure and record the peak-to-peak amplitude of the S1 burst for both heads on this cylinder (Cylinder 255 for RL01 or Cylinder 511 for RL02).
12. Adjust the read gain pot on the R/W module (see Appendix E) until one of the heads is EQUAL to its' REFERENCE AMPLITUDE SETTING and the other head is EQUAL to or GREATER THAN its' REFERENCE AMPLITUDE SETTING. Use care in loosening the glyptal before adjusting the pot. Adjustments are to be made at the inner cylinder only. Do not make adjustments at the outer cylinder.

SEE  
VALUE  
ON  
LABEL  
ON  
CARTRIDGE

Note: NO HEAD SHOULD BE ADJUSTED TO A VALUE BELOW ITS' REFERENCE AMPLITUDE SETTING.

13. If, after the previous adjustment, either head reads more than 200mv ABOVE its' REFERENCE AMPLITUDE SETTING, then one or both heads must be replaced. Two (2) approaches may be used:

NOTE: The 200 mv limit applies to reading obtained at the inner cylinder only, outer cylinder readings are for information only.

13-1 Replace the head with the "lowest" amplitude reading and repeat Step 12. If this does not reduce the difference to less than 200mv, then replace the "other" head and repeat Steps 9 thru 12.

-- OR --

13-2 Replace the "upper" head (it's the most accessible) and repeat Step 12. If this does not reduce the difference to less than 200mv, then replace the "lower" head and repeat Steps 9 thru 12.

14. Repeat the entire "check" procedure and record all values as "after adjustment" values.

2.0 SECTOR-to-S1 TIME CHECK and/or ADJUSTMENT

- Radial Alignment using the **STANDARD REFERENCE CARTRIDGE**
- The positioner radial alignment checks and verifies the following condition:
  - o The servo bursts (read by the read/write heads) must occur during the correct time period relative to the sector pulse (detected by the sector transducer at the hub). Because the sector transducer is fixed, changing the head positioner location affects this timing relationship.
  - o The servo burst/sector timing relationship must be the same at cylinder 0 and the innermost cylinder to assure the head carriage moves straight towards the the center of the cartridge.

2.1 REQUIRED TOOLS

1. Calibrated Oscilloscope with 2 probes
2. - One DIP clip, one pin-to-pin jumper, & one test lead (aligator clip)
 

OR

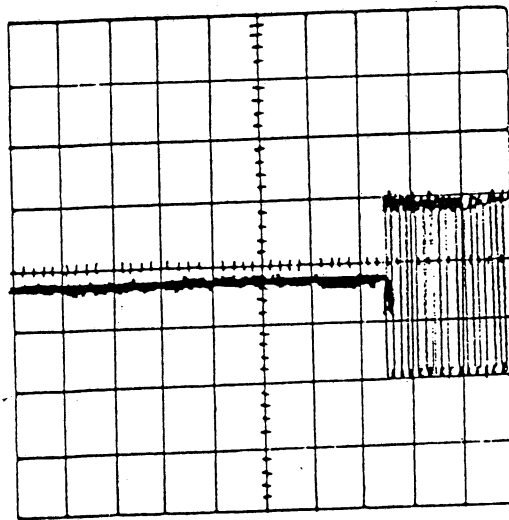
  - Two (2) DIP clips and two (2) pin-to-pin jumpers.
3. Diagnostic listed in Appendix A or toggle-in programs listed in Appendix B & C. (for head selection)
4. Standard Reference Cartridge ( RL01K-RF or RL02K-RF )

2.2 EQUIPMENT SETUPOSCILLOSCOPE

Channel 1 Probe	- Servo Data, R/W Module TP2
Channel 1 Ground	- Signal Gnd, R/W Module TP3
Coupling	- DC
Vertical Mode	- Channel 1
Vertical Gain	- (Outer Cyl) 500mv/div (50mv/div. w/X10 probe)
	- (Inner Cyl) 200mv/div (20mv/div. w/X10 probe)
Ext. Sync Probe	- DLM version 1 , TP9 (sector time)
	- DLM version 2 , TP11 (sector time)
	- DLM version 3 , TP11 (sector time)
Ext. Sync Gnd	- DLM (all) , TP2 (signal gnd)
Trigger Source	- External
Trigger Coupling	- AC
Trigger Slope	- Negative
Sweep time	- 2us/div.
Sweep mode	- Auto or Norm. trigger

## 2.3 PROCEDURE - Sector-to-S1 Check

- v1. Remove both top cover assemblies from the RL Drive.
2. Defeat SK TO (Seek Timeout) and Cover Interlock. (Appendix D)
3. Place the read/write module assembly up and away to expose the carriage assembly.
4. Install the **STANDARD REFERENCE CARTRIDGE.**
5. Press WRT PROT switch to IN.
6. Depress LOAD switch to IN and wait for the heads to load onto the cartridge.
7. Select head 0. (Appendix A)
8. Set the vertical gain to display a deflection of 500mv/div on the oscilloscope and observe a waveform similar to the one shown below.



