

Planar Components

扁平磁性元器件

EG (ShangHai) commercial co. Ltd.

依技（上海）

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Agenda

- 1, **History-发展历史**
- 2, **Product family-EG MTC产品类型**
 - **Range of terminations 安装方式**
 - **Winding design 绕组设计**
- 3, **Electrical and mechanical advantages-电气及机构上的优点**
- 4, **Product show 产品展示**
- 5, **Conditions for planar-怎样条件下可考虑平面磁性元件**

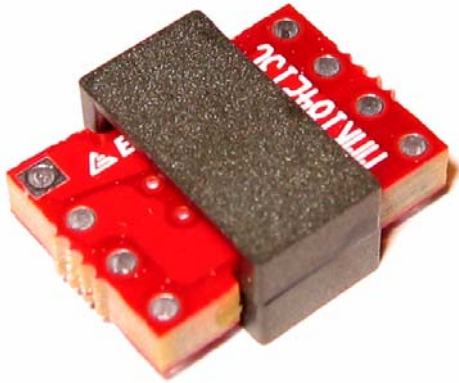
History--发展历史

- Has been used since early 1980's , military and aerospace applications.
上世纪80年代开始在军事及航空领域得到应用
- Over the past 10 years, become more common , in telecom and industrial applications.
过去十年中开始在工业及电信行业扩展
- EGMTC / in 1990's . EG MTC AB在90年代开始进入此领域
- EGMTC application areas: military, telecom and industrials.
开发产品主要应用于：电信，军事，工业领域

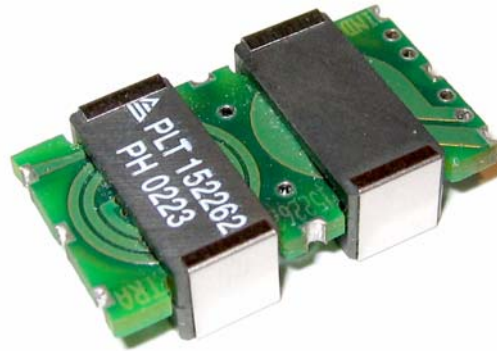
Background--背景

- Faraday's Law: $V=C*N*Ae*f*B*10^{-8}$ (where C is the form factor constant; 4 square wave, 4.44 sine wave)
- Core volume will be fixed after reaching a certain value of f due to: 磁芯体积达到一定值之后将被固定, 由于:
 - switching losses 开关损耗
 - increased core loss => flux density to be derated
磁芯损耗
 - parasitic elements 寄生因素
- Trend is to spread out this volume on, and inside, the main board (有效面积=截面积/体积)

