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Title: SONOLINE G50/G60 S Product Platform DICOM Conformance Statement

Part Number: 7847184

Revision Data

Revision	Change Description	Printed Name	Valid From Date
01	Initial work list release	Ron Sanborn	(CM will apply date on the hard copy at implementation)

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1.0 Purpose

This document describes the conformance to the ACR-NEMA DICOM 3.0 Standard by the SONOLINE G50/G60 S ultrasound system software version 1.5 from Siemens Medical Solutions USA, Inc. Ultrasound Division. It shall establish the conformance specifications for this system only, and does not apply to other products offered by Siemens Medical Solutions USA, Inc., or its affiliates.

The SONOLINE G50/G60 S system is a device that generates ultrasound images that can be sent using DICOM standard protocols and definitions to other DICOM compliant devices that support SOP classes as defined in Table 2 in this document.

2.0 Scope

The DICOM standard provides a well-defined set of structures and protocols that allow inter-operability to a wide variety of medical imaging devices.

When configured with the DICOM option, the SONOLINE G50/G60 S system provides support for essential services related to ultrasound scanning and connectivity to DICOM compliant devices. SONOLINE G50/G60 S system products will not support all features supported by the DICOM standard. This document clearly states the DICOM services and data classes that are supported by the applications included with the SONOLINE G50/G60 S. The intent of this document is to allow users and other vendors who also conform to the DICOM standard to exchange information within the specific context of those elements of the DICOM standard that SONOLINE G50/G60 S system supports.

This document is written with respect to the adopted portions of the DICOM standard, Revision 3. The following sections of this document follow the outline specified in the DICOM Standard NEMA publication PS3.2.¹

1 Second part of the DICOM standard: NEMA Standards Publication PS 3.2-2001, Digital Imaging and Communications in Medicine (DICOM), Part 2: Conformance

3.0 Definitions

The following table provides a list of terms, their acronyms (if applicable), and their descriptions.

Table 1 Terms, Acronyms, and Descriptions.

Term	Acronym	Description
American College of Radiology - National Electrical Manufacturer's Association	ACR-NEMA	
Application Entity	AE	
Conformance Statement	-	A formal statement associated with a specific implementation of the DICOM Standard. It specifies the Service Classes, Information Objects, Communications Protocols and Media Storage Application Profiles supported by the implementation
DICOM 3.0	-	Digital Imaging and Communications in Medicine, Version 3.0
DICOM Message Service Element	DIMSE	
DICOM Message Service Element, Composite Store	DIMSE C-Store	
Ethernet	-	Network methodology devised in 1976 by DIX (DigitalEquipmentCorporation/Intel/Xerox) which is the most common in practice today. Ethernet is the IEEE standard 802.3
Information Object Definition	IOD	A data abstraction of a class of similar Real-World Objects which defines the nature and attributes relevant to the class of Real-World objects represented.
Picture Archiving and Communications Systems	PACS	
Protocol Data Unit	PDU	The PDUs are message formats exchanged between peer entities within a layer. A PDU shall consist of protocol control information and user data.
Request	REQ	
Response	RSP	
Real-World Activity	RWA	That which exists in the real world which pertains to specific area of information processing within the area of interest of the DICOM Standard. Such a Real-World Activity may be represented by one or more computer information metaphors called SOP Classes.

Table 1 Terms, Acronyms, and Descriptions. (Continued)

Term	Acronym	Description
Service Class Provider	SCP	The role played by a DICOM Application Entity (DIMSE-Service-User) which performs operations and invokes notifications on a specific Association.
Service Class User	SCU	The role played by a DICOM Application Entity (DIMSE-Service-User) which performs operations and invokes notifications on a specific Association.
Service-Object Pairs	SOP	The union of a specific set of DIMSE Services and one related Information Object Definition which completely defines a precise context for communication.
Unique identifier	UID	

4.0 Implementation Model

SONOLINE G50/G60 S system users can store images and other data directly on the SONOLINE G50/G60 S system hard disk. Images can be exported to a DICOM archive server or workstation on a network. In the following sections, SONOLINE G50/G60 S system Real World Activities are indicated by “Real World Activity” name while “G50/G60 S AE” indicates the invoked Application Entity. Similarly, the activities associated with service providers are indicated as “Real World Service Activity.”

4.1 Application Data Flow Diagram

Figure 4.1 illustrates the SONOLINE G50/G60 S system’s Application Entity (AE), which is shown in the box. Relationships between users invoked activities (in the circles at the left of the AE) and the associated real-world activities provided by DICOM service providers (in the circles on the right side of the diagram) are shown.

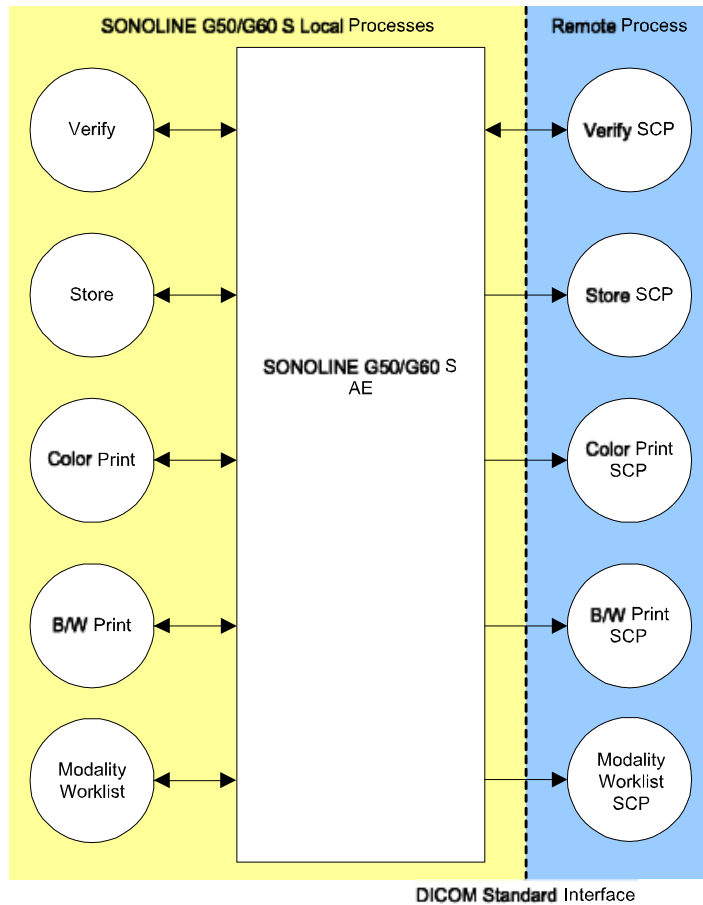


Figure 1 Implementation Model.

