KAM
KPC-4
KPC-2400
KPC-2
KPC-1

Installation Manual

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Kantronics
RF Data Communications Specialists

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The KAM, KPC-4, KPC-2400, KPC-2 and KPC-1 are Kantronics hardware and software designs incorporating the AX.25 Version 2 Level 2 Packet protocol as adopted by the American Radio Relay League. This manual contains information from earlier KPC-1, KPC-2, KPC-2400, KPC-4 and KAM manuals and addendums, modified as appropriate. In addition, Kantronics acknowledges the use of material from the original Tucson Amateur Packet Radio Corporation (TAPR) TNC-1 manual granted by OEM agreement.

We have attempted to make this manual technically and typographically correct as of the date of the current printing. Production changes to the TNC may add errata or addendum sheets. We solicit your comments and/or suggested corrections. Please send to Kantroncis Inc., 1202 E 23rd Street, Lawrence, KS 66046.

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Installation Manual
Table of Contents

Radio Frequency Interference Statement

This equipment complies with the limits for a class B computing device in accordance with the specifications in Subpart J of Part 15 of the FCC rules. These specifications are designed to minimize radio frequency interference in a residential installation; however, there are no guarantee that radio or television interference will not occur in any particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on when the radio or television is on, the user encouraged to try to correct the interference by one of the following measures:

- Reorient the radio or TV receiving antenna
- Relocate the computer with respect to the receiver
- Move the computer away from the receiver
- Plug the computer into a different outlet, so that the computer and the receiver are on diffe–rent branch circuits

If necessary the user should contact the dealer or an experienced radio/TV technician for additional suggestions. The user may find the following booklet prepared by the FCC helpful:

How to Identify and Resolve Radio-TV Interference Problems

This booklet is available from the U.S. Government Printing Office, Washington, D.C., 20402 by ordering Stock No. 004-00000345-4.

RFI Suppression

In moving to the world of digital communications via computer, a new dimension of RFI may be encountered. In spite of the equipment manufactures' diligence, each new piece of electronic equipment will react differently in each separate environment. Every amateur station will have irs own unique layout, equipment variation and antenna installations. Experience has shown that these differences are related to the total RF environment and my be causative factors in RFI induced problems. The suggestions given here may assist in resolving RFI problems you may encounter in your "unique" station.

1. Use shielded cable for all connections between equipment.

2. Make all interconnecting cables as short as practical. A balance should be maintained between cable length and equipment proximity. At times simply moving the video monitor one foot further from an interface or other device will solve the "screen hash" problem.

3. Antenna runs should be kept away from equipment control lines and/or interconnecting cables. If it is necessary for such lines to cross each other, they should do so at 90 degree angles.

4. Ground leads should be as short as possible and go to a GOOD EARTH GROUND.

5. Interconnecting cables appearing to act as radiators or antennas should be looped through a toroid. Be certain toroids, if used, are designed for the frequency in use.

PRECAUTIONS

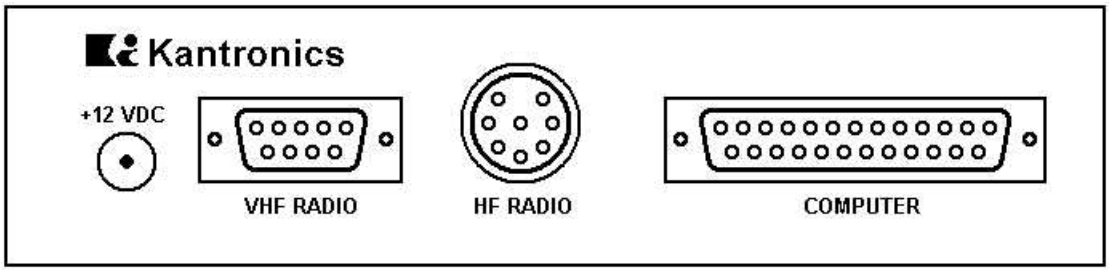
The TNC is grounded through its connections to your transceiver. Make sure your transceiver is properly grounded and your computer has equal ground potential. Follow the grounding instructions in your transceiver manual.

Cables provided with the TNC are shielded. If you decide to use other cabling, be certain it is also shielded. We do not recommend the use of unshielded RS-232 ribbon cable in the ham shack environment.

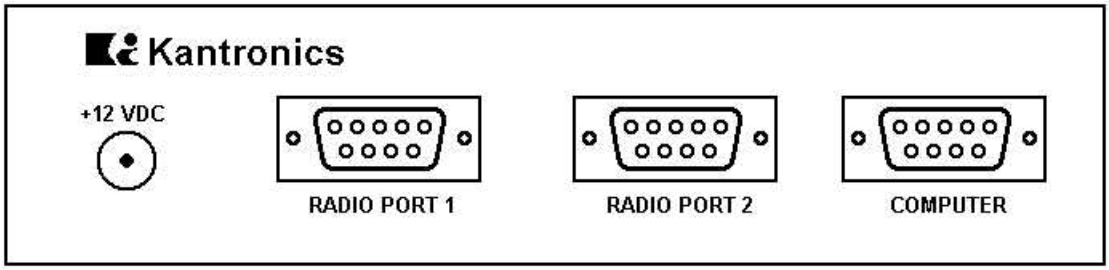
Pin 25 of the DB-25 connector on the KAM, KPC-2 and KPC-2400 has 12 volts and should never be connected to your terminal or computer port. Pin 18 in the KPC-2 is used by factory personnel only. Under no circumstances should you connect this pin to your terminal or computer output port.

Back Panels

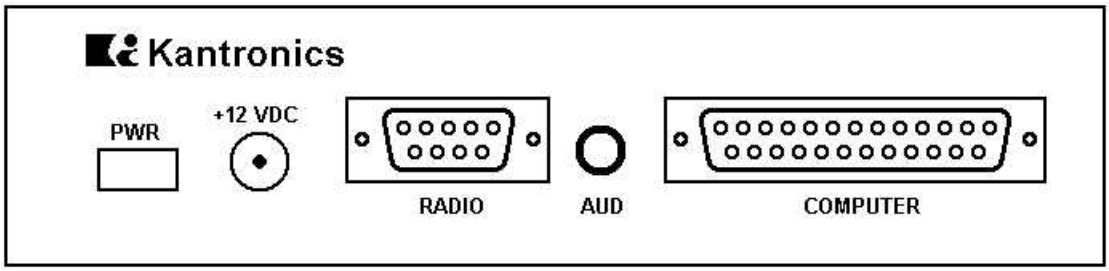
KAM



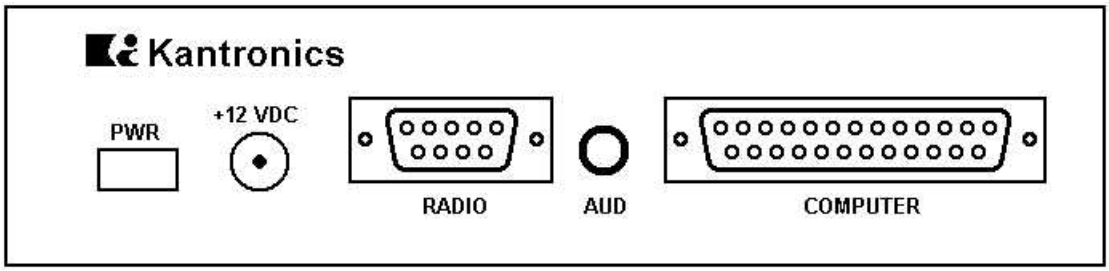
KPC-4



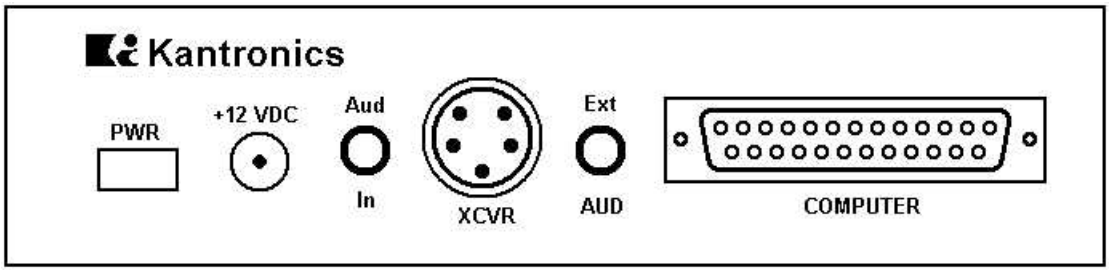
KPC-2



KPC-2400



KPC-1



Connecting the TNC to Your Computer

RS-232/TTL Jumper

Jumpers are appropriately labeled on the PC board. Refer to the parts location diagram for help in locating them. Also refer to the Assembly and Disassembly section for information on obtaining access to the interior of the TNC.

KAM	Jumper K7
KPC-4	Jumper K10
KPC-2	Jumper K2
KPC-2400	Jumper K2
KPC-1	Jumper K2

This jumper is provided to change the TNC from RS-232 to TTL operating voltage levels. All TNCs are shipped from the factory in the RS-232 position. If your computer operates at TTL level voltages, reposition this jumper prior to placing the TNC in service.

TNC to Computer Connection

The TNC is connected to the serial data port of your computer and a terminal program must be loaded into your computer. The serial port provides a place for data to be sent to or received from the TNC. The terminal program is the software which runs in the computer, allowing it to communicate with the TNC. This is also sometimes called a communication program.

A few computer systems include a terminal program on the system diskette or in the initial software package, usually named COMM, TERM or a similar name which conveys the idea of communicating. Some computer system require that a terminal program be obtained separately. Several simple terminal programs have been included in the Sample Terminal Programs section to assist you. In general, any program which allows telephone modem communications with the computer will be suitable for use with the TNC. A special program will be needed for the display of WEFAX pictures.

There are generally four variables to be set in your terminal program. These are baud rate, parity, word length (also called data bits) and the number of stop bits. If your terminal program provides for these variables, use the following settings to talk to the TNC:

Baud rate:	300, 600, 1200, 1800, 2400, 4800 or 9600
Parity:	None
Data bits:	8
Stop bits:	1

The 25-pin connector on the back panel of the TNC is for connecting to the computer. (The KPC-4 has a 9-pin connector.) When facing the back of the back of the TNC the connector on the right side is labeled COMPUTER. See page 3 for back panel diagrams.

Cable Wiring

A cable is provided with five pre-wired lines for the connector. You must provide the connector to attach these lines to your computer serial port. In most cases, unless the terminal program you use requires hardware flow control, you need only connect three of these lines – Transmit Data, Receive Data and Signal Ground. For hardware flow control, also called RTS/CTS handshaking, all five wires in the provided cable are required.

Since there are so many computers on the market, it is impossible to provide interfacing information on all of them. The following chart shows what pins are used in the TNC by name and number and the corresponding pin to connect to for the most commonly used computer connectors. A general rule, if you have a computer not covered here that has a serial data port, wire pins of the same name together. Limited information on some of the other common computers will follow.

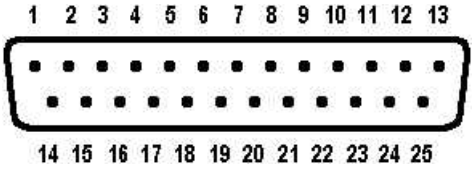
Transmit Data (TXD), Receive Data (RXD) and Signal Ground (SG) must always be wired in order for the TNC and the computer to exchange any data. Many terminal programs also require the use of hardware flow control from the TNC. For hardware flow control Request To Send (RTS) and Clear To Send (CTS) must also be wired. Check the documentation toyour terminal program to see if any other wires are required. DO NOT CONNECT ALL 25 (9) WIRES.

Some programs want to see Data Set Ready (DSR) to know that the TNC is there before operating. If this is the case, wire both DSR and Data Terminal Ready (DTR). Or sometimes you can satisfy the program's need by jumpering these two pins at the computer end of the cable. Data Carrier Detect (DCD) is needed by some BBS software to know that a connection has taken place. This would require wiring DCD. Some phone modem programs also want to see a connection before allowing you to even talk to the TNC. This case can usually be solved by jumpering DCD to DTR at the computer end of the cable. If your computer requires DSR and also DCD, it is perfectly acceptable to jumper all three pins (DTR, DSR and DCD) together on the computer end of the cable. Note: DCD, DSR and DTR connections are not pre-wired in the provided cable.

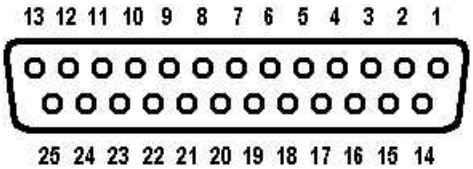
The TNC is wired as DCE (Data Communication Equipment). DCE equipment always send its data on the RXD wire. DTE (Data Terminal Equipment) talks on TXD. This means that, if a computer is wired internally as DCE and attached to the TNC, it will need to have TXD from the computer wired to RXD on the TNC and RXD from the computer wired to TXD of the TNC. Otherwise they will both be talking on the same wire and never hear what is said. If properly implemented by the DCE computer, hardware flow control may be used by connecting RTS from each device to CTS on the other device.

Caution: Make sure the power to the transceivers, computer and TNC is OFF before connecting any cables.

DB-25 Connector

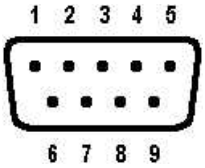


Male (Looking at Pins)



Female (Looking at Holes)

DB-9 Connector



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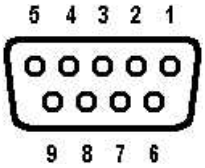


Female (Looking at Holes)

TNC (DCE)			Prewired		RS-232 Computer (DTE)	
Pin Name	DB-25 Pin No.	DB-9 Pin No.	Cable Color	Direction	DB-25 Pin No.	DB-9 Pin No.
FG*	1	N/A	black	⇦⇨	1	N/A
TXD	2	3	white	⇦	2	3
RXD	3	2	red	⇨	3	2
SG*	7	5	orange	⇦⇨	7	5
RTS	4	7	green	⇦	4	7
CTS	5	8	brown	⇨	5	8
DCD	8	1	yellow	⇨	8	1
DSR	6	6	blue	⇨	6	6
DTR	20	4	purple	⇦	20	4
mark	11	(KAM) To external scope, if desired				
space	18	(KAM) To external scope, if desired				
test	18	(KPC-2) DO NOT CONNECT TO COMPUTER				
+12 V	25	DO NOT CONNECT TO COMPUTER				

*FG (Frame Ground) and SG (Signal Ground) are tied together in the TNC. The shield is on pin 1 of the DB-25 and on pin 5 of the DB-9. The black wire is not connected in the KPC-4 serial cable.

The functions of these lines are explained below:

DB-25 Pin 2 **TXD** DB-9 Pin 3

Transmit Data. This line is the serial data from the terminal which is to be transmitted to the other station by the TNC. It is this line which is used for all communication from your terminal to the TNC, including commands.

DB-25 Pin 3 **RXD** DB-9 Pin 2

Receive Data. This line is used by the TNC to send the data it receives from the other station to your terminal. This line is also used to send TNC messages to your terminal.

DB-25 Pins 7 and 1 **SG** DB-9 Pin 5

Signal Ground. This line establishes the common reference potential for all circuits except Protectiv Ground.

DB-25 Pin 4 **RTS** DB-9 Pin 7

Request To Send. This line tells the TNC that the terminal is ready to receive data. An ON level tells the TNC it ma send data while an OFF level tells it to stop sending data. If the terminal for any reason is unable to accept data from the TNC, it will cause this line to change to an OFF state, providing that the terminal supports hardware flow control. For instance, buffer is full, terminal is turned off and so on.

