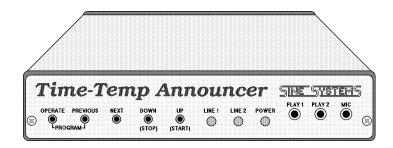# Time-Temp Announcer

— Instruction Book —
(concise edition)

This instruction book contains valid documentation for Time-Temp Announcer Hardware Version 1.00 and Software Version 1.00

This version of the product documentation has been edited for length. It contains only the sections that concern programming and operation of the product to allow for quicker electronic distribution.

Section 2 — Safety Information

2.1

⚡ ⚠ **WARNING!**

<u>The Time-Temp Announcer should be installed only by qualified technical personnel</u>. Incorrect or inappropriate installation could result in a hazardous condition.

The Time-Temp Announcer is designed for indoor use in a dry location. Installation and operation in other locations could be hazardous. Use only the original wall-plug power supply supplied with the unit.

Section 3 — FCC Information

3.1 FCC Information:

The Time-Temp Announcer complies with Part 68 of the FCC rules. On the bottom of the Time-Temp Announcer is a label that contains, among other information, the FCC registration number and ringer equivalence number (REN) for this equipment. If requested, this information must be provided to the telephone company.

The Time-Temp Announcer is designed for use with standard modular (RJ11C) telephone jacks.

The REN is used to determine the quantity of devices which may be connected to the telephone line. Excessive RENs on the telephone line may result in the devices not ringing in response to an incoming call. In most, but not all areas, the sum of the RENs should not exceed five (5.0). To be certain of the number of devices that may be connected to the line, as determined by the total RENs contact the telephone company to determine the maximum REN for the calling area.

The telephone company may make changes in its facilities, equipment, operations, or procedures that could affect the operation of the Time-Temp Announcer. If this happens, the telephone company will provide advance notice in order for you to make the necessary modifications to maintain uninterrupted service.

If trouble is experienced with the Time-Temp Announcer, please contact Sine Systems, Inc. (at the telephone number on the cover of this instruction book), for repair and/or warranty information. Additional information is contained in the "Troubleshooting and Repair" section of this manual. If trouble with the Time-Temp Announcer is causing harm to the telephone network, the telephone company may request you remove the equipment from the network until the problem is resolved. The telephone company will notify you in advance of service disconnection. But if advance notice isn't practical, the telephone company will notify the customer as soon as possible. Also, you will be advised of your right to file a complaint with the FCC if you believe it is necessary.

The Time-Temp Announcer cannot be used on public coin service lines provided by the telephone company. Connection to Party Line Service is subject to state tariffs. Contact your state public utility commission, public service commission, or corporation commission for information.

The Time-Temp Announcer is registered with the Federal Communications Commission and is certified to meet specific safety requirements. It is extremely important that <u>the Time-Temp Announcer not be modified in any way</u>. Modification of this equipment will void the FCC certification, void the warranty, and perhaps pose a hazard to the user of this equipment or to maintenance personnel of your local telephone company.

Service of the Time-Temp Announcer should be performed only by qualified technical personnel who are familiar with the implications of FCC Part 68 registration. Extreme caution should be used if the Time-Temp Announcer case is opened without first being disconnected from the telephone line. High voltages may be present on telephone lines, and although the Time-Temp Announcer is powered by 12 volts AC from a "wall plug" transformer, failure of this transformer could cause dangerous and potentially lethal voltages to become present. Only the supplied transformer should be used.

Section 5 — Installation

5.1 Items Supplied with the System

The system is supplied with a main unit, the Time-Temp Announcer (which includes a built-in rechargable 9V battery backup that is internally recharged), a temperature sensor (which is already attached to 100 feet of cable), a microphone, a pair of earphones, and a wall-plug power supply.

5.2 Installing the Unit

The Time-Temp Announcer is designed to be placed almost anywhere. It generates little heat and can be mounted in just about any convenient location where the ambient temperature does not exceed 120°F.

5.2.1   Power Supply Connection

The Time-Temp Announcer is powered by 12 volts AC. The included wall-plug power supply should be used. Simply attach the lead into the jack labeled "POWER" on the back side of the unit and then connect the plug into any standard 120V outlet.

