



# LA7780M

## QPSK Downconverter for CATV Systems

### Overview

The LA7780M is a downconverter for QPSK data demodulation for digital CATV transmission. This IC integrates a preamplifier, an AGC amplifier, a mixer, an oscillator, a post-amplifier, and other circuits in a single chip, and provides all the functions required from cable signal input through output to the A/D converter.

### Features

- Since a preamplifier is built in, the LA7780M has adequate sensitivity to handle the input signal from the cable directly.  
(Input signal level: -30 to +30 dBm)
- Both internal and external AGC are supported as the AGC amplifier drive technique.
- The output amplitude of the post amplifier used to drive the A/D converter is 2 V<sub>p-p</sub> (typical).
- Applications can be designed to use either a crystal or an inductor oscillator.

### Specifications

#### Maximum Ratings at T<sub>a</sub> = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V <sub>CC</sub> max	Pins 5, 6, and 17	7.0	V
Circuit voltage	V max	Pins 4, 12, and 24	V <sub>CC</sub>	V
Circuit current	I <sub>4</sub>	The pin 4 output current	30	mA
	I <sub>13</sub>	The pin 13 sink current	2	mA
	I <sub>16</sub>	The pin 16 sink current	2	mA
Allowable power dissipation	P <sub>d</sub> max	T <sub>a</sub> ≤ 70°C	540	mW
Operating temperature	T <sub>opr</sub>		-20 to +70	°C
Storage temperature	T <sub>stg</sub>		-55 to +150	°C

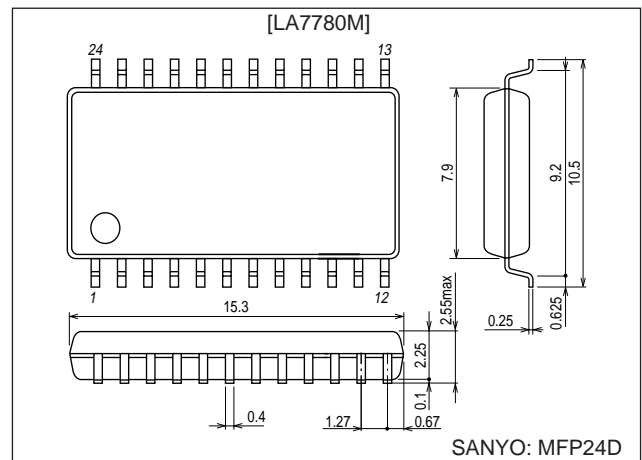
### Functions

- Preamplifier
- AGC amplifier
- Mixer
- Oscillator
- Post amplifier
- IF AGC (internal/external)
- AGC detector

### Package Dimensions

unit: mm

#### 3108-MFP24D



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# LA7780M

## Operating Conditions at $T_a = 25^\circ\text{C}$

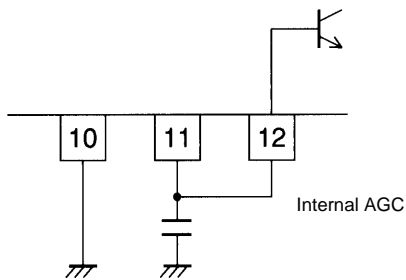
Parameter	Symbol	Conditions	Ratings	Unit
Recommended supply voltage	$V_{CC}$	Pins 5, 6, and 17	5.0	V
Operating supply voltage range	$V_{CC\text{ op}}$	Pins 5, 6, and 17	4.5 to 5.5	V

## AC Characteristics at $T_a = 25^\circ\text{C}$ , $V_{CC} = 5.0\text{ V}$ , internal AGC mode, Pin 24 is left open.

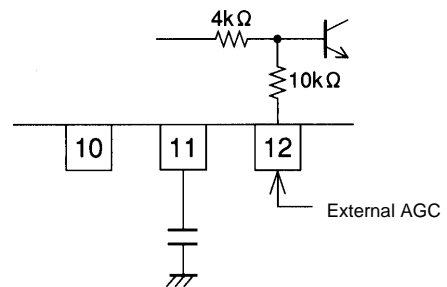
Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Circuit current	$I_{\text{total}}$	Pins 4, 5, 6, and 17: no signal	64	80	95	mA
RF input frequency range	$f_{(\text{in})}$	Pins 1, 8, and 9	30		150	MHz
IF output level	$V_{O(\text{IF})}$	Pin 13: *1	1.6	2.0	2.5	Vp-p
IF output IM3	$V_{O(\text{IM3})}$	Pin 13: *2	40			dB
IF output frequency bandwidth	BW	Pin 13: *3	15			MHz
Local oscillator frequency range	$f_{(\text{LO})}$	Pins 18, 19, 20, and 21	30		200	MHz
AGC amplifier input sensitivity	$V_{\text{in}}(\text{RF2})$	Pins 8 and 9: *4	-25	-21	-17	dBmV
AGC range	GR	Pin 13: IF output level $< \pm 1\text{ dB}$	60	80		dB
AGC flatness	$\Delta V_{O(\text{IF})}$	Pin 13: Compare with the state when $V_{\text{in}}(\text{RF2}) = 30\text{ dBmV}$	-1	0	+1	dB
Preamplifier gain	$G_{(\text{RF1})}$	Pin 4: *5	17	19	21	dB
Maximum preamplifier output level	$V_{O\text{max}}$	Pin 4: *6	50			dBmV
Oscillator output level	$V_{O(\text{OSC})}$	Pin 23: The pin 23 frequency is 1/2 that of the local oscillator	500	800	1000	mVp-p

## Operating Modes

Mode	Pin 10	Pin 11	Pin 12
Internal AGC	GND	With a capacitor between pin 11 and ground	Connected to pin 11
External AGC (Narrow control range: 3 to 5 V)	GND (AGC divider inactive)	With a capacitor between pin 11 and ground	External AGC voltage supply Pin 12 = high impedance
External AGC (Wide control range: 0 to 5 V)	Open (AGC divider active)	With a capacitor between pin 11 and ground	External AGC voltage supply Pin 12 = low impedance (14 k $\Omega$ )



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Note: In internal AGC mode, the IF output level can be adjusted by varying the pin 24 DC voltage.

Caution:

Note 1.

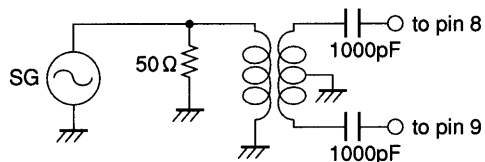
Input: SG = 69.55 MHz, 20 dBm V

Other conditions:

Internal AGC mode

Pin 24 left open.

Output: The post amplifier output (pin 13) at 5 MHz



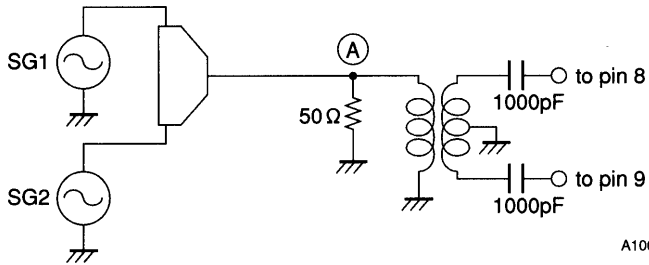
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Transfer ratio = 1 : 1

# LA7780M

Note 2.

Input: SG1 = 69.55 MHz, SG2 = 70.55 MHz



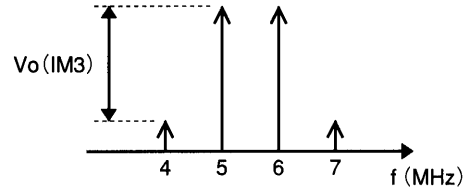
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Point (A) = 20 dBmV (69.55 MHz) + 20 dBmV (70.55 MHz)

Other conditions:

Internal AGC mode  
Pin 24 left open.