DB-25 Pin 5 **CTS** DB-9 Pin 8

Clear To Send. This line is used by the TNC to tell the terminal whether or not it may send data to the TNC. AN ON level tells the terminal it may send data while an OFF level tells it to stop sending data. This pin is the complement to the RTS pin, implementing hardware flow control in the other direction.

DB-25 Pin 8 **DCD** DB-9 Pin 1

Data Carrier Detect. This line is an output from the TNC indicating connected status of the TNC. When a connection exits on the current stream, this line will be true. (When using TTL levels, DCD at +5 V indicates connected status.) This pin has no function on the KPC-1.

DB-25 Pin 6 **DSR** DB-9 Pin 6

Data Set Ready. Some terminal programs look at this pin to see that the TNC is operating before allowing you to talk to the TNC. This pin is pulled true and is common with DTR, as shipped from the factory. In the KPC-1 DSR is jumpered to DTR and is not connected to any internal circuitry.

DB-25 Pin 20 **DTR** DB-9 Pin 4

Data Terminal Ready. This pin is common with DSR in the TNC. The TNC assumes the terminal is operating and does not require the terminal to pull this pin true. This pin may be isolated from DSR if desired. In the KPC-1 DTR is jumpered to DSR and is not connected to any internal circuitry.

DB-25 Pins 11/18 **Mark/Space**

KAM ONLY
Mark/Space. These signals are available for connecting an external scope if desired. Refer to the Scope Monitoring section for instructions.

DB-25 Pin 18 **Test**

KPC-2 ONLY
Processor Test Input. This is used by factory personnel only in repair and service operations. UNDER NOR CIRCUMSTANCES should you connect this pin to your terminal or computer output port.

DB-25 Pin 25 **Plus 12 Volts**

KAM, KPC-2 and KPC-2400
+12 V. This is an alternate input pin for supplying power to the TNC if desired. If the normal +12 VDC input jack is used, this pin will be HOT. BE CERTAIN THIS PIN IS NOT CONNECTED TO YOUR COMPUTER!

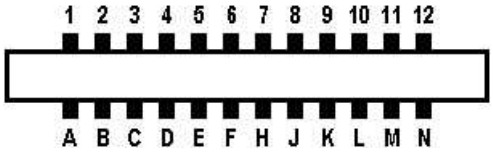
Other Common Computers

If you have a C-64, C-128, VIC-20, PCjr, Radio Shack Color Computer, TRS Model 100 or an Atari 850, some limited information follows. For a description of the functions of the TNC pins refer to the previous information.

Commodore C-64, C-128 or VIC-20

If you are using an RS-232 adapter follow the previous instructions for Cable Wiring. If you are not using an RS-232 adapter, remember to change the TNCs RS-232/TTL Internal Jumper from RS-232 to TTL (see beginning of this chapter). Many programs will only require TXD, RXD and SG. If using hardware flow control, RTS and CTS will also be required.

Commodore User Port
24 pin Double-Sided Card Edge Connector



Looking at Back of computer or Back (wiring side) of connector

TNC (DCE)			Prewired		Commodore
Pin Name	DB-25 Pin No.	DB-9 Pin No.	Cable Color	Direction	User Port (TTL) Pin ID
TXD	2	3	white	⇦	M
RXD	3	2	red	⇨	B & C
SG*	7	5	orange	⇦⇨	N
RTS	4	7	green	⇦	D
CTS	5	8	brown	⇨	K
DCD	8	1	yellow	⇨	H
DSR	6	6	blue	⇨	L
DTR	20	4	purple	⇦	E
mark	11	(KAM) To external scope, if desired			
space	18	(KAM) To external scope, if desired			
test	18	(KPC-2) DO NOT CONNECT TO COMPUTER			
+12 V	25	DO NOT CONNECT TO COMPUTER			

PCjr

The IBM PCjr has a built-in terminal program in the basic cartridge. The terminal mode is started by typing TERM. Consult the PCjr Technical Reference Manual for pin-out requirements for the PCjr serial port. You will have to buy a special connector from your computer dealer for the PCjr.

Radio Shack Color Computers

The serial port of the color computer uses a 4-pin DIN plug. Pin connections at the port are shown in the pin table below:

Pin Name	TNC DB-25	KPC-4 DB-9	Cable Color	TRS CoCo
TXD	2	3	white	4
RXD	3	2	red	2
SG	7	5	orange	3

This is known as a three-wire interface and therefore requires the use of software flow control. This cabling supports the TRS VIDTEX program. If you have a micro-color computer, such as the MC-10, cabling is different; consult your computer reference manual.

You may also use the Radio Shack Deluxe RS-232 Program Pak. This is a plug-in module for the TRS-80 Color Computer line which is available from Radio Shack Stores.

The Deluxe RS-232 Pak has a standard DB-25 serial port connector to which you connect the TNC using the following configurations:

Pin Name	TNC DB-25	KPC-4 DB-9	Cable Color	TRS RS-232
TXD	2	3	white	2
RXD	3	2	red	3
SG	7	5	orange	7

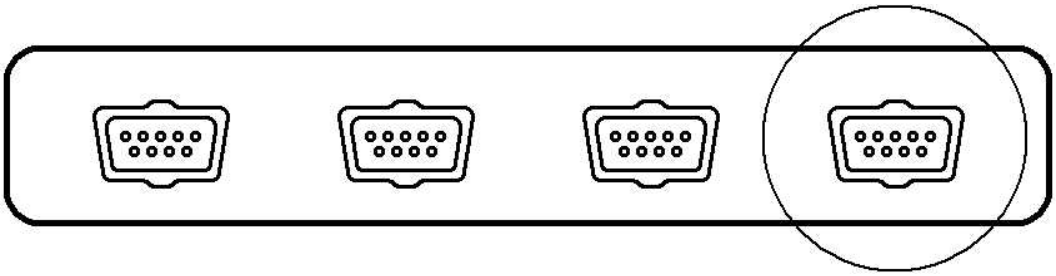
You must also install a jumper between pin 8 and pin 20 on the DB-25 connector of the Deluxe RS-232 Pak. It is not necessary to connect RTS/CTS lines. Since these lines are not connected, you must use software flow control. Configure the Deluxe RS-232 Pak as outlined in its operation manual, select the Terminal Mode and you will be ready for Packet operation.

TRS Model-100

This computer has a standard RS-232 serial port using a DB-25 connetor wired as DTE. The internal modem program DOES NOT support CTS/RTS hardware flow control. Be sure to have the TNC command XFLOW ON so that software flow control (XON/XOFF) will be used. You should make a three-wire cable as follows:

Pin Name	TNC DB-25	KPC-4 DB-9	Cable Color	TRS-100
TXD	2	3	white	2
RXD	3	2	red	3
SG	7	5	orange	7

Atari 850 Interface



Looking at socket from outside of Interface

Pin functions of Serial Port No. 1 in 850 Interface Module 9-pin female connector:

Pin Name	TNC DB-25	KPC-4 DB-9	Cable Color	Atari 850 Interface
TXD	2	3	white	3
RXD	3	2	red	4
SG	7	5	orange	5
RTS	4	7	green	7
CTS	5	8	brown	8

Connecting Your Radios

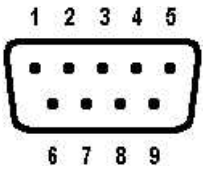
The TNC is attached to your transceiver(s) via the radio Connector(s) on the back panel. (See page 3 for back panel diagrams.) The KPC-2 and KPC-2400 each have one DB-9 connector labeled RADIO, which is used for either VHF or HF. The KPC-1 has one 5-pin DIN connector labeled RADIO, which is used either for VHF or HF. The KAM has a DB-9 connector labeled VHF RADIO and an 8-pin DIN connector labeled HF RADIO. The KPC-4 has two DB-9 connectors for VHF/UHF radio connections labeled PORT 1 and PORT 2.

Pre-wired cables are provided with the appropriate connector for the TNC port. Two cables come out of the connector. One with a speaker plug attached, to be plugged into the transceivers external speaker jack. You will need to provide the mic-jack connector for your transceiver and wire the connector to the other cable. Lines from this connector are used to control the PTT function of the transceiver, input AFSK tones from the TNC and provide other alternate Inputs/Outputs as described. The KPC-1 comes with two separate cables. One for audio with speaker plugs on both ends. The other cable has a 5-pin DIN connector on the end for the KPC-1 and you will need to provide the mic-jack connector for your transceiver and wire it to the other end of this cable.

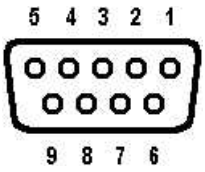
Some rados may require adjustment of the AFSK Output Levels or Equalization of the received signals. See the AFSK Output Level and Calibration/Equalization sections for information.

Caution: Check your transceiver manual to correctly wire the corresponding pins of the transceiver mic-jack.

DB-9 Radio Connector



Male (Looking at Pins)



Female (Looking at Holes)

Pins 1, 3, 5 and 6 must be connected to your radio.

Pin 1 – AFSK Out – white lead
This lines carries the AFSK tones generated by the TNC to the Audio Input (microphone) line of your transceiver. If your transceiver provides a DC voltage on its microphone input, you must isolate this voltage from the TNC. This is normally true for hand-held radios. (See the Interfacing Hand-Held Radio section.)

Pin 2 – XCD – yellow lead
This line may be used to connect the squelch line from your VHF transceiver if desired. This connection will not normally be required, nor used, unless operating on a shared voice channel. Normally the TNC detects other signals by using its internal software to determine if data is present. If this pin is connected, a ground potential on this pin will tell the TNC that a signal is present (even if there is no data) and therefore prevent the TNC from transmitting until the signal is no longer present. (See the CD parameter in the Commands Manual.)

Pin 3 – Push-To-Talk – brown lead
This line controls the PTT line in your transceiver, allowing the computer to switch the transceiver from/to transmit or receive. Connect directly to the PTT line of the mic-jack connector (See the section on Interfacing Hand-Held Radios for special notes concerning this pin.)

Pin 4 – Blue lead – KAM same as pin 5
KPC-4, both ports, same as pin 5
KPC-2 same as pin 6
KPC-2400 has no connection

Pin 5 – Audio Signal – 2 conductor audio cable, center conductor and 9-wire cable, purple conductor
This line is prewired for your use as the audio input from your transceiver external speaker jack. Do not use a headphone output from the transceiver. If you use an accessory or phone patch output, it may be necessary to provide a padding network to reduce amplitude of the signal being fed to the TNC. High level fixed outputs may have a tendency to "swamp" the TNC input circuits. Fixed output signals in excess of 50 mV should be padded.

For the KAM and KPC-4 you can plug this lead into one leg of the Y-connector cable provided in the TNC accessory bag. Plug the Y-connector cable into the external speaker jack of the transceiver. The remaining female connector on the Y-connector cable may be used for an external speaker. For the KPC-2 and KPC-2400 the audio jack on the back panel remains available for attachment of an external speaker.

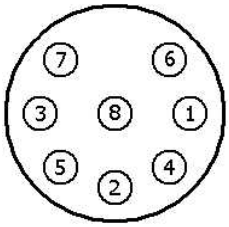
Pin 6 – Ground/Shield – shield of 9-wire cable and shield of audio cable
Connect the push-to-talk ground and AFSK shield to this line. With some transceivers which do not reference PTT and audio shielding to a common ground, it may be necessary to leave the AFSK shield (braided wire) disconnected. NOTE: All TNC grounds are common.

Pin 7 – KPC-4 Radio Port 1 External Reset – red lead
An external reset line is provided on this pin. Applying a ground, either from a local or remote source is the same as turning on the TNC. This is only on the KPC-4 Radio Port 1.

Pin 8 – Green lead – KAM same as pin 6
KPC-4, both ports, same as pin 6
KPC-2 no connection
KPC-2400 no connection

Pin 9 – Ground – Black lead – same as pin 5

8-Pin DIN Radio Connector (KAM HF)



Female (Looking at Holes)

Pins 1, 2, 3 and 6 must be connected to your radio.

Pin 1 – AFSK Out – white lead
This lines carries the AFSK tones generated by the KAM to the Audio Input (microphone) line of your transceiver.

Pin 2 – Ground/Shield – black and shield of 9-wire cable and shield of audio cable
Connect the push-to-talk ground and AFSK shield to this line. With some transceivers which do not reference PTT and audio shielding to a common ground, it may be necessary to leave the AFSK shield (braided wire) disconnected. NOTE: All TNC grounds are common.

Pin 3 – Push-To-Talk – brown lead
This line controls the PTT line in your transceiver, allowing the computer to switch the transceiver from/to transmit or receive. Connect directly to the PTT line of the mic-jack connector.

Pin 4 – Key Out – orange lead
This line may be used to control CW keying on your transceiver. Separate a small length of this lead and attach a lead with the appropriate plug for your transceiver key jack, where you would normally connect a straight key.

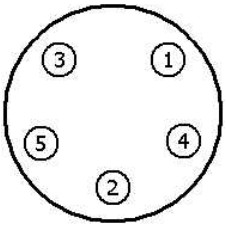
Pin 5 – FSK Out – red lead
This line is for use if your transceiver provides FSK keying for RTTY operation. Separate a small length of this lead and attach a lead with the appropriate plug for your FSK input connector on the transceiver. It will also be necessary to provide for PTT keying via the mic jack, accessory port or other method specified by your transceiver manual.

Pin 6 – Audio signal – 2 conductor audio cable, center conductor and 9-wire cable, purple conductor
Plug this lead to one leg of the Y-connector cable provided in the KAM accessory bag. Plug the Y-connector cable into the external speaker jack of the transceiver. The remaining female connector on the Y-connector may be used for an external speaker. Do not use a headphone output from the transceiver. If you use an accessory or phone patch output, it may be necessary to provide a padding network to reduce amplitude of the signal being fed to the KAM. High level fixed outputs may have a tendency to "swamp" the KAM input circuits. Fixed output signals in excess of 50 mV should be padded.

Pin 7 – Blue lead
This pin is not connected in the KAM but the blue conductor of the 9-wire cable is attached to this pin.

Pin 8 – XCD – yellow lead
This line may be used to connect the squelch line from your HF transceiver if desired. This connection will not normally be required, nor used, unless operating on a shared voice channel. (See the CD parameter in the Commands Manual.)

5-Pin DIN Radio Connector (KPC-1 Packet Communicator)



Female (Looking at Holes)

Pins 1, 2, 3 and Audio In must be connected to your radio.

Pin 1 – AFSK Out – white lead
This lines carries the AFSK tones generated by the TNC to the Audio Input (microphone) line of your transceiver. If your transceiver provides a DC voltage on its microphone input, you must isolate this voltage from the TNC. This is normally true for hand-held radios. (See the Interfacing Hand-Held Radio section.)

Pin 2 – Ground/Shield – black and stranded lead
Connect the push-to-talk ground and AFSK shield to this line. With some transceivers which do not reference PTT and audio shielding to a common ground, it may be necessary to leave the AFSK shield (braided wire) disconnected. NOTE: All TNC grounds are common.

Pin 3 – Push-To-Talk – brown lead
This line controls the PTT line in your transceiver, allowing the TNC to switch the transceiver from/to transmit or receive. Connect directly to the PTT line of the mic-jack connector (See the section on Interfacing Hand-Held Radios for special notes concerning this pin.)

