



Московский
инновационный
кластер



Development of prototypes of LED drivers with 95% efficiency

Polikarpov Vladimir Anatolievich
CEO of ITOCOR LLC



Company Profile



We are a leading developer of innovative solutions in the field of power electronics. The purpose of the activity is to make a profit through the production and sale of converter equipment, which has no analogues either in Russia or abroad, as well as through the licensing of patented innovative technologies in the domestic and international markets.

We own and manage an IP portfolio of 106 patents for invention with an estimated market value of over 1.2 billion rubles. Our innovative products are designed to regulation and conversion of electrical energy to the required levels and quality required for the maintenance and efficient operation of the electronic equipment.

The combination of unique experience, outstanding achievements and the high reputation of our innovative products is the key to our technological leadership and the key to success in today's competitive market for our customers around the world.

Project Summary



Product: A new generation LED driver with a power of 75-150 W made in Russia.

Problem the product solves: Key problems with standard LED drivers. Excessive heat generation – overheating of components and reduction of the service life of luminaires; Increased energy consumption is an increase in the operating costs of consumer companies for lighting. Millions of rubles are spent on "air heating" due to the low efficiency of power supplies; The load on the power grid is an additional risk for the stable operation of the infrastructure. Frequent routine maintenance is especially critical for hard-to-reach facilities (masts, overpasses), where the cost of replacing equipment is many times higher than the price of the luminaire itself. Limited reliability in extreme conditions – Standard drivers do not always provide stable operation in temperatures below -40 C or in areas with increased explosive hazards. The need for import substitution is 100% protection against sanctions and logistics risks.

Technical solution:

For the first time, a new generation of 75-150 W LED driver has been developed with an extended input voltage range of 187-264 V without the use of a rectifier bridge and expensive filters; has a single-stage architecture - consisting of a single energy conversion stage, 95% efficiency and an estimated service life of up to 100,000 hours - 2 times longer than analogues. We removed the rectifier bridge and ensured the transition from 4 stages of energy conversion for competitors to 1, increasing the efficiency from 88-91% to 95% - 6-7% higher than standard solutions from competitors without overheating the luminaire. We removed expensive filters and connected the LED driver directly to the network. Now, instead of expensive filters, network ripple reduction is provided by a unique built-in regulator that reduces output current ripples by up to < 1%, which is 2-4% lower than standard solutions from competitors. As a result, our LED driver contains fewer components than its Chinese counterparts, it is more energy efficient, safer and cheaper.

Technical and economic effect for the customer:

- 30-40% reduction in operating costs (OPEX)
 - Increase in investment efficiency (ROI).
 - Improving reliability and safety at vertically integrated oil companies.
 - Technological leadership and import substitution.
 - Guaranteed economic efficiency.



Problem



Due to the shortage of qualified developers, there is a problem in the domestic and international markets not only to perform high-quality reengineering of well-known solutions, but also to develop and produce new generation LED drivers, which would allow you to gain significant competitive advantages compared to competitors' analogues. For refineries, fields, oil depots and filling stations, the upgrade of lighting equipment becomes part of a systematic reduction in energy costs, improving safety and operational efficiency: here, the efficiency of the light circuit is primarily determined by the quality of power sources.

With the efficiency of the LED driver as it is now 88-91%, the remaining 9-12% of the energy is converted into heat inside lighting, overheating the LED matrix and increasing the risk of explosion hazard of the object.

1. The project solves the scientific and technical problems of LED drivers:

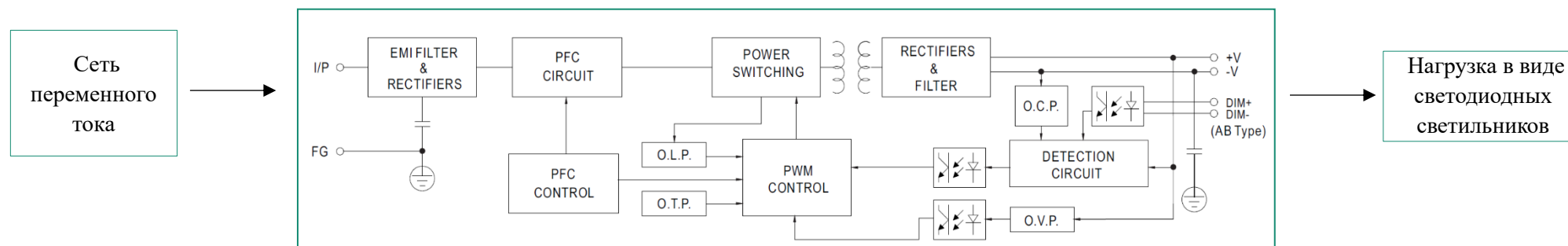
- Lack of a new power factor corrector for power supply of LED drivers;
- Lack of continuous and common-mode current generation, consumed from the input sinusoidal voltage;
- lack of stabilization of constant output voltage;
- large losses in energy conversion;
- excessive number of energy conversions,
- high ripples of the output current;
- Complexity of management;
- Increased productivity and reliability
- reduction in the size and weight of power supply sources.

2. The project solves the technical and economic problems of LED drivers:

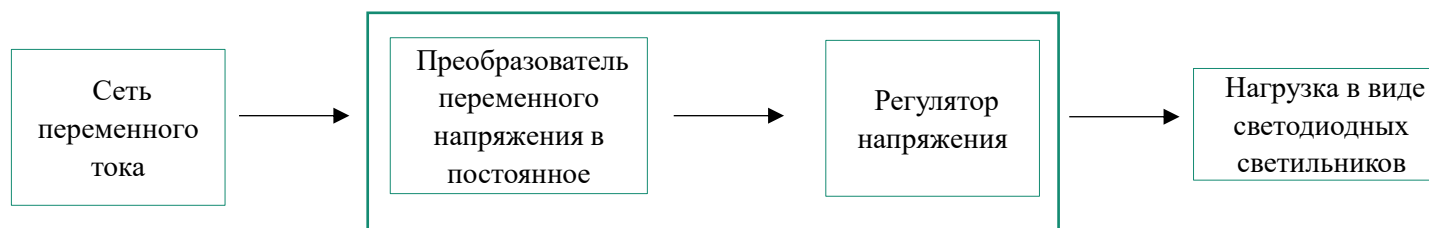
- import substitution of high-quality LED drivers for industrial and explosion-proof lighting of fuel and energy complex/oil and gas facilities;
- reducing the cost and improving the safety of lighting of transport infrastructure facilities; industrial, sports and scenic areas; streets and other objects of the urban environment;
- Reducing the risks of reengineering the failure of luminaires due to the creation of low-quality replicas that can quickly disable the LED luminaire.



