C-MOS MICRO-PROCESSOR CONTROLLED

DIGITAL PHASE LOCKED SYNTHESIZER

2m VHF FM TRANSCEIVER

MODEL FM-2030

INSTRUCTION MANUAL

Ser. NO. 08014

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1. GENERAL FEATURES

The FM-2030 is the result of matching up the objectives of obtaining maximum operating features while retaining ease of operation; all in a small front panel and overall package size. The KDK design team achieved this by calling on their many years of experience in designing compact, VHF, mobile transceivers. The maximum use of multi-functional controls with co-axial knobs and in-house development of software for a third generation C-MOS micro-processor has resulted in this latest product with a revolutionary new control system.

1. SIX IN ONE CONTROL

A multi-function control with co-axial knobs to:

Dial frequencies,
Select 10 memories, LED display shows memory number,
Select 10 memories, display shows memory frequency.
Select CALL memory,
RIT control in 1KHz increments, and
Memory write by pushing on dial.

2. ELECTRONIC ALARM

Unit beeps when upper or lower band edges or lowest or highest memory is selected. "Eyes on the Road" for maximum driving safety.

3. UP DOWN FROM MICROPHONE

For remote control dialling, selection of memories and RIT control, all from microphone. Unit beeps at band edges; and lowest and highest memory.

4. FIVE DIGIT LED DISPLAY

Five digits of front panel LED display for full presentation of frequencies down to 100Hz digit, thus full readout of a 12.5KHz channel.

5. CALL CHANNEL

Extra memory for storing frequently used frequencies. Instant recall by a flick of the function switch. Stored frequency can be changed at any time simply by pushing down on dial knob (WR) and dialling up a new frequency.

6. SPEED BUTTON

Speeds up dialling rate to 100KHz for rapid dialling to a widely separated frequency.

7. RIT (Receiver Incremental Tuning)

A digital RIT to shift receiver only in 1KHz steps.

8. REVERSE BUTTON

Permits instant monitoring of duplex transmit channels.

9. ONE CONTROL FOR VOLUME, MEMORY MODE AND POWER

This is another multiple function control with co-axial knobs. It sets up memory selection and scanning modes, controls volume and has a push ON, push OFF type power switch.

The outer knob sets up: --

A+B Selection and scanning on all 10 memories, 1 - 10.
A Selection and scanning on memories 1 through 5.
B Selection and scanning on memories 6 through 10.
AxB Duplex operation receiving on memories 1 through 5, and transmitting on corresponding memories 6 through 10. When scanned, memories 1 through 5. (6 through 10 when reverse button engaged.)

10. SQUELCH AND OFFSET CONTROL

Another multiple function control with co-axial knobs. Center knob is squelch and outer ring selects simplex, +600KHz or -600KHz transmitter offset for repeator operations. Amount of offset may be reprogrammed by changing diodes in an internal mattrix.

11. REPEATOR TONE ACCESSING

The TONE button controls an internal plug-in tone oscillator module. The TONE-2030A is for CTCSS operation and its frequency can be set by varying an internal trimpot. The TONE-2030E is a crystal controlled 1750Hz tone burst. The type of unit installed is determined by type of repeator control commonly used in the country of sale.

12. HIGH LOW BUTTON

Selects transmitter output power. HIGH, 25 watts, and LOW, 5 watts.

13. SCAN MODE

Selects mode of scanning, BUSY or OPEN. In busy mode, scanning stops when reaches a busy channel. In open mode, scanning stops when reaches a vacant channel. Center position is disengage position for manual dialling.

14. SCAN SKIP FOR MEMORY SCANNING

Scanning repetition rate is speeded up in memory scanning by reducing number of memories to be scanned. For example by using A or B mode instead of A + B. Can be further speeded up by writing in lower or upper band-edge frequency, for example 148.995MHz in unwanted memory.

15. INTERNAL NICAD FOR MEMORY BACK-UP

Dial, memory and call frequencies are retained by microprocessor even while unit is disconnected from any external power source, due to provision of an internal NICAD battery. Normal operation is sufficient to keep this charged up so that it will hold all above memories for long periods of time, even exceeding one year.

16. PLUG-IN INITIALIZING MODULES

Intializing instructions to the CPU are provided in a small plug in module with required diode mattrixes. The only change required for a change of band plan, dial stepping, etc., is to replace the diode module.

2. OPERATING CONTROLS AND FUNCTIONS

Section 2.1 describes the functions of the various knobs, switches, indicators and connectors on the front and rear panels. Photographs of the panels are provided with the same numbering as the paragraphs of section 2.1 to permit matching up with the item in the photograph.

2.1 OPERATING CONTROLS, FUNCTIONS, ETC.

(1) FUNCTION SWITCH -- Switches function of DIAL (2).

DIAL — Dial (2), selects frequency.

M-CH — Dial selects memories. Display (4), shows memory numbers.

M-FR — Dial selects memories. Display shows memory frequency.

CALL — Call channel selected and dial is disengaged.

(2) DIAL KNOB -- Changes frequencies or memories as selected by function switch (1).

For dialling, 5KHz steps. (12.5KHz in some countries.)

100KHz steps when SPEED button (17), is engaged.

1KHz steps for receiver only when RIT button (16), is engaged.

This knob becomes WRITE switch when pushed.

PRIORITY WRITE: -- Pushing dial while in dialling mode, will write dialled frequency in to memory #1.

(3) SCAN SWITCH

BSY — Scanning starts. Stops when reaches a channel in use. Resumes as soon as channel clears.

\- — Center scanning off position for manual control.

OPN — Scanning starts. Stops when reaches a vacant channel. Resumes as soon as a signal appears on channel.

TYPE OF SCAN is set by FUNCTION switch (1), as follows:

DIAL — Band scanning. Scanning limits are frequencies stored in memories 5 and 10. Scans continuously between these two frequencies.
Band scanning increments are same as dial stepping.

M-CH — Memory scanning. DISPLAY (4), shows memory numbers.

M-FR — Memory scanning. Display shows memory frequencies.

SCAN SKIP: In memory scanning, unwanted channels can be skipped to speed up scan repetition rate. Store upper or lower band edge frequency in memory to be skipped. For example 148.995MHz.

(4) DISPLAY LEDS

Shows frequency in five digits in DIAL, M-FR and CALL positions of FUNCTION switch (1). Shows memory number in M-CH position. Changes to show frequency while a new frequency is being written in to memory by pushing DIAL knob (2).

(5) RECEIVE LED

Lights up while signal is being received. (Receiver being unsquelched by incoming signal.

(6) TRANSMIT LED

Lights up during transmissions.

(7) SIGNAL/POWER METER

Dual function LED display type meter to show relative incoming signal strength and transmitter output power.

(8) MICROPHONE CONNECTOR

Receptacle for plugging in microphone. Includes 13.8 volt power source for powering KDK TM-1 tone encoder microphone. DM-100 UP/DOWN microphone provided in some countries, in which case the TM-1 may be optionally available from distributor or dealor.

(9) HIGH LOW BUTTON

Selects transmitter output power. HIGH, 25 watts, and LOW, 5 watts. Both can be re-set internally for other values. Do not set at less than 5 watts.

(10) TONE BUTTON

Selects tone for repeator use. Type of tone operation set by plug-in module. TONE-2030A for CTCSS operation; frequency can be varied by re-setting internal trim-pot. TONE-2030E for crystal controlled 1750Hz tone burst operation.

(11) SQUELCH CONTROL

Mutes receiver noises during no signal conditions. Should be set at point where noise is just squelched out when control is advanced in a CW direction from extreme CCW position.

(12) OFFSET SWITCH

S — Simplex. Transmit and receive on same frequency.

\+ — Transmit 600KHz above receive frequency.

\- — Transmit 600KHz below receive frequency.

DISPLAY (4), switches between transmit and receive frequency. Amount of offset reprogrammable by changing diodes.

(13) VOLUME/POWER CONTROL

Volume increases as knob turned in a clockwise direction.

Push on knob to turn power on. Push again for power off.

