

# **KWM - 9612 Plus** **Operations Manual**

Supplements the KPC-9612 Plus Manual and Addenda  
For use with KWM-9612 Plus

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*This manual supplement is intended for use with the KWM-9612 Plus in conjunction with the KPC-9612 Plus manual and addenda. The "KWM Commands" section of this supplement contains descriptions of those commands that have been modified or added (to the KPC-9612 Plus) for KWM-9612 Plus operations.*

## Introduction

The KWM-series of radio modems contains the AX.25 protocol found in the KPC-series modems plus other protocols that have the potential to be easily integrated into a variety of commercial applications.

AX.25 protocol operation is described in the KPC-series manuals along with the AX.25 commands used and cabling/installation instructions and other information.

Although AX.25 packet is a very robust protocol and assures near error-free exchange of data between Data Terminal Equipment (DTE) devices, it is somewhat cumbersome to implement. AX.25 requires that the user learn a highly-structured command set and the myriad of responses that can be received from the modem. Often, a long process of trial and error results in the realization that AX.25 may not be the most suitable protocol to use for a particular application.

Kantronics has developed the Transparent Unproto Packet (TUP) Mode, Poll Mode, Line Substitution (LINESUB) Mode, and Modem Mode protocols for the KWM-series in an effort to allow the modems to be more easily used with different types of installations. This manual supplement contains a detailed description of these protocols and their operation.

## Setting up the Modem

Follow the instructions in the KPC-series manual to properly power and cable the modem to your computer. How to install an address (call sign) and set the *serial port* baud rate for communications between your computer and the modem is explained in the "Getting Started" section. The exercise of connecting to your personal mailbox will assure you that the computer is properly communicating and the modem is properly responding to command input.

## Bench Test Set-up

The ideal bench set-up for testing the suitability of the operational characteristics of the selected modem protocol for an application is a pair of computer/modem "stations" with the modems cabled back-to-back. To set up the back-to-back "stations," connect the transmit audio of the first modem to the receive audio of the second modem and then connect the transmit audio from the second modem to the receive audio of the first. A common ground connection is also necessary to provide a return path for the audio signals. This allows the modems to communicate with each other using the "wire radio" just described. This preliminary step allows experimentation with the modems and the different protocol delays, responses, and characteristics without having to be concerned with an actual radio link.

After the proper protocol has been selected for a particular application, and has been demonstrated to work properly, the radios can be integrated into the test set-up. (See KPC-series manual for cabling information.) If problems appear at this stage, the radio link is probably at fault. The addition of the radio link will also add a significant amount of time to the data transfer because of transmitter key-up and return to receive delays which may require modification of initial parameter settings. Be sure that the application can tolerate the additional time that is required for the radio link!

# Protocol Descriptions and Operation

## ***Transparent Unproto Packet (TUP) Mode***

### TUP Mode Description

The TUP mode protocol utilizes the Unproto mode of the AX.25 protocol, allowing digipeaters (VIA path specified with UNPROTO command) to be used in order to effectively extend the range of a radio data system beyond simplex distance. This protocol uses the standard AX.25 CRC-16 error-checking to provide a high degree of data integrity. Data is sent and received in a totally transparent fashion, allowing all ASCII characters to be utilized (hex 00 through hex FF). Radio transmission is based on the PACTIME AFTER parameter setting of the modem, the setting of the carrier detect method, and the settings of the slot and persist channel access algorithm. Any data that is received by the modem via the radio is output to the serial port *only* if it contains no detectable errors. The received data will be *exactly* the same as the data that was sent to the input serial port of the transmitting mode, without any address headers or added formatting of the data. The modem is capable of selectively filtering monitored data from or to different modem addresses using the BUDLIST command.

