



iDEN Module iO1500R

Application and Integration

Developer's Guide

For U.S. Domestic Integrators

Release 1.5 September 2004

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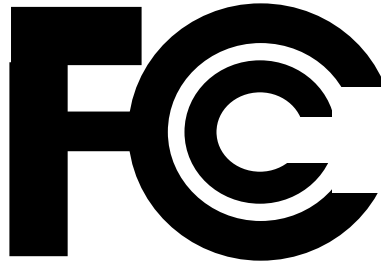
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9808901C42-A

DECLARATION OF CONFORMITY

Per FCC CFR 47 part 2 Section 2.1077(a)



Responsible party name: Motorola Inc.
Address: 8000 West Sunrise Boulevard,
Plantation, FL 33322 USA
Phone number: 1 (800) 453-0920

Hereby declares that the product:

Product name: iO1500R
Model Number: F2572A
FCC ID: AZ492FT5826

Conforms to the following regulation:

FCC Part 15, subpart B
Class B Computer Peripheral Device

Note: 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.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Date: MAY 15, 2003

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Revision History

Date	Revision		Comments
October, 2003	1.0	Ido Anin	Customer Release.
December, 2003	1.1	Philippe Lamhaut	Customer Release with voice support.
March, 2004	1.2	Philippe Lamhaut	Update RALP, helpdesk and support information & miscellaneous.
July, 2004	1.3	Philippe Lamhaut	Update voice information to reflect FCC e911 regulation.
September, 2004	1.4	Philippe Lamhaut	Update FCC testing instructions.
November, 2004	1.5	Philippe Lamhaut	Update FCC e911 regulation information for Domestic version.

Purpose Of This Document

This guide is for the application developer and system integrator who plan to use the iO1500R iDEN module in their design of an OEM product. It describes the requirements and interfaces for the integration of the iDEN iO1500R wireless module into OEM terminal/equipment. These requirements include instructions for FCC testing, requirements for use with wireless carriers, setup instructions, pin descriptions, available software, useful AT commands, and design considerations. This document also covers how to use the iO1500R via Hayes Compatible Packet Data mode for equipment that cannot support packet data.

All OEM integrators whose device(s) operates on public carrier networks, licensed in the U.S., must adhere to FCC E911 Phase II regulations. Severe penalties can be levied for failing to adhere to E911 guidelines.

Distribution

This manual will be distributed to the developer from the CGISS Mobile Data Customer Support web site at <http://www.motorola.com/cgiss/iO1500R>. This document will refer to related documents and software, which can aid the OEM designer in integrating the iO1500R into their product.

Product Support

Additional support for OEM developers will be provided by:
Motorola iO1500R Support Team email iO1500Support@motorola.com

Related Documentation

General information on iDEN technology:

<http://www.mot.com/LMPS/iDEN>

iDEN Technical Overview – Notes On The iDEN System – 68P81095E55-A

Specific information about iO1500R and related subjects:

The following documents can be found in: <http://www.motorola.com/cgiss/iO1500R>

- iO1500R Brochure
- FCC iO1500R approval (See Appendix A for instructions on how to retrieve it).
- OEM Evaluation Board User's Guide 9809801C44
- iDEN Mobile Subscriber DTE/DCE Interface for Data Services 68P81129E10-C
- Win-Wince-iDEN-IFL Development Guide
- iDEN module - Packet Data Applet – FVN5266
- iDEN Data Module iO1500R Application and Integration Developers Guide - 9808901C42, this document.

Module Descriptions and Specifications

iO1500R Description

The iO1500R module for iDEN is a wireless subscriber device for providing packet data and circuit data connectivity over the iDEN 800MHz infrastructure.

The module is supported by PC applications for installation, monitoring, service and development for the OEM and the system integrator.

For module description, features and specifications refer to the iO1500R brochure or get the information from the WEB at <http://www.motorola.com/cgiss/iO1500R>.

iO1500R Product Specifications

Electrical specifications - RF:

Frequency	TX 806-821 MHz RX 851-866 MHz
TX Output Power	Average 0.6 watts at nominal 3.6V & 25 °C
Tx. Modulation	
Circuit Data	Quad -16 QAM;
Packet Data	Quad-64 QAM, Quad-16 QAM and QPSK;
Trans. ACCPR	-60 dB @ 25 KHz -74.5 dB @ 1000 KHz
Static Rx Sensitivity	-111 dBm @ -10% BER

Electrical specifications - Audio:

Output impedance	100-ohm. External audio PA (high input impedance) required.
Nominal output	64mVrms @ 1KHz.
Input impedance	>39K-ohm. Audio source expected to have output impedance of 100 ohms. Nominal audio input is 43.5mV rms. @ 1KHz

Electrical specifications – Power supply:

Input Voltage	3.6VDC +/- 5 %, ripple 50mv max.
Current Consumption	Standby Current avg. 20mA Tx Current in slot Avg. 1000mA Rx Current in slot Avg. 100 mA

Environmental Specifications

Operating Temp	-25°C to 60°C
Storage Temp	-40°C to 85°C
Humidity:	95% RH @ 50°C , non condensing
Vibration:	Sine TIA/EIA 603 Para. 3.3.4

Shock

TIA/EIA 603 Para. 3.3.5

Mechanical Specifications

Size 85.6 X 57.7 X 6.0mm
Weight 30 grams

Approved Standards

FCC ID: AZ492FT5826
Canada ID: 109U-92FT5826

Features & Software Support

The iO1500R is an OEM module with RS-232 interface for data connectivity and MMCX antenna connector to enable wireless operation over iDEN 800MHz infrastructure. The module supports the following main features:

- Circuit data and fax transmission
- Packet data
- Hayes compatible packet data (“CD over PD”)
- Direct Connect

The iO1500R is supported by software development tools to enable short product integration:

1. Applet – program that runs on a window based operation system and supports the unit configuration, monitoring and unit service.
2. [AT](#) commands which allow a DTE to control the dialing, answering, and modem services of the unit.
3. Software Development Kit ([SDK](#)) – set of API’s that can be used when developing an application on a window based operating systems.
4. Radio Application Layer Protocol ([RALP](#)) program for integrators with non-PC operating system and supports the unit configuration, monitoring and unit service.
5. Built in testing software, controls unit transmit and receive.
6. Radio Service Software (RSS) – for changing unit code plug parameters.

See also chapter “Software Tools for Integration” at page 38.

General Notices

Safety Notice - ATTENTION



This iDEN iO1500R Module is restricted to occupational use only to satisfy FCC RF energy exposure requirements. Before using this product, read the RF energy awareness information and operating instructions in the Product Safety and RF Exposure booklet (Motorola Publication part number 6881095C99) to ensure compliance with RF energy exposure limits.

FCC Regulation - Letter of Notice

All OEM integrators whose device(s) operates on public carrier networks, licensed in the U.S., must adhere to FCC E911 Phase II regulations. Severe penalties can be levied for failing to adhere to E911 guidelines.

The iO1500R RF module that is supplied for incorporation into Final Products is a component which, when connected to the power supply, internal signaling, and antenna in a Final Product can receive and transmit RF signals.

In the United States, the Federal Communications Commission requires that RF transmitting devices obtain approval before being offered on the market, unless the device is exempt. While the iO1500R has been designed to meet applicable FCC requirements, provided in the code of Federal Regulation 47CFR part II subpart J and 47CFR part 90 subpart S, the Final Product's compliance with the FCC's requirements, including RF energy exposure requirements, must reflect product usage, positioning of the iO1500R within the product, the type of antenna used, the location of the antenna, and other factors that may vary with the design and nature of the Final Product. Therefore, the manufacturer of the Final Product is responsible for taking all steps needed to insure compliance with FCC requirements, for making the necessary testing to verify compliance and for obtaining FCC approval for the sale and the operation of the Final Product.

The Declaration of Conformity for the iO1500R as well as information covering the FCC tests that are required are located in Appendix A.

Method for integrating the iO1500R into an OEM product

General

It is assumed that the integrator has a sales agreement with an iDEN carrier, the [carrier's requirements](#) are met and the units are provisioned to operate on the iDEN system. This agreement between the integrator or the end customer with the iDEN operator is part of the sales process. The iDEN carrier has to receive "feed file" to be able to provision the unit for operation. The "feed file" includes amongst others the units information (IMEI, Serial number) and the [SIM card](#) information (SIM ID) that has the authentication information of the unit.

At this point the integrator has two options to run and operate the iO1500R.

- Integrated inside the product that is being developed
- If the final product's hardware is not yet ready, the unit can be used and tested on an evaluation board.

A [developers](#) kit can be purchased from Motorola. It includes an evaluation board and the accessories to facilitate the unit operation and testing. See below more information about the iO1500R Developers Kit.

Once the unit is operational on the evaluation board the integrator has to write the [software application](#). The software can be written using Software Development Kit (SDK) for Windows operating systems or using [RALP](#) command set for non-standard operating systems.

At the same time the integrator has to develop the [electrical hardware interface](#) and the [mechanics](#) including the antenna interface of the final product/terminal.

Once the hardware and the software of the unit are ready they have to be integrated, tested and get approvals of the local regulation authorities ([FCC](#) in the US). Use built in testing software to do the required tests for the local regulation approvals. See detailed instructions in appendix A.

The product manufacturing line has to be designed in such a way that the iDEN air protocol can be tested. This test can be performed either by locking on an iDEN site or by using the iDEN test equipment Motorola R2660 iDEN digital communications system analyzer.

Hardware Considerations

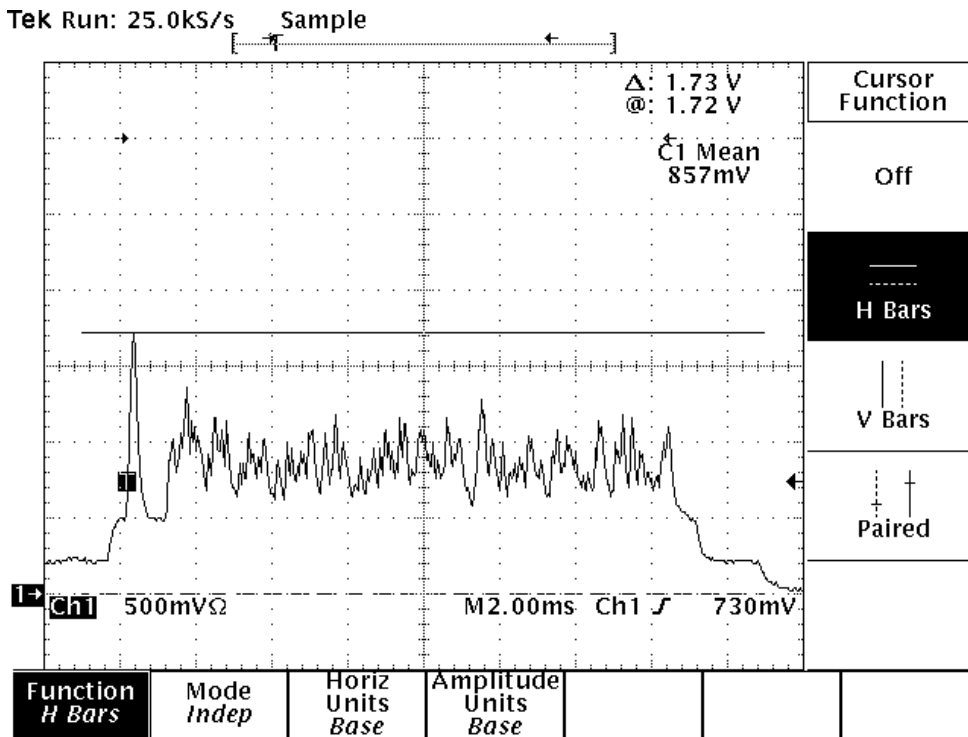
- The end product needs FCC approval, in spite of the iO1500R module having been approved by the FCC.
- For applications where the user may have to insert the SIM-card, suitable mechanical provision has to be made.
- Use of a dummy load instead of an antenna is recommended for laboratory work, when real transmission is not needed.
- Be aware of current consumption when unit is not registered.
- The module must use OEM_ON-OFF (Pin 17) to power on and off.
- The external connector on the end product MUST have direct access connections to the iO1500R's PINS, with no relays through other microprocessors or buffers.
- Developers need system test procedures for production processes.
- Developers need to be aware of the requirements of certain pins, mentioned in the pin description section in order to communicate via RS232.

