

Guide

Setting Up MAP System Digital Input and Output

Introduction

This document provides setup information for the digital input (DI) and digital output (DO) sub-boards on the MAP-system digital signal processor (DSP) boards. DI sub-boards detect and time stamp digital signals from external events. Events must be TTL (transistor-transistor logic) digital events. Behavioral control systems or stimulus generation devices typically originate these TTL signals.

The DI sub-boards support two types of events. The first type of event consists of individual events such as the start of a trial, the press of a lever, or the switching on of a light. These individual events are a single bit of information, and thus a single wire or a wire pair can carry the signal.

The second type of event consists of complex events that are encoded as an 8-bit or 15-bit data word. For example, you can encode a visual stimulus of up to 256 patterns as an eight-bit word. The external device that generates the digital word must also provide a pulse to the DI sub-board that indicates when the data word is valid. This data-ready signal is called a strobe pulse.

Figure 1 shows the front panel of a DSP board that includes three sub-boards. Only the rightmost DSP board can support from one to four sub-boards, which can be either DO or DI sub-boards. The DSP board in Figure 1 shows a DO sub-board in the first (top) section (DSP1), and two DI sub-boards in the subsequent sections DSP2 and DSP3. DSP4 is unused and the faceplate is blank at that position. The indicator LEDs are normally off. When the boards receive data, the LEDs flash. Continuously-on LEDs indicate errors.

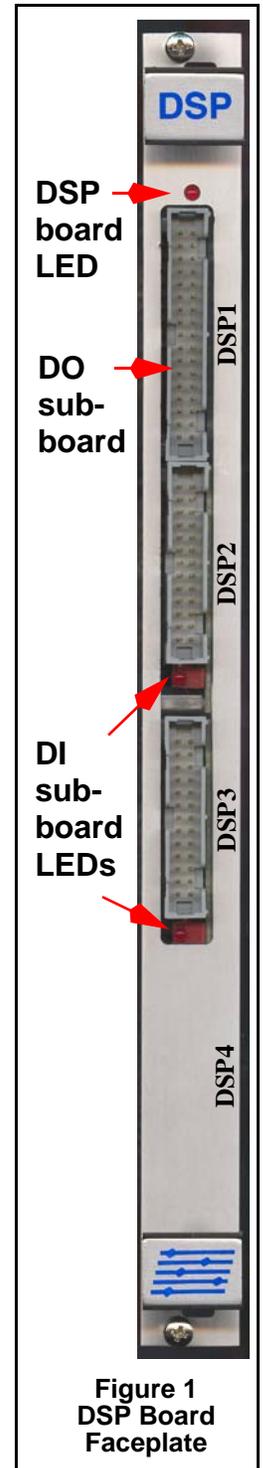


Figure 1
DSP Board
Faceplate

Modes of Operation

Each DI sub-board can process data in one of three modes, and each mode can have a positive or negative data polarity:

- Mode 1 — 14 individual TTL events
- Mode 2 — eight individual TTL events and one 8-bit strobed word
- Mode 3 — one 15-bit strobed word

To set the mode on a DI sub-board you must remove the DSP board from the MAP chassis. For board removal instructions, see [“Removing MAP Boards” on page 2](#). For sub-board arrangements on the DSP board, see [“Sub-Board Arrangements” on page 3](#). For mode setting instructions, see [“Digital Input Sub-Board Jumper Configurations” on page 6](#).

Removing MAP Boards

Use the following general instructions to remove boards from the MAP-system chassis.

Removing and installing boards in the MAP chassis

- 1 Turn the MAP system power switch off. Remove all cables from the face plate connectors on the board.
- 2 See [Figure 2](#) to locate the top and bottom mounting screws. Loosen the mounting screws until they are free from the threaded holes in the MAP chassis. The screws must wobble freely to allow full movement of the locking latches. Do not remove the screws from faceplate of the board.
- 3 As shown in [Figure 3](#), unseat the MAP board by firmly pushing the latches away from the center of the board faceplate.
- 4 Slide the board toward you to remove it from the MAP chassis.
- 5 Place the board on a bench and complete any changes, additions, or adjustments.
- 6 To install the board, locate the board guides at the top and at the bottom of the slot in the MAP chassis. The following illustration shows a bottom board guide.



