Level II and III Controller Programming and Operating Instructions

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LEVEL II and III CONTROLLER - INTRODUCTION

The Level II and III controller is pre-programmed at the factory. The Level II control mode (fixed setpoint control mode) is the pre-programmed control mode for both Level II and Level III controllers. The Level III control mode (automatic ambient tracking setpoint control mode) requires the use of an optional second sensor (sensor #2) in order to function. Also, field programming will be required to enable Level III control to operate. The following instructions outline programming and controller interface steps to modify or view program variables.

ENERGIZING THE CONTROLLER:

The controller is wired and programmed at the factory to be energized when power is supplied to the air conditioner. For air conditioners with an ON/OFF switch or supply line circuit breaker the switch or breaker must be in the ON position for the controller to be energized. When power is supplied to the controller the display will light and display the temperature sensed by temperature sensor #1 (typically the return air temperature to the air conditioner). Depending upon the model number and specifications for the air conditioner, the displayed temperature may be expressed in either Fahrenheit (F) or Centigrade(C) as received from the factory. See Program #2 instructions for identifying which is being displayed.

Note, the software revision level for the controller will display for 1/2 second upon initial power-up of the controller.

CONTROL STATUS INDICATION:

Cooling and heating control status is indicated via LED's below the words COOL/DELAY and HEAT on the front of the controller. Built in program error checking prevents simultaneous cooling and heating from occurring. The COOL/DELAY light will flash when the controller is in the compressor recycle time delay mode.

COMPRESSOR RECYCLE TIME DELAY:

To protect the air conditioner compressor from unwanted rapid cycling, the controller has a programmable recycle time delay feature(Program #1 variable P11). The minimum value for this variable is 60 seconds, meaning the controller will prevent the compressor from starting sooner than 60 seconds after it was last operating. When cooling control is being inhibited due to this time delay the COOL/DELAY light will flash. After the delay period has been satisfied the controller will turn on the compressor and the COOL/DELAY light will remain on continuously while the compressor is operating.

DISPLAYING PROGRAM VARIABLES FOR PROGRAM #1:

Program #1 contains the operating variables for temperature setpoints, temperature alarm limits, compressor recycle time delay and time delays for temperature alarm limits. A description of each variable is as follows.

P01	Cooling "on" setpoint value (F or C) - fixed setpoint control mode
P02	Cooling "off" setpoint value (F or C) - fixed setpoint control mode
P03	Heating "off" setpoint value (F or C)
P04	Heating "on" setpoint value (F or C)
P05	Cooling "on" maximum setpoint value (F or C) - auto ambient tracking control mode
P06	Cooling "off" minimum setpoint value (F or C) - auto ambient tracking control mode
P07	Cooling "on/off" differential" value (F or C) - automatic ambient tracking control mode
P08	Cooling setpoint "offset" value (F or C) - automatic ambient tracking control mode
P09	Overtemperature alarm setpoint (F or C)

P10 Undertemperature alarm setpoint (F or C)
P11 Compressor recycle time delay (seconds)
P12 Overtemperature alarm time delay (seconds)
P13 Undertemperature alarm time delay (seconds)
P14 For factory use only - not programmable
P15 For factory use only - not programmable

Note, variables P05 thru P08 will only be visible and adjustable when the automatic Ambient Setpoint Tracking Control Mode is selected (See Program #2 instructions)

To view the programmed values for each variable press the DISPLAY key once. The letters "dSP" will appear on the display followed by the characters "P01". Press the DISPLAY key once again to display the programmed value for the variable "P01".

Press the DISPLAY key once again and the characters "P02" will appear. Press the DISPLAY key once again to display the programmed value for the variable "P02".

Continue this process to display variables "P03" through "P14" and their corresponding values.

Note, once in the "dSP" display mode the display will revert to normal temperature display mode if no buttons are pressed in one minute.

CHANGING PROGRAM VARIABLES FOR PROGRAM #1 (Pr1):

Record field programmed settings on attached form and file for future reference. To enter the programming mode for Program #1 press and hold the PROG key (for approximately 3 seconds) until the letters "Pr1" appear, then release the PROG key. When the key is released the characters "P01" will be displayed. Press the PROG key once more to display the value for variable "P01". Press the ADJUST arrows, either " ^ " or " v ", to change the variable to the desired value.

