Pub. No. : TI- 1681

Date : May. 1998

14 TECHNICAL DESCRIPTION OF EQUIPMENT

14.1 Function of Active Devices (FCC Rule Part 2.983(d)(6))

(1) TX/RX Board 05P0667

Component	Symbol	Type	Function
CR5	D.B.M	SBL-1C	3rd Mixer
CR10	DIODE	SMS3926-023	2nd Mixer
CR11	DIODE	1SS135T	N.B. Switching
CR12	DIODE	1SS135T	N.B. Switching
CR18	DIODE	1SS133T	AGC
CR19	DIODE	1SS133T	AGC
CR20	DIODE	1SS133T	AM Detector
CR21	DIODE	1SS133T	AM Detector
CR22	DIODE	SMS3926-023	1st Mixer
CR27	DIODE	1SS133T	Limiter
CR30	DIODE	1SS133T	Limiter
Q1	FET	2SK937	RX RF Amp
Q2	FET	2SK937	RX RFAmp
Q3	Transistor	DTB143ESTP	T/R Control
Q4	Transistor	2SC2498	1st LO Buff Amp
Q5	Transistor	DTB143ESTP	T/R Control
Q6	Transistor	DTB143ESTP	T/R Control
Q7	Transistor	2SC2498	TX IF Buff Amp
Q8	Transistor	DTB114ESTP	T/R Control
Q10	Transistor	DTB114ESTP	Noise Blanker Control
Q11	Transistor	DTB114ESTP	T/R Control
Q12	Transistor	DTB114ESTP	T/R Control
Q13	Transistor	DTB143ESTP	TX H3E Carrier Control
Q14	Transistor	DTB143ESTP	T/R Control
Q15	Transistor	DTB143ESTP	T/R Control
Q16	Transistor	2SC1815-Y	TX IF Buff Amp
Q17	Transistor	DTB114ESTP	T/R Control
Q18	Transistor	2SC1815-Y	AGC Buff Amp
Q19	Transistor	2SC1815-Y	RX IF Buff Amp
Q20	Transistor	2SC1815-Y	RX IF Buff Amp
Q21	Transistor	DTB114ESTP	AGC Control
Q22	Transistor	DTB143ESTP	3rd LO Control

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Component	Symbol	Type	Function
Q23	Transistor	2SC1815-Y	3rd LO Buff Amp
Q24	Transistor	2SC1212A-C	TX Bias Control
Q25	Transistor	2SC3133	TX RF Amp
Q26	Transistor	2SC1426	TX RF Amp
Q27	Transistor	DTB143ESTP	T/R Control
Q28	Transistor	DTB114ESTP	Tune Control
Q29	Transistor	DTB114ESTP	Through Control
Q30	Transistor	DTB143ESTP	T/R Control
Q31	Transistor	DTB143ESTP	RX Signal Control
Q32	Transistor	DTB143ESTP	Intercom Control
Q33	Transistor	DTB114ESTP	Mute Control
Q34	Transistor	DTB114ESTP	Fan Control
Q35	Transistor	2SA1020-Y	Fan Control
Q36	Transistor	DTB114ESTP	PA Bias Control
Q37	Transistor	DTB143ESTP	Selftest Signal Control
Q38	Transistor	DTB143ESTP	Dummy Control
Q39	Transistor	2SC1815-Y	RX IF Amp
U1	IC (AMP)	MC1350D	RX IF Amp
U2	IC (AMP)	MC1350D	RX IF Amp
U3	IC (AMP)	NJM2904M	AGC/RF Gain Amp
U4	IC (AMP)	NJM2904M	AGC Camp/Smeter Amp
U5	IC (AMP)	NJM4558M	RX AFAmp/TX AF Amp
U6	IC (AMP)	MC1350D	TX RF Amp
U7	IC (AMP)	NJM2904M	ALC Amp/Power Control
U8	IC (AMP)	NJM2904M	ALC Amp/Power Control
U9	IC (REG)	AN7805F	5V Regulator
U10	IC (AMP)	NJM455M	SQL Amp
U11	IC (DRIVER)	M549972FP-30NA	Line Control
U12	IC (DRIVER)	M549972FP-30NA	Line Control
U13	IC (AMP)	NJM4558M	Line AMP/Phone Amp
U14	IC (DETECTOR)	M51304L	Mic ALC Amp
U15	IC (AF AMP)	TDDA2003H	AF Power Amp
U16	IC (ANALOG SW)	MC14066BF	IF Filter Select
U17	IC (ANALOG SW)	MC14066BF	IF Filter Select
U18	IC (ANALOG SW)	MC14066BF	Line Select
U19	IC (ANALOG SW)	MC14066BF	Line Select
U20	IC (ANALOG SW)	MC14066BF	SQL Control/Line Select
U21	IC (ANALOG SW)	MC14066BF	SP Control/AGC Control

