Newton Interconnect Port Hardware Specification for the MessagePad

This document describes the Newton Interconnect Port. This port was designed to connect the MessagePad to a variety of peripherals and devices, such as: a simple AppleTalk serial cable connection, a wireless communication device connection port, and a complex docking port for a desktop dock that provides audio I/O capabilities.

Because of the wide array of devices that may be connected to the MessagePad, the Newton Interconnect Port has been designed with the flexibility needed to accommodate the majority of such devices. There is no minimum set of required signals: a device could, for example, use only audio out to provide a connection to a set of amplified speakers.

The Newton Interconnect Port contains the following groups of pins:

■ 7-pin AppleTalk/Local Talk interface with handshaking signals, using the Serial Communications Controller Channel 0. This channel is interfaced through an LTC1323 line driver, and supports both standard RS-422 serial and AppleTalk ports. The interface provides differential-pair data signals and buffered versions of the handshaking signals. A detailed description of the LTC1323 line driver is available on Linear Technology's Web site (www.linear.com). Specifics of the RS-422 standard can be found by searching for "RS-422."

■ Serial Communications Controller Channel 3 with full control signals, ring indicator, and enable.

■ Power Adapter pins that power the MessagePad and recharge the batteries through the Newton Interconnect Port.

■ Auxiliary audio input.

■ Line-level auxiliary audio output.

■ An auxiliary +5V power source that can be turned on or off under software control.

■ A control input that allows an external peripheral to wake the MessagePad system if it is in the Sleep state (i.e., all clocks are disabled and all subsystems are shut down, with the exception of the Digital Controller's Real Time Clock). This input can also be used to alert the MessagePad to perform AutoDocking functions (if a dock or cable has been inserted in the Newton Interconnect Port).

Overview of the Serial Channels

The Newton Interconnect Port provides two serial channels — 0 and 3. Channel 0 has a LTC1323 line driver connected to the Newton Interconnect Port, and can be used as either a serial channel or as a differential AppleTalk connection. Channel 3 can also be used with a serial port, but has no line driver, so developers will probably need to provide one.

A block diagram of the Newton Interconnect Port, and its channels, is shown in Figure 1-1.

Figure 1-1   Serial Ports and Enables
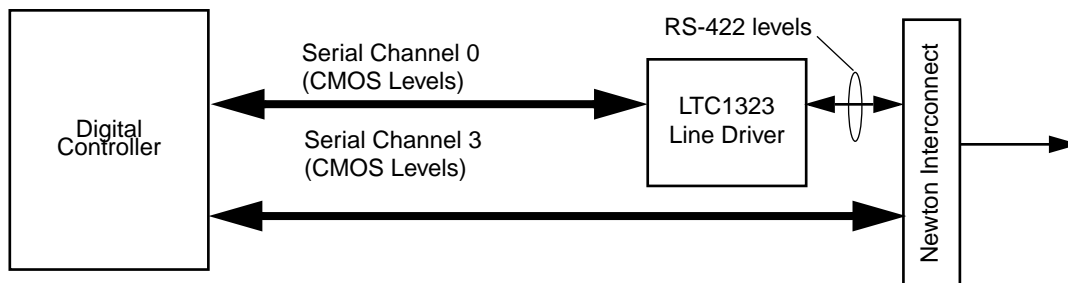
Serial Channel 0

The LTC1323 Line Driver, connecting Serial Channel 0 to the Newton Interconnect Port, provides RS-422 level inputs and outputs. Channel 0 provides a differential pair for Receive Data (RXD+/-) and Transmit Data (TXD+/-), as well as a pair of hardware handshake signals (HSKi and HSKo). There is also a General-Purpose I/O line (GPI) that can be used as a ring indicator.

Modes Supported

Channel 0 supports the following modes:

■ Async, SDLC, and LocalTalk protocols

■ NRZ, MRZI or FM encoding/decoding

- Clocking modes supporting both internal and external clocking

- Data rates up to 230.4Kb/sec when using the internal clock

- Data rates of 2Mbit/sec when using external clocking

Asynchronous Capabilities

Channel 0 supports the following asynchronous capabilities:

- 5, 6, 7 or 8 bits/character

- 1, 1.5, 2 stop bits

- Odd or even parity

- Break generation and detection capability

The line driver is enabled internally by the MessagePad via a General-Purpose I/O (GPIO) pin. When this I/O pin is not enabled, the LTC 1323 Line Driver is in shutdown mode and will not drive the internal serial bus. The Newton OS is configured to enable the 5V power supply whenever Serial Port 0 is selected.

