

**Critical Environment Technologies
Canada Inc.**

www.critical-environment.com

**Installation Manual for
AST-IS17
Infrared CO2 transmitter
Wall & Duct mount Versions**



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AST-IS17

Are infrared Carbon Dioxide (CO₂) sensor/transmitters used to measure indoor air carbon dioxide concentration and temperature. It is a very flexible controller with programmable outputs for both relay and linear control of eg. Mixed air dampers, humidifiers and fans. The measured values are indicated on the display.

The linear output functions are pre-programmed for different ventilation strategies for stand-alone control. The units can alternatively be connected to common VAV (Variable Air Volume) controllers or DDC (Direct Digital Control). All functions can be modified from a pc with the communication cable P/N A232-05-07.

Functional Description

The following describes the function of the standard configuration of a AST-IS17. Please note that the four outputs may completely or partially have other functions. These functions may be programmed before or after installation.

OUT-1, OUT-2, and OUT-3 are pre-programmed alternative outputs for demand controlled ventilation. OUT-4 is intended for connection to a heat activator, if requested.

OUT-1 = Control signal of demand of coolness and air quality (with reduced flow by extreme cold)

OUT-2 = control signal of demand air quality

OUT-3 = ON/OFF of demand of air quality

OUT-4 = control signal of heat demand

Set Point Values of temperature (air cooling and heating) and air quality (CO₂) can be adjusted individually by the unit's maintenance push-buttons. The different functions with associated outputs are seen in figures 2 to 7. When a set point value is changed the control curves of that parameter are parallel displaced! OUT-1 controls both air quality and temperature but temperature overrules so if the temperature sinks below the LIMIT value the air supply is cut down. Two different gain alternatives can be used in the temperature/cooling feed-back loop. In alternative-1 the P-band is 1-degree and in alternative-2 the P-band is 2-degrees (see figure-2). Temperature compensation of the demand control is done for temperatures below LIMIT value (see figure-4).

The standard configuration of the AST-IS17, with it's settings, is typical in many VAV applications. Even other control parameters can be programmed with the UIP software. There is a number of different regulator blocks available.

6 programmable P-bands (linear functions) with associated set points, 2 additional general purpose P-bands, plus 1 times function regulator controller by the DI1-terminal. In addition, the different regulator outputs may be mixed together using 3 multiplexer (4:1) blocks. To each of the 4 outputs 4 of the available functions can be addressed so that the sum, or the largest value is transformed to an output signal. The OUT-1 and OUT-2 outputs can be limited within defined MIN and MAX values. These MIN and MAX values can be set/updated from the push-button menu under operation.

Cooling demand with set point:

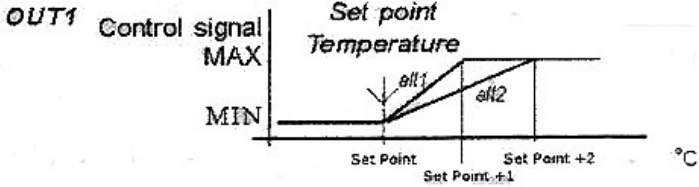


Figure 2. The control signal of the cooling demand with set point

Air demand with set point:

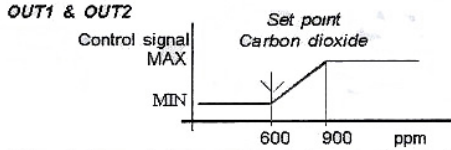


Figure 3. The control signal of the air demand with set point

Temperature compensation of demand control:

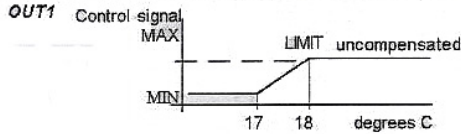


Figure 4. The control signal of the temperature compensation with LIMIT = set point -5 °C

Heating demand with dead zone to set point:

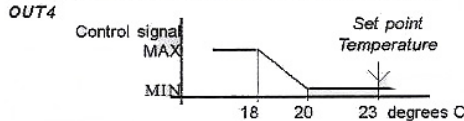


Figure 5. The control signal of heating demand with -3 °C dead zone to the set point

Forced ventilation With delayed effect:

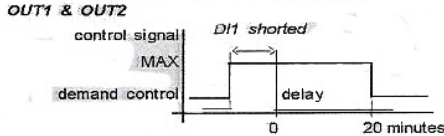


Figure 6. The control signal of forced ventilation with delay timer

Air demand (ON/OFF) with set point:

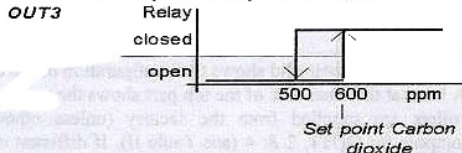


Figure 7. The control signal of air demand with set point

Terminal	Standard configuration	Standard settings*	Standard function	Configuration of this sensor	Settings of this sensor
OUT1	0-10VDC	600-900 ppm CO ₂ 23-24 °C Cut off 18-17 °C	Air control alt 1		
OUT2	0-10VDC	600-900 ppm CO ₂	Air control alt 2		
Relay	Closed Open	>600 ppm CO ₂ < 500 ppm CO ₂	Air control alt 3		
OUT4	0-10 VDC	20-18 °C	Heat control		

Table I. Default configuration of **AST-IS17**

Function description in details with all parameter settings is in a separate document.

Formulas for calculation of output values

Configuration	Output Range	Formula for calculation
0-10 VDC	0-2000 ppm CO ₂ 0-50 °C	CO ₂ value = Volt/10*2000 Temperature value in °C = Volt/10*50
2-10 VDC	0-2000 ppm CO ₂ 0-50 °C	CO ₂ value = (Volt -2)/8*2000 Temperature value in °C = (Volt -2)/8*50
4-20 mA	0-2000 ppm CO ₂ 0-50 °C	CO ₂ value = (mA-4)*2000/16 Temperature value in °C = (mA-4)*50/16
a-b	c-d	Value = (reading-a)/(b-a)*(d-c)+c a = lowest value of the configuration b = highest value of the configuration c = lowest value of the range d = highest value of the range

Table II. Calculation of CO₂ value and temperature value for **AST-IS17**

OUTPUT CONFIGURATIONS

A label on the inner side of the sensor lid shows the configuration of the outputs at the time of product delivery. A label at the inner side of the top part shows the terminal and jumpers. The sensors/controllers are supplied from the factory (unless otherwise ordered) with 4-20 mA linear outputs for OUT-1, OUT-2 and OUT-4 (see Table-II). If different output configurations are needed for the application, there have to be reconfigured before the unit is powered up. Each jumper selection is independent from the others. Default values are 0-10V and 0-20 mA. Alternative measuring ranges and other start point can be selected in the PC software.

Jumper	Position	Function
Jumper for selection of P-band cool range	alt1	Jumper top position provides 1°C as P-band cool range
	alt2	Jumper bottom position provides 2°C as P-band cool range.
OUT1	Current	Connection in position "Current" provides 0/4-20mA output range for OUT1.
	Voltage	Connection in position "Voltage" provides 0/2-10VDC output range for OUT1.
OUT2	Current	Connection in position "Current" provides 0/4-20mA output range for OUT2.
	Voltage	Connection in position "Voltage" provides 0/2-10VDC output range for OUT2.
OUT4	Voltage	Connection in position "Voltage" provides 0-10VDC for OUT4.
	Open collector	Connection in position "Open collector" provides an open collector output. Max 0,5A, 55VDC / 40VAC (half-wave rectifier).

Table II. Configuration jumpers for **AST-IS17**

PUSH-BUTTON OPERATION for AST-IS17



Figure-8 The sensor with push-buttons



Figure-9 The push-button MENU is pushed

PUSH-BUTTON OPERATION for AST-IS17



Figure-10 The push-button MENU is pushed



Figure-11 The ENTER command is done by pushing buttons MENU and ESC at the same time for about 14-seconds

DISPLAY MODES

In DISPLAY MODE the DEFAULT operation is that the sensor alternates between temperature and carbon dioxide readings presentation. The push-button MENU (+) is used to select the indicated value on the display to be the error code or the set points of temperature and CO2. After power up the display will always return to the Default display mode. If a permanent change of default values is requested the PC software is to be used. Reference Table-III on next page.

Function Line	Display	Time limit	Function description
0	Temperature / CO ₂	no	DEFAULT - Normal operation
1	Exxx	yes	Error code. If no error has been detected the code E0 is shown. The error code is reset with Entr(+).
2	Present temperature and CO ₂ set points	no	Toggle between display of temperature and CO ₂ set point with MENU(+).

