Zodiac

Integrated Power Electronics for PV modules

Zodiac is comprised of two main modules: Virgo and Pandora. The Virgo module connects to each solar cell substring, and it provides DC optimization, inversion to high voltage AC, as well as monitoring and diagnostics. Pandora is a module that aggregates the AC power from all the Virgo modules and provides a single AC output to the grid. It also provides a communication interface to external gateways/servers.

Key Benefits:

- Boosts Energy Harvest: Independent substring performance maximizes energy output.
- Cuts Installation Costs: Simplifies setup with no external MLPE and minimum connectors.
- Lowers O&M Costs: Reduces maintenance with fewer failure points.
- Minimizes Downtime: Advanced monitoring and diagnostics for quick issue resolution.

Considering the above benefits, Zodiac delivers a faster return on investment and lower levelized cost of energy when compared to conventional solutions using microinverters and string inverters with DC optimizers.

Key Features

- High performance in non-uniform irradiances, such as partial shading, soiling, and snow accumulation, resulting in an energy harvest increase of up to 42% in heavily shaded rooftop scenario.
- Distributed electronics to ensure high resilience to failure and eliminates single points of failure that happens in using MLPE approach.
- Eliminates the need for external rapid shutdown, DC optimizer, and inverter electronics.
- Designed for grid-tied systems and compliant to UL 1741-SA.
- Ultra-fast maximum power point tracking (MPPT) convergence.
- Eliminates risk of cell damage from hot spot heating and of associated module failures.
- Eliminates clipping associated with external module-level power electronics.
- Removes the need for bypass diodes between substrings and related failures.
- Provides monitoring and diagnostics at the substring level.
- Suitable for integration into PV panels with power capacity up to 1300W.
- Provides wireless communication to servers/gateways using Wi-SUN protocol.

Compliance

- Compliant to UL 1741-SA
- FCC Part 15 Class B, ICES-0003 Class B, CAN/CSA-C22.2 NO. 107.1-01
- NEC-2017 section 690.12 and C22.1-2015 Rule 64-218 Rapid Shutdown of PV Systems
- IEC 62790- Junction boxes safety tests for photovoltaic modules

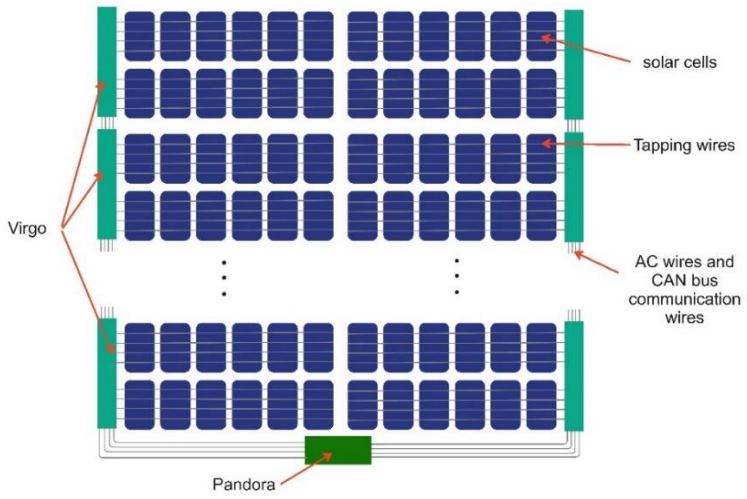

Figure 1. Example design of a Daanaa-enabled PV module with integrated Zodiac system

Table 1. Summary of Zodiac system Electrical Specification

Parameter	Min	Typical	Max	Unit
AC Output				
Output AC Voltage	211	240	264	V
Output Power			1300	W
Output AC Current			5	A
Output Frequency	57	60	64	Hz
Mechanical Data				
Operating Temperature	-40		85	°C
Connection	AC connector			

Zodiac System Configuration

Depending on the number of cells per substring in the PV module, the Zodiac system offers various configurations tailored to different use cases. These configurations can be selected based on the specific application and the desired level of shade tolerance. In general, a lower number of solar cells per substring results in higher shade tolerance and increased monitoring resolution.

#	System Components	Number of Cells in a panel	Output Power Range (W)	Number of Cells per substring
1	Virgo 0307 & Pandora	6-108	25-380	6-10
2	Virgo 0307 & Pandora	6-108	25-380	6-10
3	Virgo 0307 & Pandora	108-120	380-450	6-10
4	Virgo 0915 & Pandora	108-120	380-450	18-20
5	Virgo 0915 & Pandora	132-144	480-650	22-24
6	Virgo 0915 & Pandora	132-144	480-650	22-24
7	Virgo 0915 & Pandora	132-156	480-650	22-26

Virgo 0307 - Power Transaction Module

Virgo is a DC optimizer and solar inverter purpose-built for integration with PV modules. Each Virgo module supports DC inputs from two substrings and delivers one AC output.

FEATURES

- Designed to support up to two separate substrings
- Designed for grid-tied systems and compliant to UL 1741-SA
- Ultra-fast maximum power point tracking (MPPT) convergence
- Integrated DC optimization, inversion, and monitoring functions
- Fully compliant with rapid shutdown certification requirements
- Compatibility with all solar cell types
- CAN bus Communication for control and diagnostics

Table 2. Operating Electrical Specifications of Virgo

Parameter	Min	Typical	Max	Unit
DC Input				
Single Input MPPT Voltage Range	3.1	3.4	6.7	V
Single Input DC Start Voltage	2.9		7.5	V
Single Input Voltage Before Damage			9.0	V
Single Input Continuous DC Current			10.0	A
AC Output				
Output AC Voltage	211	240	264	V
Output Power			70	W
Output Frequency	57	60	64	Hz
MPPT Convergence time	0.2		0.7	s
MPPT Accuracy	99	99.5		%
MPPT Response time		0.1		s
Mechanical Data				
Dimensions	344 mm x 70 mm x 12 mm			
Operating Temperature	-40		85	°C
Enclosure Material	Polycarbonates (PC)			
Connection	Solderable pads			

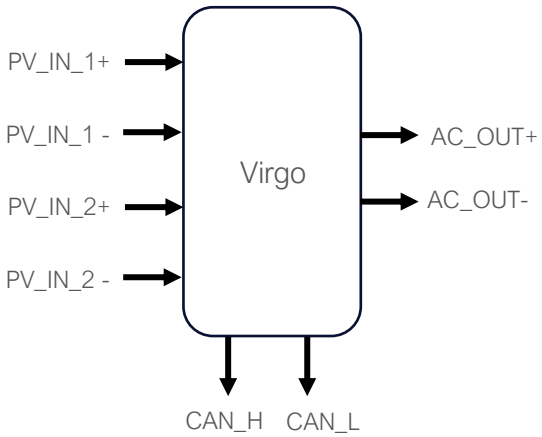

Figure 2. Virgo input and output schematic

Compliance

- Compliant to UL 1741-SA
- FCC Part 15 Class B, ICES-0003 Class B, CAN/CSA-C22.2 NO. 107.1-01
- NEC-2017 section 690.12 and C22.1-2015 Rule 64-218 Rapid Shutdown of PV Systems
- IEC 62790- Junction boxes safety tests for photovoltaic modules

Virgo 0915 - Power Transaction Module

Virgo is a DC optimizer and solar inverter purpose-built for integration with PV modules. Each Virgo module receives DC inputs from a solar substring and delivers a grid-tie AC output.

FEATURES

- Designed for grid-tied systems and compliant to UL 1741-SA
- Ultra-fast maximum power point tracking (MPPT) convergence
- Integrated DC optimization, inversion, and monitoring functions
- Fully compliant with rapid shutdown certification requirements
- Compatibility with all solar cell types
- CAN bus Communication for control and diagnostics

Table 3. Operating Electrical Specifications of Virgo

Parameter	Min	Typical	Max	Unit
DC Input				
Single Input MPPT Voltage Range	9	10.5	15	V
Single Input DC Operating Voltage	3			V
Single Input Voltage Before Damage			16	V
Single Input Continuous DC Current			10.0	A
AC Output				
Output AC Voltage	211	240	264	V
Output Power			90	W
Output Frequency	57	60	64	Hz
MPPT Convergence time	0.2		0.7	s
MPPT Accuracy	99	99.5		%
MPPT Response time		0.1		s
Mechanical Data				
Dimensions	344 mm x 70 mm x 12 mm			
Operating Temperature	-40		85	°C
Enclosure Material	Polycarbonates (PC)			
Connection	Solderable pads			

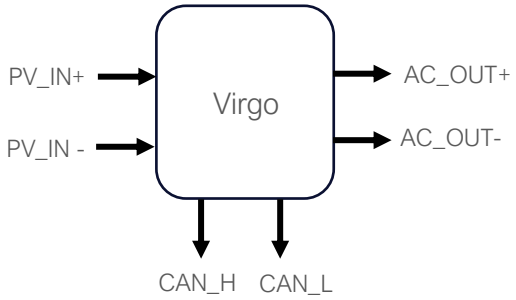

Figure 3. Virgo input and output schematic

Compliance

- Compliant to UL 1741-SA
- FCC Part 15 Class B, ICES-0003 Class B, CAN/CSA-C22.2 NO. 107.1-01
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Pandora - Power Aggregation Module

Pandora is a junction box component that aggregates the AC output of multiple Virgo modules providing a single AC output. It manages the communication with each Virgo module in the system and presents a single high-level communication interface to external systems, such as a gateway server. This interface is used for configuration, control, performance monitoring, diagnostics, and remote firmware upgrades. CAN bus is used for the communication between Pandora and the Virgo modules. Communication between Pandora and the external system done wirelessly with Wi-SUN to reduce installation complexity.

FEATURES

- Up to 1300W AC power combining
- Supports up to 14 Virgo modules
- CAN Bus communication to multiple Virgo units
- External wireless communication (Wi-SUN)
- Grid isolation and protection

Table 4. Operating Electrical Data of Pandora

Parameter	Min	Typical	Max	Unit
AC Input aggregated from Virgo modules				
AC Power			1300	W
Input AC Voltage	211	240	264	V
Input AC Current			5	A
AC Output				
Output AC Voltage	211	240	264	V
Output AC Current			5	A
Mechanical Data				
Dimensions	344 mm x 115 mm x 30 mm			
Operating Temperature	-40		85	°C
Enclosure Material	Polycarbonates (PC)			
Connection	Busbar soldering to Virgo modules Single AC connector for the panel output			

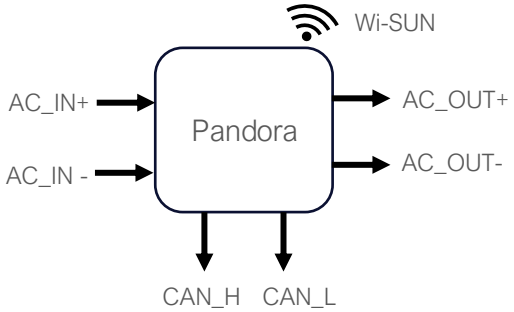

Figure 4. Pandora input and output schematic

Compliance

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- NEC-2017 section 690.12 and C22.1-2015 Rule 64-218 Rapid Shutdown of PV Systems b v
- IEC 62790- Junction boxes safety tests for photovoltaic modules