

Sensaphone® SCADA 3000
ENGINEERING SPECIFICATIONS
(02/13/2001)

I. General

The SCADA/RTU shall be a self-contained microprocessor controlled system capable of monitoring 16 input channels and controlling 8 output channels. The system shall be expandable such that additional inputs and/or outputs may be added to extend the total number to 144 I/O points. The system shall be integrated in construction and shall be installed and configured for operation by the user via Microsoft Windows™ compatible software provided at no charge. Input channels shall be capable of monitoring analog or digital signals utilizing 12-bit resolution. Output channels shall be capable of switching 2A at 125VAC using mechanical latching relays.

The system shall be capable of executing control programs created using ladder logic and/or C-programming. Such programs shall be created, compiled, and downloaded using the software provided. Process control may also be maintained using 8 PID (proportional-integral-derivative) algorithms.

The system shall have two RS-232 communication ports for direct connection to a PC, radio modem or other wireless device. A telephone interface shall be included for phone line communications. A line-seizing telephone extension jack shall also be provided. Options for 33.6Kbps phone line modem and user-recordable voice messaging shall be available. The system shall be capable of communicating to the host PC using standard radio modems or standard phone lines.

Phone Line Operation

The system shall be capable of initiating and receiving telephone calls over the public switched telephone network. Calls shall be initiated for the purpose of delivering alarm messages and sending reports. Calls shall be received to allow on-line data programming via modem or to receive voice articulated status reports.

The system shall be capable of monitoring up to 64 points for alarm purposes. Upon detection of any alarm or status change, the system shall commence dialing up to 64 telephone numbers from a list associated with the particular alarm condition(s) or combination thereof, and deliver the alarm message via a custom voice message, Fax, E-mail, modem, numeric pager or alphanumeric pager. The voice alarm message (voice option required) shall be delivered in digitized human voice using messages recorded by the user. The modem option must be installed to receive messages via Fax, modem, E-mail and alphanumeric pager. The system will continue to call telephone numbers in succession until a positive acknowledgment of the alarm message is received. Acknowledgment can be accomplished from a voice phone call, a modem phone call, or by a callback from either a touch-tone telephone or a computer with modem. Upon answering, the system shall recite a short message and wait for a response. If no response is received a data connection will be attempted. If a connection is made the system shall allow remote access to programming and operation. If a data connection is not made, the system shall recite a voice status report and allow access to remote voice message programming.

The system shall be capable of data logging inputs, outputs, calculated values, and variables. I/O on expansion modules may also be logged. The stored data can be downloaded manually or delivered as reports automatically. Reports can be delivered via phone modem to the host PC, to fax machines, or via E-mail.

Radio Modem (wireless) Operation

The system shall be capable of communicating to a host computer via radio modem using Sensaphone® SCADA 3000 programming software. Up to 247 units may be used simultaneously on a wireless net-

work. The Sensaphone® SCADA 3000 programming software shall allow full programming access to all units on the network. The host computer shall poll each unit on a continuous basis to retrieve requested I/O, alarm, and diagnostic information.

The Sensaphone® SCADA 3000 programming software shall be capable of monitoring up to 64 points from any unit on the network for alarm purposes. Upon detection of any alarm or status change, the software shall commence dialing up to 64 telephone numbers from a list associated with the particular alarm condition(s) or combination thereof, and deliver the alarm message via a custom voice message, Fax, E-mail, modem, numeric pager, or alphanumeric pager. The host PC must be equipped with a Data/Fax/Voice modem, soundcard, microphone, and speakers. The voice alarm message shall be delivered in digitized human voice using messages recorded by the user. The system will continue to call telephone numbers in succession until a positive acknowledgment of the alarm message is received. Acknowledgment can be accomplished by entering a touch-tone code.

The Sensaphone® SCADA 3000 programming software shall be capable of data logging inputs, outputs, calculated values, and variables from any unit on the wireless network. I/O on expansion modules may also be logged.

The system shall be FCC Part 15 Class A approved and FCC Part 68 registered for direct connection to the telephone network. The RTU and software shall be Year 2000 Compliant. The system shall have a three year warranty from the manufacturer. The system shall be a Sensaphone® SCADA 3000 by Sensaphone, Inc.

