Specification No. ELRS / SPEC / DNI / 0032 (Rev-0 Aug 04)

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

TECHNICAL SPECIFICATION FOR DIGITAL NOTCH INDICATOR FOR 25 KV AC ELECTRIC LOCOMOTIVES

SPECIFICATION No ELRS/SPEC/DNI/0032 (REV-0 Aug -2004)

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CONTANTS

CHAPTER 1
GENERAL

1.0 SCOPE AND OBJECTIVES:

1.1 Tap changer Electric Locomotives are provided with Tap-changers supplied by M/s. BT and M/s. Ganz. Both makes of tap changers use ECIL make Synchro Transmitter-Receiver with analogue display units for indicating the 0-32 notch positions of tap-changers. These syncro Transmitter – Receiver units have not been free from problems. Failures of transmitter and receiver & problem of syncronising the transmitter signal to the receiver were reported by user Railways. This technical specification covers the requirement of Digital Notch Indicator having half notch or notch sticking events indication and recording facility for use with BT /Ganz make tap-changers fitted in the locomotives.

1.2 The specification covers basic features of equipments and manufacture/supplier will be required to work out the circuit & necessary modification on locomotive to retrofit Digital Notch Indicator in place of existing equipment.

1.3 CONTRACTOR'S RESPONSIBILITY:

The contractor's responsibility will extend to the following:

1.3.1 Supply of detailed instruction for installation of the equipment on the locomotive. For this purpose the supplier should also depute his representative during installation of the first two equipments in the locomotive at each location (CLW / Shed / Workshop).

1.3.2 Commissioning, testing & field trials of the prototype equipment in service. The supplier shall arrange to carry out detailed test & field trial jointly with RDSO.

1.3.3 The supplier shall separately quote for special tools, instruments, testing jigs, laptop preloaded with MS Windows and application software etc and, which may be required for troubleshooting and maintenance of the system.

1.3.4 The supplier shall quote for spares, which may be required for satisfactory maintenance of the equipments for a period of 1 year after completion of warranty period.

1.3.5 The supplier will be required to enter into a maintenance contract with the user railway for repair of cards and shall indicate repair charges for the cards in a similar manner as **Clause 1.3.4** above. The repaired card will have warranty of minimum one year.

1.3.6 The supplier shall supply suitable software for evaluation of data downloaded from the system.

1.3.7 The design shall be developed as per requirement given in the specification. The detailed design shall be submitted to RDSO for scrutiny and approval before commencing of the manufacturing. Here “approval” means the “approval of design features” only. The suppliers shall be responsible for performance of complete system.

1.3.8 Warranty:

The supplier shall be responsible for any damage to equipment provided in the locomotive due to defective design, materials, workmanship for a period of 12 months after commissioning on the locomotive or 18 months from the date of supply, which ever is earlier. The supplier shall replace all such equipment during the warranty period at his own cost. The period of warranty will be extendable in case of recurring problems attributable to defective design, material or manufacturing. The supplier shall warrant that everything to be furnished hereunder shall be free from all defects and faults in material, workmanship and manufacture and shall be of the highest grade and consistent with established and accepted standards of material of the type ordered and in full conformity with specifications and drawings. The supplier’s liability in this respect of any complaints, defects and /or claim shall be limited to the furnishing and installation of replacement parts free of any charge, The warranty clause in commercial agreement, if any, will prevail.

1.3.9 GUARANTEE:

The supplier/manufacturer shall give a guarantee of 12 clear months on all components from the date of commissioning and any damage or unsatisfactory performance noticed during the period shall be rectified or component replaced by the manufacturer/supplier free of cost. the replaced components shall further be under guarantee for 12 months from the date of commissioning and should the replaced components also prove unsatisfactory in service, they shall be replaced by modified and improved components by the supplier/manufacturer free of cost.

1.3.10 FIELD TRIALS:

After successful completion of type tests, the equipments shall be subjected to field service trials for a minimum period of six months. The number of trial equipments and venue shall be as agreed between the purchaser and the supplier. The installation and commissioning of the equipments for field trials shall be carried out by the supplier at his own cost.

1.3.11 MODIFICATIONS:

Modification, if any required on the basis of the experience gained during the field trials of prototype equipment, shall be incorporated by the suppliers without any extra cost. Such modification shall be finalized in consultation with RDSO.

1.3.12 INSTALLATION INSTRUCTIONS:

Installation instruction shall be provided in acceptable form e.g. instruction card. These instructions shall include the method of inter connection, type of wire and grade of wire, maximum resistance and whether the wire is screened. The maximum safe transmitter speed shall be indicated. Details of any special precaution necessary shall also be stated

1.3.13 INSTRUCTION MANUAL:

The manufacturer or supplier shall supply sufficient copies of instruction manual. This shall include system description and operating, maintenance, calibration and installation instruction as well as Card Trouble shooting manual. List of spares with part no. or tech. specification shall also be included. Number of copies to be supplied shall be 10% of the number of equipment ordered, subject to a minimum of 2 copies per order.

1.3.14 The supplier shall be responsible for carrying out all the modifications at his own cost on any part of the equipment during the period of warranty required for satisfactory operation of the equipment as per technical specification. For any technical decision the final authority from the purchaser's side is RDSO.

1.3.15 TRAINING:

The supplier shall arrange for free of cost training to IR personnel in operation, maintenance and trouble shooting including Data downloading & evaluation of Data through Evaluation Software of the system supplied

1.3.16 The supplier shall supply the write up and the elaborate manual for operation, maintenance and trouble shooting free of cost to IR for easy maintenance.

1.3.17 The supplier shall submit detailed system design manual for the system.

1.4 RAILWAYS' RESPONSIBILITY:

Railway will be responsible for followings:

1.4.1 The cabling required in loco.

1.4.2 Cable for transmitting on line notch data from Notch indicator to microprocessor based control and fault diagnostic system.

1.4.3 Labour, consumables and electrical energy required for erection, testing & commissioning of System will be provided by Indian Railways, free of cost.

1.4.4 The wages and allowances as well as the cost of the travel to and from the place of training for railway personnel.

1.5 REFERENCE TO VARIOUS SPECIFICATIONS:

Assistance has been taken from the following international, British and Indian standard specification in formation of this specification.

