MK21 USB DAQ

Surface Ship

Bathythermograph Data Acquisition System

Installation, Operation and Maintenance Manual

P/N 308437, Rev. E

LOCKHEED MARTIN

Sea-Air Systems Division

Lockheed Martin Sippican, Inc.
Sea-Air Systems Division
Seven Barnabas Road
Marion, MA 02738

Telephone: (508) 748-1160
Fax: (508) 748-3626

www.sippican.com

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PREFACE

About This Manual

This manual describes how to install and operate the MK21 USB DAQ Bathythermograph Data Acquisition System along with how to install and operate the WinMK21 Data Acquisition and Post-Processing Software on a PC to acquire, process, view, analyze, and archive data from expendable oceanographic probes. It is provided for informational and reference purposes only and is as accurate as reasonably possible. It is also subject to change without notice.

This manual is divided into the following seven sections plus an appendix:

Section 1: System Overview. Provides a general overview of the MK21 USB DAQ Bathythermograph Data Acquisition System, the WinMK21 Data Acquisition and Post-Processing Software that controls and acquires data from the MK21 USB DAQ over a universal serial bus (USB) interface, and Lockheed Martin Sippican's expendable oceanographic probes.

Section 2: Installing WinMK21. Provides an illustrated procedure on how to install, start, and exit from WinMK21.

Section 3: Installation and Test. Provides instructions on how to unpack the system components and install them on a surface ship, including how to install the MK21 USB DAQ in a 19-inch rack and connect it to power and to a desktop or laptop PC; how to install the MK21 USB driver on your computer; and how to mount and ground an LM-2A, LM-3A or LM-4A launcher and connect it to the MK-21 USB DAQ. In addition, procedures are included for verifying operation of the system before launching a probe.

Section 4: Operation. Describes how to operate the WinMK21 Data Acquisition and Post-Processing Software to launch an expendable probe and acquire and process the data from it.

Section 5: WinMK21 Windows and Commands. Includes the same information provided by the WinMK21 Software Reference component of the online Help.

Section 6: Replaceable Parts. Provides a list of replaceable mechanical and electrical components and an illustration which identifies their locations.

Section 7: Serial-Binary Data Transmission Description. Specifies the interface requirements for WinMK21 and an external serial device to achieve the serial-binary data transmission between them.

Appendix A: Technical Notes. Includes technical notes on the pressure point calibration technique, the sound velocity and salinity equations as implemented in the WinMK21 Data Acquisition and Post-Processing Software, and the temperature measurement method for a thermistor.

Minimum System Computer Requirements

The recommended minimum system computer requirements for WinMK21 to operate efficiently include the following:

- Microsoft Windows 2000/XP
- Pentium III 700 Mhz processor
- 64 MB of RAM
- 200 MB of available hard drive space
- VGA monitor with 1024 x 768 of resolution
- Mouse
- USB 2.0 port
- RS-232 serial port for navigation input and/or data transmission

Notes, Warnings and Cautions

Where applicable, notes, warnings and cautions are provided as follows:

NOTE *Provides you with recommendations or general information that is supplemental to the information provided.*

WARNING *Alerts you to the possibility of injury or death to yourself or to others.*

CAUTION *Alerts you to the possibility of damage to equipment or to data.*

Safety Precautions

The general safety precautions listed below apply to the overall operation, installation and maintenance of the MK21 USB DAQ. All operators should observe these precautions when operating or servicing it.

Never do the following:

NEVER service or replace a component of the MK21 USB DAQ with it turned on or with the AC power cable plugged into a power outlet.

NEVER service or adjust the MK21 USB DAQ alone.

NEVER allow the MK21 USB DAQ to get wet.

NEVER touch the contact pins of the MK21 interface board as the board is electrostatic discharge (ESD) sensitive.

Always do the following:

ALWAYS turn the MK21 USB DAQ off and unplug the power cord before servicing it or replacing a component.

ALWAYS service or adjust the MK21 USB DAQ only in the presence of a person that is capable of rendering first aid.

ALWAYS ensure that persons working with or near high voltages are familiar with the modern methods of resuscitation.

ALWAYS keep the top of the MK21 USB DAQ free of books, papers and other materials.

ALWAYS follow ESD handling procedures when working with ESD sensitive components.

How to Contact Lockheed Martin Sippican, Inc.

Lockheed Martin Sippican welcomes your comments. Please contact Lockheed Martin Sippican Sea-Air Systems Division technical support to offer any comments or suggestions about this manual or to request technical support. Lockheed Martin Sippican Sea-Air Systems Division technical support can be contacted using any of the following means:

Mail

Ocean Support
Lockheed Martin Sippican, Inc.
Sea-Air Systems Division
Seven Barnabas Road
Marion, MA 02738

Email

oceansupport.dl-sippican@imc4.ems.lmco.com

Telephone

(508) 748-1160

Facsimile

(508) 748-3626

For more information about Lockheed Martin Sippican and our products, visit our Web site at **www.sippican.com**.

SECTION 1
SYSTEM OVERVIEW

The MK21 USB DAQ Bathythermograph Data Acquisition System is a portable data acquisition system that measures and outputs ocean temperature, conductivity and sound velocity versus depth using expendable probes that are launched from surface ships. The measurements are output over a universal serial bus (USB) interface to a laptop or desktop PC running the WinMK21 Data Acquisition and Post-Processing Software. WinMK21 provides a convenient, user friendly means of displaying the data in real time and recording the data on disk for later analysis. Any person having general knowledge of basic PC operating systems can operate WinMK21, which is included on a CD with the MK21 USB DAQ.

This section provides a general overview of the MK21 USB DAQ Bathythermograph Data Acquisition System, including brief descriptions of the following:

- MK21 USB DAQ components
- MK21 USB DAQ controls and indicators
- MK21 USB DAQ connectors
- WinMK21 Data Acquisition and Post-Processing Software
- XBT, XSV, XCTD, and XBP expendable probes
- Test devices
- LM-2A, LM-3A and LM-4A launchers

The MK21 USB DAQ, which includes a MK21 interface board, inputs and processes the data from Lockheed Martin Sippican XBT, XSV, XCTD, and XBP probes launched from Lockheed Martin Sippican LM-2A, LM-3A and LM-4A launchers, and outputs the data over the USB interface to a PC. With the WinMK21 Data Acquisition and Post-Processing Software installed on the PC, profiles of temperature versus depth, sound velocity versus depth, and temperature and conductivity versus depth can be displayed, stored on disk, output on a serial port of the PC, and printed. The MK-21 USB DAQ Bathythermograph Data Acquisition System comprises a MK21 USB DAQ and a connector box, as illustrated, along with the available launchers, in Figure 1-1. The supplied connector box provides an alternate ground connection for the installed launcher and is prewired with an interface cable that connects to the MK21 interface board. A watertight junction box may be used instead of the connector box.

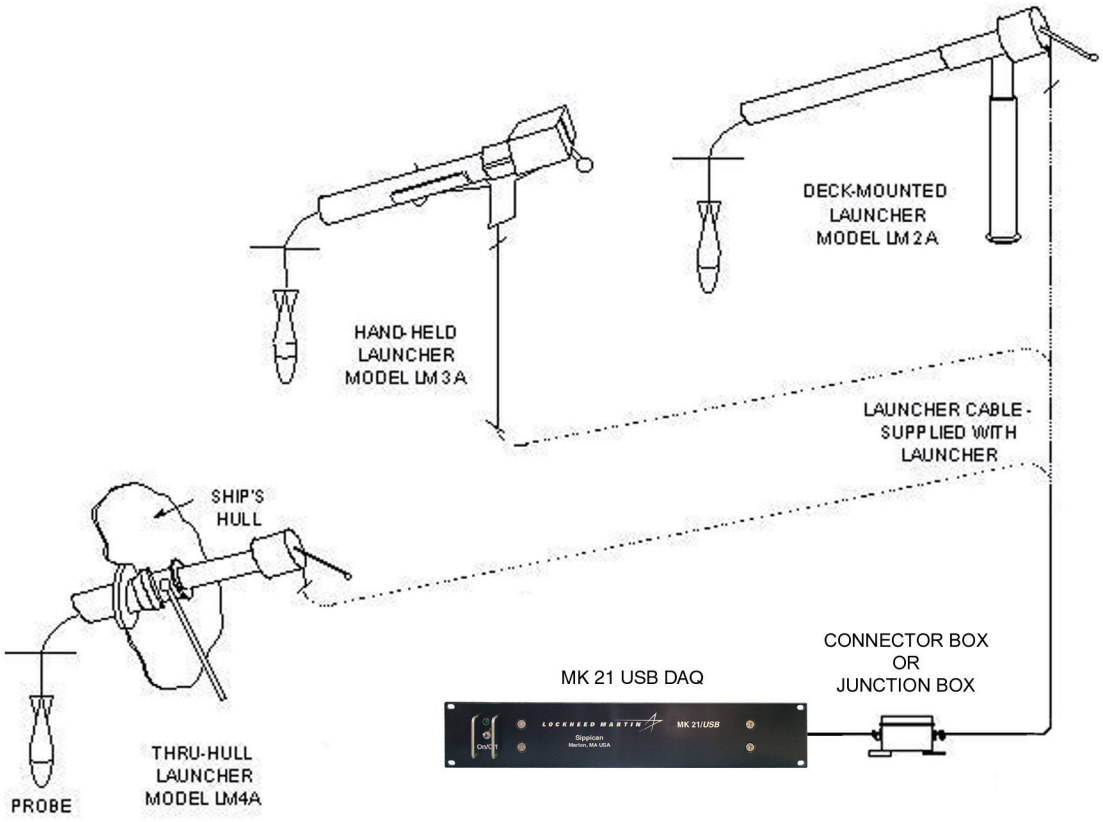


FIGURE 1-1: ***The MK21 USB DAQ Bathythermograph Data Acquisition System with the Available Launchers***

1.1 Specifications

The general specifications for the MK21 USB DAQ are the following:

Interface connection:	USB 2.0
Computer operating system requirements:	Windows 2000/XP
USB connector cable:	Type "A" male, 1-meter length

Power requirements:	100–240 VAC, 50–60 Hz, 50 watts
Weight:	6.5 lb
Size:	19.0 in. wide by 3.5 in. high (2U) by 8.25 in. deep (See Figure 1-2.)
Operating temperature range:	0°C to 40°C (32°F to 104°F)
Storage temperature range:	-10°C to 65°C (14°F to 149°F)
Relative humidity:	0–90% noncondensing
AUDIO connector:	BNC
CONNECTOR BOX connector:	DB-9S

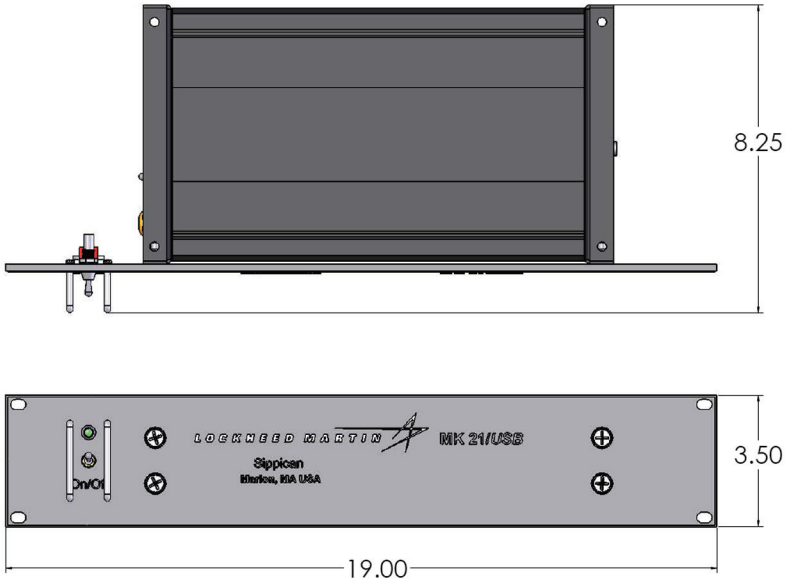


FIGURE 1-2: ***MK21 USB DAQ Overall Dimensions***

The connector box is available in two configurations: with a 3.0-meter prewired interface cable (P/N 306146-1) and with a 6.1-meter prewired interface cable (P/N 306146-2). The connector box also includes a binding post for grounding and a 4-postion terminal strip for making the launcher connection to the MK21 USB DAQ. The general specifications are the following:

Overall size: 5.5 in. long by 4.0 in. wide by 2.5 in. high (See Figure 1-3 for the mounting dimensions.)

Weight: 1 lb, 1 oz (0.48 kg), with 3.0-meter interface cable

Interface cable connector: DB-9P

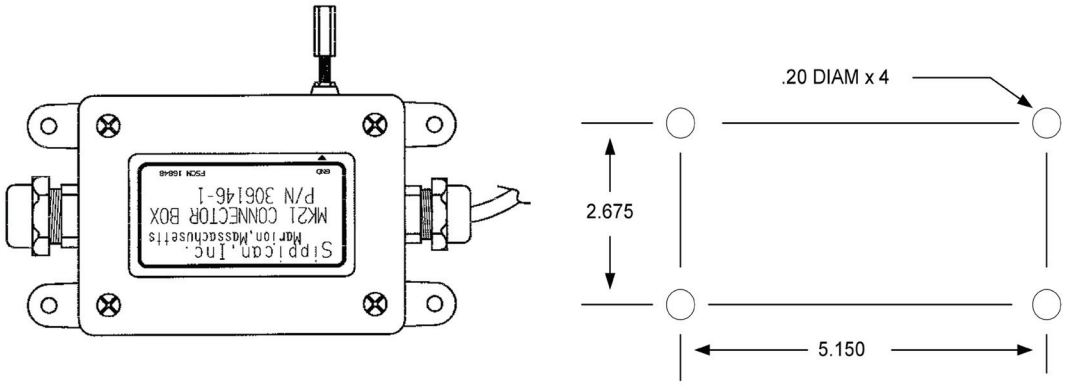


FIGURE 1-3: ***Connector Box Mounting Dimensions***

1.2 MK21 USB DAQ Components

The MK21 USB DAQ is provided in a rack-mount configuration as shown in Figure 1-4 and is composed of two main components:

- Front panel
- MK21 USB DAQ desktop unit (includes integrated USB cable)

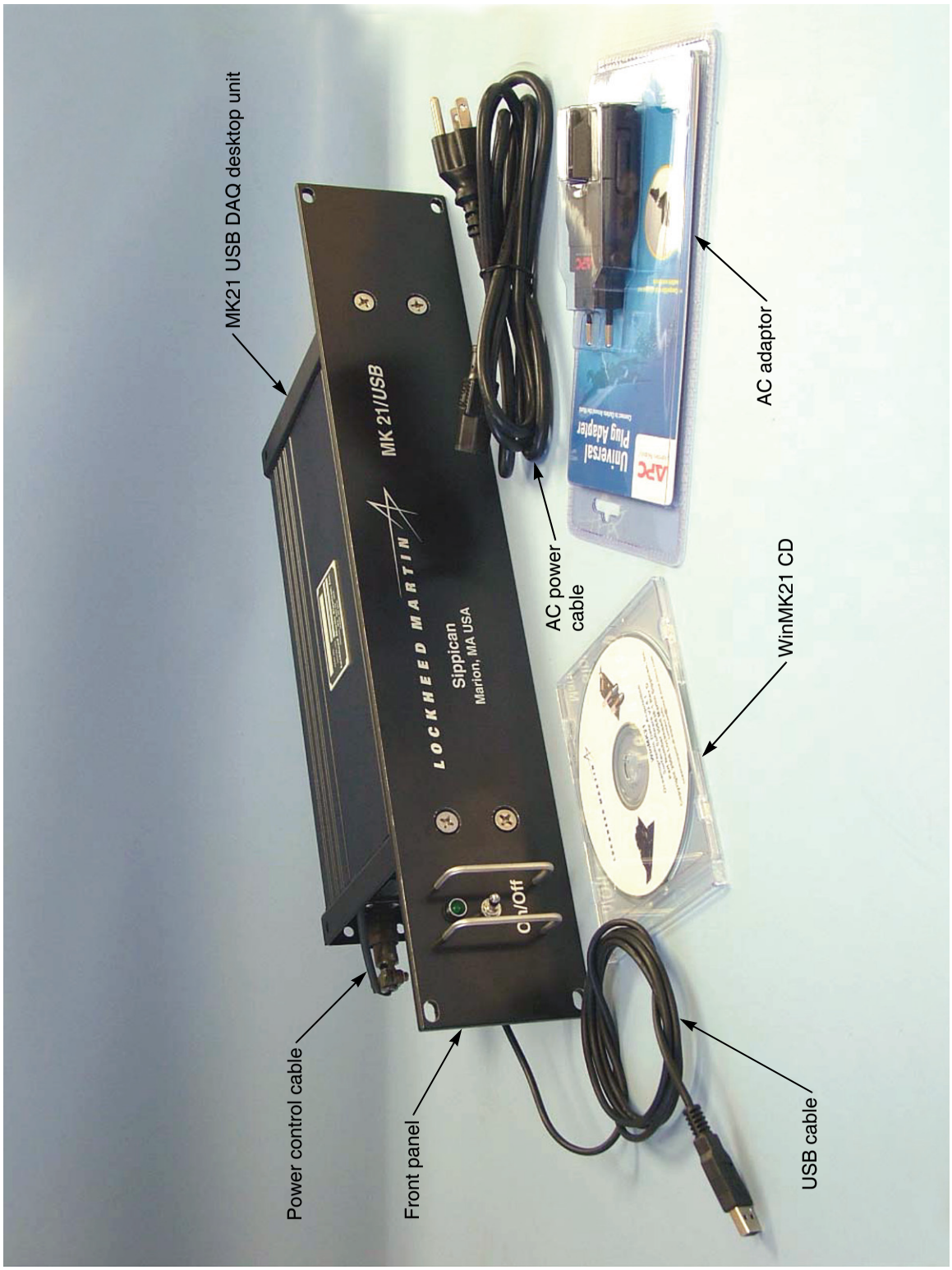


FIGURE 1-4: *The MK21 USB DAQ Components*

The following components are also included with the MK21 USB DAQ and are shown in Figure 1-4:

- AC power cable for connecting AC power to the MK21 USB DAQ desktop unit.
- International AC plug adapter.
- Power control cable which connects from the desktop unit to the front panel and allows the MK21 USB DAQ to be turned on from the front panel.
- WinMK21 Data Acquisition and Post Processing Software on a CD.

The front panel mounts to any standard 19-inch rack and includes a power switch and a power indicator. The MK21 USB DAQ desktop unit houses a MK21 interface board and includes an integrated USB cable and power supply. The front panel can be easily removed from the MK21 USB DAQ desktop unit as shown in Figure 1-5, and the desktop unit can be conveniently located next to the PC.

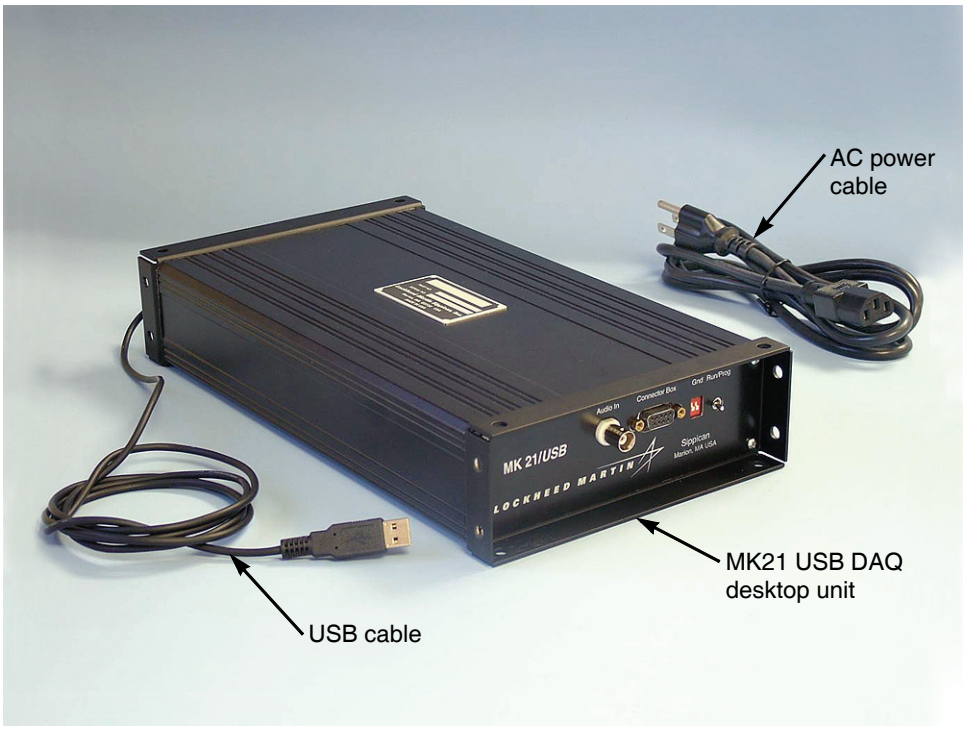


FIGURE 1-5: ***The MK21 USB DAQ Desktop Unit***

1.3 MK21 USB DAQ Controls and Indicators

The MK21 USB DAQ controls and indicators consist of two power switches and two corresponding indicators, one set each on the front panel and on the desktop unit of the MK21 USB DAQ. In addition, a switch is included that enables you to download firmware updates to the MK21 USB DAQ. These switches are shown in Figure 1-6, Figure 1-7 and Figure 1-8, and they are listed and described below.

ON/OFF switches:	Turn the MK21 USB DAQ on or off.
ON/OFF indicators:	Illuminate when the MK21 USB DAQ is on.
RUN/PROG switch:	Enables firmware updates to be loaded.

NOTE *When turning the MK21 USB DAQ on or off using the front panel ON/OFF switch, ensure that the ON/OFF switch on the desktop unit is in the OFF position.*

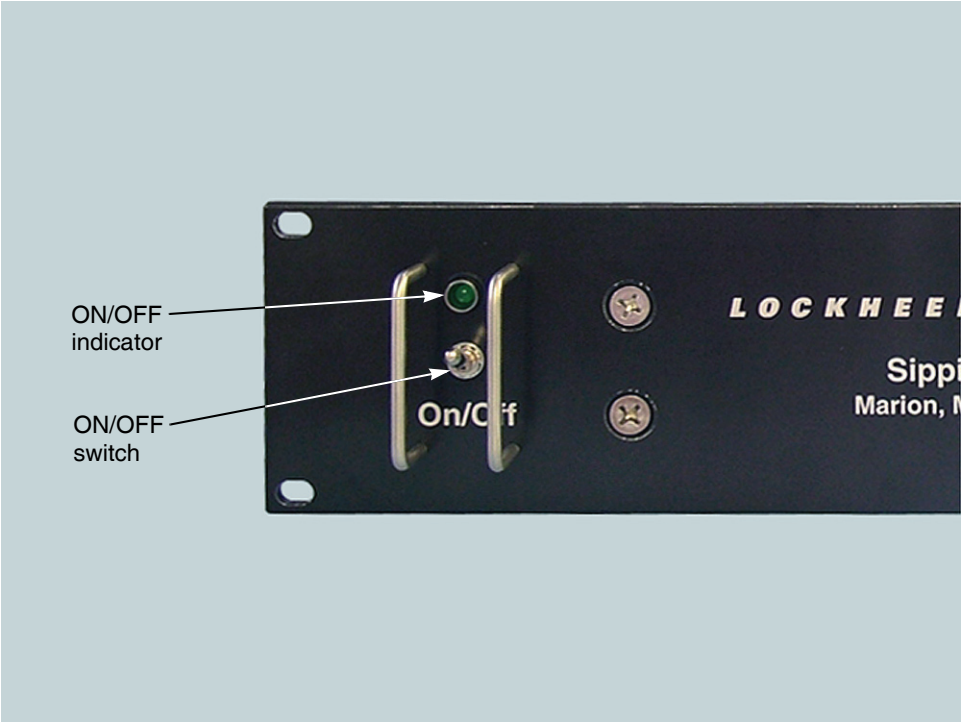


FIGURE 1-6: ***MK21 USB DAQ Front Panel ON/OFF Switch and Indicator***

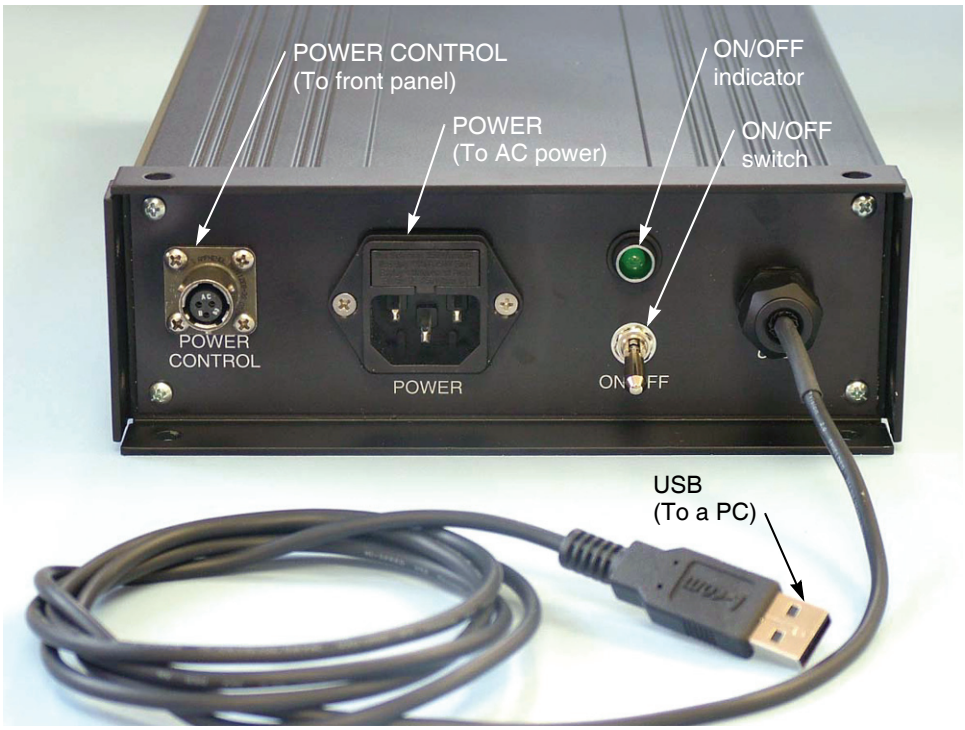


FIGURE 1-7: ***MK21 USB DAQ Desktop Unit Rear Panel Power, Power Control and USB Connectors and ON/OFF Switch and Indicator***

1.4 MK21 USB DAQ Connectors

The MK21 USB DAQ provides connectors on both the front and rear panels of the desktop unit as shown in Figure 1-7 and Figure 1-8. They are listed and described below.

AUDIO IN:	Connects to the output of a Lockheed Martin Sippican MK-10A Data Acquisition System for air-launched probes. A mating BNC connector and cable are required.
CONNECTOR BOX:	Connects to the connector box (P/N 306146-1 or P/N 306146-2) or to a junction box. A DB-9P mating connector and cable are required and are supplied.
POWER CONTROL:	Connects to the front panel using the power control cable.
POWER:	Connects to 100–240 VAC, 50–60 Hz power.
USB:	Connects to the USB port of a PC.

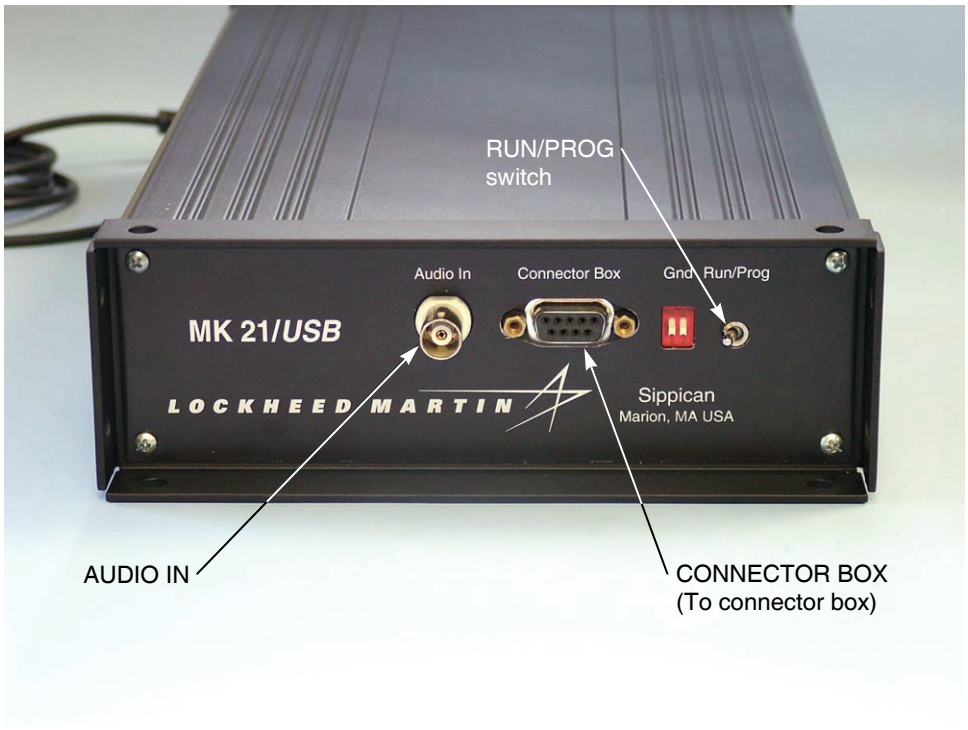


FIGURE 1-8: ***MK21 USB DAQ Desktop Unit Front Panel Audio and Connector Box Connectors and Run/Prog Switch***

1.5 WinMK21 Data Acquisition and Post-Processing Software

The MK21 USB DAQ Bathythermograph Data Acquisition System includes the WinMK21 Data Acquisition and Post-processing Software on a CD for installation on a laptop or desktop PC. The CD also includes MK21 USB drivers for installation on a computer running Windows 2000/XP. You must install a MK21 USB driver so your computer can interface with the MK21 USB DAQ over the USB interface.

NOTE *When installing the USB driver, the MK21 USB DAQ must be connected to the PC using the USB cable, and it must be switched on.*

Through the USB interface connection to the MK21 USB DAQ, WinMK21 controls the MK21 interface board inside the MK21 USB DAQ and all of its data acquisition functions. In addition, WinMK21 inputs the data from the MK21 USB DAQ over the USB interface, provides real-time display and post-processing of the data, stores the data on the

hard drive or removable storage media, and can output the data on a serial port of the PC, and print the data. With the MK-21 USB DAQ turned on and connected to the USB port of the PC, and with WinMK21 running on the PC, WinMK21 is ready to acquire new data.

1.5.1 Graphics and Launch Information Displays

After launching a probe, it descends through the water and collects measurements in real time. The MK21 USB DAQ acquires, digitizes and outputs the data from the probe to the PC over the USB interface. The data can be viewed in real time as profiles in the Graphics display in the Main window as shown in Figure 1-9, which displays the temperature and

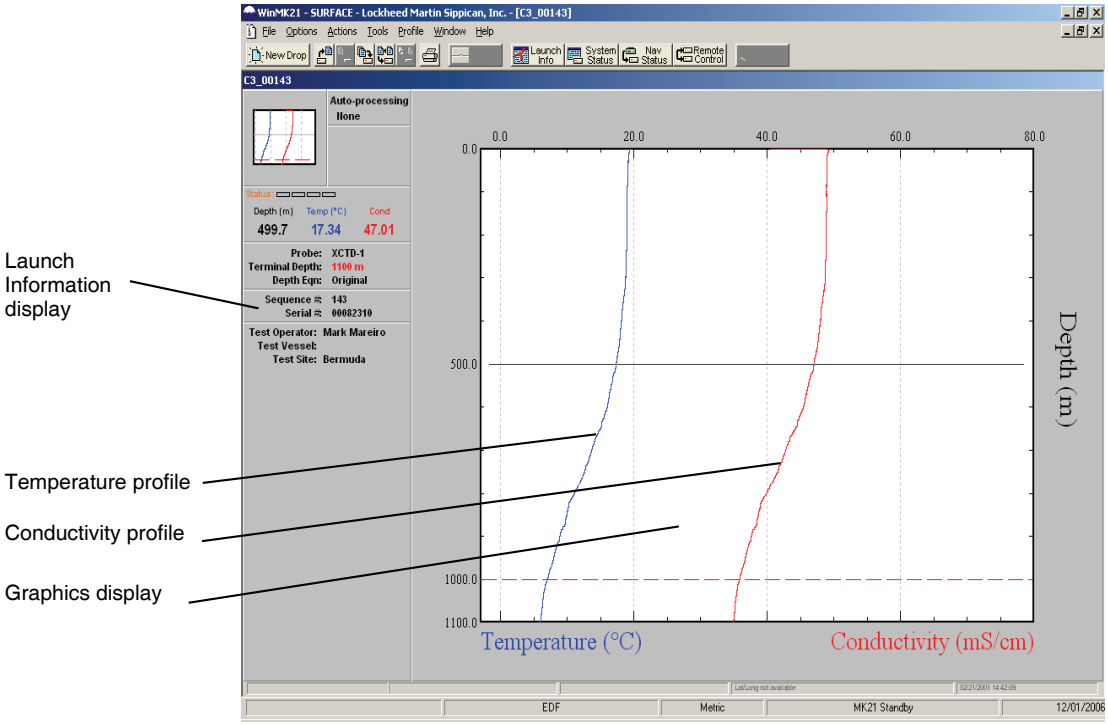


FIGURE 1-9: ***Graphics and Launch Information Displays in the Main Window at the End of an XCTD Probe Drop***

conductivity versus depth profiles acquired by an XCTD probe. In addition, the Launch Information display provides critical information about the drop. All of the measured data and all of the launch information are automatically recorded on the hard drive at the end of the drop for later use with spreadsheets and other analytical tools.

1.5.2 Operating Modes

WinMK21 operates in two modes: Data Acquisition and Post Processing. In Data Acquisition mode, "Realtime Data Acquisition" is displayed in the Title bar of the Main window. In Post-Processing mode, the name of the open file is displayed.

Data Acquisition mode encompasses the loading of a probe into its launcher, the launching of a probe and the acquiring of data throughout its descent. In Data Acquisition mode WinMK21 detects when a probe is loaded and, after launching the probe, it detects when it enters the water. During the descent the data are displayed in the Graphics display as shown in Figure 1-9 and recorded on the hard drive. The data can also be output on a serial port. At the end of the probe drop, WinMK21 automatically switches to Post Processing mode. No operator intervention is required during the entire descent.

Post-Processing mode allows you to display the stored profiles of previous probe drops, and it allows you to perform various data analysis, presentation and export operations.

1.6 Expendable Probes

Lockheed Martin Sippican expendable probes are small oceanographic sensors that are housed in tubular protective canisters. There are four types of probes that are available for use with the MK21 USB DAQ: an XBT probe, which measures water temperature; an XSV probe, which measures sound velocity in the water; an XCTD probe, which measures both water temperature and conductivity; and an XBP probe which measures deceleration upon sea floor impact. The probes free-fall in the ocean at a known rate while collecting the data.

To launch a probe from a vessel, the canister containing the probe is first inserted into one of the Lockheed Martin Sippican launchers—an LM-2A Deck-Mounted Launcher, an LM-3A Hand-Held Launcher, or an LM-4A Thru-Hull Launcher. Contacts on the canister provide the electrical connections to the launcher which is connected by cable to the MK21 USB DAQ. When the probe is ready to be launched, the operator pulls a release pin out of the canister, and the probe slides out of the canister into the water. The probe's hydrodynamic shape allows it to descend through the water at a stable and known rate, enabling continuous calculation of its depth throughout the entire descent. As the probe descends, its sensors continuously measure the water temperature, the sound velocity, or the temperature and conductivity. The measurements are transmitted by a wire back to the MK21 USB DAQ. The wire dereels both from a spool in the probe as the probe descends and from a spool in the canister as the vessel from which the probe was launched moves along the surface. This dual spooling technique enables the wire to remain stationary in the water. More than a mile of wire can be contained inside a probe less than half a meter in length. Soon after the probe reaches it’s maximum depth, its wire breaks and the probe continues its descent to the ocean floor.

1.6.1 XBT Probe

The expendable bathythermograph (XBT) probe, which is shown in Figure 1-10, measures water temperature versus water depth. And in regions of known and constant salinity, WinMK21 can calculate and display sound velocity versus depth from the temperature data acquired by an XBT probe. The probe contains a temperature sensing thermistor connected to a two-conductor insulated wire that is wound on two spools, a spool inside the probe and a spool inside the canister with the probe. The nose of the probe is a seawater electrode which provides an electrical ground path to the MK21 USB DAQ and enables the MK21 USB DAQ to detect when the probe enters the water.

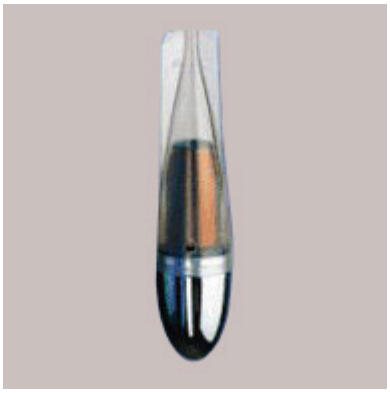


FIGURE 1-10: ***XBT Probe***

There are several types of XBT probes. They vary in their maximum depths and the maximum vessel speeds at which they can be launched. In addition, the LMP5-T1 (T-12) includes active electronics along with a thermistor. The available XBT probes and their performance characteristics are listed in Table 1-1.

TABLE 1-1: ***XBT Probe Types and Capabilities***

TYPE	APPLICATION	MAXIMUM DEPTH	MAXIMUM VESSEL SPEED
T-4	Standard Navy applications	1500 ft (460 m)	30 knots
T-5	Deep ocean scientific and military	6000 ft (1830 m)	6 knots
Fast Deep	Enhanced depth and vessel speed	3280 ft (1000 m)	20 knots
T-6	Oceanography	1500 ft (460 m)	15 knots
T-7	Special military applications	2500 ft (760 m)	15 knots
Deep Blue	Medium deep oceanography	2500 ft (760 m)	20 knots
T-10	Commercial fisheries	660 ft (200 m)	10 knots
T-11 (fine structure)	Extra fine depth resolution	1500 ft (460 m)	6 knots
LMP5-T1 (T-12)	Fast ship launch speed, deep ocean	6560 ft (2000 m)	20 knots

1.6.2 XSV Probe

The expendable sound velocity (XSV) probe, which is shown in Figure 1-11, measures sound velocity in water versus depth. Applications include antisubmarine warfare (ASW), coastal mine countermeasures and oceanographic research. It is particularly useful in regions where salinity varies with depth, making calculation of sound velocity from XBT data impractical. The XSV uses an active electronic sensor in the probe and a single-conductor insulated wire to transmit sound velocity data to the MK21 USB DAQ. An internal battery provides power for the probe's electronics. Similar to the XBT, the XSV uses two wire spools, one inside the probe and one inside the canister with the probe.

FIGURE 1-11: ***XSV Probe***

The XSV measures the speed of sound in water using a piezoelectric transducer inside the probe's nose. The sensor is in the path of the flowing water as the probe descends and is pulsed at 6.5 MHz, producing an acoustic signal. The signal travels a known distance and is reflected back to the transducer. The reflected signal is detected which triggers another 6.5-MHz pulse. This cycle is repeated continuously, causing the transducer to "sing-around" at a frequency from 27 kHz to 30 kHz, depending on the water temperature, salinity and depth. The sing-around frequency, which is linearly proportional to sound velocity, is counted down to a low audio range of 210 Hz to 233 Hz and transmitted to the MK21 USB DAQ, which converts the frequency into sound velocity.

There are three types of XSV probes. They vary in their maximum depths and the maximum vessel speeds at which they can be launched. The available XSV probes and their performance characteristics are listed in Table 1-2.

TABLE 1-2: ***XSV Probe Types and Capabilities***

TYPE	APPLICATION	MAXIMUM DEPTH	MAXIMUM VESSEL SPEED
XSV-01	ASW and Oceanography	2790 ft (850 m)	15 knots
XSV-02	Deep ocean scientific and military	6560 ft (2000 m)	15 knots
XSV-03	Enhanced depth resolution	2790 ft (850 m)	5 knots

1.6.3 XCTD Probe

The expendable conductivity/temperature (XCTD) probe, which is shown in Figure 1-12, measures water temperature and conductivity versus water depth. From the XCTD data, WinMK21 can calculate and display salinity, water density and sound velocity. The XCTD uses a conductivity cell to measure water conductivity and a high-stability, fast-response thermistor to measure water temperature. An internal, microprocessor-based circuit converts the sensor outputs into digital signals that are transmitted to the MK21 USB DAQ over a two-conductor insulated wire. An internal battery provides the required power. Similar to the XBT, the XCTD uses two wire spools, one inside the probe and one inside the canister with the probe.

FIGURE 1-12: ***XCTD Probe***

Each XCTD probe is calibrated against temperature and conductivity standards in a set of saltwater baths. The calibration data for each probe are used to determine the unique calibration coefficients for the probe's conductivity cell and thermistor. The calibration coefficients, along with the probe's serial number, terminal depth and drop rate coefficients, are permanently stored in a memory circuit in the probe. The memory is automatically accessed by the MK21 USB DAQ when the canister containing the XCTD probe is loaded into a launcher. The coefficients are used during the probe's descent to accurately calculate the acquired conductivity and temperature data. The drop rate coefficients are used to determine the water depth during the descent. WinMK21 also stores the serial number with the temperature and conductivity data.

