

1.5 kW Organic Rankine Cycle (ORC) Power Generator – Compact 28V System for Waste Heat Recovery

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<https://infinityturbine.com/1kw-orc-power-generator-28-vdc-sunstrand-study-by-infinity-turbine.html>

A detailed summary of a 1.5 kW Organic Rankine Cycle (ORC) power generator that efficiently converts low-grade heat (90–130°C) into 28V DC electricity. This compact system demonstrates the feasibility of small-scale waste heat recovery, featuring direct DC output, fast startup, and oil-free operation for off-grid and industrial use.



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Organic Rankine Cycle Silent Power Plant 1.5 kW 28 VDC from 1974 Sunstrand Aviation in Rockford Illinois

1 kW Organic Rankine Cycle (ORC) Power Generator Overview

The 1 kW ORC system represents a breakthrough in compact thermal-to-electric power conversion. Designed to produce 28 volts DC from waste heat sources, it enables direct battery charging or microgrid integration. The system is ideal for small-scale or remote applications where efficiency, reliability, and autonomy are essential.

Purpose and Objectives

- Designed to recover low-grade heat and convert it into usable electrical power.
- Provides a 28V DC output suitable for direct storage or load operation.
- Demonstrates the technical and economic feasibility of micro-ORC systems below 5 kW.
- Targets industrial waste heat, small engines, geothermal, and solar-thermal sources.

System Design and Operation

- Closed-loop Organic Rankine Cycle configuration with evaporator, micro-turbine, condenser, and pump.
- Compact and modular design for easy deployment and scalability.
- Integrated control system for automated startup, operation, and shutdown.
- Rapid startup within approximately 90 seconds.
- Designed for unmanned or remote installations with minimal maintenance.

Operating Conditions

- Heat source temperature: 90 to 130 degrees Celsius.
- Working fluid: primarily R245fa, with R134a and R1233zd(E) evaluated as alternatives.
- Turbine inlet pressure: 10 to 12 bar.
- Turbine outlet pressure: 2 to 3 bar.
- Mass flow rate: approximately 0.06 to 0.1 kilograms per second.
- Condenser temperature: about 60 degrees Celsius.

Turbine and Generator

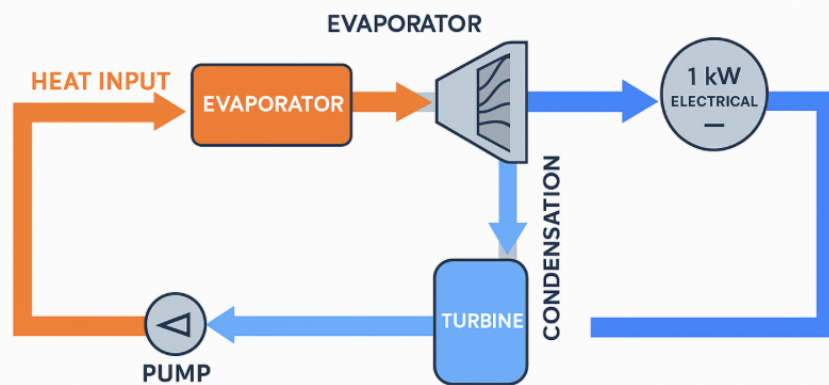
- Single-stage radial inflow micro-turbine operating at 35,000 to 55,000 RPM.
- Turbine efficiency between 65 and 70 percent.
- Direct-drive permanent magnet generator producing 28 volts DC.
- No gearbox required, minimizing mechanical losses.
- Oil-free bearing design eliminates the need for lubrication systems.

Performance Results

- Net electrical power output: 1.0 to 1.2 kilowatts.
- Thermal input: approximately 15 to 20 kilowatts.
- Overall system efficiency: 6.3 to 7.5 percent.
- Pressure ratio: 4.5 to 5.8 to 1.
- Power stability: voltage fluctuations within ± 2 percent.
- Startup time: approximately 90 seconds from cold start.

ORC and micro-turbine technology is a promising solution for small-scale power generation.

1 kW ORC SYSTEM



HEAT SOURCE TEMP
90-130°C

OUTPUT POWER
1.0-1.2 kW

EFFICIENCY
6.3-7.5%

90–130 °C
WORKING FLUID **R245fa**

1.0–1.2 kW 3.5–7.5 %

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Parameter	Value
Heat Source Temp	90–130°C
Working Fluid	R245fa
Turbine Speed	35,000–55,000 RPM
Output Power	1.0–1.2 kW
Electrical Output	28 VDC
Efficiency	6.3–7.5%
Pressure Ratio	4.5–5.8:1

Mass Flow	0.06–0.1 kg/s
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Startup Time	~90 sec
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Voltage Stability	±2%
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