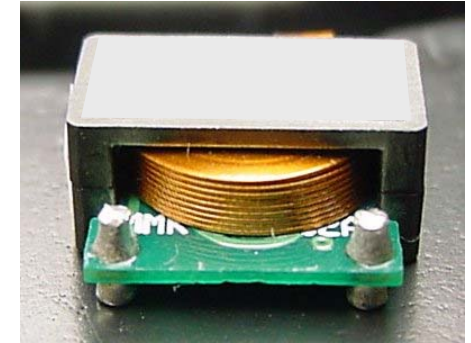
Product Family



- Transformer built on multi-layer PCB
- 磁芯集成在多层PCB上

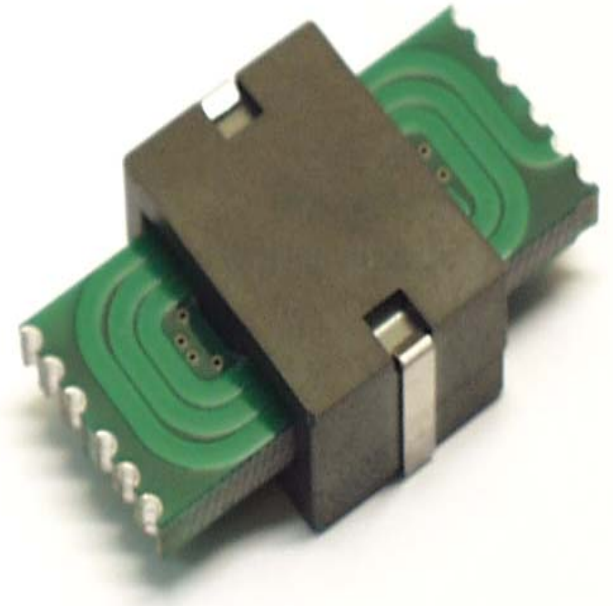
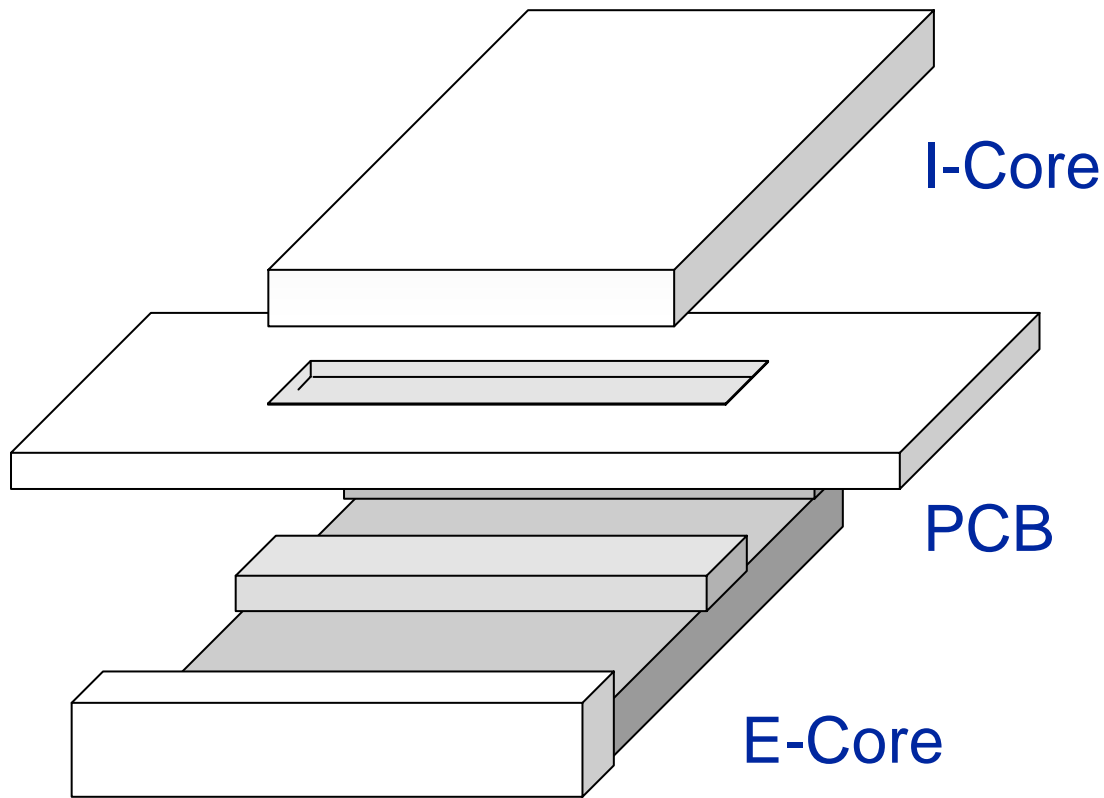


- Planar Module
- 平面模组

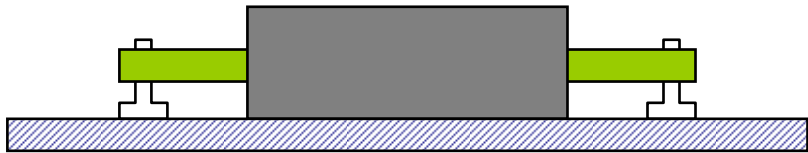


- Planar Module using PCB & Helical coil
- PCB绕组和铜箔绕组结合

Basic structure and final look --基本架构 及成品样貌



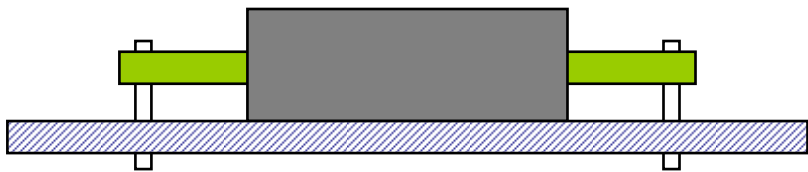
Range of Terminations—安装方式



- **SMD with specially designed SMD pin**
(不需要切开主板, 散热条件好)



