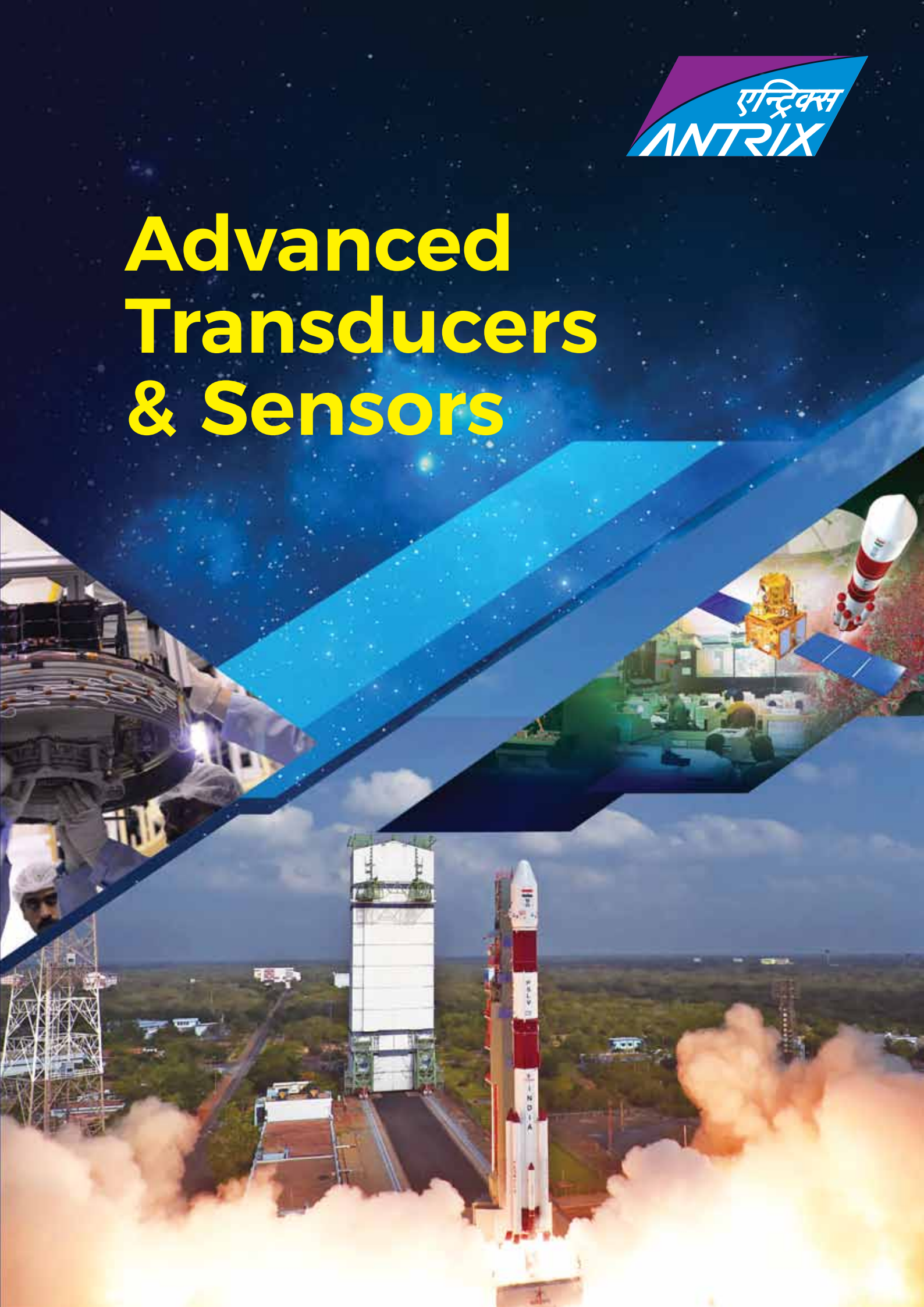
एन्ट्रिक्स
ANTRIX

Advanced Transducers & Sensors



Liquid Propulsion Systems Centre (LPSC)
of Indian Space Research organisation is engaged in design, development and realisation of liquid propulsion stages for ISRO's Launch Vehicles, as well as propulsion systems for remote sensing, communication satellites and other scientific missions. ANTRIX markets the space products and services emanating from Indian Space Program. ANTRIX's range of robust transducers and sensors suit commercial and institutional applications and make us partner of choice for our customers.

IDPT | Integral Diaphragm Pressure Transducers

The Integral Diaphragm Pressure Transducers (IDPT) of range 0-30Bar & 0-300Bar are used for pressure monitoring in the Spacecraft Chemical Propulsion systems for GEOSAT, IRNSS, IRS, and interplanetary Missions like MOM & Chandraayan. The sensor is a basic strain gauge type bonded connected in four arms active wheat stone bridge configuration on integral diaphragm and The transducer is compensated for the temperature range of −7°C to +65°C. The pressure transducer has built in electronics for signal conditioning and for obtaining a full-scale output of +5V ±0.25V at 30 bar & 300 Bar and −5V ±0.25V at zero absolute pressure. The output signal is proportional to the input pressure.

- It has proved its all expectancy of more than 15 years in satellite missions
- It has performed successfully during deep space mission like "MOM (Mars Orbit Mission) & Chandrayaan-1"

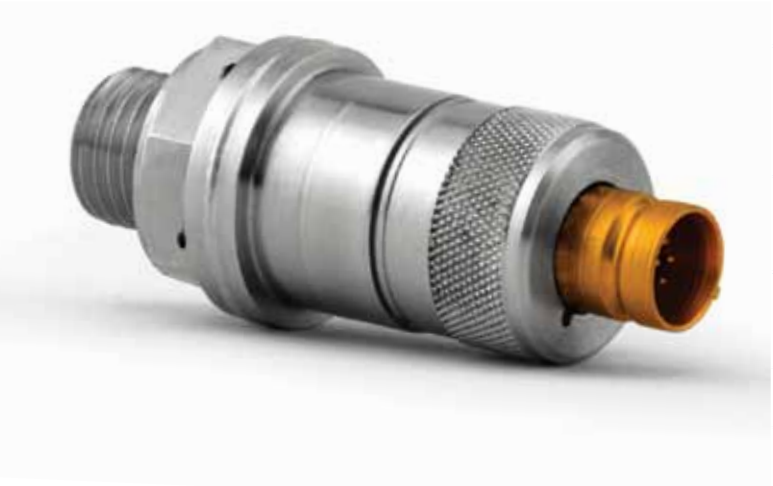
✶ This Sensor performed well in all spacecrafts like IRS, INSAT, IRNSS & GEOSAT etc,

Sl. No.	PARAMETER	SPECIFICATION
1	Pressure transducer type	Integral diaphragm with built-in amplifier (absolute)
2	Operating pressure	0-30 Bar & 0-300 Bar
3	Diaphragm thickness	650 µm for 30 bar 1650 µm for 300 bar
4	Proof pressure	45 bar (0-30bar) 400 bar (0-300bar)
5	Excitation	±15V ± 0.1 V DC
6	Amplifier configuration	2 stage amplifier with Op-Amp (OP 07A)
7	Circuit current	< 20mA
8	Output	At 0 bar-5V ±0.25V At 30 bar +5V ±0.25V At 300 bar +5V ±0.25V
9	Input impedance	>1000 ohms
10	Output impedance	<500 ohms
11	Insulation resistance	>100 MΩ at 100 V DC
12	Accuracy (NL+H)	≤ ±0.7% of FSO
13	Total error band	≤ ± 1 % of FSO
14	Compensated temperature range	-50°C to +65°C
15	Sealing	Fully hermetically sealed
16	Material in contact with media	AISI 304L & APX4
17	Mass	< 250 gms
18	Dimension	ϕ 25 x 175 mm length
19	Mechanical interface	6 mm SS 304L tube for welding ferrule connection during testing
20	Electrical interface	7 pin Deutsch connector (male), type: RSM

21NA | Pressure Transducer

21NA Pressure transducers are intended for absolute pressure sensing. The active element is a stainless steel membrane which senses the pressure to be measured. The membrane transmits a force in proportion to the pressure, to an iso-static beam on which four active strain gauges are bonded in a wheat stone bridge circuit. These transducers are totally enclosed, adequately temperature compensated and are designed to operate even under adverse environmental conditions. They are hermetically sealed and suitable for high humidity environment as well.

★ Succesfully flown in all launch vehicles

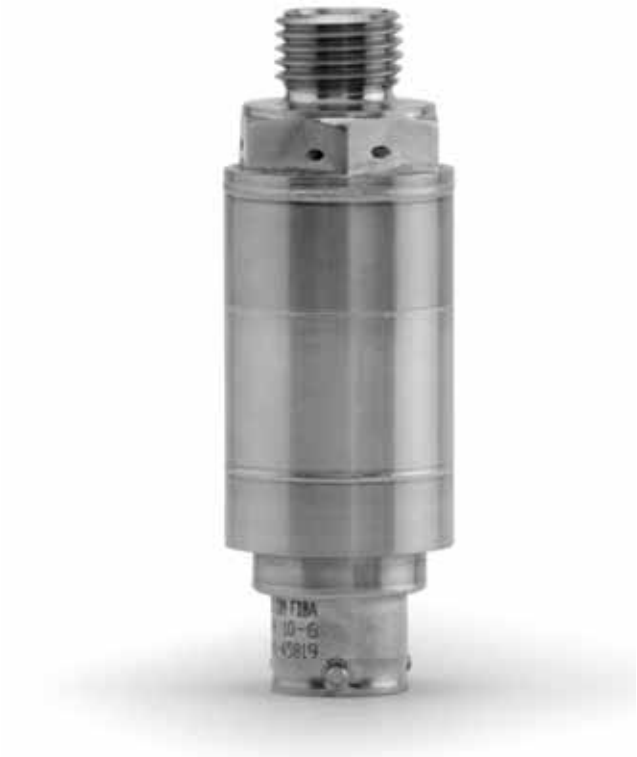


Sl. No.	PARAMETER	SPECIFICATION
1	Operating Pressure	0-3, 0-5, 0-7, 0-10, 0-15, 0-20, 0-30, 0-50, 0-70, 0-100, 0-200, 0-300 and 0-330 bar
2	Nominal Excitation	10 V DC NOMINAL ±5 mV
3	FSO for 10V Excitation	20mV +1 mV
4	Compensated Temperature range	-40°C to +120°C
5	Non Linearity + Hysteresis for 0-3 to 0-300 bar 0-330 bar	≤ ± 0.7% FSO ≤ ± 0.85% FSO
6	Hysteresis	≤ ± 0. 5% FSO
7	Sensitivity	2 + 0.1 mV/V
8	Insulation Resistance	100 M Ω@45VDC
9	Zero offset / Absolute	≤ 0.5mV
10	Zero & FSO drift in temperature	≤ ± 2 x 10^{-4} / FSO/° C
11	Zero drift & Sensitivity drift due to mechanical test	≤ 0.5% FSO
12	Noise due to Vibration	≤ 0.5% FSO
13	Construction	All welded and hermetically sealed
14	Wetted parts	SS316 / SS304 L
15	Mass	<100grams
16	Pressure Inlet	Male M14 x 1.5-6h Thread
17	Electrical Interface	7 pin Deutsch connector (male), type: RSM

IDLV | Pressure Transducer

The Integral Diaphragm Pressure Transducer For Launch Vehicles, or IDLV is a bonded foil strain gauge type transducer. In this transducer, there is a machined diaphragm, to which the circular strain gauges are bonded on one side. The pressure is applied on the other side. The deflection caused due to pressure is sensed by the strain gauges as change in resistance. These strain gauges are connected in a wheat stone bridge configuration. These transducers are totally enclosed, adequately temperature compensated and are designed to operate even under adverse environmental conditions. They are hermetically sealed and suitable for high humidity environment as well. This sensor is available in direct mount and integral clamp type with M5 hole.

