

AN3922NK, AN3922NS

FM Audio Signal Processing Circuit for VTRs

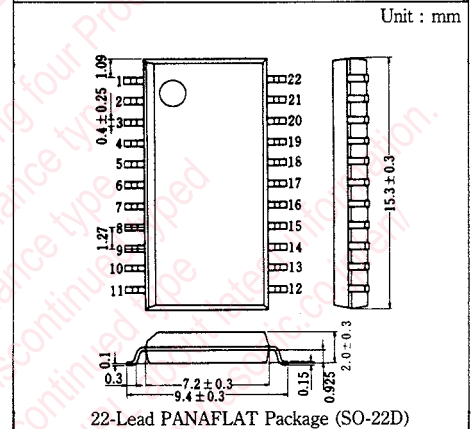
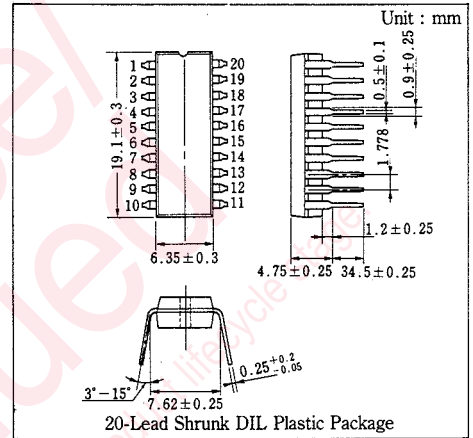
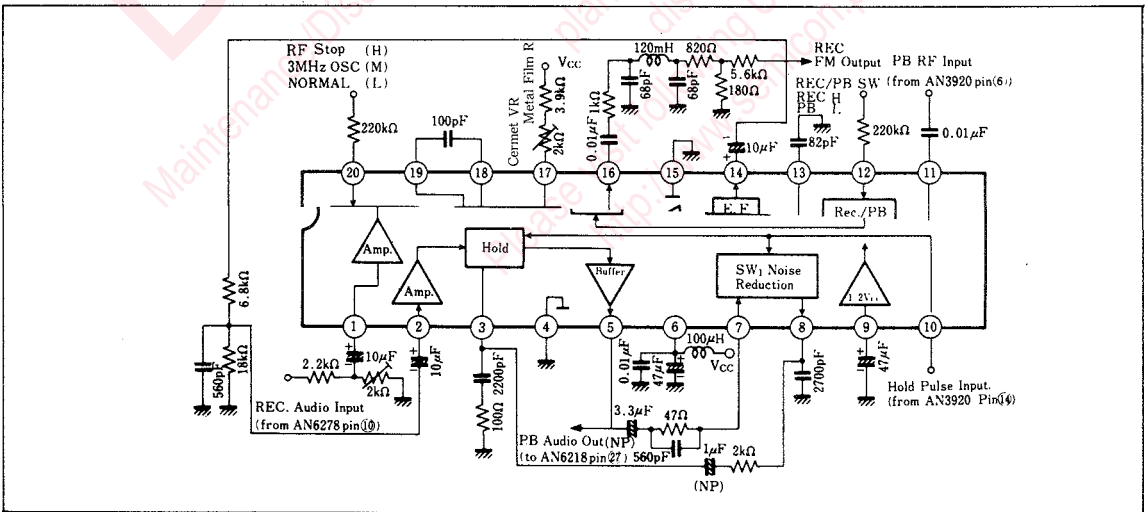
■ Outline

The AN3922NK and The AN3922NS are integrated circuits designed for the FM audio modulation and demodulation for a VTR.