Connection to a Standard Apple Serial Cable

Figure 1-2 shows the connections that convert the Newton Interconnect Port to a standard Apple Serial Connection. The figure shows a male DIN 8 connector and the Newton Interconnect Port. Both connectors are shown as they appear to the corresponding connectors on the peripheral.

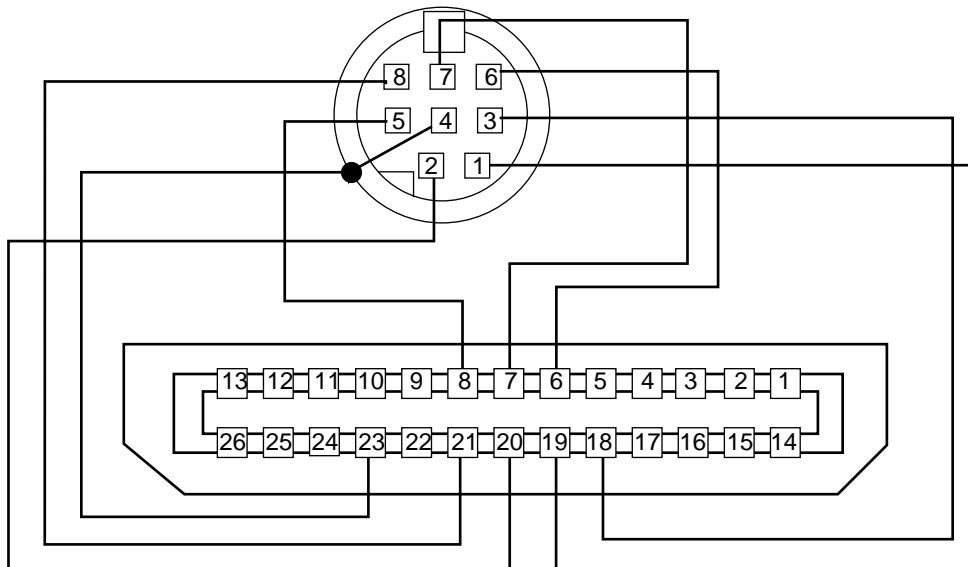**Figure 1-2**   DIN 8 Connection to Newton Interconnect Serial Port 0

Table 1-1   DIN 8 Connection to Newton Interconnect Serial Port 0

Signal Name	Newton Interconnect Pin	DIN 8 Pin
HSKo	19	1
HSKi	20	2
TXD-	18	3
Gnd	23	4
RXD-	8	5
TXD+	6	6
GPI	7	7
RXD+	21	8

Accessing Serial Channel 0

Serial Channel 0 can be accessed through communication endpoints using the standard Newton Serial Tool, AppleTalk Tool and Modem Tool. This section assumes that you are already familiar with the Newton Operating System's communication architecture. See the book *Newton Programmer's Guide: Communications* for an explanation of how to access Serial Channel 0.

Serial Channel 3

Serial Channel 3 is connected directly to the Newton Interconnect Port. Because the channel is always enabled, care must be taken in its use. The Serial Channel 3 signals are intended to be used with an external, serial line driver, such as an LTC1323. The LTC1323 inverts some of the signals, so if a peripheral will be connected directly to the Interconnect Port, invertors may be required to maintain the correct signal polarity.

Accessing Serial Channel 3

Serial Channel 3 can be accessed through communication endpoints using the standard Newton Serial Tool, AppleTalk Tool and Modem Tool. This section assumes that you are already familiar with the Newton Operating System's communication architecture. See the *Newton Programmer's Guide: Communications* for an explanation of how to access Channel 3.

Audio

The Newton Interconnect Port has both Audio Out and Audio In capabilities. These can be used to connect to auxiliary audio devices.

`AudioOut` is a single-ended signal at line level, referenced from `AGND`. `AudioOut` is capable of driving impedance loads down to 1KΩ. The Analog Controller output's audio to either the internal speaker, the `AuxAudioOut` pin, or both. See Table 1-2 for the output audio parameters.

