SIEMENS

Controller Start-up for LRC Electronic Application 2453

Dual Duct VAV/CV with BTU Compensation

TEC 0909.11

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Before You Begin

At the job site, locate the major control system and the mechanical and electrical drawings. These components include dampers, motors, and any other components working in conjunction with the LRC.

Verify that the Laboratory Controller Module (LCM) input/output (I/O) points are wired per the installation instructions.

NOTES: Update each controller at the field panel immediately after you have completed the controller start-up procedures and made all other changes to the controller's point database, including balancing, tuning, etc.

See the *Manufacturer's Installed Controls* (MIC) web page on iKnow (http://iknow.us.abatos.com/mic/) for specific manufacturers' information.

Verifying Power

1. Verify that the controller has 24 Vac power and that the fuse has been inserted into the trunk or that power to the transformer is ON. See *Figure 1*.
2. Verify that the Basic Sanity Test (BST) LED flashes once per second. See *Figure 2*.

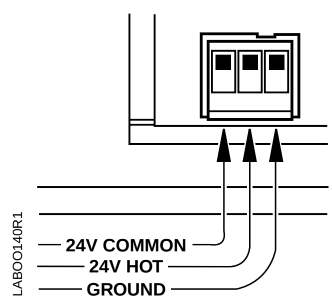


Figure 1. Power Trunk Connection.

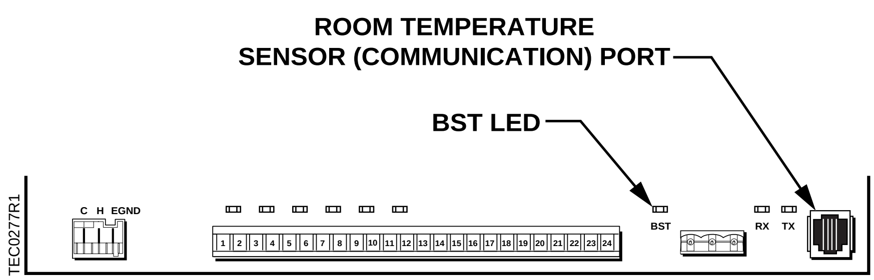


Figure 2. LRC Board Showing Location of BST LED and RTS Port.

Setting APPLICATION and CTLR Address

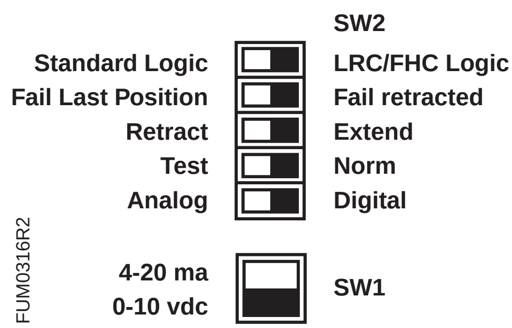
1. Plug the MMI into the Room Temperature Sensor port and verify that Application 2472 (Slave Mode) is running. See *Figure 2*.

2. Set APPLICATION (Point 2) to **2453.**

3. Set CTLR ADDRESS (Point 1) to the correct value obtained from the controller schedule. Each controller must have a unique address. Normal values are **00** to **31**, but the controller will accept values as high as 98.

Cold Deck and General Exhaust Dampers

1. Make sure the switch settings for SW2 on the AO-E module(s) are set correctly. See Figure 3.



Note: Switch selections are shown in black.
Whenever the Analog/Digital switch on SW2 is set to Digital, SW1 is ignored.

Figure 3. Switch Settings for the AO-E Module.

2. Select the direction of the cold deck damper actuator according to the specification. Set CLG DMPR DIR (Point 62) to **NCLOSED** (default) if the damper is normally closed (closed when the actuator is retracted). If the damper is normally open, set the point to **NOPEN**.

3. Check the operation of the cold deck damper. Start with the cold deck damper fully retracted (that is, its normal position). Turn off DO2 and turn on DO1. Verify that the cold deck damper goes from its fully retracted position to its fully extended position in 3 seconds or less. Turn off DO1 and turn on DO2. Verify that the cold deck damper goes from its fully extended position to its fully retracted position in 3 seconds or less.

