KENWOOD

SERVICE MANUAL

DFC-230

DIGITAL FREQUENCY CONTROLLER

CONTENTS

SPECIFICATIONS

Oscillation frequency	5.40 ~ 6.10 MHz
Output voltage	0.2V
Frequency stability	1×10^{-5} at room temp.
	3×10^{-5} at 0 ~ 50°C
Power requirement (Supplied from transceiver)	DC 9V 30 mA
	DC 13.8V 380 mA
	DC 13.8V 10 mA (Memory backup)
Semiconductor used	CPU 1
	IC 31
	Transistors 47
	Diodes 64
Dimensions	147(148)W
	51(51)H
	166(175)D mm
	(Figures in ( ) include projections.)
Weight	Approx. 1.3 kg

A product of

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BLOCK DIAGRAM/FREQUENCY CHART

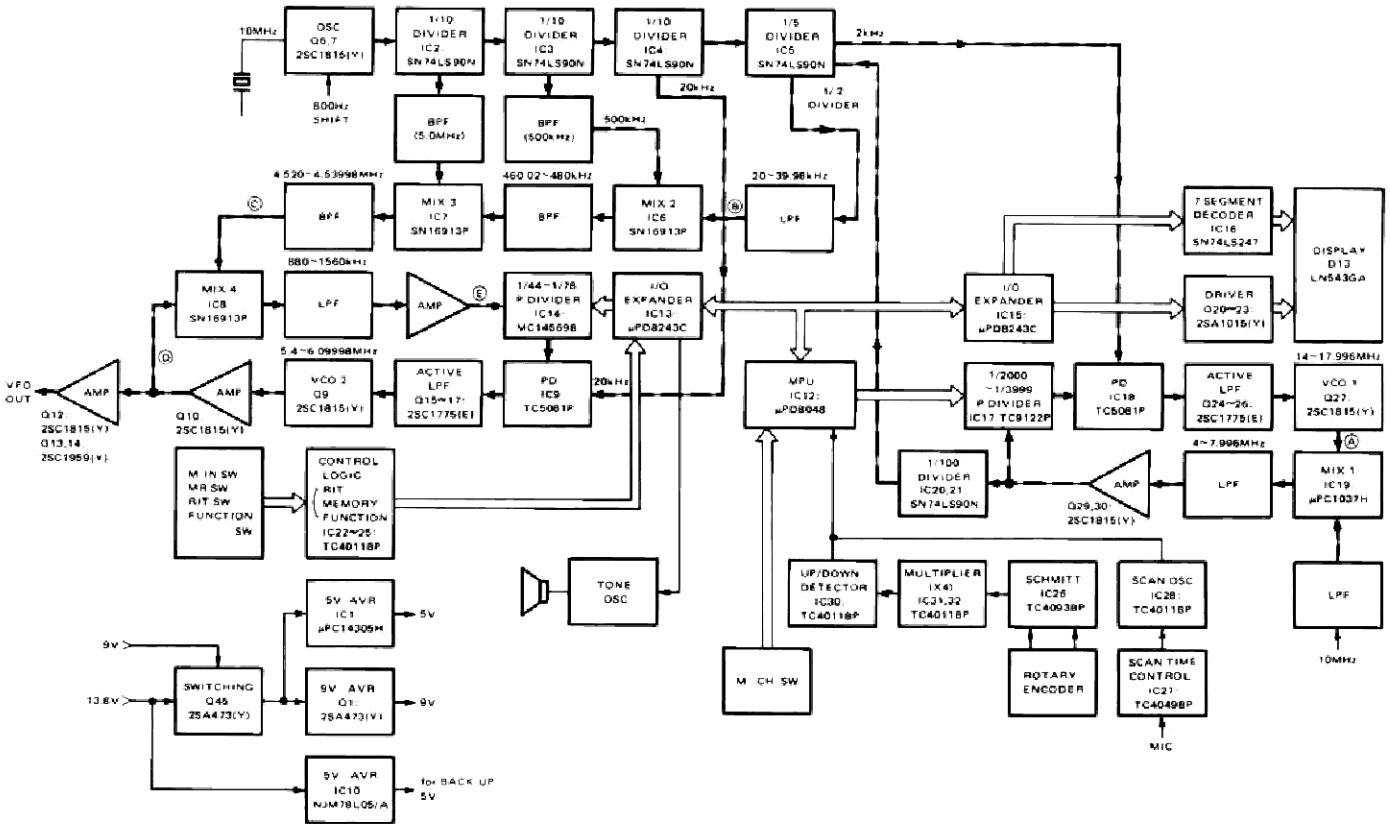


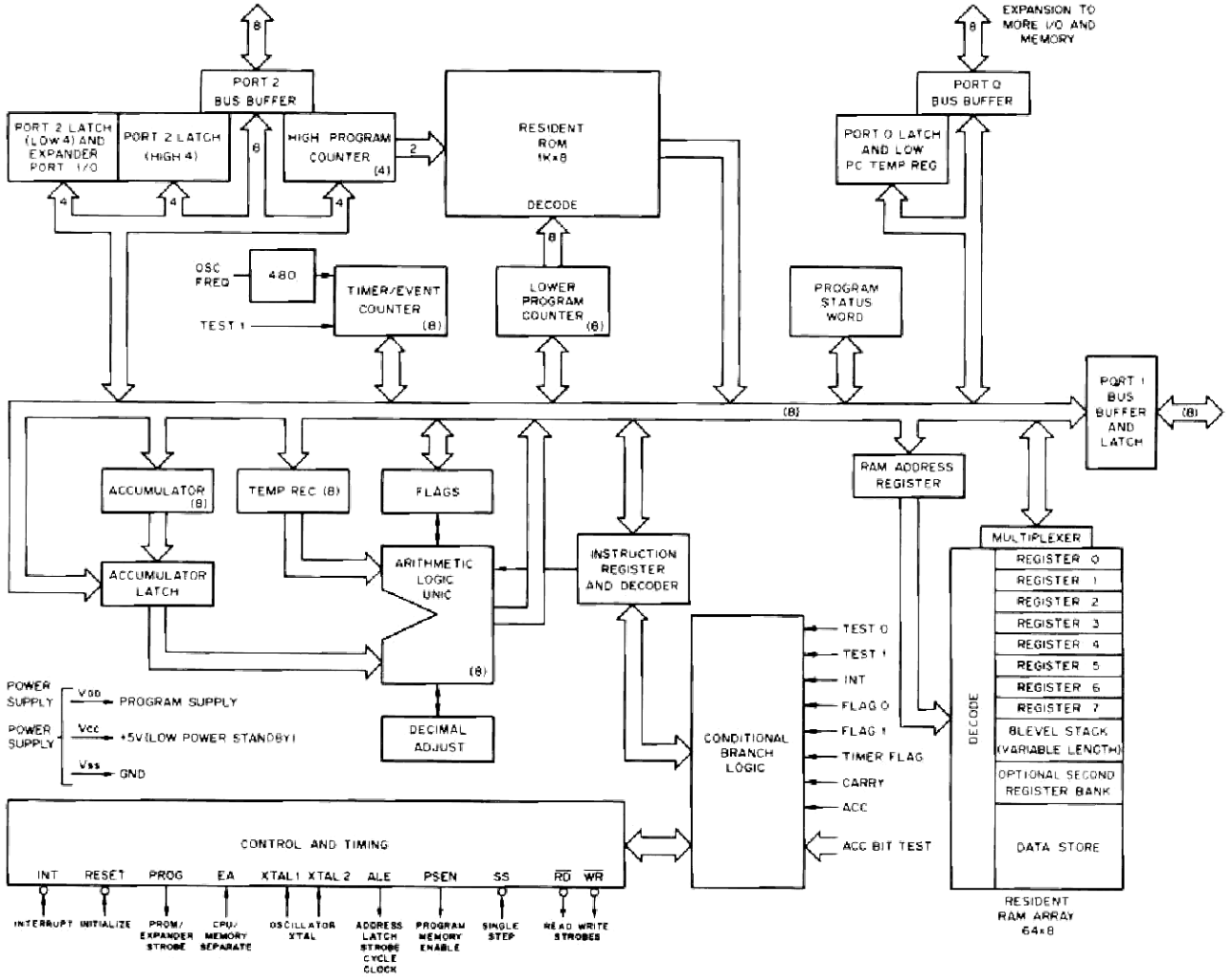
Fig. 1 Block diagram

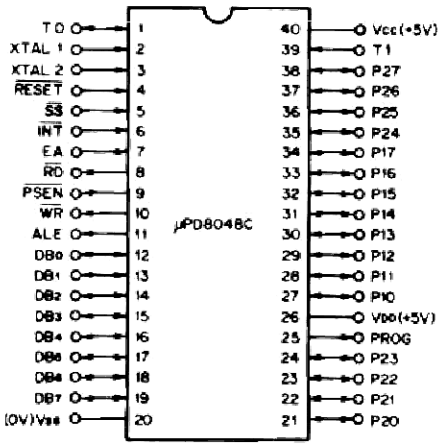
Display f.	Ⓓ Output VCO 2 (MHz)	Dividing ratio N	Ⓐ VCO 1 (MHz)	Ⓑ 1/200 divider output	Ⓒ MIX4 (IC8) input (MHz)	Dividing ratio N	Dividing ratio N (Binary)	Ⓔ Programable divider IC14 input (kHz)
					Refer to Block and Schematic diagram number			
900.0 0	5.40000	2000	14.000	20.000	4.520000	44	MSB 0010 1100 LSB	880
999.9 8	5.49998	3998	17.996	39.980	4.539980	48	0011 0000	960
0.0 0	5.50000	2000	14.000	20.000	4.520000	49	0011 0001	980
0.0 2	5.50002	2002	14.004	20.020	4.520020	49	0011 0001	980
0.0 4	5.50004	2004	14.008	20.040	4.520040	49	0011 0001	980
0.0 6	5.50006	2006	14.012	20.060	4.520060	49	0011 0001	980
0.0 8	5.50008	2008	14.016	20.080	4.520080	49	0011 0001	980
0.1 0	5.50010	2010	14.020	20.100	4.520100	49	0011 0001	980
0.2 0	5.50020	2020	14.040	20.200	4.520200	49	0011 0001	980
1.0 0	5.50100	2100	14.200	21.000	4.521000	49	0011 0001	980
10.0 0	5.51000	3000	16.000	30.000	4.530000	49	0011 0001	980
19.9 8	5.51998	3998	17.996	39.980	4.539980	49	0011 0001	980
20.0 0	5.52000	2000	14.000	20.000	4.520000	50	0011 0010	1000
40.0 0	5.54000	2000	14.000	20.000	4.520000	51	0011 0011	1020
60.0 0	5.56000	2000	14.000	20.000	4.520000	52	0011 0100	1040
80.0 0	5.58000	2000	14.000	20.000	4.520000	53	0011 0101	1060
100.0 0	5.60000	2000	14.000	20.000	4.520000	54	0011 0110	1080
200.0 0	5.70000	2000	14.000	20.000	4.520000	59	0011 1011	1180
300.0 0	5.80000	2000	14.000	20.000	4.520000	64	0100 0000	1280
400.0 0	5.90000	2000	14.000	20.000	4.520000	69	0100 0101	1380
500.0 0	6.00000	2000	14.000	20.000	4.520000	74	0100 1010	1480
599.9 8	6.09998 not displayed	3998	17.996	39.980	4.539980	78	0100 1110	1560

Table 1. Frequency chart

CIRCUIT DESCRIPTION

The DFC-230 consists of a master oscillator and frequency divider to generate reference signals, two PLL circuits, rotary encoder, waveform shaper, display, and 5V and 9V AVR circuits. Divide ratio setting, storage, display circuit control, and so forth are accomplished by an 8-bit microprocessor μPD8048.





