Remote Diagnostic Technologies Ltd.

FCC 47 CFR Part 24 Submission (via Radio Frequency Investigations Ltd.) Relating to the

Tempus 2000 Patient Monitor

Description of the Device

Written by: Chris Hannan
Submitted: 3 December 2003

1   Operational Description of the Tempus 2000 Patient Monitor

1.1   Purpose of the Device

The Tempus 2000 is a vital signs monitor designed for use in remote locations by trained non-medical expert personnel. The device monitors a variety of vital signs and transmits the data via existing wired telecommunications that are available locally that are available in the remote location.

Instead of connecting over wired networks, the Tempus is also fitted with a built-in wireless GSM card that enables it to connect over the GSM network. The GSM functionality is achieved by using a Commercial Off The Shelf (COTS) PCMCIA card supplied by SonyEricsson. This unit (called the GC75) is FCC approved under 47CFR Part 24 ref FCC ID: PBY6130201-BV. The PC card is not modified as a part of its integration into the Tempus, however an alternative antenna is used rather than the one that it is normally supplied with. This antenna is the Revie product supplied by Centurion. In order to connect the GC75 card (which is inside the Tempus) to the antenna (which although it is not visible is on the outside of the Tempus enclosure) an interconnecting cable is used to connect the GC75 to a bulkhead SMA on an interface PCB that forms part of the enclosure.

The device also incorporates an integral microphone and earpiece that allows the user to communicate with the Response Centre.

The Tempus is battery powered and has no connections to a mains supply.

1.2   The Features of the Device

The Tempus includes:
- Integral hands-free voice link
- Non Invasive Blood Pressure monitor - NIBP
- Pulse rate and blood oxygen monitor - SpO_2
- Non-invasive thermometer (infra-red tympanic)
- Respiration rate and exhaled CO_2 monitor - $ETCO_2$ (side-stream capnometer)
- 12 lead Electrocardiogram - ECG
- Full colour, still video camera

1.3   Construction of the Tempus

The Tempus is housed within a plastic enclosure which forms an internal (screened) space for the PCBs and an external space to house the patient sensors, disposables, antenna etc. The base of the unit is formed from a metal plate that provides the local ground reference.

Onto the baseplate is fitted a main board which provides computer functionality. Onto this is fitted the Tempus PCB that integrates and controls the various medical and communications devices. Onto the Tempus PCB is fitted:
- The modem
- The DSVD PCB (which integrates the voice and data signals for simultaneous voice and data communications), this then houses the serial/PCMCIA interface PCB which in turn houses the GC75 PC card

- The power supply and battery management circuitry
- The NIBP unit (which incorporates the SpO2 PCB)
- The capnometer unit
- The microphone and speaker circuitry

The Tempus PCB connects to the various external sensors etc. via the Connector Plate PCB. This is a PCB that forms part of the screened enclosure and which provides physical interconnection and isolation.

The lid of the Tempus includes a back-lit screen and a set of membrane buttons that control the device. This is connected to the Tempus PCB via the Connector Plate PCB.

The device can also be controlled with a wrist worn keypad (fitted with a membrane keypad that provides the same controls as those on the screen). In addition, this unit houses the camera and the earpiece for the voice link. This unit is connected to the Tempus PCB via the Connector Plate PCB.

1.4   GC75 PC Card (GSM) Specifications
The OEM cell phone (GSM card) has the following specifications:

Dimension	GSM 900 / E-GSM 900	GSM 1800	GSM1900
Frequency range	TX: 880-914MHz RX: 925-959MHz	TX: 1710-1785MHz RX: 1805-1880MHz	TX: 1850-1910MHz RX: 1930-1990MHz
Channel spacing	200kHz	200kHz	200kHz
Number of channels	175 Carriers * 8 (TDMA)	374 Carriers * 8 (TDMA)	299 Carriers * 8 (TDMA)
Modulation	GMSK	GMSK	GMSK
TX Phase accuracy	5° (RMS) 20° (peak)	5° (RMS) 20° (peak)	5° (RMS) 20° (peak)
Duplex spacing	45MHz	95MHz	80MHz
Frequency stability	0.1ppm	0.1ppm	0.1ppm
Transmitter RF power output	33dBm Class 4 2W peak	30dBm Class 1 1W peak	30dBm Class 1 1W peak
Transmitter spurious emission	According to GSM spec	According to GSM spec	According to GSM spec
Receiver RF level	-102dBm	-102dBm	-102dBm
Receiver RX bit error rate	$<=10^{-4}$ (Static Ch.) $<=3\%$ (EQ50)	$<=10^{-4}$ (Static Ch.) $<=3\%$ (EQ50)	$<=10^{-4}$ (Static Ch.) $<=3\%$ (EQ50)

1.5   Operational Description of the SonyEricsson GC75 PC Card

Rated RF power in watts:
GSM Band: 2 watts (33 dBm)
DCS Band: 1 watt (30 dBm)
PCS Band: 1 watt (30 dBm)

Frequency Range:
GSM Band: TX 880.2 MHz to 914.8 MHz

RX 925.2 MHz to 959.8 MHz
DCS Band: TX 1710.2 MHz to 1784.8 MHz
TX 1805.2 MHz to 1879.8 MHz
PCS Band: TX 1850.2 MHz to 1909.8 MHz
RX 1930.2 MHz to 1989.8 MHz

Operation Description:

The GC 75 operates using the PCMCIA interface.   The Tempus communicates with the card using a standard set of AT commands as defined in the GSM specification. The serial connection in Windows is setup using 115kbps, no parity, 8 data bits, 1 stop bit, and uses hardware flow control.

Circuitry Description:

Baseband:
The core processor used by the card is a proprietary chip manufactured by Mobilink (ML2029B chip). This processor interfaces with the memory (Flash/SRAM) and contains all of the mixed signal processing used to connect with the RF. Also, the ML2029B chip interfaces with the PCMCIA interface directly.

TX path:
The TX I and Q is generated in ML2029B and is used to modulate an IF VCO to produce a TX IF frequency of 424 MHz for GSM and DCS bands and 428 MHz for PCS bands. This IF frequency will feed a phase-detector that will compare with the mixed down frequency of the TX VCO. The TX VCO is then input directly into the PA module. Power is adjusted through measurement of the PA current and the output power is adjusted appropriately.

RX path:
The RX is run through a filter, and then input into an LNA. This LNA has a gain adjustment of 20dB and is used to reduce gain for strong input signals. The output of the LNA is input into another filter for reduction of the image. The output of the filter is fed into a mixer for conversion to an IF of 360MHz. This IF frequency is mixed again to I and Q and demodulated by the baseband.

Antenna and Ground System:

The antenna used is not the one that is originally supplied with the PC card. It is a triple band antenna covering GSM, DCS, and PCS bands for Europe, Asia, and the US. It is called the Revie and is supplied by Centurion. As a dipole antenna it does not use the ground plane provided by the PC card.

The ground system is simply devised of two layers in the PCB (layer 2 and layer 5) and connects throughout the ground of the PCB with vias. This outer casing is stainless steel and through the use of gasket material forms a set of conductive walls that connects the outer casing to the ground plane of the PCB. Thus the outer casing is grounded. The system ground is shared with the Tempus through the 68-pin PCMCIA connector.