MAINTENANCE MANUAL

LOGIC BOARD

19D901237G1

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DESCRIPTION

The logic board for the GE-MARC V E Classic II trunked radio controls the operation of the radio. It generates the basic timing clock, selects and generates tones, selects operating frequencies, interfaces with the handset, and controls maintenance functions.

The logic board contains the microcomputer, the digital signal processor, external program memory for the microcomputer, and the personality Program Memory.

The logic board is mounted in the top section of the chassis just above the Synthesizer/Interconnect board.

CIRCUIT ANALYSIS

MICROCOMPUTER RESET

The microcomputer, U1, is reset by several methods. These are switched A+ power up/down, watchdog timer reset, and suitcase programmer reset.

The microcomputer resets when +5 Volts from the +5V regulator, U6, is applied to pin 9 of U1 through switch Q4. In the reset state, the collector of Q3 or Q5 is pulled low by one of the three reset mechanisms: Watchdog timer (U8/Q6), low voltage, reset circuit (D9/Q2), and from the TQ2310 programmer through P1-4. This thereby turns Q4 on, passing +5V from regulator, U6, to pin 9 of the microcomputer.

Regulator, U6, maintains a constant +5V from the A+ power, and is also used for memory backup.

In a powered-down state (A+ SW off), zener diode D9 does not conduct, leaving Q2 off. With power on A+, U6 maintains a constant +5V on the emitter of Q4. With Q2 off, Q3 is turned on, enabling Q4 to be turned on and passing +5V from the emitter to collector of Q4 and on to the reset pin of U1. On power up, zener diode conducts when A+ SW reaches approximately 7.5 Volts (6.8V zener drop plus 0.7 base-emitter Q2 drop), thereby turning Q2 and Q3 off. Q4 is turned off thereby removing +5V from the collector of Q4. Pin 9 of U1 exponentially decays from +5V to 0 as determined by the RC time constant of R13 and C3. The microcomputer starts executing its program memory approximately 10 milliseconds after A+ SW reaches the turn on voltage of D9 and Q2.

If A+ and A+ SW are tied together the previous discussion still applies noting that U6 regulates +5 Volts before the application of A+ SW reaching the turn on voltage of D9 and Q2. Also, U6 continues to conduct when A+ SW drops below the turn on voltage.

When the microcomputer is operating properly watchdog timer service pulses exist on pin 1 of U1. This signal is coupled to the base of Q6 through C18. The service pulses act to periodically turn Q6 on which keeps C16 charged. This maintains a high voltage on the trigger and threshold inputs (pins 2 and 6 of U8), preventing the astable multivibrator from triggering its pin 3 output to a high value.

The watchdog timer, U8, monitors the operation of the microcomputer and generates a reset pulse in the abnormal condition that the microcomputer gets "lost" or does not execute the software

properly. If the watchdog timer does not receive programmed service pulses, it times out and applies a 140 millisecond reset pulse to U1. The watchdog timer will automatically restore the processor to proper operation so that only one pulse will occur. In the event that watchdog service pulses do not reach U8, a period waveform of approximately 3.8 Hz will appear at U1 pin 9. The TQ2310 programmer is able to reset the microcomputer by pulling P1-4 low. After release of this reset, the micro will test for the presence of the TQ2310 programmer by activity on U1-2, 4 and 5.

MEMORY BACKUP

Regulator, U6, is used for memory backup of the microcomputer contents when A+ switched power is turned off. To maintain memory backup upon power down of A+ SW, the A+ line applies constant power to the radio. U6 regulates A+ to +5 Volts. This allows the radio to remember mode, area, group, volume and backlight settings when the radio is turned off. Should the A+ supply be interrupted, the radio will revert to the first mode, area and group defined in the personality PROM, U5, with the volume at level 10 of 16 possible levels and the backlight at level 2 of 5 possible levels. The typical current drain for memory backup is 20 mA.

