# GX-Force
# Software Requirement Specification & Test Specification

Document No.GX-Force_SW001

| Approval | Review | Preparation |
|---|---|---|
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| Date<br>2020/11/27 | Date<br>2020/11/27 | Date<br>2020/11/26 |

| No. | Date | Version | Revised content | Remarks |
|---|---|---|---|---|
| Ex. | 20XX/XX/XX | RevX.X | Create New | |
| 1 | 2020/11/26 | Rev1.0 | Create New | |
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| Request number | Classification | Request detail number | Requirements | Test case | Pass / fail criteria | Check |
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| req[1] | Concentration measurement | req[ 1 - 1 ] | NC (Combustible gas) concentration calculation | Zero: AIR<br>Place in air in measurement mode | concentration to be 0% LEL. | |
| | | | | Zero: AIR<br>SPAN: CH4 100% LEL<br>Run CH4 100% LEL in measurement mode | The concentration should be 100% LEL. | |
| | | | | Zero: AIR<br>SPAN: CH4 50% LEL<br>Flow CH4 50% LEL in measurement mode and set temperature to -40, 0, 60°C | Concentration should be 50% LEL ± indication accuracy. | |
| | | | | Zero: AIR<br>SPAN: CH4 100% LEL<br>In the User mode AIRCAL screen, run CH4 120% LEL. | The concentration display should be 120% LEL. | |
| | | | | Zero: AIR<br>SPAN: CH4 100% LEL<br>Flow CH4 120% LEL in measurement mode | Over-displaying of concentration. | |
| | | | | Zero: CH4 5%LEL<br>SPAN: CH4 100%LEL<br>Place in air in measurement mode | The concentration display should be 0% LEL. | |
| | | | | Zero: CH4 10% LEL<br>SPAN: CH4 100%LEL<br>Place in air in measurement mode | The concentration display should be -10%LEL. | |
| | | | | Zero: CH4 11%LEL<br>SPAN: CH4 100%LEL<br>Place in air in measurement mode | Concentration display should be minus over. | |
| | | | | Place in the atmosphere in measurement mode | Intermittent measurement (1 sec ON - 1 sec ON - 3 sec OFF control) using two combustible gas elements. | |
| | | | | Oxygen Sensor: Disable<br>Zero: AIR<br>SPAN: CH4 100%LEL<br>Flow CH4 120%LEL in measurement mode, then place in air | Flammability protection is provided (the concentration display is held at OVER and the sensor is de-energized). | |
| | | | | Oxygen Sensor: Enabled<br>Zero: AIR<br>SPAN: CH4 100%LEL<br>Flow CH4 120%LEL in measurement mode, then place in air | Automatic return from flammability protection when oxygen concentration is 20 vol% or more. | |
| | | | | Oxygen Sensor: Disable<br>Zero: AIR<br>SPAN: CH4 100%LEL<br>Flow CH4 120%LEL in measurement mode, then place in air | ENTER button to return from flammable protection. | |
| | | req[ 1 - 2 ] | EC (Oxygen/Toxic gas) concentration calculation | AIR: AIR<br>SPAN: N2<br>Place in air in measurement mode | The oxygen concentration should be 20.9%. | |
| | | | | AIR: AIR<br>SPAN: N2<br>O2 20.4% flowing in measurement mode | The oxygen concentration should be 20.9%. | |
| | | | | AIR: AIR<br>SPAN: N2<br>O2 20.3% flowing in measurement mode | The oxygen concentration should be 20.3%. | |
| | | | | AIR: AIR<br>SPAN: N2<br>O2 21.4% flowing in measurement mode | The oxygen concentration should be 20.9%. | |
| | | | | AIR: AIR<br>SPAN: N2<br>O2 21.5% flowing in measurement mode | The oxygen concentration should be 21.5%. | |
| | | | | AIR: AIR<br>SPAN: N2<br>O2 40% LEL flowing in measurement mode | The oxygen concentration should be 40.0%. | |
| | | | | AIR: AIR<br>SPAN: N2<br>N2 flowing in measurement mode | The oxygen concentration should be 0.0%. | |
| | | | | Zero: AIR<br>Place in air in measurement mode | Toxicity concentration should be 0 ppm. | |
| | | | | Zero: AIR<br>SPAN:H2S 200.0ppm<br>Flow H2S 200.0ppm in measurement mode | Toxicity concentration shall be 200.0 ppm. | |
| | | | | AIR: AIR<br>SPAN: N2<br>Place in air in measurement mode and set temperature to -40, 0, 60°C | Oxygen concentration should be 20.9% ± indication accuracy. | |
| | | | | Zero: AIR<br>SPAN:H2S 200.0ppm<br>Flow H2S 200.0ppm in measurement mode, and set temperature to -40, 0, 60°C. | Toxicity concentration should be 200.0ppm ± indication accuracy. | |
| | | | | AIR: AIR<br>SPAN: N2<br>Flow O2 48%LEL in User mode AIRCAL screen | The oxygen concentration should be 48.0%. | |
| | | | | Zero: AIR<br>SPAN:H2S 200.0ppm<br>Run H2S 240.0ppm in User mode AIRCAL screen | Toxicity concentration shall be 240.0 ppm. | |
| | | | | AIR: AIR<br>SPAN: N2<br>O2 48% LEL flowing in measurement mode | The oxygen concentration display should be over displayed. | |
| | | | | Zero: AIR<br>SPAN:H2S 200.0ppm<br>Flow H2S 240.0ppm in measurement mode | Toxicity concentration indication should be over displayed. | |
| | | | | AIR: AIR<br>SPAN: O2 0.5<br>Place in air in measurement mode | The oxygen concentration display should be 0.0%. | |
| | | | | AIR: AIR<br>SPAN: O2 1.0<br>Place in air in measurement mode | The oxygen concentration display should be -1.0%. | |
| | | | | AIR: AIR<br>SPAN: O2 1.1<br>Place in air in measurement mode | The oxygen level display should be minus over. | |
| | | | | Zero:H2S 5.0ppm<br>SPAN: H2S 200.0ppm<br>Place in air in measurement mode | Toxicity concentration indication shall be 0.0 ppm. | |
| | | | | Zero:H2S 10.0ppm<br>SPAN: H2S 200.0ppm<br>Place in air in measurement mode | The toxicity concentration indication should be -10.0 ppm. | |
| | | | | Zero:H2S 10.5ppm<br>SPAN: H2S 200.0ppm<br>Place in air in measurement mode | The toxicity concentration display should be minus over. | |
| | | req[ 1 - 3 ] | Calibration curve processing | Enter 0%. | To process a calibration curve for percentage input (X-Y) and output 0% as a percentage. | |
| | | | | Enter 100%. | To process a calibration curve for percentage input (X-Y) and output 100% as a percentage. | |
| | | | | Enter 0%. | Inverse calibration curve processing of percentage input (Y-X) and outputting 0% as a percentage. | |
| | | | | Enter 100%. | Inverse calibration curve processing of percentage input (Y-X) and outputting 100% as percentage. | |
| | | | | Enter 120%. | Inputs exceeding ±100% shall be output without calibration curve processing. | |
| | | | | -Enter 120%. | Inputs exceeding ±100% shall be output without calibration curve processing. | |
| | | | | Changing the gas type<br>Changing the output with a dummy sensor | The calibration curve to be applied must have been changed. | |
| | | req[ 1 - 4 ] | Zero tracking | Run H2S 0.5ppm for 30 seconds in measurement mode | To update the zero point with the current value within a certain range when the zero point is out of alignment for 30 seconds continuously. | |
| | | | | Run O2 20.0% for 30 seconds in measurement mode | Oxygen should not be zero-tracked. | |
| | | | | H2S 0.5ppm<br>Measurement mode | Zero tracking process. | |

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| | | | | H2S 0.5ppm<br>Display mode | Zero tracking process. | |
| | | | | H2S 0.5ppm<br>User mode | No zero tracking process. | |
| | | | | Setting via communication | Can be turned on and off in the settings. | |
| | | | | Setting via communication | Whether to allow users to set ON/OFF. ON/OFF can be set. | |

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| | | req[ 1 - 5 ] | Zero suppression | H2S 0.3ppm | Apply smoothing processing at the specified value, and the displayed concentration should be 0.0 ppm. | |
| | | | | H2S 0.3ppm<br>Measurement mode | Zero suppression process. | |
| | | | | H2S 0.3ppm<br>Display mode | Zero suppression process. | |
| | | | | H2S 0.3ppm<br>User mode | Do not perform zero-suppress processing. | |
| | | | | Setting via communication | Can be turned on and off in the settings. | |
| | | | | Setting via communication | Whether to allow users to set ON/OFF, ON/OFF can be set. | |
| | | | | Suppress ON<br>H2S -0.3ppm | Zero suppression process. | |
| | | | | Suppress OFF<br>H2S -0.3ppm | Do not perform zero-suppress processing. | |
