CPD 3000 Lighting Controller Integration Guide

Echelon's Power Line based lighting controller, the CPD 3000, is used to control outdoor street and area lights which support proportional level control using 0-10V or PWM control. This guide describes the hardware installation and wiring specifications for the CPD 3000, plus the lighting controller interface.

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Welcome

Echelon's Power Line based lighting controller, the CPD 3000, is used to control outdoor street and area lights which support proportional level control using 0-10V or PWM control. In addition to control, the CPD 3000 collects vital data such as run hours, voltage, current, power consumption, energy usage, diagnostic alarms, and power factor. The information collected is shared through communication on the AC mains. The CPD 3000 optimizes communications with integrated power line meshing. The Revision 2 application uses a LonMark® Approved SCPTluminairController functional (3514) profile. The key difference from the original CPD 3000 is that Revision 2 is controlled using a SNVT_switch_2 typed primary control variable to support scheduling using programmed scenes. This allows for the integration of peer Traffic Occupancy Sensor (TOS) devices communicating directly to the OLC using the LonWorks network variable binding feature supported in SmartServer release 2.2 (firmware version 4.06.xxx and higher)

Smart Street Lighting with a CPD 3000 involves remotely collecting vital data from the lighting controller (such as LED drivers, HPS ballasts, Induction Generators) and communicating over the power lines with a Segment Controller (Echelon SmartServer) which manages switching and dimming schedules, and captures and forwards diagnostic alarms and energy consumption data to operations monitoring servers over TCP/IP networking, including support for GRPS or GSM wireless networks.

This document describes the hardware installation and wiring specifications for the CPD 3000, plus the lighting controller interface. Because this interface uses the SFPTsmartLuminairController (3514) profile defined by the LonMark organization, you can learn more by reading the profile definition at the LonMark International web site, www.LonMark.org.

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CPD 3000 Installation and Wiring Guidelines

The CPD 3000 Lighting Controller can be installed in four different ways. These include:

- directly within the lighting fixture,
- in the access hand hold of the lighting fixture pole,
- in the gear tray, or
- in a separate box.

Installation

Installation for the CPD 3000 OLC uses the following steps. It is important to disconnect line voltage *before* installing or replacing a CPD 3000 module.

1. Install the CPD 3000 OLC module.
2. Connect the AC mains power to the module.
3. Connect the filtered power output of the CPD 3000 OLC module to the luminaire power supply (electronic ballast/generator, ballast, or driver).
4. Connect the CPD 3000 control signal wires to the luminaire control input.

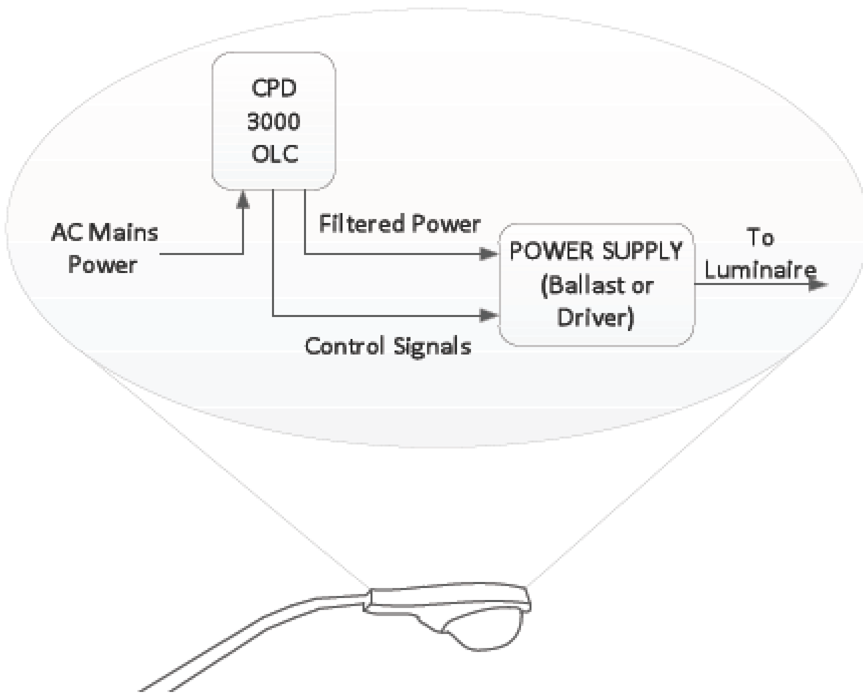


Figure 1. CPD 3000 Installed in the Light Fixture

Wiring Specification and Diagram

Here are the wiring specifications and a diagram for US and European models of the CPD 3000. The CPD 3000 is not suitable for installing above 15,000 feet altitude. The controller must be installed in the light fixture, inside a street light pole, or in a street light cabinet. The CPD 3000 is not intended to be installed in an open outdoor environment.

