TECH TIPS
CARDIAC DEVICES UPDATED LABELING FOR 3T

Siemens Specific

B_{1+RMS} as a Condition of Use

Because B_{1+RMS} is now recommended as a supplemental metric to SAR, Medtronic has begun to have device labeling approved with B_{1+RMS} limits.

For a full list of devices and leads approved for the MRI environment, refer to our MR-conditional Cardiac Device Summary Chart.

SureScan™ cardiac device 3T labeling is a little different than 1.5T labeling in that it **uses B_{1+RMS} rather than SAR when landmarking/centering below C7.** When scanning these devices at 1.5 T, SAR must be limited to the Normal Operating Mode. It is important to remember that the B_{1+RMS} limit applies to 3T ONLY. When utilizing B_{1+RMS} as a condition of use at 3T, one can utilize either Normal or First Level Controlled Mode for SAR. However, the displayed B_{1+RMS} value for each scan is not to exceed 2.8 μT (micro Tesla) when landmarking/centering below C7. When landmarking/centering above C7, either Normal or First Level Controlled mode may be used for SAR and there are no restrictions regarding B_{1+RMS}. If your 3T MR system does not display B_{1+RMS}, then only studies may be performed which are landmarked/centered above C7. **Centering/Landmarking and/or scanning below C7 is not allowed for 3T systems that do not display B_{1+RMS}.**

At 3T, most of your current protocols will need little to no modification to comply with the 2.8 μT B_{1+RMS} condition of use. As a rule of thumb, the higher the estimated SAR, the higher the likelihood that some modifications may need to be made. However at 3T, the likelihood that a sequence would need modification to comply with the 2.8 μT limit is still very low.

It should also be noted that there are no restrictions on the use of local transmit/receive coils for imaging of the head or the extremities, which includes no B_{1+RMS} restrictions. For example, if one is using a knee transmit/receive coil with a sequence requiring > 2.8 μT, this would be acceptable since the whole body coil is not being used as the transmit coil.

How one modifies scan parameters to affect the B_{1+RMS} may vary slightly between MR system brands based on available options. However, in general, whatever you do to reduce SAR on your system will likely reduce the B_{1+RMS}. If your system displays B_{1+RMS}, you will find it in the same area in which you find SAR.

Siemens 3T MR Systems

On the Siemens system, B_{1+RMS} is displayed on the prediction tab in the SAR information dialog box (Figure 1). The yellow box in Figure 1 displays the B_{1+RMS} as a percentage of an arbitrary maximum B_{1+RMS}, defined such that scanner performance will not be limited due to B_{1+RMS}. This percentage of limit does not correspond to the B_{1+RMS} limit per the Medtronic labeling. To display a bar graph with the absolute B_{1+RMS} value in μT (red box in Figure 1), click in the B_{1+RMS} field.[1] It is important to note that the B_{1+RMS} value is **not** updated in real time as scan parameters are changed. The predicted value for the scan will not be displayed until after the measurement phase. **Therefore, the series should be configured so that the scan pauses after the measurement phase.** This will allow the operator to verify the B_{1+RMS} value prior to manually initiating the scan.

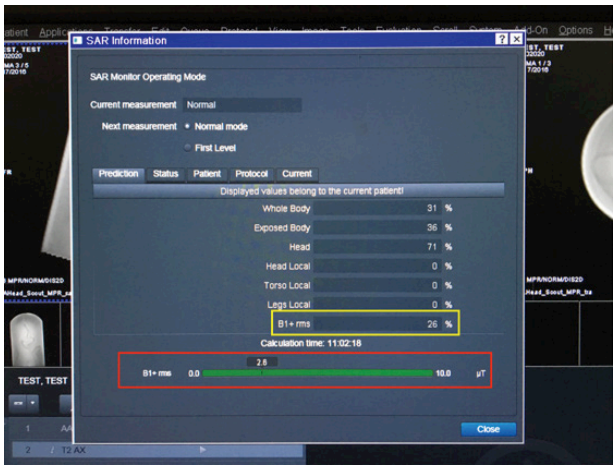

Figure 1

Medtronic

To configure the scan so the operator manually initiates the scan, follow these steps:

1. Right-click on the series you wish to configure and select "Edit Properties" (Figure 2).

Figure 2

2. Select "Execution" on the left; then select "Wait for user to start" along with "Single measurement" and then "OK" (Figure 3).

