



# SAR Controls

## Usability for Safety

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# User Control & Feedback for RF deposition (SAR)

## Standards Compliance

Operating Modes

Deliberate Action

Control Options

Visual Feedback

## Special Needs

Pregnancy

Children

Implants



Limiting values

Patient Registration UI

Popup screens

Sequence parameters

ExamCard, PSA, Sequence Info

Normal Mode suggested

T/R Knee Coil

ScanWise Implant

*Usability Engineering for validated safety and workflow solutions*

# SAR: Standards Compliance (IEC60601-2-33 Ed3.2)

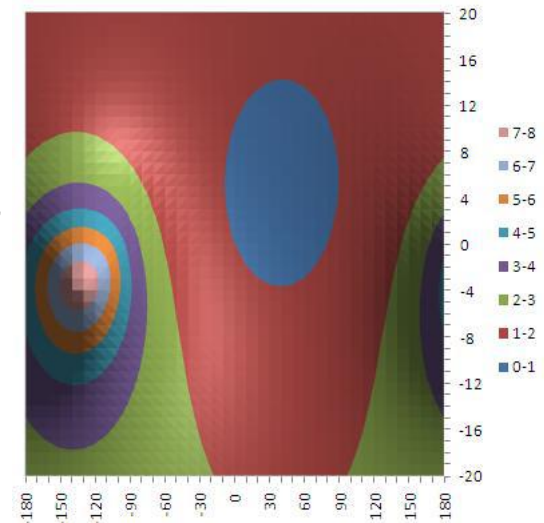
Output Limits are based on local SAR evaluation

- Virtual Human RF simulations provide local SAR and global SAR estimates
- Per-sequence exposure<sup>(\*)</sup> is limited to the most restrictive SAR type<sup>(\*\*)</sup>, either:

- Whole Body SAR
- Head SAR
- Local Torso SAR
- Local Extremities SAR

	WB SAR	Head SAR	Local SAR		
Body Region	Body	Head	Head	Torso	Extremities
Operating Mode	W/kg				
NORMAL	2	3.2	10	10	20
FIRST LEVEL CONTROLLED	4	3.2	20	20	40

- MultiTransmit (RF shimming) SAR benefit/penalty applied as scale factor relative to Quadrature
- Whole Body SAR is displayed for the running sequence, and during sequence planning
- Total RF energy deposition, SED, is accumulated, forecasted, and displayed



(\*) The Short Term SAR 2x allowance is not implemented

(\*\*) Partial Body SAR is shown by simulations to be redundant when limiting by local SAR

## New Examination

### Patient

Patient name:

Registration ID:

Date of birth:  dd-MMM-yyyy

Age:

Gender:  Male  Female  Phantom

Patient weight:  kg

### Patient conditions

Pregnant:  Yes  No  Possibly

Implant <sup>\*</sup>:  Yes  No

### Examination

Exam name:

Accession number:

Examination date:  Today  Tomorrow

Referring Physician:

Performing Physician:

Study Comments:

Allowed SAR mode:  Normal  1st Level

### Examination conditions

Maximum RF energy **2.0 W/kg**

The Operating Mode (for SAR) can be selected at **Patient Registration UI**

T1W\_TSE\_Cor 03:44    Voxel 0.74 x 0.82 x 3.00    Cor 1.00    Rel. SNR 1.00    TE 10    TR 523    [Back] [Forward] [Accept]

Summary	Geometry	Contrast	Motion	Dyn/Ang	Postproc	Offc/Ang	Coils	Conflicts
Water-fat shift (pixels)	1.2	user defined						
RF Shims	fixed							
Shim	default							
mDIXON	no							
Fat suppression	no							
Grad Rev Fat suppr	no							
Water suppression	no							
BB pulse	no							
MTC	no							
APT	no							
Research prepulse	no							
MDME	no							
Zoom imaging	high							
Diffusion mode	moderate							
T1 mapping	low							
T1 mapping	ultra low							
Transmit channels	user defined							
<b>SAR mode</b>	<b>moderate</b>							
B1 mode	default							
<b>SAR allow first level</b>	yes							

