GE
Grid Solutions

KVGC 202

Voltage Regulating Control Relay

The KVGC relay provides regulation of the supply voltage within finite limits by controlling transformer tap changing.

As part of the K Range of relays, the KVGC202 can be integrated into an overall protection and control system by utilising its integrated serial communications, thereby providing information for the day to day management of power systems.

The KVGC202 relay can be used to maintain a regulated voltage supply to electrical equipment designed to operate within finite limits of its designed rated voltage. Failure to maintain a regulated voltage supply within these defined limits may cause extensive damage. Regulation is achieved by the operation of voltage regulating transformers of various types, the most common being the on-load tap changing transformer, which maintains a stable secondary voltage by selecting appropriate tappings on the primary winding.

The tap changer operation is automatically controlled by the KVGC202 voltage regulating relay which continuously monitors the system voltage and initiates commands to the tap changer mechanism to raise or lower the voltage accordingly.

Key Features

- True RMS voltage measurement giving high immunity to harmonic distortion
- Reverse current blocking
- Local or remote control of 3 stage programmable load shedding and voltage boosting
- Tap position indication (TPI)
- Tapchanger failure and maintenance functions
- Tap change runaway protection
- Integral line drop compensation for voltage regulation at a remote point.
- Suitable for parallel transformer applications to minimise circulating current (integral reverse reactance and pilot methods)
- Comprehensive supervision functions
- Dual rated 1 A or 5 A, 50 Hz or 60 Hz
- Integral measurements, monitoring and recorder features
- Programmable digital inputs and outputs
- Integrated serial communications

Key Benefits

- Increased equipment life cycle as a result of accurate voltage control and reduced circulating currents
- Compact multi-function numerical relay
- User-friendly interface

Imagination at work

Control Functions

Transformer Tapchanger Control

To maintain the system voltage within finite limits, the target regulated voltage (VS) and the deadband (dVS) are set on the relay. When the regulated voltage moves outside of the deadband setting, the relay commands the tapchanger mechanism to raise or lower the voltage to bring it back within the set deadband limits.

To ensure that transient voltage fluctuations do not cause unnecessary tap changes, the voltage must remain outside of the deadband for an initial time delay defined by the user. This delay is selectable as either definite time or a delay that is inversely proportional to the amount the voltage has moved outside of the deadband. This inverse time delay characteristic is shown in fig. 1.

The initial time delay timer resets at a rate equal to the rate at which it operates. This ensures that a tap change sequence can only be initiated when the mean system voltage remains outside of the deadband for the initial time delay. Any voltage swing that passes through the complete deadband from one side to the other causes the initial time delay to be reset and a new timing cycle to be started.

Inter Tap Time Delay

If more than one tap change is required to bring the voltage within the deadband limits, the time delay between tap commands is determined by the inter tap time delay. This definite time delay is user selectable in the range 0 to 120 seconds and is usually set higher than the operating time of the tapchanger mechanism. Setting the delay too seconds will cause the relay to give a constant output until the voltage is within the deadband limits.

Line Drop Compensation

The KVGC relay has the facility to allow the user to simulate the resistive and reactive voltage drop across the power line. This facility, when used with the voltage regulation algorithm, allows a constant supply voltage to be maintained at the user end of the line irrespective of the load current through the line.

Parallel Transformer Applications

Whenever two or more transformers are connected in parallel, it is essential to ensure that the regulated voltage from each transformer is in step so that any circulating currents between the transformers are minimised. The KVGC202 offers two integral techniques to control transformers in this application and reduce the circulating current.

The first method, sometimes called the pilot method, requires an interconnection between the KVGC relays mounted on each parallel transformer and compensates based upon the measured circulating current component.

The second method, sometimes called the reverse reactance method, does not require any interconnection and relies upon the user to set the line drop compensation facilities to compensate for the circulating current.

As well as the above techniques, conventional hardwired master-follower type schemes can be implemented using the programmable inputs and outputs of the relay.

Load Shedding & Boosting

The regulated voltage (VS) can be lowered or raised by up to 10% of VS by means of the progammable load shedding/boosting facilities. Three levels are available, each individually programmed and available via remote communications or via opto-isolated (digital) inputs.

The state of load shedding/boosting is stored in memory by the relay during auxiliary power interruptions.

