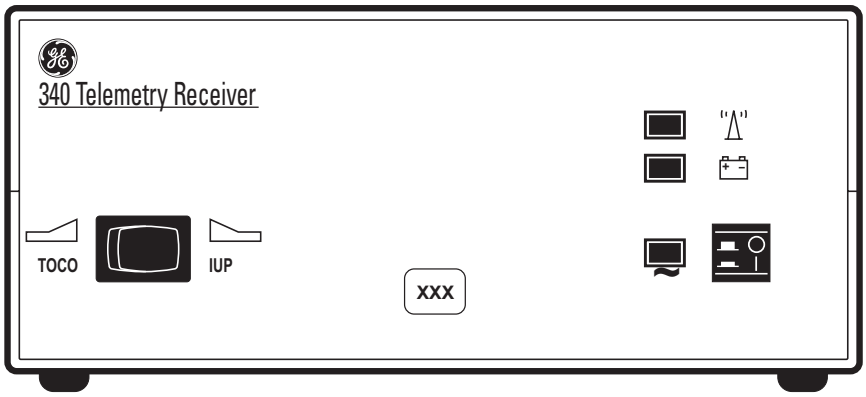
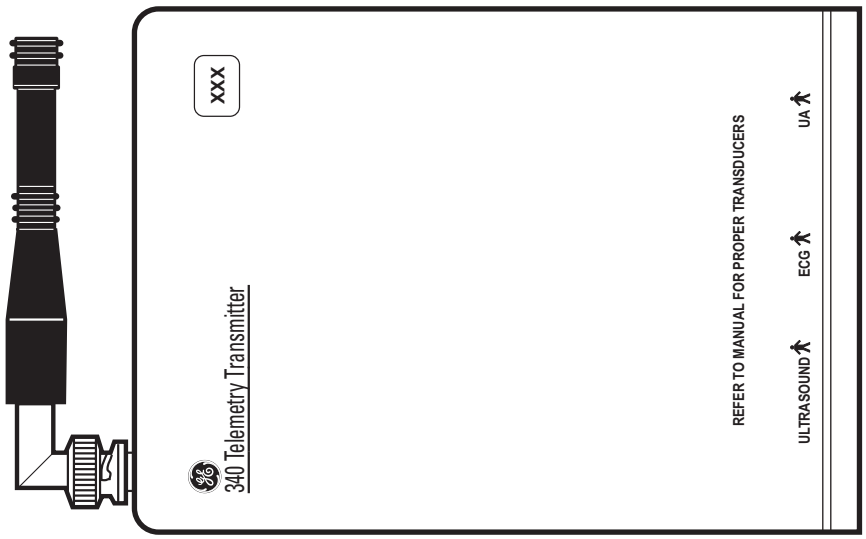
Corometrics® Model 340

SERVICE MANUAL

MANUAL P/N 2006920-001 REV. A





GE Medical Systems

Information Technologies

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Corometrics® Model 340

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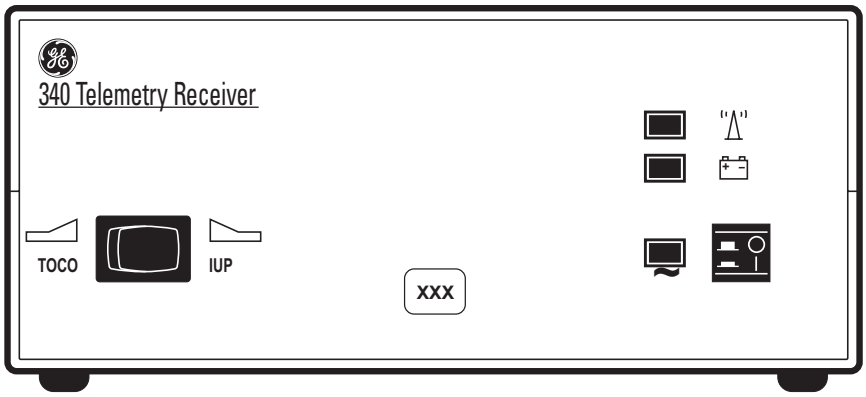

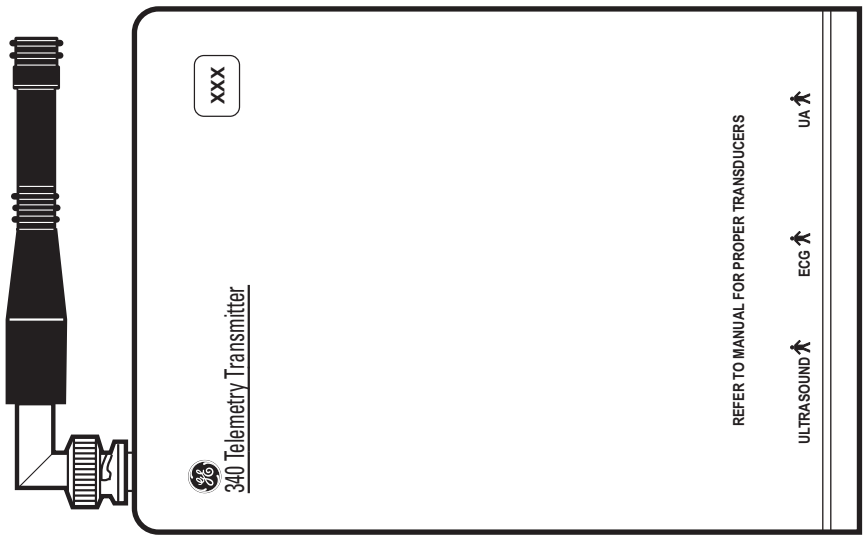

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GUARANTEE

All equipment sold by GE Medical Systems *Information Technologies*, is fully guaranteed as to materials and workmanship for a period of 1 year. *Information Technologies* reserves the right to perform guarantee service operations in its own factory, at an authorized repair station, or in the customer's installation.

Our obligation under this guarantee is limited to repairing, or, at our option, replacing any defective parts of our equipment, except fuses or batteries, without charge, if such defects occur in normal service.

Claims for damage in shipment should be filed promptly with the transportation company. All correspondence covering the instrument should specify the model and serial numbers.

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Revision A: 04-01

GE Medical Systems *Information Technologies* will make available on request such circuit diagrams, component diagrams, component parts lists, descriptions, calibration instructions, or other information which will assist the users or appropriately qualified technical personnel to repair those parts of the equipment which are classified by *Information Technologies* as repairable. Refer to the service manual for further information.

⚠ **CAUTION:** In the United States of America, Federal Law restricts this device to sale by or on the order of a physician.

Contents

For your notes

Figures

For your notes

Tables

For your notes

Preface

Overview of Telemetry Systems

This chapter provides an overview of the 340 Series of telemetry systems:

About Your System

Due to continuing product innovations, there are three versions of the Model 340 Telemetry System in hospitals today. All three versions operate identically from a user's perspective. Unless otherwise indicated, the information in this manual applies to all three devices.

Model 340 Original Release

The first release of the Model 340 Telemetry System operates in the frequency range 430–470 MHz.

Model 340 Plus

The Model 340 Plus also operates in the frequency range 430–470 MHz offering additional channel numbers than the original Model 340. In addition, the Model 340 Plus offers flexibility by allowing factory re-programming to an alternative channel number should interference become a factor in your location.

Model 340M

The Model 340M operates in the frequency range 608–614 MHz where the "M" indicates "medical". The Model 340M complies with the Federal Communications Commission (FCC) rules for Wireless Medical Telemetry Service (WMTS). In June 2000, the FCC allocated a new spectrum allowing potentially life-critical equipment to operate on an interference-protected basis. Refer to "Wireless Medical Telemetry Service" on page 1-10 in this manual for additional information.

Identifying Your System

Each GE Medical Systems Information Technologies device has a unique serial number tag for identification. For each Model 340 Telemetry System, a reference number can be used to determine if the unit is a Model 340 Original Release, Model 340 Plus, or Model 340M. If your device's REF number begins with "0", refer to "Identifying Model 340 Original Release and Model 340 Plus Telemetry Systems" next on this page. If your device's REF number begins with "3", refer to "Identifying a Model 340M Telemetry System" on the following page.

Identifying Model 340 Original Release and Model 340 Plus Telemetry Systems

If your device's REF number beings with "0":

- the fourth character identifies receiver or transmitter
- the fifth character identifies Model 340 Original Release or Model 340 Plus

Refer to Figure 1-1.

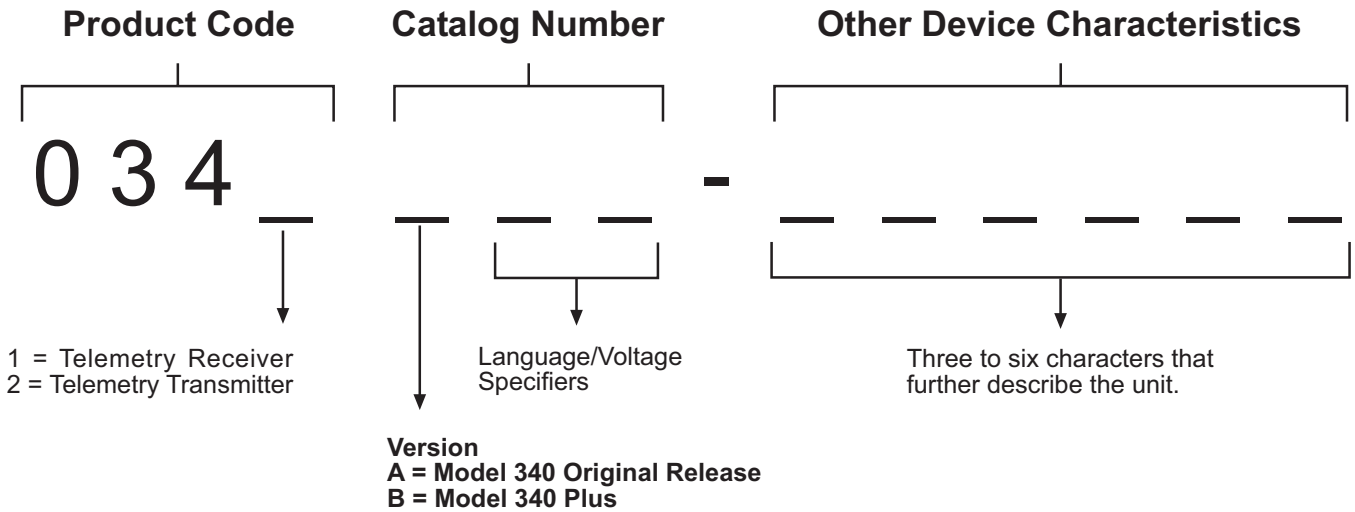


Figure 1-1. Model 340 or Model 340 Plus REF Number

Example 1: If a serial number label shows REF 0341AAN-501, it is a receiver from a Model 340 Original Release system.

Example 2: If a serial number label shows REF 0342BBN-XXX00B, it is a transmitter from a Model 340 Plus system.

