RILTON VARIABLE TRANSFORMERS

APPLICATION NOTES

ISO 9001

Outline

All the Rilton Variable Transformers are constructed of a single layer of copper wire wound on a high permeability electrical steel core. This winding is both primary and secondary and is tapped for the various input voltages detailed in the data sheets. The insulated copper wire is bared and in some models silver plated for the smooth contact of the brushgear. These brushes, made of layered long life carbon, provide an infinitely variable output voltage from zero to line voltage or above. The resolution is only limited by the volts per turn which is typically < 0.5%.

Input Voltage

The number of terminals to which the input voltage can be applied varies according to the model. There are taps at each end of the winding on all models but a large number have additional taps which offer the possibility of the output voltage being varied between zero and 118% of the input voltage.
All of the models will operate satisfactorily at up to 10% higher than the nominal rated voltage, which means that all the standard voltages in all countries can be catered for.

Output Voltage

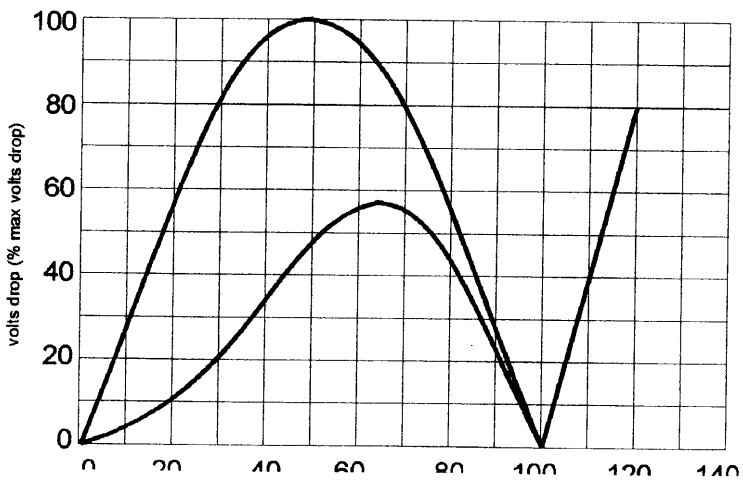
The minimum and maximum output voltages are as stated in the individual data sheets, but the end stop is designed to prevent the brush running off the end of the track and due to the width of the carbon brush, the stated variable voltage range could be reduced by approximately 1 volt.

Connections

All the variable transformers can be either panel or bench mounted and the connections are designed to permit clockwise increase in output voltage in either mounting position.
Terminals 1 and 6 are the ends of the winding and terminals 2 and 5 are intermediate tappings for overvoltage connection in one or other mounting position. Full connection details are listed on the individual data sheets.
The common input/output connection is "1" for bench mounting and "6" for panel mounting.
The variable output terminal is "3"
Terminal number 4 is a centre tap

Volt Drop

There is a voltage drop on load due to copper and brush losses which is proportional to output current and brush position.
The curves below show the percentage of the data sheet figure of voltage drop as a function of brush position.
The solid line curve relates to a constant current load (nominal current) and the broken curve applies to a constant impedance load (nominal current) where the current is approximately proportional to voltage.



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Nominal output current

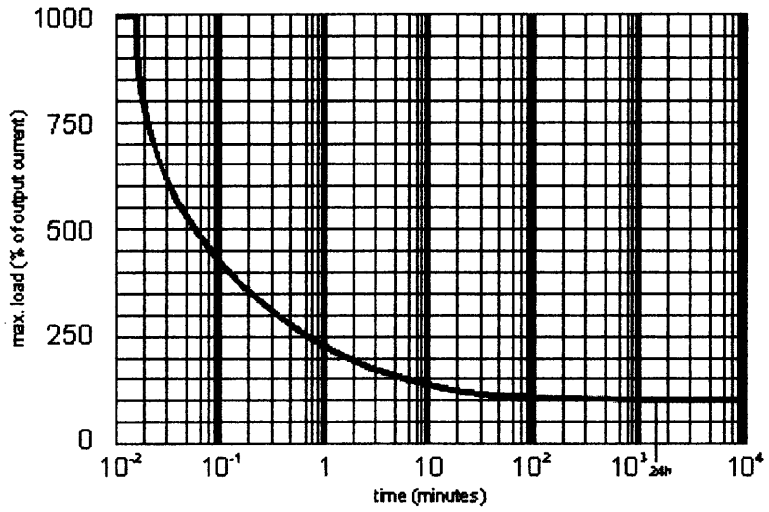
This is the current that may be taken continuously from the variable transformer from any point on the track and at the maximum ambient temperature of 40 degrees C.

