REVISED EDITION

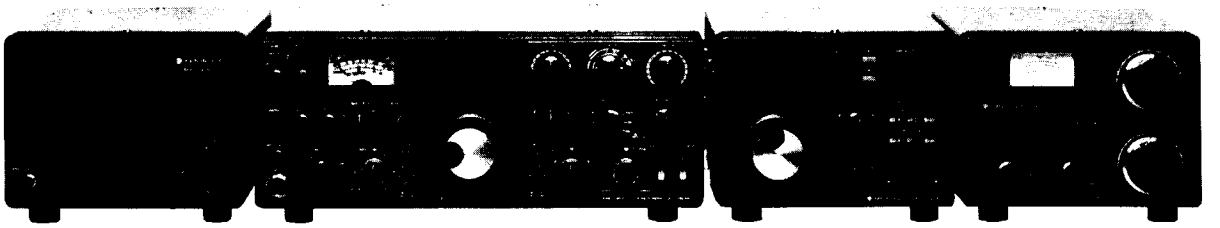
KENWOOD

SERVICE MANUAL

Model TS-830S, M (M:EXCEPT USA MARKET)

SP-230, VFO-230, AT-230, DS-2

(W) TYPE ONLY



SP-230 TS-830S VFO-230 AT-230

CONTENTS

HF SSB TRANSCEIVER

SPECIFICATIONS

[GENERAL]

Frequency Range	160 m Band 1.8 ~ 2.0 MHz
	80 m Band 3.5 ~ 4.0 MHz
	40 m Band 7.0 ~ 7.3 MHz
	* 30 m Band 10.1 ~ 10.15 MHz
	(10.0 MHz WWV)
	20 m Band 14.0 ~ 14.35 MHz
	* 17 m Band 18.068 ~ 18.168 MHz
	15 m Band 21.0 ~ 21.45 MHz
	* 12 m Band 24.89 ~ 24.99 MHz
	10 m Band 28.0 ~ 29.7 MHz
Modes	SSB/CW: 830S, SSB/AM/CW: 830M
Power Requirement	120V AC (220V modifiable), 50/60 Hz: 830S (K)
	220/240V AC (selectable), 50/60Hz : 830S (T) (W) (X)
	120/220V AC (selectable), 50/60Hz : 830M
Power Consumption	Transmit: 295 watts
	Receive: 32 watts (with heater off)
Dimensions	333 (13.3) × 133 (5.3) × 333 (13.3) mm (inch)
Weight	13.5 kg (29.8 lbs)

[TRANSMITTER]

***Final Power Input**	220W PEP for SSB operation : 830S, M
	180W DC for CW operation : 830S, M
	80W DC for AM operation : 830M
Audio Input Impedance	500Ω ~ 50 kΩ
RF Output Impedance	50Ω ~ 75Ω
Frequency Stability	Within 1 kHz during the first hour after 1 minute of warmup.
	Within 100 Hz during any 30 minute period after warmup.
Carrier Suppression	Better than 40 dB
Sideband Suppression	Better than 60 dB
Spurious Radiation	Better than 60 dB
Harmonic Radiation	Better than 40 dB
Audio Freq. Response	400 to 2,600 Hz, within −6 dB
3rd Order Intermodulation Distortion	Better than −36 dB

[RECEIVER]

Receiver Sensitivity	0.25 μV at 10 dB S + N/N for SSB, CW : 830S, M
	2 μV at 10 dB S + N/N for AM : 830M
Image Ratio	Better than 60 dB
IF Rejection	Better than 80 dB
Receiver Selectivity	
SSB/CW WIDE	2.4 kHz (−6 dB), 3.6 kHz (−60 dB) : 830S, M
CW NARROW	With YK-88C (option) 500 Hz (−6 dB), 1.5 kHz (−60 dB)
	With YK-88CN (option) 270 Hz (−6 dB), 1.1 kHz (−60 dB)
	With YG-455C (option) 500 Hz (−6 dB), 820 Hz (−60 dB)
	With YG-455CN (option) 250 Hz (−6 dB), 500 Hz (−60 dB)
	} 830S
AM	6 kHz (−6 dB), 11 kHz (−60 dB) : 830M
Variable Bandwidth	
SSB with 2.4 kHz filter	500 Hz ~ 2.4 kHz (−6 dB) continuously variable : 830S, M
CW with 500 Hz filter	150 Hz ~ 500 Hz (−6 dB) continuously variable : 830S
	With optional filter YK-88C and YG-455C added.
AM	4.5 kHz ~ 6 kHz (−6 dB) continuously variable : 830M
Notch-filter Attenuation	Better than 40 dB
Audio Output Impedance	8 ~ 16Ω
Audio Output	1.5W (8Ω)

*Will transmit on the new 30, 17, and 12 meter bands. Diodes installed for preventing accidental transmission before government amateur authorization.

