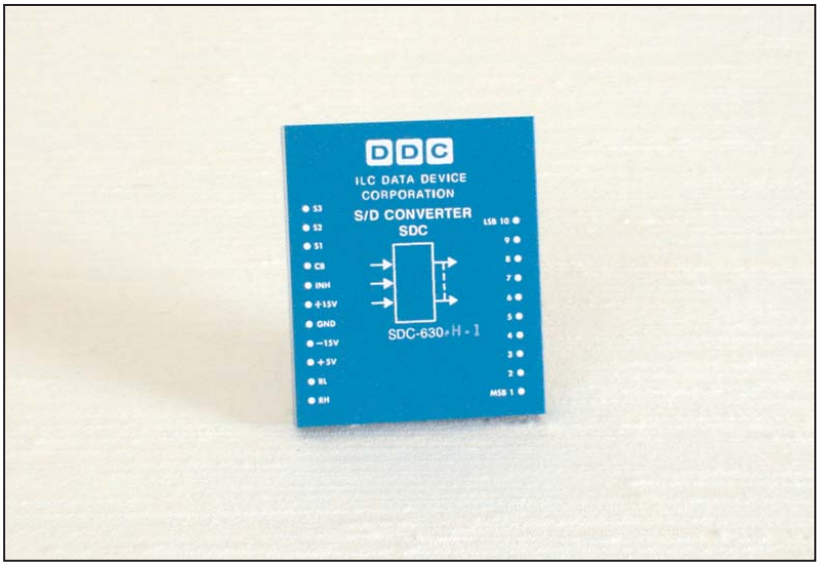
SDC-630/632/634*

10-, 12-, 14-BIT SYNCHRO-TO-DIGITAL OR RESOLVER-TO-DIGITAL CONVERTER

Make sure the next Card you purchase has...

DDC on Board®



FEATURES

- Standard Low Profile Converters with Optional Velocity Output
- Signal and Reference Input:
  - Internal Transformer Isolation
  - All Common L-L Levels and Frequencies
- Accuracy:
  10 Bit: 21 Minutes
  12 Bit: 8.5 Minutes
  14 Bit: 4 Minutes, 0.9 LSB or
  2.6 Minutes (High Accuracy)
- Logic:
  - TTL Compatible
  - Parallel Binary Angle Output
- Power Required:
  ±15 VDC and +5 VDC
- For new designs see DDC SDC-630/632/634*A/ST Series

DESCRIPTION

The SDC-630/632/634 series are low cost, low profile Synchro-to-Digital (S/D) and Resolver-to-Digital (R/D) tracking converters with standard pin configurations. They use a unique control transformer algorithm that provides inherently higher accuracy and jitter-free output. Utilizing a type II servo loop, these converters have no velocity lag up to the specified tracking rate, and output data is always fresh and continuously available. Each unit is fully trimmed and requires no adjustment or field calibration.

APPLICATIONS

These converters may be used wherever analog angle data from a synchro or resolver must be rapidly and accurately converted to digital form for transmission, storage or analysis. Because these units are extremely rugged and stable, and meet the requirements on MIL-STD-202E, they are suitable for the most severe industrial, commercial and military applications. Military ground support and avionics uses include ordnance control, radar tracking systems, navigation and collision avoidance systems.

* Patented

DDC® ©Data Device Corporation

Data Device Corporation
105 Wilbur Place
Bohemia, New York 11716
631-567-5600 Fax: 631-567-7358
www.ddc-web.com

FOR MORE INFORMATION CONTACT:

Technical Support:
1-800-DDC-5757 ext. 7771

All trademarks are the property of their respective owners.

© 1993, 1999 Data Device Corporation

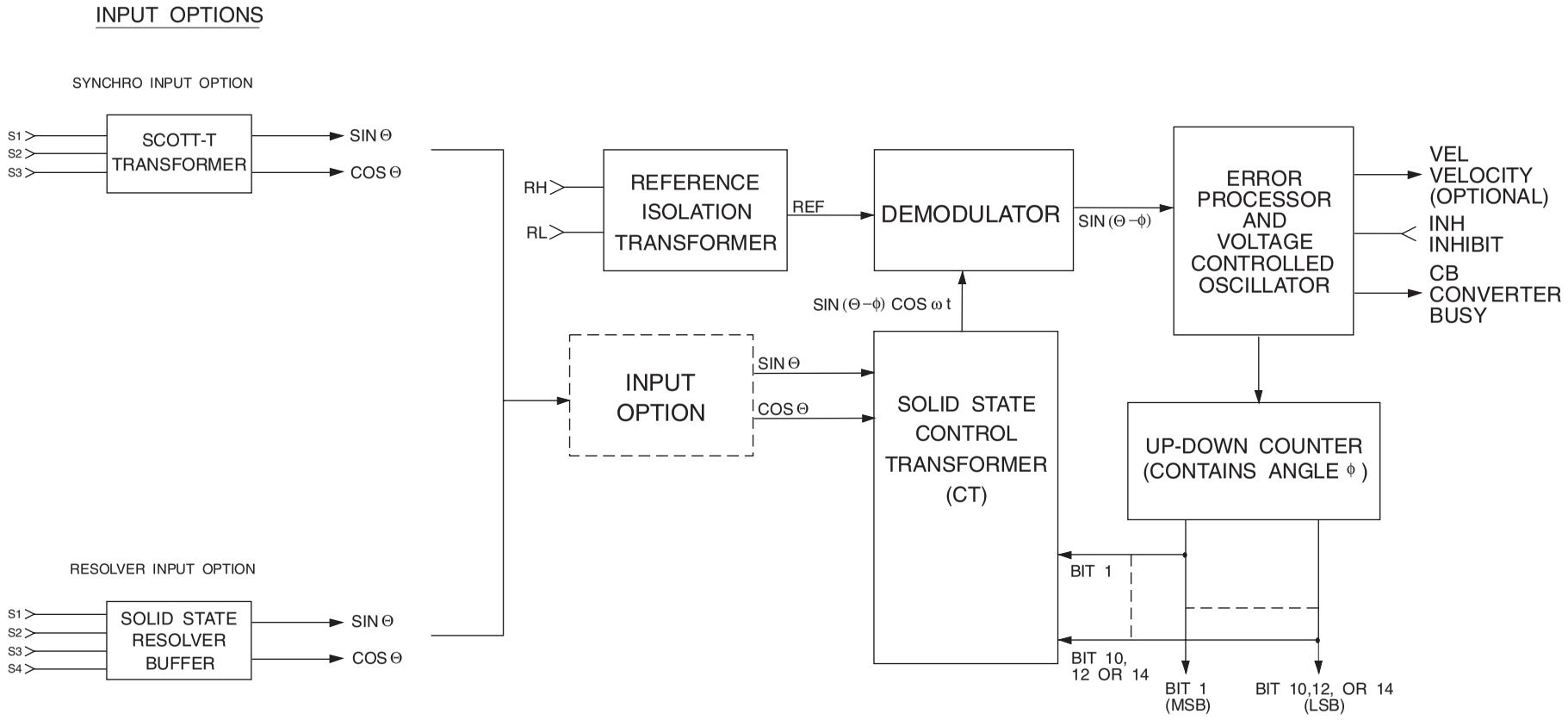


FIGURE 1. SDC-630/632/634 BLOCK DIAGRAM

TABLE 1. SDC-630/632/634 SPECIFICATIONS

(Apply over temperature range, power supply range, reference frequency and amplitude range, ±10% signal amplitude variation, and up to 10% harmonic distortion in the reference.)

PARAMETER	VALUE		
	SDC-630	SDC-632	SDC-634
RESOLUTION	10 bits	12 bits	14 bits
ACCURACY			
Standard Units	±21 min	±8.5 min	±4 min ±0.9 LSB
High Accuracy Option	—	—	±2.6 min

SIGNAL AND REFERENCE INPUT	Signal Frequency Range	Signal Input Impedance (L-L Balanced, Resistive)
Synchro Input*		
90V L-L, 400 Hz (Option H)	350-1000 Hz	148 kΩ min
90V L-L, 60 Hz (Option I)	47-1000 Hz	148 kΩ min
11.8V L-L, 400 Hz (Option L)	350-1000 Hz	19 kΩ min
Resolver Input*		
90V L-L, 400 Hz (Option H)	350-1000 Hz	198 kΩ min
26V L-L, 400 Hz (Option M)	350-1000 Hz	57 kΩ min
11.8V L-L, 400 Hz (Option L)	350-1000 Hz	26 kΩ min
REFERENCE INPUT*	Reference Voltage Range	Reference Input Impedance (Resistive)
Options H, I	40-150 Vrms	300 kΩ min
Options M, L	10-50 Vrms	80 kΩ min

*Transformer Isolated. Other voltages and frequencies available on special order.

DIGITAL INPUT/OUTPUTS	
Logic Type	TTL
Inhibit Input (INH) Loading	Logic "0" inhibits 0.2 Std. TTL loads plus 18 KΩ min pull-up resistor to +5V supply
Outputs	
Type	Low power Schottky (can drive remote loads)
10, 12, or 14 Parallel Data Bits	Natural Binary Angle; Positive logic
Converter Busy (CB)	0.5 to 1.5 µsec positive pulse. Data changes on leading edge.
Drive Capability	2 Std. TTL loads
VELOCITY OUTPUT (ON SPECIAL ORDER ONLY)	
Type	Derived from an op-amp with low impedance output. Positive Output for increasing angle
Voltage Range	10V Min
Scale Factor (for SDC-634 - Others on Request)	
Options H, M, and L	6V per rps nominal (10V = 15 rps)
Option I	3.3V per rps nominal (10V = 2.7 rps)

TABLE 1. SDC-630/632/634 SPECIFICATIONS (CONT.)

(Apply over temperature range, power supply range, reference frequency and amplitude range, ±10% signal amplitude variation, and up to 10% harmonic distortion in the reference.)

PARAMETER	VALUE					
DYNAMIC CHARACTERISTICS	Min	Typ	Min	Typ	Min	Typ
Input Rate for Full Accuracy (Min Range)						
Options H, M, L (400 Hz)	0-22 rps	40	0-40 rps	50	0-10 rps	15
Option I (60 Hz)	0-8 rps	10	0-10 rps	12.5	0-1.25 rps	3
Acceleration for 1 LSB Lag						
Options H, M, L (400 Hz)	12,600°/sec² typ		4500°/sec² typ		610°/sec² typ	
Option I (60 Hz)	770°/sec² typ		295°/sec² typ		20°/sec² typ	
Settling Time						
For Normal Tracking (Up to Specified Input Rate)	No lag error		No lag error		No lag error	
For 179° Step Change (Typical Values)						
Options H, M, L (400 Hz)						
Settling to 1 LSB	80 msec		90 msec		150 msec	
Settling to Final Value	100 msec		110 msec		200 msec	
Option I (60 Hz)						
Settling to 1 LSB	300 msec		300 msec		800 msec	
Settling to Final Value	500 msec		360 msec		1000 msec	
Velocity Constant (Type II servo loop)	$K_V=\infty$		$K_V=\infty$		$K_V=\infty$	
Acceleration Constant (Nominal Values)						
Options H, M, L (400 Hz)	K_a=36,000sec²		K_a=54,000sec²		K_a=27,800sec²	
Option I (60 Hz)	K_a=2,200sec²		K_a=3,600sec²		K_a=900sec²	
POWER SUPPLIES						
Nominal Voltage	+15 V Supply		-15 V Supply		+5 V Supply	
Voltage Range	+11 to +16.5 V		-11 to -16.5 V		+4.5 to +5.5 V	
Maximum Voltage Without Damage	+18 V		-18 V		+7 V	
Current						
SDC-630 (632) Typical	8 mA	(4)	18 mA	(18)	80 mA	(80)
Maximum	13 mA	(6)	30 mA	(30)	120 mA	(120)
SDC-634 Typical	10 mA		20 mA		100 mA	
Maximum	15 mA		30 mA		150 mA	

TEMPERATURE RANGES	
Operating	
-1 Option	-55°C to +105°C
-3 Option	0°C to +70°C
Storage	-55°C to +125°C
PHYSICAL CHARACTERISTICS	
Size (Encapsulated Module)	3.125 x 2.625 x 0.43 inches (7.94 x 6.67 x 1.07 cm)
Weight	4 oz (113 gm.)

TECHNICAL INFORMATION

TIMING

FIGURE 2 shows the timing waveforms of the converter. Whenever an input angle change occurs, the converter changes the digital angle in steps of 1 LSB, and generates a converter busy impulse (CB). The CB is a positive pulse 0.5 to 1.5µsec long. Data changes on the leading edge of the CB pulse, and data can be transferred 0.5µsec after the leading edge.

The simplest method of interfacing with a computer is to transfer data at a fixed time interval after the inhibit is applied. The converter will ignore an inhibit applied during the "busy" interval until that interval is over. Timing is as follows: (a) apply the inhibit, (b) wait 0.5µsec, (c) transfer the data, and (d) release the inhibit. Extra CB pulses will not occur if the input angle changes while the counter is locked by the INH.

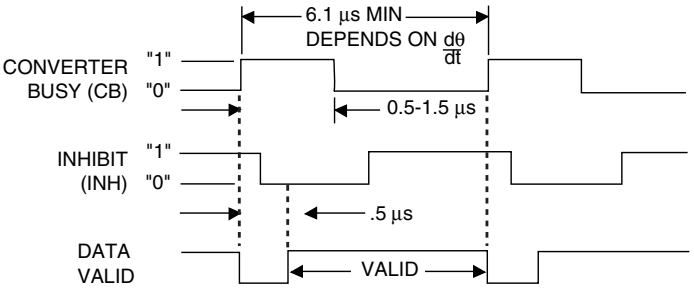


FIGURE 2. SDC-630/632/634 TIMING DIAGRAM

DYNAMIC PERFORMANCE

A type II servo loop (KV = ∞) and very high acceleration constants give these converters superior dynamic performance, as listed in the specifications. If the power supply voltages are not the +15 VDC nominal values, the specified input rates for full accuracy will increase or decrease in proportion to the fractional change in voltage. The +15 V supply voltage will determine the positive maximum velocity, and the -15 V supply voltage will determine the negative maximum velocity.

So long as the maximum tracking rate 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. FIGURE 3 shows the response to a step input. 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 a final value is a function of the small signal settling time.

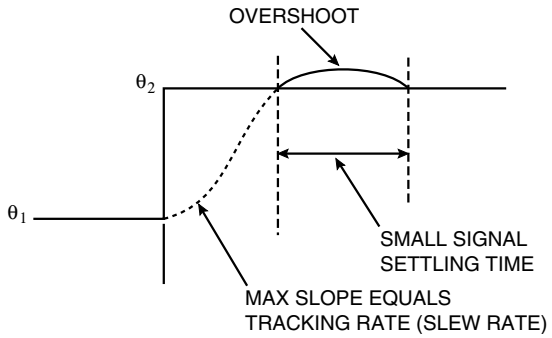


FIGURE 3. RESPONSE TO A STEP INPUT

The nominal open loop transfer function is given by

$$G = \frac{A^2 \left(\frac{S}{B} + 1 \right)}{S^2 \left(\frac{S}{10B} + 1 \right)}$$

where the parameters A and B are:

TABLE 2. TRANSFER FUNCTION PARAMETERS

		SDC-630	SDC-632	SDC-634
400 Hz	A	190 sec^{-1}	226 sec^{-1}	167 sec^{-1}
	B	91 sec^{-1}	100 sec^{-1}	56 sec^{-1}
60 Hz	A	46 sec^{-1}	58 sec^{-1}	30 sec^{-1}
	B	23 sec^{-1}	26 sec^{-1}	10 sec^{-1}

POWER SUPPLIES

The main power supplies can vary over their specified ranges with no change in the converter specifications except for a proportional change in the maximum tracking rates.

When testing or evaluating the converters, it is advisable to limit the current to each of the three power supplies. Set each limit to 50% greater than the maximum current listed for that supply in the specifications table.

TRANSFORMER INPUT

To prevent damage to the input transformers, the maximum steady state voltage should not exceed the specified input voltage by more than 30%. The maximum common mode voltage (DC plus recurrent AC peak) should not exceed 500 V.

ACCOMMODATING NON-STANDARD INPUT VOLTAGES

The signal and reference input levels of the SDC-630 series can be resistively scaled to accommodate non-standard voltages. A converter should be selected that is the next lower standard voltage and the voltage is then scaled up with resistors in series with the synchro and/or reference inputs.

For a synchro input (SDC), a resistor R_{SIG} is added in series with S1, S2 and S3, which is determined as follows:

R_{SIG} = 1.11K (New L-L Voltage - Standard Unit Voltage)

That is, 1.11K for each volt above that for which the standard unit is designed.

Example: An SDC-634-L (11.8V) is to be used at 50V L-L.

R_{SIG} = 1.11K (50-11.8) = 42.4K

The closest available high grade resistor with a low temperature coefficient of resistance should be used, and the three resistors should be matched to each other as closely as possible. In general, a 0.1% difference will introduce 1.7 arc minutes of additional error due to the effect on $\frac{SIN}{COS}$ ratio relationship.

The ABSOLUTE value of the resistor is not critical.

In the case of the RESOLVER version (RDC), the equation is:

R_{SIG} = 2.2K (New L-L level - Standard Unit L-L level)

The calculated resistors are connected in series with S1 and S2 respectively. Note only two resistors are required. The required resistor matching and its effect on accuracy, is the same as for a synchro input (See FIGURE 4).

The Reference Voltage treatment is similar, but the value selected is not critical.

R_{Ref} = 2.8K (New Ref - Standard Ref)

Here, even a 10% tolerance is adequate.

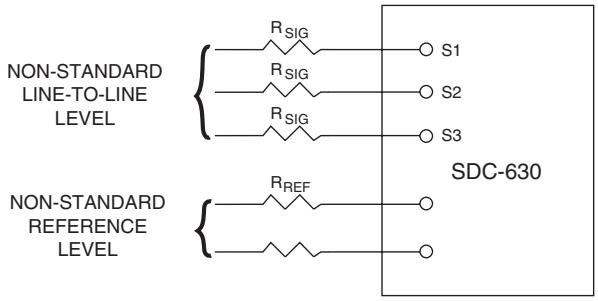
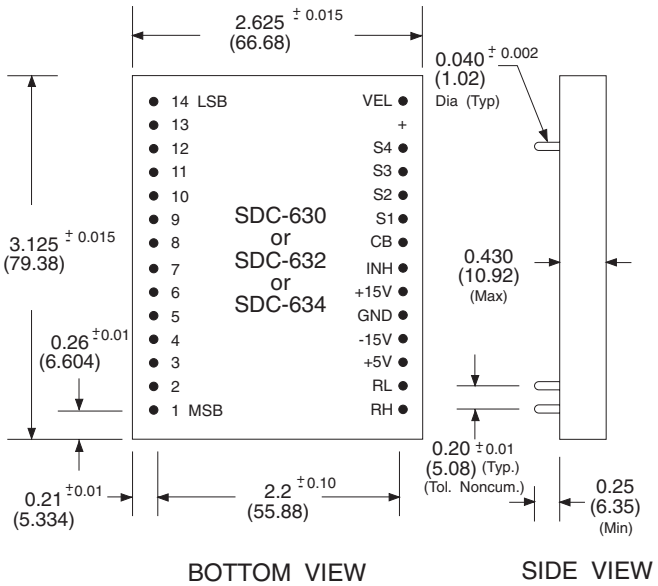


FIGURE 4. SIGNAL AND REFERENCE SCALING

Dimensions in inches (mm).



Notes:
1. Pin material is electrosoldered brass per MIL-F-14072, M222.
2. Case material is glass filled Diallyl Phthalate per MIL-M-14, Type SDG-F.
3. Pins 13 and 14 are omitted for SDC-632, and pins 11, 12, 13, and 14 are omitted for SDC-630.
4. Velocity output pin VEL is present only if requested on special order.
5. Pin S4 is present on Resolver units, and omitted on Synchro units.

FIGURE 5. SDC-630/632/634 MECHANICAL OUTLINE

ORDERING INFORMATION

XXX-XXX-X-X-X-X

Reliability Grade:
R = Enhanced Reliability (Note 1)

Accuracy:
a = High Accuracy Version, ±2.6 Minutes (SDC-634 Only)

Temperature Range:
1 = -55°C to +105°C
3 = 0°C to +70°C

Signal Input Voltage and Frequency:
H = 90 V_{L-L}, 400 Hz (Synchro or Resolver)
I = 90 V_{L-L}, 60 Hz (Synchro Only)
M = 26 V_{L-L}, 400 Hz (Resolver Only)
L = 11.8 V_{L-L}, 400 Hz (Synchro or Resolver)

Resolution:
634 = 14 bits
632 = 12 bits
630 = 10 bits

Input Type:
SDC = Synchro
RDC = Resolver

Note 1. R version only available in -55°C to 105°C temperature range (Option 1). Enhanced reliability processing provides an additional 160 hour, 105° C burn-in and temperature cycling in accordance with MIL-STD-202.

Available Sockets
P/N 9010 = socket to barrel ends for soldering direct to socket pins
P/N 9046 = socket to pin ends to solder socket to PCB
P/N 9050 = socket to wire wrap pins

STANDARD DDC PROCESSING FOR DISCRETE MODULES/PC BOARD ASSEMBLIES		
TEST	**METHOD(S)**	**CONDITION(S)**
INSPECTION / WORKMANSHIP	IPC-A-610	Class 3
ELECTRICAL TEST	DDC ATP	—

The information in this data sheet is believed to be accurate; however, no responsibility is assumed by Data Device Corporation for its use, and no license or rights are granted by implication or otherwise in connection therewith.
Specifications are subject to change without notice.

Please visit our web site at **www.ddc-web.com** for the latest information.

105 Wilbur Place, Bohemia, New York 11716-2482

For Technical Support - 1-800-DDC-5757 ext. 7771

Headquarters, N.Y., U.S.A. -Tel: (631) 567-5600, Fax: (631) 567-7358
Southeast - Tel: (703) 450-7900, Fax: (703) 450-6610
West Coast - Tel: (714) 895-9777, Fax: (714) 895-4988
United Kingdom - Tel: +44-(0)1635-811140, Fax: +44-(0)1635-32264
Ireland - Tel: +353-21-341065, Fax: +353-21-341568
France - Tel: +33-(0)1-41-16-3424, Fax: +33-(0)1-41-16-3425
Germany - Tel: +49-(0)89-15 00 12-11, Fax: +49-(0)89-15 00 12-22
Japan - Tel: +81-(0)3-3814-7688, Fax: +81-(0)3-3814-7689
World Wide Web - http://www.ddc-web.com

DATA DEVICE CORPORATION
REGISTERED TO ISO 9001:2000
FILE NO. A5976