UNION INTERNATIONALE DE PENTATHLON MODERNE - UIPM

UIPM Light Interface Spec-2019

This document gives the technical background and specification for the **UIPM-Light-Interface (ULI)**
It provides some reasons why we bother with an experiential approach and presenting a detailed working specification useful for providers and users alike.

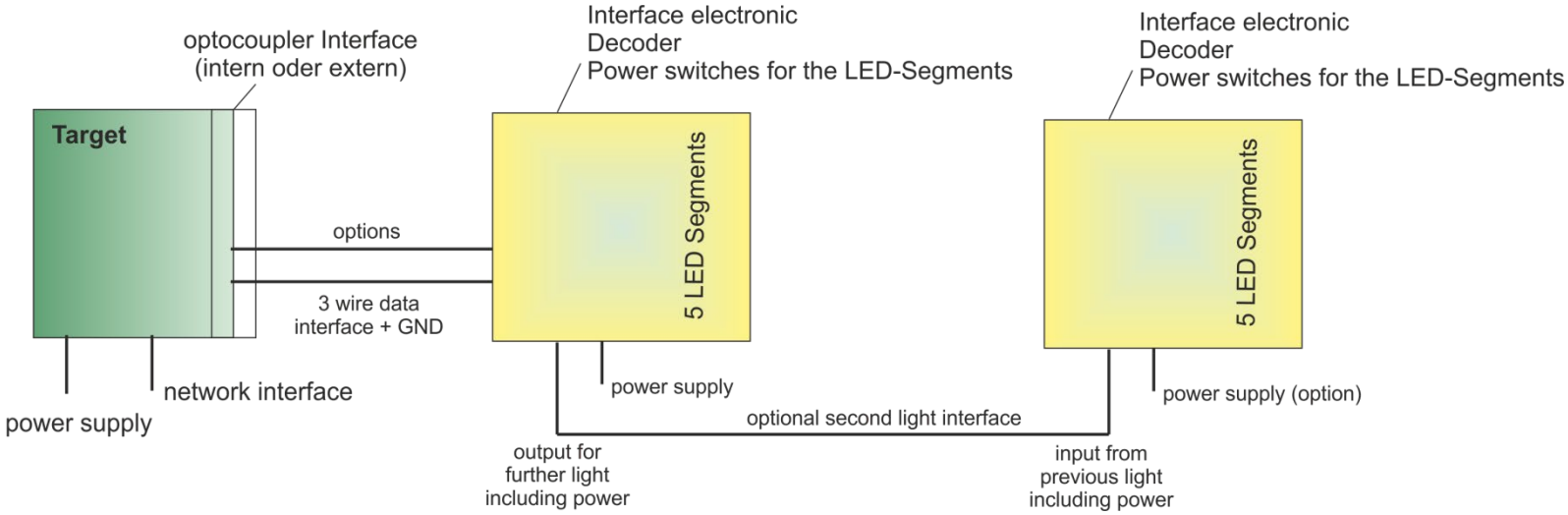
Lights are not only for feedback to the individual athletes at a certain lane. Besides the results data which are provided by the wireless local network for mobile clients Platforms and the presentation at big screens, the indicator lights should also offer online result feedback for the spectators.
You will find what the targets have to provide for a minimum functionality and with what the lights must work on.
Lights must get function with all targets which fulfill the ULI specification and vice versa.

- What kind of information the targets have to provide
- Physical specification of the Target interface (based on an analysis of provider information)
- The light has to serve both specifications
- Logical states at the target interface indicate all the time what the current result state is (nonvisible state transitions)
- Optocoupler and separated power supplies to prevent feedback noise

Targets and Lights should be decoupled by optocoupler in particular to avoid feedback effects with LED control (high current switching issues). That's why individual power supplies for Targets and Lights have to use.
The document presents its view as a comprehensive concept, yet not fixing all technical details, design examples. It gives only the minimum of what has to be compatible in the future.

