



Consumer Circuits

LM273/LM373 am/fm/ssb if amp/detector

LM274/LM374 am/fm/ssb if video amp/detector

general description

The LM273/LM373 and LM274/LM374 are broad-band communications subsystems, capable of performing the diverse functions required in AM, FM or single sideband receivers and transmitters. In addition, the LM274/LM374 may operate as high gain AGC'd video amplifier. Bandpass shaping may be performed by a single external filter, connected between amplifier sections, at frequencies from audio up to 30 MHz. The first section of the LM273/LM373 is optimized to drive low impedance loads, such as mechanical or ceramic filters. The LM274/LM374 has a high output impedance, ideal for high-Z crystal, LC or ceramic filters.

The LM273 and LM274 are specified for operation over the -25°C to $+100^{\circ}\text{C}$ military temperature range. The LM373 and LM374 are specified for operation over the 0°C to $+70^{\circ}\text{C}$ temperature range.

features

CONNECTED FOR AM OPERATION

- High gain; typical sensitivity of $10\mu\text{V}$ at 455 kHz
- Wide bandwidth; 30 MHz capability
- Self-contained detector and AGC system
- Wide AGC range, greater than 60 dB for a 10 dB output change at 27 MHz
- Less than ± 1 dB change in audio output -20°C to $+100^{\circ}\text{C}$, typically
- Access to detector input for S/N improvement
- No DC paths required through external filters

- Low feedthrough between amplifier sections, typically better than 65 dB

CONNECTED FOR FM OPERATION

- Three emitter coupled limiting stages and simple quadrature detector
- Detection of ± 5 kHz deviation FM at either 455 kHz or 10.7 MHz
- Two separated amplifier blocks, allowing filtering in two or more blocks
- No DC paths required through external filters or through quadrature network

CONNECTED FOR SSB OPERATION

- Double balanced product detector
- Self contained audio peak AGC system
- Easy external tailoring of AGC characteristic for desired AGC figure of merit

CONNECTED FOR VIDEO AMPLIFIER OPERATION

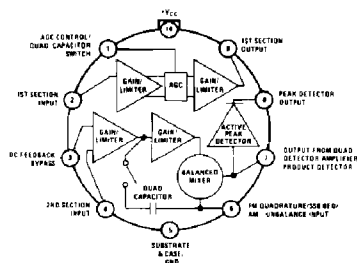
- Internal video peak detector for video AGC
- High and low level video outputs
- Gated video AGC capability

In addition, these versatile microcircuits may be used as:

- Constant amplitude or amplitude modulated RF oscillator
- Synchronous demodulating IF strip
- Mixer and IF, using AGC section as a mixer
- Double sideband modulator with audio AGC

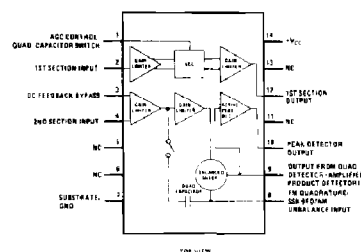
connection diagrams

Metal Can Package



Order Number LM273H or LM373H
LM274H or LM374H
See Package 14

Dual-In-Line Package



Order Number LM373N or LM374N
See Package 22

absolute maximum ratings

Supply Voltage, Operating	18V	DC Voltage Applied to Any Other Pin	+8V, -0.5V
Supply Voltage, Surge (100 ms max)	24V	Junction Temperature (Note 1)	150°C
AC Voltage Applied to Any Pin	1.4V _{pp}	Storage Temperature Range	65°C to +150°C
DC Voltage Applied to AGC Section Output Pin		Operating Temperature Range	-25°C to +100°C
LM273/LM373	+10V, -0.5V	LM273, LM274	0°C to +70°C
LM274/LM374	+18V, -0.5V	LM373, LM374	

electrical characteristics

(T_A = 25°C, V_{CC} = +12V unless otherwise noted) (Subscript numbers in parentheses are DIP pin numbers)