Time = 2us/div.

Figure 2

9. Measure the time between the start of the trace and the beginning of the S1 servo burst when the positioner is on Cylinder 0. Record this value.

\*\*\* See Note 2, Section 2.5 \*\*\*

## 2.3 PROCEDURE - Sector-to-S1 Check (continued)

10. Select Head 1. (Appendix A)
11. Repeat step 9 above for head 1 and record this value.
12. CAREFULLY move the positioner towards the spindle to the innermost cylinder. Be sure to "CAREFULLY" grab the positioner and NOT the heads themselves. You will feel a slight "detented" resistance when moving the positioner. The resistance will become noticeably greater when you attempt to move beyond the innermost cylinder into the inner guardband. Merely release the positioner and allow it to lock onto the inner cylinder.
13. Set the vertical gain to display a deflection of 200mv/div on the oscilloscope and observe a waveform similar to the one shown in Figure 2.
14. Measure the time between the start of the trace and the beginning of the S1 servo burst when the positioner is on this cylinder (255 for RL01 or 511 for RL02). Record this value for Head 1. (Note: Head 1 should still have been selected since step 10 above.)

\*\*\* See Note 2, Section 2.5 \*\*\*

15. Select Head 0.
16. Repeat step 14 above for head 0 and record this value.
17. COMPARE the Sector-to-S1 times written on the STANDARD REFERENCE CARTRIDGE for "HEAD 1" to the displayed values recorded in steps 9 and 11. Perform the alignment procedures in Section 2.4 if these values do not closely match.
18. If the alignment procedure was performed, repeat the check procedure and record all values as "after adjustment" values.
19. Review the "displayed" Sector-to-S1 times for "HEAD 0" recorded in step 18 above.



## 2.3 PROCEDURE - Sector-to-S1 Check (continued)

20. ----- (Head 1 aligned - Head 0 check) -----

o If the displayed value is greater than 17us or less than 13us at the "inner" or "outer" cylinder, replace head 0 and repeat the alignment procedure (section 2.4) and resord all new values per section 2.3.

o If Sector Jitter exists (Figure 4), then:

a) The "upper" limit for sector jitter must be 17us or less.

- AND -

b) The "lower" limit for sector jitter must be 13us or greater.

o If these limits are exceeded, replace head 0 and repeat the Alignment procedure (section 2.4).

21. If the Head 0 limits in step 20 are still exceeded, try replacing Head 1 and repeat the Alignment procedure.

## 2.4 PROCEDURE - Sector-to-S1 Alignment

1. Perform steps 1 thru 6 in Section 2.3.
2. Select Head 1. (Appendix A)
3. Find the six (6) largest Phillips screws on the positioner baseplate shown in figure 3 below.

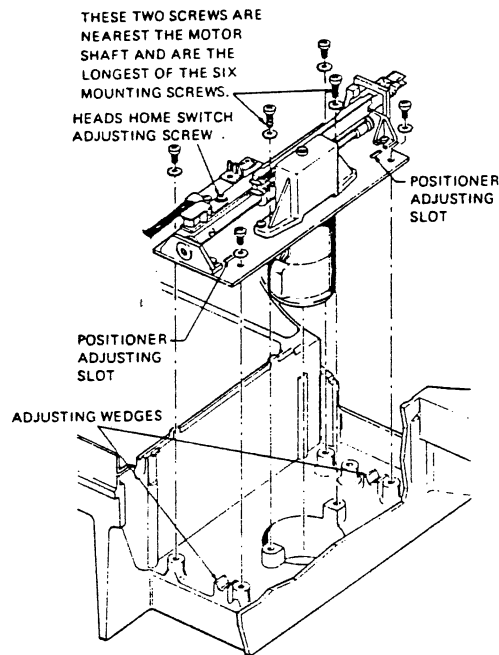


Figure 3

4. Slightly loosen but do not remove these 6 screws.
5. Insert two (2) flatblade screwdrivers into the positioner adjusting slots and adjust the positioner until the displayed servo time matches the S1 time recorded on the STANDARD REFERENCE CARTRIDGE for Surface 1, Track 0.