Identifying a Model 340M Telemetry System

If your device's REF number beings with "3":

- the third character identifies receiver or transmitter
- the fourth character identifies Model 340M

Refer to Figure 1-2.

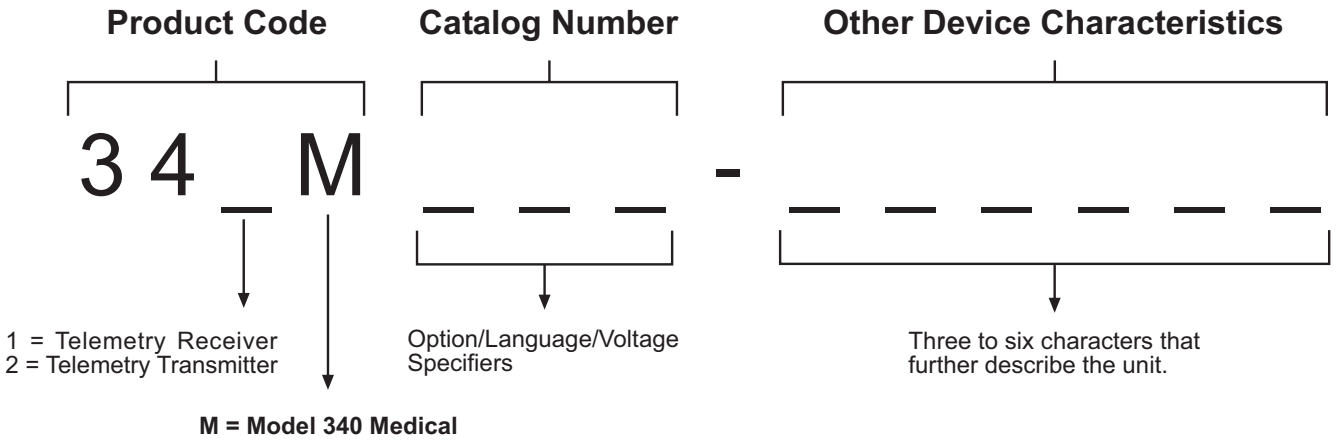


Figure 1-2. Model 340M REF Number

Example 1: If a serial number label shows REF 341MCCN-XXX00A, it is a receiver from a Model 340M telemetry system.

Example 2: If a serial number label shows REF 342MBBN-XXX000B, it is a transmitter from a Model 340M telemetry system.

Chapter 1

⚠ Safety

The information presented in this section is important for the safety of both the patient and operator and also serves to enhance equipment reliability. This chapter describes how the terms Danger, Warning, Caution, Important, and Note are used throughout the manual. In addition, standard equipment symbols are defined.

This section includes the following important information:

General Information

General Use

If any equipment is cold to the touch or below ambient temperature, allow it to stabilize before use.

To ensure patient safety, use only parts and accessories manufactured or recommended by GE Medical Systems *Information Technologies*. Parts and accessories used shall meet the requirements of IEC 601.1.1.

Disposable devices are intended for single use only. They should not be reused.

Periodically, and whenever the integrity of the equipment is in doubt, test all functions.

Refer to the "Maternal/Fetal Monitoring Operator's Manual" for information concerning the limitations of internal and external fetal heart rate monitoring techniques.

Responsibility of the Manufacturer

GE Medical Systems *Information Technologies* (hereinafter *Information Technologies*) is responsible for the effects on safety, reliability, and performance if:

- assembly operations, extensions, readjustments, modifications, or repairs are carried out by persons authorized by *Information Technoligies*;
- the electrical installation of the relevant room complies with the requirements of appropriate regulations; and
- the equipment is used in accordance with the instructions for use.

Definitions of Terminology

Six types of special notices are used *throughout* this manual. They are: Danger, Warning, Caution, Contraindication, Important, and Note. The warnings and cautions in this safety section relate to the equipment in general and apply to all aspects of the equipment. Be sure to read the other chapters because there are additional warnings and cautions which relate to specific features of the equipment.

When grouped, warnings and cautions are listed alphabetically and do not imply any order of importance.

Table 1-1. Definitions of Terminology

Danger	A **DANGER** notice indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
Warning	A **WARNING** indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
Caution	A **CAUTION** indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. Cautions are also used to avoid damage to equipment.
Contraindication	A **CONTRAINDICATION** describes any special symptom or circumstance that renders the use of a remedy or the carrying out of a procedure inadvisable, usually because of a risk.
Important	An **IMPORTANT** notice indicates an emphasized note. It is something you should be particularly aware of; something not readily apparent.
Note	A **NOTE** indicates a particular point of information; something on which to focus your attention.

Equipment Safety Information

Warnings

WARNINGS

ACCIDENTAL SPILLS—In the event that fluids are accidentally spilled on the equipment, take the equipment out of operation and inspect for damage.

APPLICATION—This equipment is not designed for direct cardiac connection.

CONDUCTIVE CONNECTIONS—Avoid making any conductive connections to applied parts (patient connection) which are likely to degrade safety.

CONDUCTIVE PARTS—Ensure that the conductive parts of the lead electrodes and associated connectors do not contact other conductive parts including earth.

CONNECTIONS—The correct way to connect a patient to the transmitter is to plug the ***electrode leads*** into the ***patient cable*** which in turn connects to the ***transmitter***. The ***receiver*** is connected to the ***wall socket*** by the ***power cord***. Do ***not*** plug the electrode leads into the power cord, a wall socket, or an extension cord.

DEFIBRILLATION—This equipment is not designed for use with defibrillators.

ELECTRICAL SHOCK—To reduce the risk of electrical shock, do not remove equipment covers. Refer servicing to qualified personnel.

ELECTROMAGNETIC INTERFERENCE—Be aware that strong electromagnetic fields may interfere with equipment operation. Interference prevents the clear reception of signals by the device. If the hospital is close to a strong transmitter such as TV, AM or FM radio, police or fire stations, a HAM radio operator, an airport, or cellular phone, their signals could be picked up as signals by the equipment. If you feel interference is affecting the equipment, contact your Service Representative to check the equipment in your environment.

WARNINGS

ELECTROSURGERY—The equipment is not designed for use with high-frequency surgical devices. In addition, measurements may be affected in the presence of strong electromagnetic sources such as electrosurgery equipment.

EXPLOSION HAZARD—Do not use this equipment in the presence of flammable anesthetics or inside an oxygen tent.

GROUNDING—Do not defeat the three-wire grounding feature of the power cord by means of adaptors, plug modifications, or other methods. A dangerous shock hazard to both patient and operator may result.

INSTRUCTIONS—For continued and safe use of this equipment, it is necessary to follow all listed instructions. However, the instructions provided in this manual in no way supersede established medical procedures concerning patient care. The device does not replace observation and evaluation of the patient, at regular intervals, by a qualified care provider who will make diagnoses and decide on treatments and interventions.

INTERFACING OTHER EQUIPMENT—Monitoring equipment must be interfaced with other types of medical equipment by qualified biomedical engineering personnel. Be certain to consult manufacturers' specifications to maintain safe operation.

LEAKAGE CURRENT TEST—The interconnection of auxiliary equipment with this device may increase the total leakage current. When interfacing with other equipment, a test for leakage current must be performed by qualified biomedical engineering personnel before using with patients. Serious injury or death could result if the leakage current exceeds applicable standards. The use of accessory equipment not complying with the equivalent safety requirements of this equipment may lead to a reduced level of safety of the resulting system. Consideration relating to the choice shall include: use of the accessory in the patient vicinity; and evidence that the safety certification of the accessory has been performed in accordance with the appropriate IEC 601.1 and/or IEC 601.1.1 harmonized national standard.

WARNINGS

LINE ISOLATION MONITOR TRANSIENTS—Line isolation monitor transients may resemble actual cardiac waveforms, and thus cause incorrect heart rate determinations and alarm activation (or inhibition).

MRI USE—Do not use the equipment during MRI scanning; conducted current could potentially cause burns.

PATIENT CABLES AND LEADWIRES—Do not use patient cables and electrode leads that permit direct connection to electrical sources. Use only "safety" cables and leadwires. Use of non-safety patient cables and lead wires creates risk of inappropriate electrical connection which may cause patient shock or death.

PACEMAKER PATIENTS—Rate meters may continue to count the pacemaker rate during occurrences of cardiac arrest or some arrhythmias. Do not rely entirely upon rate meter alarms. Keep pacemaker patients under close surveillance. Refer to your monitor's operator's manual for disclosure of the pacemaker pulse rejection capability.

SIMULTANEOUS DEVICES—Do not simultaneously connect more than one device that uses electrodes to detect ECG and/or respiration to the same patient. Use of more than one device in this manner may cause improper operation of one or more of the devices.

STRANGULATION—Make sure all patient cables, leadwires, and tubing are positioned away from the patient's head to minimize the risk of accidental strangulation.

WATER BIRTHS—Do not use a fetal or maternal/fetal monitor to ***directly*** monitor patients during water births, in whirlpool or submersion water baths, during showers, or in any other situation where the mother is immersed in water. Doing so may result in electrical shock hazard.

Cautions

CAUTIONS

ANNUAL SERVICING—For continued safety and performance of the equipment, it is recommended that the calibration, accuracy, and electrical safety of the equipment be verified on an annual basis by an *Information Technologies* Service Representative.

DAILY INSPECTION—It is essential that the equipment and accessories be inspected prior to every use.

ENVIRONMENT—The performance of the equipment has not been tested in certain areas, such as x-ray and imaging suites. The equipment is not recommended for use in these environments.

PERFORMANCE—Report all problems experienced with the equipment. If the equipment is not working properly, contact your Service Representative for service. The equipment should not be used if it is not working properly.

Equipment Symbols

The following is a list of symbols used on products manufactured by *Information Technologies*. Some symbols may not appear on your equipment.

Table 1-2. Equipment Symbols	
	ATTENTION: Consult accompanying documents.
	TYPE B EQUIPMENT. Type B equipment is suitable for intentional external and internal application to the patient, excluding direct cardiac application.
	TYPE BF EQUIPMENT. Type BF equipment is suitable for intentional external and internal application to the patient, excluding direct cardiac application. Type BF equipment has an F-type applied part.
	DEFIBRILLATOR-PROOF TYPE BF EQUIPMENT: Type BF equipment is suitable for intentional external and internal application to the patient, excluding direct cardiac application. Type BF equipment is type B equipment with an F-type isolated (floating) part. The paddles indicate the equipment is defibrillator proof.
	ALTERNATING CURRENT (AC).
IPX1	DRIP PROOF.
	EQUIPOTENTIALITY.
O	POWER OFF: disconnection from the mains.
I	POWER ON: connection to the mains.

FCC Information

FCC Rules Compliance

This equipment complies with the FCC rules shown in Table 1-3. (Refer to "Identifying Your System" on page xi for information about identifying what type of telemetry system you have in your hospital.) Operation is subject to the condition that this device does not cause harmful interference.