DC CHARACTERISTICS

PARAMETER	SYMBOL	CONDITIONS	LM273/LM274			LM373/LM374			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
Power Supply Current	I ₁₀₍₁₄₎	V _{CC} = 12V, AM Mode		14	20		14	20	mA
AGC Input Current	I ₁	-20°C ≤ T _A ≤ +100°C			21				mA
		V _{AGC} ≤ 5V		50	110		50	110	μA
		-20°C ≤ T _A ≤ +100°C			110				μA
AGC Section Quiescent Output	V ₉₍₁₂₎	V _{AGC} = 0V, LM273/LM373		4.75			4.75		V
AGC Section Output Shift	I ₉₍₁₂₎	V _{AGC} = 0V, LM274/LM374	0.5	0.7	1.0	0.5	0.7	1.0	mA
		V _{AGC} = 0V to V _{AGC} = 5V							
		LM273/LM373		0.1			0.1		V
Second Section Quiescent Output Voltage	ΔV ₉₍₁₂₎	LM274/LM374		-0.1			-0.1		mA
Peak Detector Quiescent Output Voltage	V ₇₍₉₎			3.8			3.8		V
	V ₈₍₁₀₎			3.8			3.8		V

VIDEO CHARACTERISTICS

AGC Section Voltage Gain	A ₂₋₉₍₁₁₎	V _{AGC} = 0V, f = 455 kHz V _{AGC} = 4.5V -20°C ≤ T _A ≤ 100°C LM273/LM373	30	32	-40	29	32	-40	dB
AGC Section Transconductance	g _{m2-9(11)}		28						dB
		V _{AGC} = 0V, f = 455 kHz -20°C ≤ T _A ≤ 100°C LM274/LM374	28	40		28	40		mmhos
			28						mmhos
AGC Section Bandwidth	BW _{AGC}	Z _L = 1k 3 pF		30			30		MHz
AGC Section Output Swing	V ₉₍₁₂₎ max _{pp}	R _L = 1k, V _{AGC} = 0V, V ₂ = ±300 mV, -20°C ≤ T _A ≤ 100°C	0.95	1.4		0.78	1.4		V _{pp}
			0.7						V _{pp}
AGC Section Conversion Voltage Gain	A _{C, AGC}	f ₁ = 30 MHz, f ₂ = 30.455 MHz, e ₂ = 800 mVrms (See Figure 8)		22			22		dB
Second Section Voltage Gain	A ₄₋₇₍₁₁₎	f = 455 kHz T _A = 100°C	32.5	37	39	29.5	37	-	dB
Second Section Bandwidth	BW ₂	Z _L = 100k 3 pF		20			20		MHz
Second Section Output Swing	V ₇₍₁₁₎ max _{pp}	V ₃₋₄ = ±100 mV _{pp} -20°C ≤ T _A ≤ 100°C	0.93	1.4		.83	1.4		V _{pp}
			0.75						V _{pp}

AC PORT PARAMETERS (Typical, e_{IN} = 20 mVrms)

TERMINAL	LM273/LM373			LM274/LM374		
	f = 455 kHz	f = 10.7 MHz	f = 27 MHz	f = 455 kHz	f = 10.7 MHz	f = 27 MHz
2 (V _{AGC} = 0V)	1.2k 2.5 pF	1.2k 2.5 pF	1.15k 2.6 pF	1.2k 2.5 pF	1.2k 2.5 pF	1.15k 2.6 pF
2 (V _{AGC} = 5V)	1.18k 3 pF	1.18k 3 pF	1.1k 2.7 pF	1.18k 3 pF	1.18k 3 pF	1.1k 2.7 pF
4	4.5k 4 pF	5k 5 pF	4.3k 5.5 pF	4.5k 4 pF	5k 5 pF	4.3k 5.5 pF
6(8)	3.0k 7.7 pF	3.0k 7.7 pF	3.0k 8.0 pF	3.0k 7.7 pF	3.0k 7.7 pF	3.0k 8.0 pF
7(9)	1.0k 6 pF	1.0k 6 pF	1.0k 5 pF	1.0k 6 pF	1.0k 6 pF	1.0k 5 pF
9(12)	70Ω -100 pF	60Ω 5 pF	200Ω -90 pF	600k 5.5 pF	100k 3.3 pF	10k 3.5 pF

Note 1: For operation at elevated temperatures, derate devices based on 150°C maximum junction temperature and 150°C/W junction to ambient or 45°C/W junction to case thermal coefficients for the metal can.

