RM1/RM2 Mobile Processors

RM1 Mobile Processor (RM2 not pictured)

RM1/RM2 Overview

The System 3 platform includes two self-contained real-time processors: the Mini Processor and the Mobile Processor. Designed as an affordable test-bed system for designing and debugging RPvdsEx circuits, each device includes stereo A/D and D/A, an adjustable onboard speaker, and can drive headphones at up to 100 dB SPL. The devices draw power from the USB interface of the computer and work well with laptop computers for maximum portability. These economical mobile systems can also be used for basic psychoacoustics.

For detailed information on each member of the RM family check the technical specifications of the module.

Power Requirements

Power is provided across the USB connection to a host PC. The RM draws approximately 300 mAmps from a 6 Volt input. The draw on a portable PC battery will depend on the power requirements of the portable PC and the properties of the battery. In many cases, the user may see less than 10% decrease of the battery life.

Users can attach an external power supply such as an AC adapter (available on request) or an external pack such as a motorcycle battery (input range of 6-9 Volts).

Software Control

Software control is implemented with circuit files developed using TDT's RP Visual Design Studio (RPvdsEx). Circuits are loaded to the processor through TDT run-time applications or custom applications. This manual includes device specific information needed during circuit design. For circuit design techniques and a complete reference of the RPvdsEx circuit components, see the *RPvdsEx Manual*.

RM1/RM2 Processor Hardware

The RM1 Real-time Mini Processor and RM2 Mobile Processor combine a signal processor, a power supply, and a computer interface in one small form factor. The RM consists of an Analog Devices Sharc floating point DSP with surrounding analog and digital interface circuits and 32 MB of memory for data storage and retrieval. The RM2 also includes a fiber optic connection for the RA4/RA16PA Medusa amplifier.

D/A and A/D

The RM is equipped with stereo 24-bit sigma-delta A/D and D/A that can sample at rates up to 97.656 kHz. Sigma-delta converters provide superior conversion quality and extended useful bandwidths, at the cost of an inherent fixed group delay. For the RM1 and RM2, the DAC Delay is 17 samples and the ADC Delay is 16 samples.

Digital Input/Output Bits

The TTL I/O circuits include four bits of digital input and four bits of digital output that are accessed via the 9-pin connector on the back of the RM. Bit0 can also be accessed through a BNC connector on the front panel. The RM's digital I/O can be used to implement triggers, time trigger responses, and light LEDs.

Analog Output

The RM is equipped with an external speaker for use when previewing stimulus during the circuit design process. The RM's stereo analog output can drive a headphone at up to 100 dB SPL.

USB Input Port

An USB Input port allows multiple devices to be connected for increased processing power.

Mobile Processor Front Panel Features

Bit0

The BNC connector for Bit0 allows for a direct input or output to the first bit of the RM device. This allows for a more convenient connection for a typical trigger input. Access to the other digital inputs and outputs are from a 9-pin connector on the back panel.

Status Lights

The status lights indicate the state of the RM.

Power

The power light indicates that the device is connected to a power supply. The power may be supplied by an external power supply or by a computer (powered on) via the USB interface.

Comm (Communication)

The communication light blinks when the device is sending or receiving information to or from the PC. (This requires the system to be connected to a PC.)

Err (Error) or Amp (RM2)

The error light indicates one of the following:

An error communicating with the host PC.

An error communicating with the RA4/RA16PA (RM2 Only)

Status

The status light blinks when a circuit is running. The rate at which the light blinks is a general indicator of cycle usage, with faster blinking indicating a higher cycle usage.

Bits Lights

Bit lights indicate when a bit input is set high. The LED(s) will light if the input signal is set high or if the output bit is set high. Voltage high is 3.3 volts and voltage low is nominal 0 Volts. Access to the digital I/O port is through a 9-pin connector on the back panel. The bit inputs are set logical high by default.

Analog I/O

The analog inputs and outputs use a 3.5 mm stereo plug and deliver or accept a +/- 1 Volt signal with a dynamic range of over 45 dB. The RM uses 24-bit Sigma-delta A/D and D/A converters.

In

The maximum analog input is +/- 1 Volt with a peak sample rate of 97.656 kHz. The input impedance is 10 kOhm. The analog inputs are AC-coupled; the RM cannot receive DC or very low frequency (<1 Hz) signals.

Out

The maximum analog output is +/- 1 volt with a peak sample rate of 97.656 kHz. The low-level output impedance (10 Ohm) of the system allows users to drive earphones at up to 100 dB SPL. The analog outputs are AC-coupled; the RM cannot play out DC or very low frequency (<1 Hz) signals.

