IF (Remote) SYSTEM

Assembly (Chassis) level test procedures for qualification of units

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C61 (First Frequency Converter)

The unit after assembly is to be tested for functionality using signal generators and a spectrum analyzer.

This will require the following apparatus:

- *Marconi 2031 signal generator.*
- *Marconi 2041 signal generator.*
- *Spectrum analyzer, Tek 2710 , Tek 7L14 or HP 8591E.*
- *RG 223 RF cable Type-N male to Type-N female (Two numbers).*
- *RG 223 RF cable TNC male to Type-N male.*
- *+19V DC power supply.*

The experimental setup should be as shown in Figure 1. Set the spectrum analyzer to span 55MHz around the center frequency of 70MHz. Set the signal generators as listed in Table 1, and note down the power level of the 70MHz line appearing on the center of the spectrum analyzer screen after doing a peak search. Complete the table as instructed therein. The results should be within the specified limits. Note down the unit number at the head of the table, in the space provided for this purpose.

After this test, the unit has to be kept powered on in an airconditioned test laboratory for ten days from a +19V power supply (burn in qualifier test).

After the burn in test is complete, the functionality test that was performed before the burn in test, has to be repeated, and results noted down in the appropriate column in the table. The results should again lie within specified limits.

The unit is now ready for final qualification and characterization. This will require the following apparatus:

- *HP 8753C network analyzer.*
- *Marconi 2031 signal generator.*
- *100MHz lowpass filter (a qualified C63 unit will suffice).*
- *HP 11549A 6dB resistive power splitter.*
- *HP colorpro plotter at proper HPIB address (set as per HP 8753C).*
- *Type-N 20dB attenuator pad.*
- *TNC 10dB attenuator pad.*
- *+19V DC power supply.*
- *RG 223 RF cable Type-N male to Type-N male (Three numbers).*
- *RG 223 RF cable TNC female to Type-N female.*
- *RG 223 RF cable Type-N male to Type-N female.*
- *Type-N female to Type-N female adapter.*
- *RG 223 RF cable TNC male to Type-N male.*

The procedure to measure the conversion loss or conversion gain is explained at length in the HP 8753C network analyzers' manual. Appropriate pages are being reproduced for the users' convenience here. The figure numbers and appendix numbers referred to below correspond to the numbers on these reproductions. Set up the apparatus as shown in Figure 31 of Appendix 1, and follow the instruction listed therein. Use the 100MHz lowpass filter with 20dB pad and the 10dB pad on the input side (by using appropriate RF cables) and go through the calibration procedure as listed out. The stimulus settings should be: Center Frequency 70MHz, Span 40MHz, Amplitude 0dBm.

Next reconnect the setup as shown in Figure 9. Insert the device under test, i.e. the C61 unit, in between the 20dB pad and the 10dB pad before the lowpass filter. Apply DC bias, and LO carrier as listed in Table 2 and take plots for each setting. You will require to follow the steps listed out in the measurement procedure repeatedly for each LO setting. The final plots should resemble those shown in Test Plot 1.

Table 1.

Unit Code: C61/

Marconi 2031	Marconi 2041	Spectrum Analyzer readings (dBm)		Minimum	Results		Maximu
(@+12dBm)	(@-55dBm)	Before burn-in test	After burn-in test	(dB)	(dB)	(dB)	(dB)
		A	B		A+55	B+55	
120MHz	50MHz			23			26
220MHz	150MHz			23			26
305MHz	235MHz			22			25
395MHz	325MHz			22			25
680MHz	610MHz			21			24
1070MHz	1000MHz			21			24
1270MHz	1200MHz			20			22
1490MHz	1420MHz			16			18

Table 2.

RF band	Marconi 2031 setting (CW @+12dBm)
50MHz	120MHz
150MHz	220MHz
235MHz	305MHz
325MHz	395MHz
610MHz	680MHz
1000MHz	1070MHz
1200MHz	1270MHz
1420MHz	1490MHz

Appendix 1

Accuracy Enhancements

Because a mixer is a 3-port device operating over multiple frequency ranges, it is impossible to take advantage of traditional 2-port vector accuracy enhancement when measuring its non-linear characteristics.

However, there are certain procedures that can be followed to improve the measurement accuracy of our mixer test system (e.g., frequency response and power meter calibrations).

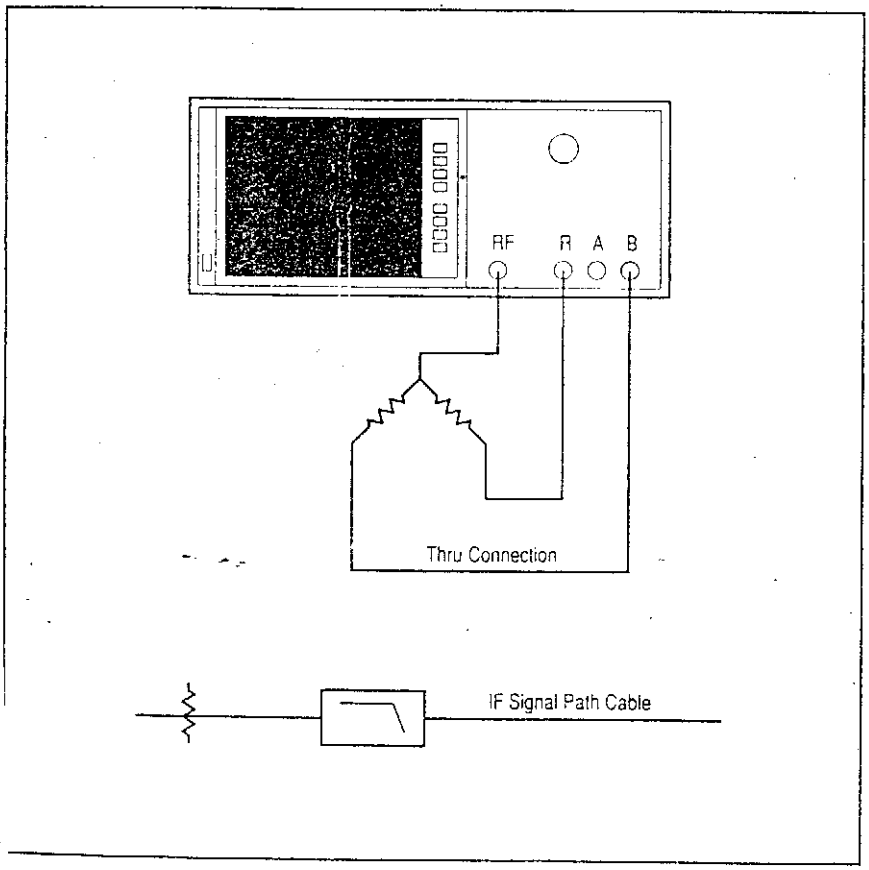


Figure 31. Connection diagram for a frequency response calibration, and device normalization.

Frequency Response Calibration

A frequency response calibration can be used to remove the frequency response characteristics of the receiver channel cabling, attenuation and filtering. This enables a direct output power measurement of the mixer under test.

Measurement Procedure

1. Configure measurement and set stimulus parameters.

Calibration Procedure

1. Connect the measurement hardware as shown in figure 31 with a thru connection between the power splitter and the HP 8753's B measurement port.

[MEAS]
[B/R]

2. Using the keystrokes shown below, perform a frequency response calibration.

[CAL]
[CALIBRATE MENU]
[RESPONSE]
[THRU]
[DONE]

3. Leaving the thru cable in place, insert the receiver channel cabling, attenuation, and filtering between the power splitter and the HP 8753's B measurement port, as shown in figure 31.

4. Store a trace of the resulting frequency response into memory. This memory trace will be used to remove the frequency response of these receiver channel components from the measurement of the device under test.

[DISPLAY]
[DATA → MEM]
[DATA/MEM]

5. Re-configure original measurement and measure the device under test.

Once this frequency response calibration is complete, the measurement system will be making direct output power measurements of the device under test.

Conversion Loss

Swept RF/IF Mixer Measurements

One of the primary contributions of the HP 8753 to mixer testing is its ability to make a swept RF/IF conversion loss measurement. This is achieved by utilizing the frequency offset measurement mode of the HP 8753.

Frequency Offset Mode

This mode of operation allows you to offset the HP 8753's source by a fixed value, above or below the HP 8753's receiver. For example, this allows stimulus of a device under test over its input frequency range and the display of its response over its output frequency range. This is precisely the measurement configuration required for a conversion loss measurement.

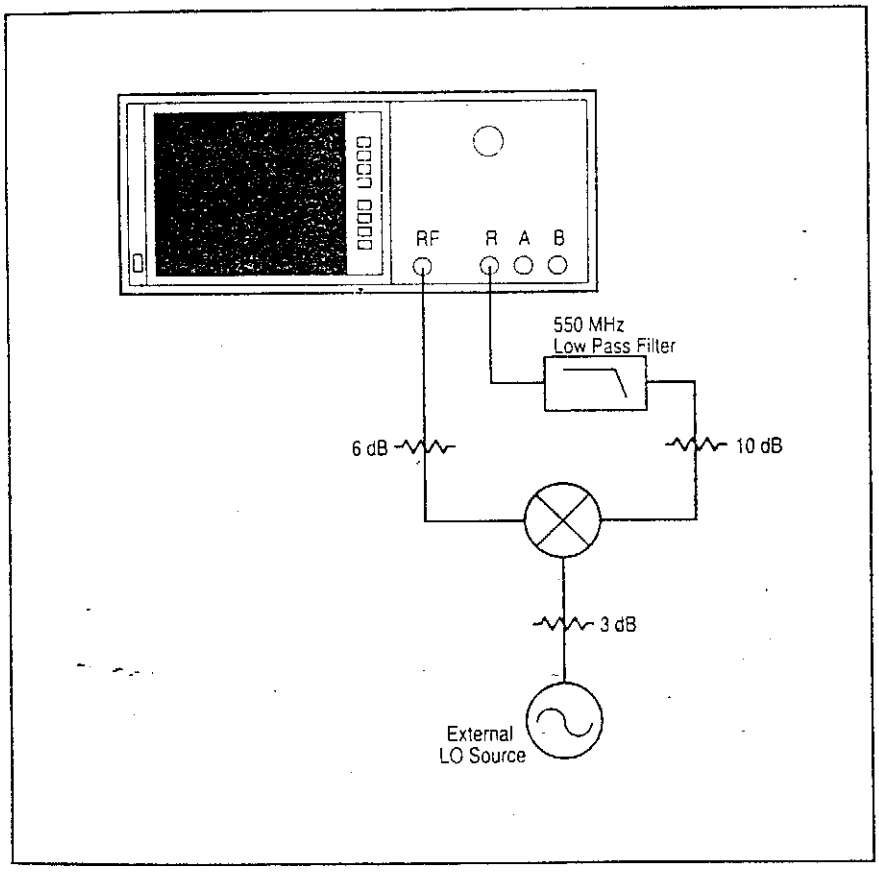


Figure 9. Connection diagram for a swept IF conversion loss measurement.

Measurement Procedure

The following procedure describes the swept IF conversion loss measurement of a broadband component mixer.

LO Source

1. Set the LO source to the desired CW frequency and power level.

[CW] [1000] [MHz]
[POWER] [13] [dBm]

HP 8753

1. Connect the instruments as shown in figure 9.

2. [PRESET] the HP 8753.

3. From the front panel of the HP 8753, set the desired receiver frequency and source output power to be used.

[START] [100] [M/μ]
[STOP] [500] [M/μ]
[MENU]
[POWER] [6] [x1]

4. View the absolute input power to the HP 8753's R channel.

[MEAS]
[R]

5. Set the frequency offset mode LO frequency.

[SYSTEM]
[INSTRUMENT MODE]
[FREQ OFFS MENU]
[LO FREQUENCY]
[1000][M/μ]

6. Select converter type.

[DOWN CONVERTER]

7. Select a high-side LO measurement configuration.

[RF<LO]

8. Activate frequency offset mode. In this high-side LO, down converter measurement, the HP 8753's source frequency range is set to equal the LO frequency [1000 MHz] – the receiver frequency range [100-500 MHz] = [900-500 MHz].

[FREQ OFFS ON]

Notice, in this high-side LO, down conversion configuration, the HP 8753's source is actually sweeping backwards, [900 MHz-500 MHz]. The measurements set-up diagram is shown in figure 10.

9. View the conversion loss, shown in figure 11.

[VIEW MEASURE]

10. Scale the data for best vertical resolution.

[SCALE REF]
[AUTOSCALE]

$$\text{Conversion loss} = \frac{(\text{output power})}{(\text{input power})}$$

In this measurement, input power is set while output power is measured. By selecting attenuation values and power levels such that the small signal input to the mixer is 0 dBm, figure 10 shows the absolute loss through the mixer, attenuator and filter versus mixer output frequency. Mixer conversion loss can be calculated by subtracting the loss of the attenuator and filter from the overall loss shown in figure 11.

Optional: For information on removing systematic frequency response errors, see Appendix 1.
Optional: For information on performing a source power meter calibration, see Appendix 2.

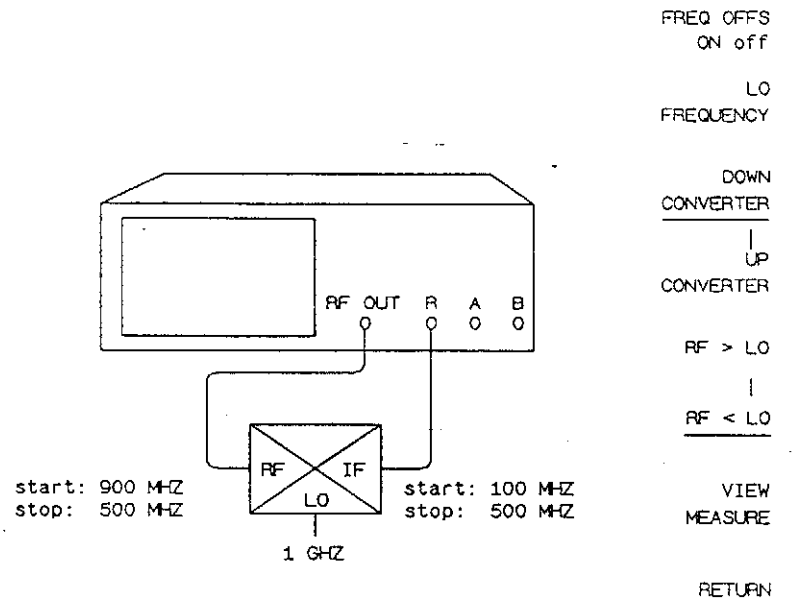


Figure 10. Measurement set-up diagram for a swept IF conversion loss measurement.

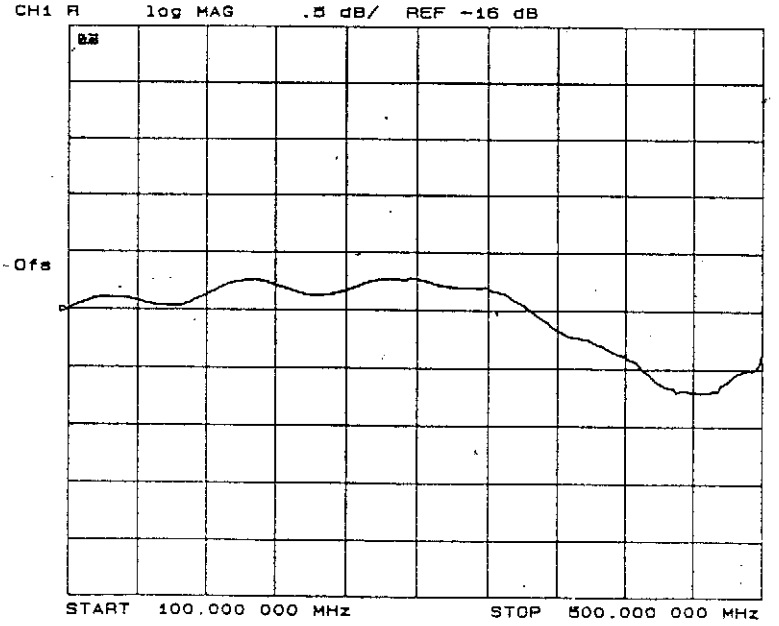


Figure 11. Plot of swept IF conversion loss.

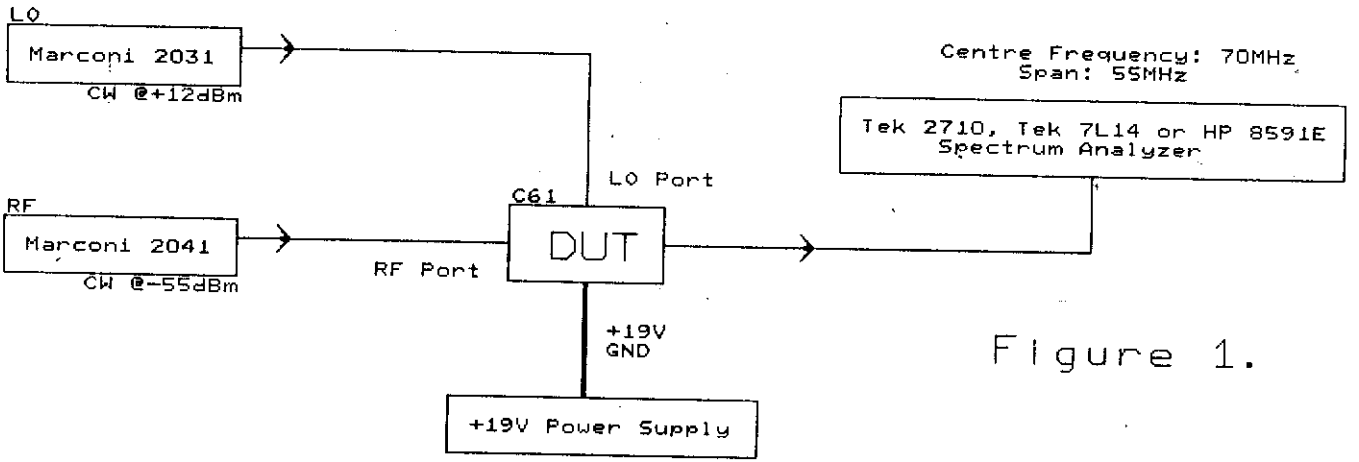
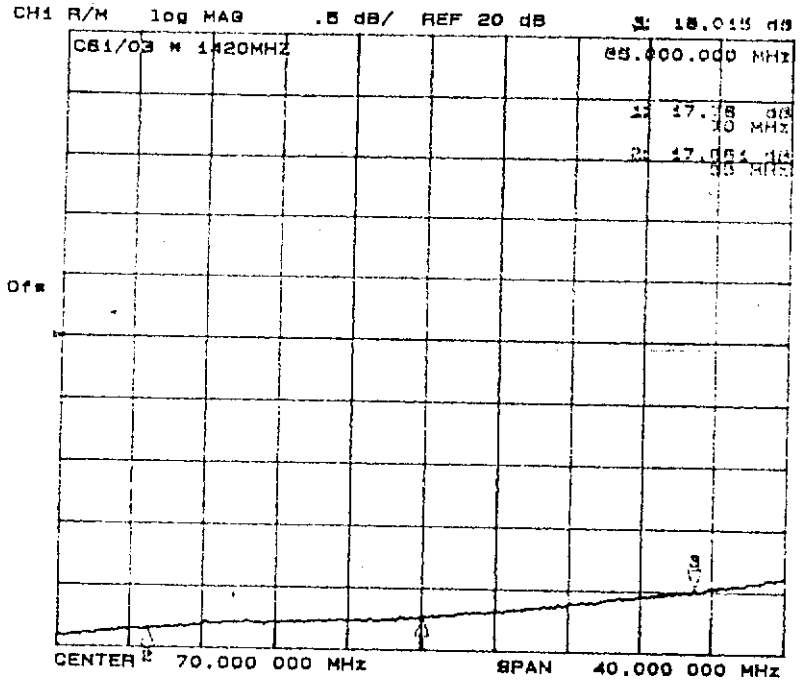
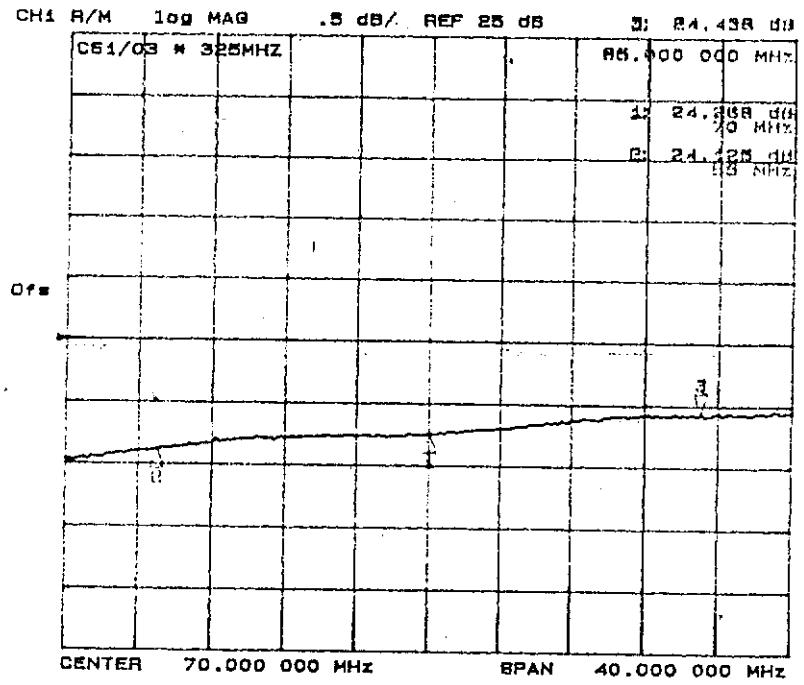
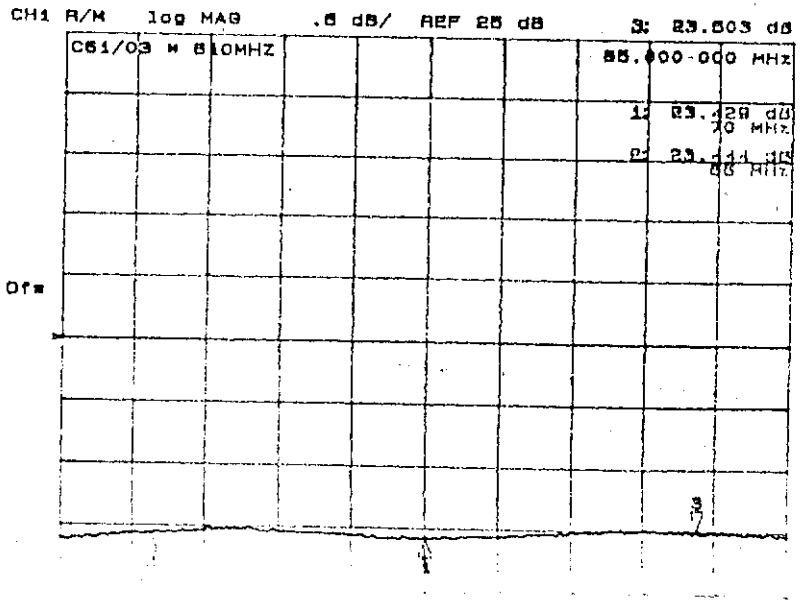
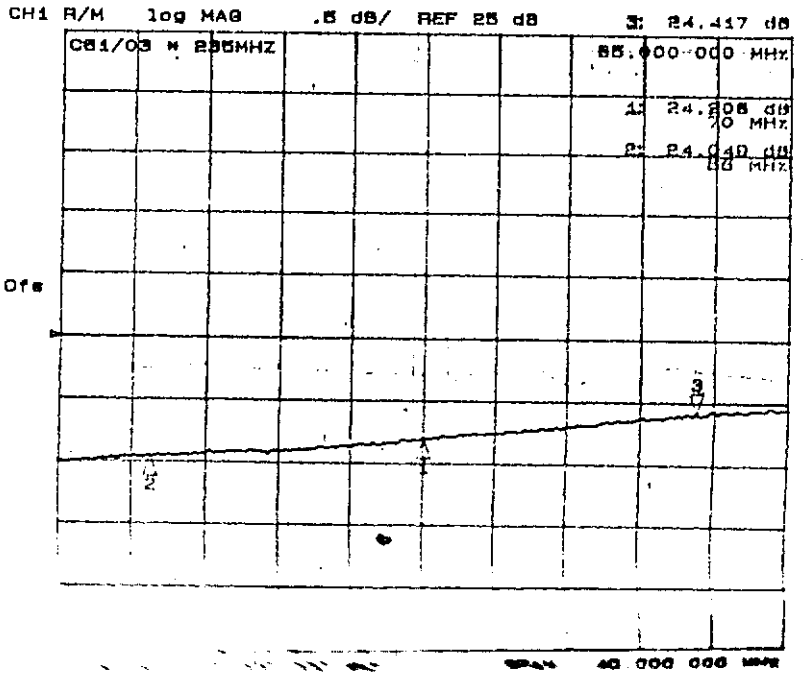

LO
Marconi 2031
CW @+12dBm
RF
Marconi 2041
CW @-55dBm
C61
LO Port
RF Port
DUT
+19V
GND
+19V Power Supply
Centre Frequency: 70MHz
Span: 55MHz
Tek 2710, Tek 7L14 or HP 8591E
Spectrum Analyzer

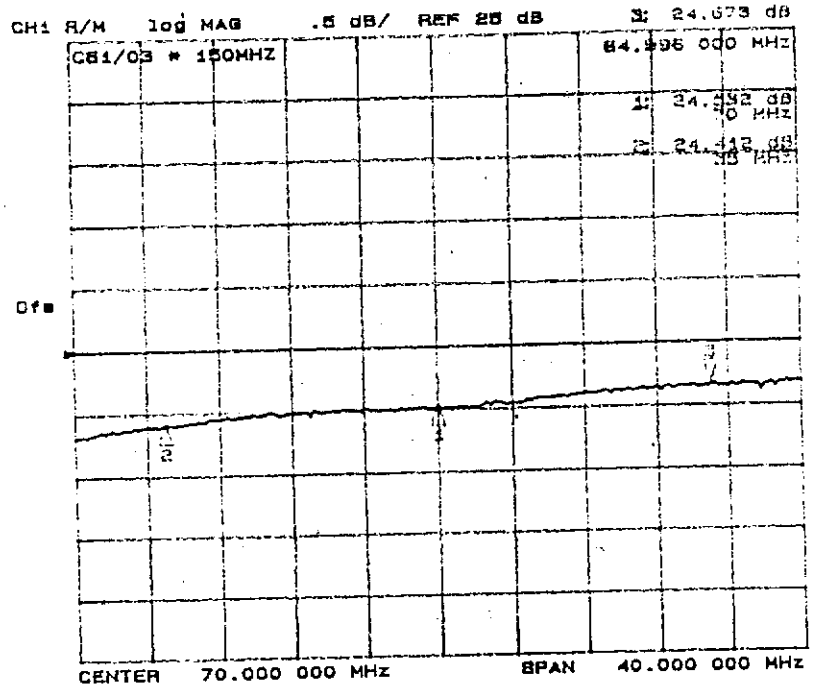
Figure 1.

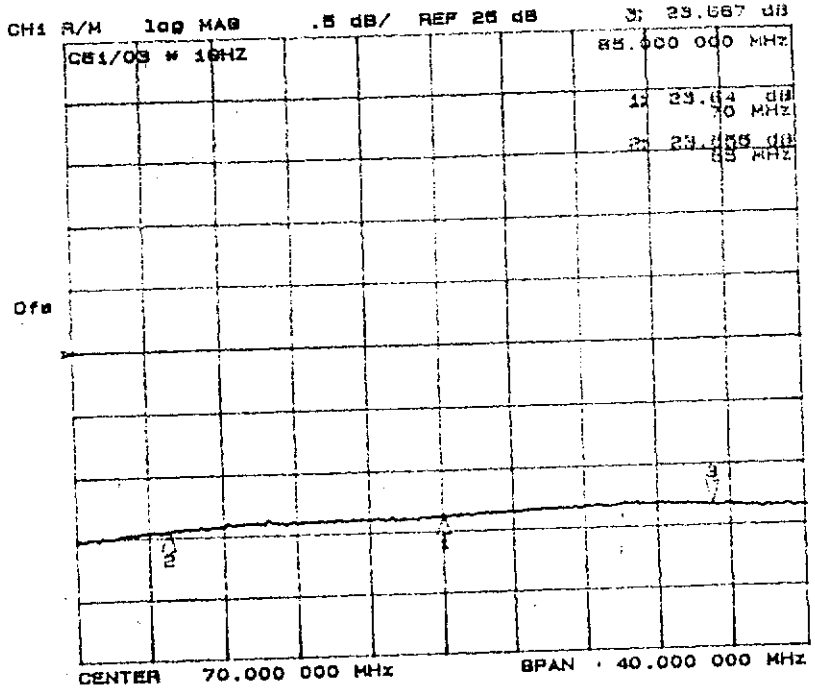

CH1 R/M log MAG .5 dB/ REF 20 dB
C61/03 M 1420MHZ
Ofs
CENTER 70.000 000 MHz
SPAN 40.000 000 MHz

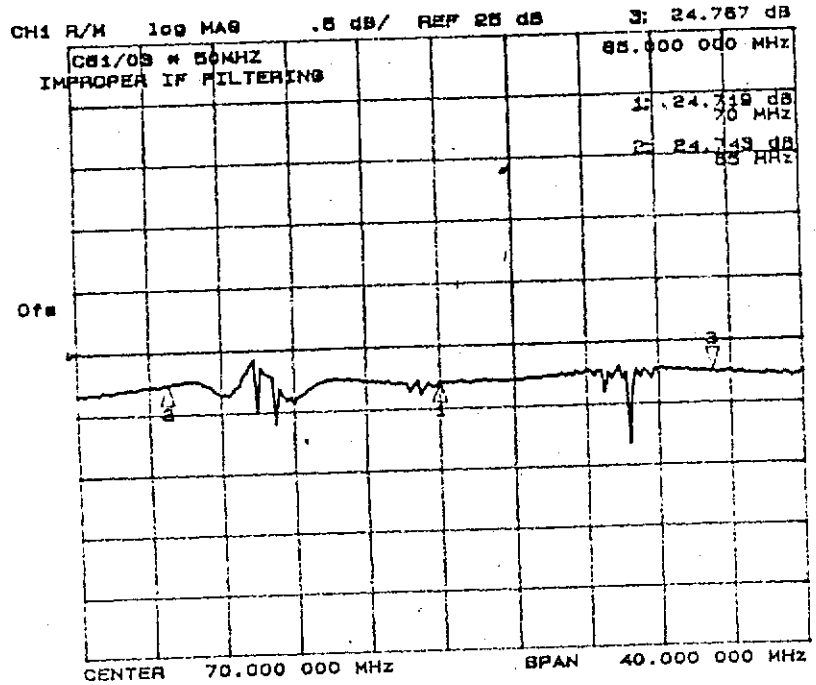

CH1 R/M log MAG .5 dB/ REF 25 dB
C61/03 M 325MHZ
Ofs
CENTER 70.000 000 MHz
SPAN 40.000 000 MHz

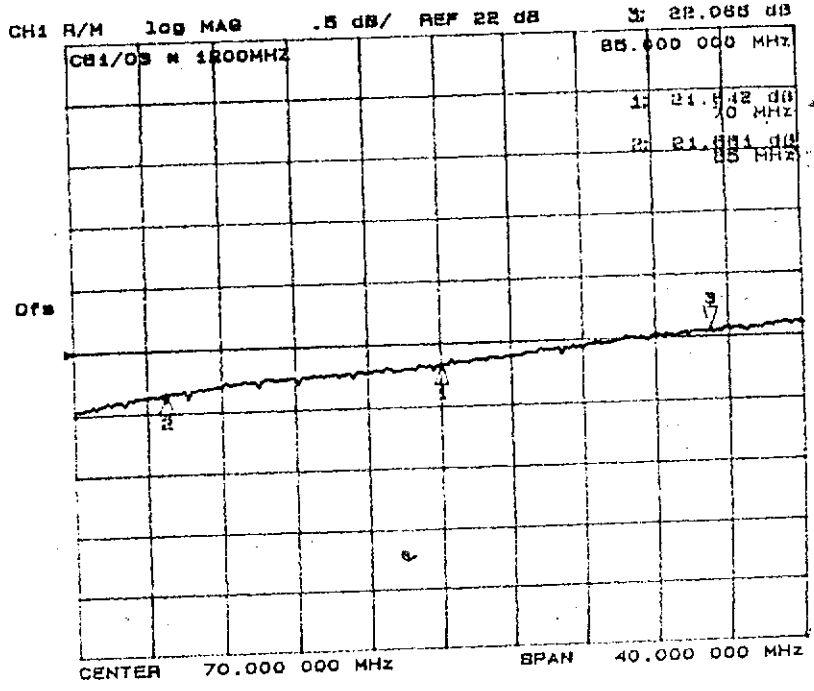

CH1 R/M log MAG .5 dB/ REF 25 dB
C61/03 M 810MHZ
Ofs


CH1 R/M log MAG .5 dB/ REF 25 dB
C61/03 M 295MHZ
Ofs


CH1 R/M log MAG .5 dB/ REF 25 dB
3: 24.673 dB
84.996 000 MHz
CS1/03 * 150MHZ
1: 24.492 dB
70 MHz
2: 24.412 dB
85 MHz
Ofs
CENTER 70.000 000 MHz
SPAN 40.000 000 MHz


CH1 R/M log MAG .5 dB/ REF 25 dB
3: 29.667 dB
85.000 000 MHz
CS1/03 * 10HZ
1: 29.64 dB
70 MHz
2: 29.656 dB
85 MHz
Ofs
CENTER 70.000 000 MHz
SPAN 40.000 000 MHz


CH1 R/M log MAG .5 dB/ REF 25 dB
3: 24.767 dB
85.000 000 MHz
CS1/03 * 50MHZ
IMPROPER IF FILTERING
1: 24.719 dB
70 MHz
2: 24.743 dB
85 MHz
Ofs
CENTER 70.000 000 MHz
SPAN 40.000 000 MHz


CH1 R/M log MAG .5 dB/ REF 22 dB
3: 22.065 dB
85.000 000 MHz
CS1/03 * 1200MHZ
1: 21.642 dB
70 MHz
2: 21.691 dB
85 MHz
Ofs
CENTER 70.000 000 MHz
SPAN 40.000 000 MHz

TEST PANEL

C62 (Programmable Attenuator)

The unit after assembly is to be tested for functionality using the polyskop.
This will require the following apparatus:

- *Polyskop*
- *RG 223 RF cable Type-N female to TNC male.*
- *RG 223 RF cable Type-N male to TNC female.*
- *±19V and +5V DC power supply.*

The experimental setup should be as shown in Figure 1. Set the polyskop to span the display from DC to 150MHz and zero it after setting the RF power level to 0dBm. The control TTL signals should be given as listed in Table 1 and the gain observed should be noted down in the appropriate column of the table. It should be within the specified limits listed therein. Note down the unit number at the head of the table, in the space provided for this purpose.

