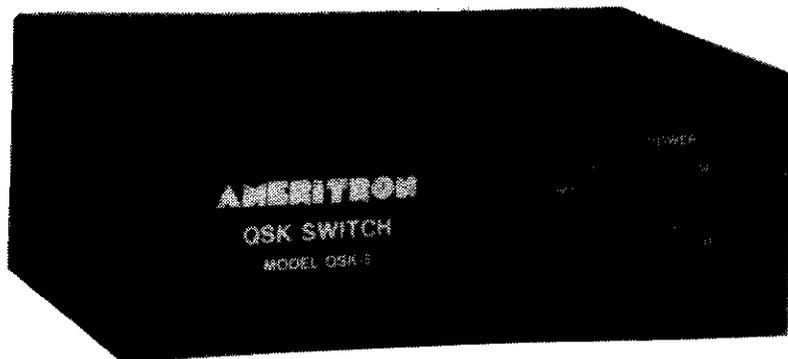


# AMERITRON



## 2.5KW QSK T/R SWITCH MODEL QSK-5 INSTRUCTION MANUAL

**AMERITRON**  
116 Willow Road  
Starkville, MS 39759



## QSK-5 T/R SWITCH

The Ameritron QSK-5 is a self contained QSK switch that adapts non-QSK amplifiers to full break-in operation. The QSK-5 is housed in an RF shielded enclosure and operates on 120 VAC power lines (QSK-5X operates on 200V - 240V). Interface connections are made on the rear panel through four standard phono jacks for control and four SO-239 connectors for RF.

The QSK-5 will handle 2000 watts of carrier on CW and 2500 watts PEP on SSB in normal amateur service when the load has a low SWR. An optional fan is required for continuous carrier modes such as RTTY and Packet at power levels over 750 watts.

Internal modifications are not required with linear amplifiers that use less than 25 volts of positive polarity on the "keying" jack.

The following requirements must be met by the station equipment (amplifier, antenna, transceiver) to insure proper operation of the QSK-5:

**AMPLIFIER REQUIREMENTS:** The Ameritron QSK-5 (QSK-5X) is compatible with all Ameritron HF Amplifiers. The keying voltage of the amplifier used with the QSK-5 must be a positive polarity below 25 volts. Most popular amplifiers will meet this requirement. The QSK-5 is designed to be used with full legal limit amateur amplifiers and will safely carry power levels up to 2000 watts on CW and 2500 watts PEP on SSB. The SSTV, RTTY and PACKET rating of the QSK-5 is 750 watts average power with 5 minute on and two minute off duty cycles without a cooling fan. The amplifier output rating on high duty-cycle modes can be extended to 1500 watts with the optional cooling fan installed.

**ANTENNA REQUIREMENTS:** The antenna SWR must be low if the QSK-5 is operated at full ratings. To calculate the safe power capability of the QSK-5 use the following formulas:

2800 divided by the SWR for SSB and high peak to average power modes.

2250 divided by SWR for CW and high average to peak power modes.

1800 divided by SWR for RTTY and other high duty-cycle, high average power modes.