Output: The post amplifier output (pin 13)



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Note 3.

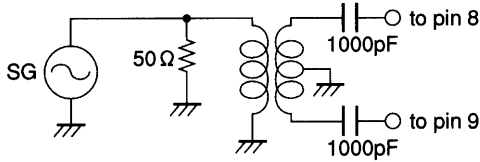
Post amplifier output level = -3 dB

Remove the low-pass filter between pins 14 and 16.

(Short the coil of 27 μH and remove the capacitors of 27 pF and 15 pF.)

Note 4.

Input: SG1 = 69.55 MHz



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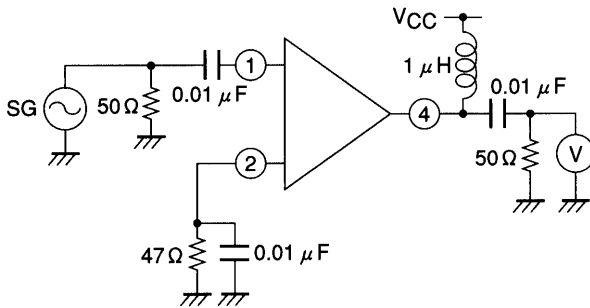
Other conditions:

Internal AGC mode  
Pin 24 left open.

Output: The signal level such that the post amplifier output (pin 13) falls by -3 dB.

Note 5.

SG = 75 MHz, 20 dBm V

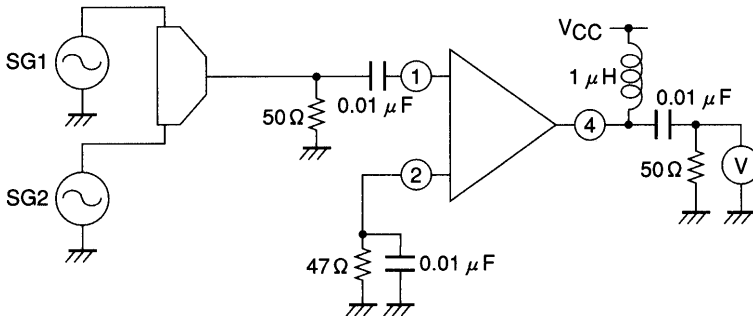


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Note 6.

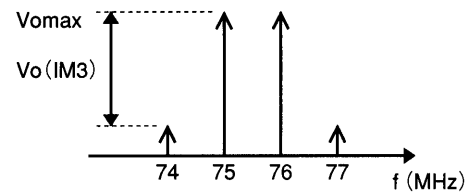
SG1 = 75 MHz, SG2 = 76 MHz,

Adjust the pin 1 level until the IM3 in the pin 4 output is 40 dB.



A10613

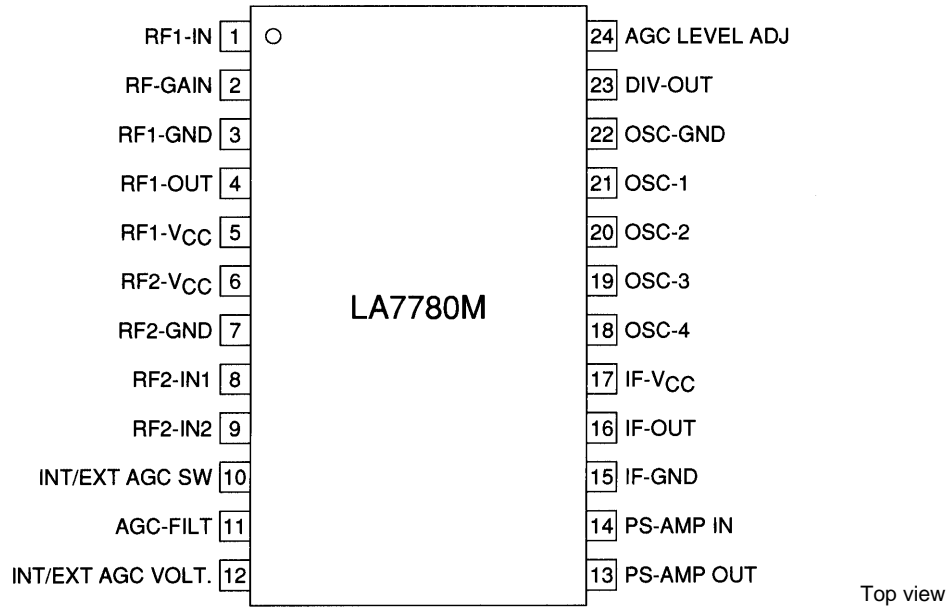
Output: RF1-OUT (pin 4)  
 $V_{O(IM3)} = 40 \text{ dB}$