- **SMD without pin**
(整体高度降低)



- **TH termination with pin**
(机械性能好)



Variable Pinning—多种引脚方式

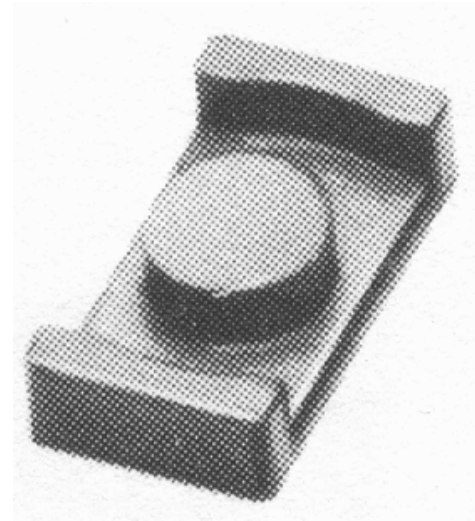
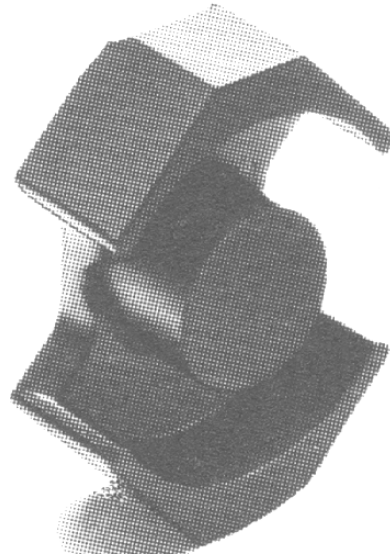
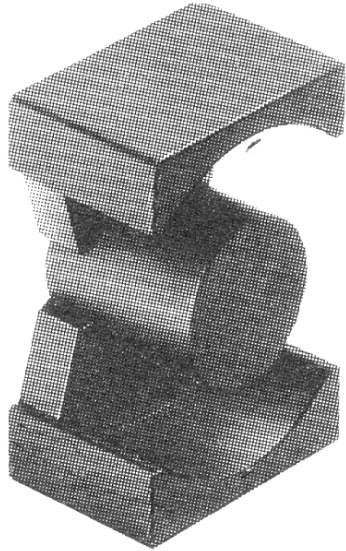
- Not forced to certain pin configuration
不需要像传统变压器那样，尺寸由bobbin定义
- Number of inputs/outputs can easily be chosen upon customer requests/demands
输入/输出由客户自行决定
- Pitch can be adjusted to fit customer application
- 脚间距可以根据客户的应用做适当的调整

Winding Design—绕组设计

- **Stacked Printed Circuit Board 单层PCB板重叠**
 - Individual boards fabricated to fit the shape of the core and the terminations can be stacked, then the electrically connected.
 - **Disadvantage** : it needs a larger winding window height, and more high cost
- **Stand Alone Multilayer Board 多层PCB板, 绕组**
 - A separate printed circuit board consisting only of the planar windings may be fabricated to fit the shape of core and terminations being used . The magnetic is assembled and then placed on the main board. Or in a cutout on the main board to conserve height
- **Integrated on Mother Board 绕组镶嵌在主板上**
 - The windings are built into the main multilayer board being designed. Cutouts for the core center-leg and outside legs are made in the board
 - **Disadvantage**: The layers of windings limited by the main board, and It is too difficult to change windings. Extra Layers of Main board wasted.

