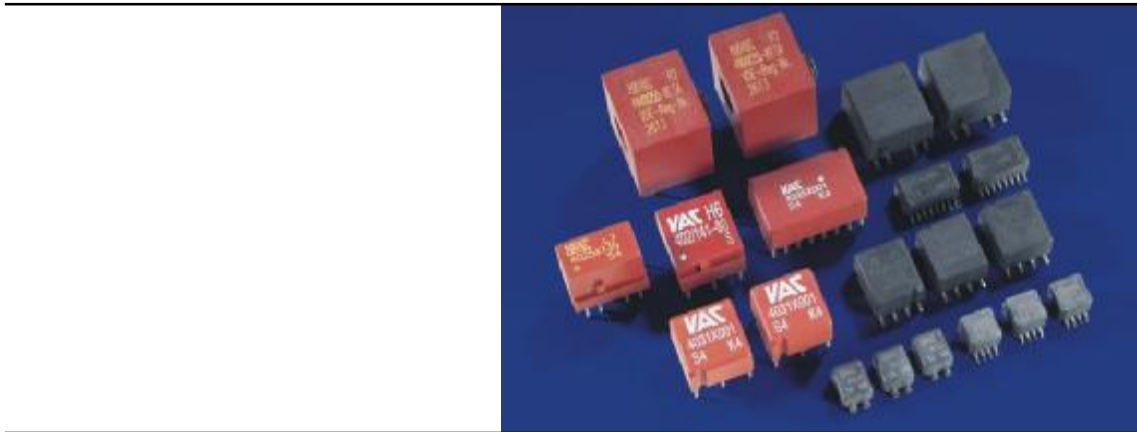


# Power Line Communication Coupling Transformers



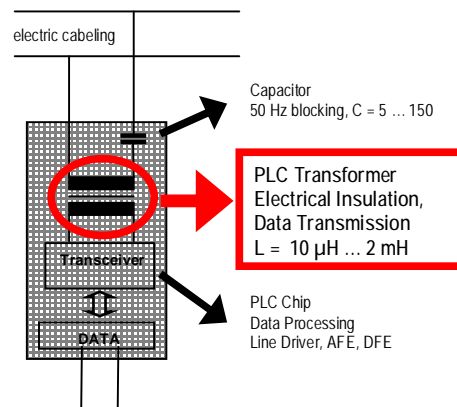
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**Introduction**

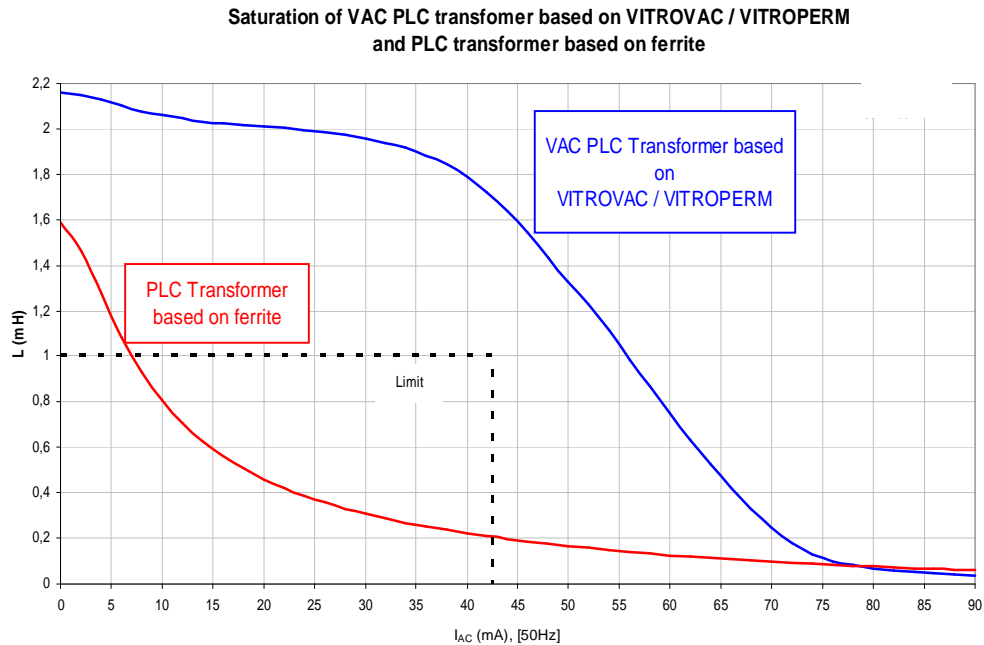
The PLC (Power Line Communication) will become one of the most interesting and various applications in the next few years. AMR (Automatic Meter Reading) for energy meters, water meters, gas meters, etc will become very important for controlling and economical use of our resources world wide. With PLC it can give the end-user a constant overview about its consumption and the possibility to plan it economical. The general energy suppliers have the opportunity to control user-groups up to a single end-user in short time-steps. They can reduce the energy spikes up to a harmonic operation of their power stations. Home automation and PC home networking will be an additional application for PLC. The cooperation between the domestic appliances and the energy meters will make the economical use perfect. PC home networking will be in competition with the wireless applications.

