T-71-35-03

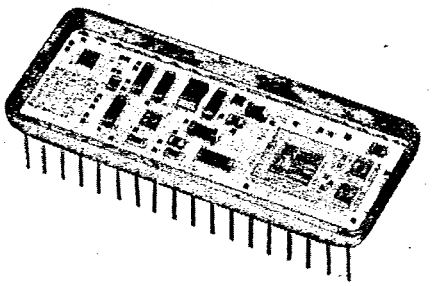
NATEL

HSRD1056RH

Radiation Hardened, Low Power Synchro/Resolver–to–Digital Converter Microprocessor Compatible 16–Bit Hybrid

Features

- ✓ **Rad-Hard CMOS Processing** (functions in excess of **100K rad**)
- ✓ **Low Power Consumption** (100 mW)
- • **2.6 Arc-Minute Accuracy**
- ✓ **True Single Supply . . . 5 Volts Only** (prevents ground loop problems)
- • **BIT Output (Built-In-Test)**
- ✓ **Reference Synthesizer** (for improved dynamic accuracy)
- ✓ **No 180° False Lockup**
- ✓ **Automatic Gain Control** (allows 2:1 signal variation)
- • **Synchro/Resolver Pin Programmable**
- • **14-/16-Bit Programmable Resolution**
- • **8- and 16-Bit Microprocessor Compatible**
- • **Hermetic 36-Pin DDIP Package**
- • **Hi-Rel MIL-STD-883B Processing**



ACTUAL SIZE

Applications

Satellites
Solar-panel control systems
Passive/Active tracking systems
Robotics
Antenna monitoring
Avionics Systems
Radar systems
Engine controllers

HSRD1056RH

Description

The **HSRD1056RH** is a radiation-hardened version of the very popular Natel **Model 1056** Converter. The **1056RH** has been characterized at total cobalt 60 radiation doses in excess of 100,000 rads. Packaged in a 36-pin DDIP hybrid, it is pin-compatible with Natel **Models 1056** and **1006** and offers the most advanced performance features ever available in Synchro/Resolver-to-Digital converters. It operates from a single 5 V-dc power supply and consumes only 20 mA of current. The low power dissipation of 100 mW not only makes the Natel **1056RH** run cool, but it puts less strain on the user's power supply, thereby improving system MTBF. The **1056RH** is fully compatible with 8- and 16-bit microprocessors. Additional superior features of the **1056RH** include Built-In-Test, an anti-180° false lockup circuit, a reference synthesizer, pin-programmable Synchro/Resolver and 14-/16-bit modes, and automatic gain control.

Using a high-accuracy differential signal conditioner for the resolver input and a resistive scott-tee for the synchro input, the converter provides common-mode rejection in excess of 70 dB. The input impedance remains constant and balanced independent of dc power to the converter. This feature prevents loading of the synchro and reference input lines when the converter is not powered. This technique also permits resistor programming for nonstandard input voltages.

Model 1056RH is a Type-II tracking converter with zero velocity lag error. An internal reference synthesizer permits improved dynamic accuracy by reducing the effect of "speed voltages" at high rotational speeds. The accuracy of the converter is maintained with signal-to-reference phase shifts of up to ±45°. An anti-180° false lockup circuit is used to assure that the converter does not get locked onto an angle 180° from the true angle when a step function of 180° is applied. Transferring data from the **1056RH** is eased through the use of a transparent latch with three-state outputs configured as two independently enabled 8-bit bytes. Not only does this allow data to be read without interrupting converter tracking, it also permits memory-mapped data interface and control with most popular 8- and 16-bit microprocessors and single-board computers.

A Built-In-Test (BIT) feature provides a logic "1" when the tracking error exceeds ±1°. Monitoring of converter dynamics is facilitated through the availability of analog signals corresponding to converter tracking velocity and instantaneous tracking error. An AGC (automatic gain compensation) circuit incorporated in the converter design allows signal voltage variations of ±30% without degradation of converter accuracy or dynamic response.

Specifications

PARAMETER	VALUE	REMARKS	TEST LEVEL
Digital Output Resolution			
	16-bits (0.33 arc-minutes) 14-bits (1.32 arc-minutes)	For pin-16 (14B) = logic "0" For pin-16 (14B) = logic "1" or open circuit	Note 2
Accuracy			
	± 5.2 arc-minutes (Option S) ± 2.6 arc-minutes (Option H)	For 0 rads total dose. Accuracy is derated depending on total dose (see next page)	Note 1
Reference Input			
Voltage	20 to 130 V-rms		Note 2
Frequency	360 to 1000 Hz (Option 4) 47 to 1000 Hz (Option 6)	400 Hz Models 60 Hz Models	Note 3
Input Impedance (minimum)	250 K Ω Single Ended 500 K Ω Differential		Note 2
Common-Mode Range	±250 V peak maximum	dc plus recurrent ac peak	Note 3
Synchro/Resolver Inputs			
Input Voltages (line-to-line)	11.8 V-rms (Option 1) 26 V-rms (Option 2) 90 V-rms (Option 9)	Accuracy of the converter is maintained with ±30% variation in signal voltages	Note 1
Input Impedance (minimum)	30KΩ (60 KΩ) minimum 75KΩ (150 KΩ) minimum 250 KΩ (500 KΩ) minimum	Line-to-GND (differential), 11.8 V-rms L-L Models Line-to-GND (differential), 26V-rms L-L Models Line-to-GND (differential), 90V-rms L-L Models	Note 2
Impedance Unbalance	0.2% maximum	For all Models	Note 3
Common-Mode Range	± 25 V peak ± 55 V peak ±180V peak	11.8 V-rms Models 26 V-rms Models 90 V-rms Models	Note 3
Common-Mode Rejection	70 dB minimum	dc to 1000 Hz	Note 3
Harmonic Distortion	10%	Without degradation in accuracy specification	Note 3
Reference Sysnthesizer		**See Natel HSRD1056 Data Sheet**	
Digital Inputs		**See Natel HSRD1056 Data Sheet**	
Digital Outputs		**See Natel HSRD1056 Data Sheet**	
Analog Outputs	Typical, unless specified		
V (Bias Voltage)	1/2 (V_L-0.7) ±10%	2.15 V-dc ±10% for 5 V-dc supply	Note 3
e (unfiltered ac error)	750 mV-rms typical for 1° error	ac voltage referenced to V	Note 3
Drive Capability	±1 mA minimum	All analog outputs	Note 3
Velocity Output		**Not tightly characterized for Model 1056RH**	
Automatic Gain Control		**See Natel HSRD1056 Data Sheet**	
Dynamic Characteristics		**See Natel HSRD1056 Data Sheet**	
Power Supply			
Voltage	5 V-dc ±10%	Without degradation in accuracy specification	Note 3
Current	10 mA typical, 20 mA maximum		Note 1
Thermal Characteristics			
Junction Temperature Rise Above Case	1°C typical, 2°C maximum	For component with highest temperature rise	Note 3
Case Temperature Rise Above Ambient	2°C typical, 4°C maximum	Without any heat sink	Note 3
Power Dissipation	50 mW typical, 100 mW maximum	For V_L = 5 V-dc	Note 3
Physical Characteristics	**36-pin Hermetic DDIP**	**See Natel HSRD1056 Data Sheet**	

T-71-35-03

Specifications Continued

PARAMETER	VALUE	REMARKS	SUB-GROUP
Radiation Effects	Typical, unless otherwise specified		
Accuracy	±.005°/10K rads typical	CO_{60}, dose rate <10K rads/minute	Note 4
$\overline{HBE}$, $\overline{LBE}$, $\overline{INH}$, 14B	Within spec to 100K rads, total dose	CO_{60}, dose rate <10K rads/minute	Note 4
B1-B16, BIT	Within spec to 100K rads, total dose	CO_{60}, dose rate <10K rads/minute	Note 4
CB	+0.2 μS/10K rads typical	CO_{60}, dose rate <10K rads/minute	Note 4
Analog Output	Within spec to 100K rads, total dose	CO_{60}, dose rate <10K rads/minute	Note 4
Dynamic Characteristic	Within spec to 100K rads, total dose except tracking rate degrades at high doses (>50K rads) due to CB pulse width increase	CO_{60}, dose rate <10K rads/minute	Note 4
Power Supply	Within spec to 100K rads, total dose	CO_{60}, dose rate <10K rads/minute	Note 4

Note 1. Compliance of each component to this specification is 100% guaranteed by Natel. To assure compliance, this key parameter is 100% tested.

Note 2. Compliance of each component to this specification is 100% guaranteed by Natel. To assure compliance, AQL levels are verified using a lot sample level in the range of one to five percent.

Note 3. Compliance of each component to this specification is 100% guaranteed by Natel. To assure compliance, AQL levels are verified using a lot sample level of less than one percent. Note 3 parameters are maximum design limits.

Note 4. Parameters are typical, a special test program can be developed if required.

If your application requires non-standard input or output characteristics, or if special processing or testing is required, please contact a Natel Applications Engineer or the Sales Department.

Radiation Testing

Natel has characterized the performance of the **1056RH** after extensive development and testing of LSI components and complete hybrids processed to Natel's exacting specifications.

The special performance of the **1056RH** has been assured through extensive process and component development rather than by performance derating.

The **Natel Model HSRD1056RH** converter has been characterized with Cobalt 60 radiation testing. All devices tested have functioned in excess of 100K rads and most have functioned in excess of 200K rads. All testing has been done with the devices fully powered.

The "accuracy" specification has shown the greatest variability from test sample to test sample, with a typical variation of ±0.005°/10K rad dose. The standard deviation about this typical value has been ±0.007°/10K rad dose.

If your application requires that particular radiation performance be guaranteed, please contact the factory to determine a suitable radiation test program and profile.

Pin Designations

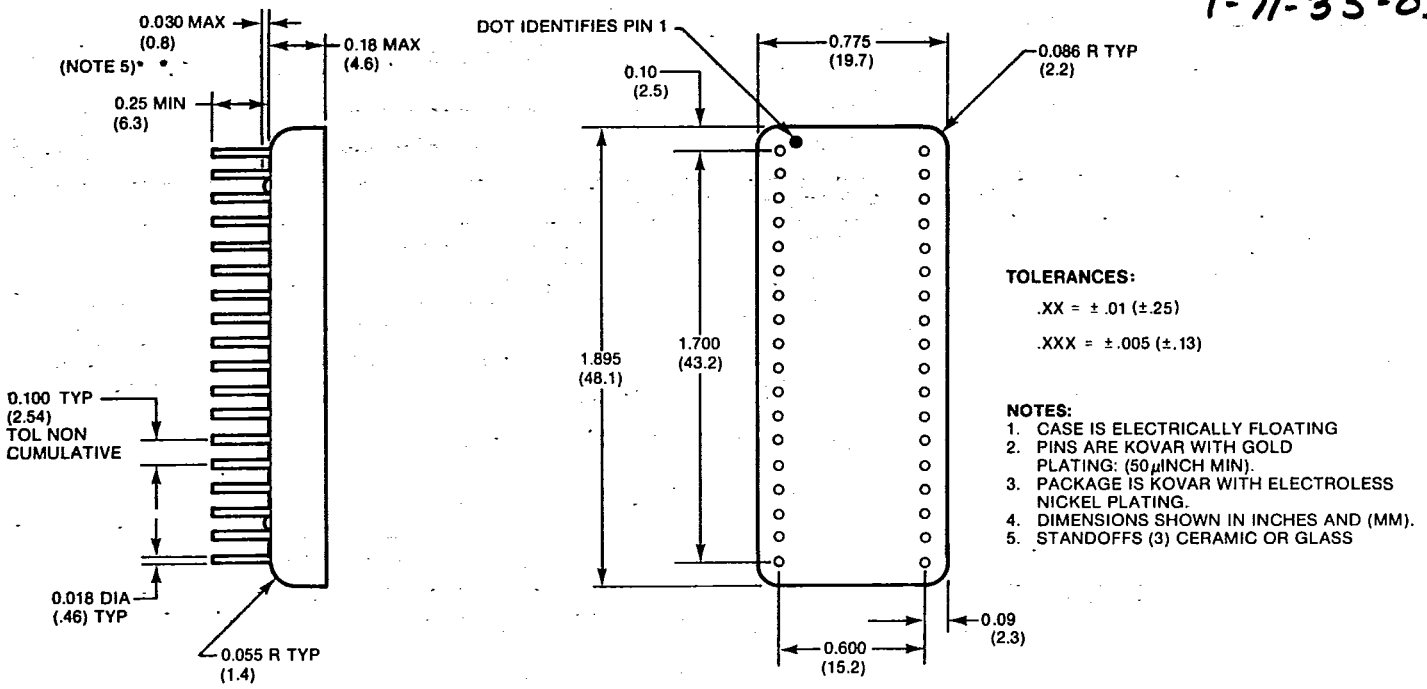
S1	1	36	V_L
S2	2	35	$\overline{HBE}$
S3	3	34	B1
S4	4	33	B2
S	5	32	B3
SR	6	31	B4
R	7	30	B5
RL	8	29	B6
RH	9	28	B7
θ	10	27	B8
V	11	26	B9
e	12	25	B10
$\overline{INH}$	13	24	B11
CB	14	23	B12
BIT	15	22	B13
14B	16	21	B14
$\overline{LBE}$	17	20	B15
GND	18	19	B16

FIGURE 1 HSRD1056RH Pin Assignments
For details, see Model HSRD1056 Data Sheet

Absolute Maximum Ratings

Signal Inputs . . . . . Twice Normal Voltage
Reference Input . . . . . 200 V-rms
Supply Voltage (V_L) . . . . . 6.5 V-dc
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 power supply V_L. A 1 μF tantalum capacitor in parallel with 0.01 μF ceramic capacitor should be mounted as close to the supply pin (36) as possible.



MECHANICAL OUTLINE (36 PIN DOUBLE DIP)

Ordering Information

HSRD1056RH – T F I A

Temperature Range
1 = 0°C to + 70°C
3 = −55°C to +125°C
2 = −25°C to + 85°C

Frequency
4 = 400 Hz
6 = 60 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
0 = Ext. Signal XFMRS
5 = Ext. Signal and Reference XFMRS

As a standard practice, all converters are built in accordance with requirements of MIL-STD-883B, including 160 hours of active burn-in.

Other products available from NATEL

- **3 arc-second accurate,** Programmable Dynamic Angle Simulator that includes 4 Related Instruments and is totally A.T.E. Programmable (L200).
- Hybrid (36-pin DDIP size) Synchro(Resolver)-to-Digital converters that operate from a **single +5V power supply** and offer excellent features such as BIT, AGC, low power dissipation and more (Models 1006, 1056, 1046 and 1044).
- 1.3 arc-minute accuracy, high power, Digital-to-Synchro converters that **do not require any DC power supplies** (Models 5031 and 5131).
- Second generation Four Quadrant Multiplying Sin/Cos DAC (HDSC2026).
- **2-channel** Digital-to-Sin/Cos Converter in a single 36-pin hybrid (HDSC2036)
- 2 VA output, Digital to Resolver Converter in a 32-pin package (HDR2116).
- Resolver Control Differential Transmitter in a single 36-pin package (HCDX3106).

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