There are three types of XCTD probes. They are listed in Table 1-3.

TABLE 1-3: ***XCTD Probe Types and Capabilities***

TYPE	LOCKHEED MARTIN SIPPICAN P/N	APPLICATION	MAXIMUM DEPTH	MAXIMUM VESSEL SPEED
XCTD-1	305927-1	Navy and oceanographic	3280 ft (1000 m)	12 knots
XCTD-2	305927-2	Deep ocean scientific and military	6068 ft (1850 m)	3.5 knots
XCTD-3	305927-3	Navy and oceanographic	3280 ft (1000 m)	20 knots

1.6.4 XBP Probe

The expendable bottom penetrometer (XBP) probe, which is shown in Figure 1-13, measures acceleration versus time using an accelerometer and specialized electronics. In particular, the probe is used to measure deceleration as a result of its impact and penetration into the sea floor. WinMK21 can measure several different aspects of impact and penetration. The impact signature indicates the nature of the sea floor, such as whether the sediment is granular or cohesive. Similar to the XBT, the XBP uses two wire spools, one inside the probe and one inside the canister with the probe.

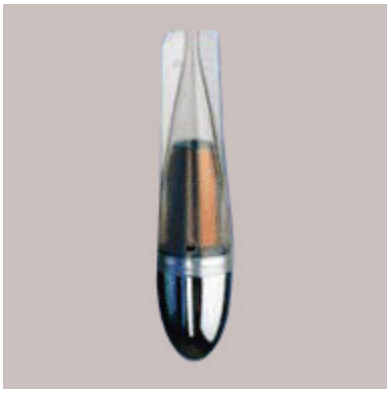


FIGURE 1-13: ***XBP Probe***

The accelerometer in each XBP probe is calibrated during the manufacturing process. The serial number and calibration factor for each probe is provided by the manufacturer and is unique for each probe. The calibration factor is used during the data acquisition process, which includes the probe's descent and sea floor impact, to accurately calculate acceleration data from the voltage output of the probe electronics. It is not possible to automatically determine when the XBP probe has been launched. As a result, WinMK21 must record the XBP data continuously for the entire "time for test," which is the time from when the XBP prelaunch test is accepted until after the probe has impacted the bottom. The time for test is derived from the terminal depth which is specified in the *Probe Attribute* dialog box for the XBP. Refer to “Probe - Selection” on page 5-6 for instructions on how to open this dialog box. Given a specific terminal depth and the drop rate coefficients, a "fall time" is calculated. This is the amount of time it will take the XBP probe to descend to its full terminal depth and impact the bottom. The time for test is three times the fall time. The XBP data acquisition will be terminated automatically once the time for test has expired.

Because the launch, the data acquisition and the post processing of data for an XBP probe have unique differences from the other probes, instructions on how to perform these functions are provided in APPENDIX A, “Technical Notes.”

There is one type of XBP probe. It is listed in Table 1-4.

TABLE 1-4: ***XBP Probe Type and Capabilities***

TYPE	LOCKHEED MARTIN SIPPICAN P/N	APPLICATION	MAXIMUM DEPTH	MAXIMUM VESSEL SPEED
XBP	311051-1	Sea floor type characterization	656 ft (200 m)	10 knots

1.7 Test Devices

The test devices are self-contained, reusable probe simulators which are used to verify the operation of the MK21 USB DAQ Bathythermograph Data Acquisition System. They provide the operator with operational confirmation without expending actual probes. Specifically, the test devices verify the proper operation of the launcher, the cabling, the MK21 USB DAQ, and the WinMK21 Data Acquisition and Post-Processing Software. Two test devices are available: an XBT Test Canister and a BT/SV/CTD Test Device. The test devices resemble the actual probe canisters; however, they are bright red.

The XBT Test Canister contains a precision resistor with the same resistance value as a thermistor that is in 1.5°C (±0.1°C) water. The BT/SV/CTD Test Device contains battery powered electronics which simulates probe drops for XBT, XSV and XCTD probe types.

The two test devices are listed in Table 1-5.

TABLE 1-5: ***Test Device Types***

TEST DEVICE TYPE	LOCKHEED MARTIN SIPPICAN P/N	APPLICATION	EXPECTED OUTPUT
XBT	301040-1	System verification and fault isolation	1.5°C (±0.1°C)
BT/SV/CTD	414095-1		Switch selectable between 3 XBT and 3 XSV profiles, and 1 XCTD profile

1.8 Launchers

Three types of Lockheed Martin Sippican launchers are available for surface ship applications: an LM-2A Deck-Mounted Launcher, which is easily installed on the deck of any vessel; an LM-3A Hand-Held Launcher, which is portable and allows you to easily position it such that it does not interfere with other equipment; and an LM-4A Thru-Hull Launcher, which is the standard launcher for all military vessels and is installed below deck for safety and convenience when launching probes under heavy weather conditions.

1.8.1 LM-2A Deck-Mounted Launcher

The LM-2A Deck-Mounted Launcher is illustrated in Figure 1-14. It consists of a launch tube, a breech, a breech adapter, a stanchion, and a 100-foot electrical cable for connection to the connector box or junction box. The LM-2A is mounted so the launch tube protrudes beyond the edge of the ship's deck. To load a probe the launch operator opens the breech, inserts the canister containing the probe into the launcher, making sure the release pin is aligned with the slot in the launcher, and then closes the breech. The connection to the three contacts on the probe canister is made automatically by pins in the breech when the

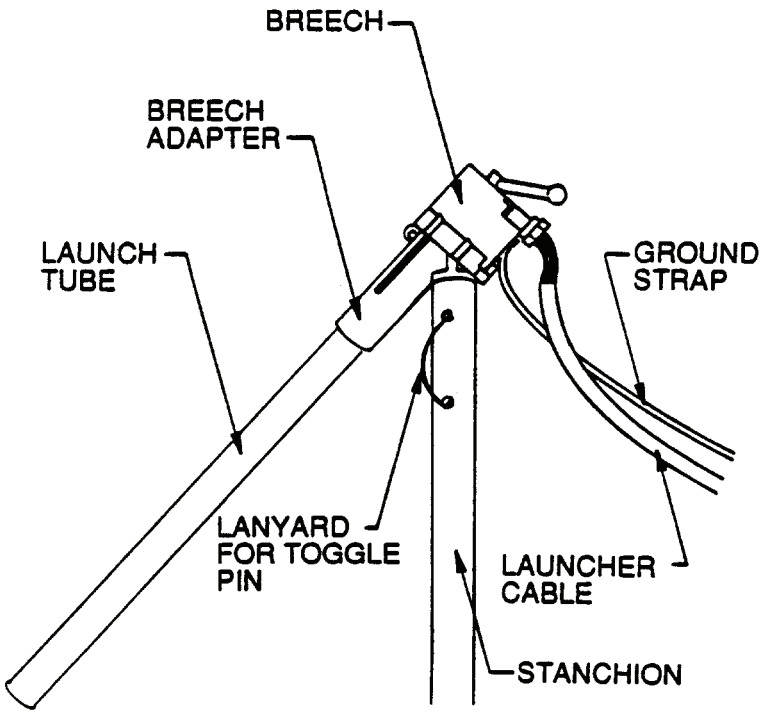


FIGURE 1-14: ***The LM-2A Deck-Mounted Launcher***

breech is closed. To launch the probe the operator pulls the pin out of the canister, allowing the probe to slide out of the launch tube and into the water. At the end of the probe drop, the operator breaks the trailing wire free. The spent canister should be retained in the launcher to protect the contacts until a new probe is loaded.

1.8.2 LM-3A Hand-Held Launcher

The LM-3A Hand-Held Launcher is a lightweight, easy to use alternative to the LM-2A Deck-Mounted Launcher. The LM-3A is illustrated in Figure 1-15. It consists of a body, a yoke, a contact pin assembly, a contact lever, and a 50-foot electrical cable for connection to the connector box or junction box. A longer cable can be supplied upon request.

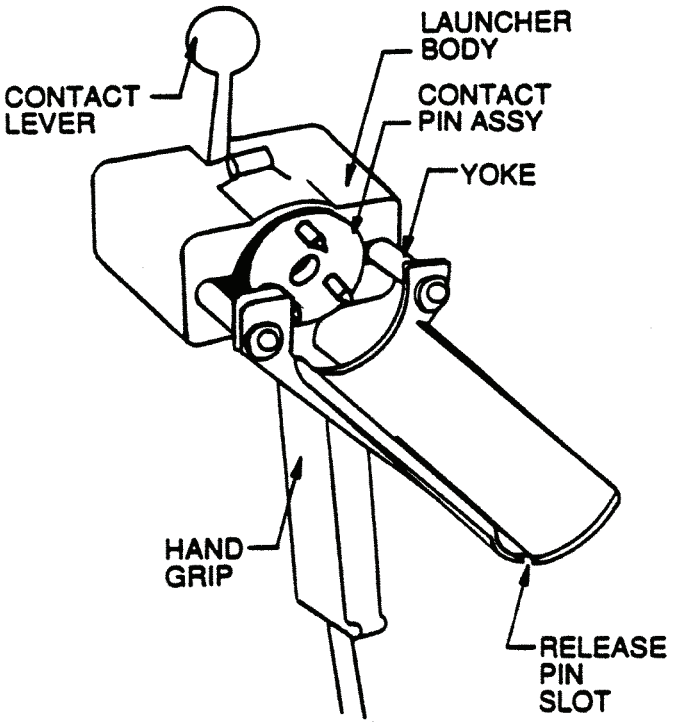


FIGURE 1-15: ***The LM-3A Hand-Held Launcher***

The LM-3A is intended for use on vessels where a permanent LM-2A Deck-Mounted Launcher installation is impractical. To load a probe, the launch operator first raises the contact lever to extend the yoke forward, then lays the canister containing the probe into the cradle such that the end cap of the canister fits into the yoke end of the launcher and the loop of the release pin is positioned in the release pin slot. Next, the operator swings

the contact lever down, pulling the yoke and canister toward the rear of the launcher. The contact pins penetrate the insulation on the back of the canister, making a reliable electrical connection with the canister contacts. To launch the probe, the operator holds the launcher over the edge of the deck and pulls the release pin out of the canister, allowing the probe to slide out of the canister and into the water. The operator must hold the launcher and canister far enough over the edge of the deck to ensure the wire does not come in contact with any part of the ship for the duration of the probe's descent. At the end of the probe drop, the operator breaks the trailing wire free. The spent canister should be retained in the launcher to protect the contacts until a new probe is loaded.

1.8.3 LM-4A Hull-Mounted Launcher

The LM-4A Hull-Mounted Launcher is intended for permanent installation on ocean going vessels. The LM-4A is illustrated in Figure 1-16. It provides the launch operator complete isolation from the weather. If the LM-4A is installed near the MK21 USB DAQ, a single operator can handle all launcher and MK21 USB DAQ tasks. The LM-4A includes a 100-ft electrical cable for connection to the connector box or junction box.

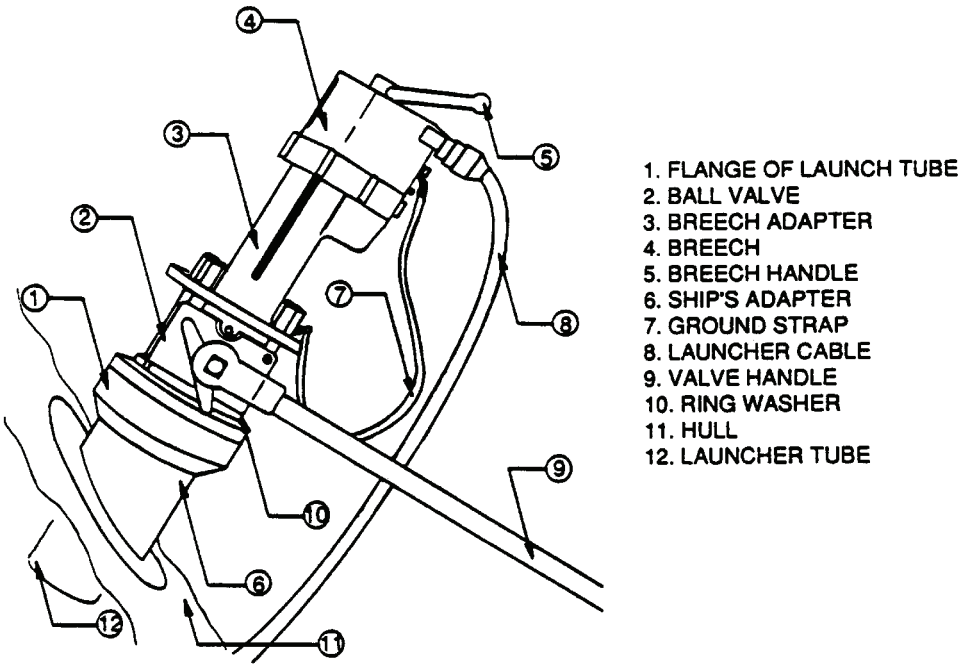


FIGURE 1-16: ***The LM-4A Hull-Mounted Launcher***

The LM-4A consists of a breech and a breech adapter that are essentially the same as on the LM-2A Deck-Mounted Launcher. The launch tube, which penetrates the hull, is made of urethane and is mounted on a ship's adapter and a manually operated ball valve. The adapter, which is welded to the interior plating of the ship's hull, provides a rigid mount for the entire assembly. To load a probe the launch operator first opens the ball valve, then the breech, and inserts the canister containing the probe into the launcher, making sure the release pin is aligned with the slot in the launcher. The operator then closes the breech. The connection to the three contacts on the probe canister is made automatically by pins in the breech when the breech is closed. To launch the probe the operator pulls the pin out of the canister, allowing the probe to slide out of the launch tube and into the water. At the end of the probe drop, the operator opens the breech, removes the spent canister, breaks the trailing wire free, letting it fall through the launch tube, and then closes the breech and ball valve. It is essential to make sure the ball valve is clear of wire before it is closed. Closing the valve with wire present is likely to damage the valve. The breech and ball valve should remain closed at all times except during the launch and descent of a probe.

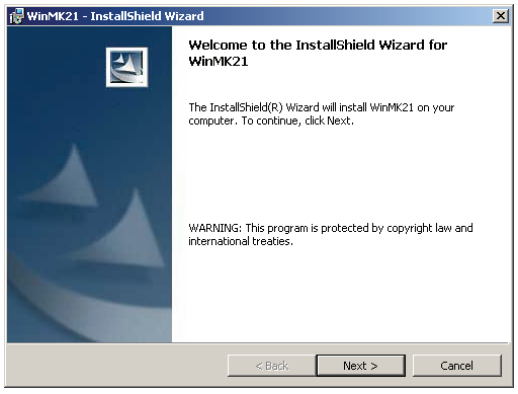
SECTION 2
INSTALLING WINMK21

This section provides an illustrated procedure on how to install the WinMK21 Data Acquisition and Post-Processing Software on a PC, and how to start and exit from WinMK21.

To install WinMK21:

1. Exit all programs and turn off any virus protection or screen saver software.
2. Insert the *WinMK21 for Windows* CD into your CD-ROM drive.

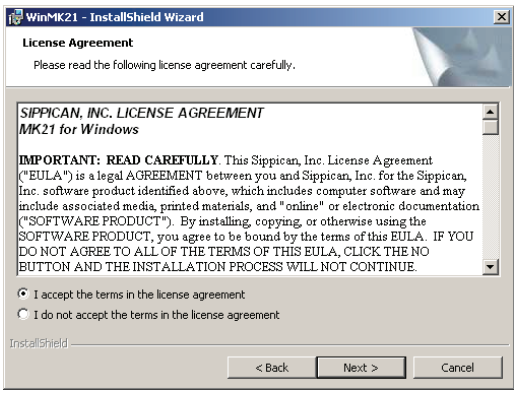
   The installation program should start automatically and the *Welcome* dialog box should open:



   If the installation program does not start automatically, select *Start* and then choose *Run* to open the *Run* dialog box. In the *Run* dialog box type d:setup, where "d" is the drive letter of your CD-ROM drive, and then click **OK**. The *Welcome* dialog box should open.

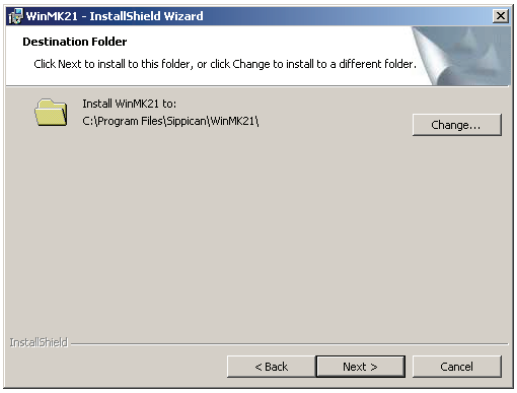
3. Click **Next** in the *Welcome* dialog box.

   The *License Agreement* dialog box opens:



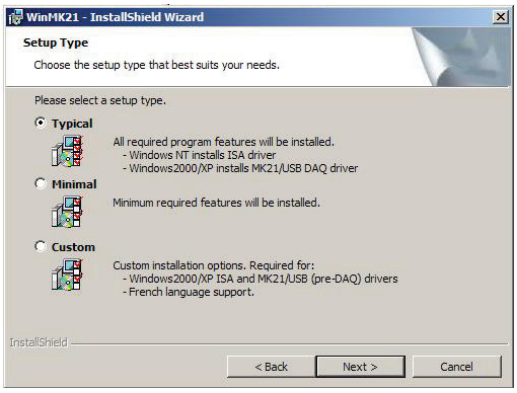
4. Select the **I accept the terms in the license agreement** option, and then click **Next** if you accept this Sippican, Inc. Software License Agreement.

The *Destination Folder* dialog box opens:



5. Click **Next** to accept the recommended directory to install WinMK21. Or instead, if you want to install the program in a different directory, click **Change**, choose the directory, and then click **Next**.

The *Setup Type* dialog box opens:

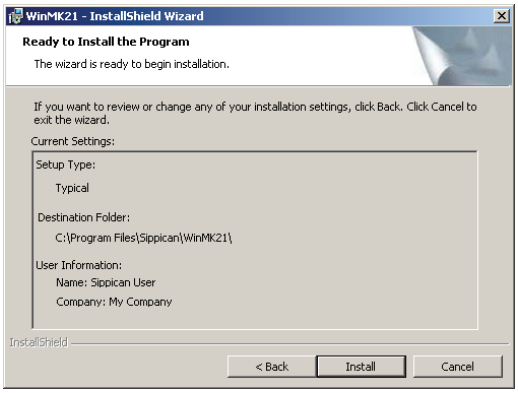


6. Do one of the following:

   - Select the **Typical** option to install the standard program features of WinMK21.
   - Select the **Minimal** option to install the minimum required features of WinMK21. The sample data and online Help are not installed.
   - Select the **Custom** option only for advanced custom installations. This option is not required for the standard MK21 USB DAQ.

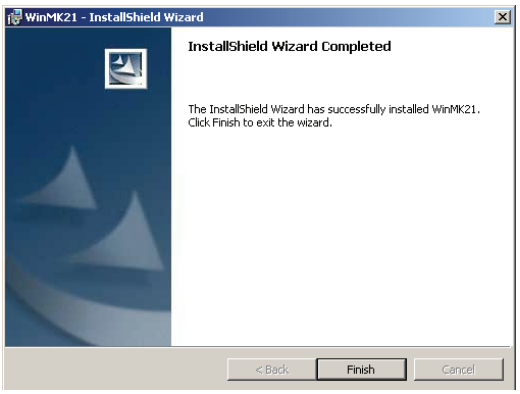
7. Click **Next**.

   The *Ready to Install the Program* dialog box opens:



8. Click **Install** to install WinMK21.

   The WinMK21 program files are copied to the specified destination directory, and then the *InstallShield Wizard Completed* dialog box opens:



9. Click **Finish**.

   WinMK21 finishes installing.

2.1 Starting WinMK21

To start WinMK21:

1. Click *Start*, select *Programs*, and then choose *Sippican - WinMK21*.
2. From the *Sippican - WinMK21* menu, choose *WinMK21*.

When you start WinMK21 for the first time, a *Message* dialog box opens. In the *Message* dialog box, click **Cancel** if you do not want to locate the default backup on the **A** drive. Otherwise click **OK**. If you click **Cancel**, a second *Message* dialog box opens indicating the default backup path has been changed. To accept the changed path, click **OK**. For more information about the backup option, see “System Parameters” on page 5-11.

WinMK21 will also ask you for a password when you start it for the first time. Either enter a password or click **Cancel**. If you enter a password, you will be asked to enter it if you attempt to access restricted features such as the System Parameters. If you click **Cancel**, you will not require a password. For more information about the password option, see “Password Protection” on page 5-53.

2.2 Exiting from WinMK21

To exit from WinMK21 choose *Exit* from the *File* menu.

SECTION 3
INSTALLATION AND TEST

This section provides instructions on how to unpack the MK21 USB DAQ Bathythermograph Data Acquisition System components and install them on a surface ship, including how to install the MK21 USB DAQ in a 19-inch rack and connect it to power and to a desktop or laptop PC; how to install the MK21 USB driver on your computer; and how to mount, ground and connect a LM-2A, LM-3A or LM-4A launcher to the MK-21 USB DAQ. In addition, procedures are included for verifying operation of the system before launching a probe.

3.1 Unpacking and Installing the MK21 USB DAQ

Unpack the MK21 USB DAQ and inspect it for damage. Report any damage to Lockheed Martin Sippican. Do not install or operate the MK21 USB DAQ if it appears damaged.

Installation of the MK21 USB DAQ encompasses the following:

- Mounting the MK21 USB DAQ
- Connecting the AC power cable
- Connecting the USB cable
- Installing the MK21 USB driver
- Verifying proper communications with the MK21 USB DAQ
- Connecting the launcher cable

3.1.1 Mounting the MK21 USB DAQ

Mount the MK21 USB DAQ in a standard 19-inch rack near a 100–240 VAC, 50–60 Hz power outlet in an area that is protected from weather and spray, and where the temperatures are consistently between 0°C and 40°C (32°F to 104°F). Ensure the rack is secure and that there is room behind it for connecting the cables. In addition, ensure there is plenty of air circulation around and on top of the MK21 USB DAQ. Use standard 19-inch rack front panel mounting hardware to secure the front panel.

CAUTION *The MK21 USB DAQ contains parts that are electrostatic discharge (ESD) sensitive. Follow ESD handling procedures when working with ESD sensitive components.*

3.1.2 Connecting the AC Power Cable to the MK21 USB DAQ

Connect the supplied AC power cable to the MK21 USB DAQ. Do not plug the AC power cable into the power outlet at this time.

If the 100–240 VAC, 50–60 Hz power source contains large amounts of line noise that might affect the performance of the MK21 USB DAQ, an isolation transformer should be connected between the power source and the MK21 USB DAQ. A Topaz Ultra Isolator, Model T100R-0250, which is for 120 VAC input/output operation at 60 Hz only, from MGE UPS Systems, Inc., Costa Mesa, California is recommended, or an equivalent for the input voltage and frequency to be used. In addition, an isolation plug should be used on the MK21 USB DAQ side of the isolation transformer as shown in Figure 3-1. The isolation plug ensures there is no third wire ground connection between the ship's ground and the MK21 USB DAQ, including peripherals such as a printer.

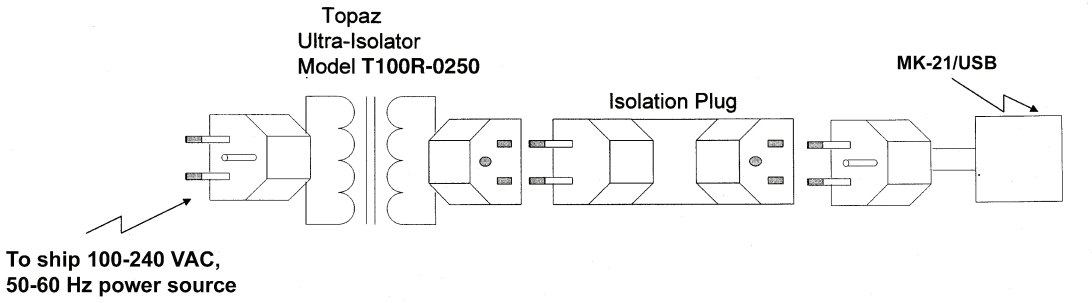


FIGURE 3-1: ***Connecting the Isolation Transformer to the MK21 USB DAQ***

3.1.3 Connecting the USB Cable to Your Computer

To connect the USB cable to a desktop or laptop PC, plug the USB cable connector into the USB port of the computer.

3.1.4 Installing the MK21 USB Driver on Your Computer

For your computer to communicate properly with the MK21 USB DAQ, you must install a MK21 USB driver. Drivers are provided for installation on a computer running Windows 2000/XP. These drivers are automatically copied to the computer's hard drive when WinMK21 is installed. For instructions on how to install WinMK21, see SECTION 2, "Installing WinMK21."

After installing the MK21 USB driver, you should verify that your computer is communicating properly with the MK21 USB DAQ. Instructions are provided below for installing the MK21 USB driver. For instructions on how to verify proper communications

with the MK21 USB DAQ, refer to “Verifying Proper Communications with the MK21 USB DAQ” on page 3-7.

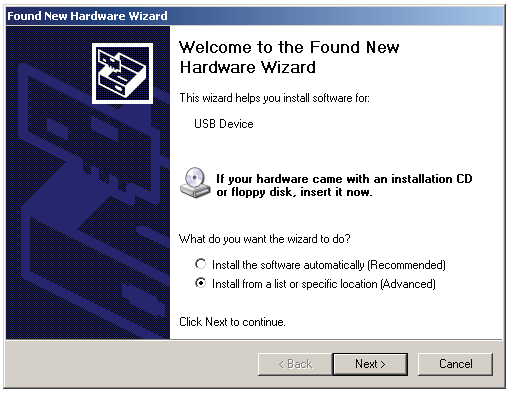
Before proceeding to install the MK21 USB driver on your computer, verify that the ON/OFF switch on the front panel of the MK21 USB DAQ is switched off and plug the AC power cable into the 100–240 VAC, 50–60 Hz power source. Also verify that the USB cable is properly connected to your computer. Then turn on the MK21 USB DAQ by switching on the ON/OFF switch.

3.1.4.1 Installing the MK21 USB Driver for Windows XP

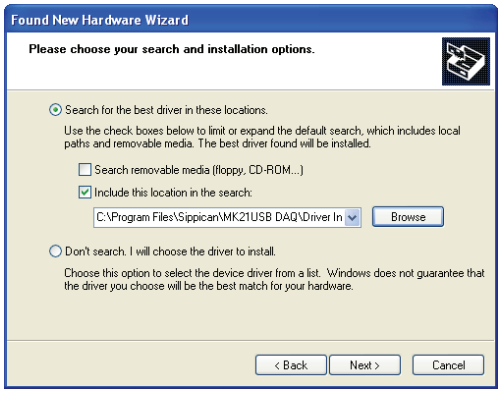
To install the MK21 USB driver on a computer running Windows XP:

1. Start Windows XP.

   Windows XP will detect the new hardware and start the Found New Hardware Wizard.

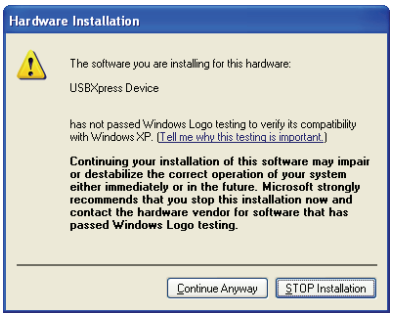


2. Select the **Install from a list or specific location (Advanced)** option, and then click **Next**.



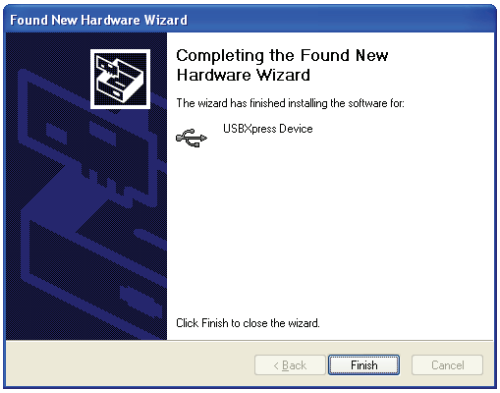
3. Select the **Search for the best driver in these locations** option.
4. Select the **Include this location in the search** check box; clear the other check box.
5. Click **Browse**, then select the C:\Program Files\Sippican\MK21USB DAQ\Driver Installation directory, or the directory selected when installing WinMK21 if different.
6. Click Next.

   Windows XP displays the warning message:



7. Click **Continue Anyway**.

   The MK21 USB driver is installed.



8. When the installation is complete, click **Finish**.

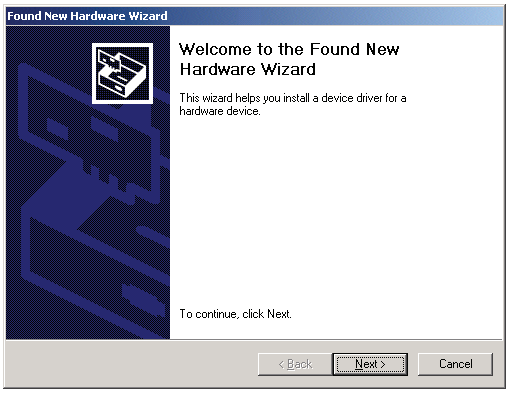
3.1.4.2 Installing the MK21 USB Driver for Windows 2000

To install the MK21 USB driver on a computer running Windows 2000:

1. Start Windows 2000.

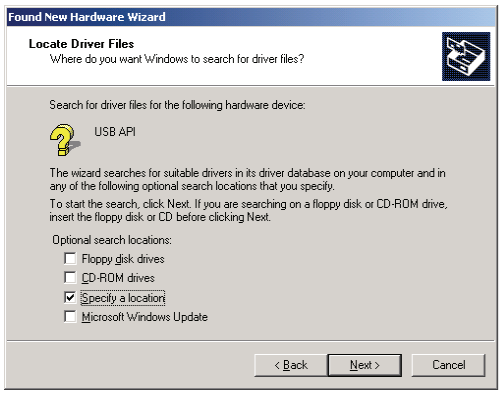
   Windows 2000 will detect the new hardware and attempt to locate the software for it.

   Windows 2000 will then start the Found New Hardware Wizard.

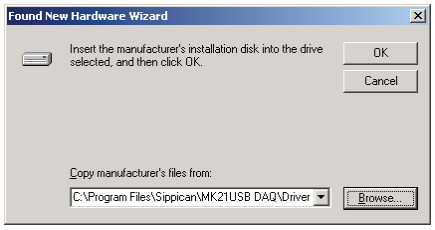


2. Click **Next**.

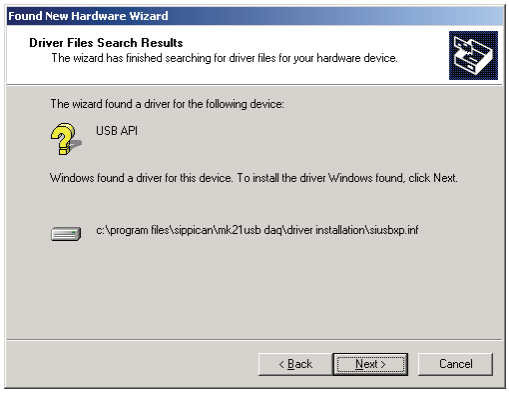
3. Select the **Search for a suitable driver for my device (recommended)** option, and then click **Next**.

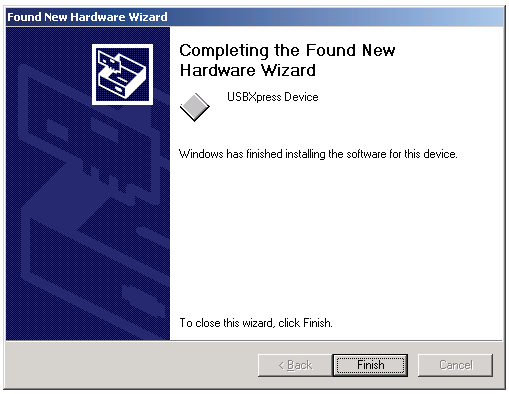


4. Select the **Specify a location** check box; clear all the other check boxes.
5. Click **Next**.



6. click **browse**, then select the C:\Program Files\Sippican\MK21USB DAQ\Driver Installation directory, or the directory selected when installing WinMK21 if different.
7. Click **OK**.





8. Click **Next**.
9. The MK21 USB driver is installed.
10. When the installation is complete, click **Finish**.

3.1.5 Verifying Proper Communications with the MK21 USB DAQ

After you have installed the MK21 USB driver on your computer, you should verify proper communications with the MK21 USB DAQ by initializing the MK21 interface board in the MK21 USB DAQ.

To verify proper communications with the MK21 USB DAQ and initialize the MK21 interface board:

1. Verify that the MK21 USB DAQ is turned on, start WinMK21 and wait until the WinMK21 Main window opens in the display of the computer. For detailed instructions, see “Turning On the MK21 USB DAQ and Starting WinMK21” on page 4-1.
2. Verify that "MK21 Standby" is displayed in the Status bar at the bottom of the window.
3. Select *MK21 I/O Board* from the *Actions* menu, and then choose *Initiate*.

   The MK21 interface board inside the MK21 USB DAQ is initialized. This process takes about seven seconds during which the messages "Detect MK21" and "Test MK21" are displayed. If proper communications are established, no additional messages are displayed.

NOTE *Should the message "Unable to access the MK21 USB device. Please ensure that the MK21 USB device is connected" appear, check the USB connection to your computer and repeat the test. Should the message appear again, restart Windows. If after restarting Windows, the connection is still not recognized, exit from Windows, shut down the computer, and then turn the computer back on. If required, contact Lockheed Martin Sippican Sea-Air Systems Division technical support.*

4. Exit from WinMK21 and turn off the MK21 USB DAQ. For detailed instructions, see “Exiting from WinMK21 and Turning Off the MK21 USB DAQ” on page 4-3.

3.1.6 Connecting the Launcher Cable to the MK21 USB DAQ

The LM-2A Deck-Mounted Launcher and the LM-4A Thru-Hull Launcher are supplied with 100 feet of 3/8-inch outer diameter, insulated, shielded, five-conductor cable; the LM-3A Hand-Held Launcher, 50 feet. Other lengths are available.

NOTE *The maximum launcher cable length is 600 feet, and splices should be in watertight junction boxes only.*

The connector box, which is shown in Figure 3-2, or a similar watertight junction box must be installed between the MK21 USB DAQ and the launcher. The connector box is prewired with an interface cable that connects to the MK-21 USB DAQ. For the connector box specifications and part numbers, see “Specifications” on page 1-2. Connector boxes are available with a 3.0-meter or a 6.1-meter prewired interface cable. Mount the connector box or junction box near the MK21 USB DAQ by fastening it to a secure surface.

To connect the launcher to the MK21 USB DAQ when using the connector box, connect the interface cable to the CONNECTOR BOX connector on the MK21 USB DAQ, and after installing the launcher, wire the launcher cable to the connector box as described below. Refer to Figure 1-8 on page 1-9 for the location of the CONNECTOR BOX connector.

To connect the launcher to the MK21 USB DAQ when using a watertight junction box, wire the junction box to the MK21 USB DAQ as described below, and after installing the launcher, wire the launcher cable to the junction box.

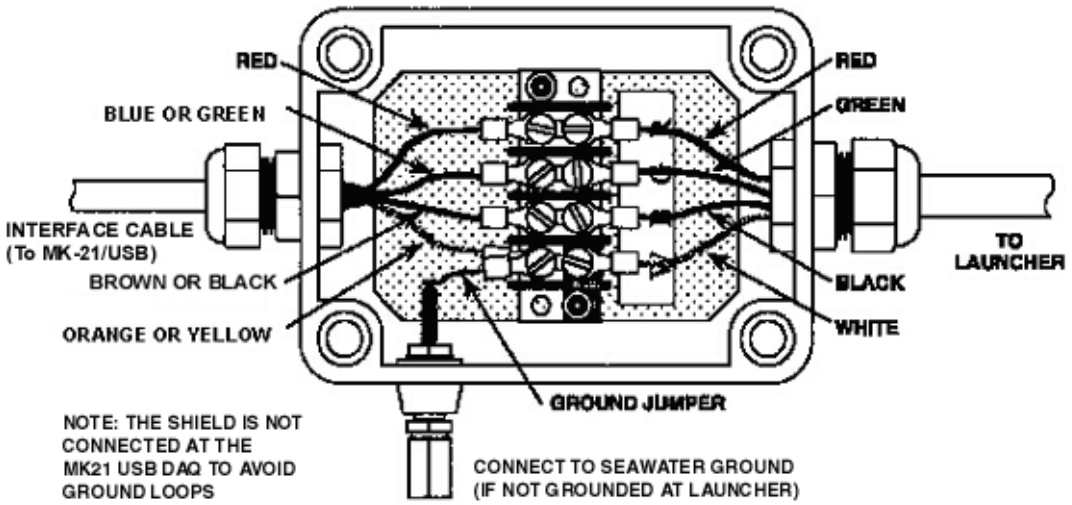


FIGURE 3-2: ***Connector Box (Lockheed Martin Sippican P/N 306146-1) with Prewired Interface Cable***

A seawater ground connection should be made at the connector box only if an adequate ground is not possible at the launcher, or if an LM-3A Hand-Held Launcher will be used, which requires that the ground connection be made at the connector box. To make the ground connection, connect a 12 AWG wire to the ground post on the outside of the connector box and to a good seawater ground, such as the ship's plumbing. The connection should be made to an unpainted surface that is clean, dry and free of rust or contaminants, and the contact resistance of the connection should be less than one ohm. Connect the ground post to the signal ground terminal as shown in Figure 3-2. If a junction box is used instead of the connector box, it should be grounded in a similar manner.

NOTE *If you make the seawater ground connection at the connector box, be sure you do not attach the ground strap of the LM-2A Deck-Mounted Launcher or the LM-4A Hull-Mounted Launcher to ground. Doing so will create an undesired ground loop.*

To wire a junction box to the MK21 USB DAQ, connect the junction box to the CONNECTOR BOX connector on the back of the MK21 USB DAQ using a mating DB-9P connector and a 24 AWG, 4-conductor, shielded cable. The CONNECTOR BOX connector is a DB-9S. Do not use a cable length longer than 30 feet. Wire the cable to the mating connector in accordance with Table 3-1. Do not connect the shield to the connector or to ground at any point, as doing so will create an undesired ground loop.

TABLE 3-1: ***Launcher Cable Connection Information***

DB-9P MATING CONNECTOR PIN NUMBER	LAUNCHER CABLE WIRE COLOR	FUNCTION
2	Red	A Lead
6	Green	B Lead
1	Black	C Lead
3	White	Signal Ground
—	Braid	Shield

To connect the launcher cable to the connector box:

1. Route the launcher cable from the launcher to the connector box.

   If a junction box is used instead of the connector box, it should be watertight and the parallel leakage resistances should exceed 50 megohms. It should also have a sealing nut and strain relief assembly similar to that shown in Figure 3-2.

2. Remove the connector box cover.
3. Loosen the sealing nut from the strain relief assembly.
4. If the launcher cable has spade lugs, remove them.
5. Flush-cut the end of the launcher cable.
6. Strip off about two inches of the jacket and cut off the shield as it is not to be connected.
7. Strip approximately 1/2 inch of insulation off each wire.
8. Insert the launcher cable through the sealing nut and strain relief assembly, allowing enough length to make electrical connections.
9. Connect the stripped wires to the terminals on the terminal block as shown in Figure 3-2. The use of lugs is preferred to that of bare conductors.
10. Tighten the sealing nut around the launcher cable and replace and secure the connector box cover.

3.2 Unpacking and Installing the LM-2A Deck-Mounted Launcher

Unpack the LM-2A Deck-Mounted Launcher and inspect it for damage. Report any damage to Lockheed Martin Sippican. Do not install or operate the launcher if it appears damaged.

The LM-2A is intended for a semi-permanent installation by bolting it to an existing rail post on the ship, or for a permanent installation by welding it to the deck of the ship. As shown in Figure 3-3, the launcher should be mounted a minimum of six feet above the water line of the ship, on the stern or on the port or starboard quarter, and so that the launch tube protrudes beyond the edge of the deck. Avoid locations near garbage chutes or other areas where solids are discharged, and areas where equipment could interfere with the wire during launching.

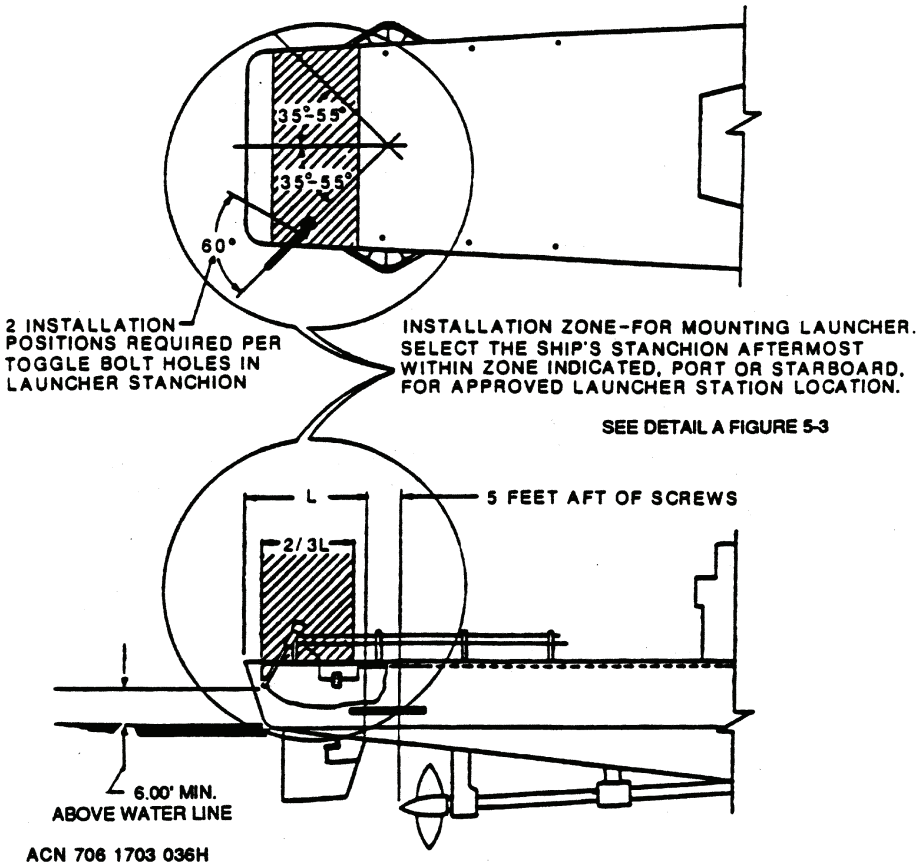


FIGURE 3-3: ***LM-2A Deck-Mounted Launcher Mounting Locations***

NOTE *After installing the LM-2A Deck-Mounted Launcher, cover the launcher with the canvas cover provided in the accessory kit with the launcher when the launcher is not in use. Secure the cover with the bronze clip, also provided.*

Installation the LM-2A encompasses the following:

- Mounting
- Grounding
- Routing the launcher cable

3.2.1 Mounting the LM-2A

The LM-2A Deck-Mounted Launcher includes a launcher assembly, a stanchion, an accessory kit, and 100 feet of cable for connection to the MK21 USB DAQ. The launcher assembly is composed of a breech, a breech adapter and a launch tube. (See Figure 1-14 on page 1-17.) The accessory kit includes two 3-inch U-bolts, a toggle pin with an attached lanyard, a 1/4-20 machine screw and flat washer, and a snap bolt. A canvas cover and a bronze clip to secure it is also provided to protect the launcher when not in use. The launcher assembly slips into the top of the stanchion and is retained by the toggle pin. The launcher assembly can also be rotated for stowage alongside the rail so that it will not be damaged when docking. Refer to Figure 3-4 when mounting the launcher.

To Mount the LM-2A:

1. Position the launcher stanchion upright against a rail post of up to three inches in diameter such that when the launcher assembly is installed, the launch tube will extend beyond the edge of the deck.
2. Orient the launcher so that the axis of the two 9/16” diameter toggle pin holes near the top of the stanchion are 35° to 55° from the centerline of the ship toward the stern if the launcher is side mounted, or approximately 90° if stern mounted.
3. Using the U-bolts, secure the stanchion such that there will be sufficient room to insert the toggle pin, to fully open the breech and to insert canisters into the launcher.
4. Install the launcher assembly by inserting its X-shaped mounting boss into the stanchion.
5. Insert the toggle pin through the stanchion and mounting boss to prevent the launcher assembly from rotating.

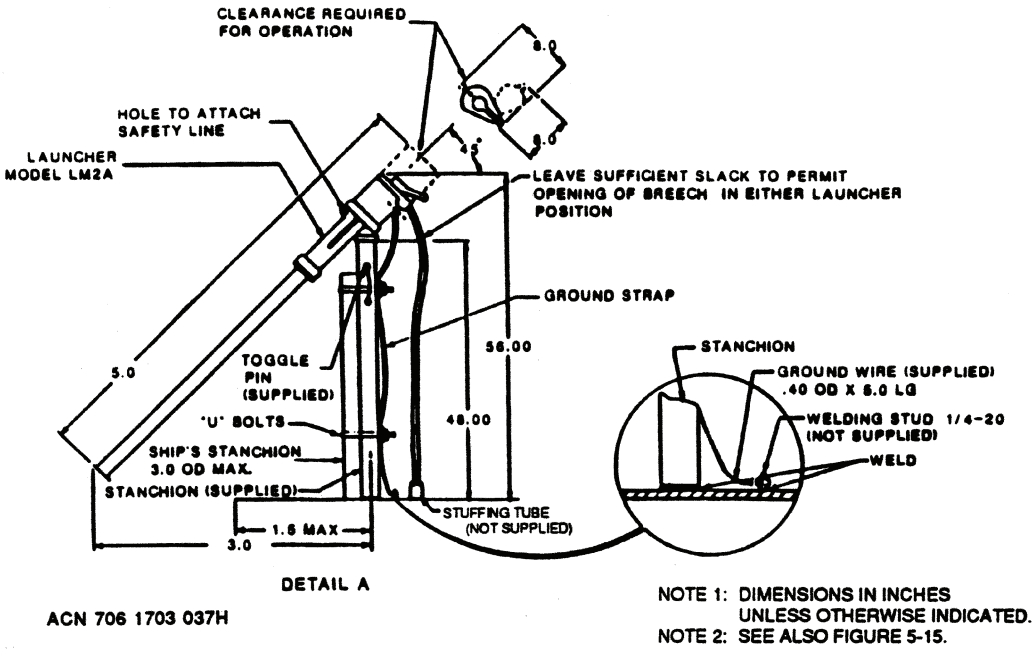


FIGURE 3-4: ***LM-2A Deck-Mounted Launcher Installation Guide***

6. Secure the free end of the toggle pin lanyard to the tapped hole in the stanchion with the 1/4-20 machine screw and flat washer.
7. Using the snap bolt, secure the launcher with a safety line attached from the hole on the top of the breech adaptor to the ship's structure.

3.2.2 Grounding the LM-2A

To ensure reliable data acquisition, the LM-2A launcher must be connected to a good seawater ground. The connection should be made to an unpainted surface that is clean, dry and free of rust or contaminants, and the contact resistance of the connection should be less than one ohm. To ground the launcher when the ship's deck is made of metal, weld a grounding lug to the deck and attach the ground strap to it as shown in Figure 3-4. For non-metal decks, use a 12 AWG or larger wire and connect it between the 1/4-20 machine screw on the breech to the ship's plumbing or to the rudder shaft.

NOTE *If an adequate seawater ground connection cannot be made at the LM-2A launcher, then make the ground connection at the connector box as described in "Connecting the Launcher Cable to the MK21 USB DAQ" on page 3-8. If you make the ground connection at the connector box, be sure you do not attach the launcher ground strap to ground. Doing so will create an undesired ground loop.*

3.2.3 Routing the LM-2A Launcher Cable

Route the LM-2A launcher cable to the connector box and connect the cable to it as described in "Connecting the Launcher Cable to the MK21 USB DAQ" on page 3-8. If the launcher cable will pass through bulkheads or beams, install proper sized bushings and packing to preserve watertight integrity. The cable must also be properly supported and strapped to prevent insulation damage. Allow sufficient slack at each end to permit installation or repair of connectors without installation of new cables.

3.3 Unpacking and Installing the LM-3A Hand-Held Launcher

Unpack the LM-3A Deck-Mounted Launcher and inspect it for damage. Report any damage to Lockheed Martin Sippican. Do not install or operate the launcher if it appears damaged.

The LM-3A is a light weight, portable launcher that allows you to easily position it such that it does not interfere with other equipment. (See Figure 1-15 on page 1-18.) It should be used on the stern or on the port or starboard quarter, and it should be held far enough over the side of the ship to ensure the wire does not come in contact with the ship.

As the LM-3A is portable, the only installation requirements are to route and connect the launcher cable to the connector box as described in "Connecting the Launcher Cable to the MK21 USB DAQ" on page 3-8.

NOTE *You must make the seawater ground connection for the LM-3A launcher at the connector box as described in "Connecting the Launcher Cable to the MK21 USB DAQ" on page 3-8.*

If the launcher cable will pass through bulkheads or beams, install proper sized bushings and packing to preserve watertight integrity. The cable must also be properly supported and strapped to prevent insulation damage.

3.4 Unpacking and Installing the LM-4A Hull-Mounted Launcher

Unpack the LM-4A Hull-Mounted Launcher and inspect it for damage. Report any damage to Lockheed Martin Sippican. Disassemble the launcher by removing the 5/8" studs. Do not install or operate the launcher if it appears damaged.

The LM-4A is intended for a permanent installation, as it penetrates the ship's hull and requires that the launcher be welded to the opening in the hull. The launcher should be mounted such that the launch tube penetrates the hull a minimum of three feet above the water line of the ship on the port or starboard quarter, and in an area where it does not interfere with other equipment.

NOTE *Headphone or voice communications to the area where the MK21 USB DAQ is located is recommended to allow coordination between the operators of the MK21 USB DAQ and the launcher.*

Installation the LM-4A encompasses the following:

- Mounting
- Grounding
- Routing the launcher cable

3.4.1 Mounting the LM-4A

The LM-4A Thru-Hull Launcher includes a breech and a breech adapter that are similar to the LM-2A Deck-Mounted Launcher. (See Figure 1-16 on page 1-19.) The launch tube, which penetrates the hull, is made of urethane and is mounted to a manually operated ball valve and a ship's adapter. The adapter, which is welded to the interior plating of the ship, provides a rigid mount for the launcher. Refer to Figure 3-5 and Figure 3-6 when mounting the launcher.

NOTE *Installation of the LM-4A Thru-Hull Launcher requires penetrating the ship's hull. A shipfitter should refer to the detailed installation information available from Lockheed Martin Sippican when installing the LM-4A. The procedure below is provided as a guide.*

To Mount the LM-4A:

1. Mount the ship's adapter to the hull.
2. Install the 5/8" studs in the ship's adapter.
3. Insert the urethane launch tube into the ship's adapter.
4. Place the ring washer over the studs and seat the washer on the face of the launch tube.

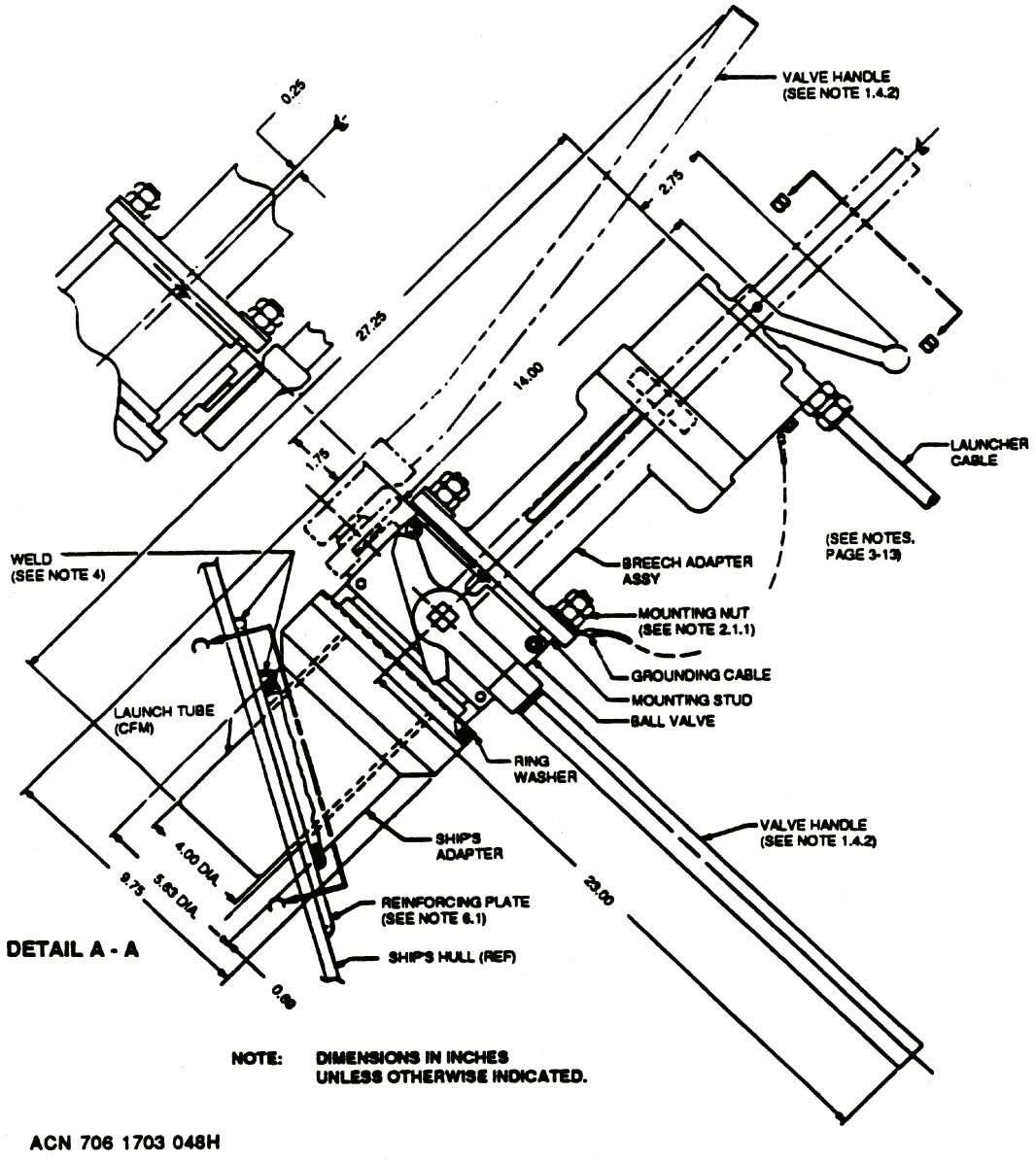


FIGURE 3-5: ***LM-4A Thru-Hull Launcher Installation Guide***

NOTES (UNLESS OTHERWISE SPECIFIED)

1. LAUNCHER CRATE:
   - 1.1 SIZE — 36.37 X 19.25 X 13.5 IN. (9452 CU. IN.)
   - 1.2 MATERIAL — PLYWOOD
   - 1.3 WEIGHT — 105 LBS., 147 LBS. CRATED
   - 1.4 CONTENTS:
     - 1.4.1 ASSEMBLED LAUNCHER (MINUS BALL VALVE HANDLE) LM4A (ONE)
     - 1.4.2 BALL VALVE HANDLE (ONE)
2. LAUNCHER MUST BE DISASSEMBLED FOR WELDING OF SHIP'S ADAPTER TO REINFORCING PLATE.
   - 2.1 LAY LAUNCHER ON A FLAT SURFACE.
     - 2.1.1 REMOVE MOUNTING NUTS (EIGHT).
     - 2.1.2 REMOVE GROUNDING CABLE AND WASHERS (FOUR).
     - 2.1.3 LAUNCH TUBE, SHIP'S ADAPTER, RING WASHER, BALL VALVE, AND BREECH ADAPTER NOW COME APART.
   - 2.2 SHIP'S ADAPTER MAY BE WELDED TO REINFORCING PLATE.
   - 2.3 REASSEMBLE UNIT.
3. LAUNCHER MUZZLE REF LINE TO WATER LINE IS ALWAYS AT LEAST THREE FEET (SIX FEET OPTIMUM) ABOVE THE WATER.
4. PERFORM ALL WELDS IN ACCORDANCE WITH EQUIVALENT TO U.S. NAVSHIPS 900-000-1000 OR EQUIVALENT SPEC.
5. CABLE SPLICING PROHIBITED WHEN ROUTING LAUNCHER CABLE.
6. REINFORCING PLATE:
   - 6.1 MATERIAL — 15.3 LB. DBLR. PLATE
   - 6.2 SIZE — 16 IN. DIAMETER
7. LOCATE THREE LABEL PLATES IN A NOTICEABLE PLACE NEAR THE EQUIPMENT, TO READ AS FOLLOWS:
   - 7.1 IN RED LETTERING — WARNING — WHEN SYSTEM IS NOT IN USE, REMOVE CANISTER AND SHUT BALL VALVE.
   - 7.2 STANDARD DAMAGE CONTROL X.
   - 7.3 OPERATING INSTRUCTIONS:
     - (1) ESTABLISH PHONE COMMUNICATION WITH RECORDER SITE.
     - (2) WHEN DIRECTED, TURN BREECH HANDLE COMPLETELY CLOCKWISE TO OPEN LAUNCHER BREECH AND REMOVE DUMMY CANISTER.
     - (3) WHEN DIRECTED, TURN BALL VALVE HANDLE TO OPEN POSITION.
     - (4) REMOVE PLASTIC CAP FROM EXPENDABLE DEVICE CANISTER.
     - (5) INSERT EXPENDABLE DEVICE CANISTER INTO LAUNCHER BREECH.
     - (6) WHEN DIRECTED, TURN BREECH HANDLE COMPLETELY COUNTERCLOCKWISE TO SHUT LAUNCHER BREECH.
     - (7) WHEN DIRECTED, REMOVE CANISTER PIN TO RELEASE EXPENDABLE PROBE.
     - (8) WHEN DIRECTED, OPEN LAUNCHER BREECH AND REMOVE EXPENDED PROBE CANISTER AND REPLACE DUMMY CANISTER.
     - (9) SHUT LAUNCHER BREECH.
     - (10) TURN BALL VALVE HANDLE TO SHUT POSITION.
     - (11) REPORT LAUNCHER SECURED.
     - (12) BREECH SHOULD REMAIN IN SHUT POSITION, EXCEPT WHEN ATTENDED DURING EXPENDABLE DEVICE LAUNCH OR TEST OPERATIONS.
8. BALL VALVE AND HANDLE ARE SHOWN IN PREFERRED POSITION (SIDE OF LAUNCHER).

   IF SPACE LIMITATIONS PREVENT MOUNTING IN THIS POSITION, BALL VALVE MAY BE ROTATED UNTIL HANDLE PROVIDES 90 DEGREES OPERATING CLEARANCE.
9. UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN INCHES.

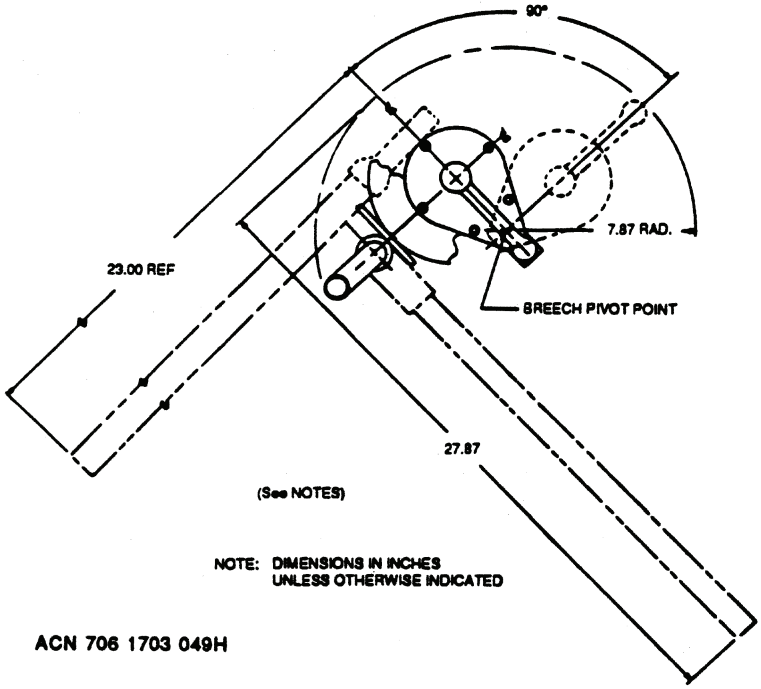


FIGURE 3-6: *LM-4A Thru-Hull Launcher Installation Notes*

5. Mount the ball valve on the 5/8" studs in such a way as to permit operation of the ball valve handle without interference from the ship's surrounding structures and framework.
6. Install the breech adapter assembly and secure it with 5/8" nuts, two per stud.

3.4.2 Grounding the LM-4A

To ensure reliable data acquisition, the LM-4A launcher must be connected to a good seawater ground. The connection should be made to an unpainted surface that is clean, dry and free of rust or contaminants, and the contact resistance of the connection should be less than one ohm. Attach the ground strap, which is attached to the 1/4-20 machine screw on the breech, to one of the 5/8" studs as shown in Figure 3-5 on page 3-16.

NOTE *If an adequate seawater ground connection cannot be made at the LM-4A launcher, then make the ground connection at the connector box as described in "Connecting the Launcher Cable to the MK21 USB DAQ" on page 3-8. If you make the ground connection at the connector box, be sure you do not attach the launcher ground strap to ground. Doing so will create an undesired ground loop.*

3.4.3 Routing the LM-4A Launcher Cable

Route the LM-2A launcher cable to the connector box and connect the cable to it as described in "Connecting the Launcher Cable to the MK21 USB DAQ" on page 3-8. If the launcher cable will pass through bulkheads or beams, install proper sized bushings and packing to preserve watertight integrity. The cable must also be properly supported and strapped to prevent insulation damage. Allow sufficient slack at each end to permit installation or repair of connectors without installation of new cables.

3.5 Verifying System Operation

After installing the components of the MK21 USB DAQ Bathythermograph Data Acquisition System, the WinMK21 Data Acquisition and Post Processing Software, and the MK21 USB driver, you should verify the proper operation of the system by testing the system using an XBT Test Canister or an BT/SV/CTD Test Device. You should perform this test before launching an actual probe. The test verifies the proper operation of the launcher, the cabling, the MK21 USB DAQ, and the WinMK21 Data Acquisition and Post-Processing Software.

3.5.1 Verifying Operation using an XBT Test Canister

To verify operation using an XBT Test Canister:

1. Turn on the MK21 USB DAQ, start WinMK21 and wait until the WinMK21 Main window opens. For detailed instructions, see “Turning On the MK21 USB DAQ and Starting WinMK21” on page 4-1.
2. Choose *Probe* from the *Options* menu, and then choose *Selection*. The *Select Surface Probe Type* dialog box opens. Select an XBT probe type by clicking its option button, and then click **OK**.

   The probe type is selected and the *Select Surface Probe Type* dialog box closes.
3. Do one of the following to initiate a new probe drop:

   - Click the **New Drop** button.
   - Choose *New Drop* from the *File* menu.

   The *Realtime Data Acquisition* window opens with "Load Probe" displayed in the Acquisition State panel, and the probe type displayed in the Launch Information display.

NOTE *If "Spent Canister" is displayed in the Acquisition State panel instead of "Load Probe," a spent canister is in the launcher. Remove the canister and the display should change to "Load Probe."*

---

4. Insert the XBT Test Canister into the launcher.
5. For an LM-3A Hand-Held Launcher, swing the contact lever down; for an LM-2A Deck-Mounted Launcher or an LM-4A Thru-Hull Launcher, close the breech.

   Immediately after the launcher pins make contact with the contacts in the canister, the display in the Acquisition State panel of the *Realtime Data Acquisition* window changes to "Testing Probe" for a few seconds, then to "Prepare for Launch" for another few seconds, and then to "Launch Probe."
6. For an LM-3A Hand-Held Launcher only, connect the release pin of the XBT Test Canister to the ship’s hull or other metal ground using a clip lead.

   "Collecting MK21 Data" is displayed in the Acquisition State panel of the *Realtime Data Acquisition* window and data acquisition begins as if a real probe has been launched. Data acquisition continues until the probe's terminal depth is reached or the test is terminated. A temperature data profile appears in the Graphics display, and the data are also displayed numerically in the Launch Information display.

7. Verify that the displayed temperature value is 1.5°C (±0.1°C).
8. To terminate the test before the end of the simulated probe drop, choose *Terminate* from the *Actions* menu. "Spent Canister" is briefly displayed in the Acquisition State panel, and then WinMK21 automatically switches to Post Processing mode.

3.5.2 Verifying Operation using an BT/SV/CTD Test Device

To verify operation using a BT/SV/CTD Test Device:

1. Turn on the MK21 USB DAQ, start WinMK21 and wait until the WinMK21 Main window opens. For detailed instructions, see “Turning On the MK21 USB DAQ and Starting WinMK21” on page 4-1.
2. Select BT1.
3. Choose *Probe* from the *Options* menu, and then choose *Selection*. The *Select Surface Probe Type* dialog box opens. Select the T-7 XBT probe by clicking its option button, and then click **OK**.

   The T-7 probe is selected and the *Select Surface Probe Type* dialog box closes.
4. Do one of the following to initiate a new probe drop:

   - Click the **New Drop** button.
   - Choose *New Drop* from the *File* menu.

   The *Realtime Data Acquisition* window opens with "Load Probe" displayed in the Acquisition State panel, and the probe type displayed in the Launch Information display.

NOTE *If "Spent Canister" is displayed in the Acquisition State panel instead of "Load Probe," a spent canister is in the launcher. Remove the canister and the display should change to "Load Probe."*

---

5. Press and hold the START button until the LED starts flashing in about one second.
6. Insert the BT/SV/CTD Test Device into the launcher.

WARNING *If CTD was selected on the XB/SV/CTD Test Device, which would be the case when verifying system operation with an XCTD probe, 60 VDC is present on the contact pins of the launcher while WinMK21 is testing the probe. Do not remove the test device while WinMK21 is testing the probe.*

---

7. For an LM-3A Hand-Held Launcher, swing the contact lever down; for an LM-2A Deck-Mounted Launcher or an LM-4A Thru-Hull Launcher, close the breech.

   After about 45 seconds, "Collecting MK21 Data" is displayed in the Acquisition State panel of the *Realtime Data Acquisition* window and data acquisition begins as if a real probe has been launched. Data acquisition continues until the probe's terminal depth is reached or the test is terminated. A temperature data profile appears in the Graphics display, and the data are also displayed numerically in the Launch Information display.

8. Verify that the displayed temperature values for a BT1 temperature profile are correct in accordance with Table 3-2.

TABLE 3-2: *BT1 Temperature Profile*

DEPTH (Feet)	LIMIT (Feet)	TEMPERATURE (°F)	LIMIT (°F)
0	+/- 5	28.0	+/- 0.1
400	+/- 5	50.0	+/- 0.1
800	+/- 5	70.0	+/- 0.1
1100	+/- 5	96.0	+/- 0.1
1400	+/- 5	70.0	+/- 0.1
1700	+/- 5	50.0	+/- 0.1
2100	+/- 5	28.0	+/- 0.1

9. To terminate the test before the end of the simulated probe drop, choose *Terminate* from the *Actions* menu. "Spent Canister" is briefly displayed in the Acquisition State panel, and then WinMK21 automatically switches to Post Processing mode.

3.6 Preparing to Reship the MK21 USB DAQ, Launcher and Probes

If reshipping the MK21 USB DAQ, the launcher, or the probes is required, refer to the general procedures provided below to prepare the items for reshipment.

3.6.1 Preparing to Reship the MK21 USB DAQ

To prepare to reship the MK21 USB DAQ:

1. Disconnect the launcher cable.
2. Disconnect the AC power cable.
3. Remove the MK21 USB DAQ from the 19-inch rack, if installed in one, by removing the mounting hardware.
4. Place the MK21 USB DAQ into its original shipping box or a similar container.
5. Pack sufficient packing material around the MK21 USB DAQ to ensure it is well protected.

3.6.2 Preparing to Reship a Launcher

To reship a launcher, first disassemble it, if necessary. Then repackage it securely in a protective wooden shipping crate. Make sure all of the launcher parts are secured in the crate so they will not break free during shipment.

After removing a LM-4A Thru-Hull Launcher from the ship's adapter, fit and secure a plate to the opening in the adapter to ensure the watertight integrity of the hull.

3.6.3 Preparing to Reship Probes

Probes are usually shipped from Lockheed Martin Sippican in cases of 12. And each probe is individually packaged in a protective plastic bag or similar container. When preparing to reship probes, they should be packaged in their original containers.

3.7 Storing the MK21 USB DAQ, Launchers and Probes

The MK21 USB DAQ, the launchers and the probes should be stored in accordance with the instructions provided below.

3.7.1 Storing the MK21 USB DAQ

The MK21 USB DAQ should be stored in its shipping box in a cool, dry place away from wind, spray, and salt water contaminants. Pack sufficient packing material in the box around the MK21 USB DAQ to ensure it is well protected. Store the MK21 USB DAQ at temperatures from 0°C to 40°C (32°F to 104°F); at or below 25°C (77°F) is ideal. Keep the box covered.

3.7.2 Storing the LM-2A Deck-Mounted Launcher

When the LM-2A Deck-Mounted Launcher is not in use, shut and secure the launcher breech and leave an expended probe canister in the breech to help prevent erosion and salt water contamination. Secure the launcher to the deck, and cover it with the protective canvas provided with the launcher. Secure the canvas cover to the deck with chain or heavy weather-resistant line.

3.7.3 Storing the LM-3A Hand-Held Launcher

When the LM-3A Hand-Held Launcher is not in use, store the launcher indoors in a cool, dry place. Do not leave the launcher on deck when it is not in use, and do not leave it exposed to the sun for extended periods. In addition, to prevent oxidation of the launcher contact pins, leave an expended probe canister in the launcher with the contact lever down.

3.7.4 Storing the LM-4A Thru-Hull Launcher

When the LM-4A Thru-Hull Launcher is not in use, shut and secure the breech and ball valve on the launcher. Remove the spent probe canister and any wire remaining in the launch tube. Flood the outer launch tube as directed by individual ship operating procedures.

3.7.5 Storing Probes

When storing probes on board ship or in a maintenance depot, you should leave them in their original containers. Store them in a cool, dry place away from wind, spray, and salt water contaminants. Store them at temperatures from 0°C to 50°C (32°F to 122°F); at or below 25°C (77°F) is ideal. The ideal storage temperature for XCTD probes is at or below 30°C (86°F).

On each of the probe shipping containers is a "Use Before..." date label. The date is engraved on the shipping label at the time of manufacture. For an XCTD probe there is also a recommended "Use Within..." date (e.g., "use within x number of days from date of manufacture"). Lockheed Martin Sippican cannot guarantee the performance of an XBT, XSV or XCTD probe used after the "Use Before..." or "Use Within..." date.

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SECTION 4
OPERATION

With the MK21 USB DAQ turned on and connected to the USB port of a PC running the WinMK21 Data Acquisition and Post-Processing Software, and with the Main window of WinMK21 open, an XBT, XSV, XCTD or XBP probe can be loaded into a launcher and launched. This section provides step by step instructions on how to turn on the MK-21 USB DAQ, launch a probe and use WinMK21 to view, acquire, store and post process data from the probe. The data acquisition sequence is shown in the flow diagram in Figure 4-1. For information on all the functions provided by WinMK21, see SECTION 5, "WinMK21 Menus and Commands." Instructions are also provided on how to exit from WinMK21 and turn off the MK21 USB DAQ.

4.1 Turning On the MK21 USB DAQ and Starting WinMK21

To launch a probe, the MK21 USB DAQ must be turned on with WinMK21 started and the Main window open. You must have also installed the MK21 USB driver on your computer. (See "Installing the MK21 USB Driver on Your Computer" on page 3-2.)

To turn on the MK21 USB DAQ and start WinMK21:

1. Switch on the ON/OFF switch on the front panel of the MK21 USB DAQ.

   The ON/OFF indicator should light.

NOTE *When turning the MK21 USB DAQ on or off using the front panel ON/OFF switch, ensure that the ON/OFF switch on the desktop unit is in the OFF position.*

---

2. Turn on the computer.

   Windows 2000/XP starts.

3. Double-click the WinMK21 icon ( ) on the Windows desktop to start WinMK21.

   After WinMK21 is started, the Main window shown in Figure 4-2 opens.

With the Main window open, WinMK21 is ready to be placed into one of its two operating modes, Data Acquisition or Post Processing. To launch a probe and to acquire and view data from it, WinMK21 must be in Data Acquisition mode.

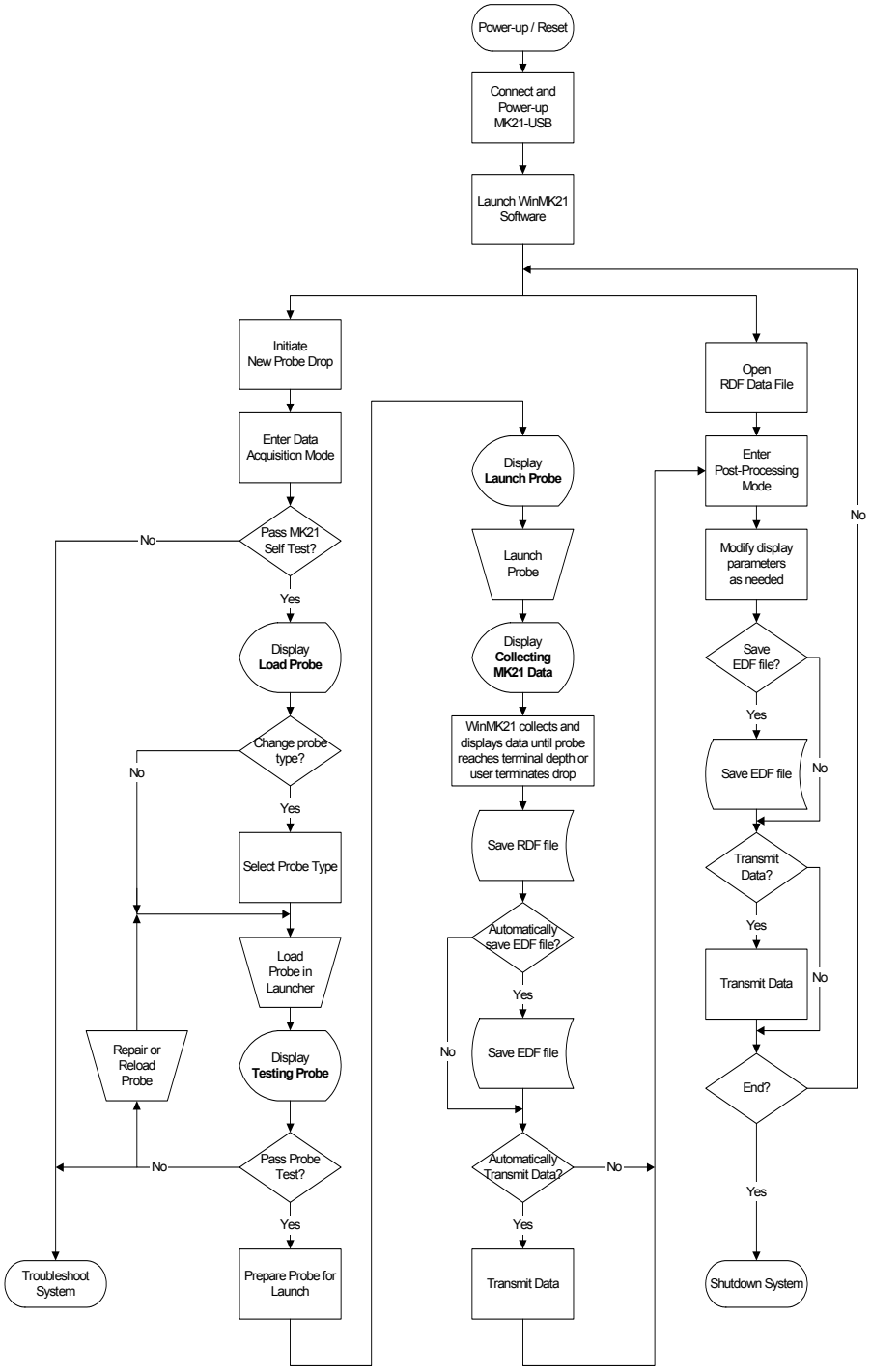


FIGURE 4-1: ***Probe Launch and Data Acquisition Sequence Flow Diagram***

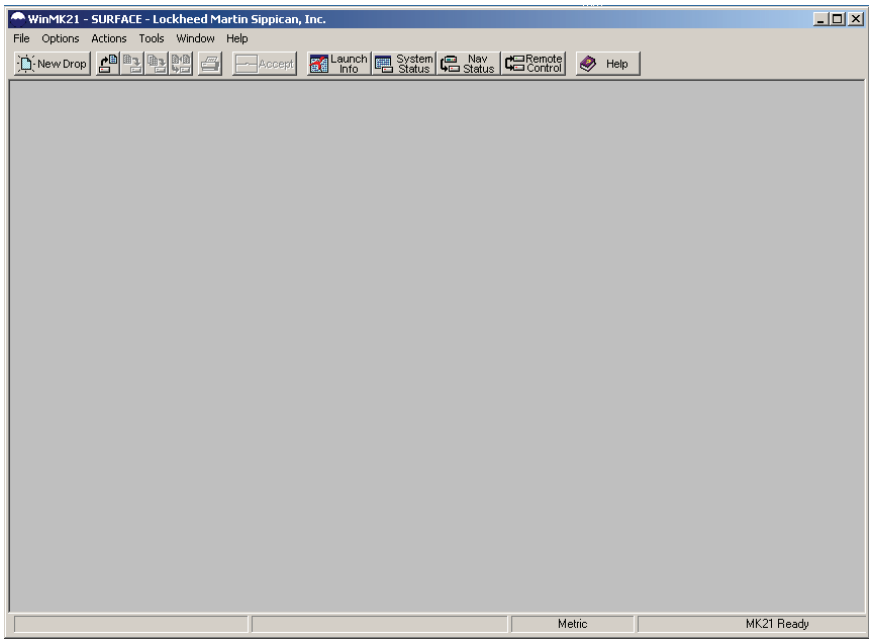


FIGURE 4-2: ***The WinMK21 Main Window***

NOTE *A number of startup options are available including an option which automatically places WinMK21 in the Data Acquisition mode at startup. For more information about this option and others, see SECTION 5, "WinMK21 Menus and Commands."*

4.2 Exiting from WinMK21 and Turning Off the MK21 USB DAQ

Before turning off the MK21 USB DAQ, you must exit from WinMK21 and shut down Windows.

To exit from WinMK21, shut down Windows and turn off the MK21 USB DAQ:

1. Do one of the following:
   - Choose *Exit* from the *File* menu.
   - Press **Alt+F4.**
   - Click the Windows close button in the Title bar.
2. Refer to the instructions provided with Windows 2000/XP and shut down Windows.
3. Turn off the MK21 USB DAQ by switching off the ON/OFF switch.

4.3 Launching an XBT, XSV or XCTD Probe

Before you can launch an XBT, XSV or XCTD probe, the MK21 USB DAQ must be turned on and the WinMK21 Main window must be open as shown in Figure 4-2 on page 4-3. In addition, WinMK21 must be in Data Acquisition mode. This mode is entered by initiating a new probe drop. You may also have to enter the probe type and edit the launch information if these items have changed since the last probe drop. The launch sequence for an XBT, XSV or XCTD probe is a 11-step procedure as follows:

STEP 1. Initiate a new probe drop.

STEP 2. Select or verify the probe type.

STEP 3. Verify the data file name.

STEP 4. Update or verify the launch information.

STEP 5. Load the probe.

STEP 6. Launch the probe.

STEP 7. Wait for terminal depth or stop data acquisition.

STEP 8. Transmit the data.

STEP 9. Perform post processing of data.

STEP 10. Edit the launch information.

STEP 11. Load another probe or exit from WinMK21.

4.3.1 STEP 1—Initiate a New Probe Drop

To initiate a new probe drop, do one of the following:

- Click the **New Drop** button.
- Choose *New Drop* from the *File* menu.

WinMK21 enters Data Acquisition mode and the *Realtime Data Acquisition* window shown in Figure 4-3 opens with "Load Probe" displayed in the Acquisition State panel. The Title bar displays "Realtime Data Acquisition," and the Graphics display appears.

NOTE *If "Spent Canister" is displayed in the Acquisition State panel instead of "Load Probe," a spent canister is in the launcher. Remove the canister and the display should change to "Load Probe."*

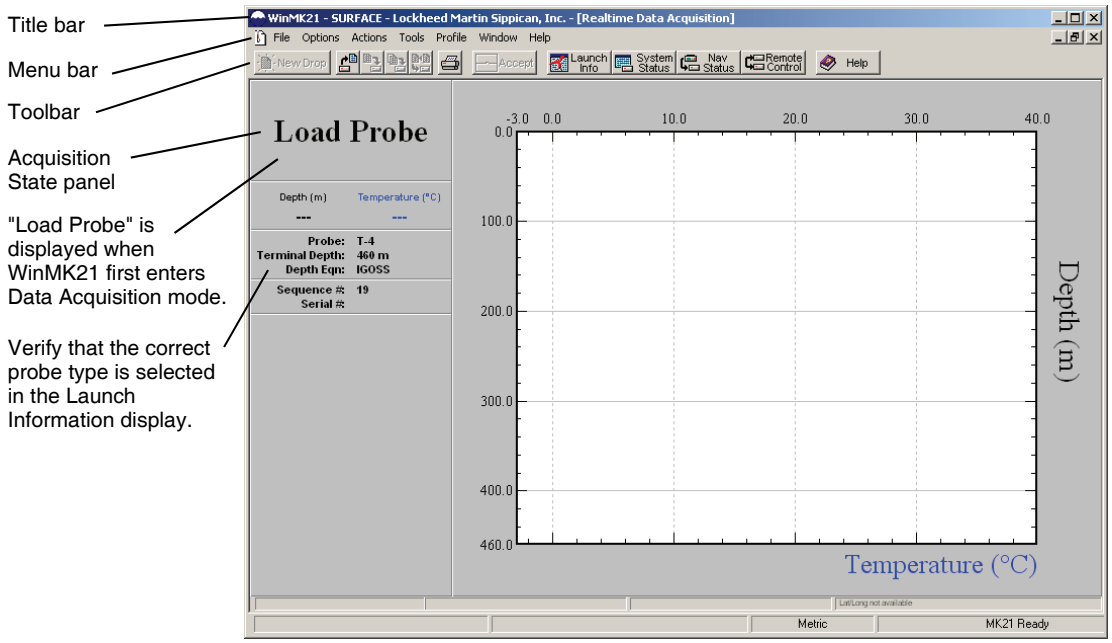


FIGURE 4-3: ***Realtime Data Acquisition Window—Load Probe***

4.3.2 STEP 2—Select or Verify the Probe Type

If the probe you are launching is different from the previous one launched, you must select the new probe type. Even if you have not changed the probe type, verify that the correct probe type, its terminal depth and its depth equation are displayed in Launch Information display.

