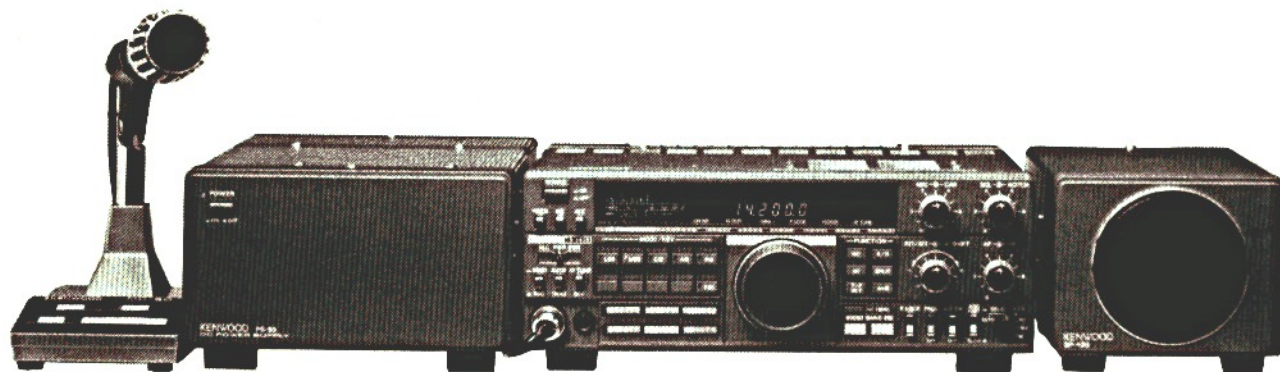


KENWOOD

SERVICE MANUAL

TS-440S PS-50, PS-430, SP-430, MB-430, VS-1 AT-440, YK-88C/CN, YK-88S/SN

HF TRANCEIVER



CONTENTS

SPECIFICATIONS	2	PACKING	88
CIRCUIT DESCRIPTION	4	ADJUSTMENT	89
SEMICONDUCTORS	27	LEVEL DIAGRAM	101
PARTS LIST	35	BLOCK DIAGRAM	103
PC BOARD SCHEMATIC DIAGRAM		OPTION	
SWITCH UNIT	69	PS-50	104
FILTER UNIT	70, 71	PS-430	109
PLL UNIT	72, 73	VS-1	111
RF UNIT	74, 75	SP-430	114
CONTROL UNIT	76, 77	MB-430	114
DISPLAY UNIT	76, 77	AT-440	114
FINAL UNIT	78	YK-88S/SN	114
IF UNIT	78, 79	YK-88C/CN	114
AT UNIT	80	SCHEMATIC DIAGRAM	113
DISASSEMBLY	81		

SPECIFICATIONS

(GENERAL)

Transmitter frequency range:

160m BAND 1.8 ~ 2.0MHz
 80m BAND 3.5 ~ 4.0MHz
 40m BAND 7.0 ~ 7.3MHz
 30m BAND 10.1 ~ 10.15MHz
 20m BAND 14.0 ~ 14.35MHz
 17m BAND 18.068 ~ 18.168MHz
 15m BAND 21.0 ~ 21.45MHz
 12m BAND 24.89 ~ 24.99MHz
 10m BAND 28.0 ~ 29.7MHz

Receive frequency range:

100kHz ~ 30MHz

Mode:

A1(CW), A3J(SSB), A3(AM), F1(FSK), F3(FM)

Antenna impedance:

50 Ohm (TX: 20 ~ 150 Ohm with AT)

Power requirement:

12.0 ~ 16.0V DC

Power consumption:

RX no signal input:

Approx. 1.9A

TX:

Approx. 20A

Frequency configuration:

RX unit:

1st IF 45.05MHz, 2nd IF 8.83MHz, 3rd IF 455kHz

**TX unit: (A1,A3J,A3,FSK)
(F3)**

1st IF 455kHz, 2nd IF 8.83MHz, 3rd IF 45.05MHz

1st IF 36.22MHz, 2nd IF 45.05MHz

CW, SSB, AM, FSK, FM: Triple conversion superheterodyne

FM: Double conversion superheterodyne

Semiconductors:

	TS-440S	TS-440S (with AT)
Tr's	157	174
FET's	22	22
IC's	49	58
Diod's	257	277

Dimensions:

	TS-440S	TS-440S (with AT)
W(mm)	270 (279)	270 (279)
H(mm)	96 (108)	96 (108)
D(mm)	313 (335)	313 (335)
Weight(kg)	6.3	7.3

The numbers in the parenthesis include protections.

(TRANSMITTER)

Rated final power input:

Band \ Mode	A1, A3J, F1, F3	A3
1.8 ~ 28 MHz	200 W PEP	110 W PEP

Carrier suppression:

More than 40dB

Unwanted sideband suppression:

More than 50dB

Harmonic content:

Less than -40dB

Transmit frequency character:

400 ~ 2600Hz (-6dB)

Maximum frequency deviation (FM):

±5kHz

Microphone impedance:

500Ω ~ 50kΩ

SPECIFICATIONS

(RECEIVER)

Sensitivity:

Mode \ Freq.	100 ~ 150kHz	150 ~ 500kHz	0.5 ~ 1.6MHz	1.6 ~ 30MHz
SSB,CW,FSK (S/N10dB)	Less than 2.5 μ V (8dB μ)	Less than 1 μ V (0dB μ)	Less than 4 μ V (12dB μ)	Less than 0.25 μ V (-12dB μ)
AM (S/N10dB)	Less than 25 μ V (28dB μ)	Less than 13 μ V (22dB μ)	Less than 40 μ V (32dB μ)	Less than 2.5 μ V (8dB μ)
FM (12dB SINAD)	—	—	—	Less than 0.7 μ V (-3 dB μ)

Squelch sensitivity: (Threshold)

Mode \ Freq.	100 ~ 150kHz	150 ~ 500kHz	0.5 ~ 1.6MHz	1.6 ~ 30MHz
SSB,CW,AM,FSK	Less than 20 μ V (26dB μ)	Less than 10 μ V (20dB μ)	Less than 20 μ V (26dB μ)	Less than 2 μ V (6dB μ)
FM	—	—	—	Less than 0.32 μ V (-10dB μ)

Image ratio:

50dB or more (100kHz ~ 1.6MHz)

70dB or more (1.6 ~ 30MHz)

IF rejection:

50dB or more (FM 3rd image ratio)

50dB or more (100kHz ~ 1.6MHz)

70dB or more (1.6MHz ~ 30MHz)

Selectivity:

Mode \ Freq.	-6dB	-60dB
SB,CW,FSK	More than 2kHz	Less than 4.4kHz
AM	More than 4kHz	Less than 18kHz (-50dB)
FM	More than 12kHz	Less than 25kHz (-50dB)

IF SHIFT variable range:

 ± 0.9 kHz or more

RIT/XIT variable range:

 ± 1 kHz or more

Audio output power:

1.5W or more (with 8 Ω load, 10% distortion)

Audio output impedance

4 ~ 16 Ω (Speaker and headphone)

(FREQUENCY STABILITY)

Frequency accuracy: (RIT/XIT OFF)

More than $\pm 10 \times 10^{-6}$

Frequency stability:

More than $\pm 10 \times 10^{-6}$ (-10°C to 50°C)

(RIT/XIT OFF: at receive)

Reference oscillator frequency:

36MHz

Note: Circuit and ratings subject to change without notice due to developments in technology.

CIRCUIT DESCRIPTION

1. Overview

- The TS-440 is a triple conversion type transceiver, incorporating a general coverage receiver, which uses 45.05 MHz as the first IF, 8.83 MHz as the second IF, and 455 kHz as the third IF.
- The TS-440 is compact, but allows for installation of an optional internal automatic antenna tuner operating in the amateur band from 3.5 MHz to 28 MHz and enables a wide range of antennas to be used.
- The TS-440 also contains a microprocessor-controlled digital PLL circuit which controls frequency in 10 Hz steps using a single crystal oscillator to implement high accuracy and stable frequency control.
- The TS-440 has the following major features:
 - (1) Selectable VFOs; VFO-A and VFO-B
 - (2) Direct frequency input using a numeric keypad
 - (3) 100-channel memory containing frequency band, and mode information (channel 90 to 99 for split frequency memory)

- (4) Memory scan in 10 channel groups and two types of program scan
- (5) RTTY (AFSK) mode available
- (6) Squelch circuit operational in all modes
- (7) Dual filters available to improve selectivity and S/N ratio (optional filter required)
- (8) IF shift, audio notch, IF filter switching, and RF ATT functions for convenient interference reduction
- (9) Large heat sink and cooling fan (100 W) enabling up to one-hour continuous transmit operation
- (10) Full and semi break-in circuits for CW
- (11) External-computer controllable (optional interface required)
- (12) Many easy-to-read meter functions such as the received signal strength (s-meter), transmitter power, SWR, and ALC level.

2. Frequency Elements

The TS-440 utilizes a triple conversion transmitter and receiver.

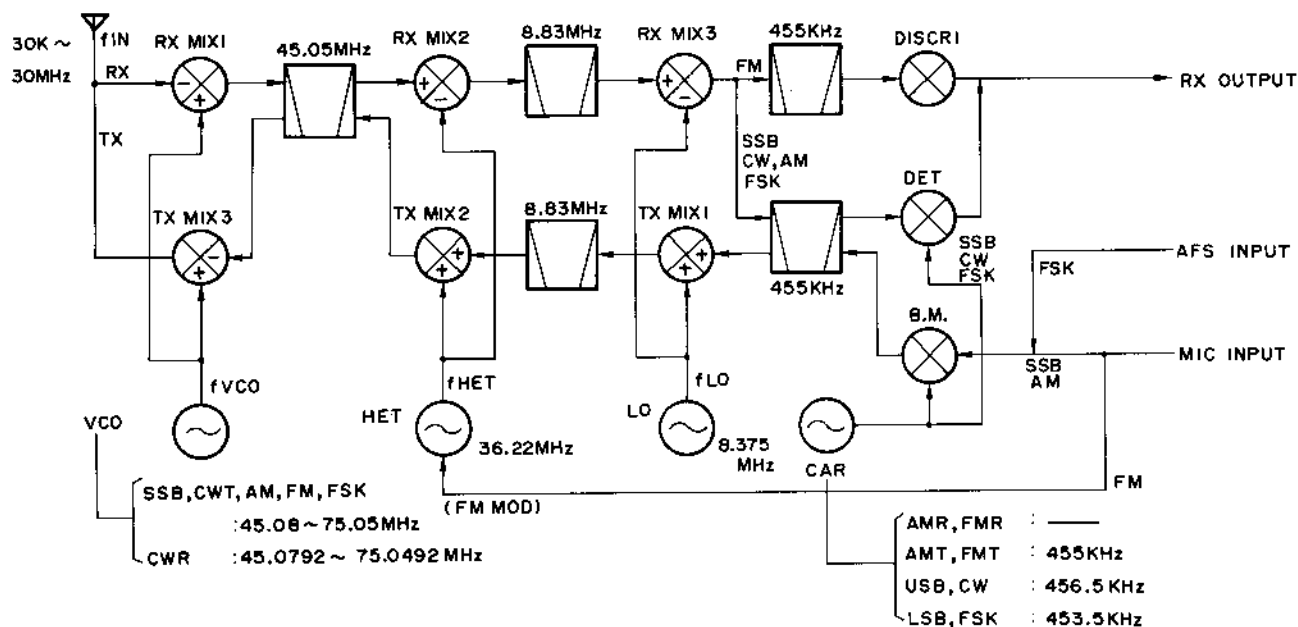


Fig. 1 Frequency configuration

The overall frequency configuration of the TS-440 is shown in Figure 1. The incoming received signal (f_{IN}) is applied to the ANT terminal. This signal is mixed with the local oscillator signal (f_{VCO}) in RX MIX 1 to obtain the first IF frequency. This signal is then mixed with the HET Oscillator signal (f_{HET}) in RX MIX 2 to obtain the 2nd IF frequency. The signal is then mixed with the LO signal (f_{LO}) in RX MIX 3 to obtain the 3rd IF frequency. The signal is then combined with the CAR signal for detection. f_{IN} is expressed mathematically as follows:

tor frequency (f_{LO}) to obtain the 3rd IF frequency. The signal is then combined with the CAR signal for detection. f_{IN} is expressed mathematically as follows:

$$f_{IN} = f_{VCO} - f_{HET} - f_{LO} - f_{CAR} \dots \dots \dots 1$$

CIRCUIT DESCRIPTION

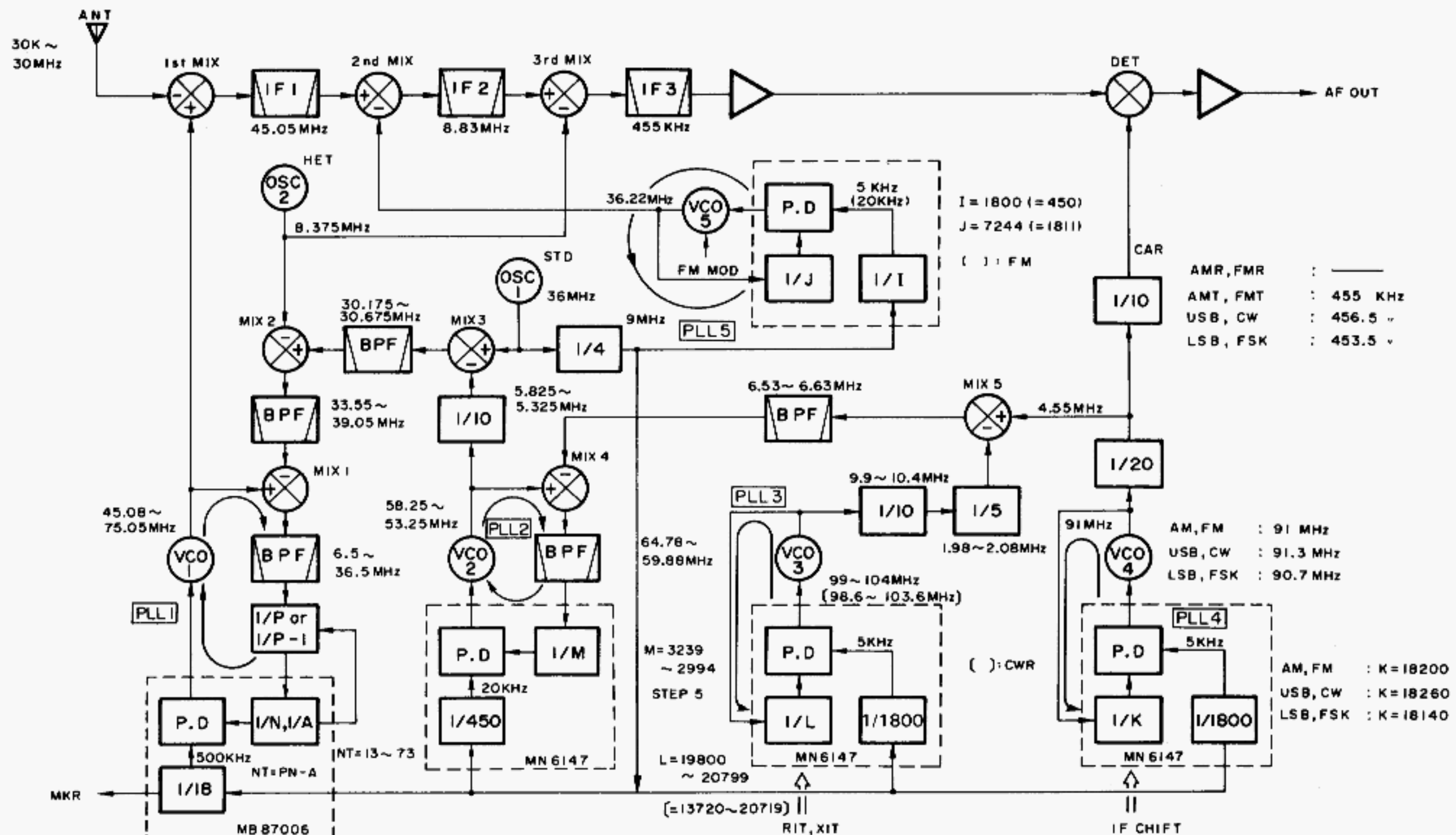


Fig. 2 PLL frequency configuration

As shown in figure 2, all received frequencies excluding the local oscillator frequency f_{LO} are generated in the PLL circuit. The frequencies generated in these loops are expressed as follows:

$$VCO5: \frac{f_{VCO5}}{J} = \frac{1}{4} \cdot f_{STD} \quad \therefore f_{VCO5} = \frac{J}{4I} \cdot f_{STD} \quad \dots 2$$

$$VCO4: \frac{f_{VCO4}}{K} = \frac{1}{4} \cdot f_{STD} \quad \therefore f_{VCO4} = \frac{K}{7200} \cdot f_{STD} \quad \dots 3$$

$$VCO3: \frac{f_{VCO3}}{L} = \frac{1}{4} \cdot f_{STD} \quad \therefore f_{VCO3} = \frac{L}{7200} \cdot f_{STD} \quad \dots 4$$

$$VCO2: \frac{f_{VCO2} + \frac{f_{VCO3}}{50} + \frac{f_{VCO4}}{20}}{M} = \frac{1}{4} \cdot f_{STD}$$

$$\therefore f_{VCO2} = \frac{M}{1800} \cdot f_{STD} - \frac{f_{VCO3}}{50} - \frac{f_{VCO4}}{20} \quad \dots 5$$

$$VCO1: \frac{f_{VCO1} - f_{LO} - f_{STD} + \frac{f_{VCO2}}{10}}{N} = \frac{1}{4} \cdot f_{STD}$$

$$\therefore f_{VCO1} = \frac{N}{72} \cdot f_{STD} + f_{LO} + f_{STD} - \frac{f_{VCO2}}{10} \quad \dots 6$$

Based on these formulas, the frequencies f_{VCO} , f_{HET} , and f_{CAR} are expressed as follows:

CIRCUIT DESCRIPTION

3. Transmitter Circuit Description

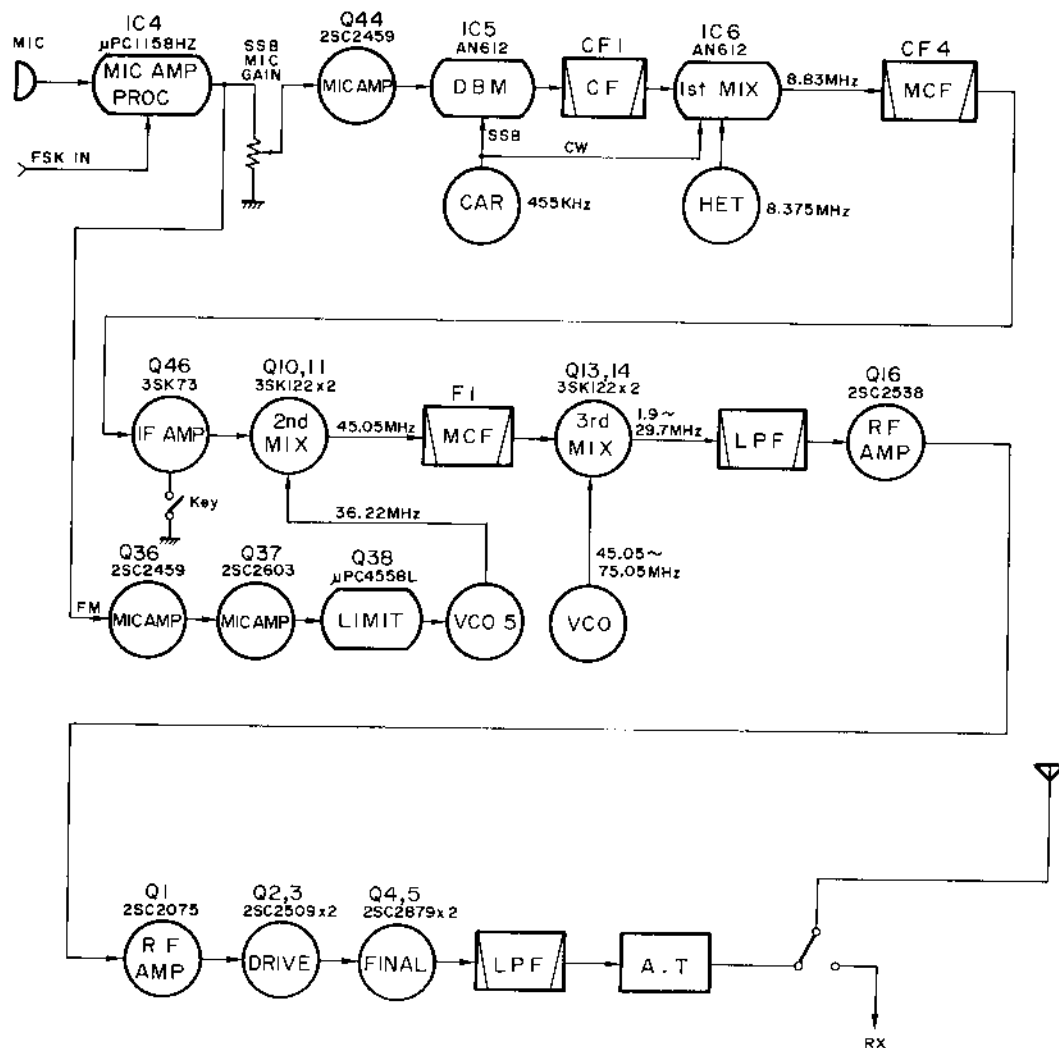


Fig. 6 Transmitter circuit configuration

In SSB, CW, AM, or FSK mode, the transmitter system uses triple conversion. In FM mode, the transmitter system uses double conversion using PLL modulation.

Audio signals from the microphone are applied to the MIC pin (connector (21)) of the IF unit and are separated into SSB modulation and VOX signals. The SSB signal is amplified approx. 8 dB by IC4 (μPC1158HZ). AFSK audio signals from the AFSK IN pin (back panel) are also applied to IC4.

IC4 functions as a SPEECH processor. Output from IC4 is distributed to the MIC GAIN control (front panel) and FM circuit (RF unit). In SSB mode, the signal applied to the MIC GAIN control is sent back to the IF unit (connector (23) MV2), amplified by Q44 (2SC2459), and supplied to the balanced modulator IC5 (AN612). In FM or CW mode, Q44 does not operate because a cut-off voltage is supplied to its emitter via diodes D82 and D46. The signal converted to 455 kHz

CIRCUIT DESCRIPTION

DSB by IC4 goes through the SSB transmit switching diodes D17 and D18, filter switching diodes D14 and D12, and SSB ceramic filter CF1, to obtain the SSB signal. The SSB signal then goes through the transmit switching diode D36 and is fed into the transmit first mixer, IC6, where the SSB signal is mixed with the output from the 8.375 MHz oscillator in the IF unit, and converted to 8.83 MHz. In CW or FM mode, the carrier signal from the PLL unit does not go through IC5 BM or the 455 kHz filter. These carrier signals are applied to IC6 via switching diodes D53 and D54. The output signal from IC6 goes through the MCF to remove spurious components, and is amplified by the IF amplifier Q46 (3SK73) and sent to the RF unit. Q46 provides ALC control and CW keying.

In the transmitter second mixer, consisting of Q11 and Q12, (3SK122), the 8.83 MHz transmit IF signal input to the RF unit is mixed with HET oscillator signal (36.22 MHz) from the PLL unit and converted to 45.05 MHz signals. The 45.05 MHz signal goes through D23 and the MCF to remove any spurious components. The 45.05 MHz signal then goes through D27 and is supplied to the transmit third mixer consisting of Q13 and Q14 (3SK122). In the third mixer the signal is mixed with VCO signal (Q21 to Q24) amplified by Q12 (2SC2668) and converted to the required transmit frequency (1.8 to 29.7 MHz). The signal from the third mixer goes through the low pass filters C156, C158, C159, and L89, and is amplified by the wide band amplifier Q15 (2SC2570). The signal then goes through the wide band transformer T19 and low pass filters C164, C165, and L90, and is further amplified by wide band amplifier Q16 (2SC2538). The signal from the Q16 goes through the output transformer T20 and is used as the drive output.

In FM mode, the PLL VCO is directly modulated. The audio signal from IF unit IC4 (UPC1158HZ) is fed into the RF unit via the FMI pin. In the RF unit, the audio signal is amplified by Q36 (2SC2459) and Q37 (2SC2603), and goes through the limiter circuit consisting of Q38 (UPC4558C) and low pass filter circuit, and is sent to the PLL unit via the FMD pin. In the PLL unit, the 36.22 MHz VCO is modulated. Q39 (2SC2603) is a switching circuit to prevent the modulated signals from being emitted from the PLL unit in a mode other than FM.

For "S" model radios the output from the RF unit is amplified to a 100 W power level by Q1 (2SC2075), Q2 and Q3 (2SC2509), and Q4 and Q5 (2SC2879) in the final unit. The 100 W output goes through the LPFs which differ by bands, and is sent as output to the antenna via the AT unit and transmit/receive switching relay. SWR and ALC detection is performed at the output of the LPFs.

1) Antenna tuner

The antenna tuner operates when the AUTO/THRU switch is in the AUTO position and the AT TUNE switch is ON. The antenna tuner is driven in the CW mode and power is reduced to 50 W by the microcomputer regardless of the mode selected before the AT TUNE switch was turned ON. The range of operating frequencies is determined by a microcomputer program, and is from 3.5 MHz to 30 MHz.

• AT unit operation

Power transmitted by the final unit passes through the current and voltage detecting transformers L1 and L2 using toroidal cores. Current and voltage components detected by the transformers are supplied to pins 9 and 13 of IC2 for wave shaping and their phases are compared by IC3 HD10131. The output from pin 3 of IC3 depends upon the phase of the voltage and current waveforms applied to IC3. The signal from IC3 pin 3 is sent to pins 10 and 15 of buffer IC IC3 HD10125. Output from pins 12 and 13 of IC3 goes through level shift Zener diodes D5 and D6 to control the input circuit of motor drive IC IC5 BA6109U2. The output signal is used to drive motor M1 to adjust the variable capacitor VC1 so that the phase difference between voltage and current components is reduced.

The current and voltage components output from the current and voltage detecting transformers is also supplied to the voltage comparator IC1 NJM2903D. The comparator output is used by motor drive IC IC6 BA6109U2 to drive motor M2 to adjust variable capacitor VC2 so that the amplitude difference is reduced. That is, the phase control variable capacitor VC1 is controlled so that the current is in phase with the voltage and the voltage control variable capacitor VC2 is controlled so that the amount of amplitude difference between the current and voltage is reduced (SWR1, an SWR of 1 to 1, is obtained when the current and voltage are in phase and the amount of amplitude difference is 0). VC1 and VC2 are designed to operate independently of each other, but since phase difference affects the amount of amplitude difference and vice versa, VC1 and VC2 will normally rotate together.

Forward and reflected waves detected by the filter unit are converted to SWR control signals in the SWR arithmetic circuit in

CIRCUIT DESCRIPTION

V_{SF} is compared with voltage from IC8 pin 6 (5.5 V). When SWR increases, V_{SF} lowers and the voltage level of IC8 pin 8 rises. At IC7 pin 3, a triangular wave is monitored. The triangular wave is compared with the wave from IC8 pin 8 and output. The triangular wave is converted to a square wave by IC10 and sent to switch Q3 and Q4. This voltage is used as the SWR control voltage.

Output voltage from IC8 pin 2 consists of the voltage compared with V_{SR}/V_{SF} and +5 DC voltage. It is distributed to IC4 the level shift/meter amplifier to move the needle in the SWR meter and IC5 the V-I converter to control the AT440.

VR14 is used to adjust the SWR meter ZERO point. VR13 is for SWR meter adjustment

3) FULL/SEMI BREAK-IN and VOX circuits

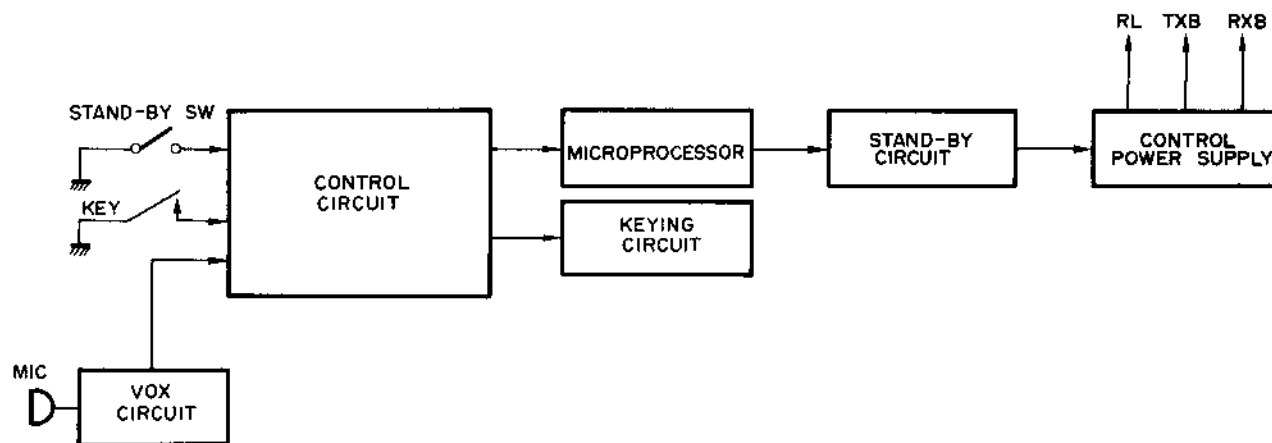
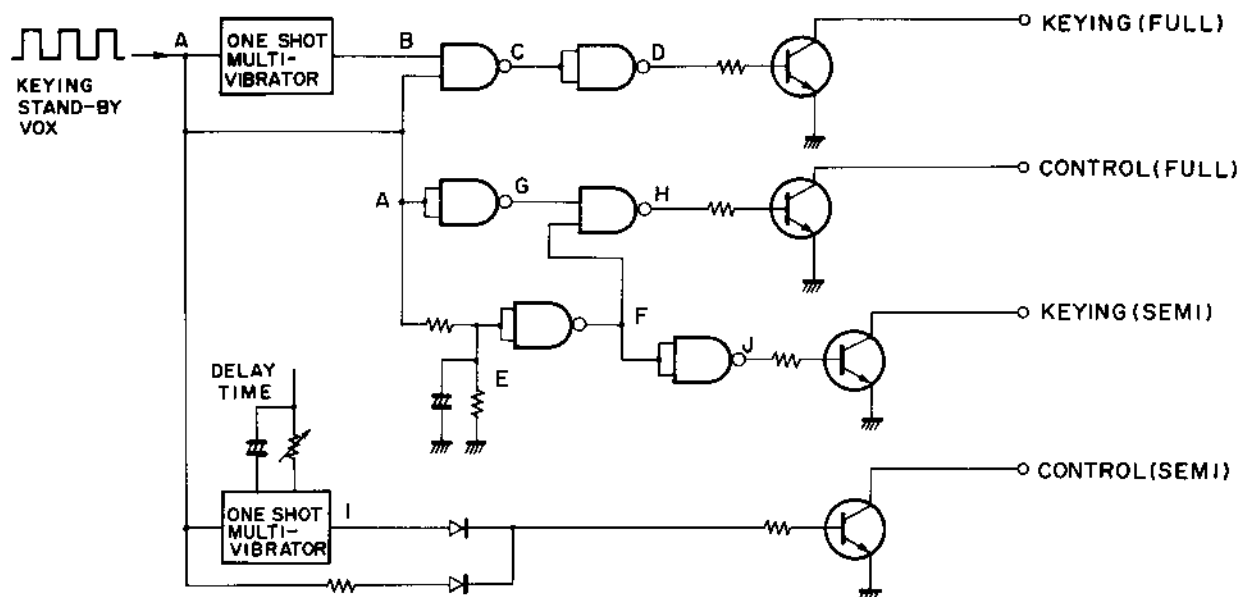


Fig. 9-1 FULL/SEMI BREAK-IN block diagram

When the standby switch, the key, or the VOX switching transistor are activated, a ground is applied to the input pin of the control circuit, which causes a standby signal to be fed to the microprocessor to determine if a valid transmit condition has been met. When that condition has been met, the

standby circuit in the IF unit will be turned on.

A keying signal is generated by the control circuit, whenever the key is depressed, to control the keying circuits in the IF unit. This keying signal is also used as the transmit/receive signal during break-in operations.



CIRCUIT DESCRIPTION

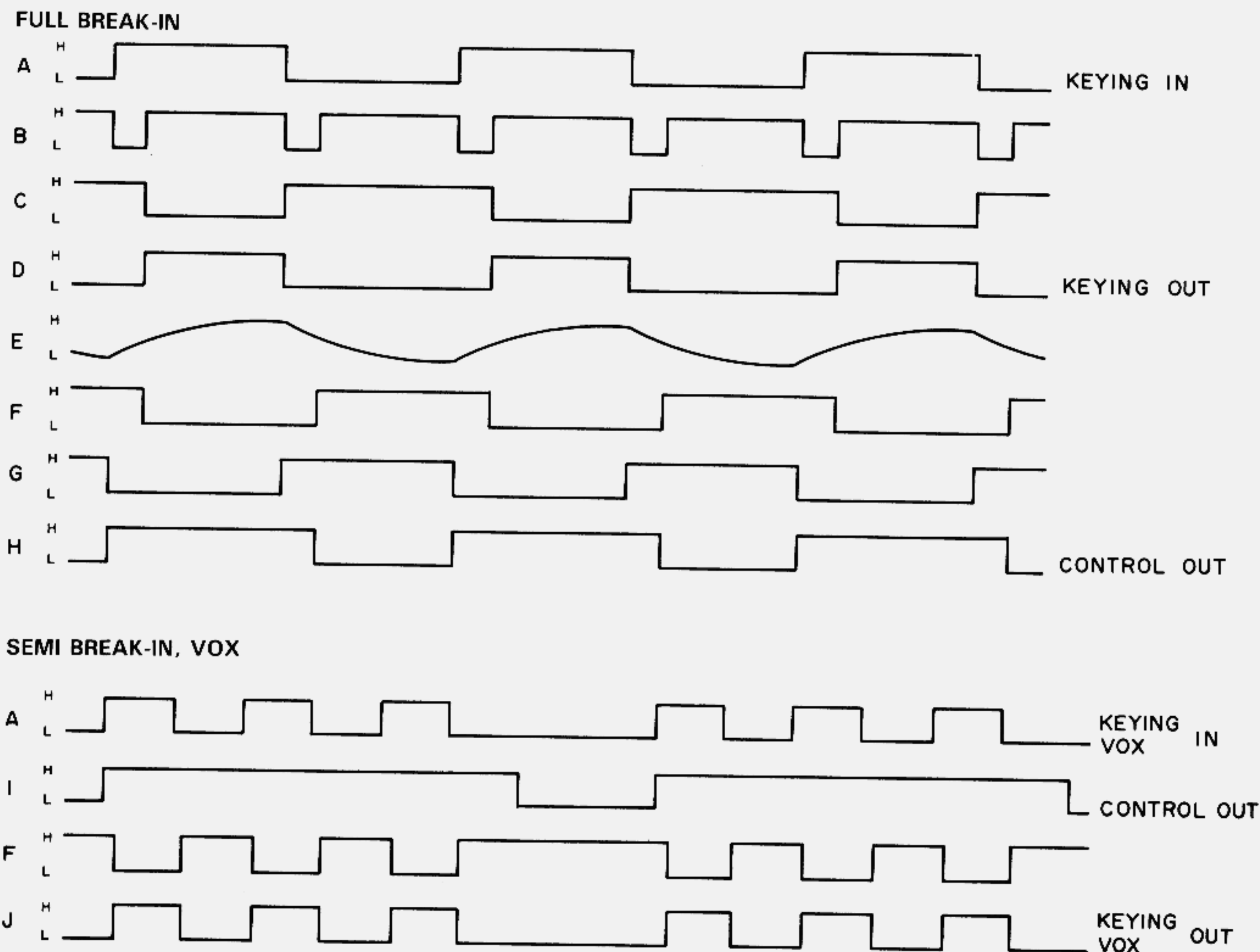


Fig. 9-3 FULL/SEMI BREAK-IN timing chart

The above timing charts show the timing for standby and keying signals.

When an input from the CW key is supplied to point A as shown in the above figure during full break-in operation, the one-shot multi-vibrator and gate circuits generate control (full) and delayed keying (full) signals. After the fundamental timing signal, RL (12V) for reception and transmission rises, the keying wave also rises, and when the key is off, RL falls according to the preset time constant.

Semi-break-in operation is synchronized to VOX. When a signal is supplied to point A, the VOX delay time multi-vibrator determines the VOX time constant. The input signal is converted to a keying (semi) signal by the gate circuit.

These keying semi/full and control semi/full signals are converted to appropriate break-in VOX mode signals us-

ing the slide switch. The control signal is checked by the microcomputer to see whether transmission is to be performed. The control signal is then used to switch CRL in the IF assembly unit and generate RL (12 V). TXB (transmit B+) (8.8 V) is generated, synchronized to RL. The receive control signal RXB (receive B+) (8.8 V) turns on/off, synchronized to the inverted TXB signal, that is, RL.



Fig. 10 STANDBY keying timing chart

CIRCUIT DESCRIPTION

4) Speech processor

IC4 in the IF unit functions as the first stage microphone amplifier or audio speech processor. When the processor switch is off, IC4 functions as a 20 dB microphone amplifier. When the processor switch is on, IC4 functions as an up to 40 dB

gain amplifier with ALC. When the processor switch is on, 8 VDC is supplied to the base of the gain adjustment switching transistor, Q41, driving the feedback amplifier.

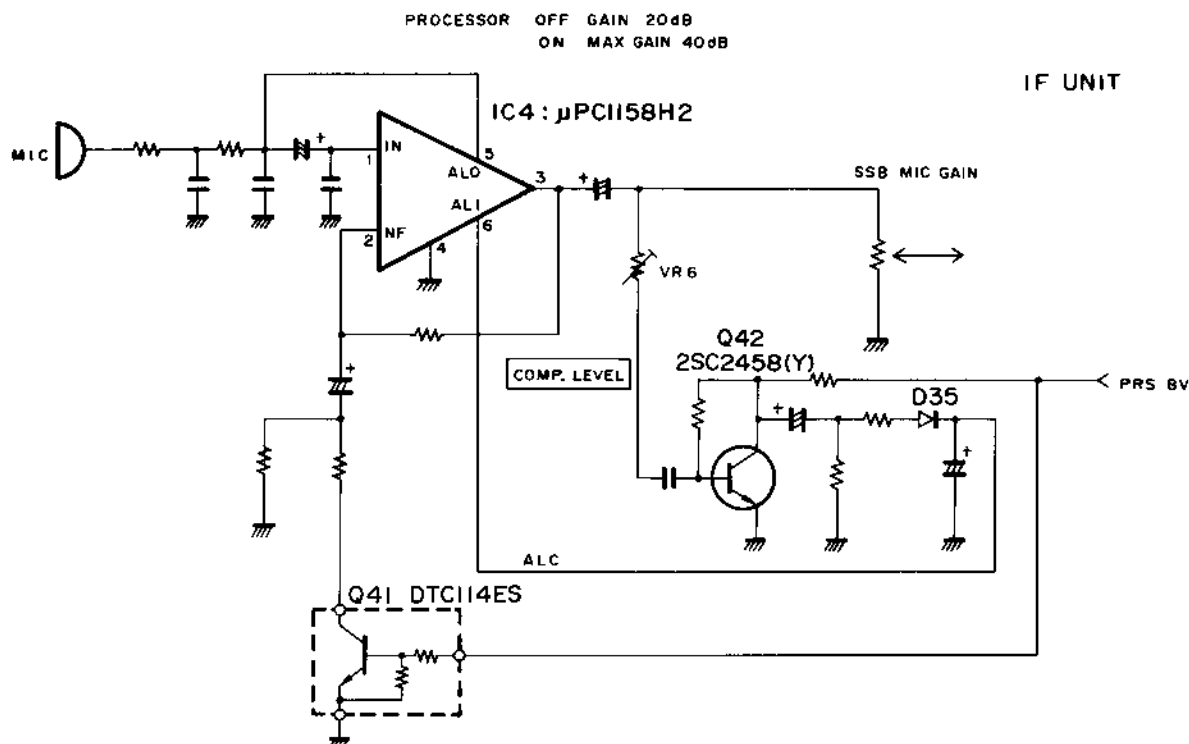


Fig. 11

4. PLL Circuits

Theory of PLL circuit operations

The TS-440 PLL circuit uses a reference frequency of 36 MHz and consists of five PLL loops covering the range of frequencies from 30 kHz to 30 MHz in 10 Hz steps. The PLL circuit has an IF shift function which is implemented by inserting carrier frequencies between PLL loops. The PLL loops include a carrier circuit PLL loop and an HET circuit PLL loop which generates a constant frequency of 36.22 MHz. Frequency division for these PLL loops is controlled by the microprocessor. In all PLL loops phase comparison is made using the reference frequency f_{STD} (frequency control using a single crystal oscillator).

Figure 12 is the PLL circuit block diagram.

The reference frequency (f_{STD}) is generated by a 36 MHz crystal oscillator and Q21 (2SC2787). Reference frequency signals are fed into the main loop's IC11 (SN16913P) via a buffer consisting of Q22 and Q23 (2SC2668). The signal is also fed into IC13 (SN74S112) via a buffer consisting of Q24 (2SC2668). In IC13, the signals are frequency divided to generate a 9 MHz signal. The 9 MHz signal is used as the

• PLL5

PLL5 consists of IC18 (MN6147) and its associated loop components. VC05, Q36 (2SK192A), is locked at a frequency of 36.22 MHz. The 9 MHz reference frequency signal is supplied to pin 3 of IC18, where the signal is divided by 1800 (450 in FM mode) to generate a 5 kHz (20 kHz in FM mode) signal used for comparison. VC05's output signal is supplied to IC18 pin 16 via Q37 (2SC2668), where the signals are frequency divided by 7244 (1811 in FM mode). The phase of the signal is then compared with that of the 5 kHz (20 kHz in FM mode) signal by the phase comparator and the VC05 oscillation frequency is locked. Frequency division data is supplied by digital unit (DA0 to DA3 and CK4).

As described above, the dividing ratio used varies depending on which mode the TS-440 is in, FM mode or SSB. This is because the apparent time constant is increased without changing the active LPF constant so that the PLL signals can be modulated easily and reducing distortion during FM transmission. In modes other than FM, the amount of frequency shift due to mechanical vibrations is reduced because the apparent time constant is reduced.

CIRCUIT DESCRIPTION

into pin 2 of MIX5 IC7 (SN16913P) via the LPF. In MIX5, the signal is mixed with the signal generated by PLL4 and goes through the BPF to generate a signal in the range of 6.53 MHz to 6.6301 MHz (in 100 Hz steps). The generated signal is supplied to pin 5.

• PLL2

PLL2 consists of IC9 (MN6147) and its loop circuitry. VC02, Q18 (2SC2668), is locked in the range of 58.25 MHz to 53.2501 MHz. The 9 MHz reference frequency signal is supplied to pin 3 of IC9, where the signal is divided by 450 to generate a 20 kHz signal for frequency comparison. VC02's output goes through buffer amplifier Q19 (2SC2668), and is fed into MIX4 pin 2 and mixed with the 6.35 MHz to 6.63 MHz signals applied to pin 5. The mixed signal then goes through the BPF to obtain 64.78 MHz to 59.88 MHz signal (in 100 kHz steps). The 64.78 MHz to 59.88 MHz signal is fed into IC9 pin 16 via buffer amplifier Q15 (2SC2668). In IC9, the signal is divided by M, and the phase of signal is compared with that of the 20 kHz reference signal by the phase comparator, and thus MIX4 output is locked (in 100 kHz step). The division ratio M is supplied from the digital unit (DA0 to DA3 and CK1), and is in 50 steps from 3239 to 2994 corresponding to 0.00 MHz to 0.49 MHz.

The output from PLL2 goes through buffer amplifier Q20 (2SC2668) and is divided by ten in IC10 (M54460L). Via the LPF, the signal is fed into pin 2 of MIX3 IC11 (SN16913P). The frequency of the signals depends on the values of L and M, and is in the range of 5.825 MHz to 5.32501 MHz (10 Hz step).

VR1 in MIX4 circuit is used to suppress spurious outputs from the mixer. It is necessary to prevent PLL2 from becoming unlocked.

Signals generated by PLL2 and the 9 MHz reference frequency are mixed in MIX3. The mixed signal goes through the BPF, and is further mixed with f_{L0} in MIX2 IC12 (SN16913P) on the IF unit. The output from MIX2 goes through the BPF to obtain 38.55 MHz to 39.04999 MHz. The signals are then mixed with the output from the final VCO oscillator in MIX1.

• PLL1

The last PLL loop, PLL1, consists of IC17 (MB87006) and its loop components. In IC17, frequency division for reference and comparison frequencies is set by serial data (SO, SCK, and LE). When an external prescaler is used, IC17 has a modulus control function for configuring the pulse swallow counter.

The VCO oscillator output from the RF unit goes through Q26 (2SC2668) in the PLL unit and is fed into MIX1. The mixed signals go through the BPF, and they are then amplified by buffer amplifiers Q27 thru Q30 (2SC2668), shaped by IC15 (SN74S10N1/3), and fed into IC16 (WN74S112N) 1/3, or 1/2 prescaler. Basically, IC16 is a two-level FF circuit and functions as a 1/4 divider. But, when IC17 of the PLL unit sends control signals, to IC16, IC16 functions as a 1/3 or 1/2 frequency divider in con-

The 9 MHz reference frequency signal is supplied to pin 1 of IC17, where the signals are divided by 18 to generate a 500 kHz signal for frequency comparison. Signals fed into IC17 pin 8 via MIX1 and the buffer amplifier are divided by N, and the phase is compared with that of the 500 kHz reference signals by the phase comparator. The signal then goes through the active LPFs Q31 to Q33 (2SC2459) and is fed into the RF unit as VCO voltage signals to control the variable capacitor of the final VCO. The frequency divider N covers the full range of operating frequencies from 30 kHz to 30 MHz (500 kHz step), and it has 61 steps of frequency division data supplied by the microprocessor in the digital unit.

The last VCO signal in PLL1 therefore depends on the values of L, M, and N, and it is in the range from 45.08 MHz to 75.05 MHz (10 Hz step). N is expressed as follows:

$$N = PN_0 - A \\ (N_0 > A)$$

P: Prescaler module value

No: Programmable counter value

CIRCUIT DESCRIPTION

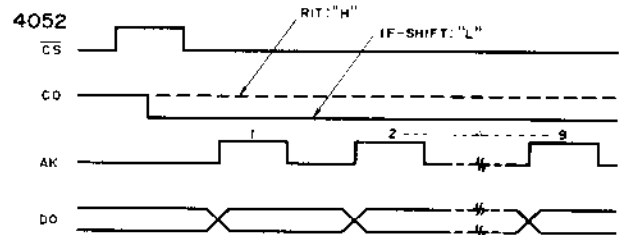
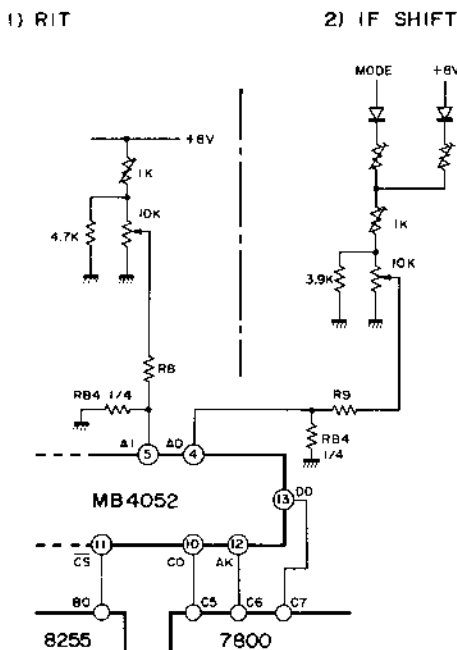
4. Static input

7800 (IC1)		
C0	Encoder U/D signal	"H" when UP
C2	Unlock signal	"L" when unlock
07	4052 (IC: Display)	A/D convertor data
8255 (IC53)		
B0	Lock switch	"L" when switch on
B2	AT switch	"L" when switch on
B3	MIC UP switch	"L" when switch on
B4	MIC DOWN switch	"L" when switch on
B5	PTT switch	"L" when switch on
B7	VS-1 busy signal	"H" when VS-1 busy

Table 11.

5. A/D convertor input

Voltages controlled by the RIT and IF shift VRs are applied to the 4052 (IC2: Display). The 4052 has four analog inputs: A0 (IC2 pin 4) is connected to the IF shift VR, and A1 (pin 5) is connected to the RIT VR, the other two inputs are not used. When reading IF shift data, the 7800 sets port C5 to 0 and selects 4052 A0. As a result, the 3255 sends a positive pulse from port B0 to reset the 4052, and the 7800 sends nine positive pulses from port C6, and port C7 receives data. When reading RIT data, the 7800 sets C0 from the 4052 to H and thereafter performs the same operations as when reading IF shift data.

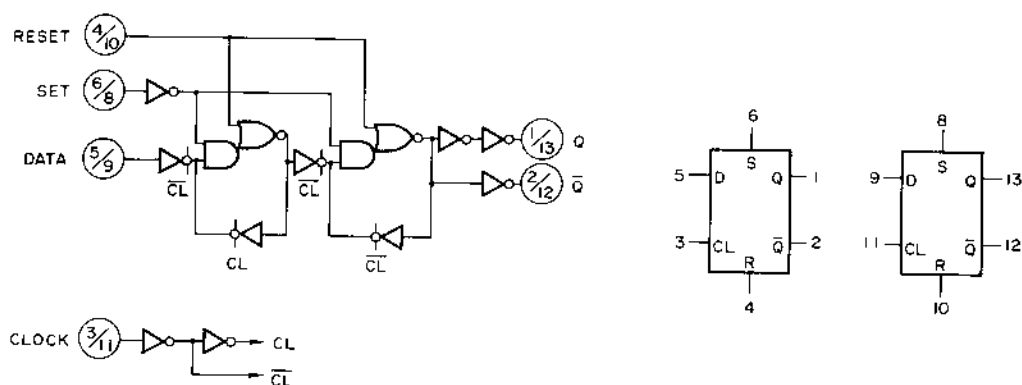
A/D convertor Input
Fig. 17 A/D convertor circuit

6. AT control

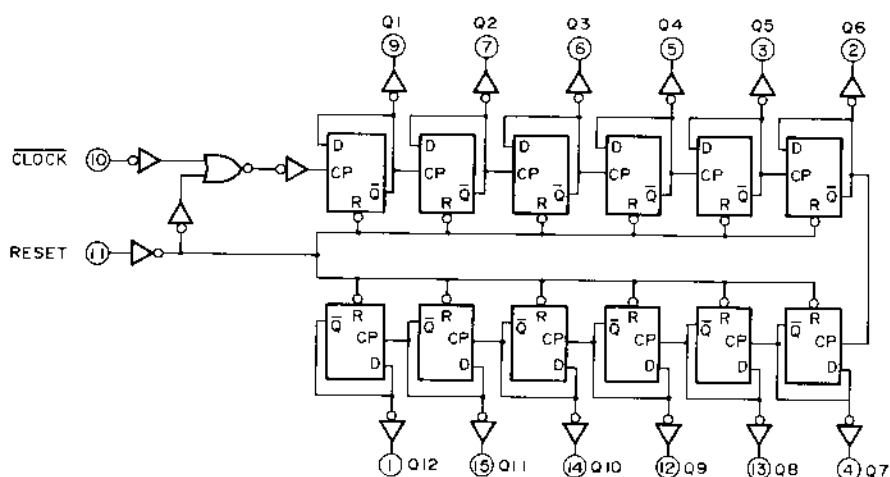
When the AT switch is turned on with the AUTO/THRU switch in the AUTO position, 8255 (IC53) ports B2 and B5 go on. When the 7800 knows that the AT switch is on via port B2, it will enter the CW-mode, and sets port A2 to H and A0, A1, and A3 to A6, and B4 to L, and transfer a power down signal. The

SEMICONDUCTOR

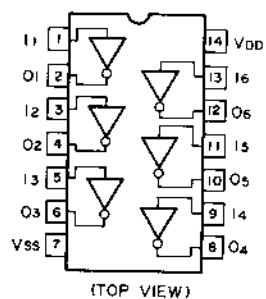
TC4013 (Display unit IC3)



TC4040BP (Control unit IC55)

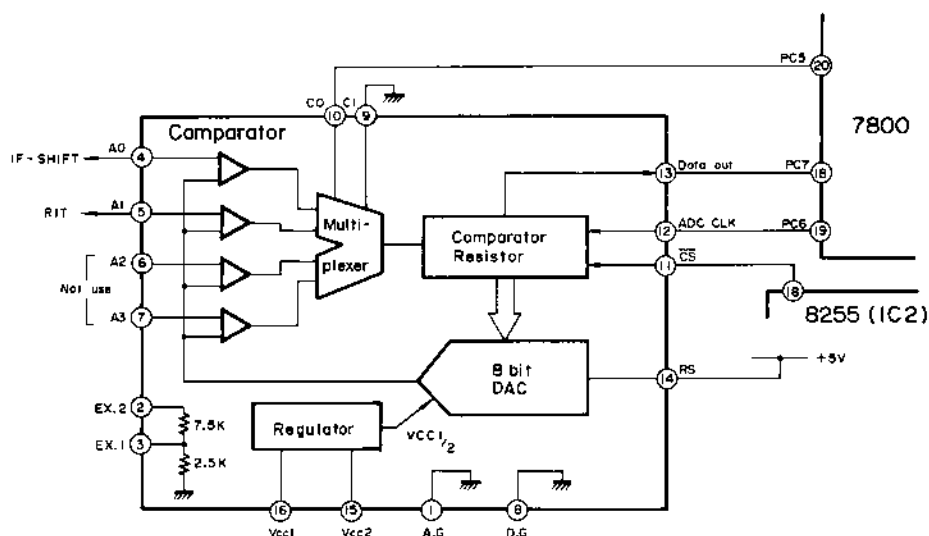


TC4069BP (Control unit IC4)



SEMICONDUCTOR

MB4052



MB4052 Pin Description

I/O Signal Pin Functions

Pin No.	Pin Name	Symbol	Function
2	Range expander input	Ex. 2	Analog input pin for expanding the range.
3	Range expander output	Ex. 1	Analog output pin for expanding the range. Connect to any pin from A0 to A3. By using Ex. 1, Ex. 2, the range is expanded to the $\times 4$ range.
4 ~ 7	Analog entrance	$A_0 \sim A_3$	4 ch analog input pin. Channel 1 is selected by channel select input C0 to C1.
9	Channel select input	C_0	The input pin to designate the analog input channel for A/D converter. This signal is latched at the trailing edge of $\overline{CS}$.
10	Channel select input	C_1	
11	Chip select input	$\overline{CS}$	This is the chip select input pin. When $\overline{CS}$ is inverted from "1" to "0", A/D converting starts and data output is enabled. After A/D converting is over or when an interrupt is required, set the $\overline{CS}$ back to "1".
12	A/D conversion clock	ADC CLK	This is the clock input pin for A/D conversion input to the comparator register sequentially. Conversion speed is determined by the clock speed. In the case of 8-bit, approx. 10 clocks will be needed. However, it is not necessary that the clock period be fixed.
13	Data output	DATA OUT	This is the open collector to output the result of A/D conversion. The data is output in the order of the start bit, most significant bit, 2nd significant bit, ..., least significant bit, and the stop bit, synchronized with ADCCLK.
14	Range select input	RS	This is the input pin for selecting the voltage range of analog input. The $VFS = V_{CC1}/8$ range is selected at "0", and the range of $FVS = V_{CC1}/2$ is selected at "1". During conversion, hold this pin to "0" or "1".
1	Analog ground	A.G.	Ground terminal
8	Digital ground	D.G.	
15	Power supply pin 2	V_{CC2}	When driving with 3.5 to 6.0 V of power, connect V_{CC1} and V_{CC2} to each other, and apply the power voltage to them. When driving 8 to 18 V of power, apply the power voltage to V_{CC2} . At this time, the 5 V stabilized voltage is output to V_{CC1} , and approx. 10 mA current can be supplied externally to the IC. When either 3.5~6.0 V or 8~18V power is used, V_{CC1} is the reference voltage for A/D conversion.
16	Power supply pin 1	V_{CC1}	

• Channel Select

C_1	C_0	Selected Ch.
0	0	A_0
0	1	A_1
1	0	A_2
1	1	A_3

• Range select

PARTS LIST

N: New Parts

*: Please note that parts are sometimes not in stock, and it takes much time to deliver.

SEMICONDUCTOR

Item	Re- marks	Name	Item	Re- marks	Name	Item	Re- marks	Name
Diode	N	1S1555	Digital Tr	N	DTC114ES		N	LM2931Z-5.0
		1S133			DTC143TS			M54460L
		1S2588			DTC124ES			M54459L
		1S1587			DTC144WS			M54561P
		1S1007			DTA114ES			M74LS00P
		1SV53A						M74LS123P
		1VS153						M74LS145P
		1SS101						MB3614
		1SS99						MB4052
		1N60						MB87006
		1N4448						MBM2718-25JA1
	N	S31C	TR	N	2SA562 (Y)		N	MBM8418-20LP- GRA
		BA282			2SA562 TM			MC10125L
		MA858			2SA950 (Y)			MC10131L
		US1090						MC10116L
		DAN401						MC3357P
								MN6147
		MC931						MN6147C
		MI204						NE555P

PARTS LIST

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Ref. No. 参照番号	Address 位置	New Parts 新	Parts No. 部品番号	Description 部品名 / 規格	Desti- nation 仕向	Re- marks 備考
TS-440						
1	1B	*	A01-0998-02	CASE (A) UPPER		
2	3A	*	A01-0999-02	CASE (B) LOWER		
3	2C	*	A20-2556-03	PANEL ASSY		
4	2B	*	A40-0617-03	BOTTOM PLATE		
9	1A		B04-0411-04	SP MOUNTING HARDWARE		
10	1A		B05-0708-04	SP GRILL CLOTH		
11	1F		B30-0817-15	PILOT LAMP (14V, 80MA)		
12	2H	*	B31-0657-05	METER		
14	3A	*	B40-3625-04	MODEL NAME PLATE	KM1M2	
14	3A	*	B40-3625-04	MODEL NAME PLATE	TW	
14	3A	*	B40-3626-04	MODEL NAME PLATE	X	
17	1A	*	B42-2422-04	VAX NAME PLATE		
22	2C	*	B43-1063-04	NAME PLATE (TRIO TS-440S)	T	
22	2C	*	B43-1064-04	NAME PLATE (KENWOOD TS-44X)	X	
22	2C	*	B43-1065-04	NAME PLATE (KENWOOD TS-440S)	KM1M2	
22	2C	*	B43-1065-04	NAME PLATE (KENWOOD TS-440S)	W	
23	1T	*	B46-0410-10	WARRANTY CARD	K	
24	1S	*	B50-8048-00	INSTRUCTION MANUAL	KM1M2	
24	1S	*	B50-8048-00	INSTRUCTION MANUAL	WX	
24	1S	*	B50-8049-00	INSTRUCTION MANUAL	T	
24	1S	*	B42-1729-04	LABEL (WITH ANTENNA TUNER)		
26	1S		E07-0751-05	7P DIN PLUG (ACCESSORY)		
27	1S		E07-0852-05	8P METAL PLUG	KM1M2	
28	1S		E30-1638-05	DC POWER CORD ASSY		
28	1S		E31-0431-15	WIRE WITH CONNECTOR (SP)	</	

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55	1E		J32-0765-04	HEX BSSS (X2) 6.5MM		
56	2F		J32-0782-04	HEX BSSS (X4) 11MM		
57	1F, 1G	*	J32-0792-04	HEX BSSS (X8) 10MM		
58	1G	*	J32-0793-04	HEX BSSS (X4) 11MM		
59	1I, 2J	*	J32-0794-04	HEX BSSS (X3) 5MM		
63	3B		K01-0407-05	CARRING HANDLE		
64	3C	*	K21-0778-02	MAIN KNOB		
65	3C		K23-0710-04	KNOB (INSIDE) X4		
66	1S		K23-0712-04	KNOB (VSW) X1		
67	3C		K23-0782-04	KNOB (SELECTIVITY) X1		
68	3C		K29-0741-24	KNOB (OUTSIDE) X4		
69	2C		K29-0758-04	PUSH KNOB (POWER) X1		
70	2C		K29-0782-05	KNOB (ALC)		
71	2C		K29-3001-04	PUSH KNOB (X4)		
72	2C		K29-3002-04	PUSH KNOB (X6)		
75	2L	*	N19-0601-14	FLAT WASHER		
76	2C		N19-0637-04	FLAT WASHER (MAIN KNOB)		
-			N87-3008-46	BRAZIER HEAD TAPTITE SCREW(X1)		
			N87-3012-46	BRAZIER HEAD TAPTITE SCREW(X2)		
AA	2C, 2E		N09-0256-05	GND SCREW (X4)		
BB	2H		N09-0644-04	BIND SCREW (X6)		
CC	2M		N09-0658-04	ROUND SCREW (X5)		
DD	2C, 3C	*	N09-0699-05	SCREW (X6)		
E	2L		N30-2608-41	PAN HEAD MACHINE SCREW (X6)		
F	1E, 1F		N32-2606-46	FLAT HEAD MACHINE SCREW (X8)		
G	2C, 2D		N32-3004-46	FLAT HEAD MACHINE SCREW (X4)		
H	1C, 2D		N32-			

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93	11,2J	*	X53-1450-11	CONTROL UNIT	WX M2	
93	11,2J	*	X53-1450-21	CONTROL UNIT		
96	1K,1G	*	X54-1870-00	DISPLAY UNIT		
97	2D,1R	*	X57-1150-00	AT UNIT		
98	1D	*	X60-1300-00	IF UNIT		
SWITCH UNIT (X41-1610-00)						
C10 ,11			CK45F1H473Z	CERAMIC 0.047UF Z		
C12			CE04W1C222M	ELECTRO 2200UF 16WV		
C13			CK45F1H473Z	CERAMIC 0.047UF Z		
C14			CE04W1C222M	ELECTRO 2200UF 16WV		
C15			CK45F1H473Z	CERAMIC 0.047UF Z		
C17			CE04W1C330M	ELECTRO 33UF 16WV		
C19 ,20			CE04W1C330M	ELECTRO 33UF 16WV		
C23			CE04W1C330M	ELECTRO 33UF 16WV		
C24			CE04W1C470M	ELECTRO 47UF 16WV		
C26			CE04W1C330M	ELECTRO 33UF 16WV		
C30			CE04W1C470M	ELECTRO 47UF 16WV		
C31			CE04W1C330M	ELECTRO 33UF 16WV		
C34			CE04W1C330M	ELECTRO 33UF 16WV		
C35			C91-0119-05	CERAMIC 0.047UF K		
C38			CE04W1C470M	ELECTRO 47UF 16WV		
C39			C91-0117-05	CERAMIC 0.01UF K		
C41			C90-2035-05	ELECTRO 100UF 16WV		
C43			CK45F1H473Z	CERAMIC 0.047UF Z		
C45			C90-2035-05	ELECTRO 100UF 16WV		
C46			CB92M1H562K	MYLAR		

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MC22 MC24 MC25 MC27 MC28			E40-0673-05 E40-0373-05 E40-5069-05 E40-3241-05 E04-0154-05	PIN CONNECTOR (MINI, 6P) PIN CONNECTOR (MINI, 3P) PIN CONNECTOR (MINI, 6P) PIN CONNECTOR (MINI, 12P) RF COAXIAL CABLE RECEPTACLE		
MC29 MC30 MC31 MC32, 33 MC34			E40-0273-05 E40-0473-05 E40-0373-05 E40-0273-05 E40-0473-05	PIN CONNECTOR (MINI, 2P) PIN CONNECTOR (MINI, 4P) PIN CONNECTOR (MINI, 3P) PIN CONNECTOR (MINI, 2P) PIN CONNECTOR (MINI, 4P)		
-			F02-0423-04	HEAT SINK		
CH1 L1 L3 -5			L15-0016-05 L40-1011-13 L40-1011-14	CHOKER COIL SMALL FIXED INDUCTOR SMALL FIXED INDUCTOR		
- - - -			N09-0641-05 N10-2030-46 N17-1030-46 N30-3004-46	SCREW (X4) HEXAGON NUT (X2) TOOTHED LOCK WASHER (X4) PAN HEAD MACHINE SCREW(X1)		
VR1 VR2 VR3 VR4 VR5		*	R19-3423-05 R24-9405-05 R12-1428-05 R12-3450-05 R19-3420-05	POTENTIOMETER (MIC, CAR) POTENTIOMETER (SQ, NOTCH) TRIMMING PST. (1K) RIT TRIMMING PST. (20K) VOLTAGE POTENTIOMETER (AF, RF)		
VR6 VR7 VR10 VR11 VR12		*	R19-3418-05 R12-1435-05 R12-0405-05 R12-5402-05 R12-3435-05	POTENTIOMETER (RIT, IF SHIFT) TRIMMING PST. (2K) VCO4 TRIMMING PST. (330) TRIMMING PST. (220K) TRIMMING PST. (47K)		
VR13 VR14 W1 -2 W7 W13			R12-1418-05 R12-1419-05 R92-0150-05 R92-0150-05 R92-0150-05	TRIMMING PST. (1K) TRIMMING PST. (1K) JUMPER REST 0 OHM JUMPER REST 0 OHM JUMPER REST 0 OHM		
W15			R92-0150-05	JUMPER REST 0 OHM		
RL1 RL2 S1 S2		*	S51-1429-05 S51-1420-05 S01-2425-05 S31-4405-05	RELAY RELAY ROTARY SWITCH (SELECT) SLIDE SWITCH		
D1 D2 D5 -12 D13 D15 -18			1S1555 MTZ7.5JA 1SS133 531C 1SS133	DIODE ZENER DIODE DIODE DIODE DIODE		
IC						

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Q5	.6		2SC2458(Y)	TRANSISTOR		
RF UNIT (X44-1680-00)						
C1			CC45SL1H390J	CERAMIC 39PF J		
C2			CC45SL1H121J	CERAMIC 120PF J		
C3			CC45RH1H330J	CERAMIC 33PF J		
C4			CK45F1H473Z	CERAMIC 0.047UF Z		
C6			C91-1008-05	CERAMIC 0.022UF K		
C7			C91-0117-05	CERAMIC 0.01UF K		
C8		*	C91-1065-05	CERAMIC 0.0068UF K		
C9	.10		C91-0117-05	CERAMIC 0.01UF K		
C11			CK45F1H103Z	CERAMIC 0.010UF Z		
C12			C91-0117-05	CERAMIC 0.01UF K		
C13			C91-0105-05	CERAMIC 0.0047UF K		
C14			C092M1H123K	MYLAR 0.012UF K		
C15	.16		C092M1H153K	MYLAR 0.015UF K		
C17			CE04W1H010M	ELECTRO 1.0UF SOWV		
C18			C91-1008-05	CERAMIC 0.022UF K		
C19	.20		C092M1H153K	MYLAR 0.015UF K		
C21			CK45B1H152K	CERAMIC 1500PF K		
C22			C91-0125-05	CERAMIC 0.0027UF K		
C23			CK45B1H152K	CERAMIC 1500PF K		
C24			CE04W1H010M	ELECTRO 101UF C1		
C25			C91-1008-05	CERAMIC 0.022UF K		
C26			CE04W1H010M	ELECTRO 101UF C1		
C27			C91-1008-05	CERAMIC 0.022UF K		
C28	.29		CK45B1H222K	CERAMIC 2200PF K		
C30			CK45B1H			

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C121			C91-0117-05	CERAMIC 0.01UF K		
C122			CC45SL1H470J	CERAMIC 47PF J		
C123			C91-0769-05	CERAMIC 0.01UF M		
C124			CC45SL1H100D	CERAMIC 10PF D		
C125			C91-0117-05	CERAMIC 0.01UF K		
C126			CE04W1H100M	ELECTR0 10UF 50WV		
C127			C91-0117-05	CERAMIC 0.01UF K		
C128			CC45SL1H040C	CERAMIC 4.0PF C		
C129-132			C91-0117-05	CERAMIC 0.01UF K		
C133			CC45SL1H101J	CERAMIC 100PF J		
C134			C91-0117-05	CERAMIC 0.01UF K		
C135			CC45SL1H121J	CERAMIC 120PF J		
C136			C91-0117-05	CERAMIC 0.01UF K		
C137			C91-0769-05	CERAMIC 0.01UF M		
C138-142			C91-0117-05	CERAMIC 0.01UF K		
C143-145			C91-0769-05	CERAMIC 0.01UF M		
C146			C91-0117-05	CERAMIC 0.01UF K		
C147,148			C91-1008-05	CERAMIC 0.022UF K		
C149,150			C91-0769-05	CERAMIC 0.01UF M		
C151			C91-0117-05	CERAMIC 0.01UF K		
C153			C91-1008-05	CERAMIC 0.022UF K		
C154,155			C91-0769-05	CERAMIC 0.01UF M		
C156			CC45RH1H020C	CERAMIC 2.0PF C		
C157			C91-1008-05	CERAMIC 0.022UF K		
C158			CC45SL1H100D	CERAMIC 10PF D		
C159			CC45SL1H120J	CERAMIC 12PF J		
C160			C91-1			

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C189 C190, 191 C192 C193 C194			CC45CH1H330J C91-0117-05 CE04W1A470M C91-0769-05 CC45RH1H680J	CERAMIC 33PF J CERAMIC 0.01UF K ELECTRO 47UF 10WV CERAMIC 0.01UF M CERAMIC 68PF J		
C195 C196 C197 C198 C199			CC45CH1H050C CC45CH1H330J CC45CH1H050C CK45F1H103Z CC45SL1H220J	CERAMIC 5.0PF C CERAMIC 33PF J CERAMIC 5.0PF C CERAMIC 0.010UF Z CERAMIC 22PF J		
C200 C202 C203 C204 C205			C91-0117-05 CC45SL1H330J C91-0119-05 C91-0117-05 C91-0747-05	CERAMIC 0.01UF K CERAMIC 33PF J CERAMIC 0.047UF K CERAMIC 0.01UF K CERAMIC 150PF K		
C206 C207 C208 C209-213 C214		*	CC45SL1H270J CC45SL1H331J CC45SL1H470J C91-0117-05 C91-0714-05	CERAMIC 27PF J CERAMIC 330PF J CERAMIC 47PF J CERAMIC 0.01UF K CERAMIC 2.7PF K		
C215, 216 C217 C218 C219 C220			C91-0117-05 CK45B1H102K CK45B1H331K CE04W1H010M C91-0117-05	CERAMIC 0.01UF K CERAMIC 1000PF K CERAMIC 330PF K ELECTRO 1.0UF 50WV CERAMIC 0.01UF K		
C221 C222, 223 C224 C225 C226			C91-0117-05 C91-0119-05 CE04W1H010M C91-0117-05 CE04W1H010M	CERAMIC 0.01UF K CERAMIC 0.047UF K ELECTRO 1.0UF 50WV CERAMIC 0.01UF K ELECTRO 1.0UF 50WV		
C227 C228 C229 C230 C231			CC45SL1H101J C91-0117-05 CS15E1VR47M C092M1H392K CE04W1A470M	CERAMIC 100PF J CERAMIC 0.01UF K TANTAL 0.47UF 35WV MYLAR 3900PF K ELECTRO 47UF 10WV		
C232 C233 C235 C236 C237			CE04W1H0R1M CK45B1H471K CE04W1H100M C092M1H333K CE04W1H100M	ELECTRO 0.1UF 50WV CERAMIC 470PF K ELECTRO 10UF 50WV MYLAR 0.033UF K ELECTRO 10UF 50WV		
C238 C239 C240 C241 C242-2						

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C2			CK45F1H103Z	CERAMIC 0.010UF Z		
C3			CK45F1H223Z	CERAMIC 0.022UF Z		
C4			CK45B1H102K	CERAMIC 1000PF K		
C5 -7			CK45F1H473Z	CERAMIC 0.047UF Z		
C8 ,9			CK45F1H223Z	CERAMIC 0.022UF Z		
C11			CM93D2H681J	MICA 680PF J		
C12 ,13			C91-1004-05	CERAMIC 0.0068UF J		
C14			CM73F2H122J	CHIP C 1200PF J		
C15			CC45SL2H151J	CERAMIC 150PF J		
C17			CK45F1H473Z	CERAMIC 0.047UF Z		
C18			CE04W1C100M	ELECTRO 10UF 16WV		
C19			CK45F1H223Z	CERAMIC 0.022UF Z		
C20			CE04W1E470M	ELECTRO 47UF 25WV		
C21			CK45F1H223Z	CERAMIC 0.022UF Z		
C22			CK45B1H102K	CERAMIC 1000PF K		
C23			CK45F1H473Z	CERAMIC 0.047UF Z		
C24			CE04W1C100M	ELECTRO 10UF 16WV		
C25			CE04W1E101M	ELECTRO 100UF 25WV		
C26 ,27			CK45F1H473Z	CERAMIC 0.047UF Z		
C28 ,29			CK45F1H103Z	CERAMIC 0.010UF Z		
C31			CK45F1H473Z	CERAMIC 0.047UF Z		
C32			CK45F1H223Z	CERAMIC 0.022UF Z		
C33			CE04W1E470M	ELECTRO 47UF 25WV		
130	2M		E04-0152-05	RF COAXIAL CABLE RECEPTACLE		
132	20		E08-0671-05	RECTANGULAR RECEPTACLE(6P)		
-			E04-0157-05	RF COAXIAL CABLE RECEPTACLE		
MC1						

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C28			CK45B1H391K	CERAMIC 390PF K		
C29			C91-0769-05	CERAMIC 0.01UF M		
C30			C91-0119-05	CERAMIC 0.047UF K		
C31 ,32			C91-0117-05	CERAMIC 0.01UF K		
C33			CC45SL1H390J	CERAMIC 39PF J		
C34			CC45SL1H820J	CERAMIC 82PF J		
C35			CC45SL1H390J	CERAMIC 39PF J		
C36			C91-0117-05	CERAMIC 0.01UF K		
C37			C91-1008-05	CERAMIC 0.022UF K		
C38 ,39			C91-0117-05	CERAMIC 0.01UF K		
C40 ,41			C092M1H223K	MYLAR 0.022UF K		
C42			C91-0119-05	CERAMIC 0.047UF K		
C43			CK45B1H182K	CERAMIC 1800PF K		
C44			C91-0119-05	CERAMIC 0.047UF K		
C45			CE04W1A470M	ELECTR0 47UF 10WV		
C46			CC45UJ1H220J	CERAMIC 22PF J		
C47			CC45CH1H100D	CERAMIC 10PF D		
C48			CC45CH1H120J	CERAMIC 12PF J		
C49			CC45CH1H220J	CERAMIC 22PF J		
C50			CC45SL1H050C	CERAMIC 5.0PF C		
C51			C91-0117-05	CERAMIC 0.01UF K		
C52			CE04W1A470M	ELECTR0 47UF 10WV		
C53			C91-0769-05	CERAMIC 0.01UF M		
C54			CC45SL1H050C	CERAMIC 5.0PF C		
C55			CC45SL1H100D	CERAMIC 10PF D		
C56			C91-0117-05	CERAMIC 0.01UF K		
C57			C91-0117-05	CERAMIC 0.01UF K		

PARTS LIST

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Ref. No. 参照番号	Address 位置	New Parts 新	Parts No. 部品番号	Description 部品名 / 規格	Desti- nation 仕向	Re- marks 備考
C95			C91-0117-05	CERAMIC 0.01UF K		
C96 ,97			CC45SL1H100D	CERAMIC 10PF D		
C98			C91-0117-05	CERAMIC 0.01UF K		
C99			C91-0769-05	CERAMIC 0.01UF M		
C100			C91-0119-05	CERAMIC 0.047UF K		
C101,102			C91-0117-05	CERAMIC 0.01UF K		
C104			CC45SL1H680J	CERAMIC 68PF J		
C106			C91-0769-05	CERAMIC 0.01UF M		
C108			CC45CH1H100D	CERAMIC 10PF D		
C109			C91-0769-05	CERAMIC 0.01UF M		
C110			CC45UJ1H180J	CERAMIC 18PF J		
C111			CC45CH1H560J	CERAMIC 56PF J		
C112			CC45CH1H050C	CERAMIC 0.5PF C		
C113			CE04W1C220M	ELECTRO 22UF 16WV		
C114			CC45SL1H050C	CERAMIC 5.0PF C		
C115			CC45SL1H100D	CERAMIC 10PF D		
C116			C91-0769-05	CERAMIC 0.01UF M		
C117-121			C91-0117-05	CERAMIC 0.01UF K		
C122			CC45SL1H101J	CERAMIC 100PF J		
C123-128			C91-0117-05	CERAMIC 0.01UF K		
C129			CC45SL1H100D	CERAMIC 10PF D		
C130			C91-0117-05	CERAMIC 0.01UF K		
C131			C91-1008-05	CERAMIC 0.022UF K		
C132			CK45B1H102K	CERAMIC 1000PF K		
C133,134			C91-0119-05	CERAMIC 0.047UF K		
C135			CK45B1H102K	CERAMIC 1000PF K		
C136,137			C91-0769-05	CERAMIC 0.01UF M		
C1						

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C178			CS15E1VR1M	TANTAL 0.1UF 35WV		
C179			CK45B1H182K	CERAMIC 1800PF K		
C180			CE04W1H100M	ELECTR0 10UF 50WV		
C181			C91-0117-05	CERAMIC 0.01UF K		
C182			CS15E1VR47M	TANTAL 0.47UF 35WV		
C183			CC45RH1H070D	CERAMIC 7.0PF D		
C184			C91-0119-05	CERAMIC 0.047UF K		
C185			CE04W1A470M	ELECTR0 47UF 10WV		
C186			C91-0117-05	CERAMIC 0.01UF K		
C187			CC45RH1H060D	CERAMIC 6.0PF D		
C188			CC45CH1H100D	CERAMIC 10PF D		
C189			CC45CH1H220J	CERAMIC 22PF J		
C190			CC45CH1H220J	CERAMIC 22PF J		
C191			CE04W1A470M	ELECTR0 47UF 10WV		
C192			C91-0117-05	CERAMIC 0.01UF K		
C193			CC45CH1H010C	CERAMIC 1.0PF C		
C194			C91-0769-05	CERAMIC 0.01UF M		
C195			CC45SL1H050C	CERAMIC 5.0PF C		
C196			CC45SL1H101J	CERAMIC 100PF J		
C197			C91-0117-05	CERAMIC 0.01UF K		
C198			CK45B1H182K	CERAMIC 1800PF K		
C199		*	CC45CH1H090D	CERAMIC 9.0PF D		
C200,201			CC45SL1H560J	CERAMIC 56PF J		
C202,203			C91-0117-05	CERAMIC 0.01UF K		
C204			CC45SL1H221J	CERAMIC 220PF J		
C205			CC45CH1H100D	CERAMIC 10PF D		
C206			C			

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L37 ,38			L40-2211-14	SMALL FIXED INDUCTOR		
L39		*	L40-1011-13	SMALL FIXED INDUCTOR		
L40		*	L40-2201-13	SMALL FIXED INDUCTOR		
L41		*	L40-1001-14	SMALL FIXED INDUCTOR		
L42		*	L40-1011-13	SMALL FIXED INDUCTOR		
L43			L40-2211-14	SMALL FIXED INDUCTOR		
L44		*	L40-1001-14	SMALL FIXED INDUCTOR		
L46		*	L40-1011-13	SMALL FIXED INDUCTOR		
L47		*	L40-1011-14	SMALL FIXED INDUCTOR		
T1 ,2		*	L32-0666-15	OSCILLATING COIL (VCO, 95MHZ)		
T3		*	L34-2269-05	COIL (6.6MHZ, BPF)		
T4		*	L34-2270-05	COIL (6.6MHZ, BPF)		
T5		*	L34-2269-05	COIL (6.6MHZ, BPF)		
T6		*	L34-2271-05	COIL (62MHZ, BPF)		
T7		*	L34-2272-15	COIL (62MHZ, BPF)		
T8		*	L34-2292-05	COIL (62MHZ, BPF)		
T9			L32-0639-05	OSCILLATING COIL (VCO, 55MHZ)		
T10		*	L34-2273-05	COIL (30MHZ, BPF)		
T11		*	L34-2274-05	COIL (30MHZ, BPF)		
T12		*	L34-2273-05	COIL (30MHZ, BPF)		
T13		*	L34-2275-05	COIL (39MHZ, BPF)		
T14		*	L34-2276-05	COIL (39MHZ, BPF)		
T15		*	L34-2275-05	COIL (39MHZ, BPF)		
T16			L34-0851-05	COIL (40MHZ, LPF)		
T17 ,18			L34-0856-05	COIL (40MHZ, LPF)		
T19			L34-0851-05	COIL (40MHZ, LPF)		
T20			L32-0677-15	OSCILLATING COIL (VCO, 36MHZ)		
T45			L34-1124-05	COIL		

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IC4 IC5 IC6 IC7 ,8 IC9		*	MN6147C MS4460L SN74LS90N SN16913P MN6147	IC(FREQ SYNTHESIZER PLL) IC(PRE SCALER) IC IC(DUBLE BALANCED MIXERS) IC		
IC10 IC11,12 IC13 IC14 IC15		*	MS4460L SN16913P SN74S112N SN16913P SN74S10N	IC(PRE SCALER) IC(DUBLE BALANCED MIXERS) IC IC(DUBLE BALANCED MIXERS) IC		
IC16 IC17 IC18 Q1 ,2 Q3 -5		*	SN74S112N MB87006 MN6147 2SC3113(B) 2SC2668(Y)	IC IC(FREQ SYNTHESIZER PLL) IC TRANSISTOR TRANSISTOR		
Q6 ,7 Q8 Q9 Q10 ,11 Q12 -15			2SC2458(Y) 2SC1959(Y) 2SC2458(Y) 2SC3113(B) 2SC2668(Y)	TRANSISTOR TRANSISTOR TRANSISTOR TRANSISTOR TRANSISTOR		
Q16 ,17 Q18 -20 Q21 Q22 -24 Q25			2SC3113(B) 2SC2668(Y) 2SC2787(L) 2SC2668(Y) 2SC2458(Y)	TRANSISTOR TRANSISTOR TRANSISTOR TRANSISTOR VARICAP		
Q26 -30 Q31 -35 Q36 Q37			2SC2668(Y) 2SC2459(BL) 2SK192A(GR)*J 2SC2668(Y)	TRANSISTOR TRANSISTOR FET TRANSISTOR		
FILTER UNIT (X51-1340-00)						
C1 ,2 C3 -6 C7 ,8 C9 ,10 C11			CC45CH1H101J CK45B1H222K CK45F1H473Z CK45B1H222K CK45F1H473Z	CERAMIC 100PF J CERAMIC 2200PF K CERAMIC 0.047UF Z CERAMIC 2200PF K CERAMIC 0.047UF Z		
C12 C13 C14 C15 C16			CK45F1H103Z CED4W1H010M CED4W1HR47M CED4W1H100M CK45F1H103Z	CERAMIC 0.010UF Z ELECTRO 1.0UF 50WV ELECTRO 0.47UF 50WV ELECTRO 10UF 50WV CERAMIC 0.010UF Z		
C18 C20 C21 C23 C24			C91-0117-05 C91-0117-05 C91-0117-05 CK45F1H103Z CK45F1H223Z	CERAMIC 0.01UF K CERAMIC 0.047UF K CERAMIC 0.01UF K CERAMIC 0.010UF Z CERAMIC 0.022UF Z		
C25 C26 C27 C28 C29			CK45F1H103Z CK45F1H473Z CK45F1H103Z CED4W1HR47			

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L37		*	L34-3154-05	COIL		
L38		*	L34-3156-05	COIL		
L40		*	L34-3157-05	COIL		
L41		*	L34-3158-05	COIL		
L42		*	L39-0422-05	COIL		
L43		*	L39-0423-05	COIL		
R1			RC05GF2H181J	RC 180 J 1/2W		
R2 -4			RC05GF2H101J	RC 100 J 1/2W		
VR1 ,2			R12-4414-05	TRIMMING PBT. (50K) PROTECTION		
VR3			R12-3447-05	TRIMMING PBT. (10K) POWER DOWN		
VR4 -6			R12-1431-05	TRIMMING PBT. (1K) ALC METER		
W13			R92-1061-05	JUMPER REST 00HM		
W14			R92-0150-05	JUMPER REST 0 8HM		
RL1 -12			S51-1420-05	RELAY (DC-1,12V)		
S1			S31-1411-05	SLIDE SWITCH		
D1			1S1587	DIODE		
D2			1S1007	DIODE		
D3 -5			1SS101	DIODE		
D4			MTZ9.1JC	ZENER DIODE		
D6		*	UZ9.1BL	ZENER DIODE		
D7			MTZ7.5JA	ZENER DIODE		
D8			MTZ9.1JC	ZENER DIODE		
D9		*	UZ9.1BL	ZENER DIODE		
D10			MTZ4.3JC	ZENER DIODE		
			MTZ3.0JB	ZENER DIODE		
D12 -23			1N4448	DIODE		
D12 -23			1S1555	DIODE		
D23			MC931	DIODE		
D25			MTZ7.5JA	ZENER DIODE		
Q1			DTC114ES	D		

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C22			C90-0822-05	ELECTR0 47UF 16WV		
C23 -38			C91-0769-05	CERAMIC 0.01UF M		
C39 -41			C91-0753-05	CERAMIC 470PF K		
C45 -48			C91-0769-05	CERAMIC 0.01UF M		
C50			C91-0119-05	CERAMIC 0.047UF K		
C51		*	C90-2020-05	ELECTR0 15UF 25WV		
C52			C91-0769-05	CERAMIC 0.01UF M		
C53 ,54			C91-0119-05	CERAMIC 0.047UF K		
C55			C90-0822-05	ELECTR0 47UF 16WV		
C56			C91-0119-05	CERAMIC 0.047UF K		
C57			C90-0822-05	ELECTR0 47UF 16WV		
C58			C91-0119-05	CERAMIC 0.047UF K		
C59			C90-0822-05	ELECTR0 47UF 16WV		
C60			C91-0769-05	CERAMIC 0.01UF M		
C61			C91-0119-05	CERAMIC 0.047UF K		
C62			C90-0822-05	ELECTR0 47UF 16WV		
C63 ,64			C91-0757-05	CERAMIC 0.001UF K		
C65 -70			C91-0769-05	CERAMIC 0.01UF M		
C100-114			C91-0769-05	CERAMIC 0.01UF M		
-			E02-0114-05	TRANSISTOR SOCKET (16P)		
-		*	E02-2001-05	TRANSISTOR SOCKET (28P)		
-			E40-3237-05	PIN CONNECTOR (MINI,2P)		
-			E40-3238-05	PIN CONNECTOR (MINI,3P)		
-			E40-3239-05	PIN CONNECTOR (MINI,4P)		
-			E40-3240-05	PIN CONNECTOR (MINI,5P)		
-			E40-3241-05	PIN CONNECTOR (MINI,6P)		
-			E40-3242-05	PIN CONNECTOR (MINI,7P)		

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D81 D82 -B4 IC1 IC2 IC2			1SS101 1SS133 UPD7800G TMP8255AP-5 UPD8255AC-5	DIODE DIODE IC (MICROPROCESSOR) IC (PROGRAMMABLE INTERFACE) IC (PROGRAMMABLE INTERFACE)		
IC3 IC4 IC5 IC6 IC7		*	PST520D TC4069UBP TC4011BP TC4030BP TC4011BP	IC (LOW POWER RESET) IC (INVERTER X6) IC (NAND X4) IC (EXCLUSIVE OR X4) IC (NAND X4)		
IC20 IC51 IC52 IC53 IC53		*	MB8418-20LP-GRA SN74LS138N MBM27128-25JA1 TMP8255AP-5 UPD8255AC-5	IC (16K RAM) IC IC (PROGRAMMABLE INTERFACE) IC (PROGRAMMABLE INTERFACE) IC (PROGRAMMABLE INTERFACE)		
IC56 Q1 -7 Q8 -13 Q14 Q18 -24 Q25 Q50		*	SN7404N DTC144WS DTA114ES DTC144WS DTA114ES DTA114ES DTC144WS	IC (6-CIRCUIT INVERTER) DIGITAL TRANSISTOR DIGITAL TRANSISTOR DIGITAL TRANSISTOR DIGITAL TRANSISTOR DIGITAL TRANSISTOR DIGITAL TRANSISTOR		
DISPLAY UNIT (X54-1870-00)						
C1 C2 C3 C4 C5 -7		*	C90-0871-05 C91-0119-05 C90-0504-05 C892M1H223K C90-0504-05	ELECTRO 220UF 16WV CERAMIC 0.047UF K ELECTRO 10UF 35WV MYLAR 0.022UF K ELECTRO 10UF 35WV		
C10 C11 C12 -14 C15 C16		*	C91-0769-05 C90-0822-05 C91-0769-05 C90-0822-05 C91-0769-05	CERAMIC 0.01UF M ELECTRO 47UF 16WV CERAMIC 0.01UF M ELECTRO 47UF 16WV CERAMIC 0.01UF M		
C17 C50 -52 C53 C54 -56 C57		*	C91-0119-05 CK45F1H103Z CK45E2H222P CK45B1H102K CK45F1H103Z	CERAMIC 0.047UF K CERAMIC 0.010UF Z CERAMIC 2200PF P CERAMIC 1000PF K CERAMIC 0.010UF Z		
- - - - -			E40-3237-05 E40-3238-05 E40-3239-05 E40-3240-05 E40-3241-05	PIN CONNECTOR (MINI, 2P) PIN CONNECTOR (MINI, 3P) PIN CONNECTOR (MINI, 4P) PIN CONNECTOR (MINI, 5P) PIN CONNECTOR (MINI, 6P)		
-			E40-3242-05	PIN CONNECTOR (MINI, 7P)		

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S53			S31-2405-05	SLIDE SWITCH		
S54 -56			S40-2440-15	PUSH SWITCH		
S57			S40-2441-15	PUSH SWITCH		
S58 -60			S40-2440-15	PUSH SWITCH		
D1 -4			1S1555	DIODE		
D5 ,6			MTZ6.2JA	ZENER DIODE		
D50 ,51			1SS133	DIODE		
D52			1SS101	DIODE		
IC1		*	UPD6300C	IC (FL LATCH DRIVER)		
IC2			MB4052	IC (4CH 8BIT A/D CONVERTER (ADE))		
IC3			TC4013BP	IC (D FLIP-FLIP X2)		
PL1		*	FIP13BM7	FLUORESCENT INDICATOR TUBE		
Q1 ,2			DTA114ES	DIGITAL TRANSISTOR		
Q3			DTC144WS	DIGITAL TRANSISTOR		
Q4 ,5			2SC1959(Y)	TRANSISTOR		
Q50			DTC143TS	DIGITAL TRANSISTOR		
AT UNIT (X57-1150-00)						
C1 ,2			C91-0117-05	CERAMIC 0.01UF K		
C3 ,4			CK45B1H102K	CERAMIC 1000PF K		
C5			C91-0119-05	CERAMIC 0.047UF K		
C6			CK45B1H102K	CERAMIC 1000PF K		
C7			C91-0119-05	CERAMIC 0.047UF K		
C8			CK45B1H102K	CERAMIC 1000PF K		
C9			C91-0119-05	CERAMIC 0.047UF K		
C10			CE04W1H100M	ELECTR0 10UF 50WV		
C11			CE04W1C470M	ELECTR0 47UF 16WV		
C12			C91-0119-05	CERAMIC 0.047UF K		
C13 -15			C91-0117-05	CERAMIC 0.01UF K		

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-			L92-0103-05	TRIDAL CORE (FOR L1,2)		
-		*	L92-0119-05	TRIDAL CORE (FOR T100,101)		
L1			L39-0416-05	COIL		
L2			L39-0415-05	COIL		
L3			L40-1011-13	SMALL FIXED INDUCTOR		
L4			L40-1011-14	SMALL FIXED INDUCTOR		
L5 -11			L40-1011-13	SMALL FIXED INDUCTOR		
L12			L40-1011-14	SMALL FIXED INDUCTOR		
L13 ,14			L40-1011-13	SMALL FIXED INDUCTOR		
L100			L40-1011-13	SMALL FIXED INDUCTOR		
T100		*	L34-3144-15	COIL		
T101		*	L34-3145-15	COIL		
T102		*	L34-3146-15	COIL		
B	1P,1Q		N88-3006-46	FLAT HEAD TAPTITE SCREW		
M	1Q,2R		N87-2606-46	BRAZIER HEAD TAPTITE SCREW		
N	2P,1R		N87-3006-46	BRAZIER HEAD TAPTITE SCREW		
R1		*	RC05GF2H510J	RC 51 J 1/2W		
VR1 ,2			R12-3425-05	TRIMMING PNT. (10K)AUT. ANT. TUN		
W11			R92-0150-05	JUMPER REST 0 OHM		
W16 ,17			R92-1061-05	JUMPER REST 0 OHM		
W19			R92-0150-05	JUMPER REST 0 OHM		
RL1		*	S51-2417-05	RELAY (DC-2,12V)		
RL 100-105			S51-1420-05	RELAY (DC-1,12V)		
M1 ,2			T42-0303-05	DC MOTOR ASSY		
D1 -4			1SS99	DIODE		
D5 ,6		*	U26.2BL	ZENER DIODE		
D7			1SS133	DIODE		
D8			1N4448			

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SIDE TONE UNIT (X59-1060-00)						
C1			CK73FB1E223K	CHIP C 0.022UF K		
C2 -5		*	CK73FB1H123K	CHIP C 0.012UF K		
C6 -8			CK73FB1E223K	CHIP C 0.022UF K		
-			E23-0471-05	TERMINAL		
R1 .2			RK73FB2A823J	CHIP R 82K J 1/10W		
R3			RK73FB2A223J	CHIP R 22K J 1/10W		
R4			RK73FB2A472J	CHIP R 4.7K J 1/10W		
R5			RK73FB2A102J	CHIP R 1.0K J 1/10W		
R6			RK73FB2A103J	CHIP R 10K J 1/10W		
R7 .8			RK73FB2A333J	CHIP R 33K J 1/10W		
R9			RK73FB2A103J	CHIP R 10K J 1/10W		
R10			RK73FB2A333J	CHIP R 33K J 1/10W		
R11			RK73FB2A183J	CHIP R 18K J 1/10W		
W1 -6			R92-0670-05	CHIP R 0 OHM		
D1			DAN202(K)	CHIP DIODE		
D2			DAP202(K)	CHIP DIODE		
D3			DAN202(K)	CHIP DIODE		
Q1			2SC2712(Y)	CHIP TRANSISTOR		
SELECTIVITY UNIT (X59-1070-00)						
-			E23-0471-05	TERMINAL		
R1			RK73FB2A473J	CHIP R 47K J 1/10W		
R2			RK73FB2A103J	CHIP R 10K J 1/10W		
R3			RK73FB2A473J	CHIP R 47K J 1/10W		
R4			RK73FB2A103J	CHIP R 10K J 1/10W		
R5			RK73FB2A473J	CHIP R 47K J 1/10W		
R6			RK73FB2A103J	CHIP R 10K		

* New Parts

Parts without Parts No. are not supplied.

Les articles non mentionnés dans le Parts No. ne sont pas fournis.

Teile ohne Parts No. werden nicht geliefert.

Ref. No. 参照番号	Address 位置	New Parts 新	Parts No. 部品番号	Description 部品名 / 規格	Desti- nation 仕向	Re- marks 備考
IF UNIT (X60-1300-00)						
C1			C91-0769-05	CERAMIC 0.01UF M		
C2			CC45SL1H150J	CERAMIC 15PF J		
C3 -6			C91-0769-05	CERAMIC 0.01UF M		
C7			CC45SL1H150J	CERAMIC 15PF J		
C8 -10			C91-0769-05	CERAMIC 0.01UF M		
C11			C91-0117-05	CERAMIC 0.01UF K		
C12 ,13			CK45F1H103Z	CERAMIC 0.010UF Z		
C14 -16			C91-0119-05	CERAMIC 0.047UF K		
C17			CK45F1H223Z	CERAMIC 0.022UF Z		
C18 -22			C91-0119-05	CERAMIC 0.047UF K		
C24			C91-1008-05	CERAMIC 0.022UF K		
C25 -30			C91-0119-05	CERAMIC 0.047UF K		
C31			CC45SL1H050C	CERAMIC 5.0PF C		
C32 -34			C91-0119-05	CERAMIC 0.047UF K		
C35			CK45F1H223Z	CERAMIC 0.022UF Z		
C36 ,37			C91-0119-05	CERAMIC 0.047UF K		
C38			C91-0769-05	CERAMIC 0.01UF M		
C39			CE04W1H0R1M	ELECTR0 0.1UF 50WV		
C39 ,40			C91-0119-05	CERAMIC 0.047UF K		
C41			C91-1008-05	CERAMIC 0.022UF K		
C43			C91-0119-05	CERAMIC 0.047UF K		
C44			CC45SL1H101J	CERAMIC 100PF J		
C45			CK45B1H102K	CERAMIC 1000PF K		
C46 ,47			C91-0119-05	CERAMIC 0.047UF K		
C48			CC45UJ1H470J	CERAMIC 47PF J		
C49			CC45U			

PARTS LIST

* New Parts

Parts without Parts No. are not supplied.

Les articles non mentionnés dans le Parts No. ne sont pas fournis.

Teile ohne Parts No. werden nicht geliefert.

Ref. No. 参照番号	Address 位置	New Parts 新	Parts No. 部品番号	Description 部品名 / 規格	Desti- nation 仕 向	Re- marks 備考
C82 -84			CK45B1H102K	CERAMIC 1000PF K		
C85		*	C90-2022-05	ELECTR0 15UF 16WV		
C86 ,87			C91-0119-05	CERAMIC 0.047UF K		
C88			CC45SL1H120J	CERAMIC 12PF J		
C89			CQ92M1H152K	MYLAR 1500PF K		
C90			CQ92M1H183K	MYLAR 0.018UF K		
C91			CQ92M1H103K	MYLAR 0.010UF K		
C92			CE04W1A220M	ELECTR0 22UF 10WV		
C93			CQ92M1H682K	MYLAR 6800PF K		
C94			CE04W1H4R7M	ELECTR0 4.7UF 50WV		
C95			CC45SL1H470J	CERAMIC 47PF J		
C95			CQ92M1H473K	MYLAR 0.047UF K		
C96			C91-0769-05	CERAMIC 0.01UF M		
C97			CC45SL1H390J	CERAMIC 39PF J		
C99			C91-0769-05	CERAMIC 0.01UF M		
C100			C91-0119-05	CERAMIC 0.047UF K		
C101			CK45B1H102K	CERAMIC 1000PF K		
C102			C91-0769-05	CERAMIC 0.01UF M		
C103			CE04W1H100M	ELECTR0 10UF 50WV		
C104			CC45SL1H470J	CERAMIC 47PF J		
C105			CK45B1H221K	CERAMIC 220PF K		
C106			C91-0119-05	CERAMIC 0.047UF K		
C107			CC45SL1H470J	CERAMIC 47PF J		
C108			CE04W1H010M	ELECTR0 1.0UF 50WV		
C109			CE04W1HR47M	ELECTR0 0.47UF 50WV		
C110			CS15E1ER47M	TANTAL 0.47UF 25WV		
C111			CE0			