II. I/O Channel Attributes and Features

A. Inputs

The system shall come standard with 16 universal input channels. The input resolution shall be 12-bit with scalable lookup tables. All analog input values shall read to two decimal places. All input channels shall be user-configurable as:

1. NO or NC digital dry contact, using 0.5mA loop current
2. 4-20mA analog, using custom look up table
3. 0-5V analog, using custom look up table
4. Temperature from thermistor, using 10K devices
5. Run time accumulator

All input channels shall allow local and remote data programming of pertinent operational data including, but not limited to:

1. Input name
2. Input type (NO/NC, 4-20mA and 0-5V analog, 10K thermistor, run time)
3. Units of measure (degrees F, degrees C, inches, feet, psi, volts, amps, pounds, gallons, and custom)
4. Table low and table high set-points
5. Calibration factor

Expansion modules shall be available to provide additional inputs to the system. Three different modules shall be provided to facilitate the use of a variety of sensors:

1. Universal Input Module - An 8 channel module compatible with dry contacts, 4-20mA transducers, 0-5V transducers and 10K thermistors. Input resolution shall be 12-bit.
2. Pulse Count Module - A 4 channel module compatible with dry contact pulsed-output transducers. The maximum pulse frequency shall be 10.8KHz
3. Thermocouple Module - A 4 channel module compatible with E, J, K, T, S and R type thermocouples. Temperature values shall be available in degrees Fahrenheit and degrees Celsius.

B. Outputs

The system shall come standard with 8 latching SPST relay outputs. Each output shall be capable of switching 2A at 125VAC. All output channels shall be capable of being controlled automatically via Ladder Logic or C-Program. Output channels may also be forced on or off via the Sensaphone® SCADA 3000 programming software.

Expansion modules shall be available to provide additional outputs to the system. Three different modules shall be provided:

1. Relay Output Module - An 8 channel module that provides 8 latching relay outputs. The relays shall be rated at 2A @125VAC. LED indicators shall be provided for each output.
2. Analog Output Module - A 4 channel module that provides output signals configurable as 4-20mA, 0-20mA, or 0-10V. Each output signal shall have 12-bit resolution, scalable tables, internally sourced power, and 1000 Ohm drive capability (mA mode only).
3. Annunciator Module - A module providing 8 LED indicators to display the status of assigned I/O points.

C. Alarms

The system shall allow any addressable point to be monitored and used as the source of an alarm. Addressable points include inputs, outputs, timers, counters, ladder bits, ladder variables, C variables, and diagnostic parameters. All alarm channels shall allow local and remote data programming of pertinent operational data including but not limited to:

1. Alarm name
2. Alarm source
3. Alarm type
4. High and Low limits
5. Input recognition time
6. Alarm reset time
7. Alarm call list for each channel
8. Enable/Disable for each channel to dial out for alarm
9. Custom voice message enable/disable & voice message number

III. Communications Features

A. Telephone Communications

1. Communication Methods

The system shall be able to communicate alarms and other status information using the following methods.

Voice option installed:

- a. Custom voice message
- b. Numeric pager

Modem option installed:

- a. Fax
- b. Modem
- c. Alphanumeric pager
- d. Internet E-mail

2. Telephone Specifications

The system shall connect to a standard analog 2-wire telephone line using pulse or tone dialing methods, with loop start only. The system shall recognize ringer frequencies from 16 to 60 Hz. No leased or dedicated lines shall be required. Call progress detection shall ensure that the alarm dial out is not hindered by no-answers or busy signals.

3. Line Seizure Feature

The system shall automatically seize control of the phone line to make an alarm phone call when the alarm occurs. All other calls, including current calls, will disconnect and all extensions will be disabled. Extensions will remain cut off until the alarm is acknowledged.

4. Destinations (Telephone Numbers and E-mail Addresses)

The system shall be capable of contacting up to 64 destinations (64 digit telephone numbers /64 character E-mail addresses). There shall be a provision to group the destinations into multiple lists to create calling schedules based on weekdays, weeknights and weekends. In addition, individual alarms may be programmed to contact specific destinations.

5. Voice Messages (optional)

The System shall have the ability to record, store and reproduce up to 64 voice messages and to use those messages to articulate the location and status of the monitored channels. In the absence of user-recorded voice messages, the system shall articulate channel status using the internally resident vocabulary. All digitized speech message data shall be stored in nonvolatile memory. Such nonvolatile memory shall be capable of protecting speech memory for at least 10 years of complete power outage. There shall be one recorded identification message for the system. Message length shall be 3.6 seconds per input and 7 seconds for system identification. A programming option shall be available to double the message length by reducing the total number of messages to 32.

