

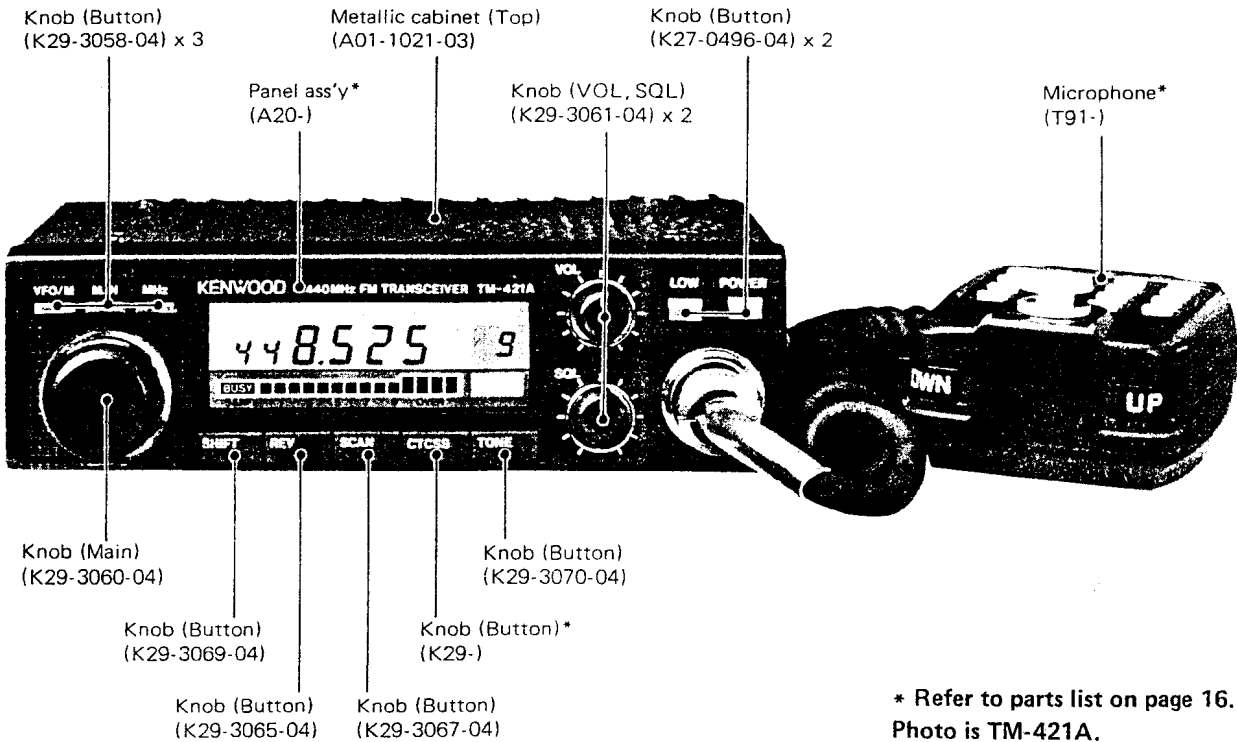
430MHz/440MHz FM TRANSCEIVER

TM-421A/E/ES

SERVICE MANUAL

KENWOOD

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* Refer to parts list on page 16.
Photo is TM-421A.

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TM-421A/E/ES

CIRCUIT DESCRIPTION

UNIT	TM-421A (35W)		TM-421E (10W)		TM-421ES (35W)	
	K	M	T1	W1	T2	W2
FINAL UNIT	X45-1370-12	X45-1370-03	X45-1370-52		X45-1370-53	
CONTROL UNIT	X53-3040-12	X53-3040-23	X53-3040-52	X53-3040-62	X53-3040-52	X53-3040-62
TX-RX UNIT	X57-3070-11	X57-3070-21	X57-3070-51		X57-3070-52	
VCO	X58-3100-11	X58-3100-21	X58-3100-51		X58-3100-51	
SQL	X59-3150-00		X59-3150-51		X59-3150-51	

Table 1 Comparison of TM-421A, TM-421E and TM-421ES

Frequency configuration

The TM-421A/E/ES utilize a PLL synthesizer system incorporating a digital VFO. (See Fig. 1.) The channel step can be selected as 5, 10, 12.5, 15, 20, or 25kHz.

The receiver operates as a double conversion system. Received signals are mixed with the first local oscillator (418.400~428.395MHz (K), 408.400~418.395MHz (M,T, W) to produce the first intermediate frequency of 21.6MHz. The first intermediate frequency is mixed with the second local oscillator (21.145MHz) to produce the second intermediate frequency of 455kHz.

The transmitter system consists of a PLL circuit incorporating a direct oscillator and direct divider. The output is amplified by a linear amplifier prior to being transmission.

Receiver system

• General

Incoming signals from the antenna pass through a low-pass filter in the Transmitter Final unit and a diode transmit/receive switch, then enter the receiver front end.

After passing through antenna matching coils the signals are amplified by a GaAs (galium arsenide) FET (Q1 : 3SK184(S)), and goes through the 2-pole helical resonator (L3). It is then supplied again to another FET stage (Q2 : 2SK125) and 2-pole helical resonator (L4) to remove undesired signals, and applied to the 1st mixer (Q3 : 3SK184(R)), which employs the same GaAs FET as in the RF stage to obtain a good 2-signal characteristics. In the first mixer (Q3) the signal is mixed with the first local oscillator from the PLL system to produce the first IF signal of 21.6MHz. Interfering Adjacent channel interference is removed from the first IF signal by a two-stage monolithic crystal filter (MCF) (L8).

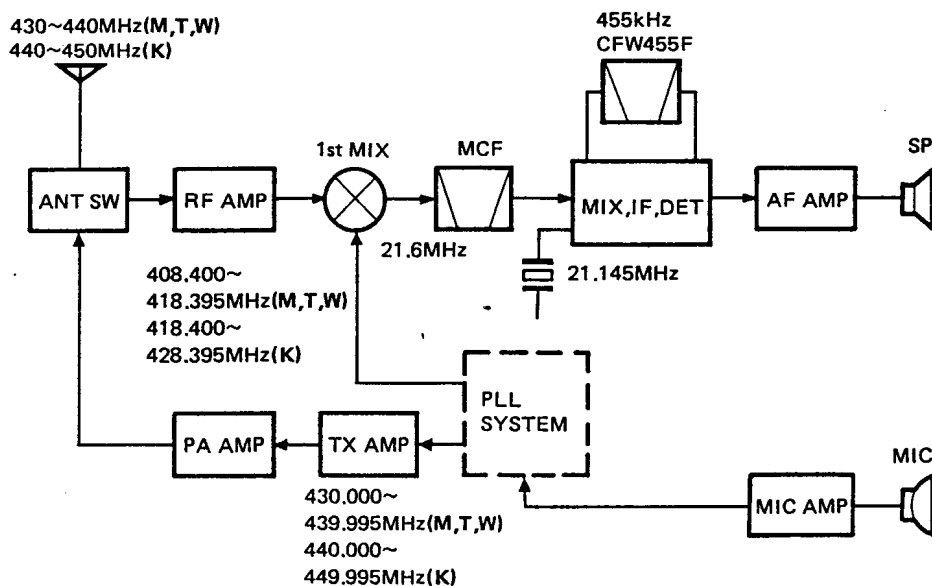


Fig. 1 Frequency configuration

CIRCUIT DESCRIPTION

The first IF signal is amplified by Q4 : 2SC2714(Y) and fed to a special narrow-FM IC (TA7761F). Here the signal is mixed with the 21.145MHz frequency from the second local oscillator to produce the 455kHz second IF signal. This signal is sharpened by passing it through a six-element ceramic filter (CFW455F). The signal is then amplified by a five-stage limiting amplifier contained in IC1. This is followed by quadrature detection which is also performed by IC1. Undesirable high-frequency components are removed from the detected signal by an active low-pass filter. The signal then passes through the audio volume control, then is amplified by the audio power amplifier (IC4), and applied to the speaker. The circuit configuration from detection onward is shown in Fig. 2.

- **S-meter circuit**

The S-meter output voltage of the special narrow-FM IC (TA7761F) is amplified by an inverting amplifier, then fed to the Control unit. The microprocessor converts the analog voltage to a digital signal that is used to control the LCD bar meter.

- **Squelch circuit**

The noise component extracted from the detector output is filtered to remove the second intermediate frequency component (455kHz), amplified twice, and is then fed to the rectifier. After rectification, the signal passes through the squelch control to the audio limiter circuit.

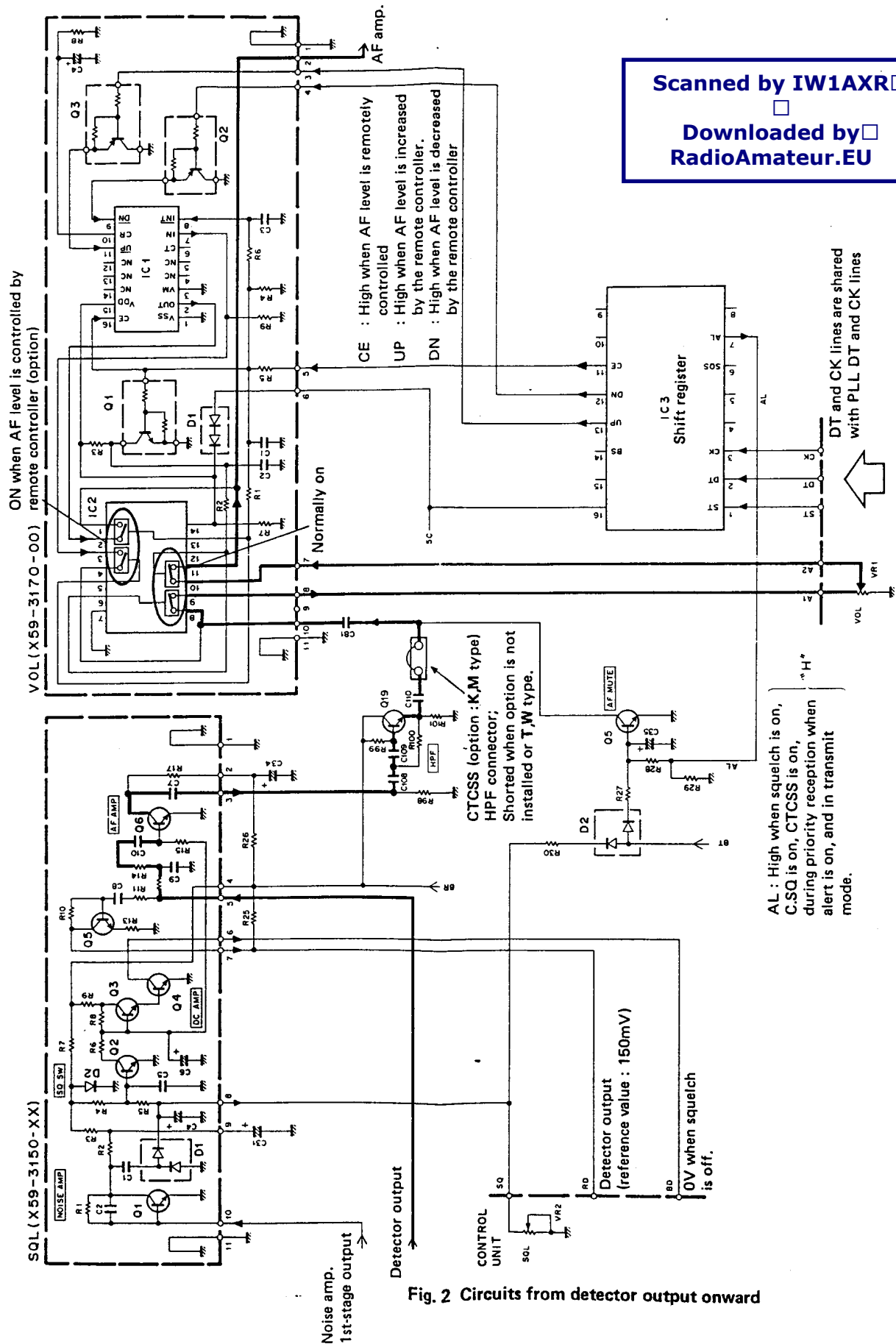
Item	Rating
Nominal center frequency (fo)	21.600kHz
3dB bandwidth	±7.5kHz or more
Attenuation bandwidth	±25kHz or less at 40dB ±45kHz or less at 60dB
Guaranteed attenuation	70dB or more within ±1MHz (Spurious response 35dB or more) 80dB or more within ±(910kHz ±20kHz)
Ripple	1.0dB or less
Loss	2.0dB or less
Input and output impedance	1kΩ/1pF

Table 2 MCF (L71-0227-05) characteristics (TX-RX unit L8)

Item	Rating
Nominal center frequency	455kHz±1kHz
6dB bandwidth	±6kHz or more (from 455kHz)
50dB bandwidth	±12.5kHz or less (from 455kHz)
Ripple (within 455±4kHz)	3dB or less
Insertion loss	6dB or less
Guaranteed attenuation (within 455±100kHz)	35dB or less
I/O impedance	2.0kΩ

Table 3 Ceramic filter CFW455F (L72-0315-05) characteristics (TX-RX unit L13)

CIRCUIT DESCRIPTION



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Fig. 2 Circuits from detector output onward

CONTROL UNIT (X53-3040-XX)

CIRCUIT DESCRIPTION

Transmitter system

● General

In the transmitter system the desired frequency is produced directly by an oscillator. Frequency modulation is obtained directly thru the use of a varactor diode.

● Modulation circuit

Audio signals from the microphone are applied to a three-stage operational amplifier which adds preemphasis, performs amplification and limiting, and includes a splatter filter to remove undesired high-frequency components. After amplification by the operational amplifier, part of the audio signal is applied to the microphone check circuit used in the low-power mode.

In the FM modulation circuit, the frequency of the VCO is directly modulated by a varactor diode.

● Preampifier stage circuit

The output from the VCO enters the linear amplifier, which is capable of high-quality signal amplification because it operates entirely in linear mode. APC, (Automatic Power Control) is performed by controlling the collector voltage of the 3 stage final preampifier stage.

● Power amplifier circuit

The drive signal is applied to the power module and amplified to the required level. In the model TM-421A/ES heat is dissipated efficiently by a large mechanically strong heatsink.

● APC and SWR protection circuits

Fig. 3 shows the basic ALC (Automatic Level Control) and SWR (Standing Wave Ratio) protection circuits. The SWR protection circuit incorporates a CM coupler that detects any reflected power caused by mismatching of the antenna. After detection and amplification, this circuit acts to lower the output control voltage, which protects the power module by reducing the gain. The automatic power control (APC) circuit incorporates a diode that is used to detect a portion of the output from the power module. The detected signal is amplified and is then used to control the power control voltage. The control voltage is inversely proportional to the output, so a constant output level is maintained.

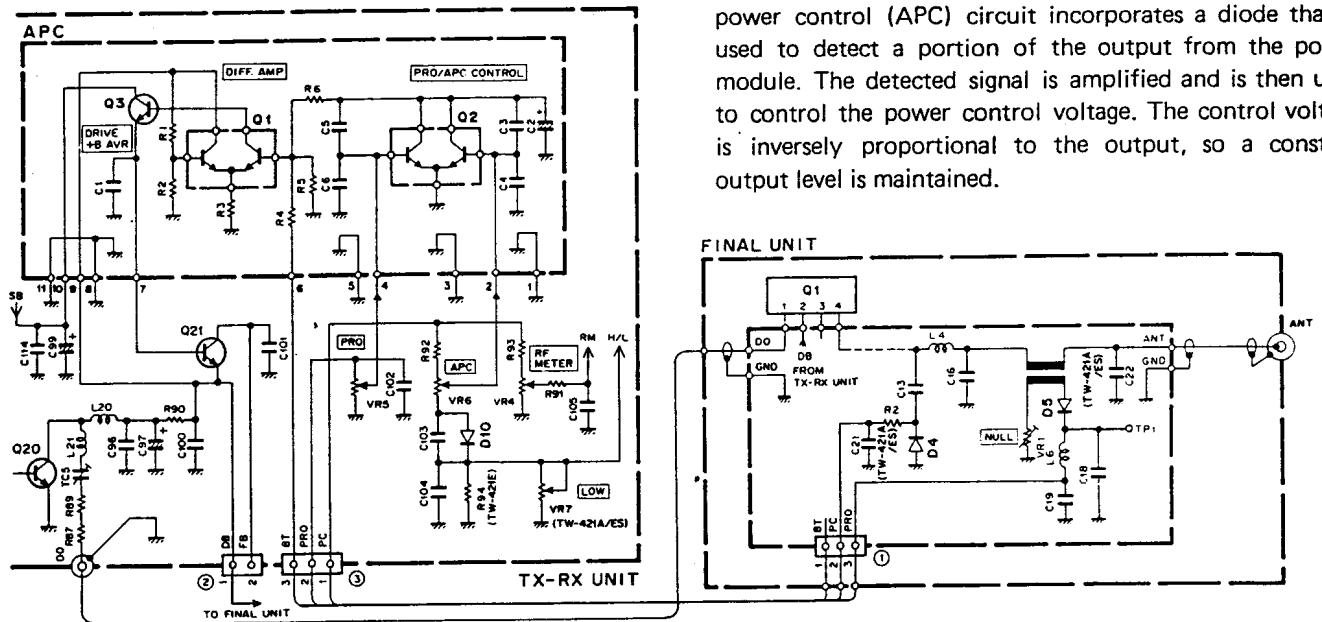


Fig. 3 APC and SWR protection circuits

Item	Symbol	TC (°C)	Unit	Condition	Specifications	
					M57752	M57788M
Operating voltage	Vcc	25	V		17	17
Current consumption	Icc	25	A		5	14
Input power	pin	25	W	Z _G =Z _L =50Ω	0.4 (V _{CC1} ≤12.5V)	0.6 (V _{CC1} ≤13.8V)
Output power	Po	25	W	Z _G =Z _L =50Ω	20	55
Case temperature (operating)	Tc(op)		°C		-30~+110	-30~+110
Storage temperature	Tstg		°C		-40~+110	-40~+110

Table 4 Power module M57752 (TM-421E), M57788M (TM-421A/ES)
absolute maximum ratings (Final unit Q1)

CIRCUIT DESCRIPTION

PLL synthesizer

Fig. 4 is the PLL system block diagram. The transmitter and receiver systems of the TM-421A/E/ES have independent VCOs and PLLs, but share a common low-pass filter.

The VCOs are configured as subunits. This construction minimizes outside influence and improves frequency stability.

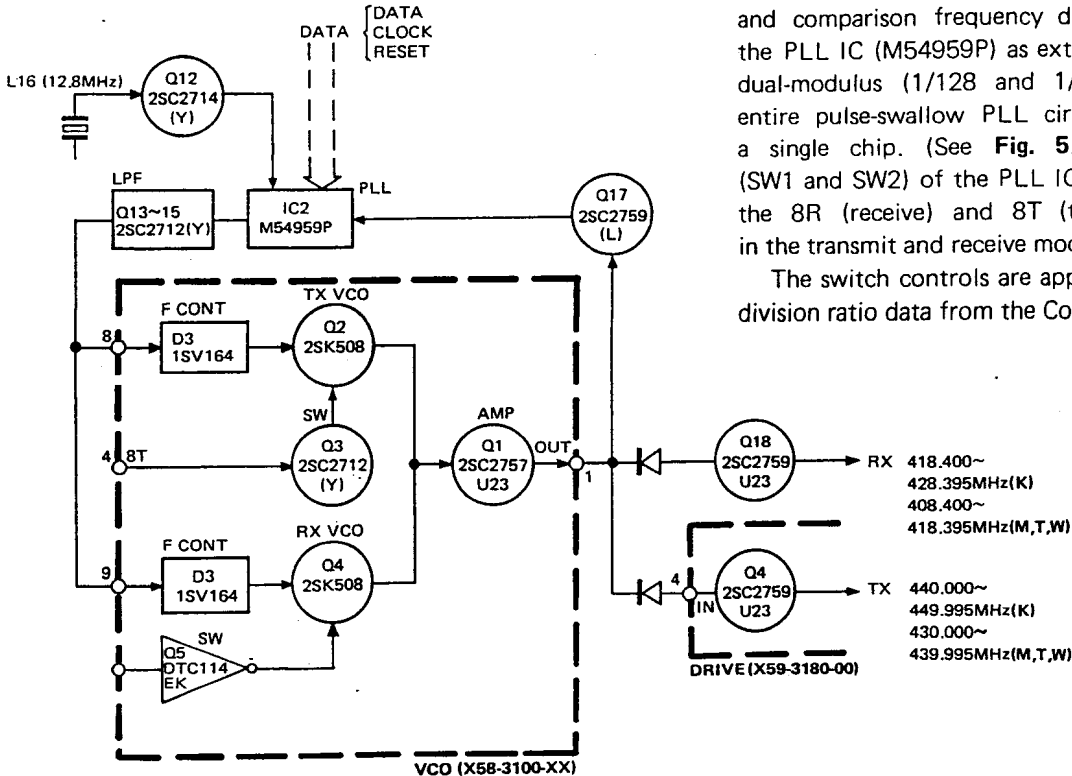


Fig. 4 PLL system block diagram

To provide 5, 10, 12.5, 15, 20, and 25kHz steps, a comparison frequency of 5kHz or 6.25kHz is obtained by dividing the 12.8MHz frequency of the reference oscillator by 2048 or 2560. In both the transmitter and receiver systems the target frequency is produced directly by the VCO, passed through one amplifier stage, then applied to a pulse-swallow PLL IC that divides the frequency, performs phase comparison, and locks the frequency.

The reference frequency division ratios (four values) and comparison frequency division ratio are supplied to the PLL IC (M54959P) as external serial data. An internal dual-modulus (1/128 and 1/129) prescaler enables the entire pulse-swallow PLL circuit to be implemented on a single chip. (See Fig. 5.) The switching functions (SW1 and SW2) of the PLL IC are used to switch between the 8R (receive) and 8T (transmit) operating voltages in the transmit and receive modes.

The switch controls are applied together with frequency division ratio data from the Control unit.

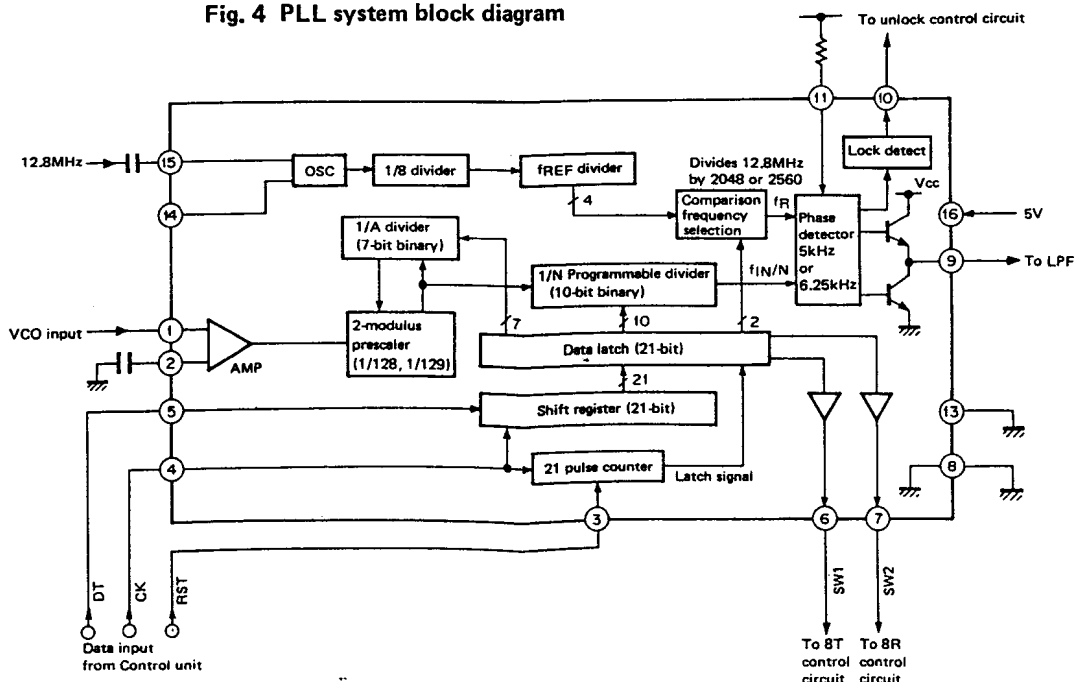


Fig. 5 PLL IC ; M54959P block diagram

CIRCUIT DESCRIPTION

At 440MHz (K), fVCO (RX) has the following relationship to the various frequency division ratios :

$$f_{VCO} = (440 - 21.6) = [(n \times 128) + A] \times f_{osc} / R$$

where, fVCO : Frequency output by the VCO

n : 10-bit binary programmable counter setting

A : 7-bit binary programmable counter setting

fosc : 12.8MHz reference oscillator

R : 14-bit binary programmable counter setting (2560)

If n=653 and A=96, then;

$$f_{VCO} = [(653 \times 128) + 96] \times 12800 / 2560$$

$$= [83584 + 96] \times 5$$

$$= 418400 \text{ kHz} = 418.400 \text{ MHz}$$

• Unlock detector circuit

Whenever the PLL is unlocked, pin 10 of the PLL IC goes high ("H") (5.5V), turning off Q16 so that Q1 and Q2 in the module unit (drive unit) turn OFF. The result is that during receive Q18 is OFF, and during transmit Q4 and Q5 in the module unit are OFF. This halts transmit, preventing unwanted radiation from the antenna. (See Fig. 6.)

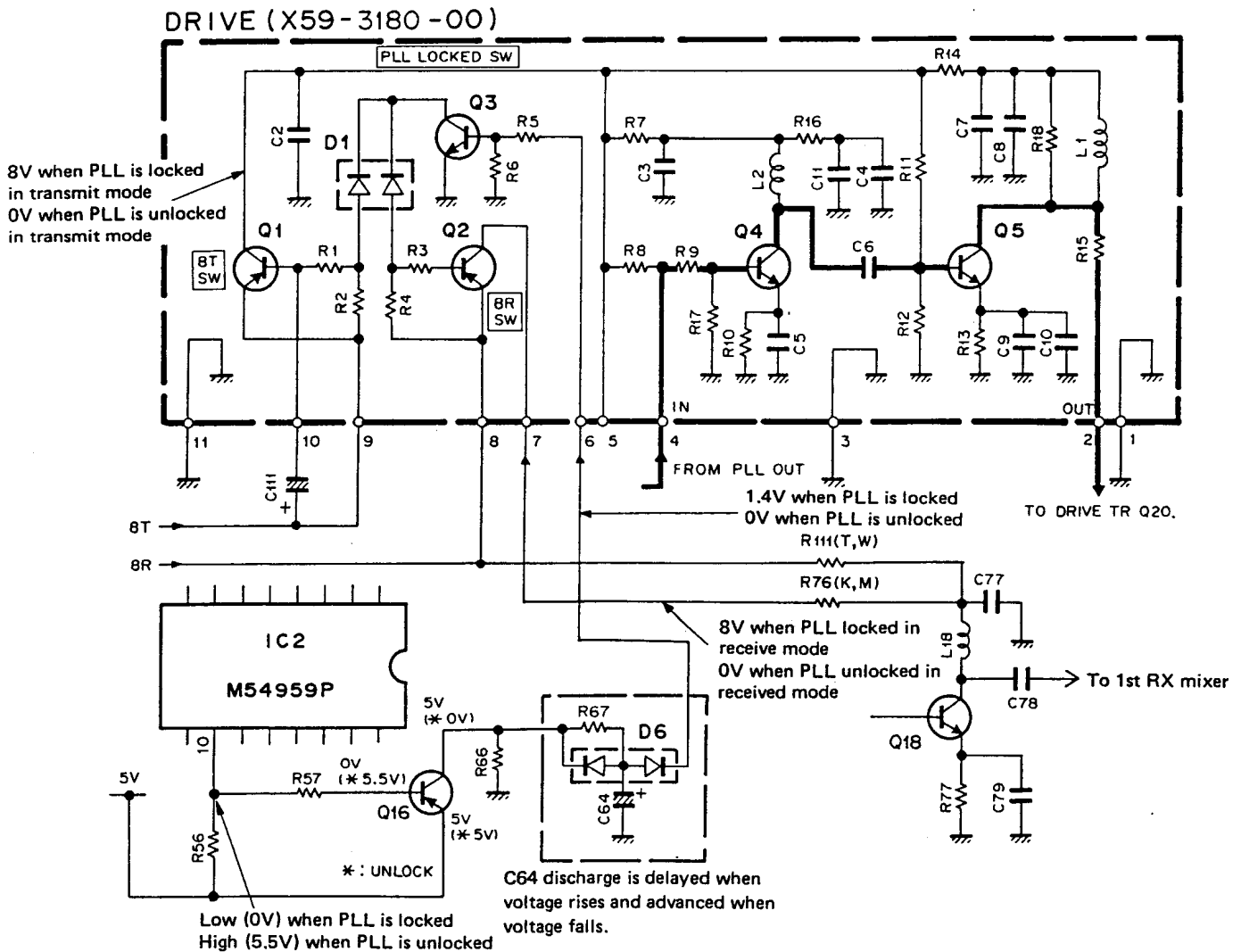


Fig. 6 PLL unlock detector circuit

CIRCUIT DESCRIPTION

Digital control unit

● General

The control unit consists of a microprocessor, input keys, peripheral circuits, and a display. The single microprocessor (IC3) controls all transceiver functions. The pin assignments of the microprocessor are listed on the Table 5.

● Keys and rotary encoder input circuits

Fig. 7 shows the input circuit for the keys and rotary encoder. Data from the front panel keys, microphone keys, and rotary encoder are applied directly to the microprocessor.

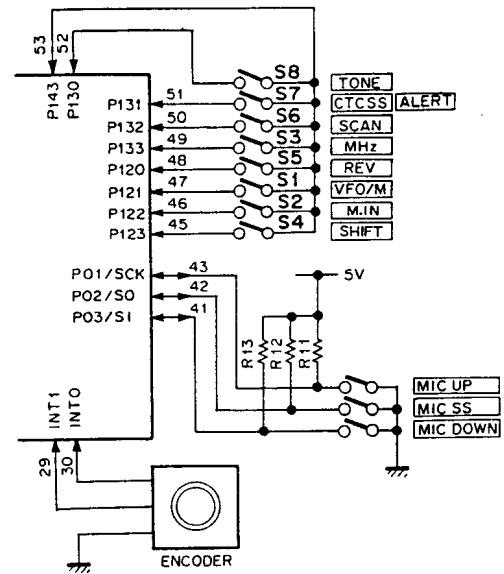


Fig. 7 Key and rotary encoder input circuits

Terminal No.	Name	I/O	Logic	Function	Terminal No.	Name	I/O	Logic	Function
1	P41	O	—	Digital output of D-A conv.	35	T11	—	—	Not used.
2	P40	O	—		36	T10	—	—	
3	P53	O	—		37	P23	O	—	
4	P52	O	—		38	P22	O	H	Squelch control during remote control.
5	P51	O	—		39	P21	O	H	Shift register strobe.
6	P50	O	—		40	PT00	O	—	Beep oscillator output.
7	RESET	I	L	Reset input.	41	P03/SI	I/I	L/—	Microphone DOWN switch input/serial data input.
8	X2	—	—	4.194304MHz crystal oscillator.	42	P02/SO	I/O	L/—	Microphone PTT switch input/serial data input.
9	X1	—	—		43	P01/SCK	I/—	L/—	Microphone UP switch input/serial data input.
10	P63	—	—		44	INT4	I	—	Backup detect input.
11	P62	—	—	Not used.	45	P123	I	L	SHIFT switch input.
12	P61	O	↑	CTCSS shift register reset (K,M)	46	P122	I	L	M.IN switch input.
13	P60	I	L	Model setting : "L" for 144MHz "H" for 430MHz band.	47	P121	I	L	VFO/M select switch input.
14	P73	O	—	LCD driver data.	48	P120	I	L	REV switch input.
15	P72	O	↑	LCD driver clock.	49	P133	I	L	Frequency step select switch input.
16	P71	O	H	LCD driver enable.	50	P132	I	L	SCAN switch input.
17	P70	—	—	Not used.	51	P131	I	L	CTCSS switch input (K,M). Alert switch input (T,W).
18	P83	I	L	Directional input.	52	P130	I	L	TONE switch input.
19	P82	I	L		53	P143	O	—	Pull-down pin.
20	P81	I	L		54	P142	O	—	Not used.
21	P80	I	L		55	P141	O	—	
22	P93	O	—	Not used.	56	P140	O	—	
23	P92	O	↓	PLL and shift register clock.	57	NC	—	—	Power supply pin (5V).
24	P91	O	—	PLL and shift register data.	58	VDD	—	—	GND terminal (0V).
25	P90	O	L	PLL enable.	59	P33	—	—	
26	Vss	—	—	GND terminal (0V).	60	P32	I	H	Tone detect input (when CTCSS is on (K,M)).
27	P13	I	L	BUSY input.	61	P31	O	—	CTCSS IC data (K,M).
28	INT2	I	—	Encoder input.	62	P30	O	↑	CTCSS IC clock.
29	INT1	I	—		63	P43	O	—	DAC digital data output.
30	INT0	I	H	Remote connection detect input (only when connected).	64	P42	O	—	
31	PTH03	I	—	Not used.					
32	PTH02	I	—	Not used.					
33	PTH01	I	—	RF meter analog input.					
34	PTH00	I	—	S meter analog input.					

CIRCUIT DESCRIPTION

● Display circuit

Located in the LCD assembly (Fig. 8), the display circuit consists of the LCD driver, its peripheral circuits, and the LCD. The LCD is driven with a 50% duty cycle

according to serial data sent from pins P71 to P73 of the microprocessor to the LCD driver. Fig. 9 shows the common output and segment output signals of the LCD driver.

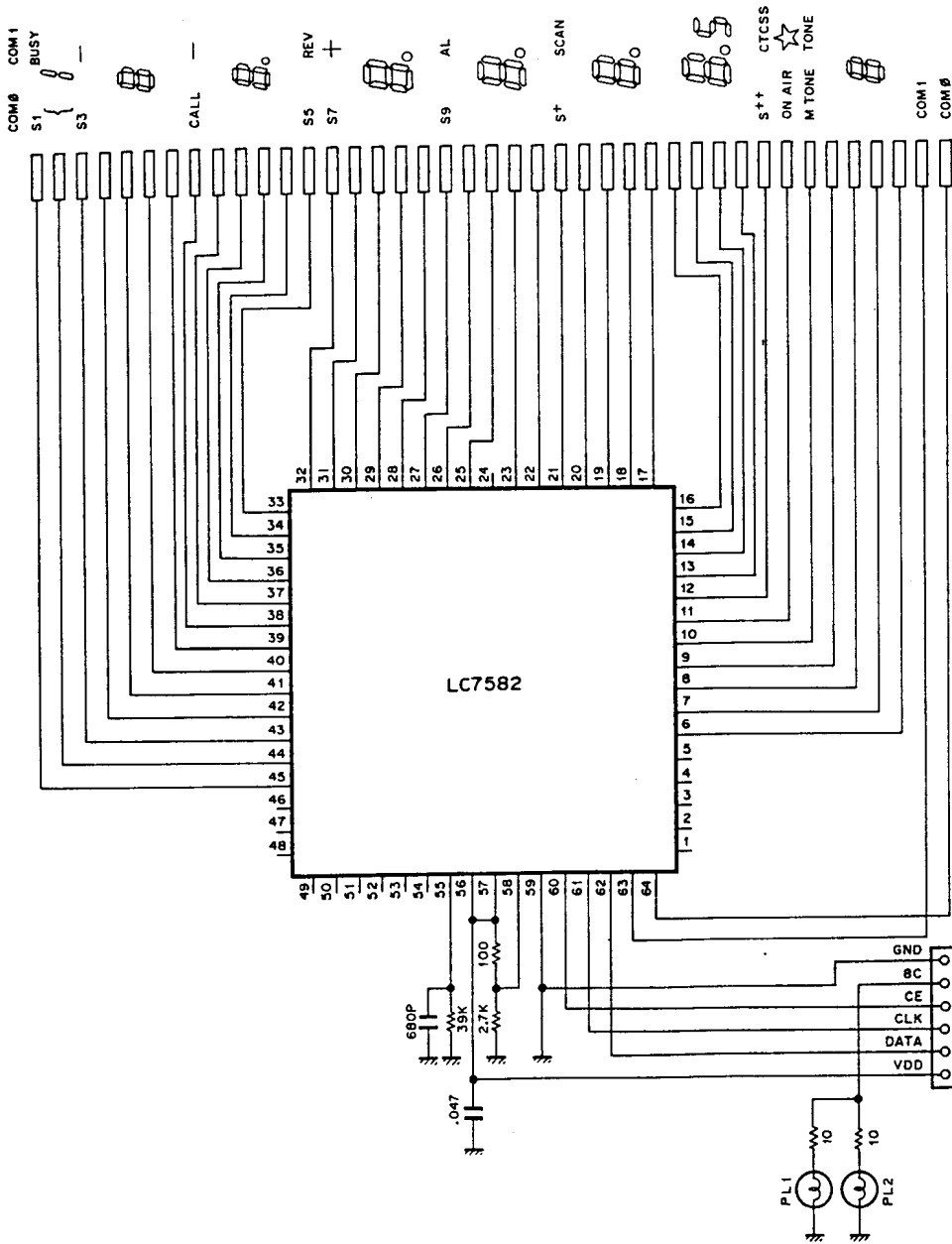


Fig. 8 LCD ass'y (B38-0303-05)

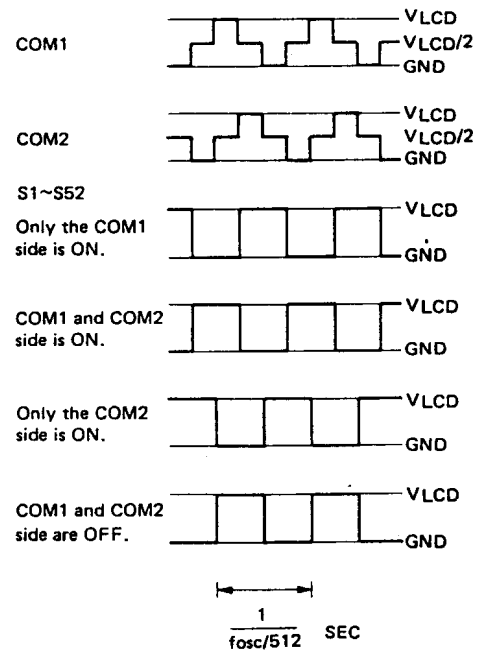


Fig. 9 LCD driver common and segment output signals

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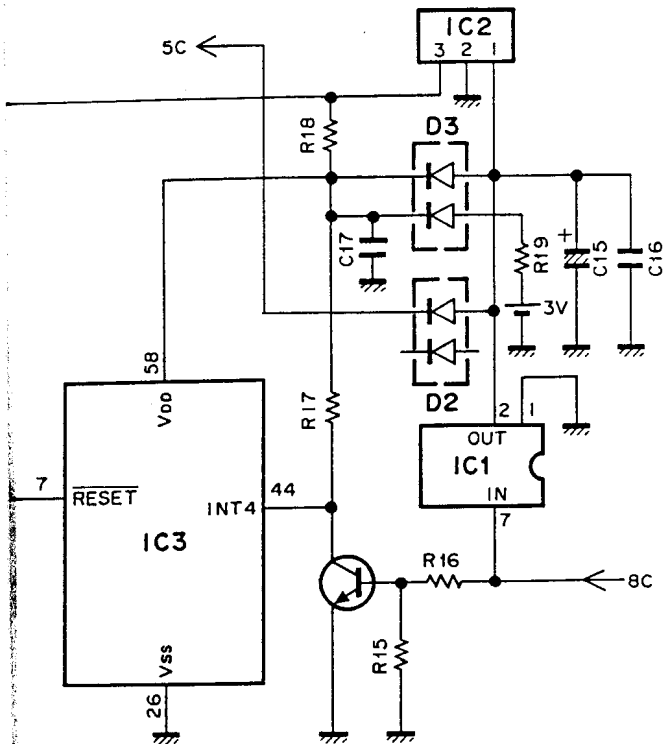
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M-421A/E/ES

CIRCUIT DESCRIPTION

● Reset backup circuit

Fig. 10 shows the reset backup circuit. When the transceiver is turned ON, 3.0V is applied at the INT4 pin causing IC3 to enter the backup mode.



IC2 timing chart

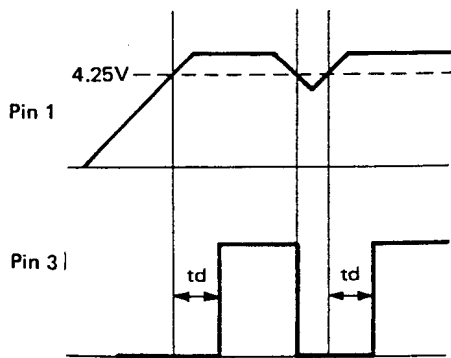


Fig. 10 Reset and backup circuit

● PLL data output

PLL data is supplied from pins P92 (CK), P91 (DT), and P90 (RST) of the microprocessor. Fig. 11 shows the data transfer format. Fig. 12 shows the data configuration.

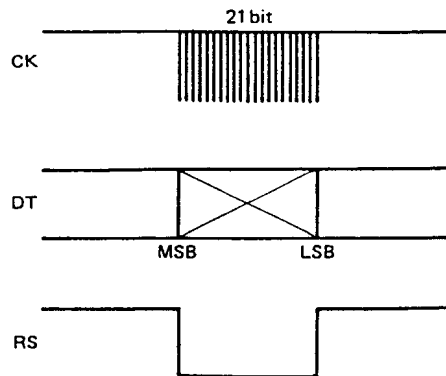
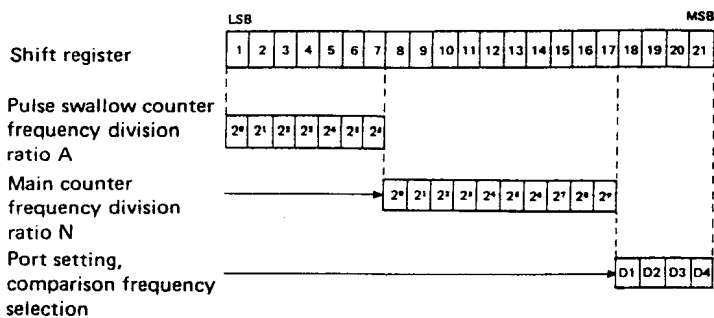


Fig. 11 PLL data transfer format



The 21-bit data is converted by the procedure below.

1. Frequency division ratio data A, N (17 bits)

$$F \text{ (RX display - 21.6MHz)} = [(N \times 128) + A] \times 12.8\text{MHz/ref}$$

N : Frequency division ratio of main 10-bit counter

A : Frequency division ratio of 7-bit pulse swallow counter

2. Comparison frequency (ref) selection (2 bits)

Data		Phase comparison frequency	
D1	D2		
L	L	5kHz	5, 10, 15, 20 or 25kHz steps
H	L	6.25kHz	12.5kHz step

3. Switch selection (2 bits)

Data		Output port		
D3	D4	SW1	SW2	
H	L	H	L	RX mode
L	H	L	H	TX mode

Fig. 12 PLL data configuration

CIRCUIT DESCRIPTION

- **Alert and electronic volume control output (when optional remote controller is connected)**

The alert and electronic volume control outputs are provided by pins P92 (CK), P91 (DT), and P21 (ST) of the microprocessor to the 8-bit shift register (IC3) in the TX-RX unit. P92 (CK) and P91 (DT) are also used for the PLL data. **Fig. 13** shows the data transfer format. **Fig. 14** shows the data configuration.

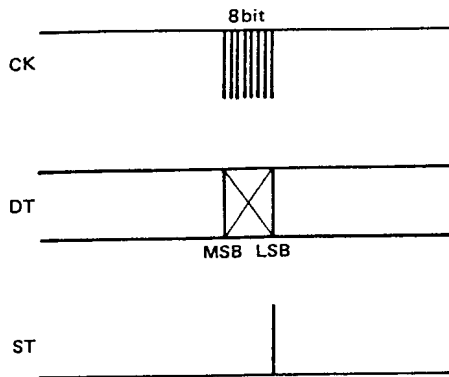


Fig. 13 Data transfer format for alert and electronic volume control

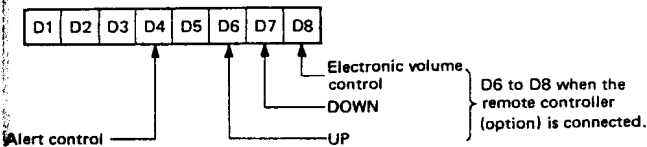


Fig. 14 Data configuration for alert and electronic volume control

- **Tone output**

The outputs from pins P40 to P43 and P50 to P53 of the microprocessor are applied to a ladder resistance network (IC4) which converts these signals into an analog waveform with 38 possible tone frequencies combinations 67.0 to 250.3Hz. **Fig. 15** shows the internal configuration of IC4.

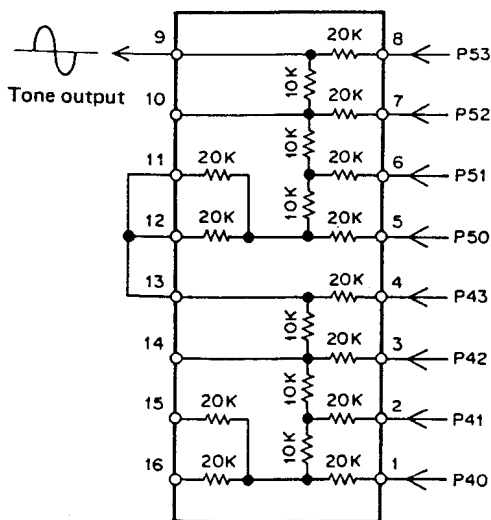


Fig. 15 Internal configuration of KRR-C001 ladder resistance network (Control unit IC4)

- **S-meter and RF meter input**

The analog voltage of the S-meter is applied to pin PTH00 of the microprocessor, and the analog voltage of the RF meter to pin PTH01. After 4-bit (16-step) analog-to-digital conversion, the resulting signal is sent to the display.

- **Busy input**

When squelch is ON and an input signal is present, a low input lights the busy indicator.

- **CTCSS unit (option : TM-421A only) input and output**

The microprocessor sends data from pins P30, P31, and P61 to the CTCSS unit. **Fig. 16** shows the data transfer format. **Fig. 17** shows the data configuration. When a tone is detected from the CTCSS unit, a "H" is applied to pin P32 of the microprocessor to open the squelch.

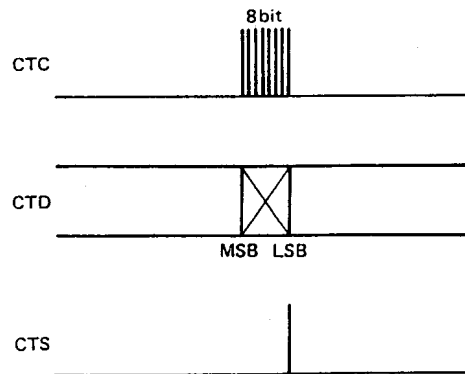
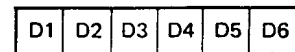


Fig. 16 CTCSS data transfer format

CTCSS unit MN6520 tone frequency select data



Ex. 88.5Hz L H L H H H

Fig. 17 CTCSS data configuration

- **Remote control (RC-10) (option) input and output**

When the RC-10 remote control unit is connected a "H" is applied to pin INTO of the microprocessor, switching the following pins to the functions indicated:

- P03 → SI : Serial data input pin
- P02 → SO : Serial data output pin
- P01 → SCK : Serial clock input/output pin

TM-421A/E/ES

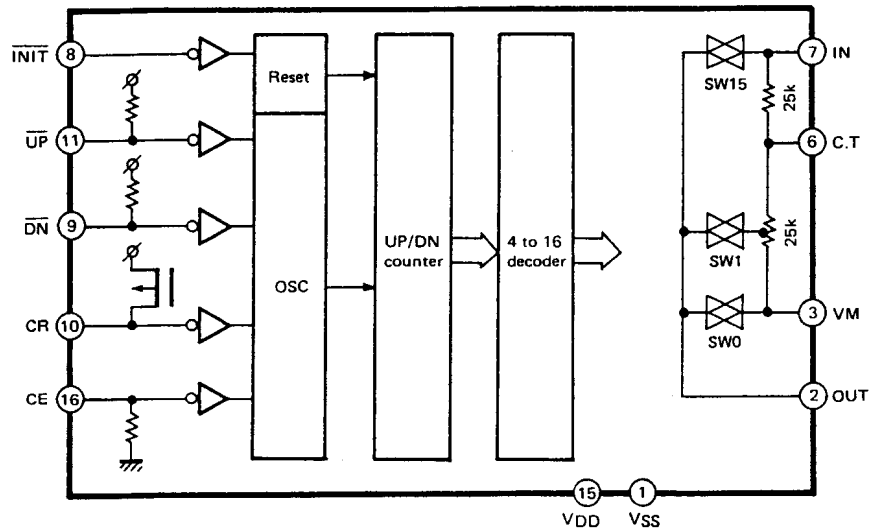
SEMICONDUCTOR DATA

Electronic volume (VOL IC1)

• Electric characteristics

Item	Symbol	Conditions	Specifications			Unit
			Min.	Typ.	Max.	
High-frequency distortion	THD1	VDD=3V, RL=50kΩ, f=1kHz, VR MAX, VIN=-20dBV		0.1	0.5	%
	THD2	VDD=2.1V, RL=50kΩ, f=1kHz, VR MAX, VIN=-20dBV		0.3	1.0	%
Output in low-power mode	X OUT	At 0dBm input : f=1kHz, RL=51kΩ		-95	-60	dB
Input impedance	R IN	UP, DN, CE	100		400	kΩ
Current consumption	IDD (1)	VDD=3V when operating		0.035	1	mA
	IDD (2)	VDD=3V, CE="L"		4		μA

• Block diagram



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DESCRIPTION OF ELEMENTS

FINAL UNIT(X45-1370-XX)

Element	Function	Description
Q1	Power amplifier	Boosts power to the required level. M57752 in TM-421E, M57788M in TM-421A/ES.
D1	Protection against reverse power connection	
D2, D3	Transmit/receive select	ON during transmit.
D4	High-frequency output voltage level detect	Detects high-frequency output level and controls output in the APC circuit.
D5	Reflected power detector	Adjustable with VR1.

CONTROL UNIT (X53-3040-XX)

Element	Function	Description
IC1	6V AVR	
IC2	Reset IC	Outputs Reset signal and detects low voltage.
IC3	Microprocessor	Controls frequencies and general set functions.
IC4	Tone DAC	Converts digital data from IC3 (P40 to P43, P50 to P53) to an analog tone frequency.
Q1	Squelch switching	Switches squelch on/off when remote controller is connected.
Q2	Switching	Controls the microprocessor's backup detect input.
D1	Reverse current protection	Protects against external voltage applied to pin 5 of the microprocessor.
D2(1/2)	Microprocessor protection	Protects against static surge.
D2(2/2)	Voltage drop	
D3(1/2)	Reverse current protection	Prevents current from flowing to the backup battery.
D3(2/2)	Reverse current protection	Prevents backup battery current from flowing to inappropriate circuits.
D4	Microprocessor protection	Protects against static surge.

TX-RX UNIT (X57-3070-XX)

Element	Function	Description
IC1	8V AVR	
IC2	PLL	Pulse-swallow type phase-locked loop.
IC3	Shift register	Controls alert (T,W), electronic volume functions.
IC4	AF amplifier	Speaker output.
Q1, Q2	High-frequency amplifier	Operates in receive mode (430MHz).
Q3	First mixer	Converts the 2 meter-band received frequency into the 21.6MHz.
Q4	High-frequency amplifier	First intermediate frequency amplifies.
Q5	AF muting	Operates when CTCSS is ON (K,M), during priority reception when alert is ON (T,W), when SQS is high, and in transmit mode.
Q6	8R switching	ON in receive mode.
Q7	8T switching	ON in transmit mode.
Q8	8T switching control	ON in transmit mode.
Q9	8R switching control	ON in receive mode.
Q10	Ripple filter	
Q11	Constant-voltage control	5V power supply for PLL.
Q12	OSC circuit	Oscillates 12.8MHz.
Q13~Q15	PLL low-pass filter	
Q16	PLL unlock control	ON when the PLL is locked.
Q17	High-frequency amplifier	Amplifies the VCO output to the level required for the PLL.
Q18	High-frequency amplifier	Amplifies the VCO output to the level required for input to the 1st IF mixer (Q3).
Q19	HPF	Improves AF frequency characteristics in the receive mode.
Q20	Transmit driver (power amplifier)	Amplifies to the level required for input to the final unit power module.
Q21	+ B (DB) AVR of Q20	Operates in transmit mode.

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M-421A/E/ES

DESCRIPTION OF ELEMENTS

Element	Function	Description
D1	Limiting	Limits the first IF signal.
D2	Reversal current protection	Turns on the SQ circuit and Q5 for AL, in transmit mode for muting of the AF line.
D3	Rectifier/Reversal current protection	Prevents flow of RF meter current to the microphone check circuit and rectifies the microphone check output.
D4	Motive power for Q10	
D5	AVR	Zener diode for setting the AVR circuit reference voltage.
D6	Switching characteristic	Diode to provide rise and fall hysteresis on the LD line.
D7	PLL output switch	ON in transmit mode.
D8	PLL output switch	ON in receive mode.
D9	Temperature compensation	Temperature compensation for Q20 (driver).
D10	Temperature compensation	Temperature compensation for APC circuit.
D11	Switching characteristic	Quickens the fall of 8R at the switching from receive mode to transmit mode.
D12	Discharging	Discharges C107 to delay the rise of RX VCO at the switching from transmit mode to receive mode.
D13,14	S-meter circuit protection	Protect for S-meter circuit when TX to RX mode.

VCO (X58-3100-XX)

Element	Function	Description
Q1	Amplifier	Operates in all modes to amplify the VCO output to the required level.
Q2	Transmit VCO	Oscillates 430 to 439.995MHz.
Q3	Transmit VCO switch	Turns on the transmit VCO.
Q4	Receive VCO	Oscillates 399.175 to 409.17MHz.
Q5	Receive VCO switch	Turns on the receive VCO.
D1	Transmit frequency control varactor	430MHz : 2.5V
D2	Transmit modulation varactor	Adds FM modulation to TX VCO.
D3	Receive frequency control varactor	430MHz : 2.5V.

APC (X59-3130-00)

Element	Function	Description
Q1	Differential amplifier	
Q2(1/2)	Protection control	Adjustable with VR5.
Q2(2/2)	APC control	Adjustable with VR6.
Q3	Drive stage + B AVR	

IF (X59-3140-00)

Element	Function	Description
IC1	Second local oscillator, mixer, IF amplifier, quadrature detector, noise amplifier	⑦ S-meter output. ⑪ Noise amplifier output (first stage). ⑨ Detector output ⑬ First IF signal input.