NOTE: The circuit and ratings may change without notice due to developments in technology.

INTRODUCTION

The TS-830S is a dual conversion transceiver using two intermediate frequencies, 8.83 MHz and 455 kHz. However, this differs from transceivers of the so called Collins type(such as the TS-520) in that the bandwidth of both intermediate frequencies is narrowed for performing VBT operation. Therefore, the TS-830S can basically be considered a single conversion transceiver with an 8.83 MHz IF.

Operation of the transmitter is opposite in process to the receiver. AN SSB signal generated at 455 kHz is converted to 8.83 MHz, and is then mixed with the PLL (local oscillator output) to produce the final transmission frequency.

The circuitry is hybrid with vacuum tubes used only in the driver (12BY7A) and final-stage power amplifier (6146B's).

The PLL circuit generates a heterodyne frequency for each band, a counter reference signal, and a 25 kHz marker, all from a single crystal oscillator.

The TS-830S incorporates an IF SHIFT circuit, VBT, VOX (also used for CW semi break-in), side tone circuit, RF speech processor, transmission monitor circuit, noise blanker, XTAL calibrator, notch filter, and etc.

RECEIVER CIRCUIT

The signal coming from the antenna is routed through step-up antenna coil via an RF ATT switch and IF trap. MOS FET (Q1: 3SK73) amplifies this signal. Approximately 9 dB of negative feedback is applied to the RF amplifier to reduce noise and expand the amplifiers range of linear operation.

The signal passes through a buffer amplifier (Q2: 2SK125) and is mixed with the PLL VCO output by a balanced mixer (Q3, Q4: 2SK125). The signal is now converted to the first intermediate frequency, 8.83 MHz. Entering the IF unit, this signal is amplified by Q1 (2SK125), passes through ceramic filter CF1 and the NB gating circuit, and is applied to crystal filter XF1 whose center frequency is 8.83 MHz. The signal leaving the crystal filter is mixed with the VBT local oscillator output at 8.375 MHz by a balanced mixer (Q2, Q3: 3SK73) where it is converted to the second intermediate frequency, 455 kHz. The signal then passes through ceramic filter CF2 whose center frequency is 455 kHz, and is amplified by Q4 (3SK73). It then is fed to the notch circuit, Q5 through Q7 (2SC1815). After being amplified by Q8 (3SK73), it is demodulated to an audio signal by the product detector (D20~D23, IN60 X4).

In the AF unit, the audio signal is amplified by Q3 (2SC2240), passes through the AF GAIN control and after being amplified by the power amplifier Q4 (HA1368R), drives the speaker.

Item	Rating
Center frequency *fo*	8.830 MHz
3 dB bandwidth 30 dB bandwidth	*fo* ± 5 kHz or more, total 25 kHz or more 100 kHz or less
Input level (at 80 dBμ output)	93.5 dB or less
Ripple (within 3 dB handwidth)	1 dB or less
Spurious response	20 dB or more within *fo* ± 1.5 MHz
Input and output impedance	330Ω

Table 1. Ceramic filter pair (L72-0310-05) 2 pcs. SFA8.83MF combined (IF unit, CF1A & B)

Item	Rating
Center frequency *fo*	8830 kHz
Center frequency deviation	Within ±150 Hz at 6 dB
Pass bandwidth	±1.35 kHz or more at 6 dB
Attenuation bandwidth	±1.7 kHz or less at 20 dB ±2.5 kHz or less at 60 dB ±3.4 kHz or less at 80 dB
Ripple	2 dB or less
Loss	6 dB or less
Guaranteed attenuation	80 dB or more within *fo* ±3.4 kHz to ±1 MHz
Input and output impedance	600Ω// 15 pF

Table 2. Crystal filter (L71-0222-05) YK88S1 (IF unit, XF1)