MICROCOMPUTER AND PROGRAM MEMORY

The microcomputer controls the operation of the radio by performing the following major functions:

- System Timing
- Frequency Selection
- Mode Selection
- Area Selection
- Group Selection
- Tone Generation
- Transmit/Receive Control
- Alert Tone Generation
- Handset Control and Display
- Audio Routing and Mute Control
- Volume Control
- Tone Detection
- Maintenance Functions
- DTMF Generation

Communication with the radio is through a 4-bit I/O expander bus, BUS 20-23 on P2-7 to 10. This bus interchanges data with the I/O expander on the Synthesizer/Interconnect board through P2. Data presented to the I/O expander is identified by the microcomputer PROG output at P2-11. A high to low transition indicates that address and control information is present. A low to high transition indicates data is present.

The microcomputer is sequenced through its program by an internal oscillator whose frequency is set by crystal Y1. The oscillator frequency is 8.192 MHz.

The microcomputer accesses its program memory from EPROM, U4. Reading of the stored program at U4 occurs when the PSEN line of U1 is low. The upper eight address lines of U1 (A8-A15) are stationary during this access time. The lower eight address lines of U1 (AD0-AD7) are captured by the octal latch, U2, and held stationary. ALE (U1-30) is used to latch the lower eight address lines. The output of U4 is then read into the data bus (AD0-AD7) of U1.

The microcomputer interfaces with the handset through MIC PTT, HKSW, SER IN and SER OUT on P1. It also interfaces with the TQ2310 programmer through HKSW, MIC PTT, SER DAT and SP RESET on P1. It also communicates with the digital signal processor, U2 and accesses the Personality EEPROM, U5.

The 8.192 MHz oscillator is buffered by U7-C and applied to U2 and the Synthesizer/Interconnect board.

DIGITAL SIGNAL PROCESSOR

The digital signal processor performs all processing on the digitized audio serial data stream from the Synthesizer/Interconnect board. The digitized input arrives on U2-21 and the processed output leaves on U2-22. Both the VOL/SQ HI and MIC HI signals are encoded at U2-21, while FLTRD VOL/SQ HI and FLTRD MIC HI are generated from the encoded stream at U2-22.

The basic clock for U2 is the 8.192 MHz clock (CLK) derived from the microcomputer's internal oscillator and crystal Y1. The serial shift clock is a 128 kHz square wave synchronous with CLK. The digital signal processor samples the receive and transmitted audio and processes them at an 8.00 kHz sampling rate.

The digital signal processor communicates with the microcomputer and transfers control, status and data information back and forth.

The digital signal processor, U2, is a program-masked IC which operates under control of microcomputer U1. The following functions are performed by the signal processor:

- Busy Tone Notching
- Signaling Tone Detection
- Busy Tone Detection
- Alert Tone Generation
- Volume Control
- Transmit Audio Pre-emphasis
- Transmit Audio Limiter
- Busy Tone Injection
- Tone Generation
- DTMF Generation

Busy tone deviation is set for 1 kHz deviation. Signalling tones are approximately 3 kHz deviation and voice limits at 3.5 kHz deviation. A burst of busy tone is transmitted on an idle channel to acquire the repeater. When the channel is acquired, signalling tones are transmitted through the repeater to other radios. After the call initialization sequence, the radio transmits attenuated busy tone in accompaniment to each transmission to hold the repeater up. Between transmissions, the radio monitors the channel for busy tone for assurance that the channel is still active.

The repeater transmits busy tone continuously when it is active, indicating that the channel is in use.

PERSONALITY EEPROM

EEPROM, U5, contains 1K x 8 bit locations in which are stored information that identify the system operating parameters, tones, frequencies, etc., present in the radio. Also included in the first 512 x 8 bit locations are stored repertoire dialer parameters used for telephone interconnect and dispatch overdial.

The total size of the EEPROM is 2K x 8 where locations 1024 to 2047 hold radio personality and frequency data and locations zero to 511 hold repertoire dialer parameters. The micro can only write into the first half of the EEPROM under normal system operation. The second half (personality and frequency) is accessable only with the TQ2310 programmer.

