TEKK INC.
SD-5200 MANUAL

5/2 WATT RF DATA RADIO

IMPORTANT NOTICE!

FCC RF Exposure Compliance requirements for Occupational Use:

- This device must be restricted to work related operations in an occupational / controlled RF exposure environment.
- Transmitting duty factor may not exceed 50%.
- All qualified users must have the knowledge to control their own, passengers and bystanders'RF exposure to comply with the General Population / Controlled MPE limit and requirements.
- The antenna used for this transmitter must be installed to provide a separation distance of at least 32cm from all persons and must not exceed an antenna gain of 0 dDd.

IMPORTANT NOTICE!

This radio can only be programmed to frequency by qualified, approved technicians using a separate PC software and cable package. Only authorized technicians can contact Tekk to purchase this programming software product.

CH.1 PRODUCT INTRODUCTION

SD-5200, This RF Data Radio is designed to operate in the frequency range is 450MHz~ 470MHz. Inside of SD-5200 is installed microprocessor and SD-5200 is operated by PLL type. RF power is 2watt and 5watt. Bandwidth is 12.5khz or 25khz

SD-5200 features

-. PLL SYNTHESIZER type

-. set parameter with PC program

-. RF power : 2 Watt, 5Watt

-. band width : 12.5/25kHz

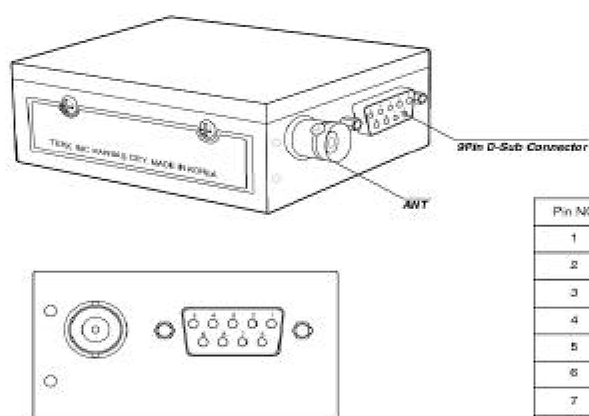
-. light weight

-. PC downloading

-. Power : DC 10V

2. SD-5200 outward view

Data Radio (SD-5200)



Pin NO	
1	DC + 12V
2	GND
3	PTT
4	DATA INPUT
5	DATA OUTPUT
6	PROGRAM I/O
7	GND
8	RSSI
9	S.Q

3. D-SUB Connector PIN Specification

PIN NO	PIN Specification	Remark
1	DC+12V	9V~15V
2	GND	
3	PTT	"Low" Active
4	DA TA INPUT	
5	DA TA OUTPUT	
6	S_I/O(PC Program)	Programming
7	GND	
8	RSSI	Receive Signal Strength Indicator
9	S.Q(CD)	Carrier Detect

4. CON2 PIN Specification (PCB Connector)

PIN NO	PIN Specification	Remark
1	RSSI	Receive Signal Strength Indicator
2	GND	
3	S_I/O	PC Program PIN

5. CON3 PIN Specification (PCB Connector)

PIN NO	PIN Specification	Remark
1	S.Q (C.D)	
2	DATA INPUT	
3	DATA OUTPUT	
4	PTT	
5	DC+12V	
6	GND	

6. CON4 PIN Specification (PCB Connector)

PIN NO	PIN Specification	Remark
1	RESET	used for modifying MPU Program
2	DC+5V	
3	S_CLOCK	
4	S_DATA	
5	GND	

CH2. SPECIFICATIONS

1. Specification

GENERAL

Operating Mode	Conventional (nontrunked) only
Frequency Range	450~470MHz
Frequency Stability	±2.5PPM(-30 to +60?)
Programmable Channels	1 Channel
Channel Spacing	Dual Channel Spacing 12.5/25kHz
Dimensions	30mm(H)×60mm(W)×95mm(L)
Weight	360g
Power Source	DC 9~15V
Current Drain(maximum)	Transmit mode - 1.8A

RECEIVER

Sensitivity	.35uV 12 dB SINAD
Squelch Sensitiviy	.25uV 10dB SINAD
Selectivity	-60dB (12.5KHz)
Spurious and Harmonic	-60dB (25KHz)
Rejection	-60dB
Intermodulation	-60dB
FM Hum and Noise	-34dB(12.5KHz), -40dB(25KHz)
Maximum Frequency Spread	UHF = 20MHz
Audio Output Power	460mW across an 8-ohm load
Audio Distortion	Less than 5% at rated output
Audio Response	±2dB from characteristic from 20~3000Hz
IF Frequencies	21.4MHz and 455kHz
Input Impedance	50 ohms

