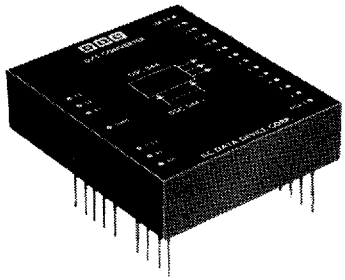
DSC-544*

14 BIT D/S CONVERTER 4.5VA; Powered From Ref Input



DESCRIPTION

The DSC-544 digital to synchro (D/S) converter complements the low profile DSC-644 industry standard by providing additional features. The DSC-544 has a 0.82" high profile and standard pinouts except that the need for +15V and -15V power supplies has been eliminated. Because the unit is powered from the reference input with an internal pulsating power supply it is much more efficient. The reduced heat dissipation has made it possible to increase the load at 400 Hz by a factor of three, and the power output at 60 Hz is limited only by the size of the internal power transformer.

The DSC-544 also retains the many improved features of the DSC-644. The output is fully protected against overloads, transients from load kickbacks, short circuits and overheating. An aluminum top plate in the module improves thermal dissipation. And a new circuit design provides a smoother, more accurate output with improved transient response and a negligible scale factor variation.

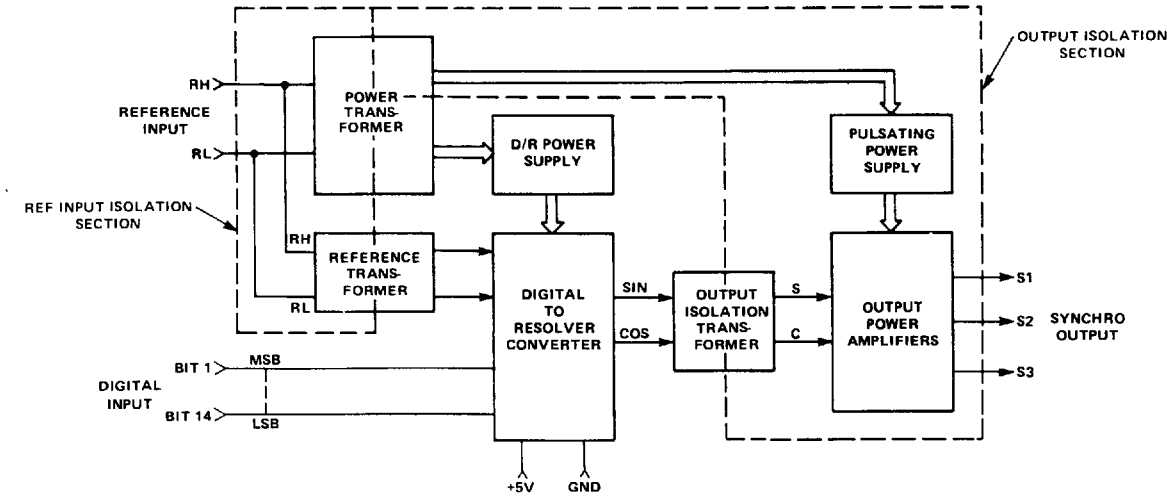
APPLICATIONS

The DSC-544 may be preferred when its special features are required: elimination of the ±15V power supplies, elimination of an external transformer at 60 Hz, greater drive capability at 400 Hz, and less heat dissipation. The converter is used in many applications where digitized shaft angle data must be converted to synchro form to drive control transformers, control differential transmitters, and angle indicators. Because these converters are very rugged, and meet the requirements of MIL-STD-202, they are suitable for the most severe industrial and military applications, including military ground support and avionics. They are used especially in computer based systems in which digital information is processed, such as simulators, flight trainers, flight instrumentation, and fire control systems.

FEATURES

- *POWER DISSIPATION CUT IN HALF:*
  AT 400 Hz, DRIVING 4.5 VA, DISSIPATES 6W
  AT 60 Hz, DRIVING 1.5 VA, DISSIPATES 3W
- *DOES NOT REQUIRE +15V OR −15V SUPPLIES*
- *NO EXTERNAL TRANSFORMER AT 60 Hz*
- *VIRTUALLY INDESTRUCTABLE:*
  RUGGED POWER AMPLIFIERS WITH CURRENT LIMITING
  COMPLETELY SHORT-CIRCUIT PROOF
  OVERVOLTAGE TRANSIENT PROTECTION
  THERMAL CUTOFF
- *OUTPUT*
  TRANSFORMER ISOLATED OUTPUT
  90V SYNCHRO OUTPUT AT 400 Hz AND 60 Hz
- *DIGITAL INPUT*
  CMOS AND TTL COMPATIBLE
  PARALLEL BINARY ANGLE INPUT
- *POWER SUPPLIES REQUIRED:*
  +5 V ONLY

*Patented



DSC-544 BLOCK DIAGRAM

DSC-544 SPECIFICATIONS

Apply over operating temperature and frequency ranges, ±5% variation of power supply, ±10% reference amplitude variation, up to 10% reference harmonic distortion, and for any load up to full load.

PARAMETER	VALUE
RESOLUTION	14 bits
ACCURACY (TO FULL LOAD)	
Output Accuracy	±4 minutes
Differential Linearity	±1 LSB max
ANALOG OUTPUT (TRANSFORMER ISOLATED)	
Drive Capability (L-L Balanced)	
Synchro Output	
90V rms L-L, 360 – 440 Hz	
(Option H)	1.33 KΩ min
90V rms L-L, 57 – 63 Hz	
(Option I)	4.0 KΩ min
Output Scale Factor	
Absolute (All Causes)	±2% max simultaneous amplitude variation on all output lines, including variation with digital angle. Output amplitude tracks reference input amplitude.
Variation With Digital Angle	±0.1% max
Output Quadrature	±0.2% max
DIGITAL INPUT	
Logic Type	Natural binary angle; parallel positive logic TTL compatible Transient protected CMOS 33 KΩ pull-up to +5V
Loading	0.13 Std. TTL load

*The output amplifiers will drive loads with any phase angle from −90° to +90°

PARAMETER	VALUE
REFERENCE INPUT (TRANSFORMER ISOLATED)	
Ref Voltage Level	115V rms ±10%
Max Voltage Without Damage	138V rms
Current	
No Load	
Option H	40 mA max
Option I	50 mA max
Additional With Load	1 mA per mA of load
POWER SUPPLY	
Voltage	+5V
Max Voltage Without Damage	+7V
Current	20 mA max
TEMPERATURE RANGES	
Operating (Temperature of Metal Plate on Top of Case)	
−1 Option	−55°C to +85°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 0.82 inch (7.94 x 6.67 x 2.08 cm)
Weight	8 oz. max (227 g)

TECHNICAL INFORMATION

INTRODUCTION

The DSC-544 circuit is divided into 3 parts which are transformer isolated from each other (see Block Diagram). The first part contains the reference input, the second part contains the digital input and an internal digital to resolver converter, and the third part contains output power amplifiers and an associated pulsating power supply.

Reference input isolation is provided both by the reference transformer and by the power transformer. The converter output signals are proportional to the applied reference, and any distortion in the reference input will appear in the output signals. The power transformer output has a voltage clamp which protects the power amplifiers against transients in the reference input.

The internal digital to resolver (D/R) converter in the DSC-544 operates from an internal power supply connected to the reference input. The circuit in the internal D/R converter is based on an alogorithm whose theoretical math error is only ±3.5 arc-seconds (less than 5% of 1 LSB), and whose theoretical scale factor variation with angle is less than ±0.015%. The output is well behaved, with negligible glitches at major transition points. The accuracy and scale factor error are limited by the physical components, not by the algorithm.

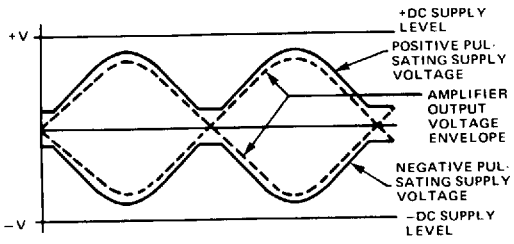
The digital inputs are transient protected CMOS switches with 33 KΩ pull-up resistors to the +5V supply, and can be driven by all standard TTL gates. If the TTL gates drive other loads as well, the circuit must allow the 33 KΩ resistors to pull up the logic 1 level to within 1.0V of the +5V supply. Bit weights for the 14 binary inputs are given in the bit weight table. Angle is determined by adding bits in the logic 1 state.

Bit	Deg/Bit	Min/Bit	Bit	Deg/Bit	Min/Bit
1MSB	180	10,800	8	1.406	84.38
2	90	5,400	9	0.7031	42.19
3	45	2,700	10	0.3516	21.09
4	22.5	1,350	11	0.1758	10.55
5	11.25	675	12	0.0879	5.27
6	5.625	337.5	13	0.0439	2.64
7	2.813	168.75	14LSB	0.0220	1.32

BIT WEIGHT TABLE

The most novel features of the DSC-544 converter are in the output section. The pulsating power supply produces two unfiltered, full-wave-rectified positive and negative voltages as shown in the diagram. These voltages are in the phase with the amplifier output voltage because the power is derived from the reference input. The amplitude of the two voltages need only be a few volts greater than the power amplifier output voltage, since both will change together if the reference level changes. As indicated in the diagram, the positive and negative pulsating power supply voltage levels will be consistently lower than the constant DC levels of any DC supplies. Because the voltage levels are lower, the power consumed will be much less. The power dissipated as heat is equal to the amplifier current times the difference in voltage between the power supply and the output. For the DSC-544, the power dissipated is reduced by approximately 50% for reactive loads.

Another advantage of deriving power from the reference input is that the amplifier section power is easily transformer isolated from the D/R converter. The converter output isolation transformer can therefore be located in front of the power amplifiers. Because it does not transfer power it can be made smaller, and an internal transformer can be used at 60 Hz.



PULSATING POWER SUPPLY VOLTAGE WAVEFORMS

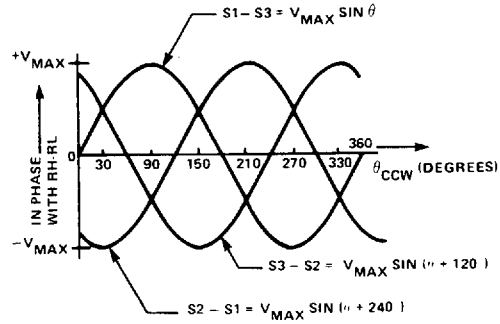
Minimum load impedances are listed in the Specifications Table under Drive Capability. The DSC-544 can drive these impedances under the worst case conditions stated in the table. The minimum load impedances correspond to 4.5 VA at 400 Hz and 1.5 VA at 60 Hz when the frequencies and voltage levels are at their nominal values. The metal top of the converter module should be provided with sufficient air circulation.

The thermal cutout disables the output power amplifiers when the internal temperature reaches 125° C. The output is automatically restored when the temperature drops again.

OUTPUT PHASING AND SCALE FACTOR

The analog output signals have the following phasing as shown in the synchro output signal diagram:

$S1 - S3 = (RH\text{-}RL)\ A_0\ (1 + A(\theta) \sin \theta$
$S3 - S2 = (RH\text{-}RL)\ A_0\ (1 + A(\theta) \sin (\theta + 120°)$
$S2 - S1 = (RH\text{-}RL)\ A_0\ (1 + A(\theta) \sin (\theta + 240°)$

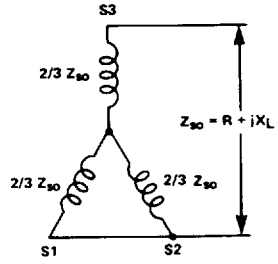


SYNCHRO OUTPUT SIGNALS

The output amplitudes simultaneously track reference voltage fluctuations because they are proportional to (RHRL). The amplitude factor A_0 is 90/115 for 90V rms L-L output. The maximum variation is A_0 from all causes is ±1.9%. The term A term $A(\theta)$ represents the variation of the amplitude with the digital input angle. $A(\theta)$, which is called the scale factor variation, is a smooth function of θ without discontinuities and is less than ±0.001 for all values of θ. The total maximum variation in $A_0\ (1 + A(\theta))$ is therefore ±2%. Because $A(\theta)$ is so small, the DSC-544 can be used to drive systems such as X-Y plotters or CRT displays in which the sin and cos outputs are used independently (not ratiometrically as in control transformer).

DRIVING CT AND CDX LOADS

When driving CT and CDX loads the DSC-544 must have enough steady state power capability to drive the Z_{SO} of the load. Z_{SO} (stator impedance with rotor open-circuited) is measured as shown in the diagram:



Z_{SO} MEASUREMENT

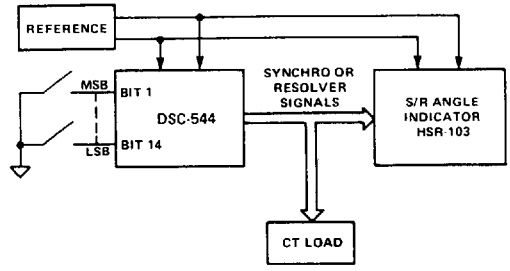
The following table shows the load impedance of some typical control transformers.

SOME COMMON CONTROL TRANSFORMERS AND THEIR LOAD IMPEDANCES

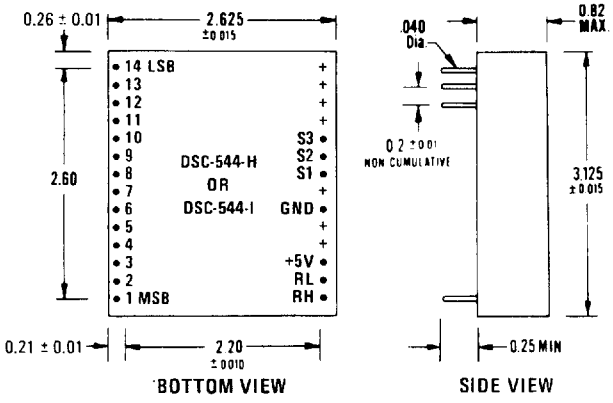
Military Type Number	Size	Z_{SO}
26V 08CT4c	08	100 + j490
26V 11CT4d	11	21 + j132
11CT4e	11	838 + j4955
15CT4c	15	1600 + j9300
15CT6b	15	1170 + j6780
18CT4c	18	1420 + j13260
18CT6b	18	1680 + j5040
23CT4a	23	1460 + j11050
23CT6a	23	1250 + j3980

ACCURACY TESTS

The accuracy of the 544 may be tested with a high accuracy synchro/resolver angle indicator and a load such as a control transformer, as shown in the diagram. The bit switches are set to the desired test angles and the output angle is measured under load. The accuracy should conform to the specifications.



MECHANICAL OUTLINE



NOTES

1. Pin labels on bottom view are for reference only.
2. All dimensions shown are in inches.
3. Pin material meets solderability requirements of MIL-STD-202, Method 208C.
4. Case material is glass filled Diallyl Phthalate per MIL-M-14, Type SDG-F, except top surface is black anodized aluminum plate for heat transfer.
5. Any LSB pins not used should be grounded.

ORDERING INFORMATION

DSC 544 – H – 1 – R

- R = Enhanced Reliability
- Operating Temperature Range of Case Metal Top
  - 1 = –55 to +85°C
  - 3 = 0 to +70°C
- Synchro Output Voltage Level and Frequency
  - H = 90 V rms L-L, 360-440 Hz
  - I = 90 V rms L-L, 57-63 Hz

If a converter module socket is required, order socket number 9010.

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