- 7 Carefully align the board with the board guides in the slot. Insert the board approximately half way into the slot. Make sure the board is correctly positioned in the guides. If there is more than a few millimeters of free movement from side to side, the board is not correctly aligned in the guides and you must remove, realign, and reinsert the board.



Figure 2
MAP Board Mounting Screw Locations

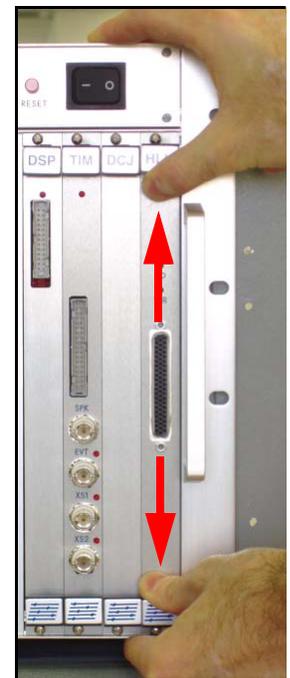
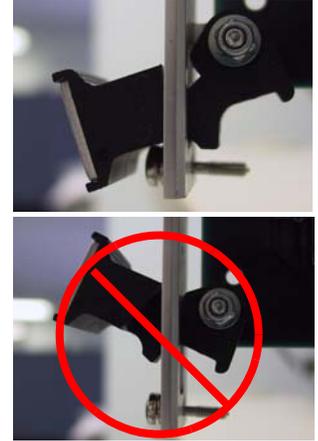


Figure 3
Unseating a MAP Board

- 8 Before you seat the board in the MAP chassis, set the locking levers away from the center of the faceplate as shown in the top illustration to the right. Do not position the levers toward the center of the faceplate as shown in the bottom illustration, this prevents the board from engaging the connector in the chassis.
- 9 Push the board into the slot until it contacts the connector in the chassis. Firmly push both locking levers toward the center of the board faceplate to seat the board in the chassis.
- 10 Tighten the mounting screws. Set the locking levers away from the center of the faceplate to the neutral position.
- 11 Examine the connectors on the cables and align them to the mating connectors on the board, then attach the cables.
- 12 Turn the MAP power switch on.



Sub-Board Arrangements

The MAP supports up to four sub-boards on the first (rightmost) DSP board. Arrange the sub-boards according to the following guidelines:

- 1 **Mode 1 DI sub-boards:** A DSP board can support up to four Mode 1 DI sub-boards, which can fit on any of the DSP sub-board mounting sections. Because Mode 1 DI event-channel numbers derive from the DSP section on which they're mounted, avoid putting Mode 1 DI sub-boards on non-consecutive DSP sections.
- 2 **Mode 2 or Mode 3 DI sub-boards:** A DSP board can support up to two Mode 2 or two Mode 3 sub-boards, or a combination of the two. Because both Mode 2 and Mode 3 use strobed words, the rules for positioning them are the same and they can be referred to collectively as Mode 2-3 DI sub-boards. If there is only one Mode 2-3 DI sub-board, it can occupy any DSP section and the high-bit of the strobed word must be set to 0 (zero). If there are two Mode 2-3 DI sub-boards, one of the Mode 2-3 DI sub-boards must occupy the top (DSP1) section, and the other sub-boards can occupy any of the three remaining sections. To distinguish the data from the first and second Mode 2-3 DI sub-boards, set the high bit to 1. For information on setting the high bit, see [“Setting the High Bit in MAP Server” on page 9](#).
- 3 **DO sub-boards:** A DSP board can support up to four digital output (DO) sub-boards. DO sub-boards generally precede DI sub-boards and attach to the lower-numbered DSP sections, unless there is a specific need for digital outputs only from higher-numbered DSP channels.
- 4 **DO and Mode 2-3 DI sub-boards in combination:** If a DSP board includes a DO sub-board and that sub-board is attached to the DSP1 section, then the DSP board can only support one Mode 2-3 DI sub-board. This occurs because the three higher-numbered DSP sections can support only one Mode 2-3 DI sub-board.