5.2.2   Back-Up Battery

The Time-Temp Announcer has provisions for a back-up battery to power the internal clock in the event of a power failure. A 9 volt rechargable battery was supplied already connected internally inside the unit. The Time-Temp Announcer has a trickle-charging circuit that will keep the rechargable battery at full charge when power is available.

> Note: When the unit is powered up for the first time it is necessary to allow at least 72 hours for the battery to reach its' fully charged state before it has the capability to supply back-up to the clock.

5.2.3   Connecting Temperature Sensor

Connection of the temperature sensor to the main unit is preformed by simply plugging the sensor plug into the jack labeled "TEMP. SENSOR" on the back side of the unit. Sine Systems offers a optional 100 foot extension for the temperature sensor cable. This connects between the supplied sensor cord and the Time-Temp Announcer, and the connection should be well insulated for moisture by wrapping the connection with electrical tape.
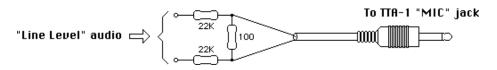
5.2.4   Connecting Headphones

The Time-Temp Announcer has two audio outputs. Both of these audio outputs appear on the right front-panel and are labeled "PLAY 1" and "PLAY 2." The second audio jack allows two people to listen to the playback on two pairs of earphones. They also allow as a check that both Line 1 and Line 2 have all the proper recorded messages in them. If a problem was suspected with one of the sound chips then plug the earphones into the "PLAY 1" jack and compare its output with that of the other chip in "PLAY 2."

5.2.5   Connecting Microphone

To allow the recording of one's own message on the Time-Temp Announcer there is a microphone jack. It is labeled "MIC" and it is located on the right side of the front-panel. Simply install the plug of the supplied microphone into the jack.

In many cases it is desirable to use a production room to pre-record the TTA-1 messages. Music can be added to the messages and audio processing equipment (equalizers and limiters) can be used. The following diagram shows how to build a "Line-To-Mic" attenuator that will allow this:

The components are available from Radio Shack. The 22K resistors are part number 271-1339, the 100 ohm resistors are part number 271-1311 and the 1/8" phone plug and cable is part number 42-2434. This circuit has an attenuation of about 53 dB and will work with any balanced or unbalanced audio source from 0 dBm to +8 dBm in level.

When producing messages for the TTA-1, the audio should be moderately limited. Audio will sound better on a telephone line if an equalizer is used to boost 2.5 to 3 kHz about 10 to 15 dB.
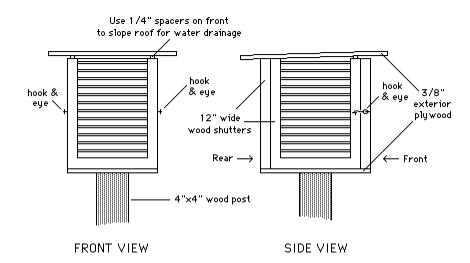
5.3 Installing the Temperature Sensor

The temperature sensor supplied with the TTA-1 includes 100 feet of cable. Using optional 100 foot extension cables, the sensor may be located up to 1000 feet from the TTA-1. After calibration, this sensor is capable of giving very accurate temperature readings that are unaffected by cable length. However, to get readings that give good correlation to readings reported by the nearest NOAA weather station, it is important to measure the temperature the same way they do. Just hanging the sensor out a window will almost surely produce disappointing results.

5.3.1   Placement of Sensor

The key to getting good temperature readings is to mount the sensor in a "standard enclosure." It provides very accurate air-temperature readings.

An alternative to buying one is to make a standard enclosure using inexpensive, locally-available materials. The primary raw material is a couple of 12-inch-wide louvered wood shutters. These are available at any home-improvement store. Cut the shutters so you end up with four equal lengths of shutter about 13 to 16 inches long. Depending on the style, a little improvising may be required. Some shutters can be cut along a solid horizontal reinforcement piece and others will require the end louvers to be stabilized with glue or a piece of wood. In either case, you will build a box with the four pieces of shutter using them for the four walls. The floor and roof of the box should consist of 3/8 inch exterior plywood. Here is how the end result will look:

Use 1/4" spacers on front
to slope roof for water drainage

hook & eye — hook & eye — 12" wide wood shutters — hook & eye — 3/8" exterior plywood — Rear → — ← Front — 4"x4" wood post