TRANSMITTER

RF Power Output	2 Watt or 5 Watt
Spurious and Harmonic	-60
FM Hum and Noise	-34dB(12.5KHz), -40dB(25KHz)
Audio Distortion	5% maximum with 1kHz modulation
Audio Frequency Response	±2dB from characteristic from 20~3000Hz
Maximum Channel Spread	UHF = 20MHz
Output Impedance	50 ohms

CH. 3 SD-5200 circuit

1. SD-5200 circuit

SD-5200 circuit is composed of RF and MPU. (RF determines communication quality and performance. MPU controls terminal performance.) RF is composed of TX and RX. TX is composed of synthesizer (Synthesizer generates TX frequency.), VCO, Data ALC (Automatic Level Control), Power Drive, final amplification and antenna switch.

RX is composed of front-end, mixer, local drive, and crystal filter. IF amplifier, IF IC and Data conduct.

MPU is composed of EEPROM storing parameter of controls in the SD-5200.

2. Transmit

2.1 SYNTHESIZER

Synthesizer is consisting of TCXO, PLL IC, Charge Pump, LPF and VCO. See illustration 2-1.

TCXO (U17) plays a key role to make usable frequency for terminal and uses a 14.4MHz(-30? C~ +60? C, 2.5ppm) of VX-23VA in JVC co. It uses resistance R65, R66 and VR13 externally for accuracy of frequency and modulation of low frequency data signal. When VR13 is turned to '+', voltage increases and frequency lowers. When VR13 is turned to '-', frequency rises.

If TX or RX frequency deviation occurs, you can control with VR13.

Inside of PLL IC, there are 4 Divider Registers (CH1, CH2 Programmable Divider, Reference Divider and Option Control).

Now, SD-2000N/5200 use only CH1 Programmable Divider

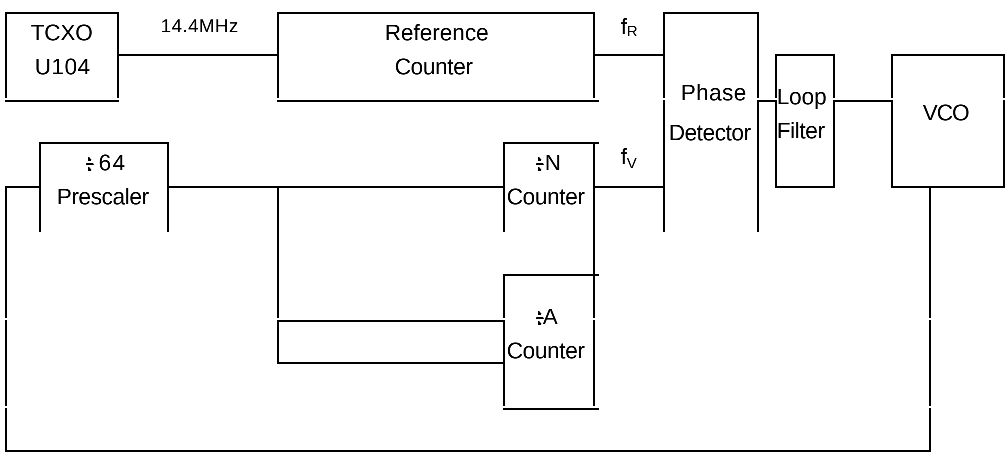


Illustration 2-1 Composition of Synthesizer

2.1.1 Composition of Divider Register

Inside of PLL IC consists of 4 Registers and is set with code.

CODE	ITEM
1 0	Number of dividers by CH1 Programmable divider(Fin1)
0 1	Number of dividers by CH2 Programmable divider(Fin2)
1 1	Number of dividers by reference divider(Xin)
0 0	Option control

1) Programmable divider

LSB MSB

A0	A1	A2	A3	A4	D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	1	0

Calculation for generating 450.0125 MHz frequency, as below.

Set basic channel as 6.25 KHz.

