

**SPECIFICATION FOR
PRESSURE SENSOR OIL CIRCUIT
TRANSFORMER
and
DIFFERENTIAL AMPLIFIER TO SENSOR OIL
CIRCUIT FOR WAG-9/WAP-7/WAP-5, 3-PHASE
ELECTRIC LOCOMOTIVES**

Specification No: CLW/ES/3/0035/H

Enclosures :-

- i) Drawing no.CLW/ES/3/SK-1/0035/H
- ii) Drawing no.CLW/ES/3/SK-2/0035/H
- iii) Drawing no.CLW/ES/3/SK-3/0035/H

ISSUED BY

DY. CHIEF ELECTRICAL ENGINEER/D-I
CHITTARANJAN LOCOMOTIVE WORKS
CHITTARANJAN — 713331
Dist: BARDHAMAN (WEST)
WEST BENGAL (INDIA)

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SSE-Design	SEE-Design	Dy.CEE/D-I

ALTERATION RECORD SHEET

Amendment Number	Date of Amendment	Page number	Alteration	Descriptions	Authority
1	12.02.02		A	Specification totally revised	Sd/-
2	10.03.03		B	Fire retardant/ self-extinguishing clause included as a note	Sd/
3	12.04.05		C	Cable length corrected as per ABB document no. 3EHN424144R5000	Sd/
4	18.11.05		D	Cable length of Pr. Sensor is changed to 2.5 m as against 5 m as per actual requirement in the locomotive. Scope of supply is listed in the drawing No. CLW/ES/3/SK-1/0035	Sd/
5	27.06.07		E	Clause no. 5.A. ix added "Cable Screen must be connected to connector body & Sensor housing to ground at both end."	Sd/
6	16.01.10		F	In clause no. 5.A.(i) the following is added:-"The force gathering element shall be flexible metal diaphragm and the sensing by Thin film strain gauge elements. The sensor shall have in built temperature compensation and zero-point compensation."	Sd/
7	03.05.12		G	Specification totally revised with introduction of Piezo-resistive technology. vide letter no. ELDD/3705/AKM dt-29-03-12 & ELDD/3705/PPR. dt. 02-05-12	Sd/-
8	28.01.2025		H	Thickness and OD of copper washer revised. Model no of ITT connector revised for amplifier. Quantity specified in scope of supply. Testing clause elaborated.	Sd/-

Note: Specification has been digitized and all the alteration i.e addition, deletion, modification etc. has been incorporated in the digitized specification.

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TABLE OF CONTENTS

SN	DESCRIPTION
1.	GENERAL DESCRIPTION
2.	SCOPE
3.	SERVICE CONDITIONS
4.	CONFORMING STANDARDS
5.	SCOPE OF SUPPLY
6.	TECHNICAL DESCRIPTION
7.	TESTS
8.	LABELING/ MARKING

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1.0 GENERAL DESCRIPTION

TECHNICAL SPECIFICATION FOR PRESSURE SENSOR and DIFFERENTIAL AMPLIFIER USED IN 3-PHASE, 50 Hz, AC WAG-9, WAP-7/WAP-5 LOCOMOTIVES.

2.0 SCOPE

This specification covers the supply of Pressure Sensor Oil Circuit Transformer and Differential Amplifier to Sensor Oil Circuit used in WAG-9, WAP-7 & WAP-5, 6000 HP, 3-Phase, 50 Hz, AC Locomotives.

3.0 SERVICE CONDITIONS

Sl. No.	Description	Remarks
1.	Maximum atmospheric temperatures	<ul style="list-style-type: none"> • Under Sun : +70°C. • In shade : +50°C.
2.	Ambient Temperature(operating)	-20°C . . . +70°C
3.	Ambient Temperature (Storage)	-30°C to +80°C
4.	Normal Humidity	60%.
5.	Maximum Humidity	100% saturation during rainy season.
6.	Altitude	1776 m above mean sea level against USBRL project condition.
7.	Rainfall	Very heavy in certain areas. The locomotive will be designed to permit it's running at 10 kilometer per hour in flood water level of 200 millimeter above rail level.
8.	Atmosphere during hot weather	Extremely dusty and desert terrain in certain areas.
9.	Coastal areas	Locomotive and equipment will be designed to work in coastal areas in humid and salt laden atmosphere.
10.	Vibration.	The equipment, subsystem and their mounting arrangement will be designed to withstand vibrations and shocks encountered in service as specified in corresponding IEC: 61373 or latest publications unless otherwise prescribed.

