

**Princeton Plasma Physics Laboratory
NSTX-U Machine Proposal**

Title: **Magnetics Calibration**

OP-XMP-106

Revision: **1**

Effective Date: **11/24/2015**

Expiration Date: **11/24/2017**
(2 yrs. unless otherwise stipulated)

Proposal Approvals

Responsible author: **C. E. Myers**

Date

ATI (NSTX Physics Ops): **D. Mueller**

Date

RLM (NSTX Expt. Research Ops): **S. P. Gerhardt**

Date

Responsible Division: **Experimental Research Operations**

Procedure Requirements
designated by RLM

	NSTX Work Permit		T-MOD (OP-AD-03)
	Independent Review		ES&H Review

RESTRICTIONS AND MINOR MODIFICATIONS
Approved by RLM

REVIEWERS (designated by RLM)		
<u>Organization/Position</u>	<u>Name</u>	<u>Signature</u>
ATI	D. Mueller	
Test Director	C. E. Myers	
Independent Reviewer		
NB system		
RF systems		
FCPC systems		
Diagnostics		

TRAINING (designated by RLM)			
Training required: No <input checked="" type="checkbox"/> Yes <input type="checkbox"/> Instructor _____			
Personnel (group, job title or individual name)	Read Only	Instruction	Hands-On
RLM _____			

NSTX MACHINE PROPOSAL

TITLE: Magnetics Calibration	No. OP-XMP-106
AUTHORS: C. E. Myers & S. P. Gerhardt	DATE: 11/14/2015

1. Overview:

Perform magnetic sensor calibrations in the following three configurations:

1. Static (DC flattop)
2. RWM (chirped SPA waveform)
3. AC (PF5, sine wave, multiple frequencies)

Notes:

- Coil current levels may be adjusted to lower values to comply with ISTEP allowables.
- The “negative” target values for the unipolar supplies in shot PF5421a may be tweaked to achieve approx. zero current without tripping the PSRTC di/dt protection algorithm.
- Use proportional gain only to achieve a true flattop on each coil.
- Three separate “Permission to Proceed” sign-offs are included in the XMP, one for each of the configurations listed above.

2. Justification:

Necessary for NSTX-U operations.

3. Plan:

1. Static calibration shots (12 shots total):

- a. Close the line switches for only the coils involved in each calibration shot.
- b. Take the six calibration shots listed in Table I (OHTF1, OHTF2, OHTF3, PF5421a, PF3, and PF1c). All shots in Table I satisfy the nominal overcurrent, overtime, and action limits for the December 2015 commissioning phase. The waveforms for the three OHTF shots are plotted in Fig. 1 for reference.
- c. Repeat the five shots in Table I at 50% of the listed current.
- d. Reference shot numbers: PF5421a 50/100% = 201285/287, PF3 50/100% = 201270/262, PF1cU 50/100% = 201280/281, PF1cL 50/100% = 201277/267, OH only 50/100% = 201274/275

2. RWM/EF calibration shots (6 shots total):

- a. Open all line switches except the SPAs.
- b. Apply the “standard” chirped SPA waveform to each of the six RWM/EF coils. This waveform can be reloaded from Shots 201952–957.

3. AC calibration shots (3 shots total):

- a. Open all line switches except PF5.
- b. Fire the three AC calibration shots in Fig. 2. These waveforms will be loaded into PCS from ASCII files provided by CEM.

Table I: The six static calibration shots (OHTF1, OHTF2, OHTF3, PF5421a, PF3, and PF1c). Time is listed in seconds and currents are listed in kA. The unipolar coils are controlled to a “negative” value when not being fired to ensure that they remain at 0 kA as desired.