4. Release DOs 1 and 2.

5. Select the direction of the general exhaust damper according to the specification. If the general exhaust damper is normally open (open when the actuator is retracted), then set GEX DMPR DIR (Point 59) to **NOPEN** (default). If the damper is normally closed, set the point to **NCLOSED**.

6. Check the operation of the general exhaust damper. Start with the general exhaust damper in its fully retracted position (that is, its normal position). Turn off DO4 and turn on DO3. Verify that the general exhaust damper goes from its fully retracted position to its fully extended position in 3 seconds or less. Turn off DO3 and turn on DO4. Verify that the general exhaust damper goes from its fully extended position to its fully retracted position in 3 seconds or less.

7. Release DOs 3 and 4.

Hot Deck Damper

1. Find the value of HD DMPR AO1 (Point 48) that closes the hot deck damper by commanding HD DMPR AO1 and observing the motion of the damper actuator. Set HD DMP CLOSE (Point 57) to this voltage value.

2. Find the value of HD DMPR AO1 that opens the hot deck damper all the way. Set HD DMP OPEN (Point 58) to this voltage value.

3. Release HD DMPR AO1.

4. Verify operation of the hot deck damper. Override HD DMPR CMD (Point 49) to **0%** and verify that the damper closes. Set HD DMPR CMD to **100%** and verify that the hot deck damper opens. Release HD DMPR CMD.

VOLUME MODE (Point 9)

Set VOLUME MODE (Point 65) to VAV or CV as appropriate. In VAV mode, TEMP CTL VOL (Point 9) varies the cooling volume to meet cooling demand; in CV mode, TEMP CTL VOL is not used.

MIN and MAX Airflow Setpoints

NOTE: Airflow readings are most accurate when duct velocity is at least 300 FPM. Minimum values should be set up with this in mind.

The equation relating airflow to air velocity is as follows:

Airflow (CFM) = Velocity (FPM) × Duct Area (sq. ft.) × Flow Coefficient.

Therefore, for best results: Airflow ÷ (Duct Area × Flow Coefficient) should be $\geq$ 300.

For example:

UOC TOT MIN (Point 72) ÷ (TOTDUCT AREA (Point 97) × TOT FLO COEF (Point 36)) $\geq$ 300.

1. Using values from the job specification(s), enter the minimum and maximum flow limits for occupied and unoccupied conditions in each air terminal. Enter values for the following points:

*OCC TOT MIN (Point 32)	OCC TOT MAX (Point 31)
OCC GEX MIN (Point 34)	OCC GEX MAX (Point 33)
UOC GEX MIN (Point 68)	UOC GEX MAX (Point 67)
*UOC TOT MIN (Point 72)	UOC TOT MAX (Point 71)

*See note for OCC TOT MIN and UOC TOT MIN below

If no unoccupied mode is specified, set the UOC values equal to the OCC values.

2. Set CLG MIN (Point 47) to the desired value.

NOTES: CLG MIN should be set high enough so that the air velocity in the cooling duct is high enough to be read reliably (at least 300 FPM). However, CLG MIN can be set to **0** CFM if desired. If CLG MIN is set to zero, CLG FLO CHK (Point 66) must be set to YES. This allows the LRC to shut the cooling duct damper when the air velocity in the cooling duct becomes so low that the airflow sensor in the cooling duct cannot read reliably. Once shut, the cooling duct damper will not reopen again until TOT FLO STPT (Point 93) is large enough that the air velocity in the cooling duct will be high enough for the airflow sensor in the cooling duct to read reliably.

OCC TOT MIN / UOC TOT MIN – For CV applications, UOC TOT MIN should be set to the CFM desired from the total supply box during unoccupied mode, and OCC TOT MIN should be set to the CFM desired during the occupied mode. (Make sure the max values (OCC TOT MAX and UOC TOT MAX) are set ≥ to the corresponding min values of OCC TOT MIN and UOC TOT MIN.

Setting the Duct Areas

1. At the Duct menu, enter the applicable duct shape of the exhaust duct.
2. Enter the exhaust duct dimensions.
3. At the Duct Dimensions menu, enter the applicable duct shape of the total duct of the dual duct box.
4. Enter the total duct dimensions.
5. Enter the cooling duct's area directly into CLGDUCT AREA (Point 8). (There is no menu selection for the cooling duct.)