Table 1-3. FCC Rules Compliance

Telemetry	Transmitter	Receiver
Model 340 Original Release	Part 90	Part 15
Model 340 Plus	Part 90	Part 15
Model 340M	Part 95	Part 15

FCC RF Exposure Compliance

IMPORTANT
RF EXPOSURE—To comply with FCC RF exposure compliance requirements, users should avoid grasping the antenna for any extended period of time while the device is in operation.

FCC Service Information

Servicing the radio frequency transmitter and receiver sections of the Model 340 Telemetry System requires an FCC General Radio Telephone License.

Any changes or modifications made to the Model 340 Telemetry System that are not expressly approved by *Information Technologies*, could void the user's authority to operate this equipment.

Wireless Medical Telemetry Service

This section applies to Model 340M Telemetry Systems only. Refer to "Identifying Your System" on page xi for information about identifying what type of telemetry system you have in your hospital.

IMPORTANT
Operation of a Model 340M Telemetry System requires prior coordination with a frequency coordinator designated by the FCC for the Wireless Medical Telemetry Service.

In June 2000, the FCC allocated new spectrum and established rules for Wireless Medical Telemetry Service (WMTS) allowing potentially life-critical equipment to operate on an interference-protected basis.

The frequency allocation for WMTS provides spectrum where the equipment can operate on a primary basis increasing the reliability of this important service. The FCC allocated 14 MHz of spectrum for use by medical telemetry equipment in the 608–614 MHz, 1395–1400 MHz, and 1429–1432 MHz bands. This allocation was based on a needs assessment conducted by the American Hospital Association (AHA).

The 608–614 MHz band, which corresponds to TV channel 37 had been reserved for radio astronomy uses, so this action elevates medical telemetry to a co-primary status with radio astronomy in this band. The 1395–1400 MHz and 1429–1432 MHz bands were government bands reallocated for non-government use.

WMTS is designated as one of the Citizen's Band Services in Part 95 of the rules and licensed by rule to eliminate the possible costs and delays to obtain individual operator's licenses. The medical telemetry equipment is authorized under the certification procedure in Part 2 of the rules. One or more frequency coordinators maintain a database of all equipment used in conjunction with WMTS.

For more information visit http://www.fcc.gov.

Chapter 2

Introduction

This chapter contains the following information:

Product Summary

The Corometrics Model 340 Telemetry System (receiver and transmitter) provides a wireless means of transmitting heart rate and uterine activity signals from an ambulatory mother to a bedside fetal or maternal/fetal monitor. The system operates with the following Corometrics brand monitors; if your monitor is not listed, check with your saleperson or service representative for a more current list.

- Model 115
- Model 116
- Model 118
- 120 Series*
- Model 145
- Model 150
- Model 151
- Model 155
- 170 Series

NOTE: The Model 340 Telemetry System does ***not*** support fetal movement detection.

The system monitors ultrasound, ECG (FECG or MECG), and uterine activity (TOCO or IUPC) signals individually or in combination—depending on which parameters are available in the fetal or maternal/fetal monitor. Refer to your monitor's operator's manual as needed.

* *A 120 Series Monitor requires a Communications Board in order to interface to a Model 340 Telemetry System. If your monitor does not have this option, an upgrade kit is available as cat. no. (REF) 1559BAO. Contact your Service Representative for more information*.

Product Features

The following is a summary of product features:

- Battery operated transmitter provides up to 20 hours* of continuous transmission when operated with fresh batteries.
- A Low Battery indicator, accompanied by an audio indicator, signals an impending low-battery condition.
- A transmitter headset* allows the patient or staff to hear the ultrasonically detected heartbeats for reassurance as well as to verify proper transducer placement.
- A Signal Quality indicator verifies the strength of the radio transmission signal.
- Transducers are quickly and easily interchangeable amongst the Model 340 Telemetry System and most Corometrics brand monitors:
  - *Models 116, 118, 150, 151, 155, and 170 Series:* transducers are interchangeable.
  - *120 Series:* ECG rectangular connector cables are *not* compatible; round connector cables are compatible.
  - *Models 115 and 145:* cat. no. (REF) 5600 ultrasound transducers *cannot* be used with a Model 340. Use only cat. no. (REF) 5700 transducers when the using a Model 115 or 145 with a Model 340 Telemetry System.
- Provides simultaneous monitoring of two heart rates (twins or maternal/fetal) when used with a monitor supporting these parameters. Refer to Table 2-1 for a summary of monitor parameters.

IMPORTANT
INSTRUCTIONS—The operator should review and be familiar with the operator's manual for the fetal or maternal/fetal monitor as well as the "Maternal/Fetal Monitoring Operator's Manual".

Table 2-1. Summary of Monitor Parameters

	115	116	118	126	128	129	145	150	151	151D	155	171	172	173	174
TOCO	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IUPC	✓	✓	✓	✓	✓	✓			✓	✓				✓	✓
US	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
FECG	✓	✓	✓	✓	✓	✓			✓	✓				✓	✓
MECG	✓	✓	✓			✓			✓	✓					

* *Use of the headset will deplete the batteries more rapidly.*

For your notes

Chapter 3

Controls, Indicators, and Connectors

This section describes all controls, indicators, and connectors on a Model 340 Telemetry System.

Receiver

Receiver Front Panel

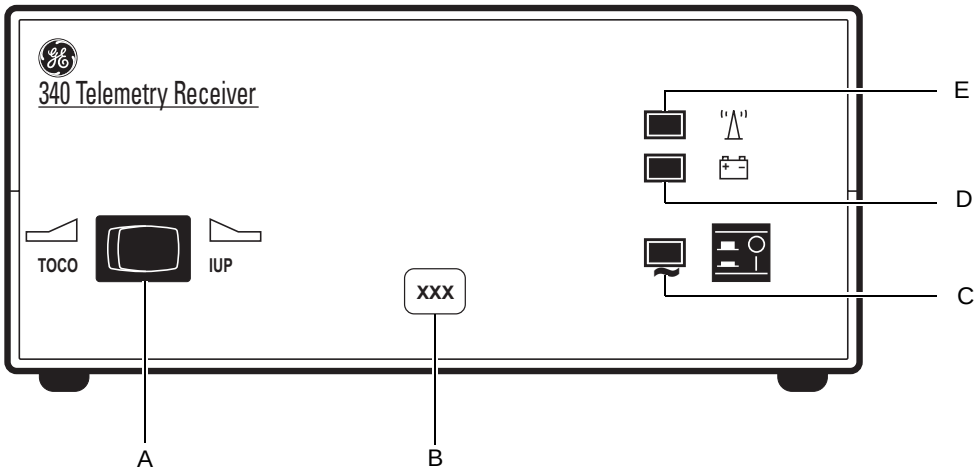
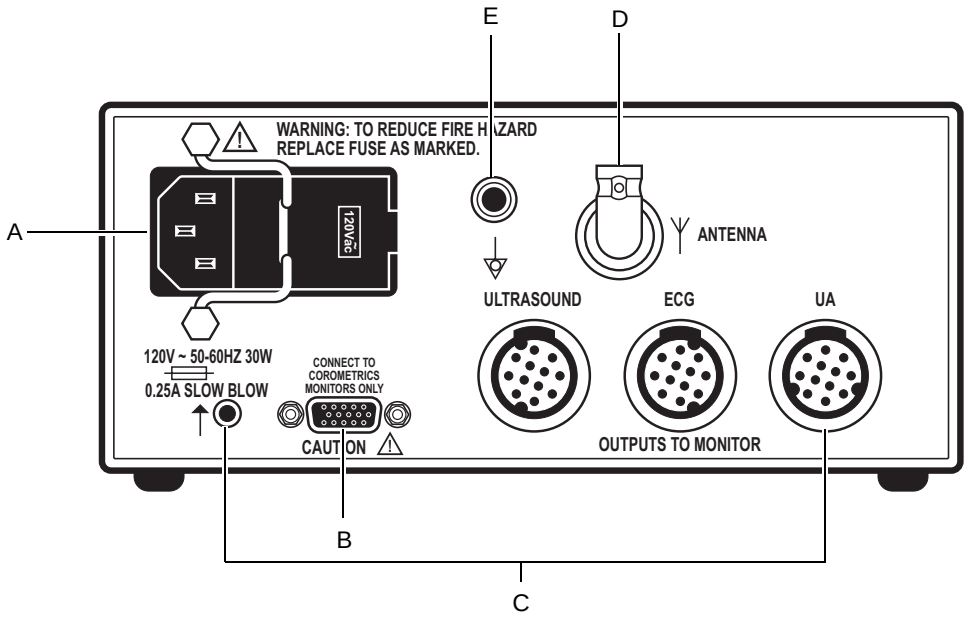


Figure 3-1. Receiver Front Panel

Table 3-1. Receiver Front Panel		
	Name	**Description**
A	UA Mode Selector Switch	This switch communicates the active uterine activity mode to the fetal or maternal/fetal monitor: ■ When monitoring with a tocotransducer, set the switch to the TOCO position. ■ When monitoring with an intrauterine pressure catheter, set the switch to the IUP position.
B	Channel Number	The channel number is the customer-designated receiving frequency of the receiver. For each telemetry system, the channel number of the receiver must be identical to the channel number of the transmitter. Also, if you have more than one telemetry system, or other RF devices, each system must have a unique channel number.
C	Power Switch and Indicator	The Power switch turns the receiver on (I) and off (O). When set to on, the green Power indicator illuminates.
D	Low Battery Indicator	The red Low Battery indicator *flashes* when you have approximately 10 minutes of transmitter battery power remaining. The Low Battery indicator stops flashing and *lights continuously* as soon as the battery is depleted.
E	Signal Indicator	The green Signal indicator *lights continuously* when the receiver is accepting radio frequency signals from the transmitter. The Signal indicator *flashes* if the signal strength is weak or marginal.

Receiver Rear Panel



Note: Antenna shown removed.

Figure 3-2. Receiver Rear Panel

Table 3-2. Receiver Rear Panel		
	Name	**Description**
A	AC Line Connector and Fuseholder Module	This module houses the AC-line input connector and the main fuses for the receiver: ■ 100–120 VAC: requires two, 0.25 A slow-blow fuses. ■ 220–240 VAC: requires two, 0.2 A time-lag fuses.
B	Auxiliary Output Connector	This connector is used with 120 and 170 Series Monitors only. Do not use this connection method for Models 115, 116, 118, 145, 150, 151, and 155 Monitors. This connector outputs the US, ECG, UA, and Mark signals, acquired by telemetry, to a 120 or 170 Series Monitor. See the Model 340 Operator's Manual for complete interconnection details. **As soon as any telemetry mode is detected, the front panel of the 120 or 170 Series Monitor is disabled and all front panel inputs are ignored. In other words, telemetry and monitor modes cannot be "mixed and matched"; you must use telemetry only or direct monitoring only.** **For proper operation with a 170 Series Monitor, disconnect all transducers from the front panel of the monitor.**
C	US, ECG, UA, and Mark Connectors	These connectors are used with Models 115, 116, 118, 145, 150, 151, and 155 Monitors only. Do not use this connection method for 120 and 170 Series Monitors. Each connector outputs the respective signal, acquired by telemetry, to the fetal or maternal/fetal monitor: ■ US: light grey connector which outputs the ultrasound signal. ■ ECG: grey connector which outputs the FECG or MECG signal. ■ UA: white connector which outputs the TOCO or IUPC signal. ■ Mark: connector which outputs the Event Mark signal. See the Model 340 Opreator's Manual for complete interconnection details.
D	Antenna Connector	Twist-on connector for attaching the receiver antenna.
E	Equipotential Lug	Binding post terminal directly connected to the chassis for use as an equipotentiality connection.

