

# CT3686 & CT3687 User Manual

## Safety Summary

To avoid personal injury and/or product damage, review and comply with the following safety precautions. These precautions apply to both operating and maintenance personnel and must be followed during all phases of operation, service, and repair of this probe.

A **WARNING** statement calls attention to an operating procedure, practice, or condition, which, if not followed correctly, could result in injury or death to personnel.

A **CAUTION** statement calls attention to an operating procedure, practice, or condition, which, if not followed correctly, could result in damage to or destruction of parts or the entire product.

### ***Do Not Work Alone***

Do not work alone when working with high voltages.

### ***Inspect the Probe***

Inspect the probe and accessories for cracks and frayed or broken leads before each use. If defects or damages are noted, DO NOT USE the probe.

### ***Dry Conditions***

Hands, shoes, floor and work bench must be dry. Avoid making measurements under humidity, dampness or other environmental conditions that might affect safety.

### ***Do Not Remove the Probe's Casing***

Removal of the probe's casing may expose you to electric shock. If necessary, disconnect the inputs and outputs of the probe before opening the case.

### ***Hazardous Contact***

To avoid injury, remove jewelry such as rings, watches, and other metallic objects. Do not touch exposed connections and components when power is present.

### ***Unexpected Charges***

Hazardous voltages may be present in unexpected locations in circuitry being tested when a fault condition in the circuit exists. Capacitors

inside the instrument may retain a charge even if the instrument is disconnected from its source of supply.

### ***Use Only in Office-Type Indoor Setting***

The probe is designed to be used in office-type indoor environments. Do not operate the probe:

- In the presence of noxious, corrosive, or flammable fumes, gases, vapors, chemicals, or finely-divided particulates.
- In environments where there is a danger of any liquid being spilled on the probe.
- In air temperatures exceeding the specified operating temperatures.
- In atmospheric pressures outside the specified altitude limits or where the surrounding gas is not air.

### ***Not for Critical Applications***

This probe is not authorized for use in contact with the human body or for use as a component in a life-support device or system.

### ***Do Not Substitute Parts***

Do not install substitute parts or perform any unauthorized modification to the instrument.

### ***Only Qualified Personnel***

Only qualified personnel should use this probe. This differential voltage probe is designed to be used by personnel who are trained, experienced, or otherwise qualified to recognize hazardous situations and who are trained in the safety precautions necessary to avoid possible injury when using such a device.

### ***Observe Maximum Working Voltage***

Do not use the CT3686 or CT3687 probes above their maximum working voltage ranges. See “Electrical Specifications” on page 10.

### ***Use Proper Power Source***

To ensure this probe functions well, use four AA cells or 6 VDC/200 mA or regulated 9 VDC/120 mA mains adapter or power leads. Do not operate this probe from a power source that applies more than the

voltage specified.

### ***Must be Grounded***

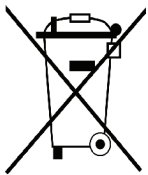
This probe is grounded by the shell of the BNC connector through the grounding conductor of the power cord of the measurement instrument. Before making connections to the input leads of this probe, ensure that the output BNC connector is attached to the BNC connector of the measurement instrument, and that the measurement instrument is properly grounded. Whenever it is likely that the ground protection is impaired, you must make the instrument inoperative and secure it against any unintended operation.

### ***Use Fused Test Probes if Necessary***

If this probe is intended to use for measurements in circuits of installation CAT III, it should incorporate the use of fused test probes.

## **Compliance Statements**

### ***Disposal of Old Electrical & Electronic Equipment***



(Applicable in the European Union and other European countries with separate collection systems). This product is subject to Directive 2012/19/EU of the European Parliament and the Council of the European Union on waste electrical and electronic equipment (WEEE), and in jurisdictions adopting that Directive, is marked as being put on the market after August 13, 2005, and should not be disposed of as unsorted municipal waste. Please utilize your local WEEE collection facilities in the disposition of

this product and otherwise observe all applicable requirements.