Alternative Core Shapes

- EQ-, PQ, RM- & ER-core 可用到的磁心形状



- **Advantage: lower DCR due to more efficient use of copper**
优点：因为会充分利用铜箔所以DCR会比较小，铜损相对的少一些

Electrical Advantages—电气性能

- **High power density 功率密度高**
 - **Up to 3 times as compared to conventional transformers**
(20-30w/inch²,传统: 10w/inch² 由散热面积, 磁芯利用率, 绕组方式决定)
- **High efficiency 效率高**
 - **Typically > 95%**
(由绕组方式决定--磁芯损耗小, 直流电阻小, 传统小于92%)
- **Low EMI emission EMI发射低**
 - **Efficient core shielding 有效磁芯屏蔽**
- **Low leakage inductance 漏感小**
 - **Typically $\leq 1\%$ of primary inductance**
(绕组方式优化)
- **Large operating frequency range**
 - **50 kHz to 50 MHz (5MHz, typical)**

Electrical Disadvantages—电气性能

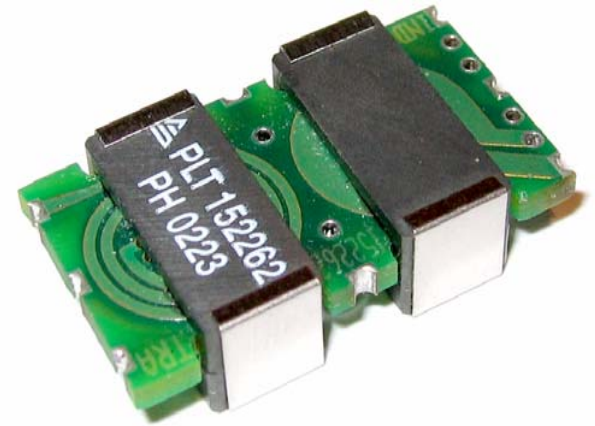
- **Only suitable for few turn solutions, PCB Layer is limited**
 - (可以做到**12层PCB**)
- **Copper thickness on PCB limited to 5oz (~175um)**
 - (由铜箔生产工艺决定)

Mechanical Advantages--机械性能

- Excellent thermal characteristics
散热面积，条件好
- High parameter of repeatability
取代传统变压器的机械绕制
- Sturdy construction
结构坚固
- Low Profile
 - 高度低
- Easy to modeling
 - 会很容易仿真
- Less weight designs
 - 适合便捷轻便的设计

Planar Modules—平面模组

- **High degree of integration**
高度集成
- **Increased efficiency**
效率提高
- **Space saving**
节省空间
- **Cost saving**
节约成本

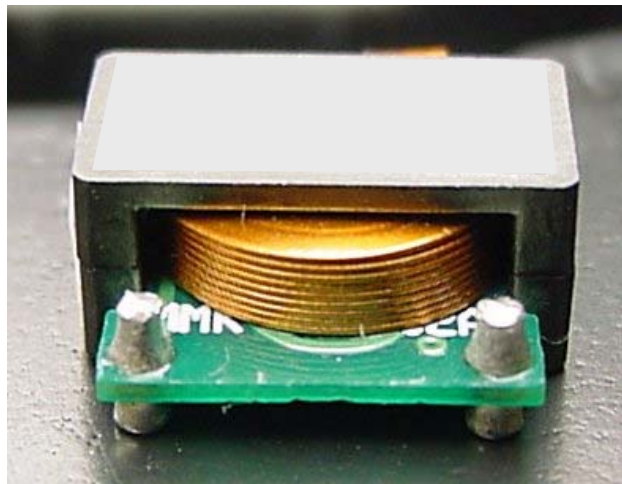


Planar Module
平面模组

Helical Product—铜箔绕组

Application 应用:

- Low Profile Inductors
输出, 储能电感
- High Current Transformers
大电流的变压器



Planar Module using
PCB & Helical coil
PCB绕组和铜箔绕组结合

Advantages:

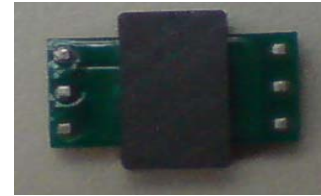
- Unlimited copper thickness 铜箔厚度没有限制
- "Self-led" termination 出头由自己决定
- Can be designed for all cores with round centre leg
适合各种圆中心柱型磁芯
- Short Lead time for prototypes
样品周期较短



