Lifeline Memorandum

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SUBJECT: Description of Modifications to the Lifeline Model 9500.

The modifications to the Lifeline Model 9500 are confined to the circuit design and microcontroller firmware of the main logic circuit card. The keyboard card and the mechanical design of the case remain unchanged. Minor alterations in pad printing of the case have been made to add a new company logo and to modify the ringer volume control graphics. The main logic card circuits effected by these changes are; the speech synthesis circuit, the speaker driver circuit, the power supply circuit, the telephone interface circuit, and the telephone ringer circuit.

Main Logic PCB Documentation & Card Size

The existing Lifeline 5810151 schematic, and associated 7800151 circuit card design, of the Model 9500 Main Logic Card, has been replaced by a new SA1810168 schematic and its associated K4804 circuit card design. Where possible, component designations from the original 5810151 schematic have been maintained for similar circuits in the SA1810168 schematic. The size of the main logic card has been reduced by reductions in parts count, more extensive use of SMT components, and replacement of 0805 size SMT parts by newer 0603 size components.

RF Circuits

The RF receiver circuit in the new SA1810168 schematic, and the location of RF receiver components, and circuit traces in its associated K4804 circuit card design, remain unchanged from the original 5810151 schematic and 7800151 circuit card design of the existing Model 9500 Main Logic Card. All 0603 size components used in place of 0805 size parts in the RF circuits are located on the original component part centers.

Speech Synthesis Circuit

The two ISD33150 speech synthesis chips, U10 and U11, used in the existing 5810151 schematic have been replaced by a single ISD4004-08 chip (U11) which provides more speech storage capacity than the original two chip design. The two SS1/ and SS2/ speech chip select lines and the six analog switches (U17B, U17C, U17D, U18A U18C & U18D) used to control speech output from U10 and U11 in the 5810151 schematic have been replaced by one speech chip select line (ISDCS/) and three analog switches (U4A, U17C & U17D) in the SA1810168 schematic. This change reduces parts count by one quad analog switch chip and four resistors (U18, R136, R148, R149 & R152 of schematic 5810151) in the SA1810168 schematic.

Speaker Driver Circuit

The LM388 chip used as the U204 speaker driver in the 5810151 schematic has been replaced, in the new SA1810168 schematic, by a TDA7267 speaker driver chip, because the LM388 chip is no longer available. Replacing the LM388 chip removes six resistors, two capacitors and one transistor (R228, R230, R231, R233, R234, R270, C223, C224 & Q201 of schematic 5810151) reducing parts count of the SA1810168 schematic by nine. Use of the new TDA7267 speaker driver chip for U204 also requires an inversion in the logic of control line VPON (U19 pin 19) which has been renamed VPOFF in the SA1810168 schematic.

Power Supply Circuit

The manual power supply voltage adjustment of voltage regulator U205, provided by SMT potentiometer R240 in the original 5810151 schematic, has been replaced, in the new SA1810168 schematic, by calibration numbers stored in the U13 EEPROM chip during factory testing of the K4804 circuit card. A new BATCTRLVL circuit (R5, R6, R238, R239, R240, C5 & U8A in the SA1810168 schematic) allows the microcontroller to use these calibration numbers to set the +BATT supply voltage through duty-cycle adjustment of the BATCTRL (U15 pin 6) voltage waveform. The heat sink design for U205 has also been replaced by a design which uses components that are common to other current Lifeline products.

The new BATCTRLVL circuit in the SA1810168 schematic also controls the battery test cycle, eliminating the BATTEST control line and its associated hardware (R241, R243, R273, R274 & U203D of the 5810151 schematic). This control line has been reassigned to the new BATSW control function. Comparator U203D, originally used in the BATTEST circuit, is now used as the ACLOW voltage comparator in place of U203C which has been moved to the BATLOW circuit to support a new threshold switching function. In the new SA1810168 schematic, the ACLOW circuit consists of R241, R243, R244 and U203D.

The original, hardware based, Model 9500 battery cut-off circuit has been modified by removal of resistors R221 and R222 in schematic 5810151, replacement of resistor R201 by series resistors R201 and R221, and addition of a BATSW (U20 pin19) output latch control line, which is now connected to the junction of R201 and R221 in the new SA1810168 schematic. These changes allow the U15 microcontroller firmware to operate the battery cut-off switch.

The original BATLOW circuit (R242, R245, R246, R247, R265, R266, C232 & U203A in the 5810151 schematic) has been replaced by a new BATLOW circuit (R245, R246, R247, R265, R266, U203A & U203C in the SA1810168 schematic) which expands the original BATLOW function to include two battery voltage thresholds, one for low battery and a second lower threshold for battery cut-off. This second threshold is created by having the microcontroller (U15) use comparator U203C to switch the BATLOW threshold level with control waveform OSRDAT.

Telephone Interface Circuit

The hook switch and off-hook relay circuits (D8, D19, K2, K3, R31, R90, R125, R126, Q5, Q20 & S1), the pulse dialing circuit (R41, R42, R43, R44, Q7 & Q8), the off-hook voltage protection clamps (D10 & SID2), and the loop current shut-down circuit (D6, D7, R22, R23, R24, R25 &

Q4), in the original 5810151 schematic, have been replaced, by a new circuit using a 400 Volt P channel MOSFET switch (D8, D10, R9, R22, R23, R24, R42, R43, R44, C4, Q2, Q7 & S1 in the new SA1810168 schematic). This circuit provides all of the Model 9500 off-hook and pulse dial switching functions. Handset hook switch S1, which was connected in parallel with off-hook relay K2 in the 58101151 schematic, is now one of three control inputs to the Q7 driver transistor of the MOSFET phoneline switch circuit in the new SA1810168 schematic. The two transistor circuits used to indicate the state of the S1 hook switch in the 5810151 schematic (R26, R27, R28, R29, R30, R89, Q16 & Q17), have been replaced by a single transistor circuit (R26, R27, R28 & Q16) which indicates the state of the hook switch in the SA1810168 schematic.

The original hardware based circuit for adjusting operating bias of the excess loop current section of the U2 telephone interface chip (R54, R55, R56, R57, R118, R119, R120, R121, C55, Q11, Q13, Q14 & Q15 in the 5810151 schematic) has been replaced by a new circuit (D6, R55, R57, R121 & Q11 in the SA1810168 schematic) which is controlled by the new MODESEL output latch control line (U15 pin 9). This allows the U15 microcontroller to adjust the U2 excess loop current for phoneline powered pulse or DTMF dialing when a.c. or battery power is not available to run the microcontroller. Diode D6 in the new SA1810168 schematic limits maximum U2 (LINE+) d.c. input voltage by drawing additional loop current under high LINE+ voltage conditions, preventing clipping of phoneline signals at the U2 input for operation at very high loop currents.

The DTMF filter circuit and the +2.5 Volt reference voltage circuit (R77, R79, R80, R81, R82, R83, R84, R85, R86, R87, R88, R116, R117, R127, R128, C33, C34, C35, C36, U7A & U7B in the original 5810151 schematic) has been replaced by a redesigned circuit (R77, R79, R80, R82, R83, R84, R85, R86, R87, R88, C33, C34, C35, C36, U7A & U7B in the new SA1810168 schematic) which reduces parts count and separates the +2.5 Volt reference voltage and DTMF filter functions.

Telephone Ringer Circuit

The RINGER differential comparator circuit (R9, R10, R11, R12, R13, R14, R15, R16, C5, C7 & U2D in the 5810151 schematic) which provides the ring signal to the speaker driver, and the NORING comparator circuit (R18, R21, C11, C12 & U2C in the 5810151 schematic) which detects the envelope of the ring signal, have been replaced by a single comparator circuit (R17, R18, R21, C11 & U2C in the new SA1810168 schematic) which sets the speaker ringer detection threshold and provides the RING/ signal to the U15 microcontroller. In the new design, ringer envelope detection and speaker ring signal generation are handled by the microcontroller firmware and a ring signal is provided to the speaker driver by the ATONE control line.

The ringer volume control circuit (R5, R6, C4, C6, R17 & R53 in the original 5810151 schematic) which provided analog ringer volume control for both the piezo ringer and the speaker ring signal has been replaced by a three position, center off, slide switch circuit (D18, D19 & S3 in the new SA1810168 schematic) which sets the speaker ring level. The three S3 positions represent Ring Loud, Ring Soft, and Ring Off. The U15 microcontroller reads S3 as part of the keyboard switch scan. The microcontroller uses the information from S3 to set the TONEHI control output for appropriate speaker ring volume when generating the ATONE ring

signal. The phoneline powered piezo ringer is now connected directly to the U1 ring chip in the SA1810168 schematic and is always operated at full volume. When speaker ring is available, the ring detection function of U1 is disabled by the U15 microcontroller to avoid acoustic clash between the two ringer functions. U1 ring detection is disabled by optical coupler U10, using the new PZRINGON (U20 pin 9) output latch function in the SA1810168 schematic.

The PERS/ control line and its associated hardware in the 5810151 schematic (R19, R20 & Q2) has been replaced, in the new SA1810168 schematic, by firmware logic and associated hardware (R228, & U2D) for the TONEHI control line. This function forces a speaker ring signal and a reasonable speakerphone volume for PERS (Personal Emergence Response System) operations even when the ringer switch is set off and speaker volume is set to minimum.

Microcontroller Firmware

The firmware in the Model 9500 microcontroller has been modified to support the hardware changes described above and to meet UL1637 requirements for supervision of fixed station RF transmitters and monitoring of low battery signals from RF transmitters. An additional display function has been added to the RED LED on the front of the Model 9500 to identify RF transmitters with supervision failures or low battery indications. Both supervision failure and low battery alarms are also sent to the central monitoring station over the telephone line.

The display identification number for each RF transmitter is established when the Model 9500 auto-learns each transmitter code. The Model 9500 distinguishes between fixed station supervised and portable unsupervised transmitters during the auto-learning mode. All unsupervised transmitters must be auto-learned in a single session and all previously learned unsupervised transmitter codes are automatically removed when the first unsupervised transmitter is auto-learned. The first unsupervised transmitter learned is given display number 1 and additional unsupervised transmitters are assigned sequential numbers in ascending order.

The first supervised transmitter to be auto-learned is given display number 8, with other supervised transmitters assigned sequential numbers in descending order. Additional supervised transmitters can be added during subsequent auto-learning sessions without removing existing supervised transmitter codes. Supervised transmitter codes can only be removed by using the Lifeline Promline programming service. A maximum of 8 transmitter codes may be auto-learned and duplication of RF codes is automatically prevented.

When an RF supervision failure or RF transmitter low battery condition exists, the display number of the RF transmitter with the failure is indicated by the number of blinks of the RED LED. If more than one transmitter is being identified the RED LED will blink the first display number, pause, and then blink the next display number. Once all required display numbers have been indicated the RED LED will pause and then repeat the complete blinking pattern. The RED LED will continue to cycle through this blinking pattern until the transmitter faults are cleared by new transmissions, or transmissions without a low battery status, or until the transmitter causing the failure indication is permanently removed from the system.