\*\*\* Refer to Notes 1 and 2, Section 2.5 \*\*\*

6. CAREFULLY move the positioner towards the spindle to the innermost cylinder. Be sure to "CAREFULLY" grab the positioner and NOT the heads themselves. You will feel a slight "detented" resistance when moving the positioner. The resistance will become noticeably greater when you attempt to move beyond the innermost cylinder into the inner guardband. Merely release the positioner and allow it to lock onto the inner cylinder.
7. Adjust the positioner until the displayed servo time matches the S1 time recorded on the STANDARD REFERENCE CARTRIDGE for Surface 1, Track 255 for RL01 or Track 511 for RL02.
8. Carefully tighten the 6 mounting screws in "small increments".
9. Perform the Alignment Check procedure in section 2.3.

## 2.5 SECTOR-to-S1 Alignment Notes

- Note 1. When aligning the positioner, adjust the "back" screwdriver when the heads are on an inner cylinder (255 or 511). Adjust the "front" screwdriver when the heads are on an outer cylinder (0).
- Note 2. When reading Sector-to-S1 time, some cartridges may exhibit "Sector Jitter". This is caused by slight variations of the distance between the machined sector slots on the cartridge hub. Figure 4 (below) shows an "Exaggerated" example of sector jitter when displayed on an oscilloscope.