Table III. On the display without entering the maintenance menu

MAINTENANCE LEVEL

A number of execution options are available from the MAINTENANCE MENU (see Table IV). This level is accessed only from the display mode in the **set points of temperature and CO₂** selection. A two-button push and access code restricts access, intended for competent trained service personnel only. The Entr(+/-) command is done by pushing MENU and ESC at the same time (hold down for about 10-seconds). The access code has eight binary digits; one press at MENU(+) equals "1" and one press at ESC(-) equals "0". The code value can be changed for your personal choice from the software UIP 4.0 The menu diagram in detail is shown in the appendix.

Always use the ESC button to return to the DEFAULT mode. Several pushes of the ESC button may be required to reach the DEFAULT mode. The Entr(+/-) push (MENU & ESC) eventually leads to execution of functions, which causes temporary or permanent change of any parameter that affects the system outputs.

Function Line	Display	Time limit	Function description
3	ECxx	yes	Access code to the service menu The default value of the code is 255 (=11111111, that is eight presses on MENU(+)). Press down MENU(+) and let it scroll until it stops. The last two digits of the code are shown. Then ENTER to accept the selected code.
4a	SPt	yes	For setting the temperature set point .
4b	The present temperature set point	yes	For increase / decrease of the temperature set point . The set point is increased by stepping with MENU(+) button. Decreasing is done by stepping with the ESC(-) button.

5a	SPc	yes	For setting the set point of the CO₂ concentration
5b	The present CO ₂ set point	yes	For increase / decrease of the CO₂-concentration set point The set point is increased by stepping with MENU(+) button. Decreasing is done by stepping with the ESC(-) button.
6a	AOUt	yes	First step of adjusting the analogue outputs MAX and MIN values
6b	An xx	no	Select analogue output by stepping with MENU(+) button
6c1	SetL	no	Leads to adjustment of the MIN value.
6d1	The present MIN value in % of FS	no	Increase the MIN value by stepping with the MENU(+) button. Decrease by stepping with the ESC(-) button. The output is set to the MIN value and can be checked with a multimeter.
6e1	Sure	no	The adjustment is saved by pressing Entr(+). Press ESC to return without saving.
6c2	SetH	no	Leads to adjustment of the MAX value
6d2	The present MAX value in % of FS	no	Increase MAX value by stepping with the MENU(+) button. Decrease by stepping with the ESC(-) button. The output is set to the MAX value and can be checked with a multimeter.
6e2	Sure	no	The adjustment is saved by pressing Entr(+). Press ESC to return without saving.
7	CALb	yes	Background calibration = CO₂-sensor calibration with fresh air. An easy way to correct the zero point error. The sensor needs fresh air (380-420 ppm CO ₂). The calibration must be confirmed by pressing Entr(+).
7a	Sure	yes	Confirm that a background calibration shall be done.
8	CAL	yes	Zero point calibration of the CO ₂ sensor. The sensor needs zero gas. See the zero point calibration instruction. The calibration must be confirmed by pressing Entr(+).
8a	Sure	yes	Confirm that a zero point calibration shall be done.

Table-IV. Maintenance functions available on the AST-IS17 to set output limits. Time limit refers to an internal time-out that returns the LCD and maintenance function back to normal. ENTER is a simultaneous pressing on MENU and ESC.

PLEASE NOTE!! If a power failure occurs when the sensor has OUT1 to OUT-4 locked to min/max limits, then the sensor will have this output locked when the power returns. It is necessary to enter this menu item and release the output manually.

EXAMPLE-1

Setting the MAX value of the analog outputs

The access code is time limited. If the time limit is exceeded the sensor returns to DEFAULT.

ENTER = MENU(+) and ESC(-) are pushed simultaneously.