NOTE: When entering the LCTLR point for an LRC at the field panel, **do not** enter a duct area. (Choose **N** for none when prompted for the duct shape.) This controller does not send the value of air volume to the field panel in velocity (FPM). Instead, it uses volume (CFM) so a conversion is not necessary.

Setting Flow Coefficients

NOTE: Air sensor(s) **must** be calibrated before determining the flow coefficient(s).

1. Calibrate the sensor connected to AI4 according to the manufacturer's instructions (if necessary).
2. Set CLG FLO COEF (Point 7) to the starting value 0.70.
3. Work with a balancer to measure air volume through the cold duct and compare this value to CLG AIR VOL (Point 10).
4. Fine-tune the flow coefficient using the formula:

   New Flow Coefficient = (Actual Volume ÷ Controller Volume) × Old Flow Coefficient

NOTE: The *Actual Volume* is the value obtained from the balancer's measurements. The *Controller Volume* is the value obtained from CLG AIR VOL (Point 10). If the controller volume is not within 2% of the actual volume, repeat the procedure until it is. Loose or kinked flow sensor tubes, tubing connected backwards, and improper actuator and/or valve operation can cause inaccurate readings.

5. Calibrate the supply and exhaust air sensors by setting CAL AIR (Point 94) to **YES** and waiting for it to switch back to **NO** on its own.
6. Set TOT FLO COEF (Point 36) and GEX FLO COEF (Point 54) to the starting value 0.70.
7. Use an air balancer to measure air volume through the total dual duct supply duct and the general exhaust duct. Compare respective values to TOT AIR VOL (Point 35) and GEX AIR VOL (Point 30) and fine-tune the flow coefficients using the formula:

   New Flow Coefficient = (Actual Volume ÷ Controller Volume) × Old Flow Coefficient

NOTE: The *Actual Volume* is the value obtained from the balancer's measurements. The *Controller Volume* is the value obtained from TOT AIR VOL (Point 35) and GEX AIR VOL (Point 30). If the controller volume is not within 2% of the actual volume, repeat the procedure until it is. Loose or kinked flow sensor tubes, tubing connected backwards, and improper actuator and/or valve operation can cause inaccurate readings.

CAUTION:

It is extremely important that flow readings are accurate and that controller volumes are within 2% of actual volumes.

Fume Hood Maximum CFM

Set MAX HOOD VOL (Point 52) to the flow corresponding to 10 volts from the input signal source. If there is more than one fume hood in the room, the signals must be averaged using a Fume Hood Flow Module (FFM).

If using an FFM: Set MAX HOOD VOL to **A02 RANGE x Number of Hoods**. The A02 RANGE point in the FHC must be set to the same value in each FHC (maximum of four fume hoods per LRC). If there is more than one fume hood in the room, the value of AO2 RANGE for each fume hood must be set to the same value that is the highest max value. For example, if one fume hood is 700 CFM and the second is 1200 CFM, the AO2 RANGE point in each FHC must be set to 1200 CFM, while MAX HOOD VOL in the LRC would be set to 2400 CFM.

NOTE: If no fume hood(s) input will be connected to AI3, make sure MAX HOOD VOL = 0 (default). This disables the alarm feature that would otherwise occur if the LRC were connected to a fume hood and the fume hood flow input dropped below 1 Vdc.

Automatic Calibration Option

To set CAL SETUP (Point 95), select the automatic calibration option value that best meets the job's requirements from Table 1. It is recommended that option **4**, the factory default, be used.

At the start of the calibration cycle, the controller automatically sets CAL AIR (Point 94) to YES. When the cycle is complete, CAL AIR returns to NO automatically.

This feature calibrates the total dual duct air velocity sensor (AVS 1) and also the general exhaust air velocity sensor. This feature does not calibrate the sensor used to calculate the Cold Duct's air velocity (the one connected to AI4).

NOTE: The general exhaust and the total dual duct air velocity sensors must be calibrated at least once every 24 hours. Also, these sensors **must** be calibrated before balancing takes place, as this will affect the balancer's results. Consult with the manufacturer of the sensor connected to AI4 as to how and how often that particular sensor needs to be calibrated.