- Care should be taken when interfacing RS232 lines to external interfaces. RS232 pins must not exceed 3.0 volts or the iO1500R will be damaged.
- To use RS232, the MUX_CNTL input (pin 15) must be held at logic low (internal pull down provided).
- The MOD pin is pulled low through an internal 22 KOhm resistor. Motorola recommends routing the MOD signal to an external connector.
- There is a change in the LEDs output pins 24 and 25 circuit between iO1000 and iO1500R. iO1500R has a switched voltage output while iO1000 has a logic level output. If logic "0" is required then an external pull down resistor should be added, recommended value 1-10Kohm.
- Antenna must be matched and suitable for iDEN 800MHz frequency range.
- Power supply requirement: support 3.6VDC 1A average, 2.2A peaks (400 microseconds). Make sure there is no voltage drops during transmit.

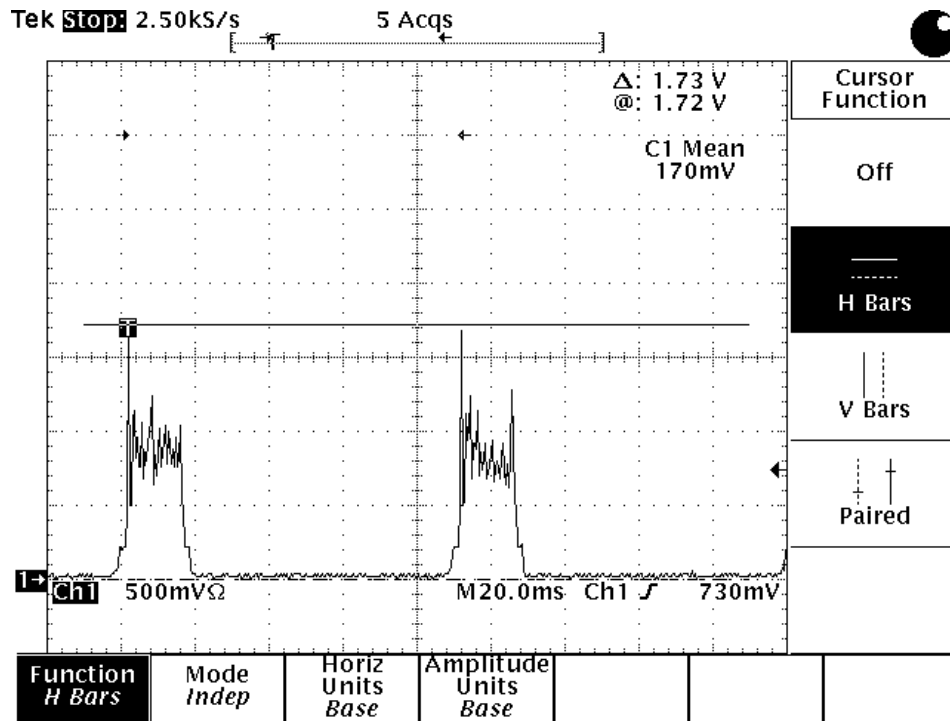
See below graph of the device power consumption measured over a typical duty cycle at TX mode.

Average mean in slot current 857mA, protocol training peak 1730mA (up to 400 micro seconds).

In Slot current graph



1:6 transmission graph



Software Considerations

- When integrating the unit inside a terminal, it is required that the user will have access to the module basic service utilities such as: Master Reset, RSSI Display, SQE Display and others. This is accomplished by use of AT commands, as explained later in this document.
- The end product needs to be able to perform a Module Reset and Master Reset commands on the module.
- It is recommended that the unit will be able to display system registration information and RSSI/SQE readings.
- Developers who change default User Image profiles must use proper profile management processes outlined in this document to properly back them up before overwriting them. Packet data services can be lost if this is not handled properly.
- Developers should be able to implement network specific status messages to the end user as an aid for users and for customer care to query the current status the iO1500R.
- Developers should be able to implement SIM card lock/Unlock commands.

Carrier's Requirements

- Developers need to work with carriers to approve applications on their network.
- To certify hardware on Nextel network contact Nextel's Developer Partner Program via <http://developer.nextel.com>
- The logistics of the SIM-card must be coordinated with Motorola and with the carrier.
- Device must have adequate diagnostic displays for carrier to provide customer care or trouble shooting.
 - LED Indicators – Status LED indicators should be ported to be visible to end-user for customer care and support.
 - Registration Logs (Dispatch Log, Packet Data Log, Mobile IP Log) should be accessible via on-screen display.
- The label of the final product must display the module information

Important Note to Developers who work under Nextel system!

The following steps must be taken to ensure your customers can activate the device on the Nextel network:

1. Clearly label the device with Mobile Serial Number (SN), IMEI, and SIM ID of the iO1500R module. Serial Number and IMEI can be found on label of iO1500R, SIM ID can be found directly on SIM card.

2. Include documentation with device instructing end-users of the following activation instructions

a. Before calling Nextel, contact your salesperson for the following recommendations:

- Packet or Circuit Data
- Public/routable IP or Private IP
- Nextel Price Plan



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- b. Record your Serial Number, IMEI and SIM ID from the label on the device.
- c. You are ready to activate. Pls. call Nextel Telesales at (800) 216-7023 and press "1" to activate.
- d. Nextel Telesales representative will walk you through the activation process.

If these steps are not taken your customer will be unable to activate their device.

For a one-page Integrators Guide with these instructions, and a one-page Activation Guide that can be sent to your customer please visit either:

<http://developer.nextel.com> or <http://www.motorola.com/cgiss/iO1500R>

iO1500R Developers Kit

The iO1500R developer's kit helps the developer and system integrator to start development of the software before their terminal hardware is ready. The developer can connect a PC to the evaluation board and communicate with the iO1500R that is registered to the system and work over the iDEN infrastructure.

The iO1500R developer's kit (FTN6363A) includes:

- The evaluation board FCN6412A
- Data cable (RS-232) - FKN4369A
- 30 pin flat cable Motorola P/N 3086229J03
- MMCX to Mini UHF jumper cable Motorola P/N 3002823C34
- Mounting accessories
 - Rubber bumpers Motorola P/N 7580198E01 * 5
 - Screw is M2x8 Motorola P/N 0310903B96 * 4
 - Washer sprig M2 Motorola P/N 0480378L02 * 4
- Antenna - RAF4136AMM
- The iO1500R Developers Kit User Guide and developers guide documents can be downloaded at <http://www.motorola.com/cgiss/iO1500R>

The evaluation board needs to be connected to a DC power supply in two possible modes:

- 3.8V directly to modem
- 6-12V via a switch regulator located on the evaluation board.

If you are developing a device supporting you will have to get audio accessories such as speaker and microphone or headset.

The speaker must have the following characteristics:

- Impedance: 8 Ohm (4 or 16 Ohm are also suitable)
- Power: 1W minimum

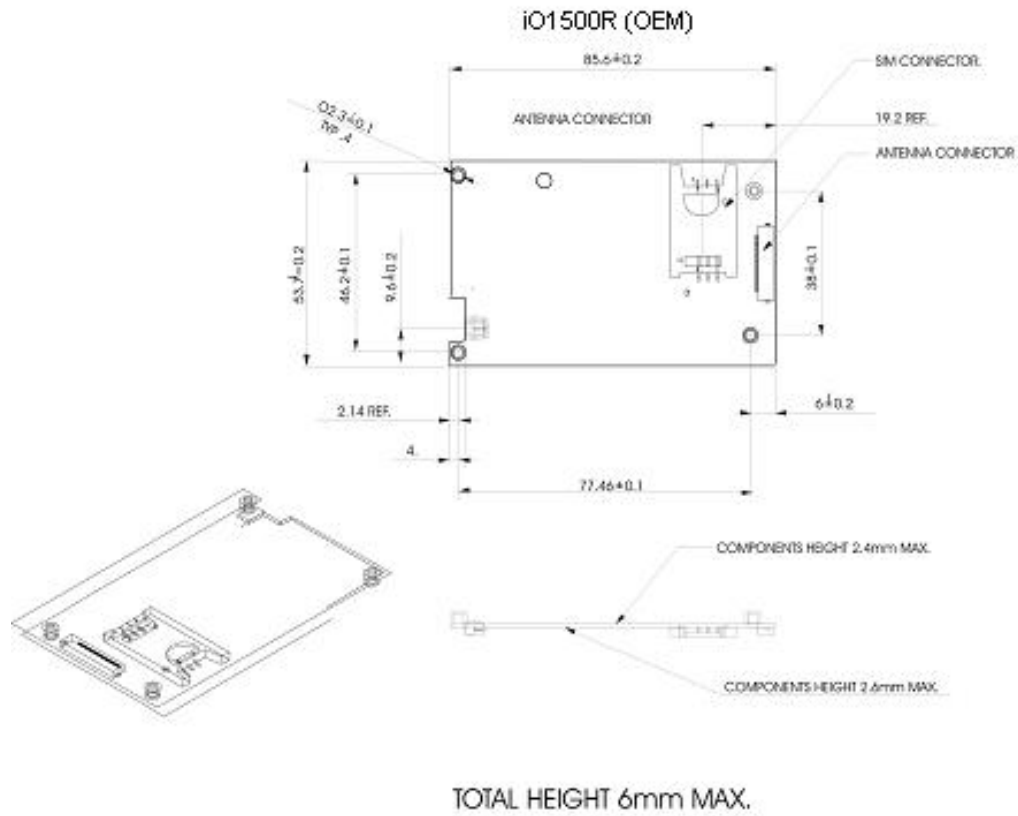
Examples of other accessories:

- Microphone: Motorola P/N SYN5708A
- Headset: Motorola P/N SYN6962A

These components can be purchased from most electronic stores (information can be found via search engine sites like www.altavista.com or www.google.com):

iO1500R Hardware Interfacing Information

Mechanical Dimensions



Connector Types:

The unit has two connectors:

- **RF output connector** MMCX Jack (female) 50 Ohm. This will accept the RG 178-11 MMCX-50-1-1 Plug (male) or RG 316-11 MMCX-50-2-3 (male).
- **The Data Interface connector** is a MOLEX 30-pin ZIF connector, MOLEX part #: 52892-3090. Motorola Part #: 0909059E06.
Matching 30-wire *flex cable* to interface to the connector:
AXON Cable Part#: FFC0.50A30/0035L3-3-06-06SBBB.
Motorola Part #: 3086229J04.

