



FEATURES

- 4.5VA output
- Industry standard pin-out
- Single +5V power supply
- 4 arc minute accuracy
- TTL/CMOS compatibility
- Transformer isolated output
- Short circuit protection
- Thermal cutoff
- Transient Protection
- No external transformer @ 60Hz

APPLICATIONS

- Operational Flight Trainers
- Simulators
- Fire Control Systems
- Flight Instrumentation

GENERAL DATA

The 192F500 series digital to synchro converter complements the 192E600 series industry standard by providing additional features. The 192F500 is a 2.62" x 3.12" x 0.8" module with standard pin-outs except that the need for +15V and -15V is eliminated. The new design also eliminates the need for external 60Hz Scott T transformers. The unit is powered from the reference input. Each 192F500 series converter incorporates an internal pulsating power supply, dramatically improving converter efficiency.

The 192F500 retains many features of the 192E600. The output is fully protected against overloads, short circuits and overheating. The converter features a new circuit design with a smoother, more accurate output and negligible scale factor variation.

THEORY OF OPERATION

The 192F500 circuit has four sections; 1) a voltage converter, 2) a reference buffer, 3) the digital to resolver converter (D/R), and 4) a synchro output section.

The voltage converter section converts the +5V logic supply into voltages necessary to operate the reference buffer and the D/R converter. The reference buffer is a true differential amplifier with extremely high common mode rejection. The buffer isolates the reference input from the D/R converter.

The digital input angle is converted to analog sine and cosine voltages by the D/R converter section. These voltages conform to their respective functions to within $\pm 0.1\%$ and have negligible glitches at major transition points.

The output section, which eliminates the need for $\pm 15V$ supplies, is a reference powered pulsating power supply, an electronic Scott T and three high voltage power amplifiers. The pulsating power supply produces two unfiltered full-wave rectified positive and negative voltages that are in phase with the amplifier output voltages. The power supply voltages and the synchro output voltages are derived from the reference input. The two supply voltages need only be a few volts greater than the synchro output voltages. Since the pulsating power supply voltage levels are consistently lower than constant DC levels, internal power consumption will be much less. The electronic Scott T converts sine and cosine voltages to 3-wire synchro signals. The synchro signals are amplified by three power amplifiers that will drive loads with any phase from $+90^\circ$ to -90° .

ELECTRICAL SPECIFICATIONS

Parameter	Value
Resolution	14 bits (0.022°)
Accuracy	±4 minutes
Analog Output	
Type	Transformer isolated 3-wire synchro
Voltage	11.8V or 90V L-L ±2%
Load	
60Hz	1.5VA max.
400Hz	4.5VA max.
Scale Factor Variation	±0.1%
Output Quadrature	±0.2%
Reference Input	
Type	Solid state differential
Isolation	0.4 MΩ to gnd
Voltage	
Operating	26V or 115V ±10%
Maximum	30V or 138V
Current	
No Load	
400Hz	20mA max.
60Hz	40mA max.
Additional with Load	1mA per mA of load
Power Supply	
Voltage	
Operating	+5V ±5%
Maximum	+7V
Current	50mA max.
Digital Inputs	
Logic Format	Parallel binary angle Positive logic TTL/CMOS compatible
Logic Type	Transient protected CMOS
Loading	0.13 std TTL load
Temperature Ranges	
Operating	
Standard	0° to 70°C
ET Option	-55° to +85°C
Storage	-55° to +125°C
Dimensions	2.64" x 3.14" x 0.82" max.
Weight	7.0 oz. max.

NOTES:

- Accuracy applies for:
 - ±5% variation in power supply voltage.
 - ±10% reference amplitude and frequency variation.
 - 10% reference harmonic distortion.
 - any balanced load from no load to full load.
 - over operating temperature ranges.
- Reference input is solid-state differential. Common mode voltages up to specified input voltage have no effect on operation.
- Signals shall not be applied to digital inputs while the +5V power is off. Digital input levels should not go below ground or exceed +5V.

REFERENCE INPUT (RH-RL)

The synchro system reference must be connected to the RH and RL inputs of the converter. Since the reference input circuitry is a true differential input either RH or RL may be grounded. The output signals S1-S2-S3 are derived from (and proportional to) the reference input. Any distortion present on the reference will appear in the output signals.

BINARY INPUTS (1-14)

The 192F500 series accept 14 bits (or less) of positive natural parallel binary angle data. To accommodate fewer input bits, simply ground the unused lower order input bit pins. These inputs are transient protected CMOS switches with 33KΩ pull-up resistors to the +5V supply and can be driven by all standard TTL and CMOS gates.

STATOR OUTPUTS (S1-S2-S3)

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

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

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

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

θ in the above equations is the binary input angle. It is important to note that K in the above equation has the form NR. N is the transformation ratio of the converter, 90/115. The R term is the scale factor variation and varies between 0.999 and 1.001 every 11.25 degrees without any discontinuities. This low scale factor variation gives an output sin/cos conformity to within ±0.1%.

OUTPUT POWER CAPABILITIES

The 192F500 (400Hz version) can deliver a continuous 4.5VA to a synchro load. The internal power transformer size limits the output power of the 192F501 (60Hz version) to a continuous 1.5VA.

HEAT SINKING AND THERMAL CUTOFF

The top of the 192F500 is a metal plate providing all the required heat sinking. The thermal resistance top plate to free air is 10°C/VA of load. A thermal cutout is incorporated that disables the output power amplifiers when the top plate temperature reaches 125°C. The output is automatically restored when the temperature drops below 125°C. This metal top plate should be provided with sufficient air circulation. The thermal resistance of the top plate may be improved by a factor of three or greater by blowing air of sufficient velocity over the plate.

The 192F501 converter (60Hz version) does not require a metal top plate or thermal cutoff. The lower power level (1.5VA) is not high enough to require these protection features.

DRIVING CT AND CDX LOADS

When driving CT and CDX loads, the 192F500 must have enough steady state power capability to drive the Z_{so} of the load. Generally a CT will be lightly loaded and the following equation can be used to calculate their VA requirement:

$$VA = \frac{.866 (E_{L-L})^2}{Z_{so}}$$

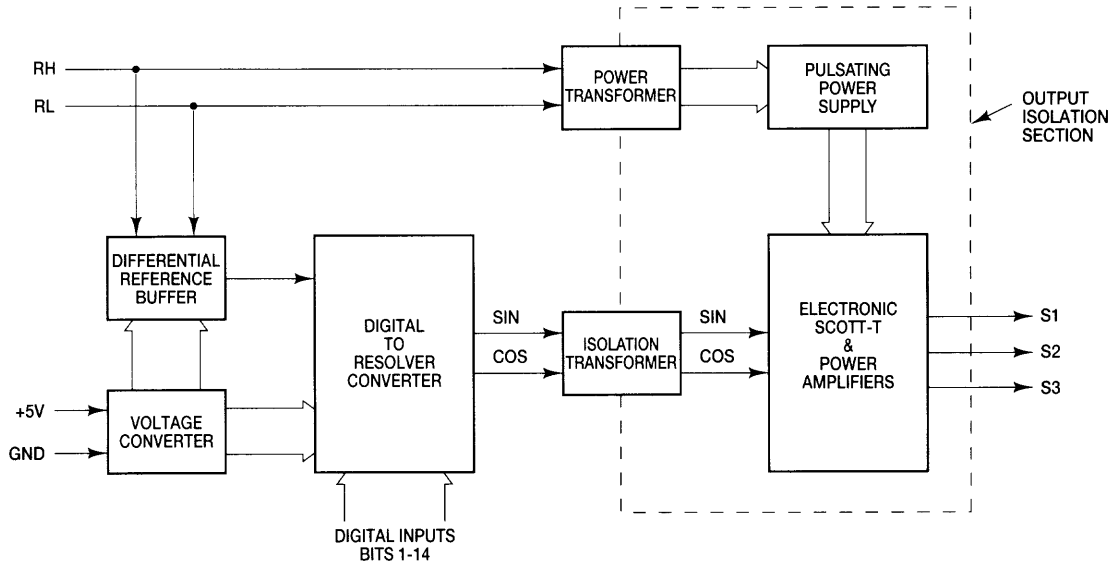
where E_{L-L} is the primary CT voltage and Z_{so} is the stator impedance.

