

Application Note

AN-EVAL-ICE2A365-1

**CoolSET™
40W Evaluation Board with ICE2A365**

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Power Management & Supply



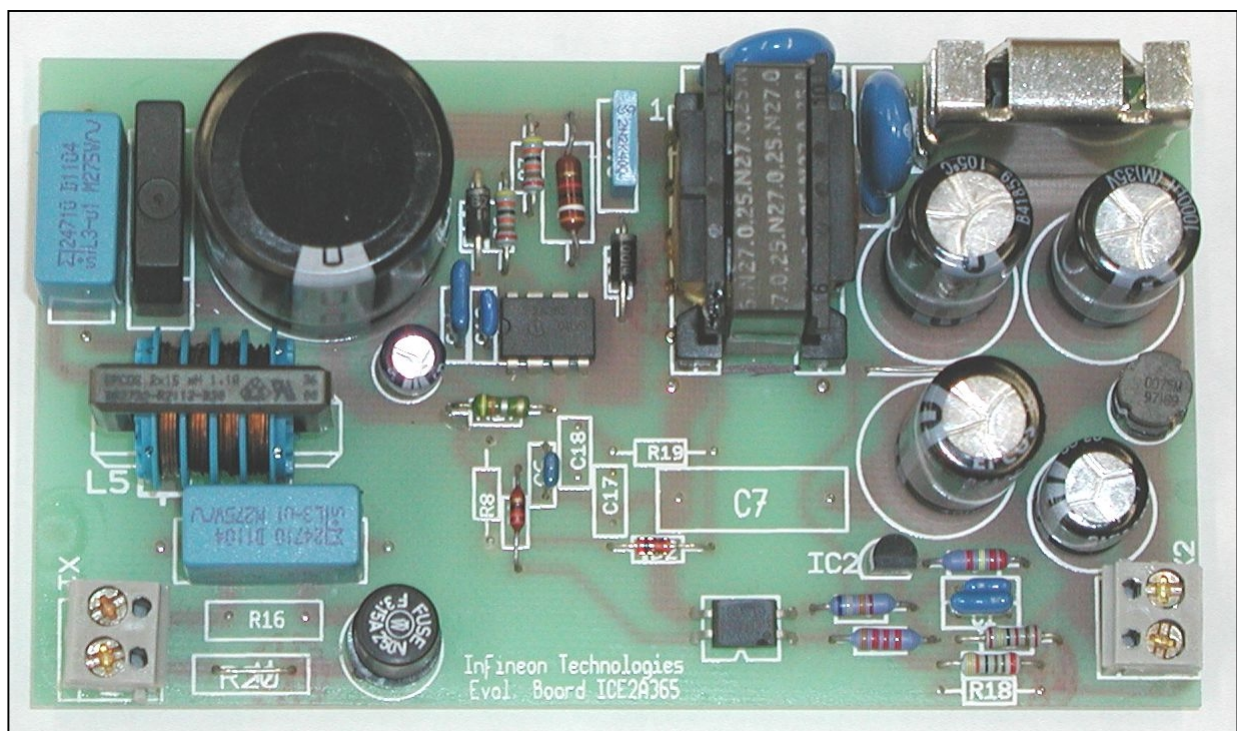
Never stop thinking

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40W Evaluation Board with ICE2A365

The board described here was designed as a typical power supply in flyback converter topology with one output voltage and secondary control. This type of switch mode power supply is particularly suitable as an AC/DC power supply for battery chargers, video games, satellite decoders, etc. The switch mode power supply **ICE2A365** chip used for this application is a current-controlled pulse width modulator with integrated CoolMOS power switch. Special efforts have been made to compensate temperature dependency and to achieve a very high accuracy of the switching frequency. Furthermore, overload and open loop protection is implemented by controlling the feedback line. In case of overload or open loop, the IC is working in **hiccup** mode.



Evaluation board

Other output voltages can also be implemented very easily by a simple modification of the transformer and the output circuitry.