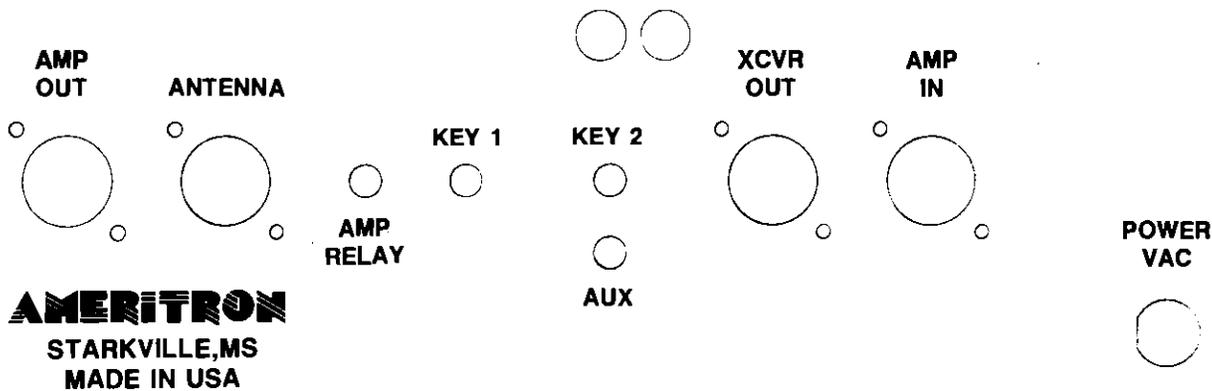
**NEVER EXCEED 2000 WATTS ON CW, 2500 WATTS ON SSB OR 1500 WATTS ON RTTY.**

The following are some typical SWR values and power ratings:

SWR	SSB	CW	RTTY
1:1	2500W	2000W	1500W
1.5:1	1875W	1500W	1200W
2.0:1	1400W	1125W	900W
3.0:1	950W	750W	600W

**TRANSCEIVER REQUIREMENTS:** The QSK-5 internal relays bypass the QSK-5 when it is turned off or if transmissions have not been made within the previous three seconds. This bypass feature allows the QSK-5 to be removed from the circuit for tuning, normal VOX operation, and other times when QSK is not desired. It also allows the amplifier to have a cool down period between transmission periods. The factory wiring of the QSK-5 gives the user flexibility in the choice of transceivers and allows tailoring the QSK-5 to almost any application.

## RX FUSE LAMPS



## BACK PANEL DESCRIPTION

### RF INTERCONNECTIONS

**AMP OUT:** This SO-239 connector should be connected to the RF output of the amplifier with a short length of good quality coax. This is also one of the places to locate a TVI low-pass filter.

**ANTENNA:** This SO-239 connector connects to the station wattmeter. The antenna switch, tuner, or antenna must follow the wattmeter. This connector should have the cable that was originally connected to the amplifier's output attached here. This is another place that a TVI filter can be located.

**XCVR OUT:** This SO-239 connector connects to the transceiver's antenna connector. This is the cable that used to go to the amplifier's input connector.

**AMP IN:** This SO-239 connector connects to the input connector of the amplifier.

### CONTROL JACKS

**AUX:** This phono jack comes factory wired to an open collect output that follows the KEY2 signal. One common use of this jack would be to connect the "hand-shake" output to the transceiver.

**KEY 2:** **CAUTION: NEVER connect any circuitry between this jack and the transceiver's QSK output line.** This phono jack connects to the input of the QSK board. This jack has approximately 5 volts DC on it and will supply one mA of current to ground when pulled low. This is the jack that must be pulled low (below 2 volts) to place the QSK switch in the transmit mode during break-in operation. The time delay from the keying of this jack to the application of RF must be at least one millisecond to prevent clipping of the leading edge of the waveform. The release must occur at or beyond the point that the RF output has dropped to zero. A full return to the receive mode occurs less than one mS after this jack goes high.

**KEY 1:** This jack connects to the VOX relay or the QSK line of the transceiver, or other points, as required. This jack will pass the full voltage and current of the amplifier's relay along to the transceiver during the first ten mS of closure. After the first ten mS passes the holding current drops to 10 mA. This jack activates the amplifiers internal relay via the AMP RELAY jack even if the QSK switch is off. This jack has no time delay at the beginning of transmissions. It holds the ampli-

fier on for three seconds after release only when the QSK-5 power is on.

**AMP RELAY:** This line connects to the amplifiers key (relay) jack. This line will carry up to one ampere at 25 volts safely. This line has no delay when activated by pulling the Key 1 line to ground, it has a one mS delay when activated by the Key 2 line. When the QSK switch is turned off (bypassed) the amplifier will be keyed by this jack when the Key 1 line is pulled low. When the QSK switch is active this jack has a three second release delay to prevent the amplifier's internal relay from chattering and distorting the signal during QSK operation. The three second

hold delay is removed when the QSK switch is turned off.

