

Siemens Medical Solutions USA, Inc. Ultrasound Division

SONOLINE G20 Product Platform DICOM Conformance Statement

Revision Data

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01	DICOM Conformance Statement for G20 1.0 Release	19-Mar-2004	

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1.0 Purpose

This document describes the conformance to the ACR-NEMA DICOM 3.0 Standard by the SONOLINE G20 ultrasound system software version 1.0 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 G20 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 G20 system provides support for essential services related to ultrasound scanning and connectivity to DICOM compliant devices. SONOLINE G20 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 G20. 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 G20 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 3.2-2003, 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	The American College of Radiology (ACR) and the National Electrical Manufacturers Association (NEMA) formed a joint committee to develop a standard for Digital Imaging and Communications in Medicine (DICOM).
Application Entity	AE	An application that supports DICOM communication with other DICOM applications.
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
Digital Imaging and Communications in Medicine, Version 3.0	DICOM 3.0	
DICOM Message Service Element	DIMSE	The DIMSE defines an Application Service Element (both the service and protocol) used by peer DICOM Application Entities for the purpose of exchanging medical images and related information.
Ethernet	-	Network methodology devised in 1976 by Digital Equipment Corporation, Intel and 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	A DICOM server that accepts medical images from another DICOM system and stores the images for later retrieval.
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	RQ	A request from one DICOM AE for service from another DICOM AE
Response	RSP	A response from one DICOM AE to the request for service from another DICOM AE

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

Term	Acronym	Description
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.
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 invokes notifications and performs operations 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	A series of digits and periods (.) used to uniquely identify an object such as an Ultrasound image in DICOM.

4.0 Implementation Model

SONOLINE G20 system users can store images and other data directly on the SONOLINE G20 system hard disk. Images can be exported to a DICOM archive server or workstation on a network. In the following sections, SONOLINE G20 system Real World Activities are indicated by “Real World Activity” name while “G20 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 1 illustrates the SONOLINE G20 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.

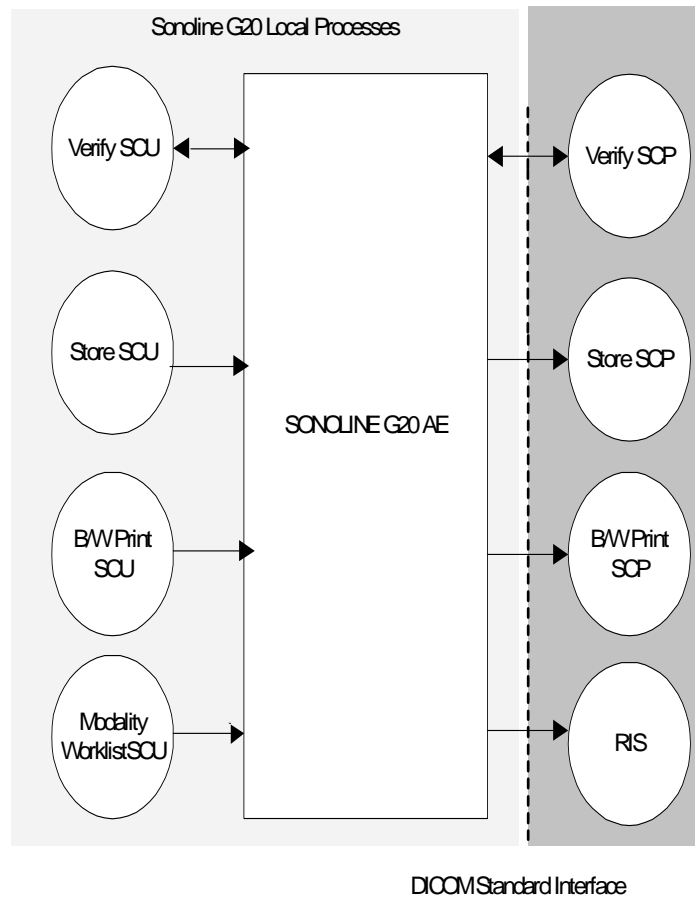


Figure 1 Implementation Model.