4.0 CONFORMING STANDARDS: The pressure Sensor and Differential Amplifier shall conform to the requirements as per IEC-60721-3-5 or latest updates/equivalents.

5.0 SCOPE OF SUPPLY

SL. No	Item Description	CLW/Drg. No	Qty/Loco
1	Pressure Sensor Oil Circuit Transformer	CLW/ES/3/SK-1/0035	04 nos.
2	Differential Amplifier to Sensor Oil Circuit	CLW/ES/3/SK-2/0035	02 nos.

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6.0 TECHNICAL DESCRIPTION**A. PRESSURE SENSOR****6.1 DESCRIPTION**

Pressure sensor will be of **thin film strain gauge technology or Piezo-Resistive technology.**

6.2. TECHNICAL REUIREMENTS

Sl. No.	Description	Remarks
1.	Ambient temperature range	unit operating : -25°C to +85°C
2.	Storage temperature range	unit not operating : -25°C to +85°C
3.	Fluid / Media Temperature range	-25°C to +125°C
4.	Accuracy	< 1.5%FS-Global Error (Including Linearity, hysteresis & repeatability)
5.	Protection Class	at least IP 53
6.	Output signal	4 ... 20mA
7.	Test voltage	500V AC 60 sec
8.	Mounting thread	G1/4"
9.	Depth of thread	11mm
10.	EMC-immunity	As per EN 61000-6-2

Firm may submit relevant test certificates in compliance of above parameters from well recognized test laboratories. Such laboratories should have proper accreditations from accredited bodies in India, Europe, USA and UK like NABL, ECCAB or AALA. Competent authority in CLW/BLW may verify such accreditations.

6.3. ENVIRONMENTAL CONDITIONS

Fluid : Shell diala S3 ZX-I of M/s Shell / Power oil, TO-10X of M/s Apar as per IEC-60296

6.4. CABLE

Cable Type : Cable Radox GKW/ RW/EMV (Electron Beam Irradiated) from approved sources of CLW/RDSO/BLW or with prior approval of CLW/BLW.

Construction:

Cores 0.5 mm²

Conductor : Stranded tin plated copper

Insulation : Radox GKW /RW

Pin 1 : +U_B

2 : GND

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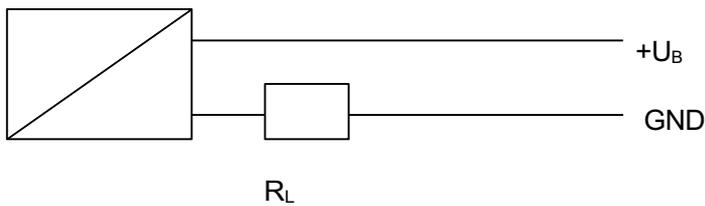
The cable screen must be fixed to the sensor housing.

Minimum bending radius: Fixed : 18 mm
Free : 28 mm

Cable Length : 2.5 Mtrs.

6.5. LOAD RESISTOR

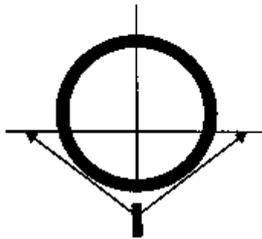
The sensor is a two-wire transmitter.



The maximum allowed load resistor must be calculated using the following Formula: $R_L (\Omega) < (U_L (V) - 14) \times 50$. ($R_L = 100\Omega$ for $U_L = 24$)

6.6. INSTALLATION

Position : The sensors are fixed to the pipe nipple facing downward



Possible installation position of the Pressure Sensor

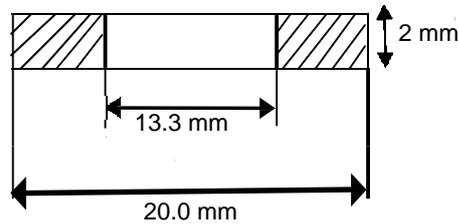
Pipe opening	A 2 mm hole.	
Seal	Oil	A copper washer to be used as seal
	Water- glycol	EPDM O-ring

Fixing torque : 8 Nm

6.7 CONNECTOR: All connection must be of ITT CANNON KPSE06E14-5S or equivalent model of GIMOTA/AAL or CLW/BLW/RDSO approved Vendor.

