The Model 5400 UWT is a compact, high-power acoustic underwater telephone for single sideband voice and modulated CW operation. Fully synthesized, the Model 5400 UWT covers a frequency range of 5 to 45* kHz, selectable in 1 Hz increments plus the AN/WQC and ARD-8000 frequencies. It is fully compatible with AN/UQC, AN/BQC, and ATM-504 series.

**FEATURES**

Advanced Digital Signal Processing results in a large number of selectable functions and frequencies with superior voice quality.

AN/UQC compatible default settings: In default mode, the system is compatible with AN/UQC series systems (carrier frequency 8.087 kHz, USB, 200 watt output power). TIPE default frequencies are also selected.

TIPE (Transponder, Interrogator and Pinger/Echo Sounder) Modes provide automatic ranging, tracking pinger, and when used with a vertically oriented transducer, depth below the surface or altitude above the bottom. It also operates on operator selected frequencies between 5 - 45* kHz.

AN/WQC Mode: In WQC Mode the system can communicate with the AN/WQC system and provide automatic ranging against an ARD-8000.

If used with an external power amplifier, the system is capable of the same output acoustic source levels as the AN/WQC.

Emergency Underwater Telephone Interface via a connector on the front panel allows access to a designated transducer by a compatible telephone.

Interface to External Equipment via rear panel connections: For XMTR Input/Output, the telephone’s signal can be routed to an external power amplifier. An external source can utilize the Model 5400 UWT’s power amplifier and transducer(s) for transmission. An Auxiliary Transducer Input allows an independent user access to the transducer not currently selected by the Model 5400 UWT. In addition, the Model 5400 UWT can mute external equipment when transmitting. The Receiver Output allows unprocessed data to be fed to external equipment for processing.

Interface to Data Communications Equipment by customer Data Communications Equipment (DCE) via an RS-232/RS-422 Serial Interface: Baud rate can be set from the front panel.

Up to four remote control stations can be accessed. The fourth remote control port can be used for DCE via an RS-232/RS-422 interface.

Built-in test Performance Monitor and Fault Location: The UWT automatically performs a self-diagnostic and front panel lamp test routine. If an error is detected, one of six error messages will be displayed, and the operator can perform a further series of tests to isolate the fault to circuit board level.

Two transducer outputs are standard on the Model 5400 UWT. For installations requiring multiple transducers, a separate Transducer Interface Unit is available.

The Model 5400 UWT is housed in a drip-proof cabinet, suitable for rack mount as well as table top installation. Cooling is by forced air from an internal fan.

The system is designed to Best Commercial Standards, using Military Specifications as design guidelines.

Mean Time Between Failure (MTBF) predicted at 2,600 hours when calculated in accordance with MIL-HDBK-217E, Parts Count Method.

*May be limited by the bandwidth of the installed transducer(s).
AVAILBLE OPTIONS

Remote Control Unit: The Model 5400 UWT can be controlled from up to four remote locations. The Remote Control Unit can perform all the functions of the master station, except for the EMERGENCY UWT interface which is disabled. The Remote Control Unit can be installed either in a standard 19-inch rack, or be bulkhead mounted. Power requirements are 110 or 220 V, 50-60 Hz.

Transducers: A selection of transducers is available, to suit a variety of applications.

Transducer Interface Unit (TIU): Where more than two transducers are to be connected (typically sector transducers), an interface unit is available. The TIU connects to the telephone transceiver via transducer position #2 and is controlled from the UWT front panel.

Optional AC/DC Power Supply: AC to DC power supplies are optionally available for operation from 110 or 220 Vac. The power supply unit is configured for installation in a 19-inch rack.

Auxiliary Power Unit: This unit contains the WQC-2A equivalent power amplifier, output transformer and 115VacC/28Vdc power Supply.

Headset with Boom Microphone: The headset with boom microphone comes with a six-foot coil cord and belt clip push-to-talk switch.

OPERATOR INTERFACE

All operator controls are located on the front panel. The front panel has adjustable backlighting, except for Power On/Off, speaker Volume, Squelch and TIPE Transmission Rate, all system operator controls are membrane switches. Frequently used functions have dedicated controls, while less frequently used functions are selected by numeric code entries on the keypad. This makes operation simple while allowing flexibility and a virtually unlimited number of functions. Functions selected and parameter values are displayed on red LEDs. The frequency and Range displays are also used for display of warning messages and for results of initiated tests.

