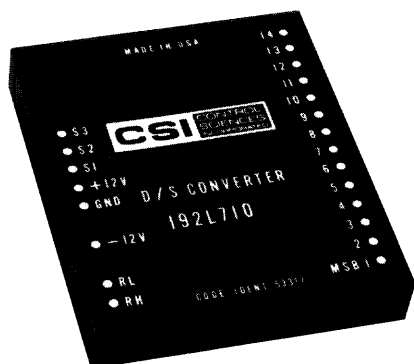




FEATURES

- 2.62" x 3.12" x 0.52" module
- Industry standard pin-out
- Only $\pm 12V$ power required
- To ± 4 arc minute accuracy
- Short circuit and overload protection
- Thermal cutoff protection
- Metal top plate heat sinking
- TTL/CMOS compatibility
- $\pm 0.1\%$ radius vector accuracy
- Output transformer isolation

APPLICATIONS

- Flight Trainers
- Simulators
- Fire Control
- Radar Systems

3-35

GENERAL DATA

The 192L710/810 digital to synchro and digital to resolver converters are low-profile modules, only 0.52" high, with industry standard pin-outs. The 192L710 series accepts a 14 bit digital input angle and the 192L810 accepts a 12 bit input angle. The input reference excitation is converted to either a synchro or resolver output with moderate drive capability. The outputs are fully protected against overloads and short circuits and a thermal cut-off is incorporated to prevent overheating. The converters incorporate an aluminum top plate that provides all the necessary heatsinking. The 192L series also has a new circuit design that provides a smoother and more accurate output with a negligible scale factor variation. The 400Hz versions contain internal output transformer isolation. The 60Hz version requires separate external output transformers.

ANALOG REFERENCE INPUT

The synchro or resolver reference excitation must be connected to the RH and RL inputs of the converter. The output stator signals are derived from (and are proportional to) the applied reference input. Any distortion present on the reference will appear in the output stator signals.

ANALOG STATOR OUTPUTS

The analog synchro output signals S1-S2-S3 are described by the following equations:

$$\begin{aligned} E_{S1-S3} &= K E_{RL-RH} \sin \theta \\ E_{S3-S2} &= K E_{RL-RH} \sin(\theta + 120^\circ) \\ E_{S2-S1} &= K E_{RL-RH} \sin(\theta + 240^\circ) \end{aligned}$$

Analog resolver output signals S1-S2-S3-S4 are described by the following equations:

$$\begin{aligned} E_{S1-S3} &= K E_{RL-RH} \sin \theta \\ E_{S4-S2} &= K E_{RL-RH} \cos \theta \end{aligned}$$

θ in the above equations is the binary input angle. It is important to remember that K has the form NR. N is the transformation ratio of the converter and R is the scale factor and varies between 0.999 and 1.001 every 11.25° without any discontinuities. This low scale factor variation gives sine and cosine conformities to within $\pm 0.1\%$.

SPECIFICATIONS

Parameter	Value
Resolution	
192L710	14 bits (0.022°)
192L810	12 bits (0.088°)
Accuracy⁽¹⁾	
192L710	±4 minutes (0.066°)
192L810	±6 minutes (0.1°)
Analog Output⁽²⁾⁽⁵⁾	
Drive Capability	
Synchro Output	
11.8Vrms L-L 400Hz	70Ω L-L min.
90.0Vrms L-L 400Hz	4000Ω L-L min.
90.0Vrms L-L 60Hz	4000Ω L-L min.
Resolver Output	
11.8Vrms L-L 400Hz	100Ω L-L min.
Output Scale Factor	±2%, tracks reference input
Variation with Input Angle	±0.1% max.
Output Quadrature	±0.3% max.
Reference Input⁽³⁾	
Type	Solid state differential
Isolation	0.4MΩ to gnd.
Voltage	26V or 115Vrms ±10%
Frequency	60Hz or 400Hz ±10%
Input Impedance	800KΩ differential 400KΩ single ended
Digital Input⁽⁴⁾	
Logic Format	Parallel binary angle TTL compatible positive logic
Logic Type	Transient protected CMOS
Loading	0.13 standard TTL loads
Power Supplies	
Voltage (operating)	±12V ±5%
Voltage (absolute max.)	±18V
Average Current (N.L.)	110mA max.
Average Current (F.L.)	180mA max.
Peak Current (turn-on)	600mA max.
Temperature Ranges	
Operating	
Standard	0° to +70°C
IT option	-25° to +85°C
Storage	-55° to +125°C
Physical Characteristics	
Size ⁽⁵⁾	2.625" x 3.125" x 0.52"
Weight	5.0 oz. max.

