FEL TEST PLAN WORKSHEET

PROGRAM DEPUTY APPROVAL	COMPLETION INFORMATION
Program Deputy Signoff: _____	Completion Date: _____
Signoff Date: _____	PI Signoff: _____
Expiration Date (max. 90 days from approval): _____	Comments (partial completion, etc.):
Presentation Required? ❑ yes ❑ no Operations Review ❑	❑

NOTE: Information addressing the appropriate content of each of the following sections can be found in Section 2.0 of the Test Plan Instructions.

Test Plan Title: **Phasing the Cryomodule using the ER dump**

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Brief Purpose of Test

To fine phase the cryomodule after transient phasing.

Anticipated Benefits

Meet nominal energy spread and bunchlength requirements for IR-FEL.

Beam Conditions Required

Complete all of the following tables, entering a value or an **X** in the appropriate spaces:

Beam Type/Current (enter value)

Beam Type	Beam Current
Beam Off	
Pulsed (1.5 μuA max.)	X
CW	

Beam Energy (select one)

350 keV	10 MeV	20 MeV	42 MeV	10 MeV (Energy Recovery)
		X		

Beam Termination Point (select one)

Inj Dump	ER Dump	First light dump	Dumplet

Type of Test (select one)

Invasive (disrupts beam delivery)	Non-invasive (does not disrupt beam delivery)
X	

Time Required

4 hours

Preferred Time of Test

8-22:00

Staff Required to Execute the Test (including contact info)

Operator should be able to perform test; in case of problems, call

R. Legg 7592 (w,p) For data analysis call Legg.

Controlled Access Requirements

None

Hardware and/or Software Changes Required

NOTE: If software changes are part of the test plan, include the name of the application, the old revision level, the new revision level, and if applicable, whether or not it is possible to roll back to the old revision level (are there hardware limitations, etc.).

The dipole MDU1F02 will be powered to the top of its hysteresis curve and will need to be reset with the magnetic field diagnostic after the test.

Setup Procedure

1. Set the cryomodule cavity PSET's to the crest values determined by the Transient Phasing testplan. This should set the cavity phases to within +/-5 degrees.

Test Procedure

1. Center the beam through the cryomodule.
   - **a.** Turn the cavities to 7 MV/m GSET.
   - **b.** Vary the cryomodule Gang Phase by +/-30 degrees and watch for beam motion on the downstream viewer, ITV1F01A.
   - **c.** Resteer the beam through the cryomodule using correctors MBH1F00H and V to minimize the motion on the downstream viewer as the phase is varied.
   - **d.** Turn all the cavities to "RF OFF".
2. Adjust the first two cavities in the cryo module to a GSET of 6 MV/m. If the beam disappears on the viewer ITV1F01A, repeat Step 1 above only using the first two cavities in the module.

3. Set the dipole MDU1F02 to 1.852e4 G-cm. Retract ITV1F01A. Adjust the GSETs for the first two cavities until the beam appears on the viewer in the dump, ITV1G01.
4. Vary the phases of the first two cavities to maximize the energy (Move to the RIGHT??? on the dump viewer). Decrease the GSETs of the cavities to keep the beam on the viewer if necessary.
5. Set the phase of the cavitiy 1F01-3 to the crest value generated by the transient phasing procedure. Set cavity 1F01-4 to anti-crest (decelerating) by subtracting (or adding) 180 degrees to the crest value. Turn both 1F01-3 and 1F01-4 to RF-ON at a GSET of 7 MV/m.
6. The beam should remain on the viewer as the two cavities balance each other, if not, adjust the GSET of 1F01-4 in 0.05 MV/m steps until the beam reappears. Mark the position of the beam with the Datacube and acquire a centroid. Record the beam position on the BPM IPM0G01 in Table 1, below.
7. Record the phase of cavity 1F01-3 and the GSET of cavity 1F01-4.
8. Change the PSET of the cavity 1F01-3 by +20 degrees. Adjust the GSET of cavity 1F01-4 down until the beam returns to the previous centroid position in 0.02MV/m steps. Record the GSET of cavity 1F01-4
9. Adjust cavity 1F01-3 to crest +10 degrees. Adjust the GSET of cavity 1F01-4 up until the beam returns to the previous centroid position in 0.02MV/m steps. Record the GSET of cavity 1F01-4.
10. Adjust cavity 1F01-3 to crest +5 degrees. Adjust the GSET of cavity 1F01-4 up until the beam returns to the previous centroid position in 0.02MV/m steps. Record the GSET of cavity 1F01-4.
11. Change the PSET of the cavity 1F01-3 to crest -5 degrees. Adjust the GSET of cavity 1F01-4 up/down until the beam returns to the previous centroid position in 0.02MV/m steps. Record the GSET of cavity 1F01-4
12. Adjust cavity 1F01-3 to crest -10 degrees. Adjust the GSET of cavity 1F01-4 down until the beam returns to the previous centroid position in 0.02MV/m steps. Record the GSET of cavity 1F01-4.
13. Adjust cavity 1F01-3 to crest -20 degrees. Adjust the GSET of cavity 1F01-4 down until the beam returns to the previous centroid position in 0.02MV/m steps. Record the GSET of cavity 1F01-4.