■ Features

- Built-in switching noise reduction circuit
- Erase oscillation (3MHz) possible
- Supply voltage: 5V

■ Block Diagram



■ Pin

Pin No.	Pin Name	Pin No.	Pin Name
1	Audio Signal Input on Rec. Mode	11	RF Signal Input on PB Mode
2	Holc. Amp. Input Terminal	12	Rec/PB Control
3	Hold Control	13	FM Demodulation Control
4	GND (Audio)	14	FM Demodulation Output
5	Hold Output Terminal	15	GND (RF)
6	V _{cc}	16	FM Modulation Output
7	Switching Noise Reduction Input Terminal	17	VCO Frequency Adjustment
8	Switching Noise Reduction Output Terminal	18	VCO Capacitance
9	1/2V _{cc}	19	VCO Capacitance
10	Hold Pulse Input Terminal	20	VCO Oscillation Control

■ Absolute Maximum Ratings (T_a=25°C)

Item	Symbol	Rating	Unit
Supply Voltage	V _{cc}	6.0	V
Power Dissipation	P _D	200	mW
Operating Ambient Temperature	T _{opr}	-20~+70	°C
Storage Temperature	T _{stg}	-55~+125	°C

■ Electrical Characteristics (V_{cc}=5V, T_a=25°C)

Item	Symbol	Test Circuit	Condition	min.	typ.	max.	Unit
Supply Current on Rec. Mode	I _{CC-Rec}	1		6.7		14.3	mA
Supply Current on PB Mode	I _{CC-PB}	1		12.3		25.6	mA
Rec. Holding Voltage	V _{12-Rec}	2		3.3		5	V
PB Holding Voltage	V _{12-PB}	2		0		1.6	V
VCO Control(1)(FM Modulation)	V _{20-L}	3		0		0.8	V
VCO Control(2) (Insert Oscillation)	V _{20-C}	3		1.8		3.1	V
VCO Free Run Frequency	V _{20-H}	3		4.3		5	V
Output Amplitude on Rec.Mode	f _{OSC}	4		1.1		1.7	MHz
VCO Control(2) (Insert Oscillation)	V ₁₆	4		0.32		0.49	V _{P-P}
VCO Insert Oscillation Frequency	f _{INS}	4		2.6		3.4	MHz
VCO Control Sensitivity	β	4		0.8		1.2	MHz
VCO Frequency Shift(+)	f _{DEV(+)}	5	ΔV ₁ =+0.113V	35		65	kHz
VCO Frequency Shift(-)	f _{DEV(-)}	5	ΔV ₁ =-0.113V	35		65	kHz
FM Demodulation Output Amplitude	V ₁₄	6	f _c =1.4MHz, V _C =70mV _{P-P} f _m =1kHz, DEV=±50kHz 6dB down of the Pin output	38		65	kHz
FM Demodulation Distortion Rate	THD ₁₄	6	f _c =1.4MHz, V _C =70mV _{P-P} f _m =1kHz, DEV=±50kHz		0.15	0.3	%
Hold Control Voltage (ON)	V _{10-H}	7		3.09		5	V
Hold Control Voltage (OFF)	V _{10-L}	7		0		1.5	V
Hold Amplifier Output Amplitude	V ₅	8	Pin ② Input 1kHz Sine Wave	430		580	mV _{P-P}

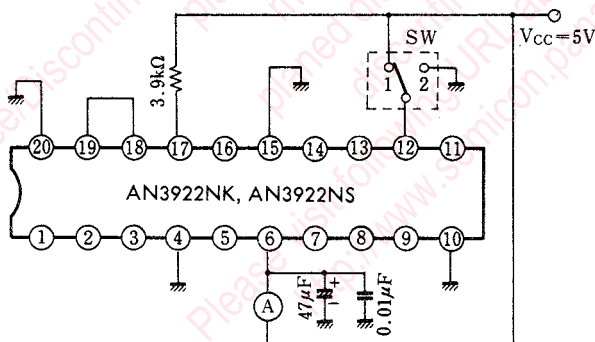
■ Electrical Characteristics (V_{CC}=5V, T_a=25°C) (Con'd)

