Universal Socket Connectivity

For Embedded Modems

SocketModem™ – MT5600SMI

SocketModem™ – MT5656SMI

SocketModem™ – MT5634SMI

SocketModem™ – MT2456SMI-22
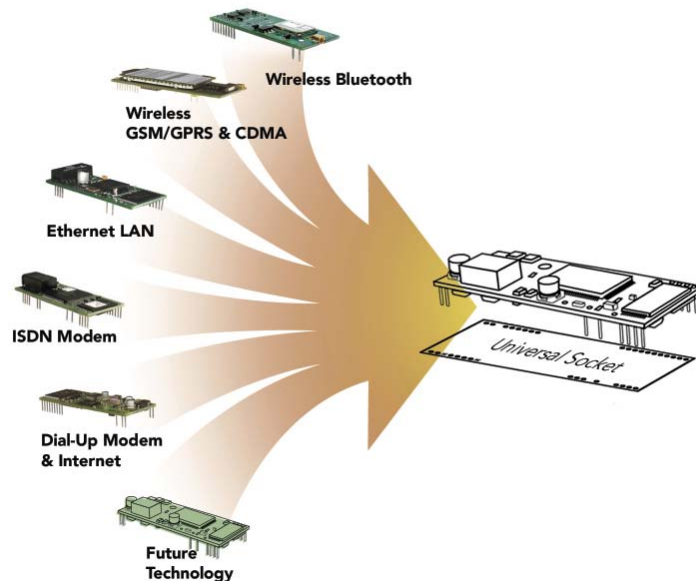
SocketModem™ IP – MT2456SMI-IP

SocketEthernet™ IP – MTXCSEM

SocketModem™ ISDN – MT128SMI

SocketModem™ GPRS – MTSMC-G

SocketModem™ CDMA – MTSMC-C

SocketWireless™ Bluetooth® – MTS2BTSMI

Hardware Guide for Developers

MultiTech® Systems

Universal Socket Connectivity Developer's Guide

PN S000342C, Version C

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Revisions

Revision Level	Date	Description
A	06/17/04	Initial release of Universal Socket Connectivity hardware guide.
B	10/01/04	Add SocketWireless with Bluetooth Technology chapter. Changed pinouts: TXCLK to TCLK and RXCLK to RCLK. Added the schematics for the MT128SMI. Added note to the SocketEthernet IP filtering drawing.
C	11/11/04	Revised GSM/GPRS mechanical drawing. More information location information about AT commands, fax commands, and voice commands. Update Bluetooth chapter.

Trademarks

Trademarks of Multi-Tech Systems, Inc. are *SocketModem*, *SocketWireless*, and the Multi-Tech logo. *Microsoft* and *Windows* are registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries. *Bluetooth* is a registered trademark of Bluetooth.

Patents

This device covered by one or more of the following patents: 6,031,867; 6,012,113; 6,009,082; 5,905,794; 5,864,560; 5,815,567; 5,815,503; 5,812,534; 5,809,068; 5,790,532; 5,764,628; 5,764,627; 5,754,589; 5,724,356; 5,673,268; 5,673,257; 5,644,594; 5,628,030; 5,619,508; 5,617,423; 5,600,649; 5,592,586; 5,577,041; 5,574,725; 5,559,793; 5,546,448; 5,546,395; 5,535,204; 5,500,859; 5,471,470; 5,463,616; 5,453,986; 5,452,289; 5,450,425; 5,355,365; 5,309,562; 5,301,274. Other Patents Pending.

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Chapter 1

Universal Socket Connectivity

Chapter 1 - Universal Socket Connectivity

Multi-Tech Embedded Solutions

Multi-Tech's family of embedded solutions creates communication-ready devices by integrating data/fax or Internet functionality into a single, universal socket design. Now you have the ability to provide remote monitoring, diagnostics, data collection, or virtually any communication ability to your existing or new device via interchangeable dial-up, wireless, or Ethernet communication modules.

Universal Socket Connectivity Features

- Flexible comm-port architecture
- Interchangeable socket modules
- Cost-effective system design
- Easy migration to future technologies
- Complete global compliance

The SocketModem's flexible comm-port architecture provides dial-up, wireless, or Ethernet socket connectivity with interchangeable modules. This means you can utilize one system design and populate it with your communication module of choice. In addition, you are assured a seamless migration to future technologies.

The Universal Socket Design

Each pin on a socketmodem corresponds to a particular function. The universal socket design provides a universal location for each function pin. This allows each socketmodem to be used in a common developer's test board.
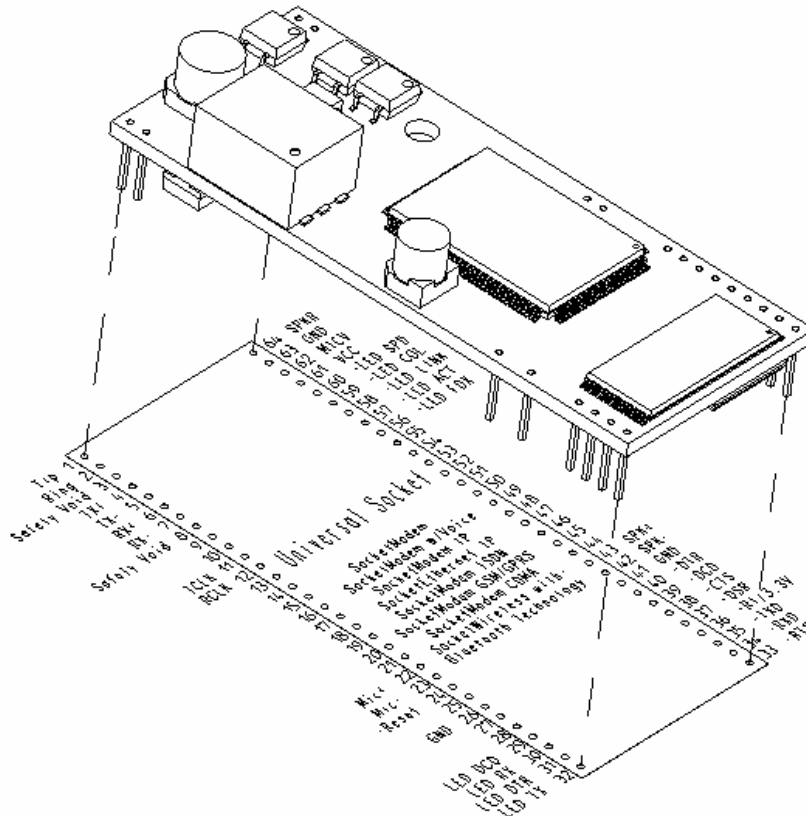
AT Commands, Fax Commands, and Voice Commands

AT Commands

Multi-Tech provides Reference Guides for each SocketModem's AT commands, fax commands, and voice commands. These reference guides are available on the CD included in the Developer Kit. They are also available by email at oemsales@multitech.com or by request using the Developer Guide Request Form on Multi-Tech's Web site.

Fax Commands

Fax Commands are included in the AT Command Reference Guide when applicable to the product. They are available on the CD included in the Developer Kit.

Note: Fax Commands supported by product:
- SocketModem MT5600SMI supports Class 1 & 1.0
- SocketModem MT5656SMI supports Class 1 & 2 (not 2.0/2.1)
- SocketModem MT5634SMI supports all Class 1 and Class 2 commands (Class 1, 1.0, 2, 2.0/2.1)
- Wireless GSM/GPRS MTSMC-G supports Class 1 core commands only (defined by ITU T.31)
- Wireless CDMA MTSMC-C supports Class 2.0

Voice Commands

Voice Commands Reference Guides are available on the CD included in the Developer Kit.
- SocketModem MT5600SMI supports +V commands
- SocketModem MT5656SMI supports +V (including speakerphone)
- SocketModem MT5634SMI supports +V commands

Table of Commands

Note: The following is a list of Reference Manuals available at the time of this Hardware Guide's publication.

Product	AT Commands	Fax Commands	Voice Commands
SocketModem (MT5600SMI)	MT5600SMI/MT5656SMI AT Commands Reference Guide # **S000306B**	MT5600/5656SMI Class 1 & 2 Fax Commands included in guide # **S000306B**	MT5600/5656SMI Voice Commands included in Guide # **S000306B**
SocketModem (MT5656SMI)	MT5600/5656SMI AT Commands Reference Guide # **S000306B**	MT5600/5656SMI Class 1 & 2 Fax Commands included in Guide # **S000306B**	MT5600/5656SMI Voice Commands included in Guide # **S000306B**
SocketModem (MT5634SMI-xx)	MT5634SMI AT Commands Reference Guide # **S000263C**	MT5634SMI Class 1 & 2 Fax Commands included in Guide # **S000263C**	MT5634SMI Voice Commands included in Guide # **S000263C**
SocketModem (MT2456SMI-22)	MT2456SMI-22 AT Commands Guide # **S000281D**	Fax Not Supported	Voice Not Supported
SocketModem IP (MT2456SMI-IP)	MT2456SMI-IP Command Line Interface Guide # **S000307C**	Fax Not Supported	Voice Not Supported
SocketEthernet IP (MTXCSEM)	MTXCSEM Command Line Interface Guide # **S000278G**	Fax Not Supported	Voice Not Supported
SocketModem ISDN (MT128SMI)	MT128SMI AT Commands Guide # **S000352B**	Fax Not Supported	Voice Not Supported
SocketModem GPRS (MTSMC-G)	GSM/GPRS AT Commands Guide # **S000293C** and IP AT Commands Guide # **S000333A**	GSM/GPRS applicable Fax Commands included in Guide # **S000293C**	Voice Not Supported
SocketModem CDMA (MTSMC-C)	CDMA AT Commands Guide # **S000294D**	CDMA applicable Fax Commands included in Guide # **S000294D**	Voice Not Supported
SocketWireless Bluetooth (MTS2BTSMI)	SocketWireless Bluetooth AT Commands Guide # **S000360B**	Fax Not Supported	Voice Not Supported

Universal Socket Configuration
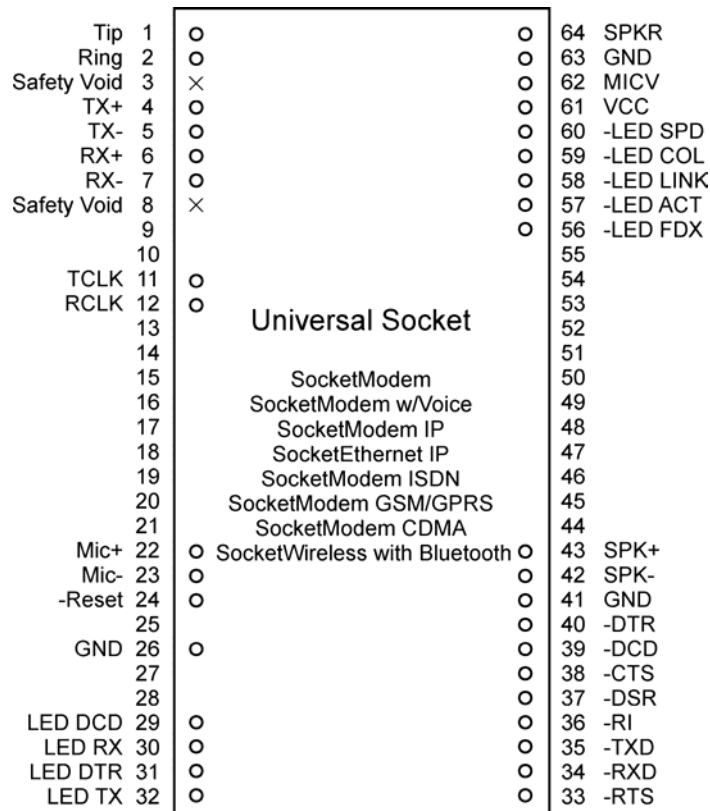
Universal Pin Descriptions

Pin	Signal Name	I/O Type	Description
1	Tip	I/O	**Tip Signal from Telco**. Tip connection to the phone line (RJ-11 Pin 4). The SocketModem is Tip/Ring polarity insensitive.
2	Ring	I/O	**Ring Signal from Telco**. Ring connection to the phone line (RJ-11 Pin 3). The SocketModem is Tip/Ring polarity insensitive.
3	Safety Void	NA	**Safety Clearance**. 2.5 mm is required between TNV circuits and SELV circuits.
4	TX+	O	**Transmit Outputs (TX+ and TX-)**. Differential transmit outputs for Ethernet and ISDN.
5	TX-	O	**Transmit Outputs (TX+ and TX-)**. Differential transmit outputs for Ethernet and ISDN.
6	RX+	I	**Receive Inputs (RX+ and RX-)**. Differential receive input pins for Ethernet and ISDN.
7	RX-	I	**Receive Inputs (RX+ and RX-)**. Differential receive input pins for Ethernet and ISDN.
8	Safety Void	NA	**Safety Clearance**. 2.5 mm is required between TNV circuits and SELV circuits.
11	TCLK	O	**Transmit Data Sync Clock**. TX synchronous data clock for ISDN sync data mode.
12	RCLK	O	**Receive Data Sync Clock**. RX synchronous data clock for ISDN sync data mode.
22	MIC+	I	**Wireless GSM/GPRS and CDMA (future).**
23	MIC-	O	**Wireless GSM/GPRS and CDMA (future).**

Pin	Signal Name	I/O Type	Description
24	–RESET	I	**Device Reset** (with pull-up). The active low –RESET input resets the device logic and returns the configuration of the device to the original factory default values of "stored values" in the NVRAM. –RESET is tied to VCC through a time-constant circuit for "Power-on-Reset" functionality. The module is ready to accept commands after a fixed amount of time after power-on or reset. **Model** **Time Constant** **"X" Time** **Minimum Reset Pulse*** MT5600SMI 250 ms 6 seconds 100us MT5656SMI 250 ms 6 seconds 100us MT5634SMI 400 ms 6 seconds 100us MT2456SMI-22 250 ms 6 seconds 100us MT2456SMI-IP 250 ms 6 seconds 100us MTXCSEM 250 ms 6 seconds 100us MT128SMI 200 ms 6 seconds 100us MTS2BTSMI 250 ms 6 seconds 100us *The SocketModem device may respond to a shorter reset pulse. **Wireless GSM/GPRS and CDMA** **Reset**. This signal is used to force a reset procedure by providing low level during reset of at least 500us*. The signal is considered an emergency reset only. A reset procedure is already driven by internal hardware during the power-up sequence*. This signal can also be used to provide a reset to an external device. It then acts as an output. If no external reset is necessary, this input can be left open. If used (emergency reset), it has to be driven by an open collector or an open drain.
26	GND	GND	**Logic Ground**.
29	LED DCD	O	**DCD LED Indicator (Active High).** Output from 74LCX14 with a 1000 Ohms resistor in series. **SocketWireless Bluetooth (MTS2BTSMI):** When lit, indicates a connection. No series resistor.
30	LED RX	O	**RX LED Indicator (Active High).** Output from 74LCX14 with a 1000 Ohms resistor in series. **SocketWireless Bluetooth (MTS2BTSMI):** No series resistor.
31	LED DTR	O	**DTR LED Indicator (Active High).** Output from 74LCX14 with a 1000 Ohms resistor in series. **SocketWireless Bluetooth (MTS2BTSMI):** No series resistor.
32	LED TX	O	**TX LED Indicator (Active High).** Output from 74LCX14 with a 1000 Ohms resistor in series. **SocketWireless Bluetooth (MTS2BTSMI):** No series resistor.
33	–RTS	I	**Request to Sent (Active Low).** –RTS signal is used for hardware flow control. –RTS input ON (low) indicates that the DTE is ready to send data to the modem. In the command state, the modem ignores –RTS. **Note:** When the –RTS pin is not in use, it should be tied low.
34	–RXD	O	**Received Data**. The module uses the RXD line to send data to the DTE and to send module responses to the DTE. In command mode, –RXD data presents the module responses to the DTE. Module responses take priority over incoming data when the two signals are in competition for –RXD. When no data is transmitted, the signal is held in mark condition.
35	–TXD	I	**Transmitted Data**. The DTE uses the –TXD line to send data to the module for transmission or to transmit commands to the module. The DTE should hold this circuit in the mark state when no data is being transmitted or during between intervals between characters.
36	–RI or PIO5	O	**RING (Active Low)**. Incoming ring signal from phone. **Ring Indicate.** –RI output ON (low) indicates the presence of an ON segment of a ring signal on the telephone line. The modem will not go off-hook when –RI is active; the modem waits for –RI to go inactive before going off-hook. **SocketWireless Bluetooth (MTS2BTSMI):** PIO5 – User definable I/O pin PIO5. Strobes 1/sec for slave indication.
37	–DSR or PIO7	O	**Data Set Ready (Active Low)**. –DSR indicates module status to the DTE. –DSR OFF (high) indicates that the DTE is to disregard all signals appearing on the interchange circuits except Ring Indicator (–RI). It reflects the status of the local data set and does not indicate an actual link with any remote data equipment. **SocketWireless Bluetooth (MTS2BTSMI):** PIO7 – User definable I/O pin PIO7. Defaults as input.

Pin	Signal Name	I/O Type	Description
38	–CTS	O	**Clear to Send (Active Low)**. –CTS is controlled by the module to indicate whether or not the module is ready to transmit data. –CTS ON indicates to the DTE that signals on TXD will be transmitted. –CTS OFF indicates to the DTE that it should not transfer data on TXD.
39	–DCD	O	**Data Carrier Detect (Active Low)**. –DCD output is ON (low) when a data connection is established and the module is ready to send/receive data.
40	–DTR or PIO6	I	**Data Terminal Ready (Active Low)**. The –DTR input is turned ON (low) when the DTE is ready to communicate. –DTR ON prepares the modem to be connected, and, once connected, maintains the connection. –DTR OFF places the modem in the disconnect state under control of the &Dn and &Qn commands. **Note:** When the –DTR pin is not in use, it should be tied low. **SocketWireless Bluetooth (MTS2BTSMI):** PIO6 – User definable I/O pin PIO6. Defaults as input.
41	GND	GND	**Logic Ground**.
42	SPK-	O/O	**Wireless GSM/GPRS and CDMA (future).**
43	SPK+	O/I	**Wireless GSM/GPRS and CDMA (future).**
56	–LED FDX	O	**LED Full Duplex (Active Low)**. LED Output. During normal operation, this pin lights the FDX LED to indicate a full duplex mode.
57	–LED ACT	O	**LED Active (Active Low)**. LED Output. During normal operation, this pin lights the Activity LED when transmitting or receiving. It flashes at a rate of 50ms high and 50ms low when active.
58	–LEDLINK	O	**LED LINK (Active Low)**. LED Output. During normal operation, this pin lights the LINK LED to indicate a good link is detected.
59	–LEDCOL	O	**LED Collision (Active Low)**. LED Output. During normal operation, this pin lights the COL LED to indicate a collision. It flashes at 50ms high and 50ms low when active.
60	–LEDSPD	O	**LED Speed (Active Low)**. LED Output. During normal operation, this pin lights the SPEED LED to indicate 100Mbps is selected.
61	VCC	PWR	**DC Input Power**. 3.3 V or 5 V DC power, depending upon the build.
62	MICV	I/O	**Single-Ended Microphone**. Single-ended microphone input for dial-up SocketModem speakerphone and TAM functions.
63	AGND	GND	**Analog Ground**. Analog ground is tied common with DGND on the SocketModem. To minimize potential ground noise issues, connect audio circuit return to AGND.
64	SPKR	O	**Speaker**. Dual purpose output for call progress signals or speakerphone functions. **Call Progress** signaling on MT5600SMI, MT5656SMI, and MT2456SMI-22 is a square wave output that can be optionally connected to a low-cost single-ended speaker; e.g., a sounducer or an analog speaker circuit. Call progress on the MT5634SMI is an analog output. **Speakerphone Output** on the MT5656SMI is under the control of +FCLASS. This is a single-ended analog output. SPKR is tied directly to the CODEC. One side of a differential AC output coupled through a 6.8K ohm resistor and capacitor.

Design Considerations

Good engineering practices must be adhered to when designing a printed circuit board (PCB) containing the SocketModem module. Suppression of noise is essential to the proper operation and performance of the modem itself and for surrounding equipment.

Two aspects of noise in an OEM board design containing the SocketModem must be considered: on-board/off-board generated noise that can affect digital signal processing. Both on-board and off-board generated noise that is coupled on-board can affect interface signal levels and quality. Of particular concern is noise in frequency ranges affecting modem performance.

On-board generated electromagnetic interference (EMI) noise that can be radiated or conducted off-board is a separate, but equally important, concern. This type of noise can affect the operation of surrounding equipment. Most local government agencies have stringent certification requirements that must be met for use in specific environments.

Proper PC board layout (component placement, signal routing, trace thickness and geometry, etc.) component selection (composition, value, and tolerance), interface connections, and shielding are required for the board design to achieve desired modem performance and to attain EMI certification.

The aspects of proper engineering practices are beyond the scope of this designer guide. The designer should consult noise suppression techniques described in technical publications and journals, electronics and electrical engineering text books, and component supplier application notes.

PC Board Layout Guidelines

In a 4-layer design, provide adequate ground plane covering the entire board. In 4-layer designs, power and ground are typically on the inner layers. All power and ground traces should be 0.05 inches wide.

The recommended hole size for the SocketModem pins is 0.036 in. +/-0.003 in. in diameter. Spacers can be used to hold the SocketModem vertically in place during the wave solder process. A spacer should be placed on pin 32 and pin 64 of the SocketModem. A suggested part number for the spacer is BIVAR 938-0.130 for P1 (0.310in) option SocketModems. The spacers can be left on permanently and will not effect operation.

All creepages and clearances for the SocketModem have been designed to meet requirements of safety standards EN60950. The requirements are based on a working voltage of 250V. When the recommended DAA circuit interface is implemented in a third party design all creepage and clearance requirements must be strictly adhered to. The third party safety design must be evaluated by the appropriate national agency per the required specification.

User accessible areas: Based on where the third party design is to be marketed, sold, or used, it may be necessary to provide an insulating cover over all TNV exposed areas. Consult with the recognized safety agency to determine the requirements.

Note: Even if the recommended design considerations are followed, there are no guarantees that a particular system will comply with all the necessary regulatory requirements. It is imperative that specific designs be completely evaluated by a qualified/recognized agency.

Electromagnetic Interference (EMI) Considerations

The following guidelines are offered to specifically help minimize EMI generation. Some of these guidelines are the same as, or similar to, the general guidelines but are mentioned again to reinforce their importance. In order to minimize the contribution of the SocketModem-based design to EMI, the designer must understand the major sources of EMI and how to reduce them to acceptable levels.

1. Keep traces carrying high frequency signals as short as possible.

2. Provide a good ground plane or grid. In some cases, a multilayer board may be required with full layers for ground and power distribution.

3. Decouple power from ground with decoupling capacitors as close to the SocketModem module power pins as possible.

4. Eliminate ground loops, which are unexpected current return paths to the power source and ground.

5. Decouple the telephone line cables at the telephone line jacks. Typically, use a combination of series inductors, common mode chokes, and shunt capacitors. Methods to decouple telephone lines are similar to decoupling power lines; however, telephone line decoupling may be more difficult and deserves additional attention. A commonly used design aid is to place footprints for these components and populate as necessary during performance/EMI testing and certification.

6. Decouple the power cord at the power cord interface with decoupling capacitors. Methods to decouple power lines are similar to decoupling telephone lines.

7. Locate high frequency circuits in a separate area to minimize capacitive coupling to other circuits.

8. Locate cables and connectors so as to avoid coupling from high frequency circuits.

9. Lay out the highest frequency signal traces next to the ground grid.

10. If a multilayer board design is used, make no cuts in the ground or power planes and be sure the ground plane covers all traces.

11. Minimize the number of through-hole connections on traces carrying high frequency signals.

12. Avoid right angle turns on high frequency traces. Forty-five degree corners are good; however, radius turns are better.

13. On 2-layer boards with no ground grid, provide a shadow ground trace on the opposite side of the board to traces carrying high frequency signals. This will be effective as a high frequency ground return if it is three times the width of the signal traces.

14. Distribute high frequency signals continuously on a single trace rather than several traces radiating from one point.

Mechanical Dimensions in Inches

Note: This tooling hole is not on all models.
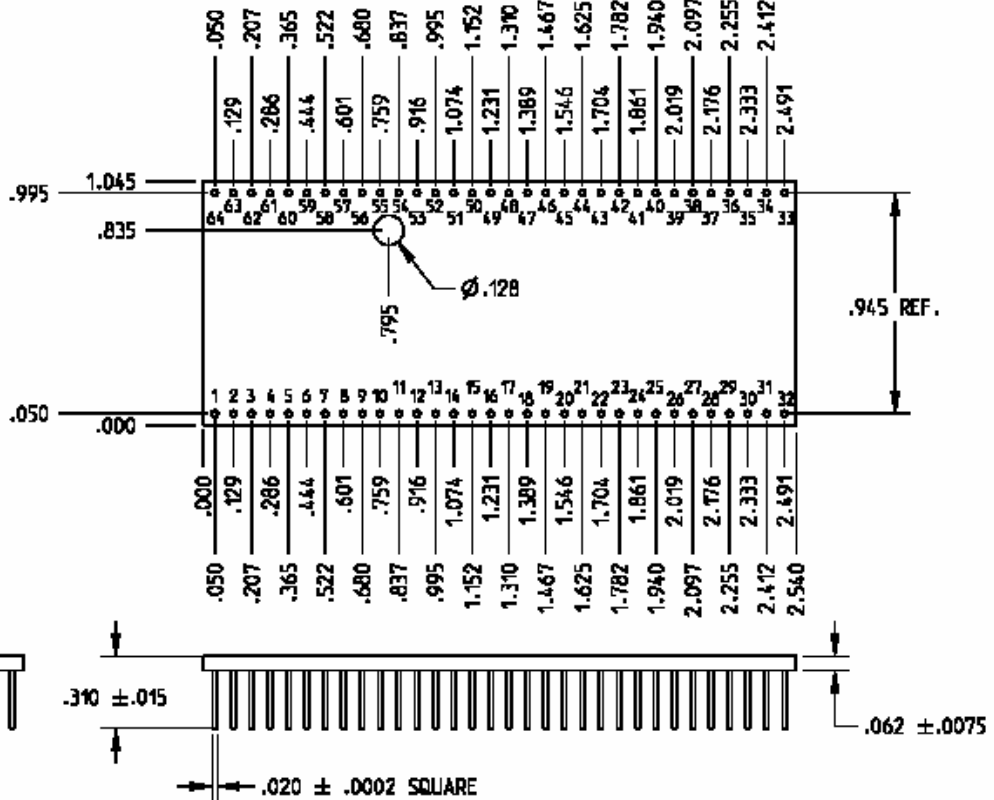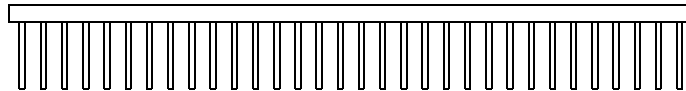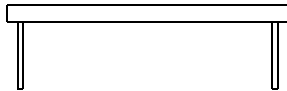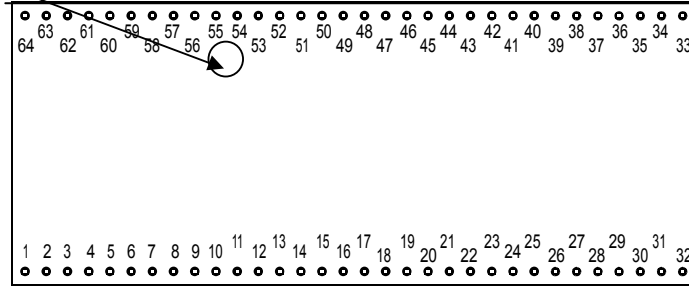
Dimensions Are Shown in Inches

Mechanical Dimensions in Millimeters
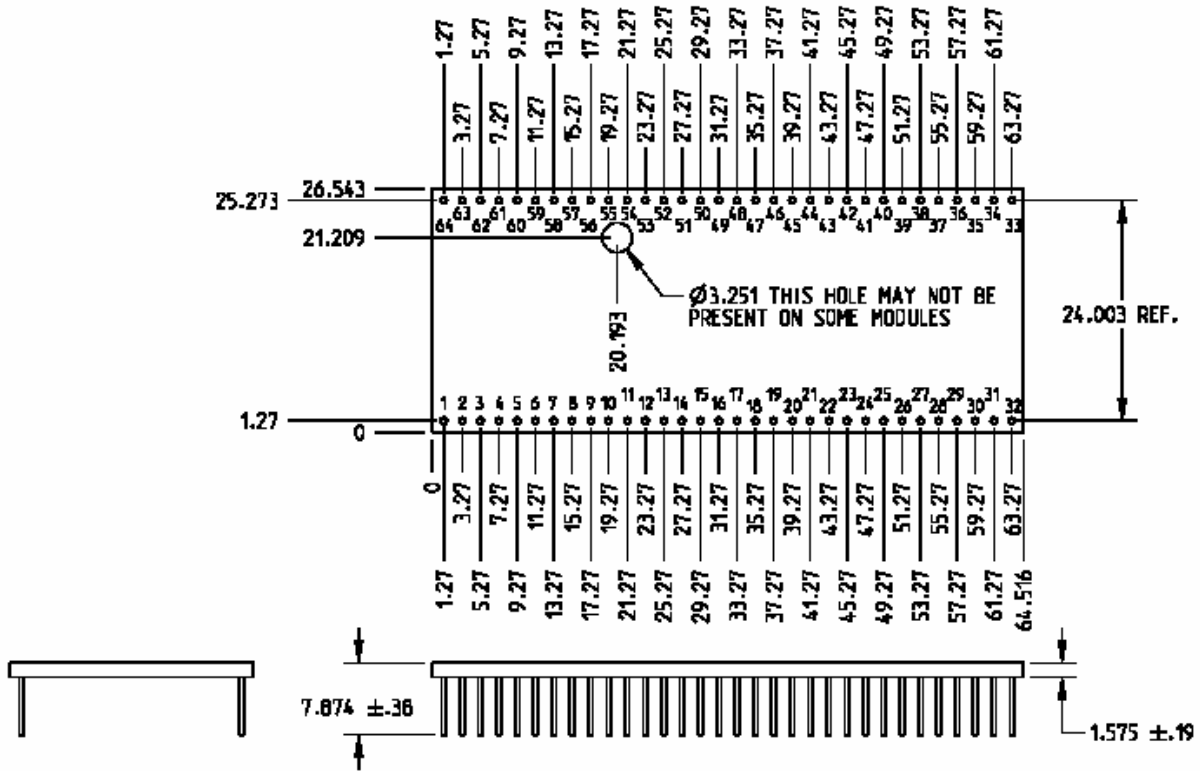
Dimensions Are Shown in Millimeters

Maximum Component Height

Product	Measurement from top of board to highest topside component	Measurement from bottom of board to lowest bottom-side component
SocketModem – MT5600SM	.110 inches (2.80 mm)	.110 inches (2.80 mm)
SocketModem – MT5656SMI	.212 inches (5.38 mm)	.110 inches (2.80 mm)
SocketModem – MT5634SMI	.290 inches (7.36 mm)	.114 inches (2.90 mm)
SocketModem – MT2456SMI-22	.212 inches (5.38 mm)	.110 inches (2.80 mm)
SocketModem IP – MT2456SMI- IP	.228 inches (5.79 mm)	.114 inches (2.90 mm)
SocketEthernet IP – MTXCSEM	.315 inches (8.00 mm)	.075 inches (1.90 mm)
SocketModem GPRS – MTSMC-G	.153 inches (3.88 mm)	.162 inches (4.11 mm)
SocketModem CDMA – MTSMC-C	.238 inches (6.04 mm)	.162 inches (4.11 mm)
SocketWireless Bluetooth – MTS2BTSMI	.270 inches (6.86 mm)	0

SocketModem Developer Board

SocketModem Developer Board Layout

This theoretical developer board drawing shows the major board components for all SocketModems.

Note that the board shipped in the Developer Kit is designed and built with only the components required by the SocketModem in that kit; e.g., a serial dialup SocketModem board will not contain components for a wireless SocketModem.

5 V / 3.3 V Jumper – JP6

The operating voltage factory default setting is 3.3 V. The JP1 jumper must be set to 3.3-volt.

Warning – Be sure to that 5 V/3.3 V jumper is set to match the requirements of your SocketModem. If this jumper is set incorrectly, damage to the SocketModem and/or the Test/Demo card could result.

Caution – Use only the provided Multi-Tech Systems, Inc. transformer with the Test/Demo board. Use of any other power source will void the warranty and will likely damage the Test/Demo board and the SocketModem. The transformer connector is keyed to prevent improper connection to the Test/Demo board.

Handling Precautions

All electronic devices should be handled with certain precautions to avoid damage due to the accumulation of static charge. Although input protection circuitry has been incorporated into the devices to minimize the effect of this static buildup, proper precautions should be taken to avoid exposure to electrostatic discharge during handling and mounting.

