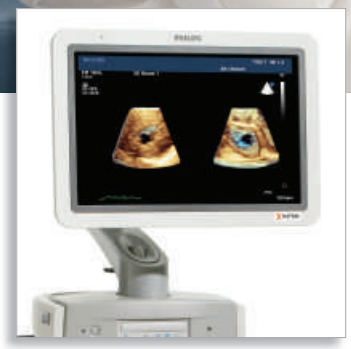



# Reveal more

**Philips iE33 echocardiography system with xMATRIX** specifications

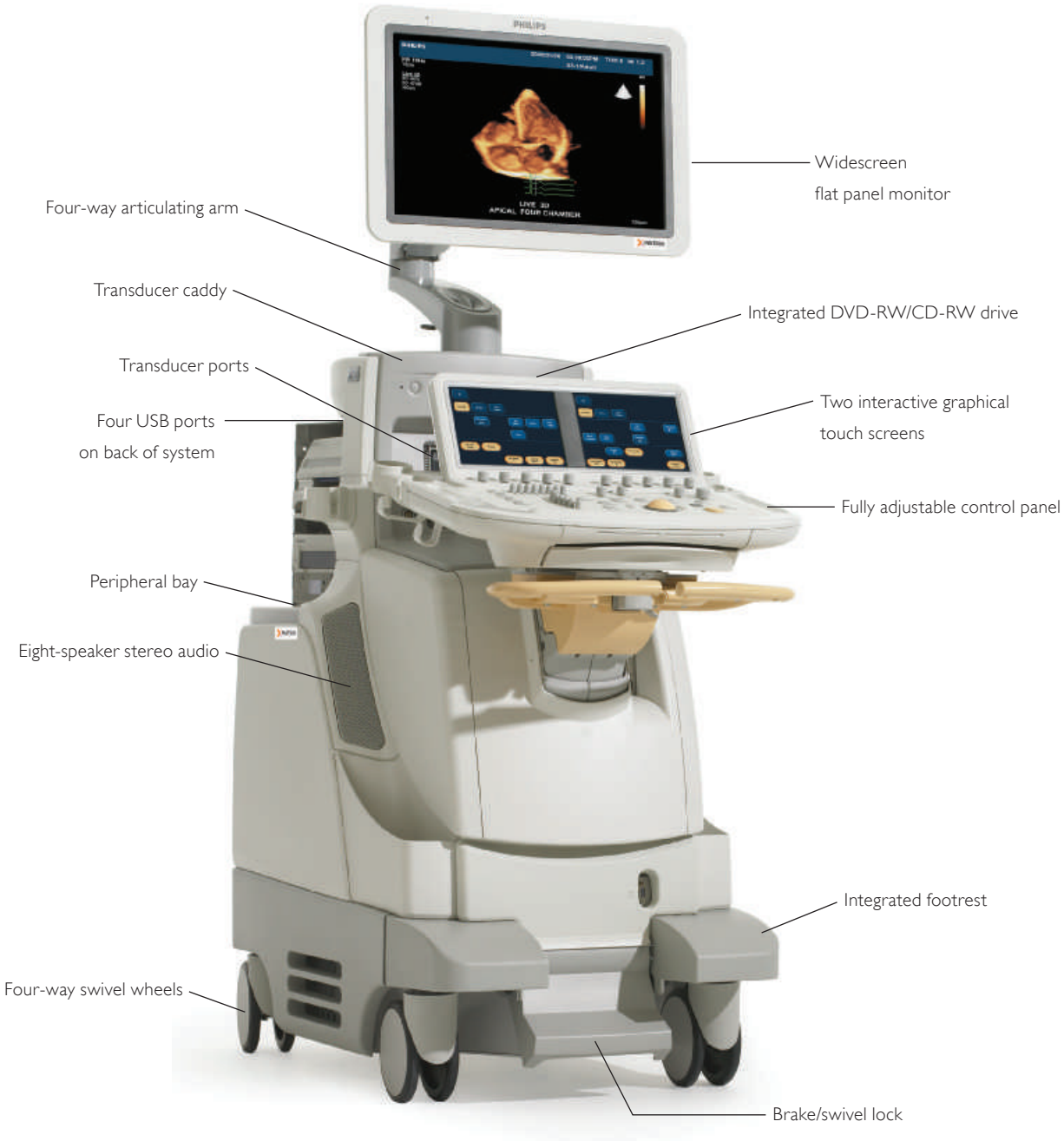
PHILIPS

sense and simplicity

# Table of contents

# 1. Introduction

The iE33 intelligent echo system addresses the need for complementary 2D and Live 3D imaging, quantification, and connected workflow solutions, helping the user answer major questions related to cardiac disease management.



### 1.1 Applications

| |
|---|
| Adult echocardiography |
| Pediatric echocardiography |
| Fetal echocardiography |
| Stress echocardiography |
| Vascular (peripheral, cerebrovascular, temporal and orbital TCD, and abdominal vascular) |
| Transesophageal echocardiography (adult and pediatric) |
| Contrast echocardiography (LVO, low MI and high MI detection) |
| Perioperative |
| Epicardial echocardiography |

### 1.2 Key performance features

| |
|---|
| Highly versatile system that can add clinical value and efficiencies throughout the non-invasive, surgery and peri-interventional cardiology departments |
| X5-1 efficiency solution for 2D and 3D transthoracic adult echo without compromising image quality; allows seamless movement between 2D and 3D to validate findings and to accommodate a range of skill sets and needs |
| Assessment of left ventrical global function and regional wall motion, deformation and timing, using both 2D and 3D |
| Live 3D TEE solution for accurate and fast assessment of atrial septal defects (ASD) and left atrial appendages (LAA); evaluation of a stenotic valve without going to the cardiac cath lab |
| "Surgeon's eye view" of valve anatomy to promote better procedure planning provided by Live 3D TEE |
| Identification of responders for biventricular pacing using complementary 2D and 3D techniques |
| Range of pediatric imaging from fetal echo to tiny neonatal (>2.5 kg) and beyond |
| Philips Remote Services that offers new productivity solutions and pro-active monitoring for greater system uptime |

The iE33 system's clinical performance and versatility make it suitable in a variety of applications and settings

# 2. System overview

The iE33 system with xMATRIX technology addresses the clinical needs of diagnosing, treating and assessing patients with heart disease by helping clinicians confidently and efficiently answer critical questions in non-invasive, interventional and surgical settings. It is a versatile system that empowers clinicians to use echo the way they think is best for the given situation: 2D, 3D, or a combination. While 3D echo has been clinically validated and used in valve and wall motion studies for many years, the iE33 system removes barriers to expanded use, contributing to confidence and efficiency in managing a broad range of cardiovascular diseases and clinical situations. Now 3D echo is easy to incorporate into any 2D exam with the highly ergonomic X5-1 transducer and simplified workflow.

## 2.1 System architecture

- Powerful Philips xSTREAM imageformer architecture capable of processing multiple data streams simultaneously for structural, functional, and Live 3D imaging
  - Built for 2D, Live xPlane, Live 3D, Live 3D zoom, Live full volume, heart failure full volume, high volume rate (HVR) imaging, Live 3D color, MPR (multiplanar reconstruction), electronic rotational echocardiography (iRotate) and panoramic imaging capability; true real-time volume image-forming capability with multiple rendering engines
- Next generation Live 3D, PureWave xMATRIX transducers, with microbeamforming and single ASIC beamforming architecture
  - 2D and Live 3D high volume rate (HVR) imaging with over 3,000 imaging elements, allowing outstanding 2D and 3D imaging from the single ergonomic transducer, eliminating the need to change between 2D and specialty 3D transducers
  - Real-time volume beamformer with up to 144,000 dynamically scalable digital channels
- Next generation digital broadband acoustic beamforming with custom ASICs
  - 3D volume scan conversion that processes 64 megavoxels per second and renders 300 mega-ray cast samples per second
  - Live full volumes with one-beat, two-beat, four-beat and six-beat options
- Eight core processing computer with 1 TByte hard drive and 4 GByte graphics display for fast frame rate large live volume 3D rendering
  - Advanced pulse shaping, pulse coding and multivariant harmonics technologies incorporated
  - Support for transducer frequencies up to 15 MHz
- Optimized for high definition LCD display
- Designed to support virtually any array configuration: sector, linear, curved, tightly curved, TEE, and xMATRIX electronic volume arrays
- Exclusive adaptive signal-to-noise ratio that achieves system dynamic range up to 180 dB for improved 2D performance and increased Doppler sensitivity
- Powerful distributed multiprocessor environment that achieves 250 billion operations per second for nearly instantaneous mode changes and support for advanced functionality and quantification
- Contrast echo with low MI, high MI, and LVO modes
  - Power modulation technology for low MI and high MI Imaging
  - Pulse inversion technology
- Live 3D color imaging
- iRotate imaging
  - Electronic rotation available with the X5-1 and X7-2t transducers
  - Standard 2D views from the same apical or parasternal window without moving scanning hand
  - Part of a stress echo protocol for fast acquisitions and more consistent views between resting phase and stress phase
- Philips next generation SonoCT real-time compound imaging
  - High precision beam-steered image compounding that acquires more tissue information and reduces angle-generated artifacts
  - Up to nine lines of sight, obtained by steering the ultrasound beam, available on linear, curved and tightly curved arrays, and mechanical volume arrays
  - WideSCAN capability to expand field of view during SonoCT imaging
  - SonoCT capability available during contrast imaging modes
- Philips next generation XRES adaptive image processing for noise and artifact reduction that improves tissue and border definition
  - Performs 350 million calculations per frame of image data up to 500 frames per second