After this test, the unit has to be kept powered on in an airconditioned test laboratory for ten days from a ±19V power supply (burn in qualifier test).

After the burn in test is complete, the functionality test that was performed before the burn in test, has to be repeated, and results noted down in the appropriate column in the table. The results should again lie within specified limits.

The unit is now ready for final qualification and characterization. This will require the following apparatus:

- *HP 8644A signal generator at HPIB address 10.*
- *HP 8508A vector voltmeter at HPIB address 12.*
- *HP 11549A 6dB resistive power splitter.*
- *PC with PCL748 GPIB and PCL203 digital IO cards.*
- *GPIB cables.*
- *RG 223 RF cables Type-N male to Type-N male (Two numbers).*
- *RG 223 RF cable Type-N male to TNC female.*
- *RG 223 RF cable Type-N male to TNC male.*
- *±19V DC power supply.*
- *HP colorpro plotter at HPIB address 5.*
- *If HP colorpro plotter is not available, then HP7475 plotter with appropriate RS 232 cable for interconnection.*

The experimental setup should be as shown in Figure 2. Boot the PC and make sure the following files are present in your working directory:

(1.) PRATR.BAS (2.) GAINS.DAT (3.) READER.BAS (4.) PLOT.BAS

Additionally, your PATH variable should point to the location of GWBASIC.EXE (or optionally GWBASIC.EXE should be located in your current working directory.).

Now run the program PRATR.BAS by typing "gwbasic pratr" at the DOS prompt. You will be prompted for the filename to store the data in. Supply the same. Then the program prompts for the unit code & number. Give the same in the format C62/---. Wait for the test to be completed. (The computer beeps on completion of the test.) Data acquisition is now complete.

The following steps show how to take a hardcopy of the data acquired above.
If you are using a HP colorpro plotter then run the program PLOT.BAS by typing "gwbasic plot" at the DOS prompt. Otherwise proceed to next step. Now run the program READER.BAS by typing "gwbasic reader" at the DOS prompt. The program will prompt you for the name of the datafile to be processed. Enter the name of the file to which you have saved the acquired data previously. The program will generate HPGL format data corresponding to the acquired data, and exit after writing this data to a new file whose name will be displayed by this program.
Load the plotter with appropriate colour pens in the carousel. (The plotter will use PEN-1 for drawing the graticule, PEN-2 for drawing the trace, and PEN-3 for labeling.) Now just type the following command at your DOS prompt to get the hardcopy plot: "copy <hpgl_filename> com1". This should set the plotter to start making the plot.
The plot should resemble Test Plot 1.

Table 1.

Unit Code: C62/

Control voltages				Maximum	Before burn-in test	After burn-in test	Minimum
K1	K2	K3	K4	(dB)	(dB)	(dB)	(dB)
0V	0V	+5V	0V	-0.5			-1.5
0V	0V	+5V	+5V	-2.5			-3.5
0V	0V	0V	0V	-4.5			-5.5
0V	0V	0V	+5V	-6.5			-7.5
0V	+5V	+5V	0V	-8.5			-9.5
0V	+5V	+5V	+5V	-10.5			-11.5
0V	+5V	0V	0V	-12.5			-13.5
0V	+5V	0V	+5V	-14.5			-15.5
+5V	0V	+5V	0V	-16.5			-17.5
+5V	0V	+5V	+5V	-18.5			-19.5
+5V	0V	0V	0V	-20.5			-21.5
+5V	0V	0V	+5V	-22.5			-23.5
+5V	+5V	+5V	0V	-24.5			-25.5
+5V	+5V	+5V	+5V	-26.5			-27.5
+5V	+5V	0V	0V	-28.5			-29.5
+5V	+5V	0V	+5V	-30.5			-31.5

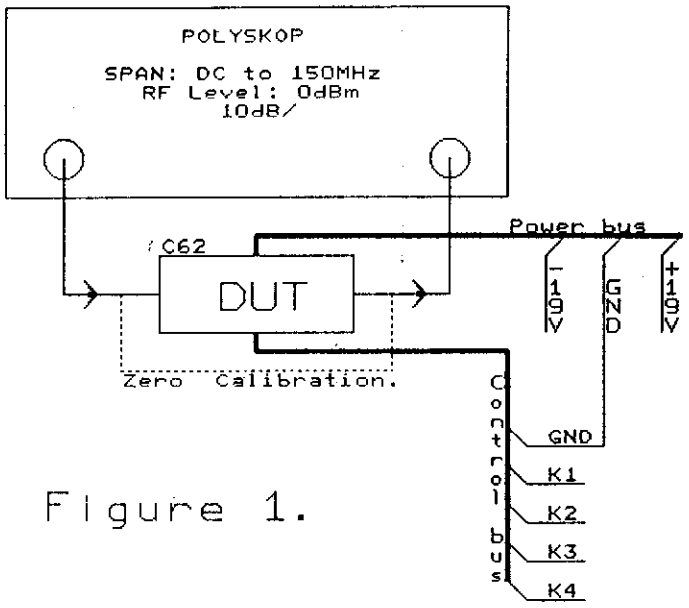
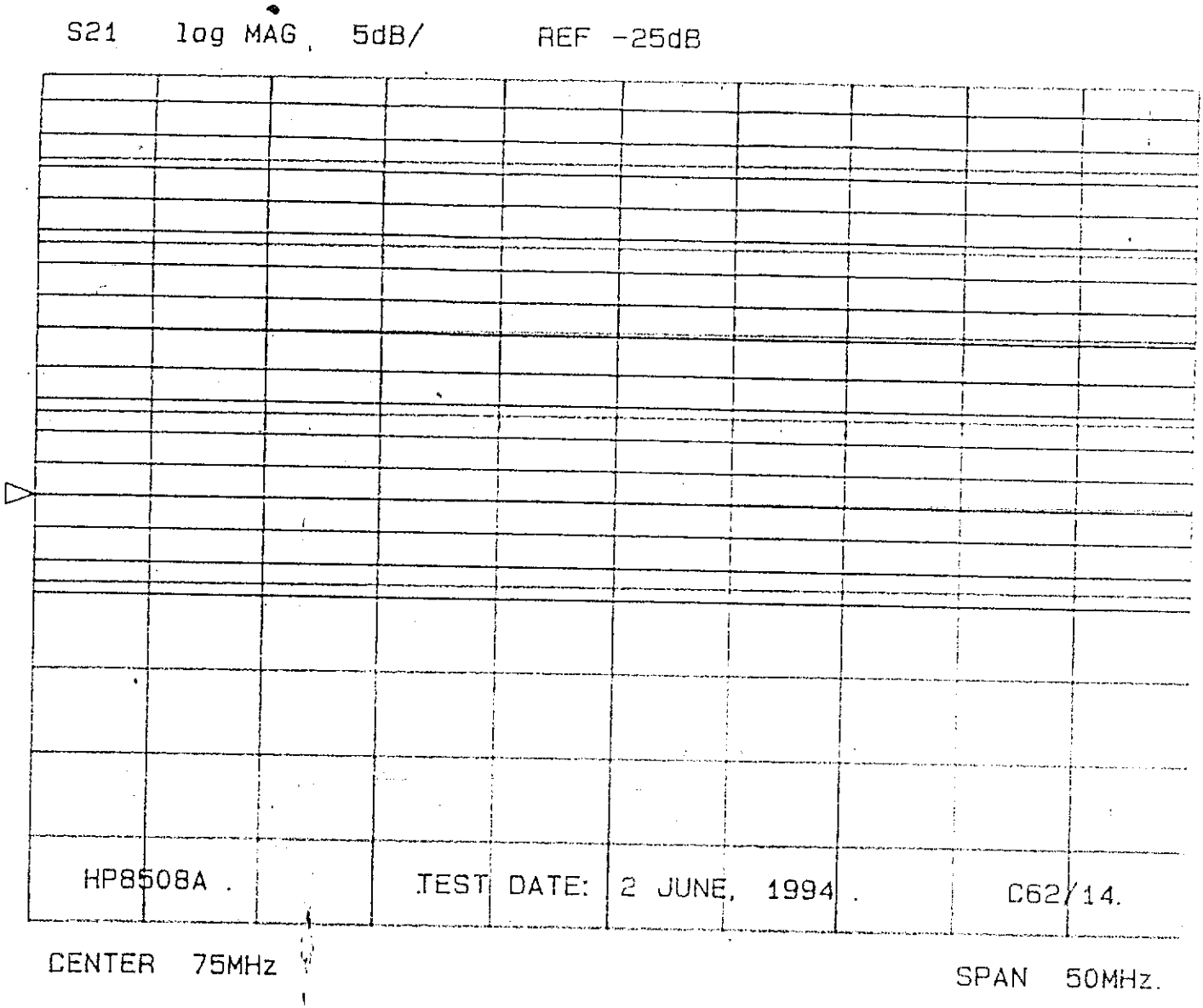


Figure 1.

Figure 2.


S21 log MAG 5dB/ REF -25dB
HP8508A .
TEST DATE: 2 JUNE, 1994 .
C62/14.
CENTER 75MHz
SPAN 50MHz.

C63 (100MHz Lowpass Filter)

The unit after assembly is to be tested for functionality using the polyskop and tuned if necessary.

This will require the following apparatus:

- *Polyskop*
- *RG 223 RF cable Type-N female to TNC female.*
- *RG 223 RF cable Type-N male to TNC male.*

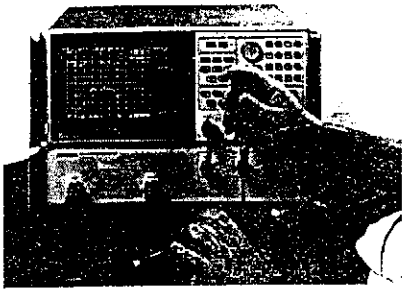
The experimental setup should be as shown in Figure 1. Set the polyskop to span the display from DC to 150MHz and zero it after setting the RF power level to 0dBm and setting the vertical scale to 1dB/div. Now revert to 10dB/div and tune the trimmer capacitors so as to get a response approximately like the one depicted in Plot 1. Revert back to 1dB/div scale and retune if required so as to reduce the ripple in the passband to within ±0.1dB. Switching back to 10dB/div, ensure that the rejection at 150MHz is around atleast -40dB. Now change the span to cover upto 1GHz. Ensure that there is no spurious passband anywhere which is more than -40dB. If any such response exists, it is necessary to retune to remove it, and iteratively repeat the above procedure till all the criteria are satisfied. This procedure is deemed completed only when the insertion loss does not exceed 0.8dB, ripple is within ±0.1dB as already specified, rejection at 150MHz is -40dB minimum, and there is no spurious passband larger than -40dBc upto 1GHz.

The unit can now be closed, marked, and is ready for final qualification and characterization.

This will require the following apparatus:

- *HP 8753C network analyzer, along with the HP 85046A S-parameter test set and HP 85032B calibration kit.*
- *HP colorpro plotter at proper HPIB address (set as per HP 8753C).*
- *RG 223 RF cable Type-N male to TNC male.*
- *RG 223 RF cable Type-N male to TNC female.*

Calibrate the network analyzer as explained in the HP 8753C network analyzers' manual. The procedure and setup required to measure the insertion loss and return loss is explained at length in the same manual and will not be repeated here. (A copy of the relevant pages of the manual is attached at the end of this writeup for the users' convenience.) Follow the necessary steps to get a display resembling the one shown in Plot 1. (It includes both the insertion loss and return loss measurements on one screen in split mode.) The insertion loss should not exceed 0.8dB (as already specified) and the return loss should be better than -18dB upto 100MHz. Take a hardcopy to resemble the one shown in Plot 1.



Transmission Measurement Examples

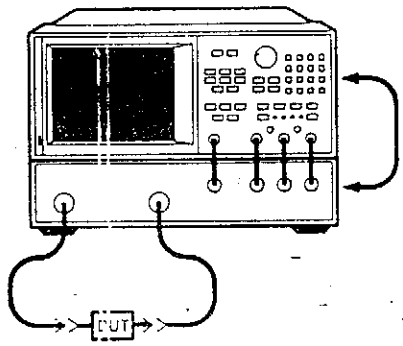
The next two chapters demonstrate the many kinds of n work measurements that can be made with the HP 8753 For each example a complete measurement setup is give following the same "Four Step Measurement Sequence" described in Chapter 2.

The examples used represent typical network measurem The DUT used in the examples is a bandpass SAW filter a 134 MHz center frequency. Modify the instrument set shown to suit your particular needs. For further informa on any of the measurements shown, refer to the HP 875 Operating Manual for the most complete description of allowable operating modes, parameters, etc.

Basic Setup

Most of the examples described in this chapter use the HP 85046A/B or HP 85047A S-parameter test set to co nect to the device under test. This approach simplifies th measurement setup, and provides fully specified results the analyzer's frequency range. Fully specified measure ments can also be made using the HP 85044A/B transm sion/reflection test set. Or you can create your own test setup with discrete power splitters, couplers, attenuator etc. If you use your own setup, note that the analyzer requires a signal level at the R input in the range of 0 to dBm to phase lock the internal source.

Measuring Insertion Loss and Gain



Insertion loss and gain are ratios of the output to input nals. When set up as shown below, the results can be re directly in decibels.

Connect the S-parameter test set to the network analyze explained in chapter 1, "Installation"

1. Choose Measurement Settings

Press [PRESET] and choose these measurement settin

Measurement	S21 (or B/R) on CH 1
Format	LOG MAG
Stimulus	CENTER 134 MHz
	SPAN 30 MHz

2. Perform Measurement Calibration

Press [CAL] *[CALIBRATE MENU]* *[RESPONSE]* to begin frequency response calibration. Connect a "thru" between the measurement cables and then press *[THRU]*. Press *[DONE:RESPONSE]* to complete the calibration.

3. Measure the Device Under Test

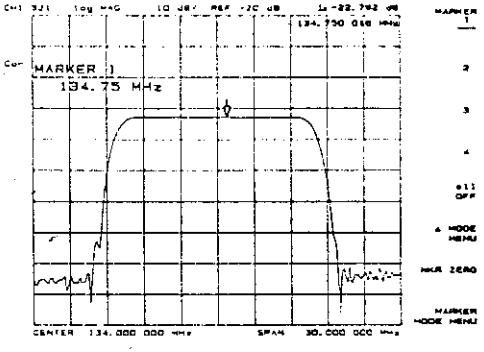
Replace the thru with the DUT. Press [SCALE REF] and *[AUTOSCALE]* if the trace needs to be repositioned. Press [MKR] [134.75] [M/μ] to set the marker as shown. Note th the CRT (and figure) show the complete response of the bandpass filter under test.

4. Output the Result

Press [LOCAL] *[SYSTEM CONTROLLER]* [COPY] *[PLO* to plot a copy of the result (details in "Printing and Plottin tutorial). Or just observe the result.

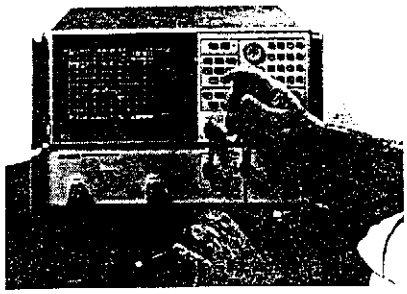
Measuring Other Aspects of Insertion Loss with Marker Functions

From this display you can derive several important filter parameters. The power of the marker functions greatly simplifies this task.



Insertion Loss

Insertion loss can be read to 0.001 dB resolution by movir the marker to any frequency of interest. The marker ampli tude and frequency are read in the upper right hand corne of the display.



Transmission Measurement Examples

The next two chapters demonstrate the many kinds of network measurements that can be made with the HP 8753C. For each example a complete measurement setup is given, following the same "Four Step Measurement Sequence" described in Chapter 2.

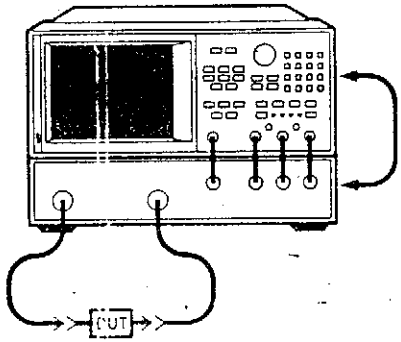
The examples used represent typical network measurements. The DUT used in the examples is a bandpass SAW filter with a 134 MHz center frequency. Modify the instrument setups shown to suit your particular needs. For further information on any of the measurements shown, refer to the HP 8753C Operating Manual for the most complete description of allowable operating modes, parameters, etc.

Basic Setup

Most of the examples described in this chapter use the HP 85046A/B or HP 85047A S-parameter test set to connect to the device under test. This approach simplifies the measurement setup, and provides fully specified results over the analyzer's frequency range. Fully specified measurements can also be made using the HP 85044A/B transmission/reflection test set. Or you can create your own test setup with discrete power splitters, couplers, attenuators, etc. If you use your own setup, note that the analyzer requires a signal level at the R input in the range of 0 to −35 dBm to phase lock the internal source.

Measuring Insertion Loss and Gain

Insertion loss and gain are ratios of the output to input signals. When set up as shown below, the results can be read directly in decibels.



Connect the S-parameter test set to the network analyzer as explained in chapter 1, "Installation"

1. Choose Measurement Settings

Press **[PRESET]** and choose these measurement settings:

Measurement	S21 (or B/R) on CH 1
Format	LOG MAG
Stimulus	CENTER 134 MHz
	SPAN 30 MHz

2. Perform Measurement Calibration

Press [CAL] *[CALIBRATE MENU]* *[RESPONSE]* to begin frequency response calibration. Connect a "thru" between the measurement cables and then press *[THRU]*. Press *[DONE:RESPONSE]* to complete the calibration.

3. Measure the Device Under Test

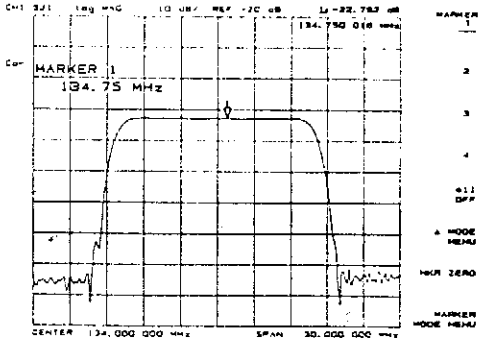
Replace the thru with the DUT. Press [SCALE REF] and *[AUTOSCALE]* if the trace needs to be repositioned. Press [MKR] [134.75] [M/μ] to set the marker as shown. Note th the CRT (and figure) show the complete response of the bandpass filter under test.

4. Output the Result

Press [LOCAL] *[SYSTEM CONTROLLER]* [COPY] *[PLO* to plot a copy of the result (details in "Printing and Plottin tutorial). Or just observe the result.

Measuring Other Aspects of Insertion Loss with Marker Functions

From this display you can derive several important filter parameters. The power of the marker functions greatly simplifies this task.



Insertion Loss

Insertion loss can be read to 0.001 dB resolution by movir the marker to any frequency of interest. The marker ampli tude and frequency are read in the upper right hand corne of the display.

Connect high quality terminations (loads) to all unused ports. With an S-parameter test set, measurement port 2 supplies this termination during measurements of S_{11} and S_{21}, while port 1 supplies the load for measurements of S_{12} and S_{22}. All switching is automatic, controlled by the analyzer. When using a transmission/reflection test set, terminate the unused port at the B input of the analyzer or with a high quality load.

Measurement Accuracy

In reflection measurements, the accuracy of the final result is highly dependent on the signal separation device, adapters, and the DUT terminations. Systematic errors such as the frequency response of the test setup, leakage signals, and mismatches degrade overall measurement accuracy. The analyzer's built-in measurement calibration routines can remove these measurement errors as explained in the "Measurement Calibration" tutorial. The most accurate measurement calibration (full 2-port) is used in the first setup in this chapter. Subsequent setups use the simpler 1-port calibration.

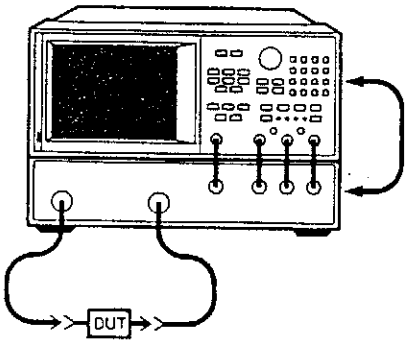
Measuring Return Loss, Reflection Coefficient, nd Standing Wave Ratio (SWR)

The signal reflected from the device under test is measured as a ratio with the incident signal. It can be expressed as reflection coefficient, a return loss, or SWR. These measurements are mathematically defined as:

$$\text{return loss (dB)} = -20 \log (\rho)$$

$$\text{reflection coefficient} = \frac{\text{reflected power}}{\text{incident power}} = \rho \text{ (magnitude only)}$$

$$= \Gamma = S_{11} \text{ or } S_{22} \text{ (magnitude and phase)}$$



Connect the S-parameter test set to the analyzer as shown. The DUT will be the SAW filter used previously.

1. Choose Measurement Settings

Press [PRESET] and choose these measurement settings:

Measurement	S11 (or A/R) on CH 1
	Format
	LOG MAG
Stimulus	
	START 119 MHz
	STOP 149 MHz

(If you press [CENTER] and [SPAN] now, you'll display the same frequencies previously entered; use whichever format is easier.)

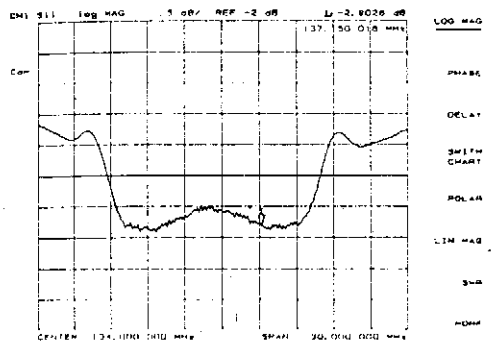
2. Perform Measurement Calibration

For maximum accuracy do a full 2-port calibration. Press [CAL], select *[CALIBRATE MENU]*, *[FULL 2-PORT]*, *[REFLECT'N]* and follow the prompts to connect and measure an open, short and load for port 1 (S_{11}) and port 2 (S_{22}). Connect the standards at ports 1 and 2 using any adapters or cables that will be used in the actual measurement. Select *[REFLECT'N DONE]* after measuring these six standards. Next select *[TRANSMISSION]*, connect a "thru" and select the four transmission measurements, one at a time. Select *[TRANS.DONE]* when done. Finally, select *[ISOLATION]*, *[OMIT ISOLATION]* and *[ISOLATION DONE]*. Isolation accuracy enhancement, as described in chapter 5, "Measurement Calibration", is not required for this measurement.

3. Measure the Device Under Test

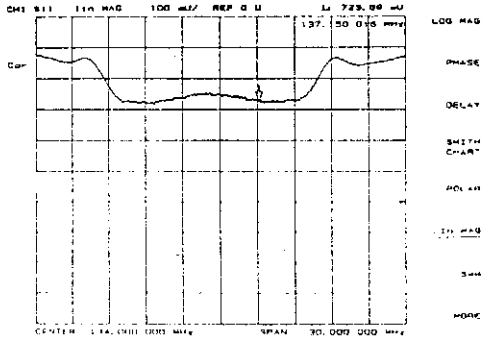
Replace the thru with the DUT and reposition the trace as before. Press [MKR] to activate the marker. You will measure the DUT in three different formats next.

Return Loss



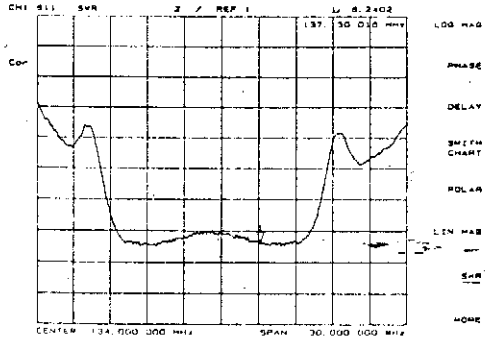
The results of a typical reflection measurement are shown. This device does not have very good match inside the filter passband, although it does illustrate that within the filter passband, the device matches the system impedance more closely than outside the passband. Therefore, the reflected signal in the filter passband is smaller than outside the passband. In terms of return loss, the value inside the passband is larger than outside the passband. A large value for return loss corresponds to a small reflected signal just as a large value for insertion loss corresponds to a small transmitted signal.

Reflection Coefficient



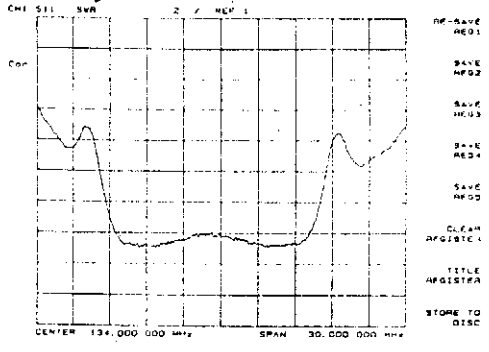
To display the same data in terms of reflection coefficient, press [FORMAT] *[LIN MAG]*. This simply redisplays the existing measurement in a linear magnitude format that varies from $\Gamma = 1.00$ at the top of the display (100% reflection) to 0.00 at the bottom of the display (perfect match).

Standing Wave Ratio



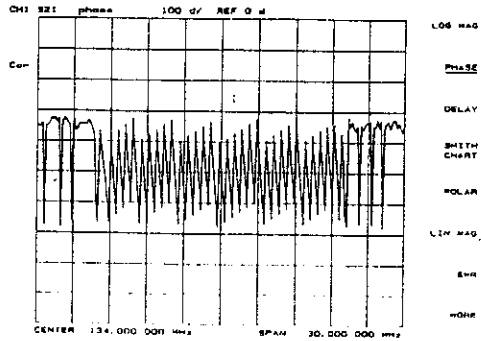
To display the reflection measurement data in terms of standing wave ratio (SWR), press [FORMAT] *[SWR]*. The analyzer reformats the display in the unitless measure of SWR with SWR = 1 (perfect match) at the bottom of the display.

4. Output the Result



After completing the full 2-port calibration you may want to save the results for future measurements. The analyzer has five memory registers that you can use to store up to five instrument states. Because instrument states can be very complex, it is possible to fill the available memory with less than five states.

4. Output the Result



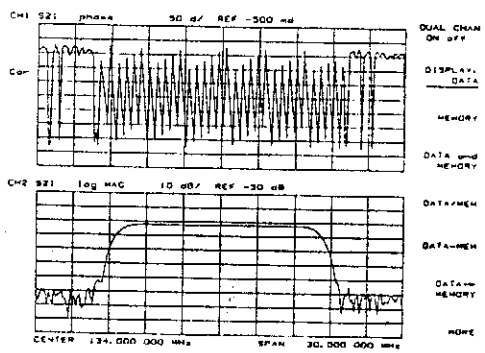
Press [LOCAL] *[SYSTEM CONTROLLER]* [SAVE] *[STORE TO DISK] [STORE FILE nn]* to store the result (data trace, measurement settings, and calibration) on an external disk. (See the "Disk Drive" tutorial for details.) Or just observe the trace.

Just as in measuring insertion loss or gain, the various marker functions (marker search, min/max, offset, etc.) can be used to examine the details of the phase response.

The figure shows the phase response of the bandpass filter. Notice the linear phase shift through the passband, and the rapid fluctuations outside this region. The random phase of the broadband noise floor causes the spurious out-of-band response.

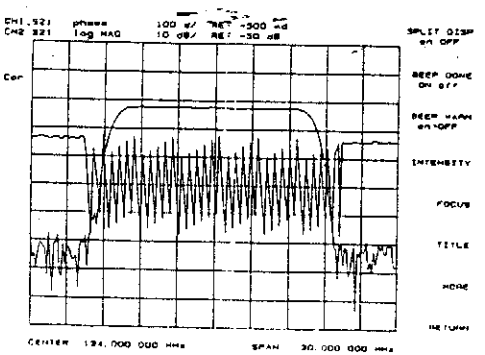
The analyzer measures and displays phase over the range −180 to +180 degrees. As phase increases beyond these values, a sharp 360 degree transition occurs in the display as the trace "wraps" between +180 and −180 degrees. This causes the characteristic "sawtooth" display usually seen on devices with linearly increasing (or decreasing) phase responses.

Using the Dual Trace Display



In some cases it is useful to be able to view more than one measured parameter at a time. Simultaneous gain and phase measurements for example, are useful in evaluating stability in negative feedback amplifiers. Such measurements are easily made using the dual channel display.

To see both channels simultaneously, press [DISPLAY] *[DUAL CHAN ON]*. Two displays appear on the CRT, with channel 1 on the upper and channel 2 on the lower display.



Sometimes it is more convenient to view both channels on a single graticule. In the [DISPLAY] menu, press *[MORE] [SPLIT DISP OFF]*.

Press *[SPLIT DISP ON]*, *[RETURN]* and *[DUAL CHAN OFF]* when you are finished with this measurement.

