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Development of Smart Street lighting technology using LED in Ho Chi Minh City - Viet Nam

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HCMUT, VNU-HCM

HCMC, March 2020

SMART STREET LIGHTING SYSTEM

SMART LIGHTING TECHNOLOGY



Communication technology:

- PLC
- ZigBee
- SigFox
- LoRa
- NB-IoT

System roles :

- Urban safety
- Energy saving
- Improve the quality of light
- Effective operation and maintenance
- Combined with electrical systems and other applications



SMART STREET LIGHTING SYSTEM

ELEMENTS IN THE SMART STREET LIGHTING SYSTEM



LED Driver

Lora WAN node module

Gateways

Sensor

CLOUD

Lighting control software



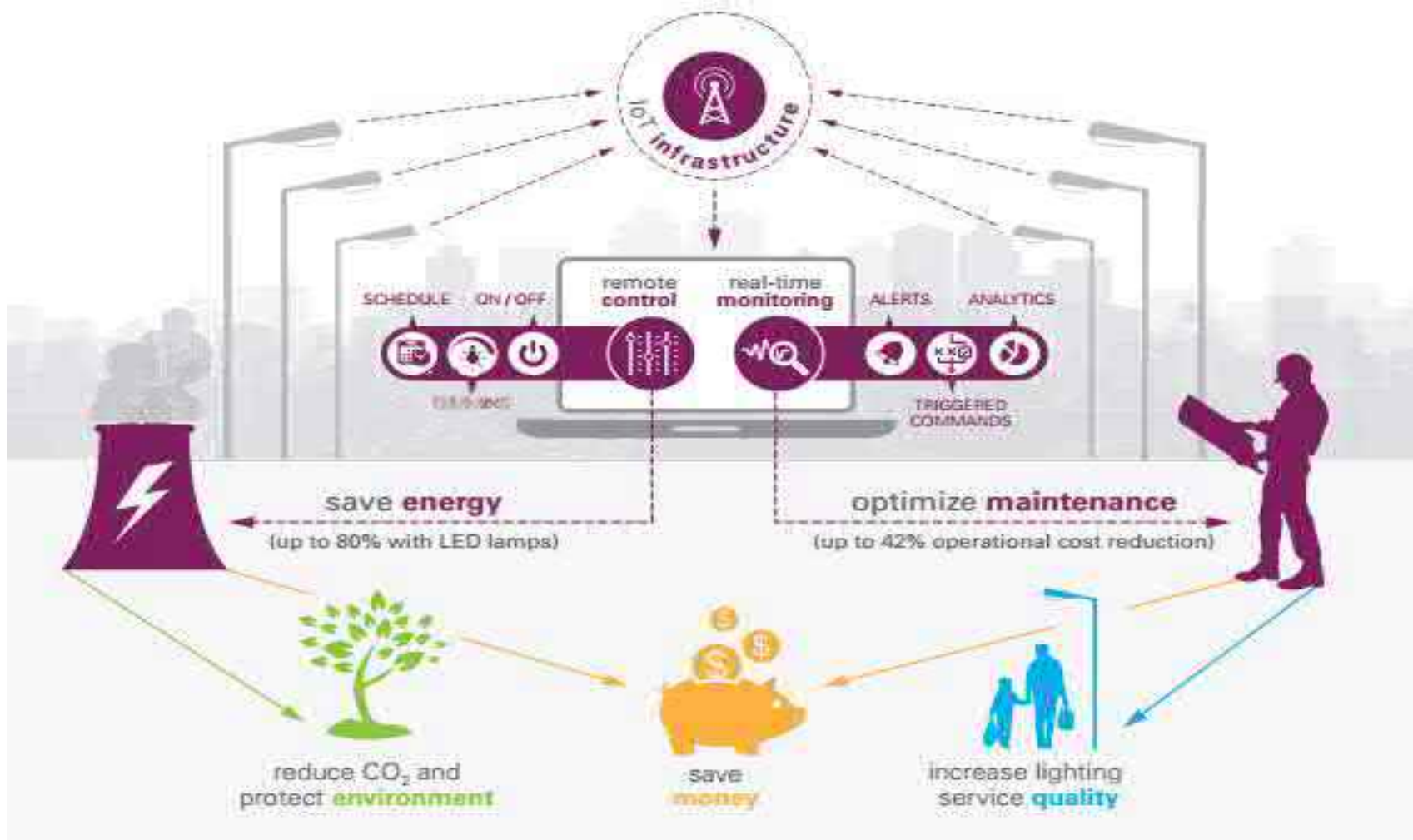
SMART STREET LIGHTING SYSTEM