To select the probe type, choose *Probe* from the *Options* menu, and then choose *Selection*. The *Select Surface Probe Type* dialog box shown in Figure 4-4 opens. Select the probe type by clicking its option button, and then click **OK**. The probe type is selected and the *Select Surface Probe Type* dialog box closes.

NOTE *To edit the terminal depth and drop rate coefficients for the selected probe type, click the* ***More*** *button in the Select Surface Probe Type dialog box. The Probe Attributes dialog box opens where you can make these changes. For more information, see SECTION 5, "WinMK21 Menus and Commands."*

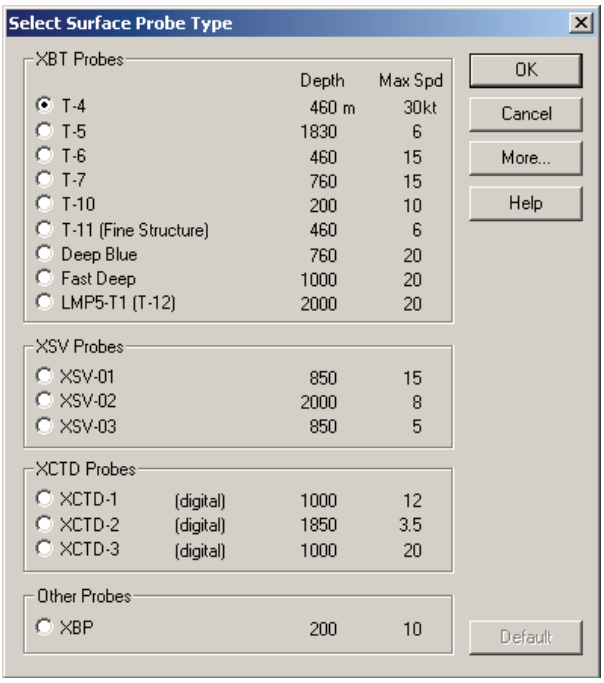
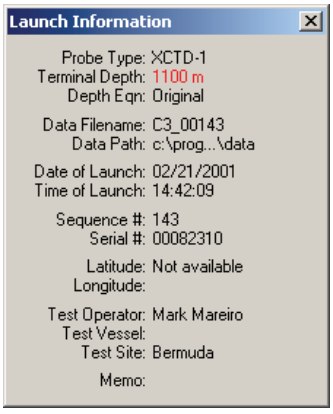


FIGURE 4-4: ***The Select Surface Probe Type Dialog Box***

4.3.3 STEP 3—Verify the Data File Name

You should verify the correct file name for the data and the folder in which the file will be stored. WinMK21 automatically names the file. The name comprises a prefix identifying the probe type, a sequence number, and the extension *.rdf*, which is for "raw data file." For example, a data file named T4_00012.RDF is a file name for a T-4 XBT probe, and the sequence number is 00012. The prefixes for each of the probe types are listed in Table 4-1.

To verify the data file name, click the **Launch Info** button. The *Launch Information* window opens:



The name of the data file and the folder in which it is stored, along with other information, are displayed. If desired, the window can remain open during the launch.

TABLE 4-1: ***Data File Name Prefixes***

TYPE	PREFIX
T-4	T4_
T-5	T5_
T-6	T6_
T-7	T7_
T-10	T0_
T-11	T1_
LMP5-T1 (T-12)	T2_
Fast Deep	TF_
Deep Blue	TD_
XSV-01	S1_
XSV-02	S2_
XSV-03	S3_
XCTD-1	C3_
XCTD-2	C4_
XCTD-3	C5_
XBP	BP_

4.3.4 STEP 4—Update or Verify the Launch Information

Along with the data, the following launch information is stored in the RDF file for each probe drop:

- Probe type and its terminal depth (entered automatically)
- Drop rate equation used (IGOSS, original or custom)
- Data file name (entered automatically)
- Data path (entered automatically)
- Date and time of launch (entered automatically)

- Sequence number (initialized manually, incremented automatically)
- Probe Serial number (entered manually for XBTs and XSVs, automatically for XCTDs)
- Latitude and longitude (entered manually or automatically updated; see SECTION 5, "WinMK21 Menus and Commands," for more information)
- Memo of up to 15 lines of up to 68 characters each (entered manually)
- Up to eight custom parameters with assigned values

To edit or verify the launch information, choose *Launch Information* from the *Options* menu. The *Launch Information Parameters* dialog box shown in Figure 4-5 opens.

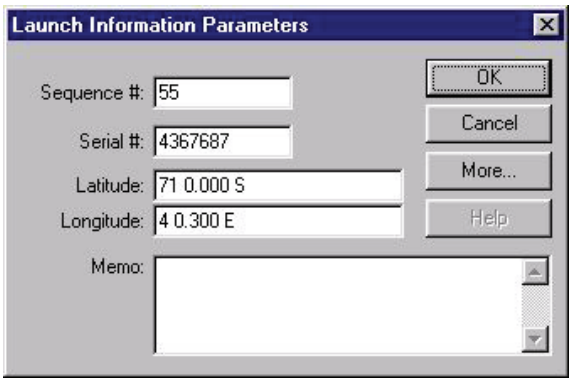


FIGURE 4-5: ***The Launch Information Parameters Dialog Box***

Verify or edit the launch information as required, and then click **OK**.

To view the updated launch information, click the **Launch Info** button, which opens the *Launch Information* window. You can also open the window by selecting *Status* from the *Window* menu, and then choosing *Launch Information.* The window can be left open during the launch. It can also be moved anywhere in the display by dragging its Title bar.

NOTE *The manually entered information in the Launch Information Parameters dialog box is stored in the RDF files for all subsequent probe drops. Therefore, before launching the next probe, you should update or delete any manual entries that have changed.*

In addition to the launch information, you can modify a number of setup parameters, which include system, scaling, post processing, navigation input, and data transmit parameters. For information about these parameters and instructions on how to modify them, see SECTION 5, "WinMK21 Menus and Commands."

4.3.5 STEP 5—Load the Probe

Remove the end cap from the canister containing the selected probe type and insert the canister into the launcher. For an LM-3A Hand-Held Launcher, swing the contact lever down; for an LM-2A Deck-Mounted Launcher or an LM-4A Thru-Hull Launcher, close the breech. For a description of the Lockheed Martin Sippican launchers and how they operate, see “Launchers” on page 1-17.

WARNING *If an XCTD probe is loaded, 60 VDC is present on the contact pins of the launcher when the contact lever is swung down or the breech is closed.*

Immediately after the launcher pins make contact with the contacts in the canister, the display in the Acquisition State panel of the *Realtime Data Acquisition* window changes to "Testing Probe," during which the probe is tested. When testing is complete, the display changes to "Prepare for Launch" for a few seconds, and then to "Launch Probe" as shown in Figure 4-6 for XBT and XSV probe types, and in Figure 4-7 for an XCTD probe type.

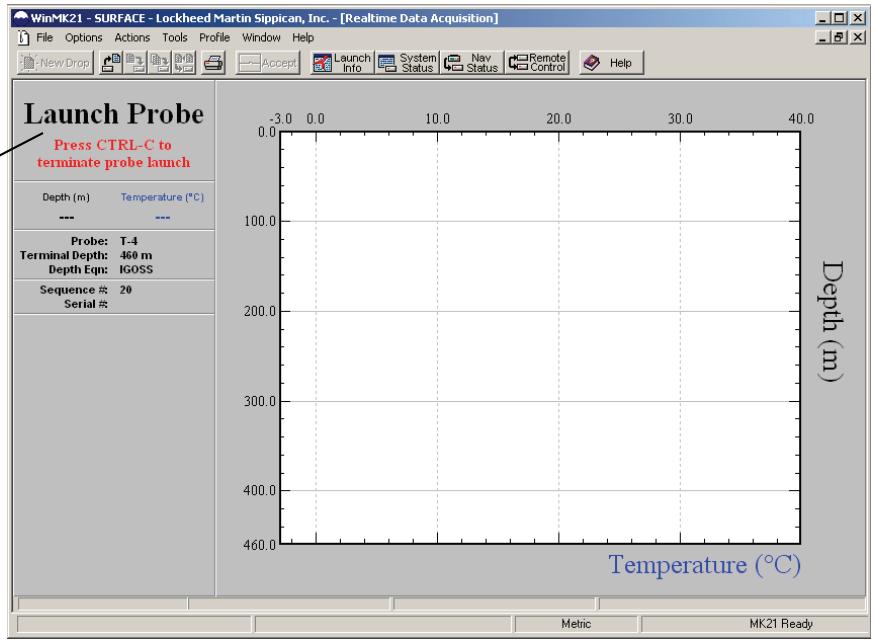


FIGURE 4-6: ***Realtime Data Acquisition Window for XBT and XSV Probe Types—Launch Probe***

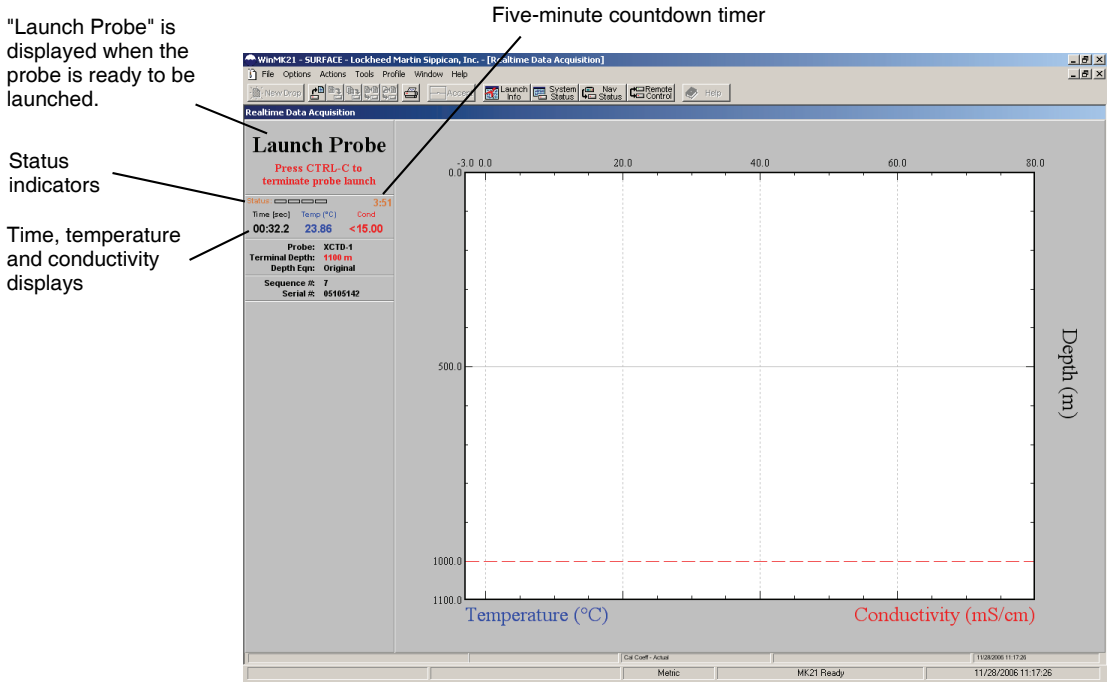


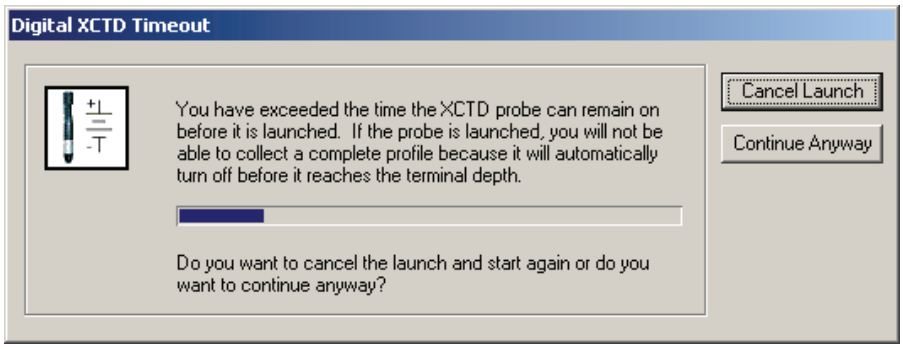
FIGURE 4-7: ***Realtime Data Acquisition Window for XCTD Probe Type—Launch Probe***

CAUTION *For an XCTD probe only, after "Launch Probe" is displayed in the Acquisition State panel, you must launch the probe within 5 minutes to ensure data are acquired throughout the entire descent up to the probe's terminal depth. Or, within the 5-minute period you must otherwise terminate the launch by choosing Terminate from the Actions menu or by pressing Crtl+C.*

If the probe is an XCTD, the probe serial number, terminal depth and depth equation that have been read from the probe's internal memory are displayed in the Launch Information display. In addition, the Launch Information display for an XCTD probe includes the following displays and indicators:

Five-minute countdown timer. The countdown timer is located in the upper right corner of the Launch Information display and counts down from five minutes, zero seconds to zero minutes, zero seconds during which the XCTD probe must be launched to ensure data are acquired throughout the entire descent up to the probe's terminal depth.

Should the countdown timer time out, it displays "TIMEOUT," and the *Digital XCTD Timeout* window opens allowing you to continue or to cancel the launch:



Status indicators. Four status indicators are located at the top of the Launch Information display. If any of these indicators are on, a problem has occurred. From left to right they are CRC Error, Preamble Error, Frame Error, and Carrier Error.

Time display. Displays the time in hours, minutes and seconds since the probe has been loaded.

Temperature display. Displays the in-air temperature before launch and the water temperature after launch.

Conductivity display. Displays the in-air conductivity before launch and the water conductivity after launch. The in-air conductivity value is not valid.

If the probe is an LMP5-T1 (T-12), the *Serial Number* dialog box opens prompting you to enter a valid 8-digit serial number. WinMK21 uses the serial number of an LMP5-T1 (T-12) probe to locate the calibration coefficients and the calibrated depth for the pressure point calibration located in the TCO and CDP files, respectively, for the probe.

4.3.6 STEP 6—Launch the Probe

With "Launch Probe" displayed in the Acquisition State panel, the probe is ready to be launched.

NOTE *To terminate the launch, choose Terminate from the Actions menu or press Crtl+C.*

To launch the probe, pull the release pin out of the canister.

The following occurs:

- "Collecting MK21 Data" is displayed in the Acquisition State panel of the *Realtime Data Acquisition* window as shown in Figure 4-8 for XBT and XSV probe types, and in Figure 4-9 for an XCTD probe type.
- Data acquisition begins.
- A data profile begins to appear in the Graphics display as shown in Figure 4-8 where the temperature profile for an XBT probe is displayed. Two profiles are displayed in Figure 4-9, temperature and conductivity, for an XCTD probe.
- The data are displayed numerically in the Launch Information display, continuously updated as the probe descends.

4.3.7 STEP 7—Wait for Terminal Depth or Stop Data Acquisition

To acquire all the data possible from a probe drop, you must wait for the probe to complete its descent by either reaching its terminal depth or hitting the bottom. However, you can stop data acquisition and save all the acquired data before the probe completes its descent. This may be desirable, for example, when launching a probe in shallow water. To stop data acquisition, choose *Terminate* from the *Actions* menu or press Ctrl+C. The profiles remain displayed in the Graphics display, the data are saved to the data file, and "Spent Canister" is briefly displayed in the Acquisition State panel. Then you are asked if you want to transmit the data and WinMK21 automatically switches to Post Processing mode as described below.

4.3.8 STEP 8—Transmit the Data

When the probe reaches its terminal depth, or if data acquisition is stopped, WinMK21 can transmit the data. If WinMK21 has been configured to transmit the data at the end of a probe drop, a dialog box opens asking you if you want to transmit the data for this probe drop. To transmit the data, click **Yes**; otherwise click **No**. For more information, see SECTION 5, “WinMK21 Menus and Commands.”

4.3.9 STEP 9—Perform Post Processing of Data

When the probe reaches its terminal depth, "Spent Canister" is briefly displayed in the Acquisition State panel and the data are saved to the data file. The profiles remain displayed in the Graphics display while WinMK21 automatically switches to Post Processing mode, and the Post Processing window shown in Figure 4-10 opens with the data file name displayed in the Title bar.

In Post Processing mode you can have WinMK21 calculate sound velocity from XBT or XCTD data, calculate salinity and density from XCTD data, and transmit the data over the RS-232 interface of the computer. You can also print the Graphics display together with the data in the Launch Information display. For instructions on how to perform these and

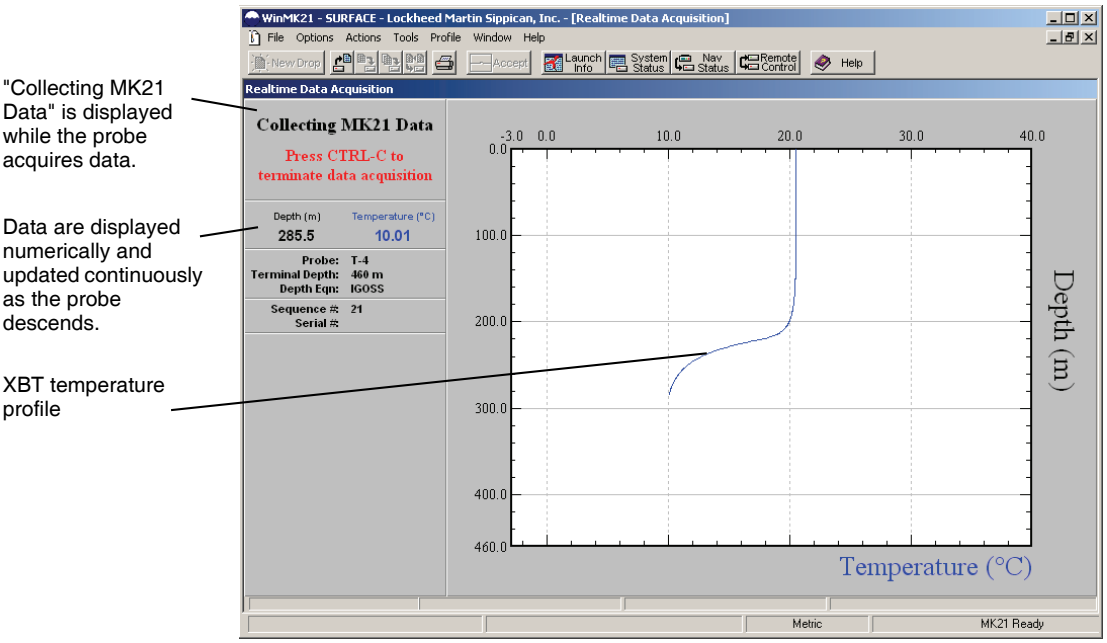


FIGURE 4-8: ***Realtime Data Acquisition Window for XBT and XSV Probe Types—Collecting MK21 Data***

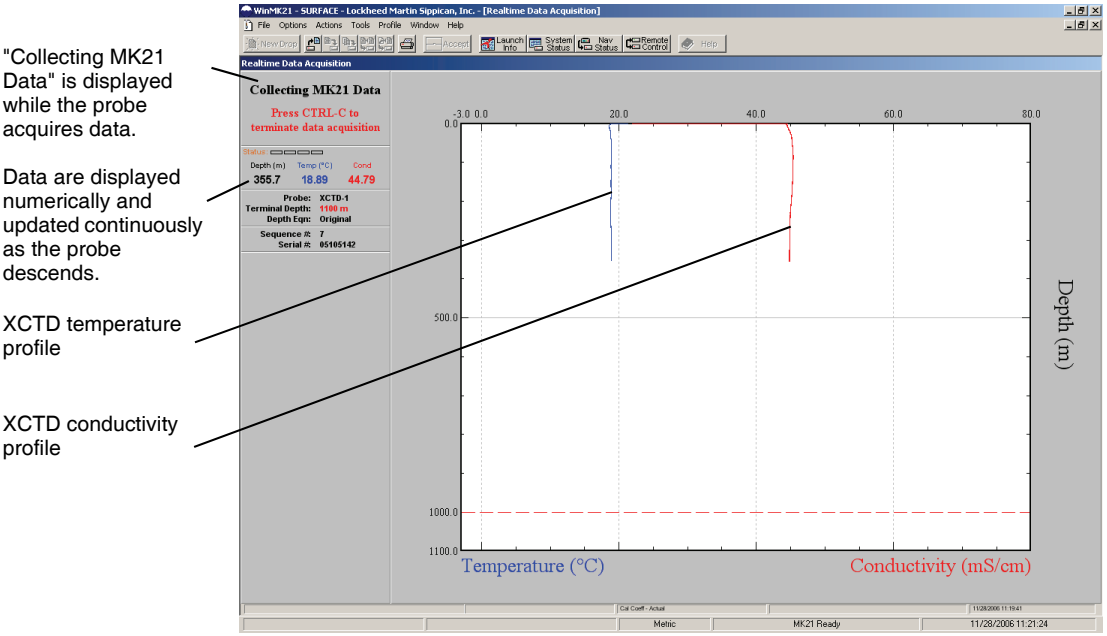


FIGURE 4-9: ***Realtime Data Acquisition Window for XCTD Probe Type—Collecting MK21 Data***

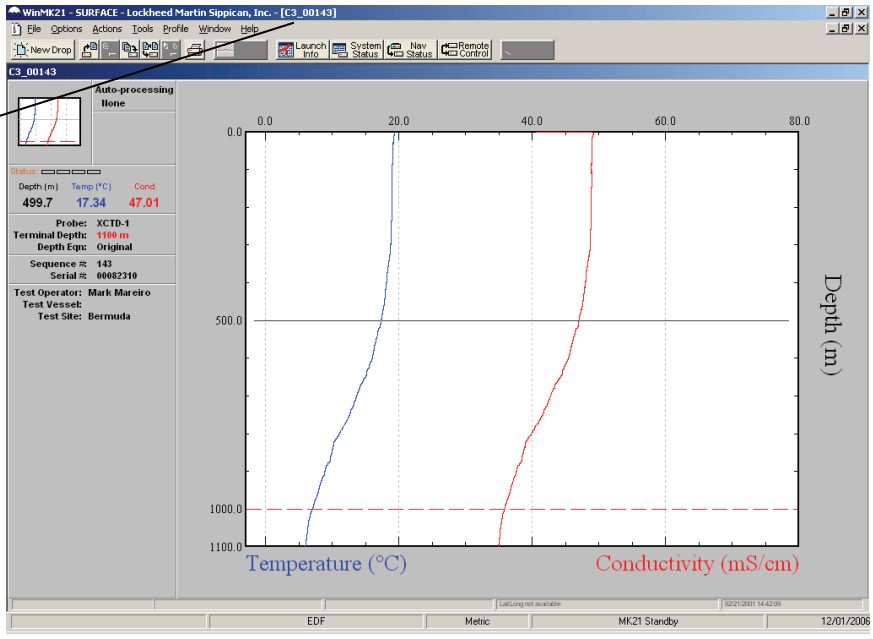


FIGURE 4-10: ***Post Processing Window—End of Probe Drop***

other tasks, see "Post Processing XBT, XSV and XCTD Data" on page 4-22, and for more information about all the functions that can be performed in Post Processing mode, see SECTION 5, "WinMK21 Menus and Commands."

4.3.10 STEP 10—Edit the Launch Information

Following completion of the probe's descent, you can edit the launch information to reflect observations made after launch. The edited data file must be saved to the original data file, overwriting the data, or saved to a new data file with a different file name.

To edit the launch information, choose *Launch Information* from the *Options* menu. The *Launch Information Parameters* dialog box shown in Figure 4-5 on page 4-8 opens.

NOTE *It is not advisable to change the sequence number displayed in the* ***Sequence #*** *text box.*

Edit the launch information as required, and then click **OK**. To view the updated launch information, click the **Launch Info** button, which opens the *Launch Information* window. To save the edited launch information, choose *Save* from the *File* menu to save the data to the original data file. Or choose *Save As* to open the *Save As* dialog box, and then create a new file name and save the data to the new data file.

4.3.11 STEP 11—Load Another Probe or Exit from WinMK21

Launch another XBT, XSV or XCTD probe, or exit from WinMK21 and turn off the MK21 USB DAQ. To launch another probe, choose *Close* from the *File* menu, and then repeat the launch sequence for a new probe. To exit from WinMK21 and turn off the MK21 USB DAQ, see "Exiting from WinMK21 and Turning Off the MK21 USB DAQ" on page 4-3.

4.4 Launching an XBP Probe

Before you can launch an XBP probe, the WinMK21 Main window must be open. In addition, WinMK21 must be in Data Acquisition mode. This mode is entered by initiating a new probe drop. You may also have to enter the probe type and edit the launch information if these items have changed since the last probe drop. The launch sequence for an XBP probe is a 13-step procedure as follows:

STEP 1. Initiate a new XBP probe drop.

STEP 2. Select or verify the XBP probe type.

STEP 3. Verify the XBP data file name.

STEP 4. Update or verify the XBP launch information.

STEP 5. Load the XBP probe.

STEP 6. Accept the XBP prelaunch test.

STEP 7. Acquire XBP data.

STEP 8. Launch the XBP probe.

STEP 9. Wait for terminal time or stop XBP data acquisition.

STEP 10. Edit the XBP launch information.

STEP 11. Select the XBP launch time and impact time and duration.

STEP 12. Generate an XBP export data file.

STEP 13. Load another XBP probe or exit from WinMK21.

4.4.1 STEP 1—Initiate a New XBP Probe Drop

To initiate a new probe drop, do one of the following:

- Click the **New Drop** button.
- Choose *New Drop* from the *File* menu.

WinMK21 enters Data Acquisition mode and the *Realtime Data Acquisition* window opens with "Load Probe" displayed in the Acquisition State panel. The Title bar displays "Realtime Data Acquisition," and the Graphics display appears.

The first time Data Acquisition mode is entered for an XBP probe, WinMK21 will test the capability of the hardware configuration to support the XBP data acquisition. The XBP support test takes 10–12 seconds and is accompanied by "XBP Support - Check MK21 firmware year," "XBP Support - Transfer Rate Test" and "XBP Support - Logging Rate Test" messages. During this time the MK21 interface board is:

- Confirmed to have the necessary firmware for XBP data acquisition
- Verified to pass the test for the XBP data transfer speed
- Verified to pass the test for the XBP data logging to the system's hard drive.

If any of these tests fail, the current hardware configuration will not be able to be used to acquire XBP data. Contact Lockheed Martin Sippican Sea-Air Systems Division technical support if the MK21 interface board fails any of these internal diagnostic tests.

NOTE *If "Spent Canister" is displayed in the Acquisition State panel instead of "Load Probe," a spent canister is in the launcher. Remove the canister and the display should change to "Load Probe."*

4.4.2 STEP 2—Select or Verify the XBP Probe Type

If the previous probe that was launched was not an XBP probe, you must select the XBP probe. Even if you have not changed the probe type, verify that the XBP probe type, its terminal time and its depth equation are displayed in the Launch Information display.

To select the XBP probe type, choose *Probe* from the *Options* menu, and then choose *Selection*. The *Select Surface Probe Type* dialog box shown in Figure 4-4 on page 4-6 opens. Select the XBP probe type by clicking its option button, and then click **OK**. The probe type is selected and the *Select Surface Probe Type* dialog box closes.

NOTE *To edit the terminal time and drop rate coefficients for the XBP probe, click the **More** button in the Select Surface Probe Type dialog box. The Probe Attributes dialog box opens where you can make these changes. For more information, see SECTION 5, "WinMK21 Menus and Commands."*

4.4.3 STEP 3—Verify the XBP Data File Name

You should verify the correct file name for the data and the folder in which the file will be stored. WinMK21 automatically names the file. The name comprises the prefix BP_ which identifies the XBP probe type, a sequence number, and the extension .rdf, which is for "raw data file." For example, a data file named BP_00012.RDF is a file name for an XBP probe, and the sequence number is 00012.

To verify the data file name, click the **Launch Info** button. The *Launch Information* window opens. The name of the data file and the folder in which it is stored, along with other information, are displayed. If desired, the window can remain open during the launch.

4.4.4 STEP 4—Update or Verify the XBP Launch Information

Along with the data, the following launch information is stored in the RDF file for each probe drop:

- Probe type and its terminal depth (entered automatically)
- Drop rate equation used (IGOSS, original or custom)
- Data file name (entered automatically)
- Data path (entered automatically)
- Date and time of launch (entered automatically)
- Sequence number (initialized manually, incremented automatically)
- Probe Serial number (entered manually)
- Latitude and longitude (entered manually or automatically updated; see SECTION 5, “WinMK21 Menus and Commands,” for more information)
- Memo of up to 15 lines of up to 68 characters each (entered manually)
- Up to eight custom parameters with assigned values

To edit or verify the launch information, choose *Launch Information* from the *Options* menu. The *Launch Information Parameters* dialog box shown in Figure 4-5 on page 4-8 opens. Verify or edit the launch information as required, and then click **OK**. To view the updated launch information, click the **Launch Info** button, which opens the *Launch Information* window. You can also open the window by selecting *Status* from the *Window* menu, and then choosing *Launch Information*. The window can be left open during the launch. It can also be moved anywhere in the display by dragging its Title bar.

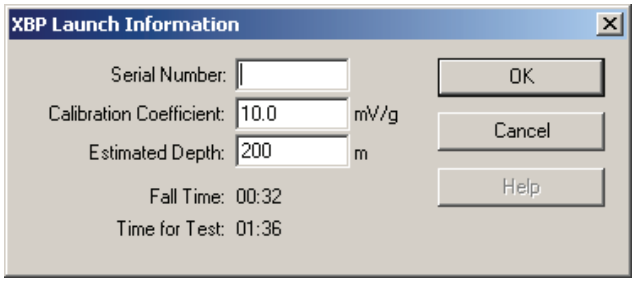
NOTE *The manually entered information in the Launch Information Parameters dialog box is stored in the RDF files for all subsequent probe drops. Therefore, before launching the next probe, you should update or delete any manual entries that have changed.*

In addition to the launch information, you can modify a number of setup parameters, which include system, scaling, post processing, navigation input, and data transmit parameters. For information about these parameters and instructions on how to modify them, see SECTION 5, "WinMK21 Menus and Commands."

4.4.5 STEP 5—Load the XBP Probe

First note the serial number and the calibration coefficient for the XBP probe. This information is printed on a label that is affixed to the canister containing the probe. Then remove the end cap from the canister and insert the canister into the launcher. For an LM-3A Hand-Held Launcher, swing the contact lever down; for an LM-2A Deck-Mounted Launcher or an LM-4A Thru-Hull Launcher, close the breech. For a description of the Lockheed Martin Sippican launchers and how they operate, see "Launchers" on page 1-17.

Immediately after the launcher pins make contact with the contacts in the canister, the display in the Acquisition State panel of the *Realtime Data Acquisition* window changes to "Testing Probe," during which the probe is tested. When testing is complete, the display changes to "Prepare for Launch," and the *XBP Launch Information* dialog box opens prompting you to enter a valid serial number and calibration coefficient:



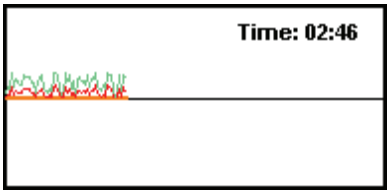
You can also enter an estimated depth at this time. WinMK21 records the serial number and calibration coefficient in the RDF file. The estimated depth is used to set the fall time and the time for test which set the amount of time available for the XBP data acquisition. The time for test is three times the expected fall time. Enter this information, and then click **OK**.

4.4.6 STEP 6—Accept the XBP Prelaunch Test

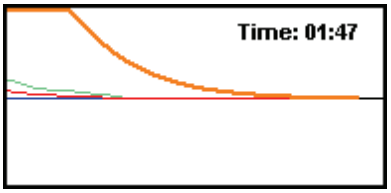
The *XBP Prelaunch Acceptance* window is displayed in the Acquisition State panel of the Realtime Data Acquisition window. This window displays the deceleration data from the XBP probe. Four separate lines are displayed as follows:

- Red: Linear scale in millivolts [±100 mv]
- Blue: Linear scale in millivolts [±1000 mv]
- Green: Log scale in deceleration [± 1000 g]
- Orange: Linear scale of running average for last 2 seconds in millivolts [±50 mv]

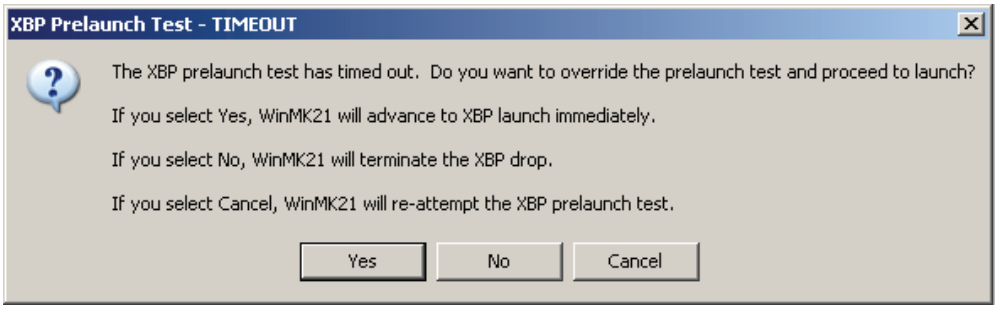
If there is an open circuit, such as when the launcher pins are not making good contact with the contacts on the canister, the traces will not be stable. In this case you should remove the canister from the launcher and reload it, ensuring that the canister is properly seated in the launcher.



All four traces should stabilize at some small offset on either side of zero, depending on the characteristics of each probe. At this point it is good practice to vertically shake or impact the launcher a few times to ensure that the sudden deceleration is visible in the *XBP Prelaunch Acceptance* window. Once the four traces have stabilized, you can click the **Accept** button on the toolbar.



The *XBP Prelaunch Acceptance* window also displays a three-minute countdown timer in the upper right corner. Once the countdown timer has elapsed, you will be prompted as to what action you would like to perform:



If you select **Yes**, WinMK21 will advance to the XBP launch immediately. This has the same effect as selecting the **Accept** button during the prelaunch test in the previous step. If you select **No**, WinMK21 will terminate the XBP drop. If you select **Cancel**, WinMK21 will re-attempt the XBP prelaunch test with a new three-minute countdown timer.

4.4.7 STEP 7—Acquire XBP Data

Once the XBP prelaunch test has been accepted, WinMK21 advances directly to the XBP data acquisition:

- "Collecting MK21 Data" is displayed in the Acquisition State panel of the Realtime Data Acquisition window while the probe acquires data.
- The time and deceleration data are displayed numerically in the Launch Information display continuously.
- A data profile begins to appear in the Graphics display

It is not possible to automatically determine when the XBP probe has been launched. As a result, WinMK21 will record the XBP data continuously for the entire time for test allocated to perform the XBP profile. As outlined previously, the time for test is three times the fall time. The fall time is derived from the estimated depth, based on the drop rate coefficients for the XBP probe.

4.4.8 STEP 8—Launch the XBP Probe

The XBP probe must be launched before the data trace reaches the two-thirds limit of the total time for test. If the XBP probe has not been launched by this time, there will not be enough time left for the probe to reach the bottom before the data acquisition is terminated automatically. In this case, it is best to terminate the data acquisition and perform the launch procedure again.

To launch the probe, pull the release pin out of the canister. The probe release and water impact may be visible in the data trace. There should not be any significant deceleration readings while the probe is descending through the water column.

4.4.9 STEP 9—Wait for Terminal Time or Stop XBP Data Acquisition

Once the bottom impact has been recorded, you can stop the data acquisition. You can stop data acquisition and save all the acquired data before the full time for test has completed. To stop data acquisition, choose *Terminate* from the *Actions* menu. The data are saved to the data file, and "Spent Canister" is briefly displayed in the Acquisition State panel.

Otherwise, when the probe reaches its terminal time, "Spent Canister" is briefly displayed in the Acquisition State panel and the data are saved to the data file. In either case the profile remains displayed in the Graphics display while WinMK21 automatically switches to Post Processing mode and the Post Processing window opens with the data file name displayed in the Title bar.

4.4.10 STEP 10—Edit the XBP Launch Information

Following completion of the probe's descent, you can edit the launch information to reflect observations made after launch. The edited data file must be saved to the original data file, overwriting the data, or saved to a new data file with a different file name. To edit the launch information, choose *Launch Information* from the *Options* menu. The *Launch Information Parameters* dialog box shown in Figure 4-5 on page 4-8 opens.

NOTE *It is not advisable to change the sequence number displayed in the* ***Sequence #*** *text box.*

Edit the launch information as required, and then click **OK**. To view the updated launch information, click the **Launch Info** button, which opens the *Launch Information* window. To save the edited launch information, choose *Save* from the *File* menu to save the data to the original data file. Or choose *Save As* to open the *Save As* dialog box, and then create a new file name and save the data to the new data file.

4.4.11 STEP 11—Select the XBP Launch Time and Impact Time and Duration

In Post Processing mode you can select the launch time and bottom impact time and duration. The launch time and bottom impact start and end times are indicated by a dotted magenta line. Once the launch time and bottom impact time and duration have been selected, WinMK21 will automatically calculate the estimated depth, estimated velocity and maximum deceleration at the time of the bottom impact. At this point, you can also generate an Export Data File.

To save the launch time and impact time and duration information, choose *Save* from the *File* menu to save the data to the original data file. Or choose *Save As* to open the *Save As* dialog box, and then create a new file name and save the data to the new data file.

4.4.12 STEP 12—Generate an XBP Export Data File

Once the launch time and bottom impact time and duration have been selected, you can generate an export data file. The export data file is an ASCII text file that contains header information specific to the XBP probe drop and the profile data for the user-defined

bottom impact event. The time and deceleration data for one second before, during and one second after the user-defined bottom impact event are written to the export data file. For information on the export data file format, see “XBP Probe Export Data Format” on page 4-30.

4.4.13 STEP 13—Load Another XBP Probe or Exit from Winmk21

Launch another XBP probe, or exit from WinMK21 and turn off the MK21 USB DAQ. To launch another probe, choose *Close* from the *File* menu, and then repeat the launch sequence for a new probe. To exit from WinMK21 and turn off the MK21 USB DAQ, see “Exiting from WinMK21 and Turning Off the MK21 USB DAQ” on page 4-3.

4.5 Post Processing XBT, XSV and XCTD Data

You can enter Post Processing mode in two ways: automatically at the end of a probe drop or by opening a data file. In Post Processing mode you can perform the following major functions:

- Open a data file.
- View the data profiles and numeric displays.
- Scale and Zoom in on the Graphics display.
- Compare two data profiles.
- Display tabulated data.
- Filter the data.
- Edit the launch information.
- Print the data profiles.
- Generate an export file.
- Transmit the data file.

A number of other functions can be performed in Post Processing mode. For information about these features and how to work with them, see SECTION 5, “WinMK21 Menus and Commands.”

4.5.1 Opening a Data File

To open a data file, select *Open* from the *File* menu. The *Open* dialog box opens. Select the data file, a file with extension *.rdf*, and then click **OK**.

NOTE *You can select only files with extension .rdf. In addition, the file name prefix identifies the probe type. The prefixes for each of the probe types are listed in Table 4-1 on page 4-7.*

The *Post Processing* window shown in Figure 4-11 opens with the name of the data file displayed in the Title bar. The data profiles are displayed in the Graphics display, and the Launch Information display displays information about the probe drop, including the probe type and its terminal depth, depth equation, sequence number, and serial number.

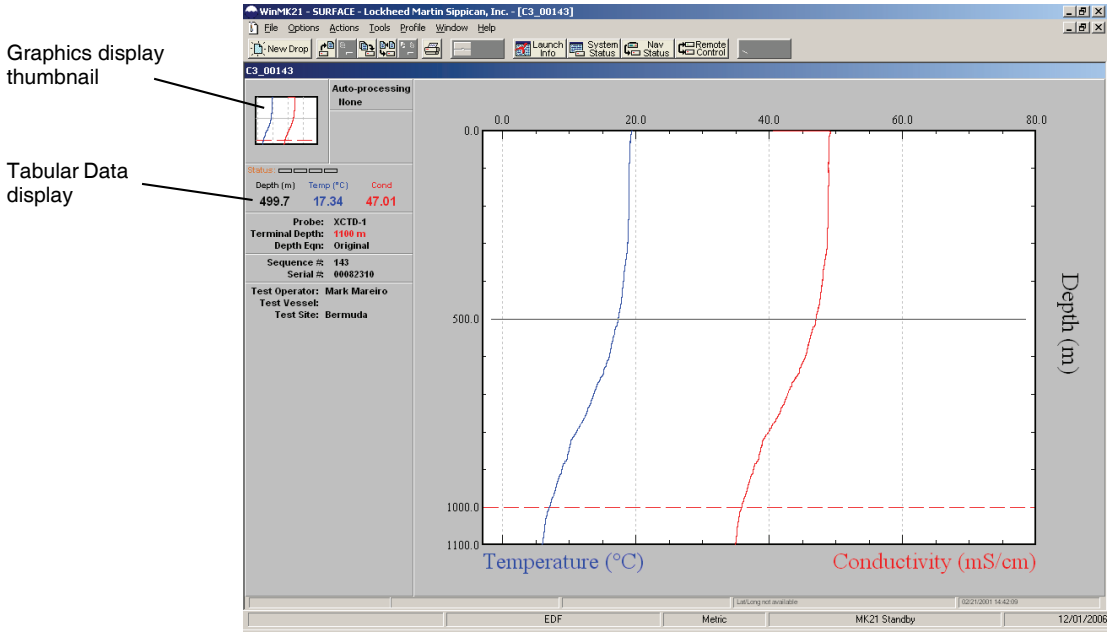


FIGURE 4-11: ***Post Processing Window—Opened Data File***

4.5.2 Viewing the Data Profiles and Numeric Displays

The data profiles are displayed in the Graphics display when you open a data file as shown in Figure 4-11. To view the numeric displays at any depth, place your pointer inside the Graphics display. A horizontal line appears. Move the pointer up and down to view the numeric data in the Tabular Data display for any depth. The horizontal line moves with the pointer and the displayed depth changes with the vertical position of the pointer. Moving the pointer off the graph, either to the left or to the right, fixes the displayed depth. To view the derived sound velocity profile from an XBT or XCTD data file, choose *Sound Velocity* from the *Profile* menu, or right click anywhere in the Graphics display and choose *Sound Velocity*. The sound velocity data profile is displayed. To return to the original display, choose *Original* from the *Profile* menu, or right click anywhere in the Graphics display and choose *Original*.