1. At the start of the setting the sensor is DEFAULT.
2. Push MENU(+) once to reach the error code. The display indicates E + the error code number. No error is shown as E000.
3. Push MENU(+) once. The display shows the temperature set point eg. 20.
4. Push ENTR(+/-) once. The display shows EC and two digits. Enter the access code to the service menu. If the default code is used, do this; Push MENU(+) until the digits stop. The display shows EC55. If the correct code is not entered before the time limit is exceeded the sensor returns to DEFAULT.
5. Push ENTR(+/-) once. The display shows "SP t" to set the temperature set point.
6. Push MENU(+) once to reach the reach the carbon dioxide set point. The display shows "SP C".
7. Push MENU(+) once to reach the setting of analog outputs. The display shows "AOUT".
8. Push ENTR(+/-) to reach the output to be set. The display shows "An" and two digits eg. "AN 01". Step to the desired output by pushing MENU(+).
9. Push ENTR(+/-) to reach the setting of the MIN value. The display shows "Set L".
10. Push ENTR(+/-) to reach the setting of the MAX value. The display shows "Set H".

Push ENTR(+/-) to set the MAX value of the output. The display shows the numerical value in % eg. the standard setting 100.0% or previously set value. Push MENU(+) to increase the MAX value. Push ESC(-) to decrease the MAX value. Push ENTR(+/-). The display shows "Sure". Push ENTR(+/-) to save the setting and return to Set H. Push MENU(+) or ESC(-) to return to Set H without saving the new setting. Push ESC(-) to return to the output to be set, item-12. Push ESC(-) once again to return to the setting of analog outputs item-11.

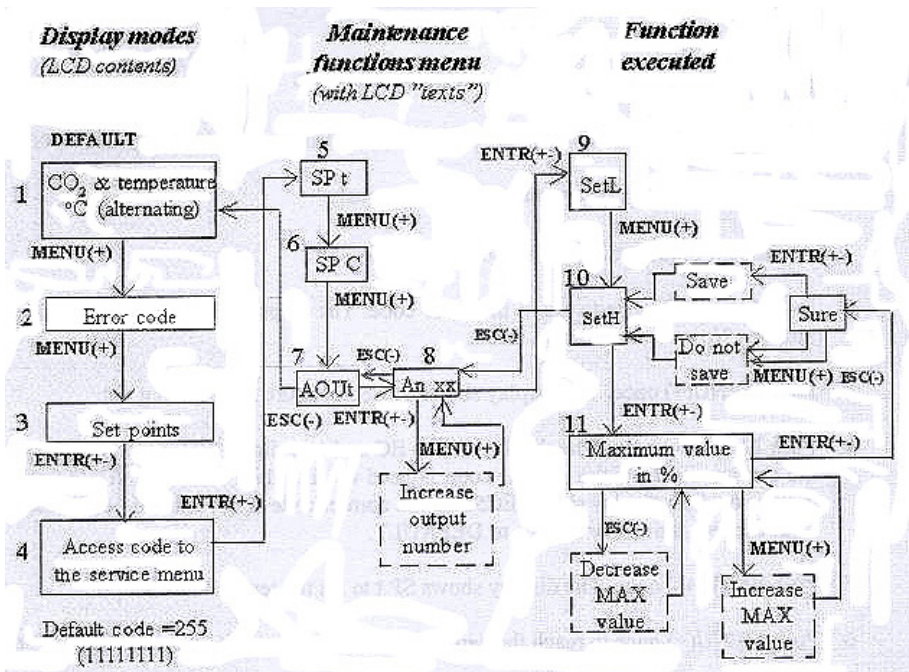


Figure-12 Maintenance functions available on AST-IS17 to set output limits. Only flow chart for setting High limits are shown but Low limit are set in the very same way. Function blocks that are time limited are indicated by blue borders. Time limits refers to an internal time-out that returns the LCD and maintenance function back to normal. ENTER is a simultaneous pressing of MENU & ESC.

Example-II

Setting Temperature set point.

