



AE Test Solutions, Inc.

***BUSMASTER***

Advanced Databus Analyzer

***2500***

# Users Guide

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This manual describes the operation of software contained in the Busmaster 2500. The operational software is copyright © 2004-2005 by AE Test Solutions, Inc.

Text format utilized in this guide:

Text in **bold, blue and underlined** indicates the name of a button that can/should be selected in order to accomplish the action that is being discussed.

Text in **bold black** indicates the name of a screen or item on that screen that is being discussed. For instance, if the guide is referring to the numbers inside of a dialog box, they would be printed as: **123.08** (example only) or the guide is discussing the options on the Touch Screen Calibration Page it would look like this: **Touch Screen Calibration Page**.

1	Introduction .....	5
2	Busmaster 2500 Components.....	6
2.1	The LCD Display .....	6
2.2	The Touch Screen .....	6
2.3	The Connector Panel .....	7
2.4	USB Interface.....	7
2.5	The Power Supply.....	7
3	Quick Start .....	9
4	Power Application .....	11
5	Touch Screen Calibration.....	12
6	Bus Selection .....	13
7	ARINC 429.....	14
7.1	Overview .....	14
7.2	Display Options.....	14
7.3	Transmitter Operation .....	14
7.3.1	Channel Setup.....	14
7.3.2	Label Setup.....	15
7.3.3	Editing Transmit Words.....	16
7.4	Receiver Operation .....	21
7.5	Receive Capture .....	22
7.5.1	Start Trigger .....	23
7.5.2	Trap Options .....	24
7.5.3	Stop Trigger .....	24
8	ARINC 575.....	26
9	ARINC 571 .....	27
10	ARINC 561 .....	28
10.1	Overview .....	28
10.2	Transmitter Operation .....	28
10.3	Receiver Operation .....	28
11	ARINC 568 .....	30
11.1	Overview .....	30
11.2	Transmitter.....	30
11.3	Receiver.....	30
12	CSDB.....	31
13	ASCB.....	32
13.1	Overview .....	32
13.2	Master Mode .....	32
13.2.1	ASCB Master Setup.....	32
13.2.2	ASCB Master Frame Setup .....	32
13.3	Equipment Setup .....	33
13.4	ASCB Monitor Mode .....	34
13.4.3	Address Overview.....	34

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13.4.4	Trapped Address .....	35
13.4.5	Display Setup .....	35
13.4.6	Print .....	35
14	Utilities.....	36
14.1	Touch Screen Calibration.....	36
Appendix A	Connector Definition.....	37
Appendix B	Supported Printers .....	39

## **1 Introduction**

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The Busmaster 2500 from AE Test Solutions, Inc. represents the latest in aviation test equipment technology. When an aircraft instrument which transmits one of the seven (7) supported buses is connected to the Busmaster, the Busmaster 2500 will monitor and display all the labels on the bus. Labels may also be transmitted directly from the Busmaster 2500 to a connected device.

Using the Busmaster 2500, an operator can determine whether an instrument is transmitting bus information correctly. By configuring the Busmaster 2500, one can simulate the transmissions of a second instrument. In this way, it can be confirmed whether a second connected device is responding to the transmitted labels as expected.

The Busmaster 2500 supports ARINC 2-wire and 6-wire buses, as well as CSDB and ASCB.

## 2 Busmaster 2500 Components

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The major components of the Busmaster 2500 include a 10.4" full color LCD display, overlaid with a touch sensitive protective screen; three (3) connectors for avionics interface; On/Off and Battery indicators; and a USB interface.

### 2.1 The LCD Display

The display is a 10.4" full color 800 x 600 pixel resolution liquid crystal display (LCD). The LCD is protected by a 1/8" glass overlay.

The LCD is contained within a bezel which may be adjusted up and down for best viewing angle. To adjust the LCD, grasp the handle at the top of the bezel and set it to the desired angle.

### 2.2 The Touch Screen

The user interface to the Busmaster 2500 is via a touch screen. This interface allows an intuitive ease of use allowing customization of the product. The touch screen overlays the LCD and provides a highly accurate indication of touch location.

#### Operating

The touch screen is most sensitive to soft objects (such as a finger) touching the screen and less sensitive to items such as a ball-point pen. Using a hard object is unlikely to damage the screen. If a stylus is desired, rather than touching with a finger, it is suggested that a hard rubber be utilized. (Stylus' are available from ELO Touch.)

To activate a button that has been shown on the screen, touch the glass over the button. A highlight of the button in either green or blue indicates it has been touched. Releasing the highlighted button will cause the action associated with that button to occur. If you maintain contact with the glass, it is possible to move from one button to another without activating the first button. If you make contact in an inactive area and then move over a button, the button will initially not be highlighted but will become highlighted when your finger moves over it. If you release pressure from the touch screen with no button highlighted, no action is taken.

## **Cleaning**

The screen is glass and can be cleaned with any glass cleaner and a soft cloth. Apply cleaner to the cloth then clean the glass with the cloth. This helps to avoid cleaners from pooling around the bezel edges.

## **2.3 The Connector Panel**

There are three (3) circular connectors that allow interfacing to avionics units under test. They are organized by the type of bus supported. The connectors are as follows:

1. 28-pin female, labeled 429/571/575 supports the 2-wire interfaces; 4 transmit channels, and 4 receive channels
2. 16-pin male, labeled 561/568 supports the 6-wire interface; 1 transmit channel, and 1 receive channel
3. 9-pin male, labeled CSDB/ASCB/RS-422 contains the non-ARINC buses.

The pin outs of these connectors are given in Appendix A.

Three wiring harnesses are included with test clips on the ends. Only one type of bus is active at a time.

## **2.4 USB Interface**

The USB interface supports Hewlett-Packard printers. See Appendix B for a listing of compatible printers. This interface has not been tested with other manufacturer's printers, although some may operate correctly.

## **2.5 The Power Supply**

The Busmaster 2500 contains a high-capacity NiMH (nickel metal/hydride) battery pack. A DC power supply is provided to charge the battery pack. The Busmaster 2500 is capable of operating and charging the battery simultaneously.

### **Charge Time**

A completely depleted battery pack will completely charge within four hours. There is no harm in leaving the DC supply connected - the internal charger will not over-charge the batteries. NiMH batteries slowly lose charge even when not in use. Therefore, it is suggested that the unit be plugged in and charging whenever not in use. The total power consumed will be less than 5 watts while in trickle charge mode.

