DSC-11520

16-BIT PIN PROGRAMMABLE D/S OR D/R CONVERTER

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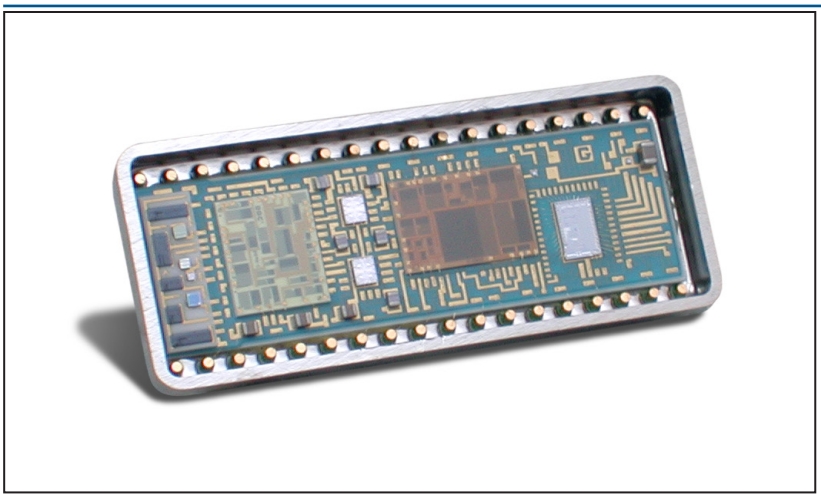

FEATURES

- Complete D/S or D/R Converter
- Accuracy up to ± 1 Minute
- DC-Coupled Reference - Accepts Most Waveforms
- Generates SIN/COS DC or Rotating PPI Sweep
- High-Rel CMOS D/R Chip
- 8-Bit/16-Bit Double-Buffered Transparent Latches

DESCRIPTION

The DSC-11520 is a versatile multiplying Digital-to-Synchro/Resolver converter. The digital input represents an angle and the output is pin programmable for either resolver type SIN/COS or three-line synchro output. The device will accept most of the commonly used waveshapes as reference, even a sawtooth input in the case of a CRT drive application. Because the reference is DC-coupled to the output, the DSC-11520 can be used in many configurations:

- Digital-to-Synchro or Digital-to-Resolver converter (using a sinusoidal reference input)
- Hybrid Digital-to-SIN/COS DC converter (using a DC reference input)
- Polar to rectangular coordinates converter (using a reference input proportional to the radius vector)
- Generate a cartwheel rotating sweep for PPI displays (using a sawtooth reference input and a rotating digital input)

Packaged in a 36-pin double DIP, the DSC-11520 is a complete D/S and D/R converter in one hybrid module.

The DSC-11520 is a light, low power, very highly reliable device with a wide operating temperature range. The internal hybrid circuit design results in high accuracy and reduces the output scale factor so that the output can drive displays directly. The output line-to-line voltage can be scaled by external resistors. The reference input provides high AC and DC common mode rejection.

APPLICATIONS

The DSC-11520's high reliability, small size, and low power consumption make it an ideal solution for most stringent and sever applications (industrial, military ground vehicles, aircraft avionics, etc.). Among the many other possible applications are computer based systems in which digital information is processed, such as simulators, flight trainers, flight instrumenation, fire control systems, radar and navigation systems, and PPI displays including moving target indicators. All versions of the DSC-11520 are available with MIL-PRF-38534 processing as a standard ordering option.

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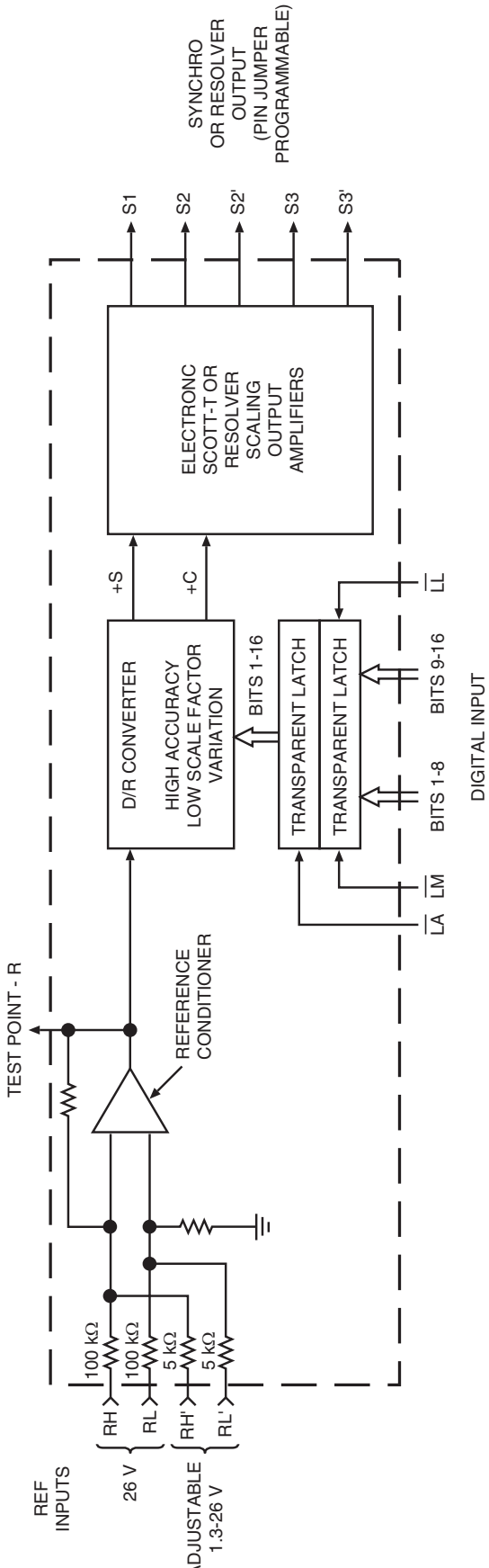


FIGURE 1. DSC-11520 BLOCK DIAGRAM

TABLE 1. DSC-11520 SPECIFICATIONS
Apply over temperature range, power supply ranges, reference voltage and frequency range and 10% harmonic distortion in the reference.

PARAMETER	VALUE	
RESOLUTION	16 bits	
ACCURACY AND DYNAMICS		
Output Accuracy	±8 minutes to ±1 min. (See Ordering Info.)	
Differential Linearity	±1 LSB max	
Output Settling Time	Less than 20 µsec for any digital step change.	
DIGITAL INPUT		
Logic Type	Natural binary angle parallel positive logic CMOS and TTL compatible. Inputs are CMOS transient protected. Each input has a 20 µA max pull down to GND.	
Logic Voltage Level	V = +4.5 V to +15 V supply Logic 0 = 0 to +0.8 V Logic 1 = 2 V to 1/3 of VDD +10%	
Load Current	20 µA max (bit 1-16) 65 µA (LL, LM, LA) See Timing Diagram (FIGURE 2)	
REFERENCE INPUT		
Type	Two differential solid-state inputs, one for standard 26 V input and one programmable.	
Frequency Range	DC to 1000 Hz	
	Standard Input	Programmable input
Voltage	26 V ±10%	1.3 V min for full output; higher voltages are scaled by adding two series resistors
Input Impedance		
Single Ended	100 kΩ ± 0.5%	5 kΩ ± 0.5%
Differential	200 kΩ ± 0.5%	10 kΩ ± 0.5%
ANALOG OUTPUT		
Type	Pin programmable for synchro or resolver mode.	
Output current	2 mA rms max.	
Max Output Voltage (Tracks Reference Input Voltage)	11.8 V rms L-L ±0.25%nominal in synchro mode 6.81 V rms L-L ±0.25%nominal resolver mode	
Transformation Ratio Tol. + Scale Factor Variation	±0.6% max	
DC Offset Each Line to GND	±15 mV standard, varies with input angle ±5 mV available- Consult Factory	
POWER SUPPLIES		
Voltage	+15 V	-15 V
Voltage Limits	±5%	±5%
Max Voltage Without Damage	+18 V	-18 V
Current or impedance	20 mA max	20 mA max
	No VI required; +5 V logic levels are derived internally.	
TEMPERATURE RANGES (CASE)		
Operating		
-1 Option	-55°C to +125°C	
-3 Option	0°C to +70°C	
Storage	-55°C to 135°C	
PHYSICAL CHARACTERISTICS		
Type	36-pin double DIP	
Size	0.78 X 1.9 X 0.21inch (2.0 X 4.8 X 0.53 cm)	
Weight	0.85 oz (24g)	

INTRODUCTION

As shown in Figure 1, the signal conversion in the DSC-11520 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 multiplied by scaling amplifiers for resolver output, or is both multiplied and converted to a synchro output by an electronic Scott-T. The output line currents are limited to 2 mA rms max, which is sufficient for driving S/D converters, solid-state control transformers, and displays. Output power amplifiers will be required for driving electro-mechanical devices such as synchros and resolvers.

POWER SUPPLY CYCLING

Power supply cycling of the DDC converter should follow the guidelines below to avoid any potential problems. Strictly maintain proper sequencing of supplies and signals per typical CMOS circuit guidelines:

1. Apply power supplies (+15V, -15V and ground)
2. Apply digital control signals
3. Apply analog signals

The reverse sequence should be followed during power down of the circuit.

OUTPUT SCALING AND REF. LEVEL ADJUSTMENT

The DSC-11520 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 Vrms for synchro output and 6.81 Vrms for resolver output.The RH, RL set of reference inputs are designed to provide this nominal output for the standard 26 Vrms reference level. The scaling adjustment is made by two internal 100 kΩ resistors in series with the reference conditioner input (see Figure 1). The maximum output levels without distortion are 10% greater than the nominal 11.8 Vrms and 6.81 V rms levels.

The RH', RL' reference inputs have 5 kΩ 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 Vrms. For higher reference voltages, two resistors R' must be inserted in series with the inputs as shown in FIGURE 2. These resistors scale the DSC-11520 outputs to the nominal 11.8 Vrms and 6.81 Vrms levels stated above, or to lower voltages if desired. The magnitude of the resistors R' in ohms is calculated as follows:

$$R' = \frac{5000}{1.3}(V_R - 1.3)\left(\frac{\text{NOMINAL L-L VOLTAGE LEVEL}}{\text{DESIRED L-L VOLTAGE LEVEL}}\right)$$

OUTPUT PHASING AND OUTPUT SCALE FACTOR

The analog output signals have the following phasing:

Synchro output

$S1 - S3 = (RH-RL)\ A_O\ (1 + A(\theta))\ \sin\theta$

$S3 - S2 = (RH-RL)\ A_O\ (1 + A(\theta))\ \sin(\theta + 120°)$

$S2 - S1 = (RH-RL)\ A_O\ (1 + A(\theta))\ \sin(\theta + 240°)$

Resolver output

$S1 - S3 = (RH-RL)\ A_O\ (1 + A(\theta))\ \sin\theta$

$S2 - S4 = (RH-RL)\ A_O\ (1 + A(\theta))\ \cos\theta$

The output amplitudes 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 term A (θ) represents the variation of the amplitude with the digital input angle. A (θ), which is called the scale factor variation, is a smooth function of θ without discontinuities.

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-11520 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.

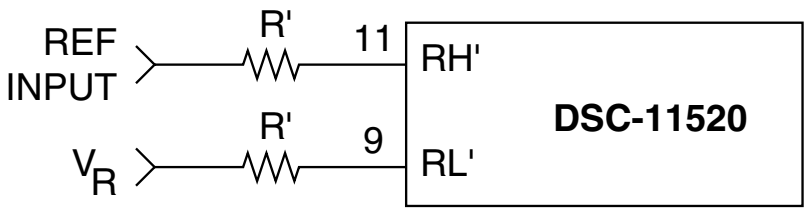


FIGURE 2. REFERENCE LEVEL ADJUSTMENT

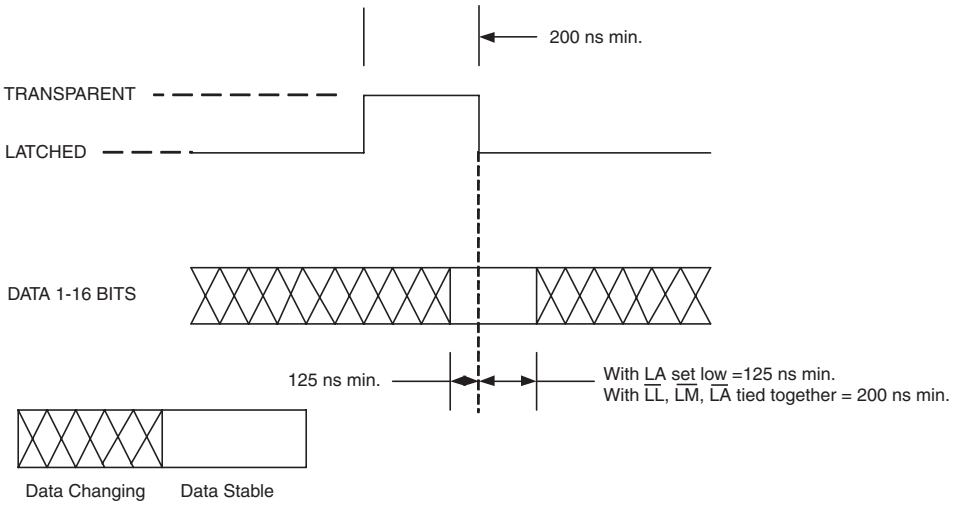


FIGURE 3A. $\overline{LL}$, $\overline{LM}$, $\overline{LA}$ TIMING DIAGRAM (16-BIT)

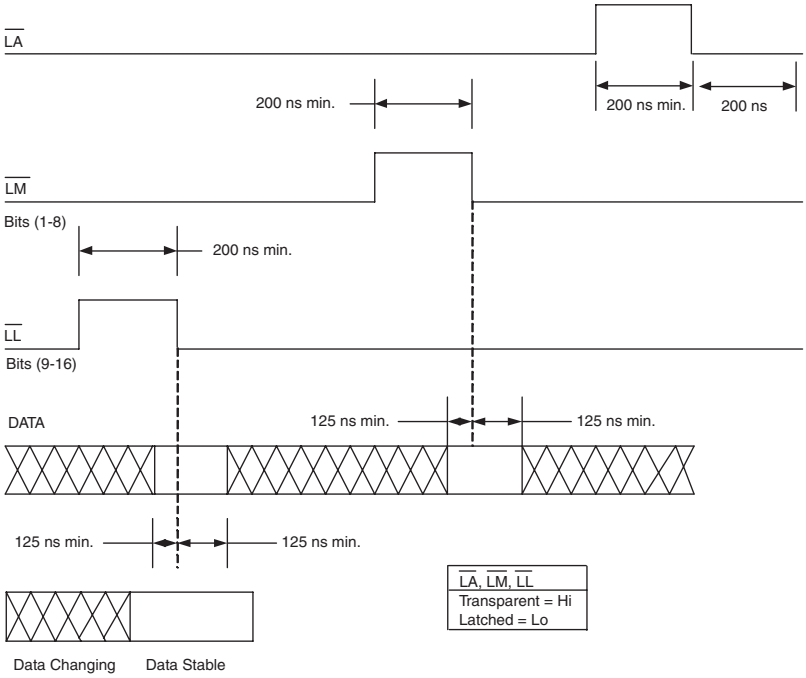


FIGURE 3B. $\overline{LL}$, $\overline{LM}$, $\overline{LA}$ TIMING DIAGRAM (8-BIT)

TABLE 2. PIN CONNECTIONS		
PIN	**FUNCTION**	**DESCRIPTION**
1	NC	No Connect (no internal wire connection)
2	+15 V	+15 VDC power supply voltage
3	GND	Ground
4	-15 V	-15 VDC power supply voltage
5	NC	No Connect (no internal wire connection)
6	NC	No Connect (no internal wire connection)
7	-R	Test point used to detect whether a reference signal is present (see Figure 1). A signal between 6 V rms and 7.5 V rms indicates that a reference input signal is present.
8	RL	Reference input Lo (respective to RH)
9	RL'	Reference input Lo' (respective to RH')
10	RH	Reference input Hi. Provides the maximum synchro or resolver output voltage for a standard 26 V rms reference input.
11	RH'	Reference input Hi'. Can be used to scale the output for other reference voltage levels. Series resistors can be added to the reference input either to accomodate lower reference levels for full output, or to reduce the output level.
12	Bit 14	Angle data word Bit 14
13	Bit 13	Angle data word Bit 13
14	Bit 12	Angle data word Bit 12
15	Bit 11	Angle data word Bit 11
16	Bit 10	Angle data word Bit 10
17	Bit 9	Angle data word Bit 9
18	Bit 8	Angle data word Bit 8
19	Bit 7	Angle data word Bit 7
20	Bit 6	Angle data word Bit 6
21	Bit 5	Angle data word Bit 5
22	Bit 4	Angle data word Bit 4
23	Bit 3	Angle data word Bit 3
24	Bit 2	Angle data word Bit 2
25	Bit 1 (MSB)	Angle data word Bit 1 (MSB)
26	Bit 15	Angle data word Bit 15
27	Bit 16 (LSB)	Angle data word Bit 16 (LSB)
28	$\overline{\text{LM}}$	Active low control signal for latching angle data word bits 1 - 8. May be left unconnected when not used. (See Figure 3B for timing diagrams).
29	$\overline{\text{LL}}$	Active low control signal for latching angle data word bits 9 - 16. May be left unconnected when not used. (See Figure 3B for timing diagrams).
30	$\overline{\text{LA}}$	Active low control signal for latching angle data word bits 1 - 16. May be left unconnected when not used. (See Figure 3B for timing diagrams).
31	NC	No Connect (no internal wire connection)
32	S1	Pin jumper programmable for synchro or single-ended resolver output. (see Figure 4)
33	S2'	Pin jumper programmable for synchro or single-ended resolver output. (see Figure 4)
34	S3'	Pin jumper programmable for synchro or single-ended resolver output. (see Figure 4)
35	S3 (+SIN)	Pin jumper programmable for synchro or single-ended resolver output. (see Figure 4)
36	S2 (+COS)	Pin jumper programmable for synchro or single-ended resolver output. (see Figure 4)

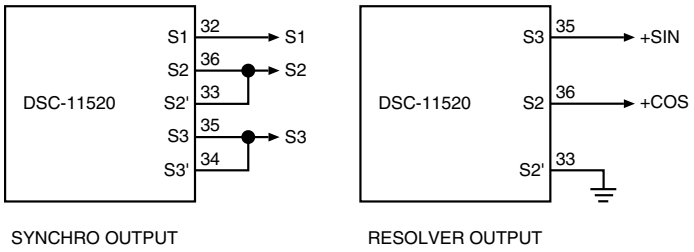
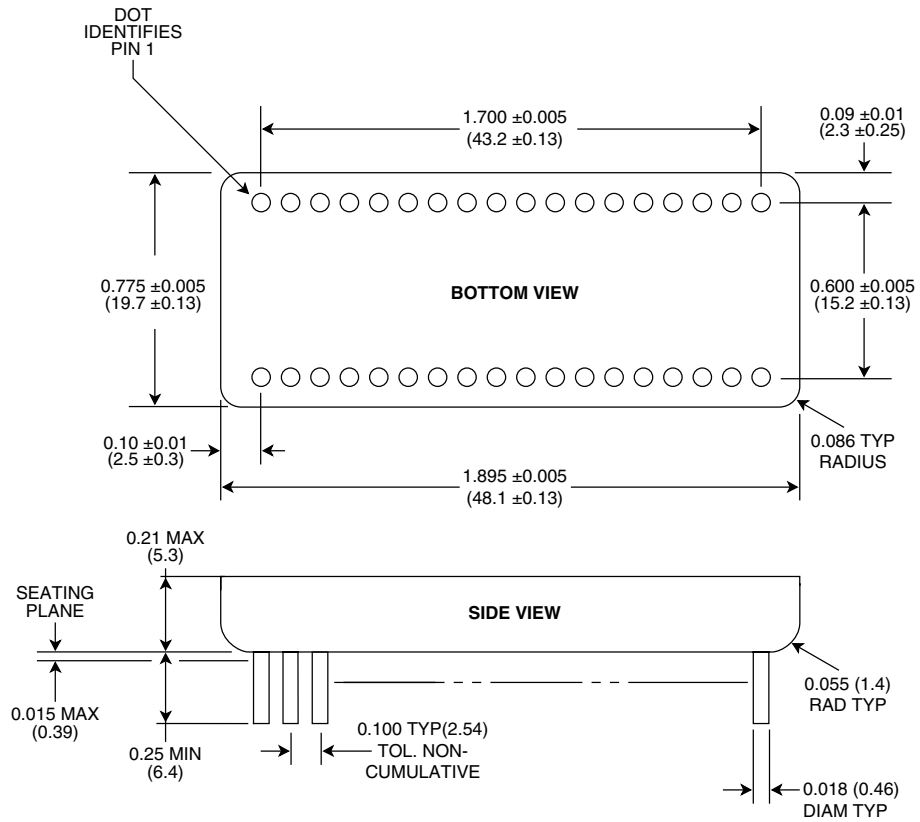


FIGURE 4. OUTPUT PIN PROGRAMMING

TABLE 3.ANGLES IN DEGREES CROSS REFERENCED TO A 16-BIT DIGITAL WORD

DEGREES (HEX)	16 BIT DIGITAL WORD (Φ) (1 = MSB, 16 = LSB)															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0° (0000)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15° (0AAB)	0	0	0	0	1	0	1	0	1	0	1	0	1	0	1	1
30° (1555)	0	0	0	1	0	1	0	1	0	1	0	1	0	1	0	1
45° (2000)	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
60° (2AAB)	0	0	1	0	1	0	1	0	1	0	1	0	1	0	1	1
75° (3666)	0	0	1	1	0	1	0	1	0	1	0	1	0	1	0	1
90° (4000)	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
120° (5555)	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
135° (6000)	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
180° (8000)	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
240° (AAAB)	1	0	1	0	1	0	1	0	0	0	1	0	1	0	1	1
270° (C000)	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
285° (CAAB)	1	1	0	0	1	0	1	0	1	0	0	0	1	0	1	1
300° (D555)	1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
315° (E000)	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
330° (EAAB)	1	1	1	0	1	0	1	0	1	0	1	0	1	0	1	1
345° (F555)	1	1	1	1	0	1	0	1	0	1	0	1	0	1	0	1
359° (FFFF)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1



NOTES:
1. Dimensions shown are in inches (millimeters).
2. Lead identification numbers are for reference only.
3. Lead cluster shall be centered within ± 0.10 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 5. DSC-11520 36-PIN DDIP MECHANICAL OUTLINE

ORDERING INFORMATION

DSC-11520-X X X

Accuracy:
- 3 = ±4 minutes
- 4 = ±2 minutes
- 5 = ±1 minutes

Reliability Grade:
- 0 = Standard DDC procedures (See table below)
- 1 = Fully Compliant with MIL-PRF-38534(note 1)
- 2 = Screened to MIL-PRF-38534(note 1) but without QCI testing
- 3 = Fully Compliant with MIL-PRF-38534(note 1) + PIND Testing
- 4 = Fully Compliant with MIL-PRF-38534(note 1) + Solder Dip
- 5 = Fully Compliant with MIL-PRF-38534(note 1) + PIND Testing + Solder Dip
- 6 = Screened to MIL-PRF-38534(note 1) + PIND Testing but without QCI Testing
- 7 = Screened to MIL-PRF-38534(note 1) + Solder Dip but without QCI Testing
- 8 = Screened to MIL-PRF-38534(note 1) + PIND Testing +Solder Dip but without QCI testing
- 9 = Standard DDC processing with Solder Dip, no burn-in (See table below)

Operating Temperature Range:
- 1 = -55°C to +125°C (case)
- 2 = -40°C to +85°C (case)
- 3 = 0°C to +70°C (case)
- 4 = -55°C to +125°C + Variables Data
- 5 = -40°C to +85°C + Variables Data
- 8 = 0°C to +70°C + Variables Data

Notes:

1. MIL-PRF-38534 product grading is designated with the following dash numbers:
   Class H is a -11X, 13X, 14X, 15X, 41X, 43X, 44X, 45X
   Class G is a -21X, 23X, 24X, 25X, 51X, 53X, 54X, 55X
   Class D is a -31X, 33X, 34X, 35X, 81X, 83X, 84X, 85X

2. The leads are specified as 50 micro-inches of gold minimum.over 50-350 micro-inches of nickel minimum. If selecting the solder dip option consider this part having a leaded lead finish. Solder dip option lead finish = tin 63%/ lead 37%.

STANDARD DDC PROCESSING FOR HYBRID AND MONOLITHIC HERMETIC PRODUCTS

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	3000g
BURN-IN	1015 (note 1), 1030 (note 2)	TABLE 1

Notes:
1. For Process Requirement "B*" (refer to ordering information), devices may be non-compliant with MIL-STD-883, Test Method 1015, Paragraph 3.2. Contact factory for details.
2. When applicable.

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