US Model

Three 16 AWG wires for AC mains input:

Black	Line In
White	Neutral In or Line 2 In*
Green	Ground

* May be powered Line-to-Line if all CPD 3000s, and the segment controller, are connected to the same circuit pair and Line-to-Line Voltage is 100-277 VAC.

Three 22 AWG wires for control of signal output (IEC60929):

Blue	10V signal for PWM control
Black	Ground
Violet	Signal for 0-10V control

European Model (Prior to Rev E)

Three 16 AWG wires for AC mains input:

Brown	Line In
Blue	Neutral In or Line 2 In*
Green/Yellow	Ground

* May be powered Line-to-Line if all CPD 3000s, and the segment controller, are connected to the same circuit pair and Line-to-Line Voltage is 100-277 VAC.

Three 22 AWG wires for control of signal output (IEC60929)

Blue	10V signal for PWM control
Black	+ Signal for 0-10V control
White	- Signal for 0-10V control

Two 16 AWG wires for filtered power output (both models)

Brown	Line Out
Blue	Neutral Out or Line 2 Out

The 0-10V control signal of the CDP 3000 works with current sourcing inputs. The CPD 3000 will sink up to 1500mA. The filtered switch AC output will handle load up to 500 VA.

European Model (Rev E)

The input cable is a double jacket insulated 3x18 AWG stranded wire. The outer diameter of the cable is 7.3mm +/- 0.5mm. This table describes the color of the individual conductor insulation.

Brown	Line In
Blue	Neutral In or Line 2 In*
Green/Yellow	Ground

* May be powered Line-to-Line if all CPD 3000s, and the segment controller, are connected to the same circuit pair and Line-to-Line Voltage is 100-277 VAC.

The low voltage control cable (IEC60929) is a double jacket insolated 3x18 AWG stranded wire. The outer diameter of the cable is 7.3mm +/- 0.5mm. This table describes the color of the individual conductor insolation.

Blue	10V signal for PWM control
Black	+ Signal for 0-10V control
White	- Signal for 0-10V control

The filtered power out cable is a double jacket insolated 3x18 AWG stranded wire. The outer diameter of the cable is 7.3mm +/- 0.5mm. This table describes the color of the individual conductor insolation. The double jacket construction of the Rev E European CPD allows the application of IP66 rated connectors if required. The addition ground wire on the switched output helps with this wiring configuration.

Brown	Line Out
Blue	Neutral Out or Line 2 Out
Green/Yellow	Ground

The 0-10V control signal of the CDP 3000 works with current sourcing inputs. The CPD 3000 will sink up to 1500mA. The filtered switch AC output will handle load up to 500 VA.

CPD 3000 Mechanical Dimensions

This diagram shows the dimensions of the CPD 3000 in millimeters.

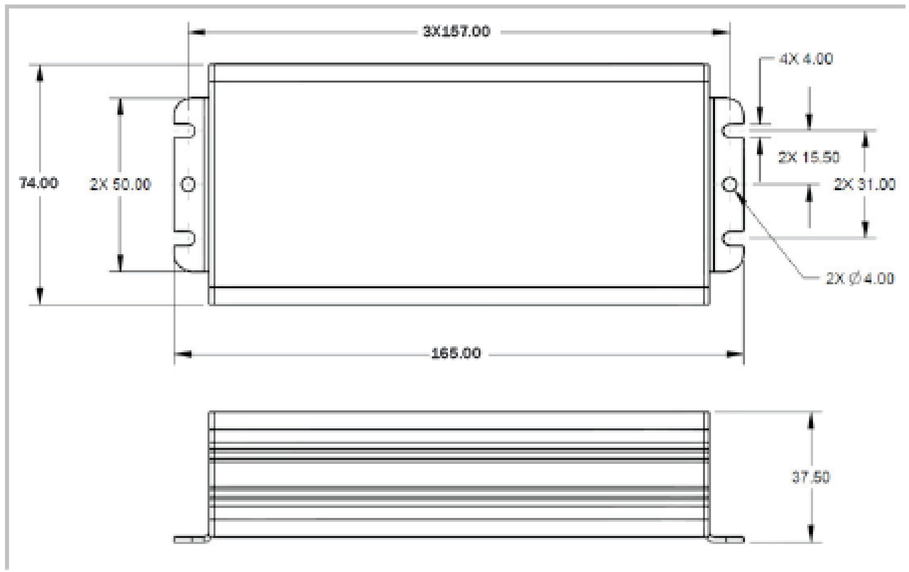


Figure 2. CPD 3000 Housing Profile

See the CPD 3000 Outdoor Lighting Controller data sheet (003-0513-01) on the Echelon web site for all specifications of the CPD 3000.