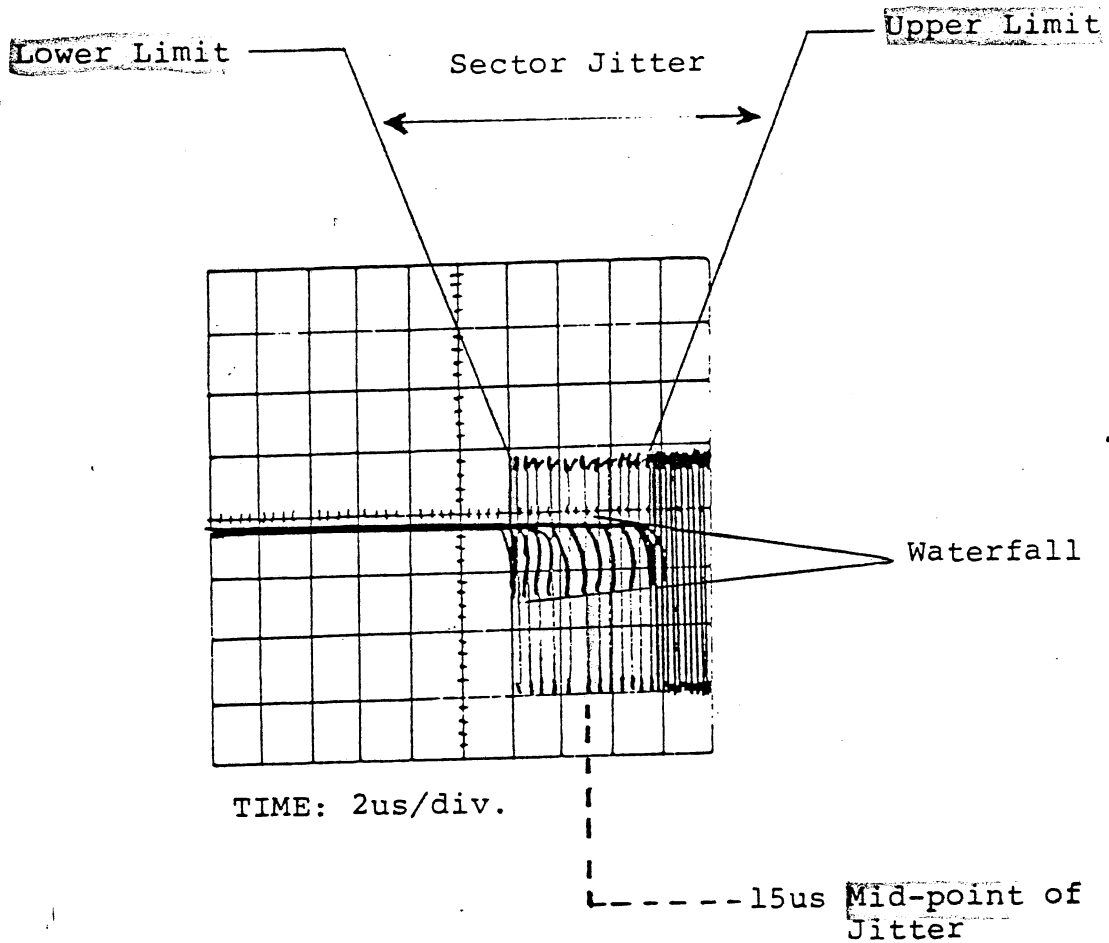


Fig. 4 S1 Servo Burst

Note the indicated "upper" and "lower" limits of the jitter. Also note the "waterfall" area caused by varying times of the S1 leading edge pulses for 40 sectors. Occasionally it may be easier to approximate the "range" of sector jitter by observing the "waterfall".

WHEN ADJUSTING OR MEASURING SECTOR-TO-S1 TIME AND DISPLAYABLE SECTOR JITTER EXISTS, THE "MIDPOINT" OF THE SECTOR JITTER RANGE SHOULD BE USED AS THE S1 TIME, NOT THE UPPER NOR LOWER LIMIT VALUES.

### 3.0 HEAD ALIGNMENT CHECK and ADJUSTMENT

- o The heads should be checked and or adjusted **"ONLY"** with a **STANDARD REFERENCE CARTRIDGE.** (RL01K-RF OR RL02K-RF)
- o The "normal" setup and alignment/check procedures may be used. These are available using any of the following documents:
  - EK-RL012-PG-003    RL01/02 Pocket Service Guide
  - EK-RLTER-PS-002    RL01/02 Pocket Service Guide

### 4.0 CARTRIDGE CHECK

- o These guidelines should be followed when checking normal cartridges (RL01K-DC, RL01K-EF, RL02K-DC, or RL02K-EF) in drives that have been pre-aligned with a **Standard Reference Cartridge.**
- o Perform all Drive alignments/checks with a STANDARD REFERENCE CARTRIDGE (RL01K-RF or RL02K-RF) before checking other cartridges in the drive.

#### 4.1 Cartridge Check - Servo Amplitude

1. The amplitude of the S1 servo burst should be no less than 500mv on either head of any cylinder. (typically checked on the inner cylinder)
2. The amplitude of the S1 servo burst should be no greater than 2.25v on either head of any cylinder. (typically checked at cylinder 0)
3. If steps 1 and 2 above cannot be achieved, the cartridge should be rejected.

#### 4.2 Cartridge Check - Sector-to-S1 Time

1. Sector-to-S1 time should be 15us +/- 3us on both heads on any cylinder. (typically checked at the inner & outer cylinders)
2. If sector jitter exists (see Fig. 4), the upper limit of sector jitter should not exceed 18us and the lower limit should not fall below 12 us.
3. If steps 1 & 2 above cannot be achieved, the cartridge should be rejected.

## Appendix A

## \*\*\*\* Head Selection Procedures \*\*\*\*

PDP-11 Based Systems

## DLM Version 1 or 2

- Load DZRLCxx or CZRLIxx
- Run Head Alignment routine
- Use WRITE PROT switch

In = select head 1  
Out = select head 0

## DLM Version 3

- Repower up RL drive to clear internal drive command/status register(s). This will assure Head 0 is default selected.
- Jumper TP21 to TP22 to select head 1
- Remove jumper to select head 0

Note: If diagnostics are unavailable, use the toggle-in program listed in Appendix B.

PDP-8 Based Systems

## DLM Version 1 or 2

- Load AJRLBxx or AJRLHxx
- Run Head Alignment routine
- Use WRITE PROT switch

In = select head 1  
Out = select head 0

## DLM Version 3

- Repower up RL drive to clear internal drive command/status register(s). This will assure Head 0 is default selected.
- Jumper TP21 to TP22 to select head 1
- Remove jumper to select head 0

Note: If diagnostics are unavailable, use the toggle-in program listed in Appendix C.