Table 1. CAL SETUP (Point 95) Option Values.

Option Values	Description
0	Calibration occurs ONLY when CAL AIR (Point 94) is set to **YES**.
1	Calibration occurs when the field panel commands an occupied/unoccupied or a day/night mode changeover. Actual calibration is subject to a time delay of 0, 1, 2, or 3 minutes. CTLR ADDRESS (Point 1) divided by 4 determines this delay (the remainder is the time delay in minutes). **Example:** If CTLR ADDRESS = 10, then the controller waits 2 minutes (10 ÷ 4 = 2 x **R2**) after it receives the occupied/unoccupied or day/night mode changeover command before beginning the calibration routine.
2	Calibration occurs immediately after the override switch is pressed.
4 (factory default mode)	Calibration occurs on the time interval set in CAL TIMER (Point 96). For example, if CAL TIMER = 12, then the calibration period is 12 hours. Actual calibration is subject to a time delay based on the value of CTLR ADDRESS. Refer to the example in option 1. This is the recommended option when using a controller with an Autozero Module.

NOTE: Summing their numbers can combine Options. For example, to calibrate as in Options 1 and 2, set CAL SETUP to **3**.

Airflow Control

Checking Range of Airflow Control

NOTE: It is very important that the minimum and maximum airflows specified can be reached. If they cannot be reached, then the fan system must be adjusted.

1. Close the Hot Deck Damper by setting HD DMPR CMD (Point 49) to 0.
2. Set TOT FLO STPT (Point 93) to either OCC TOT MIN (Point 32) or UOC TOT MIN (Point 72) (whichever is less) and verify that TOT AIR VOL (Point 35) can reach that value.
3. Set TOT FLO STPT to either OCC TOT MAX (Point 31) or UOC TOT MAX (Point 71) (whichever is greater) and verify that TOT AIR VOL can reach that value.
4. Release TOT FLO STPT and HD DMPR CMD.
5. Set GEX FLO STPT (Point 85) to either OCC GEX MIN (Point 34) or UOC GEX MIN (Point 68) (whichever is less) and verify that GEX AIR VOL (Point 30) can reach that value.
6. Set GEX FLO STPT to either OCC GEX MAX (Point 33) or UOC GEX MAX (Point 67) (whichever is greater) and verify that GEX AIR VOL can reach that value.
7. Release GEX FLO STPT.

Tuning the Flow Loops

NOTE: Prior to tuning the flow loops, set VOL DIF STPT (Point 88) to **zero.** (When finished tuning the loops, release VOL DIF STPT.)

To tune the total supply flow loop, change the flow by commanding TOT FLO STPT (Point 93) and then examine the response. If the airflow oscillates or overshoots significantly, reduce the gain. If it takes too long to reach the setpoint, increase the gain. Try different values; it should move accurately and with stability. When the desired performance is achieved, release the setpoint. Repeat this process for the general exhaust flow loop by changing GEX FLO STPT (Point 85).

Setting HD ADJUST

Be sure to set up HD ADJUST (Point 82) before moving on to the next section (*Setting-up Discharge Temperature Control*). Otherwise, discharge temperature control could be adversely affected.

Set HD ADJUST to the largest value that satisfies the following equation:

HD ADJUST $\leq$ 70 * (LOOP TIME / end to end stroke time of hot deck damper motor)

NOTES: In order to use this equation, you must first determine the end to end stroke time of the hot deck damper motor (it is not a database point).

Although using 70 instead of 100 in this equation makes the hot deck damper slower to respond to discharge temperature changes, it improves room pressurization performance.

The HD ADJUST default value of 3.2 is suitable for a LOOP TIME of 5 seconds and an end to end hot deck damper motor stroke time of between 90 and 100 seconds.

Setting HD ADJUST to 0 disables the discharge air temperature loop override feature and could cause room pressurization problems.

For more information on HD ADJUST, see *Discharge Air Temperature Loop Override* in the Application Bulletin.

Setting-up Discharge Temperature Control

If the discharge temperature limits are called out in the specification, set DISCH MIN (Point 11) and DISCH MAX (Point 14) accordingly. If they are not called out, then set the limits according to the desired HVAC system operation. For example, from 55 °F to 80 °F.