4.1.1 Verification

Verification is a part of the DICOM configuration located on the 'DICOM' page of the System Presets. Verification can be used to send a DICOM Verification request to a remote Application Entity (AE) and will listen for a response.

When used as a diagnostic tool, Verification returns the following messages to the user:

- If the verification succeeds: "DICOM - Successfully contacted system"
- If the verification fails: "DICOM - Unable to communicate with system"

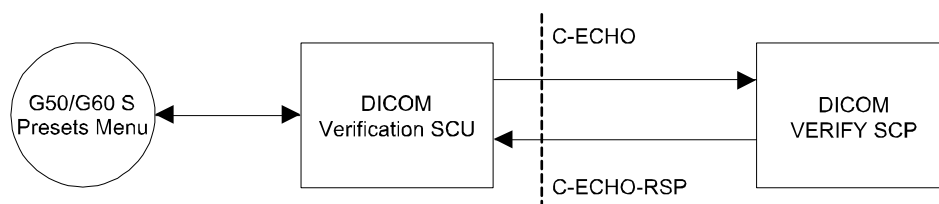


Figure 2 Verification Model.

4.1.2 DICOM Store

When requested SONOLINE G50/G60S sends images to the preconfigured DICOM Storage server.

DICOM Store can be seen as two sub-operations:

- Queueing images for transfer
- Transferring images to the storage server

Queueing images for transfer:

G50/G60 S can be configured to automatically queue up images for transfer as they are being created. "AutoStore to DICOM" option in DICOM presets has to be set for this.

Alternatively, user can select exams or individual images and manually queue them up from Review mode.

Transfer of images to the storage server:

Further, once images are queued they may be immediately transferred or delayed till the end of study using the transfer storage configuration.

G50/G60S supports two storage configurations: "Store At End of Exam" and "Store During Exam."

If the storage configuration is set to “Store At End of Exam”, images queued to destination devices will be transferred when the user selects “Close Study” or “New Patient.”

If the storage configuration is set to “Store During Exam”, images are transferred to destination devices immediately after they are queued.

For both “Store At End of Exam” and “Store During Exam” settings, image transfer will be delayed if the G50/G60 S is busy performing another DICOM Command (Store/Print/Echo).

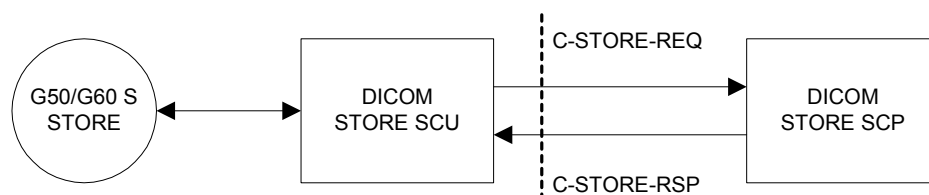


Figure 3 Store Model.

4.1.3 DICOM Print

SONOLINE G50/G60 S system is capable of grayscale (B/W) and color printing.

When requested, single frame images will be printed to a pre-configured DICOM network printer.

DICOM Print can be seen as two sub-operations:

- Paging images for transfer
- Transferring pages to printer

Paging images for transfer:

SONOLINE G50/G60 S can be configured to automatically queue up images to be printed on B/W Printer and/or Color printer as they are being created.

Alternatively, user can select exams or individual images and manually queue them up from Review mode for print.

Every image queued up is added into a page in the respective printer layout (DICOM B/W Printer Layout or DICOM Color Printer Layout).

Transfer of pages to the Printer:

Further, pages may be immediately transferred to the printer or delayed till the end of study based on the transfer configuration.

SONOLINE G50/G60S supports two configurations: “Print At End of Exam” and “Print when page full.”

If the configuration is set to “Print At End of Exam,” all pages are transferred to the destination DICOM printer as a batch when the user ends the exam.

If the configuration is set to “Print when page full”, a page is transferred to the destination DICOM printer as soon as it becomes full.

For both “Print At End of Exam” and “Print when page full” settings, page transfer will be delayed if the G50/G60 S is busy performing another DICOM Command (Store/Print/Echo).

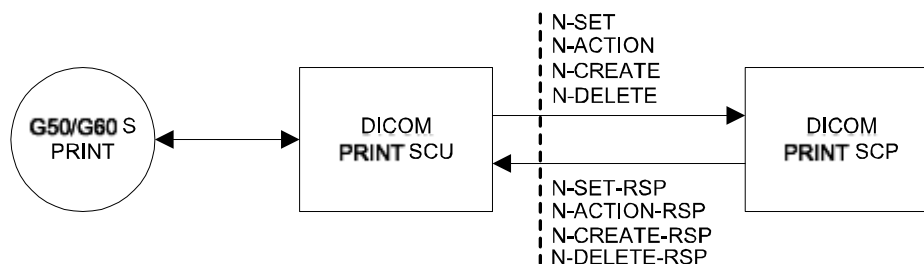


Figure 4 Print Model.

4.1.4 Patient Registration using Worklist

Patient registration can be automated by using the 'Worklist' Real World Activity. Pressing the 'New Patient' key on the keyboard initiates the patient data registration process and closes the previous active study. Pressing the 'Worklist' option on the patient data display screen invokes the Worklist query screen. (It can also be initiated from the Study screen).

Initiating the 'Search' button will attempt to find all matching patients using the information from the Worklist Query screen. Patient name fields that are partially filled or empty will be treated as though an implicit wildcard was appended at the end of each field. ID and Accession number will be exact match only. If no matches are found, a message will be presented to the operator indicating so. If more than one matching patient is found, a pick list of patient exams will be presented to the user to select from. Each of the fields will be sortable in ascending and descending order. The list will be limited to a number of preset entries. If more than this number of matching records are found in the query, the search will terminate and the user will be notified. The search list criteria will contain:

- Patient name
- Patient ID
- Accession number
- Exam start date/time range

- Requested Procedure ID
- US/All modality
- Scheduled station AE title

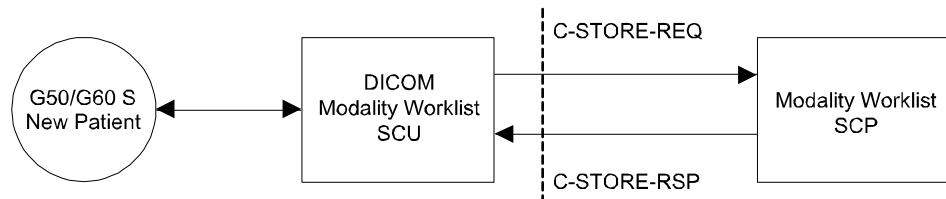


Figure 5 Modality Worklist Model

The following data fields in Modality Worklist Screen are initially populated from the New Patient Screen and are used for query:

Attribute Name	Tag
Patient's Full Name	(0010,0010)
Patient ID	(0010,0020)
Accession Number	(0008,0050)

The following data fields will be populated on the worklist screen for each return:

Attribute Name	Tag
Patient's Full Name	(0010,0010)
Patient ID	(0010,0020)
Accession Number	(0008,0050)
Exam Start Date/Time	(0040,0002), (0040,0003)
Scheduled Procedure Step Sequence	(0040,0100)*
>Scheduled Procedure Step Description	(0040,0007)
>Scheduled Protocol Code Sequence	(0040,0008)
>>Code Value	(0008,0100)
Requested Procedure Description	(0032,1060)
Exam Type	(0008,1030)**

Attribute Name	Tag
*<code1>, ..., <codeN>: <sched1>, ..., <schedn> where: code<i> = Sequence item code value(0008,0100) for a given sequence or value multiplicity sched<i> = Scheduled procedure step(0040,0007) for a given sequence or value multiplicity **if a value exists for (0008,1030). Otherwise, Exam Type is set to value of Scheduled procedure step(0040,0007). If (0040,0007) is also empty, Exam Type is set to Requested procedure Description (0032,1060) if it exists.	

The user will have the option to select a patient exam, or cancel the operation. Selection of a patient from the list will cause all demographic information for that patient to be loaded in to the patient data fields.

The following data fields will be populated on the patient data screen:

Attribute Name	Tag
Patient Name (first,middle,last)	(0010,0010)
Patient ID	(0010,0020)
Accession number	(0008,0050)
Exam start date/time	(0040,0002), (0040,0003)
DOB	(0010,0030)
Sex	(0010,0040)
Weight	(0010,1030)
Height	(0010,1020)
Physician	(0008,0090)
Indication	(0080,1080)
LMP	(0010,21D0)

Once a Worklist query is initiated, a "Querying DICOM Worklist Server" dialog will be presented to the user. The user will only have one option, "CANCEL," which will abort the query operation.

4.2 AE Functional Definition

4.2.1 Verification Real-World Activities

The SONOLINE G50/G60 S application entity performs Verification Service Class as an SCU and SCP allowing the operator to verify the ability of an application on a remote device to receive DICOM messages and allowing the operator of a remote DICOM device to verify the SONOLINE G50/G60 S system's ability to receive DICOM messages (C-ECHO DIMSE).

4.2.2 Store Real-World Activities

The SONOLINE G50/G60 S Application Entity (AE) performs all of the functions to transmit ultrasound images and associated data to network servers and / or workstations. The SONOLINE G50/G60 S AE supports the Ultrasound Image, Ultrasound Multi-Frame Image, Ultrasound Image (Retired), Ultrasound Multi-Frame (Retired) and Secondary Capture storage SOP classes as an SCU.

The SONOLINE G50/G60 S AE initiates an association for C-STORE Requests to store providers when the user invokes "DICOM Store." The association may be used to store multiple image and clips and is closed when no images or clips are available to be stored to the remote device for five seconds.

4.2.3 Print Real-World Activities

The SONOLINE G50/G60 S AE provides all aspects of the Print Management SCU. The SONOLINE G50/G60 S AE initiates an association to the printer when the user invokes "DICOM Print." The association may be used to print multiple pages and is closed when no pages are available to be printed to the remote device for five seconds.

4.3 Sequencing of Real-World Activities

Remote processing of Real World Activity SCP services which the SONOLINE G50/G60 S requests as an SCU occur in sequential fashion based on the order the user has requested. This initiation occurs with the "Store" for image store operations, "B/W Print," "Color Print" for image printing operations.

Note: In some cases, the order may not be as described above.

4.4 Modality Worklist Real-World Activities

The SONOLINE G50/G60 S AE supports the DICOM Basic Worklist Management Service as an SCU. The AE initiates an association to the active Worklist server when a Worklist query is selected (via the "Worklist" button). The association is closed upon the completion of each query. A preset number of maximum matching results is accepted, at which point, the SONOLINE G50/G60 S AE issues a C-FIND-CANCEL request.

5.0 AE Specifications

The following specifications apply to the SONOLINE G50/G60 S AE as depicted in Figure 2.1.

5.1 SONOLINE G50/G60 S AE Specification

The SONOLINE G50/G60 S AE provides conformance to the following DICOM Service SOP Classes as an SCU.

Table 2 Supported SOP Classes.

Service SOP Class Name	SOP Class UID
Verification	1.2.840.10008.1.1
Ultrasound Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.6
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1
Ultrasound Multi-Frame Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.3
Ultrasound Multi-Frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7
Basic Grayscale Print Management Meta SOP Class	1.2.840.10008.5.1.1.9
Basic Color Print Management Meta SOP Class	1.2.840.10008.5.1.1.18
Basic Grayscale Image Box SOP Class	1.2.840.10008.5.1.1.4
Basic Color Image Box SOP Class	1.2.840.10008.5.1.1.4.1
Printer SOP Class	1.2.840.10008.5.1.1.16
Modality Worklist Information Model C- FIND	1.2.840.10008.5.1.4.31

5.1.1 Association Establishment Policies

5.1.1.1 General

The SONOLINE G50/G60 S system utilizes TCP/IP. The Maximum Length PDU negotiation is included in all association establishment requests. The maximum length PDU offered for an association initiated by SONOLINE G50/G60 S is:

- Maximum PDU Offered: 28672

5.1.1.2 Association Establishment Order

G50/G60 S initiates each C-Store Request one at a time, one for each transfer request being processed.

Image format on G50/G60 S can be set to one of “Automatic,” “Old Ultrasound” or “Secondary Capture.”

In “Automatic” setting, G50/G60 S negotiates Ultrasound Image, Ultrasound Multi-Frame Image, Ultrasound Image (Retired), Ultrasound Multi-Frame (Retired) Image and Secondary Capture Image sequentially.

In “Old Ultrasound” setting, G50/G60 S forces Ultrasound Image (Retired), Ultrasound Multi-Frame (Retired) Image and Secondary Capture Image to be negotiated sequentially.