Item	Rating
Center frequency *fo*	8831.5 kHz
Center frequency deviation	Within ±250Hz at 6 dB
Pass bandwidth	+3.0 kHz or more at 6 dB
Attenuation bandwidth	+6kHz or less at 60 dB +10kHz or less at 80 dB
Ripple	2 dB or less
Loss	3 dB within +2 dB
Guaranteed attenuation (*fo* +10 kHz to *fo* +1 MHz)	80 dB or more
Input and output impedance	600Ω//15PF

Table 3. Crystal filter (L71-0223-05) YK-88A (IF unit, XF2)

Item	Rating
Center frequency	455 kHz ± 0.2 kHz
6 dB bandwidth	2.7 kHz or more
60 dB bandwidth	4.5 kHz or less
Guaranteed attenuation (0.1 ~ 1 MHz)	60 dB or more
Spurious (600 ~ 700 kHz)	40 dB or more
Ripple (within 6 dB bandwidth)	2 dB or less
Loss	6 dB
Input and output impedance	2 kΩ

Table 4. Ceramic filter (L72-0314-15) CFJ455K5 (IF unit, CF2)

Item	Rating
Center frequency *fo*	456.5 kHz
6 dB bandwidth	+3 kHz or more
50 dB bandwidth	+9 kHz or less
Ripple (*fo* +2 kHz)	2 dB or less
Loss	6 dB or less
Guaranteed attenuation (*fo* +100 kHz)	60 dB or more
Input and output impedance	2.0 kΩ

Table 5. Ceramic filter (L72-0322-05) CFW 456.5HT (IF unit, CF 3)

TRANSMITTER CIRCUIT

Audio input picked up by the microphone comes to the IF unit and is amplified by Q19~21. The input circuit adapts to any microphone impedance of from 500 ohms to 50k ohms. This amplified output is converted to a DSB signal by the balanced modulator D29-32 (1N60 x 4), passes through buffer amplifier Q22 (2SK19), a 455kHz ceramic filter, and the output appears as a SSB signal. This signal passes either buffer amplifier Q23 (2SC1815), or the speech processor consisting of Q24, 26, and 27. Then the first transmit mixer (Q28: 3SK73) converts this to an 8.83 MHz SSB signal. After passing the 8.83 MHz crystal filter and being amplified by Q29 (3SK73), the signal is applied to the second transmit mixer in the RF unit. This double balanced mixer (Q6, Q7: 3SK73), mixes the signal with the PLL VCO output to convert to the final Transmit frequency. Output is amplified by the driver tube (V1: 12BY7A) and then by the final power amplifier (two 6146B's) and is applied to the antenna via a π-matching network.

PLL CIRCUIT

The PLL signal is synthesized from the VFO, CAR, and VCO outputs. The TS-830S employs a programmable divider in the PLL to synthesize the heterodyne frequency from the standard reference oscillator frequency. This simplifies the PLL circuitry by eliminating the need for a separate HET XTAL for each band.

CIRCUIT DESCRIPTION

Frequency organization of the PLL circuit is shown in Figure 1, the circuit diagram in Figure 2, and frequency organization in other circuits is summarized in Table 4. Please refer to Figure 1 when reading the following description on PLL circuit operation. MIX (3), a double balanced mixer, mixes the CAR output with the VFO output. MIX (2) which operates in 18 MHz bands and above, mixes either 10 MHz, in the 14 and 18 MHz bands, or 20 MHz, in the 21, 24.5, and 28 MHz bands, with the output of MIX (3) to generate the appropriate frequency needed for each band, as shown in Table 4.

This is mixed with the VCO output for each band by MIX (1) to a frequency given in Table 4, which is then routed through LPF (1), amplified, and wave-shaped to a digital signal. A programmable divider divides this signal into a 500 kHz output. This programmable divider is preset, as shown in Table 4, by the BCD signal which is counter-generated from information coming from the band switch. The phase comparator used is a Motorola MC4044P. The loop filter is made of completely external components to minimize spurious radiation. Six VCOs cover all bands. If the PLL unlocks for any reason, it will be detected from the phase comparator output. This will turn off the VCO output to prevent spurious radiation and, at the same time, the digital display will be blanked to inform the operator of unlock status.

