

FTH-2009 SERVICE MANUAL

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This booklet contains supplemental technical information related to the FTH-2009 for use with the FTH-2009 Operating Manual. Service or repairs to the FTH-2009 transceiver should be performed by pualified technicians only.

YAESU MUSEN CO., LTD.

C.P.O.BOX 1500, TOKYO, JAPAN

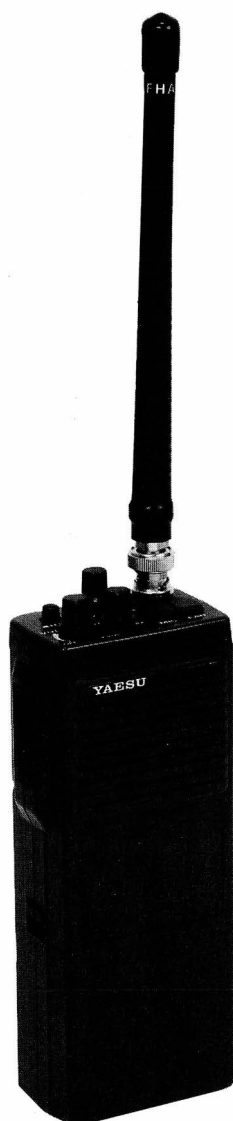
YAESU U.S.A.

17210 Ebwards Rd. Cerritos, Califorria, 90701 U.S.A.

YAESU EUROPE B.V.

Snipweg 3. 1118AA Schiphol The NETHERLANDS

FTH-2009 SERVICE MANUAL



This manual is intended to serve as a supplement to the FTH-2009 Operating Manual. Specifications and details of operation and options are provided in the Operating Manual, and are not reprinted herein. Therefore, this manual is not intended to serve as an independent reference, but to be used in conjunction with the information provided in the Operating Manual.

Two layout diagrams are provided for each double-sided glass-epoxy circuit board in the FTH-2009. Each side of the board is identified by the type of the majority of components installed on that side. In most cases one side has only chip components, and the other has either a mixture of both chip and lead components (trimmers, coils, electrolytic capacitors, packaged ICs, etc.), or leaded components only.

While we believe the technical information in this manual is correct, Yaesu assumes no liability for damage that may occur as a result of typographical or other errors that may be present. Your cooperation in pointing out any inconsistencies in the technical information would be appreciated.

Yaesu Musen reserves the right to make changes in the circuitry of this transceiver, in the interest of technological improvement, without notification of the owners.

SPECIFICATIONS

GENERAL

Frequency Coverage:	Vers. A	B	C
	MHz 136-151	150.8-163	161-174
Number of Channels:	Up to 6 simplex or semi-duplex		
Minimum Channel Step:	25 kHz		
Antenna (BNC Jack):	Supplied rubber flex antenna		
Antenna Impedance:	50 ohms (Unbalanced)		
Supply Voltage:	6.0 to 12.0 VDC		
Current Consumption (Approx):	Standby 35mA Receive 200mA Transmit 0.8A w/2.5W RF, 1.2A w/4.5W RF		
Case Size (WHD, Approx):	62 x 165.5 x 39.5mm with FNB-18		
Weight (Approx):	500g with FNB-18		

RECEIVER

Circuit Type:	Double-conversion superheterodyne
Intermediate Frequencies:	21.4MHz and 455kHz
Sensitivity:	0.22uV for 12dB SINAD
Image Rejection:	Better than 60dB
Audio Output (@8 ohms, for 10% THD):	More than 250mW @7.2VDC More than 400mW @9.6VDC

TRANSMITTER

Power Output (Selectable):	4.5 or 1.0 watts @9.6VDC (FNB-21) 2.5 or 0.5 watts @7.2VDC (FNB-18/19)
Frequency Stability:	Better than ± 10 ppm from -25 to +55°C
Modulation Type:	16F3
Maximum Deviation:	± 5 kHz
Maximum -60dB Bandwidth:	16 kHz
Spurious Emissions:	At least 60 dB below carrier
Audio Response Characteristic:	+1,-3dB of 6dB/octave Pre-emphasis from 300 to 3000 Hz

Specification subject to change without notice or obligation.

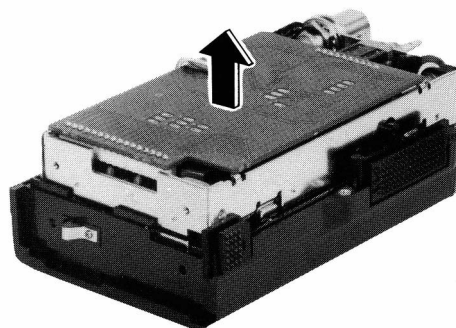
CIRCUIT BOARD ACCESS

- (1) Make sure the transceiver is off. Remove the hard or soft case, if used, and remove the battery pack. Disconnect the antenna from the top panel.

- (2) Pull off the three knobs on the top panel, and remove the EAR/MIC gasket from the antenna jack. Then remove the screw affixing the top panel and carefully remove it and the rubber gasket underneath.

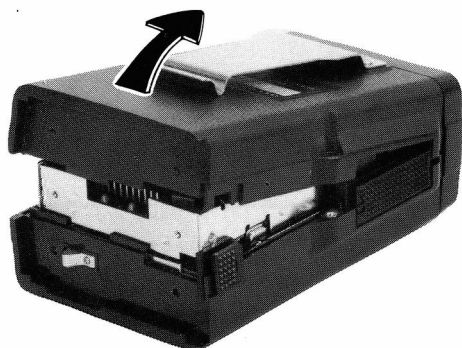
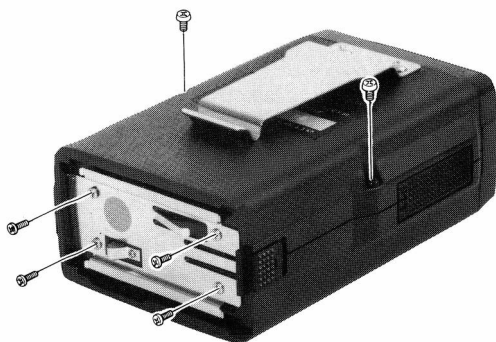


- (5) Lift the EEPROM Unit (or Matrix Unit) from the rear side of the chassis to remove it.

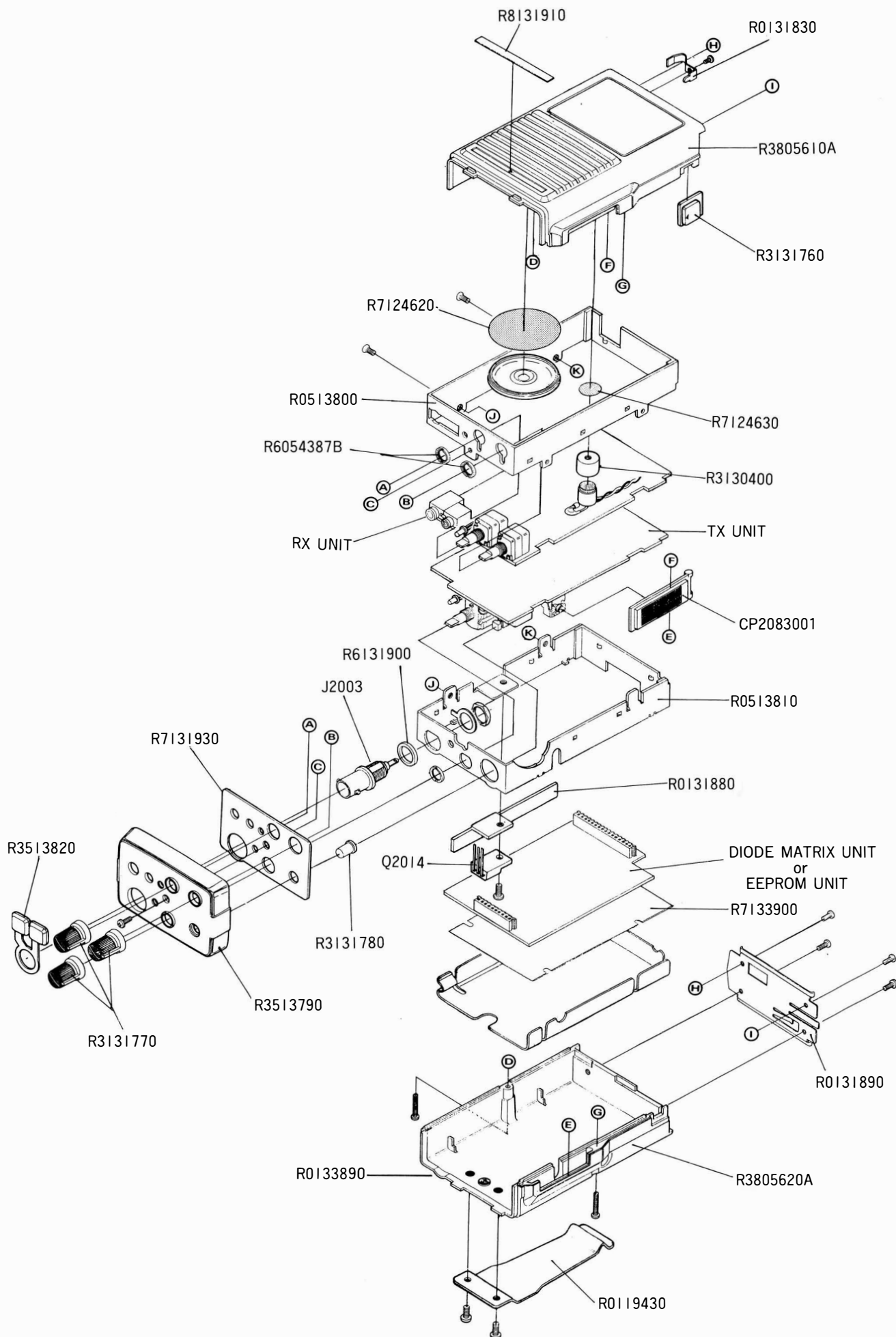


- (3) Remove the four screws in the battery spring plate on the bottom of the transceiver, and carefully remove the plate and battery latch button.

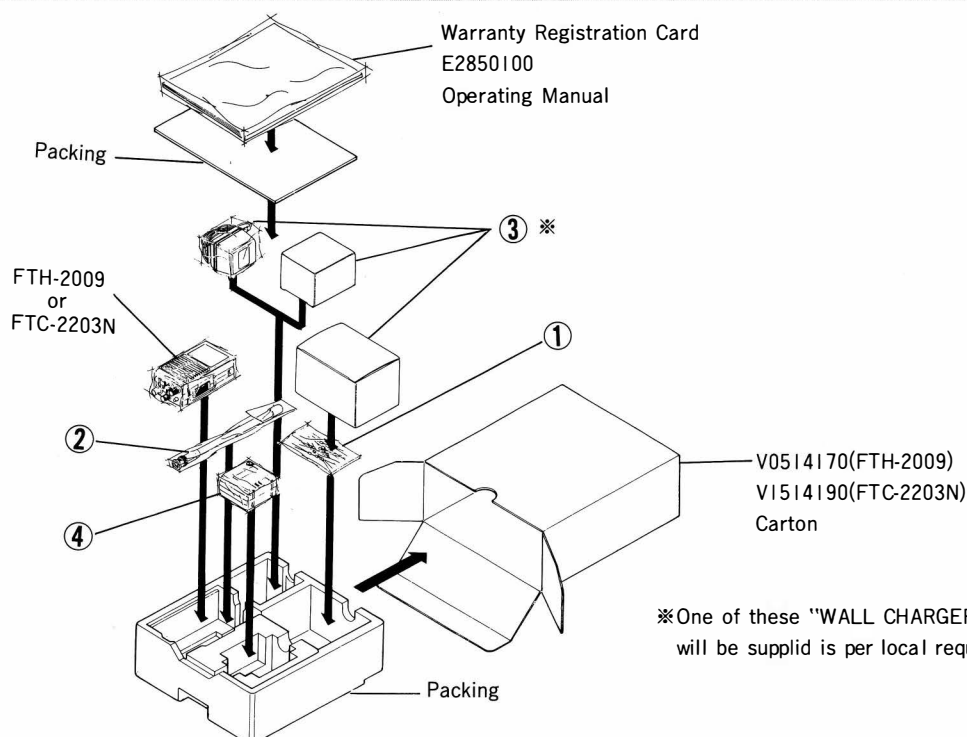
- (4) On either side of the rear panel, remove the screw affixing the front and rear halves of the case. Tilt the rear panel outwards slightly at the bottom, and remove the top panel. Then gently separate the front and rear panels from the chassis.