DESCRIPTION OF ELEMENTS

SQL (X59-3150-XX)

Element	Function	Description
Q1	Noise amplifier	
Q2	Squelch switching	ON when squelch is on.
Q3,Q4	DC amplifier	OFF when squelch is on.
Q5	Low-frequency amplifier	For RD terminal.
Q6	Low-frequency amplifier	OFF when squelch is on.
D1	Squelch noise rectifier	
D2	Base bias setting	

MIC (X59-3160-00)

Element	Function	Description
IC1(1/2)	Low-frequency amplifier	① Output, ② Input.
IC1(2/2)	Low-frequency amplifier	For microphone check. ⑥ Input ⑦ Output.
IC2(1/2)	Limiting amplifier	① Output ② Input.
IC2(2/2)	LPF	⑥ , ⑦ Output.

VOL (X59-3170-00)

Element	Function	Description
IC1	Electronic volume control (16 steps, initialized to the 6th step from the bottom)	② Output. ⑦ Input. ⑧ Initialize input : "L" → step 6. ⑨ Increase ("L" input raises the volume 1 step). ⑩ Decrease ("L" input lowers the volume 1 step). ⑪ "H" while operating.
IC2	Bidirectional switch (4 circuits)	① - ② controlled by ⑬ . ③ - ④ controlled by ⑤ . ⑧ - ⑨ controlled by ⑥ . ⑩ - ⑪ controlled by ⑫ .
Q1	Bidirectional switch enable	ON to enable electronic volume control.
Q2	Switching	ON to decrease by 1 step.
Q3	Switching	ON to increase by 1 step.
D1	Voltage drop	

DRIVE (X59-3180-00)

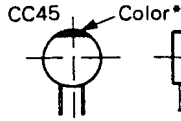
Element	Function	Description
Q1	Switching	Supplies 8V to the drive circuit; switched by Q3.
Q2	Switching	Supplies 8V to the local oscillator amplifier; switched by Q3.
Q3	Switching	ON when the PLL is locked.
Q4,Q5	High-frequency amplifier	Operates in transmit mode. When checking levels near these transistors, be careful of the probe ground points.
D1	Reversal current protection	Separates Q1 and Q2.

M-421A/E/ES

PARTS LIST

CAPACITORS

CC 45 TH 1H 220 J
1 2 3 4 5 6



Capacitor value

1 0 3 = 0.01μF

- 1 = Type ceramic, electrolytic, etc.
- 2 = Shape round, square, etc.
- 3 = Temp. coefficient
- 4 = Voltage rating
- 5 = Value
- 6 = Tolerance

- 0 1 0 = 1pF
- 1 0 0 = 10pF
- 1 0 1 = 100pF
- 1 0 2 = 1000pF = 0.001μF

2 2 0 = 22pF
1st number | Multiplier
2nd number

Temperature Coefficient

1st Word	C	L	P	R	S	T	U
Color*	Black	Red	Orange	Yellow	Green	Blue	Violet
ppm/°C	0	-80	-150	-220	-330	-470	-750

2nd Word	G	H	J	K	L
ppm/°C	± 30	± 60	± 120	± 250	± 500

Example CC45TH = -470±60 ppm/°C

Tolerance

Code	C	D	G	J	K	M	X	Z	P	No code
(%)	± 0.25	± 0.5	± 2	± 5	± 10	± 20	+ 40 - 20	+ 80 - 20	+ 100 - 0	10μF-10~+50 4.7μF-10~+75

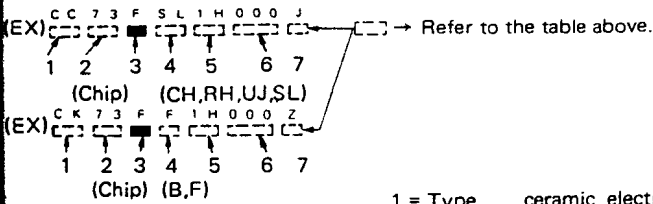
Code	B	C	D	F	G
(pF)	± 0.1	± 0.25	± 0.5	± 1	± 2

Less than 10 pF

Rating voltage

2nd word	A	B	C	D	E	F	G	H	J	K	V
1st word	0	1	2	3	4	5	6	7	8	9	10
0	1.0	1.25	1.6	2.0	2.5	3.15	4.0	5.0	6.3	8.0	-
1	10	12.5	16	20	25	31.5	40	50	63	80	35
2	100	125	160	200	250	315	400	500	630	800	-
3	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	-

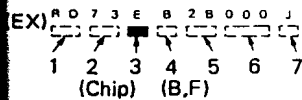
Chip capacitors



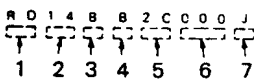
- 1 = Type ceramic, electrolytic, etc.
- 2 = Shape round, square, etc.
- 3 = Dimension
- 4 = Temp. coefficient
- 5 = Voltage rating
- 6 = Value
- 7 = Tolerance.

RESISTORS

Chip resistor (Carbon)



Carbon resistor (Normal type)



Dimension

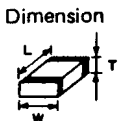
Dimension code	L	W	T
Empty	5.6 ± 0.5	5.0 ± 0.5	Less than 2.0
E	3.2 ± 0.2	1.6 ± 0.2	Less than 1.25
F	2.0 ± 0.3	1.25 ± 0.2	Less than 1.25

Dimension

Dimension code	L	W	T	Wattage
E	3.2 ± 0.2	1.6 ± 0.2	0.57	2B
F	2.0 ± 0.3	1.25 ± 0.2	0.45	2A

Rating wattage

Cord	Wattage	Cord	Wattage	Cord	Wattage
2A	1/10W	2E	1/4W	3A	1W
2B	1/8W	2H	1/2W	3D	2W
2C	1/6W				



PARTS LIST

SEMICONDUCTOR

N : New parts

Item	Re- marks	Parts No.
Diode		1S1555 1SS101
		BA282
		DSA3A1
		MI308
		UM9401
	Chip diode	
Chip zener diode		02CZ6.2(Y,Z)
Chip vari-cap diode		1SV164
Thermistor		112-502-2
Posistor	N	PTH59U332M
TR		2SC2407(1) 2SC3369
		2SD1406(Y)
	Chip TR	2SA1162(Y) 2SB1119S 2SC2712(Y) 2SC2714(Y) 2SC2759(U23) 2SC3295(B) 2SC3326(A)

Item	Re- marks	Parts No.
Digital TR		DTA114EK DTC114EK DTC124EK DTC144EK
		FMW-1
	FET	2SK125
	Chip FET	2SK508(K52)
		3SK184(R) 3SK184(S)
Power module		M57752 M57788M
IC		KRR-C001
		LA5006M LC7532M LC7582
	N	M51951BML M54959P MC7808C MN4066BS
		NJM4558M
	N	TA7761F TC4094BP
		μPC1241H μPD75106G-508-1B

TM-421A/E/ES

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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
TM-421A/E/ES						
1	1B		A01-1021-03	METALLIC CABINET(TOP)		
2	2B		A01-1022-03	METALLIC CABINET(BOTTOM)		
4	1A	*	A20-2602-02	PANEL ASSY	K1	
4	1A	*	A20-2603-02	PANEL ASSY	M1	
4	1A	*	A20-2620-02	PANEL ASSY	T1W1	
4	1A	*	A20-2620-02	PANEL ASSY	T2W2	
-			A20-2574-03	PANEL		
9	2A		B11-0442-04	REFLECTOR		
11	2A		B38-0303-05	LCD ASSY		
14	1B		B42-2455-04	LABEL (M4X8 MAX)		
15	1E		B46-0410-10	WARRANTY CARD	K1	
16	1D		B50-8148-00	INSTRUCTION MANUAL	K1M1	
16	1D		B50-8148-00	INSTRUCTION MANUAL	W1W2	
16	1D		B50-8149-00	INSTRUCTION MANUAL	T1T2	
-		*	B10-0690-03	FRONT GLASS	K1	
-		*	B10-0691-03	FRONT GLASS	M1	
-		*	B10-0695-03	FRONT GLASS	T1W1	
-		*	B10-0695-03	FRONT GLASS	T2W2	
-			B11-0446-04	REFLECTOR		
22	3D		E30-2053-05	DC CORD ASSY (ACSY)		
-			E31-3224-05	FLAR CABLE (LCD-CONTROL)		
-			E31-3239-15	LEAD WITH CONNECTOR		
27	3D		F05-1031-05	FUSE (10A) ACSY	K1M1	
27	3D		F05-1031-05	FUSE (10A) ACSY	T2W2	
27	3D		F05-5022-05	FUSE (5A) ACSY	T1W1	
30	2B		F20-0520-04	INSULATING SHEET(LITHIUM BATT)		
31	2A		F20-0521-04	INSULATING SHEET(LITHIUM BATT)		
32	2A		F29-0431-05	INSULATOR (VOL,SQL)		
-			F05-2036-05	FUSE (20A) FOR DC CORD		
			G13-0838-04	CUSHION	M1T1T2	
			G13-0842-04	CUSHION	W1W2	
			G13-0842-04	CUSHION		
			G13-0853-04	CUSHION		
35	1C		G10-0607-04	FELT (HEAT SINK)		
36	1A		G09-0405-05	KNOB FITTING SPRING		
37	1B,2B		G10-0604-04	FELT		
38	1B		G10-0651-04	FELT (SPEAKER)		
40	2A		G13-0839-04	CUSHION (KNOB)		
42	1B		G13-0845-04	CUSHION (SP)		
43	2A		G53-0508-04	FELT		
-		*	G16-0513-04	VIBRO-ISOLATING SHEET	T1W1	
-		*	G16-0513-04	VIBRO-ISOLATING SHEET	T2W2	
48	3E	*	H01-8087-04	ITEM CARTON BOX	K1	
48	3E	*	H01-8088-04	ITEM CARTON BOX	M1	
48	3E	*	H01-8089-04	ITEM CARTON BOX	T1	
48	3E	*	H01-8090-04	ITEM CARTON BOX	T2	
48	3E	*	H01-8091-04	ITEM CARTON BOX	W1	
48	3E	*	H01-8092-04	ITEM CARTON BOX	W2	
49	3D		H10-2626-02	POLYSTYRENE FOAMED FIXTURE	T1W1	
49	3D		H10-2627-02	POLYSTYRENE FOAMED FIXTURE	K1M1	
49	3D		H10-2627-02	POLYSTYRENE FOAMED FIXTURE	T2W2	

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51	1D		H13-0812-04	POLYSTYRENE FOAMED PLATE		
52	2D		H13-0814-04	BUFFER PLATE(MOUNT BLACKET)		
53	3D		H25-0049-03	PROTECTION BAG (DC CORD)		
54	2D		H25-0720-04	PROTECTION BAG (RADIO)		
55	3D		H25-0029-04	PROTECTION BAG (MIC HOOK, SCREW)	K1	
57	3D		J20-0319-24	MIC HOOK (ACSY)		K1
59	2D		J29-0416-03	MOUNTING BLACKET(ACSY)		
60	2A		J31-0141-04	SPACER RING (MIC)		
61	1B		J19-1422-04	HOLDER (SP)		
62	2D		J21-4147-14	MOUNTING HARDWARE(DBL STACK)		
-			J61-0307-05	WIRE BAND		
64	1A		K27-0496-04	KNØB(BUTTON) POWER, LOW		
66	2A		K29-3058-04	KNØB(BUTTON) MHZ, VFO/M, M. IN		
67	1A		K29-3060-04	KNØB (MAIN)		
68	1A		K29-3061-04	KNØB (VOL, SQL)		
69	1A		K29-3069-04	KNØB(BUTTON) SHIFT		
70	1A		K29-3065-04	KNØB(BUTTON) REV		
71	1A		K29-3067-04	KNØB(BUTTON) SCAN		T1W1
72	1A		K29-3066-04	KNØB(BUTTON) ALERT		T2W2
72	1A		K29-3066-04	KNØB(BUTTON) ALERT		K1M1
72	1A		K29-3068-04	KNØB(BUTTON) CTCSS		
73	1A		K29-3070-04	KNØB(BUTTON) TONE		
-			K29-3057-04	KNØB RING		
77	3D		N99-0318-05	SCREW SET		
78	3D		N46-3010-46	PAN HEAD TAPPING SCREW		K1
A	1B, 1C		N32-2606-46	FLAT HEAD MACHINE SCREW		
B	2A		N87-2606-46	BRAZIER HEAD TAPTITE SCREW		
C	2A, 2B		N89-2606-46	BINDING HEAD TAPTITE SCREW		
D	1B, 2B		N35-2606-45	BINDING HEAD MACHINE SCREW		
-			S50-1406-05	TACT SWITCH		M1T1T2
-			S50-1406-05	TACT SWITCH		W1W2
85	1B		T07-0246-05	LOUDSPEAKER(FULL RANGE)		
86	2D		T91-0359-05	MICROPHONE (ACSY)		K1
86	2D		T91-0365-15	MICROPHONE (ACSY)		M1T1T2
86	2D		T91-0365-15	MICROPHONE (ACSY)		W1W2
-			LC7582	IC(LCD DRIVER)		
94	2A		W09-0326-05	LITHIUM BATTERY		
99	1B, 1C		X45-1370-03	FINAL UNIT		M1
99	1B, 1C		X45-1370-12	FINAL UNIT		K1
99	1B, 1C		X45-1370-52	FINAL UNIT		T1W1
99	1B, 1C		X45-1370-53	FINAL UNIT		T2W2
100	2A		X53-3040-12	CONTROL UNIT		K1
100	2A		X53-3040-23	CONTROL UNIT		M1
100	2A		X53-3040-52	CONTROL UNIT		T1T2
100	2A		X53-3040-62	CONTROL UNIT		W1W2
101	2B		X57-3070-11	TX-RX UNIT		K1
101	2B		X57-3070-21	TX-RX UNIT		M1
101	2B		X57-3070-51	TX-RX UNIT		T1W1
101	2B		X57-3070-52	TX-RX UNIT		T2W2

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TM-421A : K1, M1
 TM-421E : T1, W1
 TM-421ES : T2, W2

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TM-421A/E/ES

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FINAL UNIT (X45-1370-XX) -12 : K -03 : M -52 : T1,W1 -53 : T2,W2						
C1			CK73EB1H471K	CHIP C 470PF K		
C2			CE04CW1C100M	ELECTR0 10UF 16WV	T1W1	
C2			C90-2040-05	ELECTR0 10UF 16WV	K1M1	
C2			C90-2040-05	ELECTR0 10UF 16WV	T2W2	
C3			CK73EB1H471K	CHIP C 470PF K		
C4			CE04CW1C100M	ELECTR0 10UF 16WV		
C5			CM73F2H030C	CHIP C 3.0PF C	K1	
C5			CM73F2H040C	CHIP C 4.0PF C	T1W1	
C5			CM73F2H050C	CHIP C 5.0PF C	M1T2W2	
C6	,7		CK73EB1H471K	CHIP C 470PF K		
C8			CC45SL2H040C	CERAMIC 4.0PF C	K1M1	
C8			CC45SL2H040C	CERAMIC 4.0PF C	T2W2	
C8			CC45SL2H050C	CERAMIC 5.0PF C	T1W1	
C9			CC45CH1H040C	CERAMIC 4.0PF C		
C10			CC45SL2H150J	CERAMIC 15PF J		
C11			CC45SL2H180J	CERAMIC 18PF J		
C12			CC45SL2H220J	CERAMIC 22PF J		
C13			CC45CH1H0R5C	CERAMIC 0.5PF C	T1W1	
C13			CC45CH2H0R5C	CERAMIC 0.5PF C	K1M1	
C13			CC45CH2H0R5C	CERAMIC 0.5PF C	T2W2	
C14			CK73EB1H471K	CHIP C 470PF K		
C15			CC45SL2H040C	CERAMIC 4.0PF C	K1M1	
C15			CC45SL2H040C	CERAMIC 4.0PF C	T2W2	
C15			CC45SL2H050C	CERAMIC 5.0PF C	T1W1	
C16			CM73F2H160J	CHIP C 16PF J		
C17			CC45SL2H080D	CERAMIC 8.0PF D		
C18			CK45B1H471K	CERAMIC 470PF K		
C19			CK73EB1H471K	CHIP C 470PF K		
C21			CC73ECH1H010C	CHIP C 1.0PF C	M1T2W2	
C21			CC73ECH1H1R5C	CHIP C 1.5PF C	K1	
C22			CC45SL2H020C	CERAMIC 2.0PF C	K1M1	
C22			CC45SL2H020C	CERAMIC 2.0PF C	T2W2	
C25			CK73EB1H102K	CHIP C 1000PF K	K1M1	
C25			CK73EB1H102K	CHIP C 1000PF K	T2W2	
C26			CC45SL1H040C	CERAMIC 4.0PF C	K1M1	
C26			CC45SL1H040C	CERAMIC 4.0PF C	T2W2	
110	1C		E30-2079-05	DC CABLE		
111	1C		E30-2075-05	ANT CABLE WITH CONNECTOR(N)	T1W1	
111	1C		E30-2075-05	ANT CABLE WITH CONNECTOR(N)	T2W2	
-			E11-0401-05	EAR PHONE JACK		
-			E23-0015-04	TERMINAL (GND)	K1M1	
-			E23-0015-04	TERMINAL (GND)	T2W2	
-			E30-2074-05	ANT CABLE WITH CONNECTOR(M)	K1M1	
-			E31-2066-05	COAX CABLE WITH TERMINAL(D0)		
-			E31-3230-15	COAX CABLE WITH TERMINAL(RA)		
TP1			E23-0512-05	TERMINAL (TEST TERMINAL)		
115	1C		F01-0949-05	HEAT SINK	T1W1	
115	1C		F01-0950-05	HEAT SINK	K1M1	
115	1C		F01-0950-05	HEAT SINK	T2W2	
-			F05-1031-05	FUSE (10A)	K1M1	
-			F05-1031-05	FUSE (10A)	T2W2	
-			F05-5022-05	FUSE (5A)	T1W1	

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TM-421ES : T2,W2

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120	1B		J31-0503-05	BEAD		
121	1C		J19-1375-04	COAX CABLE FITTING HARDWARE		
122	1C		J41-0033-05	BUSHING (DC CORD)	T1W1	
122	1C		J42-0425-05	BUSHING (ANT CABLE)	K1M1	
122	1C		J42-0448-05	BUSHING (ANT CABLE)	T2W2	
-			J61-0307-05	WIRE BAND		
L1			L34-0908-05	COIL (3,9.5T)		
L2			L34-1052-05	COIL (3,1.5T)	T1W1	
L2			L34-1123-05	COIL (3,1.5T)	K1M1	
L2			L34-1123-05	COIL (3,1.5T)	T2W2	
L3			L34-1032-05	COIL (3,3.5T)		
L4 .5			L34-1052-05	COIL (3,1.5T)	T1W1	
L4 .5			L34-1123-05	COIL (3,1.5T)	K1M1	
L4 .5			L34-1123-05	COIL (3,1.5T)	T2W2	
L6			L40-1091-03	SMALL FIXED INDUCTOR(1UH)		
E	1B		N09-0626-04	SCREW (M3X10)		
F	1B		N87-2606-41	BRAZIER HEAD TAPTITE SCREW		
JP1			R92-1061-05	JUMPER REST 0 ØHM	K1M1	
JP1			R92-1061-05	JUMPER REST 0 ØHM	T2W2	
R1			RD14DB2H151J	SMALL-RD 150 J 1/2W	K1M1	
R1			RD14DB2H151J	SMALL-RD 150 J 1/2W	T2W2	
R1			RD14DB2H181J	SMALL-RD 180 J 1/2W	T1W1	
R2			RD14BB2C103J	RD 10K J 1/6W		
VR1			R12-0541-05	TRIMMING PØT. (100)		
D1			DSA3A1	DIØDE		
D2			MI308	DIØDE	T1W1	
D2			UM9401	DIØDE	K1M1	
D2			UM9401	DIØDE	T2W2	
D3			MI308	DIØDE		
D4 .5			1SS101	DIØDE		
Q1			M57752	POWER MODULE	T1W1	
Q1			M57788M	POWER MODULE	K1M1	
Q1			M57788M	POWER MODULE	T2W2	
CONTROL UNIT (X53-3040-XX) -12 : K -23 : M -52 : T1,T2 -62 : W1,W2						
C1 .2			CK73FB1H103K	CHIP C 0.010UF K		
C3 .4			CC73FCH1H330J	CHIP C 33PF J		
C5 -14			CK73FB1H102K	CHIP C 1000PF K		
C15			CE04CW1C100M	ELECTRØ 10UF 16WV		
C16			CK73FB1H103K	CHIP C 0.010UF K		
C17			CK73EF1C105Z	CHIP C 1.0UF Z		
			E06-0858-05	BP METAL SØCKET(MIC)		
			E40-1878-05	PIN CONNECTØR		
L1			L77-1313-05	CRYSTAL RESØNATOR(4.194304MHZ)		
R1			RD41FB2B224J	CYLND CHIP R 220K J 1/8W	K1M1	
R1			RD41FB2B683J	CYLND CHIP R 68K J 1/8W	T1W1	
R1			RD41FB2B683J	CYLND CHIP R 68K J 1/8W	T2W2	
R2 -5			RD41FB2B105J	CYLND CHIP R 1.0M J 1/8W		
R6			RD41FB2B104J	CYLND CHIP R 100K J 1/8W		
R7			RD41FB2B105J	CYLND CHIP R 1.0M J 1/8W		
R8 .9			RD41FB2B104J	CYLND CHIP R 100K J 1/8W		

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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
R10 -13 R14 R15 R16 R17 ,18			RD41FB2B473J RD41FB2B2R2J RD41FB2B103J RD41FB2B473J RD41FB2B474J	CYLND CHIP R 47K J 1/BW CYLND CHIP R 2.2 J 1/BW CYLND CHIP R 10K J 1/BW CYLND CHIP R 47K J 1/BW CYLND CHIP R 470K J 1/BW		
R19 R20 R22 R23 R24 ,25			RD41FB2B472J RD41FB2B105J R92-0687-05 R92-0687-05 R92-0687-05	CYLND CHIP R 4.7K J 1/BW CYLND CHIP R 1.0M J 1/BW CHIP R 0 0HM CHIP R 0 0HM CHIP R 0 0HM	K1M1 W1W2 K1	
R25 R26 VR1 VR2			R92-0687-05 RD41FB2B102J R05-3441-05 R05-4420-05	CHIP R 0 0HM CYLND CHIP R 1.0K J 1/BW POTENTIOMETER(10KA)VSL POTENTIOMETER(50KB)SQL		
S1 -8 S9 ,10			S40-1086-05 S40-2458-05	TACT SWITCH PUSH SWITCH		
D1 -4 IC1 IC2 IC3 IC4			1SS184 LA5006M M51951BML 75106G-508-1B KRR-C001	CHIP DIODE IC(LOW SATURATION REGULATOR) IC(SYSTEM RESET) IC(MICROPROCESSOR) IC		
Q1 Q2			DTC124EK 2SC2712(Y) W02-0388-05	DIGITAL TRANSISTOR CHIP TRANSISTOR ROTARY ENCODER		
TX-RX UNIT (X57-3070-XX) -11 : K -21 : M -51 : T1,W1 -52 : T2,W2						
166 C1 C2 C3 C4 ,5 C6 C7 C8 C9 C10 -12 C13 C14 C15 C16 C17 C18 ,19 C20 C22 -24 C25 C26 C28 C29 C30 C31 C32 C33 C34 ,35	1B	<i>Scan by Dan</i>	A13-0675-01 CC41FCH1H100D CC41FCH1H030C CC73FSL1H101J CK73FB1H102K CC73FSL1H101J CC41FCH1H010C CK73FB1H102K CC41FSL1H390J CK73FB1H102K CC41FCH1H050C CC41FCH1H020C CC73FCH1H330J CK73FB1H102K CC73FSL1H101J CK73FB1H102K CC41FCH1H100D CK73FB1H103K CK73FB1H102K CC73FCH1H330J CE04EW1A470M CK73FB1H103K CK73FB1H102K CE04EW1C100M CK73EF1C105Z CK73FB1H103K CE04EW1A470M	FRAME CYLND CHIP C 10PF D CYLND CHIP C 3.0PF C CHIP C 100PF J CHIP C 1000PF K CHIP C 100PF J CYLND CHIP C 1.0PF C CHIP C 1000PF K CYLND CHIP C 39PF J CHIP C 1000PF K CYLND CHIP C 5.0PF C CYLND CHIP C 2.0PF C CHIP C 33PF J CHIP C 1000PF K CHIP C 100PF J CHIP C 1000PF K CYLND CHIP C 10PF D CHIP C 0.010UF K CHIP C 1000PF K CHIP C 33PF J ELECTRO 47UF 10WV CHIP C 0.010UF K CHIP C 1000PF K ELECTRO 10UF 16WV CHIP C 1.0UF Z CHIP C 0.010UF K ELECTRO 47UF 10WV		

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C36 ,37			CK73EB1E104K	CHIP C 0.10UF K		
C38 ,39			CK73FB1H102K	CHIP C 1000PF K		
C40			CE04EW1A470M	ELECTRØ 47UF 10WV		
C41			CK73EB1E473K	CHIP C 0.047UF K		
C42			CE04EW1A470M	ELECTRØ 47UF 10WV		
C43			CK73FB1H562K	CHIP C 5600PF K	K1M1	
C44			CK73EF1C105Z	CHIP C 1.0UF Z		
C45			CK73FB1H102K	CHIP C 1000PF K		
C46			CE04EW1C100M	ELECTRØ 10UF 16WV		
C47			CK73FB1H103K	CHIP C 0.010UF K		
C48			C92-0501-05	CHIP TAN 1.5UF 10WV		
C49			CE04EW1A470M	ELECTRØ 47UF 10WV		
C50			CK73FB1H103K	CHIP C 0.010UF K		
C51			CC41FCH1H150J	CYLND CHIP C 15PF J		
C52			CK73FB1H103K	CHIP C 0.010UF K		
C53			CC73FSL1H221J	CHIP C 220PF J		
C54			CC73FSL1H101J	CHIP C 100PF J		
C55			CK73FB1H102K	CHIP C 1000PF K		
C56			CC73FSL1H101J	CHIP C 100PF J		
C57 ,58			CK73FB1H223K	CHIP C 0.022UF K		
C59			C92-0501-05	CHIP TAN 1.5UF 10WV		
C60			CK73EB1E683K	CHIP C 0.068UF K		
C61			CK73FB1H102K	CHIP C 1000PF K		
C62			CK73EB1E683K	CHIP C 0.068UF K		
C63			CK73FB1H103K	CHIP C 0.010UF K		
C64			C92-0004-05	CHIP TAN 1UF 16WV		
C65			CK73FB1H103K	CHIP C 0.010UF K		
C66			CK73FB1H102K	CHIP C 1000PF K		
C67			CK73FB1H103K	CHIP C 0.010UF K		
C68			CE04EW1A221M	ELECTRØ 220UF 10WV		
C69			CK73FB1H103K	CHIP C 0.010UF K		
C70			CE04EW1A221M	ELECTRØ 220UF 10WV		
C71			CC41FCH1H020C	CYLND CHIP C 2.0PF C		
C72			CC41FCH1H060D	CYLND CHIP C 6.0PF D		
C73			CC41FCH1H030C	CYLND CHIP C 3.0PF C		
C74			CK73FB1H102K	CHIP C 1000PF K		
C75			CC41FCH1H060D	CYLND CHIP C 6.0PF D		
C76 ,77			CK73FB1H102K	CHIP C 1000PF K		
C78			CC41FCH1H100D	CYLND CHIP C 10PF D		
C79			CK73FB1H102K	CHIP C 1000PF K		
C80			CC73FCH1H330J	CHIP C 33PF J		
C81 ,82			CK73EF1C105Z	CHIP C 1.0UF Z		
C83			CK73EB1E333K	CHIP C 0.033UF K		
C84 -86			CE04EW1A470M	ELECTRØ 47UF 10WV		
C87			C90-2074-05	ELECTRØ 470UF 10WV		
C88			CK73EB1E104K	CHIP C 0.10UF K		
C89			C90-2033-05	ELECTRØ 1000UF 16WV		
C90			CK73FB1H103K	CHIP C 0.010UF K		
C91			C90-2033-05	ELECTRØ 1000UF 16WV		
C92			CC73FSL1H101J	CHIP C 100PF J		
C93			CC41FCH1H050C	CYLND CHIP C 5.0PF C		
C94			CE04EW1A470M	ELECTRØ 47UF 10WV		
C95 ,96			CK73FB1H102K	CHIP C 1000PF K		
C97			CE04EW1C100M	ELECTRØ 10UF 16WV		
C98			CC73FCH1H150J	CHIP C 15PF J	K1	