**Battery Discharge**

During use of the Busmaster 2500 under battery power only (while the DC supply is disconnected), the batteries will lose charge. When run down, the Busmaster 2500 will cease to function. NiMH batteries have no memory, so there is no need to completely discharge the batteries prior to connecting the DC power supply.

## 3 Quick Start

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Follow this quick start to begin to understand the functionality of the Busmaster 2500. This tutorial will show how to run an ARINC-429 transmission/reception. You can run this tutorial without an in-depth understanding of the capabilities of the Busmaster 2500.

1. Open the case lid.
2. Remove the DC power supply from the pouch. Insert the DC plug into the jack on the back of the Busmaster 2500 case. Insert the AC power cord into the plug on the power supply. Plug the AC power cord into a wall socket.
3. Remove the 28-pin harness from the pouch. Remove the cap from the 28-pin circular connector labeled 429/571/575 on the Busmaster. Connect the harness to the 28-pin connector.
4. Turn on the Busmaster using the [On/Off](#) switch on the left side of the Busmaster panel.
5. When the **Busmaster 2500** main screen page appears, press the [ARINC 429](#) button. (If the button doesn't activate, follow the steps in section 5, **Touch Screen Calibration**, then return here.)
6. On the **ARINC 429 Setup** page, press the upper-left box labeled [Tx Channel 1](#). This will take you to the **ARINC 429 Transmit Set-up** page. (The name of the pages are listed along the left border of the page.)
7. The **Transmit Setup** page shows all the labels that are currently being transmitted on a given channel. If this is the first time power has been applied to the unit, no labels should be being transmitted. Select the [New](#) button. This will display the **Transmit Word Setup** page initialized to all zeros.
8. Select the [Eq. ID](#) button. It will remain green after it has been activated and the text inside will have a white background showing that it is in edit mode. The keypad on the right portion of the display will ungray allowing editing of the equipment identification. Press the [CLR](#) button on the screen's numeric keypad which will clear the entry to blanks. Press the [2](#) button and then press [Enter](#) on the keypad. Note that the **Equipment ID** box stayed highlighted in green while the keypad buttons were highlighted in blue when activated. Now select the [Label](#) button and using the keypad to the right enter label [001](#), press [Enter](#). Now **Equipment ID 002**, **label 001** reads *Distance to Go*. Touch the [Value](#) button and enter [10.0](#) by touching the [1](#), [0](#), [.](#) and [0](#) buttons, then press [Enter](#). The default rate is 100 msec between labels. Touch the [Accept](#) button.

9. The new label will show in the transmit labels window (the large white window on the left side of the screen). The default font is a small font. You may change this to a large font by touching the [Channel Setup](#) button. A pop-up window provides the opportunity to change the font to **Medium** or **Large** size and select the speed of the bus to **High** or **Low**, and select whether the bus is **enabled** or **not enabled**. After making any desired changes, choose [Accept](#) for the Busmaster to accept your changes and take you back to the **Transmit Setup** page.
10. To see the data transmitted, connect the Transmit Channel 1 test clips to the Receive Channel 1 test clips (white to white, black to black).
11. Touch the [Main Setup](#) button to go back to the **429 Setup page (the tx/rx overview page)**.
12. Notice that the **Tx Channel 1** summary shows one label being transmitted. If the transmit and receive cables are looped back (step 10) the **Rx Channel 1** summary shows that a single label is being received.
13. Touch the [Rx Channel 1](#) button to go to the ARINC 429 Receive Text View page.
14. The **Distance To Go** label will be displayed in the receive window if the transmit channel clips were connected in step 11.

For more detailed descriptions on the functions of the various pages and buttons, please see the following sections.

## 4 Power Application

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The Busmaster 2500 contains a high capacity NiMH battery pack and an external DC power supply. The Busmaster 2500 is capable of operating while the batteries are charging.

The external power supply comes with a standard North American 3-pronged plug for use with 110 V 60-Hz AC that is standard in the United States. However, the external power supply is capable of handling 100 to 240 volts 50 to 60 Hz AC. A separate power cord is available.

The Busmaster's DC input is 24 V DC at 2.5 Amps.

The Busmaster 2500 has two visible indicators regarding the power status. On the left side of the face plate are two LED's: one marked **Batt** and the other marked **Power**. Whenever external DC power is applied, the **Batt** LED will be lit. When the unit is in fast charge mode the **Batt** LED will be amber, and when it is in trickle charge mode the LED is green.

The Power LED indicates that the Busmaster is turned on; it will light green whenever the power switch is in the **On** position and the batteries have sufficient charge.

### Sequence

There is no specific power up or power down sequence. The power switch may be operated at any time. Any data collected, or configuration changes made since the last Save Configuration will be lost when the unit is turned off.

## 5 Touch Screen Calibration

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On the Busmaster 2500 main menu (the main bus selection page), press the button labeled [Utilities](#). This takes you to the **Utilities** page where you may go to the **Calibrate Couch Screen** page, go to the software update screen (**SW Update**) or return to the **Main Menu**. If you were able to get to the screen without difficulty, then the screen calibration is correct, and you may select **Main Menu** to return to the Busmaster 2500 main menu screen.

If the button does not glow green when pressed, the touch screen needs to be calibrated. There are two methods to get to the **Calibration** page from the **Busmaster 2500 main menu** page.

1. Press and hold in one spot for 5 seconds; a cross-hair will appear showing where the touch screen thinks it is being pressed. While holding pressure on the screen, move the cross-hairs until the **Utilities** button glows green. When the **Utilities** button is glowing, release the pressure. This will take you to the **Utilities** page.

OR

2. Press and release the touch screen once per second (anywhere) three times in a row. (That is press/release “one-one thousand”, press/release “two-one thousand”, press/release.) When this is done on the **Bus Select** page, the **Utilities** page will be selected. If this sequence is done on the **Utilities** page, the **Touch Screen Calibration** page will be displayed.

The process of calibrating the touch screen is to first touch it in the upper right corner and then in the lower left corner. When the **Touch Screen Calibration** page is first displayed, a target will be shown in the upper right corner with instructions to touch it. Lightly tap the screen close to the cross. As soon as the touch screen controller registers your tap, a target will be shown in the lower left corner of the display. Lightly tap that target. The Busmaster 2500 will then perform the calibration and save the results to the touch screen controller. This process probably will not need to be repeated for a long time.

If at any time the calibration appears to be misaligned, return to this screen to re-calibrate the controller.

## 6 Bus Selection

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On **the Busmaster 2500 main menu**, select the bus to be used. The choices are **Arinc 429**, **Arinc 571**, **Arinc 575**, **Arinc 561**, **Arinc 568**, **CSDB** and **ASCB**. Touching the corresponding button selects that bus for output. When a bus is selected, the outputs for that bus become active immediately. If a 6-wire bus is selected, the clock line of the bus will immediately become active.