Press the PROG key again to display the characters "P02". Press the PROG key once more to display the value for variable "P02". Press the ADJUST arrows to change the variable to the desired value.

Continue to view and/or change program variables "P03" through "P13" per the above procedure. Note, variables P01 and P02 will only appear when the fixed setpoint control mode is selected (via Program #2). Likewise, variables P05 through P08 will only appear if automatic ambient tracking setpoint control mode has been selected (via Program #2).

Allowable ranges for each variable are as follows:

P01 32 to 150 F, 0 to 65 C
P02 32 to 150 F, 0 to 65 C
P03 32 to 150 F, 0 to 65 C
P04 32 to 150 F, 0 to 65 C
P05 32 to 150 F, 0 to 65 C
P06 32 to 150 F, 0 to 65 C
P07 0 to 150 F, 0 to 83 C
P08 0 to 150 F, 0 to 83 C
P09 32 to 150 F, 0 to 65 C
P10 32 to 150 F, 0 to 65 C
P11 60 to 999 seconds
P12 0 to 999 seconds
P13 0 to 999 seconds

Note, the controller will begin to control and issue alarms based on each newly entered value after scrolling to the next variable. If a programming error is detected, the controller will begin to operate on the preprogrammed factory settings until the error is corrected.

After entering all desired values for program variables, press and hold the PROG key until the characters "End" appear. The controller returns to the temperature display mode.

CHANGING PROGRAM VARIABLES FOR PROGRAM #2 (Pr2):

Program #2 contains the program variables for; the temperature display mode (F or C); the selection of control mode type - either fixed setpoint control mode or automatic ambient tracking setpoint control mode; the enabling feature for temperature sensor #2; and the enabling feature for various display and control interlock parameters. A description of each variable is as follows.

P01	" F " (Fahrenheit) or " C " (Centigrade) temperature display mode
P02	Normal "nor" (fixed setpoint control mode) or Automatic "Auo" (automatic ambient tracking setpoint control mode)
P03	"on" (enable)/ "oFF" (disable) sensor #2
P04	"on" (enable)/ "oFF" (disable) overtemperature alarm control and display features
P05	"on" (enable)/ "oFF" (disable) undertemperature alarm control and display features
P06	"on" (enable)/ "oFF" (disable) controller "on/off" button feature
P07	"on" (enable)/ "oFF" (disable) interlock to turn cooling "off " during overtemperature alarm condition
P08	"on" (enable)/ "oFF" (disable) interlock to turn heating "off " during undertemperature alarm condition
P09	"on" (enable)/ "oFF" (disable) interlock to turn cooling "off " during input alarm condition
P10	"on" (enable)/ "oFF" (disable) interlock to turn heating "off " during input alarm condition

The only way to view the program variables for Program #2 is to enter the programming mode. To enter the programming mode press and hold the PROG key (for approximately 3 seconds) until the letters "Pr1" appear. Continue holding the key (for another 3 seconds) until the letters "Pr2" appear, then release the PROG key. When the key is released the characters "P01" will be displayed.

Press the PROG key once to display the current mode for variable "P01". To change the mode press the ADJUST arrow " ^ " until the desired mode is selected.

Press the PROG key again to display the characters "P02". Press the PROG key once more to display the temperature control mode for variable "P02". To change the control mode press the ADJUST arrow " ^ " until the desired mode is selected. Note, selecting the automatic ambient tracking setpoint control mode "Auo" will automatically "enable" sensor #2 (see variable P03).

Continue to view and/or change program variables "P03" through "P10" per the above procedure.

Note, the controller will begin to control and issue alarms based on each newly entered value after scrolling to the next variable. If a programming error is detected, the controller will begin to operate on the preprogrammed factory settings until the error is corrected.

After entering all desired values for program variables, press and hold the PROG key until the characters "End" appear. The controller returns to the temperature display mode.

ALARM CONDITION DISPLAY:

There are four possible latching alarm conditions detectable by the controller.

