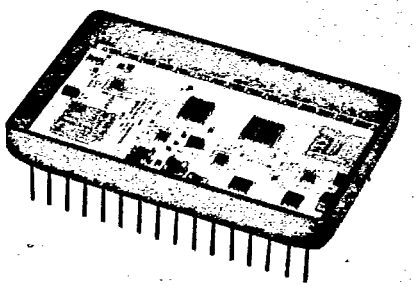
NATEL

HSD/HRD1114
HSD/HRD1112

Synchro(Resolver)-to-Digital Converter
Microprocessor Compatible
14-bit, 32-pin Hybrid

Features

- **3-state latched output** (inhibit does not interrupt tracking)
- **8- and 16- bit microprocessor compatible**
- ✓ **High common-mode rejection** (true differential inputs)
- ✓ **High input impedance**
- **2.6 arc-minute accuracy**
- ✓ **6480 degrees per second** (18 rps) **tracking rate** (Model 1112)
- **TTL and CMOS compatible**
- **Single 32-pin triple DIP package**
- **Hi-rel MIL-STD-883B processing**



ACTUAL SIZE

Applications

Avionics systems

Servo systems

Fire control systems

Coordinate conversion

Axis rotation

Antenna monitoring

Description

The HSD1114 (HRD1114) is a 14-bit Synchro (Resolver)-to-Digital Converter, packaged in a 32-pin triple DIP hybrid. It offers high accuracy, microprocessor compatibility, and excellent dynamic performance. Requiring only a single +15 V-dc main power supply for it's operation, the HSD1114 converter maintains both static and dynamic accuracy over a wide range of power supply variations. The digital output levels can be controlled independently by a logic voltage input (V_L). This logic supply can range from 4.5 V-dc to the main power supply voltage. With a 5 V-dc logic supply, the digital outputs are CMOS/TTL compatible and can drive two 54/74 gate loads or eight 54LS/74LS gate loads.

Using a high-accuracy differential signal conditioner for the resolver inputs and a resistive scott-tee network for the synchro inputs, the converter provides common mode rejection in excess of 70 dB, thereby virtually eliminating the need for any signal isolation transformers. The common-mode voltage can range as high as 250 volts from the converter ground. This feature also prevents loading of the synchro and reference input lines when the converter is not powered.

Model 1114 is a Type-II tracking converter with zero velocity lag error. The digital output from the converter is always fresh and always available. The $\overline{INH}$ input, used for gating the digital outputs onto a data bus does not interrupt tracking of the converter loop. Transferring data from the 1114 is also facilitated by the use of two independently enabled bytes. This feature permits memory mapped data interface and control with the most popular 8- and 16- bit microprocessors and single board computers.

Model 1114 converters are available with angular accuracies of 2.6 and 5.2 arc-minutes. The 12-bit version, model 1112 is available with accuracies of 8.5 and 15.3 arc-minutes. These accuracies are guaranteed over the specified frequency, signal and power supply variations, and operating temperature range.

Specifications

PARAMETER	VALUE	REMARKS
Digital Output Resolution		
Model 1114 Model 1112	14-bits (1.32 arc-minutes) 12-bits (5.3 arc-minutes)	
Accuracy		
Model 1114	± 5.2 arc-minutes (Option S) ± 2.6 arc-minutes (Option H)	Accuracy applies over the full operating temperature and includes hysteresis
Model 1112	±15.3 arc-minutes (Option P) ± 8.5 arc-minutes (Option L)	
Reference Input		
Voltage	11 to 130 V-rms	
Frequency	400 Hz or 2.6 KHz (± 10 %)	depending on frequency option ordered
Input Impedance	200 K Ω single-ended 400 K Ω differential	minimum
Common Mode Range	± 250 V-dc peak maximum	dc plus recurrent ac peak
Synchro/Resolver Inputs		Solid State Differential Input
Input Voltages	11.8 V-rms (Option 1) 26 V-rms (Option 2) 90 V-rms (Option 9)	Accuracy of the converter is maintained with ± 10 % variation in signal voltages
Input Impedance	60 K Ω minimum 150 K Ω minimum 500 K Ω minimum	11.8 V-rms L-L models 26 V-rms L-L models 90 V-rms L-L models
Impedance Unbalance	0.2 % maximum	For all models
Common Mode Range	± 50 V-dc peak maximum ± 100 V-dc peak maximum ± 250 V-dc peak maximum	11.8 V-rms L-L models 26 V-rms L-L models 90 V-rms L-L models
Common Mode Rejection Ratio	70 dB minimum	dc to 1000 Hz
Harmonic Distortion	10 % maximum	Without degradation in accuracy specification
Digital Inputs		Transient Protected CMOS
Voltage Levels Logic "0"	 -0.3 to 0.8 V-dc -0.3 to 0.3 V_L	 For V_L = 5 V-dc For V_L = 15 V-dc
Logic "1"	2.4 V-dc to 5 V-dc 0.7 V_L to V_L	For V_L = 5 V-dc For V_L = 15 V-dc
Input Currents		
$\overline{INH}$	-15 μA typical, "active" pull up to V_L	When not used, may be left unconnected
$\overline{HBE}$, $\overline{LBE}$	15 μA typical, "active" pull down to ground	When not used, may be left unconnected
Digital Input Controls		Transient Protected CMOS
$\overline{INH}$	Logic "1" Logic "0"	Digital output follows analog input signals Output data latched in holding register (Does not interrupt converter tracking loop)
$\overline{HBE}$	Logic "0" Logic "1"	8 MSBs are enabled 8 MSBs are in high impedance state of 3-state output
$\overline{LBE}$	Logic "0" Logic "1"	6 or 4 LSBs are enabled (4 for Model 1112) 6 or 4 LSBs are in high impedance state of 3-state output
Digital Outputs		CMOS Outputs
Logic Type	TTL/CMOS compatible	For 5 V-dc logic power supply (V_L)
Drive capability Data bits (B1-B14), CB	 2 standard TTL gates	
CB Logic "0" Logic "1"	 Output angle not changing Output angle changing	The leading edge initiates output data change
Pulse width	1.2 μs typical (3.0 μs max.)	
Data Bits (B1-B14)	Natural Binary Angle	Positive Logic, B1 = MSB = 180°

PARAMETER	VALUE	REMARKS
Dynamic Characteristics		
Maximum tracking rate	±18 (±12) rps minimum	For Model 1112 (1114)
Acceleration Constant	82,000 (39,000) sec^{-2} typical	For Model 1112 (1114)
Step Response	100 ms (150 ms) max.	179° step settling to 1 LSB , Model 1112 (1114)
Power Supplies		
Main Supply Voltage Current	11 to 17 V-dc (+15 V nominal) 20 mA typical, 30 mA maximum	Without degradation in accuracy specification For +15 volt supply
Logic Voltage (V_L) Current	4.5 V-dc to main power supply 3 mA maximum	5 Vdc ± 10 % for TTL compatible output
Physical Characteristics	32 Pin Triple Dip	
Size	1.14 x 1.74 x 0.28 inch (29 x 44 x 7.1 mm)	3 standoffs are added to the package to insulate it from printed circuit board traces. (Standoffs are included in 0.28 inch height dimension).
Weight	0.8 oz (23 g) maximum	

Pin Designations

+15 V — Main Power Supply-
11 V-dc to 17 V-dc

V_L — Logic Voltage-
5 V-dc (for TTL compatible output)
4.5 V-dc to +15 V-dc (for CMOS compatible output)

GND — Power Supply Ground
Digital Ground

B1-B14 — Parallel Output Data Bits-
B1 is MSB = 180 degrees
B12 is LSB for Model 1112 = 0.088 degree
(Pins B13 and B14 are not connected)
B14 is LSB for Model 1114 = 0.022 degree

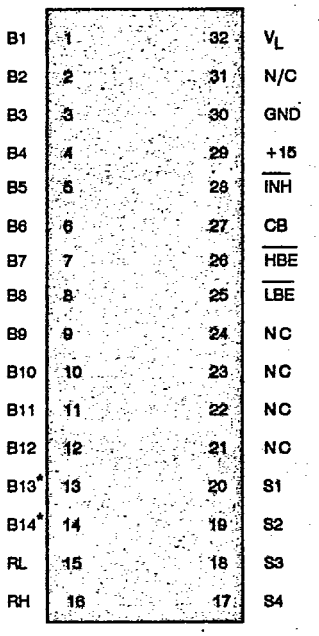
S1, S2, S3, S4 — Input Analog Signals-
(Leave S4 unconnected for synchro input)

RH, RL — Reference Voltage Input

$\overline{INH}$ — Inhibit Function-
A logic "0" freezes the digital angular output. The internal loop keeps tracking the input. For continuous operation, this pin may be left unconnected. Internal active pull-up will apply V_L to the pin.

CB — Converter Busy-
A 1.2 μs pulse which occurs during updating of the holding register. Output data can be transferred at the trailing edge of the CB pulse. When the converter output is not changing, CB is at logic "0."

$\overline{HBE}$ — High Byte Enable-
Data Bits B1 through B8 are enabled (low impedance state of 3-state output) when $\overline{HBE}$ is set to a logic "0." When $\overline{HBE}$ is set to a logic "1," the data bits B1 through B8 are disabled (high impedance state of 3-state output).



*NO CONNECTION FOR MODEL 1112

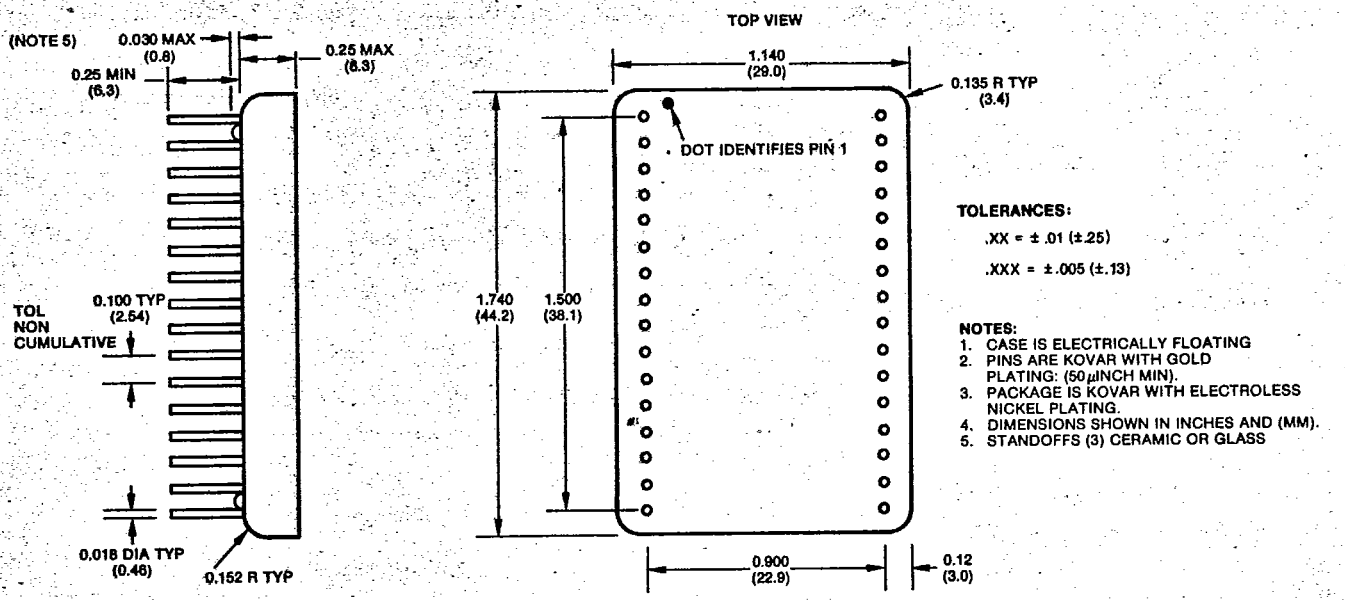
FIGURE 1. HSD/HRD1114 and HSD/HRD1112 Pin Assignment

$\overline{LBE}$ — Low Byte Enable
Data bits B9 through B14 (B12 for Model 1112) are enabled when $\overline{LBE}$ is set to a logic "0." When $\overline{LBE}$ is set to a logic "1," the data bits are disabled.

Absolute Maximum Ratings

Signal Inputs . . . . . Twice Normal Voltage
Reference Input . . . . . 200 V-rms
Main Power Supply (+15 V) . . . . . +18 V-dc
Logic Voltage (V_L) . . . . . +4.5 V-dc to +15-V supply
Digital Inputs . . . . . -0.3 V-dc to V_L
Storage Temperature . . . . . -65° C to +135° C

When installing or removing the converter from printed circuit boards or sockets, it is recommended that the power supplies and input signals be turned off. Decoupling capacitors are recommended on the main power supply (+15 V) as well as logic voltage (V_L). A 1-μF tantalum capacitor in parallel with 0.01-μF ceramic capacitor should be mounted as close to the supply pins (29 and 32) as possible.



MECHANICAL OUTLINE (32-PIN TRIPLE DIP)

Ordering Information

14-BIT MODEL

HSD1114 - T F I A

Temperature Range

1 = 0° C to +70° C
2 = -25° C to +85° C
3 = -55° C to +125° C

Frequency

4 = 400 Hz
2 = 2600 Hz

Accuracy

S = ± 5.2 arc-minutes
H = ± 2.6 arc-minutes

Input Signal

1 = 11.8 V-rms
2 = 26 V-rms
9 = 90 V-rms

SPECIFY **HRD1114** FOR RESOLVER INPUT

12-BIT MODEL

HSD1112 - T F I A

Temperature Range

1 = 0° C to +70° C
2 = -25° C to +85° C
3 = -55° C to +125° C

Frequency

4 = 400 Hz
2 = 2600 Hz

Accuracy

P = ± 15.3 arc-minutes
L = ± 8.5 arc-minutes

Input Signal

1 = 11.8 V-rms
2 = 26 V-rms
9 = 90 V-rms

SPECIFY **HRD1112** FOR RESOLVER INPUT

As a standard practice, all converters are built in accordance with the requirements of MIL-STD-883B, including 168 hours of active burn-in.

A wide range of applications assistance is available from Natel. Application notes can be requested when available... and Natel's applications engineers are at your disposal for solving specific problems.

TEL: (805) 581-3950

NATEL ENGINEERING CO., INC.

4550 RUNWAY STREET • SIMI VALLEY, CA 93063-3493
TWX: (910) 494-1959 FAX: (805) 584-4357