Item	Symbol	Test Circuit	Condition	min.	typ.	max.	Unit
Hold Amplifier Distortion	THD ₅	8	Pin ② Input 1kHz Sine Wave 50mV _{P-P}		0.05	0.3	%
Differentiating Circuit Output Oscillation	V ₈	9	Pin ② Input 10kHz Sine Wave 50mV _{P-P}	650		1150	mV _{P-P}
Hold Amplifier Maximum Output	v _{5max.}	10		2			V
Supply Current on Rec. Mode	I _{CC-REC} *	1			10		mA
Supply Current on PB Mode	I _{CC-PB} *	1			19		mA
VCO Free Run Frequency	f _{OSC} *	4			1.4		MHz
Output Amplitude on Rec. Mode	v ₁₆ *	4			0.4		V _{P-P}
VCO Insert Oscillation Frequency	f _{INS} *	4			3		MHz
VCO Control Sensitivity	β*	4			1		MHz
VCO Frequency Shift(+)	f _{DEV(+)} *	5	ΔV ₁ =+0.113V		50		kHz
VCO Frequency Shift(-)	f _{DEV(-)} *	5	ΔV ₁ =-0.113V		50		kHz
FM Demodulation Output Amplitude	v ₁₄ *	6	f _C =1.4MHz, V _C =70mV _{P-P} f _m =1kHz, DEV=±50kHz Measure 6dB down of the Pin output		50		mV _{P-P}
Hold Amplifier Output Amplitude	v ₅ *	8	Pin ② Input 1kHz Sine Wave 50mV _{P-P}		500		mV _{P-P}
Differentiating Circuit Output Oscillation	v ₈ *	9	Pin ② Input 10kHz Sine Wave 50mV _{P-P}		900		mV _{P-P}
FM Demodulation Output S/N	S/N _(D) *	6	f _C =1.4MHz, V _C =70mV _{P-P} f _m =1kHz, Dev.=±50kHz	45	55		dB
Hold Amplifier Output S/N	S/N _(H) *	8	Pin ② Input 1kHz Sine Wave 50mV _{P-P}	55	65		dB

Note) Range of the Operating Supply Voltage : V_{CC(opp)}=4.5 to 5.5V

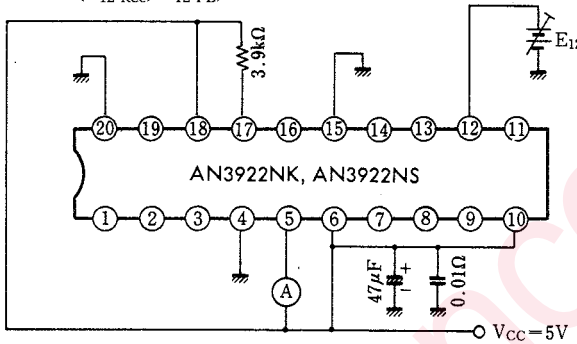
* These are reference values for designing and not a guaranteed ones.

Test Circuit 1 (I_{CC-Rec}, I_{CC-PB})



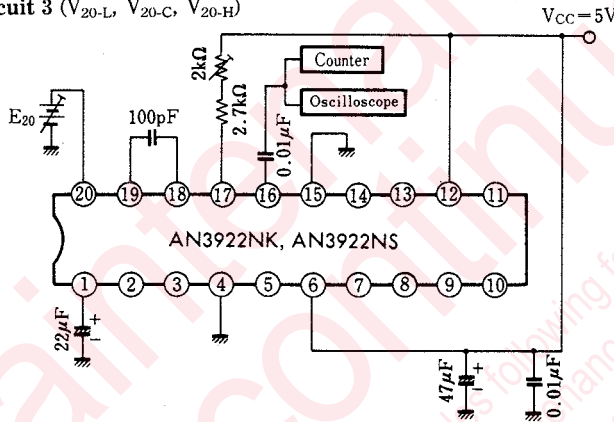
Symbol	SW
I _{CC-Rec}	1 (V _{CC})
I _{CC-PB}	2 (GND)

Test Circuit 2 (V_{12-REC} , V_{12-PB})



- V_{12-PB}
The voltage range in which ammeter values are over $250\mu A$ by increasing E_{12} from 0V.
- V_{12-REC}
The voltage range in which ammeter values are $250\mu A$ or less by increasing E_{12} still further.

Test Circuit 3 (V_{20-L} , V_{20-C} , V_{20-H})

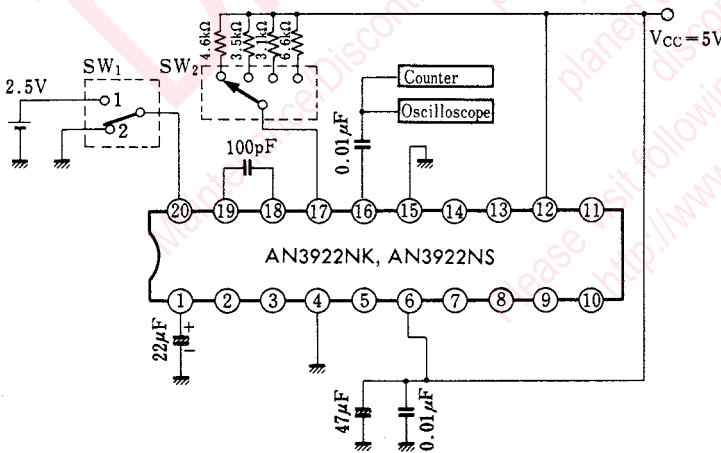


Let $E_{20}=0V$, resistor = $2k\Omega$ and $f_0=1.8MHz$.

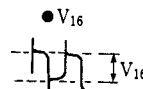
- V_{20-L}
The voltage range in which the circuit is oscillating when f is $1.8MHz$ by increasing E_{20} from 0V.
- V_{20-C}
The voltage range in which the circuit is oscillating when f is $3MHz \pm 200KHz$ by increasing E_{20} still further.
- V_{20-H}
The voltage range in which oscillation waveforms are not output by increasing E_{20} still further.

Note) The capacitance between Pin $\textcircled{18}$ and Pin $\textcircled{19}$ must be that of NPO and the percentage of errors must be within $\pm 0.2\%$. A metal film resistance and a cermet volume must be used for the Pin $\textcircled{17}$ resistance.

Test Circuit 4 (V_{16} , f_{OSC} , f_{INS} , β)



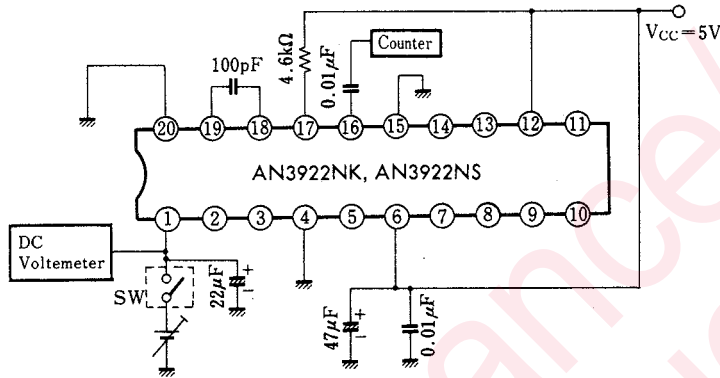
Item	Condition	SW1	SW2
f_{OSC}		2	1 (4.6K)
V_{16}		2	1 (4.6K)
f_{INS}		1	2 (3.5K)
β		2	3 (3.1K) 4 (6.6K)



- V_{16}
- β
The difference between the Pin $\textcircled{16}$ output frequency in the case where the Pin $\textcircled{17}$ resistor is $3.1k\Omega$ and that in the case where the resistor is $6.6k\Omega$.
 $\beta = f_{16}(6.6k\Omega) - f_{16}(3.1k\Omega)$

Note) The capacitance between Pin $\textcircled{18}$ and Pin $\textcircled{19}$ must be that of NPO and the percentage of errors must be within $\pm 0.2\%$. A metal film resistance must be used for the Pin $\textcircled{17}$ resistance and the percentage of errors must be within $\pm 0.2\%$.

