

CORRPOWER
RECTIFIER DIVISION

OPERATING MANUAL

FOR

PULSE GENERATOR
CURRENT INTERRUPTER

DISTRIBUTED BY
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1. INTRODUCTION

This instruction manual has been prepared for the CRD **Pulse Generator Interrupter (PGI)**. The **PGI** is designed to interrupt the DC output current of cathodic protection rectifiers during cathodic protection surveys. The interrupt timing cycles are suitable for use with a **WAVE FORM ANALYZER** or for normal survey ON / OFF cycles. The latest and most reliable of componentry has been employed to provide our customers with a high quality interrupter at a reasonable cost.

2. DELIVERY INSPECTION

If any damage has occurred to the PGI unit during shipment, FILE A CLAIM WITH THE CARRIER AT TIME OF DELIVERY. When contacting the supplier or manufacturer with regards to damages, ensure to include all relevant data; such as, Serial Number, Purchase Order Number, Invoice Number, Location, etc. This will assure you of obtaining correct and expeditious service.

3. GENERAL INFORMATION

3.1 Purpose Of The PGI

The PGI unit typically used in conjunction with a Wave Form Analyzer (WFA) to measure ON and OFF (IR drop free) pipe-to-soil potentials on impressed current cathodic protection systems. The Pulse Generator Interrupter is designed as a portable unit with three modes of operation:

- a) **WFA Mode:** The WFA mode is the normal mode of operation and is used to measure both ON and OFF pipe-to-soil potentials with the WaveForm Analyzer.
- b) **Close Spaced Survey Mode:** The CSS mode provides special rapid interrupt timings for the Waveform Analyzer to obtain IR-free potential readings at close intervals for over-the- pipe readings.
- c) **Interrupter Mode** - In the interrupter mode, the PGI functions as a standard current interrupter with a variety of user selectable timing cycles.

3.2 Description Of The PGI

The Pulse Generator Interrupter consists of our standard DC powered pulse generator logic board, multiple MOSFET modules, a 12 VDC rechargeable battery, a control panel and associated input / output connectors mounted in a durable

weather-proof enclosure. The unit comes equipped with an AC battery charger, output interrupter cables, and a chart of timing cycles.

3.3 WaveForm Analyzer/Pulse Generator System - Technical Discussion

The WaveForm Analyzer is microprocessor based handheld voltmeter which uses a complex computer algorithm to measure the ON and OFF (IR-drop free) pipe-to-soil potentials in impressed current cathodic protection systems. In order for the WFA to accurately calculate the OFF potential, a Pulse Generator must be connected to each rectifier or current source affecting the location where the P/S potential measurement is being made.

The Pulse Generator interrupts the output of the rectifier to which it has been attached, on a precise timing cycle. This interruption generates the precisely timed zero current pulse which is required by the WFA to accurately calculate the OFF potential.

The WFA uses a complex algorithm or set of computer instructions to calculate the ON and OFF P/S potential. The algorithm consists of the following steps:

- a) The WFA captures a digital picture of the P/S potential waveform by recording thousands of voltage readings on the waveform.
- b) Digital signal processing techniques are then used to filter out any induced AC or 60 cycle noise in the waveform.
- c) The ON potential readings are calculated.
- d) The IR drop contribution from the six Pulse Generators having the greatest influence on the reading is determined by analyzing the zero current pulses from the Pulse Generators.
- e) Once the total IR drop contribution is known, the OFF potential reading is calculated by subtracting the IR drop from the ON value.

It should be noted, that the WFA algorithm includes the IR drop contribution from the six rectifiers (or up to six) having the largest IR drop. To date, in extensive field testing conducted on numerous cross country pipeline, tank farms, and industrial facilities, no location has been found where more than five rectifiers were influencing the reader.

4. HOOKUP OF THE PGI

The PGI unit is designed to be used as a portable interrupter for use with cathodic protection rectifiers. The following guidelines should be followed when hooking up the PGI unit:

1. **Turn rectifier OFF!**
2. Ensure that the rectifier which is to be interrupted is within the ratings of this unit (refer to specifications). **Operation of this unit above specifications will cause premature equipment failure.**
3. The PGI unit should be operated with the carrying handle side up (i.e. the heat sink cooling fins should be vertical) especially when used with rectifiers having a current output close to the maximum rating. Placing the PGI unit in this manner will insure maximum heat dissipation.
4. There should be sufficient airflow around the PGI heatsink, especially if the rectifier is operating around the PGI's maximum rating.
5. The PGI unit must be installed in series in either the positive or negative output circuit of the rectifier. Two cables with color-coded connectors are supplied with the PGI unit for this purpose, red being positive and blue being negative. The PGI only allows DC current to flow from the positive (+) lug to the negative (-) lug.