## Appendix B

\*\*\*\* Toggle-in Program \*\*\*\*

HEAD SELECTION FOR RL11/RLV11

1000	012700	Housekeeping
1002	174400	
1004	012701	
1006	174404	
1010	105710	Wait
1012	100376	
1014	012711	Get Status Command
1016	000013	
1020	012710	
1022	000004	
1024	105710	Wait
1026	100376	
1030	013702	Status Word
1032	174406	
1034	006302	
1036	010203	
1040	006303	
1042	105702	Check HS Bit
1044	100405	
1046	005703	Check WL Bit
1050	100357	Equal, Loop
1052	012711	Set HS Bit
1054	000021	
1056	000404	Go to Seek Command
1060	005703	Check WL
1062	100752	Equal, Loop
1064	012711	Reset HS Bit
1066	000001	
1070	012710	Seek Command
1072	000006	
1074	000745	Loop

## Appendix C

\*\*\*\* Toggle-in Program \*\*\*\*

HEAD SELECTION FOR RL8A

200	6600	Clear controller
201	1234	
202	6604	Get Status Command
203	6601	Wait
204	5203	
205	6615	First Word of Status
206	0232	
207	7640	Check HS Bit
210	5217	HS=1, Go to 217
211	6615	2nd word of Status
212	0233	
213	7650	Check WL Bit
214	5201	HS=WL, Go to 201
215	7332	
216	5224	
217	6615	2nd Word of Status
220	0233	
221	7640	Check WL
222	5201	HS=WL, Go to 201
223	7300	
224	6603	Hs to Command Reg A
225	7325	
226	6604	Seek Command to Command Reg B
227	6601	Wait
230	5227	
231	5201	Loop to 201
232	0100	Constant
233	0040	Constant
234	1002	

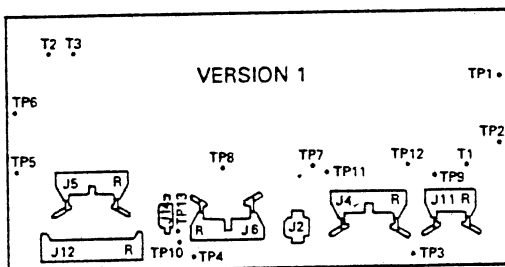
Appendix D

\*\*\*\* Service Jumpers for DLM (Drive Logic Module) \*\*\*\*

Version	Defeat Cover Switch	Defeat Filtered POS SIG	Defeat SK TO	Select Head 1
1	E33-3 to E33-7	TP8 to TP4	E17-6 to E17-7	See table 1
2	E54-12 to E54-7	TP6 to TP4	E10-7 to E10-8	See table 1
3	TP19 to TP20	TP6 to TP4	TP23 to TP24	TP21 to TP22

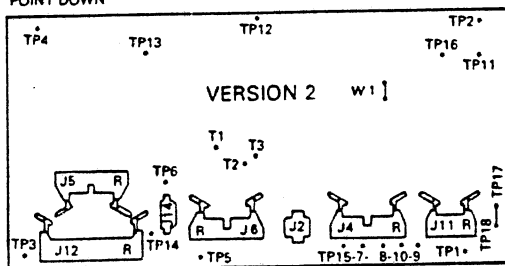
Note:

Version 1 DLM = p/n 54-12175 (RL01 only)  
 Version 2 DLM = p/n 54-13531 (obsolete)  
 Version 3 DLM = p/n 54-14025 (RL01 or RL02)