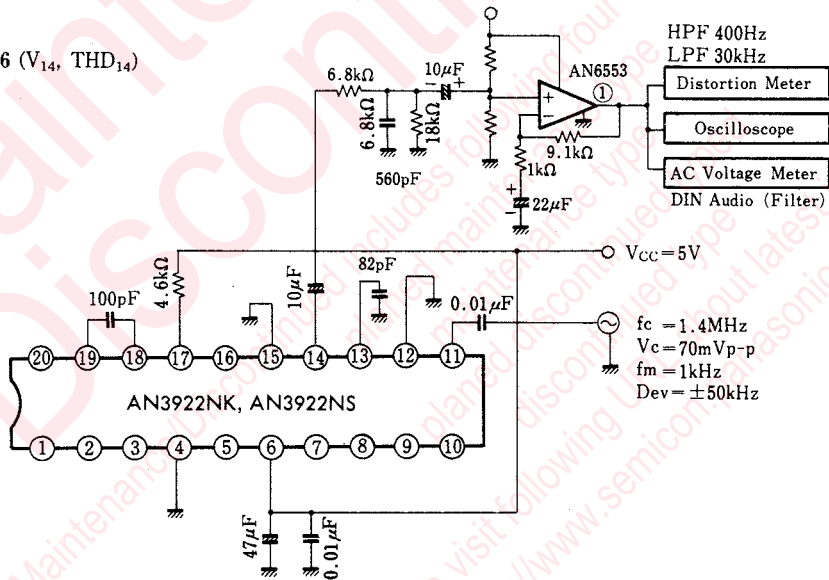
Test Circuit 5 ($f_{DEV(+)}$, $f_{DEV(-)}$)



- $f_{DEV(+)}$
After measuring the Pin① voltage V_1 and the Pin⑯ output frequency f_0 when the Pin① SW is OFF, measure the Pin⑯ output frequency $f_{(+113)}$ by applying $(V_1 + 0.113V)$ to Pin①. $f_{DEV(+)}$ is defined as follows.
 $f_{DEV(+)} = f_{(+113)} - f_0$
- $f_{DEV(-)}$
Measure the Pin⑯ output $f_{(-113)}$ by applying $(V_1 - 0.113V)$ to Pin① in the same way as in $f_{DEV(+)}$. $f_{DEV(-)}$ is defined as follows.
 $f_{DEV(-)} = f_0 - f_{(-113)}$

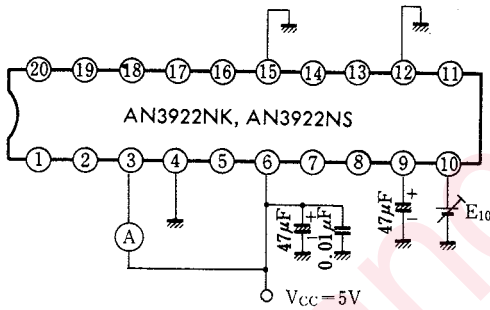
Note) The capacitance between Pin⑱ and Pin⑲ must be that of NPO and the percentage of errors must be within $\pm 0.2\%$.
A metal film resistance must be used for the Pin⑰ resistance and the percentage of errors must be within $\pm 0.2\%$.

Test Circuit 6 (V_{14} , THD_{14})



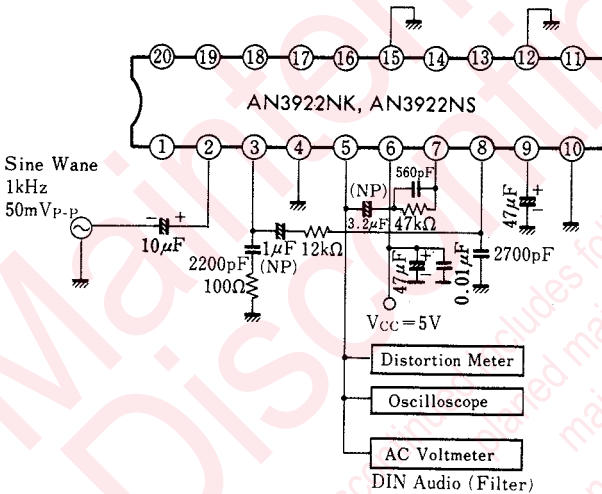
- V_{14}
Amplification is performed ten times as much with the OP-amp. in the above figure, V_{14} is one-tenth of the OP-amp. output.
Note) The capacitance between Pin⑱ and Pin⑲ must be that of NPO and the percentage of errors must be within $\pm 0.2\%$.
A metal film resistance must be used for the Pin⑰ resistance and the percentage of errors must be within $\pm 0.2\%$. The percentage of the precision of other external parts must be within $\pm 0.2\%$.
- S/N_D
The ratio of the AC voltage at point A in the case where an FM modulated wave is input to Pin⑱ to that in the case where only a carrier is input to Pin⑱ in the above figure.
- THD_{14}
Range of the harmonic: Measure from the second to the tenth harmonics

