AT7000B-MS

AT7000B

AUTOMATIC ANTENNA TUNER

TECHNICAL MANUAL

Datron World Communications Inc.
Manual Part No. AT7000-MS
Release Date: April 2000
Revision: A

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Damage to the equipment or its parts caused by lightning, static discharge, voltage transients, or application of incorrect supply voltages.

Defects or failures caused by unauthorized attempts to repair or modify the equipment.

Defects or failures caused by Buyer abuse or misuse.

Return of Equipment - Domestic: To obtain performance of any obligation under this warranty, the equipment must be returned freight prepaid to the Technical Support Services. Datron World Communications Inc., 3030 Enterprise Court, Vista, California 92083. The equipment must be packed securely. Datron shall not be responsible for any damage incurred in transit. A letter containing the following information must be included with the equipment.

a. Model, serial number, and date of installation.

b. Name of dealer or supplier of the equipment.

c. Detailed explanation of problem.

d. Return shipping instructions.

e. Telephone or fax number where Buyer may be contacted.

Datron will return the equipment prepaid by United Parcel Service, Parcel Post, or truck. If alternate shipping is specified by Buyer, freight charges will be made collect.

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a. Return the parts prepaid to "Parts Replacement" Datron World Communications Inc., 3030 Enterprise Court, Vista, California 92083; and

b. Include a letter with the following information:

1. Part number
2. Serial number and model of equipment
3. Date of installation

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Safety Considerations

This product and manual must be thoroughly understood before attempting installation and operation. To do so without proper knowledge can result in equipment failure and bodily injury.

Caution: Before applying ac power, be sure that the equipment has be properly configured for the available line voltage. Attempted operation at the wrong voltage can result in damage and voids the warranty. See the manuals section on installation. DO NOT operate equipment with cover removed.

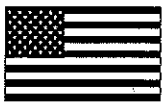
Earth Ground: All Datron products are supplied with a standard, 3-wire, grounded ac plug. DO NOT attempt to disable the ground terminal by using 2-wire adapters of any type. Any disconnection of the equipment ground causes a potential shock hazard that could result in personal injury. DO NOT operate any equipment until a suitable ground has been established. Consult the manual section on grounding.

Servicing: Trained personnel should only carry out servicing. To avoid electric shock, DO NOT open the case unless qualified to do so.

Various measurements and adjustments described in this manual are performed in ac power applied and the protective covers removed. Capacitors (particularly the large power supply electrolytics) can remain charged for a considerable time after the unit has been shut off. Use particular care when working around them, as a short circuit can release sufficient energy to cause damage to the equipment and possible injury.

To protect against fire hazard, always replace line fuses with ones of the same current rating and type (normal delay, slow-blow, etc.). DO NOT use higher value replacements in an attempt to prevent fuse failure. If fuses are failing repeatedly this indicates a probable defect in the equipment that needs attention.

Use only genuine Datron factory parts for full performance and safety of this product.



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SECTION 1: GENERAL INFORMATION

1.1 General Description

The Datron World Communications Inc. (DWC) AT7000B Automatic Antenna Tuner is designed to match the 50 ohm output of an HF/SSB transceiver to a variety of antennas for mobile, marine, and fixed station applications over the frequency range of 2 to 30 MHz. The AT7000B is specifically designed to work with the TW7000 transceiver where tuning is accomplished automatically upon initiation of a tune cycle by the operator at a controlled 10W level. A positive indication of successful tuning is provided at the end of the tune cycle. A memory feature allows scanning of up to 100 preset channels with a retune time of approximately 10 ms.

The AT7000B can also be used with other HF/SSB transceivers as long as a suitable interface is provided. Contact the factory for details concerning individual applications.

1.2 Physical Description

The AT7000B is designed for operation under the most severe environmental conditions. It is contained in a rugged, waterproof case that should be mounted as close as possible to the radiating part of the antenna.

1.3 Technical Specifications

Table 1-1 lists the technical specifications for the AT7000B.

Table 1-1
Technical Specifications

Characteristic	Specification
Electrical	
Frequency Range	1.6 to 30 MHz
Tuning Capability	Whips, wires, and doublets as shown
15 to 75 ft. antenna	2 to 30 MHz
10 to 75 ft. antenna	2.5 to 30 MHz
Doublets	Less than or equal to a ratio of 3:1 VSWR at the operating frequency
Minimum length 32 ft.	1.6 to 2.0 MHz
Rated RF Input Power	125W, PEP
Tuning Mode	Fully-automatic

Table 1-1
Technical Specifications

Characteristic	Specification
Tuning Accuracy	Typically greater than or equal to a 1.5:1 ratio VSWR referenced to 50 ohm
Tuning Time	Typically 2 seconds (initial tune), 10 ms (memory tune)
RF Tune Power	Typically 10W to 20W average
Primary Power Input	+12 Vdc at 1.8A, maximum.
Mechanical	
Weight	6.2 lbs. (2.8 kilos)
Size	14 in. x 11 in. x 3 in. (36 cm x 28 cm x 8 cm)
Case	Waterproof, ruggedized
Environmental	
Temperature	-30°C to +6°C
Shock, vibration	Per MIL-STD-810D
Connections	
RF Connection (input)	N type RF input connector
RF Connection (output)	High-voltage ceramic insulator
Control Connection	14p scaled connector
Ground Connection	Ground lug
Continuous Duty Operation (The following conditions must be observed when operating in the FSK mode)	
Antenna Lengths	Frequency Range / Antenna Length 2.0 to 30 MHz / 27m (75 ft.) 3.0 to 30 MHz / 9.6m (32 ft.) 5.0 to 30 MHz / 4.8m (16 ft.) 7.0 to 30 MHz / 3.0m (10 ft.)
Sun Loading: The AT7000B is rated to 60°C ambient. This temperature can be exceeded if the case is exposed to direct sunlight. For FSK operation it is important the AT7000B is installed away from direct sunlight.	

