

## Features

- Provides complete receiver evaluation in less than 60 minutes testing time.
- Utilizes a condensed speech recording equivalent of many hours of receiver exposure to evaluate talk-off rate.
- Checks receiver recognition bandwidths, center frequencies, maximum acceptable amplitude ratio, guard time, dynamic range, and acceptable signal to noise ratio.
- Test equipment requirement consists of a digital counter, an AC voltmeter, and a low cost cassette tape player. The tape player may require a small amplifier to achieve 2 Vrms depending upon the receiver to be tested.
- Compensation factors allow tape player speed inaccuracies of up to 2% without loss of measurement accuracy.
- Convenient C60 cassette format on low noise high bias chrome tape, recorded using Dolby B noise reduction.

## General Description

The Mitel CM7291 Tone Receiver Test Cassette cuts the total evaluation time of DTMF tone receivers to less than 60 minutes. Test equipment requirements are also minimized to a modest test setup.

## Test Content

Side one of the tape contains a series of tests involving recorded tone bursts with the parameters varied in a number of ways. Tests are performed by sending the tone bursts to the receiver, and counting the number of bursts to which the receiver responds. The results from these tests provide direct indications of receiver performance.

Side two of the tape contains a condensed speech recording which is used to evaluate the speech immunity of the receiver. Ideally a receiver's response to the speech recording should be zero, since no intentional tone bursts are present. In practice the number of responses will vary from 2 to

100 depending on the receiver quality and dynamic range.

Prompts and instructions are included on both sides of the tape to aid in receiver testing.

## Test Setup

Two test setups using the same test equipment are used. The first, shown in Figure 1, is used to perform a 1 kHz calibration test. The second, shown in Figure 2, is used for the receiver dynamic tests.

Calibration Test: The first test on both sides of the tape is a 1kHz calibration test, and is used to provide a correction factor for the playback inaccuracy of the tape player.

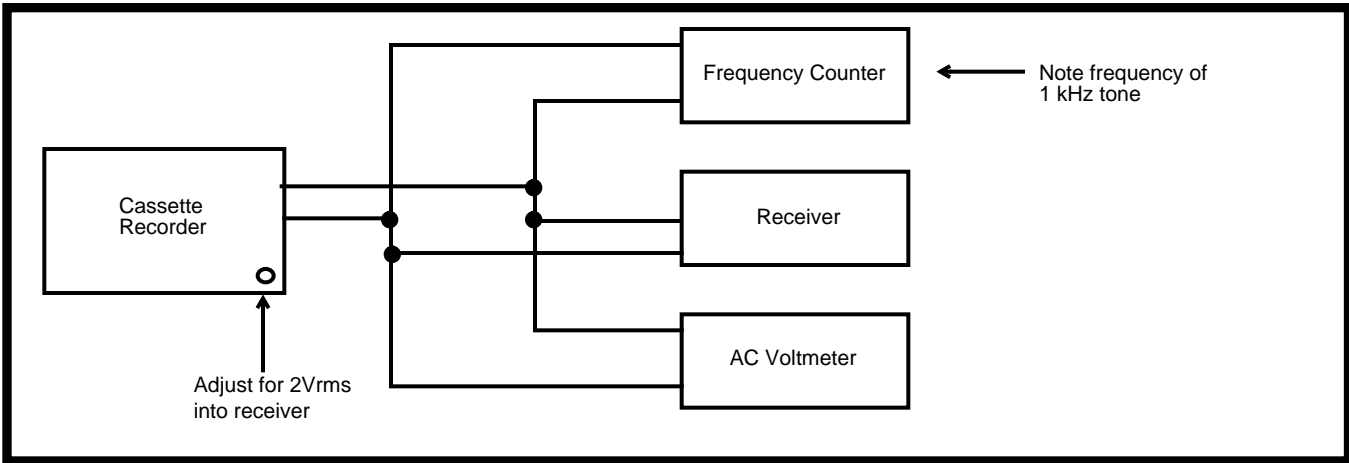
Receiver Test: Once the calibration test has been performed the test setup is changed to that shown in Figure 2 and remains the same that way for all other tests.

## Receiver Testing

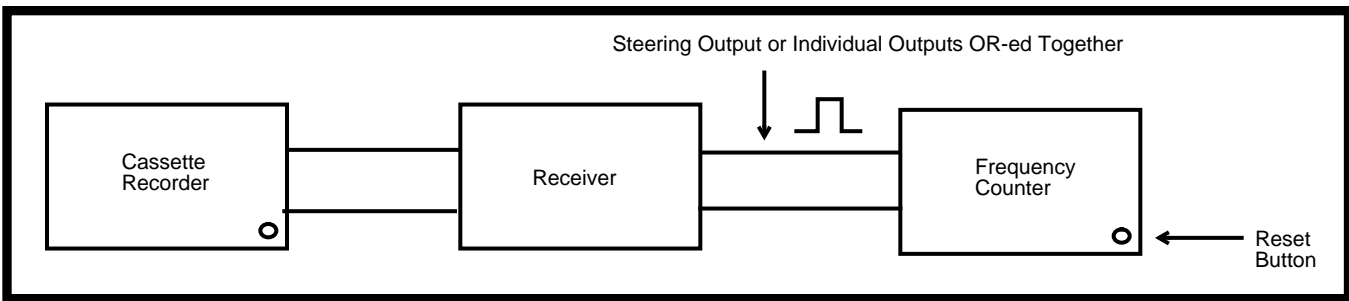
The following describes the recorded contents of both sides of the tape, and the tests provided.

The 1kHz reference signal level output from the cassette player which is adjusted to 2.0Vrms (5.656 Vp-p), is required for tone receiver systems capable of handling this level (i.e. this level won't cause internal clipping of the signal). All levels referred to in this document are referenced to the initial 2.0Vrms level setting.

Note: To use the CM7291 with tone receivers operating from a single 5 V supply, the 1kHz reference signal output level of the cassette player must be reduced. For example, if using the MT8870 tone receiver, the 1kHz reference signal level would be adjusted such that the signal observed at the device's GS pin would be a maximum without clipping. This level would be 1.738Vrms (i.e. 4.91 Vp-p). Accordingly, the levels referred to in the test descriptions must be reduced proportionally. For example, each dual tone frequency at a 1.0Vrms level would now be 869mVrms (+1dBm) and 35dB



**Figure 1 - Test Setup - Calibration Test**



**Figure 2 - Test Setup - Receiver Test**

down from this level would be 20mVrms (-34 dBm). A 200mVrms level per frequency would now be 174mVrms (-13dBm).

### Side 1 - Test 1

Calibration Tone: Consists of a continuous 1kHz tone, present for one minute. Used to provide a correction factor for tape playback speed inaccuracy using equation 1. The correction is employed when checking receiver channel center frequencies in test 3.

$$X(\%) = (f_0 - 1000)/10 \quad \dots \text{Eqn 1}$$

Frequency  $f_0$  is measured as follows, using the test setup shown in Figure 1.

- Set the level of tone at the receiver input to 2Vrms. This level setting must not be altered for the duration of the tests on side 1.
- Measure the frequency of the tone  $f_0$  at the receiver input.

### Side 1 - Test 2

Decode Check: All tone pairs associated with standard 4x4 keypad digits (i.e. L1 H1 through L4

H4) are pulsed sequentially using 50ms bursts at 1Vrms per frequency. Each tone pair is pulsed 10 times consecutively. The receiver should respond to all tone pairs it is designed to receive.

### Side 1 - Test 3

Recognition Bandwidth and Channel Center Frequency Check

This test utilized the tone pairs L1 H1, L2 H2, L3 H3 and L4 H4 (i.e. digits 1, 5, 9 and 16). Each tone pair requires four test to complete the check, making 16 sections overall. Each section contains 40 pulses of 50ms duration, with an amplitude of 0.2Vrms per frequency.

Four sections covering the tests for one tone (1 digit) are:

- a. H frequency at 0% deviation from center, L frequency at +0.1%. L frequency is then increments in +01.% steps up to +4%. The number of tone bursts is noted and designated  $N^+$ .
- b. H frequency at 0% deviation, L frequency at -0.1%. L frequency is then incremental in -0.1% steps, up to -4%. The number of tone bursts is noted and designated  $N^-$ .

- c. The test in (a) is repeated with the L frequency at 0% and the H frequency varied up to +4%.
- d. The test in (b) is repeated with the L frequency and 0% and the H frequency varied to -4%.

Receiver Recognition Bandwidth (RRB) is calculated as follows:

$$RRB\% = (N^+ + N^-)/10 \quad \dots\text{Eqn 2}$$

Receiver Center Frequency Offset (RCFO) is calculated as follows:

$$RCFO\% = X + (N^+ - N^-)/20 \quad \dots\text{Eqn 3}$$

**Side 1 - Test 4**

Acceptable Amplitude Ratio (Twist)

This test utilizes the tone pairs L1 H1, L2 H2, L3 H3 and L4 H4 (i.e. digits 1, 5, 9 and 16). There are eight sections to the test. Each section contains 200 pulses with a 50ms duration for each pulse. Initially the amplitude of both tones is 1Vrms.

Two sections to test one tone pair are:

- a. Standard Twist: H tone amplitude is maintained at 1Vrms, L tone amplitude is attenuated gradually until the amplitude ratio L/H is -20dB. Note the number of responses from the receiver.
- b. Reverse Twist: L tone amplitude is maintained at 1Vrms, H tone amplitude is attenuated gradually until the amplitude ratio is 20dB. Note the number of responses from the receiver.

The Acceptable Amplitude Ratio in dB is equal to the number of responses registered in (a) or (b), divided by 10.

**Side 1 - Test 5**

Dynamic Range

This test utilizes tone pair L1 H1 (digit 1). Thirty-five tone pair pulses are transmitted, with both frequencies starting at 1 Vrms. The amplitude of each is gradually attenuated to -35dB at a rate of 1dB per pulse. The Dynamic Range in Db is equal to the number of responses from the receiver during the test.

**Side 1 - Test 6**

Guard Time

This test utilizes tone pair L1 H1 (digit 1). Four hundred pulses are transmitted at an amplitude of 1Vrms per frequency. Pulse duration starts at 49ms and is gradually reduced to 10ms. Guard time in ms is equal to (500 - number of responses)/10.

**Side 1 - Test 7**

Acceptable Signal to Noise Ratio

This test utilizes tone pair L1 H1, transmitted on a noise background. The test consists of three sections in which the tone pair is transmitted 1000 times at an amplitude of 1Vrms per frequency, but with a different white noise level for each section. The first level is -24dBV, the second -18dBV and the third -12dBV. The Acceptable Signal to Noise Ratio is the lowest ratio of signal to noise in the test where the receiver responds to all 1000 pulses.

**Side 2 - Test 1**

Calibration Tone

A repetition of Test 1 - Side 1, at which time the signal level at the receiver input must be recalibrated to 2.0Vrms. This adjustment is entirely independent of the setting made at Test 1 - Side 1.

**Side 2 - Test 2**

Talk-Off Test

The test consists of recordings of conversations on telephone trunks made over a long period of time and condensed into a 30-minute period. Receiver immunity to talk-off is determined by the number of responses occurring during this test. A receiver with an acceptable talk-off response should register less than 30.

## Summary of Cassette Content

The following table lists the contents of the cassette together with the playing time from the start of the

tape. It is recommended that the tape counter reading for each test be recorded in the column provided. This will provide the most convenient method of test location.

Test	Description	Counter	Time Minutes:Seconds
Introduction			0
Side 1, 1	1 kHz at 2Vrms		0:20
Side 1, 2	Decode test digits 1 to 16 (10 pulses each)		2:00
Side 1, 3	Recognition bandwidth and centre frequency check (40 pulses each)		3:10
Side 1, 3a	Digit 1                      697Hz                      +0.1 to +4%		4:10
Side 1, 3b	Digit 1                      697Hz                      -0.1 to -4%		
Side 1, 3c	Digit 1                      1209Hz                      +0.1 to +4%		
Side 1, 3d	Digit 1                      1209Hz                      -0.1 to -4%		
Side 1, 3e	Digit 5                      770Hz                      +0.1 to +4%		
Side 1, 3f	Digit 5                      770Hz                      -0.1 to -4%		
Side 1, 3g	Digit 1                      1336Hz                      +0.1 to +4%		
Side 1, 3h	Digit 5                      1336Hz                      -0.1 to -4%		
Side 1, 3i	Digit 9                      852Hz                      +0.1 to +4%		
Side 1, 3j	Digit 9                      852Hz                      -0.1 to -4%		
Side 1, 3k	Digit 9                      1477Hz                      +0.1 to +4%		
Side 1, 3l	Digit 9                      1477Hz                      -0.1 to -4%		
Side 1, 3m	Digit 16                      941Hz                      +0.1 to +4%		
Side 1, 3n	Digit 16                      941Hz                      -0.1 to -4%		
Side 1, 3o	Digit 16                      1633Hz                      +0.1 to +4%		
Side 1, 3p	Digit 16                      1633Hz                      -0.1 to -4%		
Side 1, 4	Amplitude ratio (200 pulses each)		12:45
Side 1, 4a	Digit 1                      L1/H1                      0 to -20dB		
Side 1, 4b	Digit 1                      L1/H1                      0 to +20dB		
Side 1, 4c	Digit 5                      L2/H2                      0 to -20dB		
Side1, 4d	Digit 5                      L2/H2                      0 to +20dB		
Side 1, 4e	Digit 9                      L3/H3                      0 to -20dB		
Side 1, 4f	Digit 9                      L3/H3                      0 to +20dB		
Side 1, 4g	Digit 16                      L4/H4                      0 to -20dB		
Side 1, 4h	Digit 16                      L4/H4                      0 to +20dB		
Side 1, 5	Dynamic Range (35 pulses) Digit 1 -1 to -35dBV/freq		19:20
Side 1, 6	Guard Time (400 pulses) Digit 1 49 to 10ms		20:10
Aide 1, 7	Signal to Noise (1000 pulses each)		21:50

Test	Description	Counter	Time Minutes:Seconds
Side 1, 7a	Digit 1                      S/N                      24 dB/freq		22:25
Side 1, 7b	Digit 1                      S/N                      18 dB/freq		24:15
Side 1, 7c	Digit 1                      S/N                      18 dB/freq		26:05
Side 2	Introduction		0
Side 2, 1	1kHz at 2Vrms		:30
Side 2, 2	Talk-off Test (Speech)		2:00

Notes:



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