When connecting the PGI unit in the rectifier's negative circuit (rectifier structure connection), the PGI positive terminal is connected to the structure cable and the PGI negative terminal is connected to the rectifier negative lug.

When connecting the PGI unit in the rectifier's positive circuit (rectifier anode connection), the PGI positive terminal is connected to the rectifier positive lug and the PGI negative terminal is connected to the anode header cable.

5. OPERATION OF THE PGI

5.1 Timing Selection on the PGI

The ten position slide DIP switch on the PGI unit's inner panel is used to select one of the three operating modes.

1. WAVEFORM ANALYZER MODE (WFA Mode):

The WFA mode is the standard operating mode for the PGI unit. The PGI must be in the WFA mode in order for the WaveForm Analyzer to take correct OFF potential readings. The ten position DIP switch should be set as shown below for the WFA mode:

ON										
OFF										
SW #	1	2	3	4	5	6	7	8	9	10

2. CLOSE SPACED SURVEY MODE (CSS Mode):

The CSS mode is used in conjunction with the Waveform Analyzer to obtain and log the closely spaced potentials on a pipeline. The PGI provides the more rapid interrupt timings used in this mode. The timings are: .133 seconds OFF; 1.467 seconds ON. The ten position DIP switch should be set as shown below for the CSS mode:

ON										
OFF										
SW #	1	2	3	4	5	6	7	8	9	10

3. INTERRUPTER MODE:

The ten position DIP switch can also be used to set the PGI unit in the interrupter mode. In the interrupter mode, the PGI functions as a standard current interrupter, turns the rectifier on and off at the timing cycle set by the DIP switches. The ten DIP switches are divided into the following three groups:

- a) **Switch 1 - Mode Selection:** When switch 1 is in the OFF position, the PGI is in the WFA or CSS mode. When switch 1 is in the ON position, the PGI is in the interrupter mode.
- b) **Switches 2-6 - OFF Cycle Time:** These five switches are used to set the "OFF" cycle for the PGI. The five switches are used to form a binary number between 0 and 32, with switch 2 being the most significant bit and switch 6 being the least significant bit. The "OFF" cycle is calculated using the formula:

OFF cycle (seconds) = ((Number on switches 2-6) + 1)/2

- c) **Switches 7-10 - ON Cycle Time:** These four switches are used to set the "ON" cycle time for the PGI. The four switches form a binary number between 0 and 16, with switch 7 being the most significant bit in the binary number and switch 10 being the least significant bit. The "ON" cycle is calculated using the formula:

ON cycle (seconds) = (OFF cycle) * (number on switches 7-10)

If the above explanation is confusing, a table of PGI switch settings and interruption cycle times is provided at the end of this manual as well as in the lid of the unit.

5.2 Energization of the PGI Interrupter

After the timing cycle has been set, the PGI unit can now be energized. (**Note: It is very important that the PGI unit be turned "ON" before the rectifier that it is to interrupt is energized.**) Put the "MAIN POWER" switch on the PGI unit to the "ON" position and check that the timing LED is flashing at the chosen time cycle. The red timing LED on the PGI's inner panel is lit when the PGI is "ON" or conducting current. The LED is not lit when the PG is "OFF" or is not conducting current.

The rectifier can now be energized and checked for proper interruption. This can be done by observing the rectifier's metering or with a handheld digital voltmeter measuring across the rectifier's metering shunt.