NOTE *The sound velocity data profile for an XBT is based on an assumed salinity. To verify the correct salinity, or to change it, choose Post Processing from the Options menu. For an XCTD the temperature and conductivity data are sufficient to derive salinity, and therefore do not require that you verify or enter an assumed salinity.*

To view the derived salinity or density data profile from an XCTD data file, choose *Salinity* or *Density* from the *Profile* menu, or right click anywhere in the Graphics display and choose *Salinity* or *Density.* The salinity or density data profile is displayed. To return to the original display, choose *Original* from the *Profile* menu, or right click anywhere in the Graphics display and choose *Original*.

4.5.3 Scaling and Zooming in on the Graphics Display

The horizontal scaling of the Graphics display can be adjusted to provide greater display resolution. Scaling can be performed on any data profile, including derived data profiles. To scale the Graphics display, select *Scaling* from the *Profile* menu, and then choose *Set*. Or instead, right click the Graphics display thumbnail and choose *Scaling*. The *Graph Scaling - Defaults* dialog box opens. Enter the minimum and maximum values for the Graphics display, and then click **OK**.

Any area of the Graphics display can be selected to zoom in on. To zoom in on the Graphics display, click and hold the left pointing device button and drag the pointer to draw a box around the area of the Graphics display you want to zoom in on as shown in Figure 4-12. Then release the button. The zoomed in area is displayed in the Graphics display as shown in Figure 4-13. A view box representing the zoomed in area relative to the entire profile is also displayed in the Graphics display thumbnail. You can pan the Graphics display by dragging and dropping the view box anywhere in the Graphics Display thumbnail. To return to the original display, choose *Original* from the *Profile* menu, or right click anywhere in the Graphics display and choose *Original.*

4.5.4 Comparing and Overlaying Multiple Data Profiles

To compare multiple data profiles, open each file, one after the other. Then choose *Tile* from the *Window* menu. The profiles are displayed side by side in separate *Post Processing* Windows. You can perform all of the post processing functions in each window.

To overlay multiple data profiles, select *Overlay* from the *Profile* menu, and then choose *Add*. You will be prompted to select a valid RDF data file. The selected profile is displayed as an overlay in a lighter color with the existing profile. You can add up to ten different profiles as overlays. To remove the most recently added overlay, select *Overlay* from the *Profile* menu, and then choose *Remove;* to remove all the overlays, choose *Remove All*.

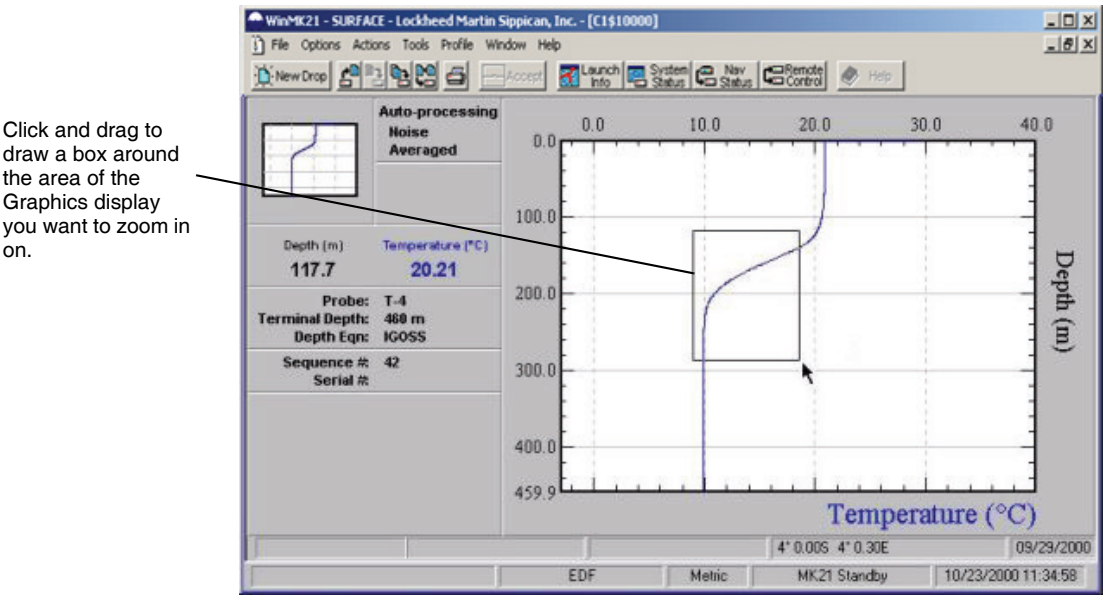


FIGURE 4-12: ***Selecting an Area of the Graphics Display to Zoom in on***

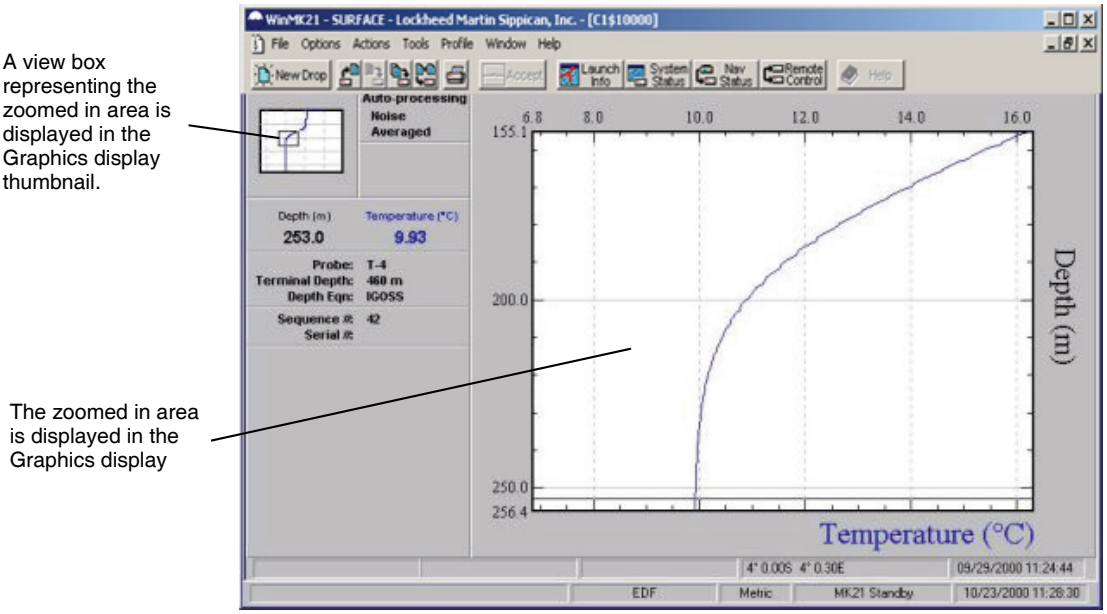


FIGURE 4-13: ***Zooming in on an Area of the Graphics Display***

4.5.5 Displaying Tabulated Data

You can display both the acquired and derived data in tabular format. To display data in tabulated format, choose *Tabular Data* from the *Profile* menu. The *Tabular Data* window opens where you can scroll through the data one line at a time, either from this window or from the Graphics display. To scroll through the data from the window, drag the vertical scroll box up or down. To scroll through the data from the Graphics display, move the pointer up or down in the Graphics display. A horizontal line appears which moves with the pointer. Moving the pointer off the graph, either to the left or to the right, selects a single line of data.

4.5.6 Filtering the Data

Data files may be filtered for display and for preparation of export files. Two filter modes are available: Noise Reduction and Averaging. When noise reduction is selected, each data point whose value exceeds a selectable threshold is deleted. Averaging includes both noise reduction and averaging of the noise-reduced data. A data file must be open to filter the data, and the original data profiles must be displayed. To display the original profiles, choose *Original* from the *Profile* menu.

To apply the Noise Reduction filter, choose *Post-Processing* from the *Options* menu, enter the desired threshold value in the **Noise Threshold** text box, and then click **OK**. To display the noise-reduced data profiles, choose *Noise* from the *Profile* menu.

To apply the Averaging filter, choose *Post-Processing* from the *Options* menu, enter the desired number of points over which to average in the **Averaging Window** text box, and then click **OK**. To display the averaged data profiles, choose *Averaged* from the *Profile* menu.

4.5.7 Editing the Launch Information

The launch information in the RDF file can be edited to reflect observations made after the launch. After editing the launch information, the edited data file must be saved to the original data file, overwriting the data, or saved to a new data file with a different file name.

To edit the launch information, first open the data file and verify that the file name in the Launch Information window is correct. Then choose *Launch Information* from the *Options* menu. The *Launch Information Parameters* dialog box shown in Figure 4-5 on page 4-8 opens.

NOTE *It is not advisable to change the sequence number displayed in the* ***Sequence #*** *text box.*

Edit the launch information as required, and then click **OK**. To view the updated launch information, click the **Launch Info** button, which opens the *Launch Information* window. To save the edited launch information, choose *Save* from the *File* menu to save the data to the original data file. Or choose *Save As* to open the *Save As* dialog box, and then create a new file name and save the data to the new data file.

4.5.8 Printing the Data Profiles

To print the data profiles, choose *Print* from the *File* menu. The *Print* dialog box opens. Select the printer, and then click **OK**. The Graphics display, as it is currently displayed, and the launch information are printed.

4.5.9 Generating an Export Data File

Any RDF file can be converted into a text-format export data file compatible with external application software such as spreadsheets. The export file format has the extension *.edf* (Export Data File) instead of *.rdf* (Raw Data File). To create an export data file, open a raw data file, and then choose *Export* from the *File* menu. The *Save As* dialog box opens. Select the directory in which the export data file is to be created, and then create a file name and save the data to the file. The export data file can be opened in a word processing or spreadsheet program.

4.5.10 Transmitting the Data File

To transmit a data file, choose *Transmit* from the *File* menu. A dialog box opens asking you if you want to transmit the data for this probe drop. To transmit the data, click **Yes**; otherwise click **No**.

4.6 Post Processing XBP Data

The post processing procedures for the XBP probe using the WinMK21 software are essentially similar to the post processing procedures for all of the other expendable probes. However, because of the unique nature of the XBP probe, there are some fundamental differences.

4.6.1 Scaling the XBP Graphics Display

The horizontal scaling of the XBP Graphics display cannot be adjusted. The scaling for the deceleration profile is fixed at ±1000 g. The deceleration is displayed using a log10 scale.

4.6.2 Zooming in on the XBP Graphics Display

Any time slice of the XBP Graphics display can be selected to zoom in on. To zoom in on the XBP Graphics display, click and hold the left pointing device button and drag the pointer to draw a time slice around the area of the Graphics display you want to zoom in on. Then release the button. The zoomed in time slice is displayed in the Graphics display. A view slice representing the zoomed in area relative to the entire profile is also displayed in the Graphics display thumbnail. You can pan the Graphics display by dragging and dropping the view slice anywhere in the Graphics Display thumbnail. To return to the original display, choose *Original* from the *Profile* menu, or right click anywhere in the Graphics display and choose *Original*.

You can also pan the Graphics display by clicking anywhere in the Graphics display. The Graphics display will be centered at the location of the pointer.

4.6.3 Displaying Tabulated Data

You cannot display the XBP data in tabular format.

4.6.4 XBP Profile Menu

The *Profile* menu contains an XBP pop-up menu for XBP settings. The XBP pop-up menu provides commands for setting the launch time and bottom impact time and duration for the current profile.

Launch - Set	Manually set time of the XBP launch at the current profile marker.
Launch - Clear	Manually remove time indicating the XBP launch.
Impact - Set Start	Manually set start time of the XBP bottom impact launch at the current profile marker.
Impact - Set End	Manually set end time of the XBP bottom impact at the current profile marker.
Impact - Clear	Manually remove times indicating the XBP bottom impact event.

4.6.4.1 Launch - Set

Select the *Launch - Set* menu item from the *Profile|XBP* menu to manually set the time of the XBP launch. The time of the XBP launch will be set to the current time as indicated by the profile marker. The launch time is used in conjunction with the impact start time to estimate depth and impact velocity.

The *Profile|XBP|Launch - Set* menu item is only available if the current probe is an XBP probe.

4.6.4.2 Launch - Clear

Select the *Launch - Clear* menu item from the *Profile|XBP* menu to manually remove the time of the XBP launch.

The *Profile|XBP|Launch - Clear* menu item is only available if the current probe is an XBP probe and the launch time has been previously set.

4.6.4.3 Impact - Set Start

Select the *Impact - Set Start* menu item from the *Profile|XBP* menu to manually set the start time of the XBP bottom impact. The start time of the XBP bottom impact will be set to the current time as indicated by the profile marker. The start time is used in conjunction with the launch time to estimate depth and impact velocity. Additionally, once the bottom impact event has been defined by both the start and end times, the maximum deceleration reading can be obtained and you can generate an EDF file.

The *Profile|XBP|Impact - Set Start* menu item is only available if the current probe is an XBP probe.

4.6.4.4 Impact - Set End

Select the *Impact - Set End* menu item from the *Profile|XBP* menu to manually set the end time of the XBP bottom impact. The end time of the XBP bottom impact will be set to the current time as indicated by the profile marker. Once the bottom impact event has been defined by both the start and end times, the maximum deceleration reading can be obtained and you can generate an EDF file.

The *Profile|XBP|Impact - Set End* menu item is only available if the current probe is an XBP probe.

4.6.4.5 Impact - Clear

Select the *Impact - Clear* menu item from the *Profile|XBP* menu to manually remove the start and end times of the XBP bottom impact.

The *Profile|XBP|Impact - Clear* menu item is only available if the current probe is an XBP probe and either the start or end time for the bottom impact has been previously set.

4.7 XBP Probe Export Data Format

The XBP Probe Export Data Format is an ASCII output file of the profile data for the user-defined bottom impact event. The file contains the generic launch and probe information in the header. The header also contains information specific to the XBP probe. The profile data for the user-defined bottom impact event is then listed in tab-delimited format with a single data sample set on each line. One second before and after the user-defined bottom impact event are also written to the export data file. A single data sample set consists of the measured time and deceleration data. An example of such a file is displayed below.

```
// This is a MK21 EXPORT DATA FILE  (EDF)
//
Date of Launch:  06/09/2004
Time of Launch:  16:10:35
Sequence #    :  54
Latitude      :
Longitude     :
Serial #      :  00097089
//
// Here are the contents of the memo fields.
//
//
// Here is some probe information for this drop.
//
Probe Type       :  XBP
Fall Time        :  00:32
Time for test    :  01:36
Depth Equation   :  Standard
Depth Coeff. 1   :  0.0
Depth Coeff. 2   :  6.301
Depth Coeff. 3   :  -0.00216
Depth Coeff. 4   :  0.0
Pressure Pt Correction:  100.0%
//
```

```
Raw Data Filename:  C:\XBPData\~XBP001.RDF
//
Display Units    :  Metric
//
//
// Here is some XBP-specific probe information for this drop.
//
Launch Time       :  00:04
Impact Time       :  00:14
Estimated Depth   :  63.4 m
Estimated Velocity:  6.3 m/s
Max. Impact g     :  18.946 g
//
//
Time (sec) - Deceleration (g)
13.45712    0.019
13.45719    0.013
13.45725    0.021
13.45731    0.004
13.45737    0.013
13.45744    0.006
13.45750    -0.002
13.45756    0.004
13.45763    0.004
```

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SECTION 5
WINMK21 MENUS AND COMMANDS

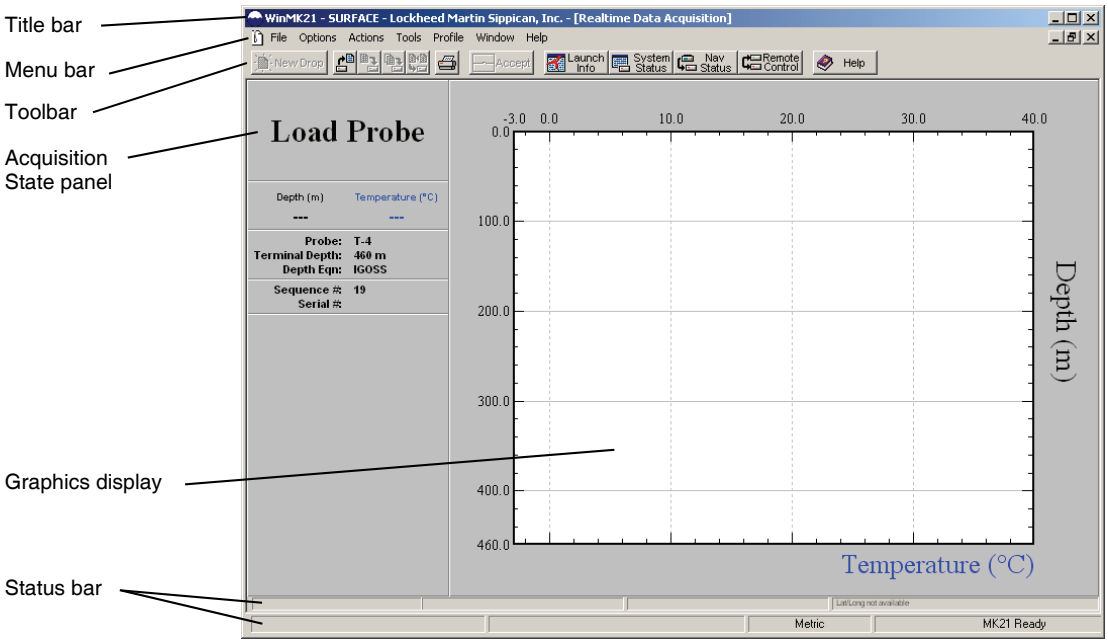
This section provides information on the menus and commands provided by the WinMK21 Data Acquisition and Post-Processing Software and includes the following main topics:

- Real-Time Data Acquisition Window
- Menu Bar
- WinMK21 Toolbar
- Dialog Overview
- Additional Information Overview
- MK21 Interface Board Port Address

In addition, you can view and print this manual as a Portable Document Format (PDF) document if you have Adobe® Reader® installed on your computer. To view the manual as a PDF, choose *Contents* from the *Help* menu or click the **Help** button.

5.1 Real-Time Data Acquisition Window

The *Real-time Data Acquisition* window shows launch state, i.e. "Load Probe," "Testing Probe," "Launch Probe," "Collecting MK21 Data," and "Spent Canister," the measured parameter(s) as a function of depth, and the graphical representation of the data being collected. This window is invoked by the *File|New Drop* command. There can be only one *Real-time Data Acquisition* window for collecting data. However, other data windows can display data in Post-Acquisition mode from previous drops.



5.2 Menu Bar

This section provides a discussion of all the commands that are accessible from the menu bar, which includes the following menus:

- File
- Options
- Actions
- Tools
- Profile
- Window
- Help

5.2.1 File Menu

The *File* menu provides commands for displaying the *Real-time Data Acquisition* window, opening existing profiles, saving profiles, printing profiles, and exiting the application.

New Drop	Display the *Real-time Data Acquisition* window.
Open	Open an existing profile.
Close	Close the current profile.
Save	Save the current profile in the Raw Data Format (.rdf).
Save As	Save the current profile with a new name in the Raw Data Format (.rdf).
Export	Export the current profile in the Export Data Format (.edf)
Transmit	Transmit the current profile to an external device.
Print Setup	Set the default printer characteristics.
Print Preview	View a sample printout of the current profile.
Print	Print the current profile.
Exit	Exit WinMK21 application.

5.2.1.1 New Drop

The *File*|*New* command creates a new *Real-time Data Acquisition* window, and makes it the active window.

5.2.1.2 Open

The *File*|*Open* command allows the user to load a Raw Data file (.rdf). The standard Windows *Open* dialog will appear from which the user can select the file to be opened.

5.2.1.3 Close

File|*Close* closes the currently active data window.

5.2.1.4 Save

The *File*|*Save* command allows the user to save any changes made to the profile in the active data window.

NOTE *If the profile data has been modified by the operator an asterik (*) is appended to the file name in the caption bar of the profile window. The asterik indicates that the profile data, or more precisely a parameter that affects the profile display, has been modified since the data file was last saved.*

5.2.1.5 Save As

The *File|Save As* command allows the user to save the profile in the active data window in a Raw Data File (.rdf) under a new name, or in a new location on disk. The command displays the *Save File As* dialog. The new file name, including the drive and directory, can be entered. The active window containing this profile is updated with the new name. If an existing file name is chosen, the user is prompted to indicate if the existing file should be overwritten.

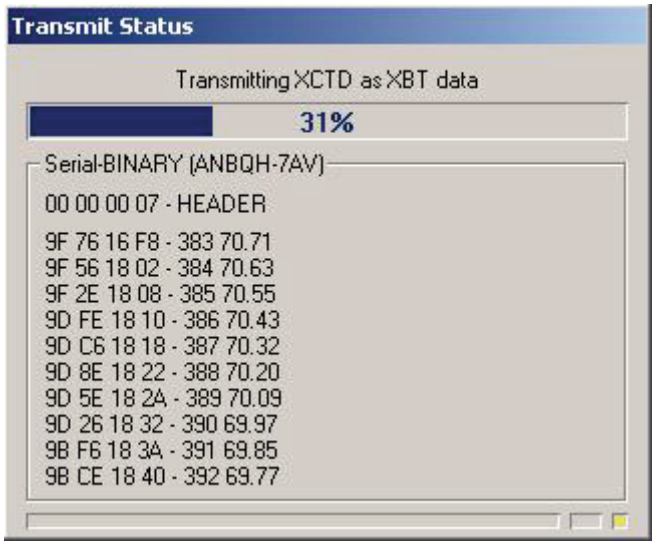
5.2.1.6 Export

The *File|Export* command allows the user to save a profile in the Export Data Format (EDF). The command displays the *Save File As* dialog. The new file name, including the drive and directory, can be entered. If an existing file name is chosen, the user is prompted to indicate whether the existing file should be overwritten.

5.2.1.7 Transmit

The *File|Transmit* command allows the transmission of the current profile to an external device using the currently selected Data Transmit parameters. These options can be accessed by selecting *Options*, and then *Transmit* from the menu bar.

During the data transmission, the *Transmit Status* dialog is displayed. The *Transmit Status* dialog allows the operator to monitor the completion status of the transmission as well as monitor the integrity of the data transmission.



The binary values and the interpreted values of the transmitted data are displayed on the dialog.

The bottom bar indicates the number of bytes in the operating system's output buffer. Under correct operating conditions this bar will appear empty since the data bytes in the output buffer should be transmitted as soon as they are sent to the output buffer. However, if the transmission serial settings do not allow the data bytes to be transmitted as fast as the WinMK21 application sends them to the output buffer, the output buffer will fill up. The short bar to the right of the bottom bar indicates if the output buffer has overflowed. Even if the output buffer is no longer full, this indicator will remain highlighted in order to indicate the overflow situation. An overflow situation will indicate a transmission failure. In this case, the baud rate of the transmit serial settings should be increased. The bottom square to the right of the two indicators flashes when activity is detected on the operating system's output buffer.

5.2.1.8 Print Setup

The *File|Print Setup* command displays the *Printer Setup* dialog which allows the user to select and configure the current printer.

5.2.1.9 Print Preview

File|Print Preview opens a special window that shows how the profile in the active window will appear when printed. The preview window shows the data profile as it would be laid out on the printer page.

5.2.1.10 Print

The *File|Print* command prints the profile of the active window. Use *File|Print Preview* to see how the profile in the active window will appear when printed. Use *File|Print Setup* to select a printer and to set printer options.

5.2.1.11 Exit

The *File|Exit* command exits the WinMK21 program.

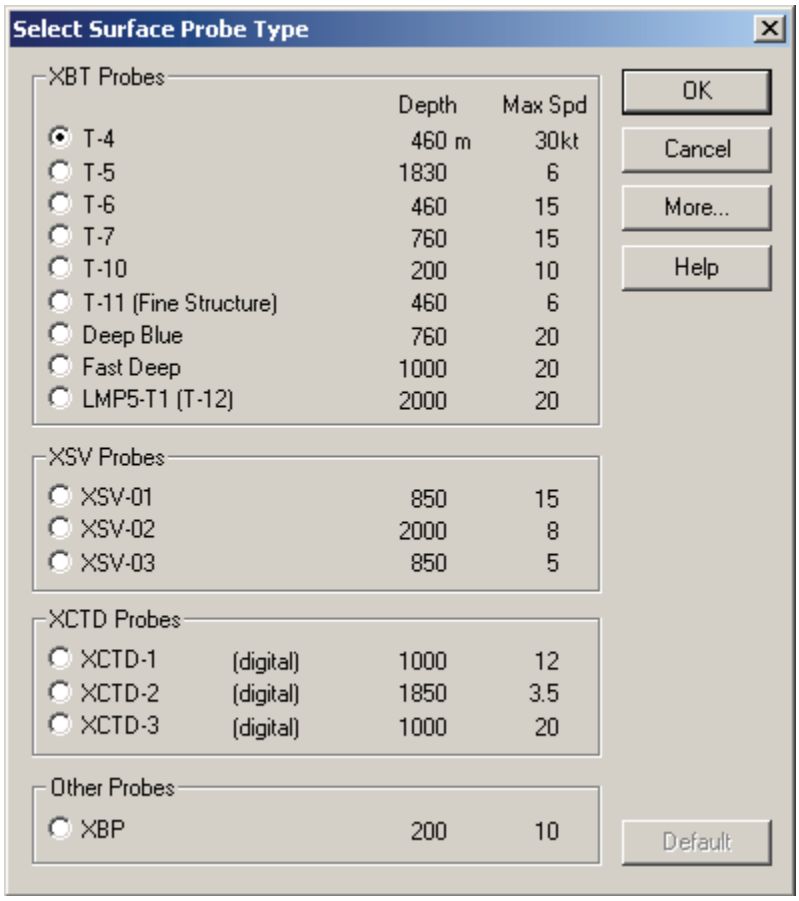
5.2.2 Options Menu

The *Options* menu provides commands for setting the WinMK21 options.

Probe	Displays pop-up menu for probe settings - selection of probe type and probe attributes.
System	Set display units, storage mode and hardware settings for the MK21 interface board.
Transmit	Set data transmission settings.
User	Set user interface settings
Scaling	Set profile scaling settings.
Post-Processing	Set profile post-processing parameters.
Launch Information	Set launch information for the active profile
Navigation Input	Set navigation input parameters
Remote Control	Set remote control parameters

5.2.2.1 Probe - Selection

There can be only one active probe type for the Data Acquisition mode. When a new probe drop has been initiated, the system will use the currently active probe type by default. Thus, if an XSV-01 probe is the currently selected data acquisition probe type, when the user starts a new drop sequence, the system will prepare the MK21 interface board for an XSV-01 probe. Therefore, the first step in starting a new drop is to ensure the desired probe type is actually the currently selected data acquisition probe type. If a different probe is desired, click *Options*, then *Probe*, then *Selection*. The following dialog appears which allows the user to select a different probe.



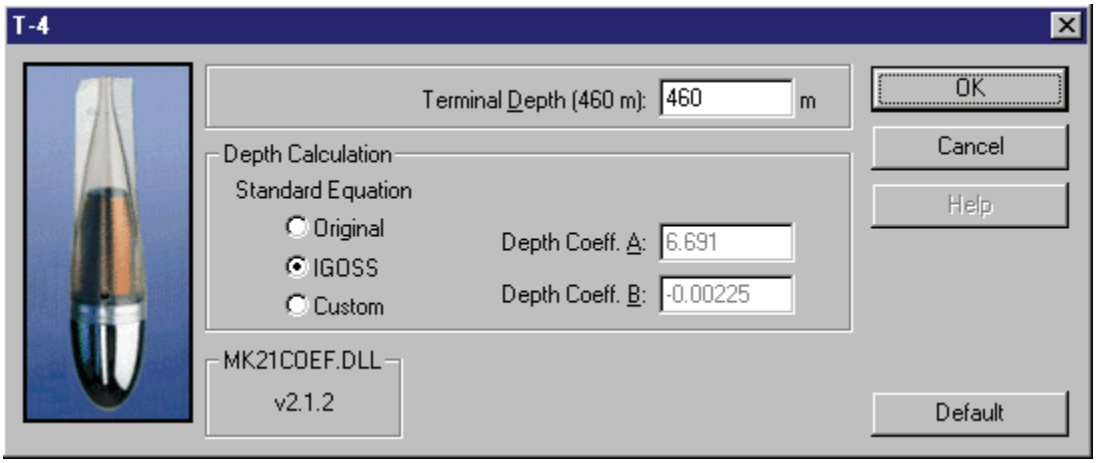
Simply click on the desired probe, and then click **OK**. Clicking the **More** button displays the *Probe Attributes* dialog for the currently selected probe. Clicking the **Default** button resets the attributes of all of the probes to their corresponding default values. The **Default** button is disabled if all of the probe attributes are currently set to their default values.

5.2.2.2 Probe - Attributes

In Data Acquisition mode, the probe attributes are displayed by clicking the **More** button in the *Probe Selection* dialog. In Data Acquisition mode, changes made to the probe attributes will affect all subsequent profiles that use the edited probe type.

In Post Processing mode, select *Options*, *Probe*, and then *Attributes* menu items to display the attributes for the probe in the currently active profile. The *Attributes* menu item is only available in Post-Processing mode. In Post Processing mode, changes made to the probe attributes are specific to the probe in the currently active profile only.

Probe Attributes Dialog. The *Probe Attributes* dialog allows the user to edit the probe's terminal depth as well as verify or modify drop rate coefficients (Original, IGOSS, or Custom). The IGOSS drop rates are the preferred drop rates. Unless there is a special need for the use of custom coefficients it is best to use the default coefficients for all of the probe types. Furthermore, in Post Processing mode, the user will be able to define Pressure Pt and Calibration coefficients if they are available. The following dialog is displayed:



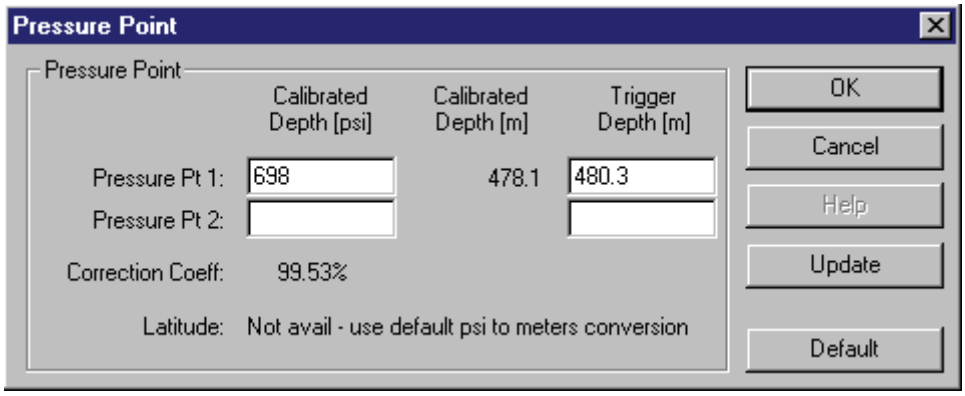
The probe type, in this case a T-4, is displayed in the caption bar of the dialog. Furthermore, a picture of the probe is displayed to avoid confusion. If the user changes any of the values in this dialog, they can be reset back to the default values by clicking the **Default** button. Note that this dialog will have a different appearance for each probe type.

The XCTD-1 probe transmits the terminal depth and drop rate coefficients from an EEPROM on the probe during the probe loading process. Thus, unlike all of the other probes, the user is not able to set the probe specific parameters prior to initiating an XCTD-1 probe.

Post-Processing Attributes. In Post Processing mode, the user will be able to define the calibrated depth of the pressure point and edit the data calibration coefficients. If the feature is supported by the probe, a corresponding button appears in the dialog for the *Pressure Point* and *Calibration Coefficients* dialogs. Clicking the **Pressure Pt.** button displays the *Pressure Point* dialog. Correspondingly, clicking the **Cal. Coeff.** button displays *Calibration Coefficients* dialog.

5.2.2.3 Probe Attributes - Pressure Point

The *Pressure Point* dialog allows the user to define the calibrated depth of the probe's pressure sensor. Furthermore, the user can manually modify or remove the trigger depth of the pressure point.



The calibrated depth is recorded as a pressure in psi. The calibrated depth in psi is then converted to a depth in meters (or feet depending on the current units). If the latitude of the probe drop is available, the WinMK21 will automatically compensate the psi to meters conversion based on the known latitude.

The trigger depth is displayed in meters (or feet). If this value is blank, then the pressure point is considered to be “Free.” Otherwise, this value reflects the current trigger depth whether it was obtained automatically using Auto-Find or set manually by the user. To remove the trigger depth for the pressure point, simply remove the value and leave the field blank.

If the trigger depth is set, the resulting correction coefficient is displayed. The correction is indicated as a required percentage change that must be applied to the derived depth in order to force the trigger depth of the pressure point signature in the probe data to be located correctly at the calibrated depth of the pressure sensor.

Clicking the **Default** button resets the calibrated depth to the default value.

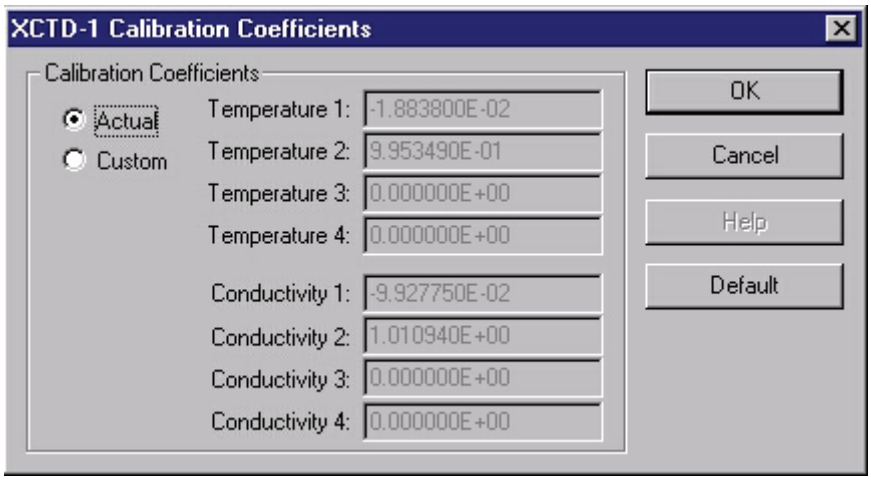
Clicking the **Update** button allows the user to update the calibrated depth from the corresponding CDP file, in which the eight-digit serial number of the probe is used for the filename of the CDP file. If the corresponding CDP file cannot be located automatically by the WinMK21, the user is prompted to search for the CDP file manually.

5.2.2.4 Probe Attributes - Calibration Coefficients

The *Calibration Coefficients* dialog allows the user to modify the data calibration coefficients used by WinMK21 to convert the raw data collected by the probe's sensors to engineering units. The calibration coefficients, which are only used for XCTD and LMP5-T1 (T-12) probes, are determined during the probe load sequence.

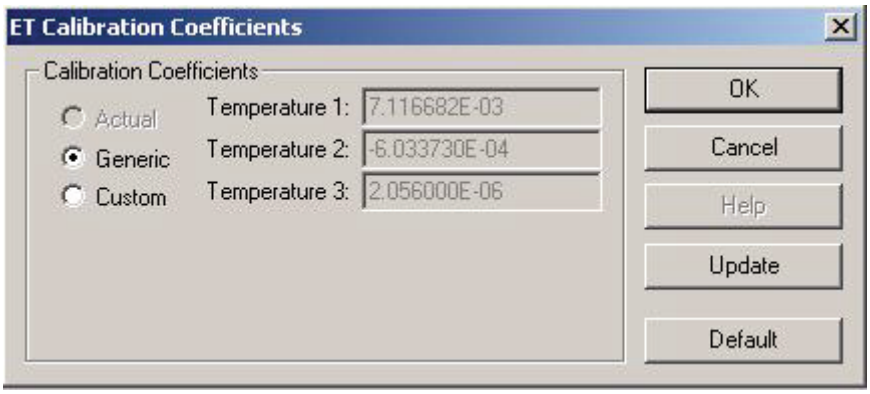
5.2.2.5 XCTD Calibration Coefficients

The Actual coefficients for the XCTD probes are defined during the probe load process directly from the EEPROM on the probe. If the Actual coefficients are not available from the EEPROM, you cannot continue with the data acquisition process. In Post Processing mode the user can enter Custom coefficients, however, this is not recommended unless otherwise instructed by Lockheed Martin Sippican. You cannot edit the Actual coefficients.



5.2.2.6 LMP5-T1 (T-12) Calibration Coefficients

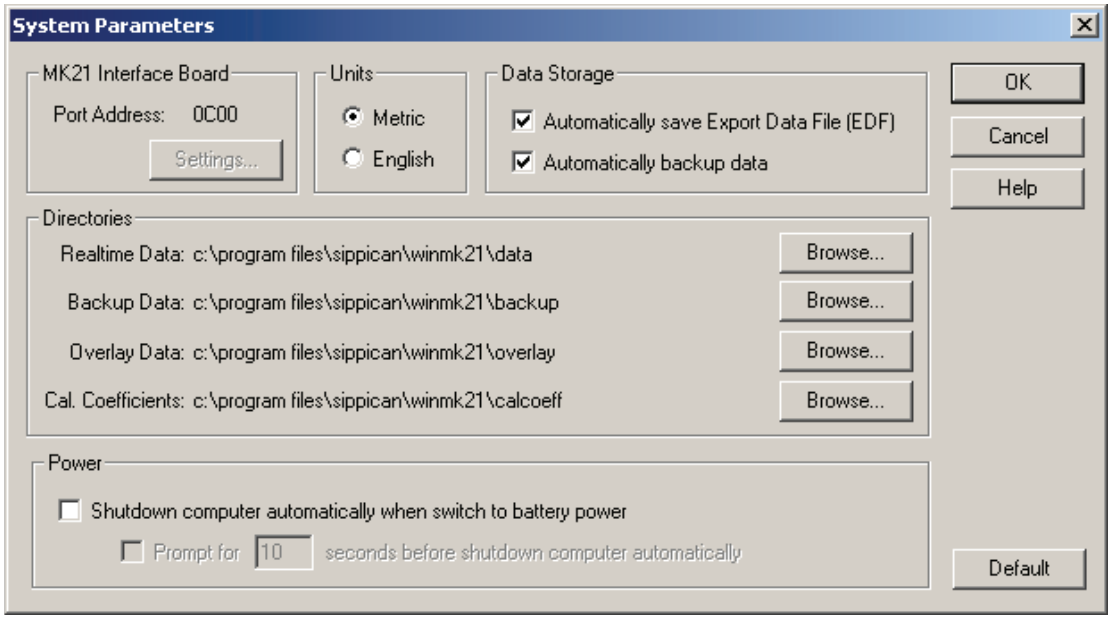
The user may select either Actual, Generic or Custom calibration coefficients for the temperature calibration coefficients. The Actual coefficients are defined during the probe load process from the probe's corresponding TCO file. If the Actual coefficients are not available, the user can elect to use Generic coefficients for the data acquisition process. The user can also enter Custom coefficients, however, this is not recommended unless otherwise instructed by Lockheed Martin Sippican. You cannot edit either the Actual or Generic coefficients.



Clicking the **Update** button allows the user to update the calibration coefficients from the corresponding TCO file, in which the eight-digit serial number of the probe is used for the filename of the TCO file. If the corresponding TCO file cannot be located automatically by the WinMK21, the user is prompted to search for the TCO file manually.