BAND	RX, Tx frequency (MHz)	VCO (MHz)	MIX (1) input (MHz)	MIX (1) output (MHz)	Division ratio	DCBA
1.5	1.5 ~ 2.0	10.33 ~ 10.83	14.33 ~ 14.83	4.0	1/8	1 0 0 0
3.5	3.5 ~ 4.0	12.33 ~ 12.83	14.33 ~ 14.83	2.0	1/4	1 1 0 0
7	7.0 ~ 7.5	15.83 ~ 16.33	14.33 ~ 14.83	1.5	1/3	1 1 0 1
10	10.0 ~ 10.5	18.83 ~ 19.33	14.33 ~ 14.83	4.5	1/9	0 1 1 1
14	14.0 ~ 14.5	22.83 ~ 23.33	24.33 ~ 24.83	1.5	1/3	1 1 0 1
18	18.0 ~ 18.5	26.83 ~ 27.33	24.33 ~ 24.83	2.5	1/5	1 0 1 1
21	21.0 ~ 21.5	29.83 ~ 30.33	34.33 ~ 34.83	4.5	1/9	0 1 1 1
24.5	24.5 ~ 25.0	33.33 ~ 33.83	34.33 ~ 34.83	1.0	1/2	1 1 1 0
28	28.0 ~ 28.5	36.83 ~ 37.33	〃	2.5	1/5	1 0 1 1
28.5	28.5 ~ 29.0	37.33 ~ 37.83	〃	3.0	1/6	1 0 1 0
29	29.0 ~ 29.5	37.83 ~ 38.33	〃	3.5	1/7	1 0 0 1
29.5	29.5 ~ 30.0	38.33 ~ 38.83	〃	4.0	1/8	1 0 0 0

