

# Introduction



Fulham's programmable LED drivers are the WorkHorse of LED drivers. These innovative drivers can be programmed with a large number of outputs, allowing the user to stock fewer SKUs. The functionality of one programmable driver can replace over 3500 standard drivers.

The following pages contain information to not only operate, but also customize Fulham's programmable LED drivers for use with in a vast array of luminaires. Fulham's programmable LED drivers are available in various configurations with wattages ranging from 40W to 200W and an impressive HotSpot Plus Emergency driver that acts as both an LED driver and Emergency driver in one compact unit. These drivers feature either 0-10V Dimming, DALI Dimming or a Wireless Protocol.

Further information on all Fulham products can be found at [www.fulham.com](http://www.fulham.com).

Currently available programmable LED drivers:

**Programmable – 0-10V Dimming**

T1M1UNV105P-40E  
T1M1UNV105P-60E  
T1M1UNV160P-60L  
T1M1UNV210P-60L  
T1M1UNV105P-60F  
T1M1UNV105P-60G  
T1M1UNV240P-96L  
T1M1UNV150P-100C  
T1M1UNV150P-150L  
T1M1UNV500P-185L  
T1M1UNV140P-200L

**Programmable – Twilight (Wireless)**

T1R1UNV150P-40C  
T1R1UNV150P-40CE  
T1R1UNV160P-60C  
T1R1UNV210P-60C  
T1R1UNV210P-60CE

**Programmable – DALI Dimming**

T1A1UNV105P-40E  
T1A1UNV105P-60E  
T1A1UNV105P-60F  
T1A1UNV105P-60G

**Programmable - HotSpot Plus with 0-10V Dimming**

FHSAC1-UNV-40C  
FHSAC1-UNV-40BLS  
FHSAC1-UNV-40L  
FHSAC1-230-45CE

Be sure to check [www.fulham.com](http://www.fulham.com) for the latest list of programmable drivers available.

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# Safety



## Safety Warnings and Instructions during design.

- Avoid touching any live parts and do not use damaged products such as products with damaged wiring.
- Disconnect mains voltage when servicing driver and before connecting or disconnecting the LED load.
- Cap off all unused wires to prevent any damage.
- The luminaire manufacturer is responsible for its own luminaire design as well as having to comply with all relevant safety standards.
- For further design support contact Fulham directly.
- Care must be taken so that NTC / Programming / R-set leads never touch LED output.

# Features



## Programmable Output Current.

All drivers are initially set to the minimum output current of the driver. The driver current can be set in several ways, all of which are accessed by using the input connections labeled **PRG + -** on the driver. As LED's become more efficient and require less drive current to achieve similar outputs as earlier versions, this allows for flexibility of design with newer technology.

There are three methods for programming output current. The TPSB-100/E setting controller allows users to program the desired voltage for a constant voltage driver or desired current for a constant current driver. Advanced programming can also be done through a PC using the Setting Tool software available at [www.fulham.com](http://www.fulham.com). In addition, on supporting drivers the current can be set by using the appropriate resistor value on the RSET input in accordance with the output current needed (note that supporting drivers are in RSET mode by default, with no additional programming needed, but if the output is subsequently changed the driver must be reprogrammed to 0mA in order to return to RSET mode).

## Adjusting Output (3 Methods):

1. RSET Mode
  - Placing an external resistor across the RSET ( + ) and RSET ( - ) input on supporting drivers. The driver will check the value of RSET and output the current corresponding to the resistor value. Please note that the driver is in RSET mode by default, with no additional programming needed, but if the output is subsequently changed the driver must be reprogrammed to 0mA with the TPSB-100/E setting Controller of the Setting Tool software in order to return to RSET mode.
2. Setting Tool Software
  - Please refer to page 5 entitled Programming.
3. Setting Controller
  - Please reference TPSB-100/E User Manual for further instructions.

# Features



## Benefits of Adjustable Output:

One common issue luminaire manufacturers face is the continuous improvement of lumen output in LEDs. As the LEDs' efficacy increase, the lumen output of the fixtures also increases. Although the same fixture is being sold, the overall lumen output of the fixture increases once a new version of an LED is used. This leaves a mismatch with previous product of lower lumen output and newer product with increased lumen output.

With Fulham's programmable output drivers the driver can be set to a lower current in order to offset the difference in light output. With this ability the manufacturer can offer a product rated for a certain lumen output without any engineering changes even when using the latest LEDs with higher lumens per watt. This helps prevent the common problem of mismatched fixtures in the field when higher lumen fixtures have been installed alongside existing lower output fixtures.

One example of this scenario is when the LED module manufacturer changes their LEDs to a newer, more efficient version. Although no physical change to the LED module has occurred, it becomes noticeably brighter. With the ability to program down the current we can ensure the system keeps the same lumen output.

The table below shows an example of how to calculate new current settings based on the improvements of the LEDs, i.e. the lumens per watt of the LED.

Luminaire System Rating (lm)	Existing LED Module Current (mA)	Existing LED Specifications (lm/w)	New LED Specifications (lm/w)	Existing LED Power	New LED Power	New LED Module Current (mA)
1500lm	350mA	130 lm/w	150 lm/w	11.5W	10.0W	304mA

## Log File Recording:

This features allows for easy maintainability and tracking of product setting during luminaire assembly. Specifically, at which point the unit was programmed and to what specification, allowing for future replacements to be easily managed. This lets an OEM know what a specific driver was programmed to in case a field replacement is needed.

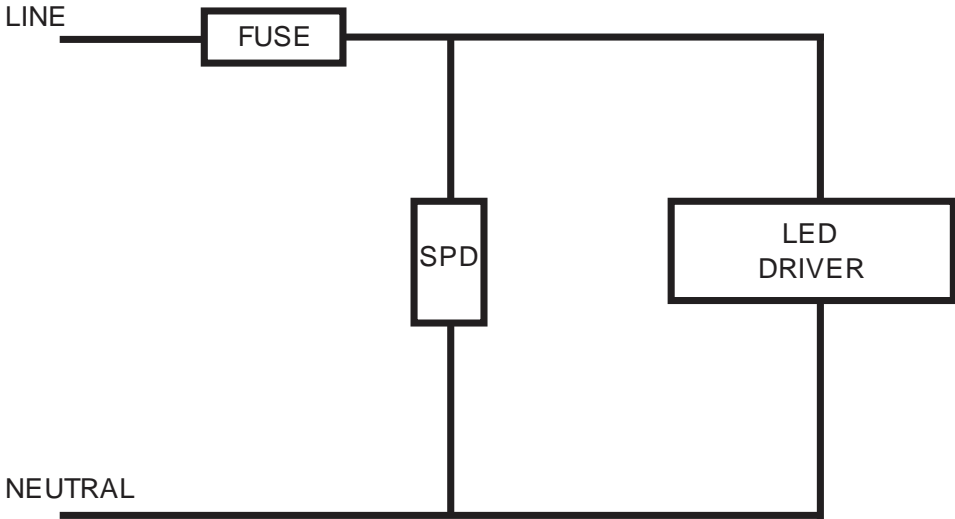
# Features



## Surge Protection:

The drivers have a level of surge protection built in to them, for actual surge ratings please refer to each driver's specification sheet. A driver specification of kV means that the driver has been tested to withstand this voltage of line transient. The drivers themselves are tested for all line coupling modes (L to N, L to PE, N to PE and L&N to PE) ensuring there rating of line voltage transient.

It is recommended to wire a series connected Surge Protection Device (SPD) in high risk applications or when higher surge ratings are required/needed. The Luminaire manufacturer should design into their fixtures sufficient surge protection in order to meet the specific category of Energy Star/ANSI requirement as needed.



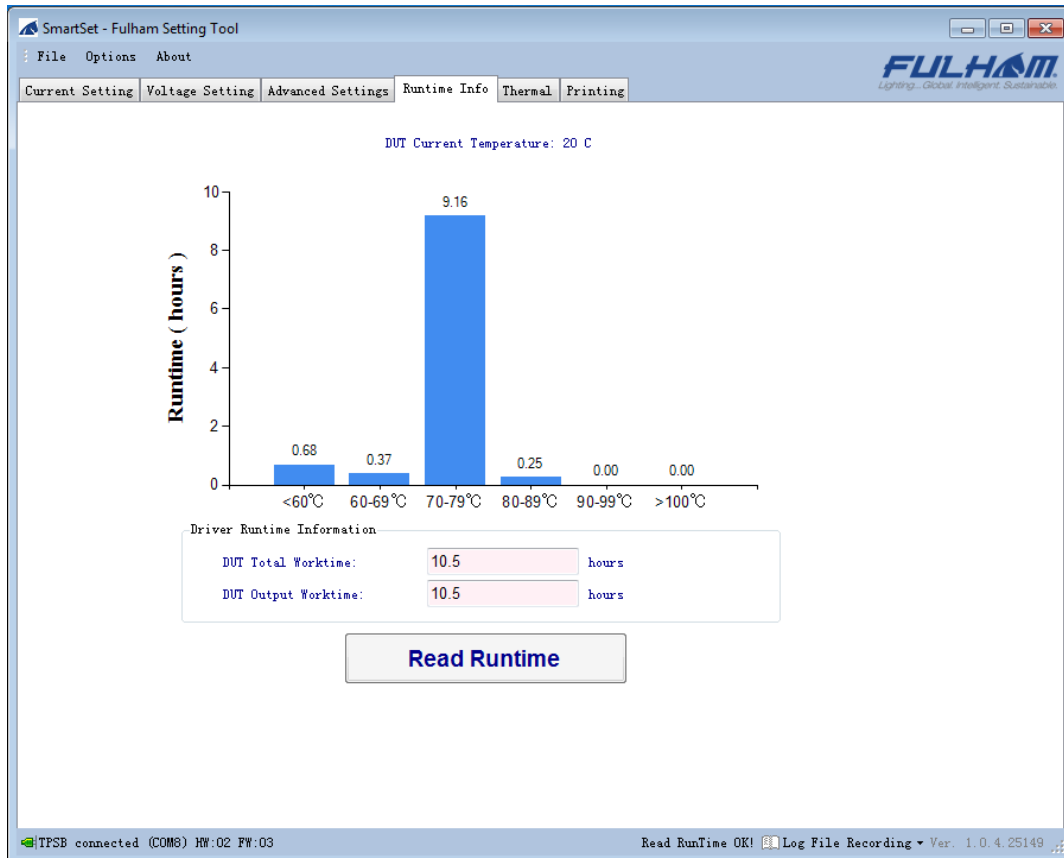
Above shows a series wired Surge Protection Device (SPD).