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# LA7780M

## Pin Assignment

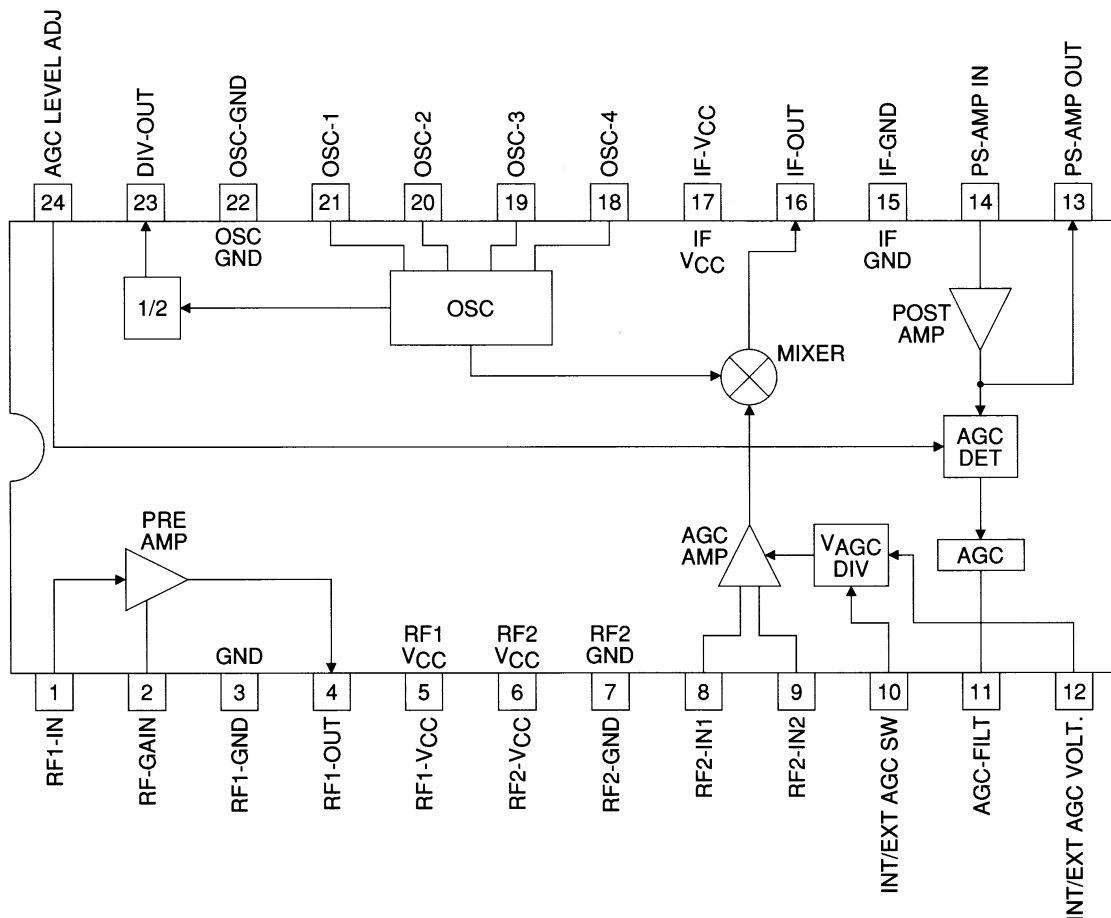


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### Usage Notes

- The oscillator may stop if the power supply rise time is extremely short. To prevent this problem, insert a 500 kΩ resistor between pin 18 and ground or between pin 21 and ground. (This applies when a crystal oscillator is used.)
- This IC should be used with the pin 13 output level between 1 V<sub>p-p</sub> and 2 V<sub>p-p</sub>.
- Use a low-pass filter with a 6-dB attenuation between pins 14 and 16.
- Since the high-frequency process is adopted, care must be taken to prevent the influence of static electricity.

### Block Diagram



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# LA7780M

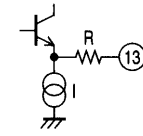
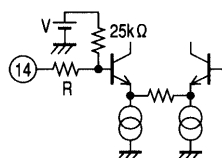
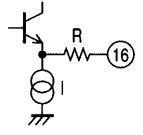
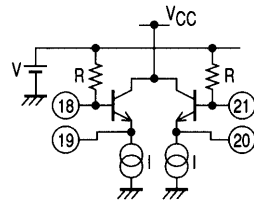
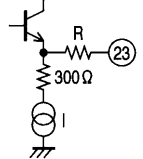