Mode changes and modifications to operating parameters are accomplished by touch switches and code entries on the front panel.

Up to 50 operator selected front panel set-ups (frequency/mode) can be stored in RAM for easy recall at any time. Five operator selectable output power levels, 200-, 100-, 60-, 10-, and 2-watts provide communication at ranges to 20,000 yards.
TYPICAL APPLICATIONS

VOICE & CW COMMUNICATION
Voice and Continuous Wave (CW) communication is the Model 5400 UWT’s primary application. Communication can be established between any two points (surface ships, submarines, fixed installations, or any combination of these) in the same body of water at ranges to 20,000 yards. Operating frequencies are selectable.

Broad frequency range, adjustable output power, and selectable USB/LSB modulation, allows the Model 5400 UWT to provide discrete communication when multiple telephones are used in the same operating area as well as communication with diver carried underwater telephones.

CW transmission is available from either the front panel push button, or by Morse key via a back panel connector.

The system is designed for simultaneous voice and TIPE operation and, when proper frequency separation is maintained, mutual interference is minimized.

TIPE OPERATION
While operating in any TIPE submode, voice operation retains priority; the voice receiving channel remains audible and immediate voice transmission is available via the selected microphone.

Transponder/Interrogator: The Transponder/Interrogator Modes are used for ranging between two platforms equipped with Model 5400 UWTs, or between a Model 5400 UWT and any other acoustic device capable of generating a compatible interrogation or response signal.

Interrogation pulses can be transmitted manually, or automatically at a rate of 1 to 60 interrogations per minute. The rate is adjustable by means of the RATE potentiometer control.

Pinger/Echo Sounder: In this mode, the telephone can be used as an acoustic beacon by transmitting a signal at a selected frequency. Pulses can be transmitted manually, or automatically at a rate of 1 to 60 pulses per minute.

Echo sounder operation is the same as Pinger operation except that the transmitted signal is directed either up or down (to the surface or to the bottom) by a directional transducer. The telephone calculates the delay of the return signal and displays the depth or altitude in yards or meters.

TELEMETRY
The Model 5400 UWT’s transceiver and transducer(s) can be used to transmit and receive data from peripheral equipment via a connector located on the telephone’s back panel.

Typical applications are interrogation of coded transponders, and Identification Friend or Foe (IFF).

Frequency coverage is 5 to 45* kHz in 1 Hz increments.

*May be limited by the bandwidth of the installed transducer(s).
Emergency Telephone connector

- In the event of a system failure or loss of power, the EMERGENCY Connector provides direct access to a designated transducer by a compatible emergency underwater telephone.
**Model 5400-2 Underwater Telephone Transceiver**

The ITT Model 5400 Underwater Telephone transceiver has been selected by Raytheon for the U.S. Navy New Attack Submarine program (NSSN), the Virginia Class SSN. This underwater telephone transceiver, designated Model 5400-2, has the following features:

- Master/Slave Operation between two Model-5400-2 transceivers
- Master/Slave selected by host computer
- Utilizes sonar system power amplifier
- Thermal warning/thermal overload sensor
- Battle short capability/indication
- Independent selection of transmit/receive transducers
- High/low power selection control
- Improved ranging accuracy
- Concurrent high/low dual band receive capability
- Ruggedized for environment condition

**Model 5400/WQC Underwater Telephone System**

ITT has been selected by Empresa Nacional Bazan, Factoria Naval de Ferrol to provide the Model 5400/WQC Underwater Telephone System for the F-100 Frigate Program. The Model 5400/WQC System is a modern, low life cycle cost NDI/COTS underwater communications system, which is equivalent to, or exceeds, the performance and functionality of the AN/WQC-2 system. The Model 5400/WQC Underwater Telephone System is a complete systems approach consisting of the Model 5400-1 Main Unit/Transceiver, the Auxiliary Power Unit, Remote Control Unit, the TR-232 for LF operation, and the ITT SB31CT HF band omni-directional transducer.
**Frequency Range (XMTR & RCVR)**