In “Secondary Capture” setting, G50/G60 S forces only Secondary Capture Image to be negotiated.

5.1.1.3 Asynchronous Nature

All associations use the default synchronous mode of operation. Asynchronous Operations Window negotiations are not supported on the SONOLINE G50/G60 S system.

5.1.1.4 Implementation Identifying Information

- Implementation Class UID: “1.3.12.2.1107.5.5.5” (see below)
- Implementation Version Name: “MergeCOM3_310”

Siemens has provided registration for all Siemens Medical Solutions Groups. This unique Class UID is defined as:

“1.3.12.2.1107.5.5.product”

Where the interpretation is:

1. = International Standards Organization (ISO)

3. = International branch of ISO

12.2.1107.5. = Assigned to Siemens-UB MED

5. = Ultrasound Modality (SMS-UG)

Product =.5 = G60 S, 6 = G50

5.1.2 Association Initiation by Real-World Activities

5.1.2.1 Real World Activity – Verification

The SONOLINE G50/G60 S is capable of supporting Verification service class as SCU or SCP. Verification can be initiated as a singular event from the Systems Presets menu to any configured SCP that supports Verification.

Proposed Presentation Contexts – Verification

The SONOLINE G50/G60 S will propose Presentation contexts as shown in table 3.

Table 3 Verification Presentation Context.

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Verification	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU/ SCP	None
Verification	1.2.840.10008.1.1	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU/ SCP	None
Verification	1.2.840.10008.1.1	Explicit VR Big Endian	1.2.840.10008.1.2.2	SCU/ SCP	None

5.1.2.2 Real World Activity – Store

G50/G60 S facilitates user to store images as they are being created or later in review mode.

Queueing Images During Acquisition

“Autostore to DICOM” option in Storage presets has to be set. One or more of “Store/Print1,” “Store/Print2,” “Digital Store” keys on the control panel can be configured for Store (Disk Store, D.Store, Clip capture). When the user presses one of the configured keys, image is acquired, stored on the hard disk and queued up to be transferred to the storage server.

Queueing Images in Review Mode

Users can select individual images from open/closed studies, one or more closed studies and queue them up for Storage. DICOM Store button is available in Review screen for this operation.

Transfer of Images to the Storage Server

Further, once images are queued they may be immediately transferred or delayed till the end of study using the transfer storage configuration.

G50/G60S supports two storage configurations: “Store At End of Exam” and “Store During Exam.”

If the storage configuration is set to “Store At End of Exam,” all images queued to destination devices will be transferred as a batch when the user selects “Close Study” or “New Patient.”

If the storage configuration is set to “Store During Exam,” images are transferred to destination devices immediately after they are created.

For both “Store At End of Exam” and “Store During Exam” settings, image transfer will be delayed if the G50/G60 S is busy performing another DICOM Command (Store/Print/Echo).

Associated Real World Activities

When images are transferred from the hard disk to a DICOM Store SCP, the system establishes an association between the G50/G60 S AE and the configured DICOM device (i.e. Network Archive Server, Workstation Server). The association may be used to store multiple image and clips and is closed when no images or clips are available to be stored to the remote device for five seconds.

Proposed Presentation Context

The following Presentation Contexts are presented to the SCP in an A-Associate request for DIMSE C-STORE storage services. The storage services utilize C-STORE services, as defined by the DICOM Standard. Table 4 represents all “Store” Real World Activities.

Table 4 Store Presentation Context.

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Ultrasound Multi-Frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Lossy JPEG 8 Bit Image Compression	1.2.840.10008.1.2.4.50	SCU	None
Ultrasound Multi-Frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
Ultrasound Multi-Frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Ultrasound Multi-Frame Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.3	DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
Ultrasound Multi-Frame Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.3	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

Table 4 Store Presentation Context. (Continued)

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Ultrasound Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.6	DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
Ultrasound Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.6	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

The SONOLINE G50/G60 S system always acts as an SCU and is the client in a client-server model.

SOP Specific Conformance to Storage Service SOP Classes

The Store REAL WORLD ACTIVITY provides standard extended conformance as an SCU for the following standard Storage Service Class SOP:

Table 5 Supported SOP Classes.

Service SOP Class Name	SOP Class UID	Conformance Level
Ultrasound Multi-Frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Standard Extended
Ultrasound Multi-Frame Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.3	Standard Extended
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Standard Extended
Ultrasound Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.6	Standard Extended
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Standard Extended

This is accomplished using the DIMSE C-STORE Service. The SCU issues a service request with a SOP instance that meets the requirements of the desired ultrasound IOD.

The following table denotes the attributes included in the Ultrasound Image Object as implemented on the SONOLINE G50/G60 S. Attributes not listed are not used.

Table 6 US Image IOD Attributes used.

Module	Attribute	Tag	Notes
Patient	Patient's Name	(0010,0010)	G50/G60 S Patient Data Screen – Last Name, First & Middle fields.
	Patient ID	(0010,0020)	G50/G60 S Patient Data Screen – ID field. Default is today's date & time (e.g., 03_04_2003_17_54_43 = Apr. 3, 2003 at 5:54:43 PM).
	Patient's Birth Date	(0010,0030)	G50/G60 S Patient Data Screen – DOB field. Default is a zero length attribute.
	Patient's Sex	(0010,0040)	G50/G60 S Patient Data Screen – Gender field. M = male F = female. O= Other Default is a zero length attribute.
	Patient's Size	(0010,1020)	G50/G60 S Patient Data Screen – Height field.
	Patient's Weight	(0010,1030)	G50/G60 S Patient Data Screen – Weight field.
	Admitting Diagnosis Description	(0008,1080)	G50/G60 S Patient Data Screen – Indication field.
General Study	Study Instance UID	(0020,000D)	
	Study Date	(0008,0020)	Date the exam started.
	Study Time	(0008,0030)	Time the exam started.
	Referring Physician's Name	(0008,0090)	G50/G60 S Patient Data Screen – Physician field.
	Study ID	(0020,0010)	
	Accession Number	(0008,0050)	G50/G60 S Patient Data Screen – Accession # field.
General Series	Modality	(0008,0060)	Set to "US."
	Series Instance UID	(0020,000E)	
	Series Number	(0020,0011)	Series Number is always 1.
General Equipment	Manufacturer	(0008,0070)	Set to "Siemens Ultrasound."
	Institution Name	(0008,0080)	G50/G60 S System Presets – Organization Name field.
General Image	Instance Number	(0020,0013)	Image number in series (1 – n)
Image Pixel	Lossy Image Compression	(0028,2110)	"00"
	Samples per Pixel	(0028,0002)	RGB = 3.