The microcomputer accesses the EE PROM by first applying power to U5, via pin 14 (low). This turns Q7 on, allowing +5V to pass to the EE PWR power line to the EEPROM. After reading U5, the microcomputer conserves power by raising pin 14 high, turning off Q7 and removing power from U5. Q8 and Q9 generate the write pulse to the EEPROM. The write line from the microcomputer is gated with the reset line as well as microcomputer address line 10. This prevents the microcomputer from writing into the second half of EEPROM which is reserved for access by the TQ2310. It also prevents erroneous writes upon power up/down of the radio.

U7-A allows external data memory accesses of the EEPROM in high microcomputer memory areas.

GENERAL ELECTRIC COMPANY • MOBILE COMMUNICATIONS DIVISION
WORLD HEADQUARTERS • LYNCHBURG, VIRGINIA 24502 U.S.A.

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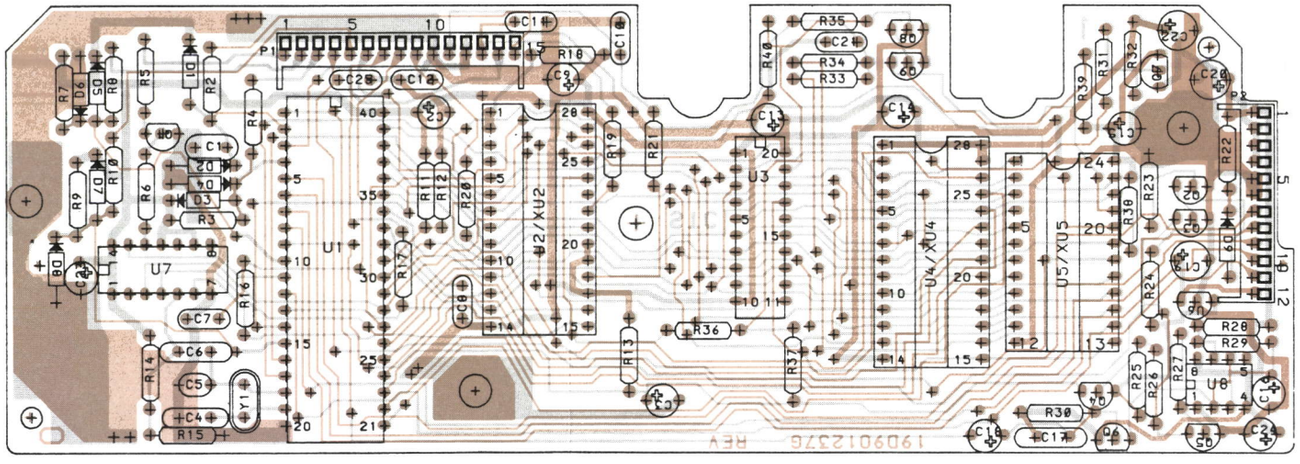
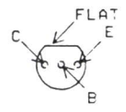
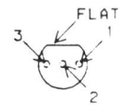


LEAD IDENTIFICATION
FOR Q1-Q9



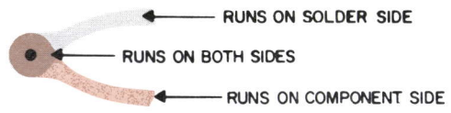
IN-LINE
TOP VIEW

LEAD IDENTIFICATION
FOR U6



IN-LINE
TOP VIEW

NOTE: CASE SHAPE IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.



