Regavolt® Technical Note

Regavolt variable transformers are one of the most useful and efficient devices ever invented for the control of ac voltage. They are used in the control of many voltage dependent paramenters such as current, power, temperature, light intensity and motor speed.

Originally developed as voltage regulating and testing devices for use in the laboratory variable transformers have found countless applications in every branch of industry.

Essentially, the Regavolt is a adjustable auto-transformer in which the action of specially designed brushgear traversing a prepared track on the winding producing a smooth on-load variation in the transformer ratio and output voltage.

Regavolt transformers are much smaller than resistive controllers of equal power rating and unlike resistive controllers they do not waste power in the form of heat. In contrast to solid-state ac power controllers, Regavolts do not effect waveform purity or power factor.

INPUT VOLTAGE:

Standard 240 volt Regavolts are wound for a maximum voltage across the whole winding of 275 volts. The input voltage can be up to the full winding voltage when the Regavolt is used in line-voltage connection. In over-voltage connection, the listed input voltage must not be exceeded. 300 series Regavolts are wound for line-voltage connection only.

Regavolts can be used on lower voltages than rated, but no increase in current rating is permissible. When a 240 volt model is used on 220 or 230 volts supply, the output voltage is reduced in proportion.

CURRENT RATINGS:

Rated current can be drawn at any brush setting. When the over-voltage connection is used, the load should not draw more than rated current.

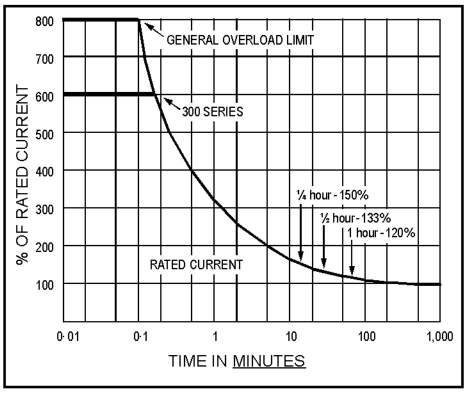

Fig. 1. Short-time overload curve

Maximum Current can only be drawn in line-voltage connection with listed (or lower) input voltage across the whole Regavolt winding (e.g. 240 volts on a 240 / 275 volt unit), and can only be drawn near zero or at or near full output voltage. A load having a linear voltage / current load line (constant impedance load) drawing maximum current at line voltage can be controlled from zero to line voltage.

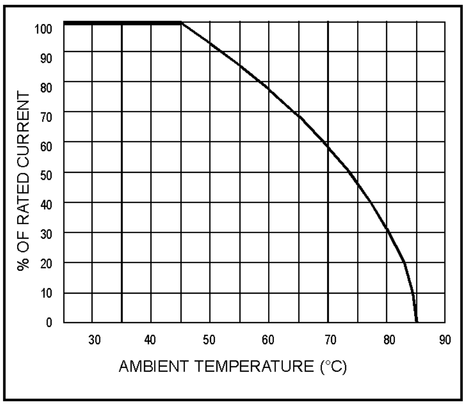

Fig. 2. Temperature de-rating curve

In the case of incandescent lamps, or other loads which are not of constant impedance, the current drawn at line voltage should normally be limited to the rated current.

Short-Time Overloads: Several times the rated current can be drawn for short periods as shown in Fig. 1. This curve applies only to non-recurrent overloads or starting surges.

Intermittent Operation: When operation is intermittent, the current rating may be multiplied by the square root of the duty cycle ratio (ratio of off-plus-on-time to on-time), provided this up-rated current does not exceed the short-time overload rating (Fig. 1) for the on-time.
Ambient Temperature: At high ambient temperature, current ratings must be reduced in accordance with Fig. 2.

FREQUENCY: Ratings of Regavolts (except high-frequency types) are for 47-65 Hz supply. They can be used at higher frequencies (e.g. 400 Hz) at rated voltage, and rated current in the case of 300 and 400 series, but with worse regulation: 700 and 1200 series models must be de-rated by 25% when used at 400 Hz. Regavolts can also be used at lower frequencies if the input voltage is reduced in proportion; there is no increase in current rating.

OUTPUT VOLTAGE:

Line-Voltage Connection: The input is applied across the whole winding and the output is variable from near zero up to input line voltage, e.g. 0 - 240 volts from a 240V supply

Over-Voltage Connection: The input is applied across less than the whole winding by means of the tapping provided, giving a step-up in voltage, e.g. 0 - 275 volts from a 240 volts supply

NO-LOAD LOSS: The listed no-load loss is measured at rated frequency and voltage, and includes both core and brush(es).