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 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"

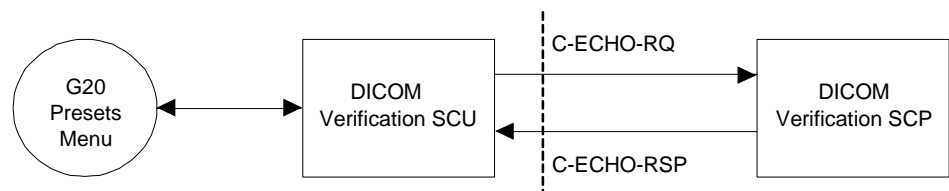


Figure 2 Verification Model.

4.1.2 DICOM Store

When requested the SONOLINE G20 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:

G20 can be configured to automatically queue up images for transfer as they are being created. "AutoStore to DICOM" option in Storage 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.

G20 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”, transfer attempts begin when the user selects “Close Study” or “New Patient”.

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

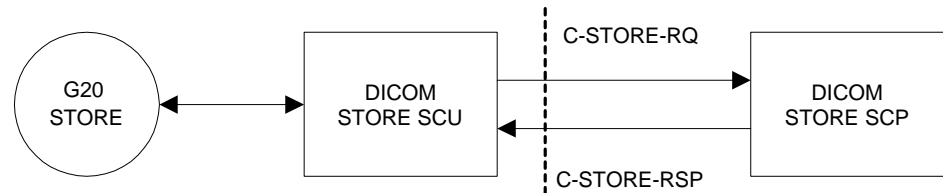


Figure 3 Store Model.

4.1.3 DICOM Print

SONOLINE G20 system is capable of grayscale (B/W) 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 G20 can be configured to automatically queue up images to be printed on B/W 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).

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 G20 supports two configurations: “Print At End of Exam” and “Print When Page Full”.

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

If the configuration is set to “Print When Page Full”, transfer attempts of a page to the destination DICOM printer begins as soon as it becomes full.

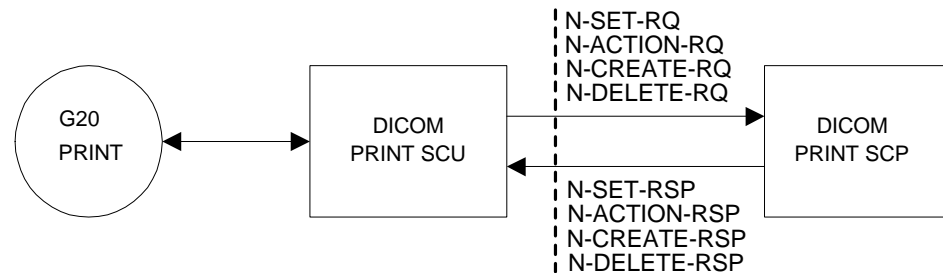


Figure 4 Print Model.

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' button on the patient data display screen invokes the Worklist query screen. (It can also be initiated from the Study screen).

Pressing the 'Search' button will attempt to find all matching patient data 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. Patient ID, Requested Procedure 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. The search list criteria will contain:

- Patient name
- Patient ID
- Accession number
- Exam start date/time range
- Requested Procedure ID
- US/All modalities
- Scheduled station AE title

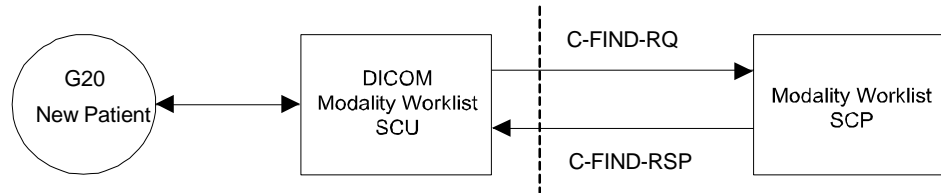


Figure 5 Modality Worklist Model

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)**

*<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 “Retrieving worklist, please wait ...” dialog will be presented to the user. The user will only have one option, “Cancel,” which will abort the query operation.

4.1.5 Removable Media Storage

The G20 can perform DICOM operations to its standard on-board 120mm CD disk drive.

The G20 performs only the File Set Creator Role for CD disks.