SIM-Card:

A SIM card is supplied with the iO1500R unit. It must be inserted to the SIM connector to enable the units operation. The SIM card comes in a credit card frame as a separate accessory. To open the SIM connector, push the white part inside and lift the SIM connector door. Detach the SIM card from the credit card frame and insert it in the connector with the contacts down. To lock the SIM, close the door and pull the white part. Verify that the SIM card is inserted firmly in the unit.

Note: SIM ID and serial numbers come in pairs. The right SIM card, the one that comes in the same package has to be inserted in the iO1500R. DO NOT mix up the pairs.

SIM activation and feed file process.

- 1) Files are exchanged between the SIM card manufacturer, Motorola the iO1500R modem manufacturer and the iDEN carrier. A file called “feed file” is fed to the carrier’s Operational & Maintenance Center (OMC) to enable the unit operation on the network.

- 2) For service reasons the serial number of the iO1500R have to be visible on the products label.

Accessory Connector Pin Functions

PIN #	PIN NAME	DIRECTION	DESCRIPTION	Notes
1	RS232_TX	OUT	RS232 Signal	3V Max
2	RS232_RX	IN	RS232 Signal	3V Max
3	RS232_DTR	IN	RS232 Signal	3V Max
4	RS232_DCD	OUT	RS232 Signal	3V Max
5	RS232_GND	IN	Signal Ground	
6	RS232_RTS	IN	RS232 Signal	3V Max
7	RS232_CTS	OUT	RS232 Signal	3V Max
8	RS232_DSR	OUT	RS232 Signal	3V Max
9	RS232_RI	OUT	RS232 Signal	3V Max
10	EXT_MIC	IN	Audio input to iO1500R	
11	AUDIO_COMMON	IN	Analog Ground	
12	AUDIO_OUT	OUT	iO1500R Audio Out	
13	OPT_SELECT_1	I/O (22K pull-up)	iO1500R configuration	Control Signal
14	OPT_SELECT_2	I/O (22K pull-up)	iO1500R configuration	Control Signal
15	MUX_CNTL	IN (69K pull-down)	Logic "0" (Mfgr.use)	Control Signal
16	OPTION_3V	OUT	Regulated 3.0V Output	
17	OEM ON-OFF	IN (15K pull-down)	Power On/Off	External On/Off 3.6V±5% Max
18	MOD	IN (22K pull-down)	Programming signal	3V Max
19	BAT_VCC	IN	3.6V iO1500R Power	
20	BAT_VCC	IN	3.6V iO1500R Power	
21	BAT_VCC	IN	3.6V iO1500R Power	
22	BAT_VCC	IN	3.6V iO1500R Power	
23	BAT_VCC	IN	3.6V iO1500R Power	
24	RED_LED	OUT	Out-Of-Range indication	Switched output 3V±2.5%
25	GREEN_LED	OUT	In-Range indication	Switched output 3V±2.5%
26	BAT_GND	IN	Ground	
27	BAT_GND	IN	Ground	
28	BAT_GND	IN	Ground	
29	BAT_GND	IN	Ground	
30	BAT_GND	IN	Ground	

Detailed Pin Descriptions

RS232 Standard Interface 8-Wire Or 4-Wire (Pin 1 through Pin 9)

This is a 3V DCE RS-232 interface. For $\pm 9V$ use, OPTION_3V (Pin16) can supply power to an external level shifter IC like MAX3238E. The 9-volt external level shifter output can be connected to a PC COM port.

Audio Interface (Pins 10, 11 and 12)

These are input ground and output of the iO1500R to provide audio communication.

Opt_Select_1 and Opt_Select_2 (Pin 13, Pin 14)

The option select lines set the communication state of the module. To support RS232 communication, the option select lines must be connected at one of three modes:

“11” – Default mode via internal 22K pull up resistors.

“01” – Option select 1 is externally pulled to ground .

Diode – Anode to Pin 13 and cathode to Pin 14.

MUX_CNTL (Pin 15)

To use RS232, this pin must be held at logic low (facilitated by internal 69K pull down resistor).

OPTION_3V (Pin 16)

A regulated 3V output from the iO1500R with a maximum drive of 30 mA. This can be used to drive an external RS232 transceiver IC.

Voltage is active only when the OEM is ON.

OEM On-Off (Pin 17)

Used to power up and power down the iO1500R OEM. This is the recommended method for turning the iO1500R on and off and in vehicle applications it can be used as an ignition sense to power up. When this pin is connected to ground, the OEM will turn OFF. When this Pin is connected to BAT_VCC 3.6V, the OEM will turn ON.

MOD (Pin 18)

This pin is internally pulled down via 22K resistor. Motorola recommends routing the MOD signal to an external connector. In order to update iO1500R software this pin must be available externally, or the flash cannot be programmed, and the iO1500R module will have to be removed from the product to reprogram it. Mod pulled to 3V at power up sets programming mode.

BATT_VCC (Pins 19 through 23)

This is the 3.6 V iO1500R power supply. All should be driven by the same source. Power: 3.6V ± 5 % max., ripple 50mV. Input current: Avg. 1A, peak 2.5A.

Out-Of-Range indication, RED LED (Pin 24)

This OUTPUT is the Out Of Range Connection Status. It is a switched 3V output voltage with a maximum drive of 10 mA.

Solid Red light - OUT OF RANGE – iO1500R not connected to the iDEN network.

Blinking Red light – iO1500R is registering or connecting to the iDEN network.

In-range indication-GREEN LED (Pin 25)

This OUTPUT is the In-Range Connection Status. It is a switched 3V output voltage with a maximum drive of 10 mA.

Blinking Green light - IN RANGE - the OEM is connected to the iDEN network.

Solid Green light – The iO1500R is in use.

BAT_GND (Pins 26 through 30)

These pins are the ground return lines for the iO1500R and should be connected together with the same ground reference as the 3.6 V power supply for the iO1500R.

Status LED Indications

An on board single LED is used for multi-purpose status indications as follows:

User Mode	
LED State	Indication
Alternating Red & Green	A fatal error was detected during power-up: - Flashstrap Fatal Error. - Invalid Battery.
Flashing Red	Registering - your PC Card is registering to your carrier's network. Please wait.
Steady Red	No service -your PC Card can't register. It will continue trying to every two minutes as long as it is turned on.
Flashing Yellow	Unit registered - no packet data service.
Flashing Green	In service - your PC Card has successfully completed Packet Data registration.
Steady Green	In use - your PC Card is currently being used

Note: To keep low operation standby current the LED is activated by a pushbutton for testing purposes only.

Voice Support

Any OEM wishing to integrate voice into a device **must** contact iO1500 support team at (iO1500Support@motorola.com) in order to get important directives, review possible options of voice control and get additional documentation required for accessing interconnect and Direct Connect from the iO1500R.

Two methods of voice control are available:

- SDK for Windows 32 based operating systems
- RALP Windows CE and other operating system.

See section "Software Tools for Integration" for more information about SDK and RALP.

RALP requires Non-disclosure agreement (NDA) and licensing. The iO1500 support team will direct the OEM to Point of contact for licensing process.

IMPORTANT:

All OEM integrators whose device(s) operates on public carrier networks, licensed in the U.S., must adhere to FCC E911 Phase II regulations. Severe penalties can be levied for failing to adhere to E911 guidelines.

The OEM must also contact the cellular carrier for specific guidelines on implementing interconnect and/or Direct Connect voice onto an OEM device.

To contact the Nextel Partner Program visit <http://developer.nextel.com>. Click on Partnerships, scroll to Technology Partner Program, click on Apply Now"

Module Software And Interface Modes

General

The iO1500R supports both standard packet data and circuit data over packet data modes. DCE refers to the iDEN iO1500R Module. DTE refers to the computer or data terminal equipment that is connected to the iO1500R Module. Below are the descriptions for each of these data modes.

Circuit Switched Data

The iO1500R Module and the iDEN network interact to provide the DTE with a circuit-switched data interface with the PSTN.

The iDEN infrastructure and data subscribers support circuit data based on TIA/EIA-602 (commonly known as the “Hayes AT Command set” defines messages and procedures that allow a DTE to control the operation of a DCE. The DCE provides dialing, answering, and module services. The messages consists of async ASCII (readable) characters and are sent “in band” between the DTE and DCE (i.e. over the same interface used to transfer the data).

See the iDEN Mobile Subscriber DTE/DCE Interface for Data Services 68P81129E10-C for detailed AT command descriptions. See “How to use Hayes Compatible Packet Data mode” for iDEN data module AT commands.

Packet Data

The iDEN Packet Data service provides wireless datagram-based networking on the iDEN network. Based on the TCP/IP protocol suite, iDEN Packet Data provides a mobile transport layer connecting the mobile node to the Internet.

The conventional method of using iDEN Packet Data (PD) service is via data terminal equipment (DTE) containing a TCP/IP protocol stack.

A DTE connected to an iDEN data module will be able to use IP protocol to transfer data to any IP capable device. For example it will be able to FTP a host computer and browse an Internet site.

Hayes Compatible Packet Data mode

Some older legacy DTE equipment that the iO1500R may be interfaced to may not have a TCP/IP stack. These devices use Hayes Module AT commands to communicate. A non-IP interface was implemented inside the module to work with these legacy DTEs using a simulation of Circuit Data Over Packet Data. Terminals that are using AT-Module protocol will be thus be able to communicate with the iDEN data modules and use the iDEN Packet Data services.

Managing User Image Profiles

General

The iO1500R ships with 3 configurable User Images (Profile 0, Profile 1, and Profile 2)

User Image 0 Profile 0 stores the default factory settings for Circuit Data calls.

User Image 1 Profile 1 is a scratchpad where Profile 0 or Profile 2 is stored by the developer when changing the default settings of Profile 0 or Profile 2.

User Image 2 Profile 2 stores the default factory IP settings for Packet Data or Hayes Compatible Packet Data services.

The iO1500R units ship from factory with the User Image Profile defaulted to Image 2.

Warning When Switching User Image Profiles

Developers should use caution when changing default settings of User Image Profiles in the iO1500R. Before settings of a profile are changed, they should be backed up into the User Image 1 scratchpad for safekeeping, and then restored later. If these backups are not performed, then the module will lose setup information and will not be able to use Packet Data services. The recovery from this failure uses several AT commands to restore all the variables one by one. Use this profile management process:

- 1) Set the user default image to the image profile that is to be modified.
- 2) Copy that user image profile into the scratchpad user image profile 1.
- 3) Then change the original image to the new desired settings.
- 4) When the user is finished using the custom settings, copy the original backed up profile from scratchpad user image profile 1 back to the original profile.

Setting The Active User Image

The ATz command sets the active User Image

This loads the specified user image profile from ROM into active RAM.

Usage: ATz<image> (where image can be 0,1 or 2)

User Image 0 Make Circuit Data the active image.