Solution. Technology



Existing competitor solutions use one legacy LED driver structure, shown in the diagram above, which uses 4 stages of power conversion: Rectifier, Boost Regulator (Boost), DC-DC Converter with Galvanic Isolation, and Rectifier Diodes. As a result, at each stage of energy conversion, power losses occur, efficiency decreases, additional costs of regulation and control increase, the number of components used increases significantly and, as a result, the cost of production and commercialization.



Our solution is different in that it is the first to develop a (75-150) W LED driver without a rectifier bridge, with fewer power conversion steps than the competition (1 vs 4). As a result, with less power loss and higher efficiency (95% vs. 93%), fewer components, which makes operation easier and reduces the additional cost of adjusting and monitoring the device. As a result, the cost of production is lower than that of competitors. Unlike competitors, it uses a high-efficiency voltage converter of a new generation developed by us, connected directly to the network, in which the transformer performs not only its direct function of a transformer, but also a smoothing link in order to obtain smoothed AC common mode current with alternating voltage, and the task of reducing network 50 Hz ripples while ensuring high efficiency and low production cost. Instead of expensive rectifiers and filters as in analogues, the regulator developed by us solves the problem, which suppresses the ripples of the output current to a level of less than 3%, which not only does not exceed, but is significantly less than the performance of competitors. As a result, at a cost lower than that of competitors, the technical characteristics are better than those of competitors.

Project Readiness Level (TRL,MRL,CRL)



The LED driver modifications recommended for production have passed the stages of development and circuit modeling of R&D with the help of special software necessary to achieve the readiness levels of TRL4 technologies, MRL 5 production and commercialization of CRL 4 technologies and, at the time of presentation, are at the stage of preparation for the production of prototypes for verification under near-real conditions.

- According to the method of setting the electrical mode for LED modules, matrices using a driver, LED drivers are implemented in the following ways:
 - voltage stabilization,
 - Current stabilization.
- The Output Voltage Stabilized LED Driver has an internal structure consisting of the following parts:
AC voltage converter to unstabilized DC without the use of rectifier diodes and smoothing capacitive filter and regulator, while the feedback in the driver is voltage-based.
- The LED driver with output current stabilization has an internal structure consisting of the following parts:
AC-to-DC converter without the use of rectifier diodes and a smoothing capacitive filter and regulator, while the feedback in the driver is set by current.
- Both types of LED drivers will have:
 - auxiliary power supply source of the control circuit, which will ensure the operability of the control unit;
 - control unit that ensures the operability of the converter and regulator.
- The appearance of both types of LED drivers is either a metal rectangular case or a plastic one, which provides mounting holes for its installation in the equipment.
- The IP65 degree of protection against the ingress of dust, moisture and solid particles of both types of LED drivers is provided by filling the interior of the case with a pouring thermally conductive organosilicon compound.
- The output current of both types of LED drivers will be stabilized to a value of no more than 1400 mA, while the output voltage will be limited to 108V.
- Both types of LED drivers are powered from a 220V AC voltage network with a frequency of 50 Hz. The minimum input voltage of both types of LED drivers is 176V, the maximum value is 264V.

Competitive Analysis

Characteristics	Direct			
	Driver Aitokor Russia	Mean Well XLG-150 Taiwan	TRIDONIC Austria	INVENTRONICS EBC-150SxxxSVA China
Stabilization Type	Voltage and current	Voltage and current	Current	Current
Voltage range of the alternating current network, V	176-264	100-305	90-305	176 - 305
Mains frequency, Hz	47-63	47-63	50-60	47 - 63
Power factor, not less than	0.95	0.95	0.95	0,91
Efficiency, %	95	91	90	91
Output power, W	150	150	150	150
Current stabilization voltage range, V	16,8-24	16,8-24	16,8-24	24 -35
Output Current Ripple P-P at f< 200 Hz, %	<1	3	5	3
Number of components	2 times less			
Number of energy conversions	1	4	4	4
Price, RUB	3400	4000	5000	5000

Intellectual property of the project



Patents granted

Patent RF No2802914 AC to DC Voltage Converter A.G. Polikarpov, A.V. Polikarpov dated 02.02.2023.

Patent RF No2802595 Single-ended DC voltage converter A.G. Polikarpov, A.V. Polikarpov dated 02.02.2023.

Patent RF No2805046 Power Factor Corrector A.G. Polikarpov, A.V. Polikarpov dated 22.02.2023.

Patent RF No2806674 Power Factor Corrector A.G. Polikarpov, A.V. Polikarpov dated 03.04.2023.

Patent RF No2807665 Power Factor Corrector A.G. Polikarpov, A.V. Polikarpov dated 04.04.2023.

Patent RF No2806673 Power Factor Corrector with Constant Output Voltage Stabilization A.G. Polikarpov, A.V. Polikarpov dated 09/11/2023.

Patent RF No2817315 Magnetically coupled power factor corrector with constant output voltage stabilization A.G. Polikarpov, A.V. Polikarpov dated 09/14/2023.

Patent RF No2817329 Magnetically coupled power factor corrector with a passive clamping element and constant output voltage stabilization A.G. Polikarpov, A.V. Polikarpov dated 09/18/2023.



Patent RF No2827585 Magnetically coupled power factor corrector with a passive clamping element and an optimized DC output voltage stabilization unit A.G. Polikarpov, A.V. Polikarpov dated 08.04.2024.

Patent RF No2834007 Magnetically coupled power factor corrector with an optimized DC output voltage stabilization unit A.G. Polikarpov, A.V. Polikarpov dated 04/09/2024.

Patent RF No2840956 Symmetrical magnetically coupled power factor corrector with a passive clamping element and constant output voltage stabilization dated 12/20/2024

Patent RF No2841358 Symmetrical magnetically coupled power factor corrector with a passive compensating clamping element and an optimized DC output voltage stabilization unit dated 06.01.2025

Patent RF No2841357 Symmetrical magnetically coupled power factor corrector with a passive compensating clamping element and constant output voltage stabilization dated 01/20/2025

Further measures to enforce IP rights will focus on building a portfolio of rights that protects R&D of RIA in both domestic and international markets.

Technological and economic effects



95% efficiency - a world record and an estimated service life of up to 100,000 hours - 2 times longer than analogues

Lower heat generation, energy consumption and operating costs for lighting, as the efficiency is higher than competitors 95% versus 88-91%. Now 10-12% of the energy does not go inside the lamp and does not overheat the matrix.