AL 1 Overtemperature alarm condition
AL 2 Undertemperature alarm condition
AL 3 Programming error
AL 4 Input alarm condition

AL 1 and AL 2 will only display when Program #2 variables P04 and P05 are programmed "on" (enabled). Also, latched interlock control will occur if Program #2 variables P07 and P08 are programmed "on" (enabled) in conjunction with P04 and P05 being programmed "on".

AL 3 will display if one or more of the following programming errors exist.

- Cooling "on" setpoint value is less than or equal to heating "off" setpoint value
- Cooling "off" setpoint value is less than or equal to heating "on" setpoint value
- Overtemperature alarm setpoint value is less than or equal to the cooling "on" setpoint value
- Heating "on" setpoint value is less than or equal to the undertemperature alarm setpoint value
- Cooling "on" setpoint value is less than or equal to the cooling "off" setpoint value
- Heating "off" setpoint value is less than or equal to the heating "on" setpoint value
- Cooling "on" maximum setpoint value for the automatic ambient tracking setpoint mode is less than or equal to the cooling "off" minimum setpoint value

When one or more AL 3 conditions exist the controller automatically reverts to factory default settings for control purposes until the error is corrected.

AL 4 will display when an input alarm (opened voltage free contact)is received to the controller. Latched interlock control will occur if Program #2 variables P09 and/or P10 are programmed "on" (enabled). Refer to Air Conditioner wiring diagram for details.

After alarm condition(s) have been corrected the latched display characters and control actions may be cleared by pressing the CLEAR key.

SENSOR FAILURE ALARM:

A sensor failure is detected when the sensor reading falls below 0 F or 0 C (indicating a possible open circuit). When this occurs, the display will show the characters OP 1 or OP 2, depending upon which temperature sensor has been detected as failed. Both cooling and heating control outputs are turned "off" when OP1 fails. Control reverts to 'nor' mode (fixed setpoint) using factory default setting if sensor 2 fails while in 'Auo' mode, and sensor 1 is still functional.

After the failed sensor is repaired or replaced, the CLEAR key must be pressed to clear the latched alarm condition. This will allow the controller to return to the programmed temperature control mode.

DISPLAYING TEMPERATURE SENSOR #2:

An optional second temperature sensor (sensor #2) may be connected to the controller. This sensor is enabled via Program #2 variable P03, or via selection of the automatic ambient tracking setpoint control mode using P02. When enabled, the temperature sensed by this sensor may be displayed by pressing the VIEW TEMP key. The letters "Sn2" will appear followed by the temperature (either F or C) sensed by sensor #2. To return to sensor #1 display press the VIEW TEMP key again. If no keys are pressed for 45 seconds the display will automatically return to sensor #1 display.

FACTORY SETTINGS FOR PROGRAM VARIABLES:

The following are factory settings for Program #1 and #2 variables.

PROGRAM #1	STANDARD FACTORY SETTING	*FIELD SETTINGS	PROGRAM #2		*FIELD SETTINGS
P01	80 F, 27 C	_____	P01	F	_____
P02	75 F, 24 C	_____	P02	nor	_____
P03	70 F, 21 C	_____	P03	oFF	_____
P04	60 F, 16 C	_____	P04	oFF	_____
P05	95 F, 35 C	_____	P05	oFF	_____
P06	75 F, 24 C	_____	P06	oFF	_____
P07	5 F, 3 C	_____	P07	oFF	_____
P08	0 F, 0 C	_____	P08	oFF	_____
P09	130 F, 54 C	_____	P09	oFF	_____
P10	50 F, 10 C	_____	P10	oFF	_____
P11	60 seconds	_____			
P12	15 seconds	_____	* To be filled in by operator		
P13	15 seconds	_____			

Note, custom factory settings may be specified in which case the custom settings will be shown on a separate sheet included with this operating manual.

LEVEL II FIXED SETPOINT CONTROL MODE:

Figure 1 illustrates Level II control (fixed setpoint control mode). The sequence of operation is as follows. Note, temperature control actions are based on the temperature measured by temperature sensor #1.

When the temperature rises above the cooling “on” setpoint value (Program #1 variable P01) the cooling output is energized to turn on mechanical cooling.

When the temperature falls below the cooling “off” setpoint value (Program #1 variable P02) the cooling output is de-energized to turn off mechanical cooling.