OPTIMAL LIGHTING CONTROL



SMART STREET LIGHTING SYSTEM

CHARACTERISTICS OF THE PROPOSED STREET LIGHTING SYSTEM



SMART STREET LIGHTING SYSTEM

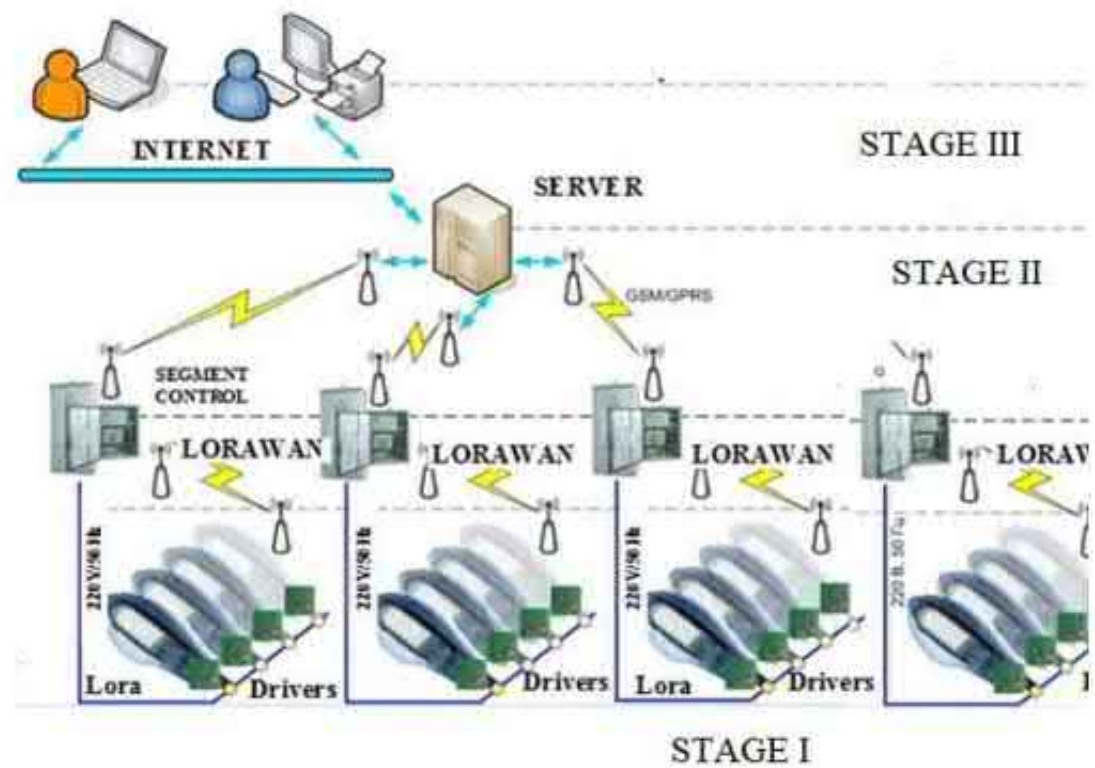
STRUCTURE OF SMART LIGHTING SYSTEM

 Control center - software for managing and controlling streetlights

 Data transmission system based on LORAWAN - lighting control cabinet and Gateway

 Smart controller + Lora node

 LED Driver + LED Module



SMART STREET LIGHTING SYSTEM

STRUCTURE OF THE STREET LIGHTING LED LAMP



SMART STREET LIGHTING SYSTEM

MOLD DESIGN



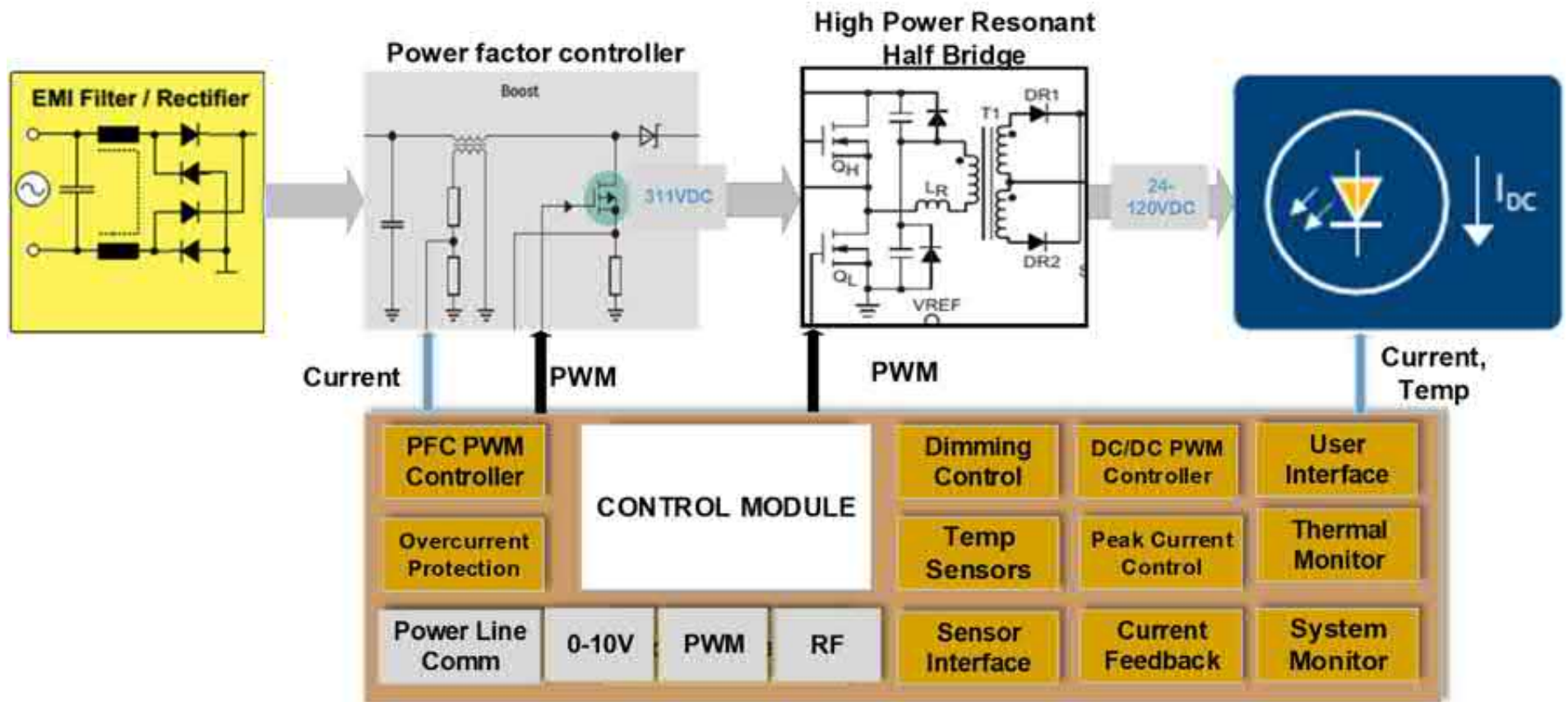
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SMART STREET LIGHTING SYSTEM

LED DRIVER CIRCUIT TOPOLOGY



SMART STREET LIGHTING SYSTEM

THREE STAGE LED DRIVER SCHEMATIC

EMI STAGE:

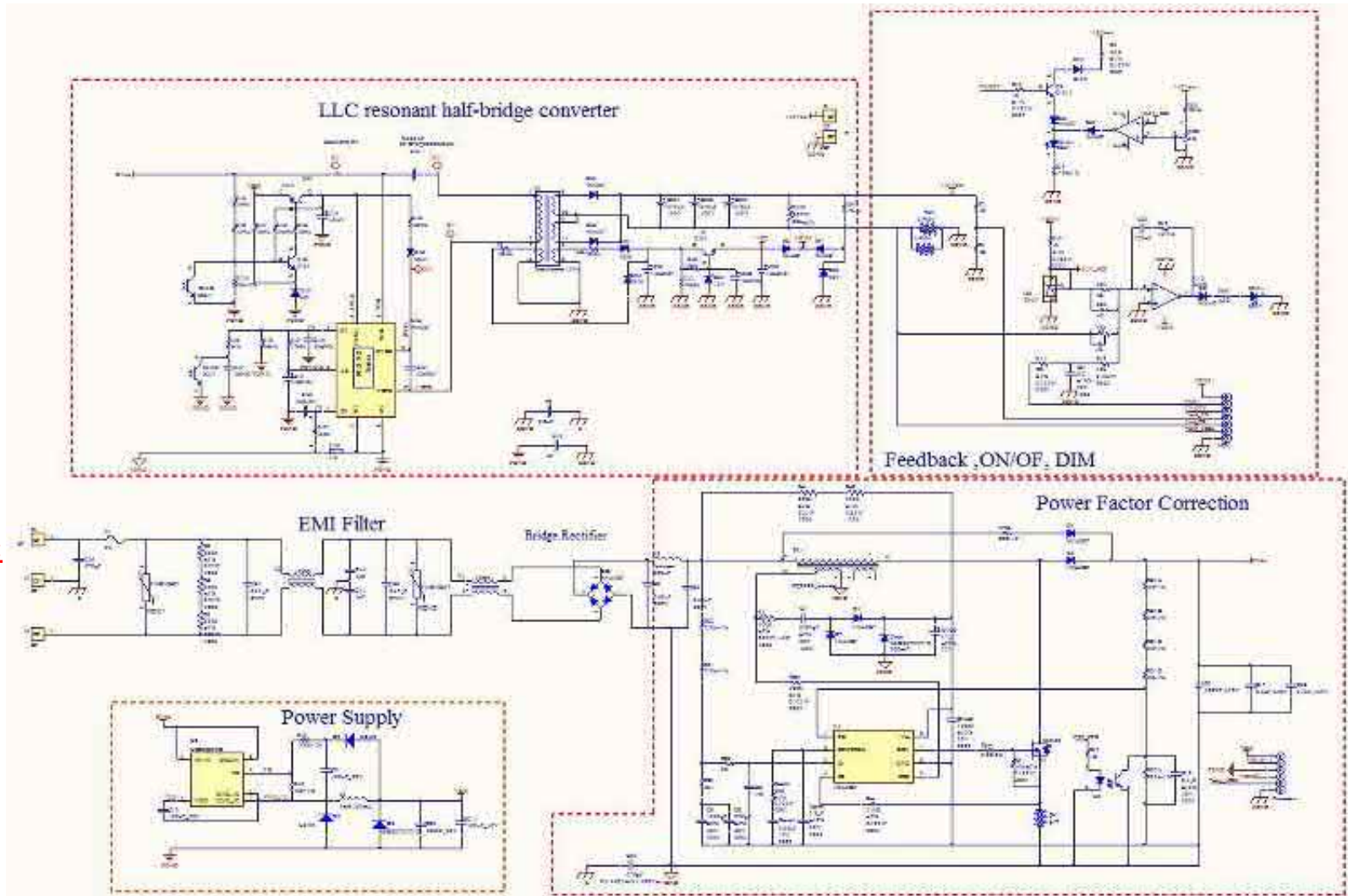
- DM Filter
- CM Filter

PFC STAGE:

- CRM Mode
- NCP1608 Controller

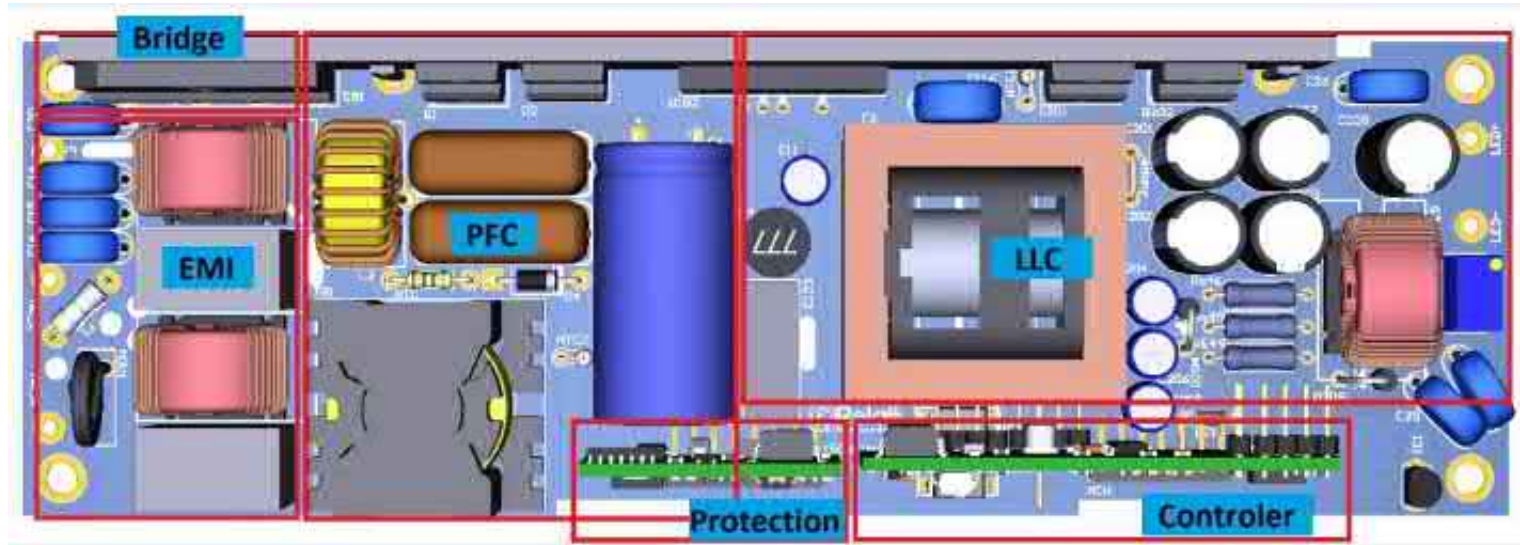
DC/DC STAGE:

- LLC Half-Bridge
- FLS2100XS Controller

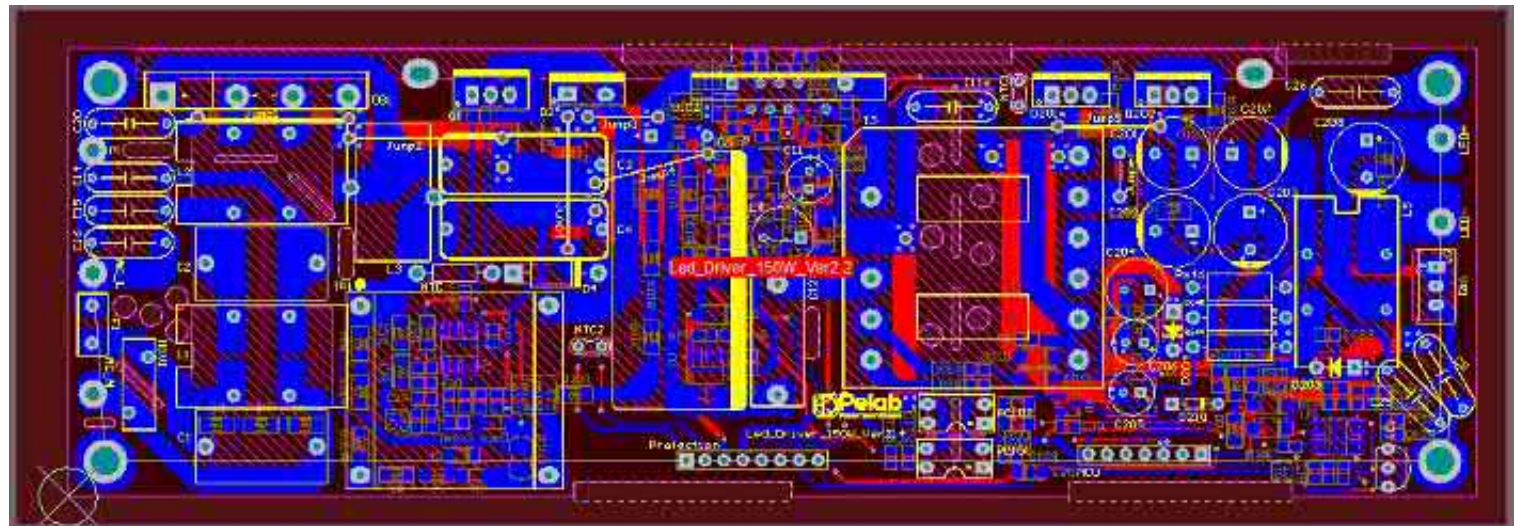


SMART STREET LIGHTING SYSTEM

LED DRIVER 3D MODEL



LED DRIVER PCB LAYOUT



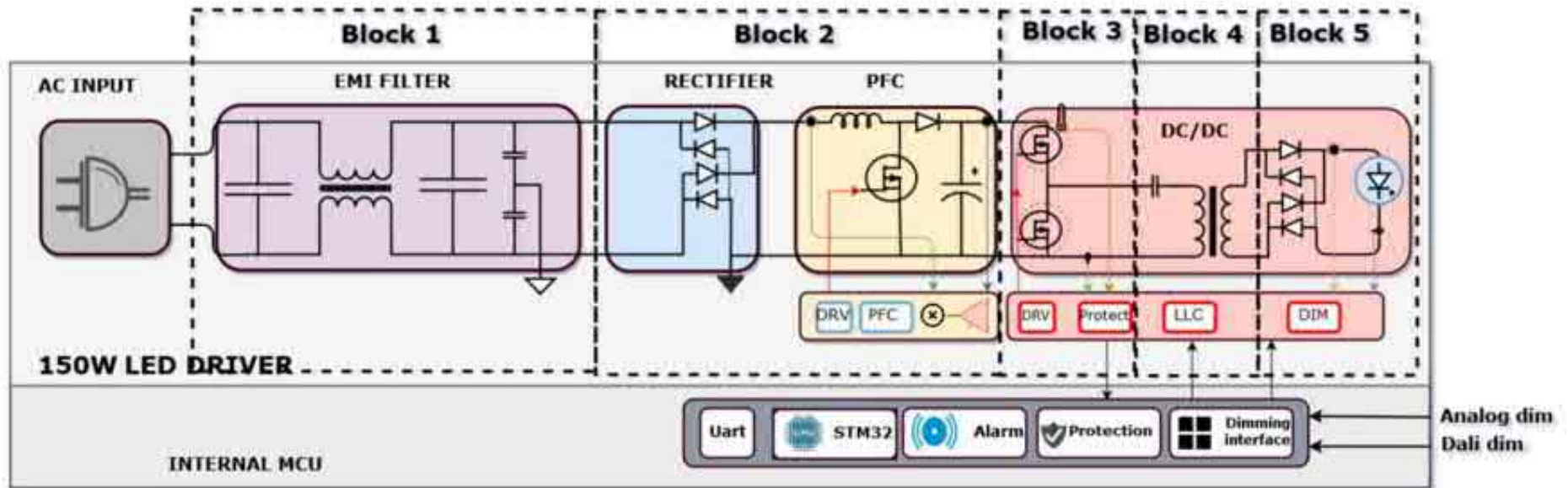
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SMART STREET LIGHTING SYSTEM

