

# **NON-CONTACT VOLTAGE DETECTOR WITH ADJUSTABLE SENSITIVITY AND IR THERMOMETER**

## ***USER'S MANUAL***



## **VR40**

*Please read this manual carefully and thoroughly  
before using this product.*

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# INTRODUCTION

Thank you for purchasing General Tools & Instruments' (General's) VR40 Non-contact Voltage Detector with Adjustable Sensitivity and IR Thermometer. Please read this manual carefully and thoroughly before using the instrument.

The VR40 offers a safe (non-contact) way to check whether a line, cable or AC outlet is "hot" (energized). It does so by using a blade tip to sense from a short distance the electromagnetic field created by AC voltage. When voltage is detected, the VR40 produces audible and visual alarms (a beeping sound, and a flashing red light adjacent to the tip).

Even unloaded AC circuits generate electromagnetic fields. Although these fields are extremely weak, their constantly changing nature means that they generate some current. A sensitive non-contact voltage (NCV) detector can sense this current via induction, in much the same way that a sensitive radio receiver can sense weak radio waves.

NCV detectors, including the VR40, cannot detect DC voltages, such as those present in automotive electrical systems. In addition, the VR40 typically cannot detect 120VAC from a distance of more than 0.25 in. (6.2mm), and never through a wall or metal conduit.

Unlike other NCV detectors with only one sensitivity level—and therefore the ability to detect only one range of voltages (typically 50 to 600VAC)—General's VR40 has four sensitivity levels. They were chosen to optimize voltage detection over four practical ranges: 12 to 25VAC, 70 to 125VAC, 150 to 240VAC and 250 to 600VAC.

The ability to detect the presence of 12VAC in non-contact fashion comes in very handy during troubleshooting of branch circuits and process plant and industrial automation systems and equipment such as gas and water valves, fans, lights, relays, inverters, solenoids and horns. 12VAC is also commonly used to power hardwired commercial and residential building doorbells/buzzers and thermostats. Separately, the VR40's ability to detect 480V using its lowest sensitivity range makes troubleshooting and installing generators and fluorescent lighting ballasts easier, faster and safer.

User-adjustable sensitivity does more than make the VR40 more versatile. It also improves the instrument's performance. The value of the VR40's highest sensitivity level (12 to 25VAC) is obvious: it allows non-contact detection of 12VAC, an ability that most other NCV detectors lack. However, the VR40's lower sensitivity levels, which cover common AC power voltages, also have great value, for the following reason.

Merely detecting the presence of 120VAC near a bundle of wires does not tell you which wire of the bundle is the “hot” wire; any of the wires could be activating the alarms. The VR40 can help you isolate the hot wire. This application calls for turning down the sensitivity in stages after the NCV detector senses voltage. As you reduce sensitivity, at some stage only the energized wire will produce a field strong enough to activate the NCV’s alarms. In this way, the VR40’s adjustable sensitivity takes the guesswork out of identifying the “hot” wire of a bundle.

Four additional features increase the versatility and utility of the VR40:

- Because its tip can fit in the slots of 110VAC receptacles, as it checks for voltage the VR40 also indicates whether the receptacle is wired correctly, or wired in reverse.
- A bright white LED flashlight
- An infrared thermometer (IRT) for non-contact measurement of local surface temperatures. Using an IRT is a safe, reliable way to detect and isolate overload currents in motors and electrical conduit and junction boxes. Measured temperatures are displayed in °F or °C on a 4-digit (2000 count) LCD and automatically held for 15 seconds after the IRT activation button is released.

- A unique, patent-pending ergonomic design that places the IR and NCV sensors and the flashlight on the same end of the instrument.

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## KEY FEATURES

- Dual indications (beeper sounds and red LED under translucent cap flashes) when voltage is detected
- Unique adjustable sensitivity feature enables accurate detection of voltage on 12VAC to 480VAC branch circuits and makes individual live wires in bundles easier to isolate
- Safe for CAT III 600V use
- Also checks 110VAC outlets for reversed wiring and open circuits
- 4:1 IRT with measurement range of  $-4^{\circ}$  to  $626^{\circ}\text{F}$  ( $-20^{\circ}$  to  $330^{\circ}\text{C}$ ) and fixed emissivity
- 4-digit (2000 count) LCD temperature readout in  $^{\circ}\text{F}$  or  $^{\circ}\text{C}$
- Powerful white LED flashlight under translucent cap
- 15-second Auto Power Off (APO)
- Low battery indication
- Pocket clip on back
- Powered by (2) “AAA” batteries

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# SAFETY INSTRUCTIONS



- You must confirm that the batteries powering the VR40 are not weak or dead before you use the unit to test for the presence of AC voltage. It is essential that you do this *each time* you use the instrument.

