GENERAL
This manual contains basic information to assist trained and qualified personnel with correct installation, start-up and maintenance of APAC packaged units.

SAFETY CONSIDERATIONS
Installation and servicing of air conditioning equipment can be hazardous due to system pressure and electrical components. Only trained and qualified service personnel should install, service or maintain air conditioning equipment.

- Follow good safe working practices when working on air conditioning equipment.
- Observe all precautions stated in the product literature and any tags or labels attached to the unit.
- Other safety precautions such as local area standards and codes may also apply.

INSPECTION
Remove all packaging and any other protective packing from cabinet, fans, coils and pipe work. Check items received correspond against packing list.
Examine unit for damage, which may have occurred in transit. Notify and document any damage on the delivery docket. Notify the manufacturer's sales representative of any damage and photograph where possible.

RIGGING AND LIFTING
Unit weights and dimensions are detailed in the equipment technical data sheets. Ensure unit is kept upright and is not dropped. Slings may be inserted to the lifting points however spreader bars MUST be used over unit to prevent sling or chain damage. Rollers may be used to move units only on underside of mounting feet.

UNIT LOCATION AND SUPPORT
The equipment must be installed in accordance with relevant local standards and codes.
Provide a solid level mounting pad and if possible, extend a minimum of 150mm beyond unit foot print.
NOTE prevent obstructing airflow to condenser coil.
Maintain minimum clearances above and around unit as per general arrangement drawing to ensure adequate air flow and service access.
Ensure unit is level and secure using the mounting holes as per general arrangement drawing with suitable fixings. Ensure all access panels open and close correctly.

DRAIN CONNECTION
An adequate drain line trap must be installed downstream of indoor coil for condensate run-off. The drain pipe should be installed with a continuous downward grade away from the unit. The gradient should not be less than 1:50. Reverse cycle systems will release water from the outdoor coil during defrost. Where required, water should be drained to waste to prevent build-up of water around the unit. **NOTE** where installed indoors, outdoor units should be mounted within a drain pan that is drained to waste.

DUCT CONNECTIONS
Where applicable units are fitted with flange connections as standard. When connecting ductwork to unit, never drill through the unit panels, this could damage or burst internal piping. Only fix to the flange connections provided.
NOTE Install flexible duct connections to prevent vibration transmittal.
All duct work passing through unconditioned space must be insulated and covered with an appropriate vapour barrier.
Insulate and weatherproof all external ductwork, joints and openings in accordance with applicable standards and codes.

EXHAUST DUCTS
Where high static outdoor fan option applies, exhaust ducts fitted to the fans / unit MUST have a removable section to allow for service access to the outdoor fan terminal box and allow the fan to be replaced in the event of failure.

FILTRATION
Return air filters must be fitted upstream of the indoor coil to prevent the heat exchanger from becoming dirty. This results in lack of air flow, increased input power and frosting of the coil in cooling and nuisance high pressure trips in heating.

ELECTRICAL CONNECTION
All electrical work must be carried out by qualified and licensed electricians and must be installed in accordance with all relevant local standards and codes.

Cable sizing is dependant of site conditions and regulations applicable to each application and is therefore deemed the responsibility of the others.

Electrical ratings are detailed in the technical data sheets and electrical wiring diagram however the electrical installation requirements are generally as follows:

- The mains power supply for the unit shall be supplied directly from a mains distribution board.
- A field supplied lockable mains power isolator shall be fitted to the incoming mains power at the unit.
- Pre-punched holes are provided in the outdoor cabinet structures and electrical enclosure for mains and control cable entries.

NOTE care MUST be taken when drilling cabinet or panels as high-pressure refrigeration pipes may be located behind.

CONTROL WIRING CONNECTION

A field supplied 24-volt control cable shall be installed from the unit to a field supplied thermostat as per the electrical wiring diagram.

Cable sizes and corresponding cable lengths are:

Cable Size	Max Recommended Cable Length
1.0mm2	100M
0.5mm2	70M

Avoid running control cables near other power sources to minimise electromagnetic interference from components, e.g. electrical motors, transformers, high current cables.