NOTES:

- (1) Accuracy applies for:
 - a) ±5% power supply variations.
 - b) ±10% reference amplitude and frequency variations.
 - c) 10% reference harmonic distortion.
 - d) Any balanced load from no load to full load.
 - e) Over operating temperature range.
- (2) Transformer isolated; any one stator may be grounded.
- (3) Common mode voltages up to specified input voltage have no effect on operation. Any one input may be grounded.
- (4) Signals shall not be applied to digital inputs while the device power supplies are off. Digital input levels should not go below ground or exceed +5V.
- (5) 60Hz units require external transformers.

OUTPUT POWER CAPABILITIES

The 192L710/810 series is capable of driving most synchro and resolver control transformers. See Specifications section for minimum impedance (Z_{so}) that the converters are able to drive.

Control transformers are highly inductive loads and it is possible to save power or to increase load driving capability by tuning such loads. Three capacitors may be placed across the legs of the synchro stator in a delta configuration. The value of the capacitors in Farads is given by:

$$C = \frac{X_L}{4\pi f(R^2 + X_L^2)}$$

Where: f = carrier frequency

R = series real component of Z_{so}

X_L = series reactive component of Z_{so}

High grade capacitors with a tolerance of ±5% must be used and they must be able to withstand the full AC output voltage.

When the load has been tuned, more loads can be driven in parallel, because the load impedance Z is increased to:

$$Z = \frac{R^2 + X_L^2}{R}$$

HEAT SINKING AND THERMAL CUTOUT

The top of the 192L consists of a metal plate providing all the required heat sinking. Thermal resistance top plate to free air is 15°C/VA. A thermal cutout is incorporated that disables the output power amplifiers when the top plate temperature reaches 105°C. The outputs are automatically restored when the temperature drops below 100°C. The thermal resistance of the top plate may be improved by a factor of three or greater by simply blowing air of sufficient velocity over the plate. It is highly recommended the the top plate be provided some air circulation.

POWER SUPPLIES

The 192L will not be damaged by sequencing either of the dc supplies or the reference input. However, if one of the 12V supplies is shut down, a maximum current of 600mA will be drawn from the other 12V supply until the missing supply is restored.

The converters have turn-on peak currents of 600mA; therefore, it is recommended that the ±12V supplies be capable of 1A peaks without current limiting.

LOGIC INPUTS

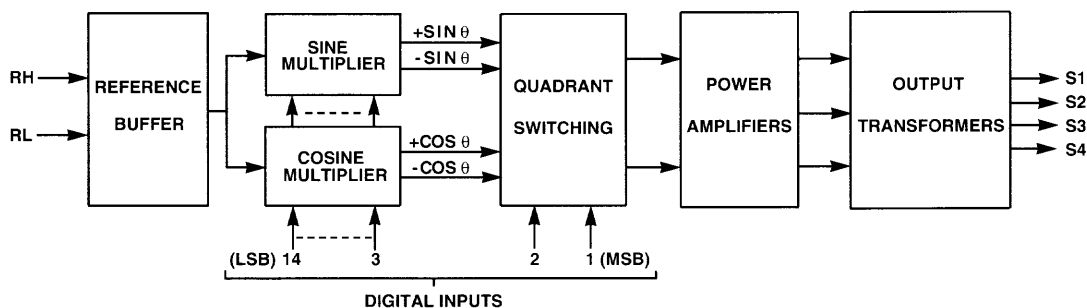
The 192L810 series accepts 12 bits of natural parallel binary angle, while the 192L710 accepts 14 bits. To accommodate fewer input bits, simply ground the unused bit pins. These digital inputs are transient protected CMOS devices with 33K Ω pull-up resistors to an internal +5V supply that guarantees TTL logic compatibility. If the TTL logic input source drives other loads as well, the internal pull-up resistors must maintain logic "1" levels of at least +4V.

Input bit 1 is the most significant bit and is equal to 180°, bit 2 is equal to 90° and so on. The least significant bits are bit 12 that is equal to 0.088° and bit 14 that is equal to 0.022°.

