

5 DESCRIPTION OF CIRCUITRY AND DEVICES (FCC Rule Part 2.1033)

5.1 Function of Each Semiconductor or Active Device

(1) Transceiver unit FM-8800S

PANEL Board: 05P0772

<u>Symbol</u>	<u>Component</u>	<u>Type</u>	<u>Function</u>
Q1	Transistor	DTD143EKT146	Switching
Q2	Transistor	DTD143EKT146	Switching
Q3	Transistor	DTD143EKT146	Switching
Q4	Transistor	DTD143EKT146	Switching
U1	IC	TA48M033F-TE16L	3.3V 3-terminal regulator
U2	IC	M5218AFP-600C	OP amp

CPU Board: 05P0773

<u>Symbol</u>	<u>Component</u>	<u>Type</u>	<u>Function</u>
Q2	Transistor	2SK3022-00L	Driver
Q4	Transistor	DTC114EKAT146	Switching
Q5	Transistor	DTC114EKAT146	Switching
Q6	Transistor	DTC114EKAT146	Switching
Q7	Transistor	DTC114EKAT146	Switching
Q8	Transistor	2SC3123	Regulation
Q10	Transistor	2SC3123	Buffer Amp
Q11	Transistor	DTC114EKAT146	Switching
Q12	Transistor	DTC114EKAT146	Switching
Q13	Transistor	DTC114EKAT146	Switching
Q14	Transistor	DTC114EKAT146	Switching
Q15	Transistor	DTC114EKAT146	Switching
U1	IC	SN74LVCC4245APWR	CENTRONICS IF
U2	IC	SN74LVCC4245APWR	CENTRONICS IF
U3	IC	TC74LCX04FT-EL	INVERTER
U4	IC	M5218AFP-600C	AF amp
U5	IC	M5218AFP-600C	AF amp
U6	IC	NJM386M-T1	AF amp
U7	IC	TC74HC595AF	8bits Shift Register
U8	IC	TC74HC595AF	8bits Shift Register
U9	IC	M5218AFP-600C	OP amp
U10	IC	AK4543	CODEC
U11	IC	M5218AFP-600C	OP amp
U12	IC	TDA2003H	AF amp
U13	IC	LTC1480CS8	Line Transmitter
U14	IC	LTC1480CS8	Line Transmitter
U15	IC	PC400	Photo Coupler
U16	IC	M5218AFP-600C	OP amp
U17	IC	AK4528VF	CODEC
U18	IC	M5218AFP-600C	2nd.IF Amp
U19	IC	TC74LCX32FT-EL	OR
U20	IC	ADSP2186NBST-320	DSP
U21	IC	TC74VHC165FT-EL	P/S Converter
U22	IC	TC4W53FU-TE12L	SW&2nd.IF Amp

<u>Symbol</u>	<u>Component</u>	<u>Type</u>	<u>Function</u>
U23	IC	NJM2904M-T1	OP amp
U24	IC	TC74VHC165FT-EL	P/S Converter
U25	IC	AD9834BRU-REEL7	DDS
U26	IC	SI-8501L	DC/DC Converter
U27	IC	TA48M033F-TE16L	3.3V 3-terminal regulator
U28	IC	TA48M033F-TE16L	3.3V 3-terminal regulator
U29	IC	AT28BV256-20SC	EEPROM
U30	IC	HD64F2377VFQ33V	CPU
U31	IC	IC41LV16100S-50T	DRAM
U32	IC	TC74LCX04FT-EL	INVERTER
U33	IC	TC74VHC74FT-EL	FLIP-FLOP
U34	IC	M51957BFP C61J	System Reset
U35	IC	TC7S08F-TE85L	AND
U36	IC	S1D13704F00A	LCD Controller
U37	IC	TC74VHCU04FT-EL	INVERTER
U38	IC	TC74VHC161FT-EL	Counter
U39	IC	TC74VHC161FT-EL	Counter
U40	IC	TC74VHC74FT-EL	FLIP-FLOP
U41	IC	TC7S08F-TE85L	AND
U42	IC	M5218AFP-600C	MIC amp
U43	IC	TA4001F-TE85L	

TX / RX Board: 05P0774

<u>Symbol</u>	<u>Component</u>	<u>Type</u>	<u>Function</u>
Q1	Transistor	2SK3074-TE12L	Driver
Q2	Transistor	2SA1213-Y-TE12L	APC
Q3	Transistor	DTC114EKAT146	Switching
Q4	Transistor	DTA114EKAT146	Switching
Q5	Transistor	2SC3356(M)-T1B	TX Driver
Q6	Transistor	PMBFJ310	1st.IF Amp
Q7	Transistor	2SC3356(M)-T1B	RF Amp
Q8	Transistor	DTC114EKAT146	Switching
Q9	Transistor	DTC114EKAT146	Switching
Q10	Transistor	2SC2712-Y-TE85L	APC
Q11	Transistor	DTC114EKAT146	Switching
Q12	Transistor	DTA114EKAT146	Switching
Q13	Transistor	2SC3356(M)-T1B	VCO Buffer Amp
Q14	Transistor	2SC3356(M)-T1B	VCO OSC
Q15	Transistor	PMBFJ310	VCO Buffer Amp
Q16	Transistor	DTC114EKAT146	Switching
Q17	Transistor	2SA1213-Y-TE12L	Switching
Q18	Transistor	DTC114EKAT146	Switching
Q20	Transistor	2SC3123	Buffer Amp
Q21	Transistor	2SA1037AKT146R	Switching
Q101	Transistor	PMBFJ310	Buffer Amp
Q102	Transistor	2SC2712-Y-TE85L	APC
Q111	Transistor	2SK882-GR-TE85L	1st.IF Amp
Q112	Transistor	2SC2712-Y-TE85L	AGC
Q113	Transistor	2SC2712-Y-TE85L	AGC
Q114	Transistor	2SC3324-B-TE85L	2nd.IF Amp

<u>Symbol</u>	<u>Component</u>	<u>Type</u>	<u>Function</u>
Q115	Transistor	DTC114EKAT146	Switching
U1	IC	RA35H1516M	TX Amp
U2	IC	DCS3D20-0157	CM Coupler
U3	IC	NJM2904M-T1	APC
U4	IC	NJM2904M-T1	APC
U5	IC	TA4001F-TE85L	Buffer Amp
U7	IC	UPC2745TB-E3	VCO Buffer Amp
U8	IC	UPC2745TB-E3	VCO Buffer Amp
U9	IC	TA48L033F-TE12L	3.3V 3-terminal regulator
U10	IC	TA4001F-TE85L	Buffer Amp
U11	IC	TC7SHU04F-TE85L	Buffer Amp
U12	IC	LMX2353TMX	PLL IC
U13	IC	LM60CIM3	Temperature Sensor