Maximum output current

In a variable transformer the copper and iron losses are a function of the brush position. The distribution of currents are such that the losses are greatest when the brush is in the mid position. It follows therefore that the amount of current that can be drawn increases as the brush is moved away from the centre position without increasing the losses and the resultant temperature rise.
The figure given in the data sheets for "maximum output current" is the value of current that can be taken within 10% of the input voltage taps.

Transient Overloads

Because of the robust construction and tolerance of the Variable Transformer, high transient overloads are possible and are limited only by the temperature of the brush gear.
The graph below illustrates the relationship between percentage overload permitted and the time it can be allowed to continue. The curve assumes that the brush is in its least favourable position.
Since there is a risk of arcing and consequential damage to the track, the absolute limit of transient overload is 1000%.
The transient overload should not be repeated until the brush gear has cooled. Additional cooling is not required.



Overload Protection and Inrush Current

Because these are variable ratio devices the secondary output current must be limited to the rating of the transformer by a fuse or MCB. This is important because a heavy overload on the secondary when the output voltage is close to zero would not be seen as an overload on the input side.

The high permeability of variable transformers can cause inrush currents of up to 20 times the rating depending on the position on the waveform when contact is made. It is therefore advisable to fuse the input side with a "slow blow" or motor start fuse.

Volts per turn

The resolution of output voltage setting is only limited by the "step" between turns. The size of this step is value of the volts per turn as stated in the data sheets.

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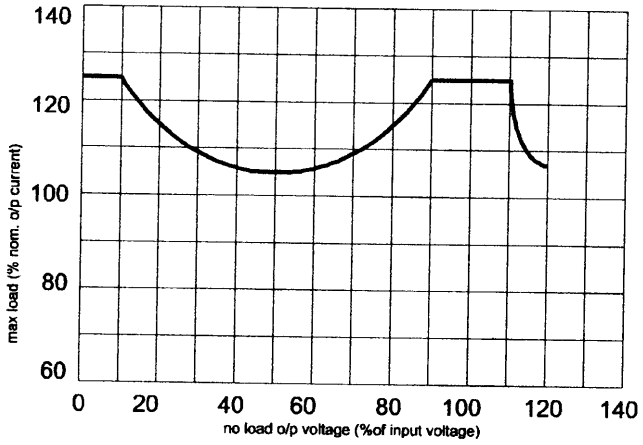
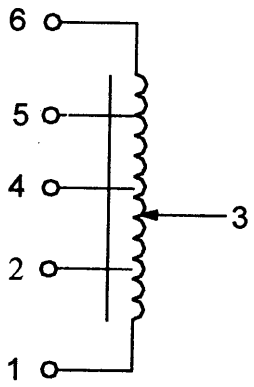
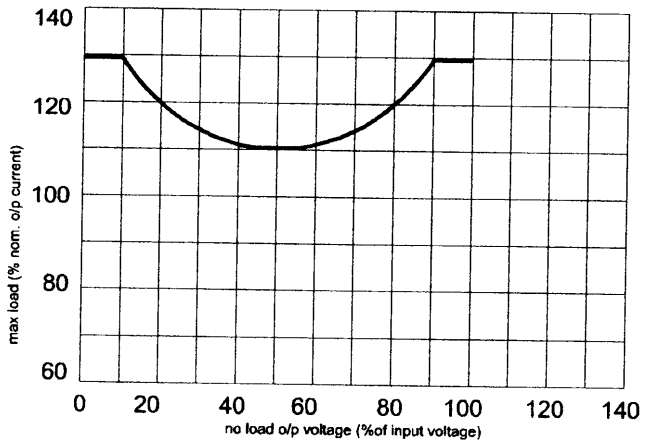
Continuous overload

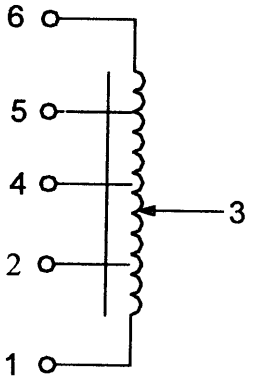
Variable transformers that have an overvoltage facility are wound with extra turns and the three graphs following illustrate the continuous overload possibilities that exist for the different types of windings and connections.



