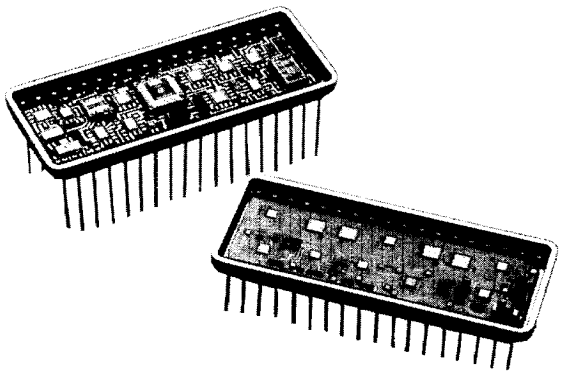
HSDC-14*

14 BIT HYBRID S/D AND R/D TRACKING CONVERTERS
High Reliability; Accuracy to ± 2.6 Minutes



Replaced by HSDC-8915 for new designs

DESCRIPTION

A direct outgrowth of DDC's well established Type II servo loop tracking converters, the HSDC-14 has two components, a control transformer and a data processor, which are interconnected by the user. These independent components may be used to form other devices: a control transformer (HSCT), a control differential transmitter (HSCDX), or a two-speed converter like the 36:1 speed ratio HSDC-360.

The HSDC-14 is available in two accuracy grades: ±4 minutes ±0.9 LSB (±4 LSB in 14 bits) and ±2.6 minutes (±2 LSB in 14 bits). This accuracy, which includes quantizing error, is maintained under all static and dynamic conditions at speeds up to ±10 rps at 400 Hz (2.5 rps at 60 Hz). The accuracy is not affected by carrier amplitude variation because the conversion is ratiometric. Phase sensitive detection in the error loop rejects quadrature and noise. Adjustments and calibration are never required.

The HSDC-14 accepts broadband inputs: 360 to 1000 Hz or 47 to 1000 Hz. Output angle is natural binary code, parallel positive logic, and TTL/DTL/CMOS compatible. Synchronization to a computer is complete via a converter busy output and an inhibit input. The angular velocity of the synchro or resolver is indicated by a DC analog voltage output, $\dot{\theta}$.

The +15 VDC nominal power supply voltage can range from +11 to +16.5 VDC, and the −15 VDC supply from 0 to −16.5 VDC, with no degradation in performance except for a change in the maximum tracking rate. To accommodate TTL/DTL and CMOS logic, the V_L power supply range is from +4.5 VDC to the positive power supply voltage (+15 VDC nominal). Predicted MTBF values are as high as 366,000 hours.

APPLICATIONS

The HSDC-14 converters are ideal for remotely located and hard to access equipment where low power requirements, small size, and high MTBF is critical. All units are processed to MIL-STD-883. They are well suited to the most stringent and severe industrial or military ground and avionics applications. In conjunction with other devices, they are readily adapted for closed loop control. Designed for printed circuit board mounting by standard techniques, the HSDC-14 can be readily incorporated into other equipment by the OEM user.

The HSDC-14 series can be used as a direct replacement for standard encapsulated S/D or R/D converter modules. A PC board mounted HSDC-14 option is offered which is pin for pin compatible with standard S/D converter sockets.

FEATURES

- *TWO HYBRID MODULES:*
  A control transformer module and a data processor module together form a complete 14 bit S/D and R/D converter
  Other functions can be implemented with these modules: CT, CDX, and two-speed S/D or R/D
- *ACCURACY:*
  ±4 minutes ±0.9 LSB standard
  ±2.6 minutes high accuracy option
- *SIGNAL AND REF. INPUTS:*
  Internal solid state isolation or external isolation transformers
  All common L-L levels and frequencies
- *LOGIC:*
  TTL and CMOS compatible
  14 bit parallel binary angle
  Converter Busy and Inhibit
- *POWER REQUIRED:*
  ±15V DC and logic voltage supply
- *ANALOG OUTPUTS:*
  Angular velocity and error voltages

*Patented

SPECIFICATIONS

Over reference amplitude, temperature, and power supply ranges; 10% signal amplitude variation; and up to 10% harmonic distortion in the reference.

PARAMETER	VALUE
RESOLUTION	14 bits
ACCURACY	
Normal Accuracy	±4 minutes ±0.9 LSB
High Accuracy Option "a"	±2.6 minutes max (total error)

SOLID STATE BUFFER INPUT (HSDC AND HRDC UNITS)

Carrier Frequency Ranges			
Option 4 (400 Hz)	360 – 1000 Hz		
Option 6 (60 Hz)	47 – 1000 Hz		
Reference Input Characteristics			
Voltage Range	4 – 130V rms		
Input Impedance	200 KΩ min, single ended		
	400 KΩ min, differential		
Common Mode Range	DC common mode plus recurrent AC peak = 210V max		

Synchro and Resolver Input Characteristics
Frequency/Voltage Options and Minimum Input Impedance (Balanced)

	ZIN Line to Line	ZIN	ZIN Each Line to GND
Synchro (HSDC)			
90V L-L (Options 4H or 6H)	130 KΩ		85 KΩ
11.8V L-L (Option 4L)	17.5 KΩ		11.5 KΩ

	ZIN Single Ended	ZIN Differential	ZIN Each Line to GND
Resolver (HRDC)			
90V L-L (Option 4H)	175 KΩ	350 KΩ	175 KΩ
26V L-L (Option 4M)	50 KΩ	100 KΩ	50 KΩ
11.8V L-L (Option 4L)	23 KΩ	46 KΩ	23 KΩ

Common Mode Ranges		
For 90V L-L Input	150V Max	DC common mode plus
For 26V L-L Input	45V Max	recurrent AC peak
For 11.8V L-L Input	20V Max	

VOLTAGE FOLLOWER INPUT (FOR TRANSFORMERS HXDC UNITS)

Carrier Frequency Range	47 – 1000 Hz
Reference Input Characteristics	
Voltage Range	4 – 130V rms
Input Impedance	200 KΩ min, single ended
	400 KΩ min, differential
Common Mode Range	DC common mode plus recurrent AC peak = 210V max
Sin/Cos Signal Input Characteristics	
Voltage Range	1V nominal, 1.15V rms, max
Max Voltage Without Damage	15V rms continuous; 100V peak transient
Input Impedance	ZIN = 10 MΩ (transient protected voltage follower)

TRANSFORMER CHARACTERISTICS

400 Hz TRANSFORMERS
Reference Transformer
(Optional for Both Solid State and Transformer Input Options)

Carrier Frequency Range	Option 4 = 360 – 1000 Hz
Voltage Range	18 – 130V
Input Impedance	40 KΩ min
Breakdown Voltage to GND	1200V peak

Signal Transformer

Carrier Frequency Range	Option 4 - 360 – 1000 Hz	
Minimum Input Impedances (Balanced)		
	Synchro ZIN (Z_{SO})	Resolver ZIN
90V L-L (Option 4H)	180 KΩ	100 KΩ
26V L-L (Option 4M)	–	30 KΩ
11.8V L-L (Option 4L)	20 KΩ	30 KΩ
Breakdown Voltage to GND	700V peak	

60 Hz TRANSFORMERS
Reference Transformer (Optional for Both Solid State and Voltage Follower Input Options)

Carrier Frequency Range	47 – 440 Hz
Input Voltage Range	80 – 138V rms; 115V rms nominal
Input Impedance	600 KΩ min, resistive
Input Common Mode Voltage	±500V rms, transformer isolated
Output Description	+R (in phase with RH-RL) and -R (in phase with RL-RH) derived from op-amps. Short circuit proof.
Output Voltage	3.0V nominal riding on ground reference V. Output voltage level tracks input level.
Power Required	4 mA typ, 7 mA max from +15V supplies.

PARAMETER	VALUE
Signal Transformer	
Carrier Frequency Range	47 – 440 Hz
Input Voltage Range	10 – 100V rms L-L; 90V rms L-L nominal
Input Impedance	148 KΩ min L-L balanced resistive
Input Common Mode Voltage	±500V rms, transformer isolated
Output Description	Resolver output, + sine (+S) and – cosine (–C) derived from op-amps. Short circuit proof.
Output Voltage	1.0V rms nominal riding on ground reference V. Output voltage level tracks input level.
Power Required	4 mA typ, 7 mA max from +15V supply
DIGITAL INPUT/OUTPUT	
Logic Type	TTL/DTL/CMOS compatible, depending on logic supply voltage
Outputs	Natural binary angle; positive logic
14 Parallel Data Bits	1.5 — 3 µs positive pulse; leading edge initiates counter update
Converter Busy (CB)	2 or 4 standard TTL loads
Drive Capability	$Z_{IN} \geq 80$ KΩ pull-up resistor to V_M (V_M = logic supply voltage or +15 supply voltage. See Interconnection Diagrams.
Inhibit Input (INH)	
ANALOG OUTPUTS	
Internal D.C. Reference (V)	+3.9 VDC nominal
AC Error Voltage (e)	0.38 mV rms per LSB of error
DC Error Voltage (E)	–1 VDC per + LSB of error
DC Velocity Voltage (θ)	+1 VDC per +1.25 rps at 400 Hz
	+1 VDC per +0.31 rps at 60 Hz
DYNAMIC CHARACTERISTICS	
Input Rate for Full Accuracy	
At 400 Hz	0 to ±10 rps min
At 60 Hz	0 to ±2.5 rps min
Velocity Constant	$K_V = \infty$ (No limitation with Type II servo loop)
Acceleration Constant	
At 400 Hz	$K_a = 58{,}000\ sec^{-2}$ nominal
At 60 Hz	$K_a = 3{,}600\ sec^{-2}$ nominal
Settling Time	
For Normal Tracking	No lag error up to specified input rates
For 179° Step Change	
At 400 Hz	120 ms typ to 1 LSB
	200 ms max to final value
At 60 Hz	480 ms typ to 1 LSB
	800 ms max to final value
TEMPERATURE RANGES	
Operating	
–1 option	–55°C to +125°C
–3 option	0°C to +70°C
Storage	–55°C to +135°C

POWER SUPPLIES

Nominal Voltage	+15 VDC	–15 VDC	Logic Supply
Voltage Range	+11 to +16.5V	0 to –16.5V	+4.5V to +15 supply
Absolute Max Voltage	+18V	–18V	+18V
Current or Impedance	40 mA max*	15 mA max*	Z_{IN} = 10 KΩ min

*Does not include current required by 60 Hz active transformers.

PHYSICAL CHARACTERISTICS

Converter Module and Data Processor Module	
Type	36 pin double DIP
Size	0.78 x 1.9 x 0.21 inch (2.0 x 4.8 x 0.53 cm)
Weight	1 oz max (28 g)
400 Hz Transformer Modules	
Type	Encapsulated module. Signal input uses 2 modules (T1A and T2B). Ref uses 1 module (T2).
Size	0.8 x 0.6 x 0.3 inch (2 x 1.5 x 0.8 cm)
Weight	0.4 oz max (11 g)
60 Hz Transformer Modules	
Type	Encapsulated module. Signal transformer and reference transformer each consist of one such module.
Size	1.125 x 1.125 x 0.42 inch (2.86 x 2.86 x 1.07 cm)
Weight	0.7 oz max (20 g)
P.C. Board Mounted Units	
Size	See Outline Drawing
Weight	
Without Transformers	2.55 oz max (72 g)
With 400 Hz Transformers	3.7 oz max (105 g)

TECHNICAL INFORMATION

INTRODUCTION

The HSDC-14 S/D converters are composed of two hybrid modules: a control transformer (HSCT, HRCT, or HXCT) and an error data processor (HDP). The major options available include:

1. Input Style. The control transformer has either a solid state input (HSCT and HRCT), or a voltage follower buffer (HXCT) which requires either an isolation transformer or a similar signal conditioner. All three inputs are DC coupled with broadband characteristics (up to 1000 Hz).

2. Signal Voltage Level. Standard line to line voltages that can be selected are 90V and 11.8V for synchro input and 90V, 26V, and 11.8V for resolver input.

3. Carrier Frequency. The data processor (HDP) can accept either a 360–1000 Hz frequency range (HDP-4) or a 47–1000 Hz frequency range (HDP-6). Both frequency ranges are usable to 10 kHz with reduced accuracy.

4. Mounting. The three standard options are: (a) individual modules interconnected by the user, (b) modules mounted and interconnected on a PC board (BM—the pins on this board are the same as those on standard modular S/D converters) and (c) board mounted units with two extra pins for velocity output (BMV).

When testing or evaluating the converter, it is advisable to limit the power supply currents as follows:

SUPPLY	CURRENT LIMIT
+15 VDC	75 mA
−15 VDC	30 mA
Logic Supply	2 mA + Digital Output Load at Logic 1

MODULE INTERCONNECTIONS

A diagram for the interconnections between the control transformer module and the data processor module is given in Figure 2. Interconnection layout is not critical. The analog outputs are derived from op-amps, have low output impedance, and are short circuit proof.

The output drive capability can be either 2 or 4 standard TTL loads as indicated in Note 3 in Figure 2. The penalty for 4 TTL load capability is that the Inhibit input, which is internally connected to V_M by an 80 KΩ pullup resistor, will be referenced to the +15V supply rather than to the logic supply voltage.

It is possible to change the interconnections shown in Figure 2 so as to decrease the resolution and increase the tracking speed of the HSDC-14. Only one additional error gradient correcting resistor will be required. Consult the factory for detailed information.

SIGNAL AND REFERENCE INPUTS AND TRANSFORMERS

Solid State Buffer Input (HSDC and HRDC):

The solid state signal and reference inputs are true differential inputs with high AC and DC common mode rejection, so most applications will not require HXDC units with isolation transformers. Input impedance is maintained with power off. The recurrent AC peak + DC common mode voltage range should not exceed the following values:

INPUT	COMMON MODE MAXIMUM	MAX TRANSIENT PEAK VOLTAGE
11.8V L-L	20V Peak	150V
26 V L-L	45V Peak	150V
90 V L-L	150V Peak	350V
Reference	210V Peak	1000V

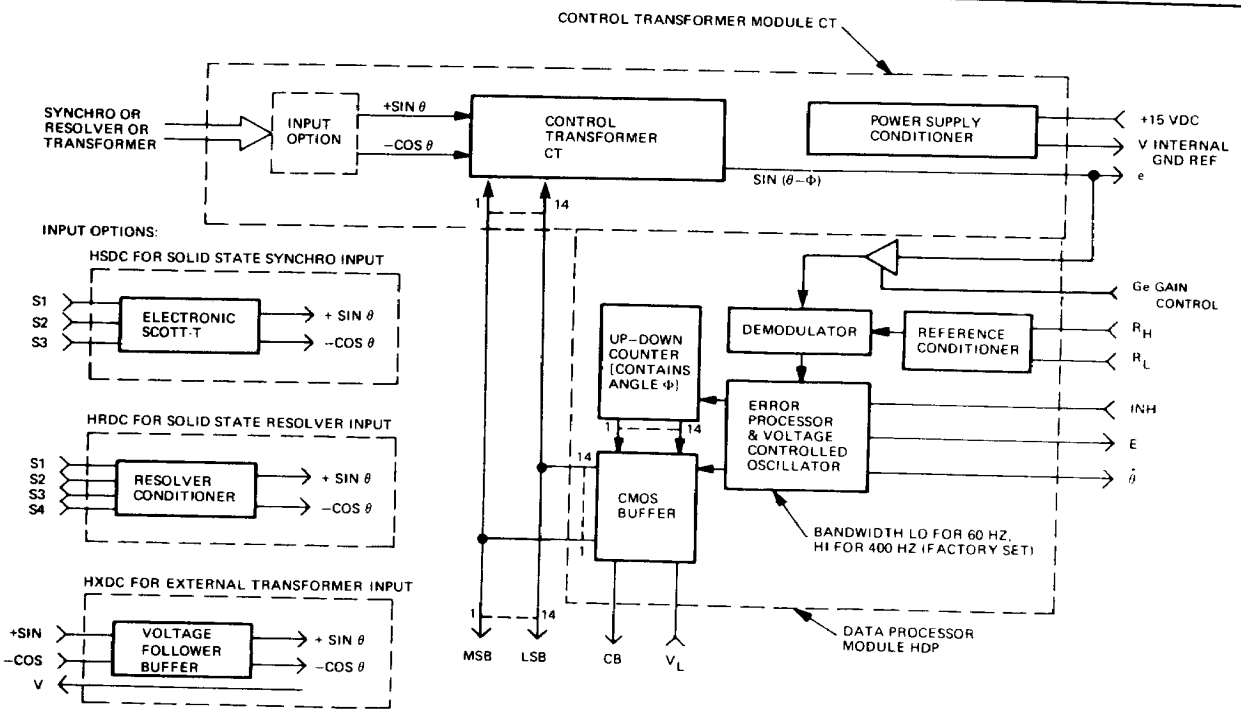
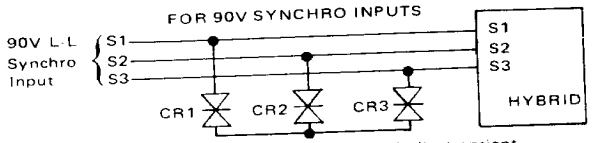
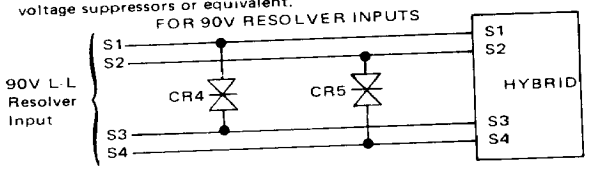


FIGURE 1. HSDC-14 BLOCK DIAGRAM

90V line-to-line systems generally have voltage transients which exceed the 350V specification listed above. These transients can destroy the thin film input resistor network in the hybrid. Therefore, 90V L-L solid state input modules should always be protected by installing voltage suppressors as shown below. Voltage transients are likely to occur whenever synchro or resolver voltages are switched on or off. For instance, a 1000V transient can be generated when the primary of a CX or TX driving a synchro or resolver input is opened.



CR1, CR2 and CR3 are 1N6130, 100V bi-polarity transient voltage suppressors or equivalent.



CR 4 and CR5 are 1N6137, 200V bi-polarity transient voltage suppressors or equivalent.

CONNECTIONS FOR VOLTAGE TRANSIENT SUPPRESSORS

Non-standard synchro and resolver voltage levels can be accommodated with no degradation in the specifications. For HSCT or HRCT inputs, a unit should be used whose voltage level 11.8V, 26V, or 90V is the next higher standard level above that of the non-standard signal. To correct the error gradient, a resistor R of the following value in ohms must be added between pins Ge and V of the HDP:

$$R = \frac{4000A}{1-A} \quad \text{where} \quad A = \frac{\text{Non Standard Signal Voltage}}{\text{Standard Signal Voltage}}$$

Voltage Follower Buffer Input (HXCDX):

HXDC units require a signal isolation transformer or a similar signal conditioner. They may be preferred in applications where the signal conditioner can be integrated with other components, as in many multiplexed systems.

Transformers

For 60 Hz applications, a 90V L-L synchro transformer and corresponding 115V reference transformer are available. These are active transformers with op-amp outputs, and require connections to the power supplies as shown in Figure 2. Active devices are provided because passive transformers require considerably more volume at 60 Hz than at 400 Hz.

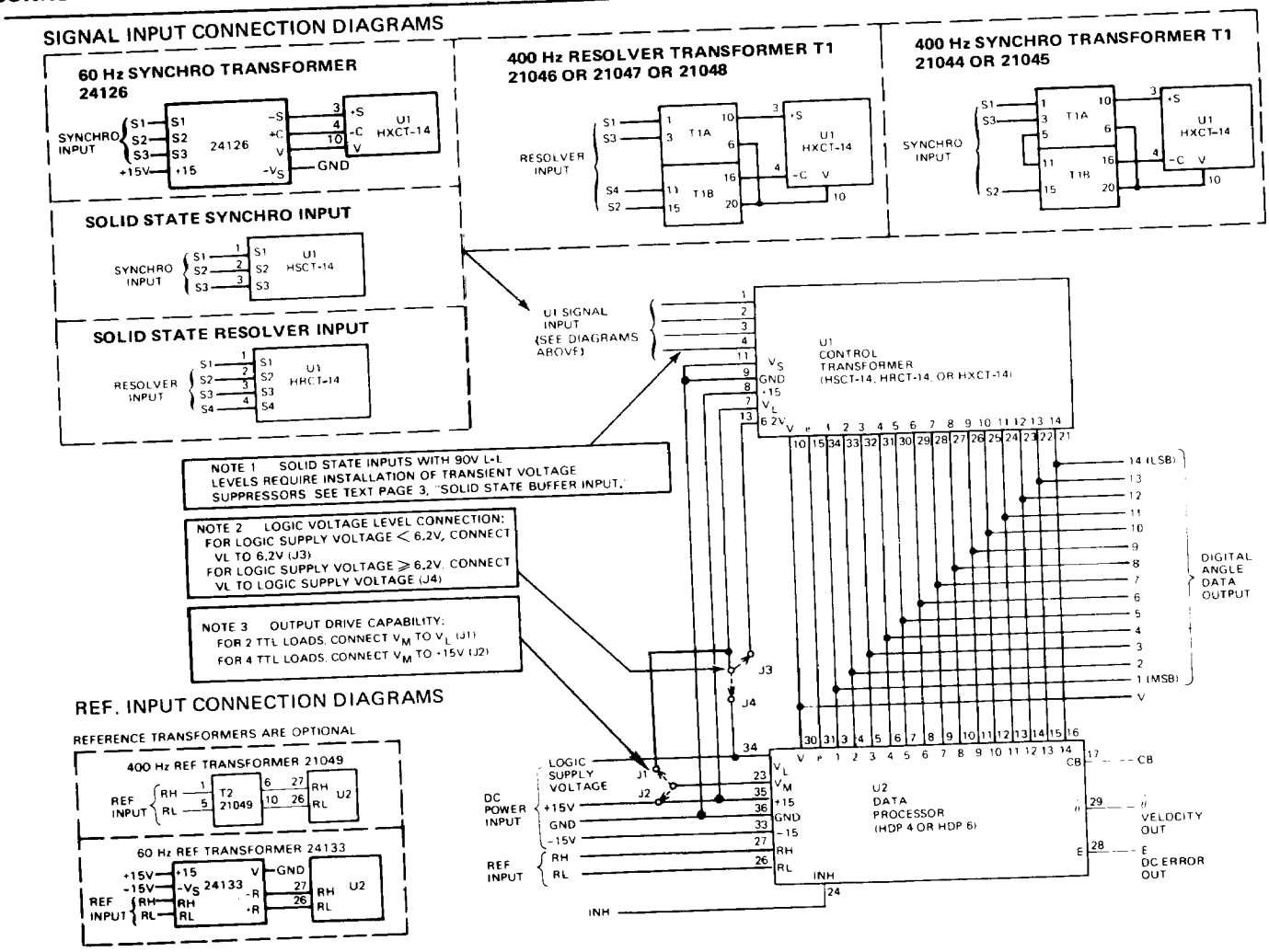


FIGURE 2. INTERCONNECTION DIAGRAM

LOGIC OUTPUTS/INPUTS

Logic outputs consist of 16 parallel binary data bits and a Converter Busy (CB). Only 14 bits are normally used. All logic outputs are short-circuit proof to ground or to positive voltages as high as V_L. The CB output is a positive 1.5–3μs pulse, and data changes on the leading edge of the pulse.

The only logic input is the Inhibit (INH), which locks or releases the internal up-down counter. Logic 0 locks the counter for transfer of data, and logic 1 allows tracking. Extra CB pulses will not occur if the input angle changes while the counter is locked by the INH. The INH has an 80 KΩ (minimum) pull-up resistor to V_M. Note that this implies that when the drive capability of the logic output is increased to 4 TTL loads by connecting V_M to +15V, the inhibit pull-up resistor will also be connected to +15V, and its logic voltage requirement will be increased (logic 1 = .7V_M to V_M).

ANALOG OUTPUTS

The analog outputs are V, e, E, and $\dot{\theta}$. V is an internal D.C. Reference + 3.9 VDC nominal. The outputs e, E and $\dot{\theta}$ ride on the D.C. reference voltage V, and should be measured with respect to V. Outputs e and E can swing ±1.5V and $\dot{\theta}$ can swing ±8V.

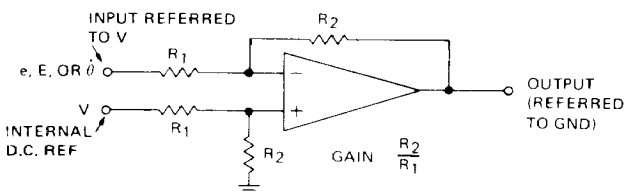
Output e is the AC error voltage and its rms amplitude at nominal input voltage is equal to sin $(\theta-\phi)$ cosωt, as indicated in Figure 1. For 1 LSB of error $(\theta-\phi)$ = 0.022°, so sin $(\theta-\phi)$ = 0.00038 and e = 0.38 mV rms. For 90° of error, e = 1.0V rms.

E is a DC voltage proportional to the error $(\theta-\Phi)$ near the null point, with −1 VDC output per +LSB of error.

$\dot{\theta}$ is a DC voltage proportional to the angular velocity $d\theta/dt = d\Phi/dt$. A +1 VDC output corresponds to +1.25 rps for 400 Hz units, and +0.31 rps for 60 Hz units.

Maximum loading for each analog output is 1 mA. Outputs e, E, and $\dot{\theta}$ are not required for normal operation of the converter; V is used as reference ground with the voltage follower buffer option (HXDC).

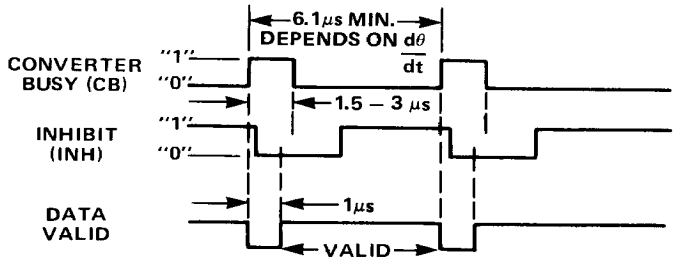
The figure below shows a difference circuit which may be used to reference the anolog outputs with respect to ground instead of the internal D.C. reference ground V.



DIFFERENCE CIRCUIT FOR ANALOG OUTPUTS

TIMING

Whenever an input angle change occurs, the converter changes the digital angle in steps 1 LSB, and generates a converter busy pulse. The output data change is initiated by the leading edge of the CB pulse. The output becomes stable in less than 2μs even though the CB pulse may last longer. The converter will ignore an inhibit command applied during the "busy" interval until that interval is over. A simple method of interfacing to a computer is to (a) apply the inhibit, (b) wait 2μs, (c) transfer the data, and (d) release the inhibit.

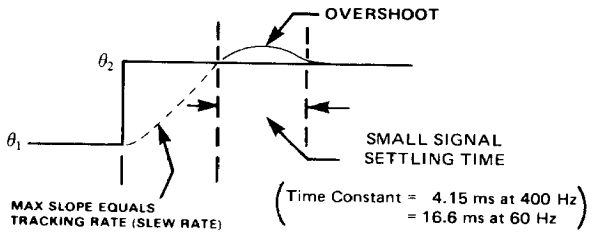


TIMING DIAGRAM

DYNAMIC PERFORMANCE

A Type II servo loop ($K_V = \infty$) and very high acceleration constants give the HSDC-14 superior dynamic performance, as listed in the specifications. If the power supply voltages are not the ±15 VDC nominal values, the specified maximum input rates will increase or decrease depending on the changes in voltage. If the power supply voltages are reduced to ±12V, the maximum tracking rates are proportionally reduced to 6 rps at 400 Hz and 1.5 rps at 60 Hz. Accuracy remains the same. For reduced power consumption, the HSDC-14 can be operated on +15V and V_L alone, without a −15V power supply. In that case, maximum tracking rates will be 2.5 rps at 400 Hz and 0.6 rps at 60 Hz.

So long as the maximum tracking rate (10 rps at 400 Hz and 2.5 rps at 60 Hz) is not exceeded, there will be no lag in the converter output. If a step input occurs, as is likely when the power is initially turned on, the response will be critically damped. The response to a step input is shown below. After initial slewing at the maximum tracking rate of the converter, there is one overshoot which is inherent to a Type II servo. The overshoot settling to final value is a function of the small signal settling time.



RESPONSE TO A STEP INPUT

The nominal open loop transfer functions for the HSDC-14 are

For 60 Hz

$$G = \frac{60^2\left(\frac{S}{25}+1\right)}{S^2\left(\frac{S}{250}+1\right)}$$

For 400 Hz

$$G = \frac{240^2\left(\frac{S}{100}+1\right)}{S^2\left(\frac{S}{1000}+1\right)}$$

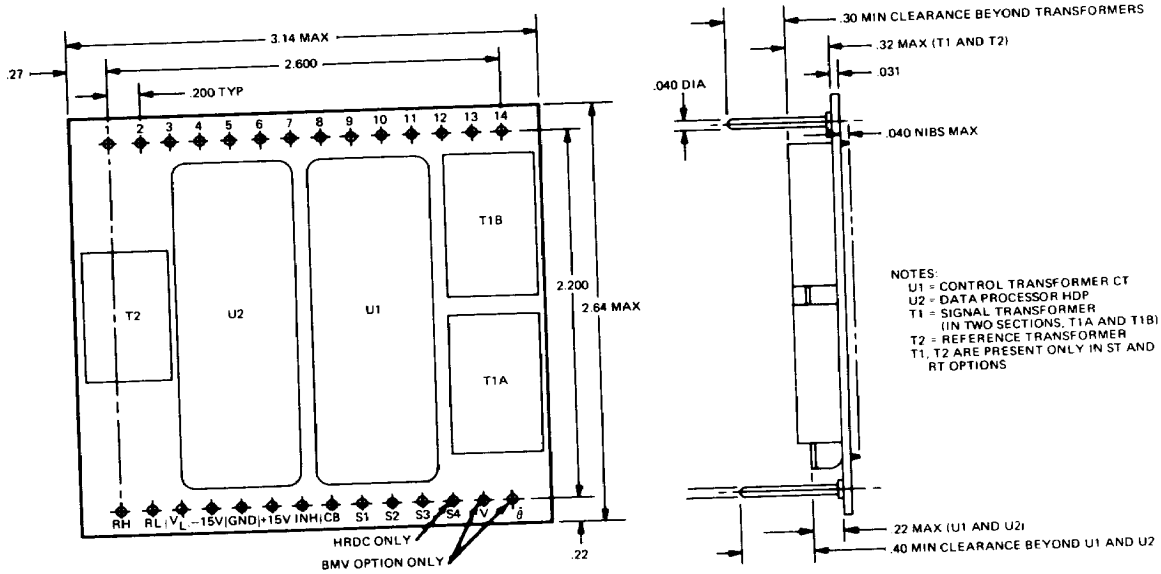
RELIABILITY

The use of MSI and thin film resistor networks, as well as careful thermal design, results in very high MTBF values. Summaries of MTBF calculations are available on request.

All DDC hybrids are built in accordance with requirements of MIL-STD-883 and are screened as shown in our Processing Flow Chart. This screening is based on the requirements of Method 5004/5008 except for burn in, which is optional. To specify preburn in tests and burn in, add 883B to the part number. The computed MTBF value for MIL-STD-883B processing (including burn in) is 600,000 hours, Ground Fixed, at 25°C.

MECHANICAL OUTLINE FOR BOARD MOUNTED UNITS, BM AND BMV

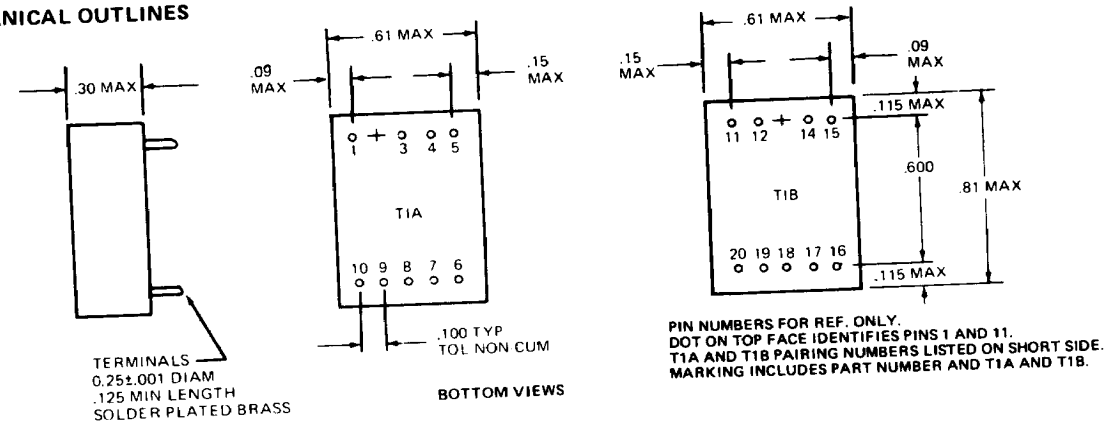
BOARD MOUNTED UNITS ARE AVAILABLE WITHOUT TRANSFORMERS OR WITH 400 Hz ONLY TRANSFORMERS, AS SHOWN



SYNCHRO AND RESOLVER TRANSFORMER DIAGRAMS FOR 400 HZ (T1A AND T1B)

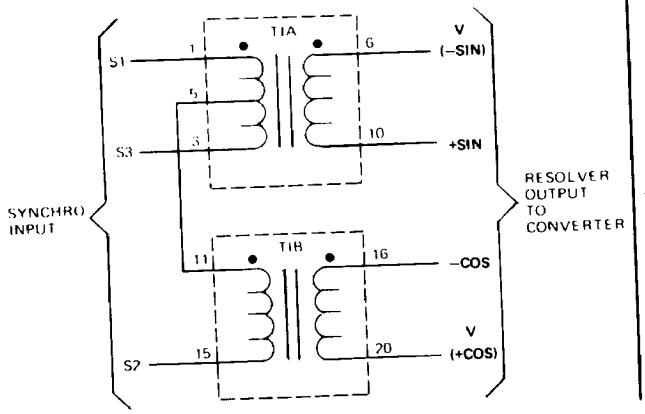
EACH TRANSFORMER CONSISTS OF TWO SECTIONS, T1A AND T1B.

1. MECHANICAL OUTLINES

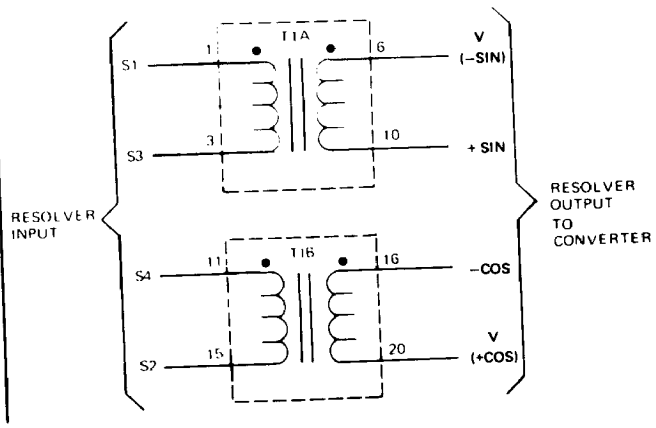


2. SCHEMATIC DIAGRAMS

A. SYNCHRO

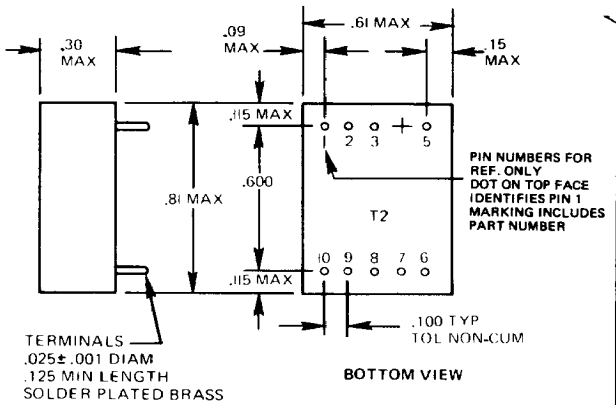


B. RESOLVER

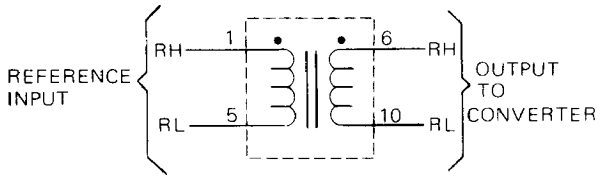


REFERENCE TRANSFORMER DIAGRAMS FOR 400 Hz (T2)

1. MECHANICAL OUTLINE

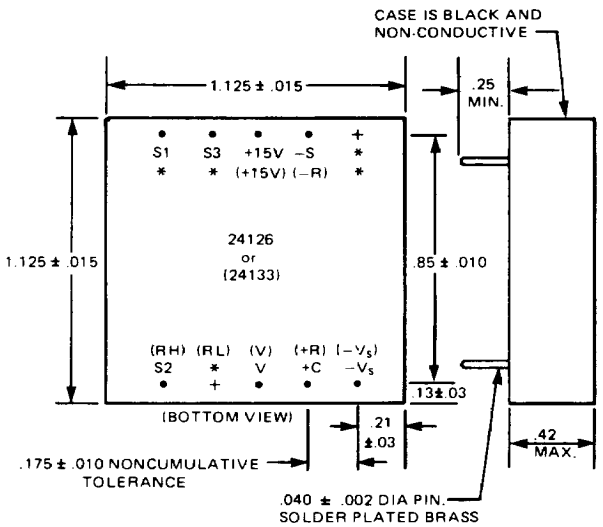


2. SCHEMATIC DIAGRAM



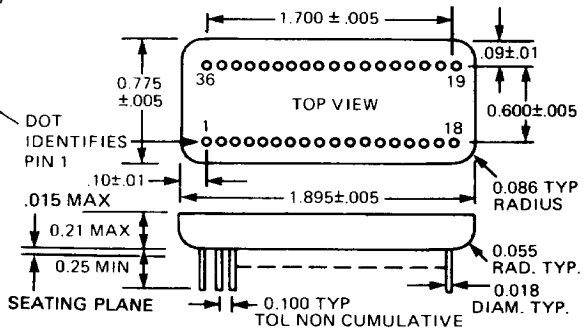
SYNCHRO AND REFERENCE TRANSFORMER DIAGRAMS FOR 60 Hz

The mechanical outline is the same for the synchro input transformer (24126) and the reference input transformer (24133), except for the pins. Pins for the reference transformer are shown in parenthesis ( ) below. An asterisk * indicates that the pin is omitted.



CONVERTER MODULE DIAGRAMS

1. MECHANICAL OUTLINE (36 PIN DOUBLE DIP)



PACKAGE IS KOVAR WITH ELECTROLESS NICKEL PLATING
PINS ARE KOVAR WITH GOLD PLATING: (50 μ INCH MIN).
CASE IS ELECTRICALLY FLOATING

2. CONTROL TRANSFORMER PIN ASSIGNMENTS

PIN	FUNCTION			PIN	FUNCTION
	HRCT	HSCT	HXCT		
1	S1	S1	N.C.	19	TP3
2	S2	S2	N.C.	20	TP1
3	S3	S3	+SIN	21	BIT 14 LSB
4	S4	N.C.	−COS	22	BIT 13
5	+BS (BUFFERED SIN)			23	BIT 12
6	−BC (BUFFERED COS)			24	BIT 11
7	V_L			25	BIT 10
8	+15V			26	BIT 9
9	GND			27	BIT 8
10	V (Internal D.C. Ref)*			28	BIT 7
11	$-V_S$			29	BIT 6
12	V' (TP)			30	BIT 5
13	6.2V			31	BIT 4
14	TP4			32	BIT 3
15	e (AC Error)			33	BIT 2
16	TP5			34	BIT 1 MSB
17	NC			35	TP6
18	TP2			36	TP7

*V must not be grounded

NOTE: TEST POINTS ARE FOR FACTORY USE ONLY
+BS AND −BC PINS ARE USED IN OTHER APPLICATIONS

3. DATA PROCESSOR PIN ASSIGNMENTS

PIN	FUNCTION	PIN	FUNCTION
1	BIT −1	19	C_a
2	BIT 0	20	U
3	BIT 1 MSB	21	T
4	BIT 2	22	R
5	BIT 3	23	V_M
6	BIT 4	24	INH (Inhibit)
7	BIT 5	25	NC
8	BIT 6	26	RL (Ref. Low)
9	BIT 7	27	RH (Ref. High)
10	BIT 8	28	$\bar{E}$ (DC Error Out)
11	BIT 9	29	$\bar{\theta}$ (Velocity Out)
12	BIT 10	30	V (Internal D.C. Ref)*
13	BIT 11	31	e (AC Error Out)
14	BIT 12	32	Ge (Gain Control)
15	BIT 13	33	−15V
16	BIT 14 LSB	34	V_L (Logic Voltage Level)
17	CB (Converter Busy)	35	+15V
18	NC	36	GND

*V must not be grounded

NOTE: BIT −1, BIT 0, Ca, U, T, AND R PINS ARE USED IN OTHER APPLICATIONS

ORDERING INFORMATION

1. Converters may be ordered as follows. For voltage follower buffer input options (HXDC) note the following:

   (a) For HXDC options which are not board mounted, a reference and or signal transformer must be ordered separately from Part 2 below.

   (b) For HXDC options which are board mounted (BM or BMV options), transformers mounted on the board are included with the part number and should not be ordered from part 2.

HSDC-14-4H-3-a-883B

- Options:
  - Blank = No options
  - a = high accuracy (±2.6 minutes)
  - 883B = Hybrids conform to MIL-STD-883, DDC procedures. If 883B is not specified, pre-burn in test and burn in are not included.
- Accuracy:
  - Blank = ±4 minutes
  - a = ± 2.6 minutes
- Temperature Range:
  - 1 = −55°C to +125°C
  - 3 = 0°C to +70°C
- Frequency and Voltage Levels:
  - 4 = 360 to 1000 Hz (400 Hz)
  - 6 = 47 to 1000 Hz (60 Hz)
  - H = 90V L-L
  - M = 26V L-L
  - L = 11.8V L-L

  Available options are:
  Synchro: 4H, 4L, 6H
  Resolver: 4H, 4M, 4L

  If input is HXDC specify 4 or 6 only and omit H, M, or L. Voltage level in this case is determined by Xfmrs ordered separately from part 2 below.
- Resolution = 14 Bits
- Input Type:
  - HSDC = Solid state synchro
  - HRDC = Solid state resolver
  - HXDC = Voltage follower buffer. Requires external signal conditioner such as an isolation transformer.

2. 400 Hz and 60 Hz transformers may be ordered by part number (P/N) as follows.

Type	Frequency	Ref. Voltage	L-L Voltage	Part Numbers Ref. Xfmr.	Part Numbers Signal Xfmr.
Synchro	400 Hz	115V	90V	21049	21045*
Synchro	400 Hz	26V	11.8V	21049	21044*
Resolver	400 Hz	115V	90V	21049	21048*
Resolver	400 Hz	26V	26V	21049	21047*
Resolver	400 Hz	26V	11.8V	21049	21046*
Synchro	60 Hz	115V	90V	24133-1† -3†	24126-1† -3†

* The part number for each 400 Hz synchro or resolver isolation transformer includes two separate modules as shown in the outline drawings.

†-1 and -3 indicate operating temperature, and range available (see ordering information)

3. Control Transformer modules may be ordered separately as follows. Note that all units operate over the full frequency range of 47 to 1000 Hz.

HSCT-14-H-1-a-883B

- MIL-STD-883 Processing:
  - 883B = Conforms to MIL-STD-883B, DDC procedures
  - Blank = Same, except pre burn in test and burn in are omitted.
- Accuracy:
  - Blank = ±4 minutes
  - a = ±2 minutes
- Temperature Range (Operating):
  - 1 = −55°C to +125°C
  - 3 = 0°C to +70°C
- Voltage Levels:
  1. Synchro solid state input (HSCT):
     - H = 90V L-L
     - L = 11.8V L-L
  2. Resolver solid state input (HRCT):
     - H = 90V L-L
     - M = 26V L-L
     - L = 11.8V L-L
  3. Voltage follower buffer input (HXCT): Omit voltage level specification. One HXCT model accepts all normal voltage levels.
- Resolution = 14 Bits
- Input Type
  - HSCT = Solid state synchro
  - HRCT = Solid state resolver
  - HXCT = Voltage follower buffer. Requires external signal conditioner such as an isolation transformer.

4. Data Processor modules may be ordered separately as follows:

HDP-4-1-883B

- MIL-STD-883 Processing:
  - 883B = Conforms to MIL-STD-883B, DDC procedures
  - Blank = Same, except pre burn in test and burn in are omitted.
- Temperature Range (Operating):
  - 1 = −55°C to +125°C
  - 3 = 0°C to +70°C
- Carrier Frequency Range:
  - 4 = 360–1000 Hz
  - 6 = 47–1000 Hz