DIMMABLE LED CONTROLLER



INTERFACE PROTOCOL

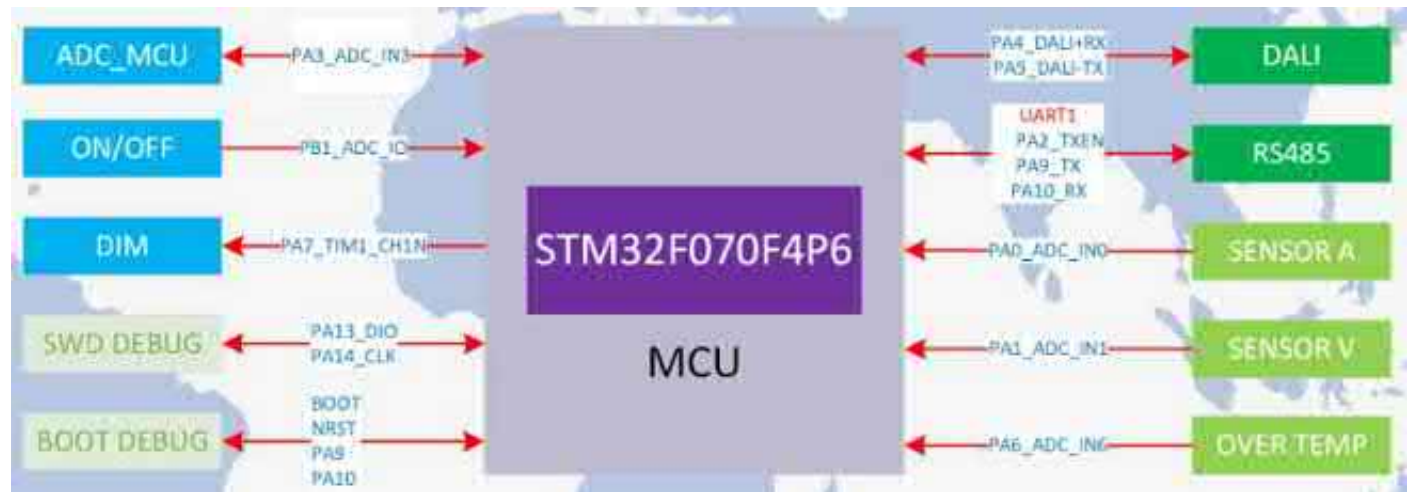
- DALI
- PWM
- ANALOG
- RS485

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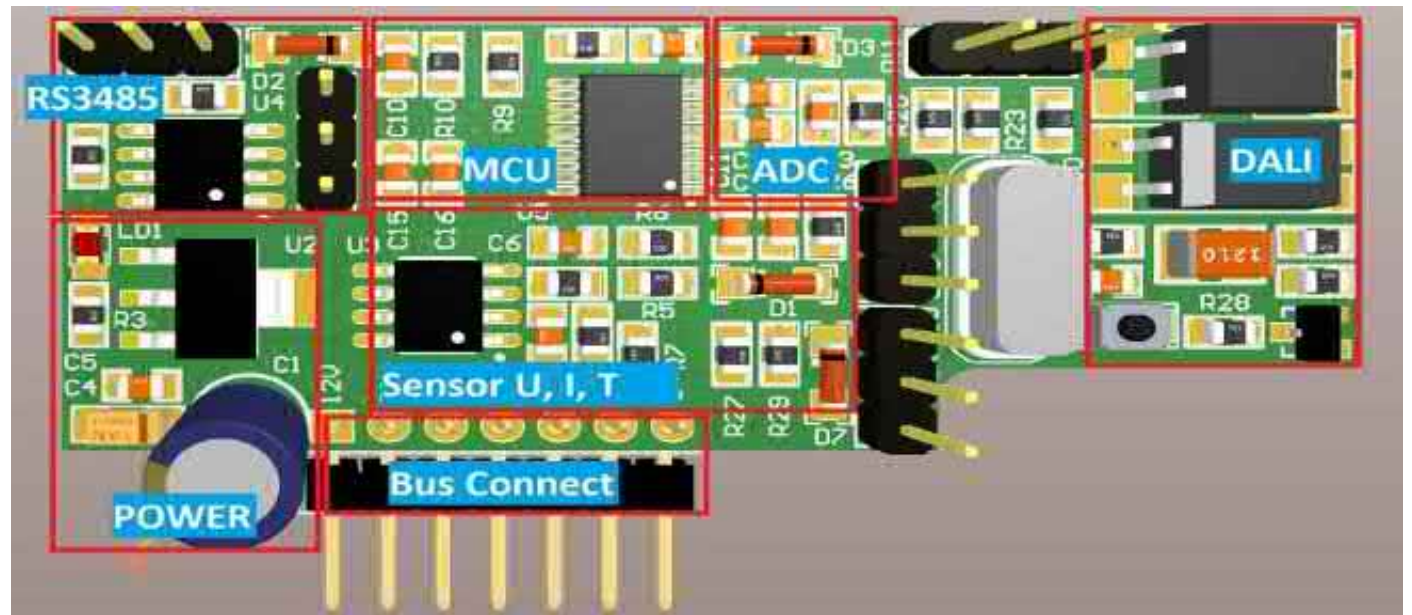


SMART STREET LIGHTING SYSTEM

DIMMABLE LED
CONTROLLER
BASE ON MCU



DIMMABLE LED
CONTROLLER
LAYOUT PCB

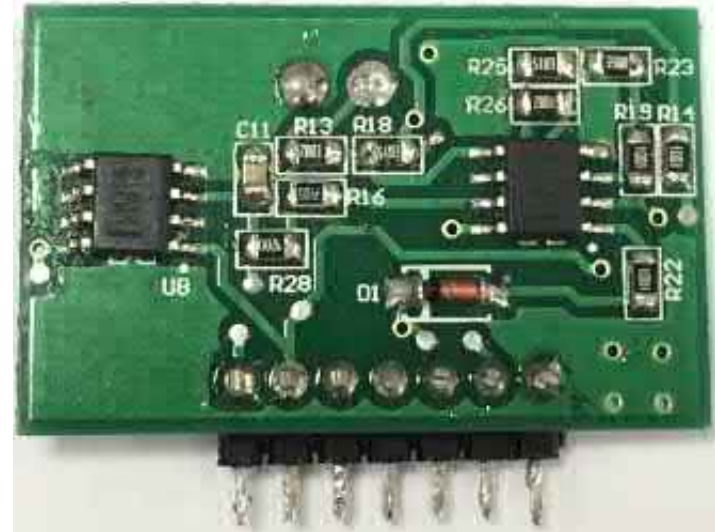
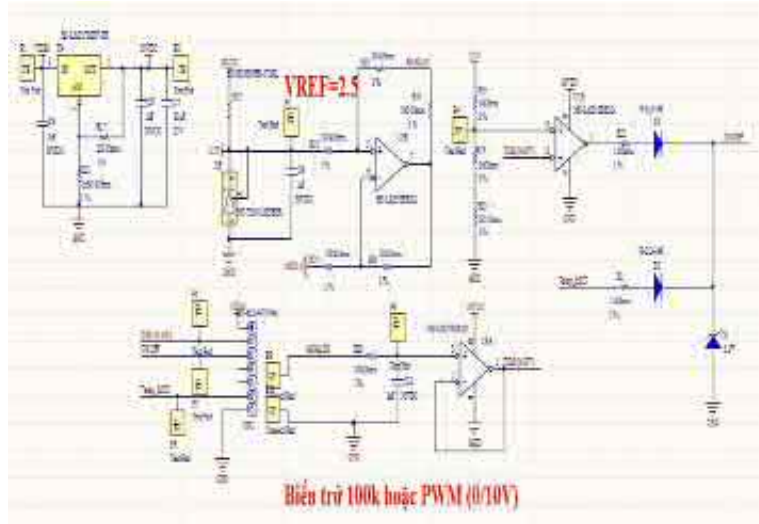


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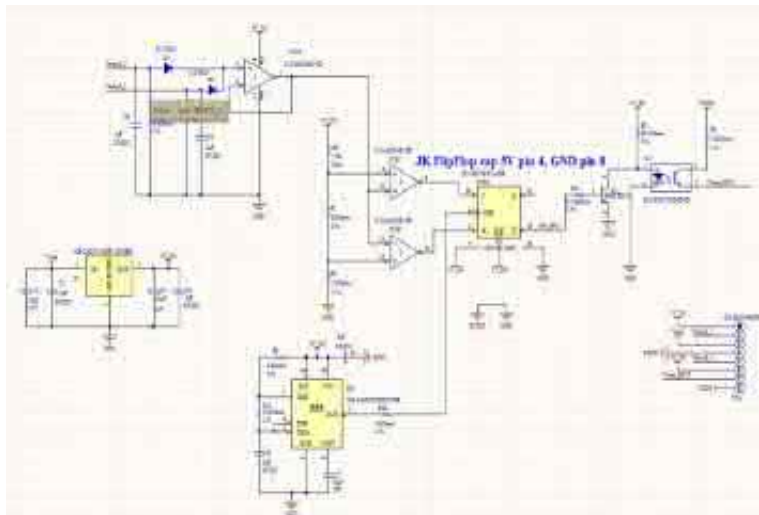