Audio in
Attach a cable from the external speaker jack of the transceiver to the Audio In jack on the rear panel of the Packet Communicator. Do not use a headphone or phone patch output from your transceiver.

External Speaker Jack
This jack can be used to loop the audio through the Packet Communicator. Use a 3.5 mm plug and shielded audio cable to connect to an external speaker.

AFSK Output Level

Audio Frequency Shift Keying

Jumpers are appropriately labeled on the PC board. Refer to the parts location diagram for help in locating them. Also refer to the Assembly and Disassembly section for information on obtaining access to the interior of the TNC.

KAM – AFSK Output – VHF – Jumper K2

This jumper is provided to alter the VHF AFSK output level. The KAM is shipped from the factory with the jumper in the LO position. The LO position sets an AFSK output level from the KAM at 10 mV. The HI position sets an AFSK output level of 50 mV. Both levels are peak-to-peak values. In general, transceivers requiring a pre-amplified microphone will also require the HI level AFSK output from the KAM. Removing the jumper entirely will provide the maximum possible output level of approximately 1.7 Vpp. Should you require an intermediate value of AFSK modulation signal, it may be obtained by replacing resistor R12 with the appropriate value chosen from the following chart. If you change R12 to obtain an intermediate value, place K2 in the HIGH position.

R12 Value	AFSK Output Level
470 Ω	24 mV
2.2 kΩ	106 mV
6.8 kΩ	290 mV
22 kΩ	680 mV
47 kΩ	1000 mV

KAM – AFSK Output – HF – Jumper K5

This jumper is provided to alter the HF AFSK output level. The KAM is shipped from the factory with the jumper in the LO position. The LO position sets an AFSK output level from the KAM at 100 mV. The HI position sets an AFSK output level of 500 mV. Both levels are peak-to-peak values. In general, transceivers requiring a pre-amplified microphone will also require the HI level AFSK output from the KAM. Removing the jumper entirely will provide the maximum possible output level of approximately 1.6 Vpp. Should you require an intermediate value of AFSK modulation signal, it may be obtained by replacing resistor R25 with the appropriate value chosen from the following chart. If you change R25 to obtain an intermediate value, place K5 in the HIGH position.

R25 Value	AFSK Output Level
680 Ω	48 mV
3.3 kΩ	209 mV
4.7 kΩ	282 mV
6.8 kΩ	377 mV
22 kΩ	800 mV

KPC-4 – AFSK Output – Jumpers K3 and K4

These jumpers are provided to alter the HF AFSK output level. The KPC-4 is shipped from the factory with the jumper in the LO position. The LO position sets an AFSK output level from the KPC-4 at 10 mV. The HI position sets an AFSK output level of 50 mV. Both levels are peak-to-peak values. In general, transceivers requiring a pre-amplified microphone will also require the HI level AFSK output from the KPC-4. Removing the jumper entirely will provide the maximum possible output level of approximately 1.7 Vpp. Should you require an intermediate value of AFSK modulation signal, it may be obtained by replacing resistor R23 or R29 with the appropriate value chosen from the following chart. If you change R25 to obtain an intermediate value, place the appropriate jumper in the HIGH position.

K3 Port 1 R23 Value	K4 Port 2 R29 Value	AFSK Output Level
470 Ω	470 Ω	24 mV
2.2 kΩ	2.2 kΩ	106 mV
6.8 kΩ	6.8 kΩ	290 mV
22 kΩ	22 kΩ	680 mV
47 kΩ	47 kΩ	1000 mV

KPC-2 – AFSK Output – Jumper K1
KPC-1 – AFSK Output – Jumper K3

This jumper is provided to alter the AFSK output level. The TNC is shipped with this jumper in the HI position. The HI position output level is 21 mVpp. In the LO position output is 4.5 mVpp. If a higher output level is required for your radio, it may be obtained by changing the resistor (R14 in KPC-2, R37 in KPC-1). The chart below gives the output levels for different values of the resistor with the jumper in the HI position.

KPC-2 R14 value	KPC-1 R37 value	AFSK level
100 Ω	100 Ω	4.5 mV
220 Ω	220 Ω	10 mV
470 Ω	470 Ω	21 mV
1 kΩ	1 kΩ	44 mV
1.5 kΩ	1.5 kΩ	65 mV
2.2 kΩ	2.2 kΩ	94 mV
8.2 kΩ	8.2 kΩ	298 mV

Should you require a still higher AFSK output level, the value of the resistor may be increased further to provide incremental increases in the same approximate ratio as that shown in the table. For maximum output level the HI LO jumper can be removed entirely. In this case, AFSK output level will be approximately 1.5 Vpp.

KPC-2400 – AFSK Ouput – Jumper K1

This jumper is provided to alter the AFSK output level. The KPC-2400 is shipped with the jumper in the HI position. In the HI position output level is 44 mVpp (open circuit, 600 Ω nominal). In the LO position output is 10 mVpp. If a higher output level is required for your radio, it may be obtained by changing R32. The chart below gives the output levels (open circuit) for different values of R32 with the jumper in the HI position.

R32 value	AFSK level
100 Ω	4.5 mV
220 Ω	10 mV
470 Ω	21 mV
1 kΩ	44 mV
1.5 kΩ	65 mV
2.2 kΩ	94 mV
8.2 kΩ	298 mV

Should you require a still higher AFSK output level, the value of R32 may be increased further to provide incremental increases in the same approximate ratio as that shown in the table. For maximum output level the HI LO jumper can be removed entirely. In this case, AFSK output level will be approximately 1.5 Vpp.

Interfacing Hand-Held Radios

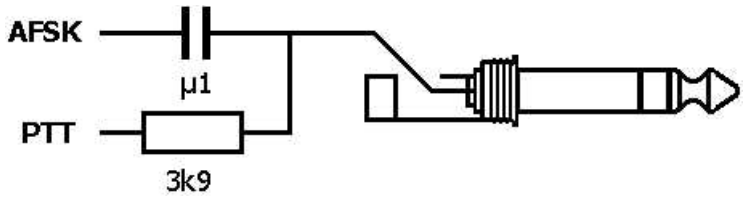
Many transceivers, especially most hand-held models, obtain Push-To-Talk keying by completing a circuit between the mic input and PTT ground. A direct PTT input to the mic input line of units with this type electret condenser microphone is not usable without some type of isolation.

If you plan to operate with a hand-held transceiver, the KAM, KPC-2 and KPC-4 have incorporated an isolation circuit which is available by jumper positioning. Should you later use a different type radio, this change may need to be reconfigured. Most other radios of current manufacture will not require any modification of the TNC.

You may also interface to a hand-held without performing this modification by incorporating the same type of circuitry in the cable from your TNC to your hand-held. Ground return and speaker audio are both supplied thru the external speaker jack of your hand-held.

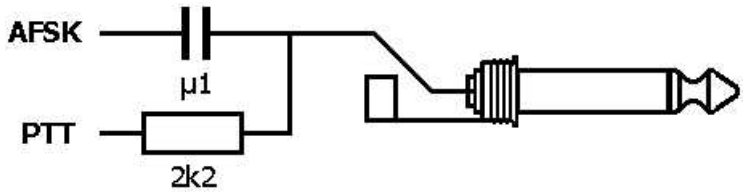
ICOM HT radios key the PTT by providing a low impedance path from the mic input to ground. To accomplish this, simply install a resistor (approximately 3.9 k seems to be a good value) in series with the PTT wire from the TNC and connect this to the mic input along with the AFSK line.

ICOM Mic Connector



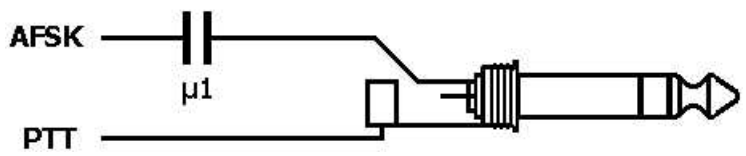
YAESU radios are similar but use a mono plug and a different resistor-

YAESU Mic Connector



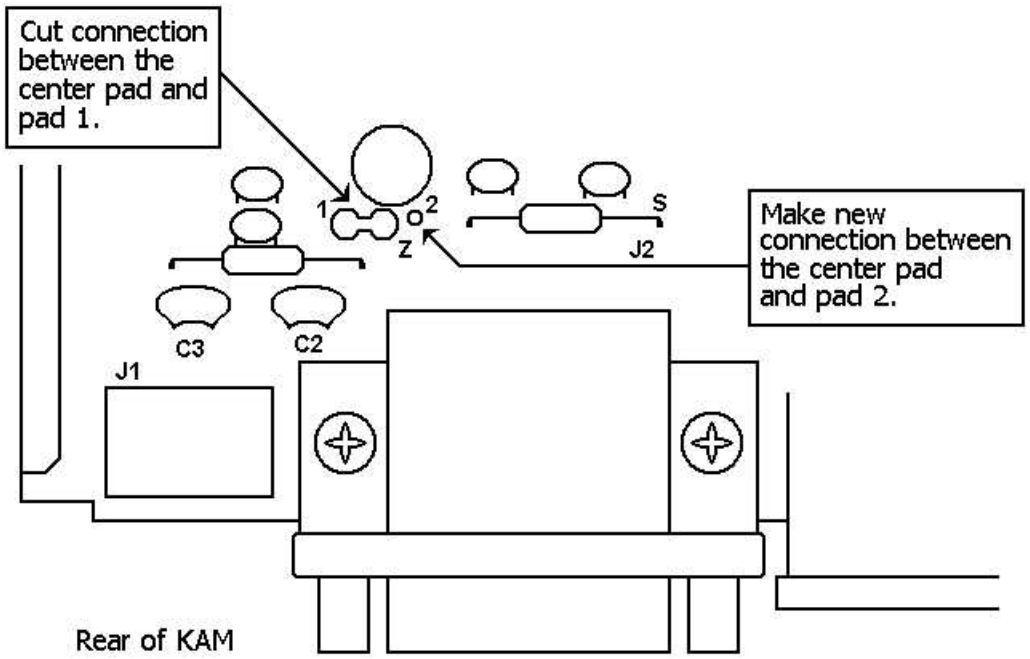
Most KENWOOD HT radios key the PTT line by connecting the sleeve of the mic connector to the sleeve of the earpiece connector. This means, that you will not need a resistor in the PTT wire from the TNC, simply connect the PTT wire to the sleeve of the mic connector. Another point to watch – most of the KENWOOD HTs (2500 and later) use a three pin mic connector. The AFSK from the TNC should therefore connect to the RING and not the TIP of the mic connector.

KENWOOD Mic Connector



Enabling the Isolation Circuit in the KAM

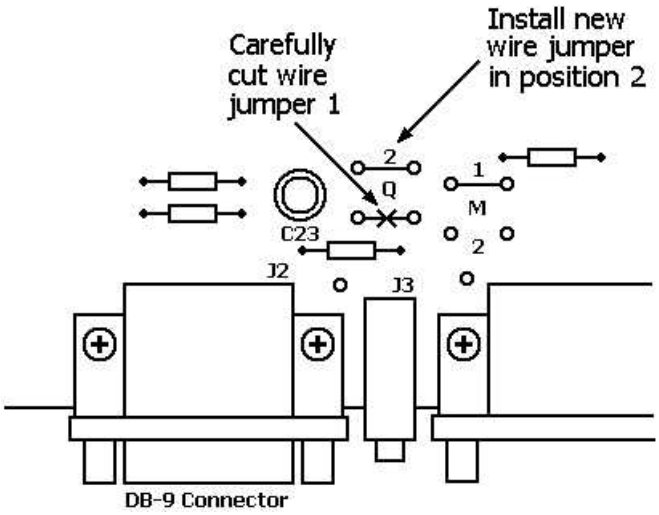
1. Refer to the Assembly and Disassembly section for instructions if necessary and remove the KAM from its case.
2. Locate point Z on the PC board. This point is at the rear, near the HF radio output port and power jack.



3. Locate the three pads associated with Z. Note, that the center pad and the pad marked 1 is larger than the pad marked 2.
4. Carefully cut the connection between the center pad and pad and 1.
5. Make a new connection between the center pad 2. You may wish to make this connection on the bottom of the PC board instead of the component side.
6. Connect the AFSK and PTT lines together.

Enabling the Isolation Circuit in the KPC-2

1. Refer to the Assembly and Disassembly section for instructions if necessary and remove the KPC-2 from its case.
2. Locate jumper Q on the PC board. This location is at the rear of the PC board.



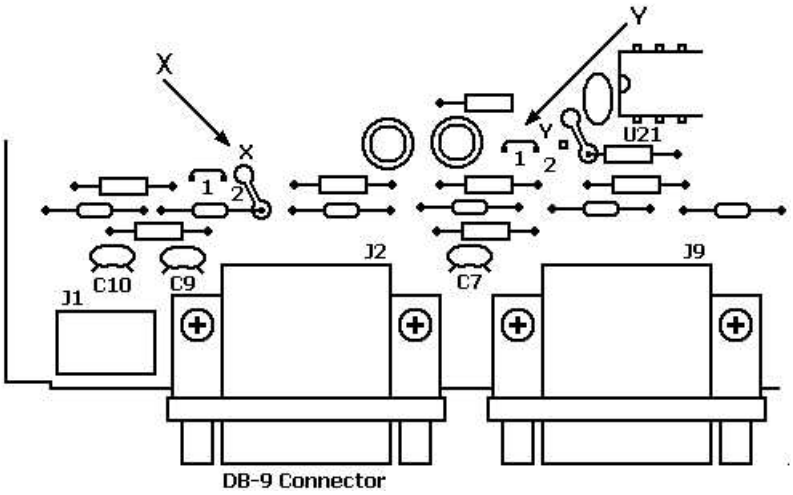
Rear of KPC-2

3. Locate the wire jumper marked 1.
4. Carefully cut the jumper.
5. Install a new jumper in position 2. You may wish to make this connection on the bottom of the PC board instead of the component side.
6. Connect the AFSK and PTT lines together.

Enabling the Isolation Circuit in the KPC-4

Separate circuits are provided for each radio port. Jumper X is for Port 1, Jumper Y is for Port 2.

1. Refer to the Assembly and Disassembly section for instructions if necessary and remove the KPC-4 from its case.
2. Locate point X or Y on the PC board. This location is at the rear of the PC board.



Rear of KPC-4

3. Locate the three points associated with X or Y. Note that there is a jumper at each of these locations which is in position 1.
4. Carefully cut the jumper.
5. Install a new jumper in position 2. You may wish to make this connection on the bottom of the PC board instead of the component side.
6. Connect the AFSK and PTT lines together.

In Case of Difficulty

Kantronics TNCs are manufactured to very stringent quality standards. If you have followed the installation procedures outlined in this manual, it is highly unlikely that you will encounter a failure. If you do have difficulty, use the procedures described in this section to assist in isolating and correcting the problem.

TNC Does Not "Sign-On" to Computer

1. Carefully recheck cabling between your computer serial port and the TNC.
2. Check carefully to insure the Transmit Data, Receive Data and Ground leads are connected to the proper pins.
3. If you have made a 5 wire connection to the computer serial port, change to a 3 wire connection.
4. Check your terminal program to be certain it is booted with the correct communications parameters (serial port, baud rate, parity).
5. Check to insure that the RS-232/TTL jumper is properly positioned for your computer.
6. Try a "Hard Reset" using the Test/Normal jumper. (Operate your terminal program at 300 baud when performing a hard reset.)

