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LA1787NM

Monolithic Linear IC

Single-Chip Car Radio System IC

Overview

The LA1787NM integrates the six circuit blocks required in a car tuner on a single chip.

Features

- Improved noise prevention and reduction.
 - Excellent three-signal characteristics equivalent to the LA1193 FM front end IC.
 - Improved medium and weak field noise canceller characteristics provide superb listenability.
 - Improved separation.
 - Built-in anti-birdie filter.
 - Improved AM and FM temperature characteristics.
 - Excellent FM S-meter linearity.
 - Modified noise canceller circuit achieves improved noise rejection.
- Improved AM adjacent channel characteristics ($\Delta 40\text{kHz}$).
- Double conversion AM tuner (upconversion).
 - Fewer external components required than earlier double conversion tuners, no crystal required (when used as a pair with the LC72144).
- Built-in FM IF circuit sample-to-sample variations correction circuit for the FM IF circuit.
(The SD, KEYEDAGC, MUTE ON, ADJ, MUTE ATT, SNC, and HCC pins can all used fixed resistors.)
- Improved FM separation temperature characteristics.
- This product inherits the block arrangement of the LA1780M, and allows pin compatible design in end products.
- The LA1787NM adds an FM S-meter shifter function to the LA1787M.

Functions

- | | |
|-------------------|--------------------|
| • FM front end. | • Noise canceller. |
| • Multiplexer. | • FM/AM switch. |
| • FM IF. | • MRC. |
| • AM upconverter. | |

LA1787NM

Specifications

Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V _{CC} 1 max	Pins 6, 40, and 61	9.0	V
	V _{CC} 2 max	Pins 7, 45, 54, 59, and 60	12	V
Allowable power dissipation	Pd max	Ta ≤ 55°C	950	mW
Operating temperature	Topr		-40 to +85	°C
Storage temperature	Tstg		-40 to +150	°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

Recommended Operating Conditions at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Recommended supply voltage	V _{CC}	Pins 6, 7, 40, 45, 54, 59, 60, and 61	8.0	V
	V _{CC} ST IND	Pins 26	5	V
Operating supply voltage range	V _{CC} op		7.5 to 9.0	V

Operating Characteristics at Ta = 25°C, V_{CC} = 8.0V, in the specified test circuit, FM IF input

* : Note that these tests are made using an IC socket, models IC-51-0644-824 and KS8277 (Yamaichi Electronics Co., Ltd.).

Parameter	Symbol	Conditions	Switch settings										Ratings			Unit
			1	2	3	4	5	6	7	8	9	10	min	typ	max	
FM Characteristics - FM IF Input																
Quiescent current	I _{CCO} -FM	No input, I40+I45+I54+I59+I60+I61	ON	B	OFF	B		ON	OFF	OFF	ON		60	94	110	mA
Demodulated output	V _O -FM	10.7MHz, 100dBμ, 1kHz, 100% modulation, the pin 15 output	ON	B	OFF	B		ON	OFF	OFF	ON		205	310	415	mVrms
Pin 31 demodulated output	V _O -FM31	10.7MHz, 100dBμ, 1kHz, 100% modulation, the pin 31 output	ON	B	OFF	B		ON	OFF	OFF	ON		190	295	380	mVrms
Channel balance	CB	10.7MHz, 100dBμ, 1kHz, Pins 15, 16 ratio	ON	B	OFF	B		ON	OFF	OFF	ON		-1	0	+1	dB
Total harmonic distortion	THD-FMmono	10.7MHz, 100dBμ, 1kHz, 100% modulation, pin 15	ON	B	OFF	B		ON	OFF	OFF	ON			0.3	1	%
Signal-to-noise ratio (IF)	S/N-FM IF	10.7MHz, 100dBμ, 1kHz, 100% modulation, pin 15	ON	B	OFF	B		ON	OFF	OFF	ON		75	82		dB
AM rejection ratio (IF)	AMR IF	10.7MHz, 100dBμ, 1kHz, fm = 1kHz, pin 15 when 30% AM	ON	B	OFF	B		ON	OFF	OFF	ON		55	68		dB
Muting attenuation (1)	Att-1	10.7MHz, 100dBμ, 1kHz, The pin 15 attenuation when V33 is changed from 0 to 2V	ON	B	OFF	B		ON	OFF	OFF	ON		5	10	15	dB
Muting attenuation (2)	Att-2	10.7MHz, 100dBμ, 1kHz, The pin 15 attenuation when V33 is changed from 0 to 2V *1	ON	B	OFF	B		ON	ON	OFF	ON		15	20	25	dB
Muting attenuation (3)	Att-3	10.7MHz, 100dBμ, 1kHz, The pin 15 attenuation when V33 is changed from 0 to 2V *2	ON	B	OFF	B		ON	ON	OFF	ON		28	33	38	dB
Separation	Separation	10.7MHz, 100dBμ, L+R = 90%, pilot = 10%, the pin 15 output ratio	ON	B	OFF	B		ON	OFF	OFF	ON		30	40		dB
Stereo on level	ST-ON	The pilot modulation such that V26 is less than 0.5V	ON	B	OFF	B		ON	OFF	OFF	ON		2.1	4.1	6.1	%
Stereo off level	ST-OFF	The pilot modulation such that V26 is less than 3.5V	ON	B	OFF	B		ON	OFF	OFF	ON		1.3	3.2		%
Main distortion	THD-Main L	10.7MHz, 100dBμ, L+R = 90%, pilot = 10%, pin 15	ON	B	OFF	B		ON	OFF	OFF	ON			0.3	1.2	%
Pilot cancellation	PCAN	10.7MHz, 100dBμ, pilot = 10%, Pin 15 signal The pilot level leakage, DIN audio	ON	B	OFF	B		ON	OFF	OFF	OFF /ON		20	30		dB
SNC output attenuation	AttSNC	10.7MHz, 100dBμ, L-R = 90%, pilot = 10%. V28 = 3V→0.6V, pin 15	ON	B	OFF	B		ON	OFF	OFF	ON		1	5	9	dB

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Parameter	Symbol	Conditions	Switch settings										Ratings			Unit
			1	2	3	4	5	6	7	8	9	10	min	typ	max	
HCC output attenuation (1)	AttHCC-1	10.7MHz, 100dB μ , 10kHz, L+R = 90%, pilot = 10%, V29 = 3V \rightarrow 0.6V, pin 15	ON	B	OFF	B		ON	OFF	OFF	ON		0.5	4.5	8.5	dB
HCC output attenuation (2)	AttHCC-2	10.7MHz, 100dB μ , 10kHz, L+R = 90%, pilot = 10%, V29 = 3V \rightarrow 0.1V, pin 15	ON	B	OFF	B		ON	OFF	OFF	ON		6	10	14	dB
Input limiting voltage	Vi-lim	100dB μ , 10.7MHz, 30% modulation The IF input such that the output is -3dB down referenced to the input	ON	B	OFF	B		ON	OFF	OFF	ON	ON	33	40	47	dB μ
Muting sensitivity	Vi-mute	The IF input level when V33 = 2V, no modulation	ON	B	OFF	B		ON	OFF	OFF	ON		27	35	43	dB μ
SD sensitivity (1)	SD-sen1FM	The IF input such that the IF counter buffer output goes to the on state (100mVrms or higher)	ON	B	OFF	B	OFF	OFF	OFF	OFF	ON		54	62	70	dB μ
SD sensitivity (2)	SD-sen2FM	The IF input such that the SD pin goes to the on state, no modulation	ON	B	OFF	B	ON	OFF	OFF	OFF	ON		54	62	70	dB μ
IF counter buffer output	VIFBUFF-FM	10.7MHz, 100dB μ , no modulation, The pin 23 output	ON	B	OFF	B	OFF	OFF	OFF	OFF	ON		130	200	270	mVrms
S-meter output	VSMFM-1	No input, the pin 24 DC output, no modulation	ON	B	OFF	B		OFF	OFF	OFF	ON		0.0	0.1	0.3	V
	VSMFM-2	50dB μ , the pin 24 DC output, no modulation	ON	B	OFF	B		OFF	OFF	OFF	ON		0.4	1.0	1.5	V
	VSMFM-3	70dB μ , the pin 24 DC output, no modulation	ON	B	OFF	B		OFF	OFF	OFF	ON		2.0	2.7	3.5	V
	VSMFM-4	100dB μ , the pin 24 DC output, no modulation	ON	B	OFF	B		OFF	OFF	OFF	ON		4.7	5.5	6.2	V
Muting attenuation	BW-mute	100dB μ , the bandwidth when V33 = 2V, no modulation	ON	B	OFF	B		OFF	OFF	OFF	ON		150	220	290	kHz
Muting drive output	V _{MUTE} -100	100dB μ , 0dB μ , the pin 33 DC output, no modulation	ON	B	OFF	B		OFF	OFF	OFF	ON		0.00	0.03	0.20	V
FM Front End Mixer Input																
N-AGC on input	VNAGC	83MHz no modulation, the input such that pin 2 becomes 2.0V or lower	ON	A	ON	B		ON	OFF	OFF			81	88	95	dB μ
W-AGC on input	VWAGC	83MHz no modulation, the input such that pin 2 becomes 2.0V or lower (when the keyed AGC is 4.0V)	ON	A	ON	B		ON	OFF	OFF			104	110	116	dB μ
Conversion gain	A. V	83MHz, 80dB μ , no modulation, the FE CF output	ON	A	ON	B		ON	OFF	OFF			19	30	48	mVrms
Oscillator buffer output	V _{OSC} BUFFFM	No input	ON	A	ON	B		ON	OFF	OFF			85	110	165	mVrms
Noise Canceller Block - NC Input (pin 30)																
Gate time	τ GATE	f = 1kHz, 1 μ s, with a 100mVp-o pulse input	ON		OFF	A	ON	OFF	OFF				55			μ s
Noise sensitivity	SN	The 1kHz 1 μ s pulse input level such that noise canceller operation starts	ON		OFF	A	ON	OFF	OFF				40			mVp-o
Noise canceller effect	SN-NC	The pulse exclusion effect due to noise canceller operation. Repetition frequency for a 1 μ s pulse. The ratio of the FM mode pin 15 output referenced to the pin 15 output in 10kHz 150mVp-o AM mode.	ON/OFF		OFF	A	ON	OFF	OFF				5			
Multipath Rejection Circuit - MRC Input (pin 27)																
MRC output	V _{MRC}	V24 = 5V	ON		OFF	B		ON	OFF	OFF			2.2	2.3	2.4	V
MRC operating level	MRC-ON	The pin 32 input level such that pin 24 = 5V and pin 27 = 2V, f = 70kHz	ON		OFF	B		ON	OFF	OFF			10	15	20	mVrms
AM Characteristics - ANT IN input																
Practical sensitivity	S/N-30	1MHz, 30dB μ , fm = 1kHz, 30% modulation, pin 15	OFF		OFF	B	ON	ON					20			dB
Detection output	V _O -AM	1MHz, 74dB μ , fm = 1kHz, 30% modulation, pin 15	OFF		OFF	B	ON	ON					130	195	270	mVrms

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Parameter	Symbol	Conditions	Switch settings										Ratings			Unit
			1	2	3	4	5	6	7	8	9	10	min	typ	max	
Pin 31 detection output	V _{O-AM31}	1MHz, 74dBμ, fm = 1kHz, 30% modulation, pin 31	OFF		OFF	B	ON	ON					110	175	230	mVrms
AGC-F.O.M	V _{AGC-FOM}	1MHz, 74dBμ, referenced to the output, the input width such that the output falls by 10dB, pin 15	OFF		OFF	B	ON	ON					51	56	61	dB
Signal-to-noise ratio	S/N-AM	1MHz, 74dBμ, fm = 1kHz, 30% modulation	OFF		OFF	B	ON	ON					47	52		dB
Total harmonic distortion	THD-AM	1MHz, 74dBμ, fm = 1kHz, 80% modulation	OFF		OFF	B	ON	ON						0.3	1	%
S-meter output	V _{SMAM-1}	No input	OFF		OFF	B	ON	ON					0.0	0.2	0.5	V
	V _{SMAM-2}	1MHz, 130dBμ, no modulation	OFF		OFF	B	ON	ON					4.8	6.0	7.3	V
Oscillator buffer output	V _{OSC-BUFFAM1}	No input, the pin 15 output	OFF		OFF	B	ON	ON					185	230		mVrms
Wideband AGC sensitivity	W-AGCsen1	1.4MHz, the input when V46 = 0.7V	OFF		OFF	B	ON	ON					92	98	104	dBμ
	W-AGCsen2	1.4MHz, the input when V46 = 0.7V (during a seek)	OFF		OFF	B	ON	ON					83	89	95	dBμ
SD sensitivity	SD-sen1AM	1MHz, the ANT input level such that the IF counter output turns on.	OFF		OFF	B	OFF	OFF					24	30	36	dBμ
	SD-sen2AM	1MHz, the ANT input level such that the SD pin goes to the on state.	OFF		OFF	B	OFF	OFF					24	30	36	dBμ
IF buffer output	V _{IF-BUFF-AM}	1MHz, 74dBμ non-mod, the pin 23 output	OFF		OFF	B	OFF	OFF					200	290		mVrms

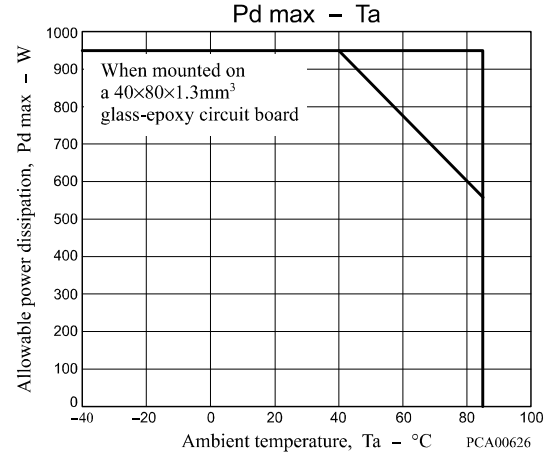
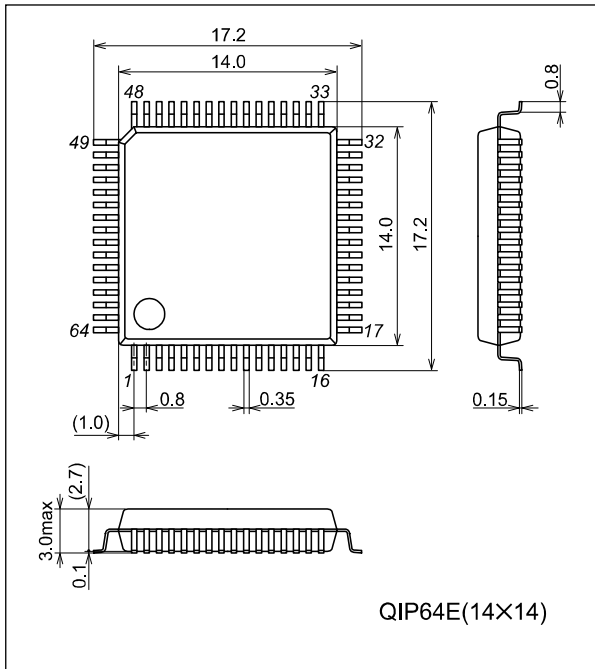
*1: When the value of the resistor between pin 58 and ground is 200kΩ.

*2: When the value of the resistor between pin 58 and ground is 30kΩ.

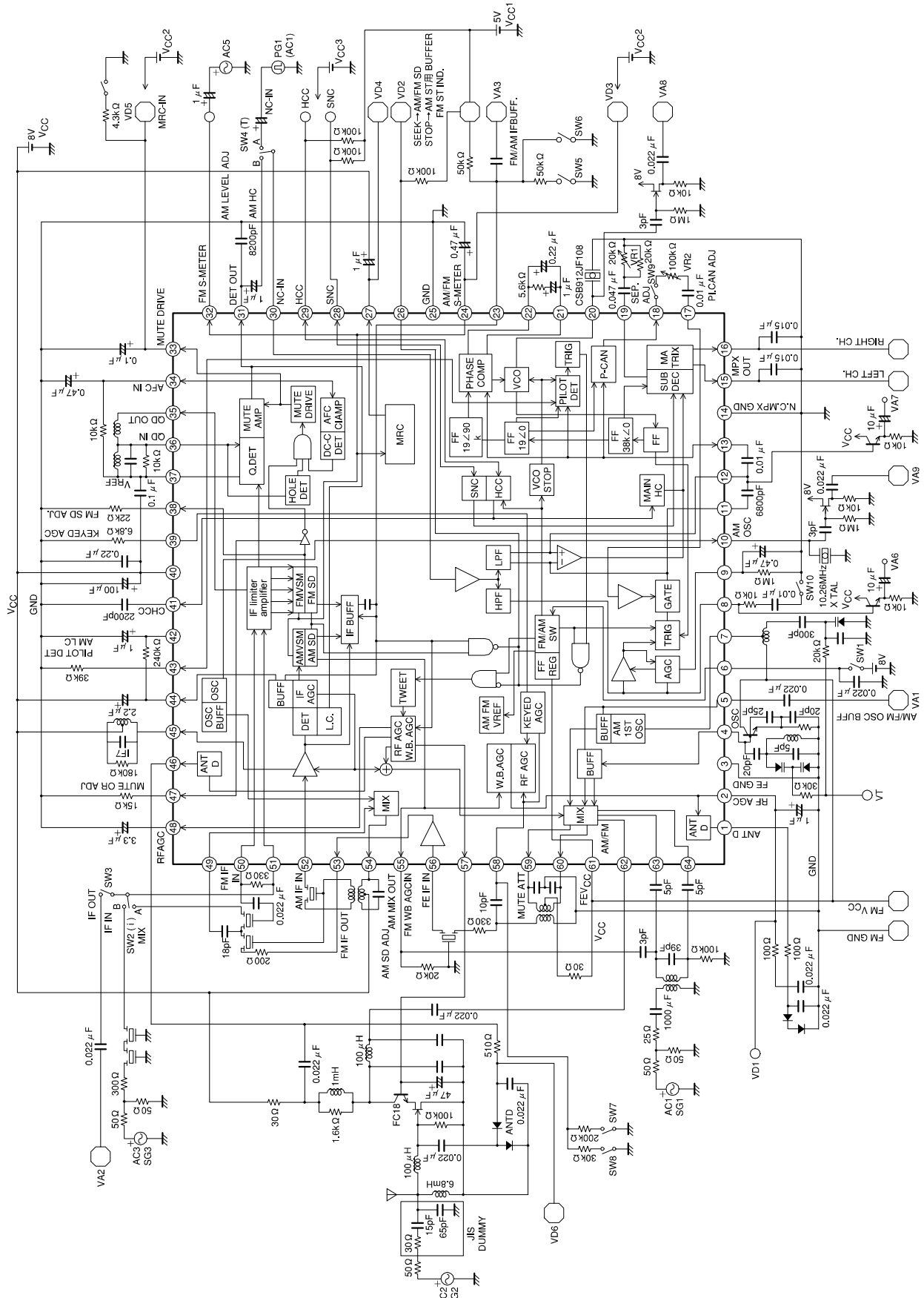
Package Dimensions

unit : mm

3159A



Block Diagram and Test Circuit



PCA00627

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