SECTION 2: INSTALLATION

2.1 General

System installation is a four-part process that includes selecting the antenna, installing the antenna, mounting the antenna tuner, and connecting the appropriate interface cables between the tuner and the transceiver.

2.2 Selecting the Antenna

The AT7000B is designed primarily for use with end-fed, unbalanced antennas such as whips and long wires. The radiating portion of the antenna is connected directly to the tuner via a high-voltage insulator.

Broadband resonant antennas like LPAs may be used with the AT7000B. Narrow-band resonant antennas, such as dipoles, may only be used if the antenna VSWR (including coaxial feedline) is less than a ratio of 3 to 1 at the operating frequency.

The AT7000B works with almost any end-fed antenna within the specified frequency range, provided an effective ground is used. Antenna efficiency is proportional to length and in most cases is of maximum efficiency at an electrical 1/4 wavelength. This means that the longest possible antenna should be selected for each installation. Very short antennas are only recommended where there is no other alternative, such as in a vehicular configuration.

2.3 Antenna Installation

The antenna system is a key part of the communication system and for satisfactory operation must be installed correctly. The AT7000B uses unbalanced antennas that use a ground as half of the antenna system. The ground forms an image antenna and is a critical part of the system. It is essential to consider both the ground and the antenna when designing the system.

2.3.1 Antenna Location

A number of issues should be carefully considered when installing the antenna.

The antenna should be located in a position free of obstructions, particularly in the desired direction of communication. It should be kept as far away as possible from buildings, trees, and vegetation.

If metallic masts or supports are used, the insulators should be arranged so that the antenna is spaced at least 2m from the mast.

Since the radiating part of the antenna starts at the tuner, the lead-in cable from the tuner to the antenna should be kept as short as possible.

Vertical antennas have an omnidirectional radiation pattern and provide equal performance in all directions.

Horizontal wire antennas have maximum radiation broadside to the antenna when the operating frequency is less than a 1/4 wavelength. As the frequency increases beyond a 1/4 wavelength, lobes appear in the radiation pattern with the principal lobes becoming closer to the plane of the antenna as the length increases. Because radiation is at a minimum at the end of the antenna, it should be located so that the ends point in directions where communications are not required.

A vee configuration minimizes the directivity of the horizontal antenna and is recommended for all-around coverage. In addition, the vee antenna is a compromise between vertical and horizontal polarization and will give good results for communications with land or marine mobiles using vertical whip antennas.

The antenna contains high RF voltages. All parts of the antenna and tuner should be protected or located where there is no possibility of accidental contact.

The antenna should not be located next to other antenna systems.

The antenna should always be rigidly supported. It will detune if it sags or sways in the wind.

The connection from the tuner to the ground must always be a small percentage of the total length of the antenna. The length of the ground strap should never exceed 1m and must be made of heavy-guage wire or strap.

If the distance between the AT7000B and transceiver exceeds 35m, it is recommended that a low-loss coaxial cable be used.

2.3.2 Ground System

The ground system is a key part of the overall antenna system and is the primary cause of poor performance when there is a problem with the system. The following sections should be observed when grounding the tuner.

2.3.2.1 *Vehicle Grounds*

The AT7000B should be connected directly to the frame of the vehicle. A heavy strap should be used and the connections cleared of paint and dirt. The grounding point should not be insulated from other parts of the vehicle by nonmetallic couplings of any type.

2.3.2.2 *Fixed Station Grounds*

In areas of high ground conductivity, an effective ground can be made with a ground rod. The rod should be approximately 3m in length and installed as close as possible to the AT7000B. It may be necessary to use several ground rods bonded together to improve the ground contact.

Water pipes are sometimes recommended as grounds and may be used if the following conditions are met:

- The pipe is close to the tuner
- The pipe enters the ground very close to the tuner bonding point
- There are no joints or couplings in the pipe that increase the resistance path to ground
- The pipe enters soil with good conductivity
- A low resistance contact is made to the pipe

Frequently, the ground conductivity is not sufficient to provide satisfactory operation of the tuner. This is the case with well-drained, sandy, rocky, or loamy soils where a counterpoise must be used instead of a rod for the ground system. This is important in a rooftop configuration where there is no existing ground plane. The ideal ground would be a conducting surface extending several wavelengths in all directions around the antenna. On a rooftop, this situation may be approximated by placing a screen of chicken wire or mesh over the roof of the building. More frequently, a counterpoise system of radial wires must be used (at least 8 to10 wires bonded together).

2.3.2.3 *Corrosion*

Ground connections are subject to corrosion and oxidation. All joints must be clean and the hardware adequately tightened. The joints may be protected by an application of silicon grease or electrical tape.

2.4 *Antenna Tuner Mounting*

The AT7000B is mounted using the proper brackets on the case. A location should be selected immediately adjacent to the antenna feeding point. A high-voltage connecting cable must be used. An RG8/U cable with solid insulation may be used if the outer shielding is removed.

2.4.1 *Antenna Connection*

The antenna lead is connected to the high-voltage insulator on the tuner. Two wrenches should be used when tightening the nut to prevent the stud from rotating. Because several thousand volts can be present at the antenna terminal, adequate protection must be taken to prevent accidental contact. It is also necessary to insure that the antenna is spaced at least 3 cm from the conducting surface. Sharp points should be avoided to prevent corona discharges.

2.5 *Transceiver Interface Cable Connections*

Connections between the AT7000B and the associated transceiver are different depending on the model used.

The AT7000B comes with a memory feature that is designed to work with the TW7000 to provide channel memory capability. Once the antenna has been tuned to a particular channel, it remembers that tune and automatically reverts to a tuned position whenever that channel is selected again.

When used with the TW7000, the cabling for the AT7000B is as follows.

Part Number	Description
C991526	TW7000 to AT7000B, RF cable
C991938	TW7000 to AT7000B, control cable

Table 2-1 shows the cabling pin connections.

