APPENDIX A - DUMMY LOAD AND CABLES CALIBRATION

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A-1 DESCRIPTION

Description

This procedure is used to calibrate the test dummy load and cables that are used with the Bird wattmeter in the RF Amplifier Tuning and Gain Characterization and Power Monitor Functional Check procedures. It is also used to calibrate the dummy load and temporary cables for Body Coil Power Absorption Measurement on systems with quadrature drive Body Coils.

The transmit and receive frequencies are offset by 488 Hz and test cables long enough to reach the cable or dummy load plus cables to be tested are connected between the Exciter RF Output and Receiver "Test In" input. Receive (R1 & R2) and transmit gain (TG) are set for full scale reading on the power spectrum during prescan calibration. A scan is taken *without* preprocessing the data, i.e. echo and chopper data are not subtracted prior to storage in the raw file. ATTEN_TEST is used to calculate the peak-to-peak amplitude squared of the I channel signal (1KHz sine wave). The first scan is used by ATTEN_TEST as a reference scan.

Next, the attenuator and/or cable(s) to be tested are inserted in series with the test cables and another scan is taken. ATTEN_TEST is again used to calculate I channel peak-to-peak amplitude squared. The ratio of the square of the initial amplitude to the square of the final amplitude yields the Peak-to-Peak Squared Gain Factor (power ratio) of the dummy load and/or cable(s) being tested.

A-2 TOOLS AND INSTRUMENTS REQUIRED

Item	Description	Part Number	Qty.
1	50 ohm dummy load, 200 watt, 30 dB attenuator - Bird Model 8322	46-255837P10	1
2	RF Test Cables Kit	46-301549G1	1

A-3 SCAN PREPARATION

1. Remove front cover from System Cabinet.
2. Reconfigure hardware as shown in Illustration A-1 for Horizon 5.X 1.5T and 1.0T systems

Note

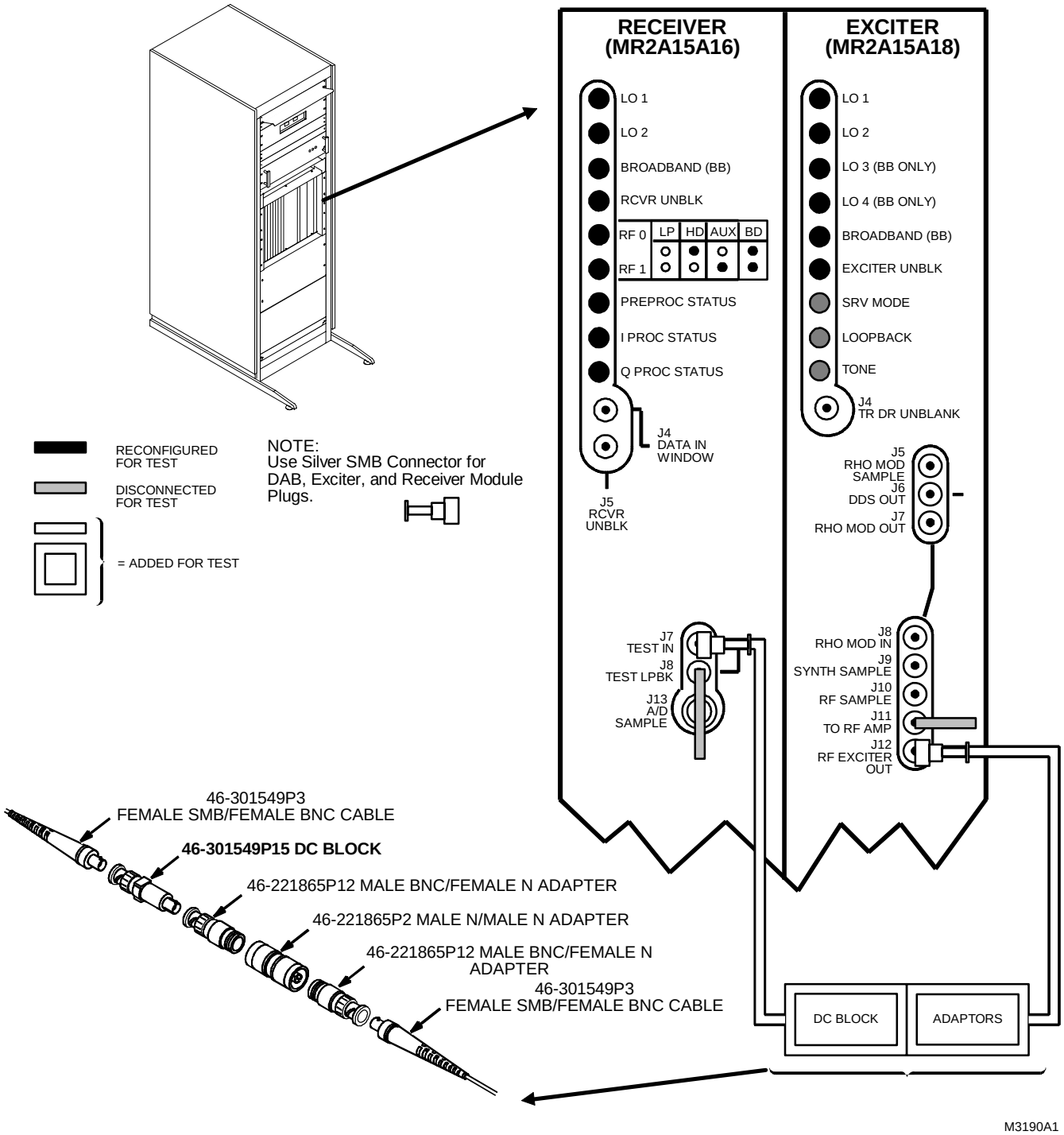
You may not use all adapters from RF Cable Kit to connect to dummy load or cable. Variances exist in equipment configurations.

