APPLICATION MANUAL

TK14620M

CONTENTS

MEETING YOUR NEEDS
TOKO, INC.

IC for TRANSMITTER
TK14620M

1. DESCRIPTION

TK14620M is the TXIC including VCO, VCO buffer amplifier, driver and output stage.
This item is suitable for CT-0 transmitter section, or VCO circuit bellow 80MHz.
Features describe as follows. Low components count, very small SMD package, 2-port type VCO circuit, and VCO buffered output port for PLL, TX power programmable output stage. Generally two VCDs are used in CT-0 application, one is for CH-tuning and the other is for modulation. In this application manual, we introduce one VCD application with TOKO's high linearity VCD KV1832C. Only one VCD is used as CH-tuning and frequency modulation in this application.

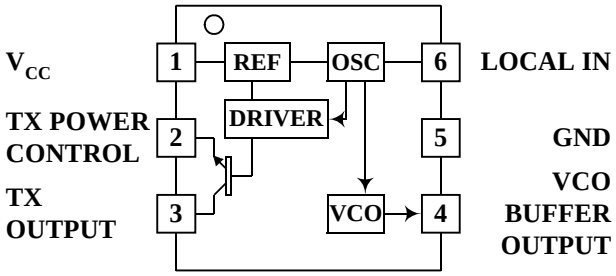
2. FEATURES

- Very Small SMD Package SOT23L-6.
- Programmable TX Output Power.
- Low Voltage 2 Cell Operation 2.0V~.
- Low External Component Count.
- VCO Buffer Output.
- Maximum Output Power +10dBm.
- Excellent C/N Rate.

3. APPLICATIONS

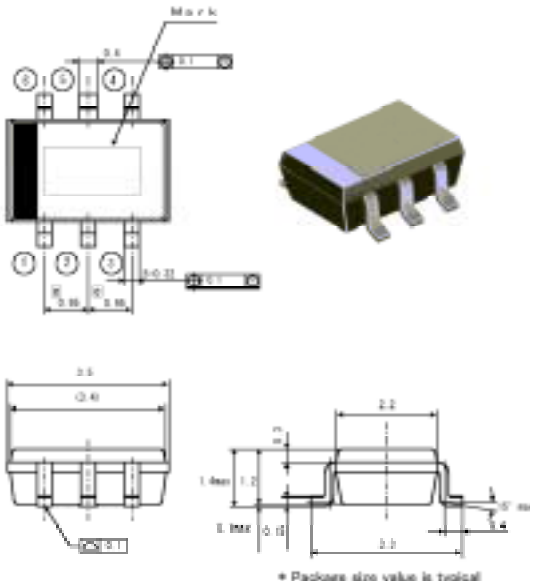
- US25ch CT-0
- Other Communication Equipment

4. PIN CONFIGURATION/ BLOCK DIAGRAM



5. PACKAGE OUTLINE

- SOT23L-6



6. ABSOLUTE MAXIMUM RATINGS

T_a=25°C

Parameter	Symbol	Rating	Unit	Condition
Supply Voltage 1	V_{CC1}	6.0	V	
Supply Voltage 2	V_{CC2}	6.0	V	* Pin 3 only.
Power Dissipation	P_D	200	mW	*
Storage Temperature Range	T_{stg}	-55 ~ +150	°C	
Operating Temperature Range	T_{OP}	-20 ~ +70	°C	
Input Frequency	f_{MAX}	~ 80	MHz	
Operating Voltage Range	V_{OP}	2.0 ~ 6.0	V	

* P_D must be derated at rate of 1.6mW/°C for operation at T_a=25°C

7. ELECTRICAL CHARACTERISTICS

Condition for Hand-Set: V_{CC1}= V_{CC2}=2.4V, R_{e1}=22Ω, R_{e2}=51Ω, f_{in}=49.7313MHz, T_a=25°C

Parameter	Symbol	Value			Unit	Condition
		MIN	TYP	MAX		
Supply Current 1	I_{CC1}	11.0	14.0	17.0	mA	$V_{CC}1$=$V_{CC}2$=2.4V, R_{e1}=22Ω, R_{e2}=51Ω
Supply Current 2	I_{CC2}	12.0	15.0	18.0	mA	$V_{CC}1$=$V_{CC}2$=5.0V, R_{e1}=22Ω, R_{e2}=51Ω
Output Power 1	P_{O1}	-2.0	+1.0	+3.0	dBm	$V_{CC}1$=$V_{CC}2$=2.4V, R_{e1}=22Ω, R_{e2}=51Ω
Output Power 2	P_{O2}	-10.5	-7.5	-5.5	dBm	$V_{CC}1$=$V_{CC}2$=2.4V, R_{e1}=22Ω, R_{e2}=510Ω
Output Power 3	P_{O3}	±0.0	+3.0	+5.0	dBm	$V_{CC}1$=$V_{CC}2$=5.0V, R_{e1}=22Ω, R_{e2}=51Ω
Output Power 4	P_{O4}	-10.0	-7.0	-5.0	dBm	$V_{CC}1$=$V_{CC}2$=5.0V, R_{e1}=22Ω, R_{e2}=510Ω
Carrier to Noise Ratio	C/N	44	50		dB	2kHz away point * Standard Condition
Signal to Noise Ratio	S/N	40	45		dB	1kHz±3kHz * Standard Condition
Output Spurious	SP		-55	-50	dB	0~1GHz * Standard Condition
VCO Buffer Output	VCO	0.55	0.80	1.02	V_{P-P}	FET Probe P6202A use * Standard Condition

*1 Electrical characteristics are measured using exclusive duplexer.
Electrical characteristics as mentioned above are at Hand-Set-Mode.

