



**Instrumentation
Northwest, Inc.**

Protecting our water resources since 1982

**AquiStar[®] CT2X
Conductivity
Smart Sensor
With Pressure Option**

**GETTING STARTED
GUIDE**

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Introduction

What is the CT2X with Pressure Option?

The Aquistar® CT2X is a submersible conductivity/temperature sensor with built-in datalogging. This device stores thousands of records of conductivity, temperature, and time data. The CT2X is also available with a pressure option based on INW's popular PT2X Smart Sensor, giving added functionality in the same sensor housing.

The CT2X incorporates 4-pole electrode cell measurement technology. This technology reduces fringe field interference errors, lessens inaccuracy caused by polarization effects, and lowers contact resistance problems. Four-pole electrode technology also allows users to work with one electrode over a wide range of conductivity.

The conductivity probe is constructed of epoxy/graphite, making it extremely durable for use in rugged field conditions. To clean, simply scrub with a small brush.

The CT2X is powered internally with one 3-volt lithium battery or with an external auxiliary power supply for data intensive applications.

The unit is programmed using a laptop or desktop Windows® based computer via its RS485/RS232 connector and easy-to-use Aqua4Plus software. Once programmed the unit will measure and collect data on a variety of time intervals.

Initial Inspection and Handling

Upon receipt of your smart sensor, inspect the shipping package for damage. If any damage is apparent, note the signs of damage on the appropriate shipping form. After opening the carton, look for concealed damage, such as a cut cable. If concealed damage is found, immediately file a claim with the carrier.

Do's and Don'ts

Do handle the device with care.

Do store the device in a dry, inside area when not in use.

Do install a desiccant tube if you are doing long-term outdoor monitoring.

Don't install the device so that the connector end is submerged.

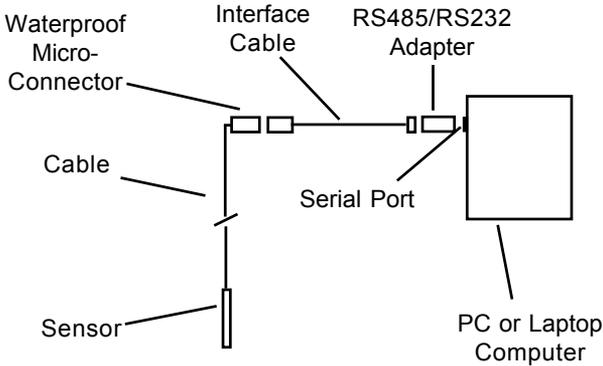
Don't support the device with the connector or with the connectors of an extension cable. Use a strain relief device to take the tension off the connectors.

Don't allow the device to free-fall down a well at high velocities as impact damage can occur.

Don't bang or drop the device on hard objects.

Connecting the Sensor to a Computer

In its standard configuration, the Smart Sensor cable is terminated with a waterproof micro-connector. Connect this to your PC or laptop serial port via the interface cable and an RS485/RS232 adapter, as shown below. If your computer does not have a serial port, you can connect to a USB port using a USB/Serial adapter. See Appendix XXX for details.



Installing the Aqua4Plus Software

1. Insert the Aqua4Plus CD in the CDROM drive on your PC or laptop. Installation should start automatically. If not, then follow steps 2 and 3. Otherwise, skip to step 4.
2. Click the Start button and select Run.
3. Type D:\setup.exe, where D: is the drive letter for your CDROM drive.
4. The Installation program will guide you through the installation process.

To start the Aqua4Plus software, use the Start Menu to navigate to the program group you selected during installation (typically this will be Aqua4Plus), and then click the Aqua4Plus icon.

Using Aqua4Plus

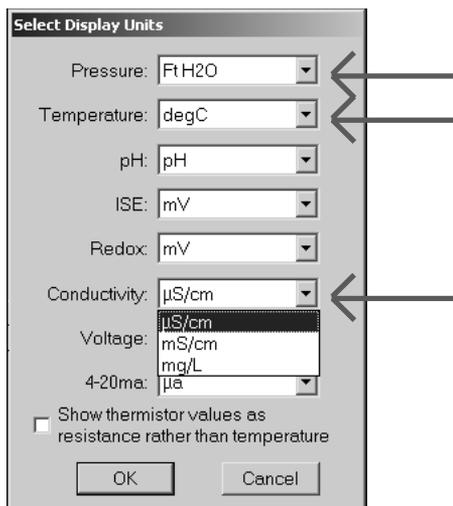
Selecting a COM Port

Select the COM port to which your sensor is connected, by clicking on the down arrow on the tool bar, and then clicking on the COM port.