A DICOM conformant CD media is created when the user saves studies in DICOM format to the CD. A DICOM 3.0 conforming DICOMDIR file is created together with the directory structures and image files.

4.2 AE Functional Definition

4.2.1 Verification Real-World Activities

The SONOLINE G20 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 G20 system's ability to receive DICOM messages. (C-ECHO DIMSE)

4.2.2 Store Real-World Activities

The SONOLINE G20 Application Entity (AE) performs all of the functions to transmit ultrasound images and associated data to network servers or workstations. The SONOLINE G20 AE supports the Ultrasound Image, Ultrasound Image (Retired) and Secondary Capture storage SOP classes as an SCU.

The SONOLINE G20 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 images and is closed when no images are available to be stored to the remote device for five seconds.

4.2.3 Print Real-World Activities

The SONOLINE G20 AE provides all aspects of the Print Management SCU. The SONOLINE G20 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 Modality Worklist Real-World Activities

The Sonoline G20 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 maximum number of matching results is accepted, at which point, the Sonoline G20 AE issues a C-CANCEL-RQ.

4.4 Removable Media Storage Real-World Activities

The Sonoline G20 AE provides partial implementation of DICOM Store to CD. The Sonoline G20 AE selects one or more studies and exports the same to CD. Sonoline G20 AE creates a DICOM File Format Image File for every image in each of the selected studies.

DICOMDIR file is created along with the files.

4.5 Sequencing of Real-World Activities

Print, Store, Echo and Worklist all occur on separate threads, so they can occur simultaneously.

5.0 AE Specifications

The following specifications apply to the SONOLINE G20 AE as depicted in Figure 1.

5.1 SONOLINE G20 AE Specification

The SONOLINE G20 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
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7

Table 2 Supported SOP Classes. (Continued)

Service SOP Class Name	SOP Class UID
Basic Grayscale Print Management Meta SOP Class	1.2.840.10008.5.1.1.9
Basic Grayscale Image Box SOP Class	1.2.840.10008.5.1.1.4
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 G20 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 G20 is:

- Maximum PDU Offered: 28672

5.1.1.2 Association Establishment Order

The SONOLINE G20 initiates each C-Store Request one at a time, one for each transfer request being processed.

Image format on G20 can be set to one of “Automatic”, “Old Ultrasound” or “Secondary Capture”.

In “Automatic” setting, G20 proposes Ultrasound Image, Ultrasound Image (Retired) and Secondary Capture Image sequentially.

In “Old Ultrasound” setting, G20 proposes Ultrasound Image (Retired) and Secondary Capture Image to be negotiated sequentially.

In “Secondary Capture” setting, G20 proposes 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 G20 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_330”

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)

5 = DICOM Implementation G20

5.1.2 Association Initiation by Real-World Activities

5.1.2.1 Real World Activity – Verification

The SONOLINE G20 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 G20 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

The SONOLINE G20 facilitates users 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). 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:

User can select either individual images from open or closed studies or 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.

G20 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 G20 is busy performing another store operation.

Associated Real World Activities

When images are transferred from the hard disk to a DICOM Store SCP, the system establishes an association between the G20 AE and the configured DICOM device. The association may be used to store multiple images and is closed when no images 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-RQ for DIMSE C-STORE storage services. The storage services utilize C-STORE services, as defined by the DICOM Standard. Table 4 represents all “Store” presentation contexts.

Table 4 Store Presentation Context.

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
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
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 G20 system always acts as an SCU for store 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 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 or Secondary Capture IOD.

The following table denotes the attributes included in the Ultrasound Image Object as implemented on the SONOLINE G20. Attributes not listed are not used.

Table 6 Ultrasound Image and Ultrasound RETIRED Image IOD Attributes

Module	Attribute	Tag	Notes
	Specific Character Set	(0008,0005)	Populated from Modality Worklist if used.
Patient Identification	Patient's Name	(0010,0010)	G20 Patient Data Screen – Last Name, First & Middle fields. Populated from Modality Worklist if used.
	Patient ID	(0010,0020)	G20 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) Populated from Modality Worklist if used.
Patient Demographic	Patient's Birth Date	(0010,0030)	G20 Patient Data Screen – DOB field; Default is a zero length attribute. Populated from Modality Worklist if used.
	Patient's Sex	(0010,0040)	G20 Patient Data Screen – Gender field. M = male F = female. O= Other Default is a zero length attribute. Populated from Modality Worklist if used.
	Patient's Age	(0010,1010)	Calculated from Patient Data Screen DOB field.