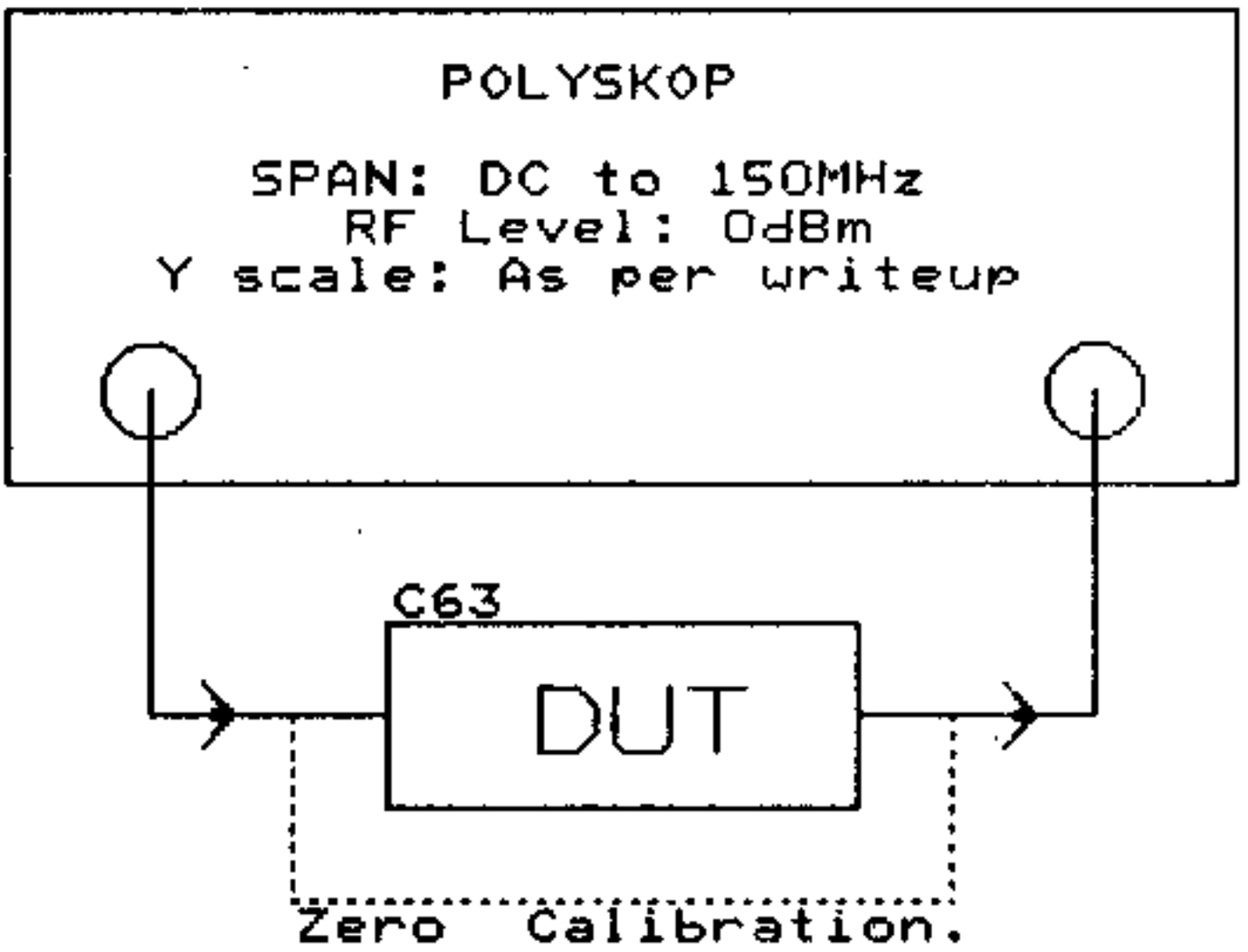
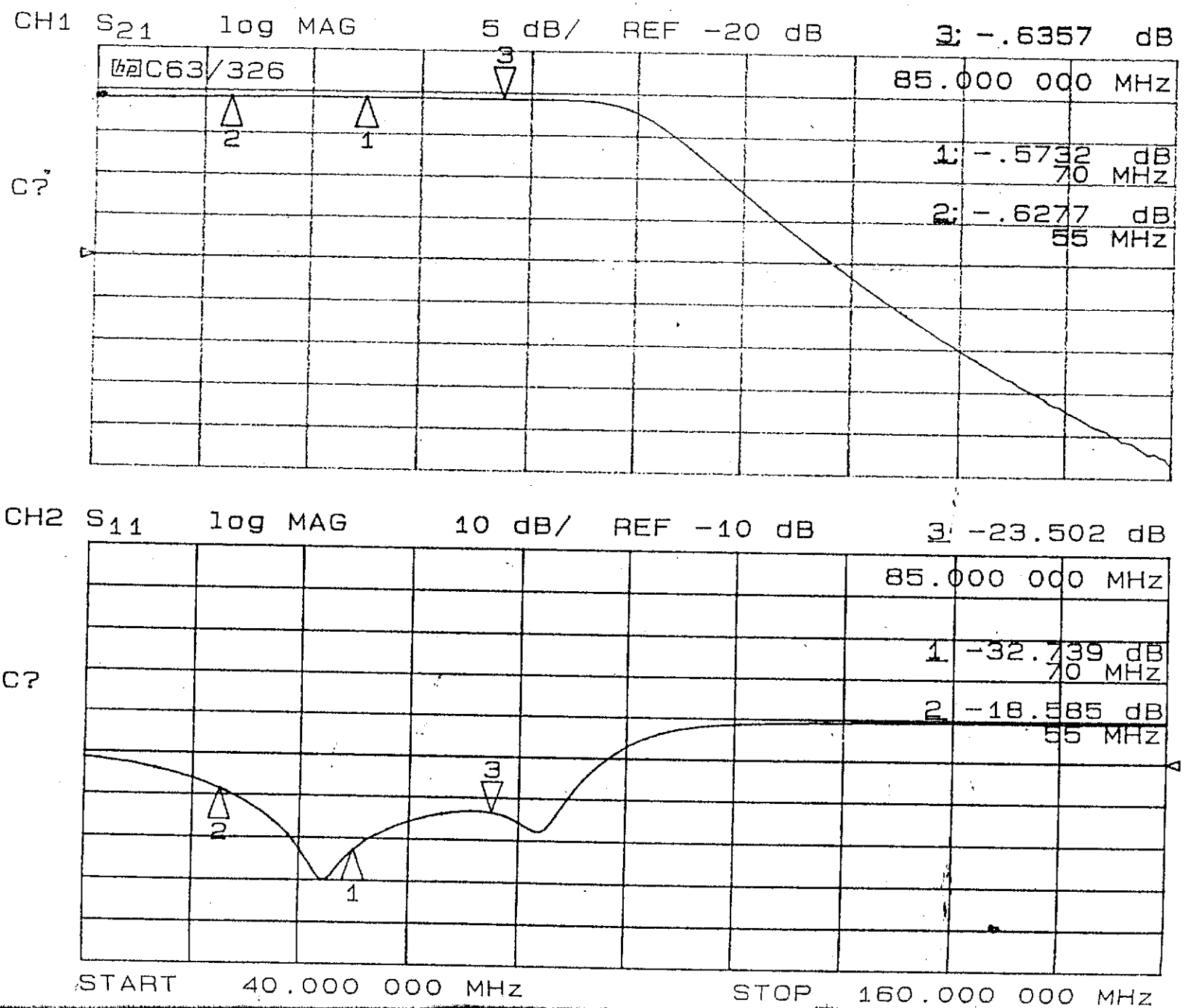

POLYSKOP
SPAN: DC to 150MHz
RF Level: 0dBm
Y scale: As per writeup
C63
DUT
Zero Calibration.

Figure 1.


CH1 S21 log MAG 5 dB/ REF −20 dB
3: −.6357 dB
85.000 000 MHz
C63/326
1: −.5732 dB
70 MHz
2: −.6277 dB
55 MHz
C?
CH2 S11 log MAG 10 dB/ REF −10 dB
3 −23.502 dB
85.000 000 MHz
1 −32.739 dB
70 MHz
2 −18.585 dB
55 MHz
C?
START 40.000 000 MHz
STOP 160.000 000 MHz

C64 (70MHz SAW Filterbank)

The unit after assembly is to be tested for functionality using the polyskop.

This will require the following apparatus:

- *Polyskop*
- *RG 223 RF cable Type-N female to TNC female.*
- *RG 223 RF cable Type-N male to TNC male.*
- *+19V and ±12V DC power supply.*

The experimental setup should be as shown in Figure 1. Set the polyskop to span 32MHz around 70MHz center frequency. With RF power as -20dBm, and vertical scale as 10dB/division, zero the polyskop. Now select the 6MHz bandwidth and ensure that the insertion gain at 70MHz is approximately 10dB. Rejection at 55MHz and 85MHz should be at least -40dBc. Now select the 16MHz bandwidth. The insertion gain at 70MHz should be approximately 5dB. Rejection at 55MHz and 85MHz should be at least -40dBc. Now select the through path. Insertion gain should be approximately 2dB throughout the band. Note down the above observations in the appropriate columns provided in Table 1.

After this test, the unit has to be kept powered on in an airconditioned test laboratory for ten days from a +19V power supply (burn in qualifier test).

After the burn in test is complete, the functionality test that was performed before the burn in test, has to be repeated, and results noted down in the appropriate column in the table. The results should again lie within specified limits.

The unit is now ready for final qualification and characterization. This will require the following apparatus:

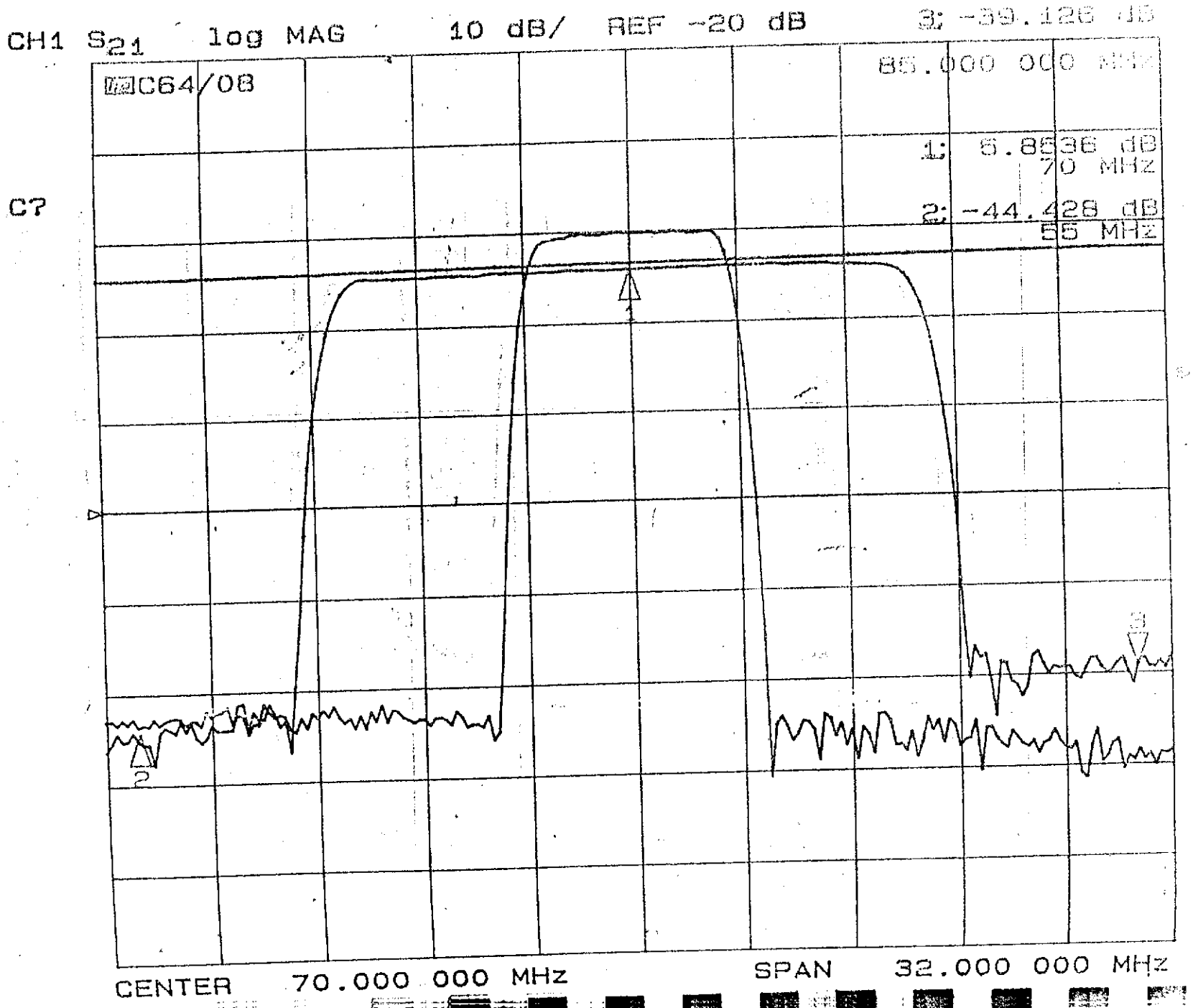
- *HP 8753C network analyzer, along with the HP 85046A S-parameter test set and HP 85032B calibration kit.*
- *HP colorpro plotter at proper HPIB address (set as per HP 8753C).*
- *RG 223 RF cable Type-N male to TNC female.*
- *RG 223 RF cable Type-N male to TNC male.*
- *+19V and ±12V DC power supply.*

Calibrate the network analyzer as explained in the HP 8753C network analyzers' manual. The procedure and setup required to measure the insertion loss is explained at length in the same manual and will not be repeated here. (A copy of the relevant pages of the manual is attached at the end of the writeup for C63 for the users' convenience.) While calibrating, set the RF stimulus to -20 dBm. Follow the necessary steps to get a display resembling the one shown in Plot 1. The insertion loss and rejection should be within the criteria already listed in table 1. Take a hardcopy to resemble the one shown in Plot 1 by superposing the three plots corresponding to the three selections on to the same paper loaded onto the plotter (It is essential not to remove the paper unless all the three plots have been superposed). The grid, markers and text should be enabled only for one of the three plots. While superposing the other plots, only trace should be plotted and the other selections should be turned off by pressing the necessary keys.

Table 1.

Unit Code:C64/

Bandwidth Selection	Insertion Gain at 70MHz (dB)			Out of Band Rejection(dBc)		
	Before burn-in	After burn-in	Nominal	Before burn-in	After burn-in	Nominal
6MHz			+10			-40
16MHz			+5			-40
Through			+2	N.A.	N.A.	N.A.


CH1 S21 log MAG 10 dB/ REF -20 dB
3: -39.126 dB
85.000 000 MHz
C64/08
1: 5.8536 dB
70 MHz
2: -44.428 dB
55 MHz
C?
CENTER 70.000 000 MHz
SPAN 32.000 000 MHz

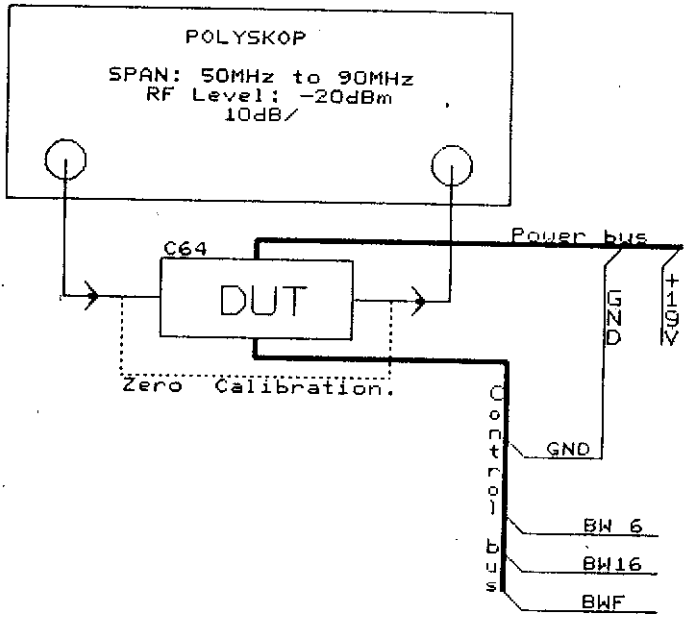


Figure 1.

Bandwidth Selection	Control Voltages		
	BW 6	BW 16	BWF
6MHz	+12V	-12V	-12V
16MHz	-12V	+12V	-12V
Through	-12V	-12V	+12V

C65 (Second Frequency Converter)

The unit after assembly is to be tested for functionality using signal generators and a spectrum analyzer.

This will require the following apparatus:

- *Marconi 2031 signal generator.*
- *Marconi 2041 signal generator.*
- *Spectrum analyzer, Tek 2710 , Tek 7L14 or HP 8591E.*
- *RG 223 RF cable Type-N male to Type-N female (Two numbers).*
- *RG 223 RF cable TNC male to Type-N male.*
- *+19V DC power supply.*

The experimental setup should be as shown in Figure 1. Set the spectrum analyzer to span 50MHz around a center frequency of 130MHz. Set the signal generators as specified in Table 1, and note down the power level of the 130MHz line appearing on the center of the spectrum analyzer screen after doing a peak search, in the appropriate column in the table. Now change the center frequency of the spectrum analyzer to 175MHz and set the signal generators as per the next entry in the table. Again note down the power level of the 175MHz line appearing on the center of the spectrum analyzer screen after doing a peak search in the appropriate column in the table. Complete the table as instructed therein. The results should be within the specified limits. Note down the unit number at the head of the table, in the space provided for this purpose.

After this test, the unit has to be kept powered on in an airconditioned test laboratory for ten days from a +19V power supply (burn in qualifier test).

After the burn in test is complete, the functionality test that was performed before the burn in test, has to be repeated, and results noted down in the appropriate column in the table. The results should again lie within specified limits.

The unit is now ready for final qualification and characterization. This will require the following apparatus:

- *HP 8753C network analyzer.*
- *Marconi 2031 signal generator.*
- *130MHz bandpass filter (a qualified C66 unit will suffice).*
- *175MHz bandpass filter (a qualified C67 unit will suffice).*
- *HP 11549A 6dB resistive power splitter.*
- *HP colorpro plotter at proper HPIB address (set as per HP 8753C).*
- *TNC 20dB attenuator pad.*
- *TNC 10dB attenuator pad.*
- *+19V DC power supply.*
- *RG 223 RF cable Type-N male to Type-N male (Three numbers).*
- *RG 223 RF cable Type-N male to TNC female.*
- *RG 223 RF cable Type-N male to TNC male.*
- *RG 223 RF cable TNC female to Type-N female.*

The procedure to measure the conversion loss or conversion gain is explained at length in the HP 8753C network analyzers' manual. Appropriate pages are reproduced for the users' convenience at the end of the writeup for C61. The figure numbers and appendix numbers referred to below correspond to the numbers on these reproductions.

Set up the apparatus as shown in Figure 31 of Appendix 1, and follow the instruction listed therein. Use the 130MHz bandpass filter with 20dB pad and the 10dB pad on the input side (by using appropriate RF cables) and go through the calibration procedure as listed out. The stimulus settings should be: Center Frequency 130MHz, Span 40MHz, Amplitude 0dBm.

Next reconnect the setup as shown in Figure 9. Insert the device under test, i.e. the C65 unit, in between the 20dB pad and the 10dB pad before the bandpass filter. Apply DC bias, and LO carrier as listed in Table 2 and take the plot. This should resemble Plot 1. You will require to follow the steps listed out above after replacing the 130MHz bandpass filter with the 175MHz bandpass filter. The calibration procedure is to be repeated with the new stimulus settings as: Center Frequency 175MHz, Span 40MHz, Amplitude 0dBm. Apply DC bias, and LO carrier as listed in Table 2 and take the plot. This should resemble Plot 2.

Table 1.

Unit Code: C65/

Marconi 2031	Marconi 2041	Spectrum Analyzer readings (dBm)		Minimum	Results		Maximum
(@+12dBm)	(@-55dBm)	Before burn-in test	After burn-in test	(dB)	(dB)	(dB)	(dB)
		A	B		A+55	B+55	
200MHz	70MHz			19			22
105MHz	70MHz			19			22

Table 2.

Bandpass filter used	Marconi 2031 setting (CW @+12dBm)
130MHz	200MHz
175MHz	105MHz

Note:
See Table-1 for the settings
of the Marconi Signal Generators.

Span	Centre Frequency
50MHz	130MHz
50MHz	175MHz

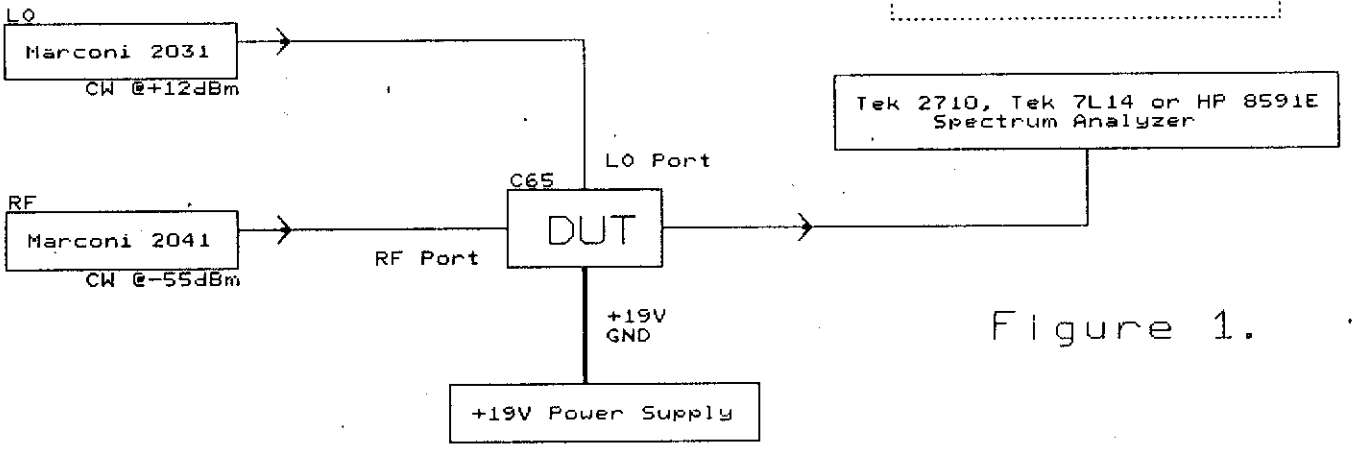
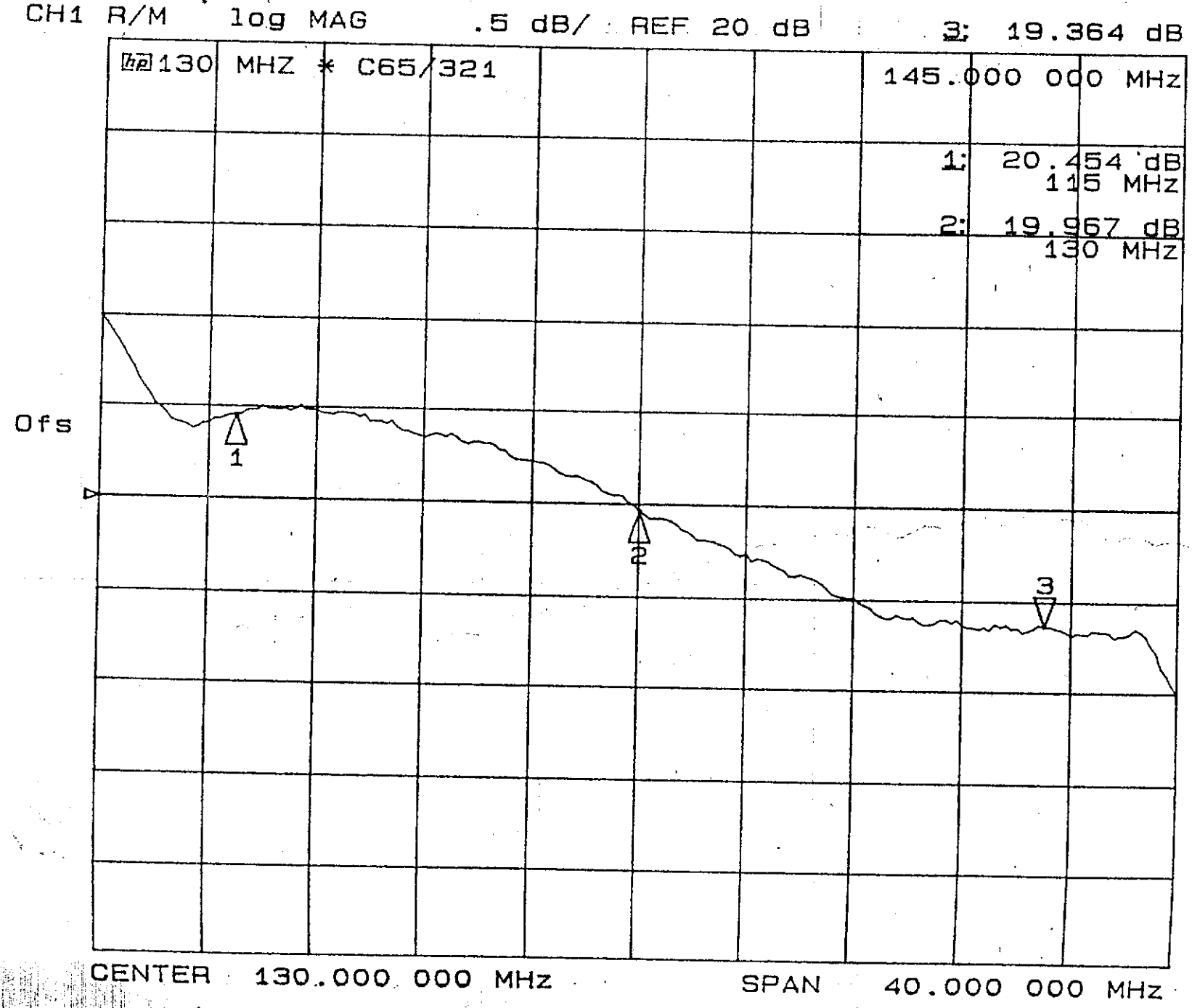
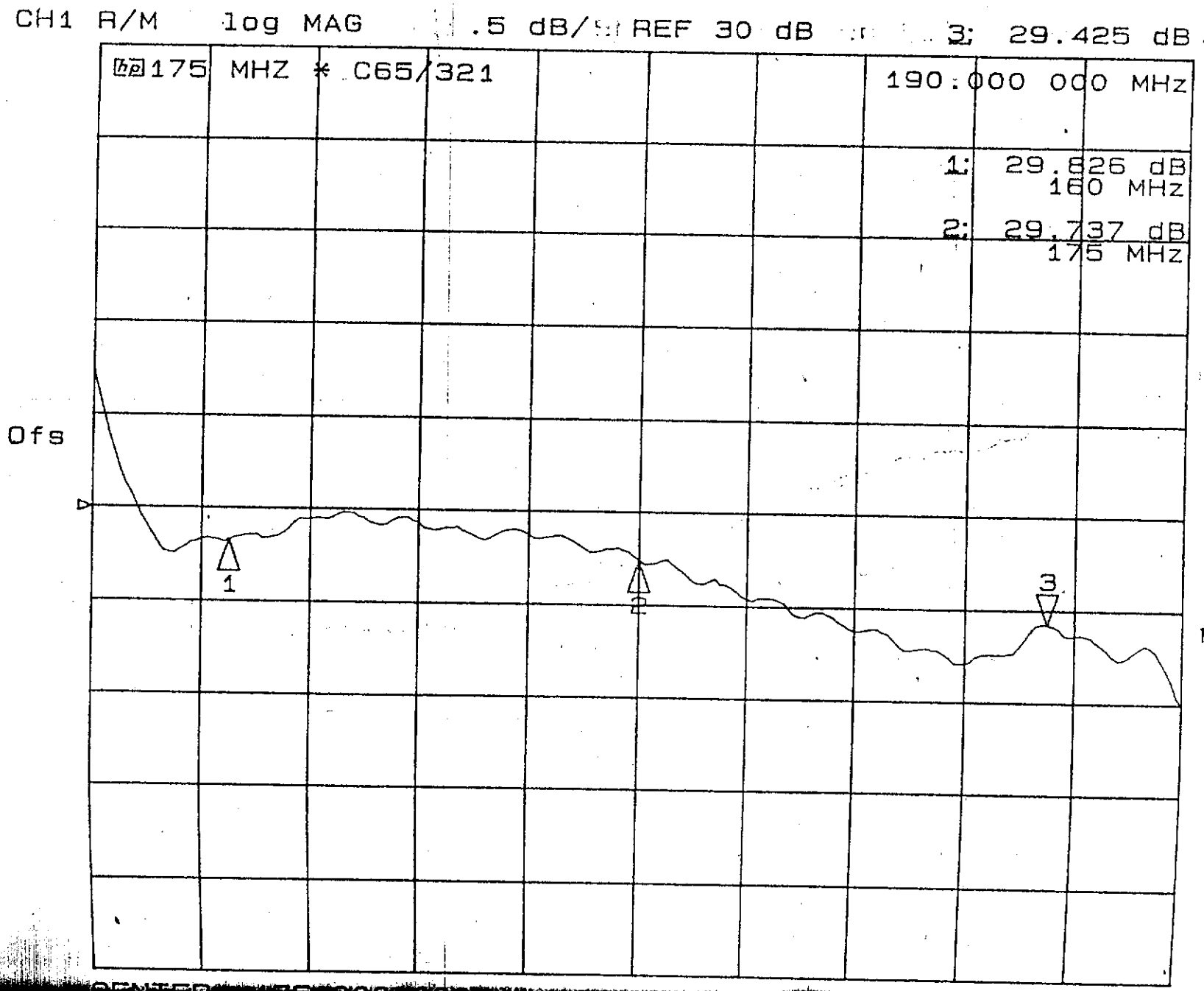


Figure 1.



PLOT - 1

NOTE: THERE IS A SYSTEMATIC ERROR IN THIS MEASUREMENT DUE TO WHICH THERE IS A 1 dB SLOPE ACROSS THE BAND. THE ACTUAL



PLOT - 2

NOTE: THERE IS A SYSTEMATIC ERROR IN THIS MEASUREMI DUE TO WHICH THI IS A 1dB SLOP ACROSS THE BAN THE ACTUAL PERFORMANCE SH BE MUCH BETTE

C66 (130MHz SAW Filter)

The unit after assembly is to be tested for functionality using the polyskop.

This will require the following apparatus:

- *Polyskop*
- *RG 223 RF cable Type-N female to TNC female.*
- *RG 223 RF cable Type-N male to TNC male.*
- *+19V DC power supply.*

The experimental setup should be as shown in Figure 1. Set the polyskop to span 100MHz around 130MHz center frequency. With RF power as -20dBm, and vertical scale as 10dB/division, zero the polyskop, and make the measurement. The insertion gain at 130MHz should be within -3dB to 0dB. The rejection at 105MHz and 155MHz should be better than -40dBc. Note down these readings in the appropriate column provided in Table 1.

After this test, the unit has to be kept powered on in an airconditioned test laboratory for ten days from a +19V power supply (burn in qualifier test).

After the burn in test is complete, the functionality test that was performed before the burn in test, has to be repeated, and results noted down in the appropriate column in the table. The results should again lie within specified limits.

The unit is now ready for final qualification and characterization. This will require the following apparatus:

- *HP 8753C network analyzer, along with the HP 85046A S-parameter test set and HP 85032B calibration kit.*
- *HP colorpro plotter at proper HPIB address (set as per HP 8753C).*
- *RG 223 RF cable Type-N male to TNC female.*
- *RG 223 RF cable Type-N male to TNC male.*
- *+19V DC power supply.*

Calibrate the network analyzer as explained in the HP 8753C network analyzers' manual. The procedure and setup required to measure the insertion loss is explained at length in the same manual and will not be repeated here. (A copy of the relevant pages of the manual is attached at the end of the writeup for C63 for the users' convenience.) While calibrating, set the RF stimulus to -20 dBm. Follow the necessary steps to get a display resembling the one shown in Plot 1. The insertion loss and rejection should be within the criteria already listed in table 1. Take a hardcopy to resemble the one shown in Plot 1.

Table 1.

Unit Code:C66/

	Before burn-in	After burn-in	Limits
Insertion Gain at 130MHz	dB	dB	Min=-3dB Max=0dB
Rejection at 105MHz	dBc	dBc	Min=-40dBc
Rejection at 155MHz	dBc	dBc	Min=-40dBc

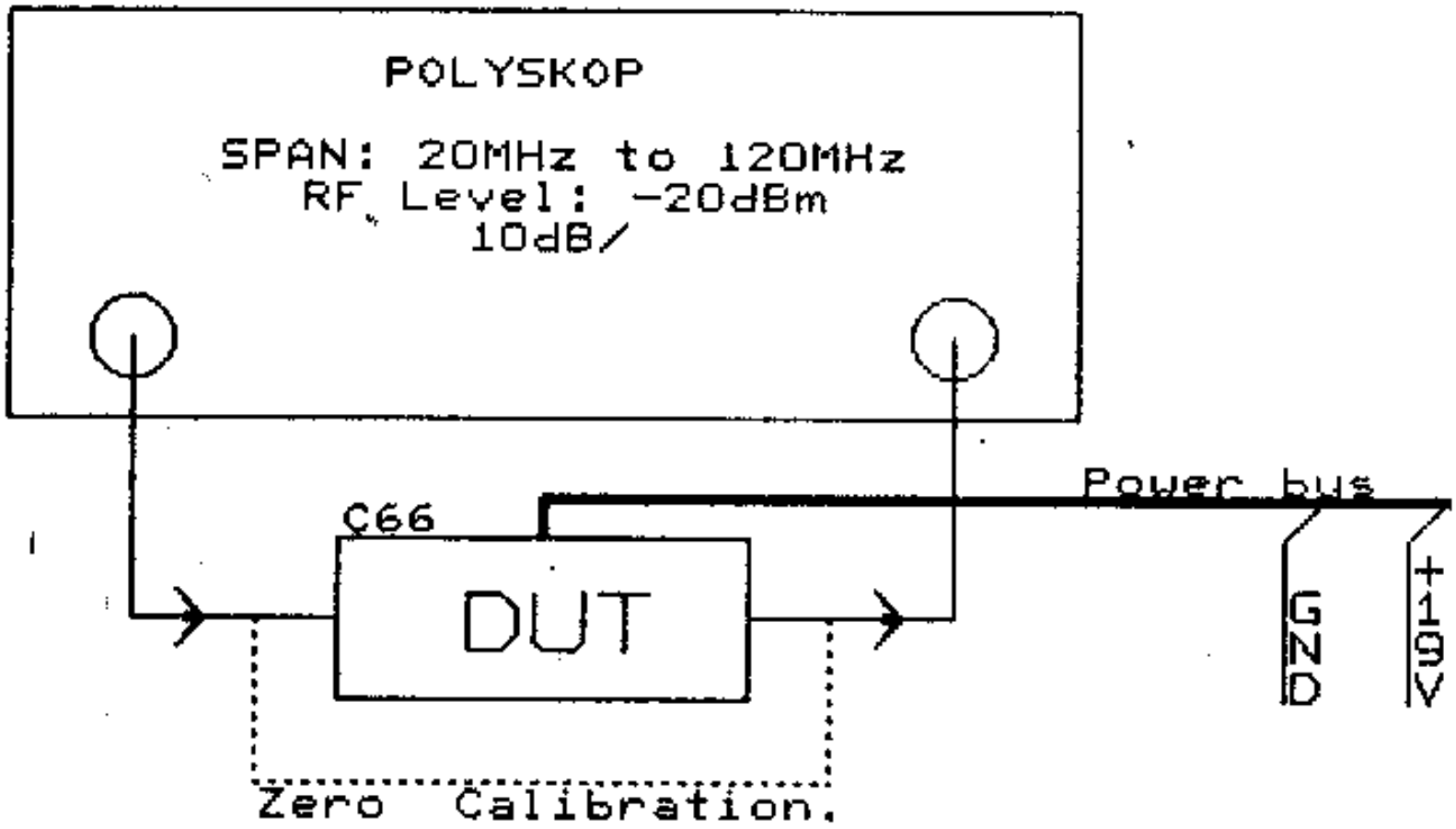
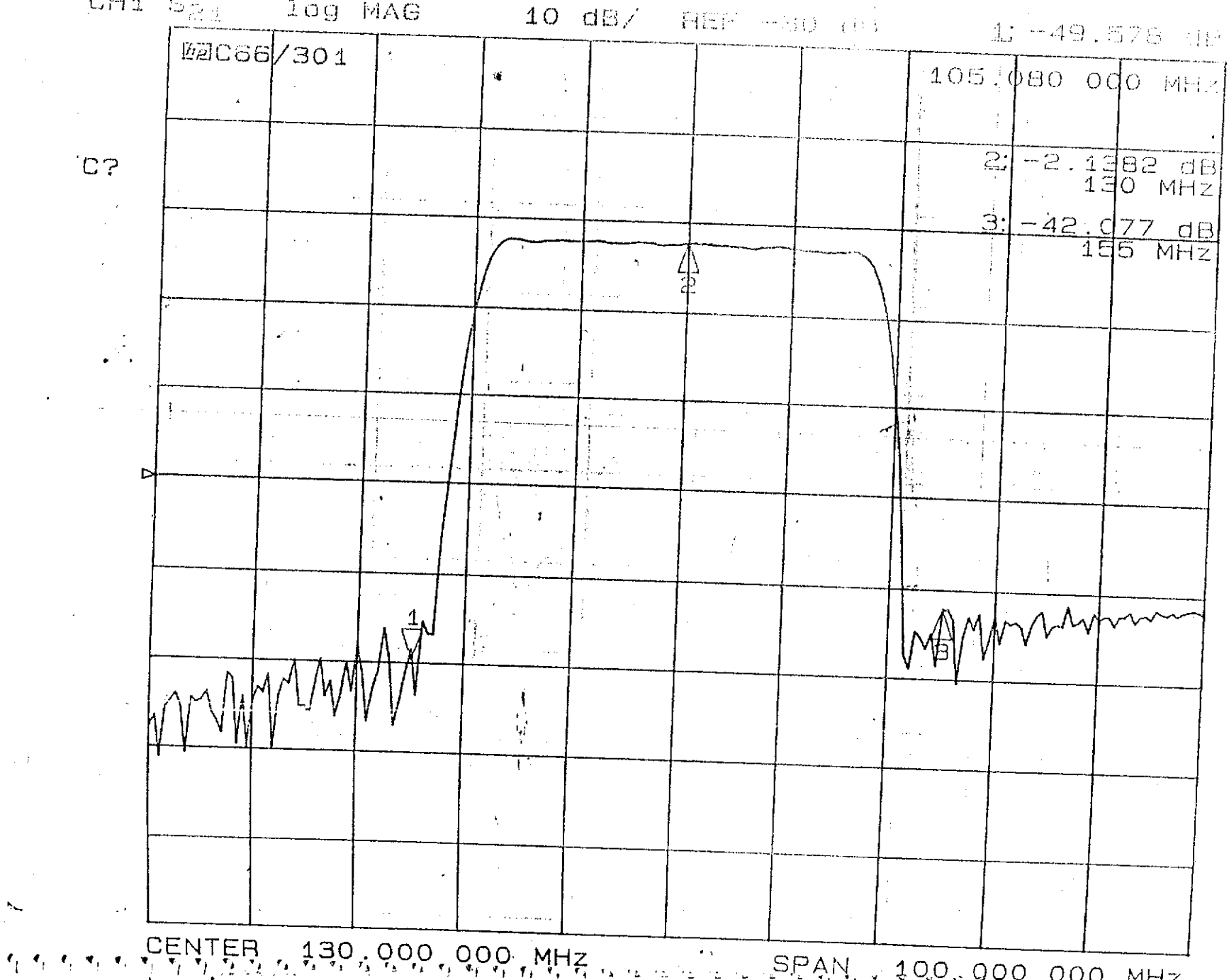

POLYSKOP
SPAN: 20MHz to 120MHz
RF Level: -20dBm
10dB/
Power bus
C66
DUT
GND
+10V
Zero Calibration.