TYPICAL AM PERFORMANCE (See Figures 1 and 2)

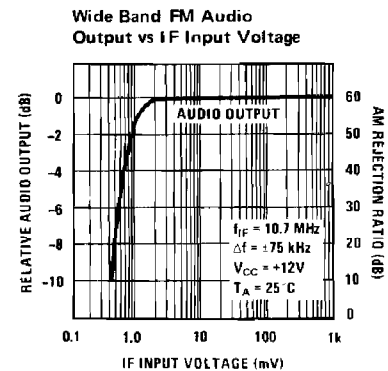
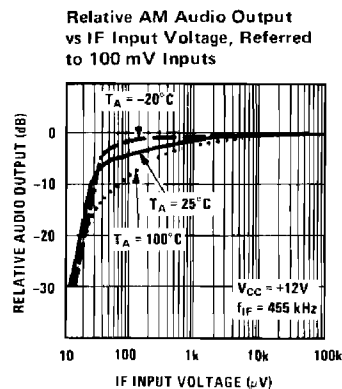
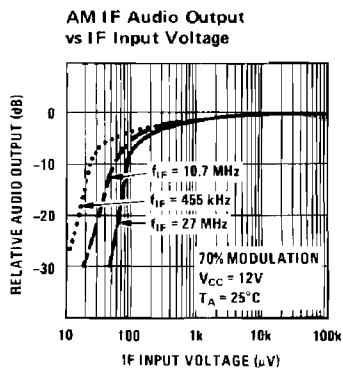
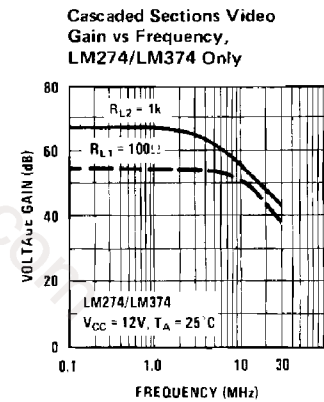
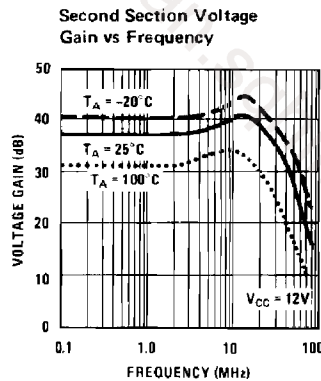
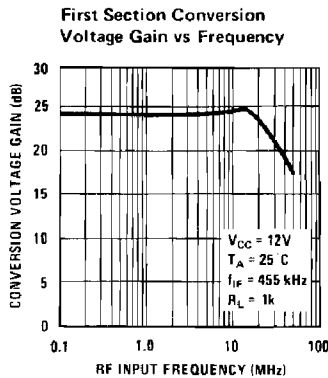
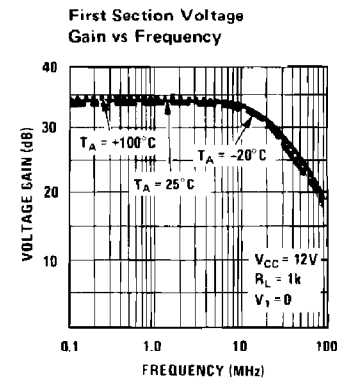
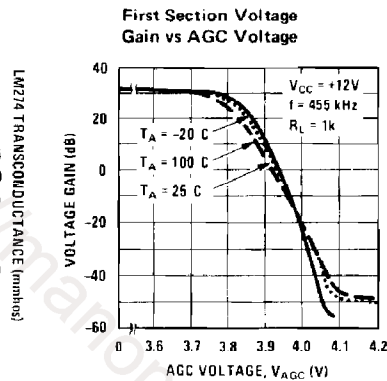
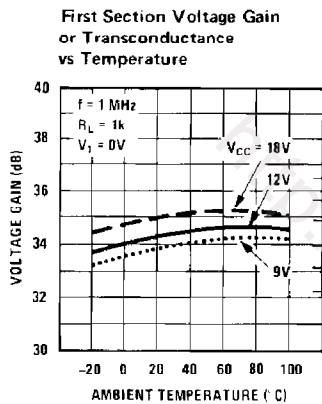
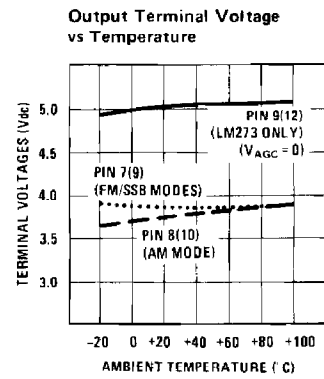
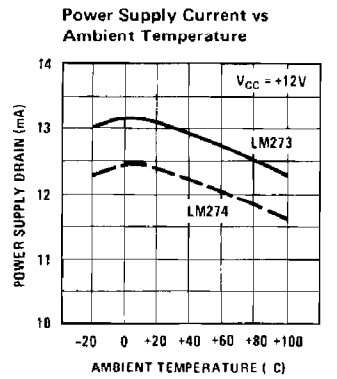
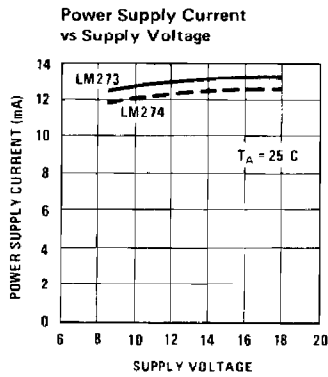
TYPICAL FM PERFORMANCE (See Figures 3 and 4)					
Limiting Threshold	$e_O = 3 \text{ dB}$ from value at $e_{IN} = 100 \text{ mVrms}$ $\Delta f = \pm 75 \text{ kHz}$		800	—	μVrms
	$\Delta f = \pm 5 \text{ kHz}$	800	800	—	μVrms
AM Rejection Ratio	$M_{im} = 1, M_{am} = 0.3$ $e_{IN} = 10 \text{ mVrms}$ $\Delta f = \pm 75 \text{ kHz}$		45	—	dB
	$\Delta f = \pm 5 \text{ kHz}$	35		—	dB
Audio Output	$e_{IN} = 10 \text{ mVrms}$ $\Delta f = \pm 75 \text{ kHz}$		80	—	mVrms
	$\Delta f = \pm 5 \text{ kHz}$	70	38	—	mVrms
	@ $T_A = 100^\circ\text{C}$, $\Delta f = \pm 75 \text{ kHz}$		50	—	mVrms
	@ $T_A = 100^\circ\text{C}$, $\Delta f = \pm 5 \text{ kHz}$ LM273 and LM274 only	40	19	—	mVrms
Audio Distortion	$e_{IN} = 10 \text{ mVrms}$ $\Delta f = \pm 75 \text{ kHz}$		1.5	—	%
	$\Delta f = \pm 5 \text{ kHz}$	2	1.0	—	%