Transmitter

Transmitter Bottom Panel

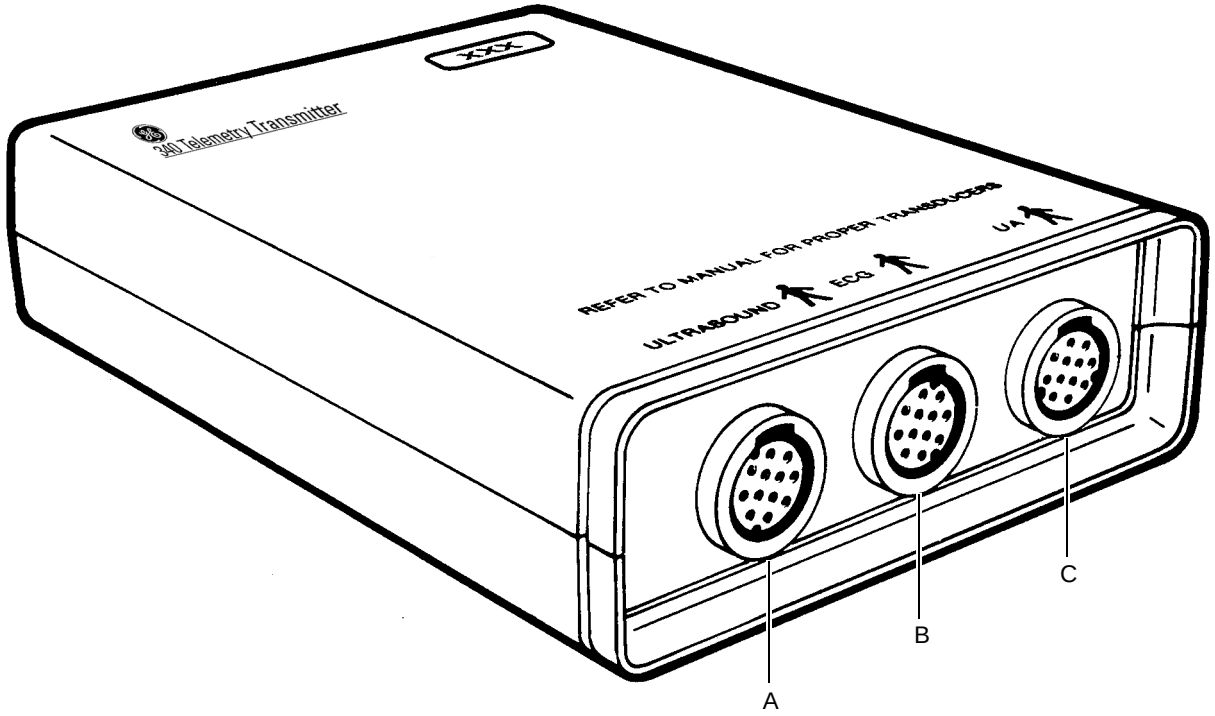
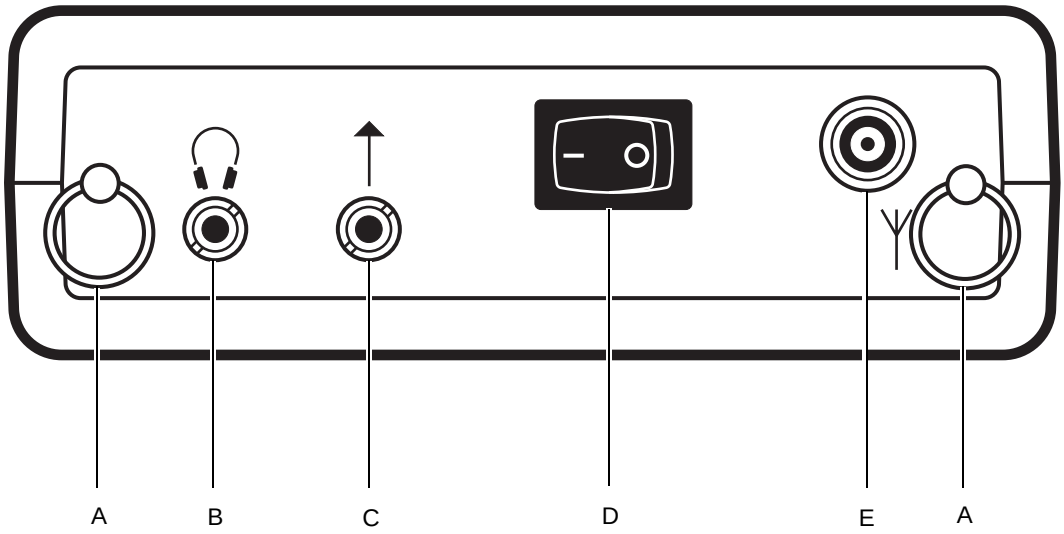


Figure 3-3. Transmitter Bottom Panel

Table 3-3. Transmitter Bottom Panel		
	Name	**Description**
A	Ultrasound Input	Connect a Corometrics 5700 Series pulsed Doppler ultrasound transducer to this light gray receptacle. **Corometrics 5600 Series continuous-wave ultrasound transducers are not compatible with the Model 340 Telemetry System. The 5600 Series Transducer was designed for use with Models 115 and 145 Monitors and Models 320 and 330 Telemetry Systems.**
B	ECG Input	Connect an FECG cable/legplate or MECG cable plug to this grey receptacle. This connector is compatible with all *round*-connector FECG/MECG patient cables used with Corometrics-brand monitors.
C	UA Input	Connect a tocotransducer, IUPC, or strain gauge transducer plug to this white receptacle. Contact your Sales Representative about compatibility.

Transmitter Top Panel



Note: Antenna shown removed.

Figure 3-4. Transmitter Top Panel

Table 3-4. Transmitter Top Panel		
	Name	**Description**
A	Loops	Loops for attaching the carrying strap.
B	Headset Connector	Connect the headset to this receptacle to listen to the fetal heart rate derived from ultrasound.
C	Remote Event Mark Connector	Connect a Corometrics Remote Event Marker to this receptacle. When the marker's button is pressed for at least one second, an event mark signal is transmitted and one of the following marks prints on the strip chart paper: ■ ↑: This annotation is commonly used to record an "event." This mark is available on all Corometrics-brand monitors. ■ FM↑: This annotation is commonly used as an indication that the mother has perceived fetal movement. (Refer to your monitor's operator's manual to learn if your monitor supports this feature. Refer to your monitor's service manual for information about enabling the option.)
D	Power Switch	Moving the switch to the *on* position (I) turns on the transmitter; moving the switch to the *off* position (O), turns off the transmitter.
E	Antenna Connector	Twist-on connector for attaching the transmitter antenna.

Transmitter Rear Panel Battery Compartment

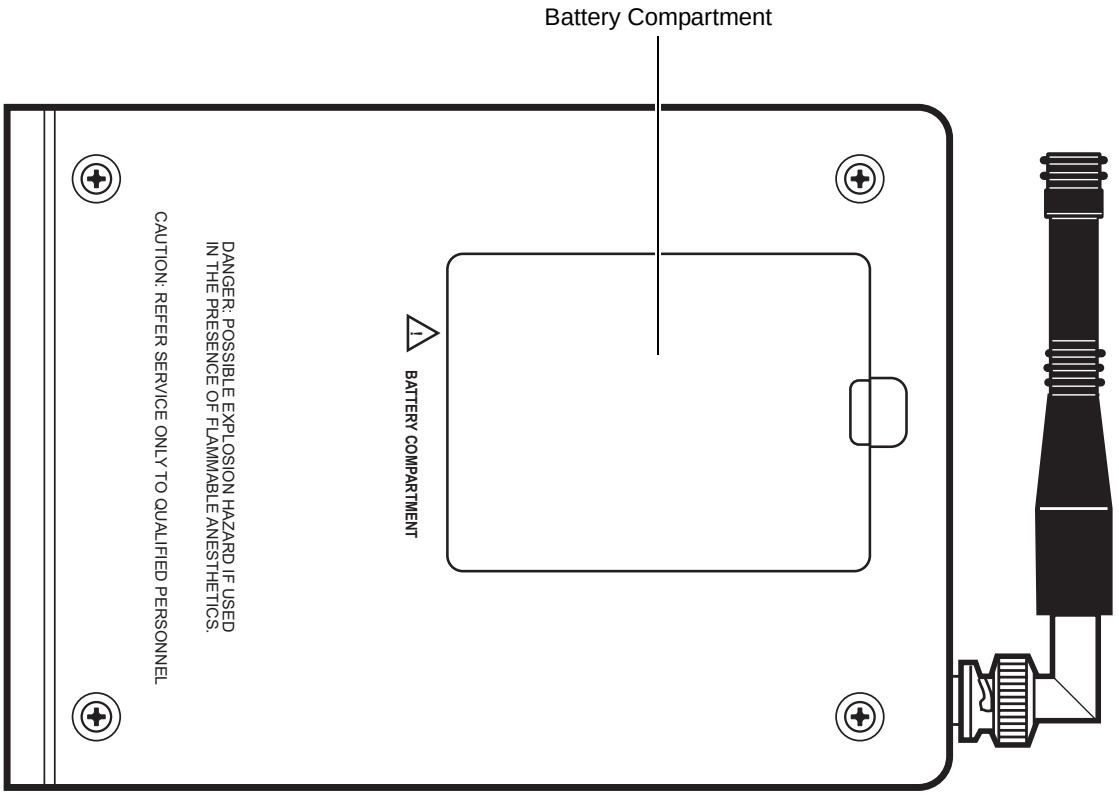


Figure 3-5. Transmitter Rear Panel Battery Compartment

The battery compartment holds four “AA” alkaline batteries.

CAUTION

BATTERY STRENGTH—When the battery power is low, the transmitter emits a chirping sound every 4–5 seconds. (For Model 340 Plus and Model 340M Systems, the frequency of chirping increases as the batteries become depleted.) The onset of chirping signals approximately 10 minutes of remaining battery power. The chirping continues until the battery power is completely depleted, at which time the transmitter stops sending data.