CH70 RX Board: 05P0775

<u>Symbol</u>	<u>Component</u>	<u>Type</u>	<u>Function</u>
Q1	Transistor	2SC3356(M)-T1B	Buffer Amp
Q2	Transistor	PMBFJ310	1st.IF Amp
Q3	Transistor	2SC3356(M)-T1B	RF Amp
Q4	Transistor	2SK882-GR-TE85L	1st.IF Amp
Q7	Transistor	2SC3324-B-TE85L	2nd.IF Amp
Q8	Transistor	2SK882-GR-TE85L	Xtal OSC
U2	IC	TA48L033F-TE12L	3.3V 3-terminal regulator

POWER Board: 05P0776

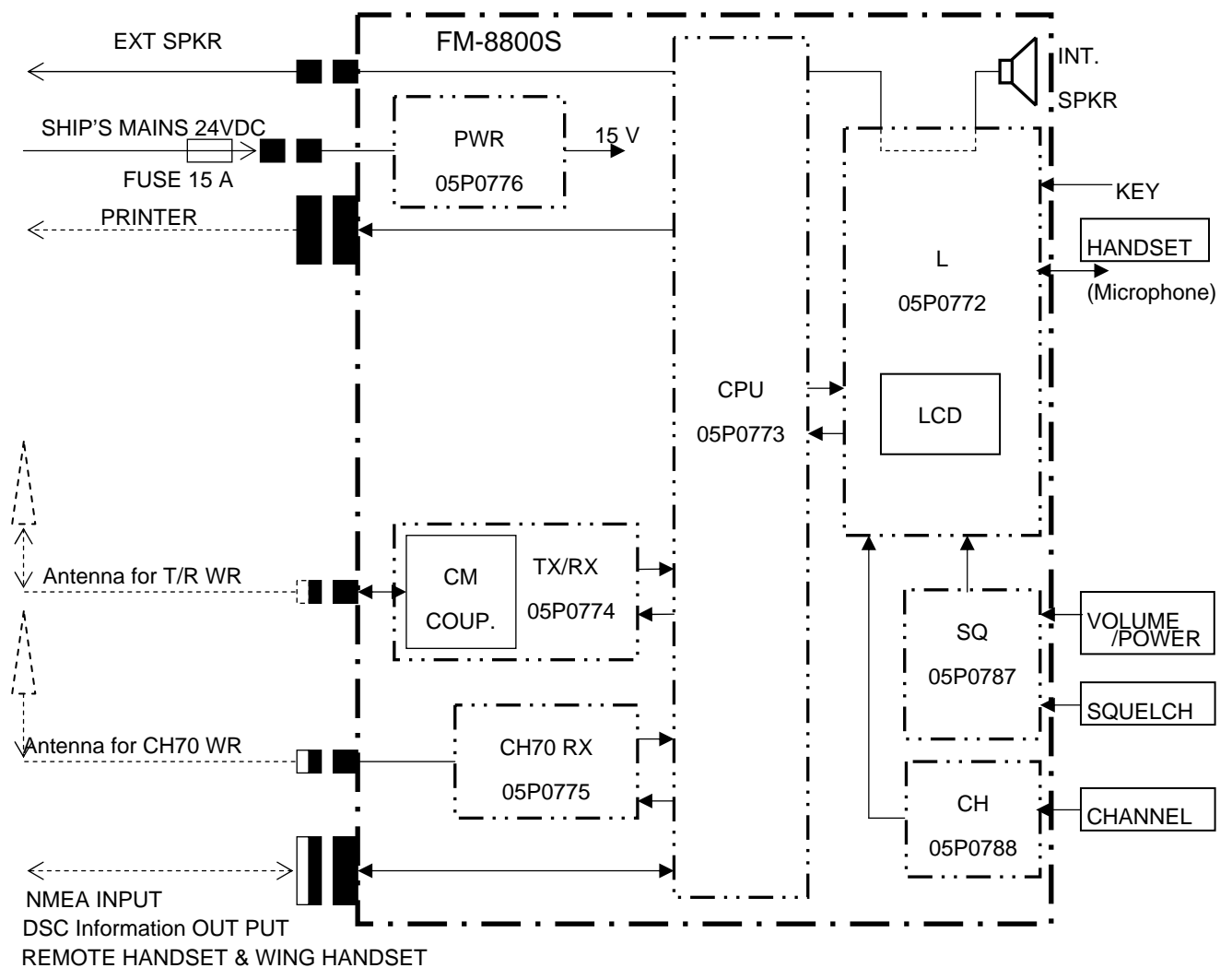
<u>Symbol</u>	<u>Component</u>	<u>Type</u>	<u>Function</u>
Q1	Transistor	2SD1271A-P	Regulation
Q2	Transistor	2SD2185S-TX	Switching
Q3	Transistor	DTC114EKAT146	Current Amp
U1	IC	CBS2002415-T	DC/DC Converter
U2	IC	M51958BFP-600D	Under-Voltage Protection

5.2 Description of the circuits employed for suppression of spurious radiation, for limiting or shaping the control pulse, and for limiting or controlling power

(1) Block Description

(1.1) General

The FM-8800S operates from 24 VDC power supply and consists of seven boards as showed below. It can be combined with the RB-8800, RB-8810, DMC-5, wing handset, navigation equipment (NMEA input and output), and printer.



GENERAL BLOCK DIAGRAM

(1.2) Function of major circuits

Table (1.2) Function of major circuits

Block name	Outline
PANEL (05P0772)	Power switch ON/OFF, Internal speaker volume control, Squelch control, Display on LCD, Control by Key-entry.
CPU (05P0773)	Consists of CPU, DSP, and its peripheral circuits. FM modulation, Demodulation process, Analog interface with radio part, DSC, system control of radio communication and I/O interface are done.
TX/RX (05P0774)	FM modulated signal 45 MHz is input from CPU Block, and converted into a transmitting frequency and power-amplified. RF Power module U1 (RA35H1516M) amplifies the signal into 25 W. VHF receiving signal is converted into 37.5 kHz IF signal which is demodulated into voice signals and tone signals at CPU Block.
CH70 RX (05P0775)	DSC receiving signal is converted to 37.5 kHz IF signal. The receiving frequency is CH70: 156.525 MHz .
PWR (05P0776)	24 VDC input is distributed to each PCB after converting to 15 VDC by the switching regulator.
SQ (05P0787)	Squelch level is adjustable automatically and manually.
CH (05P0788)	Power switch ON/OFF, Internal speaker volume control and Key control.