The system will then perform the pre-scan measurement. Following the pre-scan measurement, you will be able to verify the predicted value of B_{1+RMS} as shown previously in Figure 1. This should be done for each sequence being performed where landmarking/centering is below C7. Please note that the value of B_{1+RMS} shown on the "Prediction" tab should be used to verify that the scan sequence follows the 2.8 µT labeling limit. During the actual scan sequence, the current B_{1+RMS} is shown on the "Current" tab of the SAR information dialog box; the current value can vary in some instances due to the timing in gated scans and may even display values larger than the predicted value. However, this is acceptable as uncertainty of the predicted B_{1+RMS} in comparison to the real-time B_{1+RMS} has been accounted for in Medtronic's 3T safety assessments.

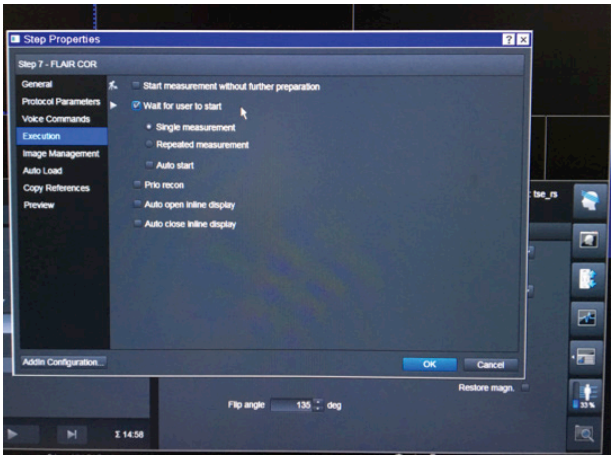

Figure 3

As previously mentioned, most parameters that affect SAR will affect the B_{1+RMS}. Also remember that once you have adjusted the parameters to obtain a B_{1+RMS} value of 2.8 µT or less, you can save that sequence in your protocols. Unlike SAR, the B_{1+RMS} value will be the same the next time you recall that sequence (provided none of the parameters are altered from when it was saved, including the number of slices).

Specific Examples for Modifying B_{1+RMS} on Siemens 3T Systems

Reducing the number of slices without increasing the TR or increasing the TR without increasing the number of slices will reduce the B_{1+RMS}. Reducing the number of slices is often not practical so increasing the TR is the more likely choice between the two. Depending on other parameters, you may have to significantly increase the TR. Besides the impact on scan time, significant increases in TR are also not practical when T1-Weighted spin echo sequences are desired.

Turbo spin echo series consist of a 90-degree pulse followed by a "train" of refocusing pulses, generally said to be 180-degree pulses. In reality these are rarely 180-degree pulses but rather 170-degrees or even less. The number of echoes generated by the refocusing pulses is referred to as the ***Turbo factor***. To reduce the B_{1+RMS} you can reduce the Turbo factor (leaving all other parameters unchanged). Figure 4 shows the selection for Turbo factor.

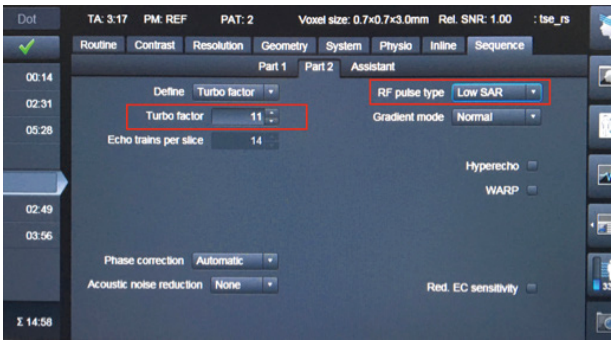

Figure 4

Siemens also allows the user to select the RF pulse type (Figure 4). Selecting the "Low SAR" option will also reduce the B_{1+RMS}. However, it is highly unlikely that selecting the "Low SAR" option will be necessary to stay below 2.8 µT.