You Are Unable to Make a "Connect"

1. Issue a connect request and observe the XMIT LEDs. If an XMIT LED illuminates, check to insure that the radio is connected to the corresponding radio port.
2. Observe the radio to determine if it is being switched to the "Transmit" condition. If not, recheck wiring between the TNC radio port, PTT pin and ground on the microphone jack.
3. Turn the VHF radio squelch control to "OFF" and see if the RCV LED illuminates an the Packet controller. If it does not light, recheck the audio connection between your transceiver and the TNC.
4. If possible, monitor your transmitted signal with another radio. If the transmitter is keying to "Transmit" but weak or no audio is monitored, increase AFSK output as necessary using the AFSK Output jumper or resistor change. (SEE the AFSK Output Level section.)

Cannot Transmit on Any Port

1. Check the 8BITCONV command. Many dumb terminals, and some Commodore programs, will not operate properly with this command turned ON. The symptoms most common for this problem are, that everything seems to work fine in Command Mode, but upon entering Converse Mode, the TNC no longer seems to operate at all. Usually you cannot return to Command Mode with a Ctrl-C, pressing return does not send a packet and it just seems like the serial cable between your computer and TNC has been unplugged.
2. Check your PARITY setting in the computer and in the TNC. These must match or else the computer may not really be sending the SENDPAC character ($0D) to the TNC.

Cannot Return to Command Mode

1. The single most common cause of this is, that the STOP character (and usually XOFF) have been inadvertently set to the same as the COMMAND character. This is usually caused by the use of the dollar sign ($) as a streamswitch. If you use the $, be aware that you cannot enter hex values without PASSing the dollar sign. Symptoms for this usually are, that you can talk to the TC fine in Command Mode, you can usually talk to others on the air, but you just can't get back to Command Mode. (In non-packet modes, you will find that you cannot enter any of the special Ctrl-C directives either!) With most PC terminal programs, pressing Ctrl-C will display the heart character, but you still don't get the `cmd:` prompt.

Kanterm Program Problems

1. The most common problems reported with the Kanterm program result from not performing the Set Parameters option from within the program. This usually occurs after upgrading your TNC to a new version of the Kantronics firmware. The cause for this is the need to do a Hard Reset after installing the new firmware and as a result, the TNC and your Kanterm program are no longer "in sync" with each other.
2. Commodore users will normally experience this problem when first setting the TNC up with their Kanterm Software. All lower case characters are hidden, only numbers and punctuation appears. In reality, The TNC did receive the proper callsign and you can correct your display by choosing the Set Parameters option from the Miscellaneous Menu.

TNC Won't Transmit on HF – VHF is OK

This problem usually is a result of attempting to switch from one port to the other by using the PORT command. The PORT command only determines which port will be the default when the TNC is first turned on, or after a reset. In order to switch from one port to the other for transmitting data, you must use the STREAMSW characters as described in Multi-Connects in the Packet section of the Operations Manual.

Assembly and Disassembly of the TNC

Should you require access to the TNC to reposition jumpers or for other purposes, disassemble as follows:

1. Turn off power to your TNC and remove all cables from he unit.

2. Using a small phillips screwdriver, remove the two front panel screws just far enough to free the panel and bezel.

3. Carefully remove the front panel and bezel.

4. Note the screw holding the voltage regulator to the metal case. Remove this screw. (Does not apply to KPC-4.)

5. Slide the PC board out of the case.

To reassemble, reverse the procedure above. Be sure to re-install the screw holding the voltage regulator to the case (not in KPC-4). Failure to do so will damage the unit as the case provides a heat sink for the voltage regulator during normal operation. Do not attach cables to the rear of the TNC without supporting the front of the PC board or having the front panel secured in place. Doing so may break the voltage regulator secured to the front of the case.

Hard Reset

The hard reset process is provided to re-initialize the TNC to its default values. This process may become necessary should operational problems be encountered or when upgrading your firmware to a newer version. The readout specified in step 5 below will be legible only if your terminal baud rate is 300. At other terminal baud rates, a reset will occur. However, no display readout will observed. This procedure is performed as follows:

1) Remove the PC board from the case as outlined in the Assembly and Disassembly section, above.
2) Locate the Text/Normal jumper which is labeled NOR T (normal-test). Jumpers are appropriately labeled on the PC board. Refer to the parts location diagram for help in locating them.

   KAM Jumper K6
   KPC-4 Jumper K7
   KPC-2 Jumper K3
   KPC-2400 Jumper K3

3) Place the jumper in the test position.
4) Apply power to the TNC.
5) Observe on the computer display (your terminal program must be set at 300 baud):

   ```
   EEPROM INIT OK
   CHECKSUM OK
   RAM OK XXXXX BYTES
   REPLACE TEST JUMPER
   ```

   Some TNCs will not display the REPLACE message.

   If you have removed the 2404 EEPROM from your unit for any reason, the EEPROM INIT message will read: `EEPROM INIT ERROR`
   This is a normal indication and does not indicate a failure with your TNC.

6) Turn power off. Do not keep the TNC power on for more than a minute or the regulator will overheat.
7) Return Test/Normal jumper to the normal position.
8) Reassemble the TNC and return to operation.

Calibration / Equalization

The CALIBRATE command is used to assist the TNC operator in determining the need for equalization of a received signal. Since this feature is unique to Kantronics TNCs, two stations using Kantronics TNCs are necessary to utilize this command.

KAM you must have your current I/O stream on the VHF radio port.

KPC-4 uses current I/O port (will not work with an external modem.)

KPC-2 The HF, HFT and CCITT commands should be OFF. Calibration is checked at 1200 baud only.

KPC-1 Tones are transmitted and received at the HBAUD setting and the frequency is specified by the HF and HFT command settings.

KPC-2400 Tones are transmitted and received at the HBAUD setting and the frequency is specified by the HF, HFT and CCITT command settings. However, calibration cannot be done at the HBAUD setting of 2400.

Once the CALIBRATE command is given, three options will appear on he terminal screen:

```
Calibrate Mode Press R,T, or X
```

Pressing X will return the TNC to the Command Mode.

Pressing T will transmit a square wave (space/mark) at the selected tones until a key is pressed.

Pressing R will measure a square wave received.

One station should be used to transmit the square wave, while the receiving station should measure and compare the space/mark square wave. The transmitting station should set the microphone level in mid range.

Once the receiving TNC is placed in the CALIBRATE receive mode, two numbers will appear on the screen. The TNC is measuring the the space/mark square wave generated by the transmitting station. For the best calibration of the receiving transceiver, set the radio tone controls so that the two given values are as close to equal as possible.

In most instances when the ratio of the numbers is within a 40/60 or 60/40 range, the Packet station will function normally. A larger disparity in the tones may cause additional retries during Packet operation. This ratio may be determined by the following formula:

(N1 × 100) / (N1 + N2) where N1 is the number to the left of the displayed slash and N2 is to the right of the slash. For instance, if the TNC displays 1400/1800, the ratio can determined by:

(1400 × 100) / (1400 + 1800) or 140000/3200 = 44

Since the total is 100, the ratio is then 44/56 and is within the 40/60 criteria.

KPC-1, KPC-2 and KPC-2400. If the ratio of the numbers exceeds 60/40, you should change the setting of the equalization command (EQUALIZE). Use the setting (ON or OFF) which results in the ratio closest to 50/50.

KAM and KPC-4. If the ratio of the numbers exceeds 60/40, you should reset the internal Equalization jumper(s) for partial equalization. If, with partial equalization these numbers are still outside the 60/40 ratio, set the Equalization jumper for NO equalization.

Jumpers are appropriately labeled on the PC board. Refer to the parts location diagram for help in locating them. Also refer to the Assembly and Disassembly section for information on obtaining access to the interior of the TNC.

KAM Jumper K1

VHF-Equalization – This jumper is provided to alter the equalization characteristics of the VHF modem. The KAM is shipped with the jumper placed on ONLY ONE of the posts effectively "OFF" so that full equalization is in effect. With no jumper installed on the 3-pin header, full equalization is in effect. With the jumper connecting the center post and the post marked 1, there is no equalization. With the jumper connecting the center post and post marked 2, partial equalization is in effect. testing has shown, that most VHF transceivers require that the input audio signal de fully equalized for best performance. Should you wish to operate the KAM in a hard wire Packet line, no equalization should be in effect.

KPC-4 Jumpers K1 (Port 1) and K2 (Port 2)

Equalization – These jumpers are provided to alter the equalization characteristics of the modems. The KPC-4 is shipped with the jumper placed on ONLY ONE of the posts, effectively "OFF", so that full equalization is in effect. With no jumper installed on the 3-pin header, full equalization is in effect. With the jumper connecting the center post and the post marked 1, there is no equalization. With the jumper connecting the center post and the post marked 2, partial equalization is in effect. testing has shown that most VHF/UHF transceivers require that the input audio by fully equalized for best performance. Should you wish to operate the KPC-4 in a hard wire Packet line, no equalization should be in effect.

Watch Dog Timers

Jumpers are appropriately labeled on the PC board. Refer to the parts location diagram for help in locating them. Also refer the Assembly and Disassembly section for information on obtaining access to the interior of the TNC.

KAM – VHF Timer – Jumper K3

This jumper is provided to disable to disable the VHF watch dog timer. The timer is disabled if the jumper is installed. Time-out of the KAM will occur after approximately 2.5 minutes, un-keying the VHF PTT line. The KAM is shipped with the jumper not connecting the jumper posts; therefore, the timer is in effect.

KAM – HF Timer – Jumper K4

This jumper is provided to disable to disable the HF watch dog timer. The timer is disabled if the jumper is installed. Time-out of the KAM will occur after approximately 2.5 minutes, un-keying the HF PTT line. The KAM is shipped with the jumper installed; therefore, the timer is not in effect.

KAM Operating Note

As shipped from the factory, the VHF watch dog timer is in effect and the HF watch dog timer is not. The HF timer is not enabled since it cannot distinguish between RTTY and Packet signals. Should you plan to operate a mode other than Packet, the HF timer will limit your transmission to approximately 2.5 minutes if it is enabled.

KPC-4 – Timers – Jumpers K5 (Port 1) and K6 (Port 2)

These jumpers are provided to disable the watch dog timers. The timer is disabled if the jumper is installed. Time-out of the KPC-4 will occur after approximately 2.5 minutes, un-keying the PTT line. The KPC-4 is shipped with the jumpers not connecting the jumper posts; therefore, the timers are in effect. Should you wish to have a SHORTER timer interval, it may be obtained by changing the appropriate resistor shown in the following chart:

K5 Port 1	K6 Port 2	Time Delay	Rsistor Value
R43	R44	1.25 min	470 kΩ
R43	R44	.75 min	220 kΩ
R43	R44	.5 min	2.2 MΩ

KPC-2400

The KPC-2400 is shipped with the Optional Watch Dog circuit board installed. (This applies to units after serial number 73400. An optional circuit board may be ordered from Kantronics for units with serial numbers before 73400 and should be installed for digipeater or unattended operation.)

K1 jumper on both pins disables watch dog circuit. If harness is unplugged from watch dog board a 2.2 kΩ 5 % ¼ Watt resistor MUST be inserted between pins 1 and 5 wiring harness connector to allow normal operation. WARNING: A resistor larger than ¼ Watt will damage the connector. PTT shut-off time is approximately 2 minutes.

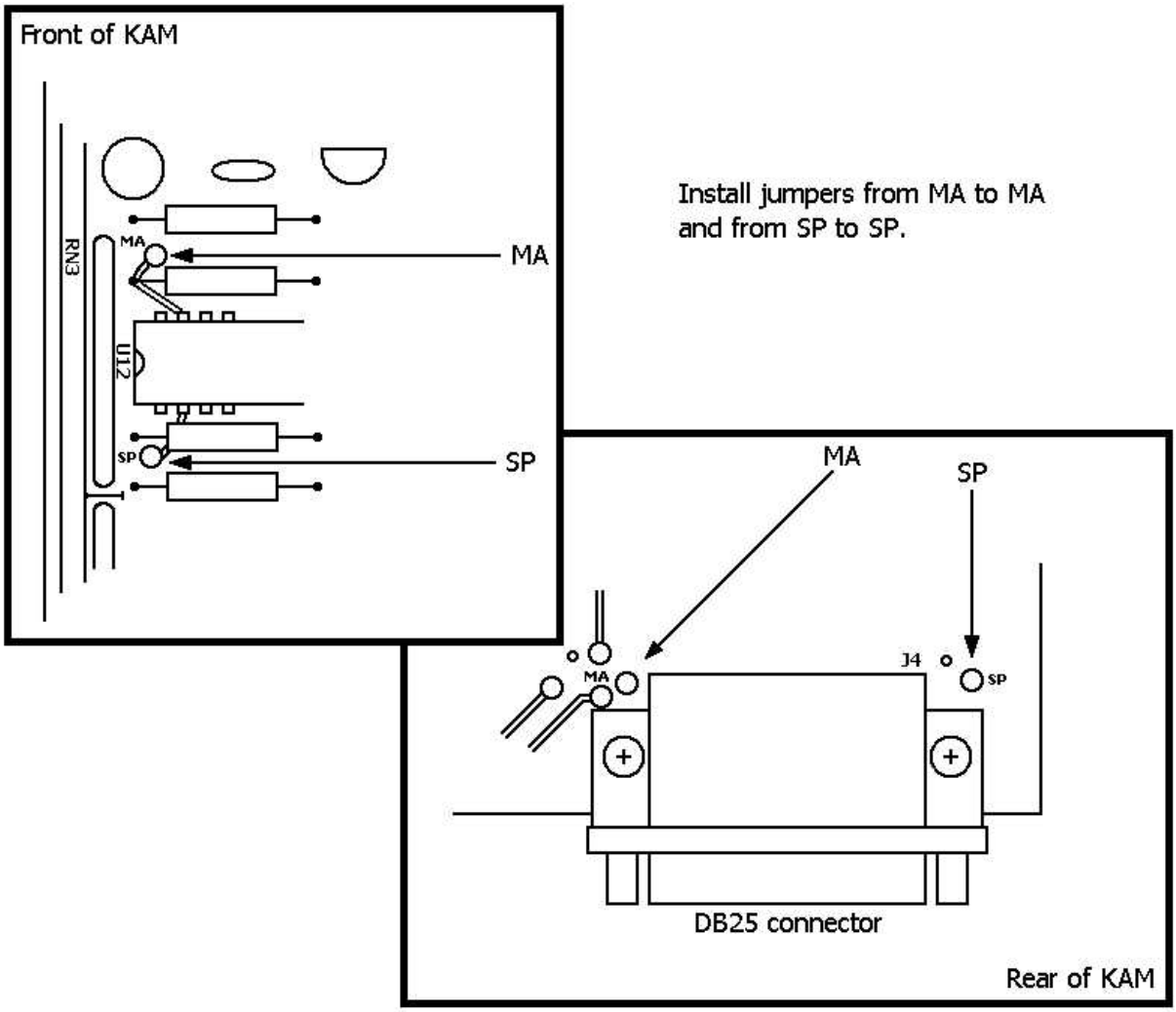
KPC-1 and KPC-2

These TNCs do not come with a watch dog timer installed. An optional circuit board may be ordered from Kantronics and should be installed for digipeater or unattended operation.

Scope Monitoring
KAM only

Obtaining Mark and Space Outputs

The schematic diagram of the KAM indicates that Mark and Space outputs are available on pins 11 and 18 of J4 (DB-25 connector). Provisions have been made for obtaining these outputs AFTER installing jumpers between the points provided on the PC board. This is accomplished by locating the four holes in the board marked MA and SP and adding wire jumpers between them. One pair of holes marked MA and SP are located next to the DB25 connector (J4) and the other pair is located on the opposite end of the board. Install jumpers from MA to MA and SP to SP and Mark/Space signals will then be present at pins 11 and 18 of J4. It is advisable to install a 100 kΩ resistor in series with these lines to protect the KAM from external voltages.



