



synchro/resolver angle position indicator auto-ranging

5 decade

AP-501



FEATURES

- Auto-ranging synchro and resolver inputs
- 47-3000Hz reference frequency range
- High, balanced input impedance
- 0.01° resolution/±0.03° accuracy
- Automatic phase shift compensation
- 0° to 359.99° and 0° to ±180.00° angle ranges
- Bright 0.56" LED display
- Binary and BCD outputs
- Diagnostic signals
- Universal AC input 85 to 265VAC, 47 to 440Hz
- Optional linear DC output

APPLICATIONS

- Antenna Range Instrumentation
- System Test
- Automatic Test Equipment

GENERAL DATA

The AP-501 is an auto-ranging synchro/resolver angle position indicator. Analog synchro or resolver position information is presented on a bright 5 digit LED display to an accuracy of ±0.03°. The display range can be selected to read either 0° to 359.99° or 0° to ±180.00°. A 3-state binary and BCD interface is available at a rear panel connector.

The heart of the AP-501 is a tracking type synchro/resolver to digital converter that incorporates a "reference synthesizer" required to maintain high accuracy even with large rotor to stator phase shifts. The unit employs ratiometric conversion techniques to provide signal amplitude insensitivity. A Type II servo loop is employed to ensure high-noise immunity and jitter-free operation.

The AP-501 incorporates many user-friendly features. The indicator is auto-ranging and operates over a frequency range of 47 to 3000Hz allowing for the measurement of all common synchros and resolvers. The indicator will warn the user of loss of reference excitation, loss of stator signals and excessive indicator error. A universal AC input, 85 to 265VAC at 47 to 440Hz, allows for usage virtually anywhere in the world.

FRONT PANEL CONTROLS

The AP-501 contains three front panel user controls: a Power ON/OFF switch, a Mode switch and a Range switch. The Power ON/OFF switch controls the AC line that powers the unit. The Mode switch configures the indicator to accept either synchro or resolver input voltages. The Range switch selects the display and BCD output for either 0° to 359.99° or 0° to ±180.00°.

SYNCHRO/RESOLVER INTERFACE

When in the Synchro mode, the convention for the inputs are as follows:

$$E_{S1-S3} = E_{RL-RH} \sin \theta$$

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

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

When in the Resolver mode, the convention for the inputs are as follows:

$$E_{S1-S3} = E_{RL-RH} \sin \theta$$

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

The synchro or resolver may be connected to the AP-501 via the front panel four-way binding posts or via the rear panel Synchro/Resolver connector. The indicator does not contain a reference excitation supply; therefore, an external AC reference source must be supplied to the RH-RL inputs.

DIAGNOSTIC SIGNALS

The AP-501 has its own built-in diagnostic circuitry that continuously monitors for the following fault conditions:

1. Excessive indicator error (FLT)
2. Loss of reference excitation (LOR)
3. Loss of stator signal voltage (LOS)

If any one of these conditions is sensed, the front panel decimal display is blanked and is replaced by fault designators, see figure 1. Certain fault conditions can cause multiple fault designators to be displayed. In that event, the probable fault is indicated by the left-most fault designator. Once the source of the fault is removed, the fault designators will automatically be replaced by the decimal display.

SPECIFICATIONS

Parameter	Value
Accuracy	±0.03°
Angular Range	
Unipolar	0° to 359.99°
Bipolar	0° to ±180.00°
Display	
Number of Digits	5 decimal digits
Size of Digits	0.56" high
Type and Color	7-segment red LED
Reference Input (RH-RL)	
Type	Auto-ranging
Voltage Range	
Resolver Mode	2-32Vrms
Synchro Mode	8-130Vrms
Frequency Range	47-3000Hz
Input Impedance	800KΩ
Stator Inputs (S1-S2-S3-S4)	
Input Type	Auto-ranging synchro/resolver
Voltage Range	
Resolver Mode	2-32Vrms
Synchro Mode	8-130Vrms L-L
Rotor/Stator Phase Shift	±50° max.
Input Impedance	
Resolver	500KΩ balanced
Synchro	250KΩ L-L balanced
Dynamic Characteristics	
Low Bandwidth	
Tracking Rate	900°/second
Ka	1,000
High Bandwidth	
Tracking Rate	1800°/second
Ka	35,000
Digital Inputs	
Type	TTL compatible
Loading	0.5 std. TTL loads max.
Inhibit	"0"=freeze "1"=track
Range	"0"=unipolar "1"=bipolar
Select	"0"=BCD "1"=binary
Bandwidth	"0"=low "1"=high
Output Control 1	"0"=D00-D07 "1"=Hi-Z
Output Control 2	"0"=D08-D15 "1"=Hi-Z
Output Control 3	"0"=D16-D23 "1"=Hi-Z
Digital Outputs	
Type	TTL compatible
Drive Capability	5 std. TTL loads max.
Binary Angle	16 bit positive logic
BCD Angle	5 decade positive logic plus sign
Sign	"0"=(+) "1"=(-)
Converter Busy	1-2µsecond positive pulse
Fault	"0"=normal "1"=excessive error
Loss of Reference	"0"=present "1"=absent
Loss of Stator Signals	"0"=present "1"=absent
DC Output (Optional)	
Unipolar	0 to +9.9994V for 0 to 359.99°
Bipolar	0 to ±5.0000V for 0 to ±180.00°
Resolution	0.022°
Accuracy	±0.1°
Power Input	
Voltage Range	85-265VAC
Frequency Range	47-440Hz
Power	10 watts
Operating Temp. Range	0° to +50°C