Wiring diagrams are shown in Fig. 2. These circuits cover nearly any application the user may require.

**Optional FAN Installation**

A small volume of airflow is necessary to cool the PIN diodes during high power, high duty cycle operation. Ameritron offers a fan kit under part number CF-5 that contains instructions and all hardware. This kit is normally not required unless operation on RTTY or other steady carrier modes exceed a 5 minute on, two minute off time period at power levels over 50% of the RTTY ratings shown on page 1.

**WIRING DIAGRAMS**

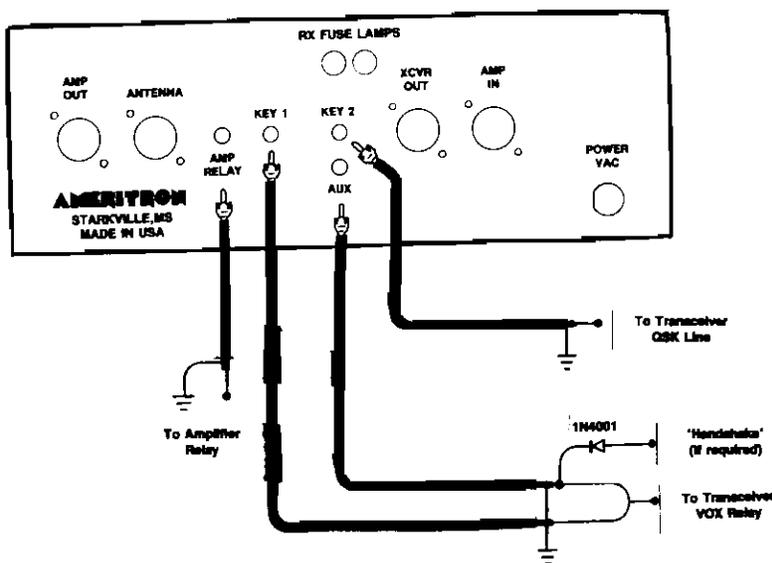


Figure 2a.

This connection diagram will work with most QSK transceivers on PACKET, CW, or SSB. The "AUX" line must be plugged into the Key 1 jack. If the transceiver requires a "handshake" line and has no VOX output, use the layout in Figure 2b.

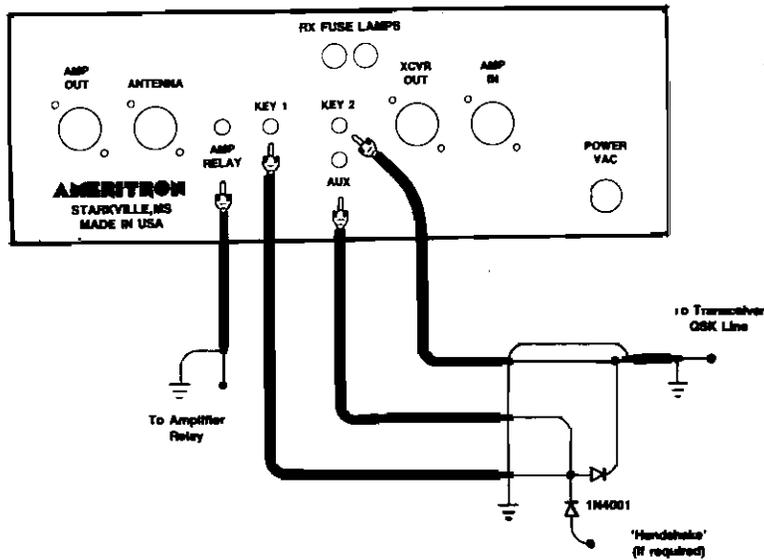


Figure 2b.

This connection diagram is for transceivers that use a "handshake" line to verify that the amplifier is ready to accept power but do not have a relay or PTT line that goes low other than the QSK line. A pair of diodes (1N4001) are used to split the AUX jack output.

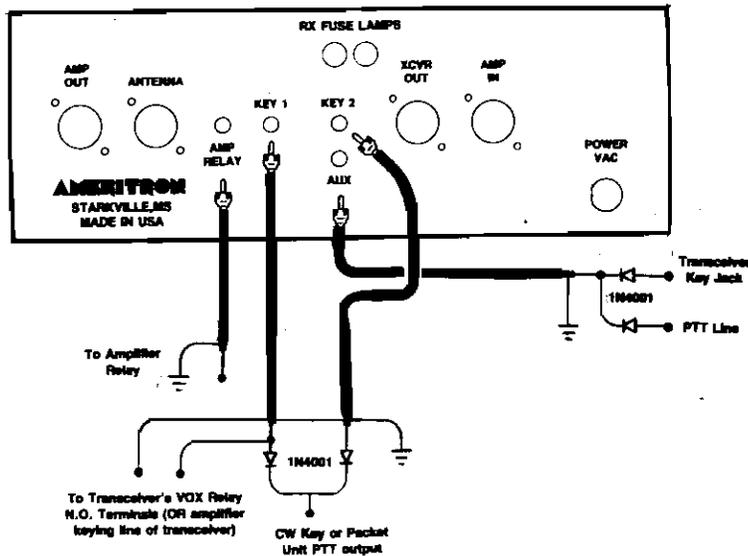


Figure 2c.

This connection diagram is for transceivers that are too slow to key the QSK switch. The primary use of this circuit for non-QSK radios would be to eliminate or reduce constant relay switching in the amplifier on packet or CW semi-break in. It is even possible to use some non-QSK radios on QSK with this set up. Four diodes (1N4001) are used to split and isolate inputs and outputs.

## Keying Circuit Timing

The timing of the transceiver keying circuit is critical with any QSK switch. The transceiver **MUST** have the proper sequencing of RF and QSK output lines. The transceiver QSK line must pull low **BEFORE** RF appears on the output connector and release **AFTER** the RF envelope reaches zero to operate with any QSK switch. A few transceivers do not meet this requirement even though they are advertised as QSK transceivers. There is no way to completely correct this problem without modifying the transceiver.

One indication of improper timing is the flashing or failure of fuse lamps LP1 and LP2. These lamps protect the transceiver from failure of the receive diodes. Any component failure that causes the receive diodes to conduct during the time interval the transmit diodes are conducting will connect the amplifier's output directly to the input. This may result in an oscillation that can cause damage to the transceiver. **NEVER REMOVE OR DEFEAT THESE LAMPS.** They will only fail if there is a timing or component problem. If you remove the fuse lamps the transceiver may be damaged.

If the lamps flash or fail a simple test can be made by sending a string of very slow dashes with a keyer. Slowly raise the power on the transceiver until the lamps begin to flash. If the lamps flash at the beginning or end of each dash the timing of the QSK line from the radio is at fault. If the lamps light throughout the entire length

of the dash the QSK line should be unplugged and the Key 2 jack of the QSK switch should be grounded. If the lamps still light then the QSK switch has a circuit problem. If the lamps do not light the problem is in the radio or the connection to the radio.

Another indication of improper timing is the generation of clicks or leading or trailing edge "chopping" of the signal. This indicates hot switching is occurring. This is strictly a timing problem.

Timing can be measured with a dual trace scope. The triggered trace should be connected to the QSK output line of the transceiver (open collector lines will need a pull up resistor connected to 12 volts) and the RF output monitored with the other trace. RF must not appear until at least one half millisecond after the QSK line is low. The QSK output line of the transceiver must not go high before the RF envelope drops to zero.

