WATCHMAN

Model

SOLID STATE SENSOR ONLY

LBW-WATCHMAN-SS

Ammonia Leak Detector

Firmware 7-30

Specifications

Ammonia Detection Sensitivity	0 to 1000 PPM (RH less than 45%) 25 to 1000 PPM (RH greater than 45%)
Display	0.8", 7-segment LED, 4-digit
Controls	Mode, enter, Up, and Down pushbuttons Rotary selector switch
Ammonia Sensor	Metal oxide semiconductor 833 mW integral heater Alumina ceramic base 100 mesh SUS 316 double gauge flame arrestor
Outputs	4-20 mA DC, conforming to S50.01 ratings, Type 2L
Operating Temperature	-50°F to 125°F
Operating Humidity	5% to 95% RH, non-condensing
Power Requirements	18 to 36 VDC 0.25 Amps max.
Dimensions	4½"H x 7½" W x 4½" D
Weight	1.5 lbs.
Enclosure	NEMA 4X rated, UL listed
Pollution Degree	1

IMPORTANT—READ THIS FIRST

PLEASE READ AND UNDERSTAND THIS SECTION BEFORE INSTALLING AND OPERATING THE WATCHMAN DETECTOR

Note: This manual is specific to an LBW-WATCHMAN with a Solid State-Sensor installed, it is possible to do a field conversion to an Electrochemical Sensor. Contact Cool Air incorporated sales - sales@coolairinc.com or 763-205-0844 for more information.

CAUTION:

After applying power be sure the detector has been powered for at least 20 minutes before testing or calibrating.

Adequately cover the detector sensor during washdown and avoid spraying the washdown liquid directly onto the sensor.

Avoiding Nuisance Alarms

To avoid nuisance alarms, place the detector in service mode before:
- Performing maintenance, repairs, testing, or calibration.
- Performing maintenance on nearby compressor systems.
- Performing refrigeration system maintenance.
- Washing down the area.
- Removing the ammonia sensor.

Furthermore, be sure of the following before placing the detector in normal operating mode:
- The ammonia concentration reading is below the Low alarm set point.

INTRODUCTION

The Cool Air Incorporated WATCHMAN is a 24VDC powered ultramodern ammonia leak detector that detects and displays ammonia concentrations of 0 to 1000 parts per million (PPM). It comes equipped with a solid-state, long-life ammonia sensor that has a quick and accurate response to ammonia concentrations or 0 to 500 parts per million (PPM) (electro-chemical sensor).

The WATCHMAN requires a DC supply voltage between 18- and 36-volts DC.

The WATCHMAN is configured to supply power to the 4-20 mA circuit(s).   Refer to **4–20 mA Analog Outputs** for more details**.**

STANDARD FEATURES

The WATCHMAN comes with these added standard features:

- Programmable Lo-Alarm and Hi-Alarm set points (for use with Cool Air Incorporated Digital Central Supervisory Alarm Panel, Local mount alarm light and horn, or remote alarm light and horn).
- 4-20 mA analog output signals, for ammonia level which can communicate directly with computer systems such as PLC's.
- Selectable PPM reading start (0PPM, 10PPM, or 25PPM)
- The detector hardware and the connected system response can be tested without exposing the sensor to ammonia
- Selectable Service Mode timeout.
- A NEMA 4X, UL-listed enclosure.

AVAILABLE OPTIONS

- A remote ammonia sensor with cable allowing the sensor to be located a maximum of 500 feet away from the detector
- Door Monitor
- External Service Mode Switch, Local or Remote, Keyed, or not keyed.

- An ABS wash-down tube installed over the sensor so that it does not get wet during washdown A remote alarm light and horn box with or without a toggle switch to TEST/NORMAL/SILENCE the alarm

- A local mount alarm light and horn box with or without a toggle switch to TEST/NORMAL/SILENCE the alarm
- RLV connection, for monitoring Relief Line vents
- AC Power Supply (mounted externally by the customer)

PARTS DESCRIPTION

Front Panel Display

The front panel display is made up of a digital display. The seven-segment, four-digit display shows a variety of information, such as ammonia concentration and more, depending on the position of the rotary selector switch. Ammonia concentration is displayed in parts per million.

Ammonia Sensor

The detector comes with a solid-state, long-life sensor that has a high sensitivity to amine compounds and a quick response to concentrations of ammonia. The sensor is protected by a flame arrestor and has an integral heater and a ceramic base that is resistant to harsh environments. Around the sensor is an adaptor that allows you to screw the Ammonia test bottle on during bump test and calibration

Panel-Mounted Circuit Board

The panel-mounted circuit board contains the controls necessary for programming and operating the detector. Each control is described in detail below.