Note: You can use sub-boards only on DSP sections that include DSP processors. For example, on a 16-channel DSP board sections DSP3 and DSP 4 do not include DSP processors. For the location of DSP processors, see the illustration [“32-Channel DSP Main Board with Three Sub-Boards” on page 5](#).

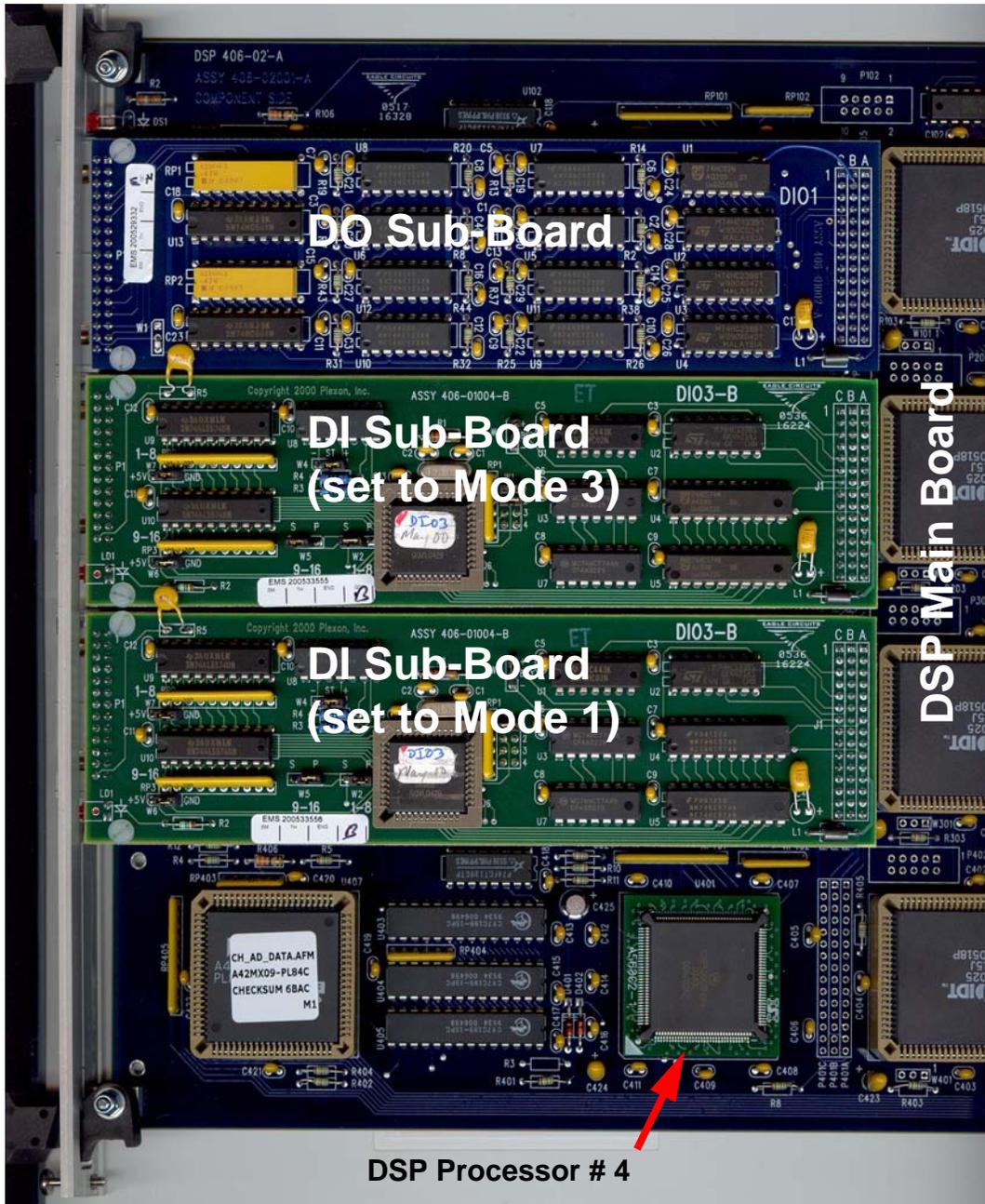
The following table provides a few examples of some acceptable sub-board arrangements in order from top (DSP1) to bottom (DSP4) sections on a DSP board:

Table 1: Examples of acceptable DSP sub-board arrangements

DI1, DI1, DI1, DI1	DI3, DI1, DI1, DI1	DI3, DI2, DI1, DI1 *
DO, DI1, DI1, DI1	DO, DI2, DI1, DI1	DO, DO, DI1, DI1
DO, DO, DI3, DI1	DI2, DO, DI3, DI1 *	DI2, DO, DI1, DI1
DI3, DI3, DO, DI1 *	DI3, DI3, DI1, DO *	DO, DO, DI1, DI3
DO, DO, DO, DI1	DO, DO, DO, DI3	DO, DO, DO, DO
For any one of the preceding arrangements, a DSP board can accommodate less than four sub-boards starting from the bottom (DSP4) and proceeding to the top (DSP1). For example, the following combinations are also valid for the DO, DI3, DI1, DI1 arrangement.		
DO, DI3, DI1, none	DO, DI3, none, none	DO, none, none, none
* For these arrangements, set the Mode 2-3 high-bit option to one in MAP Server.		

The illustration that follows shows a 32-channel DSP main board with three sub-boards mounted above the main board. DSP boards are available in 16-channel and 32-channel versions with two and four processors per board respectively. DSP processor number 4 is visible in this illustration because there is no sub-board mounted over the 4th section (DSP4); sub-boards cover processors 1 through 3. The sub-board in DSP1 (top) is a Digital Output (DO) sub-board. The sub-boards in DSP2 and DSP3 are Digital Input (DI) sub-boards. The illustration shows a “DO, DI3, DI1, none” sub-board arrangement.

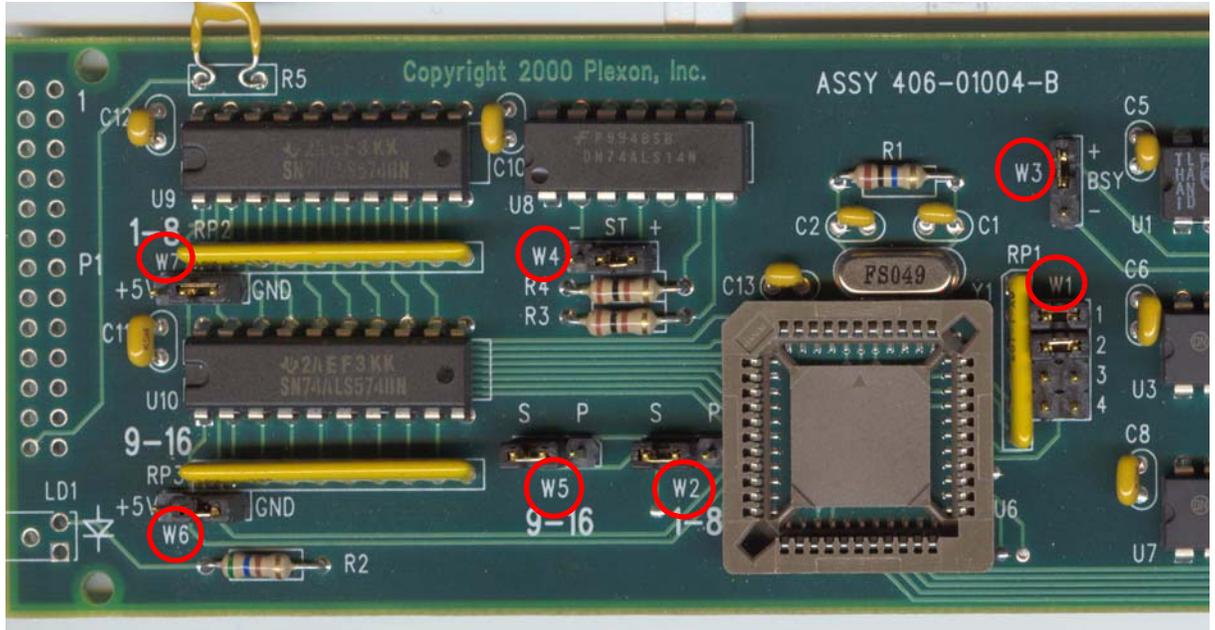
32-Channel DSP Main Board with Three Sub-Boards



Digital Input Sub-Board Jumper Configurations

The illustration that follows shows the connector end of a DI sub-board, which includes the jumper locations. The red circles highlight jumpers W1 through W7.