Dumb Modem Mode

KPC-1, KPC-2 and KPC-2400 Only

The TNC can also be used as a straight-through or dumb modem. In this mode the TNC does not use any of the protocols or special characteristics of Packet-Radio. Instead, the TNC simply outputs any information sent through the RS-232/TTL port, at up to 1200 baud.

To utilize the dumb feature, you must PERM the MODEMENA parameter ON. Hold the RTS line of the RS-232 connector at a negative voltage when the TNC is powered on. If the connector is set to the TTL level position, the RTS line must be held at a positive 5 volts when the TNC is powered on.

To operate in the dumb modem mode you must utilize the RTS and CTS lines. The TNC will function as a true RS-232 device, using these lines to control transmit and receive operation. The transmit and receive LED on the front panel will be operational. This mode uses the PERMed parameters as specified by the HF, HFT and CCITT command and checks the status of the EQUALIZE parameter.

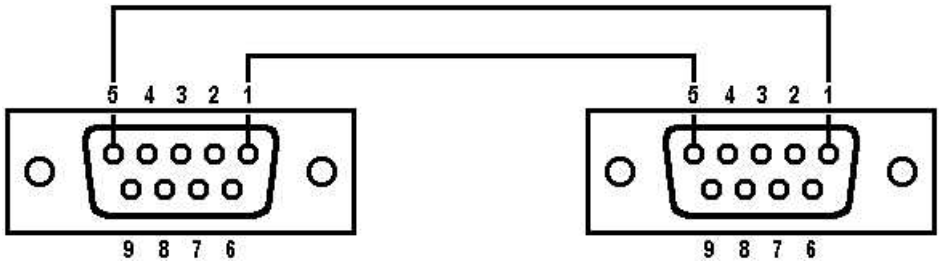
To exit this mode, you must turn the TNC off and power up with RTS free.

Performing a Loop-Back Test
KPC-4 Only

This test is to verify that your KPC-4 is functional and that the wiring to your computer is correct.

1. Remove the KPC-4 from its case. (See the Assembly and Disassembly section.)
2. Install jumpers between the radio ports as shown.

Female DB-9 Connectors (Looking at Holes)



3. Remove the header connectors from AFSK level jumpers K3 and K4.
4. Set a different callsign for Port 2. For example:

   MYCALL WK5M/DC7XJ

5. At the `cmd:` prompt enter a connect request to the callsign you have set for Port 2. Your display should look like this:

   `cmd:` C DC7XJ (<CR>)

   When you enter the carriage return the following will appear on your display:

   ```
   cmd:~A*** CONNECTED TO WK5M
   |A*** CONNECTED TO DC7XJ
   ```

   You are now in Converse Mode, connected to your Port 2. Type HELLO <CR> and the following will be added to your display:

   `|AHELLO` (this was received by Port 2)

6. You can manipulate transmission/reception between radio Port 1 and radio Port 2 by using the proper STREAMSW command, the ~ or |, or whatever streamswitch characters you have chosen.
7. These steps have shown that your KPC-4 is functional and that wiring to your computer is correct.

Modem Disconnect

KAM and KPC-4 only

Headers are appropriately labeled on the PC board. Refer to the parts location diagram for help on locating them. Also refer to the Assembly and Disassembly section for information on obtaining access to the interior of the TNC.

Headers K8 and K9

These connectors are provided for use with an external modem such as the KM-2400 modem (QPSK) or the MSK modem.

SWDETLED Modification

KPC-1 Only

To perform the Software Carrier Detect LED (SWDETLED) enable modification, remove the circuit board from the case as detailed in the Assembly and Disassembly section. Next, remove the 7910 (U-11) and bend pin25 out slightly so that it will not make contact with the socket when the IC is re-inserted in U-11. Re-install the 7910 in socket U-11. With this modification completed, you will not detect ANY packets unless CD is set to SOFTWARE.

Sample Terminal Programs

The following BASIC programs can be used to operate the Kantronics TNCs with the computers listed.

CAUTION: Each of the programs is a simple example of the necessary statements required to configure the computer for operation with an external device via the RS-232/TTL port. These simple terminal programs will NOT do file transfer or buffering of data and typing.

BASIC terminal program for the VIC-20/C-64

```
10 CLOSE2
20 OPEN2,2,3,CHR$(6)
30 GET#2,A$
40 REM
50 GET B$
55 IF B$=CHR$(133) THEN GOTO 100
60 IF B$<>""THEN PRINT#2,B$;
70 GET#2,C$
80 PRINT C$;
90 GOTO 50
100 CLOSE2
110 END
```

The #1 function key will return the C-64 computer to BASIC. If graphics characters appear, use the shift key with the Commodore key to change the character set. For use with the VIC-20, change the TNC COMMAND parameter to $05 (see Commands section of Commands Manual). The a Ctrl-2 typed on the VIC-20 will return the TNC to the Command Mode. (The VIC-20 does not have a Ctrl-C command.)

This program uses a 3-wire cable as described in the Connecting Your Computer section. Wire only RXD, TXD and SG.

Basic terminal program for the TRS-80 Model III

```
1 OUT232,0
2 OUT232,164
3 OUT233,85
4 CLS
10 IF INP(234) AND 128 THEN PRINT CHR$(INP(235));:GOTO 10
20 A$=INKEY$:IF A$="" THEN 10
30 IF INP(234)AND 64 THEN OUT 235,ASC(A$): GOTO 10 ELSE GOTO 30
```

Put the TRS-80 Model III in BASIC. Type and run the program. When the program is run, the screen will go blank. At this time turn on the TNC. The TNC will send the **PRESS * FOR AUTOBAUD** routine.

This program uses a 3-wire cable as described in the Connecting Your Computer section. Wire only RXD, TXD and SG.

BASIC terminal program for the Apple computer with the Super Serial Card

```
10 REM THIS PROGRAM SETS UP THE SSC FOR THE TNC
20 REM ASSUMES THE SSC IS IN SLOT #2
30 A$=CHR$(1):D$=CHR$(4)
40 PRINT D$;"PR#2"
50 PRINT A$;"6 BAUD": REM SET 300 BAUD
60 PRINT A$;"0 PARITY":REM NO PARITY
70 PRINT A$;"SD":REM DISABLE SPECIAL CHARS & ENABLE ESC KEY
80 PRINT A$;TERM MODE"
90 REM IN TERMINAL MODE-TALK TO TNC
100 REM PRESS<CTRL RESET>TO EXIT PROGRAM
110 PRINT A$;"RESET"
120 END
```

BASIC terminal program for the Zenith Z-100

```
10 KEY OFF: CLS: CLOSE
20 OPEN"COM1:300,8,N,1" AS #1
30 OPEN"SCRN:"FOR OUTPUT AS #2
40 A$=INKEY$:IF A$=""THEN 60
50 PRINT #1,A$
60 IF LOC(1)=0 THEN 40
70 B$=INPUT$(lOC(1),#1)
80 PRINT #2,B$
90 GOTO 40
```

BASIC terminal program for the Atari 850 Interface

```
10 GOSUB 1600
20 FOR LOOP=0 TO 1 STEP 0
50 IF PEEK(764)=255 THEN 80
60 GET #KEY,A:IF A=125 THEN A=8
70 PUT #1,A
80 STATUS #1,A:BUF=PEEK(747)
90 IF BUF=0 THEN NEXT LOOP
100 FOR I01 TO BUF
110 GET #1,A:IF A=8 THEN A=126
120 ?CHR$(A);:NEXT I
140 NEXT LOOP
1600 KEY=4
1610 XIO 36,#1,8,0,"R1:":REM-300 BAUD
1630 XIO 34,#1,48,0,"R1:"
1640 OPEN #1,13,0,"R1:"
1650 XIO 40,#1,0,0,"R1:"
1655 OPEN #KEY,4,0,"K:"
1660 RETURN
```

This program uses a 5-wire cable as described in the Connecting Your Computer section. When using this program, set the TNC's DELETE and AUTOLF commands to OFF.

Specifications

KAM, KPC-4, KPC-2, KPC-2400, KPC-1

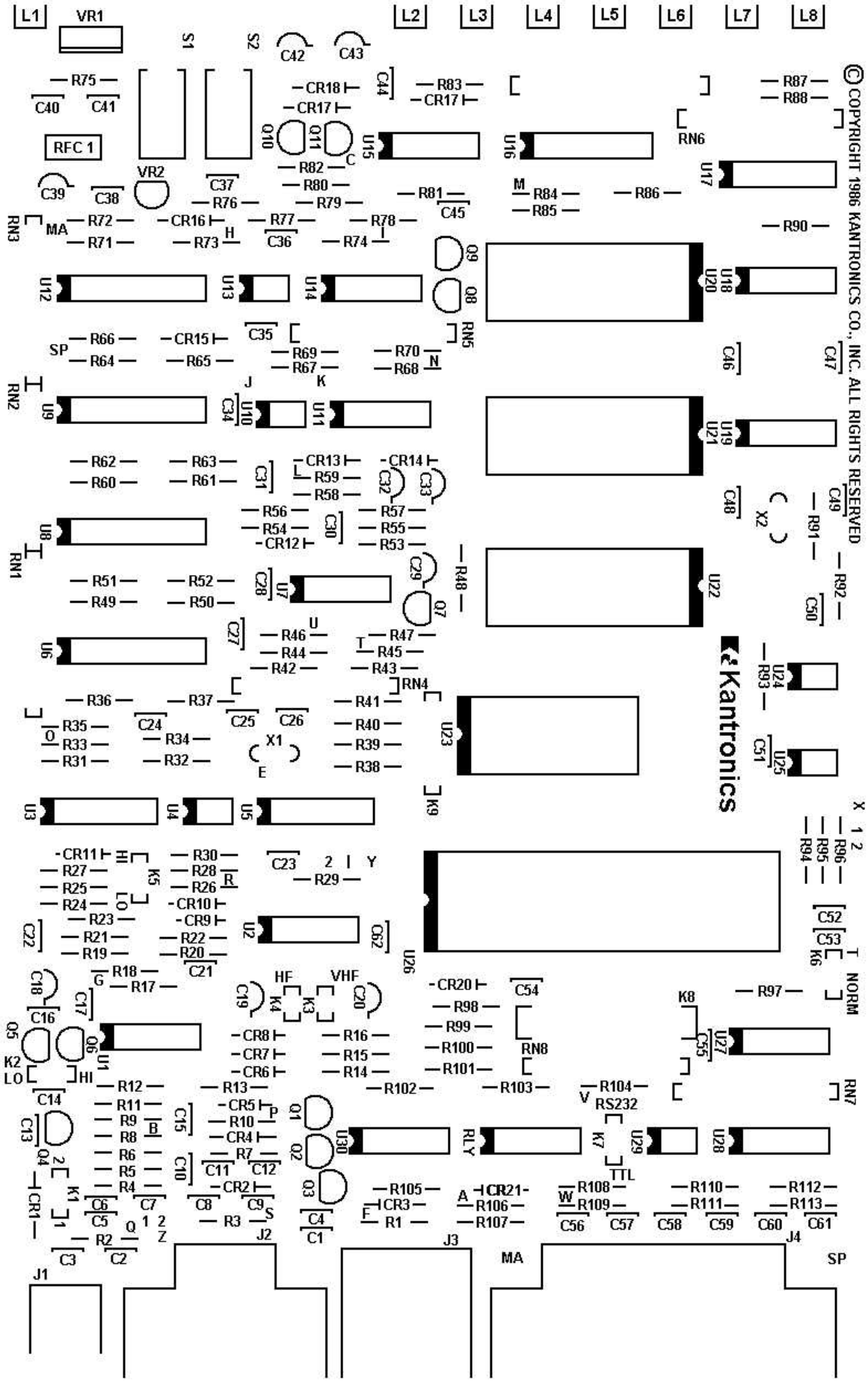
Size:	KAM:		1-¾" × 6" × 9"
	KPC-4, KPC-2, KPC-2400, KPC-1:		1-¾" × 6" × 8"
Weight:	KAM:		2-½ lbs.
	KPC-4, KPC-2, KPC-2400, KPC-1:		2-¼ lbs.
Power Requirements:	KAM:		11 VDC to 14 VDC, < 300 mA
	KPC-4:		11 VDC to 14 VDC, < 200 mA
	KPC-2:		9 VDC to 14 VDC, < 250 mA
	KPC-2400:		10 VDC to 15 VDC, < 330 mA
	KPC-1:		10 VDC to 14 VDC, < 330 mA
Power Plug Polarity:	All units:		Center pin positive
Watch Dog Timer:	KAM, KPC-4, KPC-2400: (Optional board for other units)		2 – ½ minutes
External Carrier Detect (XCD):		KAM, KPC-4:	Pulldown to ground
External Reset:		KPC-4:	Pulldown to ground
PTT Output:	All units:		Open Collector, +40 VDC max.
FSK Output:	KAM HF:		Open collector, +40 VDC max.
Key Output:	KAM HF:		Reed relay contact rated 0.5 A and 300 VDC max. (100 Ω series resistor)
Audio Output:	KAM HF		All Others
Output drive:	100 mVpp (LO) 500 mVpp (HI) 1.6 Vpp (no jump)		10 mVpp (LO) 50 mVpp (HI) 1.7 Vpp (no jump) (does not apply to KPC-1)
Output Impedance: (AC coupled)	600 Ω		600 Ω (AC coupled)
Audio Input:	KAM HF		All Others
Input Sensitivity:	20 mVpp (FM) 100 mVpp (AM)		20 mVpp
Dynamic Range:	>60 dB		>60 dB
Input Impedance: (unbalanced)	600 Ω		600 Ω
Max. Input Voltage:	±12 VDC		±12 VDC
Modes of Operation:	KAM:		Packet, CW, RTTY, ASCII, AMTOR (CCIR 476 and CCIR 625), WEFAX, KISS, NAVTEX/AMTEX, Host
	All Others:		Packet, WEFAX, Kiss, Host
Other Features:	All units:		PBBS, KA-NODE
	KAM, KPC-4:		Dual port with gateway and cross-connect