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6.8 COPPER WASHER: The copper sealing washer belongs to the scope of supply.



6.9 Cable Screen must be connected to Connector body & sensor housing to ground of both ends.

B: Differential Amplifier to Sensor Oil Circuit

SL. No.	Description	Characteristics
1.	Pressure range of sensors	0...4bar (relative)
2.	Differential pressure range	0...2bar (polarized)
3.	Operating voltage and U	18...30VDC
4.	Output signal IP	4...20mA
5.	Max. load resistor	2500
6.	Characteristic deviation	0.25% of Full Scale (FS)
7.	Zero signal	± 0.5% FS
8.	TK zero signal	<0.02% FS/K
9.	TK output range	<0.02% FS/K
10.	Influence of supply voltage change	<0.01% FS/V
11.	Zero signal current consumption amplifier	< 18mA
12.	Internal current limitation	Typ.90 mA
13.	Short circuit protection	Yes
14.	Reverse battery protection	Yes
15.	Operating temperature range	-25°C to + 85°C
16.	Compens Temperature range	-25°C to + 85 °C
17.	Operating position	Any
18.	Weight (incl. Al sheet)	690 g
19.	Condition	PIN>POUT
20.	Connector	5 pole IIT CANNON KPSE02E14-5P or equivalent model of GIMOTA/AAL or CLW/BLW approved vendor.
21.	EMC Immunity	As per EN 61000-6-2

Firm may submit relevant test certificates in compliance of above parameters from well recognized test laboratories. Such laboratories should have proper accreditations from accredited bodies in India, Europe, USA and UK like NABL, ECCAB or AALA. Competent authority in CLW/BLW may verify such accreditations.

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7.0 TESTs

- 7.1 The supplier shall make available one loco set of material as prototype for inspection and tests at his works and advise CLW/BLW as and when such sample is ready.
- 7.2 The prototype testing facilities must be arranged by the supplier at his own cost. Tests shall be carried out as per relevant IEC standard as mentioned. The tenderer shall clearly indicate in the offer, his preparedness for carrying out the prototype tests and adequacy of facilities to carry out the type /routine test at his premises or any govt, approved lab.

7.3 FOLLOWING TESTS SHOULD BE CARRIED OUT ON PRESSURE SENSOR

Sl. No.	Test Description	Type Test	Routine Test
7.3.1	Physical Verification, Quality of Workmanship, and Dimensional measurement.	Y	Y
7.3.2	Di Electric Test : All the cable leads of the sensor are shorted and a voltage of 500VAC is applied between that shorted cable ends and the body of the sensor for 60 seconds. There should not be any flash over or breakdown. Performance Test should be carry out after the test.	Y	Y
7.3.3	Performance Test : The pressure sensor output signal of 4-20mA should be checked for calibration (Accuracy of max. 1.5% of full scale) by imparting 0- 4 bar pressure at its port. Note down the zero offset ('O' bar pressure 4mA output signal) and the accuracy at full-scale reading (4bar pressure 20mA output signal).	Y	Y
7.3.4	Damp Heat Test : as per IEC: 60571	Y	No
7.3.5	Dry Heat Test : as per IEC: 60571	Y	No
7.3.6	Cooling Test : as per IEC-60571 (-25° C)	Y	No
7.3.7	Ingress Protection Test (Level- IP-53 as per IEC: 60529)	Y	No
7.3.8	Shock and Vibration Test as per IEC: 61373 and <u>VIBRATION</u> The sample with mounting arrangement should be subjected to sinusoidal vibration, the frequency of which is to be varied progressively between 1 Hz and 100 Hz and amplitude (in mm) as per: A=25/f for f between 1Hz and 10 Hz A=250/f ² for f between 10Hz and 100 Hz The duration will be 10 min. Possibility of resonance is to be detected in this duration.	Y	No