FRONT VIEW   SIDE VIEW

The roof should overhang about 3 inches on all sides. Nail and glue, or screw three of the four sides together and then attach this to the floor. The pieces of shutter should be oriented so the louvers will drain "out." Attach the roof with a couple of 1/4 inch spacers near the front so that it slopes slightly to the rear. This will prevent water from standing on top. The remaining wall should be attached with two hook-and-eye sets so it can be removed.   The enclosure should be mounted on a 4-inch-square wooden post. The floor of the enclosure should be 4 feet above the ground. Don't forget to drill a small hole in the floor near the edge of the post for the cable to come through. Also, a 1/4 inch hole drilled in one of the walls about an inch above the floor makes an easy way to insert a dial-type calibration thermometer without removing the louvered panel (see section 5.3). The enclosure should be given at least two coats of white exterior paint inside and out.

The enclosure should be placed at least 20 feet from the nearest building, preferably on grass-covered soil. It should be as far away as possible from concrete and pavement. It should not be placed near air-conditioner compressors nor under trees.

The cable for the sensor should be run up the post and through the hole in the floor.   Be particularly careful not to cut or puncture the outer insulating jacket of the cable anywhere. Lay the sensor in the center of the floor of the enclosure. When visiting the enclosure during the summer months you might want to take a can of wasp-and-hornet-killer with you. They just love to build nests in these things.

Note: If the optional 100 foot extension cable is used to sure that you keep moisture away
        from the jacks if they are located outside. Wrap electrical tape around the connection.

5.3.2   Thermometer Calibration

The Time-Temp Announcer can be programmed to read the temperature in either the Fahrenheit or the Celsius scale.   To change the temperature scale, refer to "Section 6 - Operation and Programming" of this manual. The unit must be recalibrated if the scale is changed (i.e. Fahrenheit to Celsius).   In order to calibrate the Time-Temp Announcer's thermometer, a thermometer of known accuracy should first be placed as close as possible to the temperature sensor. Give it about ten minutes to stabilize in temperature. Then set the

Time-Temp Announcer to read the same temperature as the calibration thermometer of known accuracy. This is done according to the instructions in "Section 6 - Operation and Programming."

The accuracy of the temperature reported by the Time-Temp Announcer is limited by the accuracy of the calibration thermometer. Thermometers of known accuracy are available at laboratory supply companies. A dial-type thermometer with an 8-inch stem, a 2-inch dial, a range of 25° F to 125°F and an accuracy of 1% full-scale can be ordered from Edmund Scientific Company. Their telephone number is (609)573-6250. The thermometer is stock number C36,319 and in March, 1996 was priced at $23.95.

An alternative way to easily calibrate the sensor is to fill a styrofoam cup with crushed ice and add water. Insert the sensor into the cup and allow a couple of minutes for the temperature to stabilize. Shield the sensor from direct sunlight. The reading should then be calibrated to correspond to 32° F or 0° C.

The temperature calibration and temperature scale are stored in non-volatile memory and will not be lost during a power failure, even if the back-up battery is not charged.

5.4 Installing Expansion Units

The Expansion Unit should be placed on the top or on the bottom of the Time-Temp Announcer since they must be joined on the back with the IC-3 or the IC-10 cable that is purchased separately to accommodate up to 3 or up to 10 expansion units. The expansion cable should be connected to the expansion port on the back of the Time-Temp Announcer and each one of the other ends to each expansion unit. Connect the unit to the phone lines through the jacks on the back of each unit. The units are each powered by 12 volts AC. The included wall-plug power supply should be used. Simply attach the lead into the jack labeled "POWER" on the back side of the unit and then connect the plug into any standard 120V outlet.

Note: For optimum efficiency use all of the phone line jacks on the back of the expansion units first before connecting any to the main unit. This minimizes the time required to answer a call from a worse case of 1 message cycle to a worse case of 1/2 message cycle. This is due to the fact that the phone line connected to "LINE 1" on the <u>main unit</u> is forced to only answer using the first of two digital chips, where a phone line connected to "LINE 1" on an <u>expansion unit</u> has the option to answer using either of the two digital chips. This only effects operation with the use of expansion units.

Example: You have one main unit, one expansion unit, and a total of 5 phone lines coming in. Connect the expansion unit to the main unit and then connect all the phone lines to the expansion unit. This minimizes the worse case answer time.