OHTF1	OH		TF	
	Time	Curr.	Time	Curr.
Vertex 1	-2.0	0	0.3	0
Vertex 2	-1.8	-18	1.0	-60
Vertex 3	-1.2	-18	2.0	-60
Vertex 4	-1.0	0	2.7	0
Vertex 5	-0.8	+18		
Vertex 6	-0.2	+18		
Vertex 7	0.0	0		
Time-, Imin	1.0	-18	2.4	-60
Time+, Imax	1.0	+18	0.0	0
Action	518 kA ² *s		6120 kA ² *s	

OHTF2/3	OH		TF	
	Time	Curr.	Time	Curr.
Vertex 1	-0.9	0	-0.7	0
Vertex 2	-0.7	-/+18	0.0	-60
Vertex 3	0.0	-/+18	1.6	-60
Vertex 4	0.4	0	2.3	0
Vertex 5	0.8	+/-18		
Vertex 6	1.2	+/-18		
Vertex 7	1.6	0		
Time-, Imin	1.3/1.2	-18	3.0	-60
Time+, Imax	1.2/1.3	+18	0.0	0
Action	583 kA ² *s		8280 kA ² *s	

Time	PF5421a						PF3		PF1c	
	PF5	PF4	PF2U	PF2L	PF1aU	PF1aL	PF3U	PF3L	PF1cU	PF1cL
-2.0	+0.8	-0.35	-1	-1	-1	-0.5	0	0	0	0
-1.9	-10	-0.35	-1	-1	-1	-0.5	-10	0	-8	0
-1.4	-10	-0.35	-1	-1	-1	-0.5	-10	0	-8	0
-1.3	+0.8	-0.35	-1	-1	-1	-0.5	0	0	0	0
-1.1	+0.8	-0.35	-1	-1	-1	-0.5	0	0	0	0
-1.0	+0.8	+10	-1	-1	-1	-0.5	+8	0	+10	0
-0.5	+0.8	+10	-1	-1	-1	-0.5	+8	0	+10	0
-0.4	+0.8	-0.35	-1	-1	-1	-0.5	0	0	0	0
-0.2	+0.8	-0.35	-1	-1	-1	-0.5	0	0	0	0
-0.1	+0.8	-0.35	+10	-1	-1	-0.5	0	-10	0	-8
0.4	+0.8	-0.35	+10	-1	-1	-0.5	0	-10	0	-8
0.5	+0.8	-0.35	-1	-1	-1	-0.5	0	0	0	0
0.7	+0.8	-0.35	-1	-1	-1	-0.5	0	0	0	0
0.8	+0.8	-0.35	-1	+10	-1	-0.5	0	+8	0	+10
1.3	+0.8	-0.35	-1	+10	-1	-0.5	0	+8	0	+10
1.4	+0.8	-0.35	-1	-1	-1	-0.5	0	0	0	0
1.6	+0.8	-0.35	-1	-1	-1	-0.5	0	0	0	0
1.7	+0.8	-0.35	-1	-1	+10	-0.5	0	0	0	0
2.2	+0.8	-0.35	-1	-1	+10	-0.5	0	0	0	0
2.3	+0.8	-0.35	-1	-1	-1	-0.5	0	0	0	0
3.5	+0.8	-0.35	-1	-1	-1	-0.5	0	0	0	0
2.6	+0.8	-0.35	-1	-1	-1	+10	0	0	0	0
3.1	+0.8	-0.35	-1	-1	-1	+10	0	0	0	0
3.2	+0.8	-0.35	-1	-1	-1	-0.5	0	0	0	0
3.9	+0.8	-0.35	-1	-1	-1	-0.5	0	0	0	0
4.0	0	0	0	0	0	0	0	0	0	0
Imin	-10	0	0	0	0	0	-10	-10	-8	-8
Imax	0	+10	+10	+10	+10	+10	+8	+8	+10	+10
Action	57	57	57	57	57	57	94	94	94	94

Figure 1: Waveforms for the three OHTF static calibration shots.

