CATHODIC PROTECTION RECTIFIER

USER'S MANUAL

INSTRUCTION MANUAL

OIL COOLED
CATHODIC PROTECTION

TRANSFORMER RECTIFIER

SUITABLE FOR INSTALLATION OUTDOORS

DATE OF MANUFACTURE: JAN 2007

INDEX

SECTION 1:

1.a. TRANSFORMER RECTIFIER ARRANGEMENT

The **ASAI**-transformer rectifier equipment is housed in two sections, comprising the oil tank section and control cabinet mounted on the front side of the oil tank.
A panel mounted on the oil tank houses the system fuses, electronic output control circuit, and output interrupter timer.
The main power components, i.e. the main step down transformer and Rectifier Bridge, are all mounted on a removable chassis below the cold oil level inside the oil tank.

The output adjustment knob, voltage and current meters/ indicators and shunt, a.c input breaker, interrupter control switch, surge suppressor and d.c terminals are mounted inside the control cabinet.
The control cabinet is covered by a hinged door with a markrolon to enable the viewing of the meters without opening the door.

The variable output adjustment is made with a single turn stepless output adjustment knob graduated from 0 to 100

1.b. EQUIPMENT DESCRIPTION

The type of transformer rectifier unit supplied is Oil Cooled Air Natural (ONAN) and the stepless control of d.c. output is achieved by the use of the a Silicon Controlled Rectifier (SCR) bridge.

A step-down transformer is used to step down the mains a.c. supply volts to a level suitable for the d.c. output required. This transformer is a double wound type with an earth screen between primary and secondary windings and thus effectively isolates mains primary voltage from the secondary side supplying the rectifier.
Transformer magnet wire and insulation materials are rated for class H operation (180^0C). Dipping in thermosetting varnish and baking enhance this insulation.

The varnish used exceeds CSA C22.2 No. D for Class H operation.

The transformer coils have 800cm/amp gauge wire sizing.

The magnetic cores where constructed from high grade, grain oriented steel laminations with a maximum thickness of 26 gauge.

1.c. REGULATION AND EFFEICIENCY

ASAI employs advanced electronic regulation techniques. Therefore the voltage regulation does not exceed 3% from full rated load to ½ of rated measured in accordance with the procedures described in MR-20-1958 or equivalent. The transformer efficiency is 95%.

1.d. RECTIFIER STACK

The elements of the full wave bridge rectifier, silicon diodes and controlled rectifiers are also oil immersed with the transformer for enhanced cooling during high current operation.
The dielectric strength is high being able to withstand a supply of 2000 volts, 60Hz a.c. applied between each of the discrete diode case.
The silicon diodes used in the manufacture of **ASAI** are rated to provide an adequate margin for over voltage and over current surges. A 600-peak reverse voltage (PRV) rating is a minimum for all diodes in the power circuit.

In addition, the single-phase bridges are protected by a metal oxide varistor (MOV) designed to clamp over-voltage.

1.e. CONTROL UNIT

ASAI houses a control unit that regulates the output voltage by a stepless adjustment.

The output current interrupter has a high-speed output shutdown control function that permits the output current to be readily reduced to zero in practically less than 5 milliseconds, permitting instantaneous "off" potentials to be measured.
The interrupter time control is done with 2 timer relays with variable resistor knob located on top of the relays. The timers determine how long the interruption will last as well as the frequency of interruption.

The control unit also has variable single turn resistors for calibrating the output voltage.

1.f. INSTRUMENTATION

ASAI consists of 3 analog meters and an oil gauge. The analog meters include

Transformer output d.c. Voltages
Transformer output d.c. Currents
Transformer oil temperature.

These analog meters supplied by GME Inc USA are provided for monitoring the d.c output power and oil level. These meters are of molded phenolic construction with optically clear acrylic fronts sealed so as to retard corrosion.
Accuracy of meters are within +2% of full scale at 25° C and possess stability of at least +1% per 5° C deviance for the –40° C to +75° C range.
A detailed list of parts supplier for **ASAI** is included in this brochure

SECTION 2

TRANSFOMER RECTIFIER TECHNICAL DATA/ SPECIFICATION

OIL COOLED AIR NATURAL SOLID STATE CONTROL

INPUT SUPPLY VOLTAGE	AC 240 1PH 50HZ 3 WIRE
MAXIMUM INPUT CURRENT	25A
MAXIMUM OUTPUT VOLTAGE	DC 50V
MAXIMUM OUTPUT CURRENT	DC 25A
RATED OUTPUT POWER	1.25 KW
FUSE (Transformer Secondary)	16A
FUSE (DC Output)	16A
TRANSFORMER	240 VAC input, 60 VAC output
VOLTMETER	0- 50V 100mV FSD @ 50V
AMMETER	0- 50A 75mV FSD @ 80A
SHUNT	50mA 50mV
SURGE ARRESTOR	600V a.c., 200V d.c
OUTPUT	
VOLTAGE D.C.	50V
CURRENT D.C.	25A
CONTROL RANGE	0-50V, 0-25A at load of1.0 Ohms

