PGS6454 TEST REPORT

MEMS THERMAL CONDUCTIVITY A2L
REFRIGERANT SENSOR FOR SAFETY MONITORING

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SUMMARY		
Test Item		**Test Result**
1 Response time	Response initiated within 30 s (when the refrigerant sensor is directly exposed to refrigerant gas at a concentration of 25 % LFL, the refrigerant detection system shall initiate a system response within 30 s)	Pass
2 Calibration curve	Exposed to 11400 ppm or 10 % LFL gas, the accuracy meets 10 % LFL (± 2.5 % LFL)	Pass
3 Humidity test	Exposed to temperature of 40 °C (±2 C°) and humidity of 90 % RH (± 5 % RH): Accuracy of 10 % LFL (± 5.0 % LFL)	Pass
4 Temperature test	After three hours at the upper limit of operating temperature (e.g. 60 °): Accuracy 10 % LFL (± 5.0 % LFL) After three hours at the lower limit of operating temperature (e.g. -30 °C): Accuracy 10 % LFL (± 5.0 % LFL)	Pass
5 Pressure test	7.1 exposure to pressures of 80 kPa, 90 kPa, 100 kPa, and 110 kPa for 1 h each: Accuracy 10 % LFL (± 5.0 % LFL)	Pass
6 CO^2 cross sensitivity test	Exposure to 5,000 PPM CO2: No alarm for 10 % LFL	

NOMINAL TEST CONDITIONS

Test gas concentration: % of LFL (unless otherwise indicated)

Number of samples: 3

Test gases

- Balanced with clean air
- Volume fraction shall not exceed ± 2.5 % LFL
- Standard test gas: 10 % LFL R454B in clean air
- Flow rate of test gas: 3.6 L/min

Supply voltage: 5.00 V (±0.25 V)

Ambient temperature (must be between 15 °C – 25 °C): 25 °C

Pressure (must be between 86 kPa and 108 kPa): 100 kPa

Humidity (for short applications up to eight hours): Dry

Orientation: Direction up

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TEST METHODS AND RESULTS

1 Response time

When the refrigerant sensor is directly exposed to a refrigerant gas with a concentration of 25 % LFL, the refrigerant detection system shall initiate a system response within 30 s (the time that it takes for the concentration to reach the alarm point of 11400 ppm, i.e. 10 % LFL)

a) Start collecting data

b) Start to apply dry air; hold for 5 min

c) Inject test 28,500 ppm concentration of R454B (25 % LFL) and hold for 5 min

Standard: Response within 30 s

No.	Start response time (s)	Test result
1	23	Pass
2	20	Pass
3	20	Pass

2 Calibration curve

a) Start data acquisition

b) Apply dry air and hold for 5 min.

c) Inject the test 11,400 ppm concentration R454B (10 % LFL) and hold for 5 min (accuracy conforms to 10 % LFL (± 2.5 % LFL))

Standard: Accuracy is required to meet 10 % LFL (± 2.5 % LFL)

Sample	11,400 ppm (10 % LFL)	Error % LFL	Test result
1	8.8	1.2	Pass
2	9.7	0.3	Pass
3	9.9	0.1	Pass

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3 Humidity test

The temperature and humidity box is set to 40 °C (± 2 °C), humidified to 90 % RH (± 5 % RH), and the sensor should be exposed for 1 h

a) Start data collection

b) Inject 11,400 ppm, i.e. 10 % LFL, and keep it for 5 min. The accuracy is required to meet 10 % LFL (± 5.0 % LFL) (here we need to calculate the concentration of R454B according to the actual humidity and then check the accuracy)
Temperature of 40 °C (± 2 °C); humidity of 90 % RH (± 5 % RH)

Standard: Accuracy of 10 % LFL (± 5.0 % LFL)

No.	Humidity (% RH)	9.95 % LFL (11,400 ppm at 90 % RH, 40.5 °C)	Error % LFL	Test result
1	90	8.3	-1.65	Pass
2	90	6.7	-3.25	Pass
3	90	6.6	-3.35	Pass

4 Temperature test

a) The temperature and humidity box is set to 60 °C (± 2 °C), and the sensor should be exposed for three h
   a) Start collecting data
   b) Inject 11,400 ppm, i.e. 10 % LFL, and keep it for 5 min. The accuracy is required to meet 10 % LFL (± 5.0 % LFL)

b) The temperature and humidity box is set to -30 °C (± 2 °C) and the sensor should be exposed for 3 h
   a) Start collecting data
   b) Pass in 11,400 ppm, which is 10 % LFL, and keep it for 5 min. The accuracy requirement conforms to 10 % LFL (± 5.0 % LFL)

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Temperature of 60 °C (± 2 °C)

Sample	11,400 ppm (10 % LFL)	Error %	Test result
1	9.73	-0.27	Pass
2	10.67	0.67	Pass
3	8.43	-1.57	Pass

Standard: Accuracy requirements meet 10 % LFL (± 5.0 % LFL)

Temperature of 30 °C (± 2 °C)

Sample	11,400 ppm (10 % LFL)	Error % LFL	Test result
1	8.43	-1.57	Pass
2	9.43	-0.57	Pass
3	9.72	-0.28	Pass

4 Pressure test

a) Evacuate to 20 mtorr, close the flapper valve, open the needle valve, and pass R454B 11,400 ppm i.e. 10 % LFL to 80 kPa, hold for 1 h

b) Collect data

c) Change the pressure value to 90 kPa, 100 kPa, and 110 kPa, and repeat the above operation

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Criteria: Accuracy required to meet 10 % LFL (± 5.0 % LFL)

Sample 1

Pressure (kPa)	11,400 ppm (10 % LFL)	Error % LFL	Test result
80	8.39	-1.61	Pass
90	8.99	-1.01	Pass
100	8.60	-1.40	Pass
110	9.04	-0.96	Pass

Sample 2

Pressure (kPa)	11,400 ppm (10 % LFL)	Error % LFL	Test result
80	10.73	0.73	Pass
90	10.15	0.15	Pass
100	9.73	-0.27	Pass
110	8.88	-1.12	Pass

5 CO^2 cross sensitivity test

a) Start collecting data

b) Start to apply dry air with argon (0.9 %), hold for 5 min

c) Inject test 5,000 PPM concentration of CO2 and hold for 5 min

Criteria: No alarm for 10 % LFL

Sample no.	Convert to concentration of R454B (% of LFL)	Test result
1	2.67 %	Pass
2	2.36 %	Pass
3	2.89 %	Pass