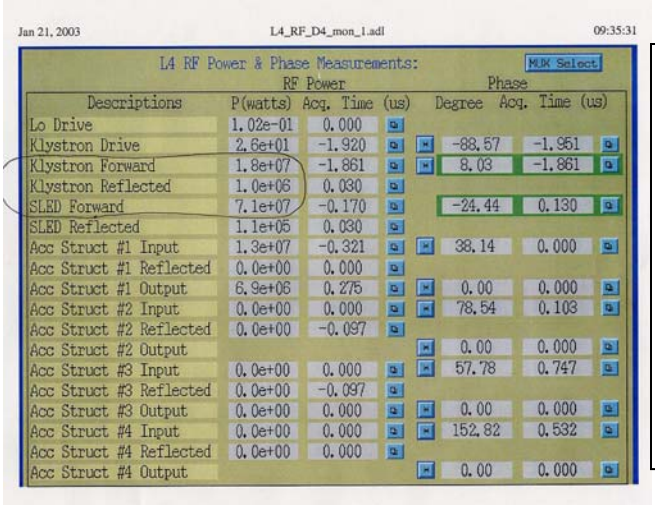
Linac Sled Tuning Procedure After Installation

(using example, 1/21/03 L4 Sled Tuning) 2-19-2003

tls

1) Observe L4 power measurements (computer screens):



Jan 21, 2003 L4_RF_D4_mon_1.adl 09:35:31

L4 RF Power & Phase Measurements: MUX Select

Descriptions	RF Power P(watts)	RF Power Acq. Time (us)	Phase Degree	Phase Acq. Time (us)
Lo Drive	1.02e-01	0.000		
Klystron Drive	2.6e+01	-1.920	-88.57	-1.951
Klystron Forward	1.8e+07	-1.861	8.03	-1.861
Klystron Reflected	1.0e+06	0.030		
SLED Forward	7.1e+07	-0.170	-24.44	0.130
SLED Reflected	1.1e+05	0.030		
Acc Struct #1 Input	1.3e+07	-0.321	38.14	0.000
Acc Struct #1 Reflected	0.0e+00	0.000		
Acc Struct #1 Output	6.9e+06	0.275	0.00	0.000
Acc Struct #2 Input	0.0e+00	0.000	78.54	0.103
Acc Struct #2 Reflected	0.0e+00	-0.097		
Acc Struct #2 Output			0.00	0.000
Acc Struct #3 Input	0.0e+00	0.000	57.78	0.747
Acc Struct #3 Reflected	0.0e+00	-0.097		
Acc Struct #3 Output	0.0e+00	0.000	0.00	0.000
Acc Struct #4 Input	0.0e+00	0.000	152.82	0.532
Acc Struct #4 Reflected	0.0e+00	0.000		
Acc Struct #4 Output			0.00	0.000

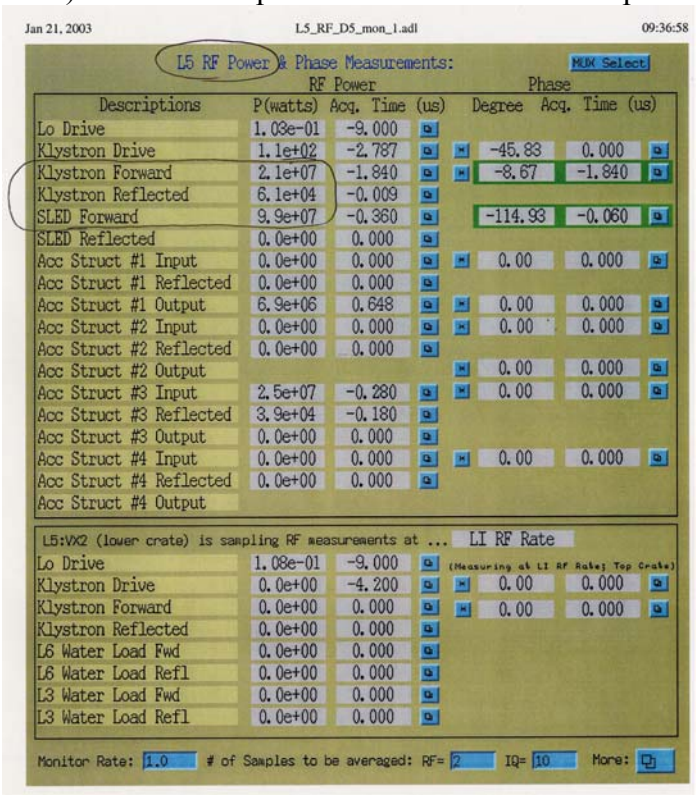
Fig. 1 (L4)