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	<p>If resonance is found then the sample should be subjected to sustained vibration, at the resonance or critical frequency for duration of 15 minutes along each of the three orthogonal axes. (DIN- EN60068- 2-6/ IEC 60068-2-27/ IEC 60068-2-32 or equivalent) However, if resonance is not found then the sustained vibration should be performed at 10 Hz frequency. In both cases the amplitude should be as per the above formula.</p> <p><u>SHOCK</u> For 18 mili seconds on each of its axis; the sensor is subjected to 50Hz vibration of such nature that max. acceleration is equal to 295 m/s² (30g). The results of the above two tests is satisfactory if there is no resulting damage or abnormality in operation. After the test, the sample is should be subjected to performance test (routine) and dielectric test as per clause no-7.3.3 and 7.3.2.</p>		
7.3.9	EMC Immunity Test as per EN61000-6-2	Y	No
7.3.10	Verification of OEM documents as per approved Bill of Material	Y	Y

7.4 FOLLOWING TESTS SHOULD BE CARRIED OUT ON DIFFERENTIAL AMPLIFIER

Sl. No.	Test Description	Type Test	Routine Test
7.4.1	Physical Verification, Quality of Workmanship, and Dimensional measurement and weight measurement.	Y	Y
7.4.2	Di Electric Test :All the cable leads of the Amplifier are shorted and 500V AC 50Hz applied between shorted end and the body for 60 sec. There must not be any flash over or break down	Y	Y
7.4.3	Performance Test :Operating voltage 18-30V DC PIN > POUT	Y	Y
7.4.4	Damp Heat Test : as per IEC: 60571	Y	No
7.4.5	Dry Heat Test : as per IEC: 60571	Y	No
7.4.6	Cooling Test : as per IEC-60571 (-25 ^o C)	Y	No
7.4.7	Shock and Vibration Test as per IEC: 61373 and IEC60068 <u>VIBRATION</u> The sample with mounting arrangement should be subjected to sinusoidal vibration, the frequency of which is to be varied progressively between 1 Hz and 100 Hz and amplitude (in mm) as per:	Y	No

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	<p>$A=25/f$ for f between 1Hz and 10Hz $A=250/f^2$ for f between 10Hz and 100Hz The duration will be 10 min. Possibility of resonance is to be detected in this duration. If resonance is found then the sample should be subjected to sustained vibration, at the resonance or critical frequency for duration of 15 minutes along each of the three orthogonal axes. (DIN- EN60068-2-6/ IEC60068-2-27/IEC60068-2-32 or equivalent) However, if resonance is not found then the sustained vibration should be performed at 10 Hz frequency. In both cases the amplitude should be as per the above formula. SHOCK For 18 milli seconds on each of its axis: the Amplifier is subjected to 50Hz vibration of such nature that max. acceleration is equal to 295 m/s^2 (30g) The results of the above two tests is satisfactory if there is no resulting damage or abnormality in operation. After the test, the sample is should be subjected to performance test (routine) and dielectric test as per clause no-7.4.3 and 7.4.2</p>		
7.4.8	EMC Immunity Test as per EN61000-6-2	Y	No
7.4.9	Verification of OEM documents as per approved Bill of Material	Y	Y

Note: The offered material shall be as per approved model of **CLW/BLW**. The Routine inspection shall be carried out on 10% of sample on offered material. In case of failure, entire lot shall be re- offered.