(14) MEMORY MODE SWITCH

A+B — Selects all memories, 1 through 10.

A — Selects only memories 1 through 5.

B — Selects only memories 6 through 10.

AxB — Duplex using memories. Receive on memories 1 through 5 and transmit on corresponding memory 6 through 10. DISPLAY (4), switches between transmit and receive frequencies.

(15) REVERSE BUTTON

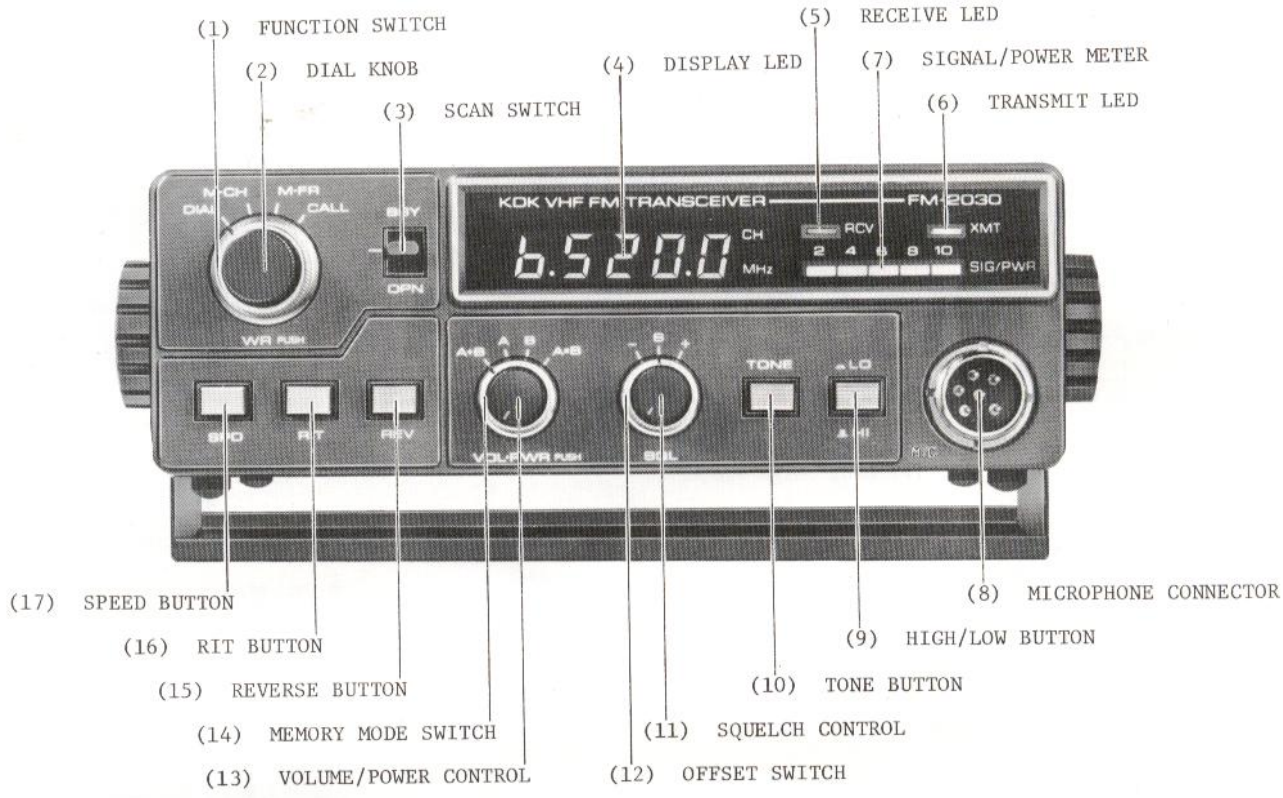
Push to monitor transmit frequency during duplex. Functions for both OFFSET switch and AxB modes of duplex. Also during RIT operation.

(16) RIT (Receiver Incremental Tuning)

When engaged, DIAL (2), or microphone UP/DOWN buttons shift receiver only in 1KHz steps. Operates in DIAL, M-FR and CALL functions.

NOTE: While RIT function remains engaged, amount of RIT introduced may be cleared and receiver returned to center frequency by switching FUNCTION switch (1), to another position and then returning it to its original position.

RIT must be disengaged in order to DIAL or select different memories.



FRONT PANEL

(17) SPEED BUTTON

Increases dialling rate to 100KHz. Used for rapid shifting to a widely separated frequency.

(18) ANTENNA CONNECTOR

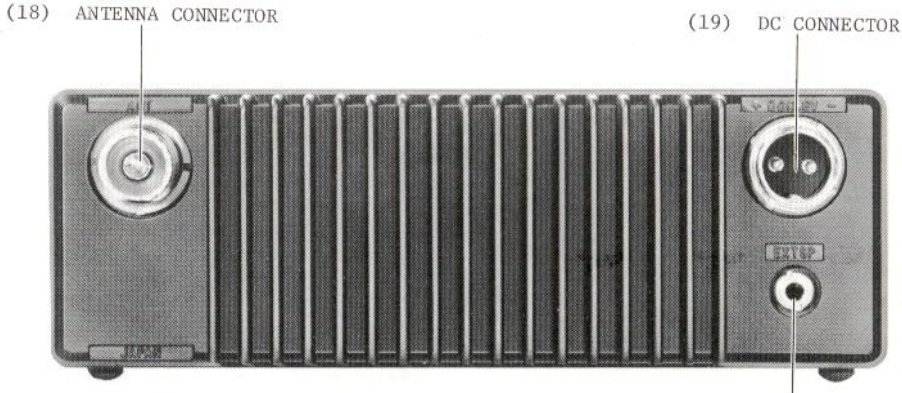
SO-239 type. Will accept both metric and inch threaded plugs.

(19) DC CONNECTOR

Receptacle for connection of DC 13.8 volts. Use cable supplied as standard accessory. Connect red lead to positive and black lead to negative. Use only 7A fuse in power cable.

(20) EXTERNAL SPEAKER JACK

Jack for connection of external speaker when desired. Impedance nominal 8 ohms. Miniature phone plug provided as a standard accessory.



REAR PANEL

(21) PTT (Press to talk) SWITCH

Press this switch to key transmitter.

(22) MICROPHONE DOWN BUTTON

Mementary push will lower frequency by one step in dialling function, select the next lower memory number in M-CH and M-FR functions and will lower frequency by 1KHz in RIT. If continue to keep button pushed such lowering action will continue until reaching low frequency band edge (DIAL and RIT), or memory 1. At this point, unit will beep and continue beeping until button is released.

(23) MICROPHONE UP BUTTON

Same operation as DOWN button (22), but direction of travel is reversed. Unit will beep when reaching high frequency band edge or memory number 10.

(24) TOUCH-TONE BUTTONS

These buttons transmit standard telephone dialling tones. Frequencies are as illustrated. Pushing buttons keys the transmitter and it is not necessary to hold down the PTT switch (20). Transmitter continues to be keyed for about .7 seconds after button is released permitting smooth key-in of a sequence of numbers.

LOW TONES	HIGH TONES		
	1209	1336	1447Hz
697	1	2	3
770	4	5	6
852	7	8	9
941	#	0	*

NOTE: Where DM-100 is standard microphone provided, TM-2 may be optionally available from distributor or dealor.

2.2 MOBILE INSTALLATION

(1) Install mounting bracket included with the unit under dashboard or other convenient location using the four 4x12mm self tapping screws located in the small plastic bag in the microphone carton. A 3mm hole should be drilled to use these self tapping screws.

(2) Mount the transceiver in the bracket using the two thumbscrews also packed in the microphone carton. Select the best angle of installation for convenience of operation. The bracket, while simple in design is quite flexible to match various mounting situations.

(3) Connect the antenna feeder to the connector on the rear panel. The SO-239 type connector will accept plugs with both metric or inch threads.

(4) Connect the red and black cable packed in the microphone carton to the power source. The red lead is + and the black lead is - (negative ground). These connections should be made to a point with the lowest possible impedance, such as directly to the + and - terminals of the battery or the fuse box.