Terminals

P10 ~ P17	Input and output port (PORT 1)
P20 ~ P27	Input and output port (PORT 2)
DB_0 ~ DB7	Data bus
T0, T1	Test
$\overline{INT}$	Interrupt
$\overline{RD}$	Read
$\overline{WR}$	Write
ALE	Address latch enable
$\overline{PSEN}$	Program store enable
$\overline{RESET}$	Reset
$\overline{SS}$	Single step
EA	External access
XTAL 1, 2	Crystal input

Maximum rating (Ta = 25°C)

Item	Symbol	Rating
Operating voltage	Vcc	−0.5 ~ +7.0V
	VDD	−0.5 ~ +7.0V
Input voltage	Vi	−0.5 ~ +7.0V
Output voltage	Vo	−0.5 ~ +7.0V
Operating temperature	Topt	0 ~ +70°C
Storage temperature	Tatg	−65 ~ +150°C

Fig. 2 μPD8048C-155 (Digital unit, IC12)

CIRCUIT DESCRIPTION

The DFC-230 uses a 10 MHz master oscillator (Q6, 7), from which all reference frequencies including 20 kHz and 2 kHz for the phase comparators and 5 MHz and 500 kHz for the mixers are divided (IC2 ~ 5). Therefore, complete frequency agreement between the transceiver and the DFC-230 can be obtained by aligning the DFC-230 10 MHz master oscillator to the main unit master oscillator.

For this calibration, a 5 MHz output is available from the DFC-230. To obtain an 800 Hz frequency shift for CW transmission, the 10 MHz master oscillation is shifted approximately 1.4 kHz in transmit mode (by Q5 and Q33).

VCO-1 operates from 14 ~ 18 MHz. This 4 MHz bandwidth is covered in 2000 steps of 2 kHz each (dividing ratio: 1/2000 to 1/3998). Since the microprocessor programs the dividing ratio at every two steps, this frequency range (of 14 ~ 18 MHz) is actually covered in 1000 steps of 4 kHz each.

The output of VCO-1 D7, 8, Q27, 28 (14 ~ 18 MHz) is mixed with the 10 MHz reference signal by IC19 (μPC1037H). The 4 ~ 8 MHz mixer output goes to two circuits. First the programmable frequency divider (IC17: TC9122P), where it is divided to 2 kHz with a dividing ratio of 1/2000 to 1/3998. The 2 kHz divider output is coupled to a phase comparator (IC18: TC5081P), where it is compared with the 2 kHz reference signal. The comparator output is fed back to the control input of VCO-1 Q24 ~ 26 (2SC1775E) to accomplish the phase-lock function. Dividing ratio "N" is furnished directly by the microprocessor (IC12: μPD8048C) in 12-bit BCD. Second, the 4 ~ 8 MHz output from the mixer is divided by 200 to a 20 or 40 kHz signal (at 20 Hz step) by IC's 20 and 21 (74LS90) is buffered at IC5 (74LS90), and is then mixed with 500 kHz at IC6 (SN16913P) and passed through a ceramic filter CF1. The 460 ~ 480 kHz output from the ceramic filter is mixed with a 5 MHz signal to be converted into 4.520 ~ 4.540 MHz by IC7 (SN16913P) and is coupled to the input of PLL-2 through Mixer IC8 (SN16913P).

VCO-2 covers a frequency range of 5.4 to 6.1 MHz. It is referenced against a 20 kHz signal and the dividing ratio "N" is 1/44 to 1/78 thus covering a band width of 700 kHz in 35 steps of 20 kHz each.

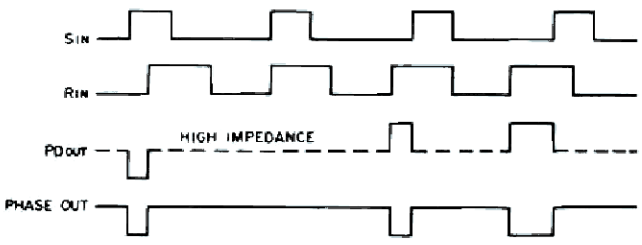


Fig. 3 TC5081P (Digital unit, IC9, 18)
Phase comparator timing chart

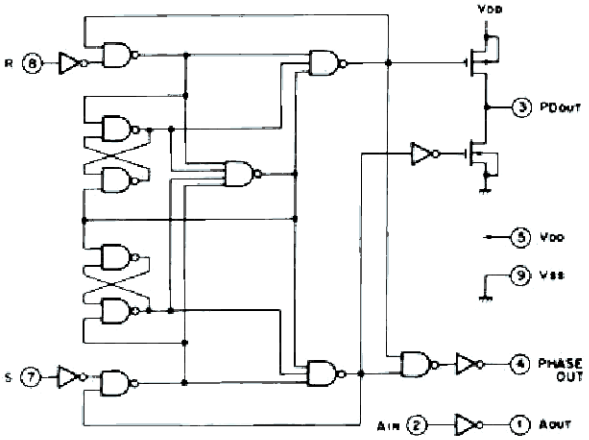


Fig. 4 TC5081P (Digital unit, IC9, 18)

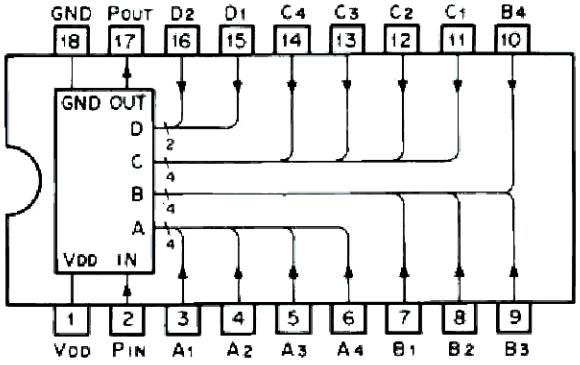


Fig. 5 TC9122P (Digital unit, IC17)

Symbol	Name	Content and operation	Remarks
PIN	Programmable counter input terminal	Programmable counter input terminal to which the signal to be divided is input	Build in bias circuit
POUT	Programmable counter output terminal	Programmable counter output terminal. Output is 1/N of the input frequency. The output pulse width equals 5 bit of the input	
$A_1 \sim A_4$ $B_1 \sim B_4$ $C_1 \sim C_4$ $D_1 \sim D_3$	× 1 × 10 × 100 × 1000 Program input terminals	Terminal to set the dividing ratio. The following input combination is prohibited.	Built in pull down resistor

A_1	A_2	A_3	A_4	B_1	B_2	B_3	B_4	C_1	C_2	C_3	C_4	D_1	D_2
1	0	0	0	0	0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0	0	0	0	0
1	0	1	0	0	0	0	0	0	0	0	0	0	0
0	1	1	0	0	0	0	0	0	0	0	0	0	0
1	1	1	0	0	0	0	0	0	0	0	0	0	0

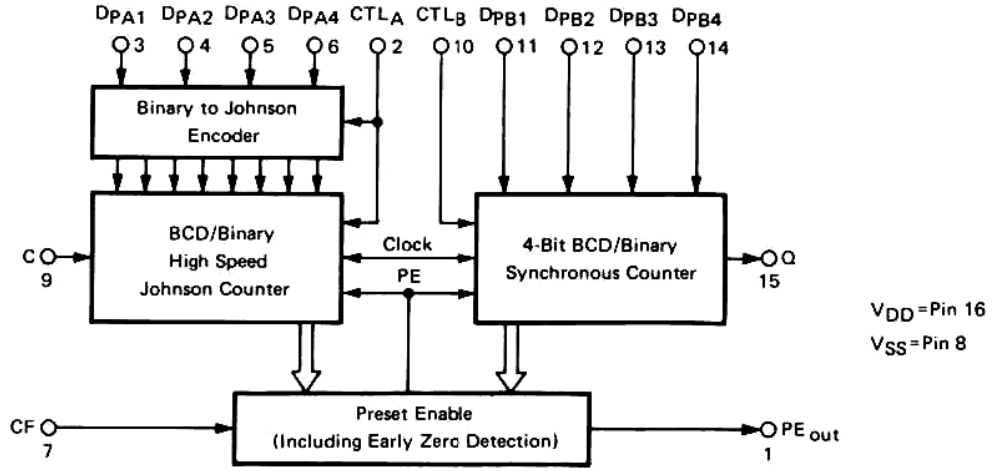
Table 2. Functions of TC9122P (Digital unit, IC17)

The 5.4 ~ 6.1 MHz output of VCO-2 is mixed with the PLL-1's output of 4.52 ~ 4.54 MHz to be converted into 880 ~ 1560 kHz by IC8 (SN16913P) before it is filtered and amplified and coupled to the programmable divider (IC14: MC14569B). The signal is frequency divided with a dividing ratio "N" 1/44 ~ 1/78 to 20 kHz, and is coupled to another phase comparator (IC9: TC5081P). The output of the phase comparator is fed back to the control input of VCO-2 to accomplish phase lock function. The dividing ratio data consists of binary 7 bits output via an I/O expander IC (IC13: μPD8243C).

Although PLL-2 generates frequencies of 5.4 ~ 6.1 MHz at 20 kHz step, it provides frequency output at 20 Hz step since it includes the 4.52 ~ 4.54 MHz signal (20 Hz step) generated by PLL-1 within its loop. The frequencies of each circuit block for the 4 ~ 8 MHz range are shown in Table 1.

CIRCUIT DESCRIPTION

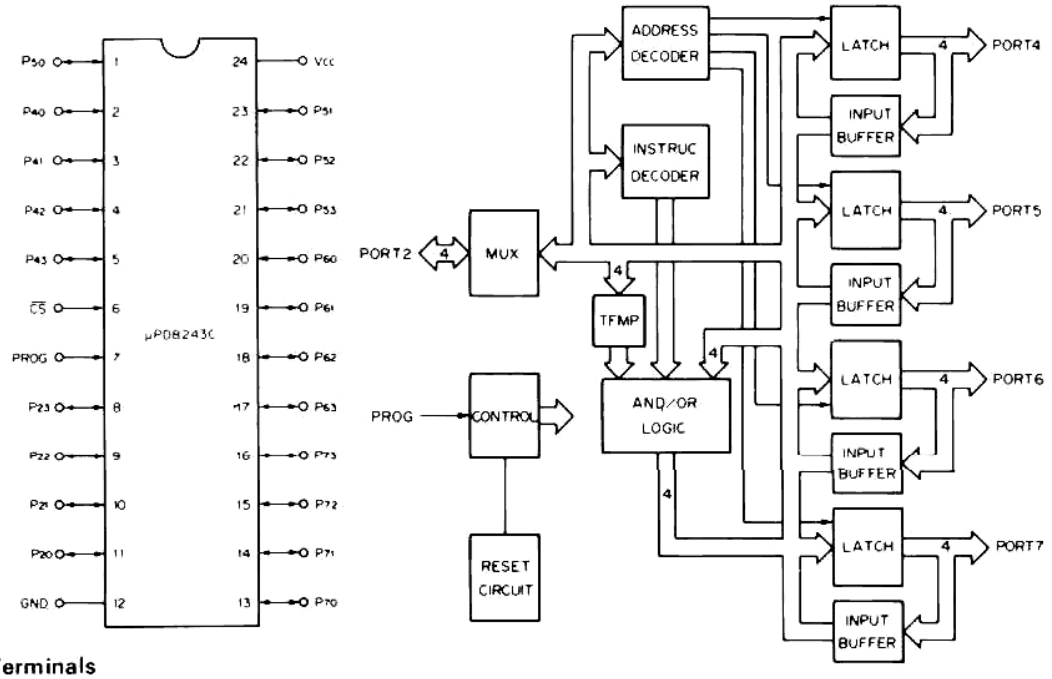
CTL = "0" for Binary Count
CTL = "1" for BCD Count



