SECTION 2 – TECHNICAL NOTES

PART DESIGNATIONS ON CIRCUIT BOARDS

FT-101Z CIRCUIT BOARDS

The FT-101Z series integrates the "mother board" concept and the "plug-in" type of circuit card. Each circuit board used in the FT-101Z has a code number assigned to it, and each part within the transceiver has a part number assigned to it (e.g. Q_{502}).

Parts numbers 01–99 (e.g. R_{12}) are located on the main chassis. Other parts, located on the circuit boards, are assigned a three or four digit part number; the last two digits are the part number for that particular board, while the first one or two digits are the code number for the board.

Thus, Q_{301} is transistor number 01, located on circuit board number 3, which is the PREMIX UNIT. Refer to the accompanying chart for a tabulation of the code numbers assigned to the various circuit boards used in the FT-101Z series.

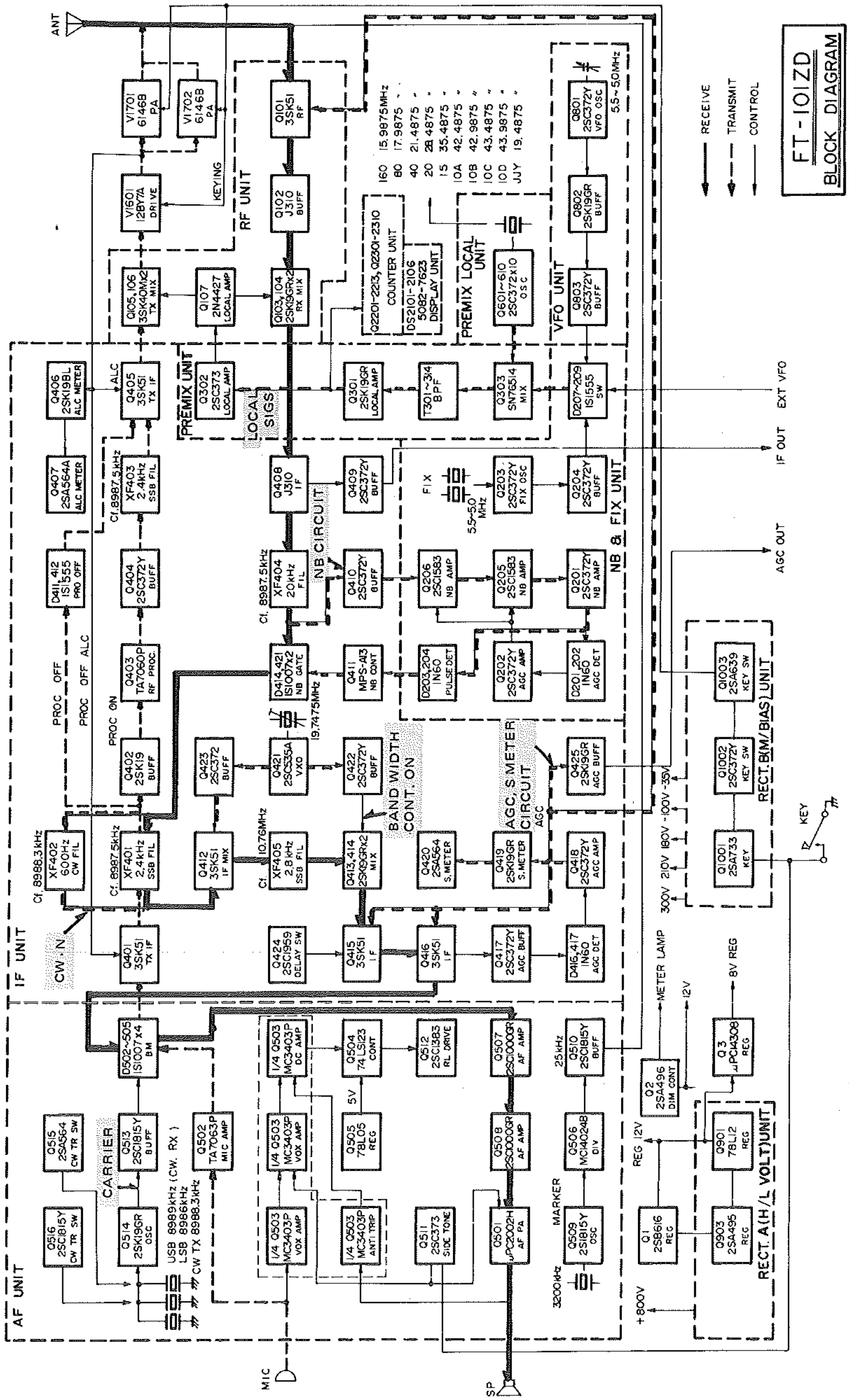
Code #	Unit	Board Designation
1	RF	PB-1960A
2	NB/FIX	PB-1961B
3	PREMIX	PB-1962A
4	IF	PB-1963B
5	AF	PB-1964A
6	PREMIX LOCAL	PB-1965
7	SELECT SW.	PB-1966C
8	VFO	PB-1440B-3420
9	RECT A	PB-1967
10	RECT B	PB-1968A
11	CAPACITOR	PB-1969A
12	TRIMMER A	PB-1970
13	TRIMMER B	PB-1970
14	TRIMMER C	PB-1092
15	BW CONT	PB-1972
16	DRIVER	PB-1714A
17	FINAL	PB-1715A
18	CLAR CONT	PB-1973A
19	LED	PB-1974A
20	LEVER SW	PB-1975A
21	DISPLAY	PB-1978
22	COUNT/DECODE	PB-1979
23	COUNTER MAIN	PB-1980
24	AM	PB-2040
32	DC-DC CONV	—

SIGNAL TRACING IN THE FT-101ZD

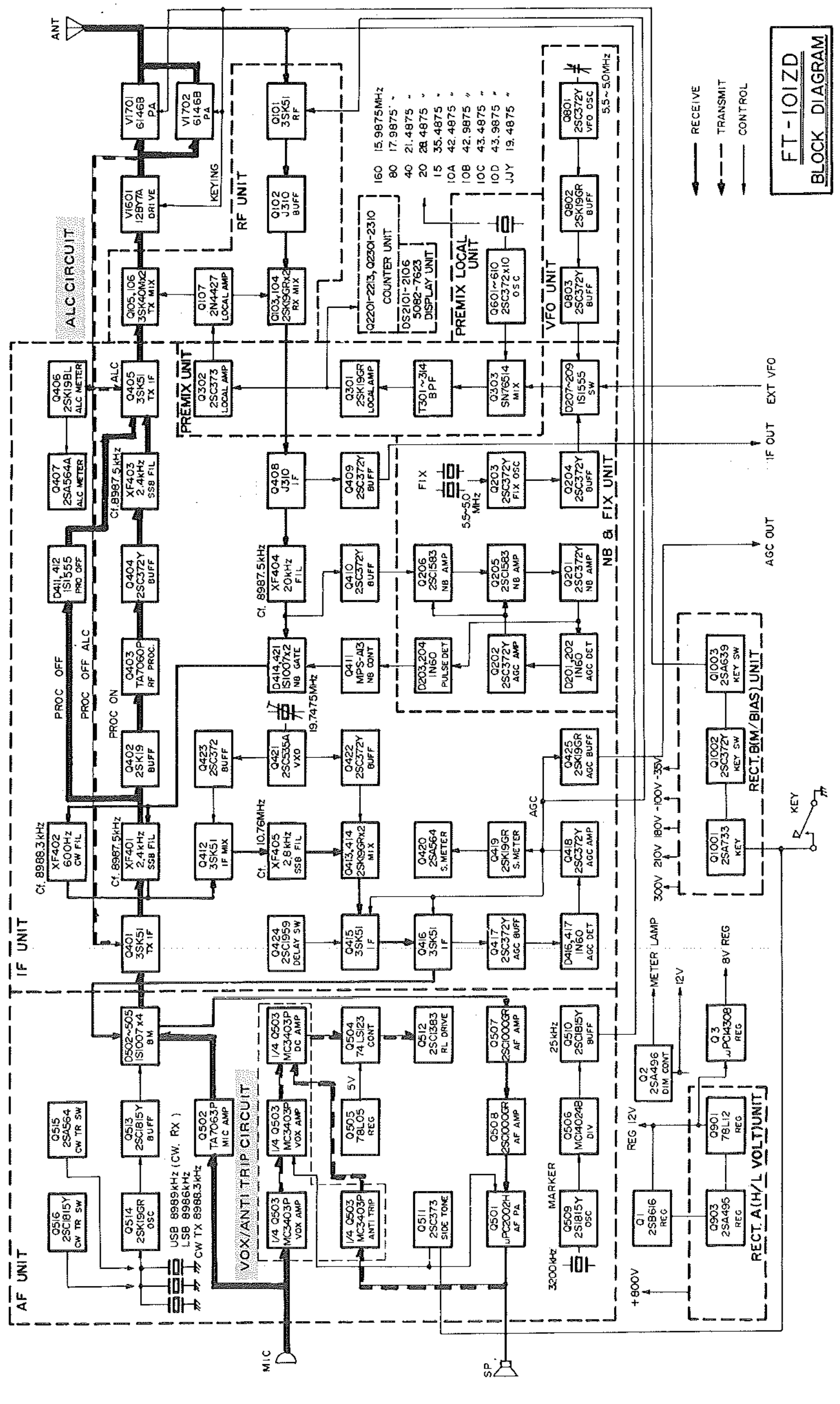
A highly useful signal in the FT-101ZD, one that can be used for most receiver alignment steps, is the internal calibrator. Fed into the receive line right at the antenna terminal, the calibrator signal should read about S9 + 10 dB, with the preselector peaked, at 14.200 MHz, SSB mode. While minor variations from this figure are no cause for alarm, a blown RF amplifier FET will cause this reading to be practically nil.

In the following section, we have presented augmented block diagrams which should help you in tracing the signal paths throughout the FT-101ZD. Armed with a couple of alignment wands and the calibrator signal, receiver peaking can be completed in short order, leaving you free to diagnose problems on the TX side.

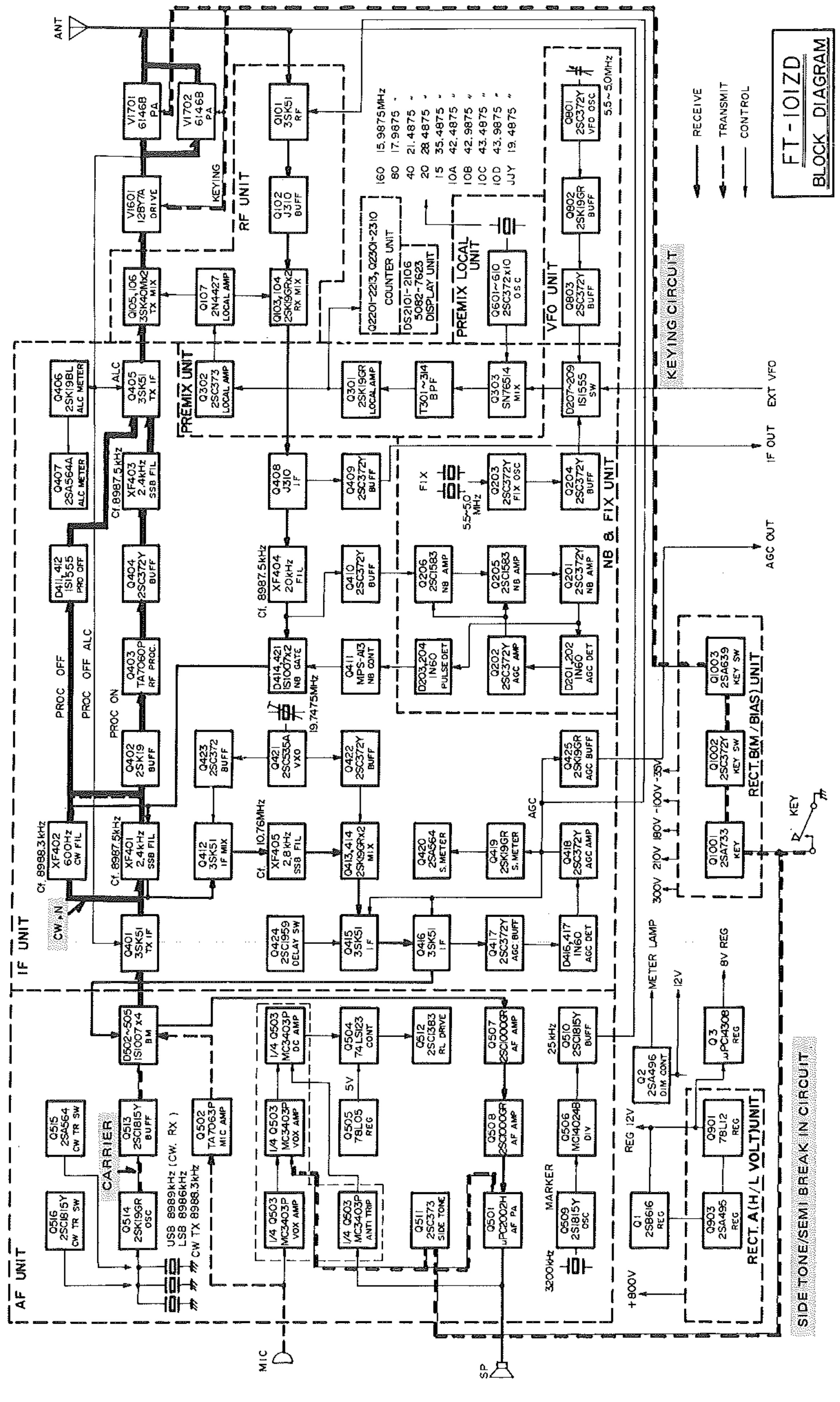
SSB/CW MODE RX

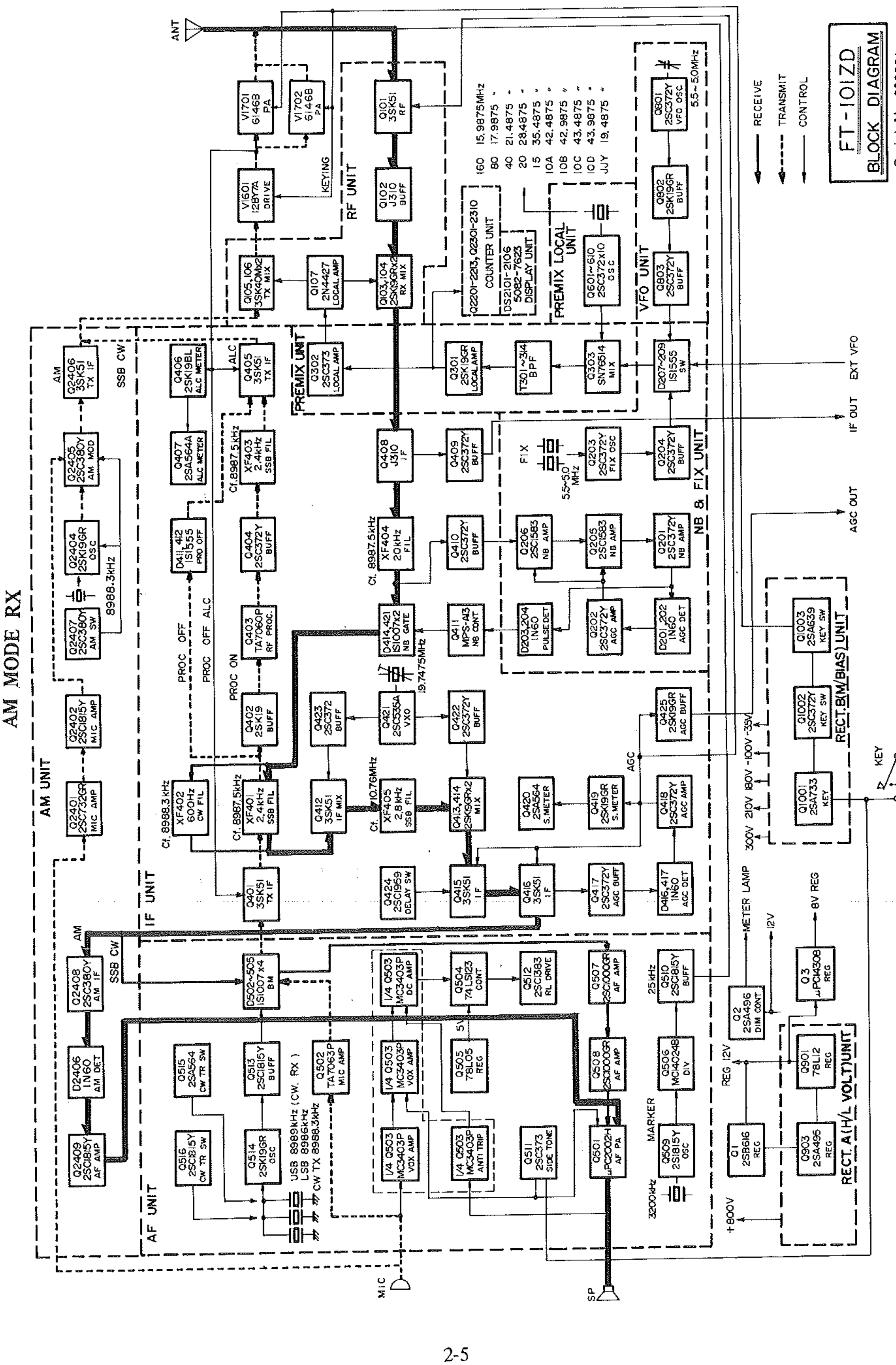


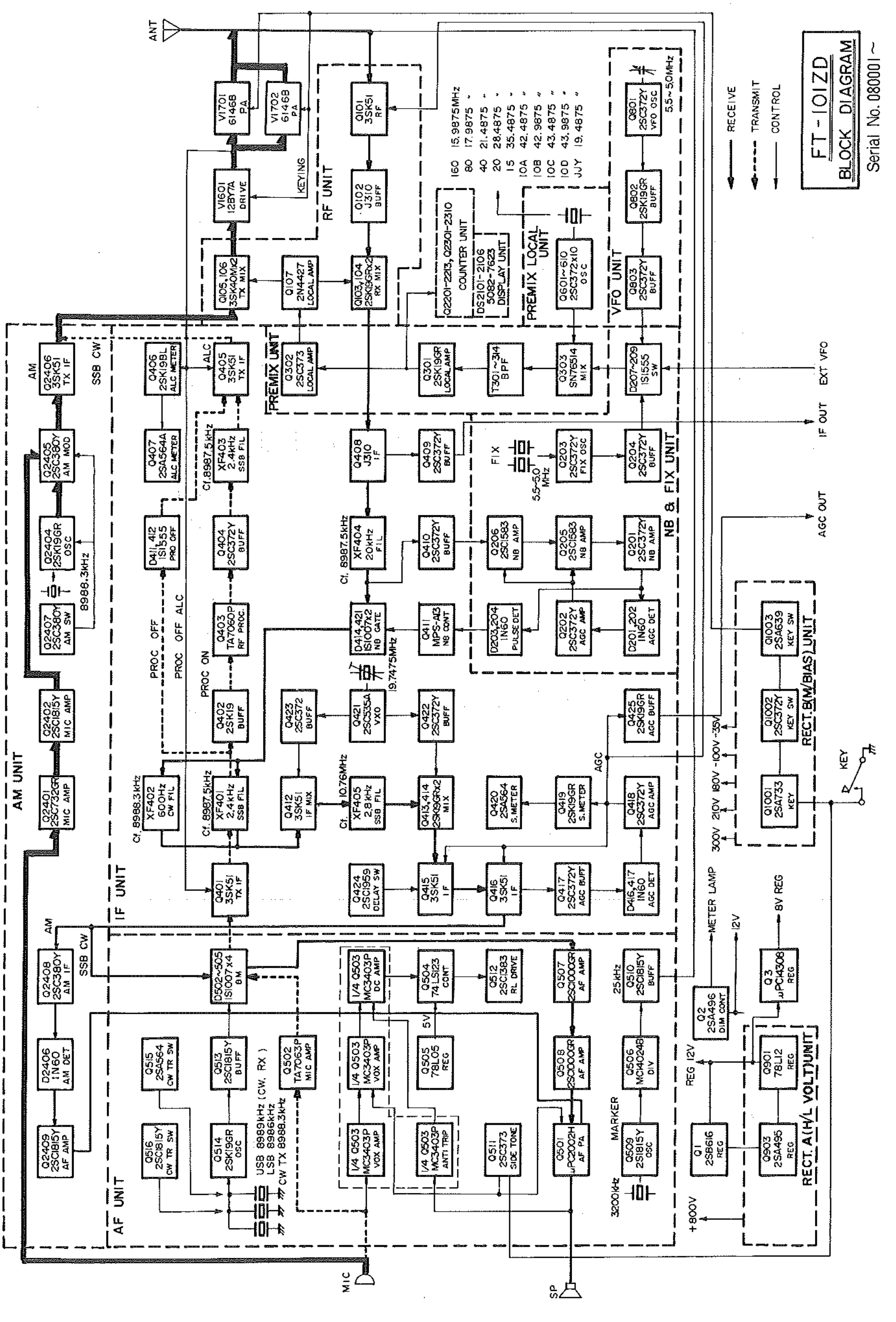
SSB MODE TX


FT-101ZD
BLOCK DIAGRAM
RECEIVE
TRANSMIT
CONTROL
ANT
V1701 6146B PA
V1702 6146B PA
V1601 12BY7A DRIVE
KEYING
RF UNIT
Q101 3SK51 RF
Q102 J310 BUFF
Q103,104 2SK19GRx2 RX MIX
Q105,106 3SK40Mx2 TX MIX
Q107 2N4427 LOCAL AMP
ALC CIRCUIT
COUNTER UNIT
Q2201~2213, Q2301~2310
DS2101~2106 5082-7623 DISPLAY UNIT
PREMIX LOCAL UNIT
Q601~610 2SC372x10 OSC
VFO UNIT
Q801 2SC372Y VFO OSC
Q802 2SK19GR BUFF
Q803 2SC372Y BUFF
5.5~5.0MHz
160 15.9875MHz
80 17.9875
40 21.4875
20 28.4875
15 35.4875
10A 42.4875
10B 42.9875
10C 43.4875
10D 43.9875
JJY 19.4875
PREMIX UNIT
Q302 2SC373 LOCAL AMP
Q301 2SK19GR LOCAL AMP
T301~314 BPF
Q303 SN76514 MIX
D207~209 1S1555 SW
EXT VFO
IF OUT
AGC OUT
IF UNIT
Q406 2SK19BL ALC METER
Q407 2SA564A ALC METER
Q405 3SK51 TX IF
ALC
XF403 2.4kHz SSB FIL
Cf. 8987.5kHz
Q404 2SC372Y BUFF
Q403 TA7060P RF PROC.
Q402 2SK19 BUFF
D411, 412 1S1555 PRO OFF
PROC OFF
PROC OFF ALC
PROC ON
XF402 600Hz CW FIL
Cf. 8988.3kHz
XF401 2.4kHz SSB FIL
Cf. 8987.5kHz
Q401 3SK51 TX IF
Q408 J310 IF
Q409 2SC372Y BUFF
XF404 20kHz FIL
Cf. 8987.5kHz
Q410 2SC372Y BUFF
D414,421 1S1007x2 NB GATE
Q411 MPS-A13 NB CONT
19.7475MHz
Q421 2SC535A VXO
Q423 2SC372 BUFF
Q422 2SC372Y BUFF
Q412 3SK51 IF MIX
XF405 2.8kHz SSB FIL
Cf. 10.76MHz
Q413,414 2SK19GRx2 MIX
Q424 2SC1959 DELAY SW
Q415 3SK51 IF
Q416 3SK51 IF
Q420 2SA564 S.METER
Q419 2SK19GR S.METER
AGC
Q417 2SC372Y AGC BUFF
Q418 2SC372Y AGC AMP
D416,417 1N60 AGC DET
Q425 2SK19GR AGC BUFF
NB & FIX UNIT
FIX
5.5~5.0 MHz
Q203 2SC372Y FIX OSC
Q204 2SC372Y BUFF
Q206 2SC1583 NB AMP
Q205 2SC1583 NB AMP
Q201 2SC372Y NB AMP
D203,204 1N60 PULSE DET
Q202 2SC372Y AGC AMP
D201,202 1N60 AGC DET
AF UNIT
Q516 2SC1815Y CW TR SW
Q515 2SA564 CW TR SW
Q514 2SK19GR OSC
Q513 2SC1815Y BUFF
USB 8989kHz (CW. RX)
LSB 8986kHz
CW TX 8988.3kHz
D502~505 1S1007x4 BM
Q502 TA7063P MIC AMP
VOX/ANTI TRIP CIRCUIT
1/4 Q503 MC3403P DC AMP
1/4 Q503 MC3403P VOX AMP
1/4 Q503 MC3403P VOX AMP
1/4 Q503 MC3403P ANTI TRIP
Q504 74LS123 CONT
Q505 78L05 REG
5V
Q512 2SC1383 RL DRIVE
Q511 2SC373 SIDE TONE
Q507 2SC1000GR AF AMP
Q508 2SC1000GR AF AMP
Q501 µPC2002H AF PA
Q510 2SC1815Y BUFF
25kHz
Q506 MC14024B DIV
Q509 2S1815Y OSC
MARKER
3200kHz
MIC
SP
Q2 2SA496 DIM CONT