Table 6 US Image IOD Attributes used. (Continued)

Module	Attribute	Tag	Notes
	Rows	(0028,0010)	Set to 502 for NTSC; 539 for PAL. For post-processed images, this value may be up to 600.
	Columns	(0028,0011)	Set to 632 for NTSC; 688 for PAL. For post-processed images, this value may be up to 800.
	Bits Allocated	(0028,0100)	Set to 8.
	Bits Stored	(0028,0101)	Set to 8.
	High Bit	(0028,0102)	Set to 7.
	Pixel Data	(7FE0, 0010)	
	Planar Configuration	(0028,0006)	Color-by-pixel. Always set to 0.
	Pixel Spacing		
	Photometric Interpretation	(0028,0004)	RGB
	Pixel Representation	(0028,0103)	0000H = unsigned integer.
US Image	Image Type	(0008,0008)	Image Type is always = “ “. The G50/G60 S never fills in a value for Image Type.
SOP Common	SOP Class UID	(0008,0016)	Always US Image – 1.2.840.10008.5.1.4.1.1.6.1 or 1.2.840.10008.5.1.4.1.1.6
	SOP Instance UID	(0008,0018)	
Image Plane	Pixel Spacing	(0028,0030)	Pixel Spacing information is only sent for single, full screen, 2D image types (2D image types are B-mode, B-mode with color, B-mode with power).

Table 7 USMF Image IOD Attributes used.

Module	Attribute	Tag	Notes
Patient	Patient's Name	(0010,0010)	G50/G60 S Patient Data Screen – Last Name, First & Middle fields.
	Patient ID	(0010,0020)	G50/G60 S Patient Data Screen – ID field. Default is today's date & time (e.g., 03_04_2003_17_54_43 = Apr. 3, 2003 at 5:54:43 PM).
	Patient's Birth Date	(0010,0030)	G50/G60 S Patient Data Screen – DOB field. Default is a zero length attribute.
	Patient's Sex	(0010,0040)	G50/G60 S Patient Data Screen – Gender field. M = male F = female. O= Other Default is a zero length attribute.

Table 7 USMF Image IOD Attributes used. (Continued)

Module	Attribute	Tag	Notes
	Patient's Size	(0010,1020)	G50/G60 S Patient Data Screen – Height field.
	Patient's Weight	(0010,1030)	G50/G60 S Patient Data Screen – weight field.
	Admitting Diagnosis Description	(0008,1080)	G50/G60 S Patient Data Screen – Indication field.
General Study	Study Instance UID	(0020,000D)	
	Study Date	(0008,0020)	Date the exam started.
	Study Time	(0008,0030)	Time the exam started.
	Referring Physician's Name	(0008,0090)	G50/G60 S Patient Data Screen – Physician field.
	Study ID	(0020,0010)	
	Accession Number	(0008,0050)	G50/G60 S Patient Data Screen – Accession # field.
General Series	Series Instance UID	(0020,000E)	
	Series Number	(0020,0011)	Series Number is always 1.
General Equipment	Manufacturer	(0008,0070)	Set to "Siemens Ultrasound."
	Institution Name	(0008,0080)	G50/G60 S System Presets – Organization Name field.
General Image	Instance Number	(0020,0013)	Image number in series (1 – n)
Image Pixel	Samples per Pixel	(0028,0002)	RGB = 3.
	Rows	(0028,0010)	Set to 502 for NTSC; 539 for PAL.
	Columns	(0028,0011)	Set to 632 for NTSC; 688 for PAL.
	Bits Allocated	(0028,0100)	Set to 8.
	Bits Stored	(0028,0101)	Set to 8.
	High Bit	(0028,0102)	Set to 7.
	Pixel Data	(7FE0, 0010)	
	Lossy Image Compression	(0028,2110)	Set to "01."
	Planar Configuration	(0028,0006)	Color-by-pixel. Always set to 0
	Photometric Interpretation	(0028,0004)	YBR_FULL_422
	Pixel Representation	(0028,0103)	0000H = unsigned integer.
US Image	Image Type	(0008,0008)	Image Type is always = "". The G5/ G60 Never fills in a value for Image Type
	Frame Increment Pointer	(0028,0009)	0x00181063

Table 7 USMF Image IOD Attributes used. (Continued)

Module	Attribute	Tag	Notes
SOP Common	SOP Class UID	(0008,0016)	Always US MF – 1.2.840.10008.5.1.4.1.1.3.1 or 1.2.840.10008.5.1.4.1.1.3
	SOP Instance UID	(0008,0018)	
Image Plane	Pixel Spacing	(0028,0030)	Pixel Spacing information is only sent for single, full screen, 2D image types (2D image types are B-Mode, B-Mode Color, B-Mode with power).
Cine	Frame Time	(0018,1063)	
Multi-Frame	Number of Frames	(0028,0008)	

Table 8 SC Image IOD Attributes used.

Module	Attribute	Tag	Notes
Patient	Patient's Name	(0010,0010)	G50/G60 S Patient Data Screen – Last Name, First & Middle fields.
	Patient ID	(0010,0020)	G50/G60 S Patient Data Screen – ID field. Default is today's date & time (e.g., 03_04_2003_17_54_43 = Apr. 3, 2003 at 5:54:43 PM).
	Patient's Birth Date	(0010,0030)	G50/G60 S Patient Data Screen – DOB field. Default is a zero length attribute.
	Patient's Sex	(0010,0040)	G50/G60 S Patient Data Screen – Gender field. M = male F = female. O= Other Default is a zero length attribute.
	Patient's Size	(0010,1020)	G50/G60 S Patient Data Screen – Height field.
	Patient's Weight	(0010,1030)	G50/G60 S Patient Data Screen – Weight field.
	Admitting Diagnosis Description	(0008,1080)	G50/G60 S Patient Data Screen – Indication field.
General Study	Study Instance UID	(0020,000D)	
	Study Date	(0008,0020)	Date the exam started.
	Study Time	(0008,0030)	Time the exam started.
	Referring Physician's Name	(0008,0090)	G50/G60 S Patient Data Screen – Physician field.
	Study ID	(0020,0010)	
	Accession Number	(0008,0050)	G50/G60 S Patient Data Screen – Accession # field.
General Series	Series Instance UID	(0020,000E)	
	Series Number	(0020,0011)	Series Number is always 1.