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M-421A/E/ES

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C99 C100-105 C106 C107 C108, 109			CE04EW1C101M CK73FB1H102K CE04EW1C220M C92-0501-05 CK73FB1H562K	ELECTRØ 100UF 16WV CHIP C 1000PF K ELECTRØ 22UF 16WV CHIP TAN 1.5UF 10WV CHIP C 5600PF K		
C110 C111 C112 C113-115 C116			CK73EB1E104K CE04EW1E4R7M CC73FSL1H101J CK73FB1H103K CC73FSL1H101J	CHIP C 0.10UF K ELECTRØ 4.7UF 25WV CHIP C 100PF J CHIP C 0.010UF K CHIP C 100PF J	K1M1	
C117 C118 TC1 ,2 TC3 TC4 ,5 TC6			CC73FSL1H101J CC45SL1H101J C05-0062-05 C05-0308-05 C05-0349-05 C05-0062-05	CHIP C 100PF J CERAMIC 100PF J TRIMMING CAP (6PF) TRIMMING CAP (4PF) TRIMMING CAP (10PF) TRIMMING CAP (6PF)		
J1 J2 J3			E04-0154-05 E31-3237-05 E40-5016-05 E40-3237-05 E40-3238-05	COAX CONNECTØR LEAD WITH CONNECTØR PIN CONNECTØR (2P) PIN CONNECTØR (2P,EH) PIN CONNECTØR (3P,EH)	K1M1 K1M1	
J4 J5 J6 J7 ,8 TP1 TP2 ,3 -			E40-3237-05 E40-3238-05 E40-3237-05 E40-5099-05 E40-0211-05 E23-0465-05 F11-0836-05	PIN CONNECTØR (2P,EH) PIN CONNECTØR (3P,EH) PIN CONNECTØR (2P,EH) PIN CONNECTØR (SSQ-9) PIN CONNECTØR (2P) TERMINAL SHIELDING CASE		
L1 L2 L3 ,4 L5 L6			L34-1115-05 L34-1052-05 L79-0690-05 L40-1072-80 L34-1115-05	COIL COIL HELICAL (435MHZ) CHIP INDUCTØR (10NH) COIL		
L7 L8 L9 L10 L11			L30-0508-05 L71-0227-05 L34-0749-05 L40-1072-80 L77-0997-05	TUNING COIL (21.6MHZ) MCF (21.6MHZ) TUNING COIL (21.6MHZ) CHIP INDUCTØR (10NH) CRYSTAL RESONATØR(21.145MHZ)	K1	
L12 L13 L14 L15 L16			L30-0531-05 L72-0315-05 L30-0503-05 L40-1001-81 L77-1311-05	TUNING COIL (455KHZ) CERAMIC FILTER (CFW455F) TUNING COIL (455KHZ) CHIP INDUCTØR (10NH) CRYSTAL RESONATØR(12.8MHZ)		
L17 ,18 L19 L20 L21			L40-2272-80 L15-0308-05 L34-1052-05 L34-1096-05	CHIP INDUCTØR (22NH) LOW-FREQUENCY CHOKE COIL COIL COIL		
B R1 ,2 R3 R4 ,5 R6	1B, 2B		N87-2606-46 RD41FB2B223J RD41FB2B104J RD41FB2B101J RD41FB2B470J	BRAZIER HEAD TAPTITE SCREW CYLND CHIP R 22K J 1/8W CYLND CHIP R 100K J 1/8W CYLND CHIP R 100 J 1/8W CYLND CHIP R 47 J 1/8W		

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R7			RD41FB2B3R3J	CYLND CHIP R 3.3 J 1/8W		
R8			RD41FB2B220J	CYLND CHIP R 22 J 1/8W		
R9	.10		RD41FB2B223J	CYLND CHIP R 22K J 1/8W		
R11			RD41FB2B102J	CYLND CHIP R 1.0K J 1/8W		
R12			RD41FB2B221J	CYLND CHIP R 220 J 1/8W		
R13			RD41FB2B470J	CYLND CHIP R 47 J 1/8W		
R14			RD41FB2B681J	CYLND CHIP R 680 J 1/8W		
R15			RD41FB2B473J	CYLND CHIP R 47K J 1/8W		
R16			RD41FB2B103J	CYLND CHIP R 10K J 1/8W		
R17			RD41FB2B471J	CYLND CHIP R 470 J 1/8W		
R18			RD41FB2B221J	CYLND CHIP R 220 J 1/8W		
R19			RD41FB2B101J	CYLND CHIP R 100 J 1/8W		
R21			RD41FB2B182J	CYLND CHIP R 1.8K J 1/8W		
R22			RD41FB2B103J	CYLND CHIP R 10K J 1/8W		
R23			RD41FB2B105J	CYLND CHIP R 1.0M J 1/8W		
R24			RD41FB2B333J	CYLND CHIP R 33K J 1/8W		
R25			RD41FB2B472J	CYLND CHIP R 4.7K J 1/8W		
R26			RD41FB2B102J	CYLND CHIP R 1.0K J 1/8W		
R27			RD41FB2B103J	CYLND CHIP R 10K J 1/8W		
R28			RD41FB2B472J	CYLND CHIP R 4.7K J 1/8W		
R29	.30		RD41FB2B223J	CYLND CHIP R 22K J 1/8W		
R31			RD41FB2B102J	CYLND CHIP R 1.0K J 1/8W		
R32			RD41FB2B103J	CYLND CHIP R 10K J 1/8W		T1W1
R32			RD41FB2B103J	CYLND CHIP R 10K J 1/8W		T2W2
R33			RD41FB2B222J	CYLND CHIP R 2.2K J 1/8W		
R34			RD41FB2B104J	CYLND CHIP R 100K J 1/8W		K1M1
R35			RD41FB2B104J	CYLND CHIP R 100K J 1/8W		T1W1
R36			RD41FB2B224J	CYLND CHIP R 220K J 1/8W		K1M1
R37			RD41FB2B274J	CYLND CHIP R 270K J 1/8W		K1M1
R38			RD41FB2B103J	CYLND CHIP R 10K J 1/8W		
R39			RD41FB2B182J	CYLND CHIP R 1.8K J 1/8W		
R40			RD41FB2B103J	CYLND CHIP R 10K J 1/8W		
R41			RD41FB2B182J	CYLND CHIP R 1.8K J 1/8W		
R42			RD41FB2B220J	CYLND CHIP R 22 J 1/8W		
R43			RD41FB2B472J	CYLND CHIP R 4.7K J 1/8W		
R44			RD41FB2B220J	CYLND CHIP R 22 J 1/8W		
R45			RD41FB2B472J	CYLND CHIP R 4.7K J 1/8W		
R46	-50		RD41FB2B473J	CYLND CHIP R 47K J 1/8W		
R51			RD41FB2B101J	CYLND CHIP R 100 J 1/8W		
R52			RD41FB2B223J	CYLND CHIP R 22K J 1/8W		
R53			RD41FB2B333J	CYLND CHIP R 33K J 1/8W		
R54			RD41FB2B222J	CYLND CHIP R 2.2K J 1/8W		
R55	-57		RD41FB2B473J	CYLND CHIP R 47K J 1/8W		
R58			RD41FB2B221J	CYLND CHIP R 220 J 1/8W		
R59			RD41FB2B103J	CYLND CHIP R 10K J 1/8W		
R60			RD41FB2B182J	CYLND CHIP R 1.8K J 1/8W		
R61			RD41FB2B822J	CYLND CHIP R 8.2K J 1/8W		
R62			RD41FB2B182J	CYLND CHIP R 1.8K J 1/8W		
R63			RD41FB2B474J	CYLND CHIP R 470K J 1/8W		
R64	-66		RD41FB2B103J	CYLND CHIP R 10K J 1/8W		
R67			RD41FB2B223J	CYLND CHIP R 22K J 1/8W		
R68			RD41FB2B102J	CYLND CHIP R 1.0K J 1/8W		
R69			RD41FB2B101J	CYLND CHIP R 100 J 1/8W		
R70			RD41FB2B472J	CYLND CHIP R 4.7K J 1/8W		
R71			RD41FB2B222J	CYLND CHIP R 2.2K J 1/8W		

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R72			RD41FB2B101J	CYLND CHIP R 100	J 1/8W	
R73			RD41FB2B102J	CYLND CHIP R 1.0K	J 1/8W	
R74			RD41FB2B222J	CYLND CHIP R 2.2K	J 1/8W	
R75			RD41FB2B331J	CYLND CHIP R 330	J 1/8W	
R76			RD41FB2B101J	CYLND CHIP R 100	J 1/8W	K1M1
R77			RD41FB2B471J	CYLND CHIP R 470	J 1/8W	
R78			RD41FB2B472J	CYLND CHIP R 4.7K	J 1/8W	
R79			RD41FB2B681J	CYLND CHIP R 680	J 1/8W	
R80			RD41FB2B101J	CYLND CHIP R 100	J 1/8W	
R81			RD41FB2B3R3J	CYLND CHIP R 3.3	J 1/8W	
R82 ,83			RD41FB2B473J	CYLND CHIP R 47K	J 1/8W	
R84			RD41FB2B333J	CYLND CHIP R 33K	J 1/8W	
R85			RD41FB2B151J	CYLND CHIP R 150	J 1/8W	
R86			RD41FB2B182J	CYLND CHIP R 1.8K	J 1/8W	
R87			RD41FB2B5R6J	CYLND CHIP R 5.6	J 1/8W	
R88			RD41FB2B221J	CYLND CHIP R 220	J 1/8W	
R89			RD41FB2B5R6J	CYLND CHIP R 5.6	J 1/8W	
R90			R92-0685-05	RD 22	J 1/2W	
R91 ,92			RD41FB2B104J	CYLND CHIP R 100K	J 1/8W	
R93			RD41FB2B103J	CYLND CHIP R 10K	J 1/8W	K1M1
R93			RD41FB2B103J	CYLND CHIP R 10K	J 1/8W	T2W2
R93			RD41FB2B472J	CYLND CHIP R 4.7K	J 1/8W	T1W1
R94			RD41FB2B223J	CYLND CHIP R 22K	J 1/8W	T1W1
R95 ,96			RD41FB2B102J	CYLND CHIP R 1.0K	J 1/8W	
R97			RD41FB2B103J	CYLND CHIP R 10K	J 1/8W	
R98			RD41FB2B223J	CYLND CHIP R 22K	J 1/8W	
R99			RD41FB2B474J	CYLND CHIP R 470K	J 1/8W	
R100			RD41FB2B473J	CYLND CHIP R 47K	J 1/8W	
R101			RD41FB2B222J	CYLND CHIP R 2.2K	J 1/8W	
R102			RD41FB2B102J	CYLND CHIP R 1.0K	J 1/8W	
R104			R92-0687-05	CHIP R 0 8HM		
R105			RD41FB2B822J	CYLND CHIP R 8.2K	J 1/8W	T1W1
R105			RD41FB2B822J	CYLND CHIP R 8.2K	J 1/8W	T2W2
R106			RD41FB2B223J	CYLND CHIP R 22K	J 1/8W	T1W1
R106			RD41FB2B223J	CYLND CHIP R 22K	J 1/8W	T2W2
R107			R92-0687-05	CHIP R 0 8HM		T1W1
R107			R92-0687-05	CHIP R 0 8HM		T2W2
R108			RD41FB2B473J	CYLND CHIP R 47K	J 1/8W	
R109			R92-0670-05	CHIP R 0 8HM		
R110			RD14BB2C103J	RD 10K	J 1/6W	K1
R111			RD41FB2B101J	CYLND CHIP R 100	J 1/8W	T1W1
R111			RD41FB2B101J	CYLND CHIP R 100	J 1/8W	T2W2
R112 ,113			RD14BB2C223J	RD 22K	J 1/6W	
VR1			R12-5047-05	TRIMMING P8T. (220K)		
VR2			R12-3096-05	TRIMMING P8T. (10K)		K1M1
VR3			R12-3096-05	TRIMMING P8T. (10K)		
VR4			R12-3099-05	TRIMMING P8T. (47K)		
VR5 ,6			R12-3096-05	TRIMMING P8T. (10K)		
VR7			R12-3098-05	TRIMMING P8T. (33K)		K1M1
VR7			R12-3098-05	TRIMMING P8T. (33K)		T2W2
D1			1SS226	CHIP DIODE		
D2			1SS181	CHIP DIODE		
D3 ,4			1SS184	CHIP DIODE		
D5			O2CZ6. 2(Y,Z)	CHIP ZENER DIODE		
D6			1SS181	CHIP DIODE		

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PARTS LIST

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D7 ,8 D9 ,10 D11 ,12 D13 ,14 IC1			BA282 1SS181 1SS184 1S1555 MC7808C	DIODE CHIP DIODE CHIP DIODE DIODE IC(VOLTAGE REGULATOR/ +14V)		
IC2 IC3 IC4 Q1 Q2			M54959P TC4094BP UPC1241H 3SK184(S) 2SK125	IC(FREQ SYNTHESIZER PLL) IC(8-STAGE SHIFT/STORE BUS REG IC CHIP FET FET		
Q3 Q4 Q5 Q6 ,7 Q8 ,9			3SK184(R) 2SC2714(Y) 2SC3326(A) 2SB1119S DTC124EK	CHIP FET CHIP TRANSISTOR CHIP TRANSISTOR CHIP TRANSISTOR DIGITAL TRANSISTOR		
Q10 ,11 Q12 Q13 -15 Q16 Q17 ,18			2SC2712(Y) 2SC2714(Y) 2SC2712(Y) 2SA1162(Y) 2SC2759(U23)	CHIP TRANSISTOR CHIP TRANSISTOR CHIP TRANSISTOR CHIP TRANSISTOR CHIP TRANSISTOR		
Q19 Q20 Q20 Q20 Q21			2SC2712(Y) 2SC2407(1) 2SC3369 2SC3369 2SD1406(Y)	CHIP TRANSISTOR TRANSISTOR TRANSISTOR TRANSISTOR TRANSISTOR	T1W1 K1M1 T2W2	
TH1 TH2 TH2			112-502-2 * PTH59U332M * PTH59U332M	THERMISTER (5K) PESISTOR (3.3K) PESISTOR (3.3K)	T1W1 T2W2	
- - - - -		*	X58-3100-11 X58-3100-21 X58-3100-51 X58-3100-51 X59-3130-00	SUB UNIT (VCO,440MHZ) SUB UNIT (VCO,430MHZ) SUB UNIT (VCO,430MHZ) SUB UNIT (VCO,430MHZ) MODULE UNIT (APC)	K1 M1 T1W1 T2W2	
- - - - -			X59-3140-00 X59-3150-00 X59-3150-51 X59-3150-51 X59-3160-00	MODULE UNIT (IF) MODULE UNIT (SQL) MODULE UNIT (SQL) MODULE UNIT (SQL) MODULE UNIT (MIC)	K1M1 T1W1 T2W2	
- -		*	X59-3170-00 X59-3180-00	MODULE UNIT (VQL) MODULE UNIT (DRIVE)		
VCO (X58-3100-XX) -11 : K -21 : M -51 : T1,W1,T2,W2						
C1 C2 C3 C4 C5			CK73FB1H102K CK73FB1H103K CC73FCH1H020C CC73FCH1H080D CC73FCH1H080D	CHIP C 1000PF K CHIP C 0.010UF K CHIP C 2.0PF C CHIP C 8.0PF D CHIP C 8.0PF D	K1	
C5 C5 C6 C7 C8			CC73FCH1H100D CC73FCH1H100D CC73FCH1H120J CC73FCH1H070D CK73FB1H102K	CHIP C 10PF D CHIP C 10PF D CHIP C 12PF J CHIP C 7.0PF D CHIP C 1000PF K	M1T1W1 T2W2	
C9 C10 C11			CC73FCH1H020C CC73FCH1H080D CC73FCH1H080D	CHIP C 2.0PF C CHIP C 8.0PF D CHIP C 8.0PF D	M1	

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C11			CC73FCH1H100D	CHIP C 10PF D	K1	
C11			CC73FCH1H100D	CHIP C 10PF D	T1W1	
C11			CC73FCH1H100D	CHIP C 10PF D	T2W2	
C12			CC73FCH1H060D	CHIP C 6.0PF D	M1	
C12			CC73FCH1H100D	CHIP C 10PF D	T1W1	
C12			CC73FCH1H100D	CHIP C 10PF D	T2W2	
C12			CC73FCH1H150J	CHIP C 15PF J	K1	
C13			CC73FCH1H050C	CHIP C 5.0PF C	M1	
C13			CC73FCH1H070D	CHIP C 7.0PF D	K1	
C13			CC73FCH1H180J	CHIP C 18PF J	T1T2W1	
C13			CC73FCH1H180J	CHIP C 18PF J	W2	
C14 -16			CK73FB1H102K	CHIP C 1000PF K		
C17			CC73FCH1H0R5C	CHIP C 0.5PF C		
C18			CC73FCH1H020C	CHIP C 2.0PF C	K1	
TC1 ,2		*	C05-0346-05	CHIP TRIMMING CAP (6PF)		
			E40-5095-05	PIN ASSY (10PF)		
L1		*	L34-1194-05	COIL (3.2.5T)		
L2		*	L34-1195-05	COIL (3.3.5T)	M1	
L2		*	L34-1196-05	COIL (3.3T)	K1T1T2	
L2		*	L34-1196-05	COIL (3.3T)	W1W2	
L3 -8			L40-5682-81	CHIP COIL (0.56UH)		
L9			L40-3972-80	CHIP COIL (39NH)		
R1			RK73FB2A121J	CHIP R 120 J 1/10W		
R2			RK73FB2A103J	CHIP R 10K J 1/10W		
R3			RK73FB2A223J	CHIP R 22K J 1/10W		
R4			RK73FB2A101J	CHIP R 100 J 1/10W		
R5			RK73FB2A471J	CHIP R 470 J 1/10W		
R6			RK73FB2A221J	CHIP R 220 J 1/10W		
R7			RK73FB2A103J	CHIP R 10K J 1/10W		
R8			RK73FB2A152J	CHIP R 1.5K J 1/10W		
R9			RK73FB2A470J	CHIP R 47 J 1/10W		
R10			RK73FB2A103J	CHIP R 10K J 1/10W		
R11			RK73FB2A104J	CHIP R 100K J 1/10W		
R12			RK73FB2A471J	CHIP R 470 J 1/10W		
R13			RK73FB2A221J	CHIP R 220 J 1/10W		
R14			RK73FB2A470J	CHIP R 47 J 1/10W		
R15 ,16			R92-0670-05	CHIP R 0 OHM		
D1 -3			1SV164	CHIP VARI-CAP DIODE		
Q1			2SC2759(U23)	CHIP TRANSISTOR		
Q2			2SK508(K52)	CHIP FET		
Q3			2SC2712(Y)	CHIP TRANSISTOR		
Q4			2SK508(K52)	CHIP FET		
Q5			DTC114EK	DIGITAL TRANSISTOR		
APC (X59-3130-00)						
C1			CK73FB1H102K	CHIP C 1000PF K		
C2			C92-0501-05	CHIP TAN 1.5UF 10WV		
C3			CK73FB1H472K	CHIP C 4700PF K		
C4			CK73FB1H102K	CHIP C 1000PF K		
C5			CK73FB1H472K	CHIP C 4700PF K		
C6			CK73FB1H102K	CHIP C 1000PF K		
			E23-0471-05	TERMINAL		

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R1 R2 R3 R4 R6	.5		RD41FB2B222J RD41FB2B102J RD41FB2B152J RD41FB2B103J RD41FB2B122J	CYLND CHIP R 2.2K J 1/8W CYLND CHIP R 1.0K J 1/8W CYLND CHIP R 1.5K J 1/8W CYLND CHIP R 10K J 1/8W CYLND CHIP R 1.2K J 1/8W		
Q1 Q3	.2		FMW1 2SA1162(Y)	DIGITAL TRANSISTOR CHIP TRANSISTOR		
IF (X59-3140-00)						
C1 C2 C3 C4 C5			CK73FB1H102K CK73FB1H472K CC73FCH1H330J CK73FB1H472K CC73FSL1H561J	CHIP C 1000PF K CHIP C 4700PF K CHIP C 33PF J CHIP C 4700PF K CHIP C 560PF J		
C6 C7 C8	-10		CK73FB1H472K CK73FB1H103K CK73EB1H104K	CHIP C 4700PF K CHIP C 0.010UF K CHIP C 0.10UF K		
L1 L2		*	E23-0471-05 L40-2211-81 L33-0695-05	TERMINAL CHIP COIL (220UH) CHIP COIL (1MH)		
R1 R4 R5	.2		RD41FB2B104J RD41FB2B332J RD41FB2B182J	CYLND CHIP R 100K J 1/8W CYLND CHIP R 3.3K J 1/8W CYLND CHIP R 1.8K J 1/8W		
IC1		*	TA7761F	IC		
SQL (X59-3150-00) -00 : K,M -51 : T1,W1,T2,W2						
C1 C2 C4 C5 C6			CK73FB1H102K CC73FCH1H330J C92-0005-05 CK73EF1C105Z C92-0504-05	CHIP C 1000PF K CHIP C 33PF J CHIP-TAN 2.2UF 6.3WV CHIP C 1.0UF Z CHIP-TAN 0.68UF 20WV		
C7 C9 C10	.8		CK73FB1E393K CK73FB1H153K CK73FB1H333K	CHIP C 0.039UF K CHIP C 0.015UF K CHIP C 0.033UF K		
R1 R2 R3 R4 R5			E23-0471-05 RD41FB2B104J RD41FB2B272J RD41FB2B222J RD41FB2B223J RD41FB2B332J	TERMINAL CYLND CHIP R 100K J 1/8W CYLND CHIP R 2.7K J 1/8W CYLND CHIP R 2.2K J 1/8W CYLND CHIP R 22K J 1/8W CYLND CHIP R 3.3K J 1/8W		
R6 R6 R6 R7 R8			RD41FB2B152J RD41FB2B152J RD41FB2B682J RD41FB2B103J RD41FB2B104J	CYLND CHIP R 1.5K J 1/8W CYLND CHIP R 1.5K J 1/8W CYLND CHIP R 6.8K J 1/8W CYLND CHIP R 10K J 1/8W CYLND CHIP R 100K J 1/8W	T1T2W1 W2 K1M1	
R8 R8 R9 R10 R11			RD41FB2B104J RD41FB2B474J RD41FB2B472J RD41FB2B474J RD41FB2B273J	CYLND CHIP R 100K J 1/8W CYLND CHIP R 470K J 1/8W CYLND CHIP R 4.7K J 1/8W CYLND CHIP R 470K J 1/8W CYLND CHIP R 27K J 1/8W	T2W2 K1M1	
R12 R13 R14			RD41FB2B223J RD41FB2B222J RD41FB2B393J	CYLND CHIP R 22K J 1/8W CYLND CHIP R 2.2K J 1/8W CYLND CHIP R 39K J 1/8W		

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M-421A/E/ES

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R15 R16 R17			RD41FB2B273J RD41FB2B331J RD41FB2B222J	CYLND CHIP R 27K J 1/8W CYLND CHIP R 330 J 1/8W CYLND CHIP R 2.2K J 1/8W		
D1 D2 Q1 Q3 Q5	,2 ,4 ,6		1S5226 1S5181 2SC2712(Y) 2SC3295(B) 2SC2712(Y)	CHIP DIODE CHIP DIODE CHIP TRANSISTOR CHIP TRANSISTOR CHIP TRANSISTOR		
MIC (X59-3160-00)						
C1 C2 C3 C4 C6	,5		CK73FB1H223K CK73EF1C105Z CK73FB1H333K CK73FB1H223K CK73EF1C105Z	CHIP C 0.022UF K CHIP C 1.0UF Z CHIP C 0.033UF K CHIP C 0.022UF K CHIP C 1.0UF Z		
C7 C8 C9 C10 C11			CC73FSL1H101J CK73FB1H272K CK73EF1C105Z CC73FSL1H101J CK73FB1H821K	CHIP C 100PF J CHIP C 2700PF K CHIP C 1.0UF Z CHIP C 100PF J CHIP C 820PF K		
			E23-0471-05	TERMINAL		
R1 R2 R3 R4 R5			RD41FB2B123J RD41FB2B473J RD41FB2B563J RD41FB2B101J RD41FB2B154J	CYLND CHIP R 12K J 1/8W CYLND CHIP R 47K J 1/8W CYLND CHIP R 56K J 1/8W CYLND CHIP R 100 J 1/8W CYLND CHIP R 150K J 1/8W		
R6 R7 R8 R9 R10			RD41FB2B104J RD41FB2B101J RD41FB2B153J RD41FB2B473J RD41FB2B561J	CYLND CHIP R 100K J 1/8W CYLND CHIP R 100 J 1/8W CYLND CHIP R 15K J 1/8W CYLND CHIP R 47K J 1/8W CYLND CHIP R 560 J 1/8W		
R11 R12 R13 R14 R17	-16		RD41FB2B274J RD41FB2B563J RD41FB2B224J RD41FB2B823J RD41FB2B103J	CYLND CHIP R 270K J 1/8W CYLND CHIP R 56K J 1/8W CYLND CHIP R 220K J 1/8W CYLND CHIP R 82K J 1/8W CYLND CHIP R 10K J 1/8W		
R19	,20		R92-0687-05	CHIP R 0 8HM		
IC1	,2		NJM4558M	IC(OP AMP X2)		
VOL (X59-3170-00)						
C1 C3 C4	,2		CK73EB1E104K CK73FF1E104Z C92-0004-05	CHIP C 0.10UF K CHIP C 0.10UF Z CHIP TAN 1UF 16WV		
			E23-0471-05	TERMINAL		
R1 R4 R5 R6 R7	-3		RD41FB2B473J RD41FB2B823J RD41FB2B103J RD41FB2B104J RD41FB2B272J	CYLND CHIP R 47K J 1/8W CYLND CHIP R 82K J 1/8W CYLND CHIP R 10K J 1/8W CYLND CHIP R 100K J 1/8W CYLND CHIP R 2.7K J 1/8W		
R8 R9			RD41FB2B104J RD41FB2B272J	CYLND CHIP R 100K J 1/8W CYLND CHIP R 2.7K J 1/8W		
D1 IC1		*	1S5226 LC7532M	CHIP DIODE IC(BILATERAL SWITCH)		