SIZE 11

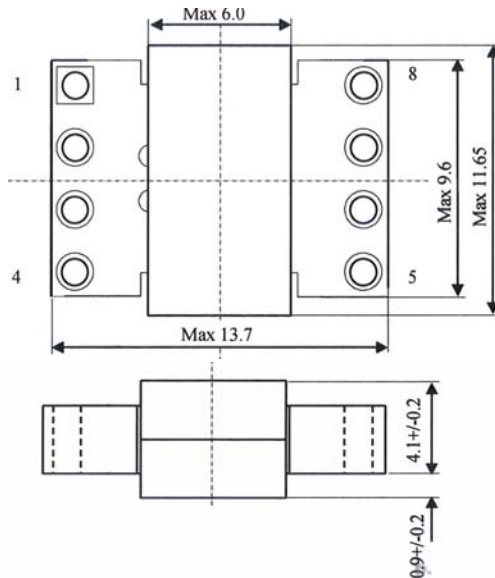
Description

- 用于 SMPS，小功率例如像电信这样的场合。
效率(97%~99%),低辐射,高重复性,
Operating frequency range 100kHz – 5MHz 功率可达60W.
- 适用架构: Full-bridge; Half-bridge; Push-pull; Forward; Flyback; Boost; Buck; Resonant topologies
- 安装方式: SMD (with or without pins), TH



Typical Design

Mechanical specification [mm]



Schematics

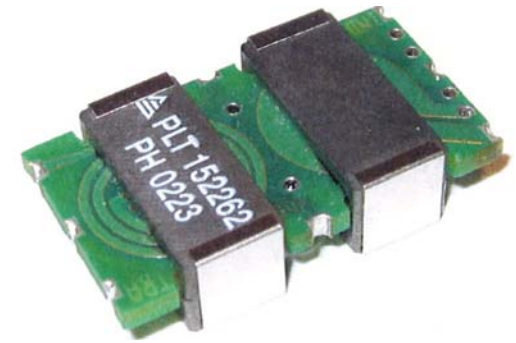


Electrical Specification @ 25 °C

Part Number	Power Rating	Turn Ratio Prim:Sec	Dielectric Strength	Primary Inductance @1MHz, 0.25V [μH min]	Leakage Inductance @1MHz,0.25V [nH max]	DCR	
						Prim. [mΩ]	Sec. [mΩ]
KERxxxxxx	60W (6V/10A)	8:1	1500Vdc	60	250	57	1.5

SIZE 14

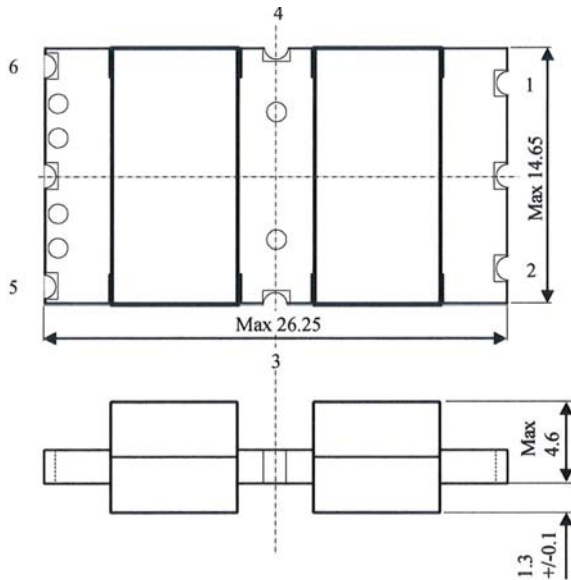
Description



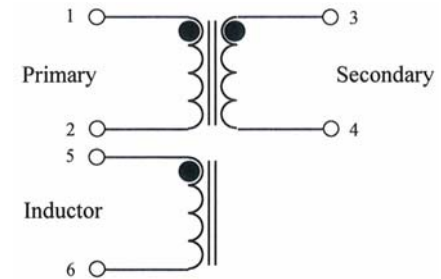
- 用于 SMPS, 小功率例如像电信这样的场合.
效率(97%~99%),低辐射,高重复性,
Operating frequency range 100kHz – 5MHz 功率可达60W.
- 适用架构: Full-bridge; Half-bridge; Push-pull; Forward; Flyback; Boost; Buck; Resonant topologies
- 安装方式: SMD (with or without pins), TH