5.2.2.7 System Parameters

The system parameters include options to modify the MK21 interface board port address, select whether the data is to be displayed in metric units or English units, and determine the directories for the data storage, backup, overlays and calibration coefficients. Additionally, if the host computer runs on a battery, the automatic shutdown option can be enabled. Select *Options*, and then *System* to display the dialog for these options:



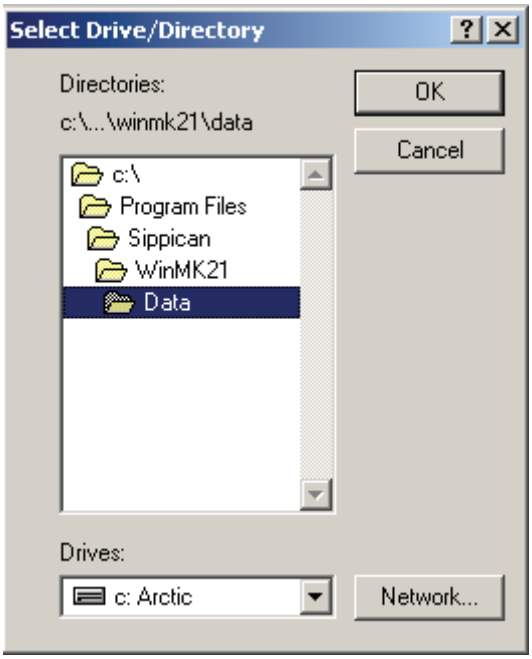
MK21 Interface Board. The port address may be changed by the WinMK21 application. Click the **Settings** button to display the *MK21 Interface Board Port Address* dialog to modify the port address. The user cannot modify the port address if the MK21 interface board is in Ready mode. A properly functioning MK21 interface board in Ready mode indicates that the port address is correct and that it does not need to be modified.

Under normal operating procedures changing the port address is not required. You should contact Lockheed Martin Sippican Sea-Air Systems Division technical support before changing the port address.

Units. To select the units in which the data is to be displayed, simply click either the **Metric** or the **English** option.

Directories. The program maintains a set of directories for the storage of Realtime Data (RDF and EDF), automatic Backup Data (RDF and EDF), Overlay Data and Calibration Coefficients. The user can select the directory by selecting the corresponding **Browse** button.

The following dialog will appear:



The user can select the directory by navigating through the directory structure until the desired directory has been found, and then clicking the **OK** button. The newly selected path will be displayed in the *System Parameters* dialog.

Data Storage. Select the **Automatically save Export Data File (EDF)** check box to automatically generate an additional export data file that will be stored in the designated data directory. Export files are recorded as text files using ASCII characters for use by other applications such as spreadsheets. The export file will be stored in the same directory as the associated raw data file, and under the same name, but with the extension *.edf* rather than the raw data file's *.rdf* extension.

Select the **Automatically backup data** check box to create a second raw data file that is written to the designated backup directory automatically. If the Export mode is currently selected, a second export data file will also be written to the backup destination.

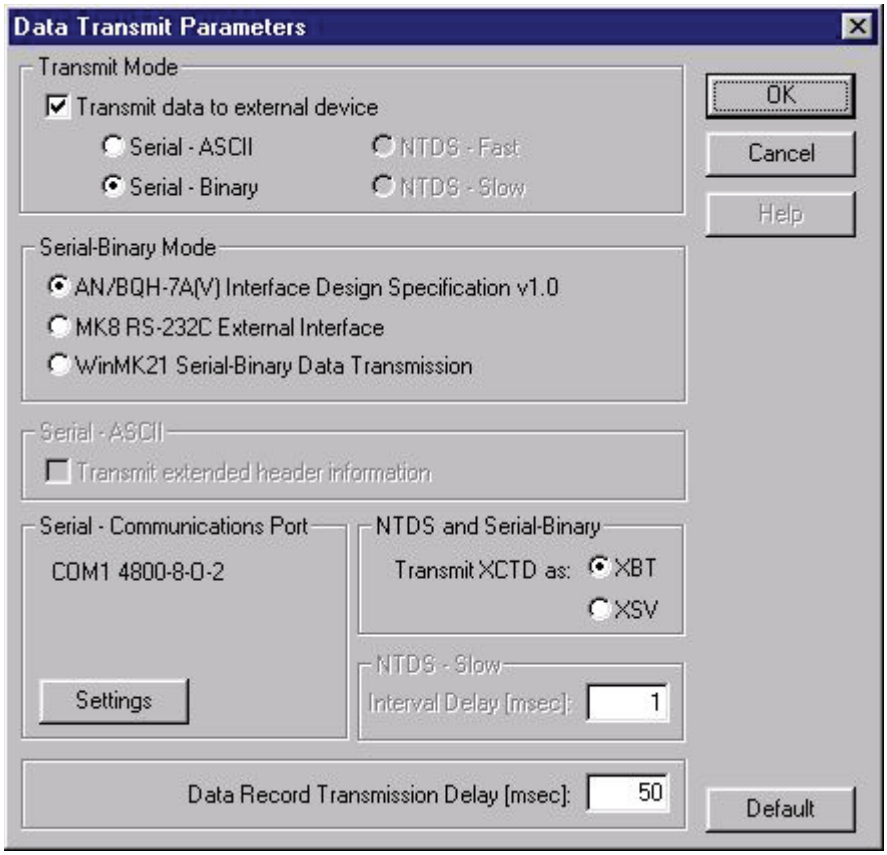
Power. Select the **Shutdown computer automatically when switch to battery power** check box to instruct WinMK21 to shutdown the WinMK21 application and the computer after a predetermined amount of time. A warning prompt can be displayed prior to the computer shutdown.

5.2.2.8 Data Transmit Parameters

The profile data may be transmitted to an external device via a serial port or an NTDS interface card. The profile data may be transmitted as follows:

Serial-ASCII:	ASCII profile data transmitted via serial port
Serial-Binary:	Proprietary binary data format based on NTDS protocol transmitted via serial port
NTDS-Fast:	NTDS protocol (proprietary binary data format) transmitted via NTDS-Fast interface card
NTDS-Slow:	NTDS protocol (proprietary binary data format) transmitted via NTDS-Slow interface card

To specify the type of external interface select *Options*, and then *Transmit*. The *Data Transmit Parameters* dialog will appear:



Enable Data Transmission. To enable data transmission, the box labeled **Transmit data to external device** must be selected. If this box is selected, the profile data from valid probes will be automatically transmitted to the selected external device at the completion of a probe drop. The user will always be prompted to confirm the data transmission. Select the transmit mode depending on the interface to the external interface. Various options may be set depending on the selected transmit mode.

All Transmit Modes. All transmit modes allow you to set the Data Record Transmission Delay. The transmission delay is used to control data flow as required. Some external readers cannot keep up with an uninterrupted data transmission either because their input buffer overflows or they are too slow. As a result, they will miss transmitted data. A variable transmission delay is a simple method to accommodate slower readers or readers with limited buffering capability. Setting the transmission delay will help control the data flow should timing between the WinMK21 and the receiver become a problem by adding a delay in milliseconds between each record that is transmitted.

Serial-ASCII Mode. The Serial-ASCII mode transmits the data via the serial port. The profile data from all probes may be transmitted in this mode. Click the **Settings** button in the **Serial - Communications Port** section to set the communications port settings. The *Communications Port Parameters* dialog will appear. The Serial-ASCII transmit mode can transmit an extended header prior to the profile data. The extended header information is similar to the header information in the Export Data Format (.edf) data file.

Serial-Binary Mode. There are three different protocols available for the Serial-Binary mode. For more information on the various protocols, see SECTION 7, “Serial-Binary Data Transmission Description.” The Serial-Binary mode transmits the data via the serial port. Click the **Settings** button in the **Serial - Communications Port** section to set the communications port settings. The *Communications Port Parameters* dialog will appear.

NTDS-Slow Mode. The NTDS-Slow mode transmits the data via an NTDS-Slow interface card. In order to remain compatible with existing systems, it may be necessary to specify an Interval Delay in milliseconds. The interval delay causes the NTDS-Slow transmission to pause between each byte in a data record transmission. The delay allows older NTDS readers enough time to read the data value before the next byte in the data record is transmitted.

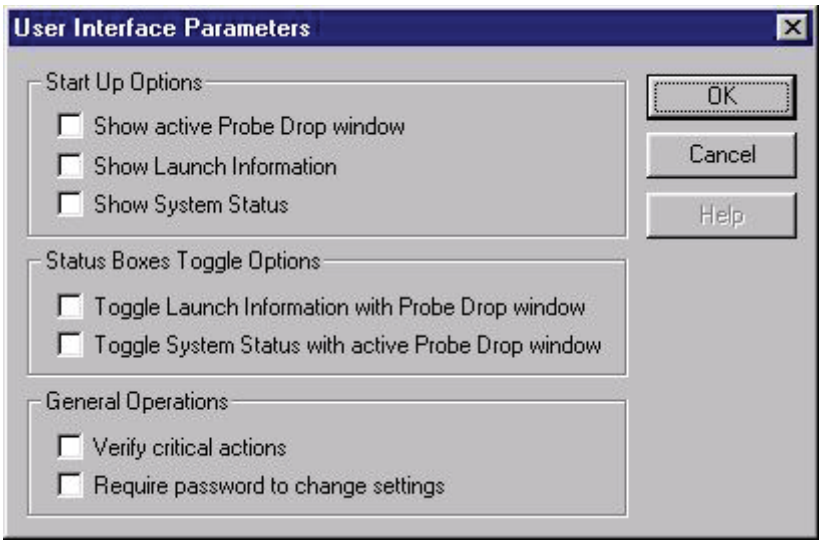
Valid Probes for Serial-Binary and NTDS Transmit Modes. The Serial-Binary, NTDS-Fast and NTDS-Slow modes transmit the data using a proprietary binary data format. The protocol only allows the profile data from specific probes to be transmitted as follows:

Serial-Binary:	T-4, T-5, T-6, T-7 and T-10 XBT and XSV-01 and XSV-02 XSV probes; however, not all of the listed probes are available for all Serial-Binary modes.
NTDS-Fast:	T-4, T-5 and T-7 XBT and XSV-01 probes.
NTDS-Slow:	T-7 probes only.

Since an XCTD has both temperature and sound velocity information, WinMK21 allows the profile data to be transmitted as XBT-like or XSV-like. When XCTD data is being transferred the operator will be asked to specify whether the XCTD data should be transmitted as XBT or XSV data. The operator is always prompted to specify the data format with the XCTD Transmit Format dialog; however, this setting is used to set the default selection.

5.2.2.9 User Interface Parameters

It is possible to control the display upon startup of the WinMK21 software. Click *Options*, and *User*, and the dialog shown below appears which displays the various display options at startup.

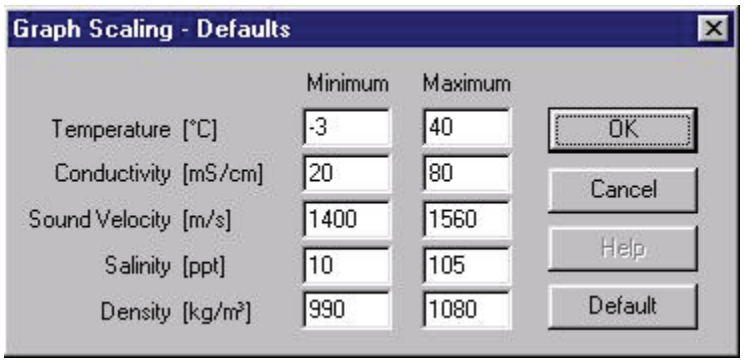


Clicking the check boxes in the section labeled **Start Up Options** will display the *Launch Information and System Status* dialog at startup. The check box labeled **Show active Probe Drop window** will automatically start the program in Data Acquisition mode when it is enabled. The **Status Boxes Toggle Options** enable/disable the display of both the active window with the *Launch Information* window whenever an active window is

launched, as well as the Real-Time Data Acquisition window with the System Status window whenever a new data acquisition is launched. **General Operations** allows the user to enable or disable verification of critical actions. The **Require password to change settings** option allows the user to protect system options with a password.

5.2.2.10 Graph Scaling - Defaults

The minimum and maximum default scaling values for the various profile displays can be modified prior to probe launch as well as after data acquisition. Click *Options*, and then *Scaling*, and the following dialog appears:

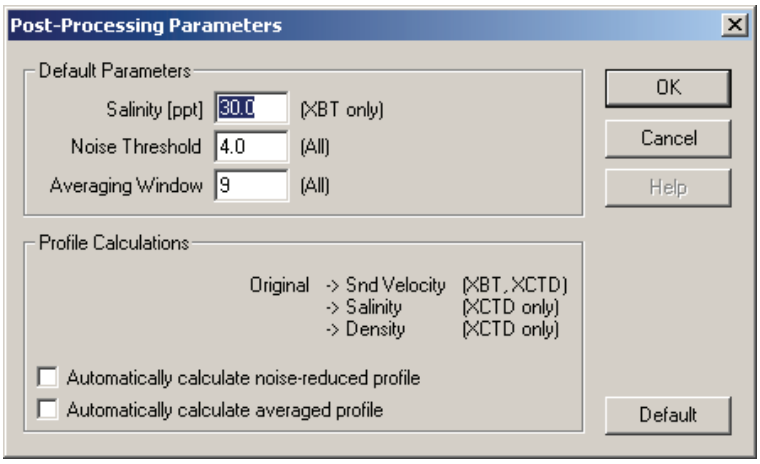


If the any of the values have been modified, clicking the **Default** button will return the values back to their associated defaults.

5.2.2.11 Post-processing Parameters

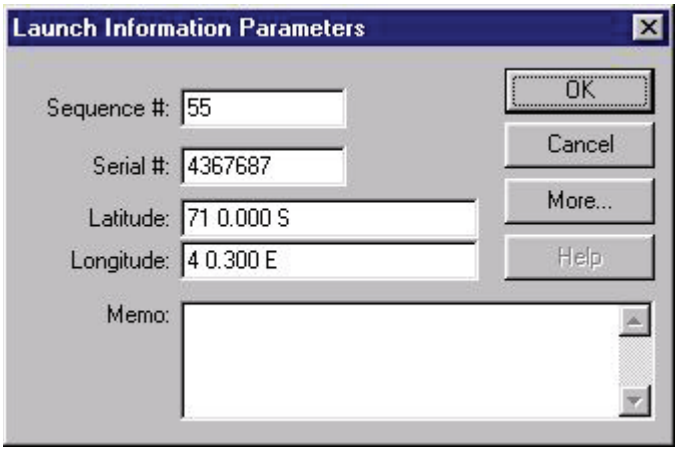
Noise spike removal and a moving average can be done to profiles. The noise threshold value and the number of points in the average are user selectable. Implementation of the noise spike removal and averaging can be selected to be automatic at the end of data collection. The *Post-processing Parameters* dialog allows the user to set the post-processing settings such as the default salinity for XBT sound velocity calculations, the noise threshold and averaging window and the automatic profile calculation settings.

Select *Options*, and then *Post-processing*. The dialog below displays the values used to do subsequent calculations with data profiles.



5.2.2.12 Launch Information Parameters

The *Launch Information Parameters* dialog displays the information related specifically to the currently active profile. Select *Options*, and then *Launch Information*, and the dialog appears as follows:



This dialog displays the:

Sequence #: The sequence number is initialized manually, but incremented automatically. Fill in the field labeled **Sequence #** to initialize this parameter.

Serial #: Each probe is assigned a unique serial number at the time of manufacture. The serial number must be entered manually for XBTs and XSVs. However, the serial number, which is stored on the probes' EEPROM, is entered automatically for XCTDs.

Latitude/Longitude: The latitude and longitude at which the probe is dropped can be defined by the user. The position information can be entered automatically by an external navigational device as outlined in the Navigation Input parameters.

Memo: A memo can be entered manually. Enter the desired text in the field labeled **Memo**. Note that typing the carriage return key or the enter key is similar to clicking the **OK** button. The cursor can be placed on a new line in this field by typing <*Ctrl*> *Return*, or <*Ctrl*> *Enter*.

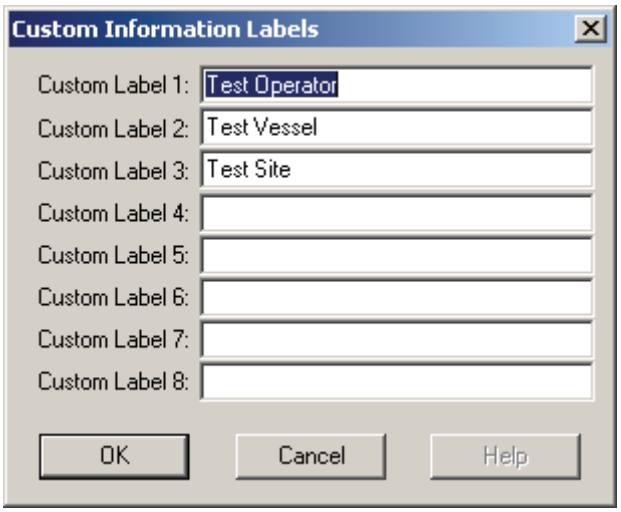
Custom Fields: Since some users might want to store additional information with each probe drop, it is possible to define up to eight custom parameters which can then be assigned values. A labeled field will appear in the *Launch Information* window for each parameter, and a value can then be entered according to the needs of the user.

5.2.2.13 Launch Information - Custom Information Labels

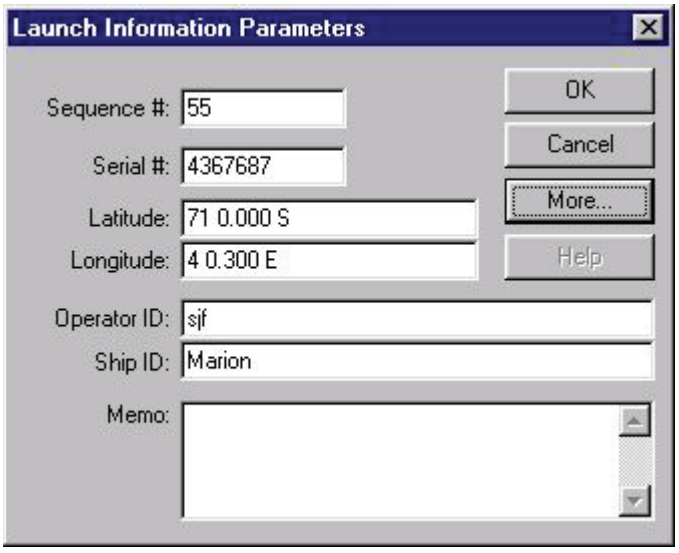
The *Custom Information Labels* dialog allows you to define additional custom labels to display user-specific information in the *Launch Information* window. Any new operator defined parameters, such as Operator ID and Station ID, appear in the *Launch Information Parameters* dialog.

To open the *Custom Information Labels* dialog, click the **More** button in the *Launch Information Parameters* dialog.

It is possible to define up to eight custom information labels which can then be assigned values. A labeled field will appear in the *Launch Information* window for each parameter, and a value can then be entered according to the needs of the user. Furthermore, the information recorded in these custom fields is included in the exported data files.



The value entered into each of the fields will serve as the label for an operator defined parameter. It is not necessary to enter a value for each of the fields in this dialog. If a value has been entered into only three fields, then there are likewise three operator defined parameters. Once the user is finished and the **OK** button has been clicked, the new operator-defined parameters appear in the *Launch Information Parameters* dialog as shown below:

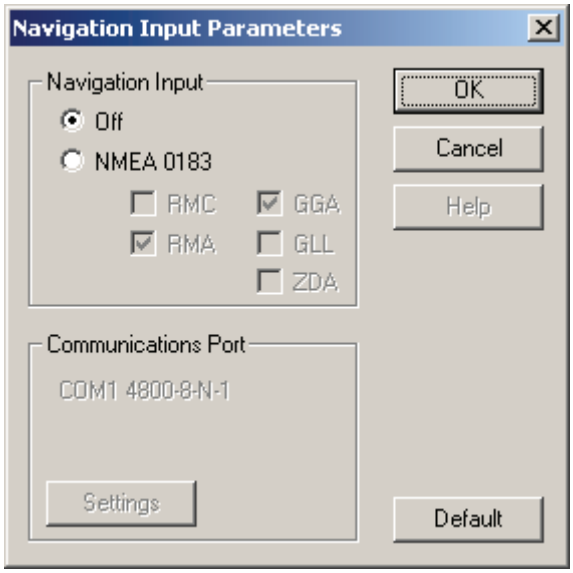


Now each parameter can be assigned a value, and that value is stored along with the data and all other information.

5.2.2.14 Navigation Input Parameters

The WinMK21 program is capable of accepting NMEA 0813 navigational information on a serial port. WinMK21 is a listener for NMEA 0813 talkers like a GPS or LORAN C, and accepts GGA, GLL, RMC, RMA and ZDA sentences. When any of the position-related NMEA 0183 sentences are received by WinMK21, the latitude and longitude information is displayed in the *Launch Information* window. The position quality is appended to the latitude (SPS Mode, Differential GPS, PPS Mode or "Fix not avail. or invalid"). Furthermore, if the time-related ZDA sentence is selected, the internal clock on the host computer is reset by the date/time of the contents of the ZDA sentence.

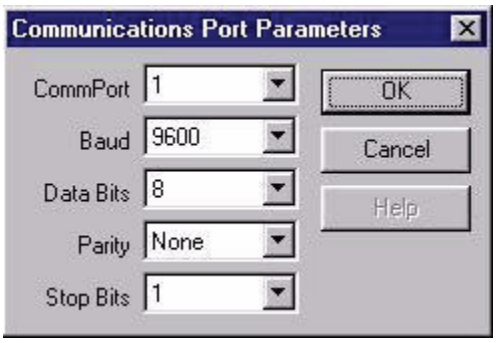
To enable Navigation Input, select *Options*, and then *Navigation Input*. The *Navigation Input* dialog is displayed as shown below:



Select the **NMEA 0183** option to enable the navigation input option. Select at least one of the NMEA 0183 sentences that is output by your navigational device so the WinMK21 can look at an incoming serial transmissions for the navigational information. Select the ZDA option if you want the internal clock on the host computer to be reset by the date/time of the contents of the ZDA sentence. The communications port settings are displayed in the **Communications Port** section. Click the **Settings** button to modify the settings. The *Communications Port Parameters* dialog will appear.

5.2.2.15 Communications Port Parameters

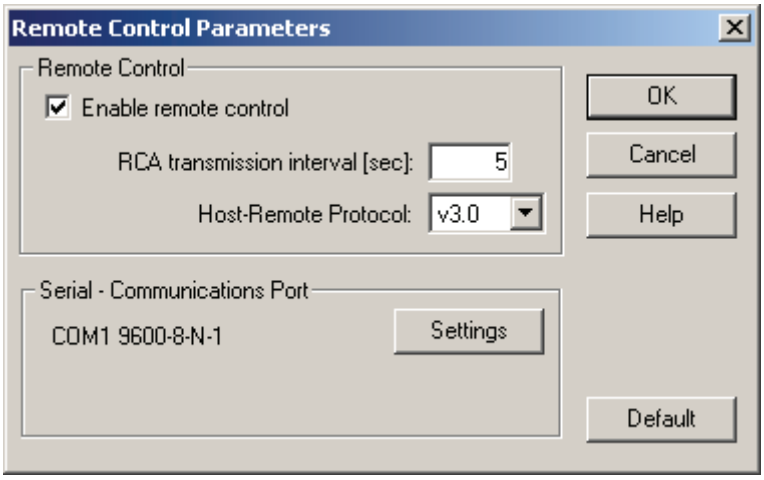
This dialog allows the operator to set the communications port number, baud rate, parity, and number of data and stop bits for a serial port. All WinMK21 options that make use of the serial ports, such as Data Transmit, Navigation Input and Remote Control, allow the operator to define the communications port using this dialog.



5.2.2.16 Remote Control Parameters

The WinMK21 program is capable of being used as a "remote" data acquisition system that is controlled by a "host" computer using the Host-Remote Communications Protocol. The Host-Remote Communications Protocol outlines a set of ASCII command, response and information sentences that are transmitted over an RS232/422 serial line.

The Host-Remote Communications Protocol is enabled from the *Remote Control Parameters* dialog. To open this dialog, select *Options*, and then *Remote Control*. The *Remote Control Parameters* dialog is displayed as shown below:



Under normal operating procedures the **Enable remote control** check box should be cleared, which disables this feature.

For more information about the Host-Remote Communications Protocol feature, contact Lockheed Martin Sippican Sea-Air Systems Division technical support.

5.2.3 Actions Menu

The *Actions* menu provides commands for initiating an action related to the operation of the MK21 interface board.

Terminate	Terminate the current the operation.
Accept XBP Prelaunch	Accept XBP prelaunch conditions.
MK21 I/O Board	Display pop-up menu for MK21 interface board operations.

5.2.3.1 Terminate

The *Actions*|*Terminate* command terminates the current operation. This menu item is only enabled when a Terminate operation is allowed. For example, the menu item is available during the data acquisition. Once the terminate operation is initiated, the user is informed that the data acquisition has been terminated. The program is then reset to a state in which it is simply checking for the presence of a probe in the launcher.

5.2.3.2 MK21 I/O Board

Selecting *MK21 I/O Board* from the *Actions* menu displays a popup menu that allow you to either manually initiate the MK21 interface board or set the MK21 interface board to Standby mode.

Initiate	Initiate the MK21 interface board.
Standby	Set the MK21 interface board to standby mode.

5.2.3.3 MK21 I/O Board - Initiate

After launching the software, the MK21 interface board is held in Standby mode. The MK21 interface board can be initialized automatically when the user proceeds into data acquisition, or as a separate event. After installing a MK21 interface board in a new machine, the user may want to manually initiate a MK21 interface board initialization to verify the board is functioning properly. To do this select *Actions*, then *MK21 I/O Board*, then *Initiate*. Initialization of the MK21 interface board takes about 7 seconds and is accompanied by "Detect MK21" and "Test MK21" messages. During this time the MK21 board is

- Confirmed to be detected at the address selected by the software settings, and
- Verified to pass internal diagnostic tests.

If the MK21 interface board should fail to be detected, the base address may be in conflict with some other process of the computer.

Contact Lockheed Martin Sippican Sea-Air Systems Division technical support if the MK21 interface board repeatedly fails one of the internal diagnostic tests.

5.2.3.4 MK21 I/O Board - Standby

After a successful initialization, the MK21 interface board is held in Ready mode even after a data acquisition has been completed. This is indicated by the Ready status shown in the *System Status* dialog. Select *Actions*, then *MK21 I/O Board*, then *Standby* to revert the the MK21 interface board back to Standby mode. However, it is not necessary for the MK21 interface board to revert to Standby mode. The MK21 interface board can safely remain in the Ready mode indefinitely.

5.2.4 Tools Menu

The *Tools* menu provides commands for the WinMK21 diagnostic feature, modifying fundamental profile attributes and for interacting with the hardware of the MK21 interface board and probes.

Diagnostic	Displays pop up menu for diagnostic feature.
Convert	Convert profile to alternative probe type
Read Probe EEPROM	Reads the contents of the EEPROMs on XCTD probes
Update Firmware	Updates the firmware of the MK21 interface board

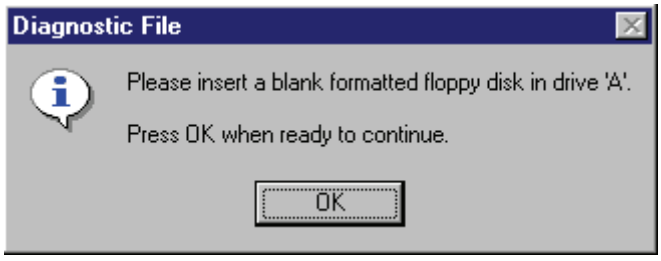
5.2.4.1 Diagnostic

The *Tools|Diagnostic* command provides commands for setting the diagnostic options.

Create File	Creates a diagnostic file.
Log to Disk	Toggle diagnostic log to disk feature.
Settings	Set diagnostic settings.

5.2.4.2 Diagnostic - Create File

The *Diagnostic/Create File* command allows the operator to easily generate a diagnostic file to send to the Lockheed Martin Sippican Sea-Air Systems Division technical support. The operator is prompted to insert a blank formatted floppy disk in drive ‘A’.

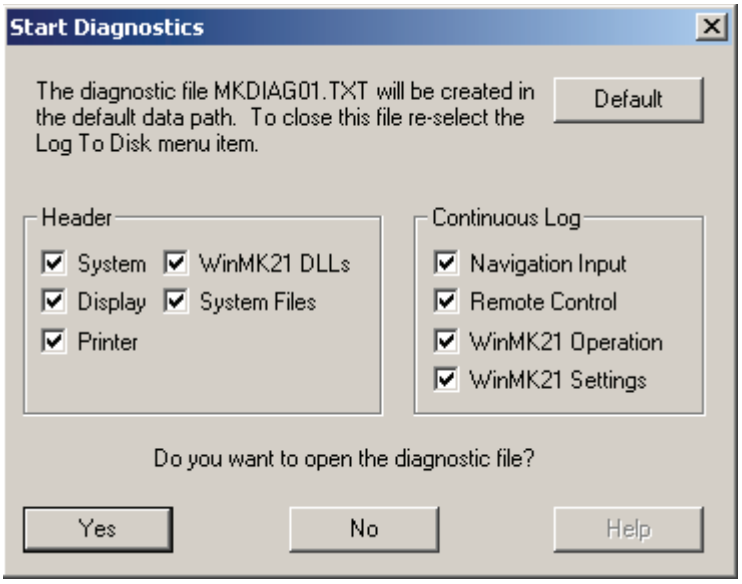


A diagnostics file, wmk_diag.txt, is written to the floppy disk. The diagnostic file is a simple ASCII text file that contains information concerning the operating system and the WinMK21 settings.

5.2.4.3 Diagnostic - Log To Disk

The *Diagnostic|Log to Disk* command is a feature which, when enabled, saves certain selectable information to a file on disk. This information can later be viewed by Lockheed Martin Sippican Sea-Air Systems Division technical support and assists in situations when either the MK21 interface board or the WinMK21 software does not seemed to be functioning properly. When enabled, a check mark will appear next to the menu item to indicate that the diagnostic information is currently being logged to disk. To stop writing the diagnostic information to disk, select this menu item again.

The *Start Diagnostics* dialog will appear. This dialog allows the user to select the items to be included in the diagnostic file header as well as items that are to be recorded continuously while the file is open.



The diagnostic information written to disk includes:

Header Information

System:	The current operating system and computer configuration
Display:	Video Display Configuration
Printer:	Printer configuration

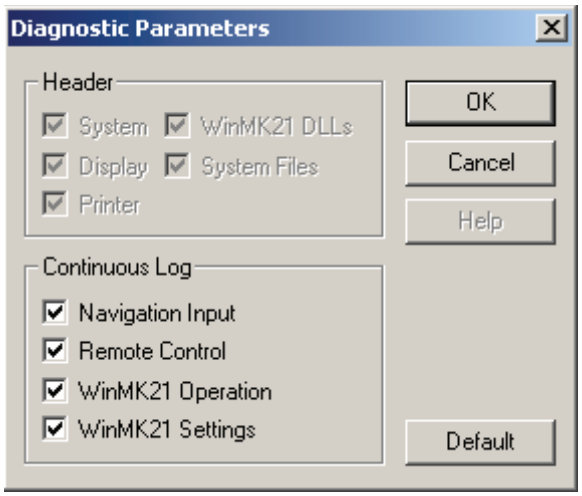
WinMK21 DLLs:	WinMK21 DLL version information
System Files:	WIN.INI and SYSTEM.INI files

Continuously Recorded Information

Navigation Input:	Serial input settings and navigational information
Remote Control:	Remote control information
WinMK21 Operation:	WinMK21 internal operations
WinMK21 Settings:	WinMK21 software settings

5.2.4.4 Diagnostic - Settings

If diagnostic information is already being recorded, then a dialog can be opened which allows the user to change what is being recorded to disk.



Header Information

System:	The current operating system and computer configuration
Display:	Video Display Configuration
Printer:	Printer configuration
WinMK21 DLLs:	WinMK21 DLL version information
System Files:	WIN.INI and SYSTEM.INI files

Any Header Information item that has already been written to the file will be gray. This indicates that this item cannot be removed from the header information once it has been written to disk.

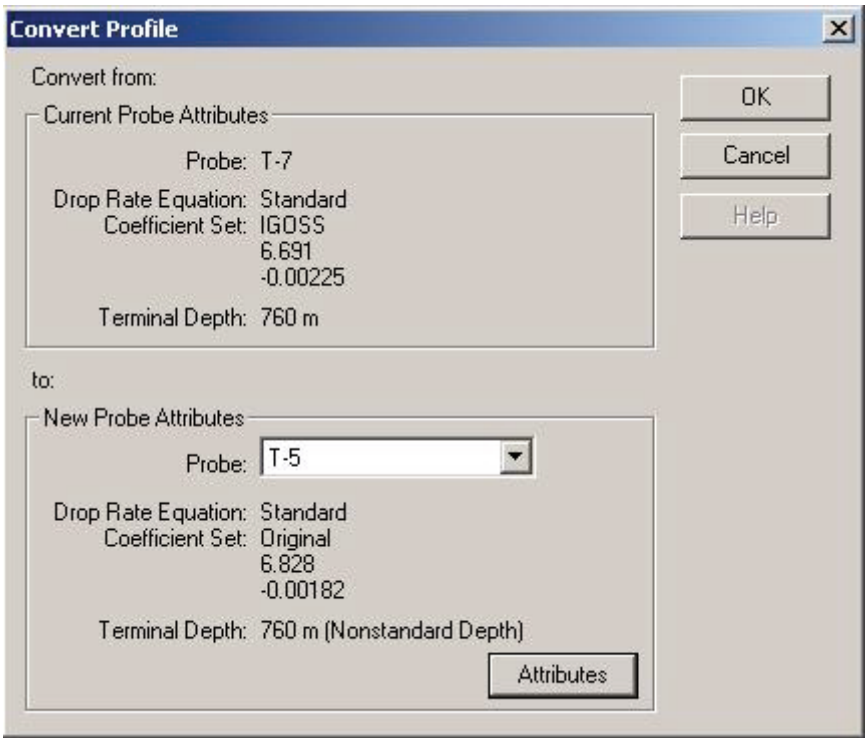
Continuous Recording

Navigation Input:	Serial input settings and navigational information
Remote Control:	Remote control information
WinMK21 Operation:	WinMK21 internal operations
WinMK21 Settings:	WinMK21 software settings

5.2.4.5 Convert

The *Convert* tool allows the operator to change the probe type of an existing data file. On occasion a probe is dropped with the incorrect probe type specified in the WinMK21 application. This can occur because all of the probes for each group share the same electrical characteristics. For example, the WinMK21 application is unable to distinguish the difference between a T-4 and a T-10. All XBT probes are treated the same by the data acquisition process in the WinMK21 application. However, it is important to specify the correct probe type since each probe within the probe group has unique drop rate coefficients which directly impact the depth calculation for the collected data. Furthermore, each probe has a unique terminal depth which determines the end of the data collection process.

To convert a profile, select *Tools* and then *Convert* from the menu bar. The *Convert Profile* dialog is displayed for the active profile.



The current probe attributes are listed in the top section. The new probe attributes are listed in the bottom section. Compatible probe types are listed in the **Probe** selection box. The operator can only convert to a probe type that has compatible electrical characteristics. For example, it is not possible to convert a T-10 to an XSV-01. Upon selection of a compatible probe type, the probe attributes are listed in the bottom section. The terminal depth of the current probe attributes are maintained for the new probe attributes.

Click the **Attributes** button to specify custom probe attributes for the new probe type.

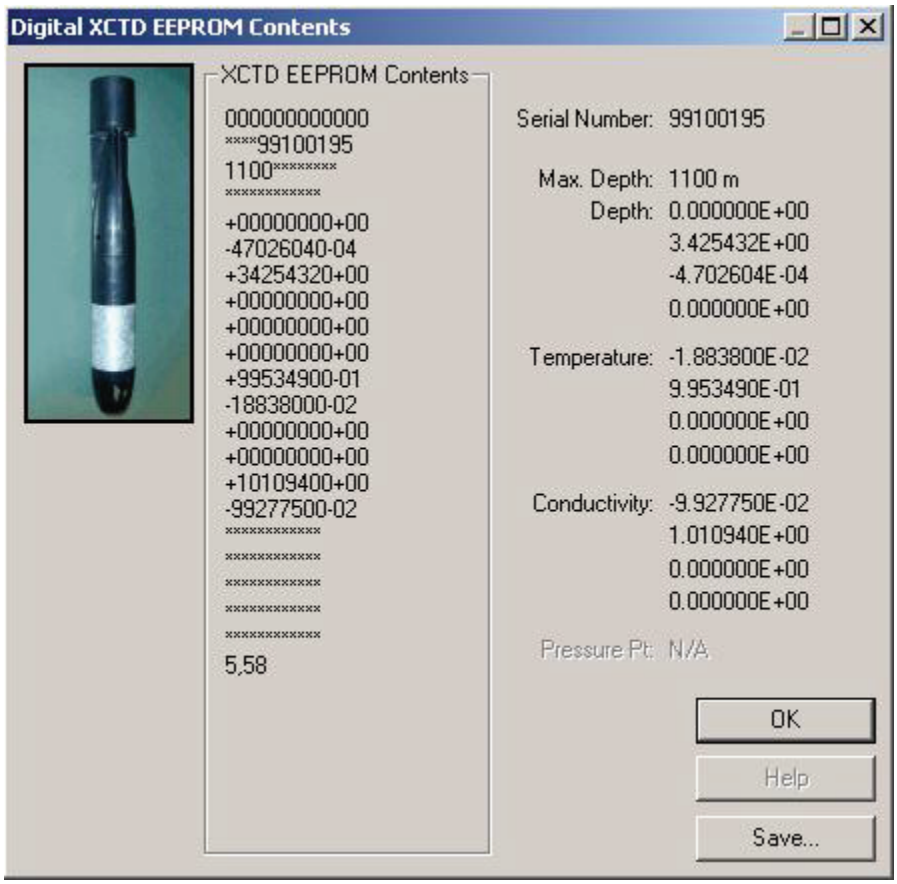
Upon selecting the **OK** button, the profile is converted to the new probe type, with the specified probe attributes. The filename is also converted using the correct prefix for the new probe type. However, the operator must resave the file to disk.

5.2.4.6 Read EEPROM (XCTD Probes only)

The Read EEPROM tool reads the contents of the EEPROM on the XCTD probes. If the active probe is an XCTD probe, then the Read EEPROM tool will attempt to read the contents of the currently active probe. The active probe is set using the Probe Selection dialog. Normally the acquisition and utilization of the contents of the probe EEPROM happens at the beginning of each launch, and is completely transparent to the user. This feature can be used as a prelaunch verification check to ensure the system integrity (computer, launcher, cable connections, and probe) prior to launching the probe.

The sensors on the XCTD probes are individually calibrated. The calibration coefficients are stored on the EEPROM of each probe and are used by the WinMK21 application to convert the sampled data into temperature and conductivity values. The XCTD maintains four temperature and four conductivity calibration coefficients. Furthermore, the EEPROM on the XCTD probes contains the serial number, drop rate coefficients and terminal depth for the probe.

Save EEPROM Contents. Click the **Save** button to save the EEPROM contents to disk in ASCII text format. The user will be prompted to specify the filename and location for the resulting text file.



5.2.4.7 Identifying the Current Firmware Version

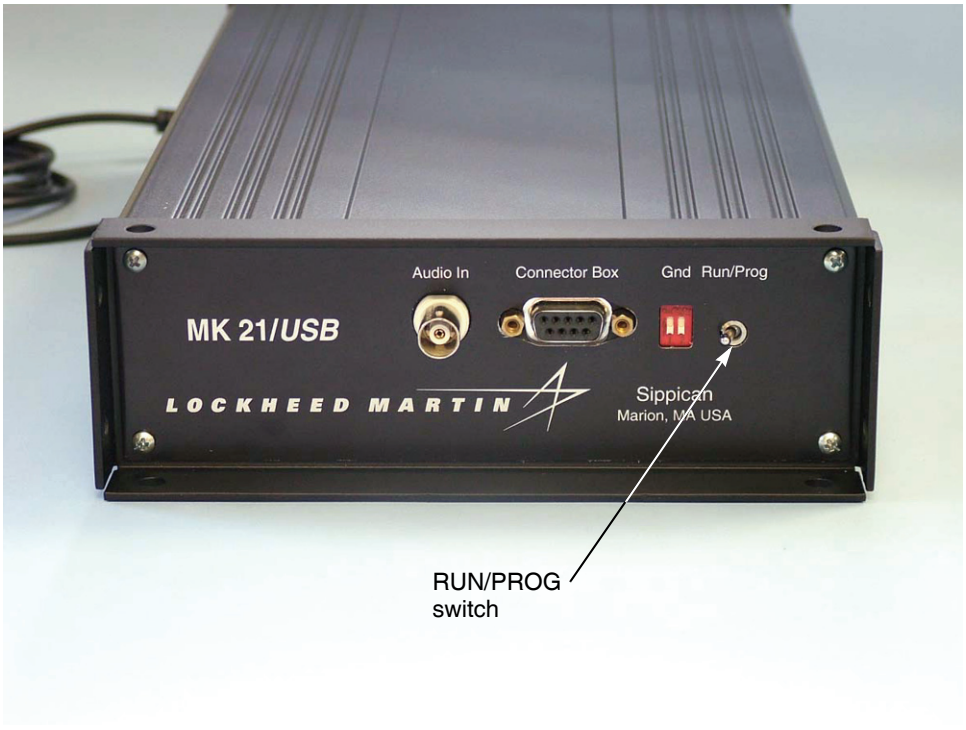
The version of firmware resident on a MK21 interface board is identified by the date. To obtain the version date, select *Help*, then *About*, then *MK21 I/O Board*. The *About MK21 Interface Board* dialog will be displayed. The version date is specified under **Firmware Id.** If the **MK21 I/O Board** button in the *About WinMK21* dialog is grayed out, the MK21 interface board needs to be initialized. To do this, select *Actions*, then *MK21 I/O Board*, then *Initiate*. Then repeat the previous procedure to obtain the Firmware Id.