Chapter 4

Theory of Operation

This section of the manual contains the electronic theory for the Model 340 Maternal/Fetal Telemetry System. The Model 340 Telemetry System is comprised of a receiver and a transmitter. The electronic theory for the transmitter (Transmitter Board and Transmitter Carrier Board) and receiver (Receiver Board and Receiver Carrier Board) is presented. For complementary information, refer to the schematics and assembly drawings contained in Chapter 9 of this manual.

This chapter contains the following technical information:

Transmitter Board (No. 2003708-001)

Ultrasound

The operation of the ultrasound circuitry is controlled by a CMOS programmable logic device (CPLD). This CPLD also contains the active circuitry used to form a 4.604 MHZ crystal oscillator, which is the main system clock from which all board logic timing is derived. The fourth division (1.151 MHZ) is the operating frequency of the ultrasound transducer. Ultrasound decoding circuitry in the CPLD generates two gated bursts of the 1.151 MHz clock division: the first is used to drive the transducer; the second to run the ring demodulator on the receiver. Both bursts are buffered by an external latch.

The transducer drive circuitry consists of a FET switch, a transformer, and a filter. The first gated 1.151 MHz burst from the CPLD is used as the control signal for the gate of the FET switch. The drain of the switch in turn drives the primary winding of the transformer. This configuration creates a burst of 1.151 MHz square waves on the primary winding during each transmit period. The secondary winding of the transformer is then coupled to the transducer through a series resonant tank circuit which is used to filter the square waves on the transformer output. The transformer, while serving as a coupling device, is also used to provide an impedance match to the transducer.

The receiver pre-amp consists of a cascode amplifier and an input matching network. The matching network is configured as a resonant “L” network and converts the low impedance of the transducer to the high input impedance of the cascode amplifier. The matching network provides a low-to-high impedance transformation, in addition to providing approximately 38 dB of voltage gain. The cascode amplifier combines a dual FET connected in parallel on the input side, with a bipolar transistor on the output. The parallel connection of the dual FET is used to increase amplifier gain (transconductance doubles) while reducing overall amplifier noise (noise adds in quadrature). The output of the amplifier is tuned with a parallel resonate tank circuit in the collector of the transistor section. The cascode amplifier gain is approximately 12 dB.

Following the pre-amp is a buffer amplifier and transformer combination. The buffer stage is unity gain and is used to establish a high impedance for the pre-amp output. The transformer converts the single ended pre-amp output to differential for the demodulator that follows.

The demodulator circuit is composed of a quad FET switch, a difference amplifier, and a sample-and-hold circuit. The switches are arranged in a doubly balanced ring detector configuration. When the CPLD generates the detector burst, the demodulator produces an output that corresponds to the Doppler shift of the input signal from the transducer. The differential output of the ring demodulator is then converted to single ended by the difference amplifier stage. Due to the gating of the detector stage, a sample-and-hold circuit is used to retain the last output level while the detector is inactive.

After the detector are four stages of main filters consisting of two high-pass and two low-pass filters, all active second order. Each filter stage has a gain of approximately 20 dB (80 dB total gain), and the composite band-pass filter is 100 to 270 Hz. A gain adjustment in the filters is used to set the gain for the entire receiver circuit (pre-amp input to filter output).

Following the main filters is the frequency doubler. This stage is necessary in order to bring the low frequency content of the Doppler shifted signals from the transducer up to a more suitable band for the human ear as well as to prevent disturbance of control signals transmitted along with the ultrasound audio in the composite modulation. The doubler consists of a precision full-wave rectifier, an active band-pass filter, and an audio amplifier. The full-wave rectifier produces two output peaks for every one peak applied to the input, effectively doubling the input frequency. However, the rectifier output is not purely sinusoidal. All undesired frequency components produced by the rectification process are removed in the next stage—the active band-pass filter. This filter has a gain of approximately 3 and a band-pass range of 200 to 500 Hz. The output from this filter is used as a component in the composite modulation for the transmitter module as well as to provide the input source for the audio amplifier. The audio amplifier is a unity-gain current amplifier that provides sufficient current output to drive a 40 Ω headphone.

UA

The UA circuitry on the Transmitter Board consists of an instrumentation amplifier, a secondary amplifier stage, a voltage-controlled oscillator (VCO), and an active low-pass filter. The instrumentation amplifier is used both to amplify and to convert the differential output of a TOCO bridge or IUP device to single ended. This stage is set for a gain of 100. The second amplifier is used to scale and filter the signals from the instrumentation amplifier for the VCO input. This stage has a gain of 13.3 and is offset to accommodate the maximum usable range of the UA transducers. Feedback components on this stage are set for a single-pole roll off at 1.6 Hz. The varying voltage levels from the output of the UA amplifier stages are converted to proportional changes in frequency in the VCO. This circuit creates a FM subcarrier with a center frequency of 1.75 kHz and a deviation of ±250 Hz. The square wave output of the VCO is then filtered by a unity-gain, third-order, low-pass filter with a breakpoint of 2 kHz. The filter output is used as part of the composite modulation supplied to the transmitter module. Power for the TOCO or IUP bridge is provided from a voltage reference and current amplifier.

ECG

The ECG circuitry is composed of an instrumentation amplifier, a fixed-gain amplifier, a gain selectable amplifier, a common mode amplifier, a VCO, and an active low-pass filter. The differential patient signals from the ECG electrodes are first amplified in the instrumentation stage which is set to a gain of 10. Additionally, the common mode voltage present across the gain set resistor on this amplifier is used to create the right leg drive signal. This common-mode voltage is first buffered in a unity-gain stage, then inverted in an integrator circuit which amplifies the common-mode signal. This voltage is fed back to the patient through the leadwires to help cancel 60 Hz noise. The single-ended output of the instrumentation stage is then AC coupled to the next amplifier, creating a single-order, high-pass function with a breakpoint of 6 Hz. This amplifier operates with a fixed gain of 101 and is rolled off at 80 Hz. The output of this amplifier is then AC coupled into the finial amplifier stage, creating an additional high-pass breakpoint at 4 Hz. This is the gain-selectable amplifier. The gain on this stage is configured by the enabled mode (FECG or MECG). In the FECG mode, the gain is set at 2.5. In the MECG mode, the gain is set at 1.25. Feedback components in both modes set the low-pass roll-off at approximately 42 Hz. The output of this stage then drives the VCO which has a center frequency of 2.7 kHz and a deviation of ±250 Hz. This circuit is configured to operate like the VCO used in the UA channel. The square wave output of the VCO is then filtered in a unity-gain, second-order, low-pass filter with a breakpoint of 3 kHz. The filter output is used as part of the composite modulation supplied to the transmitter module.

Control Circuitry

Mode information, along with battery status and remote mark data, is transmitted to the receiving unit by use of individual low-frequency tones. These tones are generated by counters contained within the CPLD and are a division of the main clock. Each tones is gated on or off dependent on the state of the mode or function it represents The tones are summarized as follows: ultrasound mode is 10 Hz; FECG is 20 Hz; remote mark is 40 Hz; and battery low is 80 Hz. The gated tones from the CPLD each connect to individual R/C low-pass filters that are then combined in a summing amplifier with a roll-off of 8 Hz. The summing gain from each R/C filter is selected to compensate for the attenuation caused by the low roll-off frequency of this stage. This configuration effectively provides two stages of low-pass filtering at each frequency. The output of the summing amplifier connects to a third-order, unity-gain, active low-pass filter with a cutoff frequency of 90 Hz. This filtered output, along with the other analog signals, is combined to form the composite modulation sent to the transmitter module. Mode status for the patient parameters comes from the individual transducer connectors via a grounding jumper. The remote mark signal is a switch contact that is time extended by a comparator with a R/C delay. Low battery is derived from a comparator that evaluates the raw battery voltage against a fixed voltage reference. Mode information at the receiver is also determined by the presence or absence of the two VCO signals. Control of the VCO enables is accomplished through logic in the CPLD based on the transducer in use. Level translation for the enable are done by rail-to-rail op-amps configured as comparators.

There are two states for the low-battery condition. The first indicates that there is approximately 10 minutes of operating time left in the batteries. The second state is entered when the battery voltage is only 0.1 V above the minimum required for the power supply regulators to operate. Both states are determined by comparators from the raw battery voltage and a fixed voltage reference. When the first low-battery comparator is activated, the CPLD will gate on the 80 Hz tone to signal the receiver of the condition as well as activate an audio alarm locally. The audio alarm is a gated 4.5 kHz tone that drives a piezo speaker. The gate time is 0.2 s on every 1.6 s. The tone and gate times are a division of the main clock. When the second comparator is activated, the CPLD disables all operating modes and the transmitter module (transmitter is turned off). Additionally, the audio alarm is altered to a 50% duty cycle with a 0.8 s period. *This state is latched*. Operation of the unit cannot be restored until power is cycled off and on. The system will also be disabled when the unit is operated below +5° C. A temperature sensor in the CPLD will disable the modes and transmitter module when the temperature falls below this threshold. *This state is **not** latched*. Normal operation will be restored automatically when the unit returns to the specified operating temperature range.

Power Supply

The main power supply for this system is a boot converter/regulator. This switcher converts the battery voltage to a regulated 6.5 V over a battery range of 3 to 6 V. The switching frequency of this regulator is synchronized to a division of the main clock (575 kHz) to reduce noise that might interfere with operation of the ultrasound circuit. A regulated –6V supply is generated off this supply using a charge pump/regulator. This converter is also synchronized to a division of the main clock (18 kHz) to prevent noise. Additional linear regulators operate off the 6.5 V to generate the +6 V and +5 V required by the system. For noise considerations, the ultrasound circuitry operates from separate +6 V, +5 V, and +2.5 V regulators.

Telemetry Receiver Board Circuitry (No. 13856A)

The RF Receiver

The RF receiver used by the Telemetry Receiver Board provides both the encoded modulation from the transmitter, as well as a voltage output that is proportional to the RF signal level received.

The signal level output from the RF receiver is connected to a pair of comparators configured as a threshold detector and monostable. When the received signal exceeds the comparator threshold, the first comparator fires enabling the monostable. The output of the monostable remains enabled as long as the signal level output from the RF receiver exceeds the threshold of the first comparator, and for drop outs of less then one-half second. The output of the monostable, in conjunction with TTL inverters and transistor drivers, is used to light a set of complementary LEDs. The LEDs are used on the front panel to indicate a received signal condition, as well as to provide an overall enable to a set of OR gates that control FET switches. The FET switches provide the mode enables to the connected fetal monitor.