2

CPD 3000 Lighting Controller Interface

The CPD 3000 Revision 2 Lighting Controller is based on the `SFPTsmartLuminairController (3514)` functional profile defined in the LonMark standard resource file set beginning at version 14.01. A round green label marked "V2" designates your CPD3000 is using this profile.

Application as Function Block

The application for the CPD 3000 is developed as a single function block. The `SFPTsmartLuminairController` is referred to as the LC in the remainder of this document.

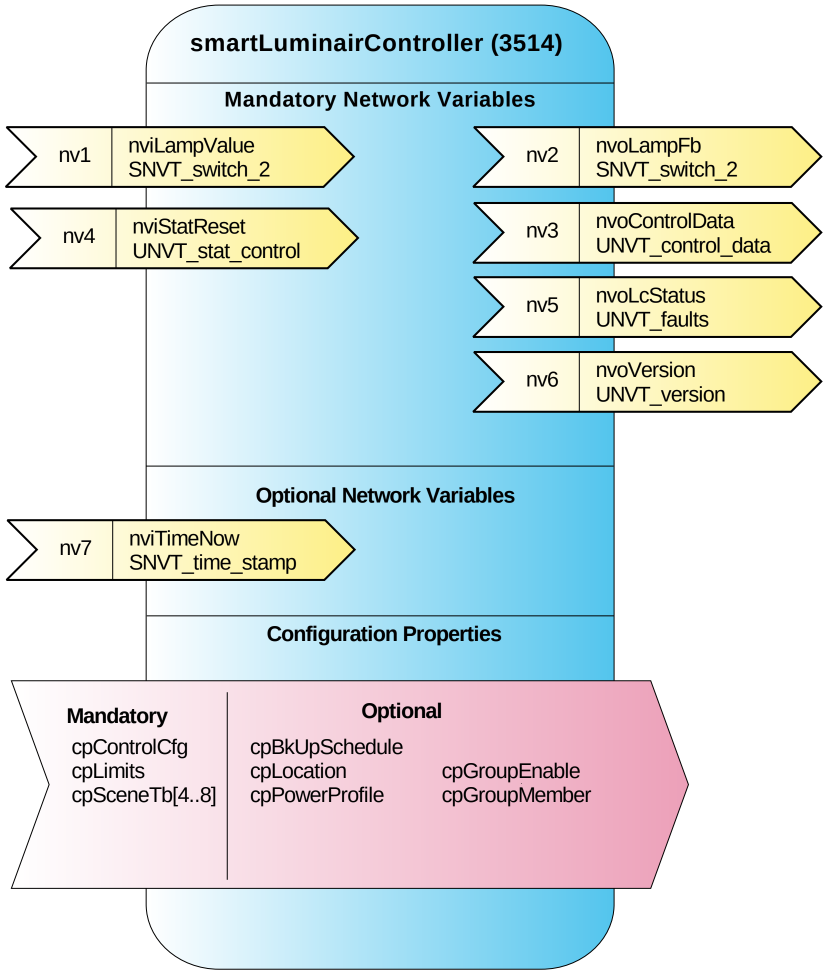


Figure 3. `SFPTsmartLuminaireController` Funtional Profile Interface.

`SFPTsmartLuminairController` Network Variables

The following table describes the network variables defined for the CPD 3000 implementation of the `SPFTsmartLuminairController`. The CPD 3000 implements only the mandatory network variables and CPs.

Table 1 SFPTsmartLuminairController Network Variables

Network Variable	Type	Notes
nviLampValue	SNVT_switch_2	Primary control input. Use to schedule scenes and process occupancy/TOS events for peer driven demand lighting applications.
nviStatReset	SNVT_stat_control	Sets/initializes energy, runtime, and error counts.
nvoControlData	SNVT_control_data	A structured variable describing all current operating values and state of the LC. Details are described below.
nvoLampFb	SNVT_switch_2	Feedback of the current nviLampValue. In normal operating conditions, this value will reflect the nviLampValue. It may differ if the heartbeat interval is exceeded and the defaultLevel differs from the value in nviLampValue.
nvoLcStatus	SNVT_faults	Feeds alarm logs only on change to minimize the data requirement on the IP network. The frequency of changes to this variable is carefully managed to minimize the size of logs.
nvoVersion	UNVT_version	A structure including fields for Major.Minor.Build

SNVT_control_data – nvoControlData Details

The LC conserves power line bandwidth by reporting the operating state of the LC in a single output network variable nvoControlData (SNVT_control_data), described in this section.

```
SNVT_control_data

Data type
typedef struct {
    SNVT_power power;
    SNVT_elec_kwh_l energy;
    SNVT_time_min_p runtime;
    SNVT_volt supplyVoltage;
    SNVT_amp_ac_mil supplyCurrent;
    SNVT_count cycleCount;
    SNVT_lev_cont levelFB;
    SNVT_faults faults;
    unsigned short nvUpdates;
    SNVT_count rcvTimeouts;
    SNVT_pwr_fact powerFactor;
    SNVT_temp_p LCtemperature;
    olc_state_t LCstate;
    SNVT_amp_ac_mil driveCurrent;
    SNVT_volt driveVoltage;
}SNVT_control_data;
```

Figure 4. `SNVT_control_data(nvoControlData)` Fields

The fields for `SNVT_control_Data` are described in table 2.