Module	Attribute	Tag	Notes
	Patient's Size	(0010,1020)	G20 Patient Data Screen – Height field; Populated from Modality Worklist if used.
	Patient's Weight	(0010,1030)	G20 Patient Data Screen – Weight field; Populated from Modality Worklist if used.
Patient Study	Admitting Diagnosis Description	(0008,1080)	G20 Patient Data Screen – Indication field; Populated from Modality Worklist if used.
General Study	Study Instance UID	(0020,000D)	Populated from Modality Worklist if used.
	Study Date	(0008,0020)	Date the exam started
	Study Time	(0008,0030)	Time the exam started
	Referring Physician's Name	(0008,0090)	G20 Patient Data Screen – Physician field; Populated from Modality Worklist if used.
	Study ID	(0020,0010)	
	Accession Number	(0008,0050)	G20 Patient Data Screen – Accession # field; Populated from Modality Worklist if used.
	Study Description	(0008,1030)	Populated from Modality Worklist if used.
General Series	Modality	(0008,0060)	Set to "US"
	Series Instance UID	(0020,000E)	
	Series Number	(0020,0011)	Series Number in study (1-n)
	Laterality	(0020,0060)	Always sent as 0 length attribute
General Equipment	Manufacturer	(0008,0070)	Set to "Siemens Ultrasound"
	Institution Name	(0008,0080)	G20 System Presets – Organization Name field
	Software Versions	(0018,1020)	DICOM software version
	Manufacturer's Model Name	(0008,1090)	Set to "G20"
General Image	Instance Number	(0020,0013)	Image number in study (1 – n)
	Patient Orientation	(0020,0020)	Always sent as 0 length attribute
Image Pixel	Samples per Pixel	(0028,0002)	Set to 1
	Photometric Interpretation	(0028,0004)	Set to "MONOCHROME2"
	Rows	(0028,0010)	Set to 480
	Columns	(0028,0011)	Set to 640
	Bits Allocated	(0028,0100)	Set to 8
	Bits Stored	(0028,0101)	Set to 8
	High Bit	(0028,0102)	Set to 7

Module	Attribute	Tag	Notes
	Pixel Representation	(0028,0103)	Set to 0
	Pixel Data	(7FE0, 0010)	
VOI LUT	Window Center	(0028,1050)	Set to 128
	Window Width	(0028,1051)	Set to 256
US Image	Image Type	(0008,0008)	Always sent as a 0 length attribute
	Lossy Image Compression	(0028,2110)	Set to "00"
SOP Common	SOP Class UID	(0008,0016)	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)	

Table 7 Secondary Capture Image IOD Attributes used.

	Specific Character Set	(0008,0005)	Populated from Modality Worklist if used.
Patient Identification	Patient's Name	(0010,0010)	G20 Patient Data Screen – Last Name, First & Middle fields. Populated from Modality Worklist if used.
	Patient ID	(0010,0020)	G20 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); Populated from Modality Worklist if used.
Patient Demographic	Patient's Birth Date	(0010,0030)	G20 Patient Data Screen – DOB field; Default is a zero length attribute; Populated from Modality Worklist if used.
	Patient's Sex	(0010,0040)	G20 Patient Data Screen – Gender field. M = male F = female. O= Other Default is a zero length attribute. Populated from Modality Worklist if used.
	Patient's Age	(0010,1010)	Calculated from Patient Data Screen DOB field.
	Patient's Size	(0010,1020)	G20 Patient Data Screen – Height field; Populated from Modality Worklist if used.
	Patient's Weight	(0010,1030)	G20 Patient Data Screen – Weight field; Populated from Modality Worklist if used.
Patient Study	Admitting Diagnosis Description	(0008,1080)	G20 Patient Data Screen – Indication field; Populated from Modality Worklist if used.
General Study	Study Instance UID	(0020,000D)	Populated from Modality Worklist if used.