## 7 ARINC 429

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The Busmaster 2500 supports all labels and equipment identifiers specified in Arinc 429 rev 16 published September 27, 2001.

### 7.1 Overview

The Arinc 429 interface is a differential 2-wire bus that is self-clocking. The bus supports 256 labels and 4 source-destination pairs. The labels take on different meanings depending on which equipment is using the bus. The equipment in use is defined by the Equipment ID (Equipment Identification).

In the Arinc 429 specification, the labels are represented in octal values ranging from 000 to 377. The Busmaster makes use of this octal representation as well. In the Arinc 429 specification, the Equipment ID is a 3-digit hexadecimal number, ranging from 000 to FFF (hex). In the current specification there are many unused Equipment ID's; the highest currently defined is 341(hex).

When the [ARINC 429](#) button is selected from the main display, a page is shown that provides an overview of the current status of the ARINC 429 bus. There is an overview for each channel of transmit and receive, as well as a button that displays the capture status. Touching any of the buttons associated with a transmit or receive channel will bring up the page associated with that channel. Touching the [Rx Trap](#) button will bring up the capture page. See section 7.3 for transmitter operation, section 7.4 for receiver operation and section 7.5 for capture operation.

### 7.2 Display Options

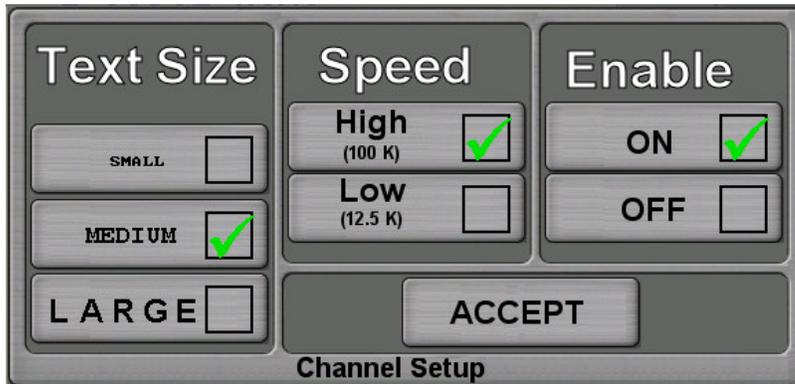
On both the **Transmit Setup** and **Receive Setup** display screens, the display options can be changed by selecting the [Channel Setup](#) button to the right of the main display screen. From the **Busmaster 2500 Main Menu** screen: select one of the bus names, select either one of the [TX Channel](#) buttons or one of the [Rx Channel](#) buttons, select [Channel Setup](#).

The options that can be selected are: [Font Size](#), [Bus Speed](#), and [Bus Enable](#). For more description see 7.3.1.

### 7.3 Transmitter Operation

#### 7.3.1 Channel Setup

When viewing the Transmit page, touching the [Channel Setup](#) button will bring up the following display:



The options you desire may be selected by touching the associated button. The green check-marks will show the currently selected item. When finished making changes to the options for the channel, touch the [ACCEPT](#) button. The screen will go back to the transmit (or receive) screen.

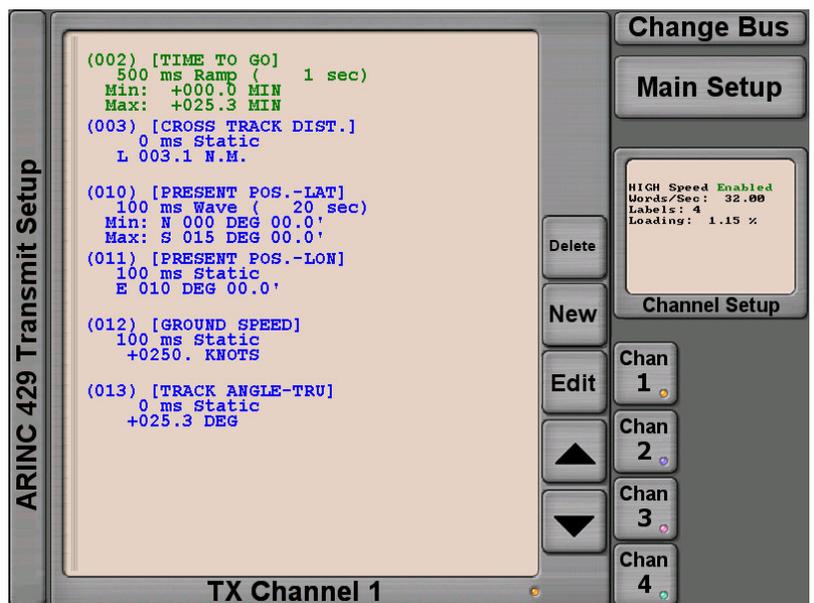
### 7.3.2 Label Setup

The Busmaster allows the user to select the labels to be transmitted, the data to be sent within the labels, and the rates at which the labels are repeated on the bus.

All four transmit channels operate at the same time. That is, they are not dependent on which channel is currently displayed. The currently displayed channel can be changed by touching the button associated with the channel to be viewed. To view **channel 1**, touch the [Chan 1](#) button, etc. The title at the bottom of the screen will tell which channel is currently being displayed. The color associated with each channel is the color of the cable for that channel. (yellow - channel 1, blue - channel 2, red - channel 3, and green - channel 4).

The data to be transmitted can be entered by selecting the [New](#) or the [Edit](#) button. If the [New](#) button is pressed, the **Transmit Word Setup** page is displayed

The ARINC 429 specification gives guidance for the rates that labels should be repeated on the bus. The Busmaster allows the user to select the rate on a per label basis. The default is 100 msec but can be set at any rate from 5 msec up to 99.999 seconds between labels.

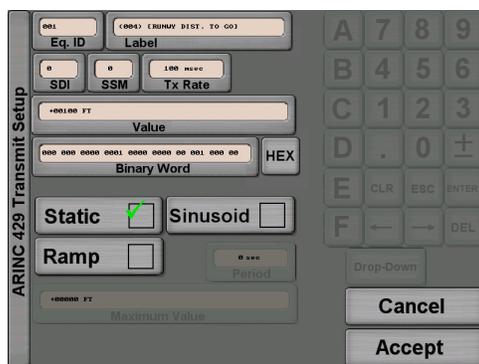


### 7.3.3 Editing Transmit Words

While viewing a channel, select **Edit** to view the **Transmit Word Setup** screen.