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IC2 Q1 Q2 ,3		*	MN4066BS DTC144EK DTA114EK	IC (QUAD ANALOG SWITCH) DIGITAL TRANSISTOR DIGITAL TRANSISTOR		
DRIVE (X59-3180-00)						
C2 -5 C6 C7 C8 ,9 C10			CK73FB1H102K CC41FCH1H220J CK73FB1H102K CK41FB1H471K CK73FB1H102K	CHIP C 1000PF K CYLND CHIP C 22PF J CHIP C 1000PF K CYLND CHIP C 470PF K CHIP C 1000PF K		
C11			CK73EF1C105Z E23-0471-05	CHIP C 1.0UF Z TERMINAL		
L1 ,2			L40-1072-80	CHIP COIL (10NH)		
R1 -4 R5 R6 R7 R8			RD41FB2B472J RD41FB2B223J RD41FB2B103J RD41FB2B101J RD41FB2B682J	CYLND CHIP R 4.7K J 1/8W CYLND CHIP R 22K J 1/8W CYLND CHIP R 10K J 1/8W CYLND CHIP R 100 J 1/8W CYLND CHIP R 6.8K J 1/8W		
R9 ,10 R11 R12 R13 R14			RD41FB2B470J RD41FB2B332J RD41FB2B681J RD41FB2B470J RD41FB2B220J	CYLND CHIP R 47 J 1/8W CYLND CHIP R 3.3K J 1/8W CYLND CHIP R 680 J 1/8W CYLND CHIP R 47 J 1/8W CYLND CHIP R 22 J 1/8W		
R15 R16 R17 R18			R92-0338-05 R92-0687-05 RD41FB2B473J RD41FB2B471J	CYLND CHIP R 0 0HM CHIP R 0 0HM CYLND CHIP R 47K J 1/8W CYLND CHIP R 470 J 1/8W		
D1 Q1 ,2 Q3 Q4 ,5			1SS184 2SA1162(Y) 2SC2712(Y) 2SC2759(U23)	CHIP DIODE CHIP TRANSISTOR CHIP TRANSISTOR CHIP TRANSISTOR		

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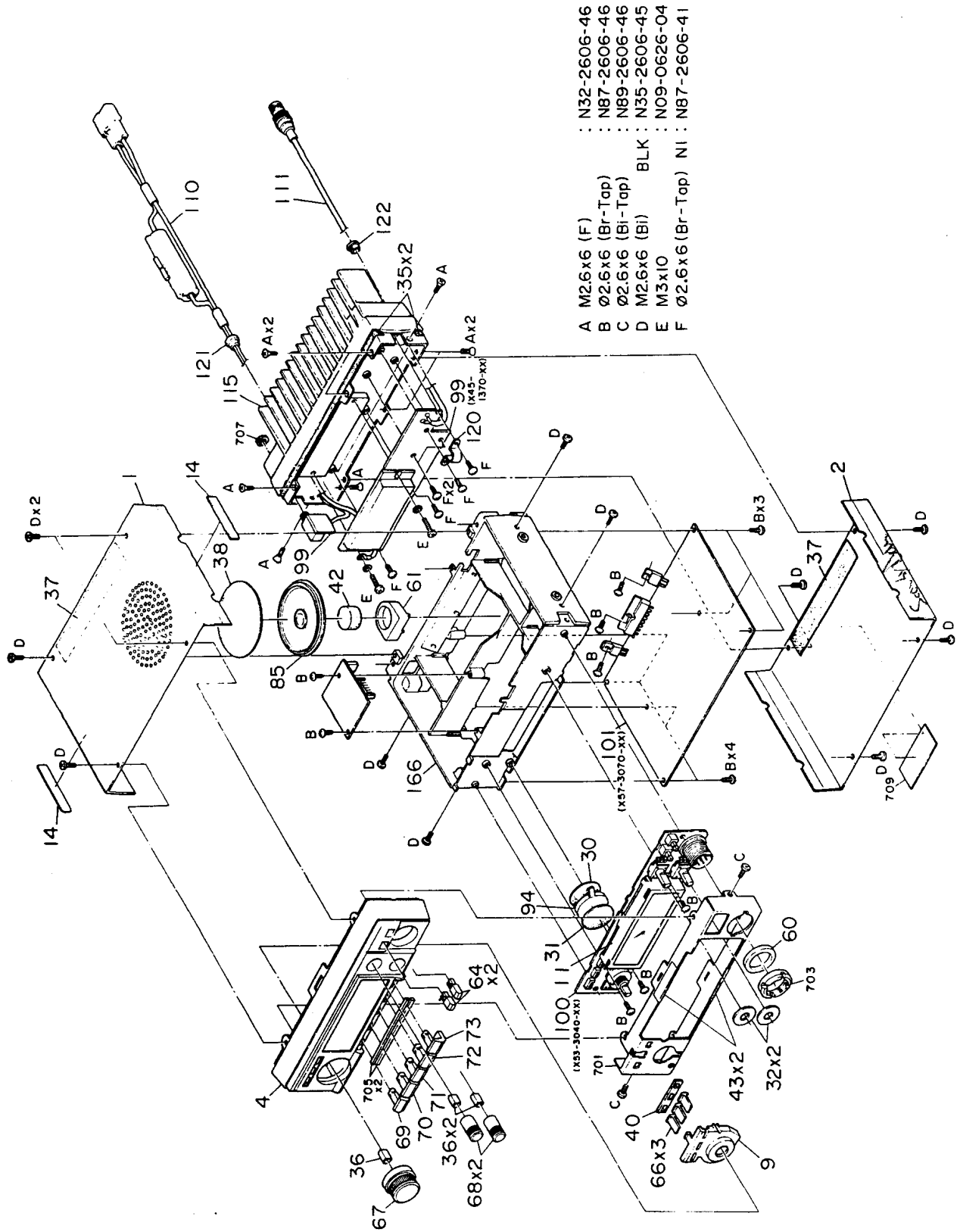
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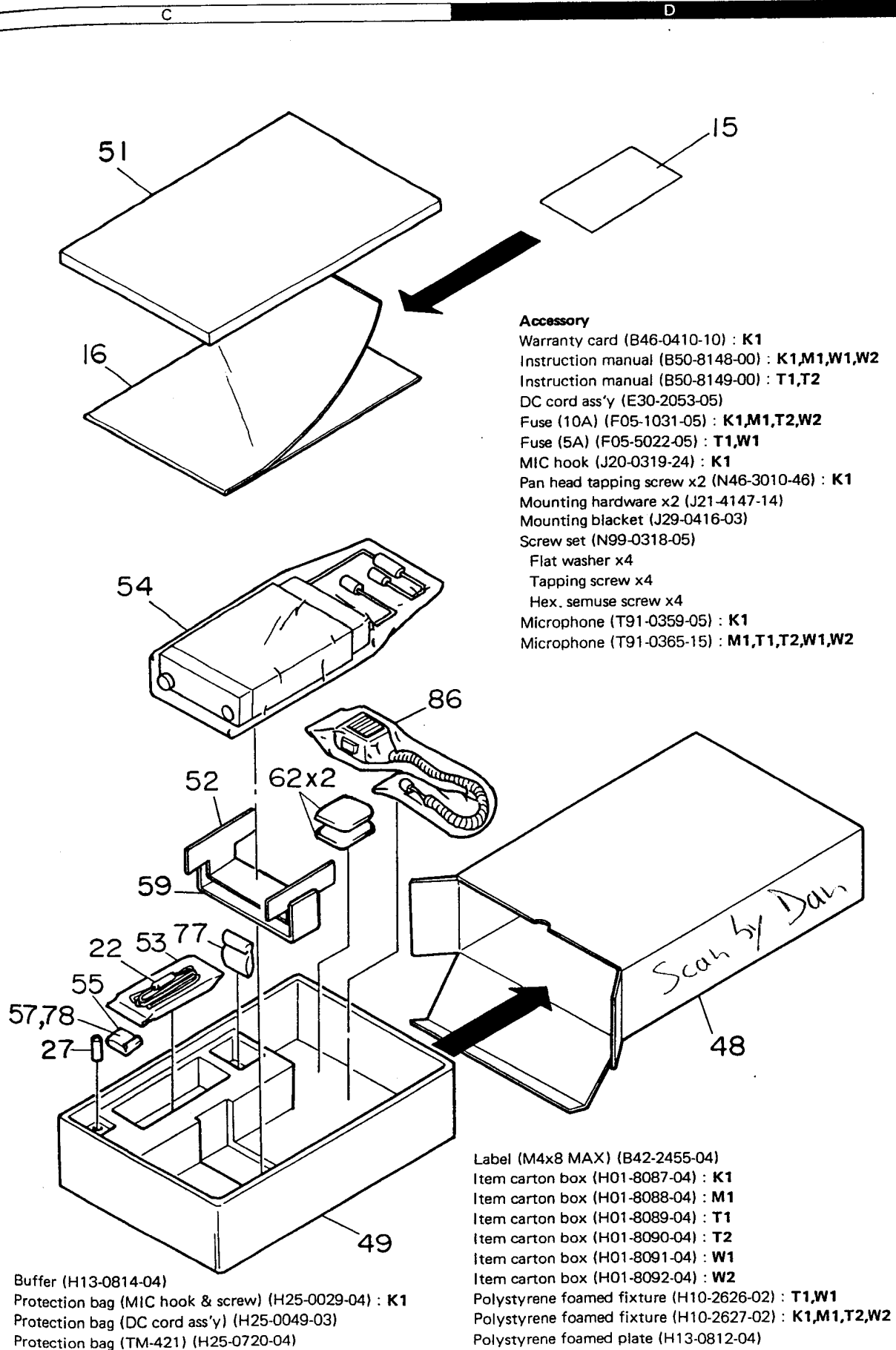
V-421A/E/ES

EXPLODED VIEW



Parts with the exploded numbers larger than 700 are not supplied.

PACKING



V-421A/E/ES

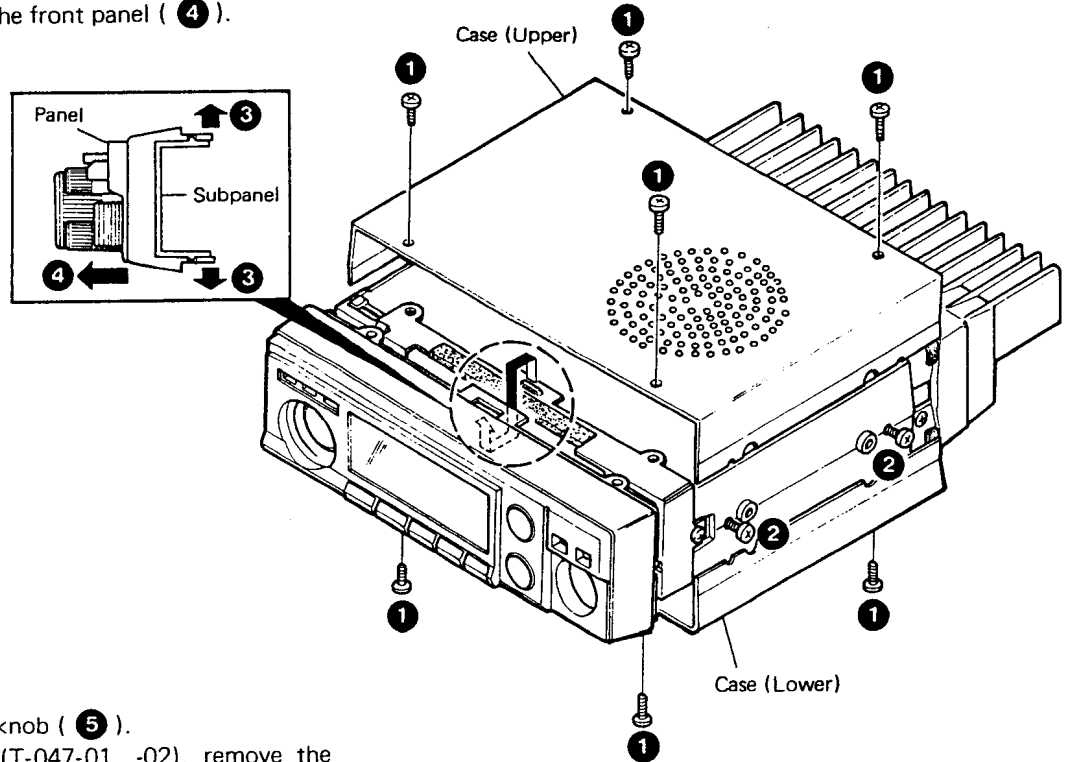
DISSASSEMBLY

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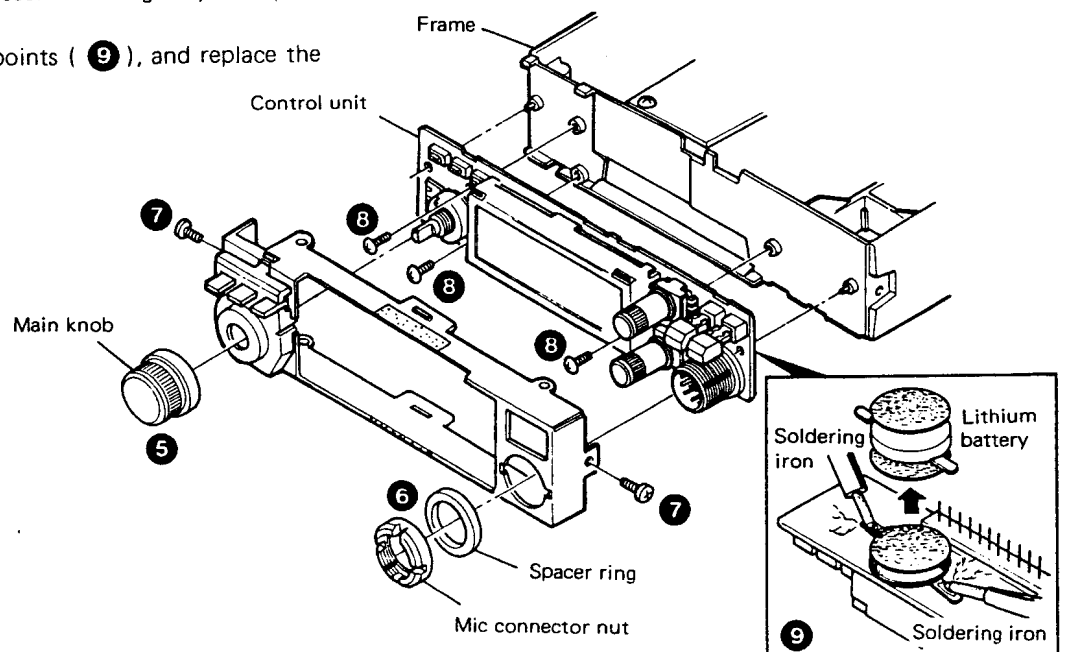
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Replacement of Lithium Battery

1. Remove the eight screws from the upper and lower case (1). Loosen the four screws on the left and right panel (2), and remove the upper and lower case.
2. Release the stoppers fixing the front panel and sub-panel (3), and remove the front panel (4).



3. Pull out the main control knob (5).
4. Using the special tools (T-047-01, -02), remove the MIC connector nut and spacer ring (6).
5. Remove the two screws (7), and remove the sub-panel.
6. Remove three screw (8), and remove the Control unit. As it is connected to the TX-RX unit at the rear of it via a connector pin, disconnect it gently when removing.
7. Remove solder from two points (9), and replace the lithium battery.



ADJUSTMENT

REQUIRED TEST EQUIPMENT

DC V.M

- 1) High input impedance

RF VTVM (RF V.M)

- 1) Input impedance : $1M\Omega$ min., $2pF$ max.
- 2) Voltage range : F.S = $10mV \sim 300V$
- 3) Frequency range : Up to $450MHz$

Frequency Counter (f. counter)

- 1) Input sensitivity : Approx. $50mV$
- 2) Frequency range : Up to $450MHz$

DC Power Supply

- 1) Voltage : $10V \sim 17V$, variable
- 2) Current : $6A$ min.

Power Meter

- 1) Measurement range Approx. : $30W, 3W, 1W$
- 2) Input impedance : 50Ω
- 3) Frequency range : $450MHz$

AF VTVM (AF V.M)

- 1) Input impedance : $1M\Omega$ min.
- 2) Voltage range : F.S = $1mV \sim 30V$
- 3) Frequency range : $50Hz \sim 10kHz$

AF Generator (AG)

- 1) Output frequency : $100Hz \sim 10kHz$
- 2) Output voltage : $0.5mV \sim 1V$

Linear Detector

- 1) Frequency range : $450MHz$

Field Strength Meter

- 1) Frequency range : $450MHz$

Directional Coupler

Oscilloscope

- 1) High sensitivity oscilloscope with horizontal input terminal

SSG

- 1) Frequency range : $144MHz$ and $430MHz$ bands
- 2) Modulation : AM and FM MOD.
- 3) Output level : $-20dB$ to $100dB$

Dummy Load

- 1) 8Ω , $50W$ (approx.)

Noise Generator

- 1) Must generate ignition-like noise containing harmonics beyond $450MHz$.

15. Sweep Generator

- 1) Sweep range : $1440MHz$ and $430MHz$ bands

16. Tracking generator

PREPARATION

- 1) Unless otherwise specified, knobs and switches should be set as follows **Table 6**.

POWER SW	ON	SHIFT SW	OFF
AF VOL VR	MIN	REV SW	OFF
SQL VOL VR	MIN	SCAN SW	OFF
LOW SW	OFF	CTCSS SW (K,M)	OFF
VFO/M SW	VFO	ALERT SW (T,W)	OFF
		TONE SW	OFF

Table 6

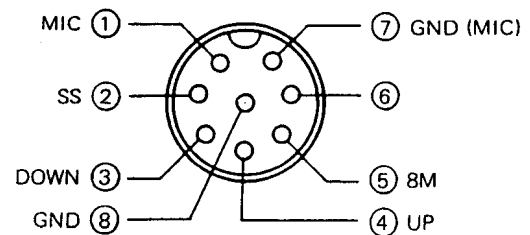


Fig 18 MIC terminals (view from front panel side)

- 2) Use an insulated adjusting rod to adjust trimmers and coils.
- 3) To prevent damaging SSG, never connect the microphone to mic jack while adjusting the receiver section.
- 4) Be sure to turn the power switch OFF, before connecting the power cable to a power source.
- 5) SSG output levels are those at the time the output terminal is open.
- 6) Meter and display section should be set as follows **Fig 19**.

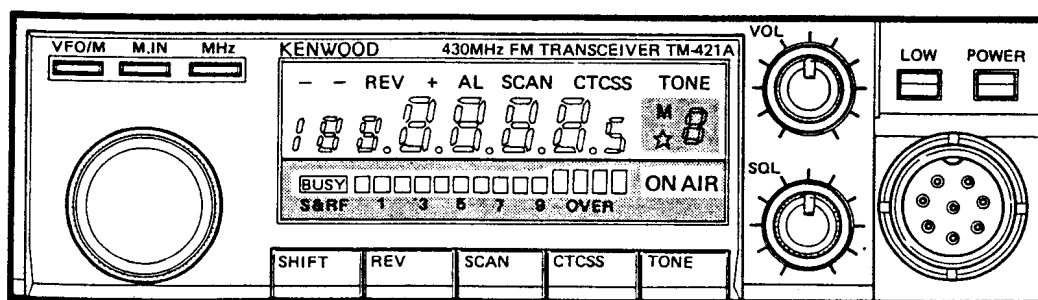




Fig 19

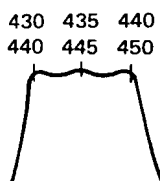
M-421A/E/ES

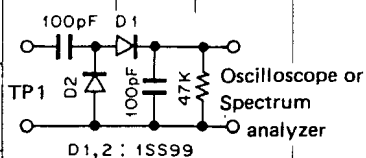
ADJUSTMENT

COMMON ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
Setting	1) Power supply : 13.8V DC Power SW : OFF VOL VR : Fully counter clockwise (CCW) SQL VR : Fully counter clockwise (CCW) VR6 on the TX-RX unit : Fully counter clockwise (CCW)							
Reset	1) Turn the Power SW ON, holding the VFO/M and M.IN SW down.							Display 440.000 (K) 430.000 (M,T,W)
	2) Release the VFO/M and M.IN SW.							 appeared during 5 sec. then,  disappeared.
PLL	1) RX VCO FREQ. : 440.000 (K) 430.000 (M,T,W) Receive.	Digital volt-meter	TX-RX	TP3 (4C)	VCO	TC2 (4B)	2.5V	±0.1V
	Check						Less than 7.2V.	
	2) TX VCO FREQ. : 440.000 (K) 430.000 (M,T,W) Transmit.				VCO	TC1 (4B)	2.5V	±0.1V
	Check				Less than 7.0V.			
TX FREQ. ADJ.	1) FREQ. : 445.000 (K) 435.000 (M,T,W) Transmit.	f.counter Power meter	Rear panel	ANT (1E)	TX-RX	TC3 (4C)	445.000MHz (K) 435.000MHz (M,T,W)	±100Hz

RECEIVER SYSTEM ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
Helical	1) FREQ. : 445.025 (K) 435.025 (M,T,W) Connect the sweep gen. to the ANT terminal and the Oscilloscope to the detector output.	Oscilloscope	TX-RX	TP1 (4E)	TX-RX	TC1 (2E) TC2 (3F) L3(3F) L4(4F)	Adjust for the waveform perform shown on right.	
	2) Connect the spectrum analyzer to the TP1 terminal, from the TX-RX unit.							
	3) Connect the TP3 terminal to GND terminal.							
MAIN	1) FREQ. : 445.025 (K) 435.025 (M,T,W) SSG output : 5dBμ MOD : OFF	Digital multi-meter	TX-RX	TP2 (4D)	TX-RX	TC6 (4E) L7(4E) L9(4E) L12 (4E)	Repeat for MIN. Repeat the adjustment in order of L7 and L9.	Check : Accurate SSG's freq.
	scri	1) FREQ. : 445.025 (K) 435.025 (M,T,W) SSG output : 20dBμ MOD : 1kHz DEV : ±5kHz	AF VM Oscilloscope 8Ω dummy load	Rear panel	SP (1B)	TX-RX	L14 (4D)	AF MAX.



ADJUSTMENT


Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
Sensitivity	1) FREQ. : 445.025 (K) 435.025 (M,T,W) SSG output : -10dBμ	AF VM Oscilloscope 8Ω dummy load	Rear panel	SP (1B)			Check	SINAD 12dB or more.
	2) FREQ. : 440.025 (K) 430.025 (M,T,W)							
	3) FREQ. : 449.950 (K) 439.950 (M,T,W)							
S-meter	1) FREQ. : 445.025 (K) 435.025 (M,T,W) SSG output : -6dBμ MOD : OFF	LCD (S-meter)			TX-RX	VR1 (4D)	Set the RF scale to reads "2 digit".	
	2) SSG output : 16dBμ							
	3) SSG : OFF							

TRANSMITTER SYSTEM ADJUSTMENT



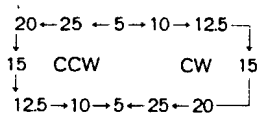
Item	Condition	Measurement			Adjustment			Specification/Remarks				
		Test equipment	Unit	Terminal	Unit	Part	Method					
RF output	1) FREQ. : 445.000 (K) 435.000 (M,T,W) VR6 (TX-RX unit) : Fully clockwise (CW) Transmit.	Power meter (DC power supply galvo meter)	Rear panel	ANT (1E)	TX-RX	TC4 (3A)	MAX.	37W or more (K) 13W or more (M,T,W)				
	TC5 (2B)											
	Final				VR1 (2E)							
							ON AIR LCD indicated.					
2) FREQ. : 440.000 (K) 435.000 (T1,W1) 430.000 (M,T2,W2) Transmit.				TX-RX	VR6 (3B)	36W (K,M,T2,W2) 12W (T1,W1)	±3W, less than 9.5A. (K,M,T2,W2) ±2W, less than 3.2A. (T1,W1)					
3) FREQ. : 445.000 (K) 435.000 (T,W) 435.000 (M,T2,W2) Transmit.						Check	33~42W, less than 9.5A. (K,M,T2,W2) 10~14W, less than 3.2A. (T1,W1)					
4) FREQ. : 449.975 (K) 439.975 (M,T,W) Transmit.												
LOW Power	1) FREQ. : 445.000 (K) 435.000 (M,T,W) LOW SW : ON Transmit						Check	0.5~2W, less than 1.5A. (T1,W1)				
					TX-RX	VR7 (3B)	5W (K,M,T2,W2)	±2W, less than 4A. (K,M,T2,W2)				
S-meter	1) FREQ. : 445.000 (K) 435.000 (M,T,W) Transmit.	LCD (RF meter)			TX-RX	VR4 (3B)	Set to the RF scale reads "3 digits".					
	2) LOW SW : OFF Transmit.											
V.	1) FREQ. : 445.000 (K) 435.000 (M,T,W) AG : 1kHz, 50mV (K,M) 1kHz, 30mV (T,W) ● MS-57A/61A (Anritsu) HPS : OFF LPF : 20kHz	Linear detector Modulation Power meter	Rear panel	ANT (1E)	TX-RX	VR3 (3C)	±4.4kHz	±200Hz				
	2) AG : 1kHz, 5mV (K,M) 1kHz, 3mV (T,W)								TX-RX	VR2 (3C)	±3kHz (K,M)	±200Hz (K,M)
											Check	±2.2~3.6kHz (T,W)

M-421A/E/ES




ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
Protection	1) FREQ. : 445.000 (K) 435.000 (M,T,W) Transmit.	Power meter Digital multi-meter	Final	TP1 (2E)	Final	VR1 (2E)	Dip point 	
	2) Disconnect the power meter from ANT terminal. Transmit.	DC AM (DC power supply galvo-meter)			TX-RX	VR5 (3C)	4.5A (K,M,T2,W2) 2.2A (T1,W1)	±0.5A (K,M,T2,W2) ±0.2A (T1,W1)
TONE (K,M)	1) FREQ. : 445.000 (K) 435.000 (M) TONE SW : ON Transmit.	Linear detector Modulation analyzer	Rear panel	ANT (1E)				FREQ. : 88.0~89.0Hz DEV. : ±0.5~1kHz
TONE (T,W)	1) FREQ. : 435.000 TONE SW : ON Transmit.	Power meter f.counter		ANT (1E)				FREQ. : 1750±10Hz DEV. : ±2.5kHz or more.

Processor operation check

Item	Condition	Operation check	Item	Condition	Operation check		
Reset	1) Turn the Power switch ON holding the VFO/M and M.IN switches down.	Display 440.000 (K) 430.000 (M,T,W) The  indicator and the Memory channel number display light for approx. 5 sec. after release the switches.	4-1. Memory entry (simplex standard offsets)	Simplex memory channels are; M0~9, MA, b. Determine the desired FREQ., SHIFT, CTCSS, TONE FREQ. then follow the procedure below.			
	2) Release the VFO/M and M.IN switches.					1) Press the M.IN switch.	The memory channel number display lights.
						2) Select the desired memory channel using the Tuning control or the Microphone UP/DOWN switch. This selection should be completed within 5 sec. after the M.IN switch is pressed.	
FREQ. Up Down	1) Press the M.IN switch.	 indicator lights.	4-2. Odd split memory channels	1) Select the desired FREQ. using the Tuning control or the Microphone UP/DOWN switch. (as described in Item 4-1.)	Memory entry is completed.		
	2) Press the M.IN switch, then press the REV switch within 5 sec.	Display 0000005 Turn the Tuning control and the UP/DOWN switches to increase or decrease the figures as shown below. 				3) Press the M.IN switch within 5 sec. after the memory channel selection is completed.	
	3) Press any switch except the LOW and the Power switches to return to the normal receive FREQ.	Receive FREQ. lights. (to return to the normal FREQ.)					
FREQ. Up Down (Hz)	1) Press the MHz switch.	The kHz digits goes off.					
	2) Turn the Tuning control switch to CW or CCW.	Rotating the Tuning control switch changes the FREQ. in 1MHz step.					
	3) Press any switch except the LOW and the Power switches to return to the normal receive FREQ.	The kHz digits lights.					

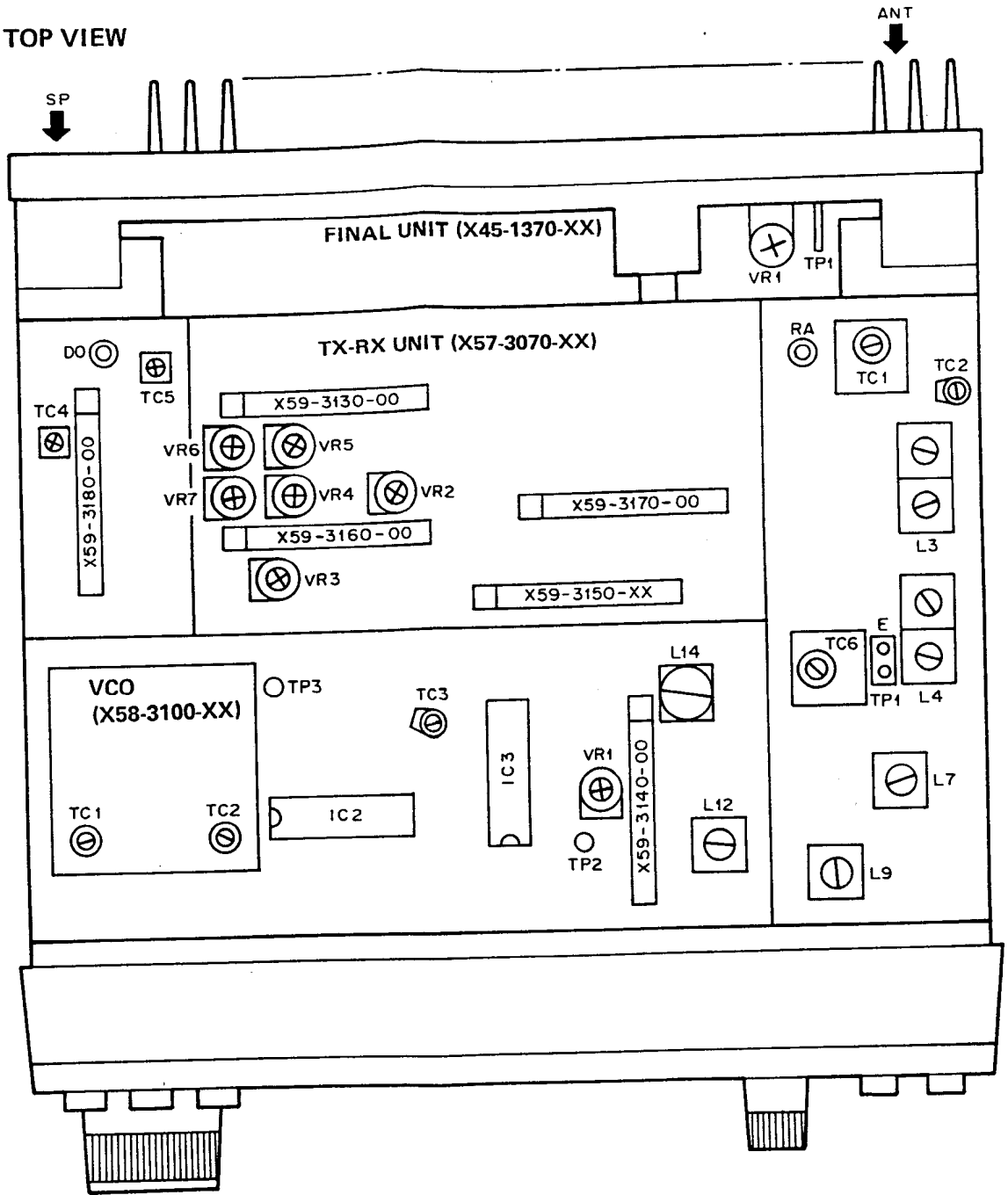
ADJUSTMENT

Item	Condition	Operation check	Item	Condition	Operation check
4-2. Odd split memory channels	2) Press the M.IN switch	The beeper sound changes.  indicator lights. The memory channel number display is not light.	5. TONE FREQ.	3) Press any switch except the LOW and the Power switches to return to the normal VFO FREQ.	Receive FREQ. lights.
	The receive FREQ. memory entry is completed, then changes to the waiting mode of the transmit FREQ. memory entry.		6. Memory channel lockout selec- tion	1) Press the VFO/M switch to select the memory channel mode.	 indicator lights.
	4) Select the desired transmit FREQ. using the Tuning control or the Microphone UP/DOWN switch.			2) Select the desired memory channel to skip using the Tuning control or the Microphone UP/DOWN switch.	
5) Press the M.IN switch.	Memory entry is completed.		3) Press the M.IN switch and the SCAN switch. When the M.IN switch is pressed, the M indicator lights. The SCAN switch should be pressed within 5 sec. after the M.IN switch is pressed, or the M indicator goes off.	 indicator lights. The asterisk (*) lights in the left of the memory channel number display. The indicated memory channel is skipped during SCAN operation.	
5. TONE FREQ.	1) Press the M.IN switch and then TONE switch. (within 5 sec. after pressing the M.IN switch.)	TONE FREQ. lights.			
	2) Select the desired TONE FREQ. using the Tuning control or the Microphone UP/DOWN switch. (a value in the 67.0 to 250.3)				

TM-421A/E/ES

ADJUSTMENT

TOP VIEW



TX-RX UNIT (X57-3070-XX)

- VR1 : S-1
- VR2 : DEV. 1kHz, 5mV, ±3kHz (K,M)
- VR3 : DEV. 1kHz, 50mV(K,M) , 30mV(T,W) , ±4.4kHz
- VR4 : RF meter
- VR5 : PRO.
- VR6 : RF output
- VR7 : Low power (K,M,T2,W2)
- L3,4 : Helical
- L7,9,12 : IF GAIN
- L14 : Discr
- TC1,2 : Helical
- TC3 : TX frequency
- TC4,5 : RF output
- TC6 : IF GAIN

FINAL UNIT (X45-1370-XX)

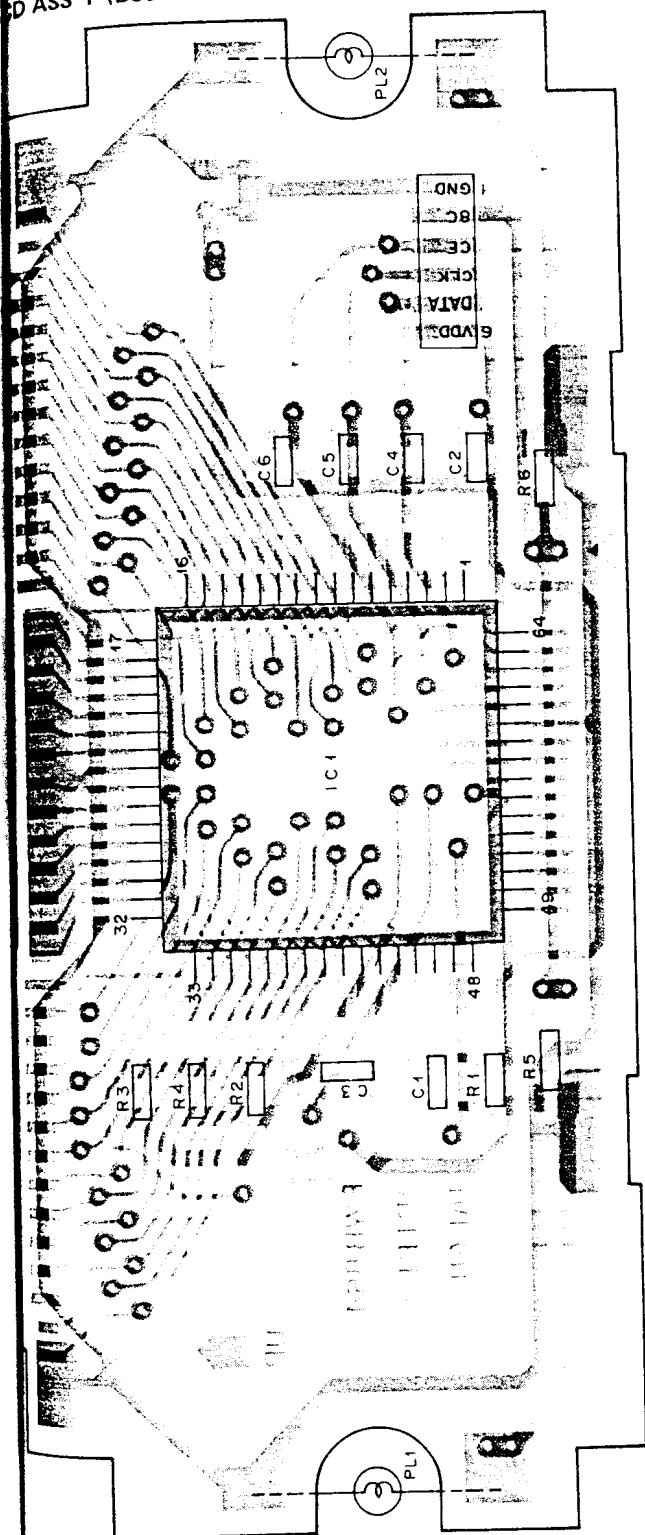
VR1 : PRO. (NULL)

VCO (X58-3100-XX)

TC1 : TX VCO
TC2 : RX VCO

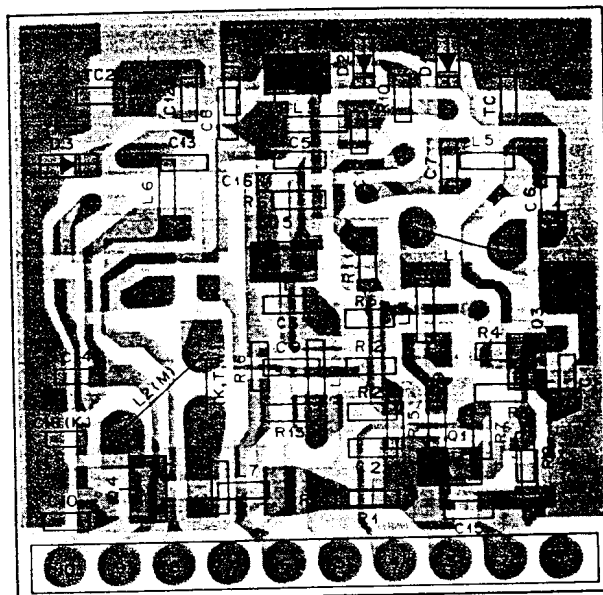
M-421A/E/ES PC BOARD VIEWS

PC BOARD ASS'Y (B38-0303-05) Component side view



IC1: LC7582

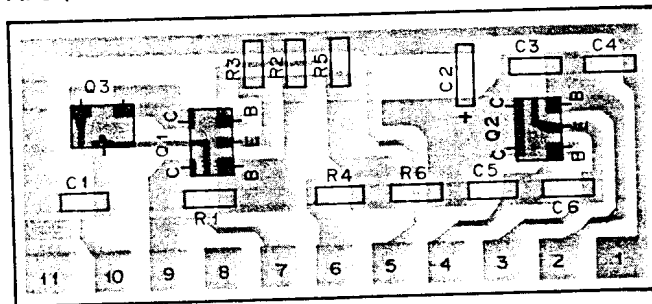
VCO (X58-3100-XX) Component side view



Q1 : 2SC2759(U23) Q2,4 : 2SK508(K52)
 Q3 : 2SC2712(Y) Q5 : DTC114EK
 D1-3 : 1SV164

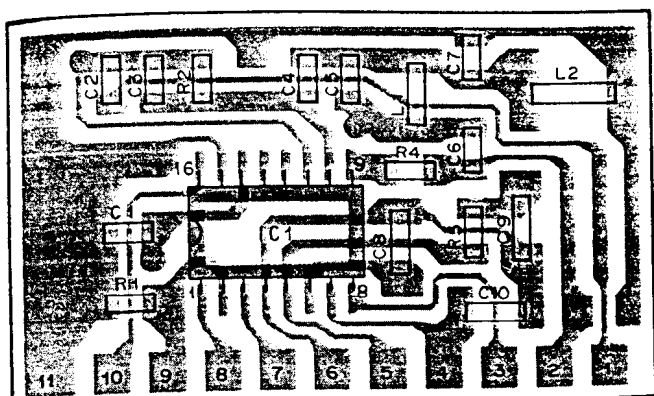
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 Downloaded by
 RadioAmateur.EU

APC (X59-3130-00) Component side view



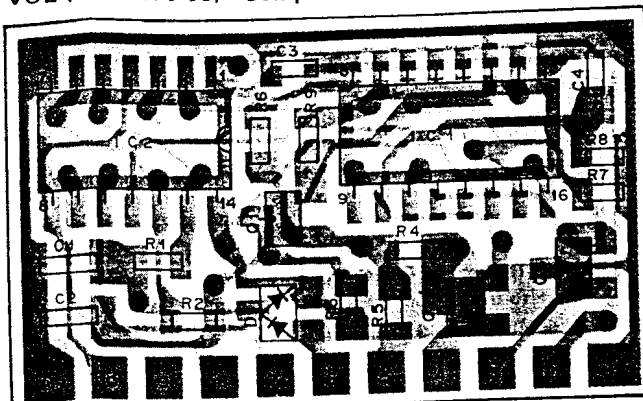
Q1,2 : FMW-1 Q3 : 2SA1162(Y)

IF (X59-3140-00) Component side view



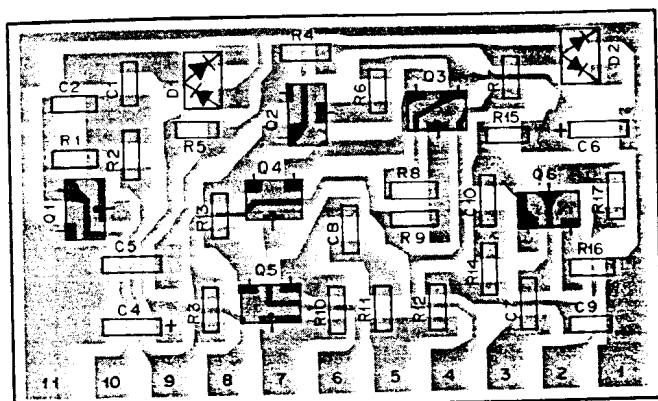
IC1 : TA7761F

VOL (X59-3170-00) Component side view



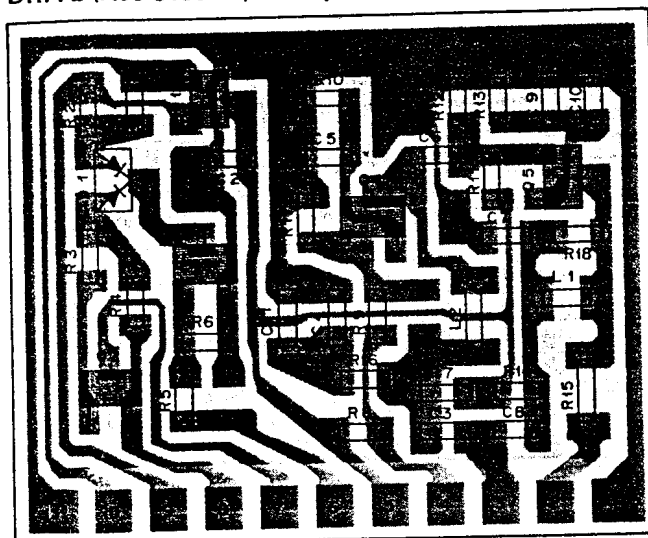
Q1 : DTC144EK Q2,3 : DTA114EK
 IC1 : LC7532M IC2 : MN4066BS
 D1 : 1SS226

SQL (X59-3150-XX) Component side view



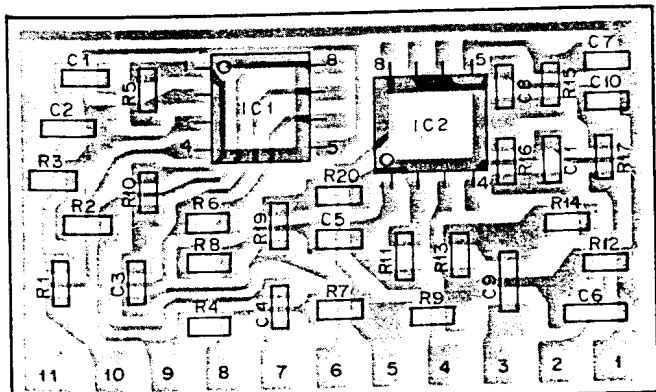
Q1,2,5,6 : 2SC2712(Y) Q3,4 : 2SC3295(B)
 D1 : 1SS226 D2 : 1SS181

DRIVE (X59-3180-00) Component side view



Q1,2 : 2SA1162(Y) Q3 : 2SC2712(Y) Q4,5 : 2SC2759(U23)
 D1 : 1SS184

MIC (X59-3160-00) Component side view



IC1,2 : NJM4558M

2SA1162 2SC2759
 2SC2712 2SC3295

2SK508

FMW-1



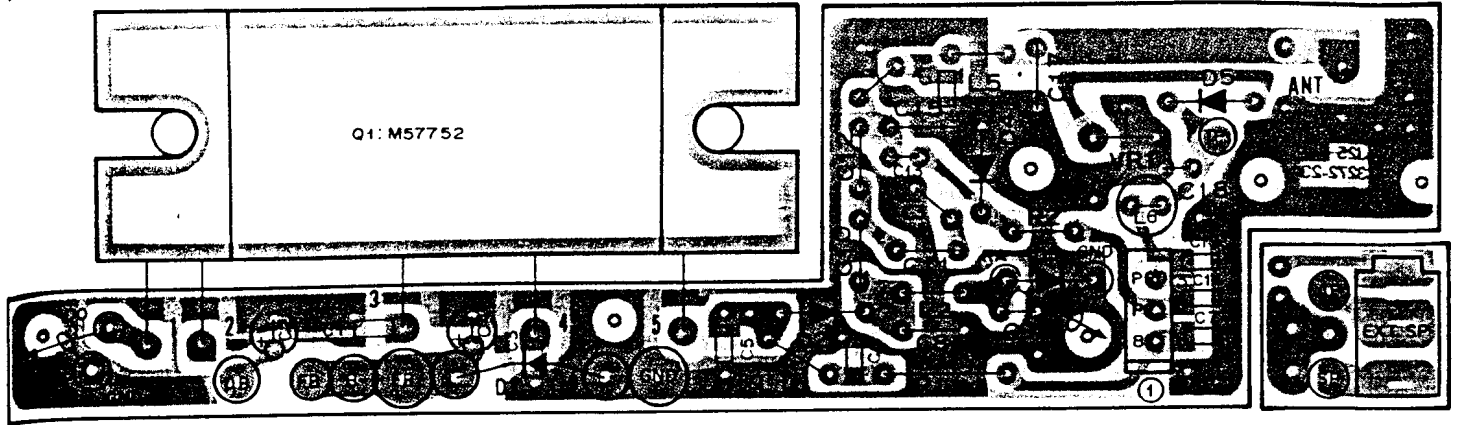
DTC114EK
 DTC144EK

DTA114EK

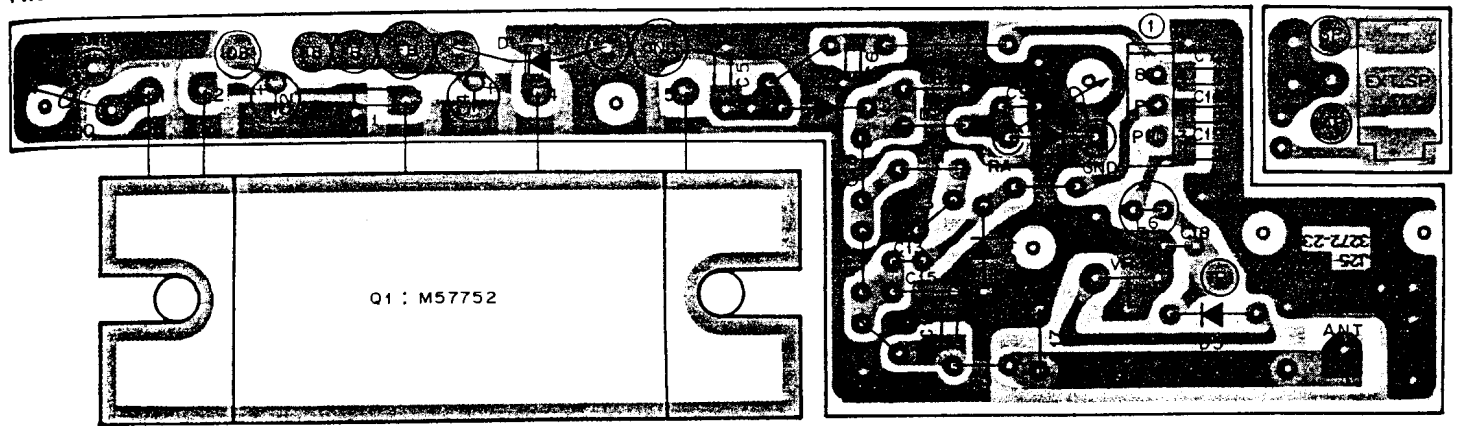


PC BOARD VIEWS TM-421A/E/ES

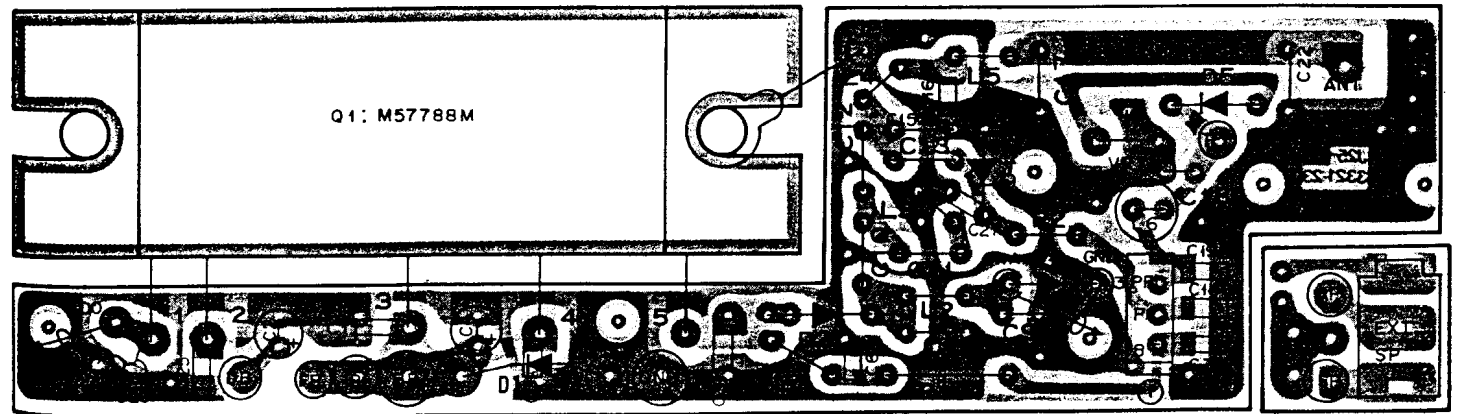
FINAL UNIT (X45-1370-52) : T1,W1 Component side view



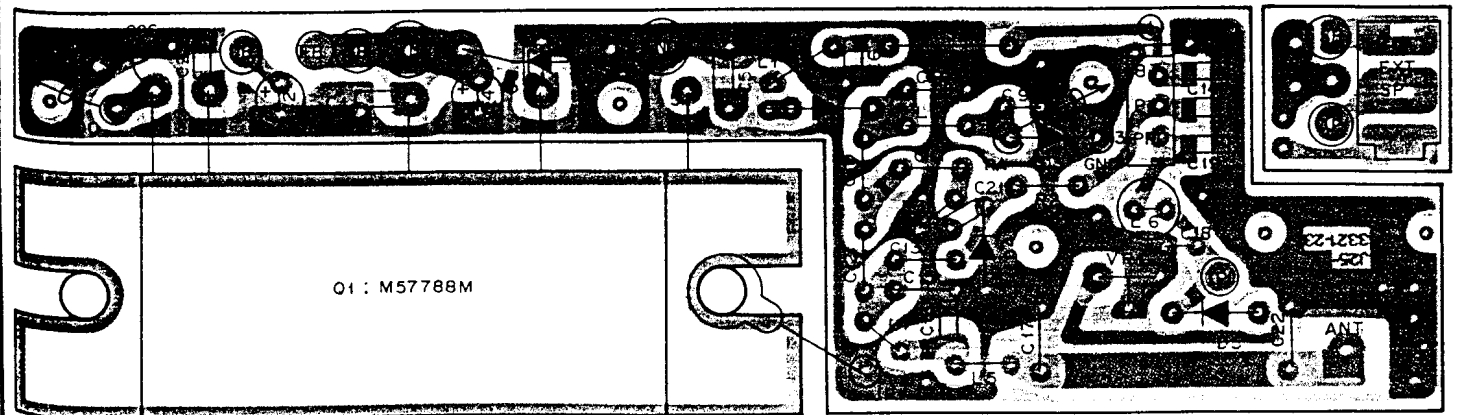
FINAL UNIT (X45-1370-52) : T1,W1 Foil side view



FINAL UNIT (X45-1370-XX) -03 : M -12 : K -53 : T2,W2 Component side view



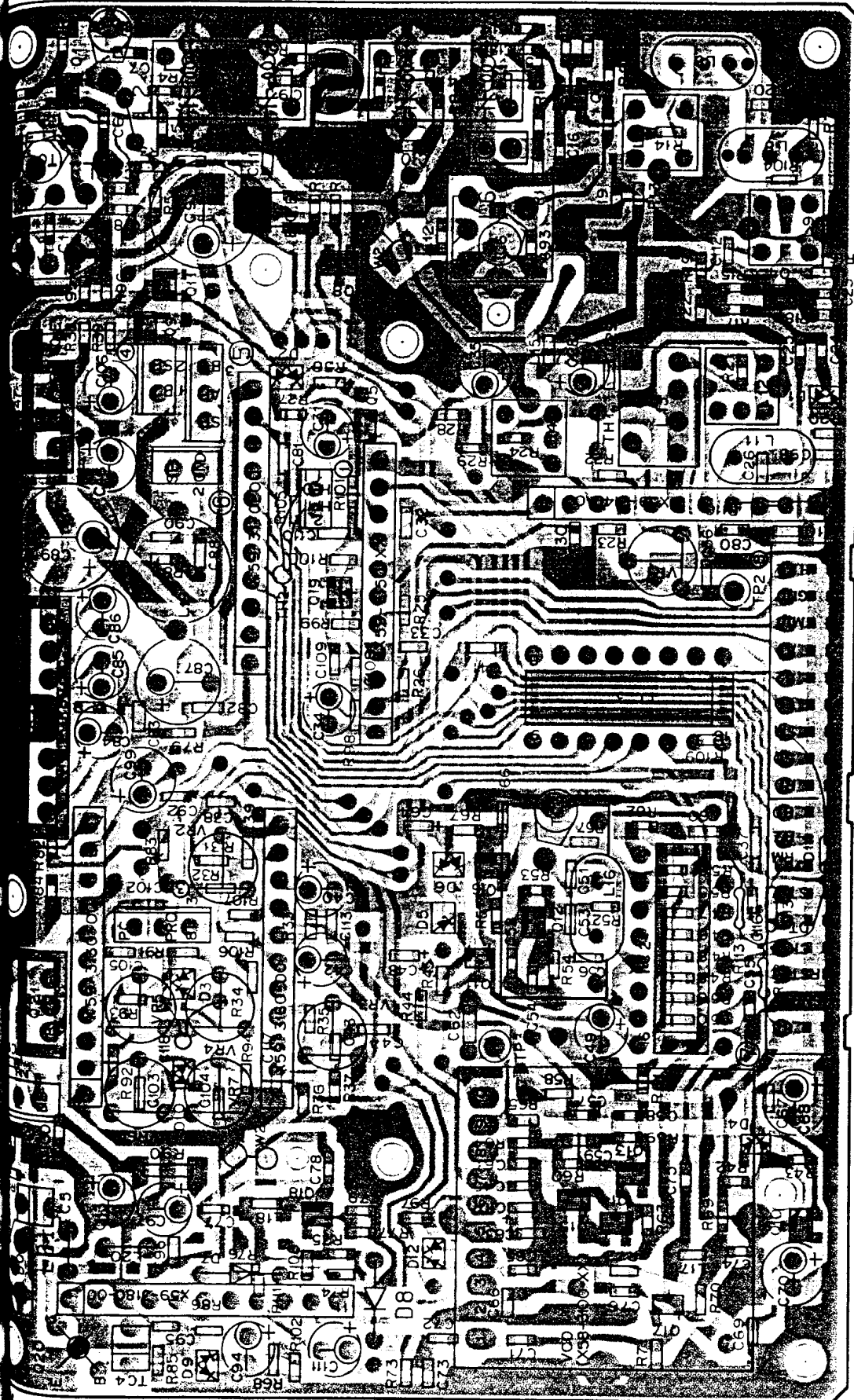
FINAL UNIT (X45-1370-XX) -03 : M -12 : K -53 : T2,W2 Foil side view