450.0125 MHz ÷ 6.25 KHz = 72002

N and A Counter values are 72002 ÷ 64 = 1125. 03125

N value = 1125 ? 465 hex

A value = 0.3125 ? 0.3125 x 64 = 20 ? 14 hex

LSB 4 1 5 6 4 MSB

0	0	1	0	1	1	0	1	0	0	1	1	0	0	0	1	0	1	0

2) Reference Divider

LSB MSB

D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	1	1

Calculation for basic frequency of 6.25 KHz with TCXO frequency

14.4 MHz ÷ 6.25 KHz = 2304 ? 900 hex

LSB	0			0		9			MSB				
0	0	0	0	0	0	0	0	1	0	0	1	1	1

3) Option Control

T	CP	CP1	CP2	SB1	CP1	CP2	SB2	SBR	LD1	LD2	SW	0	0

T : Test Mode (always "0")

CP : Charge pump output polarity

CP	Output Polarity
0	Normal
1	Reverse

Charge Pump Output Current

Control bit		Charge pump output current
CP1	CP2	
0	0	± 100 µA
0	1	± 200 µA
1	0	± 400 µA
0	0	± 800 µA

Lock detector output

Control bit				Lock detector output state
SB1	SB2	LD1	LD2	
0	0	0	0	L
		0	1	CH2 only detector
		1	0	CH1 only detector
		1	1	CH1, CH2
		0	0	L
		0	1	H

		1	0	CH2 only detector
		1	1	CH1 only detector
1	0	0	0	L
		0	1	CH2 only detector
		1	0	H
		1	1	CH1 only detector
1	1	0	0	L
		0	1	H
		1	0	H
		1	1	H

Filter Switch Control

SW	Output
0	OFF
1	ON

On CH1, data for checking PLL Lock, as below.

0	0	1	1	0	0	0	1	0	1	0	0	0	0

2.2 VCO

VCO is circuit with Colpitts Oscillator, oscillates with control voltage by synthesizer and consist of TX and RX.

RX VCO is operating when RX VCO power Switch, TR(Q28) turns on. TX VCO is operating when TX VCO power Switch, TR Q27) turns on. Control voltage of VCO change pulse voltage generated in Charge Pump of PLL IC to DC voltage as passing Low Pass Filter (C70, C71, C72, R69, R70).

Frequency range by control power, as table 3.1.

MODEL	PLL Control Power Range		frequency range	remark
SD-5200	TX	1.3 ~ 4.5 V	450 ~ 470 MHz	
	RX	1.3 ~ 4.5 V	428.6 ~448.6MHz	

Table 3.1: Control power and frequency

Operation for transmit Mode is oscillated by Q21, C84, C85, C86, C87, C88, C89, C90, C91, VC12, D15, D16 and L26 They are consist of Colpitts Oscillator.).

R7 and C86 are circuit to remain 450 ~ 470 MHz frequency stable.

Varicap Diode determines frequency range for D15. D16 alters Data.

Operation for Receive Mode is oscillated by Q20, C73, C74, C75, C76, C77, C78, C79, D14 and L21.

Q22 and extra parts are buffers to amplify RF carrier which is oscillated by TX VCO and RX VCO, remain final output $0dB_m \pm 2dB$ and prevent amplified reverse power from output part.

2.3 Input Data ALC (Automatic Level Control)

User can use different input signal level.

Input Data ALC (Automatic Level Control) is designed to use every digital signal whose input signal range is 05V~0.6V. Input signal data provided by D-sub Connector No. 4 pin amplify 47times as U16A and is provided to U16B Limiting circuit. Output of U16B restricts every signal as 1.4V and provides to VCO and TCXO. TCXO (U17) alters data signal (0~350Hz) with R63 and C64 and does not alter more than 350Hz with VCO. R60 is used as bypass, not using input Data ALC(Automatic Level Control)circuit.

2.4 POWER DRIVE

TX Drive (Q24, Q25) amplify RF power occurring VCO to meet final AMP input and restrict influence of reverse power.

First amp (Q24) operate as A level and amplify VCO output about 15dB. Second amp(Q25) amplify about 10dB to amplify final AMP(Q26) about 5W and to remain final output of C107 24~25dB. When P2.6 Port of MPU (U13) is high, Q24 and Q25 turn Q31 on and TR(Q30) provide power to TX drive.

This power provides power to ANT S/W and turn on D10 and D11 to emit TX carrier through antenna.

2.5 Final AMP and APC

Final TR (Q26) amplify RF Carrier as much as around 15dBm in the finial part of amplification. R96, VR14 and Q33 decide TX Power. Q33 and VR alter SD-5200 from 5W to 2W. When MPU (U13) becomes high, Q33 will be "ON" by dropping the gate pow er of TR (Q26).

When MPU (U13) P1.0 Port becomes High, Q33 will be ON, and alter power form 5W to 2W by dropping gate power of final TR(Q26) VR14 will control 2W RF power.

APC is designed to be operated when power is 2W

APC senses RF carrier from Final AMP and low supply power when RF Power is higher more than 2W. When RF Power is less than 2W, APC increase supply power of power Drive in order to make RF Power maintain 2W.

APC (Automatic Power Control) consist of RF Carrier sensor, amplification part that compare with standard voltage and schematic that switch the checked voltage.