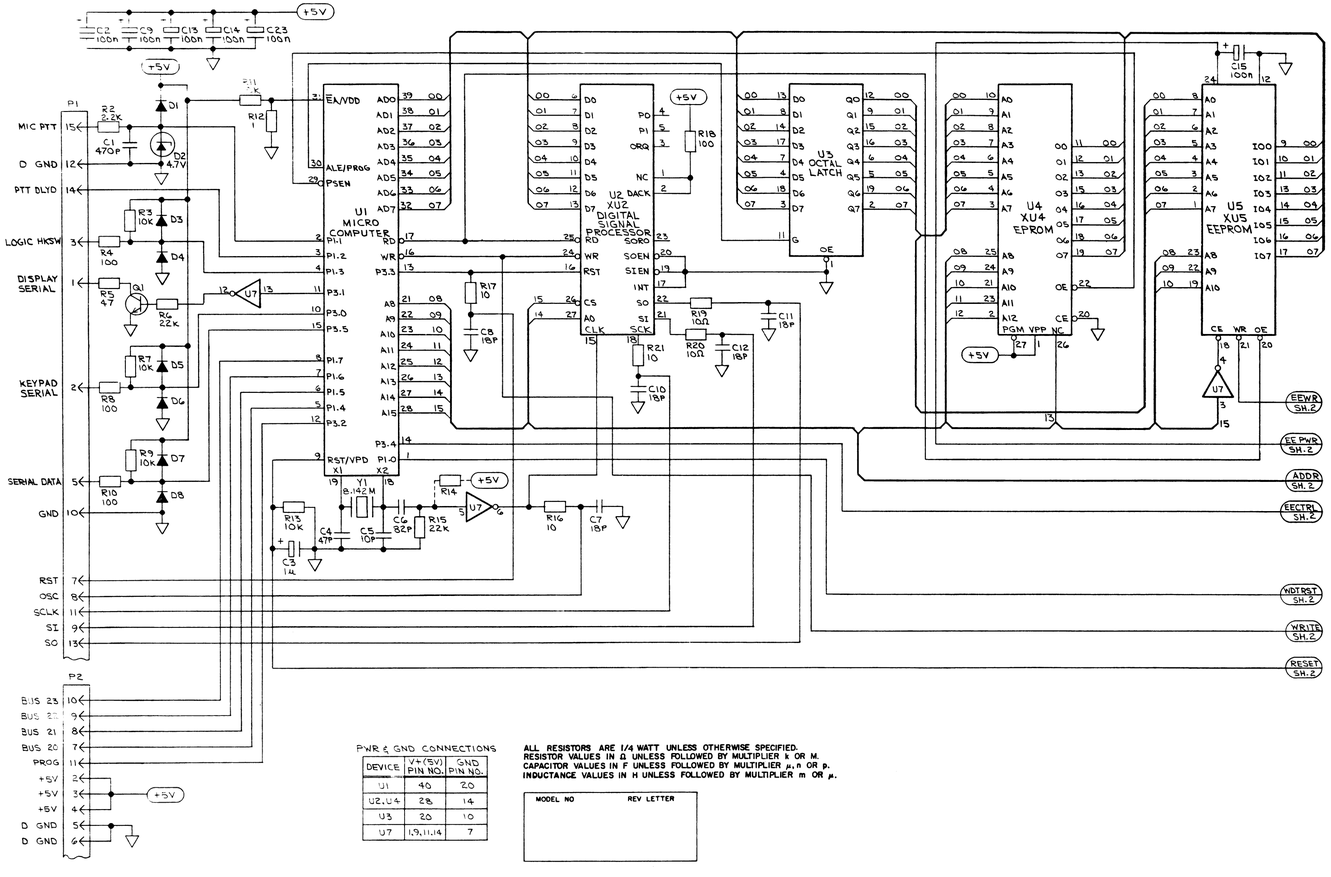
(19D901239, Rev. 0)
(19A703851, Sh. 1, Rev. 0)
(19A703851, Sh. 2, Rev. 0)

