Margin measurements, in addition to showing the distortion present in the received telegraph signals, also show speed differences between the sending and receiving machines. The effect of a slow sending speed is to cause each unit to be greater than 22 milliseconds (60 WPM) and each transition to occur progressively later than it should. The effect on the margin of operation is to raise both limits, the lower limit being raised much more than the upper limit. For example, a margin of 35 to 100 indicates the sending speed is five percent slow.

On the other hand, the effect of a fast sending speed is to cause each unit to be smaller than 22 milliseconds and each transition to occur progessively earlier than it should. The effect on the margin of operation is to lower both limits, the upper limit being lowered much more than the lower limit. For example, a margin of 5 to 60 indicates the sending speed is five percent fast.

Telegraph Test Set TS-2616/UGM

Telegraph Test Set TS-2616/UGM measures and indicates timing distortion in start-stop and synchronous teletype signals. Measurement is accomplished by comparing the time positions of the signal transitions (mark-to-space and space-to-mark) with accurate reference transitions provided either by an internal or external time base. The set also permits the operator to determine what distortion components constitute the total distortion.

FRONT PANEL CONTROLS AND INDICATORS.—The TS-2616/UGM front panel is shown in figure 11-11. Table 11-1 lists the controls and indicators, and describes their function.

OPERATION.— Operation of the TS-2616/UGM is summarized in the following paragraphs.

Plug the set into a 115 volt, 60 Hz outlet, throw the AC POWER switch (bottom right side fig. 11-11) to ON, allow approximately 10 minutes for warmup, then make the following preliminary control settings:

1. Set INPUT SELECT switch (center at bottom fig. 11-11) to the position that corresponds to the mode of signal to be analyzed.
2. Set INPUT POLARITY switch to (+).
3. Set INPUT FILTER switch to OUT.
4. Set PEAK RESET switch to OFF.
5. Set TRANSITION MARKERS switch to OUT.
6. Set CODE LEVEL switch to:

(a) SYNC, if signal to be analyzed is synchronous.

(b) S/S5, if signal to be analyzed is start-stop, 5-level code.

(c) S/S8, if signal to be analyzed is start-stop, 8-level code.

7. Set RATE BAUDS switch to rate that corresponds to bit rate of signal to be analyzed.

NOTE: If external time base is to be used instead of internal time base, set RATE BAUDS switch to EXT OSC. Connect external time-base generator (square wave) to EXT OSC connector. Set frequency of the generator to 200 times the baud rate of the signal to be analyzed. (The external signal level should not exceed 5 volts peak to peak.)

8. Set TRANSITION SELECT switch to ALL.
9. If the signal to be analyzed is to be displayed on an external oscilloscope, connect the oscilloscope to the SCOPE SIG, SCOPE SYNC, and SCOPE GRD connectors.

Connect signal to be analyzed to either the LO-Z or HI-Z jack as follows:

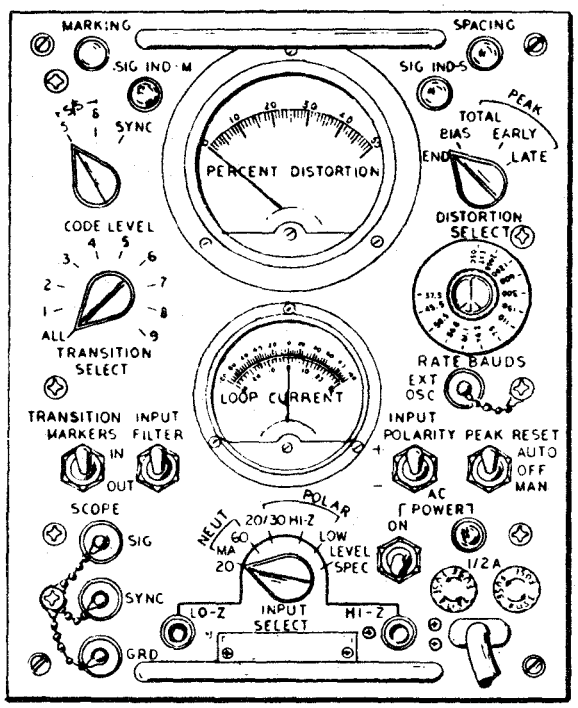

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Figure 11-11.—Telegraph Test Set TS-2616/UGM front panel.

Table 11-1.—TS-2616/UGM controls and indicators

PANEL IDENTIFICATION	DESCRIPTION	FUNCTION
AC POWER	Toggle switch	Applies primary power to unit.
AC POWER	Indicator lamp, red	Lights when primary power is applied to unit.
1/2 A (2)	Cartridge-type fuse	Fuse both sides of primary power line.
PERCENT DISTORTION	Meter	Indicates distortion of data signal under test in per cent of unit interval.
LOOP CURRENT	Meter	Indicates current magnitude, in milliamperes of high-level data signal under test.
INPUT SELECT	6-position rotary switch	Sw Pos — Function NEUTRAL 20MA — Adjusts input circuits to accept 20-milliampere neutral signals. NEUTRAL 60MA — Adjusts input circuits to accept 60-milliampere neutral signals. POLAR 20/30 — Adjusts input circuits to accept 20- or 30-milliampere polar signals. POLAR HI-Z — Adjusts input circuits to accept high-impedance polar signals. Sw Pos — Function POLAR LOW-LEVEL — Adjusts input circuits to accept low-level polar signals. SPEC — Special input to be wired by user as required.
INPUT POLARITY	Toggle switch	Reverses sense of input signal.
INPUT FILTER	Toggle switch	Sw Pos — Function IN — Inserts filter into input circuits to remove transients from input signal under test. OUT — Removes filter from input circuits.

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Table 11-1.—TS-2616/UGM controls and indicators—continued

PANEL IDENTIFICATION	DESCRIPTION	FUNCTION
CODE LEVEL	3-position rotary switch	Adjusts Analyzer circuits to accommodate input signals of either 5- or 8-element start-stop codes or synchronous signals
RATE BAUDS	14-position rotary switch	Sets internal time-base generator to correspond to input signals of 37.5, 45.5, 50, 56.8, 61.1, 74.2, 75, 110, 150, 300, 600, 1200, or 2400 bauds. EXT OSC position permits use of external time-base signal (see EXT OSC below).
TRANSITION SELECT	10-position rotary switch	Selects specific transition (of 1 through 9) to be analyzed or all transitions.
DISTORTION SELECT	5-position rotary switch	Sw Pos — Function END — Adjusts circuits to measure mark-to-space transition displacement. BIAS — Adjusts circuits to measure space-to-mark transition displacement. Sw Pos — Function TOTAL PEAK — Adjusts circuits to record the maximum transition displacement that occurs during a measuring period (see PEAK RESET below). EARLY PEAK — Adjusts circuits to record the maximum advanced transition displacement. LATE PEAK — Adjusts circuits to record maximum delayed transition displacement.
PEAK RESET	3-position toggle switch, nonlocking at MAN position	When set to AUTO, peak distortion readings (above) are reset to zero every five seconds. When momentarily set to MAN, peak readings are reset to zero.
TRANSITION MARKERS	2-position toggle switch	When set to IN, inserts timing markers (at ideal transition points) into data signal available at SCOPE SIG connector.

162.32(162A)D

Table 11-1.—TS-2616/UGM controls and indicators—continued

PANEL IDENTIFICATION	DESCRIPTION	FUNCTION
SCOPE SIG	Connector	Provides output signal to display signal under test on an external oscilloscope.
SCOPE GRD	Connector	Provides ground connection for external oscilloscope.
SCOPE SYNC	Connector	Provides sync connection for external oscilloscope.
EXT OSC	Connector	Provides connection for external time base signal (see RATE BAUDS, above).
LO-Z	Jack	Provides connection for low-impedance signal to be analyzed.
HI-Z	Jack	Provides connection for high-impedance signal to be analyzed.
MARKING	Indicator lamp, white	Lights when bias distortion component is advanced or when end distortion component is delayed.
SPACING	Indicator lamp, white	Lights when bias distortion component is delayed or when end distortion component is advanced.
SIG IND-M	Indicator lamp, white	Lights when input signal is at mark.*
SIG IND-S	Indicator lamp, white	Lights when input signal is at space.*

*Steady mark or space causes corresponding lamp to glow brightly. Data signal conditions cause both lamps to glow dimly. Relative brightness of lamps indicates the ratio of marks and spaces in signal.

1. Connect 20-, 30-, or 60-milliampere signal to LO-Z jack. Externally adjust signal current rate for correct indication on LOOP CURRENT meter.
2. Connect low-level or high-impedance signal to HI-Z jack.

Place signal under test in the steady marking condition. SIG IND-M lamp should light. If not, reverse position of INPUT POLARITY switch. Return signal under test to its normal signaling mode.

Set DISTORTION SELECT switch to the name of the component of distortion to be measured. When the switch is set to:

1. END (not used when measuring synchronous signals), the PERCENT DISTORTION meter indicates the average distortion of all mark-to-space transitions. When the MARKING lamp lights, the distortion is late. When the SPACING lamp lights, the distortion is early.
2. BIAS, the PERCENT DISTORTION meter indicates the average distortion of all space to mark transitions. When the MARKING lamp lights, the distortion is early. When the SPACing lamp lights, the distortion is late.
3. TOTAL PEAK, the PERCENT DISTORTION meter indicates the largest distortion that occurs during a given measuring period.

NOTE: With the PEAK RESET switch set to OFF, the measuring period extends until the PEAK RESET switch is momentarily set to MAN, which resets the reading to zero. With the PEAK RESET switch set to AUTO, the reading is reset automatically every five seconds.

4. EARLY PEAK, same as TOTAL PEAK except only early transitions are measured.
5. LATE PEAK, same as TOTAL PEAK except only late transitions are measured.

For start-stop signals under test set the TRANSITION SELECT switch to positions 1 through 9 for each setting of the DISTORTION SELECT switch. Positions 1 through 9 correspond to the 9 transitions between the start element and stop element of 8-level code signals (positions 7 through 9 do not apply for 5-level code signals). The PERCENT DISTORTION meter indicates the end, bias, total, early, or late peak distortion of the selected transition.

To stop the test set, turn the AC POWER switch to OFF.

FREQUENCY ACCURACY REQUIREMENTS

Determining the correct frequency Navywide is accomplished by the U.S. Naval Observatory. This correct frequency is provided to ships from Reference Oscillators (secondary standards) AN/URQ-9 and AN/URQ-10. (The AN/URQ-10 is discussed in chapter 4.) The Secondary Standards AN/URQ-9 and AN/URQ-10 are calibrated by laboratory (primary) standards periodically. WWV does not provide ships the capability of determining the correct frequency to the tolerance required by modern communication systems. The secondary standard oscillator is the only method available at present to determine the correct alignment of the equipment internal oscillators.

Equipment technical manuals assign a figure specifying the frequency stability of an equipment but this does not guarantee the the equipment's frequency accuracy. The frequency stability of an equipment only indicates the limit as to how quickly the oscillator will drift off frequency. Frequent checks of internal oscillators with the secondary standard will keep frequency errors to a minimum. Figure 11-12 shows a typical test setup for transmitter frequency output calibration.

Frequency Standards AN/URQ-9 and AN/URQ-10 are installed in a system for use as a central frequency reference rather than for use as a piece of test equipment. The basic frequency standard system (fig. 11-13) uses RF Amplifier AM-2123/U for isolation and distribution of the 0.1, 1, and 5 mHz frequencies generated by the secondary standard. This RF amplifier must be used when more than one transmitter or receiver is to be connected to the frequency standard. The

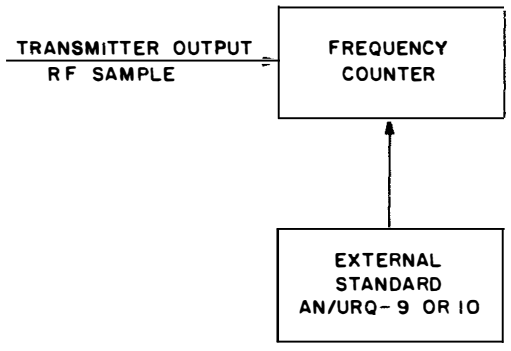

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Figure 11-12.—Transmitter frequency check.