| | | req[ 1 - 6 ] | Peak value calculation | Measurement mode | To update the MIN/MAX value/time of the concentration for each concentration calculation. | |
| | | | | Display mode | To update the MIN/MAX value/time of the concentration for each concentration calculation. | |
| | | | | user mode | Do not update the MIN/MAX value of the concentration/time at that time. | |
| | | | | Maintenance mode | Do not update the MIN/MAX value of the concentration/time at that time. | |
| | | | | factory mode | Do not update the MIN/MAX value of the concentration/time at that time. | |
| | | req[ 1 - 7 ] | Peak value display | Display mode | Except for oxygen, the peak (MAX) value should be displayed. | |
| | | | | Display mode | Oxygen should display peak (MIN) values. | |
| | | req[ 1 - 8 ] | Peak value reset | Peak value display screen<br>Press and hold AIR1sec. | "CLEAR" and "HOLD" should be displayed. | |
| | | | | Peak value display screen<br>Press and hold AIR for 3 seconds | "CLEAR" and "RELEASE" should be displayed. | |
| | | | | Peak value display screen<br>Release the AIR button while "RELEASE" is displayed. | To update the MIN/MAX values of concentration and time with the current values. | |
| | | req[ 1 - 9 ] | Average calculation | Measurement mode | Integrating numerical values for each concentration calculation and calculating the average value for one minute at a time (used only for logger and STEL calculations). | |
| | | req[ 1 - 10 ] | STEL value calculation | Measurement mode | Monitoring the concentration of toxicity and updating the STEL value for each concentration calculation. | |
| | | | | Measurement mode | STEL value shall be calculated by (average value of 60 seconds accumulated for 15 minutes every minute)/15. | |
| | | req[ 1 - 11 ] | STEL value display | Display mode | STEL values for toxic gases shall be indicated. | |
| | | | | Display mode | STEL values other than for toxic gases shall not be indicated. | |
| | | req[ 1 - 12 ] | TWA value calculation | Measurement mode | Monitor the concentration of toxicity for each concentration calculation and update the TWA value. | |
| | | | | Measurement mode | TWA value should be calculated as (average value of 60 seconds integrated every minute for 8 hours)/480. | |
| | | req[ 1 - 13 ] | TWA value display | Display mode | TWA values for toxic gases shall be indicated. | |
| | | | | Display mode | TWA values for gases other than toxic gases shall not be indicated. | |
| | | req[ 1 - 14 ] | Cumulative (AVRG) value calculation | Measurement mode | To monitor the concentration of toxicity and update the integrated (AVRG) value for each concentration calculation. | |
| | | | | Measurement mode | TWA value should be calculated as (average value of 60 seconds, accumulated for 1 hour every minute)/60. | |
| | | req[ 1 - 15 ] | Cumulative (AVRG) value display | Display mode | Indicate the total (AVRG) value of toxic gases. | |
| | | | | Display mode | Totalized (AVRG) values other than those for toxic gases shall not be indicated. | |
| req[2] | Gas alarm | req[ 2 - 1 ] | Gas warning notification | H2S 1st Alarm 25.0ppm<br>Run H2S 25.0ppm in measurement mode | Displaying alarm message. | |
| | | | | H2S 1st Alarm 25.0ppm<br>Run H2S 25.0ppm in measurement mode | Buzzer, vibration motor, and LED should work. | |
| | | | | H2S 1st Alarm 25.0ppm<br>Run H2S 25.0ppm in measurement mode | LCD backlight must be always on. | |
| | | | | CH4 1st/2nd/3rd 25%LEL/50%LEL/55%LEL<br>CH4 25%LEL in measurement mode | The 1st alarm is triggered.<br>(The priority order of the combustibility sensor's alarm points should be 1st<2nd<3rd<OVER, and the combustibility sensor's alarm pattern should be H-HH.) | |
| | | | | CH4 1st/2nd/3rd 25%LEL/50%LEL/55%LEL<br>CH4 50%LEL in measurement mode | The 2nd alarm is triggered.<br>(The priority of the combustibility sensor's alarm points should be 1st<2nd<3rd<OVER, and the combustibility sensor's alarm pattern should be H-HH.) | |
| | | | | CH4 1st/2nd/3rd 25%LEL/50%LEL/55%LEL<br>Run CH4 55%LEL in measurement mode | The 3rd alarm is triggered.<br>(The priority order of the combustibility sensor's alarm points should be 1st<2nd<3rd<OVER, and the combustibility sensor's alarm pattern should be H-HH.) | |
| | | | | CH4 1st/2nd/3rd 25%LEL/50%LEL/55%LEL<br>CH4 120%LEL in measurement mode | OVER alarm will be issued.<br>(The priority order of the combustibility sensor's alarm points should be 1st<2nd<3rd<OVER, and the combustibility sensor's alarm pattern should be H-HH.) | |
| | | | | O2 1st / 2nd / 3rd 18.0% / 17.0% / 25.0<br>Flow O2 18.0% in measurement mode | The 1st alarm is issued.<br>(The priority of the oxygen sensor's alarm point should be 1st<2nd<3rd<OVER, and the oxygen sensor's alarm pattern should be L-LL-H.) | |
| | | | | O2 1st / 2nd / 3rd 18.0% / 17.0% / 25.0<br>Flow O2 17.0% in measurement mode | 2nd alarm will be issued.<br>(The priority order of the oxygen sensor alarm points should be 1st<2nd<3rd<OVER, and the oxygen sensor alarm pattern should be L-LL-H.) | |
| | | | | O2 1st / 2nd / 3rd 18.0% / 17.0% / 25.0<br>Flow O2 25.0% in measurement mode | 3rd alarm will be issued.<br>(The priority order of the oxygen sensor alarm points should be 1st<2nd<3rd<OVER, and the oxygen sensor alarm pattern should be L-LL-H.) | |
| | | | | O2 1st / 2nd / 3rd 18.0% / 17.0% / 25.0<br>O2 48.0% flowing in measurement mode | OVER alarm will be issued.<br>(The priority order of the oxygen sensor alarm points should be 1st<2nd<3rd<OVER, and the oxygen sensor alarm pattern should be L-LL-H.) | |
| | | | | H2S 1st/2nd/3rd 1.0ppm/10.0ppm/11.0ppm<br>Flow H2S 1.0ppm in measurement mode | The 1st alarm will be issued.<br>(The priority order of the alarm points of the toxicity sensor should be 1st<2nd<3rd<OVER<TWA(AVRG)<STEL, and the alarm pattern of the toxicity sensor should be H-HH) | |
| | | | | H2S 1st/2nd/3rd 1.0ppm/10.0ppm/11.0ppm<br>Flow H2S 10.0ppm in measurement mode | The 2nd alarm will be issued.<br>(The priority order of the alarm points of the toxicity sensor should be 1st<2nd<3rd<OVER<TWA(AVRG)<STEL, and the alarm pattern of the toxicity sensor should be H-HH) | |
| | | | | H2S 1st/2nd/3rd 1.0ppm/10.0ppm/11.0ppm<br>Run H2S 11.0ppm in measurement mode | The 3rd alarm will be issued.<br>(The priority order of the alarm points of the toxicity sensor should be 1st<2nd<3rd<OVER<TWA(AVRG)<STEL, and the alarm pattern of the toxicity sensor should be H-HH) | |
| | | | | H2S 1st/2nd/3rd 1.0ppm/10.0ppm/11.0ppm<br>Flow H2S 240.0ppm in measurement mode | OVER alarm will be issued.<br>(The priority order of the toxicity sensor's alarm points should be 1st<2nd<3rd<OVER<TWA(AVRG)<STEL, and the toxicity sensor's alarm pattern should be H-HH) | |
| | | | | H2S STEL/TWA 1.0ppm/1.0ppm<br>Run H2S 1.0ppm for 15 minutes in measurement mode | STEL alarm will be issued.<br>(The priority order of the alarm points of the toxicity sensor should be 1st<2nd<3rd<OVER<TWA(AVRG)<STEL) | |
| | | | | H2S STEL/TWA 10.0ppm/1.0ppm<br>H2S 1.0ppm flowing for 8 hours in measurement mode | TWA alarm will be issued.<br>(The priority of the alarm points of the toxicity sensor should be 1st<2nd<3rd<OVER<TWA(AVRG)<STEL) | |
| | | | | Latching | Maintain alarm unless alarm is reset (key pressed). | |
| | | | | Automatic return | To automatically stop the alarm when the gas concentration no longer meets the conditions for alarm generation. | |
| | | | | Alarm silence ON | If the reset operation is performed while the alarm is sounding, only the buzzer will stop. After stopping the buzzer, when a new alarm is triggered, the buzzer resumes. | |
| | | | | Alarm silence OFF | Buzzer sound does not stop during alarming. | |
| | | | | All gas alarm OFF | No gas alarm operation. | |
| | | req[ 2 - 2 ] | Alarm point setting | Setting via communication | Must be able to set the 1st alarm point of the combustibility sensor. | |