Table 2 `nvoControlData` Fields (`UNVTcontrolData`)

Field	Type	Notes
`power`	`SNVT_power`	Reflects the instantaneous power consumed by the LC and controlled fixture. (0.1w resolution) This value is updated each second by the power measurement chip on the LC.
`energy`	`SNVT_elec_kwh_l`	Reports the accumulated energy usage to 0.1kwh resolution. The LC writes this to EEPROM memory every 12 hours, and at the transition to OFF. **Installations which shut OFF power to the streetlight segment at dawn *must* delay the switching of the power for several minutes after the lights are scheduled OFF to allow the LC to store this value in EEPROM memory.**
`runtime`	`SNVT_time_min_p`	The number of operating minutes for the fixture. Stored to EEPROM with each OFF transition. The presentation format for this field is an integer value of hours.
`supplyVoltage`	`SNVT_volts`	Measured supply voltage 0.1V resolution. This value is updated every second.
`supplyCurrent`	`SNVT_amp_ac_mil`	Measured current at 1mA resolution. This value is updated every second.

cycleCount	SNVT_count	Number of operating cycles (ON-OFF). Updated with each transition to OFF.
LevelFB	SNVT_lev_cont	0.5% resolution 0-100%. Tracks the .value field of nvoLampFb. 0% if the state is 0.
faults	SNVT_faults	Fault bits. Details are provided in the alarms section. These bits represent current conditions of the last alarm evaluation and not the latched and filtered values as reflected in nvoLcStatus.
nvUpdates	Unsigned	Used to assess application level communication performance. Every 30 minutes, this field is updated to report the number of times nviLampValue was updated in the previous interval. If the defined heartbeat for nviLampValue is defined as 10 minutes, this value reports a value of 2-4 during steady state operation.
rcvTimeouts	SNVT_count	The maximum receive timeout for this device (part of nciControlCfg) is set to three times the control input heartbeat. In practice, this number increases only when an update is not received after three heartbeat intervals.
powerFactor	SNVT_pwr_factor	Reports the measured power factor for the LC/Fixture combination. When the controlled load is OFF, this value will be very low (around .3). Alarms against power factor are only evaluated when the load is turned ON. For efficient light operation, it is good practice to limit the control signal the CPD 3000 drives to keep the power factor above 0.8.
LCtemperature	SNVT_temp_p	Reports the temperature sensed by the power measurement chip on the CPD 3000. Typical accuracy is +/-5 degrees C.
LCstate	OLC_State	Reports the current state of the CPD 3000 LC controller. Valid values include: OLC_INIT, OLC_COOLDOWN, OLC_WARMUP, OLC_ON, OLC_RCV_TMO, OLC_OFF_RCV_TMO, OLC_ON_UNOCCUP, OLC_OFF_UNOCCUP, and OLC_OFF.
driveCurrent	SNVT_amp_ac_mil	Not used. This reports the current to the controlled load. The CPD 3000 does not measure this field.
driverVoltage	SNVT_volt	Not used. This field reports the voltage to the controlled load. The CPD 3000 does not measure this field.The application overloads this field to report the number of times the OLC calculates an Unoccupied condition.

Broadcast Support

The CPD 3000 supports the limited broadcast message support implemented on SmartServer 2.1 Firmware (service release 1). The application will only process `SW_SET_GROUP_STATE_LEVEL` commands. To respond, the `scene_number` field of `cpSceneTbl[7]` must match the `scene_number` of the broadcast `SNVT_switch_2` encapsulated message. This is a deprecated feature which is better supported using LON bindings. The variable nvoLampFb.state will report the `SW_SET_GROUP_STATE_LEVEL` in its state field. Using this mechanism is not compatible with peer bindings of TOS signals to nviLampValue.

CPD 3000 Configuration (`cpControlCfg`)

The CPD 3000 uses a limited number of configuration properties (CPs) implemented using network variables on the CPD 3000. The main portion of the configuration is defined by the fields in `cpControlCfg` (`SCPTcontrolCfg`).

Configuration Property	**Type**	**Notes**
`cpControlCfg`	`SCPTcontrolCfg`	Defines many of the operating parameters for the LC.
`cpLocation`	`SCPTgeoLocation`	Provides tagging for GPS location, and physical asset tagging.
`cpLimits`	`SCPTLimits`	Used for alarm thresholds as defined in Alarming, below.
`cpPowerProfile`	`SCPTpowerProfile`	Defines the nominal power measured at 5 commanded `nviLampValues` 0.5%, 25%, 50%, 75%, 100%) while driving the driver/lamp combination. This CP must be set for lowPower/HighPower, and measured with `nvoLampFb` values to work correctly. They will depend on the `minPWM` and `maxPWM` fields defined in the following section.