Spec. no	Year & Month	Descriptions
IEC: 60571		Rules for electronic equipment used on rail vehicles
IEC/TR3 61000-1-1	1992-05	Electro magnetic compatibility (EMC) Part I general section I application & interpretation of fundamental definition and terms
IEC-61000-4-6	1996-04	Testing and measurement techniques - Section VI, immunity to conduct disturbance, induced by radio frequency fields.
ELRS/SPEC/SI/0015	Oct'2001	Reliability assurance specification for electronic components for use in rolling stock

1.6 DOCUMENTATION:

The tenderer must submit the following information with the offer in printed form and neatly compiled in a booklet form. Offer with incomplete information may not be considered.

a) Detailed specification of the offered synchro transmitter, major equipments like digital Indicator.

b) Details of semiconductor devices used, their specification and data sheet.

c) Mechanical drawings of complete system with details of dimensions, mounting arrangement and weight shall be provided.

d) System description, circuit diagram along with bill of material of major equipments, circuit description, working principle and salient features. The details of microprocessor / micro controller used, functional block

description of PCBs used, control system hierarchy, protocol used and interfacing,

e) MOU (Memorandum of understanding) with the collaborator, wherever applicable.

f) QAM (Quality assurance manual)

g) Test protocol with procedure of testing.

h) Data sheet of major components**.**

i) ISO 9001 -2000 certification.

j) Details of infrastructure, manufacturing and testing activities in line with guidelines issued vide RDSO spec no.- ELRS/SPEC/SI/0015 “Reliability of Electronics used in Rolling Stock Application.”

k) Maintenance and operating manuals.

1.7 PROVEN DESIGN AND TECHNICAL COLLABORATION

The system offered shall be of proven design. The supplier shall furnish documentary evidence of having manufactured similar system/sub-system successfully. In case of offers from foreign bidder they must indicate the plan for indigenisation in a phased manner and must enclose a copy of MOU with an Indian firm and Reserve Bank of India’s clearance.

1.8 INFRINGEMENT OF PATENT RIGHTS:

Indian Railways shall not be responsible for infringement of patent rights arising due to similarity in design, manufacturing process, use of components, used in design, development and manufacturing and any other factors which may cause such dispute. The responsibility to settle any issue lies with the manufacturer

CHAPTER-2

TECNICAL DETAILS

2.0 BASIC DESIGN AND CONSTRUCTION:

2.1 The equipment shall consist of:

a) Transmitter: A Synchro Transmitter or any other arrangement that can be used to precisely measure the angle position of the servomotor (SMGR) shaft corresponding to tap-changer (GR) notch position in tap changer. The Transmitter shall be fitted to the SMGR shaft.

b) Notch Repeaters: Two numbers Digital Notch repeaters for fitment in the two Driver's cab of the locomotive.

c) Connecting cables/connectors: The cables provided on Loco for operation of existing ECIL make analogue type notch indicator shall be used for operation of the Digital Notch Indicators to facilitate inter changeability with the existing synchro transmitter/ repeater assembly. Power supply of 110 volts +/-22.5% AC, 50 HZ supply from cable no. 15 and 16 of CHBA and 110 (70 –136 V) volts DC is from the battery circuit will be available on locomotive for operation of Digital notch indicator.

Details of the existing wiring for the Notch repeater and power supply are shown in Annexure -1

2.2 Digital Notch indicator shall be mechanically robust and shall withstand all mechanical vibration, electrical noise etc. generally encountered in the Loco applications.

2.3 TECHNICAL REQUIREMENTS

2.3.1 The system shall be capable of indication of correct notch numbers and indication/ recording of half notch events, DJ trip events and Power off events along with zero notch position with high degree of accuracy for both ABB and GANZ make of SMGR, presently in use on 25 KV AC Electric Locomotives. The display in the driver's cabs shall be stable within ±0.1º resolution corresponding to the SMGR shaft position.

2.3.2 A selector switch for choosing the ABB/ GANZ make SMGR shall also be provided so that during commissioning the same can be set to suite the make of SMGR fitted in the locomotive.

2.3.2.1 Annexure-1 may be adopted as a reference to read notch numbers and corresponding angles for ABB and GANZ type SMGR's.

2.3.3 Provision for aligning the notch repeaters to SMGR zero position for nullifying drift in transmitter electrical zero position shall be provided in the system. However, the firm should ensure that this provision shall not be accessible to unauthorised persons.

2.3.4 Provision for interfacing to others microprocessor based equipment for notch posing through CAN 2.0B.

2.3.5 The Transmitter/ Notch Indicator units shall be housed in a dust proof box.

2.3.6 Provision shall be made to enable the maintenance staff to down load the recorded half notch / DJ trip events.

2.3.7 The electronic circuits /components used and their layout shall confirm to RDSO Spec. No. ELRS/SPEC/SI/0015 of Oct.'2001 "Reliability Assurance Specification for electronic components for use in rolling stock".

2.4 MARKINGS :

The following shall be clearly and indelibly marked on the equipment at appropriate location

1. Name & Trade mark of the Manufacturer
2. Type Designation
3. Serial Number
4. Operational Voltage
5. Connection Diagram
6. Year of Manufacture

CHAPTER-3

ENVIRONMENTAL CONDITIONS

3.1 The equipment should function satisfactorily under the following environmental conditions. Which are encountered where equipment will be expected to work.

3.1.1

a) Maximum temperature
} Stabled Locomotive under sun : 70 deg. C
} On board Working loco under sun. : 55 deg. C
b) Minimum temperature : 0 deg. C
c) Average temperature : 47 deg. C

3.2 **Humidity:** Up to 100% during rainy season.

3.3 **Altitude:** Up to 1200 m above mean sea level.

3.4 **Rainfall:** Very heavy in certain areas. The loco equipment shall be designed suitably.

3.5 **Environment:** Extremely dusty and desert terrain in certain areas. The dust concentration in air may reach a high value of 1.6 mg/cm^3. In many iron ore and coalmine areas, the dust concentration is very high affecting the filter and air ventilation system.

