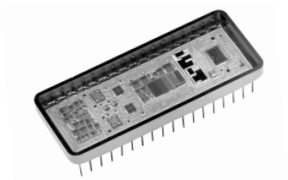


16-BIT HYBRID D/S AND D/R CONVERTER PIN PROGRAMMABLE FOR SYNCHRO OR RESOLVER OUTPUT

DESCRIPTION

The DSC-11524 is a versatile multiplying digital-to-analog converter. The digital input represents an angle, and the output is pin programmable for either resolver, sin/cos, or three-line synchro type output. The reference input will accept any waveform, even a sawtooth for CRT drive. Because the reference is DC coupled to the output, the DSC-11524 can be used in many configurations, such as: a digital-to-synchro/resolver converter using a sinusoidal reference as an input; a digital-to-sin/cos DC converter using a DC reference; a polar-to-rectangular converter using a reference input proportional to the radius vector; a rotating cartwheel sweep generator for PPI displays using a sawtooth reference.

Packaged in a 36-pin DDIP, the DSC-11524 is a complete D/S and D/R converter in one hybrid module. Hybrid technology results in low weight, low power consumption, very high reliability, and a wide operating temperature range. The DSC-11524 circuit design allows for higher accuracy and reduces the output scale factor variation so that the output can drive displays directly. The output line-to-line voltage can be scaled by external resistors. Other features include high ac and DC common mode rejection at the reference input, and output short circuit protection.

APPLICATIONS

Because of its high reliability, small size and low power consumption the hybrid DSC-11524 is ideal for the most stringent and severe industrial and military ground or avionics applications. All units are available with MIL-PRF-38534 processing as a standard option.

Among the many possible applications are computer-based systems in which digital information is processed, such as simulators, flight trainers, flight instrumentation, fire control systems, radar and navigation systems, and PPI displays including moving target indicators.

FEATURES

- ***15 mA RMS Output***
- ***11.8 V_{L-L} Synchro, 11.8 V_{L-L} Resolver, or 6.81 V_{L-L} Resolver Output***
- ***8 Bit/2 Byte Double-Buffered Transparent Latches***
- ***Pin Programmable for Synchro or Resolver Output***
- ***16-Bit Resolutlon***
- ***Complete D/S and D/R Converter***
- ***Mate to DSC-36020 IBM® PC Card***
- ***DC-Coupled Reference Accepts Any Waveform***
- ***Generates Sin/Cos DC or Rotating PPI Sweep***
- ***High-Rel CMOS D/R Chip***
- ***No +5 V Supply Required***

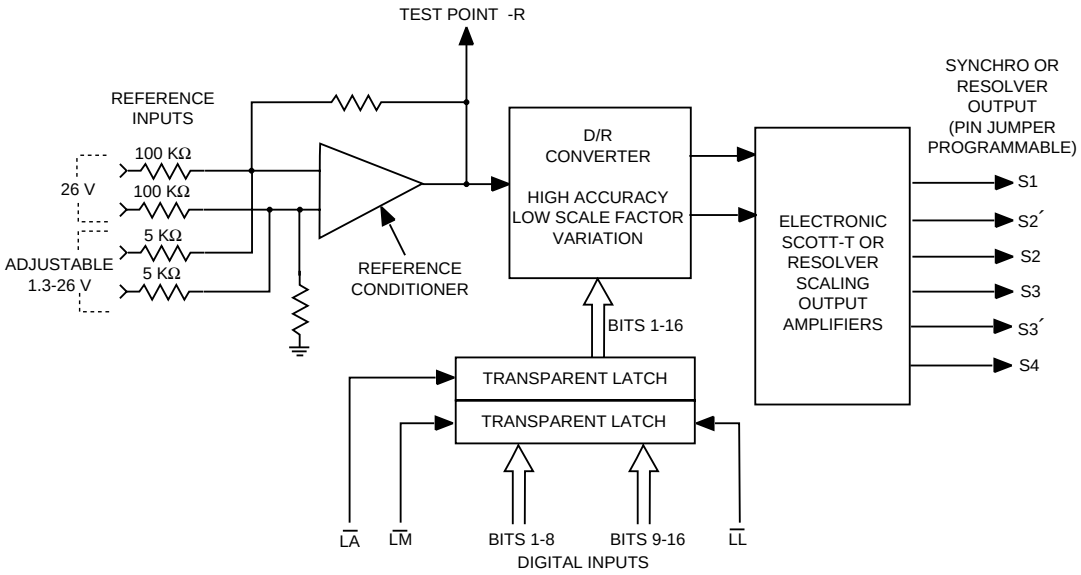


FIGURE 1. DSC-11524 BLOCK DIAGRAM

TABLE 1. DSC-11524 SPECIFICATIONS

Apply over temperature range, power supply range, reference voltage and frequency range, and 10% harmonic distortion in the reference.

PARAMETER	UNIT	VALUE	
RESOLUTION	Bits	16	
ACCURACY and DYNAMICS			
Output Accuracy	Minutes	±4 to ±2 min. (See Ordering info.)	
Differential Linearity	LSB	±1 max	
Output Setting Time	µsec	Less than 20 for any digital step change	
DIGITAL INPUT			
Logic Type		Natural binary angle, parallel positive logic CMOS and TTL compatable. Inputs are CMOS transient protected. Logic 0 = 0 to +1 V Logic 1 = +2.2 V to +5 V	
Load Current	µA	20 max to GND (bits 1-16) 20 max to +5 V ($\overline{LL}$, $\overline{LM}$, $\overline{LA}$) See Timing Diagrams (FIGURES 2A/2B.).	
REFERENCE INPUT			
Type		Two differential solid-state inputs: one for standard 26 V, one programmable.	
Frequency Range	Hz	DC to 1k (to 10k with reduced accuracy)	
		Standard Input	**Programmable Input**
Voltage	V	26 (Note 1)	1.3 minimum for full output; higher voltages are scaled by adding two series resistors
Input Impedance			
■Single Ended	k ohm	100 ±0.5%	5 ±0.5%
■Differential	k ohm	200 ±0.5%	10 ±0.5%
ANALOG OUTPUT			
Type		Pin programmable for synchro or resolver	
Output Current	mA rms	15 max	
Output Voltage		(Tracks Reference Input Voltage)	
■Synchro mode	$Vrms_{L-L}$	11.8 nominal	
■Resolver mode	$Vrms_{L-L}$	6.81 or 11.8 nominal	
Transform. Ratio Tol.	%	±0.5 max	
Scale Factor Varation	%	±0.1 max	
DC Offset (Each Line to Gnd)	mV	±15 max. Varies with input angle.	
POWER SUPPLIES			
Voltage	V	+15 ± 5%	-15 ± 5%
Max voltage without damage		+18 V	-18 V
Max Current or Impedance	mA	35+ load current	35+ load current
TEMPERATURE RANGES (CASE)			
Operation			
■-1 Option	°C	-55 to +125	
■-3 Option	°C	0 to +70	
Storage	°C	-55 to +135	
PHYSICAL CHARACTERISTICS			
Type		36-pin DDIP	
Size	in.(mm)	0.78 x 1.9 x 0.21 (19.7 x 48.3 x 5.3)	
Weight	oz. (g)	0.85 (24)	

Notes: 1) Maximum reference input voltage for RH/RL is 26 V +10%.
2) Differential is Line-to-Line (L-L); single-ended is Line-to-Ground (L-Gnd).

INTRODUCTION

As shown in FIGURE 1, the signal conversion in the DSC-11524 is performed by a high-accuracy digital-to-resolver converter whose sin and cos outputs have a low scale factor variation as a function of the digital input angle. This resolver output is either amplified by scaling amplifiers for resolver output, or is both amplified and converted to a synchro output by an electronic Scott-T. In both cases the output line currents can be 15 mA rms max, which is sufficient for driving S/D converters, solid-state control transformers and displays. Output power amplifiers will be required, however, for driving electromechanical devices such as synchros and resolvers.

The reference conditioner has a differential input with high ac and DC common mode rejection, so that a reference isolation transformer will seldom be required. There are two sets of reference inputs. The RH, RL input provides the maximum synchro or resolver output voltage for a standard 26 V rms reference input. The RH´, RL´ input is used to scale the output for other reference voltage levels. Series resistors can be added to the reference input as described below, either to accommodate higher reference levels, or to reduce the output level. The reference conditioner output -R is intended for test purposes. A signal between 6 V and 7.5 V at -R indicates that a reference input signal is present.

DIGITAL INPUT

The converter contains three input latches. The input is controlled by $\overline{LM}$ and $\overline{LL}$. Each of these enable the converter to interface with an 8-bit bus. $\overline{LM}$ controls bits 1-8 and $\overline{LL}$ controls bits 9-16. Ensure that the data is stable for 50ns before enabling a latch ($\overline{LL}$, $\overline{LM}$), and allow 100ns for the latch to input the data.

OUTPUT SCALING AND REF LEVEL ADJUSTMENT

The DSC-11524 operates like a multiplying D/A converter in that the voltage of each output line is directly proportional to the reference voltage. The maximum line-to-line levels are determined by the output amplifiers and are nominally 11.8 V for synchro output and 6.81 V or 11.8 V for resolver output. The RH, RL reference input is designed to provide this nominal output for the standard 26 V reference level. The scaling adjustment is made by two internal 100k ohm resistors in series with the reference conditioner input (see FIGURE 1).

The RH´, RL´ reference input has only 5k ohm internal resistors in series with the reference conditioner input, so that nominal line-to-line output is obtained for a reference input of 1.3 V. For higher reference voltages, two resistors, R', must be inserted in series with the inputs as shown in FIGURE 3. These resistors scale the DSC-11524 to accommodate higher reference levels, or to reduce the output levels.

The magnitude of the resistors, R´, in ohms is calculated as follows:

$$R' = \frac{5000}{1.3} \bullet (V_R - 1.3) \bullet \left[\frac{\text{Nominal L-L Voltage Level}}{\text{Desired L-L Voltage Level}}\right]$$

Note: The above equation is for scaling the RH´, RL´ inputs. To calculate R´ to scale the RH, RL input use 100,000 in place of 5,000 in the equation.

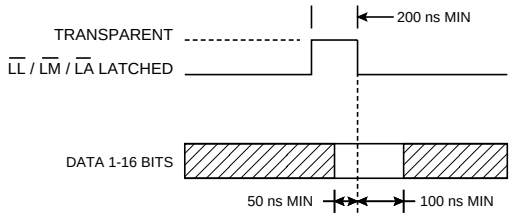


FIGURE 2A. $\overline{LL}$, $\overline{LM}$, $\overline{LA}$ TIMING DIAGRAM (16-BIT)

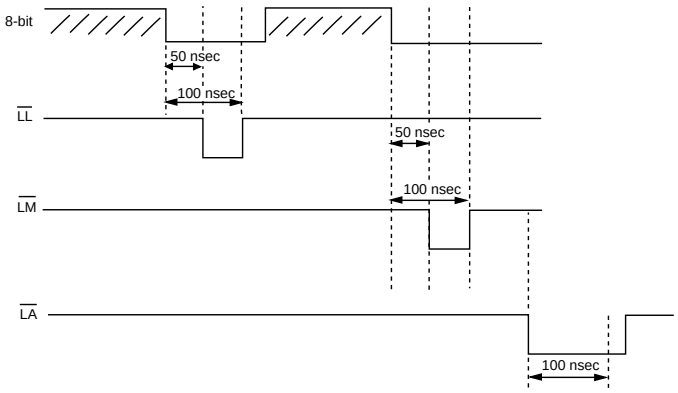


FIGURE 2B. $\overline{LL}$, $\overline{LM}$, $\overline{LA}$ TIMING DIAGRAM (8-BIT)

OUTPUT CONFIGURATION

The output amplifier section can be configured for Synchro and Resolver outputs, as shown in FIGURE 4.

OUTPUT PHASING AND OUTPUT SCALE FACTOR

The analog output signals have the following phasing:

Synchro output:
S3—S1 = (RH - RL)A_o(1 + A(θ)) sin θ
S2—S3 = (RH - RL)A_o(1 + A(θ)) sin(θ + 120°)
S1—S2 = (RH - RL)A_o(1 + A(θ)) sin(θ + 240°)

Resolver output:
S3—S1 = (RH - RL)A_o(1 + A(θ)) sin θ
S2—S4 = (RH - RL)A_o(1 + A(θ)) cos θ

The output amplifiers simultaneously track reference voltage fluctuations because they are proportional to (RH - RL). The transformation ratio A_o is 11.8/26 for 11.8 V rms L-L output. The maximum variation in A_o from all causes is ± 0.5%. The term A(θ) represents the variation of the amplitude with the digital signal input angle. A(θ), which is called the scale factor variation, is a smooth function of (θ) without discontinuities and is less than ±0.1% for all values of (θ). The total maximum variation in A_o(1 + A(θ)) is therefore ± 0.6%.

Because the amplitude factor (RH - RL)A_o(1 + A(θ)) varies simultaneously on all output lines, it will not be a source of error when the DSC-11524 is to drive a ratiometric system such as a synchro or resolver. However, if the outputs are used independently, as in x-y plotters, the amplitude variations must be taken into account.

OUTPUT TRANSFORMER

The DSC-11524 uses the 51538 step-up transformer to drive 90 V_{L-L} synchro loads. The 51538 transformer specifications are shown in TABLE 2 and the schematic and mechanical outline drawings are shown in FIGURE 5.

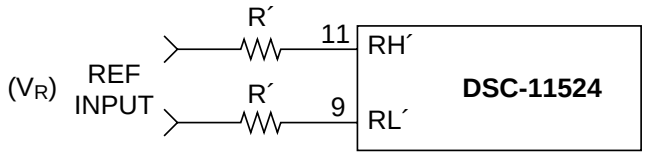


FIGURE 3. REFERENCE LEVEL ADJUSTMENT

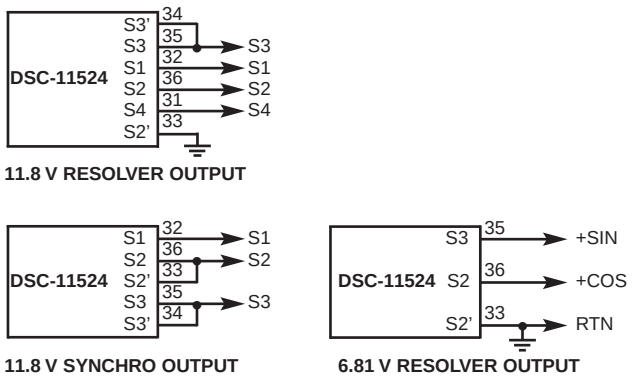


FIGURE 4. OUTPUT PIN PROGRAMMING

TABLE 2. ELECTRICAL SPECIFICATIONS FOR THE 51538 TRANSFORMER	
Synchro Input	11.8 Vrms line-to-line ±10% at 400 Hz ±10%
Synchro Output	90 Vrms ±1% Full Scale with a line-to-line input voltage of 11.8 Vrms
Input Impedance	1000 Ohms minimum
Output Impedance	500 Ohms maximum
Accuracy	The maximum additional error shall be 1.5 min. loaded with an SDC-14560 (130k Ohm)
HIPOT	Between windings and windings-to-case 900 Vrms at 60 Hz

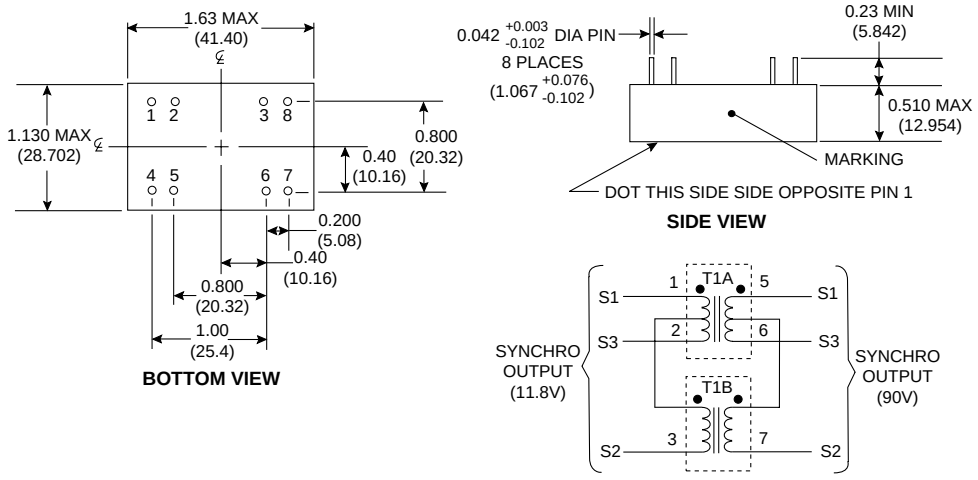
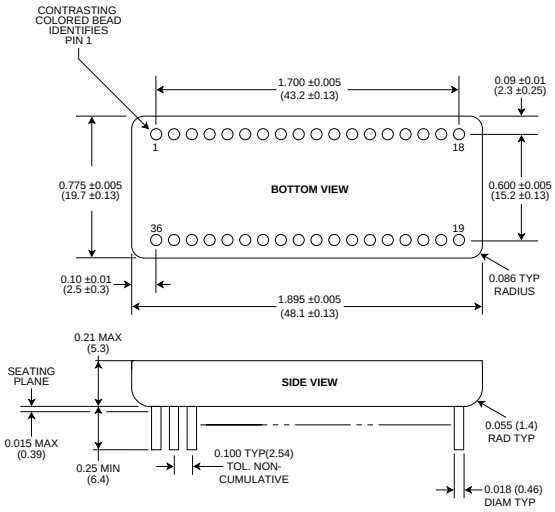


FIGURE 5. 90 VL-L, 400 Hz SYNCHRO OUTPUT TRANSFORMER (P/N 51538)

TABLE 3. PIN CONNECTION TABLE					
PIN	**NAME**	**PIN**	**NAME**	**PIN**	**NAME**
1	NC	13	Bit 13	25	Bit 1 (MSB)
2	+15V	14	Bit 12	26	Bit 15
3	GND	15	Bit 11	27	Bit 16 (LSB)
4	-15V	16	Bit 10	28	$\overline{LM}$
5	NC	17	Bit 9	29	$\overline{LL}$
6	NC	18	Bit 8	30	$\overline{LA}$
7	-R	19	Bit 7	31	S4
8	RL	20	Bit 6	32	S1
9	RL´	21	Bit 5	33	S2'
10	RH	22	Bit 4	34	S3'
11	RH´	23	Bit 3	35	S3 (+SIN)
12	Bit 14	24	Bit 2	36	S2 (+COS)

Notes:
1. -R (Pin 7) can be used for test purposes to detect whether a reference signal is present. See block diagram.
2. Functions $\overline{LL}$, $\overline{LA}$, and $\overline{LM}$ may be left unconnected when not used.



Notes:
1. Dimensions shown are in inches (millimeters).
2. Lead identification numbers are for referenced only.
3. Lead cluster shall be centered within of outline dimensions. Lead spacing dimensions apply only at seating plane.
4. Pin material meets solderability requirements of MIL-STD-202E, Method 208C.
5. Package is Kovar with electroless nickel plating.
6. Case is electrically floating.

FIGURE 6. DSC-11524 36-PIN DDIP MECHANICAL OUTLINE

ORDERING INFORMATION

DSC-11524-XXXX

Supplemental Process Requirements:
- S = Pre-Cap Source Inspection
- L = Pull Test
- Q = Pull Test and Pre-Cap Inspection
- K = One Lot Date Code
- W = One Lot Date Code and Pre-Cap Source
- Y = One Lot Date Code and 100% Pull Test
- Z = One Lot Date Code, Pre-Cap Source and 100% Pull Test
- Blank = None of the Above

Accuracy:
- 3 = ±4 minutes
- 4 = ±2 minutes

Process Requirements:
- 0 = Standard DDC Processing, no Burn-In (See table below.)
- 1 = MIL-PRF-38534 Compliant
- 2 = B*
- 3 = MIL-PRF-38534 Compliant with PIND Testing
- 4 = MIL-PRF-38534 Compliant with Solder Dip
- 5 = MIL-PRF-38534 Compliant with PIND Testing and Solder Dip
- 6 = B* with PIND Testing
- 7 = B* with Solder Dip
- 8 = B* with PIND Testing and Solder Dip
- 9 = Standard DDC Processing with Solder Dip, no Burn-In (See table below.)

Temperature Grade/Data Requirements:
- 1 = -55°C to +125°C
- 2 = -40°C to +85°C
- 3 = 0°C to +70°C
- 4 = -55°C to +125°C with Variables Test Data
- 5 = -40°C to +85°C with Variables Test Data
- 8 = 0°C to +70°C with Variables Test Data

*Standard DDC Processing with burn-in and full temperature test — see table below.

STANDARD DDC PROCESSING		
TEST	**MIL-STD-883**	
	METHOD(S)	**CONDITION(S)**
INSPECTION	2009, 2010, 2017, and 2032	—
SEAL	1014	A and C
TEMPERATURE CYCLE	1010	C
CONSTANT ACCELERATION	2001	A
BURN-IN	1015, Table 1	—

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REGISTERED TO ISO 9001
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F-08/99-500

PRINTED IN THE U.S.A.