Test Circuit 7 (V_{10-H} , V_{10-L})

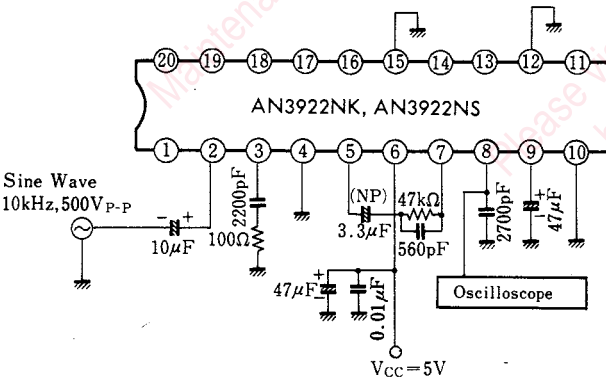


- V_{10-L}
The Pin⑩ voltage range in which Pin③ ammeter values are $200\mu A$ or over by increasing E_{10} from $0V$.
- V_{10-11}
The Pin⑩ voltage range in which Pin③ ammeter values are $200\mu A$ or less by increasing E_{10} still further.

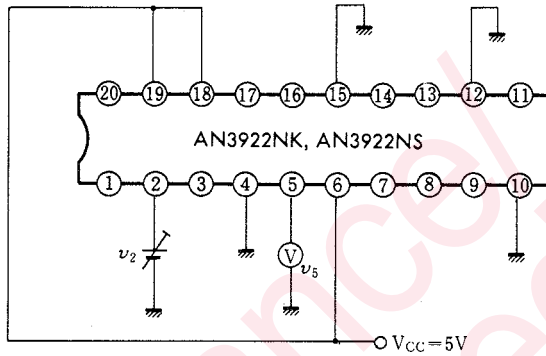
Test Circuit 8 (V_5 , THD_5)



Test Circuit 9 (V_3)



Test Circuit 10 (v_{5max} .)



● V_{5max}

● Measure the Pin⑤ output voltage V_5 ($V_2=1V$) in the case where ($V_2=1V$) is applied and the Pin⑤ output voltage V_5 ($V_2=4V$) in the case where ($V_2=4V$) is applied, and find the difference between them

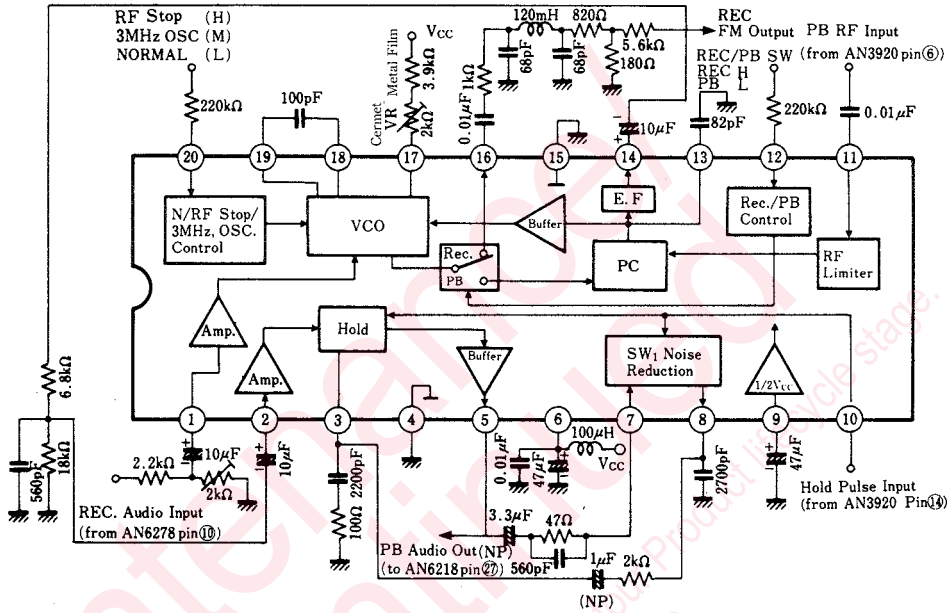
$$V_{5max} = V_5(V_2=4V) - V_5(V_2=1V)$$

Waveforms of Pins

Pin No.	Function	DC 電圧 (V)	Waveform	Impedance (Ω)	Pin No.	Function	DC Voltage (V)	Waveform	Impedance (Ω)
①	AUDIO IN	2.5	-22dBV	10k	⑪	PB RF iN I	3.2	70mV _{P-P}	6k
②	HOLD IN	3.2	50mV _{P-P}	10k	⑫	REC/PB CONT	5V/0V	—	H
③	HOLD	2.5	Hold Interval -15dBV	—	⑬	EM DEMOD	3.2	10k	10k
④	GND (AUDIO)	0	—	—	⑭	FM DEMOD OUT	2.5	E.F.	E.F.
⑤	HOLD OUT	2.5	-15dBV	E.F.	⑮	GND (RF)	0	—	—
⑥	V_{CC}	5.0	—	—	⑯	FM OUT	—	400mV _{P-P}	E.F.
⑦	SW NOISE REDUCTION IN	2.5	-15dBV	47k	⑰	VCO fo ADJ	3.85	—	—
⑧	SW NOISE REDUCTION OUT	2.5	—	—	⑱	VCO	—	—	—
⑨	$\frac{1}{2}V_{CC}$	2.55	—	—	⑲	VCO	—	—	—
⑩	HOLD PULSE IN	—	0V	H	⑳	VCO CONT	5V 2.5V 0V	RF STOP 3MHz OSC. Normal	H

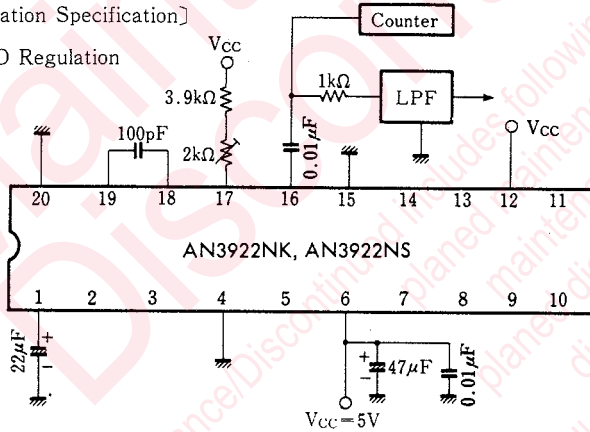
Note) The above values are standard ones and fluctuate depending on the use conditions and the unevenness of an integrated circuit (V_{CC} is 5V)

Application Circuit



[Regulation Specification]

(1)VCO Regulation



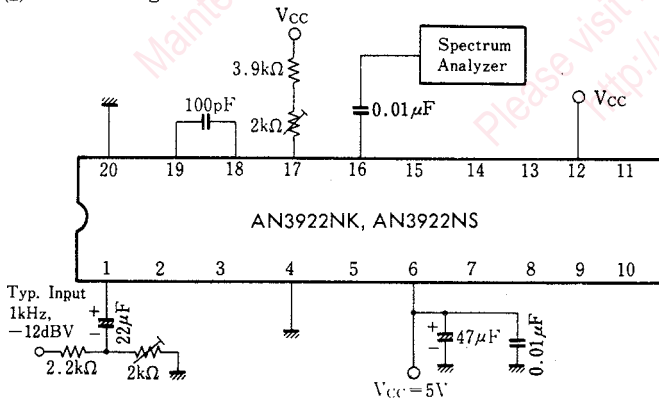
- Pin 12: In the REC. mode (3V to 5V)
 - Pin 13: In the Normal mode (0V to 1V)
- Note 1) Use the Pin 17 external fixed resistances with the following characteristics

*Pin 17 External Fixed Resistance

	R-ch		L-ch	
	Frequency	Resistance	Frequency	Resistance
NTSC	1.7MHz	2700Ω	1.3MHz	3900Ω
PAL	1.8MHz	2700Ω	1.4MHz	3900Ω

Note 2) The Pin 10 variable resistance must be regulated so that the Pin 13 frequency will be within ±5KHz of the foregoing frequencies.