If digipeaters must be used to extend the range of the system, the information frame sent by any modems in the system will be output to the serial ports of the receiving modems only once, regardless of how many times it was received correctly. Also, data sent by any modem will not be decoded by itself when the data is digipeated. The TUP mode protocol provides an automatic "Time to Live" timer that inhibits any modem from transmitting or receiving additional data until sufficient time has expired to allow in-progress data to travel through all the digipeaters specified in the UNPROTO field of the originating modem. Since the time for a given packet to travel the entire UNPROTO path may vary due to the presence of other signals or noise, TUPTIME is used to impose an additional delay time, if needed, during which each modem will be inhibited from decoding or transmitting new data. This setting can be determined experimentally. It is important to note that TUPTIME applies *only to the receiving modems* and should be set to the same value at all sites. It is the responsibility of the host system to insure that additional data is not transmitted until sufficient time has elapsed to allow data to travel to the last digipeater and the response, if any, to travel back to the host. Note that the automatic "Time to Live" timer and the TUPTIME timer are only in effect if packets are being digipeated.

### TUP Mode Operation

TUP Mode may be used in one and only one port of the KWM-9612 Plus at a time; that is, you may configure the modem for TUP operation in the 1200 baud port (port 1) or in the high-speed port (port 2). The port of choice is set by using the MAXUSERS command (before entering the TUP mode).

To set the unit for port 1 operation only, issue MAXUSERS 1/0.

To set the unit for port 2 operation only, issue MAXUSERS 0/1.

### **Commands Used**

Basic TUP Operation involves just a few commands:

**MYCALL** - The MYCALL command determines the MODEM address. This must be entered after the autobaud routine has detected an asterisk (\*).

**TXDELAY** - The TXDELAY (TXD) command determines how long the modem will assert the Push-to-Talk line of the radio before sending data. This time will have to be determined experimentally since it will vary from radio to radio. If the TXD is set too short, the data transmitted will not be received by other units in the system. Setting TXD too long will reduce channel capacity. NOTE: Since TXD is used in the computation of the automatic timer used to inhibit transmission until a digipeated packet has had time to reach its destination, TXD must be set to the same value in all modems in the system

**PACTIME** - The PACTIME parameter determines how long the modem will wait after receiving data to be transmitted from the DTE before beginning the radio key-up sequence. Normally, this parameter should be set to AFTER 1 (100 ms) in order to minimize "dead air" time on the system.

**PACLEN** - PACLEN sets the maximum size of the data packet(s). Most applications do not require large amounts of data to be transferred so the default value (128) will probably be satisfactory, allowing packets up to 128 bytes. If the amount of data to be sent exceeds the PACLEN parameter setting, the transmission will be composed of multiple packets containing the data.

PERSIST and SLOTTIME - These parameters determine how aggressively the modem will attempt to access a multi-user channel based on carrier detect. See KPC-series manual for a full explanation of these parameters.

### **Entering TUP Mode**

Use the INTFACE command to begin TUP operation. Set the INTFACE command to TUP:

```
cmd:INTFACE TUP <cr>
```

and turn the unit off and then back on.

### **Exiting TUP Mode**

If you want to exit the TUP mode to "fine tune" parameter settings (or for any other reason), the Command mode of the modem can be regained by using the transparent data escape sequence, i.e., by sending a series of three control-Cs (unless a different control character for COMMAND has been defined). (See TRANS command in the Reference manual).

## **Poll Mode**

### Poll Mode Protocol Description

The POLL mode is generally used in system applications that implement a polled-response protocol between a central site (Control Site) and one or more remote locations (Remote Site). The POLL mode is similar to the TUP mode since it uses a data transparent broadcast mode and a packet protocol with CRC-16 error-checking to insure the integrity of the received data. All ASCII characters (hex 00 through FF) can be transmitted and received. The POLL mode differs from TUP mode by allowing an application program to address specific locations without changing any modem parameters. All data sent by the application program at the central site must begin with the address (POLLID) of the intended remote modem. When any remote modem receives data from the radio, the data is checked for errors and the received POLLID is compared with its own POLLID. If they match, the POLLID is stripped and the data that follows is sent to the serial port. All data received by the central site from the remote location will arrive with the POLLID of the remote site automatically attached to the beginning of the data.

It is the responsibility of the application program to: (1) address data to be sent to the remote sites, (2) determine if the data was received, and (3) recognize responses that contain the remote site's POLLID and data. *Digipeating is not allowed*

### Poll Mode Operation

POLL Mode may be used in one and only one port of the KWM-9612 Plus at a time; that is, you may configure the modem for POLL Mode operation in the 1200 baud port (port 1) or in the high-speed port (port 2). The port of choice is set by using the MAXUSERS command.