5.2.4.8 Update Firmware

The MK21 interface board firmware can be updated by the user. This should only be done when a new release of the firmware has been made available by Lockheed Martin Sippican. The process for updating the firmware is simple; however, there are several safeguards in place to prevent the possibility of inadvertently erasing the existing firmware on the MK21 interface board. This feature will be used only when new firmware has been provided by Lockheed Martin Sippican to add additional capability to the software, or fix a problem that has been identified to be repairable with a firmware change.

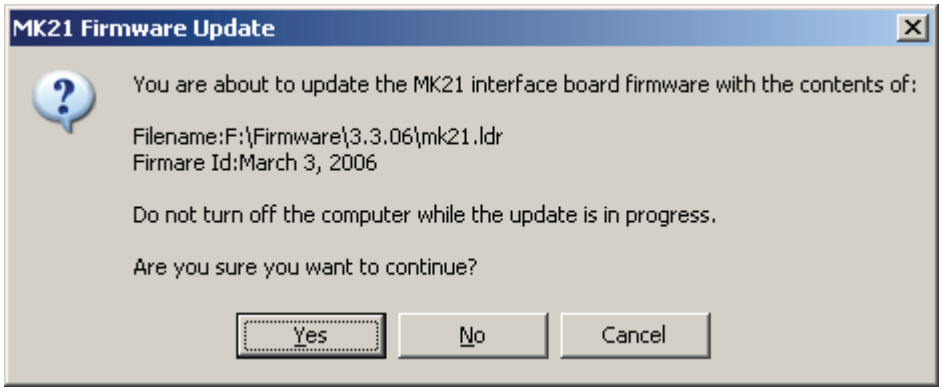
To update the firmware:

1. Obtain the MK21 firmware update file from Lockheed Martin Sippican. This is a file identified with an *.ldr* extension. It may be on a floppy disk, or copied to any disk space accessible by the WinMK21 program.
2. Select the *Update Firmware* menu item from the *Tools* menu. Using the browser, select the LDR firmware update file discussed in the previous step.



3. The MK21 Firmware Update window prompts the user to set the RUN/PROG switch to PROG. This switch is the 2-position toggle switch on the edge connector of the MK21 interface board located above the DB-9 launcher cable connector and the red/white DIP switch. The toggle switch can also be accessed from the front panel of the desktop unit. Toggle the switch in the direction away from the DB-9 launcher cable connector.
4. Click **OK** to proceed with the download.

5. At this point, the update procedure will require you to confirm the desire to continue with the firmware update using the specified LDR file. The version of selected firmware update as identified by the date is displayed. This is the last chance to cancel the firmware update procedure. Answer **Yes** to proceed with the firmware update. If you select either **No** or **Cancel**, the operation will be cancelled.



6. The firmware update will now be performed. The update process takes several minutes, during which time a progress dialog is displayed.

CAUTION *Do not try to perform any other action with the computer during the update. Do not turn off the computer while the update is in progress. Otherwise, the firmware on the MK21 interface board may become corrupted and MK21 interface board may become inoperable.*

7. Once the update is completed, the *MK21 Firmware Update* window prompts the user to set the RUN/PROG switch back to RUN. At this time toggle the switch back to its original position, in the direction towards the DB-9 launcher cable connector. Select **OK**.
8. The update procedure now indicates that the update has been completed, and confirms that the RUN/PROG switch has been set to the RUN position properly.

5.2.5 Profile Menu

The *Profile* menu provides commands for setting the profile display options. The *Profile* menu item is only available when the *Real-time Data Acquisition* window is open, or a previously acquired profile is being displayed.

Scaling	Displays pop-up menu for scaling settings.
Tabular Data	Toggle display of *Tabular Data* dialog for the current profile.
Original	Display the acquired unfiltered data.
Noise	Display the noise reduced data.
Averaged	Display the averaged data.
Salinity	Display the derived salinity data.

Sound Velocity	Display the derived sound velocity data.
Density	Display the derived water density data.
Pressure Pt	Displays pop-up menu for pressure point settings.
Overlay	Displays pop-up menu for overlay settings.
Launch	Displays pop-up menu for XSV launch settings.
XBP	Displays pop-up menu for XBP settings

5.2.5.1 Scaling

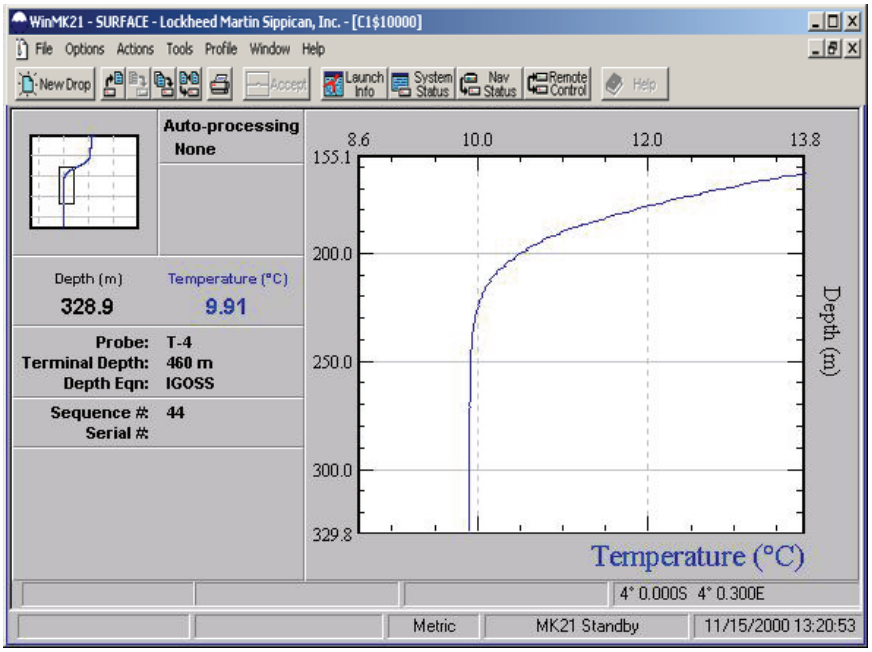
The *Scaling* pop-up menu provides commands for setting the scaling options for the current profile.

Default	Set the current profile scaling values to default values.
Auto	Set the current profile scaling values automatically.
Zoom Out	Zoom out from the current profile scaling settings.
Set	Set profile scaling settings.

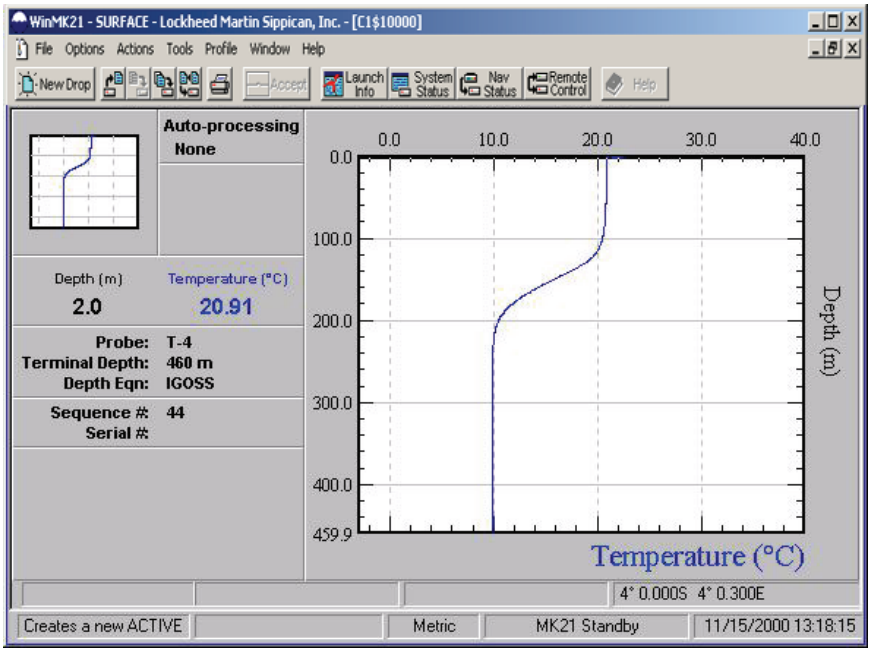
5.2.5.2 Default Scaling

The *Scaling*|*Default* command sets the current profile scaling values to default values. The default scaling values are set by the *Scaling Parameters* dialog, accessed either by the *Options*|*Scaling* or *Scaling*|*Set* menu items.

If the profile has been zoomed, it appears as follows:

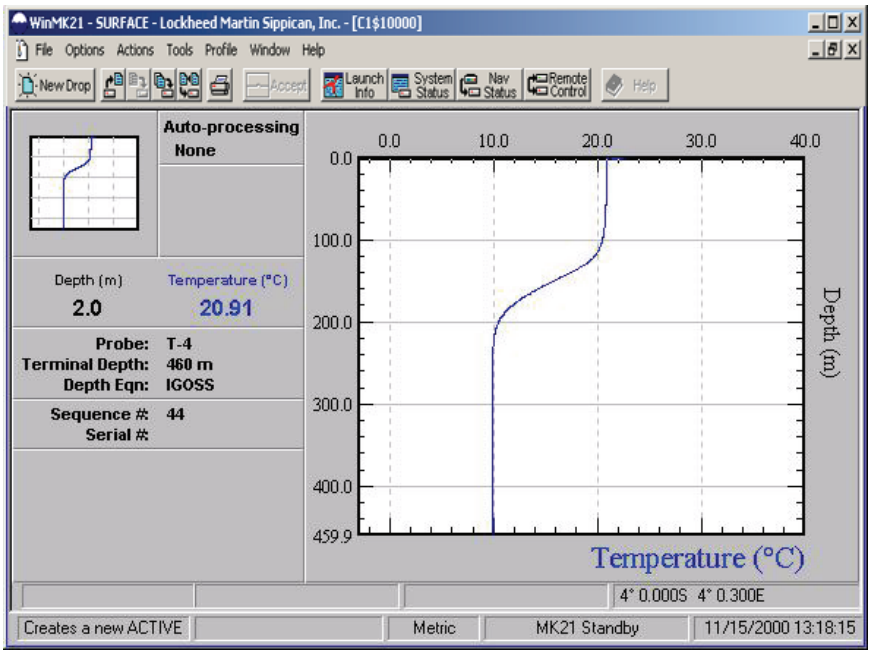


Selecting the *Default* menu item from the *Profile|Scaling* menu redraws the profile as follows:

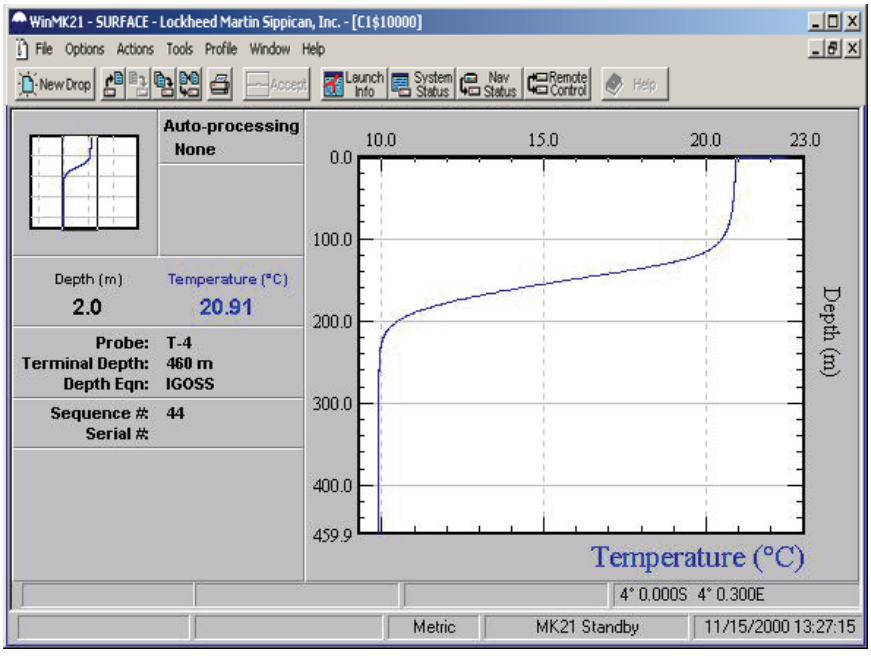


5.2.5.3 Auto Scaling

The *Scaling|Auto* command sets the current profile scaling values based on the minimum and maximum values of the profile data. A default profile appears as follows:

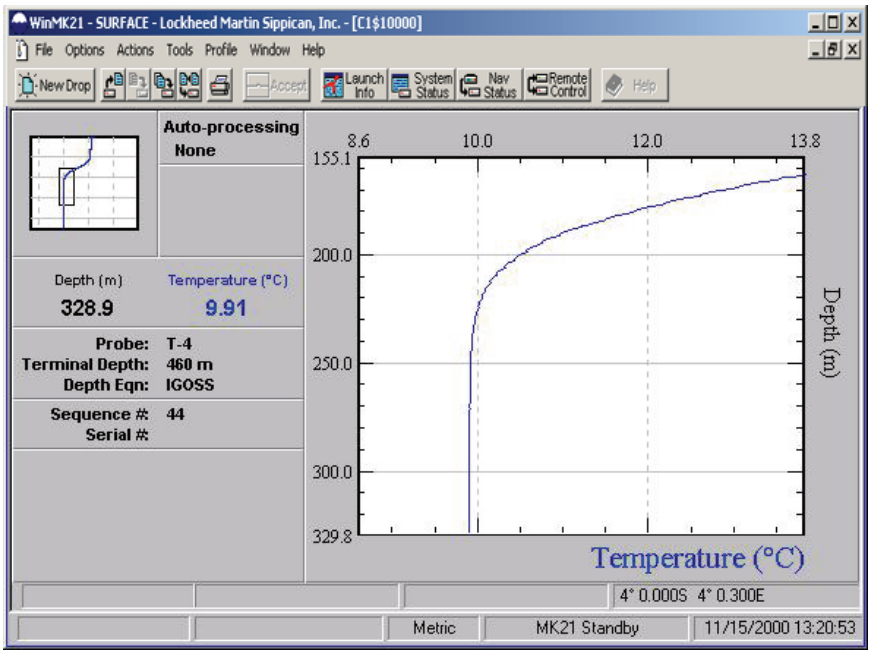


Selecting the *Auto* menu item from the *Profile|Scaling* menu redraws the profile:

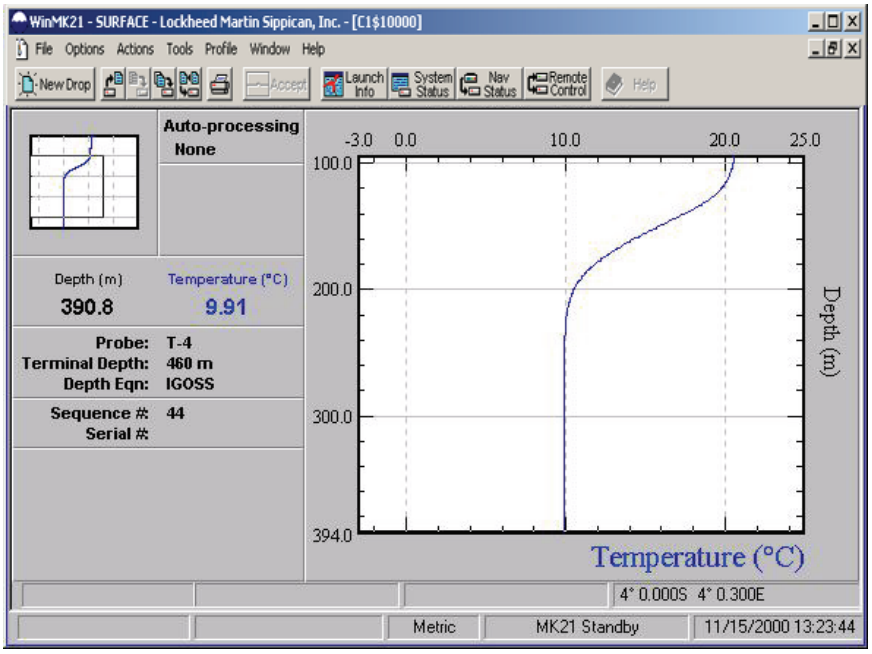


5.2.5.4 Zoom Out Scaling

The *Scaling|Zoom Out* command in the Scaling menu will expand the view of the current profile by doubling the current scaling values. A zoomed profile appears as follows:



Selecting the *Zoom Out* menu item from the *Profile|Scaling* menu redraws the profile:

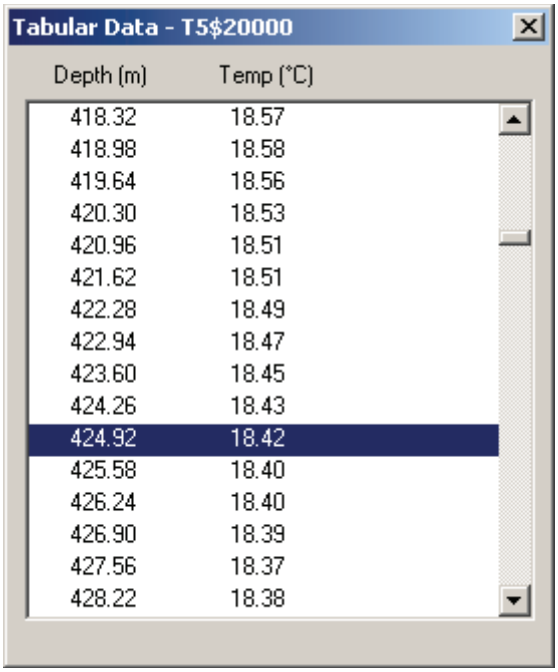


5.2.5.5 Set Scaling

The *Scaling*|*Set* command displays the *Graph Scaling - Defaults* dialog so you can set the minimum and maximum default scaling values for the various profile displays. This dialog is also accessed by the *Options*|*Scaling* menu item.

5.2.5.6 Tabular Data

The *Profile*|*Tabular Data* command toggles the display of the *Tabular Data* window. This dialog displays the profile data in a tabular format listed sequentially by depth. A check mark will appear next to the menu item to indicate the dialog for the active profile is currently visible. This dialog is shown below.



5.2.5.7 Original Profile

The original profile is a trace of the acquired and unfiltered data. To display the original profile select the *Original* menu item from the *Profile* menu. This action rewrites the original trace to the graphical display, retaining the current scaling. The acquired data is as follows for the different probes:

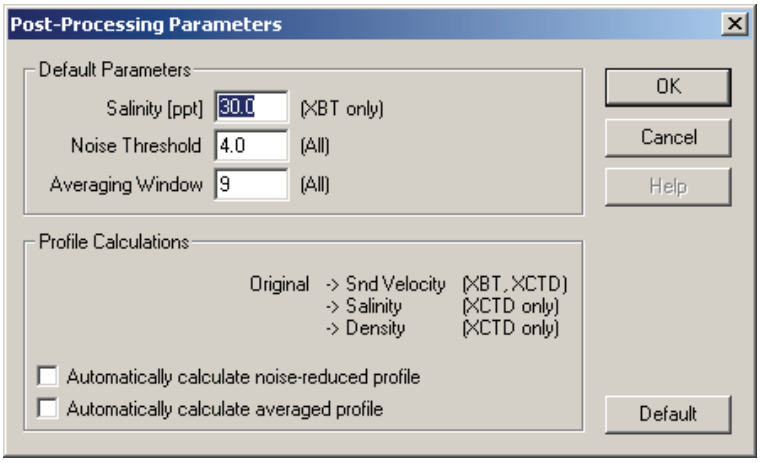
XBT:	Temperature
XSV:	Sound Velocity
XCTD:	Temperature and Conductivity

5.2.5.8 Noise Reduced Profile

The Noise Reduced profile is a trace of the data with the noise spikes removed. To display the noise reduced profile select the *Noise* menu item from the *Profile* menu. This function rewrites the trace while retaining the current scaling of the graphical display.

This function is performed by scanning each individual data point, and comparing the value of that data point with the value of the previous data point. If the difference between these two values is greater than the Noise Spike Threshold defined in the *Post-Processing Parameters* dialog, the current data point will be removed from the Noise Reduced profile. Subsequent data points are also compared to the last acceptable data point, and removed if their differences exceed the threshold. As the trace continues to be examined, the reference point is advanced when the difference drops below the threshold. After the trace is complete, there is a note in the Post-processing section of the profile window showing the percentage of points removed. For the XCTD probe, both data sets (conductivity and temperature) are processed in parallel. If either data set has a value which is suspect, then that data point is removed from both profiles.

The removal of data points can be influenced through the Noise Spike Threshold as defined in the *Post-processing Parameters* dialog. Select *Options*, and then *Post-Processing* to display the *Post-processing* dialog.



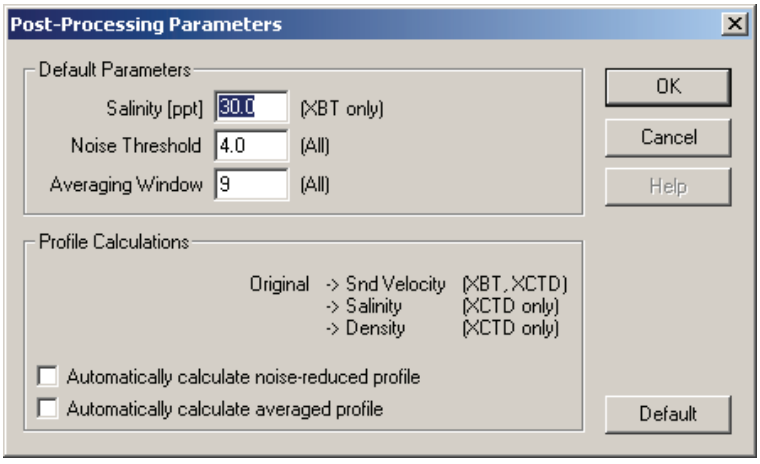
The value in the field labeled **Noise Threshold** defines the difference between data point values at which that data point will be removed. Simply enter a new value into this field to define a new threshold. Note that if the entered threshold value is too small, large voids can result in the display as groups of valid data points will be removed. Also note that this function does not modify the raw data file.

5.2.5.9 Averaged Profile

The Averaged profile is a trace of the data with the data averaged. To display the averaged profile select the *Average* menu item from the *Profile* menu. This function rewrites the trace while retaining the current scaling of the graphical display.

The WinMK21 application can optionally create a Noise Reduced profile first. Then the value of each remaining data point is averaged using a variable averaging window.

The averaging of data points can be influenced through the **Averaging Window** as defined in the *Post-processing Parameters* dialog. Select *Options*, and then *Post-Processing* to display the *Post-processing* dialog.



Enter a valid odd number in the **Averaging Window** field to change the number of values used in generating the Averaged profile. If the **Automatically calculate Noise-Reduced Profile** option has been selected in the *Post-processing Parameters* dialog, the acquired data will be automatically noise-reduced using the current settings before the data is averaged. Also note that this function does not modify the raw data file.

5.2.5.10 Salinity Profile

The Salinity profile provides computation and display of salinity. This profile display option is only available for XCTD probes. To display the salinity profile select the *Salinity* menu item from the *Profile* menu. This function rewrites the trace while retaining the current scaling of the graphical display. If the automatic post-processing options have been activated in the *Post-Processing Parameters* dialog, the acquired data will be automatically noise-reduced and/or averaged using the current settings before the salinity profile is derived.

The equation used to calculate salinity as a function of measured temperature, conductivity and depth is defined by the 1978 Practical Salinity Scale (PSS-78).[1, 2, 3]

5.2.5.11 Sound Velocity Profile

The *Profile|Sound Velocity* command computes and displays the derived sound velocity data in the graphical display. This profile display option is available for both:

XBT probes	Using the acquired temperature data and a default salinity value as set in the *Post-Processing Parameters* dialog.
XCTD probes	Using the acquired temperature and conductivity data.

If the automatic post-processing options have been activated in the *Post-Processing Parameters* dialog, the acquired data will be automatically noise-reduced and/or averaged using the current settings before the sound velocity profile is derived. The spike removal threshold, the percentage of data points that have been deleted and the size of the averaging window are displayed in the Post-processing section of the profile window.

The equation used to calculate sound velocity, often known as the UNESCO algorithm, is due to Chen and Millero.[4] For the original UNESCO paper see Fofonoff and Millard (1983).[5]

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1. UNESCO Technical Papers in Marine Science, #36 (1981a) “The Practical Salinity Scale 1978 and the International Equation of State of Seawater 1980,” UNESCO Division of Marine Sciences (Paris), 25pp.
2. UNESCO Technical Papers in Marine Science, #37 (1981b) “Background papers and supporting data on the practical salinity scale, 1978,” UNESCO Division of Marine Science (Paris), 144pp.
3. 1978 Practical Salinity Scale Equations (January 1980) IEEE Journal of Oceanic Engineering, OE-5 No. 1, p. 14.
4. C-T Chen and F.J. Millero, Speed of sound in seawater at high pressures (1977) J. Acoust. Soc. AM. 62(5) pp. 1129-1135.
5. N.P. Fofonoff and R.C. Millard Jr., UNESCO Technical Papers in Marine Science, #44 (1983) “Algorithms for computation of fundamental properties of seawater,” UNESCO Division of Marine Science (Paris) 53pp.

5.2.5.12 Density Profile

The *Profile|Density* command computes and displays the derived water density data in the graphical display. This profile display option is only available for XCTD probes.

If the automatic post-processing options have been activated in the *Post-processing Parameters* dialog, the acquired data will be automatically noise-reduced and/or averaged using the current settings before the water density profile is derived. The spike removal threshold, the percentage of data points that have been deleted and the size of the averaging window are displayed in the Post-processing section of the profile window.

The equation used to calculate density is defined in the UNESCO paper attributed to Fofonoff and Millard (1983).[1]

5.2.5.13 Pressure Point - Overview

The *Pressure Point* pop-up menu provides commands for setting the pressure point trigger depth for the current profile.

Set	Manually set the location of the pressure point signature at the current profile marker.
Remove	Manually remove the trigger depth indicating the pressure point signature.
Auto-Find	Automatically search the probe data for the pressure point signature.

5.2.5.14 Pressure Point - Set

Select the *Set* menu item from the *Profile|Pressure Pt* menu to manually set the location of the pressure point signature. The trigger depth for the pressure point will be set to the current depth as indicated by the profile marker.

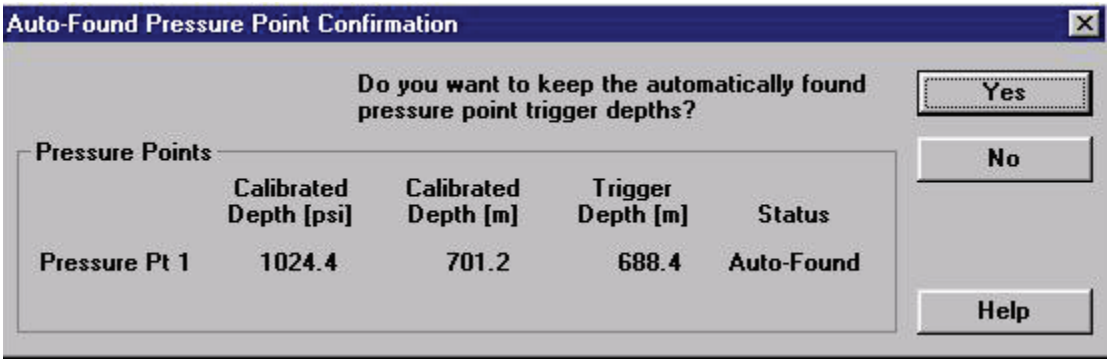
The *Profile*, *Pressure Point*, *Set* menu item is only available if the current probe is pressure point enabled and the calibrated depth of the pressure point has been properly defined. Only LMP5-T1 (T-12) probes are pressure point enabled. The calibrated depth of the pressure point is read from a CDP file.

1. N.P. Fofonoff and R.C. Millard Jr., UNESCO Technical Papers in Marine Science, #44 (1983) “Algorithms for computation of fundamental properties of seawater,” UNESCO Division of Marine Science (Paris) 53pp.

To define the calibrated depth of the pressure point, select the *Attributes* menu item from the *Options|Probe* menu. The *Probe Attributes* dialog will appear. If the probe is pressure point enabled the **Pressure Pt.** button is enabled. Click the **Pressure Pt.** button to display the *Pressure Point* dialog. The user can now define the calibrated depth of the pressure point for the current probe.

5.2.5.15 Pressure Point - Auto-Find

Select *Profile*, *Pressure Pt*, and then *Auto-Find* from the menu bar to automatically set the location of the pressure point. WinMK21 will search the probe data for the pressure point signature. The results of the search are displayed in the *Auto-Found Pressure Confirmation* dialog.



If the user confirms a successful search, the profile data is redrawn with the new corrected depths. The pressure point signature will be displayed at the calibrated depth and all the other probe depths will be adjusted accordingly.

5.2.5.16 Pressure Point - Undo

Select *Profile*, *Pressure Pt*, and then *Undo* from the menu bar to manually remove the trigger depth for the pressure point. This action effectively clears any existing pressure point correction to the depth equation.

The *Profile*, *Pressure Point*, *Undo* menu item is only available if the current probe is pressure point enabled and both the calibrated and trigger depth of the pressure point have been properly defined. Only LMP5-T1 (T-12) probes are pressure point enabled.

5.2.5.17 Overlay - Overview

An overlay allows you to multiple profiles from previous launches on the graphical display, but does so using a lighter color than the current profile. The number of overlay profiles is indicated in the caption bar of the profile window. In some cases an overlay may not be able to draw a matching profile. The probe data in the overlays must be able to automatically calculate the matching data set in order to draw the overlay profiles. For example, the data from an XSV probe drop cannot be used as an overlay for an XBT because the matching temperature profile cannot be derived automatically from the XSV data. As another example, the data from an XBT probe drop can be used as a partial overlay for an XCTD-1 probe because at least the matching temperature profile is available in the XBT data. The *Overlay* menu provides commands for adding and removing overlays for the current profile.

Add	Add an overlay profile.
Remove	Remove the most recently added overlay profile.
Remove All	Remove all of the added overlay profile.

5.2.5.18 Overlay - Add

Select *Profile*, *Overlay*, and then *Add* from the menu bar to add an overlay profile to the current profile. A dialog will appear which prompts the user to select an RDF data file of a previous launch. Once the file is selected, the overlay profile is drawn in the graphical display using a lighter color than the current profile. Furthermore, the number of overlay profiles is indicated in the caption bar of the profile window.

5.2.5.19 Overlay - Remove

Select *Profile*, *Overlay*, and then *Remove* from the menu bar to remove the most recently added overlay profile from the current profile. This menu item is only available if an overlay has been added for the current profile.

5.2.5.20 Overlay - Remove All

Select *Profile*, *Overlay*, and then *Remove All* from the menu bar to remove all of the added overlay profiles from the current profile. This menu item is only available if an overlay has been added for the current profile.

5.2.5.21 Launch - Overview

The *Launch* pop-up menu provides commands for manually setting the launch of the current XSV profile. This option is only available for the XSV profile.

Set	Manually set the location of the XSV launch.
Undo	Remove the manual launch setting.
Auto-Find from Marker Line	Automatically search the probe data for the launch signature descending from the current marker line location.

5.2.5.22 Launch - Set

Select the *Set* menu item from the *Profile*|*Launch* menu to manually set the location of the XSV launch. The XSV launch will be set to the current depth as indicated by the profile marker. Only XSV probes allow you to modify the launch.

5.2.5.23 Launch - Undo

Select *Profile*, *Launch*, and then *Undo* from the menu bar to remove the manual launch setting. This action effectively clears any existing launch correction and resets the profile to the original launch as determined during the data acquisition process.

The *Profile*, *Launch*, *Undo* menu item is only available if the current probe is an XSV and the launch has been set manually.

5.2.5.24 Launch - Auto-Find from Marker Line

Select *Profile*, *Launch*, and then *Auto-Find from Marker Line* from the menu bar to automatically set the launch of the current XSV profile. WinMK21 will search the probe data for the launch signature descending from the current maker line location. The profile data is redrawn with the new corrected depths based on the new launch.

5.2.5.25 XBP

For information on the *XBP* menu item, refer to “XBP Profile Menu” on page 4-28

5.2.6 Window Menu

The *Window* menu provides commands to control the position and layout of the application's windows.

The *Status* pop-up menu allows you to toggle the display of the various status windows. A check mark will appear next to the name of the status window if it is currently displayed.

Launch Information	Toggle display of *Launch Information* window
System Status	Toggle display of *System Status* window
Navigation Input Status	Toggle display of *Navigation Input Status* window
Remote Control Status	Toggle display of *Remote Control Status* window

The following menu items allow you organize the profile windows.

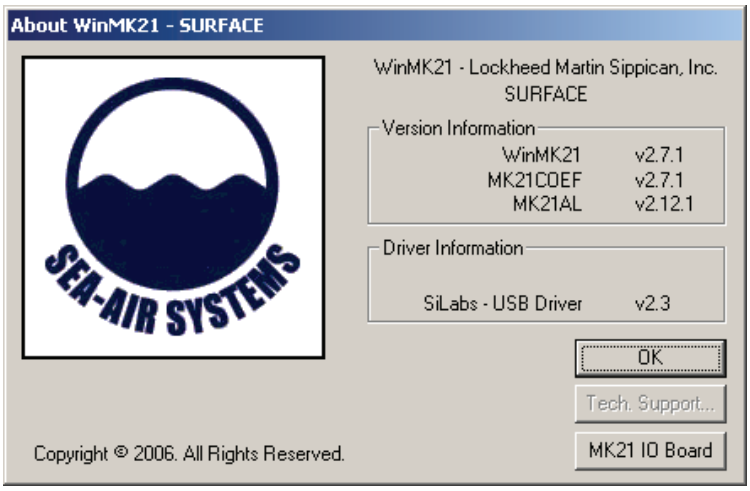
Cascade	Resize and position all profile windows, with the exception of the *Launch Information*, *System Status* and *Navigation Input Status* windows, in an overlapping pattern.
Tile	Resize and position all profile windows, with the exception of the *Launch Information*, *System Status* and *Navigation Input Status* windows, in non-overlapping pattern.
Arrange Icons	Align all iconized windows along a grid.
Close All	Close all profile windows.

5.2.7 Help Menu

You can view and print this manual as a Portable Document Format (PDF) document if you have Adobe® Reader® installed on your computer. To view the manual as a PDF, choose *Contents* from the *Help* menu or click the **Help** button. And while viewing it as a PDF, you can print any one or more pages from the manual. If there are questions not answered by the manual, additional assistance is available by contacting Lockheed Martin Sippican Sea-Air Systems Division technical support.

The *About WinMK21* dialog displays the version information for the application and its support files. Additional information is listed for the device driver.

Click the **Tech. Support** button to display information on how to contact the Lockheed Martin Sippican Sea-Air Systems Division technical support. Click the **MK21 IO Board** button to display the *About MK21 IO Board* dialog that displays version information about the MK21 interface board.



5.3 WinMK21 Toolbar

The WinMK21 toolbar is a row of buttons at the top of the Main window which represent application commands. Clicking one of the buttons is a quick alternative to choosing a command from the menu. Buttons on the toolbar activate and deactivate according to the state of the application.

New Drop	Drop a new probe	*File|New Drop*
	Open a profile	*File|Open*
	Save the profile	*File|Save*
	Save the profile with a new name	*File|Save As*
	Export the profile in the active window	*File|Export*
	Print the profile in the active window	*File|Print*
Accept	Accept XBP prelaunch conditions	*Actions|Accept XBP Prelaunch*
Launch Info	Toggle Launch Information display	*Window|Status|Launch Information*
System Status	Toggle System Status display	*Window|Status|System Status*

Nav Status	Toggle Navigation Input Status display	*Window|Status|Navigation Input Status*
Remote Control	Toggle Remote Control Status display	*Window|Status|Remote Control Status*
Help	Display help file contents	*Help|Contents*

5.4 Dialog Overview

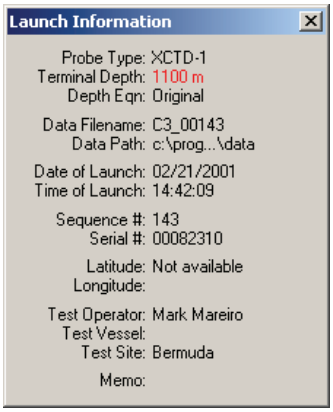
This section provides information on a few selected dialogs. These dialogs include:

- *Launch Information* window
- *System Status* dialog
- *Navigation Input Status* dialog
- *Remote Control Status* dialog

5.4.1 Launch Information

The *Launch Information* window displays the information related specifically to the currently active profile. This dialog displays the:

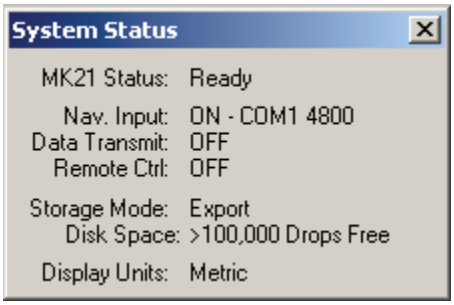
Probe Parameters:	Probe, Terminal Depth, Drop Rate Equation, Serial number.
Storage Parameters:	Data Filename, Data Path.
Launch Parameters:	Date and Time, Sequence Number, Latitude and Longitude position.
Custom Parameters:	Custom label and contents if available.



5.4.2 System Status

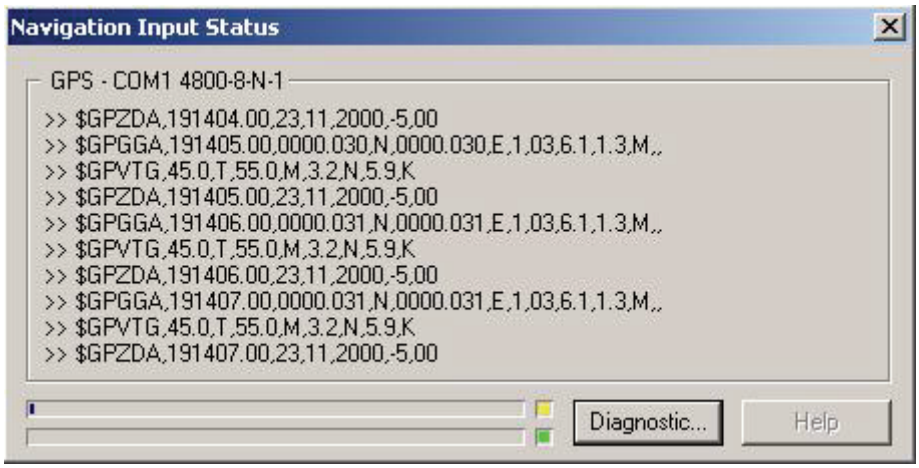
The *System Status* window displays the current system status parameters. This dialog displays the:

MK21 Status:	Indicates MK21 interface board state (Ready or Standby).
Nav. Input:	Indicates communications port state and settings.
Data Transmit:	Indicates if the collected data is to be transmitted to an external device.
Remote Ctrl:	Indicates remote control status and communications port settings.
Storage Mode:	Indicates automatic export storage mode (RDF and EDF) or standard storage mode (RDF only).
Disk Space:	Indicates amount of free space available in the current default data path as the number of drops for the currently selected probe.
Display Units:	Indicates universal system units (metric or English).



5.4.3 Navigation Input Status

The *Navigation Input Status* dialog displays diagnostic information related to the navigational input parameters and a scrolling display of the incoming serial data on the active communications port.

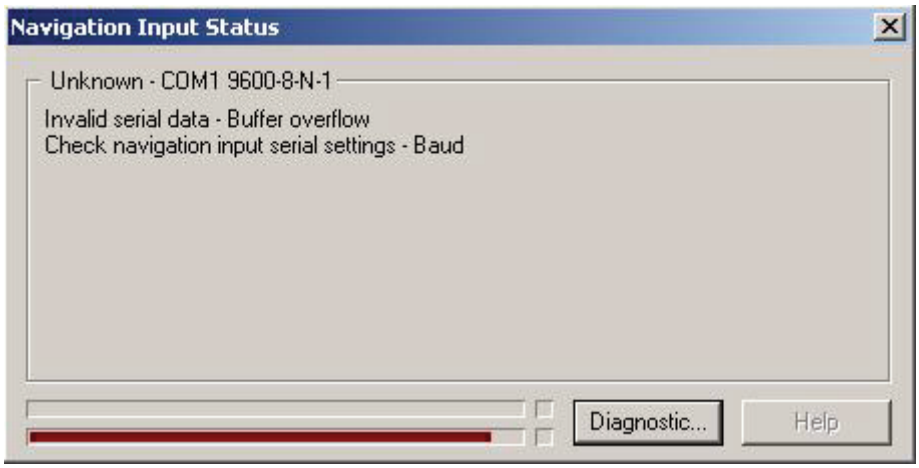


The horizontal bars at the bottom of the dialog indicate the status and activity of the two serial input buffers as follows:

Operating System Input Buffer Status. The top bar indicates the amount of bytes in the operating system's input buffer. Under normal operating conditions this bar will appear empty unless an internal process has temporarily delayed the WinMK21 application's ability to retrieve the serial information from the operating system's input buffer. The top square to the right of the indicator flashes when activity is detected on the operating system's input buffer.

Internal WinMK21 Input Buffer Status. The bottom bar indicates the number of bytes in the internal WinMK21 input buffer. Under normal operating conditions this bar will appear empty. However, it is possible for the internal WinMK21 input buffer to begin to fill up if a lengthy internal process has temporarily delayed the WinMK21 application's ability to process the data in this input buffer. Once the WinMK21 is able to process the data in the internal input buffer, the indicator will revert to empty. The bottom square to the right of the indicator flashes when activity is detected on the internal WinMK21 input buffer.