The "MODE" Pushbutton

The detector can be set to one of four modes: normal operating mode or program mode, service mode or program and service mode. The detector is in normal operating mode when the "program" and "service" LEDs are off. The detector will be in program mode when the "program" LED is on. The detector will be in service mode when the "service LED is on. When both the "program" and "service" LEDs are on the detector is in both program mode and service mode. When the detector is in the service mode only, the display will alternate between the sensor reading in PPM and "SEr" (service mode indication). This is done as a reminder to return the detector to normal mode. When in "PORGRAM and SERVICE" mode "Ser" will not flash on the display.

The "ENTER", "UP", and "DOWN" Pushbuttons
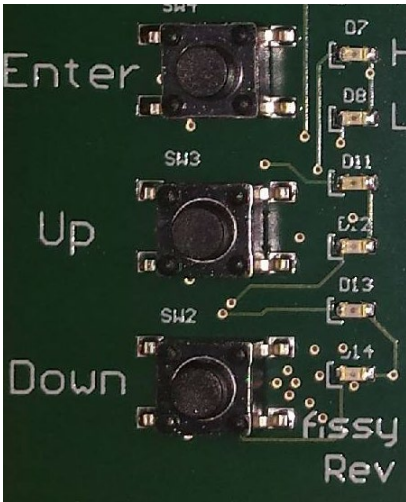
The "UP" and "DOWN" buttons are used for setting the digital display to the desired value, and the "ENTER" button is used for programming a value previously set on the digital display. These buttons are used when programming: the set points and other optional settings and during calibration of the detector.

Rotary Selector Switch

The rotary selector switch (labeled "MENU SELECT" on the panel-mounted circuit board) is used for performing functions such as:

- Setting the information displayed on the front panel
- Programming set points
- Displaying system information
- Calibrating the detector

When the detector is in operation, this switch is typically set to position "0" to continuously display the ammonia concentration.

Use the following chart to select the switch position for the desired function:

To:	Set the Rotary Selector Switch to:	See Page #
Display ammonia concentration in PPM	0	-
Display ammonia concentration in PPM	1	-
Display the firmware revision	2	-
Program the ammonia High alarm set point	3	14
Program the ammonia Low alarm set point	4	14
Display ammonia concentration in PPM (See Section Testing your system)	5	18
Factory Use	6	-
Factory Use	7	-
Factory use	8	-
Factory Use	9	-

Note: If the rotary selector switch is left in a position other than "0" without pushing an "UP" or "DOWN" button for more than 5 minutes, the digital display will begin to display ammonia concentration. If this happens, return the selector switch to the "0" position, then set the switch to the desired position. For example, if you set the rotary selector switch to position "3" to program the alarm set point, and if, after 5 minutes of inactivity the display reverts to displaying ammonia concentration. Move the switch to "0", then back to "3" to continue programming the alarm set point.

Caution: Before closing the detector enclosure, be sure to return the rotary selector switch to position "0" to correctly display ammonia concentration.

Added functions are available through the rotary selector switch when the detector is in program mode (program LED on).

To:	Set the Rotary Selector Switch to:	SEE PAGE #
Display ammonia sensor temperature (Solid State Sensor Only)	1	-
Zero adjust for the Electrochemical sensor (Electrochemical Sensor Only)	2	-
Program the ammonia sensor 4 – 20mA Range	3	15
Set the Service Mode Time out	4	16
Program the ammonia Hi-Alarm output S1 for fail safe mode	5	15
Program the ammonia LO-Alarm output S2 for fail safe mode	6	15
Set the Display start value. 0PPM, 10PPM, or 25PPM	7	14
Select for Solid State Sensor or Electrochemical Sensor	8	-
Calibrate the detector	9	19

Power

Power for the WATCHMAN must be a DC voltage between 18 and 36 volts with a current rating of at least 0.25 amps at 24 volts. Power is connected to terminal block TB1. "I+" for +DC Volts and "GndI" ground DC Volts.

4–20 mA Analog Outputs

The detector has a 4-20 mA analog output that allow it to communicate with external devices such as computers, PLCs, and digital displays. The output conforms to ISA S50.01 ratings, Type 2L.

