

# **User Manual**

## **TDS3TMT Telecom Mask Test Application Module**

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## Safety Summary

To avoid potential hazards, use this product only as specified. While using this product, you may need to access other parts of the system. Read the *General Safety Summary* in other system manuals for warnings and cautions related to operating the system.

### Preventing Electrostatic Damage



**CAUTION.** *Electrostatic discharge (ESD) can damage components in the oscilloscope and its accessories. To prevent ESD, observe these precautions when directed to do so.*

**Use a Ground Strap.** Wear a grounded antistatic wrist strap to discharge the static voltage from your body while installing or removing sensitive components.

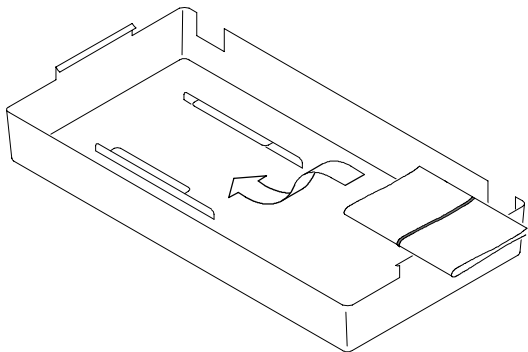
**Use a Safe Work Area.** Do not use any devices capable of generating or holding a static charge in the work area where you install or remove sensitive components. Avoid handling sensitive components in areas that have a floor or benchtop surface capable of generating a static charge.

**Handle Components Carefully.** Do not slide sensitive components over any surface. Do not touch exposed connector pins. Handle sensitive components as little as possible.

**Transport and Store Carefully.** Transport and store sensitive components in a static-protected bag or container.

## Manual Storage

The oscilloscope front cover has a convenient place to store this manual.





## **Installing the TDS3TMT Application Module**

Refer to the *TDS3000*, *TDS3000B*, and *TDS3000C Series Application Module Installation* manual for instructions on installing and testing the application module.

## **Telecom Mask Test Features**

The TDS3TMT application module adds waveform mask testing capabilities to your oscilloscope. This section provides an overview of these additional features.

### **Telecom Mask Test QuickMenu**

Use the telecom mask test QuickMenu function to display bottom and side menus that provide access to all key mask test functions from one screen.

### **Predefined Telecom Industry Masks**

The TDS3TMT application module provides compliance masks for testing to ITU-G.703 and ANSI T1.102 telecommunications standards, up to STS-1 (52 Mb/s) line rates.

### **Multiple Channel Testing**

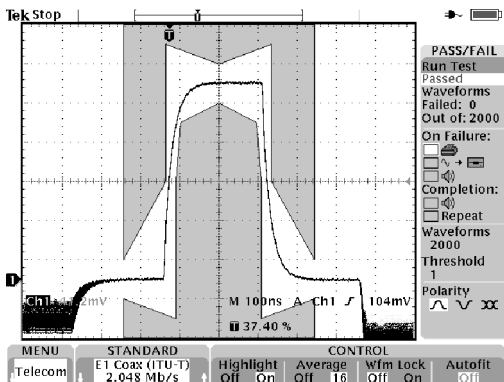
The TDS3TMT application module enables you to perform multiple simultaneous testing on all active oscilloscope channels.

## Test Automation

You can connect the oscilloscope to do automated mask testing by using the RS-232, GPIB, or LAN communication ports.

### Accessing TDS3TMT: QuickMenu

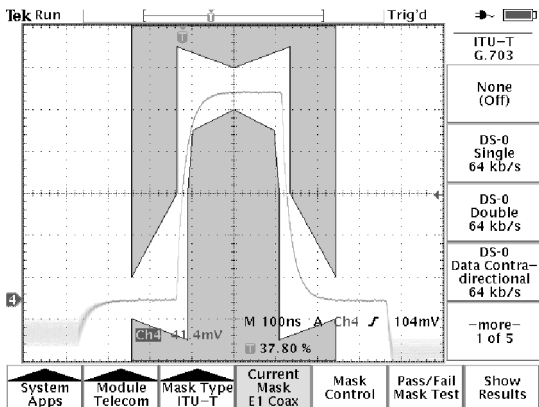
1. Push the **QuickMenu** front-panel button to display the quick menu items.
2. Push the **Menu** bottom screen button to select and display the **Telecom** bottom and side menu items.
3. Push bottom and side menu buttons to select a mask, set test control parameters, and test pass/fail responses.