EXPLODED VIEW

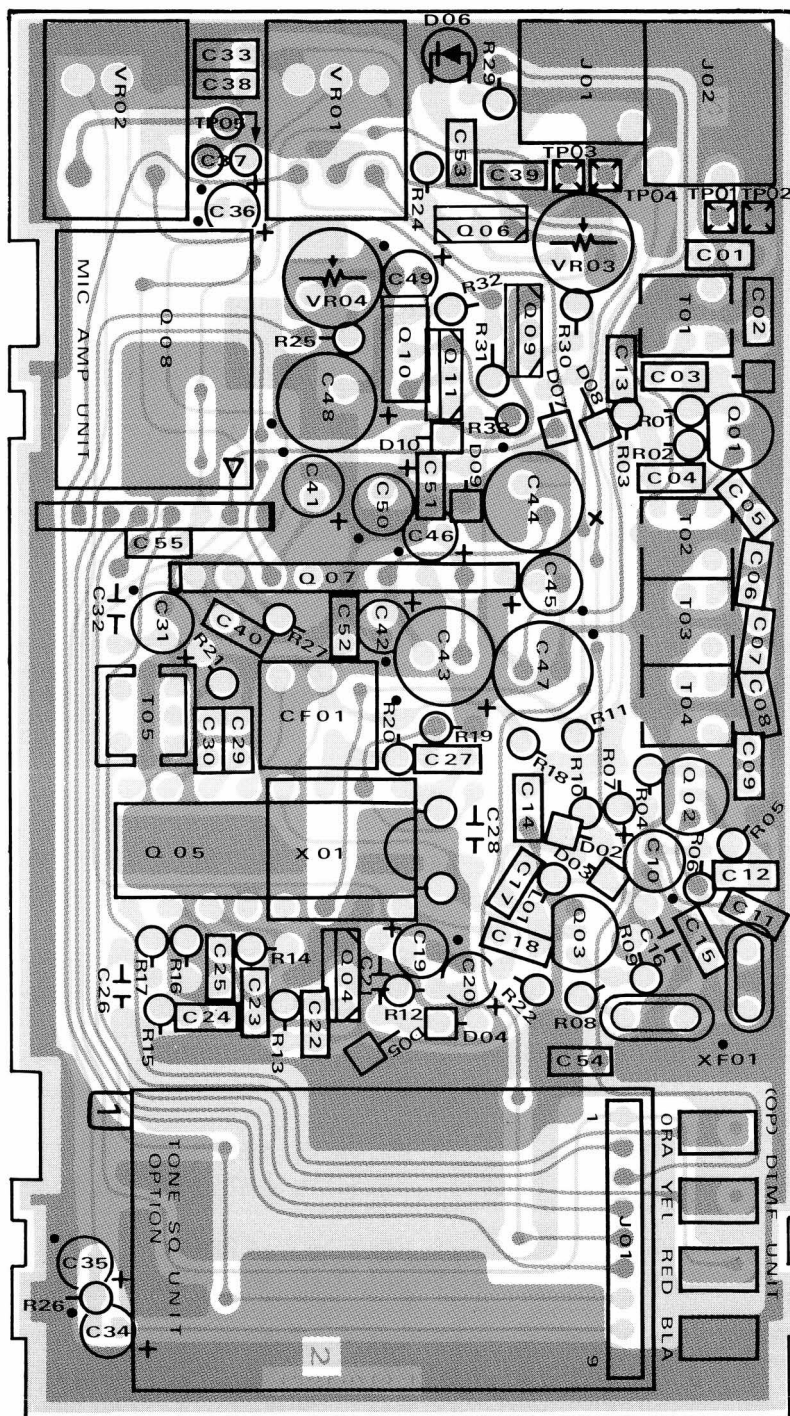
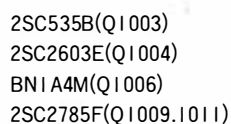
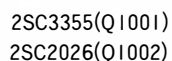
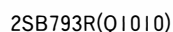
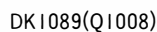
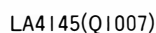


PACKAGING



*** ACCESSORIES ***					
①	G2090389	Programming Diodes		1SS133	
—	R0119430	BELT CLIP			
②	Q3000001	FHA-1A	HELICAL ANTENNA	(134-142MHz)	TYP A
	Q3000002	FHA-1B	HELICAL ANTENNA	(142-150MHz)	TYP A
	Q3000006	FHA-1C	HELICAL ANTENNA	(150-158MHz)	TYP B
	Q3000007	FHA-1D	HELICAL ANTENNA	(158-166MHz)	TYP B
	Q3000007	FHA-1D	HELICAL ANTENNA	(158-166MHz)	TYP C
	Q3000008	FHA-1E	HELICAL ANTENNA	(166-174MHz)	TYP C
	Q3000002	FHA-1B	HELICAL ANTENNA	(142-150MHz)	TYP D
	Q3000006	FHA-1C	HELICAL ANTENNA	(150-158MHz)	TYP D
③	Q3000007	FHA-1D	HELICAL ANTENNA	(158-166MHz)	TYP E
	Q3000008	FHA-1E	HELICAL ANTENNA	(166-174MHz)	TYP E
	D3000484	NC-28B	WALL CHARGER F/FNB-18	117V UL Plug	
	D3000485	NC-28C	WALL CHARGER F/FNB-18	220-234V EU Plug	
	D3000607	NC-28E	WALL CHARGER F/FNB-18	220-234V Australia	
	D3000571	NC-34B	WALL CHARGER F/FNB-19	117V UL Plug	
	D3000572	NC-34C	WALL CHARGER F/FNB-19	220-234V EU Plug	
	D3000641	NC-34E	WALL CHARGER F/FNB-19	220-234V Australia	
④	D3000642	NC-38B	WALL CHARGER F/FNB-21	117V UL Plug	
	D3000643	NC-38C	WALL CHARGER F/FNB-21	220-234V EU Plug	
	D3000644	NC-38E	WALL CHARGER F/FNB-21	220-234V Australia	
④	D3000636	FNB-18	Ni-Cd Battery Pack 7.2V	600mAh	
	D3000637	FNB-19	Ni-Cd Battery Pack 7.2V	1000mAh	
	D3000638	FNB-21	Ni-Cd Battery Pack 9.6V	600mAh	

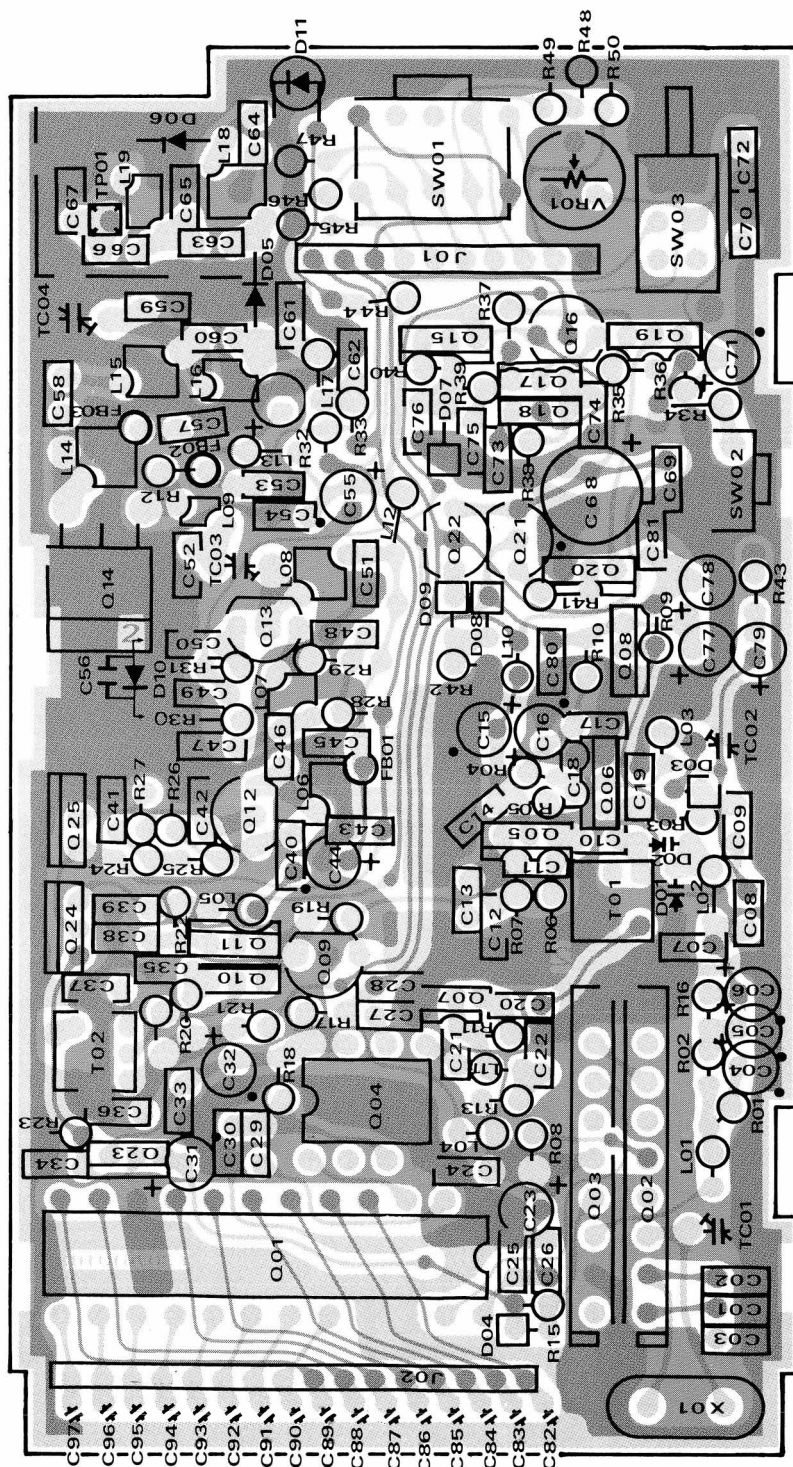
RX UNIT (No.1XXX)



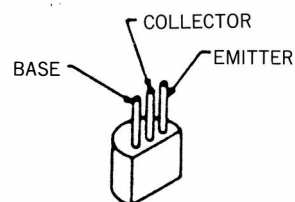
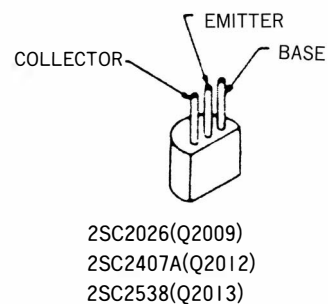
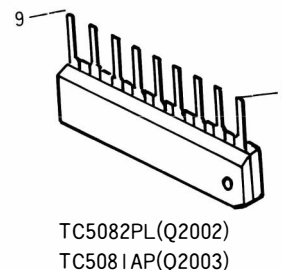
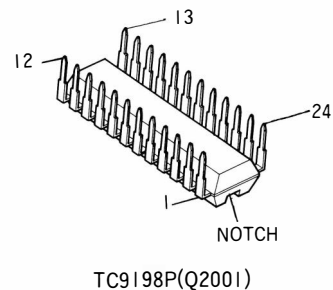
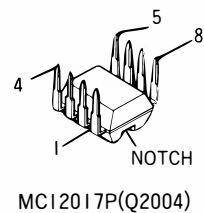
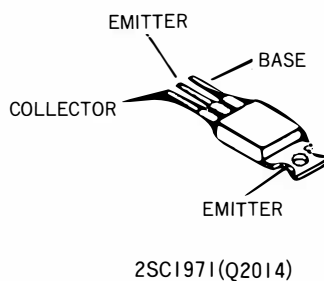
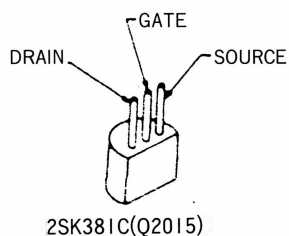
Obverse view of "Component" side

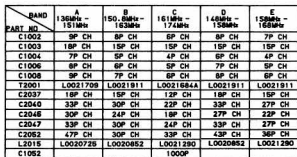
TX UNIT PARTS LAYOUT

TX UNIT (No.2XXX)



Obverse view of "Component" side





RESISTOR VALUES ARE IN Ω /K/W ;
CAPACITOR VALUES ARE IN μ F. 50V ;
(7) CAPACITOR VALUES ARE TANTALUM ;
INDUCTOR VALUES ARE IN H

UNLESS OTHERWISE NOTED.

```
(xx) RX  SQL  CLOSED
(xx) RX  SQL  OPEN
xx  TX
```

RX UNIT PARTS LIST

*** RX UNIT ***

CP2075001	RX UNIT w/ Components & Frame Front	TYP A
CP2075002	RX UNIT w/ Components & Frame Front	TYP B
CP2075003	RX UNIT w/ Components & Frame Front	TYP C

F3076102B P.C.B. W/O COMP.

C 1001	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 1002	K02173070	CERAMIC CAP.	7pF	50V	CH	TYP C
C 1002	K02173070	CERAMIC CAP.	7pF	50V	CH	TYP E
C 1002	K02173080	CERAMIC CAP.	8pF	50V	CH	TYP B
C 1002	K02173080	CERAMIC CAP.	8pF	50V	CH	TYP D
C 1002	K02173090	CERAMIC CAP.	9pF	50V	CH	TYP A
C 1003	K02175150	CERAMIC CAP.	15pF	50V	CH	TYP E
C 1003	K02175180	CERAMIC CAP.	18pF	50V	CH	TYP A
C 1003	K02175150	CERAMIC CAP.	15pF	50V	CH	TYP B
C 1003	K02175150	CERAMIC CAP.	15pF	50V	CH	TYP C
C 1003	K02175150	CERAMIC CAP.	15pF	50V	CH	TYP D
C 1004	K02172040	CERAMIC CAP.	4pF	50V	CH	TYP C
C 1004	K02172040	CERAMIC CAP.	4pF	50V	CH	TYP E
C 1004	K02172050	CERAMIC CAP.	5pF	50V	CH	TYP B
C 1004	K02172050	CERAMIC CAP.	5pF	50V	CH	TYP D
C 1004	K02173070	CERAMIC CAP.	7pF	50V	CH	TYP A
C 1005	K02172059	CERAMIC CAP.	0.5pF	50V	CK	
C 1006	K02172050	CERAMIC CAP.	5pF	50V	CH	TYP C
C 1006	K02172050	CERAMIC CAP.	5pF	50V	CH	TYP E
C 1006	K02173060	CERAMIC CAP.	6pF	50V	CH	TYP B
C 1006	K02173070	CERAMIC CAP.	7pF	50V	CH	TYP D
C 1006	K02173080	CERAMIC CAP.	8pF	50V	CH	TYP A
C 1007	K02172059	CERAMIC CAP.	0.5pF	50V	CK	
C 1008	K02173060	CERAMIC CAP.	6pF	50V	CH	TYP E
C 1008	K02173060	CERAMIC CAP.	6pF	50V	CH	TYP C
C 1008	K02173070	CERAMIC CAP.	7pF	50V	CH	TYP B
C 1008	K02173080	CERAMIC CAP.	8pF	50V	CH	TYP D
C 1008	K02173090	CERAMIC CAP.	9pF	50V	CH	TYP A
C 1009	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 1010	K40129012	AL. ELECTRO. CAP.	10uF	16V		
C 1011	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 1012	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 1013	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 1014	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 1015	K02172050	CERAMIC CAP.	5pF	50V	CH	
C 1016	K26140713	CERAMIC CAP.	0.01uF	25V		
C 1017	K02175120	CERAMIC CAP.	12pF	50V	CH	
C 1018	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 1019	K70107105	TANTALUM CAP.	1uF	10V		
C 1020	K70107105	TANTALUM CAP.	1uF	10V		
C 1021	K19149017	CERAMIC CAP.	0.022uF	25V		
C 1022	K10176101	CERAMIC CAP.	100pF	50V	B	
C 1023	K10176471	CERAMIC CAP.	470pF	50V	B	
C 1024	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 1025	K10176181	CERAMIC CAP.	180pF	50V	B	
C 1026	K26140713	CERAMIC CAP.	0.01uF	25V		
C 1027	K02175270	CERAMIC CAP.	27pF	50V	CH	
C 1028	K02175820	CERAMIC CAP.	82pF	50V	CH	
C 1029	K23170042	CAP. D55X5T1H104K21	0.1uF	50V		
C 1030	K23170042	CAP. D55X5T1H104K21	0.1uF	50V		
C 1031	K40129012	AL. ELECTRO. CAP.	10uF	16V		