Table 6. Frequency chart

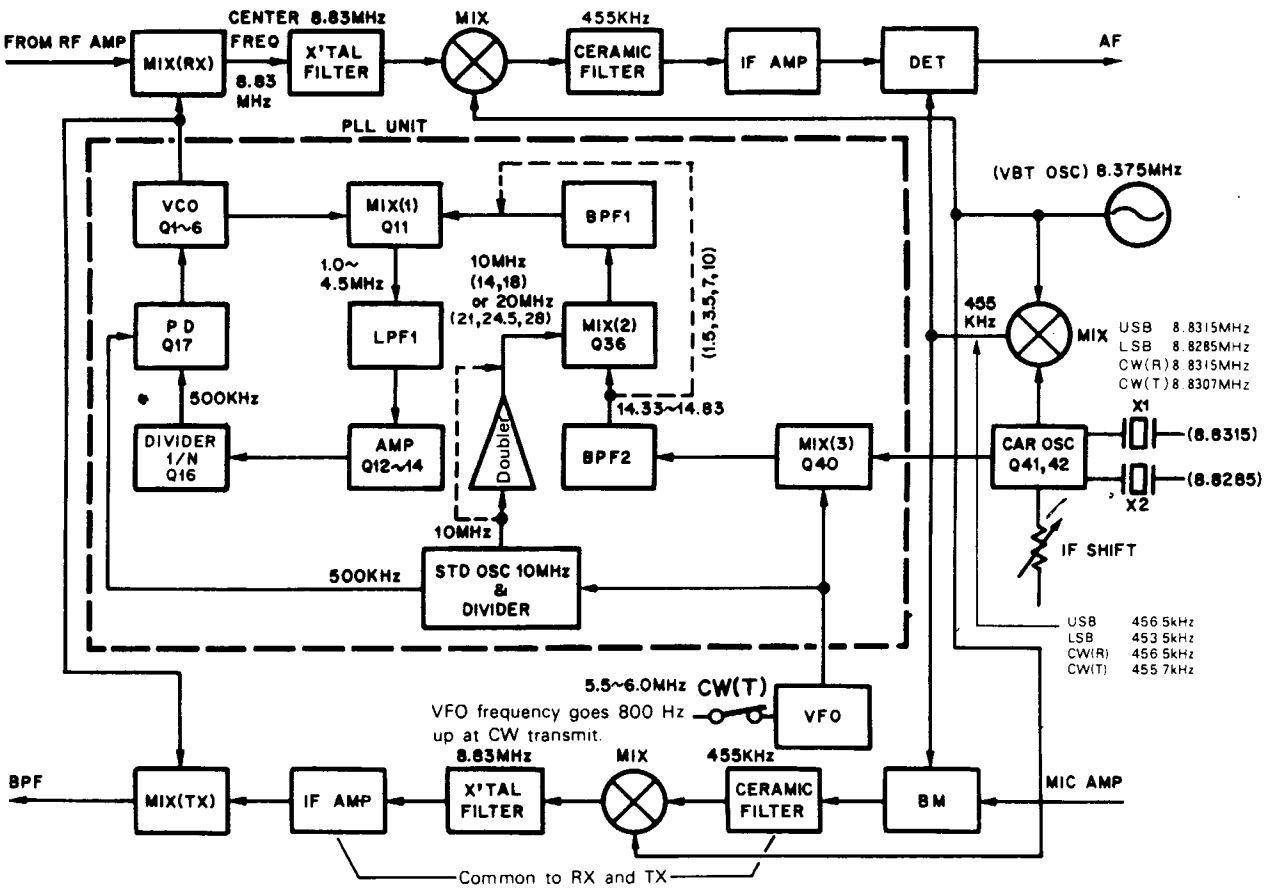


Fig. 1 TS-830 Frequency configuration

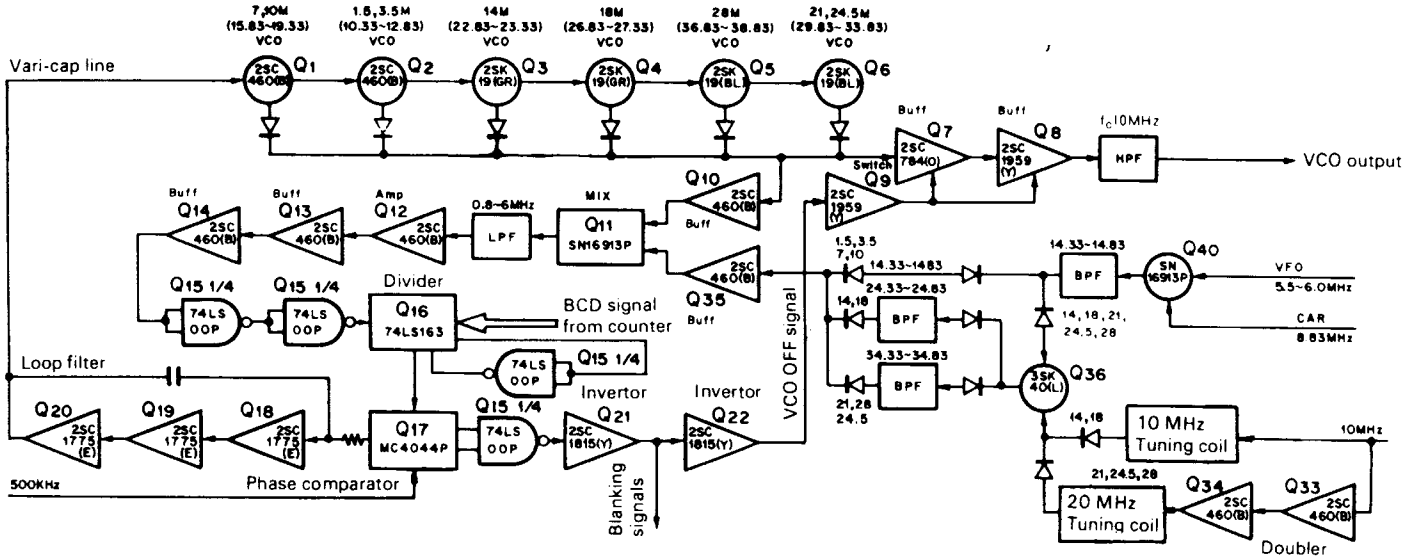


Fig. 2 TS-830 PLL circuit configuration

COUNTER

This counts the 500 kHz to 1 MHz signal which the PLL unit generates by mixing the VFO output with 5 MHz (halved from the 10 MHz reference frequency). Gate, latch, and preset pulses are generated from a 10 Hz pulse generated by dividing 1 kHz, supplied from the PLL, by 100.