# Features



## Read Runtime:

This feature allows reading of the operating hours as well as their corresponding temperatures during times of use. Through the software interface under the “Runtime Info” tab this information can be generated by directly reading the runtime information from the driver. Please note that this feature is enabled only on applicable drivers.



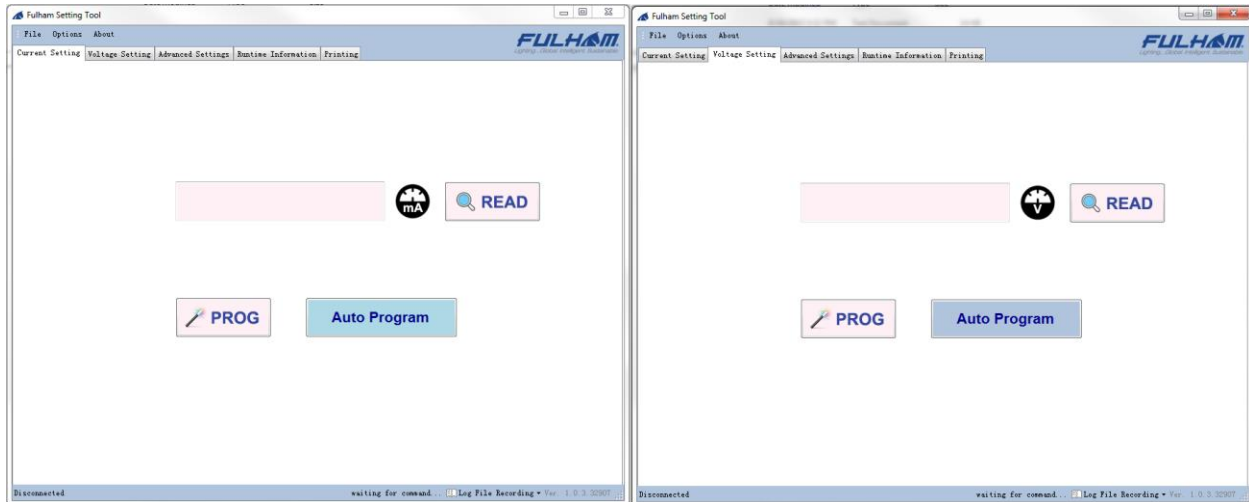
Pictured above is an example of the runtime information read from the driver.



# Programming



## Current and Voltage:



Using either the Voltage or Current tab in the Setting Tool interface the user can easily input the desired values. Depending on the particular driver, for a constant current application the user can program the desired output current dependent on the minimum and maximum current settings of the driver (refer to the specification sheet of driver for further information).

The same will apply to a constant voltage application in which a user can set a static output voltage depending on the limitations of the driver. With constant voltage the current will be determined by the maximum allowable output current of the driver (for example a driver set to a 24V output would have its maximum current set to the maximum allowable current of the driver not to exceed its total maximum power).