SCPTControlCfg (SNVT_control_cfg)

This section describes how the fields in this configuration property are applied in the LC.

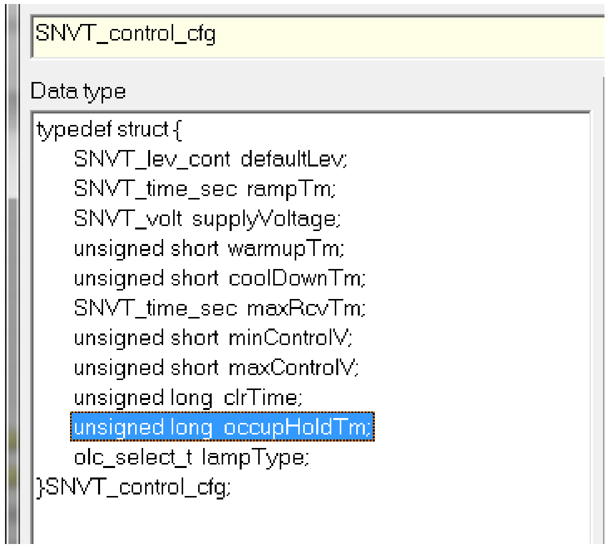


Figure 5. `SCPTcontrolConfig` Field Details

Field	Type	Notes
`defaultLev`	`SNVT_lev_cont`	This is the initial value before an update to `nviLampValue` is received by the LC to drive the lamp value at power ON or reset. The default value is 100%. This value only applies after the CPD 3000 is commissioned by the SmartServer. When unconfigured, the CPD 3000 will turn ON the controlled light to full ON. When power is applied to the OLC, the application enforces a 10s minimum time (even if `CoolDownTm` =0) before applying this value. A non-zero `CoolDownTm` will extend this time as required when controlling certain lamp types such as HPS.
`rampTm`	`SNVT_time_sec`	Controls how the LC ramps between level transitions. Only used after the lamp is ON to go between intermediate steps. The CPD 3000 limits this value to a maximum of 30s. (Default value – 1.5s)

supplyVoltage	SNVT_volt	The nominal supply voltage for the fixture. Used of voltage level alarms. (Default value – 240V).
warmupTm	unsigned short	The number of minutes the LC allows the fixture to warm up before allowing dimming commands. During warm up, the dimming commands are deferred. If the LC is set to go to 75% ON, the LC will set the 0-10V signal to 10V for warmupTm minutes before issuing the appropriate dimming level. In LED applications, this is typically 0. Any **nviLampValue** less than 100% will be delayed while the LC is in the state OLC_WARMUP. (Default value – 0s). This also delays power alarm processing which is important in the case of control of magnetic ballast technology.
coolDownTm	unsigned short	The number of minutes the LC will delay commands to turn ON after the fixture has been turned OFF. This is important for improving certain lamp technology life times. **The CPD 3000 enforces a 10s COOLDOWN to allow recovery of the inrush protection circuit. This 10s minimum is subject to change in the future.** (Default value – 0s)
maxRcvTm	SNVT_time_sec	If the LC fails to receive an update to nviLampValue for this time (0s default), the LC will drive the lamp to the defaultLevel. The segment controller should update nviLampValue up to three times within this period. If the maxRcvTm is 900s, the heartbeat rate of 300s should be used by the segment controller. Note that maxRcvTm = 0 means lights will retain the last commanded value if the SmartServer cannot communicate to the device, or if it fails.
minControlV	unsigned short	It may be necessary to set the lowest 0-10V signal to a value that can be used to drive the controlled fixture. This CP sets the control voltage when the commanded control value is a 0.5%. 0.04V resolution.
maxControlV	unsigned short	Sets the control voltage when the commanded control value is 100%.
clrTime	unsigned long	Controls the time at which faults reported by nvoLcStatus are cleared. The time is relative to when the LC is

		switched OFF at dawn. Units are minutes.
occupHoldTm	unsignedLong	Defines the number of seconds the LC will hold Occupied light levels after receiving an SW_SET_OCCUPPIED … update from a TOS sensor. Default is 900s
LampType	olc_select_t	**Not used.**

Analog Control

Dimming drivers and ballast controllers will exhibit different end results with respect to power usage and light output response when subjected to a linear control signal. An LED fixture with a particular Phillips driver was specified to operate over the range of 0-10VDC. When tested for power efficiency and visible light level response, the result was 2-8.6VDC. The fields minControlV and maxControlV are used to control how the 0-100% scene levels translate to a control signal that drives the controlled driver/ballast. The values are determined by experimenting with an actual controlled fixture. In one particular application, the minPWM value may be established by monitoring the reported power factor, or the measured delivered light level of the installed fixture. For example, at 1.5V control signal, the power factor may be adequate at .82, but the delivered light level is not adequate until 2.5V. Measuring the control signal while driving a specific driver is required to determine at what minControlV value, 2.5V is measured. The value for maxControlV may be determined by observing the measured power or the delivered lux level to the pavement using a lux sensor. You may find the last volt of control signal has no effect on the delivered light or power level measured for the load so you could choose a value for maxControlV at around 9.0.