The WinMK21 input buffer will fill up if the WinMK21 application is unable to process the data in the input buffer. This typically occurs if the navigation input serial settings, such as the baud rate, are not specified correctly for the incoming data stream.



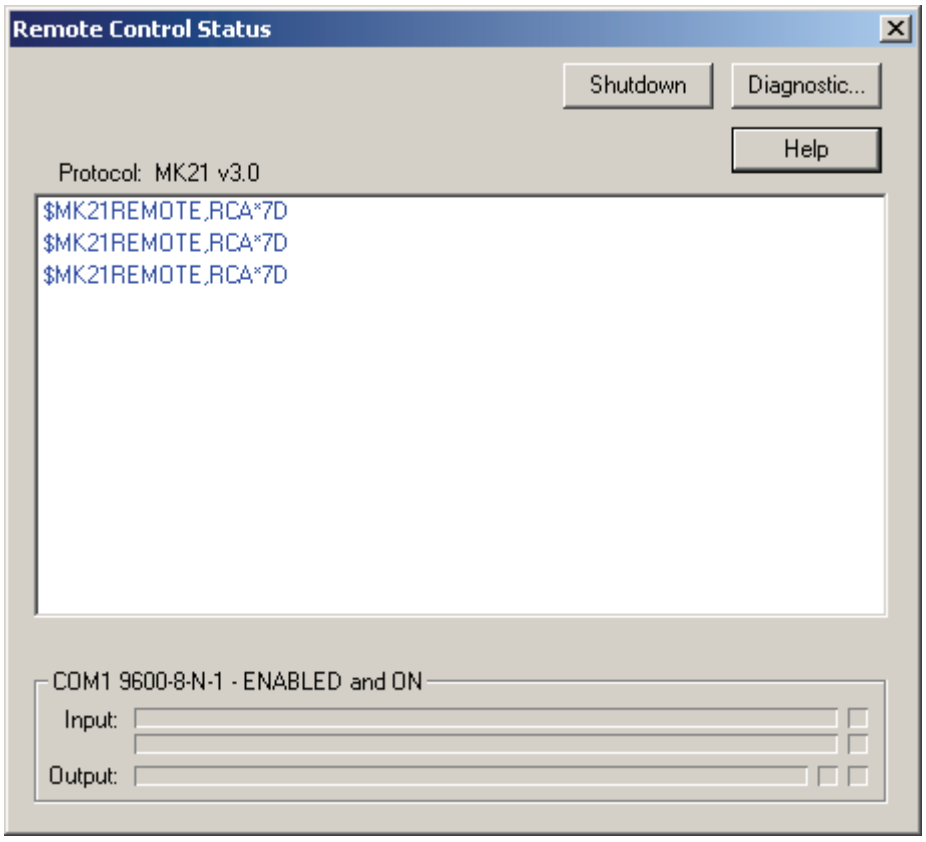
In this example, the navigation input serial settings have been set to a baud rate of 9600. The incoming data stream from the external navigation device is set to a baud rate of 4800. The WinMK21 application is still able to read the data from the serial port, however, it is unable to process the data since it doesn't make any sense because of the incorrect serial settings. As a result, the internal WinMK21 input buffer simply fills up with the unprocessed serial data until an overflow is detected. Upon detecting an overflow, the WinMK21 application clears the internal input buffer and warns the operator of the possible problem.

Diagnostics. The **Diagnostic** button activates the diagnostics feature. If not already active, a diagnostics file is automatically named and created in the default data directory. This file will contain diagnostic system information related to the serial communications and records all incoming serial data and changes to the communications settings. Selecting the **Diagnostic** button a second time will stop recording the navigation input information to the current diagnostics file.

5.4.4 Remote Control Status

The *Remote Control Status* dialog displays diagnostic information related to remote control operation and includes a scrolling display of command, response and information sentences transmitted between the Host and Remote computers using the Host-Remote Communications Protocol.

Input and Output Buffer Status. The horizontal bars at the bottom of the dialog indicate the status and activity of the serial input and output buffers. The top bar indicates the amount of bytes in the operating system's input buffer, and the bottom, the output buffer. Under normal operating conditions they will appear empty unless an internal process has temporarily delayed the WinMK21 application's ability to input and output the serial information. The squares to the right of the bars flash when activity is detected.



Diagnostics. The **Diagnostic** button activates the diagnostics feature. If not already active, a diagnostics file is automatically named and created in the default data directory. This file will contain diagnostic system information related to the serial communications and records all incoming serial data and changes to the communications settings. Selecting the **Diagnostic** button a second time will stop recording the information to the current diagnostics file.

Shutdown. The **Shutdown** button manually shuts down a currently active Host-Remote communications session.

For more information about the remote control status feature, contact Lockheed Martin Sippican Sea-Air Systems Division technical support.

5.5 Additional Information Overview

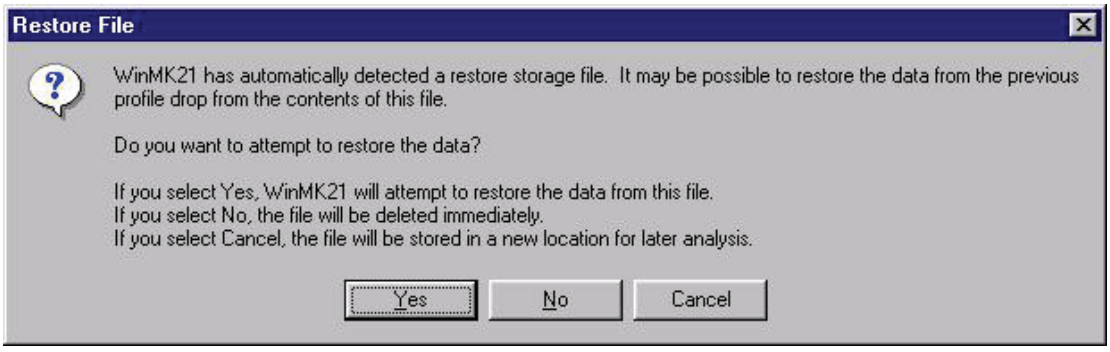
This section briefly explains some issues not related to other topics in this help file.

- Restore Storage File
- Configuration Log File
- Password Protection Overview
- Probe Filenames
- Raw Data Format
- Export Data Format
- Depth Equation
- Terminal Depth
- Navigation Input Reference - NMEA 0183

5.5.1 Restore Storage File

WinMK21 automatically creates a temporary restore storage file, MK21RSTR.SIP, in the default data folder for every probe drop. If the probe drop is completed successfully and the data is recorded to a valid RDF data file, the temporary restore storage file is automatically removed. However, if an unexpected error occurs that results in an incomplete probe drop or an unsuccessful storage of the data in a valid RDF file, the restore file remains available in the default data folder.

Upon restarting WinMK21, the restore file is automatically detected. The operator is presented with a list of options as follows:



Upon selecting **Yes**, WinMK21 will attempt to restore the data from the restore storage file. If the data recovery is successful, the data profile is displayed in a Data Window. The operator must manually save the profile to an RDF file. If the data recovery is unsuccessful, the operator is prompted to store the invalid restore storage file in a new location and send the file to the Lockheed Martin Sippican Sea-Air Systems Division technical support for further analysis. If the restore storage file is not moved to a new location, it will be overwritten automatically at the beginning of the next probe drop.

Upon selecting **No**, the restore storage file will be deleted immediately.

Upon selecting **Cancel** the operator is prompted to move the restore storage file to a new location with an optional new name. This option allows the operator to record multiple restore storage files.

5.5.2 Configuration Log File

WinMK21 maintains a configuration log file, MK21CFG.LOG, in the Windows directory of the computer. The configuration log file records the original configuration settings and any subsequent changes to the WinMK21 settings. The configuration log file should never be deleted unless specifically requested by the Lockheed Martin Sippican Sea-Air Systems Division technical support. Furthermore, the configuration log file should not be maintained or viewed by the operator. The sole purpose of the file is to aid technical support in determining the original configuration of the WinMK21 settings and subsequent changes for technical support situations.

5.5.3 Password Protection

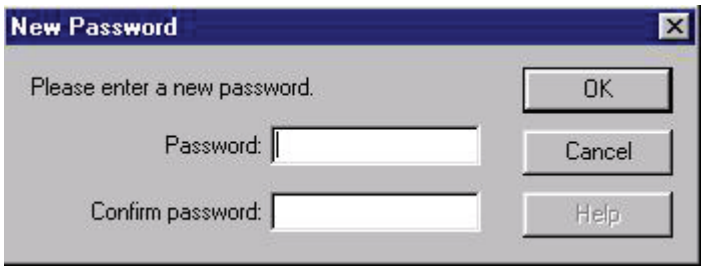
The Password Protection option allows the supervisor to restrict access to specific system options. The user can only access the restricted options if a valid password is entered. The password can contain up to 32 context sensitive alphanumeric characters, including spaces.

The Password Protection option is enabled by selecting the **Require password to change settings** option in the *User Parameters* dialog. The *New Password* dialog will appear and the supervisor is prompted to enter a new password. Once a new password has been activated, a user will be required to enter the password in the *Password Protection* dialog to access specific parameters.

If you have lost or forgotten the supervisor password, contact Lockheed Martin Sippican Sea-Air Systems Division technical support for assistance.

Password Protection Dialog. This dialog is presented when you are attempting to perform an action that is protected by a password. The dialog prompts you to enter the current supervisor password. If the password is entered correctly, you are allowed to proceed. If the password is entered incorrectly, you are not allowed to proceed.

New Password Dialog. This dialog allows you to set a new password. The new password must be entered twice to verify the correct spelling. The password can contain up to 32 context sensitive alphanumeric characters, including spaces.



5.5.4 Probe Filenames

The data filename is constructed automatically from the probe type and sequence number. The first two characters of each data filename identify the probe type. The table below shows the prefixes for each probe type:

TYPE	PREFIX
T-4	T4_
T-5	T5_
T-6	T6_
T-7	T7_
T-10	T0_
T-11	T1_
LMP5-T1 (T-12)	T2_
Fast Deep	TF_

Deep Blue	TD_
XSV-01	S1_
XSV-02	S2_
XSV-03	S3_
XCTD-1	C3_
XCTD-2	C4_
XCTD-3	C5_
XBP	BP_

The numeric portion of the data filename is taken from the sequence number.

5.5.5 Raw Data Format

The Raw Data Format is a proprietary binary file format of the profile data. This file is the standard storage format for WinMK21, WinMK12 and the DOS-based MK12 applications. Although WinMK21 is able to convert files generated by the WinMK12 and DOS-based MK12 applications, the WinMK21 RDF data files are not compatible with the earlier WinMK12 and DOS-based MK12 applications. As such, the earlier WinMK12 and DOS-based MK12 applications can not read RDF files generated by WinMK21.

5.5.6 Export Data Format

The Export Data Format is an ASCII output file of the profile data. The file contains launch and probe information in the header. The complete profile data is then listed in tab-delimited format with a single data sample set on each line. A single data sample set consists of the calculated depth and the measured and derived data for each probe, i.e. temperature, sound velocity, conductivity, etc. An example of such a file is displayed below.

```
// This is a MK21 EXPORT DATA FILE  (EDF)
//
Date of Launch:  10/10/2000
Time of Launch:  08:49:38
Sequence #     :  49
Latitude       :  4 0.000S
Longitude      :  4 0.300E
Serial #       :  0
//
```

```
// Here are the contents of the memo fields.
//
//
// Here is some probe information for this drop.
//
Probe Type       :  T-4
Terminal Depth   :  460 m
Depth Equation   :  Standard
Depth Coeff. 1   :  0.0
Depth Coeff. 2   :  6.691
Depth Coeff. 3   :  -0.00225
Depth Coeff. 4   :  0.0
Pressure Pt Correction:  100.0%
//
Raw Data Filename:  C:\SIPPICAN\WINMK21\DATA\T4_00049.RDF
//
Display Units    :  Metric
//
// This XBT export file has been noise reduced and averaged.
Noise Threshold :  10.0 (0.0% spikes)
Averaging Window:  7
//
// Sound velocity derived with assumed salinity: 30.00 ppt
//
Depth (m) - Temperature (°C) - Sound Velocity (m/s)
4.7      20.91 1575.30
5.4      20.91 1575.31
6.0      20.91 1575.32
6.7      20.91 1575.33
7.4      20.90 1575.34
8.0      20.90 1575.35
8.7      20.90 1575.36
...
454.8    9.91  1552.97
455.4    9.91  1552.98
456.1    9.91  1552.99
456.7    9.91  1553.00
457.3    9.91  1553.01
458.0    9.91  1553.02
458.6    9.91  1553.03
```

5.5.7 Depth Equation

Probe depth is determined as a function of elapsed time after detection of seawater entry. The general expression for probe depth is a quadratic equation as follows:

Depth= A * time + B * time * time

The linear term is terminal velocity and the second-order term accounts for the slight reduction in probe mass as its wire dereels, reducing its descent speed as depth increases. Because probe types vary in geometry and mass, the equation coefficients also vary from type to type.

WinMK21 maintains a set of drop rate coefficients for each probe. The drop rate coefficients for all probe types were originally determined by Lockheed Martin Sippican. In 1995, The *Integrated Global Ocean Services System (IGOSS) Task Team on Quality Control Procedures for Automated Systems.*[1] published an extensive study refining the drop rate coefficients for the T-4, T-6 and T-7 XBTs. For these probes the IGOSS coefficients have been implemented as the default values. Where there are no IGOSS coefficients available, the original Lockheed Martin Sippican values are used as defaults (IGOSS option is not selectable). Note that the coefficients can also be modified by the user to custom values. Use of the custom coefficients is extremely rare and is not recommended without consulting with Lockheed Martin Sippican Sea-Air Systems Division technical support first.

The current selection for drop rate is displayed in the *Launch Information* window as Depth Equation. Any selection other than the default selection for a given probe type will be displayed in red to alert the operator that non-default values are being used. In Data Acquisition mode, to view or change the drop rate coefficients click on *Options|Probe|Selection|More.* In Post Processing mode, click on *Options|Probe|Attributes*. In either case the *Probe Attributes* dialog is displayed for the active probe.

The XCTD probes do not allow the operator to modify the drop rate coefficients. The drop rate coefficients are stored on the EEPROM and are determined at the time the probe is loaded in the launcher. The XCTD EEPROM format has allocated space for four drop rate coefficients for use with the depth equation. However, it is only using two terms, the linear and second-order terms, at this time. If a non-standard set of drop rate coefficients are read from a probe's EEPROM and subsequently used in the depth equation, this non-standard state is indicated in red in the *Launch Information* window.

1. K. Hanawa, P. Rual, R. Bailey, A. Sy, and M. Szabados, *A New Depth-Time Equation for Sippican or TSK T-7, T-6 and T-4 Expendable Bathythermographs (XBT)* published in IOC Technical Series No. 42.

5.5.8 Terminal Depth

Lockheed Martin Sippican probes are rated for specific depths. This rated depth will appear as the default value in the *Probe Selection* dialog.

Some users may be interested in modifying this depth. To modify the terminal depth for a specific probe type, click the **More** button in the *Probe Selection* dialog to display the *Probe Attributes* dialog for the selected probe.

The terminal depth can be decreased for purposes of saving time in the case of shallow depth profiles. Alternatively, the terminal depth can be increased to maximize the amount of data collected in the case of monitoring the probe beyond it's rated depth, until data transmission is terminated by a wire break. In the event of monitoring the probe beyond the rated depth, Lockheed Martin Sippican does not recommend increasing the terminal depth by more than 20%. Also, Lockheed Martin Sippican cautions that data collected when the wire is being stretched prior to breaking is often suspect. Furthermore, termination of the data transmission by breaking of the wire can cause the data collection program to appear to be hung up, particularly if the terminal depth has been reset to be very deep relative to the rated depth. In this event, terminate the data collection by selecting the *Terminate* menu item from the *Actions* menu. All data collected until that time will be written to disk.

5.5.9 Navigation Input Reference - NMEA 0183

The *NMEA 0183 Standard for Interfacing Marine Electronic Navigational Devices* was adopted by the National Marine Electronics Association (NMEA) to allow marine instruments to transmit and receive information via a serial cable. This communication between a single talker and multiple listeners is based on a block transmission. Blocks, or groups of NMEA 0183 sentences, are transmitted over the serial cable. Each sentence has a header that uniquely identifies the talker and the information contained in the sentence. An external navigational device that supports the NMEA 0183 protocol continuously transmits at least the minimum implementation of sentences. A serial cable connects the external navigational device (talker) to a serial port of the WinMK21 control computer (listener).

The WinMK21 application will accept NMEA 0183 navigational information on a serial port. The WinMK21 application looks for the navigational information in the following sentences:

RMC:	Recommended Minimum Specific GPS/TRANSIT Data
RMA:	Recommended Minimum Specific Loran-C Data
GGA:	Global Positioning System Fix Data
GLL:	Geographic Position - Latitude/Longitude

When any of the position-related NMEA sentences are received by WinMK21 application, the latitude and longitude information is displayed in the *Launch Information* window. The position quality is appended to the latitude (SPS Mode, Differential GPS, PPS Mode or "Fix not avail. or invalid").

Furthermore, the WinMK21 application allows you to reset the computer system clock based on the external navigational device time provided by the ZDA, Time & Date sentence. The time-related ZDA sentence must be selected in the *Navigation Input Parameters* dialog.

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SECTION 6
REPLACEABLE PARTS

All of the replaceable mechanical and electrical components of the MK21 USB DAQ are listed Table 6-1. The table lists each part by description, Lockheed Martin Sippican part number and item number. An exploded view drawing of the MK-21 USB DAQ with corresponding item number callouts is shown in Figure 6-1. All of the subassemblies listed in Table 6-1 include the associated cabling and hardware shown in Figure 6-1.

TABLE 6-1: ***MK21 USB DAQ Replaceable Parts List***

LOCKHEED MARTIN SIPPICAN P/N	DESCRIPTION	ITEM NO.
352102-1	19-inch Rack Panel Subassembly	1
352101-99	Right End Plate Subassembly	2
352104-1	Left End Plate Subassembly	3
352106-1	Enclosure	4
352016-98	MK21 USB DAQ Board Assembly	5

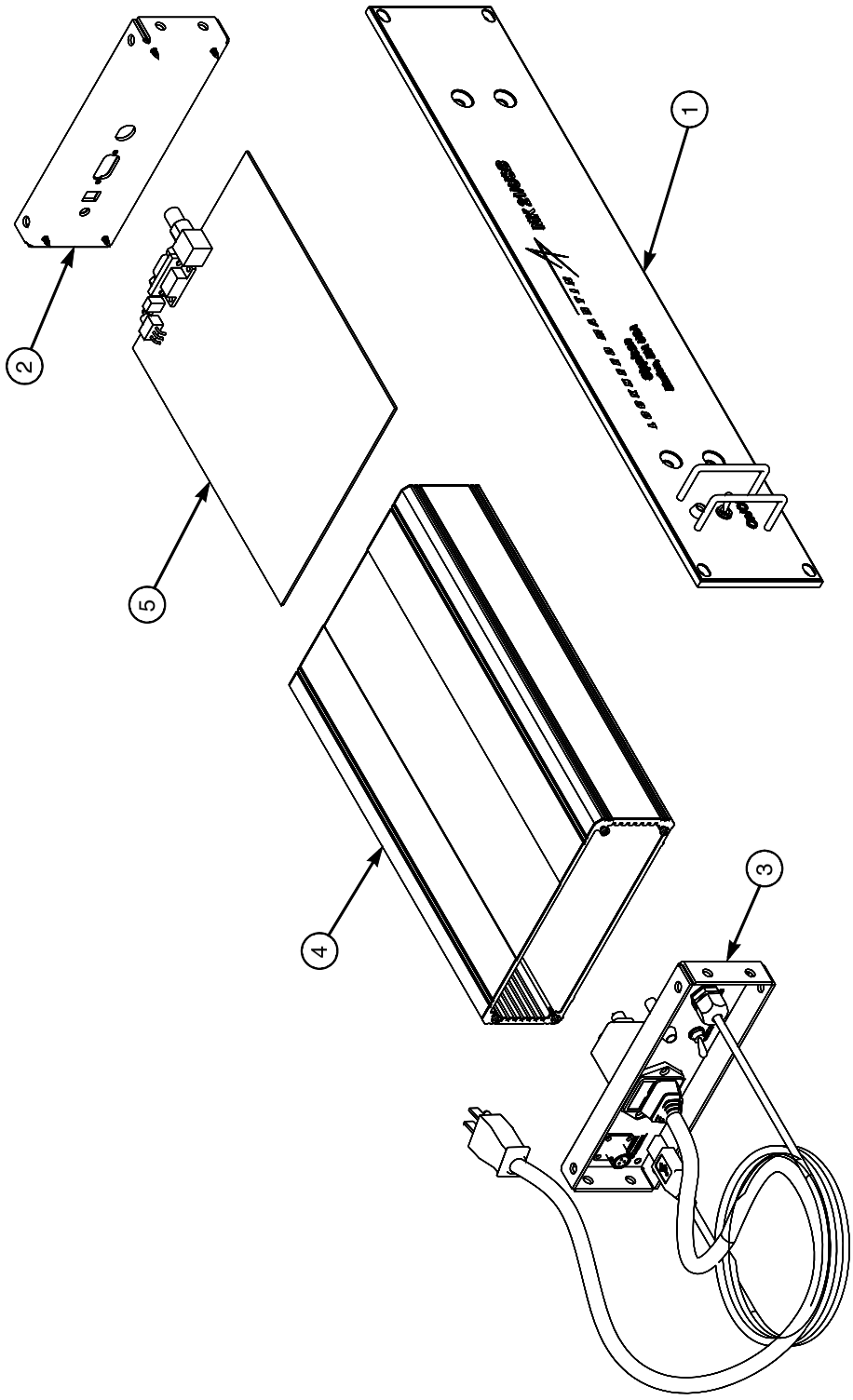


FIGURE 6-1: *MK21 USB DAQ Replaceable Parts—Exploded View*

SECTION 7
SERIAL-BINARY DATA TRANSMISSION DESCRIPTION

The WinMK21 Data Acquisition and Post-Processing Software can transmit temperature and sound velocity data either in Data Acquisition mode at the end of a probe's descent or in Post Processing mode using the serial-binary data transmission interface. This section specifies the interface requirements for WinMK21 and an external serial device to achieve the serial-binary data transmission between them.

7.1 Physical Requirements

WinMK21 provides a transmit-only serial channel that conforms to either the TIA/EIA-232 or the TIA/EIA-422 standard. WinMK21 does not support any software or hardware flow control mechanism. In relation to WinMK21, the serial interface acts as an asynchronous, simplex (TRANSMIT only) interface.

The serial channel configuration parameters are as follows:

Parameter	Setting
Baud Rate	2400
Character Bits	8
Stop Bits	2
Parity	Odd

7.2 Protocol Requirements

WinMK21 transmits a four-byte header message to inform the host system of the probe type selected by the operator. From this information, the host system can allocate the proper amount of buffer space receiving the data as well as select the appropriate data processing algorithm. The first data message is sent approximately two seconds after the header message. WinMK21 sends a precise number of data messages for each of the probe types as follows:

Probe Type	Total Number of Data Messages
T-4, T-6	750
T-5	3000
T-7	1250
T-10	330
XSV-01	1395
XSV-02	3281

A data message is sent for every two-foot depth interval. WinMK21 samples the probe data at a constant 100 millisecond interval for the duration of the probe drop. Thus, the time-based data is interpolated to generate the two-foot interval data.

7.3 Message Requirements

7.3.1 XBT Header Message Format

The four-byte header message transmitted for the XBT probes contains three bytes of all zeroes and a fourth byte of five zeroes and a three bit probe type code. The header message is transmitted only once and cannot be re-transmitted. The four-byte header message, listed from MSB to LSB, is formatted as follows:

	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**	
Byte 1	0	0	0	0	0	0	0	0	
Byte 2	0	0	0	0	0	0	0	0	
Byte 3	0	0	0	0	0	0	0	0	
Byte 4	0	0	0	0	0	P2	P1	P0	
						1	0	0	T-4, T-6
						1	0	1	T-5
						1	1	1	T-7
						0	1	0	T-10

7.3.2 XSV Header Message Format

The four-byte header message transmitted for the XSV probes contains three bytes of all ones and a fourth byte of five zeroes and a three bit probe type code. The header message is transmitted only once and cannot be re-transmitted. The four-byte header message, listed from MSB to LSB, is formatted as follows:

	7	6	5	4	3	2	1	0	
Byte 1	1	1	1	1	1	1	1	1	
Byte 2	1	1	1	1	1	1	1	1	
Byte 3	1	1	1	1	1	1	1	1	
Byte 4	0	0	0	0	0	P2	P1	P0	
						0	1	1	XSV-01
						1	1	0	XSV-02

7.3.3 Data Message Format

The bit format of the data message is not standard and requires the receiving computer to do bit manipulation and scaling to generate useful values. The data message consists of four bytes containing a twelve-bit temperature/sound velocity word and a twelve-bit depth word. The four-byte data message, from MSB to LSB, is formatted as follows:

	7	6	5	4	3	2	1	0
Byte 1	X11	X10	X9	X8	X7	X6	X5	1
Byte 2	X4	X3	X2	X1	X0	1	1	0
Byte 3	Y11	Y10	Y9	Y8	Y7	Y6	Y5	0
Byte 4	Y4	Y3	Y2	Y1	Y0	0	P	0

The bits X11–X0 contain the temperature/sound velocity word. The bits Y11–Y0 contain the depth word. Bit 0 (LSB) of byte 1 is always set to a one while bit 0 of bytes 2–4 are always set to zero. This feature can be used to properly frame a data message should individual bytes be lost. Bit 1 of byte 4 (P) provides an odd parity check of the entire data message.

7.3.4 Data Out-of-Range Messages

When the input stimulus to WinMK21 exceeds the expected range, it loads default values into the data message. The temperature/sound velocity portion of the data message (X11–X0) is set to all zeroes if the data is less than the lowest expected value. The temperature/sound velocity portion of the data message (X11–X0) is set to all ones if the data is greater than the highest expected value. In all cases, the depth data reflects the actual depth of the measurement.

7.3.5 Temperature Range

The valid temperature range of WinMK21 is 26°F to 98°F. If the input stimulus measures less than 26°F, the temperature bits are set to all zeroes in the data message. If the input stimulus measures greater than 98°F, the temperature bits are set to all ones in the data message.

7.3.6 Sound Velocity Range

The valid sound velocity range of WinMK21 is 4610 ft/sec to 5118 ft/sec. If the input stimulus measures less than 4610 ft/sec, the sound velocity bits are set to all zeroes in the data message. If the input stimulus measures greater than 5118 ft/sec, the sound velocity bits are set to all ones in the data message.

7.3.7 Processing Algorithm

When the host receives an XBT header message, bits X11–X0 of the data message contain temperature data. The host converts this twelve-bit word to temperature in degrees Fahrenheit with the following equation:

$$\text{Temperature [°F]} = X / 4095 * 72 + 26$$

When the host receives an XSV header message, bits X11–X0 of the data message contain sound velocity data. The host converts this twelve-bit word to sound velocity in feet/second with the following equation:

$$\text{Sound Velocity [ft/sec]} = X / 4095 * 508 + 4610$$

Irrespective of the header message, bits Y11–Y0 of the data message contain depth data. The host converts this twelve-bit word to depth in feet with the following equation:

$$\text{Depth [ft]} = Y * 2$$

APPENDIX A
TECHNICAL NOTES

A.1 Pressure Point Definition in WinMK21 Software

A.1.1 Overview

Probe depth is determined using a depth equation as a function of elapsed time after detection of seawater entry. The general expression for probe depth is a quadratic equation with two probe specific coefficients as follows:

$$\text{Depth} = A * \text{time} + B * \text{time} * \text{time}$$

The linear term is terminal velocity and the second-order term accounts for the slight reduction in probe mass as its wire dereels, reducing its descent speed as depth increases. Because probe types vary in geometry and mass, the equation coefficients also vary from type to type.

The WinMK21 software maintains a set of drop rate coefficients for each probe. The drop rate coefficients for all probe types were originally determined by Sippican. In 1995, *The Integrated Global Ocean Services System (IGOSS) Task Team on Quality Control Procedures for Automated Systems** published an extensive study refining the drop rate coefficients for the T-4, T-6 and T-7 XBTs. For these probes the IGOSS coefficients have been implemented as the default values. Where there are no IGOSS coefficients available, the original Sippican values are used as defaults (IGOSS option is not selectable).

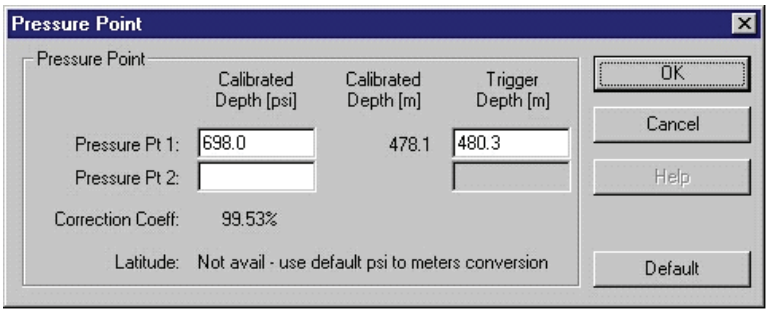
However, for an LMP5-T1 (T-12) probe that has been pressure point enabled, it is possible to obtain a greater absolute precision for the probe depth. A pressure sensor in the probe, when triggered at its calibrated pressure (psi), will add a pressure point signature to the probe data. The calibrated pressure for the pressure sensor is read from a .cdp file. Only LMP5-T1 (T-12) probes are pressure point enabled.

The WinMK21 software allows the user to graphically correlate the trigger depth and the calibrated depth of the probe's pressure sensor.

In the WinMK21 software the resulting correction is the required percentage change that must be applied to the derived depth in order to force the trigger depth of the pressure point signature in the probe data to be located correctly at the calibrated depth of the pressure sensor.

A.1.2 Setting Calibrated Pressure Point

The *Pressure Point* dialog allows the user to define the calibrated depth of the probe's pressure sensor. Furthermore, the user can manually modify or remove the trigger depth of the pressure point.



The calibrated depth is recorded as a pressure in psi. The calibrated depth in psi is then converted to a depth in meters (or feet depending on the current units). If the latitude of the probe drop is available, WinMK21 will automatically compensate the psi to meters conversion based on the known latitude.

The trigger depth is displayed in meters (or feet). If this value is blank, then the pressure point is considered to be "Free." Otherwise, this value reflects the current trigger depth whether it was obtained automatically using Auto-Find or set manually by the user. To remove the trigger depth for the pressure point, simply remove the value and leave the field blank.

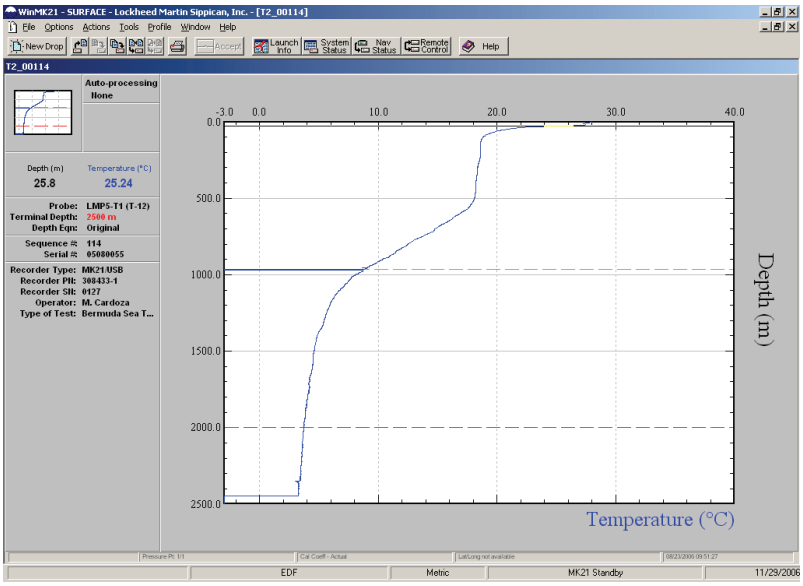
If the trigger depth is set, the resulting correction coefficient is displayed. The correction is indicated as a required percentage change that must be applied to the derived depth in order to force the trigger depth of the pressure point signature in the probe data to be located correctly at the calibrated depth of the pressure sensor.

A.1.3 Correcting Probe Depth with Pressure Point

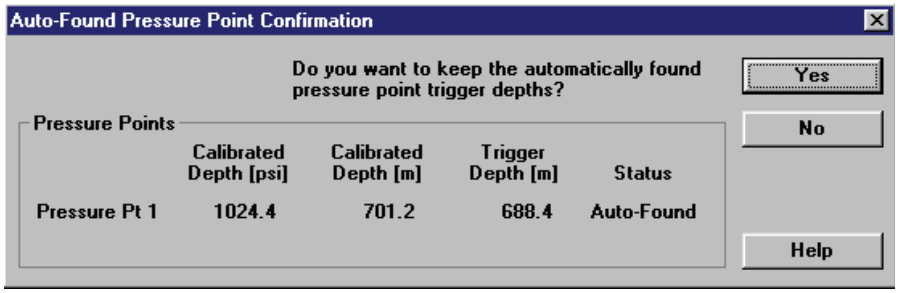
The depth of the calibrated pressure point is indicated in the profile window with a dashed green line. If a green line is not visible, then either the probe is not pressure point enabled, or the calibrated pressure point has not been properly defined.

To manually set the location of the pressure point, select *Profile*, *Pressure Pt*, and then *Set* from the menu bar. The trigger depth for the pressure point will be set to the depth as indicated by the profile marker. To manually remove the trigger depth for the pressure point, select *Profile*, *Pressure Pt*, and then *Remove* from the menu bar.

The *Profile*, *Pressure Pt*, *Set* menu item is only available if the current probe is pressure point enabled and the calibrated depth of the pressure point has been properly defined. Only LMP5-T1 (T-12) probes are pressure point enabled. The calibrated depth of the pressure point is read from a .cdp file for an LMP5-T1 (T-12) probe.



To automatically set the location of the pressure point, select *Profile*, *Pressure Pt*, and then *Auto-Find* from the menu bar. WinMK21 will search the probe data for the pressure point signature. The *Auto-Found Pressure Confirmation* dialog is displayed indicating the status of the search. If a trigger depth has been located, the user will be asked to confirm the settings. Likewise, if a trigger depth was not located in the search, the user is informed of this case also.



If the user confirms a successful search, the profile data is redrawn with the new corrected depths. The pressure point signature will be displayed at the calibrated depth and all the other probe depths will be adjusted accordingly.

A.2 Sound Velocity Equation in WinMK21 Software

The equation used to calculate sound velocity, often known as the UNESCO algorithm, is due to Chen and Millero.[1] For the original UNESCO paper see Fofonoff and Millard (1983).[2] The derived sound velocity (m/s) is a function of temperature (ºC), depth (m) and salinity (ppt). A constant salinity value, as defined in the Post-Processing Parameters, is used for XBT profiles. The C routine to calculate the sound velocity is as follows:

```
double
SoundVelocity (double dTemperature, double dDepth, double dSalinity)
{
    double dSndVel;

    double p, t;
    double D;
    double B1, B0, B;
    double A3, A2, A1, A0, A;
    double C3, C2, C1, C0, C;

        // convert depth [m] to pressure [bars]
    p = dDepth * 3.2808 * 0.03048;
        // temperature in degrees C
    t = dTemp;

        // s^2 term
    D = 0.001727 - 0.0000079836 * p;

        // s^1.5 term
    B1 = 0.000073637 + 0.00000017945 * t;
    B0 = -0.01922 - 0.0000442 * t;
    B = B0 + B1 * p;

        // s term
    A3 = (-3.389E-13 * t + 0.000000000006649 ) * t + 0.00000000011;
    A2 = ( (0.000000000007988 * t - 0.00000000016002 ) * t + 0.0000000091041 ) * t
           - 0.00000039064;
    A1 = ( ( (-0.00000000020122 * t + 0.000000010507 ) * t - 0.000000064885 ) * t
           - 0.00001258 ) * t + 0.000094742;
    A0 = ( ( (-0.0000000321 * t + 0.000002006 ) * t + 0.00007164 ) * t
           - 0.01262 ) * t + 1.389;
    A = (( A3 * p + A2 ) * p + A1 ) * p + A0;

        // the no salinity term
    C3 = (-2.3643E-12 * t + 0.00000000038504 ) * t - 0.0000000097729;
    C2 = ( ( (1.0405E-12 * t - 0.00000000025335 ) * t + 0.000000025974 ) * t
           - 0.0000017107 ) * t + 0.00003126;
    C1 = ( ( (-0.00000000061185 * t + 0.00000013621 ) * t - 0.0000081788 ) * t
           + 0.00068982 ) * t + 0.153563;
    C0 = ( ( ( (0.0000000031464 * t - 0.000001478 ) * t + 0.0003342 ) * t
           - 0.0580852 ) * t + 5.03711 ) * t + 1402.388;
    C = ( ( C3 * p + C2 ) * p + C1 ) * p +C0;

        // sound velocity in meters/sec
    dSndVel= C + ( A + B * sqrt(dSalinity) + D * dSalinity ) * dSalinity;

    return dSndVel;
}
```

1. C-T Chen and F.J. Millero, Speed of sound in seawater at high pressures (1977) J. Acoust. Soc. AM. 62(5) pp. 1129-1135.
2. N.P. Fofonoff and R.C. Millard Jr., UNESCO Technical Papers in Marine Science, #44 (1983) "Algorithms for computation of fundamental properties of seawater," UNESCO Division of Marine Science (Paris) 53pp.

A.3 Salinity Equation in WinMK21 Software

The equation used to calculate salinity (ppt) as a function of measured temperature (ºC), conductivity (mS/cm) and depth (m) is defined by the 1978 Practical Salinity Scale (PSS-78).[1] [2] [3] The C routine to calculate the salinity is as follows:

```
double
Salinity (double dTemperature, double dConductivity, double dDepth)
{
    double dSalinity;
    double fnrt35, fnc, fnb, fnfa;
    double dt, rt;

    dConductivity /= (double)42.914;
    dt= dTemperature - (double)15.0;

    fnrt35= (((0.0000000010031 * dTemperature
                  - 0.00000069698) * dTemperature
                  + 0.0001104259) * dTemperature
                  + 0.0200564) * dTemperature
                  + 0.6766097;
    fnc= ((0.000000000000003989 * dDepth
           - 0.000000000637) * dDepth
           + 0.0000207) * dDepth;
    fnb= (0.0004464 * dTemperature + 0.03426) * dTemperature + 1.0;
    fnfa= -0.003107 * dTemperature + 0.4215;

    rt= dConductivity / (fnrt35 * (1.0 + fnc / (fnb + fnfa * dConductivity)));
    rt= sqrt(rt);

    dSalinity= ((((2.7081 * rt
                          - 7.0261) * rt
                          + 14.0941) * rt
                          + 25.3851) * rt
                          - 0.1692) * rt
                  + 0.008
                  + (dt / (1.0 + 0.0162 * dt ))
                  * ((((( -0.0144 * rt
                                  + 0.0636 ) * rt
                                  - 0.0375 ) * rt
                                  - 0.0066 ) * rt
                                  - 0.0056 ) * rt
                                  + 0.0005 );

    return dSalinity;
}
```

1. UNESCO Technical Papers in Marine Science, #36 (1981a) "The Practical Salinity Scale 1978 and the International Equation of State of Seawater 1980," UNESCO Division of Marine Sciences (Paris), 25pp.
2. UNESCO Technical Papers in Marine Science, #37 (1981b) "Background papers and supporting data on the practical salinity scale, 1978," UNESCO Division of Marine Science (Paris), 144pp.
3. 1978 Practical Salinity Scale Equations (January 1980) IEEE Journal of Oceanic Engineering, OE-5 No. 1, p. 14.

A.4 XBT Data Collection - from Thermistor to Temperature

A.4.1 Sensor Device

The sensor used for measuring temperature using an XBT is a thermistor. A natural logarithm series expansion is used to convert from a measured resistance to a temperature as follows:

```
InverseKelvin =   1.290123 x 10-3
            +     2.3322529 x 10-4 x ln(Resistance)
            +     4.5791293 x 10-7 x (ln(Resistance))2
            +     7.1625593 x 10-8 x (ln(Resistance))3

Celsius =          (1.0 / InverseKelvin ) - 273.15
```

This method of calculating temperature from thermistor resistance has been used for all versions of the XBT data acquisition systems.

A.4.2 Pre-MK12 Interface Board

Systems that predate the MK12 interface boards used a look-up table with resistance-temperature values to convert the thermistor resistance values to a temperature.

A.4.3 MK12 Interface board

The MK12 interface board does not record the actual resistance value because of data transfer limitations. Instead, the MK12 interface board records the number of counts from the onboard A-to-D converter, otherwise known as AD count. The AD count value is then transferred to the MK12 software which converts it to a resistance using an algorithm specific to the A-to-D converter. The resistance is then converted to temperature using the natural logarithm series expansion described above.

A.4.4 MK21 Interface Board

The MK21 interface board records and transfers the actual thermistor resistance value. The A-to-D converter counts are not recorded. The WinMK21 software then converts the resistance to temperature using the natural logarithm series expansion described above.

A.4.5 Conclusion

The internal processes by which the MK12 and MK21 interface boards measure the thermistor resistance are similar in result; however, different in application. The repeatable accuracy of the two measurement processes, including repeatable accuracy in comparison to each other, has been well-established. The MK12 and WinMK21 software use the same natural logarithm series expansion to convert the thermistor resistance to temperature.

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