MAXIMUM RATINGS (Voltages referenced to V_{SS})

Rating	Symbol	Value	Unit
DC Supply Voltage	V_{DD}	−0.5 to + 18	Vdc
Input Voltage, All Inputs	Vin	−0.5 to V_{DD} + 0.5	Vdc
DC Current Drain per Pin	I	10	mAdc

Fig. 6 MC14569B (Digital unit, IC14)



Terminals

$P_{20} \sim P_{23}$	Input Output (Port 2)
$P_{40} \sim P_{41}$	Input Output port (Port 4)
$P_{50} \sim P_{53}$	Input Output port (Port 5)
$P_{60} \sim P_{63}$	Input Output port (Port 6)
$P_{70} \sim P_{73}$	Input Output port (Port 7)
$\overline{CS}$	Chip Select
PROG	Program pulse
	Input Output port (Port 2)

Maximum Rating (Ta = 25°C)

Item	Symbol	Rating
Operating voltage	Vcc	−0.5 ~ + 7V
Input voltage	Vi	−0.5 ~ + 7V
Output voltage	Vo	−0.5 ~ + 7V
Operating temperature	Topt	0 ~ + 70°C
Storage temperature	Tstg	−60 ~ + 150°C

Fig. 7 μPD8243C (Digital unit, IC13, 15)

CIRCUIT DESCRIPTION

The rotary encoder input circuit consists of gate circuits IC26, 30, 31, and 32. Two different signals are output from the rotary encoder. These are waveform shaped by Schmitt trigger gate IC26 (TC4093BP), then multiplied by 4 through ICs 31 and 32 (TC4011BP) before being input to the microprocessor via one-half of flip-flop IC30 (TC4011BP) to microprocessor pin 6.

The rotary encoder's direction of rotation is identified by the phase difference of its two output signals. For this purpose, the signals are also coupled to another set of microprocessor inputs (pin1) as up/down control signals via another flip-flop (1/2 IC30).

Each revolution of the rotary encoder provides 75 output pulses, which is multiplied by 4 into 300 pulses before input to the microprocessor. As a result, the encoder acts as a VFO dial covering a frequency range of 6 kHz (20 Hz × 300 = 6000 Hz) with each revolution. The timing sequence is shown in Figure 10.

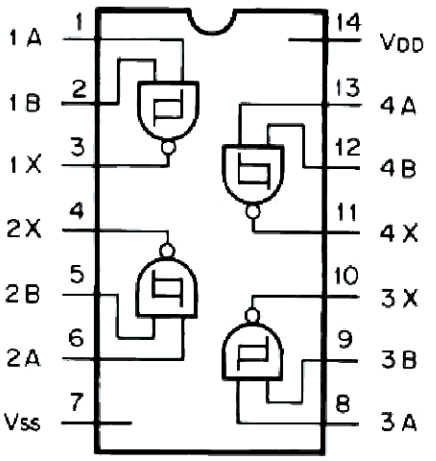


Fig. 8 TC4093BP
(Digital Unit, IC26)

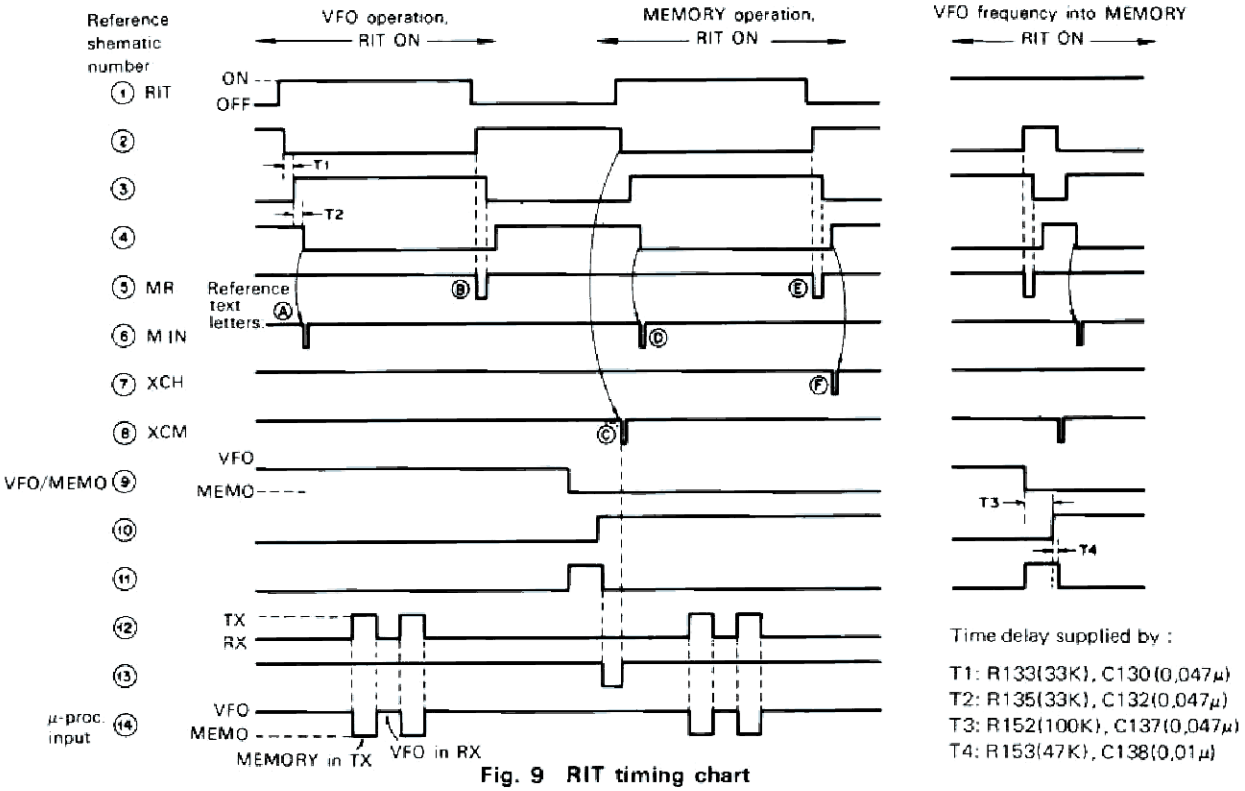


Fig. 9 RIT timing chart

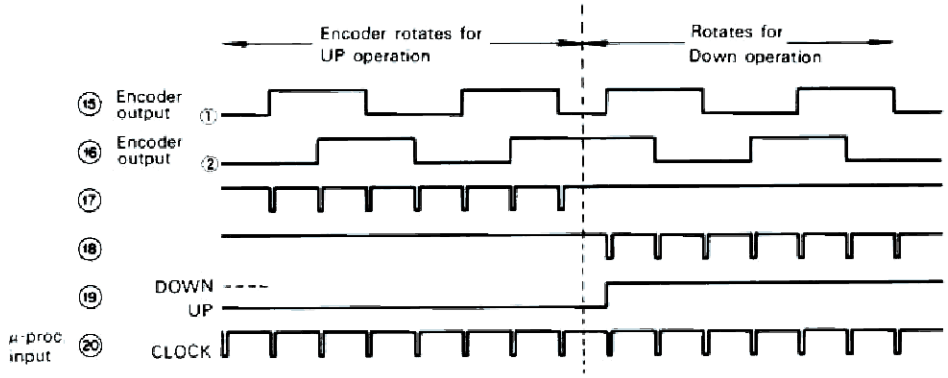


Fig. 10 Encoder timing chart

CIRCUIT DESCRIPTION

The DFC-230 permits frequency shift control by microphone-mounted switches. To generate the frequency shift control clock, the DFC-230 incorporates a dedicated clock oscillator. The oscillator consists of an astable multivibrator combining two NAND gates (IC28: TC4011BP). Its oscillation output is available in two different frequencies obtained by switching its time-constant resistors. Frequency shift speed is controlled by the interval in which the switch is held down, and is switchable between step-by-step, slow, and high speed shifting. Shift speed is determined by a CR time constant circuit and inverter IC27 (TC4049BP). The interval from the step-by-step to slow shift is determined by R177 (100 kΩ) and C168 (10 μF), and that from slow to high shifting is determined by R179 (120 kΩ) and C152 (47 μF). The clock frequency for shift control is adjustable for both slow and high speeds over approximately ±50%.

The DFC-230 uses a digital RIT circuit utilizing the main dial, instead of a conventional RIT circuit using variable resistors and varicap diodes. This is accomplished by the cross operation of the internal memory and the digital VFO, for which various control signals are created by the logic circuit comprised of IC's 22 ~ 25 (TC4011BP and TC4049BP). A timing sequence of each control block is shown in Figure 9.

Gate-Timing Circuit: General operation.

A gating circuit (IC22 ~ 25) provides control logic for the five fixed, and the single variable memory in the microprocessor (IC13). Four memories are used as fixed channel frequencies, which may be operated in either memory (not variable) or MR (variable) modes. The remaining fixed channel is storage for the existing VFO frequency when RIT is first selected.

This gate-timing circuit provides three control functions for the microprocessor. First, M-IN enters the VFO frequency into a selected memory. Second, MR recalls (Exchanges) a selected memory frequency back to the VFO channel. Third, the exchange (XCH) function swaps the VFO frequency and any selected memory frequency. The VFO frequency is stored in a fixed-channel while that fixed frequency is recalled for variable operation in the MR mode.

Therefore, when MR operation is terminated, the original VFO frequency (stored in the memory channel) and the new memory frequency (in the VFO channel) are exchanged. The original VFO frequency is again on display in the VFO channel, while the memory frequency is re-stored in its fixed channel.

When RIT is selected, the original VFO frequency is retained in the RIT (fixed channel) memory, and the VFO channel is free for variable operation as an RIT. At initial RIT-ON , the RIT and VFO frequencies are the same.

Receive (RX) operation is in the VFO channel, and transmit (TX) is in the RIT-fixed channel.

Gate-Timing Circuit: Detailed operation.

Two front-panel switches provide operator-control of the Memory and VFO RIT function. These two switches control the Gate-Timing circuit, which in turn sequences four logic lines to the microprocessor (IC13).

Pin 13 is microprocessor input, pin 14 is MR function, pin 15 is the XCH function, and pin 17 is the VFO/MEMO function.

Please refer to the timing-chart for this outline, VFO operation (in Figure 9).

Ⓐ When the RIT is turned on, the M-IN function enters the VFO frequency into the RIT memory. RX is by the VFO channel, TX in RIT memory.

Ⓑ When the RIT is turned off, the MR function recalls the VFO frequency from the RIT fixed channel. RIT frequency is not retained.

Ⓒ Memory operation
When operating in Memory mode, the first step at RIT-on is to exchange (XCH function) the selected memory and VFO frequencies.

Ⓓ The second step exchanges the VFO frequency into the RIT memory. RIT is now available.

Ⓔ When the RIT is turned off, the opposite of Ⓓ and Ⓒ occurs.
First, the RIT and VFO frequencies exchange.