  - Operates in 2D and 2D/CFI/Doppler/TDI mixed modes up to 500 frames per second
  - Offers XRES capability in contrast imaging modes
- Philips adaptive Broadband Flow imaging
  - Doppler bandwidth that automatically adjusts for optimal flow sensitivity and resolution
  - Advanced dynamic motion suppression algorithms that reduce flash artifacts
- Advanced stress echo applications
  - Stress protocols with up to 10 stages
  - Forty views per stage by five modes
- Multi-application SmartExam workflow protocols
  - Stress echo and vascular applications
  - Step-by-step on-screen guidance during exam
  - Full user customization
  - Record function for creation of custom protocols
  - Automatic mode switching
- Fully independent triplex multiple mode operation for extraordinary ease of use during Doppler procedures
- Fast system boot up: from OFF, approximately 110 seconds

### 2.2 Imaging formats

- 2D linear: WideSCAN with SonoCT imaging
- 2D curved: WideSCAN with SonoCT imaging
- 2D sector
- Dual 2D
- Panoramic
- Live 3D volume
- Live 3D zoom
- 3D full volume
- 2D, MPR and volume

### 2.3 Imaging modes

- 2D grayscale imaging with advanced pulse coding, pulse shaping, and frequency compounding technologies
- New xMATRIX-based 2D elevation compounding
- X5-1 2D imaging with 90 x 90 sector 18 cm 90 Hz imaging mode
- M-mode
- M-mode color Doppler
- M-mode tissue Doppler
- Live 3D Echo (instantaneous volume rendering of cardiac anatomy)
- Live xPlane imaging (simultaneous display of two live imaging planes)
- Tissue Harmonic Imaging (THI) with pulse inversion technology
- Left ventricular opacification (LVO) with pulse inversion and power modulation technologies
- Low MI and high MI contrast detection technology using power modulation
- SonoCT beam-steered real-time compound imaging
- Harmonic SonoCT imaging
- XRES adaptive image processing technology
- iSCAN intelligent scanning for one-button TGC, gain and compression map optimization
- iSCAN with adaptive gain compensation (AGC) for real-time line-by-line TGC optimization
- Simultaneous 2D M-mode
- Color Doppler
- Color Power Angio imaging (CPA)
- High-PRF pulsed wave (PW) Doppler
- Duplex and simultaneous 2D/PW Doppler
- Duplex continuous wave (CW) Doppler
- Duplex color flow and CW Doppler
- Duplex 2D, color flow, PW Doppler
- Duplex 2D, CPA, PW Doppler
- Auto Doppler optimization: Auto PW Doppler, color Doppler
- Tissue Doppler Imaging (TDI)
- Adaptive Doppler
- Adaptive Broadband Color Flow
- Color Compare mode
- Independent triplex mode for simultaneous 2D, color flow, PW Doppler
- Independent triplex mode for simultaneous 2D, CPA, PW Doppler
- Dual imaging with:
  - Choice of independent cineloop buffers or split screen imaging
  - Mixed mode display with one image live while other is frozen, for example, 2D/2D, 2D/color, color/color, color/CPA
- High definition zoom (write zoom)
- Reconstructed zoom with pan (read zoom)
- Panoramic imaging
- SonoCT panoramic imaging with XRES and harmonic modes
- Chroma imaging in 2D, 3D, QLAB MPR and iSlice, panoramic M-mode and Doppler modes

## 2D imaging

- Available with all imaging transducers
- Adjustable sector width and position during live imaging
- Ability to invert image left and right, top and bottom and 90 degrees, depending on transducer and exam
- Receive gain
- LGC (lateral gain compensation)
- Selection between one and eight focal zones
- Dynamic range
- Echo compression
- Soft echo enhance
- Gray map
- Chroma map and colorize
- Acquisition zoom (HD zoom): ability to position the zoom ROI anywhere within the image, and change the height and width of the zoom ROI
- Display zoom and magnify on live or frozen images up to 16 times
- Three levels of frame rate
- Support of frame rates of up to 500 Hz
- Tissue optimization
- Contrast resolution enhancement
- Tissue Harmonic Imaging
- SonoCT imaging
- Live Compare imaging; side-by-side comparison of 2D images where the current live image is compared to a stored image from the same study
- WideSCAN imaging
- Next generation XRES technology
- Persistence (frame averaging)
- Grayscale standard display
- Automatic optimization

## iRotate Echo

- Ability to image in 2D and rotate the image without moving the transducer
- Home rotational key
- High frame rate rotational imaging
- iRotate with stress echo acquire
- IRotate for contrast echo
- iRotate with color flow and CMQ speckle technology

## Live xPlane imaging

- Simultaneous display of two live imaging planes
- Available on X5-1, X3-1, X7-2, and X7-2t transducers
- Color and grayscale modes
- Lateral, rotational, and elevation steering

## Live 3D Echo

- Available on X5-1, X7-2t, X7-2 and X3-1 transducers
- Live full volume imaging
- High volume rate imaging (HVR)
- Live one-beat, two-beat, four-beat and six-beat 3D volume imaging
- Long live volume loop acquire
- Beat-by-beat retrospective 3D loop selection
- Live 3D color flow imaging
- High volume rate (HVR) color
- X5-1 xMATRIX with LVO, hi MI and low MI, xMATRIX pulse inversion and power modulation
- Live 3D zoom and Live 3D zoom preview
- One-beat focused volume
- Half clam shell
- Left and right clam shell switching
- Two volume viewing display
- Crop adjust with cropping
- 3D color flow
- 3D Zoom Color
- 3D Zoom Color Preview
- ECG display
- Enhanced Live 3D dynamic colorization for enhanced 3D effect
- Live 3D contrast for LVO and low MI imaging
- Maximum 103 degree by 98 degree Live volume imaging (mode dependent)

## M-mode

- Available with all imaging transducers except X3-1
- Selectable sweeping rates
- Time markers: 0.1 and 0.2 seconds
- Acquisition zoom capability
- Selectable display prospective or retrospective (1/3-2/3, 1/2-1/2, 2/3-1/3, side by side, full screen)
- Chroma colorization with multiple color maps
- Cineloop review for retrospective analysis of M-mode data
- 256 (8 bits) discrete gray levels

## Pulsed wave (PW) Doppler

- Available on all imaging transducers except X3-1
- Adjustable sample volume size: 0.5 to 20 mm (transducer dependent)
- Simultaneous or duplex mode of operation
- Simultaneous 2D, color Doppler, pulsed Doppler
- High-PRF capability in all modes including duplex, simultaneous duplex and triplex
- iSCAN optimization that automatically adjusts scale and baseline

## Steerable continuous wave (CW) Doppler

- Available on all imaging transducers except X3-1
- Steerable through 90 degree sector
- Maximum velocity range: 19 m/sec (transducer dependent)

## Spectral Doppler

- Display annotations include Doppler mode, scale (cm/sec), Nyquist limit, wall filter setting, gain, acoustic output status, sample volume size, normal/inverted, angle correction, grayscale curve
- Ultra-high resolution 1 millisecond spectral FFT rate
- Angle correction with automatic velocity scale adjustment
- Adjustable velocity that display ranges with nine position shifts
- Normal and invert display around horizontal zero line
- Selectable sweep speeds
- Selectable low-frequency signal filtering with adjustable wall filter settings
- Selectable grayscale curve for optimal display
- Selectable Chroma colorization maps
- Selectable display format prospective or retrospective: 1/3-2/3, 1/2-1/2, 2/3-1/3, side by side, full screen
- Doppler review for retrospective analysis of Doppler data
- Digitally enhanced eight-speaker stereo output
- 256 (8 bits) discrete gray levels
- Post-processing in PW frozen mode that includes map, baseline, invert and Chroma

## Adaptive broadband flow imaging

- Automatically adapts transmit and receive bandwidth processing based on the color box position providing optimal sensitivity and color resolution
- Available on all cardiac imaging transducers
- Cineloop review with full playback control
- Advanced motion suppression with intelligent algorithms; adapts to various application types to selectively eliminate virtually all color motion artifact
- 256 color bins
- Parallelogram steering (three angles) on linear array transducers
- Trackball-controlled color region of interest: size and position
- Maps, filters, color sensitivity, line density, smoothing, echo write priority, color persistence, gain, and baseline optimized automatically by exam type or is user selectable
- Velocity and variance displays
- Color invert in live and frozen imaging
- Color optimization control for spatial resolution and penetration optimization
- Color and 2D line density control

## Color Doppler

- Available on all imaging transducers
- Color gain
- Region of interest (ROI)
- Adaptive flow
- Seventeen selectable baseline positions
- Baseline invert
- B/W suppress
- Color blending
- Colorize
- Color compare dual display (B/W on left, color on right)
- Color map
- Color persistence
- Flow optimization
- Output power
- Lateral gain compensation (LGC)
- Magnify (range from 0.8X to 8X)
- Scale sector width and position on curved and phased array transducers
- Simultaneous mode during PW mode
- Smoothing
- Ability to continuously steer between ±20 degree steer angle on cardiac sector array transducers
- Ability to steer between ±3 degree steer angle on linear array transducers
- Variance
- Wall filter
- Write priority
- Zoom

## Tissue Doppler Imaging (TDI, TDI PW)

- Available on all cardiac imaging transducers (except X3-1, X7-2, S8-3t and S7-3t)
- High frame rate acquisition of tissue motion (up to 400 fps)
- Color gain, TGC and LGC compatible
- Eight maps
- Velocity (cm/s)