SMART STREET LIGHTING SYSTEM

ANALOG
DIMMING
MODULE



OVER
TEMPERATURE
PROTECTION
MODULE



DESL



SMART STREET LIGHTING SYSTEM

REMOTE CONTROL STREETLIGHT MODULE

LORA NODE

- SX1278 Lora IC
- ATSAM20E18

ELECTRICAL METROLOGY

- U/I/P/E/f...monitoring
- STPM33 IC

POWER SUPPLY

RELAY



SMART STREET LIGHTING SYSTEM

TESTING - OPTIMIZE DESIGN



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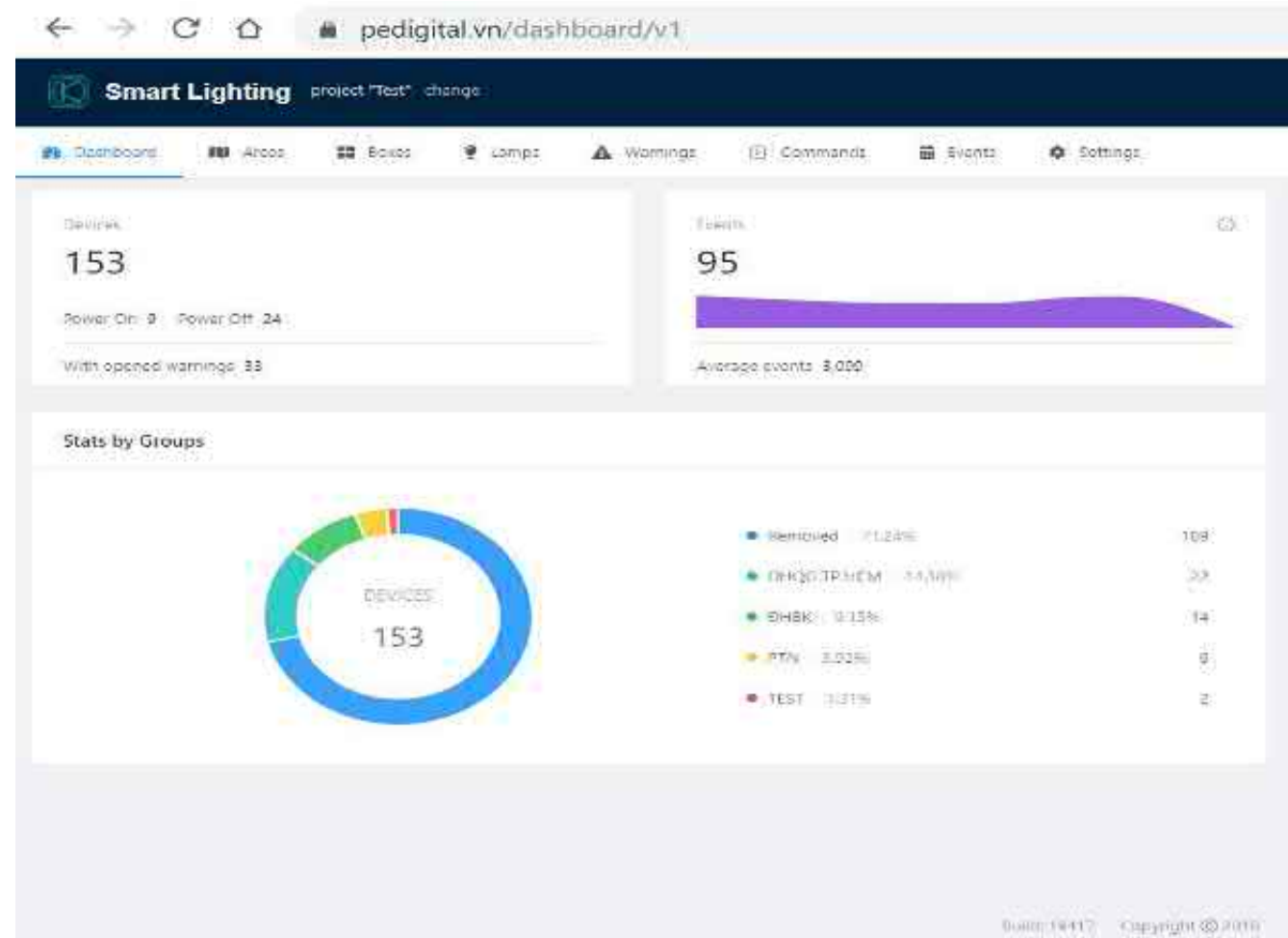


SMART STREET LIGHTING SYSTEM

CENTRAL CONTROL AND DATA MANAGEMENT

FUNCTIONS

- ❑ Manage many streetlight projects
- ❑ User access control to manage street lights at District / Ward level.
- ❑ Group control (control cabinet) and individually controlled lamp
- ❑ Directly monitor faults for each lamp / cabinet in each area
- ❑ Create groups and projects.
- ❑ Parameter storage and data provisioning
- ❑ State control and lighting control system
- ❑ Scheduling dimming control from software
- ❑ Maintenance and alarm system status



SMART STREET LIGHTING SYSTEM

LOGIN INTERFACE - MANAGEMENT AND CONTROL SYSTEM

Smart Lighting

Lighting control solution:

User authentication

demo

Sign In

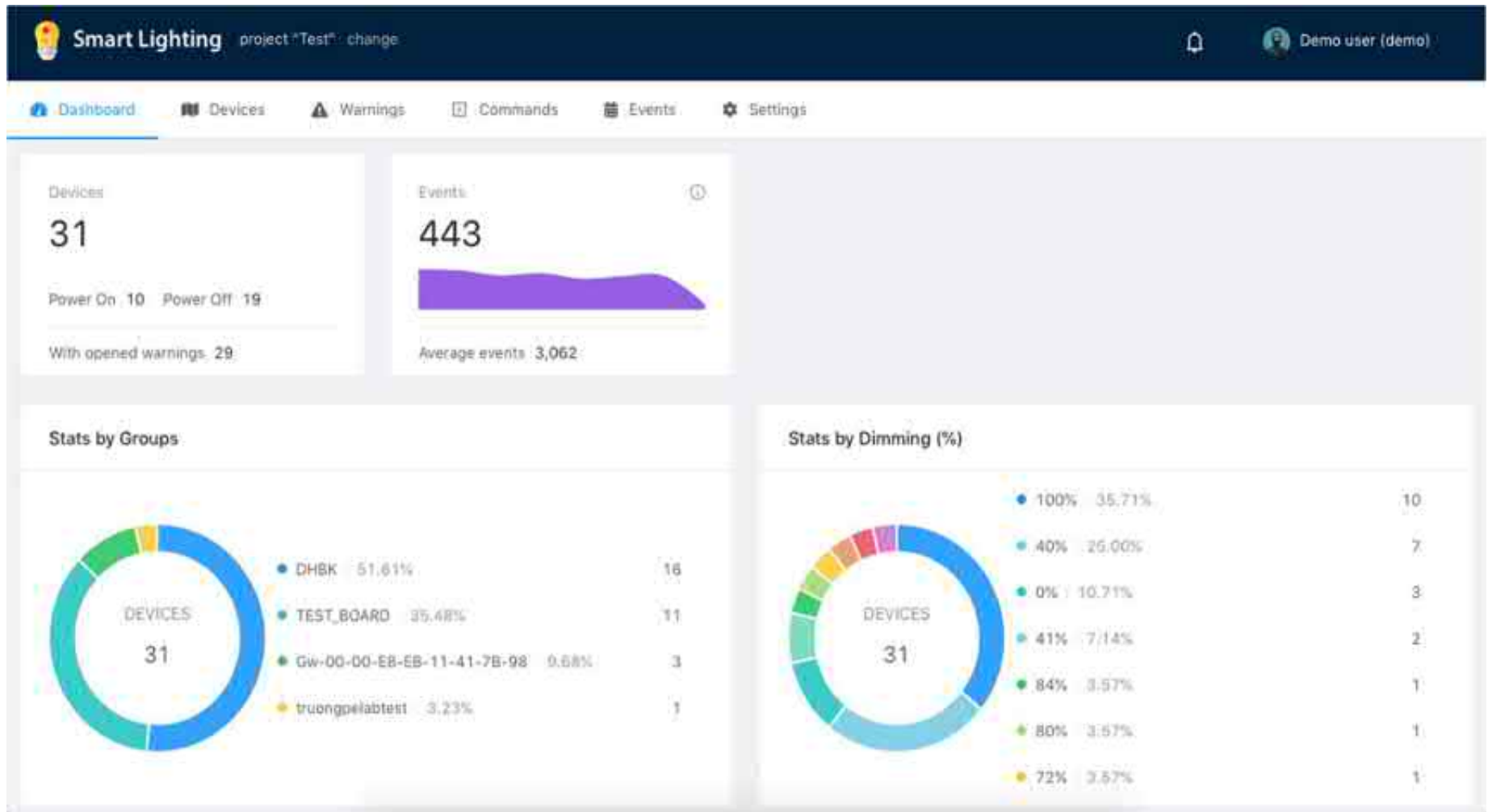
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English Vietnamese Russian



SMART STREET LIGHTING SYSTEM

FUNCTION MANAGEMENT FOR CABINET & LAMP



SMART STREET LIGHTING SYSTEM

DEVICE MANAGEMENT & NODE STATUS

The screenshot displays the 'Smart Lighting' web interface. At the top, there is a navigation bar with 'Smart Lighting' and a user profile 'Demo user (Demo)'. Below the navigation bar, there are tabs for 'Dashboard', 'Device', 'Warnings', 'Command', 'Alerts', and 'Settings'. The main content area is divided into two sections: a map and a table.

The map shows a geographical view of Ho Chi Minh City, Vietnam, with various districts labeled in Vietnamese, including Quận 1, Quận 2, Quận 3, Quận 4, Quận 5, Quận 7, Quận 8, Quận 9, Quận 10, Quận 11, Quận 12, Quận 13, Quận 14, Quận 15, Quận 16, Quận 17, Quận 18, Quận 19, Quận 20, Quận 21, Quận 22, Quận 23, Quận 24, Quận 25, Quận 26, Quận 27, Quận 28, Quận 29, Quận 30, Quận 31, Quận 32, Quận 33, Quận 34, Quận 35, Quận 36, Quận 37, Quận 38, Quận 39, Quận 40, Quận 41, Quận 42, Quận 43, Quận 44, Quận 45, Quận 46, Quận 47, Quận 48, Quận 49, Quận 50, Quận 51, Quận 52, Quận 53, Quận 54, Quận 55, Quận 56, Quận 57, Quận 58, Quận 59, Quận 60, Quận 61, Quận 62, Quận 63, Quận 64, Quận 65, Quận 66, Quận 67, Quận 68, Quận 69, Quận 70, Quận 71, Quận 72, Quận 73, Quận 74, Quận 75, Quận 76, Quận 77, Quận 78, Quận 79, Quận 80, Quận 81, Quận 82, Quận 83, Quận 84, Quận 85, Quận 86, Quận 87, Quận 88, Quận 89, Quận 90, Quận 91, Quận 92, Quận 93, Quận 94, Quận 95, Quận 96, Quận 97, Quận 98, Quận 99, Quận 100. A red location pin is placed on the map.

Below the map is a table titled 'Device status' with columns for 'Device name', 'Group', 'Ok', 'Disabling', 'Consumption', 'Current', 'Voltage', 'Power', 'RSSI', and 'SNR'. The table contains several rows of data, including device names like 'Sai (01000 52)', 'Dai (13300 81)', 'Dai (01000 52)', 'Dai (13300 81)', 'Dai (01000 52)', 'Dai (13300 81)', 'Dai (01000 52)', and 'Dai (13300 81)'. A dropdown menu is open over the 'Group' column, showing options: 'DHS-7ay', 'DHS', 'Not Linked', 'OK', and 'Fail'.

Device name	Group	Ok	Disabling	Consumption	Current	Voltage	Power	RSSI	SNR
Sai (01000 52)	DHS-7ay	OK	40%	4.8470Wh	120mA	220.262V	26.788W	-85	3.8
Dai (13300 81)	DHS	OK	4%	0.374Wh	20mA	220.7V	4.415W	-85	12.8
Dai (01000 52)	DHS-7ay	OK	7%	4.8220Wh	120mA	220.240V	26.720W	-85	3.5
Dai (13300 81)	DHS-7ay	OK	0%	3.8394Wh	90mA	220.097V	19.806W	-87	3.8
Dai (01000 52)	DHS-7ay	OK	6%	1.3485Wh	42mA	220.720V	9.300W	-84	11
Light connection Last power supply	DHS	OK	0%		54mA	220.081V	11.8770W	-100	-0.8
Light connection Last power supply	DHS	NA	0%	28463.173Wh	39A	220.160V	8.671W	-105	7.5



SMART STREET LIGHTING SYSTEM

FUNCTIONAL SETTING FOR GROUP OF LAMPS OR EACH LAMP

The screenshot displays a control interface for a smart street lighting system. On the left, a dropdown menu titled "New command" is open, listing various actions such as "Plain HEX command", "Power ON/OFF", "Set dimming %", "Power ON/OFF, Dimming (%), Date", "Set RTC", "Power On/Off, Dimming (%), Schedule", "Reset device", "Read device identification", "Read data by ID", and "Start Routine".

On the right, a table titled "Device info" lists the settings for eight individual lamps. Each row includes a plus sign, a checked checkbox, a lamp name in Vietnamese, the device type "DHBK New", an "On" status (all "Yes"), and a "Dimming" percentage.

	Group	On	Dimming
	DHBK New	Yes	40%
	DHBK New	Yes	40%
	DHBK New	Yes	60%
	DHBK New	Yes	100%
	DHBK New	Yes	50%
+ <input checked="" type="checkbox"/>	Đèn 09 (Cổng 3)	Yes	40%
+ <input checked="" type="checkbox"/>	Đèn 03 (Khu B2)	Yes	80%
+ <input checked="" type="checkbox"/>	Đèn 08 (Cổng 2)	Yes	40%
+ <input checked="" type="checkbox"/>	Đèn 05 (Khu B2)	Yes	90%
+ <input checked="" type="checkbox"/>	Đèn 02 (Khu B2)	Yes	60%
+ <input checked="" type="checkbox"/>	Đèn 14 (Khu B4)	Yes	40%
+ <input checked="" type="checkbox"/>	Đèn 12 (Khu B11)	Yes	40%
+ <input checked="" type="checkbox"/>	Đèn 07 (Cổng 2)	Yes	40%



SMART STREET LIGHTING SYSTEM

ON/OFF/ DIMMING CONTROL

ON, OFF, DIM BY TIME

- Used to schedule ON / OFF / DIM lamp according to the scenario
- There are 24 installs in 1 day
- Do not save the script
- Select the time and press Send to send down the light

New command

Power ON/OFF:

Процент яркости: 0% 20% 40% 60% 80% 100%

Date:

Send

Cancel

ON, OFF, DIM SCHEDULE

- Used to schedule ON / OFF / DIM lights according to the scenario
- There are 24 installs in 1 day
- Save the script
- Select the time and press Send to send down the light

Power On/Off, Dimming (%), Schedule

-1) 0% 20% 40% 60% 80% 100%

Sunset) 0% 20% 40% 60% 80% 100%

+1) 0% 20% 40% 60% 80% 100%

+2) 0% 20% 40% 60% 80% 100%

+3) 0% 20% 40% 60% 80% 100%

+4) 0% 20% 40% 60% 80% 100%

-4) 0% 20% 40% 60% 80% 100%

+3) 0% 20% 40% 60% 80% 100%

-2) 0% 20% 40% 60% 80% 100%

+1) 0% 20% 40% 60% 80% 100%

Sunrise) 0% 20% 40% 60% 80% 100%

+5) 0% 20% 40% 60% 80% 100%

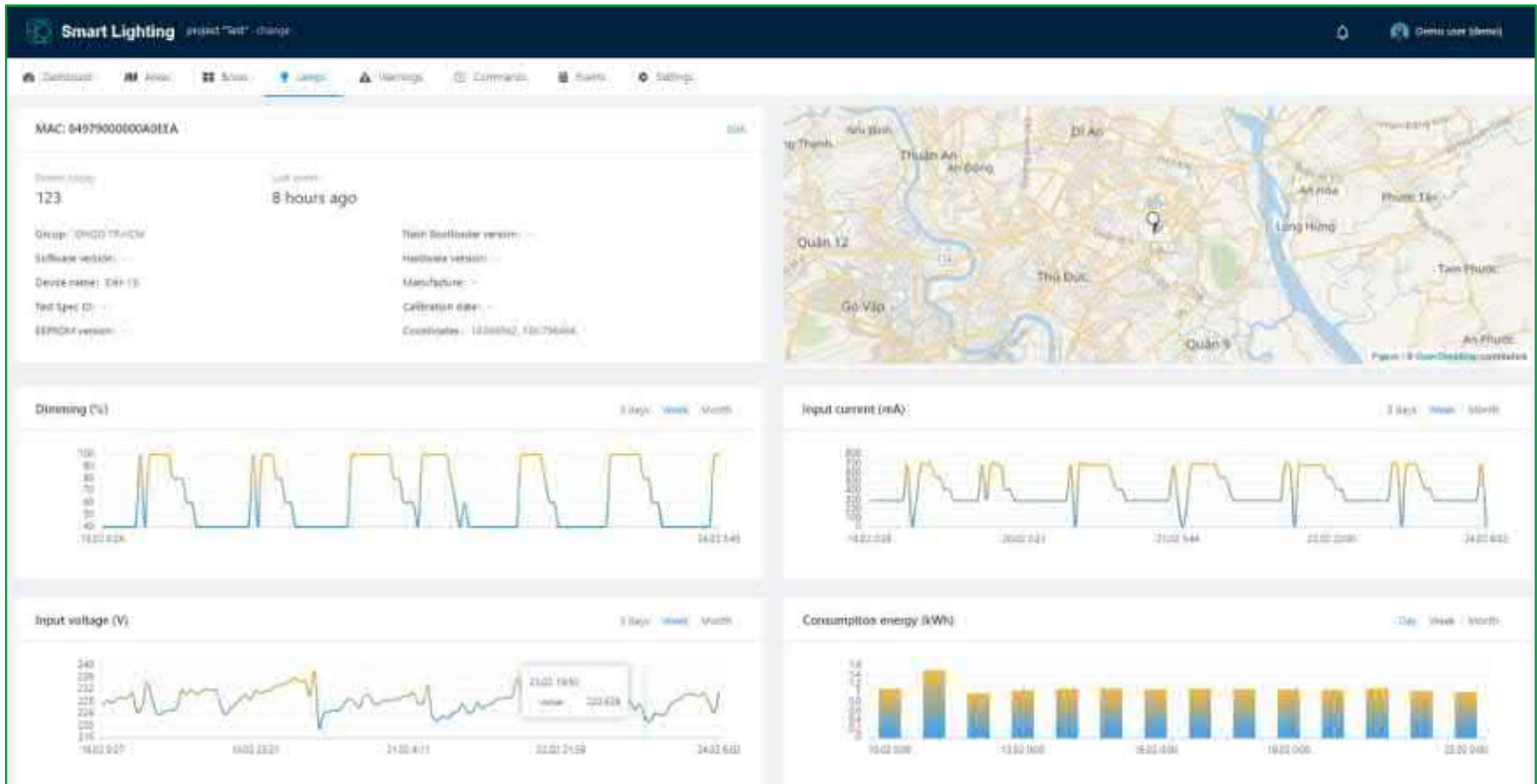
Send

Cancel



SMART STREET LIGHTING SYSTEM

DATA MANAGEMENT



SMART STREET LIGHTING SYSTEM

THE SMART LIGHTING SYSTEM AT HCMUT



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Thanks for your attention !

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