Q1 : M57752(TM-421E), M57788M(TM-421A, TM421ES)
 D1 : DSA3A1 D2 : MI308(TM-421E), UM9401(TM-421A, TM-421ES) D3 : MI308 D4,5 : 1SS101

TM-421A/E/ES PC BOARD VIEW

RX UNIT (X57-3070-XX) -11 : K -21 : M -51 : T1,W1 -52 : T2,W2 Component side view



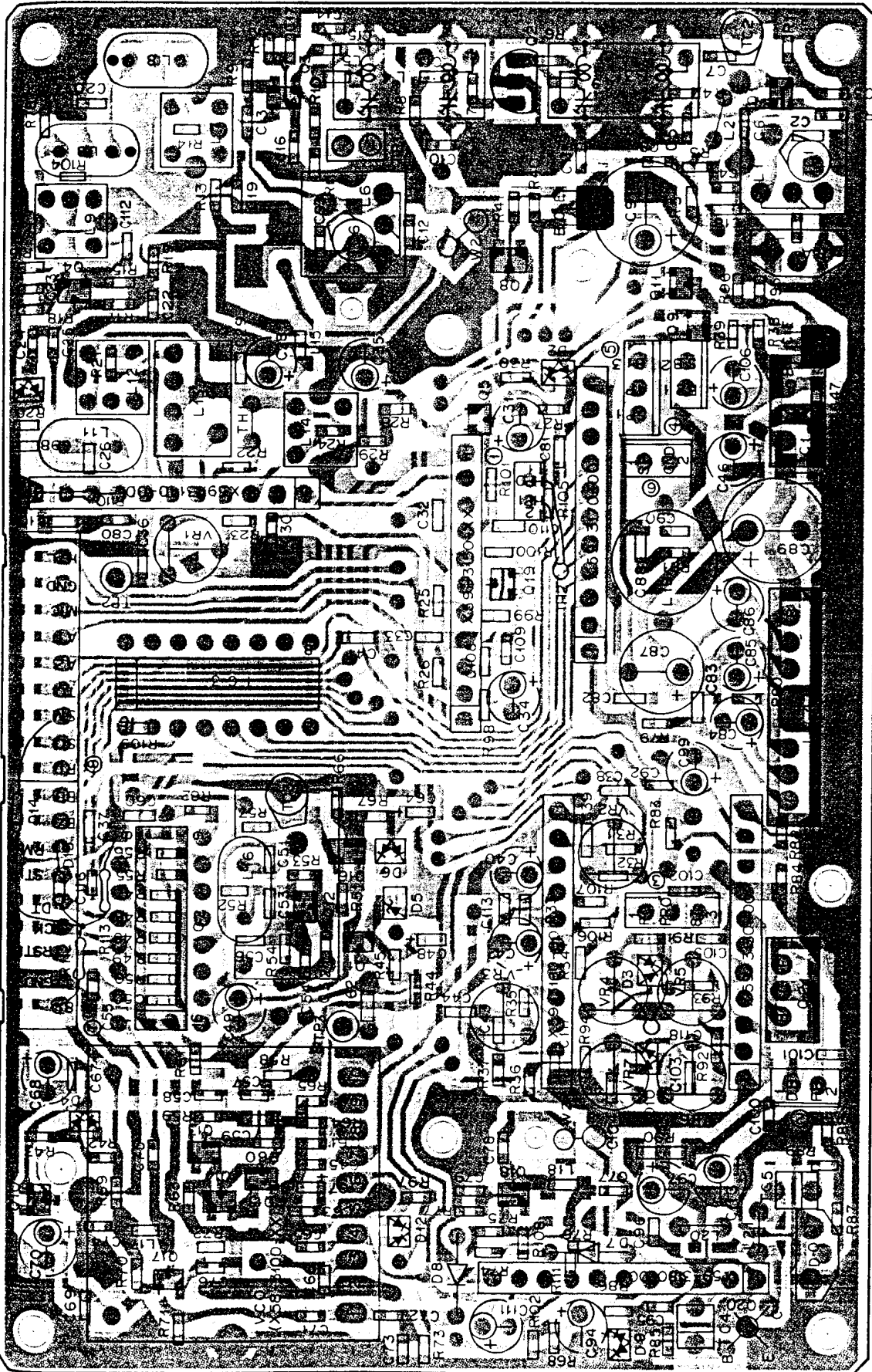
Q1 : 3SK184(S) Q2 : 2SK125 Q3 : 3SK184(R) Q4,12 : 2SC2714(Y) Q5 : 2SC3326(A) Q6,7 : 2SB119S Q8,9 : DTC124EK Q10,11,13-15,19 : 2SC2712(Y)
 Q16 : 2SA1162(Y) Q17,18 : 2SC2759(U23) Q20 : 2SC3369(TM-421A, TM-421ES), 2SC2407(1)(TM-421E) Q21 : 2SD1406(Y)
 IC1 : MC7808C IC2 : M54959P IC3 : TC4094BP IC4 : μPC1241H
 D1 : 1SS226 D2,6,9,10 : 1SS181 D3,4,11,12 : 1SS184 D5 : 02CZ6,2(Y,Z) D7,8 : BA282 D13,14 : 1S1555

	VR2	VR7	R32	R34	R36	R37	R76	R94	R105	R106	R107	R110	R111	C43	C98	C116	L10	Connector ①	TH2
TM-421A	-11 (K)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
TM-421E	-21 (M)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
TM-421ES	-51 (T1,W1)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	-52 (T2,W2)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

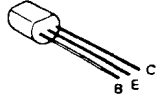
○ : Used, X : Not used

PC BOARD VIEW TM-421A/E/ES

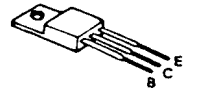
TX-RX UNIT (X57-3070-XX) -11 : K -21 : M -51 : T1,W1 -52 : T2,W2 Foil side view



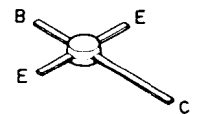
2SC2407



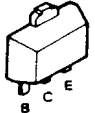
2SD1406



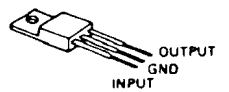
2SC3369



2SB1119S



MC7808C



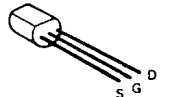
2SA1162
2SC2712
2SC2714
2SC2759
2SC3326



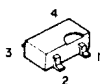
DTC124EK



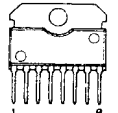
2SK125



3SK184



μPC1241H



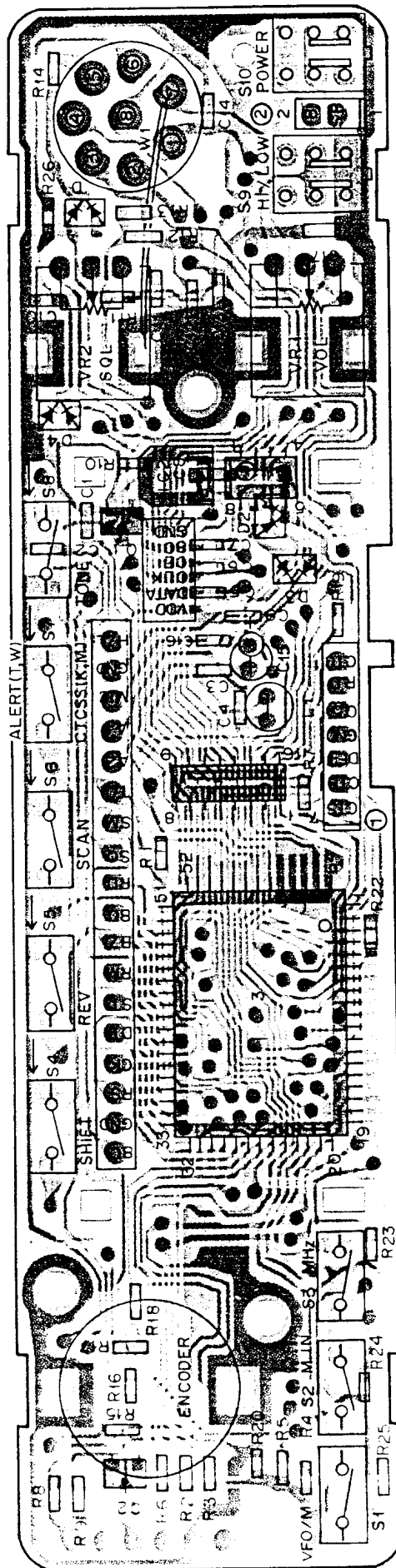
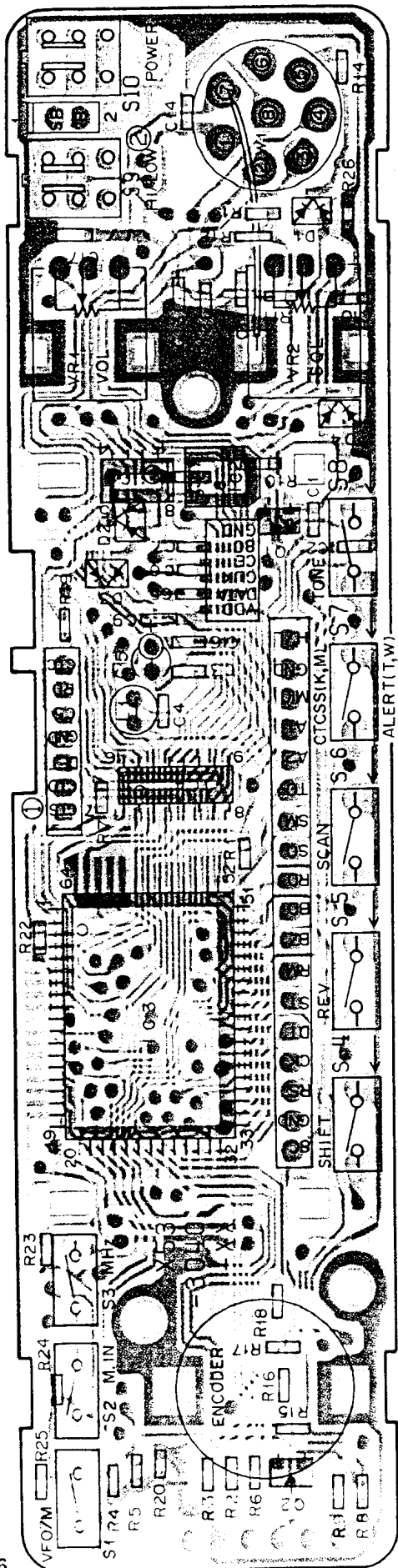
TM-421A/E/ES PC BOARD VIEWS

CONTROL UNIT (X53-3040-XX)

Component side view

CONTROL UNIT (X53-3040-XX)

Foil side view

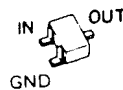


Q1 : DTC124EK Q2 : 2SC2712(Y)
 IC1 : LA5006M IC2 : M51951BML IC3 : μ PD75106G-508-1B IC4 : KRR-C001
 D1-4 : 1SS184

	R22	R23	R24
TM-421A	-12 (K)	O	X
	-23 (M)	O	X
TM-421E/ES	-52 (T1, T2)	X	X
	-62 (W1, W2)	X	O

O : Used, X : Not used

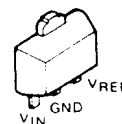
DTC124EK



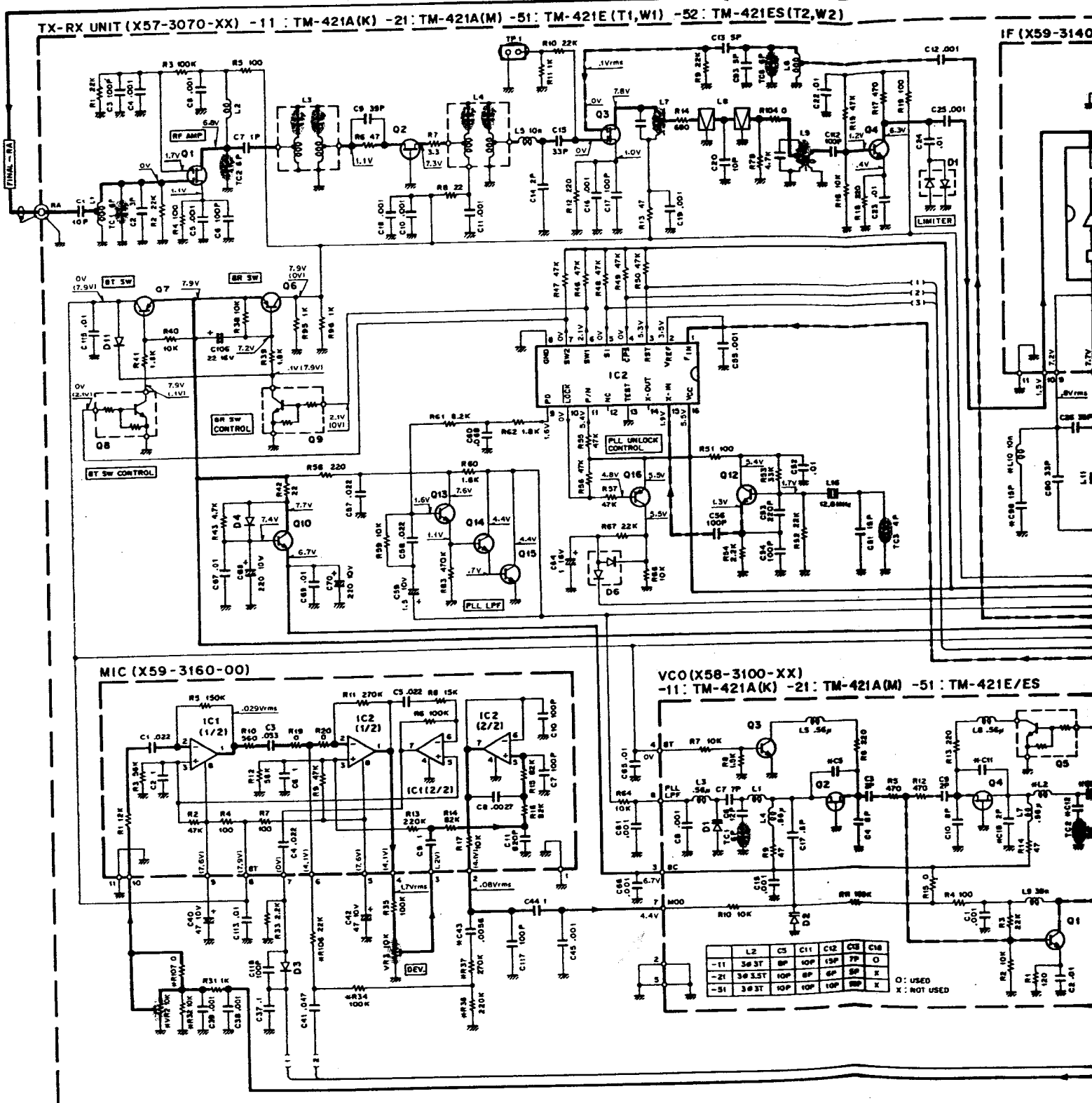
2SC2712(Y)



M51951BML



Signal line --- Control line --- Common DC line



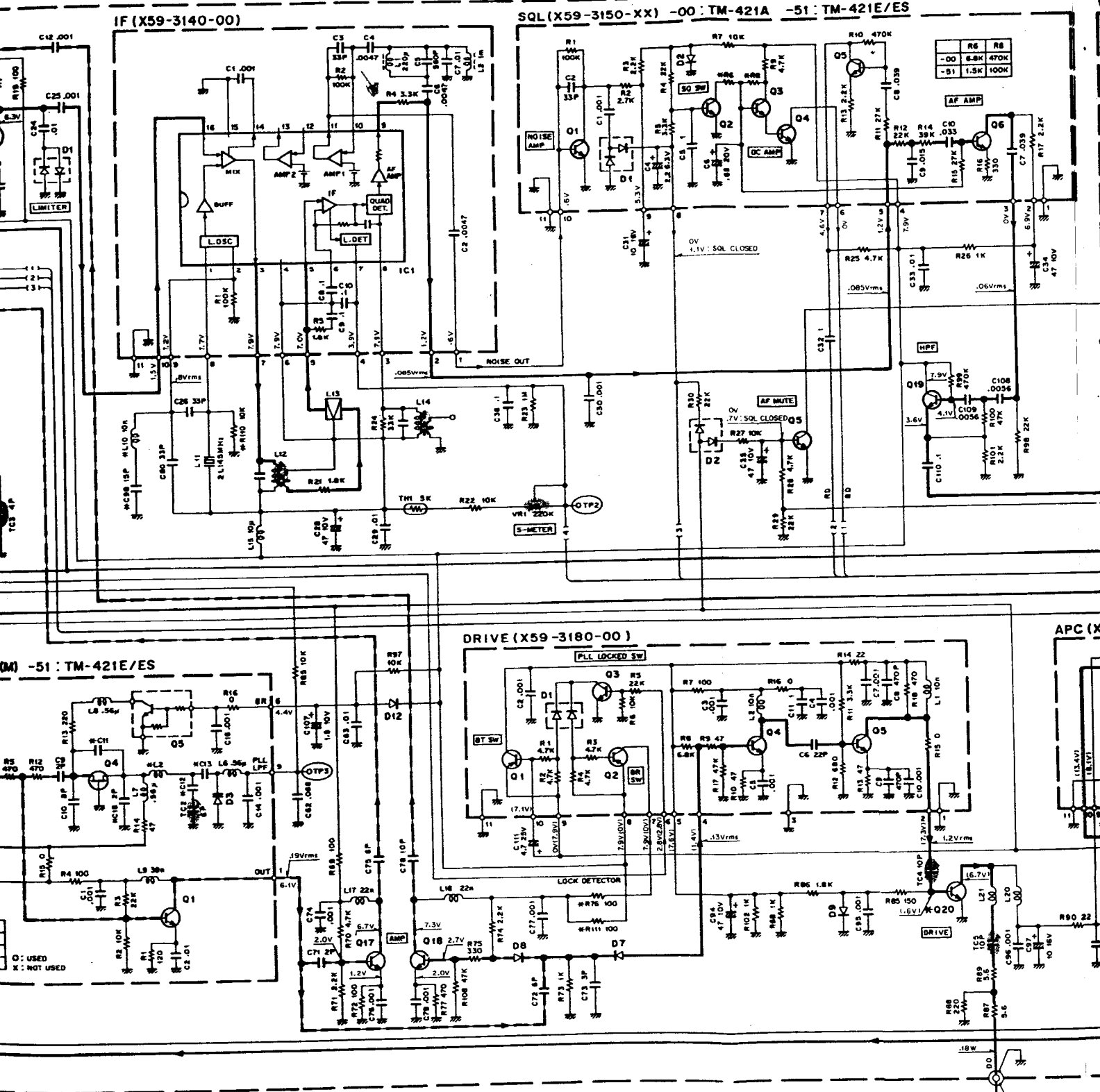
- Q1 : 35K184 (S)
- Q2 : 25K125
- Q3 : 35K184 (R)
- Q4,12 : 25C2714(Y)
- Q5 : 25C3326(A)
- Q6,7 : 25B1119S
- Q8,9 : DTC124EK
- Q10,11,13~15,19 : 25C2712(Y)
- Q16 : 25A1162(Y)
- Q17,18 : 25C2759(U23)
- Q21 : 25D1406(Y)
- IC1 : MC7808C
- IC2 : M54959P
- IC3 : TC4094BP
- IC4 : JPC1241H
- D1 : 15S226
- D2,6,9,10 : 15S181
- D3,4,11,12 : 15S184
- D5 : 02C26.2(Y,Z)
- D7,8 : BA282
- D13,14 : 151555
- TH1 : 112-502-2
- TH2 : PTH59U332M

	Q20	VR2	VR7	R32	R34	R36	R37	R38	R39	R40	R45	R106	R107	C43	Connector
TM-421A	K -11	25C3369	O	O	O	O	O	O	O	100K	X	X	X	X	O
	M -21	25C3369	O	O	X	O	O	O	O	100K	X	X	X	X	O
TM-421E	T1,W1 -51	25C2407(11)	X	X	O	X	X	X	X	4.7K	O	O	O	O	X
TM-421ES	T2,W2 -52	25C3369	O	O	O	X	X	X	X	100K	X	O	O	O	X

	L10	R76	R110	R111	C96	C116	TH2
TM-421A	K -11	O	O	O	X	O	O
	M -21	O	O	X	X	X	O
TM-421E	T1,W1 -51	X	X	X	O	X	X
TM-421ES	T2,W2 -52	X	X	X	O	X	X

O: USED
X: NOT USED

SCHEMATIC DIAGRAM



(M) -51: TM-421E/ES

O: USED
X: NOT USED

R94	R105	R106	R107	C43	Connector
X	X	X	X	O	O
X	X	X	X	O	O
O	O	O	O	X	X
X	O	O	O	X	X

O: USED
X: NOT USED

(X58-3100-XX)
Q1 : 25C2759(U23)
Q2,4 : 25K508(K52)
Q3 : 25C2712(Y)
Q5 : DTC114EK

D1-3 : 15V164

(X59-3130-00)
Q1,2 : FMW-1
Q3 : 25A1162(Y)

(X59-3140-00)
Q1 : TA7761F
IC1 : TA7761F

(X59-3150-XX)
Q1,2,5,6 : 25C2712(Y)
Q3,4 : 25C3295(B)

D1 : 15S226
D2 : 15S181

(X59-3160-00)
IC1,2 : NJM4558M

(X59-3170-00)
Q1 : DTC144EK
Q2,3 : DTA114EK

IC1 : LC7532M
IC2 : MN4066BS

D1 : 15S226

(X59-3180-00)
Q1,2 : 25A1162(Y)
Q3 : 25C2712(Y)
Q4,5 : 25C2759(U23)

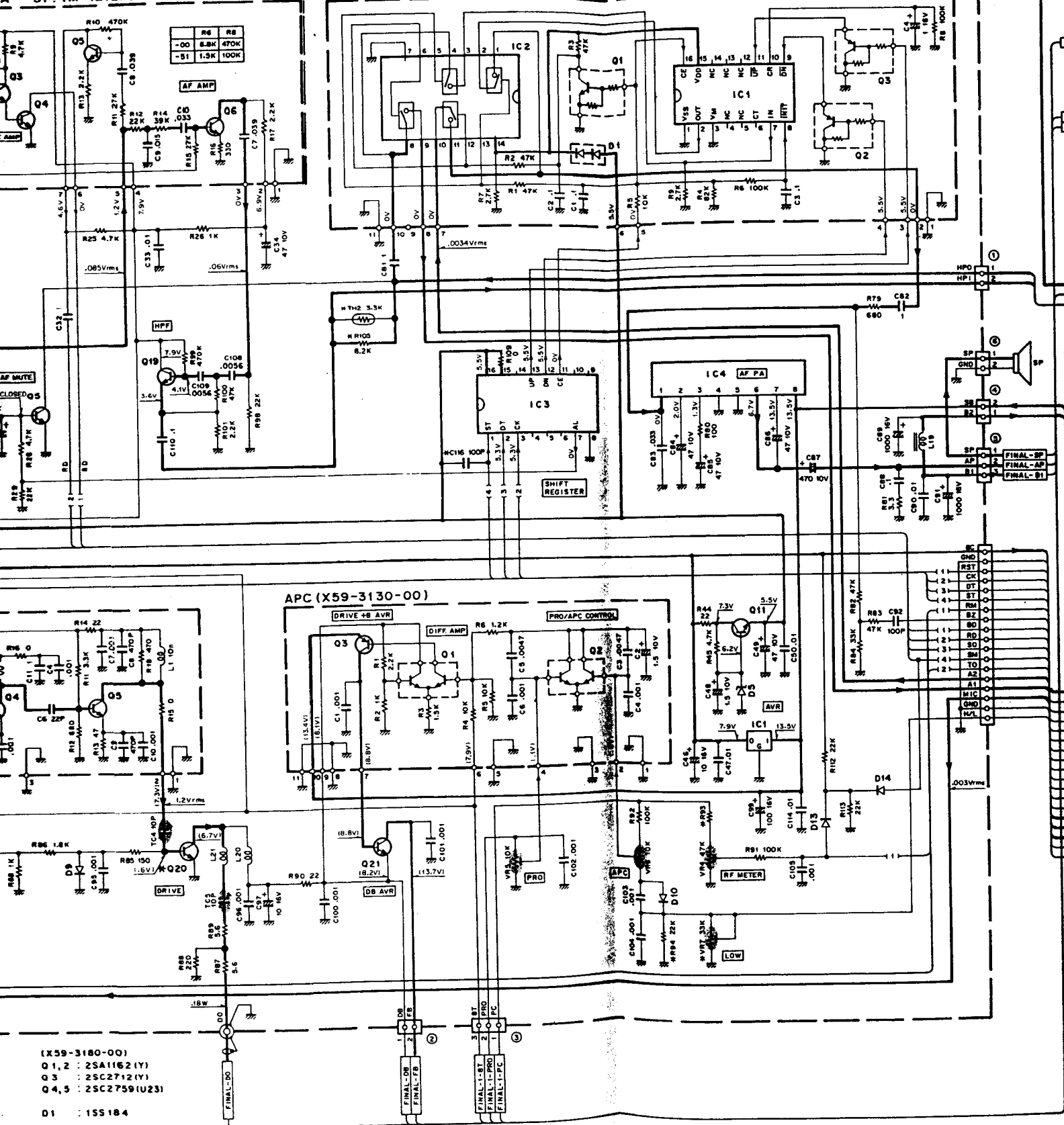
D1 : 15S184

FINAL-100

SCHEMATIC DIAGRAM

A -51: TM-421E/ES

VOL (X59-3170-00)



(X59-3180-00)
 Q 1, 2 : 2SA1162 (Y)
 Q 3 : 2SC2712 (Y)
 Q 4, 5 : 2SC2759 (U23)

D1 : 1SS184

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	R1	R22	R23	R24
TM-421A	X -12 220K	O	X	O
	M -23 220K	O	X	X
TM-421E,ES	W1,W2 -52 68K	X	X	O
	W1,W2 -62 68K	X	O	X