The usual way to check the batteries is to insert the blade tip into both slots of an outlet known to be energized; if the beeper does not sound and the LED does not light for either slot, replace both “AAA” batteries before proceeding. Another simple way to check for live batteries is to briskly rub the tip of the unit through your hair; static electricity has more than enough voltage to activate the beeper and LED.

- The VR40 is designed to indicate the presence of AC voltage with an amplitude between 12VAC and 600VAC. Accordingly, *do not* assume that the absence of a positive indication means that the circuit under test is de-energized (not “hot”). Although they can cause shock and/or serious personal injury, voltages below 12V may not be detected by the VR40.

Whenever you have reason to suspect that a line or outlet is “hot”, confirm your suspicion by measuring the voltage of the line or outlet with a multimeter or clamp meter.

- Physically separate the multiple lines of 2-phase and 3-phase circuits before testing them.
- Do not use the VR40 if it appears to be damaged or malfunctioning.
- Do not expose the tester to temperatures above 113°F (45°C), relative humidity greater than 95%, or voltages higher than 600V.
- Do not use the VR40 to test for the presence of DC voltage.
- Do not use the unit to test for the presence of AC voltage on a shielded conductor, behind a wall or conduit, or under soil.
- Keep your fingers well behind the tip when performing a test. Never touch any conductor with your hand or skin until you have confirmed that it is not “hot”. To repeat: whenever you have reason to believe that a line or outlet is “hot”, measure its voltage with a multimeter or clamp meter.





*The VR40 is a Class 2 laser product that emits less than 1mW of radiation at a wavelength between 630 and 650nm. Avoid looking directly at the laser pointer. U.S. law prohibits pointing a laser beam at aircraft; doing so is punishable by a fine of up to \$10,000 and imprisonment.*

- The laser may cause discomfort if viewed directly. Your eyes' natural aversion reflex will prevent you from looking at the beam long enough to cause harm. As a precaution, keep the VR40 out of the hands of children, especially if you have pets.
- Never stare at the laser beam through binoculars or a magnifying glass.
- Do not operate the VR40 in the presence of flammable or explosive gases or in environments full of dust or static electricity.
- Do not operate the unit near a source of a strong electromagnetic field, such as an arc welder or an induction heater.

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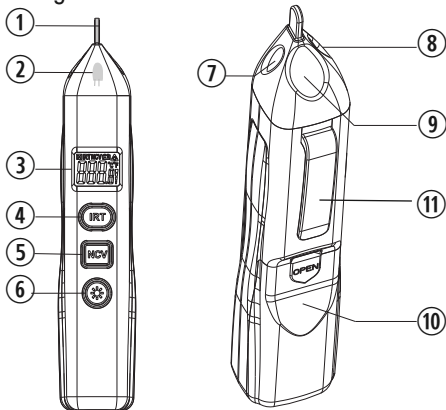
# WHAT'S IN THE BLISTER PACK

The VR40 comes fully assembled in a blister pack along with (2) “AAA” batteries and this user’s manual.

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## PRODUCT OVERVIEW

Fig. 1 shows the controls, indicators and key components of the VR40. Figure 2 shows all possible indicators on the unit’s LCD. Familiarize yourself with the labels, positions and functions of all buttons and components before moving on to the Setup Instructions and Operating Instructions.



