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**NOTES:**

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# Preface

## Warranty

**GTR® LABS**, llc warrants that this product will be free from defects in materials and workmanship for a period of twelve (12) months from the date of installation at the first end user's site; If any such product proves defective during this warranty period, **GTR®**, at it's option, either will repair the defective product without charge for parts and labor, or will provide a replacement in exchange for the defective product.

In order to obtain service under this warranty, Customer must notify **GTR®** of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. Customer shall be responsible for packaging and shipping the defective product to the service center designated by **GTR®** with shipping charges prepaid. **GTR® shall** pay for the return of the product to Customer if the shipment is to a location within the country in which the **GTR®** designated service center is located. Customer shall be responsible for paying all shipping charges, duties, taxes, and any other charges for products returned to any other locations.

This warranty shall not apply to any defect, failure, or damage caused by improper or inadequate maintenance and care. **GTR®** shall not be obligated to furnish service under this warranty 1) to repair damage resulting from attempts by personnel other than **GTR®** representatives to install, repair, or service this product; 2) to repair damage resulting from improper use or connection to incompatible equipment or power source; or 3) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

Further, **GTR® LABS**, llc warrants that the product is in compliance with U.S.A. DHHS regulations which may be in force and effect at the time of shipment of the product.

The following is not covered by the warranty: General maintenance and simple adjustments mentioned in the manuals delivered with the material.

**THIS WARRANTY IS GIVEN BY GTR® WITH RESPECT TO THIS PRODUCT IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED. GTR® AND IT'S VENDORS DISCLAIM ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. GTR®'S RESPONSIBILITY TO REPAIR OR REPLACE DEFECTIVE PRODUCTS IS THE SOLE REMEDY PROVIDED TO THE CUSTOMER FOR BREACH OF THIS WARRANTY. GTR® AND IT'S VENDORS WILL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IRRESPECTIVE OF WHETHER GTR® OR THE VENDOR HAS ADVANCE NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.**

There are no warranties which extend beyond the description mentioned in this document.

## Presentation

This manual contains information on the installation of the **V-RAD** generators.

## Notation



**NOTE:** This is an example of a **NOTE**. **NOTES** are areas that need additional attention.



**CAUTION:** This is an example of a **CAUTION**. **CAUTIONS** are procedures that the operator must heed in order to avoid damage to the equipment.

**NOTES:**

NOTES:



**WARNING:** This is an example of a **WARNING**. **WARNINGS** are procedures that the operator must heed in order to avoid bodily harm or injury.

### Applicability

This manual is applicable to the “V” Series, Single Tube RAD generators.

V-10	10 kW
V-20	20 kW
V-30	30 kW
V-40	40 kW
V-50	50 kW

This manual is shipped with generator Model # \_\_\_\_\_, Serial # \_\_\_\_\_, with Software Version \_\_\_\_\_.

### Safety

#### Mechanical-Electrical Warning

All of the electronic assemblies and parts of this equipment should be operated with care and routinely inspected in accordance with the manufacturer's recommendations.

Only properly trained and qualified personnel should be permitted access to any internal parts. Live electrical terminals are **LETHAL**. Be sure line disconnect switches are opened and other appropriate precautions are taken before removing covers or attaching accessories.

Do not remove the flexible high tension cables from the x-ray tube housing or high tension generator, and/or the access covers from the generator until the main and auxiliary power supplies have been disconnected.



**WARNING:** Failure to comply with the foregoing safeguards may result in serious or fatal bodily injuries to the operator or those in the area.

## Electrical Grounding Instructions



**WARNING:** The equipment must be grounded to an earth ground by a separate #8 conductor. The neutral side of the line is not to be considered the earth ground.

## Environment

This equipment is designed to work within a temperature range of 20°C to 30°C, with a relative humidity (non-condensing) less than 40%.