(2)Deviation Regulation



Regulate the Pin 10 input variable resistance so that the FM modulation deviation of the Pin 13 output will be ±50±2kHz by the standard input (1kHz, -12dBV). (The Pin 10 input is a standard value of -22dBV.)

[Instructions before Use]

(1) Parts

- The capacitance between Pin¹⁸ and Pin¹⁹ must be that of NPO in order to diminish the temperature change of the carrier frequency of the FM modulation. In addition, a metal film resistance and a cermet volume must be used for the Pin¹⁷ external resistance and the variable resistance respectively.
- The low precision of the capacitance between Pin¹⁸ and Pin¹⁹ causes fluctuations of the frequency of the 3MHz fixed OSC (ex. PAL: 1.8MHz→3MHz NTSC: 1.7MHz→2.9MHz) and the decline of S/N will result.

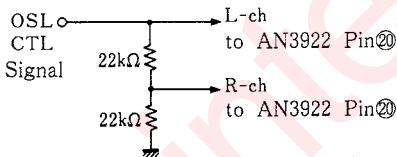
(2) Power supply

- In the case where voltage or a current is applied to each control pin of the signal processing unit with a microcomputer, etc. without applying supply voltage to this integrated circuit when the power supply is OFF, attach protective resistances to Pin¹² and Pin²⁰.

[Operating Instructions]

(1) VCO control

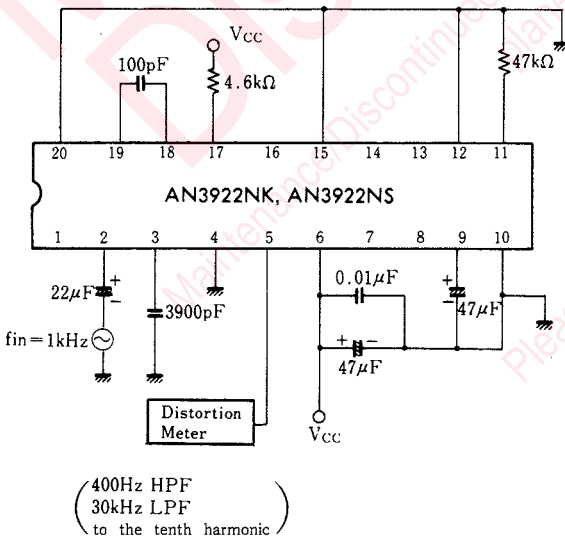
The audio Head is temporarily used for the erase and the recording is performed without the FM modulation in performing the insert on the REC. mode. For this purpose, the oscillation of NTSC(1.3MHz) and PAL(1.4MHz) of the L-ch. is halted and NTSC(1.7MHz) and PAL(1.8MHz) of the R-ch. are regulated so that they will be close to 3MHz(NTSC: 2.9MHz, PAL: 3MHz).



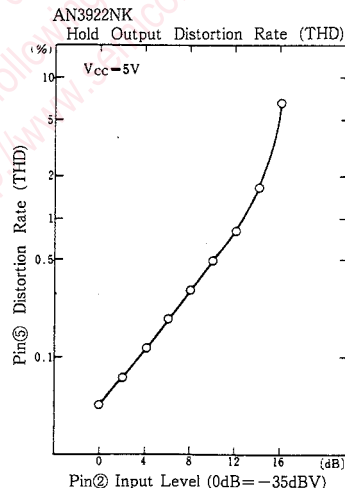
(2) SW Noise Reduction

The differentiation just before the Hold Pulse period is performed to the output for the improvement of the S/N ratio by inputting the Pin⁵ output to the differentiating circuit Pin⁷ in which the high frequency gain is increased and by the feedback from Pin⁸ to Pin³.

(3) Hold Output Distortion Rate



The Hold output distortion rate measured in the measuring circuit in the left figure is shown graphically below. The below graph shows the standard characteristic and the values fluctuate depending on the use conditions and the unevenness of an integrated circuit.



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