TCE-8000 Programming Guide

CORIOLIS TCM SERIES

Rev. 1xx

TRICOR
Coriolis Technology

www.tricorflow.com

TRICOR® Mass Flow Meter
TCE-8000 Transmitter Programming Guide

This guide contains instructions on how to reconfigure the TCE-8000 Coriolis transmitter using its integral keyboard and display. There are two packaging configurations of the TCE-8000 transmitter: field mount (cast aluminum housing) and panel mount (plastic housing). These programming instructions apply to both packaging configurations. The TRICOR TCE-8000 transmitter's keyboard and display consists of an LCD graphic display, two LEDs labeled "OK" and "ERR", and 4 pushbutton keys labeled "P", "Reset", "Display", and "Info".

Normal Operation

When the TRICOR flow meter is operating properly, the LED labeled "OK" will flash green. With the factory defaults, the display will indicate FLOW RATE on the upper line and TOTAL on the lower line. When viewing this display, reset the TOTAL to zero by pressing the "Reset" key. Press the "Display" key to view the DENSITY on the upper line and TEMPERATURE on the lower line of the display. Press the "Display" key to toggle back to the FLOW RATE and TOTAL display. The normal operation displays can be reconfigured to shown other data other than the factory defaults (see DISPLAY reprogramming).

Abnormal Operation

When the LED labeled "ERR" is flashing red, the internal diagnostics of the transmitter have sensed a problem that indicates there may be a measurement error occurring. Press the "Info" key to view the problem that has been sensed and to look at additional parameters that are important to the operation of the unit. Note: Press the "info" key during normal operation to view these additional parameters. The display that will appear is similar to the following:

SA: 140	FRE 142.74
SB: 140	DEN 1.00
DR: 5.51	OFF: -0.02
PT: 21.66	RUN: -0.0

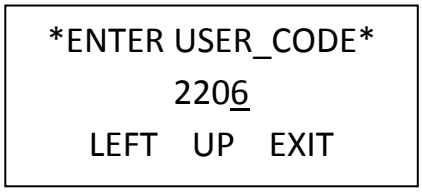
These parameters are important when discussing operational problems with a TRICOR service technician and correspond to the following data:

SA is the amplitude of Sensor A in millivolts
SB is the amplitude of Sensor B in millivolts
DR is the sensor DRive current in milliamps
PT is the temperature indicated by the Platinum **T**emperature probe in degrees Celsius
FRE is the vibrating tube FREquency in Hz
DEN is the process fluid DENsity in g/cc
OFF is the captured zero OFFset calibration in microseconds
RUN is the RUNning flow rate signal in microseconds.

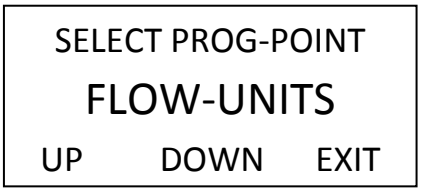
Reprogramming Operation

To enter the function that allows you to reconfigure the transmitter perform the following steps:

- Press and hold the “P” key until the following screen appears:



- Press the “UP” key, to change 2206 to 2207, then press the “P” key and the following screens will appear:



- Press the “Down” key to access the parameter(s) that needs to be changed. The menu under user code 2207 is as follows:

Displayed Parameter	Description
FLOW-UNITS	select unit of measure for flow rate display
FLOW-DP	select decimal point location in flow rate display
FLOW-FILTER	define filter value used to smooth flow rate display
TOTAL-UNITS	select unit of measure for flow totalizer display
TOTAL-DP	select decimal point location in flow totalizer display
DENS-UNITS	select unit of measure for density display
TEMP-UNITS	select unit of measure for temperature display
KEY-RESET	activate/de-activate reset key
FLOW-DIREC	select the direction of flow through the sensor
FREQ-OUT	scale the frequency or cycle out output
CURRENT 1	define and scale the milliamp 1 output
CURRENT 2	define and scale the milliamp 2 output
ZERO-POINT	initiate a zero point calibration
DISPLAY	configure the normal measurement displays 1 and 2
FAULT TIME	scale time delay before and after an error is declared
SAVE DATA	initiate a save of data changes to the backup memory
RESTORE DAT	restore data saved during the previous SAVE DATA operation
I/O – TEST	output a specified test frequency or test current
CTL-INPUT	select the control input function
INTERFACE	select the serial communication interface