ACQ matrix IM x P	472 X 550
ACQ voxel MPS (mm)	0.74 / 0.82 / 3.00
REC voxel MPS (mm)	0.58 / 0.58 / 3.00
Scan percentage (%)	90.3
Packages	3
Min. slice gap (mm)	3
Act. slice gap (mm)	0.3
Optimal slices	18
Max. slices	27
WFS (pix) / BW (Hz)	1.197 / 362.8
TSE es / shot (ms)	8.0 / 24
TEeff / TEequiv (ms)	10 / 10
Min. TR (ms)	523
Local torso SAR	< 75 %
Whole body SAR / level	< 2.4 W/kg / 1st level
SED	< 0.5 kJ/kg
Coil Power	72 %
Max B1+rms	1.98 uT
PNS / level	46 % / normal
dB/dt	40.8 T/s

The Operating Mode (for SAR) can be selected **for every individual scan**, if First Level Controlled Mode was selected at Patient Registration

Patients Examination Review Analysis System Help 13-Sep-2017, 10:23 PHILIPS

Registration ID:  Plan ▶  
Date of Birth:  Review ▶  
Gender:

Spine 00:11:47

- SURVEY\_FullF... B
- PDW\_TSE\_Tra TRA B
- T1W\_TSE\_Cor COR B
- DWI TSE spair... B

+ Add new sequence...

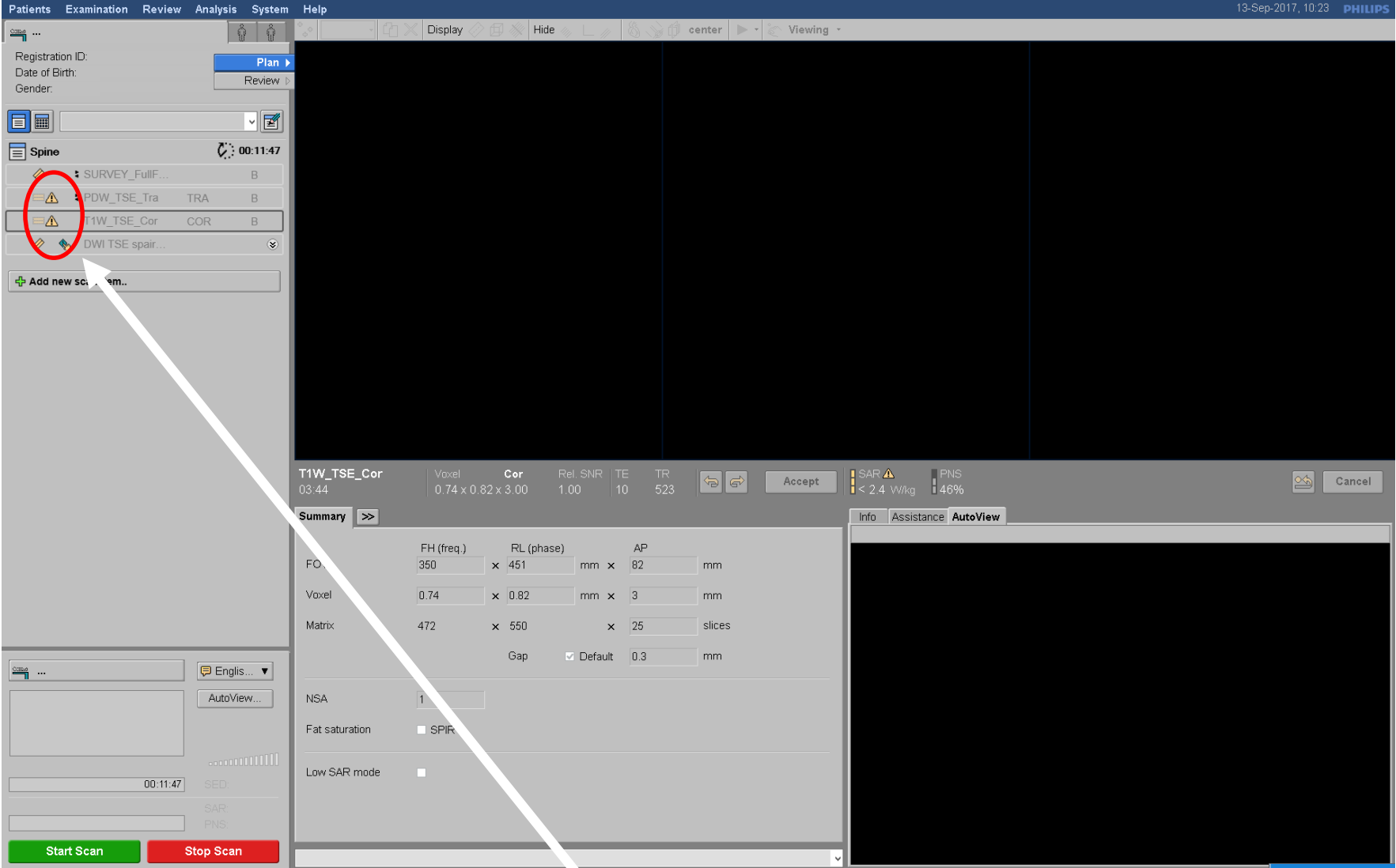
T1W\_TSE\_Cor Voxel Cor Rel. SNR TE TR Accept SAR PNS  
03:44 0.74 x 0.82 x 3.00 1.00 10 523 < 2.4 W/kg 46% Cancel

