Application note

Lamp switch management with L9177A

Introduction

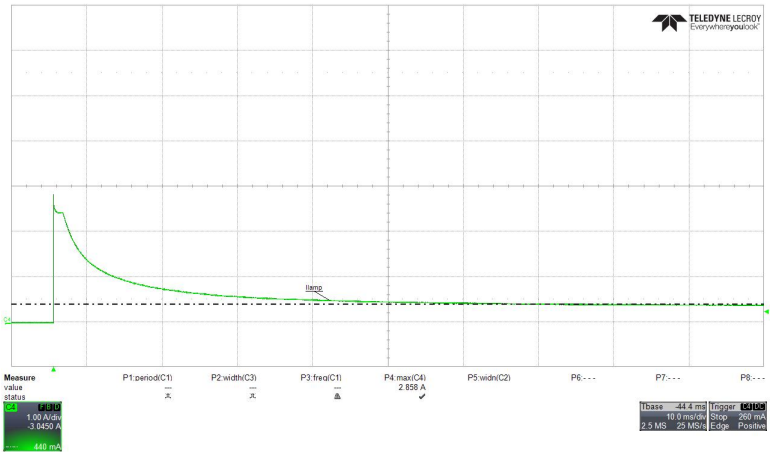
In this application note, a strategy for lamp switch management using the L9177A current limited LSD driver output (L) is proposed.

1 Description

The filament temperature of an incandescent or halogen lamp has a low initial value (ambient temperature) before lamp switching. Consequently, the resistance is very low and a large inrush current flows into the lamp at the instant of turn-on. The lamp inrush current is maximum at cold temperature and high battery voltage and it can rise to values of eight or ten times the steady-state value.

In Figure 1, the characteristic behavior of output current after a 5 W incandescent lamp switching is depicted. As the lamp is turned on, the current rises to 2.8 A, about ten times the 300 mA, which is the nominal current value reached when the lamp filament is hot.

Figure 1. Output current with a large inrush current after a 5 W incandescent lamp switching



2 Lamp switch with L9177A

In order to turn-on incandescent or halogen lamps, used for example as MIL lamps, the current limited LSD driver output (L) of L9177A can be selected. This driver has a linear current limitation above 2 A and a masking time for the overcurrent detection in the very early stage of inrush current. The driver is controlled only by SPI command bit 21 and 22 (see datasheet L9177A).

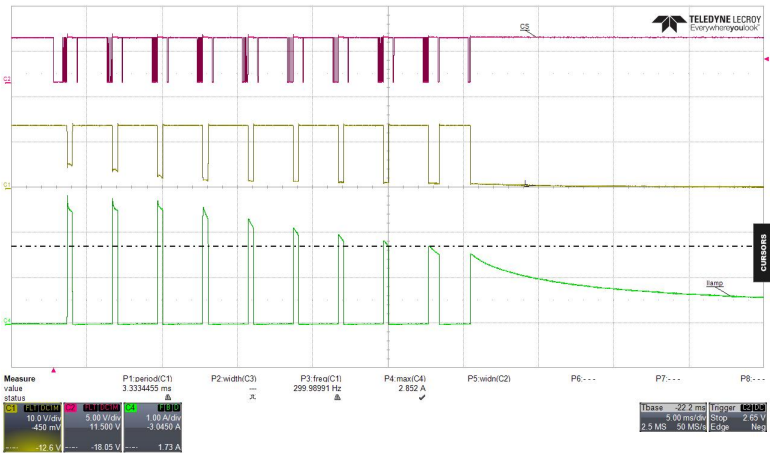
A pulsed switch command should be used for lamp switching with the current limited LS driver of L9177A. The pulsed mode allows the filament to warm up while keeping an acceptable power dissipation for the output transistors. Moreover, such a switching management also allows to extend the life of the lamps.

The proposed lamp switching strategy includes a pulsed switch-on voltage command with 500 µs ON and 2 ms OFF. The pulsed command is actuated for a maximum time of 50 ms.

When the above command is applied, L9177A diagnosis provides an initial inrush current masking time for a *Tmask_rush* of 336 µs ±25 %. Then, if an inrush overcurrent is present, the driver enters in current limitation condition for a digital filtering time *Tdgc* of 20 µs ±25 % after which, the driver is switched OFF and the fault is latched (see datasheet L9177A). The lamp switch strategy evaluates and clears the latched fault via SPI and turns ON the channel after 2 ms. This routine is repeated until the inrush current remains above the L9177A overcurrent threshold value. When the current drops below this value, the switch command can be left in ON state for a time that depends on the specific application.

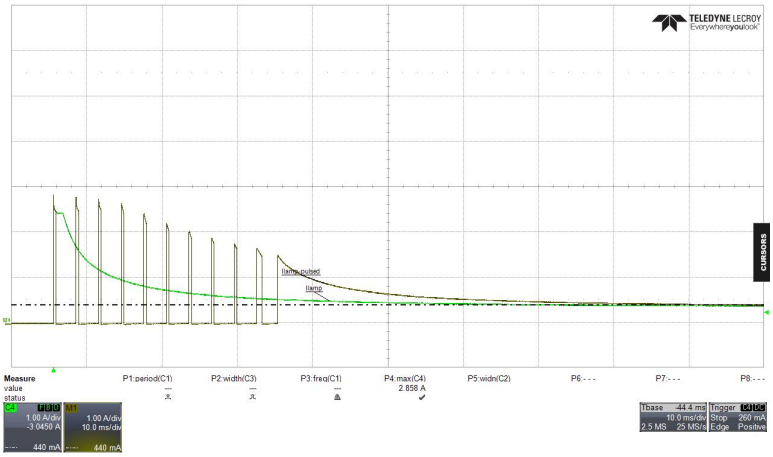
Figure 2 shows the lamp command signal and the corresponding output current when using the proposed switching strategy. The picture clearly shows that the lamp switch command includes a fully ON state for inrush current values lower than the L9177A overcurrent threshold value (dotted horizontal line).

Figure 2. Lamp pulsed command signal and corresponding output current



Because of the proposed pulsed switching strategy, the lamp filament cannot be heated as rapidly as in a normal ON mode since the supplied electrical power is reduced. The slower heating rate increases the inrush time as compared to the normal ON mode. This feature can be observed in the Figure 3.

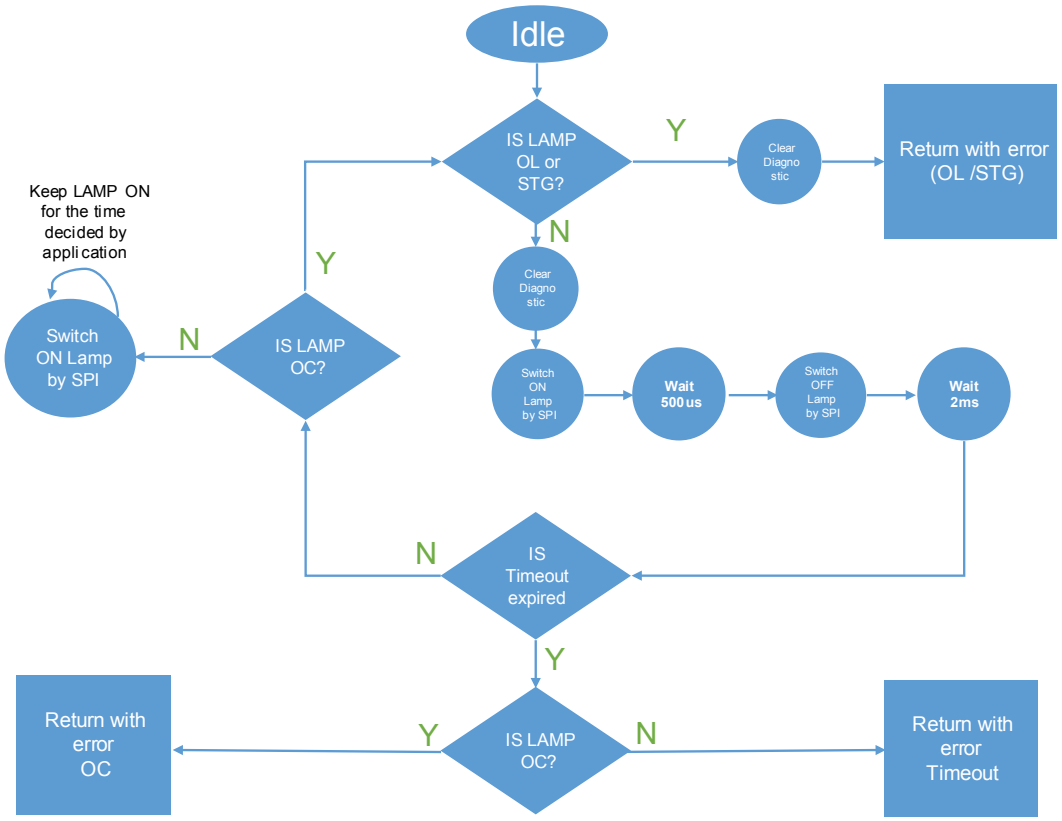
Figure 3. Increase of inrush time when a pulsed command for lamp switching is used



3 Coding example

Figure 4 shows a flow diagram of the proposed lamp switching strategy

Figure 4. Flow chart of the proposed lamp switch strategy



As indicated in the diagram, when the main application asks for a lamp switch ON, the OFF diagnostic (OL, STG) is firstly evaluated. If no fault is detected, a command for lamp switch ON of 500 µs is sent. During this time, if an inrush overcurrent is present, the L9177A diagnostics switch OFF the driver and the fault is latched. After 2 ms the fault is cleared and the lamp is switched ON by SPI. The before routine (pulsed turn on of the Lamp) continues until the OC disappears or a timeout (50 ms) expires. The function returns with two possible states:

- the OC is disappeared, so the Lamp may be switched ON for the time required by the application
- the 50 ms timeout is expired meaning that a permanent short to Battery is present and it can be notified to the application.

In the following, a coding example for L9177A lamp switching is reported. The example uses the high level functions of L9177A device driver, which is a demo FW with APIs embedding all the functions of L9177A. It can be included in SPC5Studio platform upon request.

```
/*****************************************************************************/
/***                                                                       ***/
/***                    M I L L A M P  D R I V E R                         ***/
/***                                                                       ***/
/***            Example source code, referring to the AN...                ***/
/***                                                                       ***/
/*****************************************************************************/
do {
 /* Off Diagnostics evaluation */
 if(
```

```
 (l9177aDriverDiagnostics(&L9177AD1, L9177A_LAMP) == L9177A_STG) ||
 (l9177aDriverDiagnostics(&L9177AD1, L9177A_LAMP) == L9177A_OL)
 )
 {
 /* L9177A_STG or L9177A_OL */
 l9177a_diag_state = L9177A_FAULT;
 break  /* with error */;
 } else {
 /* S T E P # 1: clearing the diagnostics */
 l9177aClearDiagnostics(&L9177AD1);
 /* S T E P # 2: swithing the lamp on */
 l9177aEnableDriver(&L9177AD1, L9177A_LAMP);
 /* S T E P # 3: waiting for 500 microseconds */
 osalThreadDelayMicroseconds(500);
 /* S T E P # 4: swithing the lamp off */
 l9177aDisableDriver(&L9177AD1, L9177A_LAMP);
 } /* if( l9177aDriverDiagnostics(&L9177AD1, L9177A_LAMP) != L9177A_NO_FAULT ... */
 osalThreadDelayMilliseconds(2);
 if(++cycle_counter == (uint8_t)L9177A_MAX_DIAG) {
  l9177a_diag_state = L9177A_FAULT;
  break /* with error */;
 };
} while(l9177aDriverDiagnostics(&L9177AD1, L9177A_LAMP) == L9177A_OVER_CURR);
/*****************************************************************************/
 if(l9177a_diag_state == L9177A_FAULT) {
 l9177a_read = l9177aSPIReadRegister(&L9177AD1);
 l9177aClearDiagnostics(&L9177AD1);
 }
```

Revision history

Table 1. **Document revision history**

Date	Version	Changes
15-Apr-2019	1	Initial release.

Contents