RX UNIT PARTS LIST

C 1032	K26140713	CERAMIC CAP.	0.01uF	25V		
C 1033	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 1034	K70167104	TANTALUM CAP.	0.1uF	35V		
C 1035	K70167104	TANTALUM CAP.	0.1uF	35V		
C 1036	K70167104	TANTALUM CAP.	0.1uF	35V		
C 1037	K40129038	AL. ELECTRO. CAP.	100uF	16V		
C 1038	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 1039	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 1040	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 1041	K70089023	TANTALUM CAP.	47uF	6.3V		
C 1042	K70167104	TANTALUM CAP.	0.1uF	35V		
C 1043	K40129038	AL. ELECTRO. CAP.	100uF	16V		
C 1044	K70107476	TANTALUM CAP.	47uF	10V		
C 1045	K40129012	AL. ELECTRO. CAP.	10uF	16V		
C 1046	K70167104	TANTALUM CAP.	0.1uF	35V		
C 1047	K40129038	AL. ELECTRO. CAP.	100uF	16V		
C 1048	K40129038	AL. ELECTRO. CAP.	100uF	16V		
C 1049	K70167104	TANTALUM CAP.	0.1uF	35V		
C 1050	K40179006	AL. ELECTRO. CAP.	2.2uF	50V		
C 1051	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 1052	K10176102	CERAMIC CAP.	0.001uF	50V	B	TYP C
C 1053	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 1054	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 1055	K10176102	CERAMIC CAP.	0.001uF	50V	B	
CF1001	H3900280	CERAMIC FILTER	LF-B12			
D 1002	G2015550	DIODE	1S1555			
D 1003	G2015550	DIODE	1S1555			
D 1004	G2090118	DIODE	1SS97			
D 1005	G2090118	DIODE	1SS97			
D 1006	G2090432	LED	GL3PG8			
D 1007	G2015550	DIODE	1S1555			
D 1008	G2015550	DIODE	1S1555			
D 1009	G2090183	DIODE	HZ9A2L			
D 1010	G2090277	DIODE	1SS205			
FB1001	L9190001	FERRITE BEAD 4A2 RI3X3-1				
FB1002	L9190044	FERRITE BEAD 3A RI2.5X1.2-1				
J 1001	P0090706	CONNECTOR 9210B-1-09-T				
J 1002	P1090370	CONNECTOR HSJ0836-01-010				
J 1003	P1090369	CONNECTOR HSJ0838-01-010				
L 1001	L1190203	M.RFC LAL03NA4R7K	4.7uH			
Q 1001	G3333550	TRANSISTOR	2SC3355			
Q 1002	G3320260	TRANSISTOR	2SC2026			
Q 1003	G3305350B	TRANSISTOR	2SC535B			
Q 1004	G3326030E	TRANSISTOR	2SC2603E			
Q 1005	G1090809	IC	MC3361P			
Q 1006	G3090080	TRANSISTOR	BN1A4M			
Q 1007	G1090558	IC	LA4145			
Q 1008	G1091024	IC	DK1089			
Q 1009	G3327850F	TRANSISTOR	2SC2785F			
Q 1010	G3207930R	TRANSISTOR	2SB793R			
Q 1011	G3327850F	TRANSISTOR	2SC2785F			
R 1001	J02225154	CARBON FILM RES.	150K	1/6W		

RX UNIT PARTS LIST

R 1002	J02225472	CARBON FILM RES.	4.7K	1/6W
R 1003	J02225102	CARBON FILM RES.	1K	1/6W
R 1004	J02225334	CARBON FILM RES.	330K	1/6W
R 1005	J02225101	CARBON FILM RES.	100	1/6W
R 1006	J02225222	CARBON FILM RES.	2.2K	1/6W
R 1007	J02225822	CARBON FILM RES.	8.2K	1/6W
R 1008	J02225821	CARBON FILM RES.	820	1/6W
R 1009	J02225274	CARBON FILM RES.	270K	1/6W
R 1010	J02225271	CARBON FILM RES.	270	1/6W
R 1011	J02225473	CARBON FILM RES.	47K	1/6W
R 1012	J02225472	CARBON FILM RES.	4.7K	1/6W
R 1013	J02225124	CARBON FILM RES.	120K	1/6W
R 1014	J02225394	CARBON FILM RES.	390K	1/6W
R 1015	J02225392	CARBON FILM RES.	3.9K	1/6W
R 1016	J02225682	CARBON FILM RES.	6.8K	1/6W
R 1017	J02225153	CARBON FILM RES.	15K	1/6W
R 1018	J02225101	CARBON FILM RES.	100	1/6W
R 1019	J02225104	CARBON FILM RES.	100K	1/6W
R 1020	J02225222	CARBON FILM RES.	2.2K	1/6W
R 1021	J02225183	CARBON FILM RES.	18K	1/6W
R 1022	J02225102	CARBON FILM RES.	1K	1/6W
R 1024	J02225225	CARBON FILM RES.	2.2M	1/6W
R 1025	J02225472	CARBON FILM RES.	4.7K	1/6W
R 1027	J02225333	CARBON FILM RES.	33K	1/6W
R 1029	J02225152	CARBON FILM RES.	1.5K	1/6W
R 1030	J02225104	CARBON FILM RES.	100K	1/6W
R 1031	J02225223	CARBON FILM RES.	22K	1/6W
R 1032	J02225829	CARBON FILM RES.	8.2	1/6W
R 1033	J02225101	CARBON FILM RES.	100	1/6W
R 1034	J01225472	CARBON FILM RES.	4.7K	1/6W
T 1001	L0021282	COIL		
T 1002	L0021282	COIL		
T 1003	L0021282	COIL		
T 1004	L0021282	COIL		
T 1005	L0190146	COIL		
TP1001	Q5000082	TERMINAL POST	TP-N	
TP1002	Q5000082	TERMINAL POST	TP-N	
TP1003	Q5000082	TERMINAL POST	TP-N	
TP1004	Q5000082	TERMINAL POST	TP-N	
TP1005	Q5000082	TERMINAL POST	TP-N	
VR1001	J60800165	POT. RK0971111 20KB/SW	20KB	
VR1002	J60800149	POT. RK0971111 20KA/SW	20KA	
	R6054387B	SPECIAL NUTS		
VR1003	J51745473	POT. H0651A017-47KB	47KB	
VR1004	J51745102	POT. H0651A007-1KB	1KB	
X 1001	H0102816	XTAL HC-49/T	20.945MHZ	
XF1001	H1102095	XTAL FILTER	21M15BU	
	R0513800A	FRAME F		

TX UNIT PARTS LIST

*** TX UNIT ***

CP2074001	TX UNIT w/Components & Frame R	5 ppm	TYP A
CP2074002	TX UNIT w/Components & Frame R	5 ppm	TYP B
CP2074003	TX UNIT w/Components & Frame R	5 ppm	TYP C
CP2074004	TX UNIT w/Components & Frame R	5 ppm	TYP D
CP2074005	TX UNIT w/Components & Frame R	5 ppm	TYP E
CP2074006	TX UNIT w/Components & Frame R	10 ppm	TYP A
CP2074007	TX UNIT w/Components & Frame R	10 ppm	TYP B
CP2074008	TX UNIT w/Components & Frame R	5 ppm	TYP B
CP2074009	TX UNIT w/Components & Frame R	10 ppm	TYP C
CP2074010	TX UNIT w/Components & Frame R	10 ppm	TYP D
CP2074011	TX UNIT w/Components & Frame R	10 ppm	TYP E

F3076101B P.C.B W/O COMP.

C 2001	K02175150	CERAMIC CAP.	15pF	50V	CH	
C 2002	K02175330	CERAMIC CAP.	33pF	50V	CH	
C 2003	K02179009	CERAMIC CAP.	22pF	50V	CH	
C 2004	K70137225	TANTALUM CAP.	2.2uF	20V		
C 2005	K70167224	TANTALUM CAP.	0.22uF	35V		
C 2006	K70167104	TANTALUM CAP.	0.1uF	35V		
C 2007	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2008	K10176101	CERAMIC CAP.	100pF	50V	B	
C 2009	K02179009	CERAMIC CAP.	22pF	50V	CH	
C 2010	K02179009	CERAMIC CAP.	22pF	50V	CH	
C 2011	K02179009	CERAMIC CAP.	22pF	50V	CH	
C 2012	K02173100	CERAMIC CAP.	10pF	50V	CH	
C 2013	K02172030	CERAMIC CAP.	3pF	50V	CJ	
C 2014	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2015	K70087106	TANTALUM CAP.	10uF	6.3V		
C 2016	K70107475	TANTALUM CAP.	4.7uF	10V		
C 2017	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2018	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2019	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2020	K02172030	CERAMIC CAP.	3pF	50V	CH	
C 2021	K02175150	CERAMIC CAP.	15pF	50V	CH	
C 2022	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2023	K70087106	TANTALUM CAP.	10uF	6.3V		
C 2024	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2025	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2026	K19149013	CERAMIC CAP.	0.01uF	25V		
C 2027	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2028	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2029	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2030	K02175330	CERAMIC CAP.	33pF	50V	CH	
C 2031	K70167105	TANTALUM CAP.	1uF	35V		
C 2032	K40129012	AL. ELECTRO. CAP.	10uF	16V		
C 2033	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2034	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2035	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2036	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2037	K02175120	CERAMIC CAP.	12pF	50V	CH	TYP C
C 2037	K02175150	CERAMIC CAP.	15pF	50V	CH	TYP B
C 2037	K02175150	CERAMIC CAP.	15pF	50V	CH	TYP E
C 2037	K02175180	CERAMIC CAP.	18pF	50V	CH	TYP D
C 2037	K02175180	CERAMIC CAP.	18pF	50V	CH	TYP A
C 2038	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2039	K10176102	CERAMIC CAP.	0.001uF	50V	B	

TX UNIT PARTS LIST

C 2040	K02175270	CERAMIC CAP.	27pF	50V	CH	TYP E
C 2040	K02175330	CERAMIC CAP.	33pF	50V	CH	TYP D
C 2040	K02175330	CERAMIC CAP.	33pF	50V	CH	TYP A
C 2040	K02179009	CERAMIC CAP.	22pF	50V	CH	TYP C
C 2040	K02179012	CERAMIC CAP.	30pF	50V	CH	TYP B
C 2041	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2042	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2043	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2044	K70127106	TANTALUM CAP.	10uF	16V		
C 2045	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2046	K02175180	CERAMIC CAP.	18pF	50V	CH	TYP C
C 2046	K02179009	CERAMIC CAP.	22pF	50V	CH	TYP E
C 2046	K02179010	CERAMIC CAP.	24pF	50V	CH	TYP B
C 2046	K02175270	CERAMIC CAP.	27pF	50V	CH	TYP D
C 2046	K02179012	CERAMIC CAP.	30pF	50V	CH	TYP A
C 2047	K02179010	CERAMIC CAP.	24pF	50V	CH	TYP C
C 2047	K02175270	CERAMIC CAP.	27pF	50V	CH	TYP E
C 2047	K02175330	CERAMIC CAP.	33pF	50V	CH	TYP D
C 2047	K02175330	CERAMIC CAP.	33pF	50V	CH	TYP A
C 2047	K02179012	CERAMIC CAP.	30pF	50V	CH	TYP B
C 2048	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2049	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2050	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2051	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2052	K02175330	CERAMIC CAP.	33pF	50V	CH	TYP C
C 2052	K02175390	CERAMIC CAP.	39pF	50V	CH	TYP B
C 2052	K02175470	CERAMIC CAP.	47pF	50V	CH	TYP A
C 2052	K02179014	CERAMIC CAP.	36pF	50V	CH	TYP E
C 2052	K02179015	CERAMIC CAP.	43pF	50V	CH	TYP D
C 2053	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2054	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2055	K40129012	AL. ELECTRO. CAP.	10uF	16V		
C 2056	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2057	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2059	K02175330	CERAMIC CAP.	33pF	50V	CH	
C 2060	K02172050	CERAMIC CAP.	5pF	50V	CH	
C 2061	K02172050	CERAMIC CAP.	5pF	50V	CH	
C 2062	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2063	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2064	K02175150	CERAMIC CAP.	15pF	50V	CH	
C 2065	K02175270	CERAMIC CAP.	27pF	50V	CH	
C 2066	K02173080	CERAMIC CAP.	8pF	50V	CH	
C 2067	K02175120	CERAMIC CAP.	12pF	50V	CH	
C 2068	K40129038	AL. ELECTRO. CAP.	100uF	16V		
C 2069	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2070	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2071	K40149011	AL. ELECTRO. CAP.	4.7uF	25V		
C 2072	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2073	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2074	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2075	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2076	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2077	K40129012	AL. ELECTRO. CAP.	10uF	16V		
C 2078	K40129012	AL. ELECTRO. CAP.	10uF	16V		
C 2079	K70167104	TANTALUM CAP.	0.1uF	35V		
C 2080	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2081	K10176102	CERAMIC CAP.	0.001uF	50V	B	
C 2082	K00175330	CERAMIC CAP.	33pF	50V	SL	
C 2083	K00175330	CERAMIC CAP.	33pF	50V	SL	