METER LAMP
12V
Q3 µPC14308 REG
8V REG
REG 12V
Q1 2SB616 REG
Q901 78L12 REG
Q903 2SA496 REG
RECT. A(H/L VOLT) UNIT
+800V
300V 210V 180V -100V -35V
Q1001 2SA733 KEY
Q1002 2SC372Y KEY SW
Q1003 2SA639 KEY SW
RECT. B(M/BIAS) UNIT
KEY

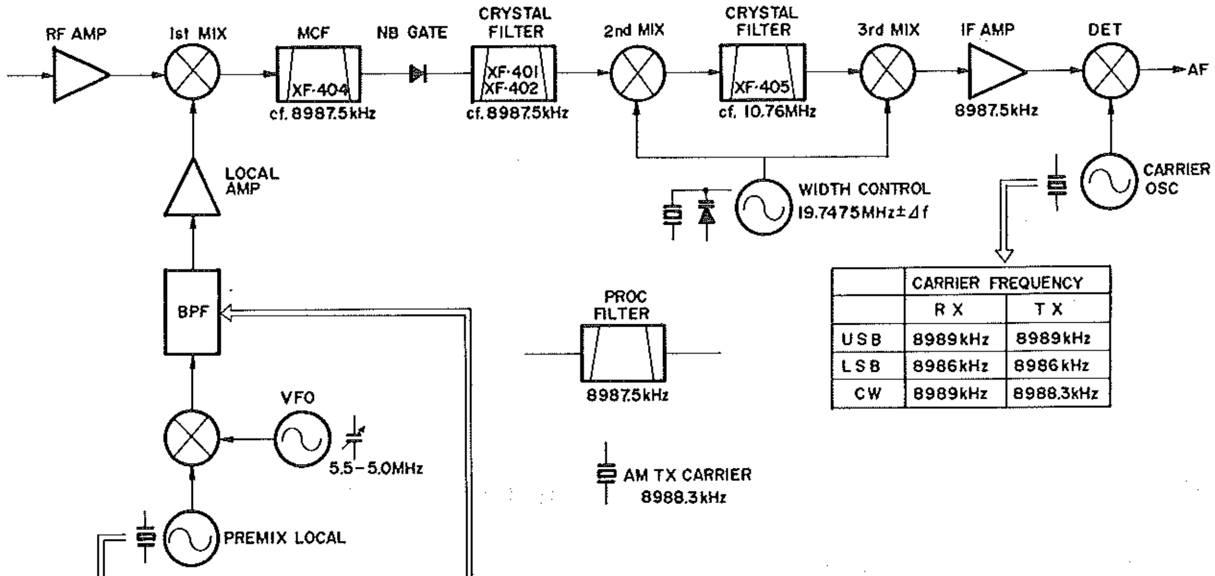
CW MODE TX


FT-101ZD
BLOCK DIAGRAM
RECEIVE
TRANSMIT
CONTROL
ANT
MIC
SP
KEY
RF UNIT
IF UNIT
AF UNIT
PREMIX UNIT
PREMIX LOCAL UNIT
VFO UNIT
NB & FIX UNIT
COUNTER UNIT
DISPLAY UNIT
KEYING CIRCUIT
SIDE TONE/SEMI BREAK IN CIRCUIT
RECT. B(M/BIAS) UNIT
RECT. A(H/L VOLT)UNIT
V1701 6146B PA
V1702 6146B PA
V1601 12BY7A DRIVE
KEYING
Q101 3SK51 RF
Q102 J310 BUFF
Q103,104 2SK19GRx2 RX MIX
Q105,106 3SK40Mx2 TX MIX
Q107 2N4427 LOCAL AMP
Q201 2SC372Y NB AMP
Q202 2SC372Y AGC AMP
Q203 2SC372Y FIX OSC
Q204 2SC372Y BUFF
Q205 2SC1583 NB AMP
Q206 2SC1583 NB AMP
D201,202 1N60 AGC DET
D203,204 1N60 PULSE DET
D207~209 1S1555 SW
Q301 2SK19GR LOCAL AMP
Q302 2SC373 LOCAL AMP
Q303 SN76514 MIX
T301~314 BPF
Q401 3SK51 TX IF
Q402 2SK19 BUFF
Q403 TA7060P RF PROC.
Q404 2SC372Y BUFF
Q405 3SK51 TX IF
Q406 2SK19BL ALC METER
Q407 2SA564A ALC METER
Q408 J310 IF
Q409 2SC372Y BUFF
Q410 2SC372Y BUFF
Q411 MPS-A13 NB CONT
Q412 3SK51 IF MIX
Q413,414 2SK19GRx2 MIX
Q415 3SK51 IF
Q416 3SK51 IF
Q417 2SC372Y AGC BUFF
Q418 2SC372Y AGC AMP
Q419 2SK19GR S.METER
Q420 2SA564 S.METER
Q421 2SC535A VXO
Q422 2SC372Y BUFF
Q423 2SC372 BUFF
Q424 2SC1959 DELAY SW
Q425 2SK19GR AGC BUFF
D411,412 1S1555 PRO OFF
D414,421 1S1007x2 NB GATE
D416,417 1N60 AGC DET
XF401 2.4kHz SSB FIL
XF402 600Hz CW FIL
XF403 2.4kHz SSB FIL
XF404 20kHz FIL
XF405 2.8kHz SSB FIL
Q501 μPC2002H AF PA
Q502 TA7063P MIC AMP
Q503 MC3403P
Q504 74LS123 CONT
Q505 78L05 REG
Q506 MC14024B DIV
Q507 2SC1000GR AF AMP
Q508 2SC1000GR AF AMP
Q509 2SC1815Y OSC
Q510 2SC1815Y BUFF
Q511 2SC373 SIDE TONE
Q512 2SC1383 RL DRIVE
Q513 2SC1815Y BUFF
Q514 2SK19GR OSC
Q515 2SA564 CW TR SW
Q516 2SC1815Y CW TR SW
D502~505 1S1007x4 BM
Q601~610 2SC372x10 OSC
Q801 2SC372Y VFO OSC
Q802 2SK19GR BUFF
Q803 2SC372Y BUFF
Q901 78L12 REG
Q903 2SA495 REG
Q1001 2SA733 KEY
Q1002 2SC372Y KEY SW
Q1003 2SA639 KEY SW
Q1 2SB616 REG
Q2 2SA496 DIM CONT
Q3 μPC14308 REG
PROC OFF
PROC ON
ALC
CARRIER
MARKER
AGC
AGC OUT
IF OUT
EXT VFO
METER LAMP
8V REG
REG 12V
+800V
5.5~5.0MHz
19.7475MHz
10.76MHz
3200kHz
25kHz
USB 8989kHz (CW. RX)
LSB 8986kHz
CW TX 8988.3kHz


