

## description

### 1. INTRODUCTION

The 479S-6A VOR/ILS Signal Generator is a solid-state VOR/ILS signal generator. The signal generator produces both rf and audio signals for use in testing VOR, localizer, glideslope, marker beacon, and vhf communications receivers. Refer to figure 1.

There are four statuses of 479S-6A VOR/ILS Signal Generator, CPN 622-4127-XXX (refer to the following chart).

479S-6A STATUSES			
STATUS	REMOTE TUNE	STORE/RECALL	IEEE-488/1978
001	X		
002	X	X	
003	X	X	X
004	X		X

Unless noted otherwise, all information in this instruction book is applicable to all four statuses.

The following nonstandard abbreviations are used throughout this instruction book:

#### ABBREVIATION

#### DEFINITION

COMP

Composite

CPU

Central processing unit

dBc

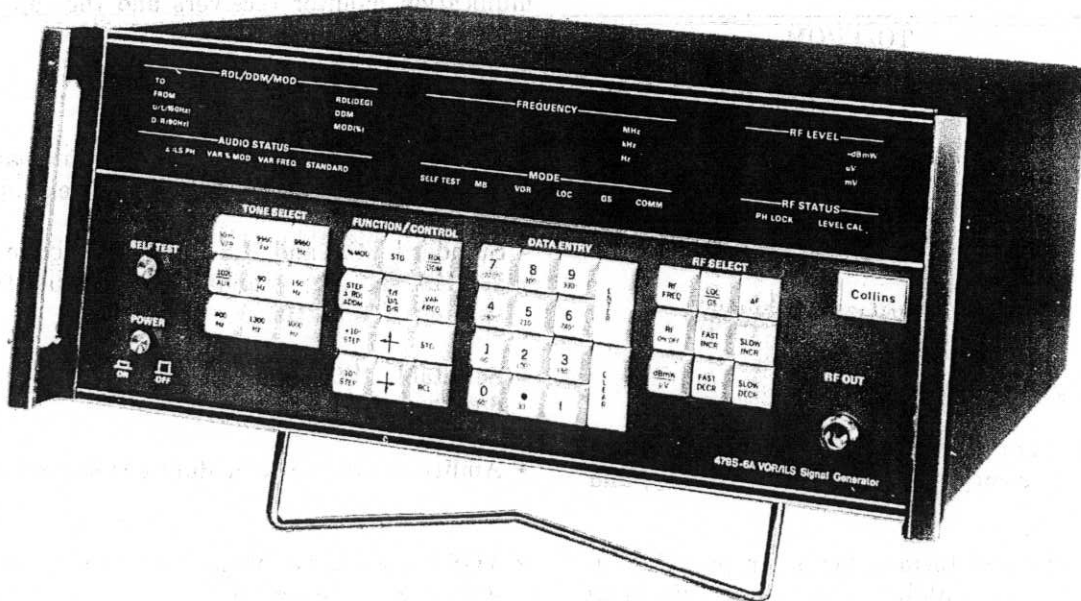
Decibel below carrier

D/R

Down/right

DDM

Difference in depth of modulation



TP5-5333-017

479S-6A VOR/ILS Signal Generator  
 Figure 1

DEG	Degree
DEM0D	Demodulation
GS	Glideslope
LSB	Least significant bit
MB	Marker beacon
MOD	Modulation
MSB	Most significant bit
PCB	Printed circuit board
ROM	Read only memory
PROM	Programmable read only memory
EPROM	Erasable programmable read only memory
RSVD	Reserved
TCXO	Temperature-compensated crystal oscillator
T/F	TO/FROM
TI	Test instrument
U/L	Up/left
VCXO	Voltage controlled crystal oscillator
$\Delta F$	Variable frequency

## 2. DESIGN FEATURES

- Microprocessor control and keyboard entry providing efficiency, versatility, adaptability, and convenience.
- Digital audio waveform synthesizer provides increased accuracy, stability, and longer calibration intervals.
- Synchronous detection and advanced design modulation loop generates precise, stable modulation levels.

- Low-noise rf frequency synthesizer allows accurate selectivity measurements.
- Extended life, digitally controlled attenuator.
- Preset operation for convenience and time-saving test setups.
- Complete digital readout of test parameters.
- Microstrip rf modulator.
- Automatic channel programming for receiver under test.
- Automatic processor memory check upon power-up or operator-controlled self-test.
- Built-in programmable audio oscillator.
- Optional growth features add stored programming and/or remote programming (IEEE 488) capability.

## 3. PURPOSE OF EQUIPMENT

The 479S-6A VOR/ILS Signal Generator produces all required audio modulation and rf carrier signals to test and troubleshoot VOR, ILS, and marker beacon receivers. It can also provide test signals for vhf communication monitor receivers and the receiver portions of vhf communication transceivers.

## 4. OPERATIONAL CAPABILITIES

- Preset condition sets signal generator parameters to standard outputs for selected mode of operation.
- Standard VOR and ILS localizer frequencies with 50-kHz spacing; standard glideslope frequency spacing of 150 kHz.
- Selectable VOR radials from 000.00 to 359.99 degrees.
- Ability to externally modulate rf section of the unit.
- VOR radial adjustable in +30, +10, -10, +0.01, and -0.01-degree increments.
- Preset 1020-Hz audio tone for identification signal.
- Programmable audio signal with a 30-Hz to 14-kHz range.

- Variable rf output level to check receiver sensitivity.
- Variable rf frequency to check receiver selectivity.
- Variable percent modulation to check receiver response.
- Variable DDM in 0.001 increments.
- Standard localizer and glideslope rf frequency pairings.
- Single key provides switching between localizer and glideslope paired frequencies and vice versa.
- Standard marker beacon frequency of 75.000 MHz with provisions for simulation of interference-type rf frequencies from 74.6 to 75.4 MHz.
- Preset 400-Hz (outer marker), 1300-Hz (middle marker), and 3000-Hz (inner marker) marker beacon audio tones.
- Remote tune output for automatic channel programming of receiver under test.
- Mode discrete outputs provide antenna switching and mode select/disable logic.
- Timing trigger output pulse coincident with any front panel keystroke for making time response measurements.
- Vhf-COMM receiver frequencies from 118.000 to 151.975 MHz with 25-kHz spacing.
- Functionally grouped controls and displays.
- 115/230-V, 50/60-Hz input power capability.

## 5. SPECIFICATIONS

Table 1 is a list of the specifications for the 479S-6A VOR/ILS Signal Generator.

## 6. CIRCUIT CARD AND MODULE ASSEMBLY LOCATION (Refer to figure 2.)

The signal generator major subassemblies are: front panel assembly A1, controller/audio assembly A2, rf modulator assembly A3, synthesizer assembly A4, power supply assembly A5, chassis assembly A6, backplane assembly A7, and remote tune assembly A8.

The -002 status contains an A9 store/recall assembly, and the -003 status contains the A9 plus an A10 IEEE-488/1975 interface assembly.

Front panel assembly A1 consists of driver board assembly A1A1 and display board assembly A1A2. Controller/audio assembly A2 consists of CPU board assembly A2A1, analog board assembly A2A2, and TDM board assembly A2A3. Rf modulator assembly A3 consists of rf strip-line assembly A3A1, demodulator/ALC board assembly A3A2, and counter-I/O board assembly A3A3. Synthesizer A4 consists of divider board and filter assembly A4A1, output amplifier board assembly A4A2, vco assembly A4A3, and tcxo assembly A4A4. Power supply assembly A5 consists of power supply terminal board assembly A5A1, power supply PCB assembly A5A2, heat sink assembly no 1 A5A3, heat sink assembly no 2 A5A4, and a blower. Chassis assembly A6 contains the interconnect wiring harness and a digitally controlled attenuator.

The front panel contains the switches, keyboard, displays, and type N coaxial connector required for operation of the signal generator and connection of receivers to be tested.

The rear of the signal generator contains a COMP BNC coaxial connector, an AUX BNC coaxial connector; a DEMOD BNC coaxial connector, an EXT MOD BNC coaxial connector; a REMOTE TUNE connector; an IEEE-488/1975 PROGRAM I/O connector; fuse F1; a 115/230-V ac, 50/60-Hz connector, and an input power identification plate.

## 7. 115/230-VOLT AC, 50/60-Hz OPERATION

Although the signal generator is shipped from the factory wired for 115-V ac, 50/60-Hz input power operation, the power transformer input wiring can be changed to provide 230-V ac, 50/60-Hz operation. If it is required to change to 230-V ac operation, refer to the maintenance section for disassembly and wiring changes required.

## 8. BLOCK DIAGRAM THEORY OF OPERATION (Refer to figure 3.)

### 8.1 General

The 479S-6A VOR/ILS Signal Generator is a microprocessor-controlled signal generator that produces audio-modulated rf signals and ARINC 410 2-of-5 tuning data. The rf output signals are used to test and troubleshoot VOR, localizer, glideslope,

Table 1. Equipment Specifications.

CHARACTERISTIC	SPECIFICATION
Physical and mechanical specifications	
Weight	19.95 kg (44 lb)
Dimensions	
Width	445 mm (17.5 in)
Height	178 mm (7.0 in)
Length	508 mm (20.0 in)
Connectors	
Front panel	
RF OUT	Type N, female
Rear panel	
AUX, DEMOD, COMP, and EXT MOD	Type BNC, female
REMOTE TUNE	37-pin dual-row Cannon type D
IEEE-STD 488/1978 PROGRAM I/O	Chassis connector per IEEE standard 448-1978
Cooling requirements	Internal blower
Environmental specifications	
Temperature	
Operating	+10 to +40 °C (+50 to +104 °F)
Storage	
-001	-20 to +85 °C (-4 to +185 °F)
-002/-003	-20 to +70 °C (-4 to +158 °F)
Humidity	<95%, relative
Electrical specifications	
Power requirements	
Voltage	115/230 V ac, ±10%
Frequency	47 to 63 Hz
Power	300 VA, maximum
Warmup time	30 min, maximum, for specified performance
Rf outputs	
Frequencies	
VOR/LOC	108.00 to 117.95 MHz, selectable in 50-kHz steps

Table 1. Equipment Specifications (Cont).

CHARACTERISTIC	SPECIFICATION
Glideslope (GS)	329.00 to 335.00 MHz, selectable in 150-kHz steps
Marker beacon	75.0 MHz fixed, 74.6 to 75.4 MHz, selectable in 25-kHz steps
Vhf communication	118.000 to 151.975 MHz, selectable in 25-kHz steps
Frequency vernier	Capable of varying selected output frequency up to $\pm$ one channel, all bands
Frequency resolution	Fixed, 1 kHz; vernier, 100 Hz
Frequency accuracy (fixed mode)	$< \pm 2$ ppm, (+10 to +40 °C (+50 to +104 °F)), including aging
Output level	
Range	
dB mW	-6 to -120 dB mW, variable in 1-dB increments
Voltage	112 mV to 0.22 $\mu$ V, variable in 1-dB increments
Accuracy	
<b>Note</b>	
The following parameters apply to the marker beacon, VOR/LOC, and glideslope bands. Performance over the 118.000- to 151.975-MHz vhf communication band may be somewhat degraded.	
-6 to -60 dB mW	$\pm 1.5$ dB
-60 to -120 dB mW	$\pm 2.0$ dB
Vswr	$< 1.5:1$
External attenuation	Not required; microvolt output is "hard microvolts" and eliminates 6-dB external attenuation requirement
Spectral purity	
<b>Note</b>	
The following parameters apply to the marker beacon, VOR/LOC, and GS bands. Performance over the 118.000- to 151.975-MHz vhf communication band may be somewhat degraded with respect to the VOR/LOC band specifications.	

Table 1. Equipment Specifications (Cont).

CHARACTERISTIC	SPECIFICATION
Harmonics	
VOR/LOC marker beacon	>30 dB below carrier
Glideslope	>25 dB below carrier
Spurious signals (excluding frequencies within $\pm 15$ kHz of carrier)	>80 dB below carrier
Broadband noise (SSB)	
	<b>Note</b>
	Broadband noise is specified in units of "dBc/Hz"; dBc/Hz = dB below carrier level measured in a 1-Hz noise bandwidth.
74.60 to 75.40 MHz (marker beacon)	>115 dBc/Hz >40 kHz from carrier
108.00 to 117.95 MHz (VOR/LOC)	>111 dBc/Hz >15 kHz from carrier >117 dBc/Hz >30 kHz from carrier >122 dBc/Hz >40 kHz from carrier
329.00 to 335.00 MHz (GS)	>112 dBc/Hz >50 kHz from carrier >119 dBc/Hz >80 kHz from carrier >122 dBc/Hz >120 kHz from carrier
VOR mode	
Modulation tones	
Frequencies	
Preset	30-Hz reference, 30-Hz variable, 9960-Hz, and 1020-Hz ident
Variable	
30-Hz variable, 30-Hz reference, 9960 Hz	Tones variable simultaneously +5%. Resolution of the 30-Hz tones is 0.1 Hz. The 9960-Hz signal varies proportionally.
Aux audio	Variable from 30 Hz to 14 kHz (0.1-Hz steps from 30 Hz to 1 kHz, 1.0-Hz steps from 1 kHz to 14 kHz)
Frequency accuracy, preset, and variable	$\pm 0.005\%$
Distortion (audio)	
Preset mode (30% modulation per tone)	
30-Hz reference and 30-Hz variable	<0.25%
9960 Hz and 1020 Hz ident	<0.5%
Aux audio	<1.0%

Table 1. Equipment Specifications (Cont).

CHARACTERISTIC	SPECIFICATION
Variable mode (5 to 35% modulation per tone)	
30-Hz variable	<1.0%
9960 Hz	<1.5%
Aux audio	<2.0%
9960-Hz FM deviation	480 $\pm$ 2-Hz peak
Radial range	000.00 to 359.99 degrees (selectable at each 30-degree heading or in 0.01-degree increments, variable in preset steps of +30 degrees, $\pm$ 10 degrees, and $\pm$ 0.01 degree)
Radial accuracy	
0°	$\pm$ 0.01 degree (settable to $\pm$ 0.005 degree)
Tracking (000.00 to 359.99°)	$\pm$ 0.01 degree referenced to 0-degree reading
	<div style="border: 1px solid black; padding: 2px; display: inline-block; text-align: center;"><b>Note</b></div> Audio radial accuracy is referenced to accuracy of standard used in calibration.
Amplitude modulation	
Range (per tone)	
1020-Hz ident	30% fixed
30-Hz variable, 9960-Hz	Preset at 30%, variable 5 to 35% in 0.1% increments
Aux audio (30 Hz to 14 kHz)	Preset at 30%, variable 5 to 35% in 0.1% increments
Accuracy	
1020 Hz (fixed at 30%)	$\pm$ 2.5% of indication
30-Hz variable, 9960-Hz	
Preset	$\pm$ 2.5% of modulation
Variable (5 to 35%)	$\pm$ 5% of indication
Aux audio	
Preset	$\pm$ 5% of indication
Variable (5 to 35%)	$\pm$ 7% of indication
Tone distortion (rf)	
Preset (30% modulation)	
30-Hz variable	<1.0%

Table 1. Equipment Specifications (Cont).

CHARACTERISTIC	SPECIFICATION
1020-Hz ident	<1.0%
9960 Hz	<1.5%
Aux audio (30 Hz to 14 kHz)	<2.0%
Variable (5- to 35-% modulation)	
30-Hz variable	<1.5%
9960 Hz	<2.0%
Aux audio (30 Hz to 14 kHz)	<3.0%
Total VOR demodulated error	< $\pm 0.05$ degree of selected radial (referenced to accuracy of standard used in calibration)
Localizer mode	
Modulation tones	
Frequencies	
Preset	90-Hz, 150-Hz, and 1020-Hz ident
Variable	
90/150 Hz	Both tones variable simultaneously $\pm 5\%$ in 0.1-Hz increments
Aux audio	Variable from 30 Hz to 4 kHz (0.1-Hz steps from 30 Hz to 1 kHz, 1.0-Hz steps from 1 to 4 kHz)
Frequency accuracy	$\pm 0.005\%$
Distortion (audio)	
Preset mode	
90/150-Hz (20-% modulation per tone)	<0.25%
1020-Hz (30-% modulation)	<0.5%
Aux audio (30-% modulation)	<1.0%
Variable mode	
90/150-Hz (5 to 40-% modulation)	<1.0%
Aux audio (5 to 30-% modulation)	<1.5%
90/150-Hz phase	
Fixed	0.0 $\pm 1$ degree
Selectable	60 $\pm 2$ degrees



Table 1. Equipment Specifications (Cont).

CHARACTERISTIC	SPECIFICATION
	<div style="text-align: center; border: 1px solid black; padding: 2px; width: fit-content; margin: 0 auto 10px auto;">Note</div> <p>The 90- and 150-Hz waveforms pass through 0 in the same direction, with 0 or 60 degrees of phase relative to the 150-Hz component, every half-cycle of the combined 90- and 150-Hz waveform.</p>
Amplitude modulation	
Range (per tone)	
90 and 150 Hz	
Preset	20%
Variable	5 to 40% in 0.1-% increments
1020-Hz ident	30% fixed
Aux audio	
Preset	30%
Variable	5 to 30% in 0.1-% increments
Accuracy	
90 and 150 Hz	
Preset	±2.5% of indication
Variable	±5% of indication
1020-Hz ident	±2.5% of indication
Aux audio	
Preset	±5% of indication
Variable	±7% of indication
Tone distortion (rf)	
90 and 150 Hz	
Preset	<1.0%
Variable	<1.5%
1020-Hz ident	<1.0%
Aux audio	
Preset	<1.5%
Variable	<3.0%

Table 1. Equipment Specifications (Cont).

CHARACTERISTIC	SPECIFICATION
DDM	
Preset	0.000
Selectable settings	0.000, $\pm 0.046$ , $+0.093$ , $\pm 0.155$ , and $\pm 0.200$
Variable range	$\pm 0.400$ in 0.001-increments
Audio error	
On course	0.0001 DDM
Off course	0.0002 to 0.200 DDM 0.0002 $+0.05\%$ DDM from 0.201 to 0.375 DDM 0.25% DDM maximum from 0.376 to 0.400 DDM
Total system error (audio + modulation)	
On course	0.00056 DDM
Off course	0.00056 DDM + 2.5-% DDM
Glideslope mode	
Modulation tones	
Frequencies	
Preset	90 Hz and 150 Hz
Variable	
90/150 Hz	Both tones variable simultaneously $\pm 5$ percent in 0.1-Hz increments.
Aux audio	Variable from 30 Hz to 4 kHz (0.1-Hz steps from 30 Hz to 1 kHz, 1.0-Hz steps from 1 to 4 kHz)
Frequency accuracy	$\pm 0.005\%$
Distortion (audio)	
Preset mode	
90/150 Hz (40-% modulation per tone)	$< 0.25\%$
Aux audio (30-% modulation)	$< 1.0\%$
Variable mode	
90/150 Hz (10 to 80-% modulation)	$< 1.0\%$
Aux audio (10 to 60-% modulation)	$< 1.5\%$
90- and 150-Hz phase	
Fixed	0.0 $\pm 1$ degree
Selectable	60 $\pm 2$ degrees

Table 1. Equipment Specifications (Cont).

CHARACTERISTIC	SPECIFICATION
	<div style="border: 1px solid black; padding: 2px; display: inline-block;"><i>Note</i></div> <p>The 90- and 150-Hz waveforms pass through 0 in the same direction, with 0 or 60 degrees of phase relative to the 150-Hz component, every half-cycle of the combined 90- and 150-Hz waveform.</p>
Amplitude modulation	
Range (per tone)	
90 and 150 Hz	
Preset	40%
Variable	10 to 80% in 0.1-% increments
Aux audio	
Preset	30%
Variable	10 to 60% in 0.1-% increments
Accuracy	
90 and 150 Hz	
Preset	±2.5% of indication
Variable	±5% of indication
Aux audio	
Preset	±5% of indication
Variable	±7% of indication
Tone distortion (rf)	
90 and 150 Hz	
Preset	< 1.2%
Variable	< 3.0%
Aux audio	
Preset	< 2.0%
Variable	< 3.0%
DDM	
Preset	0.000
Selectable settings	0.000, ±0.045, ±0.091, ±0.175, and ±0.400
Variable range	±0.800 in 0.001-increments

Table 1. Equipment Specifications (Cont).

CHARACTERISTIC	SPECIFICATION
Audio error	
On course	0.0001 DDM
Off course	0.0002 DDM to 0.400 DDM 0.0002 DDM +0.05% DDM from 0.401 to 0.750 DDM 0.25 percent DDM maximum from 0.751 to 0.800 DDM
Total system error (audio + modulation)	
On course	0.00102 DDM
Off course	0.00102 DDM + 2.5% DDM
Marker beacon	
Modulation tones	
Frequencies	
Preset	
Outer marker	400 Hz
Middle marker	1300 Hz
Inner marker	3000 Hz
Variable	
Aux audio	Variable from 100 Hz to 4 kHz (0.1-Hz steps from 100 Hz to 1 kHz, 1.0-Hz steps from 1 to 4 kHz)
Frequency accuracy	±0.005%
Distortion (audio)	< 1%, preset and variable frequencies, 15- to 97-% modulation
Amplitude modulation	
Range	
400, 1300, and 3000 Hz	
Preset	95%
Variable	90 to 97% in 0.1-% increments
Aux audio	
Preset	95%
Variable	15 to 97% in 0.1-% increments

Table 1. Equipment Specifications (Cont).

CHARACTERISTIC	SPECIFICATION
Accuracy	
400, 1300, and 3000 Hz	
Preset	±5% of indication
Variable	±6.5% of indication
Aux audio	
Preset	±5.5% of indication
Variable	±7% of indication
Tone distortion	
Preset 400, 1300, and 3000 Hz	<4%
Aux audio	5% maximum
Vhf COMM	
Modulation tones	
Preset	1020 Hz
Variable	30 Hz to 10 kHz (0.1-Hz steps from 30 Hz to 1 kHz, 1.0-Hz steps from 1 to 10 kHz)
Frequency accuracy	±0.005%
Distortion (audio)	< 2.0%, preset 1020 Hz at 30%, variable frequencies from 5 to 35%
Amplitude modulation	
Range	
Preset 1020 Hz	30%
Variable 10 Hz to 10 kHz	5 to 35% in 0.1-% increments
External modulation	
Input impedance	5 k $\Omega$ minimum
Maximum modulation depth	90%
Modulation distortion	4% maximum
Modulation bandwidth	
Marker beacon	DC - 4 kHz
Localizer	DC - 4 kHz
Glideslope	DC - 4 kHz
VOR	DC - 15 kHz
Vhf COMM	DC - 15 kHz
Remote tune	
Tuning format	2-of-5 in accordance with ARINC 410
Selection method, tuning, and mode	Spst relay closure with maximum contact rating of 28 V dc at 100 mA
Timing trigger	TTL level positive pulse, coincident with any keystroke