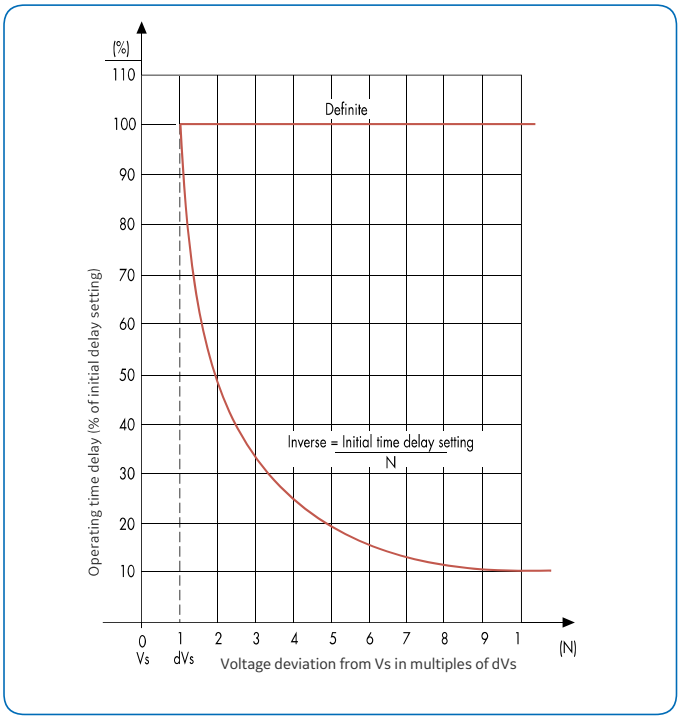

Fig 1 Operating time characteristics

Supervision & Monitoring Functions

Runaway Protection

The KVGC monitors if the tapchanger operates without a valid command, or if tapchanger operation causes the voltage to move further away from the desired regulated voltage setting. If this occurs, an alarm is raised and the relay can be set to block further tap commands if required.

Under/Overvoltage Detection & Blocking

The undervoltage and overvoltage monitors constantly measure the line voltage and can be used to operate one or more of the programmable relay outputs if the set threshold is exceeded.

In addition, the monitors also ensure that only tap changes that would restore normal voltage are permitted - and any attempts to exceed upper or lower limits of voltage are prevented. The undervoltage monitor also blocks all tap change commands if a second threshold is exceeded. The settings for the undervoltage and overvoltage monitors are all user programmable.

Overcurrent Detection

Separate overcurrent detectors are provided for excessive load current and excessive circulating current between transformers in parallel. Indication of both fault conditions are given by the selected output contacts, if set. The excessive load current detector (IL) and the excessive circulating current detector (IC) may operate internal blocking relays preventing tap change initiation, if the associated logic links are selected. In the case of the excessive circulating current, tap change initiation is prevented after a selected time delay.

Tap Position Indication (TPI)

The KVGC provides indication of the actual position of the tapchanger mechanism. Up to 40 positions can be indicated if the AC voltage used for the TPI measurement is based upon the regulated voltage. If a separate TPI supply is used, up to 30 positions can be indicated. User settable thresholds are available to provide alarm indications when the tap position exceeds defined limits. There is also indication of whether the mechanism is currently on an even or odd tap.

Tapchanger Maintenance

To help facilitate condition-based maintenance programmes, two features are provided to monitor the operation of the tapchanger mechanism:

- The tap change operations counter is used to monitor the total number of tap change operations and when it exceeds a user settable threshold, the relay can be configured to initiate an alarm contact and/or block tap change operation.
- The frequent operations monitor counts the number of tap change operations in a user settable time period and when it exceeds a user settable threshold, the relay can be configured to initiate an alarm contact and/or block tap change operation.

Tapchanger Failure Mechanism

In the event of tapchanger mechanism failure where the regulated voltage continuously remains outside the deadband for a settable time delay, one or more relay contacts can be programmed to give an alarm indication. This alarm will automatically reset when the voltage is restored within the deadband limits. This function can also be programmed to block all tap change commands.

KVGC202
Your solution for single & parallel transformer control

Configuration

The configuration of the relay is software based. Setting logic function links together with the assignment of digital inputs and outputs defines the way that the relay will operate. This allows:

- Selection of features
- Implementation of user-defined logic
- Control of the event recorder: Configuration of the relay may be performed by the user via the relay front panel function keys, or remotely via the communications system with the appropriate PC and software.
- Password Protection: To prevent accidental changes to settings that alter the configuration of the relay, password protection is provided. Each relay is supplied with a generic password, which should be changed by the user if this facility is required.

Ancillary Functions

Measurements

The measurement values provided by the relay can be accessed by an integral back-lit, liquid crystal display (LCD) or via the serial port, eliminating the requirement for additional instrumentation to be mounted in the relay panel.