5.4.1   Unit Number Switch

On the front of each expansion unit is a switch labeled "Unit Number". This is used by the Time-Temp Announcer to distinguish different expansion units. <u>No other expansion unit connected to the same Time-Temp Announcer should have the same "Unit Number".</u> For the first expansion unit use the number "1" for the "Unit Number", for the second expansion unit use the number "2" ,and so on. The number "0" represents the tenth expansion unit.

Section 6 — Operation and Programming

6.1 Selecting the Operate Mode

Pushing the "OPERATE" button on the left side of the front-panel will select the operation mode. A green LED light will turn on under the word "POWER". This LED is used for several functions:

> 1) It is normally on to indicate that external power is present and the unit is operating. The LED extinguishes during battery-only operation.
>
> 2) The LED blinks off briefly, once each minute, at zero seconds. When compared to an accurate time reference (like WWV), this can be used to accurately set the time "straight up" on the minute.

There are two other LED's labeled as "LINE 1" and "LINE 2". During the operation mode each one of these yellow indicators turn on to show which line is connected to a caller.

Note: In first time operation and when all power is lost both of the yellow LED's will blink when the power is turned on. This is a reminder that the minutes need to be set (i.e. the clock has not been set). The unit will not answer the lines if the minute value is not set.

6.2 Selecting the Programming Mode

The front panel of the Time-Temp Announcer contains five pushbutton switches. These are normally used to adjust the clock and thermometer but can also be used to record/playback the messages, search for an inactive (bad) phone line, count the number of calls received, or read the software version. To start the "PROGRAM" mode both the "OPERATE" and the "PREVIOUS" switches must be pushed in simultaneously, this is to help prevent accidental changes.

When a caller is on the line you can enter the program mode, however you are not allowed to change anything until the call is hung up. If any other key is pressed besides entering into the "Program" mode the Time-Temp Announcer will disconnect the caller.

No calls will be answered by the Time-Temp Announcer while in the programming mode.

When the Time-Temp Announcer is in the "Program" mode the green "POWER" LED will start to blink repeatly. It will continue to blink until the unit is out of programming mode. The two yellow LED's labeled "LINE 1" and "LINE 2" and the green "POWER" LED will start to rotate blink repeatly when in the record message mode and you are recording. This is to allow the operator to see when to begin and end the message that they wish to record.

6.2.1 The "Location/Value" Concept

The "Location/Value" concept is to allow the user to go through the position locations of all the variable functions and only change the desired values using the "UP/START" and "DOWN/STOP" buttons. After entering into the "PROGRAM" mode the unit will always start with "Location 1". With the included earphones hooked up the unit will say:

"Location 1, Value xxx........"

It will not say anything else or go to the next step until the operator:

1) Selects the "UP/START" button to choose a new value for that location. Refer to the "Location/Value" table to find the available ranges for each location.
   Example: In "Location 2" the value of hours has the range from 0 to 23 with one hour intervals.   Selecting the "UP/START" button will increase the value by one (i.e.; 1 to 2).
   Note: Use military time (i.e.;2 PM = 14 hours).
2) Selects the "DOWN/STOP" button to choose a new value for that location. Refer to the "Location/Value" table to find the available ranges for each location.
3) Selects the "NEXT" button to move to the next location.
4) Selects the "PREVIOUS" button to move to the last location.
5) Selects the "OPERATE" button to exit out of the program mode and back into the operation mode.

6.2.2   Location/Value Programming Table

The following table is a summary of all possible programming and data read locations in the Time-Temperature Announcer.

		Description/Range:		
		reads total number of calls since reset (up to 65,535)		
		0 to 23; use 24 hour (military) time		
		0 to 59		
		set to actual temperature		
		0=Fahrenheit; 1=Celsius		
		0 to 12 (set to "0" to disable auto-daylight-savings switch)		
		1 to 31		
		example: "96"=1996; "01"=2001		
		Message Mode:		
		Intro Message 1:		
		Intro Message 2:		
		Intro Message 3:		
		Closing Message:		
		maximum recording time in "messsage mode" table above		
		maximum recording time in "messsage mode" table above		
		maximum recording time in "messsage mode" table above		
		maximum recording time in "messsage mode" table above		

6.3 Individual Discussion of Programming Features

The Time-Temp Announcer has a variety of programmable features that can be customized by the operator. The following is a description of these features.