Summary >

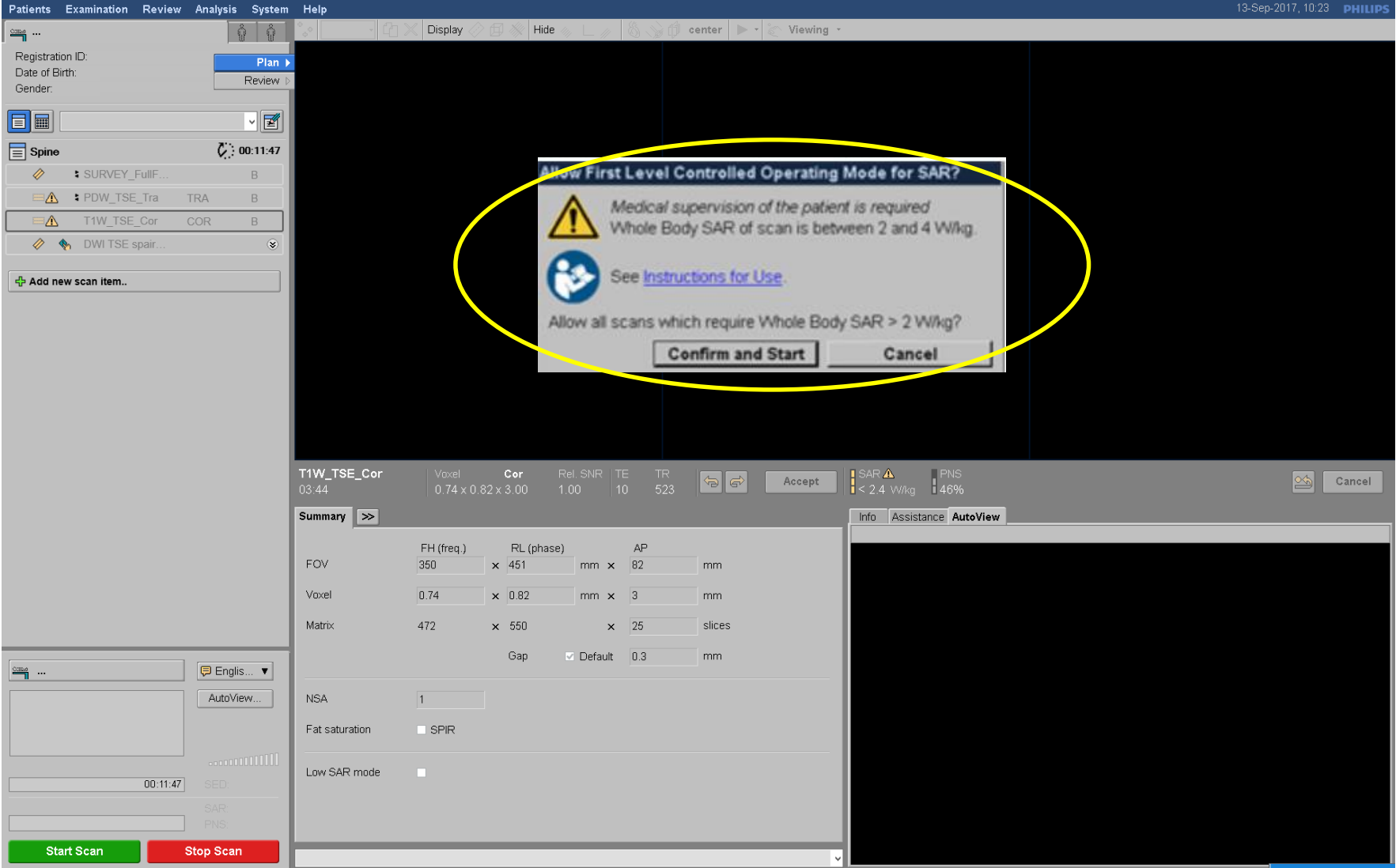
	FH (freq.)	RL (phase)	AP
FOV	350 mm	451 mm	82 mm
Voxel	0.74 mm	0.82 mm	3 mm
Matrix	472	550	25 slices
Gap		<input checked="" type="checkbox"/> Default	0.3 mm
NSA	1		
Fat saturation	<input type="checkbox"/> SPIR		
Low SAR mode	<input type="checkbox"/>		