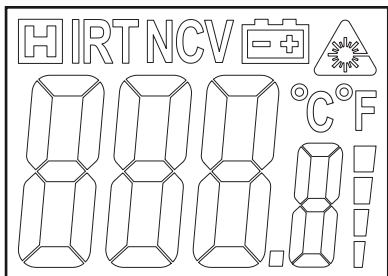
**Fig. 1. The controls, indicators and key components of the VR40.**

- 1 Non-contact voltage (NCV) detection blade tip
- 2 NCV detection LED (glows red)
- 3 LCD
- 4 Two-function **IRT** button: 1) Pressed by itself (briefly or held), activates IR thermometer and laser pointer, producing a temperature readout. When button is released, readout is held for 20 seconds, until APO function activates. 2) With **NCV** button pressed and held, each press of **IRT** button reduces sensitivity of **NCV** detector by one level. With sensitivity at lowest level, next press of button returns detector to maximum sensitivity. The last sensitivity level selected is recalled the next time the VR40 is activated.
- 5 Two-function **NCV** button. 1) Pressed and held by itself, activates **NCV** detection circuit. 2) With **IRT** button pressed and held, each press of **NCV** button toggles unit of temperature readout between °C and °F. The last temperature unit selected is recalled the next time the VR40 is activated.
- 6 LED flashlight button. Activates flashlight only when VR40 is active (display is not blank)
- 7 Laser pointer window
- 8 LED flashlight window

9 Infrared sensor

10 Battery compartment


11 Pocket clip



**Fig. 2. All possible display indications.**

 Data hold on

 IR temperature readout on


 Non-contact voltage detection on

 Low battery indication

 Laser pointer on

 IR temperature value

 IR temperature units

 NCV sensitivity level bar graph; default level at power on is last level used before APO timeout

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# SETUP INSTRUCTIONS

## ***INSTALL BATTERIES***

The VR40's battery compartment (Fig. 1, Callout 10) is accessible from the back of the unit.

To open the compartment, place your thumbnail in the slot above the word OPEN and apply enough force to release the battery compartment cover. Slide the cover down and away from the instrument.

Insert the two supplied "AAA" batteries in the well using the  $\oplus$  and  $\ominus$  markings stenciled inside the compartment as an orientation guide. Slide the battery compartment cover back onto its rails and push it forward until it snaps shut.

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# OPERATING INSTRUCTIONS

## ***DETECTING AC VOLTAGE***

Before using the VR40 to detect the presence of AC voltage, you must check a known "hot" outlet to confirm that the batteries powering the instrument are not weak or dead. It is essential that you do this *each time* you use the unit for this purpose.

**To check the charge of the batteries**, press and hold the NCV button while inserting the blade tip into both slots of an 110VAC outlet known to be energized. If the

batteries are charged, the beeper will sound repeatedly and the red LED under the translucent cap (Fig. 1, Callout 2) will flash when the tip is in one of the slots. Alternatively, briskly rub the tip of the VR40 through your hair or against your skin; static electricity has more than enough voltage to activate the beeper and LED.

Whenever the NCV detection circuit is active, the **NCV** icon will appear on the top line of the LCD.

**Before checking whether an unknown 110VAC outlet is energized**, it is important that you first maximize the VR40's sensitivity. To do so, while pressing and holding the **NCV** button press the **IRT** button as many times as necessary until "four bars" show on the NCV sensitivity level bar graph at the lower right of the LCD.

To check whether an unknown 110VAC outlet is energized, press and hold the **NCV** button while inserting the blade tip of the VR40 into both slots of the outlet, one at a time.

1. If the beeper sounds and the NCV detection LED near the tip (Fig. 1, Callout 2) flashes when the tip is inserted in the smaller slot of a modern 15A outlet (right slot of left figure on next page), the outlet is both energized and properly wired (the smaller slot is "hot" and the larger slot is neutral).

The figure below also shows which slots of two other common 110VAC receptacles are hot. In both cases, the “hot” slot is on the right and smaller.

2. If the beeper sounds and the LED flashes when the tip is in the larger (left) slot of a modern 15A outlet, the outlet is energized but wired in reverse.
3. If the beeper does not sound and the LED does not light when the tip is in either slot, the circuit is de-energized.



Modern NEMA 5-15 outlet



Modern NEMA 5-20 outlet




Old NEMA 1-15 outlet

**To determine whether an unknown 220VAC outlet is energized**, first maximize the VR40’s sensitivity by pressing and holding the **NCV** button and simultaneously pressing the **IRT** button as many times as necessary until “four bars” show on the NCV sensitivity level bar graph. Then press and hold the **NCV** button while inserting the blade tip of the VR40 into all slots of the outlet, one at a time. If the beeper sounds and the NCV detection LED near the tip flashes with the tip inserted in any slot, the outlet is energized.