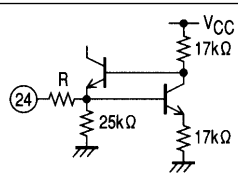
## Pin Descriptions

Pin No.	Function	Pin voltage (V)	Note	Equivalent circuit
1	RF1 input	2.8		<p style="text-align: right;">A10615</p>
2	RF gain	1.3	Impedance connected to pin 2 must be > 45 Ω	<p style="text-align: right;">A10616</p>
3	GND	0		
4	RF1 output	Open collector		<p style="text-align: right;">A10617</p>
5	V <sub>CC</sub>	5.0		
6	V <sub>CC</sub>	5.0		
7	GND	0		
8	RF2 input (1)	2.5	V = 2.5 V	<p style="text-align: right;">A10618</p>
9	RF2 input (2)	2.5	R = 1 kΩ	
10	Internal/external AGC switch	0 (GND) 1.0 (open)	Pin 10 → GND : Internal or external AGC (narrow control range) Pin 10 → open : External AGC (wide control range)	<p style="text-align: right;">A10619</p>
11	AGC filter 2	Open collector Open base (Pin 10 → GND) 4.0 (Pin 10 open)	I <sub>1</sub> = 20 μA I <sub>2</sub> = 100 μA I <sub>3</sub> , I <sub>4</sub> & Q <sub>1</sub> are switched on and off by pin 10.	<p style="text-align: right;">A10620</p>
12	AGC filter 1			

