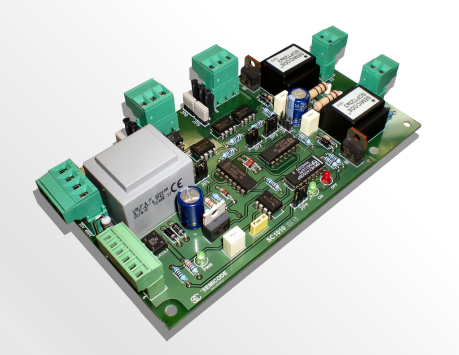
SC1010

Zero-cross thyristor firing board

PRELIMINARY TECHNICAL INFORMATION

HIGHLIGHTS

- Zero-crossing voltage network detection.
- Up to 700 V_{RMS} .
- Enable & disable state control LED indication.
- Configurable trigger mode.
- Modular system.
- Ready to use.



non-contractual photo

GENERAL DESCRIPTION

SC1010 is a solid state relay controller card. It is intended to be used in applications where high reliability is needed. This card is configurable to trigger SCR's with pulse trains synchronized with mains voltage, or in permanent mode. It can be configured to start at zero crossing or random phase. Control signal can be a logic level referred to card reference (high input impedance) or floating optocoupled input (low input impedance). Built-in power supply is feed directly from the mains, either 230 V_{AC} or 400 V_{AC}, 50/60 Hz.

ABSOLUTE MAXIMUM RATINGS

Description	*Symbol*	*Notes / Test conditions*	*Min*	*Typ*	*Max*	*Units*
Continuous working AC voltage	V_{K1K2}				700	V_{AC}
Maximum AC peak voltage	$V_{K1K2\ peak}$				1800	VPEAK
Control trigger voltage	V_{CTL}	*See **CONTROL SIGNAL & VOLTAGE LEVELS** (page 5)*				
Zero-cross signal voltage	V_{ZC}	*See **SYNCRONISM SIGNALS** (page 5)*				
Synchronism voltage	V_{SYNC}	*See **SYNCRONISM SIGNALS** (page 5)*				
Control to output isolation voltage	V_{ISO}			4000		V_{AC}

RECOMMENDED OPERATION CONDITIONS

Description	*Symbol*	*Notes / Test conditions*	*Min*	*Typ*	*Max*	*Units*
continuous working AC voltage		*network freq. 42 to 63Hz, jumper adjustment*	30		700	V_{AC}
control trigger voltage	V_{CTL}	*Optocoupled mode & logic level mode*		12		V
control current consumption	I_{CTL}	*Optocoupled mode*			6	mA

MECHANICAL SPECIFICATIONS

Description	*Symbol*		*Units*
dimensions	HxBxT	151x84x29	mm
Weight	W	215	gr
control and power terminals		extractable plug (pitch 5 mm)	
module fixation		6 Holes Ø4 mm	

ENVIRONMENTAL SPECIFICATIONS

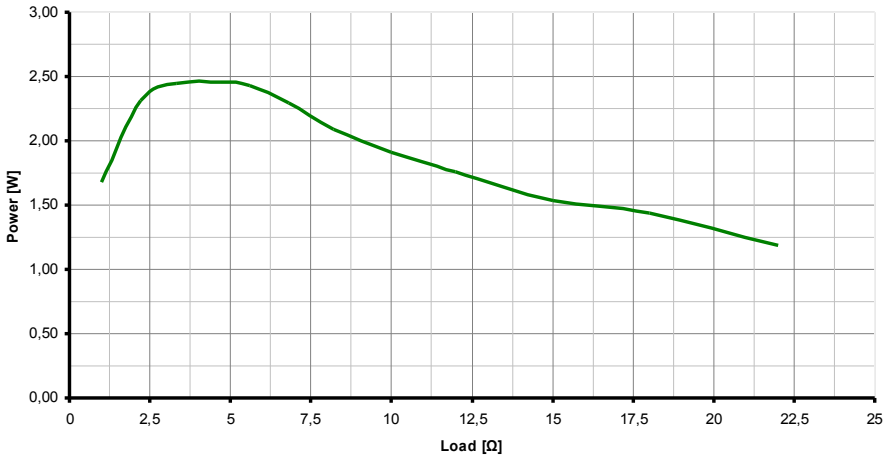
Description	
protection grade	IP-00
maximum humidity	50% Rh @ 35ºC / 70% RH @ 20ºC
pollution grade	II