(5) Plug the microphone into receptacle (8) on the front panel.

CAUTION: Avoid installing the unit in location where hot air from automobile heator flows directly on rear panel heat sink.

DM-100 UP/DOWN MICROPHONE

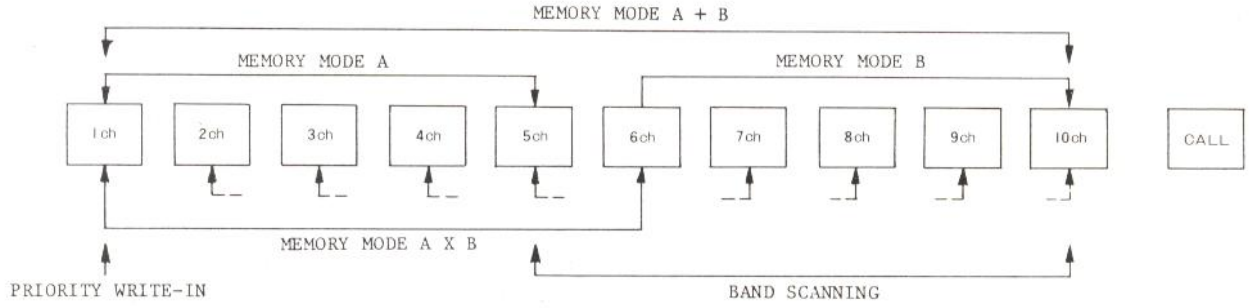
TM-2 TOUCH-TONE MICROPHONE

2.3 BASE STATION USE

(1) Small rubber feet are provided on the bottom of the unit so that the bottom is lifted off the surface below. In many cases, it may be found that slight upward tilt may be helpfor for easier access to controls and better visibility. An extra mounting bracket may be placed under the unit as shown on the cover photograph of this manual. Such extra brackets are available optionally from KDK distributors and dealors.

(2) A 13.8 volt power source such as a battery or regulated power supply of sufficient capacity is required. It should be noted that a supply of marginal capacity may result in insufficient filtering and hum on the carrier when transmitting at high power and may even damage the transmitter.

(3) Other items regarding the connection of an antenna and microphone are the same as 2.2 (D) and (E) above.



MEMORY LAYOUT DIAGRAM

2.4 MEMORY WRITE-IN, ETC.

(1) The diagram illustrates how various functions relate to the 11 memory channels in this transceiver. Suggested methods of memory write-in are covered in paragraphs (A) and (B) below.

(A) CALL CHANNEL WRITE-IN

Selected by setting FUNCTION switch to CALL position. Select frequency to be written in by pressing down on DIAL knob and rotating. As soon as desired frequency is selected release pressure on knob. This completes CALL frequency write in.

(B) MEMORY CHANNEL WRITE-IN

Set FUNCTION switch to M-CH. Rotate DIAL knob and select desired memory number. Push knob and rotate while keeping depressed. Note that M-CH indication is replaced by frequency readout which changes as knob is rotated. Select desired frequency and release knob as soon as selected. Frequency write-in is complete and DISPLAY returns to channel number indication.

(C) SCANNING LIMITS -- BAND SCANNING

The upper and lower limits for band scanning are fully programmable and it is possible to set this for scanning the entire frequency range or any portion thereof. Scan limits are the frequencies written in to memories #5 and #10. Scanning starts at the lower of these two frequencies and proceeds upwards until reaching the higher frequency at which point it returns to the lower limit and scans upwards again.

(D) SCAN SKIP -- MEMORY SCANNING

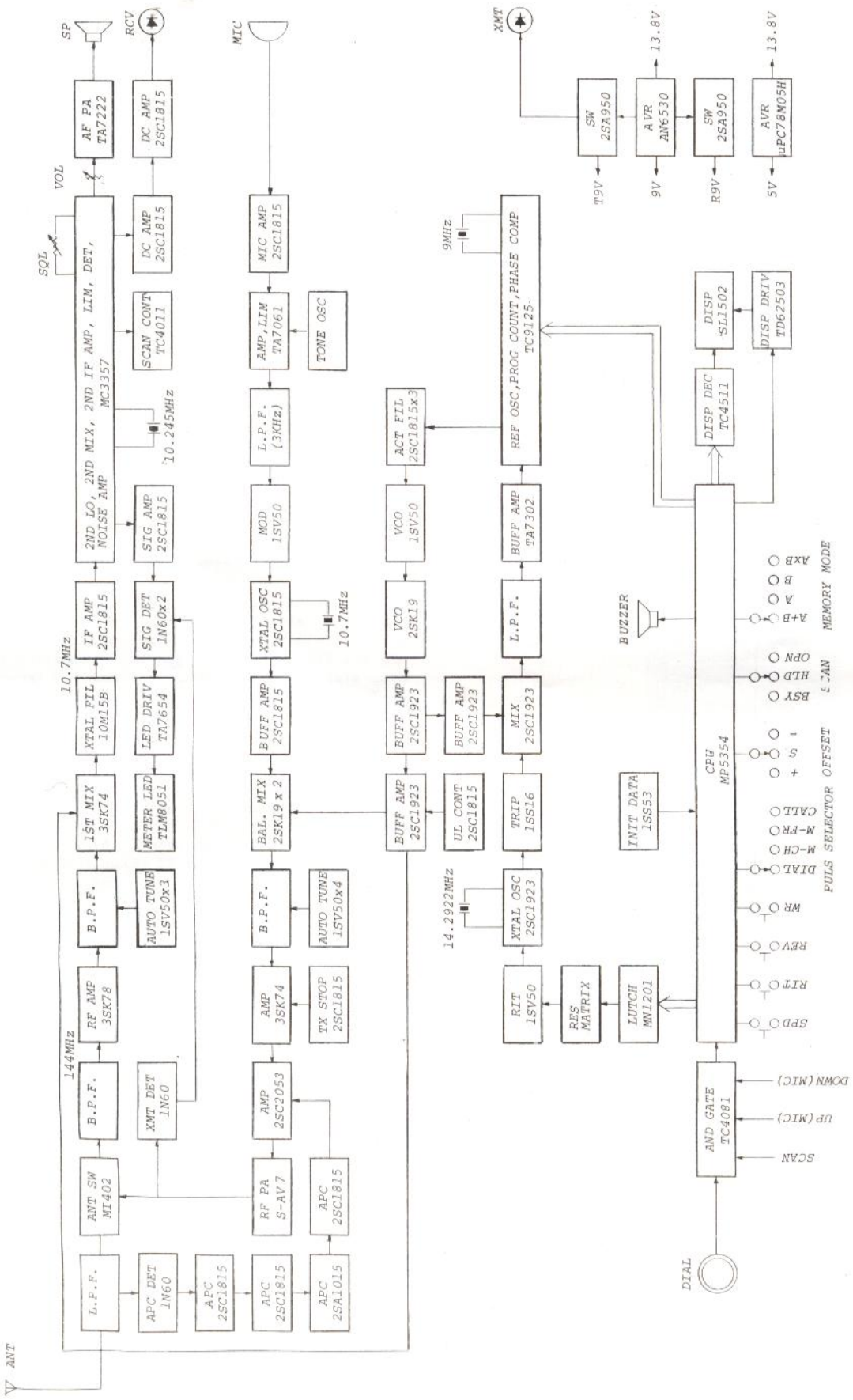
Reducing the number of channels scanned increases relative speed of scanning. This can be done by removing an unwanted memory from the scan sequence, by writing in the LFBE (LOW FREQUENCY BAND EDGE) or HFBE (High frequency band edge) frequency in the unwanted memory, for example, 148.995MHz.

CAUTION: The FM-2030 is MICRO-PROCESSOR CONTROLLED, and RIT TAKES PRECEDENCE over some other functions. Note that;

(a) RIT engaged; memory channels cannot be switched.

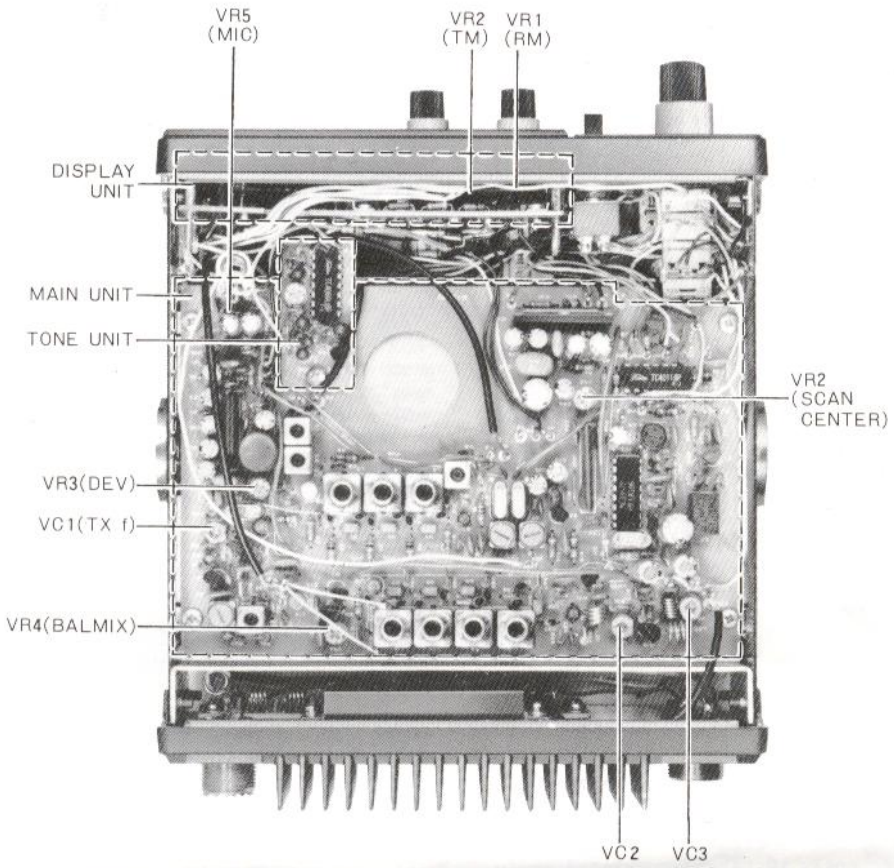
(b) RIT engaged; SPEED button not functional.
DIAL continues 1KHz stepping of receiver only.

3. BLOCK DIAGRAM

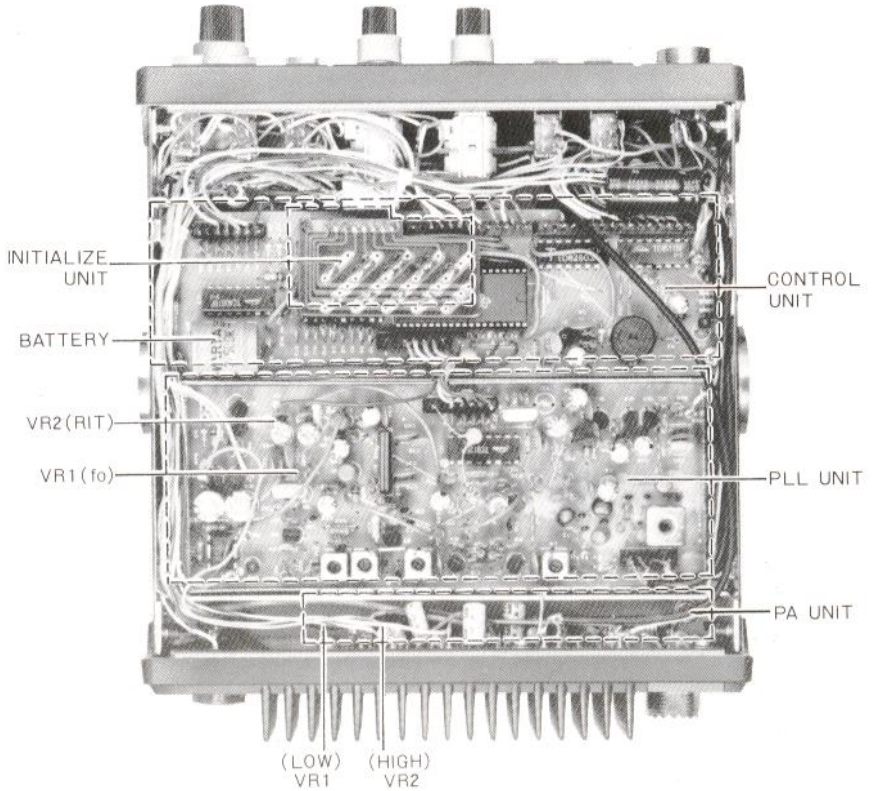


4. INTERNAL VIEWS

TOP VIEW SHOWING MAIN UNIT WITH FM-2030A TONE MODULE



BOTTOM VIEW WITH PLL COVER REMOVED AND INITIALIZE UNIT INSTALLED



5. CIRCUIT DESCRIPTION

5.1 RECEIVER

RF-AMPLIFIER: -- The input from the antenna passes through the low pass filter, L6, L5, L4, C21, C17, C16 and C15, and is applied to the receiver input terminal P1 and P2 of the MAIN unit. The signal then passes through the band pass filter, L1 and L2 and is then connected to Q1 (3SK78), a dual gate MOS-FET, where it is amplified. It then passes through the 3-stage electronic peak tuned circuit L3 through L5 and D1 through D3 (1SV50). This circuit keeps sensitivity constant over the wide band coverage as well as keeping out unwanted signals. The signal is then applied to gate 1 of Q2, the mixer.

1ST MIXER: -- The mixer (3SK74), is also a dual gate MOS-FET. The 133MHz injection voltage from the PLL VCO is connected from pins P3 and P4 through L6 to gate 2 of Q2. The 10.7MHz output from the mixer is extracted from the drain of Q2.

1ST IF AMPLIFIER: -- The converted signal is passed through a combination of two monolithic crystal filters XF with a selectivity of ±15KHz/3dB, and LC filtering, L7 and L8, to further attenuate adjacent channel interference. It is then amplified by Q3 (2SC1815), and is then passed on to the next stage, IC3.

2ND MIXER THROUGH DEMODULATOR: -- IC3 (MC3357), is a one chip multi-purpose LSI. It contains the 2nd mixer, 2nd local oscillator, 2nd IF amplifier, limiter, quadrature detector, squelch noise amplifier and muting circuitry. The use of this LSI together with the passive IC, IC1 (MR1215), greatly reduces the number of discrete components used, improving overall reliability. The 1st IF signal inputs to IC3 from pin 16 and is mixed in the IC with the 2nd local oscillator signal which is controlled by crystal X1 (10.245MHz) connected between pins 1 and 2 of the IC. The converted 455KHz signal appears at pin 3 and is passed through a ceramic filter CF with a pass-band of ±6KHz/3dB. The signal re-enters IC3 through pin 5 and is amplified and limited. The treated signal appears at pins 7 and 8 and is demodulated by the combination of internal LSI circuitry and the quadrature coil, L9. The demodulated audio appears at pin 9 of IC3.

AUDIO AMPLIFIER: -- Audio from pin 9 of IC3 (MC3357), is applied to pin 7 of IC1 (MR1215), and passes through the de-emphasis circuit in IC1. It re-appears at pin 8 of IC1 from where it is taken to the front panel volume control VR1/2. It is set to proper level and then connected to pin 4 of IC2 (TA7222P), the final amplifier. Output from IC2 is taken from pin 9 and connected to the speaker via the external speaker jack.

SQUELCH CIRCUITRY: -- The demodulated signal from pin 9 of IC3 (MC3357) is connected to pin 7 of IC1 (MR1215) from where it is connected to the internal low pass filter and squelch control circuitry. The front panel squelch control, VR2/2 is connected to pins 1 and 4 of IC1 and is used to set squelch threshold levels.