Info Assistance AutoView

Start Scan Stop Scan



First Level Controlled Mode is indicated for every **planned** sequence



If Examination allows First Level Controlled Mode ,  
a **deliberate action** is required at first sequence where SAR > 2 W/kg

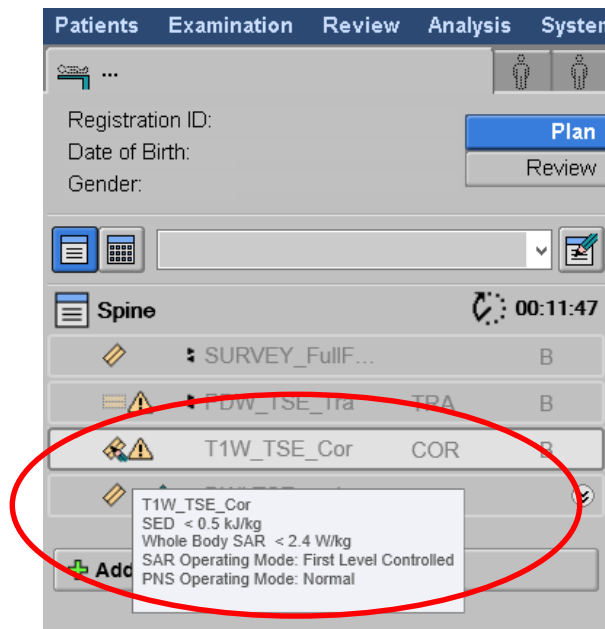
The screenshot displays the Philips MRI console interface. At the top, the menu bar includes 'Patients', 'Examination', 'Review', 'Analysis', 'System', and 'Help'. The top right corner shows the date and time '13-Sep-2017, 10:23' and the 'PHILIPS' logo. The main interface is divided into several sections:

- Left Panel:** Contains patient information (Registration ID, Date of Birth, Gender), a 'Spine' section with a timer at '00:11:47', and a list of scan items: 'SURVEY\_FullF...', 'PDW\_TSE\_Tra TRA B', 'T1W\_TSE\_Cor COR B', and 'DWI TSE spair...'. There is an 'Add new scan item...' button.
- Examination Section:** Shows 'Examination' with a progress bar and a timer at '00:18:50'. Below it, 'Current scan' displays SAR: 0.1 kJ/kg and PNS: 85%. A yellow circle highlights the SAR and PNS values. A green 'Start Scan' button and a red 'Stop Scan' button are visible.
- Right Panel:** Shows three columns of SAR and PNS data, each with a red alarm icon (a triangle with an exclamation mark). The values are: SAR: 0.0 kJ/kg, SAR: 3.3 W/kg, SAR: 0.1 kJ/kg; and PNS: 57 %, PNS: 90 %, PNS: 0.0 W/kg. Each column has a red 'Stop Scan' button.
- Bottom Section:** Shows technical parameters for 'T1W\_TSE\_Cor' (03:44), including Voxel (0.74 x 0.82 x 3.00), Rel. SNR (1.00), TE (10), and TR (523). It also shows SAR (<math>< 2.4 \text{ W/kg}</math>) and PNS (46%) limits. A 'Summary' table is visible with columns for FOV, Voxel, Matrix, NSA, Fat saturation, and Low SAR mode. A 'Start Scan' and 'Stop Scan' button are at the bottom left.

Two arrows are present: a black arrow pointing from the SAR/PNS values in the 'Current scan' section to the SAR/PNS values in the right panel, and a grey arrow pointing from the SAR/PNS values in the bottom section to the SAR/PNS values in the 'Current scan' section.

First Level Controlled Mode is indicated for the **running** sequence as “alarm”





Tooltips provide details for relevant exposure parameters and Operating Mode for **planned** sequences

T1W\_TSE\_Cor 03:44 | Voxel 0.74 x 0.82 x 3.00 | Cor 1.00 | Rel. SNR 1.00 | TE 10 | TR 523 | [Back] [Forward] [Accept]

Summary | Geometry | **Contrast** | Motion | Dyn/Ang | Postproc | Offc/Ang | Coils | Conflicts | <<

Water-fat shift (pixels)	1.2	ACQ matrix (mm)	472 x 350
RF Shims	fixed	ACQ voxel MPS (mm)	0.74 / 0.82 / 3.00
Shim	default	REC voxel MPS (mm)	0.58 / 0.58 / 3.00
mDIXON	no	Scan percentage (%)	90.3
Fat suppression	no	Packages	3
Grad Rev Fat suppr	no	Min. slice gap (mm)	3
Water suppression	no	Act. slice gap (mm)	0.3
BB pulse	no	Optimal slices	18
MTC	no	Max. slices	27
APT	no	WFS (pix) / BW (Hz)	1.197 / 362.8
Research prepulse	no	TSE es / shot (ms)	8.0 / 24
MDME	no	TEeff / TEequiv (ms)	10 / 10
Zoom imaging	high	Min. TR (sec)	5.00
Diffusion mode	moderate	Local torso SAR	< 75 %
T1 mapping	low	Whole body SAR / level	< 2.4 W/kg / 1st level
Transmit channels	user defined	SED	< 0.5 kJ/kg
<b>SAR mode</b>	<b>moderate</b>	Coil Power	72 %
B1 mode	default	Max B1+rms	1.98 uT
SAR allow first level	yes	PNS / level	46 % / normal
		dB/dt	40.8 T/s

Feedback on SAR, SED and  $B_1^+$ rms is provided for every individual sequence in the expert parameter editor view

Help

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Type in the keyword to find:

(T-wave artifact  
 Snap-to-table  
 2D Spectroscopic Imaging  
 2D-PCA  
 3 Point Planscan  
 3D APT  
 3D ASL  
 3D Brain VIEW  
 3D Breast VIEW  
 3D Free Breathing  
 3D Inflow MRA  
 3D k-space (elliptical) shutter  
 3D Mode, display planning  
 3D MSK VIEW  
 3D Nerve View  
 3D Nerve VIEW