Table 2-1
Cable Pin Connections

TW7000 (ACC3)	Signal Description	AT7000 Control
Pins 14, 15	Ground	Pins C, F
Pins 24, 25	+12 Vdc	Pins E, D
Pin 19	Rx serial data	Pin A
Pin 20	Tx serial data	Pin B

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SECTION 3: OPERATION

3.1 Tuner Option

Operation of the AT7000B can only be done with the TW7000 or an equivalent transceiver.

1. Determine the channels to be scanned or the channels for which memorized tune settings are desired.
2. Select each channel in turn and go through an initial tune procedure on that channel by pressing and releasing the tune button on the front panel of the radio. The AT7000 tunes automatically.
3. After each channel has been tuned once, the tuner remembers the settings for that particular channel and automatically reverts to them when that channel is selected.
4. If the AT7000 does not tune for any reason, the TW7000 display will indicate a bad tune. The operator should try tuning again or check the installation. Changing the grounding of the system or varying the cable lengths will often eliminate the problem.

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SECTION 4: THEORY OF OPERATION

4.1 *General*

The AT7000B is a conventional tuner that uses a standard tuning network whose elements are switched in and out of the RF path by relays. All operations are microprocessor controlled with RF detectors providing the information that drives the tuning algorithm.

4.2 *Tuning Network*

The AT7000B uses switched capacitors and inductors to form different networks in order to match a given impedance to 50 ohm. It follows a basic set of ground rules in doing this.

The tuner uses a simple L network to achieve both reactance cancellation and up or down impedance transformation. If impractical values are needed for the L network, it defaults to a P1 configuration.

For impedance down transformations, an input capacitance maximum of 3150 pF, in 50 pF binary increments is available. This is combined with a maximum inductance of approximately 69 uH in binary increments of 260 nH. For impedance up transformations, the same inductor increments are available, with an output capacitance maximum of 775 pF in 25 pF binary increments.

The P1 configuration uses a restricted combination of the values stated above.

Tuning routines differ with frequency when a determination of the input frequency restricts the maximum values that any network component may assume.

4.3 *Control Circuitry*

All automatic tuning is under the control of U5, a Motorola 68HC711D3 microprocessor. The processor directly controls the network elements, sending serial data to the three high-level relay drivers U1, U2, and U3. When the appropriate serial string has been sent, all three devices are simultaneously strobed to lock in the data until updated. All relays are fitted with kick-back diodes to eliminate the inductive voltage generated on switch-off and to cushion the relay settling time to avoid contact bounce.

Frequency measurement of the incoming RF is made by prescaling the input frequency by 4096 and measuring the duration of a full cycle of the prescaled output. This information is used to modify the network selection so that inductance and capacitance limits are appropriate for the frequency involved.

Functioning as a quad comparator, U10 is used to translate the relatively small analog outputs of the measuring systems to essentially digital responses suitable for the processor.

4.4 *RF Detectors*

All tuning decisions are made on the basis of measurements for certain parameters by the RF detector circuits. These decisions are generally made in a certain order.

1. Is the tuner receiving RF power?
2. Is the antenna already 50 ohm resistive or the tuner tuned?
3. Is the antenna inductive or capacitive?
4. Is the impedance less than 50 ohm?
5. Is the SWR much greater than approximately a 2:1 ratio?
6. Is the SWR less than approximately a 2:1 ratio?

The measurements above are determined by the impedance, phase, and SWR system. They comprise T2, a dual voltage transformer and T1, a dual current transformer, together with balanced mixer MX1.

4.4.1 *Phase Detector*

Phase determination is made by comparing the balanced mixer, MX1, and the current-derived voltage from T1 with the diode limited, phase shifted voltage sample obtained from the RF input port via C66. Because of the polarity of the connection to the mixer, the inductive impedance seen by the tuner generates a negative output at the inverting input of U10A, giving an inductive load signal to the processor.

4.4.2 *Impedance Magnitude Detector*

The impedance decision is made by combining the opposing polarity dc voltages generated by diodes D23 and D21. These inputs are voltage and current derived, respectively, so that at a 50 ohm impedance the outputs cancel. If a lower impedance exists, then a negative voltage occurs. This is fed to the inverting input of U10B, giving a positive output to the processor which gives a lower than 50 ohm signal.

4.4.3 *VSWR Detectors*

Coarse and fine SWR indications are given by U10D and U10C, respectively. The outputs of a voltage sample from T2 and a current-derived voltage sample from T1, are amplitude and phase combined so that a voltage proportional to the forward power occurs at the junction of T2 (lead 3) and T1 (lead 6).

Similarly, a voltage proportional to the reflected power occurs at lead 4 of T2. Both of these voltages are rectified positively by D20 and D22. Inverting inputs of comparators U10D and U10C are fed a sample of the forward power voltage. A proportionally larger sample of the forward power voltage is fed to the coarse comparator making it less sensitive to reverse power. The reverse power voltage is routed equally to the non-inverting inputs of both coarse and fine SWR comparators. The overall effect is to have one comparator that responds to SWRs in the vicinity of a 2:1 ratio and considerably less sensitive. This arrangement also has the effect of making the SWR indication independent of power level. This is desirable since the detectors are in circuit at all times.

4.5 *Memory Feature*

The memory feature provides nonvolatile memory to store channel numbers entered from the radio or external computer and the element combinations associated with those channel numbers. The storage of element combinations is automatic and related to frequency, with more memory locations being allocated for lower frequencies because the occurrence of impedance changes (particularly for short antennas) are more rapid in that frequency area.

The AT7000B is equipped with a bidirectional serial port, using a 2-wire, RS485 protocol for interfacing with a suitably equipped transceiver or computer. A number of functions may be performed with this port that are otherwise not available in the standard tuner. The major function is the assignment and storage of channel numbers for various tuned frequencies. Subsequent channel numbers sent to the tuner preselect the tuning elements so the AT7000B is tuned prior to the application of RF. This function has ready application in path evaluation and selection systems where scan rates of approximately five channels per second are in use.

The following are associated with the MC68HC11D3 in the memory feature.

