MICRO NETWORKS

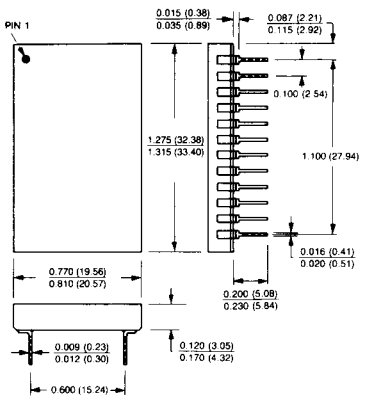
MN376

200nsec
12-Bit LINEAR
TRACK-HOLD AMPLIFIER

FEATURES

- 200nsec Max Acquisition Time 10V Step to ±0.01%
- 100nsec Max Track-to-Hold Settling Time
- ±20psec Aperture Jitter
- Use with MN5245/46 for 1MHz 12-Bit A/D Conversions; with MN5249 for 2MHz
- 78dB Feedthrough Attenuation
- TTL Compatible
- Pin-Compatible MN0300A, HTC-0300A, TP4860
- Full Mil Operation −55°C to +125°C
- MIL-H-38534 Screening Optional. MIL-STD-1772 Qualified Facility

24 PIN DIP



Dimensions in Inches (millimeters)

DESCRIPTION

MN376 is an extremely high-speed track-hold (sample-hold) amplifier. Its 200nsec maximum acquisition time (to ±0.01%) and 100nsec maximum track-to-hold transient settling time enable it to deliver accurate, 12-bit linear, analog samples at a 3.3MHz rate. Its ±5μV/μsec maximum droop rate enables it to hold acquired signals to 12-bit accuracy for periods longer than 200μsec. Its ±20psec aperture jitter (40psec total aperture window) enables it to accurately sample full scale analog signals with frequencies up to 1MHz, while its 16MHz small-signal bandwidth and 300V/μsec slew rate obviously enable it to accurately track much faster smaller-scale signals. In the hold mode, input-output feedthrough attenuation is specified at 78dB (better than ½LSB in 12 bits) at 2.5MHz.

MN376 is designed to be used with Micro Networks high-speed 12-bit A/D's to configure high-throughput, broadband, sampling/digitizing systems. It can be used with MN5245 or MN5246 (850nsec 12-bit A/D's) to configure a bonafide 1MHz sampling A/D with a 500kHz input bandwidth or with MN5249 (400nsec 12-bit A/D) to form a 2MHz digitizer with a 1MHz bandwidth.

Unlike many high-speed T/H's available today, MN376 fully guarantees acquisition time and track-to-hold settling time (a T/H's two throughput limiting specifications) to ±0.01%FS (equivalent to ±0.005% FSR or ±1mV) and not to only ±0.1% or ±1%. A 24-pin dual-in-line package, a gain of −1, an input/output range of ±10V, and TTL compatibility make the MN376 pin compatible with Micro Networks MN0300A, Analog Devices/Computer Labs HTC-0300A, and industry-standard 4860 type high-speed T/H's.

MN376 is designed to be used without external adjustments. Its thin-film nichrome resistors are actively laser trimmed to minimize gain (±0.05%), offset (±0.5mV) and pedestal (±2.5mV) errors. The stability of those resistors minimizes gain (±0.5ppm/°C), offset (±3ppm of FSR/°C) and pedestal (±4ppm of FSR/°C) drifts with temperature. Low power consumption (875mW maximum) enables full 0°C to +70°C (MN376) or −55°C to +125°C (376 H, H/B) ambient operation. Optional MIL-H-38534 screening makes the MN376H/B CH ideal for most military/aerospace high-speed sampling applications.

May 1988

MICRO NETWORKS
324 Clark St., Worcester, MA 01606 (508) 852-5400

MN376 200nsec 12-Bit LINEAR T/H AMPLIFIER

ABSOLUTE MAXIMUM RATINGS

Operating Temperature Range	−55°C to +125°C
Specified Temperature Range:	
MN376	0°C to +70°C
MN376H, MN376H/B (Note 3)	−55°C to +125°C
Storage Temperature Range	−65°C to +150°C
±15V Supply Voltage (±V_{CC}, Pins 24, 22)	±18 Volts
+5V Supply Voltage (+V_{dd}, Pin 9)	−0.5 to +7 Volts
Analog Input (Pin 13) (Note 1)	±18 Volts
Digital Inputs (Pins 11, 12)	−0.5 to +5.5 Volts
Output Current (Note 2)	±50mA

ORDERING INFORMATION

PART NUMBER — MN376H/B CH

Standard Part is specified for 0°C to +70°C Operation.

Add "H" for specified −55°C to +125°C operation.

Add "/B" to "H" models for Environmental Stress Screening.

Add "CH" to "/B" models for 100% screening according to MIL-H-38534.

SPECIFICATIONS (T_A = +25°C, Supply Voltages ±15V and +5V unless otherwise indicated)

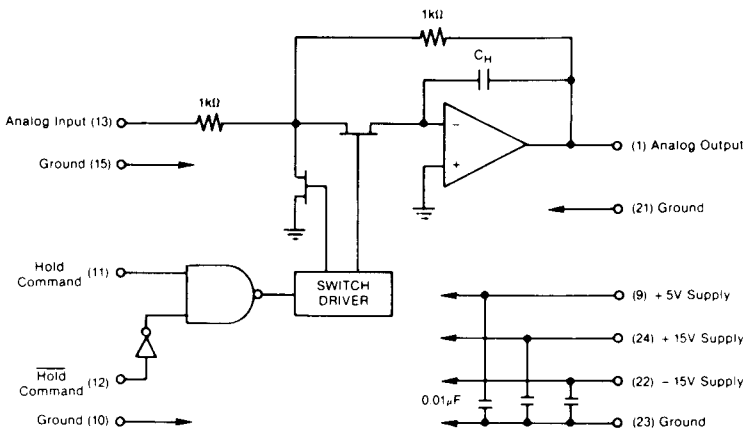
ANALOG INPUT/OUTPUT	MIN.	TYP.	MAX.	UNITS
Input/Output Voltage Range	±10.25	±11.5		Volts
Input Impedance (Note 10)		1		kΩ
Output Current (Note 2)	±20			mA
Output Impedance (Note 10)		0.1		Ω
Maximum Capacitive Load (Note 10)		100		pF
DIGITAL INPUTS				
Logic Levels (Note 4): Logic "1"	+2.0			Volts
Logic "0"			+0.8	Volts
Loading (Note 5)			1	TTL Load
TRANSFER CHARACTERISTICS				
Gain		−1		V/V
Gain Accuracy		±0.05	±0.1	%
Gain Linearity Error (Note 6)		±0.005	±0.01	%FS
Offset Voltage (Track Mode)		±0.5	±5	mV
Pedestal (Note 7)		±2.5	±20	mV
Stability: Gain Drift		±0.5	±5	ppm/°C
Offset Drift (Track Mode)		±3	±15	ppm of FSR/°C
Pedestal Drift		±5		ppm of FSR/°C
DYNAMIC CHARACTERISTICS				
Acquisition Time (Notes 6, 8): 10V Step to ±0.01%FS (±1mV)		160	200	nsec
10V Step to ±0.1%FS (±10mV)		80	170	nsec
10V Step to ±1%FS (±100mV)		60		nsec
5V Step to ±0.01%FS (±0.5mV)		120	160	nsec
1V Step to ±1%FS (±100mV)		60		nsec
Settling Time, Track-to-Hold (Note 9): to ±0.005%FS (±0.5mV)		60	130	nsec
to ±0.01%FS (±1mV)		50	100	nsec
to ±0.1%FS (±10mV)		30		nsec
Track-to-Hold Transient (Note 10)		180		mVp-p
Aperture Delay Time (Note 10)		6		nsec
Aperture Jitter (Note 10)		±20		psec
Output Slew Rate (Note 10)		±300		V/μsec
Small Signal Bandwidth (−3dB, Note 10)		16		MHz
Large Signal Bandwidth (Notes 10, 11): 100kHz		−90		dB
500kHz		−90		dB
1MHz		−84		dB
2MHz		−75		dB
Droop: +25°C		±0.5	±5	μV/μsec
+70°C		±15		μV/μsec
+125°C		±1.2		mV/μsec
Feedthrough Attenuation (20Vp-p input): 100kHz		84		dB
500kHz		84		dB
1MHz		80		dB
2.5MHz	70	78		dB

POWER SUPPLIES	MIN.	TYP.	MAX.	UNITS
Voltage Range: ±15V Supplies +5V Supply		±3 ±5		% %
Power Supply Rejection Ratio		±0.5		mV/V
Quiescent Current Drain: +15V Supply −15V Supply +5V Supply		+21 −22 +17	+25 −25 +25	mA mA mA
Power Consumption		730	875	mW

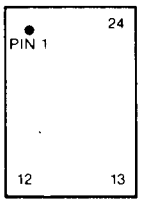
SPECIFICATION NOTES:

1. Analog input signal should not exceed supply voltage.
2. The MN376's output is current limited at approximately ±50mA and can withstand a sustained short to ground. Shorts to either supply will result in destruction. In normal operation, load current should not exceed ±20mA.
3. The MN376H/B is specified for −55°C to +125°C operation and is processed and screened to the requirements of MIL-STD-883, Method 5008.
4. See Applications Information for use of Hold and $\overline{\text{Hold}}$ inputs.
5. One TTL load is defined as sinking 40μA with a logic "1" applied and sourcing 1.6mA with a logic "0" applied.
6. FS stands for Full Scale and is equivalent to 10 volts. FSR stands for Full Scale Range and is equivalent to 20 volts. For a 12-bit system, 1 LSB = 0.024%FSR.
7. Pedestal refers to the unwanted step in output voltage that occurs as a T/H is switched from the track to the hold mode. For many T/H's, pedestal amplitude is a function of input/output voltage level. For the MN376, pedestal is constant regardless of input/output level.
8. Acquisition time is tested with no load and is relatively unaffected by capacitive loads to 50pF and resistive loads to 500Ω.
9. Track-to-hold settling time refers to the time interval between the point at which a device is commanded from the track to the hold mode and the point at which the analog output (following a transient) settles to within a specified error band around its final value.
10. These parameters are listed for reference only and are not tested.
11. Listed specification is the peak of the highest observed harmonic (usually the second) in the output spectrum. Measured in the track mode with a full scale input signal at the frequencies indicated.

BLOCK DIAGRAM



PIN DESIGNATIONS



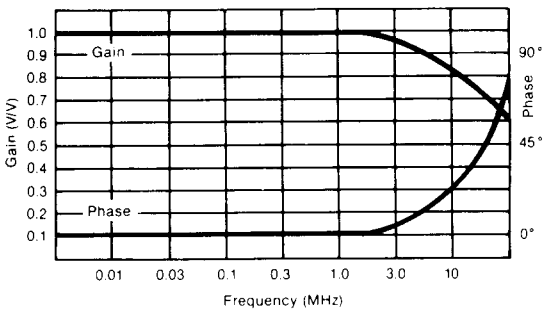
1	Analog Output	24	+15V Supply
2	N/C	23	Ground
3	N/C	22	−15V Supply
4	N/C	21	Ground
5	N/C	20	N/C
6	N/C	19	N/C
7	N/C	18	N/C
8	N/C	17	N/C
9	+5V Supply	16	N/C
10	Ground	15	Ground
11	Hold Command	14	N/C
12	$\overline{\text{Hold}}$ Command	13	Analog Input

APPLICATIONS INFORMATION

GROUNDING AND BYPASSING—With proper grounding and bypassing, the MN376 will meet all its published performance specifications without any additional external components. The device has four Ground pins (pins 10, 15, 21 and 23). All must be tied together and connected to system analog ground as close to the package as possible. It is preferable to have a large analog ground plane beneath the MN376 and have all four ground pins soldered directly to it. Pin 10 is particularly groundnoise sensitive because in the actual construction of the MN376, most of the digital elements that constitute the switch drive circuit are grounded to pin 10. Noise in the switch drive circuit couples directly through to the main op-amp summing junction—the most noise sensitive point in any T/H circuit. Therefore, most digital ground currents will enter or leave the MN376 through pin 10, and in order to keep the output clean, care must be taken to ensure that no ground potentials can exist between pin 10 and the other ground pins. This is why pin 10 must be tied to the analog and not the digital ground system. For the same reason, the +5V digital logic supply (pin 9) should be kept as clean as possible. This supply, as well as the ±15V supplies (pins 24 and 22), is bypassed to ground with 0.01μF ceramic capacitors inside the MN376's package. In critical applications, additional external 0.1μF to 1μF tantalum bypass capacitors may be required.

TRACK-HOLD COMMAND—A TTL logic "0" applied to pin 11 (or a logic "1" applied to pin 12) will put the MN376 into the track (sample) mode. In this mode, the device acts as an inverting unity gain amplifier, and its output will follow (track) its input. A logic "1" applied to pin 11 (or a logic "0" applied to pin 12) will put the MN376 into the hold mode, and the output will be held constant at the level present when the hold command was given. If pin 11 is used to control the MN376, pin 12 must be connected to digital ground. If pin 12 is used to control the MN376, pin 11 must be tied to +5V. Pins 11 and 12 each present 1 TTL load to the digital drive circuit.

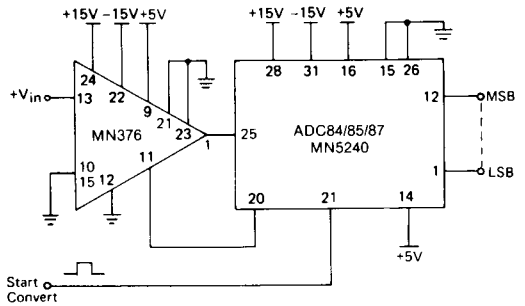
CAPACITIVE AND RESISTIVE LOADING—To avoid possible oscillations, current limiting, and performance variations over temperature, the MN376's output loading has certain restrictions. The maximum capacitive load to avoid oscillation is typically 250pF. Recommended resistive loading is 500Ω (minimum), although values as low as 250Ω may be used. Acquisition and track-to-hold settling times are relatively unaffected by resistive loads down to 500Ω and capacitive loads up to 50pF. Higher capacitances will affect both acquisition and settling time.



Track Mode Gain Amplitude and Phase Response

USING THE MN376 WITH A/D CONVERTERS—There are two important considerations when using T/H's to drive successive approximation A/D's. The first is a dual requirement—the T/H's output stage should exhibit a very low impedance compared to the A/D's input impedance (usually 1 to 10kΩ) at frequencies up to five times the A/D's clock frequency, and the T/H should be able to recover from current transients in a time interval smaller than the A/D's clock period. These requirements are based on the fact that as a successive approximation A/D's internal D/A converter changes its output current just prior to the determination of each output bit, the T/H will be required to sink or source large high frequency current transients and recover within one clock period. In the hold mode, the MN376's output impedance is typically 0.1Ω. Its output typically recovers (to ±0.01%) from a 2mA step in less than 100nsec. The second consideration involves the T/H's track-to-hold transient settling time. If the same timing pulse that puts the T/H into the hold mode intitiates the A/D conversion, the transient settling time has to be short enough to ensure that the A/D has a stable accurate input when it makes the final decision on whether its MSB output should be a "1" or "0". This decision normally takes place one clock period after a conversion has begun.

In most applications using the MN376 in front of a successive approximation A/D converter, the MN376's T/H command pin can be driven directly (or inverted if necessary) from the converter's status output. The status output changes state when the converter receives a convert command, and this change can drive the T/H from the track to the hold mode. The change in state of the A/D's status output at the end of the conversion can put the T/H back into the track mode. The diagram below illustrates an MN376 mated with an ADC85-type A/D in this manner. Since the ADC85's MSB output is not set to its final value until one clock period (approximately 150nsec for the fastest devices in this family) after a conversion begins, the MN376's track-to-hold transient will be completely settled, and no extra timing precautions are necessary.



See the MN5245 12-bit A/D data sheet for information on how to use MN376 to configure a 1MHz, 12-bit sampling A/D with a 500kHz input bandwidth. See the MN5249 data sheet to configure a 2MHz sampling A/D with a 1MHz input bandwidth.