## Auto Programming:

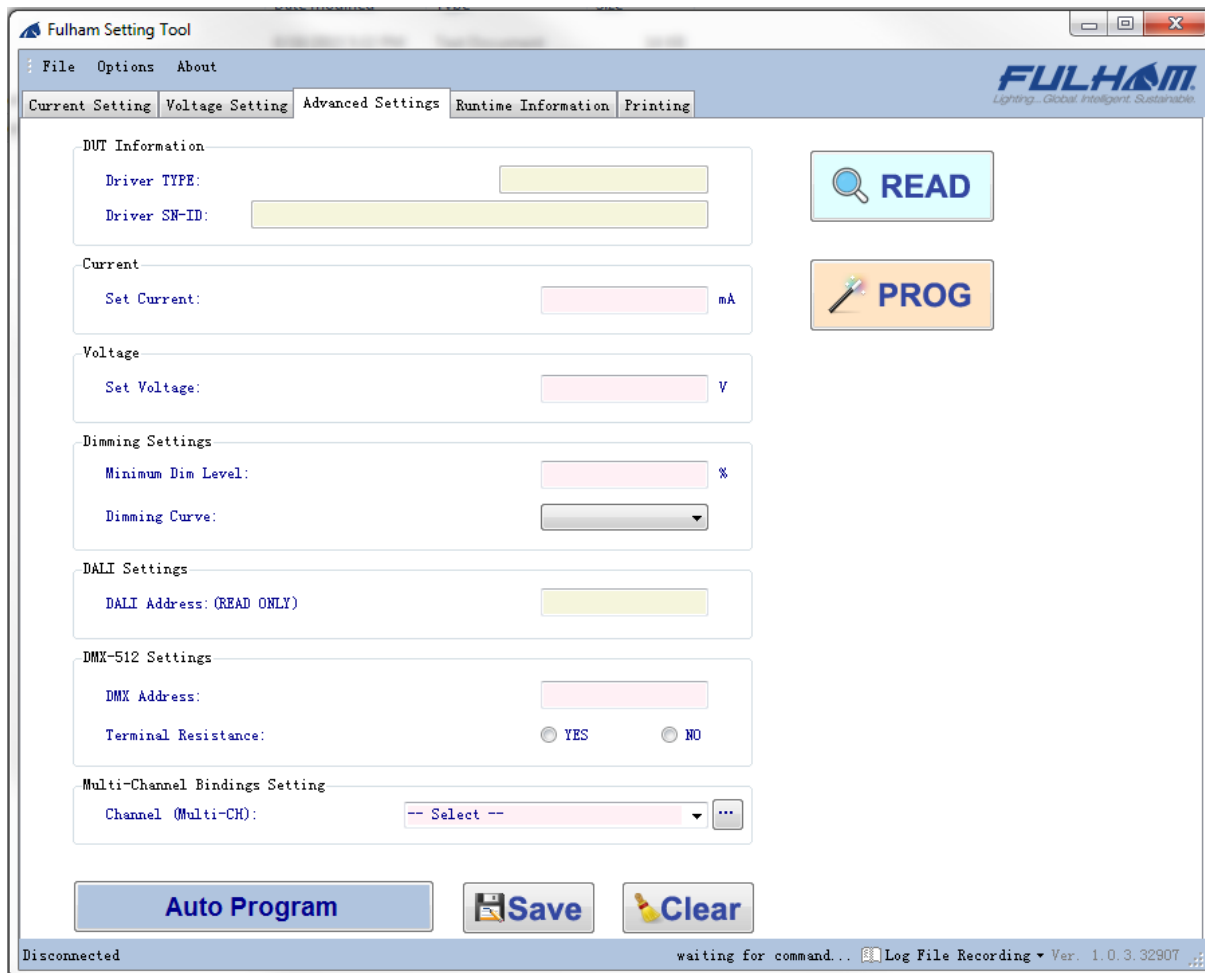
This feature will automatically program current or voltage to multiple units while leaving all other settings unchanged once the programming port / leads are connected to the TPSB-100/E. The software keeps a count of the number of drivers programmed.

# Programming



## Advance Settings:

The Advanced Settings tab of the programming software includes additional options and settings. Information that is currently saved to the driver, such as General Product Information, Current/Voltage settings, Dimming settings, DALI Settings, DMX-512 Settings, and Multi-Channel Binding settings, if applicable, are displayed here. Custom profiles can also be saved, for use when programming different configurations in high volumes.



The Advanced Setting tab also gives the user the ability to set different parameters, such as dim levels, dimming curves (linear, logarithmic or custom), and DMX settings, and even to group multiple channels on supporting drivers.

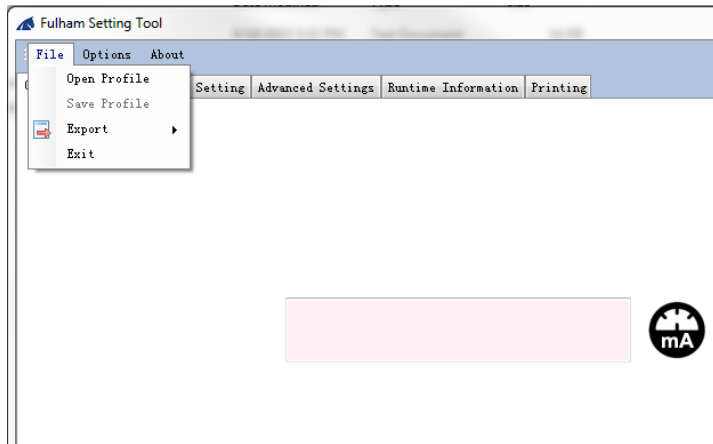
The minimum Dim level is important for applications in which the 0-10V dimming leads are connected to a normally closed contact of an occupancy sensor. For applications that require 24/7 illumination, such as stairwells, the user could set a dim level of 50% when no occupancy is detected and up to 100% when occupancy is detected.

# Programming

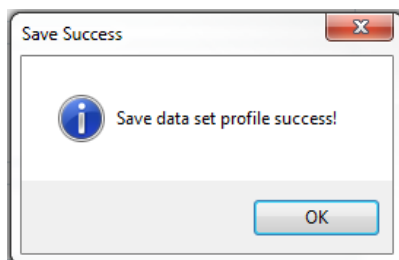
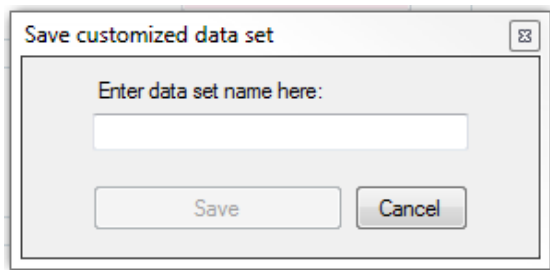
## Auto Programming In Advanced Settings:

With this feature, auto programming of the advance settings is done once the programming port / leads are connected to the TPSB-100/E. All the units are set to the appropriate current, and all settings from the Advanced Settings tab are transmitted to every unit. A count of the number of drivers that have been programmed is kept.