OUTLINE DIAGRAMS

LOGIC BOARD

19D901237G1

4 Issue 1



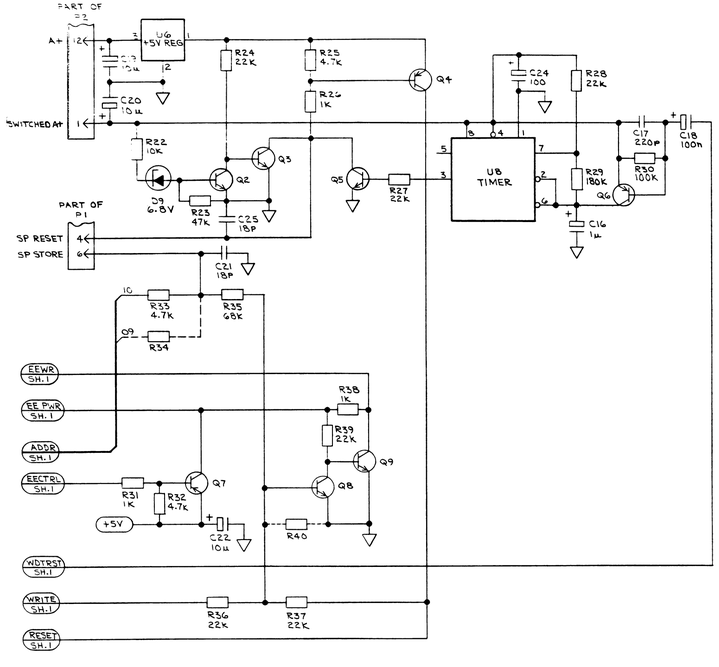
PWR & GND CONNECTIONS

DEVICE	V+(5V) PIN NO.	GND PIN NO.
U1	40	20
U2,U4	28	14
U3	20	10
U7	1,9,11,14	7

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED.
RESISTOR VALUES IN Ω UNLESS FOLLOWED BY MULTIPLIER k OR M.
CAPACITOR VALUES IN F UNLESS FOLLOWED BY MULTIPLIER μ, n OR p.
INDUCTANCE VALUES IN H UNLESS FOLLOWED BY MULTIPLIER m OR μ.

MODEL NO	REV LETTER

(19D901454, Sh. 1, Rev. 0)



(19D901454, Sh. 2, Rev. 0)

SCHEMATIC DIAGRAM

LOGIC BOARD

19D901237G1

PARTS LIST

LOBIC BOARD
19D901237G1
ISSUE 1

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	19A701602P13	Ceramic: 470 pF ±20%, 1000 VDCW; sim to Type JF Dimcap.
C2	19A701534P1	Tantalum: 0.1 uF ±20%, 35 VDCW.
C3	19A701534P4	Tantalum: 1 uF ±20%, 35 VDCW.
C4	19A700235P21	Ceramic: 47 pF ±5%, 50 VDCW.
C5	19A700235P13	Ceramic: 10 pF ±5%, 50 VDCW.
C6	19A700235P24	Ceramic: 82 pF ±5%, 50 VDCW.
C7 and C8	19A700235P16	Ceramic: 18 pF ±5%, 50 VDCW.
C9	19A701534P1	Tantalum: 0.1 uF ±20%, 35 VDCW.
C10 thru C12	19A700235P16	Ceramic: 18 pF ±5%, 50 VDCW.
C13 thru C16	19A701534P1	Tantalum: 0.1 uF ±20%, 35 VDCW.
C17	19A700235P29	Ceramic: 220 pF ±5%, 50 VDCW.
C18	19A701534P1	Tantalum: 0.1 uF ±20%, 35 VDCW.
C19 and C20	19A701534P7	Tantalum: 10 uF ±20%, 16 VDCW.
C21	19A700235P16	Ceramic: 18 pF ±5%, 50 VDCW.
C22	19A701534P7	Tantalum: 10 uF ±20%, 16 VDCW.
C23 and C24	19A701534P1	Tantalum: 0.1 uF ±20%, 35 VDCW.
C25	19A700235P16	Ceramic: 18 pF ±5%, 50 VDCW.
		- - - - - - - - - - DIODES - - - - - - - - - -
D1	19A700028P1	Silicon, fast recovery: fwd current 75 mA, 75 PIV; sim to Type 1N4148.
D2	19A700025P5	Silicon, zener: 400 mW max; sim to BZX55-C4V7.
D3 thru D8	19A700028P1	Silicon, fast recovery: fwd current 75 mA, 75 PIV; sim to Type 1N4148.
D9	19A700025P8	Silicon, zener: 400 mW max; sim to BZX55-C6V8.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P1	19A700041P64	Connector, printed wire; sim to Molex 22-02-2155.
P2	19A700041P61	Printed wire: 15 circuits; sim to Molex 22-01-2155.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q1 thru Q3	19A700023P2	Silicon, NPN: sim to 2N3904.
Q4	19A700022P2	Silicon, PNP: sim to 2N3906.
Q5	19A700023P2	Silicon, NPN: sim to 2N3904.
Q6	19A700022P2	Silicon, PNP: sim to 2N3906.
Q7	19A702504P2	Silicon, PNP; sim to 2N4403.
Q8 and Q9	19A700023P2	Silicon, NPN: sim to 2N3904.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R2	19A700019P41	Deposited carbon: 2.2K ohms ±5%, 1/4 w.