- An external 512K ROM, UT
- The address/data multiplexer, U4
- The address decoder, U8
- The electrically erasable memory, U6

An RS485 serial port is also needed in the associated transceiver; all traffic is sent out at 9600 baud.

SECTION 5: MAINTENANCE

5.1 General

The AT7000B is a single circuit-board system based on the Motorola 68HC711D3 microprocessor. It has no internal harnessing and all circuitry is contained on one board.

5.2 Alignment

The AT7000B has been thoroughly tested at the factory. It has no alignment points and requires no adjustment during setup. A failure cannot be blamed on the unit being out of alignment. Should a failure occur, it will most likely be a component problem.

5.3 Troubleshooting

The following are some simple troubleshooting hints in case of equipment failure.

5.3.1 Inspection

Should a failure occur, the interior of the tuner should be carefully checked. Look for signs of heating, arcing, or mechanical damage. The tuner is designed to handle specified RF power levels without having heating or arcing problems. If these signs are present and the tuner was operated normally, the cause is probably dirt or moisture. Before making repairs, the case should be cleaned out and dried thoroughly with warm, dry air. The case seals should be checked before reassembly.

5.3.2 Poor Tuning Performance

There can be many causes for poor performance, but relay damage should be one of the first considerations. Although the relays in the AT7000B have been selected for extended life and have an MTBF of over one million operations, they are still the components most likely to require service. A faulty relay generally manifests itself in poor tuning performance. Relay and relay driver operation should be verified if consistently poor tunes are achieved.

5.3.3 Initialization Problems

If the tuner does not initiate and run through a tune cycle when an RF signal is applied, either the VSWR is good or there is a problem. Check to see that the processor is receiving the interrupt signal and if the RF and VSWR signals are being received.

If there appears to be a problem in starting the tune sequence, the following description of what happens prior to the tuning operation might assist in troubleshooting.

Power Up: When dc power is first applied, the processor clears a block of on-board RAM and initializes itself to use either on-board or external ROM. It initializes the serial port and various other registers and sends out serial data to all relays to remove all inductors and capacitors from circuit. If the memory option is installed, it sends an acknowledgement via the RS485 port to the radio or computer that it has completed the above operation. The processor then goes into a wait condition.

Tune Initialization: The AT7000B requires a tune signal from the radio in order to tune an antenna. In addition, the presence of RF at the input terminal generates a microprocessor-interrupt that checks for the continued presence of RF and performs a check for VSWR. If it is less than a 2:1 ratio, no further action is taken and the processor reverts to the wait state.

If this check shows a high VSWR, the tuner initiates a tune sequence. The Phase, Impedance, and VSWR measurement systems remain in circuit at all times and are not switched out after the system is tuned.

Tune Sequence: If an initial capacitive condition is detected, inductors are switched in to achieve an inductive indication at the processor. Since the initial capacitive condition is indicative of an electrically short antenna, a low impedance would be expected. Input capacitance is therefore switched in and the impedance checked. Adjustment of the L/C ratio while keeping the system resonant, continues until a better than 2:1 SWR is obtained.

The reverse situation occurs when an inductive condition is initially detected. Since this condition is an indication of an antenna that is electrically too long, a high impedance is the initial assumption. Accordingly, output capacitance is added until a capacitive condition is obtained. Inductance is then added to achieve resonance. The L/C ratio is adjusted while maintaining resonance until a 2:1 or better SWR is obtained.

At frequencies above 20 MHz, the practical values of inductor are likely to be the four smallest inductors, giving only 16 possible values resulting in reduced resolution in this range.

To give more resolution, parallel inductor L5 is switched in, under software control, every second time the instruction to change inductor value is called. This results in an interpolation of inductor values, giving increased resolution in that frequency range.

5.4 *Memory Feature*

The tuner has provision for the following features incorporated in the memory:

- A 64 KB nonvolatile memory that stores the network component values for the memory channels. The memory also stores 3-digit channel numbers to tuned channels, if numbers are assigned prior to the tune operation
- A bidirectional RS485 serial port, running at 9600 baud, enables communication with the TW7000 or a computer. This enables the preselection of tuned channels

The bidirectional port gives automatic responses for the following conditions, and can be controlled and monitored by an external computer for test purposes.

- Tuner power has been switched on
- Tuner has achieved tune
- A channel number has been requested
- The information at that channel number has been updated
- No tune achieved; tune aborted for approximately three seconds

Upon a serial port request from the radio/computer, the tuner indicates the channel number currently stored (if any) and assigns a channel number or erases the entire memory. If already assigned, the network components are selected.

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REV	ECN	DESCRIPTION	DATE	APPR
A	A7388-301	PRODUCT RELEASE	6/24/96	
B	A7388-302	REV VALUES	8/16/96	
C	A7388-303	POS REV OPTION	10/16/96	
D	A7388-304	ECO ECN	5/3/96	
E	A7388-311	VAL CHGS C73,A49 ADD R67 470K	9-30-96	
F	A7388-312	ECO ECN	9-30-96	
G	A7388-313	CHG CAP TO 18pF SWAP C17,C17A	9-19-96	
H	A7388-321	RELEASE A7388B	7/25/96	
J	ECN-1423	CH C100,C98 TO 2200	10-8-96	

ANT OUT

GND

+12V

+5V

J1 TO XCVR

PANEL CONN

PCBD CONN

ATUTX

ATURX

SHIELD GND

MC MIXER

COARSE

FINE

LO-Z

PHASE

COUNTER

EXT ROM

INT ROM

MON-MEM

AUTO MEM

COUNTER

MC68HC711D3

74HC373

28C64

27512

SAM1788

MC12015

MC14024B

LM324

UCN5821A

2N6427

2N2907

* INDUCTANCE IS IN MICROHENRYS
@ DIODES ARE 1N4148
# CAPACITANCE IS IN MICROFARADS
I RESISTANCE IS IN OHMS
NOTES UNLESS OTHERWISE SPECIFIED

CATRON WORLD COMMUNICATIONS INC.

