synchro/resolver amplifier
5VA
series 175A600

FEATURES

- **Synchro amplification/voltage conversion**
- **Resolver amplification/voltage conversion**
- **Synchro/resolver and resolver/synchro conversion**
- **Full 5VA Output**
- **Transformer Isolated Output**
- **"Locked Rotor" Protection**
- **Short Circuit and Overload Protection**
- **Thermal Cutoff Protection**

APPLICATIONS

- **Training Simulators**
- **Fire Control Systems**
- **Retransmission Systems**
- **Remote Indicators**

GENERAL DATA

The series 175A600 is a 2.62" x 3.12" x 0.8" module designed for p.c. board mounting. The amplifier employs high balanced input impedances and low balance output impedances that minimize loading errors. It is designed to deliver a full 5VA making it capable of driving virtually all 400Hz size 8 and 11 control transformer (CT), control differential transmitter (CDX), torque receiver (TR) synchro loads, resolver control transformer (RC) and resolver differential transmitter (RD) loads while maintaining a ±4 arc minute accuracy. The synchro/resolver amplifier is current limited and features a thermal cut-off to prevent overheating. An aluminum top plate on the module provides all the necessary heat-sinking.

THERMAL CONSIDERATIONS

The top of the 175A600 consists of a aluminum 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 reaches 105°C. The output is automatically restored when the temperature drops below 100°C. The aluminum top plate should be provided with sufficient air circulation. The thermal resistance of the top plate may be decreased by a factor of three or greater by simply blowing air of sufficient velocity over the top plate.

INPUT/OUTPUT CONFIGURATIONS

The amplifier can be supplied as any one of four of the following configurations:

RESOLVER INPUT	*RESOLVER OUTPUT*
SIN/COS	$E_{S1-S3} = KE(SIN)\Theta$ $E_{S4-S2} = KE(COS)\Theta$

RESOLVER INPUT	*SYNCHRO OUTPUT*
SIN/COS	$E_{S1-S3} = KE(SIN)\Theta$ $E_{S2-S3} = KE(SIN)(\Theta+120°)$ $E_{S1-S2} = KE(SIN)(\Theta+240°)$

SYNCHRO INPUT	*RESOLVER OUTPUT*
S1-S2-S3	$E_{S1-S3} = KE(SIN)\Theta$ $E_{S4-S2} = KE(COS)\Theta$

SYNCHRO INPUT	*SYNCHRO OUTPUT*
S1-S2-S3	$E_{S1-S3} = KE(SIN)\Theta$ $E_{S2-S3} = KE(SIN)(\Theta+120°)$ $E_{S1-S2} = KE(SIN)(\Theta+240°)$

Where: K = output voltage/input voltage
E = input voltage
θ = synchro/resolver shaft angle

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SPECIFICATIONS

Parameter	Value
Accuracy[1]	
Passive (CT CDX RC RD)	±4 arc minutes
Active (TR)	±12 arc minutes
Analog Inputs	
Synchro (S1-S2-S3)[2]	11.8Vrms L-L 400Hz @ 100KΩ
	90.0Vrms L-L 400Hz @ 600KΩ
Resolver (SIN/COS)[3]	11.8Vrms 400Hz @ 100KΩ
Analog Outputs[4]	
Synchro (S1-S2-S3)	11.8Vrms L-L 400Hz @ 3Ω
	90.0Vrms L-L 400Hz @ 130Ω
Resolver (S1-S2-S3-S4)	11.8Vrms 400Hz @ 3Ω
Output Loading	
11.8V Output	
CT CDX RC RD	28Ω min. (Zso)
TR	3Ω min. (Zss)
90V Output	
CT CDX RC RD	1620Ω min (Zso)
TR	130Ω min. (Zss)
Power Supply Reqt.	
Voltage	±15Vdc ±5%
Current	60mA + load
Peak Current	2A
Temperature Ranges	
Operating	0° to 70°C
Storage	-55° to +125°C

NOTES:

1. Accuracy applies for:
   (a) ±5% power supply voltage variation.
   (b) ±10% signal amplitude variation.
   (c) ±10% frequency variation.
   (d) 10% signal harmonic distortion.
   (e) any balance load no load to full load.
   (f) over operating temperature range.
2. Synchro input is solid state Scott T, common mode voltages up to specified L-L voltage have no effect on operation.
3. Resolver input is solid state differential, SIN/COS returns are to be connected to the COM pin. Do not connect COM to GND
4. Synchro and resolver outputs are transformer isolated. Transformation ratio accuracy is ±2%.

POWER SUPPLIES

The short circuit current of the175A600is 2A maximum. The ±15Vdc power supplies should be capable of 2A peaks. On power-up instantaneous 2A peaks can occur.The absence any one of the supply voltages will not cause damage or excessive current flow from the other supply.

DRIVING TR LOADS

The amplifier is designed to drive synchro torque receivers (TR). The 175A600 can drive any 11.8V 400Hz TR whose Zss is greater than 3Ω or any 90V 400Hz TR whose Zss is greater than130Ω.The value of Zss can be obtained from the synchro manufacturers specification data sheet. If Zss is not specified it can be approximated from the specified rotor and stator resistances as follows:

Zss (11.8V) = stator resistance + (0.21)rotor resistance

Zss (90.0V) = stator resistance + (0.61)rotor resistance

In the null condition, when the 175A600 output angle equals the TR shaft angle theoretically no circulating currents will flow in the stator windings. However, at power-up large initial angular offsets between the amplifier output and the TR rotor shaft angle can occur. If this offset angle is to large the amplifier can't delivery enough current causing a hang-up condition known as "locked rotor" where the TR rotor shaft is not driven back to null but stalls at some other angle.The 175A600 prevents the possibility of this hang-up condition by employing a kick circuit that momentarily shifts its output by 90° when a sustained over-current condition exists. Without the kick circuit, larger drive currents would be required, therefore the kick circuit is an important asset in reducing the size of the synchro amplifier.

To determine the power required for an off null condition the following equation can be used:

$$VA = \frac{0.866(V_{LL})^2 \text{SIN}\frac{\Theta}{2}}{Z_{SS} + Z_{OUT}}$$

Where: V_{LL} = amplifier analog output voltage
Θ = offset angle
Z_{SS} = stator impedance, rotor shorted
Z_{OUT} = amplifier output impedance

Caution: Both synchro amplifier analog input signals and torque receiver reference excitation must be present otherwise large circulating currents will flow in the stator windings.

DRIVING CT AND CDX LOADS

When driving CT and CDX loads the 175A600 must have enough steady state power capability to drive the Zso of the device. Generally a CT will be lightly loaded and the following equation can be used to calculate its VA requirement:

$$VA = \frac{0.866(E_{LL})^2}{Z_{SO}}$$

Where: E_{LL} = CT stator (primary) input voltage
Z_{SO} = CT stator input impedance

CT's are highly inductive loads and it is possible to save power by tuning such loads. Three capacitors may be placed across the legs of the CT in a delta configuration. The value of the capacitance is given by:

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

Where: C = capacitance in Farads
f = frequency in Hz
R = real component of Z_{SO}
X_L = reactive component of Z_{SO}

Relatively stable capacitors should be used and must be capable of withstanding the full AC voltage.

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

$$Z_{SO} = \frac{R^2 + (X_L)^2}{R}$$

The output of a CDX is often loaded with another synchro. Therefore when computing the VA requirement, both the CDX and its load impedance must be taken into account as follows:

$$VA = \frac{0.866(E_{LL})^2(Z_{SO} + Z_{SO'})}{Z_{SO} \times Z_{SO'}}$$

Where: E_{LL} = CDX stator (primary) input voltage
Z_{SO} = CDX stator input impedance
$Z_{SO'}$ = CDX load impedance