## Accessing TDS3TMT: Utility Menu

1. Push the **UTILITY** front-panel button to display the utility menu items.
2. Push the **System** bottom screen button to display **Apps**.
3. Push the **Module** bottom screen button to select **Telecom**. The screen displays the telecom bottom and side menu items.
4. Push bottom and side menu buttons to select a mask, set test control parameters, and test pass/fail responses.



## Conventions

The following conventions apply to all TDS3TMT functions:

- You can perform multiple waveform mask testing by connecting signals to all oscilloscope input channels.
- While in Telecom Mask test mode, the **AUTOSET** front-panel button automatically sets the oscilloscope horizontal, vertical, and trigger parameters, and positions the waveform in the selected mask.
- Mask testing only works with live channels. It is recommended that you turn off math and reference waveforms while doing mask testing.

# TDS3TMT Menu

**Table 1: Utility Menu: Type = Apps, Module = Telecom**

Bottom	Side	Description
Mask- Type (ITU-T)	None (Off)	ITU-T standard masks. Each mask sets the oscilloscope vertical, horizontal, and trigger controls to acquire that standard's waveform.
	DS-0 Single 64 kb/s	
	DS-0 Double 64 kb/s	
	DS-0 Data Contra- directional 64 kb/s	
	DS-0 Timing 64 kb/s	
	Old "DS1" Rate	After selecting a standard, push the <b>AUTOSET</b> front-panel button to position the waveform in the mask.
	1.544 Mb/s	
	G.703 DS1	
	1.544 Mb/s	The oscilloscope is set to edge trigger on waveforms (per ITU-T G.703 standard).
	E1 Symetric Pair	
	2.048 Mb/s	
	E1 Coaxial Pair	
	2.048 Mb/s	
	Clk Interface Symetric	
	Pair 2.048 Mb/s	
	Clk Interface Coaxial	
	Pair 2.048 Mb/s	
	"DS2" Rate Symetric	
	Pair 6.312 Mb/s	
	"DS2" Rate Coaxial	
Pair 6.312 Mb/s		
E2 8.448 Mb/s		
32.064 Mb/s		
E3 34.368 Mb/s		
Old "DS3" Rate		
44.736 Mb/s		
G.703 DS3		
44.736 Mb/s		

**Table 1: Utility Menu: Type = Apps, Module = Telecom (cont.)**

<b>Bottom</b>	<b>Side</b>	<b>Description</b>
Mask Type (T1.102)	None (Off) DS1 1.544 Mb/s DS1A 2.048 Mb/s DS1C 3.152 Mb/s DS2 6.312 Mb/s DS3 44.736 Mb/s STS-1 Pulse 51.84 Mb/s	ANSI T1.102 standard masks. Each mask sets the oscilloscope vertical, horizontal, and trigger controls to acquire that standard's waveform.
Mask Type (Custom)	None (Off)	Turns off user mask.
	User Mask	Sets the oscilloscope to use the User mask.
	Copy Std Mask To User Mask	Copies the selected ITU-T or T1.102 mask into the User mask. Use the general purpose knob to select the standard mask to load.
	Save/Recall User Mask	Saves or recalls User masks.

**Table 1: Utility Menu: Type = Apps, Module = Telecom (cont.)**

<b>Bottom</b>	<b>Side</b>	<b>Description</b>
Current Mask		Status area that displays the name of the currently selected mask.
Mask Control	Highlight Violations On      Off	Turns on mask violation highlighting. Waveforms that violate mask parameters leave highlighted points on the mask that are the color of the failing waveform.
	Stop On Violation On      Off	When set to On, the oscilloscope stops mask testing on the first occurrence of a waveform violation. This function overrides pass/fail tests.
	Lock Mask To Waveform On      Off	Locks mask to waveform so that the mask segments move and redraw proportionally when changing the horizontal or vertical scale or position settings.
	Autofit Search Radius	Autofit repositions the waveform using a spiral algorithm to attempt to fit the waveform to a mask.