This probe is in compliance with IEC-61010-031 CAT II, Pollution Degree 2.



# 1 Introduction

## 1.1 Overview

Differential probes allow safe, accurate measurement between two voltage points where neither point is referenced to ground. The CT3686 and CT3687 both offer 100 MHz bandwidth and can test up to  $\pm 700$  V (DC + AC peak) and  $\pm 1400$  V (DC + AC peak), respectively. Compatible with oscilloscopes from all major manufacturers, the probes can be battery operated, powered by a universal adapter (optional), or powered by USB power lead (optional) if the oscilloscope is so equipped.

Features:

- Meets IEC 61010-031 safety standard
- 100 MHz bandwidth (-3 dB)
- Up to  $\pm 700$  V (DC + AC peak) common mode (CT3686)
- Up to  $\pm 1400$  V (DC + AC peak) common mode (CT3687)
- Selectable attenuation settings of 10x/100x (CT3686)
- Selectable attenuation settings of 100x/1000x (CT3687)
- Power and over-range indicators
- High accuracy ( $\pm 2\%$ )
- High CMRR
- Powered by 4 AA batteries (included)
- Power adapter, CT3723 (optional)
- USB power lead, CT4122 (optional)

## 1.2 Initial Inspection

This probe is tested prior to shipment. It is therefore ready for immediate use upon receipt. An initial physical inspection should be made to ensure that no damage has been sustained during shipment. After the inspection, verify the contents of the shipment. The kit contains:

- Differential probe
- (2) Hook probes, black & red
- (4) AA batteries
- Offset adjustment tool
- User manual

## 2 Product Description

### 2.1 Front Panel

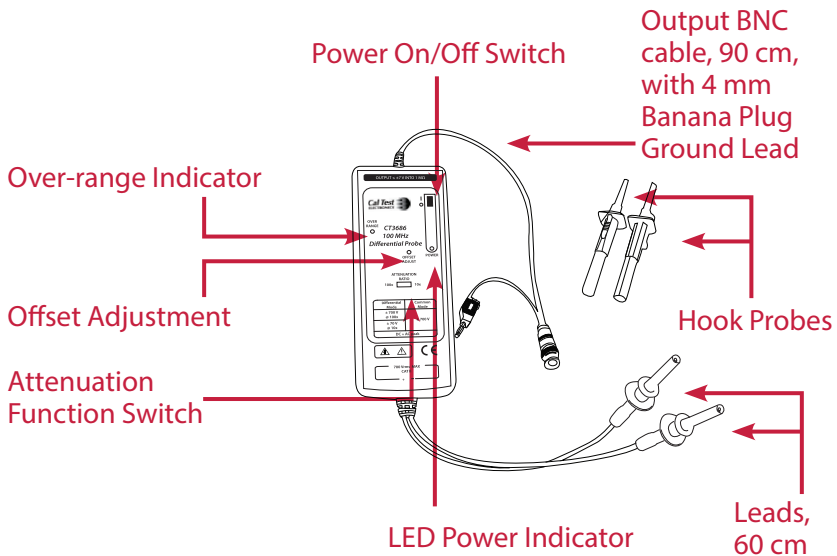


Figure 1 Front Panel Diagram

## 3 Using the Probe

### 3.1 Replacing the Batteries

Before using the differential probe for the first time, the batteries supplied with the device must be inserted in the battery compartment (unless you are using the power adapter or USB power lead).

#### **WARNING**

At the time of inserting or replacing the batteries, the input leads must not be connected to an item to be tested. Never operate the probe with the case open.

Slide back the battery cover. If necessary, the old AA batteries can then be removed and the new ones inserted into the compartment. Always ensure the batteries are positioned for proper polarity. After inserting the batteries, close the case. When the batteries are low, the power indicator will start to flicker and dim.