Lights and targets can have additional functionalities and interfaces as well but, however, the base functionality must be given without those add-ons, only by ULI.

UIPM Light Interface and Options



Timing Aspects 3 wire Parallel Interface
The target transfers the related result code after each shot event
This code represents the full result and must be equal to the indication state at each time
The respective state codes will be present at the interface up to a new state has to be transferred.

Blinking: State indication with blink effects (as stated in the rules) has to be realized by the target!

Opto-Coupler Interface
The optocoupler prevents feedback noise from the Light while the LED's switched on/off.
In the case where targets do not have optocoupler embedded, an external adapter can be used.

Parallel Data Interface
3 line parallel Interface: fulfills the basic requirements. (power, ground lines excluded)
An optional 2- or 3-line serial interface (e.g. I2C-specification): fulfills the basic requirements by a simple protocol (pushing one byte of data, see page 7).
An optional interface can be part of the same connector (together with the 3 wire parallel interface) or realized via a separate one).

Further External Light
In case of support more than one external light the interface to further Lights must again support the 3 wire parallel interface.
Separate Power supply is not mandatory herewith.

UIPM Light Interface - Pin Assignments on External Lights

The UIPM State Control specification only requires three data lines + 1 Ground line and a physical interface with OptoCouplers, where the required resisters are located on the light side.

1. Pull-up resistors (open collector outputs) for all new lights
2. Pull-down resistors scheme (pull-down outputs) can be realized easily by an adapter (for old lights which are placed in the market already).

Optocoupler should place on the target side. Existing Targets can amend by an adapter (This will also be present in the target homologation document and obligatory for all new targets from **xx.xx.xxxx** on).

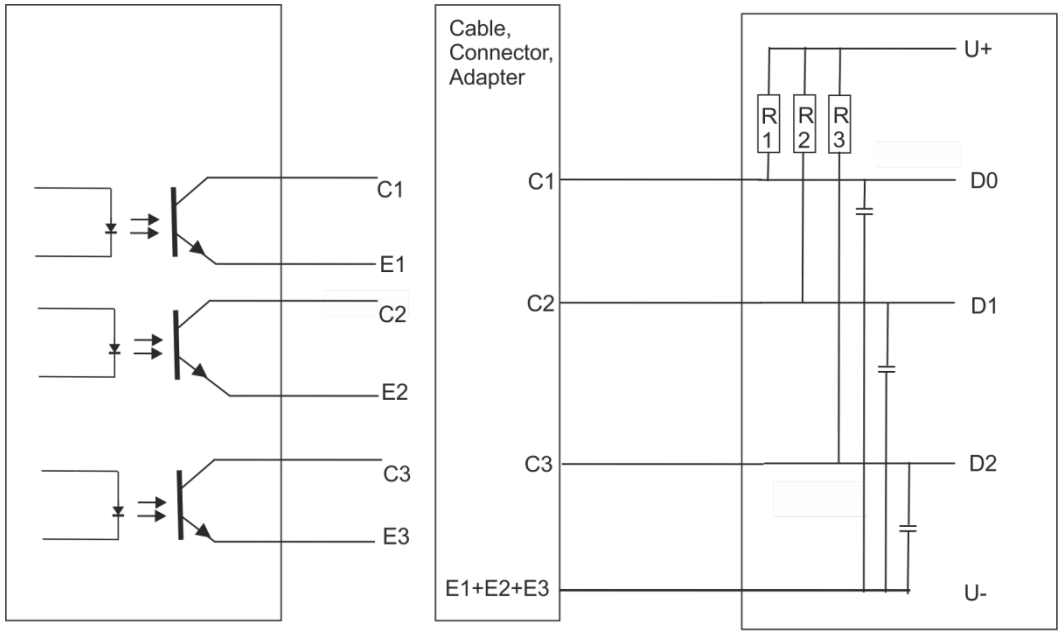
The most applied connector for lights which are present in the market have used the well-known RJ-45 Pin Connector (consumer version)
We subsequently use that connector type as the reference for the pin assignments.
Any other connector can be used as well; however, an IP65 class connector will be preferred.
The chosen connector details must be given in the manual (including the supplier's type specification).

reference Connector (RJ-45, Pinning)	UIPM State Control concept, Rev.3 Interface Light side	Target Interface (Option)	Further External Light Output (Light to Light)
1	NC /option		NC /option
2	NC /option		NC /option
3	Data_0 (LSB) *	Data_0 (LSB) *	Data_0 (LSB)
4	Data_1*	Data_1*	Data_1
5	Data_2*	Data_2*	Data_2
6	GND	GND Data_0	GND
7	NC /option	GND Data_1	NC /option
8	NC /option	GND Data_2	NC /option

3.3 V to 24V)/30mA (max)
A serial arrangement as an optional add-on (e.g. I2C, IO-Link…) is possible. Providers must give physical and logical details in their documentation if they offer such additional interfaces

Details for an Interface Solution Scheme with pull-up resistors (3 wire parallel)

The following sketch gives details for an interface realization (without reference to dedicated electronic components)



Optocoupler device on target side with optional simple passive adapter to fulfill the interface requirements

Decoder Interface on light side

3 Wire Parallel Interface
The 3 data lines represent the data D0, D1 and D2
The open collector output setup forces the light input to the state '111' in absent of any active signal on the target side

The combination of the resistors and the capacities will prevent noise effects at the decoder interface.

In designing the decoder interface the values for the resistors and the capacitors must follows the max/min ratings in view of the opto-coupler interface (see electrical specifications)

Pull-up resitors on light side
The pull-up resister on the light side provides an clear state at power up and also in the case, were the target interface shows an undefined (open switches) state.
It should be notice that the wire between target and light acts like an antenna.

From providers feedback "to take only one interface scheme", we decided for using the pull-up scheme. See explanation in the box above.

Decoder Scheme Parallel Interface (Needs also an amendment on target side software)

State Representation			Indication Light with 5 LED Segments				
D2	**D1**	**D0**	**LED Segment 1**	**LED Segment 2**	**LED Segment 3**	**LED Segment 4**	**LED Segment 5**
0	0	0					
0	0	1					
0	1	0					
0	1	1					
1	0	0					
1	0	1					
1	1	0					
1	1	1					

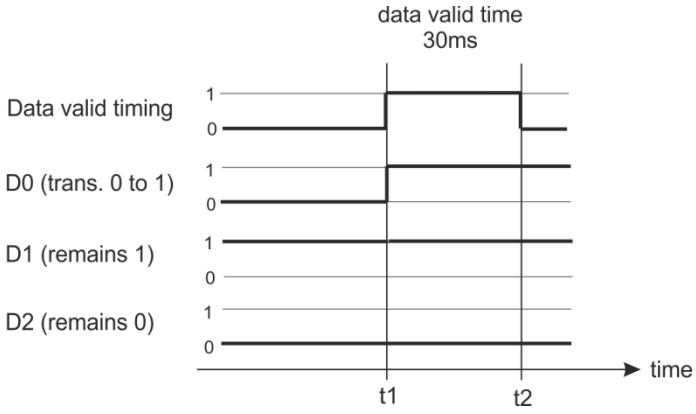
Meaning of colored areas:

	Start command frame SDF1 All light segments off
	This initial state will appear after light powered up. Used also for the “Command frame” at CF2 and CF6.
	Indicator Light segment shows **red**
	Indicator Light segment shows green

In a horizontal arrangement LED Segment_1 is left side oriented (Segment_5 is on right) and in a vertical arrangement LED Segment_1 is the first Element at the ground (Segment_5 is on top).