LOAD RATING: The nominal kVA rating given in our data sheets is the maximum current multiplied by the nominal input voltage and is equivalent to the rating of a constant impedance load as defined under `maximum current'. The kVA output in over-voltage connection is equal to output voltage multiplied by rated current. Note that output current is always the limiting factor and cannot be exceeded at lower voltage setting.

INSULATION: Regavolts are flash-tested at 2 kV rms 50 Hz

OVERLOAD PROTECTION: The most important position for a protective device is in the output from the brush. For detailed information on selection and installation please refer to our installation data sheet.

ANGLE OF ROTATION: 320º for all models except series 300 (310º).

NUMBER OF TURNS: The number of turns given for each model in the individual specifications is nominal and is provided to give a general indication of resolution.

KNOBS AND DIALS: Regavolts dials are double-sided, graduations being clockwise one side and anti-clockwise the other, for use with the dial attached to a panel or moving with the knob against a fixed pointer.

DIMENSIONS: Outline dimensions are included on the individual data sheets for each series.

HAZARD WARNING:
Regavolts operate at mains voltage and above, and installation, connection and maintenance must be carried out in accordance with good engineering practice by qualified personnel. Open models are intended only for installation as components and must never be used unprotected. Specification on data sheets must be considered carefully and the notes on installation and maintenance and any specific information supplied with the Regavolt adhered to strictly.

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Regavolt® Technical Note

Basic Single Phase Connections

In Fig. 3, the input is applied across the whole winding, and the output voltage is variable from zero up to the input voltage (e.g. 0 - 240 volts output from a 240 volt supply). Rated current can be drawn at any brush setting, and maximum current can be drawn at or near full output.
A constant-impedance load which draws maximum current at the Regavolts rated input voltage can be controlled from zero to line voltage.

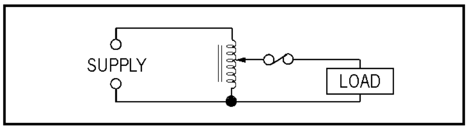


Fig. 3. Line-voltage connection

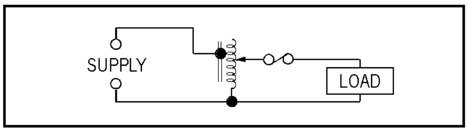


Fig. 4. Over-voltage connection

In Fig. 4, the input is applied across less than the whole winding by means of the tapping provided, and the output voltage is variable from zero to above input voltage (e.g. 0 - 275 volts output from a 240 volt supply). Rated current can be drawn at any brush setting, but should not be exceeded.

OVERLOAD PROTECTION: Figs. 3 and 4 have been drawn with a fuse in the output (brush) lead to emphasise that this is the most essential location for a protective device.

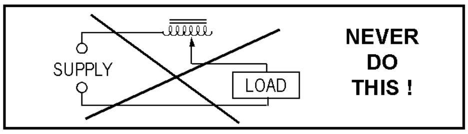
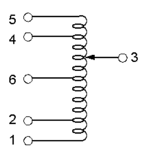


Fig. 5. Incorrect connection

CAUTION: It is most important to note that a Regavolt must never be connected in series with the load as if it were a rheostat (Fig. 5). This can cause a burn-out. The input must always be connected across the Regavolt winding.

Standard Terminal numbering

FOR INCREASE OF VOLTAGE WITH CLOCKWISE ROTATION



BENCH (SURFACE) MOUNTING	Input L - N	Output L - N
Over-Voltage Connection	4 - 1	3 - 1
Line-Voltage Connection	5 - 1	3 - 1
Terminal 1 Common		
BACK-OF-PANEL MOUNTING	**Input L - N**	**Output L - N**
Over-Voltage Connection	2 - 5	3 - 5
Line-Voltage Connection	1 - 5	3 - 5
Terminal 5 Common		

Ganged Assemblies - Parallel Connection

Two, three or more identical Regavolts may be ganged in parallel to supply a single-phase load greater than a single unit can accommodate. Reactors are included to limit circulating current, two-gang assemblies requiring one choke and three-gang assemblies two chokes.

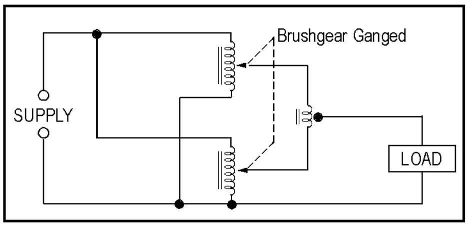


Fig. 6. Two-gang parallel-connected assembly

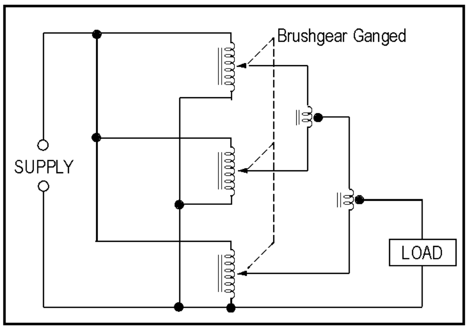


Fig. 7. Three-gang parallel-connected assembly

The output current from two units in parallel is twice that of a single unit; for three units in parallel it is three times that of a single unit, etc. The voltage rating remains that of a single unit.