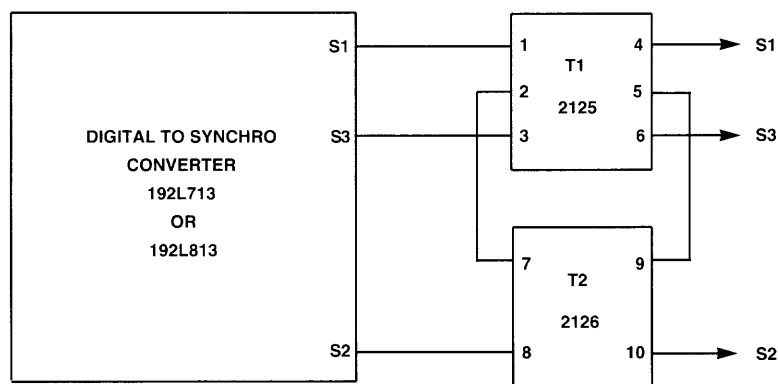
60Hz OPERATION

The 60Hz digital to synchro converters require both a converter module and external Scott T transformers. The output power amplifiers in the converter module provide a solid state, 11.8V line to line, 3-wire synchro signal to the external transformers when the reference input is 115Vrms. The external transformers, 2125 and 2126, are connected to the converter module as shown below.

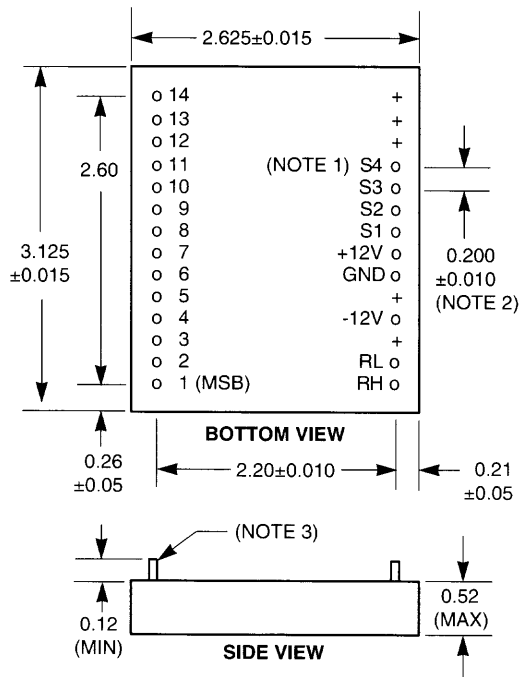
BLOCK DIAGRAM



TRANSFORMER CONNECTION DIAGRAM (60Hz)



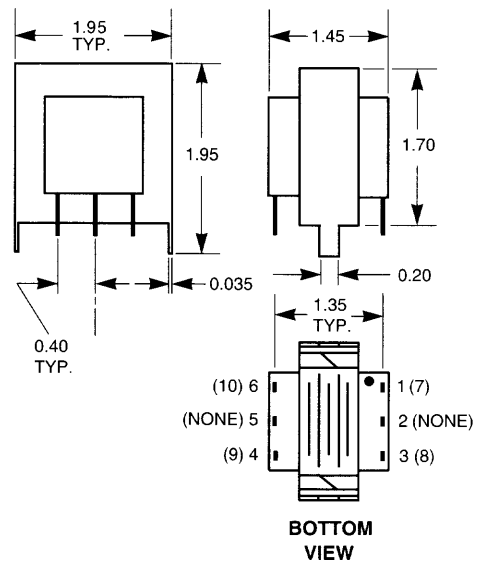
MECHANICAL OUTLINE



NOTES:

- (1) S4 pin appears on resolver output models only.
- (2) Non-cumulative.
- (3) Rigid 0.040 diameter pins suitable for solder-in or plug-in applications.
- (4) Bit pins 13 and 14 appear on 192L710 models only.
- (5) Dimensions are in inches.

EXTERNAL TRANSFORMERS (60Hz ONLY)



NOTES:

- (1) Transformer leads are 0.025 x 0.045 rectangular pins.
- (2) Pin designators in parenthesis are for the 2126 transformer, other designators are for the 2125.
- (3) Transformer weight is 9 ounces each.
- (4) Unless otherwise specified, dimensions are maximum and in inches.

ORDERING INFORMATION

192L SUFFIX	REFERENCE INPUT		STATOR OUT		BITS
	VOLTAGE	FREQ	TYPE	VOLT	
710	26	360-440Hz	SYNC	11.8	14
711	115	360-440Hz	SYNC	90.0	14
712	26	360-440Hz	RSVR	11.8	14
713	115	57-63Hz	SYNC	90.0	14
810	26	360-440Hz	SYNC	11.8	12
811	115	360-440Hz	SYNC	90.0	12
812	26	360-440Hz	RSVR	11.8	12
813	115	57-63Hz	SYNC	90.0	12

NOTES:

- (1) The 192L713/813 converters include the external 2125 and 2126 external transformers.
- (2) Standard temperature range is 0° to 70°C; add suffix IT to part number for -25° to +85°C operation.
- (3) Contact factory for non-standard input and output voltages.