Command-sequence for Intensity adjustment and flash timing start:

0	0	0	
1	1	1	
0	0	0	
D2	**D1**	**D0**	The data bits **001 – 101** represents 5 different intensity levels
D2	**D1**	**D0**	Data bit setting 110 symbols the command “Flashing Segment 1” as specified
1	1	1	
			One of the normal light state representation has to appear (bit sets 001-110)



In case of the Command sequence “Flashing Segment 1” (state 110), the electronic has to start a predefined flash sequence on light segment 1. The color scheme shall be updated as usual and independent of that.

Timing Diagram (Example of a state transition from state 010 to state 011):

A state change will be detected at time t1. Each state change will be valid (visible at the light segments) after 30ms at t2. Fore that the state must be stable for that 30ms. If any change appears, the 30ms phase starts again. This 30ms period, of course, limits the minimum flashing timing then.
This offers continuous light state emitting even during the command sequence (intensity adjustment and flash timing start).
During the command sequence, each of the states shall hold stable for 5ms (max. 6ms).
Flash Timing: 10s before End of Shooting Time Timing: The 1. LED left side blinking (5s slow/5s faster); LED1 blinks, all LEDs indicates the given state.
After activation of this function on the light side, the light electronic flashes the first light segment, but only for that 10sec (5s-+5s). The Light state (color scheme) will not be interfered. That means, the light shall follow each state change at the interface by the given timing, also while flashing the first segment.

Decoder Scheme Serial Interface (only an additional option!):

The Serial Interface is optional and not specified herein view of physical details. In view of some meters of cable length, the I2C Bus or the IO-Link interface could be an option. But any kind of serial interface can be implemented for optional use.
The provider can choose their own interface for applications out of the competition. They shall give the description in the user document.

Data Structure

The whole state information for result data shall be given by one Byte
For the decoder-scheme, information sees above (description of the Parallel Interface).

bits 7 – bit 5	bit 4, bit 3	bits 2 – bit 0
represents 6 different intensity levels	always zero	State Representation (current result state)

Timing

Requirements will be provided by the respective Bus Specification document which **should be given by the provider**.

Data representation:

The one-byte data has to be updated 25 times per second (25 refreshes per second)
The max amount of refreshes limits the resolution for any kind of blink effects which has to initiate by the target.

Electrical Specifications

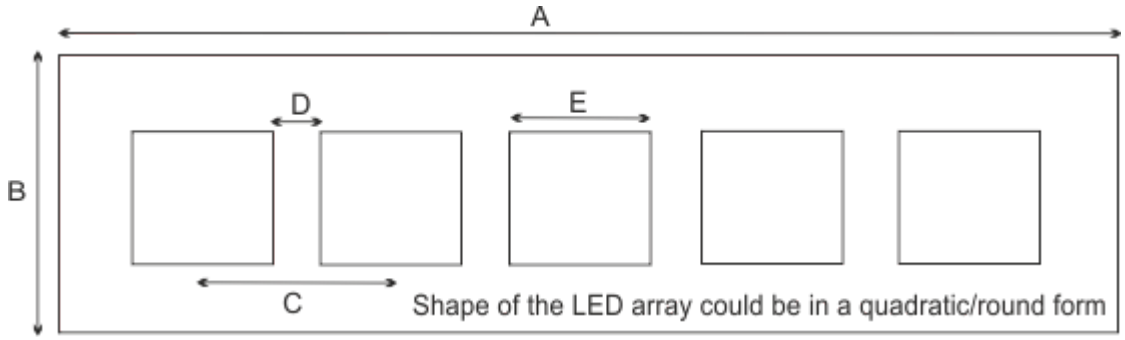
		max ratings	min ratings	remarks
Vcc/U+	Power	60V	3,3V	using higher values to reduce interferences
VDD/U-	Should be Signal ground	0V	0V	GND
VH	Logical High Level	24V	on design	depends on the setup provided by the Light Device
VL	Logical High Level	on design	on design	depends on the setup provided by the Light Device
IL	Forward current Low level	30mA	on design	depends on the setup provided by the Light Device