Additional configuration parameters can be found under user code **2208.** The menu under user code 2208 is as follows:

Displayed Parameter Description

ACTUAL TEMP	calibrate the current temperature to the value entered
Q-MAX.	define maximum flow rate in grams per second for the attached sensor
CUTOFF RATE	define the flow rate below which the unit will show zero rate and will not totalize
RESP- STEP	define the step response in flow that will reset the flow filter

FLOW-UNITS programming

When FLOW-UNITS is displayed press the "P" key to bring up the current flow rate units. Press the "Up" or "Down" key to select the desired unit of measure from the ordered list below:

Mass Flow Rate Units

FLOW-UNITS	Description
G/S	Grams/second
KG/S	Kilograms/second
LB/S	Pounds/second
OZ/S	Ounces/second
T/S	Metric tons/second
ST/S	Stones/second
G/M	Grams/minute
KG/M	Kilograms/minute
LB/M	Pounds/minute
OZ/M	Ounces/minute
T/M	Metric tons/minute
ST/M	Stones/minute
G/H	Grams/hour
KG/H	Kilograms/hour
LB/H	Pounds/hour
OZ/H	Ounces/hour
T/H	Metric tons/hour
ST/H	Stones/hour
G/D	Grams/day
KG/D	Kilograms/day
LB/D	Pounds/day
OZ/D	Ounces/day
T/D	Metric tons/day
ST/D	Stones/day

Volumetric Flow Rate Units

Flow Rate Unit	Description
CC/S	Cubic centimeters/second
L/S	Liters/second
USGAL/S	US gallons/second
LOZ/S	Fluid ounces/second
EGAL/S	English gallons/second
BBL/S	English barrels/second
CC/M	Cubic centimeters/minute
L/M	Liters/minute
USGAL/M	US gallons/minute
LOZ/M	Fluid ounces/minute
EGAL/M	English gallons/minute
BBL/M	English barrels/minute
CC/H	Cubic centimeters/hour
L/H	Liters/hour
USGAL/H	US gallons/hour
LOZ/H	Fluid ounces/hour
EGAL/H	English gallons/hour
BBL/H	English barrels/hour
CC/D	Cubic centimeters/day
L/D	Liters/day
USGAL/D	US gallons/day
LOZ/D	Fluid ounces/day
EGAL/D	English gallons/day
BBL/D	English barrels/day

When the desired flow rate unit is displayed, press the “P” key and the display will return to FLOW-UNITS. Note: Volumetric flow is computed by dividing the measured mass by the measured density.

FLOW-DP programming

When FLOW-DP is displayed press the “P” key to bring up the current position of the flow rate decimal point. Press the “LEFT” key to select the desired position of the flow rate decimal point then press the “P” key and the display will return to FLOW-DP.

FLOW-FILTER programming

When FLOW-FILTER is displayed press the “P” key to bring up the current number of samples used to calculate the flow rate display. Press the “RIGHT” and “UP” keys to define the desired number of samples between 1 and 100,000. Press the “P” key and the display will return to FLOW-FILTER.

Note: The larger the number of samples used in the FLOW-FILTER, the steadier the rate display will be but the longer the time will be to reach its final value when a change in the flow rate is made. The factory default is 500 for moderate filtering.

TOTAL-UNITS programming

When TOTAL-UNITS is displayed press the “P” key to bring up the current totalizer unit of measure. Press the “Up” or “Down” key to select the desired unit of measure from the ordered list below:

TOTAL-UNITS	Description
GRAMS	Grams
KILO	Kilograms
POUNDS	Pounds mass
OUNCES	Ounces mass
TONS	Metric tons
STONES	Stones
CC	Cubic centimeters
LITER	Liters
US-GAL	US gallons
L-OUNC	Fluid ounces
UK-GAL	English gallons
UK-BBL	English barrels

When the desired totalizer unit is displayed press the “P” key and the display will return to TOTAL-UNITS.

TOTAL-DP programming

When TOTAL-DP is displayed press the “P” key to bring up the current position of the totalizer decimal point. Press the “LEFT” key to select the desired position of the totalizer decimal point then press the “P” key and the display will return to TOTAL-DP.