Receiver Encoded Modulation

The encoded modulation from the receiver is divided into several paths: the first to extract the mode information; the second to extract the data signals. Mode information is removed from the composite signal through a three-pole, active, low-pass filter of 100 Hz. After this stage, a gain adjustment and an additional two poles of active low-pass filtering with a gain of four are added. The output of the second low-pass filter connects to four switched-capacitor, band-pass filters. The 80 Hz band-pass filter is configured to operate with its own internal R/C clock. The output of this clock also provides the clock input to a CMOS divider. This divider provides the additional clocks needed for the other band-pass filters of 40 Hz, 20 Hz, and 10Hz. The outputs of the band-pass filters connect to individual tone decoders which provide an active TTL low state when a tone at a decoder's tuned frequency is present at its input. The outputs of the tone decoders, along with the lock detect outputs of the PLL circuits used for ECG and TOCO decoding, provide the gate signals necessary to control the NOR-gate/FET-switch combination that is used to activate the different modes in the connected fetal monitor. The mode enable process for ECG requires additional logic to determine if the ECG information is FECG or MECG. This is determined by the absence or presence of the FECG enable tone, in conjunction with the lock detect output of the ECG phase lock loop (PLL). Two of the tones sent by the transmitter are not used for mode control but provide a battery low indication, and a remote mark enable. The remote mark enable is taken directly off the tone decoder output. The battery low output from the tone decoder turns on a comparator/astable oscillator which, using a transistor driver, flashes an LED on the front panel.

The data signals are extracted by first high-passing the composite signal through a three pole 150 Hz active filter. From that point the data signal is further separated into a ultrasound, ECG, and TOCO channels.

TOCO Channel

The TOCO channel includes an additional three poles of active high-pass filtering at 1.5 kHz, followed by three poles of active low-pass filtering at 2.0 kHz, followed by a 1.75 kHz active two pole band-pass filter with a gain of four. The output of this filter chain connect to the input of a PLL circuit consisting of a FSK decoder, a buffer op-amp, and a differential amplifier. The differential amplifier converts the frequency modulated TOCO sub-carrier to amplitude variations that correspond to the output of the TOCO bridge connected to the transmitter. Gain and offset adjustments are added in the following amplifier stage which, after passing through a resistor voltage divider, connect to the UA input of the connected fetal monitor. The PLL also provides a lock detect output which is used to enable the UA channel on the fetal monitor.

ECG Channel

The ECG channel operates in a similar manner to the TOCO channel described previously. The composite signal taken off the output of the 1.5 kHz high-pass filter of the TOCO channel is additionally high-pass filtered with a three-pole, active filter set to 2.4 kHz The output of the high-pass filter goes to a two-pole, active, 2.4 kHz band-pass filter with a gain of 4. The output of the band-pass filter connects to a PLL circuit of similar design to the one used in the TOCO channel. However, the output of the ECG PLL is AC coupled and does not require the differential amplifier or offset adjustments. The output stage is attenuated through a resistor voltage divider, and is connected to the ECG inputs of the connected fetal monitor. The lock detect output of the PLL in conjunction with the FECG enable tone detector provide the mode enable signals to the monitor.

Ultrasound Channel

The ultrasound channel of the receiver consists of the initial 150 Hz high-pass filter, a three-pole active low-pass filter at 550 Hz, a two-pole active low-pass filter at 600 Hz with a gain of four, a three-pole active high-pass filter at 150 Hz, and the last stage of a three-pole active low-pass filter at 500 Hz. A gain adjustment is inserted between the 550 and 600 Hz low-pass stages. The output of this channel is then connected to a FET switch which routes the output to either the ultrasound modulator, or to a frequency halver circuit, depending on whether a continuous-wave (CW) monitor or pulsed-Doppler monitor is connected.

The modulator stage utilizes a balance modulator with an offset added to produce amplitude modulation from the audio and the transmitter carrier supplied by the fetal monitor. The output tank circuit of the modulator is switched to accommodate the differences in frequency between the CW and pulsed-Doppler monitors. Detection of the monitor type is accomplished with a jumper added in the 115 ultrasound interconnect cable. The frequency halver circuit breaks the ultrasound audio off into two channels: a frequency channel; and an amplitude channel. The frequency channel takes the amplified audio off the input stage, and using a limiter stage, removes most of the amplitude variations off the audio signal. The limiter consists of an op-amp with back-to-back diodes in the feedback circuit to limit the output to ±0.6 V. The output of the limiter is amplified and connected to a zero crossing detector consisting of an op-amp configured as a comparator. The output of the zero crossing detector is converted to CMOS levels using a transistor buffer. The output of the buffer then drives a CMOS D type flip-flop configured as a divide by 2. The “Q” and “NOT Q” outputs of the divider are used as the carrier signal in a switching type amplitude modulator stage. The amplitude channel consists of a precision rectifier and a three-pole active low-pass filter at 30 Hz which produces the envelope of the audio signal. The envelope and carrier signals are combined in a switching type amplitude modulator that consists of four FET switches and a differential amplifier. The carrier signal alternately causes the FET switches to route the envelope signal between the inverting and non-inverting inputs of the differential amplifier. This produces positive and negative variation at the output of the differential stage, equal to the envelope amplitude, at a rate of the carrier frequency. The amplitude modulated signal is then run through three poles of active low-pass filtering at 500Hz, and three poles of active high-pass filtering at 100 Hz. The output of the filters are used for the modulator stage when a pulsed-Doppler ultrasound monitor is connected.

Power Supply Circuitry

The power supply is comprised of a single center tapped secondary transformer, a bridge rectifier, and filter capacitors to produce an unregulated positive and negative supply. Three terminal 78 and 79 series regulators are used for the +15,–15, +5, and –5 V supplies. A three-terminal adjustable regulator is used to supply +12 V to the RF receiver.

Telemetry Transmitter Carrier Board (2003713-001)

The Transmitter Carrier Board serves as the connection point for devices used by the system. The remote mark, headphones, antenna, and battery pack are all first routed through this board. Additionally, the transmitter RF module and audio piezo speaker are located on this board. The battery and external devices connect from the carrier board to the main board through a 16-pin board transition header. A polyswitch current limiter and polarity-reversal diode for the battery are used to protect the circuitry on the Transmitter Board from improperly installed batteries or component failures.

Telemetry Receiver Carrier Board (2004163-001)

The Receiver Carrier Board houses the RF receiver module. Additional circuitry to add gain to the two receiver outputs (audio and RSSI) are also located on this board. A linear regulator is used to reduce the 12 V from the Receiver Board to the 7.6 V required by the RF module.

Chapter 5

Calibration

This section of the manual provides a calibration procedure which allows authorized service personnel to perform an instrument alignment using a minimum of test equipment. This procedure is not intended to replace a complete instrument checkout and alignment as performed at the GE Medical Systems *Information Technologies* factory. It should be considered a performance check and troubleshooting guide to be used in conjunction with other information supplied throughout this service manual. It is important to mention, this section of the manual is not intended as a substitute for proper professional training, or familiarity with the Model 340. Only qualified service personnel should attempt servicing the Model 340.

This chapter contains the following information:

FCC Service Information

The UHF Transmitter Module and UHF Receiver Module contained in the Model 340 Telemetry System are GE Medical systems *Information Technologies* factory service items.

IMPORTANT
FCC LICENSE—You *must* have an FCC General Radio Telephone License to service the Model 340 Telemetry System UHF Transmitter Module or UHF Receiver Module.

Any changes or modifications made to the Model 340 that are not expressly approved by *Information Technologies* could void the users authority to operate this equipment.

Test Equipment

Testing or calibrating the Model 340 requires the use of properly calibrated, laboratory-class, test equipment. Although the generic equivalents of the test equipment are given in this procedure, the actual equipment selected must have specifications that substantially exceed the tolerance given for each measurement.

Throughout this chapter, the calibration procedures are augmented by icons representing the type of equipment each procedure requires. Figure 5-1 summarizes the type of equipment represented by each icon.

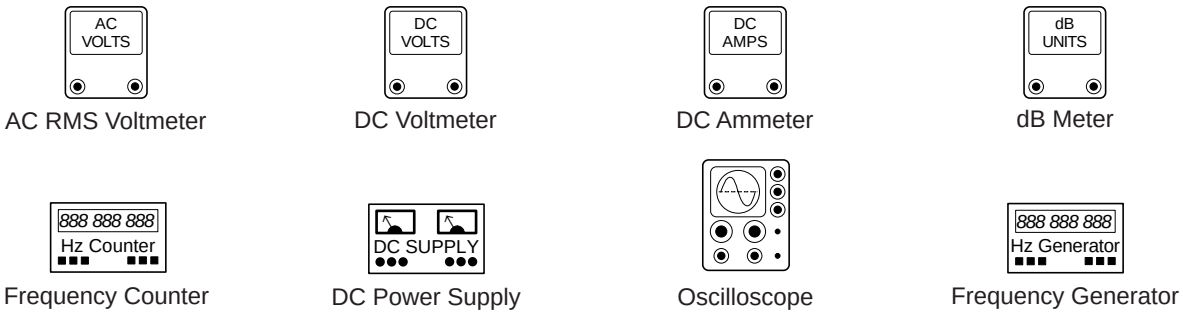


Figure 5-1. Summary of Test Equipment

Receiver Calibration

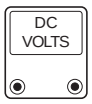
Accessing the Receiver Board

When viewing the receiver from the top with its cover removed, the Telemetry Receiver Board is located in the bottom section of the receiver chassis. Accessing the Telemetry Receiver Board requires removal of the top cover. To remove the board:

1. Remove the four receiver RF module mounting screws and disconnect the cables. Do not disconnect the antenna wire that is connected to the BNC connector. Remove the receiver module and the four standoffs. Place the module to the side.
2. Remove the two screws securing the power transformer from the side of the bracket and lay it to the side. Unplug the connector from the transformer to the PC board.
3. Remove the three heat sink screws from the side of the case.
4. Unplug the front panel cables from the PC board. Disconnect the ground wire from the front and rear panels.
5. Slide the front panel up and off the base; place it to the side.
6. Remove the six (6) PC board screws, (two (2) nuts per connector and two (2) jacksockets) from the rear panel. Slide the PC board toward the front as far as possible.
7. Slide the rear panel up and off, placing it to the side.
8. Slide the PC board out toward the rear, clearing the sides of the case and taking care not to bend the heat sink.

When servicing the Telemetry Receiver Board, refer to the board's schematic and assembly drawing in Chapter 9 of this manual.

Power Supply



When checking the power supply voltages in this section, ensure all voltage checks are within their allowable limits at both low and high AC line voltages.

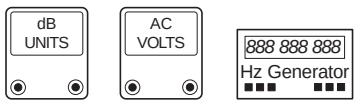
1. Refer to Table 5-1 and confirm the power supply voltages at the indicated test points.

Table 5-1. Power Supply Voltages

Test Point	Power Supply Voltage
TP23	+15 ± 0.6 Vdc
TP25	–15 ± 0.6 Vdc
TP26	+5 ± 0.3 Vdc
TP24	–5 ± 0.3 Vdc

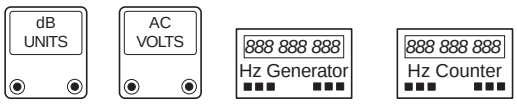
2. Confirm the voltage at TP27 is +12 ± 0.6 Vdc with the RF module connected to J6.
3. Remove the four screws retaining the RF module. Unplug the connector P6. Do not disconnect the antenna wire. Lay the module outside the receiver chassis. This will allow access to all the Telemetry Receiver Board test points and adjustments.

