# Interfaces

## LPF File

The Plate Device will read a file from an SD card whose contents indicates the intensities of light at each well in time. The file should be named “program.lpf” and reside in the root directory (folder) of the SD card.

### Version 1.0

Version 1.0 of the LPF encodes the program as the set of light intensities of all the channels at every time point, with a fixed time step.

#### Headers (bytes 0-31)

Each header field is 32-bits long.

Table ‑. Header fields

|  |  |  |
| --- | --- | --- |
| Bytes | Name | Description |
| 0-3 | FILE\_VERSION | File version of the file, constant to 0x0001. |
| 4-7 | NUMBER\_CHANNELS\* | TOTAL number of channels that the program is written for (e.g. for a 96-well TCA, NUMBER\_CHANNELS will be 2\*96 = 192). |
| 8-11 | STEP\_SIZE | Step size in ms\*\* |
| 12-15 | NUMBER\_STEPS | Number of time points\*\* |
| 16-31 | - | Reserved for future fields |

\*This value will be checked against the number of channels of the device at the beginning of the program, and it will issue an error if they don’t match. This will prevent programs from one device to be erroneously used on another one.

\*\*File size will be checked at the beginning of the program, and it should match NUMBER\_STEPS\*NUMBER\_CHANNELS\*2 + 32.

#### Data (bytes from 32)

This section contains the grayscale values of each channel, ordered by time and then by channel.

With the current implementation based on the TLC5941 LED drivers, grayscale values are represented as a 12-bit number (0-4095). Grayscale information will, however, be stored in the LPF as a 16-bit number, one for each channel and timepoint.

## Indicator LEDs

Three LEDs are to be present in a plate device for status indication:

* ON (recommended: green): Indicates proper function in the plate device. Blinking with a one-second period indicates that the device is running.
* END (recommended: yellow): Indicates that the execution of the light program specified in the LPF has concluded.
* ERR (recommended: red): Indicates some error in the execution of the LPF. Common error situations are described below.

# Errors

Error situations are irreversible, and the system should be restarted in order to go back to a functioning state. Table 2‑1 specifies the error conditions, and the corresponding signals that will be observed in the LEDs.

Table ‑. Error conditions

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Description | Solution | Detected at | LEDs |
| SD card not recognized | No SD card has been detected. | Insert or replace the SD card. | Initialization | ON: off  END: off  ERR: on |
| LPF not found | Even though the SD card was detected, a file called “program.lpf” wasn’t found. | Include a light program file in the SD card. | Initialization | ON: off  END: on  ERR: on |
| Incorrect LPF format | Headers indicate potentially incorrect information, or indicate incompatibility with this device. | Make sure your file is correct, and that you got it from a verified source. | Initialization | ON: on  END: off  ERR: on |
| Timeout | The device has not been able to maintain the specified resolution. | Try increasing the time step for light intensity update. | Runtime | ON: blink  END: off  ERR: blink |
| LPF unavailable | The file has become unavailable in the middle of the run. | Verify that your SD card is properly inserted in the SD card slot. | Runtime | ON: off  END: off  ERR: blink |

# States

The function of the device will sometimes give rise to different behaviors even in response to the same stimuli, especially in responding to different error situations. This is best managed by using states, and modeling the controller as a finite state machine. The state will be implemented as a single variable in the system. Table 3‑1 enumerates the different states of the device.

Table ‑. States of the device.

|  |  |
| --- | --- |
| State | Description |
| STATE\_INITIALIZING | The device will be in this state upon booting. In this state, the device is initializing resources and running checks on the LPF. |
| STATE\_RUNNING | The device has passed its initialization routines, and it is currently executing the program contained in the LPF. |
| STATE\_FINISHED | The device has finished execution of the LPF successfully. |
| STATE\_ERROR\_NO\_SD\_CARD | The device was not able to recognize an SD card. The system goes to this state in response to the “SD card not recognized” error. |
| STATE\_ERROR\_NO\_LPF | The device was not able to find the appropriate LPF in the SD card. The system goes to this state in response to the “LPF not found” error. |
| STATE\_ERROR\_WRONG\_LPF | The LPF doesn’t have an appropriately formatted LPF. The system goes to this state in response to the “Incorrect LPF format” error. |
| STATE\_ERROR\_TIMEOUT | The device was not able to maintain the specified time resolution. The system goes to this state in response to the “Timeout” error. |
| STATE\_ERROR\_LPF\_UNAVAILABLE | The system goes to this state in response to the “LPF unavailable” error. |