## Loading Profiles:

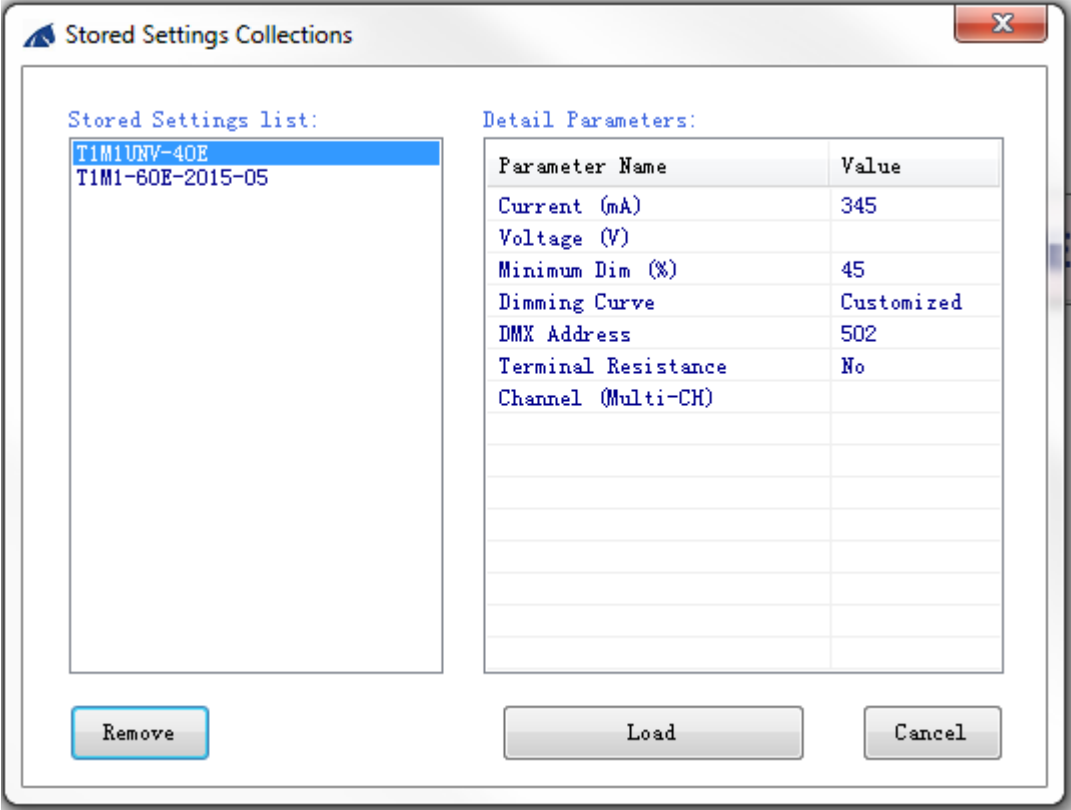
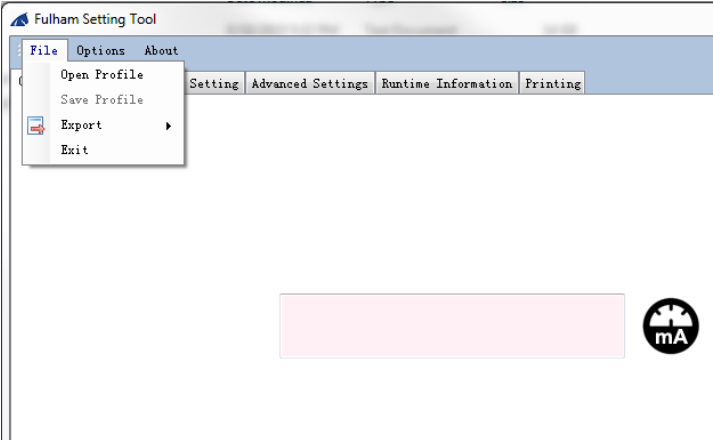


Under the File pulldown menu, the user can access the “Open Profile” or “Save Profile” options. Once a driver has been programmed to the setting needed, the profile can be saved for later access to program more drivers to these specific settings.



The above windows will pop up. One will prompt the user to assign a name to the profile and another will confirm the file has been saved.

# Programming

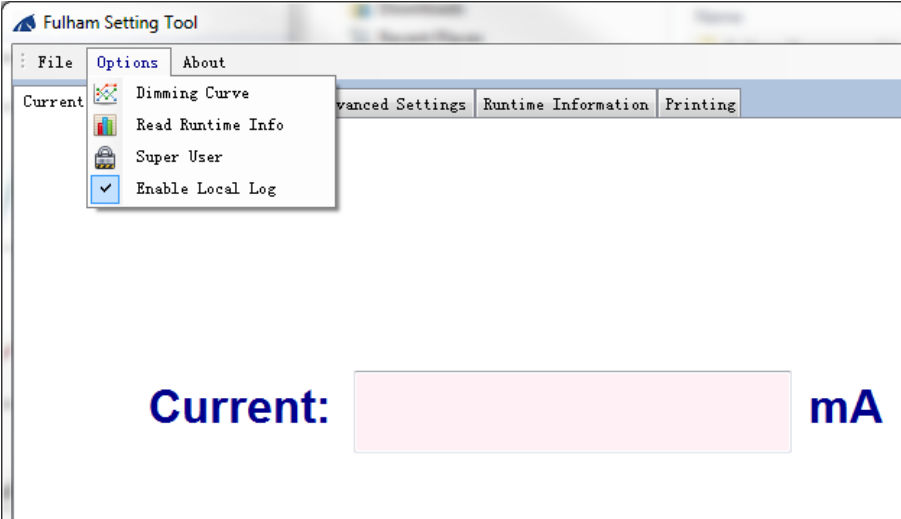


When opening a profile, the user navigates to the File pulldown menu and selects Open Profile. Next, a window will pop up showing all saved profiles. From this list one can select a profile and it will load the previously saved settings.