### 3.2 Inspection Procedure

1. Connect the BNC output connector to the vertical input the oscilloscope.
2. Power on the probe.
3. Set the oscilloscope input to DC coupling and 1V/div. Center the trace on the display.
4. Set the attenuation of the oscilloscope to match the low setting on the probe.
5. Connect the hook probes to the leads.
6. Connect the black hook probe to the ground connection on the oscilloscope and the red hook probe to the test signal on the oscilloscope (1 kHz for example).
7. A wave matching the test signal should display on the screen of the oscilloscope and this means this probe is working properly.

## 3.3 Getting Started

1. Connect the hook probes to the leads.
2. Connect the probe to the oscilloscope with the BNC cable. When using a portable or ungrounded oscilloscope, connect the output ground lead to ground.
3. Switch the probe "ON."
4. Switch to the desired attenuation ratio.
5. Use the hook probes to contact the circuit to be tested.

### **CAUTION**

This probe is used to carry out differential measurements between two points on the circuit under test. This probe is not for electrically insulating the circuit under test and the measuring instrument.

## 3.4 Overage Indicator

The overrange indicator lights when the voltage of the input signal exceeds the linear operating range of the probe. When this happens, the signal on the probe output may not accurately represent the signal on the probe input.



### 3.5 Vertical Scale on Oscilloscope

The actual vertical scale of the oscilloscope is equal to the attenuation factor multiplied by the range of vertical scale selected on the oscilloscope. For example, with the CT3686 set on attenuation 10x, the oscilloscope on 0.5 V/div, the real vertical scale is  $10 \times 0.5 = 5 \text{ V/div}$ . With the probe on 100x, the real vertical scale is  $100 \times 0.5 = 50 \text{ V/div}$ . These values apply when the oscilloscope is set to the typical 1 M $\Omega$  impedance input. When the oscilloscope is set to 50  $\Omega$  input, the actual vertical scale will be doubled: 10 V/div for the 10x setting and 100 V/div for the 100x setting. See Table 1.

Vertical Scale on Oscilloscope				
Scope Input Impedance	Probe Attenuation Setting	Actual Attenuation Setting	Vertical Scale Reading on the Oscilloscope	Actual Vertical Scale of the Oscilloscope
1 M $\Omega$	10x	10x	0.5 V/div	5 V/div
1 M $\Omega$	100x	100x	0.5 V/div	50 V/div
50 $\Omega$	10x	20x	0.5 V/div	10 V/div
50 $\Omega$	100x	200x	0.5 V/div	100 V/div

*Table 1 Oscilloscope Readings*

### Offset Zero Procedure

The CT3686 and CT3687 can be adjusted to zero the probe's offset voltage using the offset adjustment tool supplied with the probe. Follow this procedure to perform the offset adjustment.

1. Connect the probe to Channel 1 of the oscilloscope. Turn on the probe power. You may use the USB power cable or batteries to power the probe. Set the probe attenuation ratio to the low setting (10x for CT3686 and 100x for CT3687).
2. Short the + and - probe inputs together with the hook tips.
3. Turn on power to the oscilloscope. Leave both the

instrument and the probe turned on for 30 minutes to stabilize.

4. Press [Default Setup] and [Auto] on the oscilloscope.
5. Press the Channel 1 button, then press the Probe softkey and set the attenuation to match that of the probe.
6. Set the oscilloscope to DC coupled mode and the scope offset to 0 volts.
7. Set the oscilloscope to average mode (x16) or high-resolution mode to reduce oscilloscope noise.
8. Using the offset adjustment tool (included), adjust the probe offset voltage to 0 volts

## 4 Cleaning

This probe does not require any particular cleaning. If necessary, clean the case with a cloth slightly moistened with soapy water. Make sure the probe is completely dry before reconnecting it to an oscilloscope.

### **WARNING**

Dry the probe thoroughly before attempting to make voltage measurements.

### **CAUTION**

Do not subject the probe to solvents or solvent fumes as these can cause deterioration of the probe body and cables.

## Specifications

All specifications apply to the unit after a temperature stabilization time of 20 minutes over an ambient temperature range of 25 °C ± 5 °C.

