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Application Note

AN-TDA16888-0-010323

TDA 16888: Multioutput Single Transistor Forward Converter 150W / 100kHz

Author: Michael Herfurth

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Power Management & Supply

Infineon technologies

Never stop thinking

150W Output: 5V/18A; 12V/4A; -12V/1A; Standby: 5V/100mA

Operating Frequency: 100kHz

Contents:

Circuit description

Multioutput single transistor forward converter with boost PFC preconverter

The power supply for a PC using up to 150 W of power must, for example, provide the following voltages: 5V/18A; 12V/4A; -12V/0.7A; -5V/0,3A; and Standby 5V/0.1A. If any of the mains systems in use around the world may be used as a power source, then an input voltage range of 90V to 270V AC is required, taking into account the relevant tolerances.

The application circuit using the TDA 16888 is able to cover universal input voltage range mentioned above (if required). In this circuit a boost converter (Q1, L2, D5, C3) works as an active harmonic filter to provide power factor correction, intermediate circuit voltage stabilization and to supply the primary and secondary side control logic in normal and standby operation. In addition, the bridging time for dips in the mains voltage is not dependent on the mains voltage level. How the IC works in a typical application circuit is described below.

Start up

When the mains voltage is switched on, the smoothing capacitor C3 is charged by a current pulse, the current being limited by the winding resistances of the chokes and NTC resistor R36. Start-up capacitor C11A is charged by a low current (<1mA) through resistors R2 and R43. Once the switch-on threshold (14V) is reached at pin 19, the TDA 16888 changes from the passive to the active state. In the passive state the IC draws a maximum current of 100µA while monitoring the switching thresholds and actively maintaining the driver outputs at the L-level. In the active state the chip first checks whether the intermediate circuit voltage at pin 19 lies between 20% and 120% of its nominal value (e.g. between 80V and 480V for a nominal value of 400V). If this is the case, the chip concludes that monitoring for the intermediate circuit voltage is connected (FMEA) and there is no risk to operation from an overvoltage.

If the intermediate circuit voltage is found to be satisfactory, and no excess current is detected at pin 6, then the PFC converter starts working at half the rated frequency to cut the IC current consumption. During this process the TDA 16888 is initially powered from the start-up capacitor C11A until the boost converter starts to supply it, or, should the IC switch-off threshold (11V) be reached first, it switches into the passive state and a new start-up attempt is initiated. As soon as the intermediate circuit voltage has reached 80% of its nominal value, the PWM also starts running, with both converter sections now operating at the rated frequency. A soft-start procedure is used for the PMW converter, the rise time being set using C14 at pin 13.

If the voltage at pin 13 is less than 0.4V, the chip interprets this condition as standby mode, and shuts off the PWM section. In standby mode the PFC converter again works at half the rated frequency to reduce current consumption.

While the MOSFET Q1is switching, a modulated AC voltage appears at the secondary windings of choke L2. The voltage across the main winding of choke L2 varies during rated operation from 400V when Q1 is cut off and the AC input voltage passes through zero, to 400V when Q1 is conducting and the maximum input voltage is at its peak value. The lowest voltage across the main winding (±200V) arises when the input voltage is exactly half as large as the intermediate circuit voltage. This is why the standby and IC supply voltages are derived from bridge rectification of the auxiliary windings on L2, in order to use both the cut-off and conduction phase of the inductance. The voltage regulators IC5 and Q3/D11 are required because of the variation by a factor of 2 in the dc voltage obtained.

When the PFC converter is run up, the intermediate circuit voltage overshoots. Under low load it takes a considerable time to return to its nominal level, because of the slow discharge of the smoothing capacitor C3. During this period the voltage regulator would cut off the MOSFET Q1(up to more than 100ms), which would prevent the control logic being supplied from the boost converter choke. This is why the TDA 16888 has a further control loop, using input pin 20, in addition to the two control loops for the intermediate circuit voltage and the input current. A second output path from the boost converter (D6, C4, R2) is taken via potential divider R1, R27 to detect whether Q1 is operating.

This works by the voltage at C4 being set using voltage divider R1, R27 to the nominal value of the intermediate circuit voltage, or a few percent below. The short time constant of the second output path from the boost converter (C4≈10nF, R2≈500kΩ) means that any drop in the voltage at C4 is rapidly detected, and the MOSFET Q1 switched on via the PFC current regulator. If necessary this is done with such short pulses that the voltage at the main output from the boost converter does not rise, even with no load at all. The limited controllability of the boost converter during no-load conditions means that the power available at the standby output is limited. For example 5V/100mA is provided with a quite good efficiency.

Normal operation

The oscillator frequency is set by just one external resistor R24. The ramp voltages for the oscillator and the pulse width modulation (PWM) of the PFC section are generated across integrated capacitors. The duty cycle of the PFC section varies from 0 to over 90%, and for the PWM section from 0 to 50% maximum. During one switching period, the PFC MOSFET Q1 switches on first. The PWM MOSFET Q2 switches on half a period later. For greater reliability, flip-flops are used to control this timing sequence. The oscillator therefore runs at twice the rate of the external operating frequency. By integrating the capacitors, external circuitry is not required, and so the current consumption is reduced because of the smaller capacitances.

The waveform of the rectified, unsmoothed mains voltage is detected across resistors R4A, R4B, and applied to the first input of an integrated multiplier. The output voltage from the PFC voltage control amplifier is taken to at the second input to the multiplier. The current at the output of the multiplier, pin 4, is a reference value having the waveform of the rectified mains voltage and an amplitude controlled by the voltage regulator. The PFC current regulator controls the rectified mains current such that the voltage drop across shunt R6 assumes exactly the same value as the voltage drop across R5 produced by the output current from the multiplier. The output current from the PFC current regulator (pin 3) sets up the duty cycle for the MOSFET Q1 by comparison with an internally generated ramp voltage.

The intermediate circuit voltage is regulated by the PFC voltage regulator (pin 17, pin 18) at a level that is greater than or equal to the peak value of the maximum input voltage ($270V \cdot \sqrt{2} = 382V$). An intermediate circuit voltage of 380V is often chosen, because one must expect a maximum voltage of this magnitude even without a PFC converter. A 450V type smoothing capacitor (C3) is used, however, to ensure that even under transient conditions, the voltage remains below the permitted capacitor voltage. In this case it is worth increasing the intermediate circuit voltage to 410V, and to design the onset threshold for overvoltage limiting to be 430V (R11, R12 to give 5.5V at pin 19). The intermediate circuit voltage still remains below 450V during transient conditions, and the benefit lies in the 40% higher hold time, which can be bridged if the mains drops out.

The PWM converter is designed to work as a single-ended forward converter. The turn-on time is determined by the oscillator, as soon as the voltage at the soft start input pin 13 and the control input pin 14 exceeds 0.4V. After the soft start phase, the voltage at control input pin 14 together with the ramp voltage at pin 15 controls the turn-off time. An improved current ramp control technique (current mode control) is used here, where the ramp voltage has an amplitude 5 times higher than those traditionally used. The current in the Q2 source path is also measured across shunt resistor R15, and detected at pin 11. At a voltage of 1V at pin 11, the integrated overcurrent comparator switches off MOSFET Q2. The signal at pin 11 is also amplified by a factor of 5 by a linear amplifier, and taken via an internal 10k resistor to pin 15. A base ramp voltage with an amplitude of 1.5V is produced across capacitor C13 connected to this pin, even when there is no transistor current (slope compensation). This voltage can rise to over 6V when the maximum current flows through Q2. This allows pulse width modulation at higher signal levels, enabling stable operation right up to no-load conditions.

The transformer Tr1 in the forward converter works at the pre-regulated intermediate circuit voltage. This means that a higher transformer ratio can be selected, reducing the current load for the MOSFET. Furthermore, a larger duty cycle can be set during normal operation because there is a smaller variation range for the input voltage. The magnetization energy can be fed back into the smoothing capacitor using a demagnetization winding and demagnetization diode D7.

In forward converters with universal input voltage range this is not possible without pre-regulation, or causes significant losses in the required demagnetization network. In our application circuit, overvoltage peaks across MOSFET Q2 and diode D7 are efficiently limited using diodes D22 and D27 and network C31, R40. On the secondary side there is one rectifying and one freewheeling diode (D8, D9; D20, D21) for each output voltage. A damping network (e.g. R41, C29; R42, C30) is connected in parallel with every diode, to attenuate commutation-induced overvoltage spikes and transients. Another RC element (R47, C34) damps the voltage decay in intermittent dc flow, to avoid irregular premagnetization of the smoothing choke. The output voltages are taken via separate windings on a common smoothing choke L3 to convert the switched voltages into a flow of current. The smoothing capacitors (e.g. C15, C28) reduce the ripple on the output voltage and serve as a storage device when the load changes rapidly. For high output currents it is advisable to divide up the smoothing capacitance with small inductances (L5, L6), to compensate for the equivalent series resistance (ESR) of the capacitors.

The output voltage with the highest stability specification is controlled directly by regulating amplifier IC2 and optocoupler IC3. The other output voltages are stabilized indirectly by the choice of winding ratio for transformer Tr1 and choke L3 according to the ratio of the output voltages. An extra comparator IC6 and optocoupler IC4 monitor the standby output voltage. When the standby switch is closed, the PWM converter is only started once the PFC converter has produced at least 90% of the nominal voltage at the standby output. Standby operation can be initiated by opening the switch. Transistor Q4 with low-pass filter at its base, prevents noise spikes and leakage currents from the optocoupler from discharging the soft-start capacitor during normal operation.

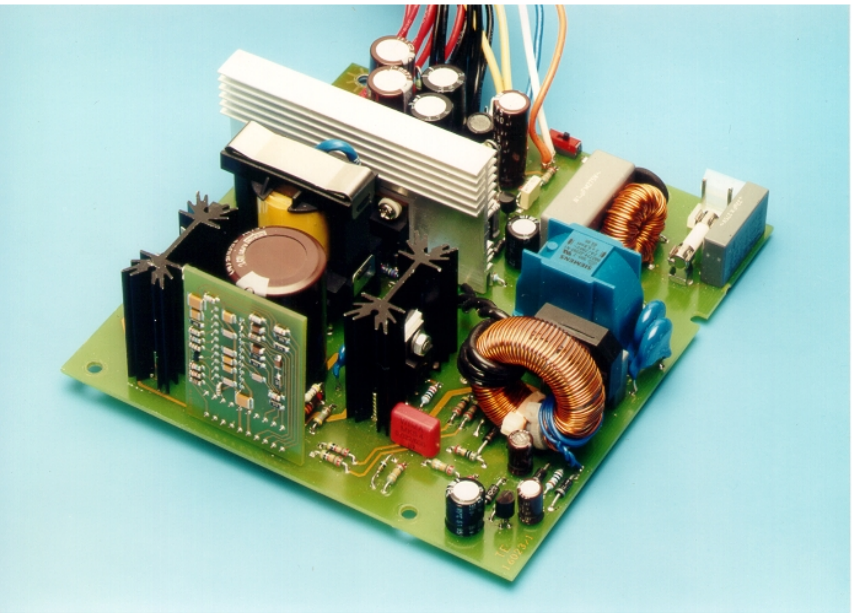
Protective features

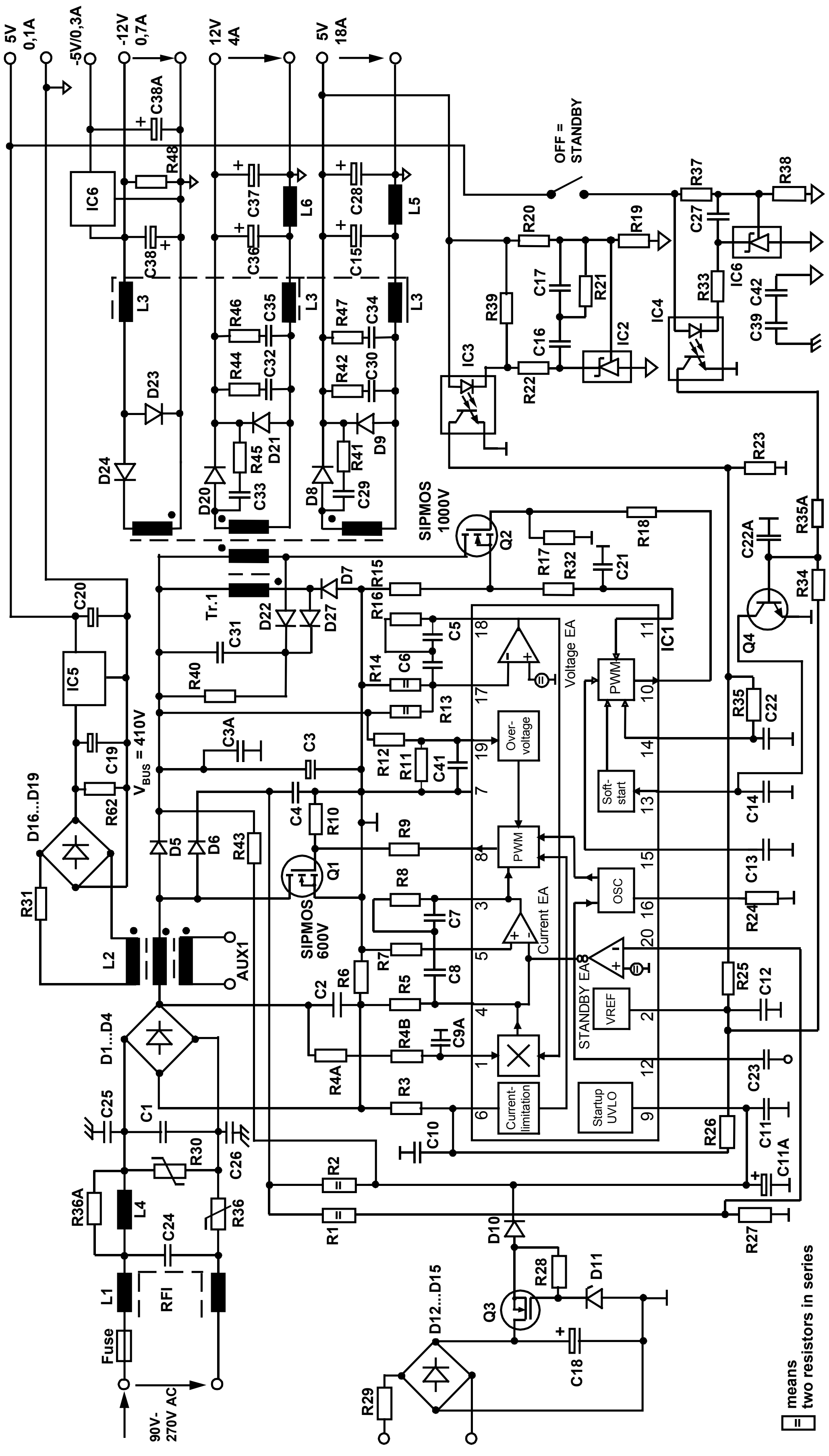
When a short circuit occurs on the output side, the primary current is limited by measuring the drop across shunt R15. In applications with several output voltages, this only works as a short-term protective measure, because the output rectifier, for example, cannot withstand the overload. Extra protection can be provided by monitoring the output voltages for a minimum value, with a delayed switch into standby mode.

To deal with overshoots in the intermediate circuit voltage, a switch-off threshold can be set as required (e.g. 5% above the nominal value) using potential divider R11, R12. If this is exceeded than the PFC converter cuts off the power to the intermediate circuit.

When transient mains surges occur which charge the smoothing capacitor C3 to 10% above the PFC switch-off threshold, the PWM MOSFEET Q2 is also cut-off to protect the power supply unit. If the mains voltage rises still further, then varistor R30 can limit it. Using these protective devices, the application circuit can withstand transient mains surges of 600V and more.

Figure 1:
A 150W PC power supply design with power factor correction using TDA 16888 fits inside a typical PC power supply silver box.





Circuit Diagram of single transistor multioutput forward converter with PFC

V in	I in	P in	PF	THD	V BUS	V out1	I out1	V out2	I out2	V out3	I out3	V out4	I out4	VStby	IStby	P out	Efficiency
V AC	A rms	W	%	%	V DC	V DC	A	V DC	A	V DC	A	V DC	A	V	A	W	%
90	2,45	220,0	99,8	4,6	380,00	5,00	18,10	12,60	4,00	-12,70	0,70	-5,00	0,30	5,00	0,10	151,8	69,0
90	1,62	146,0	99,9	3,5	380,00	5,00	18,00	13,10	1,00	-13,40	0,10	-5,00	0,00	5,00	0,10	104,9	71,9
90	0,60	54,0	99,8	2,8	380,00	5,00	5,00	12,20	1,00	-12,30	0,10	-5,00	0,00	5,00	0,10	38,9	72,1
90		4,8			380,00	5,00	0,00	12,10	0,00	-11,90	0,00	-5,00	0,00	5,00	0,10	0,5	
90		2,7			380,00	0,00		0,00		0,00		0,00		5,00	0,10	0,5	
120	1,70	205,0	99,9	3,4	380,00	5,00	18,10	12,60	4,00	-12,70	0,70	-5,00	0,30	5,00	0,10	151,8	74,0
120	1,17	140,0	99,9	2,8	380,00	5,00	18,00	13,10	1,00	-13,40	0,10	-5,00	0,00	5,00	0,10	104,9	75,0
120	0,44	53,0	99,4	6,0	380,00	5,00	5,00	12,20	1,00	-12,30	0,10	-5,00	0,00	5,00	0,10	38,9	73,5
120		4,7			380,00	5,00	0,00	12,10	0,00	-11,90	0,00	-5,00	0,00	5,00	0,10	0,5	
120		2,7			380,00	0,00		0,00		0,00		0,00		5,00	0,10	0,5	
180	1,10	198,0	99,7	3,6	380,00	5,00	18,10	12,60	4,00	-12,70	0,70	-5,00	0,00	5,00	0,10	150,3	75,9
180	0,76	136,0	99,5	1,5	380,00	5,00	18,00	13,10	1,00	-13,40	0,10	-5,00	0,00	5,00	0,10	104,9	77,2
180	0,29	51,0	97,0	12,5	380,00	5,00	5,00	12,20	1,00	-12,30	0,10	-5,00	0,00	5,00	0,10	38,9	76,3
180		4,5			380,00	5,00	0,00	12,10	0,00	-11,90	0,00	-5,00	0,00	5,00	0,10	0,5	
180		2,6			380,00	0,00		0,00		0,00		0,00		5,00	0,10	0,5	
230	0,85	196,0	99,4	4,0	380,00	5,00	18,10	12,60	4,00	-12,70	0,70	-5,00	0,00	5,00	0,10	150,3	76,7
230	0,59	135,0	98,9	4,5	380,00	5,00	18,00	13,10	1,00	-13,40	0,10	-5,00	0,00	5,00	0,10	104,9	77,7
230	0,24	51,0	94,0	14,0	380,00	5,00	5,00	12,20	1,00	-12,30	0,10	-5,00	0,00	5,00	0,10	38,9	76,3
230		4,6			380,00	5,00	0,00	12,10	0,00	-11,90	0,00	-5,00	0,00	5,00	0,10	0,5	
230		2,5			380,00	0,00		0,00		0,00		0,00		5,00	0,10	0,5	
270	0,73	196,0	98,9	4,4	380,00	5,00	18,10	12,60	4,00	-12,70	0,70	-5,00	0,00	5,00	0,10	150,3	76,7
270	0,51	134,0	98,3	5,1	380,00	5,00	18,00	13,10	1,00	-13,40	0,10	-5,00	0,00	5,00	0,10	104,9	78,3
270	0,21	51,0	90,4	16,0	380,00	5,00	5,00	12,20	1,00	-12,30	0,10	-5,00	0,00	5,00	0,10	38,9	76,3
270		4,4			380,00	5,00	0,00	12,10	0,00	-11,90	0,00	-5,00	0,00	5,00	0,10	0,5	
270		2,5			380,00	0,00		0,00		0,00		0,00				0,5	

Test Results of single transistor multioutput forward converter with PFC

Bill of Materials

Component	Value	Order-Nr.	Manufacturer
IC 1 *	TDA 16888	Q67000-A9284	Infineon
IC 2	TL 431 C		TI
IC 3	CNY 17 F-3	Q62703-N50	Infineon
IC 4	CNY 17-3	Q62703-N88	Infineon
IC 5	TLE 4264 G	Q67006-A-9139	Infineon
IC 6	TL 431 C		TI
Q 1	BUZ 91 (600V/ 0,8 Ω)	Q67078-S1342-A2	Infineon
Q 2	BUZ 51 (1000V/ 4Ω)	Q67078-S1344-A2	Infineon
Q 3	BSS 129 (240V/ 20Ω, Depletion)	Q67000-S116	Infineon
Q 4 *	BC 338 (30V/ 800mA, NPN)	Q62702-C314	Infineon
D 1...D 4	GR B250 C5000/3300		
D 5	STTA506D (600V; 5A; 20ns)		ST
D 6	MUR 160 (600V; 1A; 75ns)		Motorola
D 7	BYT 11-1000 (1000V; 1A; 100ns)		ST
D 8, D 9	MBR 2535 CTL (Schottky 35V; 2x 12,5A)		Motorola
D 10	1N4148		
D 11	BZX 83 C13		
D 12...D 15	UF 4003 (100V; 1A; 50ns)		GI
D 16...D 19	UF 4003 (100V; 1A; 50ns)		GI
D 20, D 21	BYV 32-100 (100V; 2x 10A; 25ns)		Eupec, Philips
D 22	BYT 11-1000 (1000V; 1A; 100ns)		ST
D 23, D 24	MUR 120 (200V; 1A; 50ns)		Motorola
D 27	BYT 11-1000 (1000V; 1A; 100ns)		ST
L 1	2x 6,8mH/ 2A	B82724-J2202-N1	EPCOS
L 2	1mH E36/11; N27; GAP 2mm 100turns, 0,6mm ∅ AUX 1: 8turns 0,33mm ∅ AUX 2: 5turns 0,33mm ∅	B66389-G1000-X127	EPCOS
L 3	8µH (W3) E36/11, N27, GAP 2mm W3: 9turns 2x 2x0,9mm ∅ W1: 21turns 0,7mm ∅ W2: 21turns 0,3mm ∅	B66389-G1000-X127	EPCOS
L 4	500µH EF25, N27, GAP 2mm 90turns, 0,45mm ∅	B66317-G1000-X127	EPCOS
L 5	1µH 9turns 2mm ∅ airchoke		
L 6	1µH 10turns 1,2mm ∅ airchoke		
Fuse	2,5A MT		
Component	**Value**	**Order-Nr.**	**Manufacturer**
T 1	E36/11, N27, without GAP Primary: 68 turns 0,40mm ∅ Demagn.: 68 turns 0,22mm ∅ Sec.1: 3 turns 4x 0,8mm ∅ Sec.2: 7 turns 2x 0,8mm ∅ Sec.3: 7 turns 0,4mm ∅	B66389-G-X127	EPCOS

Component	Value	Order-Nr.	Manufacturer
C 1	0,33µF 275V AC, X2	B81133-D1334-M	EPCOS
C 2	not assembled		
C 3	150µF/ 450V Elko	B43501-J5157-M	EPCOS
C 3A	0,15µF/ 630V MKP	B32652-A6154-K	EPCOS
C 4	10nF/ 1000V MKP	B32652-A103-K	EPCOS
C 5 *	47nF/63V MKT	B32529-C473-K	EPCOS
C 6 *	100nF/63V MKT	B32529-C104-K	EPCOS
C 7 *	1nF/63V MKT	B32529-C102-K	EPCOS
C 8 *	10nF/63V MKT	B32529-C103-K	EPCOS
C 9 *	not assembled		
C 9A *	6,8nF/63V MKT	B32529-C682-K	EPCOS
C 10 *	10pF/100V CG	B37979-G1100-J51	EPCOS
C 11 *	0,47µF/63V MKT	B32529-C474-K	EPCOS
C 11A *	100µF/25V Elko	B41283-C5107-T90	EPCOS
C 11B *	47nF/50V X7R	B37981-F5473-K51	EPCOS
C 12 *	0,15µF/63V MKT	B32529-C154-K	EPCOS
C 13 *	100pF/50V CG	B37979-G5101-J51	EPCOS
C 14 *	100nF/63V MKT	B32529-C104-K	EPCOS
C 15	2200µF/10V Elko	B41822-A3228-M	EPCOS
C 16	68nF/63V MKT	B32529-C683-K	EPCOS
C 17	2,2nF/63V MKT	B32529-C222-K	EPCOS
C 18	100µF/63V Elko	B41822-A8107-M	EPCOS
C 19	470µF/35V Elko	B41822-A7477-M	EPCOS
C 20	100µF/25V Elko	B41822-A1107-M	EPCOS
C 21 *	220pF/50V CG	B37979-G5221-J51	EPCOS
C 22 *	4,7nF/63V MKT	B32529-C472-K	EPCOS
C 22A *	10nF MKT	B32529-C103-K	EPCOS
C 23 *	not assembled		
C 24	0,33µF 275V AC, X2	B81133-D1334-M	EPCOS
C 25, C 26	3,3nF 250V AC, Y2, lead spacing 15mm	B81121-C-B142	EPCOS
C 25, C 26	3,3nF 250V AC, Y2, lead spacing 10mm	B81122-C1332-M	EPCOS
C 27	4,7nF/63V MKT	B32529-C472-K	EPCOS
C 28	2200µF/10V Elko	B41822-A3228-M	EPCOS
C 29	1nF/63V MKT	B32529-C102-K	EPCOS
C 30	1nF/63V MKT	B32529-C102-K	EPCOS
C 31	1nF/630V Position R 40		
C 32	2,2nF/63V MKT	B32529-C222-K	EPCOS
C 33	2,2nF/63V MKT	B32529-C222-K	EPCOS
C 34	insert wire bridge		
C 35	insert wire bridge		
C 36	1000µF/16V	B41822-A4108-M	EPCOS
C 37	1000µF/16V	B41822-A4108-M	EPCOS
C 38	470µF/16V	B41822-A4477-M	EPCOS
C 39	3,3nF 250V AC, Y1	B81123-C1332-M	EPCOS
C 41 *	220pF/50V CG	B37979-G5221-J51	EPCOS
C 40	not assembled		
C 42	insert wire bridge		
C	1,5nF/630V assembled between Heatsink of Q2 and BUS Voltage		

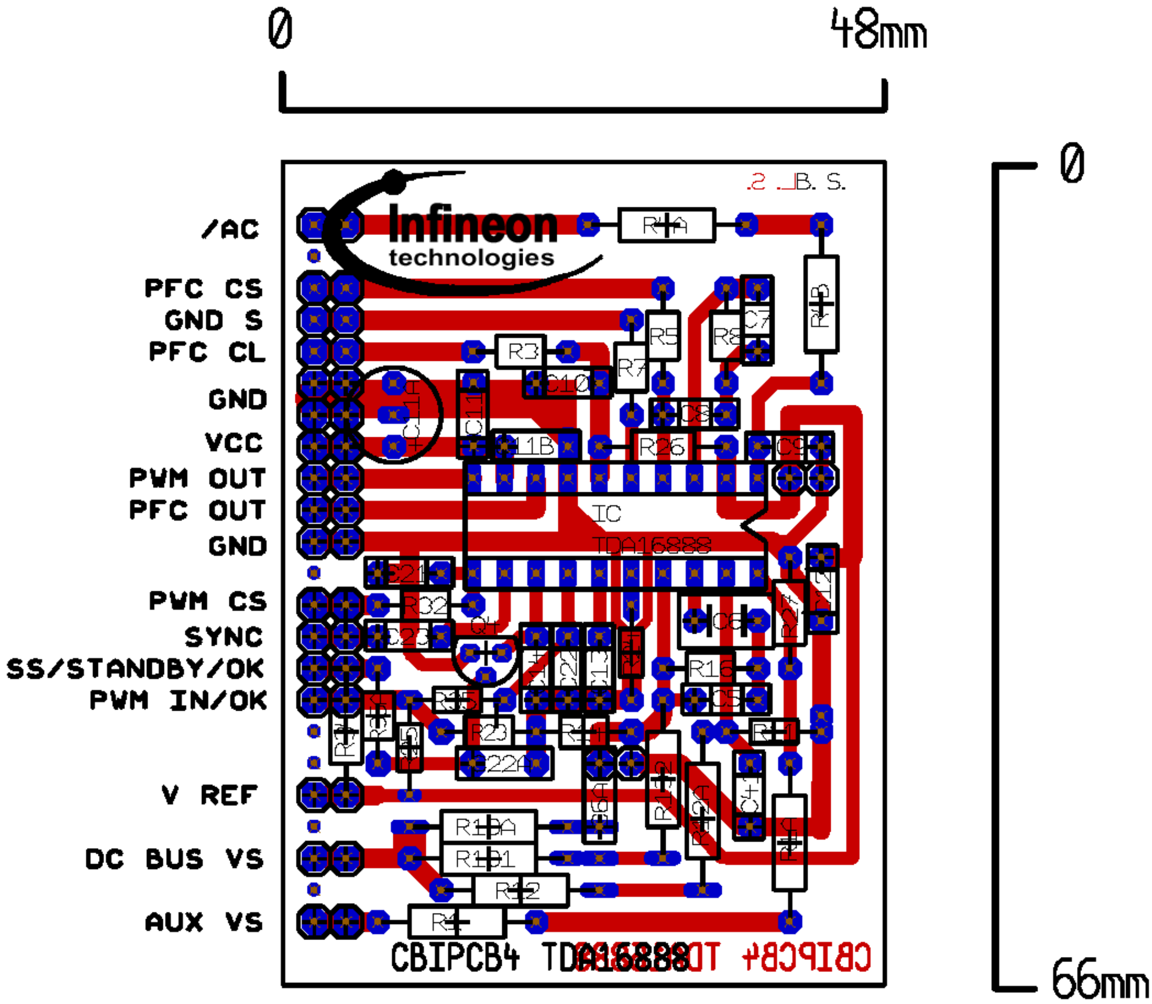
* = located on control board

Component	Value	Order-Nr.	Manufacturer
R 1 *	3825K 2x 1,91M metal		
R 2	220K		
R 2A	220K		
R 3 *	22K		
R 4A *	390K metal		
R 4B *	390K metal		
R 5 *	2,2K		
R 6	0,22 1 + 2x 0,56 parallel		
R 7 *	2,2K		
R 8 *	7,5K		
R 9	3,3		
R 10	18K		
R 11 *	51K metal		
R 12 *	3825K 2x 1,91M metal		
R 13 *	3825K 2x 1,91M metal		
R 14 *	51K metal		
R 15	0,50 2x 1 parallel		
R 16 *	390K		
R 17	18K		
R 18	3,3		
R 19	5,1K metal		
R 20	5,1K metal		
R 21	10K		
R 22	680		
R 23 *	33K		
R 24 *	51 K metal		
R 25 *	10K		
R 26 *	68K		
R 27 *	51K metal		
R 28	4,7K		
R 29	1		
R 30	SIOV-S14K250G5	Q69x4603	EPCOS
R 31	insert wire bridge		
R 32 *	1,1K		
R 33	470		
R 34 *	56K		
R 35 *	1,1K		
R 35A *	680		
R 36A	56 4W		
R 37	3,9K metal		
R 38	5,1K metal		
R 39	1K1		
R 40	220K 2W		
R 41	33		
R 42	33		
R 43	not assembled		
R 43 A	330K 2W between VBUS and VCC		
R 44	56		
R 45	56		
R 46	470		
R 47	100		
R 48	470		
R 49	not assembled		

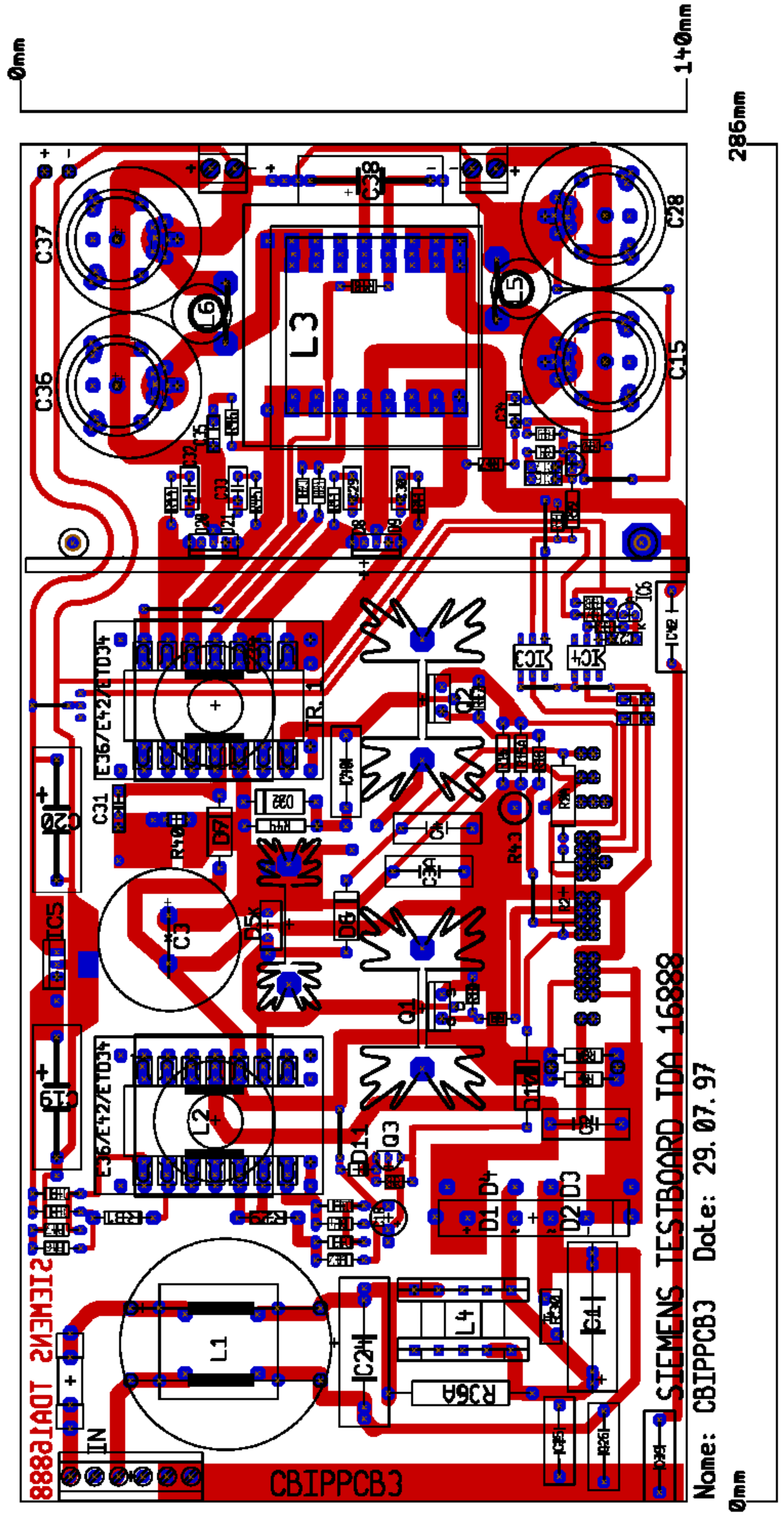
• = located on control board

Warning: Heatsink of D5 is connected to 380V BUS Voltage !

Printed Circuit Board of control circuit



Board 48 x 66mm
Name: CBIPCB4

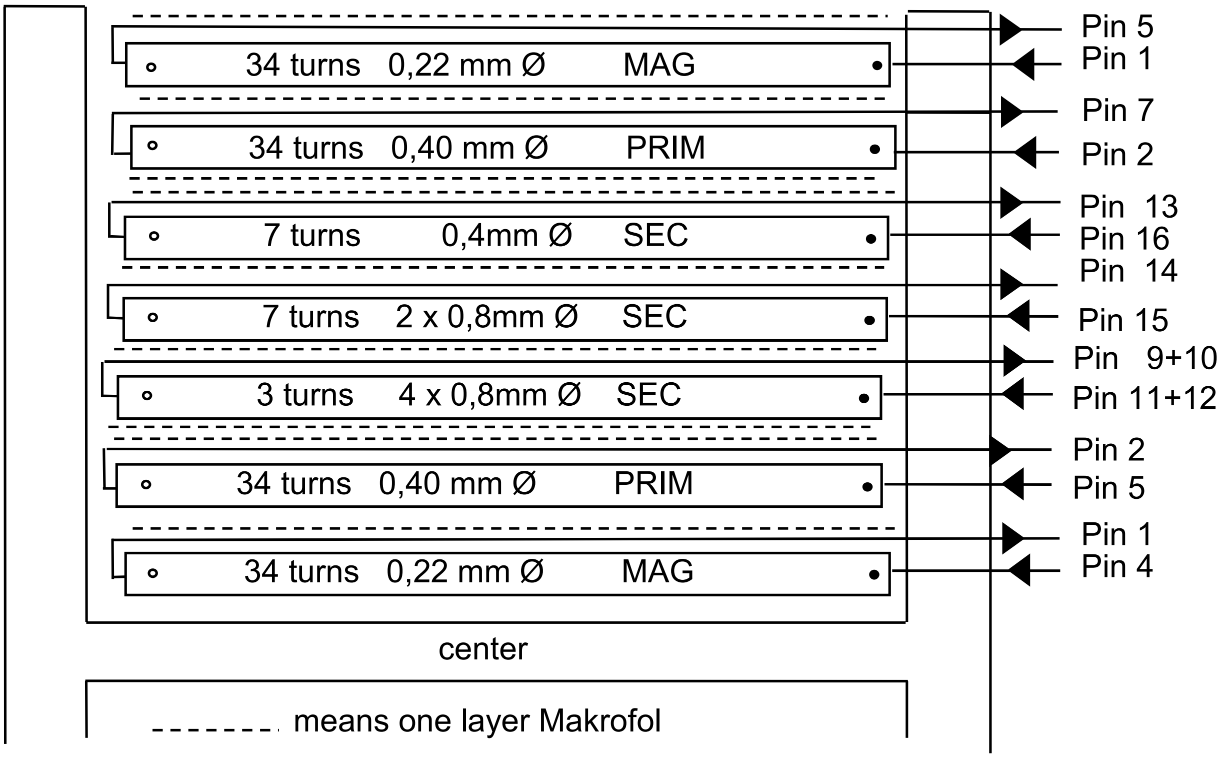


Warning: Heatsink of D5 is connected to 380V BUS Voltage !

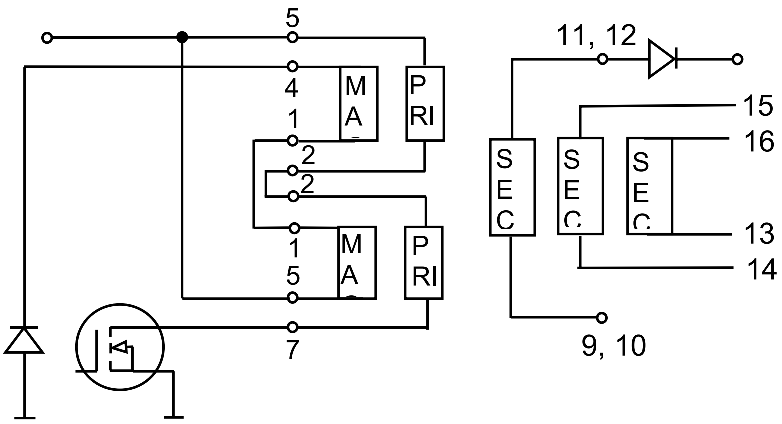
Printed Circuit Board of power circuit

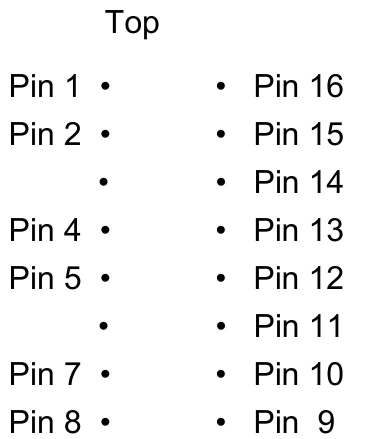
Single ended feed forward Transformer

150W / 100kHz; Output voltage: 5V/18A; 12V/4A; -12V/1A
Core E36/18/11; N27; without gap; A_{LMIN} = 2330nH; coil former vertical



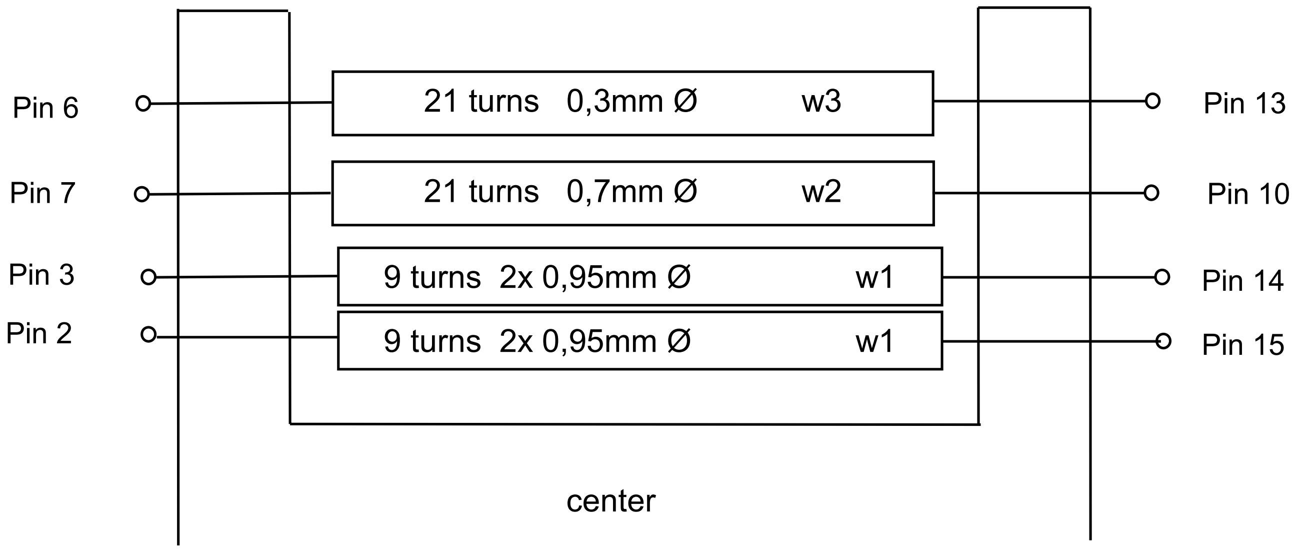
Primary winding	68 turns	0,40 mm ∅	transformer wire
Demagnetization	68 turns	0,22 mm ∅	transformer wire
Secondary winding1	3 turns	4 x 0,8 mm ∅	transformer wire
Secondary winding2	7 turns	2 x 0,8 mm ∅	transformer wire
Secondary winding3	7 turns	0,4 mm ∅	transformer wire





Smoothing Choke of single ended forward converter

Core E36/18/11; N27; total gap = 2mm; A_L = 100nH; coil former horizontal;
L = 8µH; @5V output