TX UNIT PARTS LIST

C 2084	K00175330	CERAMIC CAP.	33pF	50V	SL	
C 2085	K00175330	CERAMIC CAP.	33pF	50V	SL	
C 2086	K00175330	CERAMIC CAP.	33pF	50V	SL	
C 2087	K00175330	CERAMIC CAP.	33pF	50V	SL	
C 2088	K00175330	CERAMIC CAP.	33pF	50V	SL	
C 2089	K00175330	CERAMIC CAP.	33pF	50V	SL	
C 2090	K00175330	CERAMIC CAP.	33pF	50V	SL	
C 2091	K00175330	CERAMIC CAP.	33pF	50V	SL	
C 2092	K00175330	CERAMIC CAP.	33pF	50V	SL	
C 2093	K00175330	CERAMIC CAP.	33pF	50V	SL	
C 2094	K00175330	CERAMIC CAP.	33pF	50V	SL	
C 2095	K00175330	CERAMIC CAP.	33pF	50V	SL	
C 2096	K00175330	CERAMIC CAP.	33pF	50V	SL	
C 2097	K00175330	CERAMIC CAP.	33pF	50V	SL	
D 2001	G2090271	DIODE	1T33			
D 2002	G2090271	DIODE	1T33			
D 2003	G2090297	DIODE	1SS110			
D 2004	G2015550	DIODE	1S1555			
D 2005	G2090027	DIODE	1SS53			
D 2006	G2090027	DIODE	1SS53			
D 2007	G2090176	DIODE	HZ6A1L			
D 2008	G2015550	DIODE	1S1555			
D 2009	G2015550	DIODE	1S1555			
D 2010	G2015550	DIODE	1S1555			
D 2011	G2090433	LED	GL3PR8			
FB2001	L9190044	FERRITE BEADS 3A RI2.5X1.2-1				
FB2002	L9190001	FERRITE BEADS 4A2 RI3X3-1				
FB2003	L9190001	FERRITE BEADS 4A2 RI3X3-1				
FB2004	L9190044	FERRITE BEADS 3A RI2.5X1.2-1				
J 2001	P0090704	CONNECTOR 9210B-1-10Z097-T				
J 2002	P0090705	CONNECTOR 9210B-1-16Z097-T				
J 2003	P1090376	CONNECTOR BNC-R	050-1400			
	R7110000	WASHER				
L 2001	L1190227	M.RFC LAL03NA561K	560uH			
L 2002	L1190283	M.RFC LAL02NA1ROM	1uH			
L 2003	L1190283	M.RFC LAL02NA1ROM	1uH			
L 2004	L1190189	M.RFC LAL03NA102K	1mH			
L 2005	L1020671	RFC				
L 2006	L0020340	COIL				
L 2007	L0020725	COIL				
L 2008	L0020342	COIL				
L 2009	L0021155	COIL				
L 2010	L1190189	M.RFC LAL03NA102K	1mH			
L 2011	L1190188	M.RFC LAL03NAR22M	0.22uH			
L 2012	L1020668	RFC				
L 2013	L1020668	RFC				
L 2014	L0020679	COIL				
L 2015	L0020725	COIL				TYP A
L 2015	L0020852	COIL				TYP B
L 2015	L0020852	COIL				TYP D
L 2015	L0021290	COIL				TYP C
L 2015	L0021290	COIL				TYP E
L 2016	L0020725	COIL				
L 2017	L1190149	M.RFC LAL03NA1ROM	1uH			
L 2018	L0020427	COIL				

TX UNIT PARTS LIST

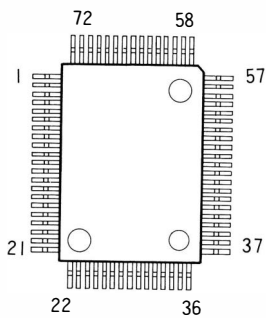
L 2019	L0020725	COIL		
Q 2001	G1090982	IC	TC9198P	
Q 2002	G1090560	IC	TC5082PL	
Q 2003	G1090473	IC	TC5081AP	
Q 2004	G1090725	IC	MC12017P	
Q 2005	G3327860L	TRANSISTOR	2SC2786L	
Q 2006	G3090080	TRANSISTOR	BA1L4M	
Q 2007	G3327860L	TRANSISTOR	2SC2786L	
Q 2008	G3090080	TRANSISTOR	BA1L4M	
Q 2009	G3320260	TRANSISTOR	2SC2026	
Q 2010	G3327850E	TRANSISTOR	2SC2785E	
Q 2011	G3327860L	TRANSISTOR	2SC2786L	
Q 2012	G3324071	TRANSISTOR	2SC2407A	
Q 2013	G3325380	TRANSISTOR	2SC2538	
Q 2014	G3319710	TRANSISTOR	2SC1971	
Q 2015	G3803810D	FET	2SK381C	
Q 2016	G3109520M	TRANSISTOR	2SA952M	
Q 2017	G3326030E	TRANSISTOR	2SC2603E	
Q 2018	G3326030E	TRANSISTOR	2SC2603E	
Q 2019	G3090081	TRANSISTOR	BN1A4M	
Q 2020	G3090080	TRANSISTOR	BA1L4M	
Q 2021	G3109520M	TRANSISTOR	2SA952M	
Q 2022	G3109520M	TRANSISTOR	2SA952M	
Q 2023	G3090084	TRANSISTOR	BL1N4M	
Q 2024	G3111150E	TRANSISTOR	2SA1115E	
Q 2025	G3090077	TRANSISTOR	BA1L3Z	
R 2001	J02225332	CARBON FILM RES.	3.3K	1/6W
R 2002	J02225102	CARBON FILM RES.	1K	1/6W
R 2003	J02225222	CARBON FILM RES.	2.2K	1/6W
R 2004	J02225224	CARBON FILM RES.	220K	1/6W
R 2005	J02225153	CARBON FILM RES.	15K	1/6W
R 2006	J02225153	CARBON FILM RES.	15K	1/6W
R 2007	J02225102	CARBON FILM RES.	1K	1/6W
R 2008	J02225101	CARBON FILM RES.	100	1/6W
R 2009	J02225102	CARBON FILM RES.	1K	1/6W
R 2010	J02225470	CARBON FILM RES.	47	1/6W
R 2011	J02225334	CARBON FILM RES.	330K	1/6W
R 2012	J02225220	CARBON FILM RES.	22	1/6W
R 2014	J02225101	CARBON FILM RES.	100	1/6W
R 2015	J02225183	CARBON FILM RES.	18K	1/6W
R 2016	J02225472	CARBON FILM RES.	4.7K	1/6W
R 2017	J02225220	CARBON FILM RES.	22	1/6W
R 2018	J02225103	CARBON FILM RES.	10K	1/6W
R 2019	J02225103	CARBON FILM RES.	10K	1/6W
R 2020	J02225154	CARBON FILM RES.	150K	1/6W
R 2021	J02225101	CARBON FILM RES.	100	1/6W
R 2022	J02225223	CARBON FILM RES.	22K	1/6W
R 2023	J02225103	CARBON FILM RES.	10K	1/6W
R 2024	J02225101	CARBON FILM RES.	100	1/6W
R 2025	J02225102	CARBON FILM RES.	1K	1/6W
R 2026	J02225471	CARBON FILM RES.	470	1/6W
R 2027	J02225220	CARBON FILM RES.	22	1/6W
R 2028	J02225101	CARBON FILM RES.	100	1/6W
R 2029	J02225821	CARBON FILM RES.	820	1/6W
R 2030	J02225221	CARBON FILM RES.	220	1/6W
R 2031	J02225479	CARBON FILM RES.	4.7	1/6W
R 2032	J02225681	CARBON FILM RES.	680	1/6W

TX UNIT PARTS LIST

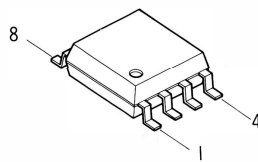
R 2033	J02225221	CARBON FILM RES.	220	1/6W	
R 2034	J02225222	CARBON FILM RES.	2.2K	1/6W	
R 2035	J02225101	CARBON FILM RES.	100	1/6W	
R 2036	J02225682	CARBON FILM RES.	6.8K	1/6W	
R 2037	J02225103	CARBON FILM RES.	10K	1/6W	
R 2038	J02225562	CARBON FILM RES.	5.6K	1/6W	
R 2039	J02225103	CARBON FILM RES.	10K	1/6W	
R 2040	J02225332	CARBON FILM RES.	3.3K	1/6W	
R 2041	J02225152	CARBON FILM RES.	1.5K	1/6W	
R 2042	J02225153	CARBON FILM RES.	15K	1/6W	
R 2043	J02225103	CARBON FILM RES.	10K	1/6W	
R 2044	J02225102	CARBON FILM RES.	1K	1/6W	
R 2045	J02225104	CARBON FILM RES.	100K	1/6W	
R 2046	J02225104	CARBON FILM RES.	100K	1/6W	
R 2047	J02225104	CARBON FILM RES.	100K	1/6W	
R 2048	J02225104	CARBON FILM RES.	100K	1/6W	
R 2049	J02225104	CARBON FILM RES.	100K	1/6W	
R 2050	J02225104	CARBON FILM RES.	100K	1/6W	
SW2001	N0190152	ROTARY SWITCH	SRBM16		
SW2002	N5090018	TACT SWITCH	KHH15951		
SW2003	N4090117	PUSH SWITCH	SPPJ32		
T 2001	L0021684A	COIL			TYP C
T 2001	L0021709	COIL			TYP A
T 2001	L0021911	COIL			TYP B
T 2001	L0021911	COIL			TYP D
T 2001	L0021911	COIL			TYP E
T 2002	L0021418	COIL			
TC2001	K91000149	TRIMMER CAP. VCT31E161A	20p		
TC2002	K91000156	TRIMMER CAP. VCT31F	30p		
TC2003	K91000156	TRIMMER CAP. VCT31F	30p		
TC2004	K91000156	TRIMMER CAP. VCT31F	30p		
TP2001	Q5000082	TERMINAL POST	TP-N		
VR2001	J51745471	POT. H0651A005-470B	470B		
X 2001	H0102945	XTAL UM-2	5.120MHZ	10 ppm	
X 2001	H0102978	XTAL UM-2	5.120MHZ	5 ppm	
	R0131850	SHIELD CASE (VCO)			
	R0131870	SHIELD PLATE			
	R0132800	SHIELD CASE			
	R0131860	SHIELD PLATE			
	R0131880	HEATSINK PLATE			
	R0513810	FRAME R			

EEPROM UNIT PARTS LAYOUT

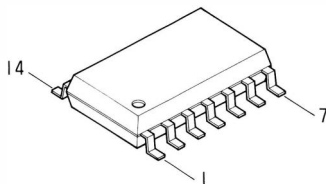
EEPROM UNIT (No.4XXX)



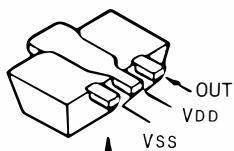
M50747-C18FP(Q4001)



CAT35C102K(Q4002)

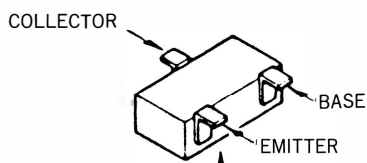


μ PD74HC4066G(Q4004)
 μ PD4030BG(Q4005)



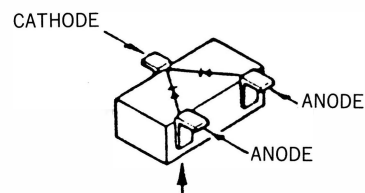
Marked Surt

RH5VA45AA(Q4003)



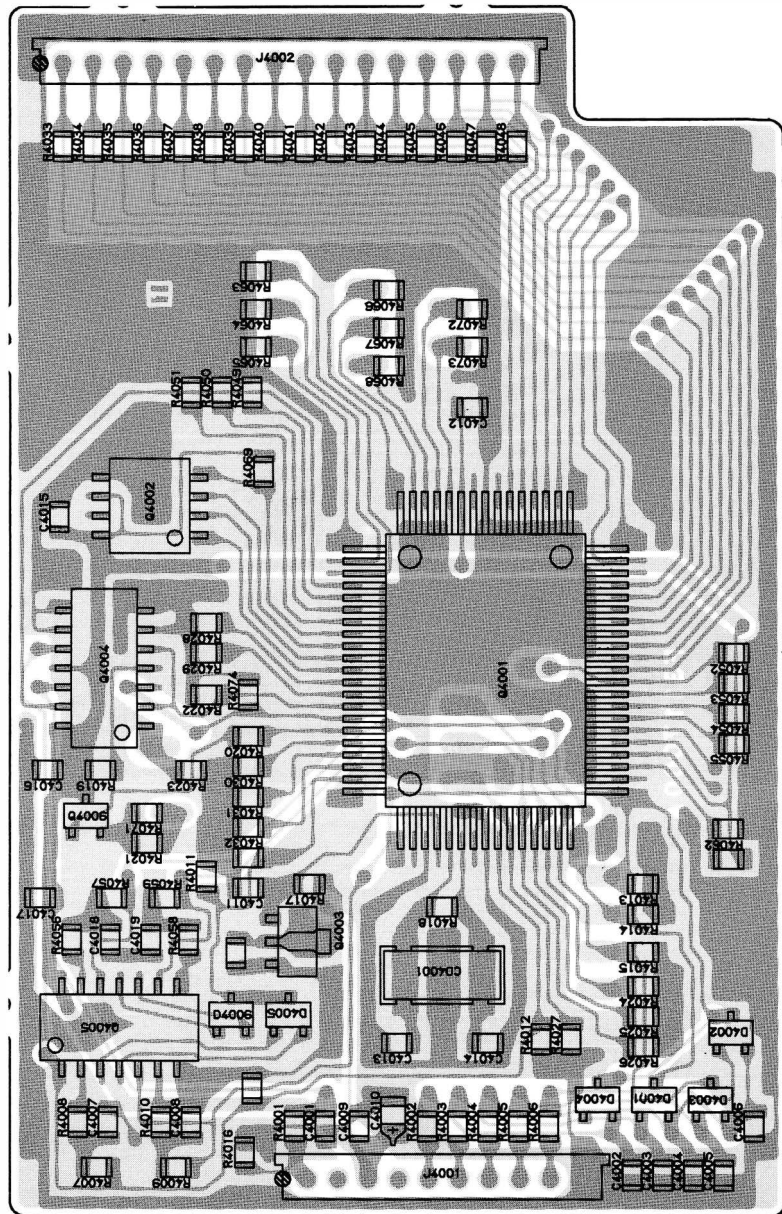
Marked Surface

2SC2712GR(Q4006)