Measurements include:

- Measured line voltage
- Regulated voltage (including compensation)
- Load and circulating current
- Power factor
- Frequency
- Tap position information: Where applicable, the measured value may be viewed in primary or secondary terms.

Default Displays

The KVGC relay provides a number of user-defined default screen options to provide a simple way of accessing key information. In the event of a tap change sequence being initiated, the default display automatically changes to show the raise/lower volts and alarm status and provides a reading of the time remaining before the next tap change.

Records

Fifty events can be stored in a cyclic buffer, with each event time-tagged within a 1 ms resolution. An event is logged following a change of state of the digital inputs and outputs, local settings change or on operation of a control function. Records may be downloaded to a PC using serial communications and appropriate software.

Test Features

A number of features are provided to assist the user during commissioning, routine maintenance and fault finding operations:

- Power-on diagnostics
- Continuous self-monitoring
- The verification of input quantities by the measurement functions
- The status of the digital inputs and relay outputs can be displayed

Hardware

The KVGC202 is housed in a 30TE (Midos size 6) case and is suitable for either rack or panel mounting.

The relay has six analog channels: 3 VT inputs, 2 CT inputs and 1 CT output used for the pilot method of circulating current control. These channels are used to isolate and condition analog signals received from line CTs and VTs and convert them to suitable signals that the relay can use in its processing.

The relay is also equipped with 16 digital channels: 8 opto-isolated inputs suitable for connection to a 48 V dc supply and 8 normally open output contacts. Each of these channels is fully configurable by the user. A current limited 48 V dc field supply is provided on the relay for use with the opto-isolated inputs. In addition, a dedicated watchdog facility is available with one normally open and one normally closed contact.

The relay front panel contains a 2 line, 16 character back-lit LCD which is activated when the keypad is touched. If there is no keypad activity for a period of 2 minutes, the back light is automatically switched off to conserve power. Four push-buttons provide local access to the relay menu structure and 3 light emitting diodes (LED) are used for visual indication of the status of the relay.

Standard Midos terminal blocks are located at the rear of the relay, providing connections for all the inputs and outputs.

KVGC202
Control, measurements and system integration

Front Panel User Interface

The features of the relay can be accessed via the menu system. The menu is arranged in the form of a table where related items (menu cells) are grouped into columns.

The front panel LCD displays one menu cell at a time. The complete menu system can be navigated with the relay's front cover in place by using the 'F' key. Easier access is possible with the cover off, by using the‘+’ and ‘-‘ keys, which are also used to change the relay settings.

Serial Communication

The relay menu can also be accessed via the serial communications facility. This allows all of the menu cells in a column to be displayed simultaneously and permits changes to be made from a PC keyboard.

To permit serial communications, the relays must be interconnected via a shielded, twisted wire pair known as K Bus. Up to 32 relays may be connected in parallel across the bus.

The K-Bus spur is connected via a protocol converter known as a KITZ, either directly or via modem, to the RS232 port of the PC.

The KITZ provides signals over the bus which are RS485 based and are transmitted at 64 kbits/s. This system allows up to 32 relays to be accessed via one RS232 communications port. A pictorial representation of this is shown in Figure 2.

Software is available with each KITZ to provide access to the relay in order to read and change settings. Additional software (Protection Access Software & Toolkit) is also available. This provides access to the event recorder and other additional functions. Each relay is directly addressable over the bus to allow communications with any selected relay. Global commands may also be given to all relays on the network.

The communications protocol used by K Range relays is called Courier. The Courier language has been specifically developed for the purpose of using generic PC programs that will, without modification, communicate with any device using the Courier language. In the Courier system, all information resides within the relay and each time communication is established with the relay, the requested information is downloaded to the PC. The protocol includes extensive error checking routines to ensure the system remains reliable and secure.