Ⓕ Second, the VFO and M (1 ~ 4) frequencies exchange.

The frequency readout uses a 4-digit green LED display to cover frequency from the 100 kHz to 100 Hz order. The digit drive output and the display data are provided by the display output of the microprocessor via the I/O expander IC15: (μPD8243C). The display data drives the anode-common display LEDs via 7-segment decoder IC16 (SN74LS247).

The frequency display coverage consists of two frequency bands, 000.0 ~ 500.0 and 500.0 ~ 999.9. These two ranges are selected from band information furnished by the main unit.

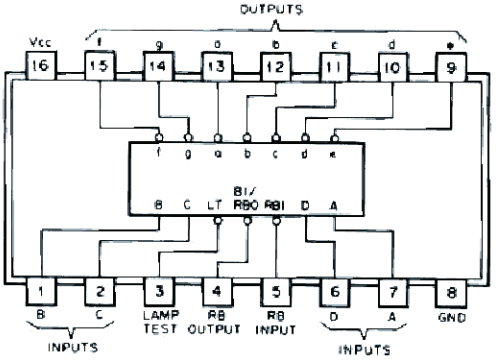


Fig. 11 SN74LS247 (Digital Unit, IC16)

CISCUIT DESCRIPTION

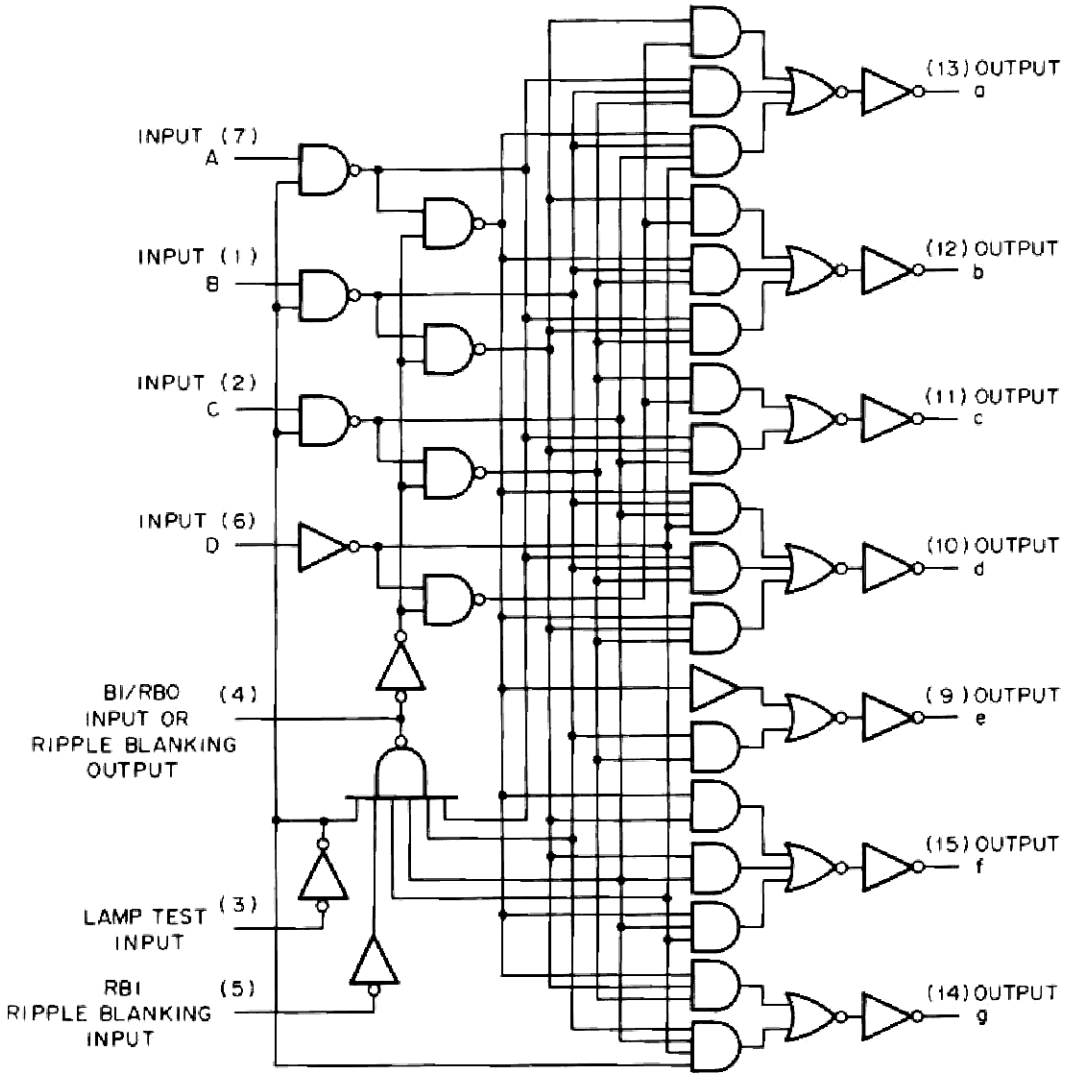
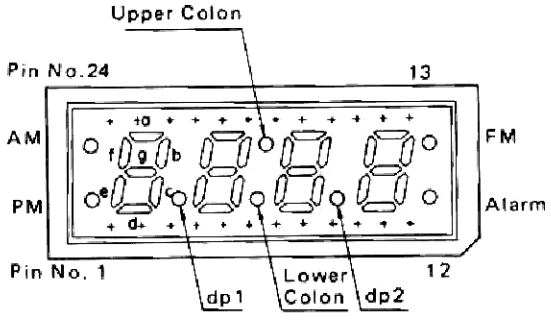


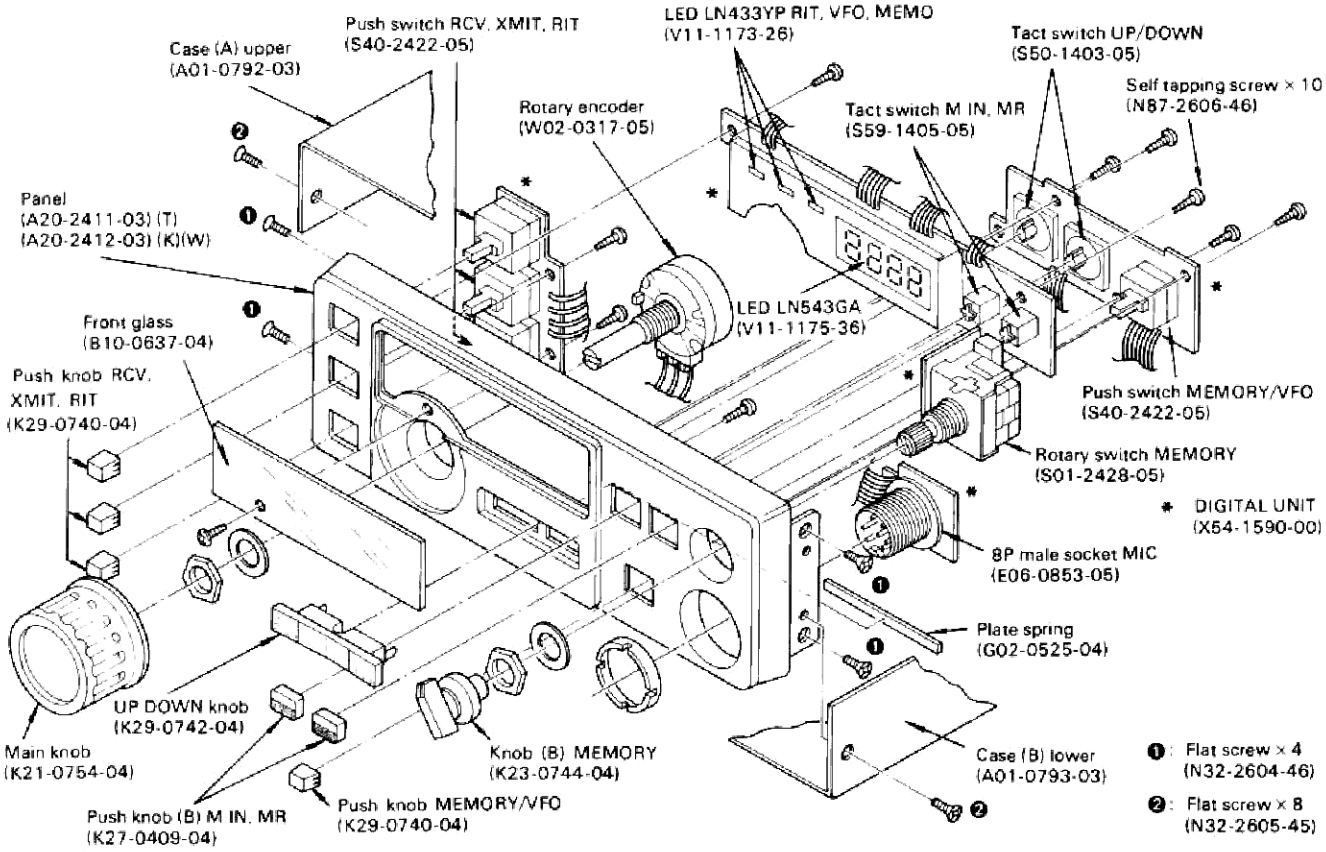
Fig. 12 SN74LS247 (Digital Unit, IC16)

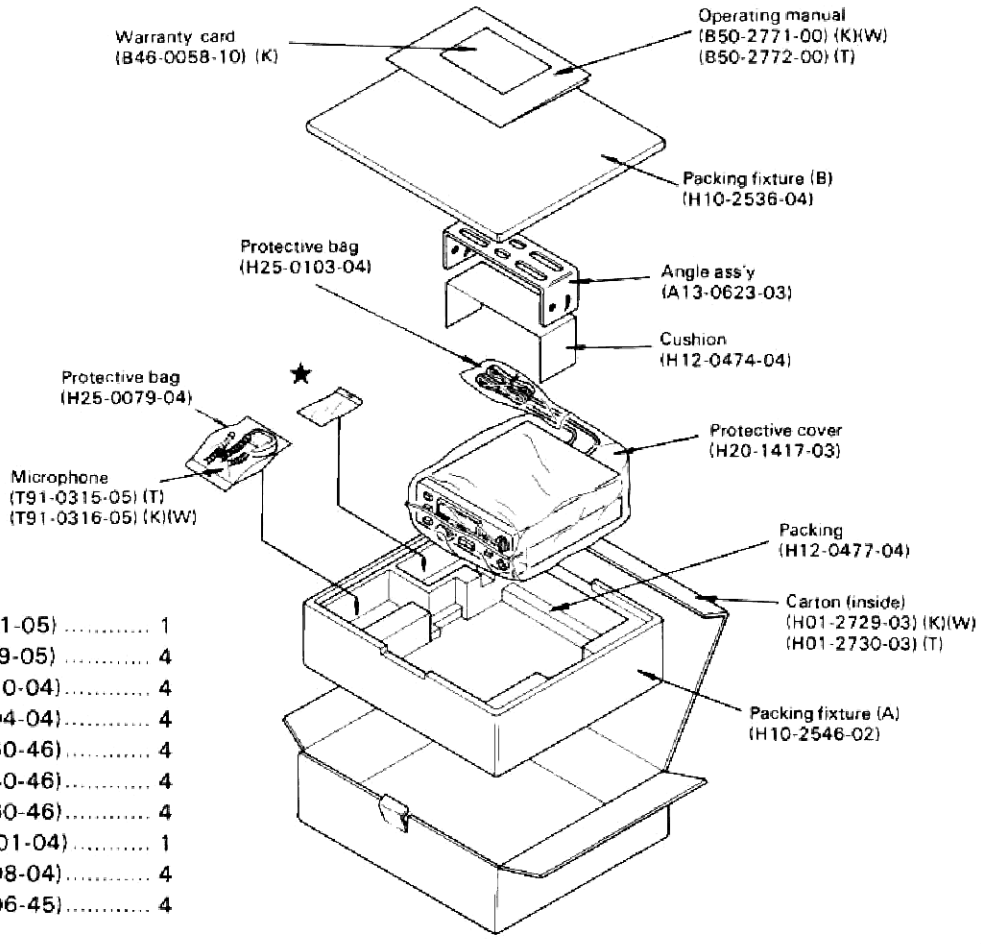


PIN No.	Assignment		PIN No.	Assignment	
1	PM	Cathode	13	FM, Alarm	Anode
2	Dig 1	Anode	14	FM	Cathode
3	Seg d	Cathode	15	Seg a	Cathode
4	d.p 1	Cathode	16	d.p 2	Anode
5	Dig 2	Anode	17	Upper Lower Colon	Anode
6	Lower Colon	Cathode	18	Seg f	Cathode
7	Upper Colon	Cathode	19	Seg b	Cathode
8	Dig 3	Anode	20	Seg c	Cathode
9	d.p 2	Cathode	21	d.p 1	Anode
10	Dig 4	Anode	22	Seg g	Cathode
11	Seg e	Cathode	23	AM	Cathode
12	Alarm	Cathode	24	AM, PM	Anode