6.3.1   Call Counter

The Call Counter feature allows the operator to keep a running count of the number of calls received by the Time-Temp Announcer (up to 65,535 calls). This value will be read automatically when at Location 1. After the value is read it can be read again by pressing the "UP/START" button or it can be reset by pressing the "DOWN/STOP" button.

6.3.2   Time, Temperature, and Calendar

The Time-Temp Announcer will not answer a call if the time has not been set or the power goes out even if the rechargable battery is fully charged. It will not read a value for the temperature if the temperature sensor has not been plugged in properly.

These features allow the operator to adjust the hour, minute, temperature, temperature scale, month, day, and year. The hours are on the range of 0 to 23 using the 24 hour military time scale (i.e.; 1AM = 1 ; 1PM = 13). The value of the hours will be read at Location 2 and can be moved up using the "UP/START" and down using the "DOWN/STOP". Minutes can be set from 0 to 59 at Location 3 the same way that hours are adjusted. Each time the minutes are changed, the seconds are set internally to "zero" so the final minute change should be made "straight up" on the minute. The temperature range is from -40°F to 120°F. At Location 4 the temperature can be adjusted up or down 7° from the sensors' true unadjusted temperature to calibrate it. The temperature scale can also be switched from Fahrenheit to Celsius. A value of 0 represents Fahrenheit and a value of 1 represents the Celsius scale at Location 5.   The temperature must be recalibrated after switching the scale (i.e. Fahrenheit to Celsius).
The Time-Temp Announcer also has a built-in calendar. The sole purpose of this feature is to allow the built-in auto-daylight saving time switch to be working properly.   On the first Sunday of April and on the last Sunday of October the auto-daylight switch will automaticly adjust the hour to its proper value according to daylight saving time. For those who do not need this feature, the month value should be set to "0" to disable this function.   To enable this feature all that needs to be done is to have the proper date (month, day, and year) entered into the unit. To adjust the month, day, or year go to the correct location and adjust the value up by using the "UP/START" button or down by using the "DOWN/STOP" button. Month 13 is a feature that allows the operator to set the time ahead one hour at the next 2 AM mark. Month 14 is a feature that allows the operator to set the hours back one on the next 2 AM mark. After the execution of month 13 or 14 the value of months goes to 0.

     Note: The Time-Temp Announcer will not read the date to a caller.

6.3.3   Message Mode

The message mode is designed to allow the operator a variety of different message times for both the intro and the closing messages.   The operator can establish up to three intro messages. When more than one intro message is established, they will automatically rotate with each incoming call.   The message mode has a range of 1 to 6 as explained   on the

"Location/Value" Table.

> Note: The times in the table are the maximum allowable recording time. A message can always be of less time (if you only record an 8 second intro message, only 8 seconds of time will be played back to a caller).

> Note: If you change the Message Mode you need to change the Record Messages in Locations 16 through 19.

6.3.4   Inactive Line Indicator

With a dedicated line for in-coming calls if can be difficult to determine if the lines are working properly. The purpose of the inactive line indicator is to test for a bad line (i.e., a line that is disconnected). To test for a inactive line go to Location 10 in the program mode and then choose the "UP/START" button. This will illuminate and rapidly blink both the "LINE 1" and "LINE 2" yellow LED's. They will continue to blink until a call has been received on that line. This can also be turned off by using the "DOWN/STOP" button.

6.3.5   Software Version

If it ever becomes necessary to know the version of software loaded in the Time-Temp Announcer's microprocessor (i.e., firmware), the value at Location 11 could be read by pressing the "UP/START" button. It will return with a version number.

6.3.6   Playing Messages

To play back the recorded messages go to the proper Location (12 through 15) and press the "UP/START" button. To stop the playback choose "DOWN/STOP" while the message is playing.

6.3.7   Recording Messages

To record a message go to the proper location (16 to 19) in accordance with the message mode choice. Press the "UP/START" button to start recording and the "DOWN/STOP" button to stop recording. As a visual acknowledgement of the recording mode all three LED's will start to blink in a rotation pattern and will continue until it has stopped recording.

> Note: Make sure that the Message Mode in Location 9 corresponded with the number of messages recorded in.