B. Radio Modem (Wireless) Communications

The host computer running Sensaphone® SCADA 3000 programming software shall continuously poll each RTU in the network and retrieve I/O information when connected to a radio modem. The host computer shall use standard modbus RTU protocol and shall operate as the modbus master. The SCADA 3000 RTUs shall operate as modbus slave devices. When configured with a Data/Fax/Voice modem the host computer shall have the capability to send alarms.

1. Communications Interface

The system shall have two built-in DB9 RS-232 serial ports, one DTE and one DCE, for the purpose of local communication and programming via computer or via radio modem.

2. Destinations (Telephone Numbers and E-mail Addresses)

The host computer shall be capable of contacting up to 64 destinations (64 digit telephone numbers /64 character E-mail addresses) to deliver alarm messages or reports. There shall be a provision to group the destinations into multiple lists to create calling schedules based on weekdays, weeknights and weekends. In addition, individual alarms may be programmed to contact specific destinations. The host computer shall be capable of providing message information via voice, pager, alphanumeric pager, fax, and e-mail.

3. Voice Messages

The Sensaphone® SCADA 3000 programming software shall have the ability to record, store and reproduce up to 64 voice messages and to use those messages to articulate the description and status of monitored channels on the network. In the absence of user-recorded voice messages, the system shall articulate channel status using the internally resident vocabulary.

IV. Programming

A. Local Programming

The System shall have a built-in RS-232 port for the purpose of locally programming all system data using an IBM PC or compatible computer with Microsoft Windows® 95, 98, NT, or 2000, and Sensaphone® SCADA 3000 programming software (included). All operational data, system setup, and configuration data, and all information regarding the status of monitored input channels shall be accessible. In addition, voice messages may be recorded and reviewed using a standard touch-tone telephone connected to the Voice Port jack.

B. Remote Programming

The system shall be capable of remote communication via the optional 33.6Kbps modem or via radio modem connected to one of the RS-232 ports for the purpose of programming and communicating all system, configuration, and input/output data. An IBM PC or compatible computer with modem or radio modem, Microsoft Windows® 95, 98, NT, or 2000, and Sensaphone® SCADA 3000 programming software shall be required. A user-programmable security password shall protect the system from unauthorized tampering. Voice messages may be recorded or reviewed via a phone call using a standard touch-tone telephone.

V. Programming Software

A. General

The system shall come standard with fully integrated programming software specifically created to perform system programming, data acquisition, monitoring, and control. The software shall run on IBM PC or compatible computers under Microsoft Windows® 95, 98, NT, or 2000 operating systems. The software shall provide a graphical user interface to program and display all pertinent operational parameters including but not limited to: system configuration, I/O programming, polling, data-logging, and alarming. The software shall also include the ability to build control programs using a built-in C-Program editor and ladder program editor. While on-line with the SCADA 3000 the user shall have the ability to edit, compile, upload, and start control programs. A screen editor shall also be included to create dynamic graphical displays capable of showing the value of selected process parameters in real-time. The software shall be capable of communicating with multiple units simultaneously via phone line modem, radio modem, or local RS-232 serial port. The software shall be Year 2000 Compliant.

The software shall be capable of operating on a minimum configuration of:

- 100Mhz Pentium personal computer
- 32MB of RAM
- 20MB of free hard disk space
- 2MB of video memory
- CD-ROM drive or 1.44MB floppy drive
- Mouse
- 33.6Kbps Phone modem or radio modem

The system shall be provided with complete user documentation, including programming examples. On-line "Help" files shall also be included to provide additional programming assistance and reference information.

The software shall support serial communications with as many as 5 serial ports simultaneously. Communications devices may consist of phone modems, radio modems, or direct serial connections.

Each serial port shall have the following programmable communications parameters: enable/disable, baud rate, packet retries, retry delay, and packet timeout.

B. Custom Features

The software shall provide a method to create custom screens to display and control process parameters in real-time. Multiple custom screens may be created to provide different views, group different sets of information, or to accommodate multiple user preferences. Each custom screen may be stored on the system disk drive for later retrieval. There shall be no limit (other than physical hard disk space) to the number of screens the user may create. The screen editor shall provide the following drawing tools and/or image libraries:

- Distributed Control Program

- Labels - static & dynamic

- I/O values

- Shapes - lines, arrows, images

- Gauges - angular , bar

- Vessels - tank, distillation tower, jacketed vessel, reactor, atmospheric tank, bin, weigh hopper

- Electrical - circuit breaker, contactor, delta connection, wye connection, fuse, motor, transformer