L4 klystron Forward Power set @ 18 MW:

L4 Sled Forward power = 71 MW

L4 Klystron Reflected Power (Sled match) = 1.0 MW. L4 klystron reflected power trip level set at 1.4 MW. Above 1.4 MW VSWR1 will fault.

2) Observe L5 power measurements to compare against L4 (computer screens):



Jan 21, 2003 L5_RF_D5_mon_1.adl 09:36:58

L5 RF Power & Phase Measurements: MUX Select

Descriptions	RF Power P(watts)	RF Power Acq. Time (us)	Phase Degree	Phase Acq. Time (us)
Lo Drive	1.03e-01	-9.000		
Klystron Drive	1.1e+02	-2.787	-45.83	0.000
Klystron Forward	2.1e+07	-1.840	-8.67	-1.840
Klystron Reflected	6.1e+04	-0.009		
SLED Forward	9.9e+07	-0.360	-114.93	-0.060
SLED Reflected	0.0e+00	0.000		
Acc Struct #1 Input	0.0e+00	0.000	0.00	0.000
Acc Struct #1 Reflected	0.0e+00	0.000		
Acc Struct #1 Output	6.9e+06	0.648	0.00	0.000
Acc Struct #2 Input	0.0e+00	0.000	0.00	0.000
Acc Struct #2 Reflected	0.0e+00	0.000		
Acc Struct #2 Output			0.00	0.000
Acc Struct #3 Input	2.5e+07	-0.280	0.00	0.000
Acc Struct #3 Reflected	3.9e+04	-0.180		
Acc Struct #3 Output	0.0e+00	0.000		
Acc Struct #4 Input	0.0e+00	0.000	0.00	0.000
Acc Struct #4 Reflected	0.0e+00	0.000		
Acc Struct #4 Output				

L5:VX2 (lower crate) is sampling RF measurements at ... LI RF Rate

Lo Drive	1.08e-01	-9.000	(Measuring at LI RF Rate: Top Crate)	
Klystron Drive	0.0e+00	-4.200	0.00	0.000
Klystron Forward	0.0e+00	0.000	0.00	0.000
Klystron Reflected	0.0e+00	0.000		
L6 Water Load Fwd	0.0e+00	0.000		
L6 Water Load Refl	0.0e+00	0.000		
L3 Water Load Fwd	0.0e+00	0.000		
L3 Water Load Refl	0.0e+00	0.000		

Monitor Rate: 1.0 # of Samples to be averaged: RF= 2 IQ= 10 More:

Fig. 2 (L5)

L5 Klystron Forward Power set @ 21 MW:

L5 Sled Forward Power = 99 MW

L5 Klystron Reflected Power (Sled match) = 61 kW. L5 Klystron Reflected power trip level is set at 1.4MW.

L4 klystron reflected power levels (sled match) are much greater than L5. As L4 klystron power output raises from 18 MW to 45 MW, the klystron reflected power will go above 1.4 MW and trip L4 off line. Therefore the L4 sled needs to be retuned to the proper resonant frequency.