Table 1:

PSET 1F01-3	+20	+10	+5	Crest	-5	-10	-20
GSET 1F01-4							

Table 1:

PSET 1F01-3	+20	+10	+5	Crest	-5	-10	-20
Viewer centroid							
BPM pos							

14. Set the phase of the cavitiy 1F01-4 to the crest value generated by the transient phasing procedure. Set cavity 1F01-3 to anti-crest (decelerating) by subtracting (or adding) 180 degrees to the crest value.

15. The beam should remain on the viewer as the two cavities balance each other, if not, adjust the GSET of 1F01-3 in 0.05 MV/m steps until the beam reappears. Mark the position of the beam with the Datacube and acquire a centroid. Record the beam position on the BPM IPM0G01 in Table 1, below.

16. Record the phase of cavity 1F01-4 and the GSET of cavity 1F01-3.

17. Change the PSET of the cavity 1F01-4 by +20 degrees. Adjust the GSET of cavity 1F01-3 down until the beam returns to the previous centroid position in 0.02MV/m steps. Record the GSET of cavity 1F01-3

18. Adjust cavity 1F01-4 to crest +10 degrees. Adjust the GSET of cavity 1F01-3 up until the beam returns to the previous centroid position in 0.02MV/m steps. Record the GSET of cavity 1F01-3.

19. Adjust cavity 1F01-4 to crest +5 degrees. Adjust the GSET of cavity 1F01-3 up until the beam returns to the previous centroid position in 0.02MV/m steps. Record the GSET of cavity 1F01-3.

20. Change the PSET of the cavity 1F01-4 to crest -5 degrees. Adjust the GSET of cavity 1F01-3 up/down until the beam returns to the previous centroid position in 0.02MV/m steps. Record the GSET of cavity 1F01-3

21. Adjust cavity 1F01-4 to crest -10 degrees. Adjust the GSET of cavity 1F01-3 down until the beam returns to the previous centroid position in 0.02MV/m steps. Record the GSET of cavity 1F01-3.

22. Adjust cavity 1F01-4 to crest -20 degrees. Adjust the GSET of cavity 1F01-3

Table 2:

PSET 1F01-4	+20 _____	+10 _____	+5 _____	Crest _____	-5 _____	-10 _____	-20 _____
GSET 1F01-3							

Table 2:

PSET 1F01-4	+20 _____	+10 _____	+5 _____	Crest _____	-5 _____	-10 _____	-20 _____
Viewer centroid							
BPM pos							

PSET 1F01-5	+20 _____	+10 _____	+5 _____	Crest _____	-5 _____	-10 _____	-20 _____
GSET 1F01-6							
Viewer centroid							
BPM pos							

PSET 1F01-6	+20 _____	+10 _____	+5 _____	Crest _____	-5 _____	-10 _____	-20 _____
GSET 1F01-5							
Viewer centroid							
BPM pos							

PSET 1F01-7	+20 _____	+10 _____	+5 _____	Crest _____	-5 _____	-10 _____	-20 _____
GSET 1F01-8							
Viewer centroid							
BPM pos							

PSET 1F01-8	+20 _____	+10 _____	+5 _____	Crest _____	-5 _____	-10 _____	-20 _____
GSET 1F01-7							
Viewer centroid							
BPM pos							

down until the beam returns to the previous centroid position in 0.02MV/m steps. Record the GSET of cavity 1F01-3

23. Repeat steps 5 through 22 for cavity pairs 1F01-5,6 and 1F01-7,8.

24. Set the cavities to the values which require the largest GSET compensation and keep the data for later analysis (fit it to a cos curve and calculate “true” crest).

Backout Procedure

1. Close the shutter and gate valve.

2. Set the field on MDU1F02 to the Bdl for straight through propagation using the magnetic field probe and cycle through the hysteresis curve.

3. Download the proper GSET’s for the rf cavities to achieve 42 MeV.

4. Load the crest angles for all cavities.

Test Results

1. Make copies of the data for analysis. Fit data to COS curve in EXCEL and calculate error bars and true crest phase.