Figure 1.


CH1 S21 log MAG 10 dB/ REF -30 (0)
1: -49.578 dB
C66/301
105.080 000 MHz
2: -2.1382 dB
130 MHz
3: -42.077 dB
155 MHz
C?
CENTER 130.000 000 MHz
SPAN 100.000 000 MHz

C67 (175MHz SAW Filter)

The unit after assembly is to be tested for functionality using the polyskop.

This will require the following apparatus:

- *Polyskop*
- *RG 223 RF cable Type-N female to TNC female.*
- *RG 223 RF cable Type-N male to TNC male.*
- *+19V DC power supply.*

The experimental setup should be as shown in Figure 1. Set the polyskop to span 100MHz around 175MHz center frequency. With RF power as -20dBm, and vertical scale as 10dB/division, zero the polyskop, and make the measurement. The insertion gain at 175MHz should be within -2dB to +1dB. The rejection at 150MHz and 200MHz should be better than -40dBc. Note down these readings in the appropriate column provided in Table 1.

After this test, the unit has to be kept powered on in an airconditioned test laboratory for ten days from a +19V power supply (burn in qualifier test).

After the burn in test is complete, the functionality test that was performed before the burn in test, has to be repeated, and results noted down in the appropriate column in the table. The results should again lie within specified limits.

The unit is now ready for final qualification and characterization. This will require the following apparatus:

- *HP 8753C network analyzer, along with the HP 85046A S-parameter test set and HP 85032B calibration kit.*
- *HP colorpro plotter at proper HPIB address (set as per HP 8753C).*
- *RG 223 RF cable Type-N male to TNC female.*
- *RG 223 RF cable Type-N male to TNC male.*
- *+19V DC power supply.*

Calibrate the network analyzer as explained in the HP 8753C network analyzers' manual. The procedure and setup required to measure the insertion loss is explained at length in the same manual and will not be repeated here. (A copy of the relevant pages of the manual is attached at the end of the writeup for C63 for the users' convenience.) While calibrating, set the RF stimulus to -20 dBm. Follow the necessary steps to get a display resembling the one shown in Plot 1. The insertion loss and rejection should be within the criteria already listed in table 1. Take a hardcopy to resemble the one shown in Plot 1.

Table 1.

Unit Code:C67/

	Before burn-in	After burn-in	Limits
Insertion Gain at 175MHz	dB	dB	Min=-3dB Max=0dB
Rejection at 150MHz	dBc	dBc	Min=-40dBc
Rejection at 200MHz	dBc	dBc	Min=-40dBc

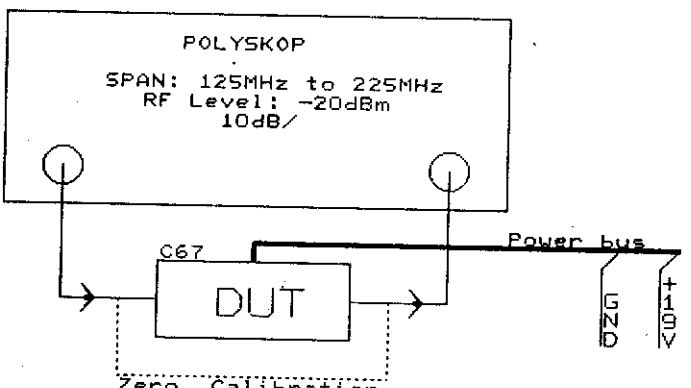
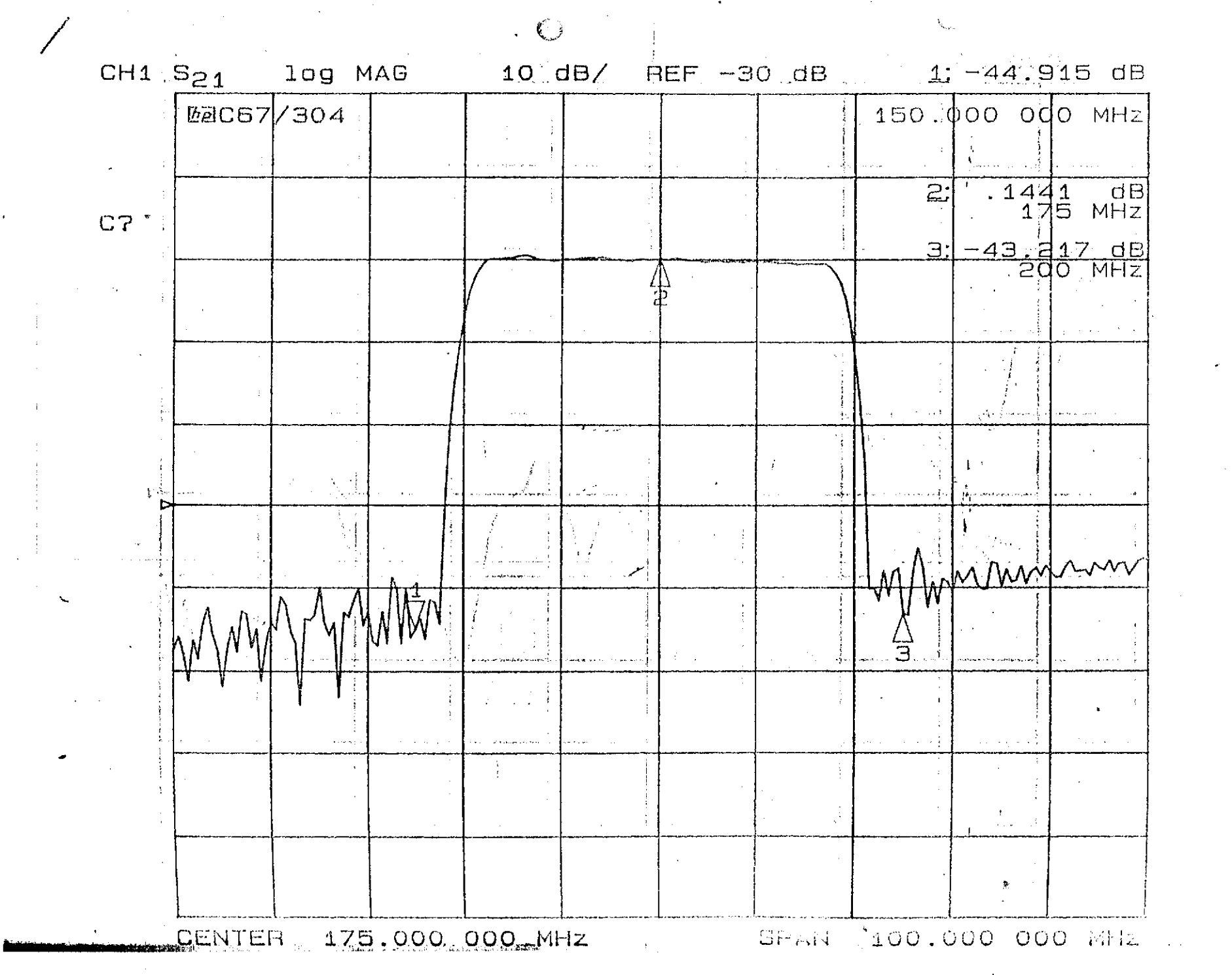

POLYSKOP
SPAN: 125MHz to 225MHz
RF Level: -20dBm
10dB/
C67
DUT
Power bus
GND
+19V
Zero Calibration.

Figure 1.


CH1 S21 log MAG 10 dB/ REF -30 dB 1: -44.915 dB
C67/304
150.000 000 MHz
2: .1441 dB
175 MHz
3: -43.217 dB
200 MHz
C?
1
2
3
CENTER 175.000 000 MHz
SPAN 100.000 000 MHz

C68 (150MHz Lowpass Filter)

The unit after assembly is to be tested for functionality using the polyskop and tuned if necessary.

This will require the following apparatus:

- *Polyskop*
- *RG 223 RF cable Type-N female to TNC female.*
- *RG 223 RF cable Type-N male to TNC male.*

The experimental setup should be as shown in Figure 1. Set the polyskop to span the display from DC to 250MHz and zero it after setting the RF power level to 0dBm and setting the vertical scale to 1dB/div. Now revert to 10dB/div and tune the trimmer capacitors so as to get a response approximately like the one depicted in Plot 1. Revert back to 1dB/div scale and retune if required so as to reduce the ripple in the passband to within ±0.1dB. Switching back to 10dB/div, ensure that the rejection at 250MHz is around atleast -40dB. Now change the span to cover upto 1GHz. Ensure that there is no spurious passband anywhere which is more than -40dB. If any such response exists, it is necessary to retune to remove it, and iteratively repeat the above procedure till all the criteria are satisfied. This procedure is deemed completed only when the insertion loss does not exceed 0.3dB, ripple is within ±0.1dB as already specified, rejection at 250MHz is -40dB minimum, and there is no spurious passband larger than -40dBc upto 1GHz.

The unit can now be closed, marked, and is ready for final qualification and characterization.

This will require the following apparatus:

- *HP 8753C network analyzer, along with the HP 85046A S-parameter test set and HP 85032B calibration kit.*
- *HP colorpro plotter at proper HPIB address (set as per HP 8753C).*
- *RG 223 RF cable Type-N male to TNC male.*
- *RG 223 RF cable Type-N male to TNC female.*

Calibrate the network analyzer as explained in the HP 8753C network analyzers' manual. The procedure and setup required to measure the insertion loss and return loss is explained at length in the same manual and will not be repeated here. (A copy of the relevant pages of the manual is attached at the end of the writeup for C63 for the users' convenience.) Follow the necessary steps to get a display resembling the one shown in Plot 1. (It includes both the insertion loss and return loss measurements on one screen in split mode.) The insertion loss should not exceed 0.3dB (as already specified) and the return loss should be better than -18dB upto 150MHz. Take a hardcopy to resemble the one shown in Plot 1.

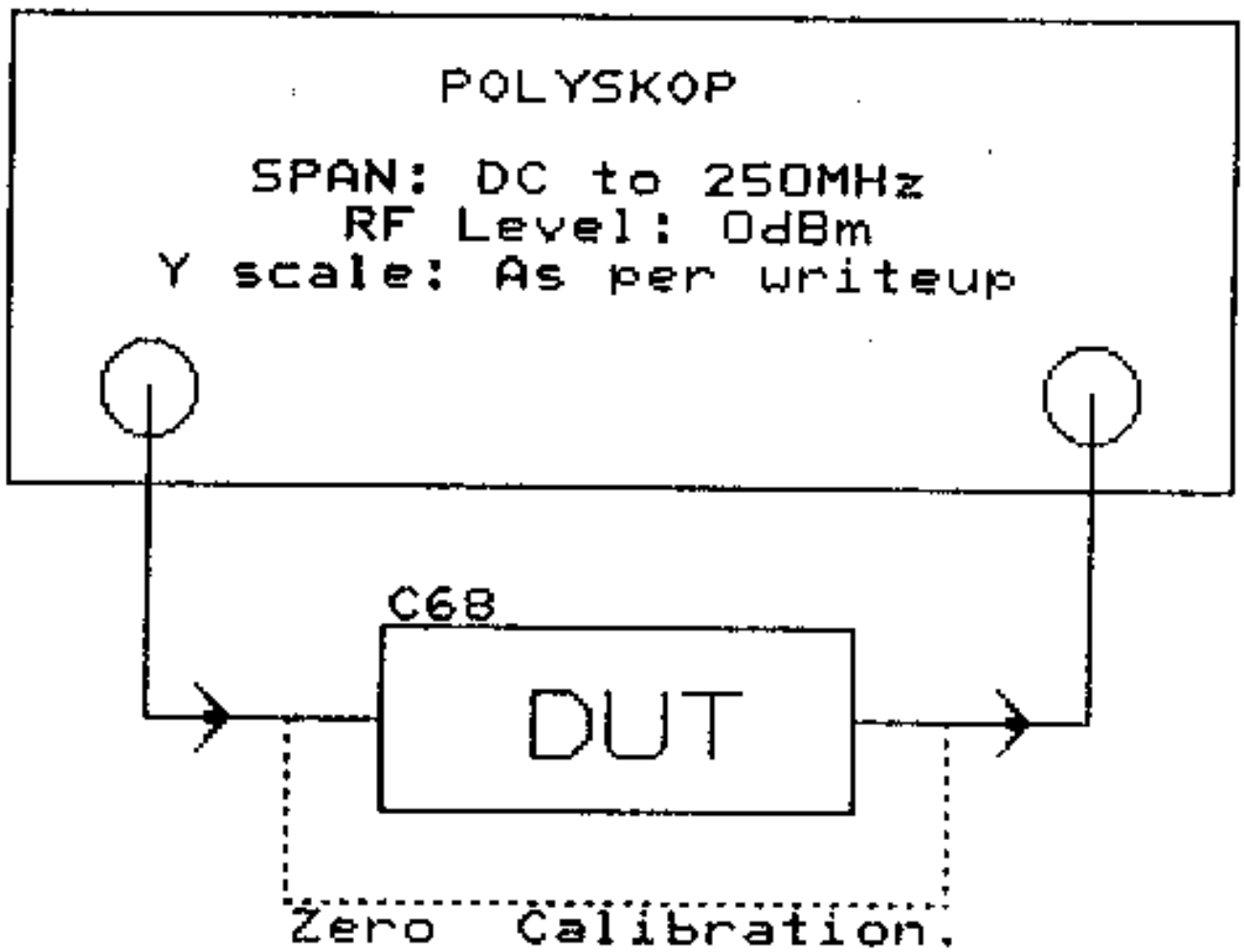
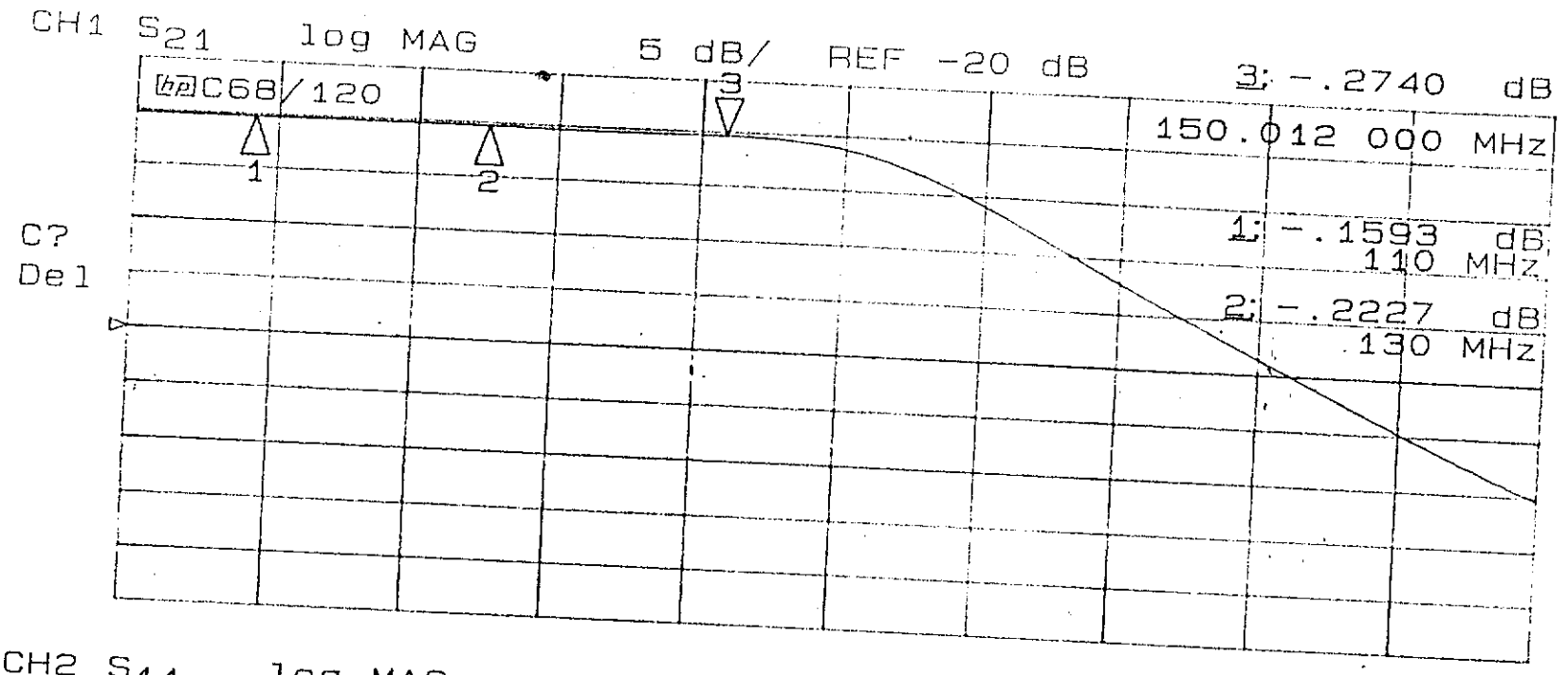
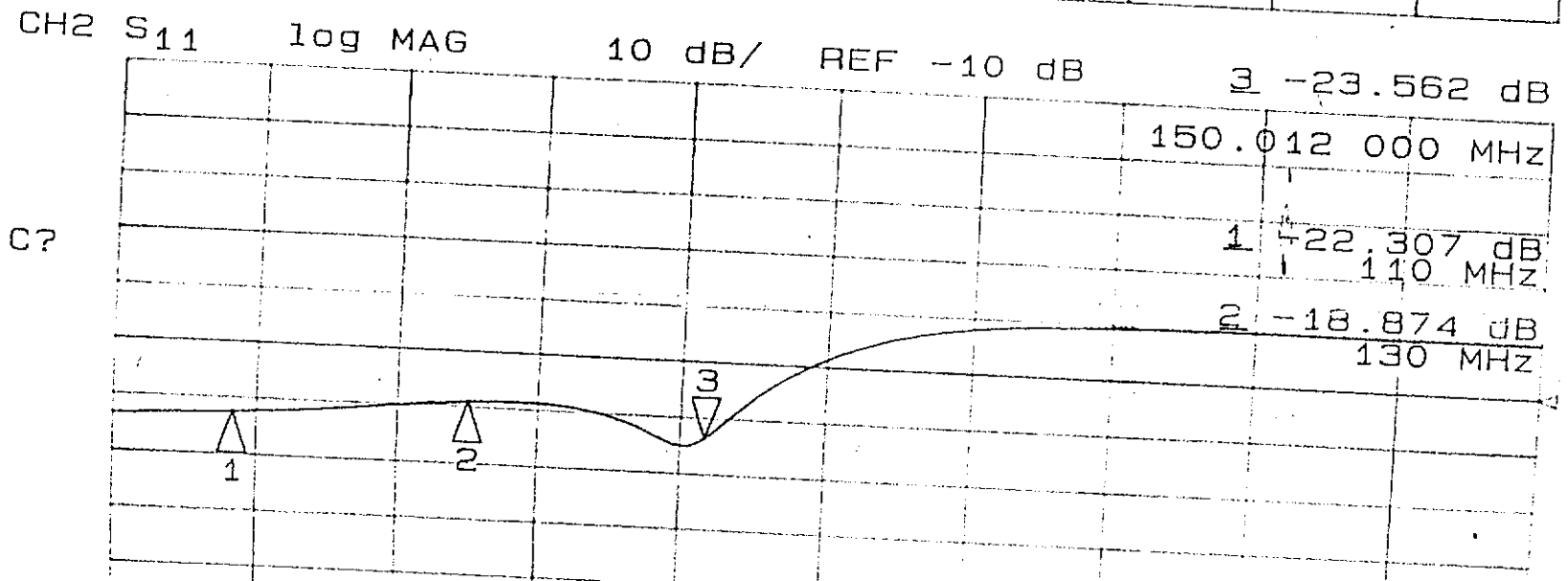

POLYSKOP
SPAN: DC to 250MHz
RF Level: 0dBm
Y scale: As per writeup
C68
DUT
Zero Calibration.

Figure 1.


CH1 S21 log MAG
5 dB/ REF -20 dB
C68/120
3: -.2740 dB
150.012 000 MHz
C?
Del
1: -.1593 dB
110 MHz
2: -.2227 dB
130 MHz


CH2 S11 log MAG
10 dB/ REF -10 dB
3 -23.562 dB
150.012 000 MHz
C?
1 -22.307 dB
110 MHz
2 -18.874 dB
130 MHz

C69 (200MHz Lowpass Filter)

The unit after assembly is to be tested for functionality using the polyskop and tuned if necessary.

This will require the following apparatus:

- *Polyskop*
- *RG 223 RF cable Type-N female to TNC female.*
- *RG 223 RF cable Type-N male to TNC male.*

The experimental setup should be as shown in Figure 1. Set the polyskop to span the display from DC to 330MHz and zero it after setting the RF power level to 0dBm and setting the vertical scale to 1dB/div. Now revert to 10dB/div and tune the trimmer capacitors so as to get a response approximately like the one depicted in Plot 1. Revert back to 1dB/div scale and retune if required so as to reduce the ripple in the passband to within ±0.1dB. Switching back to 10dB/div, ensure that the rejection at 330MHz is around atleast -40dB. Now change the span to cover upto 1GHz. Ensure that there is no spurious passband anywhere which is more than -40dB. If any such response exists, it is necessary to retune to remove it, and iteratively repeat the above procedure till all the criteria are satisfied. This procedure is deemed completed only when the insertion loss does not exceed 0.3dB, ripple is within ±0.1dB as already specified, rejection at 330MHz is -40dB minimum, and there is no spurious passband larger than -40dBc upto 1GHz.

The unit can now be closed, marked, and is ready for final qualification and characterization.

This will require the following apparatus:

- *HP 8753C network analyzer, along with the HP 85046A S-parameter test set and HP 85032B calibration kit.*
- *HP colorpro plotter at proper HPIB address (set as per HP 8753C).*
- *RG 223 RF cable Type-N male to TNC male.*
- *RG 223 RF cable Type-N male to TNC female.*

Calibrate the network analyzer as explained in the HP 8753C network analyzers' manual. The procedure and setup required to measure the insertion loss and return loss is explained at length in the same manual and will not be repeated here. (A copy of the relevant pages of the manual is attached at the end of the writeup for C63 for the users' convenience.) Follow the necessary steps to get a display resembling the one shown in Plot 1. (It includes both the insertion loss and return loss measurements on one screen in split mode.) The insertion loss should not exceed 0.3dB (as already specified) and the return loss should be better than -18dB upto 200MHz. Take a hardcopy to resemble the one shown in Plot 1.

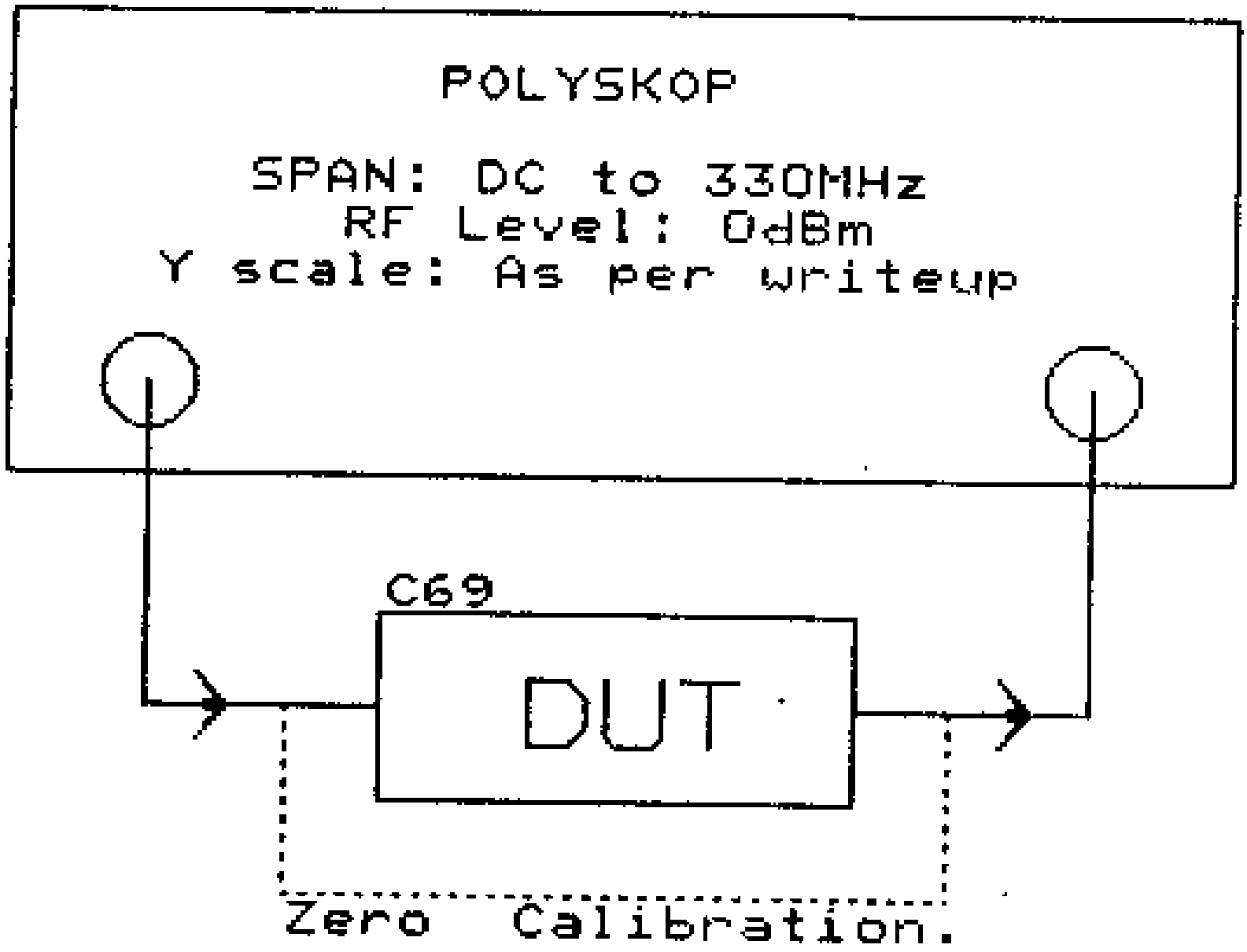
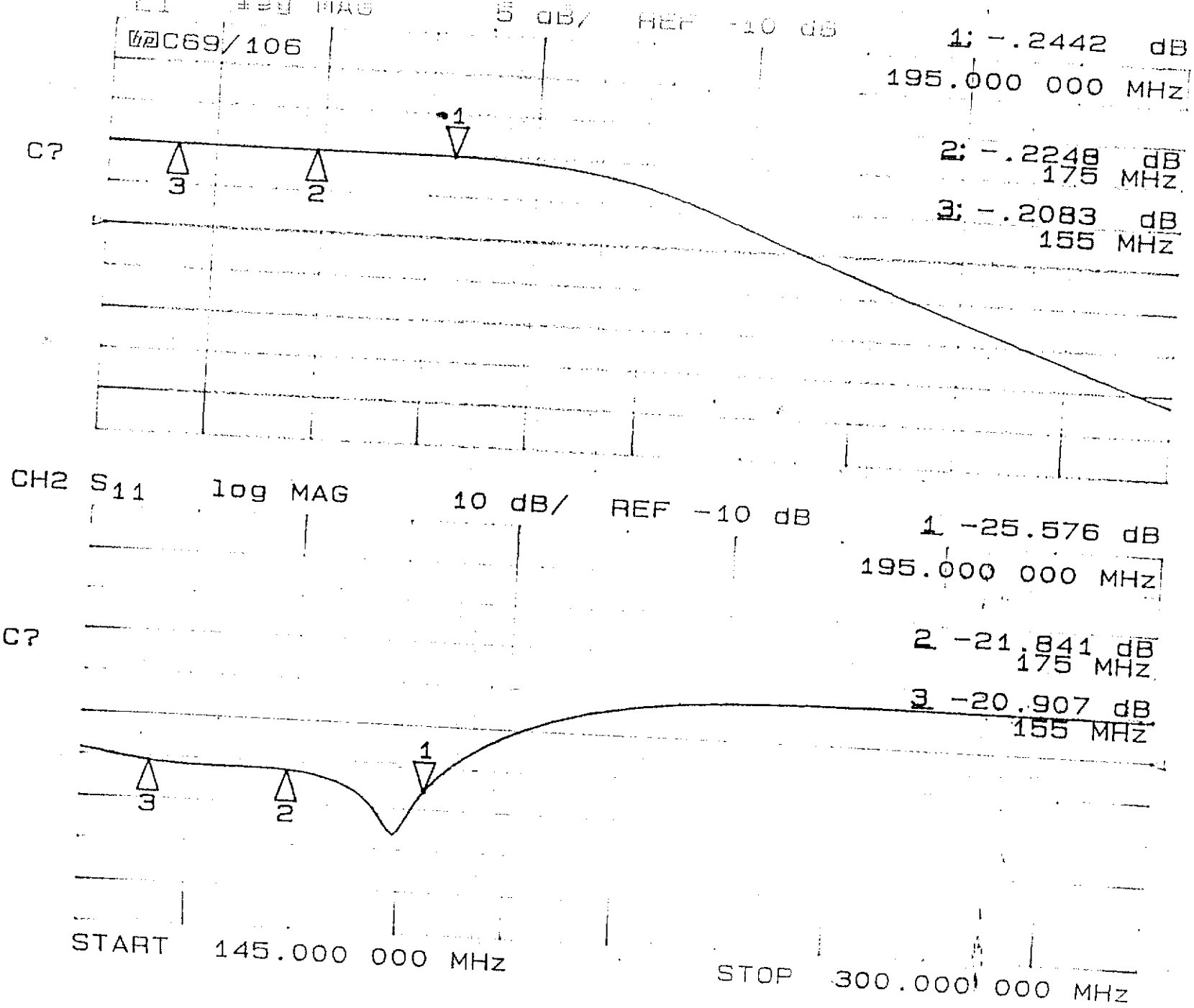

POLYSKOP
SPAN: DC to 330MHz
RF Level: 0dBm
Y scale: As per writeup
C69
DUT
Zero Calibration.