PRE-COMMISSIONING

Do not attempt to start unit, even momentarily, until the following steps have been checked and completed.

1. **Compressor Restraints** Check the compressors restraints have been removed.
2. **Power and Controls** Check mains power and supply voltage must conform to the specifications detailed in the technical data and unit nameplate. For connections refer to the electrical wiring diagrams supplied with the unit.
3. **Residual Current Operated Device** Check mains breaker is adequate for unit FLA. Where RCD is fitted, only use universal (type B, B+) RCD protective device. Like frequency inverters, RCD protective devices cannot provide personal safety while operating the device. When switching on the power supply of the device, pulsed charge currents from the capacitors in the integrated EMC filter can lead to the RCD protective devices triggering without delay. We recommend residual current devices with a trigger threshold of 300mA and delayed triggering. (Super resistant, characteristic K).
4. **Phase Imbalance** Check voltage across each phase, if phase imbalance exceeds 2% for voltage contact the local electricity supplier.
5. **Phase Rotation** Check phase rotation on incoming mains using a phase-rotation meter and check L1-L2-L3 for clockwise rotation.
6. **Electrical terminals** Check all mains electrical and control wiring connections in the electrical enclosures and ensure terminations are tight.
7. **Indoor and Outdoor Coils** Check packaging has been removed and check fin material and repair any damaged fins.
8. **Indoor fan(s)** Check packaging has been removed and fan assembly is secure in case of movement during transportation. Check fan wheel or impeller moves freely and has no restrictions.
9. **Outdoor fan(s)** Check fan blade moves freely and has no restrictions.
10. **Return Air Filters** Check that filters are installed up stream of the evaporator coil.

START-UP

Please follow this step-by-step process for start-up:

1. **Supply Air Fan** Select fan only operation at the unit controller stat and balance the supply air throughout the total system. Adjust the indoor fan speed via the speed selector switch and potentiometer located in the electrical junction box of the indoor unit whilst in operation. **NOTE** refer the min/max air volumes detailed in the fan performance data.
   Speed Selector Dial Positions 0 to 7
   0=Lowest speed
   7=Highest speed
   Speed Selector Switch Positions H-M-L
   H=High speed
   M=Medium speed
   L=Low speed
2. **Refrigeration Circuit** Connect suitable pressure gauges to the compressor suction and discharge service ports provided.
3. **Cooling Test** Select cooling mode on the unit controller and lower the set point temperature to minimum.
   - Observe gauge pressure and ensure compressor is running in the correct rotation. If compressor is noisy and incorrect pressures exist, rotate two of the three incoming mains phases to correct compressor rotation.
   - Allow system to stabilise by running for approx. 15 minutes without adjustments.
   - Once stable record system operating pressures and temperatures on refrigeration pressure gauges.
   - Also, record surface temperature of both the suction pipe at the TXV and liquid line prior to filter drier using a touch probe.
4. **Measuring Super Heat & Sub Cooling**
   Discharge temp on gauge = SCT
   Suction temp on gauge = SST
   Suction Pipe Surface Temp = ST
   Liquid Pipe Surface Temp = LT
5. **System Super Heat** Calculate system super heat: ST - SST = System super heat. Result should be between 4-8degC
6. **System Sub Cooling** Calculate system sub cooling: SCT - LT = System sub cooling. Result should be between 4-8degC
7. **Fine Tune** Measure and record outdoor ambient temperature, indoor return and supply air temperatures. Preferably measure and record wet bulb temperatures using a psychrometer. It may be required to adjust indoor fan airflow for desired volumes once evaporator coil starts removing moisture and is wet loaded.
8. Complete the start-up commissioning process by recording the required data in the Start-up Checklist & Commissioning Data Sheet.
9. For reverse cycle systems switch the system to heat mode on unit controller and ensure the system operates in a stable manner.

10. Once again record pressures, temperatures, super heat and sub cooling on the Start-up Checklist & Commissioning Data Sheet.
11. Systems fitted with TXV's may require some adjustments to obtain the desired operating conditions.

SEQUENCE OF OPERATION

This section details the basic sequence of operation of the air conditioning system and may differ depending on the options fitted to the unit.

