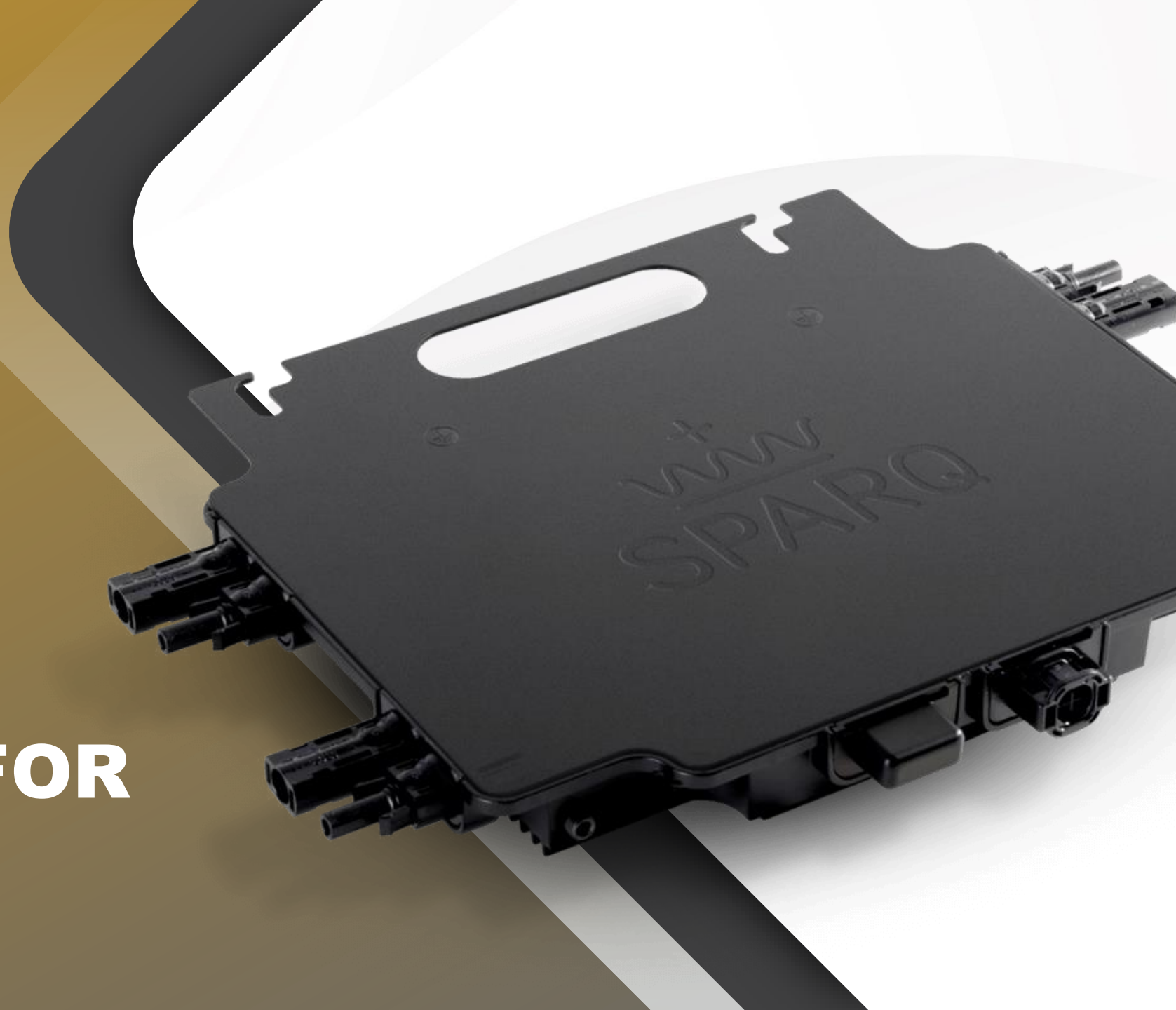
SPARQ



WHY SPARQ FOR INSTALLERS?