RF Carrier sensor will be changed to DC voltage by using C116, D20, C134 in order to supply base voltage of Q36 in the amplification part.

The voltage which is supplied to Q36 is arrange low power(2W) with VR14, High Power(5W) control Q33 (when Base is high).

Q36 in the amplification compare base voltage of Q36 which come from sensor part with base standard voltage which is supplied to Q36 and control Q35 which control RF pow er to be 2W by controlling base voltage of Q30.

2.6 Antenna Switch

Antenna switch is consist of TX carrier, switching part and low pass filter. Switching part choose RF RX signal and low pass filter eliminate spurious at TX.

TX and RX switching part is operated by Pin Diode D10, D11.

At TX, when TX+8V provide power to L36, R98 and C113, D10 and D11 turn on, RF carrier flowing receiving direction is isolated and emit to antenna. At RX, when power providing to Pin diode of TX+8V turn off, D10 and D11 turn off and RF carrier is provided to receiving direction.

Low Pass Filter eliminate needless spurious and is consist of 2 steps.

3. Receive

3.1 FRONT-END

Front-end choose and amplify bandwidth of RF signal. Front end is consist of filter and LNA (Low Noise Amp). LNA is consist of two Transistors (Q10, Q11) and amplify about 20dB. Filter use two SAW Filter (F9. F10) to remain bandwidth of 450~470MHz. When P0.1 is high, TR Q4 turn on, Band Switching Diode (D18, D19) turn off, F9 turn off and F10 turn on. Band Width of SAW Filter, as below.

3.2 Mixer

SAW Filter	P0.1	frequency range
F9	Low	460~470 MHz
F10	High	450~460 MHz

Mixer (Q12) mix received RF signal and local signal from synthesizer and then generate 21.4MHz, IF frequency. Volume of local signal is -4dBm at maximum and Conversion Gain about 2dBm.

Medium frequency is determined, as below.

$F_{IF} = F_{RF} \pm F_{LOCAL}$

For preventing spurious. n-Channel Dual Gate MOS-FET, BF998 is used and spurious level of Local and RX RF is less than -70dB$_{m.}$

3.3 Crystal filter and IF AMP

Pass Band Width of 21.4MHz X-TAL filter(F11) is ±6KHz and can use 12.5KHz and 25KHz Spec of MCF : Ripple -1dB, Insertion Loss - 3dB, MCF reduce about -35dB far from ±20KHz.

IF AMP(Q13) amplify X-TAL filter in 21.4MHz as 25dB. Consumption of voltage is less than 5mA.

3.4 IF IC

IF IC (U11) is consist of second Mixer, Ceramic Filter, 455KHz Resonator, Noise Squelch and SRRI.

Second Mixer generate 455KHz, mixing IF 21.4MHz and 2nd Local 20.945MHz(X10). This signal catches the Ceramic Filter (F13, F14) with 12.5/25KHz switch (D12, D13) and determines adjacent channel fitting with 12.5/25KHz.

Channel selection in 12.5/25KHz is operated by MPU (U13) P0.4.

When P0.4 is high, 25KHz(F13) is selected. When P0.4 is low, 12.5KHz(F14) sis selected.

455KHz Resonator eliminate Carrier between received second IF Carrie and data signal and detect signal. In 25KHz, Q14 turn on and reduce 455KHz Resonator to remain data signal stable volume of 12.5/25KHz.

Noise Squelch signal identically detect noise squelch signal in 12.5/25KHz. RSSI signal alters to voltage according to signal strength inside of IF IC and provide D-SUB connector No. 8 pin.

3.5 Data Handling

Data handling part reverse or de-reverse signal at 2V with OP AMP (U12).

If users use TX data at 1/2 VCC voltage, user can use U12A No.1 pin (Invert Signal) or U12B No.7pin (Normal Signal).

After eliminating DC part, user can use as C48.

3.6 MPU (U13)

MPU operates after down loading RF status with D-SUB Connector No. 6 pin (S_I/O).

EEPROM (U14) stores Parameter of every kind and provide information.

Each port for MPU as following table

Port 0		Port 0	
P0.0	S_CLOCK	P2.0	H/L_POW
P0.1	S-DATA/H/L_BAND	P2.1	PLL_LOCK
P0.2	S_I/O	P2.2	EEPORM DATA
P0.3	PTT	P2.3	PLL_CLOCK/ EEPROM CLOCK
P0.4	12.5/25KHz	P2.4	PLL_DATA
P0.5	RX_CON	P2.5	PLL_ENABLE
P0.6	TX_VCO	P2.6	TX_POW
P0.7	RX_VCO		