Safety > Safety during scanning > Exposure to EMF > Specific Absorption Rate (SAR) > Specific Energy Dose (SED)

## Specific Energy Dose (SED)

During an MRI examination, RF energy is transferred to the body, potentially resulting in warming sensations. The patient temperature rise is proportional to the total energy delivered to the patient (SED, expressed as kJ/kg). It is determined by the SAR and scan duration. SAR is the rate of delivered energy expressed in Watts/kg, represented as W/kg. Limiting the amount of RF energy (SED) delivered to the patient, limits the temperature rise in the patient. Specific Energy Dose is a comfort measure and provides feedback on the RF energy delivered to the patient. In general, a delivered SED value > 3.5 kJ/kg may be uncomfortable for some patients. The Philips recommended maximum for SED is 7.0 kJ/kg. Patient comfort during scanning is affected by the condition of the patient and must be taken into account. A rise in body temperature can be a hazard to a patient with impaired thermoregulation. Recommended maximum SED for this group is 3 kJ/kg although preferably SED is kept below 2 kJ/kg. Serious discomfort is reported by healthy volunteers at values greater than 7.0 - 8.5 kJ/kg.

**NOTE** Adequate patient cooling (for example by using in-bore patient ventilation and making sure examination room temperature is within the specified range) is necessary in order to keep patient comfort within desired limits. Also see [Clothing and environmental conditions](#).

### Display of SED on the console

The SED is visible in the Patient Status Area above the **Stop Scan** button (see figures below). The SED bar has a scale of 0.0 to 7.0 kJ/kg. The bar shows the scheduled SED in light grey and the delivered SED in dark grey. Once the delivered SED exceeds 3.5 kJ/kg the color changes to yellow. Information about SED is also available during planning. The SED of each scan is available on the info page.

Delivered SED	The SED of the completed scans including the SED of the currently running scan.
Scheduled SED	The SED of the scans that are scheduled for the examination.
Total SED	The total amount of the delivered and scheduled SED.

**1. SED display in Patient Status Area. SED not yet applicable since no scans are selected. 2. Light grey: total scheduled SED for this examination, dark grey: delivered SED of 1.0 kJ/kg. 3. Delivered SED exceeds 3.5 kJ/kg, bar color changes to yellow. 4. SED bar with alarm symbol and black arrow at the right side to indicate that the delivered SED exceeds 7.0 kJ/kg.**

4CH-scan  
 DSMR  
 4D-THRIVE  
 4D-TRAK  
 4D-TRAK XD  
 4D-TRANCE  
 Abdomen examination  
 Positioning  
 About ...  
 Accessories  
 Angiography Package  
 Pediatric Package  
 Acoustic Hood  
 ACQ voxel MPS  
 Acquisition mode

Once the total SED exceeds 7.0 kJ/kg, a pop-up appears:

**High total SED**

Total (delivered + scheduled) SED exceeds the recommended maximum of 7.0 kJ/kg.

[See instructions for use](#)

Lower the scan time or the SAR of the remaining scans to reduce SED.

**High total SED (High total SED)**  
 Total (delivered + scheduled) SED exceeds the recommended maximum of 7.0 kJ/kg.  
 See Instructions for Use  
 Lower the scan time or the SAR of the remaining scans to reduce the SED.  
**Continue without modification (Continue without modification)**  
**Modify examination (Modify examination)**

- Click **Continue without modification (Continue without modification)** to start the examination as scheduled.
- Click **Modify examination (Modify examination)** to lower the scan time or the SAR of the scheduled scans before continuing the examination so that total SED is lower for the patient.

Once delivered SED exceeds 7.0 kJ/kg:

- A pop-up informs you that recommended SED maximum value will be exceeded with the next scan.