For Hand-Set (49MHz Band)
TX Side: DUP3 type H829E-1134TX
RX Side: DRU5 type H869D-024RX

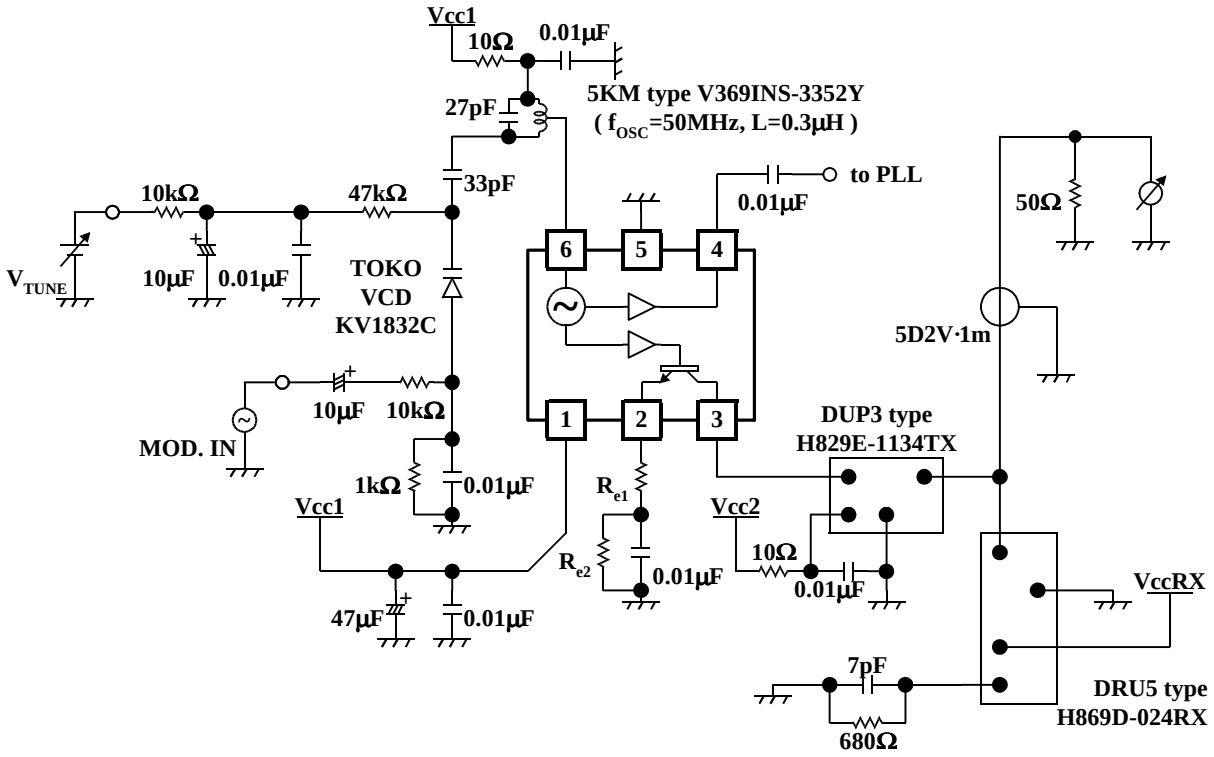
For Base-Set (46MHz Band)
TX Side: DUP3 type B803E-1135TX
RX Side: DRU5 type B869D-025RX

*2 The specification of FET probe P6202A (Tektronix) is shown below.

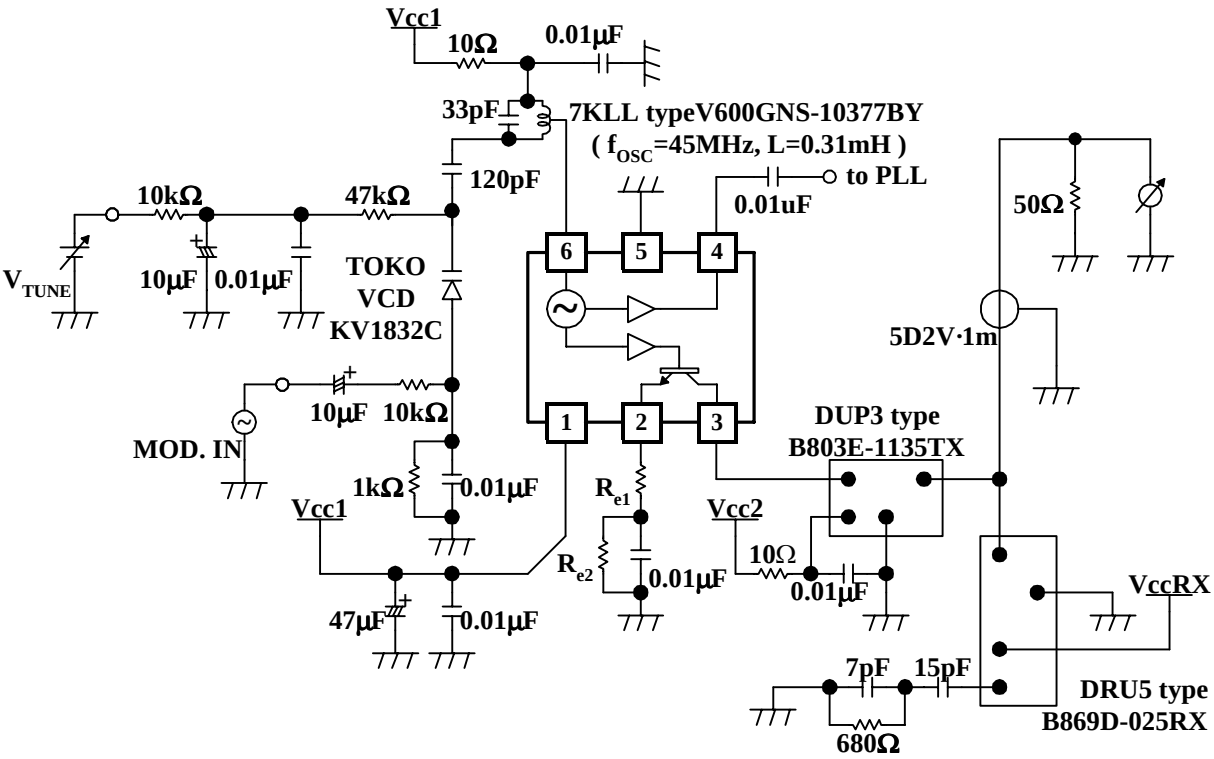
Input Impedance: 10MHz±2%, this is shunted about 2%.