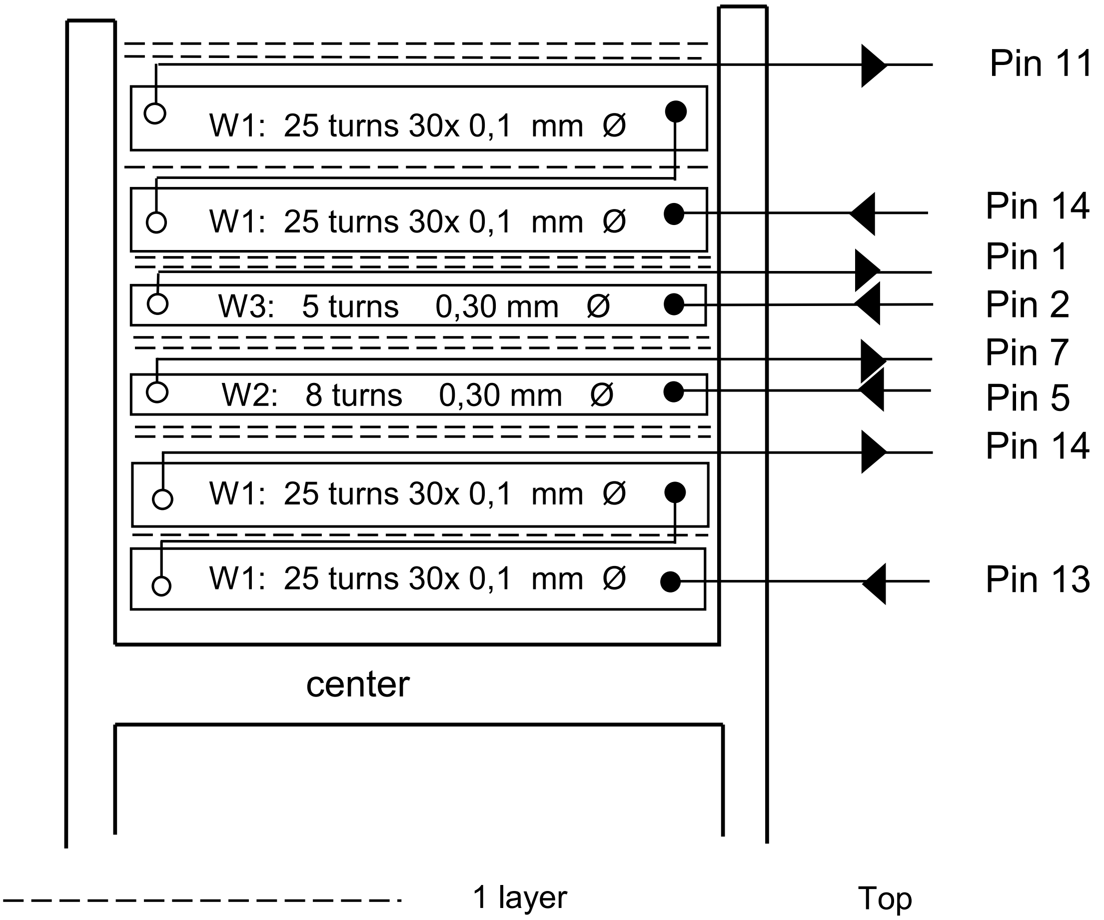
Winding 1: 9 turns 2 x 2 x 0,95 mm ∅ transformer wire
Winding 2: 21 turns 0,7 mm ∅ transformer wire
Winding 2: 21 turns 0,3 mm ∅ transformer wire

Top

Pin 8 •	• Pin 9
Pin 7 •	• Pin 10
Pin 6 •	• Pin 11
Pin 5 •	• Pin 12
Pin 4 •	• Pin 13
Pin 3 •	• Pin 14
Pin 2 •	• Pin 15
Pin 1 •	• Pin 16

Boost converter choke for PFC

Core E36/18/11; N27; total gap = 2mm; A_L = 100 nH;
L = 1 mH; I_{PEAK} = 3,5 A; coil former vertical



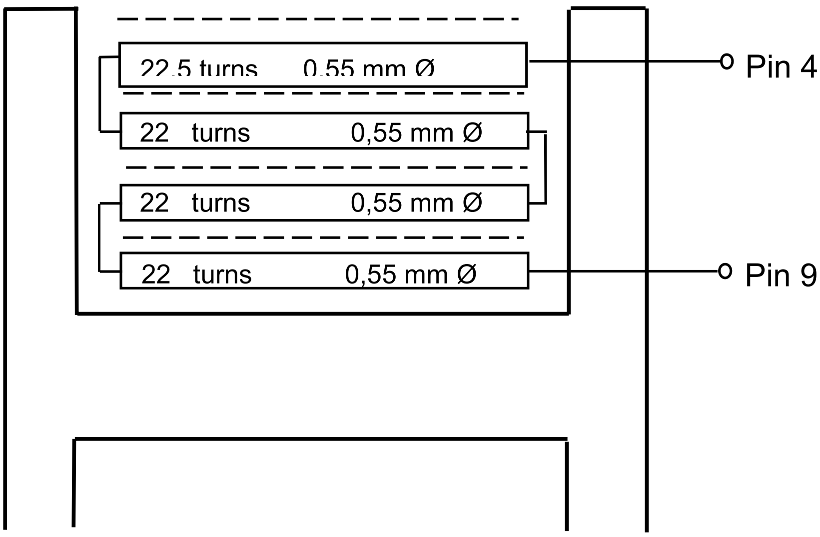
W1 : 100 turns 30 x 0,1stranded wire w/ silk
W2 : 8 turns 0,30 transformer wire
W3 : 5 turns 0,30 transformer wire

Top

Pin 1 •	• Pin 16
Pin 2 •	• Pin 15
•	• Pin 14
Pin 4 •	• Pin 13
Pin 5 •	• Pin 12
•	• Pin 11
Pin 7 •	• Pin 10
Pin 8 •	• Pin 9

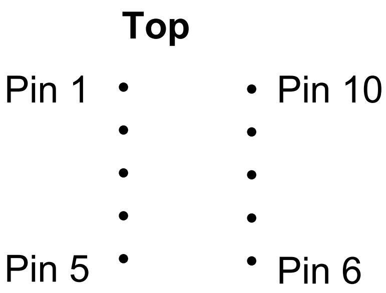
RFI Choke L= 470µH, I_{PEAK}= 3,5A

Core E 25/13/7 (EF25), N27, total gap= 2mm, A_L=54 nH,
coil former vertical



– – – – – means one layer of Makrofol

88,5 turns transformer wire 0,55 mm Ø




SIEMENS TESTBOARD TDA 16888
CBIPPCB3

References:

[1] nnn

Revision History		
Application Note AN-TDA16888-0-010323		
Actual Release: V1.1 Date:2001-03-23		Previous Release: V0.1
Page of actual Release	Page of prev. Release	Subjects changed since last release

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St.-Martin-Strasse 53,
D-81541 München

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Infineon Technologies AG sales offices worldwide – partly represented by Siemens AG

A
Siemens AG Österreich
Erdberger Lände 26
A-1031 Wien
T (+43)1-17 07-3 56 11
Fax (+43)1-17 07-5 59 73

AUS
Siemens Ltd.
885 Mountain Highway
Bayswater,Victoria 3153
T (+61)3-97 21 21 11
Fax (+61)3-97 21 72 75

B
Siemens Electronic Components
Benelux
Charleroisesteenweg 116/
Chaussée de Charleroi 116
B-1060 Brussel/Bruxelles
T (+32)2-5 36 69 05
Fax (+32)2-5 36 28 57
Email:components@siemens.nl

BR
Siemens Ltda.
Semiconductores
Avenida Mutinga,3800-Pirituba
05110-901 São Paulo-SP
T (+55)11-39 08 25 64
Fax (+55)11-39 08 27 28

CDN
Infineon Technologies Corporation
320 March Road,Suite 604
Canada,Ontario K2K 2E2
T (+1)6 13-5 91 63 86
Fax (+1)6 13-5 91 63 89

CH
Siemens Schweiz AG
Bauelemente
Freilagerstrasse 40
CH-8047 Zürich
T (+41)1-4 953065
Fax (+41)1-4 955050

D
Infineon Technologies AG
Völklinger Str.2
D-40219 Düsseldorf
T (+49)2 11-3 99 29 30
Fax (+49)2 11-3 99 14 81
Infineon Technologies AG
Werner-von-Siemens-Platz 1
D-30880 Laatzen (Hannover)
T (+49)5 11-8 77 22 22
Fax (+49)5 11-8 77 15 20
Infineon Technologies AG
Von-der-Tann-Straße 30
D-90439 Nürnberg
T (+49)9 11-6 54 76 99
Fax (+49)9 11-6 54 76 24
Infineon Technologies AG
Weissacher Straße 11
D-70499 Stuttgart
T (+49)7 11-1 37 33 14
Fax (+49)7 11-1 37 24 48