	Study Date	(0008,0020)	Date the exam started
	Study Time	(0008,0030)	Time the exam started
	Referring Physician's Name	(0008,0090)	G20 Patient Data Screen – Physician field; Populated from Modality Worklist if used.
	Study ID	(0020,0010)	
	Accession Number	(0008,0050)	G20 Patient Data Screen – Accession # field; Populated from Modality Worklist if used.
	Study Description	(0008,1030)	Populated from Modality Worklist if used.
General Series	Modality	(0008,0060)	Set to "US"
	Series Instance UID	(0020,000E)	
	Series Number	(0020,0011)	Series Number in study (1-n)
	Laterality	(0020,0060)	Always sent as 0 length attribute
General Equipment	Manufacturer	(0008,0070)	Set to "Siemens Ultrasound"
	Institution Name	(0008,0080)	G20 System Presets – Organization Name field
	Software Versions	(0018,1020)	Set to DICOM software version
	Manufacturer's Model Name	(0008,1090)	Set to "G20"
SC Image Equipment Module	Conversion Type	(0008,0064)	Set to "WSD"
General Image	Instance Number	(0020,0013)	Image number in study (1 – n)
	Patient Orientation	(0020,0020)	Always sent as 0 length attribute
Image Pixel	Samples per Pixel	(0028,0002)	Set to 1
	Photometric Interpretation	(0028,0004)	Set to "MONOCHROME2"
	Rows	(0028,0010)	Set to 480
	Columns	(0028,0011)	Set to 640
	Bits Allocated	(0028,0100)	Set to 8
	Bits Stored	(0028,0101)	Set to 8
	High Bit	(0028,0102)	Set to 7
	Pixel Representation	(0028,0103)	Set to 0
	Pixel Data	(7FE0, 0010)	
VOI LUT	Window Center	(0028,1050)	Set to 128
	Window Width	(0028,1051)	Set to 256
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 G20 AE. These status codes may be returned by a DICOM Storage CSP. A successful C-STORE operation will allow the SONOLINE G20 AE to continue to the next action desired by the user.

Table 8 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. Cannot understand.	A9xx Cxxx	None
Warning	Coercion of data Elements. Data set does not match SOP Class. Elements discarded.	B000 B007 B006	None
Success		0000	None

The SONOLINE G20 treats Warning statuses the same as Success except that information about the warning is displayed to the user in the Error column of the Store Status Screen. Error and Refused status are treated as failures.

If the C-STORE operation is not successful, the image(s) are spooled on the SONOLINE G20 hard drive. A user-configured number of additional attempt are made to store the image(s). If these attempts fail the user must select the job and press "Retry Job" on the Store Status page to complete the C-STORE operation.

5.1.2.3 Real World Activity - Print

SONOLINE G20 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). 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 printer layout (DICOM B/W Printer Layout).

Paging images in Review mode

User can select either individual images from open/closed studies, or one or more closed studies and queue them up for print. DICOM B/W Printer button is 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.

G20 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 G20 is busy performing another DICOM Print operation.

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 five seconds after 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 9 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 G20 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 10 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 11 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 12 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 13 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	
Min. Density	(2010,0120)	U	1-349	Printer specific
Max Density	(2010,0130)	U	1-349	Printer specific
Configuration Information	(2010,0150)	U	Limited by Print server/printer.	Printer specific
Smoothing Type	(2010,0080)	U	Values depend on Printer	Printer specific
Border Density	(2010,0100)	U	BLACK WHITE	
Empty Image Density	(2010,0110)	U	BLACK WHITE	
Trim	(2010,0140)	U	YES NO	

SOP Specific Conformance to Basic Grayscale Image Box SOP Class

Table 14 Supported DIMSE Services for the Basic Grayscale Image Box SOP.

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

Table 15 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	Note that Magnification Type is always set to the same value as FILM BOX
Smoothing Type	(2010,0080)	Values depend on Printer	Note that Smoothing Type is always set to the same value as FILM BOX

Table 16 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 17 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"
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)

Error Handling

The SONOLINE G20 Print AE supports the following error codes and reports failures to the user.