Figure 1.


@C69/106
5 dB/ REF -10 dB
1: -.2442 dB
195.000 000 MHz
C?
2: -.2248 dB
175 MHz
3: -.2083 dB
155 MHz
CH2 S11 log MAG
10 dB/ REF -10 dB
1 -25.576 dB
195.000 000 MHz
C?
2 -21.841 dB
175 MHz
3 -20.907 dB
155 MHz
START 145.000 000 MHz
STOP 300.000 000 MHz

C69A (205MHz Lowpass Filter)

The unit after assembly is to be tested for functionality using the polyskop and tuned if necessary.

This will require the following apparatus:

- *Polyskop*
- *RG 223 RF cable Type-N female to TNC female.*
- *RG 223 RF cable Type-N male to TNC male.*

The experimental setup should be as shown in Figure 1. Set the polyskop to span the display from DC to 330MHz and zero it after setting the RF power level to 0dBm and setting the vertical scale to 1dB/div. Now revert to 10dB/div and tune the trimmer capacitors so as to get a response approximately like the one depicted in Plot 1. Revert back to 1dB/div scale and retune if required so as to reduce the ripple in the passband to within ±0.1dB. Switching back to 10dB/div, ensure that the rejection at 330MHz is around atleast -40dB. Now change the span to cover upto 1GHz. Ensure that there is no spurious passband anywhere which is more than -40dB. If any such response exists, it is necessary to retune to remove it, and iteratively repeat the above procedure till all the criteria are satisfied. This procedure is deemed completed only when the insertion loss does not exceed 0.5dB, ripple is within ±0.1dB as already specified, rejection at 330MHz is -40dB minimum, and there is no spurious passband larger than -40dBc upto 1GHz.

The unit can now be closed, marked, and is ready for final qualification and characterization.

This will require the following apparatus:

- *HP 8753C network analyzer, along with the HP 85046A S-parameter test set and HP 85032B calibration kit.*
- *HP colorpro plotter at proper HPIB address (set as per HP 8753C).*
- *RG 223 RF cable Type-N male to TNC male.*
- *RG 223 RF cable Type-N male to TNC female.*

Calibrate the network analyzer as explained in the HP 8753C network analyzers' manual. The procedure and setup required to measure the insertion loss and return loss is explained at length in the same manual and will not be repeated here. (A copy of the relevant pages of the manual is attached at the end of the writeup for C63 for the users' convenience.) Follow the necessary steps to get a display resembling the one shown in Plot 1. (It includes both the insertion loss and return loss measurements on one screen in split mode.) The insertion loss should not exceed 0.5dB (as already specified) and the return loss should be better than -15dB upto 205MHz. Take a hardcopy to resemble the one shown in Plot 1.

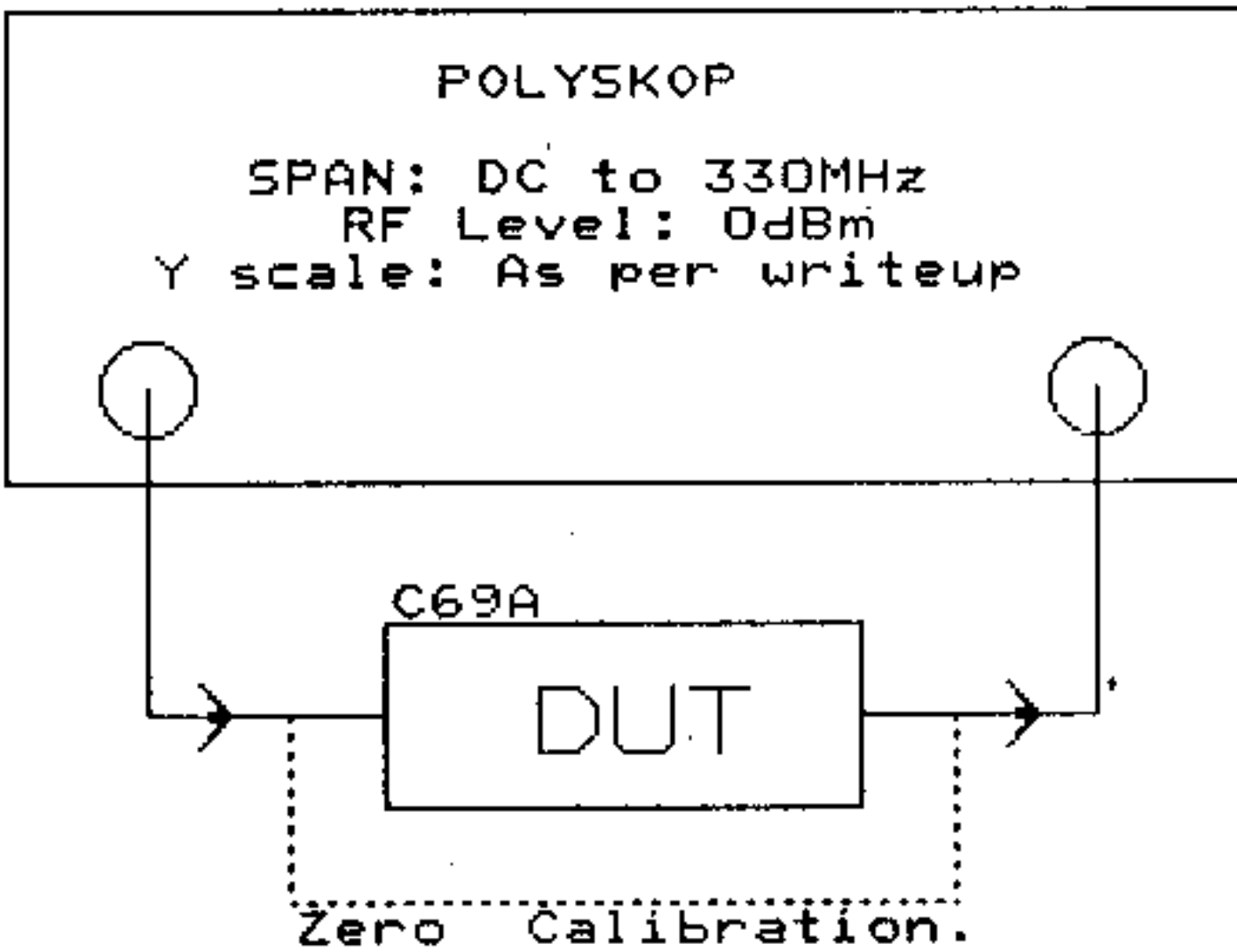
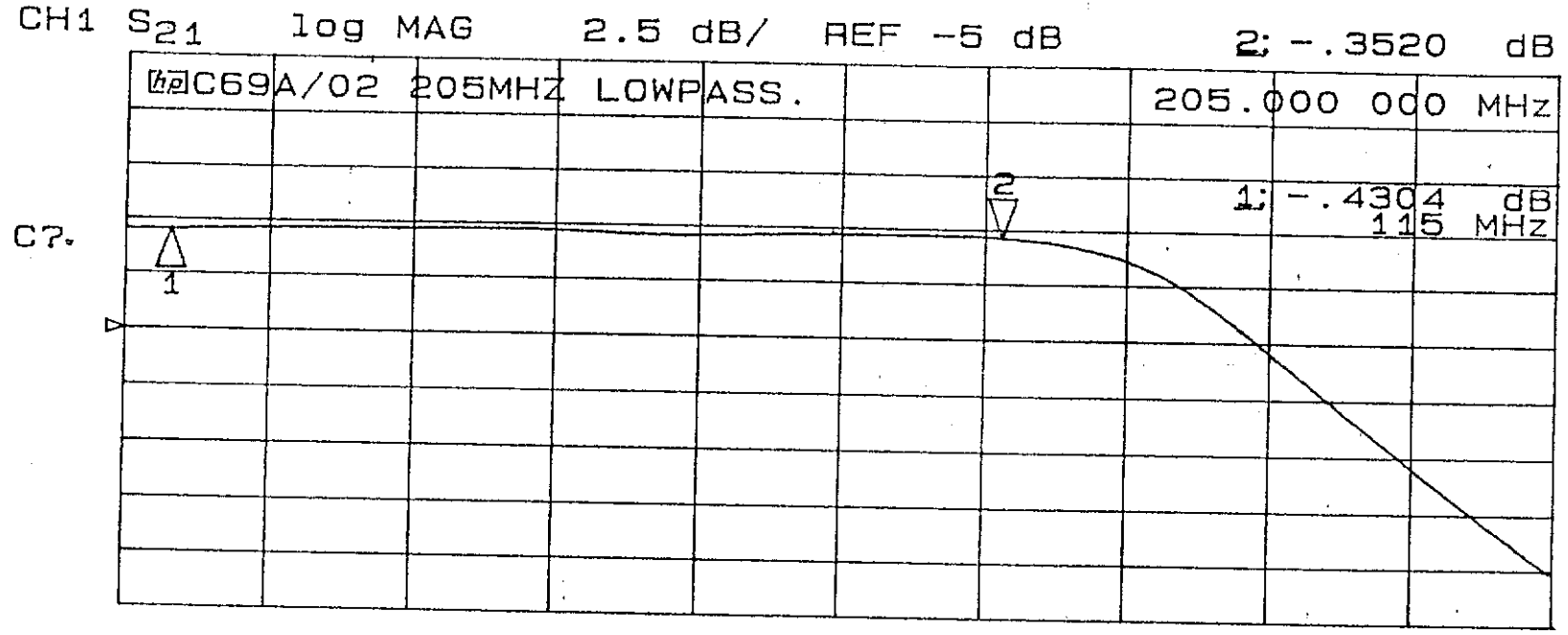
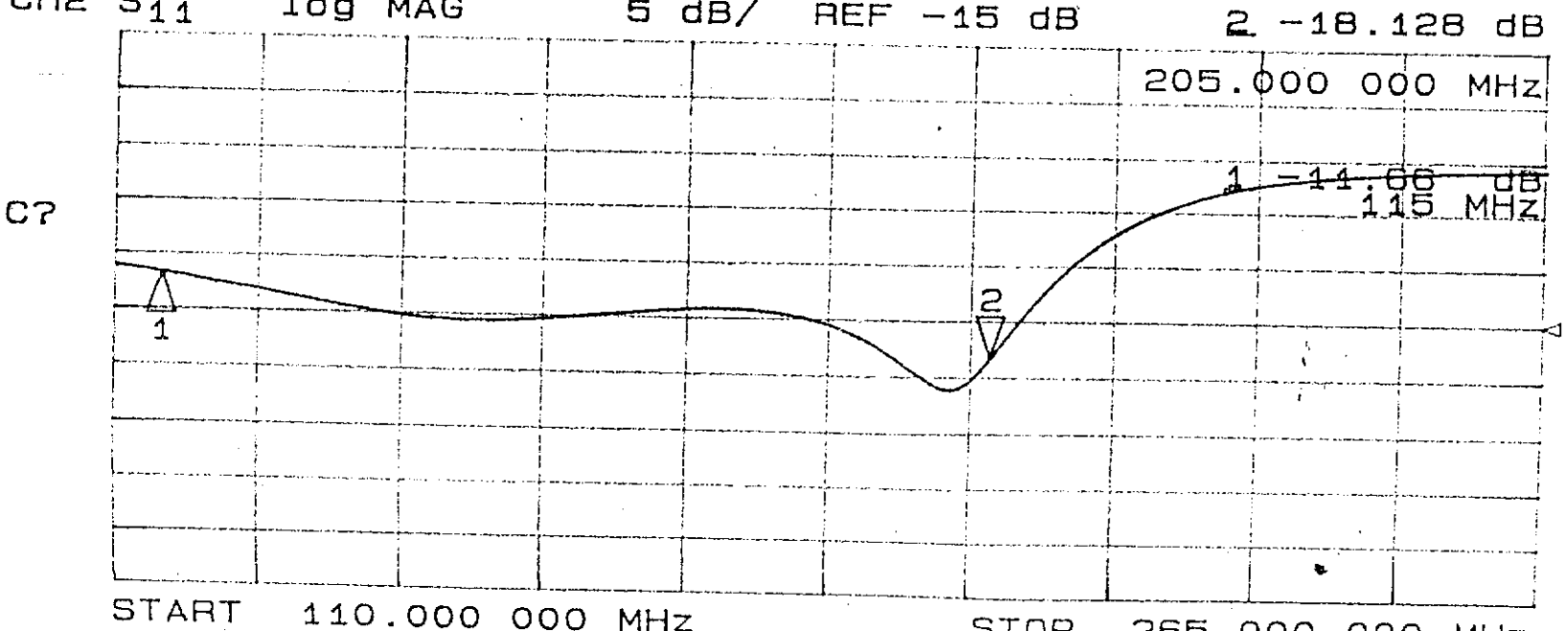

POLYSKOP
SPAN: DC to 330MHz
RF Level: 0dBm
Y scale: As per writeup
C69A
DUT
Zero Calibration.

Figure 1.


CH1 S21 log MAG 2.5 dB/ REF -5 dB
2: -.3520 dB
HP C69A/02 205MHZ LOWPASS.
205.000 000 MHz
1: -.4304 dB
115 MHz
C?
1
2


CH2 S11 log MAG 5 dB/ REF -15 dB
2 -18.128 dB
205.000 000 MHz
1 -14.66 dB
115 MHz
C?
1
2
START 110.000 000 MHz

C71A (AGC Preattenuator cum Voltage Controlled Amplifier)

The unit after assembly is to be tested for functionality using signal generator and spectrum analyzer.
This will require the following apparatus.

- *Marconi 2031 signal generator.*
- *Spectrum analyzer, Tek 2710 , Tek 7L14 or HP 8591E.*
- *A qualified C71B unit.*
- *+5V, 0-5V, ±19V and +10V DC power supply.*
- *RG 223 RF cable Type-N male to TNC male.*
- *RG 223 RF cable Type-N male to TNC female.*

The experimental setup should be as shown in Figure 1. Set the spectrum analyzer to span 100MHz around a center frequency of 150MHz. Keep the VCA control voltage at approximately 1V. Set the signal generator to output a CW at 150MHz at a power level of -50dBm. Set the the various AGC preattenuation controls as listed out in Table-1 and note down the output levels in the column provided. Make the necessary calculations. The results should be within the limits shown. Now change the VCA control voltage to +5V. The output should decrease by approximately 25dB to 30dB.

After this test, the unit has to be kept powered on in an airconditioned test laboratory for ten days from a +5V power supply (burn in qualifier test).

After the burn in test is complete, the functionality test that was performed before the burn in test, has to be repeated, and results noted down in the appropriate column in the table and appropriate calculations made. The results should again lie within specified limits.

Table 1.

Unit Code: C71A/

Control voltages (to C71B)				Before Burn in	After Burn in	Maximum	A+50	B+50	Minimum
J1.1	J1.2	J1.3	J1.4	A (dBm)	B (dBm)	(dB)	(dB)	(dB)	(dB)
0V	0V	+5V	0V			-5.5			-7.5
0V	0V	+5V	+5V			-7.5			-9.5
0V	0V	0V	0V			-9.5			-11.5
0V	0V	0V	+5V			-11.5			-13.5
0V	+5V	+5V	0V			-13.5			-15.5
0V	+5V	+5V	+5V			-15.5			-17.5
0V	+5V	0V	0V			-17.5			-19.5
0V	+5V	0V	+5V			-19.5			-21.5
+5V	0V	+5V	0V			-21.5			-23.5
+5V	0V	+5V	+5V			-23.5			-25.5
+5V	0V	0V	0V			-25.5			-27.5
+5V	0V	0V	+5V			-27.5			-29.5
+5V	+5V	+5V	0V			-29.5			-31.5
+5V	+5V	+5V	+5V			-31.5			-33.5
+5V	+5V	0V	0V			-33.5			-35.5
+5V	+5V	0V	+5V			-35.5			-37.5
0V	0V	+5V	0V			-5.5			-7.5

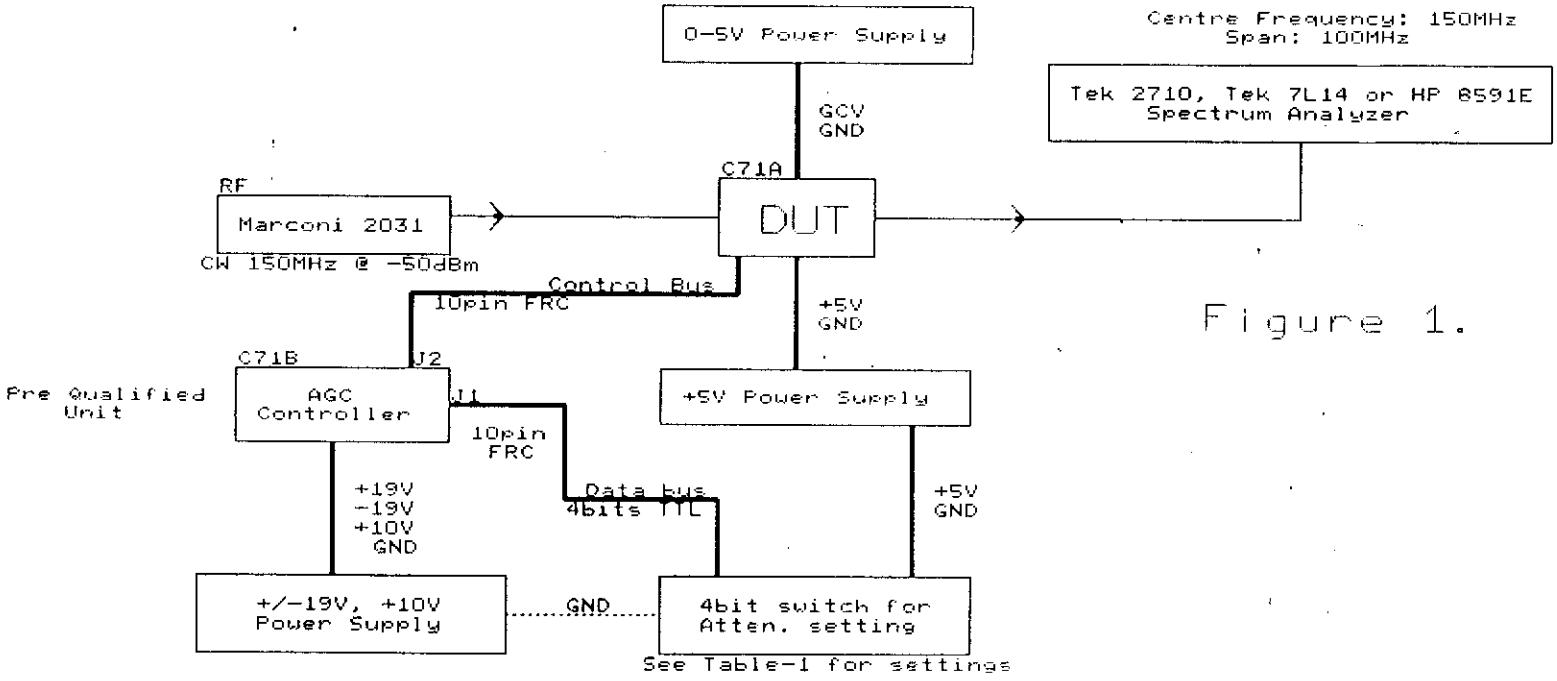

0-5V Power Supply
Centre Frequency: 150MHz
Span: 100MHz
Tek 2710, Tek 7L14 or HP 8591E
Spectrum Analyzer
GCV
GND
C71A
DUT
RF
Marconi 2031
CW 150MHz @ -50dBm
Control Bus
10pin FRC
+5V
GND
C71B
J2
Pre Qualified
Unit
AGC
Controller
J1
10pin
FRC
+5V Power Supply
+19V
-19V
+10V
GND
Data bus
4bits TTL
+5V
GND
+/-19V, +10V
Power Supply
GND
4bit switch for
Atten. setting
See Table-1 for settings

Figure 1.

C71B (AGC Controller)

The unit after assembly is to be tested for functionality using a polyskop. This will require the following apparatus.

- *Polyskop.*
- *Digital multimeter.*
- *RG 223 RF cable Type-N male to TNC male.*
- *RG 223 RF cable Type-N male to TNC female.*
- *±19V, +5V and +10V DC power supply.*

The experimental setup should be as shown in Figure 1. Set the polyskop to span 100MHz around a center frequency of 150MHz. Set the RF power level to -30dBm and vertical scale to 10dB/division and calibrate the instrument. Now measure the gain of the C71B unit. It should be approximately +8dB±0.5dB. Tune potentiomenter P1 to get GCV as approximately 3.3V and check the +5V regulated output from the unit. Now turn the polyskop RF power level to -10dBm. The GCV should increase to around 3V. The remaining potentiomenters P2 and P3 should be brought approximately in the middle of their ranges and left. These shall be tuned during the final integrated testing of the C42/C43 PIU when this unit gets integrated with the C71A unit to complete the AGC loop. These potentiomenters control the output power levels of the AGC and the time constant. Now set the the various AGC preattenuation controls as listed out in Table-1 and ensure that the output levels at the various points are as tabulated.

After this test, the unit has to be kept powered on in an airconditioned test laboratory for ten days from a ±19V and +10V power supply (burn in qualifier test).

After the burn in test is complete, the functionality test that was performed before the burn in test, has to be repeated. The results should again lie within specified limits.

Table 1.

Unit Code: C71B/

Inputs				Outputs							
J1.1	J1.2	J1.3	J1.4	J2.1	J2.2	J2.3	J2.4	J2.5	J2.6	J2.7	J2.8
0V	0V	0V	+5V	-5V	0V	-5V	0V	-5V	0V	0V	-5V
0V	0V	+5V	0V	-5V	0V	-5V	0V	0V	-5V	-5V	0V
0V	+5V	0V	0V	-5V	0V	0V	-5V	-5V	0V	-5V	0V
+5V	0V	0V	0V	0V	-5V	-5V	0V	-5V	0V	-5V	0V

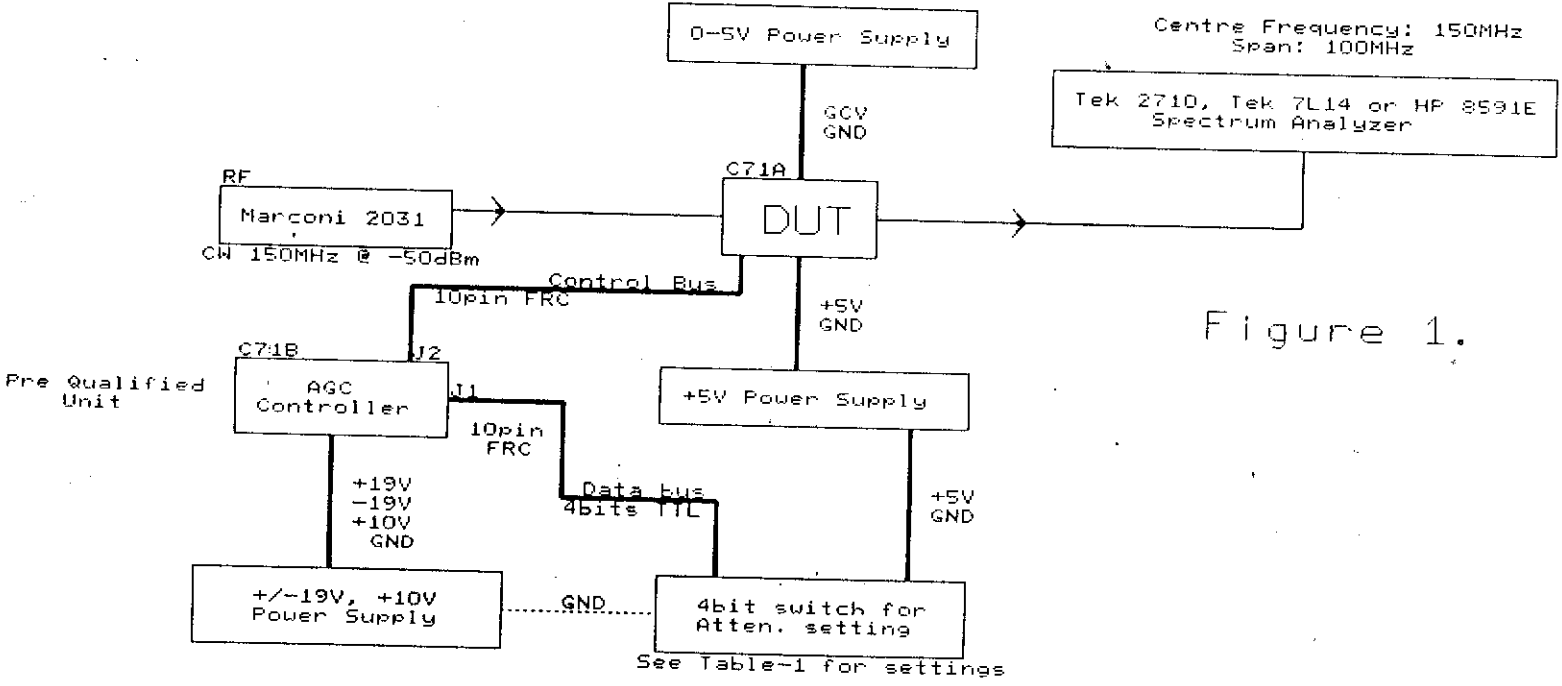

0-5V Power Supply
GCV
GND
Centre Frequency: 150MHz
Span: 100MHz
Tek 2710, Tek 7L14 or HP 8591E
Spectrum Analyzer
RF
Marconi 2031
CW 150MHz @ -50dBm
C71A
DUT
Control Bus
10pin FRC
+5V
GND
C71B
J2
Pre Qualified
Unit
AGC
Controller
J1
10pin
FRC
+5V Power Supply
+19V
-19V
+10V
GND
Data Bus
4bits TTL
+5V
GND
+/-19V, +10V
Power Supply
GND
4bit switch for
Atten. setting
See Table-1 for settings

Figure 1.

C72 (MCM-IF control interface card)

The card after assembly has to be tested for functionality.

This will require the following apparatus:

- *PC with PCL203 digital IO card.*
- *±12V and +5V DC power supply.*
- *Digital multimeter.*

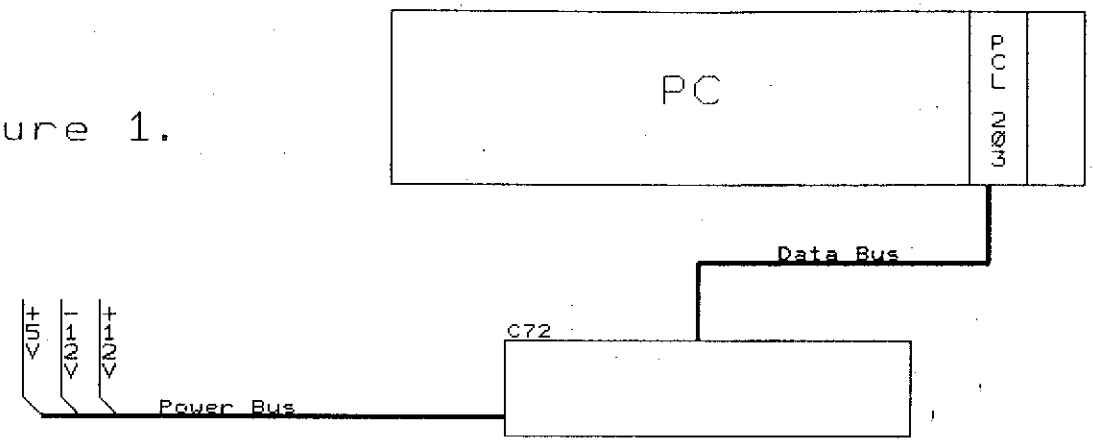
The experimental setup should be as shown in Figure 1. Boot the PC and make sure that the file IFCTL_R1.BAS is present in your current working directory. Additionally, your PATH variable should point to the location of GWBASIC.EXE (or optionally GWBASIC.EXE should be located in your current working directory.). Before proceeding, make sure that the data connections from the PCL203 card to the card under test, are connected exactly as specified in Figure 1. The connections are not one to one, though both connectors are 20pin FRC, and the test will be meaningless if these connections are incorrect. Also any mistake in making connections is liable to damage the PCL203 and/or the interface card under test.

Now run the program IFCTL_R1.BAS by typing "gwbasic iftcl_R1" at the DOS prompt. The program will start to reset the MCM-IF control interface card which is under test and various LEDs on the card will blink repeatedly. Wait till the reset is over, and then follow the instructions given by the program to go through the entire test. You will be required to note if the particular LED, as intimated by the program blinks, and check the voltage levels as required by the program at various IC and connector locations.

After this test, the card has to be kept powered on in an airconditioned test laboratory for ten days from a ±12V and a +5V power supply (burn in qualifier test).

After the burn in test is complete, the functionality test that was performed before the burn in test, has to be repeated.

Figure 1.

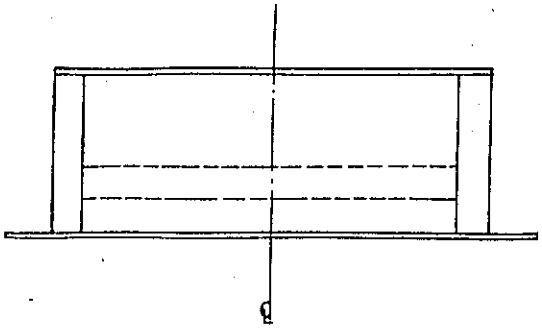


Data Bus connections.

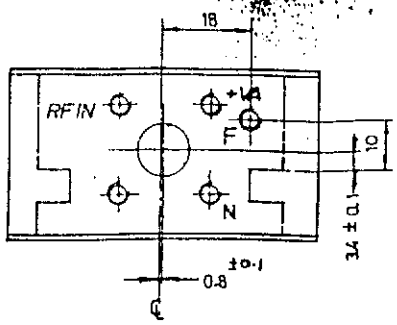
Connector J0 on test card C72	Connector CN3 on PCL 203
3	2
4	1
5	4
6	3
7	6
8	5
9	8
10	7
11	10
12	9
13	12
14	11
15	14
16	13
17	16
18	15
19	18
20	17
1 & 2 NC	19 & 20 NC

Note: These connections can be easily made by connecting two FRC female headers using a berg strip and offsetting one header in the proper direction.