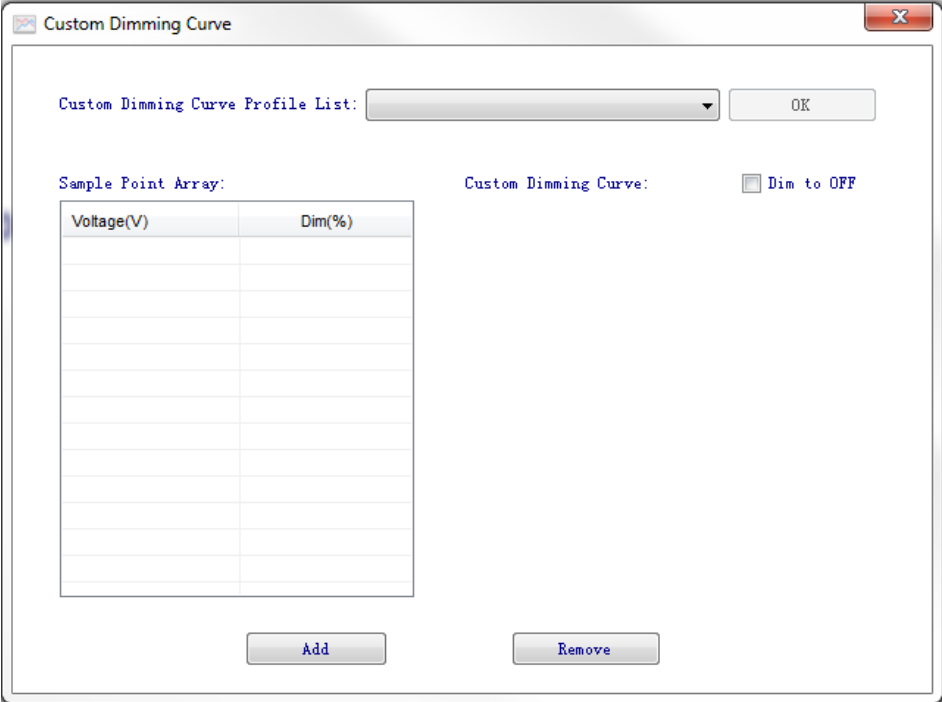
# Programming



## Custom Dimming Curve:

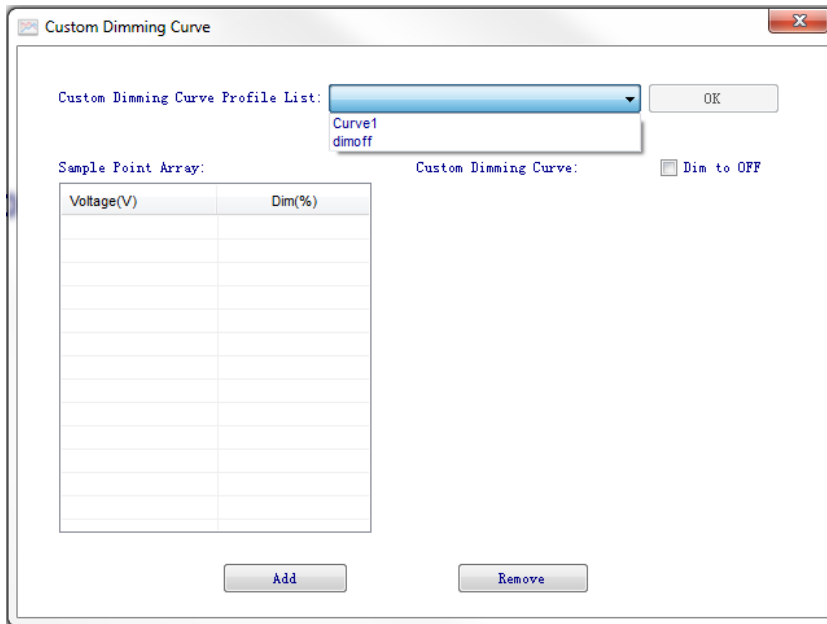


Under the Options setting the user can select the Dimming Curve option in the dropdown menu. This option allows the creation of a custom dimming curve. The user can then select certain minimum and maximum levels to dim to, as well as a dim to off.