3.6. **Coastal area:** The equipment shall be designed to work in coastal area in humidity and salt laden and corrosive atmosphere. The maximum values of the condition will be as follows:

a) Maximum pH value : 8.5.
b) Sulphate : 7 mg per litre.
c) Max. concentration of chlorine : 6 mg per litre.
d) Maximum conductivity :130 micro siemens /cm

3.7 **Vibration and shocks:** The equipment shall be designed to withstand without damage, vibration and shock as generally encountered in the locomotives and shall confirm to the standards as per tests specified in IEC-60571 and are as under:-

{i} Max. vertical acceleration: - 1.0g.
(ii) Max. longitudinal acceleration: - 3.0g.
(iii) Max. transverse acceleration: - 2.0g.

The vibrations are of the sine wave and the frequency of the vibration is between 1Hz and 5OHz. The amplitude 'a' expressed in mm is given as a function of 'f' by the equation.

a= 25/f for values of 'f' from 1 Hz to 10 Hz.
a= 250/f square, for values of 'f' exceeding 10 Hz and up to 50 Hz.

3.7.1 In the direction corresponding to longitudinal movement of the vehicle, the equipment is subjected for two minutes to 50Hz vibrations of such a value that the maximum acceleration is equal to 3g (amplitude a= 0.3mm)

3.8 **Electromagnetic and Radio Frequency Interference Pollution** – High degree of electromagnetic pollution is anticipated in locomotive through high voltage contactor operation and RFI produced through walkie talkie hand set of the driver's, where the equipment will be mounted. Necessary precaution should be taken in this regard.

CHAPTER-4

SCOPE OF SUPPLY

4.1 Scope of work

4.1.1.1 The scope under this specification covers design, development including simulation studies, manufacture, supply, erection. training and commissioning of the "Digital Notch indicator" on 25 kV ac tap changer electric locomotives. The following will be scope of supply.

Sl No.	Discriptions	Quantaty	Remarks
1.	Notch display unit	2	
2.	Syncro trasmitter	1	
3.	Mounting brackets for DNI	2	
4.	Mounting bracket for trasmitter	1	

a) One set per 5 units subject to minimum two sets of users maintenance & troubleshooting manual.

b) Assurance to give backup support for supply of cards for 5 years after the warranty period.

c) Spare part for maintenance of system for 5 years. (Optional)

d) Annual maintenance contract. (Optional)

CHAPTER-5

INSPECTION

5.1 The whole of the material or fittings used in the construction of the equipment shall be subjected to inspection by the Inspecting officer and shall be to his entire satisfaction.

5.2 The inspecting officer shall have the power to :-

5.2.1 Adopt any means he may consider necessary to satisfy himself that all the materials or fittings specified are actually used throughout the construction.

5.2.2 Visit at any reasonable time and without previous notice, either contractors works or his sub-contractor's works to inspect the manufacturers and the quality of the work at any stage.

5.2.3 To reject any materials or fittings that do not conform to the relevant standard specifications or have not been manufactured in accordance with the approved practices. The rejected materials or fittings shall be marked in a distinguishable manner and shall be disposed off in such manner as the Inspecting Officer may direct to avoid its inadvertent use in the product order as per this specification.

5.3 Testing of equipment and fittings shall, as far as possible be carried out at the works of the manufacturers. Testing of bought out components may also be carried out at sub-contractor's premises, if so required. The contractor shall provide free of charge, such materials or fittings as may be required for testing whether at his own or his subcontractor's premises. The test for which facilities are not available may be carried out at RDSO or any other approved laboratory for which the testing charges shall be payable by the supplier.

5.4 The Inspecting Officer shall select all the equipments and the fittings required for test and the tests shall be carried out in his presence.

5.5 No material shall be packed or dispatched until the Inspecting Officer has passed it. The contractor’s responsibility for its efficiency in every way shall remain the same as if the work had been manufactured and tested by him.

5.6 Should any part require alteration or any defect appear during the test or trial the contractor shall be without any extra charges make such alteration or rectify the defects to the satisfaction of the Inspecting Officer.

5.7 Copies of Maker's test certificate, guarantee the performance of the equipment shall be supplied in duplicated along with the delivery of each set of equipment.

CHAPTER-6

TESTS

6.1 CATEGORIES OF TEST

6.1.1 **TYPE TEST:** Type test shall be carried out on equipment of the approved design. If there is any change in design or source of supply of any components/sub-components/assembly, units made to the changed design or from new source shall be treated as new item for the purpose of conducting type tests.

6.1.1.1 Type tests are to be repeated in case of any major change is made. In case of minor changes, i.e. change in type, rating of component etc., special test/tests as agreed by user and manufacturer are to be conducted to ensure their suitability and effectiveness of the modifications

6.1.2 **ROUTINE TEST:** Routine test shall be carried out in every equipment of each order.

6.1.3 **ACCEPTENCE TEST:** Acceptance Test shall be carried on 10% of batch quantity subject to minimum of 5 nos. as per table given below.

6.2 Tests will be carried out on the prototype unit as per relevant IEC specification or mutually agreed test program. Manufacturer will bear the expenses of the tests.

6.2.1 The tests to be carried out on complete unit are given in the following table, together with the clause number of IEC 60571 to which reference should be made.

Sl. No.	TESTS	IEC CLAUSE NO.	SPEC. CLAUSE NO.	TYPE TEST	ROUTINE TEST	ACCEPT. TEST
1.	Visual Inspection	10.2.1	6.3.1	ü	ü	ü
2.	Performance test i) Half notch indication and recording capability ii) Voltage variations iii) Sine wave test on synchro transmitter	10.2.2	6.3.2	ü	ü	ü
3.	Cooling Test	10.2.3	6.3.3	ü		
4.	Temperature rise test (Dry heat)	10.2.4	6.3.4	ü		
5.	Temperature rise (damp heat)	10.2.5	6.3.5	ü		

6.	Supply over voltage, Surges and electrostatic discharge test	10.2.6	6.3.6	ü		ü
7.	Transient burst susceptibility test	10.2.7	6.3.7	ü		
8.	Radio Interference test	10.2.8	6.3.8	ü		
9.	Insulation test	10.2.9	6.3.9	ü	ü	ü
10.	Dielectric test	10.2.10	6.3.10	ü	ü	ü
11.	Vibration and shock test	10.2.11	6.3.11	ü		
12.	Reverse polarity test		6.3.13	ü	ü	ü
13.	Output short circuit test		6.3.14	ü	ü	ü

6.3 TESTS:

6.3.1 VISUAL INSPECTION:

The following point should be check in the system.

Check that :-

a. Supplier/maker record that the unit has been subjected to “burn in” procedure and there was no failure of any component. In case there was a failure of any component, check that the card has been again subjected to "burn in" test.

b. General workmanship fitting, finish and mounting arrangement as per approved drawing / documents.

c. Terminals, switches, indications, type number Components/ devices etc. as per approved drawing/documents.

d. System cubical is free form loose pieces i.e. leftover.

e. All PCBs are easy to inserting and removing from the rack.

f. Proper earthing for the system.

g. Quality of workman ship for ruggedness.

h. Caution/Warning message are put at the proper places.

i. Quality of the fabrication and workmanship for ruggedness.

j. Socket connections are connected at the right places.

k. Main components i.e. switches, transistors, capacitors and other conductor devices are as per check list supplied by the manufacturers and approved by purchaser.

l. Major component are checked for their industrial grade certification.

m. Stickers and nameplates fully stuck on right place and varnished.

n. Use of proper solder and flux grade on soldering of PCB

o. Electronic cards are coated with CRC spray with suitable adhesive coating (CRC Spray) and it is in dry condition.

p. The sharp corners and hardware do not damage Cables.

q. Proper air gaps between live parts and metallic surface.

r. Proper shielding between signal Cables and power cables.

s. All bolts, Screws and connectors are marked with red permanent marker.

t. All covers are proper fitted.

u. Dimensions as per drawing.

v. Colour of the equipment as per drawing.

6.3.2 PERFORMANCE TEST (FUNCTIONAL):

The synchro transmitter and receivers shall be connected as per the loco wiring diagram on a suitable test bench simulating SMGR/GR working conditions. The angle position of the SMGR shaft corresponding to the notch positions 0 – 32 on the GR for both ABB & Ganz make tap changers shall be measured with a digital angle indicator and recorded. Since the angles between the notches for ABB & Ganz make GR are different, the table corresponding to the GR under test given in Annexure 1 , shall be used. Indications and recording for Half notch and DJ trip events & zero reset function shall be checked for both the types of tap changer. Annexure-1 may be adopted as a reference to read notch numbers and corresponding angles for ABB and GENG type SMGR's.

6.3.2.1 TEST FOR HALF NOTCH INDICATION AND RECORDING CAPABILITY :

Half notch position of the GR can be defined as the segment of the Angle between two notches where the GR has not moved completely from one notch to the next notch with in specified time i.e. 0.3 sec. For example in ABB tap changer notch to notch Angle is 10º and the half notch segment can be defined as 2.6 º to 7.5 º . In GANZ make, tap changer notch-to-notch is Angle is 10.588º. Hence the half notch segment can be defined as 2.7 º to 7.9 º .

Apply the rated voltage to the system and take few notches on test bench/SMGR. Then create half notch event or angle manually on SMGR and check the display of the half notch event by the Digital Notch Indicators. Then switch off the power supply and bring back the SMGR to '0' position. Check for the storage of the half notch event in the memory.

The angle requirements shall be met with.

6.3.2.2 EFFECT OF VOLTAGE VARIATIONS:

The system shall be assembled on test bench as per loco wiring diagram with variable power source. 20 operations (notches) each shall be carried out at upper nominal and lower limit of voltage variation. The nominal voltage variation for electric locomotives are as follows :

(a) DC input : 110 Volts nominal, 70 to 136 V dc

(b) AC input : 110 Volts ±22.5%

There shall be no variation in the indication of the different notch positions.

6.3.2.3 SINE WAVE TEST ON SYNCHRO TRANSMITTER:

The rotor of the synchro Transmitter under test shall be connected with 110 VAC from CHBA cable no. 15 & 16 and two out of three stationary windings shall be connected to digital oscilloscope. The rotor shall be adjusted such that voltage at the terminals of the stationary windings become minimum/zero, which can be defined as electrical Zero /zero angle position of synchro transmitter. The rotor should be rotated slowly in steps of 10 deg. from 0 deg. to 360 deg. to draw a curve for variation of the Voltage of the stationary windings Vs angle of the rotor.

This plot should be a pure sine wave within ±10% variation.

6.3.3 COOLING TEST:

Bring down the temperature of the equipment to 0º ± 2 and keep it at the temperature for 2 hours and the carried out insulation test, Dielectric test at 85% voltage of the previous test and performance test after the recovery period of 3 hrs.

6.3.4 TEMPERATURE RISE TEST (DRY HEAT):

The temperature of the equipment is to be raised to 75ºC at the rate of 1º c at 1.5 minute and to be kept at that temperature for 6 hours. In this test equipment should be in energised condition and check the working of the

system. Cool it to the room temperature (recovery period 3 hrs) and carried out insulation test, Dielectric test at 85% voltage of the previous test and performance test.

6.3.5 TEMPERATURE RISE (DAMP HEAT):

Damp heat test shall be done keeping the equipment in deenergised condition. It is to be ensured that the RH of the oven should be between 80 to 100% during the above test. The temperature of the equipment is to be raised from ambient to 55ºC in 2 hours and kept at that temperature for 6 hours. The temperature of the equipment 55ºC should be brought down to ambient (recovery period) in 3 hours. The cycle is to be repeated at least two times and carried out insulation test, Dielectric test at 85% voltage of the previous test and performance test.

6.3.6 SUPPLY OVER VOLTAGE, SURGES AND ELECTROSTATIC DISCHARGE TEST:

6.3.6.1 OVER VOLTAGE TEST:

The test shall be conducted as per IEC-60571, clause 10.2.6.1.

1.8 times of the nominal system voltage (clause 2.1.8) shall be passed for two minute and the unit shall work satisfactory after the test.