Selecting Units

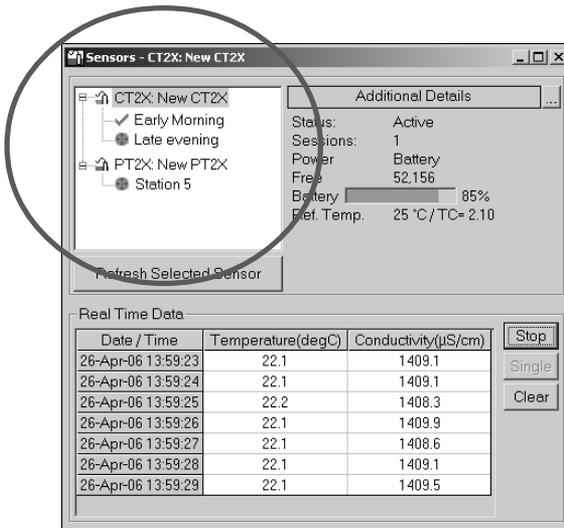
Readings from the Smart Sensor can be displayed in various different units. To set the display units, open the Options Menu, and then select Display Units. Select the units by clicking on the down-arrows next to Pressure, Temperature, and Conductivity. For Pressure many options are available, including psi, Ft H2O, and mBars. For Temperature, select from degrees Celsius, Fahrenheit, or Kelvin. For Conductivity, select from micro-Siemens per centimeter ($\mu\text{S}/\text{cm}$) or milli-Siemens per centimeter (mS/cm) for conductivity, or milligrams per liter (mg/L) for total dissolved solids (TDS).



Select Display Units

Viewing the Sensor

- Open the Sensor Window by clicking the  tool button. A list of connected sensors will appear on the Sensor Tree. For a CT2X with pressure option, you will see two sensors listed on the tree--a CT2X and a PT2X. The CT2X measures conductivity. The PT2X measures pressure. Aqua4Plus treats the CT2X and the PT2X as separate sensors--they each have their own temperature channel; they each have their own clock; and each is read separately.
- On the Sensor Tree, click on either the CT2X or the PT2X. Information regarding the selected sensor will display in the Sensor Information Panel to the right of the Sensor Tree.
- Click the + next to the desired sensor on the Sensor Tree. A list of data sessions stored in the sensor will display in the Sensor Tree below the selected sensor.



Sensor Tree on Sensor Window

Setting Sensor Descriptions

Each sensor on the sensor tree can be assigned a short description. This description is displayed on the sensor tree and is recorded with collected data. To assign a description, click on the sensor on the sensor tree. Then select the Sensor Description option from the Configure menu.

Setting Sensor Clocks

Each sensor has its own internal clock. Set this clock by clicking on the sensor, and then selecting the Sensor Clock option from the Configure menu. A pop-up box displays the

date/time currently in the sensor. Click the *Set From System Clock* button to set the sensor clock to match that of your host computer. Alternately, type in a specific date/time and click the *Set Clock* button. INW highly suggests that you set both the CT2X and the PT2X clock using *Set from System Clock*. This will assure that both sensors are set to the same time.

Calibrating

Field Calibration on the CT2X - Conductivity

The CT2X will need to be calibrated for the type of sampling you will be doing. For this calibration you will need a standard with a known conductivity at a specific temperature. For best results, select a standard that is as close as possible to the expected conductivity of your samples. If you will be using the nLFn mode for your measurements, you must use a standard that has a reference temperature of 25 degrees C.