The output of a CDX is usually loaded with a CT, therefore when computing the VA requirement of a CDX load, its load must be taken into account.

$$VA = \frac{.866 (E_{L-L})^2 (Z_{so} \times Z_{so'})}{Z_{so} + Z_{so'}}$$

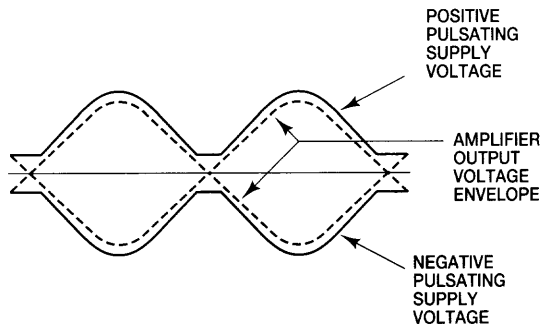
where E_{L-L} is the primary CDX voltage, Z_{so} is the CDX input impedance and $Z_{so'}$ is the CT input impedance.

BLOCK DIAGRAM

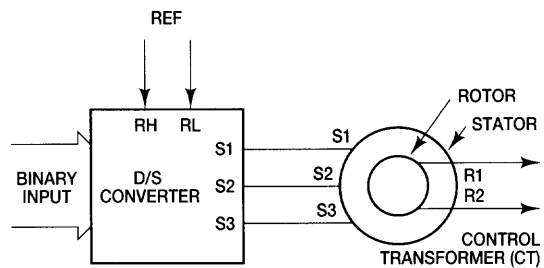


3-29

PULSATING POWER SUPPLY WAVEFORMS



DRIVING CT AND CDX LOADS



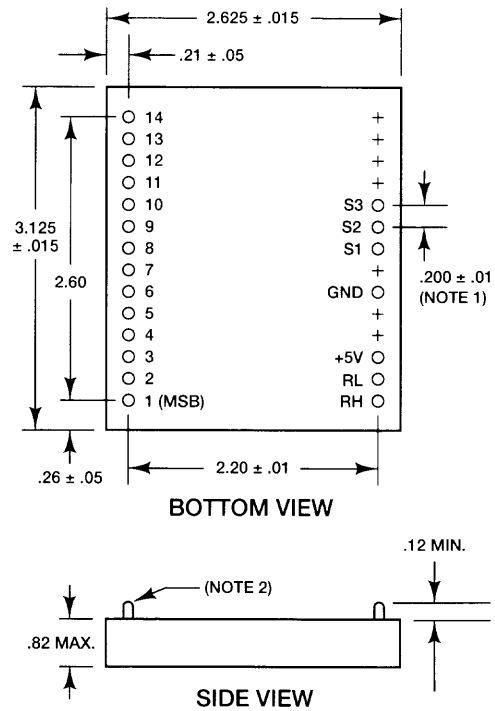
ORDERING INFORMATION:

192F SUFFIX	OUTPUT POWER	STATOR VOLTAGE	REFERENCE FREQUENCY	REFERENCE VOLTAGE
500	4.5VA	90V	360-440Hz	115Vrms
501	1.5VA	90V	57-63Hz	115Vrms
502	4.5VA	11.8V	360-440Hz	26Vrms
503	4.5VA	11.8V	360-440Hz	115Vrms

Standard temperature range is 0° to +70°C; add suffix ET to part number for extended temperature range (-55° to +85°C). Consult factory for optional voltages and frequencies.

3-30

MECHANICAL OUTLINE



NOTES:

1. Non-cumulative.
2. .040 diameter gold plated brass pin for solder-in or plug-in applications.
3. Dimensions are in inches unless otherwise specified.