Component	Symbol	Type	Function
U22	IC (DRIVER)	M54459L	Divider for self test signal
U23	IC (ANALOG SW)	MC14066BF	H3E Carrier Control
U24	IC (REG)	AN78L09	9V Regulator
U25	HIC	05P0466	NB Detector

(2) VCO (on TX/RX board 05P0666)

Component	Symbol	Type	Function
Q501	FET	2SK30ATM	Charge Pump
Q502	Transistor	2SC2240-BL	Charge Pump
Q503	FET	2SK192A-GR	VCO1
Q504	MOS FET	2SK241-GR	Buff Amp
Q505	MOS FET	2SK241-GR	Buff Amp
Q506	MOS FET	2SK241-GR	Buff Amp
Q507	FET	2SK192A-GR	VCO3
Q508	Transistor	2SC2498	Limiter Amp
Q509	Transistor	2SC2498	Buff Amp
Q510	Transistor	2SC2498	Ref. OSC
Q511	Transistor	2SC2498	Buff Amp
Q512	MOS FET	2SK241-GR	Buff Amp
Q513	MOS FET	2SK241-GR	3rd LO Buff Amp
Q514	Transistor	2SD965Q	Oven Control
Q515	Transistor	2SA1020-Y	Oven Control
Q516	MOS FET	3SK131-T2	Mixer
U501	IC	AD7008AP20	Direct Digital Synthesizer
U502	MOS IC (PLL)	MC145170D1	PLL1
U503	IC (DRIVER)	M54972FP	Band Select
U504	MOS IC (PLL)	MC14170D1	
U505	IC (DRIVER)	M54459L	1/100 Divider
U506	IC	MB511PF	1/2 Divider
U507	IC (AMP)	NJM2904M	Oven Control
Y1	CRYSTAL	05S9220-0	Ref. OSL

(3) PA/FIL Board 05P0667

Component	Symbol	Type	Function
CR1	DIODE	V06C-AB2	Protection From Reverse Connection
Q1	Transistor	2SD667A-C	Relay Drive
Q2	Transistor (DIG)	DTC114ETATP	Relay Drive Control
Q3	Transistor (DIG)	DTC114ETATP	Relay Drive Control
Q4	Transistor	2SC3133	TX RF Drive Amp
Q5	Transistor	2SC3133	TX RF Drive Amp
Q6	Transistor	2SC3240	TX RF Power Amp
Q7	Transistor	2SC3240	TX RF Power Amp
Q8	Transistor	2SD1217A-P	PA Bias Control
Q9	Transistor	2SA1020-Y	PA Bias Control
Q10	Transistor (DIG)	DTC114ESATP	BK Relay Control
Q11	Transistor	2SA1020-Y	Relay Drive Control
U1	IC (REG)	µPC1093J	Ref. Volt
U2	IC (COMP)	NJM2904D	PA Bias Control
U3	IC (REG)	AN7805F	5V Regulator
U4	IC (COMP)	NJM2904D	SWR/ALC Amp, Over-temp. check
U5	IC (COMP)	NJM2904D	SWR/ALC Amp
U6	IC (PHOTO C)	TLP521-1GB	PA Bias Control
U7	IC	M54972P	Relay Select
U8	TR (ARRAY)	TD62787AP	Relay Drive
u9	IC (REG)	AN78L05	5V Regulator

(4) CPU Board 05PO665

Component	Symbol	Type	Function
U1	LCD	05S0805-0	LCD Unit
U2	IC	HD61602	LCD Drive
U3	TR (ARRAY)	PU3122	Transistor Array
U4	IC (REG)	L78LR05C-LR	5V Regulator
U5	CMOS IC	X24C16S8-2.7T	Memory
		IC	**HD6475328CP CPU**
U6	IC (MPU)	HD6475328F10	CPU

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(5) SW REG Board 05P0668

Component	Symbol	Type	Function
CR1	DIODE	MA649	RECT
Q1	MOS FET	2SK1266	SW Reg. Drive
U1	IC (REG)	µPC1094C	SW Reg. Control
U2	IC (PHOTO C)	TLP521-1GP	Ref. Check
U3	IC (REG)	µPC1093C	Ref. Volt