Table 1-2   Audio Out Specification Parameters

Parameter	Min	Typical	Max
Full Scale Output Voltage	0.85 Vpeak	1.0 Vpeak	1.15 Vpeak
Instantaneous Dynamic Range (Attenuation at 0dB)	65 dB	68 dB	---
Frequency Response (7.2 kHz Word Rate)	-0.6dB	---	0.6dB
Frequency Response (21.6 kHz Word Rate)	-0.8dB	---	0.6dB
Programmable Output Level Attenuation	-102.4dB	---	0dB
Gain Step Size	--	2.49dB	---
Gain Drift	---	3.50ppm/C	---
Common Mode Output Voltage	---	1.0V	---
Output Impedance	---	10W	---
Load Impedance	1kW	---	---
Short Circuit Current Limit	---	---	50mA
Total Harmonic Distortion at -0.5 dB Full-Scale Level	---	0.05%	0.07%

`AudioIn` is a single-ended signal at line level, referenced from `AGND`. The Analog Controller can accept input from either the internal microphone or the Newton Interconnect Port. The parameters for AudioIn are as follows:

<u>Sound in:</u> 1V Peak-Peak typical, consumer line level audio compatible, 10K ohm nominal impedance. 2.0V Clipping.

<u>Sound Out:</u> 2.0V Peak-Peak max, 1.0V PP typical, 600 ohm nominal load impeadance.

Dock Attached

The Newton Interconnect Port provides a single control signal, `prodDockAttach`, that can be used to perform two functions: wake the system from the Sleep state, or allow the MessagePad to detect the presence of a dock and perform autodocking connection functions with a desktop machine. `prodDockAttach` is a General-Purpose I/O (GPIO) signal that the MessagePad configures as an active-low input.

Waking the System

If the MessagePad is in the Sleep state, it can be awakened by pulsing the `prodDockAttach` signal low for approximately 1msec. `prodDockAttach` must conform to the 3.3V CMOS voltage levels for logical high and low. This signal is normally held at a CMOS-level logical high by a pullup resistor. Enable this signal by connecting it to either the connector ground or to an open-drain ground that will pull it below 0.5V. The maximum current that this signal will source is 10mA.

If the MessagePad is awake, the pulse is ignored. Timing for the `prodDockAttach` signal to wake the system is shown in Figure 1-3.
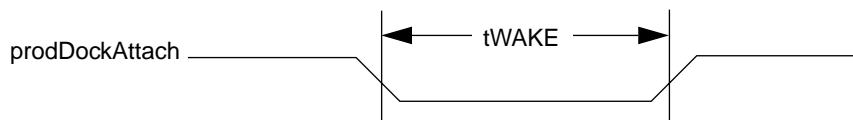
Figure 1-3   System WakeUp Timing

Table 1-3   System WakeUp Timing

Parameter	Description	Min	Max
tWake	Wake Up Pulse Width	1 msec	2 msec

AutoDocking

The `prodDockAttach` signal can also be used to alert the system that an external system peripheral has been attached to the MessagePad and that autodocking should be performed.

To perform autodocking, the `prodDockAttach` signal must be driven low, and must remain low until the dock is removed. The signal must remain low for at least 10msec to be recognized by the OS as a docking event.

If the unit is in the sleep state, the unit will awake once the prodDockAttach signal has been asserted. Timing is shown in Figure 1-4.

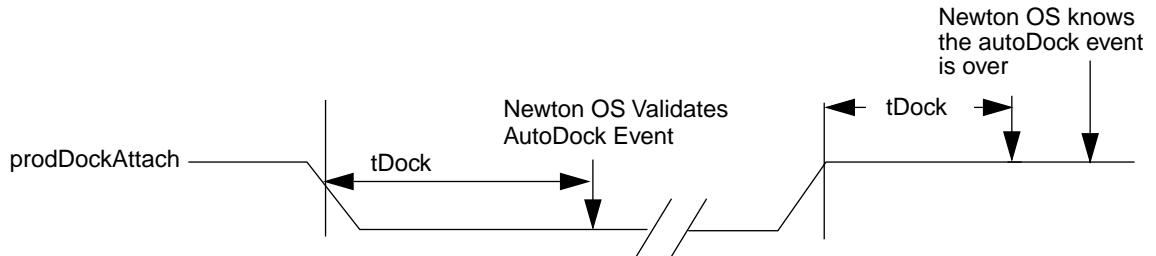**Figure 1-4**   AutoDocking Timing

Table 1-4   AutoDocking Timing

Parameter	Description	Min	Max
tDock	prodDockAttach debounce time	10 msec	--

Power Adapter Signals

The Newton Interconnect Port allows an external power source, such as an AC Power Adapter, to source 2-cell or 4-cell devices. The 2-cell devices are sourced through PowerInPos2, and 4-cell devices are sourced through PowerInPos4. All MessagePads built to date are 4-cell devices, so PowerInPos2 is not connected.

The Power Adapter is connected to five pins on the Newton Interconnect Port. The Power Adapter's positive voltage is applied to the PowerInPos4 signal on pins 2 and 14. The Power Adapter's ground is applied to the PowerInNeg signal on pins 3, 15, and 16.