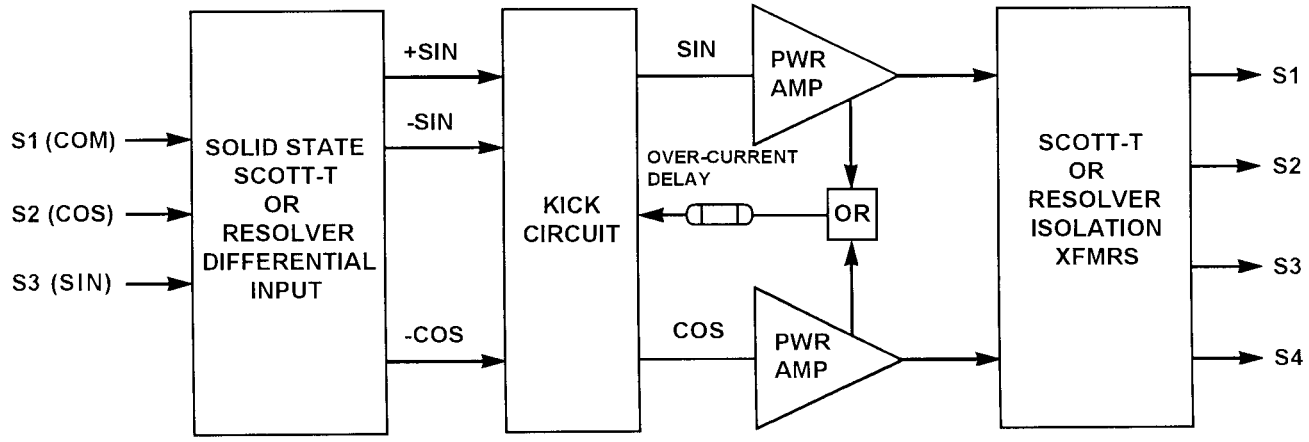
DRIVING RC AND RD LOADS

When driving resolver control transformers (RC) or resolver differentials (RD) the 175A600 must have enough steady state power capability to drive the input impedance (Zso) of the device. The following equation can be used to calculate their VA requirements:

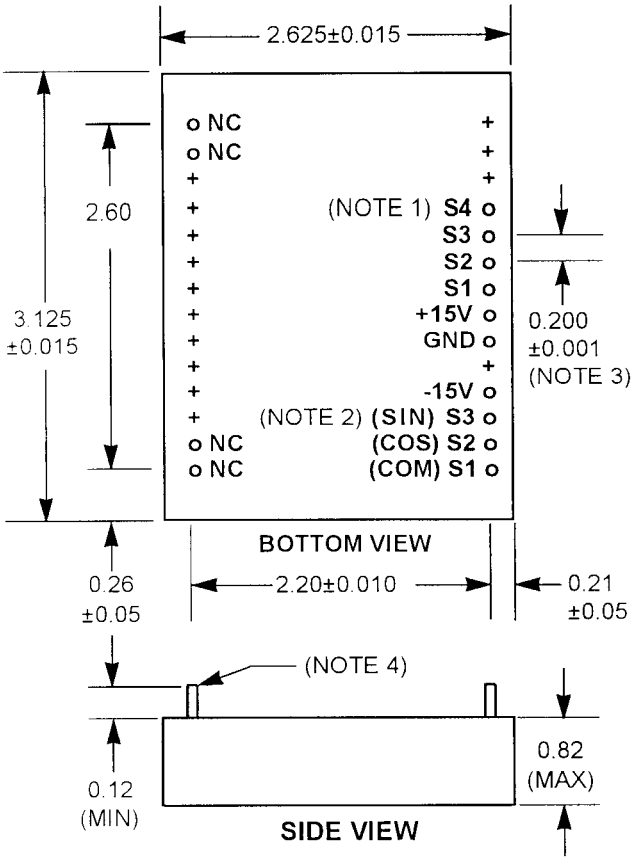
$$VA = \frac{1.41(E_{LL})^2}{Zso}$$

Where: E_{LL} = stator input (primary) input voltage
Z_{SO} = stator input impedance

BLOCK DIAGRAM



MECHANICAL OUTLINE



NOTES:
(1) Synchro/resolver output pins. S4 pin appears on resolver output models only.
(2) Synchro/resolver input pins. S1-S2-S3 designators are for synchro input models. SIN, COS and COM designators are for resolver input models.
(3) Non-cumulative.
(4) Rigid 0.040 diameter pins suitable for solder-in or plug-in applications.
(5) Dimensions are in inches.
(6) NC pins have no internal contact.
(7) Weight = 7.5oz.

ORDERING INFORMATION

175A SUFFIX	INPUT		OUTPUT		FREQ (HZ)
	TYPE	VOLTS	TYPE	VOLTS	
600	SYN	11.8V	SYN	11.8V	400HZ
601	SYN	11.8V	SYN	90.0V	
602	SYN	90.0V	SYN	11.8V	
603	SYN	90.0V	SYN	90.0V	
604	SYN	11.8V	RES	11.8V	
605	SYN	90.0V	RES	11.8V	
606	RES	11.8V	RES	11.8V	
607	RES	11.8V	SYN	11.8V	
608	RES	11.8V	SYN	90.0V	
609	RES	6.0V	SYN	11.8V	
610	RES	6.8V	SYN	11.8V	
611	RES	6.0V	SYN	90.0V	
612	RES	6.8V	SYN	90.0V	400HZ

NOTES:
(1) Standard temperature range is 0° to +70°C, add suffix IT to part number for (-25° to +85°C) temp. range.
(2) Other input/output voltages avialable on special order, consult factory.

WARRANTY

All units warranted against defects in materials and workmanship for 1 year from the date of shipment. Liability is expressly limited to servicing, adjusting or replacing any CSI product returned to our factory with delivery charges prepaid. In no case shall our liability exceed the original price.

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