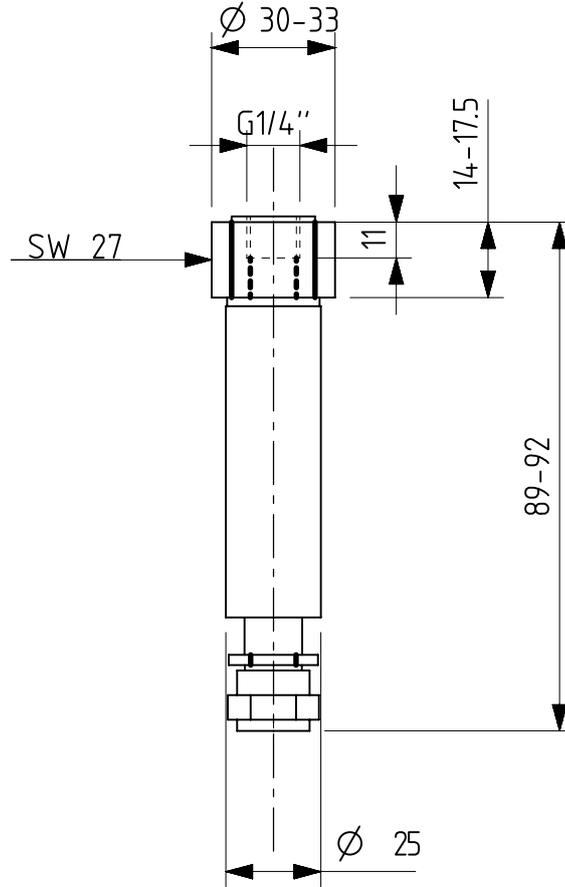
8.0 LABELLING / MARKING:

Products should be marked with the following:

- i) Type Nos. of each product should be punched for identification.
- ii) Month and Year of manufacture.
- iii) Name of manufacture with trademark, Code No. & Batch No.

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ALL DIMENSIONS ARE IN mm.

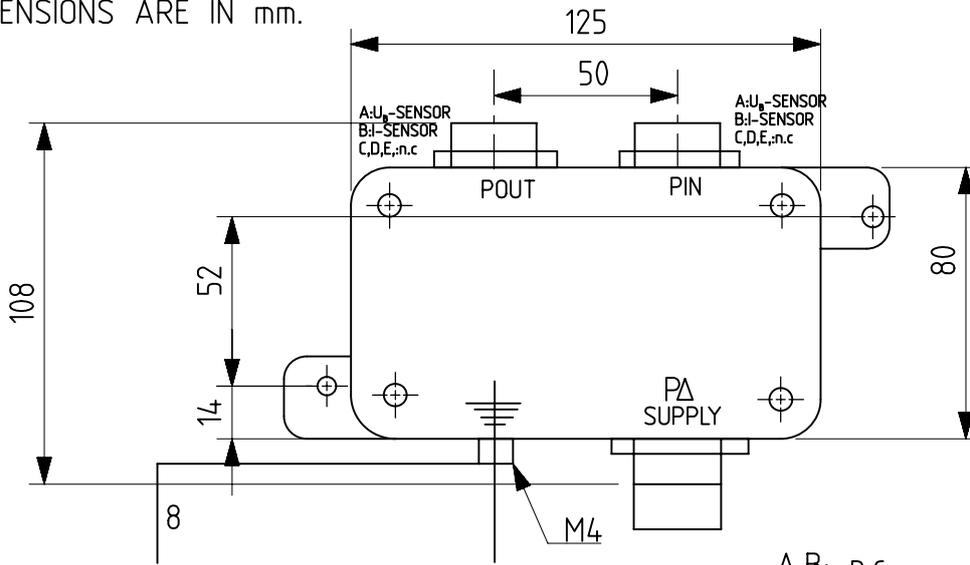


SCOPE OF SUPPLY

- I) SENSOR
- II) CABLE LENGTH -2.5 m
- III) COPPER WASHER AS PER DRG, IN CLAUSE NO. 6.8
- IV) CONNECTOR (ITT CANNON KPSE06E14-5S OR EQUIVALENT MODEL OF GIMOTA/AAL)-PLUG, 5CRIMP SOCKET TO BE PROVIDED AT THE CABLE END.