**NOTE:**

This page is not specific to ARINC 429; it is also used for ARINC 561, ARINC 575 and ARINC 571.



#### General Editing

To change the value in a field, select that field by touching it. It will highlight green then type in the new value using the numeric keypad to the right. The buttons highlight or gray-out depending on whether they are active or inactive. When there is no active value being edited, the keypad is not enabled.

The **CLR** key will clear the value to blanks.

The **ESC** key will cancel the current value edit, returning the value to what it was prior to being edited.

The **ENTER** key will end the current value edit, saving the new value.

The **<-** (left arrow) button will move the cursor to the left one character in the current value edit box. The **->** (right arrow) button will move the cursor to the right one character in the current value edit box.

The **DEL** button will delete the character to the left of the cursor.

The **.** (period) button will insert a decimal point.

The **+/-** key will change the sign of the current edit value.

The **Drop-Down** button will provide a drop down list of valid values from which to choose.

The **HEX** button changes the edit type from Binary to HEX. When the display is Binary, the HEX button is displayed; when Hex is displayed, the **BIN** button is displayed. This button may be pressed at any time – even during binary edit – to toggle between Binary and Hex.

## Equipment ID



The Equipment ID may be changed by touching the [Eq. ID](#) button. Once the button is highlighted, there are two ways to change the data:

1. Use the normal edit keys to set the value ([CLR](#), [DEL](#), arrow keys, and the hexadecimal keypad)

OR

2. Touch the [Drop-Down](#) button, and select a valid Equipment ID from the presented list.



In ARINC 429, the Equipment ID is a three digit hexadecimal number. Therefore, the hexadecimal keys are enabled on the keypad.

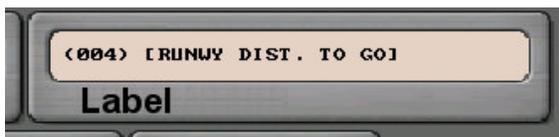
### NOTE:

When editing an ARINC 429 word, there are approximately 241 defined Equipment IDs. When editing ARINC 561, there are two, and for all other buses, the **Eq. ID** field is grayed-out.

### NOTE:

The Equipment ID for a given label being transmitted is only used while defining the data to be transmitted; the Equipment ID is only sent in label 377, which must be separately selected for transmit.

## Label



When entering a label, the data format for a given label is dependant on the **Equipment ID** selected for that label. Therefore, the text associated with a label will change depending on which equipment identification is selected.

The label is in octal format so the keypad only allows entry of the digits **0, 1, 2, 3, 4, 5, 6, and 7**.

Like the **Equipment ID**, the label may be directly entered or chosen from a drop-down list. The values listed in the **Label** drop-down list are associated with the currently selected **Equipment ID**.

If a label is entered that is not valid for the selected **Equipment ID**, the label box will show **UNKNOWN** and the **Value** box will be displayed in hexadecimal.

### Source Destination Identifier



The source destination identifier can be edited by selecting the [SDI](#) button. The SDI is a two-bit portion of the word. Therefore the SDI can hold the values [0](#), [1](#), [2](#), and [3](#). The meaning of the SDI is label dependent.

### Sign Status Matrix



The **Sign Status Matrix** can be edited directly. It is also a two-bit portion of the transmitted word. It can hold values of [0](#), [1](#), [2](#) or [3](#). The values are specified as follows:

- 0** - Valid Positive data
- 1** - No computed Data
- 2** - Functional Test
- 3** - Valid Negative data

When the value of a label (the **Value** button) is edited, the **SSM** is updated directly as a result of that edit. After a value edit, the **SSM** will be updated to be either **0** or **3**, depending on whether the value entered was positive or negative.

Even if the **SSM** was **1** or **2** prior to the value being edited, the **SSM** will change to either **0** or **3** after the **Value** edit.

### Transmit Rate



The interval at which the current label will be transmitted may be set using the [Tx Rate](#) button. The interval can be selected to be from **1** to **99,999** msec.

#### NOTE:

The ARINC specifications give guidance on the suggested min/max rates for each label. The low-speed ARINC bus takes 2.88 msec for each label; so as a practical matter, anything less than 3 msec on a low-speed bus will overload the bus.

## Value

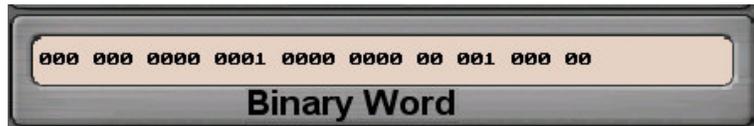


The actual value to be transmitted can be edited by selecting the **Value** button. The value is entered in decimal format. For instance to enter a value of 123.4 nautical miles for **Distance To Go**, select the **Value** button, touch **CLR** and then touch **1, 2, 3, ., 4** and then **ENTER**.

### NOTE:

When editing the value, several decimal places are displayed and can be entered. However, when **ENTER** is touched, the value entered is parsed into the binary representation and then the binary is parsed back to English and that resulting value is displayed. For example, if **Equipment ID 002**, and **label 312** are selected, then a speed of **123.4** is entered in the **Value** area; once the **ENTER** key is pressed the **123.4** is parsed into binary **01100000 01111011 01100000 01010011** which represents a ground speed of 123.375 knots. So, **123.375** is displayed. This is because the resolution is 0.125 for this label. The data entered will be rounded accordingly.

## Binary Word



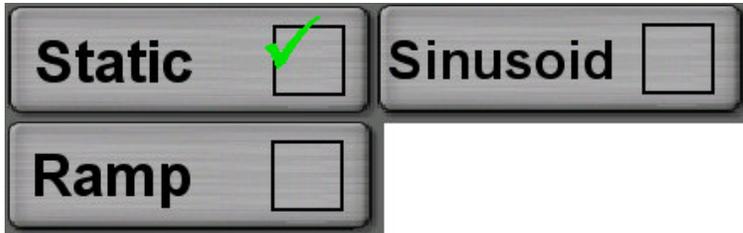
The actual bits of the word to be transmitted may be edited directly by selecting the **Binary Word** button. Note that if the label portion (the right-most 8 bits) is changed, the value displayed in the **Label** edit area will change. Likewise with the **SDI**, **SSM**, and the value portions of the label.

When editing the binary word, the only digits allowed are **0** and **1**.

## Hex Word

The same window that shows the Binary Word doubles as the hexadecimal edit window when HEX is selected. During Hex edit, 4 pairs of hex digits are displayed, and the keyboard switches to enable all of the Hex characters. Again, if the label portion (the right-most 2 digits), or the SDI or SSM portions of the data are changed, that change will be reflected in the **Label**, **SDI** and **SSM** edit areas.

## Varying Data



The Busmaster 2500 has the ability to provide either static data or dynamic data. When static is selected, the entered word will be continuously transmitted at the specified rate and will never vary. However, if dynamic data is desired, either sinusoidal or ramp data can be specified. These are selected by touching the [Static](#), [Sinusoid](#) or [Ramp](#) buttons. If either non-static variation is selected, the value portion of the transmitted word will vary between the value in the **Value** box and the value in the **Maximum Value** box.

Selecting **Sinusoid** will create a series of data that looks like a sine wave when plotted against time. Selecting **Ramp** will create a series of data that starts at the **Value** and increases linearly until reaching **Maximum Value**, then immediately start over at **Value** again.

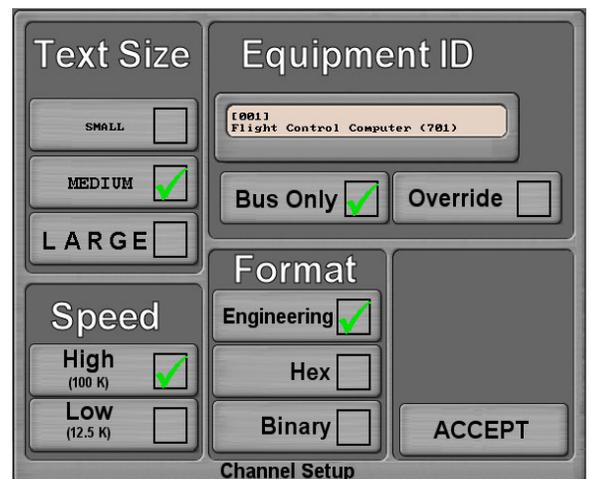
The period of the sinusoid or the ramp is specified by the [Period](#) button. The period is given in seconds.

## 7.4 Receiver Operation

The Busmaster will display all labels received. The most recent data will be displayed along with the time interval between reception of that specific label. The data is decoded according to the selected Equipment ID for the bus and the label being received. The selected Equipment ID is shown at the top of the display.

The receive channel parameters can be set up by touching the [Display Setup](#) button. This brings up a new screen (shown to the right) in which the size of text on the display can be changed between **small**, **medium**, and **large**. The speed of the receive bus can be changed between **Low** and **High** speed. The default **Equipment ID** can be selected from a drop-down list of valid Equipment IDs. The format of the labels can be selected as **Engineering**, **Hex** or **Binary**.

In ARINC 429, label 377 is reserved for the transmission of the equipment identifier. However, not all systems transmit their equipment identifier on the bus. Therefore, the Busmaster 2500 allows the user to select a default equipment identifier to



be used to interpret the data on the bus. If the [Bus Only](#) selection is checked, the data will be interpreted as specified only if a valid label 377 hasn't been received. If the [Override](#) selection is checked, the specified equipment identifier will be used, even if it conflicts with a valid equipment identifier being received on label 377.

Pressing the [ACCEPT](#) button returns to the receive screen with the selected options in place.

Any of the four receive channels may be selected by touching the associated button: [Chan 1](#), [Chan 2](#), [Chan 3](#) or [Chan 4](#). The main display screen shows which channel is being displayed along with a colored dot that is color coded with the associated probe end.

Touching the [Overview](#) button changes the display to show all 255 (377 octal) labels allowed and whether or not they are active. A label displayed in black text is not active. A label displayed in green text is currently active. A label displayed in yellow was once active on the bus but has been inactive for at least 5 seconds. Pressing the [Clear Disp](#) button clears all labels to inactive, allowing a new look at active labels.

To change from viewing the **Receive** page to viewing the **Transmit** page, touch the [Main Setup](#) button, then select the desired transmit channel from the overview page.

## 7.5 Receive Capture

The Busmaster has a receive capture feature that allows the user to specify a trigger to start data capture, to specify which data to capture and to specify a trigger to stop data capture. To access the receive capture function, touch the [Rx Trap](#) button from the main ARINC 429 page.

The received data is displayed in the same format as that specified for each channel on the normal ARINC 429 receive data page.

The parameters of the triggers and capture are set by touching the [Set Trap](#) button. This brings up a display page that has three sub-pages – one each for Start, Trap and Stop.

Pressing the [Start](#) button enables the start trigger. After the trigger, data is captured according to the Trap specification. When the Stop trigger occurs, data will no longer be captured. During the capture phase, the data being captured is displayed, and a cumulative word count is displayed in the [Display Setup](#) area. The capture may be stopped at any time by pressing the [Stop](#) button. After the capture is stopped, the data captured is displayed and may be viewed by scrolling up and down or may be printed using the [Print](#) button.

Pressing the [Start](#) button again will clear the captured data and re-enable the trigger.

### 7.5.1 Start Trigger

The allowable triggers for start are:

- a. Now
- b. Delay a number of seconds
- c. Binary Word
- d. Hex Word
- e. Engineering value equal to specified value
- f. Engineering value greater than specified value
- g. Engineering value less than specified value

If **Now** is selected, the data capture will begin as soon as the **Start** button is pressed on the trap page.

If **Delay** is selected, the **Seconds** button will become active. When the **Start** button is pressed on the trap page, the Busmaster will delay the specified number of seconds then start capturing data. Entering data for seconds is similar to entering data for the word rate described in section 7.2.

If **Bin Word** is selected, the **Value** button will become enabled. In this mode, when the **Start** button is pressed, the Busmaster will wait until a label is received on any of the 4 channels that matches the binary representation shown in the Value window. There are three states that can be specified for each bit in the binary word: '1', '0', and 'X' or 'Any'. The '1' and '0' are entered using the **1** and **0** buttons, and an 'X' is entered using the **Any** button. When the Busmaster is looking for a binary word match, it will ignore bits represented by an 'X'. To start a capture upon the receipt of a specific label – e.g. label 001, use the binary word option and specify:

XXX XXX XXXX XXXX XXXX XXXX XX 100 000 00

as the capture value. In this case, only the 8 bits associated with the label will be compared to incoming data, and the trigger will occur when those 8 bits are equal to label 001.

If **Hex Word** is selected, the **Value** button will become enabled. In this mode, when the **Start** button is pressed, the Busmaster will wait until a label is received on any of the 4 channels that matches the hexadecimal representation shown in the Value window. There are 17 states that can be specified for each nibble in the hex word: '0', through 'F', and 'X' or 'Any'. The hexadecimal values are entered using the hexadecimal buttons, and the 'X' is entered using the **Any** button. Operation is similar to the Binary Word trigger.