Help text provides guidance on (a.o.) SED, and how the user is informed on its accumulation

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Normal Mode suggested

T/R Knee Coil

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*Usability Engineering for validated safety and workflow solutions*

**New Examination**

Patient

Patient name:

Registration ID:

Date of birth:  dd-MMM-yyyy

Age:

Gender:

Patient weight:  kg

Examination

Exam name:

Accession number:

Examination date:

Referring Physician:

Performing Physician:

Study Comments:

Allowed SAR mode:

Patient conditions

Pregnant:

Implant: \*

Medical alerts:

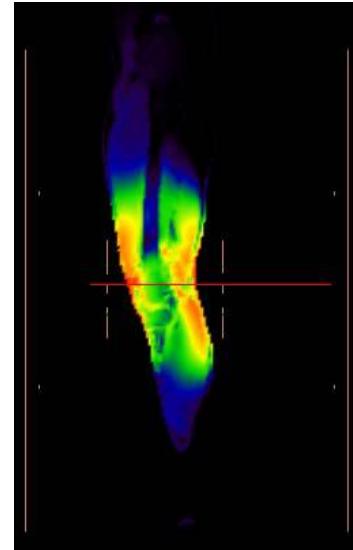
Allergies:

**Examination conditions**

Maximum RF energy: 2.0 W/kg

Patient Name	Date Of Bi...	Registration ID	Gender	Exam Name

Normal Mode is advised for Pregnant women – field can be pre-filled through HIS/RIS interface. Medical decision can allow First Level.



SAR parameters for the T/R Knee coil are for the knee, **not for babies**



# ScanWise Implant

A key to confidence with MR Conditional implants

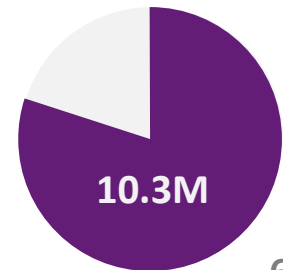


# Facts

Population with implant is mainly older adults<sup>1</sup>

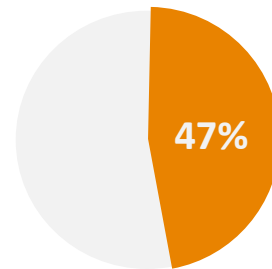


All ages

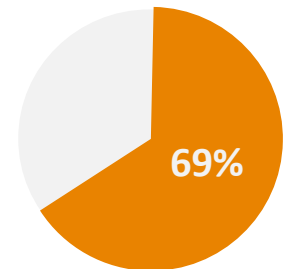


65+

Population with implants



Age 30



Age 70

Likelihood of needing an MRI within the next 10 years<sup>2</sup>

<sup>1</sup> Data on file. Based on Millennium Research Group – RPUS21LJ15, RPUS20SP15, RPGL12CR14.

<sup>2</sup> Based on Barmer GEK Arztreport 2011.





# MR Conditional scanning

## Today's challenges



### MR Conditional<sup>1</sup>

- Magnetic components
- Electrically conductive
- Radio frequency reactive

### Conditional values given by the implant manufacturer

- Field strength?
  - Static field Gradient?
  - SAR?
  - dB/dt?
- 
- Can you enter the condition values as **specified** by the manufacturer?
  - How many **screens and tabs** do you have to go through?
  - Can you be sure your MR system **adheres to the conditional values for all scans and pre-scans**?

<sup>1</sup> ASMT F2503; IEC 62570.




# ScanWise Implant guides you

Simplify your scanning process for patients with MR Conditional implants

Enter the maximum SAR value, or B1+rms as specified by the implant manufacturer

**Implant Conditions**

 MR Conditional

How is the maximum RF energy specified for the implant?