**CAUTION:** Provide adequate filtration if the generator is installed in a high dust or particulate matter environment.

## Radiation Warning



**WARNING:** X-rays are dangerous to operator unless established safe exposure procedures are observed.

The useful and scattered beams can produce serious or fatal bodily injuries to any persons in the immediate or surrounding area. Adequate precautions should be taken to avoid exposure to the central beam or to scattered radiation.

Persons authorized to operate the equipment should be familiar with the established safe exposure factors and procedures.

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# Chapter 1: Operation

## Ratings



**CAUTION:** For proper operation on a Single Phase or Three Phase Line it is recommended that you have 208 VAC (-10%/+20%).

**V-10 10 kW**

187/250 VAC, 1 Phase, 5A Standby, 35A Momentary

**V-20 20 kW**

187/250 VAC, 1 Phase, 5A Standby, 50A Momentary

**V-30 30 kW**

187/250 VAC, 1 Phase, 5A Standby, 65A Momentary

**V-40 40 kW**

187/250 VAC, 3 Phase, 5A Standby, 75A Momentary

**V-50 50 kW**

187/250 VAC, 3 Phase, 5A Standby, 100A Momentary

<b>kVp (In steps of 1 kVp)</b>	<b>40 to 125 V-10/20/30 40 to 150 V-40/50</b>
<b>mA</b>	<b>V-10 25 to 200 mA V-20 25 to 300 mA V-30 25 to 400 mA V-40 25 to 500 mA V-50 25 to 600mA</b>
<b>Time</b>	<b>2ms to 6 seconds</b>

Table 1-1 Technique Ranges

mA	2ms to .5 sec.	.6	.7	.8	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0
25														
50														
75														
100														
150														
200														

Table 1-1A Maximum Technique Selections (V-10)

mA	2ms to .5 sec.	.6	.7	.8	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0
25														
50														
75														
100														
150														
200														
250														
300														

Table 1-1B Maximum Technique Selections (V-20)

mA	2ms to .5 sec.	.6	.7	.8	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0
25														
50														
75														
100														
150														
200														
250														
300														
400	.1sec													

Table 1-1C Maximum Technique Selections (V-30)

NOTES:

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mA	2ms to .5 sec.	.6	.7	.8	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0
25														
50														
75														
100														
150														
200														
250														
300														
400														
500	.1 sec													

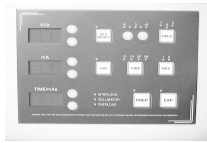
Table 1-1D Maximum Technique Selections (V-40)

mA	2ms to .5 sec.	.6	.7	.8	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0
25														
50														
75														
100														
150														
200														
250														
300														
400														
500	.1 sec													
600	.1 sec													

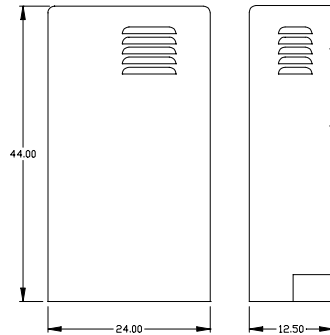
Table 1-1E Maximum Technique Selections (V-50)

Size and Weight

NOTES:



Operator's Console



Cabinet

<b>Height</b>	<b>44.0"</b>
<b>Depth</b>	<b>12.5"</b>
<b>Width</b>	<b>24.0"</b>
<b>Weight</b>	<b>70lbs (32kgs)</b>

Table 1-2 Cabinet

<b>Height</b>	<b>11.0"</b>
<b>Depth</b>	<b>16.0"</b>
<b>Width</b>	<b>12.0"</b>
<b>Weight</b>	<b>85lbs (38.5kgs)</b>

Table 1-3 HVT

<b>Height</b>	<b>8"</b>
<b>Depth</b>	<b>2.50"</b>
<b>Width</b>	<b>10"</b>
<b>Weight</b>	<b>1.0lbs (.5kgs)</b>

Table 1-4 Operator's Console

NOTES:

Configuration

Operator's Console

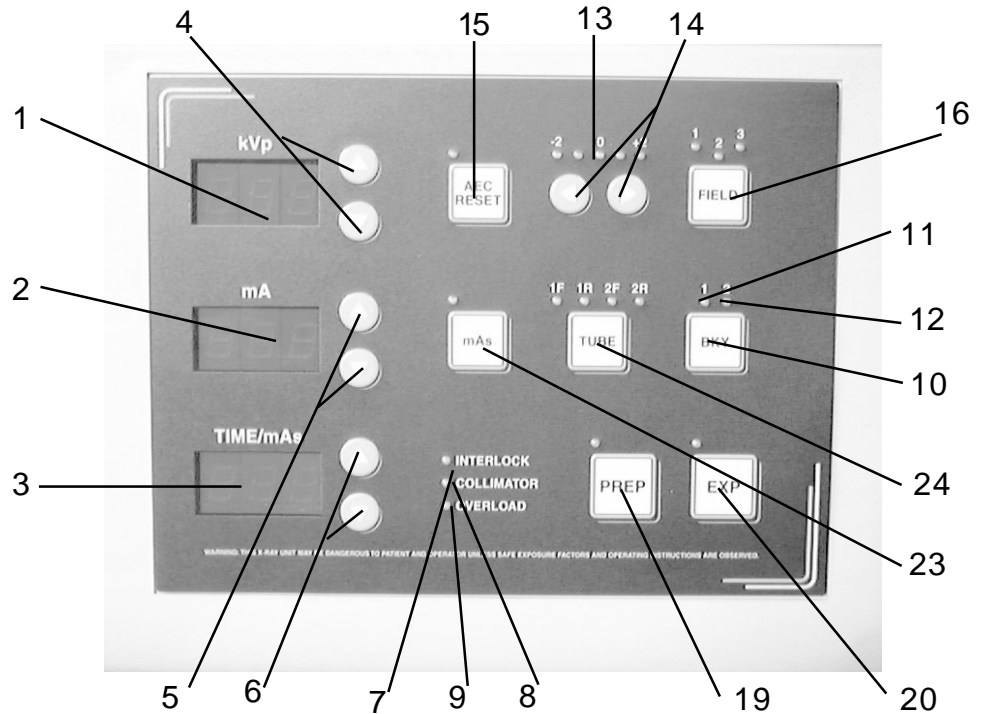


Figure 1-1A Operator's Console (Front View)

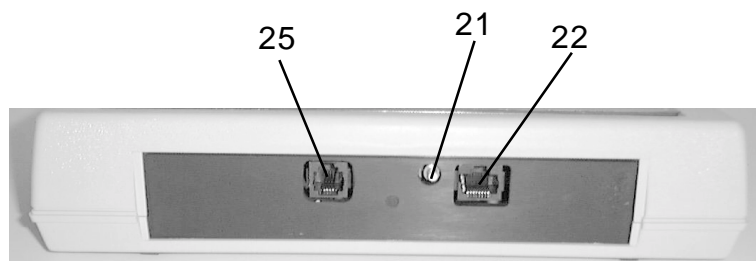


Figure 1-1B Operator's Console (Rear View)

- |                   |                         |
|-------------------|-------------------------|
| 1. kVp Display    | 12. BKY 2 LED           |
| 2. mA Display     | 13. AEC Density LEDs    |
| 3. Time Display   | 14. AEC Density Up/Down |
| 4. kVp Up/Down    | 15. AEC reset           |
| 5. mA Up/Down     | 16. AEC Field Select    |
| 6. Time Up/Down   | 19. PREP                |
| 7. Interlock LED  | 20. EXP                 |
| 8. Collimator LED | 21. On/Off              |
| 9. Overload LED   | 22. Connector           |
| 10. BKY Select    | 23. mAs Select          |
| 11. BKY 1 LED     | 24. Tube Select         |
|                   | 25. Hand Switch         |

## 1. kVp Display

The kVp Display displays the selected kVp. Additional functions include:

- **Displays software version on start-up**
- **Displays Error Codes in Self-Diagnostics**
- **Displays data during Auto-Cal**

## 2. mA Display

The mA Display displays the selected mA. Additional functions include:

- **Displays software version on start-up**
- **Displays data during Auto-Cal**

## 3. Time Display

The Time Display displays the selected Time. Additional functions include:

- **Displays Pre-Set # in SERVICE Mode**
- **Displays data during Auto-Cal**

## 4. kVp Up/Down

The kVp Up/Down push-buttons raise and lower the selected kVp. Additional functions include:

- **Toggle Error Codes in Self-Diagnostic Mode**
- **Select functions/data in calibration mode**

## 5. mA Up/Down

The mA Up/Down push-buttons raise and lower the mA. Additional functions include:

- **Toggle values for Pre-Set #s in SERVICE Mode**
- **Select values in Auto-Cal**

NOTES:

## NOTES:

**6. Time Up/Down**

The Time Up/Down push-buttons raise and lower the Exposure Time. Additional functions include:

- **Toggle Pre-Set #s in SERVICE Mode**

**7. Interlock LED**

The Interlock LED illuminates when an installed interlock is open. One or more interlocks can be connected in series to this function. Exposure is inhibited when this LED is illuminated.

**8. Collimator LED**

The Collimator LED illuminates when the collimator logic is not satisfied. Exposure is inhibited when this LED is illuminated.

**9. Overload LED**

The Overload LED illuminates when the safe exposure factors for the selected x-ray tube are exceeded. Exposure is inhibited when this LED is illuminated.

**10. BKY Select**

The BKY Select Switch is used to toggle between BKY 1, BKY 2, and No Bucky. (The condition of No Bucky is indicated when BKY 1 and BKY 2 LEDs are not illuminated.)

**11. BKY 1 LED**

BKY 1 LED is illuminated when Bucky 1 is selected. If an ion chamber is installed and enabled in the Bucky 1 position, it is selected as well.

**12. BKY 2 LED**

BKY 2 LED is illuminated when Bucky 2 is selected. If an ion chamber is installed and enabled in the Bucky 2 position, it is selected as well.

**13. Density LEDs**

Density LEDs indicate user selectable AEC Density.

## NOTES:

**14. Density Up/Down**

The Density Up/Down push-buttons increase and decrease the AEC Density.

**15. AEC RESET**

A blinking AEC RESET LED indicates that Backup Time has terminated an AEC exposure or that the 600 MAS limit has been reached. Pressing this switch resets the AEC function and another exposure may be initiated.

**16. FIELD.**

FIELD toggles between the three fields of a 3 field ion chamber.

**19. PREP**

When pressed, PREP initiates the Prep Sequence. The ready condition is indicated when the green LED is illuminated.

**20. EXP**

When pressed, with a green LED showing in PREP, EXP initiates an Exposure Sequence. "X-ray On" is indicated when the red LED is illuminated.

**21. On/Off**

This momentary pushbutton switch turns the generator on and off.

**22. Connector**

This is the serial interface connector. It connects the Operator's Console to the GCU using the Interconnecting Cable supplied with the generator.

**23. mAs Select**

Toggles TIME/mAs Display [3] between TIME indication in seconds and mAs indication. If the LED associated with [23] illuminated then the TIME/mAs Display [3] indicates mAs.

## NOTES:

**24. Tube Select**

On a single tube system this push button has no effect when pressed. On a multiple tube system this push button will toggle between the x-ray tubes. The LEDs will indicate the programmed function for each tube.

**25. Hand Switch**

This is the Hand Switch connector. Connect the Hand Switch supplied with the generator to this connector.

## Power On

Press and release the On/Off push-button [21] on the Operator's Console .

The system should come on and all segments of all the LEDs in the three displays should illuminate and the Beep should sound.

After a pause, the three displays will clear and indicate kVp, mA and Time.

## Technique Selection

Use the Up/Down push-buttons beside each display to select kVp, mA and Time.

If the Overload LED illuminates reduce the kVp until it is extinguished. Exposure is inhibited as long as this LED is illuminated.

## Last Technique Storage

The last displayed values for technique (ie. kVp, mA, Time/mAs etc.) are stored on power off. These techniques are recalled and displayed on power on.