DENS-UNITS programming

When DENS-UNITS is displayed press the “P” key to bring up the current density unit of measure. Press the “Up” or “Down” key to select the desired unit of measure from the ordered list below:

DENS-UNIT	Description
KG/L	Kilograms/Liter
LB/FT3	Pounds/Cubic foot
LB/GAL	Pounds/US gallon
G/CC	Grams/Cubic centimeter
G/L	Grams/Liter

When the desired density unit is displayed press the “P” key and the display will return to DENS-UNITS.

TEMP-UNITS programming

When TEMP-UNITS is displayed press the “P” key to bring up the current temperature unit of measure. Press the “Up” or “Down” key to select the desired unit of measure from the ordered list below:

TEMP-UNITS	Description
FAHRENHEIT	Degrees Fahrenheit
CELSIUS	Degrees Celsius

When the desired temperature unit is displayed press the “P” key and the display will return to TEMP-UNITS.

KEY-RESET programming

When KEY-RESET is displayed press the “P” key to bring up the current function of the “Reset” key. Press the “Up” or “Down” key to select the desired function of the “Reset” key from the ordered list below:

KEY-RESET	Description
KEY RES. ON	Press “Reset” key when viewing the TOTAL to zero it
KEY RES. OFF	“Reset” key does not set TOTAL to zero

When the desired function of the “Reset” key is displayed press the “P” key and the display will return to KEY-RESET.

FLOW-DIREC programming

When FLOW-DIREC is displayed press the “P” key to bring up the current selection of flow direction. Press the “Up” or “Down” key to select the desired function from the ordered list below:

FLOW-DIREC	Description
FORWARD	Flow in the direction of the arrow on the sensor will show a positive value for flow rate and the totalizer will increment. Flow in the opposite direction of the arrow on the sensor will show a negative value for flow rate and the totalizer will decrement until it reaches zero. The frequency and milliamp output will only be active during positive flow rates.
REVERSE	Flow in the opposite direction of the arrow on the sensor will show a positive value for flow rate and the totalizer will increment. Flow in the direction of the arrow on the sensor will show a negative value for flow rate and the totalizer will decrement until it reaches zero. The frequency and milliamp output will only be active during positive flow rates.

When the desired function of the FLOW-DIREC is displayed press the “P” key and the display will return to FLOW-DIREC.

FREQ-OUT programming

When FREQ-OUT is displayed press the “P” key to bring up the current function of the f-out output of the transmitter. Press the “Up” or “Down” key to select the desired function from the ordered list below:

FREQ-OUT	Description
FREQUENZ	f-out produces a frequency that is proportional to the flow rate. Frequencies up to 10,000 Hz can be produced in the FREQUENZ mode of operation. Note: Because this mode outputs a frequency proportional to flow rate, totalizing these pulses may result in a slight discrepancy from the TOTAL display.
CYCLE OUT	f-out produces pulses that are based on the internal totalizer. In the CYCLE OUT mode, a change in state from low to high, or high to low occurs when the internal totalizer increases by a set amount of mass (or volume). Totalizing these pulses results in an accurate representation of the TOTAL display. The maximum output in this mode is about 15 pulses per second.

FREQUENZ programming

When FREQUENZ mode of operation is selected press the “P” key to view and/or set the additional scaling parameter required for the frequency mode of operation. In each of the following screens set the numerical value using the “RIGHT” and “UP” keys, then “P” to advance to the next parameter.

FULLSCALE FOR F-OUT	Flow rate in the FLOW-UNITS selected that correspond to the frequency selected in the next screen, MAX FREQ. AT FULLSCALE.
MAX FREQ.AT FULLSCALE	Frequency corresponding to the flow rate entered in the previous screen, FULLSCALE FOR F-OUT.
FREQUENZ FILTER	Filter for smoothing the frequency output. Reasonable values are between 10 and 10000. Default is 100, light filtering.
FREQUENZ SAMPLE	A second filter for smoothing the frequency output. Reasonable values are between 100 and 950. Default is 110, light sampling.
FREQUENZ STEP	The frequency change that temporarily resets the filter for a faster respond to quick changes in flow rate. Reasonable values are between 5% and 10% of the MAX. FREQ AT FULLSCALE. The default is 40 Hz.

CYCLE OUT programming

When CYCLE OUT mode of operation is selected press the "P" key to view and/or set the VALUE FOR CYCLE OUT. This is the unit of mass (or volume) corresponding to a change in state of f-out. If, for example, you desire one pulse per tenth of a pound, set the VALUE FOR CYCLE OUT to 0.05000 pounds. The output will cycle from low to high after 0.05 pounds of incremental flow and from high back to low after the next incremental 0.05 pounds of flow giving one pulse per 0.1 pound. To ensure that the CYCLE OUT does not exceed the maximum frequency of 15 Hz, the VALUE FOR CYCLE OUT must be checked against the maximum flow rate expected or a shortage of pulses could result. In the example above, 15 Hz corresponds to 15 pulses per second times 0.1 pounds per pulse = 1.5 lb/second or 90 lb/minute maximum flow rate.

Press the "P" key to return to FREQ-OUT display.

CURRENT 1 (or CURRENT 2) programming

When CURRENT 1 (or CURRENT 2) is displayed press the "P" key to view and/or set the additional scaling parameter required for each milliamp output.

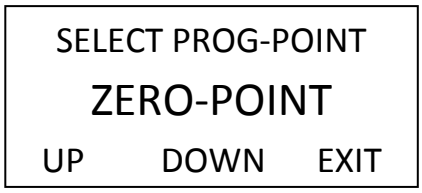
RULE CURRENT 1	4 MA OUT FLOW-RATE GRAVITY TEMPERATURE TOTAL
VALUE AT 20 mA	The value of the process variable selected at 20 mA. Not applicable if 4 MA OUT is selected.
OFFSET CURRENT 1	The current output when the measured variable is zero. Typically this is 004.0 mA but can be set as low as 2.0 mA.
FILTER CURRENT 1	Filter for smoothing the milliamp output. Reasonable values are between 10 and 10000. Default is 100, light filtering.

Note: Select 4 MA OUT for current loop 2 if HART communication is required. This current loop is the one used for the HART modem.

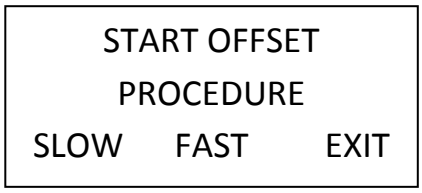
Press the “P” key to return to CURRENT 1 (or CURRENT 2) display.

ZERO-POINT programming

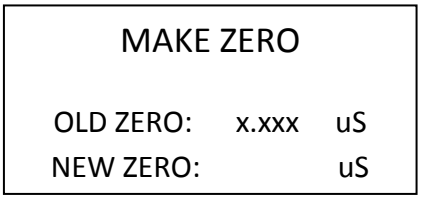
- Shut off the flow and block in the flow line with a downstream valve to ensure that the flow rate is truly zero.
- Press the “DOWN” key and the following screen appears:

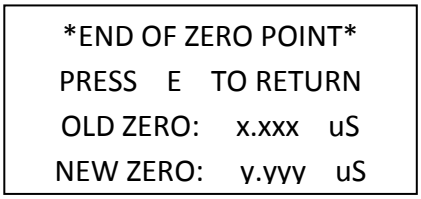


- Press the “P” key and the following screen will appear:



- Press the “SLOW” key for long averaging (about 30 seconds) or “FAST” key for short averaging (about 10 seconds) to initiate zero point calibration. Caution: Do not flow through the sensor while the following screens are displayed:





- The zero point calibration is complete. Press the EXIT key to return to the ZERO-POINT display.

DISPLAY preprogramming

The normal operating factory default display 1 is set to show RATE on the upper line and TOTAL on the lower line. The factory default display 2 is set to show DENSITY on the upper line and TEMPERATURE on the lower line. The “Display’ key is used to toggle between display 1 and display 2 during normal flowmeter operation. Display 1 and display 2 can be customized to have a single line/single parameter displayed in a larger font. Also, the double line display can be reconfigured to show different parameters of interest.

When “DISPLAY” is displayed press the “P” key.

DISPLAY	Description
MODE	Select to configure display 1 and/or display 2
BACKLIGHT	Select to turn on/off the display backlight

When MODE is displayed press the “P” key to begin configuring display 1 or display 2 and select from the ordered list below:

MODE	Description

DISPLAY 1	Select Display 1
DISPLAY 2	Select Display 2

Select the desired display (1 or 2) and press the “P” key. The current configuration of the display will be displayed. Press the “P” key to change it or the “EXIT” key for no change.
If the “P” key is pressed the current line mode will be displayed:

SELECT LINE MODE
1-LINE
2-LINES

Select the desired line mode and press the “P” key. Then select the parameter to be displayed from the ordered list below:

SELECT LINE 1
RATE
TOTAL
DENS.
TEMP.
F-OUT
CURR-1
CURR-2

Press the “P” key and repeat this procedure for LINE 2 if 2-LINES was previously selected. Press the “P” key to return to DISPLAY 1. Press “DOWN” to display DISPLAY 2 and repeat the above procedure. Press “EXIT” twice to return to DISPLAY. Press “P” key to display the following selection:

DISPLAY	**Description**
MODE	Select to configure display 1 and/or display 2
BACKLIGHT	Select to turn on/off the display backlight

Select BACKLIGHT and press the “P” key to display the following selection:

BACKLIGHT SETTINGS:
ON
OFF

Select ON or OFF then press the “P” key and then the “EXIT” key to return to DISPLAY.

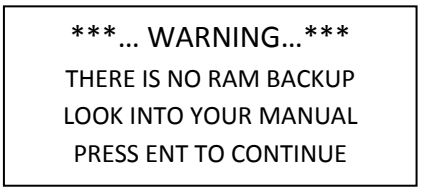
FAULT-TIME programming

When FAULT-TIME is displayed press the “P” key to show the current setting of the FAULT ON DELAY TIME. This is the amount of time after an error is detected before the “ERR” LED will begin to flash. The Control Output will also be delayed by this time. The range is 0 to 10,000 seconds. Default is 2.73 seconds. Adjust the FAULT ON DELAY TIME using the “RIGHT” and “UP” keys.

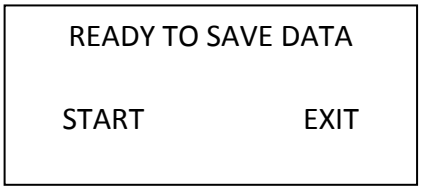
Press “P” to show the current setting of the FAULT OFF DELAY TIME. This is the amount of time after an error has gone away that the “ERR” LED continues to flash. The Control Output will also be delayed by this time. The range is 0 to 10,000 seconds. Default is 2.73 seconds. Adjust the FAULT OFF DELAY TIME using the “RIGHT” and “UP” keys then press “P” to return to FAULT TIME display.

SAVE DATA programming

When SAVE DATA is displayed all new configuration settings can be saved in the non-volatile EEPROM memory. If changes have been made but not saved, a warning message will appear during startup for about 10 seconds as follows:



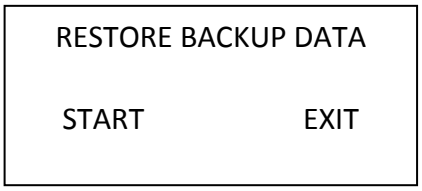
To initiate a SAVE DATA operation press the “P” key and the following screen will appear:



Press “START” and the following screens will appear:

RESTORE DATA programming

When RESTORE DATA is displayed any changes that have been made can be deleted to revert to the settings the last time SAVE DATA was performed. To initiate a RESTORE DATA operation press the “P” key and the following screen will appear:



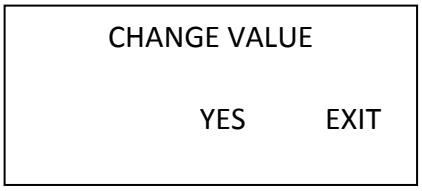
Press “START” and the following screens will appear:

I/O – TEST programming

When I/O TEST is displayed the frequency or milliamp outputs can be driven to fixed levels to test your receiving device(s). Note: STATUS OUT and RS232/485 tests are not implemented at this time. Press the “P” key to select the output to be driven from the ordered list below:

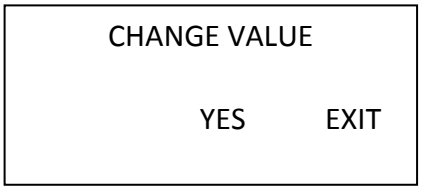
I/O TEST
FREQUENZ
CURRENT 1
CURRENT 2
STATUS OUT
RS232/485

When FREQUENZ is selected press the “P” key to ENTER FREQUENZ [HZ]. Valid entries are 1 to 9999 Hz. Press the “P” key and the frequency that was displayed will be output while the display reads as follows:



Press “YES” to enter a different frequency or “EXIT” to stop the test.

