

## Digital-to-synchro/resolver converter (MDSC/MDRC29 series)

**1. Features** (see Fig. 1 for outside view, and Table 1 for models)  
 Compatible with DTL/TTL/CMOS level  
 12-bit, 14-bit and 16-bit resolution  
 Short-circuit and overload protection  
 Metal case, with good heat rejection  
 Output power: 5W



Size: 79.4x6.7x24mm<sup>3</sup>,  
weight: 262g

Fig.1 Outside view of MDSC/MDRC29

**2. Scope of application**  
 Military servo control system  
 Antenna system  
 Radar measurement system  
 Navigation system  
 Cannon control system  
 Machine tool control

Table1 Product models

12-bit		14-bit		16-bit	
Synchro	Resolver	Synchro	Resolver	Synchro	Resolver
MDSC2912-411	MDRC2912-418	MDSC2914-411	MDRC2914-418	MDSC2916-411	MDRC2916-418
MDSC2912-412	MDRC2912-438	MDSC2914-412	MDRC2914-438	MDSC2916-412	MDRC2916-438
MDSC2912-421	MDRC2912-414	MDSC2914-421	MDRC2914-414		MDRC2916-414
MDSC2912-422	MDRC2912-415	MDSC2914-422	MDRC2914-415		MDRC2916-41-36/11.8
					MDRC2916-415

### 3. Description

MDSC/MDRC29 series product is a converter that converts the input binary signal to that of synchro or resolver. The input signal is compatible with DTL/TTL/CMOS level, and the output is 3-wire synchro or 4-wire resolver signal. This series of product continuously tracks the input 2-bit/14-bit/16-bit binary data, and outputs high-precision synchro/resolver signal after conversion. The product is equipped with power amplification circuit inside it, and its output power can reach 5W.

### 4. Electrical performance (Table 2 and Table 3)

Table 2 Rated conditions and recommended operating conditions

Max. absolute rating value	Supply voltage +V <sub>S</sub> : +13.5~+17.5V Supply voltage -V <sub>S</sub> : -17.5~-13.5V Storage temperature range: -40~100
Recommended operating conditions	Supply voltage +V <sub>S</sub> : +14.5~+16.5V Supply voltage -V <sub>S</sub> : -16.5~-14.25V Reference voltage (effective value) V <sub>Ref</sub> *: 115V±5% Signal voltage (effective value) V <sub>I</sub> *: 90V±5% Reference frequency f*: 400Hz±10% Range of operating temperature T <sub>A</sub> : -40 ~85

Note: \* indicates it can be customized as per user's requirement.

Table 3 Electric characteristics

Parameter	MDRC/DSC2912				MDRC/DSC2914		MDRC/DSC2916		Unit
	Enterprise military standard (Q/HW30857-2006)								
Resolution	12-bit		14-bit		16-bit			Bit	
Accuracy	± 8		± 4		± 4			Minute	
Digital input	5	0	5	0	5	0		V	
Reference voltage (effective value)	26, 36, 115V ± 10% *								V
Reference frequency	50, 400, 1.2K, 2K *								Hz
Output signal voltage (Effective value)	11.8, 26, 36, 90 (line-line, resolver or synchro) *								V

Note: \* means the products with different frequency and different amplitude can be made according to the user's needs.

**5. Operating principle** (Fig. 2 and Fig. 3)

One of the distinctive characteristics of MDSC/MDRC29 series product is that it can neglect the change of radius vector. Each type of digital-to-synchro/resolver converter must be provided with output sin and cos function signal, however, since the law of sin and cos function is not followed precisely all the time, its error can reach as high as ± 7%. In practical use, this error is not serious sometimes, but it is not allowed in the application of tracking rotating torque receiver or servo control loop. For MDSC/MDRC29 series product, this error can be reduced below 0.1%, which means that when the converter is used in a closed loop servo system, the closed-loop gain is independent of the input signal, thus avoiding undesired error resulting from change of reference signal.

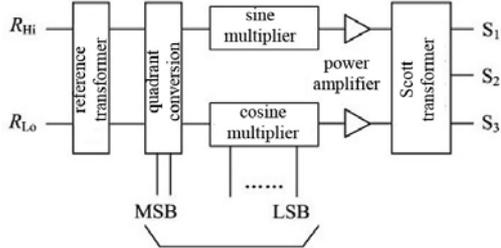


Fig.2 Schematic diagram for DSC converter

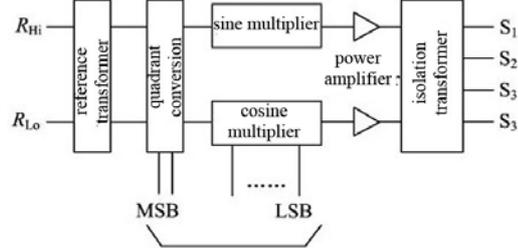


Fig.2 Schematic diagram for DRC converter

**6. Connection diagram for typical application (Fig. 4)**

DSC/DRC load connection

( 1 ) Control transformer (CT)

The simplest design is using digital converter to drive the control transformer.

The min. power for driving CT is:

$$(VA) = \frac{V^2}{|Z_{so}|} \times \frac{3}{4}$$

Where, V is line-line voltage, Z<sub>so</sub> is the impedance between nodes after the circuit from one output end of CT to other two rotor circuits is short-circuited (Z<sub>so</sub>=R<sub>so</sub>+jX<sub>so</sub>).

For example: when the impedance of CT is Z<sub>S</sub>=700+j490, the line-line voltage is 90V, then

$$|Z_{so}| = \sqrt{700^2 + 490^2} = 850\Omega$$

$$(VA) = \frac{90^2}{850} \times \frac{3}{4} = 1.23VA$$

For the adjustment of CT load, it can be reduced through 3 capacitances at the output end, as shown as below:

$$C = \frac{X_{so}}{2\omega(R_{so}^2 + X_{so}^2)}$$

The required power is: (VA) (unadjusted) x  $\frac{R_{so}}{Z_{so}}$   
 $\frac{1.23 \times 700}{850} = 1.01VA$

In the above example, the capacitance is:

$$1.23 \times \frac{700}{850} = 1.01VA$$

The required power after adjustment is:

In the design, it is required to note the errors that usually exist such as coil number, capacitance, inductance, etc. in CT.

Practical prompts for CT load adjustment:

High precision capacitance is not required, an error of 20% is enough.

Three capacitors must be used between S1 and S2, S2 and S3 as well as S3 and S1.

Withstand voltage and type of capacitance

For line-line voltage of 11.8V, the withstand voltage of capacitance between pins is 25VAC, and the type of capacitance is non-polar tantalum capacitance.

For line-line voltage of 90V, the withstand voltage of capacitance between pins is 150VAC, and it is allowed to

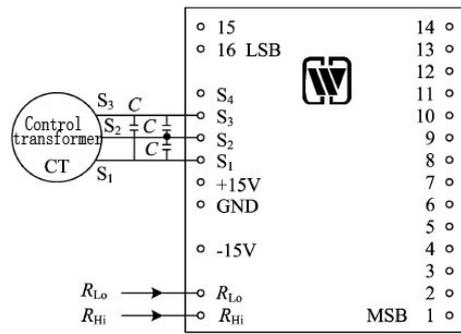


Fig. 4 Connection diagram for typical application

use ceramic capacitance with low dielectric constant.

The load adjustment of resolver only requires two capacitances. One is connected between S<sub>1</sub> and S<sub>3</sub>, and the other between S<sub>2</sub> and S<sub>4</sub>.

(2) Control differential transducer (CDX)

The load of DSC in the equipment can be considered like CT load, but its equivalent impedance Z must be calculated like CT load, its value is generally 66%~80% of Z<sub>SO</sub>.

(3) Torque receiver (TR)

Compared with CT and CDX, it is relatively difficult to control the torque receiver (TR). Generally speaking, it requires an output amplifier. Because the change of radius vector of MDSC/MDRC28 series product can be neglected, it is more suitable for controlling TR than those devices with an error of ±7%. For an error with

angle θ, the exciting current is: 
$$\frac{2 \times V \times \sin \frac{\theta}{2}}{|Z_{\omega}|}$$

Prompts:

TR should not be blocked.

The corresponding advance from reference input end to DSC shall conform to the provisions of TR.

The reference input must be always applied on TR and converter.

The output voltage of DSC/DRC must completely match with the voltage required by TR.

6. MTBF curve (Fig. 5)

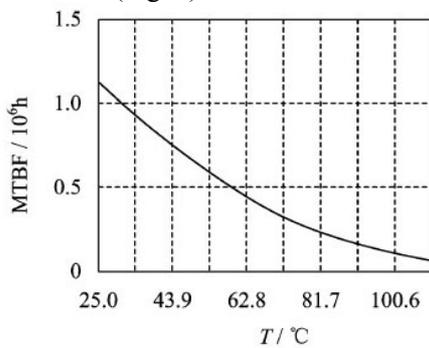


Fig.5 MTBF-temperature curve

(Note: according to GJB/Z299B-98, envisaged good ground condition)

7. Pin designation (Fig. 6, Table 4)

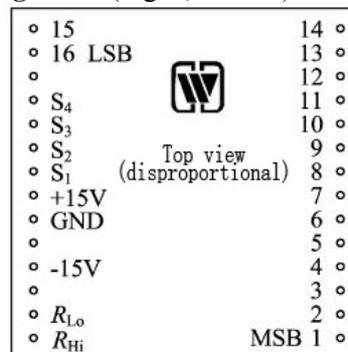


Fig.6 Schematic diagram of pins (top view)

Table 4 Pin designation

Pin	Symbol	Function	Pin	Symbol	Function	Pin	Symbol	Function
1	1 (MSB)	Digital input 1	11	11	Digital input 11	21	S <sub>1</sub>	Signal output 1
2	2	Digital input 2	12	12	Digital input 12	22	+15V	+15V input
3	3	Digital input 3	13	13	Digital input 13	23	GND	Ground
4	4	Digital input 4	14	14	Digital input 14	24	NC	Leave unconnected
5	5	Digital input 5	15	15	Digital input 15 (12-bit and 14-bit are left unconnected)	25	-15V	-15V input
6	6	Digital input 6	16	16	Digital input 16 (12-bit and 14-bit are left unconnected)	26	NC	Leave unconnected
7	7	Digital input 7	17	NC	Leave unconnected	27	R <sub>Lo</sub>	Low end of reference input
8	8	Digital input 8	18	S <sub>4</sub>	Signal output 4	28	R <sub>Hi</sub>	High end of reference input
9	9	Digital input 9	19	S <sub>3</sub>	Signal output 3			
10	10	Digital input 10	20	S <sub>2</sub>	Signal output 2			

Notes: Digital input: DSC/DRC2912 is 1~12, altogether 12 bits; DSC/DRC2914 is 1~14, altogether 14 bits; DSC/DRC2916 is 1~16, altogether 16 bits.

“1” is the highest bit (MSB);

S<sub>1</sub>, S<sub>2</sub>, S<sub>3</sub> and S<sub>4</sub>: output are used for synchro or resolver, among them, S<sub>4</sub> is only used for resolver;

R<sub>Hi</sub> and R<sub>Lo</sub>: reference input;

GND: common ground of power supply and input signal;

±15V: power supply.

### 8. Table of weight values (Table 5)

Table 5 Table of weight values

Bit	Angle	Bit	Angle	Bit	Angle
1	180.000 0	6	5.625 0	11	0.175 8
2	90.000 0	7	2.812 5	12 (for 12-bit LSB)	0.087 9
3	45.000 0	8	1.406 3	13	0.043 9
4	22.500 0	9	0.703 1	14 (for 14-bit LSB)	0.022 0
5	11.250 0	10	0.351 6		

### 9. Package specifications (unit: mm) (Fig. 7)

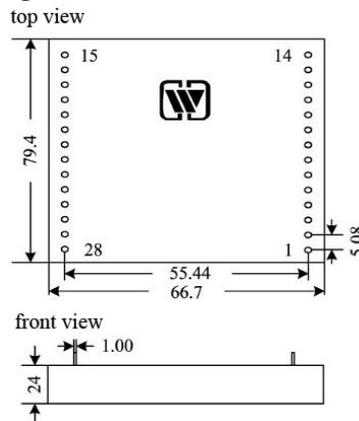


Fig. 7 Outside view and dimensions of package

### 10. Part numbering key (Fig. 8)

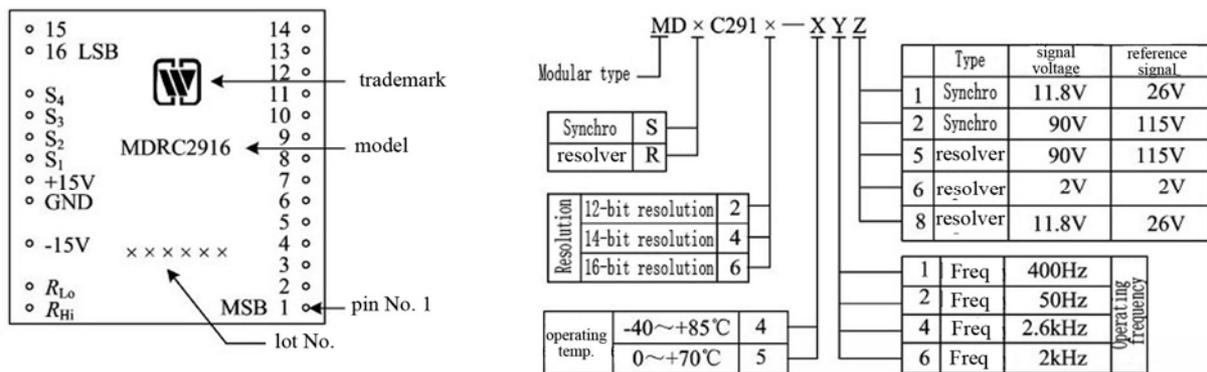


Fig. 8 Part numbering key

Note: when the above signal voltage and reference voltage (Z) are non-standard, they shall be given as follows:

$$\underbrace{M \quad D \quad X \quad C \quad 2 \quad 9 \quad 1 \quad \times \quad - \quad X \quad Y \quad - \quad \times / \times}_{\text{the same as above}} \quad \boxed{\text{Reference voltage} / \text{signal voltage}}$$

(e.g. reference voltage 40V and signal voltage 38V are expressed as -40/38)

### Application notes

- ★ Do not apply reference voltage of 115V to the device of 26V.
- ★ The voltage of power supply shall not exceed the specified range.
- ★ Do not connect reference R<sub>Hi</sub> and R<sub>Lo</sub> to other pins.
- ★ Supply voltage must be kept to the voltage of correct polarity.

- ★ When the max. absolute rating value is exceeded, the device may be damaged.
- ★ Upon assembly, the bottom of the product shall fit to the circuit board closely so as to avoid damage of pins, and shockproof provision shall be added, if necessary.
- ★ When the user places an order for the product, detailed electric performance indexes shall refer to the relevant enterprise standard.