## Bucky/AEC Selection

Use the BKY push-button to select BKY 1, BKY 2 or No Bucky.

No Bucky is selected if the BKY1 and BKY 2 LEDs are not illuminated.

Use the FIELD push-button to select AEC (if an Ion Chamber is installed).

Use the Density Up/Down push-buttons to select AEC Density



**NOTE: Select a long enough Back-Up Time on the Time Display when using AEC.**

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## NOTES:

**Prep/Exp**

The exposure sequence is as follows:

**Press and hold the PREP push-button.**

**The rotor and filament will boost.**

**The microprocessors will check interlocks and internal function.**

**The green READY LED will illuminate in the PREP push-button.**

**Press and hold the EXP push-button.**

**If a bucky is selected, the generator will wait for the Bucky Motion signal.**

**The exposure will begin.**

**The red X-RAY LED will illuminate in the EXP push-button.**

**An audible tone will sound.**

**These two indications will remain active for the length of the exposure.**

**At the end of the exposure the red X-RAY LED will extinguish and the audible tone will cease.**

**Another exposure can be initiated by momentarily releasing the EXP push-button and pressing it again without releasing the PREP push-button.**

**For AEC exposures that are less than the selected Time, the Operator's Console will display the actual exposure time in the Time display until the EXP push button or hand switch is released.**

**For Tomographic exposures that use the Bucky Motion input and are less than the selected Time, the Operator's Console will display the actual exposure time in the Time display until the EXP push button or hand switch is released.**

NOTES:

# Chapter 2: Diagnostics

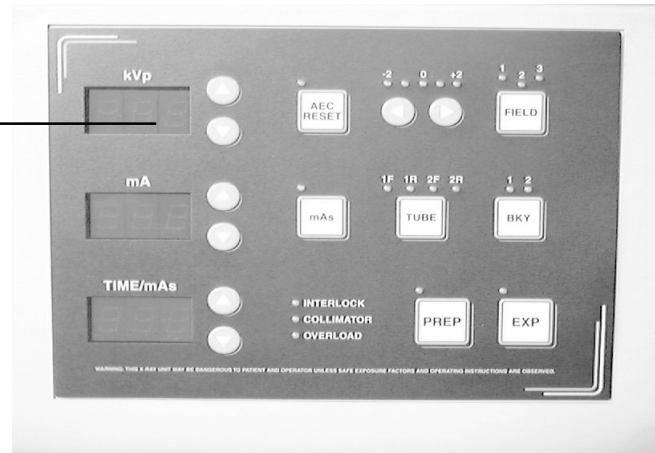
## Overview

The Self-Diagnostic System of the generator provides accurate, detailed information about the functions of the generator and any attached peripheral equipment.

This information is presented in the form of numerical Error Codes.

For the Operator, these Error Codes are presented on the kVp Display of the Operator's Console. Table 2-1 lists the Error Codes which can be displayed and describes the possible cause of the fault and the action the Operator should take.

kVp Display  
(Error Codes)



Operator's Console

## Error Codes

NOTES:

Error Code	Description	Operator Action
E01	Interface Cable	Cycle On/Off Push Button If error recurs call for service
E03	Bucky Timeout	Cycle On/Off Push Button If error recurs call for service
E04	Rotor Boost Timeout	Cycle On/Off Push Button If error recurs call for service
E05	Rotor Current w/o PREP	Cycle On/Off Push Button If error recurs call for service
E06	Filament Boost Timeout	Cycle On/Off Push Button If error recurs call for service
E07	Bad FIL Current	Cycle On/Off Push Button If error recurs call for service
E08	FIL Current Too High	Cycle On/Off Push Button If error recurs call for service
E09	Cathode kVp Fault (kVp too high)	Cycle On/Off Push Button If error recurs call for service
E10	Anode mA Fault (mA too high)	Cycle On/Off Push Button If error recurs call for service
E11	Anode kVp Fault (kVp too high)	Cycle On/Off Push Button If error recurs call for service
E12	Cathode mA Fault (mA too high)	Cycle On/Off Push Button If error recurs call for service
E13	TEC Fault	Cycle On/Off Push Button If error recurs call for service
E14	IPM #1 Fault	Cycle On/Off Push Button If error recurs call for service
E15	IPM #2 Fault	Cycle On/Off Push Button If error recurs call for service