SYMBOL	GE PART NO.	DESCRIPTION
R3	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
R4	19A700019P25	Deposited carbon: 100 ohms ±5%, 1/4 w.
R5	19A700019P21	Deposited carbon: 47 ohms ±5%, 1/4 w.
R6	19A700019P53	Deposited carbon: 22K ohms ±5%, 1/4 w.
R7	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
R8	19A700019P25	Deposited carbon: 100 ohms ±5%, 1/4 w.
R9	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
R10	19A700019P25	Deposited carbon: 100 ohms ±5%, 1/4 w.
R11	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
R12	19A700019P1	Deposited carbon: 1 ohms ±5%, 1/4 w.
R13	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
R15	19A700019P53	Deposited carbon: 22K ohms ±5%, 1/4 w.
R16 and R17	19A700019P13	Deposited carbon: 10 ohms ±5%, 1/4 w.
R18	19A700019P25	Deposited carbon: 100 ohms ±5%, 1/4 w.
R19 thru R21	19A700019P13	Deposited carbon: 10 ohms ±5%, 1/4 w.
R22	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
R23	19A700019P57	Deposited carbon: 47K ohms ±5%, 1/4 w.
R24	19A700019P53	Deposited carbon: 22K ohms ±5%, 1/4 w.
R25	19A700019P45	Deposited carbon: 4.7K ohms ±5%, 1/4 w.
R26	19A700019P37	Deposited carbon: 1K ohms ±5%, 1/4 w.
R27 and R28	19A700019P53	Deposited carbon: 22K ohms ±5%, 1/4 w.
R29	19A700019P64	Deposited carbon: 0.18M ohms ±5%, 1/4 w.
R30	19A700019P61	Deposited carbon: 0.1M ohms ±5%, 1/4 w.
R31	19A700019P37	Deposited carbon: 1K ohms ±5%, 1/4 w.
R32 and R33	19A700019P45	Deposited carbon: 4.7K ohms ±5%, 1/4 w.
R35	19A700019P59	Deposited carbon: 68K ohms ±5%, 1/4 w.
R36 and R37	19A700019P53	Deposited carbon: 22K ohms ±5%, 1/4 w.
R38	19A700019P37	Deposited carbon: 1K ohms ±5%, 1/4 w.
R39	19A700019P53	Deposited carbon: 22K ohms ±5%, 1/4 w.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - - -
U1	19A703104P2	HMOS, 8 Bit; sim to Intel TP8031AH.
U2	19A703984P2	NMOS, 16 Bit.
U3	19A700037P415	Digital: (OCTAL TRANSPARENT LATCH TRI-STATE).
U4	19A703482P1	Programmable Read Only Memory (64K Ultraviolet Erasable).
U5	19A703952P1	MEMORY. (2K X 8 5 VOLT ONLY EEPROM).
U6	19J706031P1	Linear: POSITIVE VOLTAGE REGULATOR.
U7	19A700037P313	Digital: HEX SCHMITT-TRIGGER INVERTER.
U8	19A701865P1	Linear, 555 TIMER.
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XU2	19A700156P3	Integrated circuit: 28 contacts; sim to AMP 640362P3.
XU4	19A700156P3	Integrated circuit: 28 contacts; sim to AMP 640362P3.
XU5	19A700156P1	Integrated circuit: 24 contacts; sim to Augat 324-AG39D.
		- - - - - - - - - - CRYSTALS - - - - - - - - - -
Y1	19A702511G11	Quartz: 8.192000 MHz.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - - -
	19A701516P1	Insulator, plate. (Mounts under Y1).
	19A701235P14	Spacer.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES