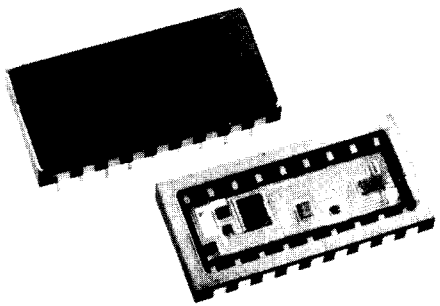
HS 2020
Programmable Gain Amplifier

FEATURES

- **Digitally Programmable 1 to 128**
- **Gain Nonlinearity 0.002%**
- **Gain Accuracy 0.002%**
- **Full Power Bandwidth 100 kHz**
- **Low Offset Drift: < 5 μV/°C**
- **MIL-STD-883 Rev. C, Level B Screening Available**



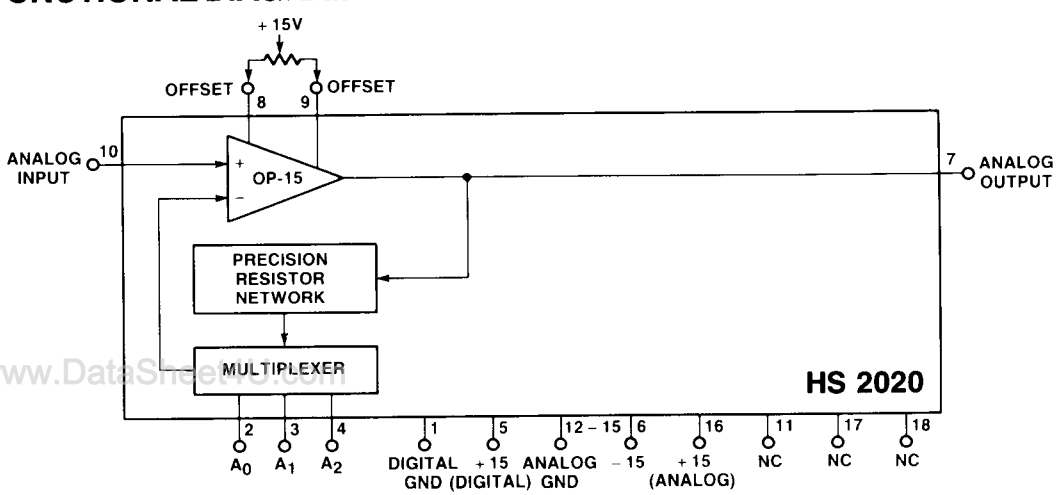
APPLICATIONS

- **Autoranging A/D**
- **μP Data Acquisition**
- **A/D Input Amplifier**
- **Sample and Hold Buffer**

DESCRIPTION

The HS 2020 is a precision hybrid amplifier that features high speed low offset performance in addition to being user programmable for gains from 1 to 128. A gain range from 1 to 128 can be achieved from binary (TTL) inputs to the HS 2020 in 8 steps. This gives the user a dynamic range of 19 bits with analog input steps from ±20 mV to ±10V. The HS 2020 uses the precision JFET OP-15 amplifier along with a laser trimmed stable nichrome thin film resistor network. The HS 2020 features very low 100 μV offset voltage which yields much less than ½ LSB in a 12 bit ADC. The excellent performance over temperature (−55°C to +125°C) is achieved by combining a proven circuit configuration with the benefits of state-of-the-art hybrid manufacturing to achieve low cost, small size, and high reliability. The HS 2020 is available in 2 versions. The HS 2020C is specified over a temperature range of 0°C to +70°C. The HS 2020B is specified from −55°C to +125°C and is fully screened and tested to MIL-STD-883 Rev. C, Level B requirements.

FUNCTIONAL DIAGRAM



SPECIFICATIONS

(Typical @ +25°C, supply voltage ±15VDC, unless otherwise specified)

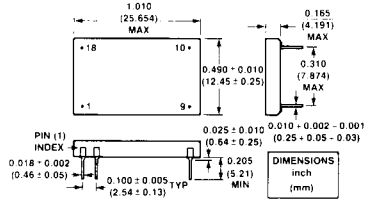
GAIN (Non-Inverting)	
Fixed Settings	1,2,4,8,16,32,64,128
Gain Nonlinearity (% FSR)	
G = 1	0.005% max (0.002% typ)
G = 8	0.006% max (0.002% typ)
G = 32	0.007% max (0.003% typ)
G = 64	0.008% max (0.003% typ)
G = 128	0.008% max (0.003% typ)
Gain Accuracy	
Initial (+25°C)	
G = 1	0.005% max (0.003% typ)
G = 128	0.2% max (0.1% typ)
VS Temperature	
(−25°C to +85°C)	
G = 1	0.008% max (0.003% typ)
G = 128	0.24% max (0.1% typ)
(−55°C to +125°C)	
G = 1	0.01% max (0.004% typ)
G = 128	0.4% max (0.2% typ)
ANALOG INPUT	
Input Impedance	$10^9\Omega$
Input Voltage Range	±12VDC
VOLTAGE OFFSET, Referred to Input	
Initial (@ +25°C)	
Adjustable to Zero	
G = 1	0.5mV max
G = 128	0.5mV max (0.1mV typ)
VS Temperature	
(−55°C to +125°C)	
G = 1	2mV max
G = 128	2mV max (0.5mV typ)
INPUT CURRENT	
Input Bias Current	±200pA max (±40pA typ)
VS Temperature	
(−55°C to +125°C)	±19nA max (±2.7nA typ)
NOISE	
Voltage Noise, RTI	
0.1 Hz to 10 Hz	
G = 1	4μV p-p
G = 128	4μV p-p
10 Hz to 1 MHz	
G = 1	200μV p-p
Current Noise	
0.1 Hz to 10 Hz	
G = 1	0.26pA p-p
G = 128	0.26pA p-p
10 Hz to 10 kHz	
G = 1	4pA p-p
LOGIC INPUT (TTL)[1]	
Logic "1"	+2.0V min
Logic "0"	0.8V min
Input Current	20μA max
Switching Time	0.7μSec
OUTPUT CHARACTERISTICS	
Output Range	±10V min (±12V typ)
Output Current	±5mA max
DYNAMIC RESPONSE	
Small Signal BW (G = 1)	5 MHz
Full Power BW	100 kHz
Slew Rate (G = 1)	15V/μSec
Output Settling (to 0.1%)	
G = 1	5.2μSec max (4μSec typ)
G = 16	8μSec max (5μSec typ)
G = 128	70μSec max (40μSec typ)
TEMPERATURE	
Operating	
-B	−55°C to +125°C
-C	0°C to +70°C
Storage	−65°C to +150°C
POWER SUPPLY	
Power Supply Range	±18V max (±15V typ)
Current	+16mA, −8mA
MBTF	260,000 hrs

NOTE:
1. Digital inputs should not exceed +8V. Logic supply at pin 5 must be at least +5V to maintain logic levels.

MECHANICAL

Case Style: Ceramic Pkg, Metal Lid

Case Dimensions

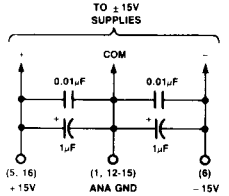


PIN ASSIGNMENTS

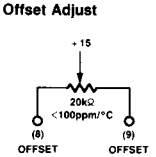
PIN	FUNCTION	PIN	FUNCTION
1	DIGITAL GND	18	NC
2	A_0	17	NC
3	A_1	16	+15 (ANALOG)
4	A_2	15	ANALOG GND
5	+15 (DIGITAL)	14	ANALOG GND
6	−15	13	ANALOG GND
7	ANALOG OUTPUT	12	ANALOG GND
8	OFFSET	11	NC
9	OFFSET	10	ANALOG INPUT

APPLICATIONS INFORMATION

RECOMMENDED POWER SUPPLY BYPASS CIRCUIT



OPTIONAL OFFSET AND GAIN ADJUSTMENTS



NOTE:
1. Analog ground shown connected to digital ground. User may elect to segregate these in a system application.

GAIN CODES AND SETTLING TIMES

GAIN	DIGITAL CODE A_2	A_1	A_0	OUTPUT SETTLING TIME* (±0.1% 20V Step)
1	0	0	0	4μSec
2	0	0	1	4μSec
4	0	1	0	4μSec
8	0	1	1	4μSec
16	1	0	0	5μSec
32	1	0	1	11μSec
64	1	1	0	20μSec
128	1	1	1	40μSec

* For each gain value the magnitude of the input step was chosen to make the output step 20V.

GAIN ACCURACIES

GAIN	ACCURACY (%)					
	25°C		−25°C to +85°C		−55°C to +125°C	
	TYPICAL	MAX	TYPICAL	MAX	TYPICAL	MAX
1	0.002	0.005	0.003	0.008	0.004	0.010
2	0.005	0.015	0.005	0.020	0.008	0.020
4	0.005	0.015	0.005	0.024	0.015	0.040
8	0.010	0.020	0.015	0.048	0.020	0.080
16	0.020	0.030	0.020	0.048	0.025	0.080
32	0.020	0.040	0.020	0.060	0.040	0.100
64	0.040	0.100	0.040	0.180	0.100	0.300
128	0.100	0.200	0.100	0.240	0.200	0.400

ORDERING INFORMATION

MODEL	DESCRIPTION
HS 2020C	Programmable Gain Amplifier 0°C to +70°C
HS 2020B	Programmable Gain Amplifier Per MIL-STD-883 Rev. C, Level B −55°C to +125°C

Specifications subject to change without notice