To calibrate, follow these steps:

- Click on the CT2X on the sensor tree.
- Erase any sessions on the sensor. (Be sure to upload any data you want to save before erasing the sessions.)
- Select the Field Calibration option from the Configure Menu.
- Click on Conductivity. The conductivity field calibration window will appear. (See next page for illustration.)
- Select reference temperature for standard you are using.
- Make sure the Non-Linear box is not checked, unless using a non-linear calibration standard.
- Enter the Temperature coefficient (2.1 for a wide variety of fluids). (Not needed if using a non-linear calibration standard.)
- Enter TDS factor, if other than default of .49 (if measuring TDS).
- Rinse probe with your standard.
- Dry with clean paper towel and cotton swab.
- Place probe in standard.
- Make sure there are no bubbles in the conductivity slot.
- Allow to thermally stabilize.
- Click **Measure** button. A measurement box will pop up.
- When readings are stable, click **OK** on measurement box.
- If reading does not match that of your standard, use the spinner to adjust cell constant until reading matches that of your standard.
- Click the **Apply** button to transfer the new CELL constant to the calibration field.
- If you will be using the non-linear mode for your sampling (for instance for measuring in natural water), checkmark the Non-Linear checkbox at this time.
- Click the **OK** button to save calibration values to the sensor.

Field Calibration and Settings

CT2X: Smart Sensor

Channels

1: Temperature
2: Conductivity

Channel Label: Conductivity

Cal Date: 25-Apr-06 16:18

Ref. Temp.: 25 °C

Non-Linear

Temp Coef: 2.10

TDS FCTR: 0.49

CELL 2: 0.550

Comment:

The reference temperature MUST match calibration solution reference temperature. Change reference temperature if needed before calibrating.

Calculator

Temperature Compensated Conductivity: 1.4145 mS/cm

CELL 2: 0.550

Measure Apply

Field Calibration Window for Conductivity

Field Calibration on the CT2X - Temperature

The temperature channel on the CT2X rarely needs calibration in the field. If you do need to adjust its calibration, one- and two-point calibration can be performed from the Field calibration window as follows:

- Click on the CT2X on the sensor tree.
- Erase any sessions on the sensor. (Be sure to upload any data you want to save before erasing the sessions.)
- Select the Field Calibration option from the Configure Menu.
- Click on Temperature.
- Follow the instructions that appear to the right of the calibration window.

Field Calibration on the PT2X - Pressure and/or Temperature

Before shipping, the pressure channel on the PT2X has been calibrated using sophisticated environmental chambers and deadweight testers. As the sensor can drift slightly over time, it may occasionally need field calibration. The temperature channel rarely needs calibration in the field. If either the pressure or the temperature needs to be calibrated, one- and two-point calibration can be performed from the Field Calibration window as follows:

- Click on the PT2X on the sensor tree.
- Erase any sessions on the sensor. (Be sure to upload any data you want to save before erasing the sessions.)
- Select the Field Calibration option from the Configure Menu.
- Click on Pressure or Temperature, depending on which you are calibrating.
- Follow the instructions that appear to the right of the calibration window.

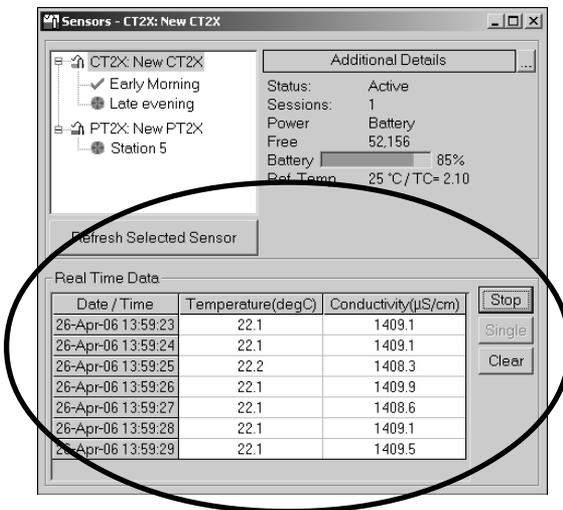
Taking Real Time Readings

Use the Real Time Monitor (lower part of Sensor Window) to view live readings from the sensor that is selected on the Sensor Map. These readings are not being recorded in the sensor, but only displayed for real time viewing. The Real Time Monitor can be used whether or not the sensor is actively recording a session.

To obtain and display a single reading, click the *Single* button.

To obtain and display readings continuously for 60 readings, click the *Start* button.

To stop the monitor, click the *Stop* button.



Real Time Monitor on Sensor Window

Recording Data

Before you can collect data in the logger, you must create a Session Profile, which describes the type and duration of records to record. The CT2X and the PT2X portions must be programmed separately. (If you will be correlating the data from both sensors, then before starting a recording session, set the clocks in both the CT2X and the PT2X to the same time using the Sensor Clock option on the Configure Menu.)