When the temperature falls below the heating “on” setpoint value (Program #1 variable P04) the heating output is energized to turn on heating within the air conditioner (note, heaters are an optional accessory with Mclean Thermal air conditioners - contact the Mclean Thermal sales representative or distributor for option availability for the air conditioner model in question).

When the temperature rises above the heating “off” setpoint value (Program #1 variable P03) the heating output is de-energized to turn off heating within the air conditioner.

LEVEL III AUTOMATIC AMBIENT TRACKING SETPOINT CONTROL MODE:

Figure 2 illustrates the Level III control mode (automatic ambient tracking control mode). Note, both sensor #1 and sensor #2 are used to determine cooling setpoints for control purposes. Heating control is identical to that of Level II control. The following example describes the sequence of operation for Level III control.

Example: Suppose Program #1 has been programmed as follows for Level III (automatic ambient tracking setpoint control).

P03	heating "off" setpoint	=	45 F
P04	heating "on" setpoint	=	40 F
P05	cooling "on" maximum setpoint	=	100 F
P06	cooling "off" minimum setpoint	=	50 F
P07	cooling "on/off" differential	=	10 F
P08	cooling setpoint "offset"	=	6 F

The controller will calculate cooling temperature setpoints as follows.

Ambient temperature (measured by sensor #2) = 73 F (assumed for example purposes)

Cooling "on" setpoint = Ambient temperature - offset + (differential / 2)
= 73 - 6 + (10 / 2)
= 72 F

Cooling "off" setpoint = Ambient temperature - offset - (differential / 2)
= 73 - 6 - (10 / 2)
= 62 F

Sequence of operation:

When the temperature measured by sensor #1 rises above 72 F the cooling output is energized to turn on mechanical cooling.

When the temperature measured by sensor #1 falls below 62 F the cooling output is de-energized to turn off mechanical cooling.

When the temperature measured by sensor #1 falls below 40 F the heating output is energized to turn on heating within the air conditioner. (note, heaters are an optional accessory with Mclean Thermal air conditioners - contact the Mclean Thermal sales representative or distributor for option availability for the air conditioner model in question).

When the temperature measured by sensor #1 rises above 45 F the heating output is de-energized to turn off heating within the air conditioner.

As the ambient temperature varies the controller calculates new cooling "on" and cooling "off" setpoints in accordance with the equations shown in the above example. Cooling control will take place in keeping with each newly calculated setpoint value.

Should the ambient temperature rise to a point where the calculated cooling "on" setpoint exceeds 100 F (the value of P05 in this example), 100F would then become the maximum allowable cooling "on" setpoint for the controller.

Should the ambient temperature fall to a point where the calculated cooling "off" setpoint goes below 50 F (the value of P06 in this example), 50F would then become the minimum allowable cooling "off" setpoint for the controller.

ENABLING THE CONTROLLER ON/OFF BUTTON(S):

To enable the on/off button(s) feature of the controller, enter the programming mode for Program #2 and change variable P06 to “on” (enable). Exit the programming mode.

The controller may now be turned off by simultaneously pressing the DISPLAY/PROG key and the CLEAR key for 2 seconds. The controller will turn on immediately and start controlling when these two buttons are pressed simultaneously.

RESETTING PROGRAM VARIABLES TO FACTORY SETTINGS:

Factory settings can be re-established after custom programming has been done be utilizing the Program #1 variable P15. Enter the Program #1 programming mode and scroll ahead to variable P15. The existing value of P15 will display as 0. Use the ADJUST arrow key “ ^ “ to scroll the display to the value of 250. Upon exiting the programming mode all variables for both Program #1 and Program #2 will be reset to the factory settings.

