**Feasibility Report: Upgrading from SiC431 (87% Efficiency) to SiC450 (95% Efficiency)**

**Assuming 24/7 Continuous Operation**

**1. Introduction**

This report evaluates the technical and economic feasibility of upgrading a buck converter design from using the SiC431 IC (87% efficiency) to the SiC450 IC (95% efficiency). The application assumes a 1.2 V, 20 A output with continuous 24/7 operation. The analysis includes energy losses, thermal benefits, and return on investment based on IC price differences.

**2. System and Operation Assumptions**

|  |  |
| --- | --- |
| Parameter | Value |
| Output voltage Vout ​ | 1.2 V |
| Output current Iout​ | 20 A |
| Input voltage Vin​ | 12 V |
| Efficiency (SiC431) | 87% (0.87) |
| Efficiency (SiC450) | 95% (0.95) |
| Operation time | 24 hours/day |
| Operation days per year | 365 days/year |
| Switching frequency | 500 kHz |

**3. Power Calculations**

**3.1. Output Power**

**3.2. Input Power and Losses**

|  |  |  |
| --- | --- | --- |
| Metric | SiC431 | SiC450 |
| Input Power |  |  |
| Power Loss | 3.59 W | 1.26 W |
| Power Saved | — | **2.33 W** less |

**3.3. Daily and Annual Energy Loss**

|  |  |  |
| --- | --- | --- |
| Metric | SiC431 | SiC450 |
| Daily Loss (Wh) |  | 1.26⋅24=30.24 Wh1.26 \cdot 24 = 30.24\,Wh1.26⋅24=30.24Wh |
| Annual Loss (Wh) | 86.16⋅365=31,436.4 |  |
| Annual Loss (kWh) | 31.44 kWh | 11.04 kWh |
| Annual Energy Saved | — | **20.4 kWh** |

**3.4. Cost Savings (Assuming €0.30/kWh)**

**4. Thermal Considerations**

* The SiC450 reduces power loss by 2.33 W.
* This can lower PCB surface temperatures, reduce cooling requirements, and potentially improve product reliability and lifespan.
* For dense or passively cooled systems, the thermal advantage may justify the upgrade independently of energy cost.

**5. Return on Investment**

|  |  |
| --- | --- |
| Item | Value |
| Typical price difference (SiC450 – SiC431) | ~€1.00–€1.50 |
| Annual energy savings | ~€6.12 per unit |
| Simple payback time | **2–3 months** |
| Net gain after 1 year | ~€4.62–€5.12 |
| Net gain after 3 years | ~€18.4 (per unit) |

The higher efficiency of the SiC450 becomes financially favorable in less than one year under 24/7 operation.

**6. Summary Table**

|  |  |  |  |
| --- | --- | --- | --- |
| Metric | SiC431 | SiC450 | Gain (SiC450 – SiC431) |
| Efficiency | 87% | 95% | +8% |
| Input Power | 27.59 W | 25.26 W | –2.33 W |
| Power Loss | 3.59 W | 1.26 W | –2.33 W |
| Yearly Energy Waste | 31.44 kWh | 11.04 kWh | –20.4 kWh |
| Annual Energy Cost (at €0.30) | €9.43 | €3.31 | **€6.12 saved** |
| Thermal Load | High | Lower | notable reduction |
| Payback Period | — | ~3 months | — |

While the SiC450 offers higher efficiency and reduced thermal loss, it comes at a slightly higher component cost—typically around €1.00 to €1.50 more than the SiC431. However, under continuous 24/7 operation, the annual energy savings (~€6.12 per unit) outweigh this difference within the first few months of operation. This results in a net gain of approximately €4.62–€5.12 per year after the cost is recovered. Therefore, even after factoring in the IC price difference, the upgrade remains financially and technically beneficial for systems with long operating hours or thermal constraints.