Working with the CPD 3000 and the target driver/ballast is required to determine the limits for the best scaling of the scene levele to the actual control signal. These values must be set before the cpPowerProfile initialization can be determined.

LC Alarm Management

The LC provides rich support for status bits which are derived from the power measurement chip included in CPD 3000 hardware. Alarms require characterization of nominal operating conditions defined by various CP fields described in this section. The current existing alarm conditions are always reflected in nvoControlData.faults before any time filters are applied. The alarms reported in nvoControlData.faults have no filters applied and are potentially quite dynamic at the transition. The CPD 3000 applies several filters to limit the frequency of alarm events. First, at each state transition (OFF to ON, or WARMUP to ON) Alarms are not checked for 120s. Second, the network variable nvoLCstatus contains latched versions of the fault bits that are set if the fault exists for 60 seconds. If a defined condition exists of 60s, the alarm flag in nvoLcStatus is set and it will persist until power to the CPD 3000 is cut, action is taken by updating the value of nviStatReset, or UNVTcontrolCfg.ClrTm minutes have expired after the lamp is switched OFF at sunrise.

It is important to understand how alarm conditions are filtered to prevent nuance alarm conditions. Alarms are only checked if the CPD 3000 state is OLC_ON or OLC_OFF. If the output level or the state is changed, alarm conditions are not checked for 120s. If you reset the CPD 3000 at T = 0s, and set control the line voltage to 100VAC with a 120V nciControlCfg.supplyVoltage value, the nvoControlData.faults.lowSupplyVoltage flag will not be set until T = 130s (the transition from OLC_COOLDOWN occurs 10s after reset). To be registered as a fault in nvoLcStatus, the condition of low supply voltage must exist for an additional 60s. The flag in nvoLcStatus is latched, and will not be cleared until the configured time after the CPD 3000 switches the load OFF at sunrise, as described below.

CP Field	Type	Notes
cpControlCfg.supplyVoltage	SNVT_volt	Nominal supply voltage for the installed streetlight segment. (Default - 240V)
cpControlCfg.defaultLev	SNVT_lev_cont	Value to use at reset, or if maxRcvTmo expires. (Default: 100%)
cpControlCfg.maxRcvTm	SNVT_time_sec	The time used to determine if communication to the segment controller no longer exists. At this point, the RcvTmo alarm is triggered, and the fixture is controlled to defaultLev (Default –0s; which means HB checking is disabled)
cpPowerProfile	SCPTpowerProfile	Defines the nominal power at 0.5, 25, 50, 75, 100% lamp nviLampValue.value. Used to determine the expected power draw using linear interpolation for nviLampValue.values in between steps defined in the table.
cpLimits.powerFault	SNVT_lev_cont	The percentage deviation of expected power below

		or above which the lowPower and highPower faults are triggered. (Default value - 20%)
cpLimits.voltageFault	SNVT_lev_cont	The percentage deviation below or above the configure supplyVoltage at which the LowSupplyVoltage and HighSupplyVoltage faults are triggered. (Default value - 20%).
cpLimits.lampVoltageFault	SNVT_lev_cont	NA for the CP 3000
cpLimits.lampCurrentFault	SNVT_lev_cont	NA for the CP 3000
cpLimits.pfLow	SNVT_pwr_fact	Power factor alarm point. Power factor alarms are only tested when the controlled load is ON. (Default value - .65)
cpLimits.rcvHb	SNVT_time_sec	The rate at which the segment controller is expected to update nviLampValue. Best practice is to set this value at 3x shorter than cpControlCfg.rcvTmo (Default value – 0s).
cpLimits.highTemp	SNVT_temp_p	The temperature above which a high temperature alarm is triggered. (Defaults value - 65.0 C)
cpLimits.lampFailFault	SNVT_lev_cont	The threshold of power drop measured when the lamp fails. In some technologies, induction lights for example, the power draw at bulb failure may be quite high. (Default value - 40%).
cpLimits.lampVoltage	SNVT_volt	NA for the CPD 3000
cpLimits.lampCurrent	SNVT_amp_ac_mil	NA for the CPD 3000

The field cpControlCfg.clrTm controls when the alarm flags reported in nvoLcStatus will be cleared. The value is the number of minutes after the OCL is scheduled OFF in relation to sunrise time. In a CMS managed lighting system, alarm logs are scheduled for daily delivery at some point *after* the sunrise OFF command. For example, this could be scheduled for 10:00AM. To support proper management of alarms, alarms should not be cleared until at least five hours (300 minutes) or more after sunrise.