## QSK Board Operation

On **RECEIVE** the QSK board functions as follows:

When terminal D is high, R10 and R16 bias Q5 into conduction. This holds the collector of Q5 below three volts. IC1A and B are biased at 50% of the supply voltage with the inputs arranged so that IC1B is on in this mode. IC1B turns Q4 on and this pulls the base of Q3 low removing the high voltage from the receive diodes (D2,3,4 and 11) and grounding the junction at L6. This allows 12 volts to flow through the diode string from L5 and L7 to the common cathode point at L6. This turns the receive diodes on. R17 and C19 control the time delay of the receive diode turn on to insure the transmit diodes have time to turn off before the receive diodes are turned on.

IC1A will be off when terminal D is high and Q2 will not conduct. This allows Q1 to be forward biased by R5 and pull L2 up to 400 volts. This voltage cuts off D1 first and then D10,9,8 and 7. This disconnects the input of the amplifier before disconnecting the output.

On **TRANSMIT** the circuit functions as follows:

Point D is held below 2 volts. This removes the forward bias on Q5 and allows the collector to go high. IC1A turns on after a slight delay caused by the charge time of R18 and C20. Q2 turns on and discharges the transmit diode string through D5. Q1 is forced off by the removal of base bias by Q2. The 12 volt

supply then flows from R27 through the diode string to Q2. This places the transmit diodes in conduction by biasing them with approximately 600 mA of forward current.

The receive diodes are disabled when Q5's collector voltage charges C19 quickly through D13. This turns IC1B off and Q4 turns off. This allows R6 to pull the base of Q3 high and the voltage at the emitter of Q3 rapidly turns the center junction of the receive diodes off by applying 380 volts of positive bias to L6.

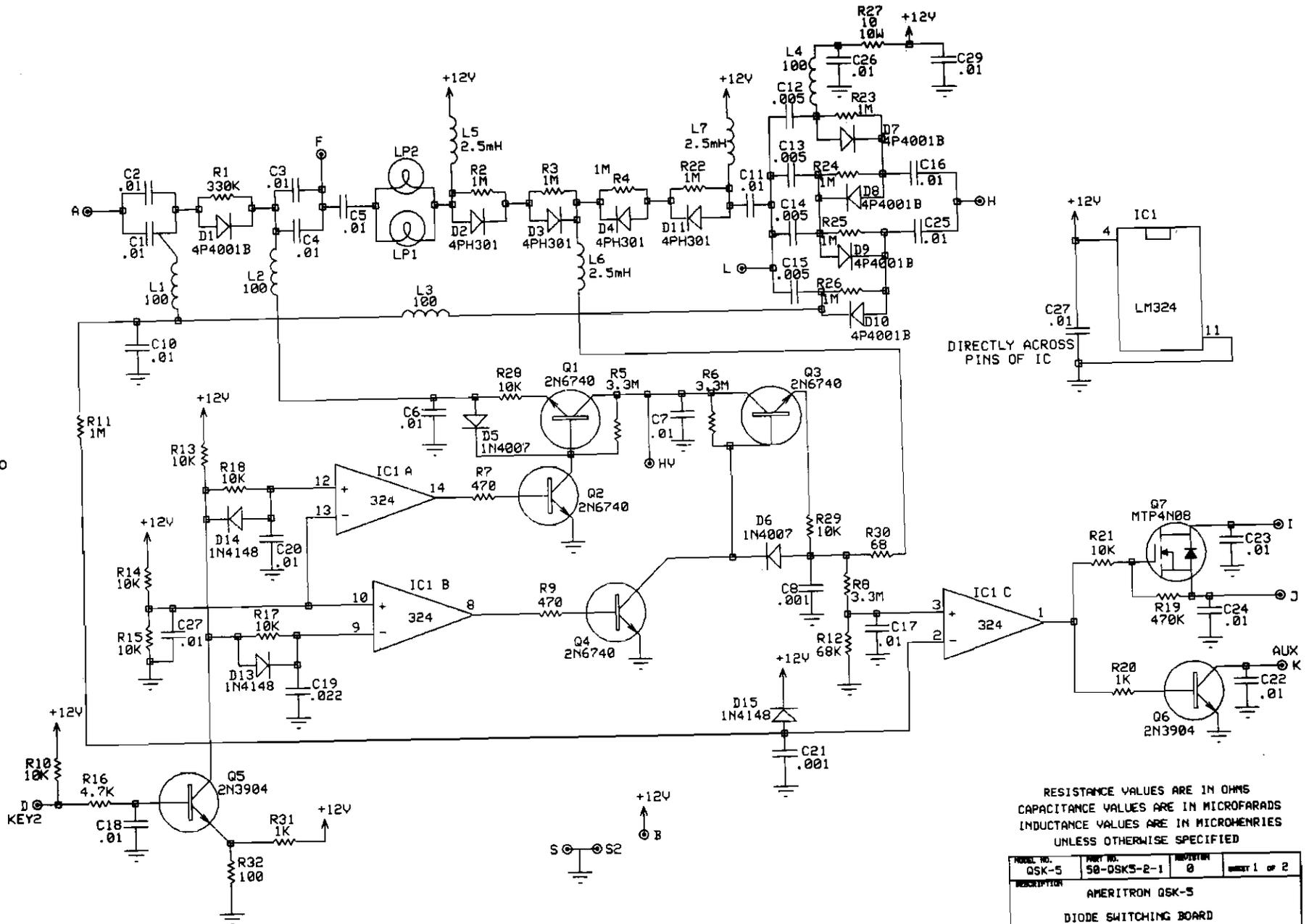
Voltage divider R8 and R12 allows IC1C to compare the status of the receive diode bias to the voltage obtained through R11 from the transmit diode string. If the transmit diode string is off and the receive diode string is on, the output of IC1C will be low and Q6 and Q7 will be off. When the transmit diode string is on and the receive diode string is off Q6 and Q7 are biased into conduction.