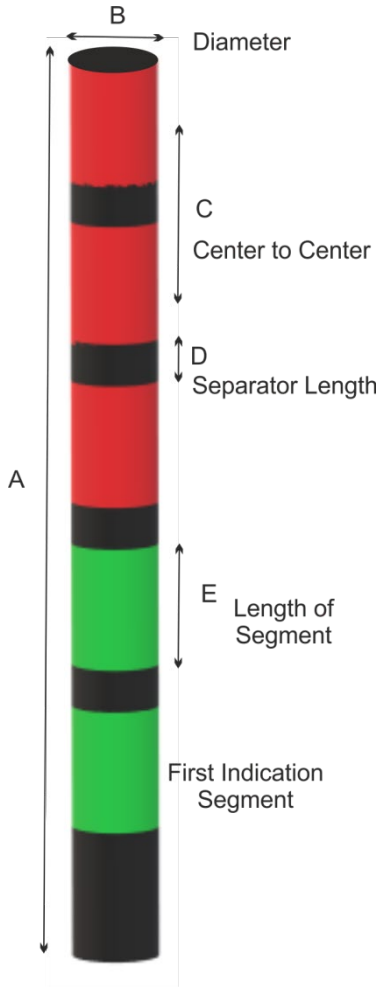
Optical Specifications

Subject	Athletes feedback light Values	Spectator lights Values	Note
Wavelength red	620nm-640nm	620nm-640nm	
Wavelength green	520nm-540nm	520nm-540nm	
Viewing angle	> H90°, V90°	H360°, V90°	Surround-view (360°)
Brightness	specification: red: green:	Segment 1 r/g: Segment 2 r/g: Segment 3 r/g:	Simplification with 3 segments of 120° each with the optical power of about the athletes feedback light within each segment **Red and green (r/g) shall adjust that they have the same brightness for the human eyes (less power for green)**
Brightness Control	20%, 40%, 60%, 80%, 100%	20%, 40%, 60%, 80%, 100%	5 Intensity levels

System Specifications

The orientation of the light can be horizontal and vertical alike.





Parameter	Athletes feedback light horizontal version	Spectator light vertical version	Note
A	500-800 mm		length
B	80-120 mm		Width (must not be “round”)
C	100 mm	100 mm	minimum
D	40 mm	40 mm	minimum
E	60mm	60 mm	minimum
Av	800 mm	800 mm	maximum/minimum
Bv	80-160 mm	80-160 mm	vertical alignment
Wavelength red	620nm-640nm		
Wavelength green	520nm-540nm		
Viewing angle	> H90°,V90°		For a vertical version “surrounding” horizontal 90° and vertical 360°

Change Log

No.	Explanation/Specification	Note
1	11-2018 There is one important parameter which has to be noticed. That is the wavelength of the red indicator light.	The wavelength of that light is specified close to that of the Laser shot signal. That's why during a competition the light should be arranged in a way to prevent that red light of the indicator light will be also incident light of targets detection area.
2	02-2019 Only one physical interface scheme with optional adapter solution for the light interface Amendments concerning the Dimensions No separate power on the data interface connector Definition of a second interface for an optional second light	Spectators_Lights_112018 rev3 After discussion with the Equipment commission
3	03-2019 Time-out sequence: The last 10s timing of the whole 50s-shot-time, was not applied in the new interface scheme. The proposed solution aims to prevent establishing an extended state space by using an additional signal line (4 lines instead of 3 line interface). Therefore the command sequence was extended to start that flash function on the light side. As a result of these amendments, the amounts of intensity-levels were reduced to 5 levels. Further feedback comes with offering various LED-power schemes and in view of that to offer up to 60V DC for a larger amount of LEDs for the whole light.	This timing specification was not given in the rules but it was specified within the homologation specification of the targets. With this new light interface scheme, the target was unable to provide this flashing scheme. With this amendment, the targets can signal this flashing scheme at their interface to the light.