Besides powering the unit, a Power Adapter can also charge the internal batteries (if a rechargeable battery pack is installed and properly detected).

Design specifications for a Power Adaptor that can source power to the MessagePad are described later in this document.

Connector Pinout

The following figures and tables illustrate the location of the signals on the Newton Interconnect Port. The connector pinout numbers are shown as they appear when looking into the respective connectors.

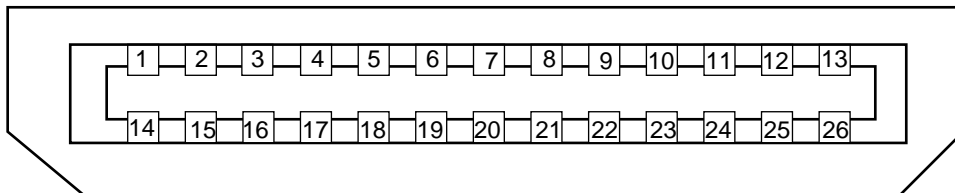**Figure 1-5**   Newton Interconnect Port - MessagePad Side
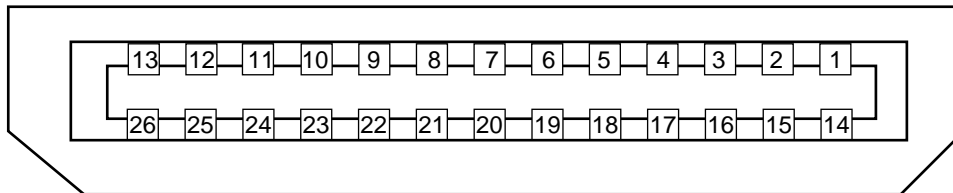

Figure 1-6   Newton Interconnect - Peripheral Side

Table 1-5   Newton Interconnect Port Pin Assignments

Pin Number	Signal Name	I/O	Signal Description
1	PowerInPos2	I	Positive Power Adapter Input Voltage (2-cell systems)
2	PowerInPos4	I	Positive Power Adaptor Input voltage (4-cell systems)
3	PowerInNeg	I	Power Adaptor Input Ground
4	auxAudOutPos	O	Audio Out (capable of driving a 1KW load)
5	AGnd	O	Auxiliary Audio Ground
6	SerialTXdP	O	Serial Channel 0 TX+
7	SerialGpi		Serial Port/General Purpose Input
8	SerialRXdN	I	Serial Channel 0 RX-
9	Chan3TXd3	O	Serial Channel 3 transmit
10	PortSel	O	Selects between Newton Interconnect Port and internal Serial Slot
11	dock5V	O	+5 Volt Supply
12	Chan3NotDTR	I	Serial Channel 3 Data Terminal Ready
13	ModemNotCTS	O	Serial Channel 3 Clear to Send
14	PowerInPos4	I	Positive Power Adaptor Voltage (4-cell systems)
15	PowerInNeg	I	Power Adaptor Ground
16	PowerInNeg	I	Power Adaptor Ground
17	auxAudioIn	I	Audio Input
18	SerialTXdN	O	Serial Channel 0 TX-
19	SerialHsko	O	Serial Channel 0 Handshake Out
20	SerialHski	I	Serial Channel 0 Handshake In
21	SerialRxdP	I	Serial Channel 0 Rx+
22	Chan3Rxd3	I	Serial Channel 3 RX
23	dGND	O	Digital Ground
24	Chan3RI3	I	Serial Channel 3 Ring Indicator
25	ModemNotRTS3		Serial Channel 3 Not Request to Send
26	prodDockAttach		Wakeup/Docking Signal