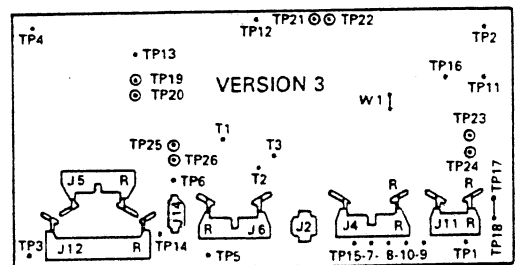
54-12175  
RL01 ONLY

NOTE:  
J11 AND J4  
POINT DOWN



54-13531  
RL02 OR RL01  
W1 IN FOR RL01  
W1 OUT FOR RL02

NOTE:  
J4 AND J11 POINT UP  
NO TP19 THRU 26



NOTE: R DENOTES RED STRIPE

54-14025

RL02 OR RL01  
W1 IN FOR RL01  
W1 OUT FOR RL02

NOTE:  
J4 AND J11 POINT UP  
HAS TP19 THRU 26

JUMPER TEST LUGS EFFECT  
19-20 DEFEAT COVER CLOSED  
21-22 SELECT HEAD 1  
23-24 DISABLE SKTO

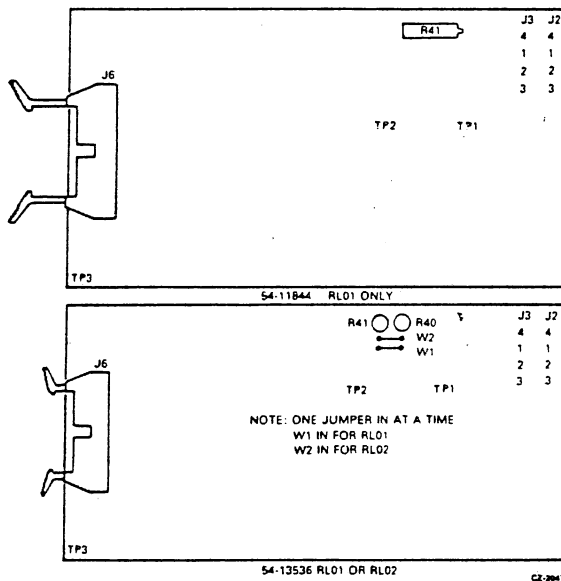
(THESE TEST LUGS ARE CIRCLED)

CZ-2046



Appendix E

\*\*\*\* READ/WRITE MODULE LAYOUT \*\*\*\*



Notes: (for 54-13536)

- o W1 "in" selects R41 (normally for adjusting RL01)
- o W2 "in" selects R40 (normally for adjusting RL02)
- o If you are adjusting R40 or R41 on the 54-13536 and the potentiometer should happen to break, merely "exchange" the W1/W2 jumpers and use the other potentiometer for that drive.

(both potentiometers are the same; W1/W2 merely determine which potentiometer is electrically inserted)

INITIAL READINGS

READINGS AFTER SETUP

VERIFICATION READINGS  
(N/A FIRST DRIVE)

DRIVE S/N- \_\_\_\_\_

CARTRIDGE S/N- \_\_\_\_\_

O.D. CYLINDER 000			
TOP		BOTTOM	
S1 AMP	SECTOR TIME	S1 AMP	SECTOR TIME
I.D. CYLINDER 511			
TOP		BOTTOM	
S1 AMP	SECTOR TIME	S1 AMP	SECTOR TIME

O.D. CYLINDER 000			
TOP		BOTTOM	
S1 AMP	SECTOR TIME	S1 AMP	SECTOR TIME
I.D. CYLINDER 511			
TOP		BOTTOM	
S1 AMP	SECTOR TIME	S1 AMP	SECTOR TIME

O.D. CYLINDER 000			
TOP		BOTTOM	
S1 AMP	SECTOR TIME	S1 AMP	SECTOR TIME
I.D. CYLINDER 511			
TOP		BOTTOM	
S1 AMP	SECTOR TIME	S1 AMP	SECTOR TIME

DRIVE S/N- \_\_\_\_\_

CARTRIDGE S/N- \_\_\_\_\_

O.D. CYLINDER 000			
TOP		BOTTOM	
S1 AMP	SECTOR TIME	S1 AMP	SECTOR TIME
I.D. CYLINDER 511			
TOP		BOTTOM	
S1 AMP	SECTOR TIME	S1 AMP	SECTOR TIME

O.D. CYLINDER 000			
TOP		BOTTOM	
S1 AMP	SECTOR TIME	S1 AMP	SECTOR TIME
I.D. CYLINDER 511			
TOP		BOTTOM	
S1 AMP	SECTOR TIME	S1 AMP	SECTOR TIME

O.D. CYLINDER 000			
TOP		BOTTOM	
S1 AMP	SECTOR TIME	S1 AMP	SECTOR TIME
I.D. CYLINDER 511			
TOP		BOTTOM	
S1 AMP	SECTOR TIME	S1 AMP	SECTOR TIME

DRIVE S/N- \_\_\_\_\_

CARTRIDGE S/N- \_\_\_\_\_

O.D. CYLINDER 000			
TOP		BOTTOM	
S1 AMP	SECTOR TIME	S1 AMP	SECTOR TIME
I.D. CYLINDER 511			
TOP		BOTTOM	
S1 AMP	SECTOR TIME	S1 AMP	SECTOR TIME

O.D. CYLINDER 000			
TOP		BOTTOM	
S1 AMP	SECTOR TIME	S1 AMP	SECTOR TIME
I.D. CYLINDER 511			
TOP		BOTTOM	
S1 AMP	SECTOR TIME	S1 AMP	SECTOR TIME