Altering the ***flip angle*** is another option for reducing B_{1+RMS}. This is actually the flip angle of the refocusing pulses. Figure 5 shows the screen where you will find the flip angle adjustment. As you reduce either the Turbo factor or the refocusing flip angle, the B_{1+RMS} will be reduced. It should be noted that at some point, reducing the refocusing flip angle can result in reduced SNR and altered image contrast. As a general rule of thumb, use caution when selecting a refocusing flip angle below 130.

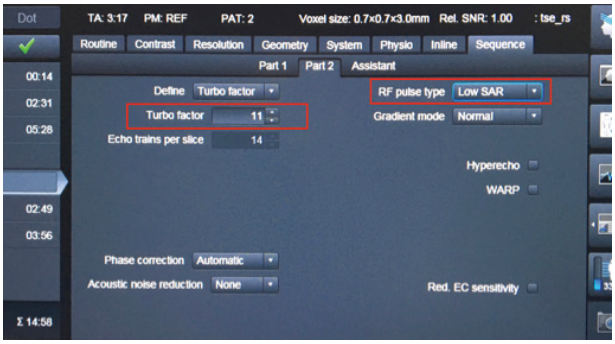

Figure 5

Remember, once you have adjusted the parameters to obtain a B_{1+RMS} value of 2.8 µT or less, you can save that sequence in your protocols. Unlike SAR, the B_{1+RMS} value will be the same the next time you recall that sequence (provided none of the parameters are altered from when it was saved, including the number of slices).

Summary

- 3T labeling uses B_{1+RMS} as the condition of use relative to RF power when landmarking/centering below C7.
- When **landmarking/centering above C7**, there are no restrictions for B_{1+RMS} and either Normal or First Level Controlled mode for SAR may be selected .
- When **landmarking/centering below C7**, the displayed B_{1+RMS} value should be less than or equal to 2.8 µT (micro-Tesla). Either Normal or First Level Controlled SAR mode may be selected.
- In the event your 3T system software does not display B_{1+RMS}, only studies in which the landmark is above C7 may be performed on a 3T system.
- The use of B_{1+RMS} as a metric for RF heating provides for greater flexibility in pulse sequence and parameter selection.
- Most parameters which affect SAR will affect B_{1+RMS}.
- Once a sequence has been modified to have a B_{1+RMS} value of 2.8 µT or less, it can be saved in the site's protocols.
- As long as the parameters affecting B_{1+RMS} are not modified, sequences saved with a specific B_{1+RMS} value will remain unchanged patient-to-patient.

Reference

[1] It should be noted that the maximum B_{1+RMS} of 10 µT shown in Figure 1 is not representative of the maximum B_{1+RMS} that will be utilized by the whole body transmit coil. In practice, it should be very rare that a sequence will reach the 2.8 µT labeling limit when using the whole body transmit coil and landmarking/centering below C7.

Brief Statement
Medtronic SureScan™ Portfolio for 1.5T and 3T MR-conditional Use
Medtronic SureScan products and systems are MR Conditional, and as such are designed to allow patients to undergo MRI under the specified conditions for use.
Pacing, ICD, CRT-P and CRT-D Systems: When programmed to On, the MRI SureScan feature allows the patient to be safely scanned while the device continues to provide appropriate pacing. A complete transvenous SureScan system, which is a SureScan device with appropriate SureScan lead(s), is required for use in the MR environment. For ICD and CRT-D Systems, when a single coil SureScan defibrillation lead is used, a Medtronic DF-1 pin plug must be secured in the SVC port to make a complete SureScan DF-1 defibrillation system. To verify that components are part of a SureScan system, visit http://www.mrisurescan.com/. Any other combination may result in a hazard to the patient during an MRI scan.

See the MRI SureScan Technical Manual before performing an MRI Scan and Device Manual for detailed information regarding the implant procedure, indications, contraindications, warnings, precautions, and potential complications/adverse events. For further information consult Medtronic's website at www.medtronic.com or www.mrisurescan.com.

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