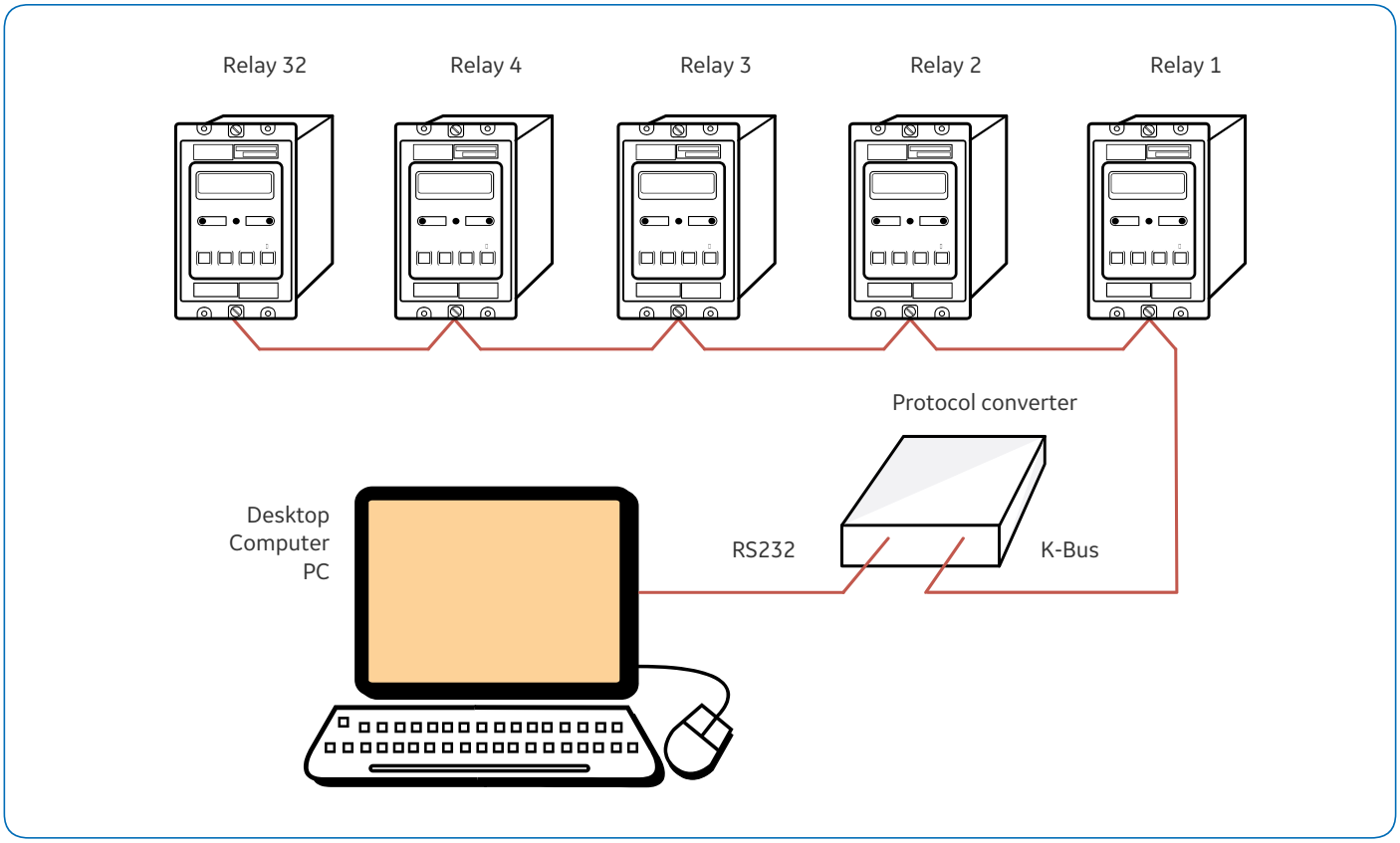

Figure 2 Basic communications system

Technical Data

Input Ratings

• AC current (In)	1 A or 5 A
• AC voltage (Vn)	110 V phase to phase
• Rated frequency:	50 / 60 Hz
• Frequency range	-6% to +2% rated frequency

• Auxiliary voltage (Vx)

Nominal voltage (V)	Operative range (V)	
	DC	AC
24 / 125	19 - 150	50 -150
48 / 250	33 - 300	87 - 265

Output Rating

• Field voltage	48 V dc (current limited to 60 mA)

Burdens

• Load current inputs	0.02 VA at In = 1 A 0.03 VA at In = 5 A
• Circulating current input	0.8 VA at In = 1 A or 5 A
• DC auxiliary voltage	4 W to 8 W typical 12 W maximum
• AC auxiliary voltage	6 VA to 14 VA typical 23 VA maximum
• Opto-isolated inputs	0.25 W per input

Thermal Withstand

• Load current inputs	3.2x In continuous 30x In for 3 s l00x In for 1 s (400 A max)
• Circulating current input	2.5x In continuous 30x In for 3 s l00x In for ls (400 A max)
• AC voltage inputs	2x Vn continuous 2.6x Vn for 10 s Vn = 110 V ph-ph