Table 18 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

The SONOLINE G20 treats Warning statuses the same as Success except that information about the warning is displayed to the user in the Error column of the Print Status Screen. Error and Refused status are treated as failures.

If the print operation is not successful, the image(s) are spooled on the SONOLINE G20 hard drive. A user-configured number of additional attempts are made to print the image(s). If these attempts fail, the user must select the job and press "Retry Job" on the Print Status page 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 19 Worklist Presentation Context Table

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Modality Worklist	1.2.840.10008.	Implicit VR	1.2.840.10008.	SCU	None
Information Model - FIND	5.1.4.31	Little Endian	1.2		

The SONOLINE G20 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 20 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 21 Modality Worklist Information Model Attributes

Attribute Name	Tag
Specific Character Set	(0008,0005)
Patient Name (first,middle,last)	(0010,0010)*
Patient ID	(0010,0020)*
Accession number	(0008,0050)*
Requested Procedure ID	(0040,1001)*
Reason For the Requested Procedure	(0040,1002)
Patient's Birth Date	(0010,0030)
Patient's Sex	(0010,0040)
Patient's Size	(0010,1020)
Patient's Weight	(0010,1030)
Referring Physician's Name	(0008,0090)
Admitting Diagnosis Description	(0080,1080)
Scheduled Procedure Step Sequence	(0040,0100)
>Scheduled Procedure Step Description	(0040,0007)
>Scheduled Protocol Code Sequence	(0040,0008)
>> Code Value	(0008,0100)
>> Coding Scheme Designator	(0008,0102)
>> Coding Scheme Version	(0008,0103)
>> Code Meaning	(0008,0104)
>Scheduled Station AE Title	(0040,0001)*
>Scheduled Procedure Step Start Date	(0040,0002)*
>Scheduled Procedure Step Start Time	(0040,0003)*
>Modality	(0008,0060)*
>Scheduled Procedure Step ID	(0040,0009)
>Comments on the Scheduled Procedure Step	(0040,0400)
Requested Procedure Description	(0032,1060)
Last Menstrual Date	(0010,21D0)
Study Instance UID	(0020,000D)
Series Instance UID	(0020,000E)
Study Description	(0008,1030)
>Requested Procedure Code Sequence	(0032,1064)
>> Code Value	(0008,0100)
>> Coding Scheme Designator	(0008,0102)
>> Coding Scheme Version	(0008,0103)
>> Code Meaning	(0008,0104)
Referenced Study Sequence	(0008,1110)

Attribute Name	Tag
>Referenced SOP Class UID	(0008,1150)
>Referenced SOP Instance UID	(0008,1155)
Requesting Physician	(0032,1032)
Patient State	(0038,0500)
Pregnancy Status	(0010,21C0)
Medical Alerts	(0010,2000)
Contrast Allergies	(0010,2110)
Special Needs	(0038,0050)
Patient Comments	(0010,4000)
*Indicates parameter may be populated for query.	

6.0 Removable Media Interchange Specifications

This implementation supports 120mm CD-R medium.

6.1 Supported Application Profiles

Sonoline G20 provides standard conformance to the following four of the Ultrasound Application Profiles.

Table 22 Application Profiles, Real-World Activities, and Roles

Supported AP	Real-World Activity	Roles	SC Option
STD-US-ID-SF-CDR	Create CD-R	FSC	Interchange
STD-US-SC-SF-CDR	Create CD-R	FSC	Interchange

6.2 Supported SOP Classes

6.2.1 Supported SOP Classes and Transfer Syntaxes

This implementation provides standard conformance to the following DICOM 3.0 SOP Classes.

Table 23 Proposed Transfer Syntaxes for Media Interchange

Service SOP Class Name	SOP Class UID	Transfer Syntax Name	Transfer Syntax UID List
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

6.3 Information Object Definition and DICOMDIR Keys

6.3.1 DICOM File Meta Information

The following table denotes the attributes included in the Ultrasound Image Object as implemented on the Sonoline G20 in addition to the attributes listed in Table 6.