To set the unit for operation in port 1, issue MAXUSERS 1/0

To set the unit for operation in port 2, issue MAXUSERS 0/1.

### Commands Used

Each modem is set up differently depending upon whether it is to be a Control modem or a Remote modem.

#### **Control Site**

**Control Site Configuration** - The POLLID command in the Control modem must be set to 0000 and the INTERFACE command must be set to POLL. (See "Entering POLL Mode" below.)

**Control Site Transmit Format** - All data sent to the Control modem via the RS-232 serial port *must* begin with a POLLID (four digit remote address between 0001-9999) and be followed immediately by the poll data. The data sent by the application to the Control modem must contain less than PACLEN bytes. If the poll data contains more characters than allowed by the setting of the PACLEN command, the data will be fragmented and multiple packets will be formed and transmitted by the modem. These additional packets will contain *only* the balance of the data received by the modem. Since these packets do not begin with a POLLID, they will be ignored by all Remote modems.

**Control Site Receive Format** - All Remote transmissions received by the Control modem shall consist of the Remote POLLID followed immediately by the Remote data. Both POLLID and data will be sent to the control DTE via the RS-232 port.

#### **Remote Site**

**Remote Site Configuration** - The POLLID command in each of the Remote modems must be set to a different number between 0001 and 9999. This assures that data is received by just one remote device.

The INTERFACE command in each modem must be set to POLL. (See "Entering POLL Mode" below.)

**Remote Site Transmit Format** - Remote sites generally do not have much computing capacity. . Therefore, the transmitted format of the data is, of necessity, straightforward. All data received via the serial port will be formed into packets and transmitted with the address (POLLID) attached to the beginning of each data packet.

**Remote Site Receive Format** - All data received by the Remote via the radio is first examined for errors using a CRC-16 error-checking algorithm. Data packets that contain errors are discarded. If the data contains no errors, it is then checked for a match of the received POLLID and its own POLLID. If there is not a match, the data is discarded. If there is a match, the POLLID is stripped and the raw data is passed to the RS-232 serial port for processing. The received data format will be *exactly* the same as the data sent to the Control Modem by the application program.

The CONMODE parameter affects when data will be sent in Poll Mode.

If CONMODE is set to CONYERS (default), data will be transmitted when any of the following conditions is met:

1. The SENDPAC character is received by the modem. The default SENDPAC character is a carriage return and can be changed to suit an existing application. The SENDPAC character can be either stripped or appended to the data by setting the CR command ON to append, or OFF to strip.
2. PACLEN is exceeded. *CAUTION: MASTER (Control Site) operation will be unusable if PACLEN is exceeded since each packet of data sent MUST begin with a Slave (Remote Site) POLLID (0001-9999).* Remote transmission may exceed the setting of PACLEN since each packet transmitted from the Remote will contain the proper POLLID. If fragmentation of data occurs, the application program is responsible for reconstructing the data. PACLEN determines the *maximum* size of data packets (default 128 characters). Normally, the amount of data to be transmitted will be considerably less than this.
3. CPACTIME is on and PACTIME expires. If CPACTIME is ON, data will be periodically transmitted based on PACTIME timeout.

If CONMODE is set to TRANS, data will be transmitted when:

1. PACLEN is exceeded, or
2. PACTIME expires.

### **Suggested Settings**

Usually, the CONMODE command is set to TRANS and the PACTIME command is set to AFTER 1. The CONMODE TRANS command makes the modem data transparent to the Remote device. The PACTIME AFTER 1 command allows the modem to transmit the data received via the serial port with as little delay as possible. This speeds up the response time of the system by reducing "dead-air" time.

It is also recommended to set the PACLEN command to zero. This allows the modem to send a single packet of data to the radio of any size between 1 and the maximum of 256 characters. If the response data from the remote contains more characters than the PACLEN command allows, the data will be transmitted in multiple packets with the Remote POLLID automatically attached to the beginning of each data packet. In such a case, it is the responsibility of the Control Application Program to reassemble the data.