Fig. 13 LED LN543GA (Digital unit, D13)

DISASSEMBLY/PACKING





★ Protective bag (H25-0049-03)

Pin plug (CAL)	(E14-0101-05)	1
Foot	(J02-0069-05)	4
Flange nut	(N14-0510-04)	4
Allen head bolt	(N99-0304-04)	4
Spring washer	(N16-0060-46)	4
Flat washer	(N15-1040-46)	4
Flat washer	(N15-1060-46)	4
Allen key	(W01-0401-04)	1
Round screw	(N09-0008-04)	4
Bind screw	(N35-3006-45)	4

ADJUSTMENTS

TEST EQUIPMENT REQUIRED

1. VTVM or DVM

1) Input resistance: More than 1 MΩ
2) Voltage range: 1.5 to 1000V AC/DC

NOTE:
A high-precision voltmeter may be used. However, accurate readings can not be obtained for high-impedance circuits.

2. RF VTVM

1) Input impedance: 1 MΩ and less than 3 pF, min.
2) Voltage range: 10 mV to 300V
3) Frequency range: 50 MHz or greater

3. AF VTVM

1) Frequency range: 50 Hz to 10 kHz
2) Input resistance: 1 MΩ or greater
3) Voltage range: 10 mV to 30V

4. OSCILLOSCOPE

Requires high sensitivity, and external synchronization capability.

5. Standard Signal Generator (SSG)

1) Frequency range: 1.8 to 30 MHz
2) Output: −20 dB/0.1 μV ~ 120 dB/1V

NOTE:
Generator must be frequency stable.

6. FREQUENCY COUNTER

1) Minimum input voltage: 50 mV
2) Frequency range: Greater than 40 MHz

7. VFO Cable
8. CAL Cable
9. TS-130 S or V

PREPARATION

- Unless otherwise specified, set the controls as follows.

1) TS-130

POWER	OFF	NAR/WIDE	NAR
STBY	REC	IF SHIFT	CENTERED
BAND	14	RF GAIN	MAX
CAL	OFF	AF GAIN	MIN
RF ATT	OFF	VFO/FIX	VFO
MODE	CW	VFO SCALE	0

2) DFC-230

RCV	MAIN
XMIT	MAIN
RIT	OFF
MEMORY/VFO	VFO
MEMORY	1

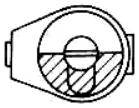
- Connection
  1) Cable the DFC-230 MIC cable and the TS-130 MIC connector.
  2) Cable the DFC-230 CONTROL cable and the TS-130 EXT. VFO socket.

- **NOTE:**
  When adjusting the trimmers or coils, use a non-inductive alignment tool made of nylon, or ceramic material.

REFERENCE

Japanese "SSG"	American "SG"
−6dB	0.25μV
0dB	0.5μV
6dB	1μV
12dB	2μV
24dB	8μV
30dB	15.8μV
40dB	50μV
50dB	158μV
60dB	500μV
70dB	1.58mV
80dB	5mV
90dB	15.8mV
100dB	50mV
120dB	0.5V

ADJUSTMENTS

Item	Condition	Measurement			Adjustment			Specification	Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method		
1. Voltage check	TS-130 POWER: ON	DVM	Digital unit A	IC15 Pin 24				5±0.5V	
				Tinned jumper wire beside IC4 (Pins 1 and 2)				9±0.3V	
	TS-130 POWER: OFF			IC12 Pin 26				5±0.5V	Backup
	POWER: ON								
2. Master oscillator	DFC-230 TC-1: Centered  TS-130 STBY: SEND	f. counter	Digital unit B	TP1	Digital unit B	TC2	5,000,700±50 Hz		
	TS-130 STBY: REC					TC1	5,000,000±10 Hz		
	TS-130 STBY: SEND						5,000,700±50 Hz	When out of specification readjust TC2.	
	STBY: REC								
3. VCO-1	DFC-230 MEMORY/VFO: VFO Display: 999.9	DVM	Digital unit A	TP5	Digital unit A	L23	7.5±0.1V		
	Display: 0.0							1.8±0.4V	Check
4. BPF 1 (500 kHz)		RF VTVM	Digital unit B	IC7 Pin 1	Digital Unit B	T3~5	MAX.		
5. BPF 2 (5 MHz)		RF VTVM	Digital unit B	TP2	Digital unit B	T1, 2 6, 7, 8	MAX.		
6. VCO-2	Display: 599.9	DVM	Digital unit B	TP3	Digital unit B	L16	7.0±0.1V		
	Display: 900.9							2.4±0.5V	Check
7. Mixer balance and CAL	DFC-230 RCV: RMT Display: 19.9 TS-130 ANT: to SSG RF output: 14.0208 MHz, 60 dB.						Adjust DFC-230 main tuning control to get maximum S meter reading on TS-130.		
	Adjust the SSG RF output to S9 + 20 dB.								
	DFC-230 Display: 20.8 (Zero beat should be obtained.)	AF VTVM, Oscilloscope	TS-130	Ext. SP	Digital unit B	VR1	Minimum beat level.		
	DFC-230 Display: 0 ~ 50							There should be no other signal besides the 14.0208 MHz signal.	
	Cable the DFC-230 CAL connector and the TS-130 ANT connector.							A beat should be obtained.	Check
8. VFO output level (check)	DFC-230 Display: 250	RF VTVM	Digital unit B	Cathode of D3				$0.2V^{+3}_{-1}$ dB	

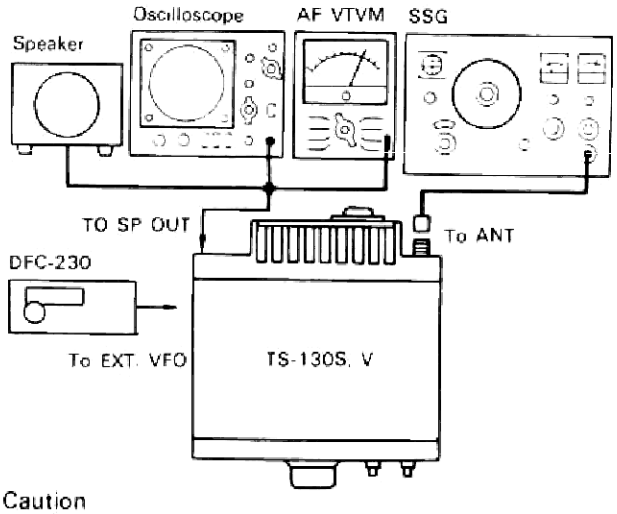
ADJUSTMENTS

Item	Condition	Measurement			Adjustment			Specification	Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method		
9. MIC SCAN	DFC-230 VR2. 3 (Digital unit B): Centered	F. counter	Digital unit B	IC28 Pin 4	Digital Unit B	(Adjust only When out of specification) VR2	45±10 Hz		Until approx. 5 sec.
	MIC connector. either Pin 3 or Pin 4: Shorted to ground.					(Adjust only When out of specification) VR3	130±20 Hz		After approx. 5 sec
	Time which scan speed changes from slow to fast with MIC connector pin 3 to ground.							5±2 sec.	
10. Display (Check)	DFC-230 Check each function: main tuning control, FAST STEP, and MIC UP/DOWN independently.							Display changes from 900.0 to 599.9.	
	TS-130 BAND: 3.5 DFC-230 FAST STEP: UP and DOWN							Display changes from 400.0 to 99.9	
	DFC-230 Turn the main tuning control one turn.							The kHz order display should vary by 6 kHz.	
11. Memory (Check)	DFC-230 Display: 10.0 MEMORY: 1 MIN: ON							"Beep" tone should be heard.	
	Display: 20.0 MEMORY: 2 MIN: ON							Tone should be heard.	
	Display: 30.0 MEMORY: 3 MIN: ON								
	Display: 40 MEMORY: 4 MIN: ON								
	MEMORY: 1 MR: ON							Displays 10.0 and tone should be heard.	
	MEMORY: 2 MR: ON							Displays 20.0 and tone should be heard.	
	MEMORY: 3 MR: ON							Displays 30.0 and tone should be heard.	
	MEMORY: 4 MR: ON							Displays 40.0 and tone should be heard.	
	TS-130 BAND: 14 DFC-230 RCV: RMT MEMORY/VFO: MEMORY							Display DFC-230 / TS-130	
	MEMORY: 1 2							10.0 / 14.010.0 20.0 / 14.020.0	
	3 4							30.0 / 14.030.0 40.0 / 14.040.0	
	TS-130 BAND: 3.5 DFC-230 RCV: RMT MEMORY/VFO: MEMORY							Display DFC-230 / TS-130	
	MEMORY: 1 2							510.0 / 3.510.0 520.0 / 3.520.0	
	3 4							530.0 / 3.530.0 540.0 / 3.540.0	

ADJUSTMENTS

Item	Condition	Measurement			Adjustment			Specification	Remarks
		Test equipment	Unit	Ter-minal	Unit	Part	Method		
12. Cross-freq. operation (Check)	DFC-230 MEMORY/VFO: VFO Display: 599.9 TS-130 Display 14.000.0 MODE USB or REV								
	After the set-up as described above, check the display and indicator functions as shown at right.								
	TS-130 STBY: REC								
13. RIT (Check)	DFC-230 RCV: RMT XMIT: RMT MEMORY/VFO: VFO Display: 599.9								
	RIT: ON Display: Any frequency (X) except 599.9							RIT indicator lights	
	TS-130 STBY: SEND							Displays 599.9	
	STBY: REC							Displays (X)	
	DFC-230 RIT: OFF							Displays 599.9	
	MEMORY/VFO: MEMORY MEMORY: 1							Displays 10.0	
	RIT: ON Display: Any frequency except 10.0								
	RIT: OFF							Displays 10.0	
14. Backup (Check)	DFC-230 MEMORY/VFO: VFO Display: 100.0 TS-130 POWER OFF							Display disappears.	
	POWER: ON							Displays 100.0	