1. Set DISCH MIN a few degrees lower than the temperature supplied by the air handler. This will prevent undesired heating if there is some discrepancy between the sensor in the air handler and the one in the supply terminal.

2. Set DISCH MAX according to the heating function required. Many lab rooms do not need "heat," meaning they never need supply air to come in above the room temperature setpoint. In cases like this, where the reheat equipment will only serve to reduce the cooling effect of the supply airflow, set DISCH MAX a few degrees higher than the room temperature setpoint. Rooms with significant exposure to cold outside conditions may call for discharge temperatures significantly above the room temperature. In these rooms, DISCH MAX should be set to the warmest discharge temperature desired for the heating function—for example, 90 degrees.

3. Check the operation of the discharge temperature loop by overriding DISCH STPT (Point 3) and observing the response of DISCH TEMP (Point 80). Tune the discharge temperature loop if necessary. Overshoot is acceptable as a suggested response (even 5 to 10 degrees), but it should dampen out within 1 or 2 cycles.

4. Release DISCH STPT (Point 3).

NOTE: Advanced PID algorithms have been implemented at and near setpoint to minimize actuator repositioning.

Room Temperature Control

Set ROOM STPT (Point 13) to the desired value or set the thermostat dial. The room temperature should settle at the setpoint with very little oscillation within an hour. If it does not settle out or reach setpoint, adjust the room temperature loop gains (Points 63 and 64). See the *APOGEE Automation Service Procedures* on InfoLink for additional information on room temperature control problems.

NOTE: Advanced PID algorithms have been implemented at and near the setpoint to minimize actuator repositioning.

Flow Tracking

Under normal circumstances the application can do a better job of room pressurization if TRACK METHOD (Point 84) is set to STPT rather than FLOW. The default for TRACK METHOD is STPT and should not need to be changed during startup. The primary purpose of the FLOW value in TRACK METHOD is so the application can handle failsafe conditions, such as if the general exhaust box damper gets stuck in position.

Room Pressurization

To set up room pressurization, complete the following steps using the pressure report:

1. Set VOL DIF STPT (Point 88) according to the job specification.

NOTE: This volume difference is defined as total exhaust minus supply. This is a positive number for a room that is negatively pressurized and vice versa.

2. Set OTHER EXH (Point 89) and OTHER SUP (Point 61) using actual airflow values for any supply or exhaust equipment not connected to the LRC that will remain constant. (These values can also be updated across the network.)

If VOLUME MODE (Point 65) equals VAV, continue with step 3. If VOLUME MODE equals CV, skip to step 7.

3. Set TOT MIN (Point 77) to either OCC TOT MIN (Point 32) or UOC TOT MIN (Point 72), whichever is less.

4. Set TOT MAX (Point 76) to either OCC TOT MAX (Point 31) or UOC TOT MAX (Point 71), whichever is greater.

5. Verify pressurization in at least four airflow operating conditions. Make sure the system operates at VOL DIF STPT (Point 88) and that the room is pressurized properly. Using the following operating conditions, set TEMP CTL VOL (Point 9) equal to TOT MAX for maximum cooling and equal to TOT MIN for minimum cooling:

   - Hoods open, minimum cooling
   - Hoods closed, minimum cooling
   - Hoods open, maximum cooling
   - Hoods closed, maximum cooling

6. When all conditions have been checked, release TEMP CTL VOL, TOT MIN, and TOT MAX. Skip the remaining steps in this section and proceed to ***Alarms***.

7. Set TOT MIN (Point 77) equal to either OCC TOT MAX (Point 31) or UOC TOT MAX (Point 71) (whichever is greater). Make sure the system operates at VOL DIF STPT (Point 88) and that the room keeps correct pressure with the hood(s) opened and closed. (Setting TOT MIN equal to the greater of the two MAX values ensures the highest possible constant volume setpoint for the occupied period.)

8. Set TOT MIN (Point 77) equal to either OCC TOT MIN (Point 32) or UOC TOT MIN (Point 72) (whichever is less). Make sure the system operates at VOL DIF STPT (Point 88) and that the room keeps correct pressure with the hood(s) opened and closed. (Setting TOT MIN equal to the lesser of the two MIN values ensures the lowest possible constant volume setpoint for the unoccupied period.)