The ammonia level detector output current (TB1, "S" terminal on lower left of Enclosure Mounted Circuit Board) is proportional to ammonia PPM dependent on the range.   The PPM value can be figured out using one of the following formulas:

|	
PPM = 62.5 (I – 4)	0 to 1000 PPM Range
PPM = 50 (I – 4)	0 to 800 PPM Range
PPM = 31.25 (I – 4)	0 to 500 PPM Range
PPM = 25 (I – 4)	0 to 1000 PPM Range
PPM = 15.67 (I – 4)	0 to 250 PPM Range
PPM = 6.25 (I – 4)	0 to 100 PPM Range

Where PPM equals ammonia concentration in parts per million and I equal the output current in mA.
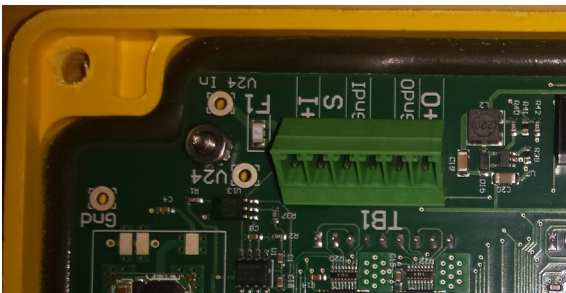
Wiring the LBW-WATCHMAN:

For the WATCHMAN, the 4-20 mA output is a simple series circuit that includes the detector, a 24 VDC power supply, and the receiving device. It is recommended that a 24 VDC, low-noise power supply be used for this application, although power supplies providing a minimum of 18 VDC to a maximum 36 VDC can be used. The voltage drop across the detector and the receiver together must not exceed the power supply voltage. This circuit is shown in Figure 1 below:

Wiring power and the 4 to 20mA output to the Watchman
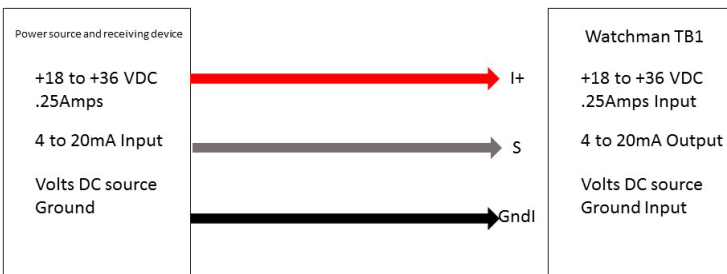
For the WATCHMAN maximum allowable resistance in the receiving device must not exceed Rmax using this formula:

$$Rmax = 50 (Vs - 7.5)$$

where Vs is the supply voltage in volts DC for the 4-20 mA circuit. For example, with a supply voltage of 24 VDC, the maximum allowable resistance is 825 Ω. The maximum allowable resistance includes the cable resistance.

INSTALLATION AND SETUP

Caution: Do not apply power to the detector until instructed to do so.

The detector should be mounted in a location where ammonia leaks are most likely to occur, such as near valve groups, compressors, and refrigeration coils. Be sure the detector is visible and easily accessible. Avoid locating the detector where it might be damaged during wash-down or forklift traffic.

The detector is set at the factory to operate on 24VDC when power is applied to the detector, it may immediately display an unusually large ammonia

concentration. This is normal. When the sensor warms to normal operating temperature (usually about a minute) the detector will return normal status. The detector is calibrated and programmed at the factory. To program the detector for its specific installation, follow these steps in the order given:

1. Apply power to the detector and allow the sensor to warm to normal operating temperature (at normal operating temperature, the display will read "0").
2. Program the ammonia Lo-Alarm and Hi-Alarm set points. See the next section on programming the ammonia Lo-Alarm and Hi-Alarm set points.
3. Program the "Service Mode Timeout" See the next section on setting the "Service Mode Timeout".
4. Set the detector to the desired operating display mode. See the next section on setting the display mode.
5. Program the 4 to 20mA range. See the section on setting the 4 to 20mA range.
6. Test the detector to ensure it is operating correctly (but allow at least 20 minutes after power is first applied to the detector before testing with ammonia). See the section on testing the detector.