"S" METER CIRCUITRY: -- The signal for the meter is taken from the output side of the ceramic filter, CF, and applied to Q4 (2SC1815), where it is amplified. It is then rectified in a voltage doubler circuit, D4 and D5 (1N60), and is then connected to the DISPLAY unit through pins P11 and RM. It is then passed on to VR1, the meter sensitivity setting control. It is then applied to pin 2 of IC1 (TA7654), where it is A/D converted. It is then connected to D3 (TLM8051), which displays indications of relative signal strengths.

RCV LED CIRCUIT: -- The squelch muting signal at pin 13 of IC3 (MC3357) is DC amplified by Q6 and Q5 (2SC1815), and drives the RCV LED, D1 (TLG205), on the DISPLAY unit. The LED lights up whenever the squelch opens giving an indication of an incoming signal or a channel busy condition.

SCAN CENTER DETECTOR CIRCUIT: -- Reception of a strong signal will cause premature scan stop before reaching the center of the channel if only the squelch signal is used for sensing. This unit features a discriminator center detector for scaning in the BUSY mode. Output from this detector and the RCV LED is taken in an "AND" circuit so scanning will halt only at the true center of the channel. The signal for this purpose is obtained from pin 9 of IC3 (MC3357), and is connected to pins 1 and 2 of IC4 (TC4011). IC4 outputs an inverted signal at pin 3 only when the output from the center detector is 2V + or - 1V. This output is connected to pin 13 of the BUSY control and is outputed from pin 11 of this control. This output is connected to pin 9 of the AND circuit. The RCV signal is applied to pin 8 and an output is obtained from pin 10 of the AND circuit only when there are simultaneous inputs at pins 9 and 8. Output from the AND circuit is used to control scanning. A center detector signal is not required for OPEN scanning. During OPEN scanning, pin 12 is set to L level, thus scanning control outputs are obtained with the receipt of only the RCV LED signal.

5.2 TRANSMITTER

MICROPHONE AMPLIFIER: -- Audio signals from the microphone is adjusted for level by control VR5 on the MAIN unit. It is then amplified by Q7 (2SC1815). It is then applied to pin 6 of IC5 (TA7061), where it is amplified and limited. It is then outputed from pin 3. The output is passed through a low pass filter, L10, C58 and C59, to remove unwanted highs. It is then set for desired maximum deviation by control VR3. This signal is applied to the modulation varicap D6 (1SV50) to obtain variable reactance frequency modulation.

LOCAL OSCILLATOR AND AMPLIFIER: -- The transmitter local oscillator is a VXO with a varicap D6 (1SV50), a crystal X2 (10.7MHz), and Q8 (2SC1815). Output from the L.O. is bufferred by Q9 (2SC1815), passed through a 10.7MHz filter, L12 and L13 and is then applied to the balanced mixer, Q10 and Q11 (2SK19). This mixer mixes the signal from the L.O. and the 133MHz signal from the VCO to obtain a 144MHz output. The output signal passes through a 4 stage electronic peak tuned circuit L16 through L19 and D7 through D10 (1SV50) to eliminate spurs. It is amplified to about .3 watts by Q12 (3SK74) and Q13 (2SC2053). The amplified output is connected to terminals P26 and P27. Q14 (2SC1815), is the power supply P/T switching transistor for Q13 (3SK74).

POWER AMPLIFIER: -- The .3 watt output from the MAIN unit is applied to IC1 (S-AV7), where it is amplified to 25 watts. The 25 watt output passes through the antenna switching diode D2 (MI402) and then through the low pass filter, L4 - L6, C15 - C16 and C21 to remove harmonics. It is then connected to the antenna connector on the rear panel.

APC CIRCUIT: -- The auto power control obtains it's signal from D5 (1SS53). Rectified output is set to proper level by controls VR1 (LOW) and VR2 (HIGH). It is then dc amplified by Q1 and Q2 (2SC1815) and Q3 (2SA1015). The amplified dc signal controls transistor Q4 (2SC1815). Controlled output from Q4 is routed to the MAIN unit through P14 and varies the supply voltage for Q13 (2SC2053) to control the output level from this transistor. The transmitter halt signal from the CPU is applied to Q1 (2SC1815), which lowers the supply voltage to Q4, effectively stopping any transmission.

5.3 PLL SECTION

VCO CIRCUIT: -- The VCO circuit consists of L1, D1 (1SV50) and Q1 (2SK19), and generates a 133MHz signal. Frequency control is achieved by obtaining a dc control voltage from the phase comparator and applying this to the varicap D1, locking the VCO into the phase lock loop. The VCO signal is bufferred by Q2 (2SC1923), amplified by Q3 (2SC1923), switched by D2 and D3 (1SS53) controlling the transmit and receive injection voltages from terminal strip P1.

PLL LOCAL OSCILLATOR AND MIXER: -- The PLL local oscillator is a VXO consisting of D4 (1SV50), X2 (14.2922MHz) and Q6 (2SC1923). Frequency of oscillation, f_O, is established by varying the voltage on D4 by the control, VR1. The RIT voltage from the computor is also applied to D4 after being set for level by VR2 and varies f_O by steps of 1KHz. L. O. output is tripled by Schotky diode D5 (1SS16). The tripled output is passed through a band pass filter L6 and L7 and is applied to the PLL mixer, Q7 (2SC1923). A portion of the VCO output is bufferred by Q4 (2SC1923) and then also applied to the mixer Q7. A converted output is obtained which is 3.67 - 9.67MHz. Unwanted harmonics are removed from this output by a low pass filter, L8, C30 and C31 and then the output is bufferred by IC2 (TA7302) by being applied to pin 1 of this IC. Bufferred output is obtained from pin 6 of this IC.

PLL CIRCUIT: -- IC1 (TC9125) is a PLL LSI containing the standard frequency oscillator and divider, a phase comparator, a programmable divider and a data latch. The standard generator is controlled by crystal X1 (9MHz) connected between pins 2 and 3. This signal is divided by 900 in accordance with data applied to pins 4 - 8 of this IC, and thus generates an accurate standard signal of 10KHz. The bufferred output from the PLL L.O. from pin 6 of IC2 is applied to pin 9 of IC1 (TC9125) and is divided by the ratio established by data set up by the CPU. The phase difference between these two signals is compared by the phase comparator and a pulse relating to this phase difference is outputed from the phase comparator from pin 15. This pulse output is smoothed out into dc by the active low pass filter Q11 - Q13 (2SC1815) and is used to control the VCO frequency as well as the electronic auto-tuning circuits of the receiver and transmitter. This voltage is called the TV (Tuning voltage) and is outputed from the PLL module through pin P3 (TV). Pin 13 outputs an "H" level during PLL unlock and is applied to Q5 (2SC1815) to lower the supply voltage on buffer amplifier Q3 and effectively stopping output from the VCO.

5.4 CPU CONTROL SECTION

All control functions of this unit are centered around the one-chip CPU, MP5354, with KDK in-house developed programming. The MP5354 has 4 bit data inputs K1 - K8 and L1 - L8, time division outputs R0 - R15, and the decode outputs 00 - 07. All control functions are achieved by connecting various input and output data to these terminals.

(1) INITIALIZATION OF COMPUTOR: -- Time division signals R7 through R11 are connected to input terminals K1 through K8 as desired by BCD coded diode mattrixes on the initialize module to establish the required limits. Details are tabulated in TABLE (1).

(2) CPU IN/OUT COMBINATIONS FOR OTHER FUNCTIONS

Details of input/output connections for the CPU, other than those required to initialize the computor are in TABLE (2).

TABLE (3) describes data output from the CPU for PLL, RIT and the 5 digit, front panel LED display.