Q7 can be used to switch the bias in an amplifier. The source (terminal J) must be within 3 volts of ground and the drain (terminal I) must be below 25 volts positive. The FET will safely carry two amperes of current.

Q6 can be used to pull up to 100 mA of current to ground (terminal K). The open circuit voltage must be below 25 volts and positive polarity.



QSK-5 DIODE SWITCHING SCHEMATIC



RESISTANCE VALUES ARE IN OHMS  
 CAPACITANCE VALUES ARE IN MICROFARADS  
 INDUCTANCE VALUES ARE IN MICROMHENRIES  
 UNLESS OTHERWISE SPECIFIED

MODEL NO.	PART NO.	REVISION	SHEET 1 OF 2
QSK-5	50-QSK5-2-1	0	
DESCRIPTION	AMERITRON QSK-5 DIODE SWITCHING BOARD		
DATE	REVISED	PC BOARD	DESIGN BY
3/13/91	11/11/91	AGSKR6	R. HANEY

## QSK-5 PARTS LIST

<u>Designation:</u>	<u>Description:</u>	<u>Part #</u>
C1, 2	.01 uF, 250V, Disc	200-2122
C3, 4	10 uF, 350V, Elec	203-0310
C5	100 uF, 25V, Elec	203-0564
C6	2200 uF, 25V, Elec	203-0207
C7	.01 uF, 50V, Disc	200-0416
C8, 9	27 pF, 500V, DM10	208-5404
CR1, 2, 3, 4, 5, CR6, R6	1N4007	300-0266
Q1	2N3906	305-0722
R2, 7	100K, 2W, Metal	103-2181
R3	33 ohm, 1/4W	100-0403
R8	3.3K, 1/4W	100-0729
RLY1	Relay, 12V DC, DPDT	408-2135
RLY	Relay, 12V DC, 3DPT	408-6140