Technical specifications:

| | |
|--------------------------------------|----------------|
| Input Voltage Range | 85 ... 270V AC |
| Input Frequency | 50, 60 Hz |
| Output Voltage | 16V +5% |
| Peak Output Power | 54W |
| Line Regulation (85 ...270V) | < 1% |
| Load Regulation (10% ... 100%) | < 1% |
| Efficiency | > 80 % |
| Output Ripple Voltage | < 200mV |
| Switching Frequency | 21...100 kHz |
| Stby Power with Burst Mode @ no-load | <400mW |
| EMI | EN55022B |
| Temperature Range | 0 ... 50°C |

Circuit description:

Introduction

The **ICE2A365** chip used here was particularly designed for the use in flyback converters. As shown on the circuit diagram (p. 3), only a few additional components are required to create an AC/DC power supply.

Line Input

The AC line input side comprises the input fuse F1 as overcurrent protection the choke L5 and X2-capacitors C8 and C22 as radio interference suppressors. After the bridge rectifier BR1 and the input capacitor C3, a voltage of 90 to 380 VDC depending on input voltage is available.

ICE2A365 Power Supply

Startup

From the DC input voltage, the chip's starting current supply is derived using the resistors R6 and R7. Because of the low current drain of <85 uA, high-value resistors can be used. Series connection of the resistors is necessary for reasons of insufficient dielectric strength of the individual resistors.

Mode of Operation

During operation, the VCC pin is supplied via a separate transformer winding with associated rectification D2 and buffering C4, C13. The Resistor R8 is used for current limiting during the charging of C4. In order to not exceed the maximum voltage at the VCC pin, an external zenerdiode D4 is applied for voltage limitation.

Softstart

The Soft-Start function is realised by an internal resistor and the external capacitor C14.

Primary Current – CoolMOS

Clamping Network

R10, C12 and D3 dissipate the energy of the leakage inductance.

Limitation of primary current

The CoolMOS source current is sensed by an external shunt resistor R17. When the voltage at R17 exceeds the internal current-limit threshold, the gate driver is shut off immediately.

Output Stage

Output Voltage

On the secondary side the power is coupled out via a fast-acting diode D1 with low forward voltage. The capacitors C5, C9, C20 provide energy buffering, a filter L3, C23 reduces the output voltage ripple considerably.

Storage capacitors C5, C9, and C20 are designed to have an internal resistance as small as possible (ESR). This minimizes the output voltage ripple caused by the triangular current characteristic. The output voltage level is set by resistors R1, R2.