6.3.6.2 SURGE TEST:

The test shall be conducted as per IEC-60571, clause 10.2.6.2. The surge pulse shall be 1.8 kV, 1.2/50 micro Sec

6.3.7 TRANSIENT BURST SUSCEPTIBILITY TEST:

This test shall be conducted as per IEC 1000 – 4 – 4.The complete system in simulated installed condition shall be put for the test as specified in IEC. The recommended test severity level is level 4 with Direct Coupling for Power Lines & with Capacitive Coupling for Communication & Signal Lines. The EFT of defined severity shall be applied on Communication line, Analog and digital input lines as follows:

Severity for Level 4		
	Power Lines	**signal Lines**
Repetition rate	2.5 kHz	5 kHz
Applied voltage	4 KV	2 KV
Rise time	5 ns+/- 30%	5 ns+/- 30%
Impulse duration	50 ns +/- 30%	50 ns +/- 30%

Burst duration	15 ms +/- 20%	15 ms +/- 20%
Burst Period	300 ms +/- 20%	300 ms +/- 20%
Connections / period	Direct Coupling both positive & negative side for 60 seconds each sides	Capacitive Coupling both positive & negative side for 60 seconds each sides

During test the equipment shall be watched for malfunctioning or any erratic behaviour. Data recorded in the memory of the system during test shall also be downloaded & evaluated through Evaluation Software for the performance of the system as well as Data Recording & Downloading system.

No degradation of the system & malfunctioning should be allowed during or after the test. For more details refer IEC 1000 – 4 – 4

6.3.8 RADIO INTERFERENCE TEST:

6.3.8.1 RFI RADIATED/RADIATED SUSCEPTIBILITY:

This test shall be conducted as per IEC 1000 – 4 – 3. The complete system in simulated installed condition shall be put in to the Radiation Chamber & desired Radiation as defined bellow shall be applied:

Freq. Range: 80 to 1000 MHz

Field Strength: 10V/m

Amplitude Modulation: 80% at 1kHz Sinusoidal

During test the equipment shall be watched for malfunctioning or any erratic behaviour. Data recorded in the memory of the system during test shall also be downloaded & evaluated through Evaluation Software for the performance of the system as well as Data Recording & Downloading system.

No degradation of the system & malfunctioning should be allowed during or after the test. For more details refer IEC 1000 – 4 – 3.

6.3.8.2 INDUCED RF FIELD CONDUCTED/ CONDUCTED RF SUSCEPTIBILITY:

This test shall be conducted as per IEC 1000 – 4 – 6. The complete system in simulated installed condition shall be put for the test specified in IEC. The desired Radiation as defined below shall be applied on DC power in lines of Recorder cum Indicator & analog and digital input lines of equipment:

Freq. Range: 0.15 to 80 MHz

Amplitude: 10V/rms

Modulation: 80% Amplitude Modulation

During test the equipment shall be watched for malfunctioning or any erratic behaviour. Data recorded in the memory of the system during test shall also be downloaded & evaluated through Evaluation Software for the performance of the system as well as Data Recording & Downloading system.

No degradation of the system & malfunctioning should be allowed during or after the test. For more details refer IEC 1000 – 4 – 6.

6.3.9 INSULATION TEST:

Megger the electronics and control circuit, lamp unit with respect to earth and check the insulation level with 500V megger range and ensure that the insulation resistances are greater than the following minimum requirements and record the actual values obtained: The time of the Meggering shall not less then 60 Sec.

- 110 V circuit and earth : 20 M ohms.
- Control and Electronics to earth : 10 M ohms.
- Screen to earth : 10 M ohms.
- Input/Output to earth : 10 M ohms.

6.3.10 DIELECTRIC TEST:

The signal conditioning unit should be subjected to 2000 V rms, main unit and display unit for 1000V rms. The test voltage should be of sine wave, 50 or 60 Hz applied for one minute between the terminals of the circuit board short circuited and ground to the metallic frame of the assembly box.

6.3.11 VIBRATION AND SHOCK TEST

6.3.11.1 Vibration test:

The test is to carry out as per IEC-60571, clause 10.2.11.

The complete unit together with its mounting arrangements including shock absorbing devices if provided shall be subject to the following tests:

The unit under test shall be secured in a suitable position to a vibration machine producing vibrations of sinusoidal form with adjustable amplitude and frequency. The test frequency lowers than 5Hz may be omitted. The unit shall be tests in energized condition at no load with the following parameter.

Vertical acc = 1 g at 2 h

Longitudinal acc. = 3 g at 2 h
Transverse acc = 2 g at 2 h

Resonance search at 10 to 100 Hz. If resonance is not meet than 10 Hz at 15 min in each direction.

6.3.11.2 Shock test:

The complete unit shall be subjected to a series of three successive shoks each corresponding to 50Hz at 3 g duration 2 min in all the three direction.

The tests are considered to be satisfactory in case there is no resulting damage, loosening of connections/components/sub-assemblies, abnormality in operation. The unit shall be able to pass electrical performance tests after this test.

6.3.12 REVERSE POLARITY TEST:

The equipment shall be tested to verify the reverse polarity protection by making the connection to reverse polarity and unit shall function normal after restoring the connection to correct polarity.

6.3.13 OUTPUT SHORT CIRCUIT TEST:

The unit shall be tested by connecting a outputs, working at normal voltage short circuit shall be created at output through a switch of suitable rating and keep the unit for 2 minutes. Unit shall perform normal after the test.

6.3.14 ENDURANCE TEST:

The synchro transmitter shall be operated continuously over its full operating range (0-32 positions) for 24 hours. This test shall be carried out at the nominal operating voltage of the system.