Select RF energy control type

SAR - Whole body (W/kg)

SAR - Head (W/kg)

B1+rms ( $\mu$ T)

Do not confuse the different RF energy control types [Know More](#)

Enter the maximum SAR for the implant  W/kg

[What I should know about SAR, B1+rms and patient heating?](#)

Field strength  
Allowed at 1.5T

Spatial gradient  
390 Gauss/cm

RF energy  
SAR: 1.1 W/kg

Additional  
No value entered

Confirm

Cancel Previous Next

# ScanWise Implant guides you

Easy set-up of scanning parameters

Enter the condition values of the implant manufacturer, for all scans just once

Your MR system automatically applies these values for the entire examination

The screenshot displays the Philips ScanWise software interface. On the left, a patient profile for 'Patient 6' is shown with registration ID 'Cardiac valve', date of birth '03-Mar-1970', and gender 'Male'. The examination is titled 'EXAMINATION\_...\_22-Oct-2015'. The 'Examination conditions' section is highlighted in yellow and lists: Maximum SAR: 1.1 W/kg, Whole body; Spatial gradient field: 390 Gauss/cm; Maximum dB/dt: Not specified. A warning icon indicates 'The implant must NOT touch the red areas'. Below this, a list of scan items is visible, including 'Cardiac\_Arrhythmia' and various 'SSH\_cine' sequences. The main window shows a scan parameter table for 'SSH\_cine\_SA\_M2D' with values for FOV, Voxel, Matrix, NSA, Fat saturation, and EPR. A callout box points to the SAR parameter, which is set to '< 1.1 W/kg'. Another callout box points to a red area on the scan image, stating 'The implant must NOT touch the red areas'. The bottom of the interface shows 'Start Scan' and 'Stop Scan' buttons, along with a status bar indicating '11:19 This turbo or api factor leads to an increased voxel size'.

**Examination conditions**

Maximum SAR	1.1 W/kg, Whole body
Spatial gradient field	390 Gauss/cm
Maximum dB/dt	Not specified

⚠ The implant must NOT touch the red areas

SAR < 1.1 W/kg

SSH_cine_SA_M2D	Voxel	Tra	Rel. SAR	TE	TR	...
00:19	16.00 19	2.92 x 4.75 x 10.0	1.00	1.71	3.4	...

Summary	Physiology	...			
FOV	RL (freq.)	AP (phase)	FH	...	
350	x 350	mm x	120	mm	
Voxel	2.6	x 3	mm x	10	mm
Matrix	124	x 74	x 12	slices	
NSA	1	...	...	...	
Fat saturation	<input checked="" type="checkbox"/>	EPR	...	...	

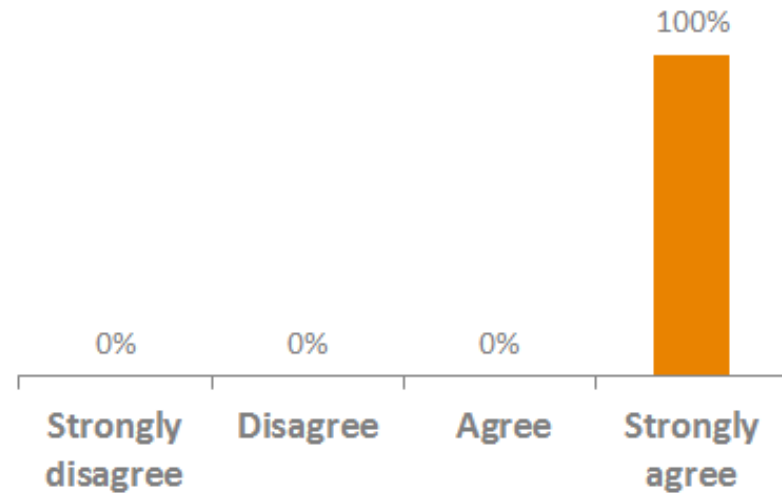
11:19 This turbo or api factor leads to an increased voxel size

# ScanWise Implant guides you

To scan with confidence

- No side calculations, no guess work
- Confidence for well trained radiographers of all experience levels

**"I feel more confident<sup>1</sup>"**



Summative test & customer evaluation, N= 19. Data on file.

**PHILIPS**