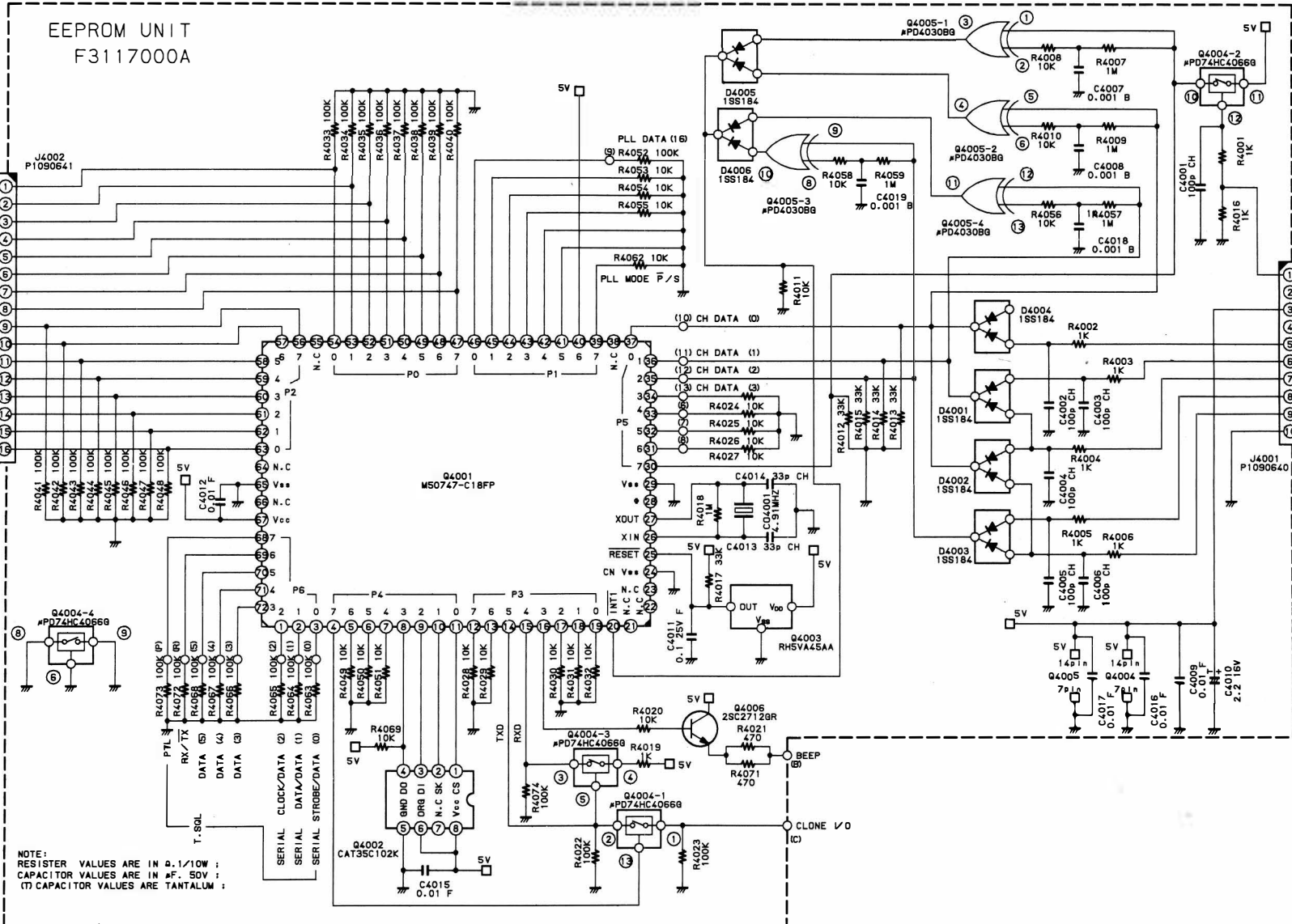
Marked Surface

ISSI84
(D4001,4002,4003
4004,4005,4006)



Obverse view of "mixed-component" side

EEPROM UNIT CIRCUIT DIAGRAM



EEPROM UNIT PART LIST

*** EEPROM UNIT ***

CA0199001 EEPROM UNIT W/COMP.

F3117000A P.C.B. W/O COMP.

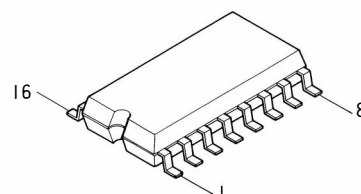
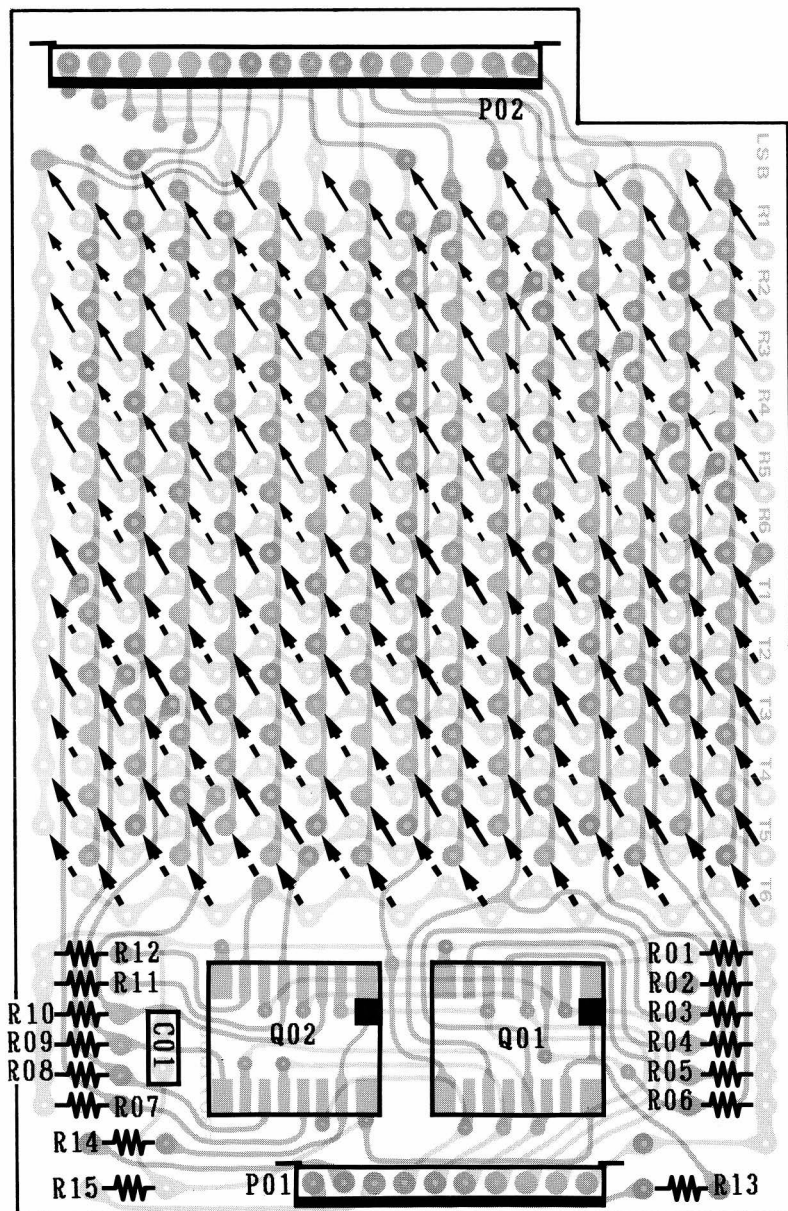
C 4001	K22170235	CHIP CAP.	100pF	50V	CH
C 4002	K22170235	CHIP CAP.	100pF	50V	CH
C 4003	K22170235	CHIP CAP.	100pF	50V	CH
C 4004	K22170235	CHIP CAP.	100pF	50V	CH
C 4005	K22170235	CHIP CAP.	100pF	50V	CH
C 4006	K22170235	CHIP CAP.	100pF	50V	CH
C 4007	K22170805	CHIP CAP.	0.001uF	50V	B
C 4008	K22170805	CHIP CAP.	0.001uF	50V	B
C 4009	K22171004	CHIP CAP.	0.01uF	50V	F
C 4010	K78120002	CHIP TA CAP.	2.2uF	16V	
C 4011	K22141005	CHIP CAP.	0.1uF	25V	F
C 4012	K22171004	CHIP CAP.	0.01uF	50V	F
C 4013	K22170223	CHIP CAP.	33pF	50V	CH
C 4014	K22170223	CHIP CAP.	33pF	50V	CH
C 4015	K22171004	CHIP CAP.	0.01uF	50V	F
C 4016	K22171004	CHIP CAP.	0.01uF	50V	F
C 4017	K22171004	CHIP CAP.	0.01uF	50V	F
C 4018	K22170805	CHIP CAP.	0.001uF	50V	B
C 4019	K22170805	CHIP CAP.	0.001uF	50V	B
C04001	H7900600	CERAMIC OSC EFO-M4914E0	4.91MHZ		
D 4001	G2070009	DIODE	1SS184	TE85R	
D 4002	G2070009	DIODE	1SS184	TE85R	
D 4003	G2070009	DIODE	1SS184	TE85R	
D 4004	G2070009	DIODE	1SS184	TE85R	
D 4005	G2070009	DIODE	1SS184	TE85R	
D 4006	G2070009	DIODE	1SS184	TE85R	
J 4001	P1090640	CONNECTOR	IMSA-9110S-10		
J 4002	P1090641	CONNECTOR	IMSA-9110S-16		
Q 4001	G1091091	IC	M50747-C18FP		
Q 4002	G1090967	IC	CAT35C102K		
Q 4003	G1090966	IC	RH5VA45AA		
Q 4004	G1090871	IC	uPD74HC4066G		
Q 4005	G1090714	IC	uPD4030BG		
Q 4006	G3327127G	TRANSISTER	2SC2712GR		
R 4001	J24205102	CHIP RES.	1K	1/10W	
R 4002	J24205102	CHIP RES.	1K	1/10W	
R 4003	J24205102	CHIP RES.	1K	1/10W	
R 4004	J24205102	CHIP RES.	1K	1/10W	
R 4005	J24205102	CHIP RES.	1K	1/10W	
R 4006	J24205102	CHIP RES.	1K	1/10W	
R 4007	J24205105	CHIP RES.	1M	1/10W	
R 4008	J24205103	CHIP RES.	10K	1/10W	
R 4009	J24205105	CHIP RES.	1M	1/10W	
R 4010	J24205103	CHIP RES.	10K	1/10W	
R 4011	J24205103	CHIP RES.	10K	1/10W	
R 4012	J24205333	CHIP RES.	33K	1/10W	
R 4013	J24205333	CHIP RES.	33K	1/10W	
R 4014	J24205333	CHIP RES.	33K	1/10W	

EEPROM UNIT PART LIST

R 4015	J24205333	CHIP RES.	33K	1/10W
R 4016	J24205102	CHIP RES.	1K	1/10W
R 4017	J24205333	CHIP RES.	33K	1/10W
R 4018	J24205105	CHIP RES.	1M	1/10W
R 4019	J24205102	CHIP RES.	1K	1/10W
R 4020	J24205103	CHIP RES.	10K	1/10W
R 4021	J24205471	CHIP RES.	470	1/10W
R 4022	J24205104	CHIP RES.	100K	1/10W
R 4023	J24205104	CHIP RES.	100K	1/10W
R 4024	J24205103	CHIP RES.	10K	1/10W
R 4025	J24205103	CHIP RES.	10K	1/10W
R 4026	J24205103	CHIP RES.	10K	1/10W
R 4027	J24205103	CHIP RES.	10K	1/10W
R 4028	J24205103	CHIP RES.	10K	1/10W
R 4029	J24205103	CHIP RES.	10K	1/10W
R 4030	J24205103	CHIP RES.	10K	1/10W
R 4031	J24205103	CHIP RES.	10K	1/10W
R 4032	J24205103	CHIP RES.	10K	1/10W
R 4033	J24205104	CHIP RES.	100K	1/10W
R 4034	J24205104	CHIP RES.	100K	1/10W
R 4035	J24205104	CHIP RES.	100K	1/10W
R 4036	J24205104	CHIP RES.	100K	1/10W
R 4037	J24205104	CHIP RES.	100K	1/10W
R 4038	J24205104	CHIP RES.	100K	1/10W
R 4039	J24205104	CHIP RES.	100K	1/10W
R 4040	J24205104	CHIP RES.	100K	1/10W
R 4041	J24205104	CHIP RES.	100K	1/10W
R 4042	J24205104	CHIP RES.	100K	1/10W
R 4043	J24205104	CHIP RES.	100K	1/10W
R 4044	J24205104	CHIP RES.	100K	1/10W
R 4045	J24205104	CHIP RES.	100K	1/10W
R 4046	J24205104	CHIP RES.	100K	1/10W
R 4047	J24205104	CHIP RES.	100K	1/10W
R 4048	J24205104	CHIP RES.	100K	1/10W
R 4049	J24205103	CHIP RES.	10K	1/10W
R 4050	J24205103	CHIP RES.	10K	1/10W
R 4051	J24205103	CHIP RES.	10K	1/10W
R 4052	J24205104	CHIP RES.	100K	1/10W
R 4053	J24205103	CHIP RES.	10K	1/10W
R 4054	J24205103	CHIP RES.	10K	1/10W
R 4055	J24205103	CHIP RES.	10K	1/10W
R 4056	J24205103	CHIP RES.	10K	1/10W
R 4057	J24205105	CHIP RES.	1M	1/10W
R 4058	J24205103	CHIP RES.	10K	1/10W
R 4059	J24205105	CHIP RES.	1M	1/10W
R 4062	J24205103	CHIP RES.	10K	1/10W
R 4063	J24205104	CHIP RES.	100K	1/10W
R 4064	J24205104	CHIP RES.	100K	1/10W
R 4065	J24205104	CHIP RES.	100K	1/10W
R 4066	J24205104	CHIP RES.	100K	1/10W
R 4067	J24205104	CHIP RES.	100K	1/10W
R 4068	J24205104	CHIP RES.	100K	1/10W
R 4069	J24205103	CHIP RES.	10K	1/10W
R 4071	J24205471	CHIP RES.	470	1/10W
R 4072	J24205104	CHIP RES.	100K	1/10W
R 4073	J24205104	CHIP RES.	100K	1/10W
R 4074	J24205104	CHIP RES.	100K	1/10W