**To detect the presence of AC voltage on an individual line or cable**, position the blade tip within 1/4 inch of the line or cable and press and hold the **NCV** button. If the beeper sounds and the LED lights, the line or cable is “hot” (energized). If you do not get both positive indications, touch the tip to all four sides of the line or cable. If the beeper sounds and the LED lights, the line or cable is “hot” (energized). If you still do not get positive indications, the line or cable is de-energized.

**To determine whether a device powered by 480VAC (a generator or ballast, for example) is energized**, simply position the tip of the VR40 near it. If the beeper sounds and the LED lights, the device is “hot” (energized). If you do not get both positive indications, the device is de-energized.

### ***USING THE IRT TO MEASURE TEMPERATURE***

**To use the VR40’s integrated IR thermometer to measure the temperature of a surface**, point the front of the unit at a surface and press and hold the **IRT** button. Note that this activates the laser pointer of the VR40’s integrated IR thermometer and causes the  icon to appear at the top right of the LCD. Use the laser pointer to “zero in” on the target—the object or surface whose temperature you wish to measure. The

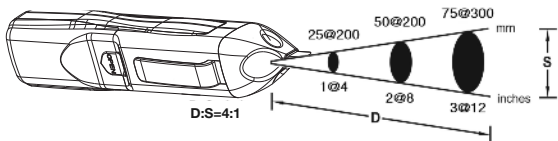


measured temperature will be displayed on the LCD, along with the IRT icon on the top line.

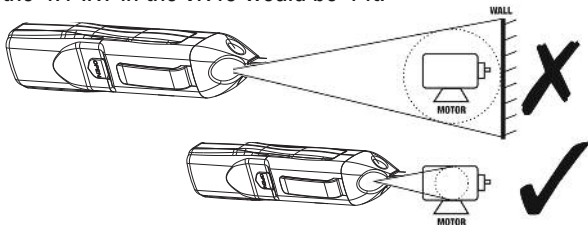
When you make temperature measurements, be sure to get close enough to the target to ensure that you are reading its temperature alone, rather than the average temperature of the target and objects behind or near it within the IRT's field of view.


The IRT in the VR40 has a distance-to-spot (D:S) ratio of 4:1. This means that the target area (spot) whose infrared radiation (temperature) is being measured increases in diameter by 1 inch for every 4 inches you move away from the target. Conversely, the diameter of the target area measured decreases by 1 inch for every 4 inches you move closer to the target.

All IRTs, including the one in the VR40, take the average temperature of all objects within a circular target area (spot). Although the distance "D" in the D:S ratio is defined as a linear value and the "S" defines the diameter of the spot (see figure at top of next page), the critical parameter is the target area. Depending on the distance to the target, the target area may include both the target and background objects near or behind the thermometer's field of view, which defines the target area or spot.



To eliminate measurement error, the VR40 must be moved close enough to the target so it is the only object in the target area. The figure below illustrates measurement of a motor's temperature from the wrong (top) and right (bottom) distance. For a motor with an area of  $1 \text{ ft}^2$ , the optimum measurement distance for the 4:1 IRT in the VR40 would be 4 ft.



Note that when you release the **IRT** button after measuring a surface temperature, the reading will be held on the LCD for 20 seconds, until the Auto Power Off (APO) function activates and powers off the instrument. During this period of time, the  and **IRT** icons will appear at the upper left of the LCD. During this interval, you can change the temperature unit of the readout.

**To change the temperature unit**, press the **NCV** and **IRT** buttons at the same time. Each simultaneous press will toggle the unit between °C and °F. The selected unit will appear on the display to the right of the measured IR temperature value. The last temperature unit selected will be recalled the next time the VR40 is activated.

**To temperature-scan the surfaces of a room** or any environment, press and hold the **IRT** button as you aim the laser pointer in various directions. Note that the IR temperature readout will track the different temperatures of different surfaces in real time, and hold the temperature of the surface being scanned when you release the **IRT** button.