KAM Parts List

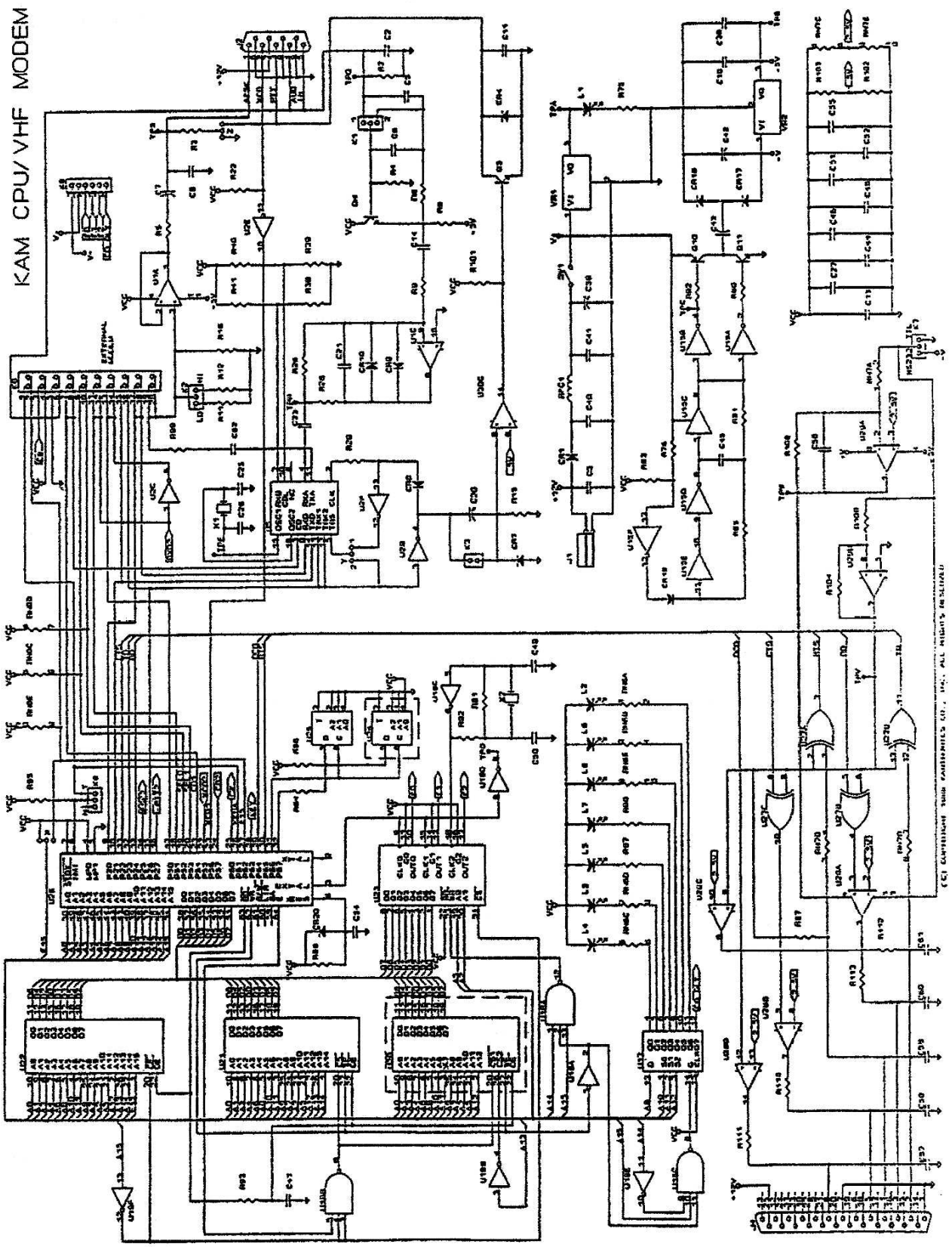
C1	-	µ01	C56	-	µ01	Q1	-	PN2222
C2	-	µ01	C57	-	µ001	Q2	-	PN2222
C3	-	µ1	C58	-	µ001	Q3	-	PN2222
C4	-	µ001	C59	-	µ001	Q4	-	PN2222
C5	-	µ001	C60	-	µ001	Q5	-	PN2907A
C6	-	µ001	C61	-	µ001	Q6	-	2N7000
C7	-	1µ Alum	C62	-	µ1	Q7	-	PN2907A
C8	-	µ001				Q8	-	PN2907A
C9	-	µ001	CR1	-	1N4003	Q9	-	PN2222
C10	-	µ1	CR2	-	1N4003	Q10	-	PN2907A
C11	-	µ001	CR3	-	1N4003	Q11	-	PN2222
C12	-	µ001	CR4	-	1N4003			
C13	-	µ1	CR5	-	1N914	R1	-	620
C14	-	µ1	CR6	-	1N914	R2	-	620
C15	-	1µ Alum	CR7	-	1N914	R3	-	10k
C16	-	µ1	CR8	-	1N914	R4	-	100k
C17	-	µ001	CR9	-	1N914	R5	-	620
C18	-	1µ Alum	CR10	-	1N914	R6	-	47k
C19	-	47µ Aum	CR11	-	1N914	R7	-	10k
C20	-	47µ Alum	CR12	-	1N914	R8	-	4k7
C21	-	µ001	CR13	-	1N914	R9	-	6k8
C22	-	1µ	CR14	-	1N914	R10	-	620
C23	-	µ1	CR15	-	1N914	R11	-	220
C24	-	µ01	CR16	-	1N914	R12	-	1k
C25	-	20p	CR17	-	1N4003	R13	-	100k
C26	-	20p	CR18	-	1N4003	R14	-	1M
C27	-	µ1	CR19	-	1N914	R15	-	1M
C28	-	µ1	CH20	-	1N914	R16	-	1M
C29	-	1µ Alum	CR21	-	1N914	R17	-	470
C30	-	µ01				R18	-	47k
C31	-	µ01	J1	-	2.5 mm Barrel	R19	-	2k2
C32	-	4µ7 Alum	J2	-	9 Pin - D	R20	-	10k
C33	-	4µ7 Alum	J3	-	8 Pin Din	R21	-	1M
C34	-	µ01	J4	-	25 Pin - D	R22	-	10k
C35	-	µ01	K1	-	3 Pin	R23	-	10k
C36	-	330p	K2	-	3 Pin	R24	-	1k5
C37	-	µ01	K3	-	2 Pin	R25	-	10k
C38	-	µ1	K4	-	2 Pin	R26	-	6k8
C39	-	10µ Tant	K5	-	3 Pin	R27	-	15k
C40	-	µ1	K6	-	3 Pin	R28	-	15k
C41	-	µ1	K7	-	3 Pin	R29	-	10k
C42	-	10µ 50V Alum	K8	-	20 Pin	R30	-	22k
C43	-	10µ 50V Alum	K9	-	6 Pin	R31	-	150k
C44	-	µ1				R32	-	150k
C45	-	µ001	L1	-	GREEN	R33	-	100k
C46	-	µ1	L2	-	GREEN	R34	-	100k
C48	-	µ1	L3	-	GREEN	R35	-	2k7
C49	-	25p	L4	-	GREEN	R36	-	1k2
C50	-	33p	L5	-	RED	R37	-	15k
C51	-	µ1	L6	-	GREEN	R38	-	10k MF
C52	-	µ1	L7	-	GREEN	R39	-	33k
C54	-	µ1	L8	-	RED	R40	-	9k1
C55	-	µ1				R41	-	8k45 MF

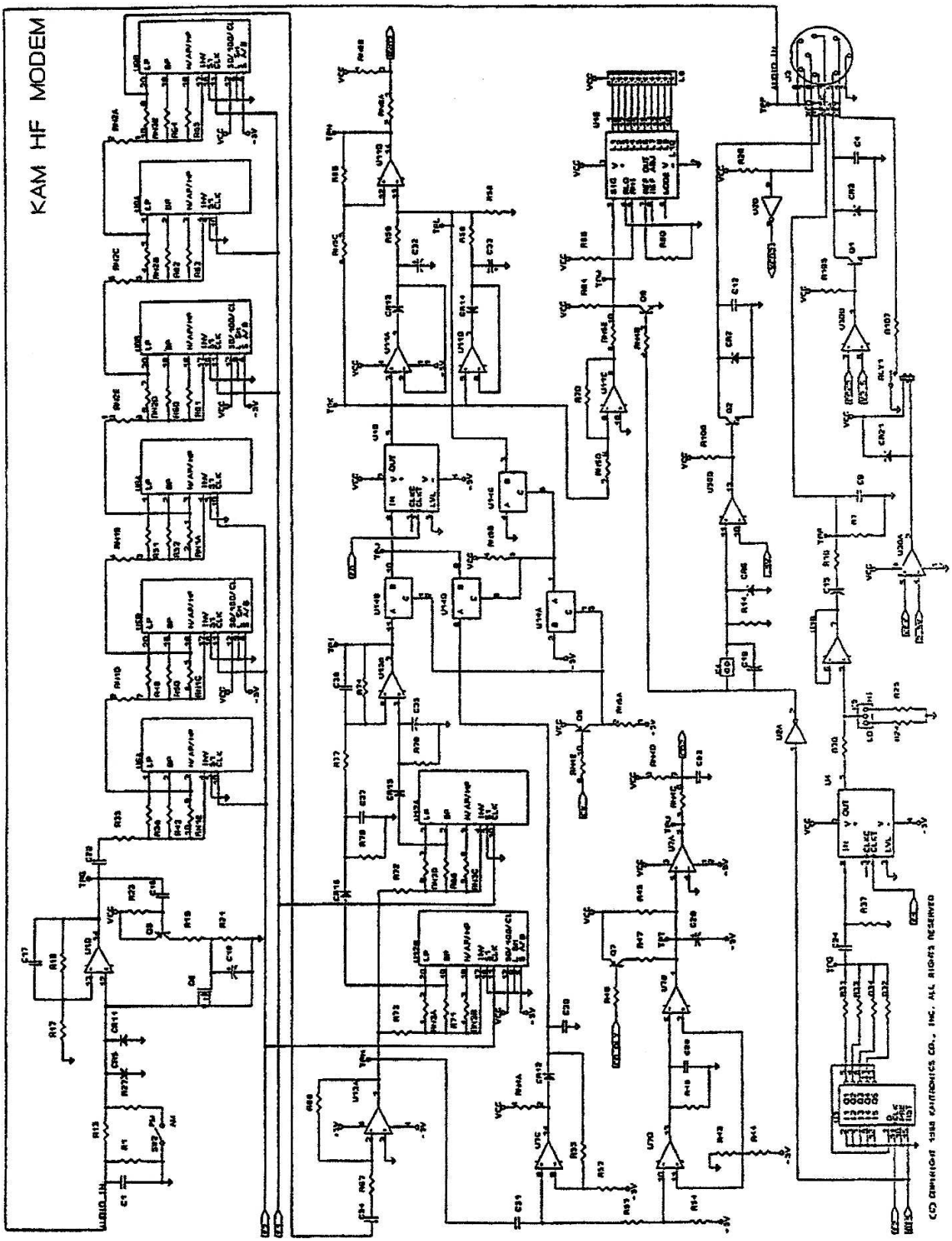
R42 - 2k7	R98 - 100k	RN1 - 10k
R43 - 22k	R99 - 33k	RN2 - 10k
R44 - 10k	R100 - 1k	RN3 - 10k
R45 - 680k	R101 - 1k	RN4 - 10k
R46 - 620k	R102 - 10k	RN5 - 10k
R47 - 220k	R103 - 100k	RN6 - 220k
R48 - 10k	R104 - 51k	RN7 - 100k
R49 - 5k1	R105 - 10k	RN8 - 10k
R50 - 15k	R106 - 6k8	
R51 - 9k53 MF	R107 - 100	
R52 - 82k	R108 - 100k	
R53 - 220k	R109 - 120k	
R54 - 100k	R110 - 270	
R55 - 150k	R111 - 270	
R56 - 150k	R112 - 6k8	
R57 - 150k	R113 - 270	
R58 - 33k		
R59 - 33k	RFC1 - 10µH	
R60 - 2k7		
R61 - 1k2	S1 - PUSH PUSH	
R62 - 15k	S2 - PUSH PUSH	
R63 - 5k1		
R64 - 82k	U1 - MC34074	
R65 - 9k53 MF	U2 - 741IC04	
R66 - 68k	U3 - 4018	
R67 - 47k	U4 - MF4CN	
R68 - 100k	U5 - TCM3105	
R69 - 150k	U6 - MF10CN	
R70 - 22k	U7 - LM339	
R71 - 68k	U8 - MF10CN	
R72 - 100k	U9 - MF10CN	
R73 - 100k	U10 - MF4CN	
R74 - 1M	U11 - LM324	
R75 - 220	U12 - MF10CN	
R76 - 180k	U13 - LM358	
R77 - 100k	U14 - 4066	
R78 - 100k	U15 - 4069	
R79 - 100k	U16 - LM3914	
R80 - 2k2	U17 - 74HC259	
R81 - 22k	U18 - 74HC10	
R82 - 2k2	U19 - 74HC04	
R83 - 100k	U20 - SPARE	
R84 - 9k1	U21 - 42832	
R85 - 100k	U22 - 27C256	
R86 - 2k2	U23 - 71054	
R87 - 220	U24 - SPARE	
R88 - 220	U25 - X2404	
R90 - 620	U26 - 63B03X	
R91 - 1M	U27 - 4070	
R92 - 2k2	U28 - MC34074	
R93 - 1k	U29 - LM358	
R94 - 2k2	U30 - LM339	
R95 - 10k		
R96 - 100k	VR1 - 78M05 +5V Reg	
R97 - 6k8	VR2 - 79L05 -5V Reg	