When CURRENT n is selected press the “P” key to ENTER CURRENT n [mA]. Valid entries are 1 to 22 mA Press the “P” key and the current that was displayed will be output while the display reads as follows:



Press “YES” to enter a different current or “EXIT” to stop the test. Press “EXIT” again to display I/O - TEST.

CTL-INPUT programming

When CTL-INPUT is displayed press the “P” key to view the current function of the control input. Select the function from the ordered list below;

SET CONTROL INPUT	Description
OFFSET	A high input level initiates a zero offset procedure
RESET TOTAL	A high input initiates a totalizer reset procedure

INTERFACE programming

When INTERFACE is displayed press the “P” key to view the current function of the serial communications interface. Select the function from the ordered list below:

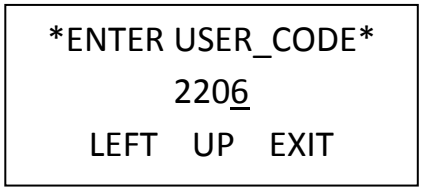
SET INTERFACE MODE	Description
RS485	Proprietary Protocol over the RS485 physical layer (consult factory for protocol details)
HART	Highway Addressable Remote Interface (HART Protocol) over milliamp 2 output physical layer (consult factory for protocol details).

Press “P” key to return to INTERFACE display. Then press “EXIT” key to return to normal operation.

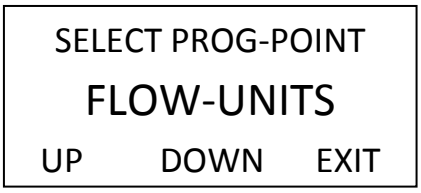
Additional Programming Parameters

Four additional parameters are available under security code 2208

- Press and hold the “P” key until the following screen appears:



- Press the “UP” key twice to change 2206 to 2208, then press the “P” key and the following screens will appear:



- Press the “Down” key to access the parameter(s) that needs to be changed. The menu under user code 2208 is as follows:

Displayed Parameter Description

ACTUAL TEMP	calibrate the current temperature to the value entered
Q-MAX.	define maximum flow rate in grams per second for the attached sensor
CUTOFF RATE	define the flow rate below which the unit will show zero rate and will not totalize
RESP- STEP	define the step response in flow that will reset the flow filter

ACTUAL TEMPERATURE programming

When ACTUAL TEMPERATURE is displayed press the “P” key to display the current temperature. This value can be fine turned if the actual temperature is known to be different from the value displayed. When ENTER ACTUAL TEMP. °C IS DISPLAYED, adjust the value using the “LEFT” and “UP” keys. Press the “P” key to accept this value and return to the ACTUAL TEMPERATURE display.

Q-MAX programming

When Q-MAX is displayed press the “P” key to display the maximum flow rate for the connected TRICOR flow sensor connected. Using the “LEFT” and “UP” keys enter the value from the table below:

TRICOR sensor model number	SENSOR Q-MAX [G/S]:
TCM300	200.00
TCM600	400.00
TCM1500	1000.00
TCM3000	2000.00
TCM6.9K	4600.00
TCM28K	7777.00
TCM65K	43333.0

Press the “P” key to return to the Q-MAX. display.

CUTOFF RATE programming

When CUTOFF RATE is displayed press the “P” key to display the current low flow CUTOFF RATE [%]. Default is 1.5% of the sensor Q-MAX. Valid entries are between 0.1 and 99 % of Q-MAX. Using the “LEFT” and “UP” keys enter the desired low flow cutoff rate and press the “P” key to return to the CUTOFF RATE display.

RESP-STEP programming

When RESP-STEP is displayed press the “P” key to display the current RESPONSE STEP: [%]. Default is 0.1% of the sensor Q-MAX. Valid entries are between 0.1 and 99 %of Q-MAX. Using the “LEFT” and “UP” keys enter the desired response step and press the “P” key to return to the RESP-STEP display. Press the “EXIT” key to return to the normal operation screen.

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