



COMPUTER CONVERSIONS CORPORATION

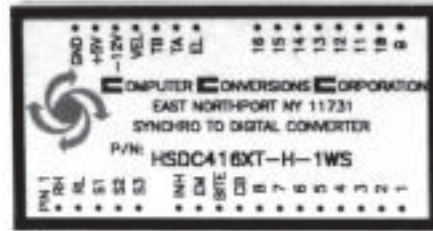
www.computerconversions.com

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HSDC/HRDC SERIES ISOLATED SYNCHRO/RESOLVER TO DIGITAL CONVERTERS WITH BUILT-IN-TEST & FORCE TEST

FEATURES

- "Whole-Converter-Product" no external components required, true field voltage inputs, assured accuracy and dynamics performance.
- 100% Transformer Isolated I/O, Non-Intrusive, High Impedance Signal & Reference Inputs.
- 3 Angle-Analog (Wrap Around) Self-Test (permits true static, and dynamic validations).
- Continuous Built-in Test & I/O Fault Detects; Loss of Signal/Ref. inputs & Overspeed/Accel.
- True Ratiometric-Type II Tracking Converters.
- Programmable 10 - 16 Bit Resolution.
- Excitation Frequencies: 47 to 10,000Hz.
- Insensitive to Freq. or Amplitude Variations.
- Repeatable, Dynamic, Lag-Free Outputs.
- Standard 36 Pin Triple Dip Package.
- 8/16 Bit Data Bus, w/Latch & 3-State Enables.
- True 3 wire Synchro & Resolver Input Formats.
- Commercial & Extended Temp. Grade Models.
- Encapsulated for Safety / Shock / Vibration, Moisture / Flame Retardant Non-Feeding.



DESCRIPTION:

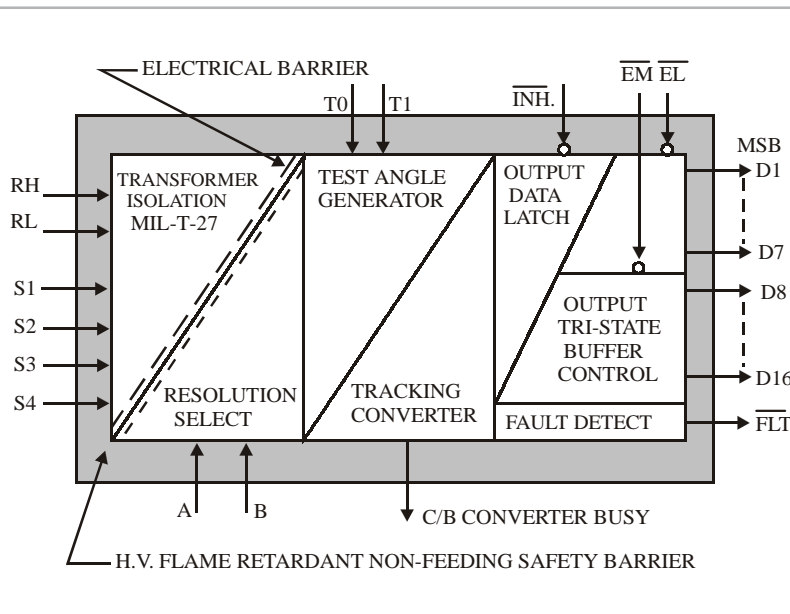
HSDC & HRDC Series are Miniature, Tracking Synchro and Resolver to Digital Converters with programmable resolution, 8/16 Bit data bus controls, continuous Built-In Self-Test report, and forced angle test modes used for functional validations on command for military and industrial applications.

Models are available with either low cost differential inputs, or internally transformer isolated inputs for military and the most demanding industrial applications.

No external signal conditioning, critical dynamics, front-end components, or circuitry is required. The HSDC/HRDC series accepts direct field voltage synchro or resolver inputs, and converts them into real-time, accurate, natural binary digital data, available over an 8 or 16 bit selectable databus. Provided as a complete plug-in solution, accuracy and performance is assured from the field

APPLICATIONS

- Military Servo Control Systems
- Artillery Fire Control Systems
- Antenna, Radar & Sonar Systems
- Avionic Systems & Instruments
- Robotics & Manipulators
- Naval Networks & Navigation
- Multi-Axis Motor Controls
- GPS & Navigation Systems
- Fuel Road Positioning Systems
- Vehicular Control Systems
- Semiconductor Water Handling
- Engine Controls & Turbines
- Commercial & Extended Temp. Grade Models
- Encapsulated for Safety/Shock/Vibration, Moisture/Flame Retardant Non-Feeding



signals to the digital user. All units are shipped with printed test data.

All the high voltage components and transformers are conformally coated and safely contained in a flame retardant non-feeding encapsulated medium with a durable through hole solder mounting for added containment and resistance to shock and vibration, designed for MIL-STD-202 environmental compliance.

The built-in-self-test provides a continuous report for loss of reference, loss of input signal detect, over-speed, and over-acceleration.

The Forced angle test mode allows the user to exercise the converter on command (typical post power check), providing 3 separate test angles verses run mode for normal operation. The forced angle test provides benefits in both user validation, and added diagnostics checks to the users system.

The resolution is programmable 10-16 Bits wide, allowing the user to select the resolution best suited to the operating speed of any particular application.

Two tri-state enables are provided for low byte, high byte select in 8 bit databus applications, or that may be tied together for any 16 bit or greater environment, or tied to ground for continuous output used in discrete logic and display applications.

The Inhibit input activates a buffered latch, and is internally synchronized to the busy, assuring that only the most recent valid data is stored and held on the outputs.

The HSDC/HRDC series are value-added whole converter solutions, designed for easy and guaranteed trouble free operation in the most demanding industrial and military applications.

ISOLATION:

HSDC Series Transformer units feature unique, proven internal Scott-T micro-transformers. These micro-transformers provide a true uncompromised galvanic isolation barrier between the field wired reference and signal lines, and the user power supplies, grounds and digital I/O.

The use of high impedance transformer isolated inputs assure that signals are neither loaded or disturbed, and prevents interaction or impediment of grounding schemes respective of any other apparatus sharing those lines.

This completely isolates the users circuitry from the all field wiring, and any other systems that may be using these signals; eliminating concerns over troublesome ground loops, separate analog grounds, differing potentials, ground interjected spikes, or ghostly field noise, that frequently cause computer system instabilities.

Unlike external transformers that require significant real-estate, and reduce converter accuracy by their inherent non-linearities, and unlike hybrid-typical transformers that suffer poor reliability because of their insufficient coil conductor size; the HSDC's/ HRDC's internal micro-transformers provide a full 500VDC minimum breakdown voltage (high-pot), and the accuracy is guaranteed for the whole synchro/resolver converter system. 60Hz. inputs do not require additional size.

The unique micro-transformer design maintains a very high impedance on the signal and reference inputs regardless of any potential mode of failure. This prevents the synchro-resolver signals and reference (often feeding other users) from being adversely loaded even in the unlikely event of failure.

THE CONVERTERS:

The HSDC Series are high performance, transformer isolated, tracking, ratiometric; synchro/resolver to digital converters, with internal three-point-angle self test, and built-in-test; having internal solid state type two servo loops that track the absolute position displacement, real-time, providing a crisp, virtually dynamic response, very high accuracy, repeatability, and resolution that may even be programmed while in motion, from 10 to 16 bits wide.

Because the converter employs the use of a type II servo loop, the converter tracks the input angle real-time without velocity lag error, the output data is dynamic, always fresh, and continuously available. Only a minimum recoverable lag may occur with extremely large excessive accelerations, at which point the data is valid with minimum lag and the fault output bit will be cleared to zero = fault (automatically recovers).

This type II servo essentially closes its loop on the tangent expressed as the ratio of the sin/cos of the input angle, making this ratiometric conversion technique inherently insensitive to absolute amplitude and frequency variations, additionally; because the complex windings in the field mounted sensors themselves expand and contract together, though their absolute voltages may vary; the ratio of the sensor outputs preserve the ratiometric accuracy, thereby this ratio-conversion technique inherently provides the converter with automatic temperature compensation on the field mounted synchro/resolver sensor itself.

A small <1LSB hysteresis is injected into the loop to assure that the data outputs are crisp, stable and jitter-free, and to assure true 1 bit monotonicity (every single bit state must be successively discernible, no jumping of bits).

Data made available to the outputs is continuously updated (tracking) without interruption; output data is stable,

SALIENT SPECIFICATIONS					
Resolution		10 Bits	12 Bits	14 Bits	16 Bits
Accuracy		+/-30'	+/-8.5'	+/-4'+1LSB	+/-4'
	<i>-GA Models</i>			+/-4.5'+1LSB	
	<i>-HA Models</i>	+/-21'		+/-2.7'	+/-2.6'
Tracking Rate	60Hz.	12.5	10	2.5	0.625
	<i>(RPS)</i>				
	400Hz.	40	40	10	2.5
	2.5KHz.+	100	80	30	5
	<i>-HS models</i>				
	2.5KHz.+	200	200	50	10
Acceleration	60Hz.	770	295	20	
	400Hz.	12600	4500	610	124
	<i>for a 1 LSB lag</i>				
	2,5KHz.	2500	9000	1620	
		1400	350	70	
	400Hz.	22000	5500	1100	
	2,5KHz.+	160K	40000	8100	
Step Response	60Hz.	200ms.	360ms.	800ms.	1200ms.
	<i>180°input</i>				
	2.5KHz.+	95ms.	95ms.	150ms.	600ms.
Frequency Range	60Hz.units	47-1000Hz.		400Hz.units	360 - 2000Hz.
	2.5KHz. units	2000-4.8KHz.		Units to 10KHz. available	
Reference Inputs	26VRMS into 90K ohms				
	115VRMS into 360K ohms				
Signal Inputs	11.8VRMS L-L into 26K ohms Minimum L-L Balanced				
	26VRMS L-L into 26K ohms Minimum L-L Balanced				
	90VRMS L-L into 200K ohms Minimum L-L Balanced				
Breakdown (volts)	500 VDC Minimum to Ground on Transformer Units				
Power Supplies	+5VDC, ±5% (to 6VDC w/o damage)@ 25ma. max.				
	-12VDC, ±5% (to 13VDC w/o damage)@ 25ma. max.				
	-15 Units: -15VDC ±5% (to 16VDC w/o damage)@ 23ma. max.				
Temperature	0°C to +70°C (-1 units)				
	(operating):	-40°C to +85°C (-3 units)			
	(Storage):	-55°C to +125°C			

Notes:

- 1) Transformer isolation is highly recommended for all high voltage inputs, also when the signals are wired to more than one device or system, where ground loops or field noise may be significant for bus concerns, radar and antenna applications, and absolutely mandated for all Naval and most military concerns.
- 2) Accuracy applies over the operating temperature range, +/-10% amplitude and frequency variations, & +/-5% power supply variations.
- 3) Different input voltages and frequencies available, higher tracking rates and accuracy.

MIL-STD-202 ENVIRONMENTALS

ENVIRONMENT	METHOD	CONDITION
Shock: 50G, 11 msec	213	A
Vibration: 10G, 2k Hz	204	C
Thermal Shock	107	A
Moisture	106*	-
Salt Spray	101	B
Altitude	105	B

MIL-STD-202 ENVIRONMENTALS & OUTPUT PHASING DETAILS

Notes:

- 1) Environmentals applies to and -3 suffix temp. variants.
- 2) *When conformally coated on PCB.
- 3) Guaranteed to meet these environmental test criteria.

MIL-STD-1399 & MIL-S-20708

Designed for compliance with MIL-STD-1399 DOD Interface Standard for Shipboard Systems, Electric Power, AC Reference and Signal, Power and Isolation Mandates, and those of MIL-S-20708 for Synchro's.



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accurate, and always fresh up to the maximum tracking rate of the converter.

NO EXTERNAL COMPONENTS:

Most other synchro/resolver converters even approaching this size require numerous external components, allowing the user to purchase a mere "core" product; no front end signal conditioning, no isolation, no required critical dynamics components. The user buys essentially a "core", and must struggle with ever-compromising trimming/matching/selecting of parts, then anticipate tuning/tweaking of many external, interactive, precision, analog components; that determine functionality, accuracy, and dynamic performance.

In many cases the user needs to have entire precision analog component inventories, synchro/resolver test stations, standards, bridges, ratio-transformers, simulators, and a strong analog engineering and R&D staff just to confirm operation under multiple static and dynamic conditions. What starts out as a reasonably high accuracy converter "core" is later degraded significantly based on the users choice (and availability) of required external components, tweak-ability and measured test results. Additionally, these "core" converters need the added real-estate to accommodate the (typically over 30+) required external components.

Core converters need a analog intensive circuit board design that requires: persistence, multiple test and trim points, and the art of analog designers wizardry' respective of the converter, and the critical paths, placement, and interactive considerations of the external analog circuitry required just to make the converter work.

Entire front ends (signal conditioners) are often left out, core converters will feature only 2 volt single ended inputs while the field voltages are running with 7, 11.8 or even 90 volt signals (external front end components will degrade accuracy and may impair functionality), no isolation is provided, and external transformers occupying more real-estate than the HSDC series "whole converter" alone may be required.

The HSDC/HRDC converters are complete, isolated, "whole converter" products, No External Components are Required. No trial and error; accuracy and dynamic performance is fully tested and assured to the system level, treated more like a simpler digital component; use reasonable care in routing the signal inputs, apply power and your done. HSDC converters are fully tested under static and dynamic condi-

tions, and printed test data with traceability is shipped with every unit.

CONTINUOUS BUILT-IN SELF TEST (BIT):

The HSDC/HRDC series include a BIT/fault output that operates autonomously in the background to report loss of signal, loss of reference, over-speed, large angle step input and tracking mode failures.

The BIT/fault output is logic level zero for fault indication.

Built-In Test (Bit) Output	
<u>Bite Output</u>	<u>Status Indication</u>
0	Error / Fault Detected
1	Status Okay

Notes:
 1) Logic Level 0 = <0.4 VDC @ 1.6 ma.
 Logic Level 1 = > 2.8 VDC @ -0.4 ma.
 2) Fault condition is > 100 LSB error + 500 nsec. for loss of signal, loss of reference and overspeed condition.

FORCED ANGLE FOR SELF TEST:

In addition to not requiring any external components, the HSDC/HRDC series is the first converter in the marketplace that also includes built-in "Forced" analog self-test ability.

On systems employing functional test confirmations, the built-in forced self-test features yield potentially huge cost savings and save significant valuable real-estate that would otherwise be required of added D-S/D-R converters and isolated switching components to perform similar forced self-test (wraparound)

Forced Angle Mode Select		
<u>Test Inputs</u>		<u>Test Mode Function</u>
<u>TA</u>	<u>TB</u>	
0	1	Inputs fed 0.0°
1	1	Inputs fed 30.0°
1	0	Inputs fed 90.0°
0	0	Normal/Run Mode

Notes:
 1) Logic level 0 = < 1.5 VDC, Logic Level 1 = > 3.5 VDC.
 2) Apply test command, await nominal 180° step response time or for lack of sensitive converter busy pulses (CB 1.2c).
 3) Test to within ± 0.15° on test angle.
 4) Pins must be terminated (not left open).

type capabilities, commonly expected if not required of newer systems. Conventionally, other converters would require expensive external D-S/D-R converters, relays and/or other switching circuitry, often suffering degraded reliability or compromising isolation throughout.

PROGRAMMABLE RESOLUTION:

The converter resolution is programmable, to accommodate the highest resolution available respective of the maximum operating speed of the particular application.

The resolution is programmable for 10, 12, 14, or 16 Bits per 360 degree input (1 part in 65,536), each resolution gradient representing typically 4 times the maximum tracking speed of the next.

This allows the user to position with very tight precision at slow speeds, and still be able to report accurate real-time data while slewing at very high speeds. A simple 2 bit command input (P1 & P2) allow the user to program the resolution from 10 to 16 bits, or, jumper these inputs respective of the resolution desired for the application at hand.

User circuitry may be employed to program a lower 10 bit resolution when slewing a very high speeds, and increase the resolution upward towards 16 bits when running at lower operating speeds.

Because the Data is MSB left aligned, the user may configure his program to expect 16 bit resolution always, for complete independence from whatever resolution he is running in the actual application.

RESOLUTION CONTROL		
Control Inputs		Resolution
P1	P2	On Data Outs
0	0	10 Bits (1 part in 1,024)
1	0	12 Bits (1 part in 4,096)
0	1	14 Bits (1 part in 16,384)
1	1	16 Bits (1 part in 65,536)

Notes:
 1) MSB aligned, always treat as a 16 Bit variable MSB aligned.
 2) Logic level 0 = < 0.8 VDC, Logic level 1 = > 2.0 VDC
 3) Internal pull-ups to +5 VDC.
 4) Higher resolution = lower maximum tracking rate (lower max. speed).

TIMING AND INTERFACE:

The output data changes respective of realized displacement on the input angle and in proportion to speed. The output data is monotonic, whereby the every 1 least significant bit of change is realized on the output with no missing counts. A 1-2 microsecond "Converter Busy" (C/B) pulse

is generated the instant the data output is being incremented/decremented, and stabilized within 0.2 microseconds respective of the C/B's leading edge.

Interface considerations range from monitoring the C/B, to using the "Inhibit" (INH) signal input to latch the data on command. A low level inhibit occurring during a C/B will be ignored until the new data is set on the outputs.

DATA TRANSFER ON DEMAND-LATCH INPUT

When the /INH. (Inhibit) input is cleared to zero; within 300 nsec. all data bits are latched, and data is valid to be read. Release the Inhibit line for 100 nsec. min. to assure that new data is transferred towards the buffered latch type output.

The INH line may also be used to capture real-time position data synchronized to a time stamp, camera strobe, or to capture several axis of data simultaneously on coordinated axis' control schemes.

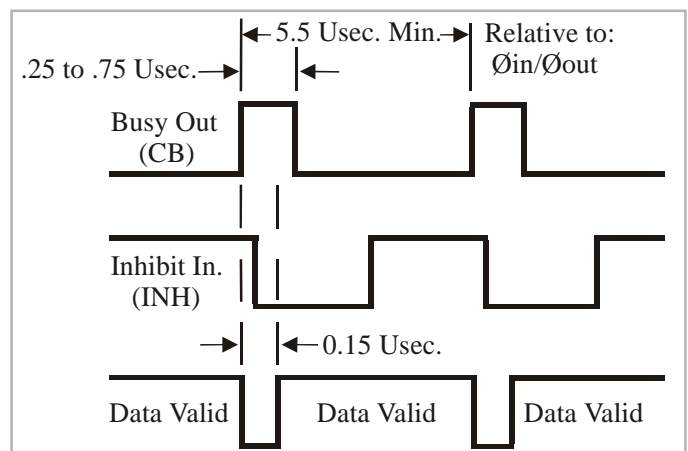
Inhibit / Data Latch Control	
Input	Output
INH.	Status
0	Latched and stable within 300 nsec.
1	Free Running

Notes:
 1) Logic Level 0 = < 0.8VDC, Logic level 1 = > 2.0 VDC
 2) Apply inhibit, wait 300 nsec. and read data.
 3) Every LSB charge appears on output when free running.

ASYNCHRONOUS DATA TRANSFER -BUSY OUTPUT

Alternatively, the C/B (converter Busy) output may be used; it will occur as fast as the max. specified tracking rate for the resolution selected (up to every 2.0 Usec. at it's fastest rate depending on the speed of the inputs changing), (ex. 27 RPS at 14 bits = 2.26 Usec.), it will be active = busy (logic 1=H) for nominally 300 nsec.; transfer data on the fallen edge.

For simple Display type devices, the converters will be free running and use of the inhibit or C/B line may not be required.





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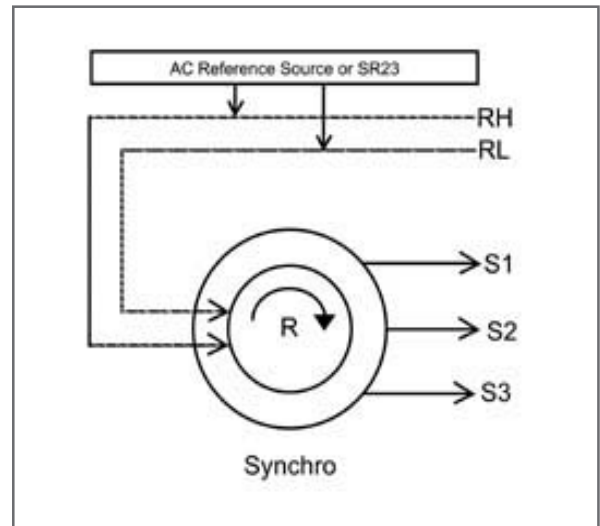
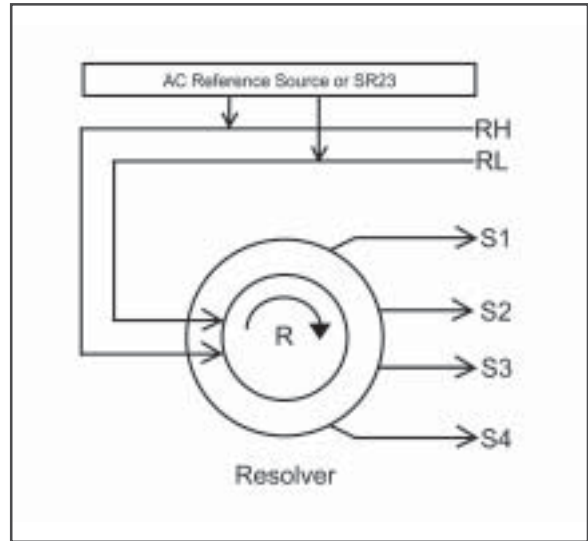
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3-STATE ENABLES & 8 OR 16 BIT BUS CONTROL:

ENH covers the 8 MSB's, ENL covers the 8 LSB's (least Significant Bits), clear to zero (logic 0VDC = L=0), data will be active on the bus within 150 nsec., for 16 Bit Bus tie both together for single line control (may also be tied to Inhibit, wait 300 nsec. for everything), if not used simply tie ENL and ENH to ground. The enable lines must be high for 40 nsec. min. to assure the outputs are all turned off of the bus.

Three State Controls			
Enable Inputs		Output Data	
EL	EM	Low Byte	Hi Byte
0	0	Active	Active
0	1	High -Z	Active
1	0	Active	High -Z
1	1	High -Z	High -Z

Notes:
 1) Logic Level 0 = < 0.8VDC, Logic Level 1 = > 2.0 VDC.
 2) 150 nsec. all active data lines stable,
 100 nsec. all high impedance met.
 3) Low Byte = Least significant data bits 9-16 (EL).
 High Byte = Most significant data bits (1-8) (EM).
 4) Synchro converters consider MSB = bit 1 = 180 degrees,
 however, most data bus consider LSB bit DO and count data
 bits in the opposite direction, using data bit DO as the LSB
 (Least significant bit).

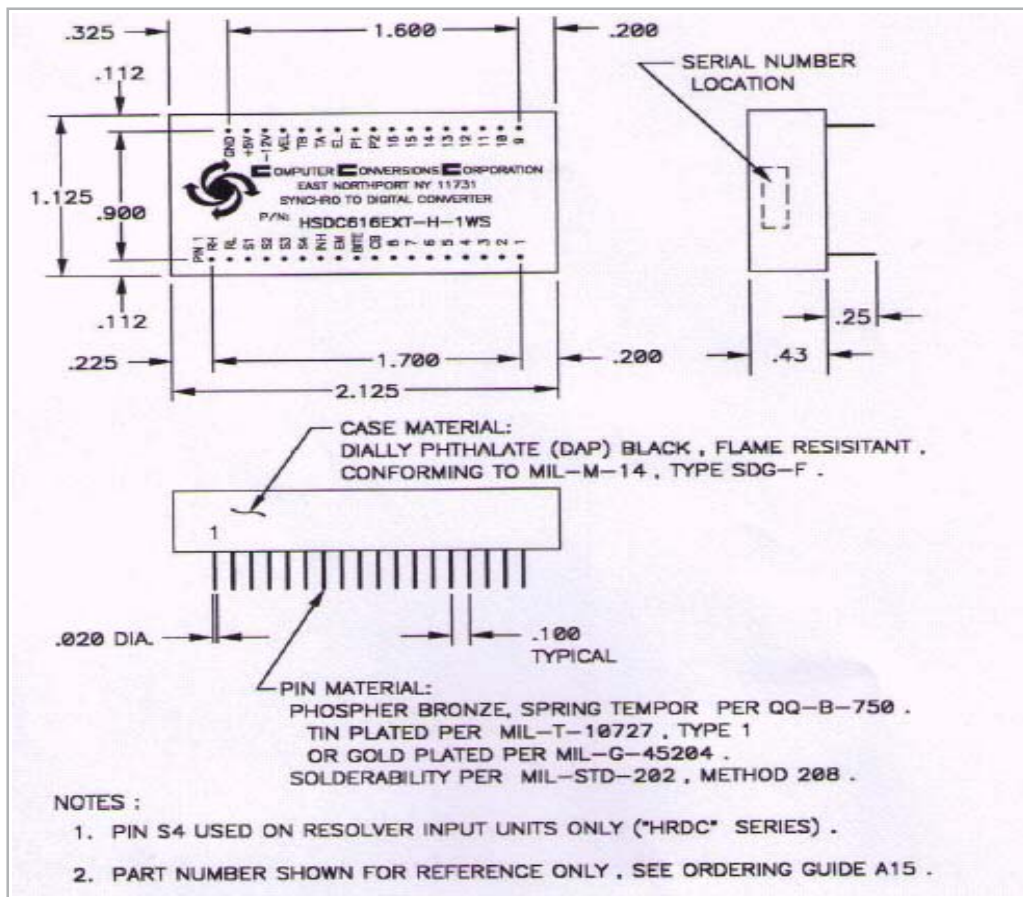


PACKAGE:

The complete converter including internal transformers, and requiring no external components, is provided in a standard 36 pin triple-dip package, w/std. .020 dia. pins, on .100" centers, with a low .43" H. profile. Comparable in size to non-isolated hybrids.

SAFETY AND CONSTRUCT:

All modules are encapsulated in an inert polymer that is self-extinguishing, flame retardant to U.L. 94VO, and will not feed or combust. Printed Circuit card material is flame retardant FR4, assemblies are conformal-coated for moisture resistance. Transformers are manufactured to MIL-T-27 and capable of withstanding high-pot to 500VDC. Case is flame resistant glass filled Diallyl Phthalate per MIL-M-14. Because all the high voltage circuitry is encapsulated within the self-extinguishing and flame retardant potting material; added protection is provided with respect to the potential for component failure, shock and vibration, and are suitable for the most severe industrial and military applications.



Model Selection Guide:

