

Model RFC-1
Remote Control System

— Software Instruction Book —

**This instruction book contains valid documentation
for RFC-1 software version 3.07 (and for software version
2.07 with the exceptions listed on page 12.1)**

SINE SYSTEMS

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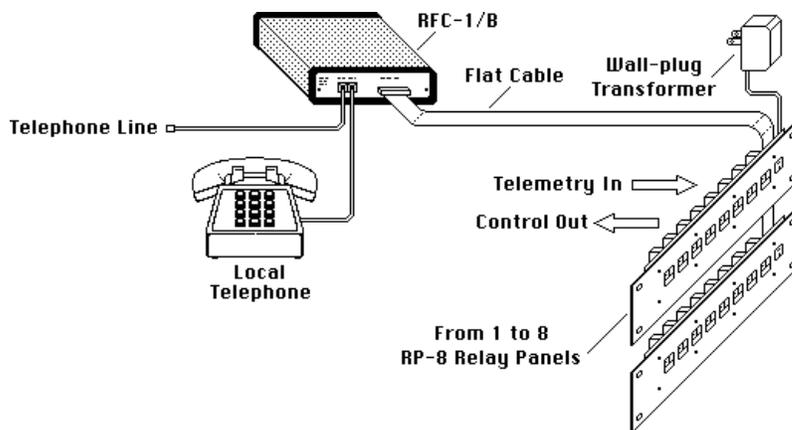
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Section 10 — Equipment Description

The RFC-1 is the central unit for a system that was designed to monitor and control a remote facility by means of an ordinary telephone. The remote operator controls the RFC-1 and requests telemetry information by means of a telephone keypad and the RFC-1 gives telemetry and status information to the operator by a synthesized voice. Many references will be made in this manual concerning the application of the RFC-1 in controlling remote broadcast transmitting facilities. While this is a common use, it is not the only application of the RFC-1. The RFC-1 is suitable for a wide range of industrial and commercial applications.

The RFC-1 is connected directly to a regular telephone line and a local telephone; and to the equipment to be monitored and controlled through RP-8 relay "interface" panels. The RFC-1 will automatically "answer" a telephone call after a preset number of rings and then allow the user, after entering a security code, to telemeter or control the facility. The RFC-1 is also capable of monitoring up to six designated telemetry channels and originating telephone calls to report anomalous readings. The following illustration shows a basic system:



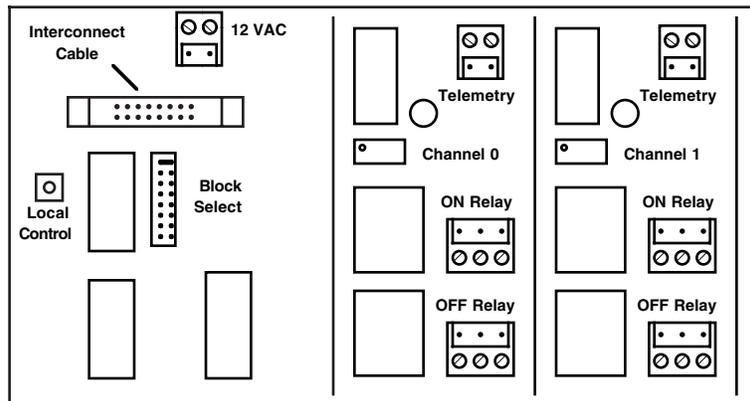
In addition to control and telemetry access by means of a dial-up telephone line, the RFC-1 also may be adapted for use with a non-dial-up communications link such as a dedicated line, a two way radio, a pager, an STL/SCA link, etc. This additional control method may be used in place of a dial-up line or in addition to a dial-up line for the purposes of an alternate or back-up control and monitoring means.

The RFC-1 is "modem-sized" (6" x 7" x 1.75") and can be mounted in any convenient location such as on a wall, on a desk top, or it may be rack mounted with an optional kit (RK-3). The RFC-1 is connected to a telephone line and a local telephone with modular jacks located on the front panel. It is connected in "daisy chain" fashion with 16 conductor ribbon cable to one or more RP-8 relay panels and optional accessories such as auxiliary relay modules and temperature modules. These panels contain the necessary relays and interface hardware to connect up to 8 channels of telemetry and control. The RP-8 panels are 3.5" high and 19" wide and mount in a standard 19" equipment rack. Two panels are shown in the illustration but anywhere from one to eight panels can be

connected for a maximum system size of 64 channels. A 12 volt AC "wall plug" transformer is supplied with the RFC-1 that connects to any one of the RP-8 panels and provides power to the entire system.

The system was designed in this way to allow the user to purchase only the hardware necessary for their particular application. As few as eight channels can be installed initially and system expansion up to 64 channels is easily accomplished later with the addition of more RP-8 panels. The interconnection cable used between the RFC-1 and the RP-8 panels uses insulation displacement connectors that can be field installed in just a few seconds without special tools. Also, it is easy to add connectors to an existing cable for purposes of system expansion. The RFC-1 is supplied with eight feet of interconnection cable and one connector. An additional connector is supplied with each RP-8 panel.