Fan Only Mode When fan only mode is selected at the unit controller, the indoor fan will run continuously. There should be no abnormalities or excessive air noise.

Cooling Compressor and condenser fan(s) will be energised if the room temperature is above the controller set point.
Compressor and condenser fan will de-energise if the room temperature is below the controller set point, leaving the evaporator fan to run continuously.
Throughout operation the system will cycle on/off in this manner.
Short cycle protection, built into the NR-1 controller prevents the compressor from restarting for at least 5 minutes after it has switched off.
The NR-1 also provides 5 second time delay between stating the compressor and the outdoor & indoor fans.
A 2-minute time delay for the compressor is provided at the initial start-up of the system.

Heating (Reverse Cycle systems only) Reversing valve, compressor and condenser fan(s) will energise if the room temperature is below the controller set point.
Reversing valve, compressor and condenser fan(s) will be de-energised if the room temperature is above the controller set point, leaving the evaporator fan to run continuously. Throughout operation the system will cycle on/off in this manner.
When the compressor is started in heat mode, the LP switch is monitored for 20 second of operation and then bypassed for 3 minutes, after which it switches back to being monitored.

Defrost Mode (Reverse Cycle systems only) Defrost control is reverse cycle type. It is activated when the temperature of the outdoor coil falls below –5ºC provided the accumulated compressor run time exceeds 30 minutes. Defrost cycle is deactivated when the outdoor coil temperature exceeds 10ºC or when defrost time exceeds 10 minutes. Typical defrost period is two to four minutes.
When defrost is active the reversing valve is de-energised and the outdoor fan(s) are turned off. The indoor fan continues to run during defrost unless otherwise requested.

Fault Lockout The NR-1 detects and responds to a number of fault conditions depending on the application. The error codes are displayed on the NR-1 controller. Refer to the fault codes and resetting methods included in this manual.

Outdoor Fans The outdoor fan(s) have two modes of operation depending on the following.

- In cooling the fan(s) speed is controlled via capacitor. The PCB senses ambient temperature, and switches between High and Low speed according to the ambient temperature.
- In heating the fan(s) run full speed.

MAINTENANCE

To ensure optimum performance and minimise premature equipment failure, routine maintenance must be performed on the air conditioning equipment. The units should be inspected at least once each year, by a qualified service person.

The absolute minimum requirements can be broken into monthly, quarterly and yearly periods:
Monthly Inspect return air filters. Replace throwaway type filters when they become clogged with dust and lint. Clean washable type filters monthly.
Quarterly Inspect outdoor coil and clean when necessary, refer coil maintenance section detailed later in this section.
Check for abnormalities such as vibration or excessive noise.
Check condensate drain pan for build-up of dirt and grime to prevent unwanted smells during the change of seasons. Refer drain pan cleaning process detailed later in this section.
Yearly The unit must be thoroughly inspected by a qualified service person on a yearly basis. In general, the following process is to be carried out.
Coil Maintenance Routine cleaning of coil surfaces is essential to maintain optimum performance of the unit. Surface dirt should be removed with a soft non-metallic bristle brush or a vacuum cleaner with soft bristle nozzle. In either case the movement should at all times be in the direction of the fins. All surface dirt must be completely removed prior to washing with low velocity water.
Condensate Drain Pan Check and clean drain pan. Clean the condensate pan using mild detergent and remove any dirt and grime build up in the drain outlet.
Indoor Fan(s) Check the fan housing and wheel for cleanliness.
Outdoor Fan(s) Check the axial fan and blades for cleanliness.
Cabinet and Insulation Inspect the unit cabinet and insulation for damage and corrosion. Repair where necessary. Check for abnormal vibrations and excessive noise. Correct where necessary.
Refrigeration components Inspect refrigerant tubing for oil accumulations. If oil is detected, leak test