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(6) Receiver Board 05P0669

Component	Symbol	Type	Function
Q1	Transistor(RF)	2SC2498	RF Amp
Q2	Transistor	2SA1020-Y	CPU Vcc Control
Q3	Transistor	2SC1815-Y	CPU Vcc Control
U1	MOS LOGIC	TC74HC390AP	RF Signal Counter
U2	IC (A/D)	µPD7001C	A/D Converter
U3	MOS LOGIC	TC74HC14AP	Control
U4	IC (RESET)	M51953BL	Reset Control
U5	IC (REG)	AN7805F	5V Regulator
U6	IC (COMP)	NJM2403D	P.D. Check
U8	MOS MPU	05S0522-0	CPU
U9	IC (G. ARRAY)	M54563P	Relay Drive
U10	IC (G. ARRAY)	M54563P	Relay Drive
U11	IC (G. ARRAY)	M54563P	Relay Drive

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14.2 Circuit Description (FCC Rule Part 2.983(d))

(1) TRANSMITTER SECTION

Audio signal applied to microphone is amplified by U14 in B04 section of TX/RX board 05P0666. U14 also compresses excessive level of speech into a certain level to limit modulation level.

The limited audio signal is switched and amplified by U18, U19, U5 and applied to CR22 Double Balanced Modulator (D.B.M.) operating as 3rd Mixer. The DBM modulates the audio signal with 3rd local oscillation frequency 456.5 kHz and output Double Side Band (D.S.B.) signal with suppressed carrier.

The D.S.B. signal is amplified by Q16 Buffer Amplifier and the unwanted Upper Side Band (U.S.B.) component is rejected by Ceramic Filter FL2 and only Lower Side Band (L.S.B.) component is selected.

In order to accommodate class of emission H3E, carrier is injected at output of FL2 by injecting the 3rd local oscillation frequency 456.5 kHz, and carrier level is adjusted by potentiometer R101 for H3E.

The L.S.B. signal is mixed by 2nd Mixer CR10 D.B.M. with 2nd local oscillation frequency 54 MHz and 54.455 MHz signal is output.

The 54.455 MHz signal is amplified by Q7 Buffer Amplifier and passes through FL1 Xtal Filter 54.455 MHz to avoid unwanted components which may be included in the signal.

1st Mixer CR5 D.B.M. mixes the L.S.B. signal and 1st local oscillation frequency, f + 54.455 MHz +1.5 kHz, to generate transmit frequency f within 16 to 30 MHz. As the Mixer outputs the subtraction frequency, the L.S.B. signal is converted into a U.S.B. signal.

The U.S.B. signal output goes to a combination of Low Pass Filter (L.P.F.) and High Pass Filter (H.P.F.) consisting of coils L4, L5, L18, L19 and capacitors C16 to C20 and C186 to C190 which clears off any unwanted component.

The signal is amplified by Wideband Amplifier IC U6 and Buffer Amplifiers Q26 and Q25 to a level required to drive B05 section of Power Amplifier (PA) and FIL board 05P0667.

The B05 section of PA/FIL board 05P0667 amplifies the applied signal with 2 push-pull amplifiers each consisting of Q4 and Q5, and Q6 and Q7 to a level of nominal output power.

Power Amplifier contains Temperature Detector made of RT2 and U4 which detects temperature of power amplifier transistors. When the temperature rises and exceeds a certain threshold, the Temperature Detector outputs DC voltage to CPU

U6 of B03 section of CPU board, and then CPU U6 in B03 generates ALC signal. This results in increase of gain control voltage of Wideband Amplifier U6 in B04 section of TX/RX board. Gain of U6 is decreased and P.A. drive level is then decreased so that P.A. section is protected from damage due to an excessive temperature.

The output signal of Power Amplifier passes through L.P.F. in B05 section which cuts off harmonic contents of the signal. Spurious components contained in the signal output from the L.P.F. is attenuated by at least 65 dB relative to the wanted signal.

T5, CR6, CR7 and U4, U5 in the B05 section of PA/FIL board make SWR Detector which detects excessive Standing Wave Ratio due to failure of antenna matching or antenna terminal open-circuited or short-circuited. If it occurs, the SWR Detector reduces gain of the Wideband Amplifier U6 in the B04 section of TX/RX board to protect the Power Amplifier from damage.

"Forward" output of the SWR Detector is applied to the Wideband Amplifier U6 as ALC signal to control gain of the U6. The U6 is also used for power reduction controlled with DC voltage by CPU.

If the Power Amplifier is driven to produce output power exceeding the nominal power of 150 Wpep, the DC voltage of ALC signal is increased, gain of U6 in B04 is decreased and the drive level (output level of the B04) is decreased to maintain the output of 150 Wpep or less.