Ultrasound Channel



1. Connect the signal generator between J6 (2) and J6 (Gnd). Adjust the signal generator for a signal level of 1.0Vp-p at TP45.
2. Confirm the –3 dB points of the band-pass frequency are at least 200 Hz and 400Hz from the input at TP45 to the output at TP14. Set R33 for a gain of 2 at the center of band-pass frequency.

TOCO Channel

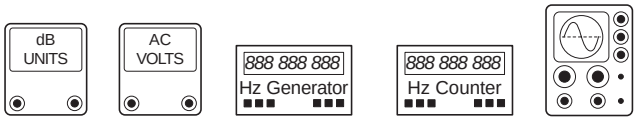


1. Confirm the –3dB points of the band-pass frequency from the input at TP45 to the output at TP29. The lower 3 dB point should measure between 1250 and 1650 Hz. The upper 3 dB point should measure between 1900 and 2250 Hz. The gain at TP29 is 2 at the center of the bandpass.
2. With input frequency at TP45 set to 1750Hz and 250 mVp-p, adjust R73 until the dc voltage at TP3 is equal to the dc voltage at TP4 ± 10 mVdc.
3. With the input frequency switched between 1750 Hz and 1505 Hz, adjust R89 for a voltage differential at TP20 of 4.14 ± 0.1 Vdc.

NOTE: The low frequency response of this output stage is approximately 0.1 Hz. Allow the stage time to settle between frequency shifts. The scale factors for the TOCO stages are 27.2 mV/mm and 16.3 mV/Hz at TP20. Any input frequency shifts can be used to achieve these scale factors.

4. Confirm frequency response at TP20 is dc to 0.1 ± 0.02Hz.
5. Confirm the PLL lock-in range. This is the frequency where it first achieves lock, not the range over which it maintains lock. PLL lock occurs at ≥1300 Hz and ≤2200Hz. Confirm lock occurs at 1300–1520 Hz and 1970–2420 Hz. Lock-in is verified by a logic low at TP5.

ECG Channel



1. Confirm the –3 dB points of the band-pass frequency are at least 2200 Hz and 3000 Hz between the input TP45 and the output TP17. Confirm the filter gain of 2 at center frequency.

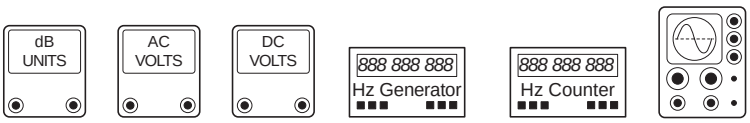
2. With input frequency set at 2700 Hz and 250 mVp-p at TP45, adjust R106 until the dc voltage at TP10 is equal to the dc voltage at TP46 ± 10 mVdc.

3. Sweep the input frequency between 2450 Hz and 2950 Hz at a rate of approximately 25 Hz. Observe the 25 Hz waveform at TP19 with an 8 ± 1.6 Vp–p amplitude.

4. Confirm the PLL lock-in range. This is the frequency where it first achieves lock, not the range over which it maintains lock. PLL lock occurs at ≥2300Hz and ≤3100Hz. Confirm lock occurs at 2205–2450 Hz and2950–3245 Hz. Lock-in is verified by a logic low at TP18.

5. Confirm the frequency response –3 dB points at TP19 are 5 and 50 Hz.

Mode Controls



1. Confirm the low-pass filter –3 dB cutoff point of 90 ± 6Hz with an input of 1.0 Vp-p at TP45 and the output at TP21. Set R61 for a gain of 2.3.
2. Adjust R177 for a frequency of 8020 ± 20Hz at TP32.
3. Confirm a 10 ± 0.1 Vp-p, 4010 ± 20 Hz square wave at TP33.
4. Confirm the center frequency and the –3 dB points of the switched capacitor bandpass filters for each IC listed in Table 5-2.

Table 5-2. Band-Pass Filter Center Frequencies and –3 dB Points

IC Reference	Center Frequency	–3 dB Point
U17-6	80 Hz	75 Hz, 85 Hz
U18-6	40 Hz	35 Hz, 45 Hz
U23-6	20 Hz	15 Hz, 25 Hz
U27-6	10 Hz	5 Hz, 15 Hz

5. With no signal applied, adjust the tone decoders for the correct center frequency indicated in Table 5-3.

Table 5-3. Center Frequencies of Tone Decoders

Test Point	Center Frequency	Adjustment
TP6	10 Hz	R95
TP8	20 Hz	R99
TP9	40 Hz	R110
RP11	80 Hz	R149

6. Refer to Table 5-4. Confirm each tone decoder output locks. The output will go to a logic low state when a 50 mVRMS sine wave of proper frequency is applied to each input at pin 3 of each IC.

Table 5-4. Tone Decoder Output Locks

Input C Reference	Input Center Frequency and Voltage	Output Test Point
U26-3	10 Hz at 50 mVRMS	TP7
U28-3	20 Hz at 50 mVRMS	TP47
U14-3	40 Hz at 50 mVRMS	TP48
U21-3	80 Hz at 50 mVRMS	TP12

7. Ground TP18. Confirm TP30 goes to a low with the presence of the 20 Hz mode tone.
8. Remove the 20 Hz tone. Confirm TP31 goes to a low with presence of 2600Hz subcarrier only, with 1.0 Vp-p at TP 45.

RF Carrier Detect

1. Disconnect the UHF receiver module at J6. Connect the positive lead of a 0 to +5 Vdc adjustable voltage source to J6 pin 3. Connect the negative lead of the variable voltage source to J6 pin 5. Set R1 fully clockwise (wiper at +5 Vdc). Set the variable voltage source to +2.0 Vdc. Observe the following: the signal indicator is off, and a high signal is on J4 pin 3. Adjust R1 counter-clockwise until TP1 goes low. Observe that the signal indicator flashes at approximately 1-second intervals. Increase the voltage from the variable voltage source until the signal indicator stops flashing and remains illuminated. Confirm the voltage source is at +3.0 ± 0.45 Vdc.

   NOTE: R1 may need to be readjusted with the UHF receiver module reconnected to J6.

2. Remove the voltage source while observing TP1. TP1 should go high between 0.2 and 0.8 seconds after the voltage source is removed.
3. With TP1 low, confirm the weak battery indicator signal located on J4, pin 5 flashes at approximately 1-second intervals with TP12 and TP7 jumpered to ground. Confirm the indicator illuminates continuously with only TP1 and TP12 low, and is off if TP1 or TP12 is high.

Mode Outputs

1. The mode output signals are generated via open collector transistor switches in U2. For test purposes, the outputs must be connected to a fetal monitor via the US, ECG and UA interconnect cables or pulled up to +5 V (TP5) by 10kΩ resistors.

   NOTE: When testing the TOCO and IUP mode outputs, the receiver front panel UA mode switch must be in the appropriate position.

2. Refer to Table 5-3. Confirm operation of U2's internal open collector transistor switches. Correct operation is a closure to ground at the connector pins indicated. The transistor switch will be open if either control signal is high.

Table 5-5. Open Collector Transistor Switch Testing

Signal Name	Control Signals	Reference Points	UA Mode Switch
USEN*	TP1 and TP7 Low	J201-11 and J10-12	—
MECGEN*	TP1 and TP31 Low	J202-4 and J10-10	—
FECGEN*	TP1 and TP30 Low	J202-2 and J10-3 Low	—
TOCOEN*	TP1 and TP5 Low	J203-12 and J10-11	TOCO
IUPEN*	TP1 and TP5 Low	J203-11 and J10-13	IUP

Pulsed Doppler Ultrasound Audio Converter

1. Feed a 1 Vp-p 300 ms burst of 300 Hz sine wave into J6 pin 2 (with J6 pin 6 as reference); observe the waveform and its envelope at TP14. Adjust the signal generator for an amplitude of 1.0 Vp-p at TP14. With J201 pin 8 open, confirm the waveform at TP43 maintains the same envelope shape, but at half the frequency (150 Hz) as the signal at TP14. Confirm the peak-to-peak amplitude at TP43 is equal to the amplitude at TP14 –0 + 0.6Vp-p.
2. Connect J201 pin 8 to ground and observe the waveforms at TP14 and TP43 are the same.

Ultrasound Modulator

1. Connect a 3 Vp-p 2.3 MHz sine wave signal source into J201 pin 1. Connect J201 pin 8 to ground. Feed a 300 Hz, 1 Vp-p sine wave into J6 pin 2, and set R146 to its mid-position. Adjust L1 for maximum output at TP13. L1 should go through a peak and drop off in amplitude on either side of the peak setting.
2. Remove the 300 Hz source, adjust R146 for minimum output at TP13. R146 should go through a null setting with the amplitude rising at either side.
3. Remove the ground on J201 pin 8 and reconnect the 300 Hz signal source. Change the frequency of the signal source on J201 pin-1 to 1.151 MHz and adjust L2 for maximum output at TP13. L2 should go through a peak and drop off in amplitude on either side of the peak setting.

Transmitter Calibration

UA Channel

1. Connect the positive lead of a 0–4 V adjustable DC lab supply to J5 pin 1 (PRESS+) through a 100 KΩ resistor and the negative lead to J5 pin 2 (PRESS–) and J5 pin 6 (GROUND). Jumper a 100 Ω resistor across J5 pin 1 and J5 pin 2. Add a jumper between J5 pin 12 and J5 pin 7. Preset R197 fully counter-clockwise (maximum resistance), and R196 to approximately the mid-adjustment point.
2. Connect a digital voltmeter to TP18. Adjust the DC lab supply for a voltage at TP18 of 0 V ± 10 mV. Connect the frequency counter to TP19 and preset R196 for a frequency of approximately 1.75 kHz. Adjust the lab supply for a voltage of –4.000 Vdc ± 10 mV at TP18. Adjust R197 for a frequency of approximately 1.5 kHz. Swap the leads from the lab supply to J5 and adjust the supply for a voltage of +4.000 V ± 10 mV at TP18. Readjust R196 for a frequency of approximately 2.0 kHz. Repeat the above procedure until TP19 produces a frequency of 2.000 kHz ± 5 Hz with TP18 at +4.000 V ± 10 mV and a frequency of 1.500 kHz ± 5 Hz with TP18 at –4.000 V ± 10 mV.

ECG Channel

1. Connect a digital voltmeter to TP6. Connect the frequency counter to TP20 and preset R193 for a frequency of approximately 2.7 kHz. Connect the positive output of the 0–4V DC lab supply to connector J3 pin 1 and the negative output of the supply to J3 pin 2. Add a jumper between J6 pin 2 and J6 pin 3. Adjust the lab supply for a voltage of –4.000 Vdc ± 10 mV at TP6. Adjust R194 for a frequency of approximately 2.45 kHz.
2. Swap the input leads from the lab supply to J3 and adjust the supply for a voltage of +4.000 V ± 10 mV at TP6. Readjust R193 for a frequency of approximately 2.95 kHz. Repeat the above procedure until TP20 produces a frequency of 2.950 kHz ± 5 Hz with TP6 at +4.000 V ± 10 mV and a frequency of 2.450 kHz ± 5 Hz with TP6 at –4.000 V ± 10 mV.