Parallel operation is only suitable for the larger models since, in the case of smaller models, it is more economical to use the next larger single unit.

Ganged Assemblies - Series Connection

Two identical Regavolts may be ganged in series for operation at up to twice the input voltage of a single unit. The current rating remains that of a single unit. It is important to note that the load cannot be earthed, or commoned to the input neutral, in the circuit of Fig. 8. When it is necessary to earth the load, an isolating transformer must be included.

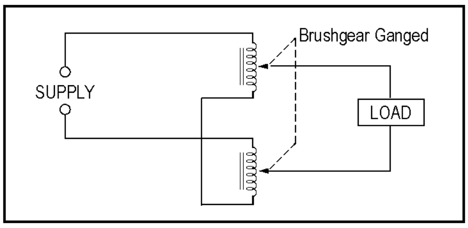


Fig. 8. Two-ganged series-connected assembly

For both increased voltage and current rating in the series 1200 frame size, series-parallel assemblies can be used, for example a four-gang assembly consisting of two parallel-connected pairs with chokes, the two pairs being connected in series. Again, the load cannot be earthed unless an isolating transformer is included.

Three Phase - Star Connection

The most commonly used three-phase circuit is the star connection of a three-gang assembly, in which the line-to-neutral voltage (phase voltage) is applied across each Regavolt unit. 240 volt models are used on 415 / 240 volt supplies, in either line-voltage or over-voltage connection. Note that the star point must always be connected as shown; otherwise an excessive voltage could be applied to one Regavolt.

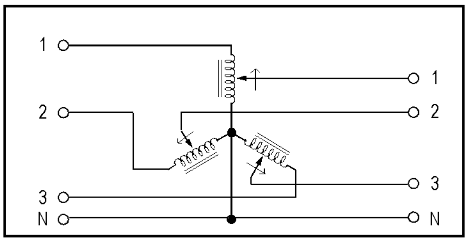


Fig. 9. Three-gang star connection showing the operation of the `star' connection system

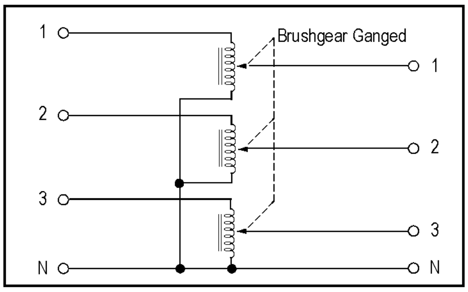


Fig. 9A. Three-gang star connection showing the operation of the three ganged Regavolts.

For increased power rating in the largest models (series 1200) a six-gang star-parallel assembly can be used, having a parallel-connected pair of Regavolts on each of the three phases.

Three Phase - Open Delta Connection

With this connection, a two-gang assembly of 240 volt units can be used to control a three-phase load from a 208 or 220V three-phase supply. The line-to-line voltage, (line voltage) is applied across each Regavolt unit, and over-voltage connection may be used if the line voltage does not exceed 240 volts. Each leg may consist of two or three parallel-connected units for increased power rating (series 1200).

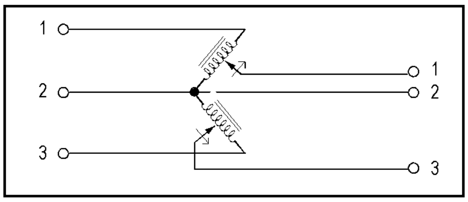


Fig. 10. Two-gang open-delta connection

The 440 volt models can be used similarly on 415V 3-wire three-phase supplies (over-voltage is not available on these types). Note that a neutral cannot be used in this circuit, and that there is a common input-output connection for one phase. This is of value in instances where one phase is earthed, such as in some 400 Hz aircraft supplies.

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Regavolt® Technical Note

Supply and load voltages beyond Regavolt range

In the example shown in Fig 11, the Regavolt is preceded by a step-down transformer and followed by a step-up transformer to obtain a variable output of 0 - 1200 volts from a 300 volt supply. In this case, the Regavolt's current rating would have to be 1200 / 240, i.e. five times the required output current.

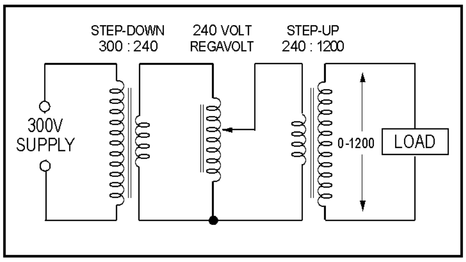


Fig. 11 Supply and load voltages beyond Regavolt range.