Note

Be sure to use the DC Block with the adapters to prevent damage to the Receiver from any DC Offset.

3. Disconnect patch connector at front of Exciter J12.

A–3 SCAN PREPARATION (continued)



CONNECTIONS FOR INITIAL AMPLITUDE SCAN (RELEASE 5.X 1.5T AND 1.0T)
ILLUSTRATION A-1

A–3 SCAN PREPARATION (continued)

4. Disconnect patch cable at front of Receiver J7.

5. Connect test cables and any adapters between Exciter J12 and Receiver J7, that will be needed later to connect either the dummy load or other calibrated cables.

6. Prepare system to scan using the following scan parameters:

SCAN PRESCRIPTION:
1. **[Scan Modes]**, **[Service]**, **[Accept]**. Select **[New Exam]**, then Landmark phantom. Enter id: **geservice**, Name, Patient Weight.
2. **[List/Sel Protocol]**, select **80** (1.5T & 1.0T). **[View Protocol]**, select Series **1**. **[⇐]**, then **[Scan Ops]**.
3. Perform **[Setup Params]**, then **[Modify CVs]** per below.

SCAN PRESCRIPTIONS

MAIN MENU	**[New Exam]**
PATIENT/EXAM INFORMATION	
id:	**geservice**
Name:	**dummy load cal**
Patient Weight:	**300**
	[Patient Position]
PATIENT POSITION	
Patient Entry	**[Head First]**
Patient Position	**[Supine]**
Axial/Sag. Landmark	**[Sternal Notch]**
Coil Type	**[Body Coil]**
Scan Plane	**[Axial]**
	[Image Params]
IMAGING PARAMETERS	
Image Mode	**[2D]**
(* *SAR must be "On"* *)	**[Monitor SAR]**
Pulse Sequence	**[Spin Echo]**
Imaging Options	**[None]**
or enter PSD Filename	**cal**
	[Scan Timing] or [Next Screen]
SCAN TIMING	
Number of Echoes	**[1]**
Echo Time (TE)	**[25 msec]**
Rep Time (TR)	**[Other] 200** msec
	[Scan Set-Up]

SCAN SET-UP	
Prescan Options	none (Release 5.4)
Auto CF	**[Peak]**
	[Scanning Range]
SCANNING RANGE	
Field of View	**[24 cm]**
Scan Thickness	**[5 mm]**
Interscan Spacing	**[Other] 0**
Start Loc(I/S):	**0**
End Loc (I/S):	**0**
No. of Scan Locations:	1
FOV Center (L/R)	0 (P/A): 0
	[⇐] [Acq Time]
ACQUISITION TIME	
Acq. Matrix (freq.)	**[256]**
Acq. Matrix (phase)	**[128]**
Frequency Direction	**[R/L]**
Phase FOV	default
Imaging Time	**[2 NEX 0:52]**
Contrast	**[No]**
Table Delta:	0 mm
	[Scan Ops]
SCAN OPERATIONS	

[Modify CV's]

calmode = **2** (trapezoid pulse)
p2 ramp = **1** (1 usec ramptime)
t2 = **50000** (50 msec tr)
pismode = **1** (exc service)
pmode = **1** (data collection)
daqm = **1** (data in window)
[Back up]

[Setup Params]

R1 = **4** (receiver analog gain setting)
R2 = **14** (receiver digital gain)
RIGHT DISPLAY
FRAME **1**
FRAME **0**
PLOT GAIN **1**
PLOT TYPE **I**
[Backup]

A-4 DATA COLLECTION

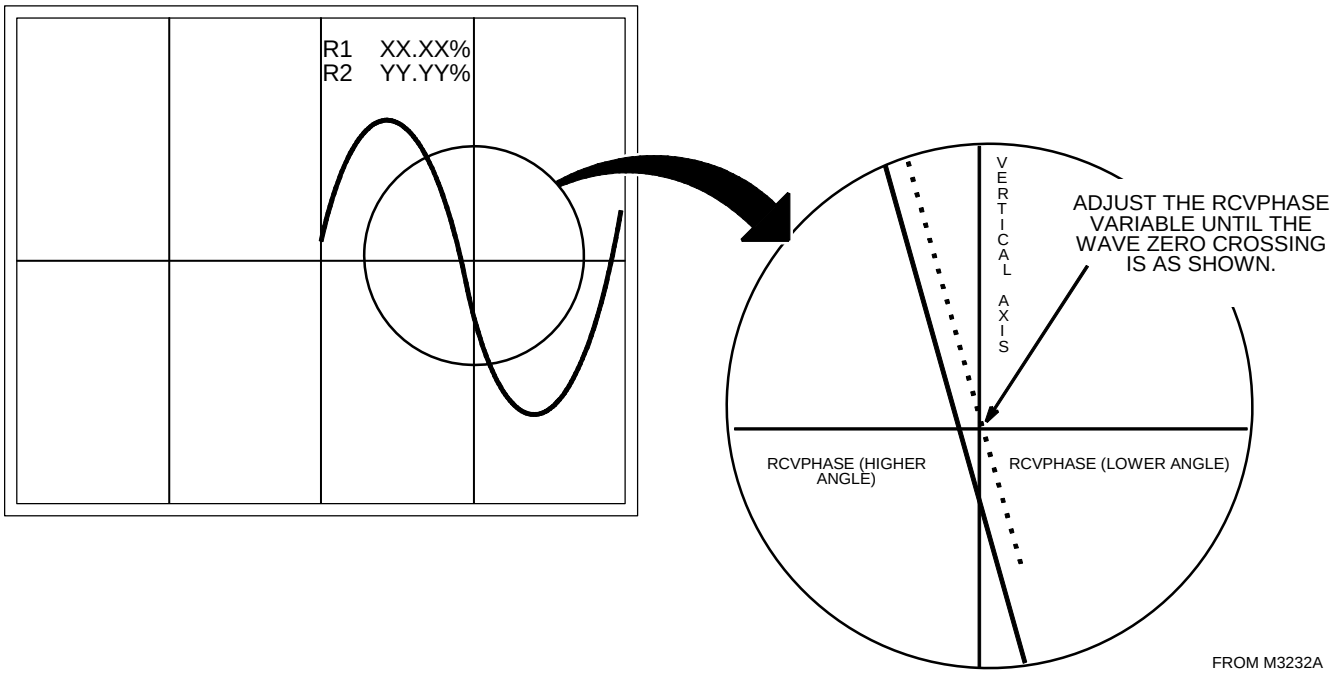
1. **[Manual Prescan].**
2. Type **mrsp <ENTER>.**
3. Type **dr 488 <ENTER>.**

Note

Modifying RSP variable “dr” (Delta Receive) will change the Receive frequency by that amount. This will produce a beat frequency (488 Hz) between the Exciter and Receiver that is one cycle long and displayed on the IP.

Note

The actual waveform may be shifted along the horizontal axis. This will be adjusted with the “rcvphase” RSP.



REFERENCE SCAN IP DISPLAY
ILLUSTRATION A-2

4. Type **rcvphase xx <ENTER>.**
5. Enter a phase angle value (xx) that lines up the zero crossing of the sine wave with the vertical axis of the IP display. See Illustration A-2.

Note

This adjusts the phase shift between the Exciter and Receiver, due to the test hardware.

A–4 DATA COLLECTION (continued)

6. Adjust Transmit Gain (TG) to achieve an R1 or R2 (on IP display) of approximately 98% without going OVER.
7. **[Back Up].**
8. **[Scan].**

Note

Ignore the message: "MR Signal too large, reduce receiver gain."

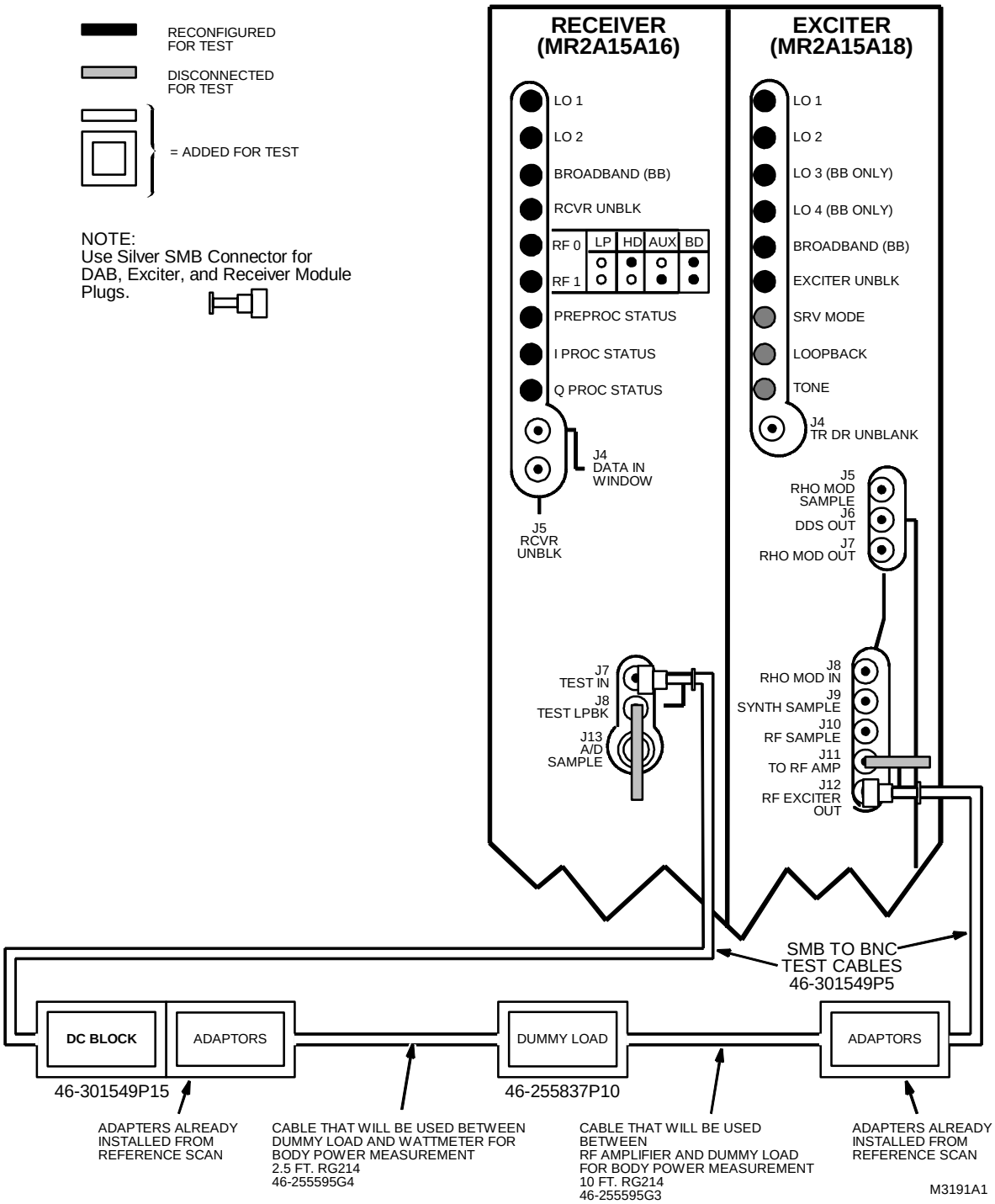
9. Select **[Utilities],** followed by **[MR Tools]** from the touch screen.
10. Use **[Atten Test]** tool selection to analyze data as follows:

OUTPUT/PROMPTS	INPUT/COMMENT
Last run number use was: XXXX	
Please enter runfile number [XXXX]:.....	**<ENTER>**
Please select Locked / Unlocked file (L, U) [U]:.....	**<ENTER>**
|**********|	(working)
**********	
Average Max. Peak to Peak Across All Views = aaaaa	
Average Max. Peak to Peak Squared = bbbbb	
Average RMS Across All Views = ccccc	
**********	
Do you want to make this run the reference (Y,N) [N]:.....	**Y <ENTER>**
Do you want to compute Gain or Attenuation Ratio (G, A) [G}:.....	(do not respond yet).

(Continued)

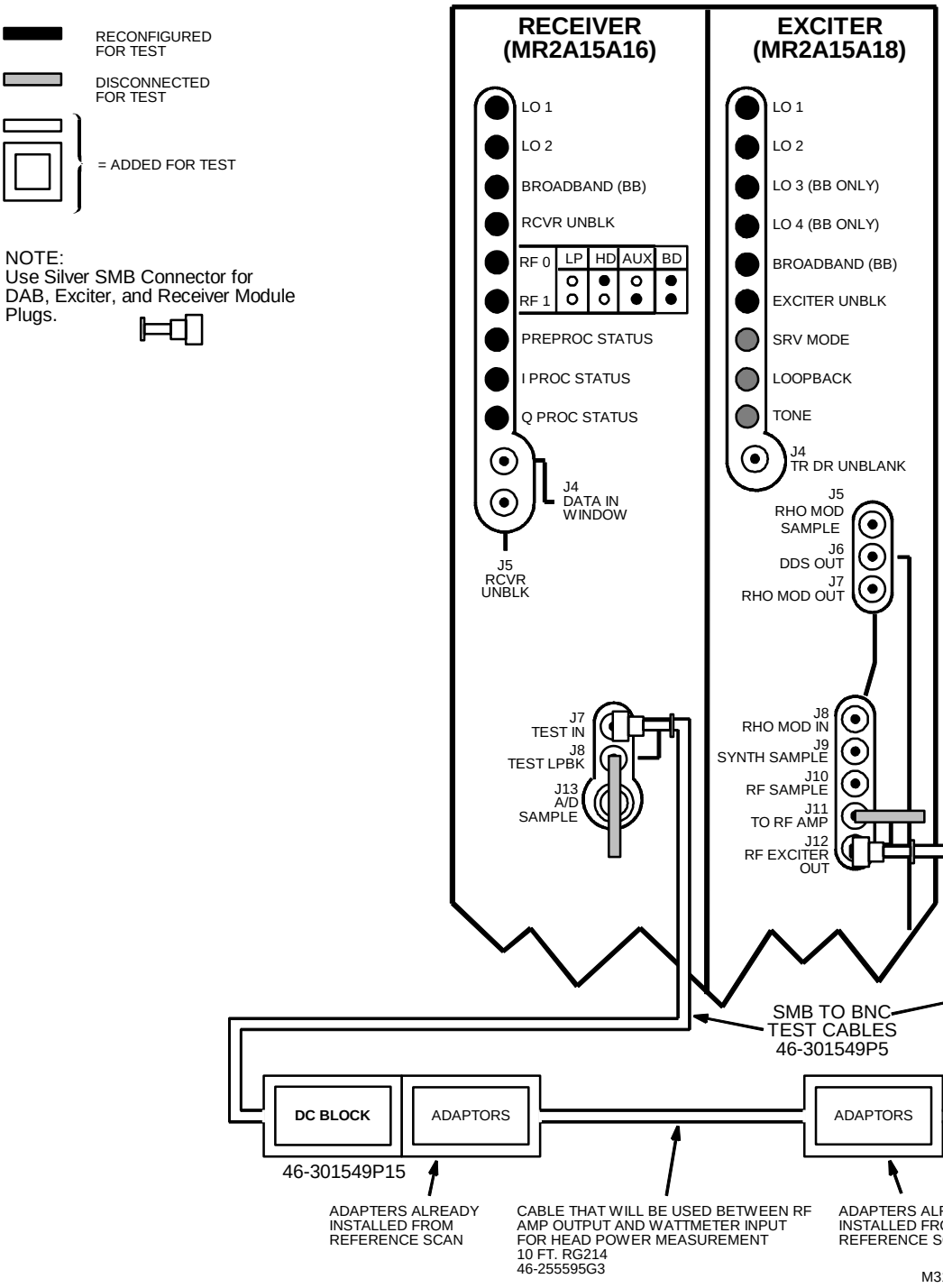
11. Connect test cables to opposite ends of either DUMMY LOAD + CABLES or AMP TO WATTMETER CABLE as shown in Illustrations A-3 or A-4 for 1.5T and 1.0T Systems.

A–4 DATA COLLECTION (continued)



CONNECTIONS FOR DUMMY LOAD + CABLES ATTENUATED AMPLITUDE SCAN (RELEASE 5.X 1.5T AND 1.0T)
ILLUSTRATION A-3

A–4 DATA COLLECTION (continued)



AMP TO WATTMETER CABLE ATTENUATED AMPLITUDE SCAN (RELEASE 5.X 1.5T AND 1.0T)
ILLUSTRATION A-4

A–4 DATA COLLECTION (continued)

12. **[Manual Prescan]**

Note

It may be necessary to increase the right display gain (RG) value to see the zero crossing of the display. This does not effect the actual signal level.

Note

Do not adjust transmit gain (TG) or Receive Gain (R1 or R2).

13. Type **mrsp <ENTER>.**
14. Type **dr 488 <ENTER>.**
15. Type **rcvphase xx <ENTER>.**
16. Enter a value (xx) that lines up the zero crossing of the sine wave with the vertical axis of the IP display. See Illustration A-2.
17. **[Back Up].**
18. **[Scan].**

Note

Do not readjust transmit or receive attenuation.

A-5 ANALYSIS

OUTPUT/PROMPTS	INPUT/COMMENTS
Do you want to compute Gain or Attenuation Ratio (G, A) [G]:.....	**A <ENTER>** (When scan is complete.)
please do the next scan	
Press <ENTER> key to continue, s or q to quit[ ]	**<ENTER>**
last run number used was: XXXX	
Please enter runfile number (s = stop) [XXXX]:.....	**<ENTER>**
Please select Locked / Unlocked file (L,U) [U]:.....	**<ENTER>**
|**********|	(Working)
**********	
Average Max. Peak to Peak Across All Views = aaaaa	
Average Max. Peak to Peak Squared = bbbbb	
Average RMS Across All Views = ccccc	
Peak to Peak Attenuation Factor = xxxxx	
Peak to Peak Squared Attenuation Factor = xxxxx ←	**Record in Table A-1.**
RMS Attenuation Factor = zzzzz	

(Continued)

A–5 ANALYSIS (continued)

1. Record "P-P Squared Attenuation Factor" value as either DUMMY LOAD + CABLES ATTEN FACTOR or AMP TO WATTMETER ATTEN FACTOR in Table A-1.
2. Repeat DATA COLLECTION and ANALYSIS for AMP TO WATTMETER CABLE. Reselect the same runfile for the reference scan.

TABLE A-1
ATTENUATION FACTORS

CALIBRATED HARDWARE	PART NUMBER(S)	VALUE	NOMINAL VALUES
DUMMY LOAD + CABLES ATTEN FACTOR	46-255595G3 + 46-255837P10 + 46-255595G4		1000 TO 1200
AMP TO WATTMETER ATTEN FACTOR	46-255595G3		1.0 TO 1.2

A-6 CALCULATION OF CALIBRATION FACTOR FOR 1.5T SYSTEMS

When measuring high frequency (64 MHz) on the TEK 468 scope, there will be an error due to the 100 MHz bandwidth limitations of the scope. The error is approximately 12 percent at 63.86 MHz. Therefore, when measuring a 10 dbm signal, the true amplitude is 1 V PK but, the TEK 468 will read ≈ 0.88 V PK. Peak voltage, **not peak-to-peak**, can be converted to power using the following formula as a check for proper operation of the Bird wattmeter:

NOTE:
Z = 50

$$\frac{\left(\frac{Peak\ Voltage}{Scope\ Correction\ Factor}\right)^2}{(2 \times Z)} \times (Dummy\ Load\ and\ Cable\ Factor) = Power\ (Watts)$$

EXAMPLE

$$\frac{\left(\frac{36}{0.88}\right)^2}{(2 \times 50)} \times (1030) = \frac{(1673)}{(100)} \times (1030) = 17{,}237\ \text{Watts}$$

Note

Due to slight differences in the calibration of the Bird Wattmeter elements, it is possible (and normal) to measure a 10% difference in power between the wattmeter and the scope methods.

A-7 CALCULATION OF CALIBRATION FACTOR FOR 1.0T SYSTEM

When measuring high frequency (42 or 21 MHz) on the TEK 468 scope, there is **no** error due to the bandwidth limitations of the scope. Peak voltage, **not peak-to-peak**, can be converted to power using the following formula as a check for proper operation of the Bird wattmeter:

NOTE:
Z = 50

$$\frac{(\textit{Peak Voltage})^2}{(2 \times Z)} \times (\textit{Dummy Load and Cable Factor}) = \textit{Power}\ (\textit{Watts})$$

EXAMPLE

$$\frac{(10.5)^2}{(2 \times 50)} \times (1030) = \frac{(110)}{(100)} \times (1030) = 1136\ \textit{Watts}$$

Note

Due to slight differences in the calibration of the Bird Wattmeter elements, it is possible (and normal) to measure a 10% difference in power between the wattmeter and the scope methods.

A-8 RESTORATION CHECK LIST

- ❑ Connect original patch connector between Exciter J11 & J12.
- ❑ Connect original patch cable between Receiver J7 & J8.
- ❑ Cover replaced on System Cabinet.
- ❑ One head or body scan performed satisfactorily.