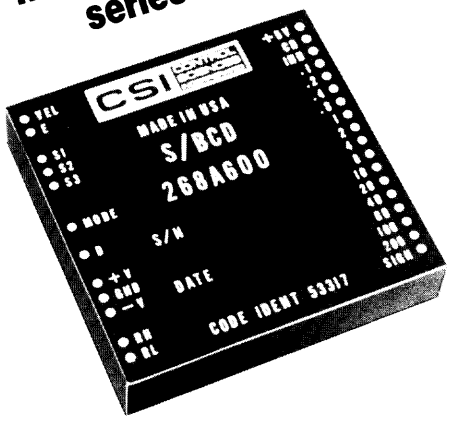
synchro/resolver to bcd converter
low power tracking 4 decade
series 268A600

micro-module series



FEATURES

- 2″ x 2″ module outline
- Pin programmable range: 0 to 359.9 or 0 to ±180
- 47 to 1200 Hz frequency range
- ±0.2° accuracy
- CMOS/TTL compatible
- 100 MW power consumption @ ±5V
- Insensitive to signal amplitude and frequency variations
- 1000% signal and reference over-voltage protection

APPLICATIONS

- Ordinance Control
- Radar Tracking Systems
- Navigation Systems
- Collision Avoidance Systems
- Process Control
- Machine Tool Control
- Angle Displays

GENERAL DATA

The series 268A600 is the first synchro/resolver to BCD tracking converter available in the new micro-module size. The converter is packaged in a 2.0″ x 2.0″ x 0.4″ module weighing only 1.5 ounces.

Inputs may be specified as either 3-wire synchro or 4-wire resolver from 2 to 130Vrms line-to-line, 50 to 1200Hz.

The converter uses a ratiometric conversion technique and employs a type II tracking loop which insures high noise immunity and jitter free operation.

The converter employs low power linear circuits and HCMOS digital circuits to achieve extremely low power consumption. The low power consumption makes the 268A600 ideal for battery powered applications.

The output is a 4 decade BCD angle plus sign which can either be pin programmed for a range of 0 to 359.9 degrees or 0 to ± 180 degrees.

OPERATION OF THE CONVERTER

The 268A600 series is a tracking converter, therefore the output follows the input for speeds up to the specified tracking rate. No convert command is necessary, a conversion is initiated by each LSB increment of the input. Each increment generates a CB pulse which in turn causes the digital output to increment one LSB.

The converter busy (CB) output and the inhibit (INH) input can be used to interface to a computer. The converter will ignore an inhibit command applied during a 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) set INH to logic '0', (b) wait 3 microseconds, (c) transfer the BCD angle, and (d) reset INH to logic '1'. Asynchronous loading is accomplished by transferring data on the negative going edge of the CB pulse.

Applying a logic '0' to the INH input opens the converter tracking loop. Under no circumstances should the INH be set to logic '0' for longer than 10 microseconds.

ELECTRICAL SPECIFICATIONS

Parameter	Value
Resolution	0.1 degree
Accuracy[1]	±0.2 degrees
Digital Outputs[2]	
BCD Angle	4-decade BCD, positive logic
Sign	logic '0' = + logic '1' = −
Converter Busy	1 - 2 usecond positive pulse
Digital Inputs	
Inhibit[3]	Logic '0' inhibits
Mode[4]	Logic '0' sets 0 - 359.9 range Logic '1' sets 0 - ±180 range
Analog Outputs	
Velocity (VEL)	
Full scale	±10 Vdc
Accuracy	±20% of F.S.
Polarity	Positive for increasing angle
Reversal Error	±10% max.
Linearity	2% for 0-20% of max velocity 6% for 0-50% of max velocity 15% for 0-100% of max velocity
Zero Offset	±2mV max
Ripple	5mVrms
Inter LSB (E)	
Polarity	Negative for increasing angle
Scale	4.5V/LSB
DC Error Voltage (D)	
Polarity	Negative for increasing angle
Scale	15mV/LSB
Signal Input Rates	
Max Tracking	10 RPS
Acceleration Ka	2000 sec^{-2}
Settling Time (179° step)	350 ms
Synchro/Resolver Inputs[5][6]	11.8 Vrms L-L @ 100 Kohms 90 Vrms L-L @ 600 Kohms
Reference Input[6]	10-130 Vrms 50-1200Hz @ 400 Kohms