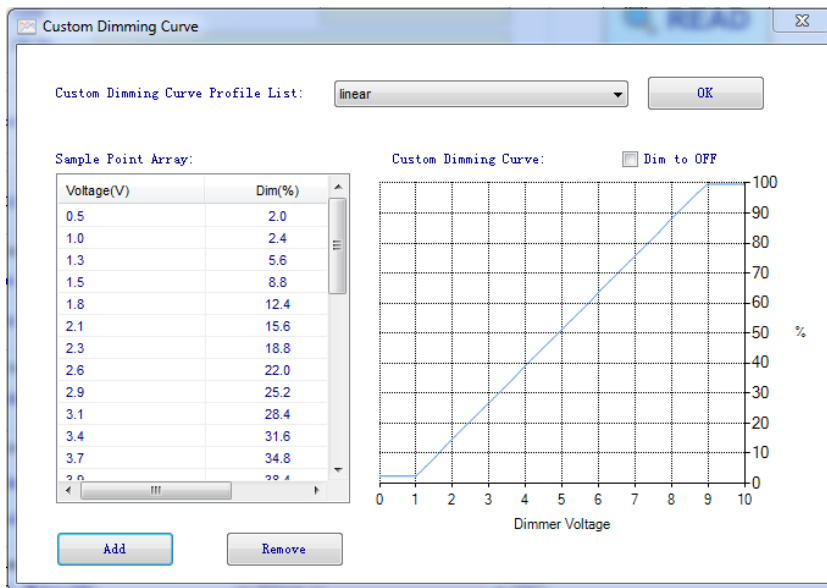


The dim to off feature allows you to dim down below a certain point where the driver turns off and then turns back on once you've got back up past that point.

# Programming



The software will generate a dimming curve based on the input set by either selecting one of the custom dimming curve profiles in the pulldown menu or entering the voltage with dimming percentage on the table to the left. A minimum of 2 points are required to generate a custom dimming curve. This allows Fulham's programmable driver to match the dimming curve of other driver suppliers.



The image above shows a plot of what the dimming curve looks like and the breakdown of the voltage assigned to the percentage of dimming.

# Programming



## NTC Feature:

With this thermal feedback feature the driver is able to regulate power to the LED module or modules during times of excess temperatures. This helps protect the LED's themselves by ensuring that temperatures do not exceed those of what is deemed appropriate by the manufacturer. The NTC (Negative Thermal Coefficient resistor) is usually placed on the LED module itself and is connected to either the yellow and orange wires or connections labeled "NTC" on the drivers.

Using the recommended NTC the derating profile is available on the drivers corresponding specification sheet.

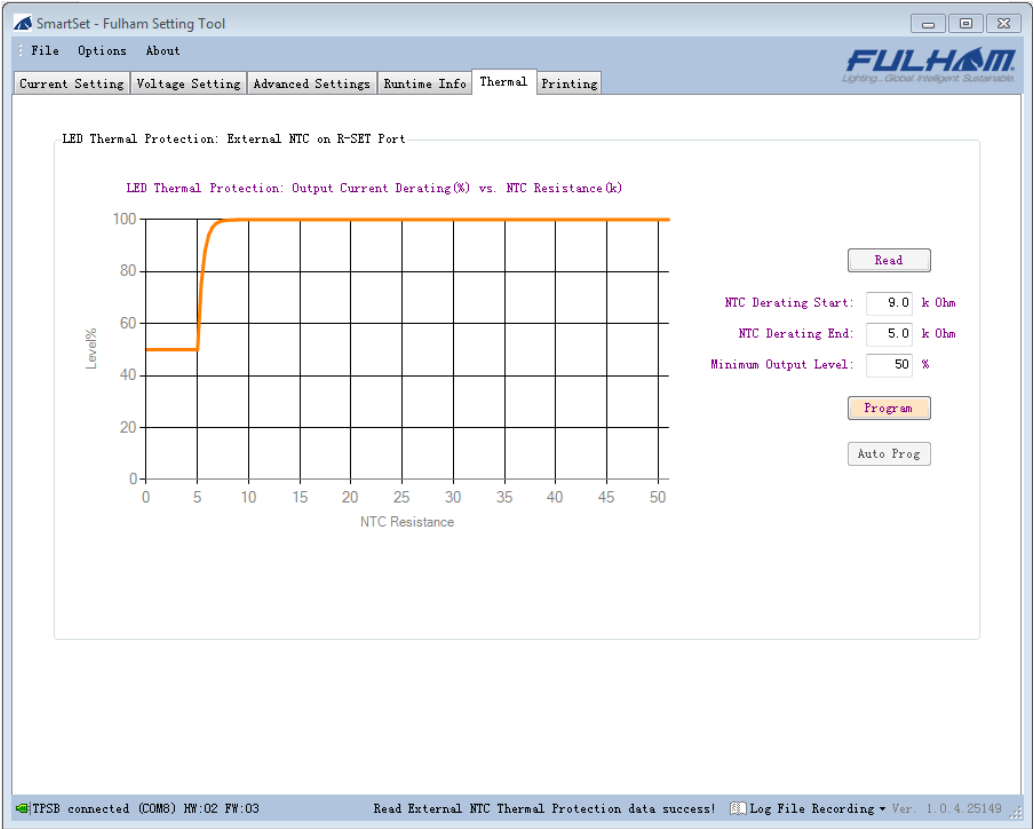
**Recommended NTC:** Thinking Electronic – TSM2A204 – SMD0805

Thinking Electronic – TSM2A204											
Temperature	0°C	25°C	50°C	60°C	70°C	80°C	90°C	100°C	110°C	120°C	130°C
Resistance	650.0kΩ	200.0kΩ	70.0kΩ	47.0kΩ	33.0kΩ	25.0kΩ	10.8kΩ	10.2kΩ	9.5kΩ	7.0kΩ	5.3kΩ

When another NTC is used one can simply program a custom derating curve by entering the start and end of the curve as well as the minimum output power level. This can all be achieved by using the Fulham SmartSet software interface. Please note that the programmable derating resistance for the LED driver is from 1k to 51k ohms.