VOLTAGE ADJUSTMENT:
0 - 100% STEPLESS AND FULL SOLID STATE

ANODE (+) TERMINALS	One
NEGATIVE (-) TERMINALS	One
DIMENSION OF TR:	
LENGTH	500.0 MM
WIDTH	450.0 MM
HEIGHT	970.0 MM
GROSS WEIGHT	45.0 KG

Continuously Rated at	50^0C ambient temperature
Maximum oil temperature,	50^oC
Degree of Weather Protection –	IP65

FINISH
Degrease and clean all surfaces
Random Orbit

1 coat Zinc etch Primer	15 microns
1 coat Polyester Powder 600UB	85 microns
TDFT:	100 microns

Color - Admiralty yellow 18 B 25 BS4800
Case - Explosion proof classification for use in potentially explosive environment
EN 50 019
EEx EII T3

Use with electrical Insulating oil to BS148/1984 Class1, 35 Litres

TANK, CONTROL ENCLOSURE & FITTINGS

Lifting Lugs
Control Enclosure (containing all operating controls & instruments, to IP65 & has Makrolon viewing window to permit instrument observation)
Oil Sight Gauge

EQUIPMENT SERIAL NO.	:	010205
CUSTOMER'S ORDER NO.	:	CENA/2004/01
MODEL NO.	:	**ASAI**
TYPE	:	OIL COOLED FOR OUTDOOR USE

SECTION 3:

3.a. INSTALLATION

The equipment is for plinth mounting. The Transformer Rectifier (T-R) should be bolted down using the four fixing holes provided in the channel base.
Earthing of the equipment should be terminated at the channel base using suitable earth cable.

For electrical connections see Schematic Diagram.

NOTE: Output negative connection is not earthed to the supply system and should not be treated as an earth connection.

IMPORTANT: Single core cables for connection to anodes must be terminated using crimped cable lugs. Structure connection must be rated for maximum **output** current.

3.b. INSTALLATION CHECKS

N.B. - IMPORTANT

Normal cable insulation checks are not to be carried out using megger equipment without first disconnecting the T-R from the high voltage during such tests. Damage to semi-conductors will result if test voltages in excess of 1000V are applied.

Check that all heavy current connections are tight and the equipment is earthed correctly.

Prove that anode terminals are connected to anodes by checking polarity.

SECTION 4

4.a. OPERATING PROCEDURE

Inspect the connections made following the installation procedures.

Carry out megger and resistance tests using appropriate meters.

Make sure the interrupt switch (on/off) on the front panel is off.

Make sure output adjustment knob is at zero (minimum).

Check oil level and make sure it is full.

ON the A.C supply to the Transformer-Rectifier.

Check the mains input voltage cables on the circuit breaker and make sure they are strongly fitted.

Turn ON the power switch (i.e. circuit breaker) on the left side of the control panel.

Gradually adjust the output adjustment knob until the required voltage and current output level is achieved. Then record readings obtained.

4.b. FAULT FINDING

In the event of no indicated d.c. output:-

Check supply volts, if ok, check fuses. Replace if necessary.

If there is still no d.c. output, check position of output adjustment knob to be sure it is not in zero.

Check primary volts into the TR, if o.k. Check primary volts into main step down transformer.

If there is still no d.c output, check the semi-conductor bridge diodes and SCRs. This may necessitate the removal of the rectifier stack for checking.

In the event of no d.c. Voltage being indicated, but current is: -

Check voltmeter.

Check on voltmeter terminals if voltage there but no readings then replace voltmeter.

In the event of no indicated d.c. output current, but voltmeter is reading d.c. Voltage: -

Check on ammeter terminals if millivolts present replace ammeter, if not proceed as below.

Check d.c. output fuse.

Check that external output circuit (groundbed and structure connections) for open circuit.

Check shunt signal by connecting milli-voltmeter on mV d.c. Across shunt at and check mV is proportional to current. Shunt rating in amps

Let this =A, then 0.075/A * OUTPUT AMPS =mV READING.

NOTE: ENSURE A.C. SUPPLY IS OFF BEFORE REMOVING TRANSFORMER TOP ENCLOSURE FOR OIL FILLING.