	Q1	Q2	D1~4
(X53-3040-XX)	Q1 : DTC124EK	Q2 : 2SC2712 (Y)	D1~4 : 1SS184

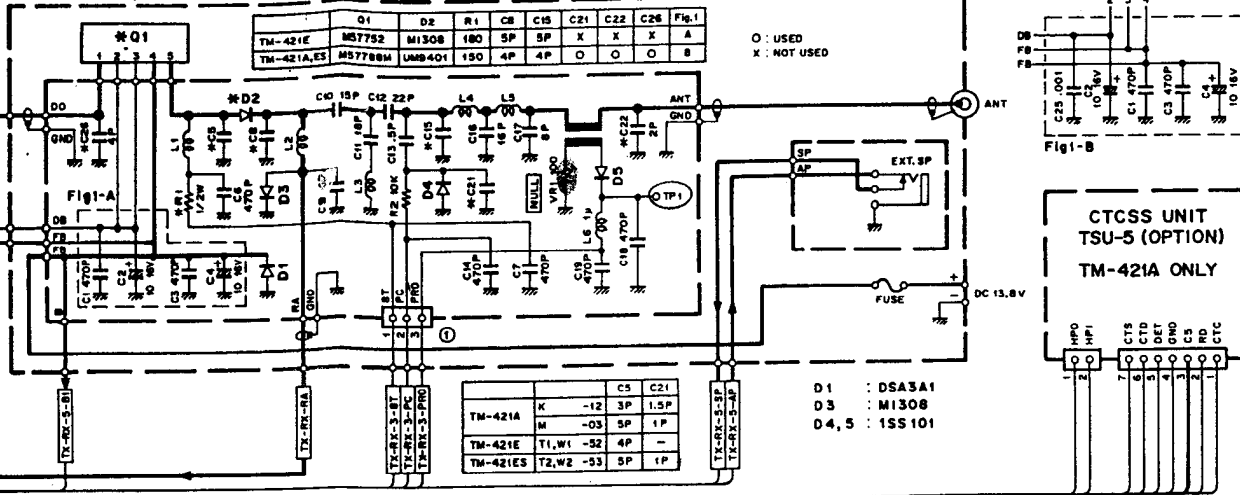
	IC1	IC2	IC3	IC4
TM-421E,ES	IC1 : LA5006M	IC2 : M51951BML	IC3 : μPD75106G-508-1B	IC4 : KRR-C001

O : USED
 X : NOT USED

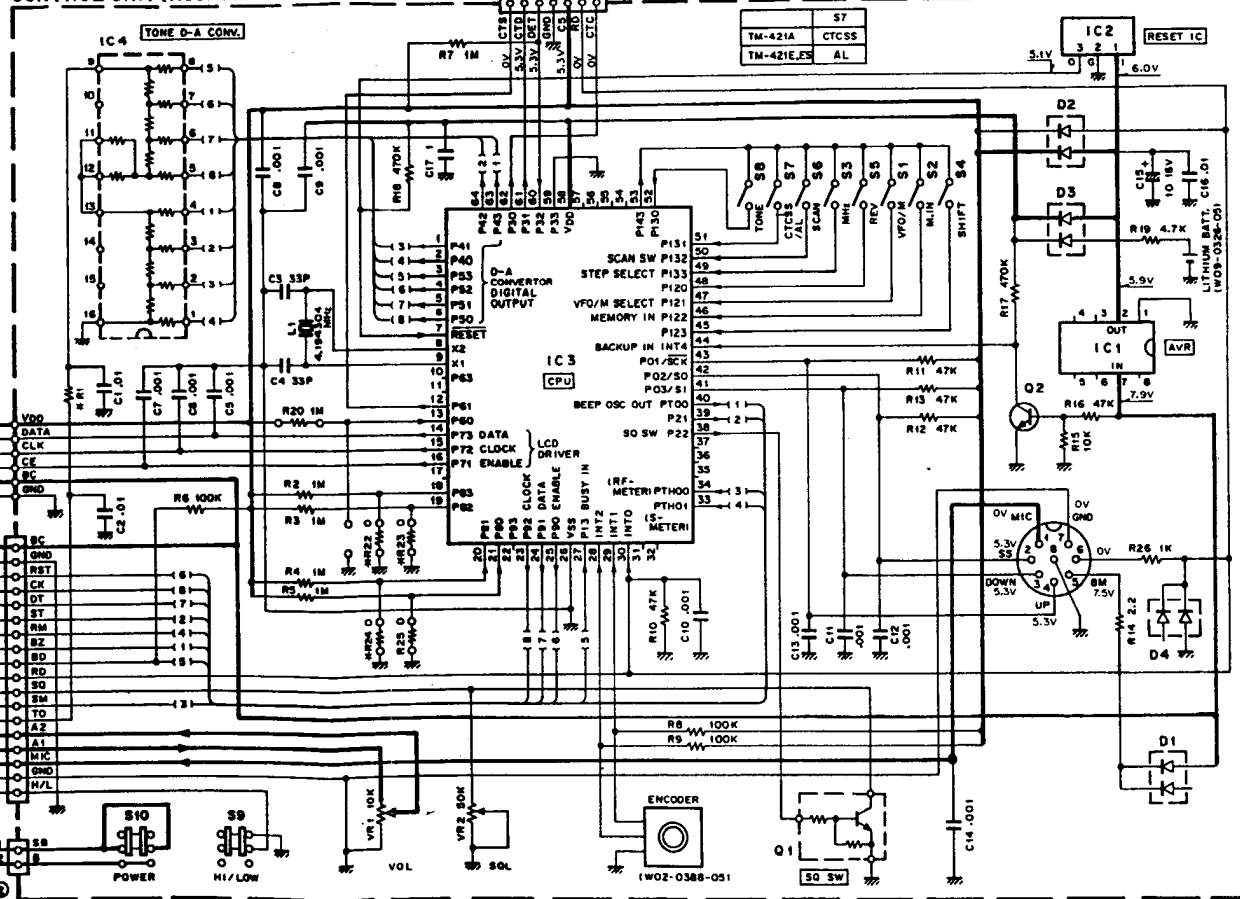
TM-421A/E/ES

Voltage measurement conditions $f = 435.06\text{MHz}$, RX no signal, () : TX.

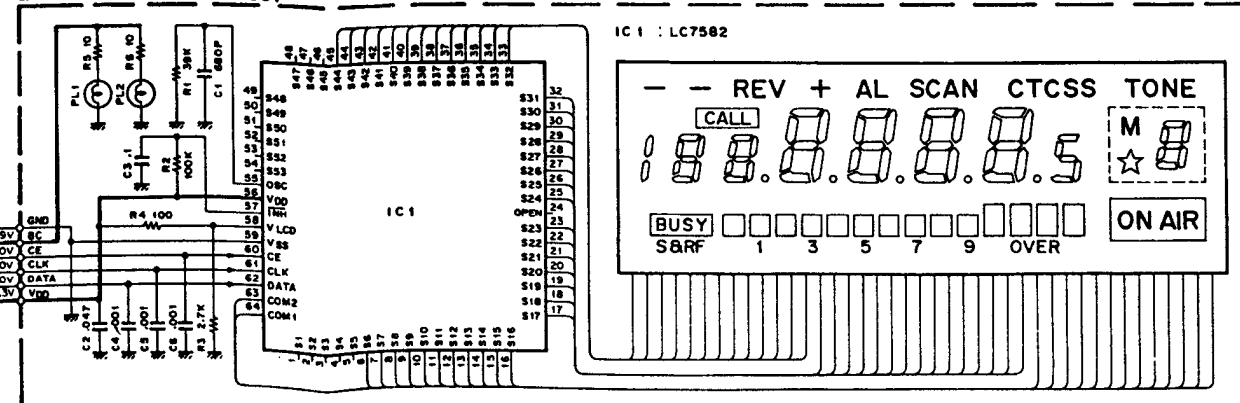
FINAL UNIT (X45-1370-XX) -03: TM-421A(M) -12: TM-421A(K) -52: TM-421E(T1,W1) -53: TM-421ES(T2,W2)



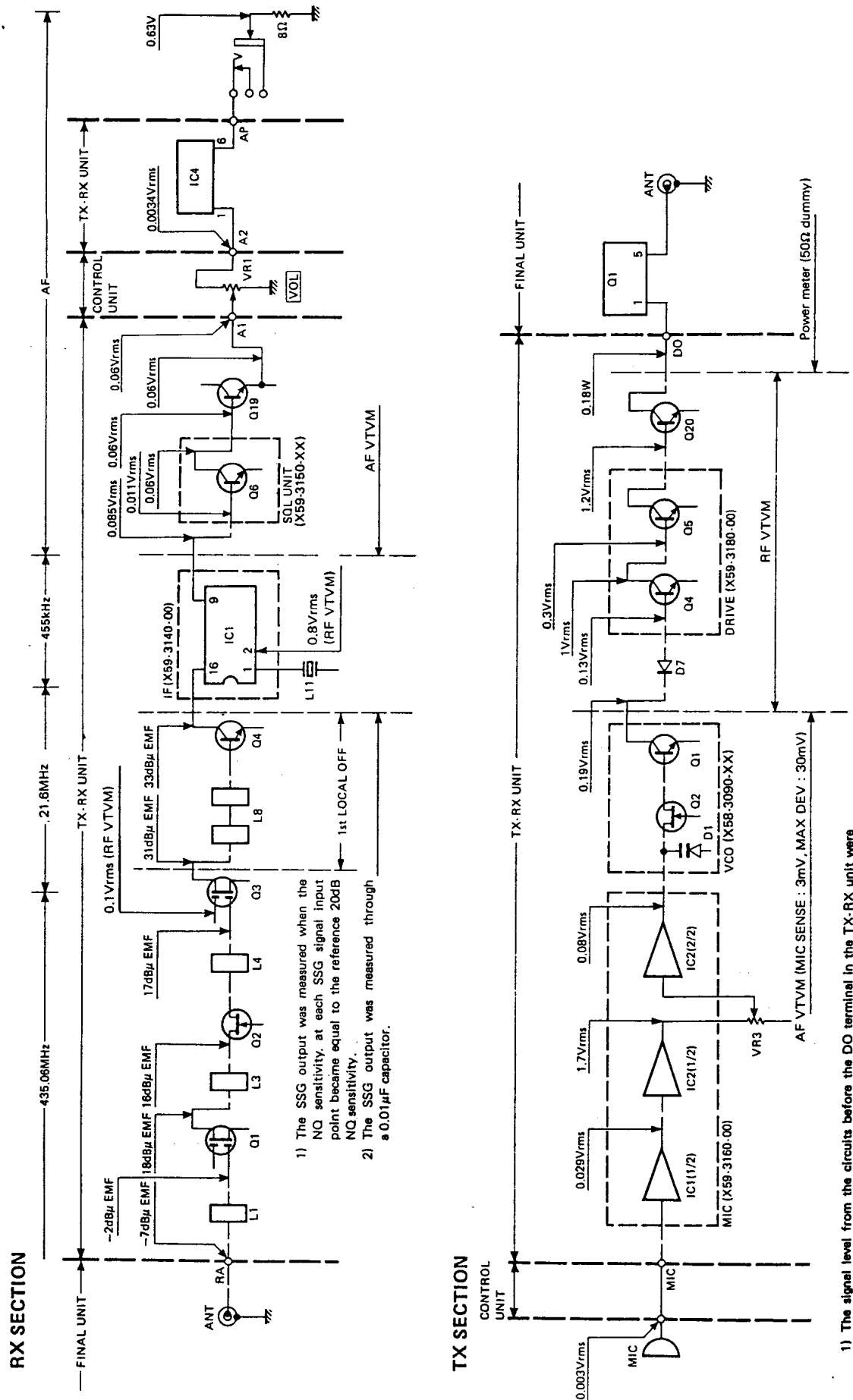
CONTROL UNIT (X53-3040-XX)



LCD ASS'Y (B38-0303-05)



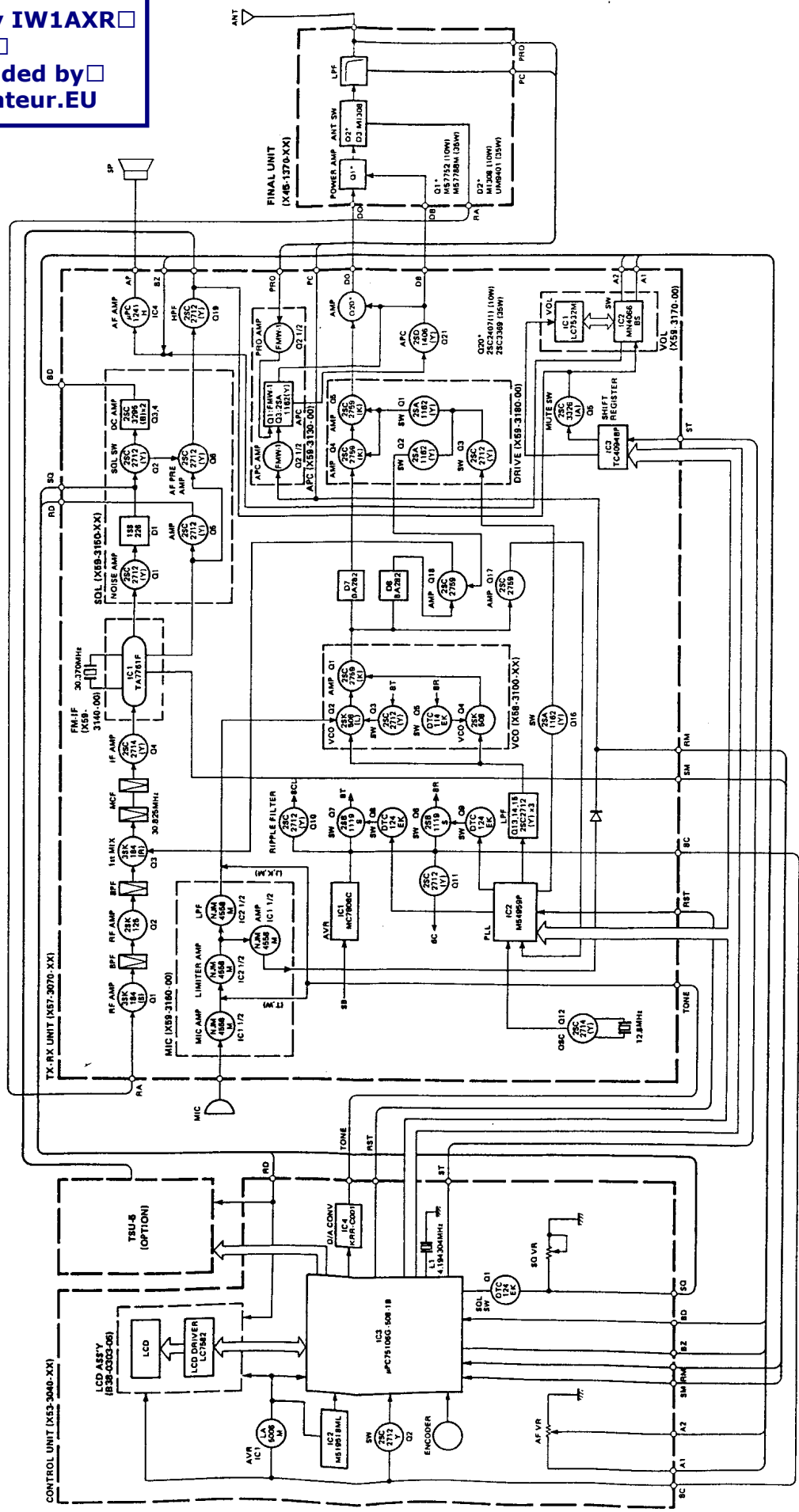
LEVEL DIAGRAM



1) The signal level from the circuits before the DO terminal in the TX-RX unit were measured with the DO coaxial cable disconnected.

BLOCK DIAGRAM

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TERMINAL FUNCTIONS

Connector No.	Terminal No.	Terminal Name	Terminal Function
FINAL UNIT (X45-1370-XX)			
①	1	8T	TX + 8T
	2	PC	Auto power control
	3	PRO	Protection
		RA	RX ANT
		DO	Drive output
		AP	Audio power
		B	+ B
		SP	Speaker
		FB	Final + B
		DB	Drive +B
CONTROL UNIT (X53-3040-XX)			
①	1	CTC	CTCSS IC clock
	2	RD	Remote data
	3	5C	+ 5V
	4	GND	GND
	5	DET	Tone detector output
	6	CTD	CTCSS IC data
	7	CTS	CTCSS shift register reset
②	1	SB	Switched + B (13.8V)
	2	B	+ B2
③		8C	+ 8V
		GND	GND
		RS	PLL enable
		CK	PLL & shift register clock
		DT	PLL & shift register data
		ST	Shift register strobe
		RM	RF meter
		BZ	Beep output
		BD	Busy display
		RD	Remote data
		SQ	Squelch
		SM	S meter
		TO	Tone output
		A2	AF output
		A1	AF input
		MIC	Mic AF input
	GND	GND	
	H/L	Hi/low switch	
④		VDD	Backup voltage
		DATA	LCD driver data
		CLK	LCD driver clock
		CE	LCD driver enable
		8C	+ 8V
		GND	GND

Connector No.	Terminal No.	Terminal Name	Terminal Function
TX-RX UNIT (X57-3070-XX)			
①	1	HPO	
	2	HPI	
②	1	DB	Drive +B
	2	FB	Final +B
③	1	PC	Auto power control
	2	PRO	Protection
	3	8T	TX + 8V
④	1	B2	+ B2
	2	SB	Switched + B (13.8V)
⑤	1	SP	Speaker
	2	AP	Audio power
	3	B1	+ B1
⑥	1	SP	Speaker
	2	GND	GND
⑦		8C	+ 8V
		GND	GND
		RST	PLL enable
		CK	PLL & shift register clock
		DT	PLL & shift register data
		ST	Shift register strobe
		RM	RF meter
		BZ	Beep output
		BD	Busy display
⑧		RD	Remote data
		SQ	Squelch
		SM	S meter
		TO	Tone output
		A2	AF output
		A1	AF input
		MIC	Mic AF input
		GND	GND
		H/L	Hi/low switch
		RA	RX ANT
	DO	Drive output	

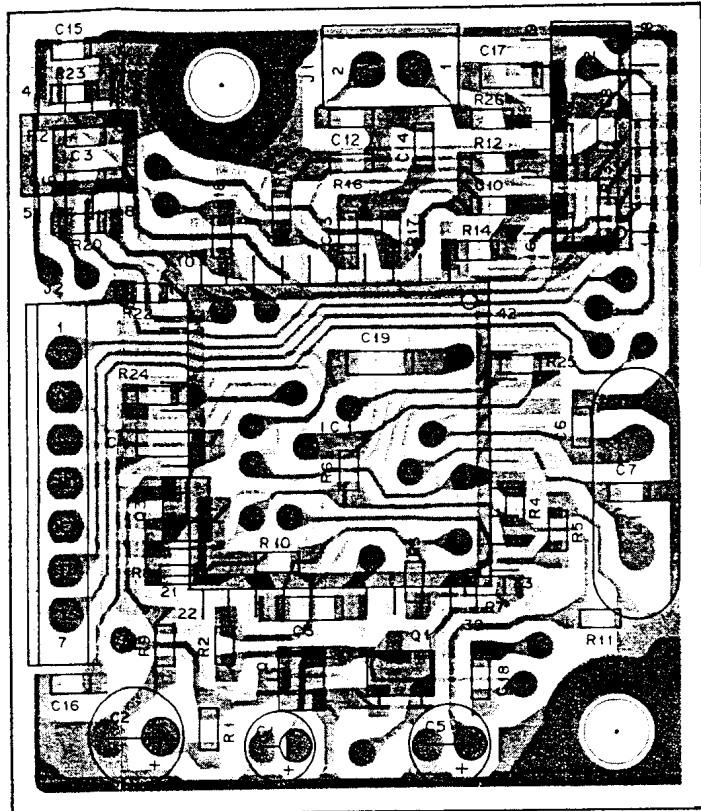
M-421A/E/ES

TSU-5 (CTCSS UNIT)

TSU-5 PARTS LIST

Parts No.	New Parts	Description	Ref. No.
TSU-5			
E31-3248-05	*	Lead with connector	
N87-2606-46		Brazier head taptite screw x 2	
X52-3060-00	*	CTCSS unit	
CTCSS UNIT (X52-3060-00)			
CC41FCH1H150J		Chip C 15pF J	C6,7
CC73FSL1H681J		Chip C 680pF J	C15
CE04CW1A100M		Electro 10μF 10WV	C1
CE04CW1A101M		Electro 100μF 10WV	C2
CE04CW1A220M		Electro 22μF 10WV	C5
CK73EF1C104Z		Chip C 0.1μF Z	C3,4
CK73EF1C105Z		Chip C 1μF Z	C17,19
CK73FB1H103K		Chip C 0.01μF K	C16,18
CK73FB1H222K		Chip C 2200pF K	C13,14
CK73FB1H272K		Chip C 2700pF K	C12
C93-0501-05	*	Chip C 680pF	C8-11
E31-3248-05	*	Lead with connector	-
E40-5016-05		Pin ass'y 2P	J1
E40-5021-05		Pin ass'y 7P	J2
L77-1333-05		X'tal 4.194304MHz	L1
RD41FB2B103J		Chip R 10k J 1/8W	R4,10,11
RD41FB2B104J		Chip R 100k J 1/8W	R1
RD41FB2B105J		Chip R 1M J 1/8W	R8,22,23
RD41FB2B122J		Chip R 1.2k J 1/8W	R26
RD41FB2B124J		Chip R 120k J 1/8W	R16
RD41FB2B153J		Chip R 15k J 1/8W	R5
RD41FB2B154J		Chip R 150k J 1/8W	R25
RD41FB2B183J		Chip R 18k J 1/8W	R3
RD41FB2B222J		Chip R 2.2k J 1/8W	R6
RD41FB2B273J		Chip R 27k J 1/8W	R19
RD41FB2B392J		Chip R 3.9k J 1/8W	R9
RD41FB2B473J		Chip R 47k J 1/8W	R2,20,21,24
RD41FB2B683J		Chip R 68k J 1/8W	R17
RD41FB2B823J		Chip R 82k J 1/8W	R7
RD41FB2B824J		Chip R 820k J 1/8W	R15,18
R92-0688-05	*	Chip R 470k	R14
R92-0689-05	*	Chip R 910k	R12,13
MN6520		IC	IC1
MN4094BS	*	IC	IC2
NJM4558M		IC	IC3
DTC114YK		Digital transistor	Q1,2
2SC2712(GR)		Chip transistor	Q3

TSU-5 PC BOARD VIEW



2SC2712



DTC114YK

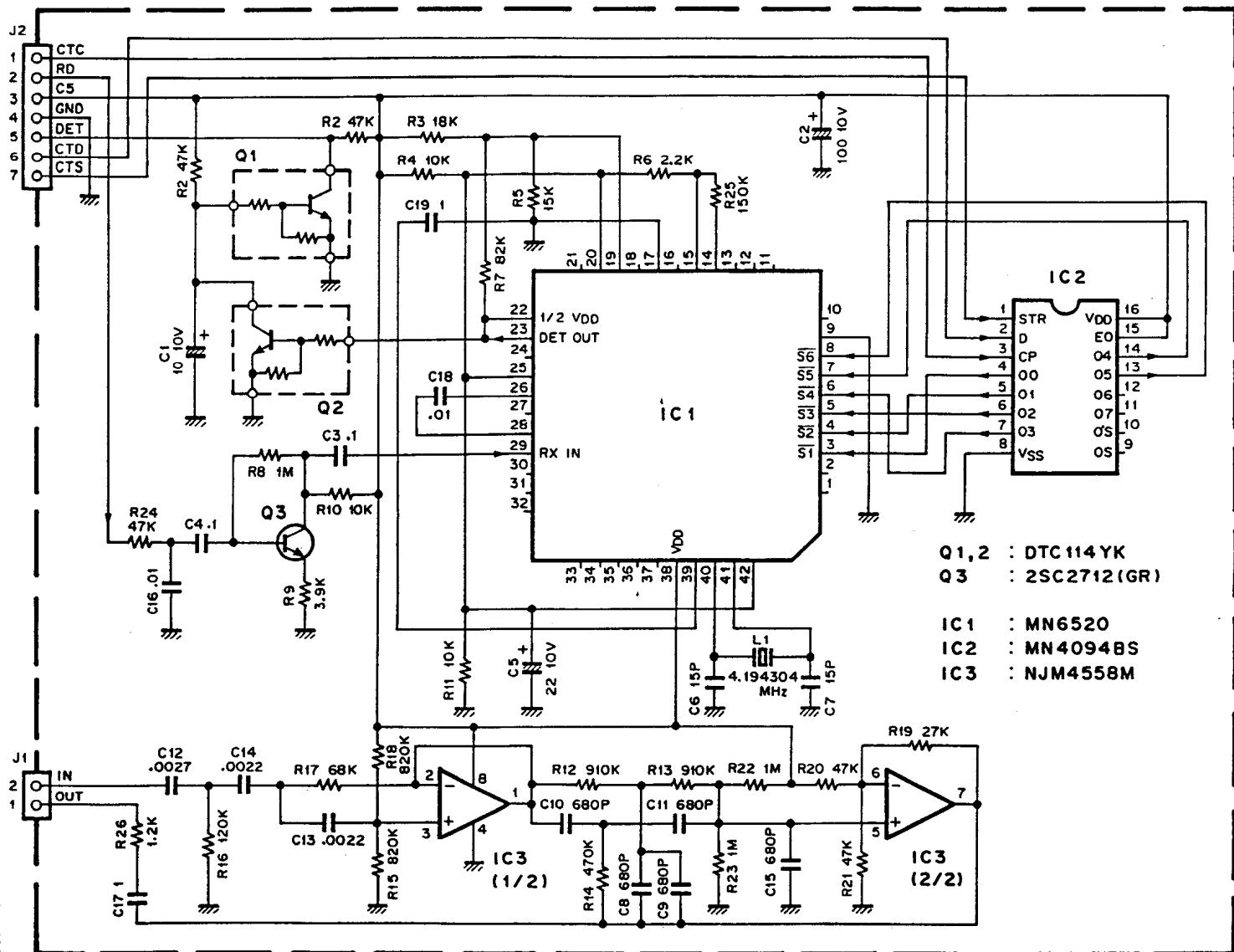


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TSU-5 (CTCSS UNIT)

TSU-5 SCHEMATIC DIAGRAM



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TM-421A/E/ES

SPECIFICATIONS

Specifications		Model	TM-421A	TM-421ES	TM-421E	
General	Frequency range		440 to 450MHz (U.S.A. version) 430 to 440MHz			
	Mode		F3E (FM)			
	Antenna impedance		50 ohms			
	Operating temperature		-20°C to +60°C (-4°F to +140°F)			
	Power requirements		13.8V DC ± 15%			
	Ground		Negative			
	Current drain	Transmit mode (Max.)		8.5A		3.2A
		Receive mode with no input signal		0.4A		
	Frequency stability		Better than ± 10 x 10 ⁻⁶			
	Dimensions (Projections included, W x H x D mm)			141 x 42 x 193		141 x 42 x 154
Weight			1.2kg		1.0kg	
Transmitter	Output power*	HI		35W		10W
		LOW		Approx. 5W Adjustable up to out 20W		Approx. 1W
	Modulation		Reactance modulation			
	Spurious radiation		Less than -60dB			
	Max. frequency deviation		±5kHz			
	Audio distortion (at 60% modulation)		Less than 3%			
Receiver	Microphone impedance		500 to 600 ohms			
	Circuitry		Double conversion superheterodyne			
	Intermediate frequency		21.6MHz/455kHz			
	Sensitivity (12dB SINAD)		Less than 0.16µV			
	Selectivity		-6dB : More than 12kHz, -60dB : Less than 26kHz			
	Spurious response		Better than 65dB			
	Squelch sensitivity		Less than 0.1µV			
	Output (5% distortion)		More than 2W across 8 ohms load			
External speaker impedance			8 ohms			

Notes :

1. Circuit and ratings are subject to change without notice due to advancement in technology.
2. * : Recommended duty cycle :
 1 minute : Transmission
 3 minutes : Reception

KENWOOD CORPORATION

Tokyo 150, Japan

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