KAM COMPONENT PLACEMENT DIAGRAM



KAM SCHEMATIC

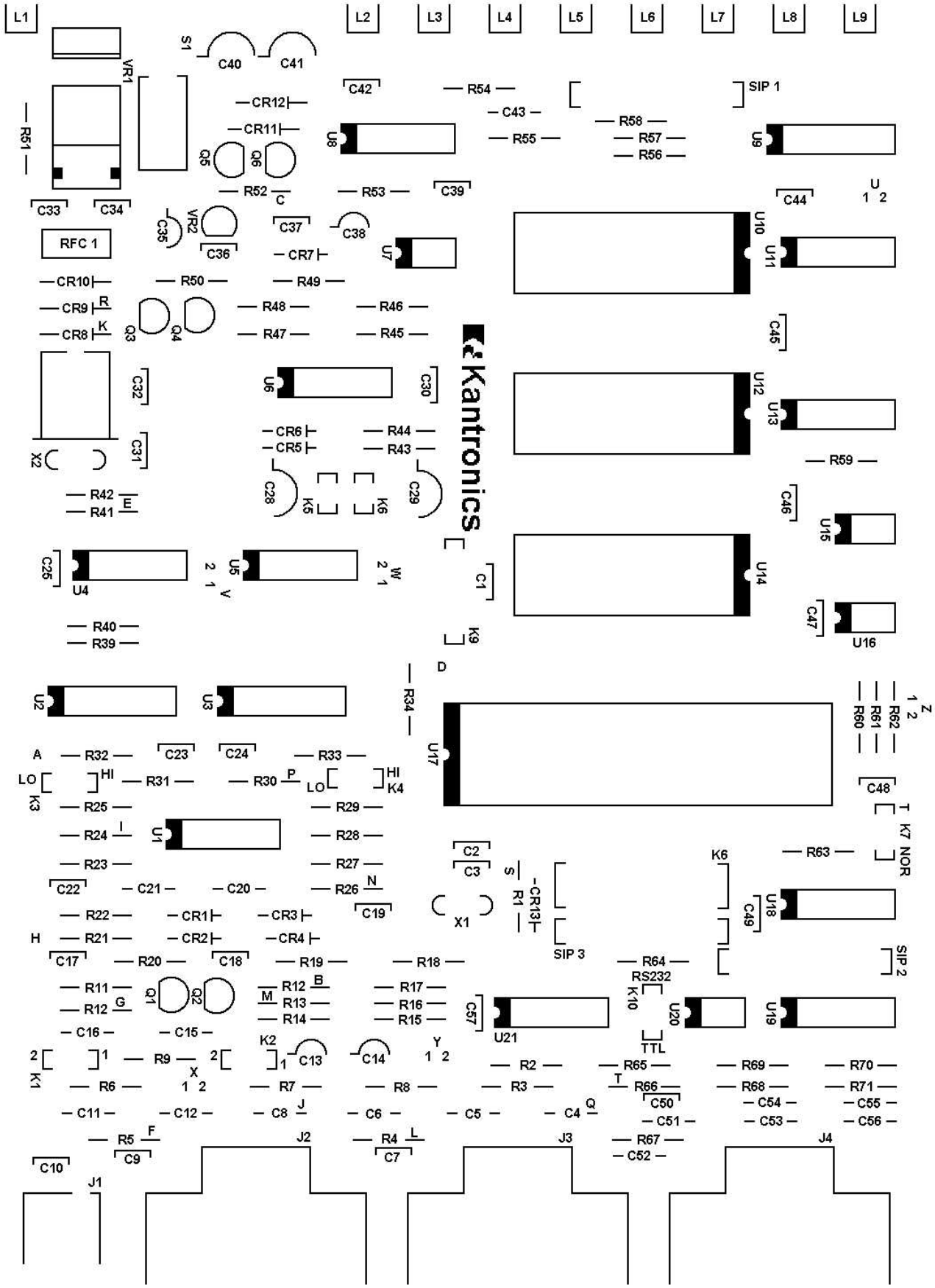



KAM HF MODEM

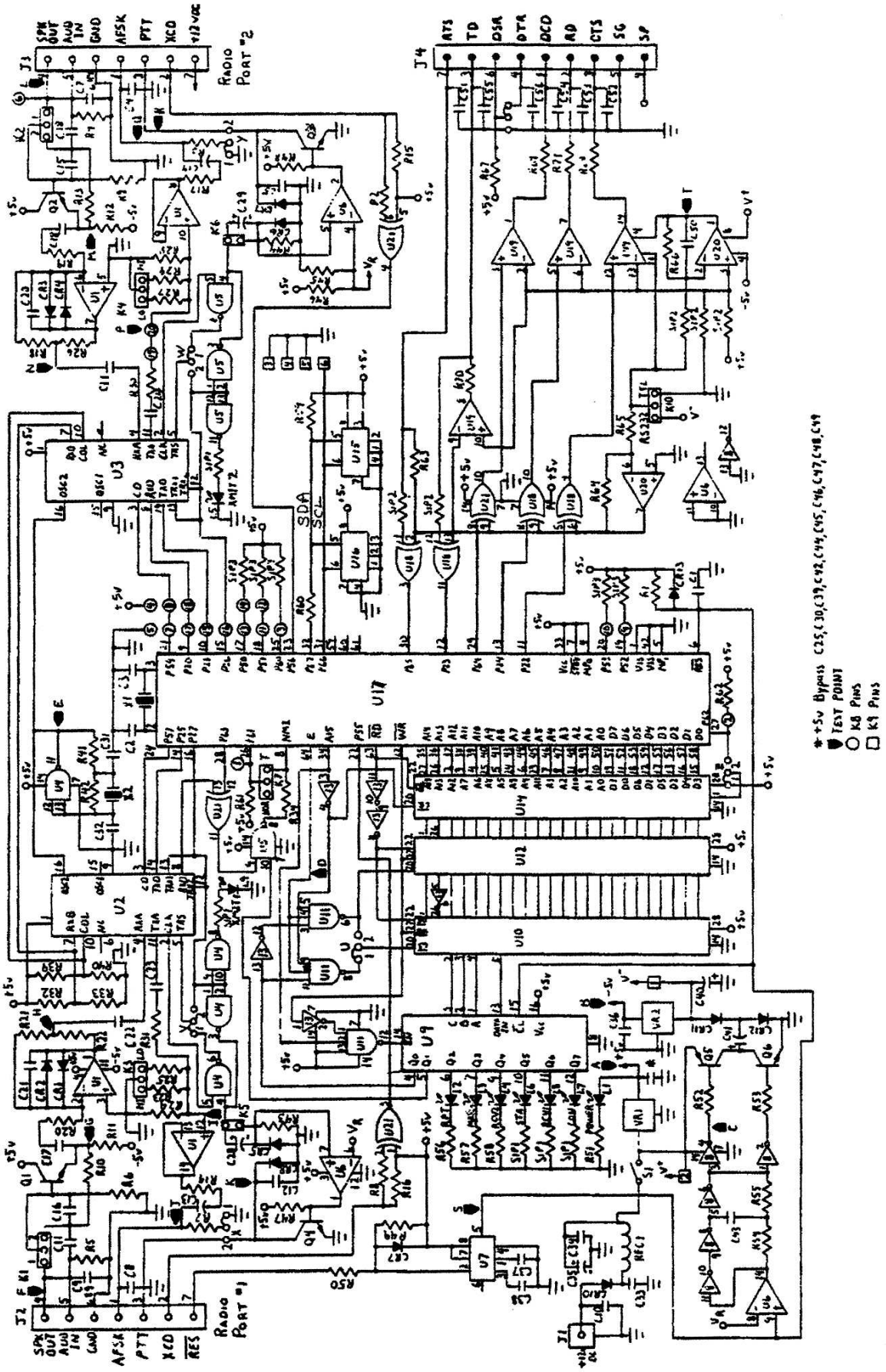
KPC-4 Parts List

C1	-	µ1	C54	-	µ001	R27	-	220
C2	-	20p	C55	–	µ001	R28	-	1M
C3	-	20p	C56	-	µ001	R29	-	1k
C4	-	µ001	C57	-	µ1	R30	-	33k
C5	-	µ001				R31	-	33k
C6	-	µ001	CR1	-	1N914	R32	-	8k45
C7	-	µ01	CR2	-	1N914	R33	-	10k
C8	-	µ001	CR3	-	1N914	R34	-	10k
C9	-	µ01	CR4	-	1N914			
C10	-	µ1	CR5	-	1N914	R39	-	9k1
C11	-	µ001	CR6	-	1N914	R40	-	33k
C12	-	µ001	CR7	-	1N914	R41	-	2k2
C13	-	1µ	CR8	-	1N4001	R42	-	1M
C14	-	1µ	CR9	-	1N4001	R43	-	1M
C15	-	µ001	CR10	-	1N4001	R44	-	1M
C16	-	µ001	CR11	-	1N4001	R45	-	10k
C17	-	µ1	CR12	-	1N4001	R46	-	100k
C18	-	µ1	CR13	-	1N914	R47	-	1k
C19	-	µ1				R48	-	1k
C20	-	µ001	Q1	-	PN2222	R49	-	100k
C21	-	µ001	Q2	-	PN2222	R50	-	10k
C22	-	µ1	Q3	-	PN2222	R51	-	220
C23	-	µ1	Q4	-	PN2222	R52	-	2k2
C24	-	µ1	Q5	-	PN2907	R53	-	2k2
C25	-	µ1	Q6	-	2N2222	R54	-	100k
						R55	-	22k
C28	-	47µ	R1	-	100k	R56	-	220
C29	-	47µ	R2	-	100k	R57	-	220
C30	-	µ1	R3	-	10k	R58	-	220
C31	-	20p	R4	-	620	R59	-	100k
C32	-	20p	R5	-	620	R60	-	2k2
C33	-	µ1	R6	-	100k	R61	-	100k
C34	-	µ1	R7	-	10k	R62	-	10k
C35	-	10µ Tant	R8	-	10k	R63	-	6k8
C36	-	µ1	R9	-	100k	R64	-	51k
C37	-	µ1	R10	-	47k	R65	-	100k
C38	-	4.1	R11	-	4k7	R66	-	120k
C39	-	µ1	R12	-	4k7	R67	-	6k8
C40	-	10	R13	-	47k	R68	-	270
C41	-	10	R14	-	620	R69	-	270
C42	-	µ1	R15	-	10k	R70	-	6k8
C43	-	µ001	R16	-	10k	R71	-	270
C44	-	µ1	R17	-	620			
C45	-	µ1	R18	-	15k	RFC1	-	10µH
C46	-	µ1	R19	-	6k8			
C47	-	µ1	R20	-	6k8	S1P1	-	220
C48	-	µ1	R21	-	15k	S1P2	-	100k
C49	-	µ1	R22	-	6k8	S1P3	-	10k
C50	-	µ01	R23	-	1k			
C51	-	µ001	R24	-	1M	U1	-	MC34074
C52	-	µ001	R25	-	220	U2	-	3105
C53	-	µ001	R26	-	6k8	U3	-	3105