Level

The RM has an internal speaker that is driven by channel 1 output. The Level knob controls the volume of the speaker and analog channels 1 and 2 when connected to the 1/8" audio jack labeled OUT. To achieve the full output level specified in your circuit on these two channels, set the Level knob to Max.

RM1/RM2 Processor Back Panel Features

USB In

The USB input on the RM acts as a USB hub. Multiple RM devices can be ganged together to increase signal processor power. A standard USB, A to B, cable is required for setup.

USB Out

The USB output connects either to another RM device, a UB4, or to the host computer's USB interface. The RM can be connected to PCs with either USB 1.1 or USB 2.0 hubs.

Digital I/O

The female DB-9 connector allows direct access to the digital inputs and outputs. Pinout information is provided on the label above the connector. Bits 0 - 3 (which map to pins 5, 9, 4, and 8 on the male DB-9 connector) are inputs and bits 4 - 7 (which map to pins 3, 7, 2, and 6 on the male DB-9 connector) are outputs. Ground is labeled G (which maps to pin 1 on the male DB-9 connector).

Note: The digital lines drive about 25 milliamps.

Amplifier (RM2 only)

A fiber optic connector is found on the RM2 for use with the Medusa RA4/RA16 preamplifier, the Loggerhead RA8GA, and the associated headstage assemblies.

Ext. Pow. (External Power)

An external power supply can be used as an alternative to drawing power from the USB connection. An adapter allowing the device to be powered form an AC power source is available upon request. A battery with an output range of 6-9 volts, such as a motorcycle battery, could also be used to power the device.

TDT recommends separate external power sources when using multiple RM devices.

Mobile Processors Digital Input/Output

The Mobile Processors are equipped with 8 bits of programmable digital input/output, accessed via the Digital I/O 9 pin connector on the back panel. See "RM1/RM2 Processor Technical Specifications" on page 5-9, for a pinout diagram.

**Note:**   The digital lines drive about 25 milliamps.

Configuring the Programmable I/O Lines

All 8 digital lines are independently configurable as inputs or outputs. By default, bits 0–3 are configured as inputs and bits 4–7 are configured as outputs. In RPvdsEx, bits 0–7 in the bit configuration register control the configuration of the eight addressable bits as inputs or outputs. Setting a bit to one will configure that bit as an output.

**To access the bit configuration register:**

1. Click the **Device Setup** command on the **Implement** menu.

2. In the **Set Hardware Parameters** dialog box, click the **Type** drop-down box and select **RM1** or **RM2** from the list.

    The dialog expands to display the **Device Configuration**.
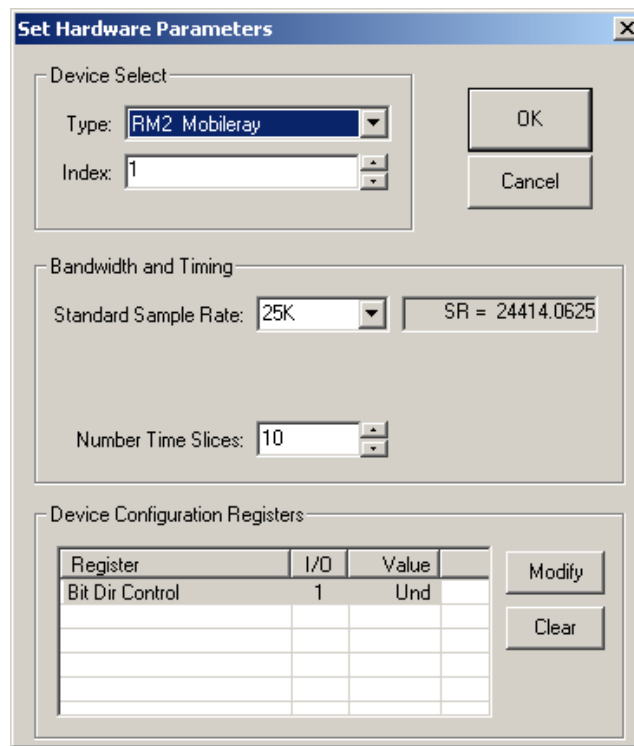
3. Click **Modify** to display the **Edit Bit Dir Control** dialog box.

    In this dialog box, a series of check boxes are used to create a bitmask that is used to program all bits.
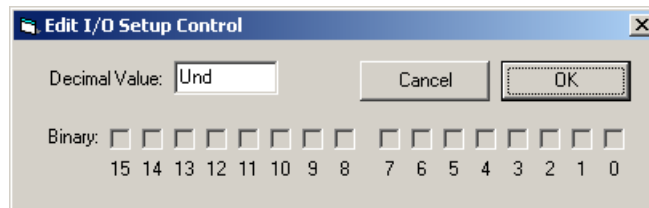
4. To enable the check boxes, delete **Und** from the **Decimal Value** box.

