RADIO-BATON INSTRUCTION MANUAL

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THE RADIO-BATON GENERAL DESCRIPTION

The Radio-Baton is a controller for musical performances. It consists of two batons, a receiving antenna board, and an electronics box. It tracks the motion of the two batons as they are moved in three-dimensional space by a performer.

The electronics box contains a processor which tracks the baton movements. It can continuously send the positions of the batons (in three-dimensional space--x,y,& z) to a computer.

The Radio-Baton also sends triggers to the computer. A trigger is generated when either baton executes a rapid down-up stroke, the bottom of the stroke being near the surface of the receiving antenna. Usually the most reliable triggers are produced by lightly "bouncing" the baton off the foam covering of the receiving antenna.

The electronics contains a standard set of MIDI-in, MIDI-out, and MIDI-thru connectors. All communication between the Radio-Baton and the computer is done via MIDI. The Radio-Baton can interact with any computer that can send and receive MIDI.

For many uses only the MIDI-out need be connected. The baton acts as a simple MIDI controller. Such a configuration may simplify the program in the computer and is especially appropriate for programs such as MAX-MSP.

HOW TO PURCHASE A RADIO-BATON

A Radio-Baton can be obtained from the Marmax Company. The current price is $1200 plus shipping costs and any applicable sales taxes.

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RADIO-BATON HARDWARE

The radio-baton uses a simple technique to determine the XYZ coordinates of the batons. At the end of each baton is a small radio transmitting antenna. On the receiving antenna board are 4 receiving antennas. By comparing the signal strengths received by the four antennas, a computer can calculate the XYZ coordinates of the positions of the transmitting antennas at the ends of the batons. Low frequencies of about 50kHz and 55kHz are used for the radio signals,each baton with its own frequency. It is appropriate to describe the radio-baton as a capacitance sensor. The radio-frequency signal is really used as a method of measuring the capacitance between a transmitting antenna electrode and a receiving antenna electrode.

The radio-baton can compute the positions of the batons every 4 milliseconds but due to MIDI speed limitations reports to the computer are sent no faster than 50 position sets per second. The accuracy of measurements is about 1 part in 100.

Figure 1 is a sketch of the electronics box showing the various connections and controls.

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+-------------------------------------------------------------+
|J1  J2    J3   J4    J5    J6    J5    J6     J7    J8    J9|
|UNUSED  ANTENNA 1    2    POWER  B15-  B14-  THRU   OUT   IN|
|                BATONS                              MIDI     |
|                                                             |
|                                                             |
|                                                             |
|                                                             |
|                                                             |
|                                                             |
|                                                             |
|                                 B14+                  UNUSED |
|                                 PUSH                  PUSH   |
|                                 BUTTON                BUTTON |
|                                      +--------------+        |
| POT    POT   POT   POT    POT      |     LCD      |        |
|  0      1     2     3      4       |    DISPLAY   |        |
|                                 B15+ +--------------+ RESET  |
|                                 PUSH                  PUSH   |
|                                 BUTTON                BUTTON |
+-------------------------------------------------------------+
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FIGURE 1: SKETCH OF BATON ELECTRONICS BOX--TOP VIEW

Referring to the figure, foot pedal switches can be plugged into J5 and J6. The state of these switches can be transmitted to a control computer for use in a music program. Typically, one pedal acts as a sustain pedal. Push button B15+ can also send triggers to the control computer. Button B14+ is used to change the mode of the baton

The positions of pots 1, 2, 3, and 4 can be sent to the control computer and used to control musical parameters. However pot 4 is always used to set the trigger sensitivity and this may conflict with any other use. Pot 0 is not presently used.

The RESET push button restores the baton computer to its power-up state.

STATE OF BATON

The baton can be switched between the modes ACTIVE-FAST, ACTIVE-MEDIUM, ACTIVE-SLOW, POLLED, and TEST by repeatedly pushing button B14+. The state of the baton is shown in the LCD display.

In the active modes, XYZ data speeds are:

fast--50 complete data sets per second
med --25 "
slow--12 "

In addition, pot positions are always sent 10 times per second in any active modes.

In the polled mode, only triggers are sent automatically. The computer must request XYZ data and pot positions when it wants this information.

In the POLLED mode, the version of the program is also shown in the LCD display. The current version at the date of writing this manual is 5.

In the TEST mode, low level outputs from the 16 twelve bit A-D converters in the baton are sent directly to the computer encoded as MIDI characters. This mode is used for testing and adjusting the baton electronics.

STICK SENSITIVITY FOR TRIGGERS AND THE SAPP TRIGGER ALGORITHM**

The trigger sensitivity can be adjusted with the P4 pot. If the baton misses triggers, increase P4. If the baton "double" triggers or generates triggers without baton strokes, reduce P4.

The trigger algorithm programmed in the baton generates a trigger when the downward acceleration of the baton reaches zero after the downward velocity has exceeded a threshold. The value of the threshold is set with the P4 pot. After a trigger is produced by one baton, a refractory period of 75 ms occurs before a subsequent trigger can be produced by that baton.

** Invented by Craig Sapp

CODES FOR INFORMATION SENT FROM BATON TO COMPUTER

The baton will send trigger and position information to the computer encoded as standard MIDI commands as follows:

	MIDI COMMAND (THREE BYTES) BYTE1	BYTE2	BYTE3**
trigger from stick 1 & whack strength	A0	1	WHACK
& X1	A0	15	X1
& Y1	A0	16	Y1
trigger from stick 2 & whack strength	A0	2	WHACK
& X2	A0	17	X2
& Y2	A0	18	Y2
trigger from B15+ button	A0	3	1
down trigger from B14- foot switch	A0	3	2
up trigger from B14- foot switch	A0	3	3
down trigger from B15- foot switch	A0	3	4
up trigger from B15- foot switch	A0	3	5
pot 1 current value	A0	4	POT1
pot 2 current value	A0	5	POT2
pot 3 current value	A0	6	POT3
pot 4 current value	A0	7	POT4
stick 1 x current position	A0	8	X1
stick 1 y current position	A0	9	Y1
stick 1 z current position	A0	10	Z1
stick 2 x current position	A0	11	X2
stick 2 y current position	A0	12	Y2
stick 2 z current position	A0	13	Z2
version number	A0	0	Version

**All data in BYTE3 is encoded in the standard MIDI range 0-127.

CODES FOR COMMANDS SENT FROM COMPUTER TO BATON

FUNCTION	COMPUTER COMMAND	BATON RESPONSE
poll sticks & pots	A0 14 1	30 BYTES ENCODING X1,Y1,Z1, X2,Y2,Z2 P1,P2,P3,P4 AS IN THE TABLE ABOVE

**All data in BYTE3 is encoded in the standard MIDI range 0-127.