PROGRAMMING AND OPERATION

The WATCHMAN detector is easy to program and operate. Follow the instructions in this section to:

- Set the desired display mode
- Program the ammonia alarm set points (for use with CAI DSAP)
- Program the desired 4 to 20mA range.
- Program the desired Service Mode Timeout

Setting the Desired Display Mode

1. Open the detector enclosure and place the detector in program mode (program LED on).
2. Set the rotary selector switch to position "7".
3. Press the "UP" or "DOWN" button until the desired start point displayed.
   a. d0 – Display shows all readings above 0PPM
   b. d10 - Display shows all readings above 10PPM
   c. d25 – Display shows all readings above 25PPM

4. Press and hold the "ENTER" button for at least 2 seconds. The new set point is now programmed.
5. Return the rotary selector switch to the position "0".
Be sure the ammonia concentration reading is below the Lo-Alarm set point (if in use), then place the detector in normal operating mode and close the detector enclosure.

Programming the Hi-Alarm and Lo-Alarm Set Points (when needed)

The ammonia Hi-Alarm set point can be programmed from 25 to 1000 PPM and Lo-Alarm set point can be programmed from 5 to 900 PPM. To program the set points, follow these steps:

1. Open the detector enclosure and place the detector in service mode. (optional)
2. Set the rotary selector switch to position "3" (to program the ammonia Hi-Alarm set point) or "4" (to program the ammonia Lo-Alarm set point).
3. Press the "UP" or "DOWN" button until the desired set point concentration in PPM is displayed.
4. Press and hold the "ENTER" button for at least 2 seconds. The new set point is now programmed.
5. Return the rotary selector switch to the position "0".
6. **Be sure the ammonia concentration reading is below the Lo-Alarm set point (if in use), then place the detector in normal operating mode and close the detector enclosure.**

Programming the Hi-Alarm and Lo-Alarm outputs (when needed) fail safe mode

Fails safe = outputs always on and go off with alarm condition
Normal = outputs always off on go on with alarm condition

7. The ammonia Hi-Alarm open collector output (S1) can be programmed for fail safe mode (default) or normal mode and Lo-Alarm set open collector output (S2) can be programmed for fail safe mode (default) or normal mode. To program the outputs, follow these steps:

   1. Open the detector enclosure and place the detector in program mode and optional service mode.
   2. Set the rotary selector switch to position "5" (to program the ammonia Hi-Alarm output S1) or "6" (to program the ammonia Lo-Alarm output S2).
   3. Press the "UP" or "DOWN" button to display "YES" for fail safe mode or "NO" for normal mode
   4. Press and hold the "ENTER" button for at least 2 seconds. The new set point is now programmed.
   5. Return the rotary selector switch to the position "0".
   6. **Be sure the ammonia concentration reading is below the Lo-Alarm set point (if in use), then place the detector in normal operating mode and close the detector enclosure.**

Programming the ammonia level 4-20 mA range

The ammonia level 4-20 mA signal can be scaled to one of six ranges, either 0-100 PPM, 0-250 PPM, 0-400 PPM, 0-500 PPM, 0-800 PPM or 0-1000 PPM. The 0-250 PPM range is preferred for most applications since the accuracy, resolution and stability of the PPM value indicated by the 4-20 mA signal is better than on higher ranges and this range is compatible with external equipment like the Cool Air DCSAP. Use the other ranges if there is reason to measure ammonia concentrations other than 250 PPM. To program the 4-20 mA range, follow these steps:

1. Open the detector enclosure and place the detector in program mode. Optionally you can place the detector in Program and Service Mode.
2. Set the rotary selector switch to position "3". The display will indicate the current range, either "r100", "r250", "r400", "r500", "r800", or "r1E3" (1000 PPM range).
3. Press the "UP" or "DOWN" button until the display indicates the desired range.
4. Press and hold the "ENTER" button for at least 2 seconds. The new range is now programmed.
5. Return the rotary selector switch to position "0".
6. Return the detector to normal operating mode and close the detector enclosure.

Programming the service mode timeout

When the Watchman is placed in Service Mode" it will disable the Lo-Alarm and Hi Alarm outputs used with the CAI DCSAP and send the 4 to 20mA signal to near 4mA or 0ppm. This allows maintenance, testing or calibration to be carried out without activating event responses. When in service mode the display will alternate between "Ser" and the PPM reading. The LBW-Watchman will remain is service mode for a period as set by the "Service Mode Timeout". Once this time has expired or "timed out" the Watchman will return to its normal operating mode.

1. Open the detector enclosure and place the detector in program mode.
2. Set the rotary selector switch to position "4". The display will show the current service mode time out "1Hr" = 1 hour, "2Hr" = 2 hours, "4Hr" = 4 hours, or "8Hr" = 8 hours.
3. Press the "UP" or "DOWN" button until the display shows the desired service mode timeout.
4. Press and hold the "ENTER" button for at least 2 seconds. The new service mode timeout is now programmed.
5. Return the rotary selector switch to position "0".
Return the detector to normal operating mode and close the detector enclosure.