Create recording sessions as follows:

- Select the sensor you want to program from the Sensor Tree.
- Start a new session: Click the  tool button. A Session Profile Window will open. (See illustration top of next page.)
- Name your session: Enter a name in the Session ID box, or leave as is to accept the default name.
- Describe a test phase:
 - Click the number at the beginning of the test phase.
 - Use the **Tab** key on the keyboard to move to the sample interval column, and enter your sample interval for this phase as dd/hh:mm:ss.
 - Enter the number of samples to record at this sampling interval, then press the **Tab** key. You will automatically move to the next phase's sampling interval field.
 - Continue entering phases as above.
- If you will be correlating the data from both sensors, follow the Delayed Start instructions below. Otherwise, skip this step.
 - Click the Delayed Start checkbox.
 - Enter the date and time you want the test to start. (Time is in 24 hour format.)
- Start the test: Click the Start button. Your session will appear on the sensor tree with a green light in front of the session name. (If you have selected a delayed start, your session will appear with a clock face in front of the session name.)

For more detailed information on creating sessions, refer to the *Aqua4Plus Control Software Instruction Manual*.

Session ID: CT2X: Smart Sensor

Delayed Start

Phase	Polling Interval dd/hh:mm:ss	# Records	Phase Duration dd/hh:mm:ss
1	00/00:00:01	100	00/00:01:39
2	00/00:00:10	100	00/00:16:40
3	00/00:01:00	50	00/00:50:00
4	00/05:00:00	250	52/02:00:00
5			

Start

Clear

Delete

Session Duration:

Session Profile Window

Retrieving Data

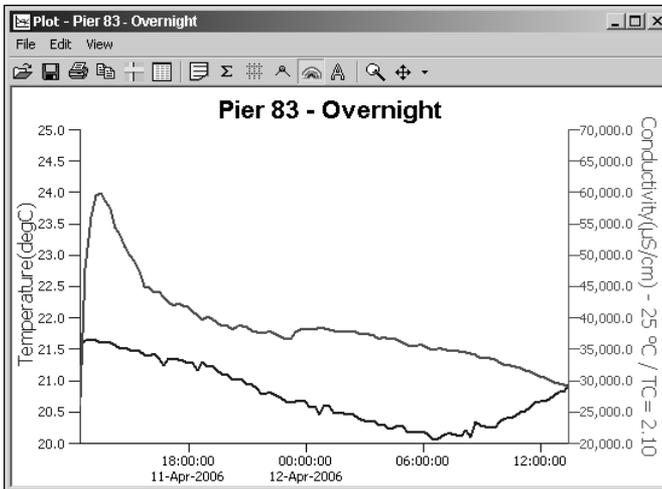
- On the Sensor Tree, click on the session you want to upload.
- Click the  tool button.
- Select a file location and enter a name for the file.
- Click Save.
- Click Start.

Viewing Data

- Click the  tool button to view data as a table.
- Click the  tool button to view data as a graph.
- Navigate to the desired file, then click the Open button. (If the File Open box does not appear, click the File Menu, then select Open.)
(See illustrations of table and graph formats on next page.)

File Display - Pier 83 - Overnight				
Sensor SN	Sensor Type	Sensor Name	Session	Records
123123	CT2X	CT2X Sensor	Pier 83-Overnight	200
		Temperature(degC)	Conductivity(μ S/cm)	
	Sensor Range	150K ohm	0-100 mS/cm	
	Minimum	20.1	26080.1	
	Maximum	21.7	59812.7	
	Mean	21.2	32762.0	
	Variance	0.28	58055574.08	
	Std Deviation	0.53	7619.42	
	Element/Ref Temp	30K5A -5 to 100	25 °C / TC= 2.10	
	Field Cal Date	30-Nov-27 00:00	11-Apr-06 09:07	
Rec#	Date/Time	Temperature(degC)	Conductivity(μ S/cm)	
1	11-Apr-06 12:24:32	21.6	30739.5	
2	11-Apr-06 12:24:33	21.5	29597.6	
3	11-Apr-06 12:24:34	21.5	28853.2	
4	11-Apr-06 12:24:35	21.5	28326.3	
5	11-Apr-06 12:24:36	21.6	28021.3	
6	11-Apr-06 12:24:37	21.6	27760.0	
7	11-Apr-06 12:24:38	21.5	27518.7	
8	11-Apr-06 12:24:39	21.6	27293.6	
9	11-Apr-06 12:24:40	21.6	27120.1	
10	11-Apr-06 12:24:41	21.6	26906.7	