If **Eng =** is selected, the **Value**, **Eq ID** and **Label** buttons will become enabled. In this mode, after the **Start** button is pressed, the Busmaster will wait until a word is received that contains the label specified with an engineering value equal to that specified in the Value window. When the equipment ID (**Eq ID**) button is selected, the **Drop Down** button becomes active allowing the equipment ID to be selected from a list of available values. Likewise, when the **Label** button is active, the **Drop Down** button will allow the user to select a label from a list of available labels associated with the specified equipment ID. The value is specified similar to that described in section 7.2

If [Eng <](#) or [Eng >](#) are selected, the operation is the same as that for [Eng =](#), except that the Busmaster will trigger if the engineering value in the received word is less than that specified ([Eng <](#)) or greater than that specified ([Eng >](#)).

### 7.5.2 Trap Options

After the Busmaster has triggered, incoming words that meet the specifications on the Trap page will be captured and displayed.

The allowable criteria for the data to be captured are:

- a. All
- b. Binary Word
- c. Hex Word
- d. Label equal
- e. Label not equal

When [All](#) is selected, all incoming data from all 4 channels will be captured.

When [Bin Word](#) or [Hex Word](#) are selected, data that meets the bits as specified in the [Value](#) field will be captured. As with the binary word and hex word specifications for Trigger, a 'X' value may be included.

When [Label =](#) is selected, the four label buttons become enabled. The user may specify 4 labels to capture. In this mode, only labels matching any of the 4 labels will be captured and displayed.

When label not equal is selected, the four label buttons become enabled. The user may specify 4 labels to not capture. In this mode, the Busmaster will capture all words that don't have any of the 4 specified labels.

### 7.5.3 Stop Trigger

The user can specify which condition will cause the capture to stop.

The allowable triggers are:

- a. Manual
- b. Delay a number of seconds
- c. Binary Word
- d. Hexadecimal Word
- e. Engineering value equal to specified value
- f. Engineering value less than specified value
- g. Engineering value greater than specified value.

If the [Manual](#) button is selected, the Busmaster will capture data until the Stop button is pressed on the capture display page.

The other trigger specifications are similar to the Start Triggers discussed in section 7.5.1.

## 8 ARINC 575

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The Busmaster 2500 supports transmission and reception of digital data defined by ARINC 575 dated July 15, 1971. There are a total 24 individual labels that can be transmitted and received.

For detailed information on the operation of the 575 functions, please refer to the Arinc 429 descriptions of those function.

ARINC 575 is a special mode of two-wire bus. On the Busmaster 2500, ARINC 575 is supported on the wires that are used for channel 1 of the ARINC 429 interface. (There is only one ARINC 575 transmit and one ARINC 575 receive channel available.)

The transmit label setup is similar to that for ARINC 429. See section 7 for details of label editing. The differences are:

1. There is no equipment identifier for ARINC 575. The option to select equipment id is grayed out on the label setup page.
2. There is no source/destination identifier. The option to select SDI is grayed out on the label setup page.
3. The sign status matrix bits are in bits 31 and 32 for BCD data with no parity. When editing labels to be transmitted, the SSM values will be placed in the proper bits based on the type of data.

The receiver operation for ARINC 575 is similar to that for ARINC 429. The differences are:

1. There is no equipment identifier.
2. There is no source/destination identifier; there is only one version of each label on the bus.

## **9 ARINC 571**

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The Busmaster 2500 supports testing of the digital data bus defined in ARINC 571-2, published May 15, 1974.

For detailed information on the operation of the 575 functions, please refer to the Arinc 429 descriptions of those function.

The user interface of the Busmaster 2500 in ARINC 571 mode is identical to ARINC 575 mode. The only difference is that the ARINC 575 database is active rather than the ARINC 571 database.

## 10 ARINC 561

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The Busmaster 2500 supports transmission and reception of digital data defined by ARINC 561-11, dated January 17, 1975, and further defined in ARINC 419-3 dated November 5, 1984.

For detailed information on the operation of the 575 functions, please refer to the Arinc 429 descriptions of those function.

### 10.1 Overview

ARINC 561 specifies a 6-wire digital serial data bus for communications with the Inertial Navigation System (INS). The bus may be in BCD or in binary mode. In ARINC 561 installations, a separate bus is provided for the two data types: one is strictly BCD and the other is strictly binary. In the Busmaster 2500, selection between these two data types is done via selection of the Equipment ID. Equipment ID 1 is binary; Equipment ID 2 is BCD. The default is BCD.

**NOTE:**

It is possible to put the Busmaster into an operational mode that is not realistic - that is transmitting both BCD and binary labels on the same bus.

### 10.2 Transmitter Operation

The Busmaster allows the user to select the labels to be transmitted in a manner similar to the ARINC 429 operation. The repetition rate is not specified in the ARINC specifications and defaults to a 100 msec repetition rate.

The selected data words are output on the 6-wire bus on the connector labeled 561/568.

### 10.3 Receiver Operation

The Busmaster receives and decodes the labels sent on the 6-wire bus on the connector labeled 561/568.

ARINC 561 is unique in that it re-uses labels for both binary and BCD data. In an aircraft installation, two separate busses are used; one transmitting BCD data only, and one transmitting binary data only. The Busmaster 2500 treats the data as BCD or as binary depending on the [Equipment ID](#) selected for the receive channel. If [BCD](#) is selected and the bus connected to it is in binary mode, the resulting display will be meaningless. If data for some labels is showing up as "BAD!" it is likely that the bus connected to it is transmitting data in binary mode.

**NOTE:**

ARINC 561 doesn't define an equipment identification field. The Busmaster 2500 simply uses the Equipment ID field to specify BCD vs. Binary bus. Any odd number will specify binary operation, and any even number will specify BCD operation.

## 11 ARINC 568

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### 11.1 Overview

ARINC 568 only utilizes a single label - DME Distance. The Busmaster has a single page for 568 operation that manages the transmission and reception of the DME Distance word. It is expected that the Busmaster will only have the **Transmit** OR the **Receive** bus connected at any one time - depending on which portion of the ARINC 568 system is being tested. The Busmaster can drive the display with the transmitter portion or listen to the output of the interrogator with the receiver portion.

For detailed information on the operation of the 575 functions, please refer to the Arinc 429 descriptions of those function.

### 11.2 Transmitter

The bottom portion of the **ARINC 568** screen controls the transmitted word. The word contains 5 digits of distance with a maximum representable distance of 399.99 nautical miles. As soon as the **ARINC 568** page is selected, the **DME Distance** that is shown on the bottom portion of the screen will be transmitted on the 6-wire interface at a 100 msec rate.

The value transmitted may be changed using the up and down arrow keys above and below each digit represented. Touching an [up arrow](#) will increase the value of the associated digit. Touching a [down arrow](#) will decrease the value of the associated digit. Each digit has a valid range of 0 to 9. The numbers wrap around when the arrows are touched. That is, if the current value is 8 and the [up arrow](#) is pressed, the value will change to **9**. If the [up arrow](#) is pressed again, the value will change to **0**. Likewise, if the current value is **0** and the [down arrow](#) is pressed, the value will change to **9**.

The sign status matrix portion of the word can be changed using the three buttons representing [Valid Data](#), [Functional Test](#) and [No Computed Data](#). Any changes made are immediately reflected in the transmitted word.

The actual 32 bits that are currently being transmitted are shown in blue above the up-arrows.

### 11.3 Receiver

The top portion of the **ARINC 568** screen shows the **received value**. The digital representation of the data received is shown in amber. If the word on the bus indicates a fault, the fault information is displayed as well.

The actual binary word being received is displayed in blue above the digital display.

## 12 CSDB

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The Busmaster 2500 supports monitoring and transmitting on the CSDB as defined in the document “COMMERCIAL STANDARD DIGITAL BUS (CSDB)” 9<sup>th</sup> Edition, issued January 14, 1998 by the General Aviation Manufacturers Association.

From the **Busmaster 2500 Main Menu** screen, select [CSDB](#). After entering CSDB mode, one of the 19 distinct busses that communicate using CSDB as detailed in the CSDB specification may be selected.

When the Busmaster 2500 CSDB Receive lines are connected to an active CSDB bus, the display will show the most likely bus it is attached to. This bus, and the most likely associated transmit bus may be selected by touching the **Use Suggested** key. If a different bus pair is desired, the transmit and receive bus may be selected using the up and down arrows, and touching the **Use Selected** key.

## 13 ASCB

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### 13.1 Overview

The Busmaster 2500 supports three modes for testing ASCB Busses. In “Master” mode, where the Busmaster is responsible for providing the framing and timing as well as requesting addresses. In “Equipment” mode, the Busmaster listens to the bus and responds to one single address request from another master. And, in “Monitor” mode, the Busmaster passively monitors the bus and doesn’t transmit anything.

When ASCB is selected from the main bus select page, the three options are presented.

### 13.2 Master Mode

When Master Mode is selected, the first page displayed is the “ASCB Master Setup” page.

#### 13.2.1 ASCB Master Setup

This page gives an overview of the addresses that will be transmitted and their timing within each ASCB frame.

The Busmaster provides a default set of labels for a starting point.

To edit the labels being sent by the master, press the screen within one of the frame listings. This will bring up the “ASCB Frame Setup” page. (See section 13.2.2)

Once the frames are set up appropriately, pressing the [View Rx](#) button will bring up the “ASCB Monitor Display” page. (See section 13.4)

#### 13.2.2 ASCB Master Frame Setup

This page allows the label requests from the master to be edited.

The frame being edited is shown after the text “Frame # “. Any of the 8 frames may be edited. To select a different frame to edit, select the corresponding frame number button at the top of the screen.

The total number of addresses to be sent is shown in blue at the top of the frame text area. The sequence of each address, and the time (in milliseconds) from the beginning of the frame that the address will be transmitted are shown.

Only one address is editable at a time. This address is displayed in the **Address** box, and its associated time is shown in the **Time (msec)** box. The sequence number for the address being edited is shown to the left of the two boxes.

The sequence number is not editable. It is determined automatically based on the time within the frame that the address is selected to transmit.

To edit the Address, touch the **Address** box. This will enable the keypad to the right side of the screen. Addresses are always edited as a two character hexadecimal number. When the address is correct, press **ENTER**. If a change has been made to the Address that isn't desired, press **ESC**.

To edit the Time associated with the current label, touch the **Time (msec)** box. This will enable the keypad for decimal entry. The time format is fixed, and is displayed in milliseconds. (The resolution is to 1 microsecond, since the time is displayed in thousandths of a millisecond.) If the time is changed, the address will be moved in sequence to the appropriate place within the frame.

The addresses may be selected by pressing the up and down arrow keys. This will scroll the display through the active addresses for the active frame.

The **Delete** key will delete the current address.

The **New** key will insert a new address immediately after the currently selected address. The minimum time between addresses is 100 microseconds.

To discard all changes made to the frames, touch the **Cancel** button. This will go back to the "ASCB Master Setup" page.

To accept the changes made to the frames, touch the **Accept** button. This will go back to the "ASCB Master Setup" page, and all changes made will be displayed.

### 13.3 Equipment Setup

If Equipment mode is selected, the "ASCB Equipment Setup" page will be displayed. This page allows the entry of which address the Busmaster will respond to, the address that will be responded with, and the data to be sent.

The Request Address box allows the entry of the address the Busmaster will listen for.

The Response Address box allows the entry of the address the Busmaster will respond with when the request address is found.

The Word Count box states the number of words (16-bits each) that will be transmitted when the requested address is found.

The main display allows the response words to be edited in hexadecimal. When the words are being edited, the keypad at the right is set to hexadecimal mode, and the current cursor position is displayed as a blue box around a white character in the edit window.

The ASCB Equipment Setup window defaults to the mode of editing the words to be transmitted.

To specify the request address, touch the [Request Address](#) box. The keypad at the right remains in hexadecimal mode, and the Request Address may be entered.

The Response Address is specified in the same manner as the Request Address.

The number of words to be transmitted may be specified by selecting the [Word Count](#) box. The number of words is specified in decimal, and the keypad changes to allow only decimal numbers. The Busmaster allows a maximum of 127 words to be sent as a response to a request when in Equipment mode.

Touching the [View Rx](#) button will bring up the “ASCB Monitor Display” page. (See section 13.4)

## 13.4 ASCB Monitor Mode

When the Busmaster is put into ASCB Monitor mode, the Busmaster doesn't actively transmit anything on the bus. It passively listens to the traffic on the ASCB bus and displays an overview of that traffic.

### 13.4.3 Address Overview

The Address Overview displays all addresses active on the bus. The address is shown in blue to the left, and the time within the frame that the address occurs within the frame is shown for each frame in green.

If a given address is not present in every frame, the frames that the address is absent in have a blank for the time. For example, if an address is only present in frame 3, then the address will be displayed to the left, and there will be a time under “Fr 3” for that address. The area associated with all other frames will be blank for that address.

The Address Overview displays 20 addresses. The display can be scrolled using the associated up and down arrows.

The data in the Address Overview window may be stale. Any data that has been received since the Busmaster was put into ASCB mode will be displayed. If the Busmaster has been moved from one ASCB bus to a different ASCB bus, the data from the old bus may still be displayed. In this case, press the Clear Disp button to erase the memory. The display will fill again with current data.

The data in the Address Overview window can be sorted in two ways. The first, and default, is by time. The data received earliest in the frame is displayed towards the top of the display, and the rest of the data is displayed chronologically. The data may also be sorted in numerical order based on the address.

To change the sort method, select the [Display Setup](#) button.

#### **13.4.4 Trapped Address**

The Trapped Address text area shows the data associated with the trapped address. This data is displayed in word chronological order. The frame and time the address was received is displayed as well. If the address is received in more than one frame, the frame number displayed will constantly be changing.

The sequence number of each word is displayed in decimal to the left, and the associated word is displayed in hexadecimal to the right.

Up to 127 words can be displayed. To scroll through the trapped words, touch the associated up and down arrow buttons.

#### **13.4.5 Display Setup**

The Display Setup box shows the current ASCB mode of the Busmaster (Monitor, Master, or Equipment), as well as the sort method for the Address Overview.

The Trapped Address, and the sort order can be changed by touching the Display Setup box.

When in Display Setup mode, the Trap Address is the active edit box, and the keypad remains in hexadecimal mode.

The Sort method may be changed by touching the [Time](#) or [Address](#) buttons.

Touching the Accept or Cancel buttons returns to the ASCB Monitor Display page.

#### **13.4.6 Print**

The data associated with the ASCB bus may be printed by touching the Print button.

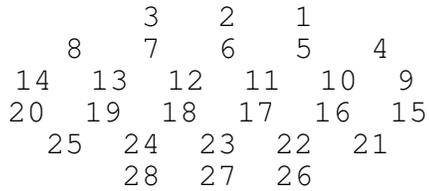
## 14 Utilities

### 14.1 Touch Screen Calibration

The **Utilities** menu also allows calibration of the touch screen. See section 5 for detailed information regarding calibration of the touch screen.

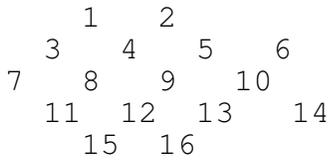
## Appendix A Connector Definition

ARINC 429/571/575



Pin	Description	Pin	Description
1	TX 1 A	15	GND
2	TX 2 A	16	n.c.
3	TX 3 A	17	GND
4	TX 4 A	18	GND
5	TX 1 B	19	GND
6	TX 2 B	20	RX 4 B
7	TX 3 B	21	n.c.
8	n.c.	22	RX 1 B
9	TX 4 B	23	RX 2 B
10	GND	24	RX 3 B
11	GND	25	RX 4 B
12	GND	26	RX 1 A
13	n.c.	27	RX 2 A
14	RX 4 A	28	RX 3 A

ARINC 561/568



Pin	Description	Pin	Description
1	TX Data H	9	Rx Shield
2	TX Data L	10	Rx Valid
3	TX Clock H	11	RX Sync L
4	TX Clock L	12	RX Sync H
5	TX Sync H	13	RX Clock L
6	TX Sync L	14	RX Clock H
7	TX Valid	15	RX Data L
8	TX Shield	16	RX Data H

CSDB/ASCB



Pin	Description
1	ASCB A
2	ASCB B
3	ASCB Shield
4	CSDB RX A
5	CSDB RX B
6	CSDB RX Shield
7	CSDB TX A
8	CSDB TX B
9	CSDB TX Shield

## Appendix B Supported Printers

### Printers Currently for Retail

- Deskjet 350C
- Deskjet 610C & 612C
- Deskjet 630C & 632C
- Deskjet 656
- Deskjet 825
- Deskjet 845C
- Deskjet 648C
- Deskjet 810C & 812C & 815C & 816C
- Deskjet 842C
- Deskjet 920
- Deskjet 932C & 935C
- Deskjet 940 & 948
- Deskjet 952C
- Deskjet 960
- Deskjet 970C
- Deskjet 980
- Deskjet 990C
- Deskjet 995
- Deskjet 1220C & 1125C
- Deskjet 3816 & 3820
- Deskjet 5550 & 5551
- Deskjet 6122 & 6127
- Deskjet 5600 & 5100 & 5800
- Deskjet 6540 & 6520
- Deskjet 5740
- Deskjet 6840
- Deskjet CP1160 & CP1700
- Deskjet 9300 & 9600
- PhotoSmart PS100 & PS130 & PS230 & PS140 & PS240 & 1000 & 1100
- PhotoSmart 320 & 370
- PhotoSmart P2500 & P2600
- PhotoSmart PS1115 & PS1215 & PS12818 & PS1315
- PhotoSmart PS7150 & PS7350 & PS7550
- PhotoSmart PS7960 & PS7760 & PS7660 & PS7260 & PS7268
- PhotoSmart 7400 & 8100 & 8400
- PhotoSmart 2600 & 2700
- PSC 2100 & 2150 & 2200 & 2300 & 2400 & 2500 & 2170
- PSC 1600 & 2350
- Officejet 5100 & 6100 & 6150 & 7100 & 9100
- Officejet 7200 & 7300 & 7400 & 6200
- Laserjet 1200 & 2200 & 4100 & 4200 & 4300 & 2300 & 1300
- LaserJet 9040 MFP & 9050 MFP & 9050 & 1320 & 1160 & 4250 & 4350 & 2410 & 2420 & 2430
- Color LaserJet 2500 & 4550 & 4600 & 5500
- Color LaserJet 2550 & 5550 & 9500
- MFP
- Apollo P2100 & P2150
- Apollo P2200 & P2250
- E-Printer e20
- Business InkJet 2200 & 2230 & 2250 & 2280 & 3000 & 1100 & 2300
- Business InkJet 1200

### Legacy Printers

- Deskjet 600
- Deskjet 640 & 642 & 644
- Deskjet 660C
- Deskjet 670 & 670TV & 672TV & 672C
- Deskjet 680C & 682C
- Deskjet 690C & 692C & 693C & 694C & 695C & 697C
- Deskjet 830C & 832C
- Deskjet 840C & 843
- Deskjet 880 & 882C
- Deskjet 895C
- Deskjet 930C
- Deskjet 950C & 955 & 957
- Deskjet 975C