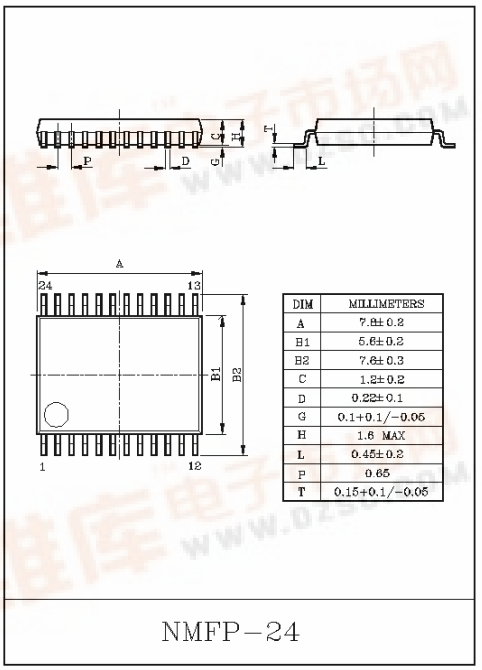
1.5V AM/FM+MPX
(for Digital Tuning System)

The KIA2022AFN is AM/FM IF+MPX system IC, which is designed for DTS Radios.
This is included many functions and these can be used for digital tuning system with IF counter.



DIM	MILLIMETERS
A	7.8±0.2
B1	5.6±0.2
B2	7.6±0.3
C	1.2±0.2
D	0.22±0.1
G	0.1+0.1/−0.05
H	1.6 MAX
L	0.45±0.2
P	0.65
T	0.15+0.1/−0.05

NMFP−24

FEATURES

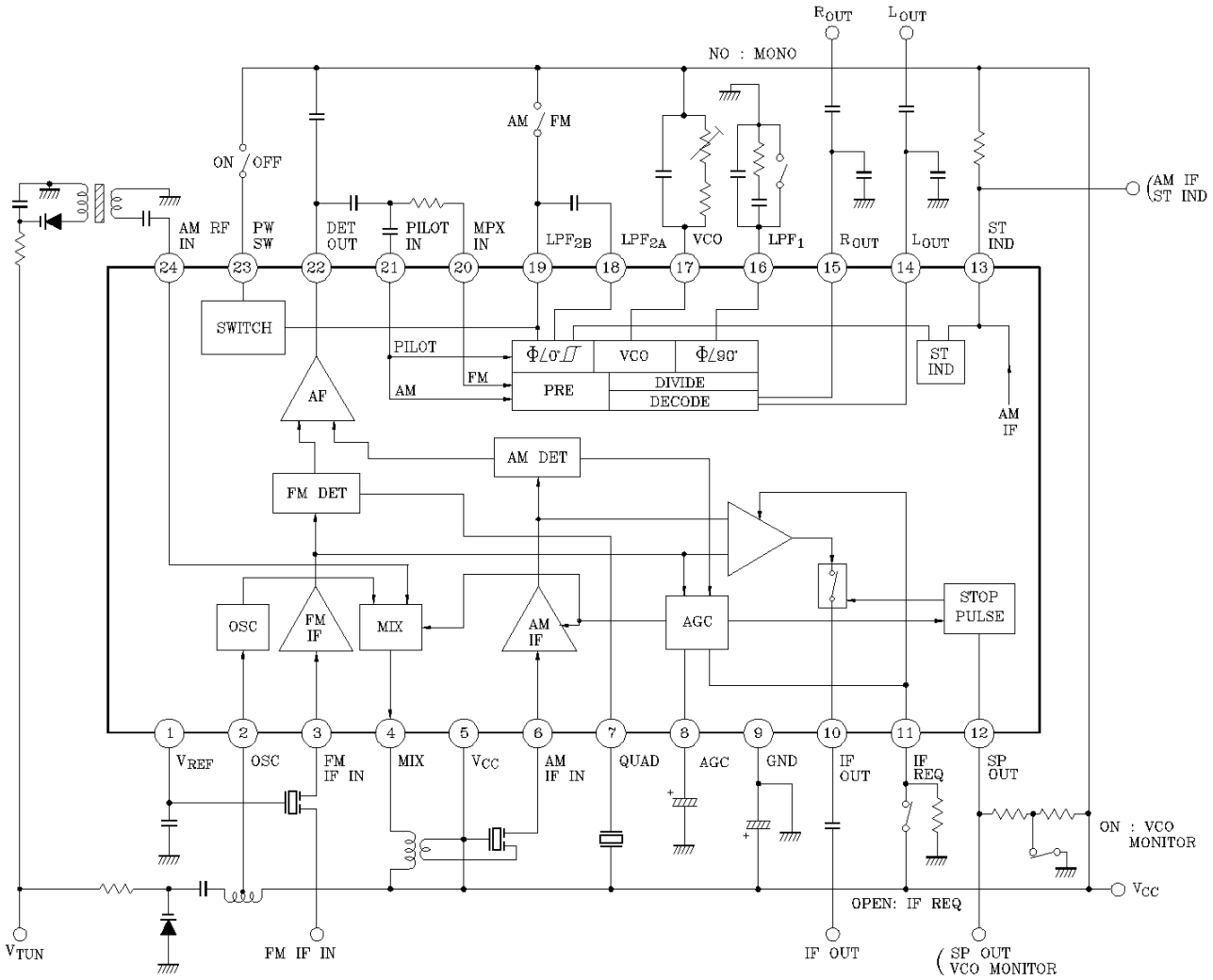
- IF counter of digital tuning system.
  Built in IF counter.
  FM : 10.7MHz
  AM : 450kHz
  Adjustable for stop pulse sensitivity on FM search.
- For adopting ceramic discriminator and ceramic resonator, it is not necessary to adjust the FM quad detector.
- Independent for FM stereo main signal input terminal and FM stereo pilot signal input terminal on MPX input terminal. (AM signal input terminal is too.)
- Built-in AM IF output.
- Built-in power ON/OFF function.
- MPX output is high impedance in power off mode.
- Built-in AM/FM switch.
- Operating supply voltage range. (Ta=25℃)
  : $V_{CC(opr)}$=0.95~2.2V.
- STEREO operating supply voltage range. (Ta=25℃)
  : $V_{CC(opr)}$=1.0~2.2V.

MAXIMUM RATINGS (Ta=25℃)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	4.5	V
Stop Pulse Voltage	V_{SP}	4.5	V
Stop Pulse Current	I_{SP}	10	mA
Stereo Indicator Voltage	V_{ST}	4.5	V
Stereo Indicator Current	I_{ST}	10	mA
Power Dissipation	P_D (Note)	500	mW
Operating Temperature	T_{opr}	-25~75	℃
Storage Temperature	T_{stg}	-55~150	℃

Note) Derated above Ta=25℃ in the proportion of 4mW/℃.

BLOCK DIAGRAM



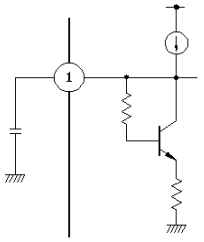
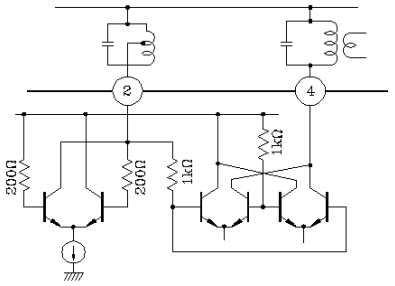
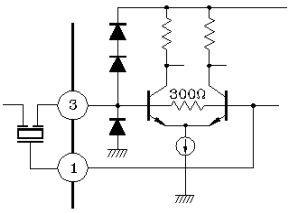
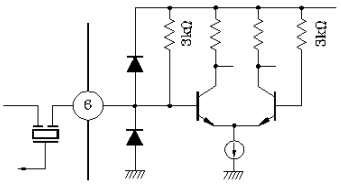
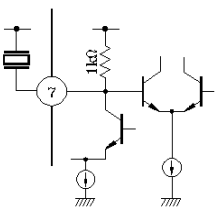
ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, V_{CC}=1.2V, Ta=25℃, SW1 : a, SW4 : OPEN, SW5 : a, SW6 : a/b, SW7 : ON
FM IF : f=10.7MHz, fm=1kHz, Δf=±22.5kHz, V_{IN}=80dBμV EMF, SW2 : ON, SW3 : b
AM : f=1MHz, fm=1kHz, MOD : 30%, V_{IN}=60dBμV EMF, SW2 : OPEN, SW3 : a
MPX : fm=1kHz, fp=19kHz, SW3 : b)

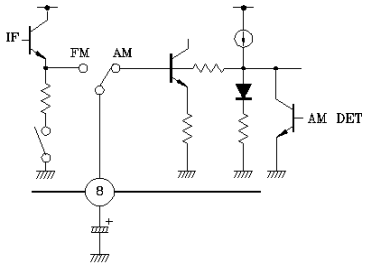
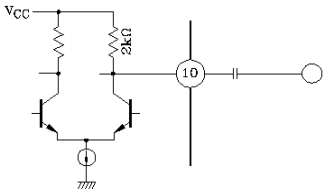
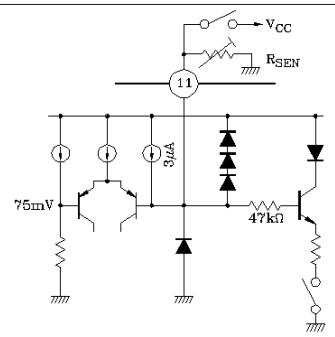
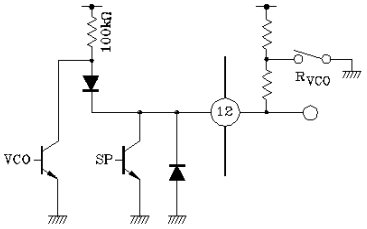
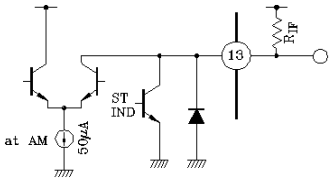
CHARACTERISTIC		SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Current		I_{CC1}	1	Power off, SW1 : b	-	-	-	μA
		I_{CC2}		FM Mode, V_{IN}=0	-	5.5	-	mA
		I_{CC3}		AM Mode, V_{IN}=0	-	3.7	-	
FM IF	Input Limiting Voltage	$V_{IN\ (lim)}$	1	-3dB Limiting Point	43	48	53	dBμV EMF
	Recovered Output Voltage	V_{OD}			35	55	70	mV_{rms}
	Signal to Noise Ratio	S/N			-	60	-	dB
	Total Harmonic Distortion	THD			-	0.5	-	%
	AM Rejection Ratio	AMR		MOD=30%	-	40	-	dB
	Stop Pulse Sense 1	SP1		I_{12}=0.5mA, SW6 : a	50	55	60	dBμV EMF
	Stop Pulse Sense 2	SP2		I_{12}=0.5mA, R_{SEN}=39kΩ, SW6 : a, SW7 : OPEN	-	64	-	
	IF Count Output Voltage	$V_{IF(FM)}$		SW7 : OPEN	-	80	-	mV_{P-P}
AM	Gain	G_V	1	V_{IN}=26dBμV EMF	15	27	-	mV_{rms}
	Recovered Output Voltage	V_{OD}			30	45	60	
	Signal to Noise Ratio	S/N			-	38	-	dB
	Total Harmonic Distortion	THD			-	1.5	-	%
	Stop Pulse Sense	SP3		I_{12}=0.5mA, SW6 : a	25	30	35	dBμV EMF
	IF Count Output Voltage	$V_{IF(AM)}$		SW7 : OPEN	-	100	-	mV_{P-P}
	Local OSC Voltage	V_{OSC}	2		30	55	-	mV_{rms}
	Local OSC Stop Voltage	V_{stop}			-	-	0.95	V

CHARACTERISTIC			SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
MPX	Voltage Gain 1		$G_{V(FM)}$	1	V_{IN}=100mV$_{rms}$ (monaural)		-1.5	+0.5	+2.5	dB
	Voltage Gain 2		$G_{V(AM)}$				-0.5	+1.5	3.5	
	Channel Balance		CB				-2	-	+2	
	Max. Composite Signal Input Voltage		$V_{IN(MAX)}$		L+R=90%, P=10%, THD=3%		-	220	-	mV$_{rms}$
	Total Harmonic Distortion	Mono	THD3		V_{IN}=100mV$_{rms}$ (monaural)		-	0.2	0.5	%
		Stereo	THD4		L+R=90mV$_{rms}$, P=10mV$_{rms}$		-	0.3	-	
		AM	THD5		V_{IN}=100mV$_{rms}$		-	0.2	-	
	Separation		SEP		L+R=90mV$_{rms}$ P=10mV$_{rms}$	fm=100Hz	-	36	-	dB
						fm=1kHz	25	35	-	
						fm=10kHz	-	34	-	
	Stereo Indicator Sensitivity	ON	$ST_{(ON)}$		Pilot Signal Input I_{13}=0.5mA, SW5 : a		-	5.5	8	mV$_{rms}$
		OFF	$ST_{(OFF)}$				2	4	-	
	Stereo Indicator Hysteresis		V_H		Stereo Indicator ON/OFF Hysteresis		-	1.5	-	mV$_{rms}$
	Capture Range		CR		P=10mV$_{rms}$, fp=19kHz		-	±7	-	%
	Signal to Noise Ratio		S/N		V_{IN}=100mV$_{rms}$ (monaural)		-	65	-	dB
Power ON Correction Current			I_{23}	2	V_{CC}=0.95V	SW1 : c	5	-	-	μA
Power OFF Correction Voltage			V_{23}			SW1 : d	0	-	0.3	V
AM Mode Correction Current			I_{19}			SW3 : c	50	-	-	μA
FM Forced Mono. Correction Voltage			V_{16}			SW4 : ON	-	0.1	-	V
IF Request Cancel Correction Voltage			V_{11}			SW7 : ON	0.9	-	-	V

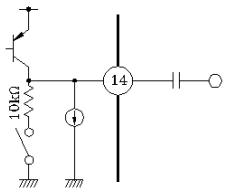
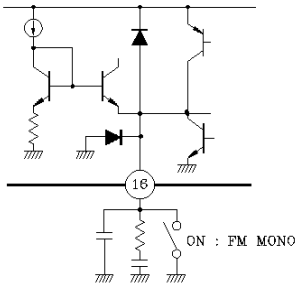
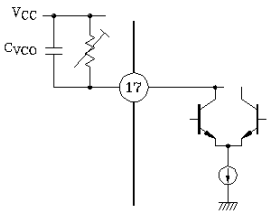
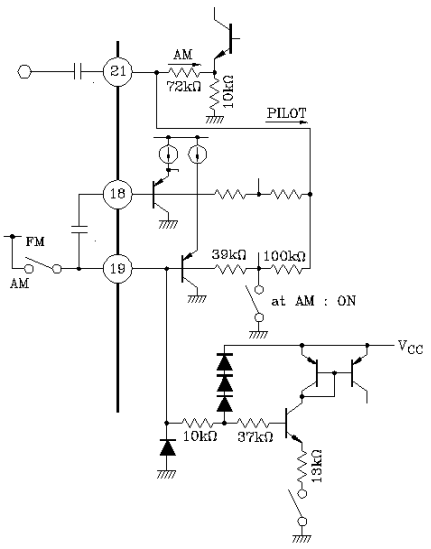
EXPLANATION OF TERMINALS

PIN NO.	TERMINAL NAME	CONTENTS	INTERNAL EQUIVALENT CIRCUIT	DC VOLTAGE (V) (at N_O Signal)	
				AM	FM
1	V_{REF}	Reference Voltage Circuit AM RF) By Pass FM IF		0.9	0.9
2	OSC	AM OSC		1.2	1.2
4	MIX	AM MIX. OUT		1.2	1.2
3	FM IF IN	FM IF INPUT · Input Impedance : 330Ω (Typ.)		0.9	0.9
5	V_{CC}	-	-	1.2	1.2
6	AM IF IN	AM IF Input · Input Impedance : 3kΩ (Typ.)		1.2	1.2
7	QUAD	FM Quadrature Detector.		1.2	1.2

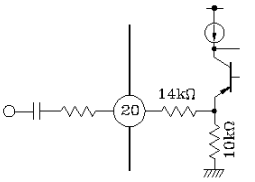
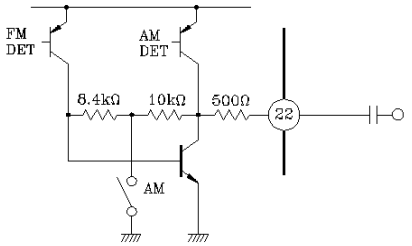
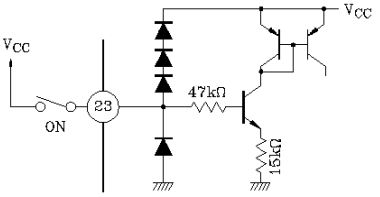
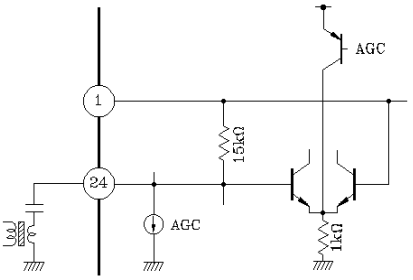
EXPLANATION OF TERMINALS

PIN NO.	TERMINAL NAME	CONTENTS	INTERNAL EQUIVALENT CIRCUIT	DC VOLTAGE (V) (at N_O Signal)	
				AM	FM
8	AGC	AGC Terminal (AM) AM : Constant of AGC to Decide FM : Level Change of Stop Pulse Signal to Controlled		-	-
9	GND	-	-	0	0
10	IF OUT	IF Count Output FM : $V_{IF(FM)}$=80mV_{P-P} (Typ.) AM : $V_{IF(AM)}$=100mV_{P-P} (Typ.)		-	-
11	IF REQ	IF Request Switch [V_{CC} : Receiving Mode [Open : IF Request		-	-
12	SP OUT	Stop Pulse Output [ON : VCO monitor [OPEN : SP out		-	-
13	ST IND	Stereo Indicator Terminal. · With a AM IF Modulation Output. · AM IF Output : 6mV_{rms} (R_{IF}=3kΩ, Typ.)		-	-

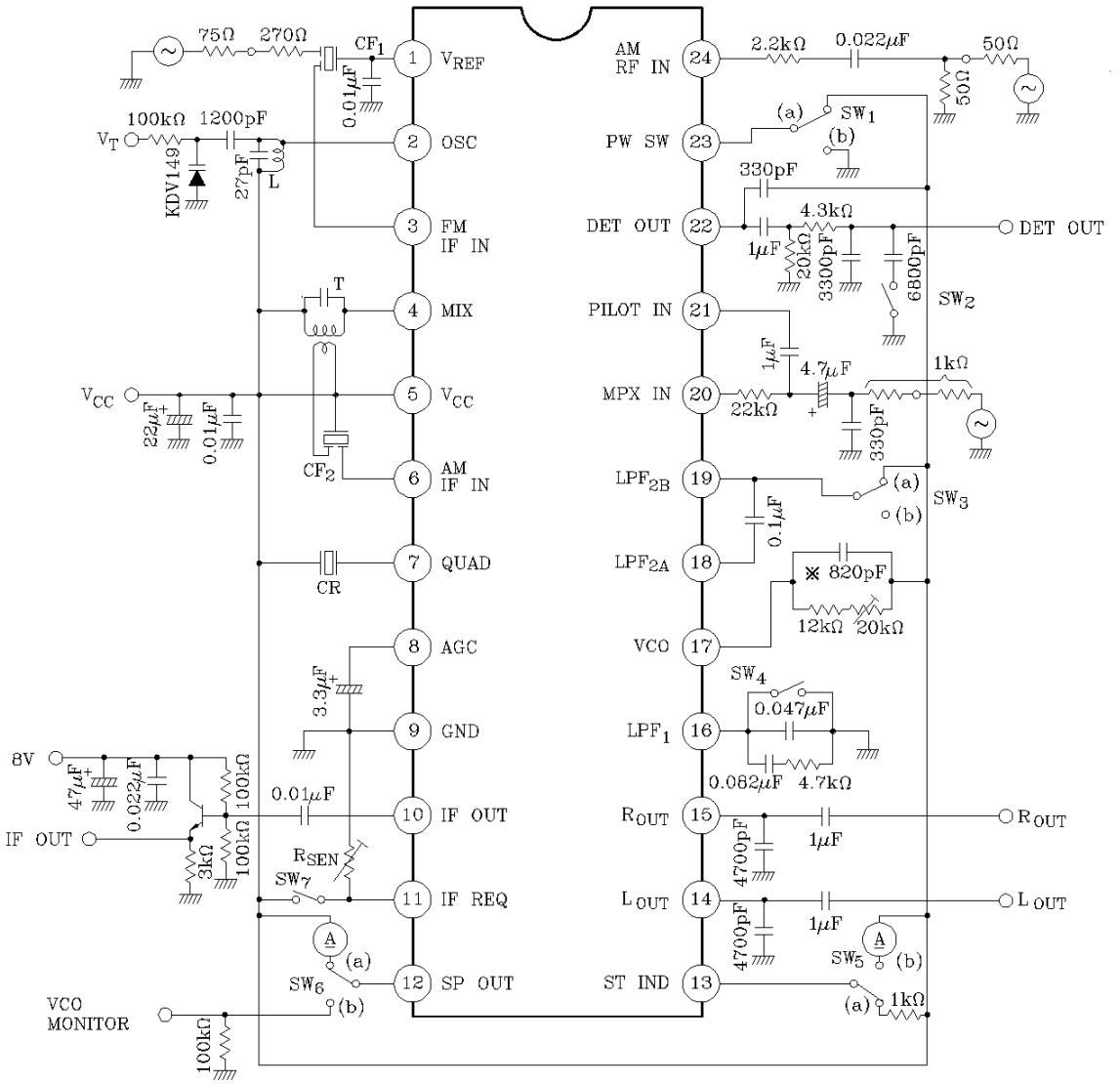
EXPLANATION OF TERMINALS

PIN NO.	TERMINAL NAME	CONTENTS	INTERNAL EQUIVALENT CIRCUIT	DC VOLTAGE (V) (at N_O Signal)	
				AM	FM
14	L_{OUT}	Stereo Output Terminal. Power OFF : High Impedance		0.5	0.5
15	R_{OUT}				
16	LPF_1	LPF Terminal for Phase Detector. V_{16}=GND→FM Mono.		-	-
17	VCO	VCO Control Terminal.		-	1.2
18	LPF_{2A}	LPF Terminal for Pilot Detector.		-	-
19	LPF_{2B}	LPF Terminal for Pilot Detector. FM/AM Mode Switch [V_{CC} : AM Mode [Open : FM Mode		1.2	-
21	PILOT IN	FM Stereo Pilot Signal and AM Signal Input Terminal.		0.1	0.1

EXPLANATION OF TERMINALS

PIN NO.	TERMINAL NAME	CONTENTS	INTERNAL EQUIVALENT CIRCUIT	DC VOLTAGE (V) (at N_O Signal)	
				AM	FM
20	MPX IN	FM Stereo Main Signal Input Terminal.		-	0.1
22	DET OUT	Detector Output Circuit Output Impedance (Typ.) AM : 10kΩ FM : 1k		0.6	0.6
23	PW SW	Power ON/OFF Switch V_{CC} : IC ON OPEN/GND : IC OFF.		1.2	1.2
24	AM RF IN	AM RF Input · Input Impedance : 13kΩ (No Signal, Typ.)		0.9	0

TEST CIRCUIT 1



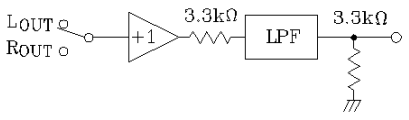


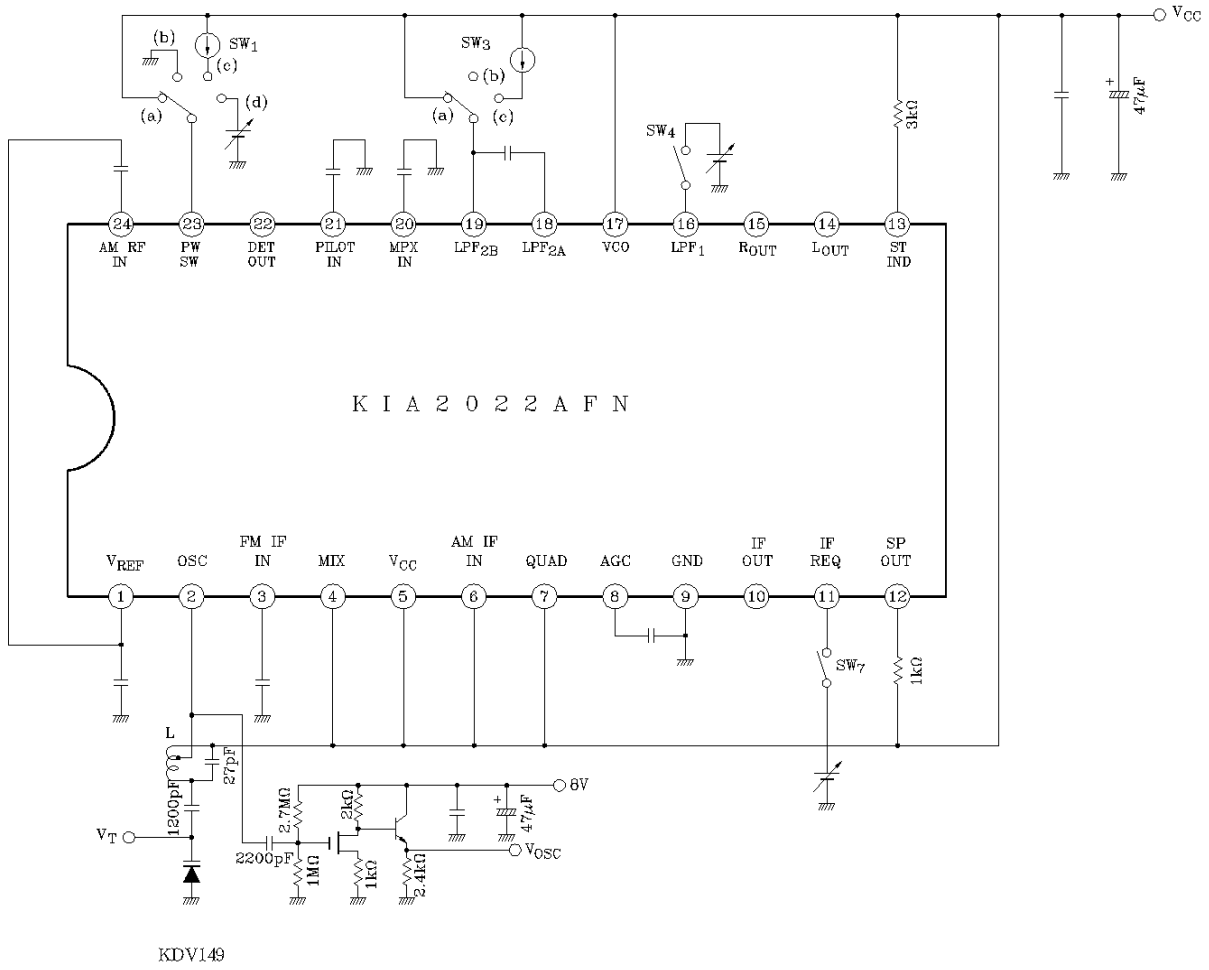
Fig.9 FILTER CIRCUIT

TEST COIL DATA

COIL SYMBOL	TEST FREQUENCY	L (μH)	C_O (pF)	Q_O	TURNS				WIRE (mmϕ)	REFERENCE
					1-2	2-3	1-3	4-6		
L AM OSC	796kHz	100	-	85	13	55	-	-	0.06 UEW	ⓢ 4187-144
T AM IFT	450kHz	-	180	65	-	-	184	29	0.05 UEW	ⓢ 4161-242

ⓢ : SUMIDA ELECTRIC Co., Ltd.

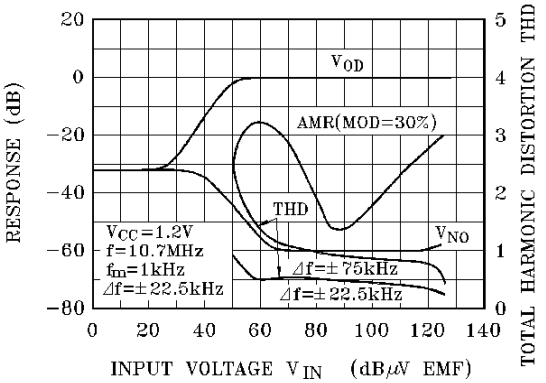
TEST CIRCUIT 2



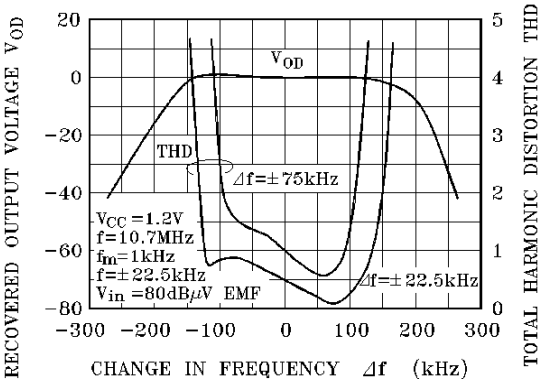
KDV149

FM IF

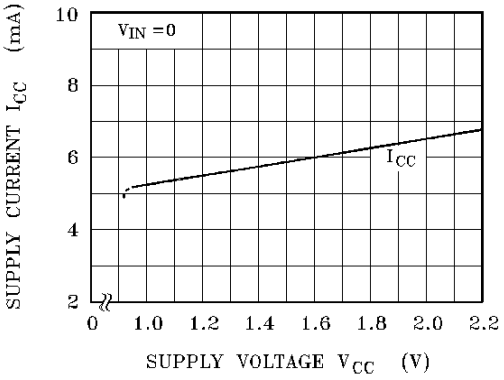
V_{OD} ,V_{no} ,THD,AMR – V_{IN}



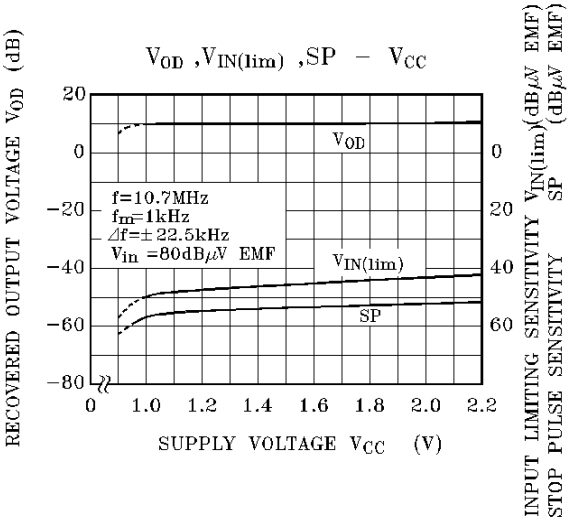
V_{OD} , THD – ΔF



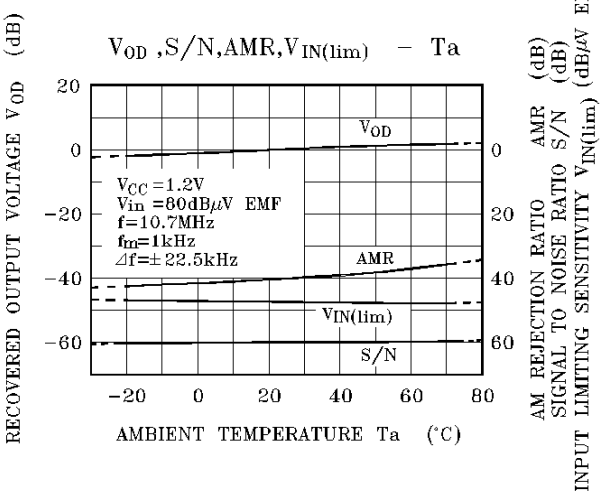
I_{CC} – V_{CC}



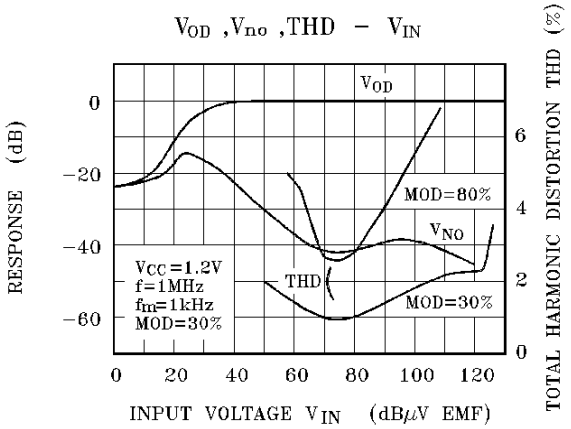
V_{OD} ,$V_{IN(lim)}$,SP – V_{CC}

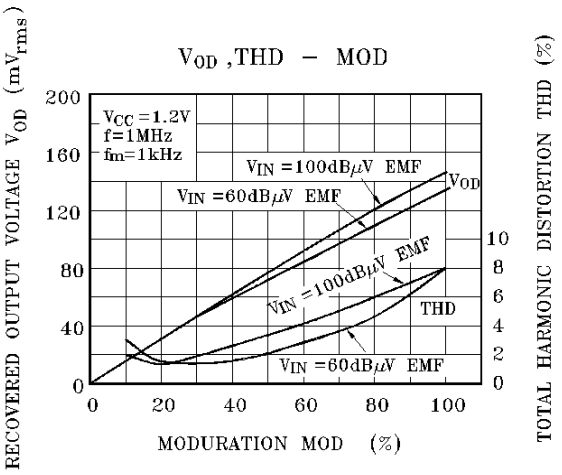


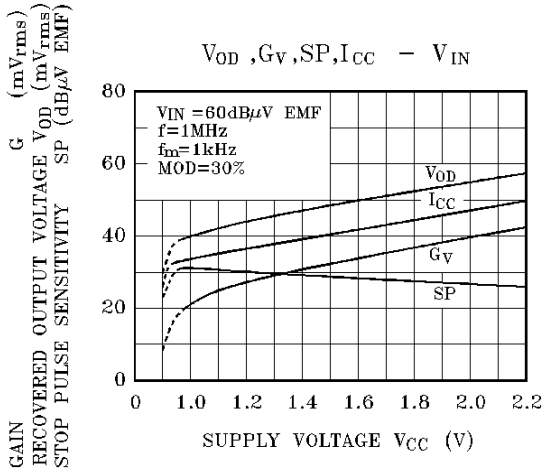
V_{OD} ,S/N,AMR,$V_{IN(lim)}$ – Ta

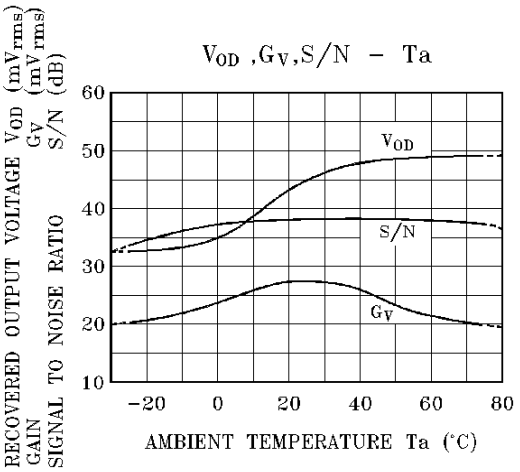


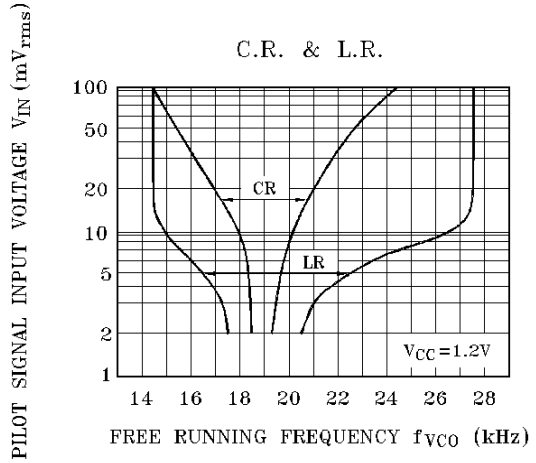
AM

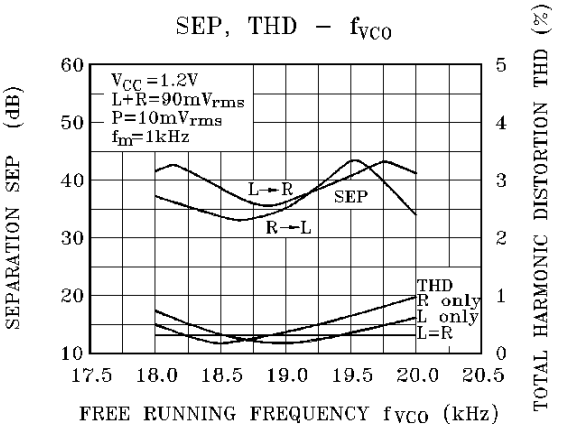

V_{OD} ,V_{no} ,THD – V_{IN}
RESPONSE (dB)
TOTAL HARMONIC DISTORTION THD (%)
V_{OD}
V_{NO}
THD
MOD=80%
MOD=30%
V_{CC}=1.2V
f=1MHz
f_m=1kHz
MOD=30%
INPUT VOLTAGE V_{IN} (dBμV EMF)


V_{OD} ,THD – MOD
RECOVERED OUTPUT VOLTAGE V_{OD} (mV_{rms})
TOTAL HARMONIC DISTORTION THD (%)
V_{CC}=1.2V
f=1MHz
f_m=1kHz
V_{IN}=100dBμV EMF
V_{IN}=60dBμV EMF
V_{OD}
THD
MODURATION MOD (%)

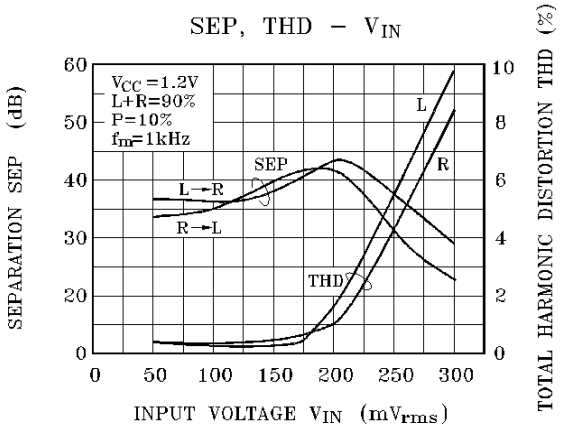

V_{OD} ,G_V,SP,I_{CC} – V_{IN}
GAIN G (mV_{rms})
RECOVERED OUTPUT VOLTAGE V_{OD} (mV_{rms})
STOP PULSE SENSITIVITY SP (dBμV EMF)
V_{IN}=60dBμV EMF
f=1MHz
f_m=1kHz
MOD=30%
V_{OD}
I_{CC}
G_V
SP
SUPPLY VOLTAGE V_{CC} (V)


V_{OD} ,G_V,S/N – Ta
RECOVERED OUTPUT VOLTAGE V_{OD} (mV_{rms})
GAIN G_V (mV_{rms})
SIGNAL TO NOISE RATIO S/N (dB)
V_{OD}
S/N
G_V
AMBIENT TEMPERATURE Ta (°C)

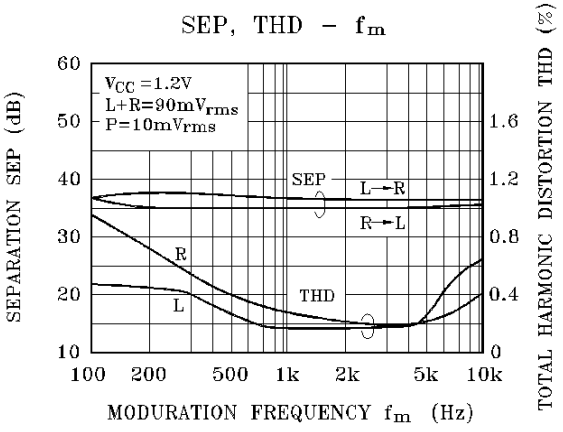

C.R. & L.R.
PILOT SIGNAL INPUT VOLTAGE V_{IN} (mV_{rms})
CR
LR
V_{CC}=1.2V
FREE RUNNING FREQUENCY f_{VCO} (kHz)


SEP, THD – f_{VCO}
SEPARATION SEP (dB)
TOTAL HARMONIC DISTORTION THD (%)
V_{CC}=1.2V
L+R=90mV_{rms}
P=10mV_{rms}
f_m=1kHz
L→R
R→L
SEP
THD
R only
L only
L=R
FREE RUNNING FREQUENCY f_{VCO} (kHz)

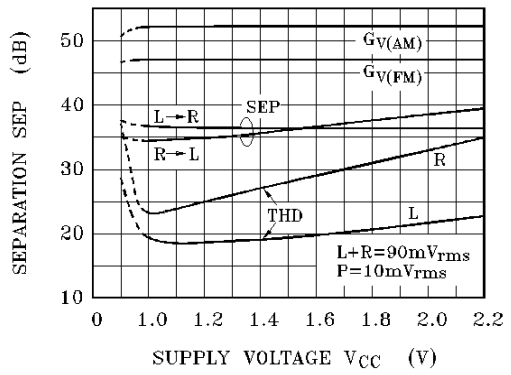
SEP, THD – V_{IN}



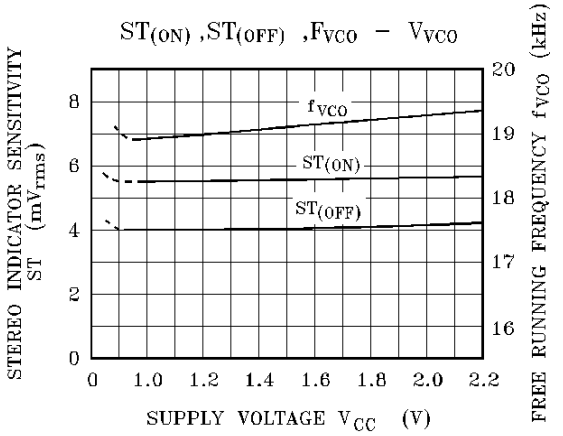
SEP, THD – f_m



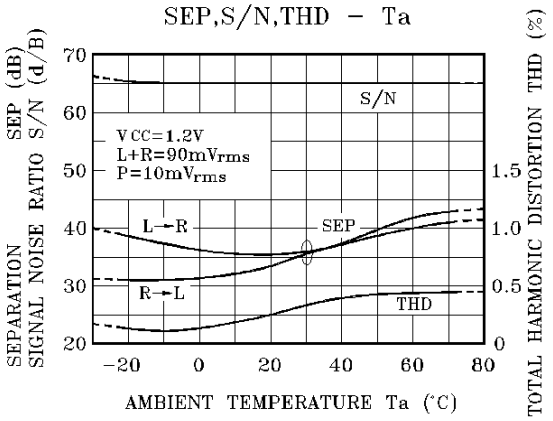
G_V ,SEP,THD – V_{CC}



$ST_{(ON)}$,$ST_{(OFF)}$,F_{VCO} – V_{VCO}



SEP,S/N,THD – Ta



$ST_{(ON)}$,$ST_{(OFF)}$ – Ta