TITLE SCHEMATIC AT7000

SIZE D | DRAWN SATTEL | ENGR | DRAWING NUMBER 994215 | REV. J

SCALE — | DATE 17 JUN 93 | SHEET 1 OF 1

PCB-738271 BOM-893-88882

Figure 5-1
AT7000B Schematic Diagram (994215 Rev. J)

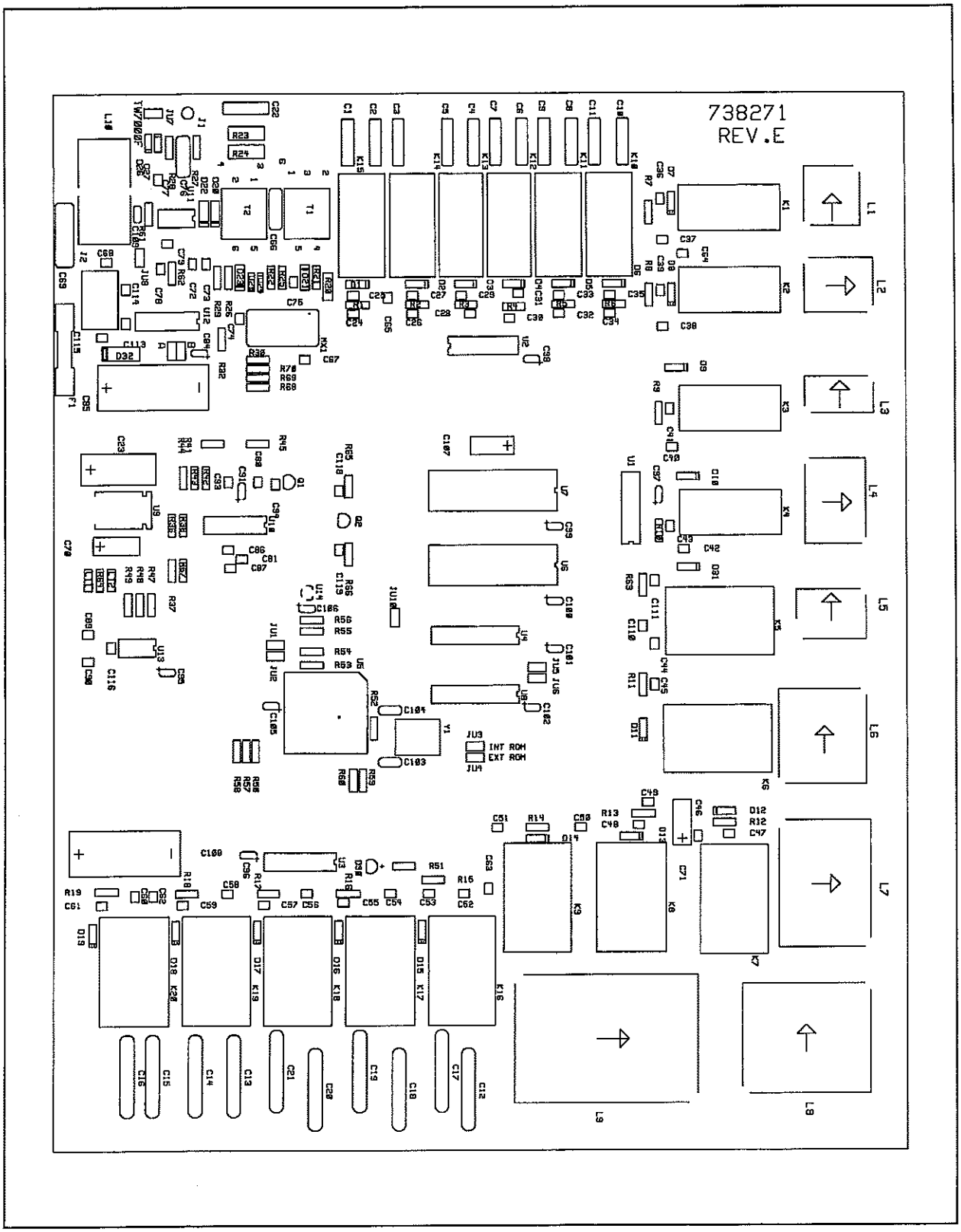

Figure 5-2
AT7000B Component Locations (738271 Rev. E)

Table 5-1
AT7000B Parts List (003-00002 Rev. T8)

Designator	Part Number	Description
C1	220220	CAP,22PF DM15 MICA
C10	224621	CAP,620PF MICA DM19
C100	241020	CAP,2.2MF DIP TANTALUM
C101	241020	CAP,2.2MF DIP TANTALUM
C102	241020	CAP,2.2MF DIP TANTALUM
C103	221270	CAP,27PF DM5 MICA
C104	221270	CAP,27PF DM5 MICA
C105	241100	CAP,10MF DIP TANTALUM
C106	241100	CAP,10MF DIP TANTALUM
C107	230100	CAP,10MF 35V ELECT
C108	230202	CAP,A,2200UF,16V,20%,AX,1.3SP
C109	210100	CAP,10 PF DISC NPO
C11	224102	CAP,1000PF DM19 MICA
C110	277104	CAP,C,0.1U,50,10%,X,AX,.25SP
C111	277102	CAP,C,1000P,100,10%,X,AX,.25SP
C113	277103	CAP,C,0.01U,100,10%,X,AX,.25SP
C114	277102	CAP,C,1000P,100,10%,X,AX,.25SP
C115	277102	CAP,C,1000P,100,10%,X,AX,.25SP
C116	277103	CAP,C,0.01U,100,10%,X,AX,.25SP
C118	277103	CAP,C,0.01U,100,10%,X,AX,.25SP
C119	277103	CAP,C,0.01U,100,10%,X,AX,.25SP
C12	212470	CAP, 47 PF 3KV DISC
C13	212101	CAP,100PF 3KV DISC
C14	212101	CAP,100PF 3KV DISC
C15	212201	CAP, 200 PF 2 KV DISC
C16	212201	CAP, 200 PF 2 KV DISC
C17	212560	CAP,C,56P,3K,5%,HT,RA,.375
C18	212101	CAP,100PF 3KV DISC
C19	212101	CAP,100PF 3KV DISC
C2	220270	CAP,27PF 5% DM15 MICA
C20	212201	CAP, 200 PF 2 KV DISC
C21	212201	CAP, 200 PF 2 KV DISC
C22	257104	CAP 0.1 MF 25OV POLY