Each RP-8 panel contains 8 reed relays for telemetry selection and 16 relays for control output (8 ON/8 OFF) each rated at 5 amperes resistive/2 amperes inductive. The following illustration shows a partial view of the rear of an RP-8 panel:



Each RP-8 panel has a movable "Block Select" jumper plug that is used to select the block of channels assigned to that panel. The blocks are: 0-7, 8-15, 16-23, 24-31, 32-39, 40-47, 48-55, and 56-63. There is also a "Local Control" pushbutton, accessible from the front of the panel, which allows all control and telemetry functions to be accessed from the local telephone.

All telemetry and control connections are made to the relay panels by means of "pluggable" screw terminal blocks. These removable blocks can be installed so the wires emerge from the relay panel either horizontally or vertically and simplify both installation and future modification or testing. To remove them, simply pull them off.

Telemetry calibration is accomplished with a 22 turn cermet potentiometer, accessible from the front of the relay panel, for each telemetry channel. Calibration is done in the local control mode by adjusting the potentiometers for the desired telemetry indication. Because the telemetry constant for each channel is stored in a potentiometer, it is "nonvolatile" and is not affected by a power interruption.

The RFC-1 has an ingenious way of making any channel either a telemetry channel or a "status" channel. Telemetry is measured over a range of 0000 to 2040. If a reading is

between 0003 and 2039, the telemetry reading is spoken as four digits. If the telemetry reading is 0002 or lower, the words "Status: Off" are spoken. If the telemetry reading is 2040 (full scale or higher) the words "Status On" are spoken. Using this system, it is easy to monitor either an analog telemetry source or a source that is either "on" or "off."

To assist in routine telemetry reading, the RFC-1 can be instructed to scan automatically the telemetry values of all channels at a rate of one channel per 5 seconds.

To restrict remote operation of the RFC-1 to authorized personnel only, the correct entry of an eight digit security code is required before any access is granted to telemetry or control. This code can be set to any one of 100,000,000 possible combinations with the "local" (on site) telephone. The degree of security attained by an eight digit security code is quite high. Working 24 hours a day, seven days a week it would take over 316 years to attempt all possible codes. As a safeguard against unintentional control actions by persons who know the security code, an additional two digit code is required before control authority is granted.

Provisions are included in the RFC-1 to allow the user to alter the number of rings required before it answers a call. This can be set to any number from 1 to 99, from either the local, or an outside telephone.

A "telephone alarm" feature is included in the RFC-1 that allows it to call two telephone numbers in rotation, up to three times each, and report anomalous telemetry conditions. This feature allows up to six channels to be designated for monitoring. Alarm limits are defined by user-programmable upper and lower trip points for each alarm channel. The designation of alarm channels, the alarm limits, and the two telephone numbers to be called (up to 12 digits each) can be programmed either locally or from an outside telephone.

The RFC-1's "ring number," security code and all "telephone alarm" programming are stored in a nonvolatile section of the internal microprocessor's memory. This memory remains intact during power outages and does not require the use of a back-up battery or "memory" capacitor.

Optional Accessories

The UPS-1 Uninterruptable Power Supply allows operation of the RFC-1 when external power is not available. The UPS-1 will power the RFC-1 for 6 to 10 hours without external power and automatically recharges its internal batteries when power is restored.

The TM-1 Temperature Monitor module attaches to the RP-8 Relay Panel and allows room temperature monitoring from 5.0° F to 203.9° F with 0.1° resolution.

The ACM-1 AC Current Monitor is useful for monitoring the current consumption of any 115 or 230 volt AC device. It is commonly used to monitor the status and condition of tower lighting.

The SP-8 Heavy Duty Surge Protector not only protects both telephone ports but eight telemetry inputs as well. The SP-8 is so effective that Sine Systems includes damage from lightning in the original one year warranty if the SP-8 protection system is used.

The AR-1 Auxiliary Relay module also attaches to the RP-8 panel and provides an

auxiliary contact closure when a defined block of channels is being telemetered by the RFC-1. This is particularly useful for directional AM stations using certain types of antenna monitors.

The AFS-1 Dual Channel Audio Failsafe may be useful for broadcast facilities which want to use the interruption of program audio as an alternate means to terminate transmission. This device has two bridging audio inputs and as long as audio is present on at least one input, a relay is closed. When audio is absent on both inputs for five minutes the relay opens and the transmitter (or other equipment) is turned off. Audio sources can be either an STL, a land-line, or a combination of the two.

The RK-3 Rack Kit is a 1-3/4" high rack panel with cutouts to mount up to three units the size of the RFC-1, AFS-1 and UPS-1.

Section 11 — Operation

Telemetry/Control From A Remote Telephone

Remote operation of the RFC-1 is accomplished with a DTMF (dual tone multi-frequency or Touch Tone®) telephone connected to a DTMF dialed telephone line. However, where DTMF service is not available, the initial call can be made with a rotary (pulse) dialing telephone if some method of generating DTMF tones is available once the RFC-1 answers the call. This could be done by using a telephone with switchable tone/pulse dialing or it could be done with an acoustically coupled DTMF keypad.