9. Once all conditions have been checked, release TOT MIN.

Alarms

Using the job specification, determine which alarms are required and set them up accordingly.

Pressurization Alarm

1. Set DIF ALM LVL (Point 38) to the specified value. If no value is specified, use 100 cfm (default). VOL DIF ALM (Point 22) is the output point that indicates an alarm condition.

2. Set DIF ALM DEL (Point 39) to the specified value. This is the delay time. If no value is specified, start with the default of 30 seconds. Adjust to eliminate nuisance alarms.

3. Set DIF ALM ENA (Point 37) to **YES** if the specification requires annunciation of the pressurization alarm through a local alarm device connected to ALARM DO6 (Point 46).

Ventilation Alarm

1. To set the ventilation alarm (VENT ALM, Point 92), set OC V ALM LVL (Point 90) to the specified alarm level for the occupied mode. It may be specified in air changes per hour; if so, convert to CFM (LPS).

   If no ventilation alarm is required, set OC V ALM LVL to **zero**.

2. To set the ventilation alarm for the unoccupied mode, set UC V ALM LVL (Point 91) to the specified value. If no unoccupied mode is specified, use the same value as OC V ALM LVL.

   If ventilation alarms are not required during unoccupied mode, set UC V ALM LVL to **zero**.

3. Set VENT ALM DEL (Point 16) to the specified value. This is the alarm delay. If no value is specified, start with the default of 30 seconds.

4. Set VENT ALM ENA (Point 17) to **YES** if the job specification requires annunciation of the ventilation alarm through a local alarm device connected to ALARM DO6.

Hardware Switch

The hardware switch is ALM SWIT DI6 (Point 27). If the specification requires the controller to pass alarms from other equipment (connected to ALM SWIT DI6) to a local alarm device via ALARM DO6, then set ALM SWIT ENA (Point 28) to **YES**.

NOTE: If DI6 will be used for some other purpose (for instance as a light switch DI to be monitored by the LRC), then set ALM SWIT ENA to **NO**. This means DI6 cannot be an alarm switch.

Network alarms

If there are other alarms to be indicated in the local ALARM DO6, they may be programmed in the field panel to operate through NET ALM CMD (Point 23). The controller requires no set-up to enable this function.

Occupancy Control

To set up occupancy control, determine the occupancy triggers required by the job specification.

- If occupancy is set according to flow through the fume hoods, do the following:

a. Set HOOD OCC VOL (Point 55) to the proper value. When the total flow through the hoods exceeds this value, the controller operates in the occupied mode. (Default for HOOD OCC VOL = 600 CFM.)

b. Set HOOD UOC VOL (Point 56) to the proper value. When the total flow through the hoods is less than this value, the controller operates in the unoccupied mode. (Default for HOOD UOC VOL = 100 CFM.)

- If the controller must set occupancy according to the state of a switch connected to OCC SWIT DI2 (Point 24), set OCC SWIT ENA (Point 18) to **YES**.
- If the controller must set occupancy according to the push button on the room thermostat, set BUTTON ENA (Point 12) to **YES**.

NOTES: The controller cannot use both OCC SWIT DI2 and the button on the thermostat. If OCC SWIT ENA is set to YES, the thermostat button is not used.

If DI2 will be used for some other purpose (for instance as a motion sensor to be monitored by the LRC), then set OCC SWIT ENA to **NO**. This means DI2 cannot be an occupancy switch.

- If there are other occupancy criteria, they may be programmed at the field panel to work through NET OCC CMD (Point 29). The controller requires no set-up to enable this function. (If network commands are not required and occupancy will be set by sources in the room, set NET OCC CMD to UNOCC. If NET OCC CMD = OCC, the controller stays in occupied mode.)

If there is no unoccupied mode specified, do the following:

1. Set BUTTON ENA (Point 12) to NO (default).
2. Set OCC SWIT ENA (Point 18) to NO (default).
3. Set HOOD OCC VOL (Point 55) to 0.

NOTE: Update each controller at the field panel immediately after you have completed the controller start-up procedures and made all other changes to the controller's point database, including balancing, tuning, etc.

The start-up is complete.