3) Measure using peak power meter HP8990A: (measure at power monitor)
    a) Klystron drive power
    b) Sled reflected power
    c) Klystron reflected power

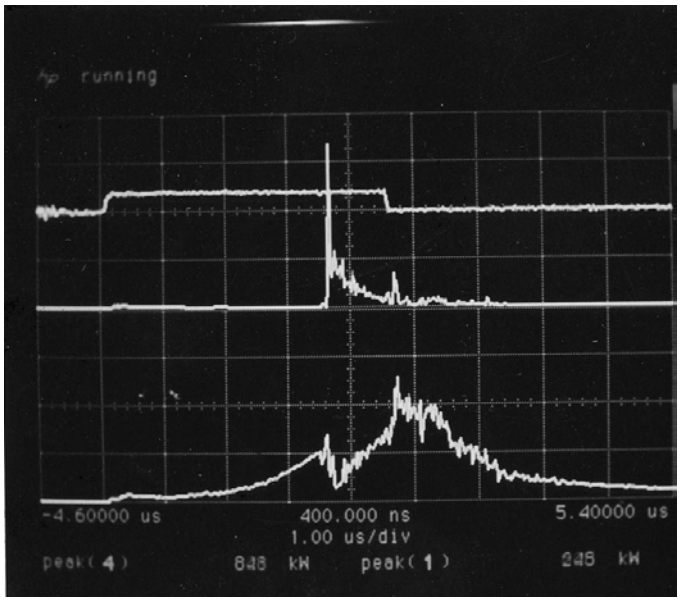


Fig. 3 (L4)

L4 Klystron drive

L4 Sled reflected power

L4 Klystron reflected power – sled match (354 kw / div.)

Fig.3 shows L4 klystron reflected and L4 sled waveforms in relation to the rf drive. Set at low power condition. L4 klystron output is 7 MW and L4 sled output is 27.9 MW.

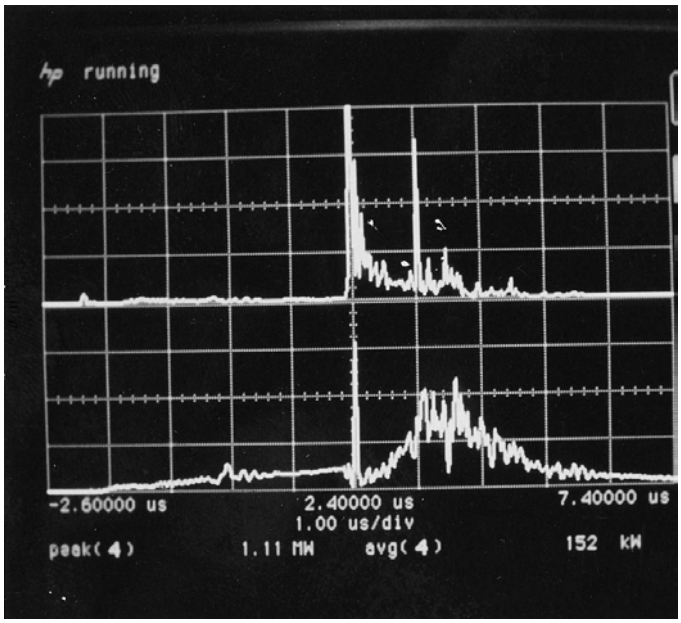


Fig. 4 (L5)

L5 Sled reflected power

L5 Klystron reflected power (354 kw / div.)

Fig. 4 shows L5 levels for comparison. L5 klystron output is set at 20 MW and L5 sled output is 98 MW.