KPC-4 COMPONENT PLACEMENT DIAGRAM



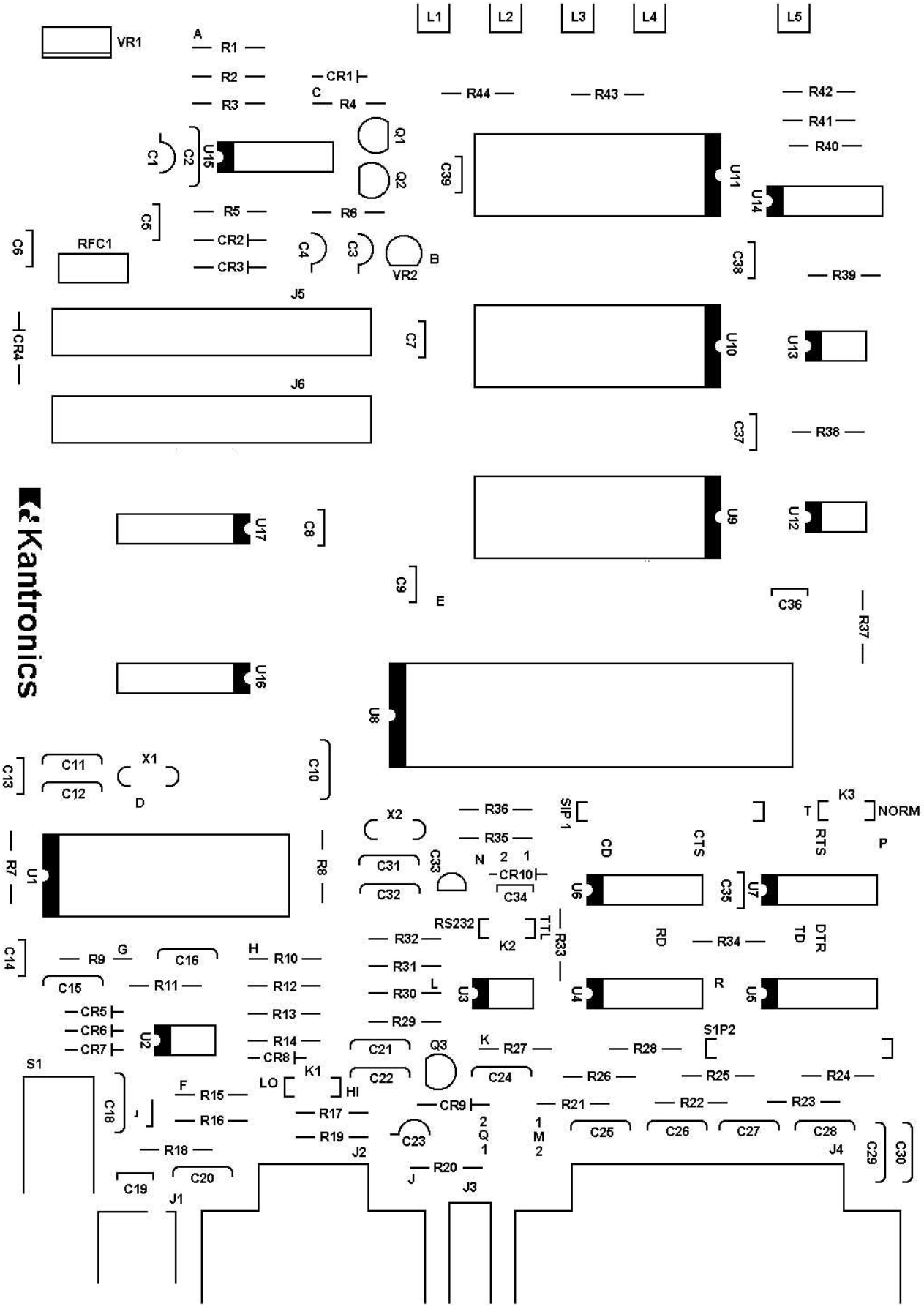
KPC-4 SCHEMATIC



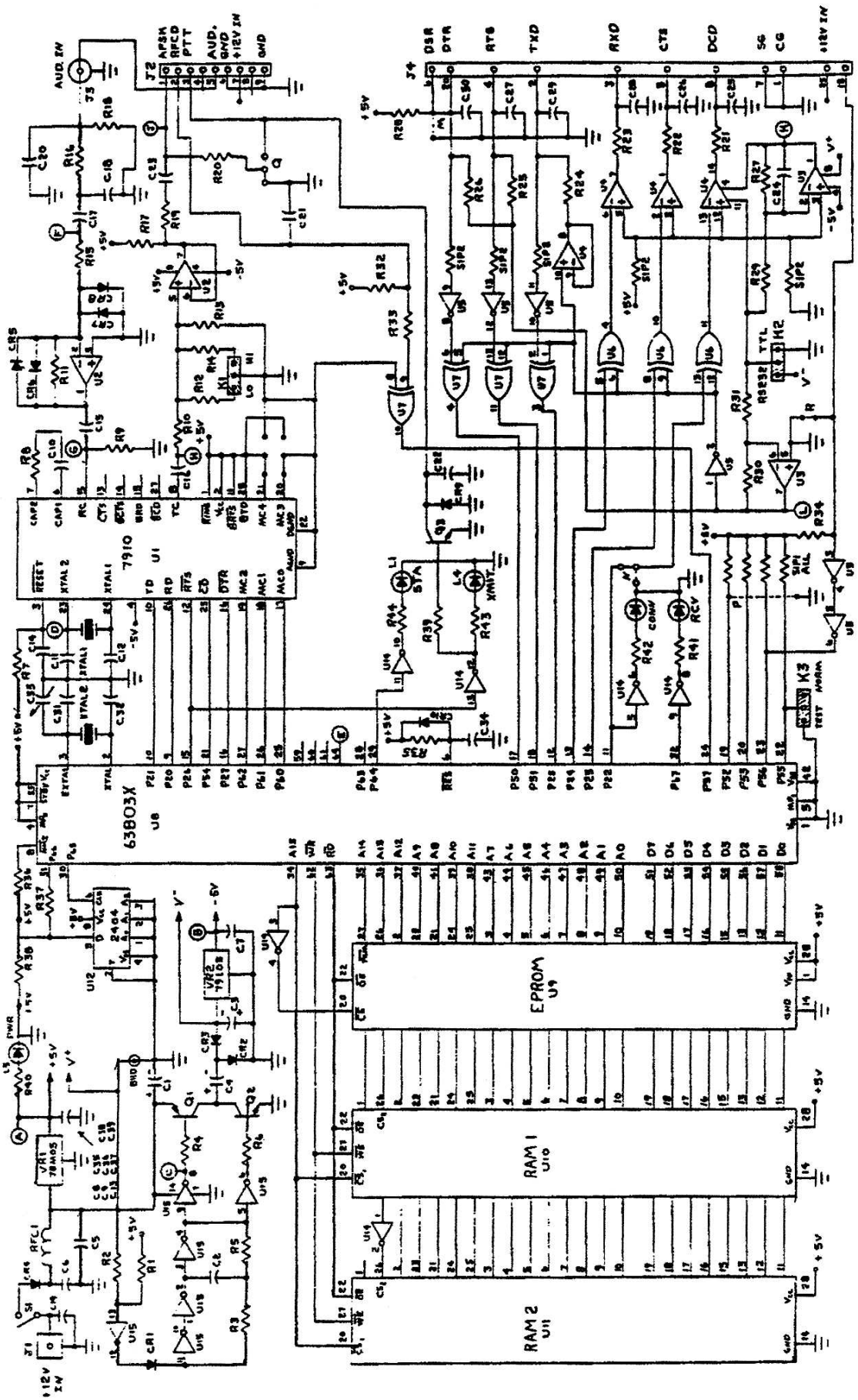
KPC-2 Parts List

C1	-	µ1	J1	-	power jack	R25	- 6k8
C2	-	10µ Tant	J2	-	9-pin D-connector	R26	- 6k8
C3	-	µ001 Disc	J3	-	3.5 audio jack	R27	- 120k
C4	-	4µ7 Alum	J4	-	25-pin D-connector	R29	- 100k
C5	-	µ1 MLC				R30	- 51k
C6	-	µ1 MLC	K1	-	3 pin header	R31	- 120k
C7	-	µ1 MLC	K2	-	3 pin header	R32	- 10k
C8	-	µ1 MLC	K3	-	3 pin header	R33	- 10k
C9	-	µ1 MLC				R34	- 10k
C10	-	µ002 Disc	L-1	-	Red LED	R35	- 100k
C11	-	20p	L-2	-	Red LED	R36	- 10k
C13	-	µ1 MLC	L-3	-	Red LED	R37	- 2k2
C14	-	µ1 MLC	L-4	-	Red LED	R38	- 100k
C15	-	µ01 Disc	L-5	-	Green LED	R39	- 4k7
C16	-	µ01 Disc				R40	- 220
C17	-	µ001 MLC	N1 J5			R41	- 220
C18	-	µ01 Disc	Q1 M1 jumper			R42	- 220
C19	-	µ1 ML	hole 9-10			R43	- 220
C20	-	µ01 Disc				R44	- 220
C21	-	µ001 Disc	Q1	-	PN2907A		
C22	-	µ001 Disc	Q2	-	PN2222	RFC1	- 10µH
C23	-	1µ Alu	Q3	-	PN2222	S1	- push push sw
C24	-	µ01 Disc					
C25	-	µ001 Dis	R1	-	100k	S1P1	- 10k
C26	-	µ001 Dis	R2	-	120k	S1P2	- 100k
C27	-	µ001 Dis	R3	-	100k		
C28	-	µ001 Dis	R4	-	4k7	U1	- 7910 28 pin
C29	-	µ001 Dis	R5	-	22k	U2	- LM358
C30	-	µ001 Dis	R6	-	4k7	U3	- LM358
C31	-	20p	R7	-	1M	U4	- MC34074
C32	-	20p	R8	-	100	U5	- 74HC14
C34	-	µ1 MLC	R9	-	100k	U6	- 4070
C35	-	µ1 MLC	R10	-	33k	U7	- 4070
C36	-	µ1 MLC	R11	-	100k	U8	- 63B03X socket
C37	-	µ1 MLC	R12	-	100	U9	- 27256 socket
C38	-	µ1 MLC	R13	-	1M	U11	- 62256 socket
C39	-	µ1 MLC	R14	-	470	U12	- 2404 socket
			R15	-	100k	U14	- 74HC04
CR1	-	1N914	R16	-	3k3	U15	- 4069
CR2	-	1N4003	R17	-	4k7		
CR3	-	1N4003	R18	-	620	VR1	- 78M05
CR4	-	1N4003	R19	-	620	VR2	- 79L05
CR5	-	1N914	R20	-	10k		
CR6	-	1N914	R21	-	270	XTAL1	- 2.4576 MHz
CR7	-	1N914	R22	-	270	XTAL2	- 7.3728 MHz
CR8	-	1N914	R23	-	270		
CR9	-	1N4003	R24	-	6k8		
CR10	-	1N914					

KPC-2 COMPONENT PLACEMENT DIAGRAM



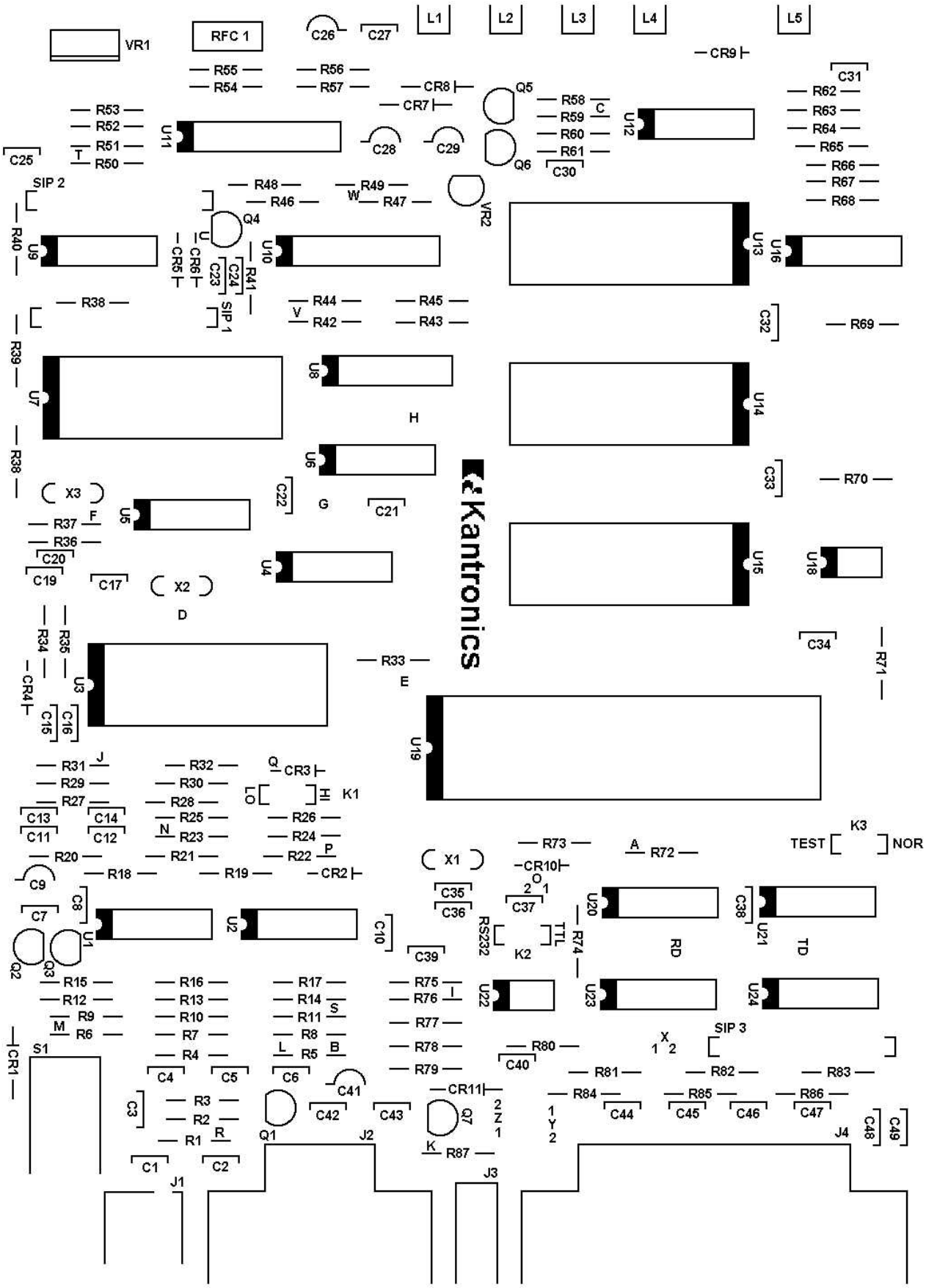
KPC-2 SCHEMATIC



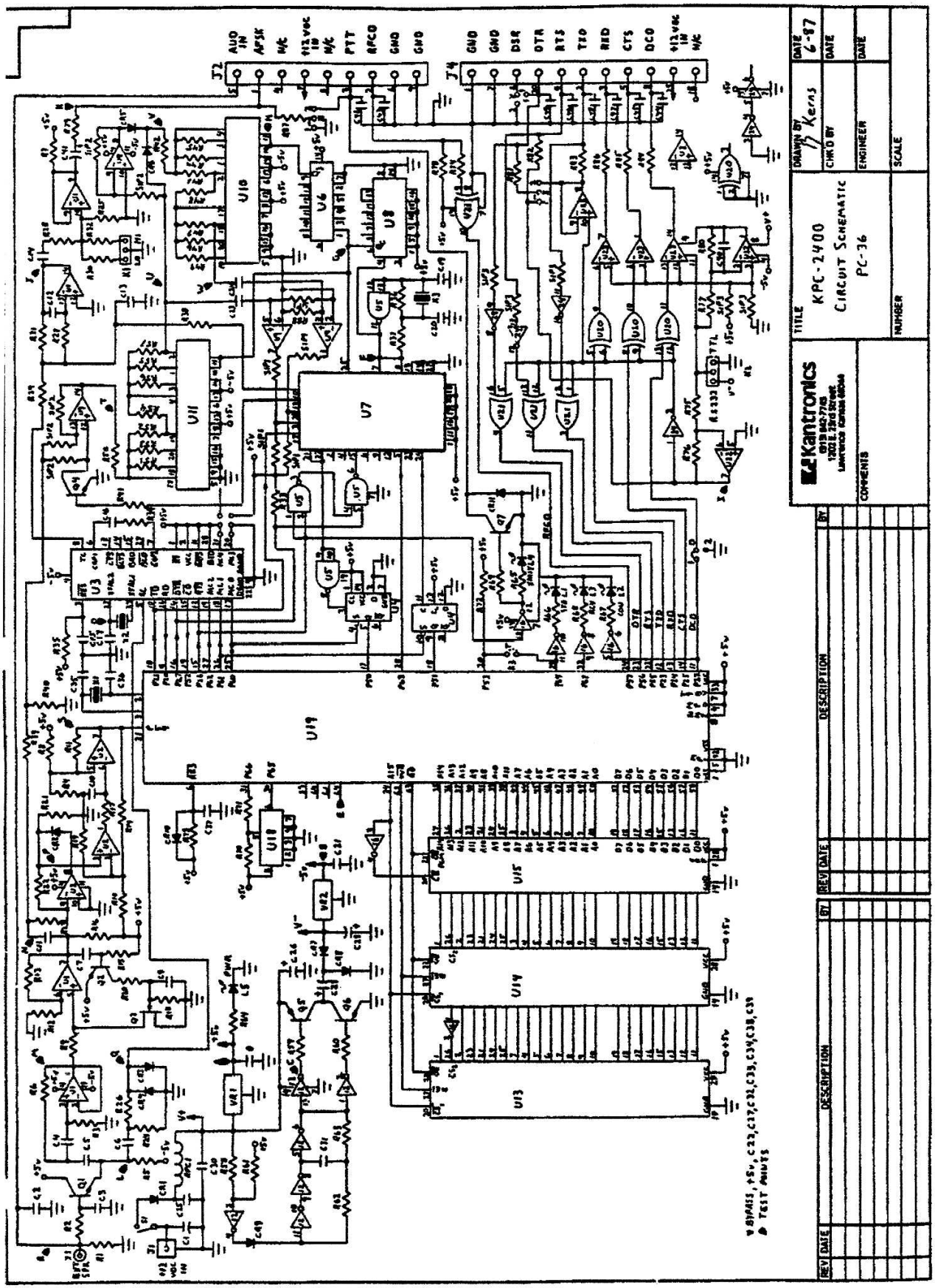
KPC-2400 Parts List

R1	-	620k	R52	-	68k	C4	-	µ001
R2	-	22k	R53	-	18k	C5	-	µ001
R3	-	100k	R54	-	33k	C6	-	µ001
R4	-	8k2	R55	-	18k	C7	-	µ1
R5	-	4k7	R56	-	9k53 MF			
R6	-	47k	R57	-	68k	C9	-	1µ Alum
R7	-	4k7	R58	-	180k	C10	-	µ1
R8	-	33k	R59	-	4k7	C11	-	µ1
R9	-	10k	R60	-	4k7	C12	-	µ001
R10	-	18k	R61	-	100k	C13	-	µ1
R11	-	470k	R62	-	100k	C14	-	µ01
R12	-	470	R63	-	22k	C15	-	µ1
R13	-	47k	R64	-	220	C16	-	µ002
R14	-	470k	R65	-	220	C17	-	20p
R15	-	10k	R66	-	220			
R16	-	4k7	R67	-	220	C19	-	33p
R17	-	100k	R68	-	220	C20	-	33p
R18	-	1M	R69	-	4k7	C21	-	µ1
R19	-	910	R70	-	100k	C22	-	µ1
R20	-	2k2	R71	-	2k2	C23	-	µ01 Disc
R21	-	1M	R72	-	10k	C24	-	µ01 Disc
R22	-	100k	R73	-	100k	C25	-	µ1
R23	-	100k	R74	-	100k	C26	-	10µ
R24	-	100k	R75	-	120k	C27	-	µ1
R25	-	1M	R76	-	68k	C28	-	10µ Alum
R26	-	47k	R77	-	100k	C29	-	10µ Alum
R27	-	470	R78	-	10k	C30	-	µ1
R28	-	33k	R79	-	620	C31	-	µ001
R29	-	47k	R80	-	120k	C32	-	µ1
R30	-	220	R81	-	6k8	C33	-	µ1
R31	-	47k	R82	-	6k8	C34	-	µ1
R32	-	1k	R83	-	6k8	C35	-	20p
R33	-	10k	R84	-	270	C36	-	20p
R34	-	100	R85	-	270	C37	-	µ1
R35	-	1M	R86	-	270	C38	-	µ1
R36	-	1M	R87	-	10k	C39	-	µ1
R37	-	2k2	R88	-	100k	C40	-	µ01 Disc
R38	-	150k				C41	-	1µ Alum
R39	-	2k2	RFC1	-	10µH	C42	-	µ001
R40	-	4k7				C43	-	µ001
R41	-	10k	XTAL1	-	7.3728 MHz	C44	-	µ001
R42	-	33k	XTAL2	-	2.4576 MHz	C45	-	µ001
R43	-	100k	XTAL3	-	4.608 MHz	C46	-	µ001
R44	-	15k				C47	-	µ001
R45	-	9k09 MF	S1P1	-	100k	C48	-	µ001
R46	-	15k	S1P2	-	100k	C49	-	µ001
R47	-	9k09 MF	S1P3	-	100k			
R48	-	33k				CR1	-	1N4001
R49	-	100k	C1	-	µ1	CR2	-	1N914
R50	-	15k	C2	-	µ01	CR3	-	1N914
R51	-	9k53 MF	C3	-	µ001	CR4	-	1N914

KPC-2400 COMPONENT PLACEMENT DIAGRAM



KPC-2400 SCHEMATIC



PACTOR Option Addendum

KAM EPROM Version 6.1

Thank you for purchasing the PACTOR Option for your KAM. We believe you'll find many hours of enjoyment and many new friends as you explore this new digital mode.

The enclosed EPROM for your KAM contains some minor changes since the original release, version 6.0. The manual indicates (on pages 3 and 10) that you must use the PTLISTEN mode to monitor PACTOR transmissions. By popular demand, this has been changed in version 6.1 to allow monitoring in Standby Mode too.

To monitor PACTOR in Standby Mode, set the MONITOR command to ON/XXX and the ARQBBS command to OFF. In PACTOR Standby Mode, you can also transmit FEC by typing Ctrl-C T and return to receive by typing Ctrl-C E.

We've also added the NAVLOG command, an immediate command, to display a list of NAVTEX messages that have been properly received in the NAVTEX Mode.