AM MODE RX
FT-101ZD
BLOCK DIAGRAM
Serial No. 080001~
RECEIVE
TRANSMIT
CONTROL


AM MODE TX
FT-101ZD
BLOCK DIAGRAM
Serial No. 080001~
RECEIVE
TRANSMIT
CONTROL
RF UNIT
AM UNIT
IF UNIT
AF UNIT
PREMIX UNIT
PREMIX LOCAL UNIT
VFO UNIT
NB & FIX UNIT
COUNTER UNIT
DISPLAY UNIT
RECT. A(H/L VOLT)UNIT
RECT. B(M/BIAS) UNIT
ANT
MIC
SP
KEY
EXT VFO
IF OUT
AGC OUT
METER LAMP
8V REG
+800V
160 15.9875MHz
80 17.9875
40 21.4875
20 28.4875
15 35.4875
10A 42.4875
10B 42.9875
10C 43.4875
10D 43.9875
JJY 19.4875
5.5~5.0MHz

FREQUENCY RELATIONSHIPS



	CARRIER FREQUENCY	
	RX	TX
USB	8989kHz	8989kHz
LSB	8986kHz	8986kHz
CW	8989kHz	8988.3kHz

BAND	FREQUENCY
160m	15.9875 MHz
80	17.9875
40	21.4875
20	28.4875
15	35.4875
10A	42.4875
10B	42.9875
10C	43.4875
10D	43.9875

BAND	RANGE
160m	10.4875–10.9875MHz
80	12.4875–12.9875
40	15.9875–16.4875
20	22.9875–23.4875
15	29.9875–30.4875
10	36.9875–38.9875

CRYSTAL DATA FT-101ZD

UNIT	FUNCTION	HOLDER	FREQUENCY (kHz)	MODE	LOAD C (pF)	EFFECTIVE RESISTANCE	DRIVE LEVEL
CRYSTAL	160m	HC-18/U	15987.5	3rd overtone	30	80(Ω)	2 mW
	80m	〃	17987.5	〃	〃	60	〃
	40m	〃	21487.5	〃	〃	45	〃
	20m	〃	28487.5	〃	〃	40	〃
	15m	〃	35487.5	〃	〃	40	〃
	10m (A)	〃	42487.5	〃	〃	40	〃
	10m (B)	〃	42987.5	〃	〃	40	〃
	10m (C)	〃	43487.5	〃	〃	40	〃
	10m (D)	〃	43987.5	〃	〃	40	〃
	WWV(5MHz)	〃	19487.5	〃	〃	40	〃
CARRIER	LSB	HC-18/U	8986	Fundamental	35	30	10mW
	USB	〃	8989	〃	〃	35	〃
	CW	〃	8988.3	〃	〃	35	〃
	AM	〃	8988.3	〃	〃	35	〃
IF	Width	〃	★cf.19747.5	Fundamental	〃	15	2 mW
COUNTER	Local	〃	18000	〃	〃	15	10mW
	Local	〃	18500	〃	〃	15	〃
	Clock	HC-14/W	655.36	〃	23	7K	2 mW
VOX/MARK	Marker	HC-6/W	3200	〃	〃	50	5 mW

★XCO FREQUENCY: 19743–19753kHz
Decided by circuit

CIRCUIT DESCRIPTION

The block diagram and following circuit description will provide you with a better understanding of the design of this transceiver. The circuit description is tailored to the full-feature FT-101ZD, and the reader should note that the counter unit and digital display are optional features for the FT-101Z.

The FT-101ZD consists of a premix-type single conversion system, using a 9 MHz IF for all modes of operation.

RECEIVER

The RF input signal from the antenna is fed through antenna relay RL_2, lamp fuse FH_2, attenuator switch S_{2004} (located on the LEVER SW unit, PB-1975), 9 MHz trap L_{2101} and C_{1207} (located on the TRIMMER A UNIT), and input transformer T_1 to pin 3 of the RF UNIT.

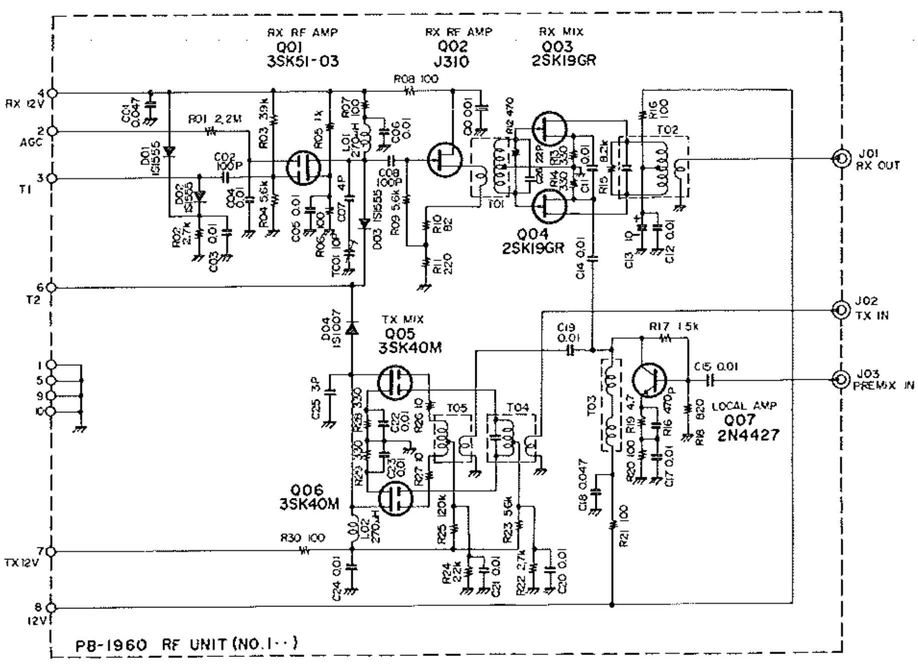
RF UNIT (PB-1960)

The incoming signal is amplified by the RF amplifier, Q_{101} **(3SK51-03)**, a dual-gate MOSFET used in a grounded source configuration. This transistor has superior immunity from intermodulation distortion. The amplified signal is then fed through a source follower, Q_{102} **(J310)**, to the balanced mixer consisting of Q_{103} and Q_{104} **(2SK19GR)**, where the input signal is heterodyned with the local oscillator signal. The local signal is delivered from buffer amplifier Q_{107} **(2N4427)**, and the resulting IF signal of 8.9875 MHz is fed through T_{102} to J_{101}.

The input and output of the RF amplifier are permeability-tuned circuits, resulting in high sensitivity and excellent rejection of unwanted out-of-band signals.

IF UNIT (PB-1963)

The IF signal at pin 9 of J_{403} is amplified by Q_{408} **(J310)** and passed through a monolithic filter, XF_{404}, which has a ±10 kHz bandwidth. The monolythic filter provides early protection from IMD, while providing a wide-bandwidth point for noise blanking. The IF signal is then fed to noise blanker gate D_{404} **(1S1007)**, which functions as an ON/OFF switch controlled by noise blanker driver Q_{411} (MPSA13).



The IF signal is then passed through the SSB filter XF_{401} (or optional CW filter XF_{402}). Selection of the filter to be used is made by diodes D_{405} - D_{408} **(1S1007)**, depending on the mode of operation.

The IF signal is then fed to the IF first mixer, Q_{412} **(3SK51-03)**, where the incoming signal is heterodyned with a 19.7475 MHz $\pm\Delta f$ local signal delivered from crystal oscillator Q_{421} **(2SC535A)** and buffer amplifier Q_{423} **(2SC372Y)**, resulting in a signal of 10.76 MHz $\pm\Delta f$.

The new 10.76 MHz $\pm\Delta f$ signal is fed through filter XF_{405} to the IF second mixer, Q_{413}/Q_{414} **(2SK19GR)**, where the filtered signal is heterodyned with the 19.7475 MHz $\pm\Delta f$ signal delivered from Q_{422} **(2SC372Y)**, resulting in an 8.9875 MHz IF signal, the same as the original IF.

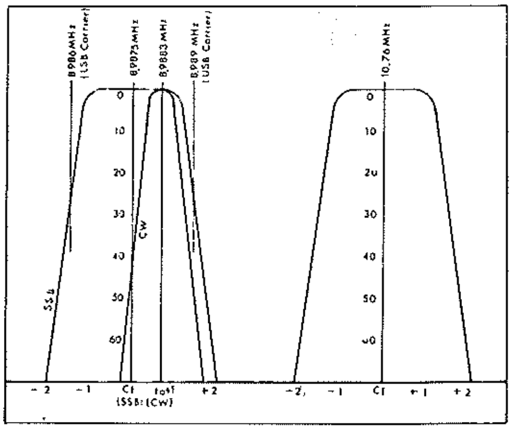
This process varies the IF signal across the passband of the second IF filter. The combination of the two filters, XF_{401} and XF_{405}, provides continuously variable width of the IF passband. The frequency of crystal oscillator Q_{421} is varied by varactor diode D_{418} **(1S2209)**.

The output from the IF second mixer is fed to a two-stage IF amplifier, consisting of Q_{415} and Q_{416} **(3SK51-03)**, and delivered through diode switch D_{401} **(1S1555)** to the AF UNIT.