Regulation

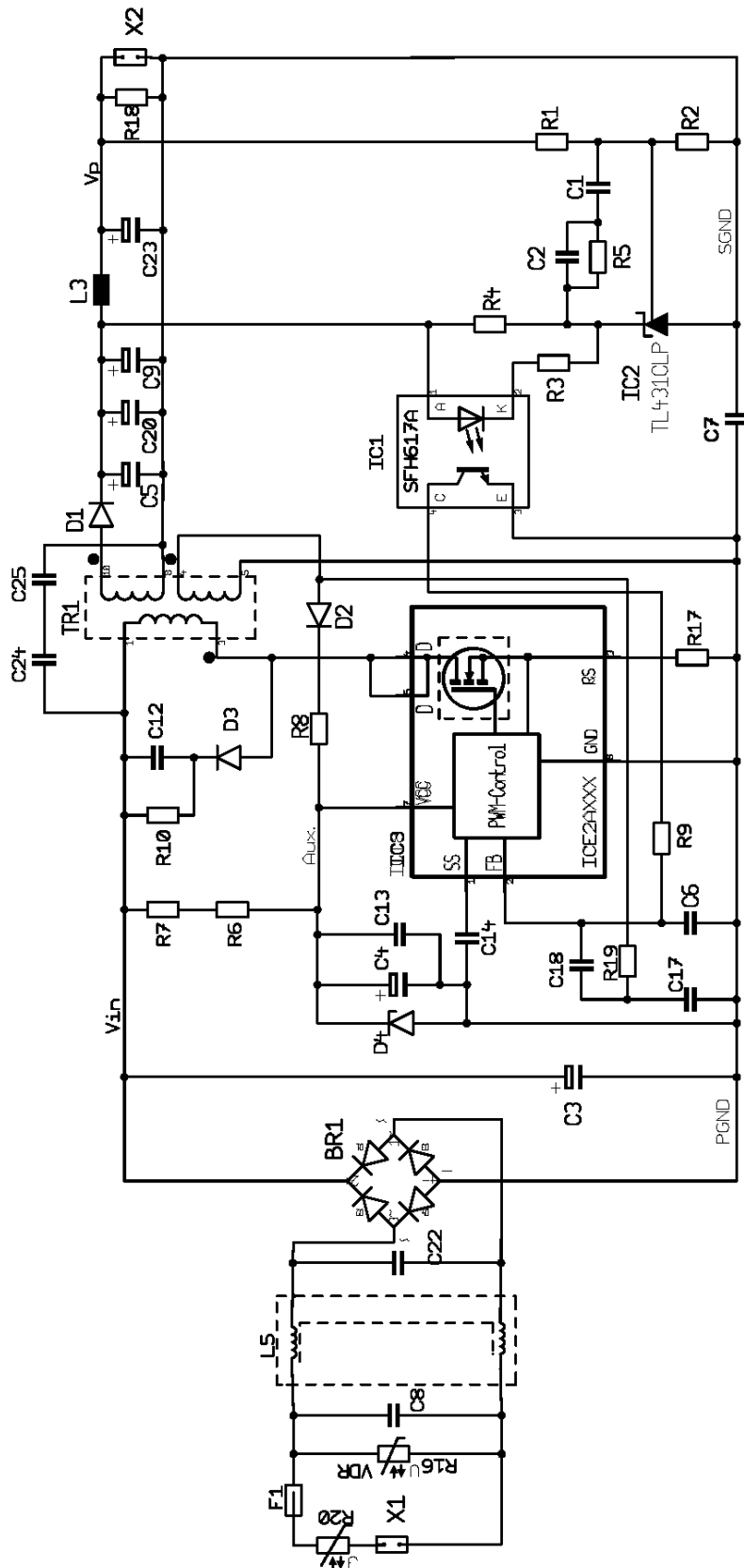
The output voltage is controlled using a type TL431 reference diode.

This device incorporates the voltage reference, the error amplifier, and a driver stage. The compensation network C1, C2, R1, R5 constitutes the external circuitry of the error amplifier of IC2. This circuitry allows the feedback to be precisely matched to dynamically varying load conditions, thereby providing stable control. The maximum current through the optocoupler diode and the voltage reference is set by the resistors R3 and R4.