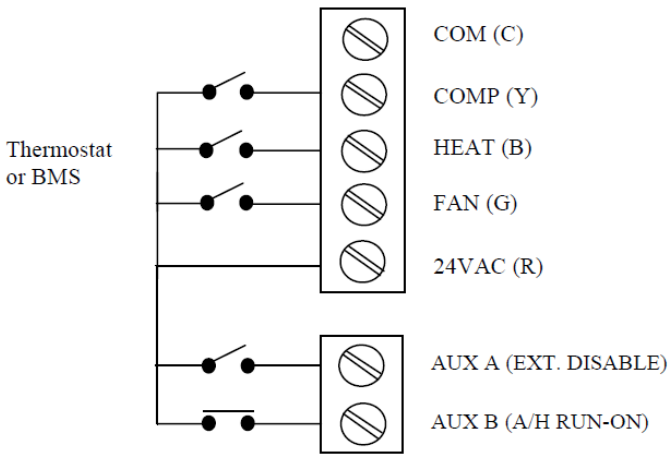
refrigerant tubing using an electronic leak detector or liquid soap solution.
System Performance In general satisfactory system performance can be evaluated from air on / off temperature readings of both indoor evaporator and outdoor condenser.

NR-1 CONTROL BOARD INTRODUCTION

The NR-1 is an intelligent electronic control board for single stage, reverse cycle air-conditioning systems. It has the following features:

- Support for standard 24VAC thermostats
- Ambient and defrost (outdoor coil) temperature sensors
- HP / LP fault detection with automatic retry
- Dual 7-segment display for the status and fault indication
- 3 push buttons for configuring the control
- 24Vac input for disabling the system from an external source such as a time clock or building management system.
- Voltage free fault output (contact) to notify external systems of a problem.
- Up to eight fault conditions can be stored in memory for later retrieval by qualified service personal
- Detection of up to four additional fault conditions which include indoor fan overload, outdoor fan overload, compressor overload and phase failure.

External 24VAC Unit Controller Any standard unit Controller or building management system can control the NR-1. This is accomplished by connecting the 24VAC (R) stat terminal to the appropriate input. See below.

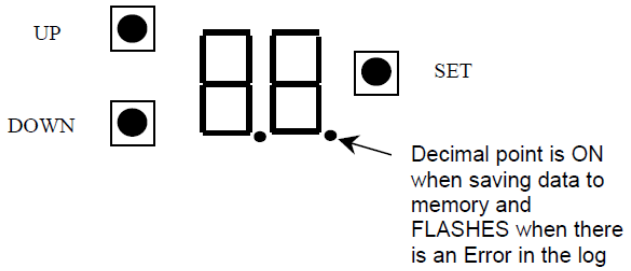


User Interface

The NR-1 user interface consists of 3 push buttons and a dual 7-segment display, which provides the following capabilities:

- Display the normal operating state
- Display of fault conditions if they exist
- Provide diagnostic information
- Enable the user to configure the control by setting various parameters
- Enable 'Speed-Up' and override 'Start Delay' mode for service personal
- Reset the control

Three push buttons, UP, DOWN and SET, navigate the system.



When power is first applied or a reset has been performed, the NR-1 will perform its normal boot-up sequence. This includes initialising hardware and software, checking the integrity of the non-volatile memory and allowing the system to stabilise before performing any functions. **NOTE** Pressing UP+DOWN+SET will reset the NR-1

Power-Up The following sequence is displayed during boot-up

8.8.	Power up
nr-1	Name of the control
rX	Revision of the firmware. The revision number replaces X.

NOTE After the above sequence is complete, the system start delay will be shown. See below.

Start delay When the NR-1 is first powered and it completes the start-up sequence, it is subject to a start delay. The default power up delay is 2 minutes. However, the remaining time is displayed after the 'start-up' sequence has completed. If the time is greater than 99 seconds, the display will only show the remaining minutes. Once the time is 99 seconds and below, the display will show seconds.
This time may be changed from 0 to 255 seconds. See the ''Installer Configuration'
This may be **overridden** by pressing the UP button during the start delay.

Speed Up To assist installation and service, the NR-1 can be put into Speed Up mode. This is enabled by holding the DOWN button during the start-up sequence.

(it doesn't take effect on 5 minutes time delay to change the Indoor Fan speed). **NOTE** If the NR-1 is left in Speed Up mode for longer than 30 minutes, the control will perform a self-reset so it returns to normal.