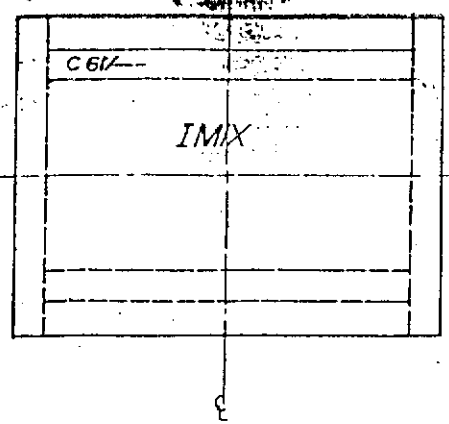
BACK COVER (VIEW Y)



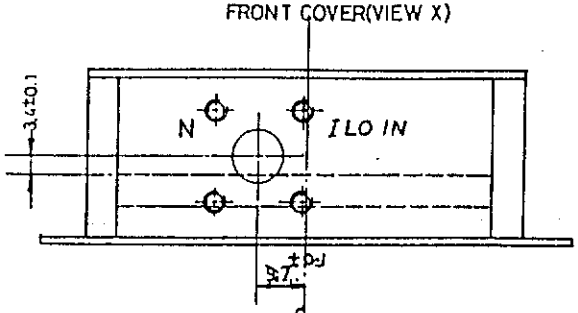
RIGHT SIDE COVER(VIEW Q)



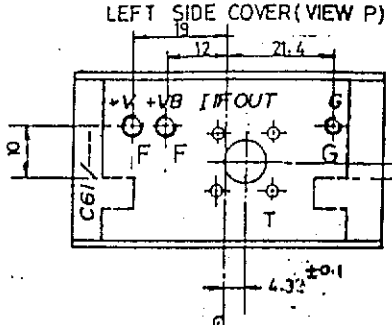
TOP COVER(VIEW R)



FRONT COVER(VIEW X)



LEFT SIDE COVER(VIEW P)



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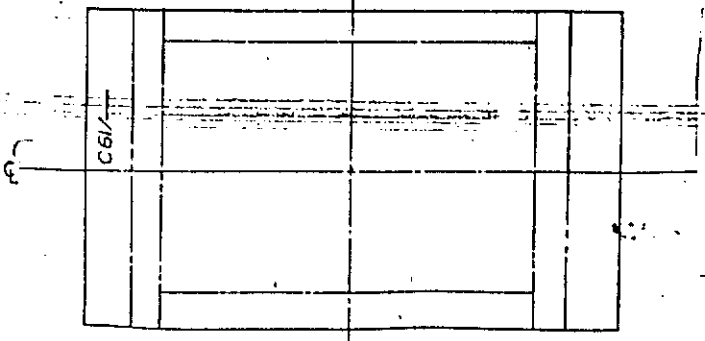
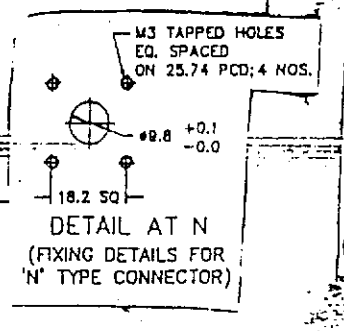
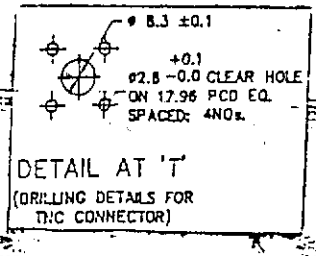
BY

FOR FABRICATION





DETAIL AT N
(FIXING DETAILS FOR
'N' TYPE CONNECTOR)



DETAIL AT 'T'
(DRILLING DETAILS FOR
TNC CONNECTOR)

NOTES:
1. U.O.S ALL DIMENSIONS ARE IN mm
2. U.O.S. FIXING HOLE LOCATIONS OF ALL CHASSIS MOUNTINGS CARRAY A TOLERANCE AS PER IS:2102, MEDIUM CLASS.
3. MANUFACTURING DETAILS FOR FOUR RAIL CHASSIS AS PER DRG.NO: G10/384 AND FOR TWO RAILS AS PER DRG.NO: G10/311
4. MASS PRODUCTION OF CHASSIS SHALL BE CARRIED OUT ONLY AFTER ACCEPTENCE OF FIRST SAMPLE CHASSIS BY T.I.F.R.
5. REST OF ALL CHASSIS SHALL BE OFFERED FOR INSPECTION BY SUPPLIER ONLY AFTER CONFIRMING THE CORRECTNESS OF THE LOCATIONS OF ALL CHASSIS MOUNTINGS SUCH AS TNC/TYPE-N/SMA CONNECTORS WITH THE RESPECTIVE TRACKS FOR SOLDERING PROVIDED ON THE SAMPLE PCBs SUPPLIED BY T.I.F.R.
6. DO NOT SCALE , IF IN DOUBT PLEASE ASK.
7. U.O.S. ALL HOLES, TAPPED HOLES AND SLOTS ARE 7mm DEEP.
8. DETAILS GIVEN IN INCLINED LETTERS SHALL BE PUNCHED ON OUTER SURFACE OF THE CHASSIS AT CORRESPONDING LOCATIONS (WITH 7mm HEIGHT FOR END USE CODE, 5mm HEIGHT FOR ITEM CODE/RUNNING NO, Nr QUANTITY, AND REST WITH 3mm HEIGHT LETTERS) SO AS NOT TO BE HIDDEN BY MOUNTINGS.
9. ALPHABETS IN STRAIGHT LETTERS ARE NOT BE PUNCHED AND PERTAIN TO DETAILS AT THAT LOCATION. THEY ARE EXPLAINED ELSEWHERE IN THIS DRAWING

46Rs

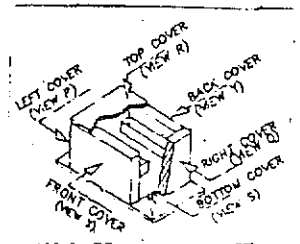
BOTTOM COVER(VIEW S)

M3 TAPPED HOLE FOR GROUND TAG

DETAIL AT G

TAPPED HOLES FOR ø8.32 UNC CLASS 2A THREADS

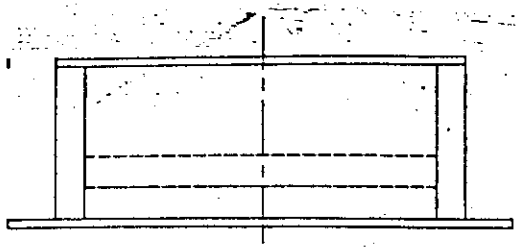
DETAIL AT 'F'
(TAPPING DETAILS FOR
FEED THRU')



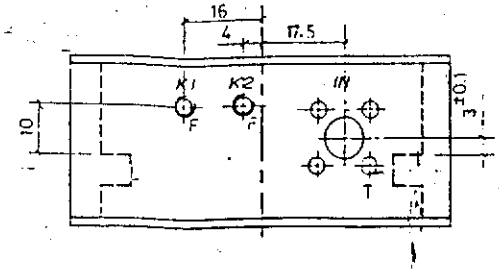
GIANT METREWAVE RADIO TELESCOPE PROJECT, PUNE

	SIGN	DATE	D TYPE CHASSIS DRILLING DETAILS FOR FIXING CONNECTOR, FEED THROUGH ETC.
Traced			
Drawn	Sonisai	22/1/93	END USE
Checked		28/01/93	I MIX
Approved		29/1/93	ITEM CODE C 61 QTY: 60
Scale: ~			DRG NO. G50/IF/017

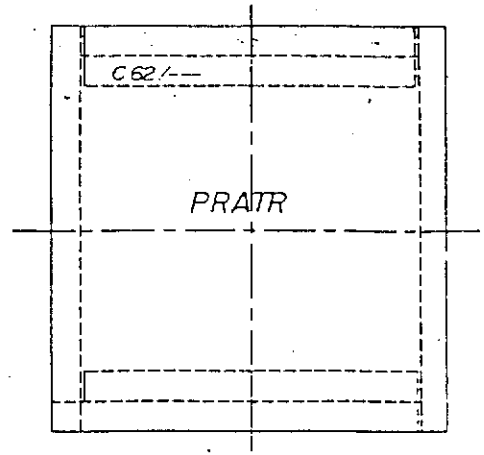
BACK COVER (VIEW Y)



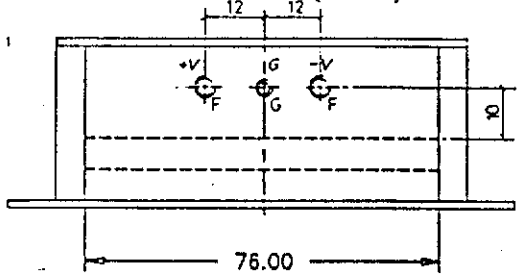
RIGHT SIDE COVER (VIEW Q)



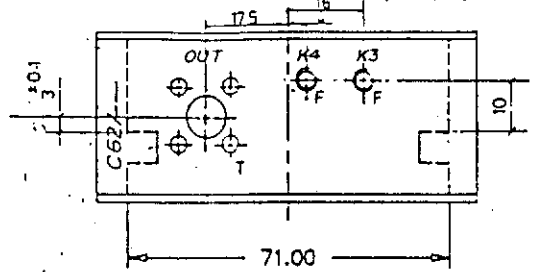
TOP COVER (VIEW R)



FRONT COVER (VIEW X)



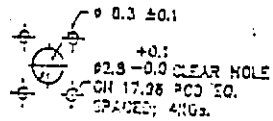
LEFT SIDE COVER (VIEW P)



TAPPED HOLES FOR
M3.32 UNC CLASS 2A
THREADS

DETAIL AT 'F'

(TAPPING DETAILS FOR
FEED THRU')

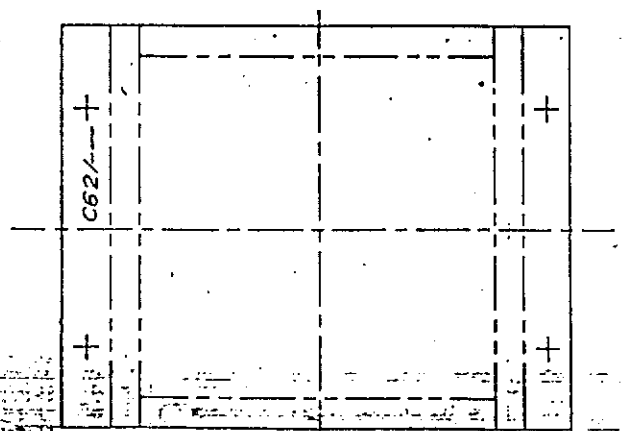


DETAIL AT 'T'

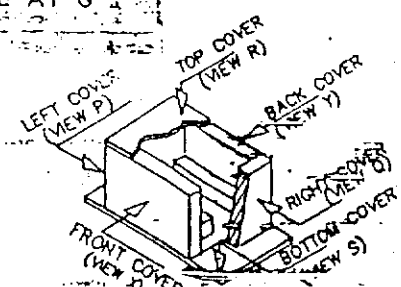
(DRILLING DETAILS FOR
TNC CONNECTOR)

M3 TAPPED HOLE
FOR GROUND TAG

DETAIL AT G



BOTTOM COVER (VIEW S)



NOTES:
1. U.O.S. ALL DIMENSIONS ARE IN mm
2. U.O.S. FIXING HOLE LOCATIONS OF ALL CHASSIS MOUNTINGS CARRAY A TOLERANCE AS PER IS:2101, MEDIUM CLASS.
3. MANUFACTURING DETAILS FOR FOUR RAIL CHASSIS AS PER DRG.NO:GIC/C64 AND FOR TWO RAILS AS PER DRG.NO:GIC/311
4. MASS PRODUCTION OF CHASSIS SHALL BE CARRIED OUT ONLY AFTER ACCEPTANCE OF FIRST SAMPLE CHASSIS BY T.I.F.R.
5. REST OF ALL CHASSIS SHALL BE OFFERED FOR INSPECTION BY SUPPLIER ONLY AFTER CONFIRMING THE CORRECTNESS OF THE LOCATIONS OF ALL CHASSIS MOUNTINGS SUCH AS TNC TYPE-N DIA CONNECTORS WITH THE RESPECTIVE TRACKS FOR SOLDERING PROVIDED ON THE SAMPLE PCBs SUPPLIED BY T.I.F.R.
6. DO NOT SCALE, IF IN DOUBT PLEASE ASK.
7. U.O.S. ALL HOLES, TAPPED HOLES AND SLOTS ARE 7mm DEEP.
8. DETAILS GIVEN IN INCLINED LETTERS SHALL BE PUNCHED ON OUTER SURFACE OF THE CHASSIS AT CORRESPONDING LOCATIONS (WITH 7mm HEIGHT FOR END USE CODE, 5mm HEIGHT FOR TEST CODE/RACKING NO. IN QUANTITY, AND REST WITH 3mm HEIGHT LETTERS) SO AS NOT TO BE HIDDEN BY MOUNTINGS.
9. ALPHABETS IN STRAIGHT LETTERS ARE NOT TO BE PUNCHED AND PERTAIN TO DETAILS AT THAT LOCATION, THEY ARE EXPLAINED ELSEWHERE IN THIS DRAWING

GIANT METREWAVE RADIO TELESCOPE PROJECT, PUNE

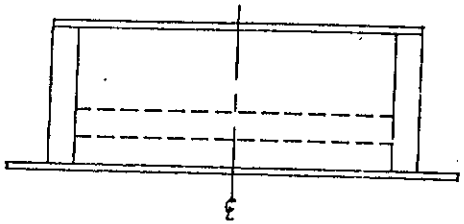
	SIGN	DATE
Traced		
Drawn	Sovdas	7/12/93
Checked		
Approved		

'C' TYPE CHASSIS DRILLING DETAILS FOR FIXING CONNECTOR, FEED THROUGH ETC

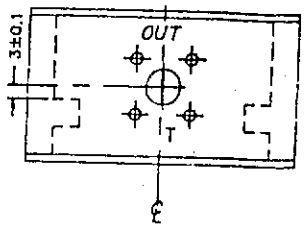
END USE: PRATR C62

Scale 1:1, N.T.S. DRG. NO. GSO/IF/019 REV (R.S.) DATE

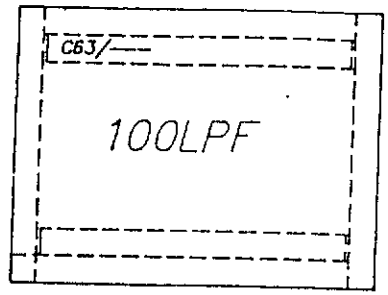
BACK COVER (VIEW Y)



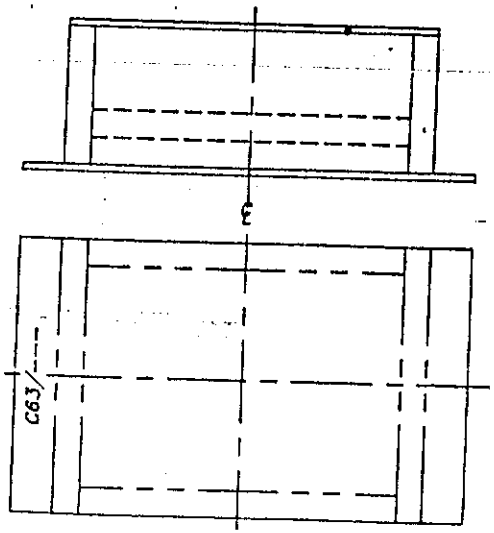
RIGHT SIDE COVER (VIEW Q)



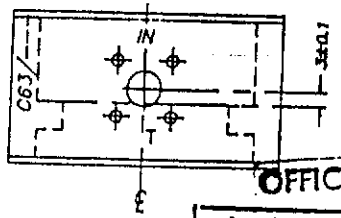
TOP COVER (VIEW R)



FRONT COVER (VIEW X)



LEFT SIDE COVER (VIEW P)



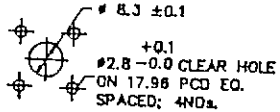
OFFICE COPY

GMRT PROJECT
ISSUED
29 JAN 1993
BY

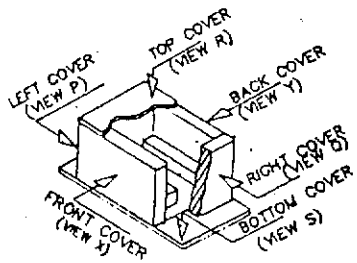
FOR FABRICATION

NOTES:
1. U.O.S. ALL DIMENSIONS ARE IN mm
2. U.O.S. FIXING HOLE LOCATIONS OF ALL CHASSIS MOUNTINGS CARRAY A TOLERANCE AS PER IS 2102, MEDIUM CLASS.
3. MANUFACTURING DETAILS FOR FOUR RAIL CHASSIS AS PER DRG.NO: 010/384 AND FOR TWO RAILS AS PER DRG.NO: 010/311
4. MASS PRODUCTION OF CHASSIS SHALL BE CARRIED OUT ONLY AFTER ACCEPTENCE OF FIRST SAMPLE CHASSIS BY T.I.F.R.
5. REST OF ALL CHASSIS SHALL BE OFFERED FOR INSPECTION BY SUPPLIER ONLY AFTER CONFIRMING THE CORRECTNESS OF THE LOCATIONS OF ALL CHASSIS MOUNTINGS SUCH AS TNC/TYPE-N/SMA CONNECTORS WITH THE RESPECTIVE TRACKS FOR SOLDERING PROVIDED ON THE SAMPLE PCBs SUPPLIED BY T.I.F.R.
6. DO NOT SCALE . IF IN DOUBT PLEASE ASK.
7. U.O.S. ALL HOLES, TAPPED HOLES AND SLOTS ARE 7mm DEEP.
8. DETAILS GIVEN IN ENCLOSED LETTERS SHALL BE PUNCHED ON OUTER SURFACE OF THE CHASSIS AT CORRESPONDING LOCATIONS (WITH 7mm HEIGHT FOR END USE CODE, 5mm HEIGHT FOR ITEM CODE/RUNNING NO. IN QUANTITY, AND REST WITH 3mm HEIGHT LETTERS) SO AS NOT TO BE HIDDEN BY MOUNTINGS.
9. ALPHABETS IN STRAIGHT LETTERS ARE NOT BE PUNCHED AND PERTAIN TO DETAILS AT THAT LOCATION. THEY ARE EXPLAINED ELSEWHERE IN THIS DRAWING

BOTTOM COVER (VIEW S)



DETAIL AT 'T'
(DRILLING DETAILS FOR TNC CONNECTOR)



GIANT METREWAVE RADIO TELESCOPE PROJECT, PUNE

	SIGN	DATE
Traced		
Drawn	[illegible]	23/12/92
Checked	[illegible]	[illegible]
Approved	[illegible]	[illegible]
Scale ~		

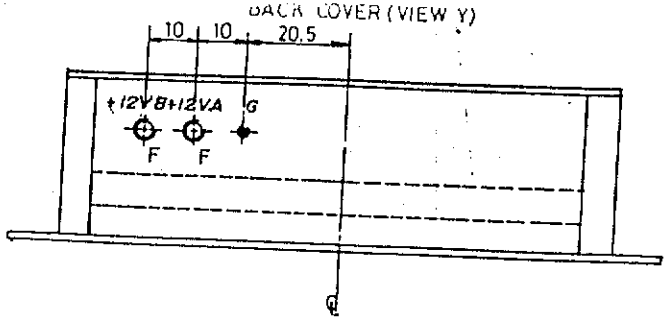
D TYPE CHASSIS DRILLING DETAILS FOR FIXING CONNECTOR, FEED THROUGH ETC

END USE. 100LPF

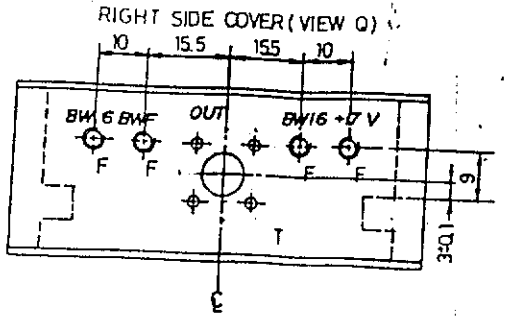
ITEM CODE: C63 QTY: 60

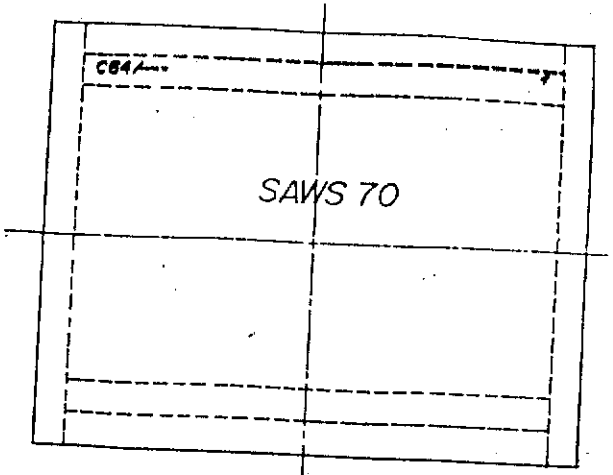
DRG. NO.G50/IF /014

BACK COVER (VIEW Y)



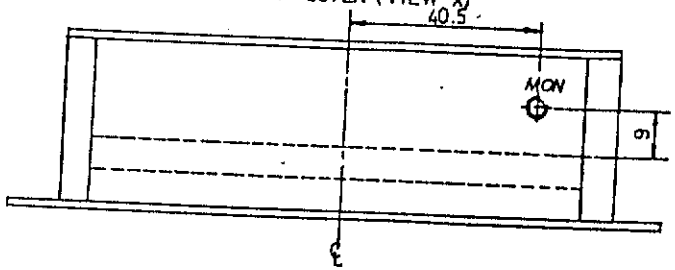
RIGHT SIDE COVER (VIEW Q)



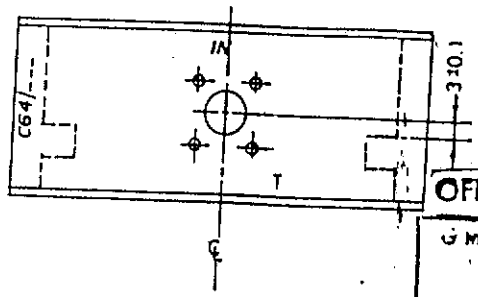


TOP COVER (VIEW R)

FRONT COVER (VIEW X)



LEFT SIDE COVER (VIEW P)



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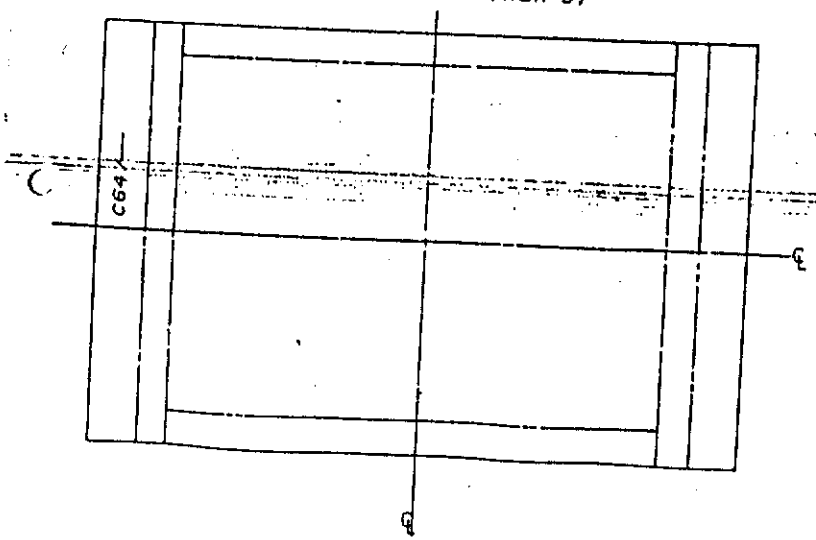
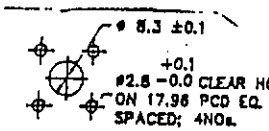
ISSUED
29 JAN 93
BY

BOTTOM COVER (VIEW S)





FOR FABRICATION

DETAIL AT 'T'
(DRILLING DETAILS FOR TNC CONNECTOR)

NOTES:
1. U.O.S. ALL DIMENSIONS ARE IN mm
2. U.O.S. FIXING HOLE LOCATIONS OF ALL CHASSIS MOUNTINGS CARRAY A TOLERANCE AS PER IS: 2102, MEDIUM CLASS.
3. MANUFACTURING DETAILS FOR FOUR RAIL CHASSIS AS PER DRG.NO: G10/384 AND FOR TWO RAILS AS PER DRG.NO: G10/311
4. MASS PRODUCTION OF CHASSIS SHALL BE CARRIED OUT ONLY AFTER ACCEPTANCE OF FIRST SAMPLE CHASSIS BY T.I.F.R.
5. REST OF ALL CHASSIS SHALL BE OFFERED FOR INSPECTION BY SUPPLIER ONLY AFTER CONFIRMING THE CORRECTNESS OF THE LOCATIONS OF ALL CHASSIS MOUNTINGS SUCH AS TNC/TYPE-N/SMA CONNECTORS WITH THE RESPECTIVE TRACKS FOR SOLDERING PROVIDED ON THE SAMPLE PCBs SUPPLIED BY T.I.F.R.
6. DO NOT SCALE. IF IN DOUBT PLEASE ASK.
7. U.O.S. ALL HOLES, TAPPED HOLES AND SLOTS ARE 7mm DEEP.
8. DETAILS GIVEN IN INCLINED LETTERS SHALL BE PUNCHED ON OUTER SURFACE OF THE CHASSIS AT CORRESPONDING LOCATIONS (WITH 7mm HEIGHT FOR END USE CODE, 5mm HEIGHT FOR ITEM CODE/RUNNING NO. IN QUANTITY, AND REST WITH 3mm HEIGHT LETTERS) SO AS NOT TO BE HIDDEN BY MOUNTINGS.
9. ALPHABETS IN STRAIGHT LETTERS ARE NOT BE PUNCHED AND PERTAIN TO DETAILS AT THAT LOCATION. THEY ARE EXPLAINED ELSEWHERE IN THIS DRAWING

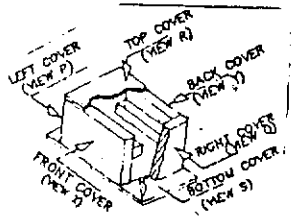
49 Rs

M3 TAPPED HOLE FOR GROUND TAG

DETAIL AT G

TAPPED HOLES FOR #8.32 UNC CLASS 2A THREADS

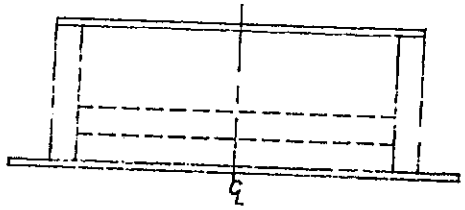
DETAIL AT 'F'
(TAPPING DETAILS FOR FEED THRU')



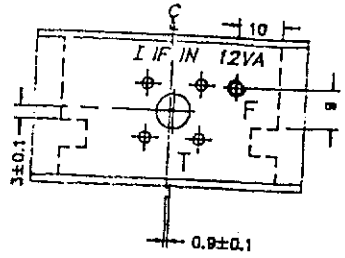
GIANT METREWAVE RADIO TELESCOPE PROJECT, PUNE

	SIGN	DATE	A TYPE CHASSIS DRILLING DETAILS FOR FIXING CONNECTOR, FEED THROUGH ETC
Traced			
Drawn	[illegible]	15/1/93	END USE
Checked	[illegible]	[illegible]	SAWS 70
Approved	[illegible]	[illegible]	ITEM CODE-C 64 QTY-30
Scale:			DRG NO. G50/IF/020

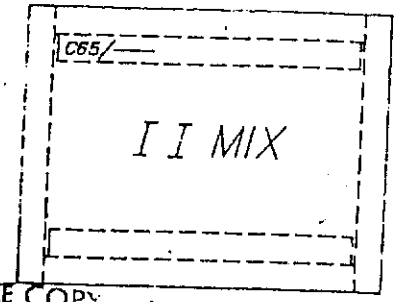
BACK COVER (VIEW Y)



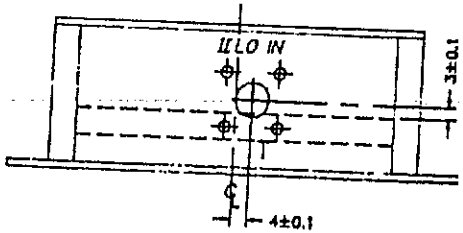
RIGHT SIDE COVER (VIEW Q)



TOP COVER (VIEW R)

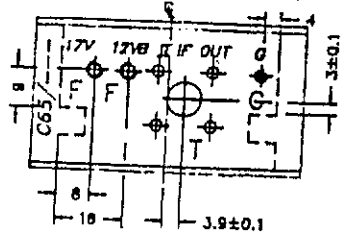


FRONT COVER (VIEW X)



ALL HOLES IN THIS VIEW ARE CLEAR TO THE FULL DEPTH.

LEFT SIDE COVER (VIEW P)



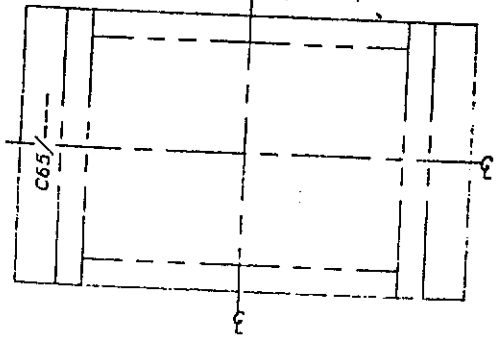
OFFICE COPY

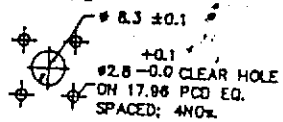
G M R T PROJECT
ISSUED
29.1.1993
BY

FOR FABRICATION

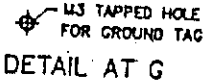
NOTES:
1. U.O.S. ALL DIMENSIONS ARE IN mm
2. U.O.S. FIXING HOLE LOCATIONS OF ALL CHASSIS MOUNTINGS CARRIAY A TOLERANCE AS PER IS 2102, MEDIUM CLASS.
3. MANUFACTURING DETAILS FOR FOUR RAIL CHASSIS AS PER DRG.NO: 010/384 AND FOR TWO RAILS AS PER DRG.NO: 010/311
4. MASS PRODUCTION OF CHASSIS SHALL BE CARRIED OUT ONLY AFTER ACCEPTENCE OF FIRST SAMPLE CHASSIS BY T.I.F.R.
5. REST OF ALL CHASSIS SHALL BE OFFERED FOR INSPECTION BY SUPPLIER ONLY AFTER CONFIRMING THE CORRECTNESS OF THE LOCATIONS OF ALL CHASSIS MOUNTINGS SUCH AS TNC/TYPE-N/SMA CONNECTORS WITH THE RESPECTIVE TRACKS FOR SOLDERING PROVIDED ON THE SAMPLE PCBs SUPPLIED BY T.I.F.R.
6. DO NOT SCALE . IF IN DOUBT PLEASE ASK.
7. U.O.S. ALL HOLES, TAPPED HOLES AND SLOTS ARE 7mm DEEP.
8. DETAILS GIVEN IN INCLINED LETTERS SHALL BE PUNCHED ON OUTER SURFACE OF THE CHASSIS AT CORRESPONDING LOCATIONS (WITH 7mm HEIGHT FOR END USE CODE, 3mm HEIGHT FOR ITEM CODE/RUNNING NO. IN QUANTITY, AND REST WITH 3mm HEIGHT LETTERS) SO AS NOT TO BE HIDDEN BY MOUNTINGS.
9. ALPHABETS IN STRAIGHT LETTERS ARE NOT BE PUNCHED AND PERTAIN TO DETAILS AT THAT LOCATION, THEY ARE EXPLAINED ELSEWHERE IN THIS DRAWING

BOTTOM COVER (VIEW S)

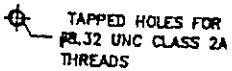




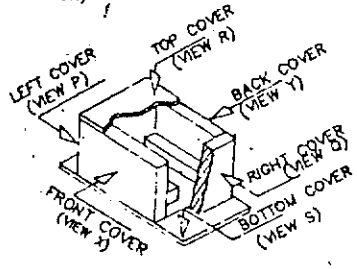
DETAIL AT 'T'
(DRILLING DETAILS FOR TNC CONNECTOR)



DETAIL AT G



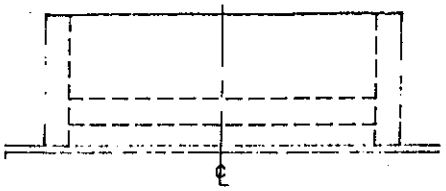
DETAIL AT 'F'
(TAPPING DETAILS FOR FEED THRU')



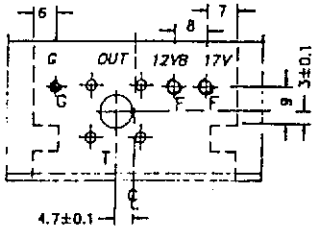
GIANT METREWAVE RADIO TELESCOPE PROJECT, PUNE			
	SIGN	DATE	D TYPE CHASSIS DRILLING DETAILS FOR FIXING CONNECTOR, FEED THROUGH ETC
Traced			
Drawn	M Hebbar	22/12/92	END USE. II MIX
Checked	[illegible]	25/12/92	
Approved	[illegible]	3.1.93	ITEM CODE: C65 QTY: 60
Scale ~			DRG. NO. G50 1F 018

5086

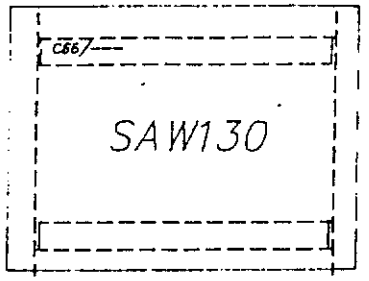
BACK COVER (VIEW Y)



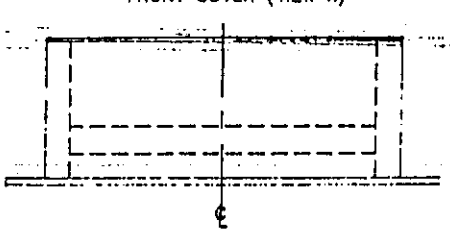
RIGHT SIDE COVER (VIEW Q)



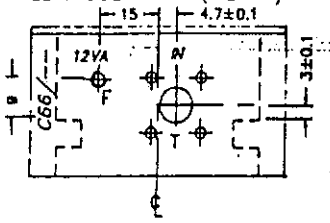
TOP COVER (VIEW R)



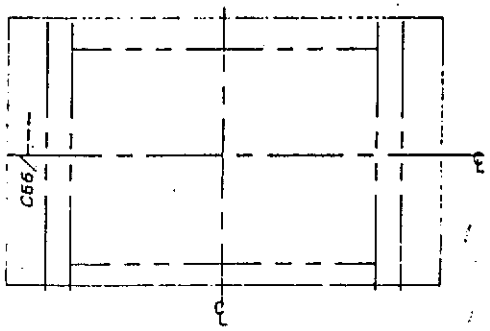
FRONT COVER (VIEW X)



LEFT SIDE COVER (VIEW P)



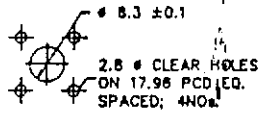
BOTTOM COVER (VIEW S)



TAPPED HOLES FOR #8,32 UNC CLASS 2A THREADS

DETAIL AT 'F'

(TAPPING DETAILS FOR FEED THRU')



DETAIL AT 'T'

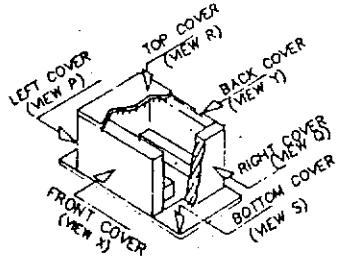
(DRILLING DETAILS FOR TNC CONNECTOR)

NOTES:

1. U.O.S. ALL DIMENSIONS ARE IN mm
2. U.O.S. FIXING HOLE LOCATIONS OF ALL CHASSIS MOUNTINGS CARRAY A TOLERANCE AS PER IS:2102, MEDIUM CLASS.
3. MANUFACTURING DETAILS FOR FOUR RAIL CHASSIS AS PER DRG.NO: 010/384 AND FOR TWO RAILS AS PER DRG.NO: 010/311
4. MASS PRODUCTION OF CHASSIS SHALL BE CARRIED OUT ONLY AFTER ACCEPTENCE OF FIRST SAMPLE CHASSIS BY T.I.F.R.
5. REST OF ALL CHASSIS SHALL BE OFFERED FOR INSPECTION BY SUPPLIER ONLY AFTER CONFIRMING THE CORRECTNESS OF THE LOCATIONS OF ALL CHASSIS MOUNTINGS SUCH AS TNC/TYPE-N/SMA CONNECTORS WITH THE RESPECTIVE TRACKS FOR SOLDERING PROVIDED ON THE SAMPLE PCBs SUPPLIED BY T.I.F.R.
6. DO NOT SCALE , IF IN DOUBT PLEASE ASK.
7. U.O.S. ALL HOLES, TAPPED HOLES AND SLOTS ARE 7mm DEEP.
8. DETAILS GIVEN IN INCLINED LETTERS SHALL BE PUNCHED ON OUTER SURFACE OF THE CHASSIS AT CORRESPONDING LOCATIONS (WITH 7mm HEIGHT FOR END USE CODE, 6mm HEIGHT FOR ITEM CODE/RUNNING NO. IN QUANTITY, AND REST WITH 3mm HEIGHT LETTERS) SO AS NOT TO BE HIDDEN BY MOUNTINGS.
9. ALPHABETS IN STRAIGHT LETTERS ARE NOT BE PUNCHED AND PERTAIN TO DETAILS AT THAT LOCATION. THEY ARE EXPLAINED ELSEWHERE IN THIS DRAWING

M3 TAPPED HOLE

DETAIL AT 'G'
(GROUND LUG)



OFFICE COPY

G M R T PROJECT
ISSUED

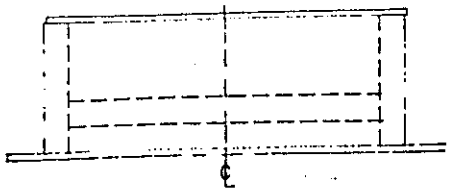
DY

FOR FABRICATION

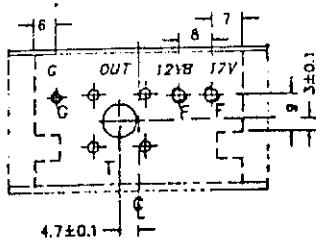
GIANT METREWAVE RADIO TELESCOPE PROJECT, PUNE			
	SIGN	DATE	D TYPE CHASSIS DRILLING DETAILS FOR FIXING CONNECTOR, FEED THROUGH ETC
Traced			
Drawn		21/12/94	END USE. SAW130
Checked			
Approved			ITEM CODE:C66 QTY.:30
Scale ~			DRG. NO. G50/1F/021

S-1 Re

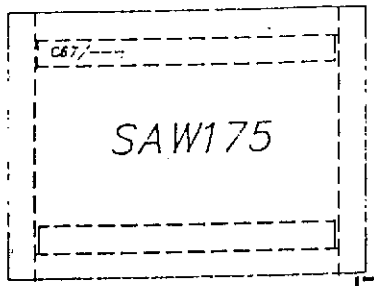
BACK COVER (VIEW Y)



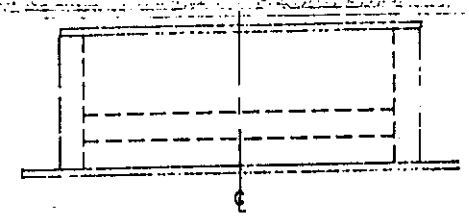
RIGHT SIDE COVER (VIEW Q)



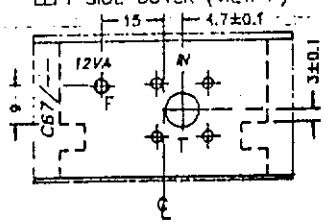
TOP COVER (VIEW R)



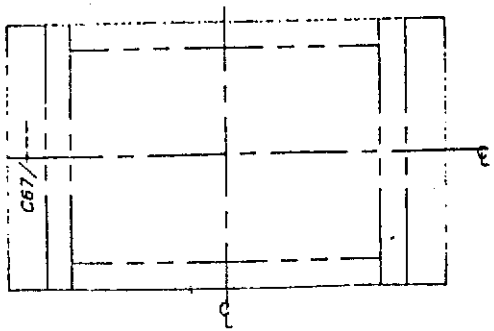
FRONT COVER (VIEW X)



LEFT SIDE COVER (VIEW P)



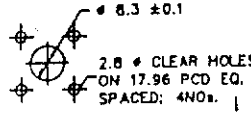
BOTTOM COVER (VIEW S)



TAPPED HOLES FOR
#8.32 UNC CLASS 2A
THREADS

DETAIL AT 'F'

(TAPPING DETAILS FOR
FEED THRU')



DETAIL AT 'T'

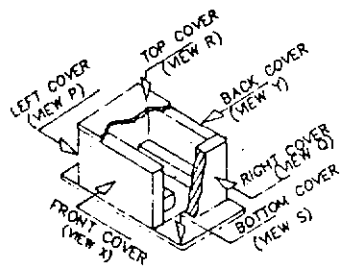
(DRILLING DETAILS FOR
TNC CONNECTOR)

NOTES:

1. U.O.S. ALL DIMENSIONS ARE IN mm
2. U.O.S. FIXING HOLE LOCATIONS OF ALL CHASSIS MOUNTINGS CARRAY A TOLERANCE AS PER IS:2102 MEDIUM CLASS.
3. MANUFACTURING DETAILS FOR FOUR RAIL CHASSIS AS PER DRG.NO: G10/384 AND FOR TWO RAILS AS PER DRG.NO: G10/311
4. MASS PRODUCTION OF CHASSIS SHALL BE CARRIED OUT ONLY AFTER ACCEPTENCE OF FIRST SAMPLE CHASSIS BY T.I.F.R.
5. REST OF ALL CHASSIS SHALL BE OFFERED FOR INSPECTION BY SUPPLIER ONLY AFTER CONFIRMING THE CORRECTNESS OF THE LOCATIONS OF ALL CHASSIS MOUNTINGS SUCH AS TNC/TYPE-N/SMA CONNECTORS WITH THE RESPECTIVE TRACKS FOR SOLDERING PROVIDED ON THE SAMPLE [illegible] SUPPLIED BY T.I.F.R.
6. DO NOT SCALE . IF IN DOUBT PLEASE ASK.
7. U.O.S. ALL HOLES, TAPPED HOLES AND SLOTS ARE 7mm DEEP.
8. DETAILS GIVEN IN INCLINED LETTERS, SHALL BE PUNCHED ON OUTER SURFACE OF THE CHASSIS AT CORRESPONDING LOCATIONS (WITH 7mm HEIGHT FOR END USE CODE, 8mm HEIGHT FOR ITEM CODE/RUNNING NO. IN QUANTITY, AND REST WITH 3mm HEIGHT LETTERS) SO AS NOT TO BE HIDDEN BY MOUNTINGS.
9. ALPHABETS IN STRAIGHT LETTERS ARE NOT BE PUNCHED AND PERTAIN TO DETAILS AT THAT LOCATION. THEY ARE EXPLAINED ELSEWHERE IN THIS DRAWING

M3 TAPPED
HOLE

DETAIL AT 'G'
(GROUND LUG)



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GMRT
ISSUED
29 JAN 93
BY
FOR FABRICATION

GIANT METREWAVE RADIO TELESCOPE PROJECT, PUNE

	SIGN	DATE
Traced		
Drawn		
Checked		
Approved		
Scale ~		

D TYPE CHASSIS DRILLING DETAILS
FOR FIXING CONNECTOR, FEED THROUGH ETC

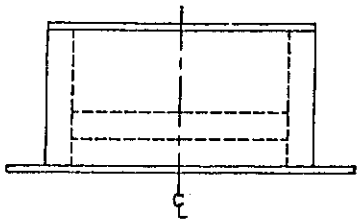
END USE. SAW175

ITEM CODE: C67 QTY.: 30

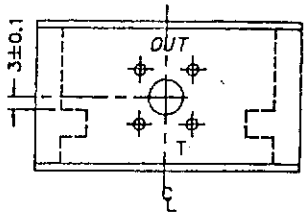
DRG. NO. G50/IF /022

S2

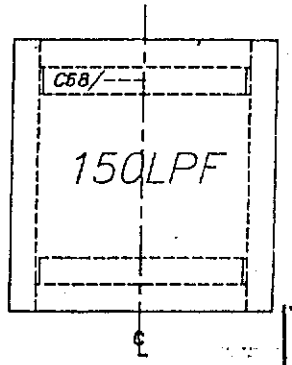
BACK COVER (VIEW Y)



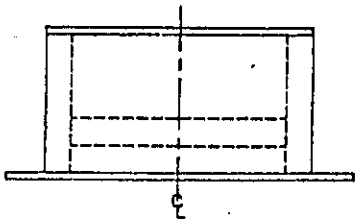
RIGHT SIDE COVER (VIEW Q)



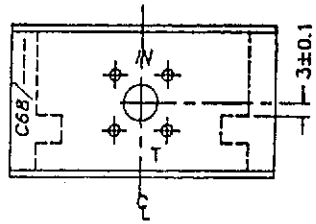
TOP COVER (VIEW R)

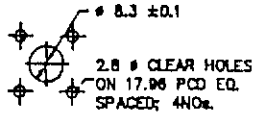


FRONT COVER (VIEW X)



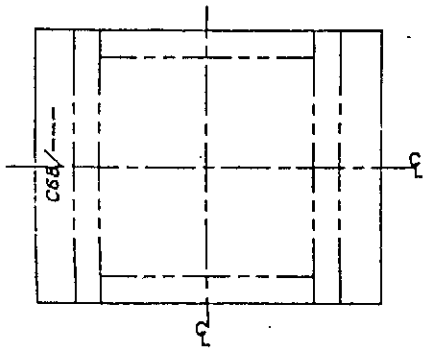
LEFT SIDE COVER (VIEW P)

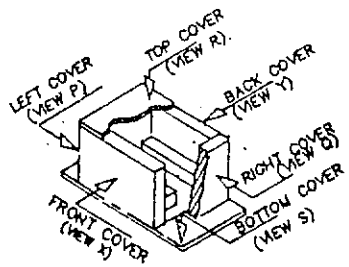




DETAIL AT 'T'
(DRILLING DETAILS FOR TNC CONNECTOR)

BOTTOM COVER (VIEW S)





OFFICE COPY

GMRT PROJ.
ISSUED
20 JAN 1993
BY

FOR FABRICATION

NOTES:
1. U.O.S. ALL DIMENSIONS ARE IN mm
2. U.O.S. FIXING HOLE LOCATIONS OF ALL CHASSIS MOUNTINGS CARRAY A TOLERANCE AS PER IS:2102, MEDIUM CLASS.
3. MANUFACTURING DETAILS FOR FOUR RAIL CHASSIS AS PER DRG.NO: 010/364 AND FOR TWO RAILS AS PER DRG.NO: 010/311
4. MASS PRODUCTION OF CHASSIS SHALL BE CARRIED OUT ONLY AFTER ACCEPTENCE OF FIRST SAMPLE CHASSIS BY T.I.F.R.
5. REST OF ALL CHASSIS SHALL BE OFFERED FOR INSPECTION BY SUPPLIER ONLY AFTER CONFIRMING THE CORRECTNESS OF THE LOCATIONS OF ALL CHASSIS MOUNTINGS SUCH AS TNC/TYPE-N/SMA CONNECTORS WITH THE RESPECTIVE TRACKS FOR SOLDERING PROVIDED ON THE SAMPLE PCBs SUPPLIED BY T.I.F.R.
6. DO NOT SCALE, IF IN DOUBT PLEASE ASK.
7. U.O.S. ALL HOLES, TAPPED HOLES AND SLOTS ARE 7mm DEEP.
8. DETAILS GIVEN IN INCLINED LETTERS SHALL BE PUNCHED ON OUTER SURFACE OF THE CHASSIS AT CORRESPONDING LOCATIONS (WITH 7mm HEIGHT FOR END USE CODE, 5mm HEIGHT FOR ITEM CODE/RUNNING NO. IN QUANTITY, AND REST WITH 3mm HEIGHT LETTERS) SO AS NOT TO BE HIDDEN BY MOUNTINGS.
9. ALPHABETS IN STRAIGHT LETTERS ARE NOT BE PUNCHED AND PERTAIN TO DETAILS AT THAT LOCATION. THEY ARE EXPLAINED ELSEWHERE IN THIS DRAWING

S3R0

GIANT METREWAVE RADIO TELESCOPE PROJECT, PUNE

	SIGN	DATE
Traced		
Drawn	[illegible]	25/12/92
Checked	[illegible]	25/12/92
Approved	[illegible]	23/1/93

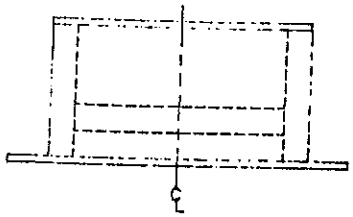
E TYPE CHASSIS DRILLING DETAILS FOR FIXING CONNECTOR, FEED THROUGH ETC

END USE: 150LPF

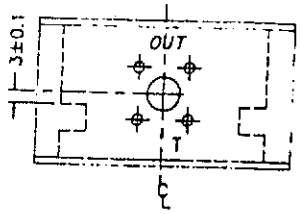
ITEM CODE: C68 QTY.:30

DRG.NO:G50/IF/015

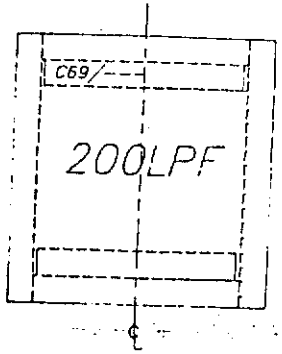
BACK COVER (VIEW Y)



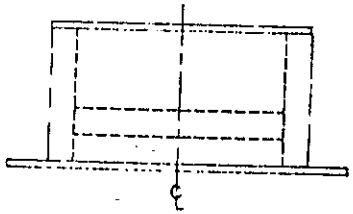
RIGHT SIDE COVER (VIEW Q)



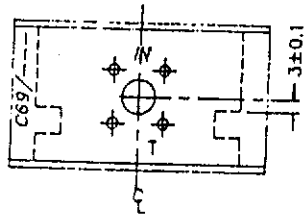
TOP COVER (VIEW R)

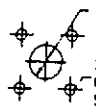


FRONT COVER (VIEW X)



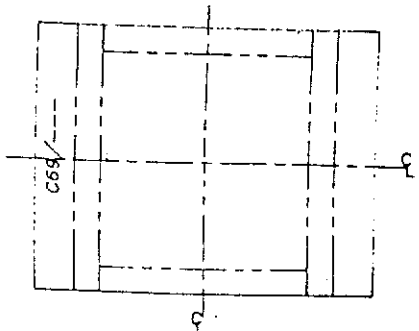
LEFT SIDE COVER (VIEW P)

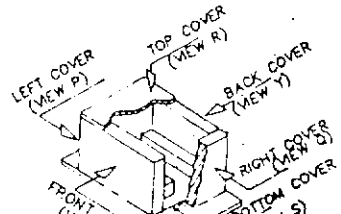




DETAIL AT 'T'
(DRILLING DETAILS FOR TNC CONNECTOR)

BOTTOM COVER (VIEW S)





OFFICE COPY
G M R T PROJE
ISSUED
29 JAN 1993
BY

FOR FABRICATION

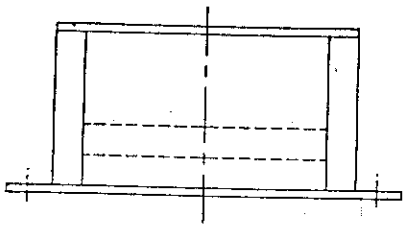
NOTES:
1. U.O.S. ALL DIMENSIONS ARE IN mm
2. U.O.S. FIXING HOLE LOCATIONS OF ALL CHASSIS MOUNTINGS CARRAY A TOLERANCE AS PER IS: 2102, MEDIUM CLASS.
3. MANUFACTURING DETAILS FOR FOUR RAIL CHASSIS AS PER DRG.NO: 010/384 AND FOR TWO RAILS AS PER DRG.NO: 010/311
4. MASS PRODUCTION OF CHASSIS SHALL BE CARRIED OUT ONLY AFTER ACCEPTENCE OF FIRST SAMPLE CHASSIS BY T.I.F.R.
5. REST OF ALL CHASSIS SHALL BE OFFERED FOR INSPECTION BY SUPPLIER ONLY AFTER CONFIRMING THE CORRECTNESS OF THE LOCATIONS OF ALL CHASSIS MOUNTINGS SUCH AS TNC/TYPE-N/SMA CONNECTORS WITH THE RESPECTIVE TRACKS FOR SOLDERING PROVIDED ON THE SAMPLE PCBs SUPPLIED BY T.I.F.R.
6. DO NOT SCALE. IF IN DOUBT PLEASE ASK.
7. U.O.S. ALL HOLES, TAPPED HOLES AND SLOTS ARE 7mm DEEP.
8. DETAILS GIVEN IN INCLINED LETTERS SHALL BE PUNCHED ON OUTER SURFACE OF THE CHASSIS AT CORRESPONDING LOCATIONS (WITH 7mm HEIGHT FOR END USE CODE, 5mm HEIGHT FOR ITEM CODE/RUNNING NO. IN QUANTITY, AND REST WITH 3mm HEIGHT LETTERS) SO AS NOT TO BE HIDDEN BY MOUNTINGS.
9. ALPHABETS IN STRAIGHT LETTERS ARE NOT BE PUNCHED AND PERTAIN TO DETAILS AT THAT LOCATION. THEY ARE EXPLAINED ELSEWHERE IN THIS DRAWING

GIANT METREWAVE RADIO TELESCOPE PROJECT, PUNE

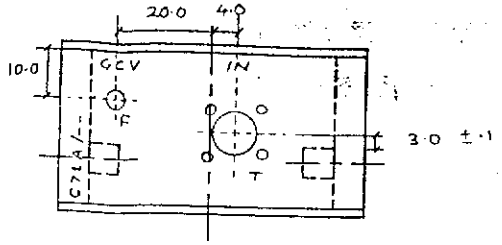
	SIGN	DATE
Traced		

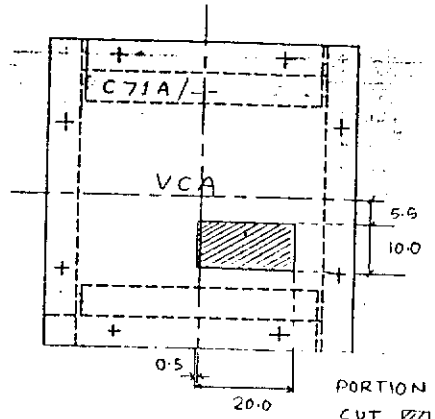
E TYPE CHASSIS DRILLING DETAILS FOR FIXING CONNECTOR, FEED THROUGH ETC

BACK COVER (VIEW Y)



RIGHT SIDE COVER (VIEW Q)

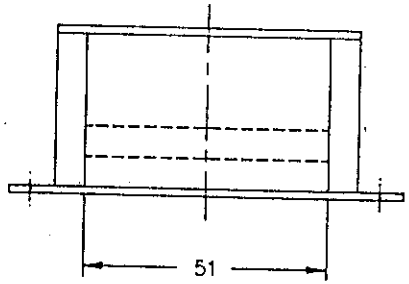




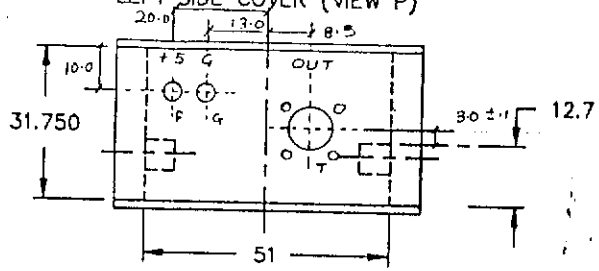
PORTION TO CUT ▨

TOP COVER (VIEW R)

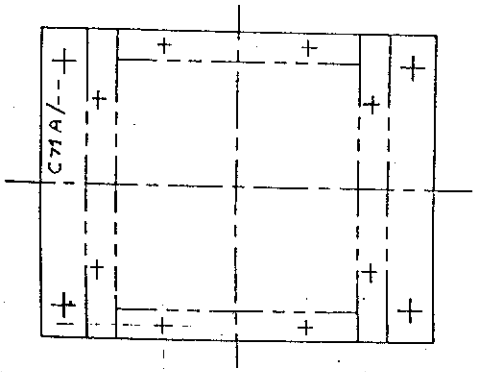
FRONT COVER (VIEW X)



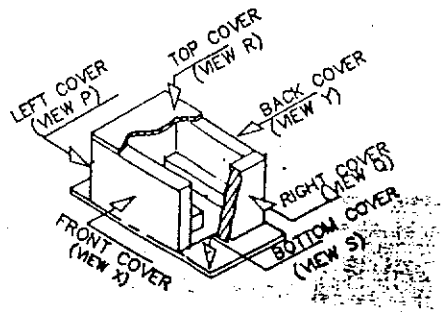
LEFT SIDE COVER (VIEW P)



NOTES. 1) F - FEED THROUGH CAP.
2) G - GROUND TAG.
3) T - TNC CONNECTOR.
4) NO TAPPING FOR TNC FIXING HOLES.
5) ALL DIA. ARE IN MM.



BOTTOM COVER (VIEW S)



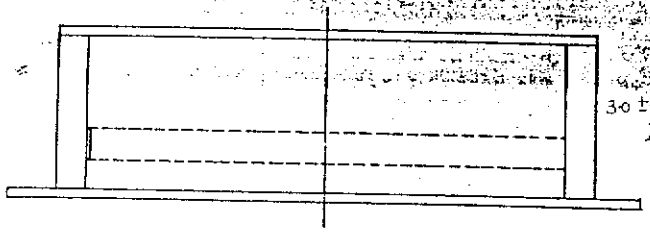
GIANT METREWAVE RADIO TELESCOPE PROJECT, PU

	SIGN	DATE
Traced	—	—
Drawn	[illegible]	15/2/91
Checked	[illegible]	17-02-91
Approved	[illegible]	17/2/91

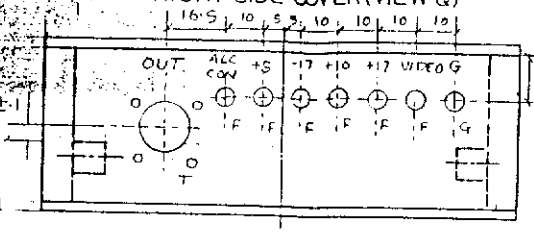
E TYPE CHASSIS DRILLING DETAILS FOR FIXING CONNECTOR, FEED THROUGH ETC

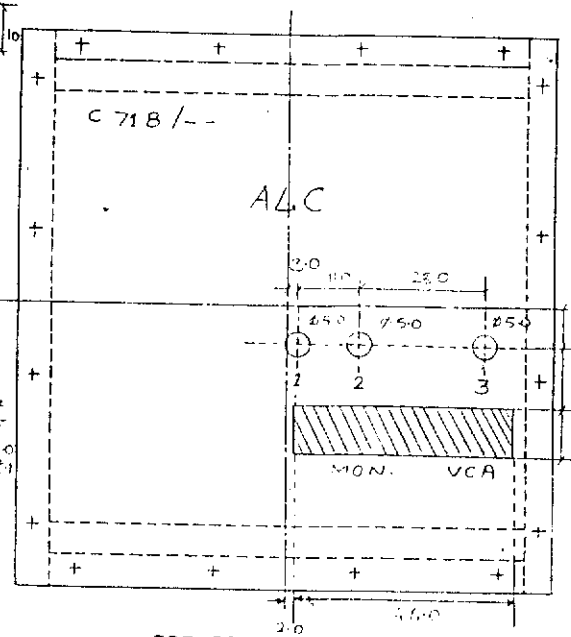
END USE: IF SYSTEM, C71A

BACK COVER(VIEW Y)



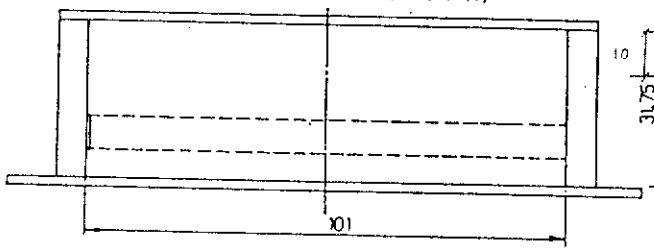
RIGHT SIDE COVER(VIEW Q)



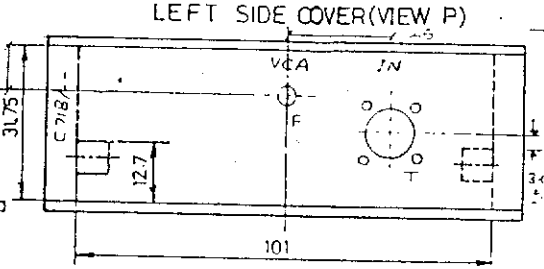


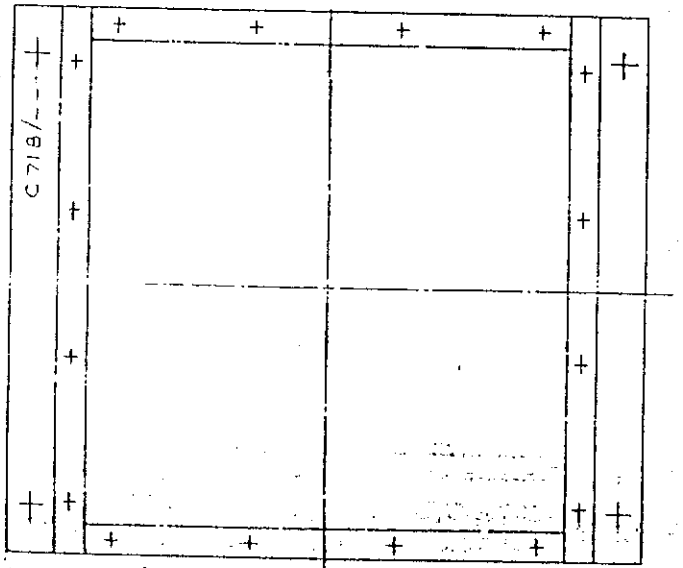
TOP COVER (VIEW R)

FRONT COVER(VIEW X)

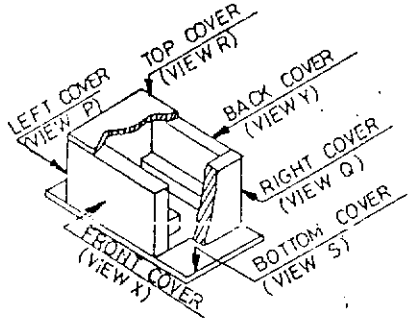


LEFT SIDE COVER(VIEW P)



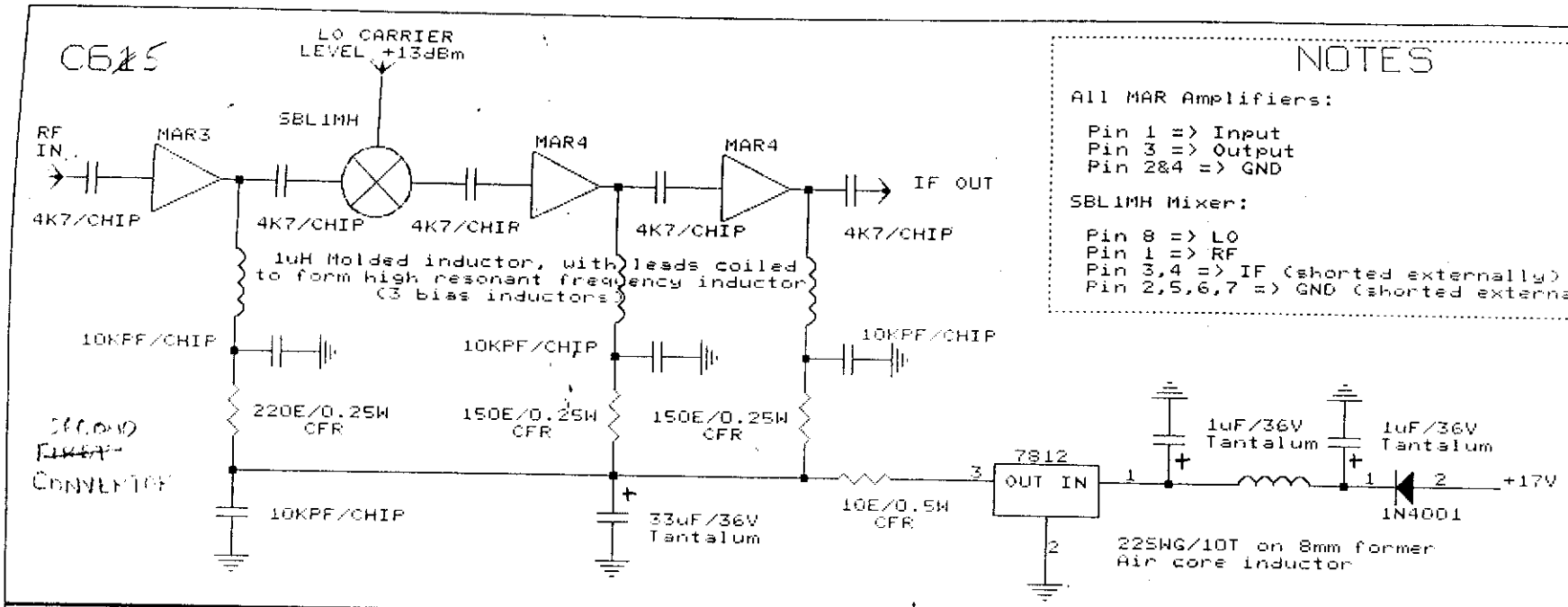


BOTTOM COVER (VIEW S)



NOTE :- 1) ALL DIA ARE IN MM.
2) T- TNC CONNECTOR
3) F- FEED THROUGH CAP
4) G- GND TAG
5) NO TAPPING FOR TNC FIXING SCREWS.

GIANT METREWAVE RADIO TELESCOPE PROJECT, PUNE			
	SIGN	DATE	H TYPE CHASSIS DRILLING DETAILS FOR FIXING CONNECTO. FEED THROUGH ETC.
Traced			
Drawn			END USE: C718
Checked			
Approved			
Scale-			DRG. NO.



