SECTION 1

GENERAL INFORMATION

1.1 INTRODUCTION

This manual contains information on how to operate the Tel-Instrument T-36 and T-360 CAT III NAV/COMM test sets. The T-36 is a portable, battery/AC powered unit for use on the ramp or bench. The T-360 is identical to the T-36, except it is AC powered and is packaged for bench operation only.

All references to the T-36 in this manual will also apply to the T-360, except where specifically noted.

1.1.1 The T-36 is a precision simulator of VOR, ILS (LOC and GS), MB, and COMM ground stations. It is designed for either bench or ramp testing of avionics equipment. The T-36 is packaged in a MIL-T-28800 Style C case and is powered either by an internal NiCad battery pack or through an A/C line cord. A simple front panel change permits switching the input power from 115VAC to 220VAC. The T-360 is packaged in a MIL-T-2880, Style E or F case and is powered by 115 VAC to 220 VAC.

1.1.2 The VOR section permits radial bearing selection by a panel-mounted lever switch, in increments of 0.1 degree. An Ident Tone of 1020 Hz is also avialable with the VOR signal. VOR RF output levels may be varied with a calibrated output attenuator.

1.1.3 The LOC and GS sections use precision 90 and 150 Hz modulation generators to provide accurately mixed signals for "on-course" and specific "off-course" simulations. An Ident Tone of 1020 Hz is also available with the LOC signal. When the ILS operating mode is selected, both localizer and its paired glide-slope frequency are provided. All LOC and GS RF output levels may be varied with a calibrated output attenuator.

1.1.4 The MB section generates a 75 MHz signal which is tone modulated with 400, 1300, or 3000 Hz. A momentary switch provides simultaneous marker signals during LOC, GS, or ILS testing modes. MB RF output levels may be varied with a calibrated output attenuator

1.1.5 COMM frequencies from 118.000 to 151.975 MHz, in 25 KHz steps, are developed by an RF generator. Individual frequencies may be selected by panel-mounted lever switches. A 1020 Hz testing tone is provided as well as an optional external variable tone input. COMM RF output levels may be varied with a calibrated output attenuator.

1.1.6 In all modes of operation, the RF generator is crystal-controlled and phase locked in 25 KHz steps. In addition, GS and LOC variable frequency controls provide a full range of 90 and 150 Hz combinations.

1.2 SPECIFICATIONS

1.2.1 Signal Generator

Signal Types and Frequencies

Marker Beacon	75 MHz
VOR	108.000 to 117.950 MHz

Localizer	108.100 to 111.950 MHz
Glide Slope	(paired with Localizer channels) 329.150 to 335.000 MHz
ILS	(consists of Localizer, paired Glide Slope, and Marker Beacon)
Communications	118.000 to 151.950 MHz
Output Level	-10/-130 dBm (Bench), +15/-105 dBm (Ramp) in one dB steps

1.2.2 VOR

Bearing/Accuracy	0-359.9+/- 0.3 degrees
Bearing Resolution	0.1 degree
Ident Tone	1020 Hz (switch selectable)
Depth of Modulation	30 Hz: 29-31%, 9960 Hz: 29-31%, 1020 Hz: 9-11%; all ±1%

1.2.3 Localizer DDM's (Left and Right)

0.000, 0.093, 0.155, 0.200, 1.000, plus continuously variable and 90 or 150 Hz delete

DDM Accuracy	±0.01
Depth of Modulation	20% +/-1% for each tone at 0.000 DDM
Ident Tone	1020 Hz (switch selectable)

1.2.4 Glide Slope DDMs (Up and Down)

0.000, 0.910, 0.175, 0.400, 1.000, plus continuously variable and 90 or 150 Hz delete

DDM Accuracy	+/-0.01
Depth of Modulation	40% +/- 1% for each tone at 0.000 ddM

1.2.5 Marker Beacon

Tone	400, 1300, 3000 Hz (switch selectable)
Depth of Modulation	95% +/-3%
Simultaneous MB	avialable on ILS, LOC, and GS Modes

1.2.6 COMM Receiver Test

Modulation	1020 Hz (0 to 95%)

1.2.7 COMM Transmitter Measurements

Frequency Range	118.000 to 151.975 MHz
ID Tone (Internal)	1020 Hz (switch selectable)
ID Tone (External)	Front Panel (BNC connector)
Depth of Modulation	0 - 95%
Power Measurement	1 Watt to 25 Watts +/-10%
Modulation Measurement	0-100 +/-5%
Frequency Error Measurement	+/-8 KHz from selected frequency
Frequency Error Accuracy	+/-500 Hz

1.2.8 Physical Characteristics

Case	T-36	MIL-T-28800 Style C
	T-360	MIL-T-28800 Style E or F
Size	T-36	20.5 x 9 x 7 inches
	T-360	7 high x 16.5 x 15 wide (Style E)
Weight	T-36	25 pounds
	T-360	20 pounds
Power	T-36	NiCad batteries (built in charger) and 115/230VAC 50-400 Hz
	T-360	115/230 VAC 50-400 Hz
Temperature		-51 to +71C storage
		-30 to +55C operating

1.3 ICAO ANNEX 10 REQUIREMENTS

Tabulated below are the specifications associated with the VOR generation and the relevant ICAO Annex 10 requirements.

1.3.1 VOR

	ANNEX 10	T-36/T-360
Accuracy of RF carrier frequency	0.002%	0.001%
Bearing Accuracy	2 degrees	1 degree
Depth of modulation due to 9960 Hz sub carrier	28%-32%	29%-31%

Modulation index of 9960 Hz sub carrier	15 to 17	15 to 17
Accuracy of 30 Hz modulation frequency	1%	0.01%
Accuracy of 9960 mid frequency	1%	0.05%
Amplitude modulation of 9960 Hz subcarrier	5%	0.5%
Depth of modulation of ident tone	10%-20%	9%-11%
Accuracy of ident frequency	50 Hz	5 Hz
Depth of modulation of 30 Hz modulation	28%-32%	29%-31%

1.3.2 Communications

	ANNEX 10	T-36/T-360
Frequency accuracy	0.002%	0.001%
Maximum modulation	greater than 85%	greater than 95%
Channel separation	25 KHz	25 KHz
Frequency Range	118MHz-136.975MHz	118MHz-151.975MHz
Accuracy of RF carrier frequency	0.005%	0.001%

1.3.3 Localizer and Glide Slope

	ANNEX 10	T-36/T-360
90 Hz and 150 Hz	1.0%	0.1%
Total harmonic distortion of 90 Hz tone	10%	2%
Second harmonic distortion of 90 Hz tone	5%	2%
Total harmonic distortion of 150 Hz tone	10%	2%
Amplitude modulated noise	0.5%	0.1%
Phase angle between the 90 and 150 Hz sine functions relative to the common 30 Hz "sub harmonic"	10 degrees	1 degree

Accuracy of RF carrier frequency	0.005%	0.001%
Depth of modulation of each tone at 0 DDM	18.0%-22.0%	19.0%-21.0%

1.3.4 Marker Beacon

	ANNEX 10	T-36/T-360
Accuracy of RF Carrier frequency	0.005%	0.001%
Accuracy of modulation frequency	2.5%	0.5%
Total harmonic distortion of modulation	15%	10%
Depth of modulation	95%+/-4%	95%+/-4%

1.4 FRONT PANEL CONTROLS

All operating controls, test jacks, and connectors for the T-36 are located on the front panel. AC input and AC fuse located on rear panel of T-360. Table 1-3 describes the function of each of these parts. Figures 1-1 & 1-2 illustrate location of the controls.

TABLE 1-3. FRONT PANEL CONTROL FUNCTIONS

Panel Designation	***Ref***	***Function***
AC INPUT	1	AC input power receptacle connects unit to power connector source via power cable supplied
1/4A SB Fuse	2	AC power fuse connector. Can be configured for 115 VAC or 220 VAC power input
1A 32V Fuse	3	DC power fuse
2A SB Fuse T-36	4	Battery charging fuse. In circuit when charging battery
AC Power Switch T-36	5	AC power for battery charging and operation from AC
AC Lamp T-36	6	AC on indicator, battery charging
DC Power Switch T-36	7	Operates T-36. Battery operation has fifteen minute automatic shut off
Power Switch T-360	7	Operates T-360

Panel Designation	*Ref*	*Function*
DC Lamp T-36	8	Power on indicator
Power On Lamp T-360	8	Power on indicator
		NOTE **When DC Switch (7) is pushed down (momentary position) DC power is shut off**
PWR MOD FREQ Switch	9	Selects type of information displayed on Meter (10): Transmitter Power Transmitter Frequency Error Transmitter Modulation Percentage
	10	Three-function Meter: Power Range WATTS 0-25 Frequency Error ΔF -8 KHz +8KHz Modulation Percent 0-100%
		NOTE **For operation, Function Switch (20) must be in COMM position**
SIG/RCV/XMTR Switch	11	The T-36/T-360 three position function switch is used to set the operating characteristics of the test set for receiver, transmitter or transceiver testing. The switch positions are described below. XMTR TEST - T-36/T-360 test set is in the transmitter parameter measurement mode. The input from the unit under test is terminated in a 25 watt dummy load and the transmitter modulation percentage, frequency error, and power may be measured. This switch position should be used when testing a communications transmitter or the transmit functions of a transceiver. A high-power dummy load is always presented to the transmitter under test so that no RF output is produced from the test set that may cause interference. RCV/XMT - This switch position allows the T-36/T-360 test set to switch from SIG GEN to XMTR TEST under control of the microphone push to talk switch. This allows the T-36/T-360 test set to simulate a communications transceiver which allows squelch and voice clarity tests to be performed.

Panel Designation	Ref	Function
		SIG GEN - This switch position allows the T-36/T-360 test set to transmit the generated desired NAV/COMM frequencies. TNC ANT Jack (30) and BNC UUT Jack (31) are used to output the generated RF signals. All switch positions have an automatic XMTR TEST sensor. If more than 0.1 watts are fed to the UUT connector on the front panel, the T-36/T-360 automatically switches to the XMTR TEST function. This prevents the UUT transmitter power from being dissipated in the signal generator section of the test set and presents a high-power dummy load to prevent damage to the transmitter under test. Therefore, transmitter parameter measurements may be made from any switch position by simply applying a transmitter with more than 0.1 watts output power. The high power output jack on the front panel provides both a higher communications channel power output and an increased receiver sensitivity so that the high power output can be used to simulate a communications transceiver for antenna to antenna testing. ***CAUTION*** ***This connector is not protected against reverse power. Therefore, never connect a transmitter or transceiver to the high-power output jack.***
MIKE Jack	12	Microphone jack for testing COMM function.
PHONES Jack	13	Headset jack for testing COMM functions
VOLUME Control	14	On-Off volume control for internal speaker or headset.
	15	Internal speaker
GS Switch	16	Outer Ring Step Switch - controls Glide Slope DDM. Four Up and four DOWN DDM positions are provided. When switch is at 90 Hz, only the 90 Hz modulation is present (150 Hz deleted). When the switch is at 150 Hz, only the 150 HZ modulation is present (90 Hz deleted). Center Potentiometer - when the step switch is at VAR, the DDM may be continuously varied from 90 Hz only to 150 Hz only by turning this control.
LOC Switch	17	Outer Ring Step Switch - controls Localizer DDM. Four LEFT and four RIGHT positions are provided. When the switch is at 150 Hz, only the 150 Hz modulation is present (90 Hz deleted). When the switch is at 90 Hz, only the 90 Hz modulation is present (150 Hz deleted).

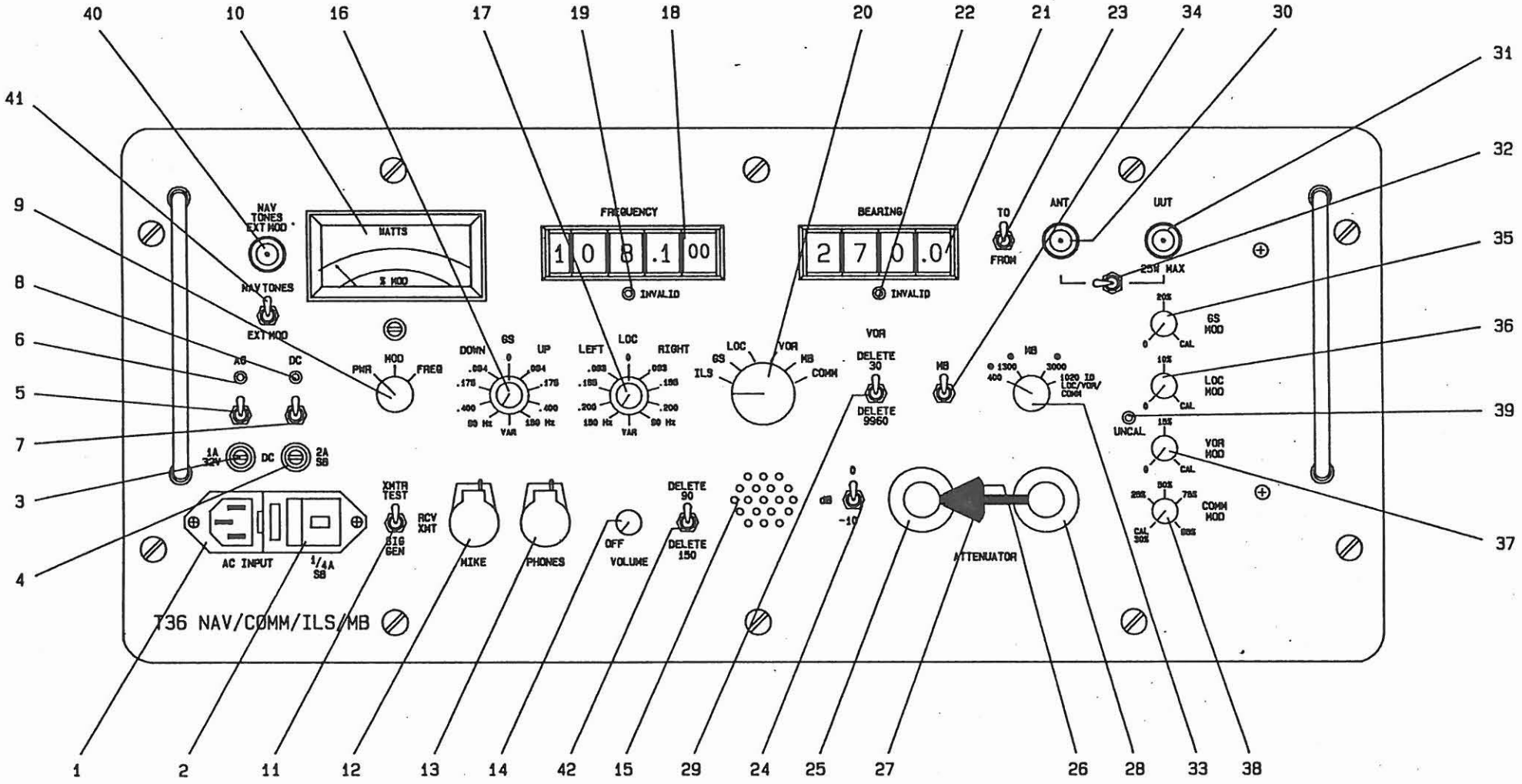
Designation	Ref	Function
		Center Potentiometer - when the step switch is at VAR, the DDM may be continuously varied from 90 Hz only to 150 Hz only by turning this control.
FREQUENCY Selector	18	Operating frequency selector controls individual operating frequency in the mode selected by the master function switch (20). 75 MHz selection is only avialable for the MB RF frequency. For GS and ILS operations, only the localizer frequency must be selected. (The paired glide slope frequency is automatically provided).

GLIDE SLOPE FREQUENCY - LOC FREQUENCY

329.15 MHz.....108.95 MHz	332.15 MHz.....111.35 MHz
329.30 MHz.....108.90 MHz	332.30 MHz.....113.30 MHz
329.45 MHz.....110.55 MHz	332.45 MHz.....109.55 MHz
329.60 MHz.....110.50 MHz	332.60 MHz.....109.50 MHz
329.75 MHz.....108.55 MHz	332.75 MHz.....111.55 MHz
329.90 MHz.....108.50 MHz	332.90 MHz.....111.50 MHz
330.05 MHz.....110.75 MHz	333.05 MHz.....109.75 MHz
330.20 MHz.....110.70 MHz	333.20 MHz.....109.70 MHz
330.35 MHz.....108.75 MHz	333.35 MHz.....111.75 MHz
330.50 MHz.....108.70 MHz	333.50 MHz.....111.70 MHz
330.65 MHz.....110.65 MHz	333.65 MHz.....109.95 MHz
330.80 MHz.....110.90 MHz	333.80 MHz.....109.90 MHz
330.95 MHz.....111.95 MHz	333.95 MHz.....108.35 MHz
331.10 MHz.....111.90 MHz	334.10 MHz.....108.30 MHz
331.25 MHz.....110.90 MHz	334.25 MHz.....110.15 MHz
331.40 MHz.....109.10 MHz	334.40 MHz.....110.10 MHz
331.55 MHz.....111.15 MHz	334.55 MHz.....108.15 MHz
331.70 MHz.....111.10 MHz	334.70 MHz.....108.10 MHz
331.85 MHz.....109.35 MHz	334.85 MHz.....110.35 MHz
332.00 MHz.....109.30 MHz	335.00 MHz.....110.30 MHz

INVALID Lamp	19	Lights when a frequency out of the function switch band has been selected.
		NOTE When **INVALID** lamp is lighted, the selected frequency is present on the output. This does not include the MB selection.
FUNCTION Switch	20	Master Function Switch - select operating mode of test set **LOC, GS, ILS, VOR, MB**, or **COMM**. **LOC**: Generates discrete localizer frequency from 108.1 to 111.9 MHz as selected **FREQUENCY** Control (18). **GS**: Generates discrete glide slope frequency from 329.15 to 335.0 MHz when paired localizer frequency is selected by **FREQUENCY** Control (18). Marker Beacon may also be added.

Panel Designation	Ref	Function
		ILS: Generates paired localizer and glide slope frequencies when the localizer frequency is selected by the **FREQUENCY** Control (18). Marker Beacon may be added to GS and LOC signals by pressing MB switch (34).
		VOR: Generates VOR radial from 108.00 MHz to 117.95 MHz with a bearing from 0 to 359.9 degrees as selected by the **BEARING** Control (21).
		MB: Generates a 75 MHz marker signal modulated at 400, 1300, or 3000 Hz as selected by MB tone control (33).
		COMM: Generates COMM signals from 118.0 MHz to 151.975 MHz as selected by the FREQUENCY control (18).
BEARING Selector	21	VOR bearing selector. Permits selection of individual VOR radial, from 1 to 359.9 degrees.
INVALID Lamp	22	Lights when a VOR radial other than 0° - 359.9° is selected.
TO/FROM Switch	23	Changes VOR bearing by 180°.
dB Switch	24	Provides 0 or -10 dB attenuation of RF output. Illuminates corresponding LED at decade attenuator control (25).
ATTENUATOR Switch	25	Decade attenuator – controls RF output in 10 dB increments from 0 to -110 dB.
Lamp	26	LED lights when dB switch is at 0 dB position.
Lamp	27	LED lights when dB switch is a -10 dB position.
ATTENUATOR	28	Unit attenuator - controls RF output in 1 dB increments from 0 to -10 dB.
DELETE 30/9960 Switch	29	Permits either 30 Hz or 9960 Hz tone signal to be deleted in VOR RF output.
ANT Jack	30	TNC antenna connector for telescoping rod antenna
UUT Jack	31	BNC connector for direct coupling to UUT.
		CAUTION
		If the 25W MAX power is exceeded when testing COMM equipment, a warning tone will be heard from the front-panel speaker.
ANT/UUT Switch	32	**ANT** or **UUT** selector switch.
MB Control	33	**400, 1300, or 3000** - provides 75 MHz marker beacon tones simulating inner, middle, and outer marker tones when master function switch (20) is set at **MB**.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NAV TONES EXT MOD
NAV TONES
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BEARING
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GS MOD
LOC MOD
VOR MOD
COMM MOD
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AC
DC
PWR
MOD
FREQ
DOWN
UP
GS
LEFT
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VAR
ILS
VOR
MB
COMM
DELETE 30
DELETE 9960
DELETE 90
DELETE 150
1020 ID LOC/VOR COMM
1A 32V
2A SB
1/4A SB
AC INPUT
XMTR TEST
RCV XMT
SIG GEN
MIKE
PHONES
OFF
VOLUME
dB
ATTENUATOR
T36 NAV/COMM/ILS/MB

Fig. 1-1