Please note that when the RSET feature is used the drivers NTC feature is disabled. This means RSET and NTC cannot be used at the same time. If the RSET/NTC wires are not used, then you can simply cap off each wire individually.

# Programming



The image above shows what the NTC derating curve will look like once it has been programmed/calibrated.



# Dimming Protocol



### DALI Dimming:

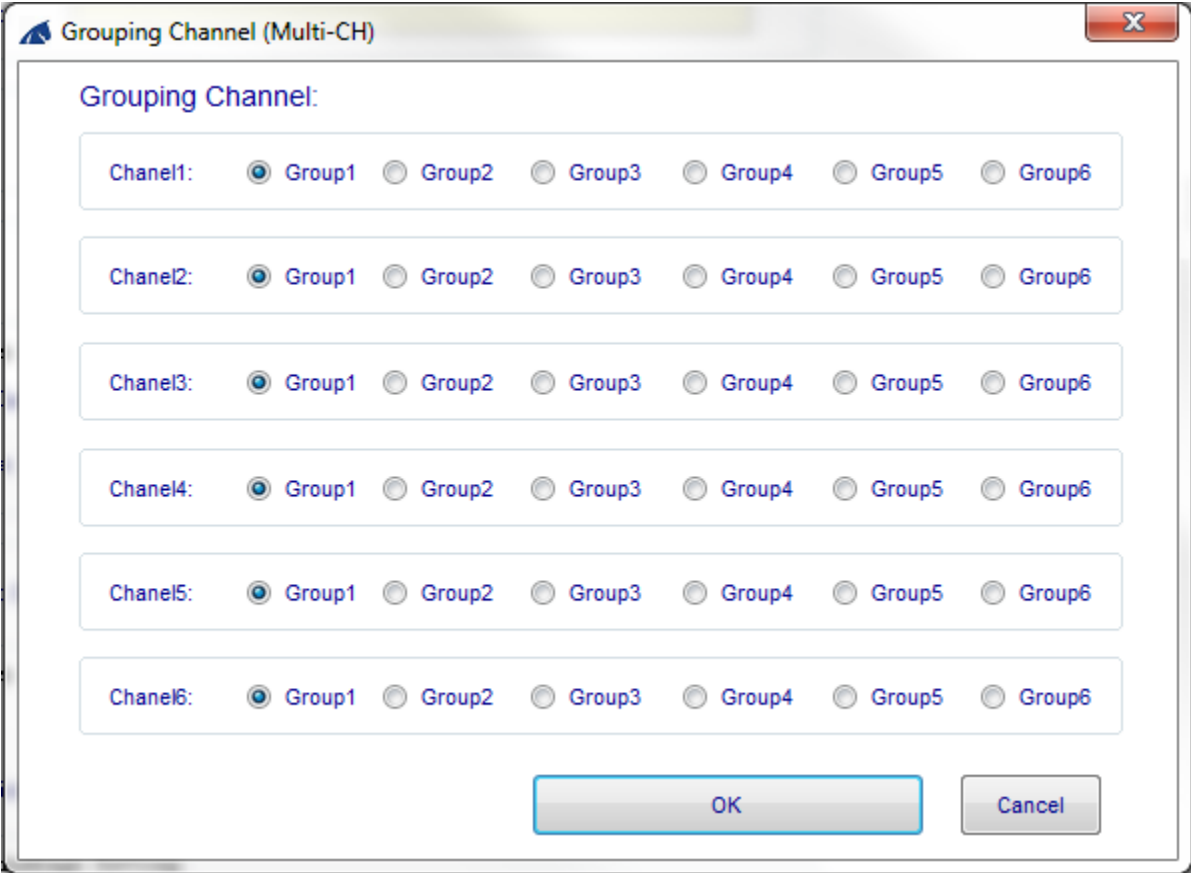
DALI dimming drivers comply with IEC #62386.

### 0-10V Dimming:

Can work with sink type dimmers and control systems that can do both sink and source.

### DMX Dimming:

DMX dimming drivers comply with DMX512 standard.



With DMX drivers, the user has the ability to group different output channels together.

# HotSpot Plus



## **LED Driver and Emergency:**

Fulham's new HotSpot Plus driver gives the flexibility of having both a stand-alone driver and emergency backup system in one. While in normal operating mode the driver is fully programmable, dependent to the minimum and maximum current/power constraints.

The emergency operation has an option of two emergency modes: 5W for 180 minutes or 10W for 90 minutes. This allows for fixture manufactures to provide one unit to do both run-times while still meeting minimum emergency light output requirements. It also comes equipped with self-diagnostic as a standard option.

By incorporating both the normal LED driver and Emergency LED driver into a single unit, Fulham is able to provide a driver with the smallest package possible. This enables a new era of luminaire designs with emergency capabilities.