BAND	100K	1 M	10M	DCBA	0.5	BAND	100K	1 M	10M	DCBA	0.5
1.5	0	1	0	1 0 0 0	H	21	5	0	2	0 1 1 1	L
3.5	0	3	0	1 1 0 0	H	24.5	0	4	2	1 1 1 0	H
7	5	6	0	1 1 0 1	L	28	5	7	2	1 0 1 1	L
10	5	9	0	0 1 1 1	L	28.5	0	8	2	1 0 1 0	H
14	5	3	1	1 1 0 1	L	29	5	8	2	1 0 0 1	L
18	5	7	1	1 0 1 1	L	29.5	0	9	2	1 0 0 0	H

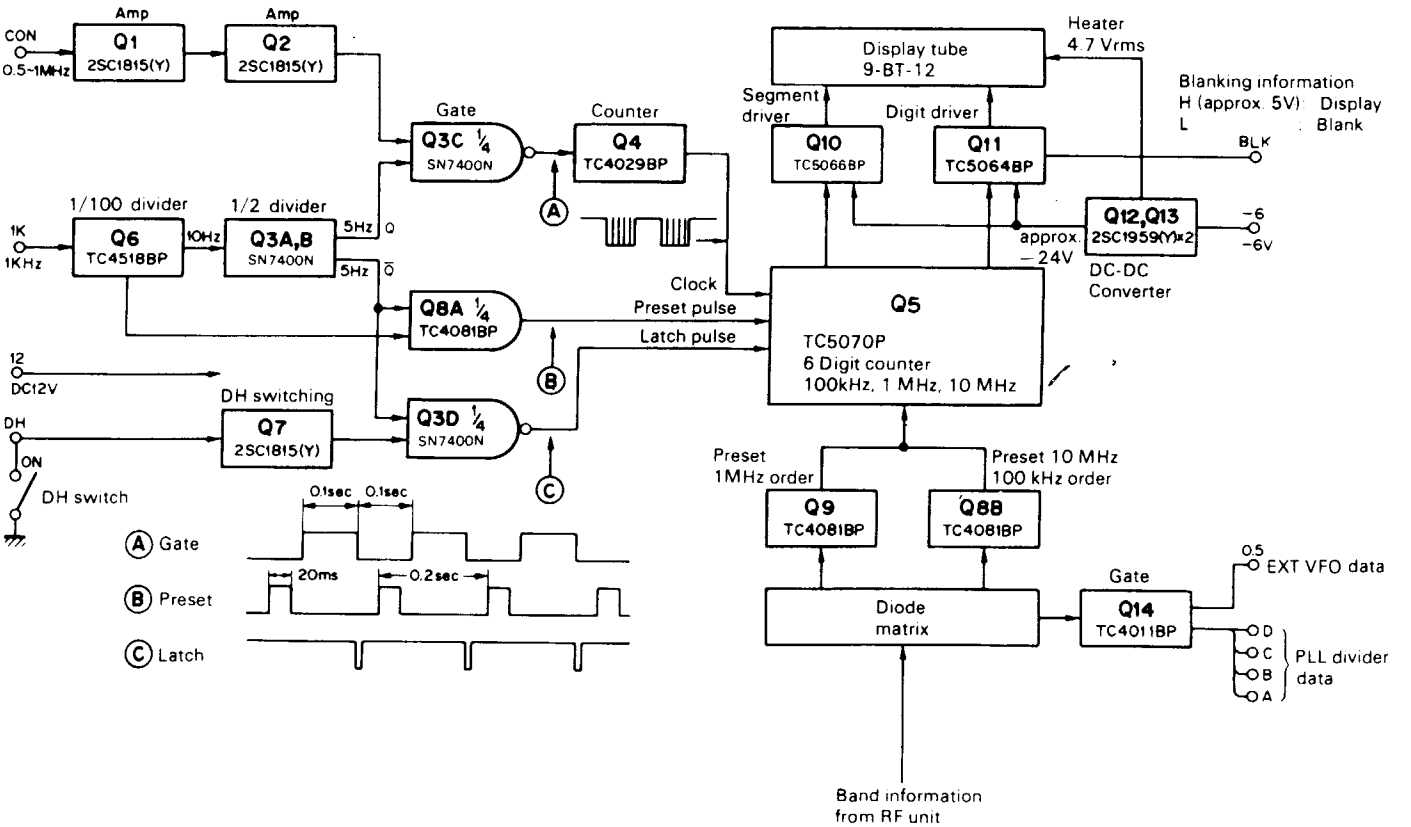


Fig. 3 Counter unit block diagram