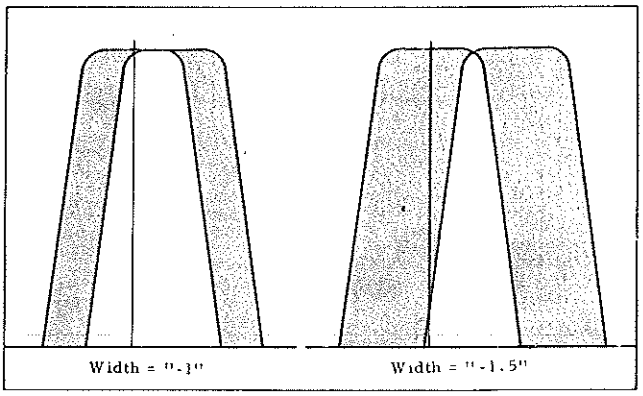
A portion of the output from Q_{416} is rectified by D_{416} and D_{417} **(1N60)** to produce AGC voltage. Q_{417} **(2SC372Y)** provides the necessary buffering between the IF and AGC circuits. The AGC voltage is amplified by Q_{418} **(2SC372Y)**, and applied to gate 2 of the RF and IF amplifiers, to control the gain of these stages. The AGC voltage is also amplified by Q_{419} **(2SK19GR)** for S-meter indication.

For use with the FV-901DM scanning VFO, or other optional equipment, the AGC voltage is fed through buffer Q_{425} **(2SK19GR)** and fed to the AGC OUT terminal on the EXT VFO jack, located on the rear panel.

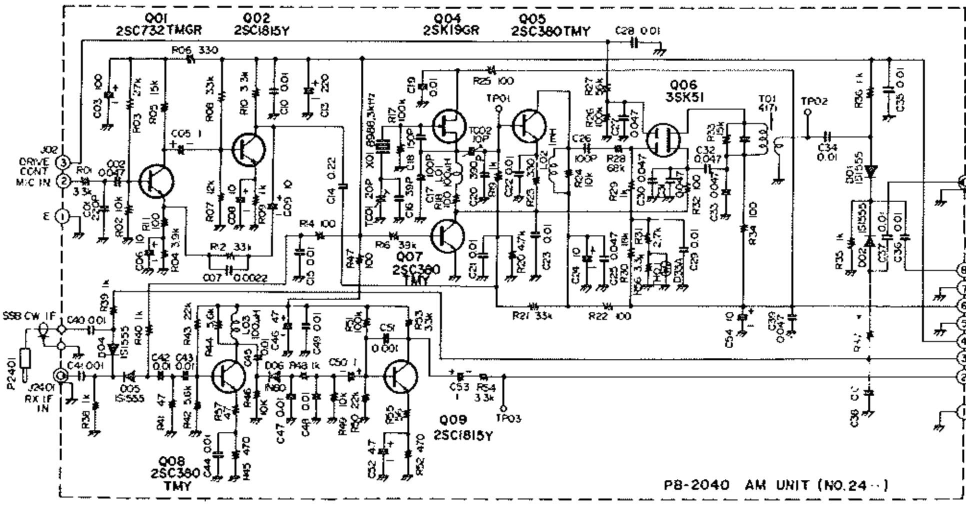
On AM, the output signal from Q_{416} is amplified by Q_{2408} **(2SC380Y)** and passed to the AM detector, D_{2406} **(1N60)**. The resulting audio signal is amplified by Q_{2409} **(2SC1815Y)** and delivered to the final audio stage.

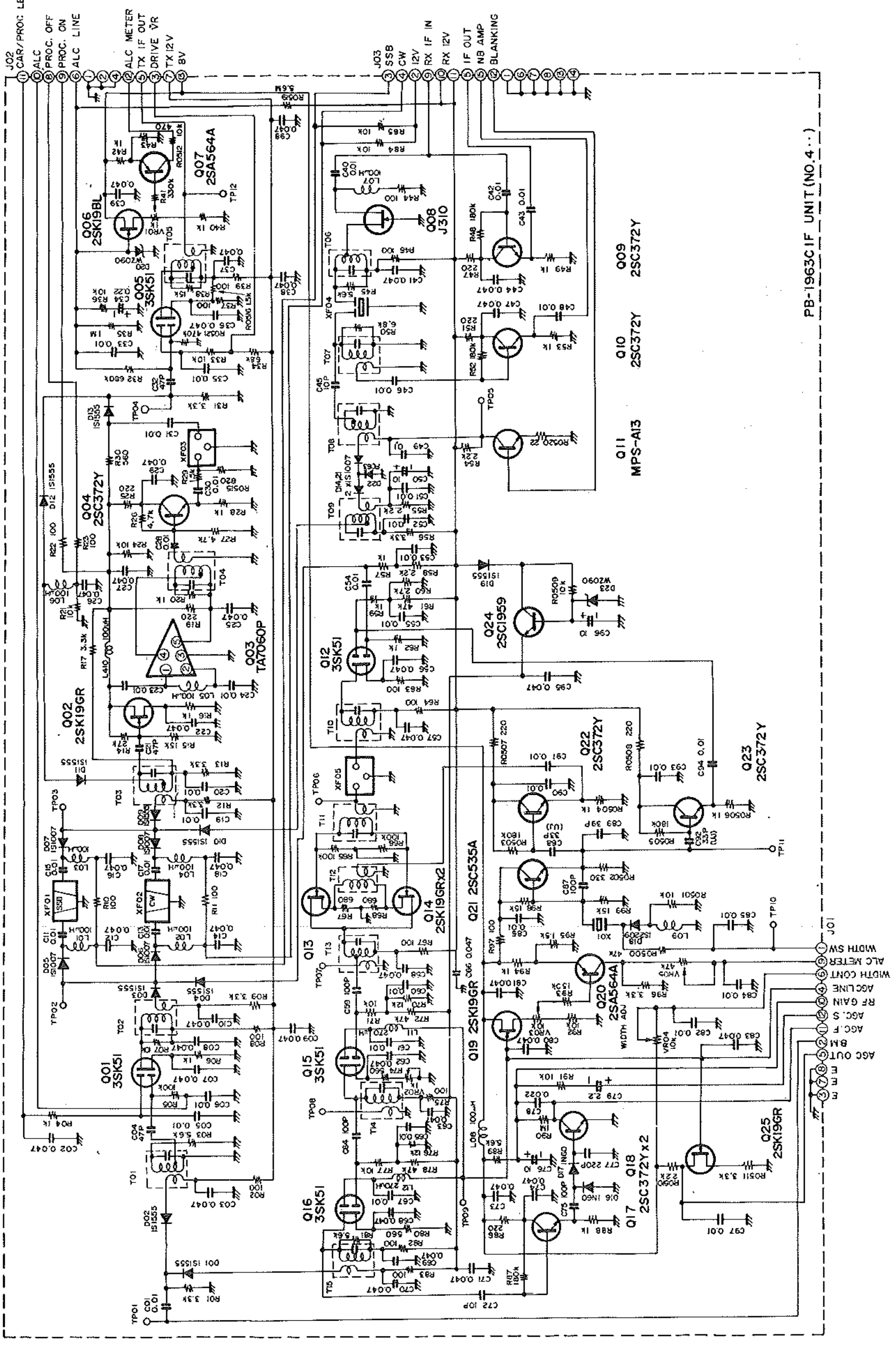


SSB, CW Filters **WIDTH Filter**



Width Control Action




PB-1963C IF UNIT (NO.4··)

NB-FIX UNIT (PB-1961)

A portion of the 8.9 MHz IF signal is fed through buffer Q_{410} (2SC372Y) and amplified by Q_{206} and Q_{205} (2SC1583).

When a carrier of noise-free modulated signal is received, the IF signal is rectified by D_{201} and D_{202} (1N60), producing a DC voltage. This DC voltage is amplified by Q_{202} (2SC372Y), which charges C_{214}, for AGC purposes. The AGC voltage is used to control the gain of Q_{206} and Q_{205}.

When impulse-type noise is received, D_{203} and D_{204} (1N60) rectify the IF signal, producing a DC voltage which controls the NB switch Q_{411} (2SC372Y).

Noise pulses have a very short duration, but high amplitude. Because of the very slow time constant of the C_{214}/R_{212} discharge path, AGC voltage is not induced by these short-duration pulses. Therefore, Q_{206} and Q_{205} operate at full gain, providing maximum voltage to the base of Q_{411}. When a pulse is received, Q_{411} biases D_{414} to block the signal path momentarily. When a desired signal and a noise pulse are received simultaneously, the blanking action is not impaired, because the relative amplitude difference between the desired signal and the noise pulse is still high. The front panel noise blanker level control varies the DC voltage applied to the base of Q_{411}.

AF UNIT (PB-1964)

The IF signal from pin 2 is fed through T_{501} to the ring demodulator, consisting of D_{502} - D_{505} (1S1007), where the IF signal is demodulated into audio, using the carrier signal delivered from Q_{503} (2SC1815Y). The carrier signal is generated by oscillator Q_{514} (2SK19GR), and it oscillates at one of the following frequencies:

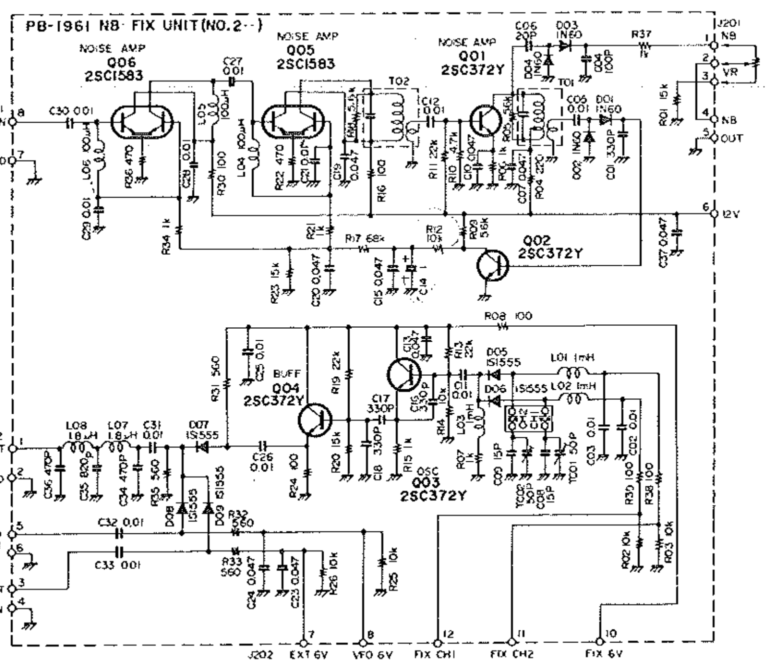
USB, CW·RX	8989 KHz
LSB	8986 KHz
CW·TX	8988.3 KHz