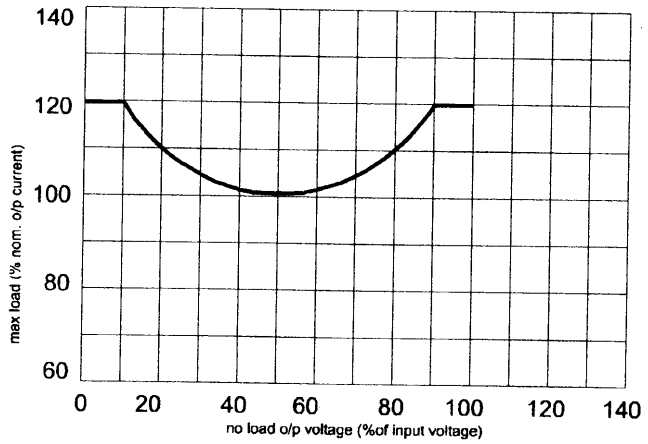


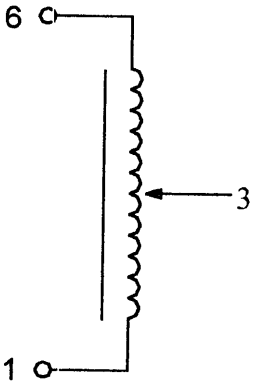
Percentage of Nom. Current related to brush position. Input connections 1 to 5 or 2 to 6 (overvoltage)





Percentage of Nom.Current related to brush position. Input connections 1 to 6 (Non overvoltage)





Percentage of Nom. Current related to brush position. Input connections 1 to 6 (Non overvoltage)

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No Load Losses

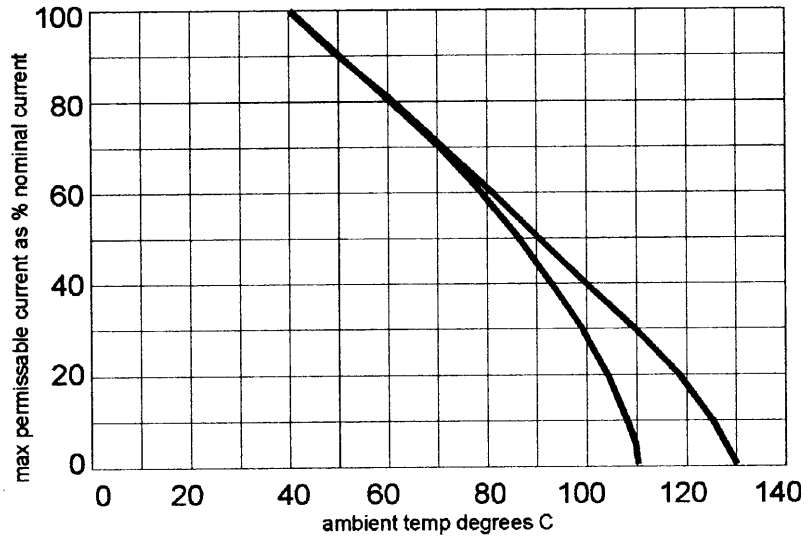
The no load losses are as stated in the data sheets and remain practically constant over the frequency range 50-400Hz

Ambient Temperature

All the data in the datasheets is valid for an ambient temperature range of -15 to +40 degrees centigrade.

Derating for higher ambient temperatures

The maximum temperature of 40 degrees C can be exceeded but the output current must be reduced in line with the curves shown below.
The right hand curve applies to those transformers with a maximum temperature rise of 90 degrees C and the left hand curve to those having a 70 degree C maximum temperature rise.



Oil Cooling

The full load current can be increased by a factor of 1.7 by immersion in transformer oil.

This enables us to offer a single phase variable transformer with a maximum rating of 244 Amps and three phase variable transformers with a maximum rating of 183 Amps line current.

Oil cooling is also useful for variable transformers operating in a corrosive environment.

All versions can be motorised and also used as a voltage stabiliser with a programmable stabiliser module.