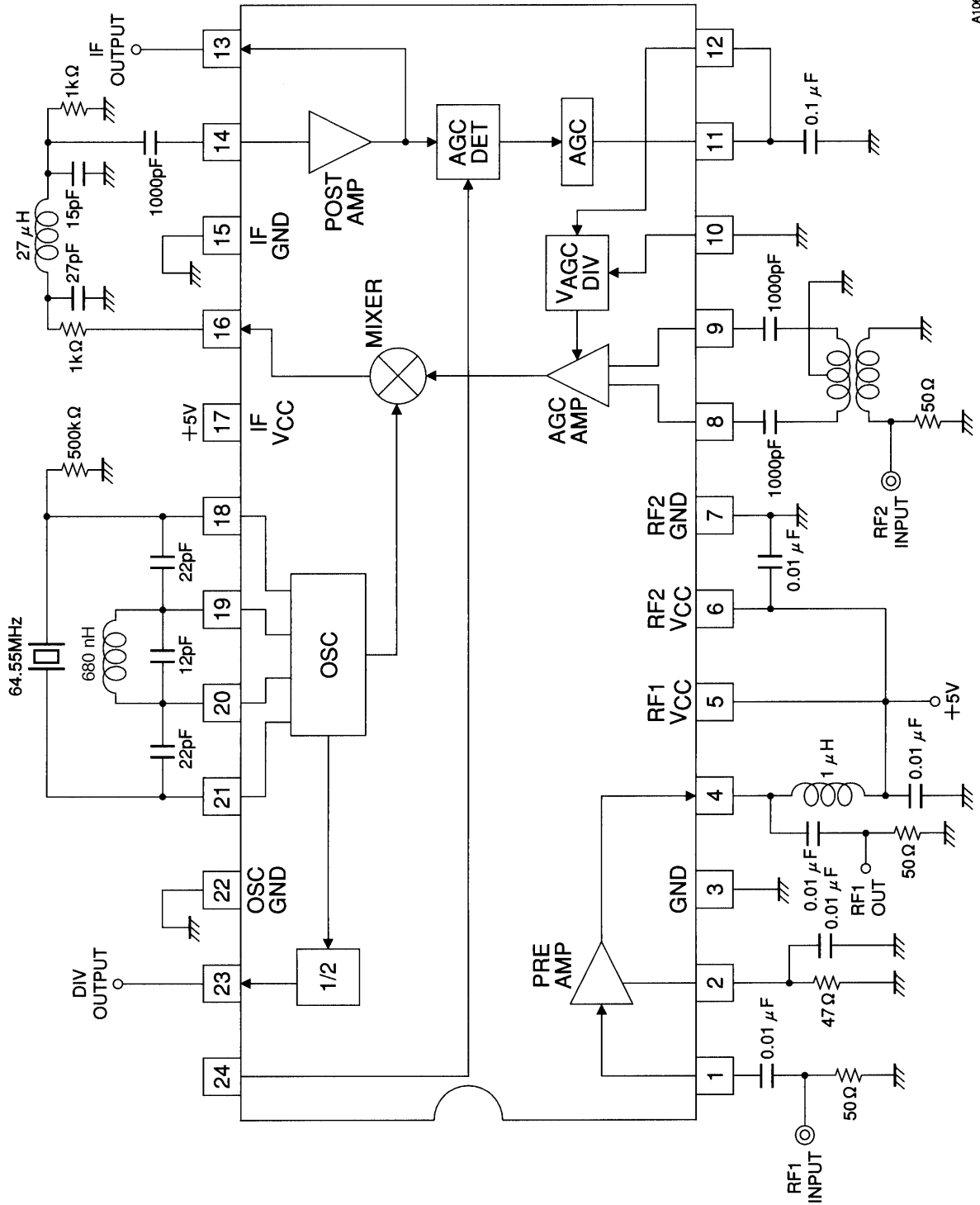
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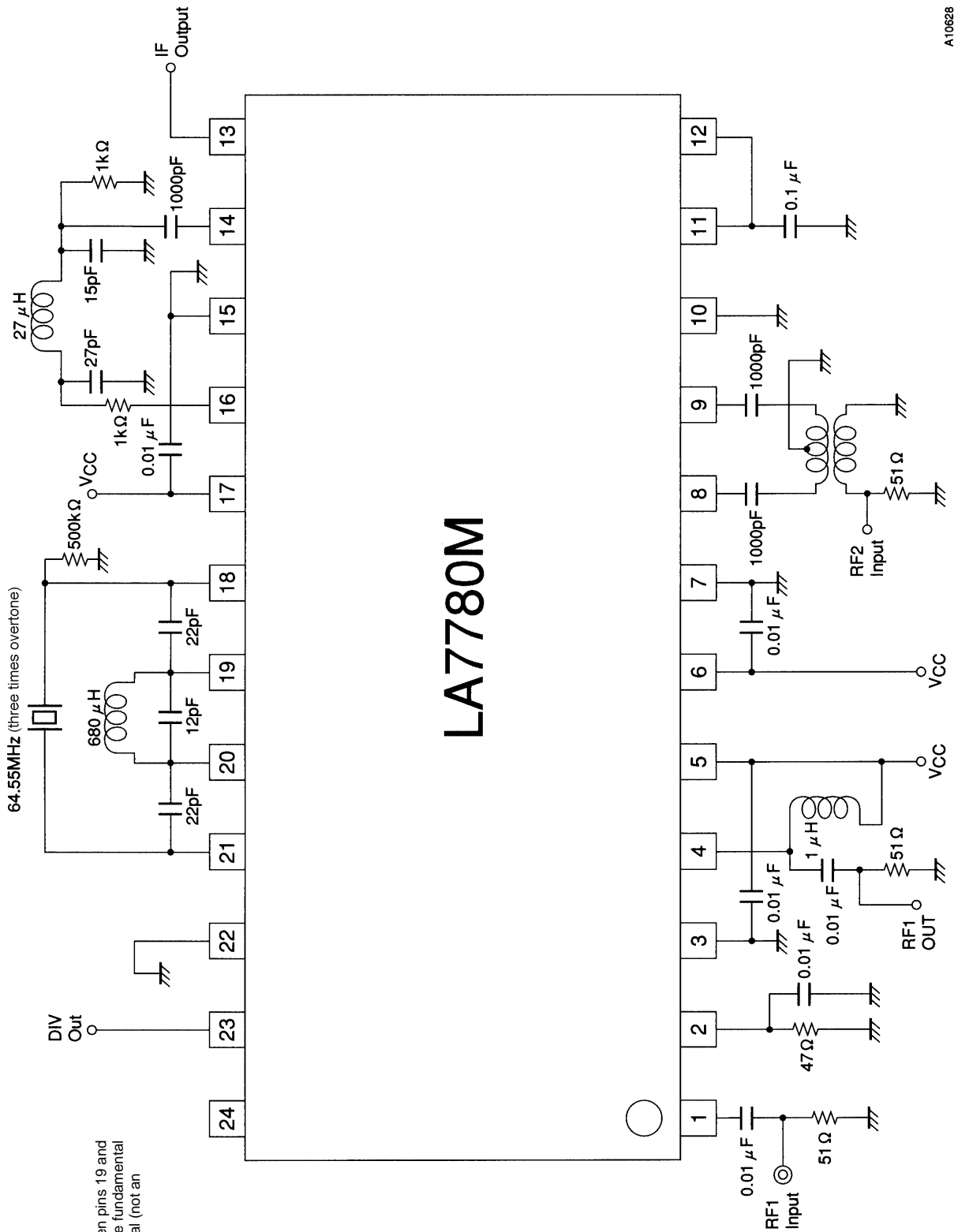
Pin No.	Function	Pin voltage (V)	Note	Equivalent circuit
13	Post-amp output	2, 3	$R = 30 \Omega$ $I = 7 \text{ mA}$	 <p style="text-align: right;">A10621</p>
14	Post-amp input	2.0	$V = 2.1 \text{ V}$ $R = 300 \Omega$	 <p style="text-align: right;">A10622</p>
15	GND	0		
16	IF output	1.7	$R = 100 \Omega$ $I = 3.5 \text{ mA}$	 <p style="text-align: right;">A10623</p>
17	$V_{CC}$	5.0		
18 19 20 21	Oscillator input 4 Oscillator input 3 Oscillator input 2 Oscillator input 1	3.0  3.0	$V = 3.0 \text{ V}$ $R = 5 \text{ k}\Omega$ $I = 1 \text{ mA}$	 <p style="text-align: right;">A10624</p>
22	GND	0		
23	Divider output	3.3	$R = 100 \Omega$ $I = 1 \text{ mA}$	 <p style="text-align: right;">A10625</p>
24	Output level adjustment	2.5	$R = 25 \text{ k}\Omega$	 <p style="text-align: right;">A10626</p>

Test Circuit



A10627

Sample Application Circuit



LA7780M

\*: The choke coil between pins 19 and 20 is not required if the fundamental frequency of the crystal (not an overtone) is used.



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