Normal When no menus are being accessed, the display remains in 'Normal' mode. In this mode, the following can be displayed depending on the status of the system.

oFF	System is OFF
FAn	Indoor fan is operating
rE / rd	'rE' indicates the R-valve is energised and 'rd' means system is still in heat mode, but valve has been de-energised cause the compressor has been off for more than 120 minutes.
Cool	The system is cooling
HEAt	The system is heating
LP-bi	The LP bypass is active
AuH	Auxiliary heat is operating
Hi	The outdoor fan is operating at high speed
Lo	The outdoor fan is operating at low speed
FiLt	A filter change is required
SPEEd	The system is in speed-up
Er --	'Er' followed by a number, indicates the current error
DELAy	The 5-minute compressor cycle delay is running
E-oFF	There is an external system OFF (AUX A input)
dEF	The system is in defrost
noFan	No call for indoor FAN(G) input was detected 10 seconds after the COMP(Y) call OR the FAN(G) was cleared before COMP(Y).

Installer Configuration The default settings on the NR-1 will be suitable for most installations. However, the following allows the NR-1 to be customised to suit a particular installation.
The NR-1 can be configured directly via the NR-1 user interface.

Entering Installer Parameters To access the installer parameters, press the SET button while the NR-1 is in the normal display mode.
Exiting Installer Parameters To exit the installer parameters, hold the SET button until '- -' is displayed. The display will then return to normal.

Setting Installer Parameters When you enter the parameter setting mode and no buttons are being pressed, the first parameter will scroll across the display. Using the UP and DOWN buttons to select the parameter you wish to modify.
Holding down the SET button will display the parameter's current value. To adjust the value, while holding SET down, use either UP or DOWN buttons.

NOTE If you hold the SET button down longer than 5 seconds without touching any other buttons, the system will exit the parameter mode and return to the 'Normal' display mode.

NOTE When changes have been made to any parameters, they are written to non-volatile memory approximately 5 seconds after the last change.

Restoring Default Installer Parameters
To restore the default installer parameters, press the UP and DOWN buttons together while in the installer parameter menu.
WARNING: After making a parameter change, you must wait 10 seconds before removing the power to ensure the changes are stored. This is not applicable to a manual reset.

PARAMETERS

The following is a list of installer parameters available.

Operating Mode						
Type	**ID**	**Default**	**Min.**	**Max.**	**Scaling**	**Units**
Installer	2	1	1	3	1	Reverse Cycle (1) Cool Only (2) Heat Only (3)

The above parameter is the operating mode for the NR-1. It determines if the system is reverse-cycle, cool only or heat only.

System Start Delay						
Type	**ID**	**Default**	**Min.**	**Max.**	**Scaling**	**Units**
Installer	3	120	1	255	1	Seconds

The above parameter determines the operating delay before the system commences operating after power up. This is to reduce the initial in-rush on a circuit where there are multiple systems.

Continuous Fan During Defrost						
Type	**ID**	**Default**	**Min.**	**Max.**	**Scaling**	**Units**
Installer	5	1	0	1	1	OFF (0) ON (1

The above parameter enables the indoor fan to operate during a defrost cycle when it is operating in 'Continuous' or 'Automatic' fan mode. This is enabled as standard for commercial situations where the indoor fan must always operate.

FAULTS

The NR-1 can detect and respond to a number of fault conditions. These errors are displayed on both the NR-1 and are stored in the NR-1 internal memory for later retrieval by qualified service personnel.

Limp The fault is isolated and the system continues to operate, but at diminished capacity. If the fault is removed, the control automatically clears the fault

Retry The fault will cause the condenser unit (not the indoor fan or auxiliary heat) to temporarily lock out for 10 minutes. It will then attempt to restart the system if the fault has cleared. The control will perform up to 2 retries and if a 3rd 'Retry' type fault occurs within 1 hour of the last, the

system will enter 'Full Lockout'. If no fault occurs within the 1 hour, the retry count is reset to zero.
If a 'Retry' type fault is still present after 10 minutes when the system attempts to restart, a full lockout will occur when the system attempts to restart

Self-resetting lockout This type of fault will cause the total system (including indoor fan and auxiliary heat) to lockout until the fault clears. When the fault clears, the control performs a full reset.