The RFC-1 will answer a call after a specified number of rings. Upon answering, after a two second delay (required by FCC rules), the RFC-1 will speak the word "Enter." This is the prompt to enter the security code. The prompt "Enter" (as opposed to "Enter Security Code") is deliberately vague to keep from tempting malicious entry into the system by other than authorized operating personnel. Successfully guessing the security code is a very remote possibility (one try has a 1 in 100,000,000 chance of success) but the repeated attempts to guess the code would tie up the line and block legitimate use. After the word "Enter" is spoken, the eight digit security code should be entered. If it is entered correctly, "OK" is spoken and access to system telemetry is granted. If the security code is not entered or incorrectly entered, the RFC-1 cannot be operated and hangs up the line 90 seconds later.

Reading Telemetry

With the entry of the correct security code, telemetry authorization is granted. The user may then access any of the 64 possible telemetry channels by pushing the two digit code for that channel on the telephone keypad. For example, to obtain telemetry on channel 07 the operator should push 07 on the keypad. The RFC-1 will then speak "Channel 07" followed by the telemetry information for that channel. This would be either four digits of telemetry data or the words "Status: On" or "Status: Off." Telemetry information is spoken in three circumstances: 1) after the channel is changed, 2) after a control function is used, and 3) automatically when the telemetry data significantly (more than 10% of full scale) changes. The latter feature is very useful when you are waiting for some event to happen. For example suppose that the filaments of a transmitter had just been turned on and the plate voltage was turned on. When the plate voltage "On" command is given, the initial telemetry indication is "Status: Off" because the filament time delay has not had sufficient time to operate. With no further action by the operator, the RFC-1 will speak the plate voltage telemetry data when the plate voltage turns on. This feature is also useful for monitoring "variable" status sources such as the flashing of tower lights, for example.

When entering a two digit channel number, enter the second digit within 5 seconds of the first digit. Otherwise the RFC-1 will clear the first digit. This applies only when switching channels. The speed of digit entry in the programming modes is not restricted.

To simplify routine telemetry reading, the RFC-1 may be instructed to scan automatically all channels and report their telemetry values. To do this, push 64. The RFC-1 will respond with "OK" and then begin to read the telemetry values for all channels beginning at channel 00, at intervals of 5 seconds. The "autoscan" feature may be interrupted at any time by entering a channel number or programming function.

Operating the Control Relays

At any time during the telephone call, telemetry authorization can be upgraded to control authorization by pushing the code 66 on the telephone keypad. When this is done, the RFC-1 speaks "OK" and all control functions are then authorized for the remainder of the call. "Off" commands are sent by pushing the * key on the keypad and "On" commands are sent with the # key. The RFC-1 control channel and the telemetry channel are always the same. For example, suppose that a transmitter's plate voltage control and telemetry were assigned to channel 07 of the RFC-1. To obtain telemetry for plate voltage, the operator would push 07 on the keypad. To turn the plate voltage off, the operator would push * on the keypad. To turn it back on the operator would push #. The control functions for that channel can be operated as often as desired until a new channel is entered. Each time a control function is entered a new telemetry reading is made. All two-digit codes below 64 are assumed by the RFC-1 to be channel selections. If an unused channel is selected, the telemetry will be read as "Status: Off" and control actions will have no effect.

The control relays at the remote facility operate for as long as the * or # keys are pressed. If you want the control relay to operate for ten seconds, hold the appropriate key down for ten seconds. Also, it is important to remember that once control authorization is granted the * and # are "live" at all times. Pushing either of these keys will initiate a control function (if connected) for the last selected channel and therefore appropriate care should be exercised.

Control is enabled as soon as the channel is selected. It is not necessary to wait for the telemetry reading before a control action is made. This feature is useful when it is desired that a series of control actions be taken rapidly. For example, if it is desired to turn one transmitter off, switch an antenna relay and turn another transmitter on, the key sequence (01*08*05#, for example) can be initiated as rapidly as the operator's fingers can push the keys. It is not necessary to wait for the channel number or telemetry readings to be spoken.

The occasional user of the RFC-1 may have trouble remembering which key is the "on" key: the * or the #. An easy way to remember this is to think of the screen on a TV set. Think of "#" representing the set being "on" and "*" is what the screen looks like as it is turned "off." In other words, #=on and *=off.

Ending a Telemetry/Control Session

When a telemetry/control session is finished, push 99. The RFC-1 will speak "Goodbye" and then hang-up. Alternately, simply hang up the telephone and the RFC-1 will hang-up approximately 90 seconds later. The RFC-1 will automatically hang up whenever 90 seconds elapses without receiving a DTMF tone. The RFC-1 warns that this is about to happen by speaking "Goodbye" 5 seconds before it hangs up. If the operator wants to continue, any key must be pushed within the next five seconds. Because of the latter attribute, the only disadvantage in not using the 99 code is that it will take 90 seconds before the RFC-1 hangs up and frees the line for another call.

Alternate Operate Mode

In addition to the normal "operate mode" (66) discussed above for operation of the control functions, another operate mode is available for special purposes. This operating mode is preferred when the RFC-1 is used to put the remote operator "on the air." It is engaged by

pushing 67. When this mode is engaged, three operating characteristics are changed. First, the RFC-1 will not speak the channel number or telemetry when a channel is changed or controlled. Second, the hang-up timer is changed from 90 seconds to 74 minutes. Third, a hang-up detector is enabled that will cause the RFC-1 automatically to hang-up about 90 seconds after the remote telephone is hung-up. The operating mode may be changed from 66 to 67, or 67 to 66 at any time.

