



# High Efficient & Compact Cooling/Heating Free Multi-Air-Conditioner LXR

SHINICHI ISOZUMI\*1  
KEN WATANABE\*1  
TAKASHI INABA\*1

MASAHIKO NAKAMOTO\*1  
TAKAHIRO KATO\*1  
ATSUSHI ENYA\*2

## 1. Introduction

"A day has four seasons" is a saying often heard in the United Kingdom. Actually in July through August, the weather is comfortable in the day time while morning and evening hours are chilly. In such case, an air-conditioner has to operate as "Cooler" in the day time and as "Heater" in morning and evening hours. Accordingly, there is a high demand in UK of cooling/heating free multi-air-conditioner capable of cooling and heating simultaneously.

Further, the cases of cooling/heating free multi-air-conditioner specified for the upstream process of equipment design are increasing in number in Japan as differential products, calling for upgrading of merchandising power.

Mitsubishi Heavy Industries, Ltd. (MHI) has so far responded to the aforesaid demand by means of KXR series. However, in order to further improve the CS and to expand the sales, MHI has made a full model change and launched the sale of a new LXR series. Compared with the KXR on the basis of the existing cooling/heating selective type LX series, the line-up has been extended, the efficiency has been drastically improved and the compact design has been realized in addition to the improvements made in workability and serviceability.

This paper introduces the features of the LXR series.

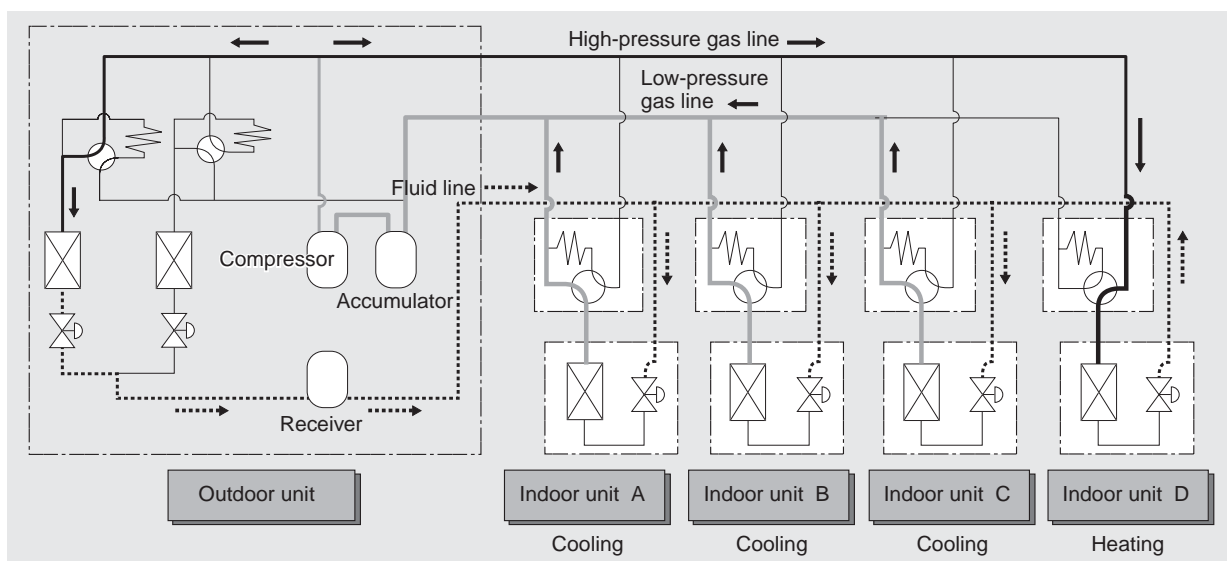
## 2. Features of the system

As compared with the conventional KXR with three types of machine: 8 HP, 10 HP and 20 HP, LXR has the line-up extended drastically to 21 types ranging from 8 HP to 48 HP, and has the features given below.

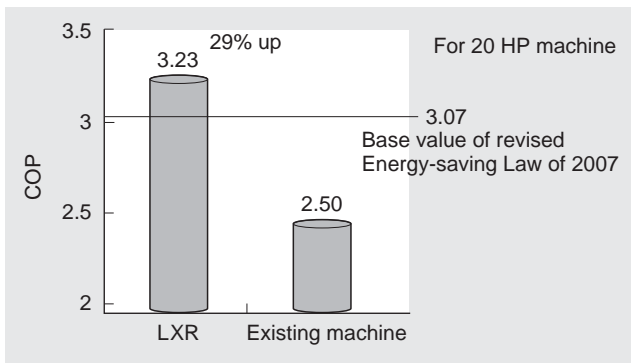
### 2.1 Simultaneous cooling/heating operation through high/low pressure control

Fig. 1 shows an example of coolant flow at simultaneous cooling/heating operation. The example involves cooling as main operation with partial heating operation mixed. In such case, based on the judgment that cooling operation is desired, the compressor carries out capacity control autonomously so that the low-pressure may attain the target level. The outdoor heat exchanger, on the other hand, carries out capacity control by switching capacity or adjusting fan speed so as to maintain high pressure to secure heating performance. In the case of Fig.1, only a part of the outdoor exchanger works as a condenser (exothermic source as seen from the coolant), keeping the thermal balance with the indoor exchanger group with a large number of evaporators (endothermic source as seen from the coolant).