Main Oscillator

Connect the frequency counter to TP7. Adjust C135 for a frequency of 4.604 MHz ± 5 Hz.

Power Supply

1. Confirm –5.6 V ± 0.2 V at TP11
2. Confirm +5.8 V ± 0.2 V at TP10
3. Confirm +5.0 V ± 0.25 V at TP16
4. Confirm +2.50 V ± 0.05 V at TP12
5. Confirm –2.50 V ± 0.05 V at TP14

For your notes

Chapter 6

Maintenance

All equipment, no matter how reliable, needs to be maintained on a regular basis. This section describes general care and cleaning instructions for the Model 340 Telemetry System.

General Cleaning Precautions

NOTE: Refer to your monitor's operator's manual for cleaning instructions for the monitor and transducers.

CAUTION

SHOCK—Unplug the fetal or maternal/fetal monitor and the Model 340R Receiver from the AC power source and detach all accessories. Do not immerse accessories in any liquid. Do not use abrasive cloth or cleaners on the monitor, the Model 340R Receiver, the Model 340T Transmitter, or any accessories.

Cleaning the Transmitter and Receiver

1. Wipe any fluids from the surface of each unit.
2. Dampen a soft cloth with isopropyl alcohol and gently rub soiled area until clean.
3. Dry with a soft, dry cloth.

For your notes

Chapter 7

Troubleshooting

This section of the manual provides a troubleshooting guide for the most basic Model 340 operational problems. If the response to a specific question is not found, contact the Service Department at one of the following telephone numbers:

Inside the United States: Call 1-800-558-5120.

Outside the United States: Call 414-355-3790;
or contact your local distributor.

Problem Chart

Table 7-1. Troubleshooting			
Problem		**Probable Cause**	**Solution**
Receiver **Power** indicator does not light when the receiver is turned on.		■ Receiver not connected to AC receptacle. ■ Defective AC power cord. ■ Defective AC outlet.	■ Connect to AC receptacle. ■ Replace AC power cord. ■ Use a different AC outlet.
	**Signal** indicator flashes with transmitter turned on.	■ Transmitter batteries completely discharged. ■ Mismatched transmitter and receiver channels.	■ Replace batteries. Dispose of used batteries according to the manufacturer's directions. ■ Ensure transmitter and receiver are labeled with identical channel numbers.
	**Signal** indicator flashes intermittently as patient ambulates.	■ Patient outside signal transmission range. ■ Metal in walls, doors, or other structures between transmitter and receiver.	■ Instruct patient to stay within signal range and designated areas where reception is clear. ■ Install optional ceiling antenna system. ■ Contact your *Information Technologies* Service Representative.
 	**Signal** and **Low Battery** indicators light with transmitter turned off.	■ External source of radio frequency interference is present. ■ Another transmitter with the same frequency is in use within the same facility. ■ Service required.	■ Contact your *Information Technologies* Service Representative. ■ Discontinue use of one of the transmitters. **NOTE:** Model 340 Plus and Model 340M Telemetry Systems can be factory re-programmed to an alternative channel number. ■ Contact your *Information Technologies* Service Representative.
	**Low Battery** indicator flashes with transducers plugged into transmitter.	Transmitter batteries have less than 10 minutes of energy left.	Replace the batteries. Dispose of used batteries according to the manufacturer's instructions.
	**Low Battery** indicator lights continuously with no transducers plugged into transmitter.	Transmitter batteries are depleted.	Replace the batteries. Dispose of used batteries according to the manufacturer's instructions.

Table 7-1. Troubleshooting (Continued)		
Problem	**Probable Cause**	**Solution**
Erratic FHR/UA recording.	■ Transducer not properly placed. ■ Transducer not properly connected to transmitter. ■ Receiver interconnection cable(s) not properly attached. ■ Receiver interconnection cable(s) defective. ■ Wrong interconnection cable(s) in use. ■ Radio frequency interference. ■ Another transmitter with the same frequency is in use within the same facility. ■ Exceeding transmission range. ■ Shielding effect of hospital structure.	■ Reposition transducer. ■ Ensure the transducer is securely attached to the transmitter. ■ Ensure interconnection cable(s) firmly attached to both monitor and receiver. ■ Replace interconnection cable(s). ■ Verify interconnection method. ■ Instruct patient to stay within signal range and designated areas where reception is clear. ■ Discontinue use of one of the transmitters. **NOTE:** Model 340 Plus and Model 340M Telemetry Systems can be factory re-programmed to an alternative channel number. ■ Install optional ceiling antenna system. ■ Contact your *Information Technologies* Service Representative.
Monitor FHR and UA displays do not light when transducers are plugged into transmitter.	■ Monitor, transmitter, and/or receiver off. ■ Receiver interconnection cable(s) not properly attached. ■ Receiver interconnection cable(s) defective. ■ Wrong interconnection cable(s) in use.	■ Ensure all three devices are turned on. ■ Ensure interconnection cable(s) firmly attached to both monitor and receiver. ■ Replace interconnection cable(s). ■ Verify interconnection method.
Transmitter “chirps” every 4–5 seconds.	Transmitter batteries have less than 10 minutes of energy left.	Replace the batteries. Dispose of used batteries according to the manufacturer’s instructions.

For your notes

Chapter 8

Technical Specifications

NOTE: Specifications are subject to change without notice.

This section contains a detailed list of the technical specifications for the Model 340 Telemetry System.

This chapter lists specifications for the following:

Transmitter

Table 8-1. Transmitter		
Category	**Technical Specifications**	
Physical Characteristics		
Height:	1.8 in (4.5 cm)	
Width:	5.4 in (13.8 cm)	
Depth:	7.5 in (19.0 cm)	
Weight:	1.75 lbs (0.8 kg)	
Environmental Conditions	**Operating**	**Storage**
Ambient Temperature:	50°F to 104°F (10°C to 40°C)	14°F to 131°F (–10°C to 55°C)
Relative Humidity:	5% to 95%, non-condensing	5% to 95%, non-condensing
Atmospheric Pressure:	700–1060 mbar (525–795 mmHg)	700–1060 mbar (525–795 mmHg)
Certification and Compliance	**340 Original Release and Plus**	**340M**
UL:	UL-544 Listed	UL-544 Listed
FCC:	Complies with FCC Part 90	Complies with FCC Part 95
Industry Canada:	Complies with RSS-119	Complies with RSS-210
Monitoring Modes		
Fetal Heart Rate:	Ultrasound (US) and Fetal ECG (FECG)	
Uterine Activity:	External Tocotransducer (TOCO) or Internal Intrauterine Pressure Catheter (IUPC)	
Maternal Heart Rate:	Maternal ECG (MECG)	
Ultrasound Mode		
System:	Pulse Doppler	
Transmitter Frequency:	1.151 MHz	
Intensity (I_{sata}):	<5 mW/cm^2	
ECG Mode		
Input Impedance:	>1 GΩ	
dc Tolerance:	±1 V	
Common Mode Rejection Ratio:	>90 dB	
FECG Sensitivity:	20 µV to 1 mV	
MECG Sensitivity:	0.5 mV to 5 mV	
TOCO Mode		
Type:	Tocotransducer	
Sensitivity:	20 µV/relative unit	
Range:	–50 to +250 relative units	
IUPC Mode		
Type:	dc Strain Gauge	
Sensitivity:	20 µV/mmHg	
Range:	–50 to +250 mmHg	
RF Section	**340 Original Release and Plus**	**340M**
Output Power:	10 mW	4 mW
Available Frequencies:	430–470 MHz	608–614 MHz
Channel Bandwidth:	25 kHz	25 kHz
Transmission Range:	**340 Original Release and Plus**	**340M**
	1640 ft (500 m), line of sight	200 ft (61 m), line of sight

Table 8-1. Transmitter	
Category	**Technical Specifications**
Antenna Type:	Flexible, detachable, BNC interconnect
Batteries Type: Life:	 Four “AA” Alkaline Cells, 6.0 Vdc at 2450 mAh 20 h, approximately[a]
Control:	On/Off Switch
Audio Indicator:	Low Battery
Connectors:	Remote Event Marker Input, Headset Output

[a] *Use of the headset will deplete the batteries more rapidly*.

Receiver

Table 8-1. Receiver		
Category	**Technical Specifications**	
Power Requirements		
Nominal Line Voltage:	100–120 VAC	220–240 VAC
Line Frequency:	50/60 Hz	50/60 Hz
Power Consumption (maximum):	30 W	30 W
Chassis Leakage:	<50 µA	
Physical Characteristics		
Height:	3.2 in (8.1 cm)	
Width:	7.4 in (18.8 cm)	
Depth:	11.4 in (29.0 cm)	
Weight:	7.0 lbs (3.2 kg)	
Environmental Conditions	**Operating**	**Storage**
Ambient Temperature:	50°F to 104°F (10°C to 40°C)	14°F to 131°F (–10°C to 55°C)
Relative Humidity:	5% to 95%, non-condensing	5% to 95%, non-condensing
Atmospheric Pressure:	700–1060 mbar (525–795 mmHg)	700–1060 mbar (525–795 mmHg)
Certification and Compliance	**340 Original Release and Plus**	**340M**
UL:	UL-544 Listed	UL-544 Listed
FCC:	Complies with FCC Part 15	Complies with FCC Part 15
Industry Canada:	Complies with RSS-119	Complies with RSS-210
Output Signals:	US, ECG, UA, and Mark	
RF Section		
Input Impedance:	50 Ω	
Input Sensitivity:	<0.4 µV for 12 dB SINAD	
Antenna Type:	Flexible, detachable, BNC interconnect (Other factory-approved external antennas or antenna systems may be used. Contact your *Information Technologies* Service Representative for more information.)	
Controls:	On/Off Switch, UA Mode Switch	
Visual Indicators:		
Power:	Green LED	
Signal Strength:	Green LED	
Transmitter Low/Depleted Battery:	Red LED	
Connectors		
AC Line Input:	3-Prong, IEC-Style	
Mark Output:	Use only with Models 115, 116, 118, 145, 150, 151, and 155 Monitors.	
Ultrasound Output:	Use only with Models 115, 116, 118, 145, 150, 151, and 155 Monitors.	
ECG Output:	Use only with Models 115, 116, 118, 145, 150, 151, and 155 Monitors.	
UA Output:	Use only with Models 115, 116, 118, 145, 150, 151, and 155 Monitors.	
Auxiliary Output:	Use only with Series 120 and 170 Monitors.	

Chapter 9

Drawings

This section of the manual provies the Model 340 schematics and assembly drawings. These drawings should be used in conjunction with other sections in this manual.

For your notes

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