

AutoCAL Functional Overview Rev 2.1 23 May 2025

# BACKGROUND

The 3900e uses a proprietary high efficiency current regulator which controls the current through the lamp filament (as opposed to regulating the voltage drop across the lamp.) This control method provides better stability, much longer lamp lifetimes, and virtually eliminates unexpected lamp burnout.

This current regulator is controlled by an internal optical radiometer that samples the light emitted from the lamp, and makes micro adjustments to the current setpoint every few seconds. This provides excellent photonic stability over the entire lifetime of the lamp. The radiometer is temperature compensated to ensure stable and repeatable performance over a wide range of ambient operating temperatures.

An embedded microcontroller controls all functions, including the light feedback system. This is the first fully digital light feedback system – there are no longer any analog feedback loops that can drift over time. The microcontroller also makes precision real time measurements of both the lamp's input electrical power and its radiometric light output. This allows the system to assess the operating condition of the lamp, and estimate its remaining lifetime. As the lamp ages, sophisticated algorithms accurately gauge the instantaneous health of the lamp, allowing it to predict the remaining lifetime of the lamp with high degree of accuracy. This is very useful in automated production environments where it is desirable to eliminate unscheduled maintenance.

This unit uses a precision MR16 style lamp, with a spectral output that varies depending on the specific model and lamp option. These lamps have been specifically designed to provide enhanced radiometric output, improved spectral stability, and higher efficiency than standard off-the-shelf MR16 lamps. They are individually calibrated and certified as part of the lamp manufacturing process. This ensures that every lamp meets or exceeds radiometric output, photonic conversion efficiency, and lifetime specifications.



### **RE-LAMPING PROCEDURE**

To replace a lamp, remove the enclosure top by removing the cover screws. Remove the shipping restraint (3) by unscrewing the Restraint Screw (7). Move the Ejection Lever (2) fully towards the REAR of the unit. Remove and discard the old lamp. To accept the new lamp, return the Ejection Lever (2) fully towards the FRONT of the unit.

With the identification letters facing upwards, grasp the new lamp on the outside only - Do NOT touch the bulb or the interior reflector with bare hands. Align the lamp's two metal pins so that they slide easily into the slots of the Ceramic Socket (4). Carefully press down on the lamp so that it slides into the Lamp Bracket (5) until the outer edge of the reflector touches the Lamp Détente (6). Ensure that the Lamp Capture Spring Wires (1) hold the reflector flush against the Lamp Bracket (5). Replace the Shipping Restraint (3) and secure with the Restraint Screw (7). Replace the lightsource cover.





#### AutoCAL PROCEDURE

Apply mains power to the unit. Depress the "AutoCAL" button on the rear of the unit. This initiates a series of automated microcontroller procedures that will be performed on the new lamp, including an automated lamp burn-in, lamp characterization, lamp electro-optical conversion efficiency check, and a calibration (in that order). During this automated process, the normal operating mode of the unit is terminated. The user should not attempt to control the unit in any manner, either manually or via the COM interface. It is best for the unit to be placed in an environment where the ambient temperature is not changing rapidly, or significantly, during this AutoCAL process.

The AutoCAL procedure begins with the lamp burn-in, a process that lasts 60-90 minutes. During this procedure the front panel status indicator LED will flash YELLOW.

The procedure will then characterize and calibrate the new lamp, a process that lasts about 5-10 minutes. This characterization provides a reference from which to make accurate lifetime predictions, and the calibration function ensues that the radiometric output is consistent with other lamps and/or 3900e units. During this procedure the front panel status indicator LED will flash RED.

Once the above routines have been successfully completed, the AutoCAL function will terminate and the unit will automatically be placed back in its normal operating mode. The front panel status indicator LED will turn continuous GREEN and the unit will be ready to operate, either manually or remotely.

#### AutoCAL STATUS INDICATION

Once the AutoCAL function is completed the unit will be automatically return to its normal operating mode. The front panel status indicator LED will remain a continuous GREEN for as long as the lamp continues to meet the specifications established for optical output calibration, electro-optical conversion efficiency, and light output stability specifications - AND remains within its useful lifetime window.



The lamp lifetime, when operating at full intensity (INT=4000) is about 500 hours. This lifetime dramatically increases as a function of intensity (lower intensity equals longer lifetime). The AutoCAL function runs detailed characterization routines that can predict the remaining life of any lamp, at any intensity, and at any time within that lamp's useful lifetime. This characterization requires the reference data accumulated at the time when the AutoCAL function was last performed. Therefore, it is recommended that the AutoCAL function be performed only one time, and only on a new lamp.

**NOTE:** Every new lightsource has a new lamp pre-installed. A new lightsource does not require the end user to initiate an AutoCAL procedure. The AutoCAL procedure has already been successfully completed as part of the manufacturing calibration and QC certification process. Therefore, the AutoCAL procedure does not need to be repeated for this pre-installed lamp. The AutoCAL procedure should only be initiated once for each new lamp installed by the end user.

## Lifetime STATUS INDICATION

There are two ways in which the lamp lifetime is indicated to the end user, via the front panel tri-color LED, and by the analog signal (0-5VDC). The following table details these indicators.

Lamp Lifetime	Analog Output (VDC)	Status LED
New (0% Consumed)	1.5 - 3.0	GREEN
Half (50% Consumed)	3.0 - 4.0	YELLOW
Old (100% Consumed)	4.0 - 4.5	RED
Replace (>100% Consumed)	4.5 - 5.0	Flashing RED

**NOTE:** If the lightsource optical output setpoint is too low, the Status LED may flash GREEN. This indicates that the unit is still functioning properly, however the radiometric output may not be able to meet the published output stability specifications. This is primarily due to feedback stability issues as the lightsource optical output set point approaches zero. In these applications, it is advised that light output on the target be reduced using neutral density filters and/or optical apertures, which will then allow the lightsource output setpoint to be sufficiently increased.