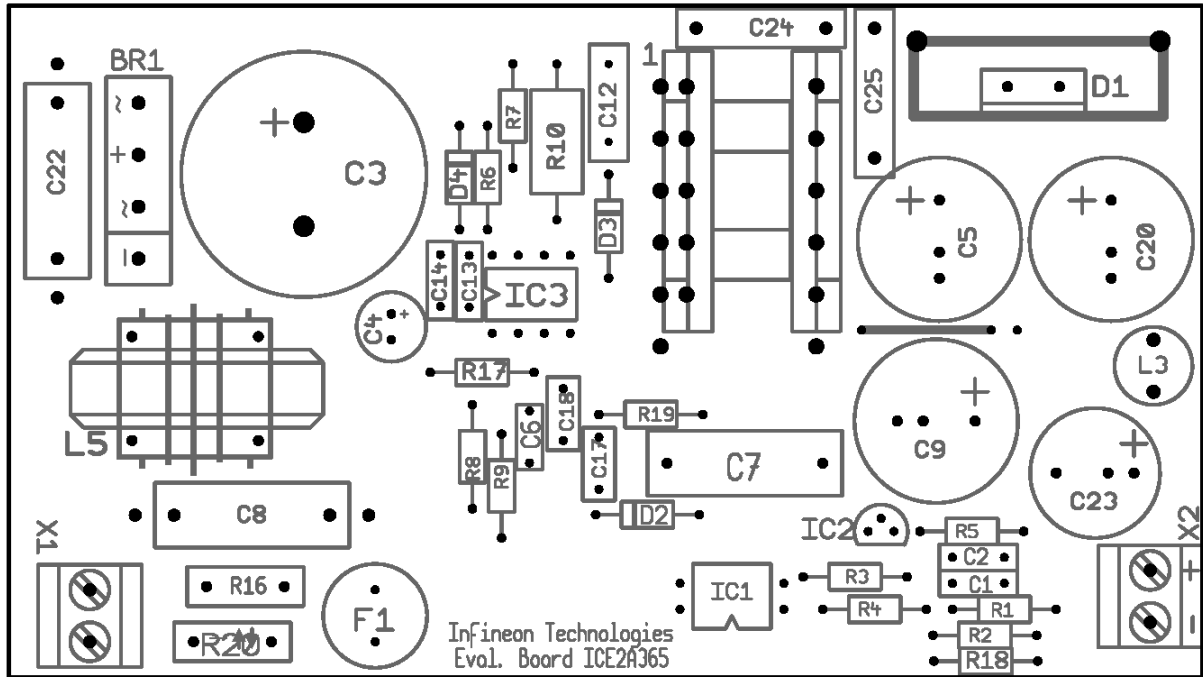
Optocoupler IC1 is used for floating transmission of the control signal to the "Feedback" input of the **ICE2A365** control device. The optocoupler meets DIN VDE 884 requirements.

Design calculations for the components and the transformer were performed in accordance with the **Application Note "AN-SMPS-ICE2AXXX for OFF – Line Switch Mode Power Supplies"**.

Schematic:

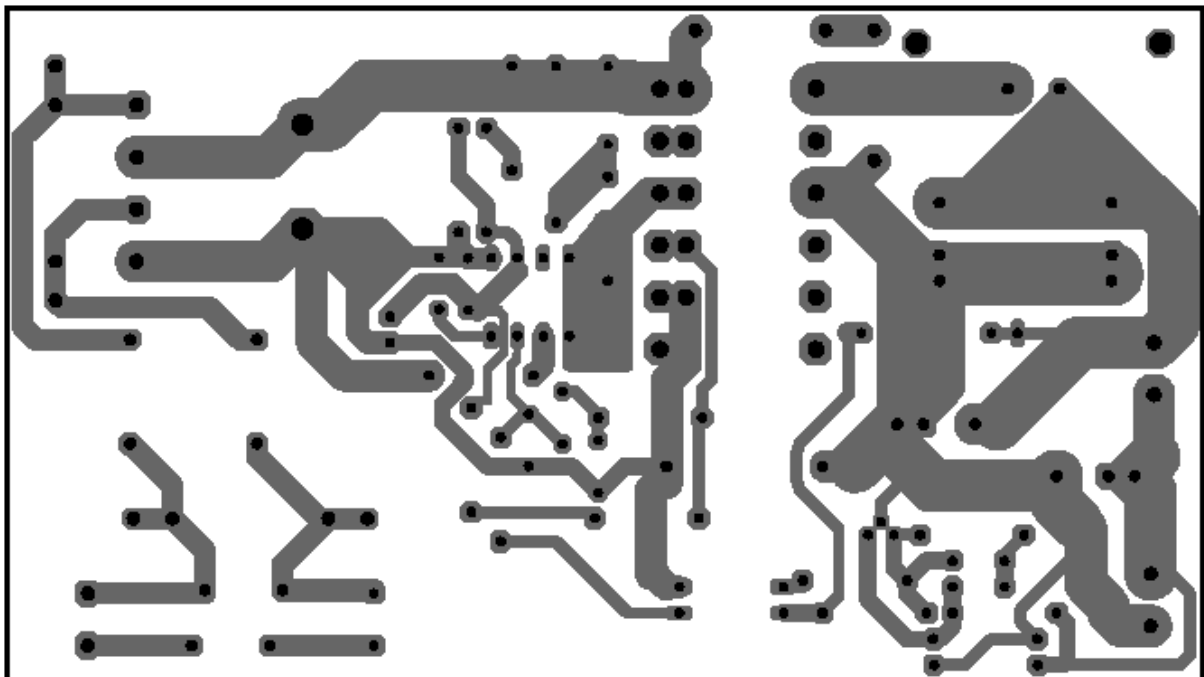


Component Legend:



Board Layout:

Component side shown



Component List:

Part List

ICE2A365 Evaluation Board 16V/ 40W

19.09.2001

| Pos. | Part | Type | Grid | Ordering Code | Manuf. |
|------|------|--------------------|--------|-----------------------------------|---------------|
| 1 | BR1 | B500 C1500 | | | |
| 2 | C1 | 330nF, 50V | 5mm | | Epcos |
| 3 | C2 | 1nF, 50V | 5mm | | Epcos |
| 4 | C3 | 150uF, 400V | 10mm | B43501-A9157-M | Epcos |
| 5 | C4 | 68uF, 35V | 2,5mm | B41821-A7476-M | Epcos |
| 6 | C5 | 1000uF, 35V | 5mm | KZE35VB1000MK25 | (NCC) Alfatec |
| 7 | C6 | 2,2nF, 50V | 5mm | B37979-G5222-J | Epcos |
| 8 | C7 | * | | | |
| 9 | C8 | 0,1uF, 275V, X2 | 15mm | B81130-C1104-M | Epcos |
| 10 | C9 | * | | | |
| 11 | C12 | 2,2nF, 400V | 7,5mm | B32520-C6222-K | Epcos |
| 12 | C13 | 100nF, 50V | 5mm | B37987-F5104-K | Epcos |
| 13 | C14 | 1uF, 50V | 5mm | B37984-M5105-K | Epcos |
| 14 | C20 | 1000uf, 35V | 5mm | KZE35VB1000MK25 | (NCC) Alfatec |
| 15 | C22 | 0,22uF, 275V, X2 | 15mm | B81130-C1224-M | Epcos |
| 16 | C23 | 470uF, 35V | 5mm | KZE35VB470MJ20 | (NCC) Alfatec |
| 17 | C24 | 2,2nF, 250V Y1 | 12,5mm | WKP 2n2 M | Wima |
| 18 | C25 | 2,2nF, 250V Y1 | 12,5mm | WKP 2n2 M | Wima |
| 19 | D1 | DSS10-01A | 5mm | | IXYS |
| 20 | D2 | 1N4148 | 10mm | | |
| 21 | D3 | 1N4937 | 10mm | | |
| 22 | D4 | ZPD18 | 10mm | | |
| 23 | F1 | Microfuse 3,15A | 5mm | | |
| 24 | IC1 | SFH617A-3X016 | | | |
| 25 | IC3 | ICE2A365 | | | Infineon |
| 26 | IC2 | TL431CLP | | | |
| 27 | L3 | 1uH, 3,7A | 5mm | 822LY-1R0M | Componex |
| 28 | L5 | 27mH, 0,9A | | B82732-R2901-B30 | Epcos |
| 29 | R1 | 24k, 1% | 10mm | | |
| 30 | R2 | 4,3k, 1% | 10mm | | |
| 31 | R3 | 680R | 10mm | | |
| 32 | R4 | 1,2k | 10mm | | |
| 33 | R5 | 150k | 10mm | | |
| 34 | R6 | 430k | 10mm | | |
| 35 | R7 | 430k | 10mm | | |
| 36 | R8 | 4,7R | 10mm | | |
| 37 | R9 | 22R | 10mm | | |
| 38 | R10 | 39k, 2W | 10mm | | |
| 39 | R16 | * | | | |
| 40 | R17 | 0,43R, 0,6W, 1%. | 10mm | | |
| 41 | R18 | * | | | |
| 42 | R20 | wire | 10mm | | |
| 43 | TR1 | E25 Coil Former | | | |
| 44 | TR1 | E25/13/7, 0,75 N27 | | see also Transformer Construction | |
| 45 | D1 | Heatsink, 18K/W | | FK224 | Fischer |
| 46 | X1 | Connector 2pol. | | | |
| 47 | X2 | Connector 2pol. | | | |