★ Succesfully flown from PSLV-C22 onwards, GSLV-D6 & LVM3 X/D1 missions

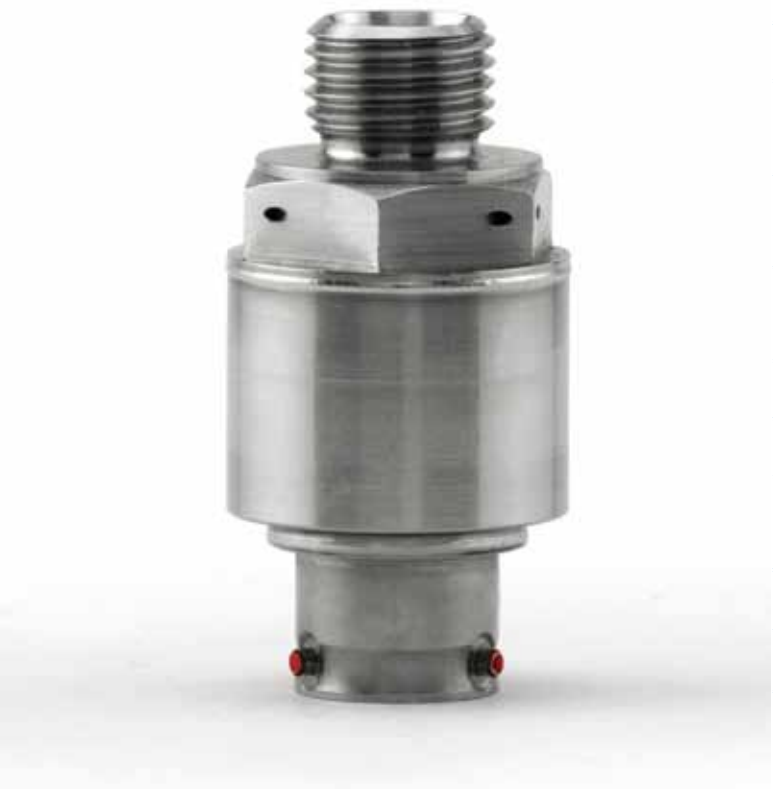


Sl. No.	PARAMETER	SPECIFICATION
1	Operating Pressure	0-50, 0-70, 0-100, 0-200, 0-300, 0-400, 0-500, 0-600, 0-700 & 0-800 bar
2	Nominal Excitation	10V DC NOMINAL ±5 mV
3	FSO for 10V Excitation	20mV +1 mV
4	Compensated Temperature range	-40°C to +120°C
5	Non Linearity + Hysteresis	≤ ± 0.5% FSO
6	Sensitivity	2 + 0.1 mV/V
7	Output resistance	1000 ± 25 Ω
8	Input resistance	1000 +300/-25 Ω
9	Insulation resistance	≥100M Ω@45VDC
10	Zero & FSO drift in temperature	± 2 x 10^{-4}/FSO/°C
11	Zero drift due to mechanical test (Vibration)	≤ ± 0.2% FSO
12	Zero offset / Absolute	0.3mV ± 0.1mV
13	Construction	All E.B welded and hermetically sealed
14	Operating Media	IPA, FREON, Earth storable and Cryogenic Propellants
15	Wetted parts	APX4/ 17-4 PH
16	Dimension	Φ 25 x 73±2.0 mm
17	Mass	120±15 grams
18	Pressure interface	M14 x 1.5 6h
19	Electrical interface	FDBA-6 pin Circular Connector

MEMS | Absolute Pressure Transducer

MEMS devices are true mechanical systems scaled down to the microscopic level. A high sensitivity piezo resistive silicon chip is used for pressure sensing. The semiconductor type pressure sensors are made of single crystal silicon material with diffused piezo resistors, which has very high sensitivity. The built-in signal conditioning electronics is screened to class S level and is used for output adjustment, temperature compensation and amplification. These transducers have higher output, smaller size, low power consumption, high accuracy and better repeatability.

★ Succesfully flown in PSLV-C18 and LVM3 X&D1 missions



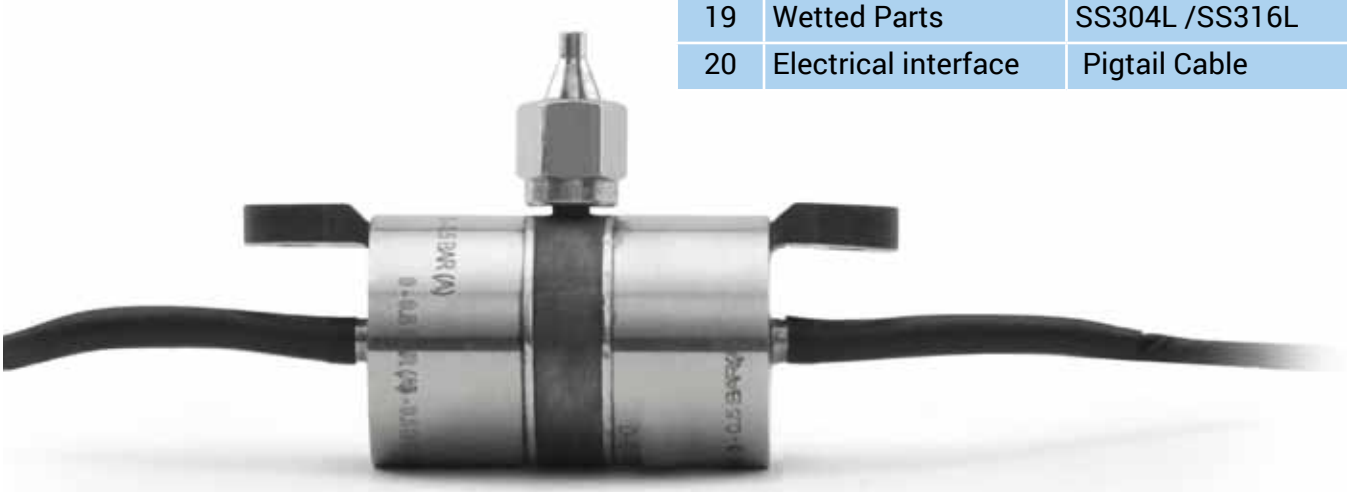
Sl. No.	PARAMETER	SPECIFICATION
1	Sensor Type	MEMS
2	Basic Sensing element	Absolute MEMS Chip
3	Operating Pressure	0.02 Mpa, 0.05 Mpa, 0.1 Mpa, 0.3 Mpa, 0.5 Mpa, 1.0 Mpa, 3.0 Mpa, 5.0 Mpa, 7.0 Mpa, 10.0 Mpa & 20.0 Mpa
4	Proof pressure	2 times operating pressure
5	Excitation voltage	+5 ± 0.1 V DC
6	Full scale output	2.40 V± 0.05V DC (4.25 V optional)
7	Maximum NL+H	≤ 0.3% FSO
8	Bridge configuration	Wheatstone Bridge
9	Insulation Resistance	>100MΩ @ 50V DC
10	Output impedance	<10 Ω
11	Zero (Absolute)	0.25 V± 0.05 V DC
12	Compensated Temp. Range	-40 to +120°C
13	Operating Temp. Range	-55 to +150°C
14	Thermal Zero drift & Span drift	< ±0.02%FSO/°C
15	Mass	< 75 gms
16	Dimension	24mm x 54mm
17	Pressure Connection	M8 x 1.0 6h / M14 x 1.5h Pressure port
18	Pressure medium	Gas / liquid
19	Wetted Parts	SS304L /SS316L
20	Electrical interface	FDBA-6 pin Circular Connector

MEMS | Absolute Pressure Transducers 2 In 1

Aerodynamic characterization of the wing body vehicle flying at different speeds from subsonic to hypersonic and at different alpha levels from 0° to 40° is one of the objectives of RLV-TD (hex) mission. In order to evaluate the aerodynamic parameters from the flight 73 pressure ports have been identified. The pressures are expected to vary from wide range of 10 Pascal to 1.0x105 Pascal. To cover this wide range with reasonable accuracy, two sensors mounted with one body with full scale of 0-0.5x105 Pa and 0-1.0x105 Pa in 2-in-1 configuration is realised.

★ Succesfully flown in RLV-TD (Re-usable Launch Vehicle-Technology Demonstrator)

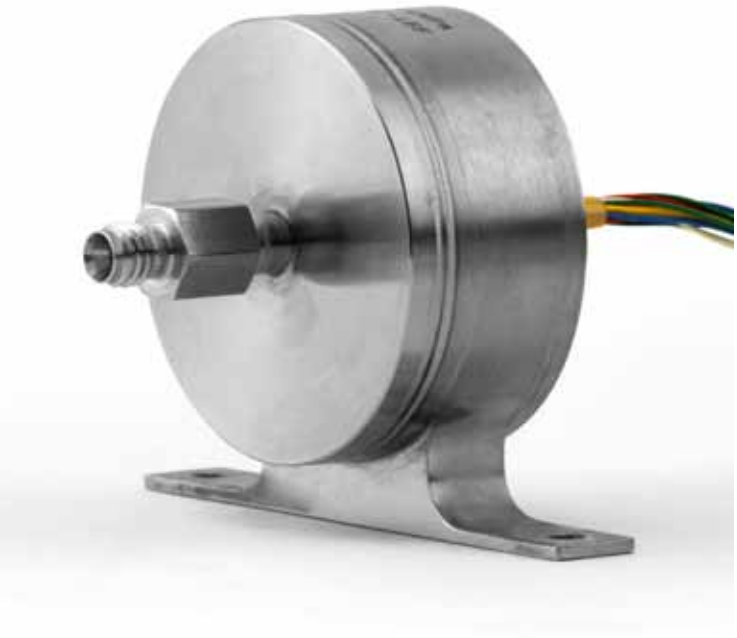
Sl. No.	PARAMETER	SPECIFICATION
1	Sensor Type	MEMS
2	Basic Sensing element	Absolute MEMS Chip
3	Operating Pressure	0-0.5/ 0-1 bar Absolute (Dual range in single housing)
4	Proof pressure	3 bar
5	Excitation voltage	+5 ± 0.1 V DC
6	Zero (Absolute)	0.25 V ± 0.05 V DC
7	Full scale output	2.4 V ± 0.05V DC
8	Accuracy	< 100 Pa with Split range calibration
9	Bridge configuration	Wheatstone Bridge
10	Insulation Resistance	>100MΩ @ 50 V DC
11	Output impedance	<10Ω
12	Compensated Temp. Range	-40°C to +120°C
13	Operating Temp. Range	-55°C to +150°C
14	Thermal Zero drift & Span drift	<± 0.02%FSO/°C
15	Mass (with pigtail cable)	< 260 ±5 gms
16	Dimension	ϕ 28 x 73.5 mm
17	Pressure Connection	Swagelok 1/8" tube socket
18	Pressure medium	Gas / liquid
19	Wetted Parts	SS304L /SS316L
20	Electrical interface	Pigtail Cable



MEMS | Absolute Pressure Transducers 3 In 1

RLV-TD uses Flush Air Data Systems (FADS) for autonomous flight management. This air data determination technique is based on flow field pressure measurements using high accuracy pressure transducers. For the same, 1.4 bar Absolute pressure transducers in Triple Mode Redundancy (TMR) logic are realized for FADS which enables the measurement of static pressures & the calculation of air data parameters in flight (M, α, β, q, h & s). Micro Electro Mechanical Systems (MEMS) based pressure transducers are ideal for measurement of pressures with high output and high accuracy. These transducers consists of three sets of pressure cells with associated signal conditioning electronics screened to Class-S level and Accuracy of 100pa was achived by using split range calibration.

★ Succesfully flown in RLV-TD (Re-usable Launch Vehicle-Technology Demonstrator)

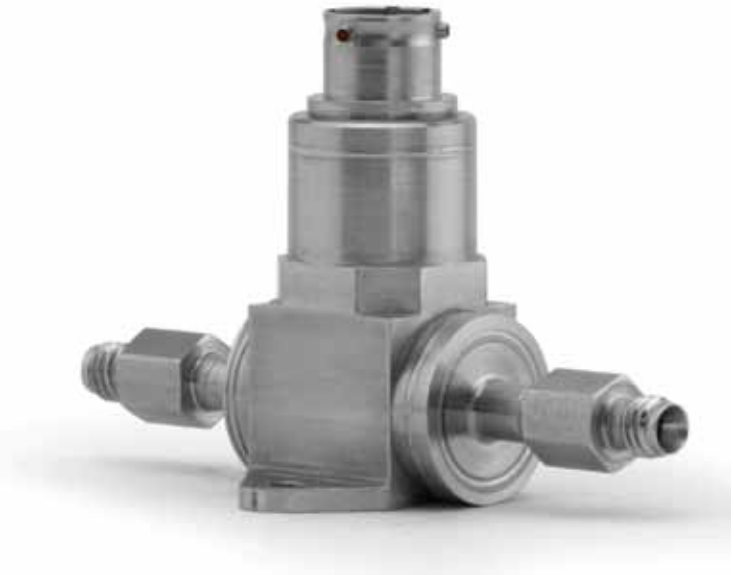


Sl. No.	PARAMETER	SPECIFICATION
1	Basic Sensing element	Absolute MEMS Chip
2	Operating Pressure	0 to 1.4 bar Absolute
3	Proof pressure	3 bar
4	Excitation voltage	+5 ±0.1 V DC
5	Zero (Absolute)	0.25 V ±0.05 V DC
6	Full scale output	4.25 V ±0.05V DC
7	NL + H	0.2% FSO
8	Bridge configuration	Wheatstone Bridge
9	Insulation Resistance	>100MΩ @ 50 V DC
10	Output impedance	<10Ω
11	Compensated Temp. Range	- 40° C to +120° C
12	Operating Temp. range	-55° C to +150° C
13	Thermal Zero drift & Span drift	< ±0.02%FSO/° C
14	Shock	Qualification: 50g, 10mSec, Half Sine
15	Mass (with pigtail cable)	< 275 gm
16	Dimension	Φ 54 mm x 60.5 mm (max)
17	Pressure Connection	Swagelok 1/8" tube socket
18	Operating medium	Gas / liquid
19	Wetted Parts	SS304L /SS316L
20	Electrical interface	Pigtail Cable

MEMS | Differential Pressure Transducer

RLV-TD uses Flush Air Data Systems (FADS) for autonomous flight management. This air data determination technique is based on flow field pressure measurements using high accuracy pressure transducers. To improve the angle of attack, slide slip, Mach number & Velocity, the National Committee on Aerodynamic characterization of RLV-TD recommended the use of MEMS based differential pressure transducers. Measurements carred across two Absolute pressure transducer ports. Electronics screened to Class-S level.

★ Succesfully flown in RLV-TD (Re-usable Launch Vehicle-Technology Demonstrator)



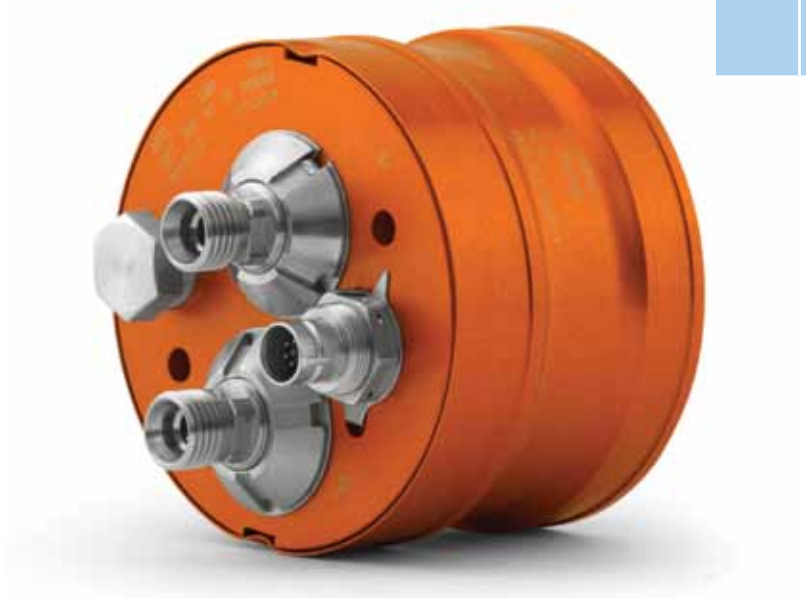
Sl. No.	PARAMETER	SPECIFICATION
1	Sensor Type	MEMS (Differential)
2	Basic Sensing Element	MEMS chip
3	Differential Pressure range	± 0.5 bar
4	Line Pressure	5 bar
5	Safe Over pressure	1 bar (Differential)
6	Excitation voltage	+ 5 ± 0.1 V DC
7	Output voltage	+2 ± 1.5 V DC
8	Minimum output (P1=0, P2=0.5bar)	+ 0.5 ± 0.1 V DC
9	Maximum output (P1=0.5bar, P2=0)	+ 3.5 ± 0.1 V DC
10	Non–Linearity + Hysteresis	< 0.3 % FSO
11	Current drawn	< 2mA
12	Output Impedance	< 10Ω
13	Bridge configuration	Wheatstone Bridge
14	Insulation Resistance	>100MΩ @ 50 V DC
15	Compensated Temperature Range	+5° C to +75° C
16	Operating Temp. Range	-55° C to +150° C
17	Thermal zero & Span drift	<±0.02%FSO/° C
18	Mass	<200 gms
19	Dimension	Φ 54 mm x 98 mm (max)
20	Pressure Connection	Swagelok 1/8" tube socket
21	Operating medium	Gas / liquid
22	Wetted Parts	SS304L /SS316L
23	Electrical interface	FDBA-6 pin Circular Connector

DPT | Differential Pressure Transducer

DPT is used where the difference in pressures at two points are to be measured. The forces developed due to these pressure (say P1 and P2) act on a balanced beam called sensing element. Four foil strain gauges are bonded on this sensing element beam which deforms proportionately to the difference between P1 and P2. The electrical output signal is positive when P1 is greater than P2 and vice versa. A mechanical stopper limits the deflection of sensing beam within the specified limits.

★ Successfully flown in all launch vehicles.

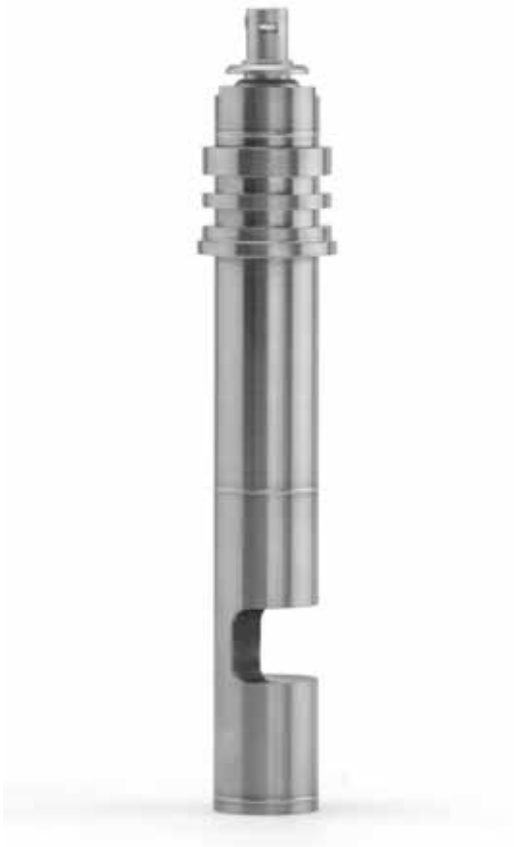
Sl. No.	PARAMETER	SPECIFICATION
1	Differential pressure range	± 3, ± 5, ±6, ± 7, ± 10, ± 15, ±20 & -1+5 bar
2	Line pressure	65 bar
3	Safe overload upto ± 10 bar ± 15 & ± 20 bar	 75 bar 80 bar
4	Excitation	10 V ± 5mV
5	Output	10m V ± 1mV
6	Non Linearity + Hysteresis	≤0.5% FSO
7	Sensitivity	1±0.1m V/V
8	Zero & FSO drift in temperature	± 3 x 10^{-4}/FSO/ °C
9	Insulation resistance	≥100 M Ω @ 45 V DC
10	Mass	≤ 950 gms
11	Wetted parts	Stainless steel, 316L/304L
12	Mechanical interface	M14 x 1.5 - 6h male (2 nos.)
13	Electrical interface	7 pin Deutsch connector (male), type: RSM



USLS | Level Sensor

The ULTRASONIC LIQUID LEVEL SENSOR (USLS) is designed and developed to sense the level of the propellant in the tank during filling operation. The USLS works on the Ultrasonic Principle. The sensing element is a pair of Piezo-electric ceramic crystal placed on both sides of the sensing gap. One side ceramic crystal is the transmitter, which converts the input electrical signal into an ultrasonic signal and then transmits across the sensing gap. The other ceramic crystal is the receiver that receives the Ultrasonic signal and converts it into an electric signal. When the gap between the transmitter and receiver is filled by a liquid medium, the vibration generated in the transmitter is transmitted to the receiver. The change in the signal level enables the electronic control unit (separate unit) to sense the presence or absence of the liquid. The amplitude of the output signal depends upon the type of the medium present across the sensing gap.

★ Successfully flown in all PS2/GS2/L40 & L110 stages of launch vehicle missions.

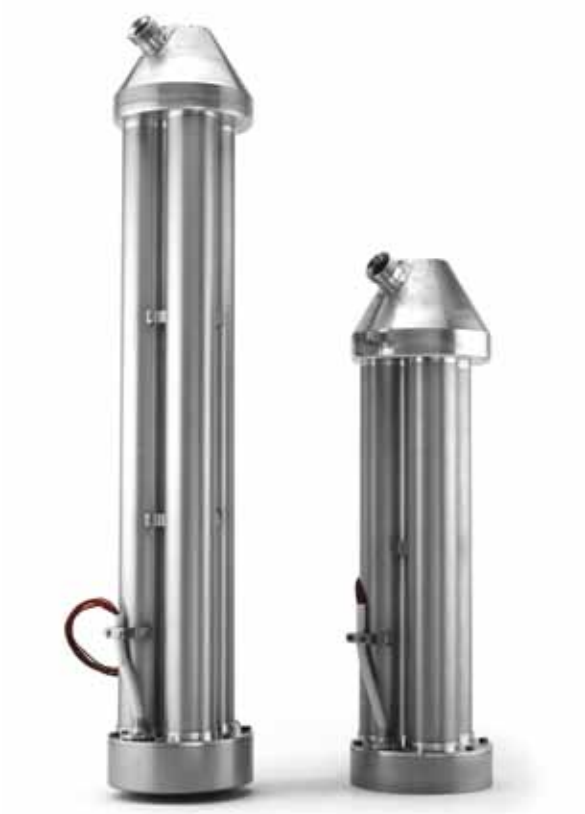


Sl. No.	PARAMETER	SPECIFICATION
1	Sensor Diameter	22.5mm
2	Immersion Length	125mm(approx)
3	Level detection	75mm below mounting flange
4	Working fluids	N_2O_4, UDMH & water
5	Test pressure	15bar
6	Insulation Resistance	>100MΩ@ 50 VDC
7	Operating Temperature	-10°C to +100°C
8	Crystal frequency	1.15±0.10 MHz
9	Attenuation in Water	< 10dB
10	Attenuation in Air	> 35dB
11	Capacitance	1000 ± 300 pF
12	Repeatability	±2mm
13	Material	AISI 304L
14	Construction	Weld(EB)
15	Electrical interface	5 pin Lemo Connector

TRLS | Level Sensor

Accurate loading of LOX & LH2 in cryogenic tanks assumes prime importance since it is the terminal stage in the launch vehicle. Exact quantity of propellants should be loaded at the specified mean mass temperature (MMT) to meet the mission demands. Towards this LPSC Bangalore has developed and qualified Triple Redundant Level Sensor for LOX & LH2 tanks. Typically, capacitance type level sensor with 700mm span is chosen for LH2 tank and 400mm span is chosen for LOX tank. The working principle of level measurement using capacitance type sensor is based on the change in capacitance of two conductive tubes separated by a uniform gap that is increased by insertion of dielectric material within the gap. In other words, the level of the liquid is determined by the change in capacitance between two conductive electrodes due to the presence of liquid having a defined dielectric constant. TRLS consists of three sets of AA 2219 tubes which work on the basis of capacitance principle. This change in capacitance value is detected by a dedicated filling algorithm and converted to filling level.

★ The functioning of TRLS has been successfully demonstrated in the GSLV D5, D6, F05, F09, Mk3 X and D1 missions.

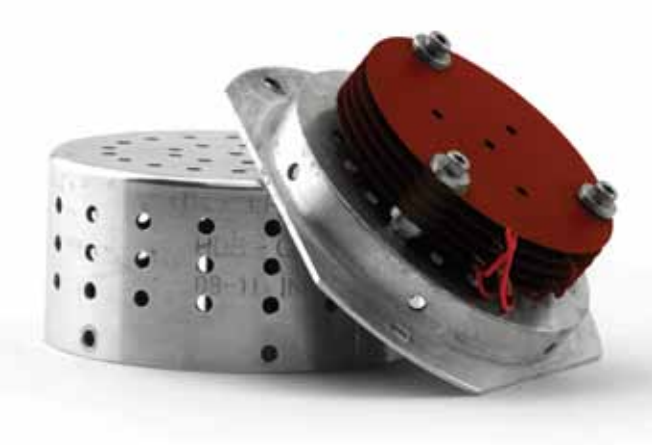


Sl. No.	PARAMETER	SPECIFICATION
1	Operating Principle	Capacitance
2	Sensing Element	Co-Axial Concentric Tubular Electrodes
3	Accuracy	±0.8% FSR
4	Non Linearity	±0.5 % FSR
5	Nominal operating Temperature LH2 Sensor LOx Sensor	 20 K 77 K
6	Insulation Material	Kel-F(PCTFE)
7	Dry Capacitance@ SRC (CDRY) LH2 Sensor LOx Sensor	 $370^{\pm 30}$ pF $210^{\pm 30}$ pF
8	Capacitance in LN_2 @ 1 bar (C_{LN2})	C_{DRY} x $1.42^{\pm 1.5}$ pF
9	Outer Electrode inner dia	$50\ ^{+0.1}_{0.0}$ mm
10	Inner Electrode outer dia	$45\ ^{0.0}_{-0.0}$ mm
11	Sensing Gap	2.5 - 2.6 mm
12	Operating Fluid	LN2, LOx, LH2
13	Joints	All Welded(EB)
14	Mass LH2 Sensor/LOx Sensor	 < 7.5 Kg / < 5.5 Kg
15	Construction Material	AA2219-T8511
16	Calibration medium	LN2
17	Operating fluid interface	M39 x 1.5-6g

HDS | Depletion Sensor

Hydrogen Depletion Sensor (HDS) is mainly used to detect the predetermined depletion level of Liquid Hydrogen in the tank during the flight. The purpose of this sensor is to sense the depletion level and to ensure that there is defined quantity of Liquid Hydrogen left inside the tank before the depletion of LOX during the flight, to avoid a possible disaster. When the dielectric medium between the two conducting plates changes the capacitance of the sensor also changes. This principle is utilized in the function of depletion sensor. The sensor works with the signal conditioning electronics. The Depletion sensors are mounted inside the bottom part of the tank. During the end of the flight the level of the propellant depleted from the predetermined level is detected and signal is sent for Engine shut off (for monitoring) before depleting the LH2. Thus the Depletion sensor plays a major role in shutting off the Cryo engine at the end of the flight.

★ The sensor worked successfully during filling and depletion in GSLV D5, D6, F05, F09, Mk3 X & D1 missions.

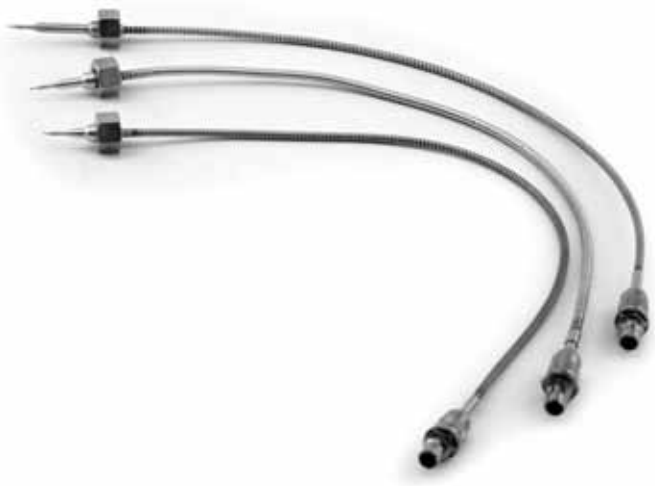


Sl. No.	PARAMETER	SPECIFICATION
1	Operating principle	Capacitance
2	Sensing Element	Stacked parallel plate Electrodes
3	Nominal operating temperature	LOX - 77 K LH2 - 20 K
4	Level detection range	5.2 ±0.5 mm
5	Dry capacitance @ SRC (C_{DRY})	24 ±3 pF
6	Capacitance in LN2 @ 1 bar (C_{LN2})	34 ±3 pF
7	Insulation resistance	>100 MW @ 45V DC
8	Diameter of electrodes	$63^{+0.1}_{-0.0}$ mm
9	Outer dia. of the sensor	79 ±0.5 mm
10	Gap	2500 – 2600 μm
11	Uncertainty in mid point level marking	± 0.5 mm
12	Vibration (Acceptance level)	9 grams, 20-2000Hz Random X, Y/Z axes
13	Total height of the sensor	41.5 ±1 mm
14	Mass with cable	< 750 grams
15	Operating fluid	LOX, LH2
16	Material of construction	SS321/AA2219
17	Electrical interface	Pigtail Cable

TCP | Temperature Sensor

TCP-84 or the thermocouple probe use ϕ1mm 'K' type thermocouple to sense the temperature. This temperature sensor has three configurations, varying only in the immersion length and thus named as TCP-84-25mm, TCP-84-32mm, and TCP-84-50mm.

★ Successfully flown in all launch vehicle missons.

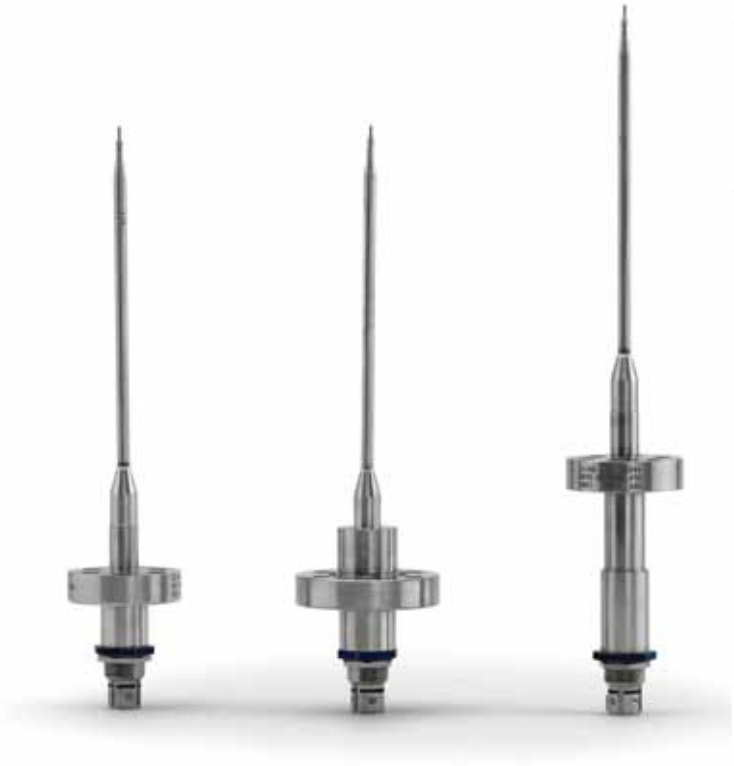


Sl. No.	PARAMETER	SPECIFICATION
1	Temperature range	0°C to +800°C
2	Thermocouple	K Type ϕ 1mm (Chromel-Alumel)
3	Junction	Ungrounded
4	Operating Pressure (max)	330 bar
5	Time constant	< 0.3 Sec
6	Insulation material	MgO
7	Insulation resistance	> 100 MΩ @ 45 VDC
8	Line Resistance	20.3 / 20.6 / 21.2 ohm ±20%
9	Sensitivity	41 μ V/°C
10	Accuracy	0 to +400°C ± 3°C > 400°C ± 0.75% of reading
11	Conduction error	0.62 x 10^{-2} W/s
12	Zero stability for • Thermal shock • Vibration	 ≤0.25°C ≤0.25°C
13	Overall Length A) TCP-25mm B) TCP-32mm C) TCP-50mm	 568.5 $^{\pm 15}$ mm 575.5 $^{\pm 15}$ mm 593.5 $^{\pm 15}$ mm
14	Mass	<100 Grams
15	Material of sheath	AISI 304 L/ Z2 CN18-10 (SS)
16	Immersion Length	25,32,50 mm
17	Mechnical interface	M14 x 1.5 - 6H
18	Electrical interface	DBAS-Circular Electrical Connector

HLP | Temperature Sensor

HLP-85 or Helium Probe Temperature sensor uses ϕ1mm 'K' type thermocouple to sense the temperature. This Temperature sensor has three configurations, namely PS2, PS4 and PS4M. The sensor uses basic element like Chromel/Alumel (K type thermocouple) with sheath and thermo well materials like AISI 304. The sensor uses unique construction techniques to obtain noise immunity and high response.

★ Successfully flown in all launch vehicle missons.



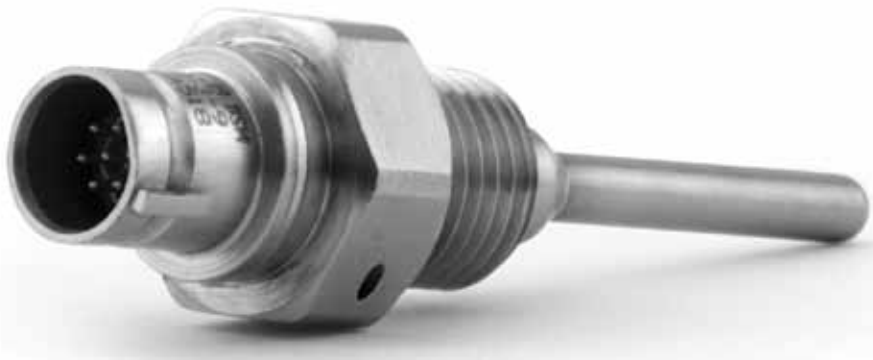
Sl. No.	PARAMETER	SPECIFICATION
1	Operating temperature	-196°C to +250°C
2	Thermocouple	K Type (Ø1mm) (Chromel-Alumel)
3	Junction	Ungrounded
4	Operating Pressure (max)	520 bar Hydraulic
5	Helium Leak testing	345 bar GHe
6	Helium Leak rate	≤ $1x10^{-6}$ Scc/Sec
7	Time constant	< 0.3 Sec
8	Insulation material	MgO
9	Insulation resistance	> 10 MΩ at 45 VDC
10	Sensitivity	41 μ V/°C
11	Accuracy	± 2.5°C for 0 to +250°C ± 6.5°C for 0 to -196°C
12	Zero stability for Thermal shock Vibration	 ≤0.25°C ≤0.25°C
13	Conduction error	≤1°C
14	Sizes A) PS2 B) PS4 C) PS4M	 ϕ 48 x L195mm ϕ 38 x L195mm ϕ 39 x L237mm
15	Material of sheath	AISI 304 L/ Z2 CN18-10 (SS)/ SS316L
16	Mass	≤150 Grams
17	Mechnical interface	ϕ 6.5mm 6 holes equi space on 35/25.5 PCD of flange
18	Electrical interface	DBAS-Circular Electrical Connector