Telephone Alarm System (the basics)

The RFC-1 has a "telephone alarm" feature that allows it to originate telephone calls and report telemetry conditions that have departed from preset limits. Up to six channels can be designated for automatic monitoring. Two telephone numbers up to twelve digits each can be programmed for calling. Instructions for programming the various features of the telephone alarm system will be discussed in the "Programming Telephone Alarm Functions" section.

Any six channels can be programmed for monitoring and each channel has programmable 4 digit upper and lower trip points. The telephone alarm system is disabled while the RFC-1 is being used from either a remote telephone or the local telephone. This allows changes to be made without triggering an alarm sequence. About 15 seconds after each telemetry/control session, the channels designated for alarm monitoring are automatically scanned by the RFC-1 and the telemetry readings are noted. The readings for each channel fall into one of three categories:

1. Below the lower limit
2. Between the lower and upper limits
3. Above the upper limit.

The appropriate category for each alarm channel is then recorded in the microprocessor's memory. Afterward, at intervals of about 90 seconds, the alarm channels are rescanned and the telemetry categories are compared to the recorded telemetry categories. If a difference is detected, an alarm sequence is initiated.

Alarm Sequence

An alarm sequence begins with a call to the first telephone number. The RFC-1 then speaks its eight digit security code and the channel number responsible for tripping the alarm. The RFC-1 speaks this information, repeatedly, for 60 seconds and then hangs up. The unit then waits 60 seconds to allow for incoming calls, and then makes a 60 second call to the second telephone number, speaking the same information. This sequence repeats until both numbers have been called three times. When calling, the RFC-1 does not have the means to detect if a telephone call is answered. The call continues for 60 seconds even if the line is busy or if the line is not answered. The alarm sequence is terminated by any of three conditions:

1. If an alarm call is answered by an operator and the unit is operated. Operation of the unit can occur simply by entering any channel number or setting the operate mode (66 or 67). It is not necessary to enter the security code.
2. If an operator calls the unit during one of the pauses and enters the correct security code.
3. After the RFC-1 makes three calls to each telephone number.

When an alarm sequence is terminated (or 15 seconds after the call, if the alarm sequence is terminated during a call), the alarm channels are scanned and new telemetry categories are recorded. The RFC-1 then begins rescanning the alarm channels every 90 seconds.

Power Failure Alarm

To alert the remote operator that there has been a power failure at the remote site, the RFC-1 can be programmed automatically to initiate an alarm sequence 15 seconds after power is returned. When this happens, the channel number reported in the alarm call will be "85." If the RFC-1 is set to alarm on power failure and it is necessary temporarily to disconnect power to the unit, an alarm can be avoided by pushing the Local Control pushbutton within the first 15 seconds after power is reapplied.

Telephone Alarm System (the finer points)

The Telephone Alarm System can be thought of as a system that reports any change in conditions that existed at the end of the last telemetry/control session. This allows complete freedom of operation without the need for a complicated system of status checks and interlocks. It also greatly simplifies the setup and operation of the RFC-1. As an illustration of this, suppose that there is a site with a main and an auxiliary FM transmitter. Power output for each transmitter is telemetered on different channels and both channels are designated as Alarm Channels. During the last telemetry/control session the main transmitter was on and the auxiliary was off. Because the last recorded telemetry category for the auxiliary transmitter power output was made when it was off, this would not cause an alarm as long as it continued to be off. Now, suppose the main transmitter failed. The RFC-1 initiates an alarm call, an operator answers the call and after not being able to get the main transmitter back on, turns on the auxiliary. When this telemetry/control session ends, new telemetry categories for the alarm channels are recorded and are then checked every 90 seconds. Now, the telemetry category recorded for the main transmitter was made when it was off, so because it is off now will not cause an alarm. An alarm would be initiated, however, if the auxiliary transmitter were to fail.

This system is not without its limitations, however. For example, the application of power to the RFC-1 after a power interruption is treated exactly like the end of a telemetry/control session. Approximately 15 seconds after power is reapplied, the alarm channels are scanned (if the Telephone Alarm System is enabled) and new telemetry categories are recorded. If a transmitter went off when the power went off and did not come back on when power was restored, an alarm would not be reported since new reference readings were made with the transmitter off. This potential situation can be averted by instructing the RFC-1 to report all power failures. How to accomplish this is covered in the "Programming the Telephone Alarm System" section. Another solution is the use of the model UPS-1 Uninterruptable Power Supply, available from Sine Systems.

Switching transmitters or changing operating conditions by a means other than the RFC-1 (for example, direct manual control or control by another remote control operating in "parallel" with the RFC-1) will cause an alarm. The only way to avoid this is to disable the Telephone Alarm System in the RFC-1 temporarily while making the changes, or make the changes with the RFC-1 instead.

Keep in mind that the Telephone Alarm System is not instant in its operation. Since

Alarm Channels are scanned once every 90 seconds, if a transmitter happens to go off right after a scan, it will be almost 90 seconds before an alarm is initiated.

Once an alarm starts, the RFC-1 stops scanning the alarm channels and it makes no difference how the telemetry readings compare to the recorded category. The alarm will continue until six call attempts are made or until it is cancelled by an operator.

If the Telephone Alarm System is enabled, the RFC-1 will be unresponsive to pressing the Local Calibrate pushbutton during the 6 seconds or so that it takes to scan the alarm channels. This occurs about 15 seconds after power-up and at approximately 90 second intervals thereafter. Also, the "Local Calibrate" pushbutton will be unresponsive while an alarm call is being made.

When the RFC-1 makes an alarm call, it gives its security code and the channel number that caused the alarm. The reporting of the security code is to enable the site to be identified in cases where more than one RFC-1 could potentially call a particular telephone number.

The following example table of alarm channels will help to illustrate the full potential of the Telephone Alarm System and provide some practical ideas:

Channel	Upper Limit	Lower Limit
00	2040	1020
01	2040	1020
02	1100	0500
05	1030	0950
08	1482	1378
10	2040	1020
13	0490	0420

In this example, channel 00 is connected to a passive infrared motion sensor to form a simple and inexpensive intrusion alarm. When an authorized person enters the remote facility, they push the Local Calibrate pushbutton and turn the Telephone Alarm System off within 15 seconds of entry. Just before they leave, they turn the Telephone Alarm System back on and do not push 99 before they hang up the phone. This gives them an additional 90 seconds to leave the building before the Telephone Alarm System starts its scan. A passive infrared sensor is inexpensive (less than \$15) and can easily be modified for use with RFC-1 by paralleling a pair of wires across its relay coil (usually 12 VDC) and connecting them to a telemetry input. Full scale telemetry in the RFC-1 is 2040 so in the above example there are only two telemetry categories: above 1020 and below 1020.

Channel 01 in the above example is connected to an inexpensive smoke detector. Like the passive infrared detector, these are also easily modified for use with the RFC-1 and offer a lot of protection for very little cost (less than \$8).

Channel 02 is connected to a TM-1 Temperature Monitor module. The channel is programmed to trigger an alarm if the room temperature exceeds 110° or falls below 50°.

Channel 05 is set to monitor the power output of an FM transmitter with trip points set at 103% and 95%. Channel 08 monitors the antenna current of an AM transmitter. An alarm is triggered if the current exceeds 14.82 amperes or falls below 13.78 amperes.

Channel 10 is connected to a pair of auxiliary contacts on the AM antenna phasor. The pattern is automatically switched by an external timer and this provides a means automatically to call the operator as a verification that the antenna pattern has changed.

Channel 13 is connected to measure the AC voltage output of a diesel generator. The generator has a timer which runs it for 30 minutes each week. When it runs, the RFC-1 calls the remote operator and the test can be recorded as successful. Some generators have malfunction annunciators that can be connected to the RFC-1. The battery voltage, block temperature and fuel tank level can also be monitored.

Remember to inform all personnel that are likely to receive an alarm call from the RFC-1 about the meaning of the various alarm channels. A completely different response would be required depending on whether the FM power is a little high or the smoke alarm has gone off.

Some telemetry sources are nonlinear in operation. For example, most FM transmitter power output telemetry sources provide a DC voltage that is proportional to the RF line voltage which, in turn, is proportional to the square root of line power. In other words, if "1000" is calibrated to be 100% power, the telemetered reading at 105% power will be "1025." Keep this in mind when setting alarm limits. A little experimentation may be necessary to determine the desired alarm trip points.

Programming the RFC-1

All functions may be programmed either from the local telephone or from a remote telephone, with the exception of the Security Code. The Security Code can be programmed only from the local telephone.

Programming the Security Code

To program the Security Code, push 72 or "SC" on the telephone keypad. When this code is entered the RFC-1 responds with "Enter Eight Digit Security Code." The operator should then enter the eight digits of the desired security code. The RFC-1 will then respond with "OK" to indicate that the programming has been accepted. The security code can be changed only from the local telephone. If 72 is entered from a remote telephone, the RFC-1 will respond with "Error." If 72 is pushed by mistake and a programming change is not desired, push #.

Programming the Ring Number

To program the Ring Number (number of rings required before the RFC-1 answers the telephone), push 76 or "RN" on the telephone keypad. When this code is entered the RFC-1 responds with "Enter Two Digit Ring Number." The operator should then enter a number from 01 to 99 that corresponds to the desired number of rings before the RFC-1 answers the call. After two digits are entered, the RFC-1 responds with "OK" to indicate that the programming has been accepted. If "00" is entered for a Ring Number, "01" is automatically substituted. If 76 is pushed by mistake and a programming change is not desired, push #.

Software Version

To determine the software version contained in the RFC-1, push 78 or "SV" on the telephone keypad. When this code is entered the RFC-1 speaks the number of the software

version contained in its microprocessor.

Programming "Telephone Alarm Status"

The operation of the telephone alarm system is controlled by programming the "Telephone Alarm Status." To program the "Telephone Alarm Status," push **82** (TA) on the telephone keypad. The RFC-1 responds with, "Enter Two Digit Alarm Status." Push the desired two digit number. The RFC-1 will respond with "OK" to indicate that the programming has been accepted. The Telephone Alarm Status also controls the dedicated control port and can be programmed to any of the following six values:

- 00 Dedicated control port off, Telephone Alarm System off
- 01 Dedicated control port off, Telephone Alarm System on
- 02 Dedicated control port off, Telephone Alarm System on, auto alarm after power failure
- 10 Dedicated control port on, Telephone Alarm System off
- 11 Dedicated control port on, Telephone Alarm System on
- 12 Dedicated control port on, Telephone Alarm System on, auto alarm after power failure

As can be seen, the dedicated control port is controlled by the left digit and the telephone alarm system is controlled by the right digit. When the left digit is "0," the dedicated control port is turned off and when it is "1" the dedicated port is on. When the right digit is "0," the Telephone Alarm System is off. When it is "1" or "2," the Telephone Alarm System is on. When it is "2," the RFC-1 will automatically initiate an alarm calling sequence after a power outage and report the alarm channel as "85." If **82** is pushed by mistake and a programming change is not desired, push **#**.

When the dedicated control port is turned "on," the front panel modular jack labeled "Telephone" becomes usable as a full-time control/telemetry port. When enabled, this dedicated port may be used in place of the dial-up port ("LINE" jack) or in addition to it. Technical details of how to use this port are covered in "Section 5—Installation" in the Hardware Book.

Programming Telephone Numbers

To program the telephone numbers to be called for alarm notification, push **86** (TN) (Telephone Number "A") or **87** (Telephone Number "B") on the telephone keypad. The RFC-1 responds with, "Enter Twelve Digit Telephone Number." Twelve digits must then be entered. If the telephone number is shorter than twelve digits, fill in the extra digits with the ***** key (5552222 * * * * *). The ***** key can also be used as a 1 second pause. For example if the RFC-1 is connected to a PBX, the number "9 * * * * 5552222" could be programmed to allow a four second pause after the "9." After twelve key strokes are entered, the RFC-1 will respond with "OK" to indicate that the programming has been accepted. If is desired for only one telephone number to be called, program the same number in both locations. In this case the number will be called six times. If **86** or **87** is pushed by mistake and a programming change is not desired, push **#**.

Programming Telephone Alarm Channels

Up to six channels in a system can be designated as Alarm Channels. The designated

channels are stored by pushing 91, 92, 93, 94, 95, or 96 for "Alarm Channel A" through "Alarm Channel F" respectively. When one of these two digit codes is entered, the RFC-1 will respond with "Enter Two Digit Channel Number." The channel to be monitored should then be entered. The RFC-1 will then speak "Enter Four Digit Upper Limit." After entry of the four digit upper limit the RFC-1 will speak "Enter Four Digit Lower Limit." After the four digit lower limit is entered the RFC-1 speaks "OK" to signify that the programming has been accepted. Program unused alarm channels with 64. Any four digits can be entered for the upper and lower limits. If 91 through 96 is pushed by mistake and a programming change is not desired, push #.

Note that the telephone numbers and the alarm channel data can be preprogrammed if desired and the Telephone Alarm System can be turned off or on with the Telephone Alarm Status (82).

Summary Of Control Codes

- 00-63 Selects the desired channel for telemetry and control. Enter both digits within 5 seconds.
 - * "OFF" command for the currently selected channel. Unit must first be in operate mode.
 - # "ON" command for the currently selected channel. Unit must first be in operate mode.

 - 64 Autoscan telemetry on all channels. Interrupt with any key entry.

 - 66 (OM) Enters the operate mode. This enables the control (OFF/ON) functions for the remainder of the call.
 - 67 Alternate operate mode. Mutes channel/telemetry speaking, enables hang-up detection and changes hang up time from 90 seconds to 106 minutes. This mode cannot be entered from the local telephone.

 - 72 (SC) Used to enter a new security code. Enter 8 digits. This function is restricted to use from the local telephone only.

 - 76 (RN) Ring Number. Enter two digits (01-99). Number of rings required before the RFC-1 answers a call.

 - 78 (SV) Causes the RFC-1 to speak the software version residing in its microprocessor.

 - 82 (TA) Telephone Alarm Status. Enter one of the following two digit numbers:
 - 00 Dedicated control port off, Telephone Alarm System off
 - 01 Dedicated control port off, Telephone Alarm System on
 - 02 Dedicated control port off, Telephone Alarm System on, auto alarm after power failure.
 - 10 Dedicated control port on, Telephone Alarm System off
 - 11 Dedicated control port on, Telephone Alarm System on
 - 12 Dedicated control port on, Telephone Alarm System on, auto alarm after power failure.

 - 86 (TN) Telephone Number "A" called by the Telephone Alarm System. Enter 12 digits. Fill extra spaces with * (pause).
 - 87 Telephone Number "B" called by the Telephone Alarm System. Enter 12 digits. Fill extra spaces with * (pause).

 - 91 Alarm Channel A.
 - 92 Alarm Channel B.
 - 93 Alarm Channel C.
 - 94 Alarm Channel D.
 - 95 Alarm Channel E.
 - 96 Alarm Channel F.
- For all alarm channels, enter 2 digit channel number, four digit upper limit and four digit lower limit. If unused,

enter channel 64.

- 99 Causes the RFC-1 to say "Goodbye" and hang-up. Also answers call when in "Local" mode.

The entry of any other two digit codes causes the RFC-1 to speak "Error." Push # if any two-digit programming code is entered by accident and a programming change is not desired.

Programming Record/Factory Programming

It is suggested that a table be recorded of "normal" programming for the RFC-1. This serves not only as a reminder of the current programming but it also acts as a handy guide to remember how to change programming. Here is an example, which includes the data programmed initially at the factory:

	Factory Programming	Current Programming
72 Security Code	12345678	_____
76 Ring Number	04	_____
82 Telephone Alarm Status	00	_____
86 Telephone Number A	* * * * *	_____
87 Telephone Number B	* * * * *	_____
91 Alarm Channel A	64 / * * * * / * * * *	_____/_____/_____
92 Alarm Channel B	64 / * * * * / * * * *	_____/_____/_____
93 Alarm Channel C	64 / * * * * / * * * *	_____/_____/_____
94 Alarm Channel D	64 / * * * * / * * * *	_____/_____/_____
95 Alarm Channel E	64 / * * * * / * * * *	_____/_____/_____
96 Alarm Channel F	64 / * * * * / * * * *	_____/_____/_____

Channel Assignment Table

To allow efficient operation, a table of information should be kept at the normal control point that documents the various control and telemetry channels. The following is an example of such a table:

Channel:

- 00 Telemetry: FM Transmitter #1 Filaments
Scale: Status
Control: FM Transmitter #1 Filaments; *=OFF, #=ON
- 01 Telemetry: FM Transmitter #1 Plate Voltage
Scale: Multiply reading by 10 volts to obtain actual value
Control: FM Transmitter #1 Plate Voltage; *=OFF, #=ON
- 02 Telemetry: FM Transmitter #1 Plate Current
Scale: Divide reading by 100 amperes to obtain actual reading
Control: none

03 Telemetry: FM Transmitter #1 Power Output
Scale: 0948=minimum legal power, 1000=exact, 1024=maximum legal power
Control: FM Transmitter #1 Power Control; *=Lower, #=Raise

Recording Telemetry Data

This is an example of a table that might be used to record telemetry data:

Channel→	01	02	03	05	06	
Source→	FM#1 Plate V	FM#1 Plate A	FM#1 Power	FM#2 Plate V	FM#2 Plate A	F P
Time↓						
10.05A	0940	0410	1000			
11.55A	0941	0412	1005			
2.08P	0942	0413	1006			
4.05P	0941	0412	1004			
5.03P	0941	0412	1004			

Here, the data is recorded only as the four digits spoken by the RFC-1. A separate table of multipliers and units for each column can be included at a single location in the log book. This makes routine data collection a very simple operation with no decimal points, multipliers or units to record.

Local Operation

Local operation of the RFC-1 is identical with remote operation except for the following: The operator should push the "Local Control" pushbutton located behind the small hole on the right-hand end of the RP-8 relay panels. This can be pushed with a pencil point or the screwdriver used for telemetry calibration. When pushed, the RFC-1 switches to the local telephone and speaks "OK." The system is now entered just past the point where the security code would have been entered if remote operation were taking place. In other words, it is not necessary to enter the security code. Telemetry authorization is available immediately and control authorization can be obtained by pushing 66. Operate mode 67 cannot be entered from the local telephone. All the codes and restrictions discussed in the "Remote Operation" section will be in effect.

If the RFC-1 is in the local control mode and an incoming call occurs, the RFC-1 will speak "Ring—Ring—Ring" when the line is ringing. To answer the call, push 99. The RFC-1 will say "good-bye" and five seconds later will connect the local telephone with the telephone line to answer the call.

The most common use for the local control mode will be the calibration of the telemetry channels. Here is a suggestion to make this a little easier. First, do not enter the Operate Mode (66). After a channel is selected, it will then be possible to repeat the telemetry reading by simply pushing one key: * or #. The RFC-1 will speak "Error" each time as a reminder that it is not in the control mode but it will follow with the telemetry reading.

The RFC-1 has a full scale telemetry value of "2040" so if you are telemetering "17.46 amps," for example, you'll probably want to set the RFC-1 to read "1746." If, however, you are

telemetrying "22.3 amperes," you'll need to set the RFC-1 to "0223." Always take advantage of as much of the scale reading as possible. For example, if you use "0100" as a calibration for "100% power," you are only using the bottom 5% of the scale and only 1% resolution will result. If you use "1000" as a calibration, 0.1% resolution is obtained and the long term accuracy will be enhanced.