- **Frequency, Operator Selectable**: 5-45 kHz in 1 Hz steps plus
- **WQC Mode**: 1.45 - 3.1 kHz
- **Accuracy**: < +/-5 Hz
- **Passband @ -3 dB**
  - USB, 5-42 kHz Carrier: 3,000 Hz wide, up from selected frequency
  - LSB, 8-45 kHz Carrier: 3,000 Hz wide, down from selected frequency
- **WQC Mode (LSB)**: 1,650 Hz wide, down from 3600 Hz carrier frequency

**Transmitter**

- **XMT Power Levels**
  - 5-45 kHz Range: Operator selectable, 2, 10, 50, 100, 200 watt RMS @ 28 Vdc
  - WQC Mode (Min): Operator selectable, 1, 5, 25, 50, 100 watt RMS @ 28 Vdc
- **XMTR Output Impedance**: 50Ω
- **Audio Band**
  - Voice, 5-45 kHz Range: 250-3,000 Hz @ -3dB
  - Voice, WQC Mode: 500-2,150 Hz @ -3dB
  - CW: 800 Hz heterodyned, single tone
  - Microphone Input: Dynamic, 600 Ω impedance
  - Boom Microphone (Headset): 600 Ω impedance
- **TIE Modes Bandwidth**
  - XPND & INTRG Modes: 30 Hz
  - Pinger Mode: 60 Hz

**Receiver**

- **Sensitivity**: 10µV for 10 dB SNR @10 kHz
- **Audio Band**
  - 5-45 kHz Range: 250-3,000 Hz
  - WQC Mode: 500-2,150 Hz
- **Audio Output**
  - Headphones, Impedance: 600 Ω
  - Built-in Speaker: 2.5 watt
- **TIE Modes Bandwidth**: 1.4 kHz

**TIPE Parameters**

- **Transponder Mode**
  - Frequency Selectable: 5-45 kHz in 1 Hz steps
  - Pulse Length: 28 ms
  - Response Delay: 116 ms
  - Frequency, WQC Mode: 2.35 kHz
  - Pulse Length: 32 ms
  - Response Delay: 116 ms
- **Interrogator Mode**
  - Frequency Selectable: 5-45 kHz in 1 Hz steps
  - Pulse Length: 28 ms
  - Frequency, WQC Mode: 1.60 kHz
  - Pulse Length: 32 ms
  - Pulse Rate
    - Manual: Any rate < 60 pulses/minute
    - Auto: 1-60 pulses/minute
  - Range Readout: Selectable, yards or meters
  - Max Displayed Range: 26,375 yards/24,000 meters
- **Pinger/Echo Sounder Mode**
  - Frequency Selectable: 5-45 kHz in 1 Hz steps
  - Pulse Length: 14 ms
  - Pulse Rate
    - Manual: Any rate < 60 pulses/minute
    - Auto: 1-60 pulses/minute
  - Range Readout: Selectable, yards or meters
  - Max Displayed Range: 26,375 yards/24,000 meters

**System Default Parameters**

- **Carrier Frequency (Voice/CW)**: 8.087 kHz
- **Modulation Mode**: Voice
- **System Mode**: Voice
- **Modulation Mode**: Upper Sideband (USB)
- **Transmitter**
  - Output Power: 200 watt
  - XMTR Configuration: Linear
  - Transducer Selected: Transducer #1
  - TIE Modes’ Defaults
    - Transponder: 9.337 kHz
    - Interrogator: 10.084 kHz
    - Pulse Rate: Manual
    - Pinger/Echo Sounder: 14.829 kHz
    - Pulse Rate: Manual
    - Range Readout: Yards
    - Speaker: On
  - **Interfaces to External Equipment via Back Panel Connectors**
    - J1 Receiver Output: 50 Ω, transformer coupled
    - J2 Access to XDCR not in use: 50 Ω
    - J3 External XMTR Input: 600 Ω
  - **J6 Main Serial Data Interface**: RS232/RS422/RS423 at sel baud rate: 300/600/1200/2400/4800/9600/19200
  - **J10 Mute Input/Output**: Line to GND
  - External CW Key: Contact closure

**Power Requirements**

- **Input Voltage**: 28 Vdc ±/- 15%
- **Power Supply**: Current @ 28 Vdc
  - Transmit: Max 20 A @ 200 watt Output
  - Receive: 1.1A

**Environmental Service Conditions**

- **Specifications and MIL Standards Used as design guidelines**: MIL-E-16400
- **General System Design**
  - **Temperature**
    - Operating: 0 degrees to 50 degrees C
    - Non-operating: -10 degrees to 70 degrees C
  - **Humidity**: 95% rel. humidity, condensing
  - **Drip Proof**: 45 degree inclination, both axes
  - **Shock**: MIL-S-901C, Grade B. Class II
  - **Vibration**: MIL-STD-167, Type I, to 33 Hz @ 1G
  - **Electromagnetic Radiation**: MIL-STD-461, Class A5, Part 6; CE01. CE03, CS01, CS06, RE01, RS01, RS02, RS03 from 14 kHz to 1 GHz
  - **Airborne Audible Noise**: <50 dB @ 3 ft from the UWT
  - **Inclination**: No limit of angle
  - **Ambient Pressure (Inboard)**: 1,000 millibars ±/- 400 millibars

**Dimensions**

- **Height**: 5.22” (132.6 mm)
- **Depth**: 13.88” (352.6 mm)
- **Width**: 17” (431.8 mm) on chassis
- **Weight**: 35 lbs (15.8 kg)

***At 50% Duty Cycle***
Summary of ITT Model 5400/WQC System

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Model 5400/WQC System</th>
</tr>
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<tbody>
<tr>
<td>Power</td>
<td>115 Vac +/- 10%</td>
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<tr>
<td></td>
<td>60 Hz, single phase</td>
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<td></td>
<td>25A max</td>
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<tr>
<td>Warm Up Time</td>
<td>6 seconds to complete built-in test functions</td>
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<tr>
<td>Heat Dissipation</td>
<td>700W (at full power)</td>
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<tr>
<td>Frequency Range</td>
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<td>High Band</td>
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<td>Low Band</td>
<td>1.45 kHz to 3.10 kHz</td>
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<td>Transmit Output Power</td>
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<td>Type</td>
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<td>Maximum</td>
<td>1400 VA, 1.4 kHz to 11.1 kHz</td>
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<td></td>
<td>1500 VA</td>
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<td>Max Audio Output Power</td>
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<td>Remote Station</td>
<td>2.5W</td>
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<td>Receiver Capability</td>
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<td>Type</td>
<td>Single Sideband</td>
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<tr>
<td>Sensitivity</td>
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<tr>
<td>High Band</td>
<td>-160 dBV, 1 Hz BW for 10 dB SNR</td>
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<tr>
<td>Low Band</td>
<td>-157 dBV, 1 Hz BW for 10 dB SNR</td>
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<tr>
<td>Load Impedance</td>
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<td>Drive Capability</td>
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<td>30 to 50 Ω at resonant frequency</td>
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<tr>
<td>Size &amp; Weight</td>
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</table>

Model 5400/WQC Auxiliary Amplifier Unit

The Auxiliary Power Unit contains the WQC-2A-equivalent power amplifier, output transformer and power supplies. The power amplifier utilizes a proven COTS-based auxiliary power unit with a power amplifier module of the PWM type. It is capable of delivering up to 1500 VA into highly reactive loads. The PWM technology provides a very efficient amplifier (85-90%) which maintains its efficiency over a wide range of operating frequencies and also when driving highly reactive transducer loads. It operates from +48 Vdc. The unit includes a high power switching type power supply that is capable of delivering up to 1800 watts of +48 Vdc power.

An output transformer is provided to match the output of the power amplifier to the WQC band transducer loads. It is capable of operating at the 1400 VA power level over the frequency range of 1.4kHz to 11.1kHz. An output relay switching matrix is also provided to select at least four different transducers. Transducer selection control is provided in the Model 5400-1 transceiver.

The Model 5400-1 transceiver has a built-in transmit/receive switch, however, in order to confine the high voltage to the power amplifier chassis, a T/R switch is provided within the Auxiliary Power Unit.

The high power amplifier will receive input drive signals by means of an existing 200 watt transmit power amplifier in the Main Unit which will be retained as a standby, redundant power amplifier in the event of main power amplifier failure.