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## **SPECIFICATIONS**

Overall Voltage Detection Range: 12 to 600VAC  
@ 50/60Hz

Detection Ranges/Sensitivities: 12 to 25VAC,  
70 to 125VAC, 150 to 240VAC, 250 to 600VAC

Non-contact Detection Distance: 0.25 in. (6.2mm), max  
Safety Rating: CAT III 600V

IR Thermometer D:S Ratio: 4:1

IRT Measurement Range: -4° to 626°F (-20° to 330°C)

Measurement Accuracy:  $\pm 3^{\circ}\text{F}$  ( $2^{\circ}\text{C}$ ) or  $\pm 1\%$  of reading (whichever is greater) above  $32^{\circ}\text{F}$ ;  $\pm 4.5^{\circ}\text{F}$  ( $2.5^{\circ}\text{C}$ ) below  $32^{\circ}\text{F}$

IRT Emissivity: Fixed at 0.95

IR Sensor Spectral Range: 8 to  $14\mu\text{m}$

Display Size and Type: 5/8 in. (16mm) diagonal LCD

Display Digits/Counts/Resolution: 4/ 2000/ $0.1^{\circ}$  (F or C)

Laser Pointer Class/Power/Wavelength:

Class 2/ $<1\text{mW}$ / $630$  to  $650\text{nm}$

Sampling Time: 2X/second

Auto Power Off Trigger: 15 seconds of inactivity

Operating Temperature:  $32^{\circ}$  to  $113^{\circ}\text{F}$  ( $0^{\circ}$  to  $45^{\circ}\text{C}$ )

@  $<95\%$  RH

Storage Temperature:  $14^{\circ}$  to  $122^{\circ}\text{F}$  ( $-10^{\circ}$  to  $50^{\circ}\text{C}$ )

@  $<95\%$  RH


Dimensions: 6.0 x 1.2 x 1.2 in. (152 x 31 x 31mm)

Weight (with batteries): 7.8 oz. (220g)

Power Source: 2 “AAA” (LR03) batteries (included)

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## **OPERATING & MAINTENANCE TIPS**

- When the  icon appears on the top line of the LCD, replace the batteries by following the procedure on p. 13. Use Alkaline batteries only.

- If the temperature of the IRT's target is lower than  $-4^{\circ}\text{F}$  ( $-20^{\circ}\text{C}$ )—the lower limit of the unit's measurement range—"LO" will appear on the readout.
- If the temperature of the IRT's target is higher than  $626^{\circ}\text{F}$  ( $330^{\circ}\text{C}$ )—the upper limit of the unit's measurement range—"HI" will appear on the readout.
- The IRT cannot make accurate measurements if there is glass or plastic between it and the target.
- Clean the lens of the infrared sensor (Fig. 1, Callout 9) often—but never use a solvent.
- Abrupt temperature changes will cause condensation and possible vapor penetration. Clean the LCD after the vapor evaporates. Blow off loose particles with clean, compressed air. Gently brush remaining debris away with a lens hair brush.
- To clean the housing, use a moist cotton swab or wet sponge. Avoid excessive amounts of water and corrosive gas or liquids.
- Remove the batteries if you don't expect to use the VR40 for an extended period of time (months or years).
- Do not drop or disassemble the instrument or immerse it in water.

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## WARRANTY INFORMATION

General Tools & Instruments' (General's) VR40 Non-contact Voltage Detector with Adjustable Sensitivity and IR Thermometer is warranted to the original purchaser to be free from defects in material and workmanship for a period of three years. Subject to certain restrictions, General will repair or replace this instrument if, after examination, the company determines it to be defective in material or workmanship.

This warranty does not apply to damages that General determines to be from an attempted repair by non-authorized personnel or misuse, alterations, normal wear and tear, or accidental damage. The defective unit must be returned to General Tools & Instruments or to a General-authorized service center, freight prepaid and insured.

Acceptance of the exclusive repair and replacement remedies described herein is a condition of the contract for purchase of this product. In no event shall General be liable for any incidental, special, consequential or punitive damages, or for any cost, attorneys' fees, expenses, or losses alleged to be a consequence of any damage due to failure of, or defect in any product including, but not limited to, any claims for loss of profits.

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## **RETURN FOR REPAIR POLICY**

Every effort has been made to provide you with a reliable product of superior quality. However, in the event your instrument requires repair, please contact our Customer Service to obtain an RGA (Return Goods Authorization) number before forwarding the unit via prepaid freight to the attention of our Service Center at this address:

General Tools & Instruments  
80 White Street  
New York, NY 10013  
212-431-6100

Remember to include a copy of your proof of purchase, your return address, and your phone number and/or e-mail address.



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