Jumper Locations on a DI Sub-Board



Use the following tables to set the jumper configurations.

Mode 1 Settings

Event	W1	W5	W2	W7	W6
Mode 1 (+) 14 events 0 words High true		S P 	S P 	+5V GND 	+5V GND 
Mode 1 (-) 14 events 0 words Low true		S P 	S P 	+5V GND 	+5V GND 

Mode 2 Settings

Event	W1	W5	W2	W7	W6
Mode 2 (+) 8 events 8-bit word High true		S P 	S P 	+5V GND 	+5V GND 
Mode 2 (-) 8 events 8-bit word Low true		S P 	S P 	+5V GND 	+5V GND 

Mode 3 Settings

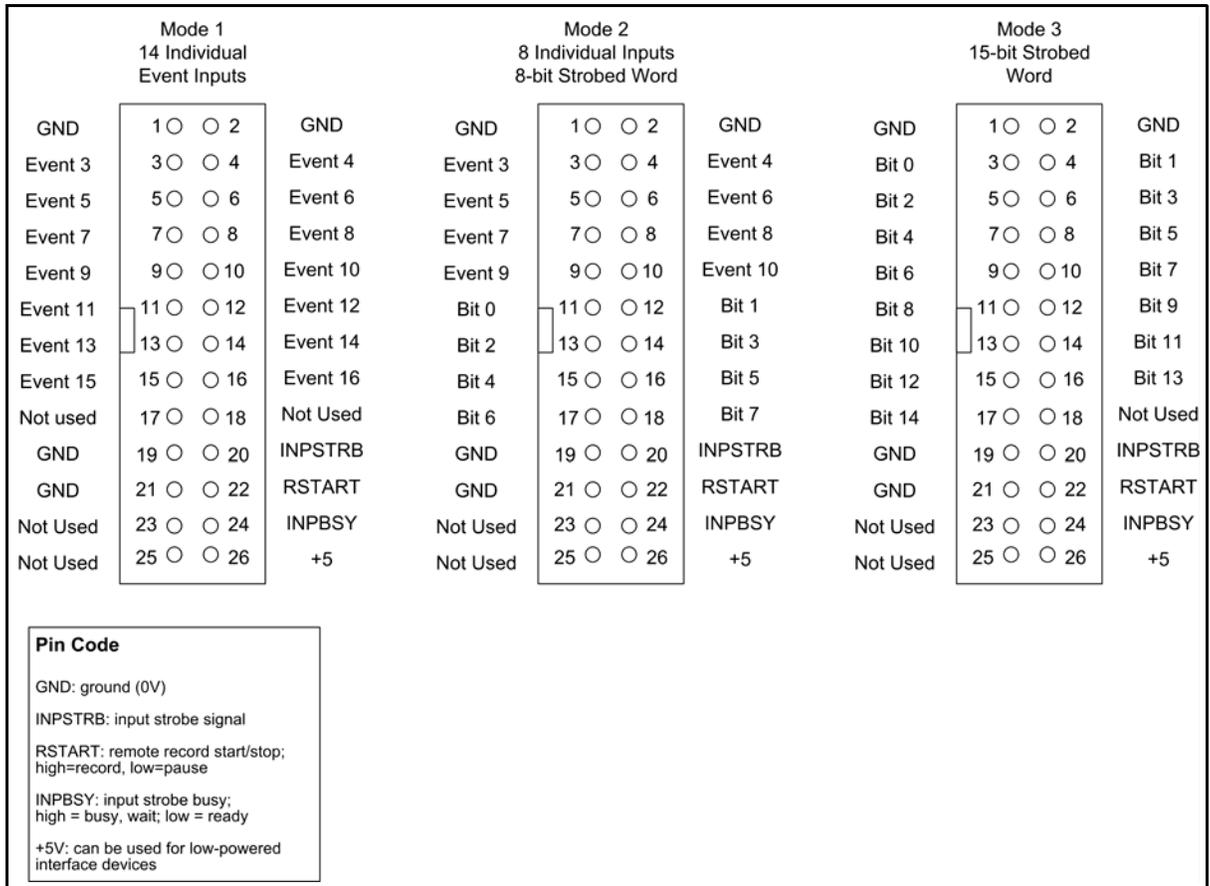
Event	W1	W5	W2	W7	W6
Mode 3 (+) 0 events 15-bit word High true		S P 	S P 	+5V GND 	+5V GND
Mode 3 (-) 0 events 15-bit word Low true		S P 	S P 	+5V GND 	+5V GND