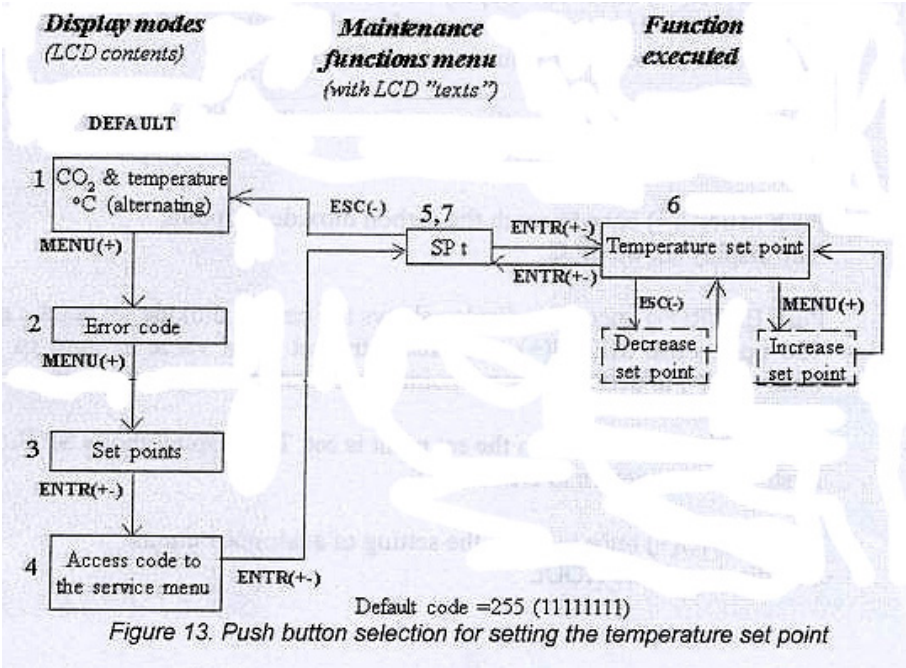
The access code and the recalibration of the sensor are time limited. If the time limit is exceeded the sensor returns to DEFAULT.

ENTER = MENU(+) and ESC(-) pushed simultaneously.

1. At the start of the setting the sensor is in DEFAULT.
2. Push MENU(+) once to reach the error code. The display shows “E” plus the error code number. No error is shown as “E000”.
3. Push MENU(+) once. The display shows the temperature Set point eg. “20”.
4. Push ENTR(+/-) once. The display shows “EC” and two digits. Enter the access code to the service menu. If the default code is used, do this: Push MENU(+) until the digits stop. The display shows “EC55”. If the correct code is not entered before the time limit is exceeded the sensor returns to DEFAULT.
5. Push ENTR(+/-) once. The display shows “SP t” to set the temperature set point.

6. Push ENTR(+/-) once. The display shows the temperature set point eg. "20.0C". Push MENU(+) to increase or ESC(-) to decrease the set point value in steps of 0.2c.

Leave the unit, which returns to DEFAULT after a delay or push ENTR(+/-) once when the set point value is set. The display shows "SP t". Push ESC(-) to return to DEFAULT.



EXAMPLE-III

Setting temperature & CO2 concentration set points, MAX & MIN values for the analog outputs & calibration of the sensor

The access code and the recalibration of the sensor are time limited. If the time limit is exceeded the sensor returns to DEFAULT.

ENTER = MENU(+) and ESC(-) pushed simultaneously

1. At the start of the setting the sensor is in DEFAULT.
2. Push MENU(+) once to reach the error code. The display shows "E" plus the error code number. No error code is shown as "E000". Push ESC(-) to return to DEFAULT if desired.
3. Push MENU(+) once. The display shows the temperature set point eg. "20.0C". And the CO2 set point eg. "750 ppm". Push ESC(-) to return to DEFAULT if desired.
4. Push ENTR(+/-) once. The display shows "EC" and two digits. Enter the access code to the service menu. If the default code is used, do this: Push MENU(+) until the digits stop. The display shows "EC55". If the correct code is not entered before the time limit is exceeded the sensor returns to DEFAULT.

EXAMPLE-III

5. Push ENTR(+/-) once. The display shows "SP t" to set the temperature set point.
6. Push ENTR(+/-) once. The display shows the temperature set point eg. "20.0C". Push MENU(+) to increase or ESC(-) to decrease the set point value in steps of 0.2C.
7. Push ENTR(+/-) once when the set point value is set. The display shows "SP t". Push ESC(-) to return to DEFAULT.
8. Push MENU(+) once to reach the CO2 set point. The display shows "SP C".
9. Push ENTR(+/-) once. The display shows the CO2 set point eg. "750 ppm". Push MENU(+) to increase or ESC(-) to decrease the set point value in steps of 50 ppm.
10. Push ENTR(+/-) once when the set point value is set. The display shows "SP C". Push ESC(-) to return to DEFAULT.
11. Push MENU(+) once to reach the setting of analog outputs. The display shows "AOut".
12. Push ENTR(+/-) to reach the output to be set. The display shows "An" and two digits eg. "An 01". Step to the required output by pushing MENU(+).
13. Push ENTR(+/-) to reach the setting for the MIN value. The display shows "Set L".
14. Push ENTR(+/-) to set the MIN value of the output. The display shows the numerical value in % eg. the standard setting 0.0% or the previously set value. Push MENU(+) to increase or ESC(-) to decrease the MIN value. Push ENTR(+/-). The display shows "Sure". Push ENTR(+/-) to save the setting and return to "Set L". Push MENU(+) or ESC (-) to return to "Set L" without saving the new setting.
15. Push MENU(+) to reach the setting of the MAX value. The display shows "Set H".
16. Push ENTR(+/-) to set the MAX value of the output. The display shows the numerical value in % eg. the standard setting 0.0% or the previously set value. Push MENU(+) to increase or ESC(-) to decrease the MAX value. Push ENTR(+/-). The display shows "Sure". Push ENTR(+/-) to save the setting and return to "Set L". Push MENU(+) or ESC (-) to return to "Set L" without saving the new setting.
17. Push MENU(+) to reach the calibration with fresh air. The sensor needs fresh air, air with 400 ppm CO2. The display shows "CALb". Push ENTR(+/-). The display shows "Sure". Push ENTR(+/-) to confirm that a background calibration should be done. After completing background calibration the sensor returns to DEFAULT. If a background calibration should not be exceeded push MENU(+) or ESC(-). The background calibration has a time limit.
18. Push MENU(+) to reach the zero point calibration. The sensor needs CO2 free air or 100% Nitrogen (N2) gas. The displays shows "CAL". Push ENTR(+/-). The display shows "Sure". Push ENTR(+/-) to confirm that a zero point calibration should be done. After completed zero point calibration the sensor returns to DEFAULT. If a zero point calibration should not be executed push MENU(+) or ESC(-). The zero point calibration has a time limit.

FUNCTIONAL TEST of CO2 / Temperature Sensors for AST-IS17

Functional Test: The unit has two LEDs, yellow and red, on the front panel found under the hinged front cover for the wall mount version. The same LEDs can be found on the circuit board under the lift off cover for the duct version. These LEDs indicate the status of the controller.

WALL MOUNT VERSION



HINGED FRONT COVER LEDs (yellow & red)

DUCT MOUNT VERSION



LIFT OFF FRONT COVER



FRONT COVER REMOVED

Yellow LED - "Call for maintenance" is lit, if an error flag is set or the measurement is out of range. This information is also shown on the display as a "wrench" icon. Any push-button press or executed maintenance function is acknowledged by emission from this LED.

Red LED - "Relay active" is lit when the relay is activated (contact closed).

A simple visual function test can be easily performed. Take a breath and exhale the air over the sensor from a distance of a few centimeters. The sensor will detect a rapid increase in CO2 concentration. The red LED is lit when CO2 goes above the preset value. If sensor is connected to a controller the flow of the ventilation system will eventually increase.

Gas verification. If a sensor is to be verified, a test gas with known concentration of CO2 in N2 must be used. Zero calibration requires 100% N2. Check value on display to verify.

Gas verification. This is for sensors with measuring ranges between 0-3000 ppm and 0-4% volume. When a zero calibration is to be performed a plastic tube with 2.2 mm OD and 0.8 mm ID shall be inserted in the marked holes of the sensor. Reference drawing below. Connect plastic tubing to the tube and flow gas between 0.3 and 1/0 LPM (liters per minute).

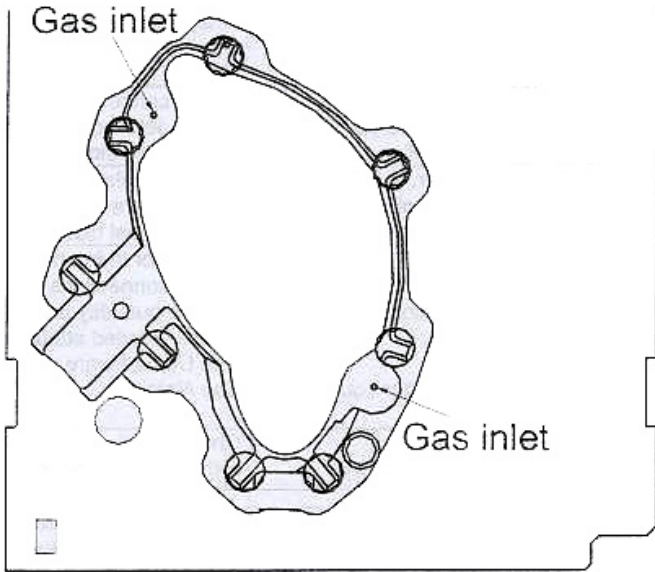


Figure 14. Part of the PCB with holes for gas inlets marked.

Self Diagnostics. The system contains a complete self diagnostics procedure. A full system test is executed automatically every time the power is turned on. For the AST-IS17 the internal voltage regulators and outputs are checked. In addition, constantly during operation, the sensor probes are checked against failure by checking the valid dynamic measurement ranges. These different system checks return error bytes to the system RAM. If any error is detected the yellow LED will be lit until the error has vanished and the error flag is reset. "Warm up" and "Out of Range" are the only bits that are reset automatically after return to normal state. All other error bits have to be reset manually after return to normal state, either by pushing MENU & ESC buttons simultaneously for (=Entr(+)-) or by power off and restart.

By depressing the push-button "MENU" the error code number "Exxx" is shown on the LCD. Descriptions of the different codes are listed on the following page.

Error code and action plan

Bit #	Error code	Error description	Suggested action
0	N/A	Fatal Error Yellow LED continuously flashes. Push buttons are not operating.	Try to restart sensor by power OFF/ON. Contact local distributor
1	2	Reserved	
2	4	Algorithm Error. Indicate wrong EEPROM configuration.	Try to restart sensor by power OFF/ON. Check detailed settings and configuration with UIP software version 4.3 and higher. Contact local distributor
3	8	Output Error Detected errors during output signals calculation and generation.	Check connections and loads of outputs. Check detailed status of outputs with UIP software version 4.3 and higher.
4	16	Self Diagnostic Error. May indicate the need of zero calibration or sensor replacement.	Check detailed self diagnostic status with UIP software version 4.3 and higher. Contact local distributor
5	32	Out Of Range Error Accompanies most of other errors. Can also indicate overload or failures of sensors and inputs. Resets automatically after source of error disappearance.	Try sensor in fresh air. Check connections of temperature and relative humidity probe. Check detailed status of measurements with UIP software version 4.3 and higher. <i>See Note 1!</i>
6	64	Memory Error Non fatal error during memory operations.	Check detailed settings and configuration with UIP software version 4.3 and higher.
7	128	Warm Up state Is always set after power up or power failure. Resets after restart sequence	If it doesn't disappear in half a minute, check power stability.

Note-1: Any probe is out of range. Occurs, for instance, during over exposure of the CO2 sensor. In this case the error code will automatically reset when the measurement values return to normal. It could also indicate the need for a zero calibration. A background calibration using push-button function "bCAL" will solve this error (a more precise zero calibration may be performed later if required). If the CO2 readings are normal and the error code still exists the temperature or relative humidity sensors can be defeated or the connections to these are broken.

Remark. If several errors are detected at the same time the different error code numbers will be added together into one single error code.

Maintenance

The AST-IS17 is basically maintenance free. An internal self adjusting calibration function takes care of normal long term drift associated with the CO2 sensor. To secure the highest accuracy a time interval of five years is recommended between CO2 calibrations unless any special situations have occurred. A zero calibration can be performed by use of the push-button functions or for a complete overview use a PC with the UIP software version 4.3 or higher. This software is available upon request from CETCI. A RS-232 cable, article code Kabel RS232 A232-05-07 prod is needed and can be ordered from CETCI. The cable is connected to the UART port slide connector (figure-15). For change of control parameters and re-calibration (CO2 & temperature) this PC tool must be used. The check can be done on site without interfering with the ventilation system.

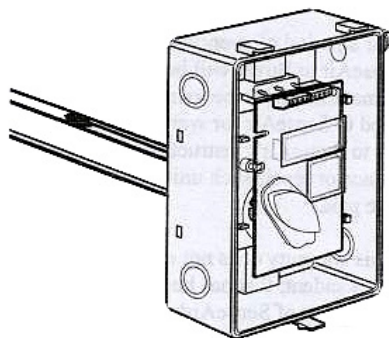


Figure 15. The AST-IS17 for duct mounting. The temperature probe is the black body in the sampling tube.

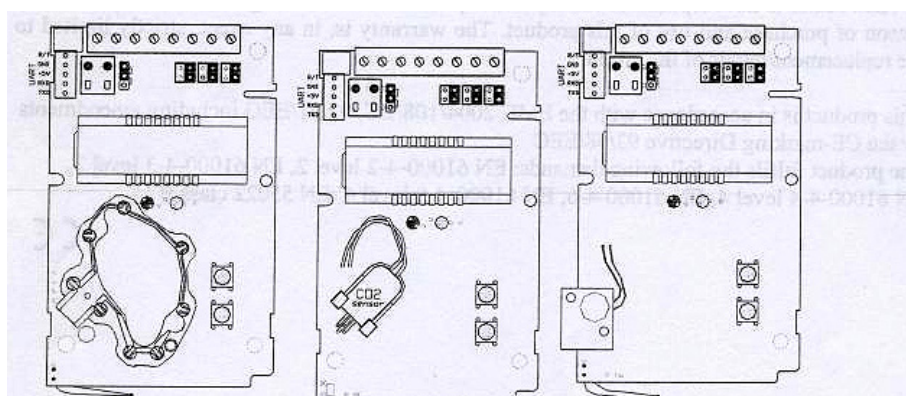


Figure 16. The AST-IS17 printed circuit board with CO₂ sensors for measuring ranges 0-3000ppm, 0-10% och 0-25%. PCBs with long temperature sensors are for duct mounting.

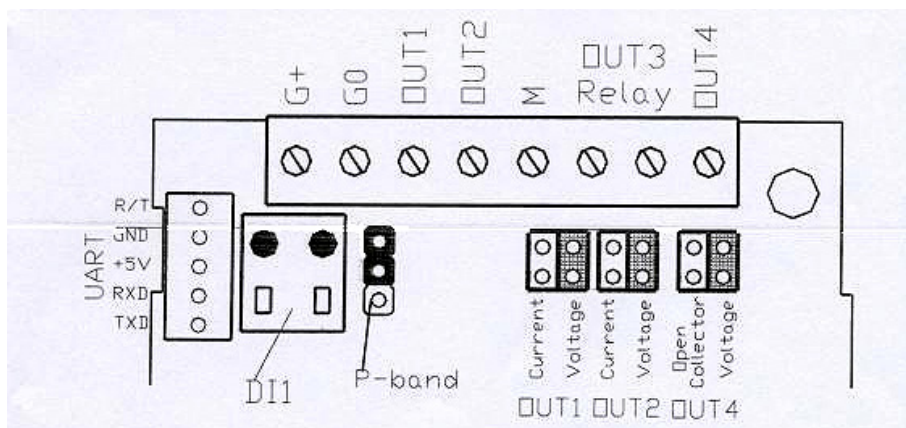


Figure 17. The connection terminal area of the AST-IS17 printed circuit board.

Warranty and Limitation of Liability

1. CETCI warrants that for a period of twenty-four (24) months following receipt by the buyer, the product supplied will be, under normal use and care, free from defects in workmanship or material and to be in material conformity with CETCI's specifications. Units returned to CETCI for warranty repairs shall be shipped to CETCI at buyer's expense and according to CETCI's instructions. Within ninety (90) days of receipt of the product, CETCI shall replace or repair such units as we see fit and shall ship them to the buyer's destination freight prepaid.

2. Warranty limitations. This warranty does not extend to any unit that has been subject to misuse, neglect or accident; that has been damaged by causes external to the unit; that has been used in violation of CETCI's instructions; that has been affixed to any no-standard accessory attachment; or that has been modified, disassembled or reassembled by anyone other than CETCI.

3. CETCI and the reseller is not responsible for any consequential loss or damages which may occur by reason of purchase and use of this product. The warranty is, in any event, strictly limited to the replacement/repair of the product.

This product is in accordance with the EMC2004/108/EC,92/31/EEG including amendments by the CE-marking Directive 93/68/EEC. The product fulfills the following demands: EN 61000-4-2 level 2, EN 61000-4-3 level 2, EN 61000-4-4 level 4, EN 61000-4-8 level 4, EN 55022 class B.