Power Supplies[7]	Max	Typ
+11.5 to +16.5V	5mA	3mA
−11.5 to −16.5V	9mA	7mA
+4.75 to +5.5V	11mA	6mA
+4.75 to +5.5V	14mA	9mA
−4.75 to +5.5V	7mA	5mA

Temperature Ranges	
Operating	0° to +70°C
Storage	−55° to +125°C

NOTES

1. Accuracy applies for:
   a) ±10% specified signal amplitude variation
   b) over entire reference voltage range
   c) 25% signal and reference harmonic distortion
   d) over power supply range
   e) over operating temperature range
2. CMOS levels capable of driving 2 TTL loads.
3. CMOS input with 51 Kohm pull-up to +5V.
4. CMOS input.
5. Other signal voltages available on special order, consult factory.
6. Solid state differential input, any one stator and/or rotor line may be grounded. Common mode voltages up to specified L-L voltage have no effect on operation.
7. Units can be ordered to operate on ±15V and +5V power supplies or ±5V power supplies, see ordering information.

BCD OUTPUT

The angle output is four decade BCD plus a sign bit. The digital output bits are 0.1 degree to 200 degrees, giving output angles over the range of 0 degrees to 359.9 degrees. The converter can be programmed via the MODE pin giving the angle output for either a range of 0 to 359.9 degrees or 0 to ±180 degrees.

VELOCITY OUTPUT

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. Refer to the electrical specifications for performance characteristics.

INTER LSB OUTPUT

The Inter LSB output (E) is a dc voltage representing the synchro or resolver shaft position within the least significant bit of the BCD angle output.

DC ERROR OUTPUT

The DC Error (D) is the output of the phase sensitive demodulator and is proportional to the error between the analog input angle and the BCD output angle. This is an unfiltered output and will increase if the output fails to track the input for any reason. This output is ideal for use as a fault detector.

MODE INPUT

The MODE input is used to set the output range of the converter. Logic '0' sets the range to 0 to 359.9 degrees, logic '1' sets the range to 0 to ±180 degrees.

DYNAMIC RESPONSE

The 268A600 series employs a type II servo loop ($Kv = \infty$) with a very high acceleration constant. The loop dynamics are completely independent of power supply variations within their specified limits. As long as the maximum tracking rate is not exceeded there will be no velocity lag and only minor acceleration lag in the BCD output. Acceleration lag (in degrees) can be computed from the following equation:

$$Ea = \frac{\text{Acceleration (deg/sec)}}{Ka}$$

The nominal open loop transfer function is given by:

$$G = \frac{58^2\left(\frac{S}{40} + 1\right)}{S^2\left(\frac{S}{182} + 1\right)}$$

CONNECTING THE CONVERTER

The power supply lines, which must not be reversed, should be connected to the +V, −V and +5V pins with the common connection to the GND pin. For units specified to operate on ±15V connect +15V to the +V pin and connect −15V to the −V pin. For units specified to operate on ±5V connect +5V to the +V pin and connect −5V to the −V pin.

Connecting the converter to a synchro is as follows:

SYNCHRO			CONVERTER
R1	H	to	RH
R2	C	to	RL
S1	X	to	S1
S2	Z	to	S2
S3	Y	to	S3

Connecting the converter to resolvers can become much more complex since no two manufacturers identify the resolver terminals in the same manner. The phase equations for the R/D converter are as follows:

$$E(S3\text{-}S1) = KE(RH\text{-}RL)\ SIN\text{-}\theta$$

$$E(S2\text{-}S4) = KE(RH\text{-}RL)\ COS\text{-}\theta$$

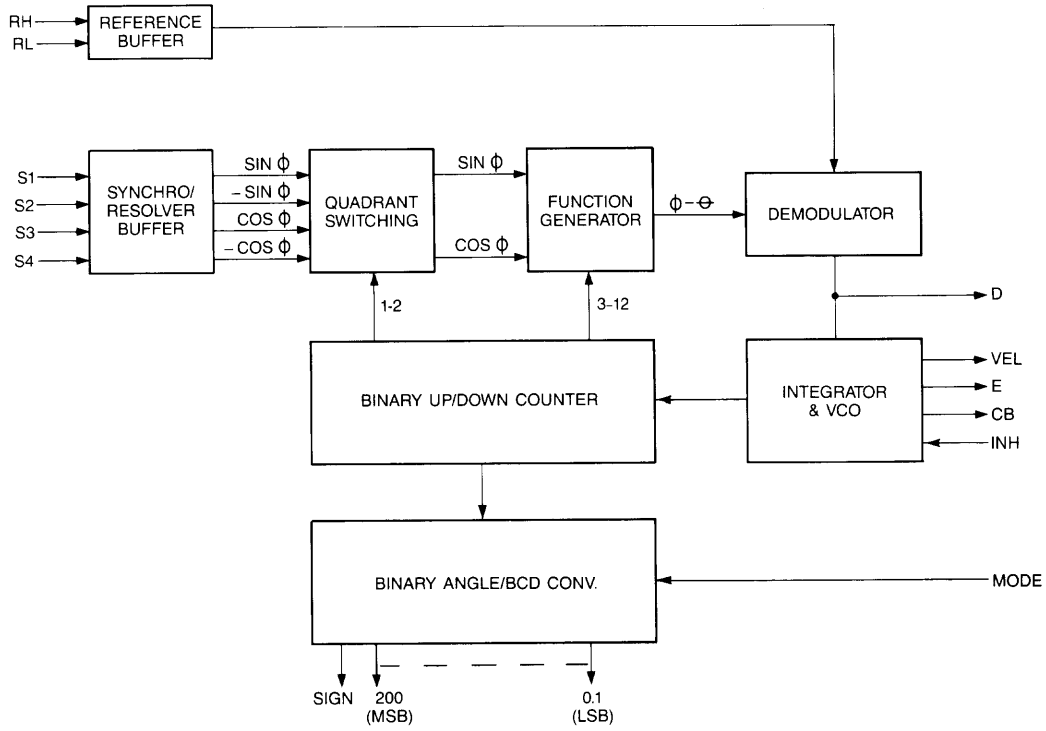
Where: E = Excitation Voltage
K = Transformation Ratio
θ = Resolver Shaft Angle

The MODE pin must always be connected to either logic '0' or logic '1'. This pin sets the range of the BCD output. The level at this pin should not be changed during normal operation, it is to be set prior to or during power-up.

If the INH input is not to be used for computer interface, it may be left open since it has an internal pull-up resistor to +5V.

It is recommended that 0.1uF ceramic capacitors be used to by-pass the power supplies as close to the module as practical.

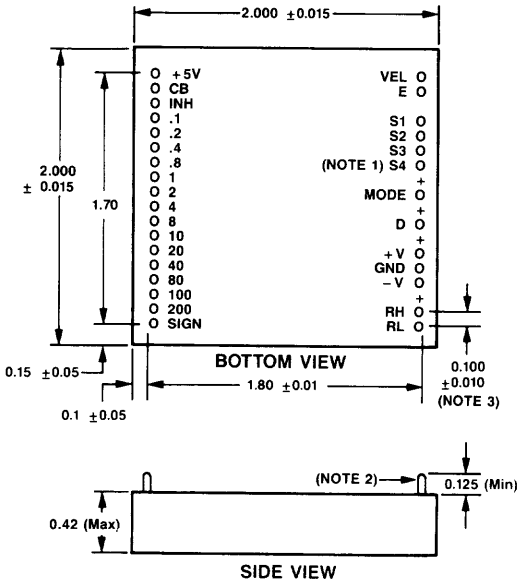
BLOCK DIAGRAM
268A600



ORDERING INFORMATION

268A SUFFIX	INPUT TYPE	L-L VOLTAGE	PWR SUPPLIES
600	SYNC	11.8V	±15V +5V
601	SYNC	90V	±15V +5V
602	RSVR	11.8V	±15V +5V
630	SYNC	11.8V	±5V
631	SYNC	90V	±5V
632	RSVR	11.8V	±5V

MECHANICAL OUTLINE



NOTES

1. S4 pin appears on multiple input and resolver models only.
2. Rigid .025 diameter pins suitable for solder-in or plug-in applications.
3. Non-cumulative.
4. Dimensions are in inches.