Table 8 SC Image IOD Attributes used. (Continued)

Module	Attribute	Tag	Notes
SC Image Equipment Module	Modality	(0008,0060)	Set to "US."
	Conversion Type	(0008,0064)	Set to "WSD"
General Image	Instance Number	(0020,0013)	Image number in series (1 – n)
Image Pixel	Samples per Pixel	(0028,0002)	RGB = 3.
	Rows	(0028,0010)	Set to 502 for NTSC; 539 for PAL. For post-processed images this value may be up to 600
	Columns	(0028,0011)	Set to 632 for NTSC; 688 for PAL. For post-processed images this value may be up to 800
	Bits Allocated	(0028,0100)	Set to 8.
	Bits Stored	(0028,0101)	Set to 8.
	High Bit	(0028,0102)	Set to 7.
	Pixel Data	(7FE0, 0010)	
	Planar Configuration	(0028,0006)	Color-by-pixel. Always set to 0
	Photometric Interpretation	(0028,0004)	RGB
	Pixel Representation	(0028,0103)	0000H = unsigned integer.
SOP Common	SOP Class UID	(0008,0016)	1.2.840.10008.5.1.4.1.1.7
	SOP Instance UID	(0008,0018)	

Error Handling

The following table indicates the response status codes, that are handled by the SONOLINE G50/G60 S AE, which a SCP may return following the SCU's C-STORE-RSP command. Only those status codes that indicate some form of error condition are presented to the user.

A successful C-STORE operation will allow the SONOLINE G50/G60 S AE to continue to the next action desired by the user.

Table 9 C-STORE Status Responses.

Service Status	Further Meaning	Protocol Codes	Related Fields
Refused	Out of resources.	A7xx	None
Error	Data set does not match SOP Class.	A9xx	None
	Cannot understand.	Cxxx	
Warning	Coercion of data Elements.	B000	None
	Data set does not match SOP Class.	B007	
	Elements discarded.	B006	
Success		0000	None

If the C-STORE operation is not successful, the image(s) are spooled on the SONOLINE G50/G60 S hard drive. One additional attempt is made to store the image(s). If this attempt fails, the user must press “Retry All Jobs” on the Store or Print Status page, or restart the system to complete the C-STORE operation.

All image storage on the SONOLINE G50/G60 S system hard drive is temporary in nature. The oldest transferred exams are automatically deleted to make room for new exams, on a need to basis. If an attempt is made to store images on a full SONOLINE G50/G60 S system hard drive, the system will attempt to delete the oldest transferred exam data. If no deleteable data exists, a “DISK FULL” message is displayed on the SONOLINE G50/G60 S system display. The user must then delete exams not transferred in order to temporarily store additional images.

5.1.2.3 Real World Activity - Print

SONOLINE G50/G60 S facilitates user to print images as they are being created or later in review mode.

Paging images during acquisition

One or more of “Store/Print1” and “Store/Print2” keys on the control panel can be configured for Print (DICOM B/W Print and/or DICOM Color Print). When the user presses one of the configured keys on the control panel, the image is acquired, stored on the hard disk and placed in a page under the respective printer layout (DICOM B/W Printer Layout or DICOM Color Printer Layout).

Paging images in Review mode

User can select individual images from open/closed studies, one or more closed studies and queue them up for print. DICOM B/W Printer and DICOM Color Printer buttons are available in Review screen for this operation. When a study is selected for print, all single-frame images belonging to the study will be paged.

Transfer of pages to the Printer

Pages may be immediately transferred or delayed till the end of study using the transfer configuration.

G50/G60S supports two configurations: "Print At End of Exam" and "Print when page full."

If the configuration is set to "Print At End of Exam", all pages queued to destination devices will be transferred as a batch when the user selects "Close Study" or "New Patient."

If the configuration is set to "Print when page full," a page is transferred to destination devices immediately after it is full.

For both "Print At End of Exam," and "Print when page full" settings, image transfer will be delayed if the G50/G60 S is busy performing another DICOM Command (Store/Print/Echo).

Associated Real World Activities

An association is established when the user initiates a "B/W Print" or "Color Print" operation from the Review screen. Individual images or entire exams can be transferred to the selected DICOM Print device. The association is opened when the first image of each selected exam is transferred and closed when the last image transfer is complete. An association is also opened after a network outage, or if images are queued to be printed, or when the system is powered-on and the images are queued to be printed.

Proposed Presentation Context to a Grayscale Print Server

Table 10 Grayscale Print Presentation Context.

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Basic Grayscale Print Management Meta SOP Class	1.2.840.10008.5.1.1.9	DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
Basic Grayscale Print Management Meta SOP Class	1.2.840.10008.5.1.1.9	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

SOP Specific Conformance to Basic Grayscale Print Management Meta SOP Class

The SONOLINE G50/G60 S AE provides standard conformance of the Grayscale Meta SOP classes as an SCU. Specifically, with respect to the Basic Grayscale Print Management Meta SOP Class this means conformance to the underlying SOP classes:

Table 11 Conformance to Grayscale Print Meta SOP Class.

SOP Class Name	SOP Class UID	Conformance Level
Basic Film Session SOP Class	1.2.840.10008.5.1.1.1	Standard
Basic Film Box SOP Class	1.2.840.10008.5.1.1.2	Standard
Basic Grayscale Image Box SOP Class	1.2.840.10008.5.1.1.4	Standard
Printer SOP Class	1.2.840.10008.5.1.1.16	Standard

All mandatory elements of these classes are supported.

Specific Conformance to Basic Film Session SOP Class

DICOM specified usage - M = Mandatory; U = User Option

Table 12 Supported DIMSE Services for Basic Film Session SOP Class.

Name	Usage	Description
N-Create	M	Creates the Film Session.
N-Set	U	Not used.
N-Delete	U	Deletes the Film Session.
N-Action	U	Not used.

SOP Specific Conformance to Basic Film Box SOP Class

Table 13 Supported DIMSE Services for Basic Film Box SOP Class.

Name	Usage	Description
N-Create	M	Creates the Film Box.
N-Set	U	Not used.
N-Delete	U	Deletes the Film Box. Issued after each film is printed.
N-Action	M	PRINT. Sent after each Film Box is filled, and at the end of the exam to force a print of partially filled Film Box.

Table 14 Optional Attributes set for the Basic Film Box SOP Class.