SocketModem Developer Board Schematics
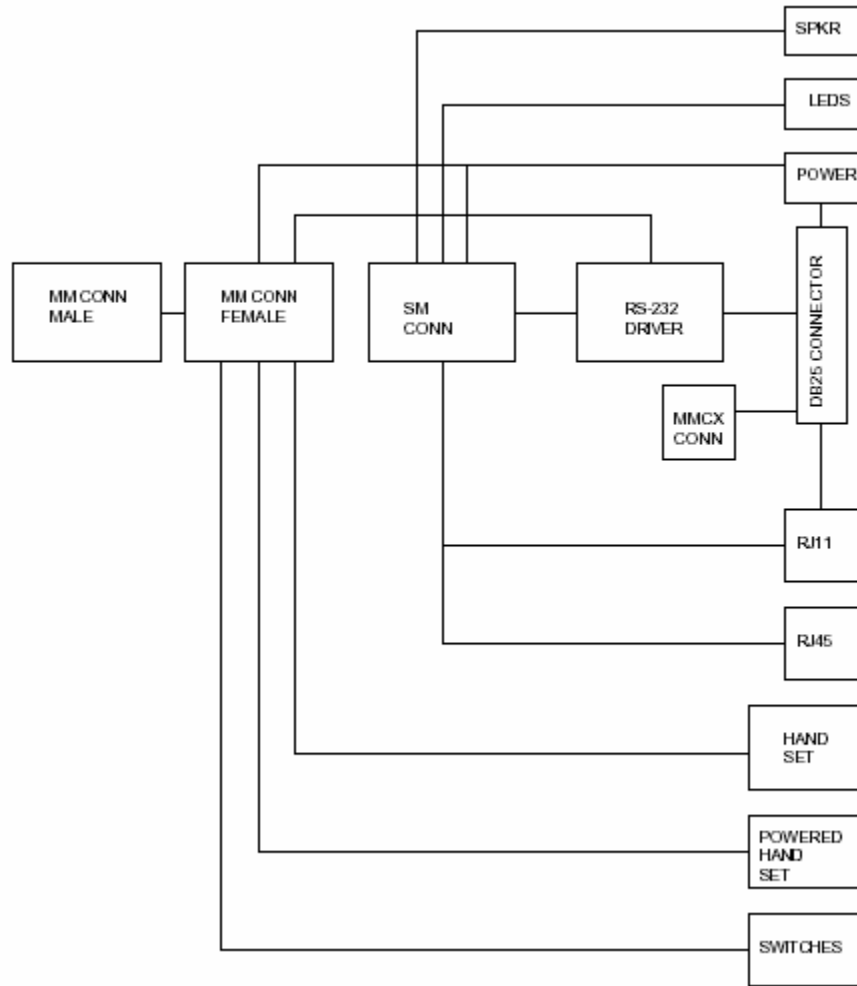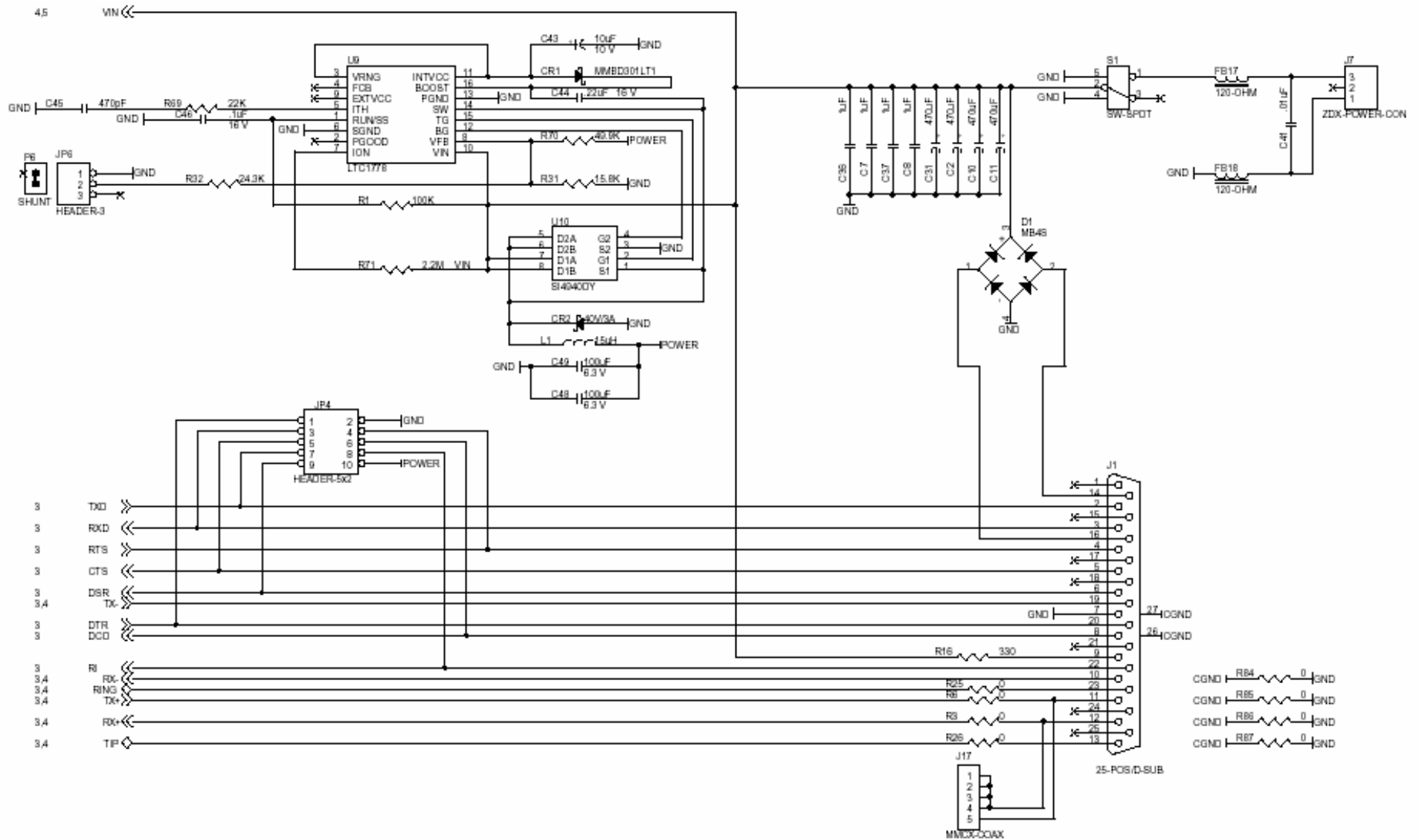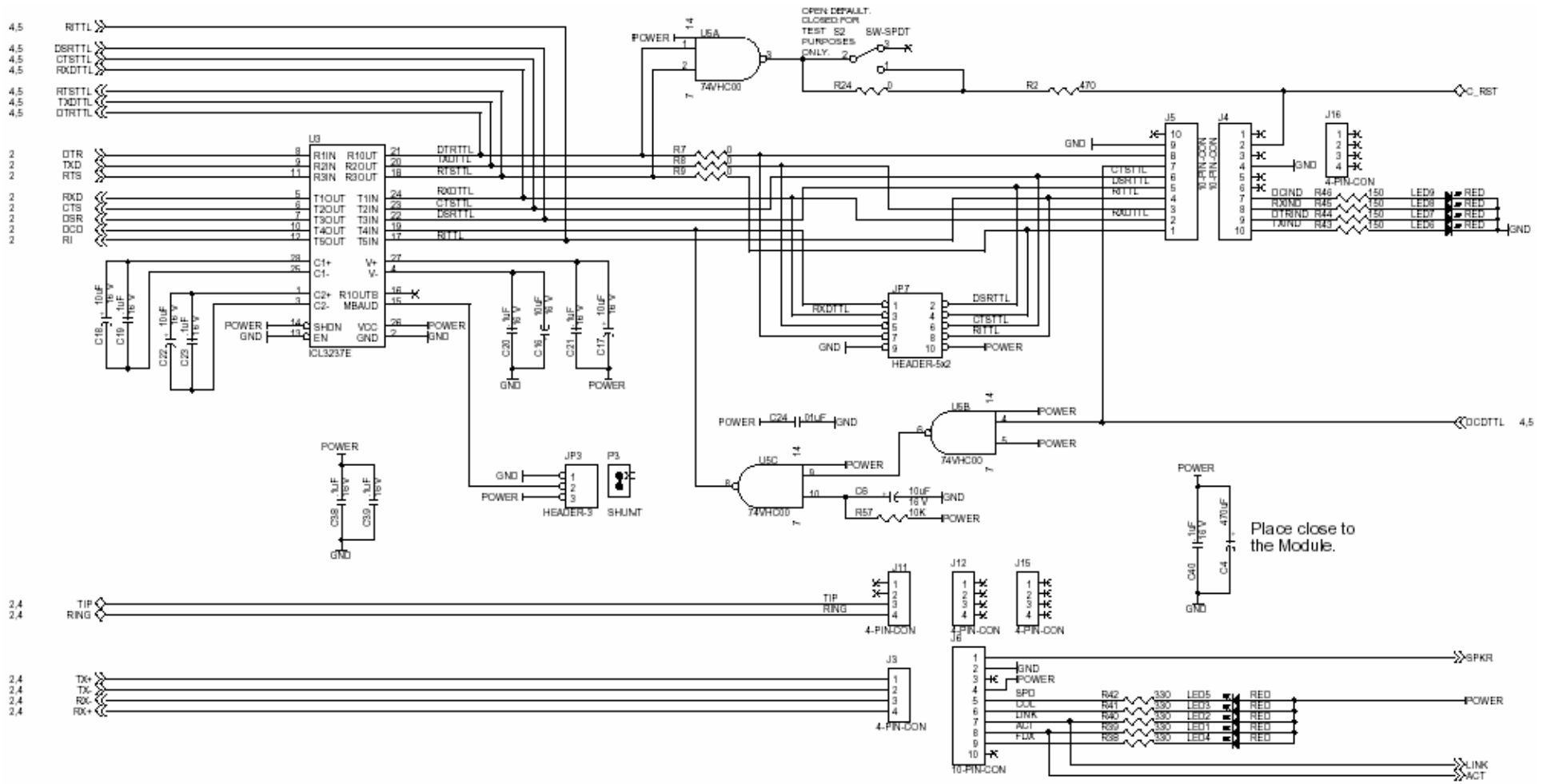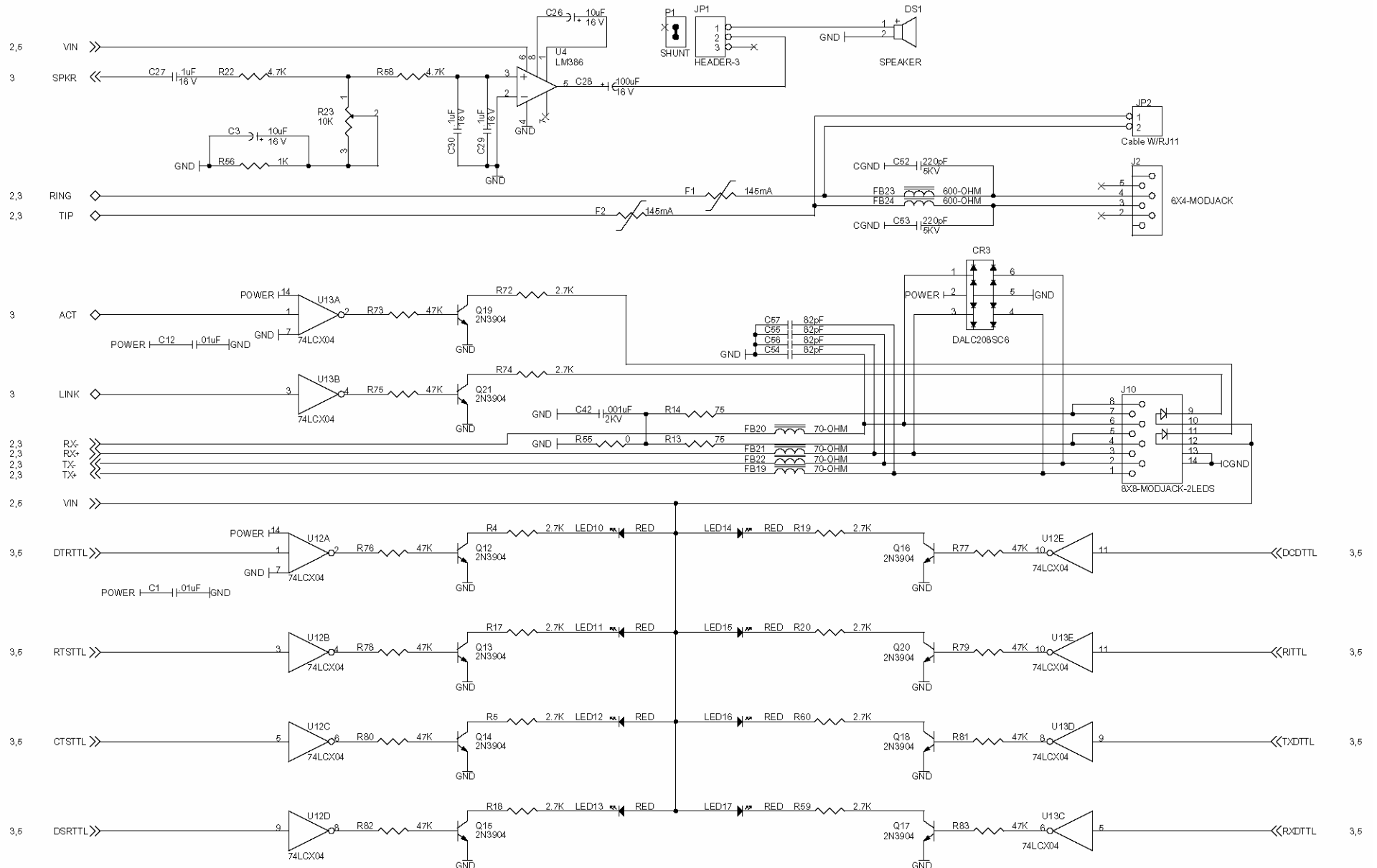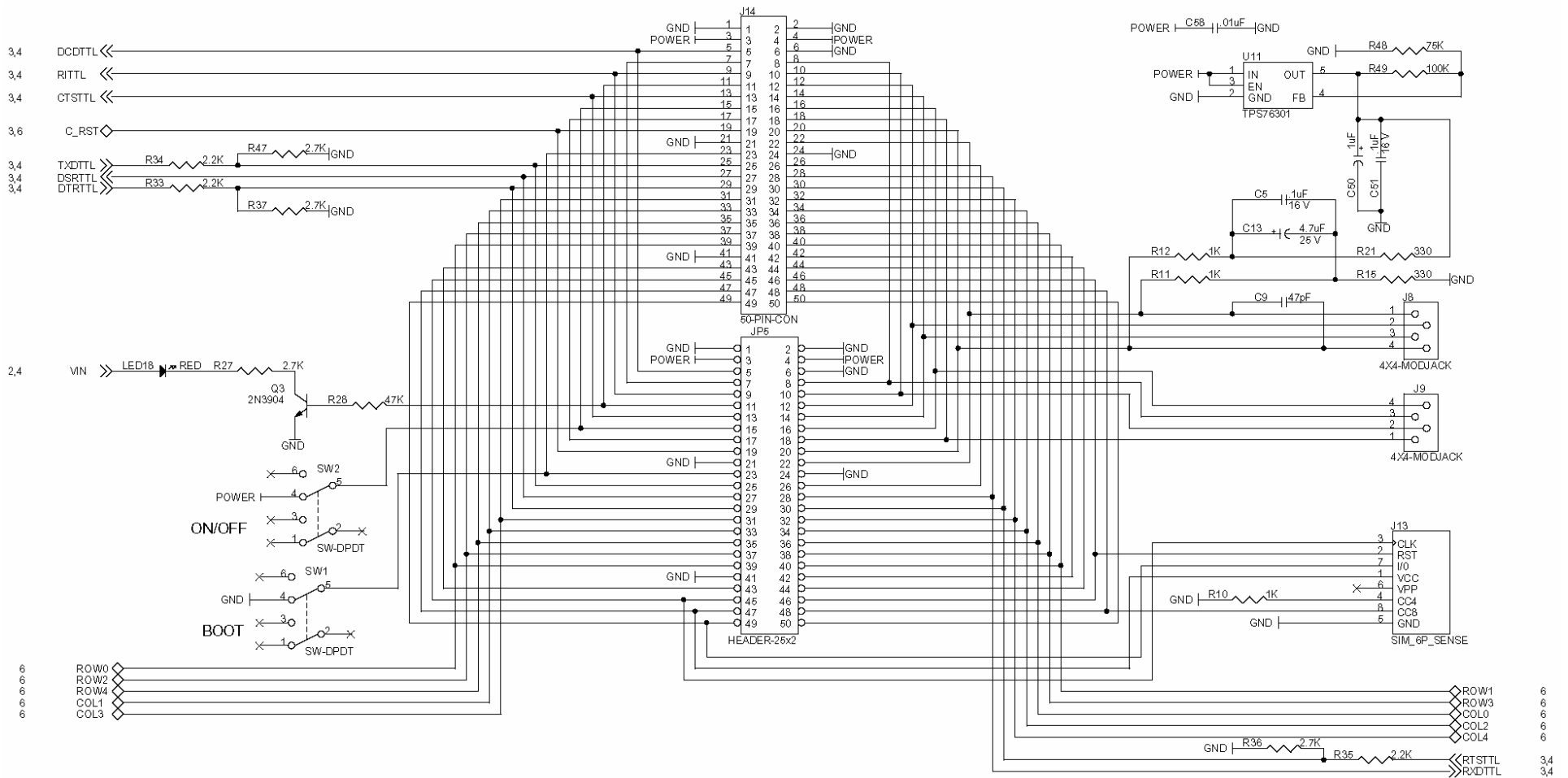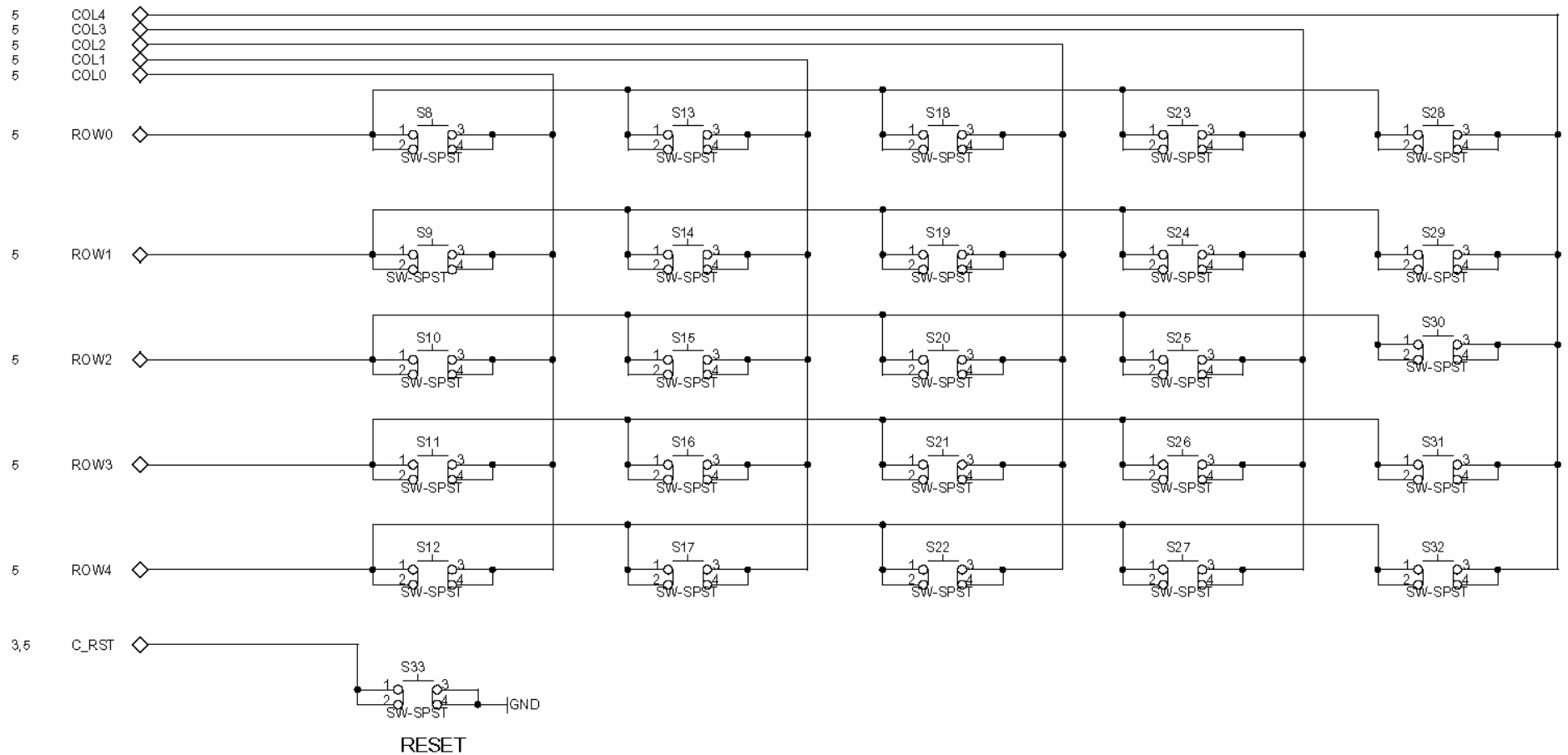
Telecom Approvals

Multi-Tech's Analog Dial-up Global* SocketModems are designed and approved for connection to the public switched telephone network in more than 50 countries or regions worldwide. Multi-Tech's SocketModems have been approved as host independent, which means our certification efforts can be transferred directly to your end product. Multi-Tech supports our approvals by supplying our customers with supporting documentation and offering a compliance label with country or region approval logos and approval numbers to be attached to an end product.

The following is a list of countries or regions that Multi-Tech completes testing and obtains** certification test reports or certificates at or near the initial release of the product. After the initial release, the product may be tested and certified for other countries or regions. Check the Multi-Tech Systems, Inc. Web site at

http://www.multitech.com/products/info/approvals/smi.asp or contact Multi-Tech at oemsales@multitech.com to obtain a current list of approvals for the SocketModem.

Countries or Regions			
Argentina	France	Latvia	Russia
Australia	Germany	Liechtenstein	Singapore
Austria	Greece	Lithuania	Slovak Republic
Belgium	Hong Kong, S.A.R. of China	Luxembourg	Slovenia
Brazil	Hungary	Malaysia	South Africa
Canada	Iceland	Malta	Spain
Chile	India	Mexico	Sweden
China	Indonesia	Netherlands	Switzerland
Cyprus	Ireland	New Zealand	Taiwan
Czech Republic	Israel	Norway	Thailand
Denmark	Italy	Philippines	Turkey
Estonia	Japan	Poland	United Kingdom
Finland	Korea	Portugal	United States

The above list is our target set of countries or regions in which the global* SocketModems are approved. Many of the approvals are completed at the time the product is released to market; whereas, others may take additional months to complete the approval.

*   Refer to each chapter for Product Ordering Information identifying the modem as Global or Regional.

**   Some countries or regions have special import requirements that require us to facilitate additional paperwork application in partner with our customers. Contact Technical Support or Multi-Tech at oemsales@multitech.com for more information.

United States Labeling Requirements

Note: Telecom does not apply to all products. For example, this not applicable for the Wireless GSM/GPRS and CDMA products.

Approved terminal equipment and approved protective circuitry shall prominently display the following information using the format shown below:

- Responsible party
- Product Identification
- Equipment Code
- Ringer Equivalence
- Ringer Type
- Indication that the product meets the requirements of FCC Part 68

The information required by the first five items shall correspond to the records in the ACTA (America's Carriers Telecommunications Association) database of approved equipment. The required information shall be encoded in the following format:

US: AAAEQ##TXXX

Where:

US: Is a fixed field that indicates the equipment meets all requirements of 47 CFR Part 68, including the requirements published by ACTA (America's Carriers Telecommunications Association).

AAA is the responsible party's Grantee Code obtained previously from the FCC's Common Carrier Bureau or currently from ACTA.

EQ Is an Equipment Code indicating to the Service Provider any special signal handling or billing requirements. The Equipment codes are listed in Annex A (normative).

is the Ringer Equivalence Number without a decimal point (e.g. REN of 1.0 = 10, REN of 0.3 = 03). In the case of a "Z" ringer, ZZ shall appear. In the case of approved equipment without a network interface and equipment not connecting to circuits with analog ringing supplied then "NA" shall appear.

T is the ringer type letter associated with the Ringer Equivalence Number, in accordance with the technical requirements. In the case of approved equipment without a network interface and equipment not connecting to circuits with analog ringing supplied, the letter "N" shall appear.

XXX Is a product identifier, unique when combined with the responsible party's Grantee Code, of at least one and up to nine alphanumeric characters (including one or more dashes (-) if desired. A dash shall not appear as the first or last character nor shall the identifier consist entirely of dashes). The responsible party shall define this identifier.

Label Physical Characteristics

The information required above shall be permanently affixed and legible without magnification. It may be etched, engraved, stamped, indelibly printed or otherwise permanently marked. Alternatively, the required information may be permanently marked on a nameplate of metal, plastic or other material fastened to the enclosure by welding, riveting or with a permanent adhesive. Such a nameplate shall be able to last for the expected lifetime of the equipment and shall not be readily detachable.

Labeling Continuity and Changes

The labeling content and format requirements in effect when a product was approved shall be effective for the life of the product. The labeling content and format requirements in effect at approval shall also continue to be effective for modified products. However, the responsible party shall have the option of conforming a product's labeling to current content and format requirements at any time.

Other Label Requirements

The label shall be placed in one of the following locations in a location where it can be found after installation:

- on an outside surface
- inside a readily available access door or panel
- on another readily accessible surface

For example, the label should not be placed on the rear of a permanently wall-mounted device in a manner such that it is not readily accessible.

Canadian Labeling Requirements

The following requirements are established under section 69.3 of the *Telecommunications Act* for purposes of section 5 of the *Telecommunications Apparatus Regulations*.

Registered equipment shall bear the following identifying marks, and the Declaring Party shall ensure that these marks are permanently affixed to the equipment:

(a) The registration number — Specifications of this mark are given in the document: *Self-Marking of the Certification/Registration Number on Terminal Equipment — Application Procedure and Agreement*; and

(b) The model identification number under which the product was registered.

A statement of compliance with Industry Canada requirements, such as the one given below, shall accompany each unit of equipment whether registered under this procedure or previously certified:

"This product meets the applicable Industry Canada technical specifications"

For terminal equipment intended for connection to loop-start or ground-start interfaces, the Ringer Equivalence Number (REN) must be calculated as per Section 1.8 of CS-03, Part I. A REN higher than that determined may be assigned by manufacturers to allow for production variations. The REN must be marked on the terminal equipment itself or added to the note below. A note similar to the following shall accompany each unit of equipment whether registered under this procedure or previously certified:

"The Ringer Equivalence Number is an indication of the maximum number of devices allowed to be connected to a telephone interface. The termination on an interface may consist of any combination of devices subject only to the requirement that the sum of the RENs of all the devices does not exceed five".

Pursuant to section 69.3 of the *Telecommunications Act*, Certified or self-declared TE will bear a valid identifying certification or registration number. The marking of the certification or registration number on the product shall be as follows:

(a) TAC holder/DP will be responsible for permanently affixing the certification/registration number on the TE. The certification/registration number (see example below) identifies Certified or self-declared TE to the public, representatives of the telecommunications common carriers, the Department, and other interested parties. The letter height must be no less than 1.5 mm and the letters must be legible without magnification.

(b) For integrated devices, e.g. a modem or one that is intended to become a sub-assembly of host equipment e.g. a data terminal, computer etc. that are designed to interface directly with the network, the certification/registration number shall be affixed to the integrated device itself.

(c) The certification/registration number for a packaged TE will denote that the total package has been registered. However, the marking will normally be placed on that unit of the package which connects to the network; e.g., in a PBX the marking will be placed on the common equipment which connects to the network, rather than on plug-in components which may be added later. The Terminal Equipment List will show the common equipment but not the standard station apparatus or any proprietary station apparatus.

(d) The marking format of the certification/registration number is as follows:

IC: XXXXXX-YYYYYYYY

Where:

- The letters "IC" have no other meaning or purpose than to identify the Industry Canada certification/registration number, and

- "XXXXXX-YYYYYYYY" is the certification/registration number; "XXXXXX" is the Company Number[1] (CN); it consists of up to six alphanumeric characters (A-Z, 0-9) assigned by Industry Canada; and "YYYYYYYY" is the Unique Product Number (UPN); it consists of up to eight alphanumeric characters (A-Z, 0-9) assigned by the applicant. Other characters, (such as & # *-) may not be used. Alphabetic characters must be capitalized.

[1] **Note**: The Company Number of registered equipment ends with an alphabetic character.
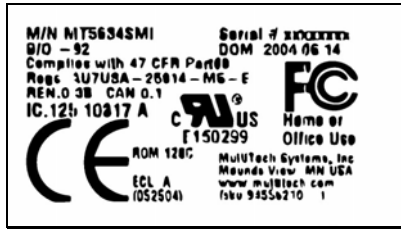
(e) Certification Numbers granted prior to the implementation of the above marking format are grandfathered.

    (i) For previously certified TE, the self-marking format shall consist of the old certification number preceded by "IC:" For example, if the certification number is "123 1234 A", then the self-mark would read "IC: 123 1234 A".

    (ii) For a new model that is registered to a family of previously certified TE, the self-marking format shall be: IC: XXXXXX-ZZZZZZZZ

        Where:

- "XXXXXX" is the Company Number, as in (d) above; and
- "ZZZZZZZZ" is either the old certification number minus the old company number, or a new Unique Product Number assigned by the applicant. For example, if a new model is registered to the family of products with certification number "123 1234 A", and that the Company Number for the registration is "123A", then the self-mark for this new model would read "IC: 123A-1234 A". If the applicant decides to replace "1234 A" with a new UPN, say "5678", then the self-mark would read "IC: 123A-5678".

Label Examples

Note: These do not apply to the Wireless GSM/GPRS and CDMA products.

	This label shows the modem model (M/N), build option (B/O), date of manufacture (DOM), serial number, and North America and European Union regulatory information.
	This is a Telecom compliance label.

Regulatory Compliance Statements

CE

EMC, Safety, and R&TTE Directive Compliance

The CE mark is affixed to this product to confirm compliance with the following European Community Directives:

Council Directive 89/336/EEC of 3 May 1989 on the approximation of the laws of Member States relating to electromagnetic compatibility;
and
Council Directive 73/23/EEC of 19 February 1973 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits;
and
Council Directive 1999/5/EC of 9 March on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity.

International Modem Restrictions

Some dialing and answering defaults and restrictions may vary for international modems. Changing settings may cause a modem to become non-compliant with national telecom requirements in specific countries. Also note that some software packages may have features or lack restrictions that may cause the modem to become non-compliant.

Telecom Requirements for the United States

FCC Part 15 Regulation

This equipment has been tested and found to comply with the limits for a **Class B** digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

Reorient or relocate the receiving antenna.
Increase the separation between the equipment and receiver.
Plug the equipment into an outlet on a circuit that is different from the one used by the receiver.
Consult the dealer or an experienced radio/TV technician for help.

This device complies with Part 15 of the FCC rules. Operation of this device is subject to the following conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference that may cause undesired operation.

WARNING – Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Industry Canada

This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.
Cet appareil numérique de la classe B respecte toutes les exigences du Reglement Canadien sur le matériel brouilleur.

New Zealand Telecom Warning Notice

1. The grant of a Telepermit for any item of terminal equipment indicates only that Telecom has accepted that the item complies with minimum conditions for connection to its network. It indicates no endorsement of the product by Telecom, nor does it provide any sort of warranty. Above all, it provides no assurance that any item will work correctly in all respects with another item of Telepermitted equipment of a different make or model, nor does it imply that any product is compatible with all of Telecom's network services.
    This equipment is not capable under all operating conditions of correct operating conditions of correct operation at the higher speed which it is designated. 33.6 kbps and 56 kbps connections are likely to be restricted to lower bit rates when connected to some PSTN implementations. Telecom will accept no responsibility should difficulties arise in such circumstances.
2. Immediately disconnect this equipment should it become physically damaged, and arrange for its disposal or repair.
3. This modem shall not be used in any manner which could constitute a nuisance to other Telecom customers.
4. This device is equipped with pulse dialing, while the Telecom standard is DTMF tone dialing. There is no guarantee that Telecom lines will always continue to support pulse dialing.
    Use of pulse dialing, when this equipment is connected to the same line as other equipment, may give rise to 'bell tinkle' or noise and may also cause a false answer condition. Should such problems occur, the user should NOT contact the Telecom Faults Service.
    The preferred method of dialing is to use DTMF tones, as this is faster than pulse (decadic) dialing and is readily available on almost all New Zealand telephone exchanges.
5. Warning Notice: No '111' or other calls can be made from this device during a mains power failure.
6. This equipment may not provide for the effective hand-over of a call to another device connected to the same line.
7. Some parameters required for compliance with Telecom's Telepermit requirements are dependent on the equipment (PC) associated with this device. The associated equipment shall be set to operate within the following limits for compliance with Telecom's Specifications:
    For repeat calls to the same number:
    *   There shall be no more than 10 call attempts to the same number within any 30 minute period for any single manual call initiation, and
    *   The equipment shall go on-hook for a period of not less than 30 seconds between the end of one attempt and the beginning of the next attempt.
    For automatic calls to different numbers:
    *   The equipment shall be set to ensure that automatic calls to different numbers are spaced such that there is no less than 5 seconds between the end of one call attempt and the beginning of another.
8. For correct operation, total of the RN's of all devices connected to a single line at any time should not exceed 5.

South African Statement

This modem must be used in conjunction with an approved surge protection device.

Other

The above country-specific examples do not cover all countries with specific regulations; they are included to show you how each country may differ. If you have trouble determining your own country's requirements, check with Multi-Tech's Technical Support for assistance.

Flash Upgrade

Your modem is controlled by semi-permanent firmware, which is stored in flash memory. Multi-Tech's firmware is nonvolatile; that is, it remains stored in memory when the modem is turned off and can be upgraded as new features are added.

Multi-Tech's *Flash Wizard* can be downloaded from Multi-Tech's FTP site and is available on CD. Use this Flash Wizard for upgrading your firmware. Documentation for using the Flash Wizard is included with the wizard.

The following table shows you which products support the Flash Wizard.

SocketModem MT5600SMI	No Flash Upgrade
SocketModem MT5656SMI	No Flash Upgrade
SocketModem MT5634SMI-xx	Multi-Tech Flash Programming Protocol Flash Wizard Software for Windows® Flash Wizard Software for Linux
SocketModem MT2456SMI-22	No Flash Upgrade
SocketModem MT2456SMI-IP	XMODEM serial port upgrade or TFTP Ethernet upgrade. See the next page for information about the XMODEM upgrade.
SocketEthernet IP MTXCSEM	XMODEM serial port upgrade or TFTP Ethernet upgrade. See the next page for information about the XMODEM upgrade.
SocketModem ISDN MT128SMI	Multi-Tech Flash Programming Protocol Flash Wizard Software for Windows® Flash Wizard Software for Linux
SocketModem GPS/GPRS/CDMA MTSMC	No Flash Upgrade
SocketWireless Bluetooth	No Flash Upgrade

Flash Wizard Software for Windows®: ftp://ftp.multitech.com/Utilities/FlashWizard/

Flash Wizard Software for Linux: http://mtflashwiz.sourceforge.net/

Important Note: Do not use the Flash Wizard for the wireless modems. Contact Multi-Tech for wireless modem firmware upgrade directions.

XMODEM Serial Port Upgrade or TFTP Ethernet Upgrade

The SocketEthernet IP Module, for example, contains a 2 MB flash wherein the boot image, the firmware and configuration files are stored in a compressed format. The flash can easily be upgraded both locally as well as remotely.

Serial Port Upgrade

The flash of the SocketEthernet IP can be upgraded locally through serial port using the upload feature of serial applications.

Serial Port Configuration

The default serial port parameters should be:

Data length – 8 bits

Parity – None

Stop bits – 1

Baud-rate of the serial port to which the SocketEthernet IP Module is connected should be set to 115200 bps for proper operation.

Example of a Serial Flash Upgrade

Following steps explain the procedure to upgrade a flash using the serial COM port (serial flash upgrade).

Connect the SocketEthernet IP Module to a PC COM Port.

- Open an application through which we can access the serial device (e.g., Meterm, zoc, hyperterm).
- Reboot the SocketEthernet IP Module.
- Wait for the boot message and prompt "press d to download" to appear.
- Press **d** when prompted.
- Select the **XMODEM** Protocol from the Terminal application.
- Choose a file (MTXCSEM-TFTP-…) file to be uploaded.
- Perform a file upload.

The SocketEthernet IP Module reboots and will be up after a few seconds (10-15 seconds).

Ethernet Port Upgrade

The flash can be upgraded remotely through the Ethernet using TFTP.

The SocketEthernet IP Module flash contains two main files, which are required for an upgrade.

1. **Binary File**
   The binary file contains the firmware of the Module.
   The name of this binary file would be in the following format.
   MTXCSEM-TFTP-v<version>w-<date in ddMmmyyyy format>

2. **Gun-zipped http.tar.gz File**
   This contains the HTML pages of the serial device and other files related to it, such as **http-host-param** (**http page configuration file**).
   The name of this tar file would always be **http.tar.gz**

Enabling TFTP Server

Enable TFTP server on SocketEthernet IP Module by issuing the following command:

```
 # set ip tftp enable
OK
```

Example of an Ethernet Flash Upgrade

The IP module can be remotely upgraded over a network. Make sure a TFTP client is already installed on the machine. The following steps explain the method to perform flash upgrade from Ethernet.

- Make sure the SocketEthernet IP Module is reachable on the LAN.
- Perform a TFTP to the SocketEthernet IP Module from a TFTP client.
  - Set binary mode ON. **Note:** This step is very important.
  - Binary
- Put the binary file.
  - put <binary filename>
- Exit the TFTP session.
  - Quit

The SocketEthernet IP Module reboots after it has been successfully upgraded.

Multi-Tech Systems, Inc. Flash Programming Protocol

This information is provided exclusively for the users of Multi-Tech Systems, Inc. modems. Such users Multi-Tech Systems, Inc. modem owners have the right to use, modify, and incorporate this code into other products provided they include the Multi-Tech Systems, Inc. notice and the associated copyright notice with any such product.

<div align="center">

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All Right Reserved

The flash programming protocol is provided "AS IS" without warranty.

Important: When interacting with the boot code, it is possible to make the modem inoperable.

Use extreme caution.

</div>

Programming the Modem

There are two ways to start flash programming a modem. It can be programmed
1. From "AT" mode
2. When the modem powers up.

The following table shows how a modem is programmed.

DTE	Modem	Comments
AT*FS\r		This effectively "restarts" the modem so that it enters the boot code.
Handshake Sequence		
M's		Many M's are sent (10 milliseconds apart) at 19200 baud. This is where the handshake starts if the modem is just powered up.
	U	U is sent at 19200 baud if M's are received within 100 milliseconds of power up. If the M's are not received within 100 milliseconds, then the modem starts up normally. If the AT*FS command is used, then you have 1 second (1000mS) to perform the handshake.
D		Sent at 19200 baud.
	M	M if can receive at 9600/19200/38400/57600/115200
	I|J|K|L|M	I if modem will be programmed at 9600 J if modem will be programmed at 19200 K if modem will be programmed at 38400 L if modem will be programmed at 57600 M if modem will be programmed at 115200
	\r\nOK\r\n	Modem is ready to be programmed
Program Sequence:		
DTE	**Modem**	**Comments**
ATFLP\r		Request to the modem to program
	G	Modem is ready for next program packet
[Length High]		High byte of data packet length
[Length Low]		Low byte of data packet length Packet lengths can be up to 4096 bytes in size for most boot code versions
[Address High]		High byte of program address
[Address Middle]		Middle byte of program address
[Address Low]		Low byte of program address Addresses are 3 byte values with a range of 00000h-FFFFFh
[Data Bytes]		These are the data bytes to be programmed at the address specified above. They must be the same number of bytes as specified above.
[Checksum]		This checksum is generated by exclusive ORing together all of the Data Bytes (do not include the Length or Address bytes in that calculation).
	\nOK\r\n \nERROR\r\n	If bytes are programmed and verified. If verify fails or checksum is bad. Retry the block 3 times on an ERROR.
….	….	More of the above sequence until all the data bytes have been sent to the modem.
ATFLEND\r		This ends programming and restarts the modem.

Other Supported Boot Code Commands

2.1	ATI0 -	returns 000 or 247 for ISDN
2.2	ATI1 -	returns boot code version number MM.mmn where MM = unique code for each different platform that has boot code mm = version number of boot code n = version letter of the boot code Examples: 2.05e, 2.12d, 35.15
	ATI4-	Boot code date and time.

Other Programming Concerns

1. The values programmed into Addresses 0000h, 0001h and 0002h should always be forced to C3h 00 01 (i.e., JP 100h).

    This is because the boot code starts at address 100h, while all normal modem code starts at 200h. By allowing 0000h to be programmed to a jump value other than 0100h, the boot code would be bypassed and no further upgrades could occur.

2. Addresses 0100h-01FFh through 70000h-7FFFFh should not be allowed to be programmed under normal circumstances, as this is the main body of the boot up code.

3. The packets sent to the modem must be presorted by address and aligned on 128 byte boundaries (i.e., each packet must start on an address that is a multiple of 128).

4. The packets should also be a minimum of 128 bytes with the non-programmed bytes set to the hex value of FF.

5. The packets sent to the modem must not span a 4K boundary (i.e., start the packet before it and go over the boundary in the middle of the packet).

6. The 10-millisecond delay between M's at the beginning of the handshake is so that the modem can sync up to the start bit. If the M's are sent one right after another, a data bit might be mistaken as a start bit.

7. Multi-Tech firmware files are in Intel Hex Format and must be read in and formatted into 128-4096 byte blocks before being sent to the modem.

Information about the Intel Hex Format

An Intel Format Hex File is a text file consisting of "records", one per line, that start with a ":" character and include only digits 0-9 and letters A-F. There are three different record types: Extended Address Records, Data Records, and End of File Records.

Data records contain the actual data that is to be programmed into a device. The address contained in the data record needs to be combined with an extended address (by adding the extended address shifted four bits left to the data record address) to determine the actual programming address for the data. If no extended address record is before a given data record in the file, then the extended address value is assumed to be zero.

Data Record

Char Pos	Field Type	Value	Description
1	Record Start	":"	
2-3	Data Byte Count "NN"		Maximum value is FF (which is 255 data bytes). Typical is 20h which causes the hex record to fit in 80 columns.
4-7	Address	"XXXX"	Lower 16 bits of 20 bit address, most significant byte first. This must be added to Extended Address left shifted four bits.
8-9	Record Type	"00"	Data Record
10+N	Data Bytes	"YY..YY"	The data bytes in hex. Each byte is two characters.
NN+1,2	Checksum	"ZZ"	Zero minus the two's complement addition of all data hex values.
NN+3,4	End of Line	"\r\n"	Carriage Return followed by a Line Feed
Example Data Record in Intel Format :2000A0005BB66DDBB66CD8B060C183060D1B366DDBB66DDBB76FDFBF7EFDFBF6EDDBB66DD4			

Extended Address Record

Char Pos	Field Type	Value	Description
1	Record Start	":"	
2-3	Data Byte Count	"02"	Always 2 bytes for this record type
4-7	Address	"0000"	Not used for this record type (must be zero)
8-9	Record Type	"02"	Extended Address Record
10-13	Extended Address	"EEEE"	Top 16 bits of 20 bit address, most significant byte first
14-15	Checksum	"ZZ"	Zero minus the two's complement addition of all data hex values
16-17	End of Line	"\r\n"	Carriage Return followed by a Line Feed
Example Extended Address Record in Intel Format :020000021000EC			

End of File Record

Char Pos	Field Type	Value	Description
1	Record Start	":"	
2-3	Data Byte Count	"00"	Always 2 bytes for this record type
4-7	Address	"0000"	Transfer Address (usually be zero)
8-9	Record Type	"01"	End of File Record
10-11	Checksum	"ZZ"	Zero minus the two's complement addition of all data hex values
12-13	End of Line	"\r\n"	Carriage Return followed by a Line Feed
Example End of File in Intel Format :00000001FF			

Wireless Account Activation

Multi-Tech – A Certified National Activation Agent

Multi-Tech Systems, Inc. is a certified national **AT&T** and **Sprint** activation agent for AT&T and Sprint wireless. To obtain information about available data plans and to purchase and activate a wireless data account, contact Multi-Tech at:

<div align="center">888-288-5470</div>

Pre-Configured Multi-Tech Products

Each Multi-Tech wireless product has been pre-configured to operate on an **AT&T** or **Sprint** or **Verizon** wireless network.

AT&T Account Setup and Activation

Follow these steps to set up a wireless account.

- Contact Multi-Tech to obtain an account.
- Provide your activation agent with the following:
  – Your Federal Tax I.D.
  – Each modem's 15-character IMEI number located on the modem's label.

Sprint Account Setup and Activation

Follow these steps to set up a wireless account:

- Contact Multi-Tech to obtain an account.
- Provide the activation agent with each modem's 8-character ESN number printed next to the bar code on the modem.
- Multi-Tech will give you three numbers for each modem. Record these numbers — they are needed in order to use your modem:
  MDN – Your 10-digit phone number
  MSID – Another 10-digit number
  OTKSL – Your 6-digit lock code, also known as SPC (Service Programming Code)
- Activate the modem by entering the following sequence of AT commands:

AT Command	Modem Response	Comment
1. AT+WSPC=1,xxxxxx<cr>	OK	"xxxxxx" is your programming code (OTKSL)
2. AT+WMDN=nnnnnnnnnn<cr>	OK	"nnnnnnnnnn" is your phone number (MDN)
3. AT+WCMT=1<cr>	OK	Modem commits the changes to memory
Wait for 10 seconds before issuing next command **Note:** If your MDN and MSID numbers are identical, then you can skip Steps 4, 5, and 6.		
4. AT+WSPC=1,xxxxxx<cr>	OK	"xxxxxx" is your programming code
5. AT+WIMI=31000ssssssssss<cr>	OK	"ssssssssss" is your MSID
6. AT+WCMT=1<cr>	OK	Modem commits the changes to memory
Wait for 10 seconds before issuing next command		
7. AT+WIOTA=4<cr>	OK	This command clears previous IOTA attempts
8. AT+WIOTA=1<cr>	;+WOAP: "Preparing Data Services" OK	This command initiates over-the-air activation. You must have network reception for this step. This process takes about 3 minutes to complete.

Modem Response
When complete, the modem will respond with: +WOAR:"Please Retry"
This response indicates that you should please retry, but you do not need to do so. Your modem should now be ready for use.

What To Do If You Do Not Receive the "Please Retry" Response
Turn the power off and then on. Repeat Steps 7 and 8

Contacting Multi-Tech Systems, Inc.
If you have any questions or problems, contact Multi-Tech Systems, Inc. Technical Support at 800-972-2439 or 763-717-5863.

Verizon Account Setup and Activation

Follow these steps to set up a wireless account:

- Contact Verizon to obtain an account.

- Provide the Verizon agent with each modem's 8-character ESN number printed next to the bar code on the modem.

- Verizon will give you the phone number for each modem. Record this number — it is needed in order to use your modem
  MDN – Your 10-digit phone number

- Once you have your Verizon account, activate the modem by entering the AT commands as follows:

AT Command	Comment
AT+WSPC=1,000000<cr>	;enter the programming code ;response from modem should be OK
AT+WMDN=nnnnnnnnnn<cr>	;"nnnnnnnnnn" is your phone number (MDN) ;response from modem should be OK
AT+WCMT=1<cr>	;modem commits the changes to memory ;response from modem should be OK

Wait for 10 seconds before issuing next command

ATD*22899; <cr>	;perform over-the-air provisioning
	;response from modem
	   +WOT1: "Programming in Process"
	   +WOTS: "SPL unlocked"
	   +WOTP: "PRL download OK"
	   +WOTM: "MDM download OK"
	   +WOTC: "Commit successful"
	   +WOT2: "Programming Successful"

Your modem should now be ready for use.

Multi-Tech Warranty Statement

Multi-Tech Systems, Inc., (hereafter "MTS") warrants that its products will be free from defects in material or workmanship for a period of two, five, or ten years (depending on model) from date of purchase, or if proof of purchase is not provided, two, five, or ten years (depending on model) from date of shipment.

MTS MAKES NO OTHER WARRANTY, EXPRESS OR IMPLIED, AND ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED.

This warranty does not apply to any products which have been damaged by lightning storms, water, or power surges or which have been neglected, altered, abused, used for a purpose other than the one for which they were manufactured, repaired by Customer or any party without MTS's written authorization, or used in any manner inconsistent with MTS's instructions.

MTS's entire obligation under this warranty shall be limited (at MTS's option) to repair or replacement of any products which prove to be defective within the warranty period or, at MTS's option, issuance of a refund of the purchase price. Defective products must be returned by Customer to MTS's factory — transportation prepaid.

MTS WILL NOT BE LIABLE FOR CONSEQUENTIAL DAMAGES, AND UNDER NO CIRCUMSTANCES WILL ITS LIABILITY EXCEED THE PRICE FOR DEFECTIVE PRODUCTS.

Repair Procedures for U.S. and Canadian Customers

In the event that service is required, products may be shipped, freight prepaid, to our Mounds View, Minnesota factory:

Multi-Tech Systems, Inc.
2205 Woodale Drive
Mounds View, MN 55112
Attn: Repairs, Serial # _____

A Returned Materials Authorization (RMA) is not required. Return shipping charges (surface) will be paid by MTS to destinations in U.S. and Canada.

Please include, inside the shipping box, a description of the problem, a return shipping address (must have street address, not P.O. Box), your telephone number, and if the product is out of warranty, a check or purchase order for repair charges.

For out of warranty repair charges, go to www.multitech.com/DOCUMENTS/Company/warranty/

Extended two-year overnight replacement service agreements are available for selected products. Please call MTS customer service at (888) 288-5470 or visit our web site at www.multitech.com/PARTNERS/Programs/orc/ for details on rates and coverage's.

Please direct your questions regarding technical matters, product configuration, verification that the product is defective, etc., to our Technical Support department at (800) 972-2439 or email support@multitech.com. Please direct your questions regarding repair expediting, receiving, shipping, billing, etc., to our Repair Accounting department at (800) 328-9717 or (763) 717-5631, or email mtsrepair@multitech.com.

Repairs for damages caused by lightning storms, water, power surges, incorrect installation, physical abuse, or user-caused damages are billed on a time-plus-materials basis.

Repair Procedures for International Customers (Outside U.S.A. and Canada)

Your original point of purchase Reseller may offer the quickest and most economical repair option for your Multi-Tech product. You may also contact any Multi-Tech sales office for information about the nearest distributor or other repair service for your Multi-Tech product. The Multi-Tech sales office directory is available at www.multitech.com/PARTNERS/Channels/offices/

In the event that factory service is required, products may be shipped, freight prepaid to our Mounds View, Minnesota factory. Recommended international shipment methods are via Federal Express, UPS or DHL courier services, or by airmail parcel post; shipments made by any other method will be refused. A Returned Materials Authorization (RMA) is required for products shipped from outside the U.S.A. and Canada. Please contact us for return authorization and shipping instructions on any International shipments to the U.S.A. Please include, inside the shipping box, a description of the problem, a return shipping address (must have street address, not P.O. Box), your telephone number, and if the product is out of warranty, a check drawn on a U.S. bank or your company's purchase order for repair charges. Repaired units shall be shipped freight collect, unless other arrangements are made in advance.

Please direct your questions regarding technical matters, product configuration, verification that the product is defective, etc., to our Technical Support department nearest you or email support@multitech.com. When calling the U.S., please direct your questions regarding repair expediting, receiving, shipping, billing, etc., to our Repair Accounting department at +(763) 717-5631 in the U.S.A., or email mtsrepair@multitech.com.

Repairs for damages caused by lightning storms, water, power surges, incorrect installation, physical abuse, or user-caused damages are billed on a time-plus-materials basis.

Repair Procedures for International Distributors

International distributors should contact their MTS International sales representative for information about the repairs for their Multi-Tech product.

Please direct your questions regarding technical matters, product configuration, verification that the product is defective, etc., to our International Technical Support department at +(763)717-5863. When calling the U.S., please direct your questions regarding repair expediting, receiving, shipping, billing, etc., to our Repair Accounting department at +(763) 717-5631 in the U.S.A. or email mtsrepair@multitech.com.

Repairs for damages caused by lightning storms, water, power surges, incorrect installation, physical abuse, or user-caused damages are billed on a time-plus-materials basis.

Replacement Parts

SupplyNet, Inc. can supply you with replacement power supplies, cables and connectors for selected Multi-Tech products. You can place an order with SupplyNet via mail, phone, fax or the Internet at the following addresses:

Mail: SupplyNet, Inc.
            614 Corporate Way
            Valley Cottage, NY 10989
Phone: 800 826-0279
Fax: 914 267-2420

Email: *info@thesupplynet.com*

Internet: http://www.thesupplynet.com

Chapter 2

SocketModem

MT5600SMI
MT5656SMI

Chapter 2 – SocketModem (MT5600SMI & MT5656SMI)

Introduction

The Multi-Tech SocketModem creates communication-ready devices by integrating data/fax/voice functionality into a single product design. The SocketModem is a space-efficient (1" × 2.5"), embedded modem that provides V.92 or V.34/33.6K data communication. The complete, ready-to-integrate modem dramatically reduces development time and costs for system designers.

The MT5600SMI/MT5656SMI SocketModem is a standard 64-pin modem used for integrating data communications.

- It is a single-port modem that integrates the controller, DSP, and DAA in a 1" x 2.5" form factor and communicates to a host controller via an asynchronous serial interface.
- It is available with an 8-bit parallel interface

Product Ordering Information

Product	Description	Region	Order this Product ✓
MT5600SMI			
MT5600SMI-32	V.32bis Serial Data/Fax - 5 V	Global	
MT5600SMI-L32	V.32bis Serial Data/Fax - 3.3 V	Global	
MT5600SMI-P32	V.32bis Parallel Data/Fax - 5 V	Global	
MT5600SMI-34	V.34bis Serial Data/Fax - 5 V	Global	
MT5600SMI-L34	V.34bis Serial Data/Fax - 3.3 V	Global	
MT5600SMI-XL34	V.34bis Serial Data/Fax Exclude LED pins - 3.3 V	Global	
MT5600SMI-P34	V.34bis Parallel Data/Fax - 5 V	Global	
MT5600SMI-PL34	V.34bis Parallel Data/Fax - 3.3 V	Global	
MT5600SMI-92	V.92 Serial Data/Fax - 5 V	Global	
MT5600SMI-L92	V.92 Serial Data/Fax - 3.3 V	Global	
MT5600SMI-XL92	V.92 Serial Data/Fax Exclude LED pins - 3.3 V	Global	
MT5600SMI-P92	V.92 Parallel Data/Fax - 5 V	Global	
MT5600SMI-PL92	V.92 Parallel Data/Fax - 3.3 V	Global	
Telecom Label			
MT5600SMI-LS	MT5600SMI-Global Regulatory Label	Global	
MT5656SMI			
MT5656SMI-V32	V.32bis Serial Data/Fax, Speakerphone Interface - 5 V	U.S./Can/Euro	
MT5656SMI-PV32	V.32bis Parallel Data/Fax, Speakerphone Interface - 5 V	U.S./Can/Euro	
MT5656SMI-V34	V.34 Serial Data/Fax, Speakerphone Interface - 5 V	U.S./Can/Euro	
MT5656SMI-PV34	V.34 Parallel Data/Fax, Speakerphone Interface - 5 V	U.S./Can/ Euro	
MT5656SMI-V92	V.92 Serial Data/Fax, Speakerphone Interface - 5 V	U.S./Can/Euro	
MT5656SMI-PV92	V.92 Parallel Data/Fax, Speakerphone Interface - 5 V	U.S./Can/Euro	
Developer Kits			
MTSMI-DK	SocketModem Serial Developer Kit	Global	
MTSMI-P-DK	SocketModem Parallel Developer Kit	Global	

How to Read the Product Codes in the Above Table:

32	V.32bis/14.4K data rate	L	3.3 V power input (default is 5 V)
34	V.34/33.6K data rate	P	Parallel interface (serial is default)
92	V.92/56K data rate	X	Excludes LED pinouts
V	Voice (speakerphone)	DK	Developer Kit

Developer Kit

A Developer Kit is available. The serial kit allows you to plug in the SocketModem and use it as a serial modem for testing, programming, and evaluation. The parallel kit turns the parallel module into an ISA modem. Each kit includes one SocketModem, one developer board with an RS-232 DB-25 connector, wall power adapter, RJ-11 jack, an RS-232 cable, and a Developer Kit CD.

Technical Specifications

The SocketModem meets the following specifications:

Category	Description
Data Format	Serial or parallel interface
Data	V.92; V.90, V.34, V.32bis, V.32, V.22bis, V.22, V.23, V.21,Bell 212A & Bell 103
Error Correction	V.42 (LAP-M or MNP 2–4)
Data Compression	V.42bis, MNP 5
Fax	V.17, V.29, V.27ter, V.21 ch.2 **MT5600SMI** Supports Fax Class 1 and 1.0 commands **MT5656SMI** Supports Fax Class 1 and 2 commands
Modes of Operation	Full duplex over dial-up lines; data mode, command mode, online command mode
Advanced	Extension pickup detection, remote hang-up detection, line-in-use detection, digital PBX detection and protection
Flow Control	XON/XOFF (software), RTS/CTS (hardware)
Command Buffer	60 characters
Interface	Serial or 8-bit parallel interface
Telephony/TAM	V.253 commands: V.253 2-bit and 4-bit ADPCM, 8-bit linear PCM, and 4-bit IMA coding 8 kHz sample rate Concurrent DTMF, ring, and U.S. Caller ID detection
Weight	0.6 oz. (0.017 kg.)
Dimensions	1.045" × 2.541" × 0.680" (2.65 x 6.45 x 1.7 cm)

Power Consumption	**3.3 V (MT5600SMI Only)** Typical: 115 mA (.38W @ 3.3 V DC);
	                                                  Maximum: 116 mA (.41 W @ 3.47 V DC)
	
	5 V (MT5600SMI & MT5656SMI) Typical: 117 mA (.58 W @ 5 V DC);
	                                                  Maximum: 118 mA (.61 W @ 5.25 V DC)

Operational Temperature	0 to +70° C Humidity Range: 20 to 90% (non-condensing)
Storage Temp.	-10º to +85° C
Voltage	3.3 V Serial 5 V Serial or Parallel
Manufacturing Information	Trade Name: SocketModem Model Number: MT5600SMI Registration No: AU7USA-46014-MD-E Ringer Equivalence: 0.1B Modular Jack (USOC): RJ11

Approvals	**Safety Certifications**
	    UL 60950
	    cUL60950
	    EN 60950
	    ACA TS 001 / AS 3260
	    CCC
	EMC Approvals
	    FCC Part 15 (Class B)
	    Canada (Class B)
	    EN 55022 (Class B)
	    EN 55024

Category	Description
Intelligent Features	Integrates the controller, data pump, and data access arrangement (DAA) in one module. Backward compatibility with lower speed data standards V.22bis Fast Connect FastPOS (V.29) Voice send and receive functions LED pin output option Industry-standard error correction and data compression DTMF detection and distinctive ring Audio circuit outputs for audio call-progress monitoring Three-number storage for automatic dialing capabilities and non-volatile memory (NoVRAM) to store user profiles Speaker interface for call progress monitoring Full-duplex data transmission over dial-up lines Line quality monitoring and retrain Line protection circuitry included Auto-dial, redial, and auto-answer Pulse or tone dial Call status display Extension pickup detection U.S. Caller ID detection Remote hang-up detection Digital PBX detection and protection 60-character command line buffering AT command compatibility Global approvals with a single module design Intelligent DAA technology detects line status MT5656SMI supports speaker/microphone features

SocketModem Configuration

MT5600SMI Serial Configuration

The serial interface use an 16-pin interface to provide an on-board DAA with tip and ring connections, audio circuit for call-progress monitoring and serial interface via logic level signals.

Note: The bolded, shaded pins are the active SocketModem pins.
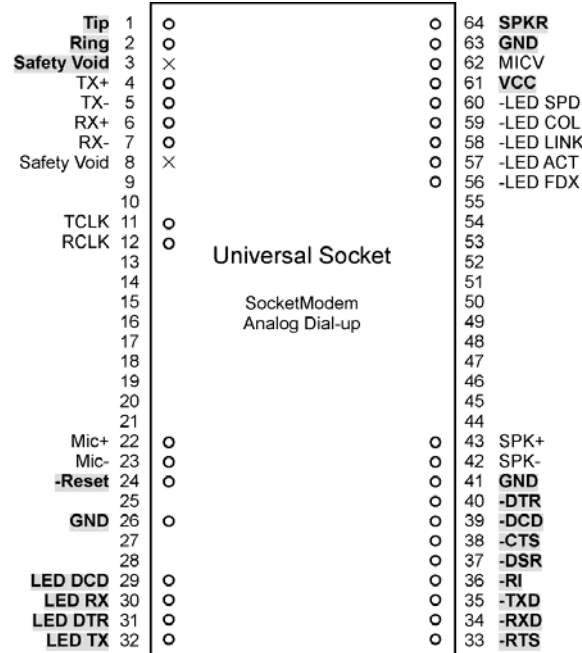
**Serial SocketModem Pinout
MT5600SMI (Available with or without LEDs)**

MT5656SMI Serial with Voice Configuration
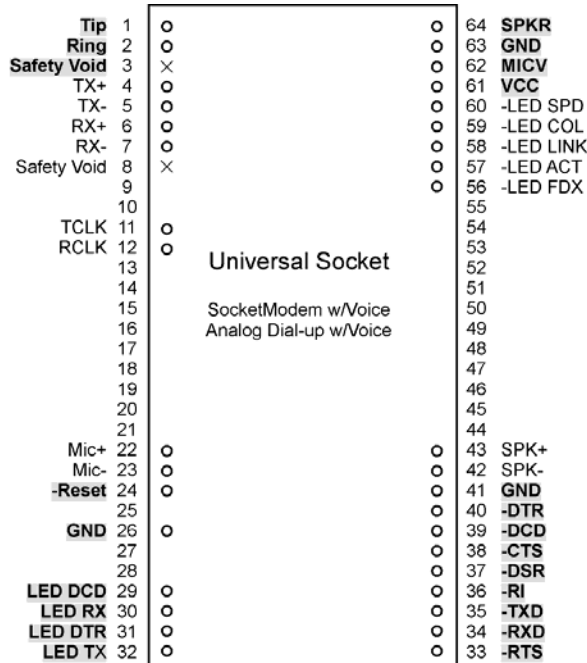
**Serial SocketModem Pinout with Voice Configuration
MT5656SMI**

Parallel Configuration

Note: The parallel configuration is not compatible with the serial universal socket.

The parallel interface SocketModem uses a 22-pin interface to provide an on-board DAA with tip and ring connections, audio circuit for call-progress monitoring, and parallel interface.
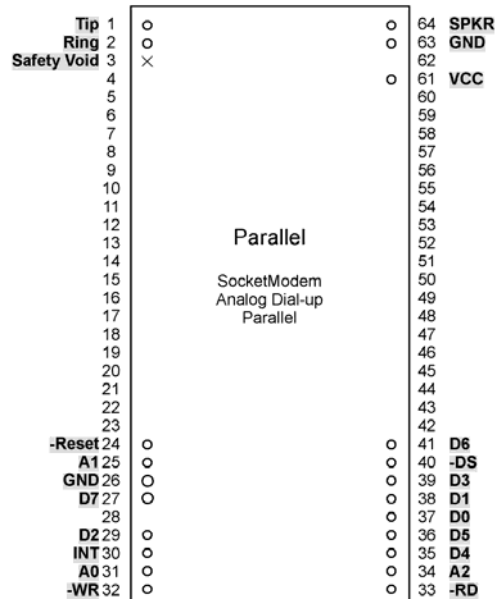
Parallel SocketModem Pinout

Parallel Pin Descriptions

Pin #	Signal Name	I/O	Description
1	Tip	I/O	**Telephone Line Interface** – **TIP**
2	Ring	I/O	**Telephone Line Interface** – **RING**
24	–RESET	I	**Modem Reset (CMOS input with pull-up).** The active low –RESET input resets the SocketModem logic and returns the AT command set to the original factory default values or to "stored values" in NVRAM. The modem is ready to accept commands within 6.5 seconds of power-on or reset. Reset must be asserted for a minimum of 15ms.
25	A1		**Host Bus Address Line 1**
26	DGND	GND	**Digital Ground**
27	D7	O	**Host Bus Data Line 7**
29	D2	O	**Host Bus Data Line 2**
30	INT	O	**Host Bus Interrupt Line (Active High, Resets on Low)**
31	A0	I	**Host Bus Address Line 0**
32	–WT	I	**Host Bus Write.** When low, allows host to write to SocketModem.
33	–RD	I	**Host Bus Read.** When low, allows host to read from SocketModem.
34	A2	I	**Host Bus Address Line 2**
35	D4	O	**Host Bus Data Line 4**
36	D5	O	**Host Bus Data Line 5**
37	D0	O	**Host Bus Data Line 0**
38	D1	O	**Host Bus Data Line 1**
39	D3	O	**Host Bus Data Line 3**
40	–CS	I	**Host Bus Chip Select (Active Low)**
41	D6	O	**Host Bus Data Line 6**
61	VCC	PWR	**3.3 V or 5 V Supply** (depends upon model).
63	AGND	GND	**Analog Ground.** This is tied common with DGND on the SocketModem. To minimize potential ground noise issues, connect audio circuit return to AGND.
64	SPKR	O	**Speaker** – Call monitor.

Differences - Legacy Voice Modems and Current Modems

Differences between the SFxxxD/SP and the MT5656SMI

Note: The SFxxxD/SP is the legacy voice modem with speakerphone I/O.

Pin 54 – "VC" This pin provided a reference voltage that is available from the data pump. This pin is not supported on the MT5656SMI SocketModem.

Pin 55 – "~Voice" This function, when active, closes the relay to switch the handset from the telephone line to a current source to power the handset where it could be used as a speaker and microphone interface to the modem. This pin is not provided on the SocketModem

Pin 57 – "LCS" (Line Current Sense) When enabled, the LCS input indicates whether the associated handset of off-hook (high) or on-hook (low). This pin is not available on the MT5656SMI SocketModem, but the functionality is part of the Smart DAA™.

Pin 58 – "Telout" (Telephone Handset Output). This pin is not supported on the SocketModem.

Pin 59 – "Telin" (Telephone Handset Input). This pin is not supported on the SocketModem.

Pin 60 – "Micm" (Microphone Modem Input). This pin is not supported on the SocketModem.

Pin 62 – "Micv" (Microphone Voice Input). This pin is supported on the MT5656SMI SocketModem in the same way as the "SF" modem.

Electrical Characteristics

3.3 V Serial SocketModem

3.3 V DC Characteristics (TA = 0°C to 70°C; VDD = 3.3 V ± 0.3 V) VDDMAX = 3.6 V

Inputs –DTR (40), –TXD (35), –RTS (33), –RESET (24)	Input High Min 2.0 V	Input Low Max 0.8 V	
Outputs –DCD (39), –CTS (38), –DSR (37), –RI (36), –RXD (34) 2 mA, Z INT = 120 Ω	Output High Min 2.4 V	Output Low Max 0.5 V	
Digital Input Capacitance			50pF

3.3 V Parallel SocketModem

Electrical characteristics for Parallel SocketModem devices are presented below.
3.3 V DC Characteristics (TA = 0°C to 70°C; VDD = 3.3 V ± 0.3 V) VDDMAX = 3.6 V

Digital Inputs –DS (40)	Input High Min 2.0 V	Input Low Max 0.8 V	
Digital Inputs (hysteresis input buffer) A0 (31), A1 (25), A2 (34), –WR (32), –RD (33) 8mA Z $_{INT}$ = 50Ω 2 mA Z $_{INT}$ = 120 Ω	Input High Min 2.0 V	Input Low Max 0.8 V	
Digital Input/Output DO (37), D1 (38), D2 (29), D3 (39), D4 (35), D5 (36), D6 (41), D7 (27) 2 mA, Z $_{INT}$ = 120 Ω	Input High Min 2.0 V Output High Min 2.4 V	Input Low Max 0.8 V Output Low Max 0.5 V	
Digital Output INT (30) 2 mA, Z $_{INT}$ = 120 Ω	Output High Min 2.4 V	Output Low Max 0.5 V	
Digital Input Capacitance			50pF

5 V Serial SocketModem

5 V DC Characteristics (TA = 0 °C to 50 °C; VDD = 5 V ± 0.25 V) VDDMAX = 5.25 V

Digital Inputs –DTR (40), –TXD (35), –RTS (33), –RESET (24)	Input High Min 2 V	Input Low Max 0.8 V	
Digital Outputs –DCD (39), –CTS (38), –DSR (37), –RI (36), –RXD (34)	Output High Min 2.4 V	Output Low Max 0.5 V	Current Drive 15 mA
Digital Input Capacitance			5 PF

5 V Parallel SocketModem

5 V DC Characteristics (TA = 0 °C to 50 °C; VDD = 5 V ± 0.25 V) VDDMAX = 5.25 V

Digital Inputs –DS (40)	Input High Min 2 V	Input Low Max 0.8 V	
Digital Inputs (hysteresis input buffer) A0 (31), A1 (25), –WR (32), –RD (33)	Input High Min 2 V	Input Low Max 0.8 V	
Digital Input / Output DO (37), D1 (38), D2 (29), D3 (39), D4 (35), D5 (36), D6 (41), D7 (27)	Input High Min 2 V	Input Low Max 0.8 V	Current Drive 8 mA
Digital Output INT (30)	Output High Min 2.4 V	Output Low Max 0.5 V	Current Drive 8 mA
Digital Input Capacitance			5 PF

Parallel Host Bus Timing Table

Symbol	Parameter	Min	Max	Units
READ (See Notes)				
^{t}AS	Address Setup	5	-	ns
^{t}AH	Address Hold	10	-	ns
^{t}CS	Chip Select Setup	0	-	ns
^{t}CH	Chip Select Hold	10	-	ns
^{t}RD	RD Strobe Width	45	-	ns
^{t}DD	Read Data Delay	-	25	ns
^{t}DRH	Read Data Hold	5	-	ns
WRITE (See Notes)				
^{t}AS	Address Setup	5	-	ns
^{t}AH	Address Hold	15	-	ns
^{t}CS	Chip Select Setup	0	-	ns
^{t}CH	Chip Select Hold	10	-	ns
^{t}WT	WT Strobe Width	75	-	ns
^{t}DS	Write Data Setup (see Note 4)	-	20	ns
^{t}DWH	Write Data Hold (see Note 5)	5	-	ns

Notes:
1. When the host executes consecutive Rx FIFO reads, a minimum delay of 2 times the internal CPU clock cycle plus 15 ns (85.86 ns at 28.224 MHz) is required from the falling edge of RD to the falling edge of the next Host Rx FIFO RD clock.
2. When the host executes consecutive Tx FIFO writes, a minimum delay of 2 times the internal CPU clock cycle plus 15 ns (85.86 ns at 28.224 MHz) is required from the falling edge of WT to the falling edge of the next Host Tx FIFO WT clock.
3. ^{t}RD' ^{t}WT $= ^t$CYC $^{+ 15\ ns.}$
4. ^{t}DS is measured from the point at which both CS and WT are active.
5. ^{t}DWH is measured from the point at which either CS and WT become active.
6. Clock Frequency = 28.224 MHz clock.

Parallel Host Bus – Read	*Parallel Host Bus - Write*
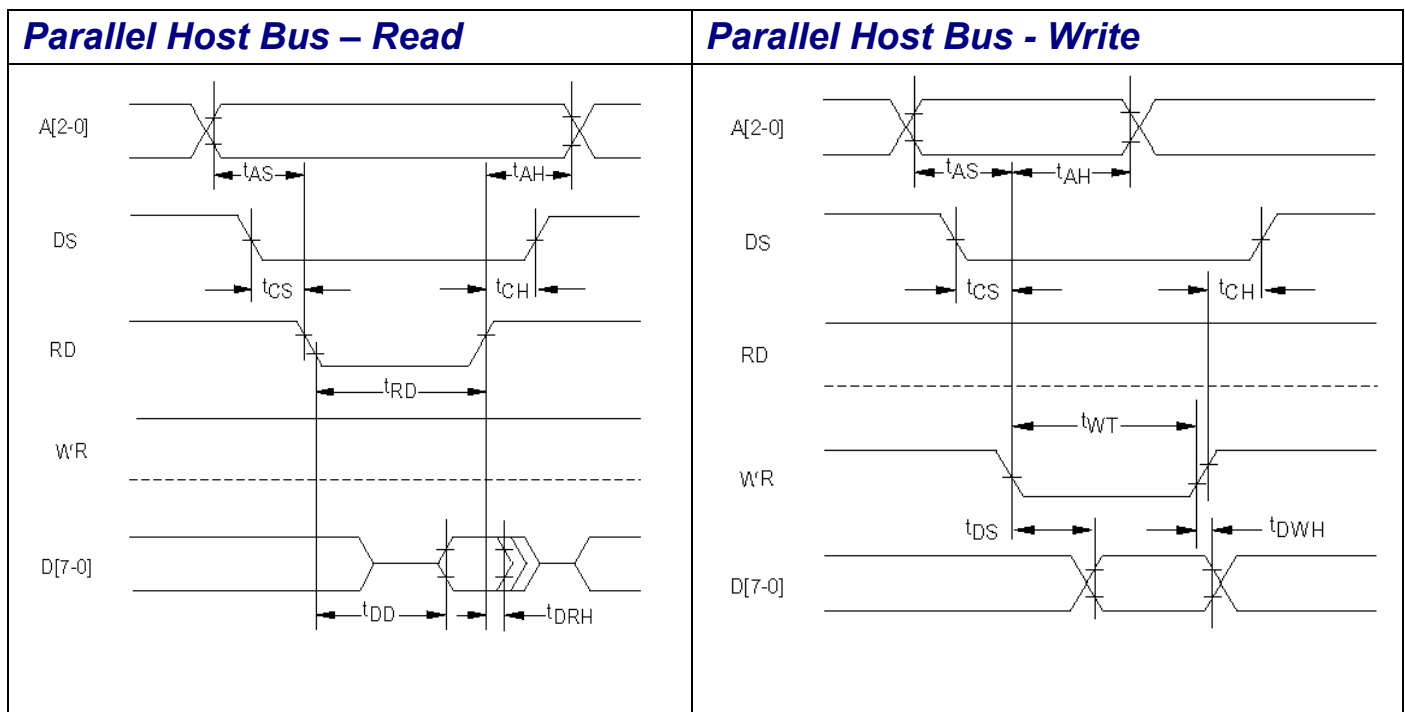
SocketModem Parallel Interface

The modem supports a 16550A interface in parallel interface versions. The 16550A interface can operate in FIFO mode or non-FIFO mode. Non-FIFO mode is the same as the 16450-interface operation. FIFO mode's unique operations are described in this chapter.

Overview

The modem emulates the 16450/16550A interface and includes both a 16-byte receiver data first-in first-out buffer (RX FIFO) and a 16-byte transmit data first-in first-out buffer (TX FIFO).

FIFO Mode Selected
When FIFO mode is selected in the FIFO Control Register (FCR0 = 1), both FIFOs are operative. Furthermore, when FIFO mode is selected, DMA operation of the FIFO can also be selected (FCR3 = 1).

FIFO Mode Not Selected
When FIFO mode is not selected, operation is restricted to a 16450-interface operation.

Receive Data
Received Data is read by the host from the Receiver Buffer (RX Buffer). The RX Buffer corresponds to the Receiver Buffer Register in a 16550A device. In FIFO mode, the RX FIFO operates transparently behind the RX Buffer. Interface operation is described with reference to the RX Buffer in FIFO and non-FIFO modes.

Transmit Data
Transmit Data is loaded by the host into the Transmit Buffer (TX Buffer). The TX Buffer corresponds to the Transmit Holding Register in a 16550A device. In FIFO mode, the TX FIFO operates transparently behind the TX Buffer. Interface operation is described with reference to the TX Buffer in both FIFO and non-FIFO modes.

Receiver FIFO Interrupt Operation
Receiver Data Available Interrupt
When the FIFO mode is enabled (FCR0 = 1) and receiver interrupt (RX Data Available) is enabled (IER0 = 1), receiver interrupt operation is as follows:
1. The Receiver Data Available Flag (LSR0) is set as soon as a received data character is available in the RX FIFO. LSR0 is cleared when RX FIFO is empty.
2. The Receiver Data Available Interrupt code (IIR0-IIR4 = 4h) is set whenever the number of received data bytes in the RX FIFO reaches the trigger level specified by FCR6-FCR7 bits. It is cleared whenever the number of received data bytes in the RX FIFO drops below the trigger level specified by FCR6-FCR7 bits.
3. The HINT interrupt is asserted whenever the number of received data bytes in the RX FIFO reaches the trigger level specified by FCR6-FCR7 bits. HINT interrupt is de-asserted when the number of received data bytes in the RX FIFO drops below the trigger level specified by FCR6-FCR7 bits.

Receiver Character Timeout Interrupts
When the FIFO mode is enabled (FCR0 = 1) and receiver interrupt (Receiver Data Available) is enabled (IER0 = 1), receiver character timeout interrupt operation is as follows:

1. A Receiver character timeout interrupt code (IIR0-IIR3 = Ch) is set if at least one received character is in the RX FIFO, the most recent received serial character was longer than four continuous character times ago (if 2 stop bits are specified, the second stop bit is included in this time period), and the most recent host read of the RX FIFO was longer than four continuous character times ago.

Transmitter FIFO Interrupt Operation
Transmitter Empty Interrupt

When the FIFO mode is enabled (FCR0 = 1) and transmitter interrupt (TX Buffer Empty) is enabled (IER0 =1), transmitter interrupt operation is as follows:

1. The TX Buffer Empty interrupt code (IIR0-IIR3 = 2h) will occur when the TX Buffer is empty. It is cleared when the TX Buffer is written to (1 to 16 characters) or the IIR is read.

2. The TX Buffer Empty indications will be delayed 1 character time minus the last stop bit time whenever the following occur: THRE = 1 and there have not been at least two bytes at the same time in the TX FIFO Buffer since the last setting of THRE was set. The first transmitter interrupt after setting FCR0 will be immediate.

Register Functional Definitions

The following table delineates the assigned bit functions for the twelve internal registers. The assigned bit functions are more fully defined in the following paragraphs.

Internal Registers

Register No.	Register Name	BIT No.							
		7	6	5	4	3	2	1	0
7	Scratch Register (SCR)	Scratch Register							
6	Modem Status Register (MSR)	Data Carrier Detect (DCD)	Ring Indicator (RI)	Data Set Ready (DSR)	Clear to Send CTS)	Delta Data Carrier Detect (DDCD)	Trailing Edge of Ring Indicator (TERI)	Delta Data Set Ready (DDSR)	Delta Clear to Send (DCTS)
5	Line Status Register (LSR)	RX FIFO Error	Transmitter Empty (TEMT)	Transmitter Buffer Register Empty (THRE)	Break Interrupt (BI)	Framing Error (FE)	Parity Error (PE)	Overrun Error (OE)	Receiver Data Ready (DR)
4	Modem Control Register (MCR)	0	0	0	Local Loopback	Out 2	Out 1	Request to Send (RTS)	Data Terminal Ready (DTR)
3	Line Control Register (LCR)	Divisor Latch Access Bit (DLAB)	Set Break	Stick Parity	Even Parity Select (EPS)	Parity Enable (PEN)	Number of Stop Bits (STB)	Word Length Select Bit 1 (WLS1)	Word Length Select Bit 0 (WLSO)
2	Interrupt Identify Register (IIR) (Read Only)	FIFOs Enabled	FIFOs Enabled	0	0	Pending Interrupt ID Bit 2	Pending Interrupt ID Bit 1	Pending Interrupt ID Bit 0	"0" if Interrupt Pending
2	FIFO Control Register (FCR) (Write Only)	Receiver Trigger MSB	Receiver Trigger LSB	Reserved	Reserved	DMA Mode Select	TX FIFO Reset	RX FIFO Reset	FIFO Enable
1 (DLAB = 0)	Interrupt Enable Register (IER)	0	0	0	0	Enable Modem Status Interrupt (EDSSI)	Enable Receiver Line Status Interrupt (ELSI)	Enable Transmitter Holding Register Empty Interrupt (ETBEI)	Enable Received Data Available Interrupt (ERBFI)
0 (DLAB = 0)	Transmitter Buffer Register (THR)	Transmitter FIFO Buffer Register (Write Only)							
0 (DLAB = 0)	Receiver Buffer Register (RBR)	Receiver FIFO Buffer Register (Read Only)							
1 (DLAB = 1)	Divisor Latch MSB Register (DLM)	Divisor Latch MSB							
0 (DLAB = 1)	Divisor Latch LSB Register (DLL)	Divisor Latch LSB							

IER – Interrupt Enable Register

(Addr = 1, DLAB = 0)

The IER enables five types of interrupts that can separately assert the HINT output signal (See the Interrupt Sources and Reset Control table in the IIR section of this chapter). A selected interrupt can be enabled by setting the corresponding enable bit to a 1, or disabled by setting the corresponding enable bit to a 0. Disabling an interrupt in the IER prohibits setting the corresponding indication in the IIR and assertion of HINT. Disabling all interrupts (resetting IER0 – IER3 to a 0) inhibits setting of any Interrupt Identifier Register (IIR) bits and inhibits assertion of the HINT output. All other system functions operate normally, including the setting of the Line Status Register (LSR) and the Modem Status Register (MSR).

The IER enables five types of interrupts that can separately assert the HINT output signal. A selected interrupt can be enabled by setting the corresponding enable bit to a 1, or disabled by setting the corresponding enable bit to a 0. Disabling an interrupt in the IER prohibits setting the corresponding indication in the IIR and assertion of HINT. Disabling all interrupts (resetting IER0 - IER3 to a 0) inhibits setting of any Interrupt Identifier Register (IIR) bits and inhibits assertion of the HINT output. All other system functions operate normally, including the setting of the Line Status Register (LSR) and the Modem Status Register (MSR).

Bits 7-4   **Not used.**
Always 0.

Bit 3   **Enable Modem Status Interrupt (EDSSI).**
This bit, when a 1, enables assertion of the HINT output whenever the Delta CTS (MSR0), Delta DSR (MSR1), Delta TER (MSR2), or Delta DCD (MSR3) bit in the Modem Status Register (MSR) is a 1. This bit, when a 0, disables assertion of HINT due to setting of any of these four MSR bits.

Bit 2   **Enable Receiver Line Status Interrupt (ELSI).**
This bit, when a 1, enables assertion of the HINT output whenever the Overrun Error (LSR1), Parity Error (LSR2), Framing Error (LSR3), or Break Interrupt (LSR4) receiver status bit in the Line Status Register (LSR) changes state. This bit, when a 0, disables assertion of HINT due to change of the receiver LSR bits 1-4.

Bit 1   **Enable Transmitter Holding Register Empty Interrupt (ETBEI).**
This bit, when a 1, enables assertion of the HINT output when the Transmitter Empty bit in the Line Status Register (LSR5) is a 1.This bit, when a 0, disables assertion of HINT due to LSR5.

Bit 0   **Enable Receiver Data Available Interrupt (ERBFI) and Character Timeout in FIFO Mode.**
This bit, when a 1, enables assertion of the HINT output when the Receiver Data Ready bit in the Line Status Register (LSR0) is a1 or character timeout occurs in the FIFO mode. This bit, when a 0, disables assertion of HINT due to the LSR0 or character timeout.

FCR – FIFO Control Register

(Addr = 2, Write Only)

The FCR is a write-only register used to enable FIFO mode, clear the RX FIFO and TX FIFO, enable DMA mode, and set the RX FIFO trigger level.

Bits 7-6   RX FIFO Trigger Level

FCR7 and FCR6 set the trigger level for the RX FIFO (Receiver Data Available) interrupt.

FCR7	FCR6	RX FIFO Trigger Level (Bytes)
0	0	01
0	1	04
1	0	08
1	1	14

Bits 5, 4   Not used

Bit 3   DMA Mode Select

When FIFO mode is selected (FCR0 = 1), FCR3 selects non-DMA operation (FCR3 = 0) or DMA operation (FCR3 = 1). When FIFO mode is not selected (FCR0 = 0), this bit is not used (the modem operates in non-DMA mode in 16450 operation).

DMA Operation in FIFO Mode

RXRDY will be asserted with the number of characters in the RX FIFO us equal to or greater than the value in the RX FIFO Trigger Level (IIR0-IIR3 = 4h) or the received character timeout (IIRO-IIR3 = Ch) has occurred. RXTDY will go inactive when there are no more characters in the RX FIFO.

TXRDY will be asserted when there are one or more empty (unfilled) locations in the TX FIFO. **TXRDY** will go inactive when the TX FIFO is completely full.

Non-DMA Operation in FIFO Mode

RXRDY will be asserted when there are one or more characters in the RX FIFO. RXRDY will go inactive when there are no more characters in the RX FIFO.

TXRDY will be asserted when there are no characters in the TX FIFO. TXRDY will go inactive when the character is loaded into the TX FIFO Buffer.

Bit 2   TX FIFO Reset

When FCR2 is a 1, all bytes in the TX FIFO are cleared. This bit is cleared automatically by the modem.

Bit 1   RX FIFO Reset

When FCR1 is a 1, all bytes in the RX FIFO are cleared. This bit is cleared automatically by the modem.

Bit 0   FIFO Enable

When FCR0 is a 0, 16450 mode is selected and all bits are cleared in both FIFOs. When FCR0 is a 1, FIFO mode (16550A) is selected and both FIFOs are enabled. FCR0 must be a 1 when other bits in the FCR are written or they will not be acted upon.

IIR – Interrupt Identifier Register

(Addr = 2)

The Interrupt Identifier Register (IIR) identifies the existence and type of up to five prioritized pending interrupts. Four priority levels are set to assist interrupt processing in the host. The four levels, in order of decreasing priority, are Highest: Receiver Line Status, 2: Receiver Data Available or Receiver Character Timeout. 3: TX Buffer Empty, and 4: Modem Status.

When the IIR is accessed, the modem freezes all interrupts and indicates the highest priority interrupt pending to the host. Any change occurring in interrupt conditions are not indicated until this access is complete.

Bits 7-6 **FIFO Mode**
These two bits copy FCR0.

Bits 5-4 **Not Used**
Always 0.

Bits 3-1 **Highest Priority Pending Interrupt**
These three bits identify the highest priority pending interrupt (Table below). Bit 3 is applicable only when FIFO mode is selected; otherwise, bit 3 is a 0.

Bit 0 **Interrupt Pending**
When this bit is a 0, an interrupt is pending; IIR bits 1-3 can be used to determine the source of the interrupt. When this bit is a 1, an interrupt is not pending

Interrupt Sources and Reset Control Table

Interrupt Identification Register					Interrupt Set and Reset Functions		
Bit 3 (Note 1)	Bit 2	Bit 1	Bit 0	Priority Level	Interrupt Type	Interrupt Source	Interrupt Reset Control
0	0	0	1	—	None	None	—
0	1	1	0	Highest	Receiver Line Status	Overrun Error (OE) (LSR1), Parity Error (PE) (LSR2), Framing Error (FE) (LSR3), or Break Interrupt (BI) (LSR4)	Reading the LSR
0	1	0	0	2	Received Data Available	Received Data Available (LSR0) or RX FIFO Trigger Level (FCR6-FCR7) Reached[1]	Reading the RX Buffer or the RX FIFO drops below the Trigger Level
1	1	0	0	2	Character Timeout Indication[1]	The RX FIFO contains at least 1 character and no characters have been removed from or input to the RX FIFO during the last 4 character times.	Reading the RX Buffer
0	0	1	0	3	TX Buffer Empty	TX Buffer Empty	Reading the IIR or writing to the TX Buffer
0	0	0	0	4	Modem Status	Delta CTS (DCTS) (MSR0), Delta DSR (DDST) (MSR1), Trailing Edge Ring Indicator (TERI) (MSR3), or Delta DCD (DCD) (MSR4)	Reading the MSR
Notes: 1. FIFO Mode only.							

LCR – Line Control Register

(Addr = 3)

The Line Control Register (LCR) specifies the format of the asynchronous data communications exchange.

Bit 7 **Divisor Latch Access Bit (DLAB)**
This bit must be set to a 1 to access the Divisor Latch Registers during a read or write operation. It must be reset to a 0 to access the Receiver Buffer, the Transmitter Buffer, or the Interrupt Enable Register.

Bit 6 **Set Break**
When bit 6 is a 1, the Transmit data is forced to the break condition, i.e., space (0) is sent. When bit 6 is a 0, break is not sent. The Set Break bit acts only on the Transmit data and has no effect on the serial in logic.

Bit 5 **Stick Parity**
When Parity is enabled (LCR3 = 1) and stick parity is selected (LCR5 = 1), the parity bit is transmitted and checked by the receiver as a 0 if even parity is selected (LCR4 – 1) or a 1 if odd parity is selected (LCR4 = 0). When the stick parity is not selected (LCR3 = 0), parity is transmit and checked as determined by the LCR3 and LCR4 bits.

Bit 4 **Even Parity Select (EPS)**
When parity is enabled (LCR3 = 1) and stick parity is not selected (LCR5 = 0), the number of 1s transmitted or checked by the receiver in the data word bits and parity bit is either even (LCR4 = 1) or odd (LCR4 = 0).

Bit 3 **Enable Parity (PEN)**
When bit 3 is a 1, a parity bit is generated in the serial out (transmit) data stream and checked in the serial in (receive) data stream as determined by the LCR4 and LCR5 bits. The parity bit is located between the last data bit and the first stop bit.

Bit 2 **Number of Stop GBITS (STB)**
This bit specifies the number of stop bits in each serial out character. If bit 2 is a 0, one stop bit is generated regardless of word length. If bit 2 is a 1 and 5-bit word length is selected, one and one-half stop bits are generated. If bit 2 is a 1 and 6-, 7-, or 8-bit word length is selected, two stop bits are generated. The serial in logic checks the first stop bit only, regardless of the number of stop bits selected.

Bit 1-0 **Word Length Select (WLS0 and WLS1)**
These two bits specify the number of bits in each serial in or serial out character. The encoding of bits 0 and 1 is:

Bit 1	Bit 0	Word Length
0	0	5 Bits (Not supported)
0	1	6 Bits (Not supported)
1	0	7 Bits
1	1	8 Bits

MCR – Modem Control Register

(Addr = 4)

The Modem Control Register (MCR) controls the interface with modem or data set.

Bit 7-5   Not used
Always 0

Bit 4   Local Loopback
When this bit is set to a 1, the diagnostic mode is selected and the following occurs:
1. Data written to the Transmit Buffer is looped back to the Receiver Buffer.
2. The DTS (MCR0), RTS (MCR1), Out1 (MCR2), and Out2 (MCR3) modem control register bits are internally connected to the DSR (MSR5), CTS (MSR4), RI (MSR6), and DCD (MSR7) modem status register bits, respectively.

Bit 3   Output 2
When this bit is a 1, HINT is enabled. When this bit is a 0, HINT is in the high impedance state.

Bit 2   Output 1
This bit is used in local loopback (see MCR4).

Bit 1   Request to Send (RTS)
This bit controls the Request to Send (RTS) function. When this bit is a 1, RTS is on. When this bit is a 0, RTS is off.

Bit 0   Data Terminal Ready (DTR)
This bit controls the Data Terminal Ready (DTR) function. When this bit is a 1, DTR is on. When this bit is a 0, DTR is off.

LSR – Line Status Register

(Addr = 5)

This 8-bit register provides status information to the host concerning data transfer

Bit 7   **RX FIFO Error**
In the 16450 mode, this bit is not used and is always 0.

In the FIFO mode, this bit is set if there are one or more characters in the RX FIFO with parity error, framing error, or break indication detected. This bit is reset to a 0 when the host reads the LSR and note of the above conditions exist in the RX FIFO.

Bit 6   **Transmitter Empty (TEMT)**
This bit is set to a 1 whenever the TX Buffer (THR) and equivalent of the Transmitter Shift Register (TRS) are both empty. It is reset to a 0 whenever either the THR or the equivalent of the TSR contains a character.

In the FIFO mode, this bit is set to a 1 whenever the TX FIFO and the equivalent of the TSR are both empty

Bit 5   **Transmitter Holding Register Empty (THRE) [TX Buffer Empty]**
This bit, when set, indicates that the TX Buffer is empty and the modem can accept a new character for transmission. In addition, this bit causes the modem to issue an interrupt to the host when the Transmit Holding Register Empty Interrupt Enable bit (IIR1) is set to 1. The THRE bit is set to a 1 when a character is transferred from the TX Buffer. The bit is reset to 0 when a byte is written into the TX Buffer by the host.

In the FIFO mode, this bit is set when the TX FIFO is empty; it is cleared when at lease one byte is in the TX FIFO.

Bit 4   **Break Interrupt (BI)**
This bit is set to a 1 whenever the received data input is a space (logic 0) for longer than two full word lengths plus 3 bits. The BI is reset when the host reads the LSR.

Bit 3   **Framing Error (FE)**
This bit indicates that the received character did not have a valid stop bit. The FE bit is set to a 1 whenever the stop bit following the last data bit or parity bit is detected as a logic o (space). The FE bit is reset to a 0 when the host reads the LSR.

In the FIFO mode, the error indication is associated with the particular character in the FIFO it applies to. The FE bit set to a 1 when this character is loaded into the RX Buffer.

Bit 2   **Parity Error (PE)**
This bit indicates that the received data character in the RX Buffer does not have the correct even or odd parity, as selected by the Even Parity Select bit (LCR4) and the Stick Parity bit (LCR5). The PE bit is reset to a 0 when the host reads the LSR.

In the FIFO mode, the error indication is associated with the particular character in the FIFO it applies to. The PE bit set to a 1 when this character is loaded into the RX Buffer.

Bit 1   **Overrun Error (OE)**
This bit is set to a 1 whenever received data is loaded into the RX Buffer before the host has read the previous data from the RX Buffer. The OE is reset to a 0 when the host reads the LSR.

In the FIFO mode, if data continues to fill beyond the trigger level, an overrun condition will occur only if the RX FIFO is full and the next character has been completely received.

Bit 0   **Receiver Data Ready (DR)**
This bit is set to a 1 whenever a complete incoming character has been received and transferred into the RX Buffer. The DR bit is reset to a 0 when the host reads the RX Buffer.

In the FIFO mode, the DR bit is set when the number of received data bytes in the RX FIFO equals or exceeds the trigger level specified in the FCR0-FCR1.

MSR – Modem Status Register

(Addr = 6)

The Modem Status Register (MSR) reports current state and change information of the modem. Bits 4-7 supply current state and bits 0-3 supply change information. The change bits are set to a 1 whenever a control input form the modem changes state from the last MSR read by the host. Bits 0-3 are reset to 0 when the host reads the MSR or upon reset.

Whenever bits 0, 1, 2, or 3 are set to a 1, a Modem Status Interrupt (IIR0-IIR3 = 0) is generated.

Bit 7	**Data Carrier Detect (DCD)** This bit indicates the logic state of the DCH# (RLSD#) output. If Loopback is selected (MCR4 = 1), this bit reflects the state of the Out2 bit in the MCR (MCR3).
Bit 6	**Ring Indicator (RI)** This bit indicates the logic state of the RI# output. If Loopback is selected (MCR4 = 1), this bit reflects the state of the Out1 bit in the MCR (MCR2).
Bit 5	**Data Set Ready (DSR)** This bit indicates the logic state of the DSR# output. If Loopback is selected (MCR4 = 1), this bit reflects the state of the DTR in the MCR (MCR0).
Bit 4	**Clear to Send (CTS)** This bit indicates the logic state of the CTS# output. If Loopback is selected (MCR4 = 1), this bit reflects the state of the RTS bit in the MCR (MCR1).
Bit 3	**Delta Data Carrier Detect (DDCD)** This bit is set to a 1 when the DCD bit changes state since the host last read the MSR.
Bit 2	**Trailing Edge of Ring Indicator (TERI)** This bit is set to a 1 when the RI bit changes from a 1 to a 0 state since the host last read the MSR.
Bit 1	**Delta Data Set Ready (DDSR)** This bit is set to a 1 when the DSR bit has changed since the host last read the MSR.
Bit 0	**Delta Clear to Send (DCTS)** This bit is set to a 1 when the CTS bit has changed since the MSR the host last read the MSR.

RBX – RX Buffer (Receiver Buffer Register)

(Addr = 0, DLAB = 0)

The RX Buffer (RBR) is a read-only register at location 0 (with DLAB = 0). Bit 0 is the least significant bit of the data and is the first bit received.

THR – TX Buffer (Transmitter Holding Register)

(Addr = 0, DLAB = 0)

The TX Buffer (THR) is a write-only register at address 0 when DLAB = 0. Bit 0 is the least significant bit and the first bit sent.

SCR – Scratch Register

(Addr = 7)

The Scratchpad Register is a read-write register at location 7. This register is not used by the modem and can be used by the host for temporary storage.

Divisor Registers

(Addr = 0 and 1, DLAB = 1)

The Divisor Latch LS (least significant byte) and Divisor Latch MS (most significant byte) are two read-write registers at locations 0 and 1 when DLAB = 1, respectively.

The baud rate is selected by loading each divisor latch with the appropriate hex value.

Programmable values corresponding to the desired baud rate are listed in Table on following page.

Divisor Latch (Hex)		Divisor (Decimal)	Baud Rate
MS	LS		
06	00	1536	75
04	17	1047	110
03	00	768	150
01	80	384	300
00	C0	192	600
00	60	96	1200
00	30	48	2400
00	18	24	4800
00	0C	12	9600
00	06	6	19200
00	04	4	28800
00	03	3	38400
00	02	2	57600
00	01	1	115600
00	00	NA	230400

Programmable Baud Rates

Application Notes

Tip and Ring Interface
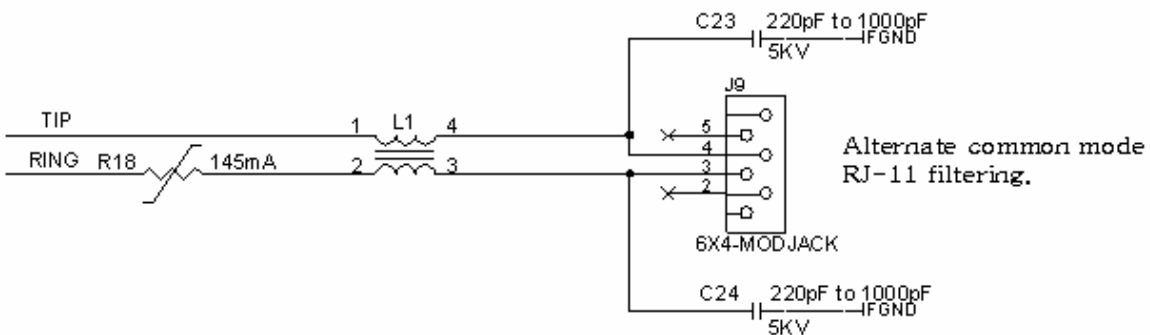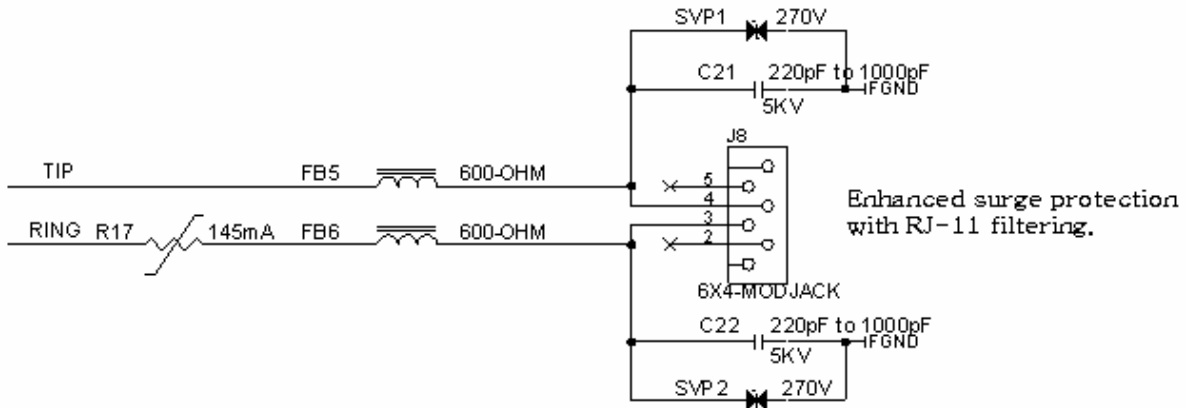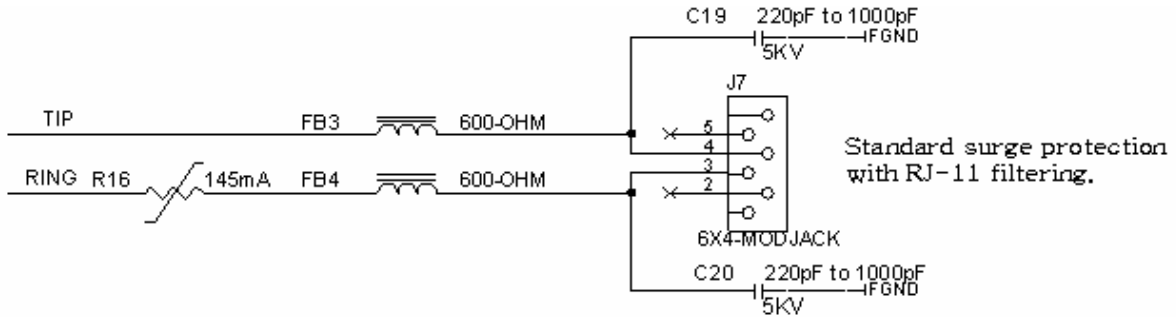
Main Board Filtering

Microphone and Speaker

Note: Applies to the MT5656SMI only.
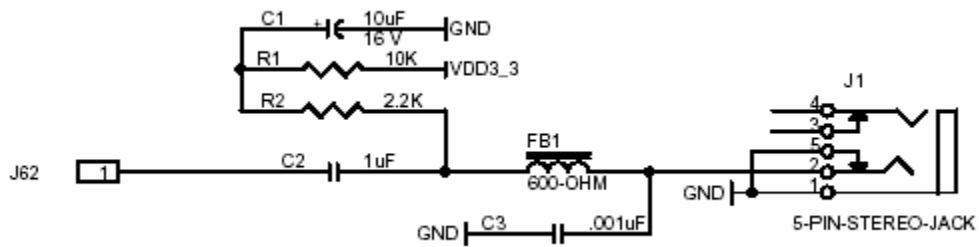
Microphone Input Option
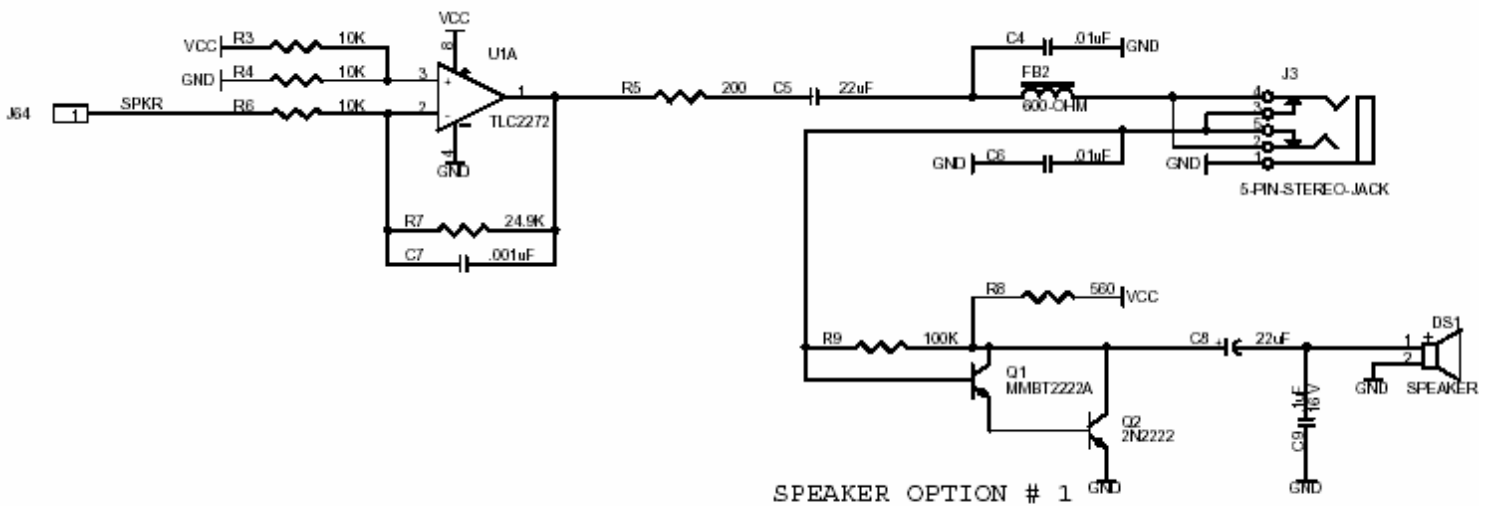
Speaker Output Option 1
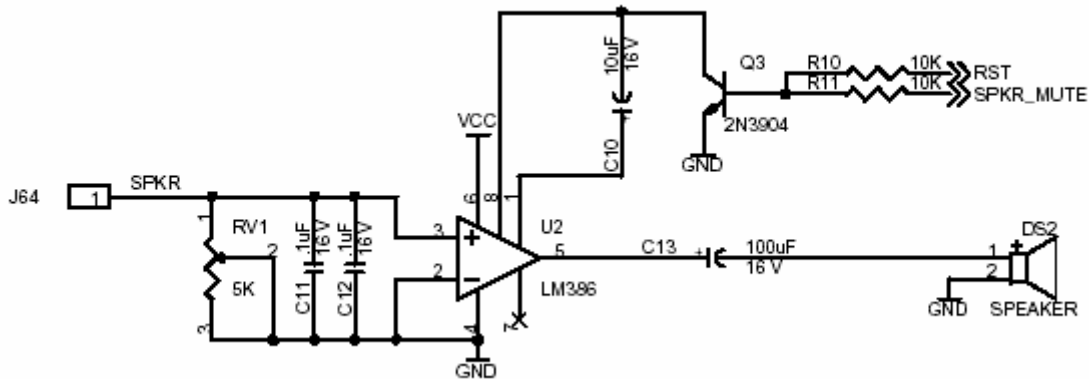
Speaker Output Option 2

Recommended Parts

Disclaimer: Multi-Tech Systems makes no warranty claims for vendor product recommendations listed below. Other vendor products may or may not operate satisfactorily. Multi-Tech System's recommended vendor products only indicate that the product has been tested in controlled conditions and were found to perform satisfactorily.

Surface mount ferrites are used on T&R (Tip and Ring) to mitigate emission levels out the RJ-11 cable. 220pF capacitors are also used on T&R to reduce the common mode emissions that may be present in certain systems. The ferrite and capacitors also aid in reducing the effects of transients that may be present on the line.

Recommended Ferrite (SMT)
Manufacturer – Associated Component Technology (ACT) – Part # - YCB-1206
Manufacturer – Murata Erie – Part # - BLM31AJ601SN1

Recommended Ferrite (Thru-Hole)
Manufacturer – Associated Component Technology (ACT) – Part # - WB2-2.OT

Recommended Capacitor
Manufacturer – NOVACAP –   Part # - ES2211NKES502NXT
Manufacturer – Murata Erie –   Part # - GA355DR7GC221KY02L (Surface mount device)
                                 Part # - DE0807B221K-KH (Thru-hole device)
Manufacturer – Ever Grace Electronic Industrials -- Part # - YP221K2EA7PS
Note: The capacitors used on T&R must have the Y2 safety rating.

Recommended Connector
Manufacturer – Stewart – Part # - SS-6446-NF-A431

Recommended Poly Switch Thermal Fuse (can be reset)
Manufacturer – RayChem – Part # - TS600-170
Note: This fuse or its equivalent is required to meet UL60950 for protection against over-voltage from power line crosses.

Telecom
The RJ-11 connector must meet FCC Part 68 requirements. Refer to FCC Part 68 section 68.500 subpart F for connector specifications. A self-healing fuse is used in series with line to help prevent damage to the DAA circuit. This fuse is needed for FCC Part 68 compliance.

Common Mode Choke
Manufacturer – TDK – Part # - ZJYS51R5-2PT

Recommended Sidactor
Manufacturer – Teccor Electronics – Part # - P#3100SA
Manufacturer – ST Microelectronics -- Part 1 – SMP100LC-270

Recommended Transceiver
Manufacturer – Analog Devices – Part # - ADM207EAR

Chapter 3

SocketModem

MT5634SMI-34
MT5634SMI-92

Chapter 3 – SocketModem (MT5634SMI-34 & MT5634SMI-92)

Introduction

Multi-Tech's SocketModem creates communication-ready devices by integrating data/fax/voice functionality into a single product design. The SocketModem is a space-efficient (1" × 2.5"), embedded modem that provides V.92/56K communication. The complete, ready-to-integrate modem dramatically reduces development time and costs for system designers.

The MT5634SMI SocketModem is used for integrating data and fax communications:

- It is a single-port modem, which integrates the controller, DSP, and DAA in a 1" x 2.5" form factor and communicates to a host controller via an asynchronous serial interface
- It is available with an 8-bit parallel interface

Product Ordering Information

Product	Description	Region	Order this Product ✓
MT5634SMI-34	V.34 Serial Data V.34 Fax - 5 V	Global	
MT5634SMI-92	V.92 Serial Data V.34 Fax - 5 V	Global	
MT5634SMI-P-92	V.92 Parallel Data V.34 Fax - 5 V	Global	
MT5634SMI-ITP-92	V.92 Serial Data V.34 Fax - Industrial Temperature - 3.3 V	Global	
MT5634SMI-P-ITP-92	V.92 Parallel Data V.34 Fax - Industrial Temperature - 3.3 V	Global	
MT5634SMI-HV-92	V.92 Serial Data V.34 Fax - High Voltage Medical Device - 5 V	Global	
MT5634SMI-P-HV-92	V.92 Parallel Data V.34 Fax - High Voltage Medical Device - 5 V	Global	
Telecom Label			
MT5634SMI-LS	MT5634SMI – Global Regulatory Label	Global	
Developer Kits			
MTSMI-DK	SocketModem Serial Developer Kit	Global	
MTSMI-P-DK	SocketModem Parallel Developer Kit	Global	

How to Read the Product Codes in the Table Above:

34	V.34/33.6K data rate
92	V.92/56K data rate
HV	High Voltage Medical Device Build
ITP	Industrial Temperature Build
P	Parallel interface (serial is default)
LS	Telecom Label
DK	Developer Kit

Developer Kit

Two SocketModem Developer Kits are available, one for serial and the other for parallel. The serial kit allows you to plug in the SocketModem and use it as a serial modem for testing, programming, and evaluation. The parallel kit turns the parallel module into an ISA modem. Each kit includes one developer board with an RS-232 DB-25 connector, wall power adapter, RJ-11 jack, an RS-232 cable, and a Developer Kit CD.

Technical Specifications

The SocketModem meets the following specifications:

Category	Description
Client-to-Server Data Rates	Supports V.92 and V.90 data rates
AGC Dynamic Range	43 dB
Cleaning	No cleaning/washing due to the manufacturing process used to produce this product.
Client-to-Client Data Rates	33,600; 31,200; 28,800; 26,400; 24,000; 21,600; 19,200; 16,800; 14,400; 12,000; 9600; 7200; 4800; 2400; 1200; 0-300 bps
Command Buffer	60 characters
DAA Isolation	**MT5634SMI-92** - 1500 Vac **MT5634SMI-HV-92** - EN60601 - 3000 Vac
Data Compatibility	V.92, V.34 enhanced, V.34, V.32bis, V.32, V.22bis, V.22; Bell 212A and 103/113, V.21 & V.23
Data Compression	ITU-T V.44 (6:1 throughput); V.42bis (4:1 throughput); MNP 5 (2:1 throughput)
Fax Compression	MH, MR, MMR (V.92 build only)
Data Format	Serial, binary, asynchronous (available with parallel interface)
Diagnostics	Local analog loop, local digital loop, remote digital loop
Dimensions	1.045" × 2.541" × 0.680" (2.7 x 6.5 x 1.8 cm)
Error Correction	Data Mode: V.42 (LAP-M or MNP 3–4) Fax Mode: Available with V.92 build only
Fax Compatibility	V.34 Super G3 fax at speeds up to 33.6Kbps V.17 G3 fax at speeds up to 14.4Kbps V.29 / V.27 / V.21 Class 1 and 1.0 Class 2 and 2.0 / 2.1 Fax mode compression MH, MR, MMR Fax mode error correction T.30 Annex A & C
Fax Data Rates	33,600; 31,200; 28,800; 26,400; 24,000; 21,600; 19,200; 16,800; 14,400; 12,000; 9600; 7200; 4800; 2400; 1200; 0-300 bps
Flow Control	XON/XOFF (software), RTS/CTS (hardware)
Frequency Stability	±0.01%
Interface	TTL serial or 8-bit parallel interface
Modes of Operation	Fax online modes; full duplex over dial-up lines; data mode, command mode, and online command mode, V.54 test mode
Operating Voltage	**Standard** 5 V DC ± 5% Absolute Maximum Supply Voltage: 5.5 V DC **MT5634SMI-ITP-92 (Industrial Temperature {3.3 V} Build Option)** 3.3 V DC, 180mA Absolute Maximum Supply Voltage: 3.6 V DC
Operational Temperature Range	**Standard** 0 to+70° C ambient under closed conditions; humidity range 20–90% (non-condensing) **MT5634SMI-ITP-92 (Industrial Temperature {3.3 V} Build Option)** –40 to +85° C ambient under closed conditions; humidity range 20–90% (non-condensing)
Power Consumption	**Standard** Typical: 245 mA (1.25 W @ 5 V DC) Standby or Sleep Mode: 148 mA Maximum: 420 mA (2.1 W @ 5.25 V DC) **MT5634SMI-ITP-92 (Industrial Temperature {3.3 V} Build Option)** Typical: 180 mA (0.59 W @ 3.3 V DC) Standby or Sleep Mode: 88 mA Maximum: 290 mA (1.04 W @ 3.6 V DC)

Category	*Description*
Receiver Sensitivity	–43 dBm under worst-case conditions
Serial Speeds	Serial port data rates adjustable to 300, 1200, 2400, 4800, 9600, 19,200, 38,400, 57,600, 115,200, and 230,400 bps
Storage Temperature	–50 to +100° C
Transmit Level	–11 dBm (varies by country setting)
Voice Compatibility	TAM (Telephone Answering Machine): S-101 AT+V commands (no CODEC for speakers/microphone interface)
Weight	0.02 Kg. (0.04 lb.)
Manufacturing Information	Trade Name: SocketModem Model Number: MT5634SMI-34 & MT5634SMI-92 Registration No: AU7USA-25814-M5-E Ringer Equivalence: 0.3B Modular Jack (USOC): RJ11

Approvals	**Safety Certifications**
	    UL60950
	    cUL60950
	    EN60950
	    IEC60950
	    ACA TS001 / AS 3260
	    CCC
	EMC Approvals
	    FCC Part 15
	    Canadian EMC
	    EN 55022
	    EN 55024
	    GB4943, GB9254

Intelligent Features	Fully AT command compatible Leased-line operation Sleep mode Autodial, redial Pulse or tone dial Dial pauses Auto answer Adaptive line probing Automatic symbol and carrier frequency during start-up, retrain, and rate renegotiations DTMF detection Distinctive ring Voice record and playback Call status display, auto-parity and data rate selections Keyboard-controlled modem options On-screen displays for modem option parameters remote configuration DTR dialing phone number storage flash memory for firmware updates NVRAM storage for user-defined parameters

SocketModem Configuration

Serial Configuration

The MT5634SMI SocketModem uses a 20-pin interface to provide an on-board DAA with tip and ring connections, audio circuit for call-progress monitoring, LED driver for call status annunciation, and serial interface.
Note: The bolded, shaded pins are the active MT5634SMI pins.

Tip	1	o	o	64	**SPKR**
Ring	2	o	o	63	**GND**
Safety Void	3	×	o	62	MICV
TX+	4	o	o	61	**VCC**
TX-	5	o	o	60	-LED SPD
RX+	6	o	o	59	-LED COL
RX-	7	o	o	58	-LED LINK
Safety Void	8	×	o	57	-LED ACT
	9		o	56	-LED FDX
	10			55	
TCLK	11	o		54	
RCLK	12	o		53	
	13			52	
	14			51	
	15			50	
	16			49	
	17			48	
	18			47	
	19			46	
	20			45	
	21			44	
Mic+	22	o	o	43	SPK+
Mic-	23	o	o	42	SPK-
-Reset	24	o	o	41	**GND**
	25		o	40	**-DTR**
GND	26	o	o	39	**-DCD**
	27		o	38	**-CTS**
	28		o	37	**-DSR**
LED DCD	29	o	o	36	**-RI**
LED RX	30	o	o	35	**-TXD**
LED DTR	31	o	o	34	**-RXD**
LED TX	32	o	o	33	**-RTS**

Universal Socket

SocketModem
Analog Dial-up

Serial SocketModem Pinout

Parallel Configuration

The parallel configuration is not compatible with the serial universal socket.
The MT5634SMI-P (Parallel) SocketModem uses a 22-pin interface to provide an on-board DAA with tip and ring connections, audio circuit for call-progress monitoring, and parallel interface.

Note: The bolded, shaded pins are the active MT5634SMI-P (Parallel) pins.
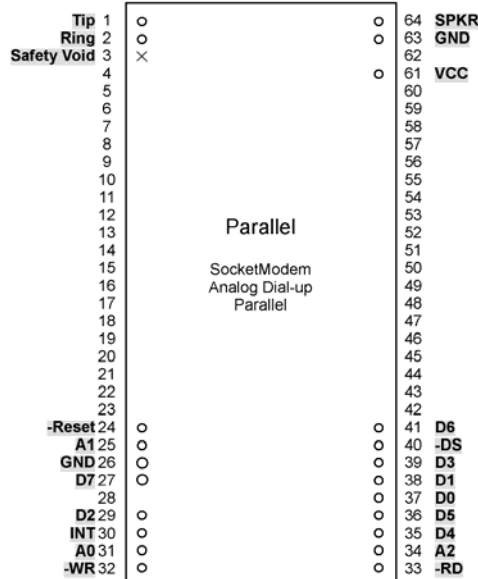
Parallel SocketModem Pins

Pin Descriptions for a Parallel SocketModem Device

Pin #	Signal	I/O	Description
1	Tip	I/O	**Telephone Line Interface – TIP**
2	Ring	I/O	**Telephone Line Interface – RING**
24	–RESET	I	**Modem Reset (with pull-up).** Active low –RESET input resets the SocketModem logic and returns AT command set to original factory defaults or to NVRAM 'stored values' . The modem is ready to accept commands within 6.5 seconds of power-on or reset. Reset must be asserted for a minimum of 30ms.
25	A1	I	**Host Bus Address Line 1**
26	DGND	GND	**Digital Ground**
27	D7	O	**Host Bus Data Line 7**
29	D2	O	**Host Bus Data Line 2**
30	INT	O	**Host Bus Interrupt Line.** INT output is set high when the receiver error flag, receiver data available, transmitter holding register empty, or modem status interrupt have an active high condition. INT is reset low upon the appropriate interrupt service or master reset operation.
31	A0	I	**Host Bus Address Line 0.**
32	–WR	I	**Host Bus Write.** –WR is an active low, write control input. When –DS is low, –WR low allows the host to write data or control words into a selected modem register.
33	–RD	I	**Host Bus Read.** –RD is an active low, read control input. When –DS is low, –RD low allows the host to read status information or data from a selected modem register.
34	A2	I	**Host Bus Address Line 2**
35	D4	O	**Host Bus Data Line 4**
36	D5	O	**Host Bus Data Line 5**
37	D0	O	**Host Bus Data Line 0**
38	D1	O	**Host Bus Data Line 1**
39	D3	O	**Host Bus Data Line 3**
40	–DS	I	**Host Bus Device Select.** –DS input low enables the modem for read or write.
41	D6	O	**Host Bus Data Line 6**
61	VCC	PWR	**+5 V or 3.3 V Supply** (depends upon model).
63	AGND	GND	**Analog Ground.** This is tied common with DGND on the SocketModem. To minimize potential ground noise issues, connect audio circuit return to AGND.
64	SPKR	O	**Speaker Output**. SPKR is a single ended-output. It is tied to the CODEC through a series 6.8K resistor and .1uf cap.

Electrical Characteristics

3.3 V Serial – *Industrial Temperature (SMI-ITP) Build Option*

3.3 V DC Characteristics (TA = -40 °C to 85 °C; VDD = 3.3 V ± 0.3 V) VDDMAX = 3.6 V

Digital Inputs –DTR (40), –TXD (35), –RTS (33)	Input High Min 2.52 V	Input Low Max 0.9 V	
–**Reset** (24)	Input High Min 2.52 V	Input Low Max 0.3 V	
Digital Outputs –DCD (39), –CTS (38), –DSR (37), –RI (36), –RXD (34)	Output High Min. 2.3 V	Output Low Max 0.4 V	Current Drive 2 mA
Digital Input Capacitance			5 pF

3.3 V Parallel – *Standard (SMI) and Industrial Temperature (SMI-ITP) Build Options*

MT5634SMI for Parallel MT5634SMI SocketModem devices are presented below.
3.3 V DC Characteristics (TA = –40 °C to 85 °C; VDD = 3.3 V ± 0.3 V) VDDMAX = 3.6 V

Digital Inputs –DS (40)	Input High Min 2.52 V	Input Low Max 0.9 V	
Digital Inputs (hysteresis input buffer) A0 (31), A1 (25), A2 (34), –WR (32), –RD (33)	Input High Min 2.52 V	Input Low Max 0.9 V	
Digital Input/Output **Output buffer can source 12 mA at 0.4 V** DO (37), D1 (38), D2 (29), D3 (39), D4 (35), D5 (36), D6 (41), D7 (27)	Input High Min 2.52 V	Input Low Max 0.9 V	
Digital Output INT (30)	Output High Min 2.3 V	Output Low Max 0.4 V	Current Drive 2 mA
Digital Input Capacitance			5 pF

5 V Serial – *Standard (SMI) and Medical Device (SMI-HV) Build Options*

5 V DC Characteristics (TA = 0 °C to 50 °C; VDD = 5 V ± 0.25 V) VDDMAX = 5.25 V

Digital Inputs –DTR (40), –TXD (35), –RTS (33)	Input High Min 3.675 V	Input Low Max 1.4 V	
–**Reset** (24)	Input High Min 3.675 V	Input Low Max 0.3 V	
Digital Outputs –DCD (39), –CTS (38), –DSR (37), –RI (36), –RXD (34)	Output High Min. 4 V	Output Low Max 0.4 V	Current Drive 2 mA
Digital Input Capacitance			5 PF

5 V Parallel – *Standard (SMI) and Medical Device (SMI-HV) Build Options*

5 V DC Characteristics (TA = 0 °C to 50 °C; VDD = 5 V ± 0.25 V) VDDMAX = 5.25 V

Digital Inputs –DS (40)	Input High Min. 3.675 V	Input Low Max. 1.4 V	
Digital Inputs (hysteresis input buffer) A0 (31), A1 (25), A2 (34), –WR (32), –RD (33)	Input High Min. 3.675 V	Input Low Max. 1.4 V	
Digital Input / Output **Output buffer can source 12 mA at 0.4 V** DO (37), D1 (38), D2 (29), D3 (39), D4 (35), D5 (36), D6 (41), D7 (27)	Input High Min. 3.675 V	Input Low Max. 1.4 V	
Digital Output INT (30)	Output High Min. 4 V	Output Low Max 0.4 V	Current Drive 2 mA
Digital Input Capacitance			5 pF

Timing Requirements

Timing Requirements for Parallel Write

Parameter	Min	Max	Unit
–DS to –WR Setup (low to low)	10	-	ns
A0, A1, A2 to –WR Setup (valid to low)	15	-	ns
–WR Pulse Width (low to high)	40	-	ns
D0–D7 to –WR Setup (valid to high)	30	-	ns
–WR to –DS hold (high to high)	0	-	ns
–WR to A0–A2 Hold (high to invalid)	0	-	ns
–WR to D0–D7 Hold (high to invalid)	0	-	ns

–WR interaccess (high to low)
  Non-MIMIC Accesses
  MIMIC Accesses
	
	10
	110
		
		-
		-
			
			ns
			ns

Timing Requirements for Parallel Read

Parameter	Min	Max	Unit
–DS to –RD Setup (low to low)	10	-	ns
A0, A1, A2 to –RD Setup (valid to low)	15	-	ns
–RD Pulse Width (low to high)	40	-	ns
–RD to –DS hold (high to high)	0	-	ns
–RD to A0–A2 Hold (high to invalid)	0	-	ns

–WR interaccess (high to low)
  Non-MIMIC Accesses
  MIMIC Accesses
	
	10
	110
		
		-
		-
			
			ns
			ns

SocketModem Parallel Interface Internal Registers

The SocketModem parallel interface is a mimic of a 16C550A UART. It is similar to the MIMIC interface used in the Zilog Z80189. The SocketModem mimic (MMM) takes advantage of this standard interface while replacing the serial to parallel data transfer with a less complicated parallel to parallel data transfer.

The MMM interface controls an 8-bit parallel data transfer which is typically interrupt driven. Interrupts usually indicate one or both of two conditions: (1) the receive (RX) FIFO has either reached a trigger level or time-out condition and needs to be emptied and/or (2) the transmit (TX) FIFO is empty and waiting for more data from the Host. An interrupt can also be triggered by a change in the modem status register (i.e., loss of carrier) or by the occurrence of errors in the line status register (overrun, parity, framing, break detect).

In addition to the receive and transmit FIFOs, there are twelve other control/status registers called the MMM register set which can be accessed through this interface.

Overview

SocketModem MIMIC (MMM) Operation

Data flow through MMM is bi-directional. Simultaneously, data can flow from the host through the transmit FIFO to the SocketModem controller, and data can flow from SocketModem controller through the receive FIFO to the Host. In the receive path, 8-bit data is asynchronously received (from the SocketModem controller) by the receive FIFO where it is stored along with associated three error bits. The error bits must arrive (via a SocketModem controller I/O write to MMM shadow line status register) prior to receiving the actual data bits. The error bits are then temporarily stored so they may be written, with associated data bits, to the 11-bit wide RX FIFO.

After every data write, the RX FIFO write pointer is incremented. RX FIFO trigger levels, data ready signal, and time-out counter are checked to see if a Host interrupt needs to be sent. The data ready signal will be activated and MMM sits poised to accept another data word.

We highly recommend the host should read the MMM IIR register to determine the type of interrupt. Then it might check bit 7 of the LSR to see if there are any errors in the data currently residing in the receive FIFO. Finally, it will (1) alternately read a data word through the RX FIFO read pointer and the error bits via the MMM LSR until the FIFO is empty, or (2) read successive data words (knowing there were no errors in the FIFO) until the trigger count is met.

A similar sequence occurs when data flows in the other direction (from host through transmit FIFO), except there is no error bit manipulation/checking involved.

FIFO Operation
The 16-byte transmit and receive data FIFOs are enabled by the FIFO Control Register (FCR) bit-0. You can set the receive trigger level via FCR bits 6/7. The receiver FIFO section includes a time-out function to ensure data is delivered to the external host. An interrupt is generated whenever the Receive Holding Register (RHR) has not been read following the loading of a character or the receive trigger level has been reached.

Receive (RX) FIFO
The RX FIFO can be configured to be 16 words deep and 11 bits wide. Each word in the RX FIFO consists of 8 data bits and 3 error bits. The RX block of the MMM contains read and write pointers and status flag circuitry that need only to be presented with data (for input), reset, read/write control signals, and read/write clock signals. The RX block of the MMM internally manages the FIFO register file and pointers, and it provides simultaneous read/write capability (no contention problems).

The RX block of the MMM provides data (for output), FIFO full flag, FIFO empty flag, and an almost full flag which uses an associated predefined trigger level (obtained from the MMM FCR control register) to signal when the trigger level has been met. Four possible trigger levels may be selected by programming bits 6-7 of the FCR control register.

A typical (interrupt driven) write to the RX block is a two-step process. The MMM micro-controller must first write the 3 error bits to a shadow MMM LSR status register. Next, the micro-controller writes the data to the RX FIFO and during this write operation, the 3 error bits are directly loaded from the LSR shadow register into the bits 8-10 of the selected (11 bit-wide) FIFO register. These error bits represent the parity error, framing error, and break interrupt signals associated with each data work transmission into the receive FIFO. When the receive FIFO is read, these error bits are loaded directly into bits 2-4 of the MMM LSR register.

A2	A1	A0	Register Name	Register Description	Host Access
0	0	0	RBR	Receive Buffer (RX FIFO)	DLAB = 0 R only
0	0	0	THR	Transmit Holding (TX	DLAB = 0 W only
0	0	1	IER	FIFO)	DLAB = 0 R/W
0	1	0	IIR	Interrupt Enable	DLAB = X R only
0	1	0	FCR	Interrupt Identification	DLAB = X W only
0	1	1	LCR	FIFO Control	DLAB = X R/W
1	0	0	MCR	Line Control	DLAB = 0 R/W
1	0	1	LSR	Modem Control	DLAB = X R only
1	1	0	MSR	Line Status	DLAB = X R only
1	1	1	SCR	Modem Status Scratch pad	DLAB = 0 R/W
0	0	0	DLL	LSB of Divisor Latch	DLAB = 1 R/W
0	0	1	DLM	MSB of Divisor Latch	DLAB = 1 R/W
1	1	1	DLX	Divisor Latch	DLAB = 1 R/W
1	0	0	MCX	Status/Control	DLAB = 1 R/W

Note 1* The General Register set is accessible only when DS is a logic 0.

Note 2* The Baud Rate register set is accessible only when DS is a logic 0 and LCR bit-7 is a logic 1.

Time Out Interrupts

The interrupts are enabled by IER bits 0-3. Care must be taken when handling these interrupts. Following a reset the transmitter interrupt is enabled, the SocketModem will issue an interrupt to indicate that transmit holding register is empty. This interrupt must be serviced prior to continuing operations.

The LSR register provides the current singular highest priority interrupt only. A condition can exist where a higher priority interrupt may mask the lower priority interrupt(s). Only after servicing the higher pending interrupt will the lower priority interrupt(s) be reflected in the status register. Servicing the interrupt without investigating further interrupt conditions can result in data errors. When two interrupt conditions have the same priority, it is important to service these interrupts correctly.

Receive Data Ready and Receive Time Out have the same interrupt priority (when enabled by IER bit-3). The receiver issues an interrupt after the number of characters received have reached the programmed trigger level. In this case the MMM FIFO may hold more characters than the programmed trigger level. Following the removal of a data byte, the user should recheck LSR bit-0 for additional characters. A Receive Time Out will not occur if the receive FIFO is empty. The time out counter is reset at the center of each stop bit received or each time the receive holding register (RHR) is read.

Register Functional Definitions

The following table delineates the assigned bit functions for the twelve internal registers. The assigned bit functions are more fully defined in the following paragraphs.

Internal Registers

A2 A1 A0	Register [Default] *3	BIT-7	BIT-6	BIT-5	BIT-4	BIT-3	BIT-2	BIT-1	BIT-0
General Register Set: Note 1*									
0 0 0	RBR [XX]	Bit-7	Bit-6	Bit-5	Bit-4	Bit-3	Bit-2	Bit-1	Bit-0
0 0 0	THR [XX]	Bit-7	Bit-6	Bit-5	Bit-4	Bit-3	Bit-2	Bit-1	Bit-0
0 0 1	IER [00]	0	0	0	0	Modem Status Interrupt	Receive Line Status interrupt	Transmit Holding Register interrupt	Receive Holding Register interrupt
0 1 0	IIR [XX]	FIFO enable	FIFO enable	0	0	Interrupt ID	Interrupt ID	Interrupt ID	Interrupt Pending
0 1 0	FCR [00]	RX Trigger (MSB)	RX trigger (LSB)	Detect change in FCR	TX FIFO overrun bit	DMA mode select	XMIT FIFO reset	RCVR FIFO reset	FIFO enable
0 1 1	LCR [00]	Divisor latch access (DLAB)	Set break	Stick parity	Even parity	Parity enable	0	Word length bit-1	Word length bit-0
1 0 0	MCR [00]	0	0	0	Loop back	INT enable	OUT 1	-RTS	-DTR
1 0 1	LSR [60]	RX FIFO data error	TX empty THR empty	THR Empty	Break interrupt	Framing error	Parity error	Overrun error	Receive data ready
1 1 0	MSR [X0]	CD	RI	DSR	CTS	Delta -CD	Delta -RI	Delta -DSR	Delta -CTS
1 1 1	SCR [FF]	Bit-7	Bit-6	Bit-5	Bit-4	Bit-3	Bit-2	Bit-1	Bit-0
Special Register Set: Note *2									
0 0 0	DLL [00]	Bit-7	Bit-6	Bit-5	Bit-4	Bit-3	Bit-2	Bit-1	Bit-0
0 0 1	DLM [00]	Bit-7	Bit-6	Bit-5	Bit-4	Bit-3	Bit-2	Bit-1	Bit-0

Note: 1* The General Register set is accessible only when DS is a logic 0.
    2* The Baud Rate register set is accessible only when DS is a logic 0 and LCR bit-7 is a logic 1.
    3* The value between the square brackets represents the register's initialized HEX value, X = N/A.

RBR – Receive Buffer (RX FIFO)

All eight bits are used for receive channel data (host read/data in; host write/data out). The three error bits per byte are copied into bits 2, 3, and 4 of the LSR during each host I/O read; therefore, they are available for monitoring on a per-byte basis.

THR – Transmit Holding Register (TX FIFO)

All eight bits are used for transmit channel data (host write/data out; host read/data in).

IER – Interrupt Enable

Bits 4–7: Reserved and will always read 0.

Bits 0-3: Set by host software only and cleared by software control or host reset.

Bit 3: Enables modem status IRQ. If bits 0–3 of the MSR are set and this bit is set to 1 (enabled), a host interrupt is generated.

Bit 2: Enables receive line status IRQ. If bits 1–4 (overrun, parity, framing, break errors) of the LSR are set and this bit is set to a logic 1, a host interrupt is generated.

Bit 1: Enables transmit holding register IRQ. If bit 5 (transmit holding register empty) of the LSR is set and this bit is set to a 1, a host interrupt is generated.

Bit 0: Enables received data available IRQ. If bit 0 (data ready) of the LSR is set and this bit is set to a 1, a host interrupt is generated.

IIR – Interrupt Identification (Read Only)

Bits 6–7: (FIFO enabled bits). These bits will read a 1 if FIFO mode is enabled and the 16450 enable bit is 0 (no force of 16450 mode).

Bits 4–5: Reserved and always read a 0.

Bits 1–3: Interrupt ID bits.

Bit 0: Interrupt pending. If logic 0 (in default mode), an interrupt is pending.

When the host accesses IIR, the contents of the register are frozen. Any new interrupts will be recorded, but not acknowledged during the IIR access. This requires buffering bits (0–3, 6–7) during IIR reads.

Interrupt Sources and Reset Control Table

Bit 3	Bit 2	Bit 1	Priority	Interrupt Source	Interrupt Reset Control
0	1	1	Highest	Overrun, parity, framing, error or break detect bits set by SocketModem Controller	Reading the LSR
0	1	0	2nd	Received data trigger level	RX FIFO drops below trigger level
1	1	0	2nd	Receiver time-out with data in RX FIFO	Read RX FIFO
0	0	1	3rd	TX holding register empty	Writing to TX holding register or reading IIR when TX holding register is source of error
0	0	0	4th	MODEM status: CTS, DSR, RI or DCD	Reading the MSR

FCR – FIFO Control

Bits 6–7:	Used to determine RX FIFO trigger levels.
Bit 5:	Used to detect a change in the FCR.
Bit 4:	TX FIFO overrun bit.
Bit 3:	DMA mode select. If bit 3 is a 0, the 16450 mode is enabled which does only single-byte transfers. When bit 3 is a 1, it enables a multiple byte (FIFO mode) data transfer.
Bit 2:	TX FIFO reset. This will cause TX FIFO pointer logic to be reset (any data in TX FIFO will be lost). This bit is self clearing; however, a shadow bit exists that is cleared only when read by the host, thus allowing the host to monitor a FIFO reset.
Bit 1:	RX FIFO reset. This will cause RX FIFO pointer logic to be reset (any data in RX FIFO will be lost). This bit is self clearing; however, a shadow bit exists that is cleared only when read by the host, thus allowing the host to monitor a FIFO reset.
Bit 0:	FIFO enable. The host writes this bit to logic 1 to put the block in FIFO mode. This bit must be a 1 when writing other bits in this register or they will not be programmed. When this bit changes state, any data in the FIFOs or the RBR and THR registers will be lost and any pending interrupts are cleared.

Bit 7	Bit 6	16 Deep FIFO Trigger Levels (# of bytes) Default
0	0	1
0	1	4
1	0	8
1	1	14

LCR – Line Control

Bit 7:	Divisor latch access bit. This bit allows the host, access to the divisor latch. Under normal circumstances, the bit is set to 0 (provides access to the RX and TX FIFOs at address 0). If the bit is set to 1, access to transmitter, receiver, interrupt enable, and modem control registers is disabled. In this case, when an access is made to address 0, the divisor latch least (DLL) significant byte is accessed. Address 1 accesses the most significant byte (DLM). Address 7 accesses the DLX divisor latch register. Address 4 accesses the MCX status/control register.
Bit 6:	Used to denote a host-generated set break condition.
Bits 0,1,3,4,5:	Used only in parity bit generation for the 7 bit data byte case. Bits 0 and 1 are used for word length select (b0 = 0 and b1 = 1 is used for 7 bit data). Bit 3 is parity enable. Bit 4 is even parity select. Bit 5 is stick parity.

MCR – Modem Control

Bits 5–7:	Reserved, and will always be 0.
Bit 4:	Used for loopback. When a 1, bits 0–3 of the MCR are reflected in modem status register (MSR) as follows: RI <= OUT1, DCD <= OUT2, DSR <= DTR, CTS <= RTS. Emulation of loopback feature of 16550 UART must be done by the host except for the above conditions. Also, when this bit is set, it allows for data loop back. This means the host can write a data word to the TX and immediately read back the same data word from the RX (in a manner similar to the 16550A).
Bit 3:	Controls the signal used to 3-state the host interrupt. If 0, then an active-low L33xV output will be set to 0, and this signal will be used to 3-state the host interrupt output pin.
Bits 0–2:	Used during LOOP function.
Bit 2:	OUT1.
Bit 1:	Request to Send (RTS).
Bit 0:	Data terminal ready (DTR).

LSR – Line Status

Bit 7: Error in RX FIFO. This bit is always set to 1 if at least one data byte in the RX FIFO has an error. This will clear when there are no more errors in the RX FIFO.

Bit 6: Transmitter empty. This bit is the same as LSR bit 5 (THRE) in MMM

Bit 5: Transmitter holding register empty. This bit is set to 1 when either the transmitter holding register has been read (emptied) by the micro-controller (16450 mode) or the TX FIFO is empty (16550 mode). This bit is set to 0 when either the THR or the TX FIFO becomes not empty in 16450 mode. In 16550 mode, it is set to 0 only after the trigger level has been met since the last occurrence of TX FIFO empty. If the transmitter timer is enabled, a shadow bit exists which delays the timer setting this bit to 1. When reading this bit, the micro-controller will not see the delay. Both shadow and register bits are cleared when the host writes to the THR or TX FIFO in 16450 mode. The trigger level must be reached to clear the bit in 16550 (FIFO) mode.

Bits 2–4: Used for parity error, framing error, and break detect. These bits are written, indirectly, by the micro-controller as follows: The bits are first written to the shadow bit locations when the micro-controller write accesses the LSR. When the next character is written to the receive buffer (RBR) or the RX FIFO, the data in the shadow bits is then copied to the RBR (16450 mode) or RX FIFO (16550 mode). In FIFO mode, bits become available to the host when the data byte associated with the bits is next to be read. In FIFO mode, with successive reads of the receiver, the status bits will be set if an error occurs on any byte. Once the micro-controller writes to the RBR or RX FIFO, the shadow bits are auto cleared. The register bits are updated with each host read.

Bit 1: Overrun error. This bit is set if the micro-controller makes a second write to RBR before the host reads data in the buffer (16450 mode) or with a full RX FIFO (16550 mode). No data will be transferred to the RX FIFO under these circumstances. This bit is reset when the host reads the LSR.

Bit 0: Data ready bit. This bit is set to 1 when received data is available, either in the RX FIFO (16550 mode) or the RBR (16450 mode). This bit is set immediately upon the micro-controller writing data to the RBR or FIFO if the receive timer is not enabled, but it is delayed by the timer interval if the receive timer is enabled. For micro-controller read access, a shadow bit exists so that the micro-controller does not see the delay that the host sees. Both bits are cleared to logic 0 immediately upon reading all data in either RBR or RX FIFO.

MSR – Modem Status

Bits 4 through 7 of the MSR can also take on the MCR bits 0 through 3 value when in MCR loop mode (i.e. when MCR b4 = 1). The transfer of bits in loop back has a null modem twist (i.e. MCR b0 goes to MSR b5 and MCR b1goes to MSR b4).

Bit 7: Data carrier detect (DCD) bit.

Bit 6: Ring indicator (RI) bit.

Bit 5: Data set ready (DSR) bit.

Bit 4: Clear to send (CTS) bit.

Bit 3: Delta data carrier detect pin. This bit is set to a 1 whenever the data carrier detect bit changes state. It is reset when the host reads the modem status register.

Bit 2: Trailing edge ring indicator bit. This bit is set to 1 on the falling edge of the ring indicator bit. It is reset when the host reads the modem status register.

Bit 1: Delta data set ready bit. This bit is set to 1 whenever the data set ready changes state. It is reset when the host reads the modem status register.

Bit 0: Delta clear to send bit. This bit is a one whenever the clear to send bit changes state. It is reset when the host reads the modem status register.

SCR – Scratch

The host programmer uses this register for temporary data storage.

DLL – Divisor Latch (LSByte)

This register contains low-order byte for the 16-bit clock divider. It is kept to maintain register set compatibility with the 16C550A interface. However, it is not used for clock generation since MMM does not require the generation of a real baud clock.

DLM – Divisor Latch (MSByte)

This register contains high-order byte for the 16-bit clock divider. It is kept to maintain register set compatibility with the 16C550A interface. However, it is not used for clock generation, since MMM does not require the generation of a real baud clock.

Programming the Baud Rate Generator Registers DLM (MSB) and DLL (LSB) provides a user capability for selecting the desired final baud rate. The example in the Table below shows the selectable baud rates available when using a 1.8432 MHz external clock input.

BAUD RATE GENERATOR PROGRAMMING TABLE

Baud Rate	16 x Clock Divisor (Decimal)	DLM Value (HEX)	DLL Value (HEX)
110	1047	04	17
300	384	01	80
600	192	00	C0
1200	96	00	60
2400	48	00	30
4800	24	00	18
9600	12	00	0C
19.2K	6	00	06
38.4K	3	00	03
57.6K	2	00	02
115.2K	1	00	01

Application Notes

Tip and Ring Interface

Main Board Filtering

Recommended Parts

Disclaimer: Multi-Tech Systems makes no warranty claims for vendor product recommendations listed below. Other vendor products may or may not operate satisfactorily. Multi-Tech System's recommended vendor products only indicate that the product has been tested in controlled conditions and were found to perform satisfactorily.

Surface mount ferrites are used on T&R (Tip and Ring) to mitigate emission levels out the RJ-11 cable. 220pF capacitors are also used on T&R to reduce the common mode emissions that may be present in certain systems. The ferrite and capacitors also aid in reducing the effects of transients that may be present on the line.

Recommended Ferrite (SMT)
Manufacturer – Associated Component Technology (ACT) – Part # - YCB-1206
Manufacturer – Murata Erie – Part # - BLM31AJ601SN1

Recommended Ferrite (Thru-Hole)
Manufacturer – Associated Component Technology (ACT) – Part # - WB2-2.OT

Recommended Capacitor
Manufacturer – NOVACAP –   Part # - ES2211NKES502NXT
Manufacturer – Murata Erie –   Part # - GA355DR7GC221KY02L (Surface mount device)
                             Part # - DE0807B221K-KH (Thru-hole device)
Manufacturer – Ever Grace Electronic Industrials -- Part # - YP221K2EA7PS
Note: The capacitors used on T&R must have a Y2 safety rating.

Recommended Connector
Manufacturer – Stewart – Part # - SS-6446-NF-A431

Recommended Poly Switch Thermal Fuse (can be reset)
Manufacturer – RayChem – Part # - TS600-170
Note: The fuse is also needed to meet UL60950 for protection against over-voltage from power line crosses.

Telecom
The RJ-11 connector must meet FCC Part 68 requirements. Refer to FCC Part 68 section 68.500 subpart F for connector specifications. A self-healing fuse is used in series with line to help prevent damage to the DAA circuit. This fuse is needed for FCC Part 68 compliance.

Common Mode Choke
Manufacturer – TDK – Part # - ZJYS51R5-2PT

Recommended Sidactor
Manufacturer – Teccor Electronics – Part # - P#3100SA
Manufacturer – ST Microelectronics -- Part 1 – SMP100LC-270

Recommended Transceiver
Manufacturer – Analog Devices – Part # - ADM207EAR

Chapter 4

SocketModem

MT2456SMI-22

Chapter 4 – SocketModem (MT2456SMI-22)

Introduction

The Multi-Tech SocketModem supports analog data modem operation with V.22bis Fast Connect, V.42bis data compression, and V.80 synchronous access mode. The SocketModem is a space-efficient (1" × 2.5"), embedded modem that is ready-to-integrate into your applications; therefore, dramatically reducing development time and costs for system designers.

The MT2456SMI-22 SocketModem is a standard 64-pin modem used for integrating data communications. It is a single-port 5 V or 3.3 V modem that integrates a modem controller, DSP, and DAA in a 1" x 2.5" form factor and communicates to a host controller via an asynchronous serial interface.

Product Ordering Information

Product	Description	Region	Order this Product ✓
MT2456SMI-22	V.22bis Serial Data Only – 5 V	Global	
MT2456SMI-L22	V.22bis Serial Data Only – 3.3 V	Global	
Telecom Label			
MT2456SMI-LS	MT2456SMI-Global Regulatory Label	Global	
Developer Kit			
MTSMI-DK	SocketModem Serial Developer Kit	Global	

How to Read the Product Codes in the Table Above:

22	5 Volt Build
L22	3.3 Volt Build
LS	Telecom Label
DK	

Developer Kit

A SocketModem Developer Kit is available for the MT2456SMI-22. It includes one developer board with an RS-232 DB-25 connector, wall power adapter, RJ-11 jack, an RS-232 cable, and a Developer Kit CD.

Technical Specifications

The SocketModem meets the following specifications:

Category	Description
Client-to-Server Data Rates	V.22 bis
Client-to-Client Data Rates	2400, 1200, 0-300 bps
Data Format	Serial, asynchronous
Modem Compatibility	V.22bis, V.22; Bell 212A and 103/113; ITU-T V.21 & V.23
Error Correction	ITU-T V.42 (LAP-M or MNP 2–4)
Data Compression	ITU-T V.42bis
Speed Conversion	Serial port data rates adjustable to 300, 1200, 2400, 4800, 9600, 19,200, 38,400, 57,600, and 115,200
Modes of Operation	Full duplex over dial-up lines; data mode, command mode, and online command mode
Flow Control	XON/XOFF (software), RTS/CTS (hardware)
Command Buffer	50 characters
Transmit Level	–12 dBm (varies by country setting)
Frequency Stability	±0.01%
Receiver Sensitivity	–43 dBm under worst-case conditions
Interface	Serial ITU-T V.24 logical interface
Diagnostics	Local analog loop
Weight	0.02 Kg. (0.04 lb.)
Dimensions	1.045" × 2.541" × 0.680" (2.7 x 6.5 x 1.8 cm)
Power Consumption	**3.3 Volt:** Typical: 60 mA (.235 W @ 3.3 V DC); Maximum: 70 mA (.264 W @ 3.6 V DC) **5 Volt:** Typical: 60 mA (.300 W @ 5 V DC); Maximum: 70 mA
Operating Voltage	Typical: 3.3 V DC ± 5%; Absolute Maximum Supply Voltage: 3.6 V DC Typical: 5 V DC ± 5%; Absolute Maximum Supply Voltage: 5.5 V DC
Operational Temperature	0 to +70° C ambient under closed conditions; humidity range 20% to 90% (non-condensing)
Storage Temperature	-10° to +85° C
Manufacturing Information	Trade Name: SocketModem Model Number: MT2456SMI-22 & MT2456SMI-22L Registration No: US: AU7MD04B2456 Ringer Equivalence: 0.4B Modular Jack (USOC): RJ11 or RJ11W (Single Line)

Category	Description
Approvals	**Safety Certifications** UL60950 cUL60950 EN60950 IEC60950 ACA TS001 / AS 3260 CCC **EMC Approvals** FCC Part 15 (Class B) Canadian EMC (Class B) EN 55022 (Class B) EN 55024
Intelligent Features	TIA-602 AT command compatible V.22bis fast connect Supports V.80 Supports Fast POS 9600 Line polarity reversal detection Line current loss detection Line-in-use detection during on-hook operation Extension pickup detection Call waiting detection Caller ID (US configuration only) Autodial, redial Pulse or tone dial Auto answer Call status display

SocketModem Configuration

Serial Configuration

The **MT2456SMI-22** SocketModem with a serial interface use a 16-pin interface to provide an on-board DAA with tip and ring connections, audio circuit for call-progress monitoring and serial interface via logic level signals.

Note: The bolded, shaded pins are active Mt2456SMI-22 pins.
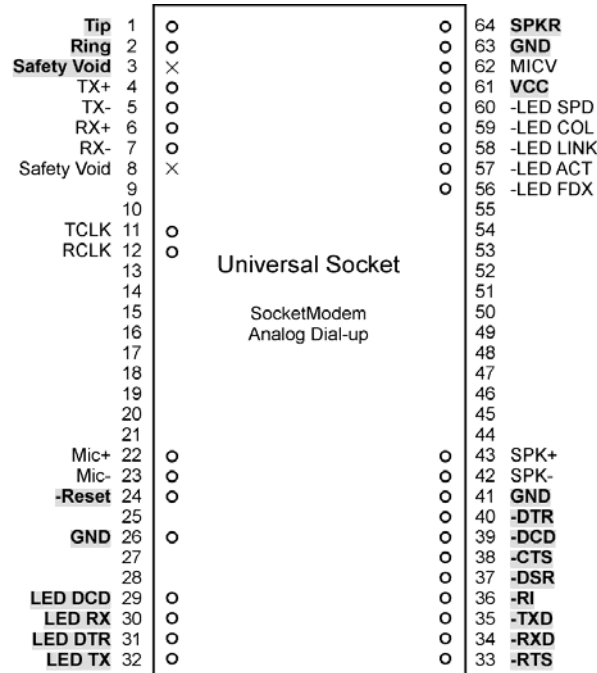
```
          Tip   1   o                    o   64  SPKR
         Ring   2   o                    o   63  GND
   Safety Void  3   x                    o   62  MICV
          TX+   4   o                    o   61  VCC
          TX-   5   o                    o   60  -LED SPD
          RX+   6   o                    o   59  -LED COL
          RX-   7   o                    o   58  -LED LINK
   Safety Void  8   x                    o   57  -LED ACT
                9                        o   56  -LED FDX
               10                            55
         TCLK  11   o     Universal Socket   54
         RCLK  12   o                        53
               13                            52
               14                            51
               15        SocketModem         50
               16        Analog Dial-up      49
               17                            48
               18                            47
               19                            46
               20                            45
               21                            44
         Mic+  22   o                    o   43  SPK+
         Mic-  23   o                    o   42  SPK-
        -Reset 24   o                    o   41  GND
               25                        o   40  -DTR
          GND  26   o                    o   39  -DCD
               27                        o   38  -CTS
               28                        o   37  -DSR
      LED DCD  29   o                    o   36  -RI
       LED RX  30   o                    o   35  -TXD
      LED DTR  31   o                    o   34  -RXD
       LED TX  32   o                    o   33  -RTS
```

Serial SocketModem Pinout

Electrical Characteristics

3.3 V and 5 V Serial SocketModem

3.3 V DC Characteristics (TA = 0°C to 70°C; VDD = 3.3 V ± 0.3 V) VDDMAX = 3.6 V

5 V DC Characteristics (TA = 0°C to 50°C; VDD = 5 V ± 0.25 V) VDDMAX = 5.25 V

Inputs	Input High	Input Low	
–DTR (40), –TXD (35), –RTS (33), –RESET (24)	Min 2.0 V	Max 0.8 V	
Outputs	**Output High**	**Output Low**	
–DCD (39), –CTS (38), –DSR (37), –RI (36), –RXD (34) 2mA, Z_{INT} = 120 Ω	Min 2.4 V	Max 0.4 V	
Digital Input Capacitance			**50pF**

Applications Notes

Tip and Ring Interface

Main Board Filtering

Recommended Parts

Disclaimer: Multi-Tech Systems makes no warranty claims for vendor product recommendations listed below. Other vendor products may or may not operate satisfactorily. Multi-Tech System's recommended vendor products only indicate that the product has been tested in controlled conditions and were found to perform satisfactorily.

Surface mount ferrites are used on T&R (Tip and Ring) to mitigate emission levels out the RJ-11 cable. 220pF capacitors are also used on T&R to reduce the common mode emissions that may be present in certain systems. The ferrite and capacitors also aid in reducing the effects of transients that may be present on the line.

Recommended Ferrite (SMT)
Manufacturer – Associated Component Technology (ACT) – Part # - YCB-1206
Manufacturer – Murata Erie – Part # - BLM31AJ601SN1

Recommended Ferrite (Thru-Hole)
Manufacturer – Associated Component Technology (ACT) – Part # - WB2-2.OT

Recommended Capacitor
Manufacturer – NOVACAP –   Part # - ES2211NKES502NXT
Manufacturer – Murata Erie –   Part # - GA355DR7GC221KY02L (Surface mount device)
                                  Part # - DE0807B221K-KH (Thru-hole device)
Manufacturer – Ever Grace Electronic Industrials -- Part # - YP221K2EA7PS
Note: The capacitors used on T&R must have a Y2 safety rating.

Recommended Connector
Manufacturer – Stewart – Part # - SS-6446-NF-A431

Recommended Poly Switch Thermal Fuse (can be reset)
Manufacturer – RayChem – Part # - TS600-170
Note: The fuse is also needed to meet UL60950 for protection against over-voltage from power line crosses.

Telecom
The RJ-11 connector must meet FCC Part 68 requirements. Refer to FCC Part 68 section 68.500 subpart F for connector specifications. A self-healing fuse is used in series with line to help prevent damage to the DAA circuit. This fuse is needed for FCC Part 68 compliance.

Common Mode Choke
Manufacturer – TDK – Part # - ZJYS51R5-2PT

Recommended Sidactor
Manufacturer – Teccor Electronics – Part # - P#3100SA
Manufacturer – ST Microelectronics -- Part 1 – SMP100LC-270

Recommended Transceiver
Manufacturer – Analog Devices – Part # - ADM207EAR

Chapter 5

SocketModem IP

MT2456SMI-IP

Chapter 5 – SocketModem IP (MT2456SMI-IP)

Introduction

The Multi-Tech SocketModem IP integrates dial-up PSTN modem functionality and a complete TCP/IP protocol stack into a single product design.

The SocketModem IP is a complete ready-to-integrate module that embeds Internet protocols inside your product device allowing it to send and receive data over the Internet without connecting to a PC or gateway server.

The space efficient (1" x 2.5") embedded modem of the SocketModem IP sends and receives data via e-mail, HTTP, or socket interfaces.

The SocketModem IP has successfully completed international compliance testing (homologation) for global approval. This means you can specify one module for each system used across the world. And, since the SocketModem IP is a host independent device, the associated telecom approvals are portable across any solution for which it is integrated.

Product Ordering Information

Product	Description	Region	Order this Product ✓
MT2456SMI-IP-L22	V.22bis/2400 SocketModem and IP – 3.3 V	Global	
MT2456SMI-IP-L32	V.32bis/14.4K SocketModem and IP – 3.3 V	Global	
MT2456SMI-IP-L34	V.34/33.6K SocketModem and IP – 3.3 V	Global	
MT2456SMI-IP-L92	V.92/56K SocketModem and IP – 3.3 V	Global	
Telecom Label			
MT2456SMI-LS	MT2456SMI-Global Regulatory Label	Global	
Developer Kit			
MTSMI-DK	SocketModem Serial Developer Kit	Global	

Developer Kit

The SocketModem IP Developer Kit allows you to plug in the SocketModem IP and use it externally connected to your PC for testing, programming and evaluation.

The kit includes one:

- One SocketModem IP module
- A developer board
- A universal power supply
- An RS-232 cable
- A Developer Kit CD

Technical Specifications

Category	Description
Data Format	Serial, asynchronous
Flash Memory	2 MEG
Client-to-Client Data Rates	33,600, 31,200, 28,800, 26,400, 24,000, 21,600, 19,200, 16,800 bps 14,400, 12,000, 9600, 7200, 4800 bps 2400, 1200, 0-300 bps
Data	V.92; V.34, V.32, V.32bis, V.22
Error Correction	V.42 (LAP-M or MNP 2–4)
Data Compression	V.44, V.42bis
Modes of Operation	Full duplex over dial-up lines; data mode, command mode, online command mode
Command Buffer	50 characters
Diagnostics	Local analog loop
Weight	0.001 kg. (0.04 lb.)
Dimensions	1.045" x 2.541" x 0.680" (2.7 x 6.5 x 1.8 cm)
Power Consumption	**V.22bis**: Typical: .135 mA (.445 W @ 3.3 V DC); Maximum: 195 mA (.702 W @ 3.6V DC) **V.92, V.34, V.32:** Typical: 165 mA (.545W @ 3.3 V DC); Maximum: 225 mA (.780 W @ 3.47 V DC)
Operating Voltage	Typical: 3.3 V DC ± 10%; Absolute Maximum Supply Voltage: 3.6 V DC
Operational Temperature	0° C to +70° C ambient under closed conditions; humidity range 20% to 90% (non-condensing)
Storage Temperature	-10 to +85° C
Manufacturing Information	Trade Name: SocketModem IP Model Number: MT2456SMI-IP Registration No: US:AU7MD0432456 Ringer Equivalence: 0.4B Modular Jack (USOC): RJ11

Approvals	**Safety Certifications**
	    UL60950
	    cUL60950
	    EN60950
	    IEC60950
	    ACA TS001 / AS 3260
	    CCC
	EMC Approvals
	    FCC Part 15 (Class B)
	    Canadian (Class B)
	    EN 55022 (Class B)
	    EN 55024
	    GB4943, GB9254

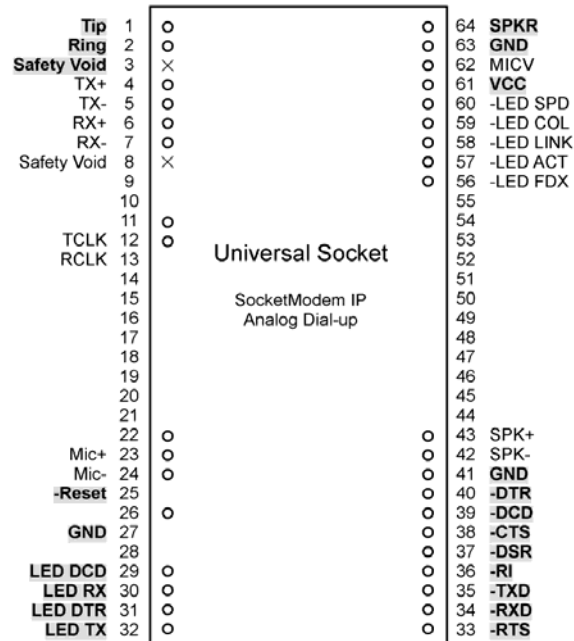| Category	Description
Telephony/TAM	TAM (Telephone Answering Machine) In modem (transparent) mode V.253 commands: V.253 2-bit and 4-bit ADPCM, 8-bit linear PCM, and 4-bit IMA coding 8 kHz sample rate Concurrent DTMF, ring, and Caller ID detection
Intelligent Features	AT command compatible in modem (transparent) mode autodial, redial pulse or tone dial dial pauses auto answer adaptive line probing automatic symbol and carrier frequency during start-up, retrain, and rate renegotiations DTMF detection call status display auto-parity and data rate selections Speaker interface for user-supplied call progress monitoring Caller ID (US configuration only) Serial interface supports DTE speeds to 230K bps Space efficient (1" x 2.5") universal socket connectivity Internet processor runs DNS, Dial in PPP, LCP, HTTP, ICMP,IP, LCP, IPCP, LCP, POP3, PPP, SMTP, SNMP, SNTP, TCP, Telnet and TFTP protocols Binary Base 64 encoding and MIME email formats PAP, CHAP, and script authentication CCP Compression Web Server supports 64K of HTML web pages HTTP version 1.0 and 1.1 support Complete data modem solution, including controller, data pump, & DAA Modem mode bypasses the IP features AT command compatibility in modem (transparent) mode for modem configuration Command Line API for Internet configuration Flash memory to update firmware with the latest enhancements Dial-in PPP using remote dial-up networking

Software Features	**Internet Applications**
	    Telnet Server & Telnet Client
	    Terminal Server
	    TFTP Server
	    Command line configuration/management via serial interface
	    User name and password authentication using local database
	    HTTP Server
	    SMTP Client
	    POP3 Client
	    FTP Client
	    SNTP Client
	Other
	    Flash Upgrade

SocketModem Configuration

Serial Configuration

The SocketModem IP use a 16-pin interface to provide an on-board DAA with tip and ring connections, audio circuit for call-progress monitoring and serial interface via logic level signals.
Note: 5 Volt Tolerant Signal Inputs are –DTR –TXD, –RTS and –RESET.

Drawing Note: The bolded, shaded pins are the SocketModem IP pins.

Tip	1	○	○	64	**SPKR**
Ring	2	○	○	63	**GND**
Safety Void	3	×	○	62	MICV
TX+	4	○	○	61	**VCC**
TX-	5	○	○	60	-LED SPD
RX+	6	○	○	59	-LED COL
RX-	7	○	○	58	-LED LINK
Safety Void	8	×	○	57	-LED ACT
	9		○	56	-LED FDX
	10			55	
	11	○		54	
TCLK	12	○		53	
RCLK	13			52	
	14			51	
	15			50	
	16			49	
	17			48	
	18			47	
	19			46	
	20			45	
	21			44	
	22	○	○	43	SPK+
Mic+	23	○	○	42	SPK-
Mic-	24	○	○	41	**GND**
-Reset	25		○	40	**-DTR**
	26	○	○	39	**-DCD**
GND	27		○	38	**-CTS**
	28		○	37	**-DSR**
LED DCD	29	○	○	36	**-RI**
LED RX	30	○	○	35	**-TXD**
LED DTR	31	○	○	34	**-RXD**
LED TX	32	○	○	33	**-RTS**

Universal Socket

SocketModem IP
Analog Dial-up

SocketModem IP Pinout

Electrical Characteristics

3.3 V Serial

3.3 V DC Characteristics (TA = -40 °C to 85 °C; VDD = 3.3 V ± 0.3 V) VDDMAX = 3.6 V

	Input High	Input Low	
Digital Inputs –DTR (40), –TXD (35), –RTS (33) **Note: These digital inputs are 5 volt tolerant**	**Input High** Min 2.52 V	**Input Low** Max 0.8 V	
Digital Inputs –RESET (24) **Note:** These digital inputs are 5 V tolerant	**Input High** Min. 2.52 V	**Input Low** Max. 0.3 V	
Digital Outputs –DCD (39), –CTS (38), –DSR (37), –RI (36), –RXD (34)	**Output High** Min. 2.3 V	**Output Low** Max 0.4 V	**Current Drive** 2 mA
Digital Input Capacitance			**5 pF**

Application Notes

Tip and Ring Interface

Main Board Filtering

Recommended Parts

Disclaimer: Multi-Tech Systems makes no warranty claims for vendor product recommendations listed below. Other vendor products may or may not operate satisfactorily. Multi-Tech System's recommended vendor products only indicate that the product has been tested in controlled conditions and were found to perform satisfactorily.

Surface mount ferrites are used on T&R (Tip and Ring) to mitigate emission levels out the RJ-11 cable. 220pF capacitors are also used on T&R to reduce the common mode emissions that may be present in certain systems. The ferrite and capacitors also aid in reducing the effects of transients that may be present on the line.

Recommended Ferrite (SMT)
Manufacturer – Associated Component Technology (ACT) – Part # - YCB-1206
Manufacturer – Murata Erie – Part # - BLM31AJ601SN1

Recommended Ferrite (Thru-Hole)
Manufacturer – Associated Component Technology (ACT) – Part # - WB2-2.OT

Recommended Capacitor
Manufacturer – NOVACAP –   Part # - ES2211NKES502NXT
Manufacturer – Murata Erie –   Part # - GA355DR7GC221KY02L (Surface mount device)
                            Part # - DE0807B221K-KH (Thru-hole device)
Manufacturer – Ever Grace Electronic Industrials -- Part # - YP221K2EA7PS
Note: The capacitors used on T&R must have a Y2 safety rating.

Recommended Connector
Manufacturer – Stewart – Part # - SS-6446-NF-A431

Recommended Poly Switch Thermal Fuse (can be reset)
Manufacturer – RayChem – Part # - TS600-170
Note: The fuse is also needed to meet UL60950 for protection against over-voltage from power line crosses.

Telecom
The RJ-11 connector must meet FCC Part 68 requirements. Refer to FCC Part 68 section 68.500 subpart F for connector specifications. A self-healing fuse is used in series with line to help prevent damage to the DAA circuit. This fuse is needed for FCC Part 68 compliance.

Common Mode Choke
Manufacturer – TDK – Part # - ZJYS51R5-2PT

Recommended Sidactor
Manufacturer – Teccor Electronics – Part # - P#3100SA
Manufacturer – ST Microelectronics -- Part 1 – SMP100LC-270

Recommended Transceiver
Manufacturer – Analog Devices – Part # - ADM207EAR

Chapter 6

SocketEthernet™ IP

MTXCSEM

Chapter 6 – SocketEthernet IP (MTXCSEM)

Introduction

The Multi-Tech SocketEthernet IP is a complete, ready to integrate serial-to-Ethernet module for connecting legacy devices to an IP network for remote monitoring, control and configuration. The space efficient module (1" x 2.5") provides a high performance Ethernet bridge as well as a complete TCP/IP protocol stack into a single, universal socket design. The SocketEthernet IP can make your existing and next generation device, machine, or system, IP-ready while you focus on developing its core features.

Product Ordering Information

Product	Description	Region	Order this Product ✓
MTXCSEM	Serial to Ethernet + IP - 5 V	Global	
MTXCSEM-L	Serial to Ethernet + IP - 3.3 V	Global	
Developer Kit			
MTSEM-DK	SocketEthernet IP Developer Kit	Global	

Developer Kit

The SocketEthernet IP Developer Kit allows you to plug in the SocketEthernet IP and use it externally connected to your PC for testing, programming and evaluation.

The kit includes one:

- One SocketEthernet IP module
- A developer board
- A universal power supply
- An RS-232 cable
- A Developer Kit CD

Technical Specifications

| Category	Description
Processor	150 MHz, ARM 9
Memory	8 MEG byte
Flash Memory	2 MEG byte
Board Dimensions	1.045" w x 2.541" h x 0.680" d; 0.6 oz. (2.65cm x 6.45cm x 1.7cm; 0.017 kg.)
Weight	0.602 lb. (0.017 kg.)
Protocols Supported	ARP, DHCP client, ICMP, IP, UDP, TCP, Telnet, TFTP, HTTP server, SMTP client, POP3 client, FTP client, SNTP client, SNMPv1 Agent, AG server support for discovery and status, PPP, and PPP compression
LAN Interface	10/100BaseT Ethernet
Ethernet Interface	IEEE 802.3
Serial Interface	Standard DCE Serial
Data Formats	Serial, binary, asynchronous
Data Rates	300; 1200; 2400; 4800; 9600; 19200; 38400; 57600; 115200; 230400 bps
Flow Control	RTS/CTS (hardware)
Management	Serial; Telnet
Security	Username and password authentication using local database
System Software	Flash ROM standard: downloadable from a TCP/IP host (TFTP) or Xmodem via Serial port
LEDs	Speed, Collision, Link, Activity, Duplex

Power Usage	**Power Consumption @ 3.3 V**
	Ethernet @ 10mbps Typical – 230 mA
	                                 Maximum – 270 mA
	Ethernet @ 100mbps Typical – 260 mA
	                                 Maximum – 300 mA
	Power Consumption @ 5 V
	Ethernet @ 10mbps Typical – 240 mA
	                                 Maximum – 280 mA
	Ethernet @ 100mbps Typical – 270 mA
	                                 Maximum – 310 mA

Operating Temperature	0 to +70C; humidity range 20-90% (non-condensing)
Storage Temperature	-40C to +85C
Cleaning	No cleaning/washing due to the manufacturing process used to produce this product
Manufacturing Information	Trade Name: SocketEthernet IP Model Number: MTXCSEM

Category	Description
Approvals	**Safety Certifications** 　UL60950 　EN60950 　IEC60950 　ACA TS001 / AS 3260 **EMC Approvals** 　FCC Part 15 　Canadian EMC 　EN 55022 　EN 55024
Intelligent Features	Serial interface supports DTE speeds to 230K bps High performance 10/100BaseT Ethernet bridge High performance processor runs ARP, DHCP client, ICMP, IP, PPP, TCP, Telnet, TFTP, HTTP server, SMTP client, POP3 client, and PPP compression. LED driver outputs for visual monitoring speed, link, activity, collision and duplex mode Half duplex or full duplex support on the LAN interface 256 frame buffer for Ethernet bridging Stores 10,000 MAC addresses Automatically learns MAC addresses Command line interface Central site setup and control of the remote modules Flash memory to update firmware with the latest enhancements Developer Kit available for testing, programming and evaluation
Software Features	**Internet Applications** DHCP Client Telnet Server & Telnet Client Terminal Server TFTP Server SMTP Client POP3 Client HTTPv1.0 Server SNMPv1 Agent FTP Client SNTP Client RAW UDP/TCP Socket Support via Serial Discovery Support and Remote Port Capture Using WinMCSI Port Redirector Command line configuration/management via Serial or Ethernet Username and password authentication using local database

SocketModem Configuration

Serial Configuration

The SocketEthernet IP uses a 23-pin interface to provide an on-board Ethernet media access controller, an Ethernet physical layer (without the RJ-45 jack), an LED driver for Ethernet monitoring, and a serial interface.

Note: The shaded, bolded pins are SocketEthernet IP active pins.
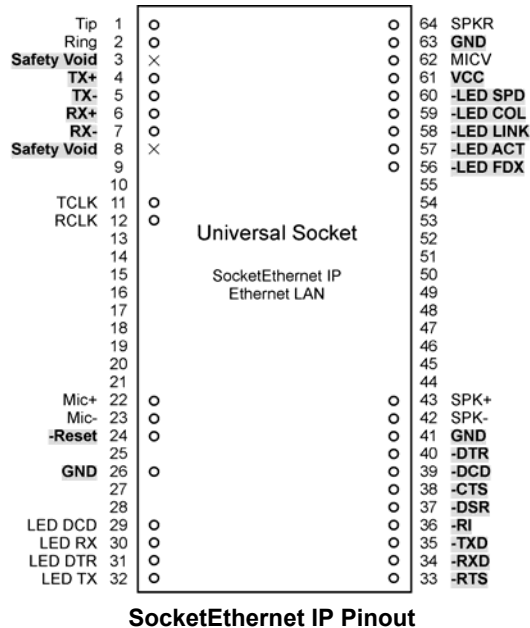
SocketEthernet IP Pinout

Electrical Characteristics

3.3 V Serial

3.3 V DC Characteristics (TA = -40 °C to 85 °C; VDD = 3.3 V ± 0.3 V) VDDMAX = 3.6 V

	Input High	Input Low	
Digital Inputs –DTR (40), –TXD (35), –RTS (33), –RESET (24) **Note: These digital inputs are 5 volt tolerant**	Min 2.52 V	Max 0.8 V	
	Output High	**Output Low**	**Current Drive**
Digital Outputs –DCD (39), –CTS (38), –DSR (37), –RI (36), –RXD (34)	Min. 2.3 V	Max 0.4 V	2 mA
Digital Input Capacitance			**5 pF**

5 V Serial

5 V DC Characteristics (TA = 0 °C to 50 °C; VDD = 5 V ± 0.25 V) VDDMAX = 5.25 V

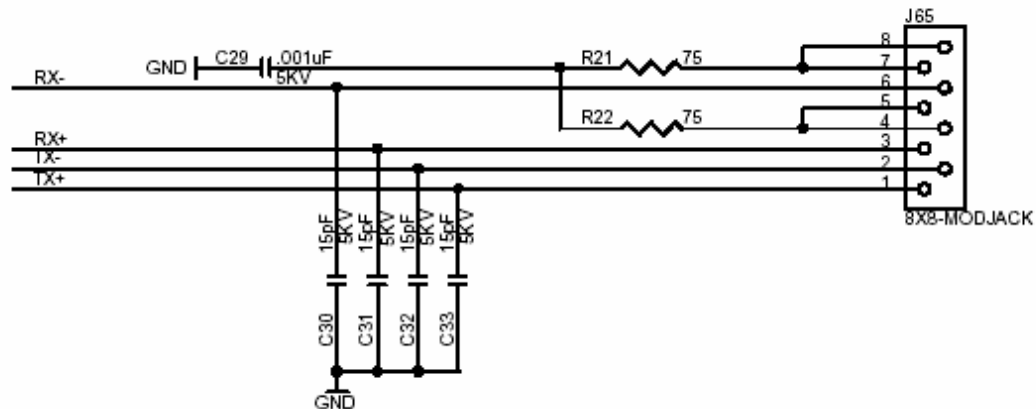|	Input High	Input Low	
Digital Inputs –DTR (40), –TXD (35), –RTS (33), –RESET (24)	Min 2.52 V	Max .0.8 V	
	Output High	**Output Low**	**Current Drive**
Digital Outputs –DCD (39), –CTS (38), –DSR (37), –RI (36), –RXD (34)	Min. 2.3 V	Max 0.4 V	2 mA
Digital Input Capacitance			**5 pF**

Application Notes

Ethernet Interface – Non-Isolated Design

Note: *VREF* stands for *Power* in this drawing.
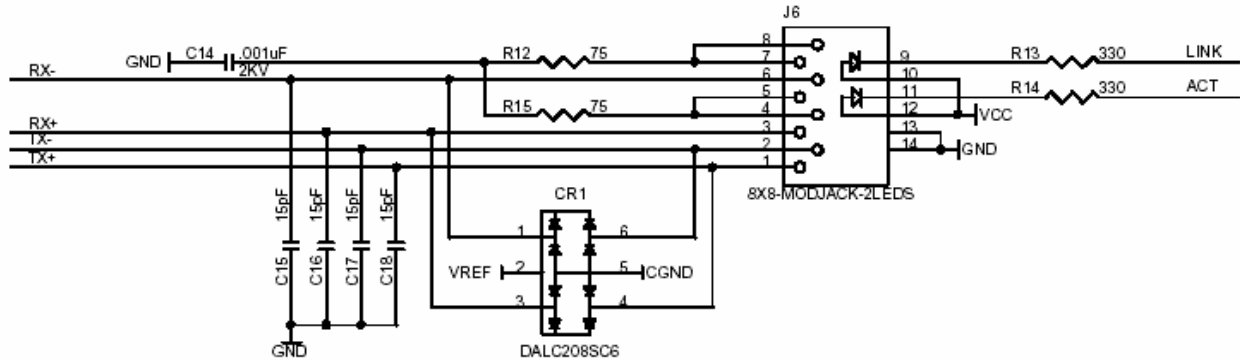
Ethernet Interface – Isolated Design

Isolated Design Application Note

The MTXCSEM – HV was designed to meet Basic Isolation at 240Vac according to the international medical directive for safety (EN60601-1). The recommended components for an isolated design comply with the same standard.

Recommended Parts

Recommended Safety Rated Capacitors: The recommended capacitors are Y2 rated and meet supplementary isolation at 240Vac along with the required creepages and clearances.
> Manufacture – NOVACAP
> Part Number – ES2211N(value)K502NXT

Recommended Resistor: The resistors are 75 ohms 1/8 watt.

Recommended Ethernet Modular Jack: The recommended jack is an eight contact, eight position, unshielded and ungrounded connector that will maintain the need isolation and spacing requirements. A shielded and grounded connector may be used, but special consideration must be made for the isolation and spacing requirements.
> Manufacture – Stewart Connector Systems
> Part Number – SS-6488-NF-K1

Chapter 7

SocketModem ISDN

MT128SMI

Chapter 7 – SocketModem ISDN (MT128SMI)

Introduction

The Multi-Tech SocketModem ISDN creates communication-ready devices by integrating BRI ISDN functionality and S/T interface into a single, universal socket design. The space-efficient (1" x 2.5") embedded modem provides bi-directional communication bandwidth of up to 128K bps. This complete, ready-to-integrate modem dramatically reduces development time and costs for system designers.

Product Ordering Information

Product	Description	Region	Order this Product ✓
MT128SMI	64/128K ISDN BRI S/T Interface – 5 V	Euro/ROW	
MT128SMI-L	64/128K ISDN BRI S/T Interface – 3.3 V	Euro/ROW	
Developer Kit			
MTSMI-IDK	SocketModem ISDN Developer Kit 100-240 V	Global	

Developer Kit

The SocketModem ISDN Developer Kit provides the ability to plug in the ISDN module and use it for testing, programming and evaluation. The kit includes one developer board with RS-232 DB-25 connector, wall power adapter, RJ-45 jack, RS-232 cable, and Developer Guide CD.

Technical Specifications

Category	Description
ISDN Interface	Service: 2B+D Interface (BRI) Interface: Four-wire S/T-type interface Rate: 64K bps/1 B-channel; 128K bps/2-channel; 16K bps/D-channel (for signaling) Sync or async (sync on one B-channel)
ISDN Switch Types	U.S. National ISDN-1, AT&T 5ESS Custom, Northern Telecom DMS-100 Custom, ETSI/DSS1/NET3 (Euro ISDN), Japan NTT INS64, France VN-4
Protocols	PPP, ML-PPP, MP+, V.120, X.75, raw HDLC, CLEAR (synchronous), CHAP MD5, PAP, & Soft Bond
Command Interface	AT command support
Dimensions	1.045" w x 2.541" h x .680" d (2.7 x 6.5 x 1.8cm)
Power Requirements	5 VDC or 3.3 VDC
Power Usage	Typical: 160 mW @ 3.3 V; 510 mW @ 5 V Maximum: 182 mW @ 3.3 V; 543 mW @ 5 V
Operational Temperature	0° to 70°C ambient under closed conditions; humidity 20 to 90% non-condensing
Storage Temperature	-10° to +85° C
Manufacturing Information	Trade Name: SocketModem ISDN Model Number: MT128SMI Registration No: Contact Multi-Tech for details Modular Jack (USOC): Contact Multi-Tech for details Ringer Equivalence: Contact Multi-Tech for details

Approvals	**Certifications:**
	  CE Mark
	EMC Approvals:
	  FCC Part 15 Class A
	  EN55022
	  EN55024
	Safety:
	  UL60950
	  cUL60950
	  EN60950
	  IEC60950
	  ACA TS001 / AS 3260
	Telecom:
	  TBR3

Intelligent Features	Calling line identification reporting (caller ID) Async or sync support Command Line API for Internet configuration AT command compatible in modem mode Complete data modem solution, including the controller and S/T interface in one module Flash memory to update firmware with the latest enhancements

SocketModem ISDN Configuration

Serial Configuration

The MT128SMI SocketModem uses a 23-pin interface.

Note: The bolded, shaded pins are the MT128SMI active pins.

Tip	1	○			○	64	SPKR
Ring	2	○			○	63	**GND**
Safety Void	3	×			○	62	MICV
TX+	4	○			○	61	**VCC**
TX-	5	○			○	60	-LED SPD
RX+	6	○			○	59	-LED COL
RX-	7	○			○	58	-LED LINK
Safety Void	8	×			○	57	-LED ACT
	9				○	56	-LED FDX
	10					55	
TCLK	11	○				54	
RCLK	12	○	Universal Socket			53	
	13					52	
	14					51	
	15		SocketModem ISDN			50	
	16		ISDN Dial-up			49	
	17					48	
	18					47	
	19					46	
	20					45	
	21					44	
Mic+	22	○			○	43	SPK+
Mic-	23	○			○	42	SPK-
-Reset	24	○			○	41	**GND**
	25				○	40	**-DTR**
GND	26	○			○	39	**-DCD**
	27				○	38	**-CTS**
	28				○	37	**-DSR**
LED DCD	29	○			○	36	**-RI**
LED RX	30	○			○	35	**-TXD**
LED DTR	31	○			○	34	**-RXD**
LED TX	32	○			○	33	**-RTS**

SocketModem ISDN Pinout

Electrical Characteristics

3.3 V and 5 V Serial SocketModem ISDN

3.3 V DC Characteristics (TA = 0°C to 70°C; VDD = 3.3 V ± 0.3 V) VDDMAX = 3.6 V

5 V DC Characteristics (TA = 0°C to 50°C; VDD = 5 V ± 0.25 V) VDDMAX = 5.25 V

Inputs	Input High	Input Low	
–DTR (40), –TXD (35), –RTS (33)	Min 2.0 V	Max 0.8 V	
–RESET (24)	Min 2.0 V	Max 0.8 V	
RX+, RX- (S/T Interface Receive)	Min 90 mV Peak Normal Mode	Min 220 mV Peak Sleep Mode	
Input Capacitance			15 pF
Outputs	**Output High**	**Output Low**	**Current Drive**
–DCD (39), –CTS (38), –DSR (37) –RI (36), –RXD (34), TCLK (11), RCLK (12)	Min 4 V/ 2.4 V	Max 0.5 V/0.5 V (5 V/3.3 V)	3.2 mA, 7.0 mA for TXD
TX+, TX- (S/T Interface Transmit)	1.17 V peak @ 6 mA RL= 50 ohms		

Application Notes

Safety Warning Telecom / ISDN-ST

This device is for connection to the ISDN S/T side of an ISDN NT1 device only.

Interface Connector Contact Assignments

Pole (contact) assignments for 8-pole connections (plugs and jacks; i.e., RJ-45)

Pole Number	Function		I.430 Polarity	Optional Polarity
	TE	**NT**		
3	Transmit	Receive	+	+
4	Receive	Transmit	+	–
5	Receive	Transmit	–	+
6	Transmit	Receive	–	–

ISDN Interface
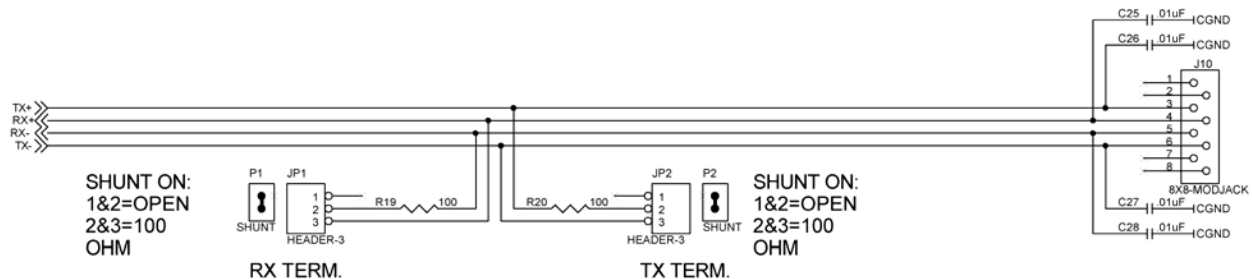
Termination Resistors:
When operating as a TE in point-to-point mode, these are also required. However, when configured as a TE in the passive bus arrangement, only one TE has these termination resistors.
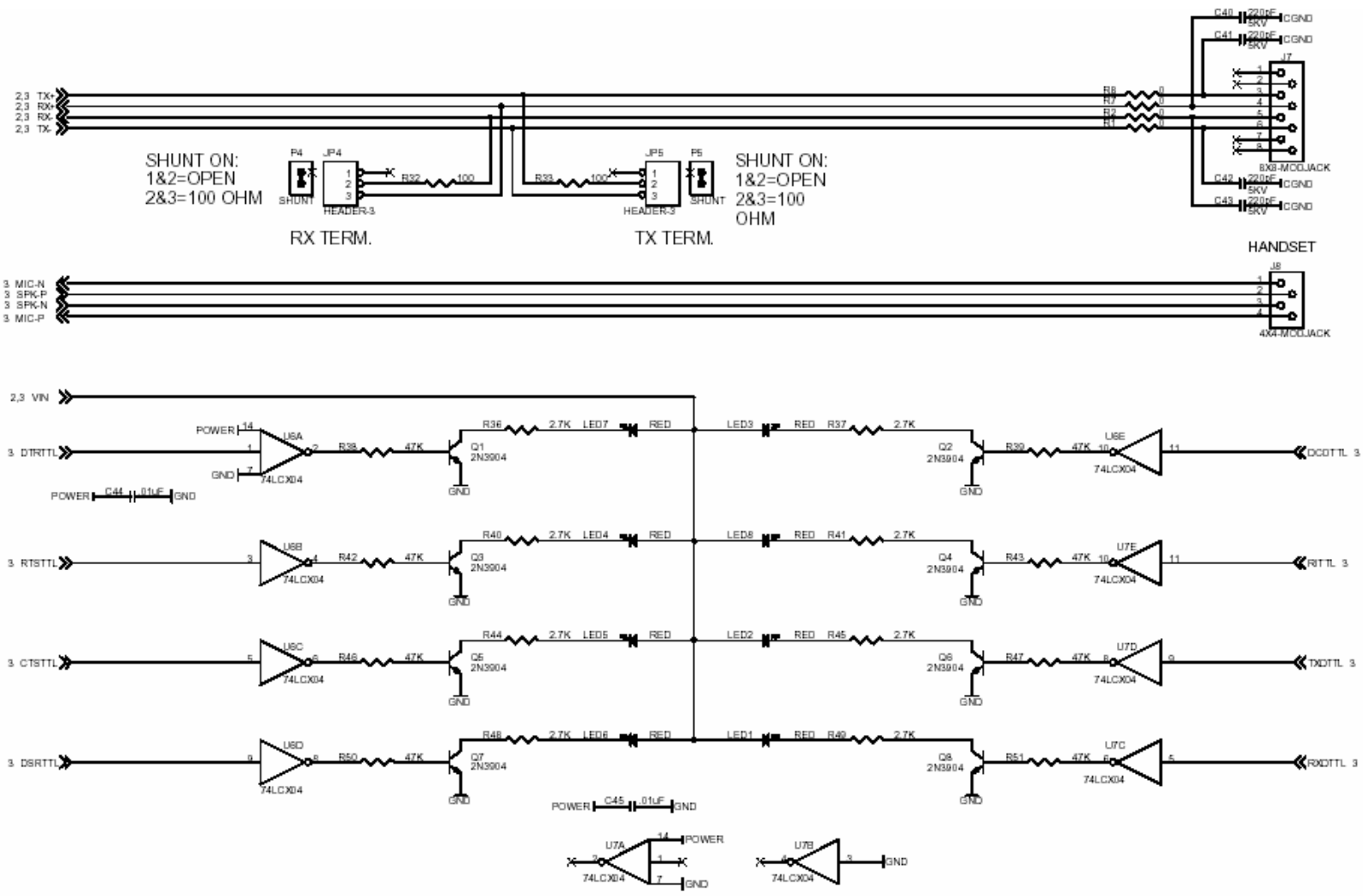
MT128SMI Developer Board
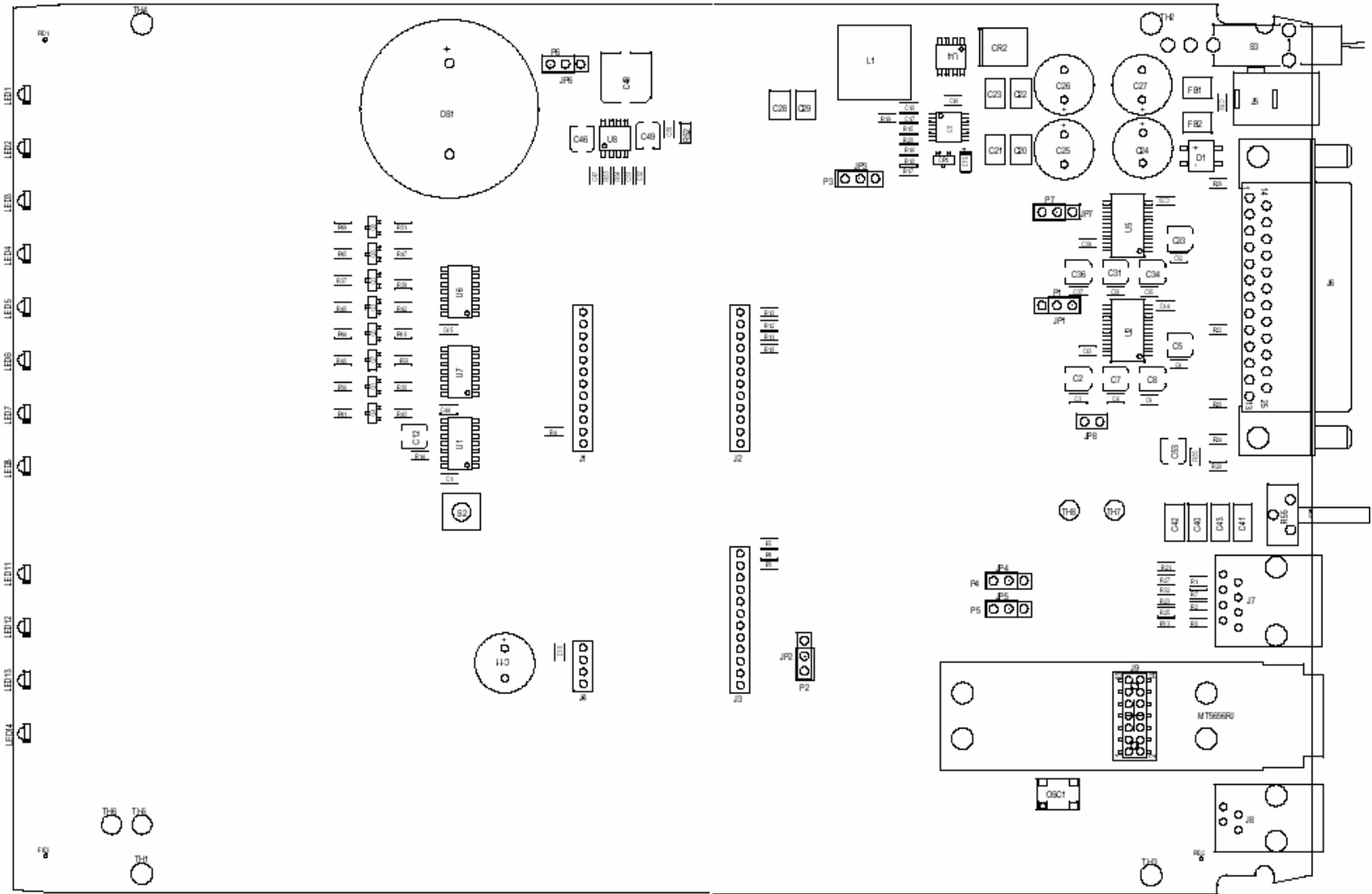
MT128SMI Schematics
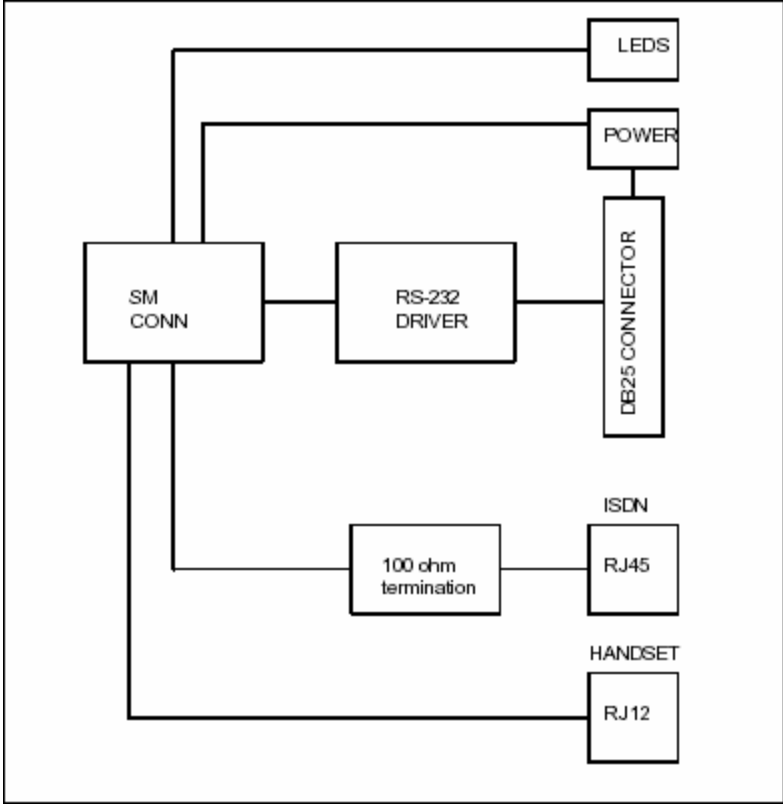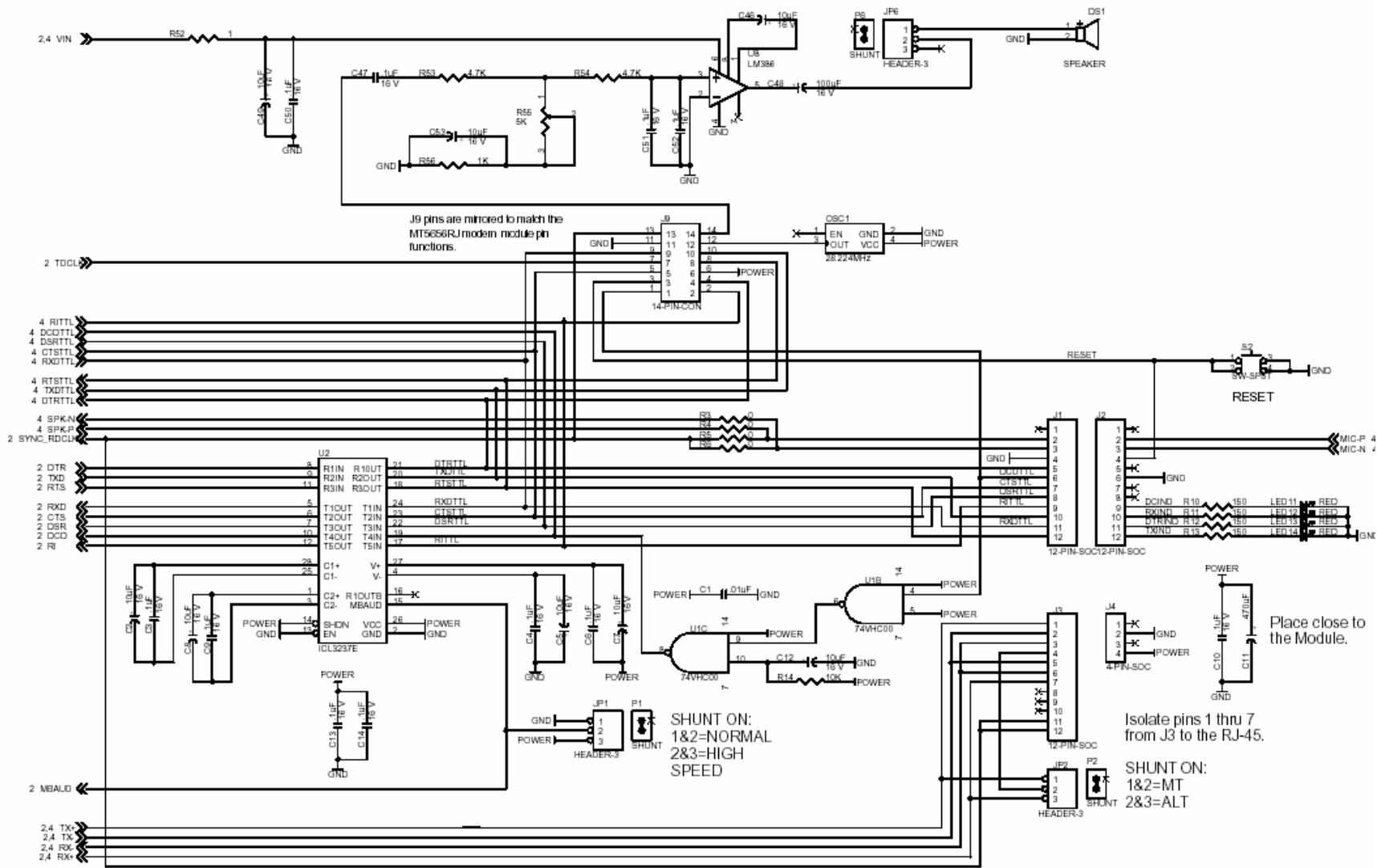
Chapter 8

SocketModem GPRS

MTSMC-G

Chapter 8 – SocketModem GPRS (MTSMC-G)

Product Description

The Multi-Tech SocketModem GPRS is a complete, ready-to-integrate, embedded wireless modem. Designed for global use, it offers standards-based multi-band GSM/GPRS Class 10. The SocketModem GSM/GPRS is based on industry-standard open interfaces and utilizes the same form factor as the SocketModem, SocketModem IP, or SocketEthernet IP modules from Multi-Tech.

Notes about Activation:

- These units are shipped without network activation.
- To connect to the wireless network, you will have to establish a wireless account. Call Multi-Tech Systems, Inc. to set up your account:
  888-288-5470
- See the Wireless Activation procedures in a separate document available on the Developer Kit CD.

Product Ordering Information

Product	Description	Region	Order this Product ✓
MTSMC-G-F1	900/1800 MHz GSM/GPRS SocketModem – 5 V	Europe/Asia/Africa	
MTSMC-G-F2	850/1900 MHz GSM/GPRS SocketModem – 5 V	North/South America	
Antennas and Cables			
45009650	Dual-band antenna for F2-type and CDMA modems (Green Dot) ¼ Wave, Stubby	Global	
45009660	Dual-band antenna for F1-type modems (Orange Dot) ¼ Wave, Stubby	Global	
45009670	Dual-band antenna for the F2-type and CDMA modems ½ Wave, Right Angle	Global	
45009675	Dual-band antenna for the F1-type modems ½ Wave, Right Angle	Global	
45009630	SMA to MMCX COAX RF cable (6 inches)	Global	
Developer Kit			
MTSMC-DK	SocketModem GPRS Developer Kit	Global	

Developer Kit

The SocketModem GPRS Developer Kit allows you to plug in the SocketModem and use it for testing, programming, and evaluation. The kit includes:

- one developer board with RS-232 DB-25 connector
- universal power supply
- antenna
- RS-232 cable
- Developer Kit CD

Technical Specifications

The SocketModem GPRS meets the following specifications:

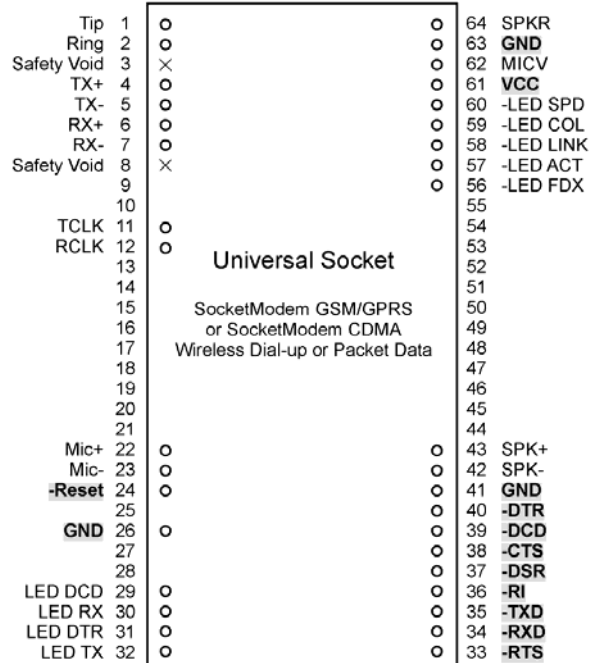| Category	Description
Data Speed	Packet data up to 85K bps Circuit-switched data (GSM/GPRS) up to 14.4K bps transparent and non-transparent
Interface	Serial interface supports DTE speeds to 115.2K
Data Compression	V.42bis data compression
Fax Compatibility	GSM/GPRS Class 1 and Class 2 Group 3 Fax
Dimensions	3.1" w x 1.4" h x 0.5" d (8.0 cm x 3.5 cm x 1.2 cm)
Weight	1 oz (26 g)
Power Requirements	5 VDC; 300 mA Average, 1.3A Peak
Operating Environment	-30° to +70° C
Storage Temperature	-30° to +85° C
Connectors	Antenna: MMCX SIM: Standard 3V SIM receptacle (5V SIM with external level shifter)
IP Protocols Supported	ARP, Dial-in PPP, DNS Resolve, FTP client, ICMP, IP, IPCP, LCP, POP 3 (receive mail), PPP, SMTP (send mail), TCP socket, Telnet client, Telnet server, CHAP, PAP
Cleaning	No cleaning/washing due to the manufacturing process used to produce this product
Manufacturing Information	Trade Name: SocketModem GPRS Model Number: MTSMC-G-F1 & MTSMC-G-F2 Registration No: AU792U03G23710
Approvals	**Safety Certifications** 　UL60950 　cUL60950 　IEC60950 　EN60950 　ACA TS001 / AS 3260 **EMC Approvals** 　CE Mark 　FCC Part 2, 15, 22, 24 　EN 55022 　EN55024 **Network** 　PTCRB
Features	GPRS Class 10 Dual-band 850/1900 or 900/1800 MHz GSM/GPRS Packet data up to 85K bps Embedded TCP/IP stack Circuit-switched data (GSM) up to 14.4K bps transparent and non-transparent GSM Class 1 and Class 2 Group 3 Fax Short Message Services (SMS) Features: 　Text and PDU 　Point-to-Point 　Cell broadcast MMCX antenna connector and SIM socket Serial interface supports DTE speeds to 115.2K bps AT command compatible MNP 2 error correction, V.42bis data compression Universal socket connectivity Management Features: 　Phone book management 　Fixed dialing number 　Real time clock 　Alarm management

Mechanical Dimensions
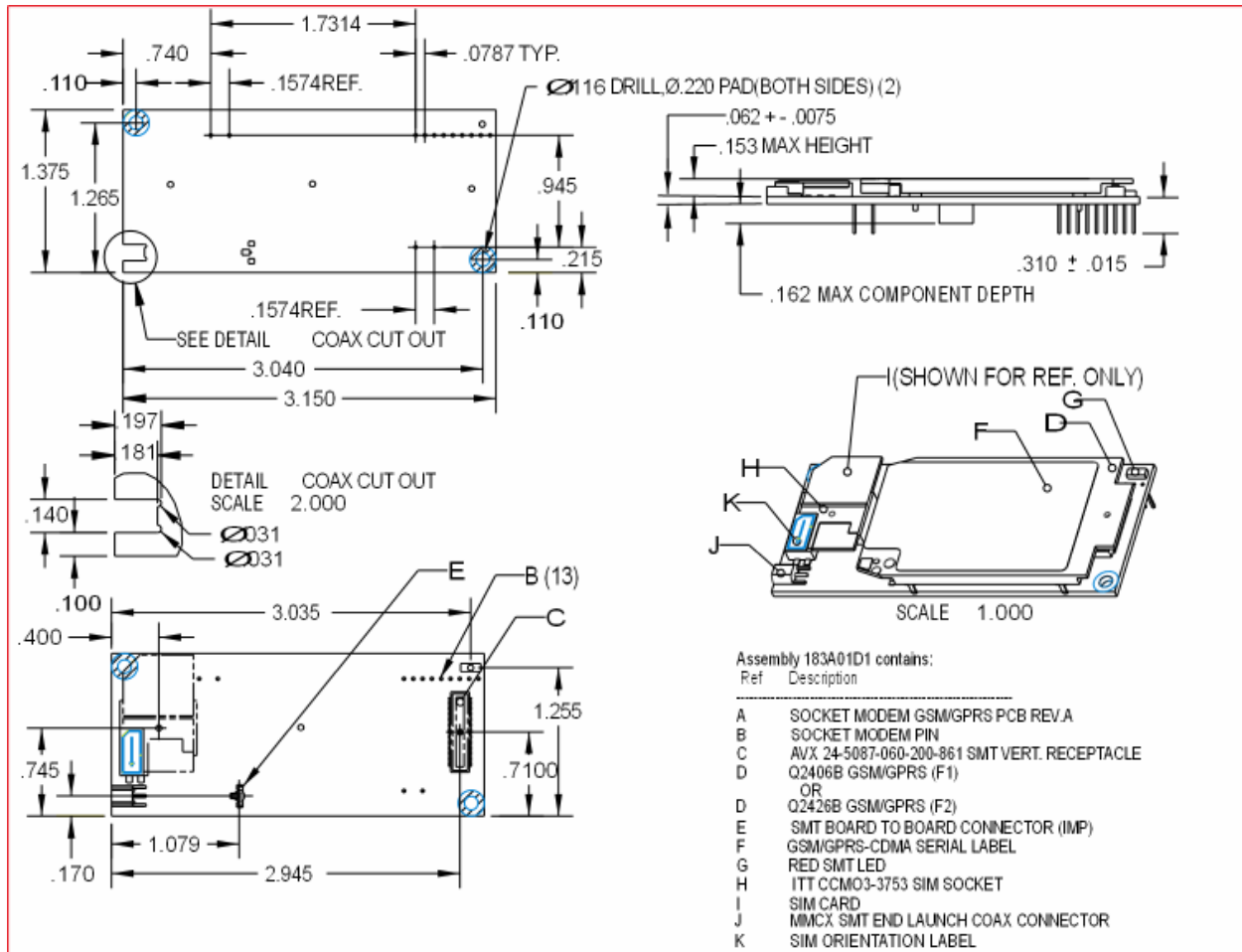
SocketModem GSM/GPRS Mechanical Drawing

SocketModem Configuration

Serial Configuration

The SocketModem GSM/GPRS uses a 13-pin interface.

Note: The bolded, shaded pins are the SocketModem GSM/GPRS active pins.

Tip	1	○	64	SPKR
Ring	2	○	63	**GND**
Safety Void	3	✕	62	MICV
TX+	4	○	61	**VCC**
TX-	5	○	60	-LED SPD
RX+	6	○	59	-LED COL
RX-	7	○	58	-LED LINK
Safety Void	8	✕	57	-LED ACT
	9	○	56	-LED FDX
	10		55	
TCLK	11	○	54	
RCLK	12	○	53	
	13		52	
	14		51	
	15		50	
	16		49	
	17		48	
	18		47	
	19		46	
	20		45	
	21		44	
Mic+	22	○	43	SPK+
Mic-	23	○	42	SPK-
-Reset	24	○	41	**GND**
	25		40	**-DTR**
GND	26	○	39	**-DCD**
	27		38	**-CTS**
	28		37	**-DSR**
LED DCD	29	○	36	**-RI**
LED RX	30	○	35	**-TXD**
LED DTR	31	○	34	**-RXD**
LED TX	32	○	33	**-RTS**

Universal Socket

SocketModem GSM/GPRS
or SocketModem CDMA
Wireless Dial-up or Packet Data

SocketModem Pinout

Electrical Characteristics

5 V DC Characteristics (TA = -20° C to 55° C; VDD = 5 V ± 0.25 V) $_{VDDMAX}$ = 5.25 V

Digital Inputs	Input High	Input Low	
–DTR (40), –TXD (35), –RTS (33), –RESET (24)	Min 3.675 V	Max .7 V	
Digital Outputs	Output High	Output Low	Current Drive: 2 mA
–DCD (39), –CTS (38), –DSR (37), –RI (36), –RXD (34)	Min. 4 V	Max 0.4 V	
Digital Input Capacitance			5 pF

Power Consumption

Power Consumption in EGSM900 and GSM850 @25 degrees C

	Conditions	I$_{NOM}$	I$_{MAX}$
+5V	During TX bursts @2 W	1.2 A	1.3 A
+5V	Average @ 2 W	250 mA	320 mA
+5V	Average @).5 W	180 mA	200 mA
+5V	Average idle mode	15 mA	25 mA

Power Consumption in GSM1800 & 1900 MHz @25 degrees C

	Conditions	I$_{NOM}$	I$_{MAX}$
+5V	During TX bursts @1 W	1.1 A	1.2 A
+5V	Average @1 W	210 mA	235 mA
+5V	Average @ 0.25 W	165 mA	185 mA
+5V	Average idle mode	15 mA	25 mA

Power Consumption in EGSM/GPRS 900 MHz and GSM/GRPS 850 MHz Mode Class 10

	Conditions	I$_{NOM}$	I$_{MAX}$
+5V	During TX bursts @ 2 W	1.2 A	1.3 A
+5V	Average @ 2 W	420 mA	470 mA
+5V	Average @ 0.5 W	280 mA	320 mA
+5V	Average idle mode	15 mA	25 mA

Power Consumption in GSM/GRPS 1800 MHz and GSM/GRPS 1900 MHz Class 10

	Conditions	I$_{NOM}$	I$_{MAX}$
+5V	During TX bursts @ 1 W	1.1 A peak	1.2 A peak
+5V	Average @ 1 W	350 mA	400 mA
+5V	Average @ 0.25 W	180 mA	210 mA
+5V	Average idle mode	15 mA	25 mA

SIM Interface Electrical Characteristics

Parameter	Conditions	Minimum	Typical	Maximum	Unit
SIMDATA V_{IH}	I_{IH} = +/- 20μA	0.7xSIMVCC			V
SIMDATA V_{IL}	I_{IL} = 1 mA			0.3xSIMVCC	V
SIMRST, SIMDATA SIMCLK V_{OH}	Source current = 20μA	SIMVCC – 0.1V			V
SIMRST, SIMDATA SIMCLK V_{OL}	Sink current = -200μA			0.1	
SIMVCC Output Voltage	I_{SIMVCC} <= 6mA	2.70	2.80	2.85	V
SIMCLK Rise/Fall Time	Loaded with 30pF			50	ns
SIMRST, SIMDATA Rise/Fall Time	Loaded with 30pF			1	μs
SIMCLK Frequency	Loaded with 30pF			3.25	MHz

Application Notes

SocketModem GSM/GPRS Interfaces

- Flashing LED
- SIM Interface
- RF Interface

Flashing LED Interface

The flashing LED signal is used to indicate the working mode of the SocketModem.

LED and SocketModem Status

Signal	SocketModem Status	
OFF	Download mode or switched OFF>	
ON	Continuously lit	Switched ON (not registered on the network)
	Flashing	Switched ON (registered on the network)

SIM Interface

The internal SIM interface of the SocketModem supports 3V SIMs only.
Note: This interface is fully compliant with GSM 11.11 recommendations concerning the SIM functionality.
Five Signals Are Available
SIMVCC: SIM power supply.
SIMRST: reset.
SIMCLK: clock.
SIMDATA: I/O port.
SIMPRES1 SIM card detect.

RF Interface

The impedance is 50 Ohms nominal.

RF Connector

The RF connector is MMCX standard type. An antenna can be directly connected through the mating connector or using a small adapter.

RF Performances

RF performances are compliant with the ETSI recommendation 05.05 and 11.10.
The main parameters are:

Receiver Features

- EGSM Sensitivity : < -104 dBm
- GSM 1800/GSM 1900 Sensitivity : < -102 dBm
- Selectivity @ 200 kHz : > +9 dBc
- Selectivity @ 400 kHz : > +41 dBc
- Dynamic range : 62 dB
- Intermodulation : > -43 dBm
- Co-channel rejection : + 9 dBc

Transmitter Features

- Maximum output power (EGSM) : 33 dBm ± 2 dB
- Maximum output power (DCS/PCS) : 30 dBm ± 2 dB
- Minimum output power (EGSM): 5 dBm ± 5 dB
- Minimum output power (DCS/PCS): 0 dBm ± 5 dB
- H2 level : < -30 dBm
- H3 level : < -30 dBm
- Noise in 925 - 935 MHz : < -67 dBm
- Noise in 935 - 960 MHz : < -79 dBm
- Noise in 1805 - 1880 MHz : < -71 dBm
- Phase error at peak power : < 5 ° RMS
- Frequency error : ± 0.1 ppm max

General Guidelines for the Use of the SocketModem

Hardware and RF

- Ground plane: Multi-Tech recommends having a common ground plane for analog, digital, and RF grounds.
- ESD protection on serial link.
- Possible spurious emission radiated by the application to the RF receiver in the receiver band

The Antenna

The antenna sub-system and integration in the application is a major issue: Choice of antenna cable (type, length, performances, thermal resistance, etc.) These elements could affect GSM performances such as sensitivity and emitted power.

The antenna should be isolated as much as possible from the digital circuitry including the interface signals.

Multi-Tech recommends shielding the terminal. On terminals including the antenna, a poor shielding could dramatically affect the sensitivity of the terminal. Subsequently, the power emitted through the antenna could affect the application.

Soldering and Cleaning the SocketModem

The pins of the SocketModem may be hand soldered or wave soldered. If wave soldered, the temperature on the top of the SocketModem must not exceed 100° C.

There should be no solvent or water washing of the SocketModem.

Do not use a hot air gun on the SocketModem.

Initial Configuration Using Mobile PhoneTools

For initial configuration of your wireless device, Multi-Tech offers a Windows-based mobile PhoneTools application.

To load Mobile PhoneTools, click the Mobile PhoneTools icon on the SocketModem CD and follow the on-screen prompts.

Sources for Peripheral Devices

GSM Antenna

The integrated modem antenna connector is a MMCX connector. The MMCX connector incorporates a 'Snap On' latching action in order to make the connection easier with an excellent RF performance. An additional advantage is its small physical size, which is 50% of the standard MCX connector.

This type of connector is suitable for the standard ranges of flexible and semi-rigid cables. The characteristic impedance of the MMCX coaxial connector is 50 ohm. The antenna manufacturer must guarantee that the antenna will be working according to the radio characteristics presented in the table below.

Radio Characteristics

	GSM 850	EGSM 900	GSM 1800	GSM 1900
Frequency RX	869 to 894 MHz	925 to 960 MHz	1805 to 1880 MHz	1930 to 1990 MHz
Frequency TX	824 to 849 MHz	880 to 915 MHz	1710 to 1785 MHz	1850 to 1910 MHz
RF Power Stand	2W at 12.5% duty cycle	2W at 12.5% duty cycle	1W at 12.5% duty cycle	1W at 12.5% duty cycle
Impedance	50 ohms			
VSWR	<2			
Typical Radiated Gain	0 dBi on azimuth plane			

MMCX Plug

The SocketModem requires an MMCX plug to connect to an antenna.

MMCX Connector Example (right angle type)

MMCX / SMA Adapter

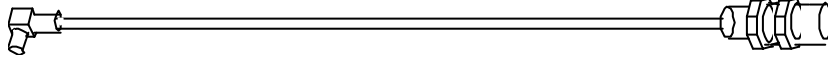A small MMCX / SMA adapter can be ordered, for example, from:
Amphenol
http://www.amphenol.com/
Order No: 908-31100

Antenna Cable

An optional 6" antenna cable can be ordered from Multi-Tech Systems, Inc.

6-Inch Antenna Cable – SMA Jack to MMCX Plug

Chapter 9

SocketModem CDMA

MTSMC-C

Chapter 9 – SocketModem CDMA (MTSMC-C)

The Multi-Tech SocketModem CDMA is a complete, ready-to-integrate, embedded wireless modem. Designed for global use, it offers standards-based multi-band CDMA200 1x performance. The SocketModem CDMA is based on industry-standard open interfaces and utilizes Multi-Tech's universal socket design.

Notes about Activation:
- These units are shipped without network activation.
- To connect to the wireless network, you will have to establish a wireless account. Call Multi-Tech Systems, Inc. to set up your account:
  888-288-5470.
- See the Wireless Activation procedures in a separate document available on the Developer Kit CD.

Product Ordering Information

Product	Description	Region	Order this Product ✓
MTSMC-C-N1	800/1900 CDMA 1xRTT Generic SocketModem – 5 V	Global	
MTSMC-C-N2	800/1900 CDMA 1xRTT Sprint SocketModem – 5 V	Global	
MTSMC-C-N3	800/1900 CDMA 1xRTT Verizon SocketModem – 5 V	Global	
Antennas and Cables			
45009650	Dual-band antenna for CDMA and F2 type modems (Green Dot)	Global	
45009630	SMA to MMCX COAX RF cable (6 inches)	Global	
45009670	Dual-band antenna for the F2-type and CDMA modems ½ Wave, Right Angle	Global	
Developer Kit			
MTSMC-DK	SocketModem Wireless Developer Kit	Global	

Developer Kit

The SocketModem CDMA Developer Kit allows you to plug in the SocketModem and use it for testing, programming, and evaluation. The kit includes:

- one developer board with RS-232 DB-25 connector
- universal power supply
- antenna
- RS-232 cable
- Developer Kit CD

Technical Specifications

The SocketModem CDMA meets the following specifications:

Category	Description
Data Speed	Packet data up to 85K bps Circuit-switched data up to 14.4K bps
Interface	Serial interface supporting DTE speeds to 230K
Fax Compatibility	CDMA Class 2.0 Group 3 Fax
Dimensions	3.1" w x 1.4" h x 0.5" d (8.0 cm x 3.5 cm x 1.2 cm)
Weight	1.2 oz (34 g)
Power Requirements	5 VDC; 400mA Typical, 700mA Maximum
Operating Environment	-30° to +70° C
Storage Temperature	-30° to +85° C
Connectors	Antenna: MMCX R-UIM: Standard 3V R-UIM receptacle For China only, 5V R-UIM with external level shifter
Cleaning	No cleaning/washing due to the manufacturing process used to produce this product
Manufacturing Information	Trade Name: SocketModem CDMA Model Number: MTSMC-C-xx

Approvals	**Safety Certifications**
	    UL60950
	    cUL60950
	    IEC60950
	    EN60950
	    ACA TS001 / AS 3260
	EMC Approvals
	    FCC Part 2, 15, 22, 24,
	    EN 55022
	    EN55024
	Network
	    CDG 1 & 2

Features	CDMA2000 1xRTT
	Qualcomm® MSM6050™ chipset
	CDMA IS-95A, IS-95B backwards compatibility
	Dual-band 800/1900 MHz CDMA
	800 MHz with R-UIM support
	Packet data up to 153K bps forward and reverse
	Circuit-switched data up to 14.4K bps
	Class 2.0 Group 3 Fax
	Short Message Services:
	    Mobile originated
	    Mobile terminated
	    Cell broadcast
	    Over the Air Activation (OTA)
	    OTASP
	    OTAPA
	MMCX antenna connector
	Serial interface supporting DTE speeds to 230K
	AT command compatible
	Universal socket connectivity
	Management Features:
	    Phone book management
	    Fixed dialing number
	    Real time clock
	    Alarm management

Mechanical Dimensions
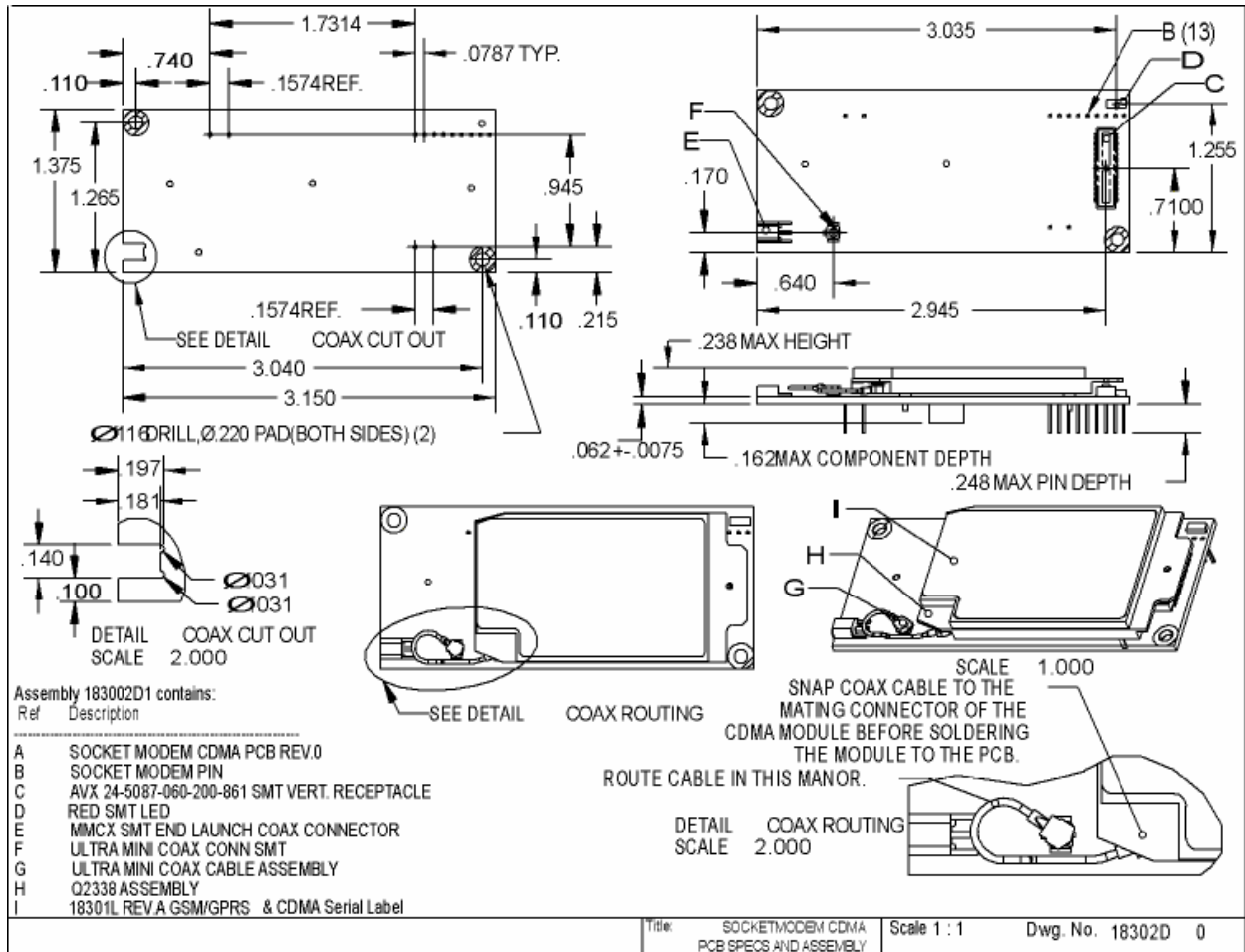
SocketModem CDMA Mechanical Drawing

SocketModem Configuration

Serial Configuration

The SocketModem CDMA uses a 13-pin interface.

Note: The bolded, shaded pins are the SocketModem CDMA active pins.
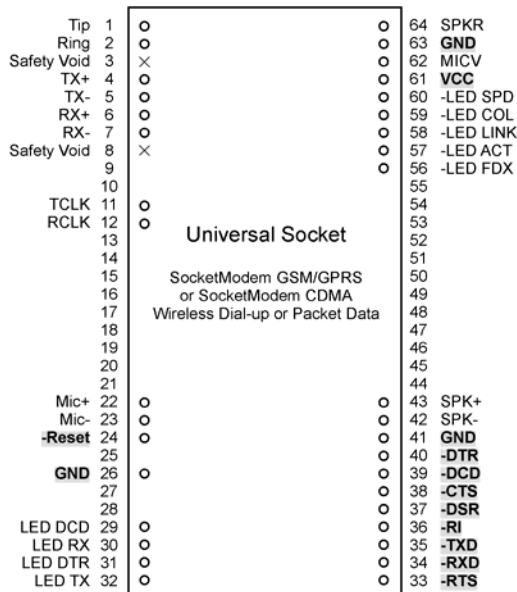
SocketModem CDMA Pinout

Electrical Characteristics

Electrical characteristics for the 5V Serial SocketModem are presented in this chapter.

5 Vdc Characteristics (TA = -20° C to 55° C; VDD = 5 V ± 0.25 V) $_{VDDMAX}$ = 5.25 V

Digital Inputs –DTR (40), –TXD (35), –RTS (33), –RESET (24)	Input High Min 3.675 V	Input Low Max 0.7 V	
Digital Outputs –DCD (39), –CTS (38), –DSR (37), –RI (36), –RXD (34)	Output High Min. 4 V	Output Low Max 0.4 V	Current Drive: 2 mA
Digital Input Capacitance			5 PF

Power Consumption

Operating Mode	Band	Average (mA)
CDMA RXTX	Cellular	615
Full Power	PCS	770
CMA RXTX	Cellular	340
Average Power	PCS	445
CDMA Standby	Cellular	20
	PCS	20

Application Notes

SocketModem Interfaces

Flashing LED Interface
The flashing LED signal is used to indicate the working mode of the SocketModem.

LED and SocketModem Status

Signal	SocketModem Status	
OFF	Download mode or switched OFF>	
ON	Continuously lit	Switched ON (not registered on the network)
	Flashing	Switched ON (registered on the network)

RF Interface
The impedance is 50 Ohms nominal.
> **RF Connector**
> The RF connector is MMCX standard type. An antenna can be directly connected through the mating connector or using a small adapter.

General Guidelines for the Use of the SocketModem

Hardware and RF
- Ground plane: Multi-Tech recommends having a common ground plane for analog, digital, and RF grounds.
- ESD protection on serial link,
- Possible spurious emission radiated by the application to the RF receiver in the receiver band.

The Antenna
The antenna sub-system and integration in the application is a major issue: Choice of antenna cable (type, length, performances, thermal resistance, etc.) These elements could affect CDMA performances such as sensitivity and emitted power.
The antenna should be isolated as much as possible from the digital circuitry including the interface signals.
Multi-Tech recommends shielding the terminal. On terminals including the antenna, a poor shielding could dramatically affect the sensitivity of the terminal. Subsequently, the power emitted through the antenna could affect the application.

Soldering and Cleaning the SocketModem
The pins of the SocketModem may be hand soldered or wave soldered. If wave soldered, the temperature on the top of the SocketModem must not exceed 100° C.
There should be no solvent or water washing of the SocketModem.
Do not use a hot air gun on the SocketModem.

Initial Configuration Using Mobile PhoneTools
For initial configuration of your wireless device, Multi-Tech offers a Windows-based mobile PhoneTools application.
To load Mobile PhoneTools: Click the Mobile PhoneTools icon on the product CD and follow the on-screen prompts.

Sources for Peripheral Devices

CDMA Antenna

The integrated modem antenna connector is a MMCX connector. The MMCX connector incorporates a 'Snap On' latching action in order to make the connection easier with an excellent RF performance. An additional advantage is its small physical size, which is 50% of the standard MCX connector.

This type of connector is suitable for the standard ranges of flexible and semi-rigid cables. The characteristic impedance of the MMCX coaxial connector is 50 ohm. The antenna manufacturer must guarantee that the antenna will be working according to the radio characteristics presented in the table below.

Radio Characteristics

	CDMA 800	CDMA 1900
Frequency RX	869 to 894 MHz	1930 to 1990 MHz
Frequency TX	824 to 849 MHz	1850 to 1910 MHz
Impedance	50 ohms	
VSWR	<2	
Typical Radiated Gain	0 dBi in at least one direction	

MMCX Plug

The SocketModem requires an MMCX plug to connect to an antenna.

MMCX Connector Example (right angle type)

MMCX / SMA Adapter

A small MMCX / SMA adapter can be ordered, for example, from:
Amphenol
http://www.amphenol.com
Order No: 908-31100

Antenna Cable

An optional 6" antenna cable can be ordered from Multi-Tech Systems, Inc.
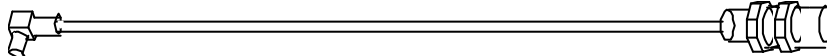
6-Inch Antenna Cable – SMA Jack to MMCX Plug

Chapter 10

SocketWireless Bluetooth

MTS2BTSMI

Chapter 10 – SocketWireless Bluetooth (MTS2BTSMI)

Introduction

The Multi-Tech Systems, Inc. SocketWireless with Bluetooth-enabled technology allows developers to establish wireless networks using a special set of AT commands and a developer board. The SocketWireless with Bluetooth technology makes the cable-replacement transition to wireless networks seamless and easy.

This chapter explains how to establish Bluetooth communication between two serial devices for data applications in a point-to-point network. Bluetooth-enabled devices create communication-ready devices by integrating data functionality into a single, universal socket design. This complete, ready-to-integrate device dramatically reduces development time and costs for system designers.

Notes about Byte Gaps and Data Latency

Because of the way Bluetooth is designed and operates, random byte gaps of 5 ms to 20 ms are common. Packet size will vary from transmission to transmission.

Although the serial bandwidth operates up to 920K, effective data throughput in fast streaming mode is approximately 200Kbp. Effective data throughput in regular data mode is 60Kbps. The reason for the slower speed in regular mode is due to the AT parser, which looks at each character for ASCII valid command scripts in the regular mode's data stream.

The SocketWireless RX has very limited buffering, so if you do not use hardware flow control and are transmitting further distances, you will quickly overflow the 50 byte buffer because of RF retransmissions, etc.

When a Bluetooth connection is made, the SocketWireless device goes into regular data mode per the power-up factory default settings. This enables the user to remotely configure the SocketWireless settings via a remote RF Bluetooth connection. Basically, you can setup the SocketWireless device so no commands are required to be sent from the embedded side of the device. This allows seamless interfacing with legacy systems without the need to modify the host device

Product Ordering Information

Product	Description	Region	Order this Product ✓
MTS2BTSMI	Serial-to-Bluetooth Module, C1 V1.2 – 5V (50 Pack)	Global	
MTS2BTSMI-L	Serial-to-Bluetooth Module, C1 V1.2 – 3.3V (50 Pack)	Global	
Developer Kit			
MTBTSMI-DK	SocketWireless Bluetooth Developer Kit	Global	

Note: Each module is available as a single pack as well as the 50 pack listed above.

Developer Kit

The SocketWireless Bluetooth Developer Kit provides the ability to plug in the module and use it for testing, programming and evaluation. The kit includes one developer board with RS-232 DB-25 connector, wall power adapter, antenna, RS-232 cable, and Developer Guide CD.

Technical Specifications

Category	Description
Serial Interface	Supports speeds from 1200bps to 920Kbps
RF Interface	**Frequency**………………2402 – 2480MHz **Modulation**………………..FHSS/GFSK **Channel Intervals**………1MHz **Number of Channels**….79CH **Transmission Rate**…….721Kbps
Data Format	**For Serial Interface -** Asynchronous, 8-N-1, Default is 9600bps
Flow Control	Hardwaret
RF Receive Sensitivity	-80dBm typical
Output Level (Class 1)	20dBm maximum
RF Range	**Class 1** - 100 meters (330 feet)
Modes of Operation	Inquiry, Idle, Data, Fast Data, Park, Sniff, Command, Master, Slave
Device Profiles	Serial Port (SPP), Dial-up Network (DUN)
Buffer	**Serial** 50 bytes **RF** 50-byte RX buffer
Weight	0.6 oz. (0.017 Kg.)
Dimensions	1.045" x 2.541" x 0.680" (2.65cm x 6.45cm x 1.7cm)

Power	**Idle:** 2mA (0.0066W @ 3.3Vdc) (0.01W @ 5Vdc)
	Connected: 7mA (0.0231W @ 3.3Vdc) (0.035W @ 5Vdc)
	Fast Data: 45mA (0.1485W @ 3.3Vdc) (0.225W @ 5Vdc)
	Inquiry: 70mA (0.231W @ 3.3Vdc) (0.35W @ 5Vdc)
	Notes: These power measurements were taken with no LEDs connected.
	                      Driving an LED through 330 ohm resistor to GND draws an additional
	                      4mA on 5V for each LED.

Operational Temperature	-40 to +70° C
Storage Temperature	-40 to +85° C
Voltage	3.3Vdc or 5Vdc

Default Power Up Settings	AT Command Response Form = Long Form
	Bluetooth Service Profile = Serial Port Profile {SPP}
	Device Role = Slave
	Baud Rate = 9600bps
	Data Bits = 8 bits
	Parity = None
	Stop bits = 1 bit
	Hardware Flow Control RTS/CTS = Enabled
	Power Mode = Never go into deep sleep mode
	Country Code = North America and Europe
	Name of Device (local name) = SocketWireless
	My Radio Status = 1,0 {slave, disconnected}
	Service Name = COM0
	Power up default ATSW24 settings = 0,0,0,0 {long response, no authentication, no
	        auto SCO connect, no minor}
	Power up default ATSW25 settings = 0,1,0,0 {slave, data, allow data to pass, SPP}
	Major & Minor Class Of Device (COD) = 00000000 {undefined}
	Security PIN and Encryption Disabled
	    Default PIN = "default" *caps sensitive*
	Page Scan Interval = 0x400 {2560msec.}
	Page Scan Window = 0x200 {11msec.}
	Inquiry Scan Interval = 0x400 {2560msec.}
	Inquiry Scan Window = 0x200 {11msec.}
	Timeout Connection Parameters
	    Inquiry = 60 seconds
	    Slave Connect = 60 seconds
	    Master Connect = 60 seconds
	    ATDM idle mode = 60 seconds
	    ATDM Master Mode = indefinitely (need to perform **ATUCL** to cancel last
	        command)
	Timeout for loss of Bluetooth connection = 4 seconds

Category	Description
Intelligent Features	Can be configured, commanded, and controlled through simple ASCII strings over the Bluetooth RF link or directly through the hardware serial UART. Low power consumption. Secure and robust communication link. • FHSS (Frequent Hopping Spread Spectrum) • 56-bit encryption, and 10 alphanumeric Personal Identification Number (PIN) • Error correction schemes for guaranteed packet delivery
Approvals	**EMC Approvals:** FCC Part 15 Class B Canada (Class B) FCC Part 15, Subpart C EN 300 328 EN 301 489-17 EN55022 EN55024 EN 301 489-1 **Safety:** UL60950 cUL60950 EN60950 **Bluetooth:** Call Multi-Tech for details

Mechanical Dimensions
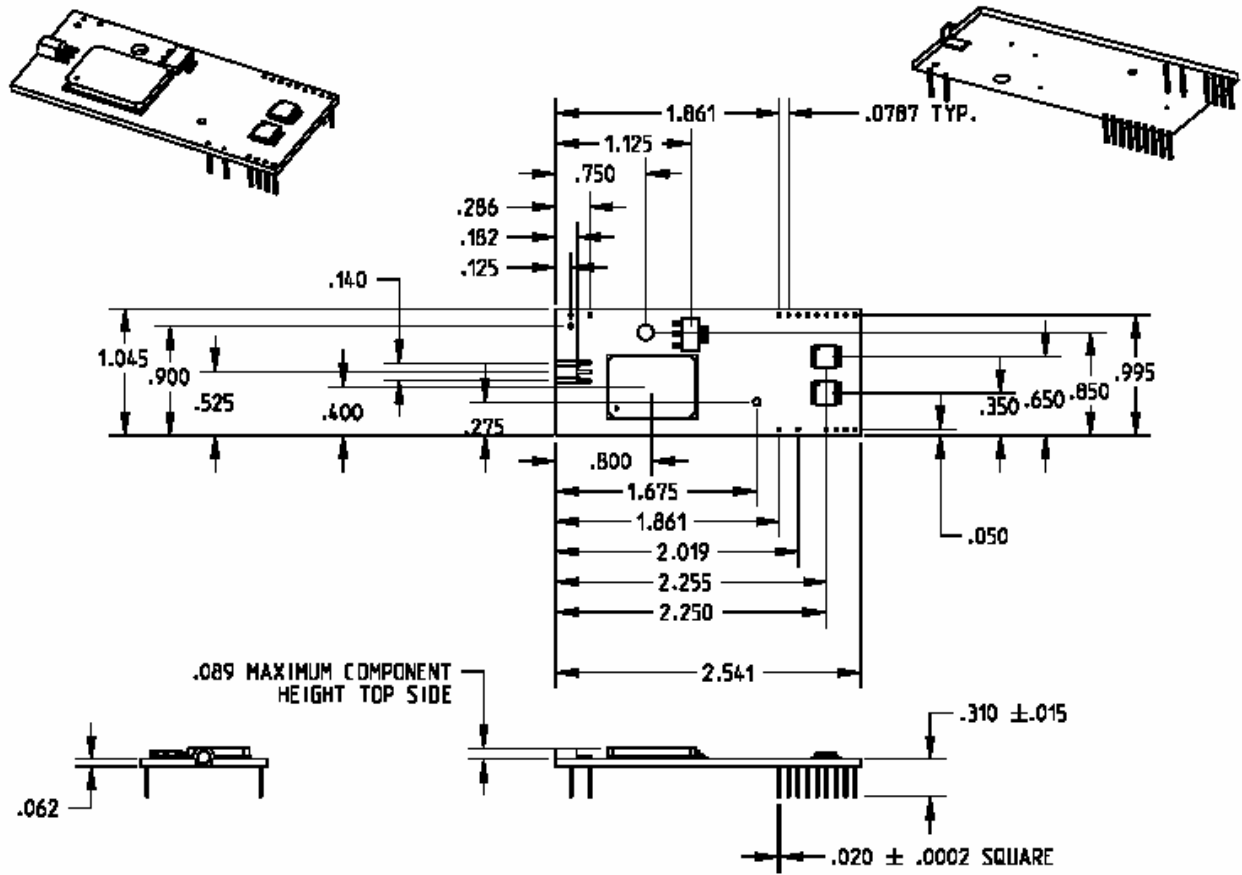
SocketWireless Bluetooth Mechanical Drawing

SocketWireless Bluetooth Configuration

Serial Configuration

The MT2BTSMI SocketWireless uses a 17-pin interface.

Note: The bolded, shaded pins are the active SocketWireless pins.

```
Tip         1   o                      o   64  SPKR
Ring        2   o                      o   63  GND
Safety Void 3   ×                      o   62  MICV
TX+         4   o                      o   61  VCC
TX-         5   o                      o   60  -LED SPD
RX+         6   o                      o   59  -LED COL
RX-         7   o                      o   58  -LED LINK
Safety Void 8   ×                      o   57  -LED ACT
            9                          o   56  -LED FDX
           10                              55
TCLK       11   o                          54
RCLK       12   o     Universal Socket     53
           13                              52
           14                              51
           15        SocketWireless        50
           16           Bluetooth          49
           17                              48
           18                              47
           19                              46
           20                              45
           21                              44
Mic+       22   o                      o   43  SPK+
Mic-       23   o                      o   42  SPK-
-Reset     24   o                      o   41  GND
           25                          o   40  -DTR
GND        26   o                      o   39  -DCD
           27                          o   38  -CTS
           28                          o   37  -DSR
LED DCD    29   o                      o   36  -RI
LED RX     30   o                      o   35  -TXD
LED DTR    31   o                      o   34  -RXD
LED TX     32   o                      o   33  -RTS
```

SocketWireless Bluetooth Pinout

Electrical Characteristics

3.3 V and 5 V Serial SocketWireless

Inputs	Input High	Input Low	
–DTR (40), –TXD (35), –RTS (33)	Min 2.0 V	Max 0.8 V	
–RESET (24)	Min 2.0 V	Max 0.8 V	
Input Capacitance			15 pF
Outputs	**Output High**	**Output Low**	**Current Drive**
–DCD (39), –CTS (38), –DSR (37) –RI (36), –RXD (34)	Min 4 V/ 2.4 V	Max 0.5 V/0.5 V (5 V/3.3 V)	3.2 mA, 7.0 mA for TXD

Application Notes

Example of a Master Discovery/Connection Sequence

From Power Up and No Connection

1. Verify local device is Master in Data Mode.
   Sent: ATSi,7 **<cr_lf>**
   Reply: <cr_lf>1,1,0,0**<cr_lf>**

2. If not Master, set to Master and Data Mode.
   Sent: ATSW25,1,1,0,0 **<cr_lf>**
   Reply: <cr_lf>OK**<cr_lf>**

3. Perform an Inquiry to obtain **BT_Addresses** (unless it is already known).
   Sent: ATMC **<cr_lf>**   // Places Radio in Command Mode
   Reply: <cr_lf>OK**<cr_lf>**
   Sent: ATUCL   // Clears radio state
   Reply: <cr_lf>OK**<cr_lf>**
   Sent: ATDI,1,00000000 {Class of Device}**<cr_lf>**   // Looks for only one Bluetooth device
   Reply: <cr_lf>00A0961F2023,00000104,SOCKETWIRELESS**<cr_lf>**DONE**<cr_lf>**CONNECT **<cr_lf>**

4. Perform a Master Connect over SPP using the **BT_Address.**
   Sent : ATDM, 00A0961F2023,1101**<cr_lf>**   // SPP connection
   Reply:<cr_lf>CONNECT**,**00A0961F008F **<cr_lf>**   // Returns Slave BT address radios is in data
                                                        mode

5. Place radio into Fast Data Mode.
   Sent : ATMC **<cr_lf>**   // Places Radio in Command Mode
   Reply:<cr_lf>OK**<cr_lf>**
   Sent : ATMF**<cr_lf>**   // Places radio in Fast Data Mode
   Reply:<cr_lf>OK**<cr_lf>**

6. Send Data.

Note about Sending Commands from the Slave When the Slave Connects in Fast Data Mode (ATSW25/or issuing ATMF)
All valid AT commands sent through the Slave's UART will be interpreted and responded by the Master as if it were the local Slave radio. Basically, in this configuration from the Slave end, you can obtain status and configure the remote Master radio. This is a unique feature that may be useful in some applications, but it can be confusing if you think you are talking to the Slave.

To Get Out of Data Mode and Check Status
1. Delay at least 50 milliseconds; this could be less or more.
2. Perform a Set Command Mode.
   Sent : ATMC**<cr_lf>**
   Reply:<cr_lf>OK**<cr_lf>**
3. Delay at least 50 milliseconds.
4. Check Status, perform a Disconnect …
   Sent : AT**<cr_lf>**
   Reply:<cr_lf>OK**<cr_lf>**

Note about Being Connected in Fast Data Mode
If connected in Fast Data Mode, it is necessary to reset the device to break the connection.

Example of a Slave Command Sequence

From Power Up:

1. Check and verify Communication to Slave.
   Sent : AT**<cr_lf>**
   Reply:<cr_lf>OK**<cr_lf>**
2. Get information on Slave Bluetooth address.
   Sent : ATSi,1**<cr_lf>**
   Reply: 12-digit address
   <cr_lf>OK**<cr_lf>**
3. Set Slave to automatically connect in Fast Data Mode on Bluetooth connection.
   Sent : ATSW25,0,0,0,0 **<cr_lf>**
   Reply:<cr_lf>OK**<cr_lf>**
4. Either cycle power or send ATURST.

Note: This command sequence assumes the radio is in factory default in which it automatically comes up and is connectable as a Slave from a Master request.

Changing Configuration

Parameters, such as the Bluetooth Name, Service Name, Class of Device, and Serial Port settings can be viewed and configured. This can be done locally through the serial port UART or from a remote Bluetooth RF link. To configure the SocketWireless Bluetooth device, the device must be in command mode by issuing **ATMC**. While in command mode, the SocketWireless Bluetooth device will accept ASCII bytes as commands.

You can use the developer board and the RS-232 cable to connect to a PC and pass ASCII characters through the terminal to the SocketWireless Bluetooth device. The communications settings should match the settings used when the SocketWireless Bluetooth device connects. For example, the defaults are:

> 9600bps
> 8 bits
> No Parity
> 1 stop bit
> Hardware flow control enabled.

Once you change these parameters, you have the option to store them permanently in the non-volatile memory.

Run your favorite terminal emulator, HyperTerminal, or other program.

- Type **AT** on your screen and follow it with a carriage return **<cr_lf>**. You should see "**OK**" returned to you. This will verify that your cable and communications settings are correct. When the SocketWireless device is not connected to another Bluetooth device, you can type the AT commands directly into the SocketWireless' UART; e.g., you do not have to type **ATMC** to change from data mode to command mode.

- Now you can enter any of the AT commands discussed in the following sections. Follow these commands by **<cr_lf>**. Valid commands will return an "**OK**" or a valid response. Invalid commands will reply **ERROR**.

- To return to data mode, type **ATMD**. You can now pass or receive data from a remote connected Bluetooth device.

Notes:

- If you change communications parameter settings, remember to change your terminal or emulator communications settings to correspond to the newly created parameter settings.
- AT commands will not echo back to the terminal.

Sources for Peripheral Devices

Antenna Requirements

Frequency Range	2.4-2.5 Ghz
Impedance	50 ohm nominal
VSWR	<2.0:1
Gain	2 dBi
Radiation	Omni
Polarization	Vertical
Wave	Half Wave Dipole
Connector	SMA Plug (male)

Antenna

An antenna that meets the requirements for use with the SocketWireless product can be ordered, for example, from Nearson.

www.nearson.com

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