Typical Design

Mechanical specification [mm]



Schematics



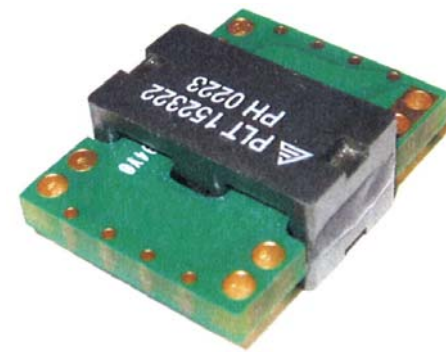
Electrical Specification @ 25 °C

Part Number	Power Rating	Turn Ratio Prim:Sec	Dielectric Strength	Primary Inductance @530kHz, 0.25V [μH min]	Leakage Inductance @530kHz, 0.25V [nH max]	DCR	
						1-2 [mΩ]	5-6 [mΩ]
KERxxxxxx	18W	4:1	1000Vdc	128	560	105	9.0

Inductor Data: 5.8μH +/- 10%, 16mΩ

SIZE 18

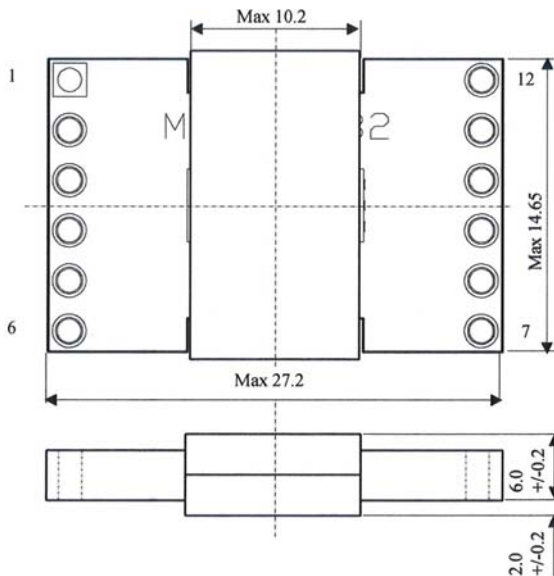
Description



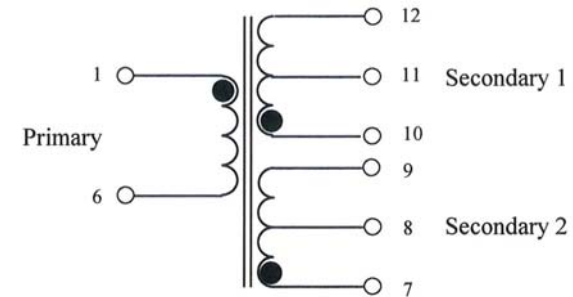
- 用于 SMPS，小功率例如像电信这样的场合。
效率(97%~99%),低辐射,高重复性,
Operating frequency range 100kHz – 5MHz 功率可达100W.
- 适用架构: Full-bridge; Half-bridge; Push-pull; Forward; Flyback; Boost; Buck; Resonant topologies
- 安装方式: SMD (with or without pins), TH

Typical Design

Mechanical specification [mm]



Schematics



Electrical Specification @ 25 °C

Part Number	Power Rating	Turn Ratio 1-3:4-5:6-10	Dielectric Strength	Primary Inductance @200kHz, 0.25V [μH min]	Leakage Inductance @200kHz, 0.25V [nH max]	DCR		
						1-6 [mΩ]	7-9 [mΩ]	10-12 [mΩ]
KEExxxxxx	41W	1:0.8:4	1000Vdc	50	TBC	11.0	275	20.0

SIZE 20

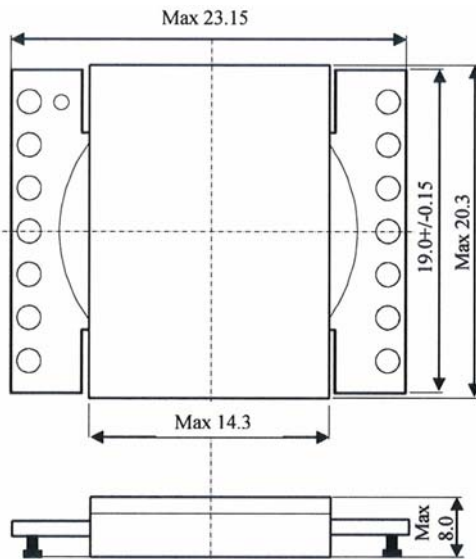


Description

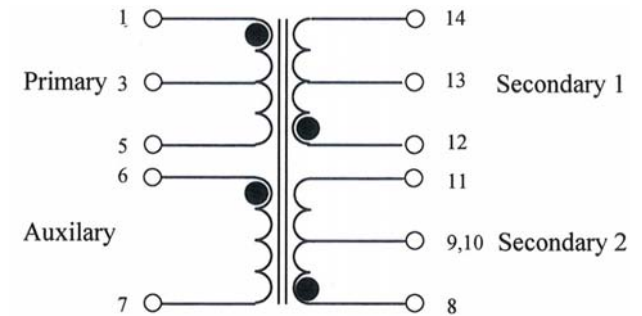
- 用于 SMPS，小功率例如像电信这样的场合。
效率(97%~99%),低辐射,高重复性,
Operating frequency range 100kHz – 5MHz 功率可达1500W.
- 适用架构: Full-bridge; Half-bridge; Push-pull; Forward; Flyback; Boost; Buck; Resonant topologies
- 安装方式: SMD (with or without pins), TH

Typical Design

Mechanical specification [mm]



Schematics



Electrical Specification @ 25 °C

Part Number	Power Rating	Dielectric Strength	Turn Ratio 1-5:6-7:8-11 1-3:12-14	Primary Inductance @150kHz, 0.25V [μH min]	DCR			
					1-5 [mΩ]	6-7 [mΩ]	8-11 [mΩ]	12-14 [mΩ]
KEQxxxxxx	57W	1000Vdc	8:4:1 4:2	140	150.0	60.0	4.0	60.0

SIZE 22

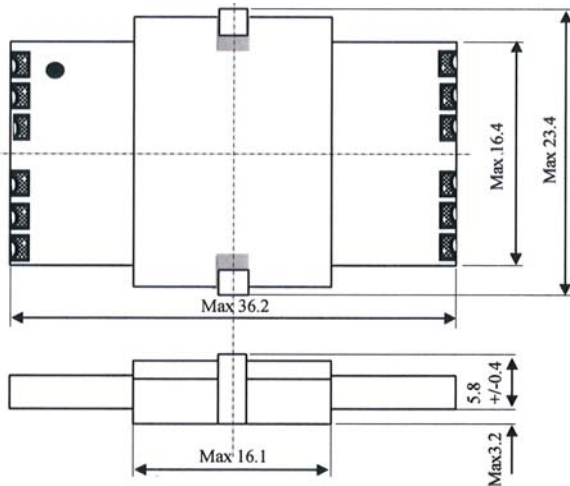
Description

- 用于 SMPS，小功率例如像电信这样的场合。
效率(97%~99%),低辐射,高重复性,
Operating frequency range 100kHz – 5MHz 功率可达200W.
- 适用架构: Full-bridge; Half-bridge; Push-pull; Forward; Flyback; Boost; Buck; Resonant topologies
- 安装方式: SMD (with or without pins), TH

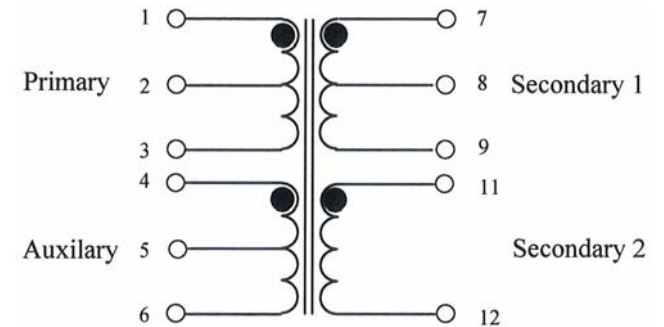


Typical Design

Mechanical specification [mm]



Schematics

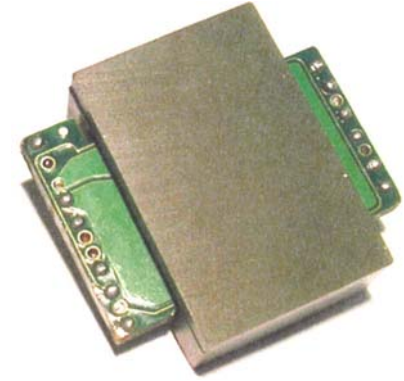


Electrical Specification @ 25 °C

Part Number	Power Rating	Dielectric Strength	Turn Ratio 1-3:4-6:7-9 ①1-3:11-12	Primary Inductance @150kHz, 0.25V [μH min]	DCR			
					1-3 [mΩ]	4-6 [mΩ]	7-9 [mΩ]	11-12 [mΩ]
KEIxxxxxx	100W	1000Vdc	5:4:2 10:19	400	110	750	30	350

SIZE 30

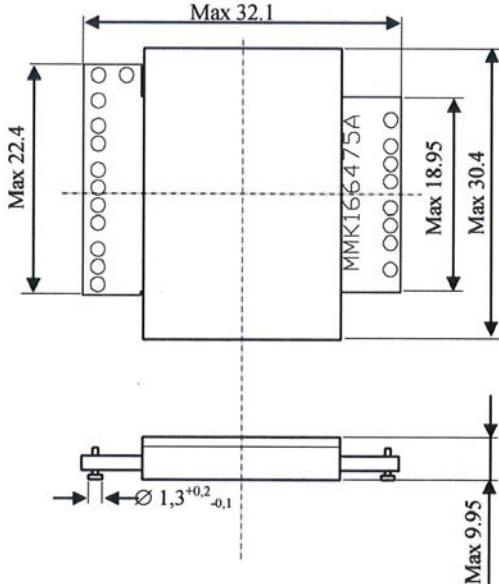
Description



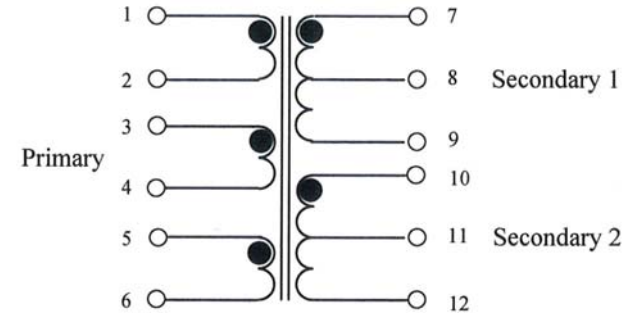
- 用于 SMPS，小功率例如像电信这样的场合。
效率(97%~99%),低辐射,高重复性,
Operating frequency range 100kHz – 5MHz 功率可达500W.
- 适用架构: Full-bridge; Half-bridge; Push-pull; Forward; Flyback; Boost; Buck; Resonant topologies
- 安装方式: SMD (with or without pins), TH

Typical Design

Mechanical specification [mm]



Schematics



Electrical Specification @ 25 °C

Part Number	Power Rating	Dielectric Strength	Turn Ratio 1-2:3-4:5-6 1-2:7-9:10-12	Primary Inductance @150kHz, 0.25V [μH min]	DCR			
					1-2=3-4 [mΩ]	5-6 [mΩ]	7-9 [mΩ]	11-12 [mΩ]
KEQxxxxxx	500W	500Vdc	1:1:0.667 1:1:1	400	6.0	180	6.0	6.0

Conditions for planar-- 下列情况下您可考虑平面磁性元器件

- 节省空间
- 低压情况下负载电流5A~20A
- 高重复性
- 传统变压器在生产及安装上面有问题
- 需要精确控制参数（漏感，EMI等）
- 结构比较复杂
- 需要的脚PIN标准的BOBBIN不能满足
- 传统的变压器不能满足温升要求