TABLE (1) CPU INITIALIZE PROGRAMMING - INT-2030 MODULE

PARAMETER	CPU IN/OUT COMBINATION	UNIT	BCD CODE	LIMIT	MIN.	MAX.
LFBE (Low freq. limit, TX/RX)	R7 to K1, 2, 4, & 8 (D1 - D4)	1MHz	A = x 3	143MHz	x 3	x15
			E = x 4	144MHz	"	"
			J = x 4	144MHz	"	"
HFBE (Upper f. limit RX only)	R8 to K1, 2, 4, & 8 (D5 - D8)	1MHz	A = x 9	149MHz	"	"
			E = x 9	149MHz	"	"
			J = x 6	146MHz	"	"
THFBE (Upper f. limit TX only)	R9 to K1, 2, 4, & 8 (D9 - D12)	1MHz	A = x 9	149MHz	"	"
			E = x 6	146MHz	"	"
			J = x 6	146MHz	"	"
OFFSET (Offset switch TX shift)	R10 to K1, 2, 4, & 8 (D13 - D16)	100KHz	A = x 6	600KHz	"	"
			E = x 6	600KHz	"	"
			J = x 6	600KHz	"	"
STEP (Dial & band scan steps)	R11 to K1, 2, 4, & 8 (D17 - D20)	2.5KHz	A = x 2	5KHz	x 1	x16 (0)
			E = x 5	12.5KHz	"	"
			J = x 4	10KHz	"	"

CAUTION: Minimum and maximums shown here are limits of CPU control capabilities. It is not intended to imply that performance can be maintained to exceed those listed in section 7. SPECIFICATIONS.

TABLE (2) CPU IN/OUT COMBINATIONS

FUNCTION	CONTROL, ETC.	CPU IN/OUT FROM	CPU IN/OUT TO	DESCRIPTION OF ACTION
DIAL	Function Sw.	R0	No conn.	Dial operates as VFO.
M-CH			KI + R4 to K8	Read and write of memories. Display shows memory #.
M-FR			K1	Memory read and write. Display shows memory freq.
CALL			K2	Call memory read and write. Displays CALL freq.
A + B	Mode switch	R1	K2	Select memories 1 through 10.
A			No conn.	Select memories 1 through 5.
B			K1	Select memories 6 through 10.
A x B			K4	Receive: - select memories 1 through 5. Transmit: - select memories 6 through 10.
OPEN	Scan switch	R2	K1	Start open mode scanning
BUSY			K2	Start busy mode scanning
+	Offset Sw.		K4	Offset TX frequency above receive frequency.
-			K8	Offset TX frequency below receive frequency.
WR	Dial (Push)	R3	K1	Pushing knob writes frequency in to memory.
REV	Rev. button		K2	Instructs to receive on TX frequency.
SPD	Speed button		K4	Speed up dial and band scan to 100KHz steps.
RIT	RIT button		K8	Instructs RX frequency changing in 1KHz steps.
T. STOP		R5	PB-2030	Outputed by CPU when frequency exceeds THFBE.
ALARM	Buzzer	R6	BZ	Outputed by CPU when dialling reaches lower or upper frequency limits, or memories 1 or 10.
SCN	MAIN pin P17	R12	K1	Instructs starting and stopping of scanning.
T9	MAIN pin P21		K4	Instructs changing to transmit.
DIAL UP	Dial Switch	R13	L1	Up signal for selecting frequencies or memories.
DN			L2	Down signal for selecting frequencies or memories.
MIC. UP	Mic. UP/DN buttons		L4	To prevent erratic opn. due noise, mic. up/dn signals
DN			L8	are fed as dc to IC5 and switched by R13, thence to CPU

TABLE (3) CPU DATA OUTPUT

ITEM	DATA SIGNAL	TIMING SIGNAL	DESCRIPTION OF ACTION
RIT Output	04 - 07	R10, R11	IC3 (04 - 07) outputs RIT BCD data and IC3 (R10 & R11) outputs latching pulses. These are D/A converted by the IC4 (4 bits x 2 latches) diode mattrix and outputed as a DC control voltage to the PLL.
PLL Output	04 - 07	R15	IC3 (04 - 07) outputs PLL BCD data and IC3 (R15) outputs the PLL latching pulse to establish the PLL programmable divider dividing ratio.
DISPLAY Output	00 - 03	R0 - R4	IC3 (00 - 03) outputs the BCD data signal which is converted to 7 segment coding by IC1 the BCD/7 segment decoder. The digit switching signal from IC3 (R0 - R4) is bufferred by IC2 and drives the dynamic display LED, D1.

(3) MEMORY BACK UP: -- As soon as the power switch is turned off, and the voltage of the 5 volt regulated supply starts falling, Q2 (2SC1815) is cut off and time division signal R12 is connected to input K8 through diode D6 (1SS53). Simultaneously, all outputs from the CPU is shut off and the CPU changes to a low current drain mode, being backed up by the internal battery, BATT (3.6v).

(4) POWER SUPPLY:

(A) A 5 volt regulated supply for the control circuits is provided by IC6 (uPC78M05H).

(B) The internal battery (BATT) is charged through R14 while the unit is switched on. When the power switch is off, this battery backs up all memories in the CPU.

6. ALIGNMENT INSTRUCTIONS

CAUTION: THESE INSTRUCTIONS ARE WRITTEN FOR USE BY QUALIFIED ENGINEERS AND TECHNICIANS WHO HAVE ACCESS TO ALL NECESSARY PRECISION TEST EQUIPMENT, PREFERABLY INCLUDING A SPECTRUM ANALYZER. ATTEMPTS BY UNQUALIFIED PERSONS TO SERVICE THE UNIT MAY RESULT IN DAMAGING THE UNIT AND A MORE EXPENSIVE REPAIR CHARGE. IT MAY ALSO VOID A WARRANTY POLICY.

6.1 PLL UNIT

(A) PLL LOCAL OSCILLATOR

Connect a spectrum analyzer to R24 (Q7 base side). Adjust L6 and L7 for maximum output as observed on the spectrum analyzer. (f = 131.63).

(B) VCO LOCK

Set dial to 144.000MHz. Connect spectrum analyzer to TP1. (f = 133MHz). Connect a VTVM to P3 of MAIN unit. Adjust L1 to obtain a reading of 1.7V on VTVM. Adjust L4 to obtain maximum reading on spectrum analyzer.

(C) RECHECK OF PLL L.O.

Connect an oscilloscope to TP2 (f = 4.67MHz). Adjust L5, L6 and L7 to peak reading on scope at approximately 1 volt.

(D) CALIBRATION OF f_o

(Set dial at 144.000MHz). Connect a frequency counter to TP1. Adjust VR1 to obtain a reading of 133.300MHz.

(E) RIT CALIBRATION

Set dial to 144.009MHz. Adjust VR2 to obtain reading of 133.309MHz.

(F) CHECK OF FREQUENCY DIALLING

Connect a frequency counter to TP1. Vary dial from 144.000 to 148.995MHz and confirm counter varies from 133.300MHz - 142.295MHz within ±200Hz. If maximum frequency is out of these limits, adjust C37 and C38.

6.2 RECEIVER

(A) CHECK OF 2ND L.O.

Connect frequency counter to pin 2 of IC3 (MC3357). Confirm frequency is 10.245MHz ±200Hz.

(B) 1ST MIXER INJECTION TUNING

Connect a 145.000MHz signal from a signal generator to the receiver through the rear panel antenna connector. Connect a VTVM to pin P11 (RM). Adjust L6 to peak reading on VTVM.

(C) RF AMPLIFIER TUNING

With 145.000MHz signal connected to receiver, adjust L1 - L8 for maximum on VTVM connected to P11 (RM). Repeat a few times.

(D) ADJUSTMENT OF S METER SETTING

Set signal generator to 10dB. Modulate with 1KHz tone at ±3KHz deviation. Adjust VR1 of the DISPLAY unit so that all LED's of meter unit are lit. Lower signal generator output to 0dB and confirm that at least one LED is lit.

(E) DISCRIMINATOR ALIGNMENT

Set signal generator to 10dB. Modulate with 1KHz tone with ±3KHz deviation. Connect an AC VTVM to Pin 12 (SP). Adjust L9 for maximum reading on VTVM.

(F) SCAN CENTER DETECTOR ALIGNMENT

Set dial to 145.000MHz. Apply an accurate signal of 144.998MHz (145 minus 2KHz) to the receiver. Connect a VTVM to pin 13 of IC4 (TC4011) and turn VR2 from extreme CCW position in a clockwise direction. Set VR2 at exact point where VTVM switches from 4 volt reading to 0 volts. Rock dial knob plus and minus 1 clicks and confirm voltage switches from 0 to 4 volts.

(G) SQUELCH SENSITIVITY CHECK

Set front panel squelch control so receiver noises are just squelched. Apply a -10dB signal to antenna connector and confirm that this unsquelches receiver.

(H) SINAD SENSITIVITY CHECK

Connect a signal generator to the antenna connector. Set for +20dB output modulated by a 1KHz tone with deviation of ±3KHz. Connect a distortion meter to pin P12 (SP). Set front panel volume control to obtain a 1.0 volt reading on the distortion meter. Reduce input from test oscillator to -6dB and confirm that total harmonic distortion is less than 10%. Tweak receiver RF amplifier, mixer and 1st IF stage to reduce reading on distortion meter.

6.3 TRANSMITTER

Set dial to 145.000MHz. Connect a dummy load, power meter, frequency counter and spectrum analyzer to the rear panel antenna connector.

(A) ALIGNMENT OF AMPLIFIER STAGES

Turn control VR2 (HIGH) on rear panel completely CW to disengage APC. All further alignment should be done with transmitter in HIGH power except when noted otherwise. Transmit, and adjust L12, L13, L16, L17, L18, L19, VC2 and VC3 to obtain maximum output. Observe spurs on spectrum analyzer and adjust VR4, L16, L17, L18 and L19 to minimize spurs.

(B) FREQUENCY CALIBRATION

Adjust VC1 and set at 145.000MHz. (This assumes that steps outlined in 6.1 PLL UNIT have been completed.)

(C) MODULATION

Connect an audio oscillator to microphone connector, pin 5. Connect an FM Linear Detector to output of transceiver. Set audio oscillator for 1KHz at 25mV. Transmit and adjust VR3 for deviation of ±5KHz. Reduce output of audio oscillator to 2.5mV. Transmit and adjust VR5 for a deviation of ±3.5KHz.

It should be noted that this is the standard method of setting modulation at the factory. Certain locations as well as individual operating techniques may require changing the above standards. Proper balance between settings of the mike gain and deviation controls is necessary so that modulation is clear and undistorted when speaking in a normal voice level, and maximum deviation is not exceeded when speaking in a louder voice although some distortion will be introduced.

(D) SETTING OF HIGH AND LOW POWER

Set power selector button to LOW. Transmit and adjust VR1 on the rear panel for an output of 5 watts. (Do not set be-

low 5 watts.) Switch to HIGH power, transmit and set VR2 for an output of 25 watts.

NOTE:

(1) Always set LOW (VR1) before setting HIGH (VR2)
(2) It will be found that with APC off, many units will deliver more than 25 watts output. Power should not be set higher than 25 watts as continued use at higher power may damage the transceiver.

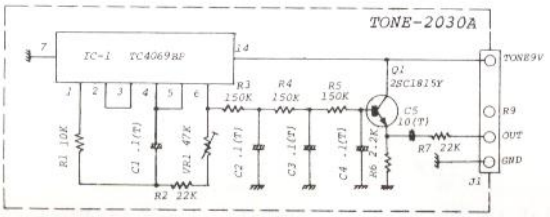
(E) POWER METER SETTING

Transmit, and adjust VR2 of the DISPLAY unit so all 5 digits of the LED meter just light up. Switch to LOW power, transmit and confirm that at least 1 digit lights up.

(F) CALIBRATION OF TONE MODULES

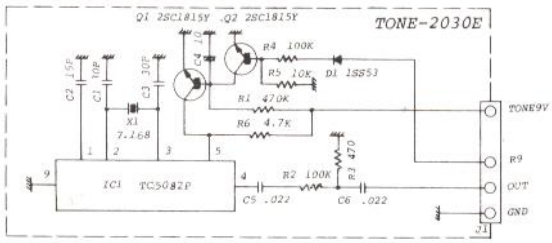
TONE-2030A: -- Depress TONE button. Transmit and adjust VR1 on the tone module so counter reads 100Hz (or desired frequency). Confirm deviation is approximately ±500Hz. Frequency can be adjusted between about 78 - 220Hz by varying VR1. Output is reduced as frequency increased. If output is insufficient, reduce values of R3, R4 and R5.

TONE-2030A



TONE-2030E: -- Depress TONE button and transmit. A tone burst of 1750Hz and about .5 seconds is transmitted. Ground hot end of resistor R1 (base side of Q1) so that unit oscillates continuously. Confirm that deviation is about 2.5KHz. Length of tone burst may be lengthened by changing value of C4. (10uF for approximately .5 seconds.)

TONE-2030E



7. SPECIFICATIONS, KDK FM-2030 TRANSCEIVER

1. GENERAL

Semi-conductors	FET x 6, TR x 29 (30), IC x 16 (17), Diode x 51 (52)
Dialing steps	5KHz (12.5KHz) per click, 20 clicks per revolution (100KHz SPD engaged)
Memory Channels	11 (A = 1 - 5, B = 6 - 10, + Call Channel)
Memory Scanning	Selectable, A + B = 1 - 10, A = 1 - 5, B = 6 - 10, A x B = 1 - 5
Band Scanning	Programmable, limits set by frequencies in memories 5 and 10
Band Scan steps	Same as dialing steps
Type of Emission	F 3
Antenna Impedance	50 ohms nominal, unbalanced feed
Power Supply	13.8 volts, ±10%, negative ground
Current Consumption	Receive: Standby .3A, maximum volume .6A Transmit: 6A 25 watts, 3A 5 watts
Dimensions	55h x 162w x 182d (mm.) protruding items not included
Shipping Dimensions and Weight	100h x 210w x 320d, 1.7Kgs transceiver only, 2.4Kgs shipping weight

2. TRANSMITTER

Frequency Coverage	143.005 - 148.995MHz (144.0125 - 145.9875MHz)
Output Power	25 watts (HIGH), 5 watts (LOW)
Modulation	Variable reactance frequency modulation
Maximum Deviation	±5KHz
Spurious Emissions	Better than -60dB to carrier
Repeator Offset	±600KHz, diode mattrix programmable
Repeator Tones	100Hz adjustable, (1750Hz crystal controlled tone burst)

3. RECEIVER

Frequency Coverage	143.000 - 149.000MHz (144.000 - 149.000MHz)
Receiver type	Double superheterodyne
RIT	1KHz steps, functional for dialing, memory and CALL channel
Reverse	Push button monitoring of duplex transmitting frequency
Intermediate Frequencies	1st = 10.7MHz, 2nd = 455KHz
Sensitivity	S/N better than 35dB at 1uV input, better than .2uV 12dB SINAD
Squelch Sensitivity	Better than .15uV
Bandwidth	±6KHz, -6dB
Selectivity	±16KHz, -60dB
Image Ratio	Better than 70dB
Audio Output	More than 1.5 watts, THD 10% at 8 ohms