Operation From A Dedicated Communications Link

In addition to being operable from a dial-up telephone line, the RFC-1 also may be operated from a non-dial-up communications link such as a dedicated line, a two way radio, a pager, an STL/SCA link, etc. This additional control method may be used in place of a dial-up line or, in addition to a dial-up line, for the purposes of an alternate or back-up control and monitoring means. Electrical details are contained in "Section 5—Installation" in the Hardware Book. The port used for the dedicated communications link is the modular jack on the front panel of the RFC-1 labeled "TELEPHONE." This is a dual-purpose jack. If the left digit of the Telephone Alarm Status is programmed as "0" the "TELEPHONE" jack can be connected to a local telephone for ordinary use and for local control and telemetry calibration as described in the above "Local Operation" section. When the left digit of the Telephone Alarm Status is programmed as "1" the "TELEPHONE" jack becomes a continuously active "dedicated control port." This jack can be used in place of the dial-up port ("LINE" jack) or both ports can be used. The dedicated control port may be used in a number of different ways and the operational details will be determined by the communications system used and the particulars of the installation. When any DTMF tone is received at the dedicated control port, the RFC-1 switches to the "dedicated control mode" that is identical to the local control mode described in the previous section. The RFC-1 will stay in the dedicated control mode until 90 seconds elapses without the reception of a DTMF tone or until the operator pushes 99. Just before the RFC-1 leaves the dedicated control mode it speaks "good-bye" on the dedicated control port. When the RFC-1 is in the dedicated control mode, the RFC-1 will not automatically answer an incoming telephone call (on the "LINE" jack) but it will speak "Ring—Ring—Ring" on the dedicated control port as an indication that the line is ringing.

Operation of the RFC-1 from the dedicated control port is identical to operation in the "Local Control" mode. It is not necessary first to enter the security code. It is necessary to enter 66 (the operate mode) to enable control functions during the current session. Fifteen seconds after the end of each dedicated control mode session, new telemetry values are automatically read by the RFC-1 if the Telephone Alarm System is enabled. Remember that the dedicated control mode will be entered with the presence of any DTMF tones at the dedicated control port, so spurious DTMF tones, or DTMF tones used for other purposes should not appear at this port. The RFC-1's speech synthesizer is active on the dedicated control port at all times and telemetry readings will be spoken as the RFC-1 makes the initial measurements for the Telephone Alarm System, as well as for subsequent scans about every 90 seconds.

"Quick Card"

To save time and avoid the pressure of trying to remember the control codes in an emergency, it is suggested that a "Quick Card" be prepared and carried by key operating personnel. Such a card could be plastic laminated for durability. Here is an example of what could be included on the card:

(615) 228-7387 [Enter]	00	FM 1; Fils; off/on
12345678 [OK] 66 [OK]	01	FM 1; Plate Volts; off/on
	02	FM 1; Plate Amps
64 Autoscan	03	FM 1; Power; lower/raise
66 Operate Mode	04	FM 2; Fils; off/on
76 Ring Number	05	FM 2; Plate Volts; off/on
82 Tel. Alarm Status	06	FM 2; Plate Amps
00=off	07	FM 2; Power; lower/raise
01= on	08	Ant. Relay; FM2* / FM1#
02=on w/power fail alarm	09	Building Power
86 Telephone Number A	10	Generator; manual off/on
87 Telephone Number B		(all; off=*, on=#)
91 Alarm Chan. A		To switch from FM1 to FM2:
\		01* 08* 04# 05#
96 Alarm Chan. F		To switch from FM2 to FM1:
(chan. # or 64)		05* 08# 00# 01#

Section 12 — Exceptions for Software Version 2.08

Software version 3.07 for the Sine Systems RFC-1/B Remote Facilities Controller was released in December, 1990 and is suitable for use with RFC-1/B hardware versions 1.99 and later. The software resides in the unit's microprocessor and determines all the RFC-1/B's operating characteristics. Software version 2.08 was created to update RFC-1/B hardware versions 1.05 and earlier (manufactured prior to August 21, 1990), and is very similar to version 3.07. However, because of the slightly different electrical characteristics of the earlier hardware versions, not all the features of 3.07 could be included in 2.08. The following are the features discussed in this manual which are different in software version 2.08.

1. When in the Local Control mode, the RFC-1/B will not speak "Ring-Ring-Ring" as an indication that someone is calling on the telephone line.
2. In the alternate operate mode (67) the RFC-1/B has no automatic hang-up detection. As a result, when using this mode the operator should always remember to push 99 before hanging-up or switch to operate mode 66. Otherwise, the unit will stay off-hook for 74 minutes before releasing the line. This only applies to operate mode 67, not to the normal operate mode, 66. As a further precaution, the "67" operate mode is enabled only if Alarm Channel F is programmed to "67." If Alarm Channel F is not programmed to "67," pushing "67" will cause the RFC-1 to speak "Error."
3. With hardware versions 1.99 and later, both the dial-up port and the dedicated control port can be activated for use at the same time (although they may not actually be used concurrently). In hardware versions 1.05 and earlier, it is an "either or" situation. The dial-up port can be activated (this is the normal case) or the dedicated port can be activated, but they cannot be used together. In hardware versions 1.05 and earlier, if the dedicated control port is activated, the RFC-1/B will not respond to a telephone call on the dial-up port. Because of this, an interlock has been added to software version 2.08 which prevents the operator from turning on the dedicated port from a remote telephone. If the left digit of the Telephone Alarm Status is attempted to be programmed "1" from a remote telephone, the RFC-1 will speak "Error" and wait for a two digit number that begins with "0." The operator should then enter the Telephone Alarm Status as 00, 01 or 02. The dedicated control port can be activated only from the local telephone.

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