Electrical Specifications		
	CT3686	CT3687
Bandwidth (-3dB)	100 MHz (driving 1 M $\Omega$ oscilloscope input)	
Rise Time (10%-90%)	3.5 ns	
Attenuation ratio	10x/100x	100x/1000x
Accuracy	±2%	
CMRR (typical)	-85 dB @ 50 Hz -55 dB @ 1 MHz	-80 dB @ 60 Hz -50 dB @ 1 MHz
Maximum Differential Input Voltage (DC + AC peak)	±70 V @ 10x ±700 @ 100x	±140 V @ 100x ±1400 @ 1000x
Maximum Common Mode Input Voltage (DC + AC peak)	±700 V	±1400 V
Absolute Maximum Rated Input Voltage (each side to ground)	700 Vrms CAT II	1000 Vrms CAT II
Input Impedance	4 M $\Omega$ // 7 pF (each side to ground)	
Output Voltage Swing	±7 V (driving 1 M $\Omega$ oscilloscope input)	
Offset (typical)	±5 mV	
Noise (typical)	0.9 mVrms	
Source Impedance	50 $\Omega$	
Power Supply	4 AA batteries (included) or CT3723 power adapter (optional) CT4122 USB power lead (optional)	

Mechanical Characteristics	
Weight	500 g
Dimensions	207 x 83 x 38 mm
BNC Cable Length	90 cm
Input Leads Length	30 cm each

## Environmental Characteristics

Operating Temp/Humidity	-10°C to 40°C / Up to 85% RH
Storage Temp/Humidity	-30°C to 70°C / Up to 85% RH
Pollution Degree	Pollution Degree 2
Altitude	Operating: 3,000 m Nonoperating: 15,300 m

## Safety Specifications

IEC 61010-031 CAT II

Specifications are subject to change without notice. To ensure the most current version of this manual, please download the current version from our website: [caltestelectronics.com](http://caltestelectronics.com)

## 5 Voltage Derating Curve

The derating curve of the absolute maximum input voltage in common mode is show as follows:

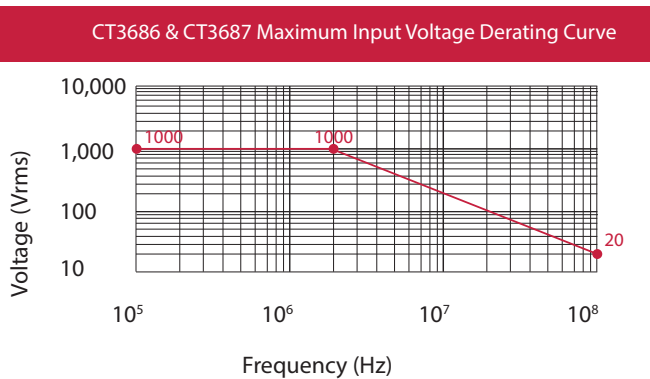


Figure 2 Derating Curve

## 6 Service & Warranty Information

### 6.1 Limited One-Year Warranty

Cal Test Electronics warrants this product to be free from defective material or workmanship for a period of 1 year from the date of original purchase. Under this warranty, Cal Test Electronics is limited to repairing the defective device when returned to the factory, shipping charges prepaid, within the warranty period.

Units returned to Cal Test Electronics that have been subject to abuse, misuse, damage or accident, or have been connected, installed or adjusted contrary to the instructions furnished by Cal Test Electronics, or that have been repaired by unauthorized persons, will not be covered by this warranty.

Cal Test Electronics reserves the right to discontinue models, change specifications, price, or design of this device at any time without notice and without incurring any obligation whatsoever.

The purchaser agrees to assume all liabilities for any damages and/or bodily injury which may result from the use or misuse of this device by the purchaser, his employees, or agents.

This warranty is in lieu of all other representations or warranties expressed or implied and no agent or representative of Cal Test Electronics is authorized to assume any other obligation in connection with the sale and purchase of this device.

### 6.2 Service

If you have a need for calibration or repair services, technical or sales support, please contact us:

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Yorba Linda, CA 92887  
800-572-1028 or 714-221-9330  
caltестelectronics.com