130305 Rev.:1

OUTPUT FIRING PULSE TRAIN

Description	symbol	notes/test conditions	Min	Typ	Max	Units
Thyristor triggering current	I_{OUT}	*Vout = 5V*			600	mA
Maximum output voltage	$V_{OUT\ max}$				6	V
Max. transferred power peak to load	$P_{OUT\ max}$				2.4	W
Output firing train frequency	f_{OUT}			8		kHz
Output firing train duty cycle	Dc_{OUT}			20		%

OUTPUT POWER vs. LOAD

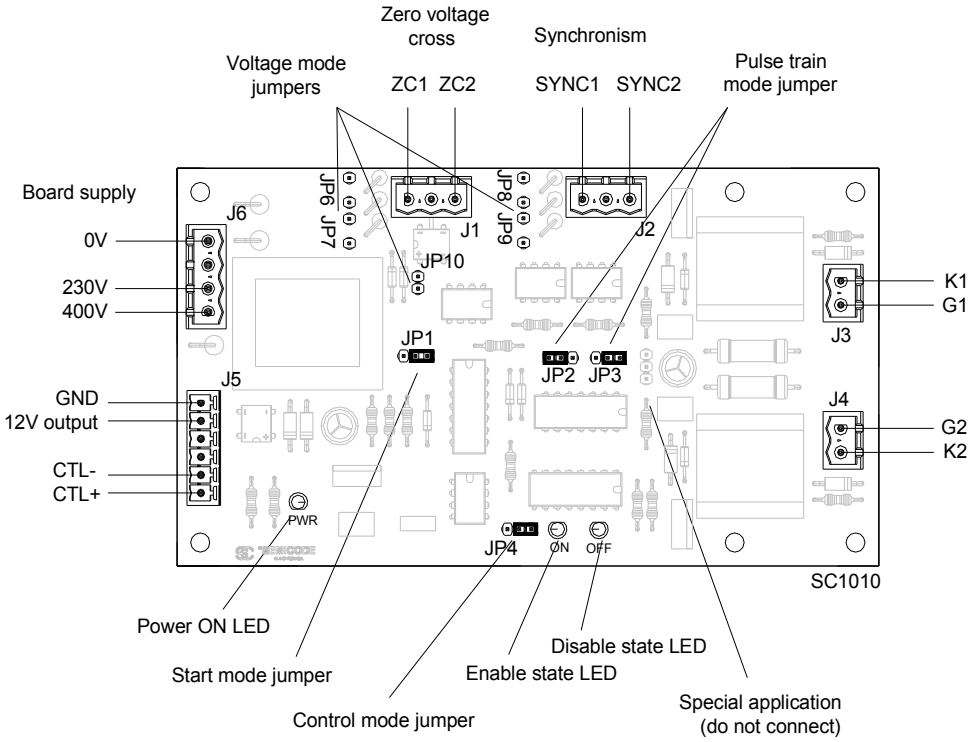


CONFORMALS

Conformal coating	MIL-1-46058, Type UR
Security	EN60950-1, UL60950-1

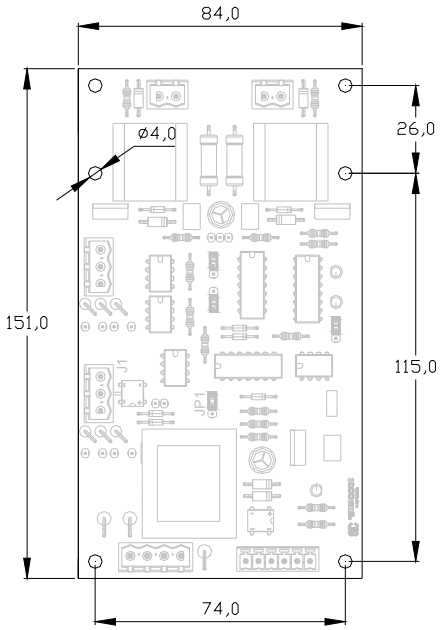
130305 Rev.:1

ELECTRICAL CONNECTIONS



connector	*designation*	*description*
J1	*ZC1*	positive pin for zero cross voltage detection
	ZC2	negative pin for zero cross voltage detection
J2	*SYNC1*	positive pin for current synchronism through thyristor
	SYNC2	negative pin for current syncronism through thyristor
J3	*G1*	thyristor 1 gate connection
	K1	thyristor 1 cathode connection
J4	*G2*	thyristor 2 gate connection
	K2	thyristor 2 cathode connection
J5	*GND*	board's ground
	12V	*12 V output*
	AC IN 1	AC/DC direct supply input
	AC IN 2	AC/DC direct supply input
	CTL-	negative control signal
	CTL+	positive control signal
J6	*0V*	0 V supply voltage connection
	230V	230 V_{AC} supply voltage connection
	400V	400 V_{AC} supply voltage connection