Error Codes

In the event of a detector error, one of these error codes will be displayed on the front panel digital display:

Error Code	Description
Err1	Zero or low ammonia sensor heater current Sensor Defective (NH3-S-RPL) Sensor not plugged in all the way Sensor cable became unplugged Defective Sensor Socket Assembly (LBW-WATCHMAN-SSH) Defective Control display board (LBW-WATCHMAN-CDB)
Err3	High or low ammonia sensor resistance Sensor Defective (NH3-S-RPL) Sensor not plugged in all the way Sensor cable became unplugged Defective Sensor Socket Assembly (LBW-WATCHMAN-SSH) Defective Control display board (LBW-WATCHMAN-CDB)
Err4	Ammonia sensor temperature sensor fault Sensor Defective (NH3-S-RPL) Sensor not plugged in all the way Sensor cable became unplugged Defective Sensor Socket Assembly (LBW-WATCHMAN-SSH) Defective Control display board (LBW-WATCHMAN-CDB)

Contact Cool Air Incorporated technical support if any one of these error codes is displayed.

Message Codes

If the detector is in service mode, the display message shows:

Message Code	Description
SEr	Service switch "on"

This is a reminder to return the detector to normal operating mode.

4-20 mA Error Indication

Any error condition will cause the ammonia level 4-20 mA signal to go below zero showing a fault.

TEST AND CALIBRATION

Be sure to follow all codes and company procedures that pertain to the maintenance, repair, testing, and calibration of all safety equipment, including this detector. At a minimum, the detector must be tested after installation and at least once a month in critical areas and once a quarter in non-critical areas thereafter to ensure it is operating correctly. Also, the detector must be calibrated at least once a year to ensure it is detecting and displaying ammonia concentration accurately.

At the time of calibration, you must use a new test bottle of ammonia that can be bought from Cool Air Inc. or their distributors.

The detector is initially calibrated and programmed at the factory. However, if a new ammonia sensor is installed, the detector must be recalibrated.

All tests and calibrations must be recorded on a suitable log sheet.

Testing the Detector

The detector hardware and the connected system response can be tested without exposing the sensor to ammonia. Rotate the rotary switch to position 5. Pressing the "DOWN" button will force the detector to simulate an ammonia concentration equal to the LOW Alarm Set Point. Pressing the "UP" button will force the detector to simulate an ammonia concentration equal to the HI Alarm Set Point. The 4 to 20mA output current will indicate the simulated ammonia concentration according to the 4 to 20mA range selected.

To test the detectors response to ammonia (for best results, allow at least 20 minutes after first applying power to the detector):

1. Open the detector enclosure and place the detector in service mode, if needed. This step deactivates the Lo-Alarm, Alarm, and Hi-Alarm outputs. In some applications, if alarming is required, leave the detector in normal operating mode.
2. Screw a sample bottle of ammonia over the sensor.
3. Check the following:

- Digital display shows an increasing concentration of ammonia in PPM.
- 4-20 mA output signal shows an increasing value that corresponds to the digital display.
4. Remove the ammonia sample.
5. **If the detector was placed in service mode wait until the ammonia concentration reading is 0ppm**, then return the detector to normal operating mode position and close the detector enclosure. Testing is now complete.

Calibrating the Detector

Follow these instructions to calibrate the detector:

1. Open the detector enclosure and place the detector in program mode if needed the detector can be placed in program and service mode. This step deactivates the Lo-alarm and Hi-alarm outputs and sets the 4 to 20mA output to 4mA or 0ppm.
2. Take a sample bottle of known ammonia concentration and wipe clean the inside and outside surface of its neck. Screw the bottle over the sensor wait until a stable ammonia concentration reading is displayed or 90 seconds, whichever occurs first.
3. Set the rotary selector switch to position "9".
   Press the "UP" or "DOWN" button until the display indicates as near as possible the concentration of the known sample. For example, if the sample ammonia concentration is 100 PPM, press the "UP" or "DOWN" button until the display indicates 100 PPM.
4. Press and hold the "ENTER: button for at least 2 seconds.
5. Remove the sample bottle.
6. **Wait until the ammonia concentration reading returns to 0ppm**, then set the rotary selector switch to position "0" and return the detector to normal operating mode. Calibration Complete

Testing and maintenance supplies;