The L.P.F. B05 section of PA/FIL 05P0667 incorporates 6 L.P.F's. B1 through B6, one of which is selected depending on the frequency in use as follows:

L. P. F.	Cut-off Frequency
B1	2.4 MHz
B2	3.6 MHz
B3	6.0 MHz
B4	10.0 MHz
B5	18.0 MHz
B6	30.0 MHz

(2) LOCAL OSCILLATOR SECTION

All local oscillation frequencies are generated in VCO in B04 section of TX/RX board.

36.0 MHz is oscillated by Q510 with Crystal, temperature-compensated by an oven. The 36.0 MHz is divided by 2 by U506 into 18.0 MHz, which is used as the reference frequency for each PLL Oscillator.

1st local oscillation frequency is generated by PLL1 and DDS (Direct Digital Synthesizer): PLL1 consisting of Variable Divider U502 and VCO Q503, and DDS comprising U501, FL501 and FL502. DDS outputs reference frequency for PLL1. Dividing data in 10 Hz steps is inputted to U501 and Dividing data in 1 MHz is inputted to U502, and finally PLL1 generates 1st local oscillation frequency,

f+54.4565 kHz in 10 Hz steps.

2nd local oscillation frequency, 54.0 MHz, is synthesized with crystal oscillation frequency, 36.0 MHz and the reference frequency 18.0 MHz.

The PLL3 consisting of U504 Variable Divider and Q507 VCO generates 45.35 to 45.67 MHz in 10 kHz steps. This is divided by 100 by U505 to generate 3rd local oscillation frequency 453.5 to 456.7 kHz depending on class of emission.

(3) RECEIVER SECTION

Receive signal of frequency "f" picked up by antenna is applied to connector J1 of B04 section of TX/RX board 05P0666, passing through LPF in B05 section of PA/FIL board 05P0666. The signal then passes through LPF which protect local frequency signals from inducing to antenna system and through Induction Rejecter CR3 and CR4, and is supplied to 1st Mixer CR6 D.B.M. Incoming broadcasting signal in BC band is trapped by shifting the position of J8 and J9 (this means inserting LPF).

The receive signal is mixed by the 1st Mixer with the 1st local oscillation frequency (f+54.4565 MHz). 1st IF of 54.455 MHz is output. After passing through filter FL1 of $\pm$4 kHz bandwidth for unwanted components to be rejected the IF signal is amplified by U1.

The amplified 1st IF signal is mixed by 2nd Mixer CR10 D.B.M. with 2nd local oscillation frequency 54.0 MHz and converted into 455 kHz 2nd IF signal. CR11, CR12 and the hybrid IC U25 cut spike noise in the 2nd IF signal. The 2nd IF signal is applied to a suitable bandpass filter FL2, FL3 or FL4 in accordance with class of emission selected. It is then amplified by U2 and supplied to Detector.

Detector CR22 mixes the 2nd IF signal with 3rd local oscillation frequency 456.5 kHz and outputs audio frequency signal. For reception of H3E signal, CR20 and CR21 Detectors are used to obtain audio signal which is amplified by U5.

The U4 and U3 generate AGC signal to control gain of U1 1st IF Amplifier and U2 2nd IF Amplifier with DC voltage.

The audio signal is applied to U18 and U20 and then to U13 Line Amplifier. The output of Line Amplifier is used as line output but also applied to U10. The output of U10 is applied to B03 (CPU) as squelch control signal. Squelch Control mutes audio output when only noise is detected.

The audio signal is finally amplified by U15 AF Power Amplifier to drive a loudspeaker. Level of audio output is adjusted by a volume control on the front panel.

(4) PANEL/CPU SECTION

U6 CPU on B03 of CPU board 05P0665 receives and processes panel key entry and channel selector entry. Analogue receive signal strength or transmitter "forward" RF power is converted into digital signal by CPU. The level is graphically indicated on the LCD.

ITU channel data is stored in ROM section of U6 CPU and user-programmed channel data (199 channels) is stored in U5 Electrically Erasable PROM.

When a frequency is selected through keyboard or rotary knob, U6 CPU displays the frequency on the LCD and send necessary data to DDS and each PLL on TX/RX board.

For dimmer control, in accordance with instructions through keyboard the CPU controls amount of currents to be supplied to each illumination lamp.

(5) ANTENNA COUPLER SECTION

Transmit signal supplied from transmitter is brought to antenna system through SWR Detector (T1), Phase Detector (T2) and matching network consisting of C1 to C18 and L1 to L10.

U8 CPU selects suitable constants by combination of capacitors and coils depending on signals sent from T1 and T2. The initial constants are automatically defined by CPU, reading counter made of Q1 and U1 for frequency selected. The suitable value is stored in memory which is used as initial value when the same frequency is selected later. This greatly reduces time to tune.

Press S1 "TUNE" to activate tune operation and transmitter generates pilot signal for tuning.