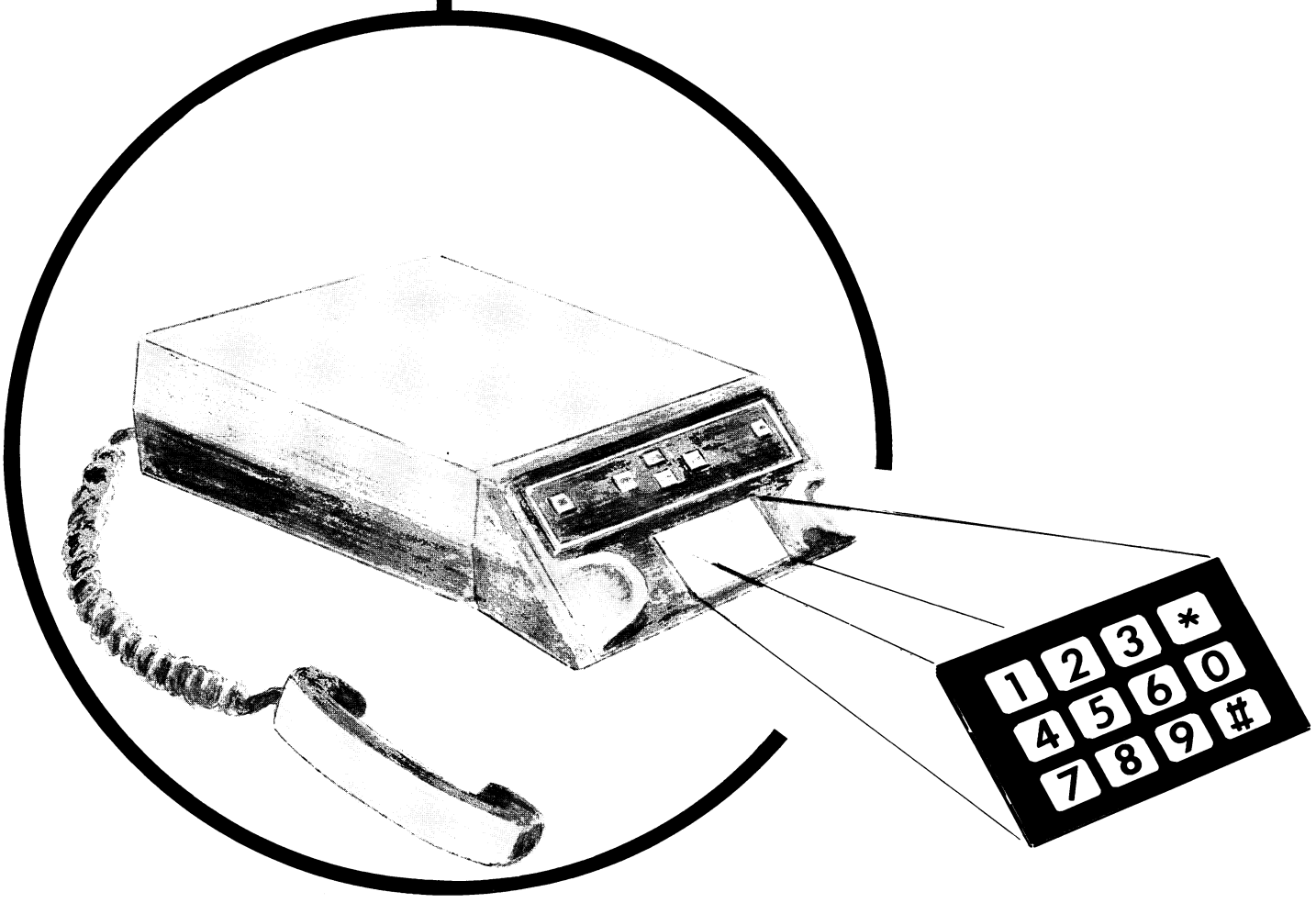
LB131158B

TYPE 4913 DTMF MOBILE ENCODER

FOR INSTALLATION IN

GE MARC V™ CLASSIC

TRUNKED MOBILE RADIO
COMMUNICATIONS SYSTEM



SPEEDCALL CORPORATION

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Hayward CA 94545-1789
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TYPE 4913 DTMF MOBILE ENCODER SPECIFICATIONS

OUTPUT	
Format:	Standard 2-of-7 Touch-Tone® (DTMF)
Transmit Audio:	
Tone Duration	Continuous while any digit is keyed
Signal Level	Adjustable 0 to 250 mV rms into 600 ohm load
Frequency Stability	±0.25% between -30°C to +65°C
Tone Level Differential (Twist)	2.0 dB maximum
Amplitude Stability	±1.0 dB @ ambient temperature (±3.0 dB between -30°C to +65°C)
Total Distortion	4% maximum @250 mV across 600 ohms
Sidetone Level:	150 mW maximum (37 ohms composite resistance in series with an 8-ohm speaker)
TIMING	
Initiate Delay:	40 ms ±10 ms
Interdigit Interval:	1.0 seconds ±0.25 sec.
KEYING CIRCUIT	(PTT-) Transistor collector capable of sinking 50 mA maximum (collector voltage not to exceed input voltage)
POWER	
Voltage:	13.8 VDC ±20% (11.0 to 16.6 VDC)
Current:	
Standby	25 mA @ 13.8 VDC
Operate	≃35 mA @ 13.8 VDC (sidetone output open) ≃60 mA @ 13.8 VDC (sidetone speaker connected)

TOUCH-TONE is a Registered T.M. AT&T Co.

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DESCRIPTION

Speedcall Type 4913 is a Touch-Tone® (DTMF) Encoder contained on a single printed-circuit board. It is designed for installation in the GE-MARC V Classic radio, and mates with the 12-button Touch-Tone keypad on the front panel of the radio. The Encoder is a solid-state device which generates a DTMF tone pair when any button is pressed on the keypad.

The 4913 Encoder is used in communications signaling systems as a means for the operator to enter address, command, and other access codes for selective calling, remote control, and alarm/status reporting applications. Similar to telephone operation, number groups sequentially dialed on the keypad may vary in length and number content. Local procedures based on the type of decoders in use and application will govern the spec ific number groups to be used.

FUNCTIONS AND FEATURES:

- Automatic transmitter keying when any keypad button is pressed, and the radio is in the "ready" mode (see System Description on pages 3-5 in the GE-MARC V radio manual). If the radio is in the "idle" mode, the Encoder's transmitter keying and tone output circuits are disabled.
- Generation of DTMF tone frequencies corresponding to digits dialed on the keypad (see Circuit Analysis in this manual for description of the DTMF format and frequencies).
- Internal timing for control of signal output, transmitter keying, 1-second interdigit interval, and reset.
- Continuous tone output as long as any digit is keyed on the keypad.
- Sidetone output to the radio speaker to permit monitoring of tones as they are transmitted.
- Uses standard Touch-Tone format for high signaling reliability, equipment compatibility, and protection from obsolesence.

OPERATION

The 4913 Encoder will operate only when the radio is in the "ready" mode. Its transmitter keying and tone output are disabled at all other times.

Remove the radio handset from its cradle and, with the radio indicating Ready, dial the number sequence on the keypad as defined by local user operating procedures. It is not necessary to use the handset PTT switch to key the transmitter as the 4913 Encoder contains automatic transmitter keying circuitry for this purpose.

Press the first digit of the number sequence. Transmission of this digit will be indicated by illumination of the transmit light, and an audible tone from the radio speaker. Release the first digit and dial the remaining digits of the number sequence.

Each digit in the sequence must be dialed within one second of the succeeding digit to maintain transmitter keying between digit entries. If this period is exceeded, the Encoder will release the transmitter.

After the last digit of the sequence is dialed, the Encoder will maintain transmitter keying for approximately 1 second. The radio will normally remain in the "ready" mode for several seconds after the Encoder releases the transmitter, indicating the channel is still available.

If the radio reverts to "idle" mode after reset of the Encoder, use the handset PTT switch to again acquire a channel, then dial the number sequence as described above.

Sidetone will be heard as each digit is dialed, and transmitted. Sidetone sound level may be softened by removing one or more of the resistors identified in the Circuit Analysis section of this manual.

INSTALLATION

PHYSICAL:

The Installation Diagram in Figure 2 defines the physical and electrical installation of the Type 4913 Encoder in the GE-MARC V radio.

SIGNAL LEVEL:

Before operating the 4913 Encoder, it may be necessary to adjust the output signal level for correct deviation. This adjustment will normally be correct when received from the factory. However, the following instructions are provided if adjustment becomes necessary. Adjustment of deviation requires the use of a GE-MARC V Microprocessor Control Set TL5B (19C330671G2), a dummy load, and a suitable FM Deviation monitor.

1. Connect the dummy load to the antenna jack on the radio.

2. Connect the Microprocessor Control Set to the test jack on the Synthesizer/Interconnect board.

3. Following the instructions for the Microprocessor Control Set, select the desired test frequency (30, 31 or 32) and tone '00'.

4. Set up the FM deviation monitor on the selected transmit frequency of the radio.

5. Select the Display Test position on the Control Set. This will light all the displays (including those on the Control Set). This turns on the WT/Ready light on the radio, enabling the DTMF Encoder.

6. Press and hold any digit on the keypad to produce a continuous tone output. Adjust R17 (Tone Dev. Adj.) on the Encoder Board through the access hole on the bottom of the Classic's "nose piece" for 1.5 ±0.1 kHz of deviation.

NOTE

If peak deviation exceeds 2.75 kHz with busy tone, clipping in the audio stages of the transmitter may introduce distortion, causing erratic operation of receiving decoders.

SIDETONE:

Sidetone volume from the Encoder is not adjustable. It may, however, be reduced by removing one or more of the parallel resistors R9 through R12, thereby increasing the composite resistance in the output circuit. Do not remove all four resistors as this will open the output circuit and disable sidetone.

CIRCUIT ANALYSIS

TOUCH-TONE FORMAT:

The 4913 Encoder uses standard Touch-Tone (dual-tone multi-frequency - or DTMF) format, originally developed by AT&T Co. for telephone dialing. Each digit is identified by a unique combination of two tones; one corresponding to the horizontal row, and the other to the vertical column of pushbutton positions shown in Figure 1. The frequencies are grouped about the geometric center of the 300 to 3000 Hz voice band used in telephone and radio systems. The two tones are generated simultaneously and remain on as long as a digit is being sent. Row tones are in a lower frequency group than column tones. The frequencies are non-harmonic to give high immunity to false identification from beat frequencies and distortion-produced overtones.

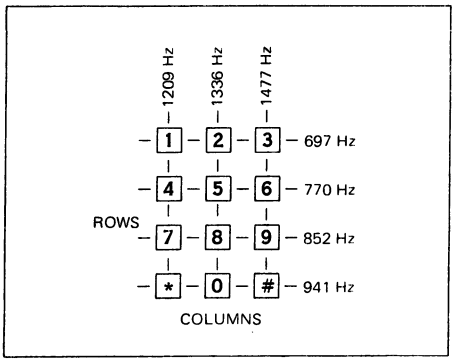


Figure 1 - Touch-Tone Keypad and Frequency Format

NOTE

The *, 0, and # buttons are placed vertically on the right side of the keypad used with the 4913 Encoder on the GE-MARC V Classic radio. However, the row and column designations illustrated in Figure 1 remain unchanged.

CIRCUIT DESCRIPTION:

Refer to the 4913 Circuit Schematic in Figure 4:

In the following description, IC pin numbers are in parenthesis after the component number. High voltage levels are in range of +5.95 to +8.5 VDC. Low levels are in the range of 0 to +0.5 VDC.

A1 is an integrated DTMF tone generator with a 3.579 MHz crystal at pins 7 and 8 as a frequency standard. The row and column inputs are triggered by a ground contact from the keypad when any button is pressed. Each button on the keypad connects the corresponding row and column inputs to ground.

When the radio is in the "idle" mode, the Chip Disable (CD) input to A1 (2) is held low by the A3A gate to inhibit transmitter keying and tone output. When the radio enters the "ready" mode, J2-1 on the Encoder is

driven low. C3 discharges through R4, causing A3A (1 & 2) to go low, and its output (3) to go high. The CD input to A1 remains high as long as the radio is in the "ready" mode. C3 discharge time is approx. 1.25 sec.

The Any Key Down (AKD) output of A1 (10) is an open circuit when no key is pressed. Any keyed digit drives pin 10 low to sink the base of Q3. The Q3 collector then supplies a high voltage to the A3B (6) gate. Output of A3B (4) goes low and drives A3D (11) high to turn on Q6 for transmitter keying control.

With the Q3 collector high, CR3 is forward-biased, permitting C12 to charge through R29. When the voltage at A4 (2 & 6) reaches 2/3 of the voltage at pin 8, pin 3 goes low and removes the +V from the base of Q4 to turn Q4 off. The "input" A3C (8) goes high through R33, forcing its output (pin 10) and A3D (12) to go low.

When the keyed digit is released, A1 (10) becomes an open circuit and removes A- from the base of Q3. Q3 turns off and removes the +V supplied to A4 (2 & 6) and A3B (6). The collector of Q3 is pulled low by R31, and A3B (4) goes high. However, A4 (3) is held low by the charge across C12, which also keeps the PTT line low. C12 starts discharging through CR4 and R30. When the voltage at pins 2 & 6 of A4 drops to 1/3 of that at pin 8, pin 3 switches high and forces the PTT line high. The discharge time of C12 is approximately 1 second. This is the Interdigit Interval of the Encoder.

If any digit is keyed before C12 discharges to 1/3 of the voltage at pin 8, its charge is refreshed to keep pins 2 & 6 above the threshold voltage of A4. Pin 3 and the PTT line are kept low to retain transmitter keying between digit entries for the interdigit interval (1 sec.).

With no digit keyed, the tone output of A1 (16) is at ground potential. When any digit is keyed, the appropriate row and column inputs to A1 are pulled to ground, and pin 16 is removed from ground. DTMF tones are generated, summed, and output at pin 16. The tone output from pin 16 is capacitively-coupled by C4 to the A2A (2) inverting amplifier. The output of A2A (1) is capacitively-coupled by C6 to the base of Q1, and also by C7 to the negative input of A2B (6).

When the output of gate A3B (4) is high, Q5 conducts through R13 to keep the Q1 base at ground to prevent it from conducting. When the A3B (4) output goes low, Q5 turns off and removes A- from the base of Q1, allowing it to conduct and produce a sidetone output at its collector. Sidetone output is not adjustable, but its volume may be reduced by removing one or more of the parallel resistors R9 through R12.

The amplitude of the audio transmit signal at A2B (7) is controlled by adjusting R17. The signal is coupled through C10, Q2 (P-channel FET), and C11. However, the signal present at the source terminal of Q2 is transferred to the drain terminal only when the A3C (10) gate is driven low, removing the bias voltage applied to the gate of Q2, allowing Q2 to conduct.

The maximum effective value of the transmit audio level at J2-3, when connected to a 600 ohm load, should not be less than 250 mV rms.

MAINTENANCE

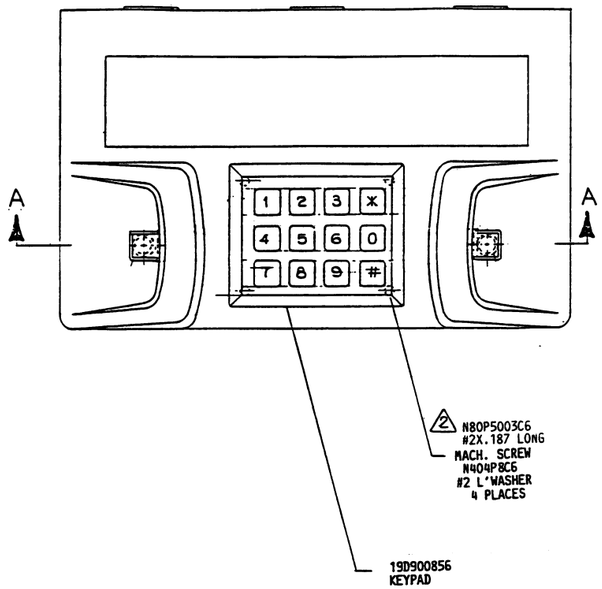
The Speedcall Type 4913 Encoder is designed for stable, trouble-free operation over extended periods of time. No periodic alignment or adjustments are necessary after installation.

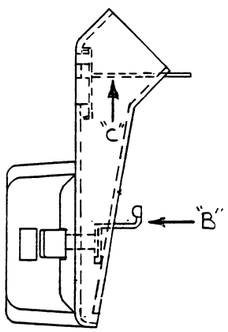
Good preventive maintenance procedures are recommended to keep the unit clean and free from corrosive atmospheres.

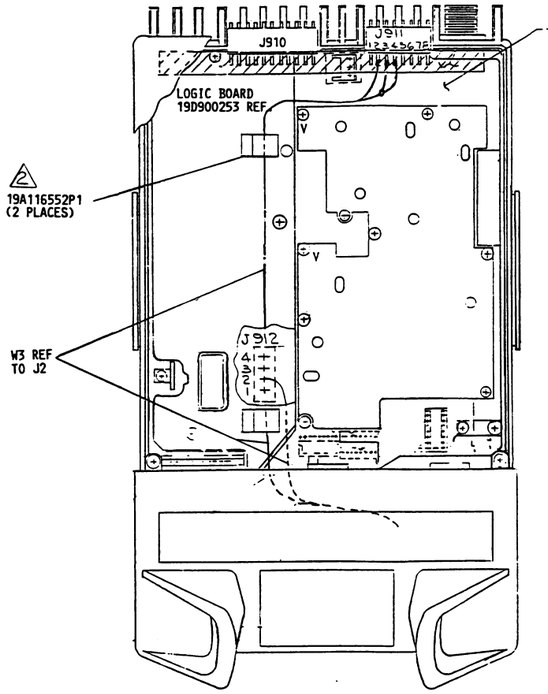
Should any problem develop in operation of the 4913 Encoder, it is recommended to follow the troubleshooting chart contained in this manual. Should this procedure not reveal the problem, try substituting a known operational unit for the defective unit. If the operational unit also fails to operate, the problem is most likely elsewhere in the system.

Do not overlook the fact that the receiving decoder may be at fault, or that the delay timing may be incorrect for the system in which the Encoder is used. If the Encoder resets due to extended pauses between digit entries, some receiving decodes may also reset to their first count position. This typically requires a maximum of 3 seconds. Thus, starting a sequence over without waiting at least 3 seconds may result in the receiving decoder not being able to accept the new sequence. Excessive signal output may also result in erratic operation of the decoder. Also ensure that the decoder is programmed for the code being used.

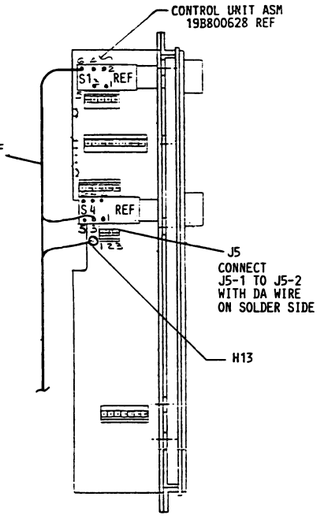
When used with some automatic phone patches, the '*' and '#' digits may need to be transmitted for an extended period (typically 1 second) for proper operation.



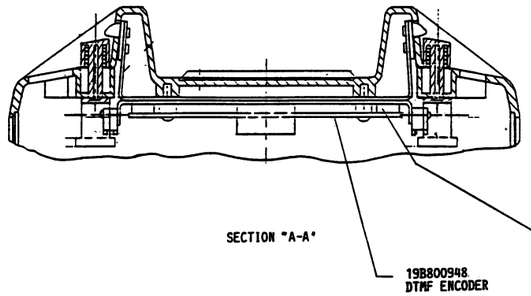


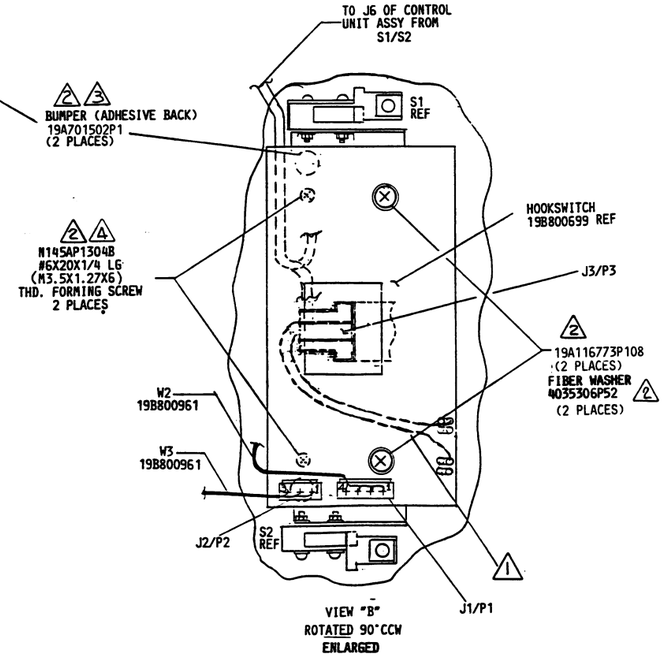


TOP VIEW



VIEW "C"
(ROTATED 180°)





VIEW "B"
ROTATED 90°CCW
ENLARGED

18 DTMF ENCODER APPLICATION

NOTES:

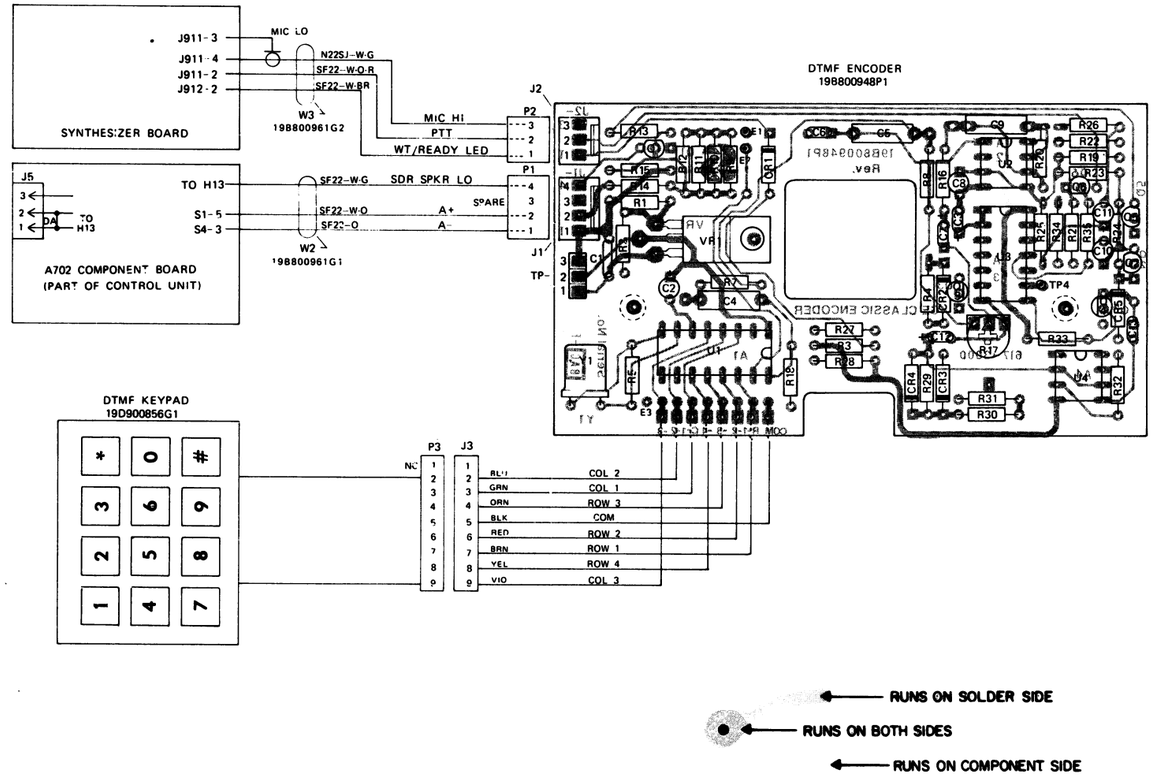
1. ROUTE CABLE BETWEEN RETAINER SPRING AND PLASTIC HOUSING
2. PART OF KIT PL19A701522.
3. ATTACH BUMPERS TO METAL BRACKET APPROX. AS SHOWN.
4. DISCARD TWO N145AP1304B.

DTMF CABLES TO RADIO CONNECTION CHART

FROM	TO	WIRE COLOR	NOTES
W2	S4-3	O	SOLDER
W2	S1-6	Y	SOLDER
W2	H13	G	SOLDER
W3	J911-2	V	SOLDER
W3	J911-3	SHIELD	SOLDER
W3	J911-4	W-G(SHIELDED)	SOLDER
W3	J912-2	BL	SOLDER
J5-1	J5-2	DA	SOLDER

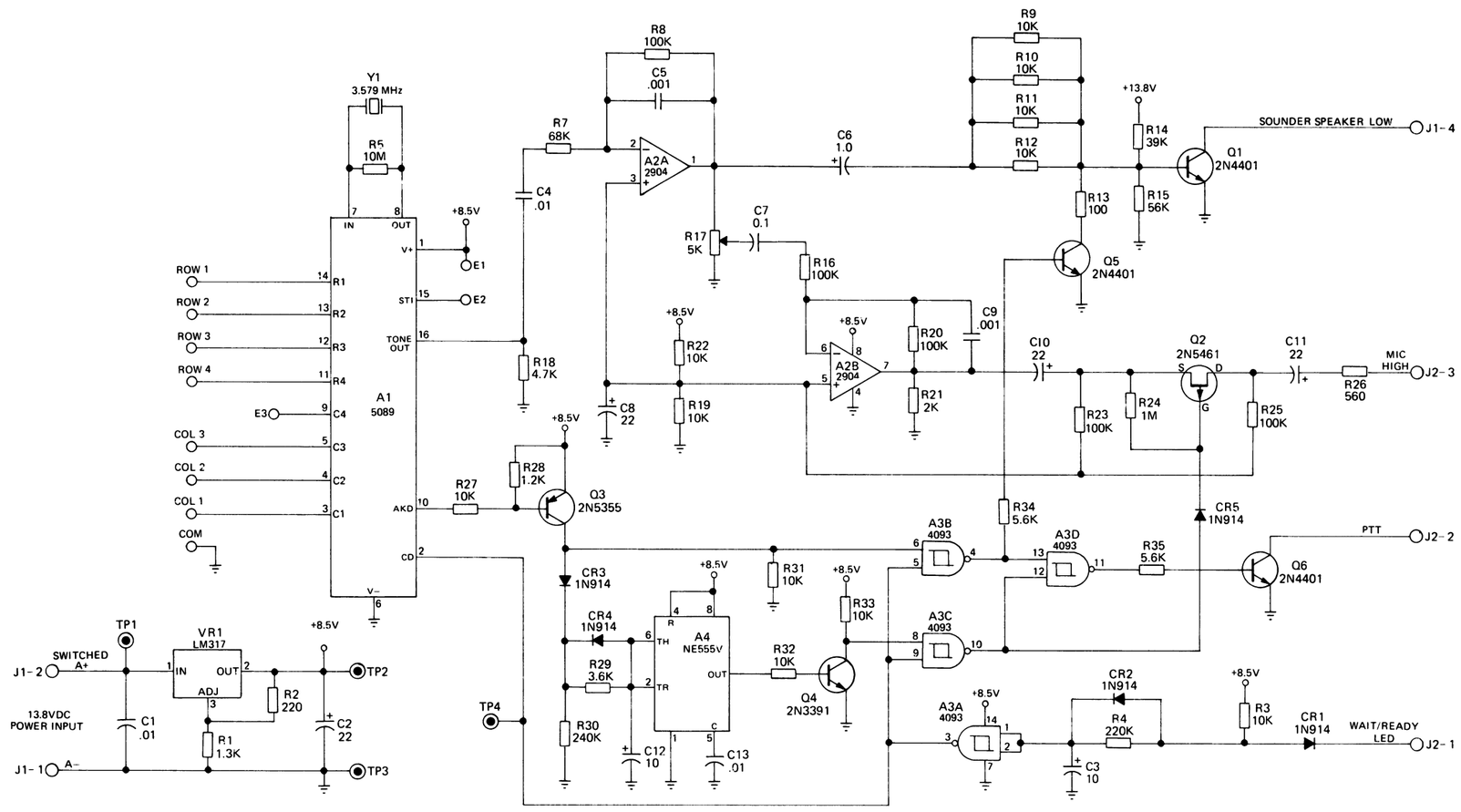
INSTALLATION DIAGRAM

(FRONT MOUNT) Figure 2
TYPE 4913 DTMF MOBILE ENCODER
(19D900386, Sh. 7, Rev. 4)



COMPONENT LAYOUT & WIRING DIAGRAM

Figure 3
TYPE 4913 DTMF MOBILE ENCODER

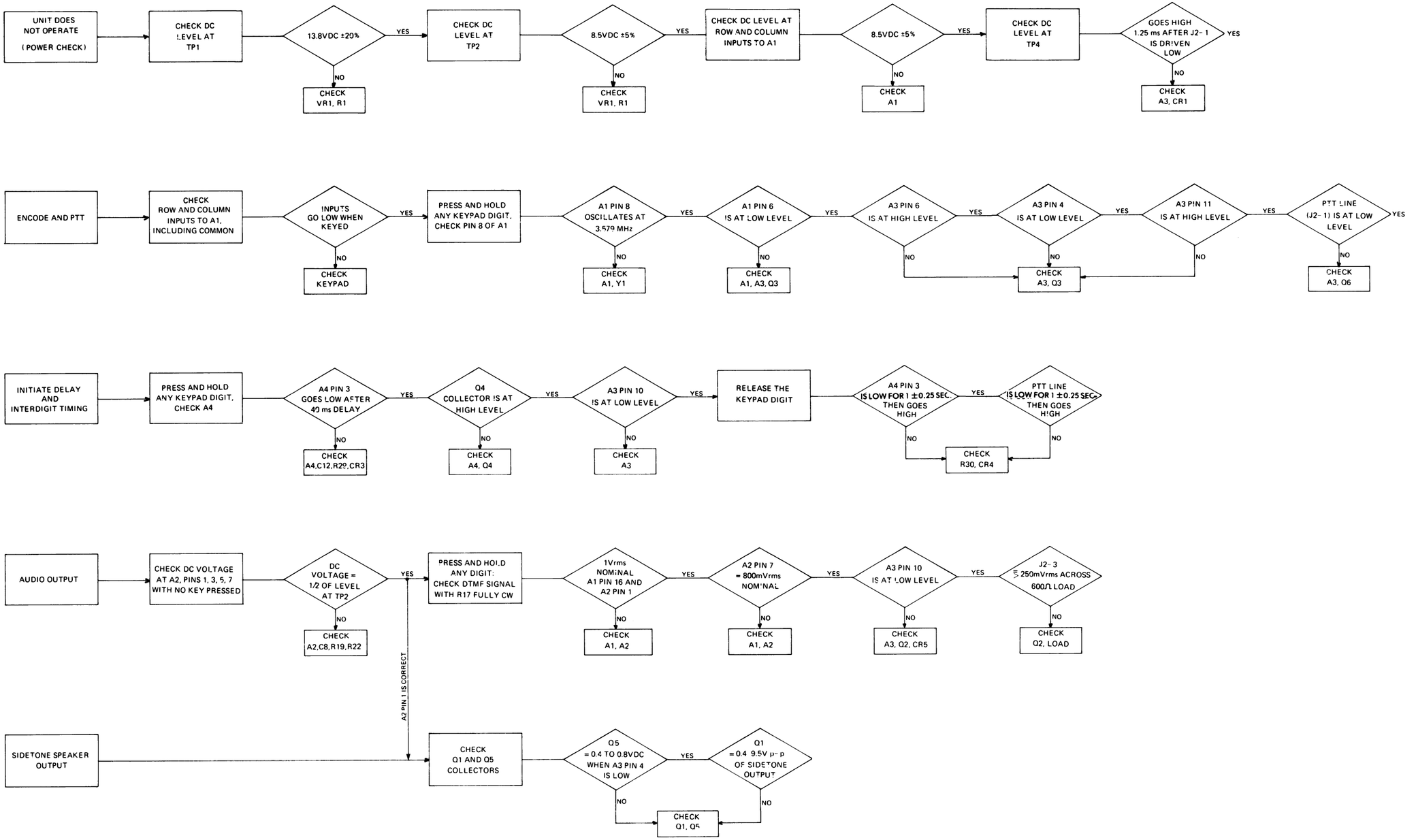


NOTES:

1. Unless otherwise specified:
   Capacitance values are in microfarads
   Resistance values are in Ohms, 1/4W, 5%
2. Component R6 is not used

CIRCUIT SCHEMATIC

Figure 4
TYPE 4913 DTMF MOBILE ENCODER



TROUBLESHOOTING CHART

Figure 5
TYPE 4913 DTMF MOBILE ENCODER

TYPE 4913 ENCODER REPLACEABLE PARTS LIST

SYMBOL	SPEEDCALL* PART NUMBER	DESCRIPTION
		---INTEGRATED CIRCUITS---
A1	160-0004	Type 5089 Tone Encoder, 16-pin
A2	161-0001	Type 2904 Dual Op Amp, 8-pin
A3	19A134097P62	Type 4093B Quad 2-Input, 14-pin
A4	19A116968P1	Type 555 Linear Timer, 8-pin
		---------CAPACITORS---
C1	051-0006	Ceramic .01uF 50V
C2	056-0010	Electrolytic 22uF 20% 15V
C3	053-0012	Tantalum 10uF 20% 20V
C4	052-0012	Mylar .01uF 5% 100V
C5	052-0030	Mylar .001uF 10% 100V
C6	053-0005	Tantalum 1.0uF 35V
C7	053-0001	Tantalum 0.1uF 35V
C8	056-0010	Electrolytic 22uF 20% 15V
C9	052-0030	Mylar .001uF 10% 100V
C10	053-0008	Tantalum 22uF 16V
C11-C14	053-0021	Tantalum 47uF 20% 10V
C12	053-0012	Tantalum 10uF 20% 20V
C13	051-0006	Ceramic .01uF 50V
		---------DIODES---
CR1-CR5	153-0004	Type 1N914
		---------RESISTORS---
		All resistors are deposited carbon, 1/4W, 5%, with values shown in the Circuit Schematic, except as listed below:
R5	136-1005	Carbon Composition 10M 1/4W 5%
R17	126-0030	Potentiometer 5K
		---------TRANSISTORS---
Q1	178-0011	Type 2N4401 NPN
Q2	182-0001	Type 2N5461 JFET P-Channel
Q3	176-0002	Type 2N5355 PNP
Q4	178-0001	Type 2N3391 NPN
Q5-Q6	178-0011	Type 2N4401 NPN
		----JACKS AND RECEPTACLES---
J1	036-0033	Square Pin Friction Lock Wafer 4-pin
J2	036-0032	Square Pin Friction Lock Wafer 3-pin
J3	033-0013	Connector, 9-pin
TP1-TP3	036-0031	Wafer Connector, polarizing 3-pin
		---------CRYSTAL---
Y1	097-0001	3.579 MHz Color
		---------REGULATOR---
VR1	19A134471P2	Voltage Regulator Adjustable LM317T
		---------CABLE---
	617-0200	Cable Assembly with J3
		---------HARDWARE---
	083-0055	Swage Spacer No. 10 x 1/8 (2 each)

NOTE: The Keypad Assembly used with the 4913 Encoder is G.E. supplied. P/N 19D900856G1

* When ordering parts for the encoder which do not have a GE part number (those beginning with "19") precede the part number with "SPD/". Example: 161-0004 should appear as SPD/161-0004.

LBI-31285

GE MARC V CLASSIC - DTMF ENCODER
ISSUE 1

SYMBOL	GE PART NO.	DESCRIPTION
		DTMF TRUNK MOUNT CABLE 19B800961G1
		- - - - - - - - - - - - PLUGS - - - - - - - - - - - -
P1		Connector. Includes:
	19A700041P30	Shell.
	19A700041P26	Contact: sim to Molex 08-50-0113. (Quantity 3).
		DTMF CABLE 19B800961G1
P2		Connector. Includes:
	19A700041P29	Shell.
	19A700041P26	Contact: sim to Molex 08-50-0113. (Quantity 3).
		TOP HOUSING 19C850661G4 BLACK 19C850661G5 PEBBLE 19C850661G6 SADDLE BROWN
	19B800597P1	Switch button. (Used with S1 & S2).
	19B800596P1	Switch actuator. (Used with S1 & S2).
	19A700140P2	Compression spring. (Located between actuator button & housing).
	N145AP904B	Screw, phillips POZIDRIV®, thread forming No. 4-24 x 1/4. (Secures actuator to housing).
	19B800623G1	Handset retaining spring.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19B800948P1	DTMF Encoder.
	19C851212P1	Keypad. (Includes frame).
	19A116773P108	Tap screw, Phillips POZIDRIV®: No. 7-19 x 1/2. (Secures DTMF Encoder).
	N80P5003C6	Machine screw, pan head, Phillips: No. 2-56 x 3/16. (Secures Keypad).
	N404P8C6	Lockwasher. (Secures Keypad).
	19A116552P1	Cable clip. (Quantity 2).
	19A701502P1	Plastic bumper. (Located on back of DTMF Encoder).
	4035306P52	Fiber washer. (Quantity 2).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

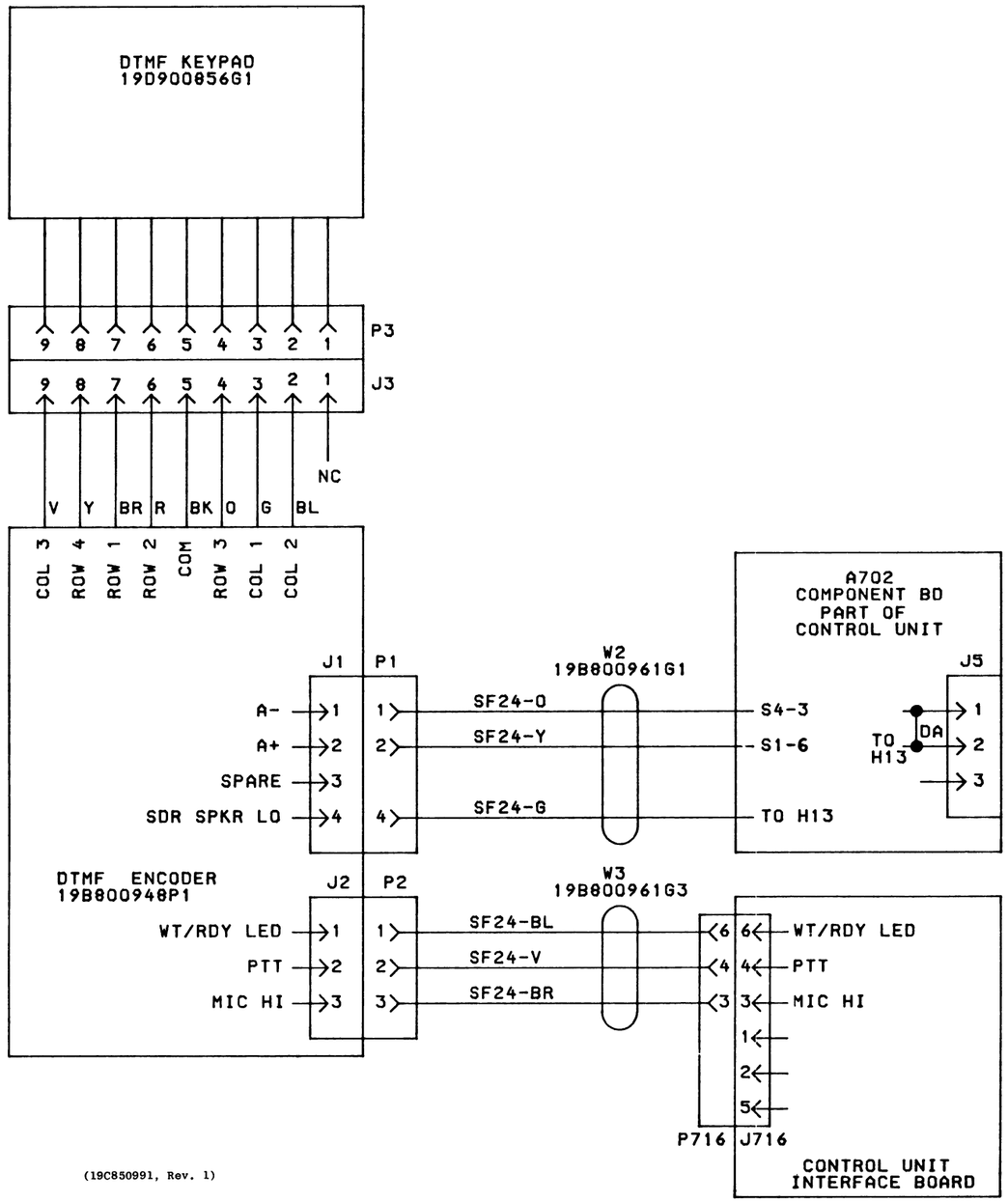
PARTS LIST

LBI31177

GE MARC V (DTMF ENCODER) CLASSIC RM

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - - CABLES - - - - - - - - - - - -
W2		ENCODER/A702 CABLE 19B800961G2
		- - - - - - - - - - - - PLUGS - - - - - - - - - - - -
P2		Connector. Includes:
	19A700041P30	Shell.
	19A700041P26	Contact: sim to Molex 08-50-0113. (Quantity 3).
W3		ENCODER/INTERFACE BOARD 19B800961G3
		- - - - - - - - - - - - PLUGS - - - - - - - - - - - -
P716		Connector. Includes:
	19A700041P32	Shell.
	19A700041P26	Contact: sim to Molex 08-50-0113. (Quantity 6).
		TOP HOUSING 19C850661G4
	19B800597P1	Actuator button. (Used with S1 & S2).
	19B800596P1	Switch actuator. (Used with S1 & S2).
	19A700140P2	Compression spring. (Located between actuator button and housing).
	N145AP904B	Screw, phillips POZIDRIV® thd. forming: No. 4-24 x 1/4. (Secures actuator to housing).
	19B800623G1	Handset retaining spring.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - - -
	19B800948P1	DTMF Encoder.
	19D900856G1	Keypad. (Includes frame).
	19A116773P106	Tap screw, POZIDRIV®: 7-19 x 3/8. (Secures DTMF Encoder).
	N80P5002C6	Machine screw, phillips: No. 2-56 x 1/8. (Secures Keypad).
	N404P8C6	Lockwasher. (Secures Keypad).
	19A116417P1	Plastic bumper. (Located on back of DTMF Encoder).
	19A116552P1	Cable clip. (Quantity 2).

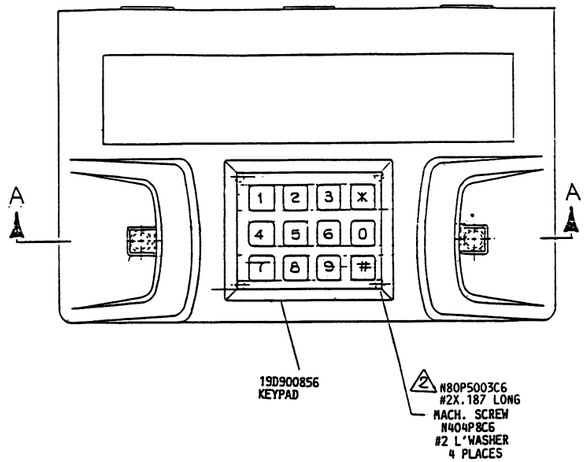
*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

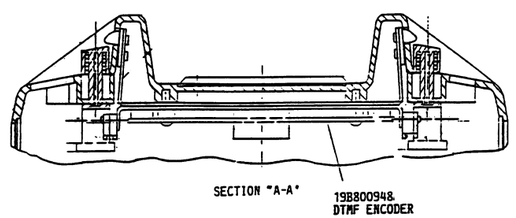


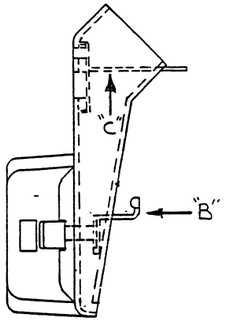
(19C850991, Rev. 1)

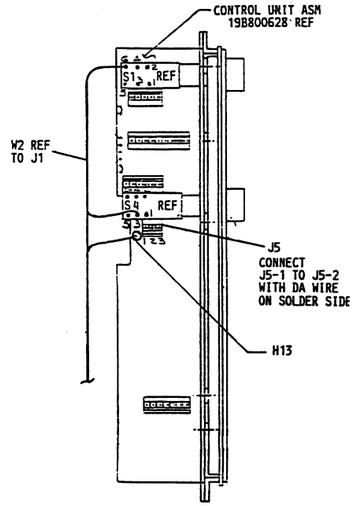
INTERCONNECTION DIAGRAM

DTMF ENCODER
GE MARC V CLASSIC RM

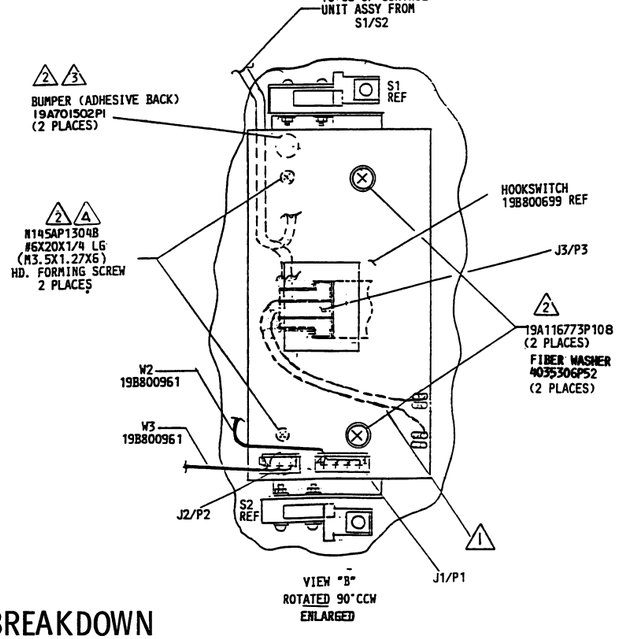




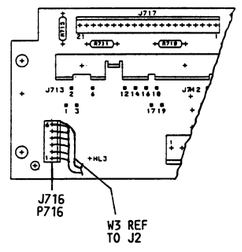




VIEW "C"
(ROTATED 180°)



VIEW "B"
ROTATED 90°CCW
ENLARGED



DTMF CABLES TO CONTROL UNIT CONN. CHART

FROM	TO	WIRE COLOR	NOTES
W2	S4-3	O	SOLDER
W2	S1-6	Y	SOLDER
W2	H13	G	SOLDER
J5-1	J5-2	DA	SOLDER

(10) DTMF ENCODER OPTION

NOTES:

1. ROUTE CABLE BETWEEN RETAINER SPRING AND PLASTIC HOUSING
2. PART OF KIT PL19A701522. DISCARD TWO 19A116552P1 CABLE CLAMPS.
3. ATTACH BUMPERS TO METAL BRACKET APPROX. AS SHOWN.
4. DISCARD TWO N145AP1304B.

(19D900930, Rev. 4)

MECHANICAL BREAKDOWN

DTMF EMCODER
GE MARC V CLASSIC RM

ADDENDUM NO.1 TO LBI31158B
PC07

This addendum describes changes that are required to improve receive audio when the SPEEDCALL DTMF Encoder with MONITOR pushbutton is used with the C-800 or C-900 Control Unit.

The MONITOR pushbutton is referenced to A- when pressed. When the MIC is taken off-hook CG Disable is referenced to CNTRL A-, thus setting up a ground loop between A- and CNTRL A-. This problem is corrected by moving the CG hookswitch A- return from Pin 14 (CNTRL A-) on the Control Unit Accessory connector J901 to Pin 3 (A-).