For PLC it's necessary to have a coupling transformer for the data transmission between the electric cabling and the transceiver. Its inductance has a value between  $10 \mu\text{H} \dots 2 \text{mH}$  and its electrical insulation depends on its application. The capacitor in the system is for blocking the 50 Hz or 60Hz frequency currents.



Based on our own developed and produced amorphous material VAC offers a complete product range of PLC coupling transformer for different low and high bit rate chipsets. Please look at the internet pages at [www.vacuumschmelze.com](http://www.vacuumschmelze.com) in the telecommunication/powerline pages and find your used PCL chipset and we will present you our PLC transformers in different designs. Beside the standard PLC transformer VAC also develops PLC transformer with individual requirements. The PLC transformers are manufactured by VAC in process and cost optimized plants. Our in-depth knowledge of the application fields and technical requirements puts us in a position to find the ideal solution and turn this into a competitive product.

VAC's own developed and produced amorphous material VITROVAC or VITROPERM is an excellent material for the core of a PLC transformer. One of the main advantages is shown in the following diagram. The saturation in comparison to a PLC transformer based on ferrite is significant. At  $I_{ac}=45\text{mA}$  the VAC PLC transformer based on VITROVAC has 1,6mH the version based on ferrite on 0,2mH. This shows that the PLC transformer based on ferrite is in saturation and produces high harmonic distortion, especially 50 Hz distribution. On the other hand the VAC PLC transformer meets the target.



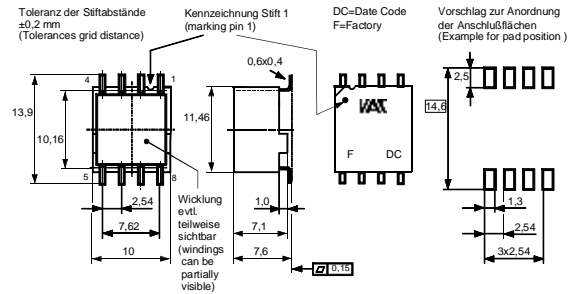
**The advantages of VAC PLC coupling transformers are:**

- Excellent transmission characteristics
- Low insertion loss
- Low THD, especially low 50Hz distortion
- Matching transformer for leading IC's
- Insulation according to EN 60950 / UL 1950
- Compact designs
- Casing variety (SMD, PTH, high, flat)
- Compliance with all PLC standards, Homeplug 1.0, EIA 709.2 . CENELEC EN 50065-1, and CEA R7.3

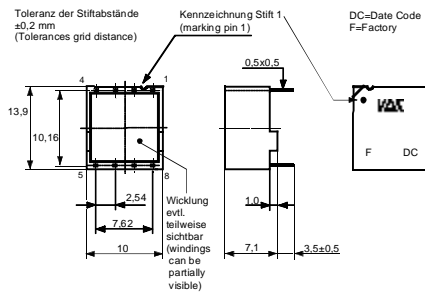
## Standard Casings of the VAC PLC Transformer

- Mechanical dimensions

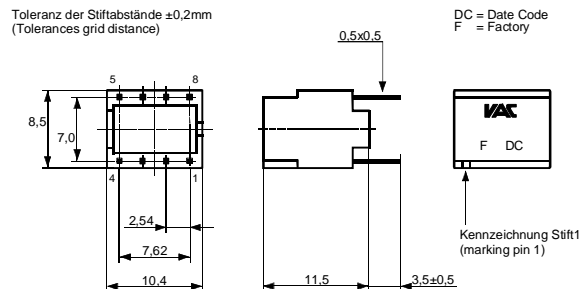
- casing SMD flat (5024-x...)



- casing PTH flat (4081-x...)



- casing PTH high (4085-x...)