Table 1-6   Newton Interconnect Port Signal Groups

Power Signal Name	Pin	I/O	Signal Description
PowerInPos2	1	I	Positive Power Adaptor Input Voltage 2 Cell Systems
PowerInPos4	2, 14	I	Positive Power Adaptor Input voltage 4 Cell Systems
PowerInNeg	3, 15, 16	I	Power Adaptor Input Ground
dGND	23	I	Digital Ground
dock5V	11	O	+5 Volt Supply
Audio Signal Name	**Pin #**	**I/O**	**Signal Description**
auxAudOutPos	4	O	Line Level Audio Out
auxAudioIn	17	I	Audio Input
AGnd	5	O	Audio Ground
Serial Port 0 Signal Name	**Pin #**	**I/O**	**Signal Description**
SerialTXdP	6	O	Serial Channel 0 TX+
Serial Gpi	7	I	Serial Port 0 General Purpose Input
SerialRXdN	8	I	Serial Channel 0 RX-
SerialTXdN	18	O	Serial Channel 0 TX-
SerialHsko	19	0	Serial Channel 0 Handshake Out
SerialHski	20	I	Serial Channel 0 Handshake In
SerialRxdP	21	I	Serial Channel 0 Rx+
Serial Port 3 Signal Name	**Pin #**	**I/O**	**Signal Description**
ChanTXd3	9	O	Serial Channel 3 Transmit
Chan3NotDTR	12	I	Serial Channel 3 Not Data Terminal Ready
ModemNotCTS	13	O	Serial Channel 3 Not Clear to Send
Chan3Rxd3	22	I	Serial Channel 3 RX
Chan3RI3	24	I	Serial Channel 3 Ring Indicator
Chan3NotRTS3	25		Serial Channel 3 Request to Send
IntModemSel	10	O	Enable for Internal Serial Channel 3
Control Signal Name	**Pin #**	**I/O**	**Signal Description**
prodDockAttach	26	I	Wakeup/Docking Signal

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Output Connection for Newton Interconnect Connection

The Newton Interconnect Port requires a JAE 26-pin custom mating plug. This plug is available in locking and non-locking configurations. The non-locking configuration should be used when designing accessories that require smooth connection and have other mechanical means of securing the accessory to the MessagePad, such as a dock. The JAE part number for the non-locking connector is RX04-26P1-SF1.

The locking connector configuration should be used when designing accessories that require a more secure connection, such as a cable. The JAE part number for the locking connector is RX04-26P-SF1.

+5 Volt Power Supply

The Newton Interconnect Port has a +5V power supply that can be used to power external devices connected to the port. The supply is enabled by any of the following three events:

- Channel 0 or 3 is active. Note that the channel must be turned on—simply connecting a device to the port will not enable the supply.

- An audio signal is being played over the `auxAudioOutPos` line. Note that the supply is enabled only for the duration of the audio signal.

- An audio signal is being recorded over the `auxAudioIn` line. Note that the supply is enabled only for the duration of the recording.

The total 5V power budget is 500mA, which must be shared by other devices in the system (such as PC Cards), in addition to the Newton Interconnect Port. Of this power budget, the Interconnect Port can draw a maximum of 100mA from the 5V power supply.

5-volt Power Supply Specifications

This section specifies the DC operating conditions for the 5V power source available on the Newton Interconnect Port.

Table 1-7   5-Volt Power Supply Voltages

Supply	Min Voltage	Max Voltage
Dock 5V	4.5V	5.5V

Table 1-8   Power Supply Current Specifications

Supply	Min Voltage	Max Voltage
Dock 5V	---	100mA

Power Adapter

This section defines the electrical criteria that a power adapter for the MessagePad must meet. The power adapter can be connected to the MessagePad via an external power adapter jack, other internal connectors, or the Newton Interconnect Port. When a power adapter is attached to any of these connections, and to an AC power source, it supplies the power to the system and can recharge batteries. If the power adapter is connected to the system, but not connected to an AC power source, it will draw a maximim of 100uA from the batteries.

DC Output Requirements

The output of the adapter must be designed to appear as a Thevenin equivalent source with an open circuit voltage of 6.75V to 7.50V, and have a source resistance of 0.2Ω to 0.4Ω over an output current range of 5mA to 1300mA.

When the current is below 5mA, the source voltage may not exceed 7.7V. The output from the adapter must be current-limited to between 1.1A and 1.3A, over the input voltage range of 4.5V to 7.0V.

Below an output of 4.0V, the current limit may be folded back or stepped back without damage. The following table gives the acceptable output range for several load conditions

Table 1-9   Constant Current Mode

Output Current (mA)	Min.Voltage Limit (VDC)	Max.Voltage Limit (VDC)
5	7.27	7.50
500	7.07	7.50
1000	6.87	7.50
1300	6.75	7.50

Table 1-10   Constant Voltage Mode

Output Voltage (VDC)	Min.Current Limit (mA)	Max.Current Limit (mA)
7.50	1100	1300
7.00	1100	1300

Output Voltage (VDC)	Min.Current Limit (mA)	Max.Current Limit (mA)
5.60	1100	1300
4.00	100	1300
0.00	0	1300

Table 1-11   Other Electrical Requirements

Parameter	Nominal	Max.
Ripple peak-to-peak	—	100 mV
Leakage Current VIN	—	0.75 mA
Instantaneous Over Voltage Protection	10.0 V	12.0 V

Figure 1-7 shows the Power Adapter's acceptable operating region.

Figure 1-7   Power Adapter Operating Range-Typical