- 0 to 1000 PPM Solid State Sensor P/N NH3-S-RPL
- Ammonia 100 PPM Calibration Test bottle P/N TB-XXX
  Where XXX = test standard i.e., P/N TB-100 is 100PPM
- Sensor Cable Assembly P/N LBW-WATCHMAN-SC

TECHNICAL SUPPORT

For technical support, contact Cool Air Incorporated using any of these methods:

Contact:	Technical Support
Phone:	(763) 205-0844 (USA)
Fax:	(763) 432-9295 (USA)
E-mail:	info@coolairinc.com
Web site:	www.coolairinc.com
Address:	Cool Air Incorporated
	1544 134th Ave NE
	Ham Lake, MN 55304
	USA

WARRANTY

36-Month Limited Warranty & Limitation of Liability

1. Limited Warranty

    Cool Air incorporated (CAI) warrants to the original purchaser and/or ultimate customer ("Purchaser") of CAI ammonia leak detector ("Product") that if any part thereof proves to be defective in material or workmanship within thirty-six (36) months from the date of shipment, such defective part will be repaired or replaced, free of charge, at CAI's discretion if shipped prepaid to CAI at 1544 134th Avenue NE, Ham Lake, MN 55304, in a package equal to or in the original package. Before making the return shipment, contact CAI @ 763-205-00844 to request an RMA # to be prominently displayed on the returned package. The product shall be returned freight prepaid and repaired or replaced if it is determined by CAI that the part(s) failed due to defective materials or workmanship. The repair or replacement of any such defective part shall be CAI's sole and exclusive responsibility under this limited warranty.

2. Inclusions:

    A. As of September 2, 2014, the defined Product that is covered by this thirty-six (36) month limited warranty is the LBW-50, LBW-420, LBW-420-1, LBW-RLV, LBW-WATCHMAN, and DCSAP.
    B. If an ammonia gas sensor is part of the Product, the ammonia gas sensor is covered by the same thirty-six (36) month limited warranty offered by CAI.
    C. In order for this thirty-six (36) month limited warranty to be fully effective, the Purchaser shall be responsible for following the manufacturer's recommended monthly bump testing in critical areas, every 3-months bump testing in non-critical areas, and annual or twelve (12) month calibration service, which shall include proof of recordkeeping for testing and calibration by the Purchaser.

3. Exclusions:

A. If an ammonia gas sensor is covered by this thirty-six (36) month limited warranty, the ammonia gas sensor shall be subject to inspection by CAI for abuse, misuse, negligence, damage by accident, abnormal conditions of operation, handling or use by the Purchaser. Should such inspection indicate that the ammonia sensor has prematurely failed due to abuse, misuse, negligence, or damage by accident or abnormal conditions of operation, handling or use by the Purchaser, this limited warranty shall not apply to the ammonia gas sensor.

B. This thirty-six (36) month limited warranty does not cover consumable items such as back-up batteries or ammonia test bottles.

4. Warranty Limitation, Inclusions, & Exclusions:

Cool Air Incorporated shall have no further obligation under this limited warranty. All warranty obligations of Cool Air Incorporated are extinguishable if the Product has been subject to abuse, misuse, negligence, or damage by accident or abnormal conditions of operation, handling or use by the Purchaser or if the Purchaser fails to perform any duties set forth in this limited warranty or if the Product has not been operated in accordance with the instructions, or if the Product serial number has been removed or altered.

Disclaimer of Unstated Warranties

THE WARRANTY PRINTED ABOVE IS THE ONLY WARRANTY APPLICABLE TO THIS PURCHASE. ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED

Limitation of Liability

IT IS UNDERSTOOD AND AGREED THAT COOL AIR INCORPORATED'S LIABILITY, WHETHER IN CONTRACT, IN TORT, UNDER ANY WARRANTY, IN NEGLIGENCE OR OTHERWISE SHALL NOT EXCEED THE AMOUNT OF THE PURCHASE PRICE PAID BY THE PURCHASER FOR THE PRODUCT AND UNDER NO CIRCUMSTANCES SHALL COOL AIR INCORPORATED BE LIABLE FOR SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES. THE PRICE STATED FOR THE PRODUCT IS A CONSIDERATION LIMITING COOL AIR INCORPORATEDS' LIABILITY. NO ACTION, REGARDLESS OF FORM, ARISING OUT OF THE TRANSACTIONS UNDER THIS WARRANTY MAY BE BROUGHT BY THE PURCHASER MORE THAN FIVE YEARS AFTER CAUSE OF ACTIONS HAS OCCURRED.

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