## PLC Transformers for Low Bit rate Applications


### Technical characteristics:

Order-Nr. T60403-K	Turn-ratio	Freq. Range (MHz)	Inductance (mH)	Insulation	Design
5024-X044	1 : 1	0,001 - 1	1,4	reinforced (3kV)	SMD
4081-x004					PTH flat
4085-x004					PTH high
5024-X080	1 : 1	0,001 - 1	1,0	reinforced (3kV)	SMD
5024-xK24313	1 : 1	0,001 - 1	1,0	reinforced (3kV)	SMD
4096-X046	1 : 1	0,001 - 1	1,3	reinforced (6kV)	PTH
K23974	1 : 1	0,001 - 1	1,3	reinforced (6kV)	PTH
4021-X137	1 : 1	0,001 - 1	1,65	reinforced (6kV)	PTH
4097-X078	1 : 1	0,001 - 1	1,7	reinforced (3kV)	PTH
5024-X078	1 : 1	0,001 - 1	2,5	reinforced (3kV)	SMD
4021-xK23590	1,44 : 1	0,001 - 1	0,946	reinforced (4kV)	PTH
4031-x009	2 : 1	0,001 - 1	1,0	reinforced (6kV)	PTH
5024-X079	2 : 1	0,001 - 1	1,4	reinforced (3kV)	SMD
4900-X255	5 / 1 : 1	0.095 - 0.1485	0,217	reinforced (4kV)	PTH
4325-X017	5 : 1 : 1	0.095 - 0.1485	0,227	reinforced (4kV)	PTH

Technical details on request.

- Other transformers are available on request -


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## PLC Transformers for High Bit rate Applications

### Technical characteristics:

Order-Nr. T60403-K	Turn-ratio	Freq. Range (MHz)	Inductance (mH)	Insulation	Design
5024-X043	1 : 1 : 1 : 1	1 - 30	0,023	reinforced (3kV)	SMD
4081-x003					PTH flat
4085-x003					PTH high
5024-xK24347	1.4 : 1.4 : 1 : 1	1 - 30	0,023	reinforced (3kV)	SMD
5011-xK23120	1 : 1	1 - 30	0,00774	operational (1kV)	SMD
5026-X023	1 : 1	1 - 30	0,03	reinforced (3kV)	SMD
4025-xK23269/A	1 : 1 : 1	4 - 21	0,023	operational 1,5kV	PTH
5024-xK23269/B	1 : 1 : 1	4 - 21	0,023	operational 1,5kV	SMD
6100-xK23461	1 : 1 : 1	4 - 21	0,01	reinforced (3kV)	PTH
5024-xK23658	1 : 1 : 1	4 - 21	0,014	reinforced (3kV)	SMD
5034-xK24081	1 : 1 : 1	4 - 21	0,014	reinforced (3kV)	SMD
4031-X008	1 : 1 : 1 : 1	1 - 30	0,04	reinforced (3kV)	PTH
K23712	2 : 1 : 1	1 - 21	0,025	reinforced (6kV)	SMD
K23713	1 : 1 : 1 : 1	1 - 21	0,25	reinforced (2kV)	SMD
5011-xK23560	1.67 : 1	1 - 30	0.03	reinforced (3kV)	SMD
	1.67 : 1	1 - 30	0.03	reinforced (3kV)	SMD

Hybrid Moduls Order-Nr. T60403-K	Turn-ratio	Freq. Range (MHz)	Inductance (mH)	Insulation	Design
5026-xK22221	1:1 and 1/1:1:1	0,3 - 30	4,7	reinforced (3kV)	SMD
5026-xK22896	1:1 and 1/1:1:1	0,3 - 30	4,7	operational 1,5kV	SMD
5014-X021	2:2:1:1:1:1	1 - 30	3,0	operational 0,5kV	SMD

Technical details on request.

- Other transformers are available on request -

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## PLC Transformers for DS2 chipsets


### Technical characteristics:

Order-Nr. T60403-K	Chipset	Turn-ratio	Freq. Range (MHz)	Inductance (mH)	Insulation	Design
<b>5024-X043</b> *	DSS4200+DSS7500 DSS900X+DSS7700	1 : 1 : 1 : 1	1 - 30	0,023	reinforced (3kV)	SMD
<b>4081-X003</b> *						PTH flat
<b>4085-X003</b> *						PTH high
5024-xK24824	DSS4200+DSS7500 DSS900X+DSS7700	1 : 1 : 1 : 1	1 - 30	0,023	reinforced (3kV)	SMD
5024-xK24347	DSS4200+DSS7500 DSS900X+DSS7700	1.4 : 1.4 : 1 : 1	1 - 30	0,023	reinforced (3kV)	SMD
5011-xK23120	DSS4200+DSS7500 DSS900X+DSS7700	1 : 1	1 - 30	0,00774	operational (1kV)	SMD
5011-xK24661	DSS4200+DSS7500 DSS900X+DSS7700	1 : 1	1 - 30	0,06	reinforced (3kV)	SMD
<b>4031-X008</b> *	DSS4200+DSS7500 DSS900X+DSS7700	1 : 1 : 1 : 1	1 - 30	0,04	reinforced (3kV)	PTH
4031-xK24825						PTH
5011-xK23560	DSS4200+DSS7500 DSS900X+DSS7700	1.67 : 1	1 - 30	0.03	reinforced (3kV)	SMD


\* official approved by DS2

Technical details on request.