User Image 1 Make the scratchpad the active image.

User Image 2 Load the module with Packet Data parameters.

The iO1500R units ship from the factory defaulted to Image 2.

Example: To select circuit data (Image 0), enter this AT command: **ATz0**

Example: To select packet data (Image 2), enter this AT command: **ATz2**

Properly configuring, saving, and restoring user image profiles

Here is an example of how to properly manage the user image profile AT commands.

Example: The module by default boots up in User Image Profile 2, which is packet data mode. This example will back up Profile 2 into Profile 1 for safe keeping, then change Profile 2 to become Circuit Data, and save these settings permanently into to Module ROM so that the module boots up into Circuit Data mode.

Changing the settings of a user image

- 1) Make User Image 2 the active image: **ATz2**
- 2) View stored parameters to verify: **AT&V**
- 3) Save Profile 2 to Profile 1 for safekeeping: **AT&W1**
- 4) Now make User Image 0 the active image so parameters can be copied: **ATz0**
- 5) Write the Profile 0 parameters to Profile 2: **AT&W2**
- 6) Make User Image 2 the active image to verify the change took place: **ATz2**
- 7) View stored parameters: **AT&V**

The module will now power up in Profile 2, which was customized to be in circuit data mode by the above example. To recover Profile 2, do the following steps:

Restoring the settings of a saved user image

- 1) Make User Image 1 the active image to recover the Image 2 profile data: **ATz1**
- 2) View stored parameters to verify: **AT&V**
- 3) Save Profile 1 to Profile 2 for safekeeping: **AT&W2**
- 4) Make User Image 2 the active image to verify the change took place: **ATz2**
- 5) View stored parameters: **AT&V**

How To Use Hayes Compatible Packet Data mode

General

Some older legacy DTE equipment that the iO1500R may be interfaced to may not have a TCP/IP stack. These devices use Hayes Module AT commands to communicate. A non-IP interface was implemented inside the module to work with these legacy DTEs using a simulation of Circuit Data Over Packet Data. Terminals that are using AT-Module protocol will be thus be able to communicate with the iDEN data modules and use the iDEN Packet Data services. This capability is only available in the iO1500R and not on any of the standard iDEN modules.

Circuit Data over Packet Data Operation

The non-IP DTE will use the AT command set described in the TIA/EIA-602 standard for Circuit Switched Data transmissions, with the following modification:

ATD<IP_address..Port_Number>

instead of:

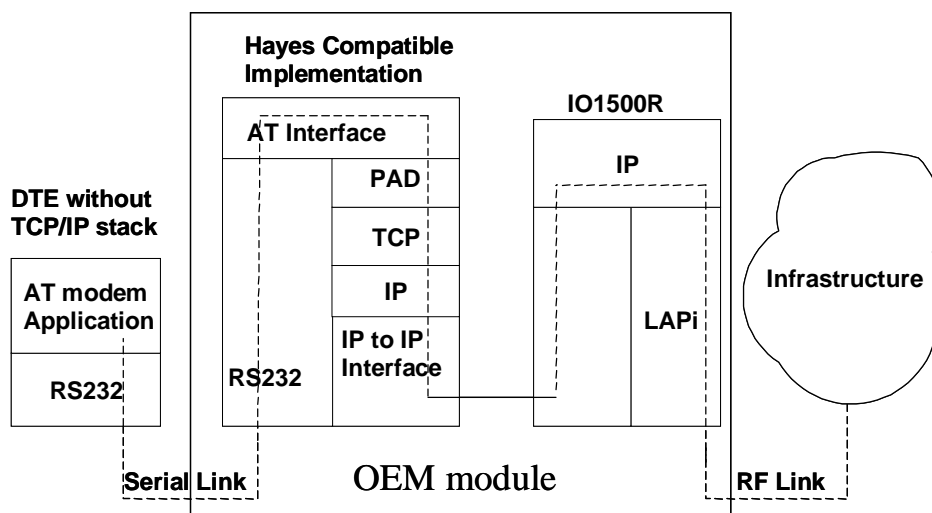
ATD<Phone_Number>

Note: There is no Fax support while in Hayes compatible packet data mode.

An AT command interpreter, implemented in the module software, receives the **ATD<IP_address: Port_Number>** command and transfers it to the Packet Assembler/Disassembler (PAD) which prepare the data in a mobile TCP/IP format which is recognized and transferable by the iDEN infrastructure.

The end result is circuit data interface with packet data over the air.

The user gets circuit data interface for it's dumb terminals with the response time and data rates of packet data.



There are 2 methods to setup the configuration to send Circuit Data AT commands over the packet data network in the iO1500R:

Method 1: Use the wireless data services for windows applet from the CD supplied with your module to initialize packet data parameters (IP address etc.) in your module and to set the profile for Hayes Compatible Packet Data.

Method 2: Use the **AT+ws45** and **AT+ws46** commands.

AT+ws45 is the Select DTE-Side Stack command, which sets the DTE-side protocol stack to be used by the DCE in on-line data state.

ATws+46 is the WDS-side side (Wireless Data System) stack command, which sets the WDS protocol stack to be used by the DCE for network activities.

Example: Place the DTE side in Hayes compatible packet data mode:

AT+ws45=0

To verify the mode, simply query the module with this command: **AT+ws45?**

The module should respond back with: 0.

Example: To place the WDS side in PPP mode, enter this command:

AT+ws46=24

To verify the mode, simply query the module with this command: **AT+ws46?**

The following table shows the modes and the corresponding parameters for both the **AT+ws45** and **AT+ws46** commands:

Mode	AT+ws45	AT+ws46
iDEN Circuit data/Fax	0	23
Hayes compatible packet data	0	24
Packet data & SLIP	3	24
Packet data & PPP	4	24

WARNING: Use proper profile management procedures mentioned earlier to backup default profiles before changing and writing them to the module.

When verifying that Hayes compatible packet data mode is setup properly, this is the only valid combination: **AT+ws45=0** and **AT+ws46 = 24**

This command will then instruct the DCE (iO1500R module) to originate a call:

ATd <IP_address>..<port#>

Where <IP_Address> = n.n.n.n OR n,n,n,n where 1<n<255, and

<port#> is optional ..p or ,,p 1<=p<= 65535

<IP_address> and <port#> MUST be separated by two dots”..” or two commas “,,”, but no matter which character is used, there must be 2 of them.

Example: ATd 128.54.88.104..80

will tell the iO1500R to connect to the IP address shown above, and through port #80.

The DCE will respond with: ”Connect <baud rate>”, which means the module is connected at the baud rate displayed.

1. Continue to work. Transmit and receive data from the other side.
2. To disconnect the call and get back to command mode type +++.
3. The module will respond with “OK”. Then type ATH to hang up.

Recommendation:

It is strongly recommended to set the Idle Time-out timer (S30) to a non-zero value (1-255 in Seconds), so that if no data is transmitted or received for the specified period of time, the DCE will disconnect the call, return the OK result code, and return to command mode.

If S30 value is set to zero (infinite) for CD over PD calls, the DTE is responsible to close CD over PD call. In a situation where the DCE will be out of range, the DTE will stay in CD over PD connection and will be unable to receive data until the DTE will end the active CD over PD call. In another situation where the DTE is in receive mode (reply/response to remote side requests), it might not get requests from the remote site and then never close the call since the timer is set to infinite.

See iDEN Mobile Subscriber DTE/DCE Interface for Data Services 68P81129E10-C for more details about the ATS30 command.

Other Useful AT Commands

View stored parameters with the AT&V command

To verify that the right image is used enter this command: **AT&V**

The iO1500R will display several lines of information regarding the current setup of the module. The very first line of information will display “Active User Image”. If the iO1500R is in packet data mode, the display will read “Active User Image: 2”. The AT&V query command also displays the current status of the AT+ws45 and AT+ws46, a sanity check to determine if the module is setup in Hayes Compatible Packet Data mode, or any other mode.

How to configure the baud rate with the AT+IPR command

IMPORTANT: Do not leave as auto baud.

Configure the iDEN data module for the baud rate of your DTE. The default baud rate of the module is auto baud. To configure the baud rate of the iDEN data module, use this command:

AT+IPR=baud rate

Example: **AT+IPR=19200** will set the baud rate to 19200.

The status of the current baud rate setting can then be shown with the baud rate query: **AT+IPR?**

The iO1500R will respond back with: **+IPR: 19200**

Instructions for setting modem baud rate by application

The OEM may want to write or adapt an application to set the baud rate of the modem to a given value. Here is an example of code that will do this by sending the appropriate AT+IPR command.

[Example of code to add in application in order to change the iO1500 baud rate from 19200 bps to 9600 bps. Written in Visual C++](#)

```
//Open Com port
m_hComPort = CreateFile( ComPortName, //COM1, for
example. if port number > 9, then need to add \\.\ before it's name
    GENERIC_READ | GENERIC_WRITE, // comm devices
    must be opened w/exclusive-access
    0, // 0 = No share
    NULL, // no security attributes
    OPEN_EXISTING, // comm devices must use OPEN_EXISTING
    0, // not overlapped I/O
    NULL // hTemplate must be NULL for comm devices
```

```
);

if (m_hComPort == INVALID_HANDLE_VALUE)
{error - port wasn't opened}
else
{
// Set COM port baud rate to 19200 in order to communicate with iO1500
if(!GetCommState(m_hComPort, &m_Dcb))
{
error
}
m_Dcb.BaudRate = 19200; # or any other current baudrate of the modem
SetCommState(m_hComPort, &m_Dcb);

// Send AT command to change iO1500 baud rate to auto
CString Command = "at+ipr=9600\r";
unsigned long NumOfWrittenBytes=0;
char *Buff= Command.GetBuffer(0);
int WriteSize =strlen(Buff);
if ( !( WriteFile(m_hComPort,Buff,WriteSize,&NumOfWrittenBytes,NULL) ) )
{
//error report GetLastError
}

//Remember to close the COM port
if (m_hComPort != INVALID_HANDLE_VALUE)
{
if(!CloseHandle(m_hComPort)) return FALSE;
m_hComPort = INVALID_HANDLE_VALUE;
}
}
}
```

Reset, Master Reset, Power off

The requirements of setting these functions may vary by service provider. The service provider may ask the developer to perform these functions, which are accomplished through a keypad on a normal phone. But on the iO1500R, these functions can be accomplished using the Applet program from the CD, or by using AT commands that can be sent to the iO1500R:

AT Command To RESET the iO1500R

This command perform a full reset as if the module recycled the power:

AT+wwreset

Note: If SIM feature is enabled, there will not be a request to enter the SIM PIN at the end of the reset process as there is for a regular power recycle.

AT Command For Master Reset

The carrier may ask the developer to Master Reset the iO1500R when certain changes are made, or the developer will need to Master Reset the iO1500R after new software is flashed into the module. This is not the same as RESET, and should only be run in the above scenarios. This is the AT command to be used:

AT+wwmr="xxxx"

Where "xxxx" is the correct pass code. Typically on new units, the default pass code is 0000. In most cases to perform a master reset, enter the AT command like this:

AT+wwmr="0000" (no space between any characters).

AT Command To Power the iO1500R off.