Full lockout Depending on the fault type, either the condenser unit or the total system will be locked out. Once the lockout is initiated, it requires someone to intervene and reset the control

ERROR CODES

Error Code	Description	Type
31	Ambient sensor short	Limp
32	Ambient sensor open	Limp
33	Defrost sensor short	Limp
34	Defrost sensor open	Limp
35	NR-1 Internal Error	Limp
41	LP trip	Retry
42	HP trip	Retry
43	LP bypass failure	Retry
51	LP lockout	Lockout
52	HP lockout	Lockout
53	LP bypass lockout	Lockout
54	Compressor fault or Soft starter temperature sensor trip	Lockout
55	Outdoor fan fault	Lockout
56	Indoor fan fault	Lockout
57	Low 24VAC	S/R Lockout
58	No 24VAC	S/R Lockout
59	Phase fault	S/R Lockout

S/R is Self-Resetting

Resetting Faults
HP, LP, compressor and outdoor fan lockouts can be reset by the following:
- Cycling the COMP(Y) terminal OFF-ON.
- Resetting the control by pressing UP+DOWN+SET or cycling the power

Indoor fan lockout can be reset by the following:
- Cycling the FAN(G) terminal OFF-ON.
- Resetting the control by pressing UP+DOWN+SET or cycling the power

NOTE All the above methods will result in the NR-1 performing a complete reset.

Common Fault Output
An output is provided to indicate the following:
- Limp errors
- Lockout errors

This output is a voltage free, relay contact that is closed during a fault condition.
The fault output will be activated 5 seconds after the fault has been registered by the control.
WARNING: The output is only rated for 24 Volt.

Equipment Warranty Registration Form

To comply with the terms of Product Warranty, complete and return this page within 10 days of commissioning to your Rinnai Representative

Start-up and Commissioning checklist for APAC units. (See Note)

Unit Model Number:		Unit Serial Number:	
Project			
Job Name:			
Installation Address:			
Technician			
Name of technician doing the start-up (Print):			
Company Name:		Contact Number:	
Pre-Commissioning (Tick each box when complete)			
☐ All transport packing removed		☐ Phase rotation is correct	
☐ Drain connected and installed as per instructions		☐ Electrical terminals checked for tightness	
☐ Compressor restraints removed		☐ Coils protection removed and any damaged fins repaired	
☐ Mains power conforms to the name plate		☐ Indoor fan moved freely	
☐ Residual circuit breaker is rated for 300mA		☐ Outdoor fan moves freely	
☐ Phase imbalance is within 2%		☐ Return air filter is installed and clean	
Power			
Mains supply voltage	L1-L2:	L2-L3:	L1-L3:
Compressor(s)			
Compressor 1 Model No.		Compressor 2 Model No.	
Compressor 1 Serial No.		Compressor 2 Serial No.	

Start-Up (Record the following data after at least 15 minutes run time)

Pressures / Temps	Stage 1		Stage 2		Unit Measure	Ok or N/A
	Cooling	Heating	Cooling	Heating		
Suction Pressure					kPa	
Suction Pipe Temp					ºC	
Discharge Pressure					kPa	
Discharge Pipe Temp					ºC	
Liquid Pipe Temp					ºC	
Superheat					ºC	
Sub-cooling					ºC	
Ambient Temp					ºC	
Air on Indoor Temp					ºC	
Air off Indoor Temp					ºC	
Running Amps (Record the following data after at least 15 minutes run time)						
Compressor(s) L1					A	
Compressor(s) L2					A	
Compressor(s) L3					A	
Outdoor Fan(s) L1					A	
Outdoor Fan(s) L2					A	
Outdoor Fan(s) L3					A	
Indoor Fan(s) L1					A	
Indoor Fan(s) L2					A	
Indoor Fan(s) L3					A	
Pipe Work (Measure the inter-connecting piping to calculate additional charge)						
Actual Line Length					M	
Number of Bends					Qty	
Equivalent Length					M	
Gas Charge (Weight any additional refrigerant charged during commissioning)						
Additional Charge					kg	

Comments
NOTE - Unit does not require high pressure switch testing.