## Contrast imaging

- System optimized for left ventricular opacification (LVO low MI and high MI technology)
- One-touch solution (one-button access in LVO preset) with settings for bolus and infusion
- 2D, Live xPlane, Live 3D Echo, and full volume 3D
- X5-1 and S5-1 broad bandwidth pulse inversion and power modulation technologies for high sensitivity and high resolution visualization of contrast agent at low MI and high MI power levels
- LVO, low MI contrast and high MI contrast on and off, and contrast optimization choices and transmit power settings that can be saved with Gain Save feature for stress echo studies, eliminating setup time for image acquisition at peak stress
- Low MI with flash
- Low MI with triggered replenishment imaging (TRI) that provides excellent 2D image quality on the S5-1 transducer
- X5-1 with iRotational contrast imaging and iRotational stress contrast imaging
- X5-1 with Live xPlane for contrast imaging
- X5-1 with xMATRIX elevation compounding for contrast imaging
- X5-1 with triggered replenishment imaging
- X5-1 with 3D contrast echo
- Supported on the S5-1, X3-1 (does not include pulse inversion), S7-2omni, and X7-2t transducers

## Tissue Harmonic Imaging (THI)

- Provides second harmonic processing to reduce artifacts and improve image clarity
- Incorporates patented pulse inversion phase cancellation technology for optimal detail resolution during harmonic imaging
- Available on all imaging transducers
- Extends high performance imaging capabilities to all patient body types
- Supports SonoCT (harmonic SonoCT) and XRES modes

## Color Power Angio imaging (CPA)

- Highly sensitive mode for small vessel visualization
- Available on linear array imaging transducers
- Cineloop review
- Multiple color maps
- Individual controls for gain, filters, sensitivity, echo write priority, and color invert
- Dynamic motion differentiation
- Adjustable CPA region of interest: size and position
- User-selectable persistence
- User-selectable blending

## Live 3D and MPR/iSlice imaging

- Supported on X5-1, X3-1, X7-2, and X7-2t xMATRIX transducers
- Volume display with surface rendering (transparency, brightness, and lighting controls)
- Multiplanar reconstruction (MPR) and iSlice view display with QLAB software, including nine simultaneous views from 3D
- Specialized algorithms and maps that increase 3D display
- Cropping tools on volume views with both anatomic and red, green, blue crop planes
- Dual 2D reference planes optionally available with Live 3D imaging
- Supported XRES modes to reduce noise artifacts

## Panoramic imaging

- Real-time extended field-of-view composite imaging, in fundamental and SonoCT modes
- Ability to acquire composite images in XRES mode
- Ability to back up and realign the image during acquisition
- Full zoom, pan, cineloop review and image rotation capabilities
- Auto fit of composite image
- Distance measurement, curved-linear distance and area in review mode with distance marker displayed via skin-line ruler
- Display or removal of skin-line ruler
- Measurements on individual frames during cineloop review
- Scaling information included for still frames allowing for measurements on a workstation
- Available on linear and curved array transducers

# 3. System controls

Philips common user experience provides readily accessible and logically grouped primary controls along with an easy-to-learn graphical user interface.

### 3.1 Optimization controls

#### 2D grayscale imaging

- Smart TGC: pre-defined TGC curves optimized for consistently excellent imaging with minimal adjustment
- LGC (lateral gain compensation) and Smart LGC
- Adjustable temporal and spatial resolution with DRS control
- Depth: adjustment from 2.0 to 30 cm depending on transducer and exam
- Selection between one and eight transmit focal zones
- Soft echo enhance: special 2D optimization setting for soft tissues
- XRES and advanced XRES: ability to reduce speckle noise and enhance border definition
- SonoCT: ability to remove virtually all clutter and artifact (available on linear and curved array transducers for B-mode)
- Sixteen-level digital reconstructed zoom with pan capability
- High definition zoom that concentrates all image processing power into a user-defined area of interest: possible to combine high definition (HD) zoom with pan zoom
- Selectable 2D compression settings
- Sector size and steering control for sector and curved array image formats
- Selectable 2D line density with DRS control
- Dual imaging with independent cineloop buffers
- Chroma imaging with multiple color maps
- 256 (8 bits) discrete gray levels
- 2D acquisition frame rate up to 500 frames per second (dependent on field-of-view, depth, and angle)

#### Live 3D Echo

- 3D LVO setting (available on X5-1, X3-1 transducers)
- Rotation in either absolute or relative trackball motion
- Live 3D zoom mode with zoom preview
- Grayscale imaging controls
- 3D vision control
- 3D OPT control
- 3D home
- 3D swivel
- Up and down invert
- XRES technology
- Magnify
- Show or hide echo or color
- Reset controls
- Rotate
- Auto crop
- Manual crop
- Brightness
- Smoothing
- Reference images
- Colorize
- Post processing
- Right invert
- Density
- Resolution vs. speed
- Capture
- Compress
- Gain
- ECG
- ECG trigger
- Cineloop/Live 3D
- Review/full volume
- Calibrated 3D grid
- 3D volume: front, center, back
- 3D view control: up, down, left, right, front, back
- Elevation width control
- Lateral width control
- Lateral position control
- Elevation position control
- 3D color optimization
- 3D size and position
- Independent trackball control of lateral and elevation sizing and positioning in live full volume and Live 3D color modes
- iSlice – automated cropping of 3D volume into four MPR views using standard or user-defined slicing protocols
- iCrop: two orthogonal MPR views with volume mode
  - Enables cropping during the exam or from review
  - Separates elevation and lateral rotation of cropping tools
  - Provides variable view directions and view direction color indicator
  - Allows prospective or retrospective long volume loop acquire
- Beat-by-beat 3D loop selection

## XRES adaptive image processing

- Available on all imaging transducers
- Eliminates virtually all speckle noise and enhances border definition
- Available in all imaging modes including color flow and Doppler
- Available in contrast modes
- Operates in conjunction with SonoCT imaging
- Offers high speed processing that allows up to 500 frames-per-second displays

## Advanced XRES adaptive image processing

- Available on S5-1, S8-3, S12-4, X5-1, X3-1, X7-2, C5-1, X7-2t, L9-3*, and S8-3t transducers with all 2D TSI applications
- High resolution algorithms for advanced speckle noise reduction, refined tissue pattern displays, and fine border definition
- High speed processing that allows 150 frames-per-second displays
- Available in all imaging modes including color flow and Doppler
- Available in contrast modes
- Operates in conjunction with SonoCT imaging

## SonoCT real-time compound imaging

- Available on linear and curved array transducers
- Automatic selection of the number of steering angles based on the user-selected resolution and frame rate (Res/Speed) condition
- Up to nine lines of sight – automatically adjusted via DRS control
- Operates in conjunction with Tissue Harmonic Imaging, panoramic imaging, and duplex Doppler
- Operates in conjunction with XRES imaging
- Available in contrast modes
- Available with WideSCAN format during 2D imaging for extended field-of-view operation with linear and curved array transducers

## Auto Doppler

- Auto color Region of Interest placement
- Auto color Region of Interest and Pulsed Wave sample volume steering
- Auto pulsed Doppler sample volume placement
- Auto pulsed Doppler angle correction
- Available on L9-3, L11-3, and L15-7io transducers

## iSCAN intelligent optimization

- One-touch image optimization
  - In 2D mode, one-button automatic adjustment of:
    - TGC and receiver gain to achieve optimal uniformity and brightness of tissues
    - Compression curve based on the range of detectable tissue signals
  - In vascular Doppler mode, one-button automatic adjustment of:
    - Doppler PRF based on detected velocity
    - Doppler baseline based on detected flow direction
- Available on the S5-1, S8-3, S7-2omni, X5-1, X3-1, X7-2, and X7-2t transducers (2D)
- Available on the L11-3, L9-3, and L8-4 linear array transducers (PW Doppler)
- Operates in conjunction with SonoCT and XRES imaging
- Auto Doppler optimization, including auto flow tracking, adjusts color scan angle, pulsed Doppler scan angle, Doppler angle correction
  - Operates with L11-3, L9-3 and L15-7io transducers
- Adaptive gain compensation (AGC) that dynamically adjusts (every pixel on every scan line) low level 2D echoes to reduce gain artifacts (shadows and through transmission) and enhanced image uniformity with 2D

## iCOMMAND intelligent voice control

- Exclusive Philips voice recognition engine
  - Adapts to user speech patterns and enchances performance with use
  - Creates a database of users for increased accuracy and flexibility
  - Provides wireless microphone technology
- Controls most system functions with a simple voice command: mode changes and annotation
- Reduces keystrokes and repetitive motion
- Allows "hands-free" system control during difficult scanning environments
- Copies voice profiles to DVD and transfers to other systems of like configuration

*Venous, arterial and carotid

### iFOCUS intelligent focusing technology

- Provides automatic computation of beam characteristics for selected region of interest
- Provides detailed resolution and tissue uniformity for selected area
- Decreases need for traditional focus controls
- Simplifies exam optimization
- Available on all imaging transducers

### iOPTIMIZE intelligent optimization

- Multiple technologies for one-button approach to automatically and instantly adjust system performance for different patient sizes, flow states, and clinical requirements
  - Tissue specific imaging: adjusts over 4,000 parameters during transducer or application selection
  - Patient optimization: adjusts 2D performance to instantly adapt to different patient sizes
  - Flow optimization: adjusts flow performance to instantly adapt to different flow states
  - Dynamic resolution system (DRS): adjusts nearly 40 parameters simultaneously with one control for user preference of spatial resolution or temporal resolution during clinical procedures
- One control optimizes functions such as:
  - Line density
  - Persistence
  - Pulse inversion harmonics
  - Power modulation
  - Synthetic aperture
  - Number of lines of sight (SonoCT)
  - RF interpolation
  - Parallel beamforming
  - Frame rate

## 3.2 Control panel and user interface

- Easy-to-learn graphical user interface
- Ergo-centric design of primary controls readily accessible and logically grouped
- Tri-state control panel lighting (active, available, and unavailable)
- Ambient lighting control for optimal image viewing in both light and dark environments
- Two full-color touch screens for mode selection and secondary controls
- Temporary patient ID allows for a quick start to patient exam
- Ability to change patient name post exam start
- Dual-function mode switch and independent gain controls for 2D, Color, CPA, PW, CW, and M-mode
- Eight-slide pot control adjustment of TGC curve
- Eight-slide pot control adjustment of LGC curve
- iSCAN control for 2D and Doppler automatic optimization
- iFOCUS intelligent focusing control
- High definition pan and zoom control
- Freeze control
- Programmable print control
- Transducer selection and tissue specific imaging control
- Report and review controls
- Protocol selection control

The ergo-centric iE33 control panel places primary keys for easy accessibility. It features tri-state lighting to help you while scanning in dark environments.