**CAUTION:** Allowing the Control Site application to send more data than that permitted by the PACLEN command is the most common cause of failure using the POLL mode. **BE ABSOLUTELY SURE THAT CONTROL SITE TRANSMISSIONS NEVER EXCEED THE PACLEN LIMIT!**

### **Entering POLL Mode**

When you have entered the POLLID of the unit and made any desired changes from the default settings in the parameters, use the INTFACE command to begin POLL operation. Set the INTFACE command to POLL:

```
cmd:INTFACE POLL <cr>
```

and turn the unit off and then back on.

## Exiting POLL Mode

If you want to exit POLL mode to "fine tune" parameter settings (or for any other reasons), the command mode of the modem can be regained as follows:

If CONMODE = CONV

Enter: 0000QUIT<cr> (NOTE: MUST BE IN UPPER CASE)

If CONMODE = TRANS

Use the transparent data escape sequence, i.e., send a series of three control-Cs (unless a different control character has been defined). (See TRANS command in the Reference Manual).



## **Line Substitution (LINE SUB) Mode**

### LINE SUB Mode Protocol Description

The LSUB mode of operation provides a method of transmitting-and receiving raw ASCII data via a radio. Data is sent and received in a totally transparent fashion, allowing all ASCII characters to be utilized (hex 00 through hex FF). There is no addressing, error-detection or automatic retransmission of the data. When the receiving modem detects the proper Start-of-Data sequence generated by the transmitting modem, it will output the data that follows to its; serial port. At the end of the received data there is an End-of-Data sequence that permits the receiving modem to recognize the end of the data and quit translating the receiver audio. This allows the modems to operate with open squelch audio from the radios. Since the protocol constitutes a very small portion of the transmission, the effective data throughput is very nearly that of the radio baud rate (HBAUD).

### LSUB Mode Operation

LSUB Mode may be used in one and only one port of the KWM-96 12 Plus at a time; that is, you may configure the modem for LSUB operation in the 1200 baud port (port 1) or in the high-speed port (port 2). The port of choice is set by using the MAXUSERS command.

To set the unit for port 1 operation only, issue MAXUSERS 1/0.

To set the unit for port 2 operation, issue MAXUSERS 0/1.

### Commands Used

TXDELAY - The TXDELAY (TXD) command determines how long the modem must key the Push-To-Talk line of the radio before sending data. This time will have to be determined experimentally since it will vary from radio to radio. If the TXD is set too short, the data transmitted will be garbled and not received by other units in the system. Setting TXD too long will reduce channel capacity.

PACTIME - The PACTIME parameter determines how long the modem will wait after receiving data to be transmitted from the DTE before beginning the radio key-up sequence. Normally, this parameter should be set to AFTER 1 (100 ms.) in order to minimize "dead-air" time on the system.

PERSIST and SLOTTIME - These parameters determine how aggressively the modem will attempt to access a multi-user channel based on carrier detect. See KPC-series manual for a full explanation of these parameters.

### Entering LSUB Mode

When you have made any desired changes from the default settings for the above parameters, use the INTFACE command to begin LSUB operation. Set the INTFACE command to LINESUB:

```
cmd:INTFACE LINESUB <cr>
```

and turn the unit off and then back on. Be aware that there is *no* data flow control.

### Exiting LSUB Mode

If you want to exit LSUB mode to "fine tune" parameter settings (or for any other reason), the Command mode of the modem can be regained by using the transparent data escape sequence, i.e., by sending a series of three control-Cs (unless a different control character has been defined). (See TRANS command in the Reference Manual).

## **Modem Mode**

### Modem Mode Protocol Description

It is important to note that when the MODEM mode is used, the modem is acting as a pure modulator/demodulator and uses the RTS and CTS lines of the serial port to control transmission of the data. There is *no* addressing, error correction, error detection, or flow control of the data as it is transmitted or received. The audio tones generated and received by the modem will directly mimic the data in composition and speed. Because of this, it is essential that all Data Terminal Equipment (DTE) associated with this mode have identical serial port parameters in use.

EXAMPLE: 1200 baud, No parity, 8 data bits, 1 stop bit

### Modem Mode Operation

This mode is available only with port 1, the 1200 baud port.