Table 2-1a Error Codes

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NOTES:

Error Code	Description	Operator Action
E16	Setup/Calibration Data Fault	Cycle On/Off Push Button If error recurs call for service
E17	Voltage Monitor Fault	Cycle On/Off Push Button If error recurs call for service
E18	GPU not responding to Console	Cycle On/Off Push Button If error recurs call for service
E19	Tube Voltage Drop during Fluoro	Cycle On/Off Push Button If error recurs call for service
E20	Voltage on capacitors during standby	Cycle On/Off Push Button If error recurs call for service
E31	%HU Over 85%	Wait for X-Ray Tube Anode to Cool
E32	Sync Missing or Incorrect	Cycle On/Off Push Button If error recurs call for service

Table 2-1b Error Codes

**E01 Interface Cable**

This Error Code indicates one (or more) of the external or internal Interface Cables is disconnected.

**E02 Tube Thermal Interlock**

This Error Code indicates that the x-ray tube has overheated.

You must wait until the x-ray tube cools and this Error Code is automatically reset before you can make an exposure.

**E03 No Bucky Motion/Tomo**

This Error Code indicates there is no bucky motion after you press the EXP push-button.

If you have a Tomo device connected to the generator this Error Code indicates no Tomo motion after you press the EXP push-button.

**E04 Rotor Boost Timeout**

This Error Code indicates no rotor current sensed after the PREP push-button is pressed.

**E05 Rotor Current without PREP**

This Error Code indicates a fault in the rotor start circuit.

**E06 Filament Boost Timeout**

This Error Code indicates no filament boost after the PREP push-button is pressed.

**E07 No FIL I**

This Error Code indicates no filament current.

**E08 FIL I Too High**

This Error Code indicates an excessive filament current when the PREP push-button is pressed.

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## NOTES:

**E09 Anode Fault (kVp Too High)**

This Error Code indicates excessive Anode kVp during an exposure.

**E10 Anode Fault (mA Too High)**

This Error Code indicates excessive Anode x-ray tube current during an exposure.

**E11 Cathode Fault (kVp Too High)**

This Error Code indicates excessive Cathode kVp during an exposure.

**E12 Cathode Fault (mA Too High)**

This Error Code indicates excessive Cathode x-ray tube current during an exposure.

**E13 TEC Fault**

This Error Code indicates a fault on the TEC pcb.

**E14 IPM 1 Fault**

This Error Code indicates excessive current through IPM 1.

**E15 IPM 2 Fault**

This Error Code indicates excessive current through IPM 2.

**E16 Setup/Calibration Data Fault**

This Error Code indicates corrupted or missing Setup/Calibration Data on startup.

**E17 Voltage Monitor Fault**

This Error Code indicates a fault in the voltage on the storage capacitors sensed when the PREP push-button is pressed.

**E18 GPU Not Responding**

This Error Code indicates that the GPU pcb is not responding to the Operator's Console.

**E19 kVp Drop During Exposure**

This Error Code indicates that the kVp (Anode or Cathode) dropped during an exposure. This could be due to a line voltage drop or a short in the high voltage circuit.

**E20 Voltage on Capacitors in Stand By**

This Error Code indicates that there is voltage on the storage capacitors during the Stand By mode. This indicates a fault on the SIB pcb.

**E31 % HU over 85%**

This Error Code indicates that the total heat stored in the anode of the x-ray tube has exceeded 85%. When the % HU drops below 85% this error will automatically clear itself.

**E32 Sync Missing or Incorrect**

This Error Code indicates that the line frequency was missing or incorrect on Power On. This value is critical for Tube Protection.

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