- Other transformers are available on request -

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## PLC Transformers for Intellon chipsets


### Technical characteristics:

Order-Nr. T60403-K	Chipset	Turn-ratio	Freq. Range (MHz)	Inductance (mH)	Insulation	Design
5024-X043	INT51X1 ; INT5200; INT5500 ; INT6000	1 : 1 : 1 : 1	1 - 30	0,023	reinforced (3kV)	SMD
4081-X003						PTH flat
4085-X003						PTH high
5011-xK23120	INT51X1 ; INT5200; INT5500 ; INT6000	1 : 1	1 - 30	0,00774	operational (1kV)	SMD
4025-K23269/A	INT51X1 ; INT5200; INT5500 ; INT6000	1 : 1 : 1	4 - 21	0,023	operational 1,5kV	PTH
5024-K23269/B	INT51X1 ; INT5200; INT5500 ; INT6000	1 : 1 : 1	4 - 21	0,023	operational 1,5kV	SMD
6100-xK23461	INT51X1 ; INT5200; INT5500 ; INT6000	1 : 1 : 1	4 - 21	0,01	reinforced (3kV)	PTH
5024-xK23658	INT51X1 ; INT5200; INT5500 ; INT6000	1 : 1 : 1	4 - 21	0,014	reinforced (3kV)	SMD
5034-xK24081	INT51X1 ; INT5200; INT5500 ; INT6000	1 : 1 : 1	4 - 21	0,014	reinforced (3kV)	SMD
4031-X008	INT51X1 ; INT5200; INT5500 ; INT6000	1 : 1 : 1 : 1	1 - 30	0,04	reinforced (3kV)	PTH
5032-xK24825	INT51X1 ; INT5200; INT5500 ; INT6000	1 : 1	1 - 30	0,04	reinforced (3kV)	PTH

Technical details on request.

- Other transformers are available on request -


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## PLC Transformers for Echelon chipsets


### Technical characteristics:

Order-Nr. T60403-K	Chipset	Turn-ratio	Freq. Range (MHz)	Inductance (mH)	Insulation	Design
5024-X044	PLT-21;PLT-22; PLT3120; PLT3150	1 : 1	0,001 - 1	1,4	reinforced (3kV)	SMD
4081-X004						PTH flat
4085-X004						PTH high
4096-X046	PLT-21;PLT-22; PLT3120; PLT3150	1 : 1	0,001 - 1	1,3	reinforced (6kV)	PTH
5024-X080	PLT-21;PLT-22; PLT3120; PLT3150	1 : 1	0,001 - 1	1,0	reinforced (3kV)	SMD
5024-X078	PLT-21;PLT-22; PLT3120; PLT3150	1 : 1	0,001 - 1	2,5	reinforced (3kV)	SMD
4097-X078	PLT-21;PLT-22; PLT3120; PLT3150	1 : 1	0,001 - 1	1,7	reinforced (3kV)	PTH
5024-xK24313	PLT-21;PLT-22	1 : 1	0,001 - 1	1,0	reinforced (3kV)	SMD

Technical details on request.

- Other transformers are available on request -

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## PLC Transformers for ST Microelectronics chipsets

### Technical characteristics:


Order-Nr. T60403-K	Chipset	Turn-ratio	Freq. Range (MHz)	Inductance (mH)	Insulation	Design
<b>5024-X044</b> *	ST7538 and ST7540	1 : 1	0,001 - 1	1,4	reinforced (3kV)	SMD
<b>4081-X004</b> *						PTH flat
<b>4085-X004</b> *						PTH high
<b>4096-X046</b> *	ST7538, ST7540	1 : 1	0,001 - 1	1,3	reinforced (6kV)	PTH
5024-X080	ST7538, ST7540	1 : 1	0,001 - 1	1,0	reinforced (3kV)	SMD
5024-X078	ST7538, ST7540	1 : 1	0,001 - 1	2,5	reinforced (3kV)	SMD
4097-X078	ST7538, ST7540	1 : 1	0,001 - 1	1,7	reinforced (3kV)	PTH
4021-xK23590	ST7538, ST7540	1,44 : 1	0,001 - 1	0,946	reinforced (4kV)	PTH
4031-x009	ST7538, ST7540	2 : 1	0,001 - 1	1,0	reinforced (6kV)	PTH
5024-X079	ST7538, ST7540	2 : 1	0,001 - 1	1,4	reinforced (3kV)	SMD
4021-X137	ST7538, ST7540	1 : 1	0,001 - 1	1,65	reinforced (6kV)	PTH
4096-X047	ST7538, ST7540	1 : 1	0,001 - 1	1,3	reinforced (6kV)	PTH
4900-X255	ST7537 and ST7536	5 / 1 : 1	0.095 - 0.15	0,217	reinforced (4kV)	PTH
4325-X017	ST7537 and ST7536	5 : 1 : 1	0.095 - 0.15	0,227	reinforced (4kV)	PTH

\* official approved by STM

Technical details on request.