**Table 1: Utility Menu: Type = Apps, Module = Telecom (cont.)**

<b>Bottom</b>	<b>Side</b>	<b>Description</b>
Mask Control	Vertical Margin Percentage (User mask only)	When enabled, adjusts the User mask vertical margins as a percent of the nominal waveform amplitude for the mask standard.
Pass/Fail Mask Test	Pass/Fail Mask Test On      Off	When set to On, resets the status information and starts mask testing.
	Status:	Displays pass/fail test status information: the number of waveforms that have violated the mask per number of waveforms tested in the current test, and the number of failed tests per the total number of tests run (if Repeat on Completion is On).  If the number of waveforms that fail exceeds the violation threshold setting, status text changes from <b>Passing</b> to <b>Failing</b> .

**Table 1: Utility Menu: Type = Apps, Module = Telecom (cont.)**

<b>Bottom</b>	<b>Side</b>	<b>Description</b>
Pass/ Fail Mask Test (cont.)	Repeat On Completion On      Off	When set to On, repeats the pass/fail test cycle using the current settings. The status area Failures/Test values show how many times the test has repeated and how many of those tests failed.
	Number Of Waveforms	Sets the number of waveforms to acquire for each pass/fail test cycle. Use the general purpose knob to set the value. Any value above 100,000 sets the waveform count to infinity.  If waveform averaging is on, the actual number of waveforms acquired is the Number Of Waveforms value times the waveform averaging value.

**Table 1: Utility Menu: Type = Apps, Module = Telecom (cont.)**

<b>Bottom</b>	<b>Side</b>	<b>Description</b>
Pass/ Fail Mask Test (cont.)	Violation Threshold For Failure	Sets how many failed waveforms define a failed test. Use the general purpose knob to set the value.
	Pre-Test Delay	Sets a time value that delays the start of a pass/fail test. Use the general purpose knob to set the value.
	Polarity	Sets the polarity of all active waveform channels. Values are positive, negative, or both. If set to Both, the oscilloscope tests the first half of all active channel acquired waveforms in normal (uninverted) mode, and then inverts all active channels and tests the second half of acquired waveforms.
	Beep On Completion On        Off	When <b>On</b> , causes the oscilloscope to emit a tone when the pass/fail test is complete.
	Beep On Failure On        Off	When <b>On</b> , causes the oscilloscope to emit a tone when the pass/fail test status changes from <b>Passing</b> to <b>Failing</b> .



**Table 1: Utility Menu: Type = Apps, Module = Telecom (cont.)**

<b>Bottom</b>	<b>Side</b>	<b>Description</b>
Pass/ Fail Mask Test (cont.)	Hard Copy On Failure On      Off	When <b>On</b> , causes the oscilloscope to send the screen image to the hard copy device when the pass/fail test status changes from <b>Passing</b> to <b>Failing</b> .
	Save Failed Wfm To Disk On      Off	When <b>On</b> , saves the failing signal waveform(s) data to the oscilloscope media drive when the mask test fails.
Show Results	Count Hits On      Off	When <b>On</b> , displays the number of mask hits (failures) per channel and per mask segment. Enabling count hits slows down the mask test rate; if mask test speed is important, turn Count Hits Off.

**Table 1: Utility Menu: Type = Apps, Module = Telecom (cont.)**

<b>Bottom</b>	<b>Side</b>	<b>Description</b>
Show Results	Violations/ Waveforms, ...	Displays pass/fail test status information: the number of waveforms that have violated the mask per number of waveforms tested in the current test, and the number of failed tests per the total number of tests run (if Repeat is On).
	Segment 1 Hits ... Segment 8 Hits	Status area that displays the number of hits for each channel on each mask segment.

**Mask Testing and Pass/Fail Testing.** Mask testing means the detection and highlighting of mask segment violations. Pass/Fail testing is setting conditions for mask testing, such as the number of waveforms to test, how many mask violations are allowed before failing a test, whether to repeat testing upon completion, what action to perform at the completion of a test, and so on.

**Turn Off Mask Testing.** To turn off mask testing and remove the mask from the screen, set the mask standard to **None**.

**Standards and Pulse Amplitudes.** For those cases where a mask standard defines a valid pulse amplitude as being within a range of values, the TDS3TMT mask is drawn for the maximum permitted amplitude.

For those cases where a mask standard does not define pulse amplitude, the TDS3TMT mask is drawn for a nominal 1 V pulse.

**Highlight Violations.** Highlight Violations must be on in order for the oscilloscope to perform mask comparisons. If Highlight Violations is off, the oscilloscope will not inform you of mask violations using highlighting or the Stop On Violation command, and hits counting will not count. Also, turning on pass/fail testing, Count Hits, or Stop on Violation automatically turns on Highlight Violations.

**Pass/Fail Testing: Averaging.** When averaging is on, the oscilloscope first generates an averaged waveform, then the averaged waveform is compared to the mask. This means that the total number of waveforms acquired is equal to the waveform averaging number times the number of waveforms being tested. For example, if pass/fail Number of Waveforms is set to 500, and waveform averaging is set to 8, then the total number of waveforms acquired for one pass/fail test cycle is  $500 \times 8 = 4,000$ .

**Saving Waveforms to Disk.** The default saved file name is TEKnnnnn.fff, where nnnnn is an incrementing number that usually starts at 00000, and fff is the file format (Internal, Spreadsheet, or Mathcad file format) as set in the **SAVE/RECALL > Save Waveform to File** menu. For internal file format waveforms (.isf), if more than one waveform is being tested, look at the .isf file preamble information at the top of the file to determine from which channel that waveform data came. Refer to the *TDS3000, TDS3000B, and TDS3000C Series Programmer Manual* for .isf file format information.

**Proper Signal Termination.** Make sure to correctly terminate communication test signals. Tektronix offers optional AMT75 adapters for correct communication signal termination.

**Pass/Fail Testing: Polarity.** When polarity is set to both, the oscilloscope tests the first half of all active channel acquired waveforms with positive polarity, and then inverts all active channels and tests the second half of acquired waveforms.

**Stop On Violation.** If Stop On Violation is On, the pass/fail status area displays Violation if there is a violation, regardless of the pass/fail test settings. In other words, Stop On Violation has a higher precedence than pass/fail tests.

**Running Mask Test Indefinitely.** To run a mask test indefinitely while counting the number of violations, set **Number of Waveforms** to infinity ( $\infty$ ).

**Triggering.** Selecting a mask standard automatically sets trigger parameters for that standard. However, to assign specific trigger parameters to a mask (most likely for a new User mask), push the Trigger **MENU** button, selecting **Comm**, and selecting the mask standard to use for triggering. The oscilloscope assigns the selected standard's trigger parameters to the current mask.

**Testing For Infrequent Errors.** To automatically capture and save waveform violations that occur infrequently over long periods of time, set Pass/Fail testing Repeat to **On**, Number of Waveforms to **1**, and Hardcopy/Wfm On Failure to **On**. You may also want to set **UTILITY > Hard Copy > Options > Compression** to **ON** to compress the saved hardcopy data and thus store more files on the floppy disk. Compression is not available for waveform (\*.isf) format data.

**On-Screen Mask Positions.** Many of the mask standards have their mask drawn on the right side of the graticule to allow enough room to the left for acquiring sufficient serial trigger data.

When using the Lock Mask To Waveform feature, be careful not to move the mask too far left or else you may lose your serial trigger. Use Lock Mask To Waveform after acquisitions have stopped to examine a mask violation more closely.