8. TEST CIRCUIT

8-1. For Hand-Set



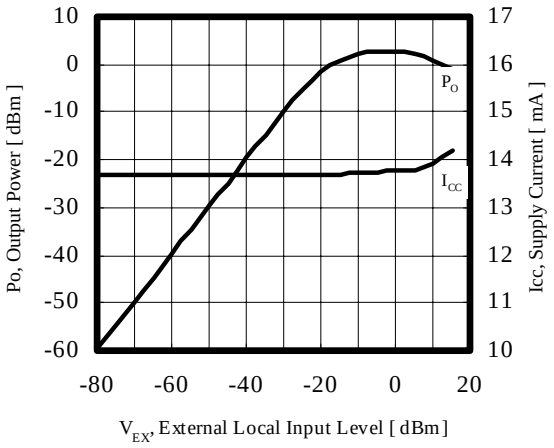
8-2. For Base-Set



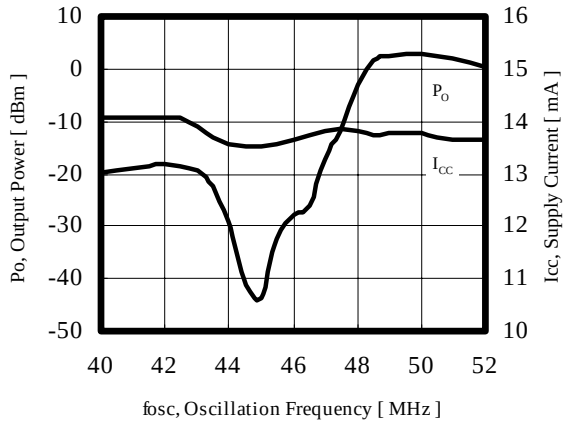
9. TYPICAL CHARACTERISTICS

9-1. STANDARD CHARCTERISTICS (HAND-SET-MODE APPLICATION)

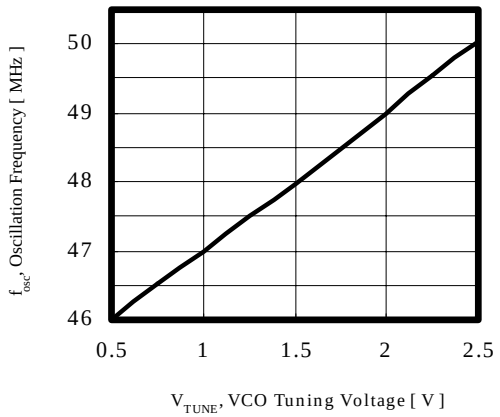
■ Output Power , Supply Current versus External Input Level



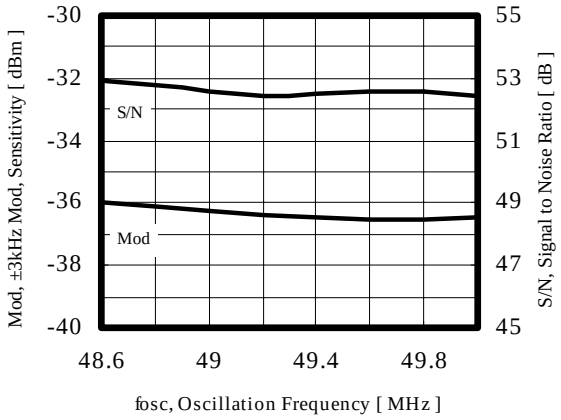
■ Output Power, Supply Current versus Oscillation Frequency



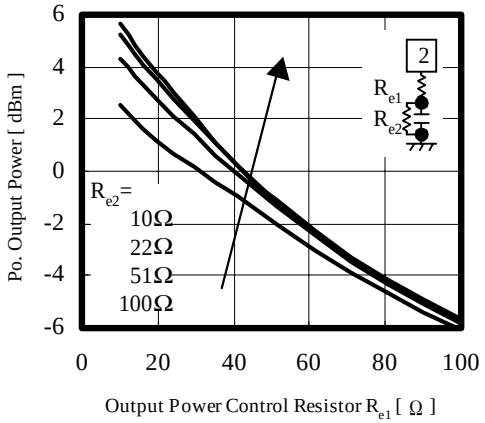
■ VCO Tuning DC Voltage versus VCO Oscillation Frequency



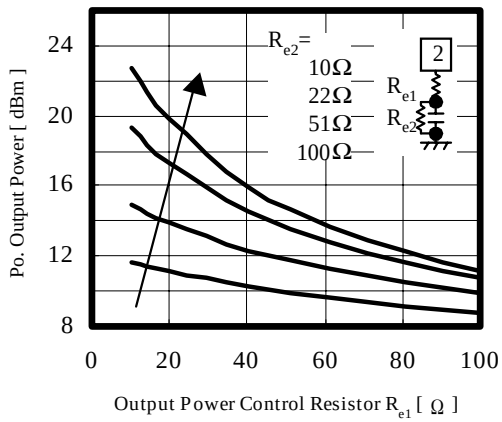
■ ±3kHz Modulation Sensitivity, Signal to Noise Ratio versus VCO Oscillation Frequency