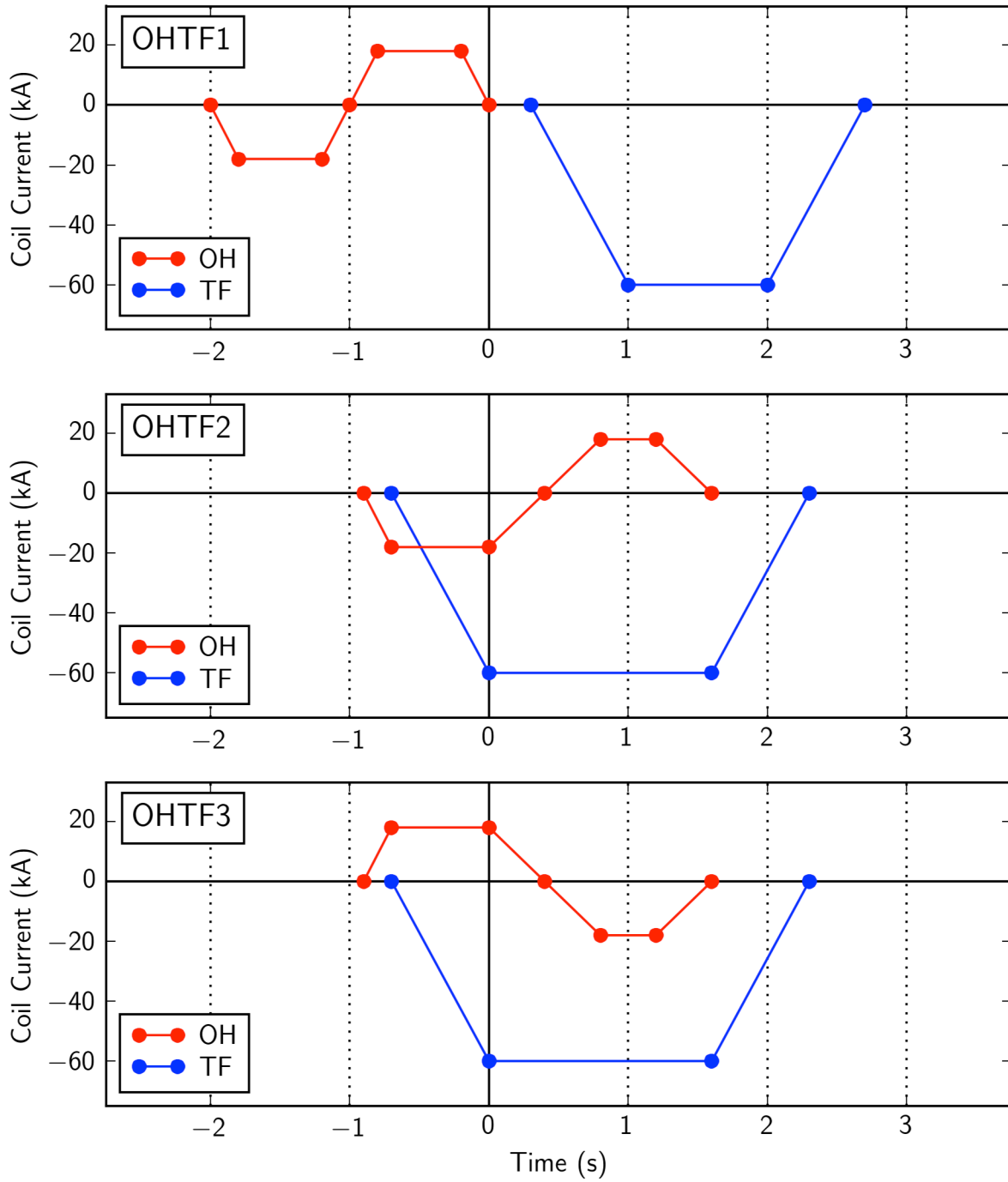
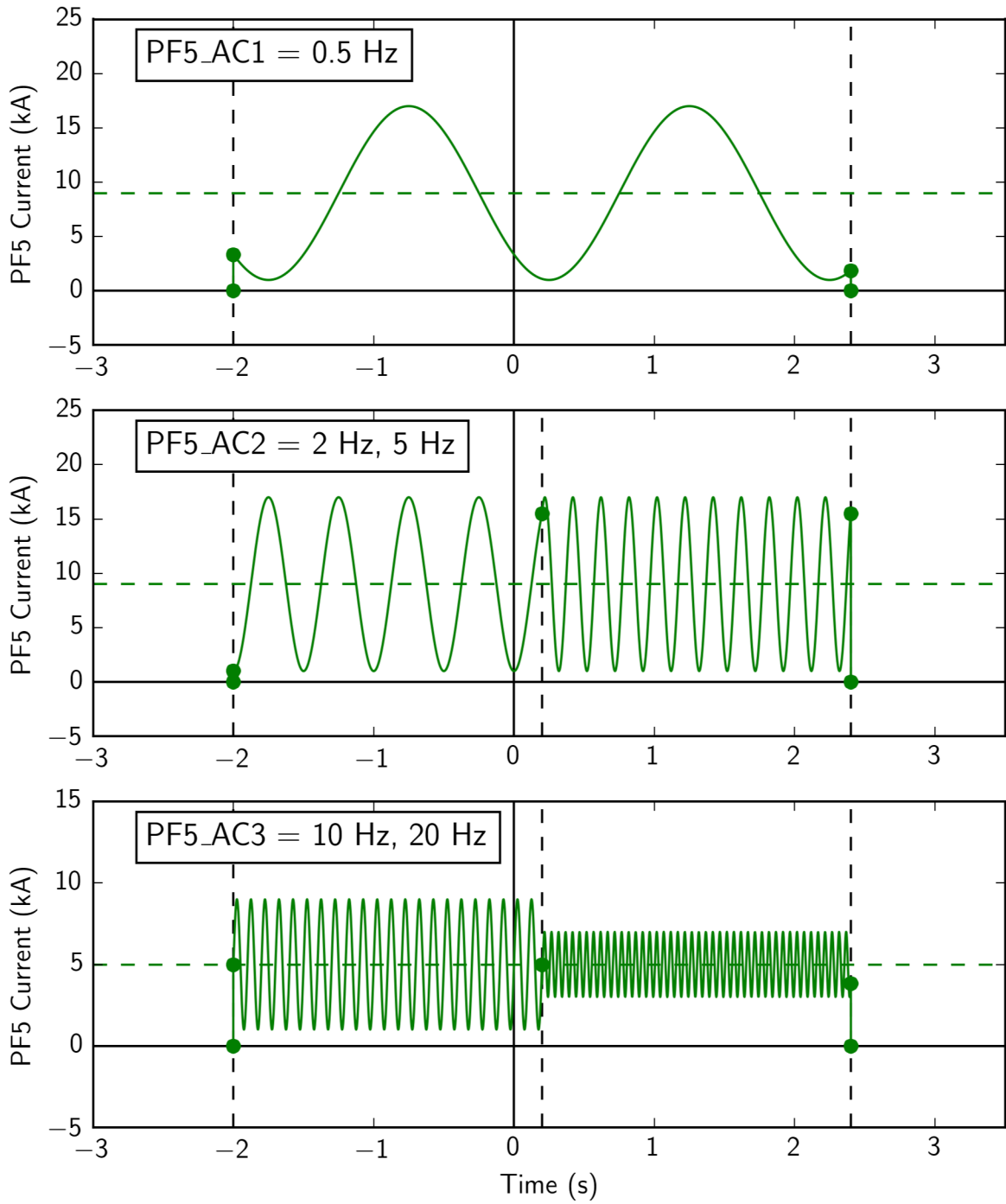


Figure 2: Waveforms for the three PF5 AC calibration shots.



4. Required machine, beam, ICRF and diagnostic capabilities:

NSTX-U coil system, rectifiers, and magnetic sensors.

5. Sign off at run time:

5.1 Permission to Proceed on static DC calibration shots:

Physics Operations or Research Operations

5.2 Permission to Proceed on SPA RWM/EF calibration shots:

Physics Operations or Research Operations

5.3 Permission to Proceed on AC calibration shots:

Physics Operations or Research Operations

5.4 Documentation of results:

Documentation of the results completed, attached to proposal and sent to Ops. Center with copies to Cognizant Physicist and Head of Physics Operations.

Cognizant Physicist/Test Director