- Filter - liquid filter, vacuum filter

- Heat transfer - exchanger, furnace, rotary kiln

- HVAC - cooling tower, evaporator, finned exchanger

- Material Handling - conveyor, mill, roll stand, rotary feeder, screw conveyor

- Mixing - agitator, inline mixer

- Reciprocating - reciprocating compressor

- Rotating - blower, compressor, pump, turbine

- Scrubbers - electrostatic precipitator, scrubber

- Separators - cyclone separator, rotary separator, spray dryer

- Valves - actuator, throttling actuator, valve, 3-way valve, butterfly valve, check valve, relief valve

In addition to these libraries the editor shall also allow the importation of bit-map objects. Once imported these images will be treated as a single object.

The screen editor shall allow certain elements to dynamically update. A property editor shall be used to assign I/O information to dynamically alterable elements. Programmable properties shall include:

- Data Source

- Position

- Height

- Width

- Fill color

C. Distributed Control Program

The software shall provide the ability to create and execute a Distributed Control Program. The program shall be integrated into the Real-time screen from which it can be started and stopped. The Distributed Control Program will allow the user to read I/O values from multiple SCADA 3000 units, execute program logic, and write to I/O values. The Distributed Control program shall be written in the Visual Basic script language. All I/O points used in the distributed control program shall be refer-

enced on the Real-time screen. The Distributed Control Program shall typically be used when multiple units are connected via a radio network and information must be shared to allow intelligent control among multiple units.

D. PC Alarm Dialout

The software shall provide the ability to deliver alarm messages from the host computer for SCADA 3000 units online via a radio network. The PC Alarm Dialout program shall have the capability to deliver alarm messages via voice, fax, pager, alphanumeric pager, and email. The software shall be capable of delivering alarm messages to multiple destinations and shall also receive user acknowledgement via touch-tone telephone. The PC Alarm Dialout program shall require a Diamond SupraExpress Speakerphone modem and Soundcard in the host computer.

E. Programming Options

The software shall provide fill-in menus to program all parameters of system features including but not to: system programming, I/O parameters, alarm monitoring, destination programming, datalogging, reporting, LCD programming, voice programming, and PID programming.

1. System Programming

The system programming shall entail general parameters that are global in nature. The system programming information shall encompass the following parameters:

Unit Name	Maximum calling rounds
Unit Phone Number	Voice repetitions
Slave Address	Alphanumeric page speed
Date & Time	Rings till answer
Daylight savings compensation	Carrier wait time
Dialing method	On-line timeout

2. I/O Programming

The inputs and outputs shall be configurable to support a variety of sensors. Engineering units may be configured to simplify usage. Programming screens shall automatically display pertinent parameters for any type of I/O module connected to the system. The I/O programming information shall consist of the following parameters:

I/O Name	Table High value
I/O type	Calibration or offset
Units of measure	Forced status
Table Low value	

3. Alarm Programming

The system shall be capable of monitoring any addressable parameter in the unit. Up to 64 alarms may be programmed. Custom voice messages may be assigned to individual alarms. The alarm monitoring information shall consist of the following parameters:

Alarm name	Low limit
Enable/disable	Recognition time
Alarm type	Reset time
Source address	Voice Message assignment
High limit	Call list

4. Destination Programming

The software shall be capable of configuring up to 64 destinations for alarm and reporting purposes. The destination programming information shall consist of the following parameters:

Destination name	Alarm call mode
Phone number/E-mail address	Dial type
Call zone selection	Intercall delay
Call zone configuration	Report enable/disable

5. Data Logger Programming

The software shall be capable of configuring the system Data Logger. It shall also provide the ability to retrieve, store, display, graph, and export data for each unit in the database. The data logging programming information shall consist of the following parameters:

Enable/disable	I/O selection
Datalog interval	Data query
Next log time	Data export

6. Report Programming

The software shall be capable of configuring the RTU to send event log and data log reports. The report programming information shall consist of the following parameters:

Enable/disable data log	Number of Event Log records
Enable/disable event log	Next report time
Number of Data Log records	Report Interval

7. LCD Programming

The software shall be capable of configuring the LCD display. The LCD programming information shall consist of selecting I/O points or process variables to be displayed on the scrolling LCD from a pull down menu.