* = not assembled

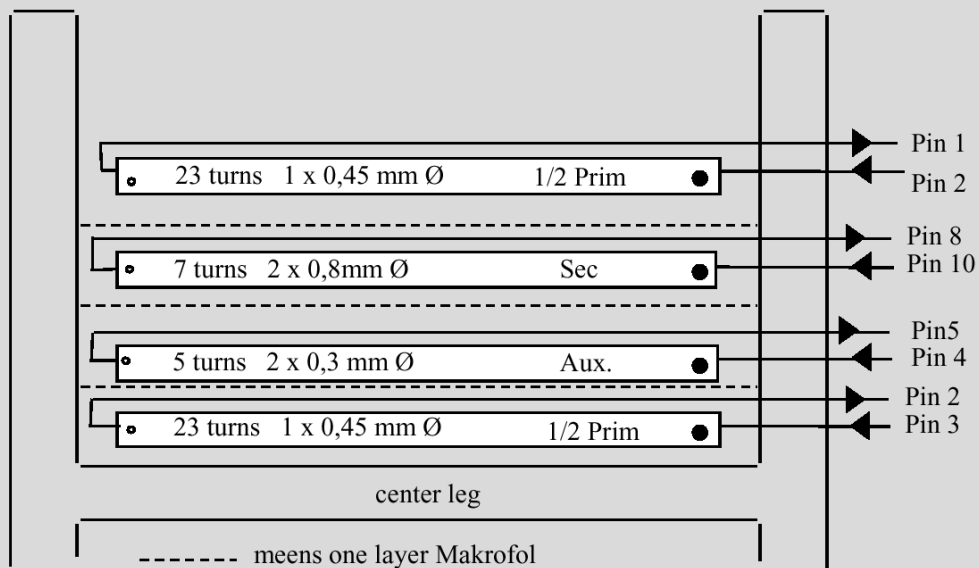
Transformer Construction

50W/100 kHz Flyback Transformer

Evaluation Board 16V, 50W with ICE 2A365

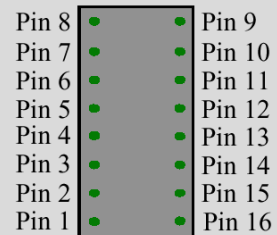
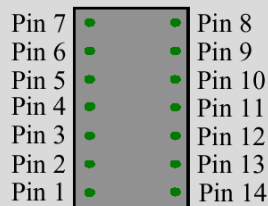
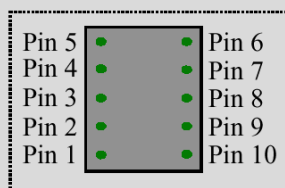
Coil former: vertical version

Core E25/13/7; N27; $A_{MIN} = 51,5 \text{ mm}^2$; total gap = 0,75 mm; $A_L = 111 \text{ nH}$; $L_p = 235 \text{ uH}$



| | | | |
|-------------------|---------------|---------------|-------------------|
| Primary winding | 23 + 23 turns | 1 x 0,45 mm Ø | |
| Auxiliary winding | 5 turns | 2 x 0,30 mm Ø | spread |
| Secondary winding | 7 turns | 2 x 0,80 mm Ø | triple Insulation |