<u>Designation:</u>	<u>Description:</u>	<u>Part #</u>
C1, 2, 3, 4, 5, 6, C7, 10, 11	.01 uF, 1 KV, Disc	200-2121
C8	.001 uF, 1 KV, Disc	200-2120
C12, 13, 14, 15	.005 uF, 1 KV, Disc	200-3535
C16, 25	.01 uF, 250 V, Disc	200-2122
C17, 18, 22, 23, 24 C26, 27, 29, 30	.01 uF, 50 V, Disc	200-0416
C19	.022 uF, 50 V, Mono	205-3220
C20	.01 uF, 50 V, Mono	205-3100
C21	.001 uF, 100 V, Poly	201-2100
D1, 7, 8, 9, 10	4P4001B	300-5712
D2, 3, 4, 11	4PH301	300-5301
D5, 6	1N4007	300-0266
D13, 14, 15	1N4148	300-5301
L1, 2, 3, 4	Choke, 100 mH	409-2150
L5, 6, 7	Choke, 2.5 mH	402-1162
Q1, 2, 3, 4	2N6740	305-0706
Q5	FET, MTP-4N08	305-6751
R1	330K, 1/4W	100-5330
R2, 3, 4, 11, 22, R23, 24, 25, 26	1 Meg, 1/4W	100-0730
R5, 6, 8	3.3 Meg, 1/4W	100-6330
R10, 13, 14, 15, R17, 18, 21, 28, 29	10K, 1/4W	100-4100
R12	68K, 1/4W	100-4680
R16	4.7K, 1/4W	100-1470
R19	470K, 1/4W	100-0188
R20, 31	1K, 1/4W	100-0727
R27	10 ohm, 10W	103-9702
R30	68 ohm, 3W	103-3533
R32	100 ohm, 1/4W	100-2100

**AMERITRON**  
**116 Willow Road**  
**Starkville, MS 39759**

**Limited Warranty**

Ameritron warrants to the original purchaser that this product shall be free from defects in material (except tubes and RF output transistors) or workmanship for one year from the date of original purchase.

During the warranty period, Ameritron or an authorized Ameritron service facility will provide free of charge both parts (except tubes and RF output transistors) and labor necessary to correct defects in material or workmanship

To obtain such warranty service, the original purchaser must:

- (1) Complete and send in the Warranty Registration Card.
- (2) Notify Ameritron or its nearest authorized service facility, as soon as possible after discovery of a possible defect, of:
  - (a) The model number and serial number, if any;
  - (b) The identity of the seller and the approximate date of purchase;
  - (c) A detailed description of the problem, including details on the equipment
- (3) Deliver the product to the Ameritron or the nearest authorized service facility, or ship the same in its original container or equivalent, fully insured and shipping charges prepaid.

Correct maintenance, repair and use are important to obtain proper performance from this product. Therefore, carefully read the Instruction Manual. This warranty does not apply to any defect that Ameritron determines is due to:

- (1) Improper maintenance or repair, including the installation of parts or accessories that do not conform to the quality and specifications of the original parts.
- (2) Misuse, abuse, neglect or improper installation.
- (3) Accidental or intentional damage.

**All implied warranties, if any, terminate one (1) year from the date of the original purchase.**

The foregoing constitutes Ameritron's entire obligation with respect to this product, and the original purchaser and any user or owner shall have no other remedy and no claim for incidental or consequential damages. Some states do not allow limitations on how long an implied warranty lasts or do not allow the exclusion or limitation of incidental or consequential damage, so the above limitation and exclusion may not apply to you.

This warranty gives specific legal rights and you may also have other rights which vary from state to state.

**PLEASE RECORD THIS INFORMATION:**

**Model** \_\_\_\_\_ **Serial No:** \_\_\_\_\_

**Date of Purchase** \_\_\_\_\_

**Purchased From** \_\_\_\_\_

**Warranty Card Mailed On** \_\_\_\_\_