`cpControlCfg.clrTm` should be set to 300 minutes to support clearing of the alarms after the logs have been delivered.

During characterization of a driver/lamp combination, it may be useful to use `nviStatReset.cmd`, a value of `SM_CLEAR_ALARMS`. The following table lists the fault bits reported by `nvoControlData.faults` and `nvoLCstatus`.

Table 3. Fault Bit Reported by `nvoControlData.faults`, and `nvoLCstatus`

Fault Bit	Condition
`LowPower`	Measured power is `nciLimits.powerLowFault %` below the expected power
`HighPower`	Measured power is `nciLimits.powerHighFault` % above the expected power
`LowSupplyVoltage`	Measured voltage is `nciLimits.voltageLow` % below the voltage defined by `nciControlCfg.supplyVoltage`
`HighSupplyVoltage`	Measured voltage is `nciLimits.voltageHigh` % above the voltage defined by `nciControlCfg.supplyVoltage`
`RelayFailed`	Power measured when the load switch relay is disengaged above 6.0W. This would occur if the relay contacts were to weld shut.
`FailedStart`	**Not supported at this time**
`Cycling`	**Not supported at this time**
`CommMargin`	Set if no update to `nviLampValue` is received before `nciLimits.rcvHb`. It is recommended that the `rcvHb` parameter be set to a value that is 50% longer than the configured update rate for `nviLampValue` by the segment controller.
`RcvTmo`	Set if the no update to `nviLampValue` is received before `nciControlCfg.maxRcvTm`. This alarm typically results in the load under control being driven to the level defined by `nciControlCfg.defaulLev.`
`HighTemp`	Set when the onboard temperature sensor exceeds 65 degrees C.
`LampFailed`	Occurs when the power measured is below the % low value defined by `nciLimits.lampFailFault`.
`LowPF`	Set if the power factor of the controlled load falls below `nciLimits.pfLow` when the load is ON. It is normal for the power factor reported in `nvoControlData` to be in the range of .30-.40 when the load is OFF. Alarm is only set if the load is ON.

`nviLampValue -> nvoLampFb` Relationship

The `SNVT_switch_2` provides several mechanisms to control LC output. The recommended way to schedule LC output levels is through the use of scenes defined in `cpScneeTbl[0..7]` on the CPD 3000. The values derived from an SW_RECALL_SCENE command will be reflected in the nvoLampValueFb.value.setting field, while the state (SW_RECALL_SCENE) and the scene_number fields from the nviLampValue update will be carried to the feedback variable.

`nviLampValue` is set to SW_NULL 0 0 at powerup/reset.

CPD 3000 Scheduling

Integrating the CPD 3000 Rev 2 on SmartServer

The CPD 3000 Rev 2 uses a Standard profile (SFPTsmartLuminairController (3514) as define in the standard resource files beginning in version 14.0. The SmartServer image beginning with version 4.06.56, the XIF file defining the CPD 3000 Rev 2 was named CPD_3514.xif. The name was later changed to PL3514.xif.

Product	XIF File	PID
CPD 3000 Rev 1	CPD_3000.xif	80:00:01:1E:00:03:11:03
CPD 3000 Rev 2	CPD_3514.xif or PL3515.xif	80:00:01:23:0E:04:10:05

It is possible to download the PL3514 image to CPD 3000 Rev 1 hardware, but remember to observe the consistency between APB and XIF images.

TOS (Traffic Occupancy Sensor) Driven Systems

The `SNVT_switch_2` type used for `nviLampValue` supports peer connections to as many as 11 TOS. This type of system assumes a single SmartServer schedules levels using `SW_RECALL_SCENE 0,0 [scene number]`, and the TOS devices peer connected to 1 or more OLCs in generate updates `SW_SET_OCCUPIED/SW_SET_UNOCCUPIED` updates to `nviLampValue`. The figure below shows a typical configuration with a group of OLCs being coordinated by signals from 3 TOS devices.