6. Battery Maintenance

The PGI unit's battery is a 12VDC gell cell type with a 7.0 Amp per Hour rating. Depending on conditions during use (ie: temperature, timing cycle, etc), the battery should last an average of 30 days continuous use. After this time the battery should be charged. The PGI unit is shipped with an AC battery charger, which can be used in any standard 115VAC wall outlet. It connects to a receptacle on the control panel and will charge the battery to 12.0-12.5 VDC. **It should be noted that the unit could only be charged when the Main Power switch is in the "OFF" position.** It takes approximately 6 - 8 hours for a full charge. **During charging, the PGI unit should be positioned with the heatsink on the bottom (this ensures that the battery is upright during the charging cycle). It is recommended that the unit not be charged after only a few hours of use continually, as this can cause degradation of battery life.** Expected battery life is approximately 3 - 4 years depending on use and conditions.

7. Troubleshooting

A number of possible Pulse Generator Interrupter problems and suggested remedies are listed below:

A. No Rectifier Current Output

There will be no current output from the rectifier if:

1. The PGI unit's polarity has been reversed when connected to the rectifier (refer to Section IV in this manual for correct connection procedures).
2. There is no DC power to the PGI unit.

B. PGI Panel LED is always OFF

If the PGI panel LED is always off, check:

1. The Mode Selection 10 position DIP switch and make sure it is set properly.
2. Make sure there is DC power to the PGI unit.

C. PGI Panel LED is always ON

If the PGI panel LED is always on, check:

1. The Mode selection 10 position DIP switch and make sure it is set properly.

For additional troubleshooting information or technical assistance, please contact:

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Service Dept., CRD Division
10848 - 214 Street
Edmonton, Alberta, Canada
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Tel: (780) 447 4189
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8. MODE SELECTION SWITCH SUMMARY TABLE

SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8	SW9	SW10	OFF	ON	MODE
I	0	0	0	0	I	0	0	0	I	1 SEC	1 SEC	INTER
I	0	0	0	I	I	0	0	0	I	2 SEC	2 SEC	INTER
I	0	0	I	I	I	0	0	0	I	4 SEC	4 SEC	INTER
I	0	I	I	I	I	0	0	0	I	8 SEC	8 SEC	INTER
I	0	I	I	I	I	0	0	I	0	8 SEC	16 SEC	INTER
I	0	I	I	I	I	0	0	I	I	8 SEC	24 SEC	INTER
I	0	I	I	I	I	0	I	I	I	8 SEC	56 SEC	INTER
I	0	I	I	I	I	I	I	I	I	8 SEC	120 SEC	INTER
I	0	0	0	I	0	I	0	I	I	1.5 SEC	14 SEC	INTER
I	0	0	0	I	I	0	0	I	I	2 SEC	6 SEC	INTER
I	0	0	I	I	0	0	0	I	I	3.5 SEC	9.5 SEC	INTER
I	0	0	I	I	0	0	0	0	I	3.5 SEC	3.5 SEC	INTER
I	I	I	I	I	I	0	0	0	I	16 SEC	16 SEC	INTER
I	I	I	I	I	I	0	0	I	0	16 SEC	32 SEC	INTER
I	I	I	I	I	I	I	I	I	I	16 SEC	240 SEC	INTER
0	0	0	I	I	I	I	I	I	I	.267	4.000	WFA
0	0	0	0	I	I	I	0	I	I	.133	1.467	CSS
I	0	0	0	0	0	I	I	I	I	ALWAYS ON		INTER

I = SWITCH ON
 0 = SWITCH OFF
 OFF = OFF CYCLE TIME
 ON = ON CYCLE TIME
 INTER = INTERRUPT MODE
 WFA = WAVEFORM ANALYZER MODE
 CSS = CLOSE SPACED SURVEY

IX. SPECIFICATIONS:

Interrupt Capacity: PGI-8012 - 80 Amps DC Maximum
 PGI-6012 - 60 Amps DC Maximum
 PGI-4012 - 40 Amps DC Maximum

 ALL MODELS - 120 Volts DC Maximum (Filtered)
 MODELS - 80 Volts DC Maximum (Non-Filtered)

Battery : 12VDC Rechargeable Battery

- (Panasonic - LCR12V6.5P)
- (PowerSonic - PS-1270)

Charge - 0 to + 40°C
Normal Use - -15 to + 45°C

Charger : Input - 120 VAC (60 Hz)
 Output - 12 VDC 500mA

Cables : #4 AWG Multi-Strand Cable, c/w 100 Ampere Clamps

Dimensions : 11.5 X 10.0 X 7.0"

Weight : Approximately 12 pounds