DIMENSIONS DRAWING



(all dimensions in milimeters)

TYPICAL APPLICATION

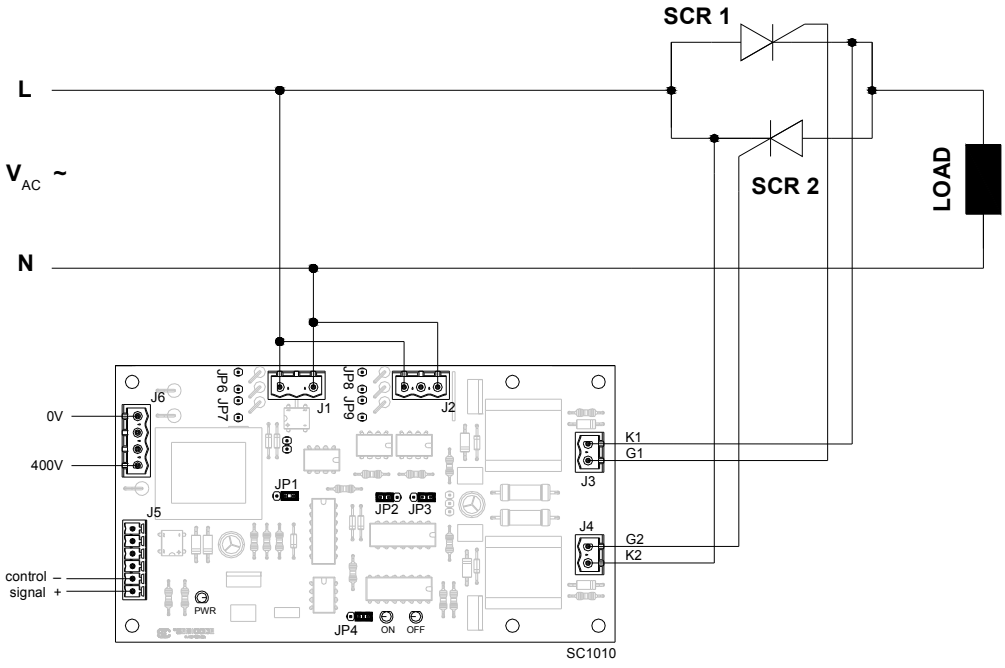


Image 1: Typical SC1010 connection to fire a W1C scheme with zero-crossing start, syncronous pulse train and optocoupled input triggering signal.

130305 Rev.:1

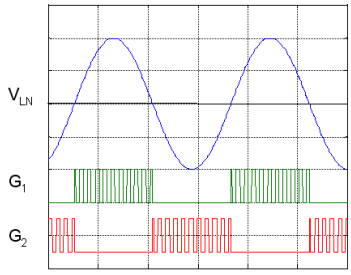
CONFIGURATION

GATE SIGNAL MODE

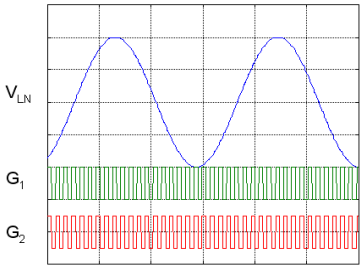
Regarding gate signals, the board can operate in two different modes; «Synchronous Pulse Train» or «Permanent Pulse Train». Operation mode is jumper selectable by means of JP1 and JP2.

- Synchronous pulse train mode (JP2 right connected; JP3 left connected)
In synchronous pulse train mode the board produces synchronized pulse trains and in phase with the mains voltage for each SCR. This operation mode is recommended since commutation and gate losses are reduced.

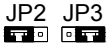
- Permanent pulse train mode (JP2 left connected; JP3 right connected)
In permanent pulse train mode the board produces a pulse signal for each SCR. Gate losses are higher than for «synchronous pulse train» mode.