Table 5-1
AT7000B Parts List (003-00002 Rev. T8)

Designator	Part Number	Description
C23	236101	CAP,100MF 25V ELECT AXL
C24	277102	CAP,C,1000P,100,10%,X,AX,.25SP
C25	277104	CAP,C,0.1U,50,10%,X,AX,.25SP
C26	277102	CAP,C,1000P,100,10%,X,AX,.25SP
C27	277104	CAP,C,0.1U,50,10%,X,AX,.25SP
C28	277102	CAP,C,1000P,100,10%,X,AX,.25SP
C29	277104	CAP,C,0.1U,50,10%,X,AX,.25SP
C3	224101	CAPACITOR 100PF DM19 MICA
C30	277102	CAP,C,1000P,100,10%,X,AX,.25SP
C31	277104	CAP,C,0.1U,50,10%,X,AX,.25SP
C32	277102	CAP,C,1000P,100,10%,X,AX,.25SP
C33	277104	CAP,C,0.1U,50,10%,X,AX,.25SP
C34	277102	CAP,C,1000P,100,10%,X,AX,.25SP
C35	277104	CAP,C,0.1U,50,10%,X,AX,.25SP
C36	277104	CAP,C,0.1U,50,10%,X,AX,.25SP
C37	277102	CAP,C,1000P,100,10%,X,AX,.25SP
C38	277102	CAP,C,1000P,100,10%,X,AX,.25SP
C39	277104	CAP,C,0.1U,50,10%,X,AX,.25SP
C4	224101	CAPACITOR 100PF DM19 MICA
C40	277102	CAP,C,1000P,100,10%,X,AX,.25SP
C41	277104	CAP,C,0.1U,50,10%,X,AX,.25SP
C42	277102	CAP,C,1000P,100,10%,X,AX,.25SP
C43	277104	CAP,C,0.1U,50,10%,X,AX,.25SP
C44	277102	CAP,C,1000P,100,10%,X,AX,.25SP
C45	277104	CAP,C,0.1U,50,10%,X,AX,.25SP
C46	277102	CAP,C,1000P,100,10%,X,AX,.25SP
C47	277104	CAP,C,0.1U,50,10%,X,AX,.25SP
C49	277102	CAP,C,1000P,100,10%,X,AX,.25SP
C5	224101	CAPACITOR 100PF DM19 MICA
C50	277102	CAP,C,1000P,100,10%,X,AX,.25SP
C51	277104	CAP,C,0.1U,50,10%,X,AX,.25SP
C52	277104	CAP,C,0.1U,50,10%,X,AX,.25SP
C53	277102	CAP,C,1000P,100,10%,X,AX,.25SP

Table 5-1
AT7000B Parts List (003-00002 Rev. T8)

Designator	Part Number	Description
C54	277104	CAP,C,0.1U,50,10%,X,AX,.25SP
C55	277102	CAP,C,1000P,100,10%,X,AX,.25SP
C56	277104	CAP,C,0.1U,50,10%,X,AX,.25SP
C57	277102	CAP,C,1000P,100,10%,X,AX,.25SP
C58	277102	CAP,C,1000P,100,10%,X,AX,.25SP
C59	277104	CAP,C,0.1U,50,10%,X,AX,.25SP
C6	224201	CAP,200PF DM19 MICA
C60	277102	CAP,C,1000P,100,10%,X,AX,.25SP
C61	277104	CAP,C,0.1U,50,10%,X,AX,.25SP
C62	277103	CAP,C,0.01U,100,10%,X,AX,.25SP
C63	277103	CAP,C,0.01U,100,10%,X,AX,.25SP
C64	277103	CAP,C,0.01U,100,10%,X,AX,.25SP
C65	277103	CAP,C,0.01U,100,10%,X,AX,.25SP
C66	220390	CAP,39PF DM15 MICA
C67	277104	CAP,C,0.1U,50,10%,X,AX,.25SP
C68	277103	CAP,C,0.01U,100,10%,X,AX,.25SP
C69	254104	CAP,0.1MF 100V MYLAR
C7	224201	CAP,200PF DM19 MICA
C70	230100	CAP,10MF 35V ELECT
C71	230100	CAP,10MF 35V ELECT
C72	277103	CAP,C,0.01U,100,10%,X,AX,.25SP
C73	277103	CAP,C,0.01U,100,10%,X,AX,.25SP
C74	277103	CAP,C,0.01U,100,10%,X,AX,.25SP
C75	277103	CAP,C,0.01U,100,10%,X,AX,.25SP
C76	220070	CAP,7PF DM15 MICA
C77	277102	CAP,C,1000P,100,10%,X,AX,.25SP
C78	277102	CAP,C,1000P,100,10%,X,AX,.25SP
C79	277103	CAP,C,0.01U,100,10%,X,AX,.25SP
C8	224331	CAP,330PF DM19 MICA
C80	277102	CAP,C,1000P,100,10%,X,AX,.25SP
C81	277102	CAP,C,1000P,100,10%,X,AX,.25SP
C84	241100	CAP,10MF DIP TANTALUM
C85	230202	CAP,A,2200UF,16V,20%,AX,1.3SP

Table 5-1
AT7000B Parts List (003-00002 Rev. T8)