This message tells the modem to perform a safe software power off:

At+wwpo

SIM AT commands

As for Condor based product, the iO1500R modem has a SIM card. The management of the SIM cards can be done using the following AT commands:

AT Command To Unlock the iO1500R SIM card.

At+wwsim

The SIM PIN should be between 4-8 digits Operator.

Operator	Syntax
Execute	+wwsim="<SIM PIN>"
Query	+wwsim?
Range	+wwsim=?

Response:

- "NO LOCK" - in case the SIM is not locked.

- "SIM LOCK" - in case SIM is locked. PIN must be entered in order to unlock the SIM.
- "PIN BLOCK" - in case the PIN is blocked due to three consecutive unsuccessful attempts to unlock the SIM. Need to use the Configuration Applet program or AT+WVSIMPUK command and PUK code delivered by the SIM card provider in order to unblock, or get service.
- "PUK BLOCK" - in case PUK is blocked due to ten consecutive unsuccessful attempts to unblock the SIM PIN. The SIM has become unusable.
- "LOCK NO SIM" - There is no SIM in the radio. Need to insert SIM.
- "LOCK SIM MEM ERR" - Memory error in the SIM. Need to get service.
- "LOCK SIM TECH ERR" - Technical error in SIM. Need to get service.
- "ERROR" - All other cases.
-

AT Command To enable or disable the SIM PIN lock mechanism

At+wvsimtgl

The SIM PIN should be between 4-8 digits. The first parameter indicates whether to enable or disable the lock mechanism.

Operator	Syntax
Execute	+wvsimtgl= <i>n</i> ,"<SIM PIN" with <i>n</i> =0 for enable and <i>n</i> =1 for disable
Query	+wvsimtgl?
Range	+wvsimtgl=?

Response:

- ENABLED
- DISABLED
- ERROR

AT Command To change the SIM PIN

At+wvsimpin

The OLD SIM PIN and NEW SIM PIN should be between 4-8 digits Operators.

Operator	Syntax
Execute	+wvsimpin="<OLD SIM PIN", "<NEW SIM PIN"
Range	+wvsimpin=?

Response:

- "CHANGED: SIM PIN
OK" in case SIM PIN was successfully changed
- "INCORRECT PIN, TRY AGAIN
OK" in case of wrong SIM PIN.
- "INCORRECT PIN, SIM BLOCKED"

- OK” in case of 3 consecutive unsuccessful SIM requests causing SIM to block.
- “SIM PIN SHOULD BE ENABLED OK” in case SIM PIN feature is disabled.
- “ERROR” in case of other errors.

AT Command To unblock the SIM

At+ wvsimpuk

The SIM PUK should be 8 digits Operator.

The SIM PIN should be between 4-8 digits Operator.

Operator	Syntax
Execute	+wvsimpuk="<SIM PUK>","<SIM PIN>"
Range	+wvsimpuk=?

Response:

- "CHANGED: SIM PIN OK” in case SIM was successfully unblockedRemark: the command will be completed by a reset.
- PIN BLOCK in case unblock command was unsuccessful
- PUK BLOCK in case unblock command was unsuccessful 10 consecutive times causing SIM.PUK BLOCK.
- “NO LOCK OK” in case SIM PIN feature was not blocked.
- “ERROR” in case of other errors.

Service Status Log (SSL) AT command

To assist “customer care” in troubleshooting many of their most frequently experienced “registration” and activation issues, the MS captures the results of DAP registration, Location Updates, PD Registrations and MIP Registrations in a log that can be displayed via the “diagnostic mode” menu. Also, results for Phone Restricted can be displayed for SIM capable phones. The result of the most recent transaction (per procedure) is saved. Any subsequent transactions will overwrite the result previously stored. These results are only stored in volatile memory and therefore are not stored across power ups. In Addition the log shows the current IN or OUT of service state for DAP, LU, PD and MIP.

SSL command syntax

At+wptrace

SSL Command response

The SSL AT command response will have the following syntax:

DISPATCH [IS,NS (2 bytes)] [ACPT, RJCT, N_AT (4 bytes)] [RNC (6 bytes)] [0-4 cause codes, 2 bytes each, separated by comma]

INTERCONNECT [IS,NS (2 bytes)] [ACPT, RJCT, N_AT (4 bytes)] [RNC (6 bytes)] [0-4 cause codes, 2 bytes each, separated by comma]
PACKET DATA [IS,NS (2 bytes)] [ACPT, RJCT, N_AT (4 bytes)][RNC (6 bytes)] [0-4 cause codes, 2 bytes each, separated by comma]
MOBILE IP [IS,NS (2 bytes)] [ACPT, RJCT, N_AT (4 bytes)][RNC (6 bytes)] [0-4 cause codes, 2 bytes each, separated by comma]
PHONE RST [IS,NS (2 bytes)] [RSTR, N_AT (4 bytes)] [RNC 6 bytes] [0-4 cause codes, 2 bytes each, separated by comma]

Each SSL entry is presented in one line.

The [] signs indicate a field with possible values and length.

Motorola iX1500 Modem Applet

This program can be used with the iO1500R sitting on the Evaluation Board. Download from the support site at <http://www.motorola.com/cgiss/iO1500R> the iO1500 installation package "New_OEM_CD_R0100.zip" to your computer and unzip. Double click on file GSetup.exe to start the installation and follow the instructions.

The installation program will create the applet program group (Start->Programs) with a default name "Motorola iX1500 Modem Applet". The following shortcuts will be placed there: Configuration program, Service program, Status program, online manual and the applet read me file.

Supported Operating Systems

Version R01.00 of iO1500R installation package and Applet application supports the following Operating Systems:

- Windows 98 Second Edition

- Windows NT 4.0 Workstation (Service Pack 4, 5, or 6),

- Windows 2000 Professional (Service Pack 1,2,3,4),

- Windows XP Home and Professional (Service Pack 1 and 1a)

There is no guaranty that new Service Packs released by Microsoft after iO1500 R01.00 Release date (August 2003) will be fully supported.

The complete application is composed of three software modules: Status Program, Configuration Program and Service Program.

Status Program

The Status Program window is a Windows only program that is part of the module applet, and provides an enhanced method of starting a PPP or SLIP connection to the module. It also provides some helpful information about the DCE (iO1500R OEM Module) and Packet Data communication. For example the program can display RSSI, Kbytes sent/received and more.

Configuration Program

The Configuration Program provides a method for configuring and displaying networking parameters (Primary and secondary DNS, Server IP address, etc.) and

modem parameters for packet data services. It provides a method for customizing user settings (for example: Master Reset, SIM PIN change/unblock/enable/disable, etc.) and allows the user to define the default data service.

Service Program

The Service Program is a GUI that provides service technicians a method to perform field-testing for an iO1500R modem.

Recommendation:

To work simultaneously with both the LAN and the modem Dial-Up connection, the dial-up entry of the iO1500 has to be modified so that in the "Advanced TCP/IP settings", the "Use default gateway on remote network" will be unchecked.

Otherwise, the computer will lose connection with the LAN when initiating dial-up connection.



Software Tools for Integration.

General

The iDEN data module integrator has a choice of software tools to help in the development of applications for the iO1500R OEM Module:

1. AT command set as described in iDEN Mobile Subscriber DTE/DCE Interface for Data Services (see *Commonly used AT commands & S-Register* at p. 59).
2. SDK contains a set of DLL's that provides an API to access the iO1500R features for Windows operating systems. The SDK functions were developed over the RALP protocol (see next item). Details about SDK can be found in the iO1500R Win-Wince-iDEN-IFL Development Guide at the iO1500R Website at: <http://www.mot.com/cgiss/iO1500R>. The SDK is downloadable from the [iDEN developer site \(see link below\)](#).
3. For integrators with non-PC operating system, Motorola provides two types of RALP (Module Application Layer Protocol) command support:
 - a. Lite RALP giving functionality equivalent to the SDK.
 - b. Full RALP giving additional network error logging.

Note: There is an NDA and a fee required to get the RALP document.

RALP is a set of commands that is already implemented in the iO1500 modem. After license agreement is signed, the customer gets the RALP document that gives detailed instructions on the way to use it.

Writing applications using RALP requires more development efforts than the two previous methods.

For more information about RALP contact the iO1500R Support Team at: iO1500Support@motorola.com

Visit the iDEN developer site for an overview, download documentation, get sample code and other data application development tools at:

http://idenphones.motorola.com/iden/developer/developer_home.jsp.

Unit Registration

The following is a procedure to verify operation of the iDEN data modules with the DTE and the iDEN infrastructure.

1) Configure the iDEN data module for the baud rate of your DTE. The default baud rate of the module is auto baud. Do not leave as auto baud.

AT

Check communication with the module.

AT+IPR=baud rate

Configure the baud rate of the iDEN data module.

2) Configure the iO1500R module for a PPP/SLIP connection.

AT	Check communication with the module first.
ATZ2	Sets Profile 2 with.AT+WS46=24
AT+WS45=4	Sets the DTE protocol stack to Packet Data PPP/SLIP
ATE0	Set ECHO Off
AT&W2	Store configuration to module's Profile 2. (Storing new Configuration will overwrite the default configuration.)

3) Check module network status.**PPP Connection should not be established until MIP Registration is complete.**

Network status can be checked using AT commands.

Check Signal Quality with this AT command: **AT+WS53?**

Range: 0-100 (Minimum working levels for Signal Quality are between 75-80).

Check mobile IP registration with this AT command: **AT+WPSTATE**

(Return data has a few lines; the last line contains the Mobile IP registration status)

See the iDEN Mobile Subscriber DTE/DCE Interface for Data Services 68P81129E10-C for detailed AT command descriptions.

If SQE value read in using the AT53 command is OK and the iDEN data module is Mobile IP registered go to step 4).

If Signal Quality is not good, wait in the loop, checking signal quality every 10 sec, until a usable value is measured.

If the iDEN data module is not Mobile IP registered wait for 1 minute, checking MIP registration status every 10 seconds. If after one minute the iDEN data module is not MIP registered, a new registration needs to be forced. Use AT-commands to force the module de-registration and re-registration:

Force deregistration **AT+WPDEREG**Force registration **AT+WPREG**

Go back to Step 3) again.

4) Wait for at least 2 seconds and make the PPP/SLIP connection**ATZ2** Go to profile 2.**ATD** Start PPP/SLIP connection, according to the AT+WS45 setup.**5) During the PPP/SLIP connection check network status periodically.**Check Signal Quality with this AT command: **AT+WS53?**

If Signal Quality is not good, wait in the loop, checking signal quality every 10 sec, until a usable value is measured.

If iDEN data module is not Mobile IP registered wait for 1 minute, checking MIP registration status every 10 seconds. If after one minute the iDEN data module is not MIP registered, a new registration needs to be forced. Drop PPP/SLIP connection. Use AT-commands to force iDEN data module de-register and re-register again.

Force deregistration **AT+WPDEREG**

Force registration **AT+WPREG**

Go back to Step 3)

Additional Information For Registering and Going Offline

Module Activation and Registration

When you buy the module from iDEN operators your module must be registered in the system database. Upon power up, the module is registered and a set of data parameters is downloaded *over the air* into the unit. In case the module is not registered, you will need to give to the system administrator the unit SIMID number for registration (some operators may also need the serial number of the unit). These numbers can be found on the unit label together with the model number, the FCC ID number and the Canadian safety ID number.