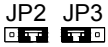
gate pulses in synchronous pulse train mode



gate pulses in permanent pulse train mode



synchronous pulse train mode



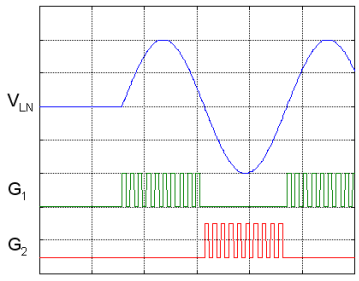
permanent pulse train mode

START MODE

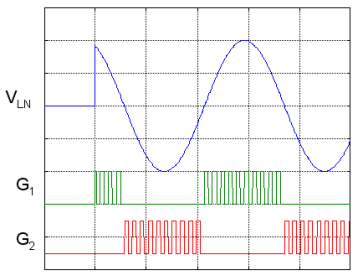
Regarding the start up, the board can operate in two different modes; «zero-cross start» or «random phase start». Start mode is jumper selectable by means of JP1. Starting mode only affects at the first cycle after a start control signal is applied.

- Zero-cross start mode.
In zero-cross start mode, first cycle of load voltage always start at zero cross of the mains voltage.

- Random phase start mode
In random phase start mode, voltage is applied to the load at the moment that control signal is applied.



gate pulses and load voltage in «zero crossing start» mode



gate pulses and load voltage in «random phase start» mode

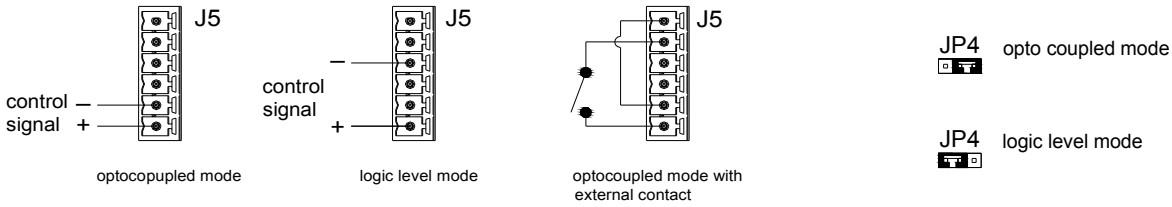
zero crossing start

random phase start

CONTROL SIGNAL & VOLTAGE LEVELS

Input type of control signal is jumper selectable between «logic level» or opto-isolated. Logic level input is intended to be controlled directly from a logic signal source (PLC, microcontroller, etc.). It is advised logic level circuits are high impedance, so attention must be paid to avoid undesirable interference. Shielded lines must be used for control signals. Opto-isolated mode requires a control signal source capable of deliver at least 5 mA at 15 V. In this mode 5.22 kΩ input impedance helps to prevent interference influence, nevertheless shielding is suggested.

A mechanical external switch can be used but opto-coupled input mode must be selected since a high impedance open circuit can produce undesirable operation. Since the switch is fed from internal power supply, isolation is not achievable in this mode.



control signal	optocoupled mode	logic level mode
enable	6-30V	9-12V
disable	0-3V	0-3V

SYNCHRONISM SIGNALS & VOLTAGE RANGE OF OPERATION

The SC1010 card uses 2 signals for synchronize the gate pulses with the network.

- Zero voltage cross

This signal is used to determine the time when the voltage across the thyristors is zero (zero crossing). When the SC1010 is enabled by control signal, the first of the gate pulse trains not appears in the output until this signal isn't in zero crossing. This way the thyristor always turns-on at zero voltage (this not applies in random start mode).

- Synchronism and voltage range of operation

This signal is used to synchronize the width and timing of gate train pulses with the current through the thyristors (this not applies in permanent pulse train mode). According the jumper configuration this output can work in three different voltage range:

Voltage range	JP6	JP7	JP8	JP9	JP10
30 – 100 V_{RMS}	ON	ON	ON	ON	ON
100 – 400 V_{RMS}	OFF	ON	OFF	ON	OFF
400 – 700 V_{RMS}	OFF	OFF	OFF	OFF	OFF

Note that in resistive loads, the current and the voltage waves are in phase, then the ZC and the SYNC signals are the same. Also in applications where the cos Φ is near 1 (motors, inductive loads) the same signal for ZC and SYNC could be used. For applications where the voltage and current are strongly out of phase, then different signals for ZC and SYNC should be used, for example in reactive compensation (LC filtering) applications (see **REACTIVE COMPENSATION** on page 6).