4.c. ROUTINE & PREVENTIVE MAINTENANCE

Check calibration of the system every six months.

Check tightness of all electrical connections periodically.

Keep the inside of the control enclosure clean and check that gasketting and fastening are in good order.

Check that all connections, particularly those carrying high current are tight.

Maintain oil level.

Check the input voltage to ensure that the desired voltage level is fed into TR at all times.

Check the effectiveness of equipment earthing periodically.

BILL OF QUANTITIES

Item	Type	Quantity
Diodes D1 and D2	Heavy-duty silicon diodes on a heat sink.	2
SCRs 1 and 2	Heavy-duty silicon silicon controlled rectifier on a heat sink.	2
Transformer T1 (Single)	Oil immersed heavy duty main multi output 1 – phase, high current transformer, 240 VAC input, 60 vac output	1
Transformer T2 (Double)	240 volts, 12v × 2 output, 500 mA transformer.	1
Circuit breaker	Input protection and output interrupter contactor	1
Fuses	Output DC fuse, 16A Transformer primary fuse, 16A	1 1
Meter M1	Output dc voltage meter max 50V	1
Meter M2	Output dc current meter max, 50A	1
Output adjustment Pot	Single turn 10 K variable resistor	1
Adjustable interrupter timers	Adjustable 0 sec – 60 sec maximum setting	2
Metal oxide varistors P1 P2	 Input – protection Output – protection	 1 1
Surge suppressor	600vac, 200 vdc (sov's)	1

LIST OF PARTS SUPPLIERS

PART	SUPPLIER
OUTPUT ADJUSTMENT KNOB	SURPLUS SALES NEBRASKA, USA
INTERRUPTER TIMER RELAYS	ANLY TIMERS, USA
PANEL VOLTMETER AND AMMETER	GME, USA
TEMPERATURE GUAGE	WIKA INC, USA
OUTPUT CONTROL CIRCUIT	CENA SUMMIT TECH
SURGE SUPPRESSOR	BOWTHORPE EMP UK. LTD

SERIAL NUMBER: ----------

MODEL NUMBER: ----------

CUSTOMER: ----------

TYPE OF TEST	ADJUST. KNOB POSITION	TRANSFORMER PRIMARY		SECONDARY		RECTIFIER OUTPUT			
		AC VOLTS	CURRENT	AC VOLTS	CURRENT	DC VOLTS	AMPS	WATTS	EFFIC.
TRANSF ON NO LOAD									
						*********	*******	******	*******
						*********	*******	******	*******
						*********	*******	******	*******
						*********	*******	******	*******
						*********	*******	******	*******
						*********	*******	******	*******
						*********	*******	******	*******
						*********	*******	******	*******
TRANSF LOAD TEST						*********	*******	******	*******
						*********	*******	******	*******
						*********	*******	******	*******
						*********	*******	******	*******
						*********	*******	******	*******
RECT. LOAD TEST									
RATED									