> Operation Note on Length of Messages:
> Please remember that although up to thirty seconds has been allowed for a single intro message most of the people that are calling will either hang-up or never call again if forced to listen to a thirty second advertisement. Instead use one of the other modes and allow the messages to rotate or record one message for a shorter amount of time.

> Example: Intro message time is sold to a local bank and instead of one long message explaining all their services have them use three smaller ones that rotate to talk about their low rates on auto loans, high interest saving accounts, or their no minimum free checking account.

Examples of Closing Messages:

   1) Thanks for calling KPOP's time and temperature service.
   2) Tune to KPOP 105.2 FM for up to the minute traffic and weather information every thirty minutes.
   3) Today's weather will be partly cloudy with a high of 75 and a low tonight of 62, expect showers tomorrow with a high of 68. For up to the minute weather and news tune to KPOP 105.2 FM.

6.4 Expansion Unit Operation

Once all the connections for the expansion units have been made, operation of the units fall onto the control of the Time-Temp Announcer. Features like the Inactive Line Indicator and Call Counter are incorporated into the expansion unit although they are controlled by the master unit (Time-Temp Announcer).

Section 7 — Troubleshooting and Repair

7.1 Common Problems

Problem: TTA won't answer a call. The green indicator light is blinking on and off every half second.

Solution: The TTA is in the programming mode. Push the OPERATE button.

Problem: TTA won't answer a call. The green indicator light is on and the yellow "Line 1" and "Line 2" indicator lights turn on for a half second every two seconds.

Solution: The indicator lights are giving the signal that the clock has not been set. Rather than have the TTA answer a call and give the wrong time, it is designed to not answer calls if the clock is not set. Set the clock (Section 6.3.2) and the yellow indicator lights will stop blinking and the TTA should begin answering calls.

Problem: The TTA gives the time but not the temperature.

Solution: The TTA is designed to skip the temperature announcement if the temperature sensor is not connected or it is defective. Be sure the sensor is plugged in the correct location (TEMP SENSOR on the rear panel) and that the cable has not been damaged.

Problem: The TTA plays only part of the opening message.

Solution: Check the Message Mode (Section 6.3.3). The Message Mode should be chosen and set before the messages are recorded. If a 30 second message is recorded while in Message Mode 4 and the Message Mode is then switched to 6, then some of the calls will hear only the middle or last 10 seconds of the message.

Problem: The TTA skips the closing message.

Solution: Check the Message Mode (Section 6.3.3). If a closing message is desired, the mode must be set to 4, 5 or 6.

7.2 Circuit Description

The central component of the TTA is a Motorola microprocessor—the MC68HC711. It is a single chip microprocessor (or microcontroller) in the sense that it contains a CPU, clock, RAM, ROM, EEROM, and various serial and parallel input and output ports. The EEROM is used to store the user set-up information: the temperature scale, the temperature calibration and the message mode. Because these are stored in non volatile memory they will not be lost even if a total power down state is achieved. U4 is a low-voltage detector which shuts down

the microcontroller when the supply voltage drops below 4.5 volts. This insures a clean shut-down and prevents possible erratic operation (undesired writes to EEROM or sound chips) at low supply voltages. The clock crystal is 8 MHz and a 2.000 MHZ square ware should appear on pin E.

A sample of the 50/60 Hz AC power signal is fed into the microcontroller (PA0) to synchronize the time-of-day clock (as opposed to the microcontroller's clock). This insures the long-term accuracy of the clock.

The TTA contains an on-board ni-cad back-up battery. This serves to keep the microcontroller's clock and calendar operating during a power failure. The battery is a standard 9 volt rechargable battery should it ever need replacing. It is charged by RN1 at a rate of about 0.5 milliampere. This is a very slow charge rate (to insure long battery life) and it will take several days to fully recharge a dead battery. The microprocessor is programmed to sense when external power fails and to switch all non-vital circuits to a low-power condition to preserve battery life.

The various pushbutton switches and LED indicators on the TTA are operated directly by parallel I/O pins on the microcontroller.

A serial input/output port is connected to the EXPANSION connector to allow control of the expansion units. The serial format is 0-5 volt logic level, NRZ, 8 data bits, no parity and one stop bit. The data rate is 31.5 k baud. A single conductor is used for both send and receive using tri-stated transmitters and a proprietary communication protocol. RN3, C8 and D4 provide RF and surge protection for this port.