# 4. Workflow

The iE33 combines premium imaging technologies with revolutionary ergonomics and ease of use to help keep busy departments on schedule.

### 4.1 Ergonomics

- Philips common user experience control panel with central trackball and easily accessed mode keys
- Tri-state lighting that provides immediate feedback of active, available, and unavailable controls
- Independent adjustment of height, rotation and lateral movement of monitor and control panel allowing improved user posture, increasing comfort during exams (meets industry standards recommendation for the prevention of WRMSD)
- Highly mobile cart with single pedal operation facilitating portable exams and positioning in confined space environments

### 4.2 Stress echo

- Acquisition of single-frame or full-motion digital clips in any mode, including 2D, color flow, power Doppler, etc. (type of image to be acquired may be changed on-the-fly by the operator)
- Gain Save that adjusts automatically to different views and automatically saves your preferred control settings, such as MI (Mechanical Index), gain and depth:
  - For each view while acquiring resting images
  - At immediate post-exercise, automatic retrieval of saved settings for each view
  - Different gain profiles for parasternal LAX and SAX views, AP4 and AP2 views allowed
- Length of acquired images that is user-adjustable between 1 and 180 seconds
- Ability to acquire routine cardiac images in timed and R-R interval clip (varies with selected compression ratio and available system memory)
- Live 3D stress echo imaging
  - Live volume, one-beat, two-beat, four-beat, six-beat and HVR 3D stress echo acquire
  - Automated protocols for parasternal and apical iSlice imaging
  - 3D stress echo integrated into protocols with pre and post echo review
  - User-selectable slicing schemes
  - iCrop to select 3D volume and help with foreshortening iSlice preview state
  - iSlice in review to four 2D cut planes; up to 16 slices via QLAB
  - Ability to defer selection of 3D images
  - Ability to re-label any stage after capture from review
- Live iRotate 2D stress echo
  - Sequential stress echo single touch acquire without moving the transducer
  - Apical and parasternal rotational protocols
  - Apical preset: LAX: 0 degrees, SAX: 90 degrees, AP4: 0 degrees, AP2: 310 degrees, AP3: 245 degrees
  - Touch acquire to advance to subsequent images
  - Full frame rate up to 90 Hz for 90 x 90 2D sector width at 18 cm
  - xMATRIX based elevation compounding
  - Gain Save angles of minor 2D adjustment from rest to stress stages
- Live iRotate 2D and 3D stress echo
- For timed acquisition, the ability to start acquisition on the R-wave if the ECG is active and an R-wave is present
- Live Compare
- Ability to defer selection by stage
- Default stress protocols
  - Factory-provided non-editable default protocols include:
    - Two-stage exercise stress
    - Four-stage pharmacological stress
    - Three-stage exercise stress (bicycle)
    - Four-stage quantitative: wall motion and contrast
  - Default protocols that may be used as the basis for user-defined versions
- User-defined stress protocols that may be defined to do any or all of the following:
  - Support between 1 and 10 stages
  - Support user-defined stage names
  - Support between 1 and 40 views per stage
  - Support user-defined view names
  - Prompt for a particular stage and view
  - Assign stage and view names
  - Set clip length for each image or group of images
  - Set the number of cycles or beats for each image
  - Define prospective, retrospective, or multicycle and full-disclosure acquisition
  - Define the capture format of each image or group of images
  - Define the default replay mode for each protocol
  - Enable or disable “accept” prior to store

  - Set mode acquisition for each view
  - Support for up to five modes
  - Save user-defined protocols within a preset
  - Save user-defined protocols to removable media for import onto other systems at the same software level
  - Modify protocols during use
  - Add stages at any point after the current stage
  - Change the name of a stage at any point up to acquisition of the first image of the stage
  - Add views to any non-completed stages
  - Change the name of a view at any point up to the acquisition of that view: save the modified protocol (not automatically saved)
- CMQ stress
  - Pre and post data curves
  - Pre and post bull's-eye maps
  - Pre and post strain comparisons

### 4.3 Display annotation

- On-screen annotation of all pertinent imaging parameters for complete documentation, including transducer type and frequency, active clinical options and optimized presets, display depth, TGC curve, LGC curve, grayscale, color map, frame rate, compression map value, color gain, color image mode, and hospital and patient demographic data
- User-selectable display of patient birth date or user ID
- Fixed position title area for persistent annotation
- Patient name and ID that can be turned off (hidden) for generating still images for publications
- Scan plane orientation marker
- User-selectable depth scale display
- Real-time display of mechanical index (MI)
- Real-time display of thermal index (TIb, TIc, TIs)
- Multiple trackball-driven annotation arrows
- Pre-defined annotations and body markers (application specific), with two body markers supported in dual imaging format
- User-configurable annotations, based on application
- Doppler baseline invert in live and frozen modes
- TGC curve, LGC curve (user-selectable on/off display)
- TGC values, LGC values (on/off display)
- Tool Tips that provide brief descriptions of the abbreviated on-screen image parameters
- Informative trackball arbitration prompts
- Thumbnail display of images printed and stored
- Calculations results and analysis labels
- Graphical tabs that allow navigation to other analysis features
- Network and connectivity icons to allow instant feedback about network and printer conditions
- Cineloop frame number display
- Cineloop bar with trim markers
- Prompt region for informational message display
- Frequency icon on screen: 2D optimization frequency bandwidth icon
- Contrast specification

### 4.4 SmartExam protocols

- Exam guide with on-screen display
- Required views based on exam type
- SmartExam customization
  - Creation of a protocol as the user performs an exam
  - Saving of all annotations, body markers and labeled measurements defined in each view
  - Record of modes used to capture each view
  - Capture of the acquisition method (freeze, acquire) in each individual view
  - Ability to pause and resume recording process if needed
  - User-edit of views before finalizing the new protocol
- Fully customizable protocol capability for any clinical application supported on the system with flexibility to conduct the examination protocol in any sequence
- Preset protocols for transthoracic and transesophageal cardiac and vascular exams based on industry and accreditation guidelines
- Automatic launching of annotation and body marker icon on required views
- Ability to automatically launch modes (2D, M-mode, color, Doppler, TDI) defined in a protocol
- Ability to pause and resume protocol function at any time
- System analysis capabilities supported in all defined protocols
- Custom protocol transfer between iE33 systems of like configuration

### 4.5 Image presentation

- Up and down
- Left and right
- Multiple duplex image formats (1/3-2/3, 1/2-1/2, 2/3-1/3, side by side and full screen)
- Depth from 1 cm to 30.5 cm (transducer dependent)

### 4.6 Cineloop review

- Acquisition, storage in local memory, and display in real-time and duplex modes of up to 2,200 frames (up to 180 seconds of information dependent upon imaging parameters) of 2D, color, Doppler, M-mode, Live 3D, and 3D zoom for retrospective review and image selection
- Prospective or retrospective loop acquire "accept" prior to store or clip store
- Trackball control of image selection
- Variable playback speed
- 3D iCROP from cineloop review
- 3D iSlice from cineloop review
- Trim capability of 2D data
- Capture of over 20 seconds of Live 3D imaging per loop
- Available in all imaging modes plus:
  - Panoramic imaging
  - 3D imaging
  - Independent control of 2D image or spectral data in duplex mode
  - Simultaneous control of 2D and spectral data in simultaneous mode
- On-screen display of current 2D frame number QuickSAVE feature
- The ability to save preferred system settings as individual exam types
  - Up to 45 QuickSAVE exams can be created per transducer
  - Saved parameters include virtually all imaging parameters as well as color box size
  - QuickSAVE exams can be copied to DVD and transferred to systems of like configuration

### 4.7 QuickSAVE feature

- The ability to save preferred system settings as individual exam types
  - Up to 45 QuickSAVE exams can be created per transducer
  - Saved parameters include virtually all imaging parameters as well as color box size
  - QuickSAVE exams can be copied to DVD and transferred to systems of like configuration

### 4.8 Exam management features

- Internal storage
- Data export
- Temporary ID feature
  - One-click start of exam from patient data entry screen with system provided information
  - Ability to store images that were created without a patient name with a temporary identification

### 4.9 Connectivity

- Standard connectivity features
  - Local print to on-board or off-board video printers
  - Page report print
  - DICOM print
  - Image and waveform export to removable media (DVD/CD/USB)
  - Export of report data to off-line analysis computer programs
  - Gigabit ethernet output
  - Append to study
  - Pixel spacing
- De-identification feature
  - Sends studies to PACS without identifying information
  - Creates demonstration studies or an image for a presentation without identifying information
  - Provides configurable option to export only the image de-identified, or export the image totally scrubbed of identifying information, including the DICOM data
- NetLink connectivity
  - Image and waveform export to network storage servers
  - DICOM Worklist with RIS support and automatic patient demographic entry