File Display Window



Graph Window

Exporting Data

- Using the File Display window, open the file you want to export.
- Click on the  tool button.
- Select a file location and enter a name for the file or leave as is to accept the current file name.
- Select a file type. Files can be saved in either Text (.csv) or Excel (.xls) formats. Select the file type from the drop-down Save-as-type box. (.xls formatted files can be opened in Excel. .csv formatted files can be opened in Excel and most other popular spreadsheets, databases, and word processors.)
- Click Save. You will be given the option of viewing it in Excel. (Note, you must have Excel installed on your machine in order to make use of this option.)

Importing Data Into a Spreadsheet

To import data to a spreadsheet or database, you must first Upload and Export the data to a .csv file. (See previous sections on uploading and exporting.) Most spreadsheets and databases can readily import .csv files. Microsoft® Excel can import either .csv or .xls files. Following are instructions for importing a data file into Excel. For importing into other programs, see documentation with the particular program.

1. Open Excel.
2. Click on the File menu, and then select Open.
3. On the Open dialog box, click the down-arrow to the right of the *Files of Type* field. (This is the last field on the dialog box.)
4. Click the option *All Files*.
5. Navigate to the saved file, and then click the Open button in the lower right corner of the dialog box.

The data will be opened in Excel. (Note: While Aqua4Plus can handle over 130,000 records, Excel is limited to approximately 65,000 records.)

Appendix A: Grounding Issues

It is commonly known that when using electronic equipment, both personnel and equipment need to be protected from high power spikes that may be caused by lightning, power line surges, or faulty equipment. Without a proper grounding system, a power spike will find the path of least resistance to earth ground – whether that path is through sensitive electronic equipment or the person operating the equipment. In order to ensure safety and prevent equipment damage, a grounding system must be used to provide a low resistance path to ground.

When using several pieces of interconnected equipment, each of which may have its own ground, problems with noise, signal interference, and erroneous readings may be noted. This is caused by a condition known as a *Ground Loop*. Because of natural resistance in the earth between the grounding points, current can flow between the points, creating an unexpected voltage difference and resulting erroneous readings.

The single most important step in minimizing a ground loop is to tie all equipment (sensors, dataloggers, external power sources and any other associated equipment) to a **single common grounding point**. INW recommends connecting the shield to ground at the connector end.

Appendix B: Technical Specifications

Wiring Information

Cable Type: 9-conductor, vented

Shield	=	Ground
White	=	Vaux (5.5 to 15 VDC)
Brown	=	Digital out
Blue	=	Ground
Yellow	=	Comm D+
Purple	=	Comm D-

Conductivity/Temperature Module

BODY

Body Material	316 stainless steel
Probe Material	Epoxy/Graphite
Electrode	4-pole
Wire Seal Materials	Viton® and Teflon®
Terminating Connector	Available
Weight	Less than 1 lb.

CABLE

OD	0.28" maximum
Break Strength	138 lbs.
Maximum Length	2000 feet
Weight	4 lbs. per 100 feet

CONDUCTIVITY

Static Accuracy	±0.5% of measured value
Resolution	0.1 for microSiemens 0.001 for milliSiemens
TDS	0 - 2000 mg/L
Cell Constant	.55 (<i>standard</i>)

TEMPERATURE

Accuracy	±0.2° C (at 25° C)
Resolution	0.1° C

TIME

Accuracy	±6 sec/day (maximum) ±2 sec/day (typical)
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Operating Temp. Range 0° C to 80° C

Pressure/Temperature Module (Optional)
BODY

Body Material	316 stainless steel
Wire Seal Materials	Viton® and Teflon®
Terminating Connector	Available
Weight	Less than 1 lb.

CABLE

OD	0.28" maximum
Break Strength	138 lbs.
Maximum Length	2000 feet
Weight	4 lbs. per 100 feet

PRESSURE

Static Accuracy (B.F.S.L. 25° C)*	±0.1% FSO (maximum) ±0.06% FSO (typical)
Temperature Error (reference 25° C)	±0.5% FSO (maximum) ±0.25% FSO (typical)
Maximum Zero Offset at 25° C	±0.25% FSO
Resolution	16 bit
Ranges	various from 5 - 300 psi - absolute and gauge
Over Range Protection	2x (except 300 PSIA)

TEMPERATURE

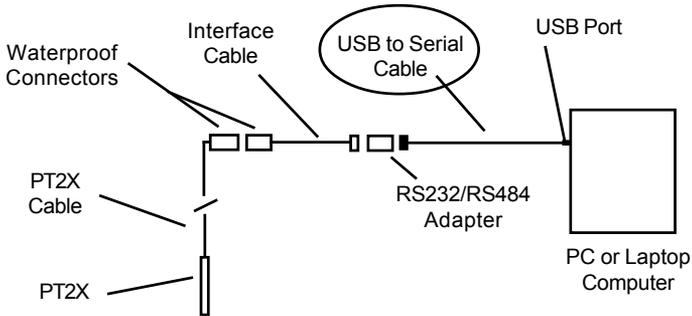
Accuracy	±0.75° C (maximum)
Resolution	0.1° C

TIME

Accuracy	±4 min/yr (maximum) ±2 min/yr (typical)
Operating Temp. Range	0° C to 40° C

Appendix C: Using USB to Serial Cables

The standard communication cable/RS485-232 adapter that comes with the Smart Sensor plugs into a 9-pin serial port on the PC or laptop. Many new computers, especially laptops, do not come with 9-pin serial ports. If you have one of these computers, or if all of your serial ports are in use, you can connect to a Smart Sensor using a USB to Serial adapter, as shown below.



Connection using a USB to Serial Cable

USB-to-Serial cables are readily available from many electronics and computer stores, as well as numerous sites on the Internet. INW has tested and recommends the Keyspan USA-19HS. It is available from INW or from CompUSA.

Install as follows:

- Plug into USB port
- Install the drivers provided with the particular unit
- Determine the port number to which the adapter assigned
 - Right-click on My Computer
 - From the popup menu, select Manage to open the Computer Management window
 - On left panel, click on Device Manager
 - On right panel, double-click on Ports
 - A list of active COM ports will be displayed. Note the COM number assigned to the adapter you just installed.

For example:  Keyspan USB Serial Port (COM8)

- Close Manager.
- Connect to the Smart Sensor
- On the Aqua4Plus software, select the COM port. (Note: if you do not see your new COM port in the drop-down box, open the Communications dialog box from the Options menu. Increase the Highest COM port number.)

Reordering Information

For sales & service offices, please contact:

Instrumentation Northwest, Inc.

www.inwusa.com

800-776-9355

**LIMITED WARRANTY/DISCLAIMER - *AquiStar*® PT2X and CT2X
SUBMERSIBLE PRESSURE and CONDUCTIVITY SENSORS**

A. Seller warrants that products manufactured by Seller when properly installed, used and maintained **with a properly installed desiccant tube**, shall be free from defects in material and workmanship. Seller's obligation under this warranty shall be limited to replacing or repairing the part or parts or, at Seller's option, the products which prove defective in material or workmanship within ONE (1) year from the date of delivery, provided that Buyer gives Seller prompt notice of any defect or failure and satisfactory proof thereof. Any defective part or parts must be returned to Seller's factory or to an authorized service center for inspection. Buyer will prepay all freight charges to return any products to Seller's factory, or any other repair facility designated by Seller. Seller will deliver replacements for defective products to Buyer (ground freight prepaid) to the destination provided in the original order. Products returned to Seller for which Seller provides replacement under this warranty shall become the property of Seller.

This limited warranty does not apply to lack of performance caused by abrasive materials, corrosion due to aggressive fluids, mishandling or misapplication. Seller's obligations under this warranty shall not apply to any product which (a) is normally consumed in operation, or (b) has a normal life inherently shorter than the warranty period stated herein.

In the event that equipment is altered or repaired by the Buyer without prior written approval by the Seller, all warranties are void. Equipment and accessories not manufactured by the Seller are warranted only to the extent of and by the original manufacturer's warranty.

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Printed on recycled paper.

Doc# 9B00830r1 05/2006



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