EFFICIENCY:
(AT RATED) DIODE BRIDGE: _____ OVERALL RECTIFIER: _____

DATE TESTED: _____

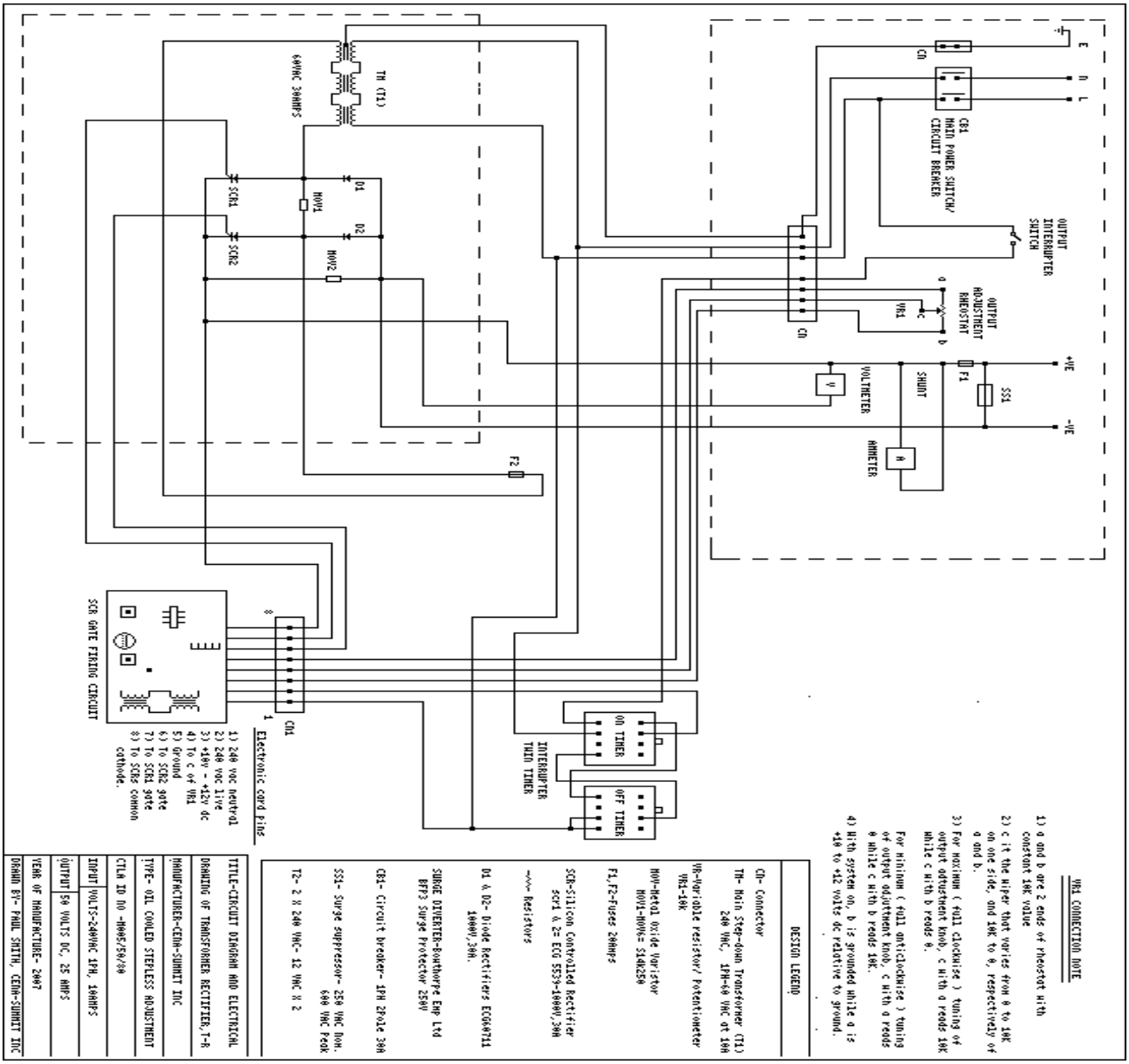
RECTIFIER INSPECTION

TIGHTEN ALL CONNECTIONS: _____ (BY) DATE: _____

ASSEMBLE UNIT: _____ (BY) DATE: _____

FINAL INSPECTION: _____ (BY) DATE: _____

ELECTRICAL DRAWING



RECTIFIER SECTIONS

Angular view of rectifier showing the oil level gauge.

Front view of rectifier with door open showing the output control knob, meters, breaker, Switches, surge suppressors, input and output terminals and fuses.

Side view of rectifier showing the oil temperature gauge (Thermometer)

1: IDENTIFICATION OF THE SUBSTANCE / PREPARATION AND OF THE COMPANY / UNDERTAKING

Product Name: **Insulating Oil BS 148: 1984 Class 1** Code: **12512- UK**

Application: **Transformer oil**
Company: **Castrol (U.K.) Limited**
Address: **Burmah Castrol House, Pipers Way, Swindon, Wiltshire, SN3 1RE**
Telephone (24 hours): **0793 512712**

2: COMPOSITION / INFORMATION ON INGREDIENTS

Composition: Highly refined mineral oil

Hazardous Ingredient(s)	Symbol Risk Phrases	Other Information	%
None of the ingredients of this Product are classified as Hazardous			

All constituents of this product are listed in EINECS (European Inventory of Existing Commercial Chemical Substances) or ELINCS (European List of New Chemical Substances) or are exempt.

Refer to Section 8 for Occupational Exposure Limits.

3: HAZARDS IDENTIFICATION

This product is NOT classified as hazardous

4: FIRST AID MEASURES

Eyes:	Irrigate immediately with copious quantities of water for several minutes
Skin:	Was thoroughly with soap and water or suitable skin cleanser as soon as possible
Inhalation:	Remove from exposure
Ingestion:	Obtain medical attention. Do NOT induce vomiting.

5: FIRE FIGHTING MEASURES

Suitable Extinguishing Media:	Carbon dioxide, powder, foam or water fog – Do not use water jets
Special Exposure Hazards:	None
Special Protective Equipment:	None

6: ACCIDENTAL RELEASE MEASURE

Personal Precautions:	Split product presents a significant slip hazard
Environmental Precautions:	Prevent entry into drains, sewers and water courses

7: HANDLING AND STORAGE

Handling: To avoid the possibility of skin disorders, repeated or prolonged contact with products of this type must be avoided. It is essential to maintain a high standard of personal hygiene.

Storage: No special precautions.

8: EXPOSURE CONTROLS / PERSONAL PROTECTION

Occupational Exposure Limits: -

Substance	8 Hr. TWA	STEL	Source/Other Information
Mineral oil (see Oil mist, mineral) 5mg/m3	10mg/m3	EH40	

Engineering Control Measures:	Mechanical methods to minimize exposure must take precedence over personal protective measures.
Personal Protective Equipment:	Avoid skin and eye contact. Wear impervious gloves (e.g. of PVC), in case or repeated or prolonged contact. Change contaminated clothing and clean before re-use.

9: PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid
Colour:	Amber
Odour:	Mild
Boiling Point/Range (^{O}C):	Above 250
Pour Point (^{O}C):	Below minus 30
Kinematic Viscosity @ 40^{O}V (cSt):	16
Flash Point (closed, ^{O}C):	Above 130
Autoignition (oC):	Above 250
Explosive Properties (%):	Not determined
Relative Density (at 20^{O}C);	Below 1.0

Water Solubility:	Insoluble
Fat Solubility:	Not determined

10: STABILITY AND REACTIVITY

Stability:	Stable, will not polymerize
Conditions to Avoid:	Temperatures (^{O}C) above 90
Materials to Avoid:	Strong oxidizing agents
Hazardous Decomposition Products:	None

11: TOXICOLOGICAL INFORMATION

The following toxicological assessment is based on a knowledge of the toxicity of the product's components Expected oral LD50, rat > 2g/kg

Health Effect:

	May cause transient irritation
On Skin:	Unlikely to cause harm on brief or occasional contact
By Inhalation:	Mist and vapours may cause irritation to nose and respiratory tract
By Ingestion:	May cause nausea, vomiting and diarrhoea
Chronic:	repeated and prolonged skin contact may lead to skin disorders
Other:	None known.

12: ECOLOGICAL INFORMATION

Environmental Assessment: When used and adequately disposed of, no adverse environmental effects are foreseen.

Mobility:	Mobile liquid. Insoluble in water. Involatile.
Persistence and Degradability:	Inherently biodegradable
Bioaccumulative Potential:	Bioaccumulative based on log P values of constituents
Ecotoxicity:	Not expected to be exotoxic to fish/daphnia/algae Not expected to be inhibitory to sewage bacteria.

13: DISPOSAL CONSIDERATIONS

Disposal must be in accordance with local and national legislation.

Unused Product:	May be sent for reclamation
Used/Contaminated Product:	Dispose of through an authorized waste contractor to a licensed site. May be incinerated.
Packaging:	Must be disposed of through an authorized waste contractor May be steam cleaned and recycled

14: TRANSPORT INFORMATION

This product is NOT classified as dangerous for transport.

15: REGULATORY INFORMATION

Hazard Label Data: -
This product is NOT classified as dangerous for supply in the UK

EC Directives:	Waste Oil Directive, 87/101/EEC Framework Waste Directive, 91/156/EEC
Statutory Instruments:	Health & Safety at Work, etc. Act 1974 Consumer Protection Act 1987 Environmental Protection Act 1990.
Codes of Practice:	Waste Management. The Duty of Care
Guidance Notes:	Occupational skin diseases: health and safety precautions (EH 26) Occupational exposure limits (EH 40) Carcinogenicity of mineral oils (EH 58) Skin cancer caused by oil [MS(B)5] Save your skin! – Occupational Contact Dermatitis [MS(B)6] Dermatitis – cautionary notice [SHW 367] Effects of mineral oil on skin [SHW 397].

16: OTHER INFORMATION

Castrol publication: Talking About Health and Safety – Lubricants and Allied Products

The data and advice given apply when the product is sold for the stated application or applications. The product is not sold as suitable for any other application. Use of the product for applications other than as stated in this sheet may give rise to risks not mentioned in this sheet. You should not use the product other than for the stated application or applications without seeking advice from us.

If you have purchased the product fro supply to a third party for use at work, it is your duty to take all necessary steps to secure that any person handling or using the product is provided with the information in this sheet.

If you are an employer, it is your duty to tell your employees and others who may be affected of any hazards described in this sheet and of any precautions, which should be taken.

Further copies of this Safety Data Sheet may be obtained from Castrol (U.K.) Limited.