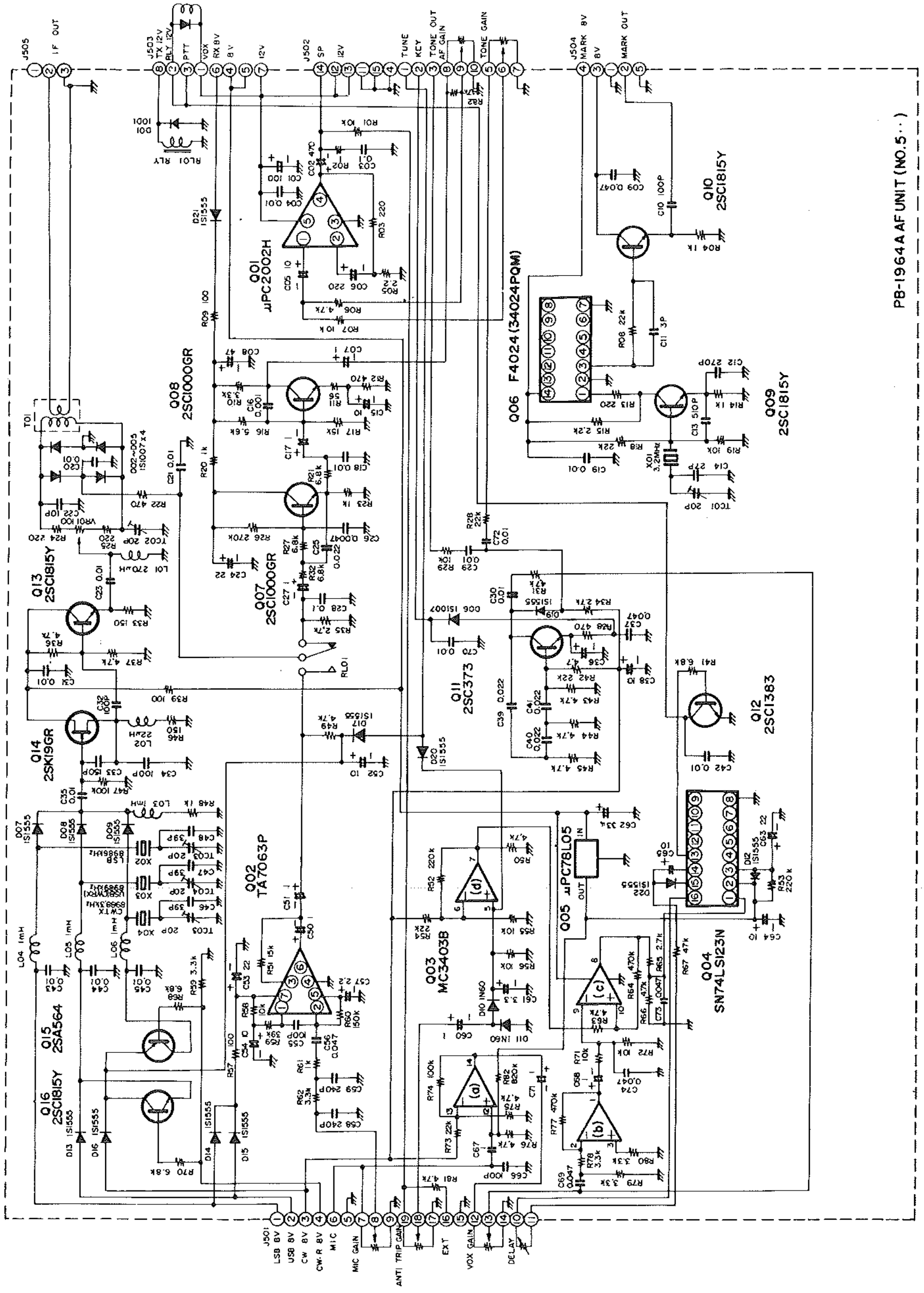
The audio signal is then amplified by audio amplifiers Q_{507}, Q_{508} (2SC1000GR), and Q_{509} (μPC2002), delivering 3 watts of audio output to the speaker.

The audio spectrum is shaped by an active low-pass filter of f_0 = 2.7 kHz, -12 dB/octave.

MARKER GENERATOR

A 25 kHz marker signal is provided, for alignment and testing purposes. Marker generator Q_{509} (2SC1815Y) generates a basic 3200 kHz signal, which is divided into 25 kHz multiples by Q_{506} (MC14024B), a binary counter.




PB-1964A AF UNIT (NO.5··)
Q01 µPC2002H
Q02 TA7063P
Q03 MC3403B
Q04 SN74LS123N
Q05 µPC78L05
Q06 F4024 (34024PQM)
Q07 2SC1000GR
Q08 2SC1000GR
Q09 2SC1815Y
Q10 2SC1815Y
Q11 2SC373
Q12 2SC1383
Q13 2SC1815Y
Q14 2SK19GR
Q15 2SA564
Q16 2SC1815Y

TRANSMIT CIRCUIT

SSB MODE

The output from microphone jack J_2 is fed through the MIC GAIN control VR_{3a} to pin 8 of the AF UNIT.

AF UNIT (PB-1964)

The speech signal from pin 8 is amplified by microphone amplifier Q_{502} **(TA7063P)** and fed through relay RL_{501} to the ring modulator, D_{502} - D_{505}, where the speech signal modulates the carrier signal delivered from Q_{513}. The resulting double sideband signal is fed to the IF UNIT.

IF UNIT (PB-1963)

The 8.9875 MHz double sideband signal is amplified by Q_{401} **(3SK51-03)** and passed through sideband filter XF_{401} by diode switches D_{403}, D_{409} **(1S1555)**, D_{405}, and D_{407} **(1S1007)**. Here the signal is converted to a single sideband signal by removal of the unwanted sideband.

The signal is then fed to buffer amplifier Q_{402} **(2SK19GR)**. When the RF speech processor is OFF, diode switches D_{411} and D_{412} **(1S1555)** feed the IF signal to IF amplifier Q_{405} **(3SK51-03)**. When the RF speech processor is ON, the SSB signal is amplified by buffer amplifier Q_{402} **(2SK19GR)** and further amplified by limiter Q_{403} **(TA7060P)**, where signals that exceed the preset clipping level are sliced out.

This highly clipped SSB signal is amplified by buffer amplifier Q_{404} **(2SC372Y)** and passed through a selective filter, XF_{403}, which removes RF harmonics that result from signal clipping. The signal is then fed to IF amplifier Q_{405}, and subsequently delivered to the RF UNIT. The front panel COMP LEVEL control, VR_4, controls the voltage at gate 2 of Q_{401}, thus setting the processor level.

The return of the grid circuit of the final amplifier tubes is fed to Q_{406} **(2SK19BL)**, which produces ALC voltage. This voltage is fed to gate 1 of Q_{405}, controlling the gain of this stage. When the RF processor is off, ALC voltage is also fed to gate 1 of Q_{401}. Q_{407} **(2SA564)** amplifies the ALC voltage for indication on the front panel meter.

RF UNIT (PB-1960)

The IF signal is fed through T_{104} to the transmit mixer, consisting of parallel-connected Q_{105} and Q_{106} **(3SK40M)**, where the IF signal at gate 1 is mixed with the local signal fed to gate 2, producing the RF output signal. The RF signal is then fed through diode switch D_{104} **(1S1007)** to the DRIVE UNIT.

DRIVE UNIT (PB-1714), PA UNIT (PB-1715)

The RF signal is amplified by driver V_{1601} **(12BY7A)**, and delivered to PA UNIT final amplifier tubes V_{1701} and V_{1702} **(6146B)**. The output from the final tubes is fed to the antenna jack.

A portion of the RF signal is coupled through C_{14} to the cathode of the 12BY7A driver, for the purpose of improving the linearity of the final amplifier. This technique is known as RF negative feedback.

CW MODE

For CW, the 8.9883 MHz carrier is generated by oscillator Q_{514} at the frequency set by X_{504}. The carrier signal is fed through buffer Q_{513} and fed to the ring modulator. The same carrier frequency is used in the tune mode.

DC voltage is applied through diode switch D_{517} **(1S1555)** and relay RL_{501}, unbalancing the ring modulator for CW operation. The carrier signal is then fed to the IF UNIT. The signal path is identical to that on SSB, up to the DRIVE UNIT.

DRIVE UNIT (PB-1714), PA UNIT (PB-1715)

Keying of the transmitter is accomplished by changing the bias voltage to the driver and final tubes. During "key up," the tubes are cut off by application of -35 volts to V_{1601} and -110 volts to V_{1701} and V_{1702}. These cutoff voltages are reduced to –0.1 volt and –60 volts, respectively, during "key down" conditions.

The key is connected to the KEY 2 terminal on the RECT B board, PB-1968. When the key is closed, the base of Q_{1001} (2SA733) is grounded, causing Q_{1002} (2SC372Y) to conduct. The base of Q_{1003} (2SA639) is thus set to 0 when the transistor conducts. Under these circumstances, the bias voltage applied to V_{1601}, V_{1701}, and V_{1702} places these tubes in the normal operating condition.

VOX circuit

A portion of the microphone input signal is amplified by three stages of Q_{503} (MC3403P), which drive the VOX control gate, Q_{504} (SN74LS123N). The output from pin 13 of Q_{504} is fed to the base of Q_{512} (2SC1383), switching the VOX relay on and off according to the presence or absence of a speech signal.

A portion of the speaker output is detected by D_{510} and D_{511} (1N60), providing a bucking voltage which is fed to Q_{503}, preventing the speaker output from tripping the VOX.

The VOX delay may be set by adjusting VR_{2b} for the desired delay time.

CW SIDETONE

CW sidetone oscillator Q_{511} (2SC373) oscillates at a frequency of approximately 800 Hz. The output from Q_{511} is amplified by the final audio amplifier, Q_{501}, for delivery to the speaker. The output from the sidetone oscillator is also fed to VOX amplifier Q_{503}, providing semi-break-in operation for CW.

