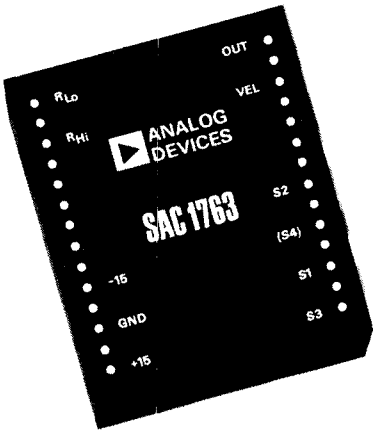
ANALOG DEVICES

Synchro to Linear D.C. Converter

SAC 1763

FEATURES
High Dynamic Performance (13,000°/sec)
Tracking Conversion Loop (Noise Immunity)
Internal Micro Transformers (50Hz or 400Hz)
12 Bit Resolution ±11 Arc Minutes Accuracy
±10V Output at 5mA
Low Output Ripple (<5mV p-p)
Analog Voltage Proportional to dθ/dt



DESCRIPTION

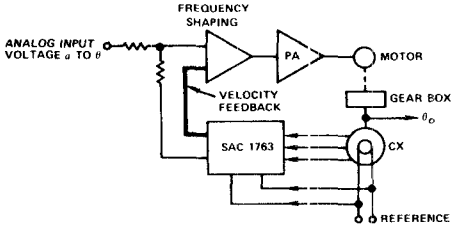
The SAC 1763 is a synchro to linear dc converter; it takes input angular information in synchro or resolver form voltages and gives an output voltage which is linearly proportional to the input angle. The output voltage of ±10V at ±5mA represents an input angular change of ±180° of the synchro or resolver format signals applied to the converter input. An additional voltage proportional to dθ/dt is provided for control loop applications.

Options are available for all the standard line to line voltages and frequencies for either synchro or resolver inputs. These options together with commerical or extended temperature ranges are determined by a code following the type number (see ordering information). An important feature of the SAC 1763 series converters is that no external transformer modules are required; the transformer isolation and conversion to resolver form is carried out by microtransformers which are inside the converter module *even for the 60Hz versions.*

The conversion is carried out by the use of a tracking synchro to digital converter followed by a precision DAC. The high dynamic performance of the internal tracking converter with an acceleration of 10,000° per second^2 (400Hz version) for only 5 arc minutes additional error makes the converter suitable for precision measurement and control applications.

The static overall accuracy of the SAC 1763 is ±11.0 arc minutes with a termperature coefficient of <0.2 arc minutes per degree C.

Applications of the SAC 1763 are in measurement and control of angular movement usually but not necessarily where the total excursion of angle is ±180° or less. In measurement the output may feed into an X-Y plotter of FM recorder, etc. The diagram shows the SAC 1763 being used inside an angular control loop where the input is a dc voltage representing the angle. The availability of the velocity voltage eliminates the need for a tacho generator for stabilization.



Analog to Shaft Angle Using the SAC 1763

CONNECTING PINS AND THEIR FUNCTIONS

The electrical connections to the SAC 1763 are by means of hard gold plated brass pins of length 0.2" (5.08mm) and 0.040 ±0.001 in diameter (1.016mm ±0.25mm). The electrical function and marking of the pins in the order in which they occur on the module are as below.

OUT
This pin provides the output voltage of ±10V representing ±180°. The current available is ±5mA. The output common is the GND pin.

VEL
This pin provides the voltage output which is proportional to velocity. The scale of the differential velocity voltage is ±10.0V for dθ/dt max of the option. The VEL pin increases in voltage, i.e., goes positive for a counter clockwise rotation of the synchro as viewed from the shaft end and reduces in voltage for a clockwise rotation. The output impedance of the pins is 1Ω and the max current which can be provided is 1mA from either pin.

S2, S4, S1, S3
These pins are for the synchro or resolver form input signals. Pin S4 is omitted for synchro versions. The input voltages will be either 90 or 11.8V line to line at frequencies of 60 or 400Hz according to the option. The connection data is given overleaf. The input impedance is resistive and is 200kΩ line to line for the 90V option, and 26kΩ line to line for the 11.8V options.

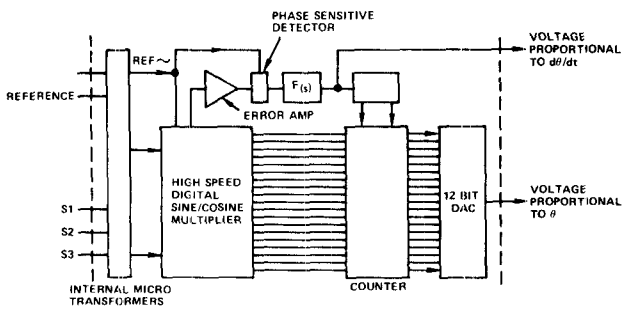
R_{Lo}, R_{Hi}
These pins are for the reference input voltages which will be at either 115V or 26V line to line at either 60 or 400Hz according to option. The input impedance is resistive and is 200kΩ line to line for the 115V option and 45kΩ line to line for the 26V option.