REACTIVE COMPENSATION

SC1010 may be used in reactive energy compensation control, connecting the AC switches inside the delta connection formed by capacitors. The connection of the zero-cross voltage signal (J1) and the synchronism signal (J2) should be as the following figure:

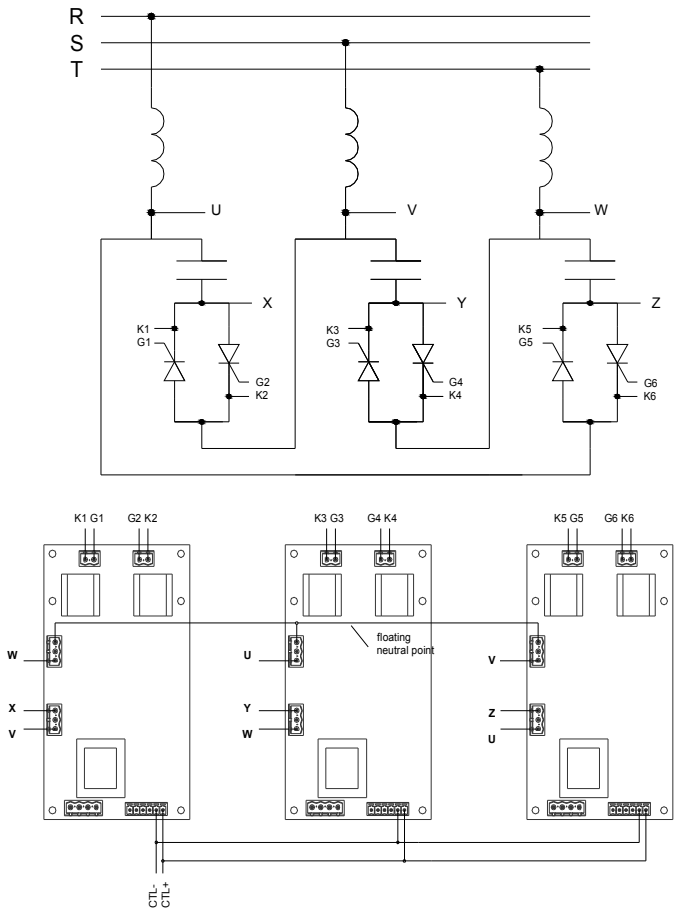


Image 2: Typical SC1010 connection to fire a W3C scheme inside delta's connection.

Note that for the most thyristor modules, the auxiliary cathode is galvanically united with power cathode; then it is possible to reduce the number of wires from cards SC1010 to power stack, only large wires for K and G connections from J3 and J4 are required. J1 and J2 connections may be plugged to J3 and J4 following this table.

J3/J4	J1/J2
K1	X
K2	V
K3	Y
K4	W
K5	Z
K6	U

NOTES & RECOMMENDATIONS

The card has an internal power supply, that could be supplied at 230 or 400 V_{AC}. It is mandatory that the supply of the SC1010, and of its controllers (PLC, micro-controller, etc) will be ready, almost 100 ms, before the activation of the control signals (enable). If not, a non correct working of the card could be produced. This could cause potentially dangerous failures if the power stack is supplied.

Be careful with the continuity in the supplying of the card. An interruption couldn't be permitted whenever the card is connected to power stack, and the stack is working.

The gate and cathode wires between the card and the thyristor must be twisted pair, in order to avoid external interferences. Wires must be as short as possible.

130305 Rev.:1

Cost Effective Products

SEMICODE ELECTRONICA

Offers to the market a comprehensive range of products from recognized manufacturers at the best price/quality relationship, this products are provided with a basic reference code that allows maintaining the same product reference even if the original device manufacturer is replaced. SEMICODE product reference has to be considered as a generic brand.

Seeking the market needs and trends, we are constantly increasing the product portfolio with new products and suppliers, please ask for the updated information available to our local contacts.

SEMICODE products include semiconductors, passive components and accessories focused in power electronics market.

Datasheet Annotations:

SEMICODE ELECTRONICA annotate datasheets in the top left hard corner of the front page, to indicate product status. The annotations are as follows:
Tentative information: This is the most tentative form of information and represents a very preliminary specification. No actual design work on the product has been started.
Preliminary Information: The product is in design and development. The datasheet represents the product as it is understood but details may change.
Advance Information: The product design is complete and final characterisation for volume production is well in hand.
No Annotation: The product parameters are fixed and the product is available to datasheet specification.

130305 Rev.:1