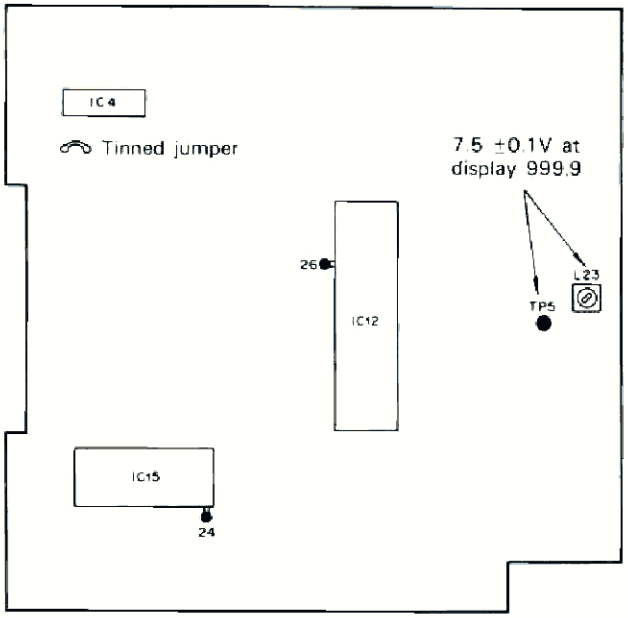
TS-130 STBY SW \ DFC-230		RCV: MAIN XMIT: MAIN	RCV: RMT XMIT: MAIN	RCV: RMT XMIT: RMT	RCV: MAIN XMIT: RMT
REC	Display (TS-130)	14.000.0	14.599.9	14.599.9	14.000.0
	Indicator	VFO (TS-130)	VFO (DFC-230)	VFO (DFC-230)	VFO (TS-130)
SEND	Display (TS-130)	14.000.0	14.000.0	14.599.9	14.599.9
	Indicator	VFO (TS-130)	VFO (TS-130)	VFO (DFC-230)	VFO (DFC-230)



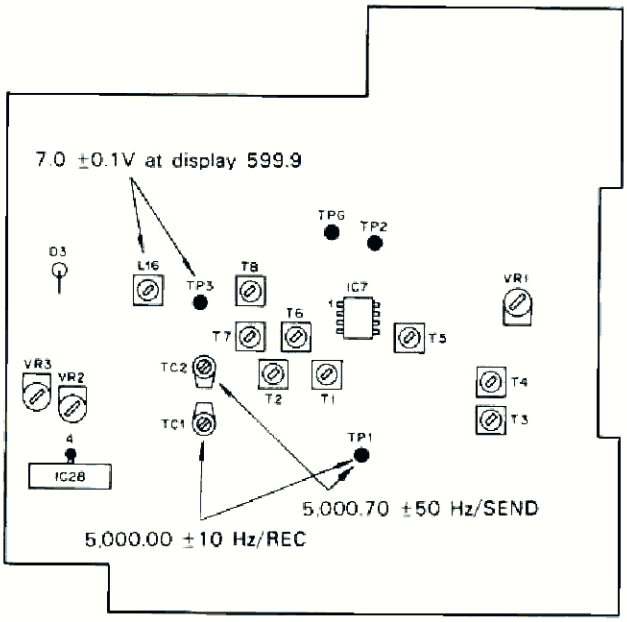
☆ Caution
NEVER transmit when SSG is connected to the ANT terminal.

Fig. 14 7. Mixer balance

ADJUSTMENTS / PARTS LIST



Digital unit A



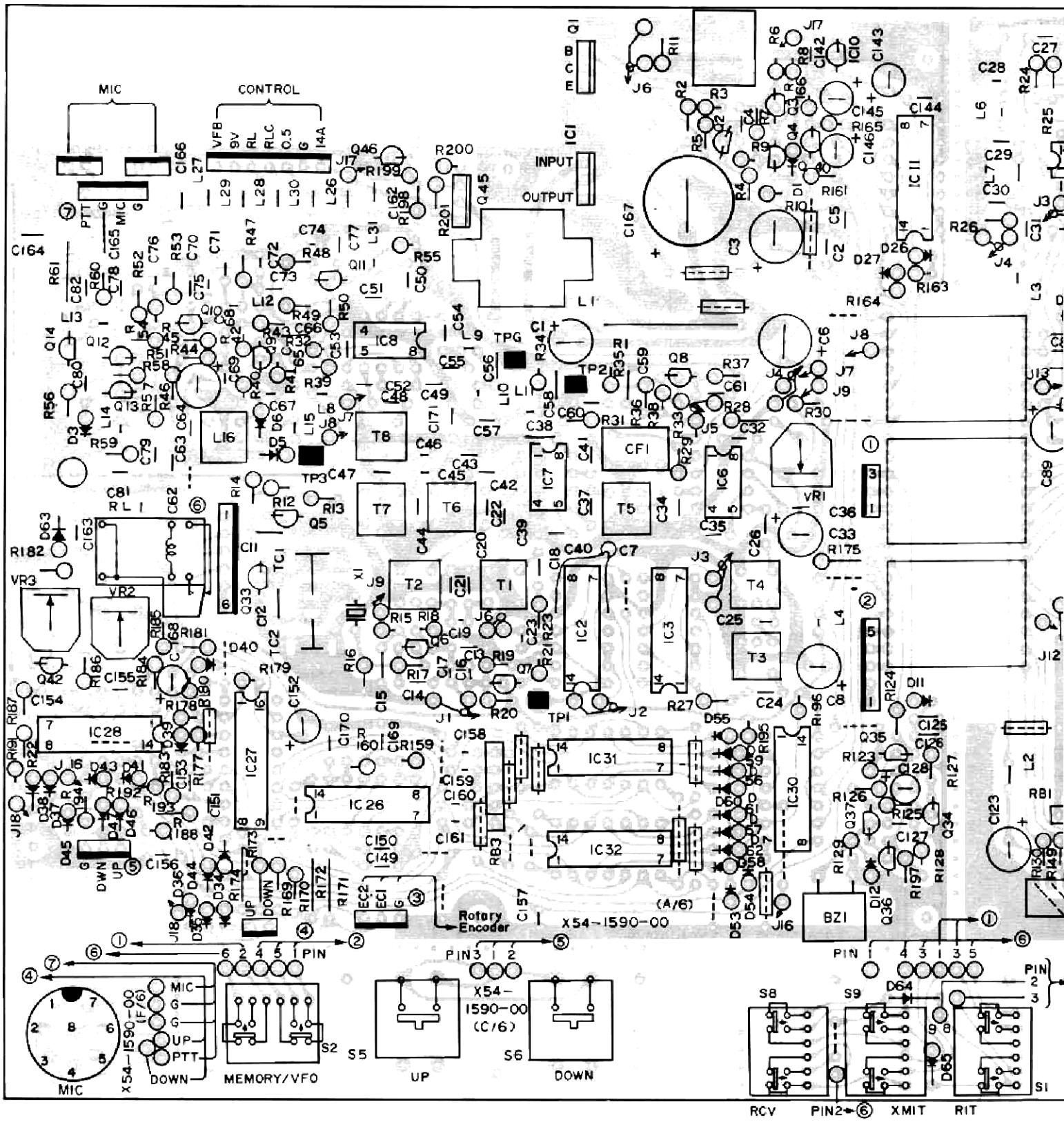
Digital unit B

DFC-230 Semiconductor ☆: New parts

Item	Name	Parts No.	Re-marks
Diode	1S1555	V11-0076-05	
	1S1587	V11-0370-05	
Vari-cap diode	1SV54GC	V11-4173-46	
Zener diode	WZ-061	V11-0243-05	
	XZ-049	V11-4175-46	
LED	LN433YP	V11-1173-26	
	LN543GA	V11-1175-36	☆
TR	2SA473 (Y)	V01-0473-06	
	2SA1015 (Y)	V01-1015-06	
	2SC1775 (E)	V03-1775-06	
	2SC1815 (Y)	V03-1815-06	
	2SC1959 (Y)	V03-1959-06	

Item	Name	Parts No.	Re-marks
IC	MC14569B	V30-1100-06	
	NJM78L05A	V30-1020-16	
	SN16913P	V30-1048-06	
	SN74LS90N	V30-1005-26	
	SN74LS247N	V30-1030-56	
	TC4011BP	V30-0301-70	
	TC4049BP	V30-1009-26	
	TC4093BP	V30-1214-16	
	TC5081P	V30-1132-06	
	TC9122P	V30-1036-16	
	μPC1037H	V30-0177-16	
	μPC14305H	V30-1029-36	
	μPD8048C-155	V30-1176-26	
	μPD8243C	V30-1177-16	