Designator	Part Number	Description
C86	277102	CAP,C,1000P,100,10%,X,AX,.25SP
C87	277102	CAP,C,1000P,100,10%,X,AX,.25SP
C89	277102	CAP,C,1000P,100,10%,X,AX,.25SP
C9	224471	CAP,470PF DM19 MICA
C90	277102	CAP,C,1000P,100,10%,X,AX,.25SP
C91	241100	CAP,10MF DIP TANTALUM
C93	277102	CAP,C,1000P,100,10%,X,AX,.25SP
C94	277102	CAP,C,1000P,100,10%,X,AX,.25SP
C95	241020	CAP,2.2MF DIP TANTALUM
C96	241020	CAP,2.2MF DIP TANTALUM
C97	241020	CAP,2.2MF DIP TANTALUM
C98	241020	CAP,2.2MF DIP TANTALUM
C99	241020	CAP,2.2MF DIP TANTALUM
D1	320101	DIODE, RECT. SI 1A 600V
D10	320101	DIODE, RECT. SI 1A 600V
D11	320101	DIODE, RECT. SI 1A 600V
D12	320101	DIODE, RECT. SI 1A 600V
D13	320101	DIODE, RECT. SI 1A 600V
D14	320101	DIODE, RECT. SI 1A 600V
D15	320101	DIODE, RECT. SI 1A 600V
D16	320101	DIODE, RECT. SI 1A 600V
D17	320101	DIODE, RECT. SI 1A 600V
D18	320101	DIODE, RECT. SI 1A 600V
D19	320101	DIODE, RECT. SI 1A 600V
D2	320101	DIODE, RECT. SI 1A 600V
D20	320002	DIODE,SI 100MA 1N4148/1N4150
D21	320002	DIODE,SI 100MA 1N4148/1N4150
D22	320002	DIODE,SI 100MA 1N4148/1N4150
D23	320002	DIODE,SI 100MA 1N4148/1N4150
D24	320002	DIODE,SI 100MA 1N4148/1N4150
D25	320002	DIODE,SI 100MA 1N4148/1N4150
D26	320002	DIODE,SI 100MA 1N4148/1N4150
D27	320002	DIODE,SI 100MA 1N4148/1N4150

Table 5-1
AT7000B Parts List (003-00002 Rev. T8)

Designator	Part Number	Description
D3	320101	DIODE, RECT. SI 1A 600V
D30	320411	LED RECTANGLE,RED
D31	320101	DIODE, RECT. SI 1A 600V
D32	320103	DIODE,SI 3A 50V 1N5400
D4	320101	DIODE, RECT. SI 1A 600V
D5	320101	DIODE, RECT. SI 1A 600V
D6	320101	DIODE, RECT. SI 1A 600V
D7	320101	DIODE, RECT. SI 1A 600V
D8	320101	DIODE, RECT. SI 1A 600V
D9	320101	DIODE, RECT. SI 1A 600V
F1	630018	FUSE CLIP,MIDGET-MOUSER44H052
J1	614025	CONN,RF FEMALE-VERTICAL
J2	610211	HEADER,MLX,4PIN,.156,POLAR
JU1	650048	HEADER,2 PIN .025 SQ
JU1	860097	MICRO SHUNT, .100 CENTERS
JU10	650048	HEADER,2 PIN .025 SQ
JU10	860097	MICRO SHUNT, .100 CENTERS
JU2	650048	HEADER,2 PIN .025 SQ
JU3	650048	HEADER,2 PIN .025 SQ
JU3	860097	MICRO SHUNT, .100 CENTERS
JU4	650048	HEADER,2 PIN .025 SQ
JU4	860097	MICRO SHUNT, .100 CENTERS
JU5	650048	HEADER,2 PIN .025 SQ
JU6	650048	HEADER,2 PIN .025 SQ
JU6	860097	MICRO SHUNT, .100 CENTERS
JU7	650048	HEADER,2 PIN .025 SQ
JU8	650048	HEADER,2 PIN .025 SQ
JU8	860097	MICRO SHUNT, .100 CENTERS
JUA	650048	HEADER,2 PIN .025 SQ
JUB	650048	HEADER,2 PIN .025 SQ
K1	540301	RELAY SPST JR1AFDC12V AROMAT
K10	540301	RELAY SPST JR1AFDC12V AROMAT
K11	540301	RELAY SPST JR1AFDC12V AROMAT

Table 5-1
AT7000B Parts List (003-00002 Rev. T8)

Designator	Part Number	Description
K12	540301	RELAY SPST JR1AFDC12V AROMAT
K13	540301	RELAY SPST JR1AFDC12V AROMAT
K14	540301	RELAY SPST JR1AFDC12V AROMAT
K15	540301	RELAY SPST JR1AFDC12V AROMAT
K16	540302	RELAY 2PST AT7000
K17	540302	RELAY 2PST AT7000
K18	540302	RELAY 2PST AT7000
K19	540302	RELAY 2PST AT7000
K2	540301	RELAY SPST JR1AFDC12V AROMAT
K20	540302	RELAY 2PST AT7000
K3	540301	RELAY SPST JR1AFDC12V AROMAT
K4	540301	RELAY SPST JR1AFDC12V AROMAT
K5	540302	RELAY 2PST AT7000
K6	540302	RELAY 2PST AT7000
K7	540302	RELAY 2PST AT7000
K8	540302	RELAY 2PST AT7000
K9	540302	RELAY 2PST AT7000
L1	459300	AIR COIL .26UH AT7000
L10	459320	IND ASSY 35T#20AWG 490014 VERT
L11	430040	INDUCTOR 100 UH AXIAL LEAD
L12	430040	INDUCTOR 100 UH AXIAL LEAD
L2	459301	AIR COIL .53UH AT7000
L3	459302	AIR COIL 1.06UH AT7000
L4	459303	AIR COIL 2.12UH AT7000
L5	459303	AIR COIL 2.12UH AT7000
L6	459304	AIR COIL 4.25UH AT7000
L7	459305	AIR COIL 8.5UH AT7000
L8	459306	AIR COIL 17UH AT7000
L9	459307	AIR COIL 34UH AT7000
MX1	380007	MIXER
Q1	310064	XISTOR,NPN,DARL,2N6427,TO92
Q2	310064	XISTOR,NPN,DARL,2N6427,TO92
R1	124100	RES,10 OHM 1/4W 5% CARBON FILM

