Ordering number : ENA1859B

SANYO Semiconductors
DATA SHEET

An ON Semiconductor Company

Monolithic Linear IC

LA72914V — FM Modulator and Demodulator IC

Overview

The LA72914V is a FM modulation and demodulation IC for audio signals. And it is possible to use that for the data pulse or the control pulse, etc.

Functions

- Alignment-free FM modulator and demodulator of 4.5MHz.
- Alignment-free FM modulator and demodulator of 6.5MHz.
- ALC/ FMAGC, Emphasis/ De-emphasis
- Carrier frequency adjustment function, Standby switch

Specifications

Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{CC} max		7.0	V
Allowable power dissipation	Pd max	Ta ≤ 70°C *	300	mW
Operating temperature	Topr		-20 to +70	°C
Storage temperature	Tstg		-40 to +150	°C

When mounted on a 114.3mm × 76.1mm × 1.6mm, glass epoxy.

Recommended Operating Conditions at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Recommended supply voltage	V_{CC}	Ta=25°C	5.0	V
Allowable operating voltage range	V_{CC} op	Ta = -20 to +70°C	4.7 to 5.5	V

Electrical Characteristics at Ta = 25°C, V_{CC} = 5V

DC Characteristic

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
2.4V regulator	VREG	Measure the DC voltage at pin 2	2.2	2.4	2.6	V
Current dissipation	$I_{CC}1$	Measure the current into pin 4 in normal mode.	26.0	33.0	40.0	mA
	$I_{CC}2$	Measure the current into pin 4 in stand-by mode.	2.0	2.5	3.0	mA
Control pin (6 pin) Low level	CNT6L	Low level of input pin (6pin) in 4.5MHz TX mode.	0		0.4	V
Control pin (6 pin) Middle level	CNT6M	Middle level of input pin (6pin) in stand-by mode.	2.0		3.0	V
Control pin (6 pin) High level	CNT6H	High level of input pin (6pin) in 6.5MHz TX mode.	4.5		5.0	V
AGC stop at pin 11 control voltage	AGCS	Voltage of input pin (pin 11) in AGC stop	4.5		5.0	V
TX OFF mode at pin 16 control voltage	CNT16L	Voltage of input pin (pin 16) in TX off mode	0		0.4	V

Sound FM Modulation Block (TX)

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
FM carrier output frequency	FFM1	Output frequency of T1B in no signals. T6=0.6V, T14:open	4.455	4.500	4.545	MHz
	FFM2	Output frequency of T1B in no signals. T6=4.2V, T14:open	6.435	6.500	6.565	MHz
FM carrier output level	VOFM1	Output level of T1B in no signals. Load impedance = 1kΩ T1-GND. T6=0.6V	1.9	2.3	2.6	Vp-p
	VOFM2	Output level of T1B in no signals. Load impedance = 1kΩ T1-GND. T6=4.2V	1.3	1.7	2.1	Vp-p
FM carrier output second harmonics distortion	2HD1	2^{nd} harmonics distortion of T1B in no signals. Load impedance = 1kΩ T1-GND. T6=0.6V		-30	-20	dB
	2HD2	2^{nd} harmonics distortion of T1B in no signals. Load impedance = 1kΩ T1-GND. T6=4.2V		-30	-20	dB
FM carrier output mute level	VFMT	Output level of T1B in TX off mode. T6=0.6V (4.2V)		-60	-50	dB
FM deviation	DEV	FM deviation of T1A, T6=0.6V (4.2V), input at T16=1.0Vp-p/1kHz (sine)	20	25	30	kHz
Emphasis Characteristic	FEMP	T16=200mVp-p, 1kHz (sine), M1=T1 output deviation. T16=200mVp-p, 5kHz (sine), M2=T1 output deviation. FEMP=M2-M1	7	12	17	kHz
ALC characteristic	ALC1	T16A=0.25Vp-p, 1kHz (sine), T3:Open, T6=0.6V, T3 output level	0.45	0.5	0.55	Vp-p
	ALC2	T16A=0.6Vp-p, 1kHz (sine), T3:Open, T6=0.6V, T3 output level	0.9	1.0	1.1	Vp-p
	ALC3	T16A=1.0Vp-p, 1kHz (sine), T3:Open, T6=0.6V, T3 output level	0.95	1.05	1.15	Vp-p
FM carrier "fo" adjustment (reference)	FCNT1	No signal input. Measure T1B frequency. T16:Open, T6=0.6V (4.2V), T14=0.5V		-0.22		MHz
	FCNT2	No signal input. Measure T1B frequency. T16:Open, T6=0.6V (4.2V), T14=4.5V		+-.22		MHz

Sound FM demodulation block (RX)

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Sound demodulation level	$V_{OUT}1$	Input signal: CAR=4.5MHz, DEV=±25kHz, MOD=1kHz, Level: 100mVp-p. T5A input. Measure T9B signal level. (T9B-GND: R_{OUT}=10kΩ) T6=4.2V	0.6	0.9	1.3	Vp-p
	$V_{OUT}2$	Input signal: CAR=6.5MHz, DEV=±25kHz, MOD=1kHz, Level: 100mVp-p. T5A input. Measure T9B signal level. (T9B-GND: R_{OUT} =10kΩ) T6=0.6V	0.7	1.0	1.4	Vp-p
S/N	SN1	Input signal: CAR=4.5MHz, No-modulation. Level: 100mVp-p. T5A input. T6=4.2V, (IHF-A) M1=T9B signal level. (T9B-GND: R_{OUT} =10kΩ) SN1=20log(V_{OUT}1/M1)	35	50		dB
	SN2	Input signal: CAR=6.5MHz, No-modulation. Level: 100mVp-p. T5A input. T6=0.6V, (IHF-A) M1=T9B signal level. (T9B-GND: R_{OUT} =10kΩ) SN1=20log(V_{OUT}2/M1)	35	50		dB

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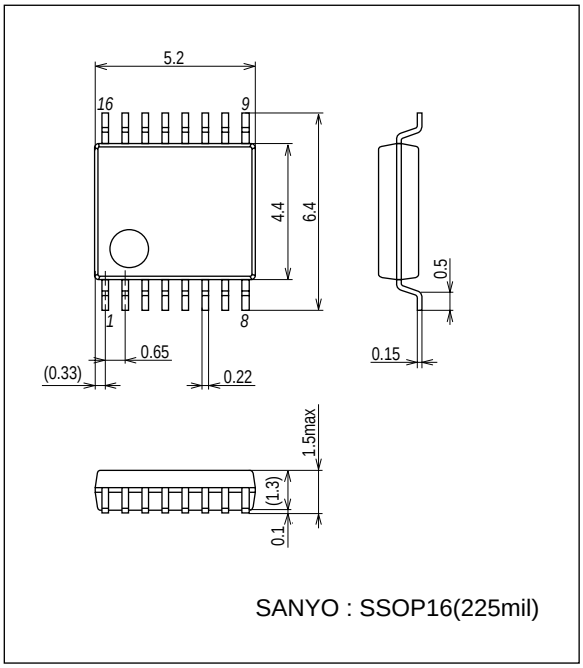
Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
THD	THD1	Same condition $V_{OUT}1$. Measure T9B signal.	0	0.3	1.0	%
	THD2	Same condition $V_{OUT}2$. Measure T9B signal.	0	0.3	1.0	%
De-emphasis characteristic	DEEM1	Input signal: CAR=4.5MHz, DEV=±25kHz, MOD=5kHz, Level: 100mVp-p. T5A input. T6=4.2V, M1=T9B signal level. DEEM=20log(M1/$V_{OUT}1$)	-10	-7.5	-5	dB
	DEEM2	Input signal: CAR=6.5MHz, DEV=±25kHz, MOD=5kHz, Level: 100mVp-p. T5A input. T6=0.6V, M1=T9B signal level. DEEM=20log(M2/$V_{OUT}2$)	-10	-7.5	-5	dB
Trap-filter characteristic	TRP1	T11=4.5V, T6=4.2V, T5A=4.5MHz, 100mVp-p. T12A=A1. T5A=6.5MHz. 100mVp-p. T12A=B1. TRP1=20log(B1/A1)		-20	-15	dB
	TRP2	T11=4.5V, T6=0.6V, T5A=4.5MHz, 100mVp-p. T12A=A1. T5A=6.5MHz. 100mVp-p. T12A=B1. TRP2=20log(A1/B1)		-20	-15	dB
FM AGC characteristic	AGC1	T6=4.2V. T5A=4.5MHz, 300mVp-p. Measure T12 signal level.	250	350	450	mVp-p
	AGC2	T6=0.6V. T5A=6.5MHz, 300mVp-p. Measure T12 signal level.	250	350	450	mVp-p
	AGC3	T6=4.2V. T5A=4.5MHz, 30mVp-p. Measure T12 signal level.	200	300	400	mVp-p
	AGC4	T6=0.6V. T5A=6.5MHz, 30mVp-p. Measure T12 signal level.	200	300	400	mVp-p
FM AGC STOP characteristic	AGCSTP1	T6=4.2V. T11=4.5V, T5A=4.5MHZ, 100mVp-p. Measure T12 signal level.	70	100	140	mVp-p
	AGCSTP2	T6=0.6V. T11=4.5V, T5A=6.5MHz, 100mVp-p. Measure T12 signal level.	70	100	140	mVp-p
FM input sensitivity	FMIN1	Input signal: CAR=4.5MHz, DEV=±25kHz, MOD=1kHz, T6=4.2V. When T9B signal is OK, then measure T5A FM input level range.	30	100	300	mVp-p
	FMIN2	Input signal: CAR=6.5MHz, DEV=±25kHz, MOD=1kHz, T6=0.6V. When T9B signal is OK, then measure T5A FM input level range.	30	100	300	mVp-p

Package Dimensions

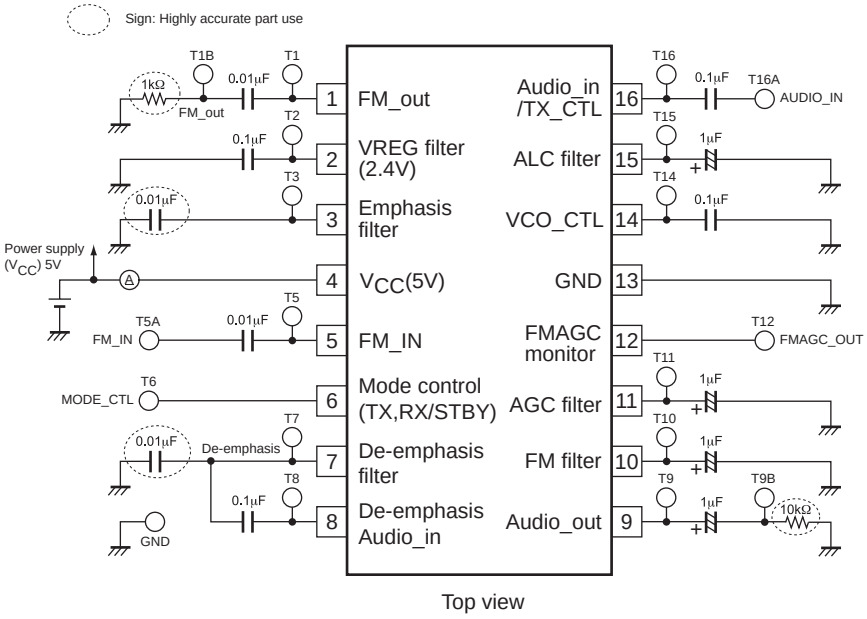
unit: mm (typ)

3178B



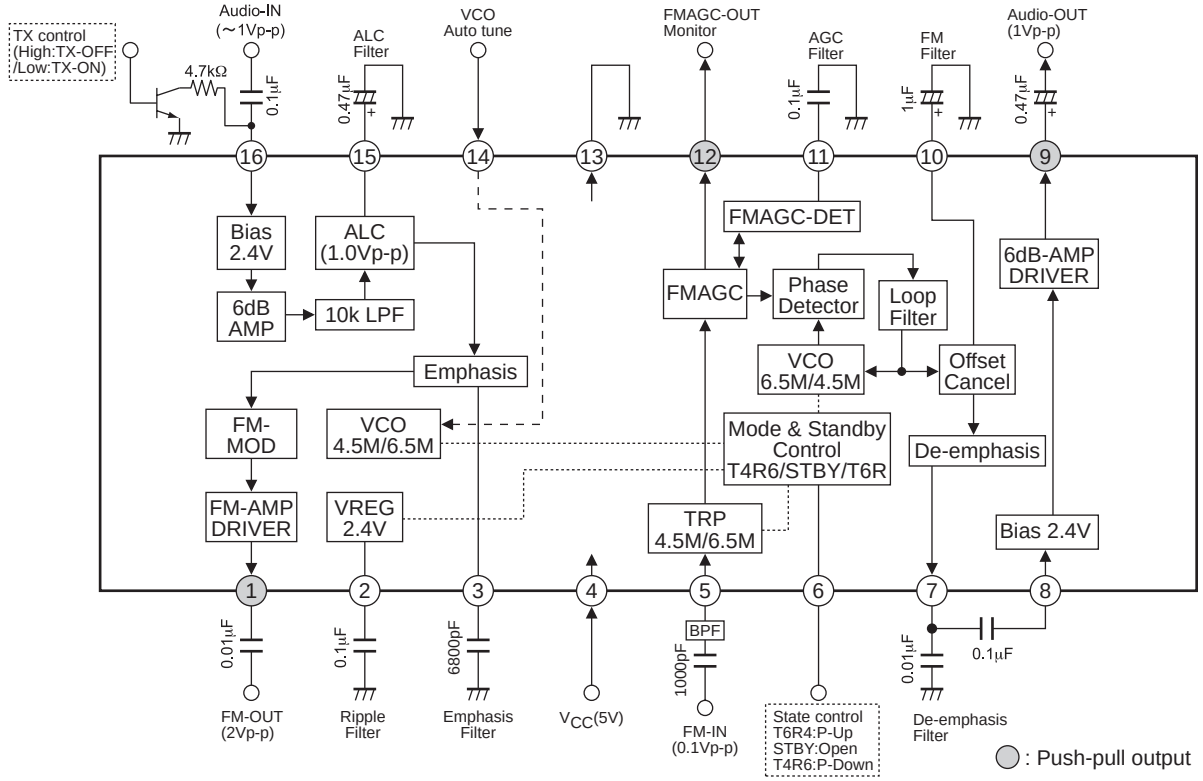
SANYO : SSOP16(225mil)

Pin Layout and Measurement circuit

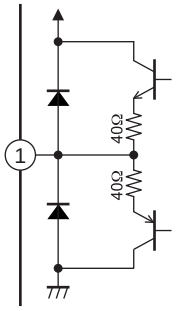
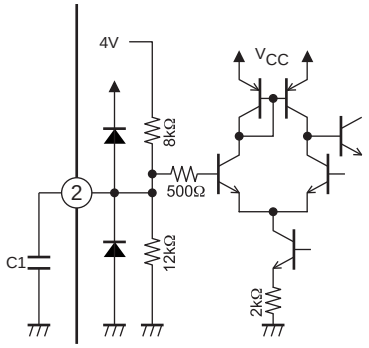
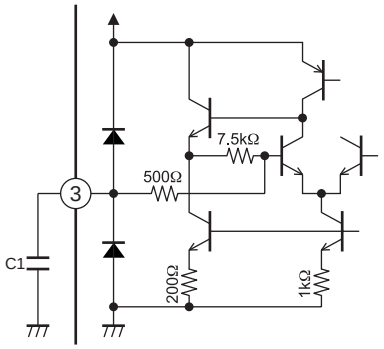
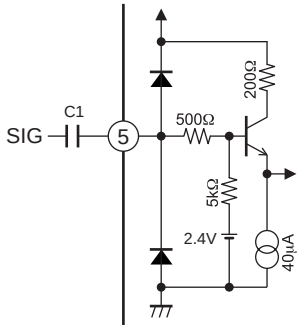
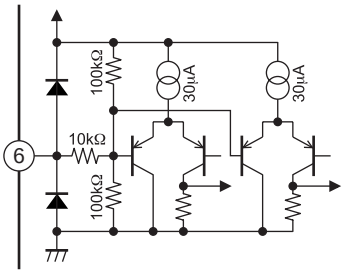


Top view

Block Diagram and Application Circuit



Pin Description

Pin No.	Pin Name	Description	Equivalent circuit
1	FM OUT	4.5MHz or 6.5MHz FM carrier output. Push-pull output pin. Output level is 2.5Vp-p (Load resistance=1kΩ)	
2	2.4V REG Filter	Internal regulator filter pin. Please connect 0.1μF (C1)	
3	Emphasis Filter	Emphasis filter pin. Before FM modulation, make emphasis Characteristic at audio signal. C1(6800pF) Emphasis time constant must be matching de-emphasis time constant. (If you don't need the emphasis, this pin is open.)	
4	V_{CC}	V_{CC} pin. Supply voltage is 5V DC. Please connect de-coupling capacitor. (about 47μF)	
5	FM IN	FM signal input. Please use capacitor coupling.	
6	Mode CTL	MODE control pin. Control modulation frequency TX=4.5MHz: 0 to 0.4V Stand-by: 2.0 to 3.0V TX=6.5MHz: 4.5V to V_{CC}	

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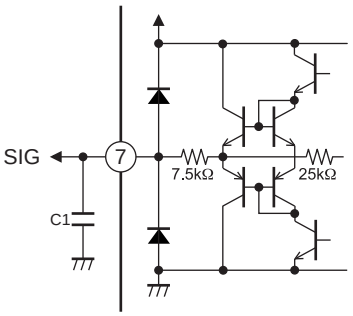
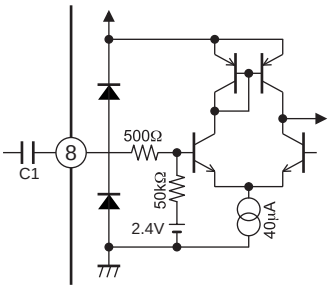
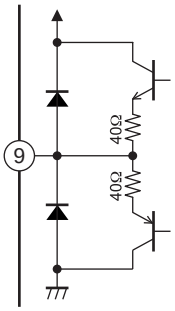
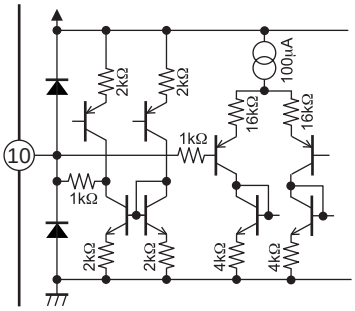
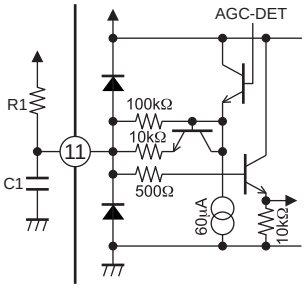
Pin No.	Pin Name	Description	Equivalent circuit
7	De-emphasis Filter	De-emphasis filter pin. De-emphasis time constant must be matching at emphasis time constant. Recommend value is 6800pF to 0.01μF. Connect Cap. Coupling to pin8.	
8	RX Audio IN	Internal DC bias is 2.4V. Please connect Cap. coupling.	
9	Audio OUT	Audio signal output pin. Push-pull output pin. Output level is 1.0Vp-p at 1kHz. (Load resistance=10kΩ)	
10	FM Filter	FM demodulator filter pin. Please connect 1.0μF capacitor. (If you need rising of low frequency gain, then change more large capacitor in use.)	
11	AGC Filter	FM AGC filter pin. Please connect 0.1μF capacitor. If you need reduce AGC-gain, then connect resistor (R1: 11pin-V_{CC}) If FM AGC no need, please set pin11 voltage over 4.5V DC voltage.	

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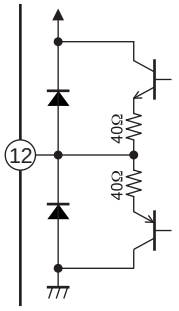
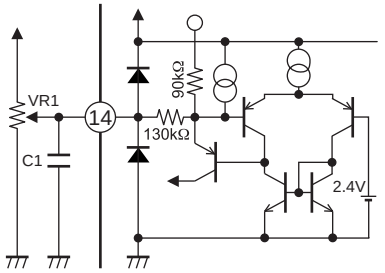
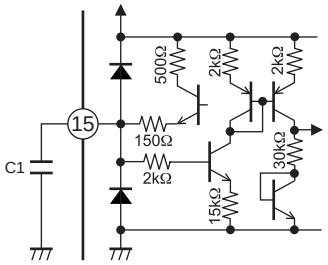
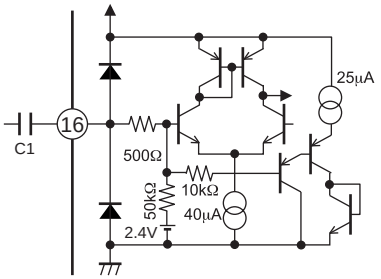
Pin No.	Pin Name	Description	Equivalent circuit
12	AGC monitor	FM AGC monitor pin.	
13	GND	GND pin.	
14	V_{CO} CTL	Modulation frequency fine control pin. Adjustment frequency is, about ±220kHz at 0.5V to 4.5V DC.	
15	ALC CTL	Audio ALC filter pin. Please connect 0.47μF capacitor.	
16	TX Audio IN (TX-OFF_CTL)	Audio signal input pin. Internal bias is 2.4V DC. Please use capacitor coupling. If DC voltage set to under 0.4V DC, then modulator circuit stops. Demodulation circuit is work. This is receiving only mode. (TX-OFF: 0 to 0.4V)	

Signal processing outline

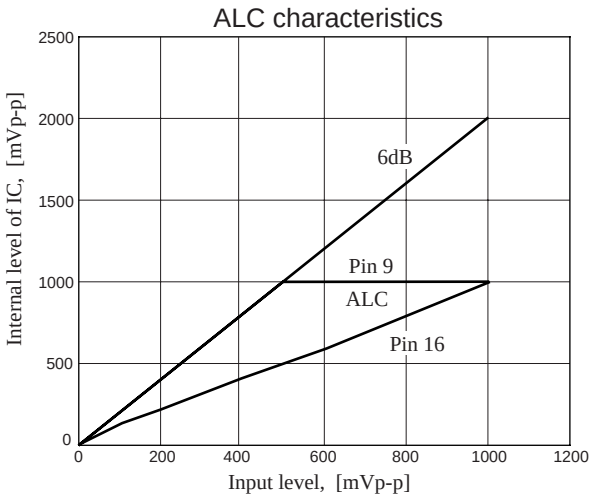
[Modulation block]

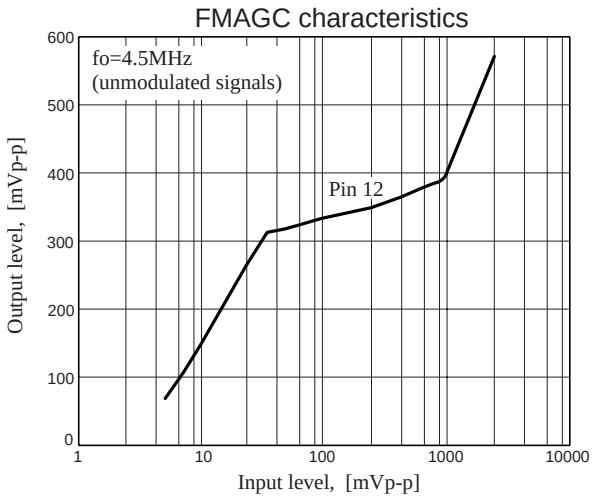
- Audio signal is input from pin16. (Internal bias is DC 2.4V.) Go through AMP (6dB)/ALC/LPF (10 kHz) and emphasis circuit, then input FM-modulation block. After FM-modulation block, go to output driver block then FM-audio signal output from pin1.
- ALC: ALC circuit work at pin16 input level over than 0.5Vp-p.
- LPF: LPF gain is -3dB at 10 kHz and -6dB/oct. Keep over modulation from emphasis characteristic.
- Emphasis circuit: The pin3 owns an Emphasis characteristic which connected capacitor. Recommended value = 6800pF.
- FM modulation: Carrier frequency is choosing from pin6 voltage. When pin16 input level is 0.5Vp-p, then FM deviation set to ±25 kHz. Internal LPF reduce harmonic spectrum.
- Output Driver: Output AC voltage is about 2.0Vp-p. (Load resistance: 1kΩ)

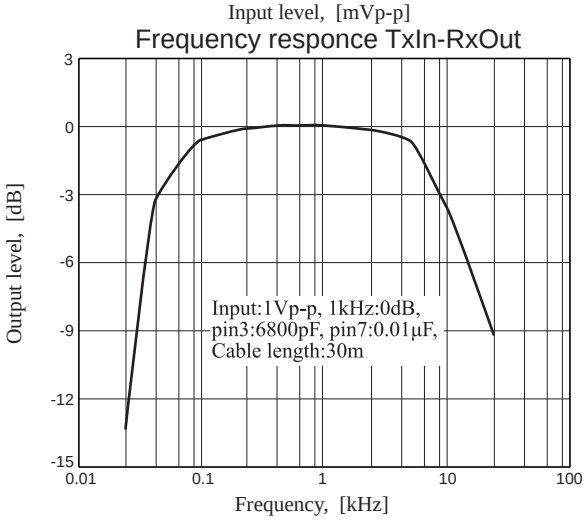
[De-modulation block]

- Demodulate audio signal from modulated audio signal.
- FM-Audio signal is input from pin5. Go through 4.5M-Trap-filter or 6.5MHz-Trap-filter and AGC go to demodulator. After demodulator go to De-emphasis circuit. After de-emphasis circuit signal is output pin7. Pin7 signal is charge to DC bias for coupling capacitor at pin8. Audio signal from pin8 go to 6dB AMP then output from pin9. (Door-phone application, there are two FM carrier. In this case we recommend add BPF before pin5 FM-Audio signal input.)
- 4.5M/6.5MHz-Trap-filter: Internal Trap-filter is change for pin6 mode control. (If modulator frequency is 4.5MHz, then internal Trap-filter is 4.5MHz.)
- AGC: After AGC level is control about 0.3Vp-p. After AGC signal go to pin12 FM-monitor and de-modulator.
- De-emphasis circuit: The pin7 owns an De-emphasis characteristic which connected capacitor. Recommended value = 10nF.
- Output signal level: If input FM signal deviation is ±25 kHz, then output signal level is 1Vp-p (TYP) from pin9/ (Load resistance: 10kΩ at 1 kHz.)

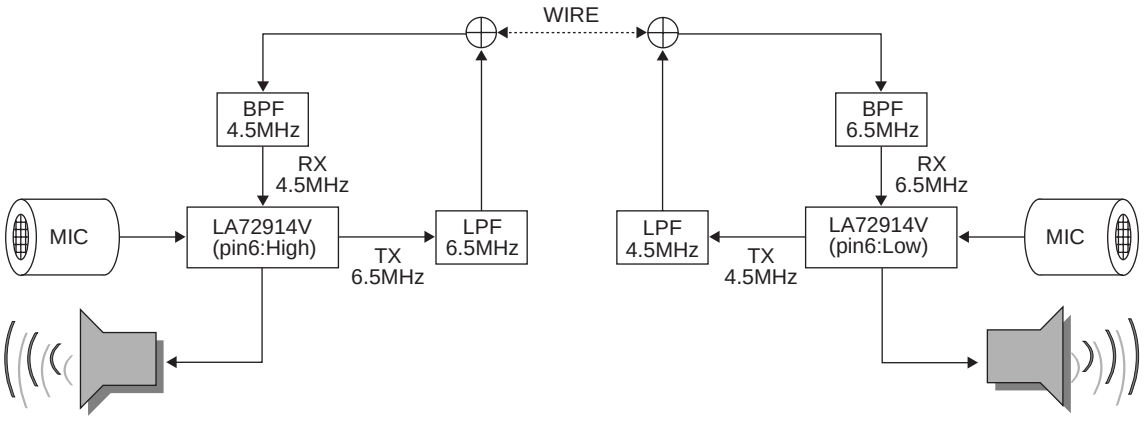
Characteristics







Application example



[Above-mentioned recommendation BPF]
Made by Murata Mfg.: SFSKA4M50DF00 (4.5MHz)/SFSKA6M50CF00 (6.5MHz)