D
Infineon Technologies AG
Halbleiter Distribution
Richard-Strauss-Straße 76
D-81679 München
T (+49)89-92 21 40 86
Fax (+49)89-92 21 20 71

DK
Siemens A/S
Borupvang 3
DK-2750 Ballerup
T (+45)44 77-44 77
Fax (+45)44 77-40 17

E
Siemens S.A.
Dpto.Componentes
Ronda de Europa,5
E-28760 Tres Cantos-Madrid
T (+34)91-5 14 71 51
Fax (+34)91-5 14 70 13

F
Infineon Technologies France,
39/47,Bd.Ornano
F-93527 Saint-Denis CEDEX2
T (+33)1-49 22 31 00
Fax (+33)1-49 22 28 01

FIN
Siemens Components
Scandinavia
P.O .Bo x 6 0
FIN-02601 Espoo (Helsinki)
T (+3 58)10-5 11 51 51
Fax (+3 58)10-5 11 24 95
Email:
scs@components.siemens.se

GB
Infineon Technologies
Siemens House
Oldbury
GB-Bracknell,Berkshire
RG12 8FZ
T (+44)13 44-39 66 18
Fax (+44)13 44-39 66 32

H
Simacomp Kft.
Lajos u.103
H-1036 Budapest
T (+36)1-4 57 16 90
Fax (+36)1-4 57 16 92

HK
Infineon Technologies
Hong Kong Ltd.
Suite 302,Level 3,
Festival Walk,
80 Tat Chee Avenue,
Yam Yat Tsuen,
Kowloon Tong
Hong Kong
T (+8 52)28 32 05 00
Fax (+8 52)28 27 97 62

I
Siemens S..A.
Semiconductor Sales
Via Piero e Alberto Pirelli,10
I-20126 Milano
T (+39)02-66 76 -1
Fax (+39)02-66 76 43 95

IND
Siemens Ltd.
Components Division
No.84 Keonics Electronic City
Hosur Road
Bangalore 561 229
T (+91)80-8 52 11 22
Fax (+91)80-8 52 11 80
Siemens Ltd.
CMP Div,5th Floor
4A Ring Road,IP Estate
New Delhi 110 002
T (+91)11-3 31 99 12
Fax (+91)11-3 31 96 04
Siemens Ltd.
CMP Div,4th Floor
130,Pandurang Budhkar Marg,
Worli
Mumbai 400 018
T (+91)22-4 96 21 99
Fax (+91)22-4 96 22 01

IRL
Siemens Ltd.
Electronic Components Division
8,Raglan Road
IRL-Dublin 4
T (+3 53)1-2 16 23 42
Fax (+3 53)1-2 16 23 49

IL
Nisko Ltd.
2A,Habarzel St.
P.O.Box 58151
61580 Tel Aviv –Isreal
T (+9 72)3 -7 65 73 00
Fax (+9 72)3 -7 65 73 33

J
Siemens Components K.K.
Talanawa Park Tower 12F &17F
3-20-14,Higashi-Gotanda,
Shinagawa-ku
Tokyo
T (+81)3-54 49 64 11
Fax (+81)3 -54 49 64 01

MAL
Infineon Technologies AG
Sdn Bhd
Bayan Lepas Free Industrial Zone1
11900 Penang
T (+60)4 -6 44 99 75
Fax (+60)4 -6 41 48 72

N
Siemens Components
Scandinavia
Østre Aker vei 24
Postboks 10,Veitvet
N-0518 Oslo
T (+47)22-63 30 00
Fax (+47)22-68 49 13
Email:
scs@components.siemens.se

NL
Siemens Electronic Components
Benelux
Postbus 16068
NL-2500 BB Den Haag
T (+31)70-3 33 20 65
Fax (+31)70-3 33 28 15
Email:components@siemens.nl

NZ
Siemens Auckland
300 Great South Road
Greenland
Auckland
T (+64)9-5 20 30 33
Fax (+64)9-5 20 15 56

P
Siemens S.A.
an Componentes Electronicos
R.Irmaos Siemens,1
Alfragide
P-2720-093 Amadora
T (+351)1-4 17 85 90
Fax (+351)1-4 17 80 83

PK
Siemens Pakistan Engineering
Co.Ltd.
PO Box 1129,Islamabad 44000
23 West Jinnah Ave
Islamabad
T (+92)51-21 22 00
Fax (+92)51-21 16 10

PL
Siemens SP.z.o.o.
ul.Zupnicza 11
PL-03-821 Warszawa
T (+48)22-8 70 91 50
Fax (+48)22-8 70 91 59

ROK
Siemens Ltd.
Asia Tower,10th Floor
726 Yeoksam-dong,Kang-nam Ku
CPO Box 3001
Seoul 135-080
T (+82)2-5 27 77 00
Fax (+82)2-5 27 77 79

RUS
INTECH electronics
ul.Smolnaya,24/1203
RUS-125 445 Moskva
T (+7)0 95 -4 51 97 37
Fax (+7)0 95 -4 51 86 08

S
Siemens Components Scandinavia
Österögatan 1,Box 46
S-164 93 Kista
T (+46)8-7 03 35 00
Fax (+46)8-7 03 35 01
Email:
scs@components.siemens.se

RC
Infineon Technologies
Asia Pacific Pte.Ltd.
Taiwan Branch
10F,No.136 Nan King East Road
Section 23,Taipei
T (+8 86)2-27 73 66 06
Fax (+8 86)2-27 71 20 76

SGP
Infineon Technologies Asia
Pacific,Pte.Ltd.
168 Kallang Way
Singapore 349 253
T (+65)8 40 06 10
Fax (+65)7 42 62 39

USA
Infineon Technologies Corporation
1730 North First Street
San Jose,CA 95112
T (+1)4 08-5 01 60 00
Fax (+1)4 08-5 01 24 24
Siemens Components,Inc.
Optoelectronics Division
19000 Homestead Road
Cupertino,CA 95014
T (+1)4 08-2 57 79 10
Fax (+1)4 08-7 25 34 39
Siemens Components,Inc.
Special Products Division
186 Wood Avenue South
Iselin,NJ 08830-2770
T (+1)7 32-9 06 43 00
Fax (+1)7 32-6 32 28 30

VRC
Infineon Technologies
Hong Kong Ltd.
Beijing Office
Room 2106,Building A
Vantone New World Plaza
No.2 Fu Cheng Men Wai Da Jie
Jie
100037 Beijing
T (+86)10 -68 57 90 -06,-07
Fax (+86)10 -68 57 90 08
Infineon Technologies
Hong Kong Ltd.
Chengdu Office
Room14J1,Jinyang Mansion
58 Tidu Street
Chengdu,
Sichuan Province 610 016
T (+86)28-6 61 54 46 /79 51
Fax (+86)28 -6 61 01 59
Infineon Technologies
Hong Kong Ltd.
Shanghai Office
Room1101,Lucky Target Square
No.500 Chengdu Road North
Shanghai 200003
T (+86)21-63 6126 18 /19
Fax (+86)21-63 61 11 67
Infineon Technologies
Hong Kong Ltd.
Shenzhen Office
Room 1502,Block A
Tian An International Building
Renim South Road
Shenzhen 518 005
T (+86)7 55 -2 28 91 04
Fax (+86)7 55-2 28 02 17

ZA
Siemens Ltd.
Components Division
P.O.B.3438
Halfway House 1685
T (+27)11-6 52 -27 02
Fax (+27)11-6 52 20 42