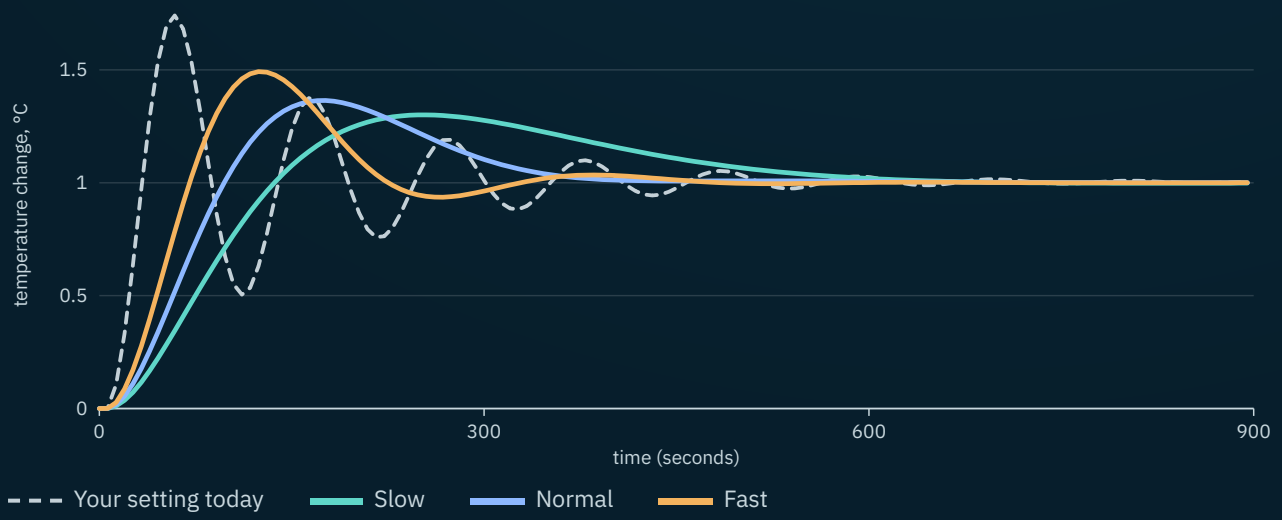
LOOP TUNING FOR PROCESS PLANTS

Settings your loops can trust.

CARI-Tune finds the controllers whose settings are too aggressive, puts the valve check first, and gives your engineer three new settings for each: slow, normal and fast. Every setting comes with its safety margin, pictures of the predicted response, and a sheet in your controller block's own field names and units.

CARI-Tune includes everything in CARI-Loops, the health check of every loop and valve, and adds the tuning.

Worked example: reactor temperature loop. Predicted response to a 1 °C set-point step, today and with each new setting



1.74 → 1.36 °C
peak after a 1 °C set-point step, today against Normal

497 → 340 s
time to settle within 5 %, today against Normal

3 settings
slow, normal, fast, each with its stated safety margin

10 sheet styles
in control systems' own field names and units

AT A GLANCE

One tuning job, from the swing to the signed change.

Choose the balance each loop needs: a calmer answer to set-point moves, a firmer hold against load changes, and a stated safety margin. CARI-Tune gives your team one clear path from the loop that swings to the change that is approved, entered and checked.

Rank the loops

Every loop from the built-in health check in one table: the worst first, or the costliest first when you give your own cost of error. Whole units at once.

Check the valve first

A loop whose trouble is the valve or the instrument gets no new settings. It gets a plain reason and what to test first.

Compare three settings

Slow, normal and fast for each loop to retune. Each has a stated safety margin and its predicted response drawn beside the setting you run today.

Approve, enter and re-check

A sheet in your controller block's own field names and units. A proposer and an approver on every change, a sealed history, and a monthly re-check.

THE PATH, STEP BY STEP

1 Find	2 Check the valve	3 Test	4 Choose	5 Approve	6 Re-check
The health check names the loops that swing.	Your engineer runs a valve stroke test.	A short loop test, run by your engineer.	One of three settings, by its predicted response.	Proposer and approver; the engineer enters it.	Read-back and trend now; each month after.

Built for the control engineer. CARI-Tune works from the exports your control system already keeps and from two tests your own engineer runs, planned with your operating team. No new sensors. Your engineer enters every setting through your own change procedure.

WORKED EXAMPLE IN THIS BROCHURE

A reactor temperature loop on a standard published test plant: the routine record and the loop test on page 6, the three settings and their predicted responses on page 7, the settings sheet on page 8.

WHAT YOU SEND, WHAT YOU RECEIVE

From a health check to settings you can enter.

CARI-Tune includes the CARI-Loops health check, taking your team from a ranked export to approved tuning settings. The health check grades every loop in your export; the loops that need retuning go straight in.

YOU SEND

Trend export of the unit
Time, measurement, set point, controller output and mode for each loop, as CSV from your DCS, PLC, SCADA or historian.

Current gain, integral time and action
Add them to compare with today. Enter them before approval, so the change record holds the setting being replaced.

Your cost of error
Per unit of error per hour, or per off-spec hour. Optional; turns health order into money order.

Valve stroke test result
Passed or not. Run by your engineer only on the loops the health check grades for retuning.

Short loop test file
A short recording by your engineer: steady running, one small step of the controller output, then a few small moves each way around the working point. Twelve minutes in the worked example.

→

YOU RECEIVE

One ranked table for the unit
Every loop with its grade, the finding behind it and the reason in words.

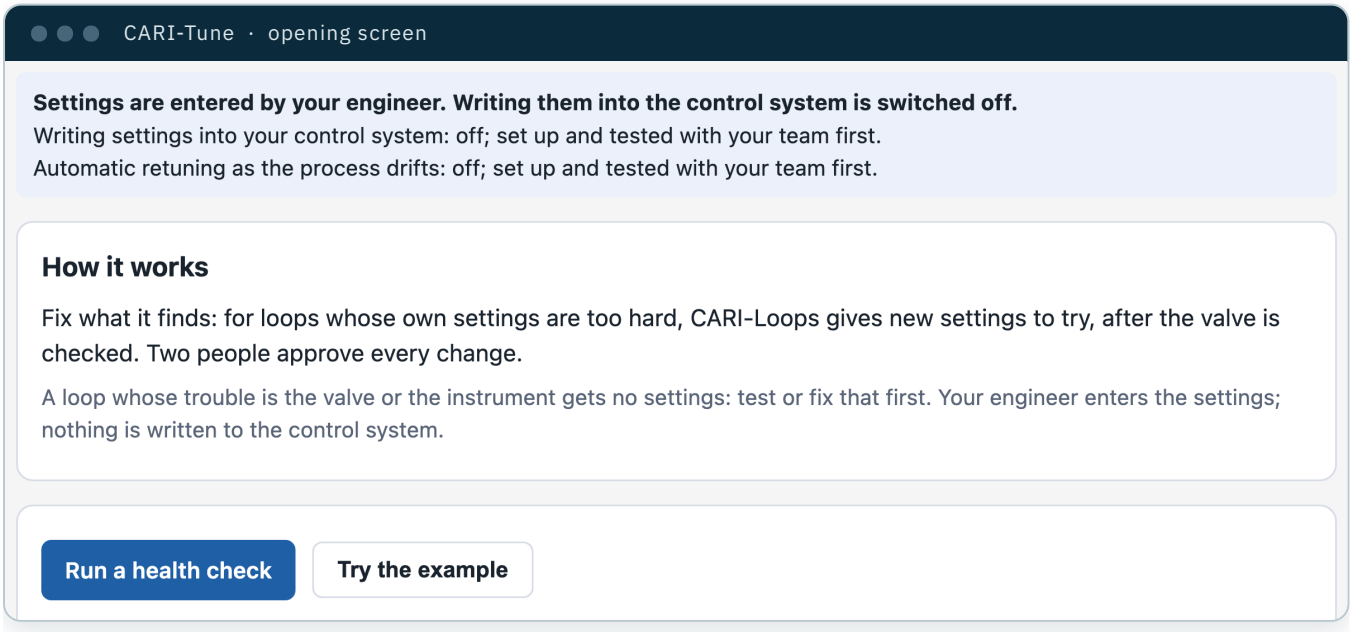
Three settings for each loop to retune
Slow, normal and fast: gain, integral time and the stated safety margin of each.

Two pictures for each of those loops
A set-point move and a load upset, each setting drawn beside today's.

A plain answer against today
The Normal setting against today's, on the predicted responses: better, worse or too close to call.

A settings sheet in your system's style
Field names, units and action as your controller block shows them; CSV and a printable page.

A sealed change history
Proposer, approver, old and new settings, date and a record code.



The opening screen. Enter only the figures you have. Your records stay on your own PC.

THE VALVE-FIRST RULE

Check the valve. Then tune the loop.

A sticking valve needs valve work, not new settings. So CARI-Tune grades every loop first, and gives settings where the health check and the loop test point to the settings themselves.

GRADE ON SCREEN	WHAT IT MEANS	WHAT YOU GET
needs retuning	The record points to the current settings as the cause of the swing.	Three settings, two pictures, a settings sheet.
test the valve	The swing has the look of a valve that sticks or has play.	No settings. A valve stroke test to run first.
instrument first	The record shows a measurement that is frozen or appears to drift.	No settings. The transmitter to check.
no problem found	No tuning issue was found in this record.	Left alone. Nothing to tune.

1 Find the loop

The built-in health check names the loops that swing and grades the likely cause.

2 Check the valve

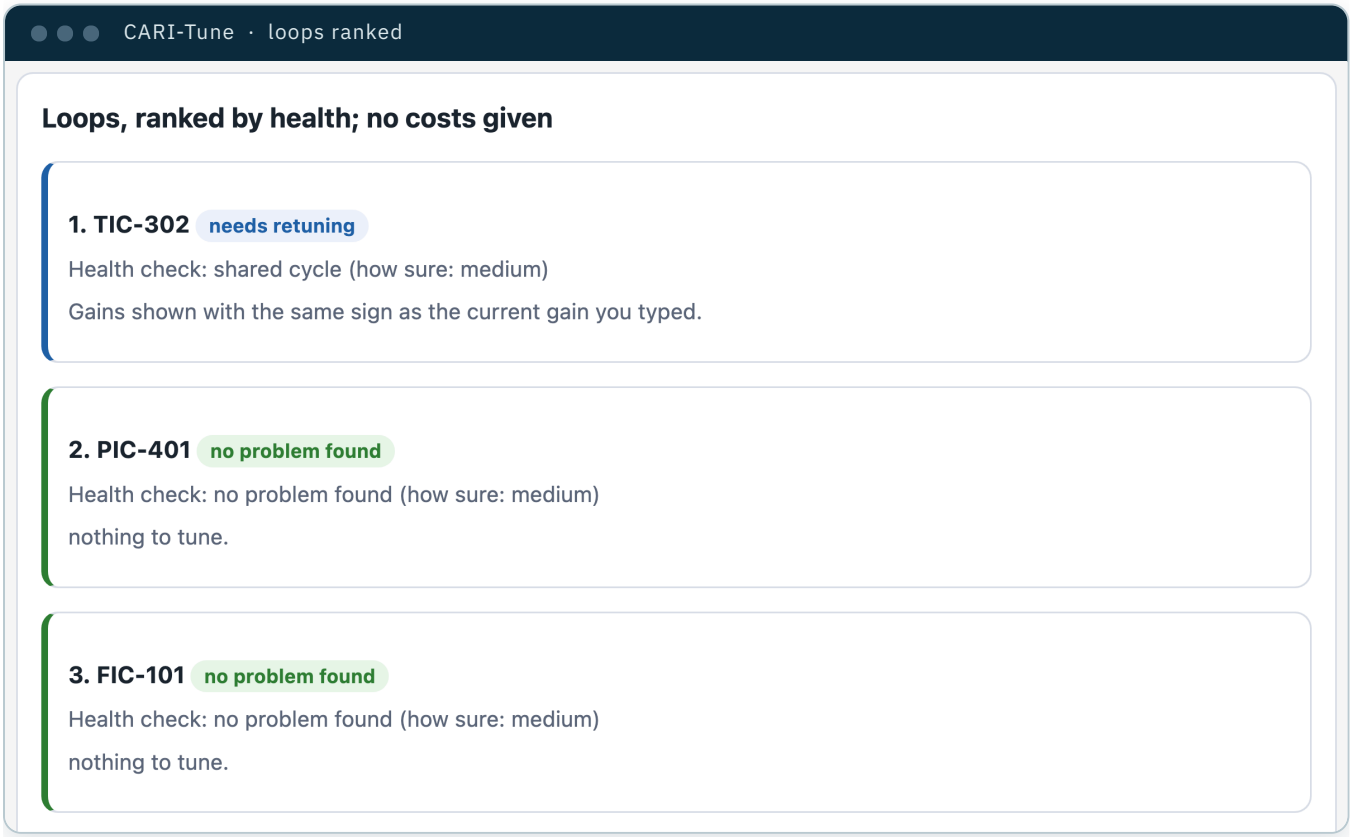
Your engineer runs a valve stroke test. A valve that fails is fixed first.

3 Short loop test

One small step of the controller output, then a few small moves each way, run by your engineer.

4 Three settings

Slow, normal and fast, drawn beside the setting you run today.



The ranked table on the example plant: one loop to retune, two left alone. Before any test, your engineer and operating team agree the controller mode, the size of the output moves and the test period.

THREE SETTINGS AND THEIR SAFETY MARGINS

Slow, normal, fast. Each with a stated margin.

One answer is rarely right for every loop. CARI-Tune gives three, each with its stated margin.

Slow
The gentlest choice, with the largest stated margin: at least 3.5×.

Normal
The middle choice, with a stated margin of at least 2.67×.

Fast
The firmest choice, with a stated margin of at least 2×.

In the worked example Slow gives the lowest set-point peak, Fast settles soonest and today's setting gives the smallest load bump. Compare both predicted responses.

STATED SAFETY MARGIN



Safety margin here means gain margin: the factor by which the process gain can rise before the predicted response reaches steady cycling. “At least 2×” puts that boundary at twice the gain found in the test, or more.

CARI-Tune · one loop, three settings

1. TIC-302 needs retuning

Health check: shared cycle (how sure: medium)

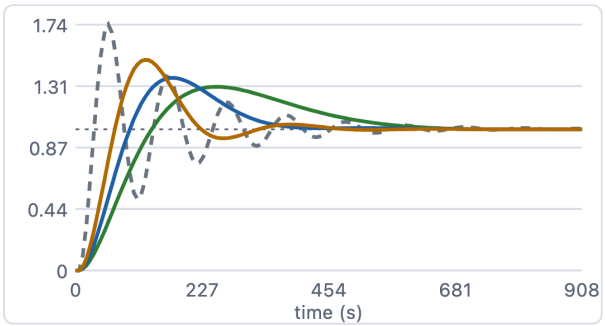
Setting	Gain	Integral time	Gain margin	
Slow	-2.567	227.0 s	**at least 3.50 on the loop model** model 15.60	Approve
Normal	-3.898	181.6 s	**at least 2.67 on the loop model** model 9.89	Approve
Fast	-6.017	136.2 s	**at least 2.00 on the loop model** model 5.98	Approve

Gains shown with the same sign as the current gain you typed.

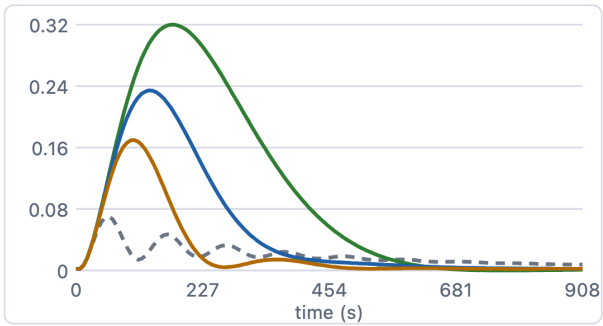
What each setting does, on the loop model

Current setting — Slow — Normal — Fast

When the set point moves one step



When a load pushes the process one step



One loop on screen: three settings with their safety margins, an Approve button for each, and both pictures.

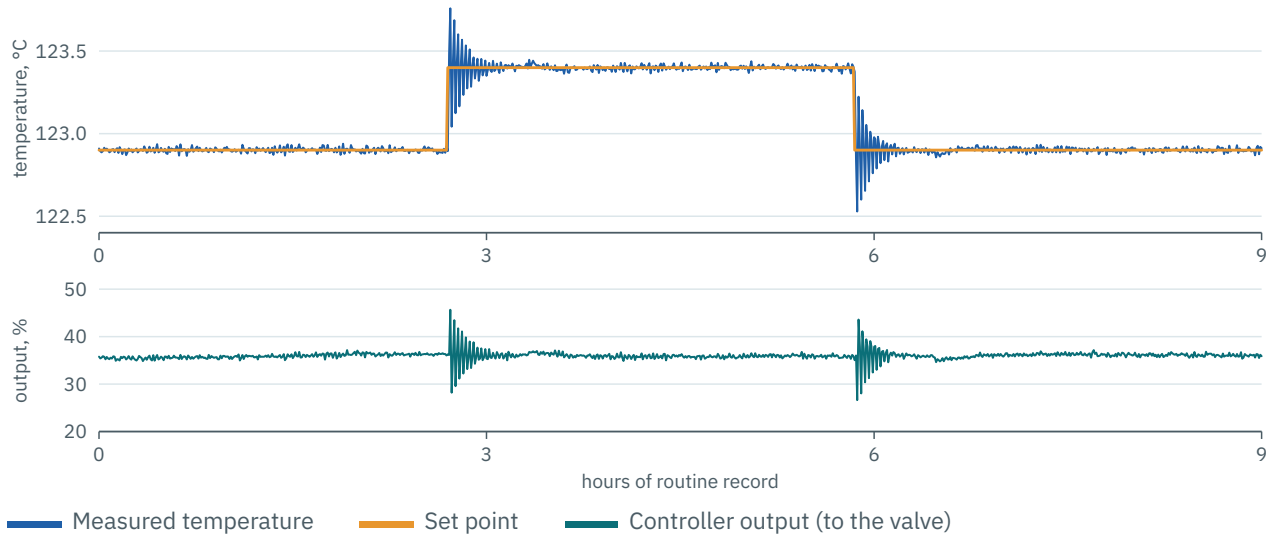
WORKED EXAMPLE, PART 1 · THE RECORD AND THE TEST

A reactor temperature loop that swings on every move.

The app opens with a worked example from a standard published test plant: a chemical process with reactor loops. Three loops were exported; one of them swings for minutes after every change of set point.

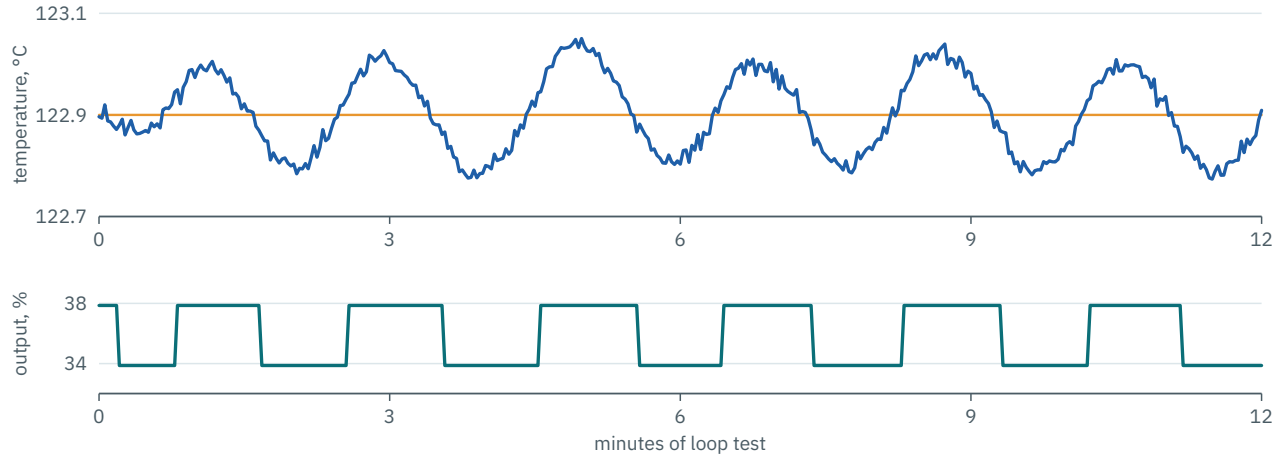
The routine record

Reactor temperature loop TIC-302 · 9 hours · one row every 9 seconds



The short loop test

Run by the engineer after the valve stroke test passed · 12 minutes



24 to 47 %
range of the controller output in the routine record

± 2 points
percentage points of controller output moved in the loop test

under 0.2 °C
how far the temperature moved from its starting value in the test

12 minutes
of loop-test recording in the worked example

WORKED EXAMPLE, PART 2 · THE ANSWER

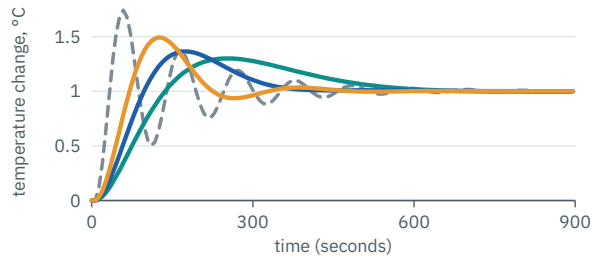
Three settings, drawn next to today's.

The health check graded the loop “needs retuning”. The valve passed its stroke test, and the short loop test supported retuning. CARI-Tune then gave these.

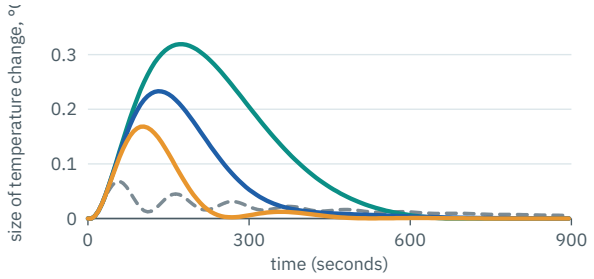
SETTING	GAIN	INTEGRAL TIME	SAFETY MARGIN	SET-POINT PEAK (1 °C STEP)	SETTLES WITHIN ± 5 % OF THE STEP	LOAD PEAK (1 % INPUT STEP)
Today	−24	450 s	not stated	1.74 °C	497 s	0.07 °C
Slow	−2.57	227 s	at least 3.5×	1.30 °C	529 s	0.32 °C
Normal	−3.90	182 s	at least 2.67×	1.36 °C	340 s	0.23 °C
Fast	−6.02	136 s	at least 2×	1.49 °C	294 s	0.17 °C

For this temperature example, gain is in percentage points of controller output per °C. In CARI-Tune, a negative gain denotes direct action. The settings sheet (page 8) writes the gain as a positive size and lists the action separately; your engineer confirms the block's scaling before entry.

Predicted temperature response to a 1 °C set-point step



Predicted response, °C, to a load step of 1 % at the process input



Your setting today · Slow · Normal · Fast

TODAY

The high gain gives the smallest load bump. The predicted set-point response peaks at **1.74**, swings about the target and takes about **497 seconds** to settle.

NORMAL

The peak falls from 1.74 to **1.36**, the swinging is gone and the response settles in about **340 seconds**, with a margin of at least **2.67×**.

THE CHOICE IS YOURS

Slow gives the lowest peak. Fast gives the smallest load bump of the three and settles soonest, at about **294 seconds**. Compare both pictures and choose what the loop needs.

Figures are read from the app's own example output. Both pictures show the predicted change of the measurement, worked out from the loop test before anything is changed on the plant; the load picture shows its size.

From answer to action. The chosen setting is written in the controller block's own style (page 8), approved and kept in the change history (page 9), then re-checked (page 10).

YOUR CONTROL SYSTEM'S OWN WORDS

The same setting, in your block's own words.

Pick your controller block. The sheet gives the gain or the proportional band, the integral setting in the block's own units, and the controller action, side by side. A gain of 3.9 becomes a band of 25.7 %; 182 seconds becomes 3.03 minutes. Nobody converts by hand at the panel.

CONTROL-SYSTEM STYLE	GAIN FIELD	INTEGRAL FIELD	GAIN VALUE	INTEGRAL VALUE
Generic ISA / ideal textbook form	Kc	Ti (s/repeat)	**3.898**	**181.6**
Emerson DeltaV PID function block	GAIN	RESET (s/repeat)	**3.898**	**181.6**
Honeywell Experion / TDC PID	K (gain)	T1 (min/repeat)	**3.898**	**3.027**
Yokogawa CENTUM VP PID	P (PB %)	I (s)	**25.66**	**181.6**
Siemens PCS 7 CONT_C / PIDConL	GAIN	TI (s)	**3.898**	**181.6**
Rockwell Logix PIDE — Dependent gains	PGain	IGain (min/repeat)	**3.898**	**3.027**
Rockwell Logix PIDE — Independent gains	PGain (Kp)	IGain (Ki, 1/min)	**3.898**	**1.288**
Foxboro (Schneider) I/A Series PIDA	PBAND (%)	INT (min/repeat)	**25.66**	**3.027**
ABB 800xA PidCC / PidAdvanced	Gain	Ti (s)	**3.898**	**181.6**
Generic Reset-rate style (repeats/min)	Kc	Reset (repeats/min)	**3.898**	**0.3303**

The Normal setting of TIC-302 in each of the ten styles. Gains are in the units of your export; a band is 100 divided by the gain, right for a span of 100 units. Your engineer confirms the block's span, scaling and action.

CARI-Tune · settings sheet

Settings in your control system's own style

Pick your control system. The settings are shown with its field names and units, ready for your engineer to enter.

Control system: Yokogawa: CENTUM VP PID | Download CSV | Printable page

Loop	Current	Slow	Normal	Fast
TIC-302	4.1667 / 450.0000	38.9494 / 227.0370	25.6561 / 181.6300	16.6209 / 136.2220

Each cell: P (PB %) / I (s). Confirm this block's structure and units against the block's own documentation before entering anything. Your engineer enters the settings; nothing is written to the control system.

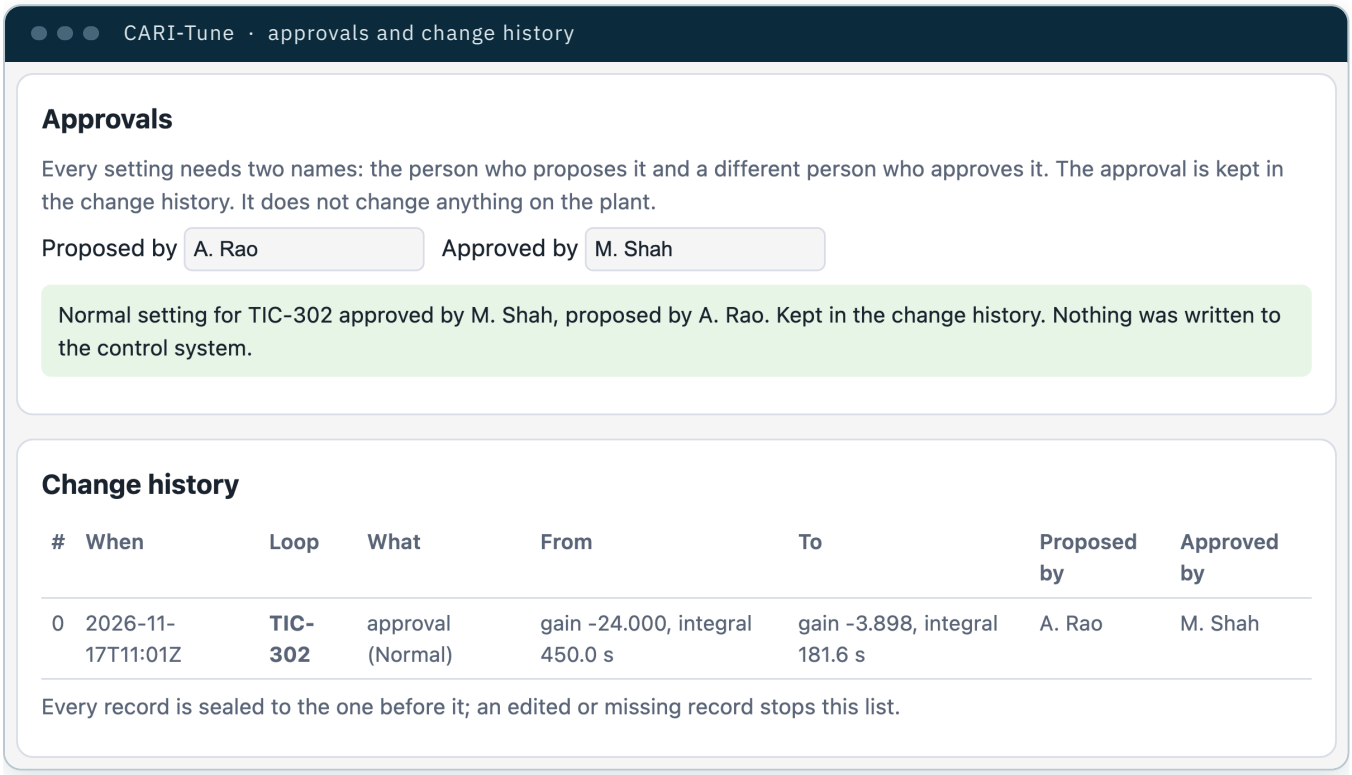
No settings: PIC-401, FIC-101.

CSV and a printable page. One sheet per unit: loop, action, today's setting and the three new ones.

APPROVALS AND CHANGE HISTORY

Proposer, approver, and a code on the print.

Tuning changes are small to type and large in effect. CARI-Tune treats each one as a controlled change: proposed by one person, approved by another, and kept in the change history.



PROPOSER AND APPROVER

Different proposer and approver names are required. CARIMO sets up sign-in and approval responsibilities with your team.

OLD AND NEW, SIDE BY SIDE

Each record keeps the loop, the setting chosen, the old and new gain and integral time, both names and the time.

SEALED RECORDS

Every record is sealed to the one before it. CARI-Tune checks the chain each time it reads the history and reports a failed check.

ONE CHANGE RECORD, AS KEPT

Loop	TIC-302
What	approval (Normal)
From	gain −24.000, integral 450.0 s
To	gain −3.898, integral 181.6 s
Proposed by	A. Rao
Approved by	M. Shah
Record code	`3f44cdc2 … d4a38637`

THE TAMPER CHECK ON THE PRINT

The printed report records the length of the history and its last record code at that time:

> Change history: 1 change record recorded. Last record code: `3f44cdc2 … d4a38637`.

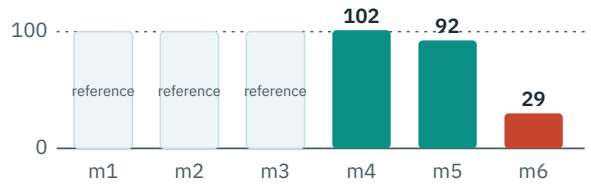
CARI-Tune checks the saved chain each time it reads the history. Keep the signed report with your change records, so the saved history can be checked against it later.

MONTHLY RE-CHECK AND READINESS

Check the change. Then keep checking.

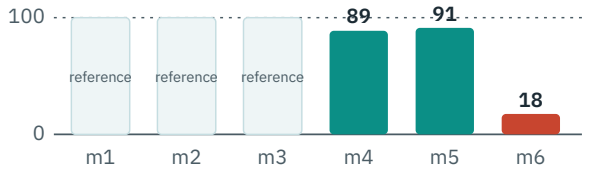
After entry, your engineer checks the controller read-back and the loop trend. Then, once a month, add that month's readings: CARI-Tune compares each loop with its own reference months. After a retune, one button starts a fresh set.

PIC-210 pressure loop · verdict in month 6: slower



Health index 102 and 92, then 29. The control has become slower: check whether the gains were lowered.

FIC-118 flow loop · verdict in month 6: valve-like



Health index 89 and 91, then 18. A regular cycle has appeared: check the valve for sticking before any retune.

Two of our own test loops. Index 100 means as in the loop's own reference months; it is an index, not a percentage.

CARI-Tune · monthly re-check

Monthly re-check

PIC-210

month 1 **reference** | month 2 **reference** | month 3 **reference** | month 4 **no change** | month 5 **no change** | month 6 **slower**

Health index by month — 29 of 100 now, against this loop's own earlier months

FIC-118

month 1 **reference** | month 2 **reference** | month 3 **reference** | month 4 **no change** | month 5 **no change**

PREPARING FOR ADVANCED CONTROL · READINESS CHECK

Advanced control stands on the base loops. The readiness column reads each loop's routine record and names what would spoil a step test: a loop in manual, a frozen measurement, a sticking valve or dead band, an output at its limit, a loop that cycles. A clean loop reads **“nothing found in the routine record”**.

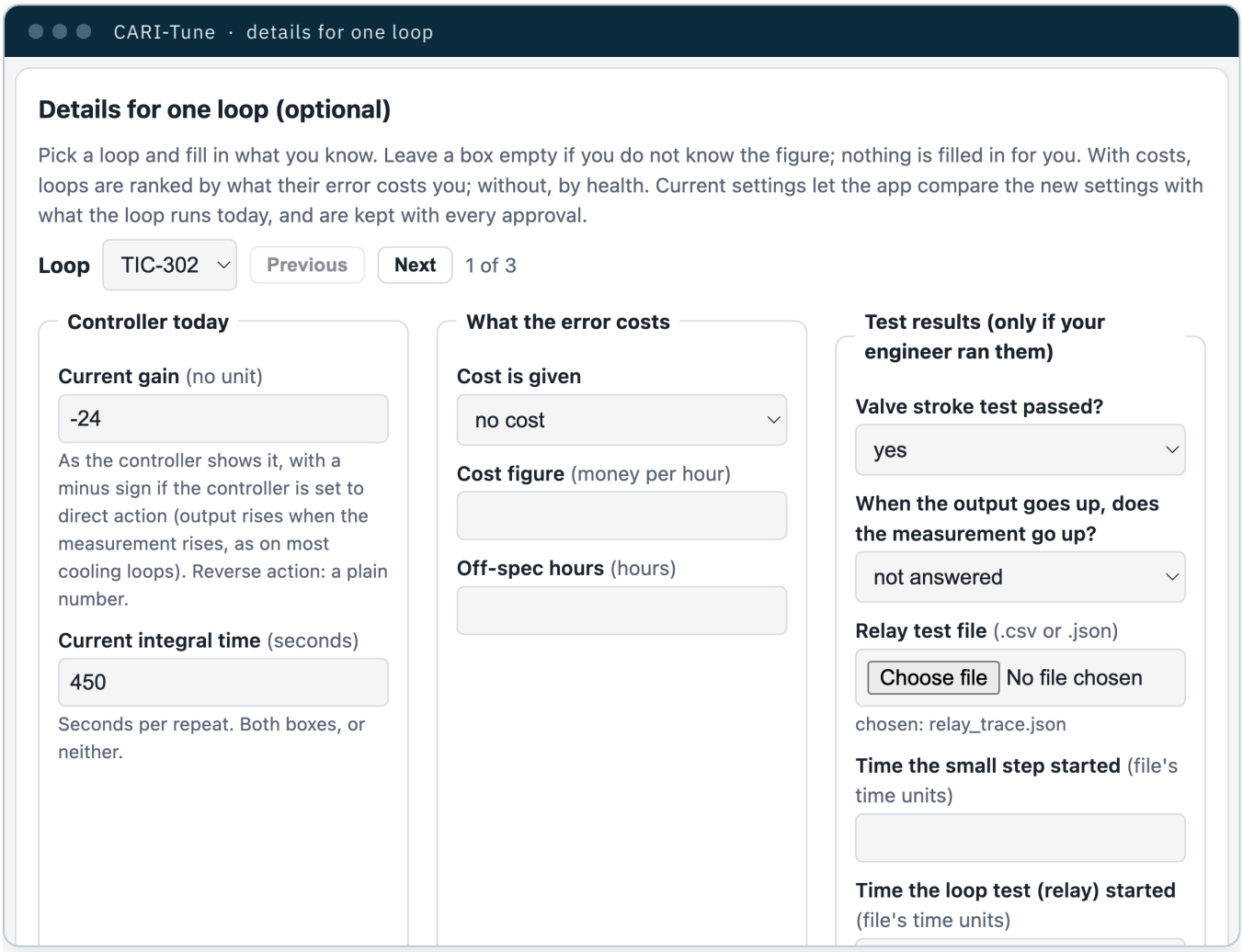
CARI-Tune · readiness column

Before an advanced-control step test

- **TIC-302**: issue found
  - the loop cycles with its neighbours: the cycle hides the step response
- **FIC-101**: nothing found in the routine record
- **PIC-401**: nothing found in the routine record

WORKING WITH YOUR TEAM

On your own PC. Under your own change procedure.



LOOP TYPES IN THE APP

flow · level · pressure · temperature · analysis · density · speed · weight

Direct and reverse acting controllers. Gain and integral time for each setting. Whole units at once, in a few seconds per loop, with the same answer as loop by loop.

WHERE IT RUNS

On your own PC, set up with your team, and opened in a web browser. Your records stay on your PC.

CARI-Tune reads exported files. It needs no link to the control system: your engineer enters each approved setting from the sheet.

CARIMO sets up the app with your team, maps your tags and controller style, and supports the first unit.

SET UP AND TESTED WITH YOUR TEAM FIRST

Writing an approved setting into the control system and **automatic retuning as the process drifts** are set up and tested with your team first. From day one CARI-Tune works as your adviser: every change goes through your engineer and your own change procedure.

START WITH ONE LOOP

Show us one loop. See three settings.

Start with one loop, or send the trend export of a unit and we choose the first loop together. Your engineer runs the valve stroke test and the short loop test on it, and you see the three settings, the predicted responses and the sheet in your own controller's style. We agree the export, the test plan and the first-loop review with your team.

1

You send

A trend export as CSV: time, measurement, set point, controller output and mode.

2

Your engineer tests

A valve stroke test and a short loop test on the loop graded for retuning.

3

You receive

Three settings with safety margins, two pictures, the settings sheet and the change history.

WRITE TO US

contact@carimo.tech

WEB

carimotech.com

PART OF THE FAMILY

CARI-Loops finds the trouble. CARI-Tune is CARI-Loops plus tuning.