DIODE MATRIX UNIT PARTS LAYOUT

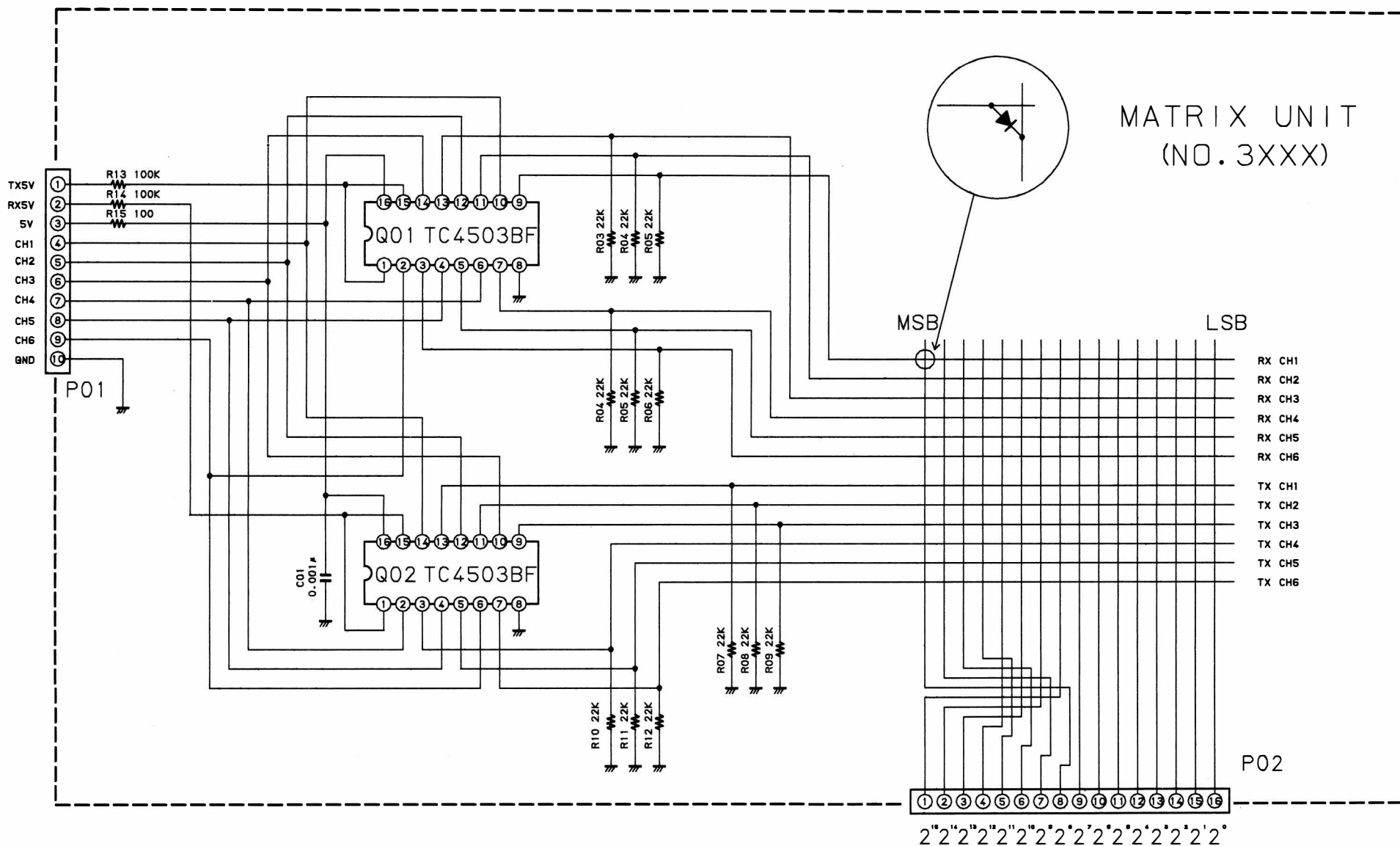
DIODE MATRIX UNIT (No.3XXX)



TC4503BF(Q3001,3002)

Obverse view of "mixed-component" side

DIODE MATRIX UNIT CIRCUIT DIAGRAM

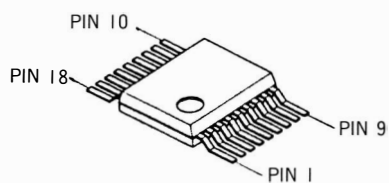


DIODE MATRIX UNIT PARTS LIST

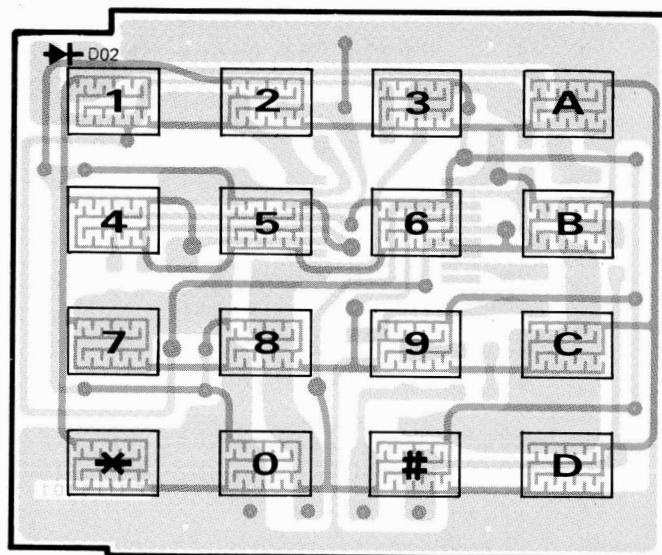
*** DIODE MATRIX UNIT ***					
CP2081001 Diode Matrix Unit w/Components (except Programming Diode)					
F3077000 P.C.B. W/O COMP.					
C 3001	K10176102	CERAMIC CAP.	0.001uF	50V	B
L 3001	L1190148	M.RFC LAL03NA 100K	10uH		
L 3002	L1190148	M.RFC LAL03NA 100K	10uH		
L 3003	L1190148	M.RFC LAL03NA 100K	10uH		
L 3004	L1190148	M.RFC LAL03NA 100K	10uH		
P 3001	P1090640	CONNECTOR IMSA-9110S-10			
P 3002	P1090641	CONNECTOR IMSA-9110S-16			
Q 3001	G1091017	IC	TC4503BF		
Q 3002	G1091017	IC	TC4503BF		
R 3001	J01225223	CARBON FILM RES.	22K	1/6W	
R 3002	J01225223	CARBON FILM RES.	22K	1/6W	
R 3003	J01225223	CARBON FILM RES.	22K	1/6W	
R 3004	J01225223	CARBON FILM RES.	22K	1/6W	
R 3005	J01225223	CARBON FILM RES.	22K	1/6W	
R 3006	J01225223	CARBON FILM RES.	22K	1/6W	
R 3007	J01225223	CARBON FILM RES.	22K	1/6W	
R 3008	J01225223	CARBON FILM RES.	22K	1/6W	
R 3009	J01225223	CARBON FILM RES.	22K	1/6W	
R 3010	J01225223	CARBON FILM RES.	22K	1/6W	
R 3011	J01225223	CARBON FILM RES.	22K	1/6W	
R 3012	J01225223	CARBON FILM RES.	22K	1/6W	
R 3013	J01225104	CARBON FILM RES.	100K	1/6W	
R 3014	J01225104	CARBON FILM RES.	100K	1/6W	
R 3015	J01225101	CARBON FILM RES.	100	1/6W	
	R0131850	SHIELD CASE			
	R0131870	SHIELD PLATE			
	R0132800	SHIELD CASE			

DTMF UNIT (FTT-6) PARTS LAYOUT OPTION

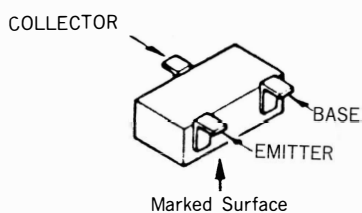
DTMF UNIT (No.5XXX)



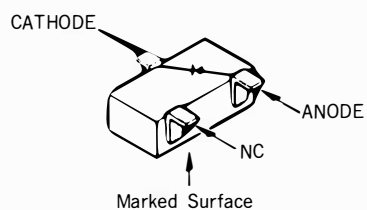
LR40872(Q5001)



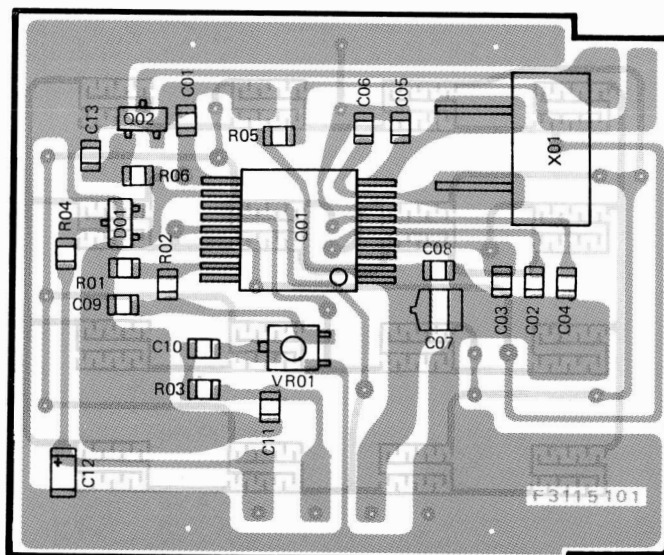
Obverse view of "Key mold" side



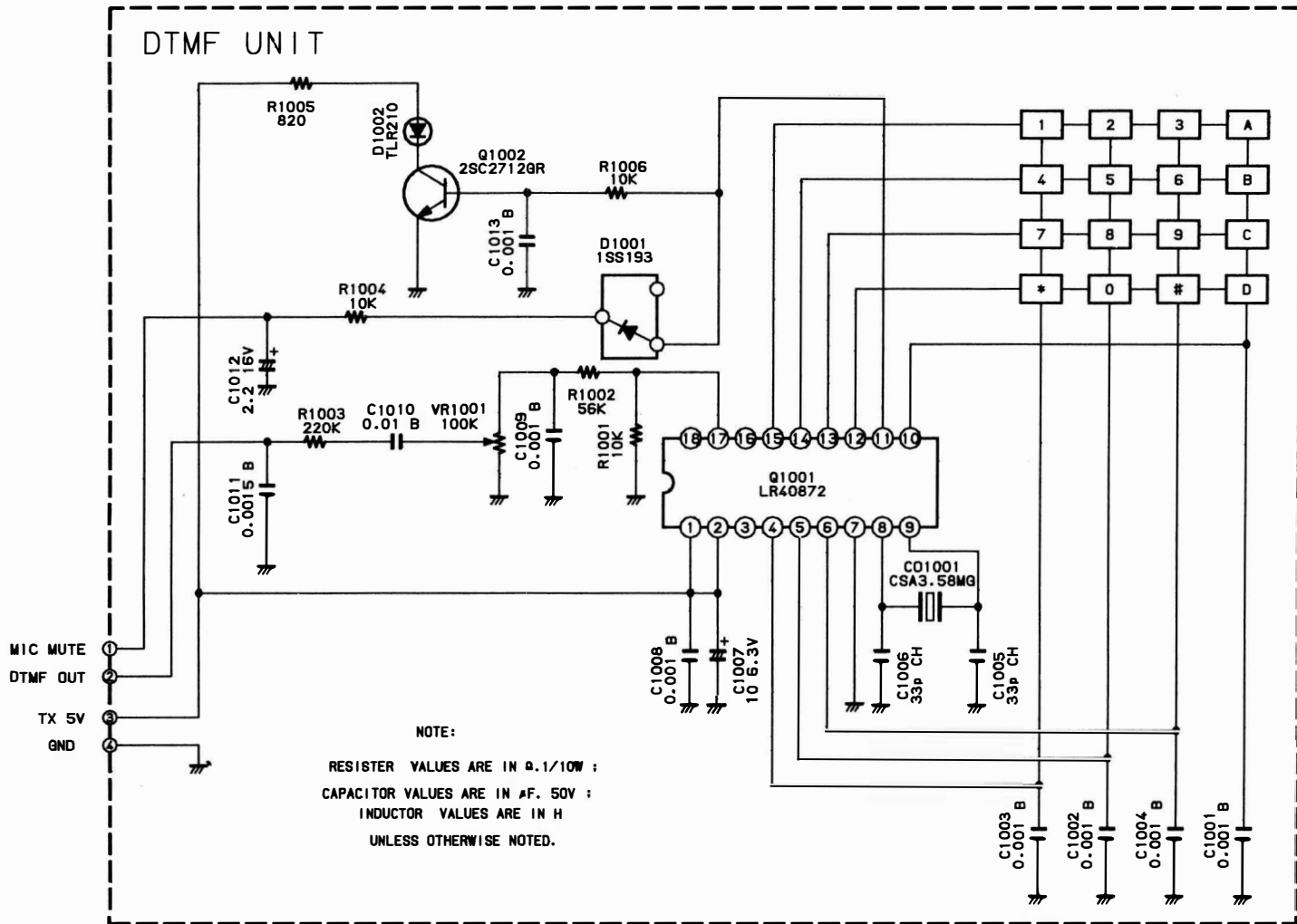
2SC2712GR(Q5002)



ISS193(D5001)