Annexure - I

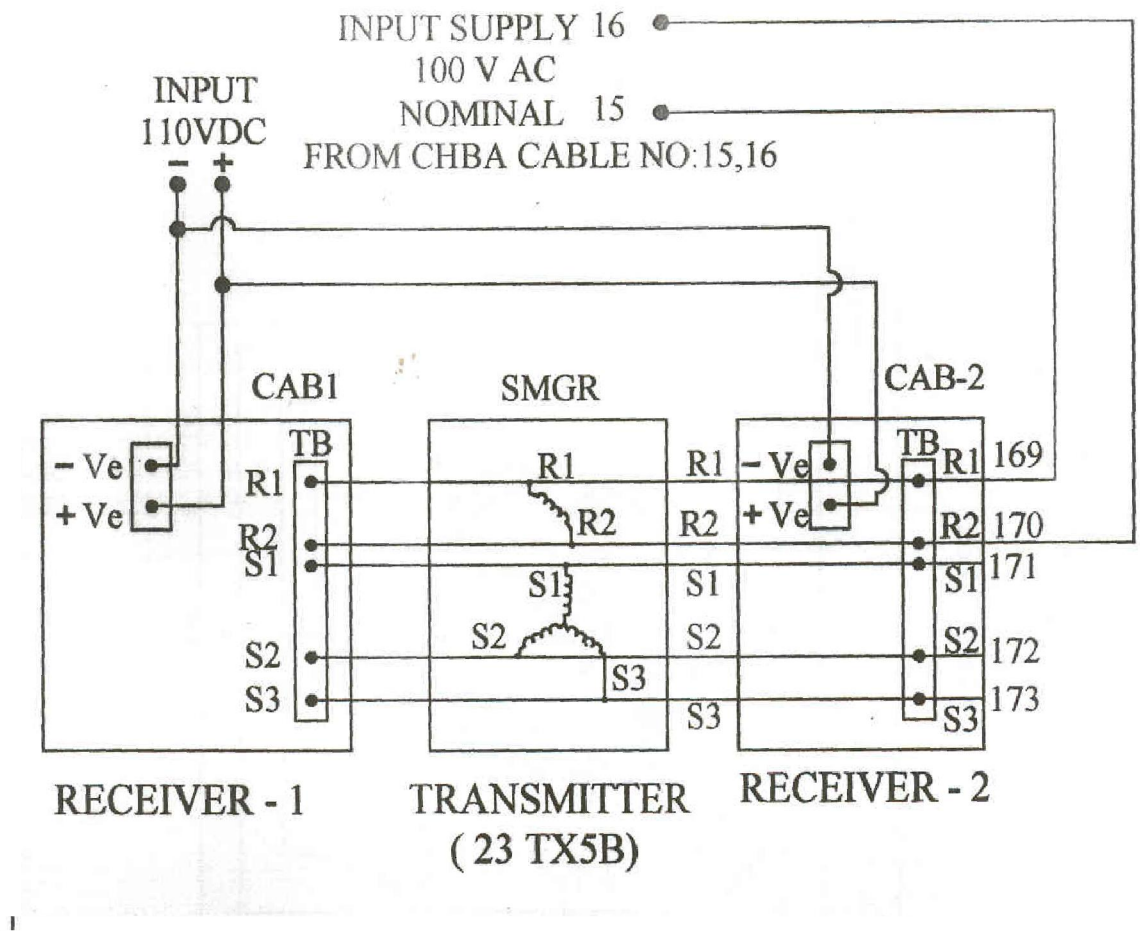
ABB type ASMGR

Width	Half Width (Before)	Full Width		Half Width (After)	
0	325.1	357.0	357.1	2.6	5.0
1	5.1	7.5	7.6	12.6	15.0
2	15.1	17.5	17.6	22.6	25.0
3	25.1	27.5	27.6	32.6	35.0
4	35.1	37.5	37.6	42.6	45.0
5	45.1	47.5	47.6	52.6	55.0
6	55.1	57.5	57.6	62.6	65.0
7	65.1	67.5	67.6	72.6	75.0
8	75.1	77.5	77.6	82.6	85.0
9	85.1	87.5	87.6	92.6	95.0
10	95.1	97.5	97.6	102.6	105.0
11	105.1	107.5	107.6	112.6	115.0
12	115.1	117.5	117.6	122.6	125.0
13	125.1	127.5	127.6	132.6	135.0
14	135.1	137.5	137.6	142.6	145.0
15	145.1	147.5	147.6	152.6	155.0
16	155.1	157.5	157.6	162.6	165.0
17	165.1	167.5	167.6	172.6	175.0
18	175.1	177.5	177.6	182.6	185.0
19	185.1	187.5	187.6	192.6	195.0
20	195.1	197.5	197.6	202.6	205.0
21	205.1	207.5	207.6	212.6	215.0
22	215.1	217.5	217.6	222.6	225.0
23	225.1	227.5	227.6	232.6	235.0
24	235.1	237.5	237.6	242.6	245.0
25	245.1	247.5	247.6	252.6	255.0
26	255.1	257.5	257.6	262.6	265.0
27	265.1	267.5	267.6	272.6	275.0
28	275.1	277.5	277.6	282.6	285.0
29	285.1	287.5	287.6	292.6	295.0
30	295.1	297.5	297.6	302.6	305.0
31	305.1	307.5	307.6	312.6	315.0
32	315.1	317.5	317.6	322.6	325.0

GAMZ type ASMGR

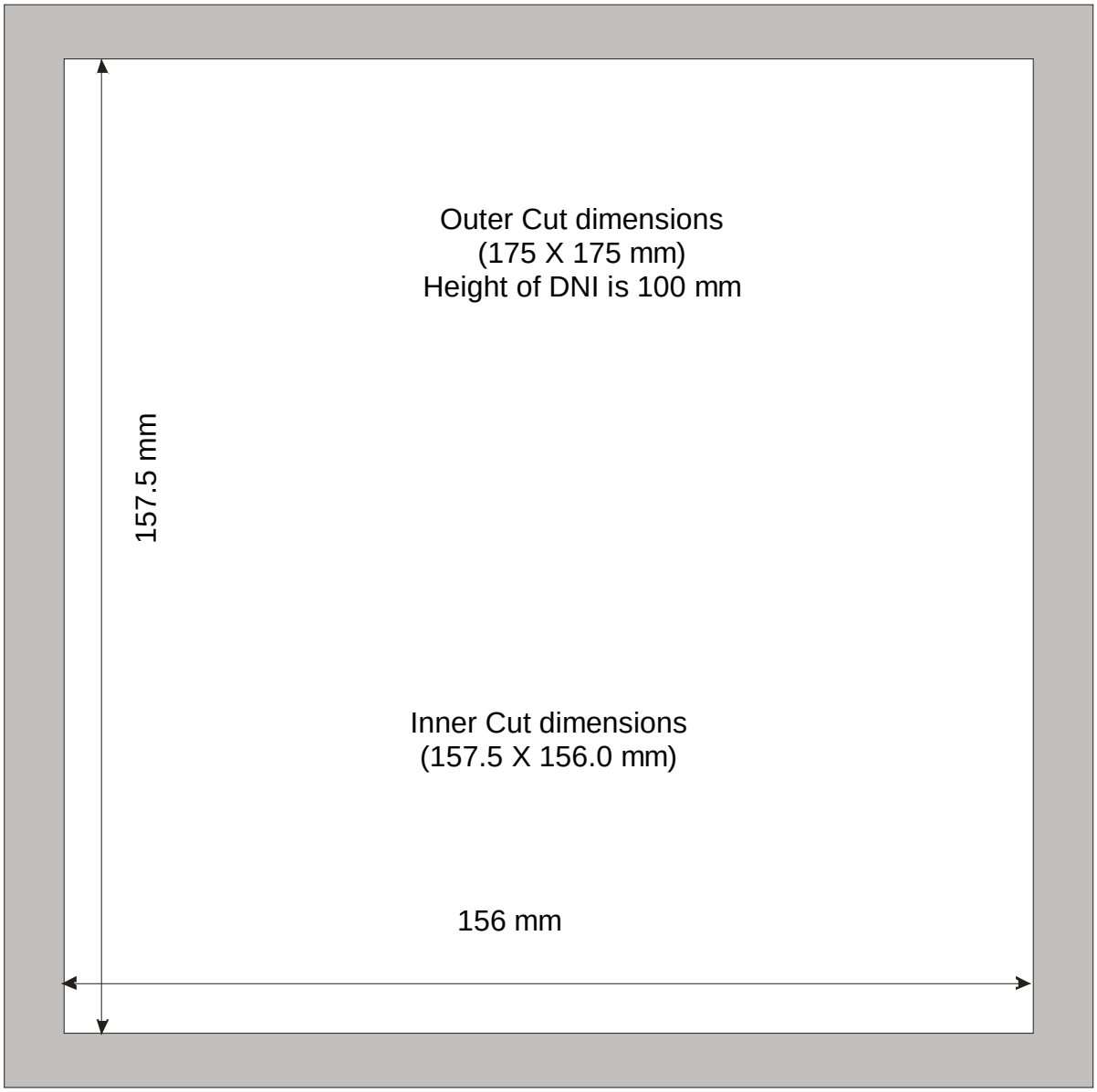
Width	Half Width (Before)		Full Width		Half Width (After)	
0	5.3	7.9	357.0	2.6	2.7	5.2
1	15.9	18.5	8.0	13.2	13.3	15.8
2	26.5	29.1	18.6	23.8	23.9	26.4
3	37.1	39.7	29.2	34.4	34.5	37.0
4	47.7	50.2	39.8	45.0	45.1	47.6
5	58.3	60.8	50.3	55.5	55.6	58.2
6	68.9	71.4	60.9	66.1	66.2	68.8
7	79.5	82.0	71.5	76.7	76.8	79.4
8	90.1	92.6	82.1	87.3	87.4	90.0
9	100.6	103.2	92.7	97.9	98.0	100.5
10	111.2	113.8	103.3	108.5	108.6	111.1
11	121.8	124.4	113.9	119.1	119.2	121.7
12	132.4	135.0	124.5	129.7	129.8	132.3
13	143.0	145.5	135.1	140.2	140.3	142.9
14	153.6	156.1	145.6	150.8	150.9	153.5
15	164.2	166.7	156.2	161.4	161.5	164.1
16	174.8	177.3	166.8	172.0	172.1	174.7
17	185.3	187.9	177.4	182.6	182.7	185.2
18	195.9	198.5	188.0	193.2	193.3	195.8
19	206.5	209.1	198.6	203.8	203.9	206.4
20	217.1	219.7	209.2	214.4	214.5	217.0
21	227.7	230.2	219.8	224.9	225.0	227.6
22	238.3	240.8	230.3	235.5	235.6	238.2
23	248.9	251.4	240.9	246.1	246.2	248.8
24	259.5	262.0	251.5	256.7	256.8	259.4
25	270.0	272.6	262.1	267.3	267.4	269.9
26	280.6	283.2	272.7	277.9	278.0	280.5
27	291.2	293.8	283.3	288.5	288.6	291.1
28	301.8	304.4	293.9	299.1	299.2	301.7
29	312.4	314.9	304.5	309.7	309.8	312.3
30	323.0	325.5	315.0	320.2	320.3	322.9
31	333.6	336.1	325.6	330.8	330.9	333.5
32	344.1	346.9	336.2	341.4	341.5	344.0

