1.5V FM stereo demodulator

BA1362F/BA1362FS

The BA1362F and BA1362FS are FM stereo demodulator ICs designed for 1.5V audio systems. Both ICs have a PLL circuit that generates a 19kHz or 38kHz signal in synchronous with the input signal, a synchronous detector circuit that detects the presence or absence of a 19kHz pilot signal in the input signal, and a demodulation circuit that switches to divide the input signal into left and right channels. In addition, there is forced-monaural circuit that can turn the stereo signal into a monaural signal, and a stereo indicator LED driver circuit.

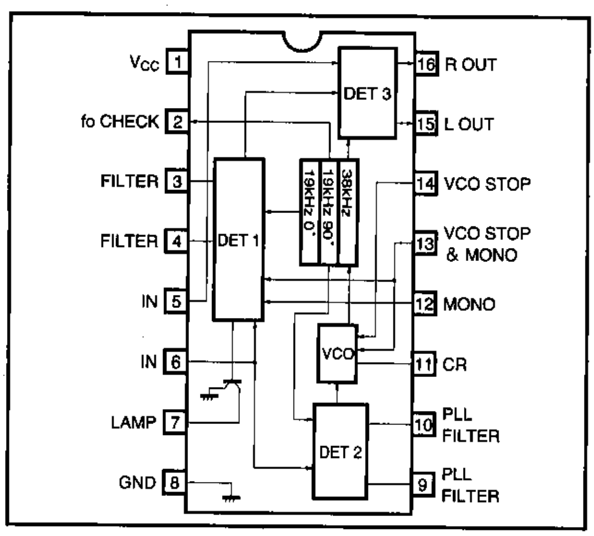
●Applications

1.5V headphone stereos

●Features

1) Excellent low-voltage characteristics (stereo operation down to 1.0V, monaural down to 0.9V, recommended operating voltage range 1.0V to 2.5V).
2) Gain can be set to either 0dB or 2.5dB by the input block wiring, with no external components.
3) VCO stop pin provided to prevent beat during AM operation.
4) Channel separation controlled by the input block high-frequency cut-off filter.
5) Output resistor that sets the de-emphasis is on the chip ($R_{OUT} \fallingdotseq 5k\Omega$).
6) Built-in drive circuit for stereo indicator LED.
7) Good compatibility with the BA4230AFS 1.5V AM/FM IF system IC.

●Block diagram



●Absolute maximum ratings (Ta = 25℃)

Parameter		Symbol	Limits	Unit
Supply voltage		V_{CC}	3.0	V
Power dissipation	BA1362F	Pd	300*1	mW
	BA1362F S		500*2	
Operating temperature		Topr	−25~75	℃
Storage temperature		Tstg	−55~125	℃

*1 Reduced by 3mW for each increase in Ta of 1°C over 25°C.
*2 Reduced by 5mW for each increase in Ta of 1°C over 25°C.

●Recommended operating conditions (Ta = 25℃)

Parameter	Symbol	Min	Typ.	Max.	Unit
Supply voltage	V_{CC}	1.0	1.25	2.5	V

●Electrical characteristics (Ta = 25℃, V_{CC} = 1.25V, f = 1kHz, V_{IN} = 100mV, L + R = 90%, Pilot = 10%)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Quiescent current	I_Q	1.6	4	6.2	mA	−
Separation	Sep	30	35	−	dB	Input phase compensation
Total harmonic distortion	THD	−	0.3	0.8	%	MAIN signal
Channel balance	CB	−2	0	2	dB	MONO signal
LED ON level	V_P	2.5	4.5	7.0	mV_{rms}	PILOT signal only
LED hysteresis	Hys	−	4.3	9.5	dB	−
Input resistance	R_{IN}	4.5	8.2	12.0	kΩ	Pin 5, pin 6 shorted
Output resistance	R_{OUT}	3.6	5.1	6.6	kΩ	−
Input/output gain	G_V	−	2.5	−	dB	−
Signal-to-noise ratio	S/N	−	68	−	dB	−
Capture range	C_R	−	±3	−	%	MAIN signal
Forced monaural operating voltage	V_{CP12}	−	OPEN	−	−	Forced release by earthing
VCO stop voltage	V_{VCO14}	−	0.9	−	V	−
Pilot detector output pin pull-in current	I_P	−	5	−	mA	−
Input level	V_{IN}	150	−	−	mV	THD=6%

●Measurement circuit

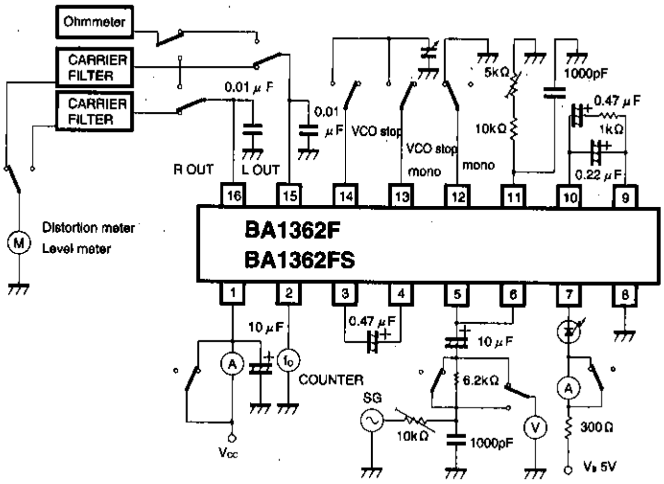
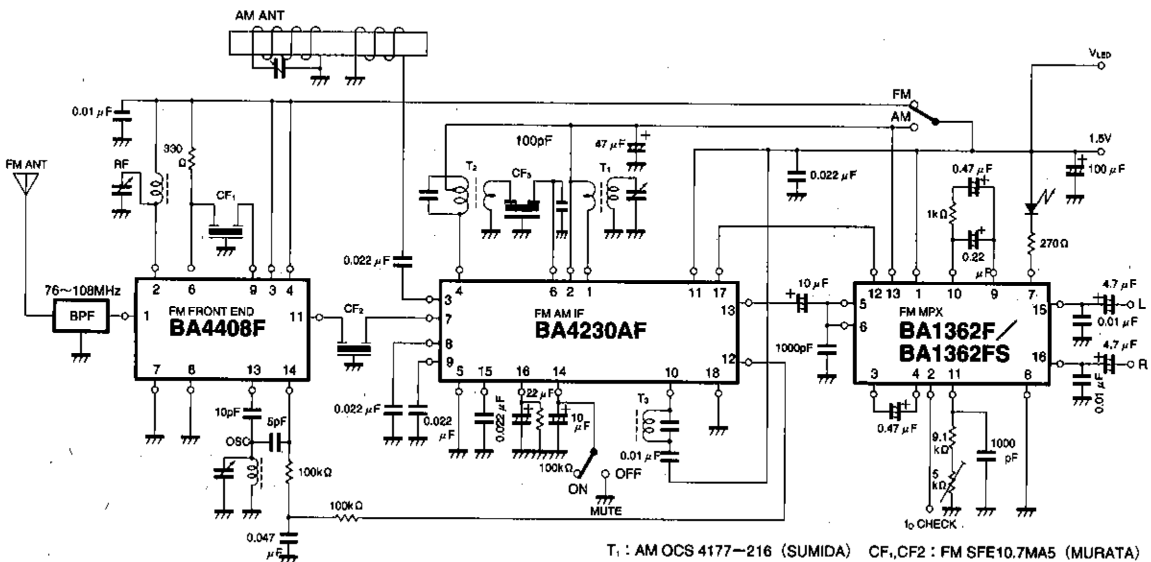


Fig. 1

●Application example



T₁ : AM OCS 4177−216 (SUMIDA) CF₁,CF2 : FM SFE10.7MA5 (MURATA)
T₂ : AM IFT 4175−352 (SUMIDA) CF₃ : AM PFB455J (MURATA)
T₃ : FM DET 4176−303 (SUMIDA)

Fig. 2

●Circuit operation

(1) PLL circuit

The PLL circuit generates 19kHz and 38kHz signals that are synchronized with the 19kHz pilot contained in the composite signal, and uses them for the synchronous detector and as the demodulation signal for the stereo demodulation circuit.

The circuit is a closed circuit, and consists of a phase comparator, low-pass filter, VCO, and two divide-by-two frequency dividers. The capture range of the PLL is set by the CR filter circuit connected between pins 9 and 10, and the lock range and f0 of the VCO are set by the time constant of the CR circuit connected between pin 11 and GND.

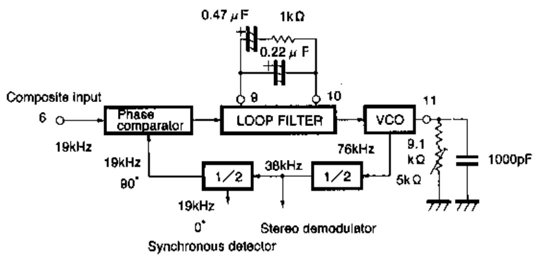


Fig. 3

(2) Synchronous detector circuit

Synchronous detection is performed by comparing the pilot signal in the composite signal (19kHz) and the 19kHz signal generated by the PLL to detect the presence of the pilot signal. The detector output is smoothed by a filter and used to turn the LED driver and stereo demodulation circuits on and off. The value of the capacitor connected between pins 3 and 4 sets the stereo/monaural switching time.

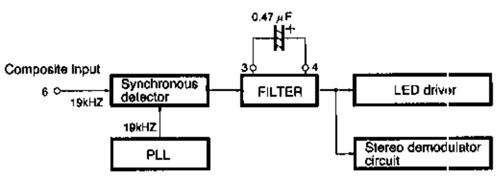


Fig. 4

(3) Stereo demodulator circuit

The stereo demodulator circuit switches the composite signal between the left and right channels at 38kHz to perform stereo demodulation. The composite signal is given by the following formula.

$$C(t) = (L+R) + (L-R)\cos\omega t + p\cos\frac{\omega t}{2}$$

ω : sub-carrier angular frequency

p : pilot signal amplitude

$\omega t = 2n\pi$ $\quad C(t) = (L+R) + (L-R) = 2L$

$\omega t = (2n+1)\pi$ $\quad C(t) = (L+R) - (L-R) = 2R$

The output impedance is set at 5kΩ, and pins 15 and 16 are connected via capacitors to GND to form the de-emphasis circuit.

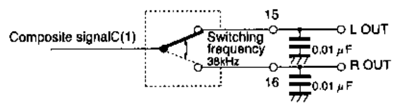


Fig. 5

(4) Monaural circuit

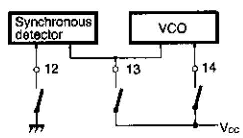
Stereo/monaural switching is done either automatically by the level of the pilot signal, or manually forced using pins 12, 13, and 14.

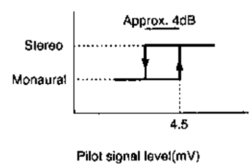
1) Automatic monaural switching

Automatically switches between stereo and monaural operation depending on the level of the pilot signal included in the composite signal. Some switching hysteresis is provided for stability.

2) Forced monaural operation

Force monaural operation by making pin 12 open circuit, and release it by pulling pin 12 down to GND. Pull pin 14 up to V_{CC} to stop the VCO oscillation, and make it open circuit to release the VCO. Pull pin 13 up to V_{CC} to simultaneously stop the VCO and force monaural operation, and make it open to release them.





●Application circuit PCB layout

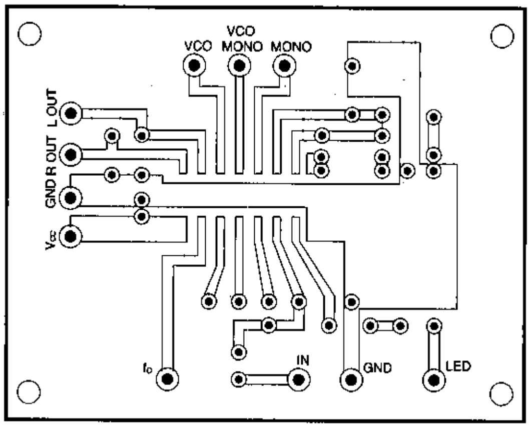


Fig. 6

●Application circuit component layout

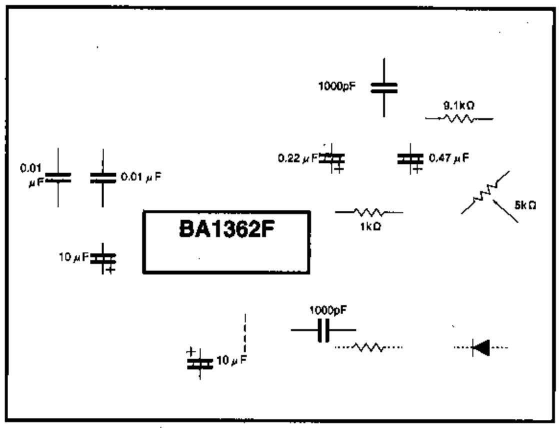


Fig. 7

●Electrical characteristics curves

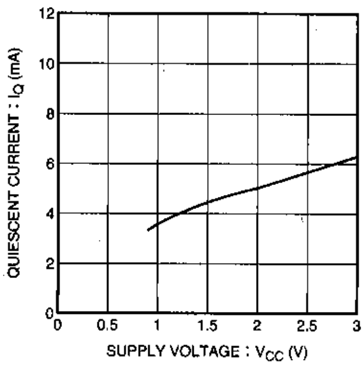


Fig. 8 Quiescent current vs. supply voltage

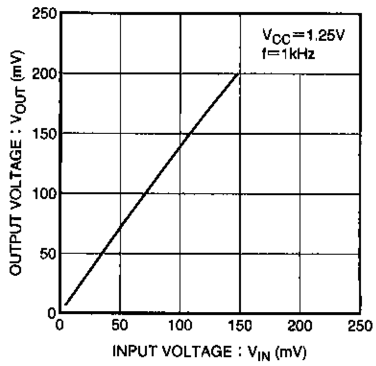


Fig. 9 Output voltage vs. input voltage

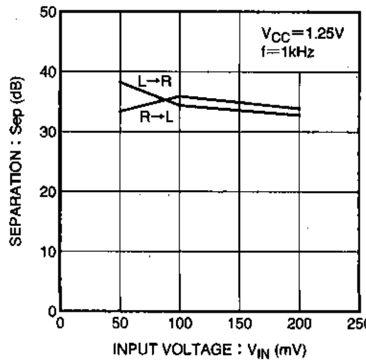


Fig. 10 Separation vs. input voltage

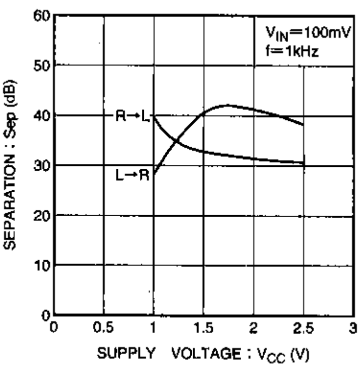


Fig. 11 Separation vs. supply voltage

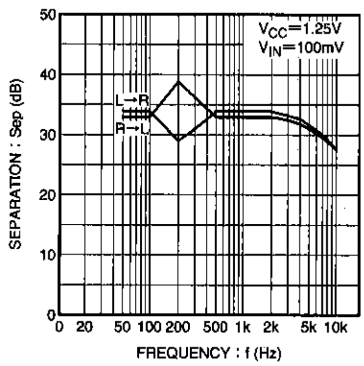


Fig. 12 Separation vs. frequency

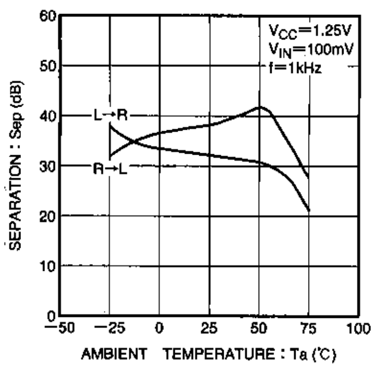


Fig. 13 Separation vs. ambient temperature

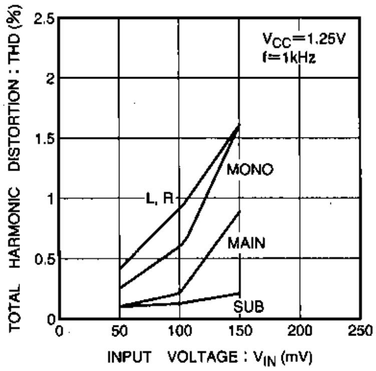


Fig. 14 Total harmonic distortion vs. input voltage

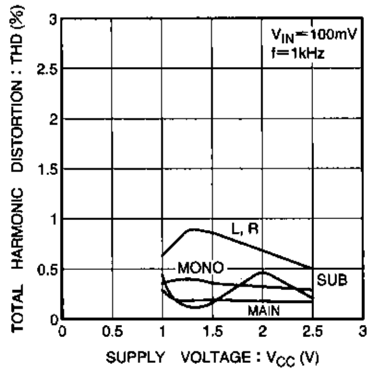


Fig. 15 Total harmonic distortion vs. supply voltage

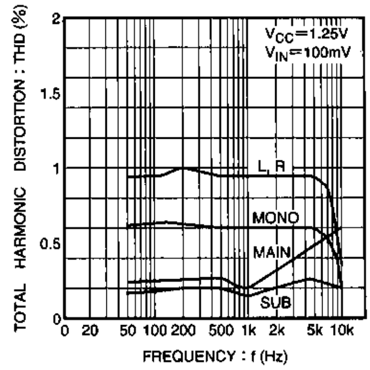


Fig. 16 Total harmonic distortion vs. frequency

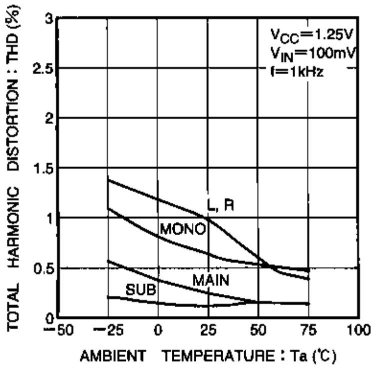


Fig. 17 Total harmonic distortion vs. ambient temperature

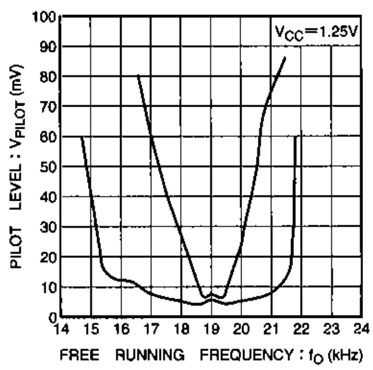


Fig. 18 Capture range and lock range vs. free-running frequency

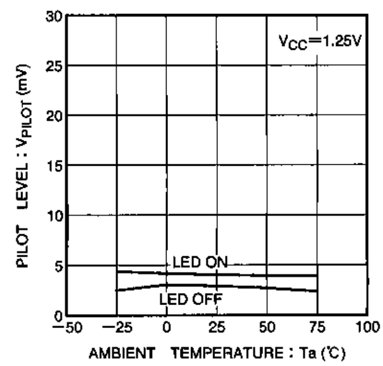


Fig. 19 LED ON/OFF levels vs. ambient temperature

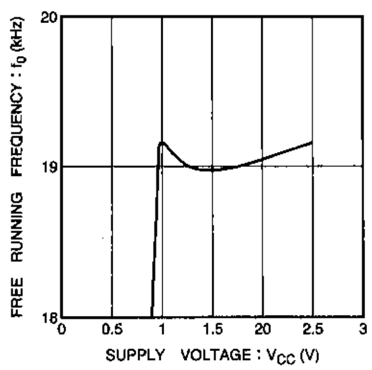


Fig. 20 Free-running frequency vs. supply voltage

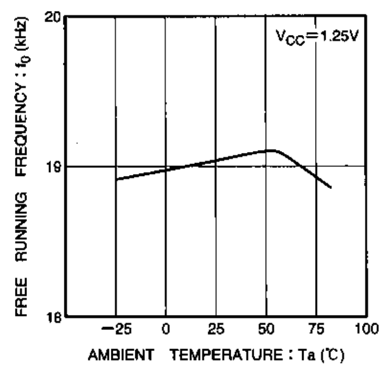


Fig. 21 Free-running frequency vs. ambient temperature

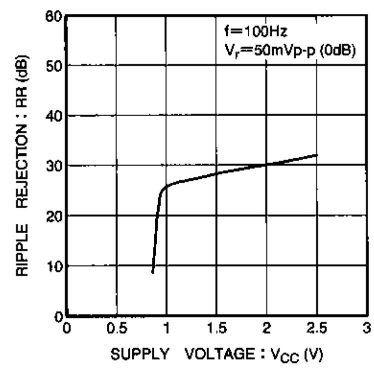


Fig. 22 Ripple rejection ratio vs. supply voltage

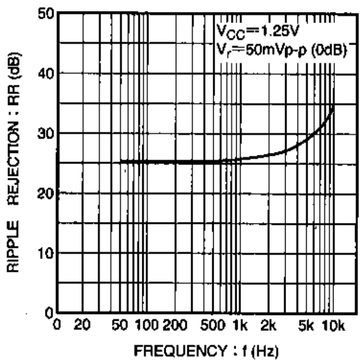
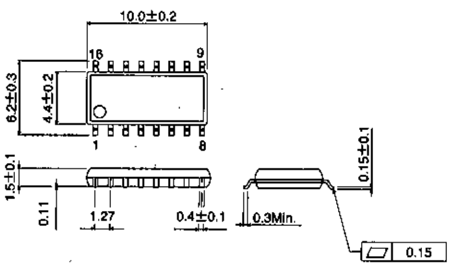


Fig. 23 Ripple rejection ratio vs. frequency

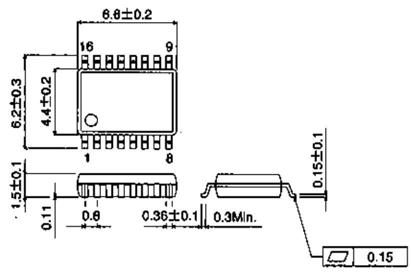
●External dimensions (Unit: mm)

BA1362F



SOP16

BA1362FS



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