Obverse view of "chip-only" side

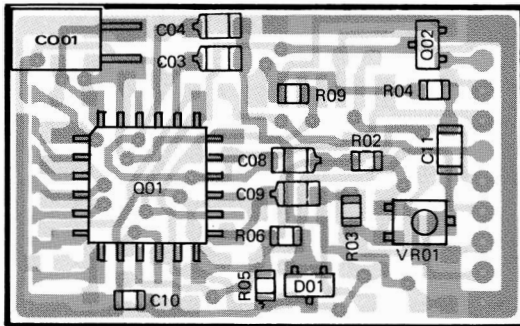


DTMF UNIT (FTT-6) PARTS LIST OPTION

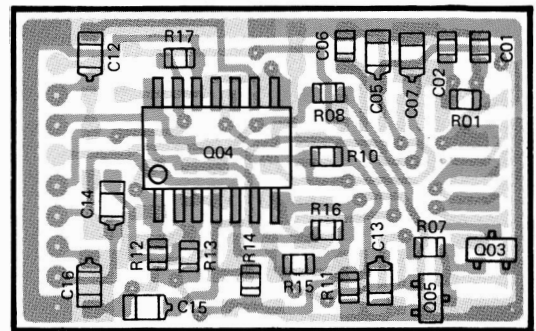
*** FTT-6 ***					
F3115100 P.C.B. W/O COMP.					
C 0001	K10176102	CERAMIC CAP.	0.001uF	50V	B
MC0001	M3290008	MIC ELEMENT	EM-78C YE		
SP0001	M4090077	LOUDSPEAKER T036S23Y2610	0.5W 8-0hm		
C 5001	K22170805	CHIP CAP.	0.001uF	50V	B
C 5002	K22170805	CHIP CAP.	0.001uF	50V	B
C 5003	K22170805	CHIP CAP.	0.001uF	50V	B
C 5004	K22170805	CHIP CAP.	0.001uF	50V	B
C 5005	K22170223	CHIP CAP.	33pF	50V	CH
C 5006	K22170223	CHIP CAP.	33pF	50V	CH
C 5007	K78080003	CHIP TA CAP.	10F	6.3V	
C 5008	K22170805	CHIP CAP.	0.001F	50V	B
C 5009	K22170805	CHIP CAP.	0.001F	50V	B
C 5010	K22170817	CHIP CAP.	0.01F	50V	B
C 5011	K22170807	CHIP CAP.	0.0015F	50V	B
C 5012	K78120002	CHIP TA CAP.	2.2F	16V	
C 5013	K22170805	CHIP CAP.	0.001F	50V	B
C05001	H7900510	CERAMIC OSC	CSA3.58MG		
D 5001	G2070052	DIODE	1SS193TE85R		
D 5002	G2090243	LED	TLR210		
Q 5001	G1090731	IC	LR40872		
Q 5002	G3327127G	TRANSISTOR	2SC2712GR		
R 5001	J24205103	CHIP RES.	10K	1/10W	
R 5002	J24205563	CHIP RES.	56K	1/10W	
R 5003	J24205224	CHIP RES.	220K	1/10W	
R 5004	J24205103	CHIP RES.	10K	1/10W	
R 5005	J24205821	CHIP RES.	820	1/10W	
R 5006	J24205103	CHIP RES.	10K	1/10W	
VR5001	J51778104	POT.	100K	1/10W	
	N5090020	KEYPAD SM-723			
	R0131830	CONTACT			
	R3130400	MIC HOLDER			
	R3514710	PANEL FRONT			
	R7124620	NYLON MESH			
	R7124630	NYLON MESH			

OPTION CTCSS UNIT (FTS-20) PARTS LAYOUT

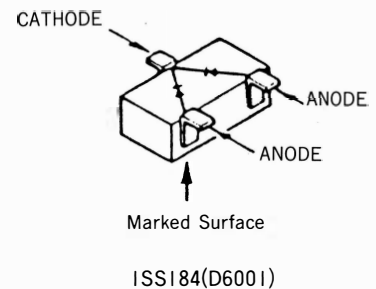
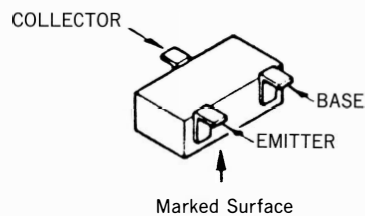
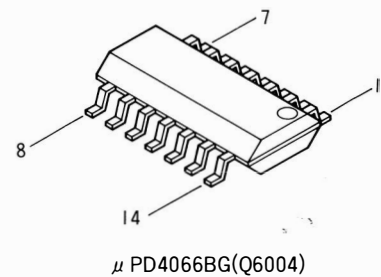
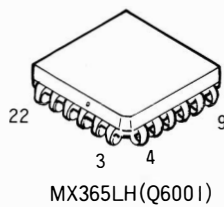
CTCSS UNIT (No.6XXX)

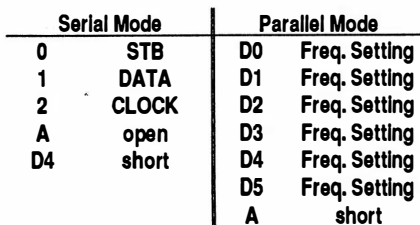


Obverse view of "CERAMIC OSC" side



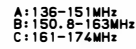
Obverse view of "chip-only" side

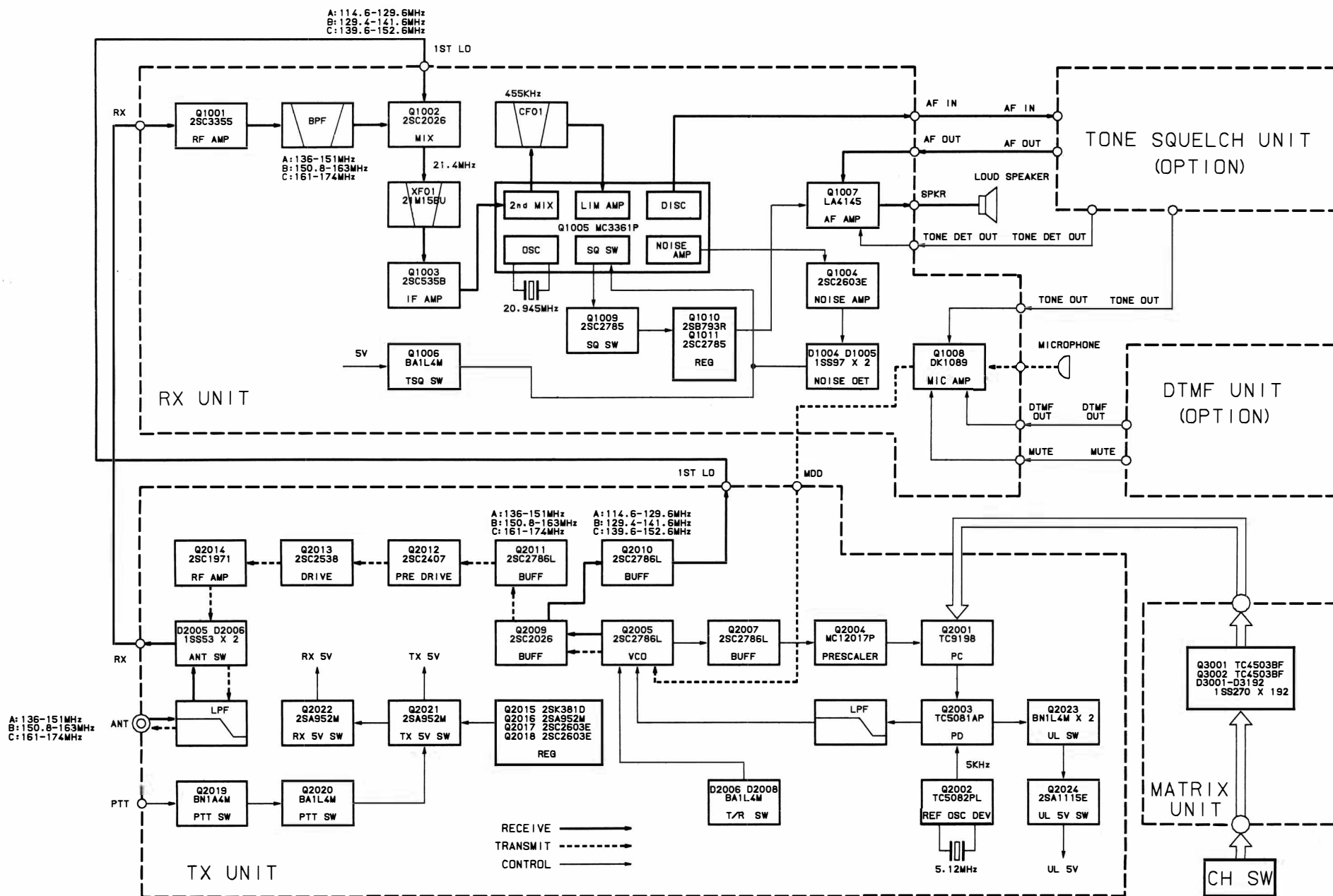




CTCSS UNIT (FTS-20) PARTS LIST

*** CTCSS FTS-20 ***					
F3116100 P.C.B. W/O COMP.					
C 6001	K22170243	CHIP CAP.	220pF	50V	CH
C 6002	K22170243	CHIP CAP.	220pF	50V	CH
C 6003	K78140013	CHIP TA. CAP.	1uF	25V	
C 6004	K78140013	CHIP TA. CAP.	1uF	25V	
C 6005	K78080017	CHIP TA. CAP.	4.7	6.3V	
C 6006	K22170805	CHIP CAP.	0.001uF	50V	B
C 6007	K78160029	CHIP TA. CAP.	0.47uF	35V	
C 6008	K78140013	CHIP TA. CAP.	1uF	25V	
C 6009	K78140013	CHIP TA. CAP.	1uF	25V	
C 6010	K22141809	CHIP CAP.	0.1uF	25V	B
C 6011	K22141809	CHIP CAP.	0.1uF	25V	B
C 6012	K78140013	CHIP TA. CAP.	1uF	25V	
C 6013	K78100015	CHIP TA. CAP.	3.3uF	10V	
C 6014	K78140013	CHIP TA. CAP.	1uF	25V	
C 6015	K78140013	CHIP TA. CAP.	1uF	25V	
C 6017	K78080017	CHIP TA. CAP.	4.7uF	6.3V	
C06001	H7900550	CERAMIC OSC	CSB1000J		1MHZ
D 6001	G2070009	DIODE	1SS184		
Q 6001	G1090897	IC	MX365LH		
Q 6002	G3070001	TRANSISTOR	FA1A4M		
Q 6003	G3327127G	TRANSISTOR	2SC2712GR		
Q 6004	G1090602	IC	uPD4066BG		
Q 6005	G3070001	TRANSISTOR	FA1A4M		
R 6001	J24205105	CHIP RES.	1M	1/10W	
R 6002	J24205103	CHIP RES.	10K	1/10W	
R 6003	J24205274	CHIP RES.	270K	1/10W	
R 6004	J24205472	CHIP RES.	4.7K	1/10W	
R 6005	J24205225	CHIP RES.	2.2M	1/10W	
R 6006	J24205563	CHIP RES.	56K	1/10W	
R 6007	J24205563	CHIP RES.	56K	1/10W	
R 6008	J24205102	CHIP RES.	1K	1/10W	
R 6009	J24205104	CHIP RES.	100K	1/10W	
R 6010	J24205224	CHIP RES.	220K	1/10W	
R 6011	J24205224	CHIP RES.	220K	1/10W	
R 6012	J24205104	CHIP RES.	100K	1/10W	
R 6013	J24205104	CHIP RES.	100K	1/10W	
R 6014	J24205104	CHIP RES.	100K	1/10W	
R 6015	J24205103	CHIP RES.	10K	1/10W	
R 6016	J24205103	CHIP RES.	10K	1/10W	
R 6017	J24205103	CHIP RES.	10K	1/10W	
VR6001	J51778473	POT. RH03AYAS4X 47K	47K		





CIRCUIT DESCRIPTION

Receiver

The input signal from the antenna passes first through a lowpass filter on the Tx Unit, and is directed to the Rx Unit by t/r switching diodes when receiving. On the Rx Unit the signal is bandpass filtered before amplification by Q1001 (2SC3355), and then filtered by a three-stage high-Q resonator network before application to first mixer Q1002 (2SC2026). The high-Q resonators minimize cross modulation and intermodulation while providing a low noise figure for the receiver front end. Q1002 also receives a local signal 21.4 MHz below the receiving frequency from VCO Q2005 (2SC2786L) on the Tx Unit, buffered by Q2010 (2SC-2785F).

The 21.4 MHz product from the first mixer is passed through 4-pole monolithic crystal filter XF1001 (+/-7.5 kHz BW) and amplified by Q1003 (2SC535B) before application of the resulting 1st IF signal to FM receiver sub-system IC Q1005 (MC3361P), which contains local oscillator, mixer, IF limiter and FM detector circuits. The amplified first IF signal is applied to the mixer section, along with the second local signal internally generated via 20.945 MHz crystal X1001. The 455 kHz product, filtered by CF1001, is then amplified and limited remove amplitude variations before application to the discriminator.

The resulting audio output from Q1005 is delivered to the Tone Unit connector. If no tone unit is installed, the audio is de-emphasized by C1034 before passing through VOL potentiometer VR1002 to audio amplifier Q1007 (LA4145) and the loudspeaker or earphone. If a Tone Unit is installed, resistance for the de-emphasis network is provided on that board.

When no signal is being received, high frequency noise is present at the output of the discriminator stage of Q1005. This noise is sampled and high-pass filtered by R1016 and C1025, and then amplified by a noise amplifier in Q1005 and Q1004 (2SC-

2603E), the output of which is rectified by D1004/D1005 to provide DC for squelch switching. This squelch control DC (adjustable by the operator via Squelch control VR1001) triggers a gate within Q1005 to provide a squelch gate control signal output at pin 14. This signal is applied to squelch gate Q1009 (2SC2785), which then drives Q1010 (2SB793R) and Q1011 (2SC2785) to turn off the supply voltage to AF amplifier Q1007 when no signal is received. A sample of this signal also causes TX/RX indicator LED D1006 to glow green when the squelch is open.

Transmitter

When the push-to-talk switch is pressed, audio from the microphone is delivered to Mic Amp Unit Q1008 (DK1089), which provides audio pre-emphasis, IDC (instantaneous deviation control) and lowpass filtering to prevent overdeviation from excessive microphone levels.

Processed audio from Q1008 is passed through deviation trimmer VR1004 to varactor diodes D2001 and D2002 (both 1T33) to modulate VCO Q2005 (2SC2786L), oscillating at the transmit frequency. The output of Q2005 is buffered by Q2009 (2SC2026) and Q2011 (2SC2786L), and then delivered to the three-stage RF amplifier consisting of Q2012 (2SC2407), Q2013 (2SC2538) and Q2014 (2SC1971), providing up 2.5 or 4.5 watts RF output, depending on the battery voltage and High/Low power switch setting.

