DAIKIN
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07.17

CONTROLS APPLICATION GUIDE

VRV

AUXILIARY HEATER CONTROL FOR VRV SYSTEMS

CAG-VRVAHC

ABOUT DAIKIN:

Daikin Industries, Ltd. (DIL) is a global Fortune 1000 company which celebrated its 90th anniversary in May 2014. The company is recognized as one of the largest HVAC (Heating, Ventilation, Air Conditioning) manufacturers in the world. DIL is primarily engaged in developing indoor comfort systems and refrigeration products for residential, commercial and industrial applications. Its consistent success is derived, in part, from a focus on innovative, energy-efficient and premium quality indoor climate and comfort management solutions.

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1. Introduction

External heat sources are frequently applied in addition to the VRV system in various applications. In cold climate areas, additional auxiliary heaters are used to supplement the system when the outside temperature falls below the operation range. In retrofit projects, the existing heat source may be integrated with the VRV system as an alternative heat source. Typical external heat sources include electric heat, gas, oil, or hot water.

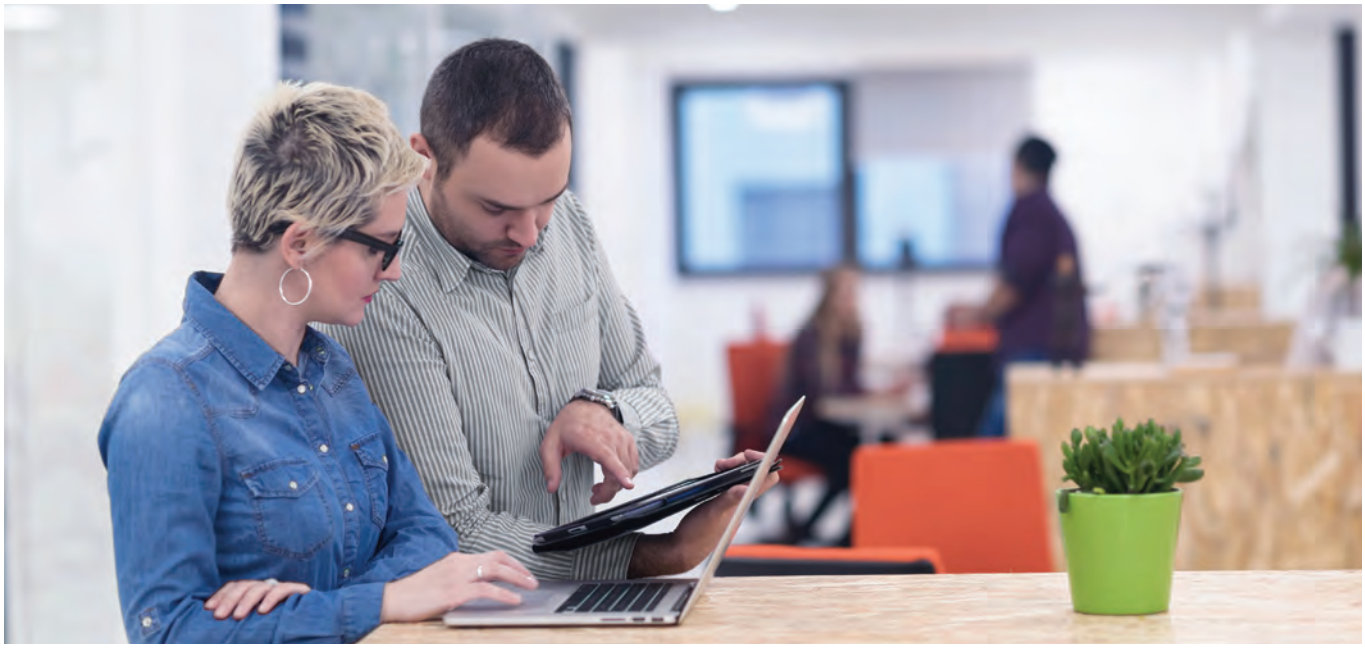
The VRV systems have a built-in control logic to control the auxiliary heater. The indoor unit is capable of operating the auxiliary heater as both supplemental heat with the VRV Heat Pump heating, and emergency heat when the VRV Heat Pump heating is locked out.

- **Auxiliary Heater as supplemental heat with the VRV Heat Pump heating –** The auxiliary heater operates together with the VRV heating as a supplemental heat to help maintain the room temperature. The indoor unit controls the auxiliary heater based on the room temperature and setpoint. The control logic varies based on different indoor unit models. In addition, the VRV IV outdoor unit has the capability to allow or prohibit auxiliary heat.

- **Auxiliary Heater as emergency heat when the VRV Heat Pump heating is locked out –** The external heat source operates as an emergency heater when the VRV Heat Pump heating is locked out. The VRV IV outdoor unit is configurable for being locked out when the ambient temperature is low or the VRV system is in error. When the VRV heating is unavailable in a Heat Pump lockout event, the indoor unit will control the auxiliary heat to provide heating to the indoor environment.

The following five sections provide details of the following:

- Section 2 introduces the KRP1C Wiring Adaptor that connects external heaters to the indoor unit.
- Section 3 discusses the auxiliary heat control logic during regular Heat Pump heating. This section also reviews the outdoor unit field settings and the indoor unit control logic.
- Section 4 introduces the auxiliary heat control logic during the Heat Pump lockout period.
- Section 5 summarizes the outdoor unit field settings, the control logic, compatibility, field setting for each indoor unit, and the FXTQ_TA indoor unit logic.
- Section 6 discusses the application of the auxiliary heater on different types of heaters.



2. KRP1C Wiring Adaptor

Typically, indoor units control the external heater through the Wiring Adaptor KRP1C74/75. The KRP1C74/75 Wiring Adaptor connects external equipment with a VRV indoor unit. It can be applied to interlock external equipment with indoor unit's thermo-on status, fan on status, heating thermo-on status, and auxiliary heater control output. VRV indoor unit's compatibility with the KRP1C board depends on the indoor unit model (Refer to Section 5.2 for compatibility information). Based on the indoor unit's operation status, the KRP1C Adaptor provides normally open dry contact closure through the terminals.

Table 1. KRP1C74/75 Terminals and Outputs

Terminals	Normally Open Dry Contact that Interlocks with:
X1-X2	Indoor unit thermo-on status*
X3-X4	Indoor unit fan on status
Y2-YC	Indoor unit heating thermo-on status
Y1-YC	Auxiliary heater control output

* The X1-X2 output can be configured by indoor unit field setting 12(22)-0-xx

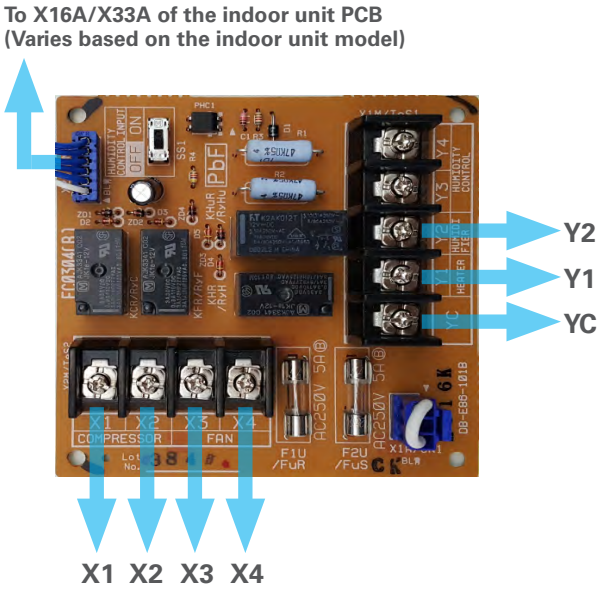


Fig. 1 KRP1C74/75 Wiring Adapter

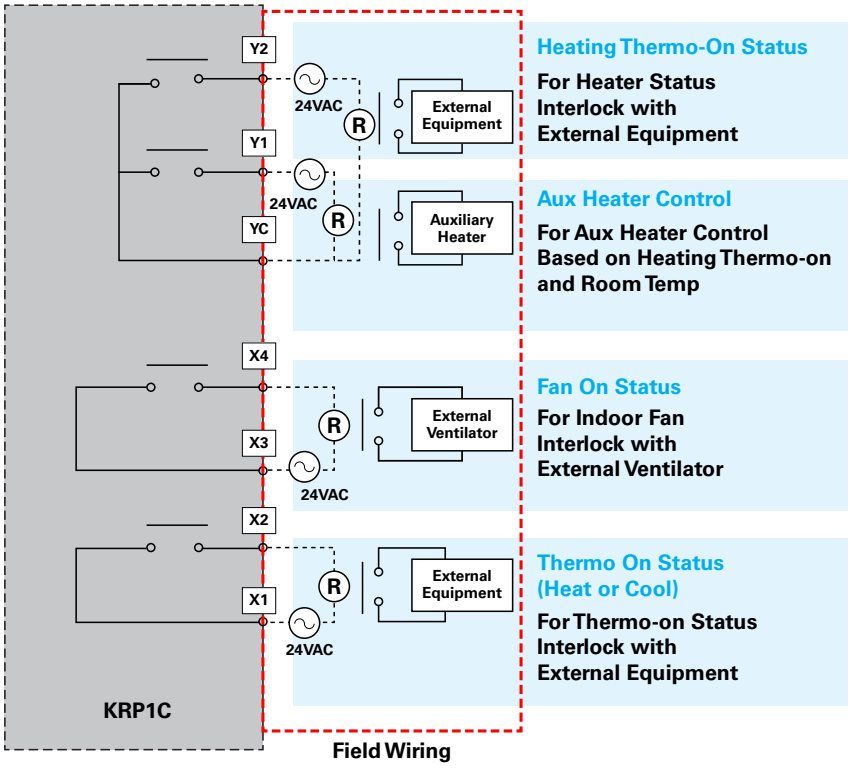


Fig. 2 Wiring Adapter Wiring and Functionality

2.1 X1-X2 (Thermo-on Status) and Y2-YC (Heating Thermo-on Status)

X1-X2 output interlocks external equipment based upon the indoor unit thermo-on status for either cooling or heating. The thermo-on status is a result of the indoor unit actively cooling or heating the space.

Y2-YC output interlocks the auxiliary heaters with the heating thermo-on status of the indoor unit. The thermo-on status is a result of the indoor unit actively heating the space.

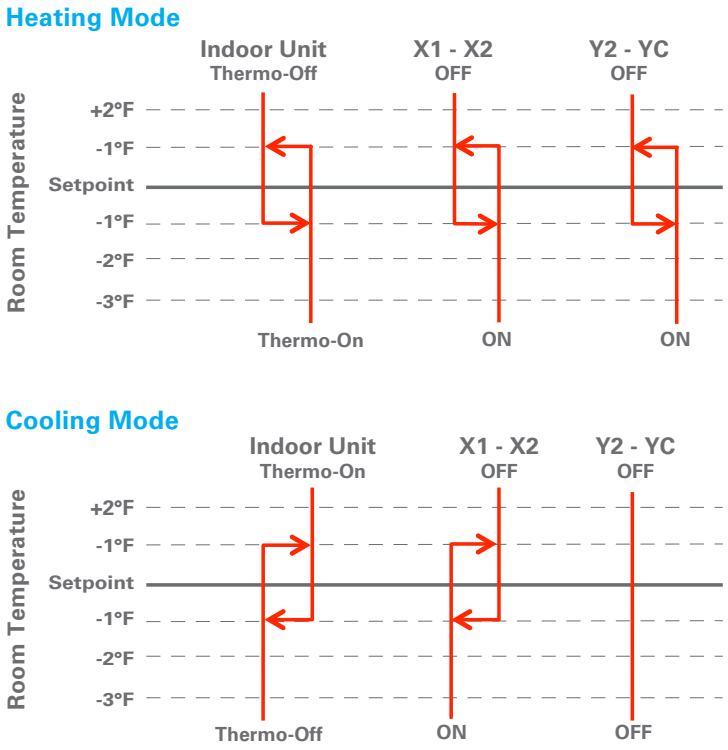


Fig. 3. X1-X2 and Y2-YC Outputs with a Thermo-On/Off Deadband of 1°F

The deadband can be configured to either 1°F or 2°F by indoor unit field setting 12(22)-2-XX.

Table 2. Field Setting for Thermo-On/Off Deadband

Description	Mode #	First Code #	Second Code #	
			01	02
Thermo-On/Off deadband*	12(22)	2	2°F (1°C)	1°F (0.5°C)

* Default value varies for different indoor unit models

2.2 X3-X4 (Fan-on Status)

X3-X4 interlocks external equipment with the indoor unit fan ON status. Generally, when the indoor unit is OFF, or the outdoor unit is in Hot Start or Defrost operation, the indoor unit fan is OFF. The indoor unit fan is ON when the indoor unit is in thermo-on status. During the thermo-off period, the indoor unit fan ON/OFF status depends on the indoor unit field settings 12(22)-3-XX (in heat mode), and 12(22)-6-XX (in cool mode).

Table 3. Field Setting for Fan Speed in Thermo-Off

Description	Mode #	First Code #	Second Code #		
			01	02	03
Fan Speed in Heating Thermo-off*	12(22)	3	LL (Default)	User set	Off
Fan Speed in Cooling Thermo-off*		6	LL	User set (Default)	Off

* May not be available for all VRV indoor units. Verify applicable field settings in the indoor unit Installation Manual.

When the fan is in LL status, the fan is running in a "Low-Low" speed, which is lower than the low fan speed setting. When the fan is in LL fan speed during thermo-off, the fan status is considered as Fan On, and thus X3-X4 output is closed.

Note: Certain VRV system errors will cause the indoor unit fan to turn off in certain situation. Refer to Appendix I for the list of errors that may turn off the indoor unit fan in certain situations.

2.3 Y1-YC (Auxiliary Heater Control Output)

Y1-YC provides normally open (NO) dry contact to control the auxiliary heater. The Y1-YC output is controlled by the indoor unit, and the control logic varies with indoor unit model. Section 3 explains in detail how the auxiliary heater control logic works for different indoor units.

3. Auxiliary Heater Control Logic with Heat Pump Heating

3. Auxiliary Heater Control Logic with Heat Pump Heating

To control the auxiliary heater as supplement heat to the VRV heating, the indoor unit provides room level auxiliary heater control via the KRP1C Wiring Adaptor. The auxiliary heater output is determined by two factors:

a. Outdoor unit field setting (set through the outdoor unit PCB) limits the outdoor ambient temperature condition to allow the auxiliary heater to be energized. However, only indoor unit models FXEQ_PVJU, FXFQ_TVJU, FXLQ_MVJU9, FXMQ_PBVJU, and FXNQ_MVJU9 have implemented this logic and will follow the prohibition command. Other indoor unit models have not implemented this logic and therefore will ignore this field setting. Refer to Section 5.2 for the list of indoor units that ignore/follow this command.

b. The indoor unit model determines the control logic of the auxiliary heater ON/OFF temperature. For FXDQ_MVJU, FXHQ_MVJU, FXMQ_MVJU, FXMQ_MFVJU, FXZQ_MVJU9, and other obsolete indoor unit models, the ON/OFF temperature is fixed; while for other indoor unit models, the ON/OFF temperatures can be set through the indoor unit field setting. Refer to Section 5.2 for the control logic of each indoor unit model.

3.1 Allow/Prohibit Auxiliary Heater from VRV IV Outdoor Unit

For indoor unit models that follow the prohibition command from the outdoor unit, the auxiliary heater can be prohibited when the ambient temperature is high, and is only allowed to energize when the ambient temperature is low based upon the outdoor unit field settings. To enable this function, two outdoor unit field settings are required:

›› Auxiliary Heater Maximum Allowable Temperature

›› Auxiliary Heater Maximum Allowable Temperature Release Differential

Once the ambient temperature falls below the auxiliary heater maximum allowable temperature, the auxiliary heat is allowed to energize. Once the outdoor ambient temperature rises above the auxiliary heater maximum allowable temperature by the Release Differential, the auxiliary heater is de-energized and prohibited from re-energizing while the Release Differential is exceeded. Figure 4 shows how the control logic works to allow/prohibit the auxiliary heater.

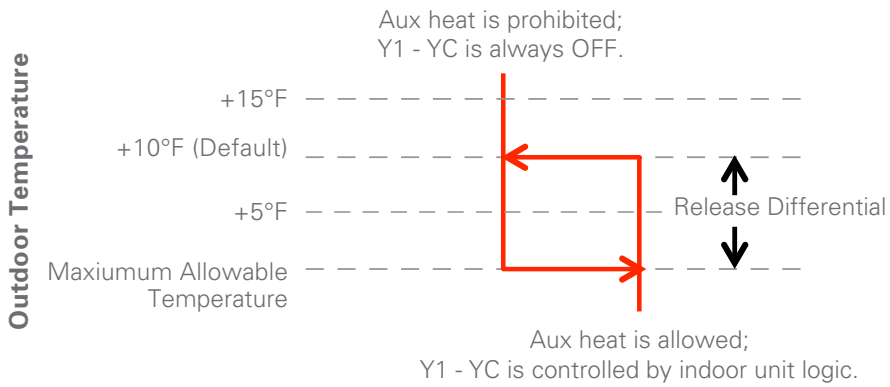


Fig. 4. Allow/Prohibit Auxiliary Heater with Outdoor Unit Field Settings

Table 4 shows the field setting numbers for each VRV IV outdoor units. This logic is not available for VRV IV Water Cooled outdoor unit (RWEYQ).

Table 4. VRV IV Outdoor Unit Field Setting Numbers for Allowing/Prohibiting Auxiliary Heater

Outdoor Unit Model / Outdoor Unit Field Setting	VRV IV			
	Heat Pump (RXYQ)	Heat Recovery (REYQ,RELQ)	VRV IV-S (RXTQ)	VRV IV W (RWEYQ)
Auxiliary Heater Max Allowable Temp	2-96	2-97	2-50	n/a
Auxiliary Heater Max Allowable Temp Release Differential	2-97	2-98	2-56	n/a

Table 5 shows the field settings for auxiliary heater maximum allowable temperature. The field setting can also be set to always allow or always prohibit the auxiliary heater.

Table 5. Auxiliary Heater Maximum Allowable Temperature Field Setting

Field setting 2-96/2-97/2-50	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Auxiliary Heater Max Allowable Temp (°F)	0	5	10	15	20	25	30	35 (Default)	40	45	50	55	60	65	AUX Heater Always Prohibited	AUX Heater Always Allowed

Table 6 shows the field settings for auxiliary heater maximum allowable temperature release differential.

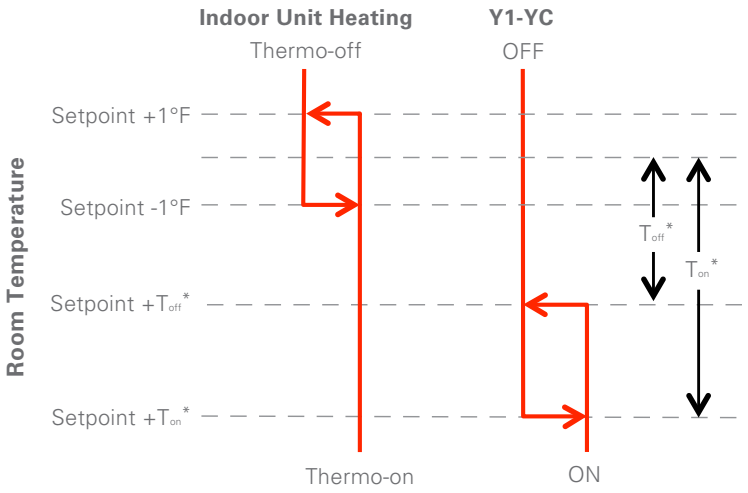
Table 6. Auxiliary Heater Maximum Allowable Temperature Release Differential Field Setting

Field setting 2-97/2-98/2-56	0	1	2
Auxiliary Heater Max Allowable Temp Release Differential (°F)	5	10 (Default)	15

If the auxiliary heat is prohibited by the conditions mentioned above, the Y1-YC output will always be OFF regardless of indoor unit conditions. However, only indoor unit model FXEQ_PVJU, FXFQ_TVJU, FXLQ_MVJU9, FXMQ_PBVJU, and FXNQ_MVJU9 have implemented this logic and will follow the prohibition command; other indoor units will ignore this prohibition from the outdoor unit field setting.

3.2 Indoor Unit Auxiliary Heater Control Logic

If not prohibited by the outdoor unit, the auxiliary heater output is controlled by the indoor unit internally, and the control logic varies by indoor unit models. The auxiliary heater output is determined by the differential between room temperature and setpoint. In heating mode, when the room temperature drops to the Auxiliary Heater Turn On Temperature (T_{on}) from the setpoint, the auxiliary heater is energized. When the room temperature rises and reduces the differential between room temperature and setpoint to the Auxiliary Heater Turn Off Temperature (T_{off}), the auxiliary heater is de-energized.



* Actual temperature may change due to adaptive logic (S Logic):

$T_{on}^* = T_{on} + S$

$T_{off}^* = T_{off} + S$

Fig. 5. Indoor Unit Auxiliary Heater Control Logic

The temperature T_{on} and T_{off} vary for different indoor units, and can be configured by indoor unit field settings for certain indoor units. Three types of Ton/Toff configuration are available in the VRV indoor units:

a) **Type A – Fixed Logic** (applies to FXDQ_MVJU, FXHQ_MVJU, FXMQ_MVJU, FXMQ_MFVJU, FXZQ_MVJU9 and other obsolete models):

T_{on} and T_{off} are fixed. T_{on} = -7.2°F, T_{off} = -3.6°F.

b) **Type B – Linked Logic** (applies to FXFQ_TVJU, FXMQ_PBVJU, FXTQ_PBVJU):

T_{on} and T_{off} are configurable together through one field setting.
The differential between T_{on} and T_{off} is fixed to 3.6°F.

Table 6. Indoor Unit Field Settings for Linked Logic

Description	Field Setting (Mode-First Code #)	Second Code #					
		01 (Default)	02	03	04	05	06
T_{on}	11(21) -01 or 10(20)-07*	-7.2	-6.3	-5.4	-4.5	-3.6	-2.7
T_{off}		-3.6	-2.7	-1.8	-0.9	0	0.9

* FXTQ_PBVJU uses field setting 10(20)-07.

c) **Type C –** Individually Adjustable Logic
(applies to FXEQ_PVJU, FXLQ_MVJU9, FXNQ_MVJU9, and FXTQ_TAVJU):

T_{on} and T_{off} can be configured individually.

Table 7. Indoor Unit Field Settings for Individually Adjustable Logic

Description	Mode #	First Code #	Second Code #					
			01(Default)	02	03	04	05	06
T_{on}	11(21)	1	-7.2	-6.3	-5.4	-4.5	-3.6	-2.7
T_{off}		2	-3.6	-2.7	-1.8	-0.9	0	0.9

The combination of T_{on} and T_{off} is limited in order to maintain a minimal 3.6°F differential and reliability. The allowed combinations are shown in the Table 8.

Table 8. Limited Combination of T_{on} and T_{off}

T_{OFF} \ T_{ON}	-7.2	-6.3	-5.4	-4.5	-3.6	-2.7
0.9	•	•	•	•	•	•
0	•	•	•	•	•	N/A
-0.9	•	•	•	•	N/A	N/A
-1.8	•	•	•	N/A	N/A	N/A
-2.7	•	•	N/A	N/A	N/A	N/A
-3.6	•	N/A	N/A	N/A	N/A	N/A

• = Available. N/A = Not Available.

Moreover, the indoor units have built-in adaptive control logic (named S logic) to adjust the actual auxiliary heater ON/OFF temperature based on room temperature trend. During operation, the actual auxiliary heater ON/OFF temperature is not fixed to T_{on} /T_{off}, but varies with an "S" value.

The "S" value continually changes based on the setpoint, the current room temperature, and the room temperature over time. The following logic is implemented in the indoor unit's control logic:

Step 1: Determine the interval time to update the "S" value. "S" value is updated:

a) Whenever the setpoint is changed;

b) Or every 5 mins (7 mins if the thermo-on/thermo-off dead band is 2°F) if the room temperature variation is less than 2°F;

c) Or every 3 mins if the room temperature variation is more than 2°F;

Step 2: Calculate the new "S" value. The "S" value is updated as following:

a) The "S" value is reset to 0 whenever the indoor unit is thermo-off.

b) The "S" value increases if the room temperature continues to drop; The "S" value decreases as the room temperature rises.

Table 9 shows the mathematical calculation method on how to calculate the new "S" value RT: room temperature, SP: setpoint):

Table 9. How to Calculate the New "S" Value

Condition			"S" Calculation Result
Situation	**Current Room Temp: RT_0**	**Next Room Temp: RT_1**	
Room temperature exceeds the setpoint a lot	$SP+0.9°F \leqq RT_0$	—	S=0
Room temperature is close to the setpoint	$SP-0.9°F \leqq RT_0 < SP+0.9°F$	$SP+1.8°F \leqq RT1$	S=S-2.7°F
		$SP+0.9°F \leqq RT_1 < SP+1.8°F$	S=S-1.8°F
		$SP \leqq RT_1 < SP+0.9°F$	S=S-0.9°F
		$SP-0.9°F \leqq RT_1 < SP$	S=S
		$SP-1.8°F \leqq RT1 < SP-0.9°F$	S=S+0.9°F
		$RT_1 < SP-1.8°F$	S=S+1.8°F
Room temperature is lower than the setpoint a lot	$SP-1.8°F \leqq RT_0 < SP-0.9°F$	—	S=S+0.9°F
	$RT_0 < SP-1.8°F$	—	S=S+1.8°F

c) In cooling mode, the maximum S value is 3.6°F, and the minimum S value is -8.1°F; In heating mode, the maximum S value is 8.1°F, and the minimum S value is -3.6°F.

Based on the updated "S" value, the Actual Turn On Temperature (T_{on}*) and the Actual Turn Off Temperature and (T_{off}*) for the auxiliary heater is updated as:

$$T_{on}^* = T_{on} + S$$

$$T_{off}^* = T_{off} + S$$

Figure 6 shows an example to demonstrate the dynamic change of S value as well as how to calculate T_{on}* and T_{off}*.

Assume the indoor unit is configured to T_{on} = -7.2°F and T_{off} = -3.6°F, and the initial setpoint is SP = 72°F. At the time t = 0 min, the initial S = 0, and room temperature RT = 71.5°F. The room temperature variation is monitored by the indoor unit. For the following 5 minutes, if the room temperature variation is less than 2°F, then S value shall be calculated at t = 5 mins.

At t =5 min, RT = 70.5°F, the new S value will be calculated based on the algorithm table. Since the previous room temperature was 71.5°F and the new room temperature is 70.5°F; the new S value will be calculated based on:

If the previous room temperature SP-0.9°F ≦RT_0≦SP+0.9°F, and the new room temperature is SP-1.8°F ≦RT_1<SP-0.9°F, then S = S + 0.9°F.

Thus, the new S is updated to S = 0.9°F. The updated T_{on}* = -7.2 + 0.9 = -6.3°F. After t=5 mins and before the S value is recalculated again, if the temperature falls below 65.7°F (setpoint +T_{on}*), the auxiliary heater will turn on. The S value calculation continues as long as the indoor unit is ON. Figure 6 shows the S value variation and the related Heater status.

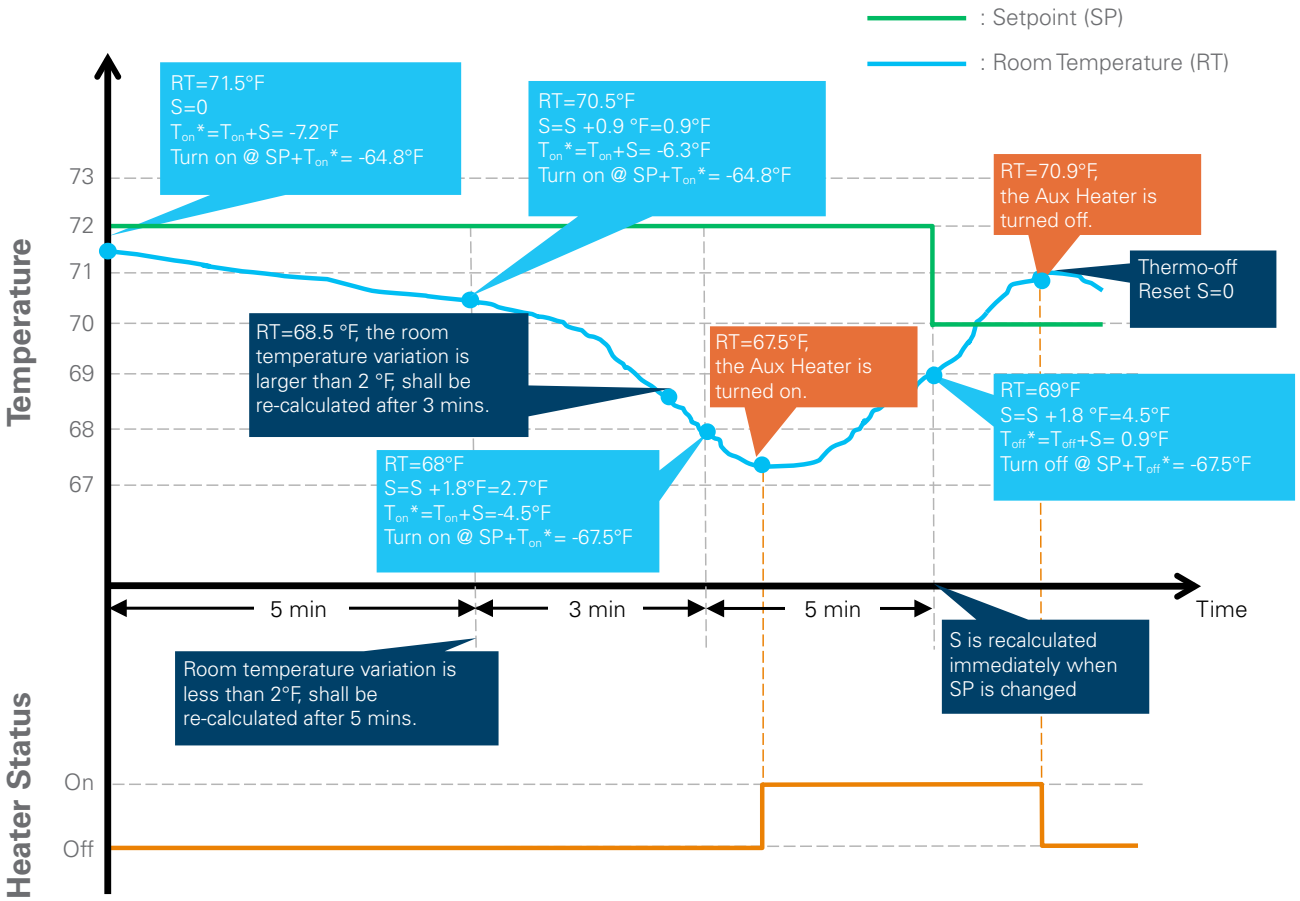
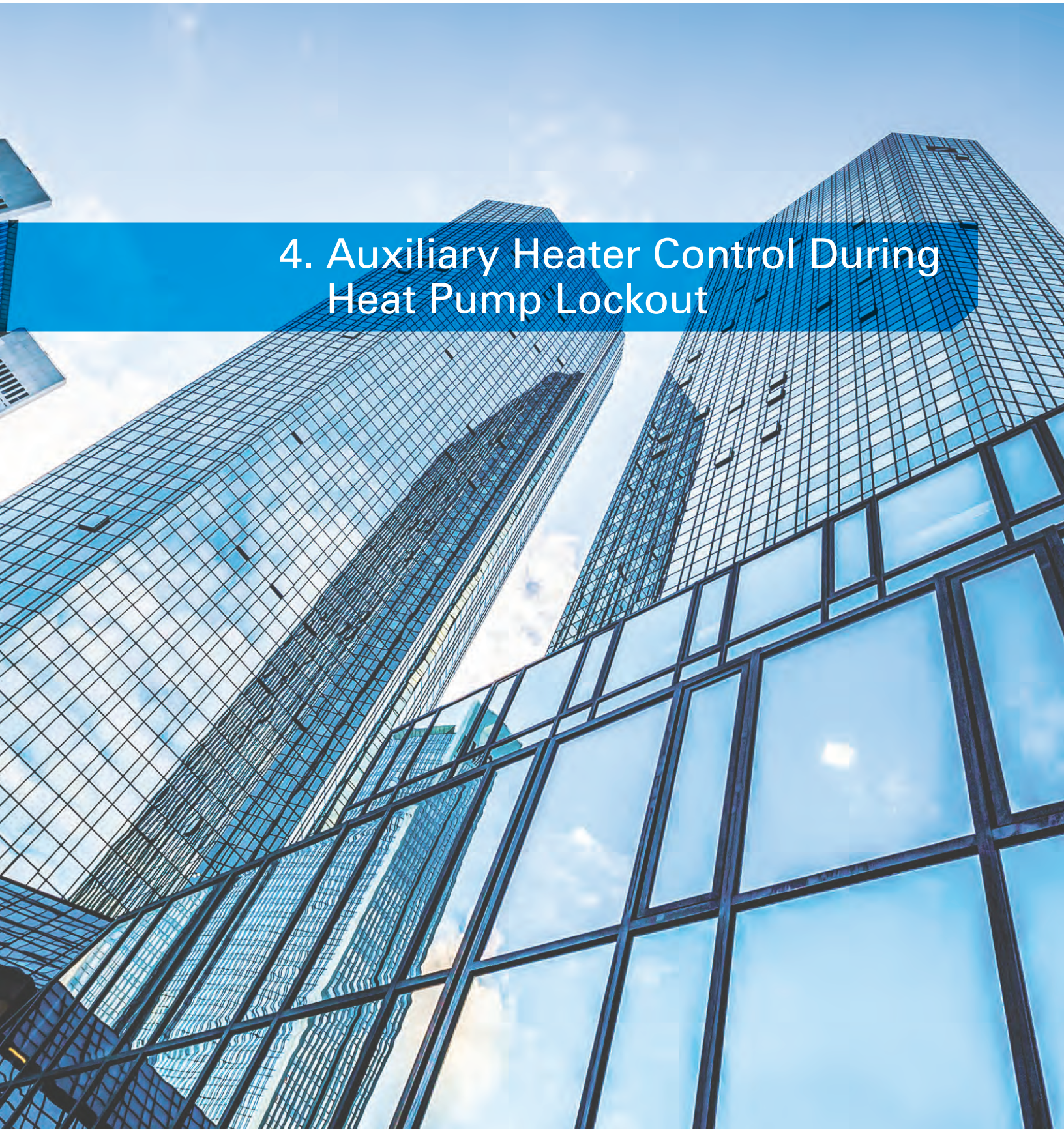


Fig. 6. An Example of the Dynamic Variation of "S" Value



4. Auxiliary Heater Control During Heat Pump Lockout

4. Auxiliary Heater Control During Heat Pump Lockout

The Heat Pump lockout mode means the outdoor unit's compressor is locked out and stopped due to preset or ambient conditions falling outside the systems operating range. When the outdoor unit is in the Heat Pump lockout mode and the indoor unit is calling for heat, the indoor unit will not provide heating, but it will energize the auxiliary heater through the KRP1C Wiring Adapter. This function usually applies to cold climate areas where the ambient temperature may fall below the VRV operation range during winter conditions.

In a Heat Pump lockout event, the KRP1C outputs will react differently from standard operation when the Heat Pump lockout is engaged. The changes are as follows:

- X1-X2 output is OFF for the duration of a Heat Pump lockout;
- X3-X4 fan status output varies depending on the outdoor unit field setting (see Table 10);
- Y2-YC is still determined by the indoor unit heating thermo-on status;
- Y1-YC auxiliary heater control logic is overridden in a Heat Pump lockout event. Y1-YC follows the same heating thermo-on logic as Y2-YC (see Table 10).

The Heat Pump lockout function is set through the outdoor unit field settings. Except for the VRV IV Water Cooled (RWEYQ) that does not have an ambient air temperature sensor, other VRV IV outdoor units have the built-in logic to lockout the outdoor unit compressor based upon ambient temperature measured by the factory-installed ambient temperature sensor. VRV III systems require an external input (i.e., a field-installed ambient thermostat) and the ABC terminal (BRP2A81) to lockout the compressor.

Table 10 summarizes different options to lock out the outdoor unit compressor, the relevant results, and compatibility with different outdoor unit models.

Table 10. Heat Pump Lockout Methods and Results

Description	How to set the lockout mode		Result				Compatibility		
	ODU Field Setting	ABC terminal shorted between	When in heating Thermo-on		When in heating Thermo-on		VRV III	VRV IV	
			Aux Heater	Fan	Aux Heater	Fan		RXYQ, REYQ, RELQ, RXTQ	RWEYQ
Heat pump heating is always locked out	2-16 = 1 (& 2-37 = 0 [4])	—	ON	ON (user set)	OFF	LL [3]	•	•	•
Lockout is controlled by ABC terminals [2]	2-37 = 1	A-C	ON	ON (user set)	OFF	LL [3]	•	•	•
		B-C				OFF	•	•	•
	2-37 = 2 [1]	A-C		LL		LL [3]	•	•	N/A
		B-C		LL		OFF	•	•	N/A
Lockout is controlled by the outdoor ambient temperature and setpoint (configured by field settings)	2-37 = 3	—	ON	ON (user set)	OFF	LL [3]	N/A	•	N/A
	2-37 = 4	—				OFF	N/A	•	N/A
	2-37 = 5 [1]	—		LL		LL [3]	N/A	•	N/A
	2-37 = 6 [1]	—		LL		OFF	N/A	•	N/A

(1) Mode 2, 5, and 6 apply to an external heater which does not need air flow (i.e.: baseboard heater).

(2) For VRV III, an ABC terminal kit BRP2A81 is required. For VRV IV-S 4 ton and 5 ton outdoor units, an ABC terminal kit BRP2A82 is needed. For other VRV IV units, the ABC terminal is factory installed.

(3) In order to set the fan speed to go to LL (Low-Low) in heating thermo-off, the indoor unit field setting 12(22)-3-01 shall be set (default value). X3-X4 output is closed in LL fan speed.

(4) To always lock out the Heat Pump heating by setting 2-16 to 1, the field setting 2-37 must be set to 0 (Default) as well. Otherwise, the setting 2-16 =1 cannot lock out the Heat Pump heating.

When applying Mode 3 - 6, the outdoor temperature is measured by the ambient temperature sensor of the outdoor unit. Therefore, no additional temperature sensor is required. Two outdoor unit field settings are required for Mode 3 - 6:

- Heat Pump Lockout Temperature
- Heat Pump Lockout Temperature Release Differential

The outdoor unit will be locked out when the outdoor ambient temp is lower than the Heat Pump Lockout Temp. The outdoor unit operation will resume when the outdoor ambient temperature rises to meet or exceed the Release Differential. The following diagram shows this logic. Additionally, Mode 3 - 6 has a minimum 30 minutes lockout time to prevent frequent Heat Pump lockout and release.

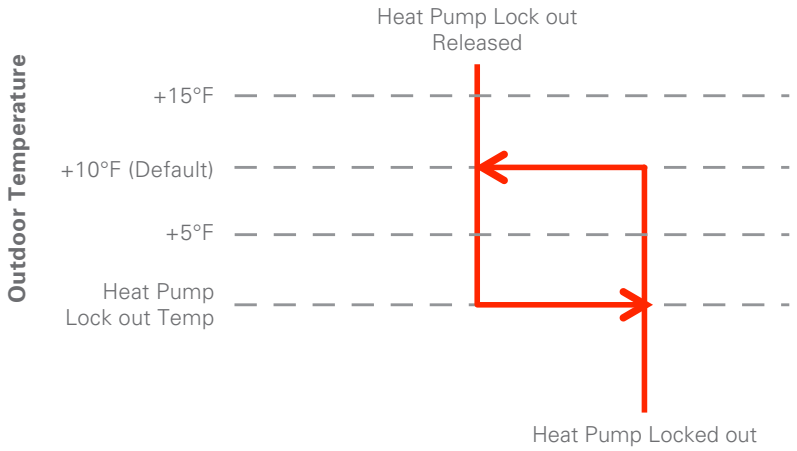


Fig. 7. Heat Pump Lockout Logic

The field setting number is different for different VRV IV outdoor units, as shown in Table 11.

Table 11. VRV IV Outdoor Unit Field Setting Numbers for Heat Pump Lockout

Outdoor Unit Field Setting \ Outdoor Unit Model	VRV IV		
	Heat Pump (RXYQ)	Heat Recovery (REYQ,RELQ)	VRV IV-S (RXTQ)
Heat Pump Lockout Temperature	2-94	2-78	2-57
Heat Pump Lockout Release Differential	2-95	2-79	2-47

The following table shows the field settings for the Heat Pump Lockout Temperature. It can be set to always lock out the heat pump.

Table 12. Heat Pump Lockout Temperature Field Setting

Field setting 2-94/2-78/2-57	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Heat Pump Temp (°F)	-15 (default)	-10	-5	0	5	10	15	20	30	35	35	40	45	50	Forced Heat Pump Lockout

Table 13 shows the field settings for the Heat Pump Lockout Temperature Release Differential.

Table 13. Heat Pump Lockout Temperature Release Differential Field Setting

Field setting 2-94/2-78/2-57	0	1	2
Heat Pump Lockout Release Differential (°F)	5	10 (default)	15

Note: Depending on the type of error, the VRV IV outdoor unit may automatically go to lockout mode when the outdoor unit is in error (see Appendix II for list of errors). This function is another improvement compared to VRV III outdoor units, as the backup heat can remain in operation when the VRV outdoor unit is in error. When the error is cleared, the outdoor unit will exit the lockout mode if the normal Heat Pump lockout condition is not met.

Note: For the manifold outdoor units, the backup operation will take priority. If the backup operation is available, the outdoor unit will not go to lockout mode.

5. Control Logic Summary

Table 14 summarizes the related outdoor unit field settings for VRV IV outdoor units. Tables 15-19 lists the field setting details.

Table 14. Summary Table of VRV IV Field Settings for Auxiliary Heater Control

Outdoor Unit Field Setting \ Outdoor Unit Model		VRV IV				Default Setting
		Air-Cooled Heat Pump (RXYQ)	Air-Cooled Heat Recovery (REYQ,RELQ)	VRV IV-S (RXTQ)	VRV IV W (RWEYQ)	
Prohibit Aux Heater from Outdoor Unit (1)	Auxiliary Heater Max Allowable Temp	2-96	2-97	2-50	n/a	7
	Auxiliary Heater Max Allowable Temp Release Differential	2-97	2-98	2-56	n/a	1
Heat Pump Lockout	Heat Pump heating always locked out	2-16	2-16	2-16	2-16	0
	Advanced Heat Pump lock out mode	2-37	2-37	2-37	2-37 (2)	0
	Heat Pump lock out temperature	2-94	2-78	2-57	n/a	0
	Heat Pump lock out temperature release differential	2-95	2-79	2-47	n/a	1

(1) Only certain indoor unit model will follow this prohibition command. Refer to Table in Section 5.2.

(2) For VRV IV-W, 2-37 has only 0 (OFF) and 1 (Mode 1) available.

Table 15. Auxiliary Heater Maximum Allowable Temperature Field Setting

Field setting 2-96/2-97/2-50	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Auxiliary Heater Max Allowable Temp (°F)	0	5	10	15	20	25	30	35 (Default)	40	45	50	55	60	65	Aux Heater Always Prohibited	Aux Heater Always Allowed

Table 16. Auxiliary Heater Maximum Allowable Temperature Release Differential Field Setting

Outdoor unit field setting 2-97/2-98/2-56	0	1	2
Auxiliary Heater Max Allowable Temp Release Differential (°F)	5	10 (Default)	15

Table 17. Heat Pump Lockout Methods and Results

Description	How to set the lockout mode		Result				Compatibility		
	ODU Field Setting	ABC Terminal Shorted Between	When in heating Thermo-on		When in heating Thermo-off		VRV III	VRV IV	
			Aux Heater	Fan	Aux Heater	Fan		RXYQ, REYQ, RELQ, RXTQ	RWEYQ
Heat pump heating is always locked out	2-16 = 1 (& 2-37 = 0 [4])	—	ON	ON (user set)	OFF	LL [3]	•	•	•
Lockout is controlled by ABC terminals [2]	2-37 = 1	A-C	ON	ON (user set)	OFF	LL [3]	•	•	•
		B-C				OFF	•	•	•
	2-37 = 2 [1]	A-C		LL		LL [3]	•	•	N/A
		B-C		LL		OFF	•	•	N/A
Lockout is controlled by the outdoor ambient temperature and setpoint (configured by field settings)	2-37 = 3	—	ON	ON (user set)	OFF	LL [3]	N/A	•	N/A
	2-37 = 4	—				OFF	N/A	•	N/A
	2-37 = 5 [1]	—		LL		LL [3]	N/A	•	N/A
	2-37 = 6 [1]	—		LL		OFF	N/A	•	N/A

(1) Mode 2, 5, and 6 apply to an external heater which does not need air flow (i.e.: baseboard heater).

(2) For VRV III, an ABC terminal kit BRP2A81 is required. For VRV IV-S 4 ton and 5 ton outdoor units, an ABC terminal kit BRP2A82 is needed. For other VRV IV units, the ABC terminal is factory installed.

(3) In order to set the fan speed to go to LL (Low-Low) in heating thermo-off, the indoor unit field setting 12(22)-3-01 shall be set (default value). X3-X4 output is closed in LL fan speed.

(4) To always lock out the Heat Pump heating by setting 2-16 to 1, the field setting 2-37 must be set to 0 (Default) as well. Otherwise, the setting 2-16 =1 cannot lock out the Heat Pump heating.

Table 18. Heat Pump Lockout Temperature Field Setting

Outdoor unit field setting 2-94/2-78/2-57	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Heat Pump Lockout Temp (°F)	-15 (default)	-10	-5	0	5	10	15	20	30	35	35	40	45	50	Forced Heat Pump Lockout

Table 19. Heat Pump Lockout Temperature Release Differential Field Setting

Outdoor unit field setting 2-95/2-79/2-47	0	1	2
Heat Pump Lockout Release Differential (°F)	5	10 (Default)	15

Table 20 summarizes the auxiliary heater control logic, field settings, KRP1C Wiring Adapter compatibility, and mounting box/plate for each indoor unit model.

Table 20. Summary Table of Auxiliary Heater Control for Each Indoor Unit

Indoor Unit Type	Description	Ignore/Follow Outdoor Unit Prohibition(1)	Indoor Unit Aux Heater Logic	Indoor Unit Field Setting	KRP1C Compatibility	Installation Plate/Box	Connector
FXAQ_PVJU	Wall Mounted Unit	Not Available					
FXDQ_MVJU	Slim Duct Built-in Concealed Ceiling Unit	Ignored	Fixed (Type A)	N/A	KRP1C75	KRP1BA101	X16A
FXEQ_PVJU	One Way Blow	Follow	Individually Adjustable (Type C)	11(21)-1-XX (T_{on}) 11(21)-2-XX (T_{off})	KRP1C75	KRP1BA101	X33A
FXFQ_TVJU	Round-flow Cassette	Follow	Linked (Type B)	11(21)-1-xx (T_{on} & T_{off})	KRP1C75	KRP1H98	X33A
FXHQ_MVJU	Ceiling Suspended	Ignored	Fixed (Type A)	N/A	KRP1C74	KRP1C93	X16A
FXLQ_MVJU9	Floor Standing Unit	Follow	Individually Adjustable (Type C)	11(21)-1-XX (T_{on}) 11(21)-2-XX (T_{off})	KRP1C74	–	X16A
FXMQ_PBVJU	DC Ducted Concealed	Follow	Linked (Type B)	11(21)-1-xx (T_{on} & T_{off})	KRP1C74	KRP4A96	X33A
FXMQ_MVJU	Concealed Ceiling Unit	Ignored	Fixed (Type A)	N/A	KRP1C74	–	X16A
FXMQ_MFVJU	100% Outside Air Processing Unit	Ignored	Fixed (Type A)	N/A	KRP1C74	–	X16A
FXNQ_MVJU9	Concealed Floor Standing Unit	Follow	Individually Adjustable (Type C)	11(21)-1-XX (T_{on}) 11(21)-2-XX (T_{off})	KRP1C74	–	X16A
FXTQ_PBVJU	Vertical Air Handling Unit	Ignored	Linked (Type B)	10(20)-7-XX (T_{on} & T_{off})	KRP1C75	KRP1BA101	X33A
FXTQ_TAVJU	Multi-Position Air Handling Unit	Ignored	1st Stage: Individually Adjustable (Type C) 2nd Stage: related to 1st stage temp	11(21)-1-XX (T_{on}) 11(21)-2-XX (T_{off})	KRP1C75 (Not needed for HKS kit control)	KRP1BA101 (Not needed for HKS kit control)	X33A
FXUQ_PVJU	4-Way Blow Ceiling Suspended	Not Available					
FXZQ_MVJU9	2'x2' 4-Way Ceiling Cassette	Ignored	Fixed (Type A)	N/A	KRP1C75	KRP1BA101	X16A

(1) As explained in Section 3.1, VRV IV outdoor units have the control logic to set the Auxiliary Heater Maximum Allowable Temperature through outdoor unit field setting. Please note certain indoor unit models will ignore this control logic from outdoor unit. That is, the auxiliary heater controlled by these indoor units can still be enabled when outdoor unit prohibition is set.

In addition to control external heat source with the KRP1C heater output, FXTQ_TA indoor unit PCB board has factory-installed heater control outputs for Daikin produced electric heat kit (HKS series) heater control. Single stage electric heat is supported up to 10kW, and two-stage electric heat is supported up to 25kW. Field setting 11(21)-5-xx configures the capacity of the installed electric heater kit.

Table 21 provides the compatibility list for the FXTQ_TA indoor unit models and their associated allowable electric heater capacity field settings.

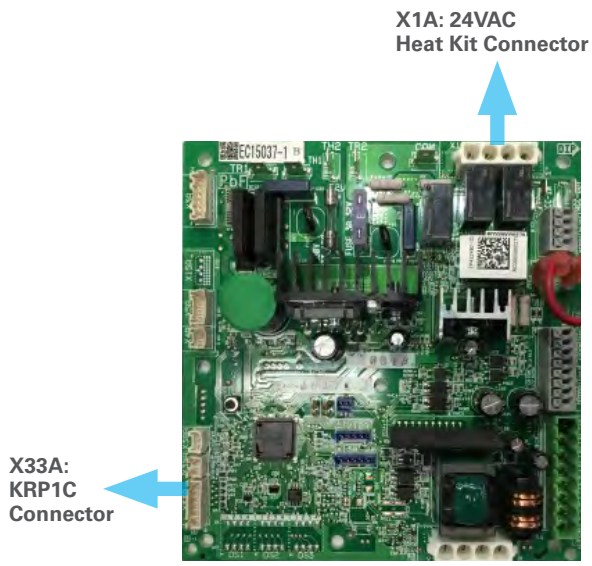


Fig. 8. FXTQ_TA Indoor Unit PCB

Table 21. FXTQ_TA Electric Heater Capacity Compatibility and Field Settings

Model	Mode No.	First Code No.	Heater (kW)									
			No Heat Kit	3	5	6	8	10	15	19	20	25
			Second Code No.									
			01*	02	03	04	05	06	07	08	09	10
FXTQ09TAVJUA	11(21)	5	•	•	•							
FXTQ09TAVJUD			•	•	•							
FXTQ12TAVJUA			•	•	•	•						
FXTQ12TAVJUD			•	•	•	•						
FXTQ18TAVJUA			•	•	•	•	•	•				
FXTQ18TAVJUD			•	•	•	•	•	•				
FXTQ24TAVJUA			•	•	•	•	•	•				
FXTQ24TAVJUD			•	•	•	•	•	•				
FXTQ30TAVJUA			•	•	•	•	•	•				
FXTQ30TAVJUD			•	•	•	•	•	•				
FXTQ36TAVJUA			•	•	•	•	•	•				
FXTQ36TAVJUD			•	•	•	•	•	•				
FXTQ42TAVJUA			•		•	•	•	•	•	•		
FXTQ42TAVJUD			•		•	•	•	•	•	•		
FXTQ48TAVJUA			•		•	•	•	•	•	•		
FXTQ48TAVJUD			•		•	•	•	•	•	•		
FXTQ54TAVJUA			•		•	•	•	•	•		•	•
FXTQ54TAVJUD			•		•	•	•	•	•		•	•
FXTQ60TAVJUA			•		•	•	•	•	•		•	•
FXTQ60TAVJUD			•		•	•	•	•	•		•	•

* Default setting • Available Not available

The first stage heater ON/OFF temperature utilized the Type C (Individually Adjust Logic) and can be configured by field settings 11(21)-01-xx and 11(21)-02-xx. The second-stage heater ON/OFF is related to the first-stage heater ON/OFF temperature, and is not adjustable. Figure 9 shows the control logic for the two stage control of FXTQ_TA series.

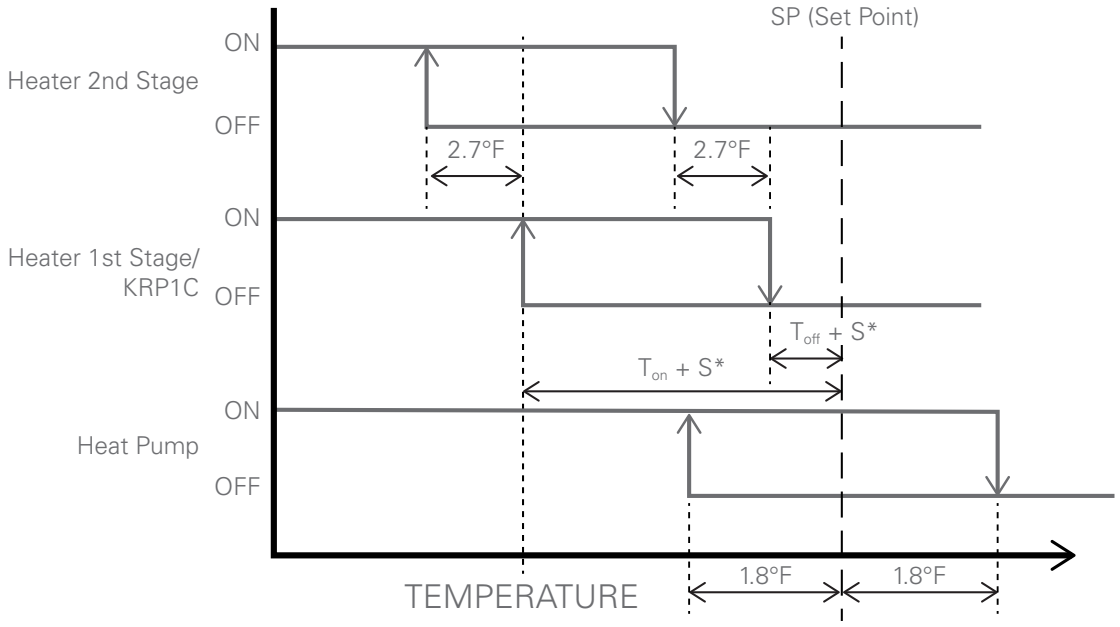


Fig. 9. FXTQ_TA Two-Stage Auxiliary Heater Output with Heat Pump Heating

The KRP1C output follows the first stage output of the heater kit. However, if no electrical heater kit (HKS series) is used but KRP1C output is used for an external heater (i.e., baseboard heater), the field setting 11(21)-5-xx needs to be changed to another available value other than the default (01) to enable the KRP1C output. If a duct heater is utilized and controlled by KRP1C, this field setting shall set to the capacity of the duct heater.

For FXTQ_TA units, indoor unit field setting 11(21)-3-XX configures to allow/prohibit the electrical heater kit to be energized when outdoor unit is actively heating and in Defrost/Oil Return operation. Table 22 shows this field setting for FXTQ_TA series.

Table 22. FXTQ_TA Indoor Unit Field Setting to Allow/Prohibit Auxiliary Heater in Heat Pump Heating and in Defrost/Oil Return Operation

Description	Mode #	First Code #	Second Code #			
			01(Default)	02	07	08
Heater Operation	11(21)	3	Electric Heater with Heat Pump not Allowed	Electric Heater with Heat Pump Allowed	Electric Heater with Heat Pump not Allowed	Electric Heater with Heat Pump Allowed
Electric Heater Run for Defrost/Oil Return Operation			Not Allowed	Not Allowed	Allowed	Allowed

Figure 10 shows the two-stage heater output during Heat Pump lockout period when the outdoor unit compressor is stopped and the aux heater provides heating to the room.

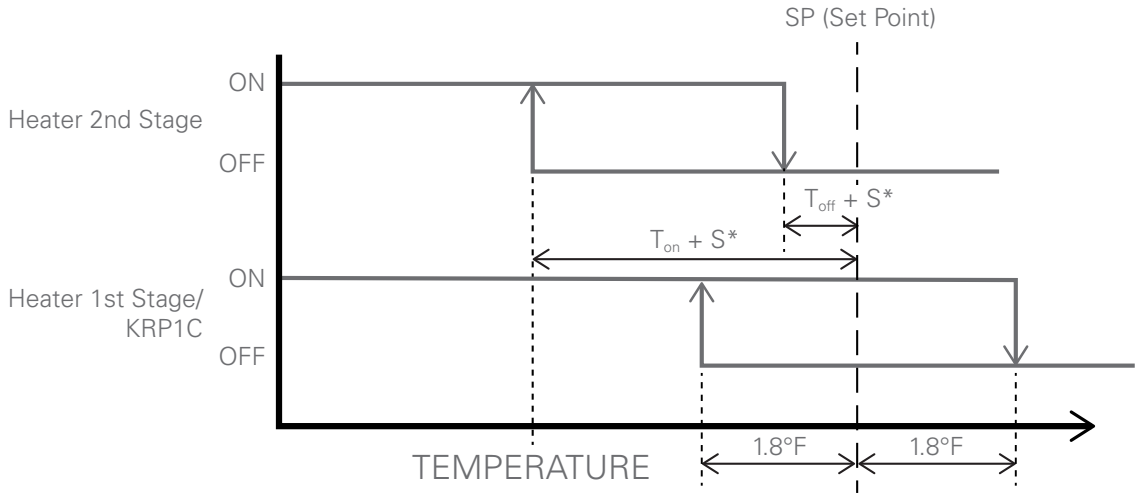


Fig. 10. FXTQ_TA Two-Stage Heater Output in Heat Pump Lockout Period

6. Applications

The application approach can vary for different heater type and applications. Since the VRV system controls the auxiliary heater at room level, the typical application is to control a baseboard heater or a ducted electric heater in a room. The wiring diagram in Figure 11 shows a typical application of controlling a single stage baseboard heater through the Y1-YC output.

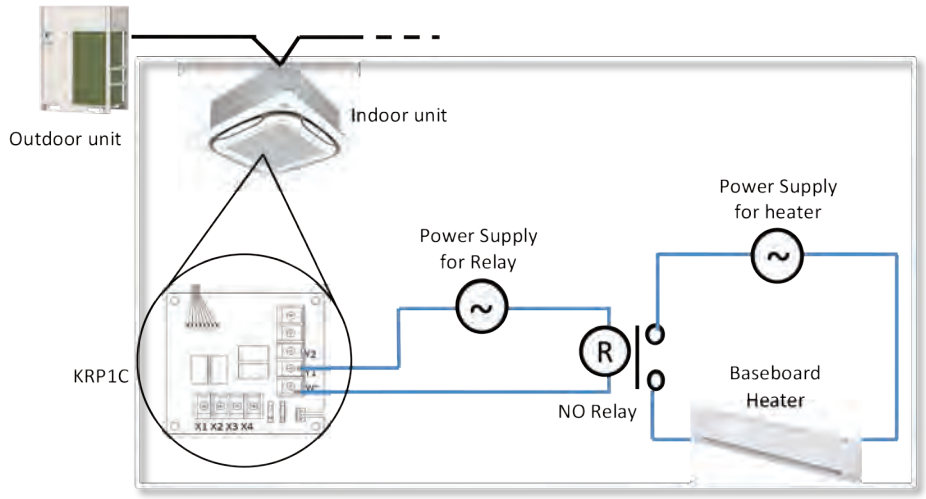


Fig. 11. Application of Controlling a Single Stage Baseboard Heater

For a retrofit building, the auxiliary heater controller can be used to integrate a pre-existed heater source, such as a boiler. The wiring diagram in Figure 12 shows a possible configuration to integrate the boiler into the VRV system as an auxiliary heater. The boiler needs to be controlled at the system level with an independent controller. The individual indoor unit can control the valve of the hot water that enters the room.

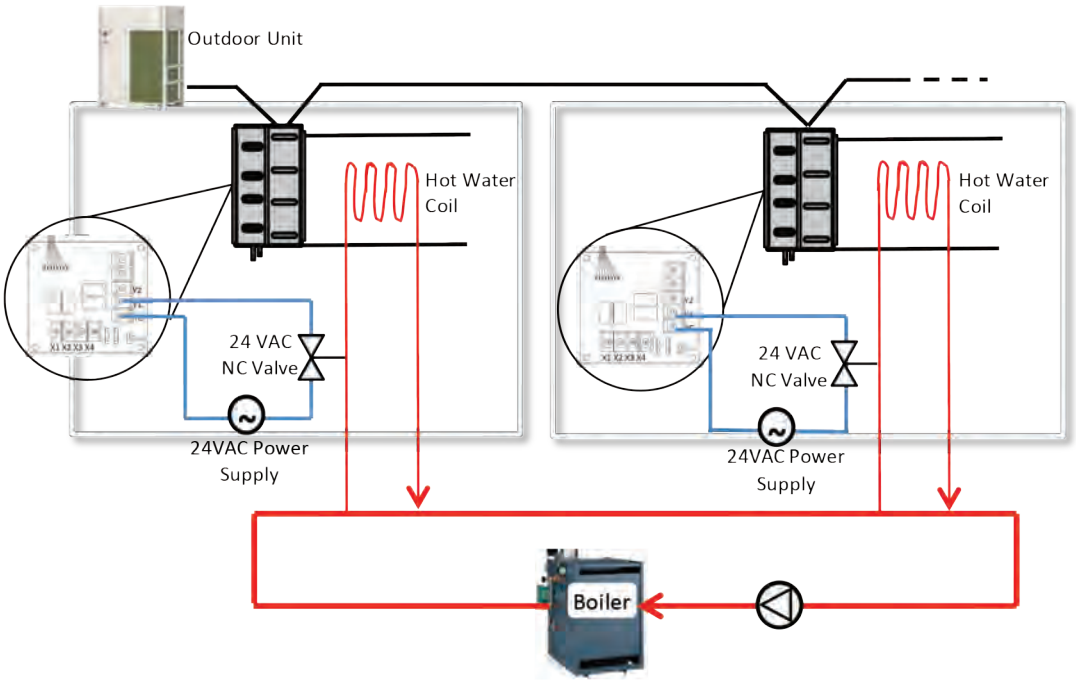


Fig. 12. Application of Integrating a Boiler in a Retrofit Project

Since the auxiliary heater control output is an ON/OFF signal that cannot provide modulating control to heaters, an additional controller is needed for stage control or modulating control. Figure 13 shows an approach to control a ducted electric heater by an additional SCR Controller. The indoor unit enables the heater ON/OFF, while the SCR heater controls the modulating of heater output.

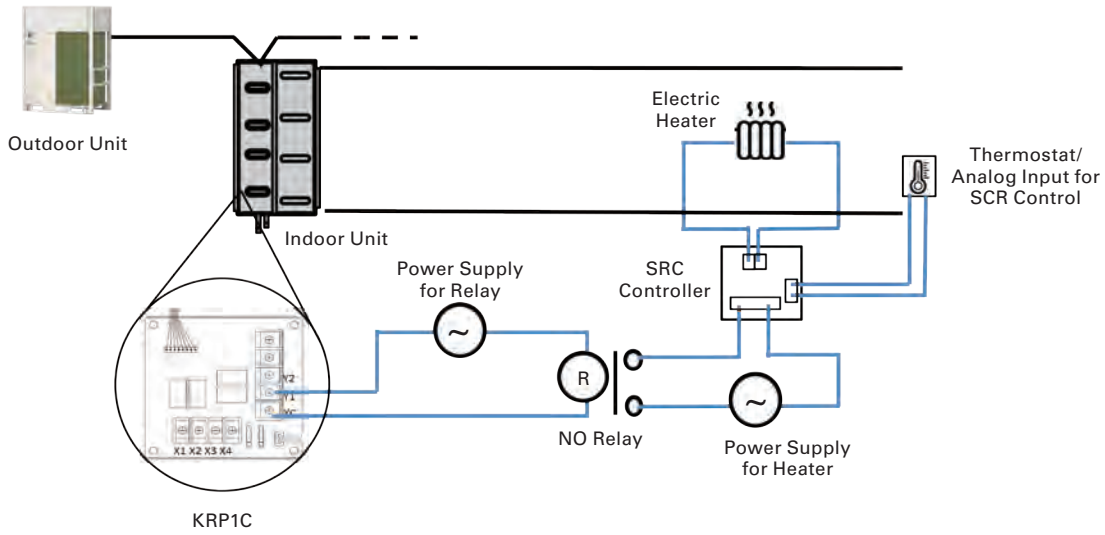


Fig. 13. Application of Controlling and Modulating a Ducted Heater with an Additional SCR Heater

6.2 Control Configuration

The following settings in Table 23 need to be considered at the design stage and configured at the commissioning stage.

Table 23. Auxiliary Heater Configuration Considerations

What to Control		What to Consider	Related Settings	ODU Field Setting Number and Value	IDU Field Setting Number and Value
Auxiliary Heater with Heat Pump heating	Prohibit the Auxiliary Heater in high ambient temperature	1. Will the connected indoor unit follow this outdoor unit command? 2. Preferred prohibit/ release temperature	Auxiliary Heater Max Allowable Temp		N/A
			Auxiliary Heater Max Allowable Temp Release Differential		N/A
	Indoor Unit Auxiliary Heater Control Logic	1. The available T_{on}/T_{off} field setting for the specified indoor unit 2. Preferred T_{on}/T_{off} value 3. The type of auxiliary heater and preferred fan speed in thermo-off period	T_{on}/T_{off}	N/A	
			Fan speed in thermo-off	N/A	
Auxiliary Heater as Primary Heater in Heat Pump Lockout		1. Whether to always lockout the Heat Pump or only lockout the Heat Pump at predetermined low ambient temperature 2. Preferred fan speed when the room is in thermo-off 3. Preferred temperature to lock out and release the Heat Pump heating	Heat Pump heating always locked out		N/A
			Advanced Heat Pump lockout mode		N/A
			Heat Pump Lockout Temperature		N/A
			Heat Pump Lockout Temperature Release Differential		N/A

6.3 Contact Information

For more information, please contact the VRV Controls Product Marketing Team at VRVControlsMarketingGroup@daikincomfort.com

Appendices

Appendix I – List of Errors That Turn Off the Indoor Unit Fan in Certain Situations

Table 24. List of Errors That Turn Off the Indoor Unit Fan in Certain Situations

Error Code	Error Description	Will the error code always turn off the indoor unit fan?
A0	External protection device abnormality	Always
A1	Indoor unit PCB abnormality	Always
A6	Indoor fan motor (M1F) lock, overload Indoor fan motor abnormality Overload/overcurrent/indoor fan motor lock	Always
A8	Power supply voltage abnormality	Always
AJ	Capacity determination device abnormality	Not Always (in certain situations, the indoor unit fan will stop; in other situations, the fan will continue running)
C1	Transmission abnormality (between indoor unit PCB and fan PCB)	Not Always (in certain situations, the indoor unit fan will stop; in other situations, the fan will continue running)
C6	Combination abnormality (between indoor unit PCB and fan PCB)	Always
E1	Outdoor main PCB abnormality	Always
E3	Activation of high-pressure switch	Always
U0	Refrigerant shortage	Always
U5	Transmission error between remote controller and indoor unit	Always
UA	Improper combination of indoor and outdoor units, indoor units and remote controller	Always
UE	Transmission error between centralized controller and indoor unit	Depends on whether a remote controller is available (If a remote controller is available, the indoor unit fan will continue operating)

Appendix II – List of Errors That Enable the Heat Pump Lockout Automatically for VRV IV

Table 25. List of Errors That Enable the Heat Pump Lockout Automatically for VRV IV

Error Code	Error Description	Function of Heat Pump Lockout Automatically				
		VRV IV HP (RXYQ)	VRV IV HR (REYQ)	VRV IV AURORA (RELQ)	VRV IV-S (RXTQ)	VRV IV W (RWEYQ)
E3	Actuation of high-pressure switch	•	•	•	•	N/A (Cannot lockout the Heat Pump automatically when in error)
E4	Actuation of low-pressure sensor	•	•	•	•	
E5	INV. compressor motor lock	•	•	•	•	
E6	Compressor damage alarm	•	•	•	N/A	
E7	Outdoor unit fan motor abnormality	•	•	•	•	
E9	Electronic expansion valve coil abnormality	•	•	•	•	
H3	Harness abnormality (between control PCB and inverter PCB)	•	•	•	N/A	
H7		•	•	•	•	
H9	Outdoor air thermistor (R1T) abnormality	•	•	•	•	
F3	Discharge pipe temperature abnormality	•	•	•	•	
F4	Wet alarm	•	•	•	N/A	
F9	BS Electronic expansion valve coil abnormality	•	•	•	•	
J3	Discharge pipe thermistor (R21T, R22T) abnormality Compressor surface temperature thermistor (R8T) abnormality	•	•	•	•	
J5	Accumulator inlet thermistor (R3T) abnormality	•	•	•	•	
J6	Heat exchanging deicer thermistor (R7T) abnormality Heat exchanging gas thermistor abnormality	•	•	•	•	
J7	Subcooling heat exchanger liquid pipe thermistor (R5T) abnormality	•	•	•	•	
J8	Heat exchanger liquid pipe thermistor (R4T) abnormality	•	•	•	N/A	
J9	Heat exchanger gas pipe thermistor (R6T) abnormality	•	•	•	•	
JA	High-pressure sensor abnormality	•	•	•	•	
JC	Low-pressure sensor abnormality	•	•	•	•	
L1	Inverter PCB abnormality	•	•	•	•	
L3	Reactor temperature rise abnormality	•	•	•	N/A	
L4	Inverter radiation fin temperature rise abnormality	•	•	•	•	
L5	INV. compressor instantaneous overcurrent	•	•	•	•	
L8	INV. compressor overcurrent	•	•	•	•	
L9	INV. compressor startup abnormality	•	•	•	•	
LC	Transmission error between inverter and control PCB	•	•	•	•	

Notes

ADDITIONAL INFORMATION

Before purchasing this appliance, read important information about its estimated annual energy consumption, yearly operating cost, or energy efficiency rating that is available from your retailer.

Daikin is one of the largest manufacturers of HVAC products in North America delivering environmentally-friendly conscious, air intelligent technology solutions for residential, commercial, and industrial applications.