ALARM OUTPUT CONTACT

The level II and III controller has an alarm output contact rated 3 amps at 120VAC/28VDC. This output is “open” during alarm conditions, and “closed” when normal.
Alarm conditions are:

- Alarm input signal to controller (opened voltage free contact)
- Over or undertemperature alarm condition as programmed in Program #2
- Programming error (see Alarm Condition Display)

Figure 1

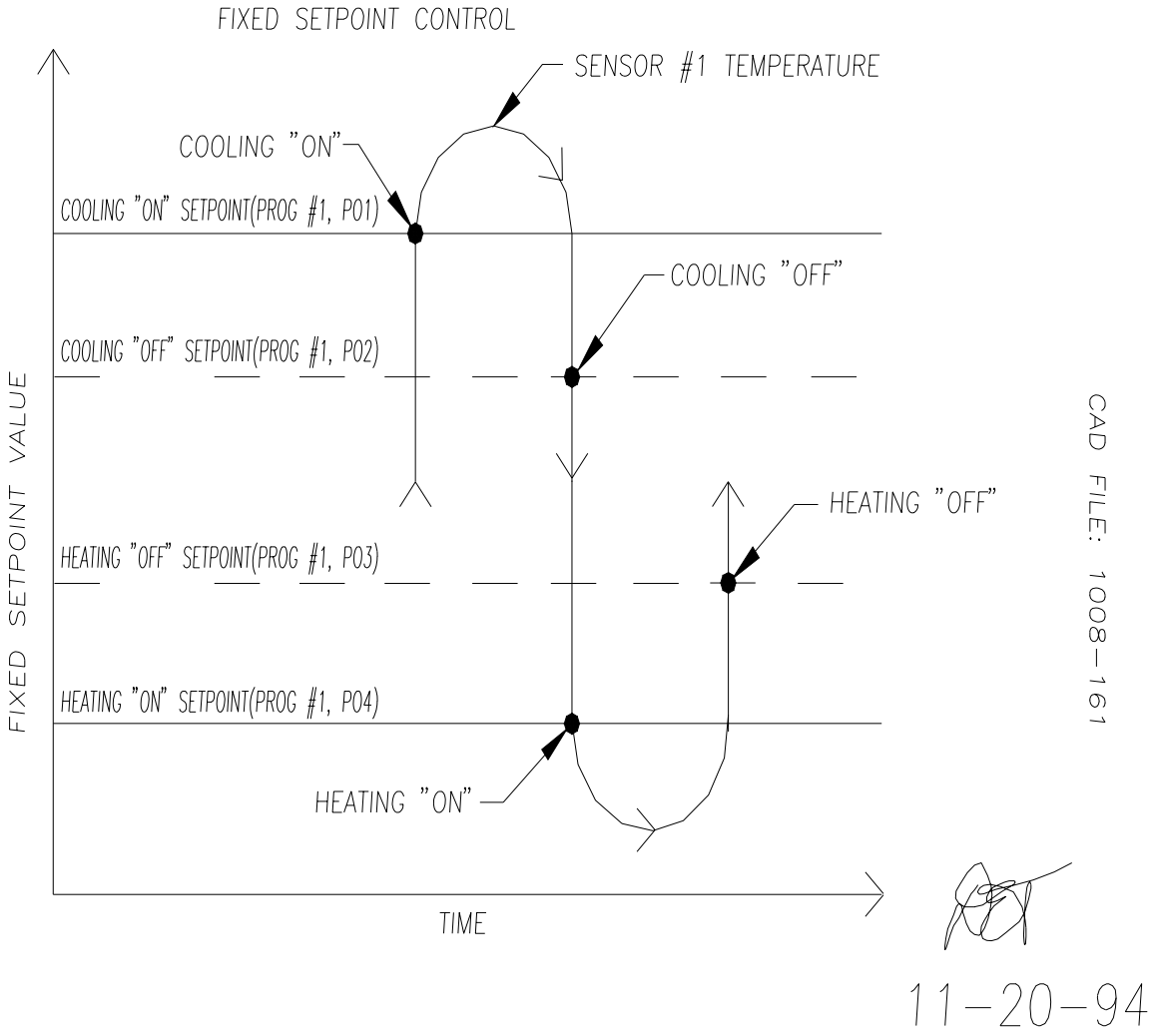
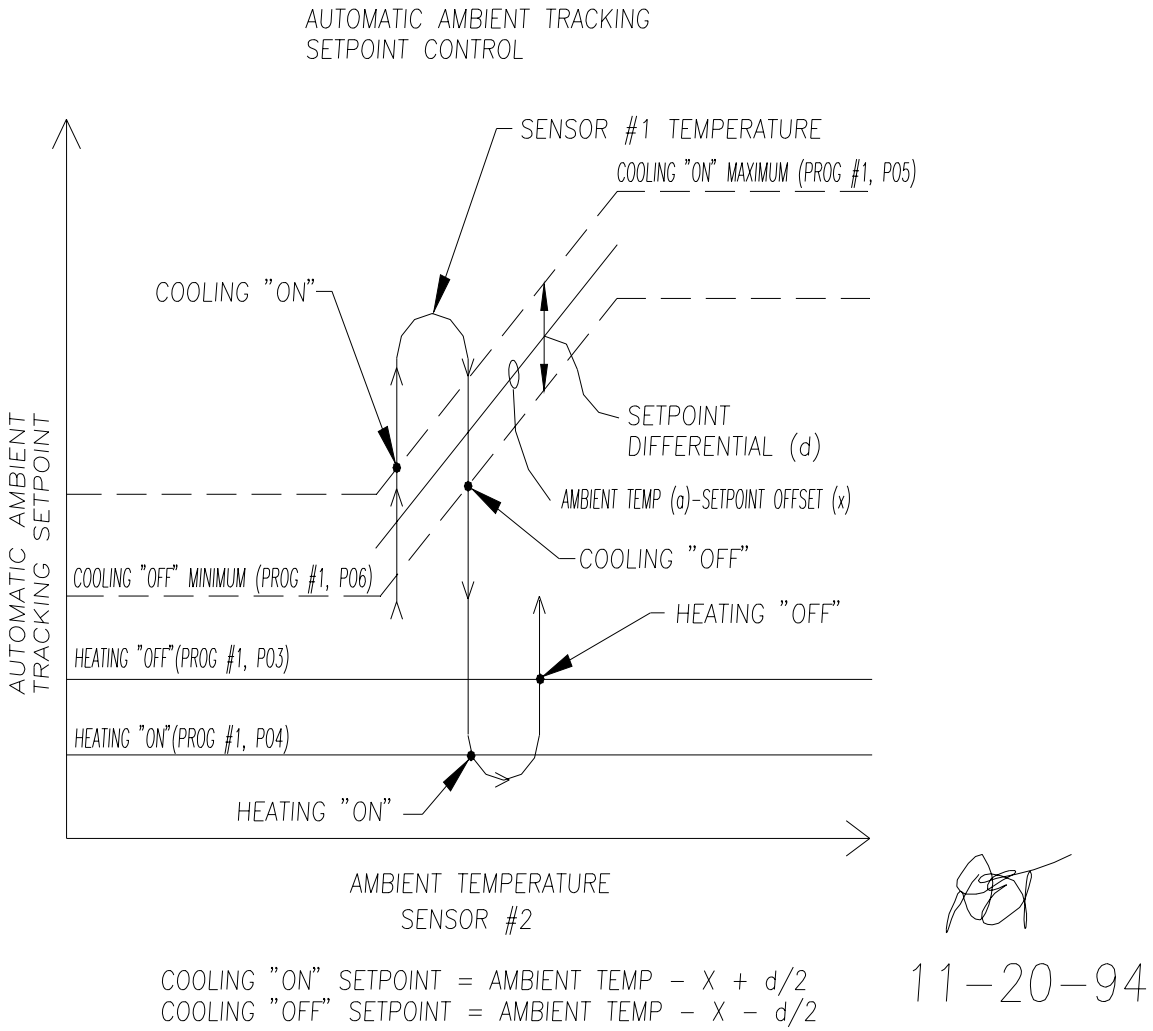

FIXED SETPOINT CONTROL
SENSOR #1 TEMPERATURE
COOLING "ON"
COOLING "ON" SETPOINT(PROG #1, P01)
COOLING "OFF"
COOLING "OFF" SETPOINT(PROG #1, P02)
HEATING "OFF"
HEATING "OFF" SETPOINT(PROG #1, P03)
HEATING "ON" SETPOINT(PROG #1, P04)
HEATING "ON"
FIXED SETPOINT VALUE
TIME
CAD FILE: 1008-161
11-20-94

Figure 2



COOLING "ON" SETPOINT = AMBIENT TEMP – X + d/2
COOLING "OFF" SETPOINT = AMBIENT TEMP – X – d/2

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