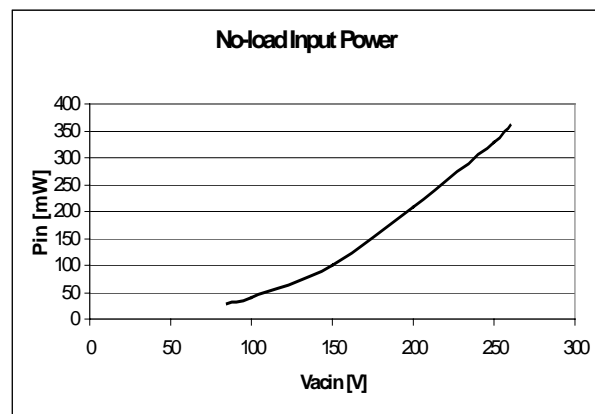
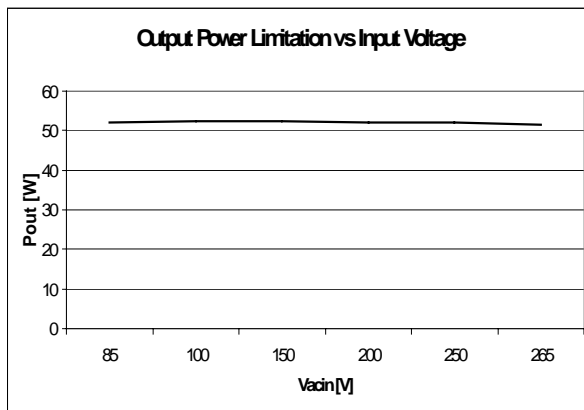
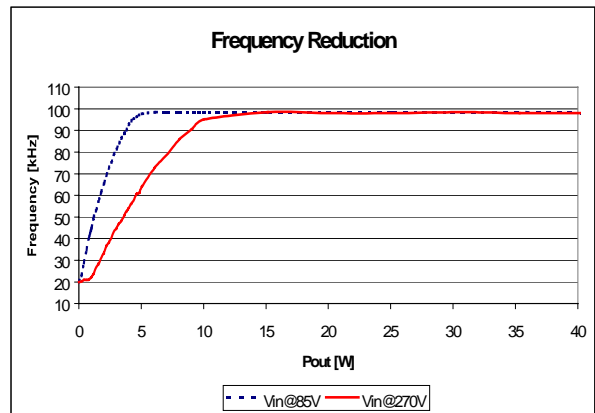
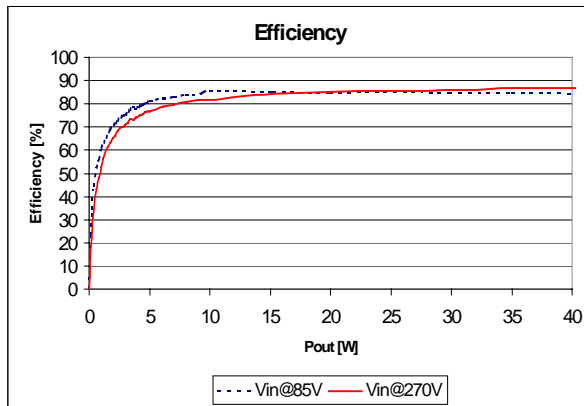
Bottom View:



Note:

The built-in transformer does **not** comply with EN60950 safety requirements in respect of electrical isolation.

Measurements:



References:

- [1] ICE2AXXX for OFF-Line Switch Mode Power Supplies Application Note, Infineon Technologies
- [2] CoolSET-II Off-line SMPS Current Mode Controller with High Voltage CoolMOS on Board Datasheet, Infineon Technologies

| Revision History | | |
|--|--------------------|-------------------------------------|
| Application Note AN-EVAL-ICE2A365-1 | | |
| Actual Release: V1.2 Date:16.08.2001 | | Previous Release: V1.1 |
| Page of actual Rel. | Page of prev. Rel. | Subjects changed since last release |
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| 12 | 12 | Part List |

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