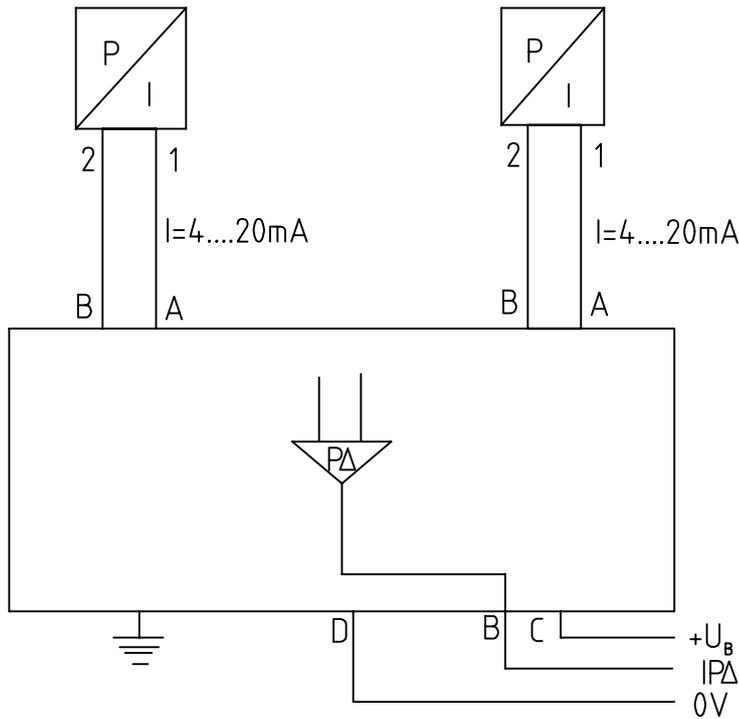
												अधिकल्पित DGN		 चित्तारंजन रेलइंजन कारखाना CHITTARANJAN LOCOMOTIVE WORKS, INDIA				
												जॉचा व.अ.अ. CHD SSE				पदार्थ MATL		प्रति भार कि. ग्रा. WT. EACH IN KG
परिवर्तन संख्या ALT.NO.	प्राधिकार AUTHY	वर्णन DESCRIPTION										दिनांकित बाबत DATED INITIAL	समीक्षित स.वि.अ. / व.वि.अ. REVIEWED AEE / SEE	विशिष्ट SPECN				
सतह - रुकता का मान मा. मा. 3073 / अ. मा. सं. 1302 SURFACE ROUGHNESS VALUE TO IS:3073 / ISO:1302		अतिरिक्त सद्य - सीमा मा. मा. : 2102 / अ. मा. सं. : 2768 UNSPECIFIED TOLERANCE TO IS : 2102 / ISO : 2768										TOL. CLS.	अनुमोदित उ.यु.वि.अ. APPROVED DYCEE	वर्णन DESCRIPTION				
		धातु-वेल्डन चिन्ह मा. मा. : 813 / अ. मा. सं. : 2553 WELDING SYMBOLS TO IS:813 / ISO:2553											दिनांक DATE	PRESSURE SENSOR OIL CIRCUIT TRANSFORMER AND DIFFERENTIAL AMPLIFIER TO SENSOR OIL CIRCUIT				
पदांक GRADE NO.	सं1 N1	सं2 N2	सं3 N3	सं4 N4	सं5 N5	सं6 N6	सं7 N7	सं8 N8	सं9 N9	सं10 N10	सं11 N11	सं12 N12	रैखिक अनुपात SCALE	N.T.S	आरेखण संख्या DRAWING NO.	CLW/ES/3/SK-1/0035/H		
Rz	0.16-0.3	0.5-0.7	0.9-1.1	1.5-2.0	2.5-3.8	5.0-6.3	9.0-12	16-25	30-40	50-63	75-100	160-250	संदर्भ / REF.					
Ra μ m	0.025	0.05	0.1	0.2	0.4	0.8	1.6	3.2	6.3	12.5	25	50	परिवर्तन संख्या ALTERATION. NO.		पर्ण SHEET	11 OF 13	A4	
चिन्ह SYMBOL													ALT.-					

ALL DIMENSIONS ARE IN mm.

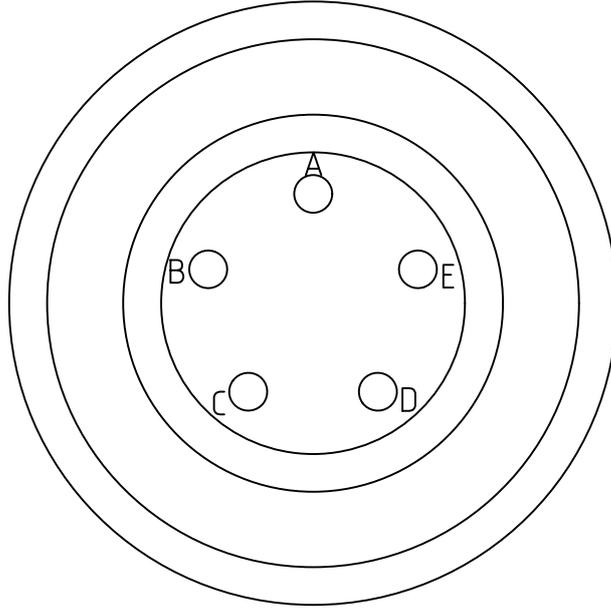


A,B: n.c
 C: +U_B
 D: 0V
 E: I_{PA}

SCHEME OF DIFFERENTIAL AMPLIFIER



												अधिकल्पित DGN		 <p>चितरंजन रेलइंजन कारखाना CHITTARANJAN LOCOMOTIVE WORKS, INDIA</p>	
												जॉचा व.अ.अ. CHD SSE			
परिवर्तन संख्या ALT.NO.	प्राधिकार AUTHY	वर्णन DESCRIPTION										दिनांक DATED	समीक्षित स.वि.अ. / व.वि.अ. REVIEWED AEE / SEE	प्रति भार कि. ग्रा. WT. EACH IN KG	
सतह - रुकता का मान मा. मा. 3073 / अ. मा. सं. 1302 SURFACE ROUGHNESS VALUE TO IS:3073 / IS:1302		अगिदिष्ट सद्य - सीमा मा. मा. : 2102 / अ. मा. सं. : 2768 UNSPECIFIED TOLERANCE TO IS : 2102 / ISO : 2768										TOL. CLS.	अनुमोदित उ.यु.वि.अ. APPROVED DYCEE	वर्णन DESCRIPTION	
		धातु-वेल्डन चिन्ह मा. मा. : 813 / अ. मा. सं. : 2553 WELDING SYMBOLS TO IS:813 / ISO:2553										दिनांक DATE	रेखिक अनुपात SCALE	वर्णन DESCRIPTION	
पदांक GRADE NO.	सं1 N1	सं2 N2	सं3 N3	सं4 N4	सं5 N5	सं6 N6	सं7 N7	सं8 N8	सं9 N9	सं10 N10	सं11 N11	सं12 N12	N.T.S	आरेखण संख्या DRAWING NO.	
Rz	0.16-0.3	0.5-0.7	0.9-1.1	1.5-2.0	2.5-3.8	5.0-6.3	9.0-12	16-25	30-40	50-63	75-100	160-250	CLWES/3/SK-2/0035/H		
Ra μm	0.025	0.05	0.1	0.2	0.4	0.8	1.6	3.2	6.3	12.5	25	50	परिवर्तन संख्या ALTERATION. NO.		
चिन्ह SYMBOL													परिपत्रक संख्या SHEET 12 OF 13		
												संदर्भ / REF.		परिपत्रक संख्या SHEET 12 OF 13	
												ALT.-		A4	



PIN CONFIGURATION

PLUG ITT CANON KPSE06E14-5S		OUTPUT SIGNAL 4-20 mA
A	(WIRE 1)	SUPPLY+
B	(WIRE 1)	SUPPLY-/COMMON
C	(WIRE 1)	CONNECTED TO ENCLOSURE
D	NO TERMINAL MOUNTED	
E	NO TERMINAL MOUNTED	
SCREEN IN CABLE IS ESSENTIAL		

												अधिकल्पित DGN		 चिततरंजन रेलइंजन कारखाना CHITTARANJAN LOCOMOTIVE WORKS, INDIA		
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Rz	0.16-0.3	0.5-0.7	0.9-1.1	1.5-2.0	2.5-3.8	5.0-6.3	9.0-12	16-25	30-40	50-63	75-100	160-250	संदर्भ / REF.			
Ra μ m	0.025	0.05	0.1	0.2	0.4	0.8	1.6	3.2	6.3	12.5	25	50	ALT.-		परिवर्तन संख्या ALTERATION. NO.	पर्ण SHEET 13 OF 13
चिन्ह SYMBOL															A4	