TYPICAL SSB PERFORMANCE (See Figures 5 and 6)

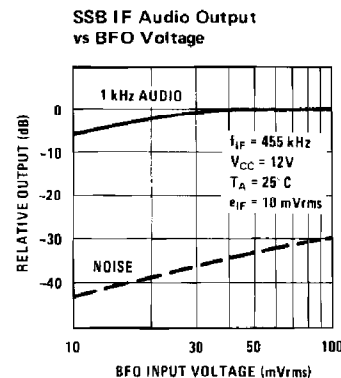
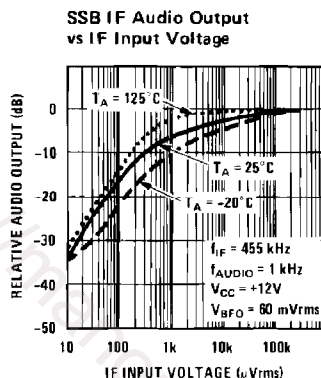
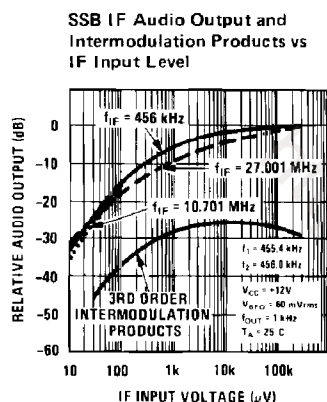
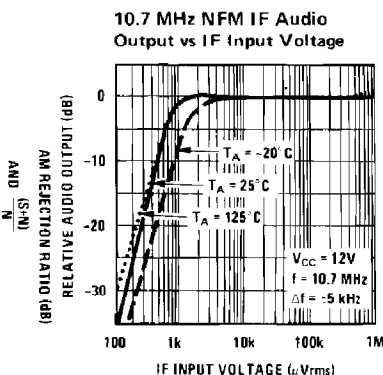
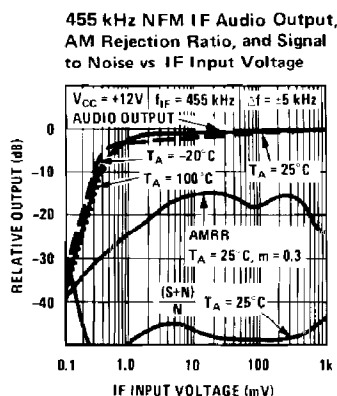
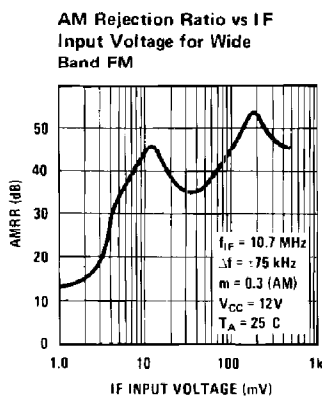
Sensitivity	(Signal + Noise)/Noise = 10 dB $e_{LO} = 60 \text{ mVrms}$	25	30	60	μVrms
AGC Threshold	Same as AM	300	300	500	μVrms
AGC Figure of Merit	Same as for AM	60	60	50	dB
Audio Output Voltage	$e_{IN} = 100 \text{ mVrms}$	60	80	85	mVrms
	$T_A = 100^\circ\text{C}$ LM273 and LM274 only	40	55	60	mVrms

Pin connections shown are for TO-5 package only.

typical performance characteristics



typical performance characteristics (con't)



APPLICATION HINTS

The LM273/LM373 and LM274/LM374 devices have been designed for stability and minimum usage of external components, while at the same time offering wide versatility through access to inputs and outputs of nearly every major functional block of the device. This makes possible the detection of AM, FM, and SSB signals with a single device with a minimum of circuitry switching. Experience has shown that for optimum performance of the multiple mode IF strip, the following suggestions should be noted.

First, as with any radio frequency gain device, proper layout and minimum lead length should be observed. The first gain block, Pin 2 to Pin 9, shows a typical gain of 32 dB and the second gain block, Pin 4 to Pin 7, shows a typical gain of 37 dB so it is clear why any stray coupling or long leads should be kept clear from any of the gain input pins. Despite its high gain, however, the device does not require any shielding between stages. Construction on a copperclad printed circuit type board is more than adequate. It should also be observed that good power supply bypassing directly at Pin 10 and DC feedback bypassing at Pin 3 is always necessary.

The devices can be wide-band coupled to provide video gain response up to approximately 50 MHz. For AM operation, however, it is much more desirable to limit the IF bandwidths. This will greatly increase both input sensitivity and AGC figure of merit by preventing the device from AGCing on wideband detected noise. There are two ways of accomplishing this. One is to insert filtering from the first gain block to the second, Pin 9 to Pin 4, but the most effective way is to AC couple an L-C tank from the input of the active peak detector to ground. A lossy filter from Pin 9 to Pin 4 should be avoided as this will greatly reduce the audio output and AGC figure of merit. In addition the tank on Pin 7 should have high enough Q to limit noise yet low enough to pass the full IF signal. It should also have a high enough impedance (>5k) to avoid affecting the gain of that stage. Proper audio output is attained by a small capacitor at Pin 8 to peak detect the RF envelope, followed by a series RC roll off to shape the audio response. Here again excessive loading will reduce available output. There is a trade off available between audio level out and AGC range so the feedback resistor from Pin 8 to the AGC feedback, Pin 1, should be adjusted to give the desired results. Pin 1 must

be filtered well with approximately $15\ \mu\text{F}$ capacitor or larger to prevent any AC variation from causing erratic AGC action.

For proper FM operation, the input level needs to be larger, on the order of $1\ \text{mV}$ to give full limiting which is necessary for good AM rejection. Here again low loss coupling from Pin 9 to Pin 4 is desired. The phase shift network on Pin 6 should be shielded to prevent any extraneous RF pickup or radiation. Also the Q of the network should be adjusted to give the proper bandwidth for the type of signal to be detected, whether wideband or narrowband FM. Obviously, it should be tuned to the same center frequency as the IF input and the Pin 9 to Pin 4 filtering so that detection takes

place symmetrically around the resonant frequency of the tank. Since the audio output for FM is at Pin 7, it should be RF bypassed along with audio rolloff and de-emphasis.