Table 24 US Image Attributes Used (Refer Table 6 for additional attributes used)

Attribute Name	Tag	Notes
File Preamble	No Tag or Length fields	All bytes are set to 00H
DICOM Prefix	No Tag or Length fields	Set to DICOM Prefix "DICM"
Group length	(0002,0000)	
File Meta Information Version	(0002,0001)	Always set to 0001H
Media Storage SOP Class UID	(0002,0002)	Always Ultrasound Image 1.2.840.10008.5.1.4.1.1.6.1
Media Storage SOP Instance UID	(0002,0003)	
Transfer Syntax UID	(0002,0010)	Always Explicit VR Little Endian 1.2.840.10008.1.2.1

6.3.2 Basic Directory IOD - File-set Identification Module

Attribute	Tag	Notes
File-Set ID	(0004,1130)	Always Set

6.3.3 Basic Directory IOD - Directory Identification Module

Attribute	Tag	Notes
Offset of the First Directory Record of the Root Directory Entry	(0004,1200)	
Offset of the Last Directory Record of the Root Directory Entry	(0004,1202)	
File-set Consistency Flag	(0004,1212)	
Directory Record Sequence	(0004,1220)	
>Offset of the Next Directory Record	(0004,1400)	
>Record In-use Flag	(0004,1410)	
>Offset of Referenced Lower-Level Directory Entity	(0004,1420)	
>Directory Record Type	(0004,1430)	
>Referenced File ID	(0004,1500)	
>Referenced SOP Class UID in File	(0004,1510)	
>Referenced SOP Instance UID in File	(0004,1511)	
>Referenced Transfer Syntax UID in File	(0004,1512)	

6.3.4 Physical Storage Media and Media Formats

The physical storage media supported is 120mm CD-R Medium.

7.0 Communication Profiles

All SONOLINE G20 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.

7.1 TCP/IP Stack Supported

Each process inherits its TCP/IP stack from the SONOLINE G20's operating systems TCP/IP stack. Port number 104 is used as the default for DICOM communication with the SONOLINE G20.

7.1.1 Physical Media Supported

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

7.1.2 Chapter Extensions/Specializations/Privatizations

No private elements are used by the SONOLINE G20 AE.

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

8.0 Configuration

SONOLINE G20 Networking and DICOM parameters can be configured through the SONOLINE G20 System Presets Menu screens. The following configuration is supported:

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

8.1 General System Configuration

The following system parameter can be configured via the SONOLINE G20 System Presets Basic Menu screens. This parameter is mapped to a DICOM image attribute:

- Hospital Name

8.1.1 Hospital Name

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

8.2 DICOM Network Configuration

DICOM and networking parameters can be configured for both the local G20 device and remote DICOM service class providers through the System Presets DICOM Network Menu.

8.2.1 Local

The SONOLINE G20 local network parameters are configurable. The following network parameters can be configured for a SONOLINE G20 device:

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

- DICOM Application Entity Title

8.2.2 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

8.3 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 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 25 User-configurable printer parameters.



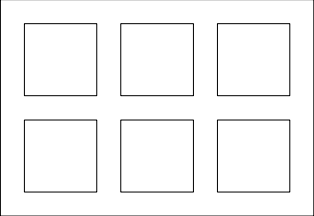
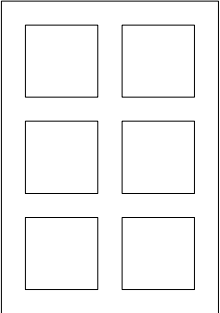
Parameter	Description
Printer Type:	Black and White
Film Size	Select the size of the film - 8x10 inches, 8.5x11 inches, 10x12 inches, 10x14 inches, 11x14 inches, 11x17 inches, 14x17 inches, 24x24 centimeters, 24x30 centimeters, A3, or A4.
Film Orientation	Select from Portrait: <div style="text-align: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

Table 25 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.</p> <p>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

8.4 External Equipment Configuration

The SONOLINE G20 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 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.

8.5 Support of Extended Character Sets

The “ISO-IR 100” Latin Alphabet 1 Extended character set is supported by the SONOLINE G20 system.