PTS | Temperature Sensor

PTS-84 or Platinum Temperature Sensor uses Platinum based 100 ohm RTD element to sense the temperature. The basic element used here is a wire wound platinum temperature sensor which has 100Ω at 0°C and encapsulated with S.S. AISI 304/ material. The Pt100 sensors are incorporated in a thermo well for a very stable and accurate temperature measurement between -200°C to +250° C.

★ Successfully flown in all launch vehicle missons.

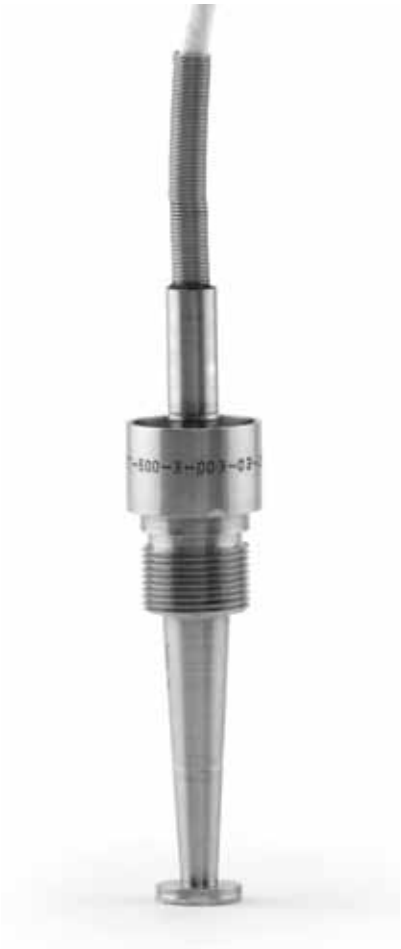
Sl. No.	PARAMETER	SPECIFICATION
1	Operating temperature	-200°C to +250°C
2	Resistance at 0°C	100 ± 0.25 Ω
3	Time constant	≤ 3 Sec
4	Insulation resistance	> 100 MΩ @ 45 VDC
5	Sensitivity	0.385 Ω/°C
6	Continuity Resistance	≤10m Ω at 10mA
7	Stability of Resistance at 0°C	100 Ω Nominal ± 0.001 Ω
8	Pressure (max)	330 bar
9	Coefficient	a = (3.85 ± 0.3) x10^{-3} b=0.11 c= 1.48± 0.15
10	Conduction coefficient	≤ 0.01
11	Material of sheath	AISI 304 L/ Z2 CN18-10 (SS)
12	Immersion Length (IL)	50 mm
13	Mass	≤100 Grams
14	Recommended tightening torque	≤ 20 Nm
15	Maximum Flow rate	20 m/s (Perpendicular to the Sensor
16	Electrical interface	DSM-Circular Electrical Connector



CTT | Temperature Sensor

CTT is used for cryogenic temperature measurement. The sensor uses thin film PRTD 500 Ω element with 1/3 DIN class B accuracy. Small size, compactness, fast response time, low self-heating rate, excellent long-term stability & high reliability are its salient features. Each sensor contains three sensing elements in a single housing for redundancy.

★ This Sensor successfully flown in LVM3 - D1 Mission



Sl. No.	PARAMETER	SPECIFICATION
1	Operating temperature	75K-330K
2	Operating Pressure	Max. 150 bar
3	Proof Pressure	270 bar
4	Resistance at 77K (LN2) @ 1 bar	97.5 ± 0.5 Ω Spread corresponds to ±0.2 K
5	Resistance at 273.16K (ice point) @ 1 bar	500 ± 0.5 Ω Spread corresponds to ± 0.25° C
6	Resistance at 298 K (25°C) @ 1 bar	549 ± 0.6 Ω Spread corresponds to ± 0.3° C
7	Transducer Accuracy (NL+ Repeatability)	±0.3K
8	Sensitivity (80K-95K)	2.15 ± 0.1 Ω/K
9	Recommended Continuous Excitation Current	< 1 mA
10	Response time (from 90K to 80K)	< 3 Seconds
11	Random Vibration levels (Radial & Axial)	13.5 grms Qual 9 grms Acceptance
12	Mass	<100 grams
13	Wetted Parts	AISI 304L/ Z2CN18-10
14	Mechanical Interface	M16X1-6g
15	Electrical Interface	Pigtail- 12 core shielded cable of length 1 meter

CRYO | Speed Sensor

Cryo upper stage of GSLV uses Liquid Oxygen and Liquid Hydrogen as propellant that are stored at - 183°C and – 253°C respectively. These are to be pumped from the respective tanks using individual booster pumps to the main turbo pumps that runs at a critical rotational speed. As the speed of the turbine is a very critical parameter, it is to be monitored continuously. A speed sensor is used for this purpose.

The speed sensor is designed for contact free measurement of the speed (rpm) of the turbo booster pumps in the engine unit. The design employs the principle of electromagnetic induction to generate EMF in the copper coils which is used to measure the speed of the booster pump (rpm). The design incorporates a permalloy core with copper coils wounded over a teflon bobbin. A PCB is used to take the electrical outputs. Suitable potting compound is used for electrical insulation. The entire assembly is enclosed in housing (Z2CN18-10).

Sl. No.	PARAMETER	SPECIFICATION
1	Measuring range	600 to 60000rpm
2	Frequency range	20Hz to 2000 Hz
3	Minimum O/P signal @ 600 RPM	20 mV (p-p) / coil
4	Temperature range	-253°C to 100°C (20K to 373K)
5	No. of coils	4
6	Insulation Resistance	>100 M Ohm @ 45 V DC
7	Vibration	13.5 grms. Qual 9 grms Acceptance
8	Material of Constrution	SS 304L
9	Mass	<150gm
10	Mechanical Interface	M18X1.5 6g
11	Electrical Interface	Pigtail- 12 core shielded cable of length one meter

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