  - Performed Procedure Step (PPS)
  - Storage Commit (SC)
  - Structured Reporting (SR) includes cardiac and vascular
  - Query/Retrieve (ultrasound only)
  - Append to Study
- DICOM compression
  - Up to 2,200 frames per acquisition
  - Image and waveform export to network storage servers
  - DICOM Worklist with CIS support and automatic patient demographic entry
- Image network display choices (five): Legacy, CRT, LCD, GDSF, CRT2
- Native data and native data compression attached to DICOM image, strain, strain rate, TDI, 2DQ (off-line LGC, TGC, gain, border suppress, Color Kinesis, border tracking, threshold control, ROI measures dB vs. time, and 2D quantification)
  - 3D volume data set attached to DICOM image
    - Ability to crop, resize, gain, compression, automated border tracking, color baseline, 3D vision control, colorize, color suppress, B/W suppress, XRES and 3D quantification
  - Scrolling Doppler acquisitions
  - Storage Commit (SC)
  - Structured Reporting (SR) for cardiac and vascular
  - Query/Retrieve (ultrasound only)
  - Multiple archive server support
  - DICOM Append
- 3D clips in DICOM format
- QLAB clips of 2D, TDI and 3D images
  - Send Images
    - After end of exam (batch send)
    - After each acquire
    - Send on demand
- Digital media exchange – CD/DVD (standard)
  - The system supports specific DVD and CD media, and allows the following capabilities:
    - Read-only CD formatted specifically for the system
    - Read and Write (single session) to CD (CD+R)
    - DVD Read-only (DVD+R)
    - DVD Read + Write (single session) (DVD+RW)
  - DICOM viewer saved onto media for off-line review
- USB Storage
  - Export image data and information via USB ports
  - Import image data and information via USB ports to compatible iE33 systems
- Data storage formats that include DICOM, JPG (full frame images) and AVI (motion clips); full frame images that can be compressed (JPG, loss less, lossy low, lossy medium, lossy high)
- Native data storage for TDI and volume exams
- User-selectable compression that is available for motion clip storage
- DICOM images stored on disk that can be recalled on the ultrasound system
- Availability of scaling data to allow measurements
- JPG images and AVI clips that can be recalled on off-line viewing stations
- On-board patient exam storage
  - Direct digital storage of B/W and color loops to internal hard disk drives
  - Combined 350 gigabyte storage capacity
  - Storage capacity of approximately 350 patient exams (assuming 40 images, 6 seconds of clips and reports per exam)
  - Fully-integrated user interface
  - User configurable auto-delete capability
  - On-screen recall, measurement and text editing
  - Exam directory
- DICOM compression options
  - Configurable image size/loop export 640 x 480 or 800 x 600 or 1,024 x 768
  - Configurable JPEG quality factor from 60 to 100


Clear images facilitate the iE33 system's highly sensitive spectral Doppler.

# 5. Transducers

### 5.1 Transducer selection

- Electronic switching of transducers using three universal connectors
- Dedicated (Pedoff) continuous wave Doppler connector
- Automatic parameter optimization of each transducer for exam type through tissue specific imaging (TSI) software
- User-customizable imaging presets for each transducer
- Automatic dynamic receive focal optimization
- Transmit focal characteristics automatically controlled through TSI, iFOCUS, and DRS functions

#### PureWave crystal technology

- Available on the X5-1, S5-1, C5-1, X7-2, and X7-2t transducers
- Breakthrough crystal technology that allows greater acoustic efficiency and bandwidth

#### xMATRIX array technology

- Available on the X5-1, X3-1, X7-2, and X7-2t transducers
- Unique array configuration of fully-sampled elements that allow 2D, Live volume, and Live xPlane imaging

**One touch.**
Switch from 2D to 3D imaging with one touch and display live volume images in a single heartbeat with all xMATRIX transducers.

### xMATRIX arrays

#### X5-1 xMATRIX array with PureWave technology

- Ergonomic xMATRIX handle with lightweight cable
- Shorter length for easy apical fit
- 2D and Live 3D Echo solution with all modes
- 3,040 elements with microbeamforming
- 5 to 1 MHz extended operating frequency range
- 2D, Live 3D volume, high volume rate (HVR), one-beat, two-beat, four-beat, six-beat, Live volume, color flow, Live 3D color, PW, CW, M-mode, color M-mode, contrast hi MI, contrast low MI, pulse inversion, flash imaging, high 2D frame rate mode, TDI, TDI PW, CMQ quantification, Live xPlane imaging
- 3D color zoom, 3D color zoom preview, high volume rate (HVR) color, and two-volume view display
- iRotate – Rotatable scan angle from 0 to 360 degrees
- Extended cable length
- Single ASIC architecture
- Adult, contrast LVO, pediatric CHD, contrast low MI, contrast hi MI, cardiology coronary, adult general
- Physical dimensions
  - Dimensions: 9.2 x 3.9 x 2.9 cm (3.6 x1.5 x 1.1 in) LWD with a shallow waist and push ridges for optimal scanning comfort. The shortened 3D length helps to fit into the bed for apical views.
  - Lens: 1.7 x 2.3 cm (0.67 x 0.9 in)
- GREEN label approved transducer (environmental improvement measure)

#### X7-2t xMATRIX array TEE with PureWave technology

- Live 3D Echo transesophageal xMATRIX array transducer with 2,500 elements
- 7 to 2 MHz extended operating frequency range
- Physical dimensions:
  - Tip: 1.7 x 3.8 cm (0.7 x 1.5 in) WxL
  - Shaft: 1 cm (0.4 in ) diameter, 1 m (39.4 in) L
- Mechanically rotatable array from 0 to 180 degrees
- Electrocautery suppression
- 2D, advanced XRES, harmonic imaging, M-mode, color M-mode, color flow, PW Doppler, CW Doppler, Live xPlane imaging, Live 3D Echo, Live 3D zoom, 3D zoom color, 3D zoom color preview, two-volume view, triggered full volume and triggered 3D color volume
- Adult TEE applications: patients >30 kg (66 lb)

### X7-2 xMATRIX array with PureWave technology

- 2D xMATRIX array with 2,500 elements
- 7 to 2 MHz extended operating frequency range
- 2D, advanced XRES, harmonic imaging, M-mode, color M-mode, color flow, PW Doppler, CW Doppler, Live xPlane imaging, Live 3D Echo, Live 3D zoom, 3D zoom color, 3D zoom color preview, two-volume view, triggered full volume and triggered 3D color volume
- iRotate
- Neonatal and pediatric cardiac applications
- Epicardial imaging

### X3-1 xMATRIX array

- xMATRIX phased array with 2,400 elements
- 3 to 1 MHz extended operating frequency range
- 2D, biplane (Live xPlane), triggered full volume, Live 3D Echo, color Doppler with 2D, biplane and 3D, advanced XRES, harmonic imaging, LVO, low MI and high MI
- Adult and pediatric cardiac applications
- Epicardial imaging

## Sector arrays

### S5-1 sector array with PureWave technology

- Sector array, 80 elements
- 5 to 1 MHz extended operating frequency range
- 2D, steerable PW Doppler, CW Doppler, High PRF Doppler, color Doppler, tissue Doppler, advanced XRES, and harmonic imaging including LVO, low MI, and high MI
- Adult, pediatric, and congenital cardiac applications
- TCD, abdominal vascular, and renal applications

### S7-2omni sector array TEE

- Transesophageal sector array with 64 elements
- 7 to 2 MHz extended operating frequency range
- Physical dimensions:
  - Tip: 1.5 x 3.5 cm (0.6 x 1.4 in) WxL
  - Shaft: 1.0 cm (0.4 in) diameter, 1 m (39.4 in) L
- Mechanically rotatable array from 0 to 180 degrees
- Electrocautery suppression
- 2D, steerable PW Doppler, CW Doppler, High PRF Doppler, color Doppler, tissue Doppler, XRES, harmonic imaging, and LVO
- Adult TEE applications: patients > 25 kg (55 lb.)

### S7-3t sector array TEE

- Transesophageal sector array with 48 elements
- 7 to 3 MHz extended operating frequency range
- Physical dimensions: .
  - Tip: 10.7 x 8 x 27 mm (0.42 x 0.31 x 1.1 in)
  - Shaft: 7.4 mm (0.29 in) diameter, 70 cm (27.6 in) L
- Manually rotatable array from 0 to 180 degrees
- 2D, steerable PW Doppler, CW Doppler, color Doppler, XRES, and harmonic imaging
- Pediatric and adult TEE applications: patients > 3.5 kg (7.7 lb)

### S8-3t sector array multiplane microTEE

- Micro-transesophageal sector array with 32 elements
- 8 to 3 MHz extended operating frequency range
- Physical dimensions:
  - Tip: 7.5 x 5.5 x 18.5 mm (0.3 x 0.2 x 0.7 in), WHL
  - Shaft: 5.2 mm (0.2 in) diameter, 88 cm (34.6 in) L
- Manually rotatable array from 0 to 180 degrees
- 2D, steerable PW Doppler, CW Doppler, color Doppler, advanced XRES, M-mode, and harmonic imaging
- Pediatric, including infants, and adult TEE applications: patients > 2.5 kg (5.5 lb)

### S8-3 sector array

- Phased array, 96 elements
- 8 to 3 MHz extended operating frequency range
- 2D, steerable PW Doppler, CW Doppler, High PRF Doppler, color Doppler, tissue Doppler, advanced XRES, and harmonic imaging
- Adult and pediatric cardiac applications; fetal echo

### S12-4 sector array

- Phased array, 96 elements
- 12 to 4 MHz extended operating frequency range
- 2D, steerable PW Doppler, CW Doppler, High PRF Doppler, color Doppler, tissue Doppler, advanced XRES, and harmonic imaging
- Pediatric and adult cardiac applications
- Epicardial imaging

## Linear arrays

### L15-7io compact linear array

- 15 to 7 MHz extended operating frequency range
- Steerable pulsed and color Doppler; Color Power Angio, panoramic, and XRES imaging
- Auto Doppler optimization
- Auto flow tracking
- High resolution cerebrovascular and intraoperative vascular applications

### L11-3 broadband linear array

- Linear array with 288 elements
- 11 to 3 MHz extended operating frequency range
- Steerable pulsed and color Doppler; Color Power Angio, SonoCT, XRES, and harmonic imaging
- Auto Doppler optimization
- Auto flow tracking
- Vascular (carotid, arterial and venous) and superficial imaging applications
- Cerebrovascular (carotids, vertebrals), peripheral vascular (venous, arterial), and internal mammary vessels

### L9-3 broadband linear array

- Linear array with 160 elements
- 9 to 3 MHz extended operating frequency range
- Steerable pulsed and color Doppler; Color Power Angio, SonoCT, XRES, and harmonic imaging
- Auto Doppler optimization
- Auto flow tracking
- Vascular (carotid, arterial and venous) and superficial imaging applications
- Cerebrovascular (carotids, vertebrals), peripheral vascular (venous, arterial), and internal mammary vessels
- Precision Doppler with fine angle steering

### L8-4 broadband linear array

- Linear array with 128 elements
- 8 to 4 MHz extended operating frequency range
- Steerable pulsed and color Doppler; Color Power Angio, SonoCT, XRES, and harmonic imaging
- Vascular (carotid, arterial and venous) and internal mammary vessel applications

## Curved arrays

### C5-1 broadband curved array with PureWave technology

- 5 to 1 MHz extended operating frequency range
- Curved array, 160 elements
- Maximum 100 degree field of view, dependent on imaging parameters
- Steerable pulsed, high-PRF and color Doppler; and Color Power Angio, SonoCT, advanced XRES, and harmonic imaging
- Fetal echo, abdominal vascular and renal application
- TSIs for deep abdominal penetration
  - Tissue aberration correction (speed of sound correction) in 2D and harmonic modes
  - Coded beamforming (chirp) for improved simultaneous detail resolution and penetration

### C8-5 broadband curved array

- 8 to 5 MHz extended operating frequency range
- Maximum 116 degree field of view, dependent on imaging parameters
- Steerable pulsed Doppler, color Doppler, Color Power Angio, SonoCT, and XRES imaging
- Cerebrovascular applications

### C9-4 broadband curved array

- 9 to 4 MHz extended operating frequency range
- Steerable pulsed wave and color Doppler, Color Power Angio, SonoCT, XRES and harmonic imaging
- General purpose small adult and pediatric abdominal, obstetrical and gynecological applications

## Non-imaging

### D5cwc CW transducer (Pedoff)

- Dedicated 5 MHz continuous wave Doppler
- Deep venous and arterial applications

### D2cwc CW transducer (Pedoff)

- Dedicated 2 MHz continuous wave Doppler
- Adult cardiology application

### D2tcd PW transducer (Pedoff)

- Dedicated 2 MHz pulsed wave Doppler
- Transcranial Doppler applications

### TY-306 heartsound pulse contact sensor

- Patient heartsound and carotid pulse
- 0.04 to 300 Hz frequency response
- Cardiac and vascular applications

## 5.2 Transducers application guide

| |  |  |  |  |  |  |
|---|---|---|---|---|---|---|
| **Name** | **S5-1** | **S8-3** | **S12-4** | **X3-1** | **X5-1** | **X7-2** |
| Type of array | Sector | Sector | Sector | xMATRIX | xMATRIX | xMATRIX |
| Number of elements | 80 | 96 | 96 | 2400 | 3040 | 2500 |
| Scanplane aperture | 20.3 mm | 15.4 mm | 9.78 mm | Proprietary | Proprietary | Proprietary |
| Field of view | | | | | | |
| Broadband frequency range | 5 to 1 MHz | 8 to 3 MHz | 12 to 4 MHz | 3 to 1 MHz | 5 to 1 MHz | 7 to 2 MHz |
| Frequency | | | | | | |
| PureWave Technology | ● | | | | ● | ● |
| **Application** | | | | | | |
| Cardiac | | | | | | |
| - Adult | ● | ● | | ● | ● | |
| - Pediatric | | ● | ● | ● | ● | ● |
| - Adult congenital | ● | | | | ● | ● |
| Perioperative | | | | | | |
| - Adult TEE | | | | | | |
| - Pediatric TEE | | | | | | |
| - Epicardial | ● | | ● | ● | ● | ● |
| - Intraoperative | | | | | | |
| - Intervention | | | ● | | | |
| Fetal | | | | | | |
| - Fetal echo | | ● | | | | |
| Vascular | | | | | | |
| - Abdominal | ● | | | | ● | |
| - Cerebrovascular | | | | | | |
| - Intraoperative | | | | | | |
| - TCD | ● | | | | | |
| - Peripheral vascular | | | | | | |

## 5.2 Transducers application guide

| |  |  |  |  |  |  |
|---|---|---|---|---|---|---|
| **Name** | **X7-2t** | **S8-3t** | **S7-2omni** | **S7-3t** | **C5-1** | **C5-2** |
| Type of array | xMATRIX | Sector | Sector | Sector | Curved | Curved |
| Number of elements | 2500 | 32 | 65 | 48 | 128 | 128 |
| Scanplane aperture | Proprietary | 5 mm | 8.64 mm | 7.63 mm | | |
| Field of view | | | | | 60° | 60° |
| Broadband frequency range | 7 to 2 MHz | 8 to 3 MHz | 7 to 2 MHz | 7 to 3 MHz | 5 to 1 MHz | 5 to 2 MHz |
| Frequency | | | | | | |
| PureWave Technology | ● | | | | ● | |
| **Application** | | | | | | |
| Cardiac | | | | | | |
| - Adult | ● | ● | ● | | | |
| - Pediatric | | ● | | ● | | |
| - Adult congenital | | | | | | |
| Perioperative | | | | | | |
| - Adult TEE | ● | ● | ● | | | |
| - Pediatric TEE | | ● | | ● | | |
| - Epicardial | | | | | | |
| - Intraoperative | ● | ● | | | | |
| - Intervention | | | | | | |
| Fetal | | | | | | |
| - Fetal echo | | | | | ● | ● |
| Vascular | | | | | | |
| - Abdominal | | | | | ● | ● |
| - Cerebrovascular | | | | | | |
| - Intraoperative | | | | | | |
| - TCD | | | | | | |
| - Peripheral vascular | | | | | | |

## 5.2 Transducers application guide

| |  |  |  |  |  |
|---|---|---|---|---|---|
| **Name** | **C8-5** | **C9-4** | **L9-3** | **L11-3** | **L15-7io** |
| Type of array | Curved | Curved | Linear | Linear | Linear |
| Number of elements | 128 | 192 | 160 | 288 | 128 |
| Scanplane aperture | | | 38 mm | 39 mm | 23 mm |
| Field of view | 90° | 65° | | | |
| Broadband frequency range | 8 to 5 MHz | 9 to 4 MHz | 9 to 3 MHz | 11 to 3 MHz | 15 to 7 MHz |
| Frequency | | | | | |
| PureWave Technology | | | | | |
| **Application** | | | | | |
| Cardiac | | | | | |
| - Adult | | | | | |
| - Pediatric | | | | | |
| - Adult congenital | | | | | |
| Perioperative | | | | | |
| - Adult TEE | | | | | |
| - Pediatric TEE | | | | | |
| - Epicardial | | | | | ● |
| - Intraoperative | | | | | ● |
| - Intervention | | | | | |
| Fetal | | | | | |
| - Fetal echo | | ● | | | |
| Vascular | | | | | |
| - Abdominal | | | | | |
| - Cerebrovascular | ● | | ● | ● | ● |
| - Intraoperative | | | | | ● |
| - TCD | | | | | |
| - Peripheral vascular | | | ● | ● | |

# 6. Measurements and analysis

### 6.1 Measurement tools and general description

- 2D distance
- 2D circumference and area by ellipse, continuous trace, trace by points
- 2D distance and area on a 3D volume
- 2D angle: intersection of two lines
- M-mode distance, time, and slope measurements
- Manual Doppler distance for time and velocity
- Manual Doppler trace
- Two methods of manual Doppler trace: Doppler continuous trace and trace by points
- Trace erase by backing up the trackball
- Trace erase segmentally using the erase control
- Time and slope measurements in Doppler and M-mode
- High Q automatic Doppler analysis (vascular only) Doppler values including PI, RI, S/D indices
- Volume flow rate
- 2D volume (two volume methods)
- Heart rate (intelligent heart rate tool: automatically capture from the physio trace, or directly measure from M-mode and Doppler traces)
- Trackball-controlled electronic measurement calipers: eight sets
- User-defined protocols, measurements, and equations
- On-the-fly measurement labels
- Fully editable results data sheet
- Integrated patient exam report
- User-configurable touch panel layout per analysis application
- Simpson's trace methods: traditional trace or three-point adjustable border
- 2D all points guided workflow
- M-mode all points guided workflow
- PISA methods with automatic aliasing velocity acquisition
- Body surface index calculations
- User-friendly powerful equation editing wizard
- Units and precision set independently for all measurements and calculations
- Adult echo TDI measurement package
- Vascular graft measurement package
- User-adjustable results box position that is remembered per image display format, and across power cycles
- Export measurement and analysis package to CD or DVD and import onto other iE33 ultrasound systems
- Ability to add images to the report

### 6.2 Measurement tools and quantification

QLAB software facilitates PC-based quantification for 2D and 3D diagnostic ultrasound analysis for cardiology, vascular and contrast applications.