The TTA contains two solid-state audio recorders made by Information Storage Devices. These are U2 and U3. Each device has the ability to store 90 seconds of audio in non-volatile memory. About half of this memory contains the factory-recorded words necessary to speak the time and temperature. The other 45 seconds is reserved for user-recorded messages.

⚠ **WARNING!**
Do not test or apply power to this chip when it is removed from its socket. This could cause the factory-recorded words to be erased.

To cause a message playback, the address lines A0 through A9 are set and then CE is briefly lowered. The output of the microphone preamplifier in U2 is used to feed the analog input pins (A IN) of both chips. The characteristic of the built-in AGC circuit are controlled by R3 and C15. The values of these components should not be altered. The playback audio is a differential output and can be found at pins O+ and O-. The playback audio feeds the telephone line network interface, a front-panel headphone jack (PLAY 1 or PLAY 2), and the EXPANSION connector on the rear panel. The leads to the EXPANSION connector are protected from RF and transients by RN5, C9, C10, D5 and D6.

Beginning at the modular jack, the telephone line interface consists of a series resettable fuse (trade name Polyswitch) and a shunt solid-state circuit protector (trade name Sidactor). A CP Clare TS117 serves as a solid-state hookswitch and ring detector (with C11/C13 and R1/R2). Diodes D7 through D10 and capacitors C12 and C14 provide additional RF and transient protection.

The external temperature sensor is made by Analog Devices. It has three terminals: ground, +5 and temperature output. The temperature output of the sensor is in the form of an approximately 45 Hz square wave signal with the temperature encoded in the duty cycle of the square wave. Because the temperature is encoded by edge location (time) rather than by voltage level, the temperature measured by the TTA is independent of lead length. The duty cycle is precisely measured by the TTA using a crystal-controlled clock, and then a mathematical formula is applied to extract the actual temperature. The sensor is factory calibrated to about ±3°F and by means of a simple user-calibration (Section 5.3.2) this error can be reduced to ±1°F. The microprocessor software is programmed to analyze the signal from the temperature sensor and ignore the reading if the sensor is defective or if the reading is below -70°F or above 150°F.

7.2.1 Time-Temperature Announcer Expansion Unit

The TTA Expansion Unit contains a Motorola MC68HC811 microcontroller very similar to the microcontroller in the main unit. However, because they contain different software programs, microcontrollers in the Expansion Units are not interchangeable with the microcontroller in the main unit. Ring detection signals, hook relay control signals, LED indicators and the the "Unit Number" switch all interface parallel I/O pins on the microcontroller. The Unit Number switch gives each Expansion Unit a unique identity to the main unit and allows all Expansion Units to communicate on a common line. The serial port is connected to the common buss in the same way as the main unit.

The telephone line interfaces on the Expansion Unit are identical to the main unit (see above). The audio source is a differential amplifier preceded by a SPDT solid-state switch to select the audio source. The audio source can be either of the two message recorders in the main unit. The input to the SPDT switches comes from two audio buffers U6a and U6b.

7.3 Field Repair

⚠ **WARNING!** Field repair of the Time-Temp Announcer is not difficult. However, incorrect repair could result in a condition which could cause damage to equipment or be hazardous to personnel. Only a qualified service technician should attempt to repair the Time-Temp Announcer.

Using the appropriate schematic diagram, the above circuit description and common troubleshooting techniques, it should not be too difficult to repair a TTA or an Expansion Unit. The TTA requires 12 volts AC for operation. Operation on a DC supply will not work because the absence of the AC signal will cause the microcontroller to think the power is off and go into a power-down mode. Expansion Units can operate on AC or DC.

Disconnect any Expansion Units and test operation of the main unit by itself. Reconnect and test Expansion Units one at a time.

A logic "high" turns on a hook relay and a ring will be indicated by a pulsed "low". Audio signals, when present, should be about 1.5 volts P-P. The resettable fuses (RF1 through RF2 or RF6) should have about 4 to 5 ohms resistance. The shunt surge suppressors (SD1 to SD2 or SD6) should be essentially an open circuit at low (<100 VDC) voltages. The signal from the temperature sensor should be a 20 to 50 Hz square wave.