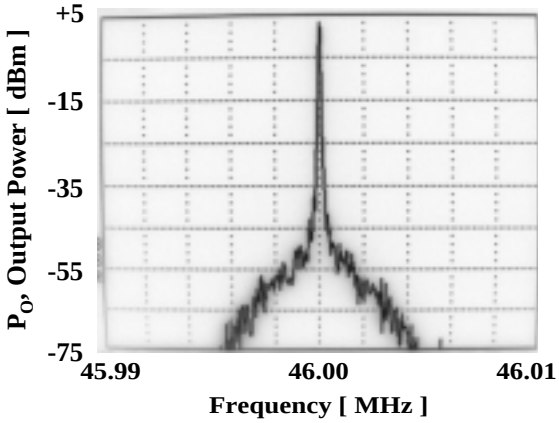
■ Output Power versus Control Resistor



■ Supply Current versus Control Resistor

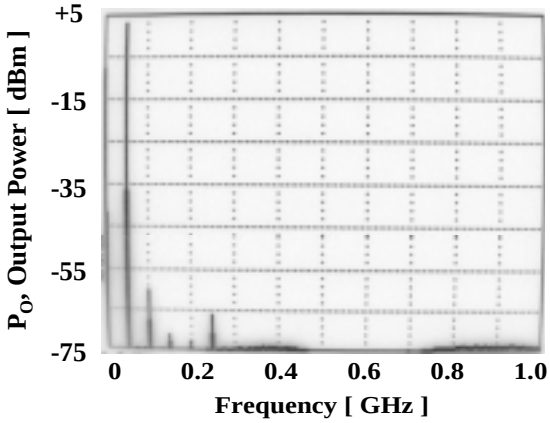


■ Output Spectrum (f_{OSC}=49MHz)



Measurement Condition：SPAN 20kHz, VBW 30Hz

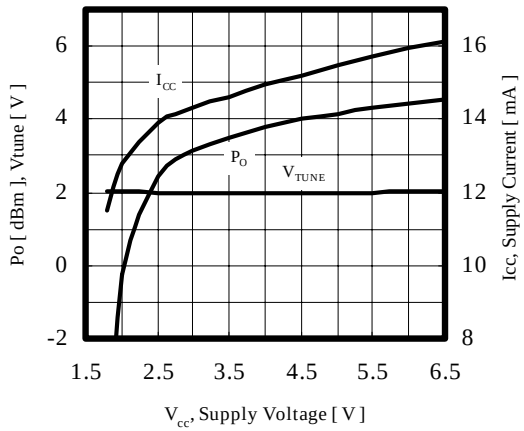
■ Output Spurious (f_{OSC}=49MHz)



Measurement Condition：VBW 10kHz

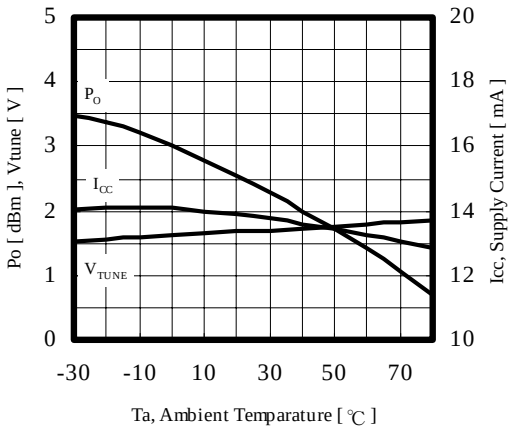
9-2. VERSUS SUPPLY VOLTAGE CHARACTERISTICS (HAND-SET-MODE APPLICATION)

■ Output Power, Supply Current, VCO Tuning DC Voltage versus Supply Voltage

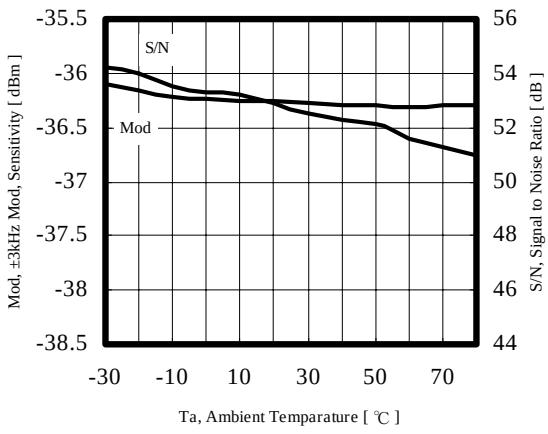


9-3. VERSUS TEMP. VOLTAGE CHARACTERISTICS (HAND-SET-MODE APPLICATION)

■ Output Power, Supply Current versus Ambient Temperature

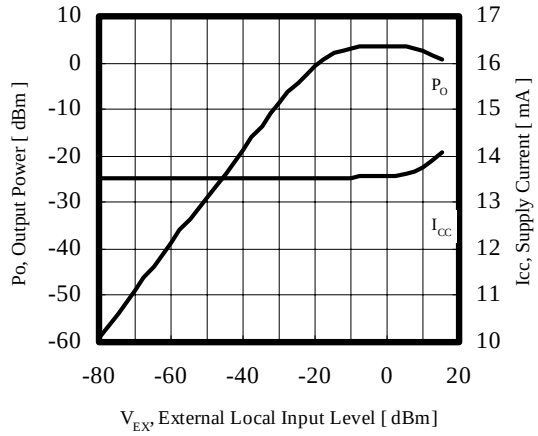


■ ±3kHz Modulation Sensitivity, Signal to Noise Ratio versus Ambient Temperature

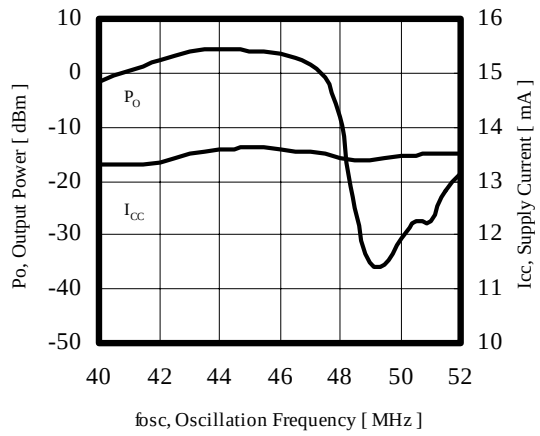


9-4. STANDARD CHARCTERISTICS (BASE-SET-MODE APPLICATION)

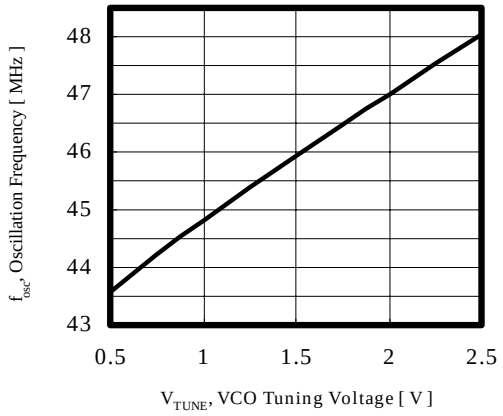
■ Output Power , Supply Current versus External Input Level



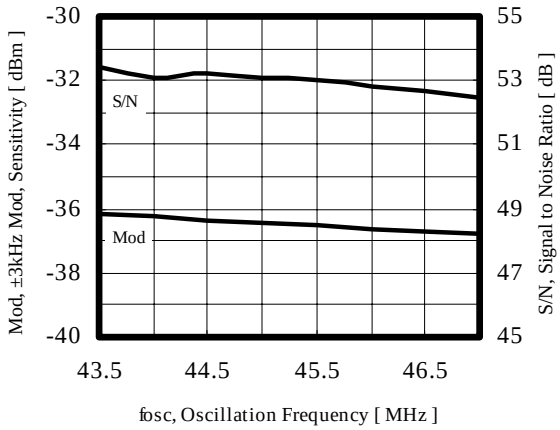
■ Output Power, Supply Current versus Oscillation Frequency



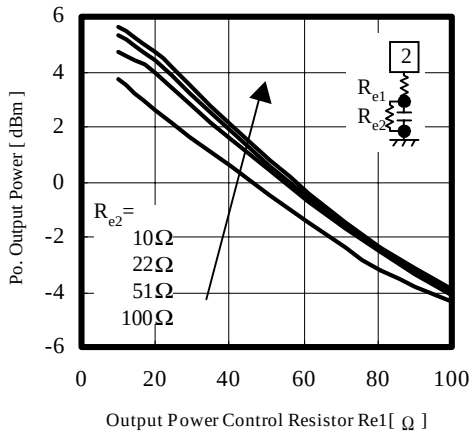
■ VCO Tuning DC Voltage versus VCO Oscillation Frequency



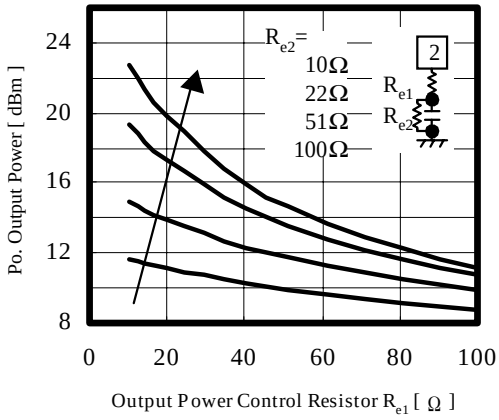
■ ±3kHz Modulation Sensitivity, Signal to Noise Ratio versus VCO Oscillation Frequency



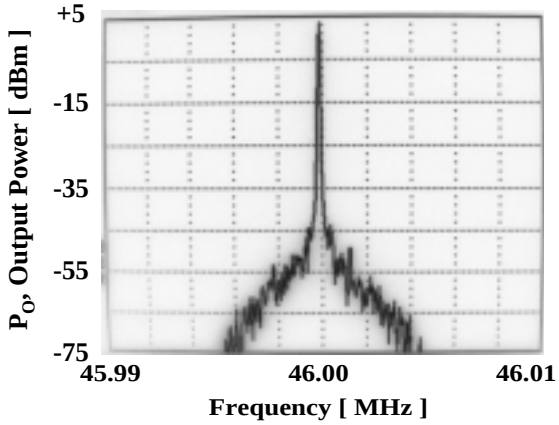
■ Output Power versus Control Resistor



■ Supply Current versus Control Resistor

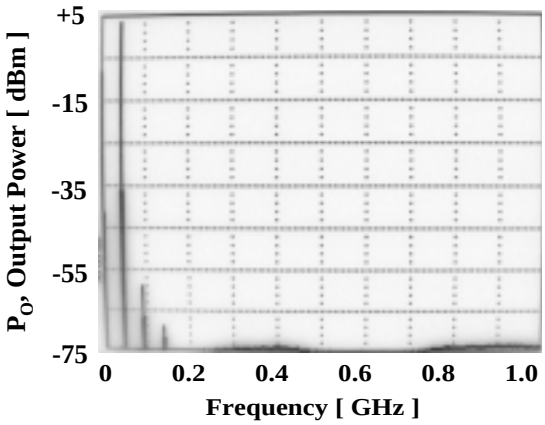


■ Output Spectrum (f_{OSC}=46MHz)



Measurement Condition：SPAN 20kHz, VBW 30Hz

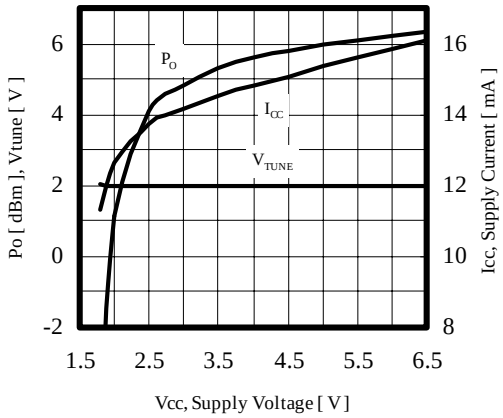
■ Output Spurious (f_{OSC}=46MHz)



Measurement Condition：VBW 10kHz

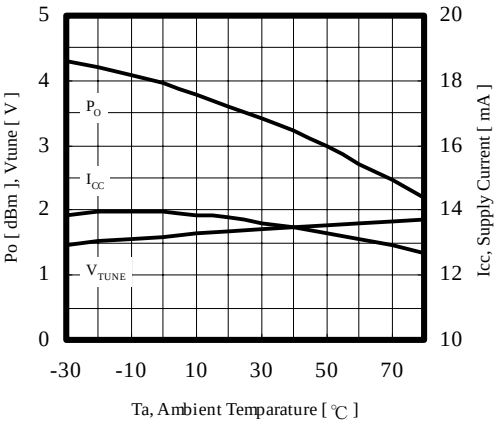
9-5. VERSUS SUPPLY VOLTAGE CHARACTERISTICS (BASE-SET-MODE APPLICATION)

■ Output Power, Supply Current, VCO Tuning DC Voltage versus Supply Voltage

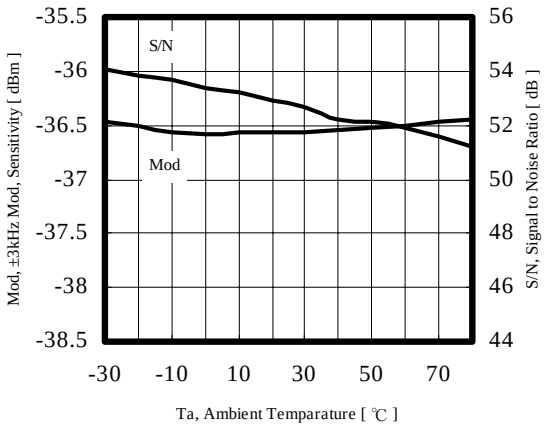


9-6. VERSUS TEMP. VOLTAGE CHARACTERISTICS (BASE-SET-MODE APPLICATION)

■ Output Power, Supply Current versus Ambient Temperature

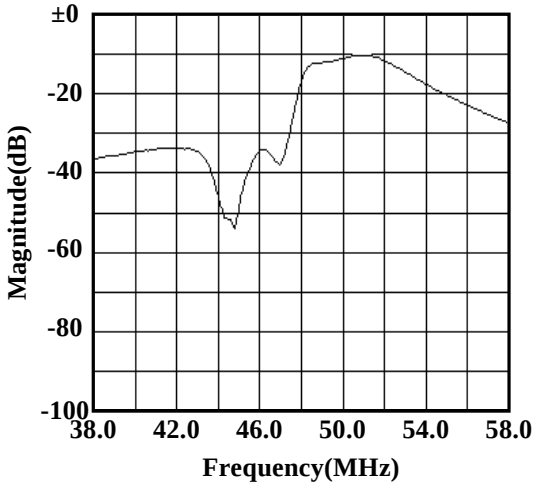


■ ±3kHz Modulation Sensitivity, Signal to Noise Ratio versus Ambient Temperature

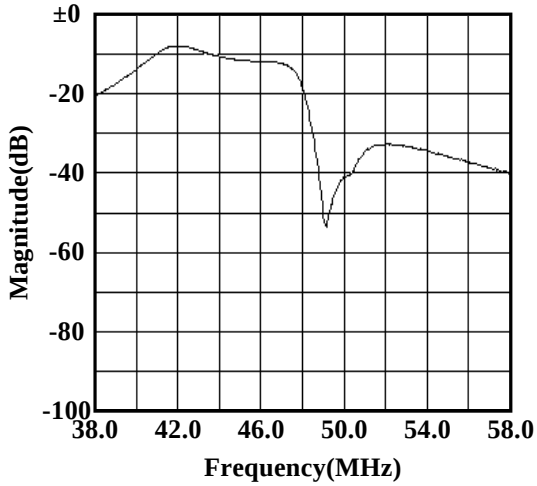


9-7. DUPLEXER FILTERING CHARACTERISTICS

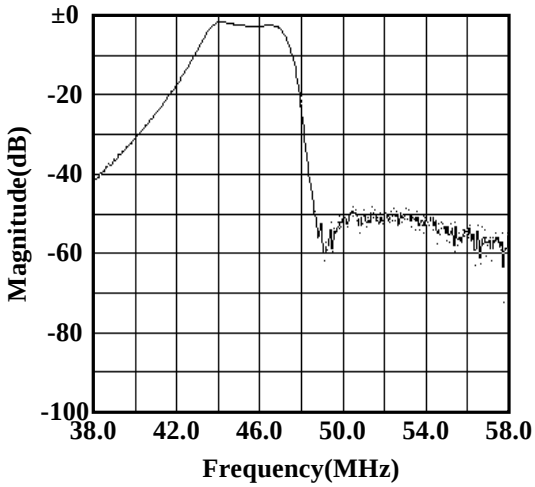
■ Hand-Set-Mode: Transmitter Side(H829E-1134TX)



■ Base-Set-Mode: Transmitter Side(B803E-1135TX)



■ Hand-Set-Mode: Receiver Side(H869D-024RX)



■ Base-Set-Mode: Receiver Side(B869D-025RX)

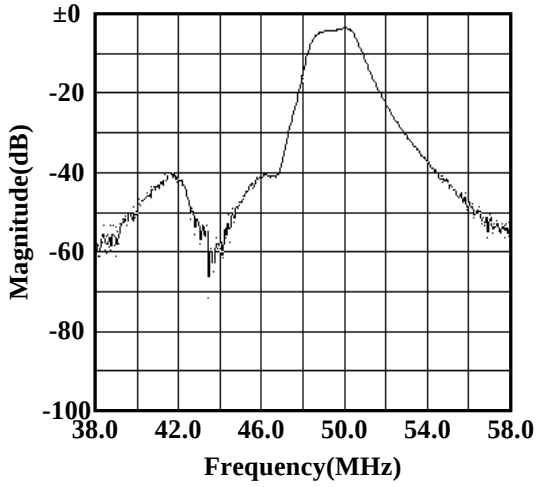
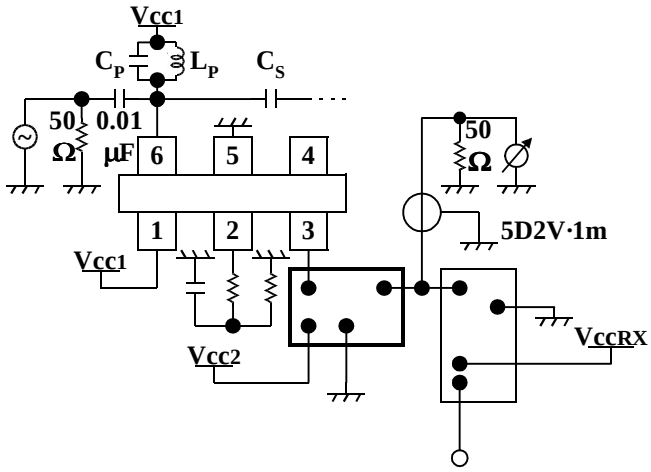
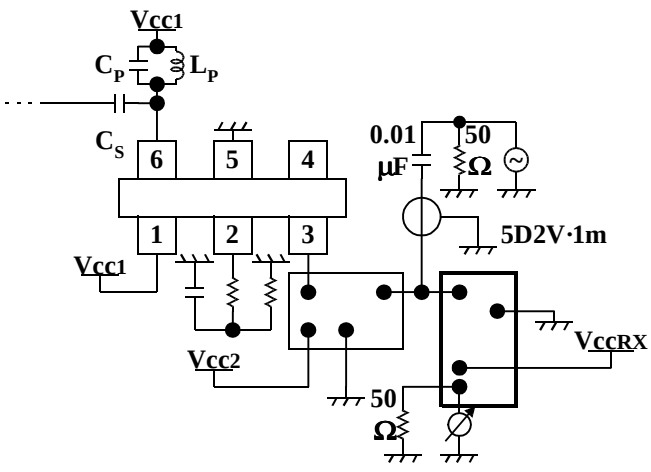


Figure1: Duplexer Test Circuit

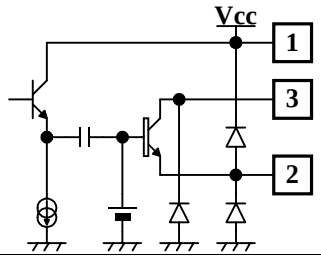
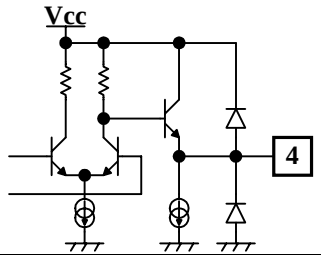
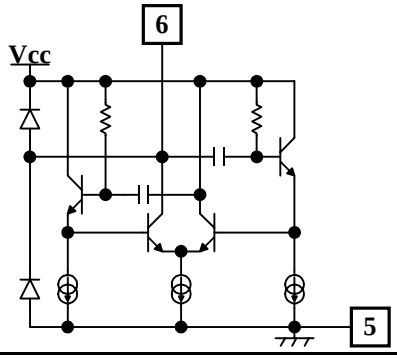
■ TX Side



■ RX Side



10. PIN DESCRIPTION

Pin	Symbol	Internal Equivalent Circuit	Description
1	V_{CC}		■ Supply Voltage ~2.0 to 6.0V is the operating range. V_{CC} is decoupled to ground.
2	TX POWER CONTROL		■ TX output power pin. Control resisters are connected to this pin.
3	TX OUTPUT		■ TX output pin. The output power is programmable by the value of the control resistors connected to pin 2.
4	VCO BUFFER OUTPUT		■ Voltage-Controlled-Oscillator buffer output pin.
5	GND		■ Ground. The ground area should be continuous and unbroken. In a two-sided or more sided layout, the component side has the ground plane. In a single-sided layout, the ground plane fills around the traces on the circuit side of the board and not interrupted
6	LOCAL IN		■ Local oscillator input pin. Up to 80MHz.

11. TEST BOARD

Figure 2: Solder Side View (Circuit View)

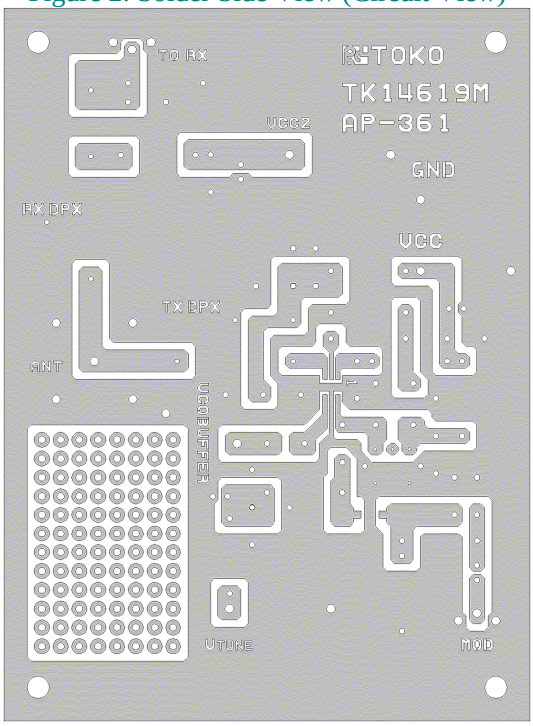
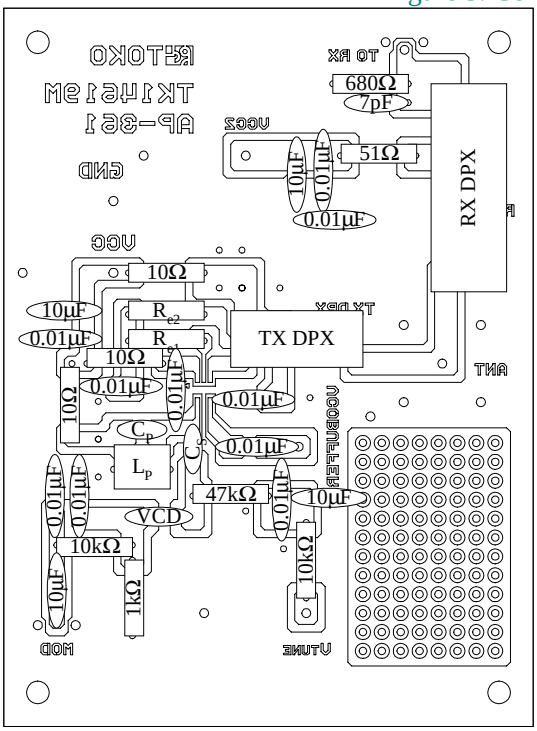


Figure 3: Component Layout View



	Hand-Set (49MHz BAND)	Base-Set (46MHz BAND)
TX Side Duplexer	DUP3 type H829E-1134TX	DUP3 type B803E-1135TX
RX Side Duplexer	DRU5 type H869D-024RX	DRU5 type B869D-025RX

Scale 1:1 (95mm×70mm)
Above PC Board is laid out for the TEST CIRCUIT.