A 2.5-fold reduction in heat generation is critical for explosive areas (classes 1 and 2) and significantly increases the safety of consumers of our products. Higher efficiency, lower explosion hazard at the facility.

Reducing energy consumption by 5-10% compared to analogues saves millions of rubles for consumers of our products. Greater efficiency difference, higher site savings.

Extended overhaul intervals reduce maintenance costs by 60% for our customers. Higher efficiency, less overheating and crystal degradation, longer service life.

Fewer power conversion steps – higher PFC power factor of the LED driver than competitors: $PF \geq 0.98$. Higher efficiency and power factor - lower load on the grid, which will allow the released additional capacity of the power grids of the facilities to be directed to other technological needs.

Fewer components mean higher reliability and significantly lower production costs, even in Russia, which reduces delivery times and logistics costs.

Команда проекта



Polikarpov Vladimir Anatolievich

CEO and Founder of Itocor

Senior manager (USA), lawyer, master and graduate students in the field of electronics and nanoelectronics), as well as in the field of power electronics (Russian Federation). 10 years of entrepreneurial experience in e-commerce and IP management. He is the author of 105 inventions and 5 international publications in the field of power electronics.



Polikarpov Anatoly Grigorievich

Deputy General Director for Research; Scientific supervisor of the project

Professor, Doctor of Technical Sciences in the field of power electronics. 50 years of experience in research, development and teaching in the field of power electronics. He is the author of more than 300 inventions and more than 60 publications. in this area. Outstanding member of the technical staff (DMTS) of AT&T Bell Labs (Lucent Technologies Power Systems, TYCO Electronics Power Systems), member of the Board of Directors - Director of Scientific Research of Vicor, Executor of government contracts in Rostec in the amount of 5 billion rubles. Scientific researcher and project manager.



Afanasyev Andrey Alexandrovich

Chief Designer

Engineer. Participates in the installation, testing, commissioning and start-up of new product designs. Submits for approval changes made to the technical documentation. 20 years of engineering experience in the positions of Electronics Engineer and Lead Electronics Engineer in the field of power electronics.

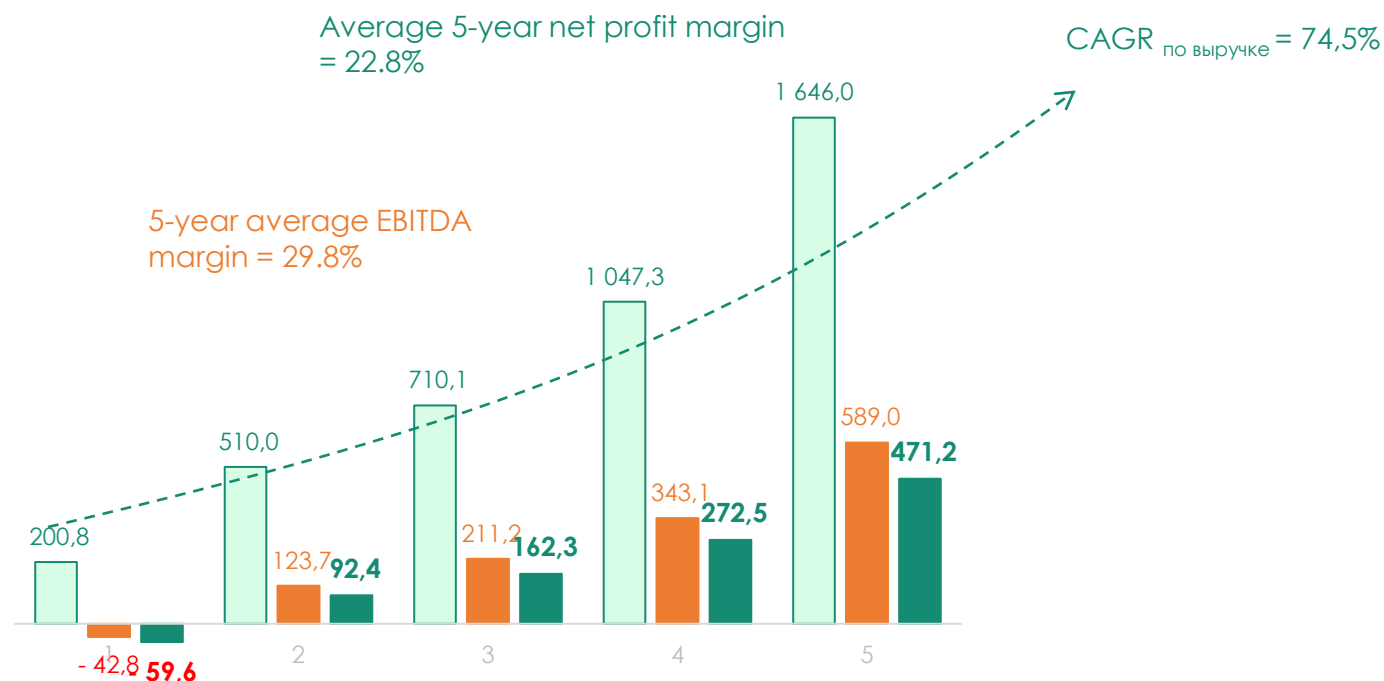


Business model and development plan

At this stage of development, our business model is a fabless company. A factoryless company is a company that develops innovative technologies and manages intellectual property by outsourcing the production of its equipment. We strive to transform it into a vertically integrated structure with full-cycle production in the Russian Federation.

Development forecast

в млн Р / годы	1	2	3	4	5	Σ
	2029 / 2030	2030 / 2031	2031 / 2032	2032 / 2033	2033 / 2034	
Revenue	200,8	510,0	710,1	1 047,3	1 646,0	4 114,1
EBITDA	-42,8	123,7	211,2	343,1	589,0	1 224,0
пер. EBITDA	-21,3%	24,3%	29,7%	32,8%	35,8%	29,8%
Net profit	-59,6	92,4	162,3	272,5	471,2	938,8
пер. ЧП	-29,7%	18,1%	22,9%	26,0%	28,6%	22,8%



Offer for customers



We propose to consider a strategic partnership for the implementation of R&D for specific facilities, the development and implementation of specialized series of LED drivers with a power of 75-150 W with an efficiency of 95% and their adaptation to the specifics of specific facilities.

Additional stage: pilot testing at facilities to confirm the declared characteristics and calculate the exact payback in real operating conditions.

Flexible collaboration models

Off-take contract (Take-or-Pay) with guaranteed redemption of products.

R&D agreement with an investment share.

Creation of a joint venture (JV) to control the technology.

Royalty License Agreement.