This arrangement can be used for voltages either above or substantially below the rated input voltage. Of course, if either the supply voltage or the required output voltage is within the ratings of the Regavolt transformer, only one auxiliary transformer is required.

Variable low - voltage output

In the example shown in Fig. 12, a 1 ampere, 240 volt Regavolt (Type 404) is used with a 40 : 1 step - down transformer to provide a variable output of 0 - 6 volts at 40 amperes rated current. The larger units or ganged assemblies can be used in this way to provide low - voltage output at very high current (a Type 1225 - G3P assembly used in the above circuit would give 0 - 6 volts at 3600 amperes rated current).

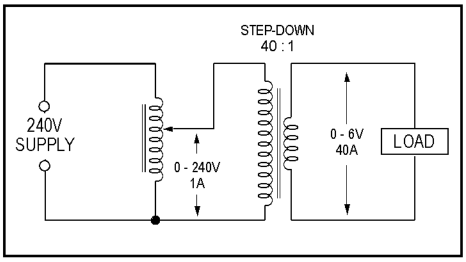


Fig. 12. Variable low-voltage output

In both the circuits of Figs. 11 and 12, fixed auto-transformers may often be used instead of the double-wound transformers shown where isolation is unnecessary. This is more economical where the transformation ratio is not high. (Up to 2 : 1 typically).

Buck or boost circuit

For limited-range variation in one direction from supply voltage, boosting of low mains etc. Refer to Fig. 13, below.

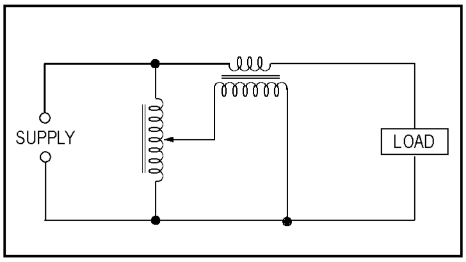


Fig. 13. Buck or boost circuit.

The output of the Regavolt feeds the primary of the step-down transformer, the secondary of which is connected in series with the supply. According to the way the fixed transformer is connected, this gives limited-range variation from supply voltage upwards (boost) or downwards (buck). The range of voltage variation is the Regavolt's output range divided by the ratio of the fixed transformer, and the output current available is the Regavolt's current rating multiplied by that ratio.

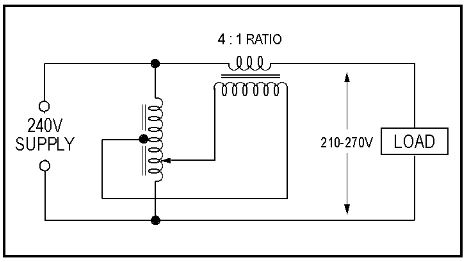


Fig. 14. Buck-and-boost circuit.

See Fig. 14, for limited-range voltage adjustment both above and below supply voltage, i.e. for under and over-voltage testing, stabilisation of varying mains voltages, etc.

The primary of the fixed transformer is connected between the brush and a tapping on the Regavolt winding. The tap position is determined by the relative amounts of buck and boost required.

In the examples shown, a centre-tapped Regavolt and 4 : 1 fixed transformer provide a total variation of 25% of supply voltage, with equal swings above and below. The output current available is four times the Regavolt rating.

Coarse and fine voltage control

Two Regavolt transformers can be used with a fixed transformer in a buck-and-boost circuit to provide a coarse and fine voltage control.

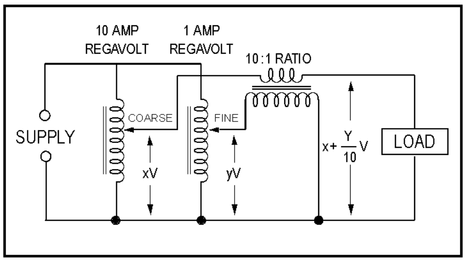
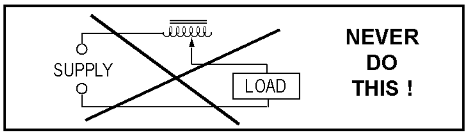


Fig. 15 Coarse and fine voltage control

In the example shown, the fine adjustment is one-tenth of the coarse adjustment, and can be as required according to the ratio of the step-down transformer.



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Standard Terminal numbering

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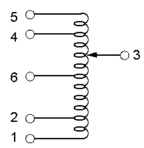

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Terminal 1 Common		

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Line-Voltage Connection	1 - 5	3 - 5
Terminal 5 Common		

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