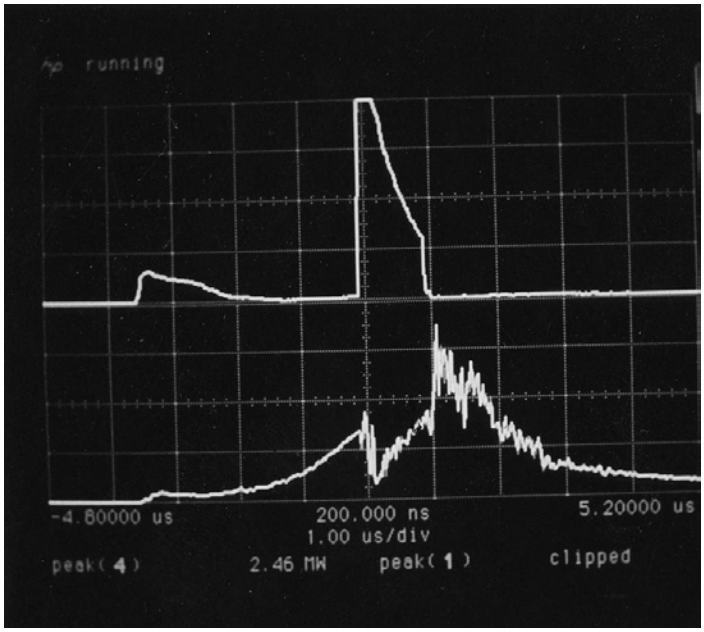


Fig. 5 (L4)

L4 Sled forward power

L4 Klystron reflected power (709 kw / div.)

Fig. 5 L4 klystron output level is 18 MW and L4 sled output is 73.5 MW.
Therefore peak power meter (HP 8990A) readings agree with computer screen readouts.

Use Gigatronics model 605/2-8 (sn.447806) spare generator to drive L4 low level RF drive. Generator output goes to "pre-amp phase shifter assembly" box input (bottom of cabinet, rack # RA:1). Set generator to 2.856000 GHz, level +12.7 DBm. 400W amplifier drive input is 0.10 watts. Turn off RF drive for klystron.

Fig. 6 (Sled structure)

With RF drive to klystron off, remove sled terminations from left and right cavity reflected port and connect another HP peak power meter. Close sled housing doors.

Apply RF by setting "klystron atten." to approx. 3.10 or a sled output of approx 1.5 MW.

Generator frequency will now be adjusted in 1 KHz steps above and below 2.856000 GHz, to find the peak amplitude of each sled cavity.

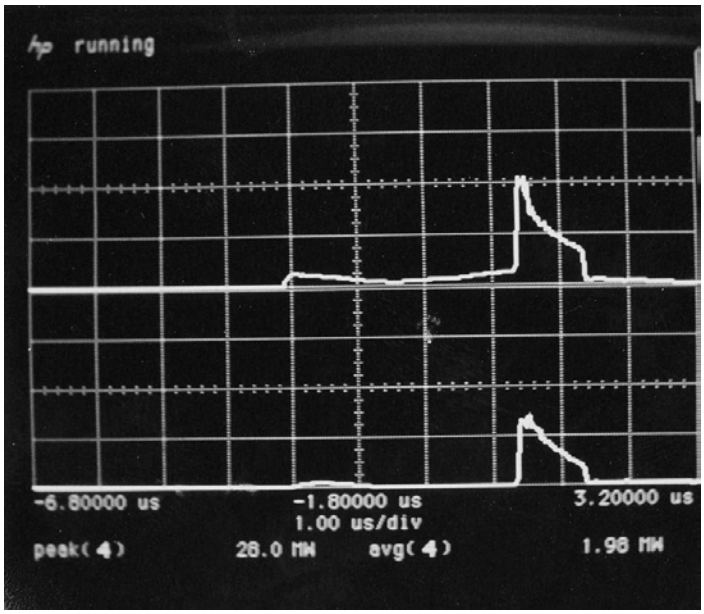


Fig. 7 (L4)

L4 Sled – left cavity

L4 Sled – right cavity

Fig. 7 Generator frequency is set at 2.856000 GHz. Left cavity is peaked at this frequency and will not require tuning.