Polarity of Strobe and Busy Signals

Strobe Polarity (INPSTRB)	W4	Busy Signal Polarity (INPBSY)	W3
Positive	- ST + 	Positive	+ BSY -
Negative	- ST + 	Negative	+ BSY -

Digital Input Connector Pin Diagram

The following illustration shows the pin connections for DI sub-board connectors on the face-plate of the DSP board.



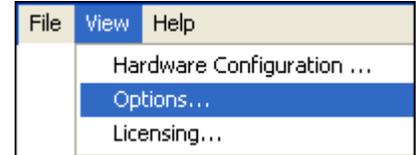
Note: Events 1 and 2 do not appear on this diagram because they are not provided through the DSP board; the TIM (timing) board provides the input for Events 1 and 2 through the XS1 and XS2 connectors.

Setting the High Bit in MAP Server

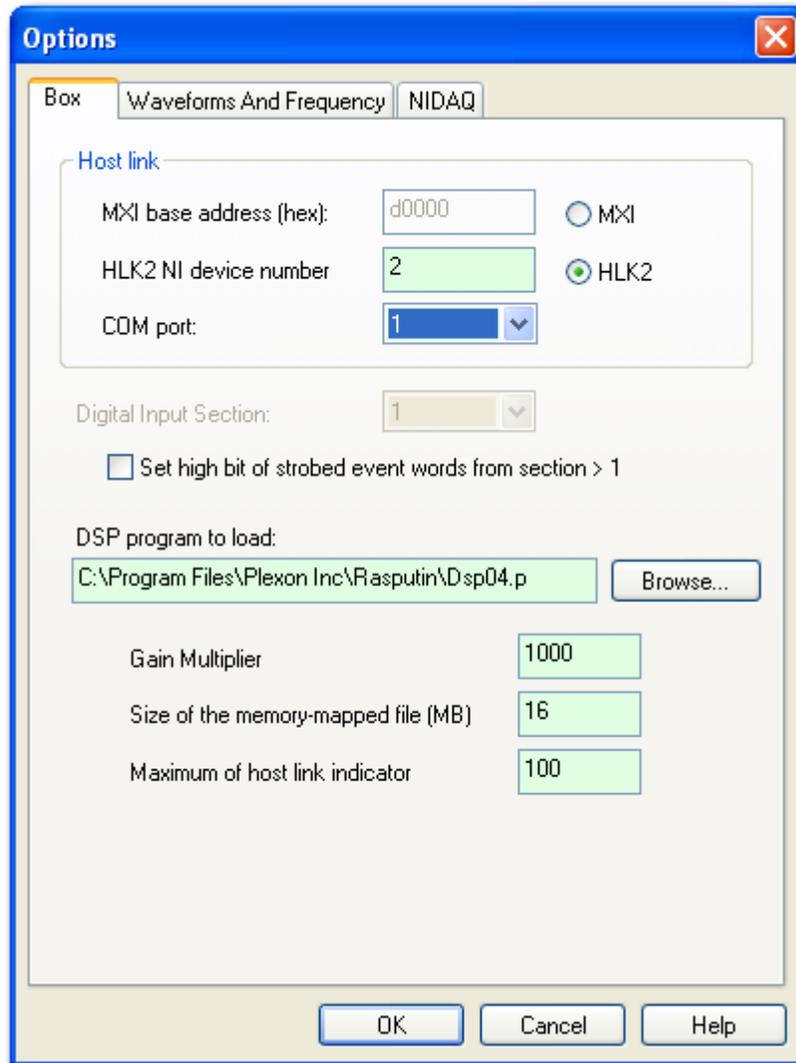
For strobed words that originate from a DI sub-board located on DSP2, DSP3, or DSP4, check the **Set high bit of strobed event words from section > 1** box to set the high bit to 1. When the high bit is set to 1, you can have two strobed DI sub-boards, with one sub-board on DSP1 and one sub-board on DSP2, DSP3, or DSP4; the high bit of the strobed word indicates which strobed DI sub-board the event came from. Start MAP Server and use the following instructions to set the high bit.