AM MODE

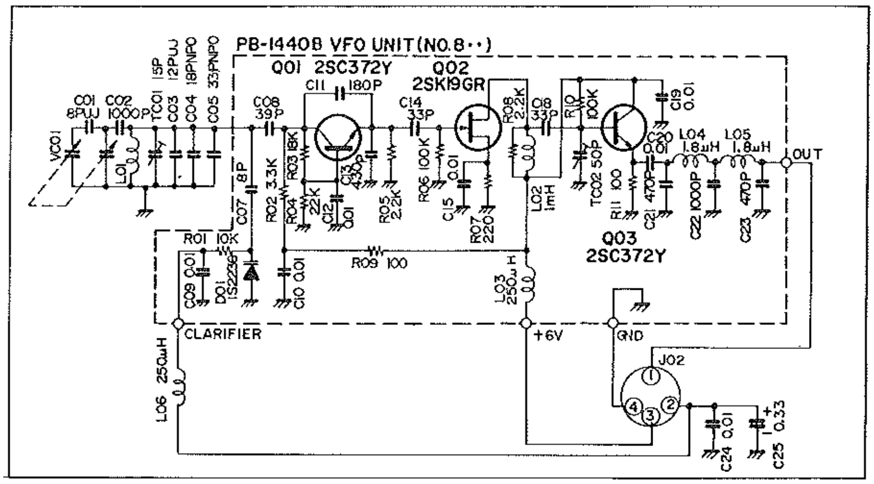
The speech signal from the microphone is amplified by Q_{2401} (2SC732GR) and Q_{2402} (2SC1815Y) and passed to modulator Q_{2405} (2SC380Y), where the speech signal modulates the AM carrier signal at 8988.3 kHz delivered from Q_{2404} (2SK19GR). The modulated signal is amplified by Q_{2406} (3SK51) and delivered to transmit mixer Q_{105}/Q_{106}.

COMMON CIRCUITS

VFO UNIT (PB-1440B-3420)

A modified Colpitts-type oscillator is used to generate a 5.0 - 5.5 MHz VFO signal, thus producing a 500 kHz tuning range. The oscillator signal generated by Q_{801} (2SC372Y) is varied by VC_{801}, which is geared to a precision-built dial tuning mechanism. VC_{801} consists of two sections; the sub-blades compensate for the capacitance variation of the main blades, which may result from extreme temperature change.

Varactor diode D_{801} (1S2209) may be varied by tuning L_{806}, providing ±2.5 kHz offset from the dial frequency (clarifier).



The VFO signal is amplified by buffer amplifiers Q_{802} (2SK19GR) and Q_{803} (2SC372Y), and passed to the PREMIX UNIT.

NB & FIX UNIT (PB-1961)

Two crystal-controlled channels are provided for operation with this transceiver. The oscillator signal is generated by Q_{203} (2SC372Y) and amplified by Q_{204} (2SC372Y), and delivered to the PREMIX UNIT. Crystals X_{201} and X_{202} oscillate in the 5.0 - 5.5 MHz range.

PREMIX LOCAL UNIT (PB-1711)

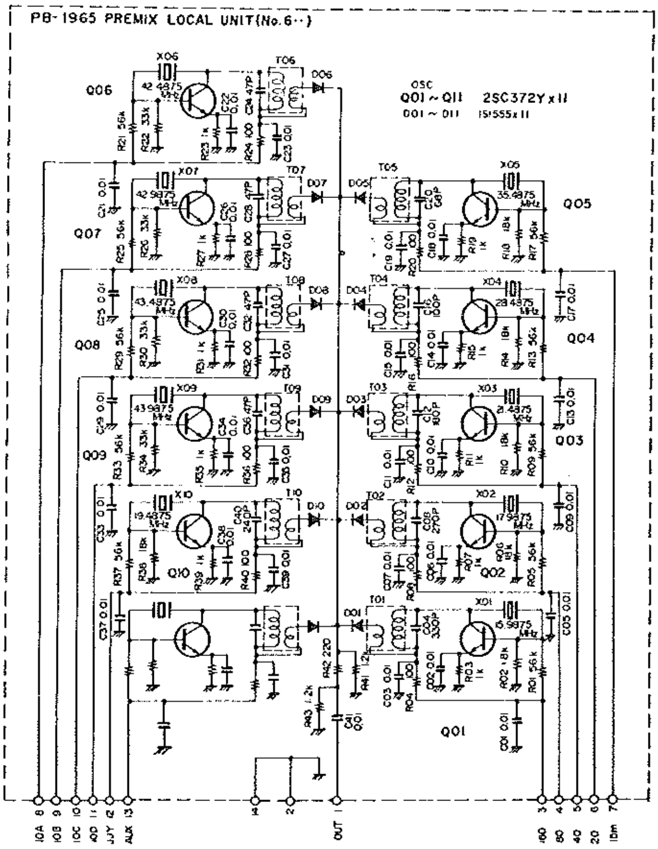
Crystal oscillators Q_{601} - Q_{610} (2SC372Y) generate the premix local signal at the frequencies shown in Table 3. Diode switches D_{601} - D_{610} (1S1555) select the proper local signal for the band in use. The local signal is then delivered to the PREMIX UNIT.

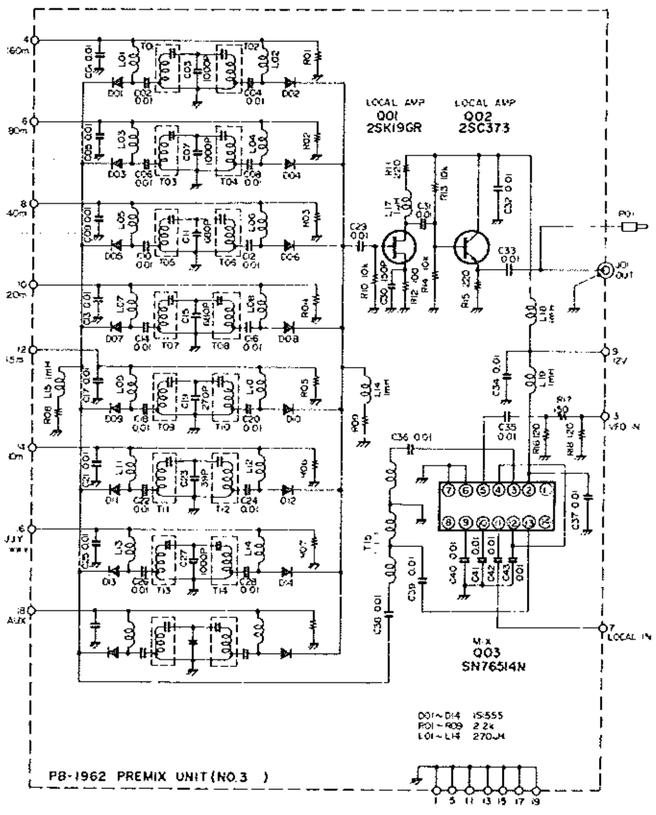
PREMIX UNIT (PB-1962)

The premix signal is produced at Q_{303} (SN76514N), a double-balanced mixer, where the premix local signal from Q_{601} - Q_{610} is mixed with the VFO or crystal controlled 5 MHz signal. The premix output frequencies are shown in Table 3. The premix signal is passed through bandpass filter T_{301} - T_{304}, and amplified by Q_{301} (2SK19GR) and Q_{302} (2SC373). The amplified signal is then fed to the RF UNIT, where the signal is further amplified by Q_{107} for delivery to the transmitter and receiver mixers.

		XCO Frequency	PREMIX OUT Frequency
160m	X_{601}	15.9875MHz	10.4875~10.9875MHz
80m	X_{602}	17.9875MHz	12.4875~12.9875MHz
40m	X_{603}	21.4875MHz	15.9875~16.4875MHz
20m	X_{604}	28.4875MHz	22.9875~23.4875MHz
15m	X_{605}	35.4875MHz	29.9875~30.4875MHz
10mA	X_{606}	42.4875MHz	36.9875~37.4875MHz
10mB	X_{607}	42.9875MHz	37.4875~37.9875MHz
10mC	X_{608}	43.4875MHz	37.9875~38.4875MHz
10mD	X_{609}	43.9875MHz	38.4875~38.9875MHz
JJY/WWV	X_{610}	19.4875MHz	13.9875~14.4875MHz

Table 3





COUNTER UNIT (PB-1978, PB-1979, PB-1980)

The premix local signal from the PREMIX LOCAL circuit is fed to amplifier Q_{2301} **(3SK51-03)**, located on PB-1980. The amplified signal is then fed to waveshaper Q_{2302} **(MC10116)**. Q_{2303} **(MPS3640)** acts as an interface between Q_{2302} and the TTL circuitry. The signal is then fed to the counter gate, Q_{2304} **(SN74S00N)**.

The clock pulses are generated by Q_{2305} **(MSM5564)**, which produces a 655.36 MHz signal. The signal is divided by a factor of 2^{17}, producing a 5 Hz signal which is fed to the counter gate.

The pulses which pass through the gate are fed to decade counter Q_{2309} **(SN74196N)**, which counts 10 Hz digits. In turn, Q_{2302} - Q_{2307} **(SN74LS196N)** count 100 Hz, 1 kHz, 10 kHz, 100 kHz, 1 MHz, and 10 MHz digits. The BCD output signal from Q_{2302} - Q_{2307} is fed through drivers Q_{2208} - Q_{1213} **(MSM561)** to the display digits, DS_{2101} - DS_{2106} **(HP 5082-7623)**.

The system of presetting the counter can best be explained by example. For a frequency of 3.500 MHz LSB, the premix local frequency is 12.486 MHz. The LSB preset code is 91.014.0. 12.486 + 91.0140.0 = 103.500. The "1" digit on the left-hand side is dropped (overflow), and the "0" preceeding the "3" causes a blanking signal to be sent to the 10 MHz digit. The result is a frequency of 3.500 MHz, and this number is displayed.

For USB, the preset number is 91.011.0. For a frequency of 14.000 MHz USB, the manipulation is as follows: 91.011 + 22.989 (Premix freq.) = 114.000. The first digit is the overflow digit, and the remaining digits are displayed. Note that the second digit from the left is not zero, so no blanking signal is sent to the 10 MHz digit.

For a CW or AM frequency of 21.000 MHz, the premix frequency is 29.9883, and the preset frequency is 91.011.7. The manipulation is: 91.011.7 + 29.9883 = 121.0000. The first digit is dropped, and the remaining digits are displayed.

The preset frequencies are programmed by Q_{2307} and Q_{2308} **(μPA54H)** and diode matrix D_{2306} - D_{2312} **(1S1555)**. Please refer to Table 5 for definition of the premix frequencies for the various bands.

The 5 volt supply is regulated by Q_{2310} **(μPC 14305)** for the TTL circuitry. The DIM control controls the emitter/collector voltage at Q_{2201} **(2SA496Y)**, to control the brightness of the digital display and lamps.