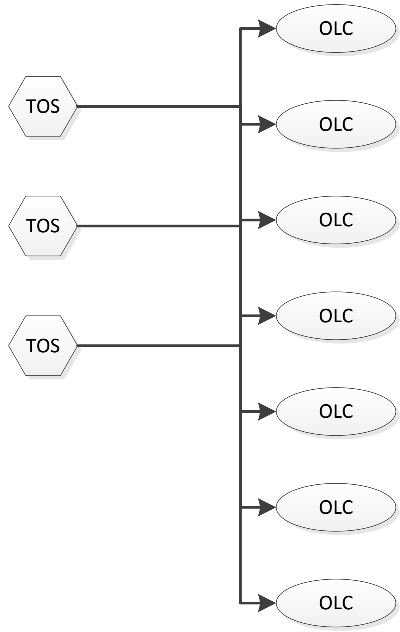


Figure 4. TOS Devices and OLCs

The `SW_SET_OCCUPIED` update initializes the occupany hold timer for each OLC (default 900s). `SW_SET_UNOCCUPIED` results in no action. When the occupancy hold timer expires, the OLC will set the light levels defined by the current unoccupied scene defined for the scheduled scene. TOS devices should generate updates using a heartbeat that is 3 times longer than the occupancy hold timer, and the holdtime of the TOS `SW_SET_OCCUPIED` event should be at a similar rate. Care must be taken to avoid too much traffic. If a system includes less than 20 occupancy sensors, the 300 second heartbeat/hold time at the TOS device, and a 900s hold timer at the OLC should be appropriate. There are a few considerations for this control strategy:

1. OLCs that miss a TOS SW_SET_OCCUPIED event will potentially operate at a lower output level.
2. `nvoControlData.LCstate` will indicate the OLC is unoccupied with the values `OLC_ON_UNOCCUP` or `OLC_OFF_UNOCCUP`
3. If the OLC is scheduled with `SW_RECALL_SCENE 0.0 255`, the OLC will not respond to `SW_SET_OCCUPIED/SW_SET_UNOCCUPIED`.
4. Systems using TOS events to demand driven lighting must not be scheduled using the `LonTalkBroadcastMsg.` OLCs will not properly process `SW_SET_OCCUPIED/SW_SET_UNOCCUPIED` events in this case.
5. The OLC will not respond to TOS events if it is not scheduled using `SW_RECALL_SCENE`. The controller must have an active scene in order to calculate its `SW_SET_OCCUPIED/SW_SET_UNOCCUPIED` behavior.
6. Only 11 TOS devices can be connected to a CPD 3000 because of the 10 entry alias table entry size lime of this device.

3

CPD 3000 Compliance Testing

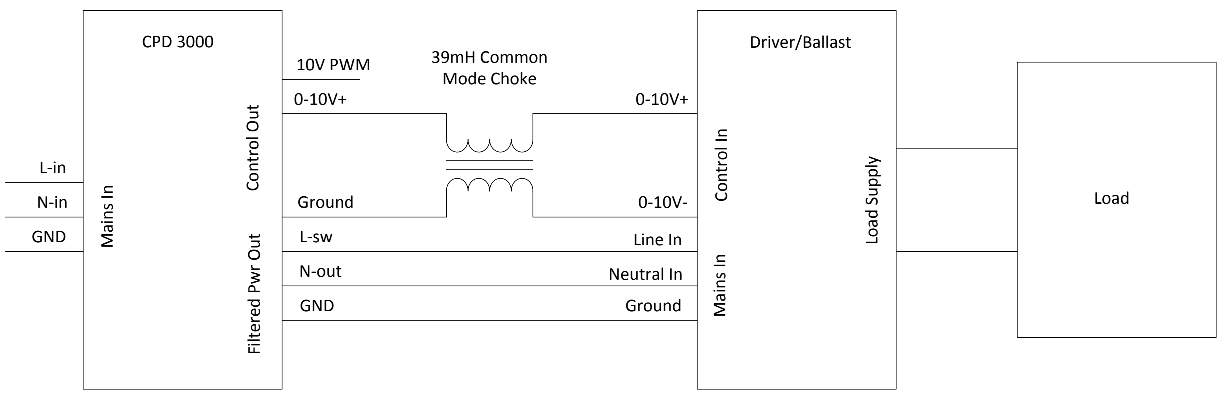
When a CPD 3000 is integrated into a luminaire's gear tray by an OEM, the complete assembly will have to comply with all relevant regulations.

This chapter provides guidance on conducted emissions testing.

Conducted Emmissions Testing

A light fixture with an integrated CPD 3000 Lighting Controller should be compliance tested as a whole assembly for amongst other things, conducted emissions, in line with the relevant local norms such as EN50065-1 (Signalling on low-voltage electrical installations in the frequency range 3 kHz to 148.5 kHz – Part 1: General requirements, frequency bands and electromagnetic disturbances) and EN55015 (Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment).

If a CPD 3000 Lighting Controller is connected to the 0-10V input of a driver or ballast that has a low AC impedance to ground, it may be necessary to filter the connection to meet conducted emission limits. To isolate any unwanted high frequency AC components and allow the DC control signal to be used, a series 39mH common choke can be inserted as shown in the following diagram:



The common mode choke should have a DC current rating of ≥ 10mA and an insertion loss characteristic similar to Würth’s 744821039.