O.D. CYLINDER 000			
TOP		BOTTOM	
S1 AMP	SECTOR TIME	S1 AMP	SECTOR TIME
I.D. CYLINDER 511			
TOP		BOTTOM	
S1 AMP	SECTOR TIME	S1 AMP	SECTOR TIME

DRIVE S/N- \_\_\_\_\_

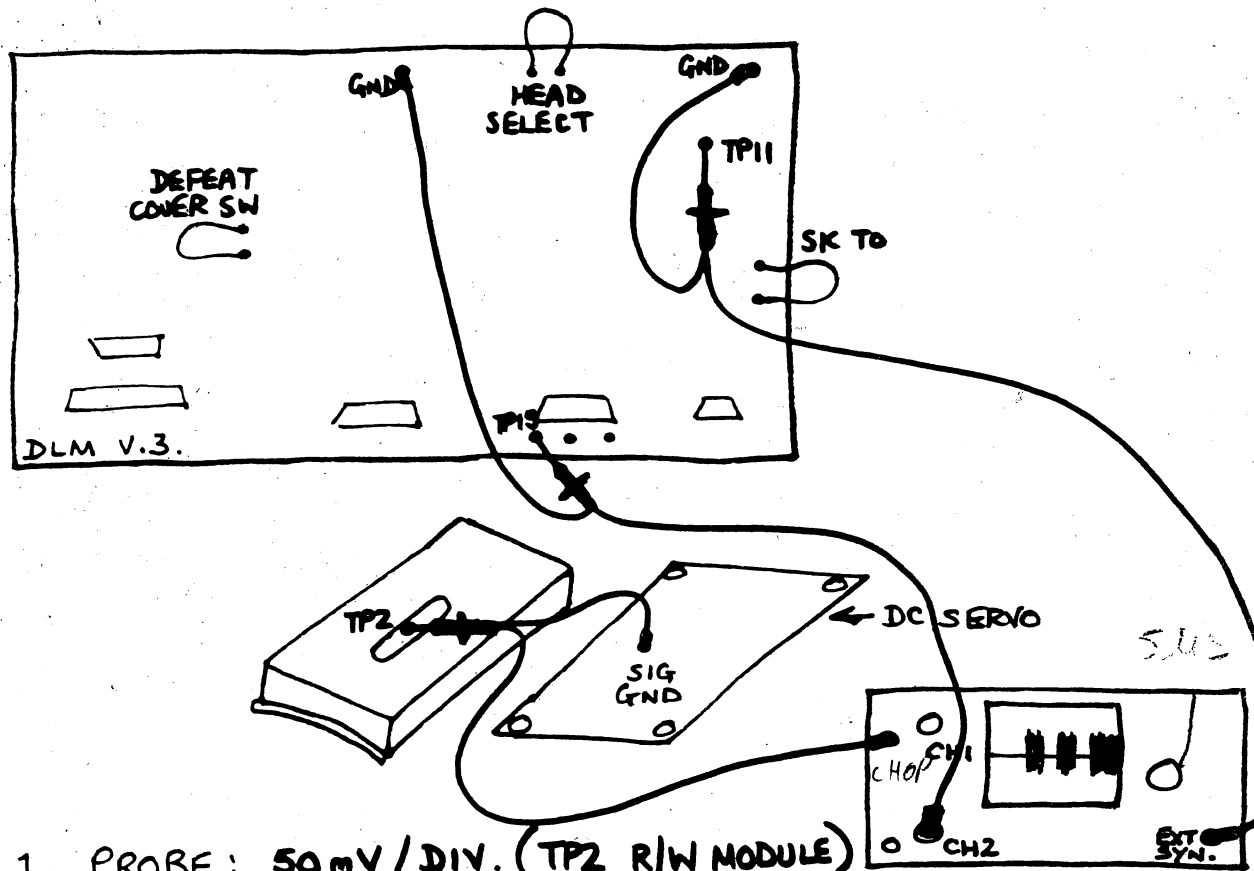
CARTRIDGE S/N- \_\_\_\_\_

O.D. CYLINDER 000			
TOP		BOTTOM	
S1 AMP	SECTOR TIME	S1 AMP	SECTOR TIME
I.D. CYLINDER 511			
TOP		BOTTOM	
S1 AMP	SECTOR TIME	S1 AMP	SECTOR TIME