DIGITAL INPUTS

Inhibit

The Inhibit (INH) input is used to freeze the display, binary and BCD outputs. When INH is at logic "1" or open, the display and digital outputs track the synchro or resolver input; when at logic "0", they are latched.

Range

The Range (RNG) input is used to set the display and BCD output angle range. A logic "0" sets to unipolar range and a logic "1" sets to bipolar range. When using this input, set front panel RANGE switch to the ±180° position, leave input open for front panel control.

Bandwidth

The Bandwidth (BW) input is used to set the dynamic response of the AP-501. A logic "0" or open sets the unit to the low bandwidth and a logic "1" sets it to the high bandwidth. The unit employs a Type II servo loop converter; so as long as the maximum tracking rate is not exceeding, there will be no velocity lag and only minor acceleration lag at the binary output. Acceleration lag (in degrees) can be calculated from the following equation:

$$E_a = \frac{\text{Acceleration } (^\circ/\text{sec}^2)}{K_a}$$

See the chart below for the dynamic characteristics for the two bandwidths.

DYNAMIC CHARACTERISTICS				
BANDWIDTH	FREQ RANGE	MAX TRACKING	Ka	SETTLING TIME*
LOW	47-3000Hz	2.5rps	1,000	2.5sec
HIGH	360-3000Hz	5.0rps	35,000	200msec

*Settling time for 179° step

Select

The Select (SEL) input places either binary or BCD data on the D00-D23 digital output lines, see figure 2. A logic "0" selects BCD data and a logic "1" or open selects binary data.

Output Control

The Output Control lines (OC1, OC2 and OC3) are used to select the three byte outputs: D00-D07, D08-D15 and D16-D23, see figure 2. A logic "0" enables the corresponding byte output and a logic "1" or open places the outputs in the high impedance state.

DIGITAL OUTPUTS

The AP-501 provides 24 3-state output data lines that can be configured as a single word or any combination of 8 bit bytes. See Truth Table, figure 2, for configuration.

Binary/BCD Outputs

Either a 16 bit parallel binary angle or a 5 decade parallel BCD angle can be selected. The binary angle is a real time word and may be transferred reliably at synchro/resolver rotational rates of up to specified maximum tracking.

A simple method of synchronously transferring data is to: a) set INH to logic "0", b) wait 2µsec minimum, c) transfer binary data and d) set INH to logic "1". Asynchronous loading is accomplished by transferring the data on the trailing edge of the CB pulse.

The BCD angle output has a sampling rate of 16 samples a second minimum. This output is only useful for static readings or for driving remote displays.

Fault

The synchro/resolver to digital converter is continuously monitored for proper operation. If a converter failure or over-velocity condition is detected, the Fault (FLT) output is set to logic "1".

Loss of Reference Excitation

The reference excitation input is also monitored. When the reference excitation is present, the LOR output is a logic "0". If the reference is not present, the LOR output will be a logic "1".

Loss of Stator Voltage

The stator input signals are monitored and when the signals are present, the LOS output is a logic "0". If these signals are not present, the LOS output will be a logic "1".

CALIBRATION

It is recommended calibration be checked once a year. A Calibration Test Procedure will be furnished upon request.

DISPLAY FAULT DESIGNATORS

FIGURE 1



TRUTH TABLE

FIGURE 2

OUTPUT	SELECT		OC1		OC2		OC3	
	L	H	L	H	L	H	L	H
D00	0.01°	0.005°	EN	Z	X	X	X	X
D01	0.02°	0.011°	EN	Z	X	X	X	X
D02	0.04°	0.022°	EN	Z	X	X	X	X
D03	0.08°	0.044°	EN	Z	X	X	X	X
D04	0.1°	0.088°	EN	Z	X	X	X	X
D05	0.2°	0.176°	EN	Z	X	X	X	X
D06	0.4°	0.352°	EN	Z	X	X	X	X
D07	0.8°	0.703°	EN	Z	X	X	X	X
D08	1°	1.406°	X	X	EN	Z	X	X
D09	2°	2.812°	X	X	EN	Z	X	X
D10	4°	5.625°	X	X	EN	Z	X	X
D11	8°	11.25°	X	X	EN	Z	X	X
D12	10°	22.50°	X	X	EN	Z	X	X
D13	20°	45.00°	X	X	EN	Z	X	X
D14	40°	90.00°	X	X	EN	Z	X	X
D15	80°	180.0°	X	X	EN	Z	X	X
D16	100°	"0"	X	X	X	X	EN	Z
D17	200°	"0"	X	X	X	X	EN	Z
D18	SIGN	CB	X	X	X	X	EN	Z
D19	FLT	FLT	X	X	X	X	EN	Z
D20	LOR	LOR	X	X	X	X	EN	Z
D21	LOS	LOS	X	X	X	X	EN	Z
D22	"0"	"0"	X	X	X	X	EN	Z
D23	"0"	"0"	X	X	X	X	EN	Z

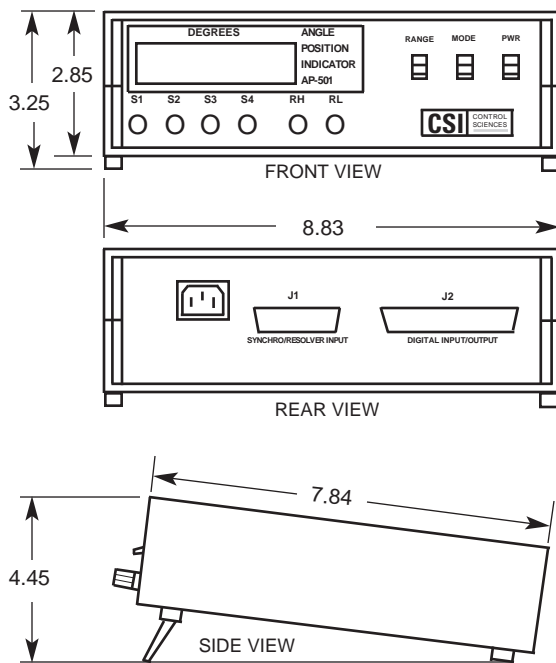
H=high level
L= low level
X=irrelevant
Z=hi-impedance
EN=enabled
"0"=logic 0

PIN ASSIGNMENTS

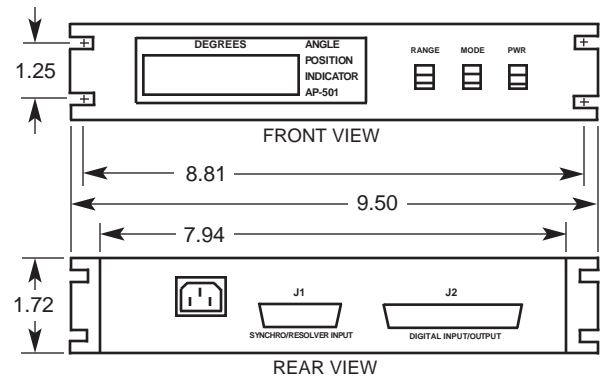
SYNCHRO/RESOLVER INPUT J1	
PIN#	FUNCTION
1	S1
2	S2
3	S3
4	S4
5	RH
6	RL

DIGITAL INPUT/OUTPUT J2					
PIN#	FUNCTION	PIN#	FUNCTION	PIN#	FUNCTION
1	N/C	14	D19	27	OC1
2	GND	15	D17	28	D09
3	GND	16	D22	29	D11
4	D01	17	D21	30	D13
5	D03	18	D20	31	D15
6	D04	19	INH	32	D18
7	D05	20	DC Out	33	OC3
8	D07	21	GND	34	D16
9	D08	22	D00	35	D23
10	D10	23	D02	36	BW
11	D12	24	RGN	37	AGND
12	D14	25	SEL		
13	OC2	26	D06		

MECHANICAL OUTLINE



BENCH TOP CONFIGURATION



HALF RACK CONFIGURATION

NOTES:

1. Dimensions are in inches.
2. J1 is a DA-15P type connector with jack nuts.
3. J2 is a DC-37P type connector with jack nuts.
4. Units supplied with mating connectors and power cord.
5. Weight: 2.63 lbs. max.

ORDERING INFORMATION

AP-501 X X - X X

- Options
- DC = Optional DC output
- Mechanical Configuration
- BT = Bench top version
- HR = Half rack version

WARRANTY

All units are 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 purchase price.