8. Status Report & Custom Voice Programming

The software shall be capable of configuring voice related functions. These functions include message assignments, status reports, and voice-mode password programming. The voice programming information shall consist of the following parameters:

32/64 voice message selection	Recite main power in status report
Use password for incoming telephone call	Recite current consumption in status report
Use password for local voice port	Recite configured status messages
Recite ID phone number	Recite Battery voltage
Recite custom ID message	Recite ladder program run status
Speak canned with custom messages	Recite C-Program run status
Alarm type selection in status report	Text description of message
I/O & variable selection in status report	I/O & variable custom message assignment

9. PID Programming

The software shall be capable of configuring up to eight PID algorithms. Each algorithm shall run independently. The PID programming information shall consist of the following parameters:

PID text description	Constant/variable gain factor selection
Enable/disable	Proportional gain factor/address
Source input address	Integral gain factor/address
Control variable output address	Derivative gain factor/address
Output limit enable/disable	Target set point
High limit	Reload time
Low limit	Dead zone

10. Event & Data Log Polling

The software shall be capable of polling units via telephone connection to automatically retrieve and store data logger and/or event log information on a central computer. The software shall allow individual scheduled polling times to be selected for any unit. The downloaded information may be queried at any time on the host computer.

11. Web Status Programming

The Software shall be capable of polling units via telephone, serial port, or radio modem to automatically retrieve the values of selected I/O points and/or alarms and create a web page for each unit. The software shall automatically upload the web page to an internet server immediately following each poll. The software shall allow scheduled polling times to be programmed for each unit. The host PC shall be required to have internet access. Storage space on a web server which supports FTP shall also be required.

12. E-mail Server Programming

The software shall be capable of functioning as an e-mail server for the purpose of receiving e-mail calls via telephone and forwarding e-mail messages via the internet, from one or more units. The host PC shall be required to have internet access.

13. C-Program Editor

The software shall provide the capability to edit, upload, download, syntax check, compile and start a C-Program. The C editor shall provide typical text editor features such as cut, copy, paste, undo, save, and load. Additional features include pull-down menus to select I/O and variable addresses for insertion into the control program.

14. Ladder Logic Programming

The software shall provide the capability to edit, syntax check, compile, upload, and start a ladder logic program. The software shall also provide the capability to monitor ladder program execution such that instructions will highlight on the computer monitor as they are executed in real-time. Counter and timer values shall also be displayed as the program executes. The software shall allow ladder programs to be saved and loaded on the host computer. In addition, the ladder program shall provide fields to store the program name, author, compile date, and a brief program description that shall be stored in the RTU.

VI. Control Features

A. Ladder Logic

The system shall provide the ability to execute a ladder logic program developed using the Sensaphone® SCADA 3000 programming software. The ladder logic commands supported include: XIC, XIO, OSR, OTE, OTL, OTU, TON, TOF, RTO, CTU, CTD, RES, EQU, NEQ, LES, LEQ, GRT, GEQ, ADD, SUB, MUL, DIV & MOV. The system shall be capable of executing a maximum compiled program size of 32K. The unit shall support floating point mathematical operations. Up to 128 floating point variables may be defined. In addition, up to 4096 bit variables may be defined. All instruction and variable values shall be addressable within other parts of the SCADA 3000 including but not limited to the C-Program, LCD display, Alarm functions, PID calculations, Voice reports, and Data Logger. Specific ladder parameters may be overridden on-the-fly to facilitate program testing and system tuning. These parameters include: Ladder variables, ladder bits, timer values/status bits, and counter values/status bits. A brief description of the supported Ladder instructions, execution time, memory usage, and addressable data sources is listed below:

Examine if closed (XIC) - This instruction determines if a contact has closed or if a bit is on. The instruction executes in 2.8 μ s and takes up 24 bytes. The instruction may use addresses from I/O points, timer bits, counter bits, bit variables, C variables, and alarms.

Examine if Open (XIO) - This instruction determines if a contact has opened or if a bit is off. The instruction executes in 2.8 μ s and takes up 24 bytes. The instruction may use addresses from I/O points, timer bits, counter bits, bit variables, C variables, and alarms.

One Shot Rising (OSR) - This instruction will cause event to occur once when rung conditions go false to true. The instruction executes in 3.5 μ s and takes up 44 bytes. The instruction may use addresses from bit variables and C variables.

Output Energize (OTE) - This instruction turns on an output or a bit when rung conditions are true. The instruction executes in 3.1 μ s and takes up 38 bytes. The instruction may use addresses from Outputs, bit variables, C variables, and alarms.