In the case of the heating operation as main (with partial cooling operation), the compressor carries out the high-pressure control, and the outdoor exchanger carries out the low-pressure control.



**Fig. 1 Flow of coolant at simultaneous cooling/heating operation**  
Part of outdoor regenerator working as a condenser of cooling main operation (partial heating)



**Fig. 2 Comparison of 20 HP COP**  
COP has been improved to 29% up from the conventional machine, clearing the base value of revised Energy-saving Law of 2007.

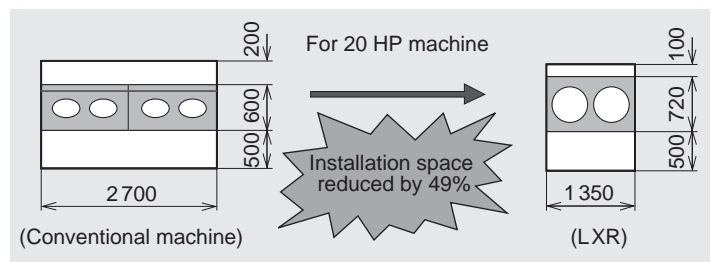
Further, the operation pattern of the outdoor equipment (for example cooling main → heating main) has to be switched depending on the change in cooling/heating-operation-units of the indoor equipment. In that case, the feed forward operation pattern is determined by comparing the total capacity values of the indoor-cooling/indoor-heating units respectively after the switching. The transitional fluctuation of pressure and temperature is prevented.

Thus, the outdoor equipment (including compressor and exchanger) is positioned as a pressure generator of the air-conditioning system, and autonomous control for high-pressure/low-pressure is done respectively. A stable simultaneous cooling/heating operation, which is not affected by load variation or air conditions, could be realized.

### 2.2 High-efficiency and compact design

All types of machines in LXR series including integrated type and combined type have cleared the COP: 3.07 level, the standard value for 10 HP machines specified in the revised Energy-saving Law, ensuring top class energy saving. As for the 20 HP machines, COP level has been improved by 29% of the conventional machines as shown in Fig. 2, with the mainly improved points for high efficiency being as follows.

- (1) Adoption of high-efficiency compressor
    - DC motor used for drive section
    - Optimization of design pressure ratio corresponding to HFC410A
  - (2) Development of new unit structure
    - Extension of heat exchange area through 4-face arrangement of exchanger at the top of the unit, providing large air flow, and optimization of air route structure
    - DC fan motor used for outdoor machine
    - Development of new-type high-efficiency fan
- Further, because of the adoption of new master block



**Fig. 3 Comparison of installation space**  
Reduced to half of the conventional machine

accompanied with the aforesaid high efficiency, the outdoor machines from 8 HP to 24 HP were designed to have integrated-type module structure. In the meantime, the unit width was standardized to 1 350 mm and the depth to 720 mm similar to the 8 and 10 HP machines in conventional KXR series. Thus, the integrated type machines were all designed to have the same floor space to allow preferably minimized installation space and to realize outstanding, compact design. The installation space for 20 HP machines could be reduced to half of the conventional machines as shown in Fig. 3.

### 2.3 Improvement in workability and serviceability

Similar to LX series, high importance was placed to workability and serviceability in LXR series, and the improvements given below were materialized.

- (1) Maximum connecting pipe length increased: In order to allow application to large-scale stores, etc. the maximum connecting pipe length has been extended from conventional 100 m to 160 m, the longest in the industry.
- (2) Expansion of lower limit outside temperature at heating operation: The lower limit outside temperature has been lowered down from conventional  $-15^{\circ}\text{C}$  to  $-20^{\circ}\text{C}$  to promote sales in cold districts.
- (3) Display/save of outdoor machine operation data using personal computer and 7 segment display: The new system allows easy acquisition of temperature, pressure and error data, which is effective for checking the operation status and for troubleshooting.

### 3. Conclusions

The newly developed LXR series has the product specifications drastically improved from the conventional KXR series on the basis of the existing LX series. The features including stable, simultaneous cooling/heating operation, high-efficiency, compact design, etc. are sure to prove widely advantageous not only to the end users, but also to the executing companies and service companies.

We are determined to be attentive in gathering various needs so as to offer timely air-conditioners to the society.



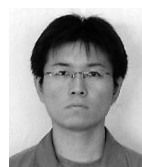
Shinichi Isozumi



Masahiko Nakamoto



Ken Watanabe



Takahiro Kato



Takashi Inaba



Atsushi Enya