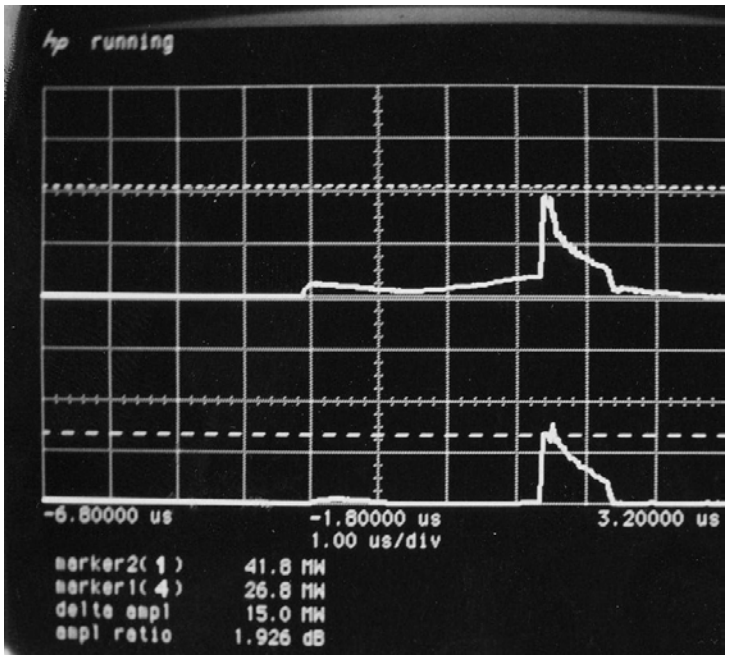


Fig. 8 (L4)

L4 Sled – left cavity

L4 Sled – right cavity

Fig. 8 Generator frequency is set 2.856000 GHz – 25 KHz. Right cavity peaks at this frequency and the left cavity amplitude drops slightly. The right cavity needs to be retuned at 2.856000 GHz and the right cavity smaller amplitude may indicate that the left cavity has a higher Q.

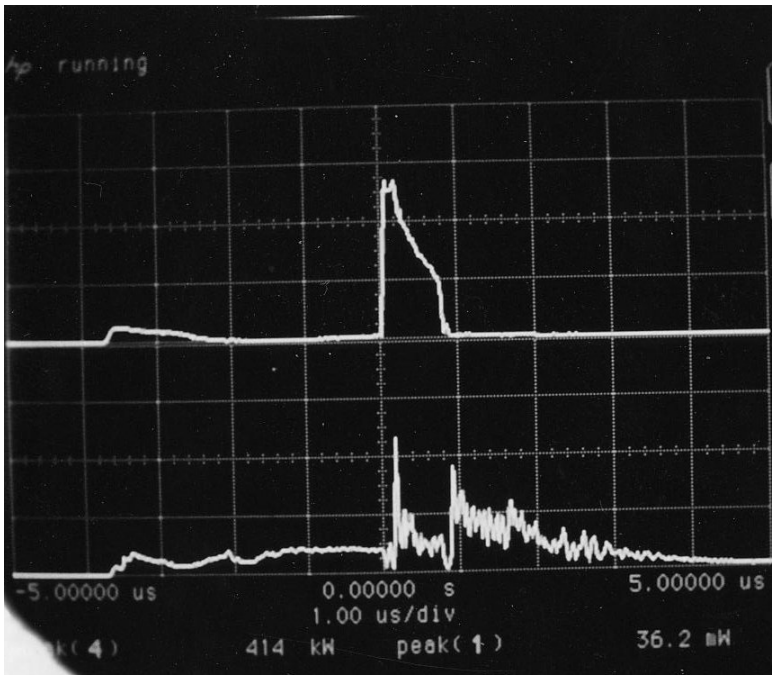
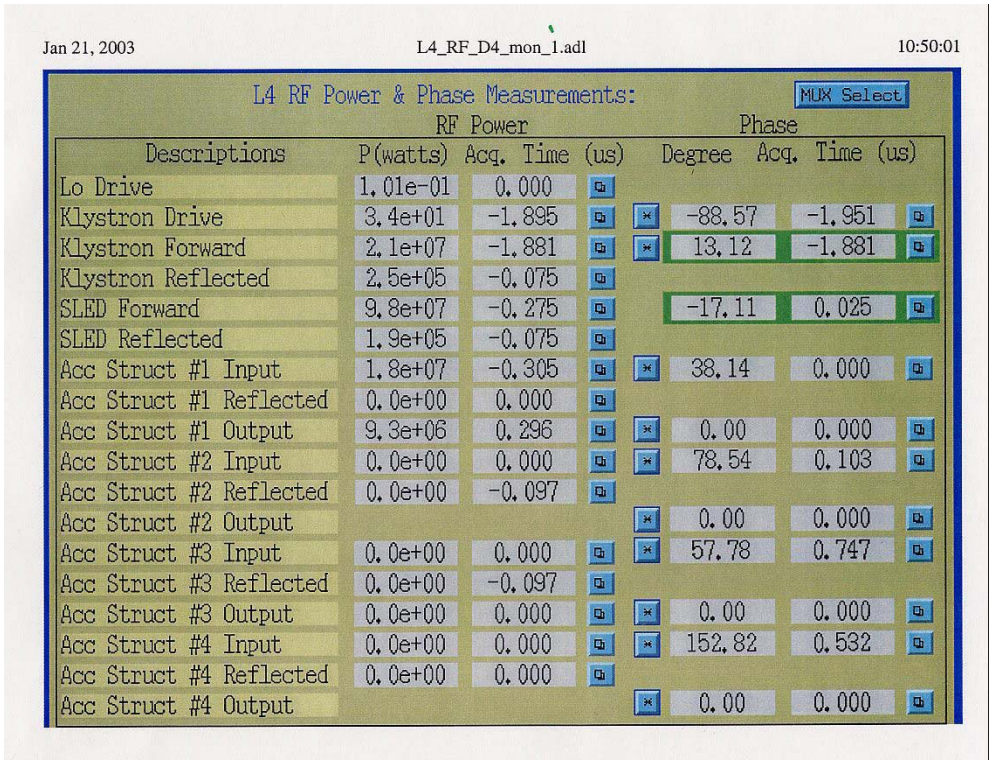