O.D. CYLINDER 000			
TOP		BOTTOM	
S1 AMP	SECTOR TIME	S1 AMP	SECTOR TIME
I.D. CYLINDER 511			
TOP		BOTTOM	
S1 AMP	SECTOR TIME	S1 AMP	SECTOR TIME

O.D. CYLINDER 000			
TOP		BOTTOM	
S1 AMP	SECTOR TIME	S1 AMP	SECTOR TIME
I.D. CYLINDER 511			
TOP		BOTTOM	
S1 AMP	SECTOR TIME	S1 AMP	SECTOR TIME

# HEAD ALINEMENT ON RLO2 USING VERSION 3 DLM



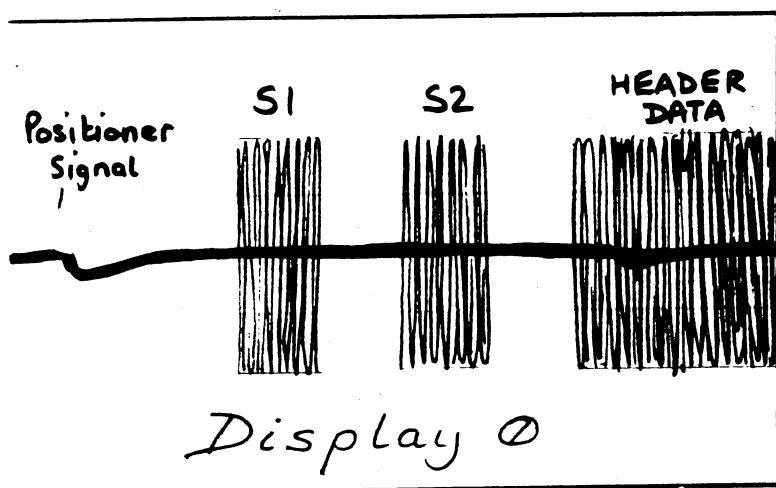
- CHANNEL 1 PROBE: 50mV/DIV. (TP2 R/W MODULE)  
GROUND: ANY SIGNAL GROUND
- CHANNEL 2 PROBE: 2V/DIV. (TP15)  
GROUND: ANY SIGNAL GROUND
- EXTERNAL SYNC. PROBE: (TP11) EXTERNAL TRIGGER (AC COUPLING).  
GROUND: SIGNAL GROUND DC SERVO MODULE

- 1) Install the bottom head (HEAD 1) and before tightening slide head off the end stop by approximately 1mm.
- 2) Install the top head (HEAD 0) and tighten only finger tight at this time
- 3) Load 'BLUE REFERENCE PACK', link head select terminal with a jumper this will select the bottom head. Spin the drive up and the heads will load on to the pack with

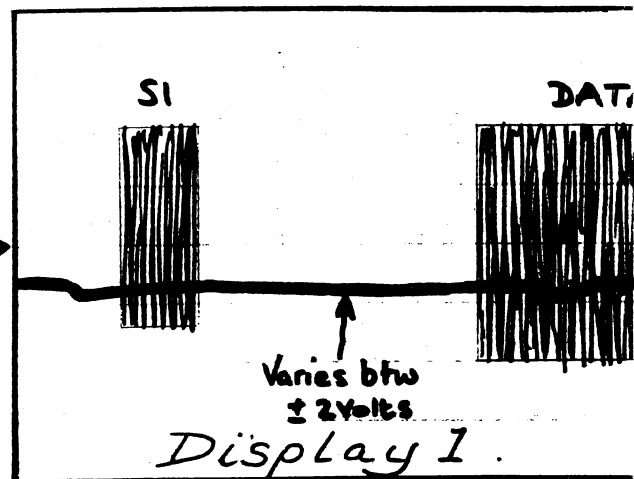
the bottom head sitting directly over track 0

4) Disconnect the RED wire from the DC servo module to the Positioner. (This will allow the heads to move freely over the pack, so be careful not to move the head off track 0)

5) Remove the head select jumper, The oscilloscope display will show where head 0 is sitting. Adjust the top head outwards until the display matches that of the original display for head 1.



Head directly over track 'n'



When selecting head 0 after head 1 directly over track 0, this type of display should be seen.

Adjust top head outward until it is the same as display 0.

Be careful to make sure the top head is over track 0, its easy to go to far and line it up over the wrong track.

### Positioner Signal

Outer Guard band: +8 V.

Inner Guard band: -8 V.

Before track: -2V rising.

After track: higher than 0 Volts.