To use Lock Mask to Waveform to make the mask fill more of the screen, increase the acquisition record length by pushing **ACQUIRE > Horizontal Resolution > Normal** to set the record length to 10K points (note that Normal mode only works with lock mode for horizontal settings of 100 ns/div or faster). You can also use Zoom to examine a mask and waveform, provided that you pan and zoom in such a way that there is enough space to the left of the mask for the oscilloscope to detect the serial trigger.

**Autofit Key Points.** The following are some Autofit-specific key points:

- The Autofit radius defines the size of a square search grid radius of  $(2 \times \text{radius} + 1) \times (2 \times \text{radius} + 1)$  pixels, centered on the waveform position. Autofit moves the waveform using a spiral pattern, testing for mask violations at each position. For example, the following table represents a spiral pattern for a radius value of 2, where the number represents the order of the waveform moves, and the position of the number represents the position the waveform is offset relative to the starting point (s). A radius of two attempts to fit the waveform in 25 tries (start position plus 24).

9	10	11	12	13
24	1	2	3	14
23	8	s	4	15
22	7	6	5	16
21	20	19	18	17

- If pass/fail testing is used in conjunction with Autofit, the Autofit center point is reset at the beginning of each pass/fail test.
- Autofit is most appropriate when the waveform(s) being tested is already close to fitting inside the mask.

- When Autofit moves the waveform, it only moves the location where the waveform is drawn on the display. It does not change any of the underlying vertical, horizontal, or trigger parameters used to acquire the waveform.

A consequence of this is that when moving the waveform left (or right), the waveform points at the right (or left) edge of the screen will be blank if the horizontal settings are such that the entire acquired waveform is displayed on screen. This is acceptable because those points are typically outside the mask region.

- If the waveform is a significant distance from the mask, AUTASET should be used first to adjust the vertical, horizontal, and trigger parameters.
- When numerous waveforms are violating the mask by substantial amounts, thereby causing Autofit to run almost continuously, the instrument responsiveness is significantly degraded. This is another reason why AUTASET is more appropriate than Autofit for waveforms which violate the mask by large amounts.



**Automated Pass/Fail Testing Process.** The recommended automated pass/fail testing process is:

1. Set the oscilloscope to default settings using the **SAVE/RECALL->Recall Factory Setup** menu.
2. Set the Graticule type to Frame (**DISPLAY->Graticule** menu).
3. Select the mask standard.
4. Turn off all waveforms not being tested.
5. Connect the appropriate input signals.
6. Push the **Autoset** button.
7. Set Autofit to a reasonably small value, such as 4.
8. Set Polarity to **Both**.
9. Set the number of Waveforms to 100.
10. Run the pass/fail test.
11. Note the pass/fail test status (Passed or Failed) and take appropriate action.
12. Connect new signals.
13. Repeat from step 10.

## Telecom Pass/Fail Mask Test Example

In this example, you want to test an ITU-T telecom signal that needs to meet the E1 Coaxial Pair 2.048 Mb/s standard. You want to highlight any waveform mask errors, as well as set up pass/fail testing to test 500 waveforms, then stop.

Use the Telecom QuickMenu to set the TDS3TMT mask parameters as listed in the table. Connect the signal to CH 1 on the oscilloscope, then press the **AUTOSET** front-panel button. After Autoset completes, press the **Run Test** side menu button to perform the pass/fail test.

### Telecom QuickMenu

Menu Item	Parameter	Value
Standard	Use buttons to scroll through mask standard list	E1 Coax (ITU-T) 2.048 Mb/s
Control	Highlight	On
	Average	Off
	Wfm Lock	Off
	Autofit	On ( $\geq 1$ )

## Telecom QuickMenu (cont.)

<b>Menu Item</b>	<b>Parameter</b>	<b>Value</b>
Pass/Fail	Send hardcopy to printer	Off (unchecked)
	Send waveform to file	Off (unchecked)
	Beep on failure	On (checked)
	Beep on completion	On (checked)
	Repeat test	Off (unchecked)
	Waveforms	500
	Threshold	1
	Polarity	Positive

Use the upper menu button to select a response, and then use the lower menu button to enable or disable the selected response. You can select and enable any combination of responses.