Attribute Name	Attribute Tag	Usage	Range	Description
Image Display Format	(2010,0010)		STANDARD\ X,Y	Where X, Y can be configured/ selected as 1*1, 1*2, 2*2, 2*3, 3*2, 3*3, 3*5, 4*5, 4*6, 5*6
Film Orientation	(2010,0040)	U	PORTRAIT LANDSCAPE	Range may be limited by print server/printer.
Film Size ID	(2010,0050)	U	8INX10IN 8.5INX11IN 10INX12IN 10INX14IN 11INX14IN 11INX17IN 14INX17IN 24CMX24CM 24CMX30CM A3 A4	Range may be limited by print server/printer.
Magnification Type	(2010,0060)	U	REPLICATE BILINEAR CUBIC NONE	Used.
Min. Density	(2010,0120)	U	1-349	Used - printer specific
Max Density	(2010,0130)	U	1-349	Used - printer specific
Configuration Information	(2010,0150)	U	Limited by Print server/printer.	Not Used.
Smoothing Type	(2010,0080)	U	Values depend on Printer	Used.
Border Density	(2010,0100)	U	BLACK WHITE	
Empty Image Density	(2010,0110)	U	BLACK WHITE	
Trim	(2010,0140)	U	YES NO	Used.

SOP Specific Conformance to Basic Grayscale Image Box SOP Class

Table 15 Supported DIMSE Services for the Basic Grayscale Image Box SOP.

Name	Usage	Description
N-Set	M	The SCP for each potential image of the film box creates an image box instance. Only those instances, which actually contain images, will be updated with the N-SET message.

Table 16 Optional Attributes set for the Basic Grayscale Image Box SOP Class.

Name	Attribute	Range	Description
Image Position	(2020,0010)	1-30	Value according to Image Display Format
Polarity	(2020,0020)	NORMAL, REVERSE	Intensity mapping between display and print
Magnification Type	(2010,0060)	REPLICATE, BILINEAR, CUBIC, NONE	Used. Note that Magnification Type is always set to the same value as FILM BOX
Smoothing Type	(2010,0080)	Values depend on Printer	Used. Note that Smoothing Type is always set to the same value as FILM BOX

Table 17 Supported DIMSE Services for the Printer SOP.

Name	Usage	Description
N-Event-Report	M	Ignored and not handled.
N-Get	U	May be issued by this device at any time to get printer status.

Table 18 Supported Printer SOP Class Elements.

Name	Usage	Range	Description
Printer Status	U	WARNING FAILURE	During a "Failure" the Print job will be displayed as "Failed, awaiting retry"
Printer Status Information	U	Vendor specific	Reported to user if printer status = WARNING or FAILURE.
Printer Name	U		Used (not reported to user)
Manufacturer	U		Used (not reported to user)
Manufacturers Model Name	U		Used (not reported to user)
Device Serial Number	U		Used (not reported to user)
Software Versions	U		Used (not reported to user)
Date of Last Calibration	U		Used (not reported to user)
Time of Last Calibration	U		Used (not reported to user)

Proposed Presentation Context to a Color Print Server

Table 19 Color Print Server Presentation Context.

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Basic Color Print Management Meta SOP Class	1.2.840.10008.5.1.1.18	DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
Basic Color Print Management Meta SOP Class	1.2.840.10008.5.1.1.18	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

SOP Specific Conformance to Basic Color Print Management Meta SOP Class

The SONOLINE G50/G60 S Print AE provides standard conformance to the color printing Meta SOP classes as an SCU. Specifically, with respect to the Basic Color Print Management Meta SOP Class this means conformance to the underlying SOP classes:

Table 20 Conformance to Color Print Meta SOP Class.

SOP Class Name	SOP Class UID	Conformance Level
Basic Film Session SOP Class	1.2.840.10008.5.1.1.1	Standard
Basic Film Box SOP Class	1.2.840.10008.5.1.1.2	Standard
Basic Color Image Box SOP Class	1.2.840.10008.5.1.1.4.1	Standard
Printer SOP Class	1.2.840.10008.5.1.1.16	Standard

SOP Specific Conformance to Basic Color Image Box SOP Class

The Basic Color Print Management Meta SOP Class makes identical use of the *Basic Film Session SOP Class*, *Basic Film Box SOP Class* and *Printer SOP Class* elements, which have been previously described, for grayscale image printing. Therefore, these will not be described again in this section on color printing. However, it should be noted that certain attributes, such as Medium Type which is defined in the Basic Film Session SOP Class, are highly likely to require printer/print server specific media.

Table 21 Supported DIMSE Services for the Basic Color Image Box SOP Class.

Name	Usage	Description
N-Set	M	The SCP for each potential image of the film box creates an image box instance. Only those instances, which actually contain images, will be updated with the N-SET message.

Table 22 Optional attributes set for the Basic Color Image Box SOP Class.

Name	Attribute	Range	Description
Planar Configuration	(0028,0006)	Color-by-plane	Red plane, Green plane, Blue plane.

The Printer SOP Class behavior is identical to that used for grayscale printing.

Error Handling

The SONOLINE G50/G60 S Print AE supports the following error codes and reports failures to the user.

Table 23 Supported Error Codes for Printer Classes.

Service Status	Further Meaning	Protocol Codes
Success	Film accepted for Printing	0000
Warning	Film accepted for Printing, one or more settings ignored.	107,116,B600,B605
Failure	Printing not successful	C602, C603, C613

If the print operation is not successful, the image(s) are spooled on the SONOLINE G50/G60 S hard drive. One additional attempt is made to print the image(s). If this attempt fails, the user must press “Retry All Jobs” on the Store or Print Status page, or restart the system to complete the print operation.

5.1.2.4 Real World Activity - Worklist

A separate Network association is established by the AE for each Worklist query operation, with only one active query at a time. The association is closed at completion of the query.

Table 24 Worklist Presentation Context Table.

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Modality Worklist Information Model - FIND	1.2.840.10008.5.1.4.31	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
Modality Worklist Information Model - FIND	1.2.840.10008.5.1.4.31	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

The SONOLINE G50/G60 S will always act as an SCU and be the client in a client-server model.

SOP Specific Conformance to Modality Worklist Service SOP Classes

The Worklist AE provides conformance to the following DICOM Service SOP Classes as an SCU all at a standard extended level of conformance:

Table 25 Supported SOP Classes.

Supported SOP Class Name	SOP Class UID	Conformance Level
Modality Worklist Information Model - FIND	1.2.840.10008.5.1.4.31	Standard Extended

The following table provides the list of attributes requested in the Modality Worklist Query.

Table 26 Modality Worklist Information Model Attributes.

Attribute Name	Tag
Patient Name (first,middle,last)	(0010,0010)*
Patient ID	(0010,0020)*
Accession number	(0008,0050)*
Requested Procedure ID	(0040,1001)*
US/All Modality	(0008,0060)*
Scheduled Station AE Title	(0040,0001)*
Exam start date/time	(0040,0002), (0040,0003)*
DOB	(0010,0030)
Sex	(0010,0040)
Weight	(0010,1030)
Height	(0010,1020)
Physician	(0008,0090)
Indication	(0080,1080)
Scheduled Procedure Step Sequence	(0040,0100)
>Scheduled Procedure Step Description	(0040,0007)
>Scheduled Action Item Sequence	(0040,0008)
>> Code Value	(0008,0100)
Requested Procedure Description	(0032,1060)
LMP	(0010,21D0)
Study UID	(0020,000D)
Series UID	(0020,000E)
*Indicates parameter may be populated for query.	

5.1.2.5 Error Handling

The user is informed of an error if the server is detected but an association cannot be formed.

6.0 Communication Profiles

All SONOLINE G50/G60 S system application entities utilize the DICOM 3.0 TCP/IP communication support as defined in PS3.8 (Part 8) of the DICOM 3.0 Standard.

6.1 TCP/IP Stack Supported

Each process inherits its TCP/IP stack from the SONOLINE G50/G60 S's operating systems TCP/IP stack. Port number 104 is used as the default for DICOM communication with the SONOLINE G50/G60 S.

6.1.1 Physical Media Supported

Standard representations of IEEE 802.3 10BaseT/100BaseT ("twisted pair") is supported

6.1.2 Chapter Extensions/Specializations/Privatizations

No private elements are used by the SONOLINE G50/G60 S AE.

Pixel Spacing information is only sent for single, full screen, and 2D image types (B-mode, B-mode with color, and B-mode with power).

7.0 Configuration

SONOLINE G50/G60 S Networking and DICOM parameters can be configured through the SONOLINE G50/G60 S System Presets Menu screens. The following configuration is supported:

- General system
- Network (local and remote)
- DICOM Store
- DICOM Print
- Modality Worklist

7.1 General System Configuration

The following system parameter can be configured via the SONOLINE G50/G60 S System Presets Basic Menu screens. This parameter is mapped to DICOM image attributes:

- Hospital Name

7.1.1 Hospital Name

The user can enter the organization (i.e. hospital, clinic, etc.) as a text string in the Organization Name field of the System Presets - Basic menu. The Organization Name field is transferred to DICOM devices as Institution Name - DICOM data element (0008, 0080).

7.2 DICOM Network Configuration

DICOM and networking parameters can be configured for both the local G50/G60 S device and remote DICOM service class providers through the System Presets DICOM Network Menu.

7.2.1 Local

The SONOLINE G50/G60 S local network parameters are configurable. The following network parameters can be configured for SONOLINE G50/G60 S device:

- Host Name
- IP address
- Subnet IP mask
- Default Gateway

- Port Number
- DICOM Application Entity Title

7.2.2 Remote

Multiple DICOM service class providers can be configured through the system presets. The following network parameters can be configured for each remote device:

- DICOM Device Application Entity Title
- IP address
- Port Number

7.3 DICOM Print Configuration

For each DICOM Print server, the following data is configurable by the user using the System Presets DICOM Print User Interface. The user can change each element at any time during the operation of the SONOLINE G50/G60 S. The effect of changing parameters of the DICOM Print server will be seen at the next created film sheet. The current film sheet is not affected by changing these parameters.

Table 27 User-configurable printer parameters.



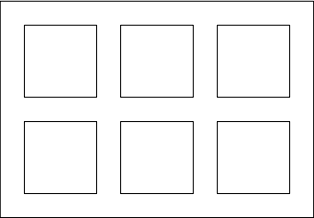
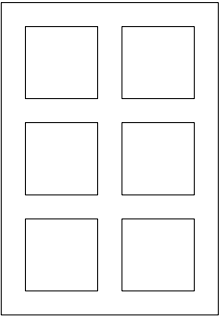
Parameter	Description
Printer Type:	Color or Black and White - depends on printer
Film Size	Select the size of the film - 8x10 inches, 8.5x11 inches, 10x12 inches, 10x14 inches, 11x14 inches, 11x17 inches, 14x17 inches, 24x24 centimeters, 24x30 centimeters, A3, or A4.
Film Orientation	Select from Portrait: <div style="text-align: center; margin: 10px 0;">  </div> or Landscape: <div style="text-align: center; margin: 10px 0;">  </div>

Table 27 User-configurable printer parameters. (Continued)

Parameter	Description
Display Format	<p>You must supply the number of rows and columns of images on the printed sheet. For example, a 6 on 1 print with Landscape mode should have 3 columns and 2 rows:</p>  <p>A 6 on 1 with Portrait mode would have 2 columns and 3 rows:</p> 
Print Priority	HIGH, MEDIUM or LOW
Medium Type	PAPER, CLEAR FILM, BLUE FILM, TRANSPARENCY or CURRENT (to use the currently loaded media)
Film Destination	MAGAZINE, PROCESSOR or CURRENT
Max. Density	Used to define the Black value - printer specific
Min. Density	Used to define the White value - printer specific
Smoothing Type	Printer specific value
Border Density	BLACK or WHITE
Empty Image Density	BLACK or WHITE
Trim	YES/NO to having a border around each image
Polarity	Normal/reverse. Normal means black is printed as black. Reverse means the grayscale is inverted so that black comes out as white and white as black.
Configuration Information:	Printer Specific values

7.4 DICOM Worklist Configuration

Remote DICOM Worklist Service Class Providers are configured through the DICOM - Worklist page of the System Presets. The following parameters can be configured for each Worklist server:

- AET (Application Entity Title)
- IP Address
- Port number
- Alias
- 'Active' listbox - makes the current selected device the active Worklist server.

Additionally, these can be specified over all servers:

- Maximum number of returns per query.
- Streamlined search

7.5 External Equipment Configuration

The SONOLINE G50/G60 S user can configure “Hard Key” to “Output Device” mapping through the System Presets - Customize Keys. Print images are acquired and sent to the assigned device when the user presses the associated key. The following key assignments are supported:

- **Digital Store** – This key can be assigned to Multi-frame Store Capture, Cine Store or Disk Store
- **Print/Store 1** – This key can be assigned to any configured DICOM Printer, DICOM Store or OEM printer device.
- **Print/Store 2** – This key can be assigned to any configured DICOM Printer, DICOM Store or OEM printer device.

7.6 Support of Extended Character Sets

The “ISO-IR 100” Latin Alphabet 1 Extended character set is supported by the SONOLINE G50/G60 S system.