Fig. 9 (L4)

L4 Sled forward power

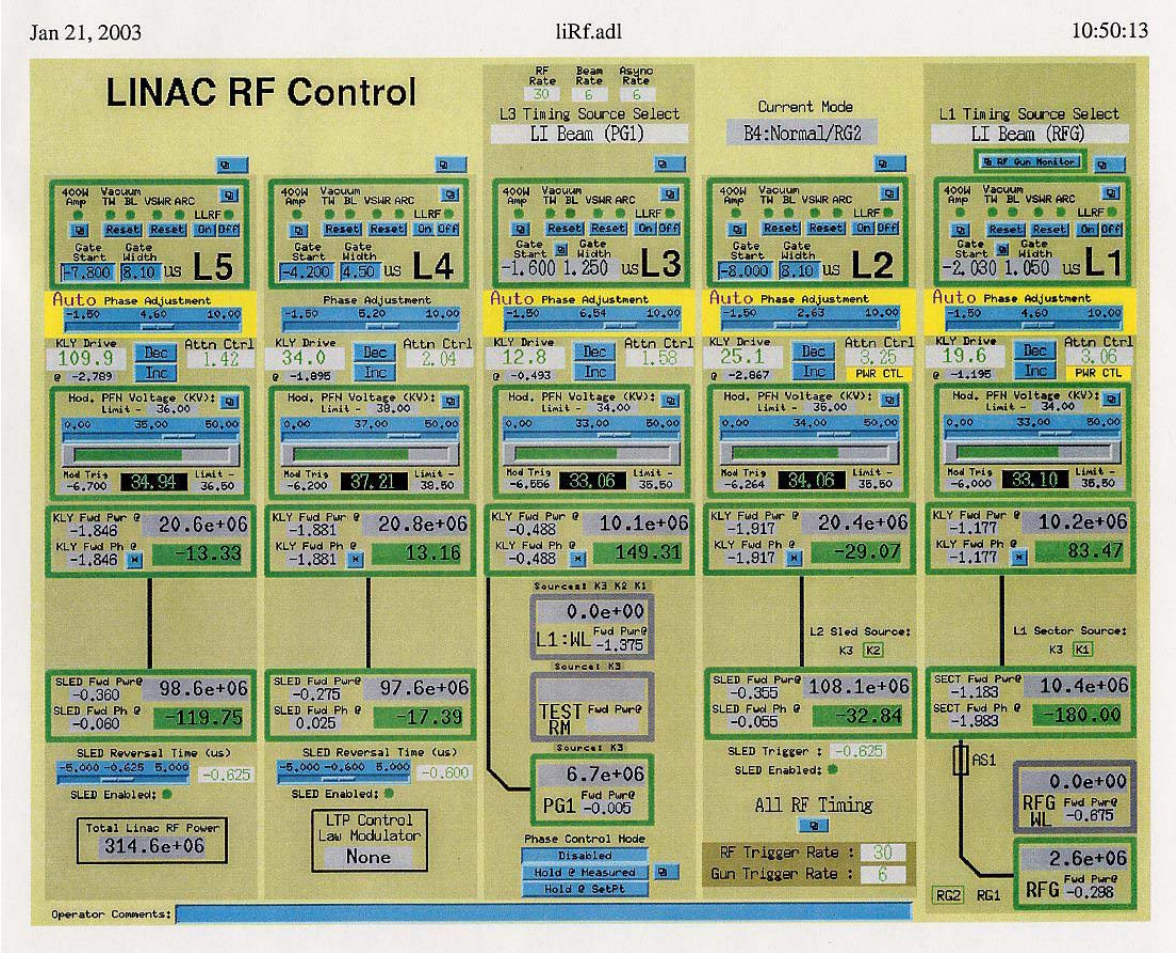
L4 Klystron reflected power (354 kw / div.)

Fig. 9 Generator frequency was set at 2.856000 GHz and right cavity was adjusted 3/8 of a turn clockwise for peak amplitude. Fig. 9 shows the original peak power meter connected to the power monitor. As the right cavity was adjusted the L4 "sled forward power" maximized and the L4 "klystron reflected power" minimized.



Descriptions	RF Power P(watts)	RF Power Acq. Time (us)	Phase Degree	Phase Acq. Time (us)
Lo Drive	1.01e-01	0.000		
Klystron Drive	3.4e+01	-1.895	-88.57	-1.951
Klystron Forward	2.1e+07	-1.881	13.12	-1.881
Klystron Reflected	2.5e+05	-0.075		
SLED Forward	9.8e+07	-0.275	-17.11	0.025
SLED Reflected	1.9e+05	-0.075		
Acc Struct #1 Input	1.8e+07	-0.305	38.14	0.000
Acc Struct #1 Reflected	0.0e+00	0.000		
Acc Struct #1 Output	9.3e+06	0.296	0.00	0.000
Acc Struct #2 Input	0.0e+00	0.000	78.54	0.103
Acc Struct #2 Reflected	0.0e+00	-0.097		
Acc Struct #2 Output			0.00	0.000
Acc Struct #3 Input	0.0e+00	0.000	57.78	0.747
Acc Struct #3 Reflected	0.0e+00	-0.097		
Acc Struct #3 Output	0.0e+00	0.000	0.00	0.000
Acc Struct #4 Input	0.0e+00	0.000	152.82	0.532
Acc Struct #4 Reflected	0.0e+00	0.000		
Acc Struct #4 Output			0.00	0.000

Fig. 10 With L4 sled output power of 98 MW, klystron reflected power (sled match) is now 250 kW. Before adjustments (Fig. 1) with L4 sled output of 71 MW, L4 klystron reflected power was 1.0 MW.



With L4 klystron output at 20.8 MW, the L4 sled output power is now at 97.6 MW as compared to approx 81 MW before the sled right cavity tuning. Sled power ratios for L4 and L5 are now nearly equal.