What's New in OPEN 6.2

A summary of software changes for the LI-6400XT

If you already know how to run an LI-6400, then this document is for you. It contains what you need to know to use version 6.2.

All items discussed are also found in detail in the 6.2 edition of the manual, *Using the LI-6400XT*, and the page references are given in the discussions below.

Major Changes

Odds and Ends

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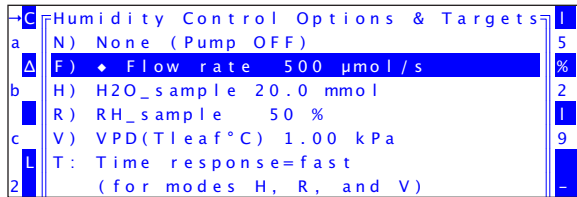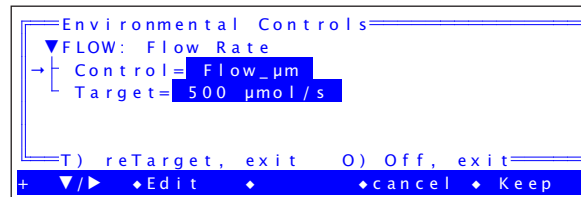## New Measurements Control Panel

The New Measurements Control Panels are the screens one uses to change Flow, CO_2, Temperature and Light manually in New Measurements mode. In version 6.2, this interface has changed to a node-based dialog, allowing more clarity and flexibility (the version 6.2 manual, chapter 7).
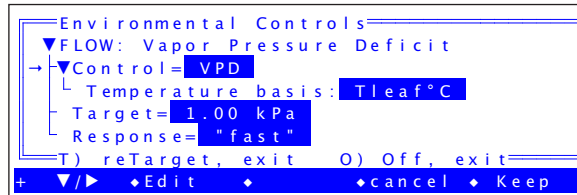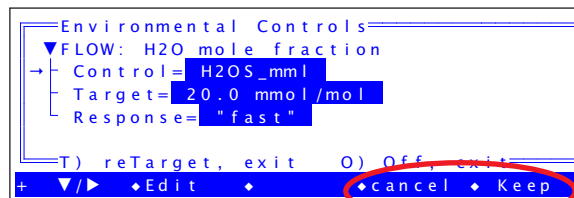
Old Look

New Look

```
→C┌Humidity Control Options & Targets┐I
a ‖N) None (Pump OFF)                ‖5
 △‖F) ◆ Flow rate  500 µmol/s        ‖%
b ‖H) H2O_sample 20.0 mmol           ‖2
  ‖R) RH_sample    50 %              ‖I
c ‖V) VPD(Tleaf°C) 1.00 kPa          ‖9
 L‖T: Time response=fast             ‖
2 ‖   (for modes H, R, and V)        ‖–
```

```
┌═Environmental Controls═════════┐
‖ ▼FLOW: Flow Rate                ‖
→‖  ┌Control=  Flow_µm             ‖
 ‖  └Target= 500 µmol/s           ‖
 ‖                                ‖
 └═T) reTarget, exit   O) Off, exit═┘
+   ▼/▶  ◆Edit   ◆        ◆cancel ◆ Keep
```

Only relevant entries are visible. Fixed flow (above) only requires a target, but vapor pressure deficit (below) has a few more settings.

```
┌═Environmental Controls═════════┐
‖ ▼FLOW: Vapor Pressure Deficit   ‖
→‖ ▼Control=  VPD                  ‖
 ‖  └ Temperature basis: Tleaf°C   ‖
 ‖  ┌ Target= 1.00 kPa            ‖
 ‖  └ Response=  "fast"            ‖
 └═T) reTarget, exit   O) Off, exit═┘
+   ▼/▶  ◆Edit   ◆        ◆cancel ◆ Keep
```

It's a Dialog

One big difference in the new interface is that it is a dialog box, which means you can change several settings and then implement them with **f5 (Keep)**, or abandon them with **f4 (cancel)**.

```
┌═Environmental Controls═════════┐
‖ ▼FLOW: H2O mole fraction        ‖
→‖ ┌ Control= H2OS_mml            ‖
 ‖ ├ Target= 20.0 mmol/mol        ‖
 ‖ └ Response=  "fast"            ‖
 ‖                                ‖
 └═T) reTarget, exit   O) Off, exit═┘
+   ▼/▶  ◆Edit   ◆        ◆cancel ◆ Keep
```

The Control Node

The Control node determines what quantity is being controlled. For example, if you edit the control node in Flow Control, you will see this familiar list of possibilities:

```
┌═Environmental Controls═════════┐
‖ ▼FLOW: Flow Rate                ‖
→‖ ┌ Control= Flow_µm             ‖
 ‖ └ Target= 500 µmol/s           ┌E═══════Flow Control Types═════════┐
 ‖                                ‖ ▼F  Off                            ‖
 └═T) reTarget, exit   O)         ‖ ┌   ◆ Flow Rate                    ‖
+   ▼/▶  ◆Edit   ◆        ◆        ‖ ├   H2O mole fraction              ‖
                                  ‖ ├   Relative Humidity              ‖
                                  ‖ └   Vapor Pressure Deficit         ‖
                                  └T                                   ‖
                                        ◆        ◆       ◆Cancel ◆OK
```
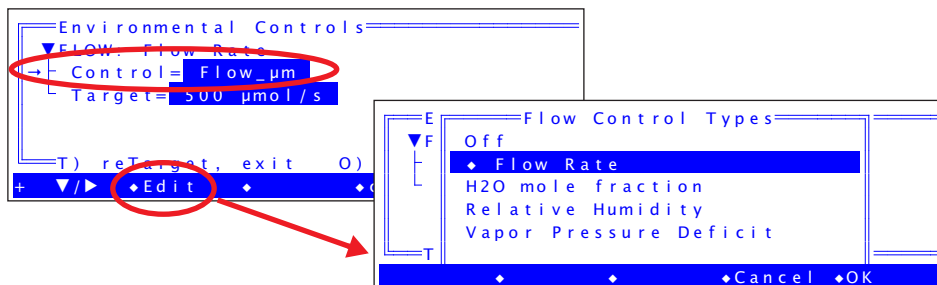
The Target Node

The Target node holds the desired value of the control setting. When you edit this node, you will see a target value entry dialog that shows not only the current value of the target, but also the current value of the variable being controlled. For example, if you just changed to controlling mole fraction, you might see something like this:

```
┌═Environmental Controls═══════════
│ ▼FLOW: H2O mole fraction
│ ┌ Control= H2OS_mml
→ ┤ Target= 20.0 mmol/mol
│ └ Response= "fast"
│
└═T) reTarget, exit    O) Off, exit═
  ▼/▶   ◆Edit   ◆       ◆cancel ◆ Keep
```

```
┌═Environmental Controls═══════════
│ ┌─Target for H2OS_mml──────────
│ │
│ └─20.0mmol/mol──────────────
│ Note: Enter 'c' to use the current
│   value of H2OS_mml (11.0)
│   or '#' for a variable target.
│ DelLn   ◆ClrEnd  ◆DelChar◆CapLock◆AnyChar
```
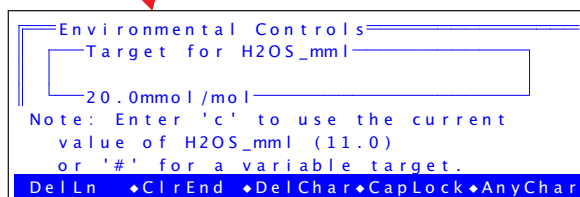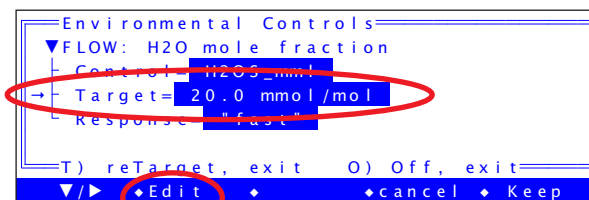
At this point, you have several options:
Type in a new value,
 - or -
Enter nothing, and target remains 20
 - or -
Enter **c**, and target becomes 11
 - or -
Enter **#**, and pick the variable target,
 - or -
Enter **#id** (e.g. #255, #-13, etc.) to enter the variable target id directly, if you know what it is.

Note the improvement: you can lock in the current variable's value as the control target, without having to remember to check it before entering the control panel screen.
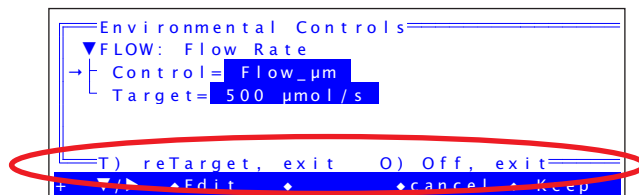
Shortcuts

Since the control panels are now dialogs, once you get all the nodes the way you want, you have to press **Keep** (**f5**) to implement it. However, there are two shortcuts available:

Press **T** to edit the Target node and - if the entry ends with **enter** being pressed, and not **escape** - it will exit the dialog (by **Keep**) automatically.
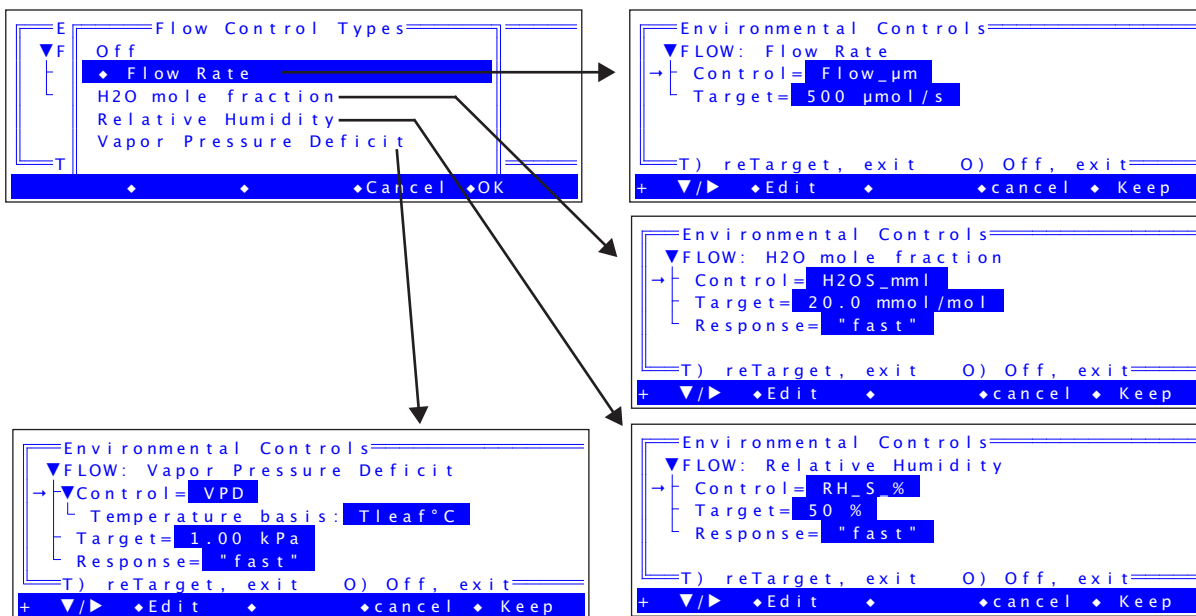
Press **O** (that's a letter, not a number) to select the 'off' option and exit (by **Keep**) automatically.

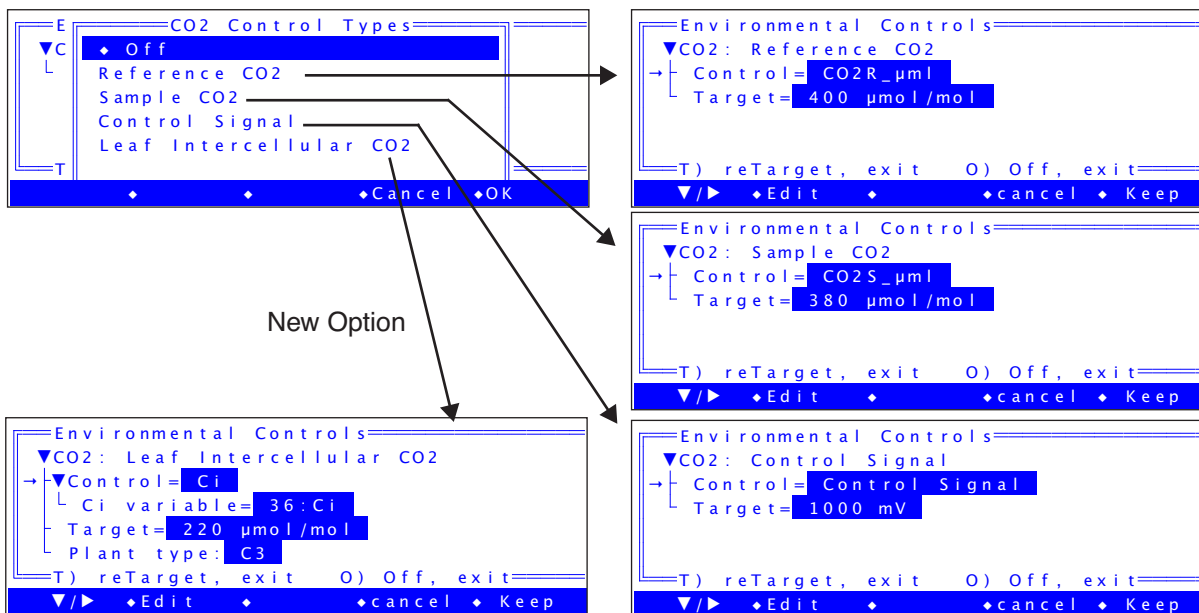The control panel dialog provides a reminder of the shortcuts.

```
┌═Environmental Controls═══════════
│ ▼FLOW: Flow Rate
→ ┤ Control= Flow_µm
│ └ Target= 500 µmol/s
│
│
└═T) reTarget, exit    O) Off, exit═
   ▼/▶   ◆Edit   ◆       ◆cancel ◆ Keep
```

Flow Control Options and Nodes

The flow control panel has these options:

```
┌─E──────Flow Control Types─────┐      ┌────Environmental Controls────┐
│▼F  Off                        │      │▼FLOW: Flow Rate              │
│┌    ◆ Flow Rate  ──────────── │ ───→ │→┌ Control= Flow_µm           │
││   H2O mole fraction ──────   │      │ └ Target= 500 µmol/s         │
││   Relative Humidity ──       │      │                              │
││   Vapor Pressure Deficit     │      │                              │
│└─T─────────────────────────── │      │└─T) reTarget, exit  O) Off, exit─┘
│    ◆       ◆    ◆Cancel ◆OK   │      │+  ▼/▶  ◆Edit  ◆    ◆cancel ◆ Keep│
└───────────────────────────────┘      └──────────────────────────────┘

                                       ┌────Environmental Controls────┐
                                       │▼FLOW: H2O mole fraction      │
                                       │→┌ Control= H2OS_mml          │
                                       │ ├ Target= 20.0 mmol/mol      │
                                       │ └ Response= "fast"           │
                                       │└─T) reTarget, exit  O) Off, exit─┘
                                       │+  ▼/▶  ◆Edit  ◆    ◆cancel ◆ Keep│
                                       └──────────────────────────────┘

┌────Environmental Controls────┐      ┌────Environmental Controls────┐
│▼FLOW: Vapor Pressure Deficit │      │▼FLOW: Relative Humidity      │
│→▼Control= VPD                │      │→┌ Control= RH_S %            │
│ └ Temperature basis: Tleaf°C │      │ ├ Target= 50 %              │
│ ├ Target= 1.00 kPa           │      │ └ Response= "fast"           │
│ └ Response= "fast"           │      │                              │
│└─T) reTarget, exit O) Off, exit─┘   │└─T) reTarget, exit  O) Off, exit─┘
│+  ▼/▶  ◆Edit  ◆    ◆cancel ◆ Keep│  │+  ▼/▶  ◆Edit  ◆    ◆cancel ◆ Keep│
└──────────────────────────────┘      └──────────────────────────────┘
```

CO_2 Control Options and Nodes

The CO_2 control panel has these options (note the addition of C_i control):

```
┌─E──────CO2 Control Types──────┐      ┌────Environmental Controls────┐
│▼C  ◆ Off                      │      │▼CO2: Reference CO2           │
│└    Reference CO2 ──────      │ ───→ │→┌ Control= CO2R_µml          │
││   Sample CO2 ──────          │      │ └ Target= 400 µmol/mol       │
││   Control Signal ──          │      │                              │
││   Leaf Intercellular CO2     │      │                              │
│└─T─────────────────────────── │      │└─T) reTarget, exit  O) Off, exit─┘
│    ◆       ◆    ◆Cancel ◆OK   │      │   ▼/▶  ◆Edit  ◆    ◆cancel ◆ Keep│
└───────────────────────────────┘      └──────────────────────────────┘

                                       ┌────Environmental Controls────┐
                                       │▼CO2: Sample CO2              │
                                       │→┌ Control= CO2S_µml          │
                                       │ └ Target= 380 µmol/mol       │
          New Option                   │                              │
                                       │                              │
                                       │└─T) reTarget, exit  O) Off, exit─┘
                                       │   ▼/▶  ◆Edit  ◆    ◆cancel ◆ Keep│
                                       └──────────────────────────────┘

┌────Environmental Controls────┐      ┌────Environmental Controls────┐
│▼CO2: Leaf Intercellular CO2  │      │▼CO2: Control Signal          │
│→▼Control= Ci                 │      │→┌ Control= Control Signal     │
│ └ Ci variable= 36:Ci         │      │ └ Target= 1000 mV            │
│ ├ Target= 220 µmol/mol       │      │                              │
│ └ Plant type: C3             │      │                              │
│└─T) reTarget, exit O) Off, exit─┘   │└─T) reTarget, exit  O) Off, exit─┘
│   ▼/▶  ◆Edit  ◆    ◆cancel ◆ Keep│  │   ▼/▶  ◆Edit  ◆    ◆cancel ◆ Keep│
└──────────────────────────────┘      └──────────────────────────────┘
```

The new C_i control option is discussed in the manual on page 7-17, but in summary, it is best used for maintaining constant C_i while doing a rapid light curve. Do not try and do an A-Ci curve with this option, however.
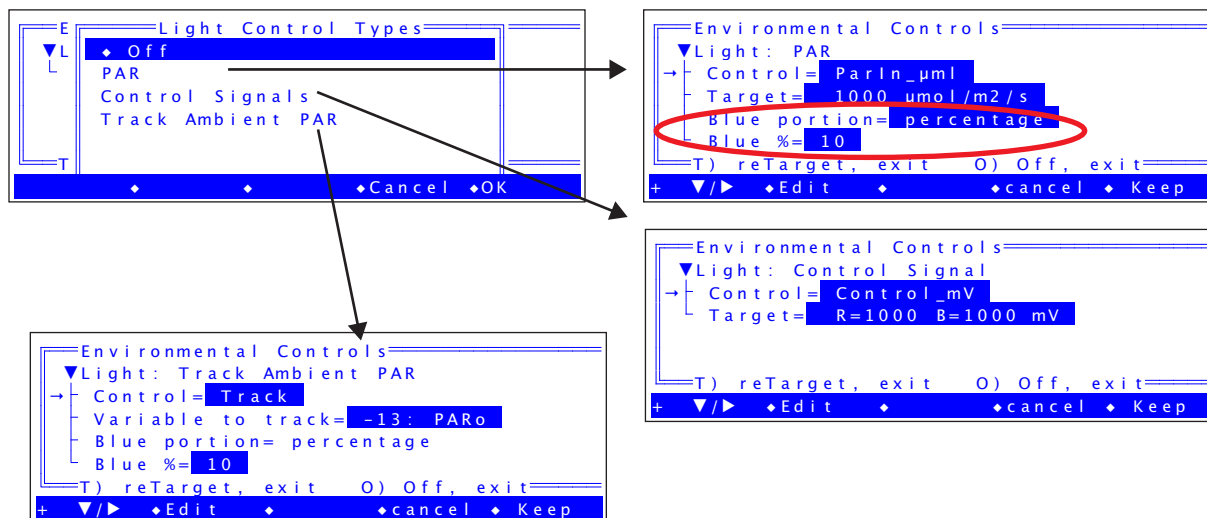
Temperature Control Options and Nodes
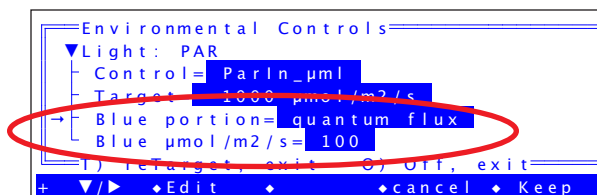The temperature control panel has these views

```
E══Temperature Control Types═══════
▼T   ◆ Off
 L   Block Temperature ─────────────┐
     Leaf Temperature ──────┐       │
                            │       │
 T                          │       │
    ◆       ◆       ◆Cancel ◆OK     │
```

```
═══Environmental Controls═══════
▼TEMP: Block Temperature
→├ Control= Tblock
 └ Target= 20.0 C

═══T) reTarget, exit    O) Off, exit═══
+  ▼/▶  ◆Edit   ◆        ◆cancel ◆ Keep
```

```
═══Environmental Controls═══════
▼TEMP: Leaf Temperature
→├ Control= Tleaf
 └ Target= 20.0 C

═══T) reTarget, exit    O) Off, exit═══
+  ▼/▶  ◆Edit   ◆        ◆cancel ◆ Keep
```
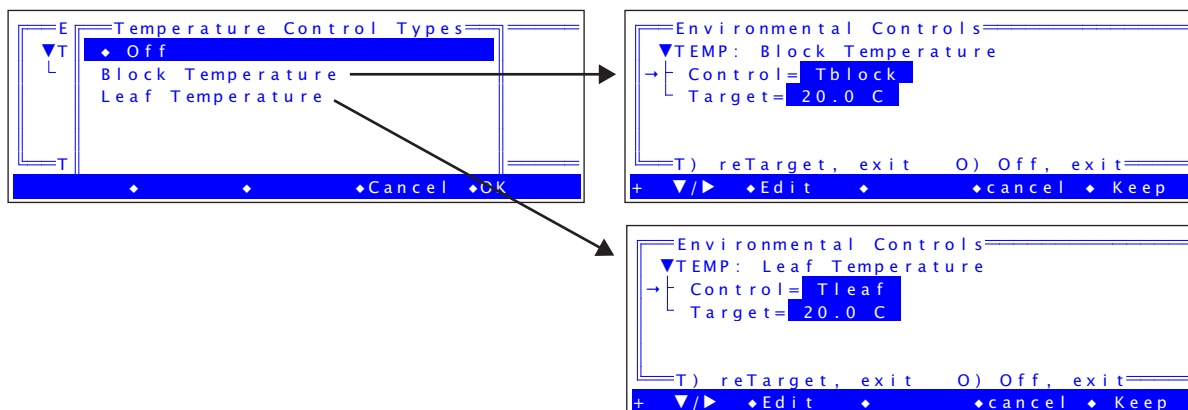
Light Control for the 6400-40 LCF
When configured for the LCF, the Light Source screens will look like this:

```
E═══Light Control Types═══════
▼L   ◆ Off
 L   PAR ──────────────────────────┐
     Control Signals                │
     Track Ambient PAR ─────┐       │
 T                          │       │
    ◆       ◆       ◆Cancel ◆OK     │
```

```
═══Environmental Controls═══════
▼Light: PAR
→├ Control= ParIn_µml
 │ Target= 1000 µmol/m2/s
 ├ Blue portion= percentage
 └ Blue %= 10
═══T) reTarget, exit    O) Off, exit═══
+  ▼/▶  ◆Edit   ◆        ◆cancel ◆ Keep
```

```
═══Environmental Controls═══════
▼Light: Control Signal
→├ Control= Control_mV
 └ Target= R=1000 B=1000 mV

═══T) reTarget, exit    O) Off, exit═══
+  ▼/▶  ◆Edit   ◆        ◆cancel ◆ Keep
```

```
═══Environmental Controls═══════
▼Light: Track Ambient PAR
→├ Control= Track
 ├ Variable to track= -13: PARo
 ├ Blue portion= percentage
 └ Blue %= 10
═══T) reTarget, exit    O) Off, exit═══
+  ▼/▶  ◆Edit   ◆        ◆cancel ◆ Keep
```

The change here is that the old options of "PQuantum" and "FQuantum" have gone away. Now there is just one PAR option, and you set *Blue portion* to be *percentage* or *quantum flux*. In the above panel (circled), it is set to percentage. If you set it to quantum flux, it looks like this:

```
═══Environmental Controls═══════
▼Light: PAR
 ├ Control= ParIn_µml
 ├ Target= 1000 µmol/m2/s
→├ Blue portion= quantum flux
 └ Blue µmol/m2/s= 100
═══T) reTarget, exit    O) Off, exit═══
+  ▼/▶  ◆Edit   ◆        ◆cancel ◆ Keep
```

Light Control for the 6400-18 RGB

When configured for the RGB source, the Light Control screens will look like this:

```
┌─E┌────Light Control Types════┐      ╔═Environmental Controls═══════╗
│▼L│  ◆ Off                    │      ║▼Light: PAR                   ║
│  └  PAR                      │     →║  ┌ Control=  ParIn_µm         ║
│     Control Signals          │      ║  ├ Target=  1000  µmol/m2/s   ║
│     Track Ambient PAR        │      ║  └▼Color=   White            ║
│  ┌──                         │      ║    ├ Red fraction=  1         ║
└─T┤                           │      ╚═T) reTarget, exit    O) Off, exit═╝
   │       ◆        ◆     ◆Cancel ◆OK│   +   ▼/▶   ◆Edit   ◆        ◆cancel ◆ Keep
```

```
╔═Environmental Controls═══════╗
║▼Light: Control Signals       ║
→║  ┌ Control=  Control         ║
║  └ Target=  %R=0  %G=0  %B=0  ║
║                              ║
║                              ║
╚═T) reTarget, exit   O) Off, exit═╝
+   ▼/▶    ◆Edit    ◆        ◆cancel ◆ Keep
```

```
╔═Environmental Controls═══════╗
║▼Light: Track Ambient PAR     ║
→║  ┌ Control=  Track           ║
║  ├ Variable to track= -13: PARo║
║  └▼Color=  White             ║
║    ├ Red fraction=  1         ║
╚═T) reTarget, exit   O) Off, exit═╝
+   ▼/▶    ◆Edit    ◆        ◆cancel ◆ Keep
```

The color option is available when controlling on PAR or Tracking Ambient.

Edit color by ...

```
╔═Environmental Controls═══════╗
║  ┌ Target=  1000  µmol/m2/s  ║
→║ ▼Color=  Cyan               ║
║  ┌ Red fraction=  0          ║
║  ├ Green fraction=  1        ║
║  └ Blue fraction=  1         ║
╚═T) reTarget, exit   O) Off, exit═╝
+   ▼/▶    ◆Edit    ◆        ◆cancel ◆ Keep
```

...picking from a list...   ...or entering RGB proportions.

```
┌─Enviro┌═════Pick Color═══════┐      ╔═Environmental Controls═══════╗
│▼Light:│ White                │      ║  ┌ Targe┌═Red fraction═════┐ ║
│ ┌ Contr│ Red                 │      ║  └▼Color│ 1                │ ║
│ ├ Targe│ Yellow              │      ║   ┌ Red │                  │ ║
│ └▼Color│ Green               │      ║   ├ Green fraction=  1      ║
│ ┌ Red  │ Cyan                │      ║   └ Blue fraction=  1       ║
│ └ reT  │ Blue         exit   │      ╚═T) reTarget, exit   O) Off, exit═╝
│ Add      ◆        ◆    ◆Cancel ◆Select│ DelLn  ◆ClrEnd ◆DelChar◆CapLock◆AnyChar
```

You can easily add named colors to the list

```
┌─Enviro┌═════Pick Color═══════┐
│ ┌ Targe│ White               │
│ └▼═════┌Enter R G B relative values═┐
│  ┌     │ 0.33  0.33  0.33         │
│  │     │                          │
│  ├ Blue│ Cyan                     │
└─T) reT │ Blue              exit   │
  DelLn   ◆ClrEnd ◆DelChar◆CapLock◆AnyChar
```

AutoProgram Changes

AutoPrograms are discussed in the version 6.2 manual starting on page 9-31.

Nearly all of the AutoPrograms in OPEN 6.2 have been revised. Some have been eliminated. (If you've upgraded from an earlier version, all of your old AutoPrograms will be found in the directory /User/Configs/AutoProgs_old).

Table 1: Autoprogram Changes in 6.2

Program	Remarks
AutoLog2	Replaces AutoLog. New interface, increased capability.
A-CiCurve2	Replaces A-CiCurve. New interface, increased capability.
LightCurve2	Replaces LightCurve. New interface. Adapts to current light source.
TimedLamp2	Replaces TimedLamp. New interface. Added capability.
StandardSystemTest	Unchanged
Flr Kinetic	Removed. Use AutoLog2.
Flr A-CiCurve	Removed. Use A-CiCurve2.
Flr LightCurve	Removed. Use LightCurve2.
CO2Curve_MultipleLight	New. Adapts to current light source.
LightCurve_MultipleCO2	New. Adapts to current light source.
FlrLoop2	Replaces Flr Loop. New front interface.

Node-based Interface
The 6.2 versions of AutoPrograms use a node-based interface. This allows the user to interact with the complete configuration in any order, instead of the old "one pass through" method. For example, the LightCurve2 program interface looks like this:

```
═══ (1/4) LightCurve2 Setup═══
→▶Flr Actions: DarkAdapt +
 ▶Summary: 9 SetPts for Qntm
 ▶Stability Definition: 4 items
 ▶Log Opts: beep ctrl


+    ▼/▶    ◆         ◆      ◆cancel  ◆ START
```
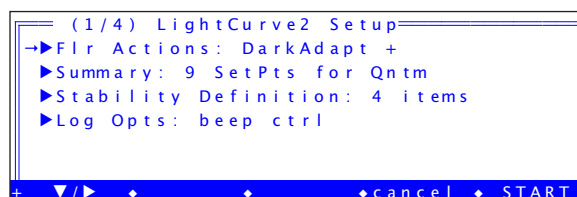
The first thing to note is that it is a dialog, so once the settings are the way you want them, press **f5** (**START**) to launch the program, or **f4** (**cancel**) to quit.

The next thing to note is the nodes. There are usually three or four. The first one in the above example, *Flr Actions*, appears only if the instrument is configured for a fluorometer. The next one, *Summary*, is the one that is specific to each AutoProgram. The bottom two, *Stability* and *Log Opts*, are generic, and appear if they are relevant to the AutoProgram. Details follow.

Flr Actions
If the LI-6400 is configured for the 6400-40 LCF, then most AutoPrograms will display a *Flr Actions* node. If you elect to do dark adaptation at the start of the program, it looks like this:

```
→▼Flr Actions: DarkAdapt +
 ↳▼Dark adapt before starting= yes
  ├ Dark time (min) before FoFm= 30
  ├ Light time (min) after FoFm= 30
  └ Measure dark photo at Fo= yes
 ├ Save each flash= no
→├ Save each flash= no
 ├ Save each dark pulse= no
 └ Flr Recording= "Off always"
```
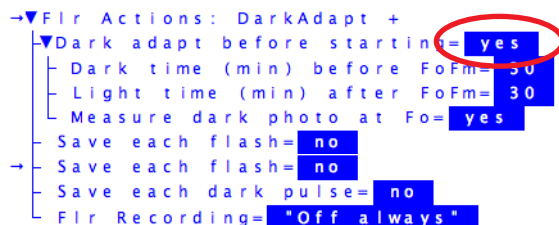
If skipping dark adaptation, it looks like this:

```
→▼Flr Actions
 ↳▼Dark adapt before starting= no
  ├ Dark photo rate= -1
  ├ Fo value= 0
  └ Fm value= 0
 ├ Save each flash= no
 ├ Save each dark pulse= no
 └ Flr Recording= "Off always"
```
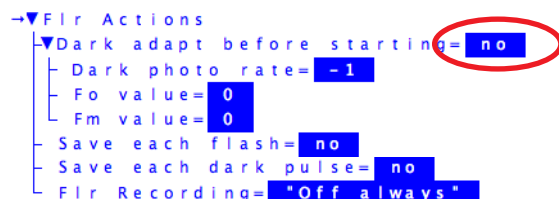
Stability Node
The stability definition node lets you define your criteria for stability that will take effect if you launch the AutoProgram. These are not necessarily the current definitions, but if you do launch the AutoProgram, they will take effect and remain in effect after the AutoProgram is done.

```
→▼Stability Definition: 3 items
 ↳▼items= "Std Stability"
  ├ items[1]= CO2S (-2) 15 Slp<1
  ├ items[2]= H2OS (-5) 15 Slp<1
  └ items[3]= Flow (-7) 15 Slp<1
```
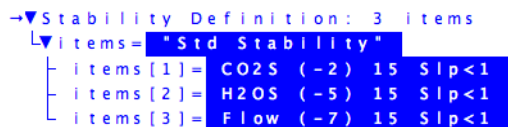
Log Opts Node
The Log Options node lets you define the log options that will take effect if you launch the autoprogram. Note that these are not necessarily the currently defined log options, but if you do launch the AutoProgram, they will take effect and remain in effect after the AutoProgram is done.

Audible beep for each log

```
→▼Log Opts: beep mean ctrl
 ├ Beep: on
 ↳▼Statistics: active (15 s)
  ├ Means->log file: yes
  ├ Stats->.STATS file: no
  └ period: 15
 ├ Control changes: yes
 └ Echo to Comm: no
```

New Option. Record averaged values (15s) in the log file, instead of the typical 2 or 4 sec average.

New Option. Log a remark documenting each control setting
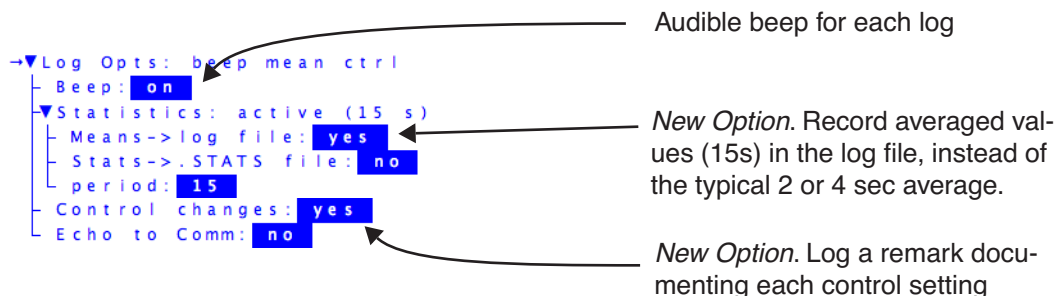
The two new options are described below. See "Log Option Changes" on page 19.

Summary Node

This is the node that contains the settings unique to each AutoProgram, such as light levels for a light curve, minimum and maximum wait times, etc. In the case of LightCurve2, it looks like this:

If configured for LCF, you have some further options.
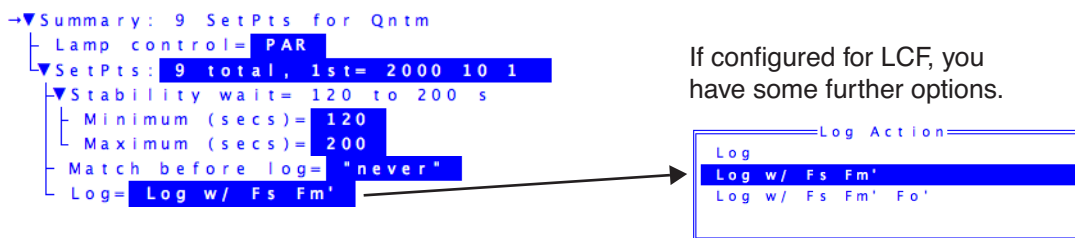
One of the items within the Summary node in this example is one about Matching, named *Match before log*. This item controls when matching occurs, and is described next.

Conditional Matching

You can now elect to never match, always match, or else match only if one of three conditions is true: 1) time since last match exceeds some threshold, 2) reference CO_2 is now sufficiently different from when it was last matched, or 3) the CO_2 delta is sufficiently small. In the configuration tree, the match node (contained in the Summary node) looks like this

Save and Recall Settings in Named Files

Another advantage of the new interface is that not only are previous choices always remembered, but the user can elect to save and recall settings in named files. Also, the AutoPrograms have factory default settings that you can revert to at any time while you are interacting with the configuration tree.
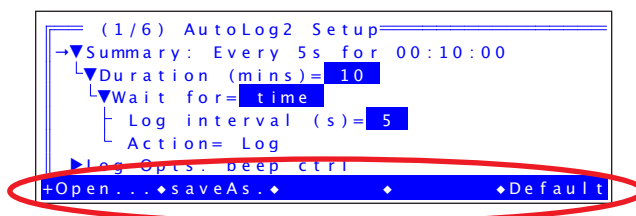
Adapts to Light Source in Use

The new AutoPrograms are adaptive. That is, they adapt to whatever light source you have attached. For example, the LightCurve2 program looks like this for the three light source options.

If using -02B
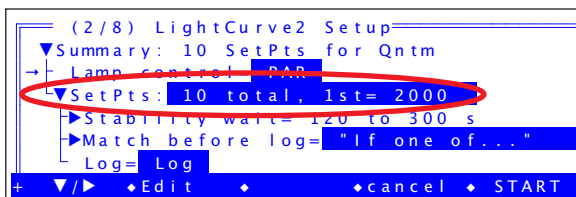
Each setpoint is a single value (PAR)

If using RGB
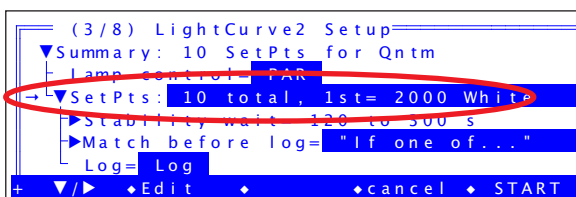
Each setpoint contains a PAR value and a color.

If using LCF
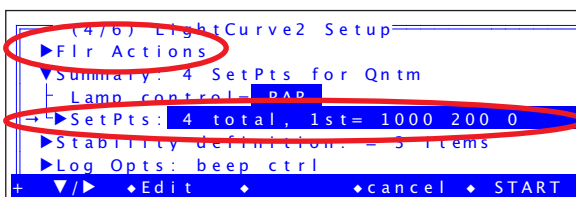
Each setpoint contains three values: total PAR, blue value, and a 1 or 0, where 0 means the blue value is μmol m^{-2} s^{-1}, and 1 means the blue value is %. Here, our first point is 1000 μmol m^{-2} s^{-1} total, 200 of it blue. Also note the Flr Actions node.

This means that AutoPrograms that ask for multiple light levels (LightCurve2, CO2Curve_MultipleLight and LightCurve_MultipleCO2) have some built-in capability that the old LightCurve program did not have: you can now change color (for the RGB) or how blue is handled (for the LCF) as you progress through the light levels.

For the LCF, you enter three values for each light level (see next page): total, the blue value, and a flag (0 or 1). The flag determines how the blue value is to be interpreted. 0 means μmol m^{-2} s^{-1}, and 1 means percent.

For the RGB, you enter multiple values for each light level (see next page): total, and color. The color can be a name, or a three-value color specifier.

In all cases, there is a handy shortcut for entering light values. If you don't specify all the expected values, the missing ones default to their previous ones. So, to specify a light curve for the LCF using 10 percent blue all the time, you can just put the blue info in the first entry, like this:

```
2000, 10, 1
1500
1000
:
```

Set points for the LCF and RGB are entered via a full screen editor. For the LCF:

```
══  (4/6) LightCurve2 Setup══
  ►Flr Actions
  ▼Summary: 5 SetPts for Qntm
  ─ Lamp control=  PAR
→ └►SetPts: 5 total, 1st= 2000 10 1
  ►Stability definition: = 3 items
  ►Log Opts, beep ctrl
+   ▼/►  ◆Edit   ◆        ◆cancel  ◆ START
```

Lamp Control = PAR

```
══3 Vals/Line: Total, Blue, 0(µm)or1(%)══
║2000, 10, 1
║1500
║1000
║500, 50, 0
║200
║100
+DelLn   ◆ClrEnd  ◆DelChar◆Cancel  ◆OK
```

Lamp Control = Control Signal

```
══2 Values/Line: RedmV BluemV══
║1000, 5000
║500, 3000
║100, 1000
║100, 50▄
║
║
+DelLn   ◆ClrEnd  ◆DelChar◆Cancel  ◆OK
```

Note that you don't necessarily have to enter all 2 or 3 entries per line. In the above left example, the 2nd and 3rd setpoints will re-use the blue value from the 1st set point (10%), while the 4th and later set-points will use the blue value of 50 μmol m^2 s^{-1} from the 4th setpoint.

The setpoint editors when using the RGB look like this:

Lamp Control = PAR

```
══2 Values/Line: PAR, Color══
║2000, White
║1500
║1000, 0 1 1▄
║500
║250
║120
+ColorN ◆ColorV ◆        ◆Cancel  ◆OK
```

Lamp Control = Control Signal

```
══3 Values/Line: Red% Green% Blue%══
║80, 80, 80
║,,60
║,40
║20
║10 10 10▄
+DelLn   ◆ClrEnd  ◆DelChar◆Cancel  ◆OK
```
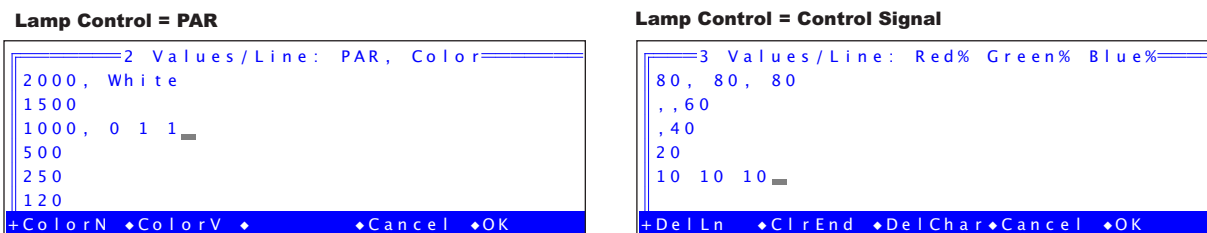
The first two points will use white, then for the 3rd and remaining points, the color changes to cyan (no red, and matched green and blue). It is equivalent to this:

Once again, not all values need be entered. Missing values use the previous value. Thus, the above settings (if you re-edit to check) will come out looking like this:

```
══2 Values/Line: PAR, Color══
║2000, white
║1500, White
║1000, 0 1 1
║500, 0 1 1
║250, 0 1 1
║120, 0 1 1
+ColorN ◆ColorV ◆        ◆Cancel  ◆OK
```

```
══3 Values/Line: Red% Green% Blue%══
║80, 80, 80
║80, 80, 60
║80, 40, 60
║20, 40, 60
║10, 10, 10
+DelLn   ◆ClrEnd  ◆DelChar◆Cancel  ◆OK
```
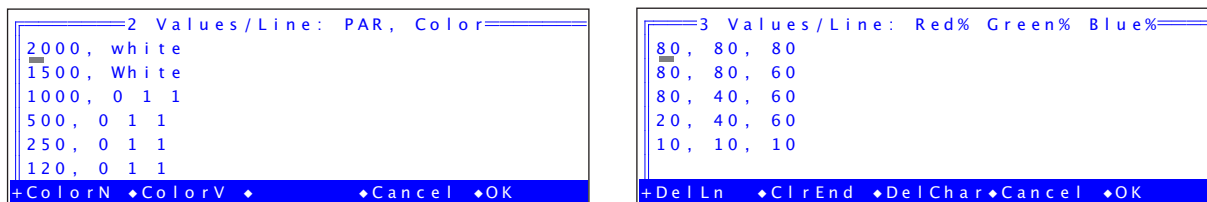
One last thing: Note the **ColorN** and **ColorV** keys. These keys will pop up the color dialog (below) which will insert the specified <u>N</u>ame or triple <u>V</u>alues into the text at the cursor location.

```
══Pick Color══
║ White
║ Red
║ Yellow
║ Green
║ Cyan
║ Blue
```
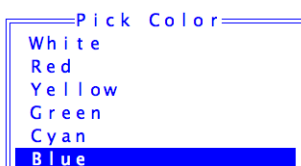
AutoLog2 Summary Node

AutoLog2 will log a fixed number of times. The interval between the logs can be a fixed time, or else based on stability. The summary node looks like this:

```
→▼Summary: Every 5s for 00:10:00          →▼Summary: Every 30-120s for 00:10:00
  └▼Duration (mins)= 10                      └▼Duration (mins)= 10
   └▼Wait for= time                          └▼Wait for= stability
    ├ Log interval (s)= 5                     ├▼Stability wait= 30 to 120 s
    └ Action= Log                            │ ├ Minimum (secs)= 30
                                             │ └ Maximum (secs)= 120
                                             ├ Match before log= "never"
                                             └ Action= Log
```
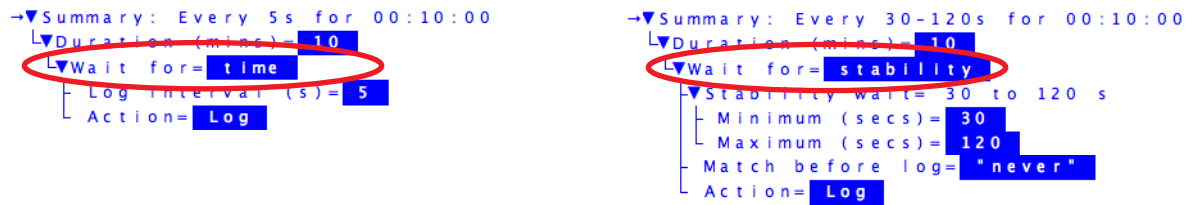
LightCurve2 Summary Node

The summary node for the light curve program looks like this:

```
→▼Summary: 9 SetPts for Qntm
  ├ Lamp control= PAR
  └▼SetPts: 9 total, 1st= 2000 10 1
   ├▼Stability wait= 120 to 200 s
   │ ├ Minimum (secs)= 120
   │ └ Maximum (secs)= 200
   ├ Match before log= "never"
   └ Log= Log w/ Fs Fm'
```
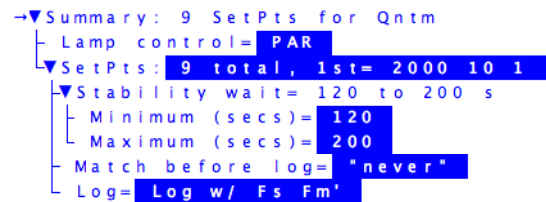
A-CiCurve2 Summary Node

The Summary node for the A-Ci program is

```
→▼Summary: 8 (400→600) of Reference CO2
  ├ CO2 control= Reference CO2
  └▼CO2= { 400 300 200 100 50 400 400 6
   ├▼Stability wait= 60 to 120 s
   │ ├ Minimum (secs)= 60
   │ └ Maximum (secs)= 120
   ├ Match before log= "never"
   └ Log= Log
```
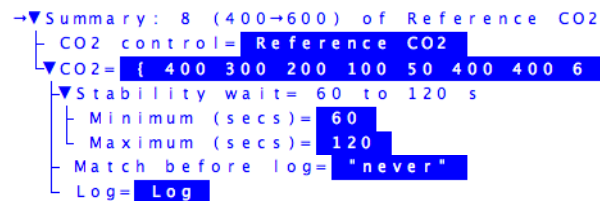
LightCurve_MultipleCO2 Summary Node

This program does light curves at multiple CO_2 settings. The summary node looks like this:

```
→▼Summary: 9 Qntm in 4 Sample CO2
  ├▼CO2 control= Sample CO2
  │ └ Setpoint units= ppm
  ├▼CO2= { 385 280 550 700 }
  ├ Lamp control= PAR
  └▼Setpts: 9 total, 1st= 2000 10 1
   ├ Extra wait (min), 1st Setpt= 20
   ├▼Stability wait= 60 to 300 s
   │ ├ Minimum (secs)= 60
   │ └ Maximum (secs)= 300
   ├ Match before log= "never"
   └ Action= Log w/ Fs Fm'
```
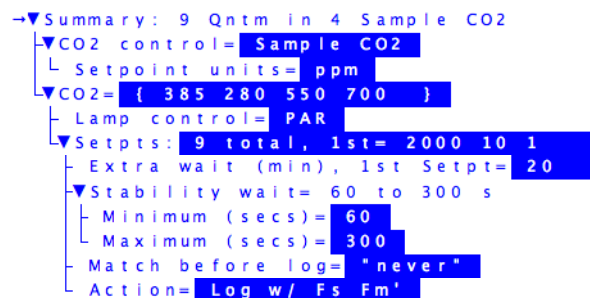
CO2Curve_MultipleLight Summary Node

This program does CO_2 curves at multiple light levels. The summary node looks like this:

```
→▼Summary: 8 Reference CO2 in 4 Qntm
 ├ Lamp control= PAR
 └▼Setpts: 4 total, 1st= 2000 10 1
   ├▼CO2 control= Reference CO2
   │ └ Setpoint units= ppm
   └▼CO2= { 400 300 200 100 50 400 400
     ├ Extra wait (min), 1st Setpt= 20
     ├▼Stability wait= 60 to 300 s
     │ ├ Minimum (secs)= 60
     │ └ Maximum (secs)= 300
     ├ Match before log= "never"
     └ Action= Log w/ Fs Fm'
```
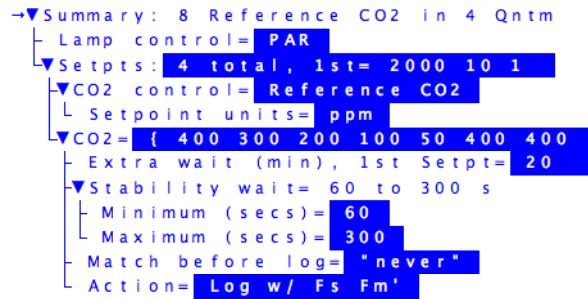
TimedLamp2 Summary Node. TimedLamp2 does what TimedLamp did before, but with some enhancements. It now uses a configuration tree interface.

```
╔══ (2/2) TimedLamp Setup═══════════╗
║ ▼Summary: 6 Steps
→╙ values= 6 Steps, 1st= (300, 100, 10




║+   ▼/►  ♦Edit   ♦       ♦cancel ♦ OK
```
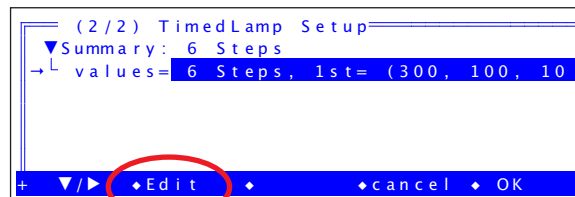
```
┌3/Line: Time(s), Intensity, logEvery(s)
║300, 100, 10
║10, 1000, 1
║10, 1800, 1
║10, 1000, 1
║300, 100, 5

+DelLn   ♦ClrEnd ♦DelChar♦Cancel  ♦OK
```
As before, you specify time, intensity, and log intervals.

```
┌3/Line: Time(s), Intensity, logEvery(s)
║240, 100, 10
║"LPMatch"
║60, 100, 10
║10, 1000, 1
║10, 1800, 1
║10, 1000, 1
+DelLn   ♦ClrEnd ♦DelChar♦Cancel  ♦OK
```
A new feature: if you wish to do a match somewhere in there, just insert it in the sequence.

```
┌3/Line: Time(s), Intensity, logEvery(s)
║"1 1 1 LPRGBSetColor "
║"400 2 MixerSetNewTarget"
║120 2000 0
║"LPMatch"
║"LPLog"
║"200 2 MixerSetNewTarget"
+DelLn   ♦ClrEnd ♦DelChar♦Cancel  ♦OK
```
In fact, you can insert any command you wish, allowing you to write a completely separate autoprogram that does not necessarily have anything to do with light sources.

LI-6400 Apps

Until now, the support software for the LI-6400 has been almost exclusively Windows based. That has now changed. With the launch of version 6.2, we are also launching a collection of support programs that will run on Mac OS X, Linux, and Windows.

On Windows
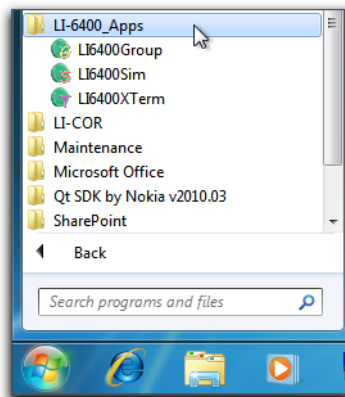
On Linux
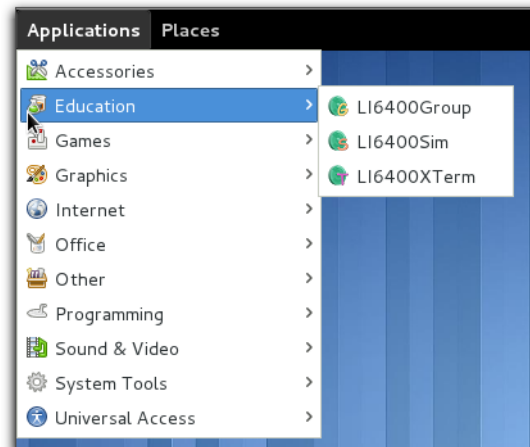
On OS X

The Apps are LI6400XTerm (remote terminal and file exchange operations), LI6400Sim (simulates an LI-6400 running any of 6 versions of OPEN from 3.4.3 to 6.2), and LI6400Group (remote terminal for multiple LI-6400s). They are all described in the version 6.2 manual in chapter 11.

Faster IRGA zeroing

The IRGA zeroing routine has added the ability to automatically zero the reference cells only, and the ability to set the sample to match the reference value, depending on the state of the match valve.

Slight change in key labels on level 1.

Four Levels of FCT keys are accessed by pressing the numbers 1-4.

Level 2 is new. Depending on the match valve, you can zero a reference channel, or match a sample to a reference.

Levels 3 and 4 allow individual channels to be manually adjusted, as before.
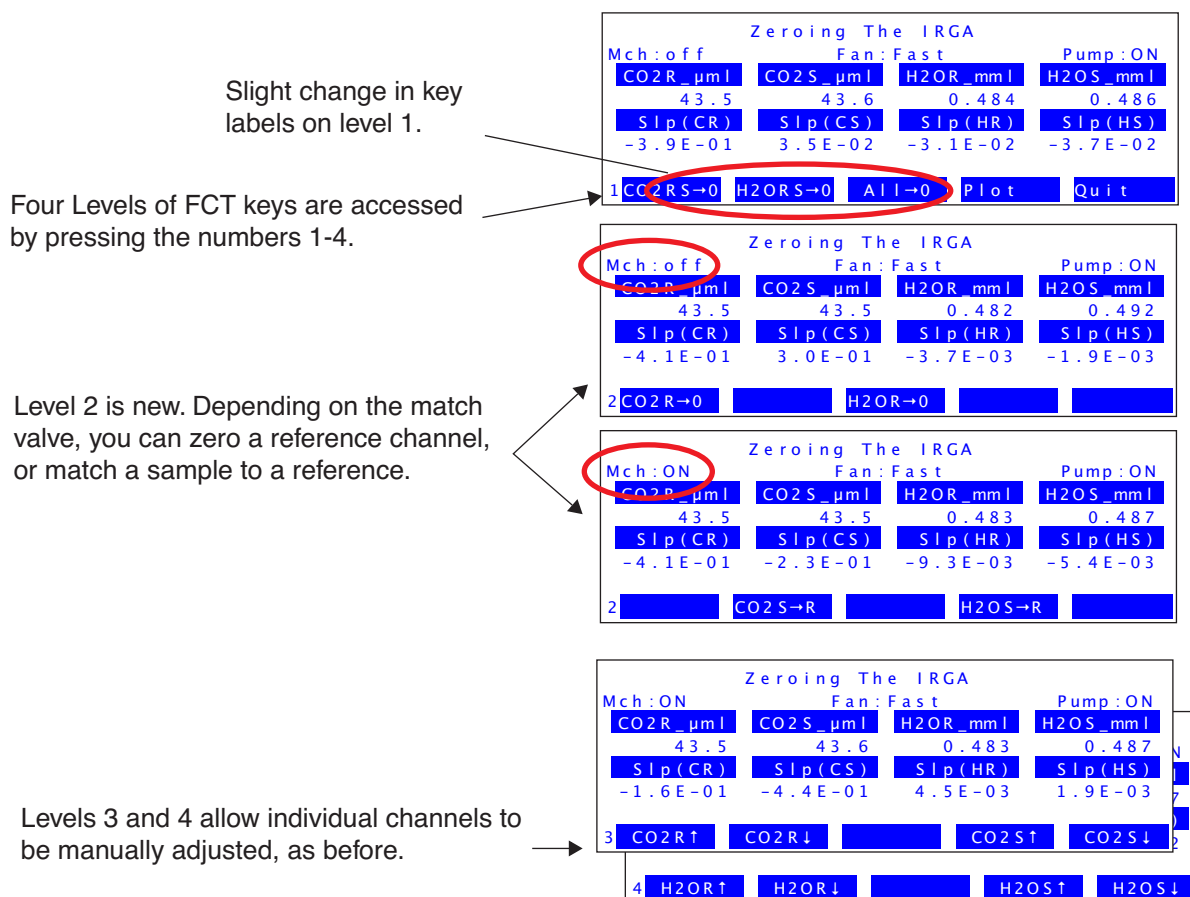
You can use this capability to do more rapid zeroing, since you don't have to wait for the sample cell to become stable at zero. Here's how:

1. Zero reference only
Match off. When reference is stable, **f1** (level 2) to zero CO_2, **f3** (level 2) to zero H_2O.

2. Match sample to reference
Match ON, wait 30 seconds for the reference to adjust, then **f2** (level 2) to "zero" CO_2, and **f4** (level 2) to "zero" H_2O. You aren't really zeroing them, but rather doing a zero adjustment to make them match the value as reported by the reference cell.

For more details, see the version 6.2 manual, page 18-16.

User Definable Function Keys

Version 6.2 provides a method to easily define 7 of the New Measurements function keys: **f1** and **f2** in level 3 (by default, the Area and Stomatal ratio key), and **f1** through **f5** on level 7 (usually unused). Any of these function keys can be in one of three states: 1) disabled, 2) prompt for a constant, or 3) custom.

Prompting for a constant (any value with a sys or user ID number) will make the fct key show the constant's name and value in its label, and when pressed, will prompt you for a new value.
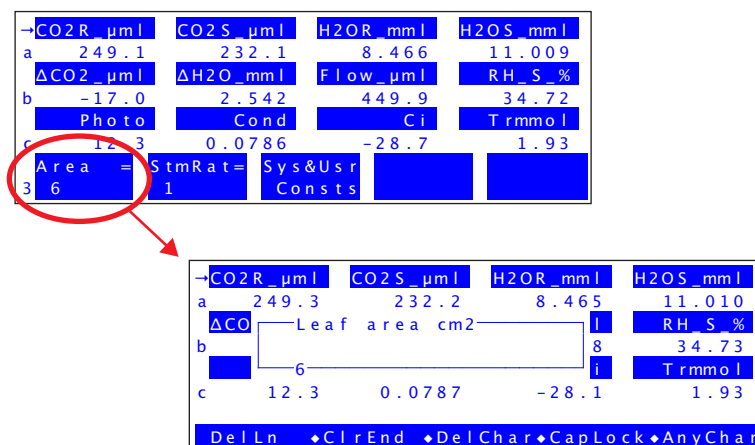
To define a key to prompt for a constant, go to Config Menu -> View/edit..., and find the <open> <comps> <fctkeys> node. Entries for the 7 definable function keys are listed under that.
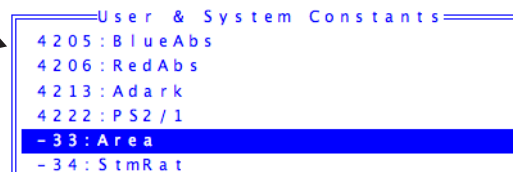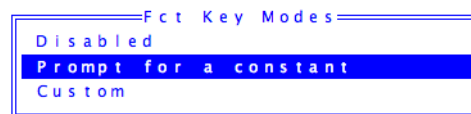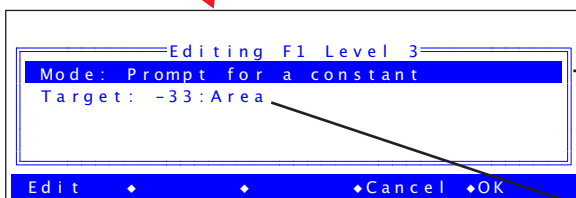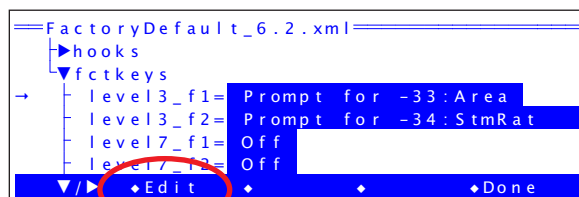
If used for prompting for a constant, any system or user defined value can be its target.

For more, see the version 6.2 manual page 16-22.

Configuration Builder Revamped

The Configuration Builder (Config Menu -> New...) is now tree-based. That is, once you've decided what to build a configuration for, all the options are in front of you, and you can adjust them at will before actually implementing it. Below is an example for building a config for the 2x6 chamber.
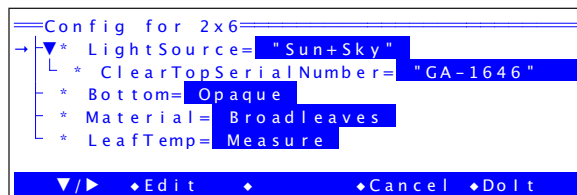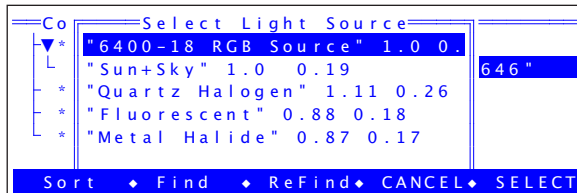
1. Start with a 2x6 chamber

```
┌─Make a NEW Config for...──────
│  ▶Light Sources
│  ▶Clear 2x3 Tops
│  ▼Larger Chambers
│     6400-07 or -11 2x6 Chamber...
│     6400-05 Conifer Chamber...
│     6400-17 Whole Plant Arabidopsis..
│  ▼/▶   ◆      ◆        ◆ EXIT  ◆ SELECT
```
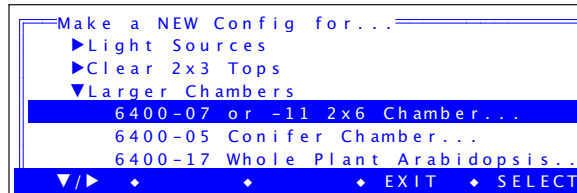
2. You'll be asked which calibrated chamber top to use.

```
┌─Make a NEW Config for...──────
│ ┌──Select a chamber top──────
│ │ GA-1646
│ │
│ │
│ │                        .
│ │                      sis..
│    ◆Add      ◆      ◆Cancel ◆Select
```
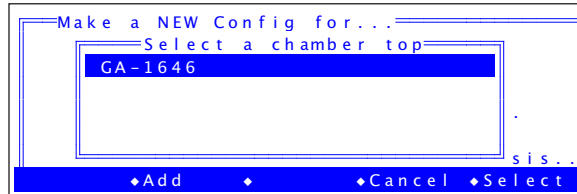
3. Here is the config setup tree. You can edit any node you wish.

```
═══Config for 2x6═══
→├─▼* LightSource= "Sun+Sky"
│ └  * ClearTopSerialNumber= "GA-1646"
├  * Bottom= Opaque
├  * Material= Broadleaves
└  * LeafTemp= Measure

  ▼/▶   ◆Edit    ◆        ◆Cancel ◆DoIt
```

4. Let's change the light source to the RGB.

```
═Co┌─────Select Light Source──────┐
 ├─▼*│ "6400-18 RGB Source" 1.0 0.│
 │ └ │ "Sun+Sky" 1.0  0.19        │646"
 ├  *│ "Quartz Halogen" 1.11 0.26 │
 ├  *│ "Fluorescent" 0.88 0.18    │
 └  *│ "Metal Halide" 0.87 0.17   │
   Sort   ◆ Find   ◆ ReFind◆ CANCEL◆ SELECT
```

5. Then change the bottom from opaque to clear. Notice the *ClearTopSerialNumber* node is gone (cal not used with RGB), and the LeafTemp is forced to be energy balance.

```
═══Config for 2x6═══
 ├─▼* LightSource= "6400-18 RGB Source"
→├  * Bottom= Clear
 ├  * Material= Broadleaves
 └  * LeafTemp= EnergyBalance

  ▼/▶   ◆Edit    ◆         ◆Cancel ◆DoIt
```
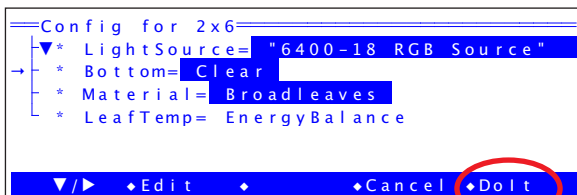
6. When you are done editing, you are taken to the familiar final dialog box.

```
Config Modifications Ready. Pick one:

N) implement as a New config named:
   '2x6 RGB ClrBtm EB'
C) apply to the Current config
V) View the modifications
E) return and Edit your settings
<escape> - discard and quit
```
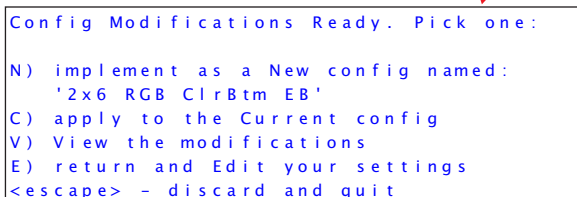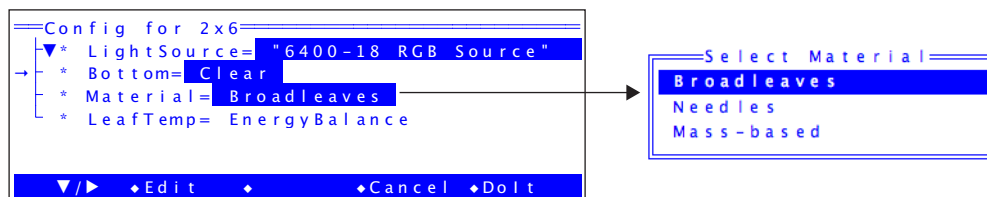
For more information, see the version 6.2 manual page 16-5.

Mass Based Fluxes

Mass based fluxes means computing photosynthesis and transpiration on a per mass basis, rather than a per area basis. Sometimes it is easier to determine weight rather than area, such as when measuring insects, pieces of fruit, mosses, etc.

With 6.2, you can now configure for mass-based fluxes for any chamber using the new configuration builder (described above). There is a "Material" node in the config tree that lets you select between broadleaves, needles, and anything mass-based.

```
═Config for 2x6═════════            ═Select Material═══
 ▼* LightSource= "6400-18 RGB Source"    Broadleaves
→⊢ * Bottom= Clear                       Needles
 ⊢ * Material= Broadleaves               Mass-based
 └ * LeafTemp= EnergyBalance

 ▼/▶   ◆Edit    ◆       ◆Cancel ◆DoIt
```

For more details, see the version 6.2 manual, page 16-51.

Match Mode System Variables

Three system variables have been added that pertain to matching, and can be found on display line m. $matchCO2$ (ID=-112) is the CO_2 at the last match, $matchH2O$ (ID=-113) is the water concentration at the last match, and $mchElpsd$ (ID=-114) is the time (HH:MM:SS) since the last match. If matching has not yet occurred, $mchElpsd$ will show "Too Long".

```
→matchCO2    matchH2O    mchElpsd
m    533.7       7.55    00:01:24
 ΔCO2_µml    ΔH2O_mml    Flow_µml        RH_S_%
b     -0.0      -0.007      500.7         22.47
     Photo        Cond          Ci       Trmmol
c   0.0387   -0.000226         783     -0.00552
     Open     <view    <close    <add      Match
1LogFile     file>     file>   remark>
```
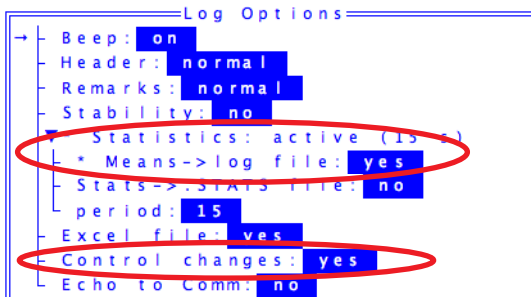
These will be on display line m for the configuration FactoryDefaults_6.2.xml, and also for any new configurations that you create. (Existing configurations are unchanged.)

For further details, see the version 6.2 manual, page 14-27.
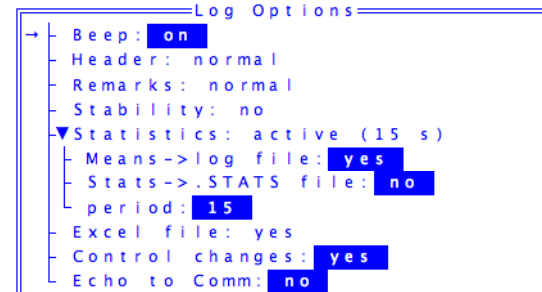
Log Option Changes

There are some changes in the Log Options: we've made a couple of changes, and one of them is that you can now access the Log Options (**f3** level 5) when a log file is open. You won't be allowed to change some of them, however, and they are the ones without inverse value fields (below right).

No log file open

```
════════════Log Options════════
→├ Beep:  on
 ├ Header:  normal
 ├ Remarks:  normal
 ├ Stability:  no
 ▼   Statistics:  active (15 s)
 ├ * Means->log file:  yes
 ├   Stats->.STATS file:  no
 └   period:  15
 ├ Excel file:  yes
 ├ Control changes:  yes
 └ Echo to Comm:  no
```

Log file open

```
════════════Log Options════════
→├ Beep:  on
 ├ Header:  normal
 ├ Remarks:  normal
 ├ Stability:  no
 ▼Statistics:  active (15 s)
 ├ Means->log file:  yes
 ├ Stats->.STATS file:  no
 └ period:  15
 ├ Excel file:  yes
 ├ Control changes:  yes
 └ Echo to Comm:  no
```

Log Option: Statistics

The old statistics log option created a .stats file in parallel with the log file that recorded the means, standard deviations, and rates of change of all logged floating point variables. Version 6.2 adds an option to this. When **Means→logFile** is enabled, the logged value of all floating point variables will be the average over the previous x seconds (x = whatever the Period is set to). Thus, this affects the <u>value in the log (and Excel) file</u>, not just the mean value in the .stats file. In fact, the two will now agree.

For further details, see the version 6.2 manual, page 9-16.

Log Option: Control Changes

When this option is enabled, any control changes (flow/humidity, CO_2, temperature, or light) that happen while a log file is open will have a remark added indicating the control change.

```
"17:17:06 "
$STARTOFDATA$
"Obs""HHMMSS""ETime""Photo""Trmmol""TChamAir""Tair""Tleaf""TBlk ""CO2R "…"Status"
"17:22:27 CO2 Mixer: CO2R -> 400 uml"
1    "17:22:30"342.87.36    1.16    26.52    24.56    26.52    26.02    249.20  232.25…
2    "17:22:31"343.37.35    1.16    26.52    24.56    26.52    26.02    249.02  232.08…
"17:22:40 Coolers: Tleaf -> 20.00 C"
3    "17:22:46 359.37.44    1.16    26.52    24.56    26.52    26.02    249.25  232.11…
4    "17:22:47"359.87.3     1.16    26.52    24.56    26.52    26.02    249.08  232.25…
```

This is discussed in the version 6.2 manual, page 9-17.

Fluorescence Computational Changes

F_m

Prior to 6.2, the maximal fluorescence achieved during a rectangular flash was simply determined from the maximum value. That is, just one data point. In version 6.2, the program finds the maximum, then averages it together with the six neighboring data points (three on each side) to determine F_m. This is, in other words, a .06 second average centered on the maximum value).

F_o, F_s

Prior to 6.2, these values were simply the latest value of F at the moment the SetFo or SetFs command occurred (or button pressed). In version 6.2, these values are now set using the mean value of F over the previous x seconds, where x is the period specified by the <FlrSettings> <stats> <period> node in the fluorescence configuration tree.

These statistics on fluorescence are not new: this is in fact how the dF/dt stability variable has always been computed. What is new is that the period is now accessible for user setting, and the mean value is now being used for something (setting F_o and F_s), and is available for the first time as a system variable (ID #-114) for logging, plotting, etc.

Mixer Cal Handles Low Concentrations

A while ago we published an App Note describing how to replumb the console to allow the CO_2 mixer to control concentrations down to 0 ppm, instead of the normal 40 or 50 ppm (App Note 7, *Modification of LI-6400 to Control at Low CO_2*, PPS-267). That note describes some file editing that was necessary to get the mixer calibration program to cover that range. Version 6.2 takes care of all that, with a mixer calibration that doesn't depend on whether or not that modification has been done.

The following scheme is used: 10 setpoints are tried, (the normal 8, plus two more: 50 and 0 mV). On the 8th one (100 mV), the program starts computing the change in CO_2 per the change in mV setpoint. When this drops below 0.1, it is done. Thus, calibrating a normal console will probably quit after the 100 mV set point, while calibrating a modified one will go all the way to zero.
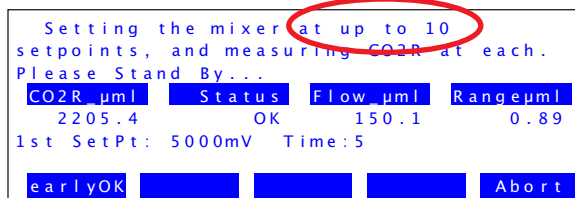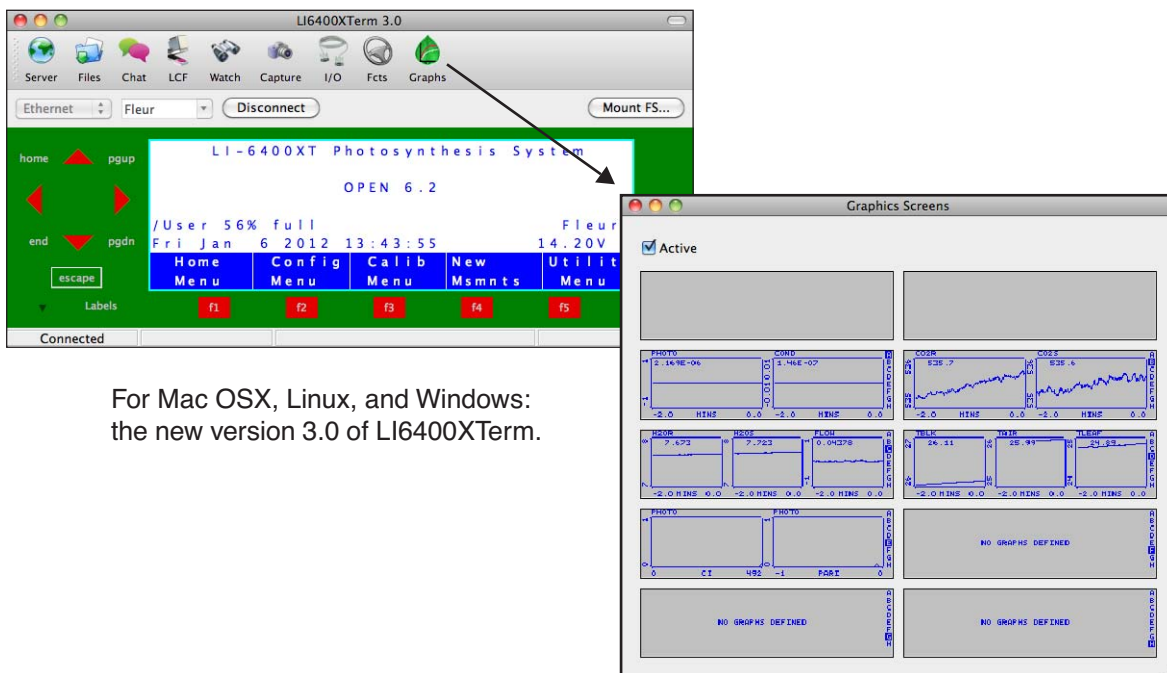

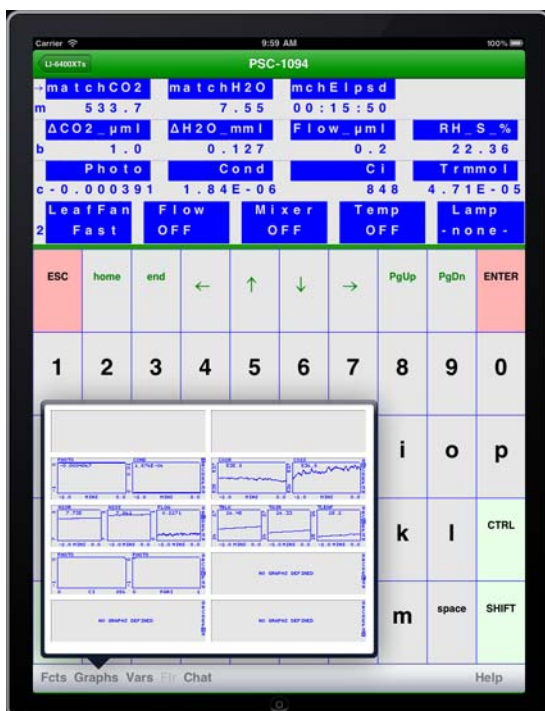The only outward sign of the change is the vague message.

The mixer calibration is described in the version 6.2 manual, page 18-25.

View All Graphs Simultaneously

Version 6.2 supports showing all graphics screen simultaneously on a remote terminal.

For Mac OSX, Linux, and Windows:
the new version 3.0 of LI6400XTerm.

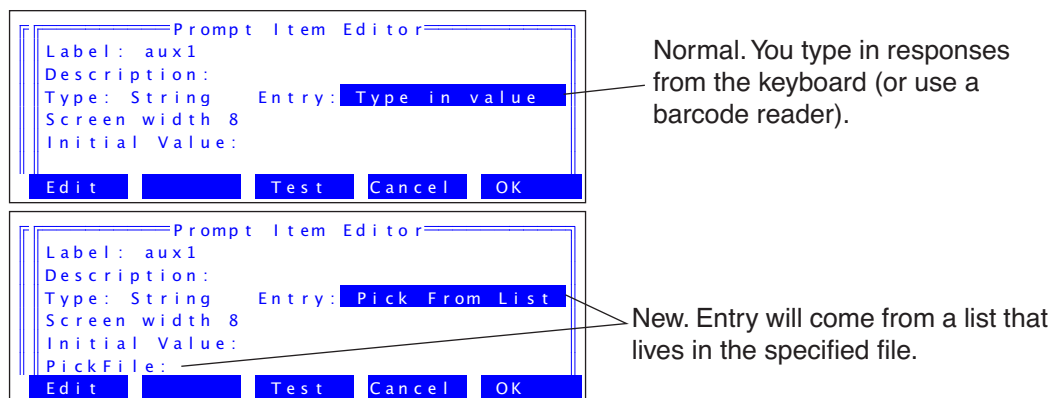For iPad: LI6400TermHD version 1.1 (to be
released early 2012)

On the LI6400XTerm version 3, you can directly change the graph parameters on the instrument without having to do any navigating or editing on the instrument. You simply right click on the plot to change, as shown below.
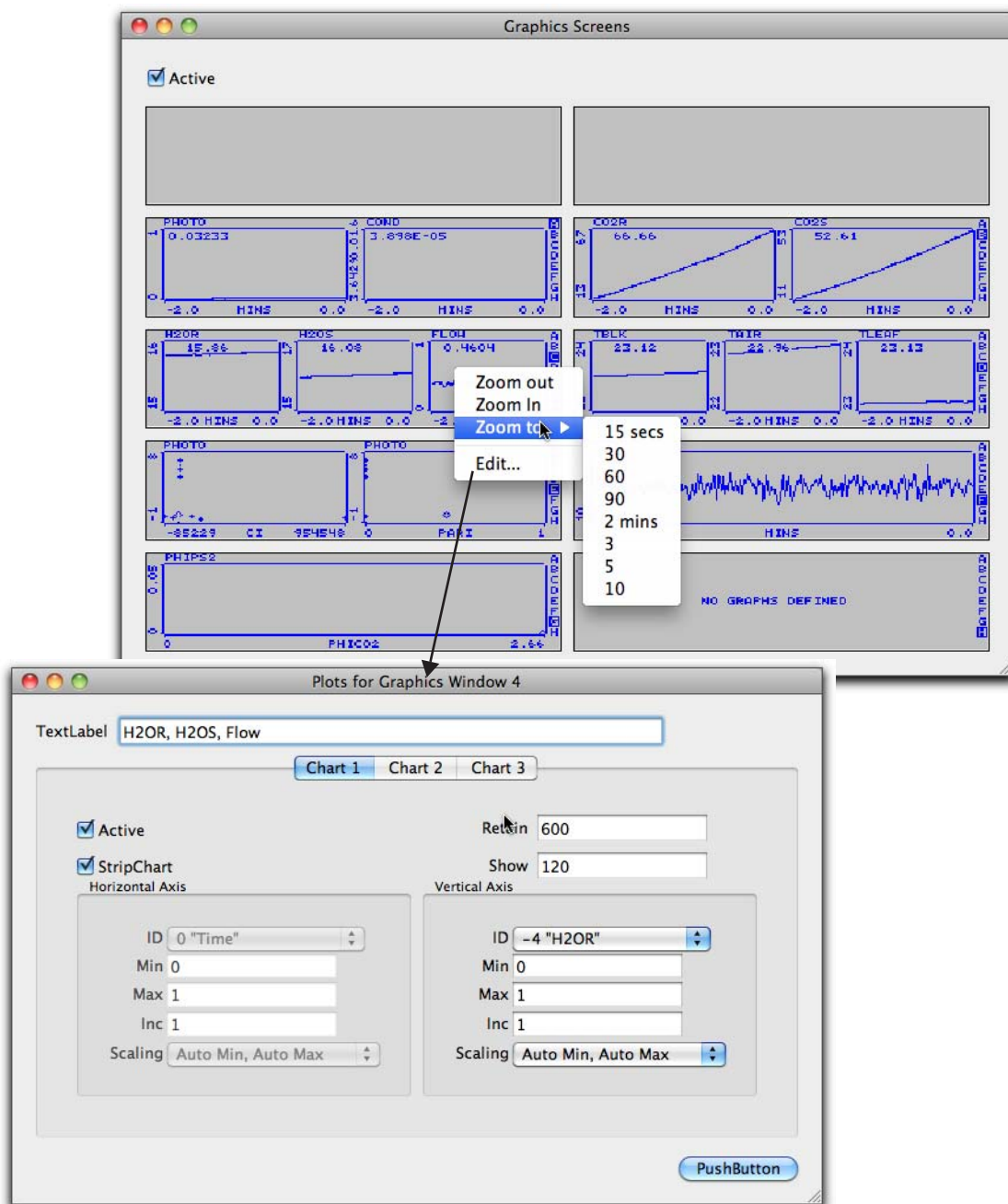
Pick-From-List Prompts

Sometimes it is convenient to have a prompt whose response comes from an item in a list, instead of having to type in the response. For example, a plot identifier might be some long string (e.g. "A274-B324K"), but there are only some limited number of them, so can be "pre-loaded" in a list.

Version 6.2 introduces the "Pick From List" option for entering prompts. The Prompt Item Editor now looks like this:

```
┌──────────Prompt Item Editor──────────┐
│ Label: aux1                           │
│ Description:                          │
│ Type: String    Entry: Type in value  │
│ Screen width 8                        │
│ Initial Value:                        │
│                                       │
│   Edit          Test   Cancel   OK    │
└───────────────────────────────────────┘
```
Normal. You type in responses from the keyboard (or use a barcode reader).

```
┌──────────Prompt Item Editor──────────┐
│ Label: aux1                           │
│ Description:                          │
│ Type: String    Entry: Pick From List │
│ Screen width 8                        │
│ Initial Value:                        │
│ PickFile:                             │
│   Edit          Test   Cancel   OK    │
└───────────────────────────────────────┘
```
New. Entry will come from a list that lives in the specified file.

When a prompt whose entry method is specified as 'Pick From List' is asked (e.g. as part of **Prompt All** (**f5** level 3) or **Sys&Usr Consts** (**f3** level3), it looks like this:

```
→CO2 ┌─Select value for PlotID─┐ _mml
a    │ A123-457DP              │ .491
 ΔCO │ A123-746DP              │ _S_%
b    │ A123-836DP              │ 7.15
     │ A123-111DP              │ mmol
c-1. │ A150-879DP              │ 15E-0
     └'E'-sel+edit '^E'-edit all┘
   Sort   ◆ Find  ◆ ReFind◆ CANCEL◆ SELECT
```
Pick the desired response, and press enter or f5.

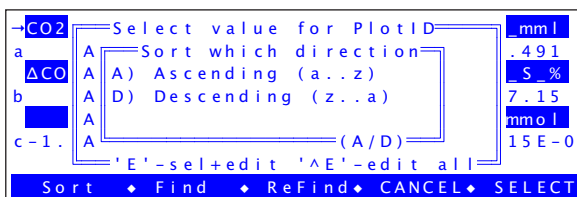Notice there are also some options:
f1 - sort the list
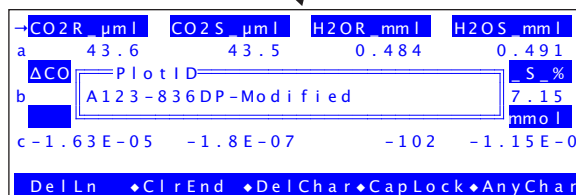**f2** - search for target
f3 - find the next occurrence of the target
E - select the current item, then edit it like a normal prompt response
ctrl+**E** - edit the whole list, and update the file.

f1 - Sort

```
→CO2 ┌─Select value for PlotID─┐ _mml
a    │A┌─Sort which direction─┐ │ .491
 ΔCO │A│A) Ascending (a..z)   │ │ _S_%
b    │A│D) Descending (z..a)  │ │ 7.15
     │A│                      │ │ mmol
c-1. │A└──────────(A/D)───────┘ │ 15E-0
     └'E'-sel+edit '^E'-edit all┘
   Sort   ◆ Find  ◆ ReFind◆ CANCEL◆ SELECT
```

E - Select + Edit

```
→CO2R_µml  CO2S_µml  H2OR_mml  H2OS_mml
a    43.6      43.5     0.484     0.491
 ΔCO ┌─PlotID──────────────────┐    _S_%
b    │ A123-836DP-Modified     │    7.15
     │                         │    mmol
c-1.63E-05  -1.8E-07     -102  -1.15E-0
   DelLn   ◆ClrEnd ◆DelChar◆CapLock◆AnyChar
```
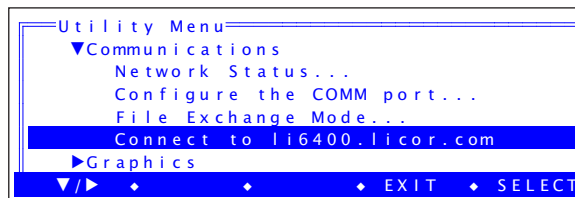
For further details, see the version 6.2 manual, page 9-25.

Connecting to li6400.licor.com

The routine for connecting an LI-6400XT to li6400.licor.com (See Using the LI-6400XT, Connection via Internet, page 11-35) is now found in the Utility Menu

```
═══Utility Menu═══
    ▼Communications
        Network Status...
        Configure the COMM port...
        File Exchange Mode...
        Connect to li6400.licor.com
    ▶Graphics
  ▼/▶    ◆         ◆         ◆ EXIT   ◆ SELECT
```

```
Connect to LI6400.licor.com

L)ocal id: psc1094
R)emote id: rmt
C)onnect

Choose L/R/C/T:▬
```
Prior to connecting

```
Connected to LI6400.licor.com

Local id: psc1094
Remote id: rmt
Status: Waiting▬

Press D) to disconnect, or
any other key to exit
```
Connected to li6400.licor.com, but waiting for the other party (local id = rmt, remote id = psc1094)

```
Connected to LI6400.licor.com

Local id: psc1094
Remote id: rmt
Status: Talking▬

Press D) to disconnect, or
any other key to exit
```
You and the other party connected and talking.

The difference in 6.2 is that the connection *persists* even when the user on the other end of the server disconnects his terminal. This means you can connect the LI-6400XT to the server, go home, and connect to the LI-6400XT from there. Disconnect and reconnect all you want to - the LI-6400XT will always be there. The only way to get it to stop is to press **D** in the connection dialog (above).

The **T** option tests the server, to see what connections or pending connections there are.

One connection pending. ('abc' is waiting for someone).

How many packets the server has handled.

How long the server has been running.

```
connections: abc:***
packets: 21112021  151047
uptime: 2065:04:32


Press Any Key▬
```

This connection routine is described in the version 6.1 manual on page 11-38.