Annexure-2



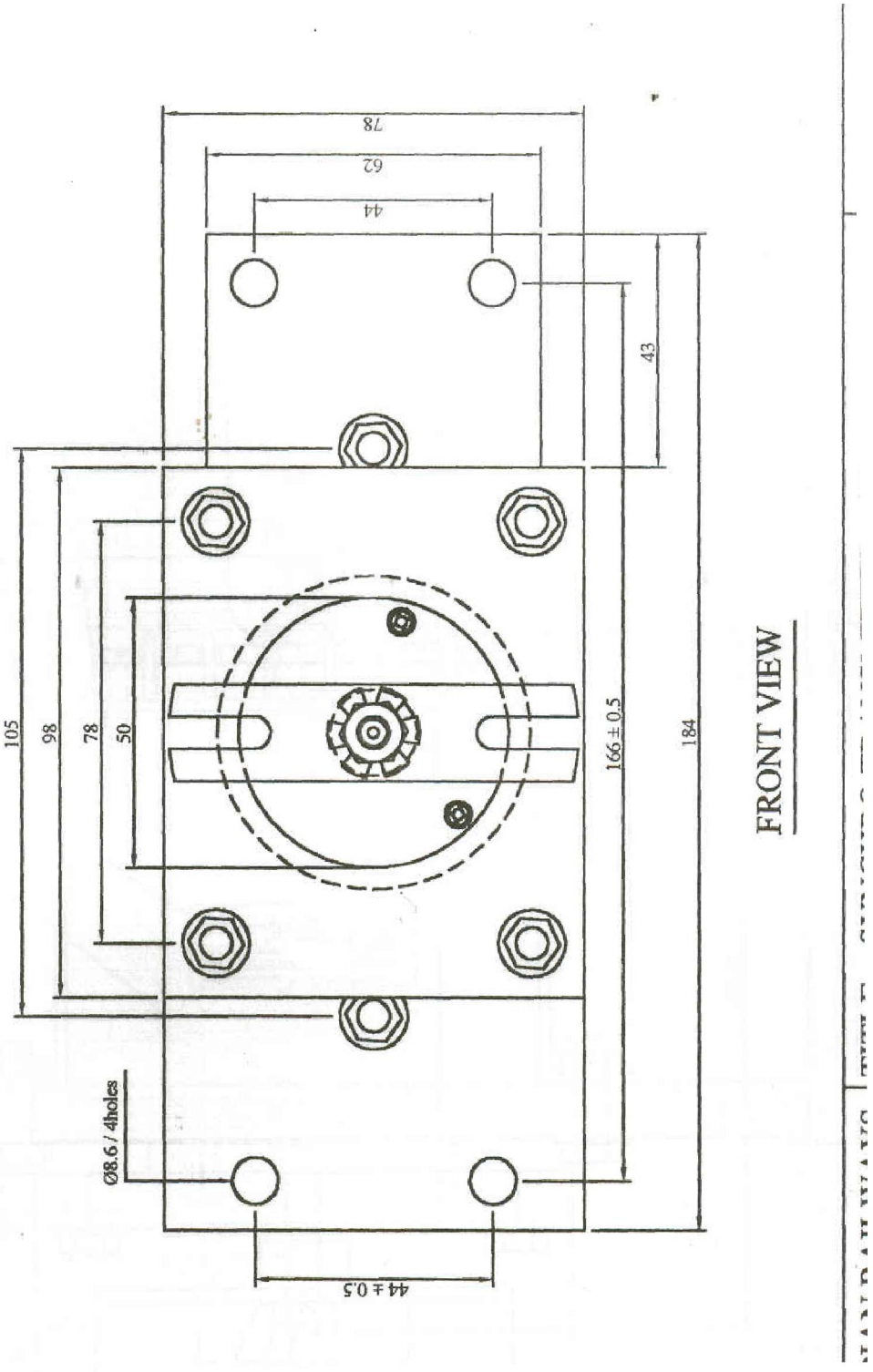
Connection Diagram

Drawing-1



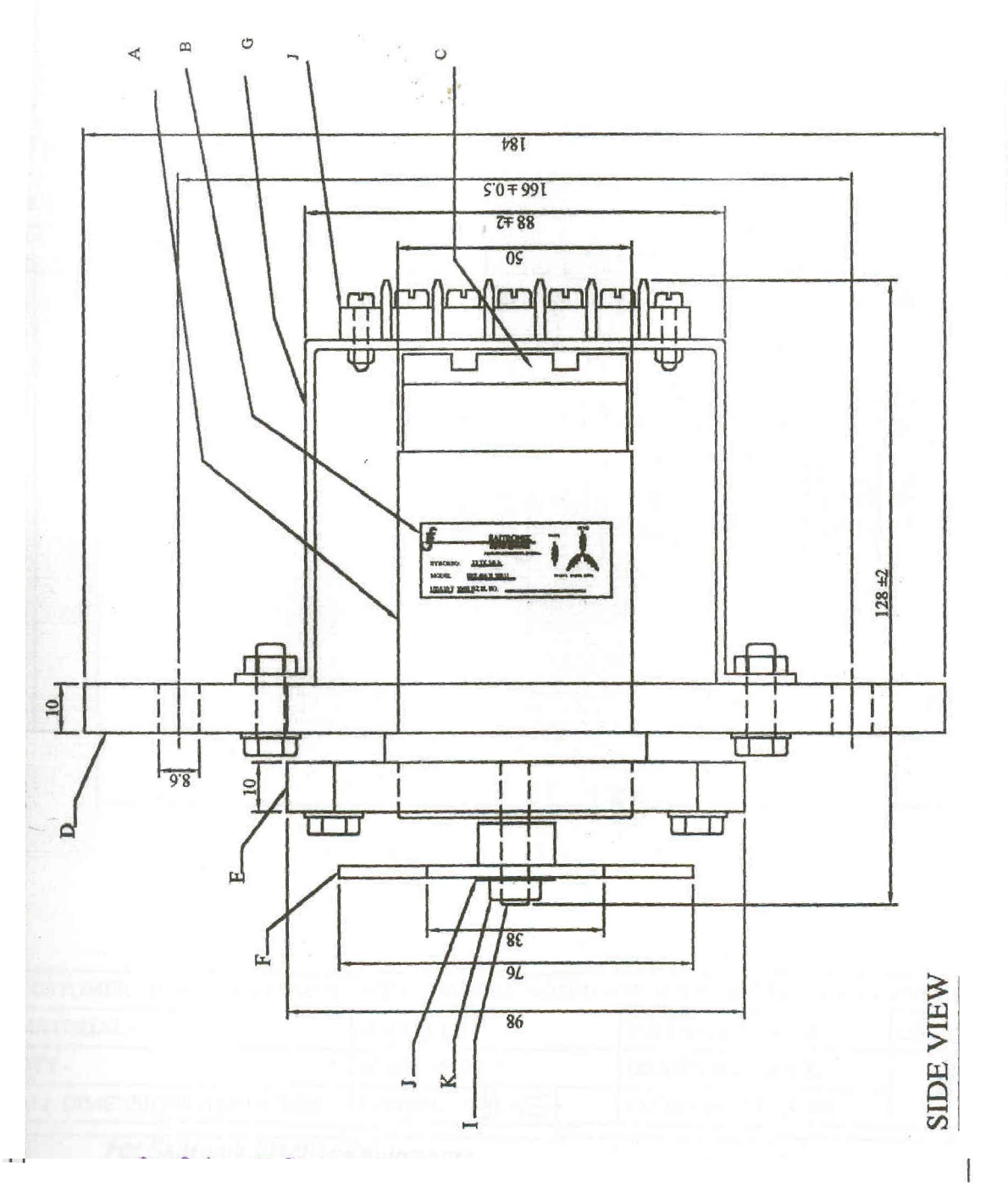
DNI fitment Space

drawing-2



Mounting of transmitter

Drawing-3



Mounting of transmitter