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# HA19216/MP

6-Bit Flash Type Analog-to Digital Converter

# HITACHI

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## Description

The HA19216/MP bipolar LSI performs high speed 6-bit A/D conversion. Digital data output and clock input terminals are compatible with TTL and CMOS. The HA19216/MP are designed for video signal processing application.

## Features

- 6-bit resolution (including overflow)
- 6-bit latched three-state outputs
- Maximum conversion Rate: 20 Msps (Min)
- Single Power Supply: +5 V
- Digital data output, high impedance state control and clock input terminals compatible with TTL and CMOS
- Needs no sample and hold circuit
- 18-pin DIP package and 28-pin surface mount package.
- Output current:
  - $I_{OL} = 1.4$  mA (guaranteed)
  - $I_{OH} = -5$  mA (guaranteed)

## Application

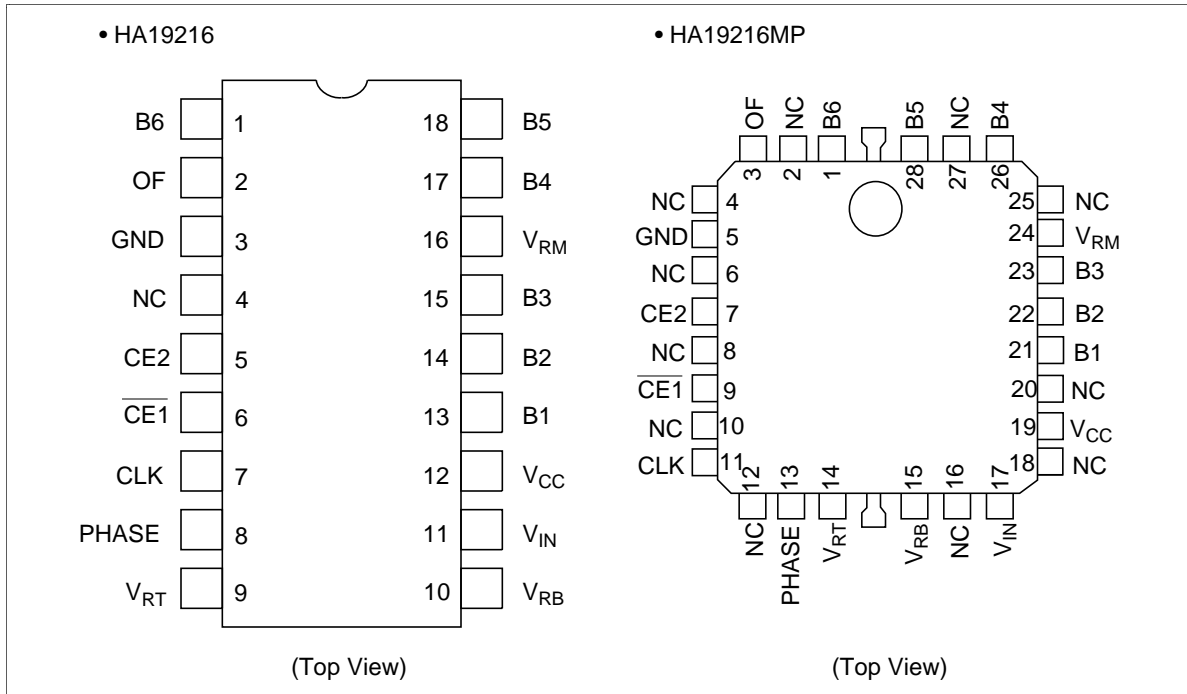
- Pattern recognition using a computer
- High-speed measuring instruments

## Ordering Information

Type No.	Package
HA19216	300mil 18 pin plastic DIP (DP-18A)
HA19216MP	28 pin plastic QFI (MP-28)

# HA19216/MP

## Pin Arrangement



## Pin Function

Pin No.		Symbol	Function	Remarks
HA19216	HA19216MP			
1	1	B6	Bit 6 digital output (MSB)	
2	3	OF	Digital output (Overflow)	
3	5	GND	Ground	
4	—	NC	Not connected	
5	7	CE2	Digital output high	Impedance control input
6	9	$\overline{\text{CE1}}$	Digital output high	Impedance control input
7	11	CLK	Clock input	
8	13	PHASE	Clock phase control input	
9	14	$V_{\text{RT}}$	High level reference voltage input	
10	15	$V_{\text{BR}}$	Low level reference voltage input	
11	17	$V_{\text{IN}}$	Analog input	
12	19	$V_{\text{CC}}$	Power supply	
13	21	B1	Bit 1 digital output (LSB)	

**Pin Function (Cont)**

Pin No.		Symbol	Function	Remarks
HA19216	HA19216MP			
14	22	B2	Bit 2 digital output	
15	23	B3	Bit 3 digital output	
16	24	$V_{RM}$	Reference voltage center tap	
17	26	B4	Bit 4 digital output	
18	28	B5	Bit 5 digital output	

Note:

$\overline{CE1}$	CE2	B1 – B6	OF
×	L	Z	Z
L	H	H/L	H/L
H	H	Z	H/L

H: High level

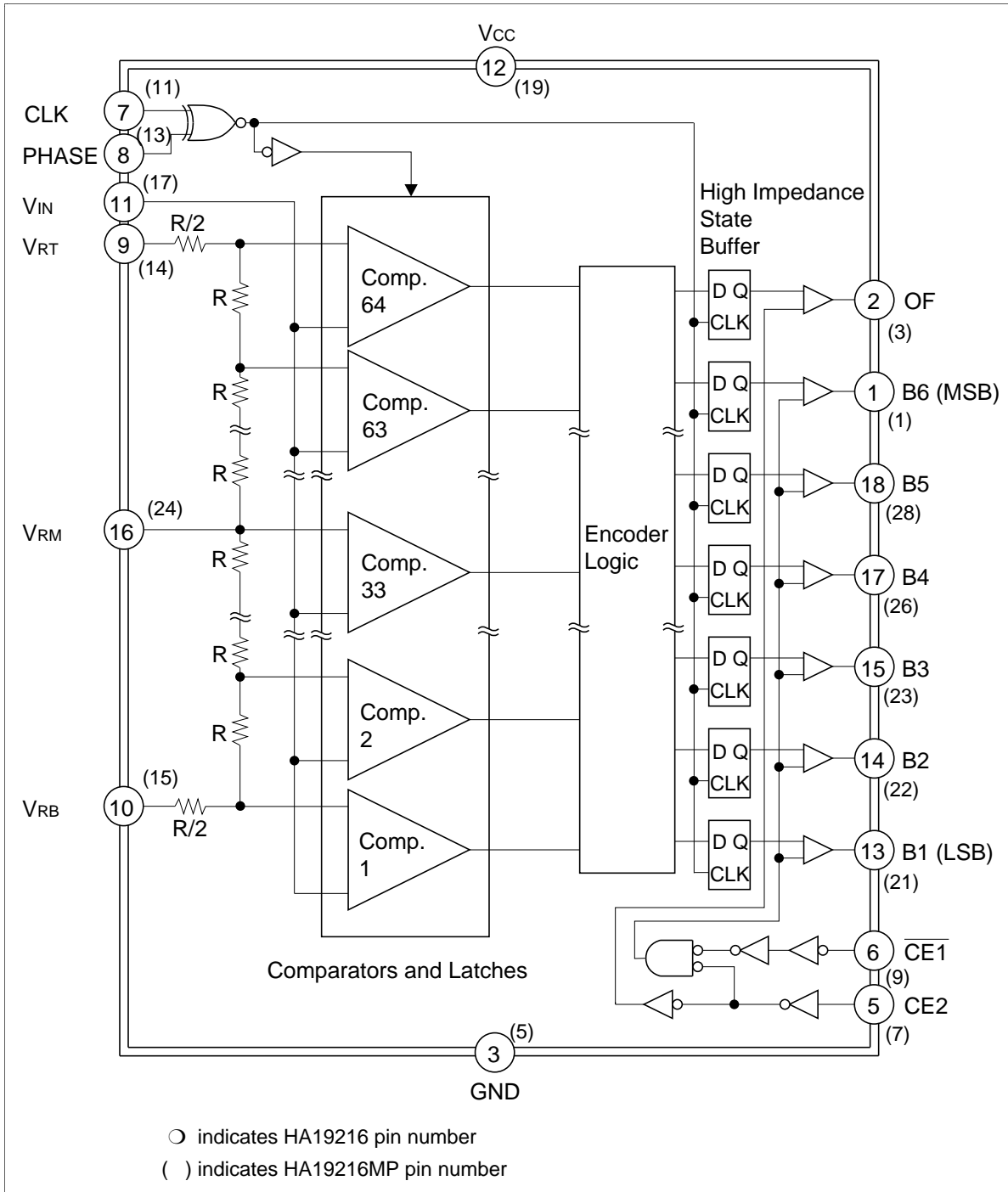
L: Low level

×: Don't care

Z: High impedance

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## Block Diagram



Interface

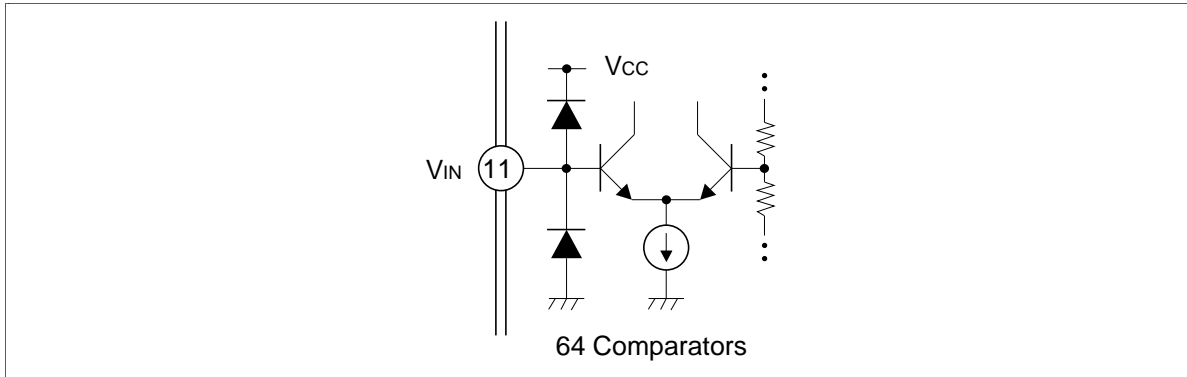


Figure 1 Analog Input

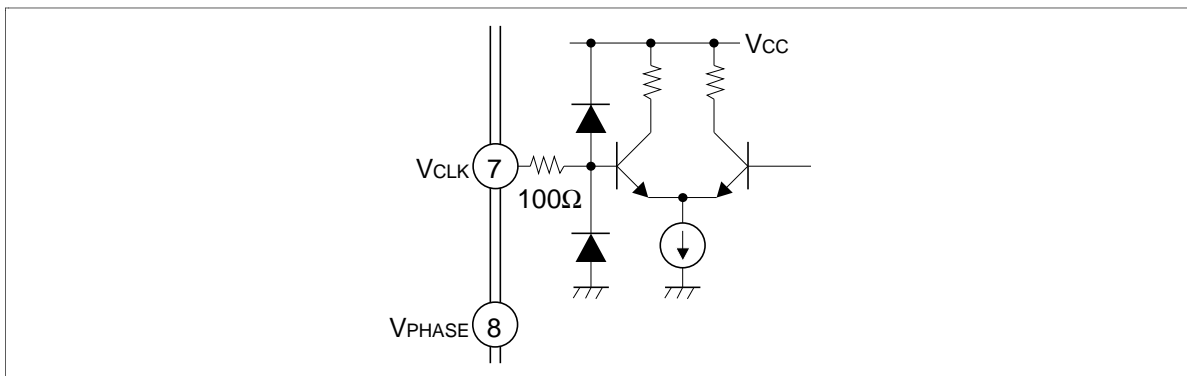


Figure 2 Clock Input

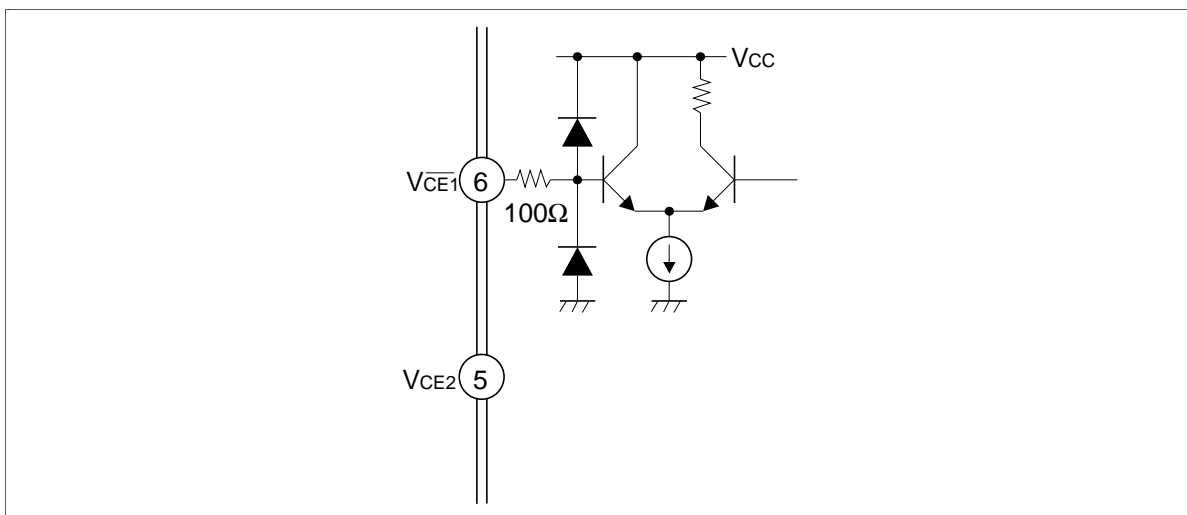


Figure 3 High Impedance State Control Input

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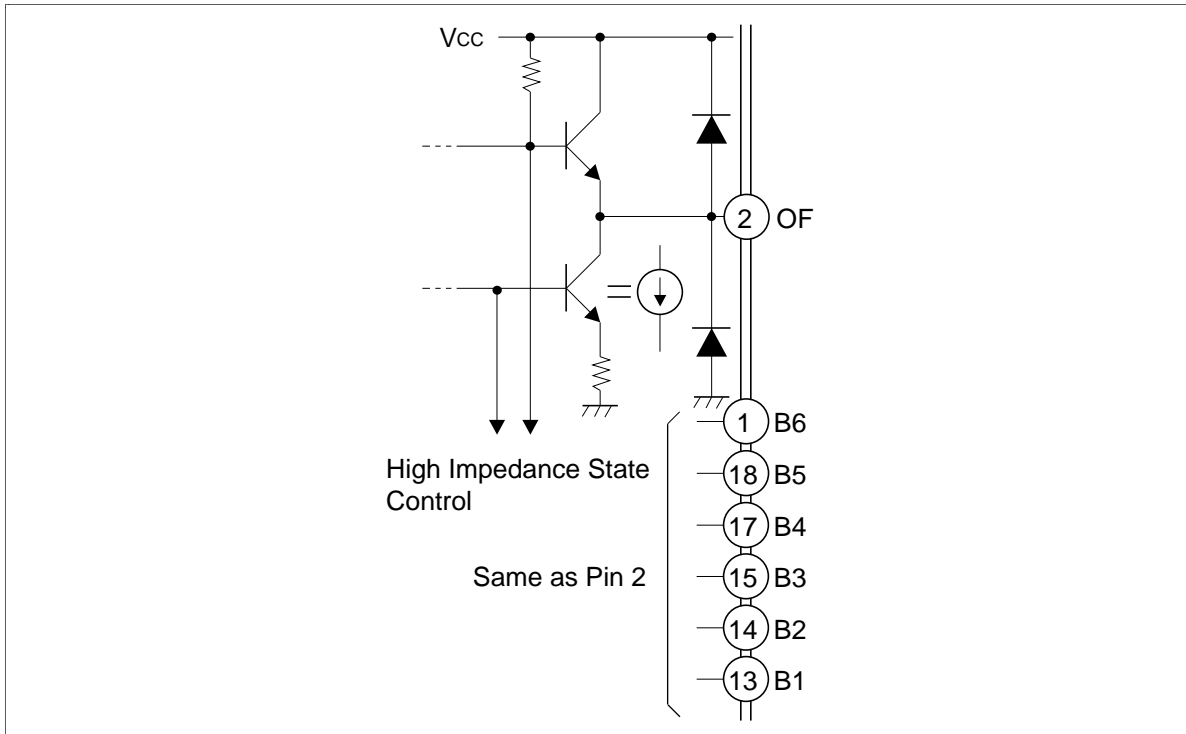


Figure 4 Digital Output

### Absolute Maximum Ratings ( $T_a = 25^\circ\text{C}$ , unless otherwise specified)

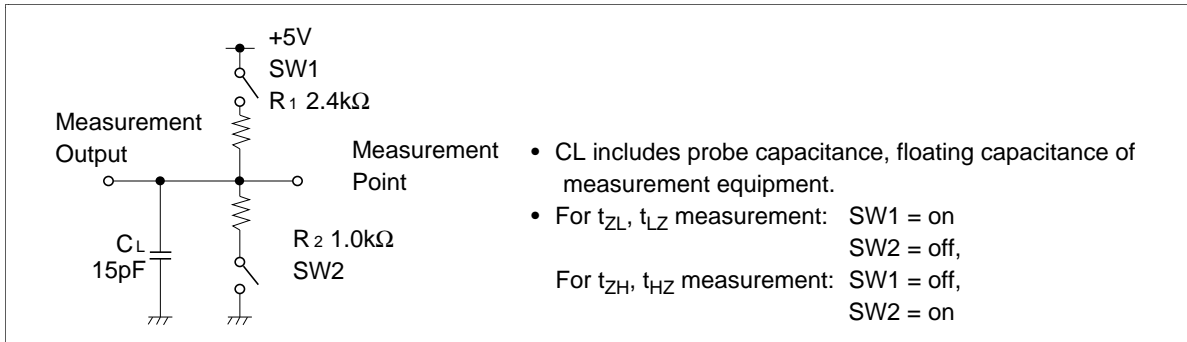
Item	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	+7.0	V
Input signal voltage*	$V_{IN}$	0 to $V_{CC}$	V
Input reference voltage*	$V_R$	0 to $V_{CC}$	V
Digital input voltage	$V_I$	0 to $V_{CC}$	V
Voltage applied to digital output pin in high impedance	$V_O$	0 to $V_{CC}$	V
Power dissipation	$P_T$	550	mW
Operating temperature	$T_{opr}$	0 to +70	$^\circ\text{C}$
Storage temperature	$T_{stg}$	-55 to +125	$^\circ\text{C}$
Reference voltage difference	$V_{RT} - V_{RB}$	1.3	V
Reference center tap voltage	$V_{RM}$	Open state voltage $\pm 0.1$	V

Note:  $V_{IN}$  and  $V_R$  should not be lower than 1.5 V at the same time.

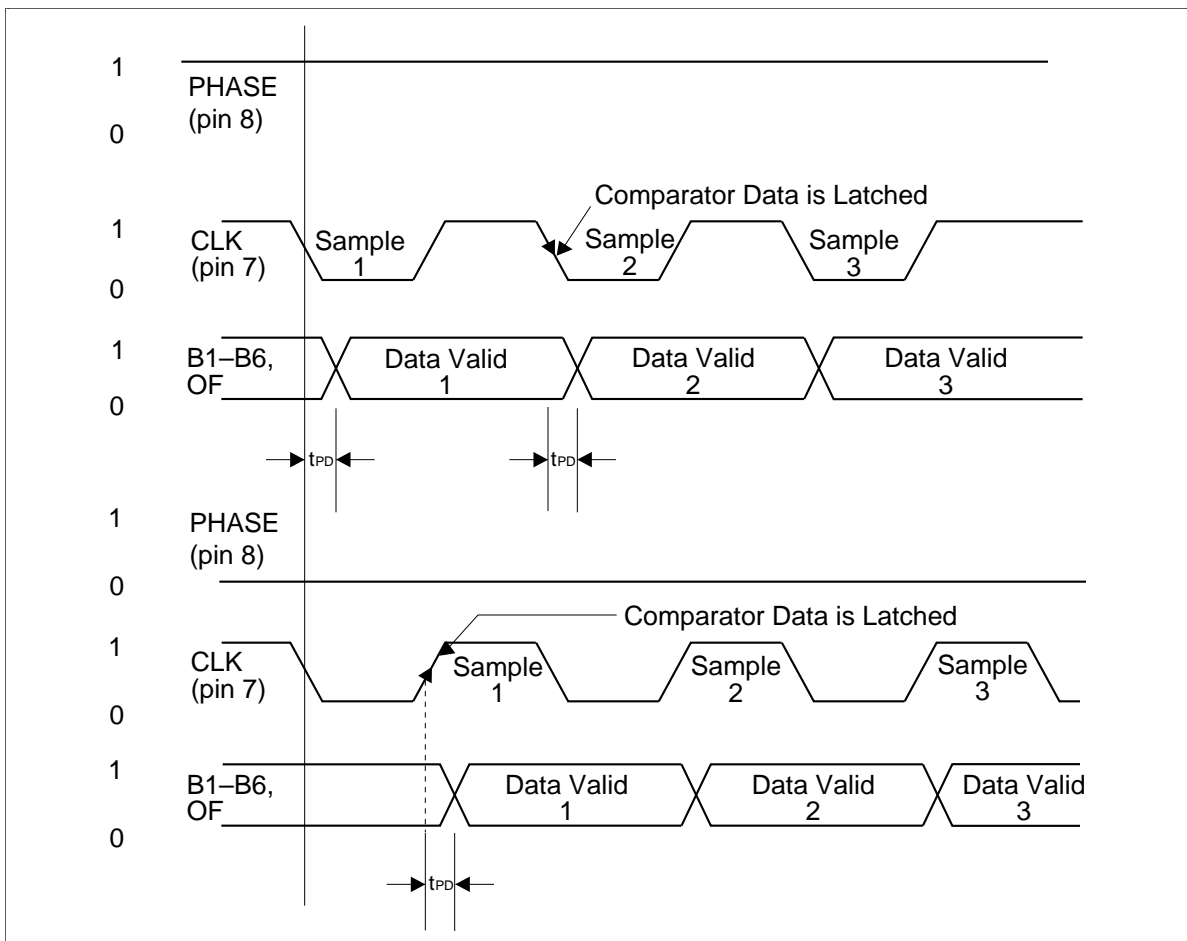
**Electrical Characteristics** ( $T_a = 25^\circ\text{C}$ ,  $V_{CC} = 5.0\text{ V}$ ,  $V_{RT} = 3.0\text{ V}$ ,  $V_{RB} = 2.0\text{ V}$ , unless otherwise specified)

Item		Symbol	Min	Typ	Max	Unit	Test Condition
Resolution			6	6	6	bits	
Operating supply voltage		$V_{CC}$	4.75	5.0	5.25	V	
Quiescent current		$I_{CC}$	—	50	84	mA	$f_{CLK} = 20\text{ Msps}$
Digital input voltage	High	$V_{IH}$	2.0	—	$V_{CC}$	V	
	Low	$V_{IL}$	0	—	0.8	V	
Digital input current	High	$I_{IH}$	—	—	100	$\mu\text{A}$	$V_I = 2.7\text{ V}$
	Low	$I_{IL}$	-100	—	—	$\mu\text{A}$	$V_I = 0.4\text{ V}$
Digital output voltage	High	$V_{OH}$	3.4	3.8	—	V	$I_{OH} = -5\text{ mA}$
	Low	$V_{OL}$	—	0.61	0.76	V	$I_{OL} = 1.4\text{ mA}$
Digital output current (High impedance)	High	$I_{OZH}$	—	—	100	$\mu\text{A}$	$V_O = 5.0\text{ V}$
	Low	$I_{OZL}$	-100	—	—	$\mu\text{A}$	$V_O = 0.5\text{ V}$
Reference current	RT	$I_{RT}$	—	8	12	mA	$V_{IN} = 1.9\text{ V}$
	RB	$I_{RB}$	-12	-8	—	mA	$V_{IN} = 3.1\text{ V}$
Input current		$I_{IN}$	—	20	50	$\mu\text{A}$	$V_{IN} = 3.1\text{ V}$
Input capacitance		$C_{IN}$	—	15	—	pF	$V_{RB} < V_{IN} < V_{RT}$ , $f(V_{IN}) = 1\text{ MHz}$
Static linearity error	Differential	D.N.L.	-0.25	—	+0.25	LSB	
	Integral	I.N.L.	—	—	1.0	LSB <sub>p,p</sub>	
Maximum conversion rate		$f_{CLK}\text{ max.}$	20	—	—	MspS	
Digital output propagation delay		$t_{PD}$	—	34	50	ns	$C_L = 15\text{ pF}$
Digital output rise time		$t_{TLH}$	—	10	15	ns	$C_L = 15\text{ pF}$
Digital output fall time		$t_{THL}$	—	17	25	ns	$C_L = 15\text{ pF}$
Digital output enable time (High impedance)		$t_{ZH}$	—	12	20	ns	
		$t_{ZL}$	—	48	70	ns	
Digital output disable time (High impedance)		$t_{HZ}$	—	32	43	ns	
		$t_{LZ}$	—	23	33	ns	
Clock pulse width	Vphase = 0.8 V	$t_{WH}$	28	32	—	ns	
		$t_{WL}$	15	18	—	ns	
	Vphase = 2.0V	$t_{WH}$	10	13	—	ns	
		$t_{WL}$	33	37	—	ns	

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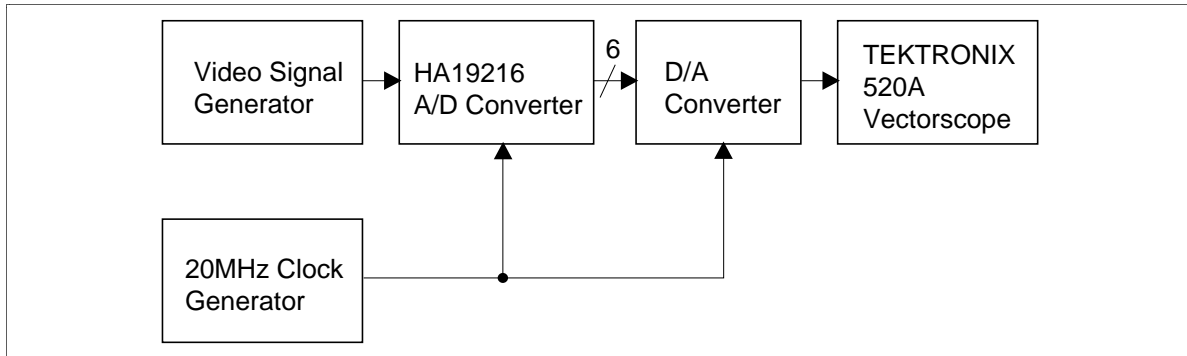


**Figure 5 Measurement Load for Digital Output, Enable Time, Disable Time**

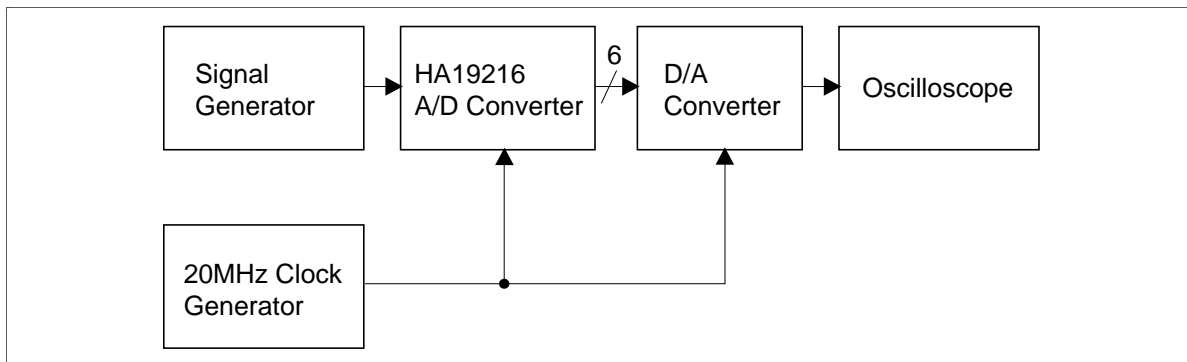


**Figure 6 Timing Diagram**





**Figure 7 Measuring Circuit for DG and DP**



**Figure 8 Measuring Circuit for Analog Input Frequency Response**

High Frequency Input Response

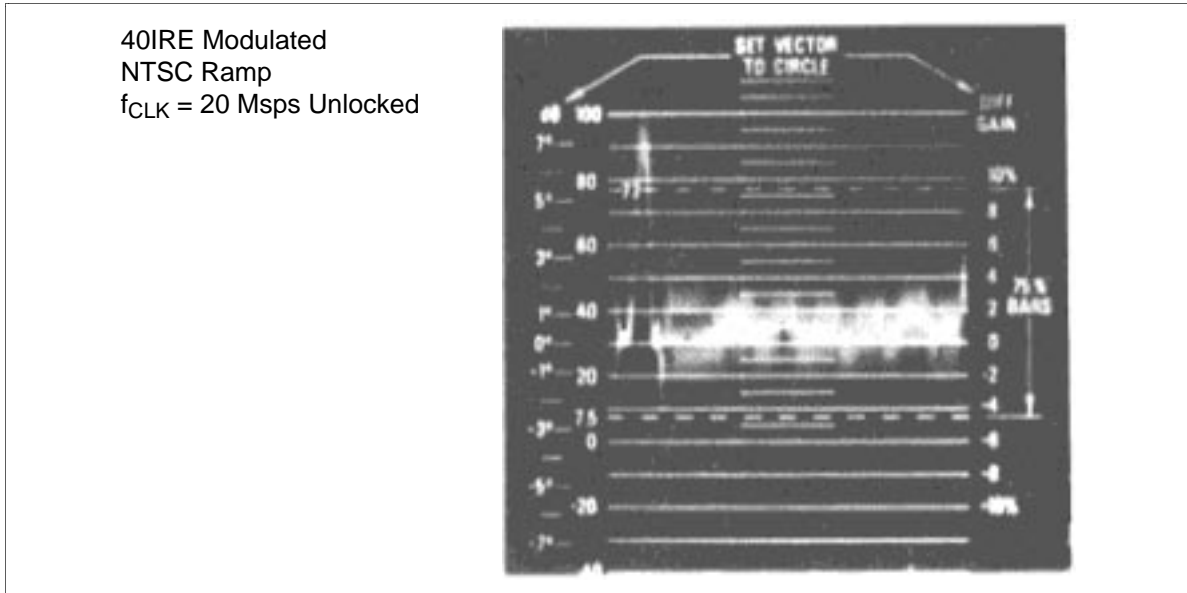


Figure 9 High Frequency Analog Input Response Differential Phase

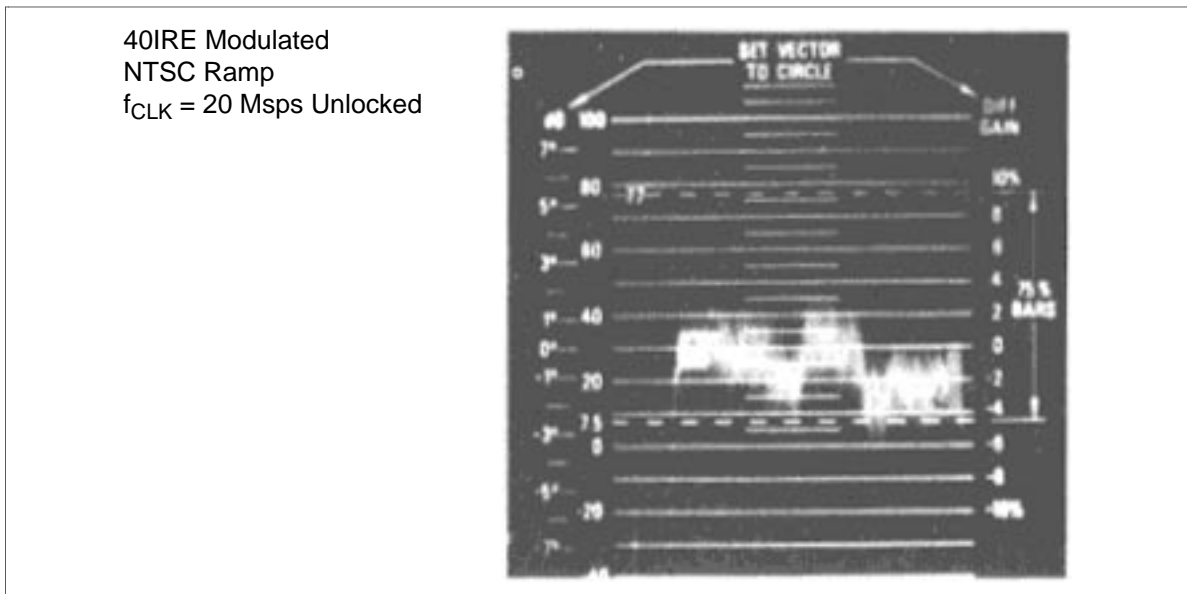


Figure 10 High Frequency Analog Input Response Differential Gain

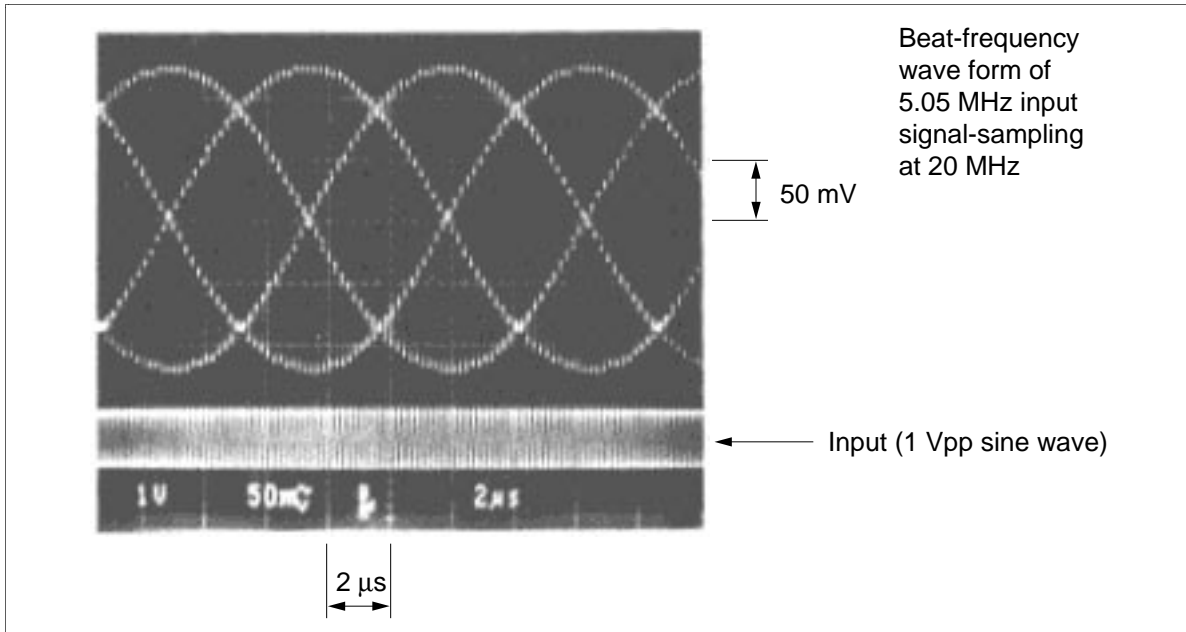


Figure 11 Beat-Frequency Waveform of 5.05 MHz Input Signal-Sampled at 20 MHz

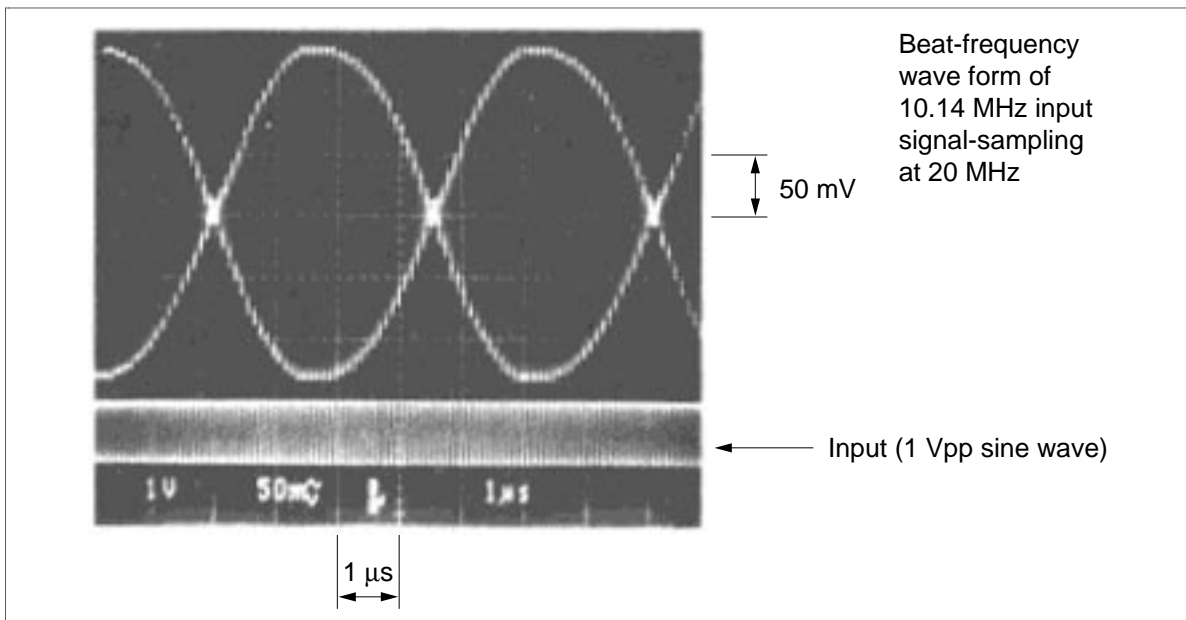


Figure 12 Beat-Frequency Waveform of 10.14 MHz Input Signal-Sampled at 20 MHz

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## HA19216/MP

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