Table 5-1
AT7000B Parts List (003-00002 Rev. T8)

Designator	Part Number	Description
R10	124100	RES,10 OHM 1/4W 5% CARBON FILM
R11	124100	RES,10 OHM 1/4W 5% CARBON FILM
R12	124100	RES,10 OHM 1/4W 5% CARBON FILM
R13	124100	RES,10 OHM 1/4W 5% CARBON FILM
R14	124100	RES,10 OHM 1/4W 5% CARBON FILM
R15	124100	RES,10 OHM 1/4W 5% CARBON FILM
R16	124100	RES,10 OHM 1/4W 5% CARBON FILM
R17	124100	RES,10 OHM 1/4W 5% CARBON FILM
R18	124100	RES,10 OHM 1/4W 5% CARBON FILM
R19	124100	RES,10 OHM 1/4W 5% CARBON FILM
R2	124100	RES,10 OHM 1/4W 5% CARBON FILM
R20	144150	RES, 15ohm, 1W, METAL OXIDE
R21	124101	RES,100 OHM 1/4W 5% CF
R22	124100	RES,10 OHM 1/4W 5% CARBON FILM
R23	154470	RES,47 OHM 2W 5% FILM
R24	154470	RES,47 OHM 2W 5% FILM
R25	124273	RES,27K 1/4W 5% CARBON FILM
R26	124273	RES,27K 1/4W 5% CARBON FILM
R27	124273	RES,27K 1/4W 5% CARBON FILM
R28	124222	RES,2.2K 1/4W 5% CARBON FILM
R29	124104	RES,100K 1/4W 5% CARBON FILM
R3	124100	RES,10 OHM 1/4W 5% CARBON FILM
R30	124103	RES,10K 1/4W 5% CARBON FILM
R32	124103	RES,10K 1/4W 5% CARBON FILM
R36	124103	RES,10K 1/4W 5% CARBON FILM
R37	124333	RES,33K 1/4W 5% CARBON FILM
R38	124103	RES,10K 1/4W 5% CARBON FILM
R4	124100	RES,10 OHM 1/4W 5% CARBON FILM
R41	124273	RES,27K 1/4W 5% CARBON FILM
R42	124103	RES,10K 1/4W 5% CARBON FILM
R43	124562	RES,5.6K 1/4W 5% CARBON FILM
R44	124103	RES,10K 1/4W 5% CARBON FILM
R45	124272	RES,2.7K 1/4W 5% CARBON FILM

Table 5-1
AT7000B Parts List (003-00002 Rev. T8)

Designator	Part Number	Description
R47	124472	RES,4.7K 1/4W 5% CARBON FILM
R48	124472	RES,4.7K 1/4W 5% CARBON FILM
R49	124472	RES,4.7K 1/4W 5% CARBON FILM
R5	124100	RES,10 OHM 1/4W 5% CARBON FILM
R50	124101	RES,100 OHM 1/4W 5% CF
R51	124332	RES,3.3K 1/4W 5% CARBON FILM
R52	124105	RES,1M 1/4W 5% CARBON FILM
R53	124103	RES,10K 1/4W 5% CARBON FILM
R54	124103	RES,10K 1/4W 5% CARBON FILM
R55	124222	RES,2.2K 1/4W 5% CARBON FILM
R56	124562	RES,5.6K 1/4W 5% CARBON FILM
R57	124101	RES,100 OHM 1/4W 5% CF
R58	124101	RES,100 OHM 1/4W 5% CF
R59	124472	RES,4.7K 1/4W 5% CARBON FILM
R6	124100	RES,10 OHM 1/4W 5% CARBON FILM
R60	124472	RES,4.7K 1/4W 5% CARBON FILM
R61	124102	RES,1K 1/4W 5% CARBON FILM
R62	124334	RES,330K 1/4W 5% CARBON FILM
R63	124100	RES,10 OHM 1/4W 5% CARBON FILM
R64	124151	RES,150 OHM 1/4W 5% CF
R65	124273	RES,27K 1/4W 5% CARBON FILM
R66	124332	RES,3.3K 1/4W 5% CARBON FILM
R67	124474	RES,470K 1/4W 5% CARBON FILM
R68	113684	RES,680K 1/8W 5% CARBON FILM
R69	113684	RES,680K 1/8W 5% CARBON FILM
R7	124100	RES,10 OHM 1/4W 5% CARBON FILM
R70	113684	RES,680K 1/8W 5% CARBON FILM
R8	124100	RES,10 OHM 1/4W 5% CARBON FILM
R9	124100	RES,10 OHM 1/4W 5% CARBON FILM
T1	459308	XFMR ASSY AT7000 CURRENT DUAL
T2	459309	XFMR ASSY AT7000 VOLTAGE DUAL
U1	330384	IC,UCN5821A
U10	330030	IC,LIN,LM324N,DIP14,OP-AMP

Table 5-1
AT7000B Parts List (003-00002 Rev. T8)

Designator	Part Number	Description
U11	330105	IC,PRE,MC12015,2 MOD
U12	330503	IC MC14024B
U13	330392	IC, BUS, XCUR
U14	330397	IC,MC33064 UNDERVOLT SENSING
U2	330384	IC,UCN5821A
U3	330384	IC,UCN5821A
U4	330429	IC,74HC373N OCTA D TYPE LATCH
U5	330500	IC, MICRO OTP VERSION
U6	330501	IC 28C64 EEPROM
U8	003-00044	AT/RAT7000 DECODER U8
U9	330015	IC,VREG,7805,TO220,5V
XU5	621015	SOCKET 44 PIN PLCC
XU6	621009	SOCKET,28 PIN DIP
XU7	621009	SOCKET,28 PIN DIP
XU8	621011	SOCKET IC DIP 20 PIN
Y1	360027	CRYSTAL MICROPRCSSR 4.9152MHZ
C48	277104	CAP,C,0.1U,50,10%,X,AX,.25SP