To change MAP Server Options

- 1 From the **View** menu, click **Options**.



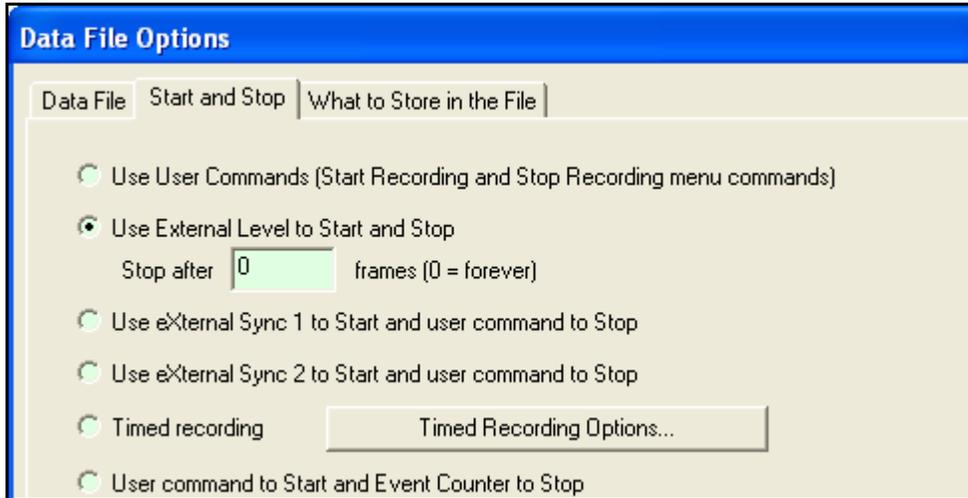
The **Options** window opens with the **Box** tab selected.



- 2 To set the high bit to 1, click **Set high bit ...** Otherwise, click to clear the checkbox.

Remote Starting

In all modes, if you enable remote starting, a signal on the remote start line (RSTART, see “[Digital Input Connector Pin Diagram](#)” on page 8) controls the actual interval of recording. When RSTART goes high, recording starts as a new data frame. To enable remote starting in Sort Client, click the **Start Recording** button. When the **Data File Options** window opens, click the **Start and Stop** tab, then click **Use External Level to Start and Stop**.



DI boards must be configured for incoming data signals that are either high-true or low-true signals. A high-true signal registers an event when the signal goes from 0V to +5V. A low-true signal registers an event when the signal goes from +5V to 0V.

In addition to any DSP inputs, the MAP System TIM (timing) board provides two additional event inputs through the BNC connectors labeled XS1 and XS2. These events are registered within 25 µsec of the next MAP clock tick.

Input Timing

Individual TTL events must meet the following requirements:

- Pulse width must be $\geq 250 \mu\text{sec}$.
- The event time is marked at the rising edge of the pulse.
- There is a variable latency of 25 to 250 µsec in the timestamp.

Strobed word inputs must meet the following requirements:

- Strobe pulse width must be $\geq 250 \text{ nsec}$.
- Minimum interval between strobe pulses = 150 µsec (i.e. maximum frequency $\approx 6.6 \text{ kHz}$).
- The delay between the strobe pulse and the first data bit is $< 100 \mu\text{sec}$.
- There is a variable latency of 25 to 150 µsec in the timestamp.