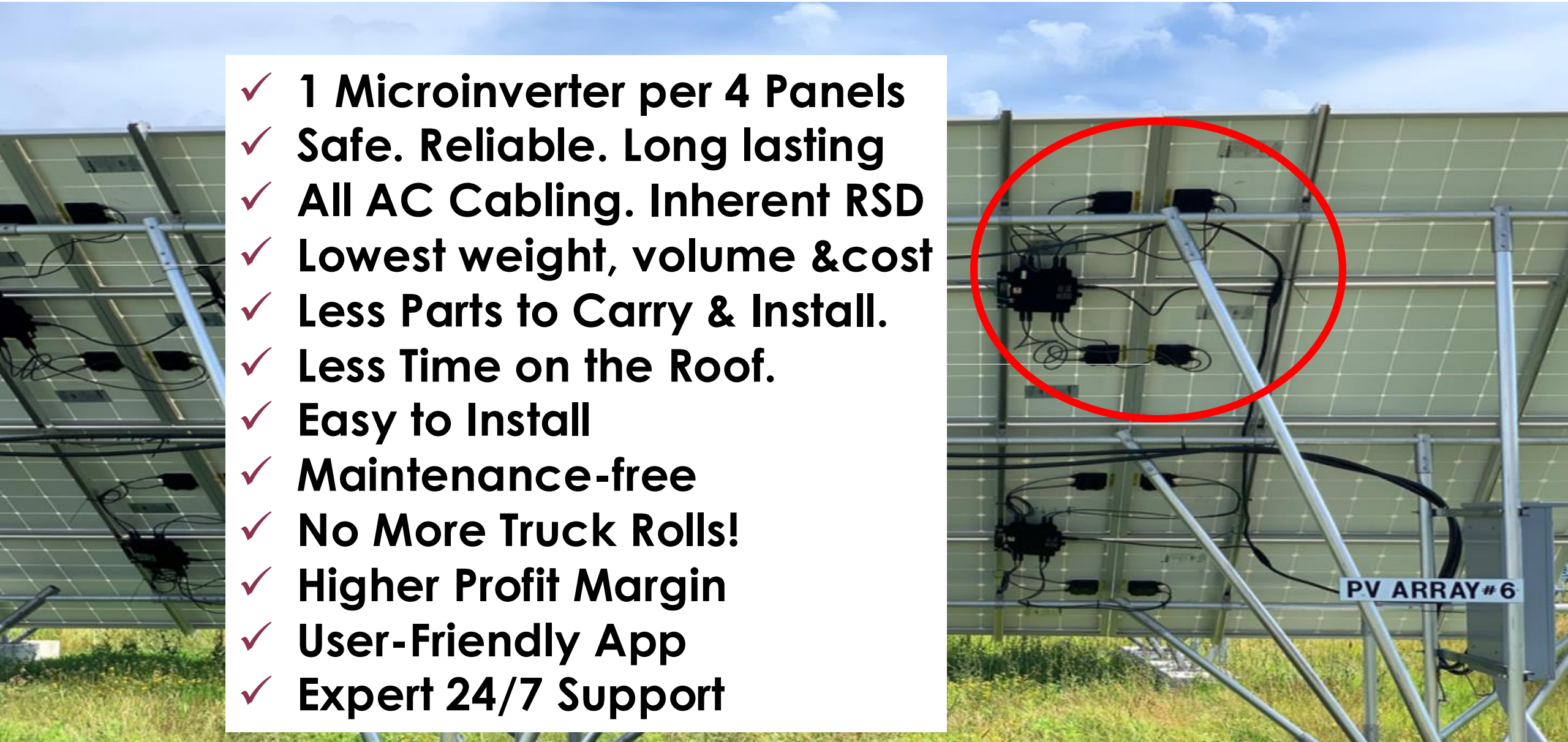
OVERVIEW

- Why Sparq Systems To Serve You And Your Customers?
- How Sparq Resolves Longstanding Limitations of Leading Brands?

WHY SPARQ SYSTEMS TO SERVE YOU AND YOUR CUSTOMERS?

SPARQ

1. SPARQ QUAD ARCHITECTURE ADVANTAGE!



- ✓ 1 Microinverter per 4 Panels
- ✓ Safe. Reliable. Long lasting
- ✓ All AC Cabling. Inherent RSD
- ✓ Lowest weight, volume &cost
- ✓ Less Parts to Carry & Install.
- ✓ Less Time on the Roof.
- ✓ Easy to Install
- ✓ Maintenance-free
- ✓ No More Truck Rolls!
- ✓ Higher Profit Margin
- ✓ User-Friendly App
- ✓ Expert 24/7 Support

2. WE SHARE THE SAME **PASSION**

Affordable, Sustainable and Clean Energy For All

1. Photovoltaic energy revolution
2. Safe, accessible, affordable and sustainable energy for all
3. Clean energy, clean air, clean water and clean jobs
4. Grid-independence and energy self-sufficiency
5. Environment stewardship
6. Prevent global warming
7. Improve standard of living through grid-resilient, distributed energy
8. Improve energy efficiency and reduce cost of electricity

Provide Best-in-Class PV Energy Products

3. YOUR SUCCESS IS OUR MAIN PURPOSE

Our Main Purpose: Satisfied PV Energy Customers.

Mission:

Accelerate transition to affordable, self-sufficient PV Energy

Vision:

Become #1 leader for Microinverters, battery storage and energy management in PV industry.

Value:

Deliver safe, reliable, and cost-effective solutions that are best-in-class, easy to install, and maintenance-free.

Exceed User-Experience and Quality Expectations.

4. BEST-IN-CLASS PRODUCTS AND SERVICES

Leading-Edge Microinverters, Battery Storage & Power Management

1. Safe, Highly Reliable and No System Single-Point-Failures
2. No Electrolytic Capacitor, No Low-Reliability Parts
3. Best-in-Class Longevity
4. Highest Specific Power and Power Density
5. Maximum Energy Harvesting
6. Dual-Mode Operation, Grid-Resilient and
7. Remote Monitoring and S/W Update
8. Reduced Manufacturing BOM and Lowest Life-cycle Cost
9. Cost-effective To Manufacture, Easy To Install and Maintenance-free

Standard 12 Year Warranty, Extendable to 25 Years.

5. EXPERT PEOPLE AND SUPPORT

Innovative Products and Leading Experts Recognized by PV Industry

➢ World-Renowned Power Electronics Experts

- Multiple technology firsts commercialized for various industries
- Advanced science and technology of PV Systems for benefit of society
- Trained and educated thousands of engineers and graduate students
- Check “Meet the Team” for bio summaries and details

➢ Prestigious Industry Recognitions

- Received Frost & Sullivan’s 2017 ‘New Product Innovation Award’
- Included in TSX Venture 50 list in Clean Technology and Renewable Energy, underscoring strength of strategy and excellence in execution

Check Our Awards and Online Learning & Training

6. DISRUPTIVE INNOVATIVE PRODUCTS

Patents: 65 Granted, 10 Pending and 12 In-preparation

- **Increasing reliability and reducing overall weight, volume and cost:**
  - Eliminated low reliability electrolytic capacitors
  - Integrated four DC-DC having individual MPPT, one HV DC energy combiner and one DC-AC converter, all in one easy to install enclosure
  - Eliminated three DC-AC inverters. One shared FPGA for all controls
  - Reduced BOM cost by more than 25% and installation cost by 70%
  - Simpler logistics, less cabling, and fewer failure points
  - Reliable and user-friendly web and mobile remote monitoring & control

One Microinverter per Four Panels=Less Time on the Roof!

7. LONG-TERM STRATEGIC PARTNERSHIPS

Key Partnerships for R&D, Manufacturing and Distribution.

- **Centre for Energy and Power Electronics Research (ePOWER)**
  - Academic and industrial collaborate at Queen's University
  - Develop innovative, efficient, cost effective and environmentally friendly power electronic solutions for renewable energy.
- **Jio Things and Reliance**
  - Enables large-scale manufacturing of microinverters
  - Leverages scale, technology-leadership and software-centric design of partners to create cutting-edge use cases
  - Tremendous endorsement of Sparq's leading Energy Products

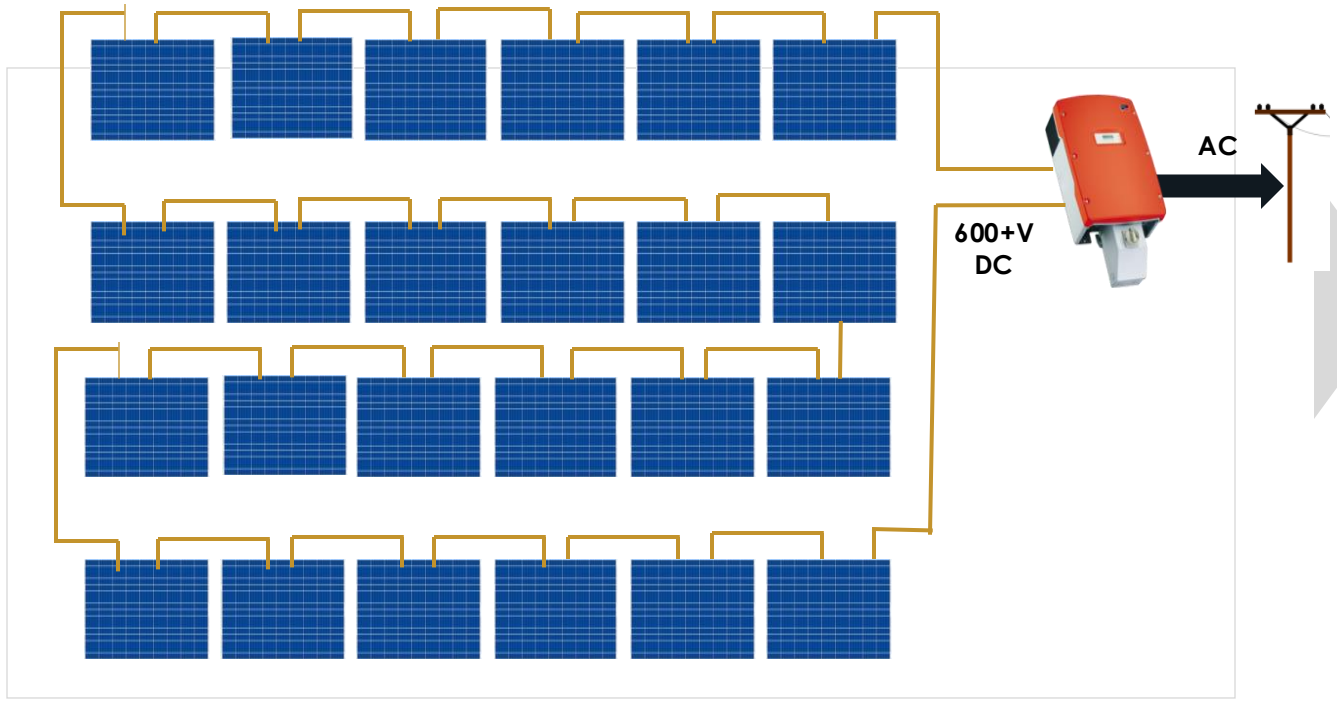
Sparq Selected After Extensive Market Assessment

HOW SPARQ RESOLVES LONGSTANDING LIMITATIONS OF LEADING BRANDS?

SPARQ

TRADITIONAL STRING INVERTERS

Traditional String Inverter: Many Panels In Series and One Central DC-AC Inverter



Multiple series Panels + One HV Central Inverter → **Cheap, But…**

Reliability

- Design life of 10 years → requires replacement
- Single point of failure

Productivity

- Module mismatch, shading, soiling, "Christmas light" effect

Design & installation

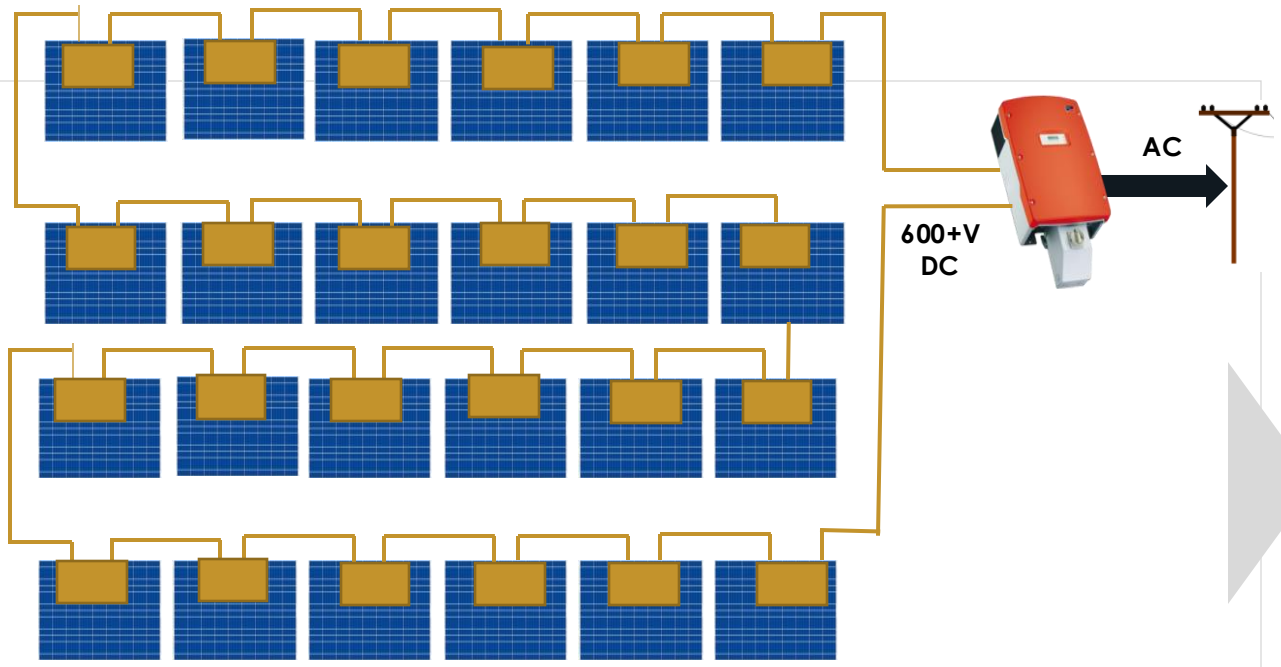
- Requires specialized design and installation
- Requires expensive Balance of System

Safety

- High voltage (600V+) arc faults → leading cause of fires of PV installations
- Always live; no module level disconnect/shut-off

MANY OPTIMIZERS + STRING INVERTER

SolarEdge: One Optimizer/Panel + Many Panels In Series + HV DC-AC Inverter



Reliability

- Design life of 12 years → requires costly replacement
- Single point of failure

Productivity

- 5-20% more energy as a result of individual Maximum Power Point Tracking (MPPT)

Design & installation

- String sizing required – difficult to design, install, maintain and repair

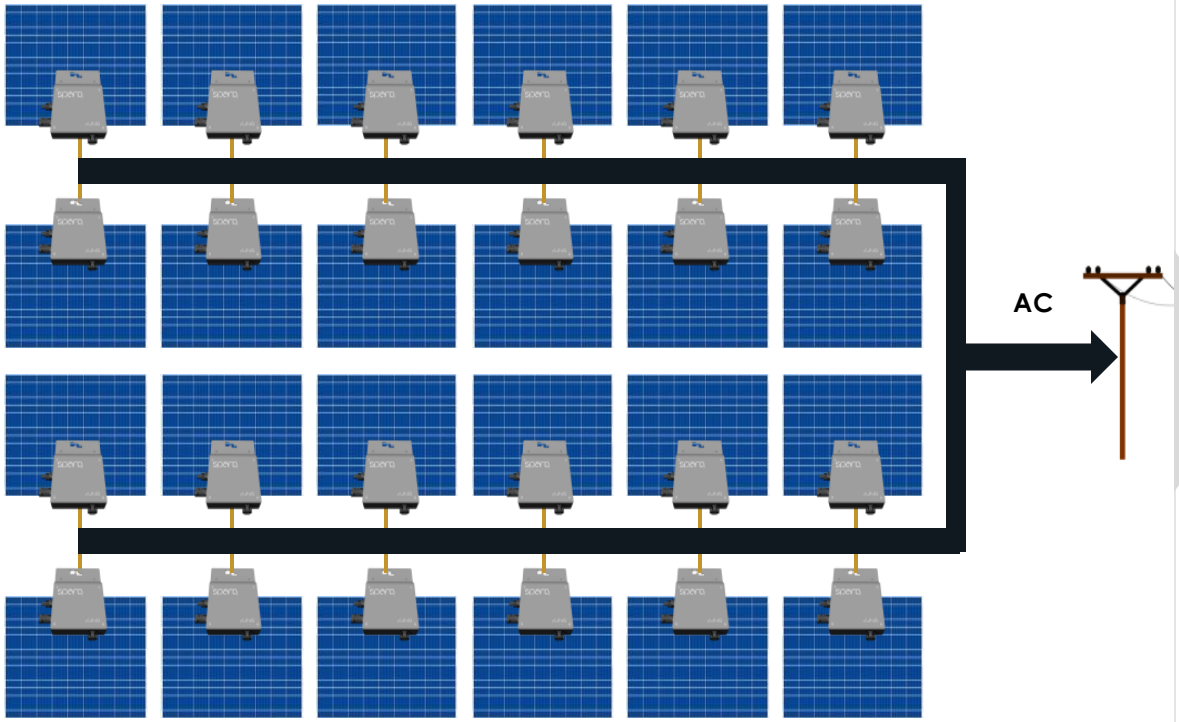
Safety

- High voltage (600V+) arc faults → leading cause of fires in PV installations, electirck shock hazard
- Module level disconnect/shut-off

One Optimizer Per Panel + **HV Central Inverter** **Medium Cost Safety Risk**

SINGLE-CHANNEL MICROINVERTERS

Enphase: One Single-Channel Microinverter with MPPT per Panel



One Microinverter per Panel → Cost High

Reliability

- \+ No single point of failure
- − Design life of 12 years (Electrolytic Capacitor)

Productivity

- \+/− 5-20% more energy as a result of individual Maximum Power Point Tracking (MPPT)

Design & installation

- \+/− No risky high voltage DC simplifies design and installation
- − High overall life-cycle cost (manufacture, install and repair after 12 years

Safety

- \+ "All Alternating Current (AC)" solution at low voltage eliminates arc faults

CHOOSE SPARQ TO AVOID THESE LIMITATIONS

SolarEdge String Inverters

- X Safety risk due to high voltage DC and arcing
- X Conventional power electronics and time-averaged liner control method
- X Require large electrolytic capacitors
- X No galvanic isolation
- X Low MTBF, poor system availability and reliability
- X Multiple Single point failures in the system
- X Low energy harvesting without optimizers
- X Optimizers, an after thought for shading and MPPT
- X Require excessive power quality and EMI fi
- X Excessive volume, weight and cost penalty
- X Low energy harvesting due to power clipping at high ambient temperatures
- X Inefficient supply chain, tedious to install & repair

Enphase Single-Channel Microinverters

- X Conventional Flyback boost Converters
- X Conventional power electronics and time-averaged liner control method
- X Mainly H/W based with simplified control methods using averaged models
- X Require huge electrolytic capacitors
- X Low MTBF and poor reliability
- X Require excessive power quality and EMI due to high Total Harmonic Distortion
- X Excessive volume, weight and cost penalty
- X Low energy harvesting due to power clipping at high end of the normal operational ambient temperatures
- X Inefficient supply chain, tedious to install & repair

Competing microinverters suffer from poor performance and reliability due to use of conventional H/W based technologies with linear control techniques.

STANDARD Q2000 PRODUCT FAMILY OFFERING

Best-in-Class Single and Three Phase Microinverters, Battery Storage and Energy Management

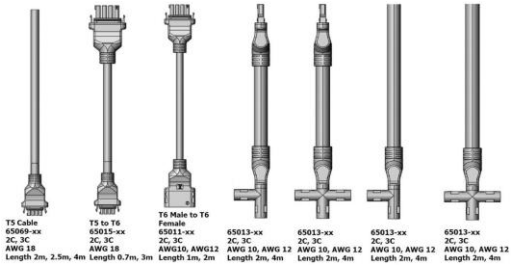
Q2000
1-Phase
Dual mode

Q2000
3-Phase
Solar water Pump

Q2000
Energy Storage

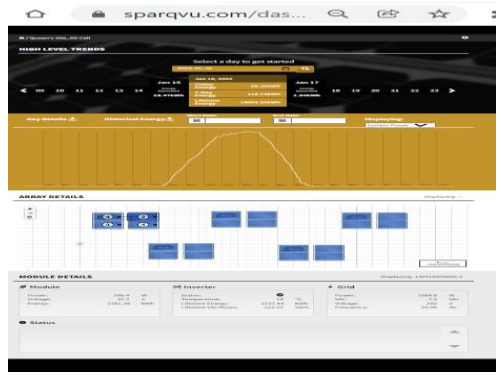
SparqLinq
Gateway

AC Cabling



SparqVu
Web Monitoring

SparqSync
Mobile App



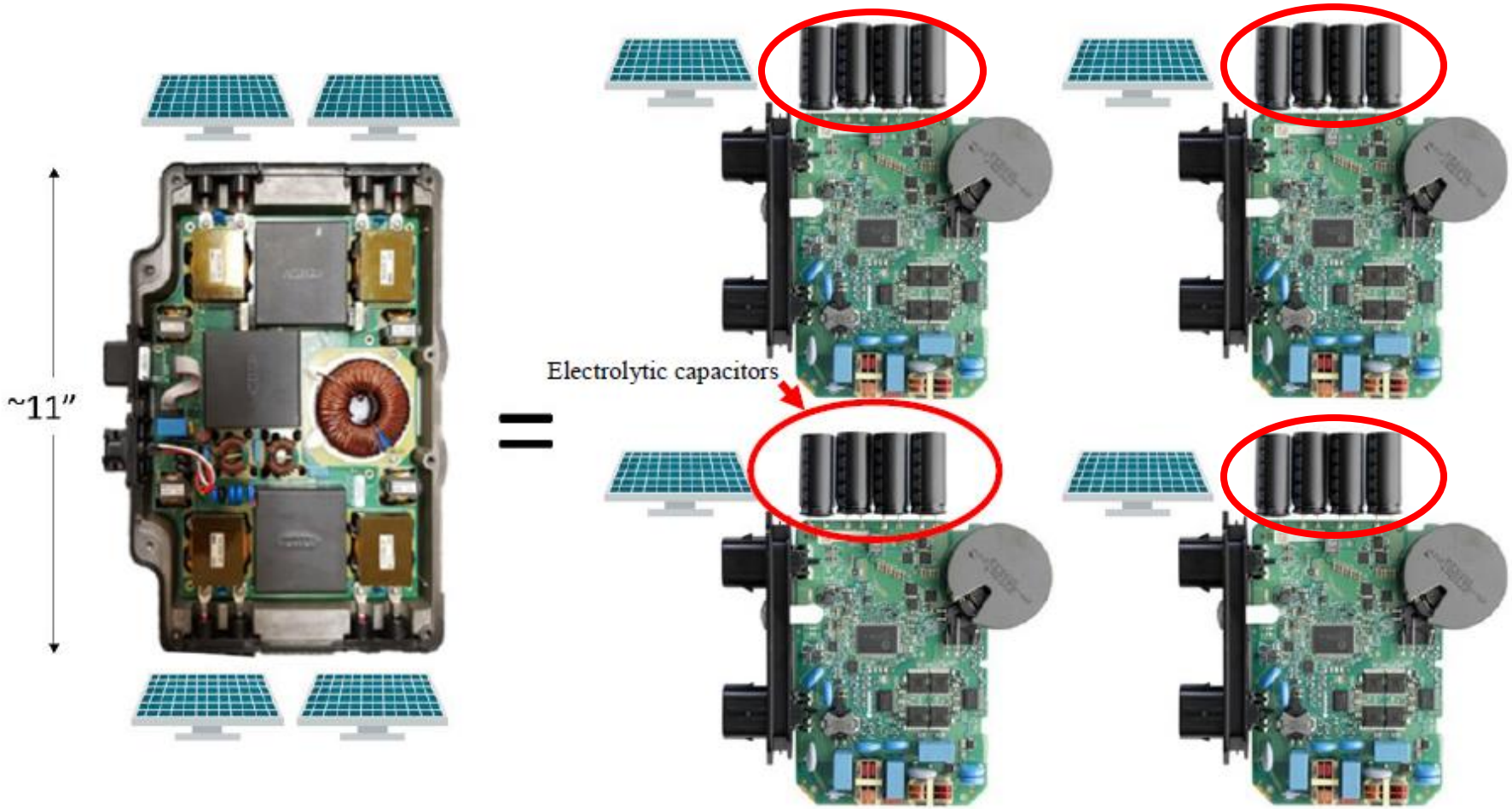
SPARQ QUAD MICROINVERTERS

Best-Selling Microinverter	Sparq Quad Microinverter

SPARQ's Quad Architecture Integrates FOUR Microinverters in ONE Enclosure.

SPARQ MICROINVERTER VS. LEADING BRAND

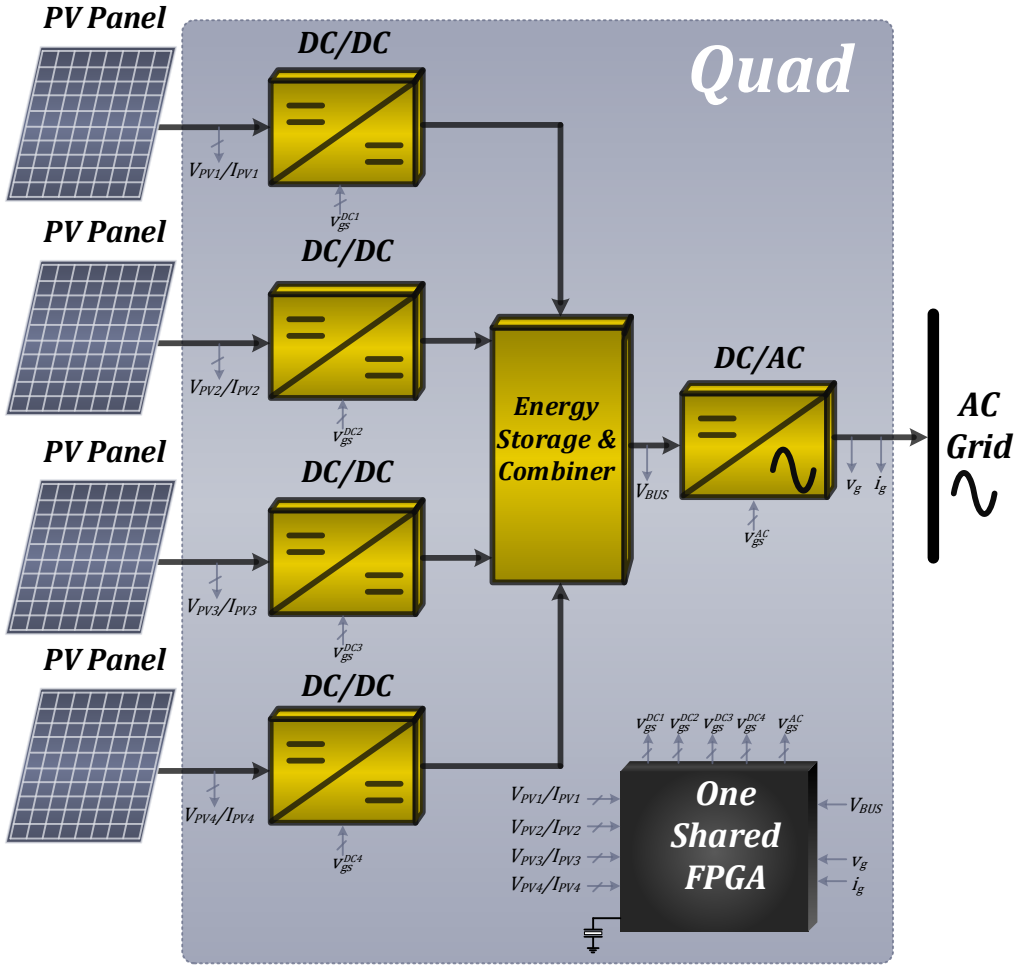
Improving Reliability and Reducing Cost of Supply-Chain, Manufacturing and Installation



SPARQ Microinverters Eliminates Electrolytic-Caps and All Other Low-Reliability Parts

SPARQ QUAD MICROINVERTER ADVANTAGE

Fewer Devices = High Reliability, Easy Installation, Lower Cost/Risk and Maintenance-Free



Sparq Patent No. 9,859,714

- ✓ Eliminated Low Reliability Electrolytic Capacitors
- ✓ Eliminated three DC-AC Inverters
- ✓ One Shared Digital Controller for Four DC-DC and One DC-AC converters
- ✓ Reduced BOM Cost by more than 25%
- ✓ Reduced Installation Cost by about 70%
- ✓ Reduced weight, volume and overall cost of MLPE microinverters for PV Systems

COMPARISON OF SINGLE-PHASE MICROINVERTERS

		Enphase (IQ8H-240-72-2-US)	SPARQ (Q2000-4102)
DC Power (Panel)		540+ (clipping at 390)	540+ (clipping at 450)
AC Power		380	2000
Power Density (W/in^3)		5.63	19.57
Weight Density (W/kg)		351.8	606.1
Power Clipping		390 per channel	450 per channel
MPPT		Highly fluctuating (3.5% Average)	Single point (~0% fluctuations)
MPPT Efficiency		Not Specified	Static: 99.85% Dynamic: 99.8%
Total Harmonic Distortion (THD)		<5%	<2%
Power Factor (PF)		Limited 0.85 leading – 0.85 lagging	Full-Range 1.0 leading – 1.0 lagging
Efficiency (Peak/CEC)		97.6/97.0	97.5/97.0
Continuous AC Power		No, Burst-Mode below 30% load	Yes
Modes of Operation	Grid-Connected	Yes	Yes
	Off-Grid without Battery Inverter	Limited, not supported by Enphase as a use case	Yes, seamless operation with any disconnect switch
	Off-Grid with Battery Inverter	Yes, only with Enphase Battery Inverter and dedicated communication	Yes, with any Battery Inverter and autonomously (without Communication)

COMPARISON OF THREE-PHASE MICROINVERT

Critical to Quality (CTQs)	Enphase (IQ8H-3P-72-E-US)	SPARQ (Q2000-4302)
DC Power (Panel)	380–640 (clipping at 475W)	680+ (clipping at 500W per channel)
AC Power (W)	475	2000
MPPT voltage range (V)	35.5–53	19.5V to 60
Power Density (W/in^3)	4.13	12.46
Weight Density (W/kg)	297	400
Power Clipping	475 per channel	500 per channel
MPPT	Highly fluctuating (3.5% Average)	Single point (~0% fluctuations)
MPPT Efficiency	Not Specified	Static: 99.85% Dynamic: 99.8%
Total Harmonic Distortion (THD)	<5%	<2%
Power Factor (PF)	Limited 0.85 leading – 0.85 lagging	Full-Range 1.0 leading – 1.0 lagging
Efficiency (Peak/CEC)	97.6/97.0	97.5/97.0
Continuous AC Power	No, Burst-Mode below 30% load	Yes
Modes of Operation	Grid-Connected	Grid-Connected, Off-Grid or Dual-mode Motor Control (BLDC, IM, PSMS)

SPARQ PRODUCTS VALUE PROPOSITION

Best-in-Class Microinverters Disrupting the PV Industry!

Performance

- ✓ Software centric flexible Power Electronics with accurate real-time nonlinear control
- ✓ Ultra high frequency, soft switching topology
- ✓ Individual MPPT for each panel
- ✓ No risk of HV DC arcing or personnel electric shock
- ✓ Lowest weight, highest weight density (W/kg)
- ✓ Lowest volume, highest power density (W/ in^3)
- ✓ Maximum Energy Harvesting
- ✓ Dual Mode Operation (On-grid & Off-grid)
- ✓ Grid-Resilience without energy storage
- ✓ Grid independence and energy self-sufficiency
- ✓ Future ready for being flexible and scalable
- ✓ SparqLinq: advanced gateway to rule them all
- ✓ SparqVu: Web monitoring with Intuitive displays
- ✓ SparqSync: user-Friendly mobile app

Safety & Reliability

- ✓ No Electrolytic Capacitor
- ✓ Other low-life components eliminated
- ✓ Safe, all-AC cabling with inherent Rapid-Shut-Down (RSD) compliance
- ✓ No risk of HV DC arcing
- ✓ No Risk of HV electric shock hazard for 1st responders
- ✓ High reliability
- ✓ High system availability
- ✓ No PV system single point failure
- ✓ Fewer system components to install and maintain results in high MTBF
- ✓ Best-in-class Longevity

Cost-Effectiveness

- ✓ Quad Architecture
- ✓ Reduced manufacturing BOM
- ✓ Reduced Balance of System (cabling, grounding, junction boxes etc)
- ✓ Reduced manufacturing cost
- ✓ Reduced installation cost
- ✓ Maintenance-free
- ✓ Lowest cycle-life-cost
- ✓ Outlier on Performance-Cost Curve

Highest Performance, Safe and Most Reliable, Lowest weight, Volume and Cost.

THANK YOU!

SPARQ

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