| | | | | Setting via communication | The 2nd alarm point of the combustibility sensor must be able to be | |
| | | | | Setting via communication | The 3rd alarm point of the flammability sensor must be able to be set. | |
| | | | | Setting via communication | Ability to set the 1st alarm point of the oxygen sensor. | |

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| | | | | Setting via communication | Ability to set the 2nd alarm point of the oxygen sensor. | |
| | | | | Setting via communication | Ability to set the 3rd alarm point of the oxygen sensor. | |
| | | | | Setting via communication | Ability to set the 1st alarm point of the toxicity sensor. | |
| | | | | Setting via communication | Ability to set the 2nd alarm point of the toxicity sensor. | |
| | | | | Setting via communication | Ability to set the 3rd alarm point of the toxicity sensor. | |
| | | | | Setting via communication | Ability to set TWA (AVRG) alarm points for toxicity sensors. | |
| | | | | Setting via communication | The STEL alarm point of the toxicity sensor must be configurable. | |
| | | req[ 2 - 3 ] | Latching / automatic reset setting | Setting via communication | Ability to set whether to self-hold or auto-recover. | |
| | | req[ 2 - 4 ] | TWA/Cumulative selection setting | Setting via communication | Ability to set whether CO TWA alarm or totalization alarm. | |
| | | req[ 2 - 5 ] | All gas alarm OFF setting | Setting via communication | All gas alarms must be able to be turned on and off at once. | |
| | | | | Setting via communication | Must be configurable only with configuration software. | |
| | | req[ 2 - 6 ] | Alarm silence setting | Setting via communication | Ability to set alarm silence ON/OFF. | |

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| req[3] | Fault alarm | req[ 3 - 1 ] | Fault warning notification | Failure indication mode | Displaying fault messages. | |
| | | | | Failure indication mode | Buzzer and LED should work. | |
| | | | | Failure indication mode | LCD backlight must be always on. | |
| | | | | Failure indication mode | Communication must be possible during fault message display. | |
| | | | | Failure indication mode | A fault that can be recovered should be recovered by pressing the ENTER key briefly. | |
| | | | | Failure indication mode | Non-recoverable faults shall not be recoverable unless the power is turned off. | |
| | | | | Failure indication mode | Latching (no automatic recovery) operation. | |
| | | req[ 3 - 2 ] | Self-diagnosis | Start with a SUM value different from the calculated value | To be a post-initial ROM failure. | |
| | | | | RAM address rewriting during RAM check | To be a post-initial RAM failure. | |
| | | | | Startup by partially rewriting the data in non-volatile memory | To be a post-initial non-volatile memory failure. | |
| | | | | Set the RTC to an abnormal value and start | To be an internal clock failure after initialization. | |
| | | | | Start by dropping the circuit voltage (SV,MV,ECV1,ECV2,ECV3,HCV,PZF) to GND. | Circuit voltage failure after initialization. | |
| | | | | Changed thermistor AD value to -55°C equivalent | Thermistor failure after initialization. | |
| | | | | Start by removing the combustibility sensor. | To be a sensor failure. | |
| | | | | Remove the oxygen sensor and start it up. | To be a sensor failure. | |
| | | | | Remove and activate toxicity sensor. | To be a sensor failure. | |
| | | | | Reduce lithium-ion battery voltage to less than 3.4V | To be a battery voltage drop failure. | |
| | | | | Remove the sensor circuit and start up | To be a sensor circuit failure. | |
| | | | | Clog the gas flow passage and start up | To be a flow failure. | |
| | | | | Remove the pump and start up | To be a pump failure. | |
| req[4] | Test | req[ 4 - 1 ] | BUMP test | User Mode<br>Bump test | It should be possible to apply the gas and check if the concentration reaches the set threshold within a certain period of time. | |
| | | | | User mode<br>Test failure in bump test | Can be calibrated with the gas being used (BUMP calibration). | |
| | | | | User mode<br>End of Bump Test | To display the results of executing BUMP. | |
| | | | | Setting via communication | Ability to set the conditions (time) for the BUMP test. | |
| | | | | Setting via communication | Ability to set conditions (thresholds) for the BUMP test. | |
| | | | | Setting via communication | Ability to set the conditions (time) for BUMP calibration. | |
| | | | | Setting via communication | Ability to set the BUMP calibration ON/OFF. | |
| | | req[ 4 - 2 ] | Gas alarm test | Display mode<br>ENTER in the alarm point display screen (1st) | Able to run the 1st alarm test. | |
| | | | | Display mode<br>ENTER in the alarm point display screen (2nd) | Able to run 2nd alarm test. | |
| | | | | Display mode<br>ENTER in the alarm point display screen (3rd) | Able to run 3rd alarm test. | |
| | | | | Display mode<br>ENTER in the alarm point display screen (F.S.) | Be able to run tests on OVER alarms. | |
| | | | | Display mode<br>ENTER in the alarm point display screen (TWA) | Must be able to run tests on TWA alarms. | |
| | | | | Display mode<br>ENTER in the alarm point display screen (integration) | Able to perform integration alarm testing. | |
| | | | | Display mode<br>ENTER in the alarm point display screen (STEL) | Be able to run STEL alarm tests. | |
| req[5] | Sensor adjustment | req[ 5 - 1 ] | Manual zero (air) calibration | User Mode<br>AIRCAL Screen | Ability to perform zero (air) calibration. | |
| | | | | Maintenance Mode<br>AIRCAL screen | Ability to perform zero (air) calibration. | |
| | | | | Run AIRCAL. | Set to 0 for all but oxygen. | |
| | | | | Run AIRCAL. | For oxygen, set to 20.9. | |
| | | | | Run AIRCAL with O2 0.0% flowing | Air calibration fails and air calibration error is displayed. | |
| | | req[ 5 - 2 ] | Demand zero calibration | Measurement mode<br>Press and hold the AIR button. | Must be able to perform air calibration. | |
| | | | | Measurement mode<br>While holding down the AIR button | Display a confirmation screen. | |
| | | | | Setting via communication | Ability to set demand zero on/off. | |
| | | req[ 5 - 3 ] | Auto zero calibration | Auto zero ON<br>Initial mode | Air calibration shall be performed at the end of the initial. | |
| | | | | Auto zero ON<br>Initial mode | Prompting the user to confirm whether to perform auto-calibration. | |
| | | | | Auto zero ON<br>Initial mode<br>No operation for 15 seconds on auto calibration confirmation screen | Transition to the measurement screen without executing auto-zero. | |
| | | | | Auto zero ON<br>Initial mode<br>Select auto-zero execution on the auto-calibration confirmation screen. | Running auto-zero. | |
| | | | | Auto zero ON<br>Initial mode<br>Select auto-zero non-execution on the auto-calibration confirmation screen. | Do not run auto-zero. | |
| | | | | Auto zero ON<br>Initial mode<br>Select auto-zero execution on the auto-calibration confirmation screen. | If air calibration fails, retry process up to three times. | |
| | | | | Setting via communication | Ability to set auto-zero ON/OFF. | |
| | | req[ 5 - 4 ] | Auto (span) calibration | User Mode<br>AUTOCAL screen | Ability to perform auto-calibration. | |
| | | | | Maintenance Mode<br>AUTOCAL screen | Ability to perform auto-calibration. | |
| | | | | Maintenance Mode<br>AUTOCAL screen | Can be calibrated for all gases simultaneously. | |
| | | | | Maintenance Mode<br>AUTOCAL screen | Gases to be calibrated simultaneously can be specified. | |
| | | | | Maintenance Mode<br>AUTOCAL screen | Ability to calibrate all gases individually. | |
| | | | | Setting via communication | Ability to set which gas types to calibrate. | |
| | | | | Maintenance Mode<br>AUTOCAL screen | Calibrate with the pre-specified calibration concentration value. | |
| | | | | Setting via communication | Ability to change the calibration concentration value. | |
| | | | | O2 calibration concentration 12.0%<br>Run AUTOCAL at O2 40.0%. | Auto-calibration should fail and produce an error. | |
| | | req[ 5 - 5 ] | Calibration expiration | Domestic specifications<br>Calibration deadline display ON<br>Initial mode | No indication regarding the calibration period shall be provided. | |
| | | | | Export Specifications<br>Calibration deadline display ON<br>Initial mode | Perform the process of checking whether the calibration deadline has expired and provide an indication regarding the calibration deadline. | |
| | | | | Setting via communication | The calibration expiry action can be selected from "Use after confirmation", "Do not use", and "Do nothing". | |
| | | | | Export Specifications<br>Calibration deadline display ON<br>Initial mode<br>No expired sensor | The number of days remaining until the calibration deadline should be displayed. | |
| | | | | Export Specifications<br>Calibration deadline display ON<br>Initial mode<br>Expired sensor is present<br>Expired operation: Use after confirmation | The expiration date is displayed and can be confirmed (released) with a short press of the ENTER key. | |
| | | | | Export Specifications<br>Calibration deadline display ON<br>Initial mode<br>Expired sensor is present<br>Expired operation: Use prohibited | Do not display expired and transition to the next item. | |
| | | | | Export Specifications<br>Calibration deadline display ON<br>Initial mode<br>Expired sensor is present<br>Expired operation: Do nothing | Display expiration date and transition to the next item after 6 seconds. | |
| | | | | Setting via communication | Calibration deadline display "ON/OFF" can be set. | |
| | | | | Setting via communication | Ability to select and set the number of days from 1 to 1000 days until the calibration deadline. | |

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| | | req[ 5 - 6 ] | Bump expiration | BUMP deadline display ON<br>Initial mode | Processing to check if the BUMP deadline has expired and displaying information about the BUMP deadline. | |
| | | | | No BUMP expired sensor<br>Normal startup | The ✓ mark should be displayed. | |
| | | | | Setting via communication | BUMP expiration behavior can be selected from "Use after confirmation", "Do not use", and "Do nothing". | |
| | | | | BUMP deadline display ON<br>Initial mode<br>No BUMP expiry sensor | To display the number of days remaining until the BUMP expires. | |
| | | | | BUMP deadline display ON<br>Initial mode<br>BUMP expired sensor is present<br>BUMP expired operation: Use after confirmation | The expiration date is displayed and can be confirmed (released) with a short press of the ENTER key. | |
| | | | | BUMP deadline display ON<br>Initial mode<br>BUMP expired sensor is present<br>BUMP expired operation: use prohibited | Do not display expired and transition to the next item. | |
| | | | | BUMP deadline display ON<br>Initial mode<br>BUMP expiry sensor is present<br>BUMP expiry action: No action | Transition to the next item after 6 seconds. | |
| | | | | Setting via communication | Ability to set the BUMP deadline display "ON/OFF". | |
| | | | | Setting via communication | Ability to select and set the number of days until the BUMP deadline from 0 to 365 days. | |
| | | req[ 5 - 7 ] | Maintenance expiration | Domestic specifications<br>Maintenance deadline display ON<br>Initial mode | Perform a check process to see if the maintenance deadline has expired and display information about the maintenance deadline. | |
| | | | | Export Specifications<br>Maintenance deadline display ON<br>Initial mode | No indication regarding maintenance deadlines. | |
| | | | | Maintenance mode<br>Maintenance deadline setting screen | The maintenance expiration date and time should be able to be cleared to "0 year, 0 month, 0 day" by keystroke. | |
| | | | | initial mode | The maintenance expiration date and time should be updated with the current date and time when the main unit is turned on, if it is "0 year, 0 month, 0 day". | |
| | | | | Setting via communication | Maintenance expiration behavior can be selected from "Use after confirmation", "Do not use", and "Do nothing". | |
| | | | | Domestic specifications<br>Maintenance deadline display ON<br>Initial mode<br>No maintenance expiry sensor | Display the number of days remaining until the maintenance expires. | |
| | | | | Domestic specifications<br>Maintenance deadline display ON<br>Initial mode<br>There is a maintenance expiration sensor<br>Maintenance expired operation: Use after confirmation | The expiration date is displayed and can be confirmed (released) with a short press of the ENTER key. | |
| | | | | Domestic specifications<br>Maintenance deadline display ON<br>Initial mode<br>There is a maintenance expiry sensor<br>Maintenance expiry operation: Use prohibited | Do not display expired and transition to the next item. | |
| | | | | Domestic specifications<br>Maintenance deadline display ON<br>Initial mode<br>There is a maintenance expiry sensor<br>Maintenance expired operation: No action | Display expiration date and transition to the next item after 6 seconds. | |
| | | | | Setting via communication | The maintenance deadline display can be set to "ON/OFF". | |
| | | | | Setting via communication | Ability to select and set the number of days from 1 to 1000 days until the maintenance deadline. | |
| | | req[ 5 - 8 ] | Gas information setting | Setting via communication | Sensor combination can be set (ON/OFF for each of the 4 sensors). | |
| | | | | Setting via communication | Ability to set each sensor ON/OFF. | |
| | | | | All sensors OFF<br>Initial mode | If all sensors are off, an error should occur during initialization. | |
| | | | | Setting via communication | Gas type for each sensor should be selectable. | |
| req[6] | Equipment adjustment | req[ 6 - 1 ] | Display adjustment | Measurement mode<br>Press any key | LCD backlight should be on. | |
| | | | | Measurement mode<br>Optional gas alarm triggering | LCD backlight should be on. | |
| | | | | Measurement mode<br>Backlight OFF time: 10 seconds<br>No operation | The backlight must be turned off after 10 seconds. | |
| | | | | Setting via communication | Ability to select and set the time from 0 to 255 seconds before turning off the backlight. | |
| | | | | Connect to SDM | Forcing the backlight to turn on. | |
| | | req[ 6 - 2 ] | Key operation sound | User mode<br>Press any button | The buzzer should output a single tone. | |
| | | | | Setting via communication | Ability to set the key operation sound ON/OFF. | |
| | | req[ 6 - 3 ] | Confirmation beep | Confirmation beep：BUZZER<br>Confirmation interval：1 minute<br>Measurement mode<br>No alarm | Buzzer to sound every 1 minute. | |
| | | | | Confirmation beep：BUZZER<br>Confirmation interval：1 minute<br>Display mode<br>No alarm | Buzzer to sound every 1 minute. | |
| | | | | Setting via communication | Ability to set the operation of the confirmation beep. | |
| | | | | Setting via communication | Ability to set the operation time of the confirmation beep. | |
| | | | | Confirmation Beep: BUMP | Flashing LED every 1 minute. | |
| | | | | Confirmation beep：ALARM<br>Confirmation interval: 1 minute<br>Measurement mode<br>Alarm has been issued | Flashing LED every 1 minute. | |
| | | req[ 6 - 4 ] | Lunch Break | Setting via communication | Ability to set lunch break on/off. | |
| | | | | Lunch break ON<br>After gas measurement in measurement mode, turn off the power and start again. | To be able to take over the previous PEAK and TWA values at startup (resume function). | |
| | | | | Lunch break ON<br>After gas measurement in measurement mode, turn off the power and start again. | The user should be able to choose whether or not to perform a resume. | |
| | | | | Lunch break ON<br>After gas measurement in measurement mode, turn off the power and start again<br>Wait 5 seconds at resume selection screen | Automatically execute resume if the user does not perform any operation. | |
| | | | | Turn off the power after gas measurement in measurement mode. | To record the data (PEAK value, TWA value and accumulated value) necessary for resume when the power is turned off. | |
| | | req[ 6 - 5 ] | User ID/Station ID | Setting via communication | Ability to register a list of user IDs/station IDs. | |
| | | | | Setting via communication | Ability to select the ID to be used from a list of user IDs/station IDs. | |
| | | | | Display mode<br>ID list selection screen | Ability to select an ID list. | |
| | | req[ 6 - 6 ] | Default processing | Read data after execution via communication | The non-volatile memory shall be initialized and initial values shall be written. | |
| | | | | Read data after execution via communication | Initialize the logger data, and that no data has been written to it. | |
| | | | | Read data after execution via communication | Power supply logger data must be initialized and no data must be written to it. | |
| | | req[ 6 - 7 ] | Protection setting for non-administrator | Setting via communication | To prevent unauthorized users from changing settings, it is necessary to be able to hide setting items in display mode. | |
| | | | | User mode<br>Display mode setting item display ON | Ability to show/hide setting items in the display mode. | |

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| | | req[ 6 - 8 ] | Password security | User mode password ON<br>User mode transition | A password request is made and the user must be able to enter a 4-digit password. | |
| | | | | User mode password ON<br>User mode password:1234<br>User mode transition | When [1234] is entered, it should be possible to move to the user mode item selection. | |
| | | | | User mode password ON<br>User mode password:1234<br>User mode transition | When [0000] is entered, a password mismatch is displayed and the system transitions to initial mode. | |
| | | | | Setting via communication | Ability to change the numerical value of the user mode password. | |
| | | | | User mode password ON<br>User mode password:1234<br>User mode transition | When the wild code [0405] is entered, the user should be able to move to the user mode item selection. | |
| | | | | Setting via communication | Turn on security features in user mode. | |
| | | | | Maintenance mode password ON<br>Maintenance mode transition | A password request is made and the user must be able to enter a 4-digit password. | |
| | | | | Maintenance Mode Password ON<br>Maintenance mode password: 2345<br>Maintenance mode transition | When [2345] is entered, it should be possible to move to the maintenance mode item selection. | |
| | | | | Maintenance Mode Password ON<br>Maintenance mode password: 2345<br>Maintenance mode transition | When [0000] is entered, a password mismatch is displayed and the system transitions to initial mode. | |
| | | | | Setting via communication | Ability to change the numerical value of the maintenance mode password. | |
| | | | | Maintenance Mode Password ON<br>Maintenance mode password: 2345<br>Maintenance mode transition | When the wild code [2202] is entered, the user should be able to move to the maintenance mode item selection. | |
| | | | | Setting via communication | Ability to set the security function of maintenance mode ON/OFF. | |
| | | | | Gas Select Transition | When [2014] is entered, it should be possible to move to the selection of the gas select item. | |
| | | | | Gas Select Transition | When [0000] is entered, a password mismatch is displayed and the system transitions to initial mode. | |
| | | | | Factory mode transition | When [1994] is entered, it should be possible to move to the factory mode item selection. | |
| | | | | Factory mode transition | When [0000] is entered, a password mismatch is displayed and the system transitions to initial mode. | |
| | | req[ 6 - 9 ] | Password protection | Password protection ON<br>Power OFF transition | A password is required to prevent non-administrators from running the program, and a 4-digit password can be entered. | |
| | | | | Password protection ON<br>Measurement mode<br>Demand Zero Execution | A password is required so that only the administrator can execute it, and a 4-digit password can be entered. | |
| | | | | Password protection ON<br>Measurement mode<br>Alarm has been issued | When resetting the alarm, a password is required so that only the administrator can execute it, and a 4-digit password can be entered. | |
| | | req[ 6 - 10 ] | Factory reset (Factory setting) | Maintenance mode<br>Factory reset screen | Data in non-volatile memory must be able to be restored to factory-recorded values. | |
| | | | | Maintenance mode<br>Factory reset screen | Provide a confirmation message to the user before resetting. | |
| | | | | After factory reset, read out the setting values. | The data in the non-volatile memory shall match the values recorded at the factory. | |
| | | | | Factory Mode<br>Factory reset setting screen | Must be able to record current data as factory default data in non-volatile memory. | |
| | | | | Factory Mode<br>Factory reset setting screen | A confirmation message should be displayed to the user before recording. | |
| | | | | Factory mode<br>After executing the factory reset setting, read the non-volatile memory value. | The data in the non-volatile memory must match the current data. | |
| | | req[ 6 - 11 ] | Power supply processing | Power off state<br>Press and hold the POWER key for 1 second. | Power supply should be activated. | |
| | | | | Power ON state<br>Press and hold the POWER key for 3 seconds. | Power shutdown. | |
| req[7] | External communication | req[ 7 - 1 ] | Communication | Execute communication from PC. | Communication between the PC (master) and the main unit (slave) must be possible. | |
| | | | | Execute communication from PC. | Ability to rewrite the main unit program from a PC. | |
| | | | | Read after setting via communication | The serial number of the device must be able to be entered and read from a PC. | |
| | | | | Read after setting via communication | The temporary serial number of the device must be able to be entered and read from a PC. | |
| | | | | Read after setting via communication | The SPE number of the main unit must be able to be entered and read from a PC. | |
| | | | | Setting via communication | Ability to set up a list of user IDs/station IDs from a PC. | |
| | | | | Setting via communication | Ability to set up domestic, export, RKI, and EN destinations from a | |
| | | | | Acquired via communication | Ability to read out logger data from a PC. | |
| | | | | Setting via communication | Ability to change logger settings from a PC. | |
| req[8] | Data logger | req[ 8 - 1 ] | Data logging | Power ON | Power ON. | |
| | | | | Interval trend interval: 5 minutes<br>Left in measurement mode for 18000 minutes with no alarm | 3600 interval trends are recorded. Recording of concentration data and gas data at each set time. | |
| | | | | Measurement mode<br>Gas alarm is triggered 8 times every 30 minutes | Eight alarm trends are recorded. To be recorded at 5-second intervals for 30 minutes before and after the time of occurrence. | |
| | | | | Generate gas alarm 100 times in measurement mode. | 100 alarm events will be recorded. Recorded using the surface-switching update method. | |
| | | | | Causing a total of 100 failures | 100 failure events will be recorded. Recorded using the surface-switching update method. | |
| | | | | Execute auto-calibration a total of 100 times. | 100 calibration histories are recorded, with calibration events including BUMPs, using the surface-switching update method. | |
| | | | | Run the BUMP test. | One calibration history will be recorded. (Confirmation that BUMP and calibration history are common) | |
| | | | | Execute setting changes a total of 100 times. | A history of 100 setting changes will be recorded. Only the values that are valid for tracking are recorded using the surface-switching update method. | |
| | | | | Execute snap log a total of 256 times. | 256 snap logs will be recorded. The recorded concentration data and date can be viewed in display mode. | |
| | | req[ 8 - 2 ] | Clear log | Read data after executing logger data clear via communication | Clearing logger data other than power log from flash memory. | |
| | | | | Read data after executing power supply logger data clear via communication. | Clearing the power log from flash memory. | |
| | | req[ 8 - 3 ] | Detailed fault Information Log | Generate an arbitrary fault | Logging of failure details in case of failure. | |
| | | req[ 8 - 4 ] | Logger overwrite | Logger overwrite ON<br>Interval trend interval: 5 minutes<br>Restart detector after 9000 minutes of no alarm in measurement mode<br>Left in no-alarm state in measurement mode for 12000 minutes | Interval trend data must be overwritten and recorded from the beginning. | |
| | | | | Logger overwrite ON<br>Interval trend interval: 5 minutes<br>Left in measurement mode for 20000 minutes with no alarm | If the capacity is full after one interval of power-on, the logger shall stop recording. | |
| | | req[ 8 - 5 ] | Interval trend time | Setting via communication | Ability to set interval trend time. | |
| | | req[ 8 - 6 ] | USER_ID record | Setting via communication | Record the 16-digit user ID. | |
| | | req[ 8 - 7 ] | STATION_ID record | Setting via communication | Record the 16-digit station ID. | |
| req[9] | Mode select | req[ 9 - 1 ] | Measurement mode | Power ON | To be able to switch to the mode to measure and display the concentration. | |
| | | req[ 9 - 2 ] | Display mode | Measurement mode<br>Press ENTER key | Selectable display mode to show current values (other than measured concentration, such as PEAK) and settings. | |
| | | | | Display mode<br>Press and hold the AIR+ENTER key. | Transition to measurement mode. | |
| | | | | Display mode<br>No operation for 20 seconds | Transition to measurement mode. | |
| | | req[ 9 - 3 ] | User mode | Power off state<br>Press AIR+ENTER key for 1 second | The ability to select user mode to publish up to one user. | |
| | | req[ 9 - 4 ] | Maintenance mode | Power off state<br>Press AIR+ENTER key for 4 seconds | The ability to select a maintenance mode that is open to the public until the maintenance man. | |
| | | req[ 9 - 5 ] | Gas select mode | Power off state<br>Press AIR+ENTER key for 7 seconds<br>Enter the password for gas select | The ability to select the gas select mode to be released only to RKIs. | |

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| req[ 9 - 6 ] | Factory mode | Power off state<br>Press AIR+ENTER key for 7 seconds<br>Enter the password for factory mode | Ability to select the factory mode to be used during manufacturing. | |
| req[ 9 - 7 ] | Communication mode | Initial mode<br>Communication starts from PC during date display | Must be able to transition to communication mode. | |
| | | Initial Mode<br>Simultaneously press AIR+ENTER key during date display | Must be able to transition to communication mode. | |
| | | Power OFF state<br>Place a magnet near the Hall IC | Must be able to shift to power ON and transition to communication mode. | |
| | | Power OFF state<br>Place a magnet near the Hall IC<br>Leave for 10 seconds after startup | If no communication partner is found within 10 seconds, turn off the power. | |
| | | Power OFF state<br>Place a magnet near the Hall IC<br>After startup, establish communication connection with PC. | The power must remain ON. | |
| req[ 9 - 8 ] | Initial mode | Power ON | Moves to initial mode at startup and transitions to measurement mode after a certain period of time. | |

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| | | req[ 9 - 9 ] | Mode transition | User mode<br>Select Initial Start | Transition to initial mode. | |
| | | | | Maintenance Mode<br>Select Initial Start | Transition to initial mode. | |
| | | | | Gas Select<br>Select Initial Start | Transition to initial mode. | |
| | | | | Factory mode<br>Select initial start | Transition to initial mode. | |
| | | | | Initial mode<br>Communication mode transition conditions are met. | Transition to communication mode. | |
| | | | | Initial mode<br>Approx. 40 seconds elapsed | Transition to measurement mode. | |
| | | | | Measurement mode<br>Press ENTER key | Transition to display mode. | |
| | | | | Display mode<br>Measurement mode transition conditions are met | Transition to measurement mode. | |
| req[10] | Device information messages | req[ 10 - 1 ] | Connected device visual confirmation | initial mode | All LCD cells should light up during initialization to confirm that the LCD is working properly. | |
| | | | | initial mode | All LEDs should light up during the initialization, and it should be possible to confirm that the LEDs are working properly. | |
| | | | | initial mode | The vibration motor must be able to operate during initialization to confirm that the operation is normal. | |
| | | | | initial mode | The backlight should light up during initialization to confirm that the operation is normal. | |
| | | | | initial mode | A buzzer shall operate during initialization to confirm that the operation is normal. | |
| | | req[ 10 - 2 ] | Measured gas specification informatio | initial mode | The gas name and unit of the gas to be measured shall be indicated during initialization. | |
| | | | | initial mode | Display the full scale of the gas to be measured during the initial. | |
| | | | | initial mode | The initials shall indicate the operating specifications of latching or automatic recovery. | |
| | | | | initial mode | To automatically display the settings of each alarm point of the measuring gas in the order of 1st, 2nd, 3rd, STEL and TWA(AVRG) in the initial. | |
| | | | | Display mode<br>Press the AIR key in the alarm point display screen. | To display the setting of each alarm point (1st, 2nd, 3rd, STEL and TWA(AVRG)). | |
| | | req[ 10 - 3 ] | Date and time information | initial mode | Date and time (year, month, day, hour, minute) must be displayed in initials. | |
| | | | | Measurement mode | Time (hours, minutes) shall be displayed during measurement. | |
| | | | | Display mode<br>Date and time display screen | Date and time display. | |
| | | | | Setting via communication | Ability to change the date and time. | |
| | | req[ 10 - 4 ] | Battery information | initial mode | Battery voltage display during initialization. | |
| | | | | Power ON state | Display an icon indicating the remaining battery capacity. | |
| | | req[ 10 - 5 ] | ROM/SUM value information | User mode<br>ROMSUM display screen | ROM number must be verifiable. | |
| | | | | User mode<br>ROMSUM display screen | The ROM number should be displayed in five digits. | |
| | | | | Power ON | To calculate the SUM value of the ROM area. | |
| | | | | User mode<br>During ROMSUM display screen transition | To calculate the SUM value of the ROM area. | |
| | | | | User mode<br>ROMSUM display screen | Must be able to check SUM values. | |
| | | | | User mode<br>ROMSUM display screen | SUM value should be displayed in 4 digits (HEX). | |
| | | | | User mode<br>ROMSUM display screen | During SUM value calculation, "----" should be displayed. | |
| | | | | User mode<br>ROMSUM display screen | Version number should be displayed. | |
| | | | | User mode<br>ROMSUM display screen | Version number should be displayed in five digits. | |
| | | req[ 10 - 6 ] | ID information | ID display ON<br>Initial mode | To display the user ID set during initialization. | |
| | | | | ID display ON<br>Initial mode | Display the station ID that is set during initialization. | |
| | | | | ID display OFF<br>Initial mode | Do not display the user ID/station ID. | |
| | | | | Setting via communication | ID information display should be able to be set ON/OFF. | |
| | | req[ 10 - 7 ] | A/D value information | Factory mode<br>AD value display screen | All A/D values must be visible in factory mode. | |
| req[11] | Requests from Sales | req[ 11 - 1 ] | Temperature display | Display modeDate and time temperature display screen | To display temperature in display mode. | |
| | | | | Measurement mode<br>20 minutes at 55°C environment | To issue an out-of-operating-temperature-range warning. | |
| | | | | Measurement mode<br>-25°C environment for 20 minutes | To issue an out-of-operating-temperature-range warning. | |
| | | | | Measurement mode<br>5 minutes elapsed under 25°C environment while warning out of operating temperature range is issued | Out of operating temperature range warning should be reset. | |
| | | | | Measurement mode<br>20 minutes in 55°C environment while warning out of operating temperature range is issued | In addition to the out-of-operating-temperature-range warning, a buzzer shall sound every 5 seconds. | |
| | | req[ 11 - 2 ] | Energy saving mode | Setting via communication | The ability to select an energy-saving mode that doubles the OFF time for intermittent measurement of combustible gases and extends the continuous use time. | |
| | | | | Power OFF | Energy saving mode setting ON/OFF shall be retained even when the power is turned off. | |
| | | | | Measurement mode | Display that the energy saving mode setting is ON during | |
| | | | | Energy saving mode ON<br>Measurement mode | Energy saving mode should work. | |
| | | | | Energy saving mode ON<br>Display mode | Energy saving mode should work. | |
| | | | | User mode<br>Energy saving mode ON | Energy saving mode should not work. | |
| | | | | Setting via communication | The ability to set whether the energy saving mode setting is displayed in display mode. | |
| | | req[ 11 - 3 ] | Sensor life diagnosis | Margin value display ON<br>Successful auto-calibration | At the end of calibration, the margin value of the sensor shall be displayed. | |
| | | | | Margin value display ON<br>Successful auto-calibration | The concentration value at the time of calibration, and the concentration at the sensor output MAX. | |
| | | | | Setting via communication | Ability to set the margin value display ON/OFF. | |
| | | req[ 11 - 4 ] | Stealth Mode | Setting via communication | Stealth mode without buzzer, LED, vibration motor, and backlight can be selected and set. | |
| | | | | Setting via communication | Ability to set the vibration motor ON/OFF. | |
| | | | | Stealth mode ON<br>Stealth motor ON<br>Power ON | The buzzer, LED, vibration motor, and backlight should not operate. | |
| | | | | Stealth mode ON<br>Stealth motor OFF<br>Power ON | The buzzer, LED, and backlight should not operate, and only the vibration motor should operate. | |
| | | req[ 11 - 5 ] | Combustible gas species conversion | Setting via communication | Combustible gas species must be able to be read by calibration of the calibration gas only. | |
| | | | | Display mode<br>Combustible replacement gas selection screen | Must be able to set the reading order. | |
| | | | | Combustible replacement gas: i-C4H10<br>Measurement mode | While reading, the name of the gas to be read shall be displayed. | |
| | | | | Confirm setting value after power off/on | The read-only setting shall be retained even when the power is turned off. | |
| | | req[ 11 - 6 ] | Combustible gas LEL value switching | Setting via communication | Ability to set STD/ISO/IEC. | |
| | | req[ 11 - 7 ] | Calibration record display | Calibration deadline function ON<br>Display mode<br>Calibration record display screen | Be able to check the record of calibration date and time. | |
| | | | | Calibration deadline function OFF<br>Display mode | No record of the calibration date and time can be verified. | |
| | | req[ 11 - 8 ] | BUMP record display | BUMP deadline function ON<br>Display mode<br>BUMP record display screen | Be able to check the record of BUMP date and time. | |
| | | | | BUMP deadline function OFF<br>Display mode | Unable to check the BUMP date and time record. | |
| | | req[ 11 - 9 ] | Alarm point reset setting | Factory Mode<br>Factory reset setting screen | Able to record alarm points for alarm point reset function. | |

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| | | | | User mode<br>Alarm point setting screen | The alarm point can be reset by the alarm point reset function. | |
| | | | | User mode<br>After resetting the alarm in the alarm point setting screen, read | The alarm point for the alarm point reset function and the current alarm point must match. | |
| | | | | User mode<br>Alarm point setting screen | Ability to reset alarm points by user. | |
| req[12] | Engineering request | req[ 12 - 1 ] | Gas test | Maintenance Mode<br>Gas test screen | Must be able to confirm that the gas is flowing and setting off the alarm. | |
| | | | | Maintenance Mode<br>Gas test screen | The alarm buzzer is so loud that it does not sound when the alarm is triggered. | |
| | | req[ 12 - 2 ] | Date of sensor/pump/battery replacement | Maintenance mode<br>Replacement date and time record screen | The date and time of sensor replacement cannot be attached to the main unit, so it must be recorded in the main unit. | |
| | | | | Maintenance mode<br>Replacement date and time record screen | Since the date and time of pump replacement cannot be attached to the main unit, it must be recorded in the main unit. | |
| | | | | Maintenance mode<br>Replacement date and time record screen | Since the date and time of battery replacement cannot be attached to the main unit, it must be recorded in the main unit. | |
| | | | | Maintenance mode<br>Replacement date and time record screen | Record the current date and time when the record is executed. | |
| | | | | Maintenance mode<br>Replacement date and time record screen | Date and time should be able to be recorded for each sensor. | |
| | | | | Maintenance mode<br>Replacement date display screen | The date and time of replacement must be available on the product itself. | |
| req[13] | Microcomputer | req[ 13 - 1 ] | IO port | Power ON | Be consistent with the IO map. | |
| | | req[ 13 - 2 ] | ROM | Calculate the SUM value from the created mot file and set it as the pre-calculated SUM value. | No ROM failure after startup. | |
| | | | | Create a mot file with different ROM numbers and calculate the SUM value. | Even if the ROM number in the program is changed, the SUM value should not change. | |
| | | req[ 13 - 3 ] | RAM | Check RAM after power on and every 24 hours | Check the RAM area used after the power is turned on and every 24 hours.<br>(MainMCU:0x0000E900~0x0000E907,0x00000004~0x00006000,0x0000EB00~0x0000FFFF,SensorMCU:0x000FE700~0x000FE705,0x000FF780~0x000FFF00) | |
| | | | | Check RAM memory when checking RAM | Write 0x55 and 0xAA to the used RAM area and check in bit units.<br>(MainMCU:0x0000E900~0x0000E907,0x00000004~0x00006000,0x0000EB00~0x0000FFFF,SensorMCU:0x000FE700~0x000FE705,0x000FE780~0x000FFE00) | |
| | | | | bit error occurred | Show special status | |
| | | | | All bits are normal | Do not Show special status | |
| | | | | Turn on the power and shift to the measurement mode | Finish the check before transitioning to measurement mode | |
| | | req[ 13 - 4 ] | Timer | Checking the screen | LCD is updated every 250msec (Confirmation of normal operation of timer). | |
| | | req[ 13 - 5 ] | PWM | Arbitrary buzzer sound generation | A buzzer sound should be generated (confirming normal PWM operation). | |
| | | req[ 13 - 6 ] | A/D converter | Power ON | The A/D converter must operate at a reference voltage of 2.8V. | |
| | | | | 0V input | The AD value should be 0 V. | |
| | | | | 1.4V input | The AD value should be 1.4V. | |
| | | | | 2.8V input | The AD value should be 2.8V. | |
| | | req[ 13 - 7 ] | UART | Power ON | The communication settings with the sensor MCU are<br>Baud rate: 38400bps<br>Data length: 8 bits<br>Parity: None<br>Stop bit: 1 | |
| | | | | Power ON | The communication settings with the USB module are<br>Baud rate: 115200bps<br>Data length: 8 bits<br>Parity: Even<br>Stop bit: 1 | |
| | | | | Connect the sensor MCU and start | Must be able to send and receive data from the sensor MCU. | |
| | | | | Execute communication with PC. | Must be able to send and receive data from the USB module. | |
| | | req[ 13 - 8 ] | SPI | Power ON | The communication settings with the non-volatile memory are<br>Baud rate: 3686.4 kbps<br>MSB first<br>SPI mode 0 | |
| | | | | Read after changing the setting value. | Must be able to send and receive data from FRAM. | |
| | | | | Read after writing logger data | Able to send and receive data with serial FLASH. | |
| | | req[ 13 - 9 ] | I2C | Power ON | The communication settings with LCD/RTC are<br>Baud rate: 400kbps<br>MCU side master | |
| | | | | Initial mode<br>Date and time display | Must be able to send and receive data from the RTC. | |
| | | | | Power ON | Must be able to send and receive data from LCD. | |
| | | req[ 13 - 10 ] | WDT | Power ON | The WDT settings are<br>Clock division ratio: IWDTCLK/128<br>Frequency: 0.117kHz<br>Timeout cycle: 512<br>Timeout period: 4369.067msec | |
| | | | | Power ON | WDT resets should not occur due to normal use. | |
| | | req[ 13 - 11 ] | Data processing | Power ON | Must be able to process the data required by each function. | |
| | | req[ 13 - 12 ] | Setting processing | Power ON | Microcontroller settings must be as per the IO map. | |
| | | req[ 13 - 13 ] | MCU power supply voltage monitoring | Lower the power supply voltage of the MCU<br>(MainMCU:2.39V,SensorMCU:2.49V) | Show special status | |
| | | | | The power supply voltage of the MCU is normal<br>(MainMCU: 2.80V, SensorMCU:2.80V) | Do not Show special status | |
| | | req[ 13 - 14 ] | DAC | Power ON | Voltage of 2.0V should be output from the DAC. | |
| req[14] | Microcomputer connection device | req[ 14 - 1 ] | FRAM | Memory read after default | Must be able to read FRAM. | |
| | | | | default | Must be able to write FRAM. | |
| | | | | Check the SUM value of FRAM. | The SUM value of addresses 0x0100 to 0x0AFF must match the calculated value (equipment setting value). | |
| | | | | Check the SUM value of FRAM. | The SUM value of addresses 0x0B00 to 0x14FF must match the calculated value (equipment setting value). | |
| | | | | Check the SUM value of FRAM. | The SUM value of addresses 0x4100 to 0x4AFF must match the calculated value (equipment setting value). | |
| | | | | Check the SUM value of FRAM. | The SUM values for addresses 0x4B00 to 0x54FF must match the calculated values (equipment setting values). | |
| | | | | Check the SUM value of FRAM. | The SUM values for addresses 0x1500 to 0x1EFF must match the calculated values (factory default). | |
| | | | | Check the SUM value of FRAM. | The SUM values for addresses 0x1F00 to 0x28FF must match the calculated values (factory default). | |
| | | | | Check the SUM value of FRAM. | The SUM values for addresses 0x5500 to 0x5EFF must match the calculated values (factory default). | |
| | | | | Check the SUM value of FRAM. | The SUM values for addresses 0x5F00 to 0x68FF must match the calculated values (factory default). | |
| | | | | Check the SUM value of FRAM. | The SUM value of addresses 0x3400 to 0x34FF must match the calculated value (alarm point for reset). | |
| | | | | Check the SUM value of FRAM. | The SUM value of addresses 0x3500 to 0x35FF must match the calculated value (alarm point for reset). | |
| | | | | Check the SUM value of FRAM. | The SUM value of addresses 0x7400 to 0x74FF must match the calculated value (alarm point for reset). | |
| | | | | Check the SUM value of FRAM. | The SUM value of addresses 0x7500 to 0x75FF must match the calculated value (alarm point for reset). | |
| | | | | Check the SUM value of FRAM. | The SUM value of addresses 0x3600 to 0x36FF must match the calculated value (lunch break). | |
| | | | | Check the SUM value of FRAM. | The SUM value of addresses 0x3700 to 0x37FF must match the calculated value (lunch break). | |
| | | | | Check the SUM value of FRAM. | The SUM value of addresses 0x7600 to 0x76FF must match the calculated value (lunch break). | |
| | | | | Check the SUM value of FRAM. | The SUM value of addresses 0x7700 to 0x77FF must match the calculated value (lunch break). | |
| | | req[ 14 - 2 ] | FLASH | Memory read after default | Must be able to read FLASH. | |
| | | | | default | Must be able to write FLASH. | |
| | | req[ 14 - 3 ] | RTC | Power ON | RTC settings must be made as per HW001. | |
| | | | | Date and time setting request via communication | Ability to input date and time. | |
| | | | | Date and time read request via communication | Must be able to output date and time. | |
| | | req[ 14 - 4 ] | USB | Power ON | The USB module must be configured as described in HW001. | |
| | | | | Communication with PC | Must be able to transmit data. | |

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| | | | | Communication with PC | Must be able to receive data. | |
| | | req[ 14 - 5 ] | LCD | Power ON | LCD driver settings must be made as described in HW001. | |
| | | | | Power ON | Ability to create display data. | |
| | | | | Power ON | Display data transmission must be possible. | |
| | | req[ 14 - 6 ] | LED | Measurement mode<br>Trigger an arbitrary alarm | Must be able to turn on/off the lamp. | |
| | | req[ 14 - 7 ] | Light | Display mode<br>Execute the light ON/OFF operation. | Must be able to turn on/off the light. | |
| | | req[ 14 - 8 ] | Buzzer | Measurement mode<br>Trigger an arbitrary alarm | The buzzer sound should change depending on the frequency setting. | |
| | | req[ 14 - 9 ] | Vibration motor | Power ON | ON/OFF operation. | |
| | | | | Power ON | Motor must run temporarily and then stop (motor ON/OFF must be controllable). | |
| | | req[ 14 - 10 ] | Button | Measurement mode<br>Press any key | To monitor the ON/OFF status of the key (IO port) every 10 msec. | |
| | | req[ 14 - 11 ] | Thermistor | Display mode<br>Temperature display screen | Ability to calculate temperature of thermistor output. | |
| | | req[ 14 - 12 ] | Pump | Power ON | Must be able to turn on pump. | |
| | | | | Measurement mode<br>Clog the gas flow passage. | Must be able to turn off pump. | |
| | | | | Pump off menu ON<br>Display mode<br>Enter pump OFF menu | Must be able to turn off pump. | |
| | | req[ 14 - 13 ] | Pressure sensor | Factory mode<br>Pressure sensor output confirmation screen | Ability to obtain sensor output for pressure. | |
| | | req[ 14 - 14 ] | Hall IC | Power off state<br>Place a magnet near the Hall IC | The power supply is activated and the system transitions to the communication mode (SDM mode). | |
| | | | | Power ON state<br>Place a magnet near the Hall IC | Nothing should happen (ignore the input of the Hall IC while the power is on). | |
| | | req[ 14 - 15 ] | NC (combustible) sensor | Factory mode<br>NC sensor output confirmation screen | Ability to obtain sensor output for combustible gases. | |
| | | req[ 14 - 16 ] | EC (oxygen,toxicity) sensor | Factory mode<br>EC sensor output confirmation screen | Ability to obtain sensor output for oxygen and toxic gases. | |
| | | req[ 14 - 17 ] | Lithium rechargeable battery | Insert the lithium rechargeable battery and turn on the power<br>Initial mode<br>Battery voltage display screen | Ability to obtain battery voltage of lithium rechargeable batteries. | |