Measurement Accuracy

• Measured voltage	±0.3% Vn in range 70 - 160 V ±2% Vn (typical)
• Regulated voltage	±5% Vn in range 80 -160 V
• Load current	±2% In (typical)
• Circulating current	±5% In at <l00 mA ±10% In (typical)
• Power factor	±5% (typical)
• Frequency	±1% (typical)

Current Transformer Requirements

• Relay & CT Secondary rating	1 A or 5 A
• Nominal output class	2.5 VA
• Accuracy Class	5P
• Accuracy Limit Factor	5

Opto-isolated (Digital) Inputs

• Quantity	8 (one group of 3 and one group of 5)
• 'On' voltage	>35 V dc
• 'Off Voltage	<12 V dc
• Capture time	12.5±2.5 ms at 50 Hz, 10.4±2.1 ms at 60 Hz

Relay Output Contacts

Programmable contacts: 8 normally open (make)

• Contact Ratings

Make & Carry continuously:	5 A ac or dc
Make & Carry for 200 ms:	7500 VA with maxima of 30 A and 300 V ac or dc ±10% In (typical)
Break (ac):	1250 VA with maxima of 5 A and 300 V
Break (dc):	50 W resistive, 25 Ω inductive (L/R = 40 ms) with maxima of 5 A and 300 V

Watchdog contacts: 1 normally open (make) and 1 normally closed (break)

• Contact Ratings

Make & Carry continuously:	5 A ac or dc
Make & Carry for 200 ms:	10 A
Break (ac):	1250 VA with maxima of 5 A and 300 V
Break (dc):	30 W resistive, 15 Ω inductive (L/R = 40ms) with maxima of 5 A and 300 V

Contact Durability

• Loaded	>10,000 operations
• Unloaded	>100,000 operations

Electrical Environment

EMC compliance CE 89/336/EEC EN 50081-2:1994 EN 50082-2:1995	Compliance with the European Commission Directive on EMC is claimed via the Technical Construction File route.
EN 50081-2:1994 EN 50082-2:1995	Generic standards were used to establishconformity

Product Safety

CE 73/23/EEC EN61010-1:1993/A2:1995 EN60950:1992/A11:1997	Compliance with the European Commission Low voltage directive is demonstrated by reference to generic safety standard.

Additional Information

- Service Manual KVGC202/EN M/I11
- Courier Communications R4113

Case

KVGC202 relays are supplied in 30TE (Midos size 6) cases, shown in Figure 3.

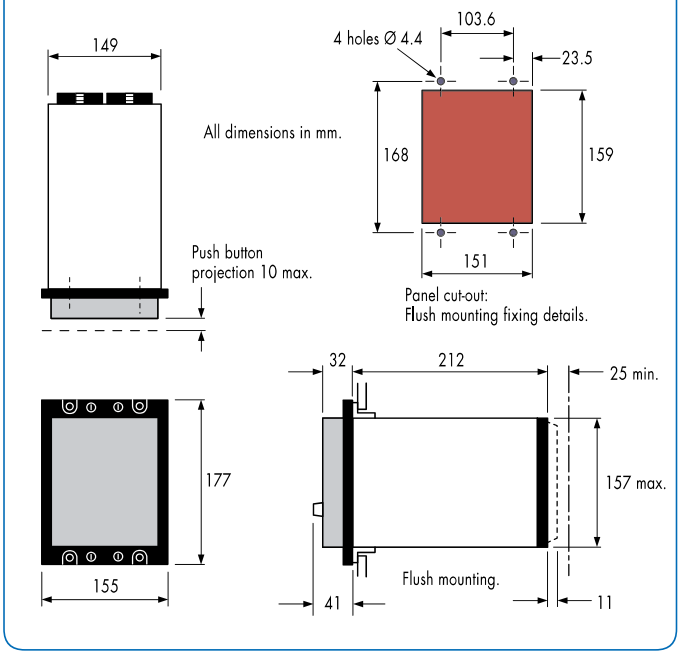

Figure 3 Case outline 30TE (size 6)

Information Required with Order

Relay Type	KVGC	2	0	2								

Configuration

Standard	0 1

Case Size

30TE (Size 6) Case	V

Auxiliary Voltage

19 - 150Vdc , 50 - 153Vac	2
37 - 300Vdc, 87 - 265Vac	5

Operating Voltage

110 Vac 50 - 60Hz	1

CT Rating

1A / 5A Dual Rated	G

Language

English	E
French	F
German	G
Spanish	S

Hardware Suffix

Factory Defined	

Device Track Record - Voltage Regulating Control Reays

Over 5,000 MVGC relays have been delivered since 1983
Over 2,500 KVGC relays have been delivered since 1997

For more information please contact
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