- For faster word transfers, instead of using fixed timing the sending computer can monitor the input strobe busy pin (INPBSY, see “[Digital Input Connector Pin Diagram](#)” on page 8) and send data whenever the DSP processors are idle.

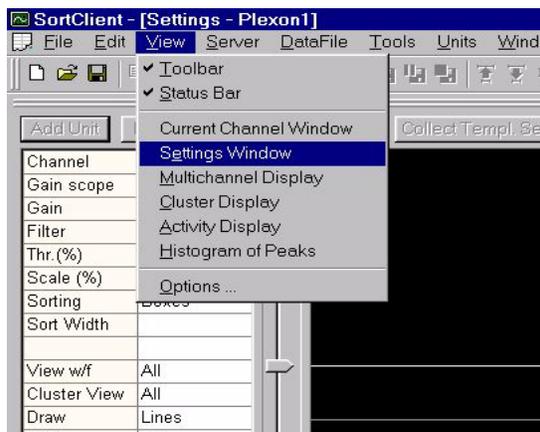
To configure the DI sub-board to monitor the INPBSY pin, see “[Digital Input Sub-Board Jumper Configurations](#)” on page 6.

Viewing the Events in Sort Client

You can monitor the external events in Sort Client in much the same way that you can monitor a single unit firing.

To enable the display of the external events

- 1 From the **View** menu select **Settings Window**:



- 2 In the Settings Window, click **Events**.



- 3 In the **Events** window under the **Show** column, click the boxes corresponding to the events that you want to monitor, for example, **Event001** through **Event016**, **Strobed**, and **Start/Stop**.

	Channel	Name	Show
1	1	Event001	<input checked="" type="checkbox"/>
2	2	Event002	<input checked="" type="checkbox"/>
3	3	Event003	<input checked="" type="checkbox"/>
4	4	Event004	<input checked="" type="checkbox"/>
5	5	Event005	<input checked="" type="checkbox"/>
6	6	Event006	<input checked="" type="checkbox"/>
7	7	Event007	<input checked="" type="checkbox"/>
8	8	Event008	<input checked="" type="checkbox"/>
9	9	Event009	<input checked="" type="checkbox"/>
10	10	Event010	<input checked="" type="checkbox"/>
11	11	Event011	<input checked="" type="checkbox"/>
12	12	Event012	<input checked="" type="checkbox"/>
13	13	Event013	<input checked="" type="checkbox"/>
14	14	Event014	<input checked="" type="checkbox"/>
15	15	Event015	<input checked="" type="checkbox"/>
16	16	Event016	<input checked="" type="checkbox"/>
17	257	Strobed	<input type="checkbox"/>
18	258	Start	<input type="checkbox"/>
19	259	Stop	<input type="checkbox"/>
20	101 (keyboard Alt+1)	Keyboard1	<input type="checkbox"/>
21	102 (keyboard Alt+2)	Keyboard2	<input type="checkbox"/>
22	103 (keyboard Alt+3)	Keyboard3	<input type="checkbox"/>
23	104 (keyboard Alt+4)	Keyboard4	<input type="checkbox"/>
24	105 (keyboard Alt+5)	Keyboard5	<input type="checkbox"/>
25	106 (keyboard Alt+6)	Keyboard6	<input type="checkbox"/>
26	107 (keyboard Alt+7)	Keyboard7	<input type="checkbox"/>
27	108 (keyboard Alt+8)	Keyboard8	<input type="checkbox"/>
28	109 (keyboard Alt+9)	Keyboard9	<input type="checkbox"/>

Note: For example, for a Mode 1 DI sub-board check the boxes corresponding to Event003 through Event016. Event001 and Event002 can appear, without a DI board and in all modes because they come from the XS1 and XS2 inputs on the TIM board. In Mode 2 and Mode 3, you cannot view the values of the 8-bit and 15-bit words. However, you can monitor the strobed word event times by clicking the **Strobed** checkbox.

- 4 To monitor the incoming events, from the **View** menu select **Activity Display**.