#### **Commands Used**

The TXDELAY (TXD) command sets the parameter to control the time necessary (in 10 ms steps) for the transmitter to be keyed prior to transmitting data tones. TXD is the only command in the manual that affects the MODEM mode of operation. This timing interval can be adjusted to suit a particular radio by changing the value of the TXD parameter.

#### **Entering MODEM Mode**

When you have set the TXD parameter as desired, use the INTFACE command to begin MODEM operation. Set the INTFACE command to MODEM:

```
cmd:INT MODEM <cr>
```

Turn the unit OFF and then back ON *with RTS held low*.

The idle state of the CTS and RTS lines between the DTE and the modem is normally low (negative voltage). When the RTS line is asserted by the DTE, the modem will immediately key the transmitter, sending a "Mark Hold" tone and return CTS to the DTE after the TXDELAY (TXD) time period has expired. The return of CTS indicates to the DTE that the radio is transmitting and that the modem is ready to accept data via the serial port at any speed up to 1200 baud. Releasing the RTS signal from the DTE to the modem will cause the modem to release the Push-To-Talk line to the radio and drop the CTS to the DTE.

#### **Exiting MODEM Mode**

Since all data appearing on the serial input to the modem is regarded as data to be sent, the Command mode of the modem *cannot* be regained by using the transparent data escape sequence, i.e., by sending a series of three control-Cs as described in the TRANS command in the Reference manual. If you wish to exit MODEM mode to change the TXD parameter (or for any other reason), holding the RTS line high during power-up will restore the unit to the Command mode.

## **TNPP Mode**

*Note: We assume that you're familiar with the Teleocator Network Paging Protocol (TNPP). A full description of TNPP may be obtained in booklet form (for a fee) from the Personal Communications Industry Association (PC/A), 500 Montgomery Street, Suite 700, Alexandria, VA 22314-1561, 703-739-0300, fax 703-836-1608.*

*Note: The KWM-9612 Plus (and KPC-9612 Plus) support RPC1 (POCSAG) paging but not other formats such as Golay or Flex. See the KPC-9612 plus for a detailed description of the PAGE command, supporting the transmission of 512, 1200, and 2400 baud POCSAG numeric and alphanumeric pages.*

Two commands were added to accommodate TNPP receive-only mode: TNPPDEST and TNPPCRC. These are described in the command section at the end of this supplement. In addition, the INTFACE command was modified so that the KWM-9612 Plus may enter TNPP receive-only mode upon power up. All paging operations are via port 2.

## **TNPP Mode Description**

Many full service paging terminals utilize TNPP to send pages to other terminals in ASCII format (for wide area paging). Full implementation of the protocol would include an acknowledgment by the receiving terminal to the sending terminal of pages received. However, many systems use an open-ended version, thus receiving but not acknowledging pages sent in the TNPP ASCII format. The KWM-9612 Plus receives but does not acknowledge pages when placed in "TNPP Mode."

TNPP Mode is entered by setting the INTFACE command to TNPP and then causing a reset by command or by turning the KWM-9612 Plus off and then on. To exit TNPP mode, one must use three control-Cs as described for exiting transparent packet mode (in the KPC-9612 Plus manual). Since end-of-text (ETX) is also a control-C, you may want to change the character used for exiting modes to something else like control-D(\$04 see COMMAND command).

The KWM-9612 Plus keeps a record of the last 64 serial numbers received in TNPP packets, even if the destination matches none of the TNPPDEST entries (see TNPPDEST command in the commands section of this supplement). If a TNPP packet is received with a serial number equal to 0 the table of 64 serial numbers is cleared. The table is also cleared any time the unit is turned on or reset. No pages in the TNPP packet are processed if the serial number is 0.

When a TNPP packet is received and processed, the pages are put in the PAGELOG buffer, waiting for transmission. If you exit TNPP, you can see the log of pages with the PAGELOG LIST command. If for some reason the PAGELOG should fill because it can't send pages as fast as the TNPP packets are received, the new pages are discarded; if a multi-page packet is received, the pages that will fit in the PAGELOG are saved while those that don't are discarded; no matter how many pages are saved or discarded, the serial number is still saved in the serial number buffer.

## **TNPP Mode Operation**

There are several commands which should be changed from factory defaults for TNPP receive-only operation.

PBBS	set -to-O
MAXUSERS	set to 0/1, all paging is via port 2
PAGELOG	set to maximum
PAGECWID	set to OFF or your preference
COMMAND	used to get out of TNPP mode; you may wish to change this to \$04
DAYTIME	when pages are put in the PAGELOG buffer, they are time stamped
INTFACE	set to TNPP

Note also that there is no flow control in TNPP.

# KWM Commands

*This section contains only those commands which have been added or modified for use with the KWM-9612 Plus. All other commands are found in the command section in the KPC-9612 Plus Reference manual or addenda.*

## Added Commands

### **POLLid 0000-9999 {default 0000}**

Pollid is used with the Poll Mode. The four-digit POLLID determines if the modem is a Control or a Remote modem. If the modem is a Remote, POLLID also sets the Remote address. If POLLID is equal to 0000, the modem is a Control Modem. If POLLID is 0001 to 9999, the modem is a Remote Modem.

### **TUptime n (n = 0 - 225) {default 1}**

TUPTIME is used *only* in TUP mode and imposes an additional time to live (in 100 ms increments) for digipeated packets.

### **TNPPDEST [+|-] [enter up to 32 addresses of 4 hex numbers]**

This command allows setting up to 32 TNPP destination addresses, which are compared to an incoming TNPP packet. If the destination of the incoming TNPP packet matches any of the TNPPDEST entries, and the serial number of the TNPP packet does not match any of the serial numbers kept in the KWM-9612 Plus, then the pages in the TNPP packet are processed.

The TNPPDEST command expects addresses to be expressed in hex, such as

```
TNPPDEST A401, 3005, 4BC1
```

Destinations can be added or removed, e.g.

```
TNPPDEST-3005 A401  
TNPPDEST +5F03
```

### **TNPPCRC [ON | OFF]**

This command can be used to enable or disable CRC checking by the KWM-9612 Plus on received TNPP packets. It is defaulted ON (enabled). When on, the KWM-9612 Plus checks the next two bytes after the end-of-text (ETX) in the TNPP packet for correct CRC; if not correct, the packet is ignored. When TNPPCRC is OFF, the unit does not check the CRC bytes and in fact does not even look at them. If the TNPPCRC command is off, the KWM-9612 Plus starts looking for start-of-header (SOH) immediately after receiving an ETX. If the unit receives a packet with CRC bytes, it is possible that a CRC which contains an SOH may confuse the KWM-9612 Plus.

## Modified Commands

### **INTface [Terminal | KISS | XKISS | GPS | LINESUB | MODEM | TNPP | TUP | POLL] {default TERMINAL}**

The TUP, POLL, LINESUB (LSUB), and MODEM modes have been added to the INTFACE command for the KWM-9612 Plus. NEWUSER has been deleted from the KWM firmware.

TNPP blind, not TNPP full, is implemented. TNPP blind allows for the reception of pages from a full service paging terminal but does not acknowledge receipt.

### **PAGE [-An | -Nn] [-512 | -1200 | -2400] [<call>] {name | capcode} message**

Note that an "n" has been added to the basic KPC-9612 Plus paging command. An "n" value of {0,1,2,or 3} may be entered to force a POCSAG (RPC1) function code of "00", "01", "10", or "11 ". "00" is normally used with numeric pages and is the default; "11" is the default for alphanumeric pagers. Some services use the other function codes for special services such as stock quotes, game score pages, etc.

**PAGEMON ON | OFF | ALL | LIST | CLEAR | nzza | {[+|-] capcode[,capcodes]}**

Note that the ability to monitor a number of specific capcodes, as entered in a list, is added. If one specifies PAGEMON LIST, then only those pages containing capcodes in the list will be monitored. If ALL is on, then all pages will be monitored. You use PAGEMON also to enter a list of these cap codes or one capcode at a time, or to delete the list or one capcode at a time.

For example, to enter a single capcode issue the command PAGEMON + n, where n is the a legal capcode number.

To turn on the list and monitor only those pages with capcodes in the list enter the command PAGEMON LIST. To clear the list, issue PAGEMON CLEAR.