SPECIFICATIONS (typical @ +25°C unless otherwise noted)

Accuracy* (maximum error)	±11 Arc Minutes
Resolution	1 Part in 4096
Analog Output	±10V @ ±5mA
Drift (maximum)	0.2 Arc Minutes per Degree C
Ripple and Noise	< 5mV p-p
Signal and Reference Frequency	60Hz and 400Hz
Signal Voltage	90V Line to Line or 11.8V Line to Line
Signal Impedances	90V–200kΩ 11.8V–26kΩ
Reference Voltages	115V (90V Signal) 26V (11.8V Signal)
Reference Impedances	270kΩ High Level 56kΩ Low Level
Transformer Isolation	500V dc
Synchro Input Rates (For Full Accuracy)	60Hz Version 5 Revolutions/Second 400Hz Version 36 Revolutions/Second
Acceleration (Minimum for Additional Error Less Than 6 Arc Minutes)	60Hz Version 200°/Second/Second 400Hz Version 10,000°/Second/Second
Velocity Voltage	±10V for ± Velocity Maximum of the Option
Power Supply Requirements	+15V @ 100mA Voltages ±5% -15V @ 25mA
Power Dissipation	1.9W (Maximum)
Operating Temperature Range	0 to +70°C Standard -55°C to +105°C Extended
Storage Temperature	-55°C to +125°C
Dimenstions	3.125" x 2.625" x 0.8" (79.4mm x 66.7mm x 20.3mm)
Weight	7ozs (200 grams)

*NOTE: Accuracy for:
(a) ±10% signal and reference amplitude variation
(b) 10% signal and reference harmonic distortion
(c) ±5% power supply variation

Specifications subject to change without notice.



Functional Diagram of the SAC 1763, Synchro to dc Converter

-15, GND +15V

These are the power line pins for the +15V, -15V power supplies; the voltage should be ±15V ±5%. The currents taken are 100mA on the +15V supply and 25mA on the -15V supply. The power lines must not be reversed. The GND pin is also the common pin for the output voltage.

OPERATION

The electrical connections are straight forward; the power lines (which must not be reversed) are connected to the +15 and -15 lines with the common connection to the ground pin GND. The analog output voltage representing the digital angle is between the pin OUT and GND. ±10V corresponding to ±180°, up to 5mA may be taken from the OUT pin. The analog voltage proportional to the rate of change of angle is provided between the pins VEL and GND. The variation is ±10.0V for the maximum velocity of the option.

Input connection is made to the pins S1, S2, S3, S4, R_{Hi} and R_{Lo} (S4 is not used for synchro inputs). The convention for the connections is as follows:

Synchro Connection

$E_{S1-S3} = E_{RLo-RHi} \sin \omega t \sin \theta$
$E_{S3-S2} = E_{RLo-RHi} \sin \omega t \sin (\theta + 120)$
$E_{S2-S1} = E_{RLo-RHi} \sin \omega t \sin (\theta + 240)$

Resolver Connection

$E_{S1-S3} = E_{RLo-RHi} \sin \omega t \sin \theta$
$E_{S2-S4} = E_{RHi-RLo} \sin \omega t \cos \theta$

Since the SAC 1763 uses a tracking converter with a very fast response it will often be used inside control loops. For these applications it will be useful to know the transfer function connecting the output voltage representing angle to the input synchro angle. The transfer function for the 400Hz option is:

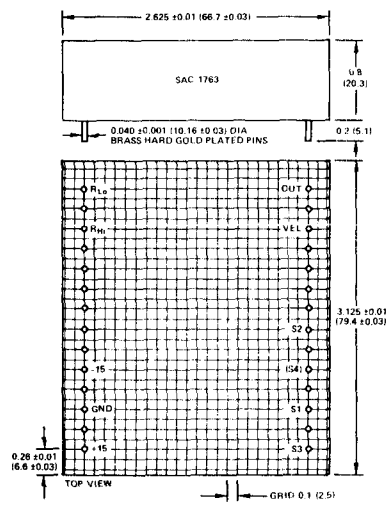
$$\frac{\overline{\theta}_0}{\overline{\theta}_1} = \frac{1655\ (1 + 4.7 \times 10^{-3} S)}{1.03 \times 10^{-5} S^3 + 1.25 \times 10^{-2} S^2 + 7.78S + 1655}$$

and for the 60Hz version the transfer function is:

$$\frac{\overline{\theta}_0}{\overline{\theta}_1} = \frac{229\ (1 + 3.0 \times 10^{-2} S)}{4.5 \times 10^{-4} S^3 + 8.3 \times 10^{-2} S^2 + 6.88S + 229}$$

OUTLINE DIMENSIONS

Dimensions shown in inches and (mm).



ORDERING CODE

The SAC 1763 type number is followed by a code defining the temperature range, frequency and voltage options, i.e.,
SAC 1763/XYZ
where X, Y and Z are replaced by numbers which define the variation. The permissible options for the SAC 1763 are:

X = 5 signifiying 0 to +70°C operation
X = 6 signifying -55°C to +105°C operation
Y = 1 signifying 400Hz operation
Y = 2 signifying 60Hz operation
Z = 1 signifies Synchro signal 11.8V, reference 26V
Z = 2 signifies Synchro signal 90V, reference 115V
Z = 8 signifies Resolver signal 11.8V, reference 26V

For other than these options consult the factory.