For SSB operation, the devices operate almost the same as in the AM mode, with the exception that the product detector which was unbalanced and used as a simple gain stage for AM is now balanced and used for detection. The local oscillator signal is fed into Pin 6 at an optimum level around $60\ \text{mVrms}$. For better AGC, a capacitor may be added to Pin 8 in addition to the one already at Pin 1 to provide even more filtering for AGC feedback voltage. The output level and AGC figure of merit is still adjusted by the feedback resistors from Pin 8 to Pin 1.

typical applications

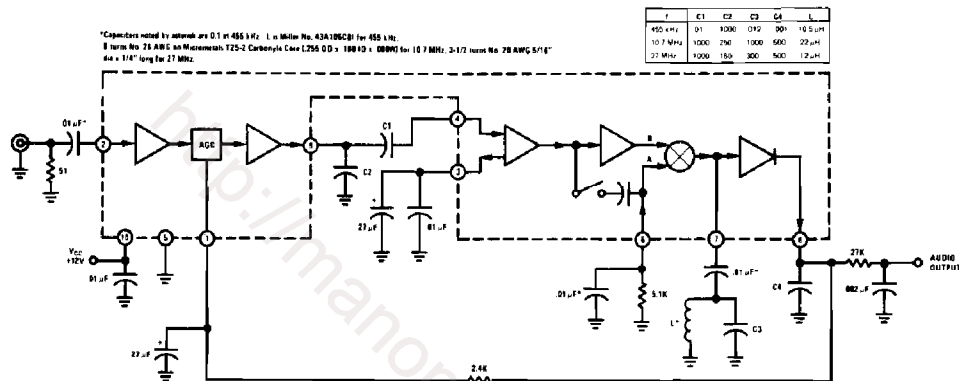


FIGURE 1. LM273/LM373 AM IF Connection

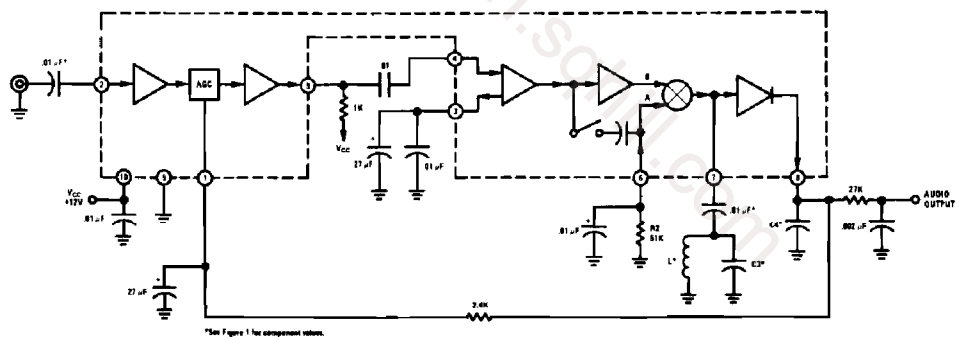


FIGURE 2. LM274/LM374 AM IF Connection

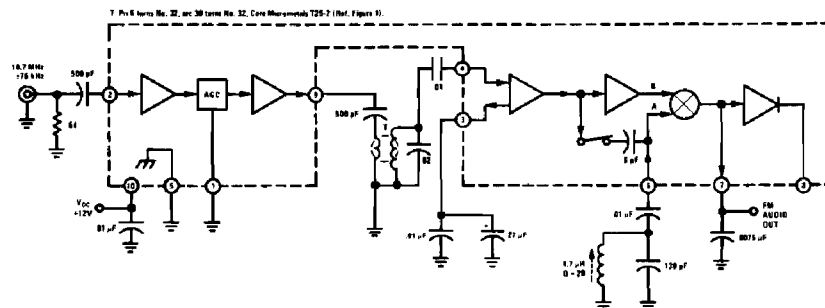


FIGURE 3. LM273/LM373 Wide Band FM IF Connection

typical applications (con't)