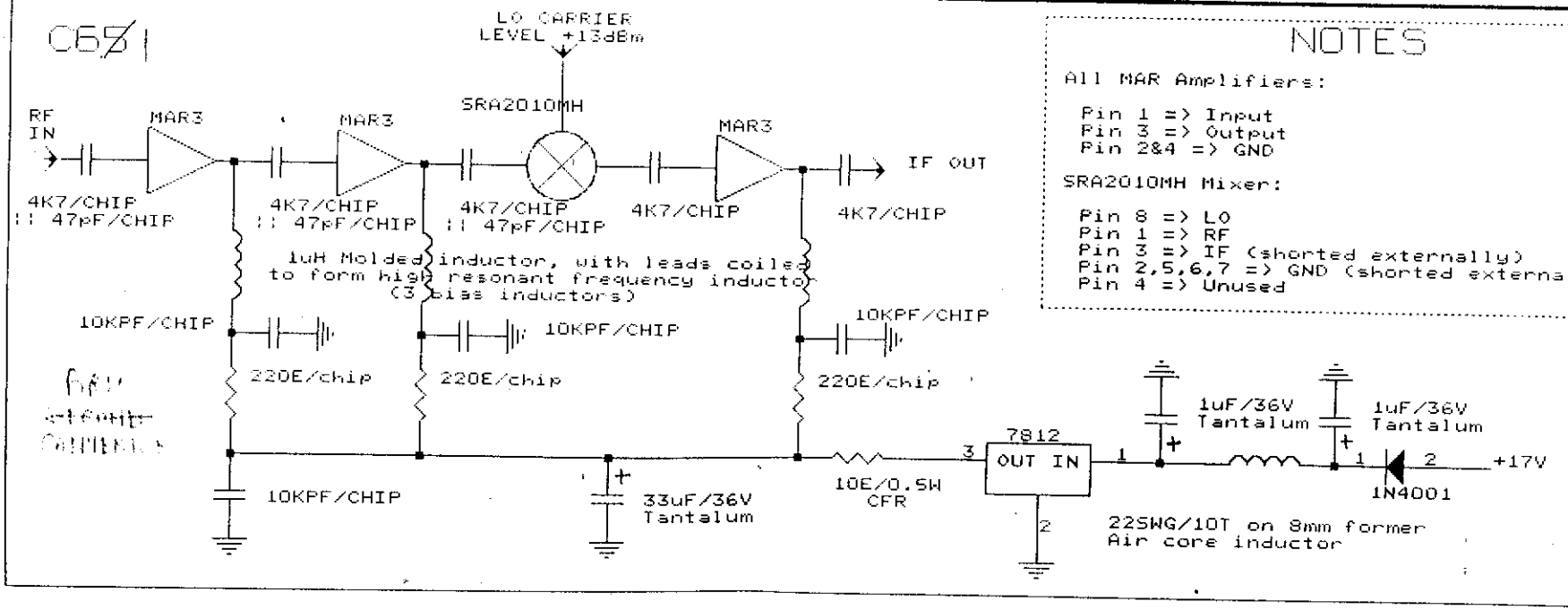
NOTES

All MAR Amplifiers:

Pin 1 => Input
Pin 3 => Output
Pin 2&4 => GND

SBL1MH Mixer:

Pin 8 => LO
Pin 1 => RF
Pin 3,4 => IF (shorted externally)
Pin 2,5,6,7 => GND (shorted externally)



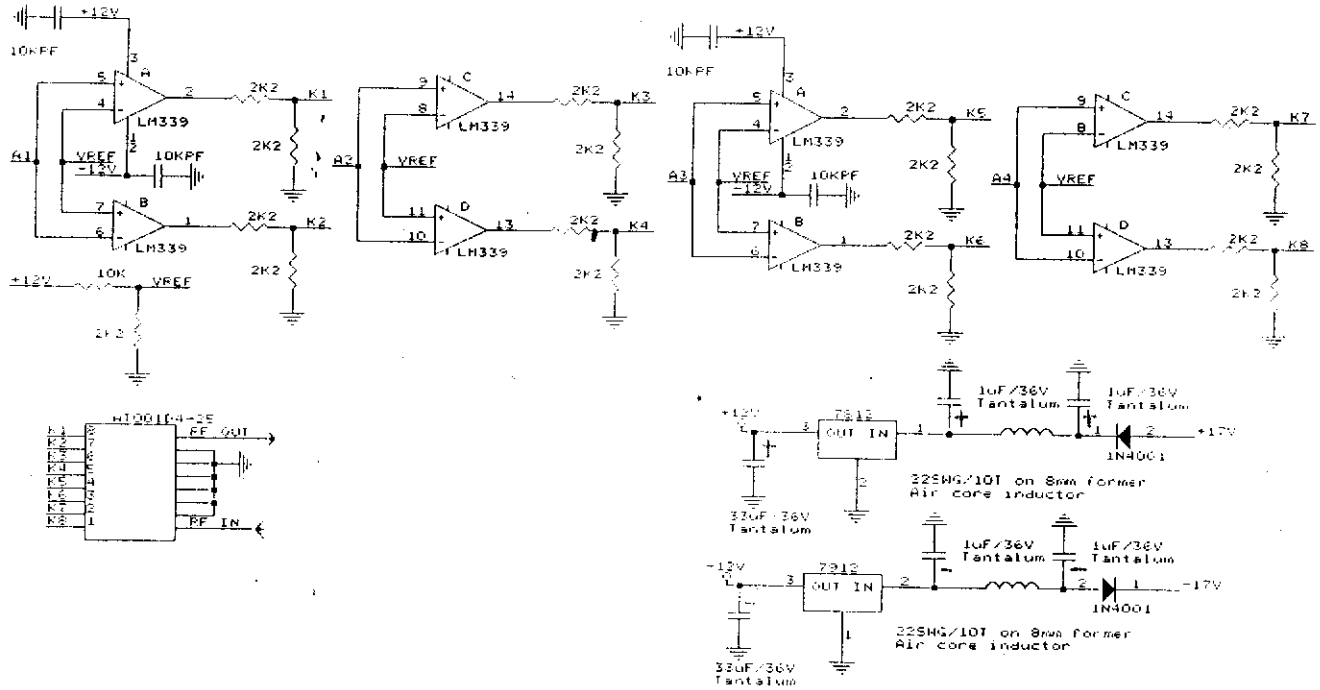
NOTES

All MAR Amplifiers:

Pin 1 => Input
Pin 3 => Output
Pin 2&4 => GND

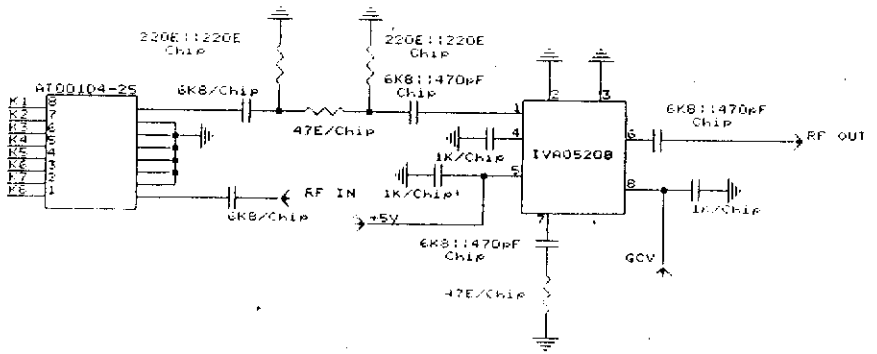
SRA2010MH Mixer:

Pin 8 => LO
Pin 1 => RF
Pin 3 => IF (shorted externally)
Pin 2,5,6,7 => GND (shorted externally)
Pin 4 => Unused



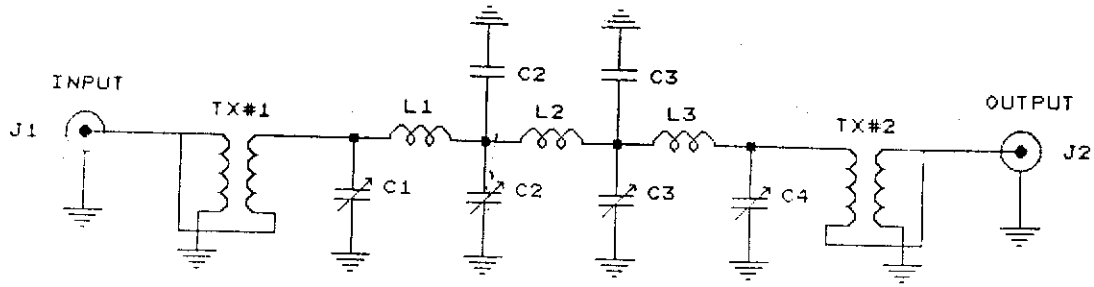
IF ATTENUATOR

C62

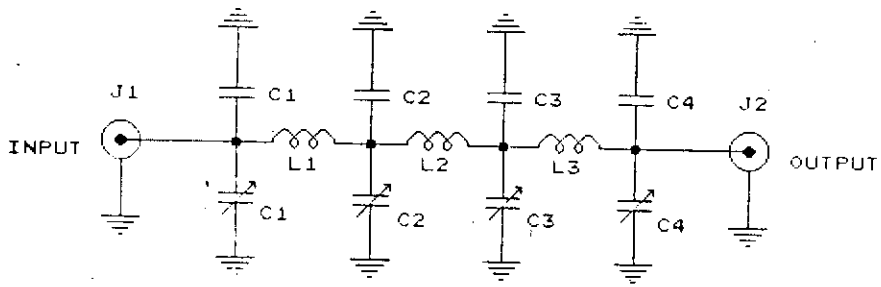


AGC PREATTENUATOR.
SUM VCAMPLIFIER

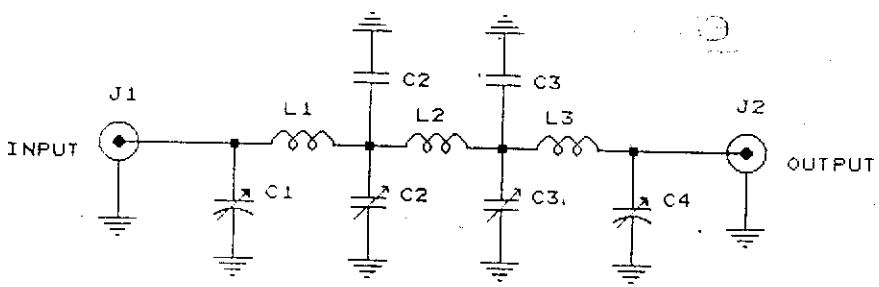
C71A



100MHz LOWPASS FILTER



150 MHz LOWPASS FILTER



200MHz LOWPASS FILTER

NOTES:

CER - CERAMIC DISK CAPACITOR
TRIM - TRIMMER CAPACITOR
H.M. - HOME MADE AIR CORE COIL
T - TURNS OF COIL
- GAUGE OF WIRE FOR COIL
D - DIA. OF COIL (MM.)

VALUES FOR 100MHz LOWPASS FILTER

C1,C2- 2-22pF(TRIM)
C2,C3-10pF(CER) :: 2-22pF(TRIM)
L1,L3-H.M.(6T,22#,8D)
L2-H.M.(7T,22#,8D)
TR1,TR2-TORIDAL 4:1 X'FORMER
(TWISTED 10T,32# ONBLACK TOROIDE)
J1-TNC (MALE)
J2-TNC (FEMALE)

VALUES OF 150 MHz LOWPASS FILTER

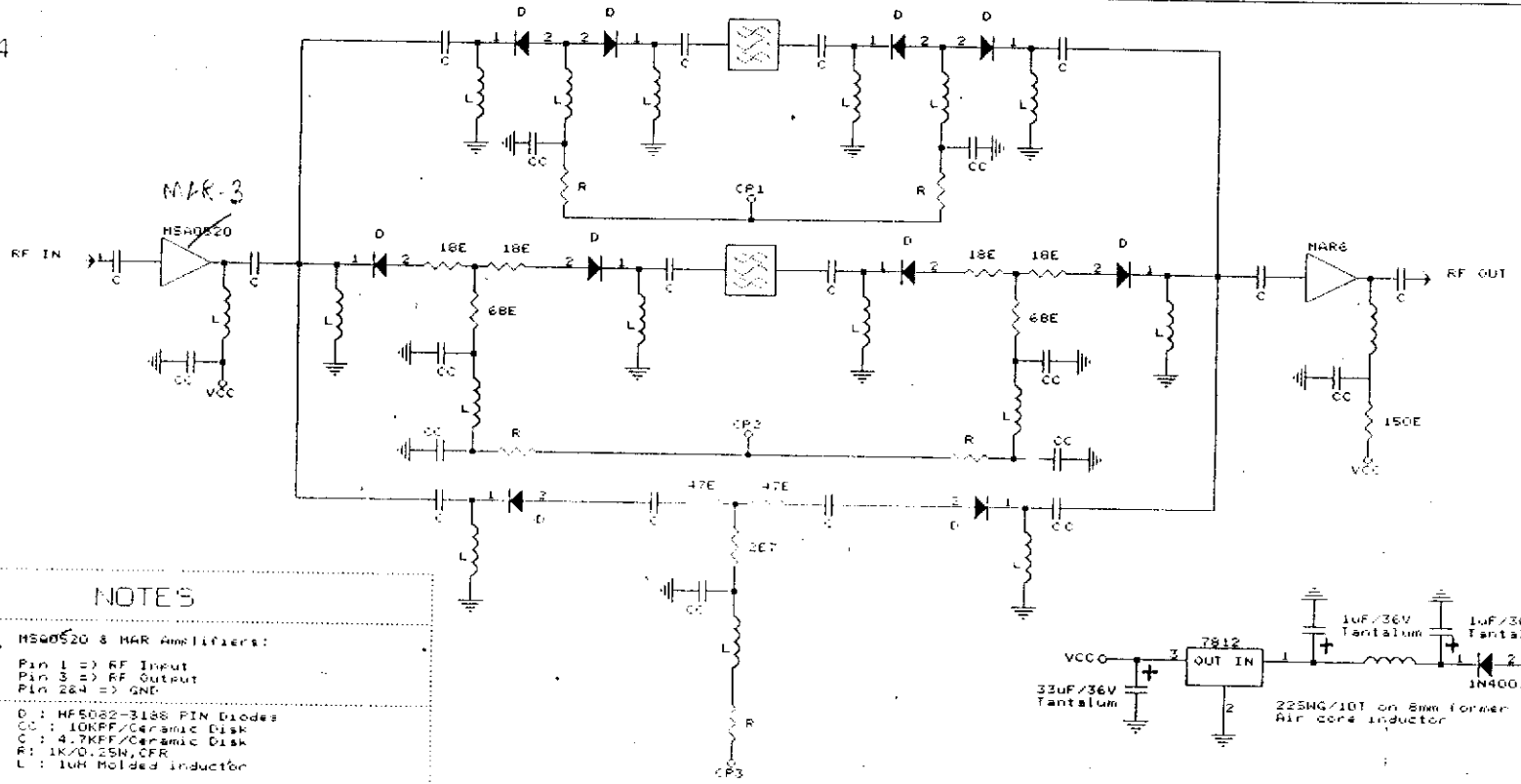
C1,C4-10pF(CER) :: 2-22pF(TRIM)
C2,C3-22pF(CER) :: 2-22pF(TRIM)
L1,L3-H.M.(2T,22#,6D)
L2-H.M.(3T,22#,6D)
J1-TNC (MALE)
J2-TNC (FEMALE)

VALUES FOR 200MHz LOW PASS FILTER

C1,C4- 2-22pF(TRIM)
C2,C3-10pF(CER) :: 2-22pF(TRIM)
L1,L3-H.M.(3T,22#,6D)
L2-H.M.(4T,22#,6D)
J1-TNC (MALE)
J2-TNC (FEMALE)

TIFR NCRA GMRT PUNE-7		
Title: 100MHz, 150MHz, 200MHz LOWPASS FILTERS.		
Size: A	Document Number: F:HOME\ELAB\SUDHIR\RCAD\LOWPASS.DWG	REV: R1
Date: July 28, 1993	Sheet of	

C64



NOTES

MAR, MSA0520 & MAR Amplifiers:

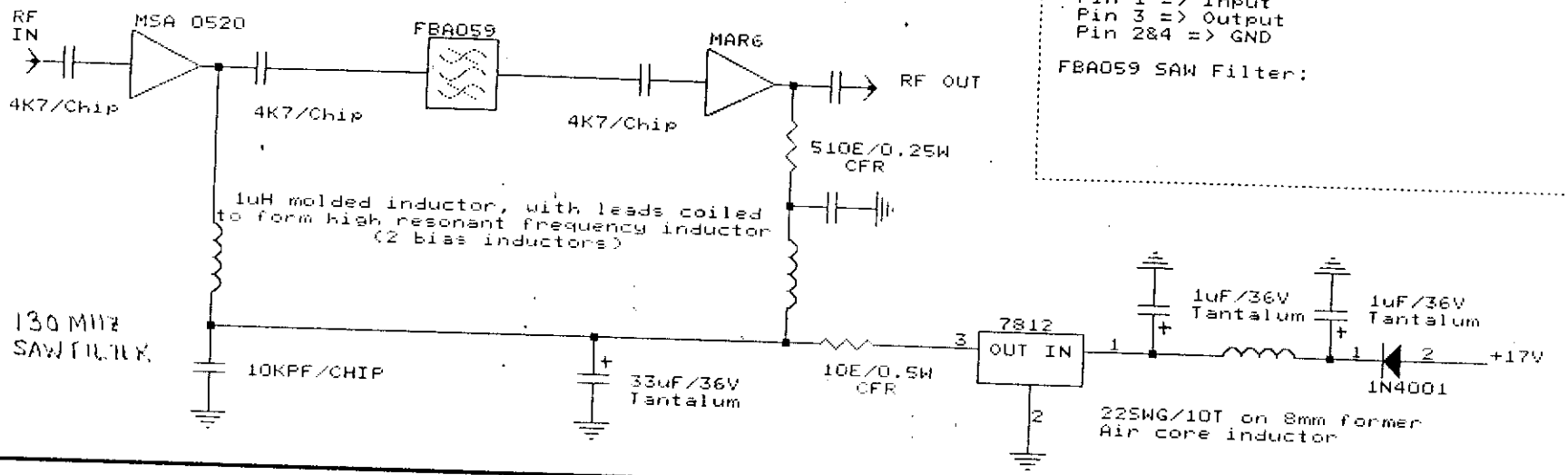
Pin 1 => RF Input
Pin 3 => RF Output
Pin 2&4 => GND

D : HF5082-3188 PIN Diodes
CC : 10KPF/Ceramic Disk
C : 4.7KPF/Ceramic Disk
R: 1K/0.25W,CFR
L : 1uH Molded Inductor

Unless otherwise stated, all resistors are 0.25W/CFR

70 MHz.
SAW FILTER BANK

C66



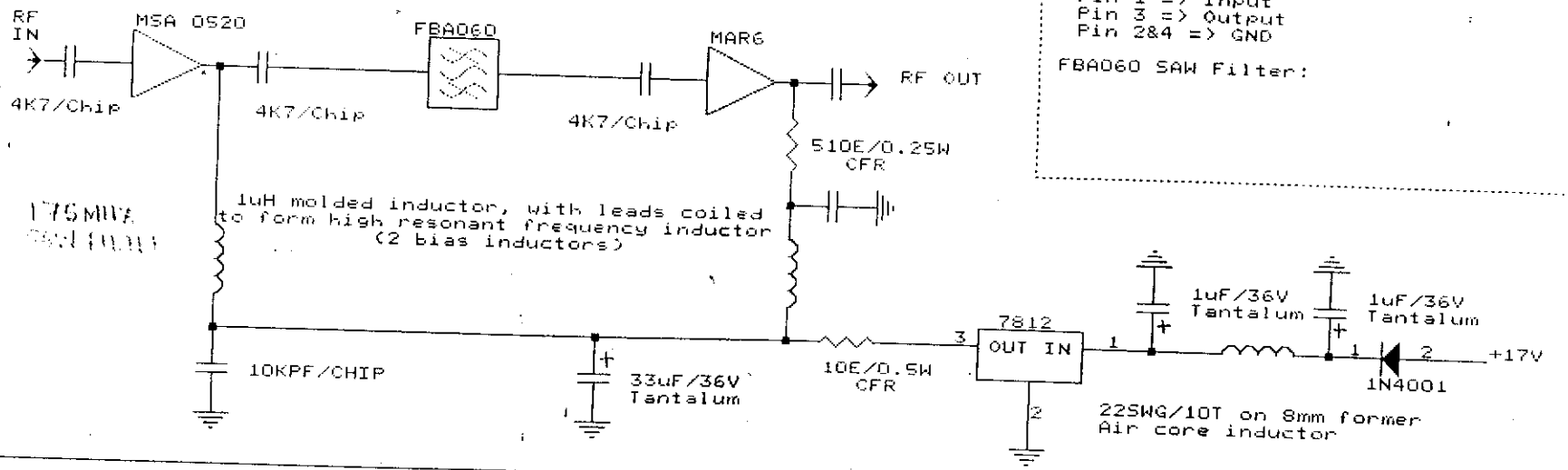
NOTES

All MAR and MSA Amplifiers:

Pin 1 => Input
Pin 3 => Output
Pin 2&4 => GND

FBA059 SAW Filter:

C67

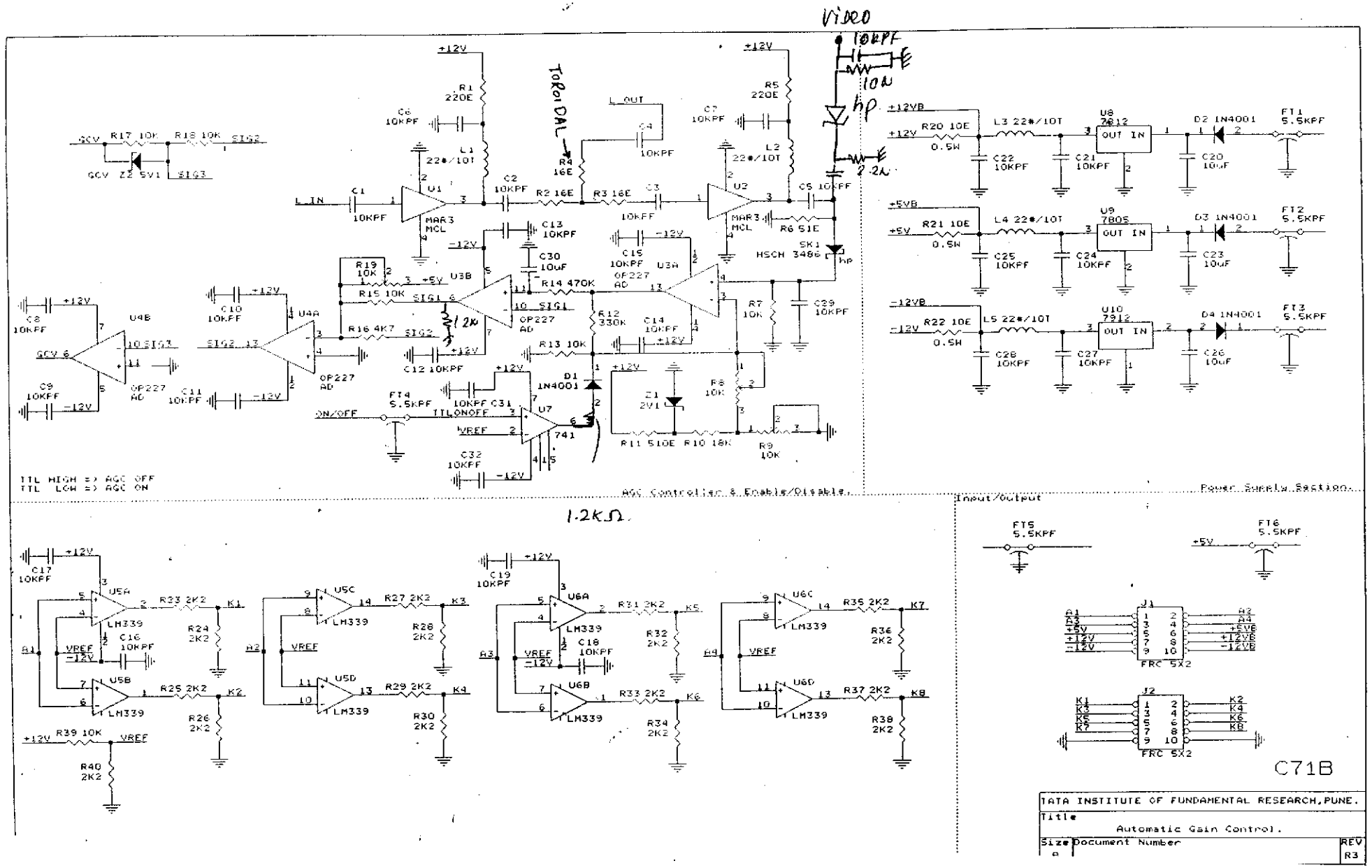


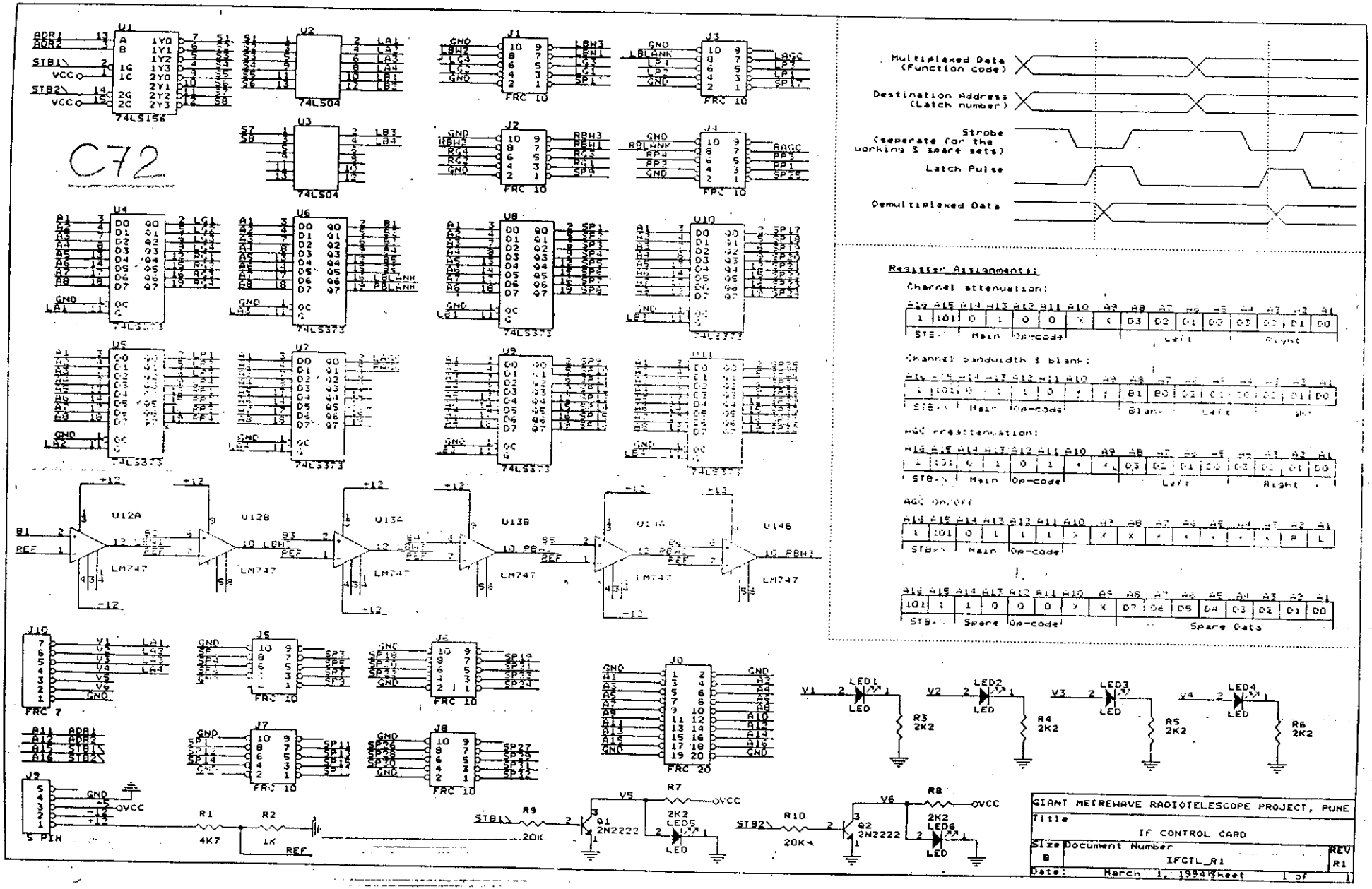
NOTES

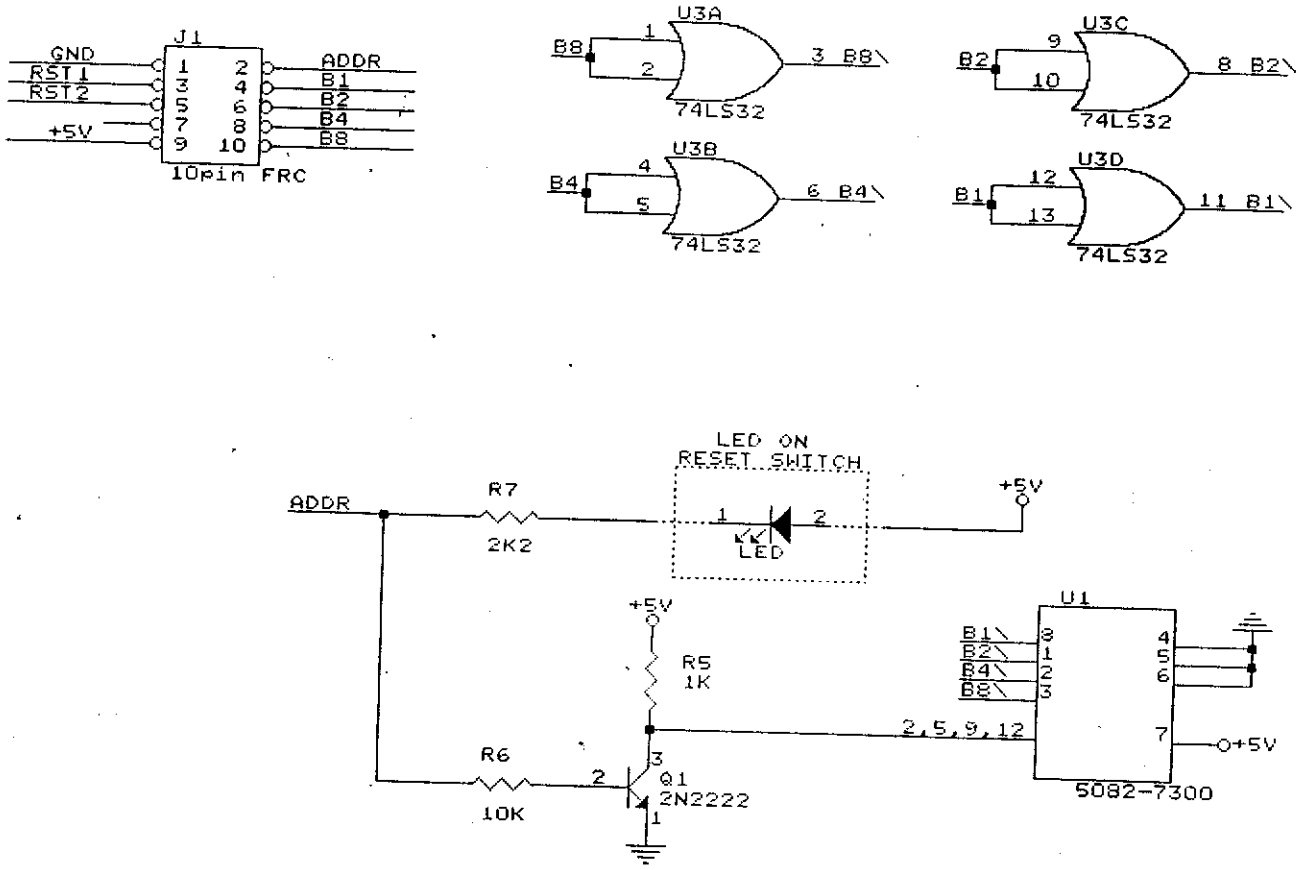
All MAR and MSA Amplifiers:

Pin 1 => Input
Pin 3 => Output
Pin 2&4 => GND

FBA060 SAW Filter:


VIDEO
10KPF
10K
hp
2.2K
TOROIDAL
L_OUT
L_IN
+12V
-12V
+5V
+12VB
-12VB
+5VB
R1 220E
R5 220E
L1 22#/10T
L2 22#/10T
C1 10KPF
C2 10KPF
C3 10KPF
C4 10KPF
C5 10KPF
C6 10KPF
C7 10KPF
R2 16E
R3 16E
R4 16E
U1 MAR3 MCL
U2 MAR3 MCL
R6 51E
SK1 HSCH 3486
hp
C13 10KPF
C30 10uF
C16 10KPF
U3A OP227 AD
U3B OP227 AD
R14 470K
R15 10K
R19 10K
R12 330K
C14 10KPF
R7 10K
C29 10KPF
R13 10K
D1 1N4001
Z1 2V1
R8 10K
R11 510E
R10 18K
R9 10K
C31 10KPF
U7 741
FT4 5.5KPF
ON/OFF
TTLONOFF
VREF
C32 10KPF
U4A OP227 AD
U4B OP227 AD
C10 10KPF
C11 10KPF
C12 10KPF
C8 10KPF
C9 10KPF
R16 4K7
SIG1
SIG2
SIG3
GCV
R17 10K
R18 10K
GCV ZZ 5V1
TTL HIGH => AGC OFF
TTL LOW => AGC ON
AGC Controller & Enable/Disable.
R20 10E
R21 10E
R22 10E
0.5W
L3 22#/10T
L4 22#/10T
L5 22#/10T
U8 7812
U9 7805
U10 7912
OUT IN
C22 10KPF
C21 10KPF
C20 10uF
C25 10KPF
C24 10KPF
C23 10uF
C28 10KPF
C27 10KPF
C26 10uF
D2 1N4001
D3 1N4001
D4 1N4001
FT1 5.5KPF
FT2 5.5KPF
FT3 5.5KPF
Power Supply Section.
1.2KΩ.
U5A
U5B
U5C
U5D
U6A
U6B
U6C
U6D
LM339
C16 10KPF
C17 10KPF
C18 10KPF
C19 10KPF
R23 2K2
R24 2K2
R25 2K2
R26 2K2
R27 2K2
R28 2K2
R29 2K2
R30 2K2
R31 2K2
R32 2K2
R33 2K2
R34 2K2
R35 2K2
R36 2K2
R37 2K2
R38 2K2
R39 10K
R40 2K2
A1
A2
A3
A4
K1
K2
K3
K4
K5
K6
K7
K8
VREF
Input/Output
FT5 5.5KPF
FT6 5.5KPF
J1
J2
FRC 5X2
C71B
TATA INSTITUTE OF FUNDAMENTAL RESEARCH, PUNE.
Title
Automatic Gain Control.
Size
Document Number
REV
R3


C72
74LS156
74LS04
74LS373
FRC 10
FRC 20
FRC 7
5 PIN
LM747
LED
2N2222
Multiplexed Data (Function code)
Destination Address (Latch number)
Strobe (seperate for the working & spare sets)
Latch Pulse
Demultiplexed Data
Register Assignments:
Channel attenuation:
Channel bandwidth & blank:
AGC preattenuation:
AGC On/Off
Spare
Spare Data
GIANT METREWAVE RADIOTELESCOPE PROJECT, PUNE
Title
IF CONTROL CARD
Size
B
Document Number
IFCTL_R1
REV
R1
Date:
March 1, 1994
Sheet
1 of 1



C76

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Size A	Document Number IFDSPL_P0	REV P0
Date: December 10		