- Other transformers are available on request -

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## PLC Transformers for YITRAN chipsets

### Technical characteristics:

Order-Nr. T60403-K	Chipset	Turn-ratio	Freq. Range (MHz)	Inductance (mH)	Insulation	Design
5024-X044 *	IT800	1 : 1	0,001 - 1	1,4	reinforced (3kV)	SMD
4081-X004 *						PTH flat
4085-X004 *						PTH high
4096-X046	IT800	1 : 1	0,001 - 1	1,3	reinforced (6kV)	PTH
5024-X080	IT800	1 : 1	0,001 - 1	1,0	reinforced (3kV)	SMD
5024-X078	IT800	1 : 1	0,001 - 1	2,5	reinforced (3kV)	SMD
4097-X078	IT800	1 : 1	0,001 - 1	1,7	reinforced (3kV)	PTH
4031-xK24727	IT800	1 : 1	0,001 - 1	1,4	reinforced (3kV)	PTH

\* official approved by YITRAN

Order-Nr. T60403-K	Chipset	Turn-ratio	Freq. Range (MHz)	Inductance (mH)	Insulation	Design
5024-X043	ITM1 ; ITM10	1 : 1 : 1 : 1	1 - 30	0,023	reinforced (3kV)	SMD
4081-X003						PTH flat
4085-X003						PTH high
5011-xK23120	ITM1 ; ITM10	1 : 1	1 - 30	0,00774	operational (1kV)	SMD
4031-008	ITM1 ; ITM10	1 : 1 : 1 : 1	1 - 30	0,04	reinforced (3kV)	PTH

Technical details on request.

- Other transformers are available on request -

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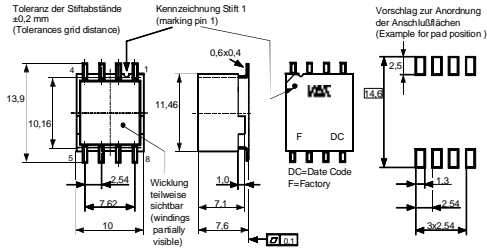
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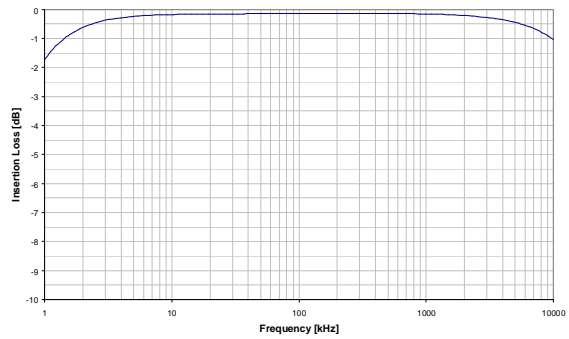
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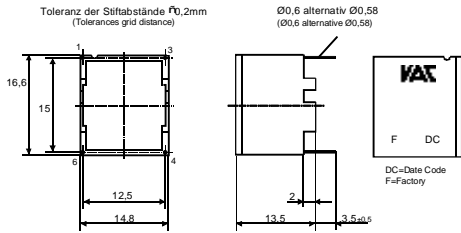
**T60403-K5024-X080**  
Mechanical:



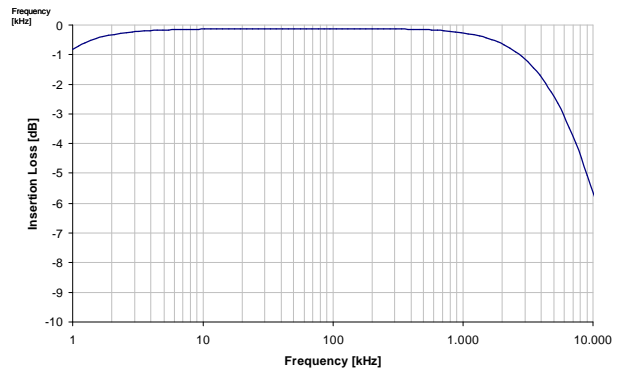
Typical Insertion Loss based on a 10 Ω system:



**T60403-K4096-X046**  
Mechanical:



Typical Insertion Loss based on a 10 Ω system:

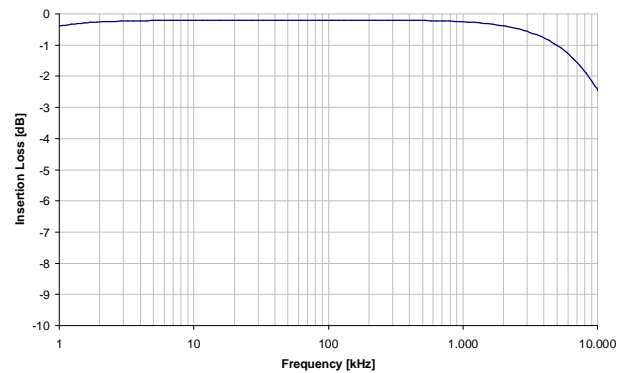


**T60403-K5024-X044**  
**T60403-K4081-X004,**  
**T60403-K4085-X004**

Mechanical:

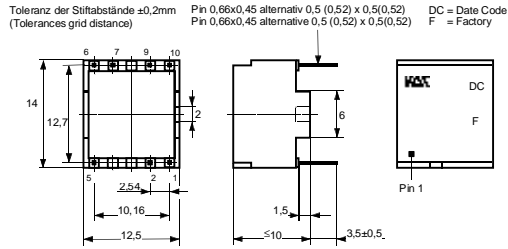
Available in 3 casing variations  
 SMD, PTH flat, PTH high (see page 4)

Typical Insertion Loss based on a 10 Ω system:

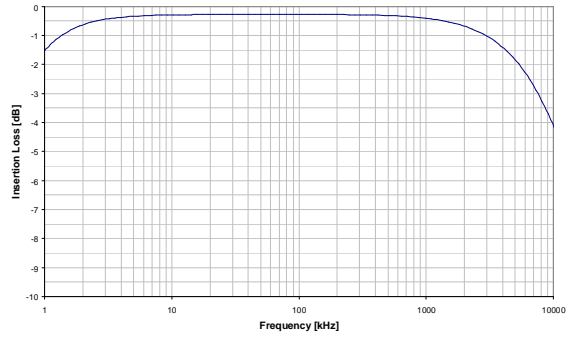


## T60403-K4021-X137

Mechanical:

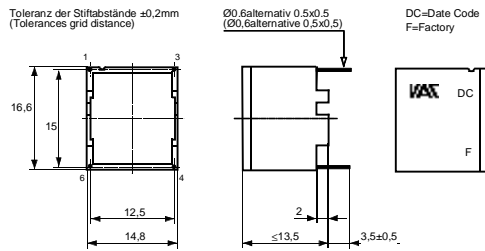


Typical Insertion Loss based on a 10 Ω system:

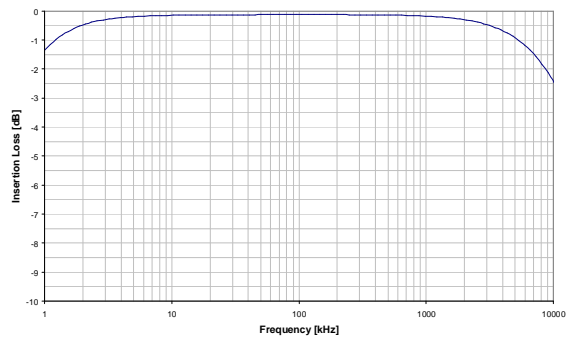


## T60403-K4097-X078

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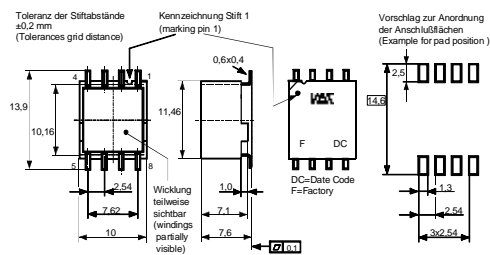


Typical Insertion Loss based on a 10 Ω system:

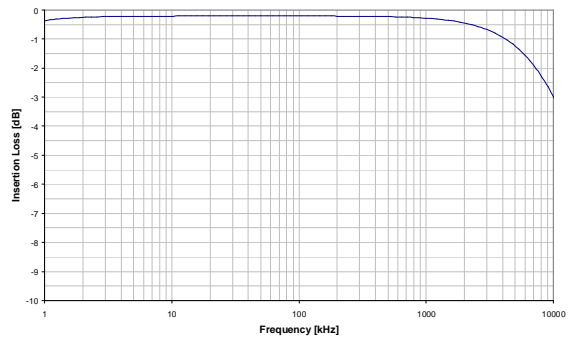


## T60403-K5024-X078

Mechanical:

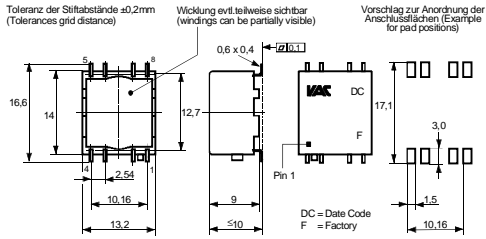


Typical Insertion Loss based on a 10 Ω system:

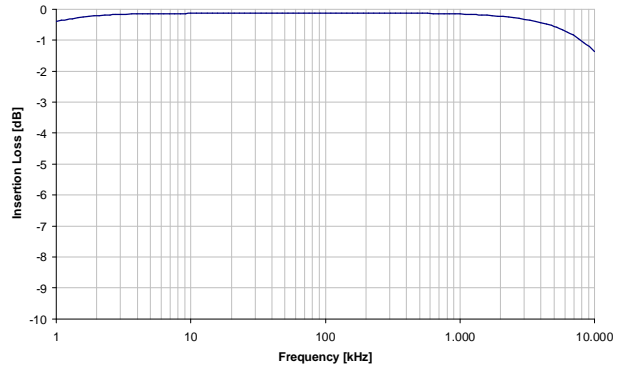


## T60403-K5032-X089

Mechanical:

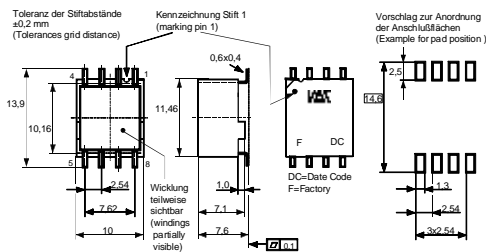


Typical Insertion Loss based on a 10 Ω system:

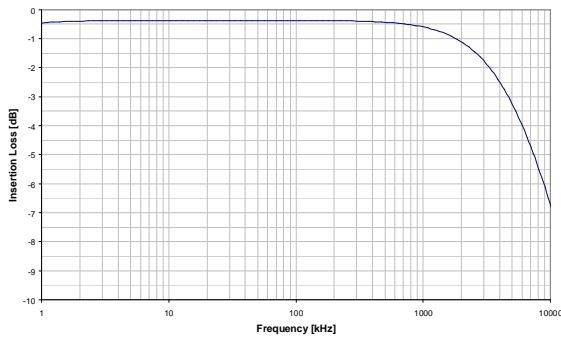


## T60403-K5024-X079

Mechanical:



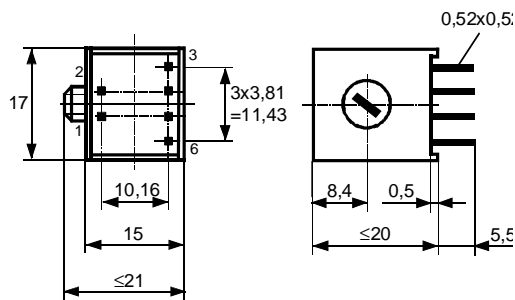
Typical Insertion Loss based on a 10 Ω system:



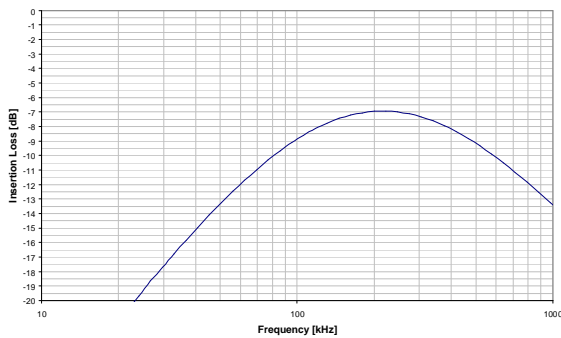
## T60403-K4900-X255

Mechanical:

Toleranz der Stiftabstände  $\pm 0,2\text{mm}$   
(Tolerances grid distance)

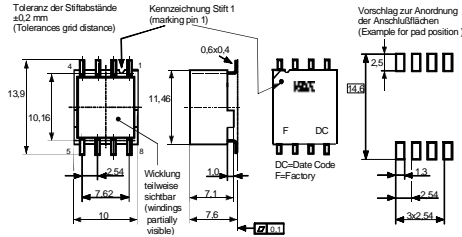


Typical Insertion Loss based on a 10 Ω system:

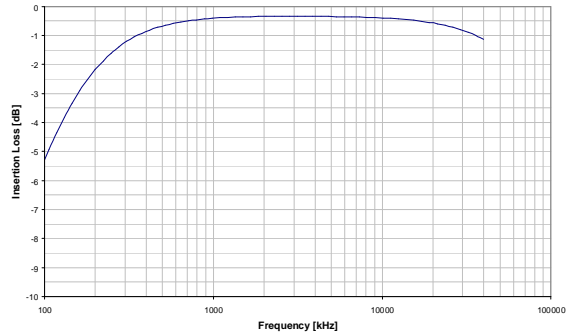


## T60403-K5024-X043

Mechanical:

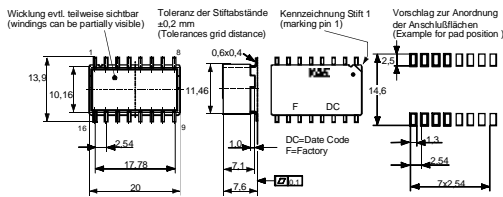


Typical Insertion Loss based on a 50 Ω system:

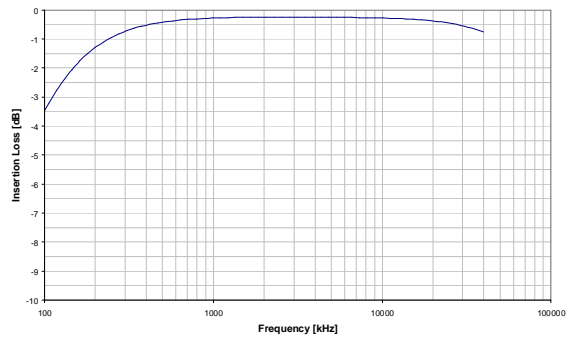


## T60403-K5026-X023

Mechanical:

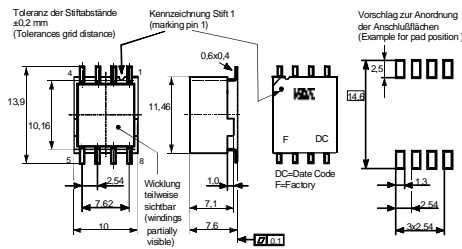


Typical Insertion Loss based on a 50 Ω system:

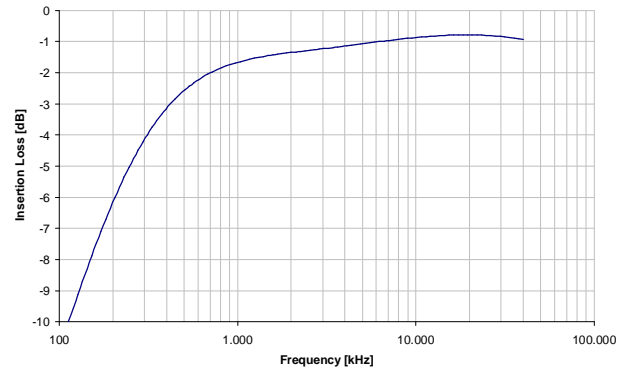


## T60403-K5024-X076

Mechanical:



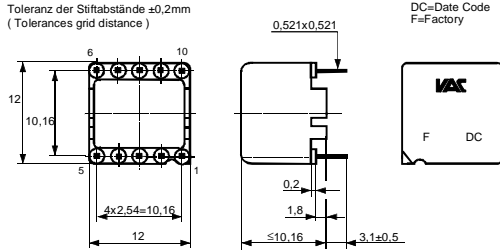
Typical Insertion Loss based on a 50 Ω system:



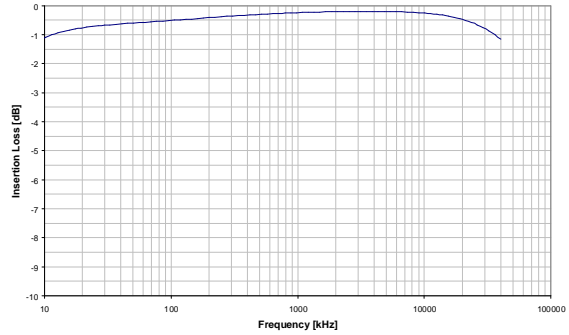


## T60403-K4031-X008

Mechanical:

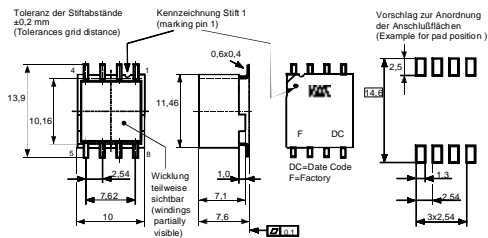


Typical Insertion Loss based on a 50  $\Omega$  system:



## T60403-K5024-X..., K23658

Mechanical::



Typical Insertion Loss based on a 50  $\Omega$  system:

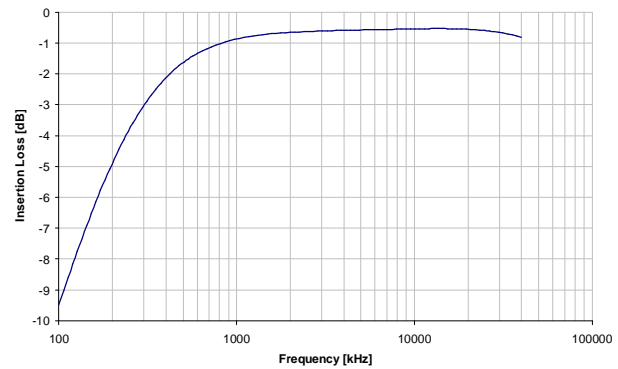


Fig. 3: T60403-K5024-X043  
T60403-K4081-X003,  
T60403-K4085-X003

Mechanical:

Available in 3 casing variations  
SMD, PTH flat, PTH high (see page 4)

Typical Insertion Loss based on a 50  $\Omega$  system:

