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DESCRIPTION

This document is intended to be used by experienced Manufacturing Technicians, Field Engineers and their support personnel as a guide to diagnosis of problems detected by System Performance Test (SPT).

1- INTRODUCTION

For many of the test parameters, the approach to isolating a failure reported by SPT will be similar to that followed for TLT, so your experience with TLT will still be useful.

2- Z-ISOCENTER

If a Z-Isocenter failure is reported, it means that either the measured value was outside allowable absolute limits, the required change was too great or that image signal is much too small or absent. Failures are always based on the "Recommended Config New" value in the report. See file /usr/g/service/cclass/spt/cal.spt for limits.

2-1 Outside Absolute Limits

- Most likely cause is incorrect magnet or magnet shield type entered in the Service Config File.

2-2 Required Change Too Great

- Bad landmark.
- First time run of SPT after installing new hardware in a bay using config file values restored from previous bay load.
- Running SPT on an uncalibrated system may cause this failure. SPT is only intended to be used to "touch up" Z-Isocenter calibration.

2-3 Low Signal

An abnormally small signal, or noise only image, will cause Z-Isocenter to fail. Such conditions can be caused by:

- Incorrect center frequency.
- Power off to resistive shim supply, if present.
- Missing phantom or incorrect landmark.
- Cradle unlatches from trolley while advancing to scan.
- Head coil quick disconnect not plugged in or defective head coil.
- Faulty TNF or TNF continuously blanked by oscillating preamplifier(s).
- Other hardware fault that prevents transmitting or receiving properly.

3- GRAD CAL

If a Grad Cal failure is reported, it means that either the measured value was outside allowable absolute limits or that the required change was too great. Failures are always based on the "Recommended Config New" values in the report. See file /usr/g/service/cclass/spt/cal.spt for limits.

3-1 Outside Absolute Limits

- Default grad cal entries in config file.
- Incorrect config file entries for hardware configuration.

3-2 Required Change Too Great

- First time run of SPT after installing new hardware in a bay using config file values restored from previous bay load.
- Running SPT on an uncalibrated system will cause this failure. SPT is only intended to be used to "touch up" Grad Cal calibration.
- Faulty DQA-III phantom (usually Y axis). Compare thin outside line at top of phantom to wide outside line at bottom of phantom. Illustration L1 shows that the DQA-III phantom internal structures are improperly centered in the phantom shell.

ILLUSTRATION L1
IMPROPERLY CENTERED DQA-III INTERNAL STRUCTURES

- Faulty Gradient Driver Power Module or GRAM.
- Faulty Epoxy Filled Gradient Coil.

4- SYSTEM GAIN

If a System Gain failure is reported, it means that either the measured value was outside allowable absolute limits or that the required change was too great. Failures are always based on the "Recommended Config New" value in the report. See file /usr/g/service/cclass/spt/cal.spt for limits.

4-1 Outside Absolute Limits

- Faulty TNF.
- Head only, failure to use new style head quick disconnect box with built-in isolation network.
- Faulty preamplifier.
- Head only, faulty quick disconnect box.
- Faulty cables anywhere between the coil and receiver.
- Faulty receiver.
- Faulty T/R switch or hybrid splitter.
- Faulty dynamic disable bias driver or T/R switch bias driver.
- Faulty coil.

4-2 Required Change Too Great

- First time run of SPT after installing new hardware in a bay using config file values restored from previous bay load.
- Running SPT on an uncalibrated system will cause this failure. SPT is only intended to be used to "touch up" System Gain calibration.
- Faulty TNS.
- Faulty preamplifier.
- Head only, faulty quick disconnect box.
- Faulty cables anywhere between the coil and receiver.
- Faulty T/R switch or hybrid splitter.
- Faulty dynamic disable bias driver or T/R switch bias driver.
- Faulty receiver.
- Faulty coil.

5- MAGNET SHIM

If a Magnet Shim failure is reported, it means that the measured value was outside allowable absolute limits. In the /usr/g/service/cclass/spt directory see file ge_s1.spt, ge_s2.spt, ge_s3.spt, ge_s4.spt, ge_s5.spt, ge_sx.spt, ge_sxc.spt, ge_max.spt or ox.spt for limits applicable to your magnet type.

5-1 Run Grad Shim using LVShim

If only first order coefficients are out of specification, try running LVShim in Grad Shim mode. SPT Magnet Shim should now pass. If SPT Magnet Shim does not pass, but stand-alone LVShim does, stand-alone LVShim takes precedence over SPT Magnet Shim. Report the discrepancy and continue.

6- LONG EDDY CURRENTS

The Long Eddy Currents test in SPT is identical to Grafimage in TLT. See file /usr/g/service/cclass/spt/eddyl.spt for limits. If results are outside allowable limits, perform appropriate eddy current and B0 calibration procedure.

7- SNR

If an SNR Test failure is reported, it means that at least one of Signal, Noise, SNR or TG was found outside allowable limits. See file /usr/g/service/cclass/spt/snr.spt for specifications.

7-1 Signal

If the system has previously passed the SNR test and no calibrations have been performed since the SNR test passed, consider the following:

- If signal is failing high, the phantom may be warm due to heating from gradients during prior testing. Try using a phantom that has been stored for the last several hours at normal room temperature (not in an unusually warm bay).
- A phantom that is too cold can cause signal to fail low. This is usually a problem only with mobile systems that have recently had phantoms exposed to winter temperature conditions.
- Low signal can be caused by other system performance parameters that affect imaging physics such as shim, eddy currents, severe instabilities or faulty Grad Cal. Really bad RF amplifier linearity or exciter rho modulator missing bits could also degrade signal, but this is very rare.
- Oscillating preamplifier(s) can cause the TNF to blank continuously or intermittently.
- Faulty TNF.
- Head only, failure to use new style head quick disconnect box with built-in isolation network.
- Faulty preamplifier.
- Head only, faulty quick disconnect box.
- Faulty cables anywhere between the coil and receiver.
- Faulty T/R switch or hybrid splitter.
- Faulty dynamic disable bias driver or T/R switch bias driver.
- Faulty receiver.
- Faulty coil.

System Gain may be out of calibration, especially if this is a first time run of SPT after installing new hardware in a bay using config file values restored from previous bay load or if the system has not been calibrated at all.

7-2 Noise

If the system has previously passed the SNR test and no calibrations have been performed since the SNR test passed, consider the following:

- Screen room door not properly closed or faulty. Coherent noise test would also likely fail.
- Faulty lighting in screen room. Coherent noise test would also likely fail.
- Cover open or removed from SRI. Coherent noise test would also likely fail.
- Hardware changes (usually additions) have been made that violate RF shield integrity. This could include special test cables, test equipment etc. in the screen room without proper filtering or shielding. Coherent noise test would also likely fail.
- Faulty TNS.
- Head only, failure to use new style head quick disconnect box with built-in isolation network.
- Faulty preamplifier.
- Head only, faulty quick disconnect box.
- Faulty cables anywhere between the coil and receiver.
- Faulty T/R switch or hybrid splitter. Try running PIN diode noise test.
- Faulty dynamic disable bias driver or T/R switch bias driver.
- Faulty receiver.
- Faulty coil.

System Gain may be out of calibration, especially if this is a first time run of SPT after installing new hardware in a bay using config file values restored from previous bay load or if the system has not been calibrated at all.

7-3 SNR

If SNR is failing, either signal is too low or noise is too high. Refer to signal and noise sections for guidance.

7-4 TG

Most likely cause is RF amplifier gain calibration.
If RF amplifier gain calibration is verified OK, also consider:

- Head only, failure to use new style head quick disconnect box with built-in isolation network.
- Head only, faulty quick disconnect box.
- Faulty cables anywhere between the coil and RF amplifier output.
- Faulty T/R switch or hybrid splitter.
- Faulty dynamic disable bias driver or T/R switch bias driver.
- Faulty coil.

8- STABILITY

SPT has two stability tests using the clinical Fast Spin Echo (FSE) and Fast Gradient Echo (FGRE) PSDs. As a very loose general rule, FSE stability, with its high RF duty cycle, is more sensitive to RF related problems while FGRE, which stresses primarily the gradient drivers, is more sensitive to gradient related problems. It must be stressed, however, that this is by no means a hard and fast rule. If a Stability Test failure is reported, it means that at least one of Time Domain Echo Shift, Constant Phase Drift, or Magnitude Drift results was found outside allowable limits at a slice location. In the /usr/g/service/cclass/spt directory, see files fsestb.spt and grestb.spt for specifications.

8-1 Time Domain Echo Shift

The rate of phase accumulation during the readout window is proportional to the integral of the gradient field from the center of the RF 90 pulse for FSE or 30 pulse for FGRE to the center of the readout window. If the echo pops up exactly in the center of the readout window, the gradient integral is zero. Phase accumulation rate is positive if the echo is late and negative if it is early. SPT does not report the actual echo position, only how it shifts from view to view.

- If echo shift errors are similar at isocenter and off-isocenter slices, the problem is most likely to be caused by the readout gradient.
- If echo shift errors are small at isocenter but large and opposite in polarity at opposed off-isocenter slices, the problem is most likely to be caused by the slice select gradient.
- RF transmit pulse errors have no appreciable effect on time domain echo position unless the RF errors are really huge.

8-2 Constant Phase Drift

Early in each sequence, the spins in a slice are excited by an RF pulse (excitation). At this point the spins are all rotating in synchronism with some absolute phase. At receive time (readout), when the echo is refocused, the spins are again all rotating in synchronism with some absolute phase. Constant phase is the average absolute phase that is left over after the time domain echo shift is removed from each view (i.e., the echoes are moved to the exact center of the readout window). Constant phase drift results when the phase shift between excitation and readout changes from view to view.

- Basically, anything that changes the magnetic field between excitation and readout can cause constant phase drift.
- As in the echo shift case, if the drift is small at isocenter but large and opposite in polarity at opposed off-isocenter slices, the problem is most likely to be caused by the slice select gradient.
- If constant phase drift is similar at isocenter and off-isocenter slices, the problem is most likely to be caused by the readout gradient or external factors such as vibration, moving metal, etc.
- RF transmit pulse errors have no appreciable effect on constant phase drift unless the RF errors are really huge.

8-3 Magnitude Drift

SPT compares mean magnitude of each view to mean magnitude of all views. The result is displayed as a percentage of mean magnitude of all views.

- In general, magnitude problems are caused by RF transmit or receive faults. There are exceptions, of course. Severe gradient errors can also sometimes cause magnitude drift problems, especially if slice location is changing due to drift of the slice encoding gradient.

REVISION HISTORY

REV	DATE	AUTHOR	PRIMARY REASONS FOR CHANGE
A	Mar 25, 1998	L. Loehrer	Converted Toolbook document to MS Word 7.0
0	Oct 14, 1999	M. Keber	Added correct proprietary heading to document.
1	March 27, 2001	D. Thome	Corrected path for location of stability spec files. Fixed formatting errors.