PC BOARD VIEW (



2SA473

2SA1015 2SC1775
2SC1815 2SC1959

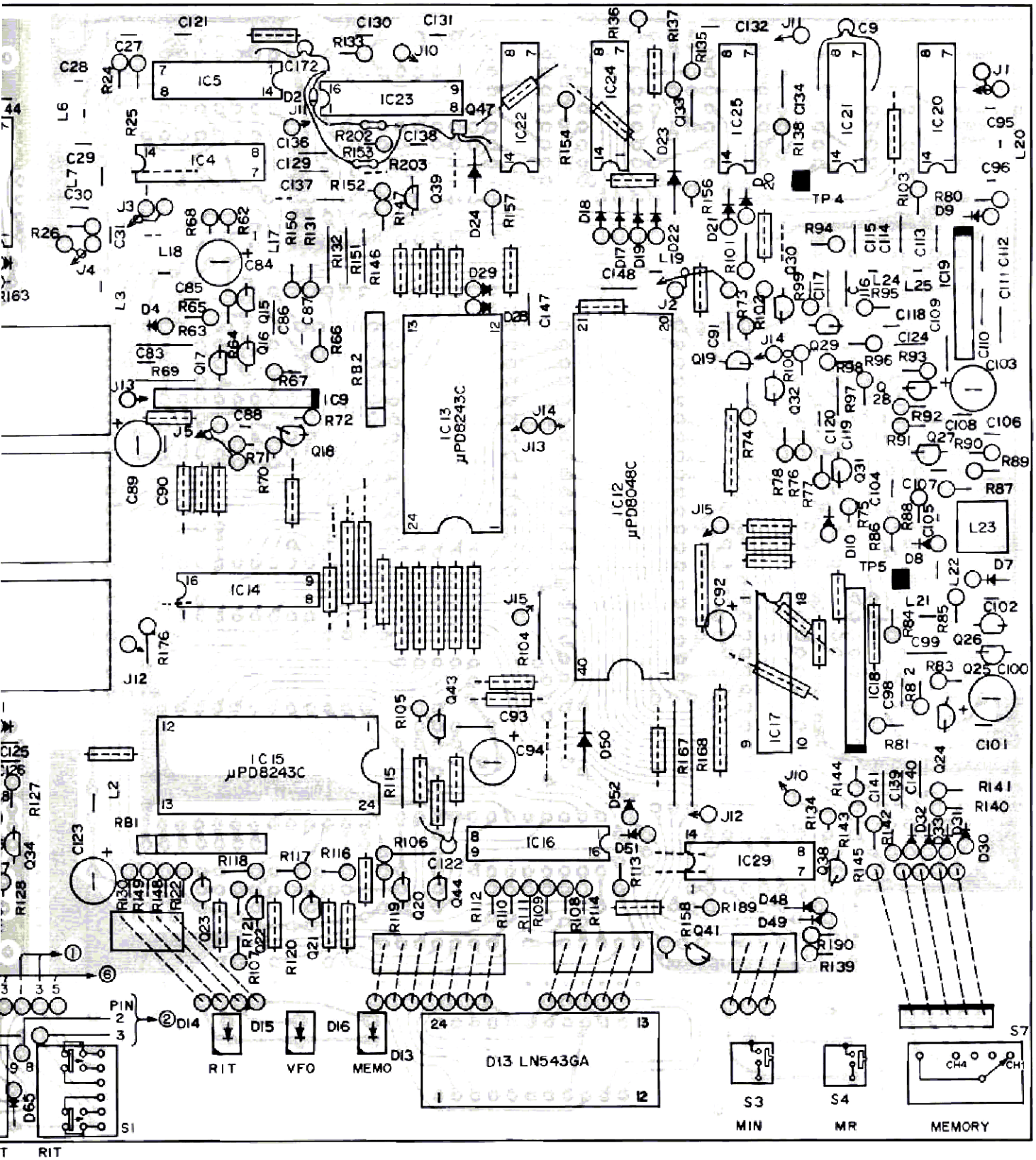
μPC1037H

LN433

μPC14305H

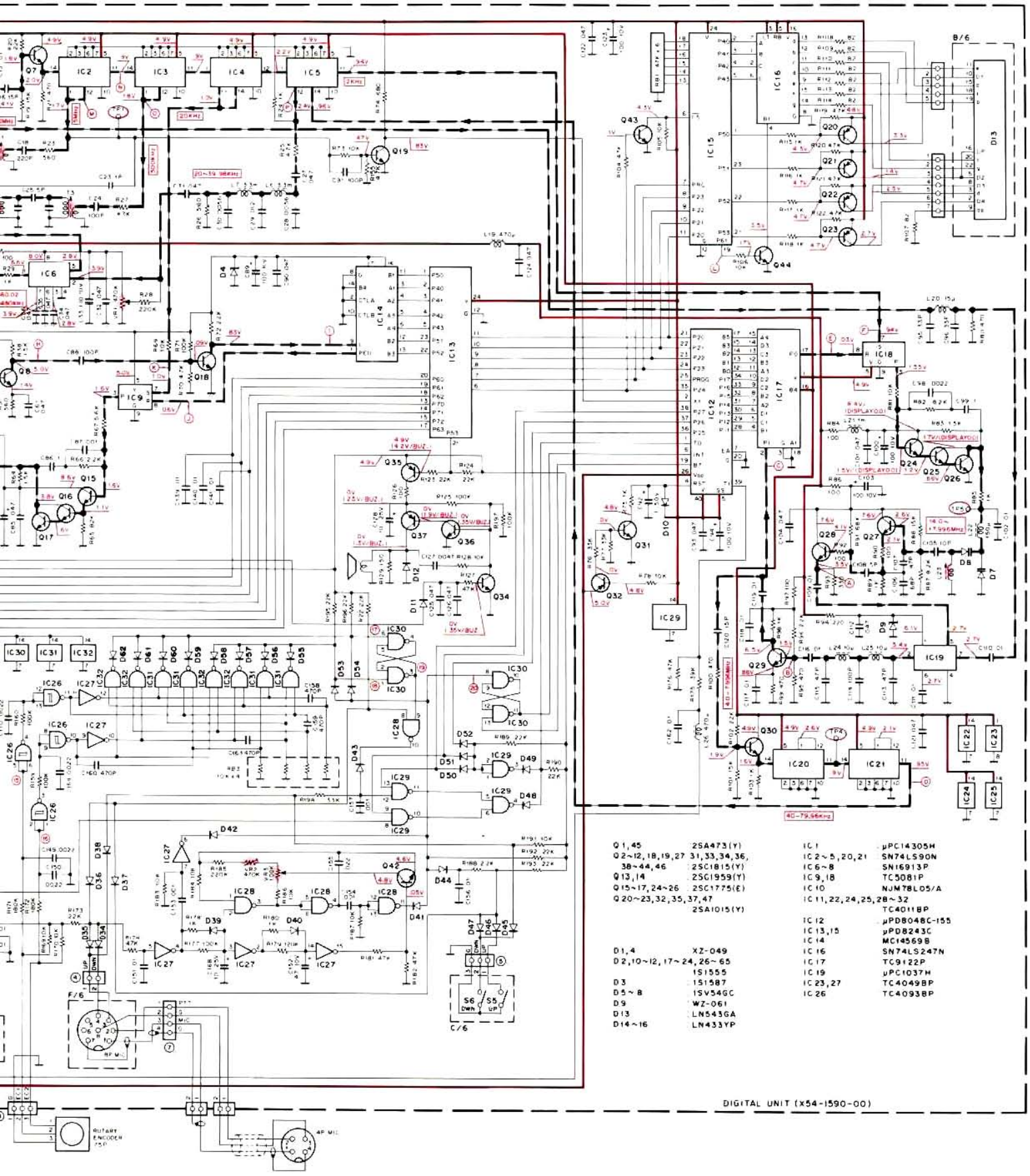
Q1,45:
Q20 ~
IC1: μP
IC12:μP
IC26: T
D1,4: X

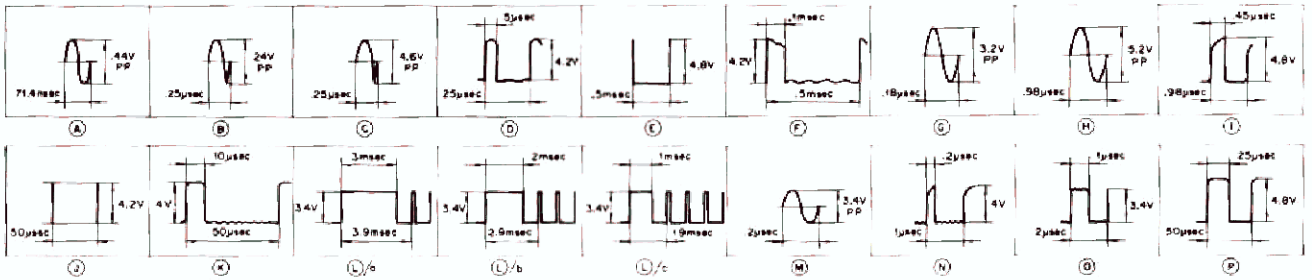
ARD VIEW (COMPONENT SIDE)



Q1,45: 2SA473(Y) Q2～12,18,19,27～31,33,34,36,38～44,46: 2SC1815(Y) Q13,14: 2SC1959(Y) Q15～17,24～26: 2SC1775(E)
Q20～23,32,35,37,47: 2SA1015(Y)
IC1: μPC14305H IC2～5,20,21: SN74LS90N IC6～8: SN16913P IC9,18: TC5081P IC10: NJM78L05A IC11,22,24,25,28～32: TC4011BP
IC12:μPD8048C-155 IC13.15: μPD8243C IC14:MC14569B IC16: SN74LS247N IC17: TC9122P IC19: μPC1037H IC23.27: TC4049BP
IC26: TC4093BP
D1,4: XZ-049 D2,10～12,17～24,26～65: IS1555 D3: IS1587 D5～8: ISV54GC D9: WZ-061 D13: LN543GA D14～16: LN433YP

CHEMATIC DIAGRAM



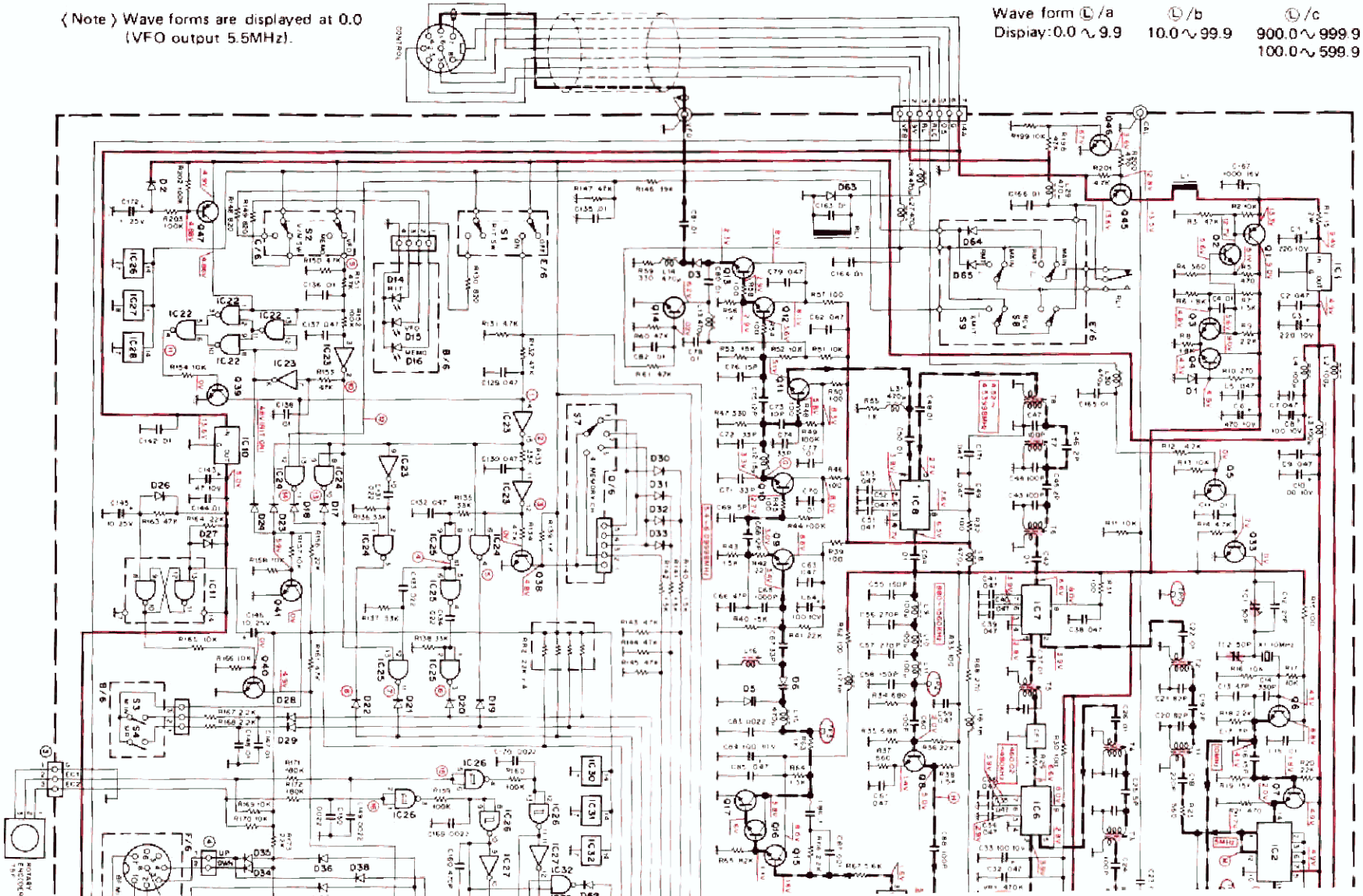


〈Note〉 Wave forms are displayed at 0.0 (VFO output 5.5MHz).

