digital to synchro/resolver converter
1.5 va 14 bit
series 192B500

GENERAL DATA:

The series 192B500 are a family of miniature DTL/TTL/CMOS compatible digital to synchro (or resolver) converters. The converter occupies less than 7 cubic inches and is capable of driving most control transformers.

Fourteen bit natural binary angle data is continuously and accurately converted back to analog form...either as 3-wire synchro or 4-wire resolver signals. All converters have output transformer isolation and are short circuit and overload protected.

All units are completely trimmed and adjustment-free; allowing absolute interchangeability. Reliability is assured by the use of high grade components rigidly encapsulated and electrically stressed to the lowest possible levels.

APPLICATIONS:

COORDINATE CONVERTERS - DUMMY DIRECTORS - COMPUTER CONTROLLED ANTENNAS

ELECTRICAL SPECIFICATIONS:

Parameter	Value
☐ Resolution	14 bits (0.022°)
☐ Accuracy(1)	4 minutes
☐ Digital Input(2)	Natural parallel binary angle Positive DTL/TTL/CMOS logic Input current—300 microamps max.
☐ Input Data Rate	4000°/second
☐ Settling Time	100 microseconds
☐ Output(3) (4) (6)	
Synchro	11.8Vrms 400Hz driving 100 ohms L-L 90Vrms 400Hz driving 5K ohms L-L 90Vrms 50-60Hz driving 4K ohms L-L
Resolver	11.8Vrms 400Hz driving 100 ohms L-L 90Vrms 400Hz driving 5K ohms L-L 90Vrms 50-60Hz driving 4K ohms L-L
☐ Reference Input(3) (5)	26Vrms @ 100K ohms minimum 115Vrms @ 800Kohms minimum

☐ Power Supplies

Voltage	+15V	-15V	+5V
Current, max. avg.	150ma	150ma	5ma
Current, peak	450ma	450ma	5ma

ENVIRONMENTAL SPECIFICATIONS:

☐ Temperature Ranges: Operating: 0° to 70°C std.
(-55° to 85°C optional)
Storage: -55° to 125°C

FEATURES:

- ☐ DTL/TTL/CMOS compatible
- ☐ Short-circuit and overload-protected
- ☐ 14 bit resolution
- ☐ ± 4 arc minute accuracy
- ☐ High power output
- ☐ Choice of synchro or resolver types
- ☐ Cyclic L-L variations of only 2%

OPTIONS:

- ☐ -55° to +85°C temperature range
- ☐ Custom mechanical configurations
- ☐ Higher power outputs

NOTES:

(1) Accuracy applies for:
(a) ±5% variation in power supply voltages.
(b) ±10% reference amplitude and frequency variation.
(c) 10% reference harmonic distortion.
(d) Any balanced load from no load to full load.
(e) Over operating temperature range.

(2) Signals shall not be applied to the digital inputs while the device power supply is off. Digital input levels should not go below ground or exceed +5V.

(3) Other voltages and frequencies available.

(4) Transformer isolation.

(5) Solid state type

(6) An isolation transformer is an integral part of all units except the 50-60Hz models which have separate transformers.

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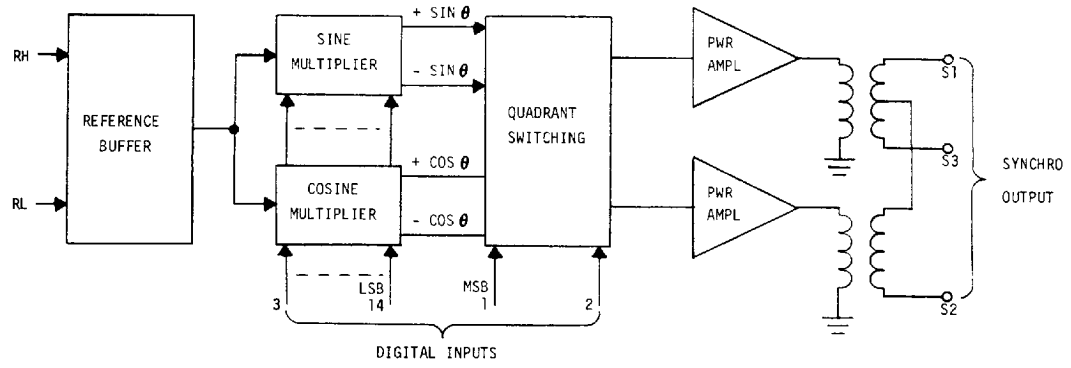
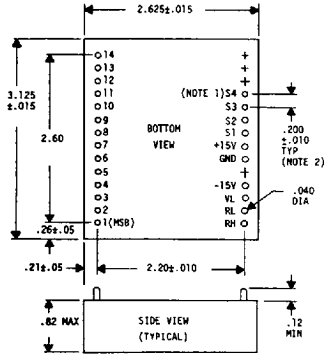
BLOCK DIAGRAM:



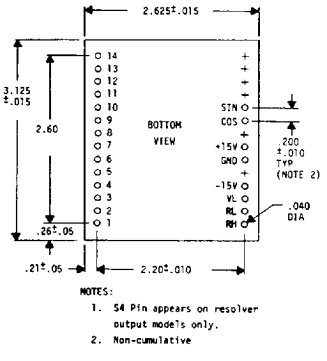
CONFIGURATION:

400Hz CONVERTER



Weight: 7.5 oz

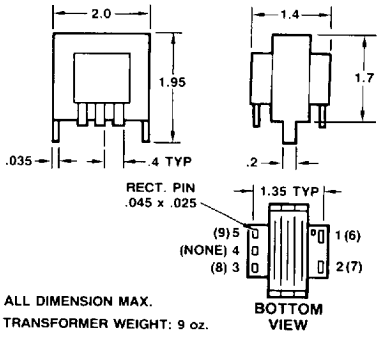
50/60Hz CONVERTER



NOTES:
1. S4 Pin appears on resolver output models only.
2. Non-cumulative

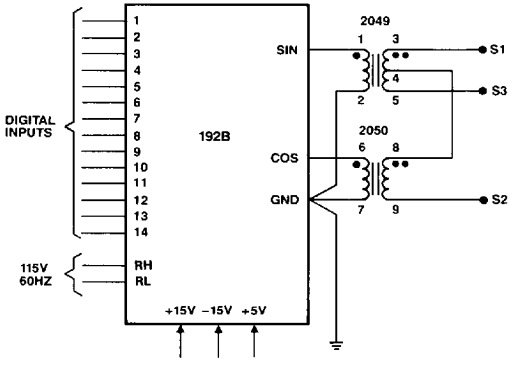
Weight: 6.5 oz.

TRANSFORMERS 2049 AND 2050 (60 Hz ONLY)



ALL DIMENSION MAX.
TRANSFORMER WEIGHT: 9 oz.

INTERCONNECTING DATA (50/60 Hz):



ORDERING INFORMATION:

192B SUFFIX	OUTPUT TYPE	L-L VOLTAGE	REFERENCE INPUT
500	SYNC	11.8V	26V 400HZ
501	SYNC	11.8V	115V 400HZ
502	SYNC	90V	115V 400HZ
503	RSVR	90V	115V 400HZ
504	RSVR	11.8V	26V 400HZ
505	RSVR	11.8V	115V 400HZ
506A	SYNC	90V	115V 50-60HZ

Above part numbers describe commercial temperature devices (0° - +70°C), add suffix ET to part number for extended temperature range (-55° - +85°).

POWER SUPPLIES

Three supplies are required. They should be well regulated, and when testing or evaluating the converter on the bench use the current-limit type. Set the current limiting as follows:

+15.0V @ 500ma -15.0V @ 500 ma V_L @ 10 ma

Use extreme care in connecting the supplies. Reverse polarity protection is incorporated in the power lines, but it is only effective if the supplies are current limited to ½ amp. Absolute maximum on the ±15.0V supplies is ±18.0V. Absolute maximum on the V_L supply is +10.0V.

INPUT REFERENCE SIGNAL (RH-RL)

The output AC signlas are derived from the applied reference; therefore the input reference signal must be the correct amplitude and frequency as specified for the particular converter.

ANALOG OUTPUT

The analog output signals from the 192B500 series are described by the following equations:

Synchro outputs: $E_{S1\text{-}S3} = KE_{RL\text{-}RH} \sin \theta$

$E_{S3\text{-}S2} = KE_{RL\text{-}RH} \sin (\theta + 120°)$

$E_{S2\ S1} = KE_{RL\text{-}RH} \sin (\theta + 240°)$

Resolver outputs: $E_{S1\text{-}S3} = -KE_{RH\text{-}RL} \sin \theta$

$E_{S2\text{-}S4} = KE_{RH\text{-}RL} \cos \theta$

It is important to note that K in the above equation has the form NR. N is the transformation ratio of the converter, i.e., 115/90. And R varies between 1.1 and .98 every 11.25°. In all synchro/servo systems, scale factor variation is not a source of error. But in other applications where the sines and cosines are used independently, you must determine whether the scale factor variation will not cause error.

The series 192B500 is capable of driving most control transformers (CT). Control transformers are highly inductive, with a reasonable Q; therefore it is possible to resonate this load by placing three capacitors of the proper value across the synchro output in a delta configuration. The same holds for the resolver output except that only two are required. By tuning the load you can raise the effective load impedance. Note that good grade capacitors are necessary, and that they must be able to withstand the full AC output voltage. The formula for determining the capacitor size is given below.

$$C = \frac{X'_{LSO}}{6\pi f[(R'_{SO})^2 + (X'_{SLO})^2]}$$

Where:

C = Tuning capacitor in farads in delta connection

X'_{LSO} = Reactive component of impedance of one stator winding leg with rotor open circut

f = Frequency in Hz

R'_{SO} = Resistive component of impedance of one stator winding leg with rotor open circuit

Note:

$Z_{SO}' = \frac{2}{3} (Z_{SO})$

Z_{SO} = Stator winding impedance with rotor open circuit

The Series 192B500 cannot drive Torque Receivers directly. Torque Receivers are a class of synchro which positions its shaft directly according to the applied stator voltages, and does not use a servo to obtain power. CSI does manufacture higher power D/S converters (7VA & 25VA), specifically designed to drive Torque Receivers.

To conclude the discussion on the analog output characteristics, it must be noted that there are minor transients which occur when the data angle changes. The transient duration is approximately 10 microseconds and usually does not cause any error since the bandwidth of the driven servo filters these transients out.

LOGIC INPUTS

The 192B500 series will accept 14 bits (or less) of digital angle data. If you have fewer than 14 bits, simply ground the unused input bit pins. Inputs are DTL/TTL/CMOS compatible, employing CMOS inputs with pull-up resistors to guarantee bipolar compatability. Input sink current is -300 microamps at V_L = +5V. Logic '1' inputs of +5 to +10V are selectable by setting the V_I pin voltage to the desired level.

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