SMARTCOOL ECO3

ECO3 Technical Note #2 – Self-Validation of the ECO3 Single Channel (Simplex)
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Application: This note applies to the ECO3 simplex, commonly used in residential split air conditioning systems and walk in coolers. Please refer to the owner's manual for additional information.

Purpose: The ECO3 has a built in feature to determine the performance of the AC/refrigeration system it is connected to, as well as the effectiveness of the Smartcool software being applied to that system. This procedure is useful for diagnostic evaluation as well as verification that the ECO3 and the AC system are working properly. It is usually performed at installation, but may be performed at any time.

Operation Notes:
Run Mode

1. Run mode is entered when the ECO3 is ready to pass the thermostat signal to the compressor to start. When the signal arrives, the LED turns yellow and the compressor starts.

Note the yellow LED and the run data "0.508" which means 508 run hours accumulated (the "." point is actually a comma).

2. Save Mode is entered when the ECO3 is ready to block the thermostat signal to the compressor. If a signal arrives, the LED turns green and the compressor either stops or does not start.

Note the green LED and the save data "0.175" which means 175 save hours accumulated.

3. Bypass mode stops optimization and just logs actual compressor run time.
Bypass mode is activated by holding down the single button, usually for 5-8 seconds. The display will switch to read "0.002" which means 2 hours
   Hold the button again for 24 hours bypass
   Hold the button again for 168 hours bypass
   Hold the button to cancel bypass and return to optimization.

Note the RED LED is solid (non-blinking) and the bypass data of "0.052" which means 52 hours of compressor run time accumulated in bypass mode.
-- The display will count down the bypass hours sequentially and automatically return to optimization.

4. Override is an automatic bypass. It is entered when the ECO3 determines the system is unable to maintain the set point. Two-three hours a day in hot weather is not unusual.

Note the RED LED is blinking and the override data of "0.283" which means 283 hours of compressor run time accumulated in override mode.

5. Date Reporting
    Data is usually reported in 4 registers as below:

Run	Save	Bypass	Override
508	175	52	283

Alternatively as 508, 175, 52, 283

Simply press the button and write down the four numbers.

Two Week Self-Validation Procedure

Now that the basics of operation and collecting data are understood, we look at performing a self-validation of a specific system to ascertain performance and savings.

In this process, we log a week of run time in bypass mode followed by a week of operation in optimizing mode. Then we can calculate the savings percentage and look at how hard the system is working.

1. The installer usually leaves the ECO3 in 168 hours (1 week) of bypass after performing the installation test. This is so the 2 week validation check can be made if desired.
    If the ECO3 is already in bypass (solid red LED), the test may already have started.
2. We assume the ECO3 is starting from 0,0,0,0. The ECO3 can be master-cleared by cutting power to the ECO3, holding the button firmly, and restoring power. Release after 1 second.
    Alternatively, record the numbers at the test start and subtract from the finish numbers.
3. After 1 week in bypass (set to 168 hours) the bypass mode expires and the unit enters optimization. No action is required.
4. After 2+ weeks, read the data. Suppose it looks like this:

Run	Save	Bypass	Override
30	15	50	3

$$\%\text{Save}= \frac{(\text{Save hours}) \times 100}{(\text{Run} + \text{Save} + \text{Override})} = \frac{(15)}{(30 + 15 + 3)} = 31.25\%$$

This is the most important value and most people stop here.

To calculate dollar savings, you need to know:
1. Electrical rate of dollars per kilowatt-hour (assume $ 0.145/KWH)

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2. Kilowatt rating of the condensing unit (KW)—check condenser data label
   a. KW= voltage x [RLA (compressor) **+** FLA (fan)] / (1000)

Dollar savings = save hours x KW x electrical rate. Example:
$$= [(15 \text{ hours}) \times (.145 \text{ \$/kwh}) \times (240 \text{ volts} \times (18.5 + 2.2)]/1000 = \$10.80$$
To estimate a month (732 hours) of savings= (10.80/168) x 732 = $47.06

More validation:
In the first week in straight thermostat operation (bypass), we see
Utilization= (50 bypass/168 elapsed hours) = 29.7% utilization
In the second week with optimization, we see:
Demand = (30+ 15 + 3)/(168 elapsed hours)= 28.5% demand factor
Utilization= (30 + 3) / 168 = 19.6% utilization (optimized)

Comments on the example:
In the first week the compressor ran **29.7%** of the time. Fairly normal summer use for a well sized system.
In the second week with optimization, we see the thermostat demand was about the same (**28.5%),** indicating similar heat loads—but now the utilization has dropped to 19.6%—reflecting the savings percentage from above.
This validates several things:
1. The installation is correct and the system fully operational
2. The savings percentage is nominal at 31%
   a. The savings is valid because compressor run hours went from 50 hours per week to 33 hours per week (run + override). For a similar heat load.
3. Cash savings is $10.80 per week (for these loads on this AC).