12. APPLICATIONS INFORMATION

12-1. VCO

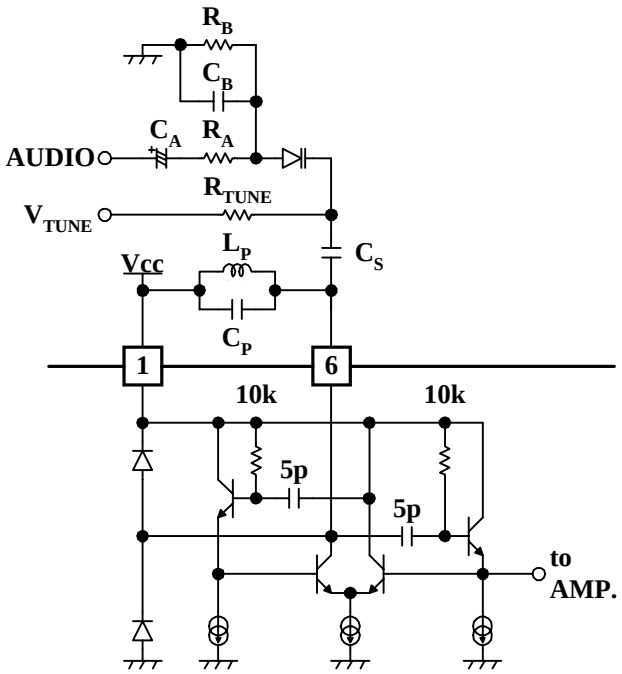
Figure 4 shows internal 2-port type VCO block with minimum external components count. OSC level depends on oscillator circuit's loop gain. But feedback constant and operating current are fixed. Therefore oscillation level is decided by tank circuit's resonant impedance connected between Pin 6 and V_{CC} line. Lower the resonant impedance is, higher the oscillation stability gets. On the other hand, oscillation strength gets lower. The relationship is existence, that oscillation strength and stability are tradeoff. In this viewpoint, we recommend the resonant impedance more than 1.6kΩ. This value include internal bias resistor value, 10kΩ.

The oscillator C/N is depending on the loaded Q of resonant circuit, so high Q is desirable.

Figure 4 shows one VCD application, CH-tuning voltage incurred to anode of VCD and modulation signal incurred to the cathode of VCD. This application can minimized external components count, by only our high linearity VCD KV1832C.

The shook and vibration characteristics of the oscillator coil are very important. If applied normal one as oscillator coil, shook noise may generate extraordinary sounds when shook is added to the set. The oscillator coils in this application are designed for VCO that is very stable for that case.

Figure 4: VCO



12-2. OSC Circuit External Parts Value

Oscillator external component values are calculated same as 3-point tracking of radio tuner.

Appearing the characteristics of tuning voltage versus oscillation frequency as modulation sensitivity deviation, the oscillator's linearity is very important. In the case of USA CT-0, these problems hardly appear in hand-set application because TX-Band is narrow (48.76~49.97MHz). But it is necessary for base-set application to design carefully because TX-Band is wide (43.72~46.97MHz).

Adopting element values described in this application note, these modulation sensitivity deviations are within ±0.5dB in band.

Element value for USA CT-0 described the table shown below.

Table5: OSC Circuit External Parts Value

Symbol	Hand Set Application	Base Set Application
L_P	V369INS-3352Y (L=0.3µH)	600GNS-10377BY (L=0.31µH)
C_P	27pF	33pF
C_S	33pF	120pF

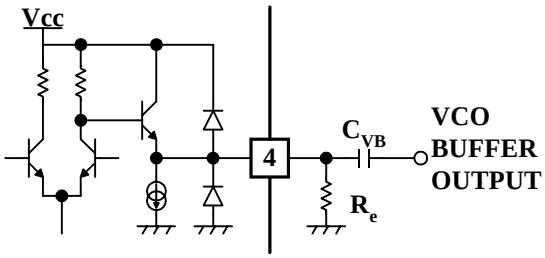
12-3. VCO Buffer Output

VCO buffer output circuit is shown in Figure 6. This output is emitter-follower output via a buffer amplifier. So output impedance is low about 100Ω. In the case of reactive load is heavy, we recommend connecting the external resistor between Pin 4 and GND, to increase the emitter follower operating current. In Figure 6, R_e is the external resistor to increase operating current. The increase current is calculated as follows.

$$I = \frac{V_{CC} - 1.2}{R_e} \quad (1)$$

Getting enough amplitude, this resistor R_e is needless.

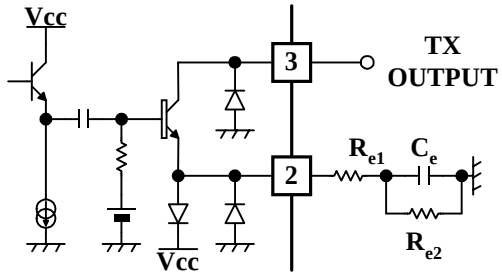
Figure 6: VCO Buffer Output



12-4. Output Stage

TK14620M output stage is one power transistor circuit shown in Figure 7. Because this circuit is enough flexible. The input impedance of duplexers that are described in this application 50Ω for hand-set and is 200Ω for base-set. Output impedance is 50Ω in common. TX output power decided by duplexer input impedance and emitter resistors connected between Pin 2 and GND. Increasing operating current by decreasing the emitter resistor value, output power increase too. Emitter resistors are R_{e1} and R_{e2} shown in Figure 7. To control output power, we recommend the way to vary the R_{e1} value.
This way is useful to reduce the floor noise. And that is effective for minimizing the receiver sensitivity degeneration at once.

Figure 7: Output Stage



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14. OFFICES

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