Ordering number : ENA1494A

SANYO Semiconductors
DATA SHEET

An ON Semiconductor Company

Bi-CMOS IC

LV2285VB — FM transmitter IC with Stereo Modulation, Auto Sleep Function

Overview

The LV2285VB is IC for FM transmitter. This IC is chiefly composed of the following block. MPX block for stereo modulation, RFVCO block for FM modulation, and PLL block for RF output frequency. At the result, this IC achieves FM transmitter with low power consumption by 1chip.
Additionally, the auto sleep function is installed. This function automatically switches the standby and active according to the state of the audio input. It is possible to achieve a more dynamic electric power reduction as a result.

Feature

- The function necessary for FM transmission has been integrated into 1chip.
- The best low current consumption operation for portable application
- The auto sleep function to reduce more dynamic current consumption
- General I^2C I/F and, SANYO original audio control I/F is installed

Functions

- Audio: Stereo modulation using pilot tone system, Audio attenuation
- RF: VCO, programmable gain driver amplifier
- Bus control: I^2C I/F , Audio control I/F
- PLL: 70MHz to 110MHz 100kHz step
- Regulator: 2.8V LDO regulator, Auto sleep function

Specifications

Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{CC} max	Pin 6	7.0	V
Maximum input voltage	Vin max		Vcc + 0.3	V
Minimum input voltage	Vin min		-0.3	V
Allowable power dissipation	Pd max	Ta ≤ 85°C, Mounted on a specified board.*	500	mW
Operating temperature	Topr		-10 to 85	°C
Storage temperature	Tstg		-55 to 150	°C

* Specified board: 114.3mm × 76.1mm × 1.6mm, glass epoxy board.

Recommended Operating Conditions at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Recommended Supply voltage	V_{CC}	Pin 6	3.3	V
Operating supply voltage	V_{CC} op	Pin 6	2.8 to 5.5	V

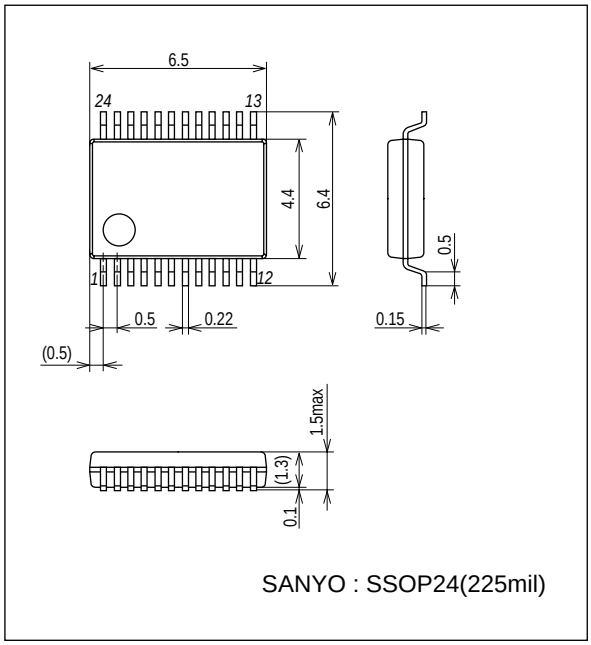
Electrical Characteristics at Ta = 25°C, V_{CC} = 3.3V, L/R input = 1kHz, 425mVrms, I^2C bits = Initial

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Circuit current	I_{CC}	Pin 6 (No signal)		8	10	mA
Standby current	I_{STB}	Pin 6 (No signal, I^2C"EN"="0")		40	60	μA
Audio and MPX Block						
Minimum audio input	V_AMIN	Pin 1 and 24 input	30			mVrms
Maximum audio input	V_AMAX	Pin 1 and 24 input			900	mVrms
Audio input frequency	FAF	Pin 1 and 24 input	20		15k	Hz
Channel separation	SEP	Pin 7, composite output, L>R, R>L	20	40		dB
Channel balance	CB	Pin 7, composite output	-2	0	+2	dB
Total harmonic distortion	THD	Pin 7, composite output		0.1	0.3	%
Pilot tone output level	PMOD	I^2C bits "ST"="1", "PILOT"="1"	0.5	0.85	1.2	mVpp
Composite output level	MPXOUT		2.9	3.8	4.6	mVrms
Audio mute	MUTE	I^2C bit "MUTE"="1"	30	35		dB
Audio attenuation step	ATT(1)	ATT[2:0] = "111" – "110"		2.3		dB
	ATT(2)	ATT[2:0] = "110" – "101"		2.2		dB
	ATT(3)	ATT[2:0] = "101" – "100"		2.8		dB
	ATT(4)	ATT[2:0] = "100" – "011"		2.3		dB
	ATT(5)	ATT[2:0] = "011" – "010"		4.3		dB
	ATT(6)	ATT[2:0] = "010" – "001"		3.3		dB
	ATT(7)	ATT[2:0] = "001" – "000"		1.6		dB
Crystal Oscillator Frequency(1)	FXOSC(1)	Pin 21 and Pin22		76		kHz
Audio control Block						
Audio Control Frequency	F_{CONT}	Pin 2 and 23 input		7.5		kHz
Audio Control input	V_{CONT}	Pin 2 and 23 input		1.2		Vp-p
Auto sleep Block						
Turn-off time	T_{OFF}	The time from no signal to turn-off. If the V_{CC} voltage is supplied, LV2285VB maintains I^2C data. Ctc (Pin 20) = 2.2μF	45	70	300	sec
PLL Block						
I^2C input "High" voltage	V_H		0.8V_{CC}		V_{CC}+0.3	V
I^2C input "Low" voltage	V_L		-0.3		0.2V_{CC}	V
RF input frequency	FPLL	Step = 100kHz, See table 2	70		110	MHz
Crystal Oscillator frequency	FXOSC(2)	Pin 16		16	-	MHz
External Clock Frequency	FEXT	• External clock injection to Pin 16 instead of 16MHz crystal oscillation. • When the LSI is standby mode, external clock should be stop.	1		24	MHz
CP output current	I_{CP}	CP voltage = 1.4V		30		μA
RF Block						
RFoutput	RF_{OUT}	f = 98MHz, RF[2:0] = "011", Pin 12 output	109	112	115	dBμV
RF output adjustment step	RF_{STEP}	RF[2:0] = "000" to "111", totally 8 steps.	0.3	0.9	1.4	dB
RF frequency	F_{RF}	100kHz step	70		110	MHz
I^2C Block						
I^2C input switch	I2CSW *	Input to Pin 2/23 : Audio control I/F	-0.3		0.2V_{CC}	V
		Input to Pin 17/18 : I^2C I/F	0.8V_{CC}		V_{CC}+0.3	V

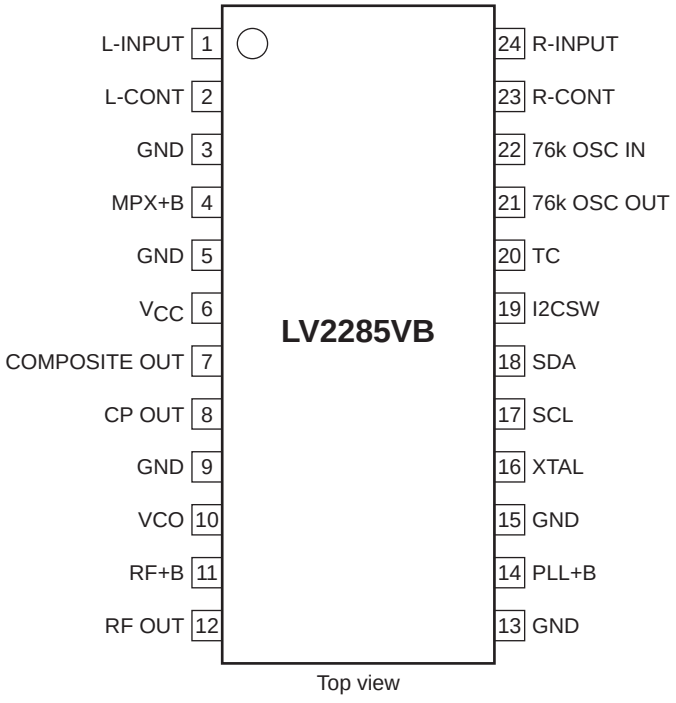
* Use case (I^2C I/F) : Please set Pin 19 = High.

Package Dimensions

unit : mm (typ)
3287

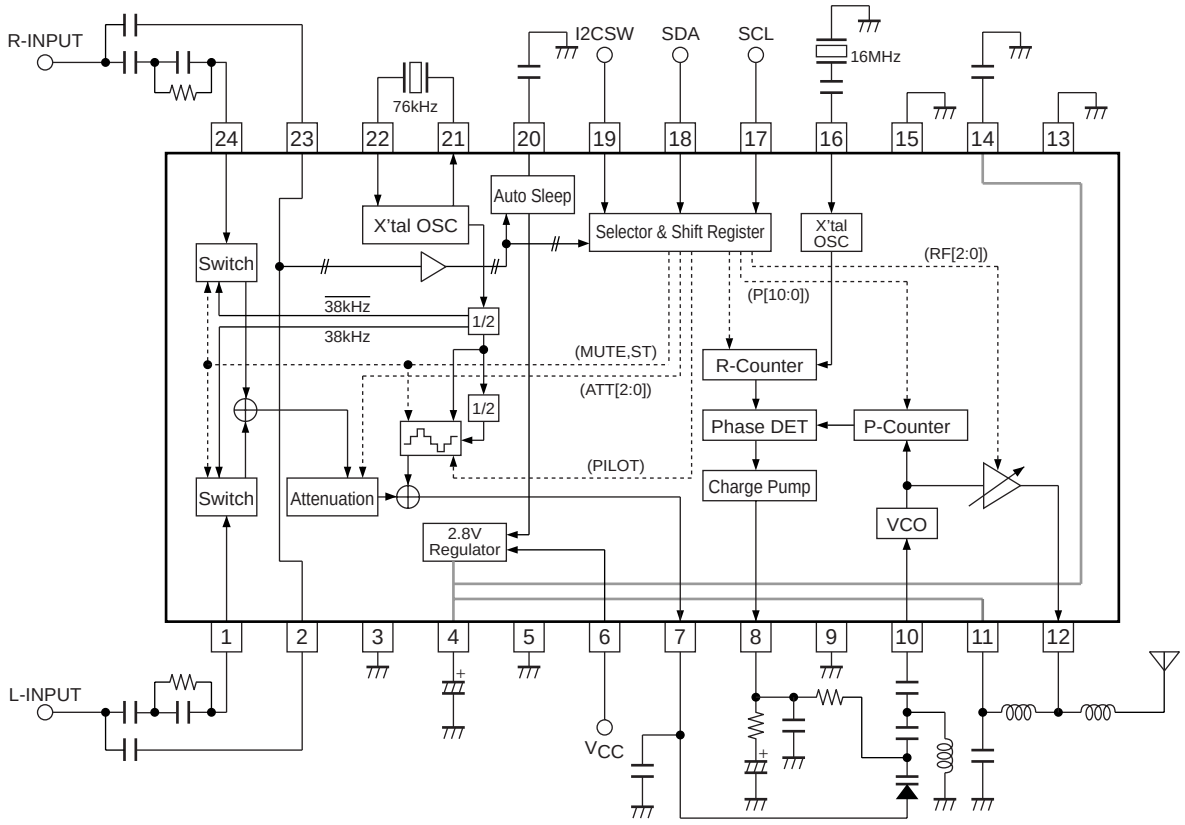


Pin Assignment

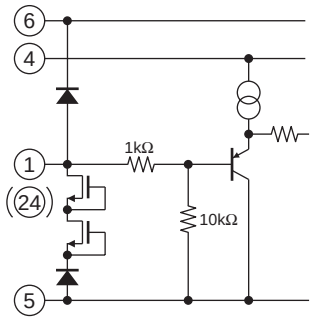
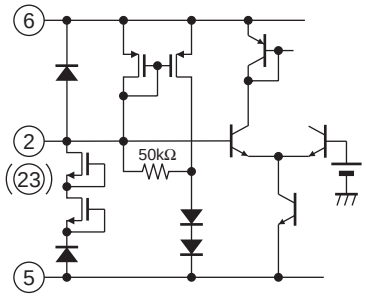
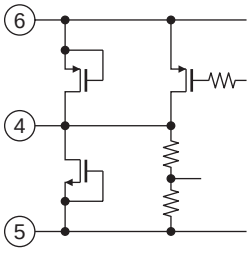
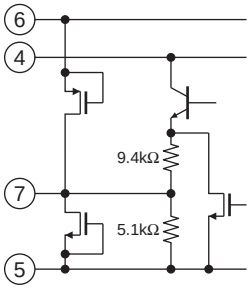
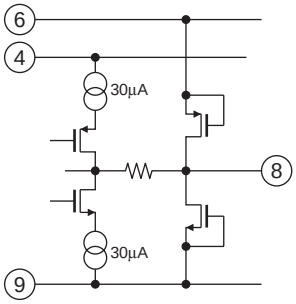


Top view

Block Diagram and Application Circuit Example



Pin Function

Pin No.	Pin name	DC voltage (V)	Function	Equivalent circuit
1	L-INPUT	0	Left channel input. If audio source DC voltage is not 0V, AC coupling capacitance is required. Pre-emphasis capacitance and resistance should be required.	
2	L-CONT	1.2	Data input pin for Audio control. External coupling capacitance is required.	
3	GND	0		
4	MPX+B	2.8	LDO regulator output. External decoupling capacitance is required.	
5	GND	0		
6	V_{CC}	3.3		
7	COMPOSITE OUT		Stereo modulated output.	
8	CP OUT		Charge pump current output.	
9	GND	0		

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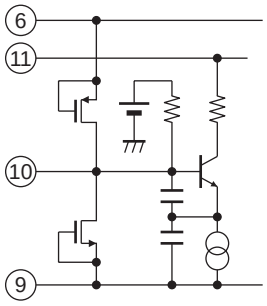
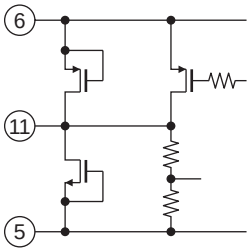
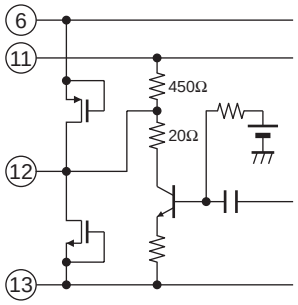
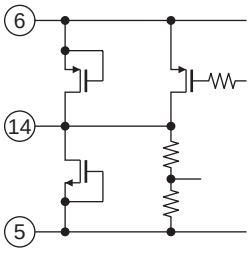
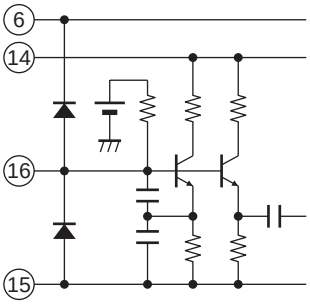
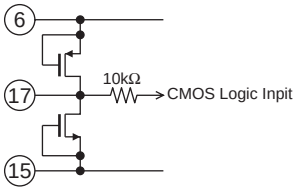
Pin No.	Pin name	DC voltage (V)	Function	Equivalent circuit
10	VCO	2.2	Transistor BASE pin for Colpitz oscillator.	
11	RF+B	2.8	LDO regulator output for RF blocks.	
12	RF OUT	2.8	Collector output. Inductance should be connected Between pin 11 and pin 12 for getting resonant frequency and making pin 12 DC bias 2.8V.	
13	GND	0		
14	PLL+B	2.8	LDO regulator output for digital blocks.	
15	GND	0		
16	XTAL		16MHz crystal is needed for PLL reference frequency. If external clock is injected to pin 16. Frequency should be from 1MHz to 24MHz and N(integer) × 200kHz.	
17	SCL		I^2C clock input.	

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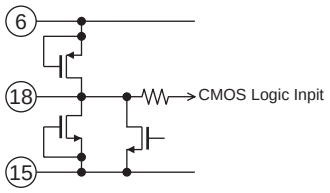
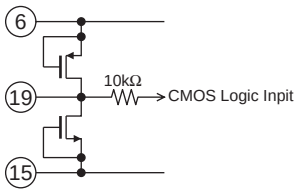
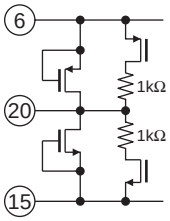
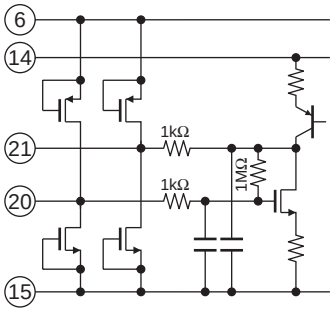
Pin No.	Pin name	DC voltage (V)	Function	Equivalent circuit
18	SDA		I^2C data input.	
19	I2CSW		The change switch of the I^2C data input pin. When Pin 19 = GND case, Audio control I/F is selected (Pin 2/23). In one side, when Pin 19 = V_{CC} case, I^2C I/F is selected (Pin 17/18).	
20	TC	2.8	Connect capacitance. Turn-off time is in proportion to this capacity value.	
21	76k OSC OUT	2.0	For stereo modulator pilot signal and sub carrier. 76kHz crystal should be connected between Pin 21 and Pin 22.	
22	76k OSC IN	0.7	See pin 21.	See pin 21.
23	R-CONT	1.2	Clock Input for Audio Control. See Pin 2	See pin 2.
24	R-INPUT	0	See pin 1.	See pin 1.

I²C Bus Definition

Table 1 : I²C Register map

Name	Byte	Bit								ACK
		MSB *1							LSB	
Address Byte	1	AD7	AD6	AD5	AD4	AD3	AD2	AD1	R/W	A
		1	1	0	1	0	0	0	0	
Control Byte 1	2	P10	P9	P8	P7	P6	P5	P4	P3	A
		0	1	1	1	1	0	1	0	
Control Byte 2	3	P2	P1	P0	RES2	ST	PILOT	EN	MUTE	A
		1	0	0	0	1	1	0	0	
Control Byte 3	4	RES1	RES0	RF2	RF1	RF0	ATT2	ATT1	ATT0	A
		*2	*2	0	1	1	0	1	0	
Control Byte 4	5	R6	R5	R4	R3	R2	R1	R0	TEST	A
		1	0	1	0	0	0	0	0	

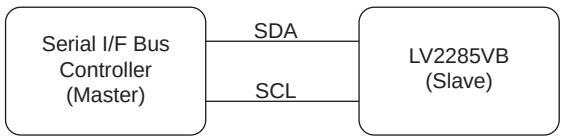
*1 : MSB is transmitted first.

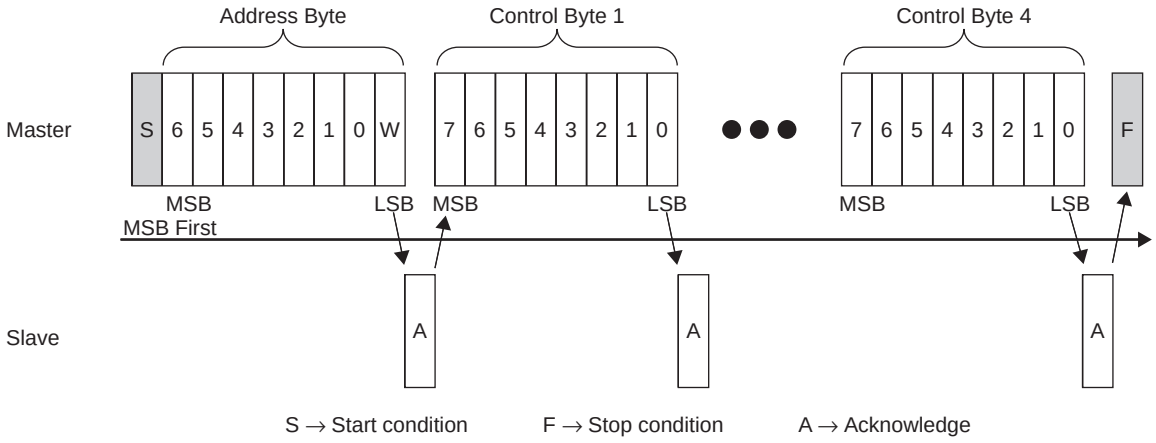
*2 : Don't care

Table 2 : I²C Register map description

Bit	Name	Initial	Description
AD[7:0]	Address bit	1101 000	LV2285VB I²C 7bit address
R/W	Read / Write	0	Write mode only
A	Acknowledge		
P[10:0]	Programmable counter	0111 1010 100	11bit Programmable counter. RF frequency=(P10 × 2^{10} + P9 × 2^{9} + ··· P1 × 2^{1} + P0) × 100kHz
RES2	Reserved bit	0	
ST	MONO / Stereo	1 (stereo)	Stereo modulation control. "ST"="0" Monaural mode, "ST"="1" : Stereo mode.
PILOT	Pilot tone output	1	Pilot signal control. "PILOT"="0" : No pilot, "PILOT"="1" : with Pilot
EN	Enable	0 (Standby)	Internal LDO control. "EN"="1" : Active, "EN"="0" : Standby
MUTE	Mute	0	Audio mute control. "MUTE"="1" : Enable, "MUTE"="0" : Disable
RES[1:0]	Reserved bits	00	
RF[2:0]	RF output adjustment	011	RF output level control. RF[2:0]="111" : Maximum, RF[2:0]="000" : Minimum
ATT[2:0]	Audio attenuator	010	This attenuator is used to adjust FM modulation level."111" is Minimum (0dB)."000" is Maximum (19dB). See Audio and MPX Block specification.
R[6:0]	Reference counter	1010 000	7bit reference counter. Reference frequency should be set 100kHz. {Crystal oscillator frequency(Pin 16)}/{(R6 × 2^{6} + R5 × 2^{5}···+R1 × 2^{1} + R0) × 2} = 100kHz
TEST	Reserved bit	0	

I²C Bus Operation





Time chart

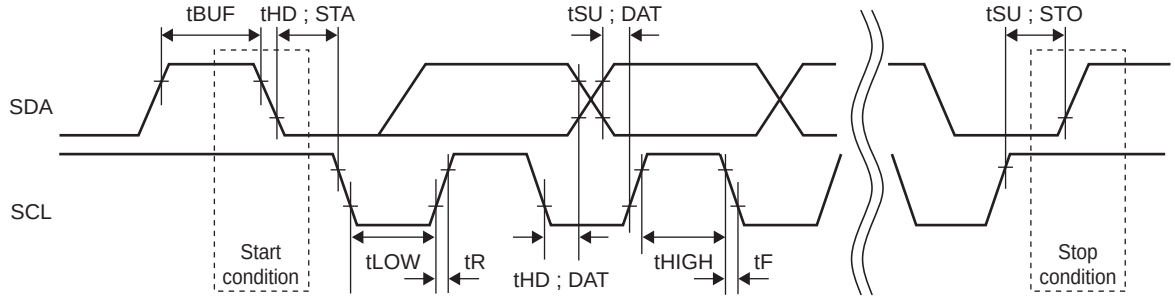


Table 3 : Timing specification

Parameter	Symbol	Ratings			unit
		min	typ	max	
SCL clock frequency	fSCL			100	kHz
Bus free time between a STOP and START condition	tBUF	4.7			μs
Hold time START condition	tHD;STA	4.0			μs
Low period of the SCL clock	tLOW	4.7			μs
High period of the SCL clock	tHIGH	4.0			μs
Data hold time	tHD;DAT	0.0			μs
Data set-up time	tSU;DAT	250			μs
Rise time of both SDA and SCL signals	tR			1000	ns
Fall time of both SDA and SCL signals	tF			300	ns
Set-up time for STOP condition	tSU;STO	4.0			μs

I²C Bus AC characteristics: Temp = 25°C, V_{CC} = 3.3V

Note: I²C Bus is registered trademark of the Philips Co..

Usage note

Stereo modulation

In generally, How to generate stereo modulating signals explain below figure 1. LV2285VB generate composite signal like below figure 2. And it is possible to control sub signals at register [ST]. Pilot signal is controlled at register [PILOT]

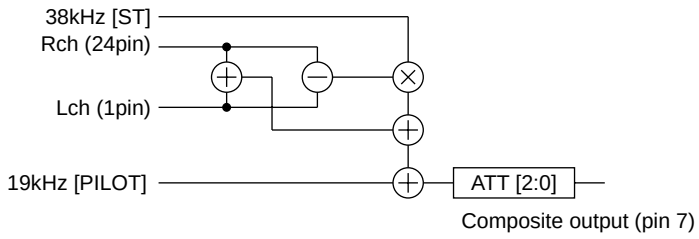


Figure 1

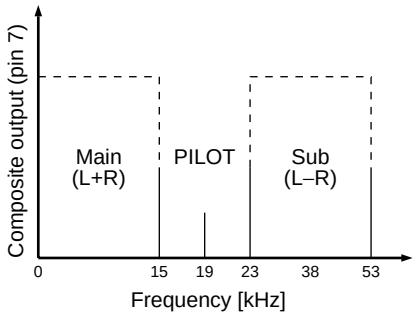


Figure 2

FM modulation

The LV2285VB have best performance of FM modulation at ±75kHzdev.

FM modulation level changes in proportion to composite output level (pin 7)

In LV2285VB composed of recommended parts, Table 1 is shown relationship that set ATT [2:0] value against audio input signal level.

Please refer to Table 1 to obtain better audio quality.

Table 1

Audio input signal level V.S ATT[2:0] setting		
Large attenuation	000	L , R input level = 780mVrms
	001	L , R input level = 640mVrms
	010	L , R input level = 425mVrms
	011	L , R input level = 260mVrms
	100	L , R input level = 190mVrms
	101	L , R input level = 140mVrms
	110	L , R input level = 110mVrms
Small attenuation	111	L , R input level = 80mVrms

AC Test Circuit