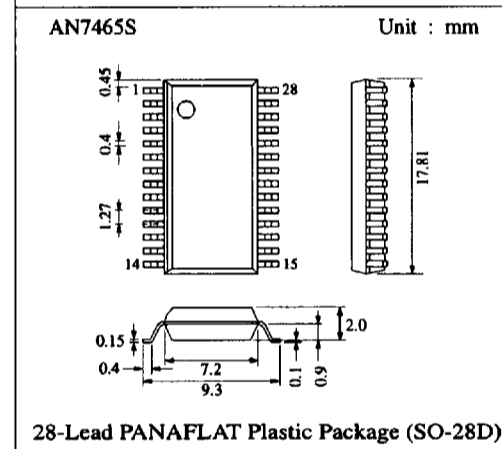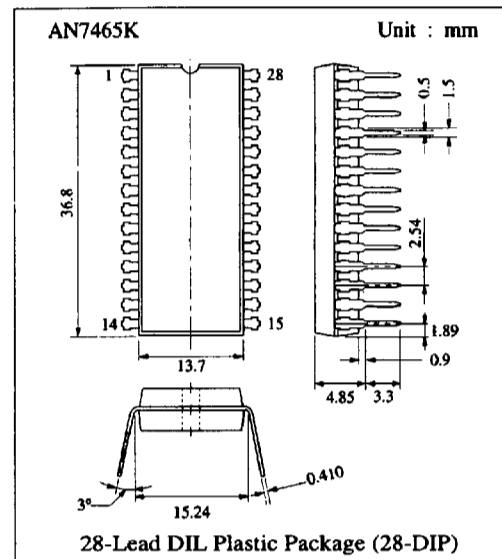# AN7465K/S

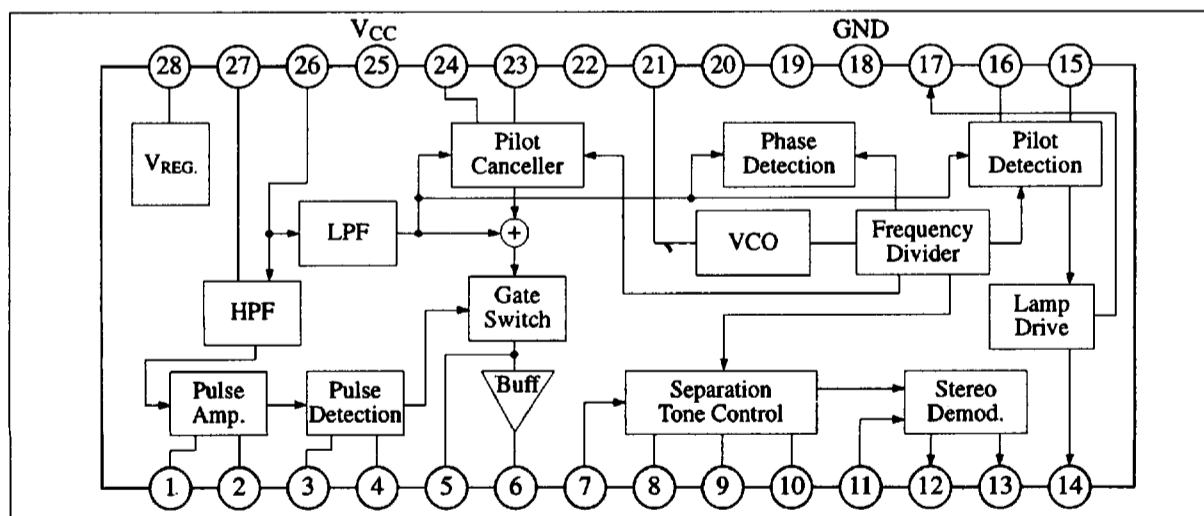## FM Noise Canceller/Stereo Multiplex Demodulator for Car Radio

■ Description

The AN7465K/S are the monolithic integrated circuits for car stereo configured FM noise canceller and PLL multiplex demodulator in a single chip.

■ Features

- HPF/LPF of noise canceller input section built-in
- Good S/N and distortion due to use of quasi sine wave as pilot canceller negative wave
- HPF band auto switching by monaural and stereo
- With ASC/ATC functions reducing noise at weak electric field smoothly
- With forced monaural and VCO stop

AN7465K   Unit : mm

28-Lead DIL Plastic Package (28-DIP)

AN7465S   Unit : mm

28-Lead PANAFLAT Plastic Package (SO-28D)

■ Block Diagram

AN7465K/S

■ Absolute Maximum Ratings (Ta=25°C)

| Item	Symbol	Rating	Unit
Supply Voltage	V_{CC}	10	V
Supply Current (Without Lamp)	$I_{CC(1)}$	25	mA
Supply Current (With lamp)	$I_{CC(2)}$	30	mA
Power Dissipation	P_D	280	mW
Operating Ambient Temperature	Topr	-30 ~ +75	°C
Storage Temperature	Tstg	-55 ~ +125	°C

Operating Supply Voltage Range: V_{CC} = 6.0V ~ 10.0V

■ Electrical Characteristics (Ta=25°C)

Item	Symbol	Condition	min.	typ.	max.	Unit
Total Circuit Current	I_{tot}	V_{in} = 0mV	10	15	20	mA
AGC Voltage (1)	V_{AGC1}	V_{in} = 0mV, R_s = 10kΩ		0.05	0.4	V
AGC Voltage (2)	V_{AGC2}	V_{in} = 2mV, f = 150kHz	1	1.3	1.5	V
Noise Detection Voltage	V_{DET}	V_{in} = 100mV, f = 150kHz		0.05	0.3	V
Gate Pulse Width	PW	V_{in} = 0.3V_{p-p} Pulse, t_W = 1μs, f = 1kHz	20	25	30	μs
Residual Noise Voltage	V_{NR}*	V_{in} = 1V_{p-p} Pulse*, t_W = 10μs, f = 1kHz		0.3	0.7	mV
Output Voltage	V_O	V_{in} = 300mV, f = 1kHz	250	290	330	mV
Channel Balance	CB	V_{in} = 300mV, f = 1kHz		0	1	dB
Separation (1) (R9 = 820Ω fixed)	Sep_1	$V_{(L+R)}$ = 270mV, V_p = 30mV, f = 1kHz	22	32		dB
Separation (2) (at R9 adjustment)	Sep_2	At $V_{(L+R)}$ = 270mV, V_p = 30mV, f = 1kHz, Adjustment		40		dB
Total Harmonic Distortion (Stereo)	THD	$V_{(L+R)}$ = 270mV, V_p = 30mV, f = 1kHz		0.05	0.3	%
Total Harmonic Distortion (Mono)	THD	V_{in} = 300mV, f = 1kHz		0.05	0.3	%
Residual Pilot Voltage	V_{PC}	V_p = 30mV		2.5	10	mV
Lamp ON Pilot Voltage	$V_{p(ON)}$	Input only Pilot Signal	11	16	21	mV
Lamp OFF Pilot Voltage	$V_{p(OFF)}$	Input only Pilot Signal		8		mV
Capture Range	CR	V_p = 30mV	±1.8	±3		%
VCO Stop Voltage	V_{14-18}	Pin 14, VCO Stop Voltage	3	3.4	3.8	V
Maximum Input Voltage	$V_{in(max)}$	f = 1kHz, Input at lamp ON	0.7			V
Input Impedance	Z_{in}	Pin 26		53		kΩ
Output Impedance	Z_O	Pin 12, 13		3.3		kΩ

* Input through LPF of R = 150Ω, C = 0.033μF

■ Application Circuit
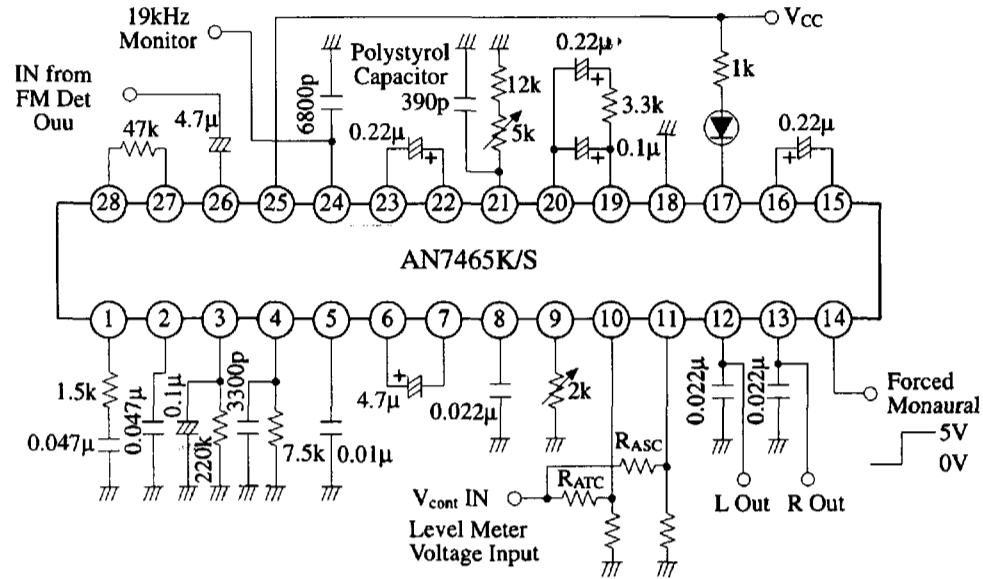
Note: R_{ATC} and R_{ASC} must be determined by size of level meter.
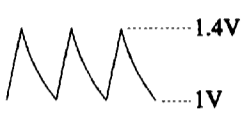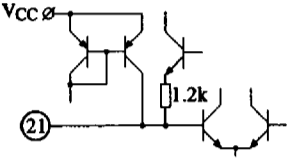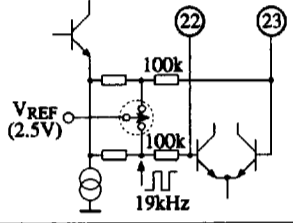When user use half-fixed VR; use $100k\Omega$

■ Pin Descriptions
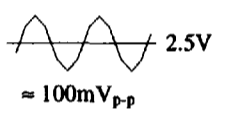
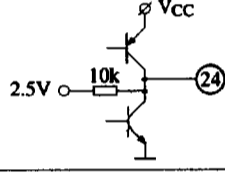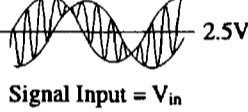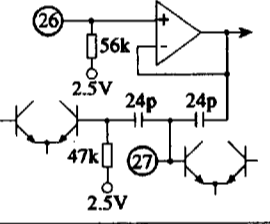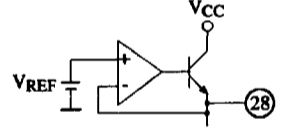| Pin No.	Pin Name	Pin Waveform, Voltage	I/O Impedance	Equivalent Circuit
1	AGC Amp. LPF	2.5V	$6.2k\Omega$	
2	Pulse Amp. LPF	1.8V	$2.7k\Omega$	
3	Noise Amp. AGC	2.5V / 0V Noise level	At charge ... $15k\Omega$ At discharge ... High	
4	Gate Time Adj.	$2.5V_{max}$ / 0V Normal	Usually High Low at operation	
5	NC. Hold	$V_{(AC)} = V_{in} - V_p$ $V_{(DC)} \approx 2.5V$	$1.5k\Omega$	
6	NC. OUT	DC 1.2V	$1k\Omega$	
7	MPX. IN	$V_{(AC)} = V_{in} - V_p$	$33k\Omega$	

■ Pin Descriptions (Continue)

Pin No.	Pin Name	Pin Waveform, Voltage	I/O Impedance	Equivalent Circuit
8	ATC LPF	High level down $V_{(DC)} \approx 1.9V$	$5.1k\Omega$	
9	Separation Adj.	$DC_{(max)} \approx 1.2V$ $AC = 0 \sim V_7$	$2k\Omega$	
10	ATC	Input level meter output voltage	High	
11	ASC	Input level meter output voltage	High	
12	L-ch. OUT	$3.2V$ $0.9V_{P-P}$	$3.3k\Omega$	
13	R-ch. OUT		$3.3k\Omega$	

| 14 | ST/MONO Control |

Pin Voltage	Demod.	LED	Pilot Can.	VCO
0~1V	0	0	0	0
1.7~3.2V	X	X	0	0
3.9~Vcc	X	X	X	X

| | | | High | |

Pin No.	Pin Name	Pin Waveform, Voltage	I/O Impedance	Equivalent Circuit
15	Pilot Detection LPF	$DC \approx 2.5V$	$\approx 14k\Omega$	
16	Pilot Detection LPF	$DC \approx 2.5V$	$\approx 14k\Omega$	
17	LED Driver	At Stereo $DC \approx 0.7V \sim 1V$	Low	
		At Monaural Determined by external voltage	High	
18	GND	0V	Low	
19	PLL LPF	DC 2.5V	$\approx 11k\Omega$	
20	PLL LPF	DC 2.5V	$\approx 11k\Omega$	

■ Pin Descriptions (Continue)

Pin No.	Pin Name	Pin Waveform, Voltage	I/O Impedance	Equivalent Circuit
21	VCO RCC Time Constant	1.4V / 1V	1.2kΩ	
22	Pilot Canceller Control LPF	DC 2.5V	≈ 100kΩ	
23	Pilot Canceller Control LPF	DC 2.5V	≈ 100kΩ	
24	Pilot Canceller Quasi Sine	2.5V ≈ 100mV$_{p-p}$		
25	V$_{CC}$	DC 8V	Low	
26	NC. IN	2.5V Signal Input = V$_{in}$	56kΩ	
27	NC. HPF	Low level down DC is determined by external voltage (2.5V)	High	
28	V$_{REF}$	2.5V constant voltage	Low	

■ Characteristics Curve

Sep - V$_{CC}$

R-ch
L-ch

V$_{CC}$ = 8V
f$_{in}$ = 1kHz
Monaural V$_{in}$ = 300mV
Stereo L+R V$_{in}$ = 270mV
V$_p$ = 30mV

Separation (dB)
Supply Voltage V$_{CC}$ (V)

Sep - Ta

L-ch
R-ch

V$_{CC}$ = 8V
f$_{in}$ = 1kHz
Monaural V$_{in}$ = 300mV
Stereo L+R V$_{in}$ = 270mV
V$_p$ = 30mV

Separation (dB)
Ambient Temperature Ta (°C)

VCO - V$_{CC}$

V$_{in}$ = 0mV
Monitor at Pin 24

Oscillation Frequency VCO (kHz)
Supply Voltage V$_{CC}$ (V)
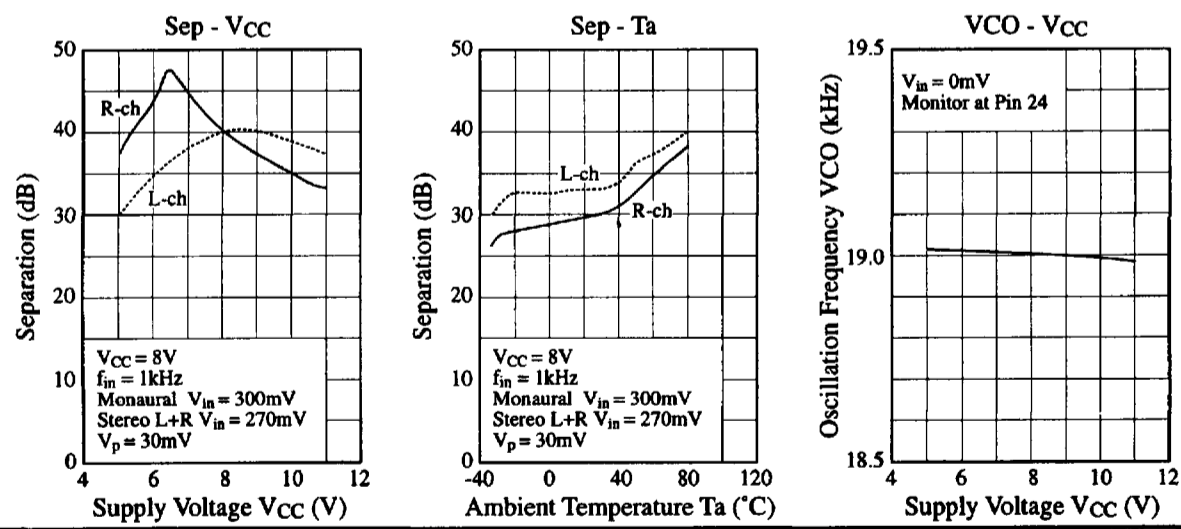
AN7465K/S

■ Characteristics Curve (Continue)

VCO - Ta

Capture/Lock Range

Vo, THD - fin

Sep - fin

NC LPF Characteristics

NC HPF Characteristics (Mono)

NC HPF Characteristics (Stereo)

Lamp ON/OFF - Vcc

Lamp ON/OFF - Ta

■ Characteristics Curve (Continue)

Forced Monaural ON Level - V_{CC}

V_{CC}=8V, f_{in}=1kHz
Monaural V_{in}=300mV
Stereo L+R=270mV
V_p=30mV

VCO STOP

Forced Monaural

Supply Voltage V_{CC} (V)

Forced Monaural ON Level - Ta

V_{CC}=8V, f_{in}=1kHz
Monaural V_{in}=300mV
Stereo L+R=270mV
V_p=30mV

VCO STOP

Forced Monaural

Ambient Temperature Ta (°C)

NC Gate Pulse Width - V_{CC}

1μs
0.3V
1ms Input Pulse

Supply Voltage V_{CC} (V)

NC Gate Pulse Width - Ta

1μs
0.3V
1ms Input Pulse

Ambient Temperature Ta (°C)

I_{tot} - Ta

V_{in}=0mV

--- V_{CC}=6V
——— V_{CC}=8V
······· V_{CC}=10V

Ambient Temperature Ta (°C)

V_{REF} - Ta

V_{CC}=8V, f_{in}=1kHz
Monaural V_{in}=300mV
Stereo L+R=270mV
V_p=30mV

Ambient Temperature Ta (°C)

V_{out} - f_{in}

V_{ATC}=2V
V_{ATC}=0.2V
V_{ATC}=0.8V

V_{CC}=8V, f_{in}=1kHz
Monaural V_{in}=300mV
Stereo L+R=270mV
V_p=30mV

Input Frequency f_{in} (kHz)

ASC Characteristics

--- -30°C
——— 25°C
······· 75°C

V_{CC}=8V, f_{in}=1kHz
Monaural V_{in}=300mV
Stereo L+R=270mV
V_p=30mV

V_{ASC} (V_{11}) (V)

ATC Characteristics

V_{CC}=8V
V_{in}=300mV
f=10kHz

——— -30°C
······· 25°C
--- 75°C

Ambient Temperature Ta (°C)

■ Characteristics Curve (Continue)

THD - V_{in}

Total Harmonic Distortion THD (%) vs Input Voltage V_{in} (mV)

V_{CC}=8V, f_{in}=1kHz
Monaural V_{in}=300mV
Stereo L+R=370mV
V_p=30mV

—— mono
·········· L+R
—·—· L or R

■ Supplementary Explanation
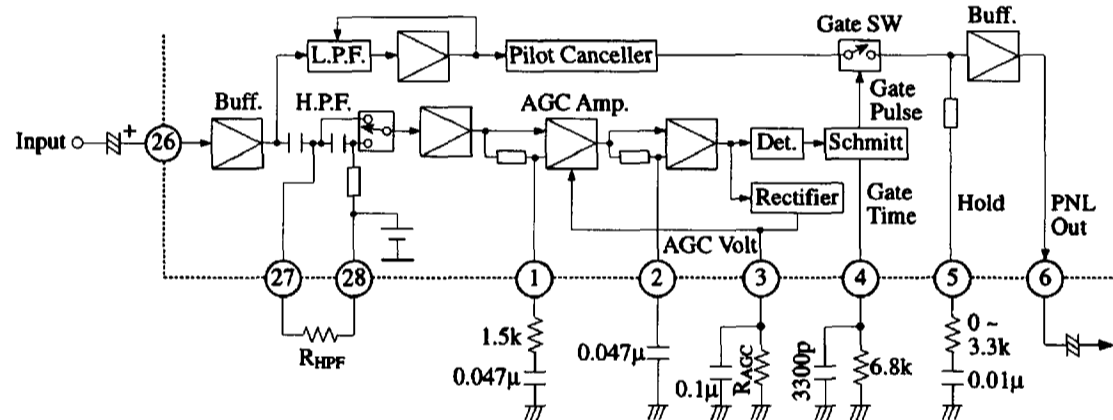
● Selection Standard of Noise Canceller Resistance Value

Fig. 1 Pulse Noise Eliminator (PNL) Block Diagram

(1) Relation to field strength

1. In weak electric field where noise is apt to increase, the AGC effectively controls the PNL operation.

   (a) In case operation error is frequently caused by white noise
   Suitably increase the value of Pin 3 R_{AGC}. (220kΩ ~ 1MΩ)

   (b) In case operation error is frequently caused by overmodulation
   Suitably increase the value of R_{HPF} between Pin 27 and Pin 28. (47kΩ ~ 470kΩ)

2. In medium to strong electric field relatively free from noise generation, the AGC becomes less effective and noise is detected almost at the maximum sensitivity.

   (a) In case the detection sensitivity is too high
   Suitably decrease the value of R_{HPF} between Pin 27 and Pin 28. (10kΩ ~ 47kΩ)

3. In every electric field

   (a) In case the detection sensitivity is excellent but the PNL effect deteriorated due to holding level fluctuation by noise, suitably increase the resistance value of the resistor connected in series with the Pin 5 holding capacitor. (1kΩ ~ 3.3kΩ)

   (b) In case noise of the gate pulse itself is conspicuous, suitably narrow the gate pulse width by decreasing the resistance value of the Pin 4 resistor. (3kΩ ~ 6.8kΩ)

■ Supplementary Explanation (Continue)

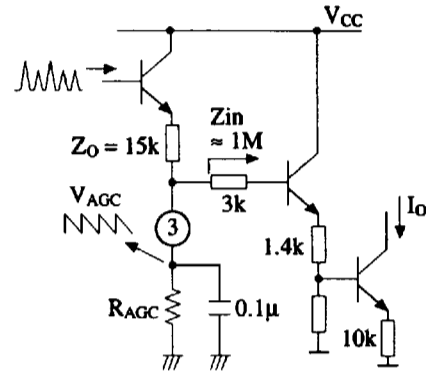(2) Selection of AGC Resistor R_{AGC} Pin 3

Fig. 2

Pin 3 is the AGC LPF, and enables AGC effective level adjustment. The equivalent circuit in the vicinity of this pin has been so constituted as shown in Fig. 2, and the output impedance at the charging time is 15kΩ while the input impedance at the discharging time is about 1MΩ.

The standard value of R_{AGC} is 220Ω, but in case operation error is frequently caused in weak electric field by white noise, selectively increase the value of R_{AGC} to a suitable level between 200kΩ and 1MΩ. So long as the value of R_{AGC} was properly increased, the AGC voltage proportionally becomes higher to prolong the discharging time constant, and the rate of operation error sharply drops with decrease of the gain of the AGC Amp. (Through Pin 3, the noise components are put to peak (envelope) detection. Even if the value of R_{AGC} was increased, the charging time and voltage remain almost unchanged because $Z_O = 15kΩ$.)

(3) Selection of HPF Resistor R_{HPF} Pin 27
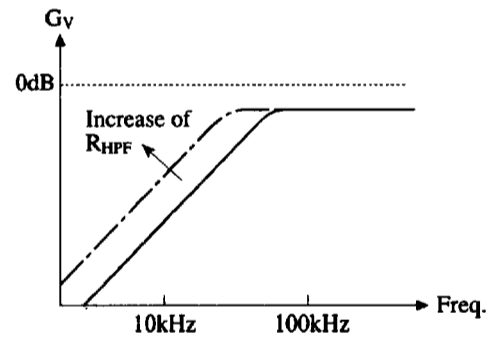
When the resistance value R_{HPF} of the resistor between Pin 27 and Pin 28 was increased, the cut-off frequency of the HPF proportionally becomes lower. The standard value of R_{HPF} is 47kΩ, but in case operation error is frequently caused in a weak electric field by white noise at the modulation time or non-modulation time, selectively increase this R_{HPF} to a suitable value not exceeding 470kΩ.