4. STANDARD ACCESSORIES INCLUDED

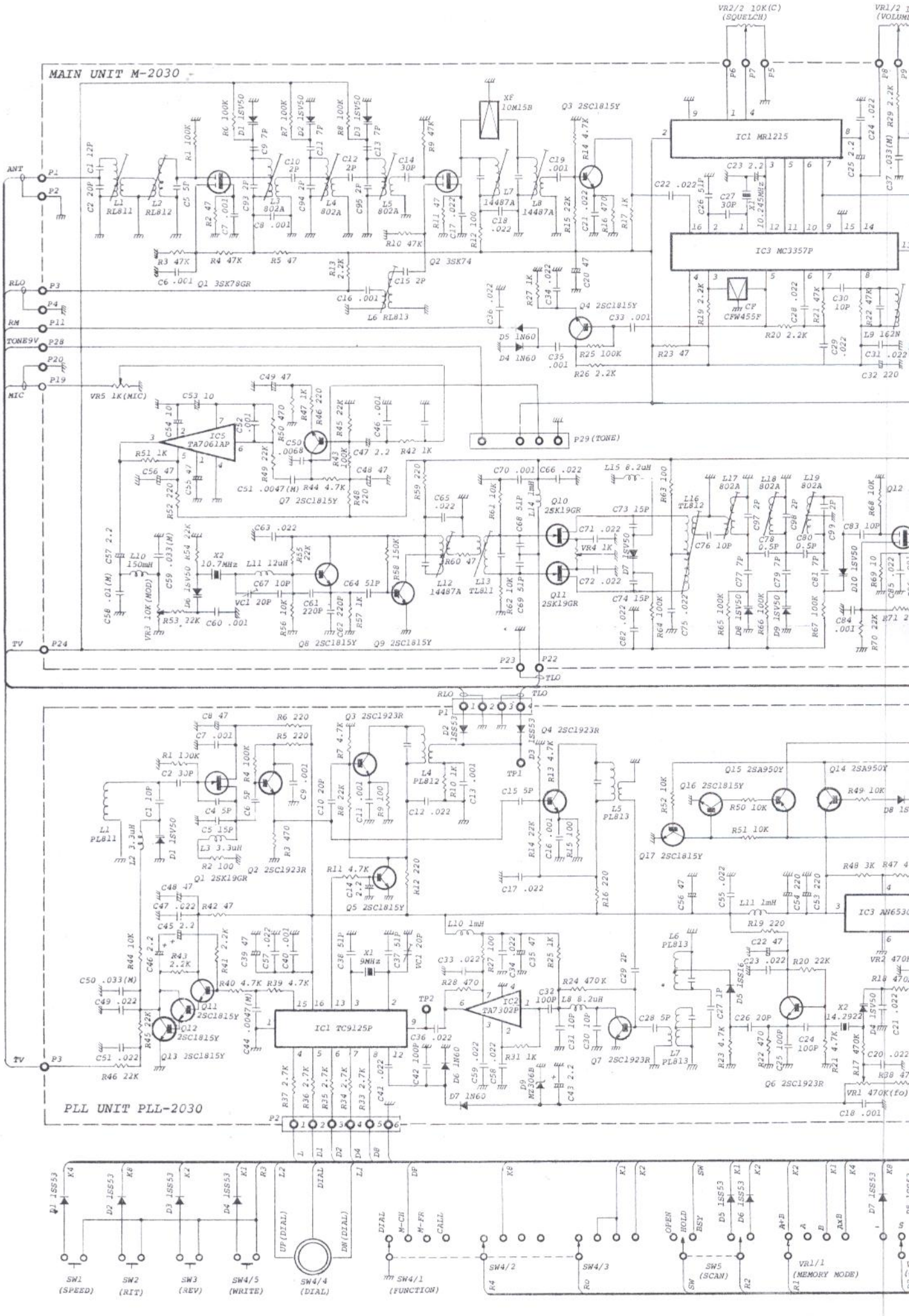
Microphone	Handheld dynamic, 500 ohms with U/D and tone encoder buttons (Handheld dynamic, 500 ohms with U/D buttons)
Power Cable	With 2 conductor metal connector and fuse holder
Spare Fuse	1 piece, 7A
External speaker plug	1 piece, miniature phone plug type
Mobile Mounting Bracket	1 piece, black
Mounting Hardware	4 pieces, 4 x 10mm self tapping screws 4 pieces, plain washers 2 pieces, thumbscrews for transceiver mounting in bracket 1 set, mircophone clip with mounting screws
Instruction Manual	Includes circuit diagram (fold-in)

NOTE: A receiver spur may be noted at 144.000MHz due to harmonic of 9MHz frequency standard.

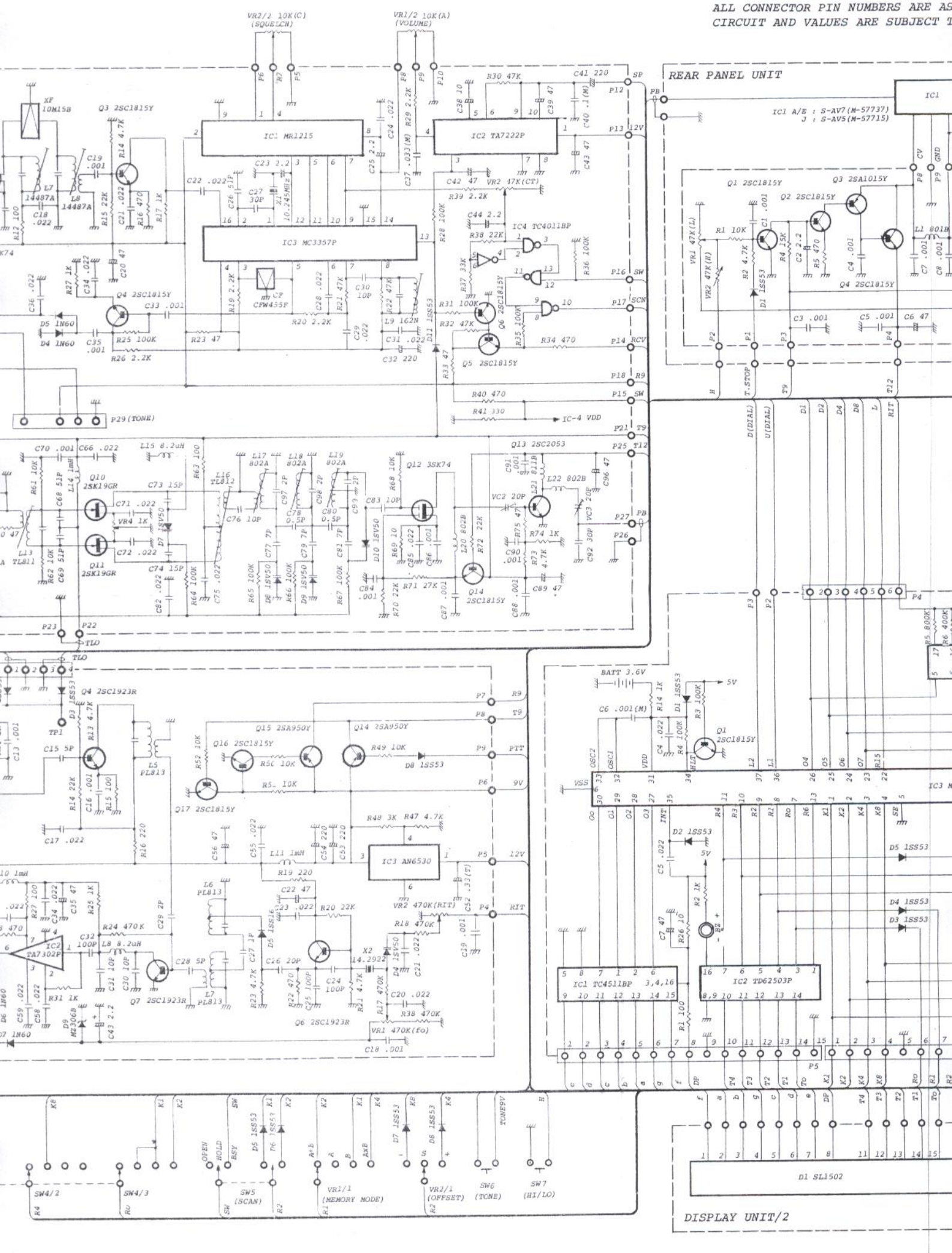
Figures in parenthesis for E version for sale in European countries.

Printed in Japan 20250

model FM-2030 CIRCUIT DIAGRAM



NOTE:
UNLESS OTHERWISE INDICATED VALUE
ALL CONNECTOR PIN NUMBERS ARE AS
CIRCUIT AND VALUES ARE SUBJECT T



NOTE:
UNLESS OTHERWISE INDICATED VALUES ARE: RESISTANCE IN OHMS AND CAPACITANCE IN MICRO-FARAD.
ALL CONNECTOR PIN NUMBERS ARE ASSIGNED AS VIEWD FROM OUTSIDE OF THE TRANSCEIVER.
CIRCUIT AND VALUES ARE SUBJECT TO CHANGE WITHOUT ADVANCE NOTICE FOR IMPROVEMENT.