QLAB quantification software (version 9.0)

- Intima Media Thickness (IMT) Quantification plug-in
  - Automated assessment of the IMT on user-selected frames
  - For carotid and other superficial arteries

- Region of Interest (ROI) Quantification plug-in
  - Pixel intensity index: pixel intensity analysis, data types (echo, velocity)
  - Data types: echo, velocity (color) or power (angio)
  - Up to 10 user-defined regions
  - Thumbnail display of frames for easy trimming
  - TDI velocity timing measurements
  - Log and linear data display selection
  - Smoothed data display option with various curve fitting techniques
  - Vascularization Index, Flow Index and Vascularization Flow Index results on color mode files
  - Motion compensation for multiframe objects (user-selectable on/off)

- Strain Quantification (SQ) plug-in
  - For evaluation of regional myocardial function, assessment of synchronicity and guidance during biventricular pacing procedures
  - Tissue Doppler imaging (TDI) velocity quantification
    - Measures the myocardial velocity and derives the displacement-strain rate and strain along user-defined M-lines
    - Capable of drawing up to four M-lines at a time
    - Obtains values from any point on the M-mode display with point-of-interest tool
    - Provides user-defined and automatic M-Line motion to follow the myocardial motion
    - Presents TDI results in two display formats: anatomical M-mode display and graph display
  - User-selectable waveforms for optimal sub-region visualization
  - Curve processing modes
    - TDI velocity timing caliper measurements
    - Ability to overlay pulse or phono signal and cardiac mechanical events on TDI waveforms

- Cardiac Motion/Mechanics 2D Quantification (CMQ)
  - Objective assessment of left ventricle global function and regional wall motion, deformation and timing using the next generation of 2D speckle tracking technology
  - Quantification of 2D native ultrasound PureWave data sets from X5-1, S5-1, X7-2, and X7-2t transducers
  - Available methods with dedicated preferences settings:
    - CMQ method:
      - Next-generation 2D speckle tracking
        - Dense tracking mesh (user-editable mesh density)
        - Multiple cardiac views and images
        - AHA/ASE 17 left ventricle segmentation templates (three apical views and three short-axis view templates)
        - Easy-to-edit template position and shape
        - Intuitive step-by-step protocol-driven user interface
        - Tracking quality tool: editable threshold to help display various quality tracking
        - User-editable post LV segments display: consistent display with corresponding waveform and reported values
        - Multiple cardiac-beat cycle capable or beat-to-beat selection
        - Tracking that can be initiated from any frame
      - Display
        - Mesh (hide or show)
        - Border (hide or show)
        - Vector velocity field (hide or show)
        - Paremetric image PI (hide or show)
        - Transmural, Endo+Epi, Endo, Epi layer waveforms and values available from a single computing step
        - Cardiac phases (overlay of AVO, AVC, MVO, MVC mechanical events auto imported from ultrasound cart analysis via DICOM SR or manual entry)
        - Cardiac cycle average
        - Global curves that toggle on and off
      - 2D speckle parameters
        - Longitudinal strain and strain rate
        - Circumferential strain and strain rate
        - Transversal strain and strain rate (apical views only)
        - Radial and transversal displacement
        - Wall thickening (apical views only)
        - Radial fractional shortening
        - Radial velocity
        - Speed (absolute angle independent velocity)
        - Local and regional rotation and rotation velocity
        - Global rotation
        - Endo-Epi mural torsion and local rotation
      - Measurement and calculations
        - Waveform auto peak detection-to-report time to peak-and-peak values
        - Timing calipers
      - Report
        - One view and global report pages
        - Display of results in AHA/ASE 17 LV segment bull's-eye plot format and numerical table
        - Global longitudinal strain
        - Global circumferential strain
        - Global transversal strain
    - Free strain method:
      - For specific local strain analysis
      - Up to 17 dedicated colors to help differentiate each cord and corresponding waveform
    - Tissue motion annular displacement (TMAD) method:
      - Based on speckle tracking technology
      - Tracks mitral valve and other valve annular motion over time
      - Computes valve annular displacement curves over time
      - Uses the Color Kinesis overlay to visualize valve annular plane motion parametrically
    - Complex and simple CK methods:
      - Duplication of 2DQ plug-in functionalities for CMQ users
      - Area/Simpson volume: single-plane volume measurements based on 5/6 area-length method and Simpson's Single Plane Method of Disks (MOD)
      - Fractional area change (FAC), ejection fraction (EF), peak ejection rate (PER), peak rapid filling rate (PRFR) and atrial filling fraction (AFF)
      - Color Kinesis (CK) overlay for color coded visualization of global and regional wall motion in systolic, diastolic and cycle modes
      - Transparency control to visualize echo grayscale under a semi-transparent CK overlay

- CK display for arbitrary frame rates (high frame rate CK display)
- Manual user-editable timing overrides for the onset and duration of the CK parametric display

– Other:
- Non-cardiac area analysis over time
- Area detection based on complex border algorithm

• Cardiac Motion/Mechanics 2D Quantification for Stress (CMQ Stress)
– Designed to help objectify stress echo exam interpretation
– Requires CMQ plug-in
– Offers unique combination of Philips 2D PureWave images, next-generation 2D speckle tracking and a user interface specifically designed for stress echo exams and around stress echo practitioners
– Next generation 2D speckle tracking
- Dense tracking mesh (user-editable mesh density)
- Compatible with multiple cardiac views and stress echo stages
- AHA/ASE 17-segment left ventricle templates (one short-axis and three apical view templates)
- Easy-to-edit template shape
- Intuitive step-by-step protocol-driven user interface
- Tracking quality tool: editable threshold to help display various quality tracking

– View and stage tab
- User interface that auto adapts to display the existing user's stress acquisition protocol, facilitating navigation through stress echo files
- Compatible with stress echo sub-loops

– ROI tab
- AHA/ASE 17-segment left ventricle templates (one short-axis and three apical view templates)
- Easy-to-edit template position and shape
- Multiple cardiac-beat cycle capable or beat-to-beat selection
- Tracking that can be initiated from any frame
- User-editable display of post LV segments: consistent display with corresponding waveform and reported values

– Analysis tab
- Transmural, Endo+Epi, Endo, Epi layer waveforms and values available from a single computing step
- Parametric image selection
- Cardiac phases (overlay of AVO, AVC, MVO, MVC mechanical events auto imported via DICOM SR, or manually enterable)
- Cardiac cycle average
- Global curves that toggle on and off
- One view measurement preview

– Results tab
- Stage-by-stage report pages
- Display of results in AHA/ASE 17-segment LV bull's-eye plot and numerical table formats
- Summary page showing side-by-side bull's-eye plots
- Global longitudinal strain
- Global circumferential strain
- Global radial and transversal strain

• Cardiac 3D Quantification (3DQ)
– Provides capability to perform 2D measurements from volume and color volume slices (multiplanar reconstruction views)
– Review and quantification of Live 3D, 3D zoom, 3D full volume and Live 3D color files
– Supported on X5-1, X3-1, X7-2 and X7-2t xMATRIX transducers
– 3D image controls: 3D vision map, 3D single or dynamic colorization, 3D color render, 3D color suppress control
– Multiplanar reconstruction (MPR) and iSlice views
- 3D slice plane
- Quad plane display
- Apical two-chamber view flip on and off
- 2 x 2, 3 x 3, 4 x 4 iSlice layout
- Mix apical and short axis or all short axis in iSlice display
- Thick slice control
- Slice interval spacing
- 3D color depth rendering
- Absolute versus relative location
- Auto-view with up, down, left, right
- Parallel planes
- Unlimited MPR and iSlice manipulation

- Plane rotation, tilt and movement controls to reduce left ventricle foreshortening
- 3D annotation

– 3D quantification from MPR views includes distance and area calculations, biplane LV volume (Simpson), LV ejection fraction by method of disk using biplane Simpson, and LV mass

• Cardiac 3D Quantification Advanced (3DQ Advanced)
– Left ventricle global and regional volume and timing analysis with no geometric assumptions
– Comprehensive report capability with AHA/ASE 17-segment bull's-eye plots and numeric values
– Image quality index using dedicated color scale for 3D volume quality control
– Display and manipulation of dynamic 3D rendering and left ventricular (LV) true volumes
– Displays 3D or dynamic 3D renderings in grayscale, single colorization or dynamic colorization
– Multiplanar reconstruction (MPR) views
– Option to flip LV apical two-chamber display and corresponding SALI sequence
– iSlice display capability
– Measurements of LV endocardial true volume, LV ejection fraction and stroke volume using semi-automated 3D border detection
– Regional volume computation based on AHA/ASE 17-segment LV model
– Enhanced edit mode that adds flexibility and accuracy for optimal 3D border tracking in four dimensions
– Global LV volume waveforms to display all 17 regional volume waveforms or a subset of user-selected regional volume waveforms
– Dyskinetic segments and corresponding volume waveforms display in specific color and format
– Regional and end-diastolic normalized regional volume display of waveforms
– User-selectable waveforms: single, by wall, by level (ring) modes
– Bull's-eye visualization of all 17 regional segments or the user-defined and selected regional segments
– Global and regional reports providing 3D LV global values and regional timing indices from all or a subset of 17 regional segments and bull's-eye-based parametric imaging display
- 3D true volume-based EDV, ESV, stroke volume and EF
- Standard deviation and maximal difference of time to minimum systolic volume (Tmsv) based on a subset of 17 regional segments
- Tmsv values displayed in time (msec) or normalized to the R-R interval (%)
- Bull's-eye view showing the user-selected segments used for the Tmsv calculation
- LV timing and radial excursion parametric images in bull's-eye format using effective color-coded scales
- Parametric imaging supporting AHA/ASE 17-segment overly on the bull's-eye for direct and rapid visualization
- Radial excursion threshold slider for selective visualization of LV segments in the timing parametric display

