Ordering number : ENA0229

SANYO Semiconductors
DATA SHEET

Monolithic Linear IC

LA1787NM — 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 Sanyo 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 (Δ40kHz).
- 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.
- Multiplexer.
- FM IF.
- AM upconverter.
- Noise canceller.
- FM/AM switch.
- MRC.

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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

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, 100dBμ, 10kHz, L+R = 90%, pilot = 10%, V29 = 3V→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, 100dBμ, 10kHz, L+R = 90%, pilot = 10%, V29 = 3V→0.1V, pin 15	ON	B	OFF	B		ON	OFF	OFF	ON		6	10	14	dB
Input limiting voltage	Vi-lim	100dBμ, 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	dBμ
Muting sensitivity	Vi-mute	The IF input level when V33 = 2V, no modulation	ON	B	OFF	B		ON	OFF	OFF	ON		27	35	43	dBμ
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	dBμ
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	dBμ
IF counter buffer output	$V_{IFBUFF-FM}$	10.7MHz, 100dBμ, no modulation, The pin 23 output	ON	B	OFF	B	OFF	OFF	OFF	OFF	ON		130	200	270	mVrms
S-meter output	$V_{SM}FM-1$	No input, the pin 24 DC output, no modulation	ON	B	OFF	B		OFF	OFF	OFF	ON		0.0	0.1	0.3	V
	$V_{SM}FM-2$	50dBμ, the pin 24 DC output, no modulation	ON	B	OFF	B		OFF	OFF	OFF	ON		0.4	1.0	1.5	V
	$V_{SM}FM-3$	70dBμ, the pin 24 DC output, no modulation	ON	B	OFF	B		OFF	OFF	OFF	ON		2.0	2.7	3.5	V
	$V_{SM}FM-4$	100dBμ, 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	100dBμ, 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	100dBμ, 0dBμ, 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	dBμ
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	dBμ
Conversion gain	A. V	83MHz, 80dBμ, 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, 1μs, with a 100mVp-o pulse input	ON		OFF	A	ON	OFF	OFF					55		μs
Noise sensitivity	SN	The 1kHz 1μs 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 1μs 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, 30dBμ, fm = 1kHz, 30% modulation, pin 15	OFF		OFF	B	ON	ON					20			dB
Detection output	V_O-AM	1MHz, 74dBμ, 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_{SM}AM-1	No input	OFF		OFF	B	ON	ON					0.0	0.2	0.5	V
	V_{SM}AM-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_{IFBUFF}-AM	1MHz, 74dbμ non-mod, the pin 23 output	OFF		OFF	B	OFF	OFF					200	290		mVrms

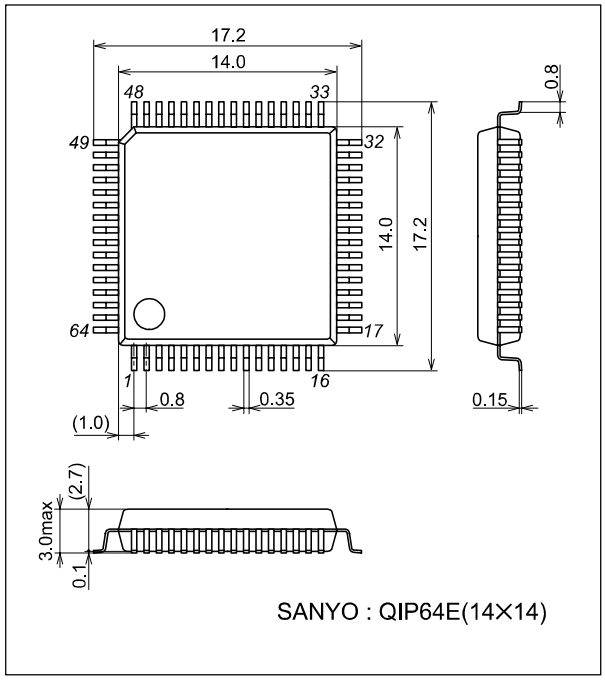
*1: When the value of the resistor between pin 58 and ground is 200kΩ.