Wave form Ⓛ/a Display: 0.0 ∿ 9.9

Ⓛ/b 10.0 ∿ 99.9

Ⓛ/c 900.0 ∿ 999.9, 100.0 ∿ 599.9



SCHEMATIC

PARTS LIST

DFC-230 General

Ref. No.	Parts No	Description	Re-marks
	A01-0792-03	Case (A) upper	☆
	A01-0793-03	Case (B) lower	☆
	A13-0623-03	Angle ass'y	☆
	A20-2411-03	Panel (T)	☆
	A20-2412-03	Panel (K)(W)	☆
	B05-0713-04	Grill cloth, Transducer	
	B10-0637-04	Front glass	☆
	B46-0058-10	Warranty card (K)	☆
	B50-2771-00	Operating manual (K)(W)	☆
	B50-2772-00	Operating manual (T)	☆
	E07-0852-05	8P Metal plug MIC	☆
	E14-0101-05	Pin plug (CAL)	
	E30-1677-05	8P DIN cord REMOTE	☆
	E30-1679-05	4P MIC cord	☆
	G02-0525-04	Plate spring	☆
	H01-2729-03	Carton (inside) (K)(W)	☆
	H01-2730-03	Carton (inside) (T)	☆
	H10-2536-04	Packing fixture (B) Top	
	H10-2546-02	Packing fixture (A) Bottom	☆
	H12-0474-04	Cushion	
	H12-0477-04	Packing	☆
	H20-1417-03	Protective cover	
	H25-0049-03	Accessory bag (Foot, Screw)	
	H25-0079-04	Accessory bag (MIC)	
	H25-0103-04	Accessory bag (Cord)	
	J02-0069-05	Foot	
	J42-0420-05	Cord bushing MIC	
	J42-0425-05	Cord bushing CONTROL	☆
	J61-0019-05	Vinyletie	
	K21-0754-04	Main knob	☆
	K23-0744-04	Knob (B) MEMORY	☆
	K27-0409-04	Push knob (B) M. IN, MR	
	K29-0740-04	Push knob, RCV, X MIT, RIT, MEMO/VFO	
	K29-0742-04	UP DOWN knob	☆
	N08-0070-04	Screw Rear panel (GND)	
	N09-0008-04	Round screw (Angle)	
	N14-0510-04	Flange nut (Angle)	
	N15-1040-46	Flat washer (GND, Angle)	
	N15-1060-46	Flat washer (Angle)	
	N16-0060-46	Spring washer (Angle)	
	N32-2605-45	Flat screw (Case)	
	N35-3006-45	Bind screw (Foot)	
	N87-2606-46	Self tapping screw	
	N87-3006-46	Self tapping screw	
	N99-0304-04	Allen head bolt M4 × 6 (Angle)	
	S50-1406-05	Tact switch	
	T91-0315-05	Microphone (T)	☆
	T91-0316-05	Microphone (K)(W)	☆
	W01-0401-04	Allen key (Angle)	
	W02-0317-05	Rotary encoder	☆
	X54-1590-00	Digital unit	☆

Digital Unit (X54-1590-00)

Ref. No.	Parts No	Description	Re-marks
C1	CE04W1A221M	E 220 μF 10V	
C2	C91-0456-05	C 0.047 μF 25V	
C3	CE04W1A221M	E 220 μF 10V	
C5	C91-0456-05	C 0.047 μF 25V	
C6	CE04W1A471M	E 470 μF 10V	
C7	C91-0456-05	C 0.047 μF 25V	
C8	CE04W1A101M	E 100 μF 10V	
C9	C91-0456-05	C 0.047 μF 25V	
C10	CE04W1A101M	E 100 μF 10V	
C12	CC45CH1H270J	C 27 pF	
C13	CC45SL1H470J	C 47 pF	
C14	CC45SL1H331J	C 330 pF	
C16	CC45SL1H150J	C 15 pF	
C17	CC45SL1H070D	C 7 PF ±0.5 pF	
C18	CC45SL1H221J	C 220 pF	
C19	CC45CH1H020C	C 2 pF ±0.25 pF	
C20,21	CC45RH1H820J	C 82 pF	
C23	CC45CH1H010C	C 1 pF ±0.25 pF	
C24	CC45SL1H101J	C 100 pF	
C25	CC45CH1H050D	C 5 pF ±0.5 pF	
C27	CQ92MIH473K	ML 0.047 μF 50V	
C28	CQ92MIH562K	ML 0.0056 μF 50V	
C29	CQ92MIH123K	ML 0.012 μF 50V	
C30	CQ92MIH562K	ML 0.0056 μF 50V	
C31	CQ92MIH473K	ML 0.047 μF 50V	
C32	C91-0456-05	C 0.047 μF 25V	
C33	CE04WIA101M	E 100 μF 10V	
C38	C91-0456-05	C 0.047 μF 25V	
C43,44	CC45RH1H101J	C 100 pF	
C45,46	CC45CH1H020C	C 2 pF ±0.25 pF	
C47	CC45RH1H101J	C 100 pF	
C49	C91-0456-05	C 0.047 μF 25V	
C55	CC45SL1H151J	C 150 pF	
C56,57	CC45SL1H271J	C 270 pF	
C58	CC45SL1H151J	C 150 pF	
C59	C91-0456-05	C 0.047 μF 25V	
C60	CC45SL1H101J	C 100 pF	
C61～63	C91-0456-05	C 0.047 μF 25V	
C64	CE04W1A101M	E 100 μF 10V	
C66	CC45RH1H470J	C 47 pF	
C67	CC45RH1H330J	C 33 pF	
C68	CC45RH1H120J	C 12 pF	
C69	CC45RH1H050C	C 5 pF ±0.25 pF	
C71,72	CC45SL1H330J	C 33 pF	
C73	CC45SL1H100D	C 10 pF ±0.5 pF	
C74	CC45SL1H330J	C 33 pF	
C75	CC45SL1H120J	C 12 pF	
C76	CC45SL1H150J	C 15 pF	
C79	C91-0456-05	C 0.047 μF 25V	
C84	CE04W1A101M	E 100 μF 10V	
C85	C91-0456-05	C 0.047 μF 25V	
C86	CQ92MIH104K	ML 0.1 μF 50V	
C87	CQ92MIH102K	ML 0.001 μF 50V	
C88	CC45SL1H101J	C 100 pF	
C89	CE04WIA101M	E 100 μF 10V	
C90	C91-0456-05	C 0.047 μF 25V	
C91	CC45SL1H101J	C 100 pF	
C92	CE04W1H01O	E 1 μF 50V	
C93	C91-0456-05	C 0.047 μF 25V	
C94	CE04W1A101M	E 100 μF 10V	
C95,96	CC45SL1H330J	C 33 pF	
C98	CQ92M1H222K	ML 0.0022 μF 50V	
C99	CQ92M1H104K	ML 0.1 μF 50V	
C100	CE04W1A101M	E 100 μF 10V	
C101	C91-0456-05	C 0.047 μF 25V	

PARTS LIST

Ref. No.	Parts No.	Description	Re-marks
C103	CE04W1A101M	E 100 μF 10V	
C104	C91-0456-05	C 0.047 μF 25V	
C105	CC45RH1H100D	C 10 pF ±0.5 pF	
C106	CC45RH1H680J	C 68 pF	
C107	CC45RH1H470J	C 47 pF	
C108	CC45RH1H050C	C 5 pF ±0.25 pF	
C112	C91-0456-05	C 0.047 μF 25V	
C113	CC45SL1H470J	C 47 pF	
C114	CC45SL1H101J	C 100 pF	
C115	CC45SL1H470J	C 47 pF	
C120	CC45SL1H150J	C 15 pF	
C121,122	C91-0456-05	C 0.047 μF 25V	
C123	CE04W1A101M	E 100 μF 10V	
C124～126	C91-0456-04	C 0.047 μF 25V	
C127	CQ92M1H472K	ML 0.0047 μF 50V	
C128	CE04W1E100M	E 10 μF 25V	
C129,130	C91-0456-05	C 0.047 μF 25V	
C131	C91-0457-05	C 0.022 μF 25V	
C132	C91-0456-05	C 0.047 μF 25V	
C133,134	C91-0457-05	C 0.022 μF 25V	
C137	C91-0456-05	C 0.047 μF 25V	
C143	CE04W1A470M	E 47 μF 10V	
C145,146	CE04W1E100M	E 10 μF 25V	
C152	CE04W1A470M	E 47 μF 10V	
C155	C91-0457-05	C 0.022 μF 25V	
C167	C90-0817-05	E 1000 μF 10V	
C168	CE04W1E100M	E 10 μF 25V	
C171	C91-0456-05	C 0.047 μF 25V	
C172	CS15E1E010M	T 1 μF 25V	
TC1,2	C05-0029-15	Ceramic trimmer 40 pF	
	E04-0154-05	Coax connector	
	E06-0853-05	8P male socket (MIC)	☆
	E13-0163-05	1P pin jack CAL	
	E23-0046-04	Square terminal	
	E40-0273-05	Mini connect wafer 2P	
	E40-0373-05	Mini connect wafer 3P	
	E40-0374-05	Mini connect wafer 3P L type	
	E40-0473-05	Mini connect wafer 4P	
	E40-0474-05	Mini connect wafer 4P L type	
	E40-0573-05	Mini connect wafer 5P	
	E40-0574-05	Mini connect wafer 5P L type	
	E40-0673-05	Mini connect wafer 6P	
	E40-0773-05	Mini connect wafer 7P	
	E40-0774-05	Mini connect wafer 7P L type	
	F20-0516-05	Insulating sheet	
	F29-0014-05	Shoulder washer	
	J31-0517-05	Spacer	
L1	L15-0016-05	Choke coil	
L2,3	L40-1011-04	Ferri-inductor 100 μH	
L4	L40-4711-03	Ferri-inductor 470 μH	
L6,7	L40-3325-04	Ferri-inductor 3.3 mH	
L8	L40-4711-03	Ferri-inductor 470 μH	
L9～11	L40-1011-03	Ferri-inductor 100 μH	
L12	L40-1501-03	Ferri-inductor 15 μH	
L13～15	L40-4711-03	Ferri-inductor 470 μH	
L16	L32-0636-05	Oscillating coil	
L17,18	L40-1021-03	Ferri-inductor 1 mH	
L19	L40-4711-03	Ferri-inductor 470 μH	
L20	L40-1501-03	Ferri-inductor 15 μH	
L21	L40-1021-03	Ferri-inductor 1 mH	
L22	L40-1511-03	Ferri-inductor 150 μH	

Ref. No.	Parts No.	Description	Re-marks
L23	L32-0193-05	Oscillating coil	
L24,25	L40-1001-03	Ferri-inductor 10 μH	
L26～31	L40-4711-03	Ferri-inductor 470 μH	
T1,2	L34-0996-05	Tuning coil 4.5 MHz	
T3～5	L34-0991-05	Tining coil 470 kHz	
T6～8	L34-0996-15	Tuning coil 4.5 MHz	
CF1	L72-0321-05	Ceramic filter CFW470C	
X1	L77-0482-05	Crystal 10 MHz	
VR1,2	R12-6401-05	Trim. pot 470 kΩ	
VR3	R12-5030-05	Trim. pot 100 kΩ	
RB1	R90-0522-05	Resistor block 47 kΩ × 6	
RB2	R90-0509-05	Resistor block 22 kΩ × 5	
RB3	R90-0515-05	Resistor block 10 kΩ × 4	
	R92-0150-05	Short jumper	
S1,2	S40-2422-05	Push switch RIT, MEMORY/VFO	☆
S3,4	S59-1405-05	Tact switch M IN, MR	
S5,6	S50-1403-05	Tact switch UP/DOWN	
S7	S01-2428-05	Rotary switch MEMORY CH	☆
S8,9	S40-2422-05	Push switch RCV, XMIT	☆
RL1	S51-1404-05	Relay G2E	
BZ1	T95-0052-05	Transducer	

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