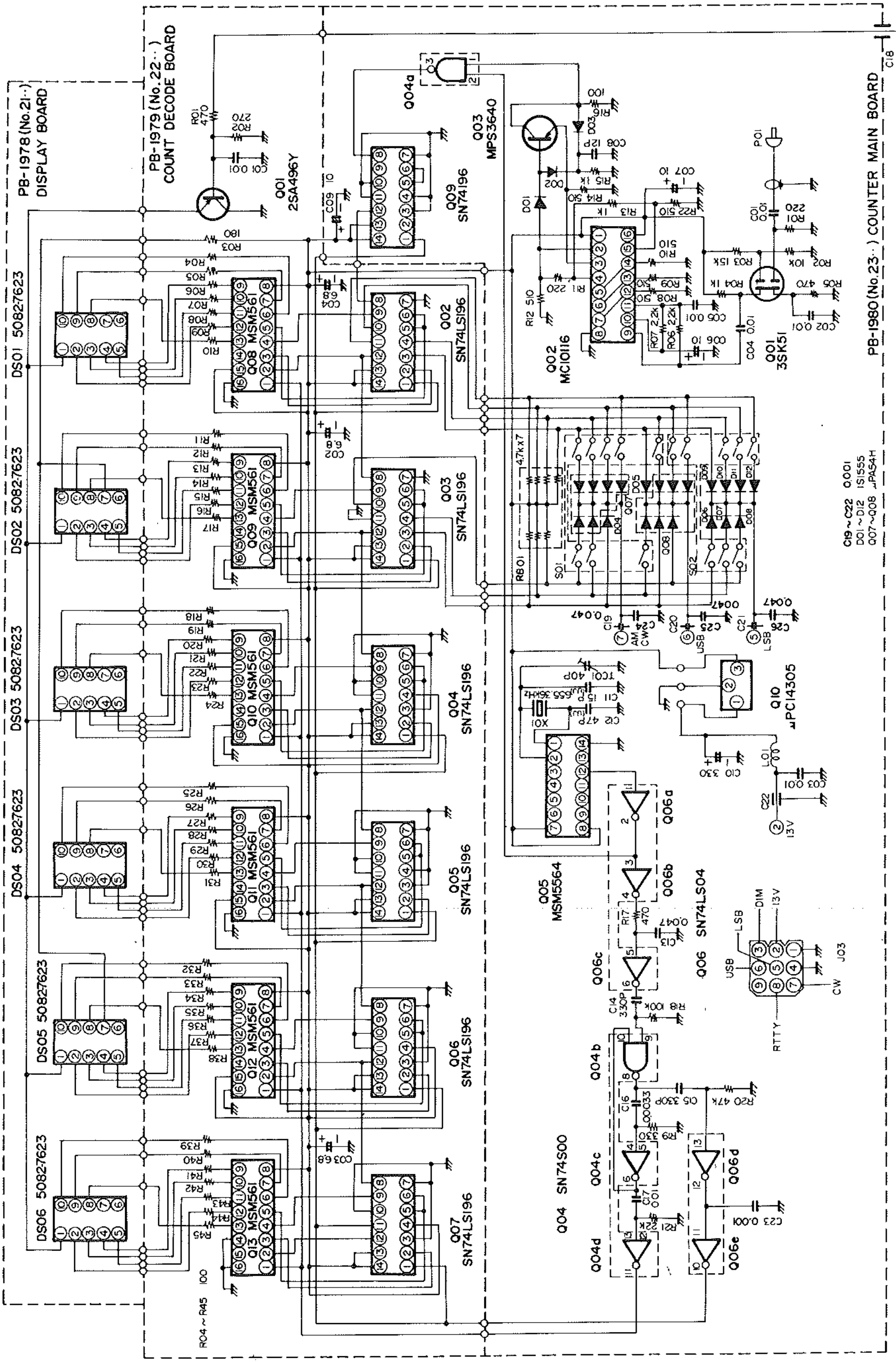
	10MHz	1MHz	100kHz	10kHz	1kHz	100Hz
	(Q_{2207})	(Q_{2206})	(Q_{2205})	(Q_{2204})	(Q_{2203})	(Q_{2202})
LSB	9	1	0	1	4	0
USB	9	1	0	1	1	0
CW AM	9	1	0	1	1	7

Preset Number

Table 4

	Nominal Premix Local Frequency	LSB	USB	CW / AM
160m	10.4875 – 10.9875(MHz)	10.486 – 10.986(MHz)	10.489 – 10.989(MHz)	10.4883 – 10.9883(MHz)
80m	12.4875 – 12.9875	12.486 – 12.986	12.489 – 12.989	12.4883 – 12.9883
40m	15.9875 – 16.4875	15.986 – 16.486	15.989 – 16.489	15.9883 – 16.4883
20m	22.9875 – 23.4875	22.986 – 23.486	22.989 – 23.489	22.9883 – 23.4883
15m	29.9875 – 30.4875	29.986 – 30.486	29.989 – 30.489	29.9883 – 30.4883
10mA	36.9875 – 37.4875	36.986 – 37.486	36.989 – 37.489	36.9883 – 37.4883
10mB	37.4875 – 37.9875	37.486 – 37.986	37.489 – 37.989	37.4883 – 37.9883
10mC	37.9875 – 38.4875	37.986 – 38.486	37.989 – 38.489	37.9883 – 38.4883
10mD	38.4875 – 38.9875	38.486 – 38.986	38.489 – 38.989	38.4883 – 38.9883

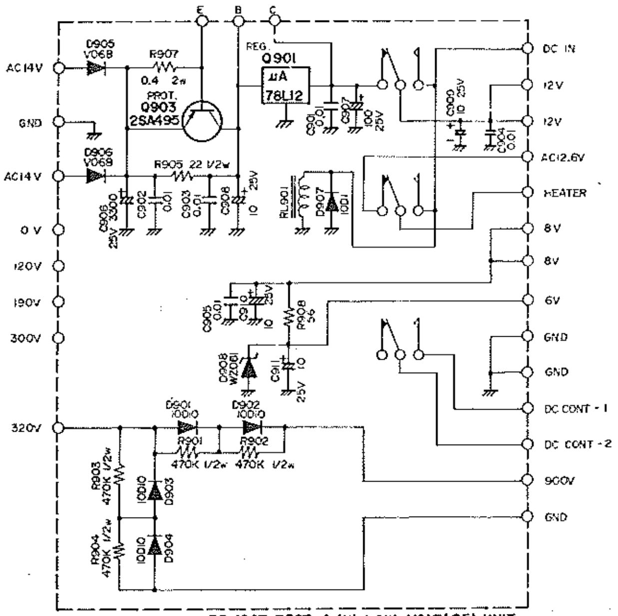
Table 5


PB-1978 (No.21··) DISPLAY BOARD
PB-1979 (No.22··) COUNT DECODE BOARD
PB-1980 (No.23··) COUNTER MAIN BOARD

POWER SUPPLY

The power supply is designed to operate from 100/110/117/200/220/234 volts AC. A DC-DC converter is an available option, providing operation from 13.5 volts DC. Insertion of the appropriate power plug into the rear panel receptacle makes the necessary connections for AC or DC operation.

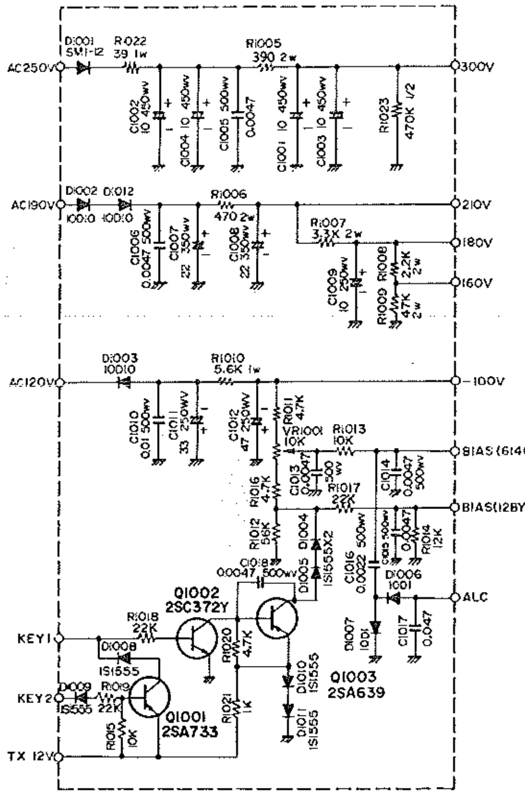
When the transceiver is operated from a DC 13.5 volt power source, using the optional DC-DC converter, transistors Q_{3201} and Q_{3202} **(T20A6)** function as a low frequency oscillator, providing AC voltage at approximately 80 Hz to the power transformer. All of the tube heaters receive their power through the HEATER switch on the front panel. When the HEATER switch is OFF, voltage is still supplied to the receiver section, thus allowing continuous reception with reduced power consumption. The heaters of the two 6146B are connected in series to operate at 12 volts DC.



PB-1967 RECT. A (HI-LOW VOLTAGE) UNIT

The 14 volt AC power delivered from the secondary winding of the power transformer is rectified by D_{905} and D_{906} **(V06B)**. Voltage regulators Q_1 **(2SB616)**, Q_{901} **(78L12)**, and Q_{903} **(2SA495)** stabilize the DC supply at 12 volts. The supply voltage is further stabilized at 8 volts by Q_3 **(μPC14308)** for delivery to the counter, AF, and other units. The 6 volt supply for the VFO is provided through zener diode D_{908} **(WZ061)**, while the 5 volt supply for the TTL integrated circuits is provided by Q_{505} **(78L05)**.

The power amplifier plate voltage of +800 volts is supplied from the bridge-controlled doubler, located on the RECT. A UNIT, and consisting of D_{901} - D_{904} **(10D10)**.



PB-1968 RECT. B(M.BIAS VOLTAGE) UNIT

AC 190 volts is rectified by D_{1002} **(10D10)**, producing 210 volts for the screen grid supply of the power amplifier tubes. The screen grid voltage for the driver tube is obtained by rectifying 250 volts AC at D_{1001} **(10D10)**, producing 300 volts. This voltage is dropped to 180 volts by a resistor for delivery to the driver tube screen grid.

The 120 volt AC power from the transformer secondary winding is rectified by D_{1003} **(10D10)** in order to obtain -140 volts for the driver and final amplifier tube grid bias.