Output Latch (OTL) - This instruction latches an output on or a bit on when rung conditions are true. The instruction executes in 3.1 μ s and takes up 42 bytes. The instruction may use addresses from Outputs, bit variables, C variables, and alarms.

Output Unlatch (OTU) - This instruction turns off an output or a bit when rung conditions are true. The instruction executes in 3.1 μ s and takes up 42 bytes. The instruction may use addresses from Outputs, bit variables, and C variables.

Timer On Delay (TON) - This instruction provides a programmable timer which starts when rung conditions become true and sets an output when the timer has expired. The instruction includes timer enabled, running and done bits. The system supports 64 timers. The instruction executes in 4.5 μ s and takes up 84 bytes.

Timer Off Delay (TOF) - This instruction provides a programmable timer which starts when rung conditions become false and clears an output when the timer has expired. The instruction includes timer enabled, running and done bits. The system supports 64 timers. The instruction executes in 4.5 μ s and takes up 84 bytes.

Retentive Timer (RTO) - This instruction provides a programmable timer which starts when rung conditions become true and sets an output when the timer has expired. The timer retains its value even when rung conditions become false. The instruction includes timer enabled, running and done bits. The system supports 64 timers. The instruction executes in 4.5 μ s and takes up 84 bytes.

Count Up Counter (CTU) - This instruction increments a counter and sets an output when a preset value is met. The instruction includes counter enabled, done and overflow bits. The system supports 64 counters. The instruction executes in 5.7 μ s and takes up 176 bytes.

Count Down Counter (CTD) - This instruction decrements a counter and sets an output when a preset value is met. The instruction includes counter enabled, done and underflow bits. The system supports 64 counters. The instruction executes in 5.7 μ s and takes up 176 bytes.

Reset (RES) - This instruction resets the accumulated values and status bits of the addressed timer or counter. It can also be used to reset addressed pulse count values, run time values, and alarms. The instruction executes in 2.5 μ s and takes up 22 bytes. The instruction may use addresses from Inputs, Timers, Counters, and alarms.

Move (MOV) - This instruction moves a value from one location to another. The source value can be an input, output, timer, counter, ladder variable, C variable or constant. The destination value can be an input, output, timer, counter, ladder variable, or C Variable. The instruction executes in 2.9 μ s and takes up 44 bytes.

Equal (EQU) - This instruction compares two values to see if they are equal. The instruction executes in 15 μ s and takes up 44 bytes. The instruction may use addresses from I/O points, timers, counters, ladder variables, and C variables.

Not Equal (NEQ) - This instruction compares two values to see if they are not equal. The instruction executes in 15 μ s and takes up 44 bytes. The instruction may use addresses from I/O points, timers, counters, ladder variables, and C variables.

Less Than (LES) - This instruction compares two values to see if one is less than the other. The instruction executes in 15 μ s and takes up 44 bytes. The instruction may use addresses from I/O points, timers, counters, ladder variables, and C variables.

Less Than or Equal (LEQ) - This instruction compares two values to see if one is less than or equal to the other. The instruction executes in 15 μ s and takes up 44 bytes. The instruction may use addresses from I/O points, timers, counters, ladder variables, and C variables.

Greater Than (GRT) - This instruction compares two values to see if one is greater than the other. The instruction executes in 15 μ s and takes up 44 bytes. The instruction may use addresses from I/O points, timers, counters, ladder variables, and C variables.

Greater Than or Equal (GEQ) - This instruction compares two values to see if one is greater than or equal to the other. The instruction executes in 15 μ s and takes up 44 bytes. The instruction may use addresses from I/O points, timers, counters, ladder variables, and C variables.

Addition (ADD) - This instruction adds two values. The operands may be inputs, outputs, timers, counters, ladder variables, C variables, or constants. The result may be written to an analog output, ladder variable, or C Variable. The instruction executes in 15 μ s and takes up 68 bytes.

Subtraction (SUB) - This instruction subtracts one values from another. The operands may be inputs, outputs, timers, counters, ladder variables, C variables or constants. The result may be written to an analog output, ladder variable, or C Variable. The instruction executes in 15 μ s and takes up 58 bytes.

Multiplication (MULT) - This instruction multiplies two values. The operands may be inputs, outputs, timers, counters, ladder variables, C variables or constants. The result may be written to an analog output, ladder variable, or C Variable. The instruction executes in 15 μ s and takes up 68 bytes.

Division (DIV) - This instruction divides one value by another. The operands may be inputs, outputs, timers, counters, ladder variables, C variables or constants. The result may be written to an analog output, ladder variable, or C Variable. The instruction executes in 15 μ s and takes up 80 bytes.

Power (POW) - This instruction raises a value to a power. The operands may be inputs, outputs, timers, counters, ladder variables, C variables or constants. The result may be written to an analog output, ladder variable, or C variable. The instruction executes in 45 μ s and requires 114 bytes.

B. C-Program

The system shall provide the ability to execute a C-Program developed using the Sensaphone® SCADA 3000 programming software. The system shall be capable of executing a maximum program size of 32K of source code. Up to 1024 floating point variables may be defined. Variables may be defined as either integer, character, or floating point types. The C-Program may be set to run synchronously or asynchronously. In synchronous mode, the inputs are scanned before the program starts, and the outputs will not update until the C-Program has finished executing. If a ladder program is also running, then the C-Program will execute immediately after the ladder program in a synchronized fashion. Also the outputs will not update until both programs run to completion. In asynchronous mode, the C-Program runs independent of the ladder program on its own time interval. In this case, the inputs and outputs are updated on the fly as changes occur during program execution. All variable values shall be addressable within other parts of the SCADA 3000 including but not limited to the Ladder Program, LCD display, Alarm functions, PID calculations, Voice reports, and Data Logger. C Variables may be overridden on-the-fly while the C program is executing.

C. PID Algorithms

The system shall provide 8 individually programmable PID algorithms to execute feedback control. Any addressable input and any addressable output may be used in the algorithm. Proportional, integral, and derivative gain factors may be programmed as constants or as addressable variables. Other operational parameters include: target set-point, dead zone, reload time, output limiting, and enable/disable.

VII. System Features

A. Microprocessors and Memory

The system shall include two Motorola 68300 series microcontrollers to maximize the operational performance of the SCADA 3000. 5.1Mbits of high speed static RAM memory devices shall be used to minimize power consumption and allow retention of programming parameters via lithium battery. The lithium battery shall retain programming for up to 5 years and shall be monitored internally as a system diagnostic parameter. Main program firmware shall be stored in 8Mbits of re-programmable flash memory devices.

B. Power

The system shall require 10-15VDC (.215A minimum/1.50A maximum) for proper operation. The low-power design of the system shall make it suitable for solar power applications. Optional power supplies shall be available from the manufacturer to convert 100-240VAC to 15VDC. Such power supplies shall be approved, registered, listed and/or certified by UL, CSA, VDE, TUV & CE. The system shall internally produce a power source of 24VDC/320mA for powering analog transducers. The system shall monitor internal and external voltages for faults. System power consumption shall be internally monitored. All power supply voltages shall be internally protected against voltage transients using 1500W solid state transient voltage suppressors.

C. Battery Backup

The system shall be capable of operating from and charging a sealed lead-acid gel cell battery. Two battery kit options, 5AH and 18AH, shall be available from the manufacturer. The battery shall provide backup power to the SCADA 3000 and any connected expansion modules. Actual battery backup time shall be dependent upon the number of expansion modules utilized, external power requirements, the Amp-Hour rating of the battery, age of the batteries, ambient temperature, and the charge condition. The unit shall include an integrated battery charging circuit. The battery charging shall be intelligent

with microprocessor guided precision voltage control, which will activate only when batteries are installed. Deep discharge protection shall also be included to prevent battery damage during an extended power outage. The system shall monitor external battery voltage for diagnostic purposes.

5AH Battery Kit Dimensions: 5.25"W x 5.00"H x 2.88"D

18AH Battery Kit Dimensions: 9.38"W x 7.68"H x 3.13"D

D. Local Visual Indication

The system shall have a backlit 4x20 character LCD display, seven system status LEDs, and eight output LEDs. The LCD display shall be programmable to automatically scroll through a custom list of input/output values, variables, and alarms. A four-button keypad shall be located below the display for on-demand requests for specific input/output data from the system and any connected expansion modules. System status messages shall also be available from the display. Seven status LEDs shall be visible to indicate: power on/off, alarm status, system fault, control program running, alarm monitoring enabled, battery condition, and phone line communication status. Eight additional LEDs shall indicate the on/off status of the eight relay output channels.

E. Data Log

The system shall feature user-programmable built-in data storage for logging input/output values and/or calculated variables. Items to be stored shall be selectable to maximize memory usage. Up to 50,000 total samples can be stored in the unit's nonvolatile memory. The time between logs shall be user-programmable. The system shall have the capability to send the datalog information via fax or E-mail on a time-programmable basis. Data-log information may also be retrieved on-demand via computer and modem or automatically by using the polling option of the Sensaphone® SCADA 3000 programming software.

F. Event Log

The system shall maintain an event log to keep track of important system events. As many as 36 different messages may be stored in the event log. The system will maintain the last 1000 messages in the event log and will overwrite the oldest messages once the log becomes full. Typical event messages stored in the log include: alarms, incoming and outgoing telephone calls, alarm acknowledgment, ladder program download, C-Program download, ladder program start/stop, and C-Program start/stop.

G. Diagnostics

The system shall include built-in diagnostics to monitor critical system parameters. A fault LED will light to indicate detected problems to on-site personnel. The Sensaphone® SCADA 3000 programming software shall display the system diagnostics on demand. System parameters measured include: power supply voltages, current consumption, main & memory battery voltage, processor status, firmware revision, reset count, and circuit board temperature.

H. Security

The system shall provide optional password-secured user access to the system when connecting via local serial port or modem. Up to 64 user accounts may be configured with four programmable levels of user access. The four different types of accounts include: Administrator, Programming, Operator and Status-Only. User accounts may also be disabled temporarily by the system administrator.

In voice mode, the system shall have a programmable touch-tone security code to prevent unauthorized access to voice mode functions.

I. Field Upgrades

The system shall be designed using flash memory technology to permit field firmware upgrades. Such upgrades shall be performed using a personal computer either on-site or remotely via modem. Firmware upgrades shall be available from the manufacturer at no charge.

VIII. Remote Operation Features - (Phone Line operation only)

A. Status Report (voice option required)

The system shall allow the user to call into the unit at any time using any standard telephone to obtain a full status report of all monitored channels. The status report shall be articulated using the resident voice-synthesized English vocabulary, in combination with digitized user-recorded voice messages.

B. Data Status Report

The system shall allow the user to call into the unit (modem option required) with a computer, modem and the Sensaphone® SCADA 3000 programming software. The system shall allow interrogation and programming access to system parameters and status. The real-time input status can also be displayed graphically via user-customized screens. Data log and Event log reports can also be automatically transmitted to E-mail or Fax destinations on a time schedule.

C. Voice Acknowledgment

An alarm on any monitored channel may be acknowledged remotely by pressing tones on a touch-tone telephone keypad during the actual alarm call or by calling the system back within a specified time period and entering the appropriate touch-tone code.

D. Data Acknowledgment

An alarm on any monitored channel may be acknowledged remotely by the user via a computer, modem, and the Sensaphone® SCADA 3000 programming software. Alarms may be acknowledged manually by calling into the unit or they may be acknowledged automatically using the alarm-answer mode of the Sensaphone® SCADA 3000 programming software.

IX. Enclosure and Environmental

A. Enclosure/Main Unit

The system shall be housed in a durable aluminum enclosure with integral mounting brackets for wall or panel mounting. Dimensions: 9.4"W x 12.2"H x 2.0"D. Shipping Weight: 8 lbs.

1. Universal Input/Thermocouple/Relay Output Modules

Dimensions: 6.11" w x 6.33"H x 1.25"D. Shipping Weight: 3 lbs.

2. Pulse Count/Analog Output Module

Dimensions: 4.20"W x 6.33"H x 1.25"D. Shipping Weight: 3 lbs.

3. Annunciator Module

Dimensions: 3.75"W x 1.88"H x 5.5"D. Shipping Weight: 3 lbs.

1/8 DIN cut out size: 3.58"W x 1.73"H

Clearance depth required behind panel: 5.00".

B. Electrical Protection

Power and telephone connections shall have internal spike and surge protection using metal oxide varistors and solid-state transient suppressors. All input channels shall have fault protected input circuits.

C. Additional Electrical Surge Protection

Additional Power and Telephone line surge protection shall be available from the manufacturer. When so installed, the system shall be fully warranted against any damage caused by transient surges entering the system through Power or Telephone lines.

D. Environmental

The system shall function over an operating temperature range of 32°F to 158°F at up to 0 - 90% RH, non-condensing. The system may be stored within the temperature range of -4°F to 158°F.

E. Maintenance

The system manufacturer shall have in-house service facilities. Unlimited technical assistance shall be available during normal business hours, Monday - Friday 8AM - 5PM(EST), via telephone, E-mail (support@sensaphone.com), and website www.sensaphone.com.

Specifications subject to change without notice.

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