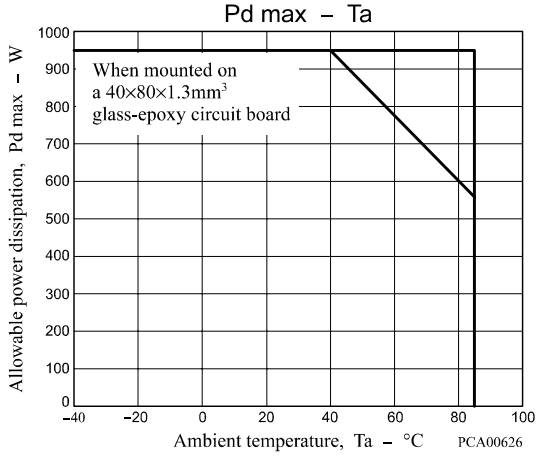
*2: When the value of the resistor between pin 58 and ground is 30kΩ.

Package Dimensions

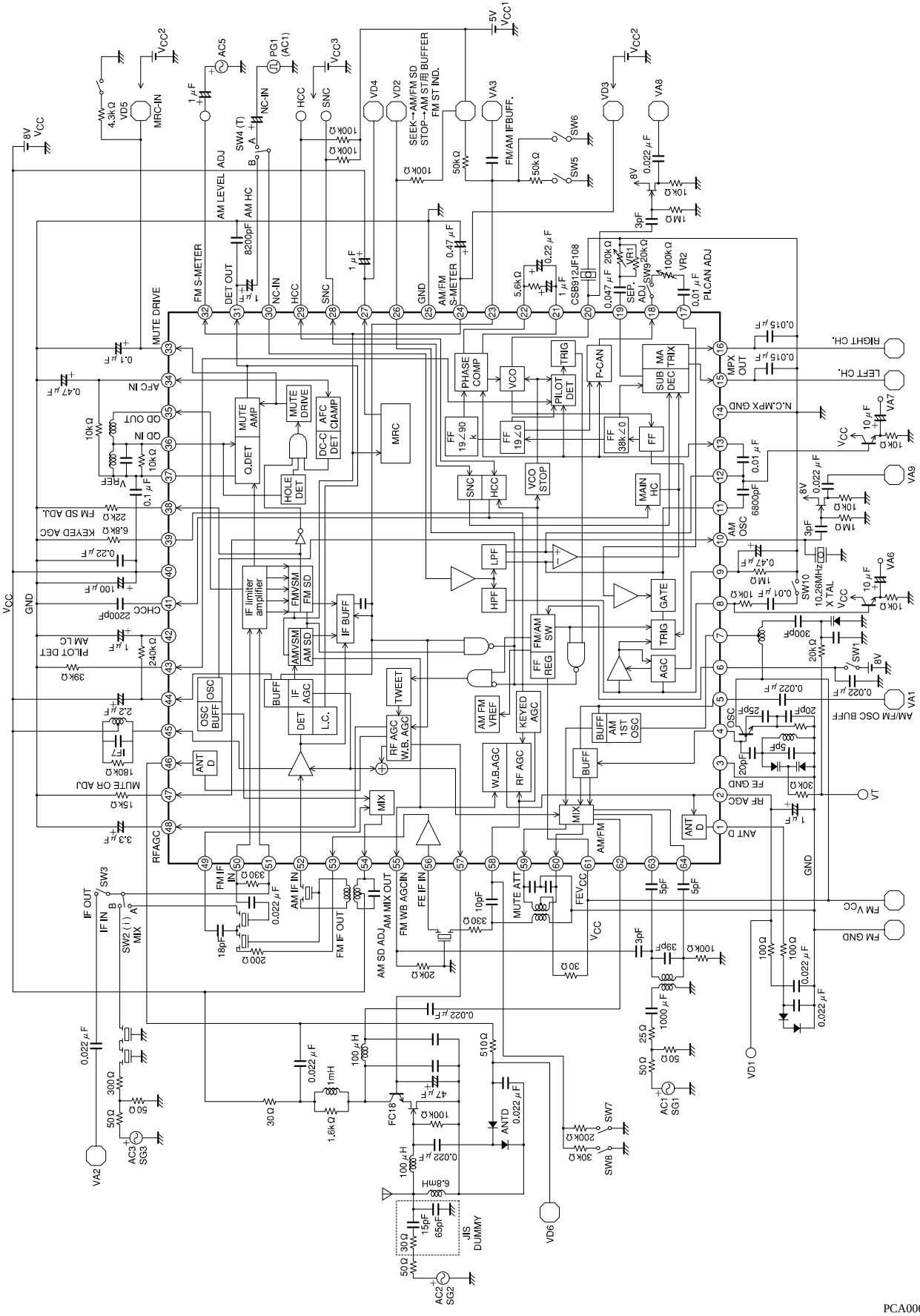
unit : mm

3159A





Block Diagram and Test Circuit



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