Contacts



Thank you for your attention!

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<http://i.moscow/company/50815980>



Itokor LLC

TIN 9702043040

OGRN 1227700281852

Annex 1. Russian market size



In physical terms:

In monetary terms (rubles):

Total market (thousand units)

1 250 000 units

Total market (RUB million)

5 billion rubles

Product-ready marketplace

1 125 000 units

Product-ready marketplace

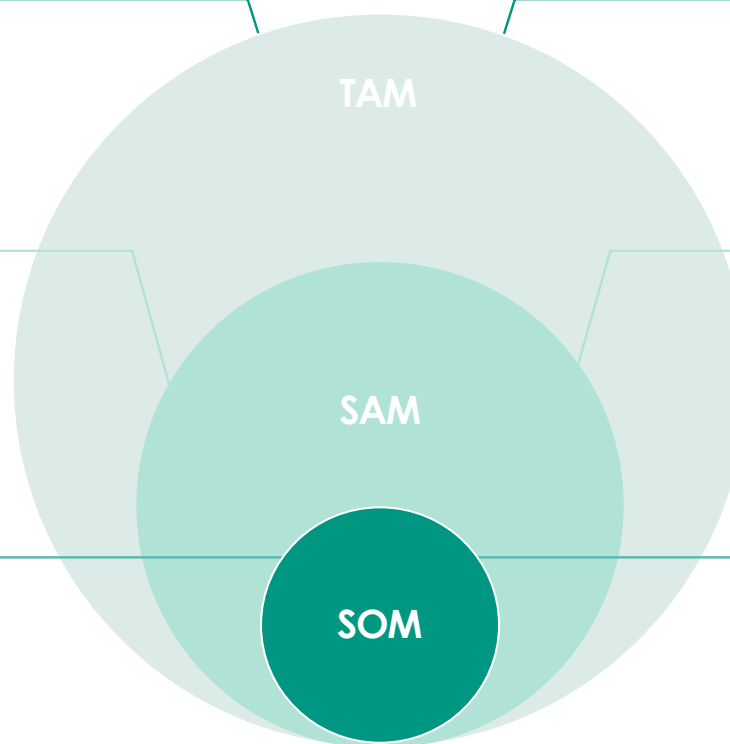
4.5 billion rubles

Target market

1 125 000 units

Target market

4 billion rubles.



Annex 2. Economic significance of the project

By project topic

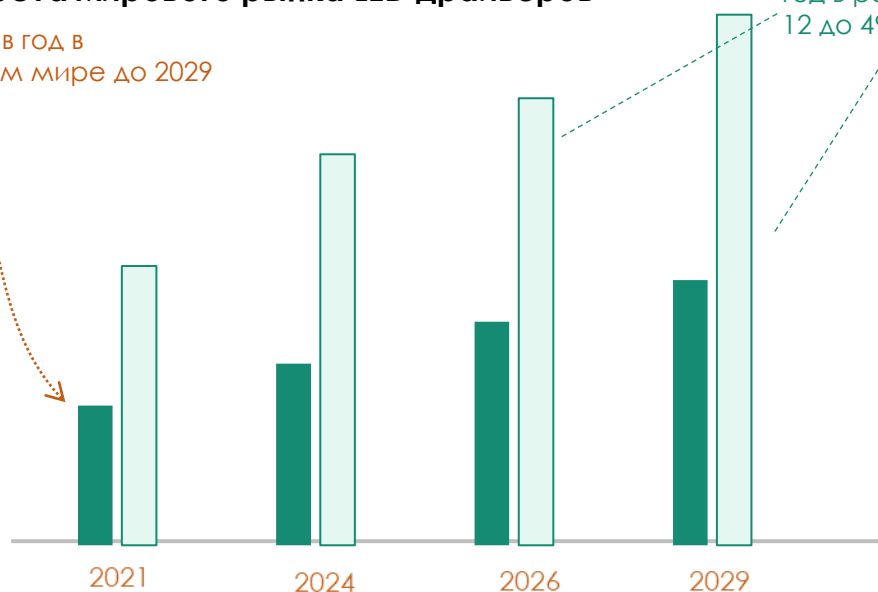
The target consumer segments (markets) of the created product in accordance with the subject of the project are:

- The Russian market of LED drivers, the volume of which is currently 5 billion rubles, and analysts' forecasts will continue to grow at a high rate of more than 25% per year over the next 5 years. Under the license agreement with MGK Lighting Technologies, we have developed and patented 5 high-performance voltage regulators and converters for effective import substitution of LED drivers.
- The global market of LED drivers, the total volume of which today is about 12 billion dollars. According to the forecasts of leading analytical agencies, it will continue to grow at a high rate of 45% per year and by 2029 will amount to \$49 billion. Compared to conventional lights, LED lights are environmentally friendly and save about 90% of total energy, which is a major growth driver.

Темпы роста мирового рынка LED драйверов

Рост 15% в год в
остальном мире до 2029

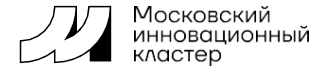
Рост темпом 45% в
год в регионе ATP с
12 до 49 млрд долл.



Объем рынка LED драйверов по регионам на 2021



Annex 3 Competitive Analysis



Differentiating from competitors

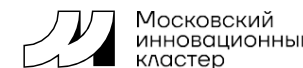
Our company competes with many large, diversified manufacturers of power supplies, as well as many small and specialized manufacturers focused on specialized products or narrowly defined market segments or geographical regions. The overall market, including those segments in which we compete, is characterized by rapid commoditization and intense price competition.

In the context of a shortage of electronic components due to the consequences of sanctions restrictions and the destruction of supply chains, our flexible and low-cost business model, combined with the innovative technologies we offer, the product and solution described on the slide, as well as the justification of the innovative nature of the project, provide significant competitive advantages in promoting our innovative products in the domestic and foreign markets, solve the problem of import substitution by creation of new promising developments instead of widely used imported samples and significant savings in electronic components used in our innovative technical solutions.

Although many competitors in these market segments have significantly greater financial and marketing resources, and longer market experience, we are confident that our competitive presence in the overall DC-DC and AC-DC segments will expand significantly as our portfolio of innovative products expands. We believe that an increasing number of our competitors, finding themselves involved in increasing competition, especially in conditions of scarce resources, trying to speed up the time to market for their new products, where they are expected to be able to produce newer generations of products in a shorter period of time, will move towards less costly and efficient solutions. As a result, due to the unique reputation and experience of our developers, as well as the uniqueness of our innovative products, it will be more profitable for them to become our partners by outsourcing the development to us or purchasing a license from us for a ready-made and cheaper innovative product, than to use outdated solutions or their own facilities for the development of new technologies that take significantly more time and money, to develop them independently without a guarantee of success, since often they simply do not have such competencies.