(2) Transmission Signal Flow
(2.1) Transmission Signal Flow

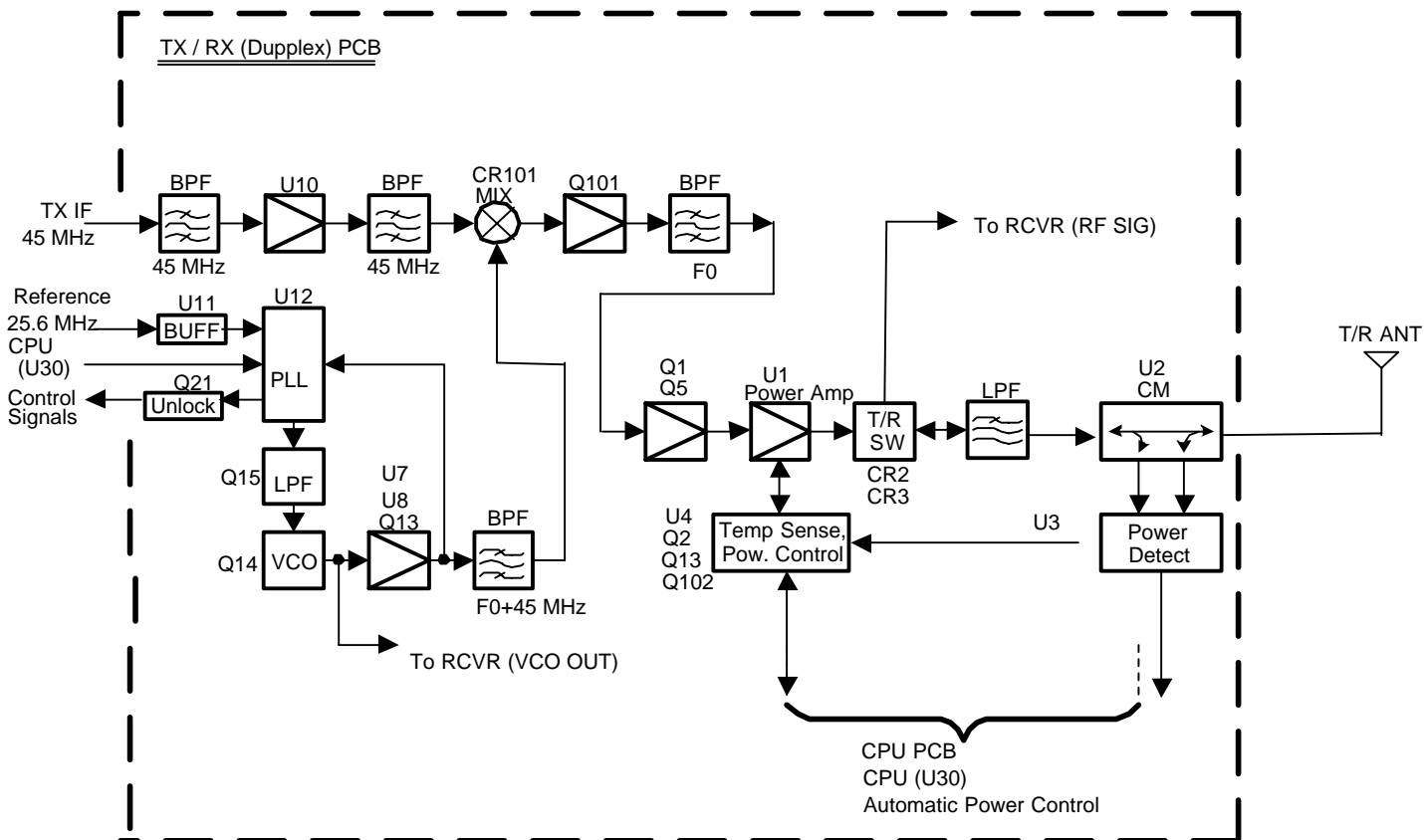
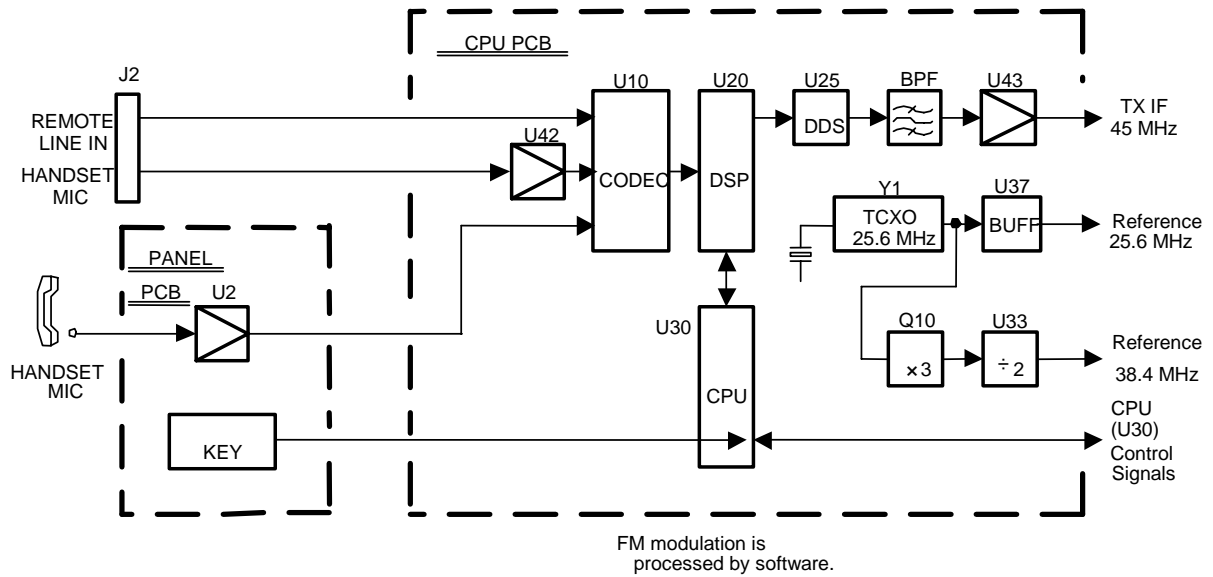


Fig. (2.1-1) TRANSMISSION SIGNAL FLOW

Voice signal coming from the microphone (standard modulation: 600 Ω , -49 dBm) is input to U10 Codec (AK4543) of CPU Board(05P0773) after amplified by 20 dB at U2 OP.AMP (M5218AFP) of PANEL Board (05P0772).

The signal is sampled by the sampling frequency of 8.33 kHz at U10 Codec, and FM-modulated at U20 DSP (ADSP2186NBST) after converted to digital signals.

Amplitude information of the signal is changed into the frequency ones by the software.

The details about the software processing are shown in Subclause (2.1.1).

The frequency information is of 45 MHz FM-modulated wave at U25 DDS (AD9834BRU) of CPU Board (05P0773), and is amplified up to 50 Ω , -28 dBm at U43 RF AMP (μ PC1675G) after passing the B.P.F made up of L/C. Finally the TX IF signal is output to TX/RX Board (05P0774).

The spurious components included in the transmission modulated signal coming from TX IF signal is reduced at FL1 B.P.F (Passband width: \pm 10 kHz, Stopband attenuation: more than 80 dB at \pm 900 kHz) of TX/RX Board (05P0774).

The signal is mixed at CR101 (1SS271) with the 1st local oscillated frequency (200.000 MHz to 206.475 MHz) produced by the PLL circuit, and is converted to the frequency of 155.000 MHz to 161.475 MHz.

The next stage B.P.F is made of L/C circuit, reducing the spurious components produced by the frequency conversion. U1 is of HPA module (Gain: 30 dB or more, Attenuation of 2nd harmonics: 40 dB or more) and holds 25 W output.

The output of HPA is of spurious attenuated by an LPF (Cut-off freq.: 195 MHz, Attenuation of harmonics: 60 dB or more) made of the L/C circuit, and is connected to VHF ANT terminal via U2: CM coupler.

Y1: 25.6 MHz of CPU Board (05P0773) is a reference oscillator (TCXO) of the PLL circuit of TX/RX Board (05P0774), and has an accuracy of \pm 2.5 ppm at -25°C to +70°C, maintaining the VHF transmitting frequency tolerance within \pm 400 Hz.

2.1.1 Explanation of signal processing by software

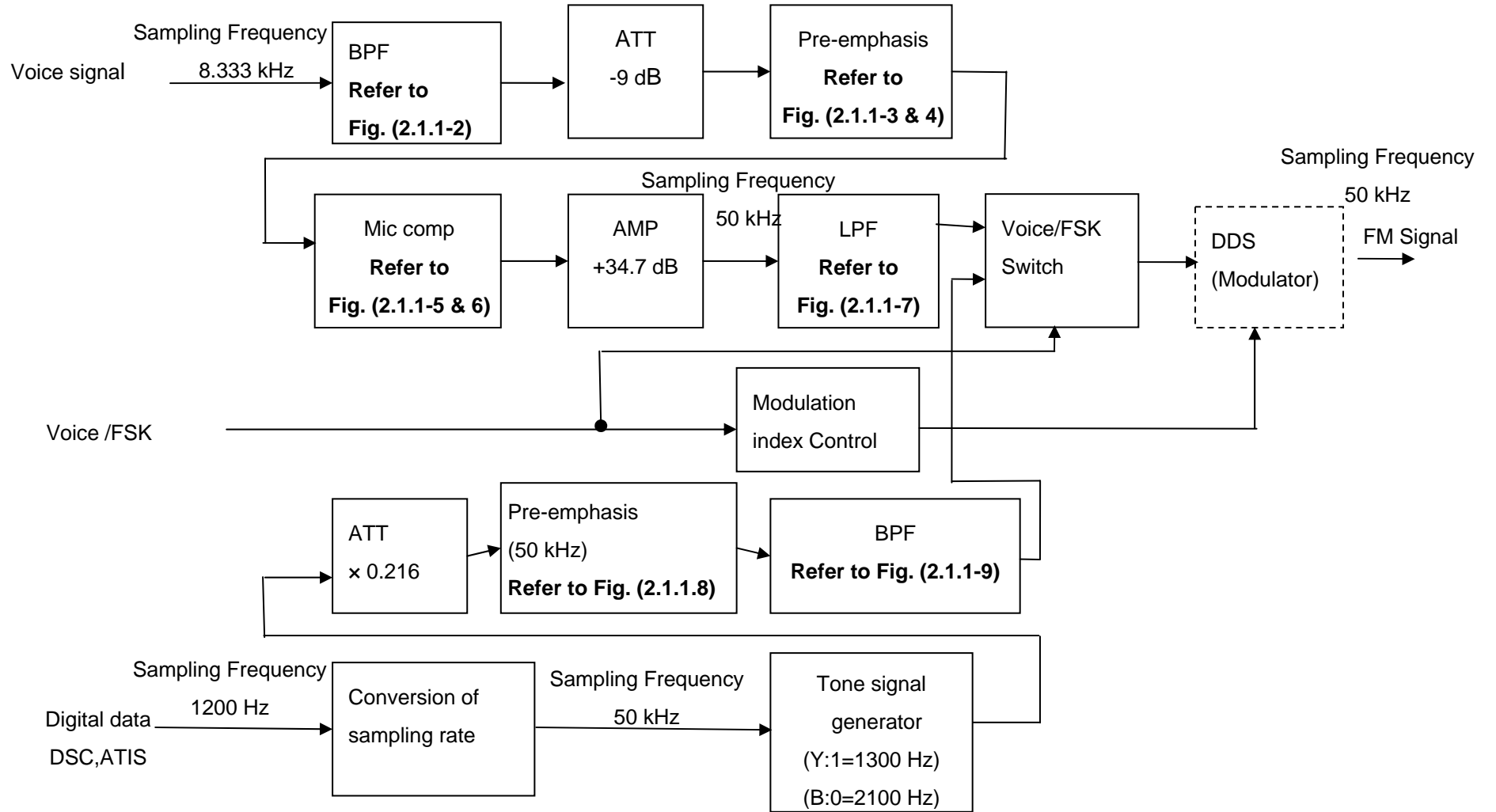


Fig. (2.1.1-1) The outline of Signal processing by software

FM modulation is performed by the software processing at U20 DSP (ADSP2186NBST). Its outline is indicated in Fig. (2.1.1-1).

The voice signal converted into the digital signal is passed to B.P.F. (Fig. (2.1.1-2)) removing unnecessary harmonics, and then goes into the filter having pre-emphasis characteristics (Fig. (2.1.1-3)).

Fig. (2.1.1-4) indicates the measurement data of pre-emphasis characteristics.

The voice signal is compressed by a mic-compressor and controlled not to exceed a frequency shift of 5 kHz. See Fig. (2.1.1-5) and Fig. (2.1.1-6).

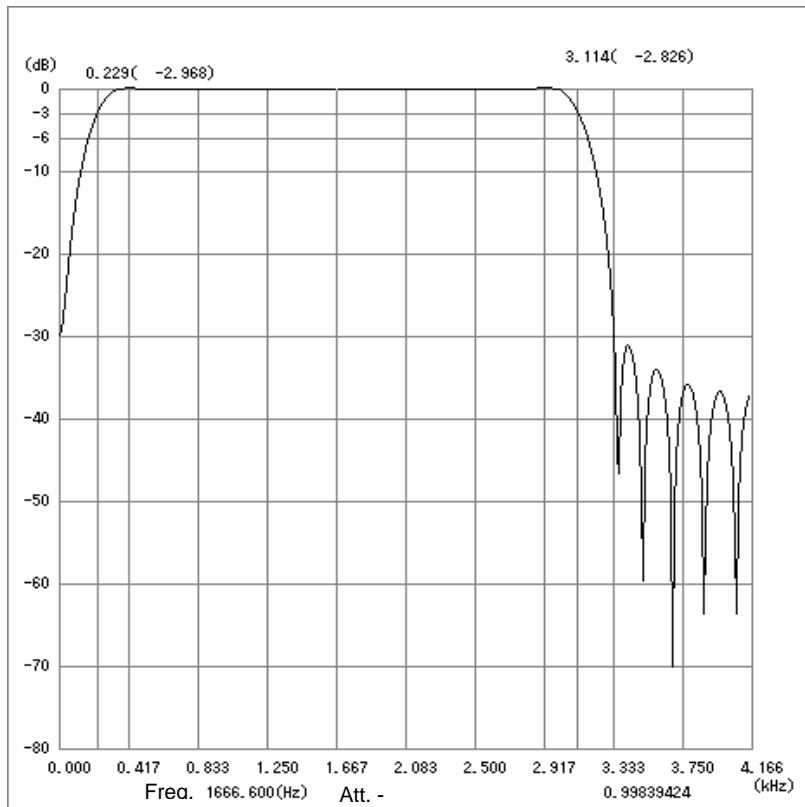
Further, L.P.F (Fig. (2.1.1-7)) compresses the frequency shift of 3 kHz or more, and attenuates the element of leaked power to the adjacent channel. U25 DDS (AD9834BRU) generates FM-modulated signal of direct 45 MHz.

On the other hand, DSC, ATIS signal is produced with 1300 Hz and 2100 Hz tone signals at DSP sine-converting the digital data produced at U30 CPU (HD64F2377) of CPU Board (05P0773).

Tone signals pass the pre-emphasis filter shown in Fig. (2.1.1-8).

Likewise the voice signal, B.P.F compresses the frequency shift of 3 kHz or more, and attenuates the element of leaked power to the adjacent channel. FM modulated signal of direct 45 MHz by DDS is generated. See Fig. (2.1.1-9).

Modulation by DDS varies the modulation index depending on the type of signals to be modulated. DSC signals are controlled with the modulation index to be 2, while ATIS signals are to be 1.



Band pass filter
Sample freq.: 8333.0(Hz)
Stop limit freq.: 0.0(Hz)
Pass limit freq.: 350.0(Hz)
Pass limit freq.: 3000.0(Hz)
Stop limit freq.: 3350.0(Hz)
Stop reduction : 31.0(dB)
Coeff. tap : 41
Coeff. format : Q15

Fig. (2.1.1-2) The characteristics of BPF

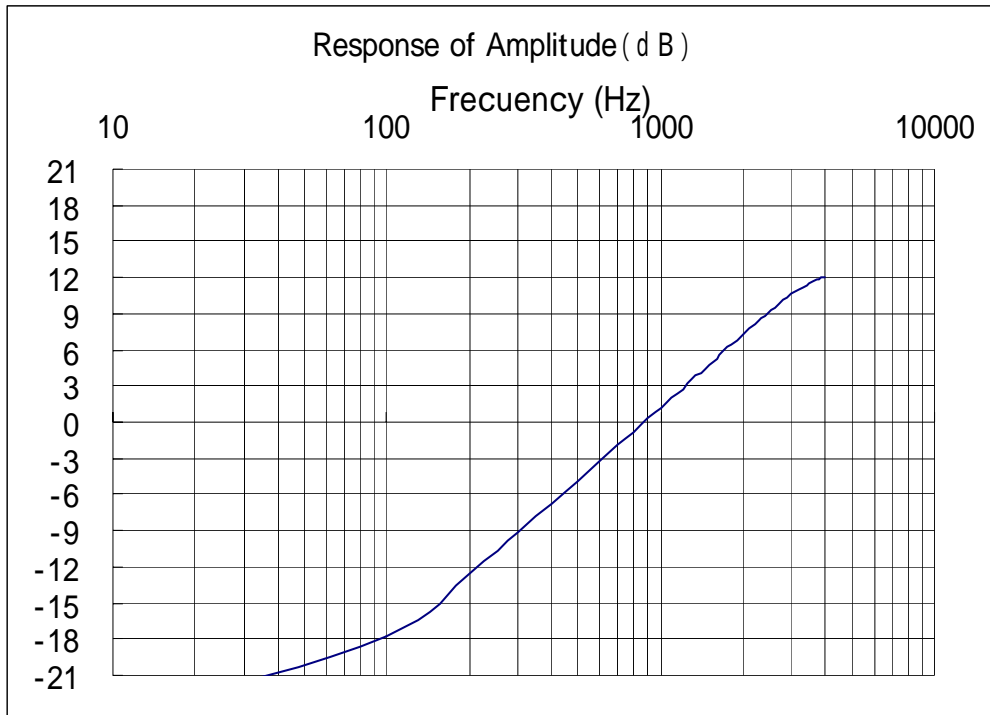


Fig. (2.1.1-3) The characteristics of Pre-emphasis

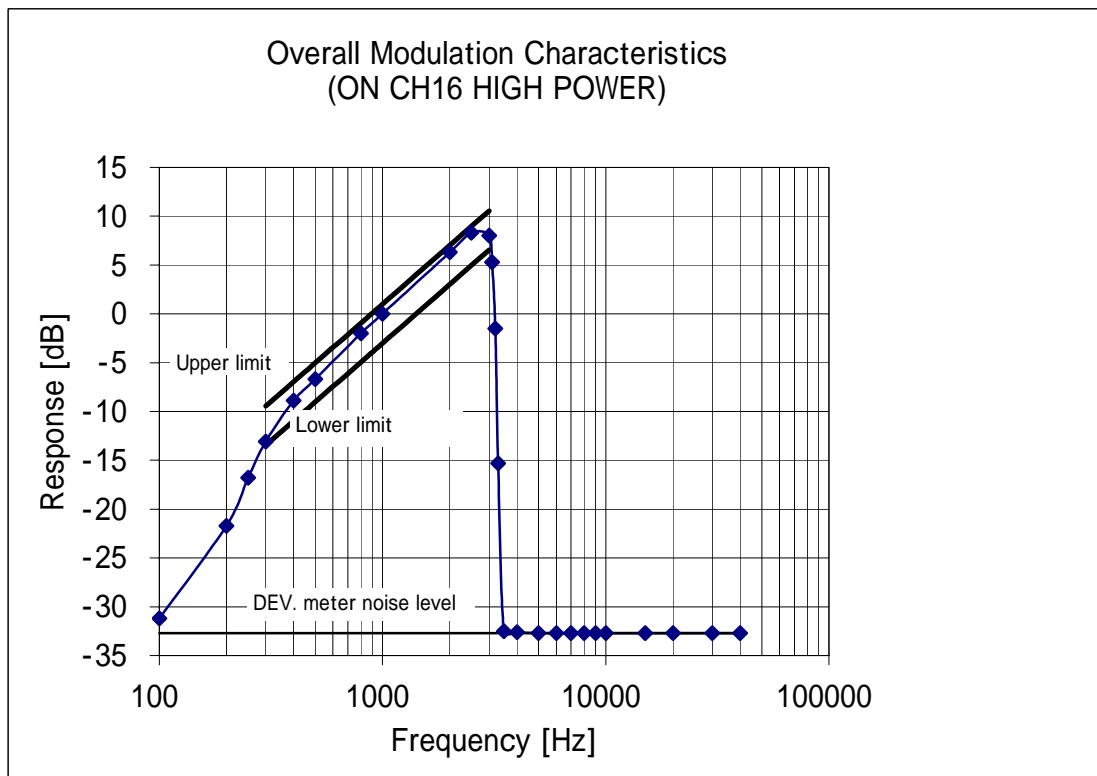


Fig. (2.1.1-4) The characteristics of Pre-emphasis (Survey data)

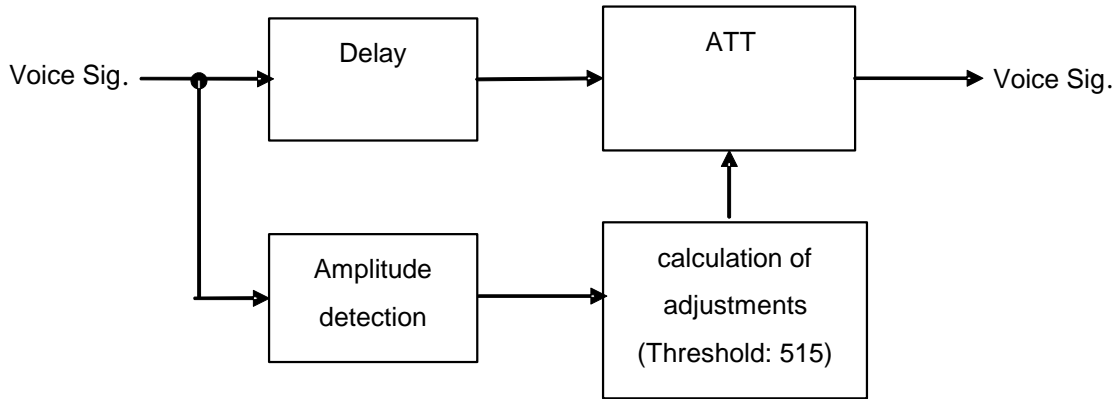


Fig. 2.1.1-5 Details of Mic comp

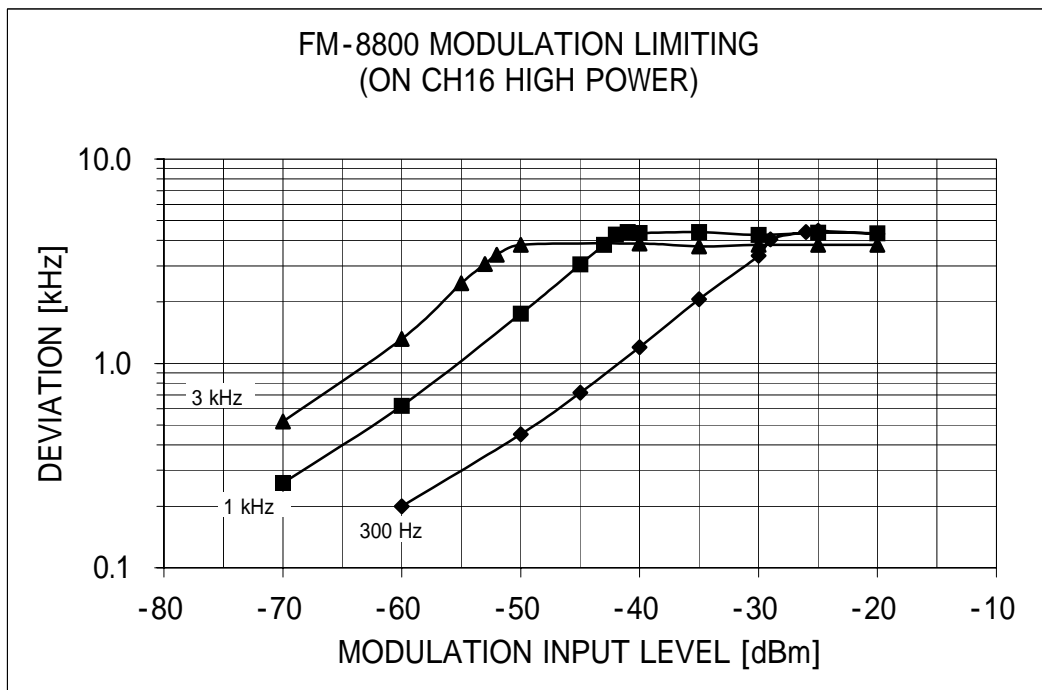
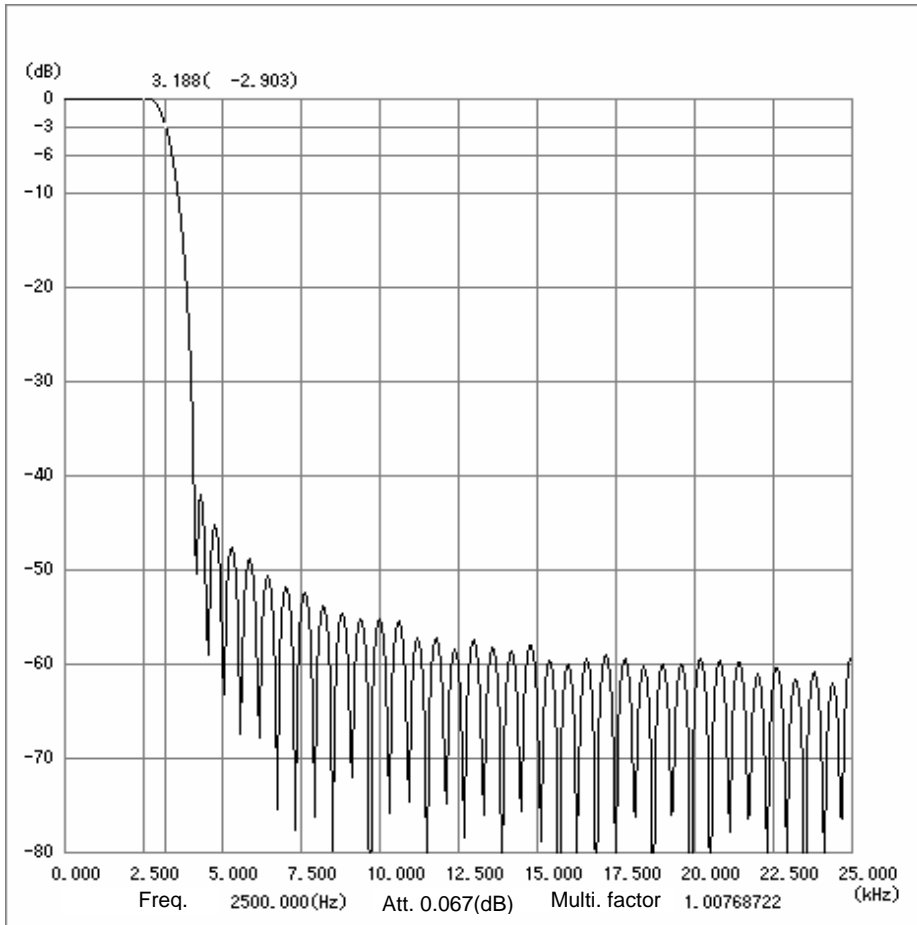


Fig. 2.1.1-6 The characteristics of Modulation Limiting (Survey data)



Low pass filter
 Sample freq.: 50000.0 (Hz)
 Pass limit freq.: 2700.0 (Hz)
 Stop limit freq.: 4100.0 (Hz)
 Stop reduction: 40.9 (dB)
 Coeff. Tap : 83
 Coeff. format : Q17
 Coeff. mag. : 1.50

Fig. 2.1.1-7 The characteristics of LPF

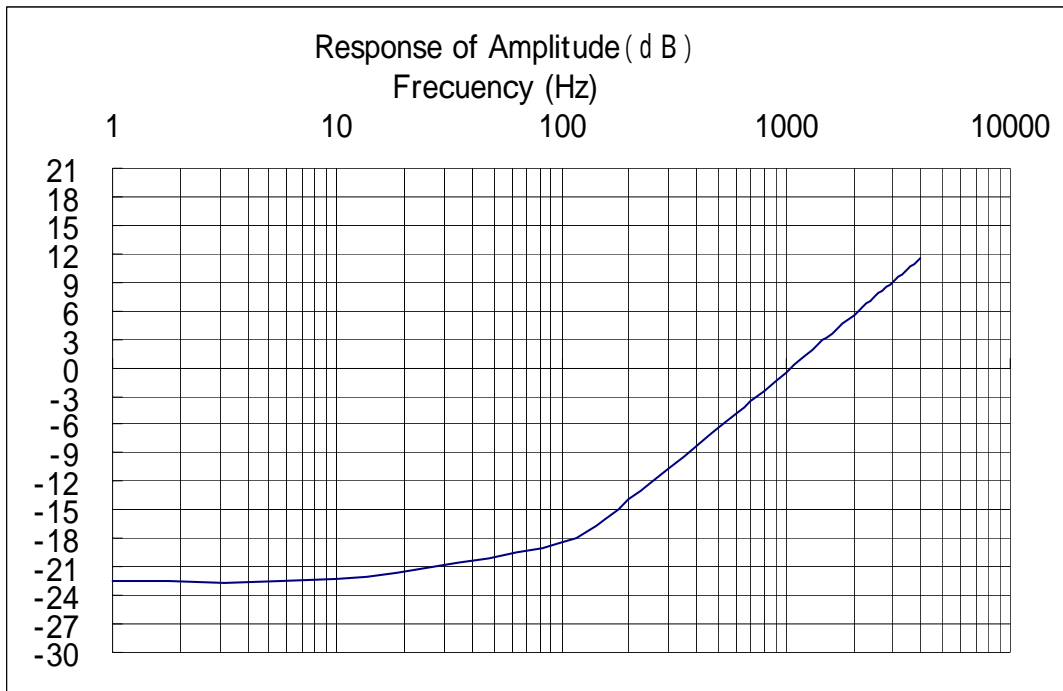
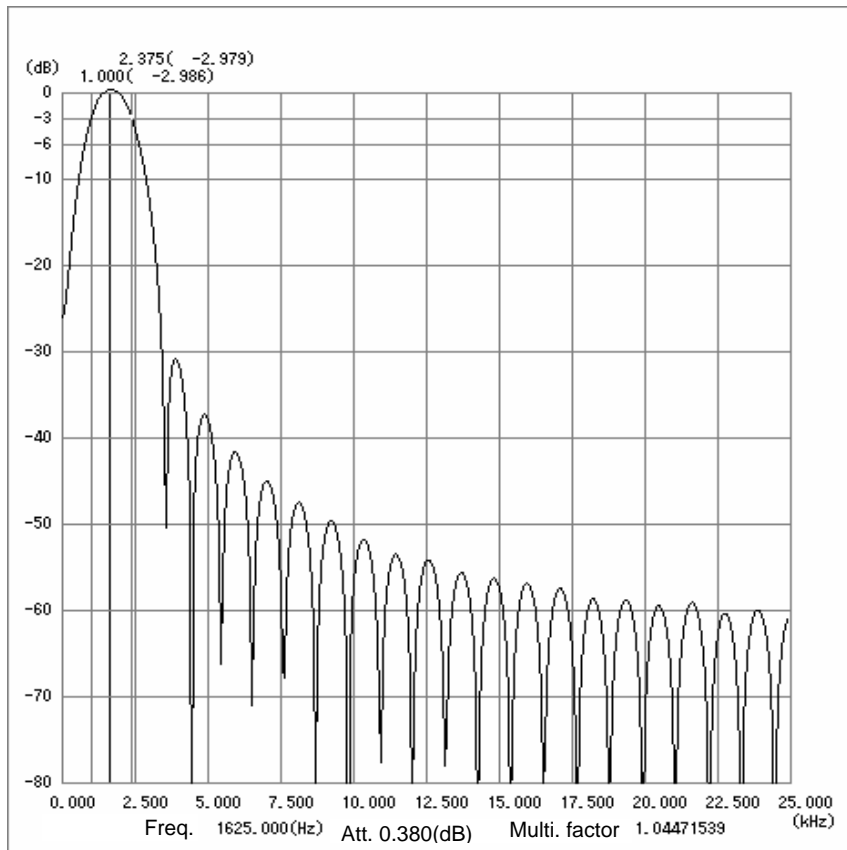


Fig. 2.1.1-8 The characteristics of Pre-emphasis (50 kHz)



Band pass filter
 Sample freq. : 50000.0 (Hz)
 Stop limit freq. : 0.0(Hz)
 Pass limit freq. : 1500.0 (Hz)
 Pass limit freq. : 1900.0 (Hz)
 Stop limit freq. : 3400.0 (Hz)
 Stop reduction : 26.0 (dB)
 Coeff. tap : 43
 Coeff. format : Q15
 Coeff. mag. : 1.00

Fig. (2.1.1-9) The characteristics of BPF

(3) Reception Signal Flow on Simplex channel

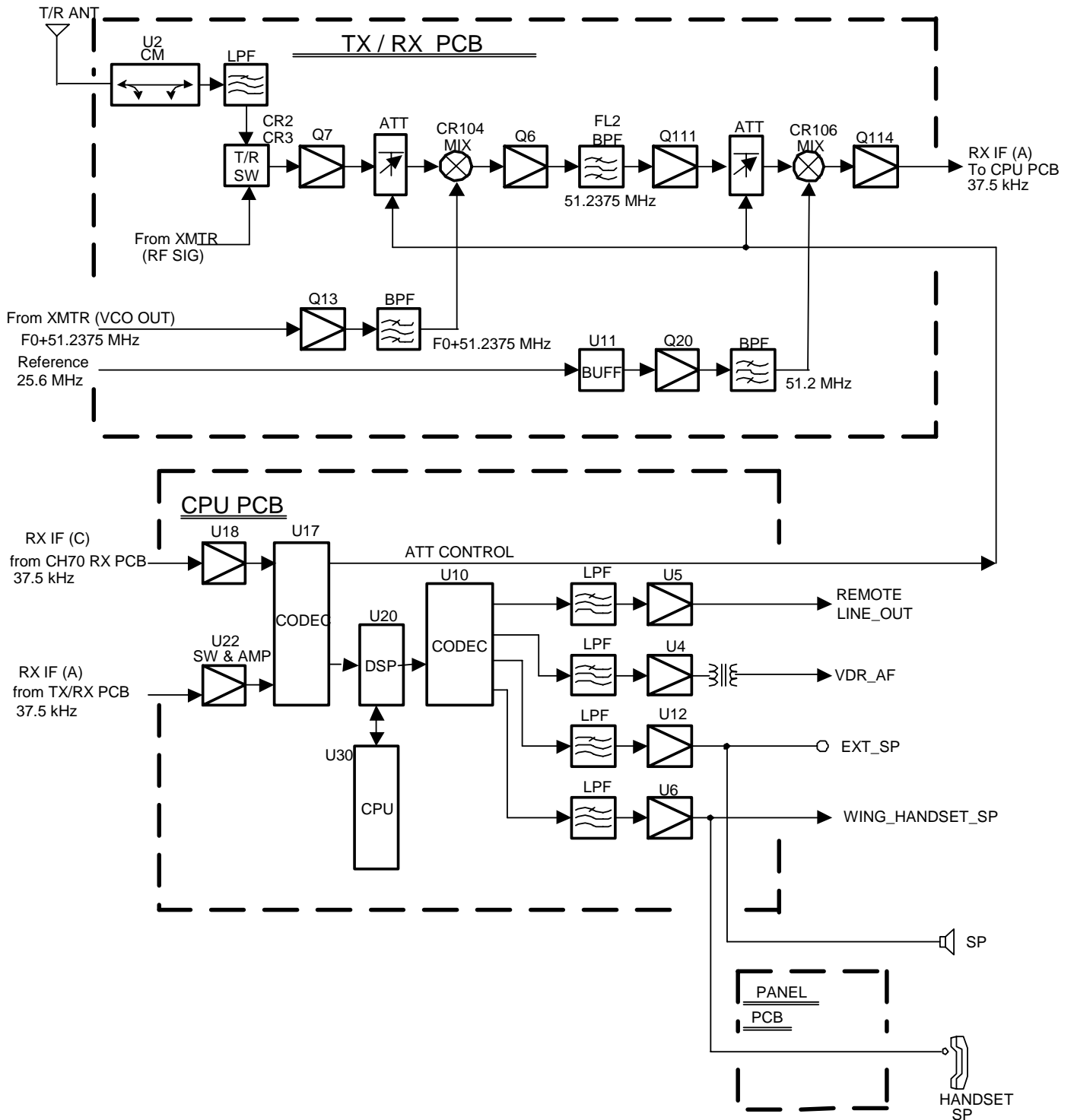


Fig. (3-1) VHF Reception Signal Flow

VHF RX signal reaches the 1st mixer circuit CR104 (1SS271) after passing a Directional coupler, Duplexer, LPF and T/R switching and amplified by Q7 at TX/RX Board (05P0774). At CR104, RX signal of 150 MHz band and 1st local oscillation freq. of 206 to 210 MHz produced by PLL circuit are mixed to convert to 1st IF frequency of 51.2375 MHz. The BPF, FL2 for 1st IF stage has a pass-bandwidth of ± 7.5 KHz attenuating the spurious components created by the frequency conversion. The RX 1st IF signal comes to 2nd mixer circuit CR106 (1SS271) after amplified at Q111. At CR106, the RX 1st IF signal is converted to 2nd IF signal of 37.5 kHz by means of the 2 multiplied local oscillation of 25.6 MHz coming from CPU Board (05P0773). Then, it is converted to the digital signal by U17 CODEC (AK4528VF) of CPU Board (05P0773), and FM-demodulated by the software.

(4) CH70 Reception Signal Flow

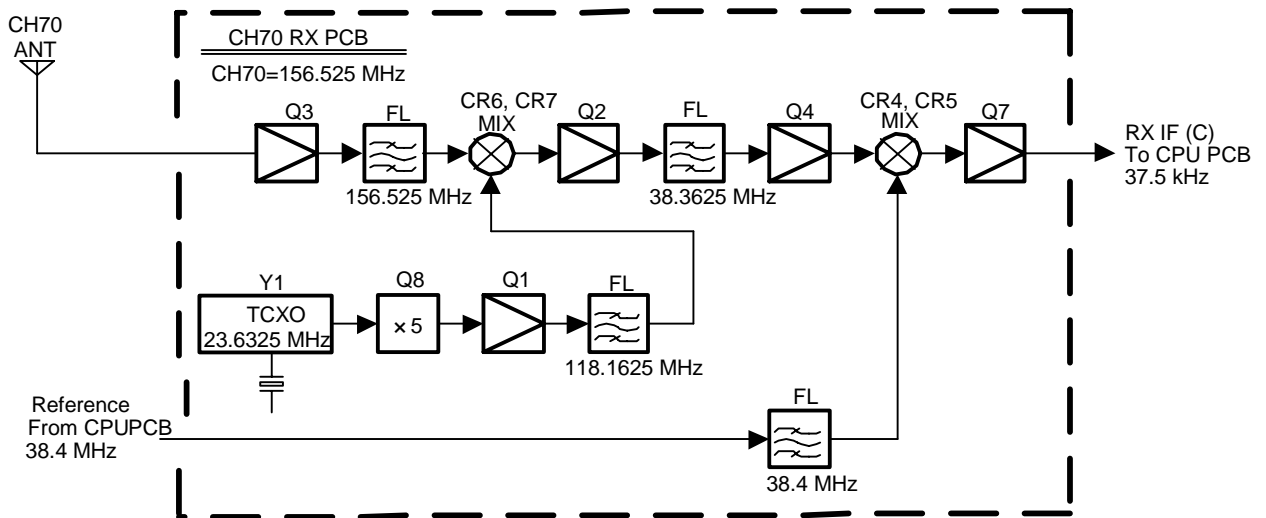
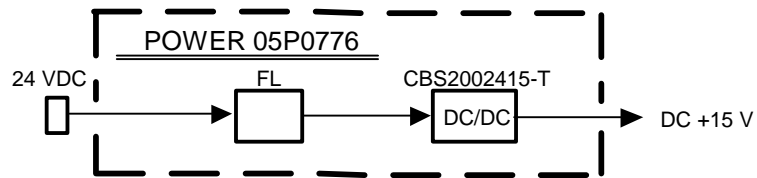


Fig. (4-1) CH70 Reception Signal Flow

CH70 RX Board (05P0775) produces 1st local oscillation frequency of 118.1625 MHz by multiplying 23.6325 MHz by 5 produced by the crystal oscillator Y1(TCXO). The RX 1st IF signal of 38.3625 MHz is converted to 2nd IF signal of 37.5 kHz by 2nd local oscillation frequency 38.4 MHz which is dividing (25.6 MHz x 3) by half at CPU (05P0773). Then, after the amplification, it is converted to the digital signal by U17 CODEC (AK4528VF) of CPU Board (05P0773), and demodulated to the DSC signal by the software.

(5) Power Supply Circuit

This is a switching power supply with the oscillation frequency of 370 kHz producing the output voltage of 15 VDC.