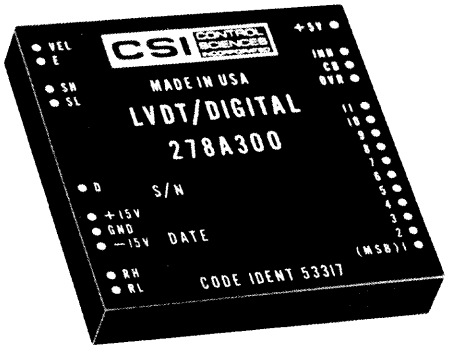
LVDT/RVDT to digital converter ratiometric 11 bit

series 278A300

micro-module series



FEATURES

- 2″ X 2″ Module outline
- High repeatability
- Drift-free performance
- Insensitive to amplitude changes
- No external trims
- Reference frequency 400 Hz to 10 kHz
- High MTBF
- 11-bit position output
- 80 Hz bandwidth on 400 Hz models
- 250 Hz bandwidth on 1 to 10 kHz models

APPLICATIONS

Avionic controls — Machine tool controls — Industrial Instrumentation — General purpose AC/Digital conversion

5-15

GENERAL DATA

The series 278A300 converters translate the outputs of LVDT and RVDT transducers into an 11-bit, offset binary digital code. No preamplifiers, trims, demodulators or filters are required. The 278A300 series can also be used as a general purpose ratiometric A-to-D converter.

THEORY OF OPERATION

The 278A300 is a tracking converter employing a (Type II) servo loop which exhibits no velocity errors and only minor acceleration errors. The output automatically follows the input without the need of a convert command. A conversion is initiated by a change of input signal equivalent to 1 LSB of the output and is indicated by a Converter Busy (CB) pulse which brackets the output code change.

The 278A300 series operates only on the ratio of the two inputs, therefore is insensitive to change in excitation voltage, amplitude, frequency and wave shape. Since a phase sensitive demodulator is used in the conversion loop the converter has a high rejection to signals that are not phase and frequency coherent with the excitation voltage.

With an LVDT connected to give a null at center position, the output will track the input from digital "1 + all zeros" to digital "all ones" for in-phase condition, and digital "1 + all zeros" to digital "all zeros" for out-of-phase condition.

In the event the signal input exceeds the normal range, the over range output is set to logic '1' and output data is invalid.

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ELECTRICAL SPECIFICATIONS

Parameter	Value
Resolution	11 bits
Accuracy[1]	
0°C to 70°C	0.1% (full scale)
Linearity	±1/2 LSB
Reference Frequency	400 Hz - 10 kHz
Signal Inputs[2]	2.5V rms (RH-RL) (SH-SL)
Input Impedance	200 Kohms differential
Slew Rate	
400 Hz	200 LSB/ms
1 kHz - 10 kHz	400 LSB/ms
Settling Time (99% FS Step)	
400 Hz	50 ms
1 kHz - 10 kHz	25 ms
Acceleration Constant (Ka)	
400 Hz	70,000 sec^{-2}
1 kHz - 10 kHz	650,000 sec^{-2}
Converter Busy(CB)	1.0 usec positive pulse
Over-Range (OVR)	Logic '1' = Over-range
Inhibit Input	Logic '0' inhibits 0.5 LSTTL load
Power Supplies[3]	
+15V @	25 mA max. (18 mA typ.)
−15V @	25 mA max. (18 mA typ.)
+ 5V @	100 mA max. (80 mA typ.) LSTTL 15 mA max. (5 mA typ.) HCMOS
Temperature Ranges	
Operating	0°C to 70°C
Storage	−55° to +125°C
Dimensions	2.00″ X 2.00″ X 0.395″
Weight	1.25 oz

NOTES:

1. Accuracy applies for:
   (a) ±20% signal voltage variation
   (b) over operating temperature range
   (c) over operating frequency range
   (d) not greater than 3° phase error between reference and signal inputs
2. This is a nominal value.
3. All units can operate on voltages between ±12V to ±17V. The tolerance on the 5 Vdc supply is +4.75 to +5.25V.

DIGITAL OUTPUT CODES

	MSB									LSB	PHASE
+FULL SCALE	1	1	1	1	1	1	1	1	1	1	IN
ZERO	1	0	0	0	0	0	0	0	0	0	
−FULL SCALE	0	0	0	0	0	0	0	0	0	0	OUT

Irrespective of the method of input connection the output codes will be offset binary.

LOGIC INPUTS/OUTPUTS

This converter series is available with HCMOS or LSTTL logic with load and drive capabilities as specified under Electrical Specifications. The Converter Busy (CB) output is a positive 1.0 microsecond positive pulse which brackets the output code change to indicate output update. The inhibit (INH) input locks the internal up-down counter, thus preventing the converter from tracking. Logic "0" or ground inhibits, logic "1" or open allows tracking. Application of extremely long inhibit times can cause erratic operation.

TIMING

Whenever an input angle change occurs, the converter changes the digital angle in steps of 1 LSB and generates a Converter Busy pulse. During the Converter Busy time the output data is changing and should not be transferred. The converter will ignore an inhibit command applied during the Converter Busy interval. There are two methods of interfacing with a computer: (1) synchronous and (2) asynchronous. A simple method of synchronous loading is to: (a) apply the inhibit, (b) wait 2 microseconds, (c) transfer the data, and (d) release the inhibit. Asychronous loading is accomplished by transferring data on the trailing edge of the CB pulse.

ACCELERATION ERROR

A tracking converter like a 278A300 employing a "Type II" servo loop does not suffer any velocity lag, however, there is an additional error due to acceleration. This additional error can be defined using the acceleration constant K_a of the converter.

$$K_a = \frac{\text{Input acceleration}}{\text{Error in output angle}}$$

The numerator and denominator have the same units. K_a does not define maximum acceleration — only the error due to acceleration. Maximum acceleration is in the region of 5 times the K_a figure (deg/sec^2).

VELOCITY VOLTAGE

The Velocity output (VEL) is a dc voltage proportional to the angular velocity of the synchro or resolver shaft. Voltage polarity is positive for an increasing angle. This output can be used in many applications to provide loop stabilization and velocity feedback data. Scaling is ±10 Vdc for maximum velocity.

INTER LSB VOLTAGE

The Inter LSB (E) voltage is a dc analog voltage representing the synchro or resolver shaft position within the least significant bit of the digital angle output. Polarity is negative for increasing angle. Scaling is ±4.5 V/LSB.

DC ERROR VOLTAGE

The DC Error Voltage (D) is the signal at the output of the phase sensitive demodulator and is proportional to the error between the analog input angle and digital output angle. This is an unfiltered output and will increase if the output angle fails to track the input for any reason. Polarity is negative for increasing angle. Scaling is 15 mv/LSB.

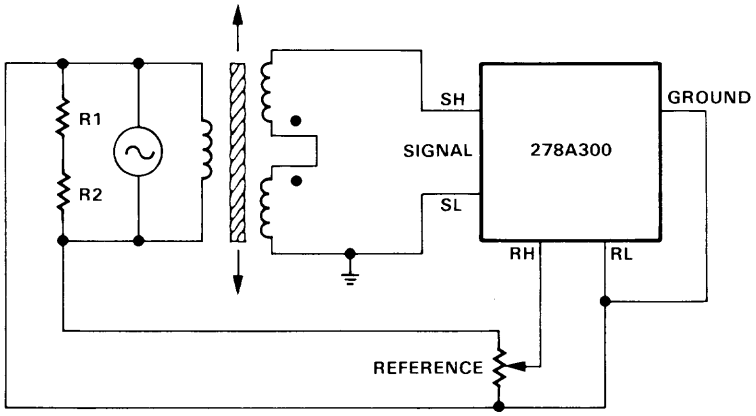
TWO-WIRE SYSTEM

The two-wire system of connection converts the widest range of LVDT sensors. It should be used in cases where the sum of the output voltages (SH + SL) is not constant with piston displacement. Where the A input is in phase with the RH input the digital output increases towards positive full scale.

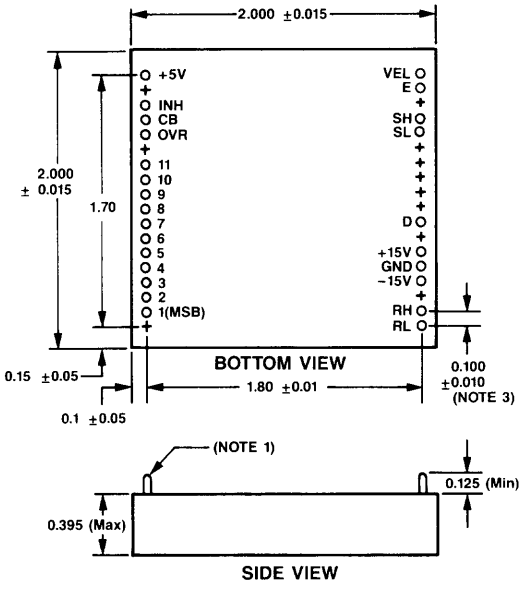
SCALE ADJUSTMENT

Scale adjustment can be accomplished by inserting a potentiometer in the reference circuit as shown. This can be used instead of the fine mechanical trimming of piston position in some applications. Typical pot value is 10 Kohms.

TWO-WIRE SYSTEM BLOCK DIAGRAM



MECHANICAL OUTLINE



NOTES

1. Rigid .025 diameter pins suitable for solder-in or plug-in applications.
2. Non-cumulative.
3. Dimensions are in inches.

ORDERING INFORMATION

278A Suffix	Operating Frequency	Logic Type
X00	400 Hz	LSTTL
X01	1 kHz-10 kHz	LSTTL
X02	400 Hz	HCMOS
X03	1 kHz-10 kHz	HCMOS

Standard temperature range (0° to 70°C).

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