Annex 4

Competitors



In foreign markets

Texas Instruments (USA), Murata Manufacturing Co. Ltd. (Japan), General Electric (USA), Delta Electronics Inc. (Taiwan (China)), Vicor (USA), SynQor (USA), Infineon Technologies (Germany), Artesyn Technologies (USA) including the acquisition of Astec Power (USA), STMicroelectronics (Switzerland), TDK Corporation (TDK-Lambda) (Japan), ABB LTD (Switzerland) including the acquisition of Power-One Inc. (USA), Advanced Energy Industries, Inc. (USA), Astronics Corporation (USA), Crane Co. (USA), BEL Fuse Inc. (USA), Meggitt Plc (UK), FDK Corporation (Japan), Mean Well (Taiwan (China)), Inventronics (China), Tridonic (Austria), Signify (Netherlands), Cosel (Japan), Recom Power (Austria), STMicroelectronics (Switzerland), Power Mate Technology Co (P-DUKE Technology) (Taiwan (China)), Manson Engineering Industrial Limited (China), Sunpower Technology Corp. (Taiwan (China)), Powernet Oy (Finland), Deutronic Elektronik GmbH (Germany), Michael Riedel Transformatorenbau GmbH (Germany), Arch electronics Corp. (Taiwan (China)), AcBel Polytech (formerly API Technology) (Taiwan (China)), XP Power (Singapore), Sanken Electric (Japan), Analog Devices (USA), Omron (Japan), PULS Group (Germany), Lite-On Technology (Taiwan (China)), GAIA Converter (Canada), Acopian Technical Company (USA), ATNG Power Co.,Ltd. (China), Weidmuller (Germany), DELIXI Electric (China), AnHuiEcriee power (ECP) (China), China Electronics Technology Group Corporation (China), SIEMENS (Germany), Phoenix Contact (Germany), VPT Inc. (USA), Victor Power (USA), Traco Power (Switzerland), Total Power International, Inc. (USA), Sunny (Czech Republic), Alfatronix (UK), Aimtec (Canada), Absopulse Electronics Ltd. (Canada), Astrodyne TDI (USA), CHINFA Electronics (China), Bel Fuse Inc. (USA), CALEX Mfg. Co., Inc. (USA), SL Power Electronics (USA), Cincon Electronics (Taiwan (China)), FLEX (formerly Ericsson) Power Modules (Singapore-USA), Hightech (Changzhou) Electronic Co., Ltd (China), Inpotron (Germany), Integrated Power Design (USA), Interpoint (Crane Aerospace & Electronics) (USA), Mascot (Norway), PEAK Electronics (Germany) and others...

In domestic markets

"MMP-Irbis", Elim, NPP ElTom, Alexander Electric Power Supplies, NPO Energy Electronics (Aedon), Electroninvest Group, Transvit Group.

Annex 5

Social significance of the project



Designed on the basis of high-performance voltage regulators and converters for AC and DC networks, LED drivers should:

1) to contribute to reducing the cost and improving the quality of lighting of the urban environment, sports and other facilities illuminated by means of LED lighting equipment;

2) to ensure the environmental friendliness of lighting due to the stable performance of LED lighting equipment used in the urban environment, at sports and other facilities, and the exclusion of fluorescent lamps containing mercury from use;

3) to ensure the long service life and economy of the use of lighting equipment powered by the developed drivers, due to the absence of the need for its disposal, unlike fluorescent lamps;

4) Contribute to noise reduction in contrast to fluorescent lamps, which makes the developed drivers especially indispensable in applications with LED light sources in libraries, hospitals, educational institutions, offices, residential premises, etc.

5) to increase the comfort of lighting for human vision in the urban environment, at sports and other facilities due to a higher color rendering index of LEDs;

6) contribute to ensuring the safety of lighting in the urban environment, at sports and other facilities due to the fact that:

- LED lighting devices powered by the developed drivers are low-voltage equipment, that is, they have a high degree of electrical safety,
- the danger of overloading the power grids at the time of switching on the LED luminaires powered by the developed drivers is significantly reduced,
- LED luminaires powered by the developed drivers do not have the effect of low-frequency pulsations (stroboscopic effect), which can be observed in fluorescent and gas-discharge lamps,
- LED luminaires powered by the developed drivers do not create electromagnetic interference,
- Powered by the developed drivers, there is a relatively low power consumption and low heating, which provides a high degree of fire safety.

7) provide mobility of control of LED luminaires powered by drivers under development, including using smartphones.

8) to provide the most important thing - the positive emotions that are so necessary for every ordinary citizen of our country, available with the help of the possibility of obtaining different colors and shades of radiation powered by the developed drivers of LEDs in the urban environment and at various facilities.

Приложение 6

The company's reputation as a technology leader in the industry



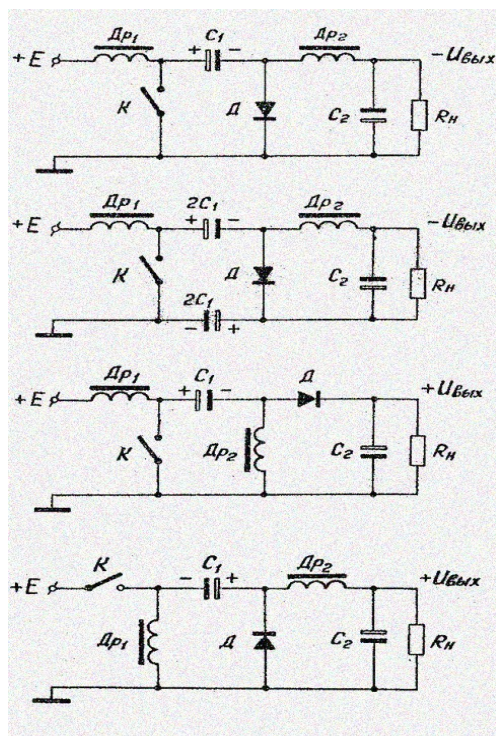
Professor, Doctor of Technical Sciences Polikarpov A.G. is widely known all over the world as the inventor of the "Single-ended DC Voltage Converter" Patent (AS USSR) No 892614 dated 11.04.1980 and other patents on his basis with the development of this technology. This surge arrester, better known as the Active Clamp Converter, is by far the most sought-after and most efficient converter in the world. Professor, Doctor of Technical Sciences Polikarpov A.G. was the first in whose publications for the first time in the world to give descriptions and analysis of IC topologies, which later became known in the USA and around the world as the Chuk, Sepic, Zetta converter. In the former USSR, they were published in the article of the MPEI (Power and Information Electronics) proceedings No275 in 1975 under the title "Switching DC Voltage Regulators for Secondary Power Supplies".

Professor, Doctor of Technical Sciences Polikarpov A.G. is not just a leading specialist in the world in the field of power electronics, he is actually the creator of modern power electronics. Since 1975, he has been the author of all progressive solutions in this field without exception. Thanks to his inventions, over the past forty-45 years there has been a technological revolution in the field of high technology and today, in connection with the development of fully controllable devices, power electronics already covers almost all spheres of human life: equipment for the control of the fuel and energy complex, industrial equipment and equipment for the control of the production process, medical and transport equipment, communication and data processing equipment, auto-test equipment and equipment for testing semiconductor devices, network equipment and power grid maintenance equipment, aerospace and military equipment, consumer electronics, etc.

Annex 7

Advantages in the target market

Polikarpov regulators

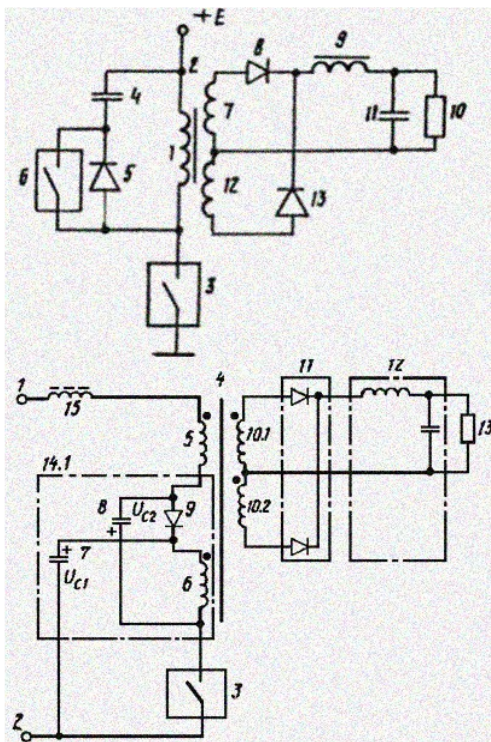


By the early 70s of the 20th century, three main schemes of switching DC voltage regulators were known: step-down regulator (buck), step-up regulator (boost) and inverting regulator (buck-boost), which made up the first generation of switching DC voltage regulators. In 1970, Professor, Doctor of Technical Sciences A.G. Polikarpov invented and published a new - universal pulsed DC voltage regulator of the second generation, eliminating the non-delivery of all the above types of regulators. More efficient and cost-effective, the second-generation Polikarpov Regulator combines the advantages of all three of the above and previously known types of switching DC voltage regulators, simultaneously allowing to obtain high efficiency, small weight and dimensions, small output voltage ripples, a wide range of output voltage level regulation, continuous current consumption from the input voltage source, electrical isolation between the input and output voltage voltage, as well as other advantages. From that moment to the present day, Professor, Doctor of Technical Sciences Polikarpov A.G. has been a leader in innovations in the field of switching DC voltage regulators.

Today, our company offers numerous and superior technological solutions in the field of switching DC voltage regulators. Our products can be classified as pulse Polikarpov regulators of the third and fourth generation, which have significantly better technical and economic characteristics compared to the known ones.

Annex 8

Advantages in the target market of Polikarpov transducers



By the mid-70s of the 20th century, two types of single-ended DC-DC converters were known: straight-stroke surge arresters, so called because the transfer of energy from the primary circuit to the load was carried out with the help of a single power switch at the stage of the closed state of the power switch, i.e. in a single-ended mode at the stage of direct movement, and reverse surge arresters, so called because, that the transfer of energy from the primary circuit to the load was also carried out with the help of a single power switch, but at the stage of the open state of the power switch, i.e. also in a single-ended mode, but at the stage of reverse. In 1978, Professor, Doctor of Technical Sciences A.G. Polikarpov invented and on April 11, 1980 patented a new - universal type of OPN, a single-ended converter of the second generation. More efficient and cost-effective, the second-generation single-ended Polikarpov converter combined the advantages of all previously known types of well-known types of conduits, both single-ended and push-pull, and for the first time, being a single-ended converter in terms of the number of power switches, acquired the ability to work like a push-pull converter of constant voltage into direct voltage, i.e. it ensured the transfer of energy to the load on both strokes, but only with the help of one power switch. From that moment to the present day, Professor, Doctor of Technical Sciences Polikarpov A.G. has been a leader in innovations in the field of DC voltage converters.

To date, our company offers numerous and superior innovative products that can be classified as Polikarpov transducers of the third and fourth generation, and have significantly better technical and economic characteristics compared to the known ones.

Annex 9

Scientific component of the project



Documents of protection

USSR Author's Certificate No1598073 DC Pulse Voltage Regulator
A.G. Polikarpov, E.F. Sergienko with priority dated 05.12.1988 .

US Patent US 6,282,109 B1 Controller for non-isolated power factor
corrector and method of operating the power factor corrector
A.G. Polikarpov, S. Fraidlin dated 28.08.2001.

USSR Author's Certificate No892614 Single-Ended DC Voltage
Converter A.G. Polikarpov A.G., E.F. Sergienko E.F. from 11.04.1980.

USSR Author's Certificate No1628164 Single-Ended Voltage
Converter A.G. Polikarpov, E.F. Sergienko E.F., A.N. Frolov dated
06.20.1988.

Patent RF No2807665 Power Factor Corrector A.G. Polikarpov, A.V.
Polikarpov dated 04.04.2023.

USSR Author's Certificate No1003067 Single-Ended DC Voltage
Regulator A.G. Polikarpov A.G., E.F. Sergienko E.F. dated 04.01.1981



Publications

1. Single-ended converters in power supply devices of the REA
A.G. Polikarpov, E.F. Sergienko, "Radio and Communication",
1989, p.47 fig.2.1.
2. Pulse Voltage Regulators and Stabilizers A.G. Polikarpov, E.F.
Sergienko. MPEI, "Trudy MPEI", 1983.
3. Pulsed DC Voltage Regulators for Secondary Power Supply
Sources, Polikarpov A.G. "Trudy MPEI", 1975.



Annex 10

Sources of financing and material and technical base

- Foundation-M Grant
- Grants of the Foundation-MIC
- Licensing revenue
- R&D Equipment



Annex 11

Innovative technical solutions



ITOCOR offers innovative solutions for building highly efficient power supplies that surpass the world's best analogues in terms of their technical and economic characteristics.

The power supplies of the proposed types are designed for high-efficiency power supply of the following electronic equipment:

- LED lighting equipment
- Equipment for managing the fuel and energy complex;
- industrial equipment;
- Equipment for monitoring the production process;
- medical equipment;
- transport equipment designed for modern railway infrastructure and electric vehicle infrastructure;
- communication and data processing equipment;
- Automatic diagnostic and control tools;
- Equipment for testing semiconductor devices;
- network equipment;
- equipment for maintenance of the power grid;
- robotics;
- aerospace engineering (airplanes, helicopters, UAVs, satellites, missiles) and dual-use;
- computer equipment for various purposes, and especially microprocessors;
- consumer electronics, etc.

Annex 12

Intellectual Property



Granted patents for inventions

1. Patent for invention RF No 2802914 AC to DC voltage converter 02.02.23
2. Patent for invention RF No 2802595 Single-ended DC voltage converter 02.02.23
3. Patent for invention RF No 2805046 Power factor corrector 22.02.23
4. Patent for invention RF No 2806668 DC voltage converter with active clamping 12.04.23
5. Patent for invention RF No 2806673 Power factor corrector with constant output voltage stabilization 11.09.23
6. Patent for invention RF No 2806674 Power factor corrector 03.04.23
7. Patent for invention RF No 2807665 Power factor corrector 04.04.23
8. Patent for invention RF No 2809335 Low-voltage DC voltage converter with active clamping 11.05.23
9. Patent for invention RF No 2809337 DC voltage converter with active clamping 10.04.23
10. Patent for invention RF No 2809839 Low-voltage semi-bridge DC voltage converter 13.05.23
11. Patent for invention RF No 2812961 Reverse Pass DC Voltage Converter with Active Clamping 11.08.23
12. Patent for invention RF No 2812962 Bipolar DC voltage regulator 09.10.23
13. Patent for invention RF No 2815073 Bipolar DC voltage regulator 02.10.23
14. Patent for invention RF No 2815076 Switching DC regulator of step-up type 28.10.23
15. Patent for invention RF No 2815071 Wide-range DC voltage regulator 15.10.23
- Patent for invention RF No 2815075 High-efficiency switching DC voltage regulator of step-up type 21.10.23
17. Patent for invention RF No 2815910 Step-up type DC voltage regulator 01.11.23
18. Patent for invention RF No 2817315 Magnetically coupled power factor corrector with constant output voltage stabilization 14.09.23
19. Patent for invention RF No 2817329 Magnetically coupled power factor corrector with a passive clamping element and constant output voltage stabilization 18.09.23
20. Patent for invention RF No 2818293 Push-pull DC voltage converter 02.01.24
21. Patent for invention RF No 2818294 Push-pull DC voltage converter by doubling current 04.01.24

Annex 13

Intellectual Property



Granted patents for inventions

- 22. Patent for invention RF No 2818295 Quasi-two-stroke single-stroke DC voltage converter 15.01.24
- 23. Patent for invention RF No 2815911 High-efficiency DC voltage converter with active clamping 11.08.23
- 24. Patent for invention RF No 2822282 Transformer DC voltage fly-back converter with active clamping 19.02.24
- 25. Patent for invention RF No 2822283 Transformer wide-range DC voltage return converter with passive clamping 20.02.24
- 26. Patent for invention RF No 2823793 Straight-way DC voltage converter with energy transmission in pause 08.03.24
- 27. Patent for invention RF No 2823794 Straight-stroke DC voltage converter with pulse energy transmission 08.03.24
- 28. Patent for invention RF No 2823795 Transformer wide-range DC voltage fly-back converter with active clamping 19.02.24
- 29. Patent for invention RF No 2823796 Transformer DC voltage flyback converter with passive clamping 20.02.24
- 30. Patent for invention RF No 2825888 Single-ended DC voltage converter with direct and reverse transmission of energy to load 11.03.24
- 31. Patent for invention RF No 2825889 Single-ended DC voltage converter with reverse transmission of energy to load 17.03.24
- 32. Patent for invention RF No 2826681 Magnetically coupled single-ended DC voltage converter 31.03.24
- 33. Patent for invention RF No 2826684 Magnetically coupled single-ended DC voltage converter with voltage doubling on load 26.03.24
- 34. Patent for invention RF No 2826686 Magnetically coupled single-ended DC voltage converter with voltage multiplication on load 26.03.24
- 35. Patent for invention RF No 2826687 Single-ended DC voltage converter with direct transmission of energy to load 17.03.24

Annex 14

Intellectual Property



Granted patents for inventions

36. Patent for invention RF No 2827585 Magnetically coupled power factor corrector with a passive clamping element and an optimized DC output voltage stabilization unit 08.04.24
37. Patent for invention RF No 2829317 Low-voltage DC voltage converter with active clamping 21.05.24
38. Patent for invention RF No 2830651 Single-ended DC voltage converter with pulse energy transmission 24.12.23
39. Patent for invention RF No 2830652 Low-voltage semi-bridge converter of constant voltage 22.05.24
40. Patent for invention RF No 2833063 DC voltage converter with active clamping 07.07.24
41. Patent for invention RF No 2833064 Magnetically coupled DC voltage converter with active clamping 07.07.24
42. Patent for invention RF No 2833626 DC voltage converter with active clamping 13.07.24
43. Patent for invention RF No 2833627 Power factor corrector with optimized DC output voltage stabilization unit 31.07.24
44. Patent for invention RF No 2834005 Magnetically coupled DC regulator of step-up type 22.08.24
45. Patent for invention RF No 2834007 Magnetically coupled power factor corrector with an optimized DC output voltage stabilization unit 09.04.24
46. Patent for invention RF No 2835157 Step-up type DC voltage regulator 09.08.24
47. Patent for invention RF No 2835158 Magnetically coupled DC voltage regulator of step-down type 17.08.24
- Patent for invention RF No 2835159 Step-up type DC voltage regulator 30.08.24
49. Patent for invention RF No 2835160 Step-down type DC voltage regulator 14.08.24
50. Patent for invention RF No 2835572 Step-up type DC voltage regulator 12.08.24
51. Patent for invention RF No 2835573 Magnetically coupled DC voltage regulator of step-down type 16.08.24
52. Patent for invention RF No 2835574 Magnetically coupled DC regulator of step-down type 19.08.24
53. Patent for invention RF No 2835575 Magnetically coupled DC voltage converter with active clamping 03.09.24
54. Patent for invention RF No 2836034 Single-ended DC voltage converter 18.09.24

Annex 15

Intellectual Property



Granted patents for inventions

- 55. Patent for invention RF No 2836035 Magnetically coupled non-regulated single-ended DC voltage converter 27.09.24
- 56. Patent for invention RF No 2836036 Magnetically coupled non-regulated single-ended DC voltage converter with active clamping 29.09.24
- 57. Patent for invention RF No 2836037 Straight-stroke single-stroke DC voltage converter with adjustable input voltage 04.10.24
- 58. Patent for invention RF No 2836853 Magnetically coupled DC regulator of step-up type 26.08.24
- 59. Patent for invention RF No 2837260 Straight-stroke single-stroke DC voltage converter with adjustable input voltage 04.10.24
- 60. Patent for invention RF No 2838635 DC voltage converter with active clamping 23.05.24
- 61. Patent for invention RF No 2840956 Symmetrical magnetically coupled power factor corrector with a passive clamping element and constant output voltage stabilization 20.12.24
- 62. Patent for invention RF No 2841357 Symmetrical magnetically coupled power factor corrector with a passive compensating clamping element and constant output voltage stabilization 20.01.25
- 63. Patent for invention RF No 2841358 Symmetrical magnetically coupled power factor corrector with a passive compensating clamping element and an optimized DC output voltage stabilization unit 20.01.25

Annex 16

Intellectual Property



Granted patents for inventions

64. Patent for invention RF No 2841989 Symmetrical magnetically coupled power factor corrector with a passive doubled compensating clamping element and an optimized DC output voltage stabilization unit 22.01.25
65. Patent for invention RF No 2841990 Symmetrical magnetically coupled power factor corrector with a passive doubled compensating clamping element and constant output voltage stabilization 24.01.25
66. Patent for invention RF No 2842692 Step-down regulator of constant voltage 04.12.24
67. Patent for invention RF No 2843335 Symmetrical magnetically coupled power factor corrector with a passive clamping element and an optimized DC output voltage stabilization unit 06.01.25
68. Patent for invention RF No 2843336 Push-pull symmetrical magnetically coupled power factor corrector with a passive clamping element and an optimized unit for double stabilization of constant output voltage 18.02.25
69. Patent for invention RF No 2843337 Push-pull symmetrical magnetically coupled power factor corrector with a passive clamping element, single-phase two-half-cycle rectification and constant output voltage stabilization 21.02.25
70. Patent for invention RF No 2843338 Push-pull symmetrical magnetically coupled power factor corrector with a passive clamping element and double DC output voltage stabilization 18.02.25
71. Patent for invention RF No 2844141 Push-pull symmetrical magnetically coupled power factor corrector with a passive clamping element and constant output voltage stabilization 03.02.2025
72. Patent for invention RF No 2844142 Push-pull symmetrical magnetically coupled K.K.M. with a passive clamping element, single-phase two-half-cycle rectification and double DC output voltage stabilization 02.03.2025
73. Patent for invention RF No 2846898 Push-pull symmetrical M.K.K.M. with a passive clamping element, single-phase two-half-cycle rectification and an optimized DC output voltage stabilization unit 02.03.2025
74. Patent for invention RF No 2846899 Push-pull DC voltage converter 12.03.2025
75. Patent for invention RF No 2846900 Push-pull non-regulated DC voltage converter 19.03.2025

Annex 17

Intellectual Property



Granted patents for inventions

- 76. Patent for invention RF No 2847148 Magnetically coupled push-pull converter of constant voltage 14.04.25
- 77. Patent for invention RF No 2850522 Wide-range magnetically coupled push-pull converter of constant voltage 13.05.25
- 78. Patent for invention RF No 2849998 Step-down regulator of constant voltage of increased efficiency and power 01.06.25
- 79. Patent for invention RF No 2852757 Step-up regulator of DC voltage of increased efficiency 13.06.25
- 80. Patent for invention RF No 2853177 DC voltage converter with high-voltage output voltage and low-voltage active clamping 06.07.25
- 81. Patent for invention RF No 2852752 DC voltage converter with high-voltage output voltage, load current separation and low-voltage active clamping 08.07.25
- 82. Patent for invention RF No 2853725 DC voltage converter with Low Voltage Active Clamping 30.06.25
- 83. Patent for invention RF No 2853690 DC voltage converter with extended control range with low-voltage active clamping 13.07.25
- 84. Patent for invention RF No 2853179 DC voltage converter with low-voltage active clamping of increased efficiency 15.07.25
- 85. Patent for invention RF No 2853724 DC voltage converter with low-voltage active clamping with one magnetic component 18.07.25
- 86. Patent for invention RF No 2853726 DC voltage converter with active clamping with an extended control range 31.07.25
- 87. Patent for invention RF No 2853754 DC voltage converter with active clamping with an extended control range of increased efficiency 31.07.25
- 88. Patent for invention RF No 2856015 Single-ended DC converter Voltages with passive clamping 03.09.25
- 89. Patent for invention RF No 2856020 Straight-stroke single-ended converter DC voltage with passive clamping 03.09.25

Annex 18

Intellectual Property



Granted patents for inventions

- 90. Patent for invention RF No 2856021 Reversible single-ended DC voltage converter with passive clamping 03.09.25
- 91. Patent for invention RF No 2856022 Direct-reverse single-stroke DC voltage converter with passive clamping 03.09.25
- 92. Patent for invention RF No 2853670 DC voltage converter with Low-Voltage Active Clamping 12.07.25
- 93. Patent for invention RF No 2856027 Complex single-ended converter DC voltage with passive clamping 03.09.25
- 94. Patent for invention RF No 2856024 Single-ended DC voltage converter with active clamping of subtraction type 09.09.25
- 95. Patent for invention RF No 2856026 Straight-stroke single-ended converter DC voltage with active subtraction type clamping 09.09.25
- 96. Patent for invention RF No 2856028 Reversible single-stroke DC voltage converter of subtraction type 09.02.2026
- 97. Patent for invention RF No 2857798 Direct-reverse single-ended DC voltage converter with active clamping of subtraction type 11.04.26
- 98. Patent for invention RF No 2857799 Complex single-ended converter DC voltage with active subtraction type clamping 11.04.26

Annex 19

Intellectual Property



PCT Applications

- PCTRU2024000027 (USA, India, China)
- PCTRU2024000028(USA, India, China)
 - PCTRU2024000123
- PCTRU2024000124 (USA, India, China)
 - PCTRU2024000156
 - PCTRU2024000157
 - PCTRU2024000284
 - PCTRU2024000285



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