• Mitral Valve Quantification (MVQ)
– Quantification of the mitral valve with Live 3D TEE data acquired with the X7-2t transducer
– Quantification and display of mitral leaflets and leaflet segments, annulus, coaptation lines and distance to papillary muscle
– Three mitral measurement protocols
– Displays: leaflet, minimum tenting area, surface area
– Edit measurement points
– MVQ report pages with images
– Setup of measurements, protocols and tracking points
– MVQ measurements:
- Anterior to posterior diameter
- Anterolateral to posteromedial diameter
- Annular height
- Commissure to commissure diameter
- 3D annulus perimeter
- Anterior leaflet total, exposed and coapting lengths
- Posterior leaflet total, exposed and coapting lengths
- 2D projected circumference
- 2D circularity index
- Projected area in 2D

- Leaflet and leaflet segment surface areas (total, exposed, coapting)
- Minimum surface 3D area from annulus
- Projected circumference ratio 2D to 3D
- Saddle height to commissure width ratio
- Planimetered surface area of regurgitation
- Chordal length
- Anterior and posterior leaflet angle
- Non-planar angle
- Coaptation length 2D to 3D

### 6.3 High Q automatic Doppler analysis

- Vascular imaging applications
- Automatic real-time and retrospective tracing of:
  - Instantaneous peak velocity
  - Instantaneous intensity weighted mean velocity
- Automatic real-time display of (user selectable up to eight):
  - Volume flow
  - Time-averaged peak velocity
  - Time-averaged mean velocity
  - Resistive index
  - Pulsatility index
  - Systolic/diastolic ratio
  - Acceleration/deceleration times

### 6.4 Clinical option analysis packages

- Cardiac analysis
  - Volume by area/length method
  - M-mode ejection fraction (via Teichholz or cubed method)
  - Novel three-point adjustable Simpson's template
  - Simpson's biplane and single plane volume and ejection fraction
  - Area, length, volume, and ejection fraction
  - LV mass
  - 2D all points
  - M-mode all points
  - Peak velocity
  - Maximum and mean pressure gradients
  - Pressure half-time
  - E/A ratio
  - D/E slope
  - Continuity equation
  - Diastolic function
  - Cardiac output
  - Acceleration time
  - Heart rate
- Vascular analysis
  - Right and left carotid artery protocols
  - ICA/CCA ratio
  - Bilateral lower extremity arterial and venous labels
  - Bilateral upper extremity arterial and venous labels
  - Percent diameter and area reduction
  - Vascular graft measurement package
  - User comments
  - High Q automatic Doppler analysis
- Pediatric analysis
- Fetal echo analysis
  - BPD
  - FL
  - HC
  - AC
  - EFW
- TCD analysis
  - Bilateral
    - MCA
    - ACA
    - PCA
    - Orbital
    - Occipital
- Pediatric analysis package – designed for the pediatric cardiologist
  - Unique patient data entry study page for pediatric echo
  - Pediatric echo displays QLAB results in the analysis report
  - Collection and groups for pediatrics: 2D, M-mode and Doppler
  - Touch panel designed by pediatric cardiologists
  - Measurements for pediatrics driven by pediatric flow vs. adult structures
    - Multiple ASD diameter measurements
    - Five labeled aorta measurements
    - BSA weight only
    - Qp/Qs

# 7. Physical specifications

### System cart

- State-of-the-art ergonomic design
- Easy maneuverability and mobility
  - Wheel-lock and monitor adjustments to facilitate bedside exams
- Control panel
  - Articulates to facilitate optimal positioning
    - Moves up and down 6.5 in/16.5 cm
    - Rotates 30 degrees (± 15° from center)
    - Moves side-to-side slide 6 ± 3 in/15.2 ± 7.6 cm
    - Provides a retractable, lighted alphanumeric keyboard
  - Palm rest
- Storage bins and TEE tray
- Flat panel LCD display monitor
  - 20 in/50 cm wide format, high resolution flat panel TFT/SIPS display
  - High contrast ratio >800:1 high definition 1,680 x 1,050 resolution
  - Extended viewing angle >170° (horizontal and vertical)
  - Response time: <16 ms
  - Virtually flicker-free technology that reduces eyestrain
  - Ambient lighting control for optimal image viewing in both light and dark environments
  - Mounted on fully articulating extension arm
    - Four-way articulation with range of height adjustment from 55 to 61 in/140 to 155 cm
    - Side-to-side lateral adjustment
    - Nearly infinite positioning adjustments: height, swivel, and tilt
  - Optimized screen layout
    - Large thumbnail displays of acquired images/loops
    - Supports on-cart advanced QLAB applications
- Cart that accommodates user heights ranging between 60 in/152.4 cm to 78 in/198.12 cm
- Easily accessed transducer connector ports, DVD media drive and USB ports
- Transducer and gel bottle holders (removable for easy cleaning)
- Mobility through high quality shock-absorbing casters with foot pedal controls for:
  - Four-wheel swivel
  - Two-wheel swivel lock
  - Two-wheel brakes
- Digitally enhanced eight-speaker high fidelity stereo output
- Integrated footrest
- Three-position footswitch for stress echo exams
  - Any non-protocol state: freeze, print, record
  - Any protocol state: acquire, accept, record
- On-board storage in convenient side bins and accessory tray; universal peripheral bay for easy access for up to three on-board hardcopy and documentation devices
- Built-in A/C line conditioner that provides isolation from voltage fluctuations and electrical noise interference
- Four high-capacity fans with automatic speed adjustment to optimize cooling efficiency with minimal audible noise

### Physical dimensions

| | |
|---|---|
| Width | 55.9 cm (22.0 in.) |
| Height | 139.7–162.6 cm (55–64 in.) |
| Depth | 109.2 cm (43 in.) |
| Weight | 150 kg (331 lb.) without peripheral devices |

### Physio

- One three-lead ECG input
- Selectable between leads I, II, III
  - Gain, sweep rate and display position controls
  - Automatic heart rate calculation and display
  - Fault condition display
  - Cineloop locator displayed on ECG trace
  - Pediatric and disposable leads available

### Peripheral devices, exam documentation

- Digital video recorder (DVR) with operation via user interface
- Up to three on-board peripheral devices (excluding report printers)
- Video-recording peripherals, operated via system user interface
  - DVD recorder (cart-dependent) or super VHS VCR
  - Small format digital color printer (USB)
  - Small format digital B/W printer (USB)
- Support for large format external color printer
- Support for various Hewlett-Packard brand color and monochrome report printers (USB, externally mounted)
- Export of measurement and analysis data to off-line reporting software packages (USB)

### Electrical power, video parameters

- 100V-127V, 50Hz/60Hz, NTSC
- 220V-240V, 50Hz/60Hz, NTSC and PAL
- Integrated A/C line conditioning
- Power consumption depends on system configuration

### Safety requirements

- Electromechanical safety standards met
  - CAN/CSA 22.2 No. 60601-1, Medical Electrical Equipment: General requirements for basic safety and essential performance
  - IEC 60601-1, Medical Electrical Equipment, General requirements for safety
  - IEC 60601-1-2, Collateral Standard, Electromagnetic compatibility
  - EC 60601-2-37, Particular Requirements for Safety: Ultrasonic medical diagnostic and monitoring equipment
  - UL 60601-1, Underwriters Laboratories Standard for Medical Electrical Equipment
- Electromechanical safety standards met (EU Only)
  - EN60601-2-37, Particular requirements for the basic safety and essential performance of ultrasonic medical diagnostic and monitoring equipment
- Agency approvals
  - Canadian Standards Association (CSA)
  - CE Mark in accordance with the European Medical Device Directive issued by British Standards Institute (BSI)

The highly mobile iE33 facilitates portable exams and its revolutionary cart design allows for improved user posture and comfort during exams.

# 8. Maintenance and service

### Maintenance

- Proven reliable platform
- Easy customer access to trackball and air filter for cleaning
- Optional service agreements to:
  - Contain risk
  - Maximize uptime
  - Access Philips best-in-class service

### Service

- Clinical applications support available
- Philips Remote Services connectivity* that allows for many advanced service features, including:
  - Virtual on-site visits for both clinical and technical support in order to provide fast resolution to issues and questions
  - Remote clinical education
  - Remote log file transfer that decreases downtime by allowing fast diagnosis of problems by call center personnel
- On-line support request:
  - Simplifies support engagement
  - Provides fast response to clinical questions and technical issues
  - Allows user to enter request directly on the ultrasound system.
- Proactive monitoring:
  - Reduces unscheduled downtime
  - Monitors key system parameters
  - Sends an alert to Philips call center so action can be taken before system operation is affected
- Optional utilization reports that provide data to manage the site's ultrasound assets:
  - System and transducer usage information
  - Data on number and types of studies, as well as study duration
  - Data for staff credentials and accreditation
  - Identification of opportunities for outreach and referral
  - Communications

* Service agreement required for access to Philips Remote Services. Access to the internet required. Not all remote features available in all countries; contract your Philips representative for details.

**Philips Healthcare is part of Royal Philips Electronics**


How to reach us
www.philips.com/healthcare
healthcare@philips.com

Asia
+49 7031 463 2254

Europe, Middle East, Africa
+49 7031 463 2254

Latin America
+55 11 2125 0744

North America
+1 425 487 7000
800 285 5585 (toll free, US only)


Please visit www.philips.com/iE33 for more information




Printed in The Netherlands.
4522 962 81841 * APR 2012