

TECHNICAL MANUAL for RF Data Link Kits (K173, K174, K175, K176)

This document describes the message format used by the RF Data Link kits. There are four kits in the series:

1. K173 Serial Input transmitter
2. K174 Serial Output receiver
3. K175 Parallel Input transmitter
4. K176 Parallel Output receiver

OVERVIEW

Data is transmitted in packets using the following format:

<preamble><start_symbol><byte_count><data><CRC_byte>

The 'preamble', 'start_symbol', 'byte_count' and 'CRC_byte' are used for housekeeping and are inserted automatically into the message by the transmitter kits.

The 'data' field contains the user's data and is limited to a maximum of 64 bytes.

The 'preamble' and 'start_symbol' bytes are used by the receivers to synchronize to the start of the message.

The 'byte_count' indicates the length (number of bytes) in the 'data' field.

The 'CRC_byte' is a checksum of the 'byte_count' and 'data'. It is used to detect any errors in the message that may occur during transmission. It is generated using the CCITT-8 polynomial $X^8 + X^5 + X^4 + 1$.

At the receiver end the number of received bytes in the data field are counted and a CRC generated. If either differs from that sent in the original then the message is discarded.

Received bytes are stored in a buffer. If the bytes received > buffer size then extra bytes are stored in last buffer location, overwriting previous data. Obviously the byte counts will differ and the message discarded.

DESTINATION ADDRESS

The destination address is stored in the 'data' field of the message and is a single HEX digit in the range 0 - F (upper or lower case).

The destination address is optional but if used in **must** start in the first position of the data field using the following format:

<@n ... more data bytes>

where '@' is the address leadin character and
'n' is the address of the receiver.

For example: To send a message to the receiver at address 5 insert '@5' at the start of the message.

NOTE: The address is part of the 'data' field. It takes up 2 of the maximum 64 bytes allowed.

Both receiver kits, K174 and K176, contain a 4-way DIP switch which sets the receiver's address. This allows up to 16 receivers to be used in a single network. Only receivers matching the destination address will process the data.

As mentioned the destination address is optional. A message without an address is called a **broadcast** message because **all** receivers respond to it. A broadcast message is useful for sending the same data to all receivers at the same time.

K173: RF DATA LINK TRANSMITTER – SERIAL INPUT

Serial input data format is **8N1** (8 data, no parity, 1 stop).

SW1:2	SW1:1	Baud Rate
OFF	OFF	300
OFF	ON	1200
ON	OFF	2400
ON	ON	9600

SW1:3 Transmit Mode

OFF	BINARY mode
ON	ASCII mode

BINARY mode

- Data bytes can be anything in the range 00h - FFh.
- Data transmitted when low pulse received on SEND input (SEND should normally be high).
- BUSY low when ready to receive data.
- BUSY high while transmitting.
- Attempting to load more than 64 bytes causes BUSY to go high and the extra bytes discarded.
- DTR/DSR used to implement SEND/BUSY.

A note about RS232 voltage levels

In the RS232 world logic levels are specified as follows:

High -3 to -15 volts

Low +3 to +15 volts

Please bear this in mind when we talk about **SEND** or **BUSY** being high or low.

ASCII mode

- Only printable ASCII characters from 20h to 7Eh are allowed - all others are ignored.
- Data transmitted when <cr> character received.
- Characters can optionally be echoed (see SW1:4)
- BUSY set to low and stays low; SEND not used.

SW1:4 Echo ON/OFF

- Only works in ASCII mode
- Echos each received character back to the serial port.
- Echos CR/LF when CR received

SW1:5 - SW1:8 Destination address J1 Destination address enable

The destination address is normally entered as part of the data. However it can be added automatically by inserting jumper J1. In this case SW1:5 to SW1:8 set the address.

K174: RF DATA LINK RECEIVER – SERIAL OUTPUT

Expected data format: <@n><data bytes>

where '@n' is the optional receiver address.

Serial output data format is **8N1** (8 data, no parity, 1 stop).

TECHNICAL MANUAL for RF Data Link Kits (K173, K174, K175, K176)

SW1:1 - SW1:4 Receiver address

Sets the address of the receiver.

J1 Disable receiver address

J2 Append CR/LF

J3 Baudrate: On = 2400, Off = 9600

J1 Receiver address disable

Disables the receiver address.

The kit will respond to ALL messages received, regardless of whether they contain an address or not.

Useful when debugging or monitoring activity in a network. Connect to a PC and run a terminal program and all messages will be displayed, showing what messages are being sent and what data they contain.

J2 CR/LF enable

Send carriage return/line feed after each message.

Useful if displaying messages on a screen - each message will start on a new line. Also necessary if the messages are being captured by a program or onto disk - a carriage return is often required to terminate the message.

J3 Baudrate select

Sets serial port baudrate - **ON = 2400, OFF = 9600.**

Only checked at power - kit should be powered down before changing.

K175: RF DATA LINK TRANSMITTER – PARALLEL INPUT

- Continually monitors 8-bit input for ANY change.
- If change detected the inputs are debounced (20mS).
- If still different then save and transmit.

The transmitted data format is '\$xx' where '\$' is the hex byte leadin character and 'xx' is the hex value of the 8-bit input as ASCII characters.

Debouncing is necessary when inputs such as toggle switches, pushbuttons and relay contacts are used.

SW1:1 - SW1:4 Destination address

J1 Destination address enable

If J1 is inserted then a 'destination address' is inserted into the data stream. The address format is '@n' where 'n' is the address as read from DIP switches SW1:1 - SW1:4.

The resulting message looks like this:

@n\$xx

where n = destination address

xx = hex value of input as ASCII characters

K176: RF DATA LINK RECEIVER – PARALLEL OUTPUT

Expected data format: <@n><data bytes>

where '@n' is the optional receiver address.

SW1:1 - 4 Receiver address

Sets the address of the receiver.

SW2 BUSY signal enable/disable

Enable or disable the BUSY signal.

Used when connected to a Centronics printer. Disabling BUSY blocks the BUSY signal from the printer and forces output. Should be enabled normally.

There are 3 modes of outputting the received message:

1. **Bit mode**
2. **Byte mode**
3. **Print mode**

Bit Mode

Numbers 0-7 specify which output D0-D7 to turn ON.

Eg. '012' turns on outputs D0,1 and 2 (all others off).

Any character outside the range 0-7 turns **all** outputs off.

In bit mode the STROBE line is pulsed low whenever data is output but the BUSY line is ignored.

Byte Mode

Outputs a single hex byte.

The '\$' symbol is used to denote this mode and if used must be the first character received (after '@n' if specified).

The '\$' symbol must be followed by two valid hex characters which make up the byte to output. If either character is not valid hex then nothing is output.

Any data following the hex characters is ignored.

Each bit within the byte refers to an output ie. bit 0 is output 0, bit 1 is output 1, etc. If the bit is high then the corresponding output is high.

Eg. '55' (01010101) turns on outputs 6,4,2 and 0.

In byte mode the STROBE line is pulsed low whenever data is output but the BUSY line is ignored.

Print Mode

Message string is output using the 'Centronics' handshaking system (see below).

The '!' symbol is used to denote this mode and if used it must be the first character received (after '@n' if specified).

All characters following the '\$' symbol are printed.

There are two special operators that can be embedded in the message string.

TECHNICAL MANUAL for RF Data Link Kits (K173, K174, K175, K176)

- '\n' outputs a carriage return/line feed (starts a new line)
- '\f' outputs form feed (starts a new page)

To print the '\ ' character use '\\ '.

Some printers may need a 'form feed' character before the data is actually printed.

CENTRONICS HANDSHAKING

This is the 'standard' method used to transfer data to a parallel printer.

Data is written to the output then BUSY is checked. If BUSY is low then the printer is ready to accept data. The STROBE output is then pulsed low for 100uS. The printer accepts the data and indicates it is busy processing by asserting BUSY high. When done BUSY returns low and the cycle repeats.

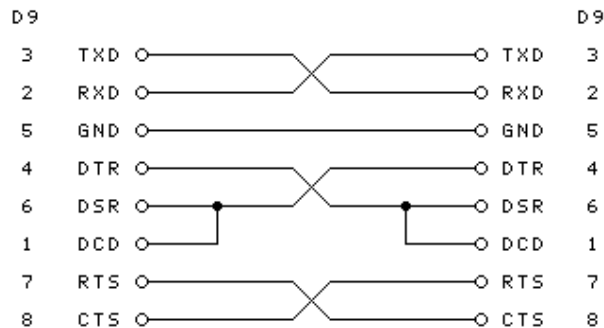
Further information on Centronics handshaking can be found at "www.beyondlogic.org/spp/parallel.htm"

SERIAL PORTS AND CROSSOVER CABLES

Kits K173 and K174 use an RS232 serial port for sending and receiving data. The gender (male or female) of the connectors plus their pinout is designed to interface directly with other DIY kits. For example, K145 plugs directly into K173 while K174 plugs directly into the PC serial port.

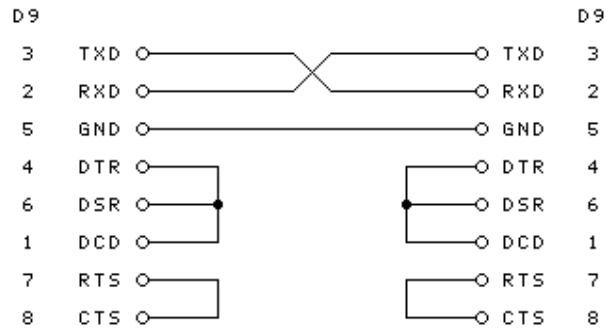
However if you want to send messages from a PC you will need to connect K173 to the PC serial port. Not only are the connectors both male but the pinouts don't allow a direct 'one-to-one' straight through connection. In this case you will need a 'crossover' cable with female D9 connectors at both ends.

The following diagram shows the connections required.



If you are only need a simple 3-wire connection then you can use this diagram instead.

Note: You will not be able to use 'binary' mode as this cable does not take the DTR/DSR connection to the other end.



For more information about interfacing serial/RS232 ports go to "<http://www.beyondlogic.org/serial/serial.htm>"