5. To determine the desired value, select or clear the check boxes. By default, all check boxes are cleared (value = 0). Click the check boxes for desired bits (0 –7) to set the bit to one and configure that bit as an output.

> **Note:** Modifying any of the bits will change the default configuration (by default, bits 0-3 are inputs and bits 4-7 are outputs).

6. When the configuration is complete, click **OK** to return to the **Set Hardware Parameters** dialog box.

Using the RM2 Fiber Optic Port

The RM2 Fiber Optic Port can be used with a Medusa or Loggerhead preamplifier; however, it is unlikely that a single RM2 device can acquire 16 channels of high frequency activity. Instead we recommend that the RM2 be used for low channel count (up to four channels) high sample rate acquisition or for high channel count low sample rate activity (e.g. 16 channels of slow EEG activity). Using the RM2 as part of a Medusa/Loggerhead system effectively provides two channels of high quality A/D inputs and up to 16 channels of signal input running at 25 kHz. The signal input lines accessed via the analog I/O and fiber optic port are mapped as described below to allow for simultaneous use of the high quality A/D and the amplifier input channels.

	RM2 Channel		RM2 Channel
Analog I/O Input Channel 1	Channel 1	Amp Channel 8	Channel 24
Analog I/O Input Channel 2	Channel 2	Amp Channel 9	Channel 25
Amp Channel 1	Channel 17	Amp Channel 10	Channel 26
Amp Channel 2	Channel 18	Amp Channel 11	Channel 27
Amp Channel 3	Channel 19	Amp Channel 12	Channel 28
Amp Channel 4	Channel 20	Amp Channel 13	Channel 29
Amp Channel 5	Channel 21	Amp Channel 14	Channel 30
Amp Channel 6	Channel 22	Amp Channel 15	Channel 31
Amp Channel 7	Channel 23	Amp Channel 16	Channel 32

For more information about the Medusa, see the "RA16PA/RA4PA Medusa PreAmps" on page 7-87.

Software Control for the Mobile Processor

In general, the RM processors can use any circuit that has been designed for the RP2.1. There are a few caveats that relate to the number of digital inputs and outputs, the positioning of the input channels from the fiber optics on the RM2, and the maximum signal voltage.

Digital I/O

The RM has only eight digital I/O channels. Circuits that use more than four TTL outs or four TTL ins will not work with the RM.

RM2 Acquisition Channel Input

The channels from the preamplifier to the RM2 are mapped so that the system can acquire from both the high quality analog inputs and the preamplifier. For acquisition channels across the fiber optic connection, channel numbers are offset by 16. Channel one from the preamp maps to channel 16 of the RM2, channel two maps to 17, and so forth. Users must modify existing circuit designs and OpenEx files by setting an offset value to match the channel organization of the RM2.

There is no fiber optic repeater to allow multiple RM2s to be linked for data acquisition from a single preamplifier. All acquisition from the preamplifier must take place on a single RM2.

Signal Voltage

The maximum signal voltage for acquisition and presentation is +/− 1 volt. Circuits that have components generating signals greater than +/− 1 volt will cause the device to clip either on input or output.

RM1/RM2 Processor Technical Specifications

DSP	50 MHz Sharc 21065, 150 MFLOPS
Memory	32 MB
A/D	2 channels 24−bit sigma−delta A/D
S/N (typical)	85 dB (20 Hz to 20 kHz)
Distortion (typical)	80 dB for 1 kHz input at 630 mV rms
Sample Delay	16 samples
Highpass Filter	1 Hz
D/A	2 channels 24−bit sigma−delta D/A
S/N (typical)	85 dB (20 Hz to 20 kHz)
Distortion (typical)	80 dB for 1 kHz input at 630 mV rms
Sample Delay	17 samples
Highpass Filter	1 Hz
Digital I/O	8 user selectable
System Reset	Front panel next to ERR light
Input Impedance	10 kOhm
Output Impedance	10 Ohm

RM2 Fiber Optic Inputs

Input	up to 16 channels
Sampling Rate	24.414 kHz max

Digital I/O DB9 Female Connector Pin Out
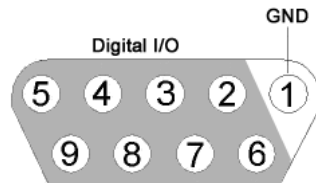
Pin	Name	Description
1	GND	Ground
2	D6	Digital Input/Output Channels
3	D4	
4	D2	
5	D0	
6	D7	
7	D5	
8	D3	
9	D1	