The transmit signal from final amplifier Q2014 is lowpass filtered by L2015/L2016, TC2004 and C2059-2061, passed through t/r switching diode D2005, and then lowpass filtered again by L2019 and C2065-2067 to suppress harmonics before application to the antenna.

Transmit/receive switching is controlled by Q2019 (BN1A4M), Q2020 (BA1L4M) and Q2021 (2SA733AP). When the PTT switch lowers the impedance at the base of Q2019,

CIRCUIT DESCRIPTION

the TX 5V line is activated, biasing Q2020 and Q2021 on, which then brings t/r switch D2005 into conduction. Otherwise, when the PTT switch is open, the RX 5V line is activated via Q2022 (2SA733AP).

When low power is selected by opening High/Low power switch SW2003, DC bias at RF amplifiers Q2013 and Q2014 is altered to reduce their gain, with VR2001 allowing fine adjustment of the bias of Q2013 to set the low power level.

PLL

The first local signal for the receiver (21.4 MHz below the channel frequency), and the carrier for the transmitter (at the transmit frequency) are generated by VCO Q2005, as already mentioned, under control of the PLL circuit. The oscillating frequency is determined primarily by the level of DC voltage fed from the loop lowpass filter to varactor diodes D2001/2002. A sample of the VCO oscillating frequency is taken at T2001 and buffered by Q2007 (2SC2786L) for application to prescaler Q2004 (MC12017P), which divides the sampled VCO frequency by 64 or 65 according to a control signal fed back from the prescaler control logic section of programmable divider IC Q2001 (TC9198P).

The divided signal from the prescaler is fed to the programmable divider where it is further divided down to 5 kHz according to data read from the diodes installed on the Matrix Unit and selected via Q3001/3002 (both TC4503BF) by the channel selector. This 5 kHz signal is applied to phase comparator Q2003 (TC5081AP). Meanwhile, reference oscillator/divider Q2002 (TC-5082P) generates a 5 kHz signal from 5.12 MHz crystal X2001, which signal is also applied to Q2003.

Q2003 compares the phase of the 5 kHz signal from the programmable divider with that of the reference signal, and any phase difference appears as a pulse train, the pulse width of which varies in accordance with the difference in phase between the input signals. This pulse train is then

lowpass filtered by L2001, L2002, R2001, R2002, R2016 and C2004-2006 to DC, which is applied to varactors D2001/2002, phase locking the VCO to the crystal reference.

When the VCO is unlocked, the voltage at pin 4 of Q2003 drops, turning Q2023 (BN1L4M) on, and Q2024 (2SA1115E) and Q2025 (BA1L3Z) off, which biases the transmitter RF amplifier stages off to prevent transmission.

ALIGNMENT

The FTH-2009 has been aligned at the factory for the specified performance across the frequency range specified for each version. Realignment should therefore not be necessary except in the event of a component failure, or alteration of version. All component replacement and service should be performed only by an authorized Yaesu representative, or the warranty policy may be voided.

The following test equipment is required for alignment:

- RF Signal Generator:
 - calibrated output level at 200 MHz
- Deviation Meter (linear detector)
- Oscilloscope
- AF Milivoltmeter
- SINAD Meter
- Inline Wattmeter: 200 MHz
- Regulated DC Power Supply:
 - adjustable from 4 to 17V, 2A
- 50-ohm Non-reactive Dummy Load: 10W at 150 MHz
- Frequency Counter:
 - +/-0.2ppm accuracy at 150 MHz
- AF signal Generator
- DC Voltmeter: 10-megohm impedance

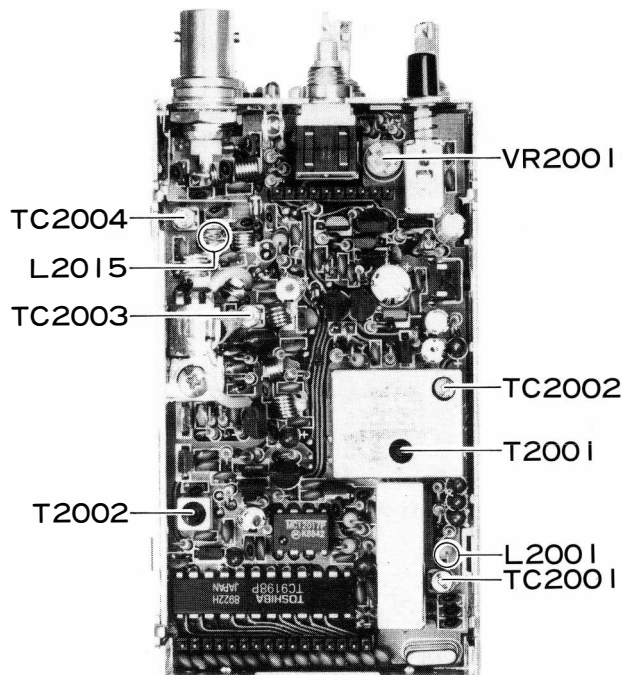
Before beginning alignment, we recommend replacing the customer's Matrix Unit with one preprogrammed with the alignment frequencies for the corresponding version, as shown in the following tables. Otherwise, it will be necessary to make note of all diode locations for the customer's channel frequencies, and to temporarily replace them with the alignment frequencies in the table.

Alignment Channel Frequencies

Vers.A (136-151 MHz)			Vers.B (150.8-163MHz)		
Ch.	Tx	Rx	Ch.	Tx	Rx
1	141.000	141.100	1	154.000	154.100
2	146.000	146.100	2	159.000	159.100
3	143.500	143.600	3	156.500	156.600
4	140.000	140.100	4	153.000	153.100
5	147.000	147.100	5	160.000	160.100
6	142.500	142.500	6	155.450	155.450

Vers.C (161-174 MHz)			Vers.D (148-158 MHz)		
Ch.	Tx	Rx	Ch.	Tx	Rx
1	165.000	165.100	1	150.500	150.600
2	170.000	170.100	2	155.500	155.600
3	167.500	167.600	3	153.000	153.100
4	164.000	164.100	4	149.500	149.600
5	171.000	171.100	5	156.500	156.600
6	166.500	166.500	6	154.500	154.500

Vers.E (158-168 MHz)		
Ch.	Tx	Rx
1	160.500	160.600
2	165.500	165.600
3	163.000	163.100
4	159.500	159.600
5	166.500	166.600
6	164.500	164.500



Transmitter Alignment Setup

ALIGNMENT

PLL & TRANSMITTER

Set up the test equipment as shown above for transmitter alignment. Adjust the supply voltage to 7.2V for all steps.

PLL VCV (Varactor Control Voltage)

- 1) Connect the DC voltmeter between L2001 on the TX Unit and chassis ground.
- 2) Set the transceiver to alignment channel 5. Key the transmitter and adjust transformer T2001 on the TX Unit for 4.0V on the voltmeter.
- 3) While receiving on alignment channel 5, adjust trimmer TC2002 on the TX Unit for 4.0 volts DC.
- 4) Set the transceiver to alignment channel 4, and confirm the low-end VCV is 0.5 volts while transmitting, and 0.5 volts while receiving.

Transmitter Output Power

- 1) Set the transceiver to alignment channel 3, and set the transceiver to HIGH power.
- 2) Adjust L2015, TC2003 and TC2004 on the TX Unit for peak output power on the wattmeter.
- 3) Press the H/L button (on the front panel), to set the transceiver to LOW power. Adjust VR2001 on the Mother Board for 0.5 watts output.

PLL Reference Frequency

With the transceiver set to alignment channel 3, adjust TC401 on the PLL Unit, if necessary, so the counter frequency matches the Tx frequency in the alignment channel chart corresponding to the version being aligned, when transmitting.

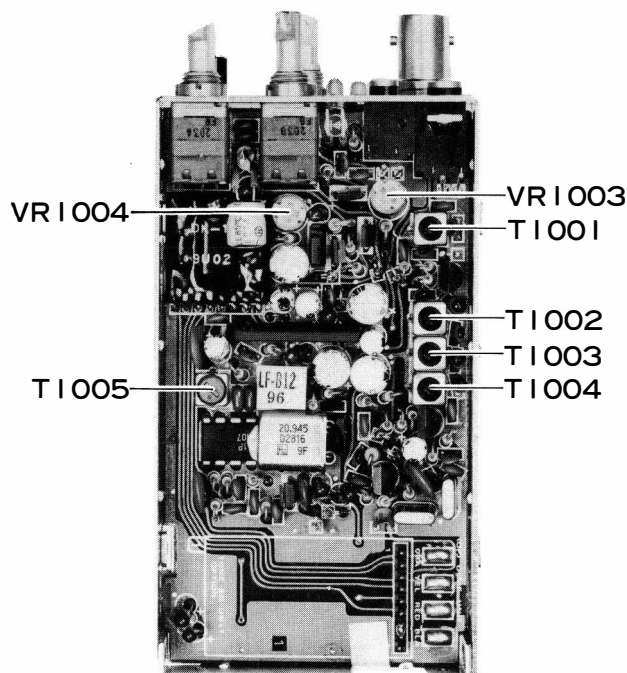
Modulation Level

- 1) With the transceiver set to alignment channel 3, adjust the AF generator for 25mV output at 1 kHz to the MIC jack.
- 2) Adjust VR1004 on the RX Unit for 4.5 kHz deviation on the deviation meter.

RECEIVER

Set up the test equipment as shown below for receiver alignment.

- 1) With the transceiver set to alignment channel 3 and the RF signal generator tuned to the corresponding receive frequency shown in the alignment frequency chart, set the generator for 3.0 kHz deviation of a 1 kHz tone, and set the output level for 40dbu at the antenna jack.
- 2) Adjust T1001 through T1004 on the RX Unit for optimum SINAD, and adjust T1005 on the RX Unit for peak of AF output power.



Receiver Alignment Setup

COMPONENT INFORMATION

RX Unit

Location	Nomenclature	Type	Application
Q1001	2SC3355	NPN Si Transistor	Rx RF Amplifier
Q1002	2SC2026	NPN Si Transistor	Rx 1st Mixer
Q1003	2SC535B	NPN Si Transistor	Rx IF Amplifier
Q1004	2SC2603E	NPN Si Transistor	Rx Noise Amplifier
Q1005	MC3361P	FM Rx Subsystem IC	2nd IF, Detector
Q1006	BA1L4M	NPN Si Transistor	Tone SQ Switch
Q1007	LA4145	AF IC	AF Amplifier
Q1008	DK1089	IC Module	MIC Amp Unit
Q1009	2SC2785F	NPN Si Transistor	Squelch Switch
Q1010	2SB793R	PNP Si Transistor	Regulator
Q1011	2SC2785F	NPN Si Transistor	Regulator
D1001	MC301	Silicon Diode	Rf Protector
D1002	1S1555	Silicon Diode	IF Limiter
D1003	1S1555	Silicon Diode	IF Limiter
D1004	1SS97	Schottky Diode	Rx Noise Detector
D1005	1SS97	Schottky Diode	Rx Noise Detector
D1006	GL3PG8	LED	Rx Indicator
D1007	1S1555	Silicon Diode	Rx Squelch Switch
D1008	1S1555	Silicon Diode	Tx Squelch Switch
D1009	HZ9A2L	Zener Diode	Voltage Follower
D1010	1SS205	Silicon Diode	Voltage Follower
XF1001	21M15BU	Crystal Filter Pair	Rx 1st Filter
X1001	20.945 MHz	Crystal	Rx 2nd Local Osc Crystal
CF1001	LF-B12	Ceramic Filter	Rx 2nd IF Filter

TX Unit

Q2001	TC9198P	IC	PLL Programmable Divider
Q2002	TC5082P-L	IC	PLL Reference Oscillator
Q2003	TC5081AP	IC	PLL Phase Comparator
Q2004	MC12017	IC	Prescaler
Q2005	2SC2786L	NPN Transistor	PLL VCO
Q2006	BA1L4M	NPN Transistor	T/R Switch
Q2007	2SC2786L	NPN Transistor	PLL Loop Buffer
Q2008	BA1L4M	NPN Transistor	T/R Switch
Q2009	2SC2026	NPN Transistor	PLL Output Buffer
Q2010	2SC2785F	NPN Transistor	PLL Output Buffer
Q2011	2SC2786L	NPN Transistor	PLL Output Buffer
Q2012	2SC2407A	NPN Transistor	TX RF Amplifier
Q2013	2SC2538	NPN Transistor	TX RF Amplifier
Q2014	2SC1971	NPN Transistor	TX RF Final Amplifier
Q2015	2SK381D	FET	DC Regulator
Q2016	2SA952M	PNP Transistor	DC Regulator
Q2017	2SC2603E	NPN Transistor	DC Regulator
Q2018	2SC2603E	NPN Transistor	DC Regulator
Q2019	BN1A4M	NPN Transistor	PTT Switch
Q2020	BA1L4M	NPN Transistor	PTT Switch
Q2021	2SA733AP	PNP Transistor	Tx 5V Switch
Q2022	2SA733AP	PNP Transistor	Rx 5V Switch
Q2023	BN1L4M	PNP Transistor	Unlock Switch
Q2024	2SA1115E	NPN Transistor	Unlock 5V Switch
Q2025	BA1L3Z	NPN Transistor	Tx Inhibit
D2001	1T33	Varactor Diode	VCO Tuning
D2002	1T33	Varactor Diode	VCO Tuning
D2003	1SS110	Silicon Diode	Modulator T/R Switch
D2004	1S1555	Silicon Diode	Unlock Switch
D2005	1SS53	Silicon Diode	T/R Switch
D2006	1SS53	Silicon Diode	Antenna Switch
D2007	HZ6A1L	Zener Diode	DC Regulator
D2008	1S1555	Silicon Diode	T/R Switch
D2009	1S1555	Silicon Diode	T/R Switch
D2010	1S1555	Silicon Diode	T/R Switch
D2011	GL3PR8	LED	Tx Indicator
X2001	5.12 MHz	Crystal	PLL Reference

Matrix Unit

Q3001	TC4503BF	Hex 3-State Buffer	T/R Channel Switch
Q3002	TC4503BF	Hex 3-State Buffer	T/R Channel Switch

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São Paulo, Agosto de 2021