AT-commands:

Each AT command sent is expecting its own response as an echo, or an OK.

To make the iO1500R module re-register perform these steps:

1. Send the **AT+WPDEREG** command to un-register the module.
2. Wait three second for the iO1500R module response.
3. Send the **AT+WPREG** command to register the module.
4. Wait 5 seconds. **Do not check module response while waiting.**
5. Poll registration status using the **AT+WPREGSTATE** command.
6. Wait for 2 seconds for the reply from the iO1500R.
7. Loop: If the DTE did not receive a response go back to Step 5.
8. If the “REGISTERED” response is received, proceed to the next stage.

Monitoring The RS232 CD pin and Going Offline:

While online, the DTE should monitor the CD signal on the iO1500R to see if it went inactive. If the iO1500R did go inactive, DTE should do the following:

- 1) Tear down the PPP/SLIP connection.
- 2) Disconnect the module using +++ string, wait one second.
- 3) Send an **AT** command. The module should respond with an OK. If the DTE is not getting an OK it should continue sending +++ to disconnect the module.
- 4) Wait one second and send the **AT** command until an “OK” is received.

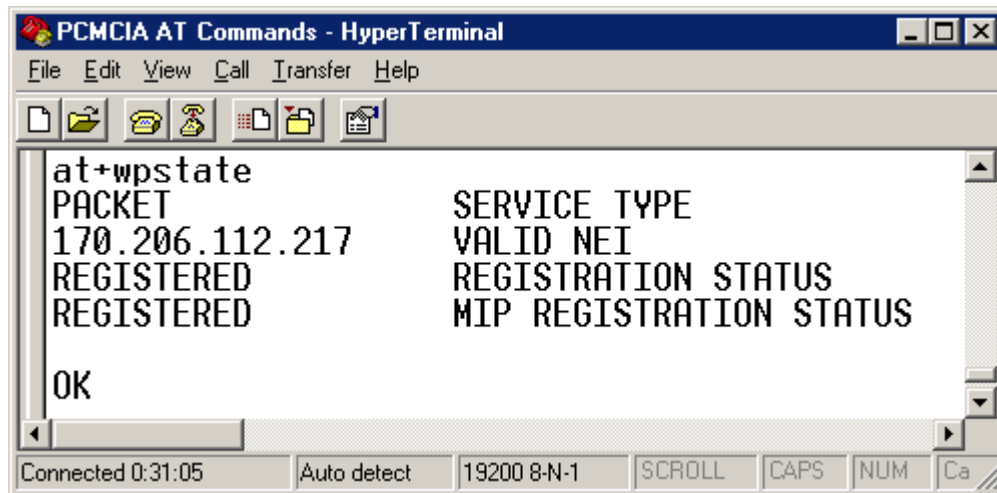
If the timeout elapsed with no module response or during wait time another message has been received (e.g. NO CARRIER) start to reconfigure the module all over again.

Packet Data Status Information Command

To check the current state of the iO1500R, use the Packet Data Status Information command. This is the AT command to be used:

AT+wpstate

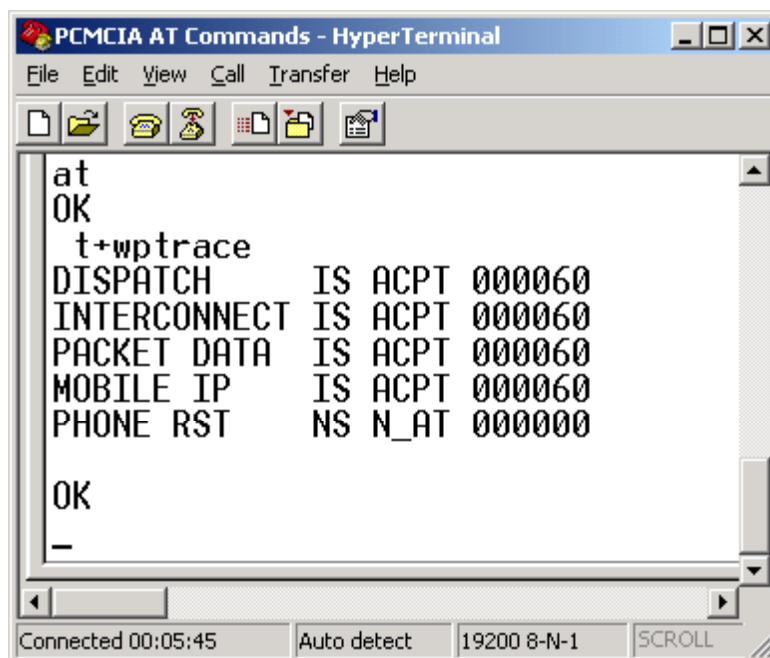
Below is what the iO1500R might respond with when this command is used:



```
PCMCIA AT Commands - HyperTerminal
File Edit View Call Transfer Help
[at+wpstate]
PACKET 170.206.112.217 SERVICE TYPE
REGISTERED VALID NEI
REGISTERED REGISTRATION STATUS
MIP REGISTRATION STATUS
OK
Connected 0:31:05 Auto detect 19200 8-N-1 SCROLL CAPS NUM Ca
```

AT+wptrace

Below is what the iO1500R might respond with when this command is used:



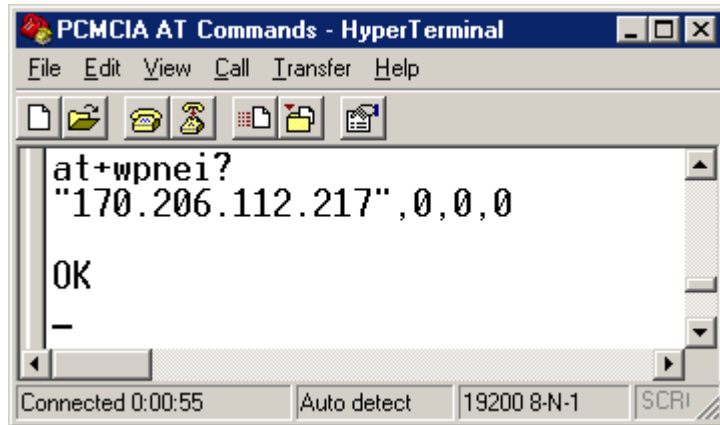
```
PCMCIA AT Commands - HyperTerminal
File Edit View Call Transfer Help
[at]
OK
[at+wptrace]
DISPATCH IS ACPT 000060
INTERCONNECT IS ACPT 000060
PACKET DATA IS ACPT 000060
MOBILE IP IS ACPT 000060
PHONE RST NS N_AT 000000
OK
Connected 00:05:45 Auto detect 19200 8-N-1 SCROLL
```

IP Address/ Network Entity Identifier (NEI) Command

To check the current IP address of the iO1500R node, as well as the Network Entity Identifier (NEI), use the DTE IP Address query command as follows:

AT+wpnei?

Below is what the iO1500R might respond with when this command is used:



The screenshot shows a HyperTerminal window titled "PCMCIA AT Commands - HyperTerminal". The window contains the following text:

```
at+wpnei?  
"170.206.112.217",0,0,0  
  
OK  
_
```

The status bar at the bottom of the window displays "Connected 0:00:55", "Auto detect", "19200 8-N-1", and "SCR1".

First the IP address is displayed in quotes, followed by the current NEI.

Summary Of AT Commands

This is a consolidated list of the AT commands mentioned in this document.

See the **iDEN Mobile Subscriber DTE/DCE Interface for Data Services 68P81129E10-C** for detailed AT command descriptions.

General AT Commands

Command	Usage	Remarks
AT	AT	Checks communication.
ATE _x	ATE0 or ATE1	Sets echo on or off.
AT&V	AT&V	Displays module parameters.
AT+IPR	AT+IPR= baud rate	Sets the baud rate of the modem

User Image Profile Management Commands

Command	Usage	Remarks
ATz	ATz0, ATz1, or ATz2	Sets the specified image as the active image.
AT&W _x	AT&W0, 1, or 2.	Writes active image to the specified profile.

Hayes Compatible Packet Data Commands

Command	Usage	Remarks
AT+ws45	AT+ws45=0 or 3 or 4	Selects the DTE side protocol stack.
AT+ws46	AT+ws46=23 or 24	Selects the carrier/network side stack.
ATd	ATd <IP_address>.<port#>	Tells module to originate a call.

Registration, Reset, and power off Commands

Command	Usage	Remarks
AT+wwreset	AT+wwreset	Resets the iO15 modem.
AT+wwmr	AT+wwmr="xxxx" (0000)	Master Resets the iO15 modem.
AT+wwpo	At+wwpo	Software Powers Off the iO15 modem.
AT+WPDEREG	AT+WPDEREG	Forces modem to deregister.
AT+WPREG	AT+WPREG	Forces modem to register
AT+wptrace	AT+wptrace	Service Status Log

SIM card management Commands

Command	Usage	Remarks
AT+wwsim	+wwsim="<SIM PIN>"	Unlocks the SIM card.
AT+wwsim	+wwsim?	Query SIM status.
AT+wwsim	+wwsim=?	Range.
AT+wwsimtgl	+wwsimtgl=1,"<SIM PIN>"	Enables SIM PIN mechanism
AT+wwsimtgl	+wwsimtgl=0,"<SIM PIN>"	Disables SIM PIN mechanism
AT+wwsimtgl	+wwsimtgl?	Query SIM PIN mechanism status.
AT+wwsimtgl	+wwsimtgl=?	Range.
AT+wwsimpin	+wwsimpin="<OLD SIM PIN>", "<NEW SIM PIN>"	Change SIM PIN

AT+wvsimpin	+wvsimpin=?	Range
AT+wvsimpuk	+wvsimpuk="<SIM PUK>","<SIM PIN>"	Unblock SIM
AT+wvsimpuk	+wvsimpuk=?	Range

Network Status Commands

Command	Usage	Remarks
AT+WS53?	AT+WS53?	Check Signal Quality.
AT+WS50?	AT+WS53?	Check Signal Strength.
AT+WPSTATE	AT+WPSTATE	Check mobile IP registration.
AT+WPNEI?	AT+WPNEI?	DTE IP Address

Appendix A: Requirements For FCC Testing

Instructions for FCC Testing

The iO1500R has a special software used for FCC testing. In order to get a unit with this software please contact the Motorola iO1500R Support Team at email: iO1500Support@motorola.com

In this mode, the developers can communicate with the iO1500R using an RF_Tester application provided by Motorola with detailed instructions. This application sends command scripts to the iO1500R module via a PC COM port.

IO1500R FCC Filing data

It is recommended that development engineers who will be taking data for FCC approval use the Motorola iO1500R FCC filing as a guide. This filing can be viewed online at the FCC's web site. These instructions show how to access the filing:

Preferred method of accessing the iO1500R FCC filing

If you are viewing this guide online, simply click on this link below to access the iO1500R FCC filing:

http://gullfoss2.fcc.gov/cgi-bin/ws.exe/prod/oet/forms/reports/Search_Form.hts?mode=Edit&form=Exhibits&application_id=92993&fcc_id=AZ492FT5826

Alternate method of accessing the iO1500R FCC filing

If you cannot access the iO1500R FCC filing using the above method, try this manual method that will also take you to the filing.

- 1) On the Internet, browse to the FCC search site: www.fcc.gov/oet/fccid/
- 2) Two pieces of information are needed here to locate the filing. In the field marked "Grantee Code", enter this value: **AZ4**.
- 3) In the field marked Equipment Product Code, enter this value: **92FT5826**.
- 4) Hit the "Start Search" button. The results page shows a table listing the different versions of the filing that were submitted.
- 5) In the query results, click the icon under "Display Exhibits". This brings up a list of all the exhibits (documentation, test results, charts, graphs, test methodology, etc.) that were submitted for this filing, in PDF format.

Which files to use

The files that are the most useful are the Test Reports and also the Test Setup files. Specifically, look for Measured Data A, Measured Data B, Measured Data C, and Test Setup Photos, which also contain test procedures.

Measurements for FCC Filing

The following tests should be performed on the iO1500R by qualified personnel to submit for FCC type approval of the product that will contain the iO1500R:

- **Conducted Emissions and Radiated Emissions Transmit Mode**

The iO1500R is cabled to a spectrum analyzer, looking for spurious emissions. Data should be taken at 3 TX frequencies: low, mid and high, with the iO1500R set to continuous transmit. Data should be taken from the 10th harmonic, down to lowest fundamental frequency in the unit. The low, mid, and high frequencies used are: 806.0625 MHz, 813.5625 MHz, and 824.9875 MHz.

Note: in USA the iO1500R must operate at 820.9875 MHz maximum according to FCC Grant.

- **Conducted Antenna Output Jack Receive Mode** – Typically used for Canada filings. A spectrum analyzer is cabled to the iO1500R. Look on the spectrum analyzer for spurious power out of receive band. Data should be taken at 2 frequencies, low and high, and the iO1500R set to continuous receive.
- **Receiver Spurious Radiation** – The iO1500R should not be registered to a cell tower during the test. Ensure that the iO1500R module is in continuous searching mode, with no timeout set. A dummy load should be used to ensure that the iO1500R does not find any carrier. Canada requires this data to be taken, the U.S. does not. Data should be taken up to the third harmonic, at three frequencies.
- **Occupied Bandwidth Pursuant to 47 CFR 2.989** - Tested at 3 different data transmit modes, measured both at high and low power output.

ERP- Effective Radiated Power, CW test method. – To run this test the unit has to be tuned to maximum burst power.

TROUBLESHOOTING

If you have a problem while setting up and using your modem for data calls, read the symptoms and troubleshooting tips provided in the following table.

If the system responds with an error message, refer to “Error Messages” on page 50.

Note that the response time for a wireless data call is slower than that for a wireline (normal) data call.

Table 1: Identifying Symptoms

Symptom	Troubleshooting Tips
Your modem does not respond to AT commands.	Make sure that: <ul style="list-style-type: none"> • The modem is powered on. • The cable is properly connected to the modem. • The cable is connected to the correct port and that this is the same port specified for use in your communication software. • The modem is set to the same baud rate as that specified in your communication software.
Computer screen appears distorted.	Turn off Auto Baud by activating AT+IPR command. Make sure that the baud rate setting in your software matches the baud rate setting on the modem.
No characters are displayed on the computer screen.	Turn on Local Echo by activating the ATE1 command.
The modem does not auto-answer incoming data calls (not default operation).	Make sure that the S0 register contains a value other than 0 (zero) by issuing an AT&V command. You can also explicitly set ATS0=x from the software’s command mode where x is any number between 1 and 255.
The NO CARRIER message display when the modem attempts data calls.	Make sure that the S7 register contains a value greater than or equal to 60 by issuing an AT&V command or by explicitly setting ATS7=x where x is any number between 1 and 255.
Received data is unrecognizable.	Make sure that flow control is set to RTS/ CTS (that is, hardware flow control is enabled) in the communication software and set to &K3.
Data is intermittently lost.	Make sure that flow control is set to RTS/ CTS (that is, hardware flow control is enabled) in the communication software and set to &K3.
The modem does not respond to a hang-up command from the software’s command mode.	Make sure that: <ul style="list-style-type: none"> • Drop DTR on Hang-Up is enabled in the communication software. • The hang-up string setting is “+++ATH”.
Modem seems to respond slowly than usual and/or drops connections occasionally.	Check the signal strength icon to be sure the signal is not weak.
Software reports various modem initialization errors when it attempts fax calls.	Make sure that: <ul style="list-style-type: none"> • The modem is switched on. • The cable is connected properly. • The cable is connected to the correct port and that this

	<p>is the same port specified for use in your communication software.</p> <ul style="list-style-type: none">• You are subscribed to the Data feature with your iDEN carrier.• The baud setting on the modem matches the baud setting in your software.• A generic Class 2 fax/modem is selected in the communication software.• The computer port's baud rate is locked at the recommended 19200 setting as specified in the installation instructions.• The RTS/CTS flow control is enabled in the fax application and set to &K3.
Images transmitted/received are of poor quality	Ensure that the RTS/CTS flow control is enabled in the communication software and set to &K3.

Error Messages

While making or receiving data calls, you might receive error messages on your modem display or on the computer screen. Refer to the following list before contacting your carrier.

Table 2: Error Messages

Message	Explanation
In the Software Application	
BUSY	The number that you called is busy; the modem is ready for another command. Try again later.
ERROR	The command was not recognized, the command line maximum length was exceeded, an invalid parameter value was entered, or there is another problem with the command line. The modem is ready for another command. Make sure that the command (and parameters) that you issued are valid.
MODEM INITIALIZATION FAILED OR EQUIVALENT ERROR MESSAGE	Your communication software assumes that Auto Baud is supported by the modem. Make sure that: <ul style="list-style-type: none"> • You are using one of the communication packages listed. • If Autobaud is turned on in the software, it requires being turned on in the programming menu of your modem.
NO CARRIER	Your connection was terminated, or an attempt to establish the connection failed. Try your call again or contact your iDEN carrier.
NO DIALTONE	Cannot gain access to the network; the modem is ready for another command. You might not have subscribed to the Data service. If you have a valid subscription and are not able to access the system, contact your iDEN carrier.

Fatal Errors

When the LED indicator alternates between red and green it means that a fatal error has been detected during power-up.

You may be requested by your carrier to get some more information about the error as follows:

1. Power-down the modem.
2. From the Control Panel, Double-click “iX1500 Modem”. The Communication setting window opens.

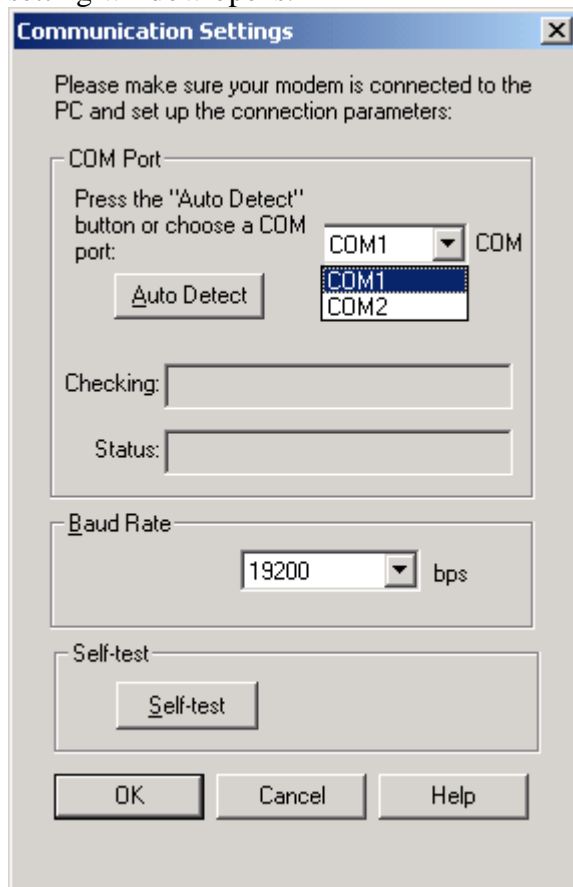


Figure 1. Communication Settings Window

3. Click “Self-Test”. The Self-Test window opens.

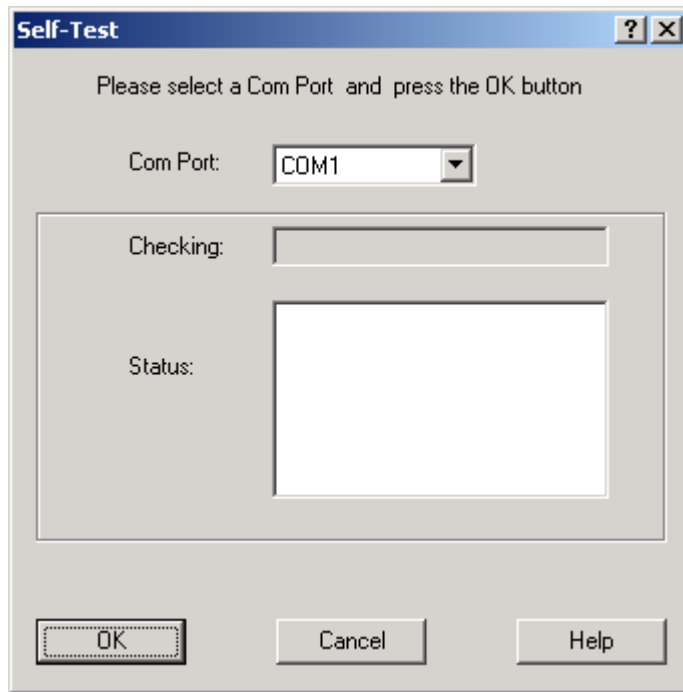


Figure 2. Self-Test Window

4. Choose the COM Port modem connection and click OK.
5. Wait for the message display notifying you to power-up the modem.
6. Power-up the modem and click OK.
7. The self-test results will be displayed after a few seconds.

For Advanced Users

If you are an experienced user, refer to this section for:

- [Setting HyperTerminal](#)
- [Installing packet data without the disk](#)
- [Using AT commands and S-Registers](#)

Setting HyperTerminal

To enter AT commands, you must set HyperTerminal.

NOTE

If, during this procedure, you cannot find the HyperTerminal file in the Accessories folder, search for it as follows:

1. From the taskbar on your Windows 98, Windows 2000, or Windows XP desktop, select “Start”.
2. Select “Find”.
3. Select “Files or Folders” and search for the file name “hypertrm.exe”.

If a search does not find the file, you can install it from your Windows 98, Windows 2000, or Windows XP installation disks. Then repeat the procedure for Setting HyperTerminal described below.

To set HyperTerminal:

1. From the taskbar on your desktop, select “Start”.
2. Select “Programs”.
3. Select “Accessories”.
4. Select “Communications”.
5. Double-click “HyperTerminal”. The New Connection – HyperTerminal window opens, displaying the Connection Description dialog box.
6. Enter a name for your connection. For example, if you are using COM1, enter “Communication to COM1.”
7. Select an icon to display with the name.
8. Click “OK”. The modem Number dialog box opens, displaying the icon that you created above.



Figure 3. Modem Number Dialog Box

9. In the Connect using field, select the name of the Motorola iDEN iX1500 modem.
10. Click “OK”. The Connect window opens.

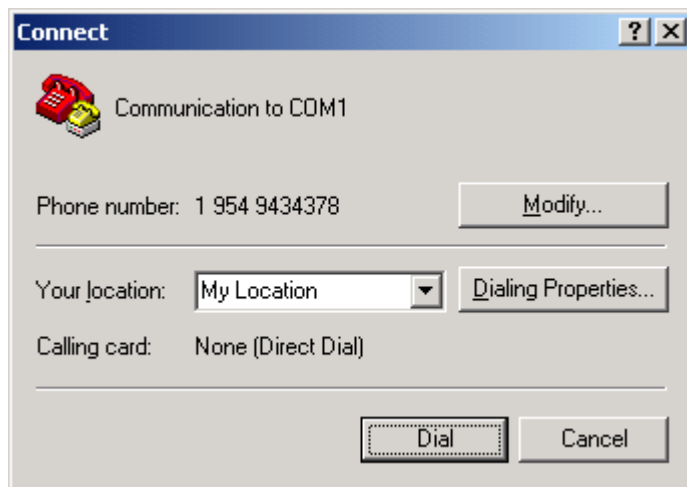


Figure 4. Connect Window

11. Click “Dial”.
12. When your call is complete, click “Yes” to save and close the session or click “No” to close the session without saving it.
13. When you finish, click “OK”.

Configuring the modem for Packet Data—without the Disk

If you installed the packet data software on Windows 98, Windows 2000, or Windows XP with the disk, skip this section. You can configure your modem for iDEN packet data services manually (that is, without the installation program) for a personal computer or a hand-held computing device.

Installation Requirements

- An iDEN data modem
- A data cable (PC-compatible)
- A personal computer, or a hand-held device with an RS232C serial port
- An active account with your iDEN carrier
- Communication software

If you have been using a wireline modem with your software application, make sure that the serial (COM) port that you specified in your communication software is the same port to which the modem is connected.

Installing Dial-Up Networking

This section provides the procedure for setting up Dial-Up Networking on your Windows 98 computer. For Windows 2000 and Windows XP Dial-Up Networking is an integral part of the O.S. and does not need to be installed separately.

Make sure that your Windows 98 installation media (CD-ROM or disks) is available. You may be asked to insert the CDROM or floppy disk later in the installation procedure.

1. From the Control Panel, double-click “Add/Remove Programs”. The Add/Remove Programs Properties window opens.
2. Select the “Windows Setup” tab.
3. Highlight “Communications” in the Components box.
4. Click “Details”. The Communications dialog box opens.
5. In the Communications dialog box:
 - a. Make sure that the selection box to the left of “Dial Up Networking” has a check mark in it.
 - b. Make sure that the selection box to the left of “HyperTerminal” has a check mark in it.
 - c. Click “OK” to close the dialog box, and then click “OK” again.
6. Restart your computer.
7. Continue with defining your dial-up networking connection.

Establishing Communication

To set up your iDEN modem for packet data services using AT commands, you must first establish basic communication with the modem function of the modem.

If you have not connected the data cable to the computer and your modem, do so now.

Software Connections

After you establish the hardware connections, you must run a terminal software program on your computer. The terminal program provides simple communication through the computer serial port.

To test the connection,

1. Type ATi4 in the Terminal Window.
2. Press Enter. You should see one of the following messages:

```
MOTOROLA, IDEN
OK
```

or -

```
MOTOROLA, IDEN
0
```

If the Connection Fails

If the message, OK, or the message, 0, does not display when you issue the AT command, check the connections and try again. Make sure that:

- The modem is powered on.
- The cable is connected according to the instructions.
- The serial (COM) port on the computer, to which the cable is connected, is the same as the serial port specified in your communication software.
- The communication program that you are using is listed.
- The software is configured according to the procedure described in this section.

If, after taking the above measures, the connection continues to fail, see “Troubleshooting” on page 48.

Configuring Port and Dial Settings

If you are installing data-enabled phone on a computer or hand-held device that does not use Windows 98, Windows 2000, or Windows XP, configure your port and dial settings, as follows:

```
Baud rate=19200
Data bits=8
Stop bits=1
Parity=None
Duplex=Full
Dial Method=Tone
Flow Control=Hardware
Data Initialization String=AT&K3
```

If the hardware flow control is not supported, set the Data Initialization String to AT&K4.

Extended Error Result Codes

Extended error result codes report the network reason why a data connection failed. If you report a failed connection to technical support, be sure to provide the code. See the following table for a list of the extended error result codes that the modem can return.

Table 3: Extended Error Result Codes

Code	Description
General Modem Operation	
257	No further information is available.
259	A command was issued during an improper state (Command/Online).
260	The connection was aborted by the user.
261	The DCE does not recognize an AT Command.
262	The connection was aborted due to a connection timeout.
263	The parameters for an AT Command are out of range.
266	The +FCLASS command failed due to incompatibilities with the current setting of the +WS46 command.
267	The +WS45 command failed due to incompatibilities with the value of the +WS46 command.
268	Invalid DTE-IP address was specified (+WPNEI).
269	Invalid Home Agent Address was specified (+WV305).
270	Invalid MIP Security Parameter Index was specified. (+WV309).
271	DCE IP address matched Home Agent IP Address (+WV304, +WV305).
272	The DTE tried to lock or unlock the DCE using an incorrect PIN.
275	An AT Command is not compatible with the currently active data service. Packet Data Operation
Packet Data Operation	
519	Requested level of encryption is not allowed.
545	Service is not present.
612	A data registration error was found. Contact your Service Provider.
833	FA: Mobile Node Administratively is prohibited from registration.
835	FA: Mobile Node Authentication failed.
836	FA: Home Agent Authentication failed.
897	HA: Mobile Node Administratively is prohibited from registration.
899	HA: Mobile Node Authentication failed.
900	HA: Foreign Agent Authentication failed.
1025	SLIP/PPP failed to respond.

1026	SLIP/PPP failed to configure the connection.
1027	SLIP/PPP link terminated.
Circuit Data Operation	
1280	No information is available.
1290	Unspecified Transmit Phase A Error
1300	Unspecified Transmit Phase B Error
1320	Unspecified Transmit Phase C Error
1330	Unspecified Transmit Phase D Error
1350	Unspecified Receive Phase B Error
1360	Unspecified Receive Phase C Error
1370	Unspecified Receive Phase D Error
Network Error Codes	
1538	No route to specified transit network.
1539	No route to destination.
1553	Called unit is busy.
1563	Destination is out of order.
1564	Invalid number format - incomplete
1570	No circuit/channel is available.
1574	Network is out of order.
1577	Temporary failure
1578	Switching equipment congestion
1580	Requested circuit/channel is not available.
1583	Resource is unavailable.
1594	Bearer capability is not presently available.
1593	Bearer capability is not authorized.
1599	Service or option is not available.
1601	Bearer service is not implemented.
1602	Channel type is not implemented.
1615	Service or option is not implemented.
1624	Incompatible destination.

Commonly used AT commands & S-Register

Refer to document “iDEN Mobile Subscriber DTE/DCE Interface for Data Services 68P81129E10-C” for a full description of the AT commands supported by the iO1500R modem and detailed explanation on S-Registers.

This document can be downloaded from the iO1500 Website at:

<http://www.mot.com/cgiss/iO1500R>

(Click on link “iO1500R iDEN-Data Communications Interface Specification”).

GLOSSARY

API	Application programming interface.
asynchronous	Data without an accompanying time signal. Timing is built into data characters as start and stop bits.
AT command	An order entered into the computer to request your modem to perform certain actions, such as dial a teledem number. AT commands are Hayes-compatible modem commands.
baud rate	Signaling speed of the modem. Common baud rates are 2400, 4800, 9600, 19200, and 38400 bps.
bps	Bits per second. The rate at which data passes over the teledem line or through the air. The basic unit of measure for serial data transmission capacity.
burst	A unit of information consisting of a sequence of signals.
circuit-switched data	Continuous data communication, such as a modem call.
CTS	The Clear to Send signal passed from the local modem to the local terminal when the data port is ready to transmit data. Occurs in response to the Request To Send (RTS) signal.
command mode	The mode that accepts AT commands. Also known as TerminalMode. When your modem is in this mode, it is waiting to receive AT commands that you type from your communication software.
communication software	A computer program designed to connect your computer to an external source, such as another computer or a fax machine.
data services	One of the functions of your iDEN

modem. Wireless data services uses both circuit-switched and packet data transmissions.

DCD	Data Carrier Detect. An acceptable carrier signal received by the modem over the modem line. Also known as Received Line Signal Indicator (RLSI).
DCE	Data Communications Equipment. The equipment that establishes, maintains and terminates a connection. It converts data into units of sound and vice versa for communication over telemodem or cellular networks.
DLL	Dynamic Link Libraries.
default	A factory preset choice that, under normal circumstances, works best for your system. You can either accept the default or change it.
dialing directory	A modem book of frequently called modem numbers that you can set up and maintain in your communication software.
DTE	Data Terminal Equipment. A computer or hand-held device that generates and receives data, and provides functions that control data communications through a device like the modem.
hand-held devices	Small computing appliances, such as palm tops, personal digital assistants, and pen based computers.
home agent	The server that is responsible for routing data from your home network to your computer.
iDEN carrier	Provider of packet data services.
Internet	Inter-connected networks that all use the TCP/IP protocols.
Intranet	A private network inside a company or organization.

laptops	Portable computers, such as notebooks and subnotebooks.
mobile IP	Mobile Internet Protocol—a locating device. Provides the capability to locate you on the network at all times.
modem	MOdulator/DEModulator. An electronic device enabling digital data to be sent over analog transmission facilities. Converts a digital signal to analog and back to digital again.
NDA	Non-disclosure agreement
non-volatile memory	Permanently stored information. It is not lost when the power is turned off.
packet data	A block of data for transmission.
parity bit	An error-checking method in asynchronous transmission. An additional non-data bit added to a group of bits to indicate whether the number of bits in the group is odd or even.
PIN	Personal Identification Number. A security number that allows you to access a system.
PPP	Point-to-point protocol.
protocol	A set of conventions regulating the format and relative timing of message transfer between two communication terminals.
RAM	Random Access Memory. The working memory of the computer where you can enter information and call up data.
RTS	Request to Send. Signal sent from the local terminal to the local modem to prepare the modem for data transmission.
serial port	An input/output (I/O) port that transmits data one bit at a time; as opposed to a parallel port which transmits multiple (usually eight) bits

	simultaneously. RS232C is a common serial interface standard.
service provider	Provides your computer with Internet access. Also known as an ISP (Internet Service Provider).
service-specific software	A program that is designed for a designated online service.
stop bit	A data bit used in asynchronous transmission to signal the end of a character.
system administrator	The person responsible for monitoring computer activity in a specified area, such as a department or a company.
terminal mode	The mode that accepts AT commands. Also known as Command Mode. When your modem is in this mode, it is waiting to receive AT commands that you type from your communication software.
transmission rate	The rate at which data is transferred, in bits per second.
wireless data services	See data services.