

Industrial Robot Support Service “iQ Care MELFA Support”

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Abstract

Production sites in the manufacturing industry have experienced labor shortages in recent years. To resolve this issue, the industry is adopting robots as automation, and there is a growing need for further productivity improvement and stable operation of production equipment.

Against this backdrop, we are offering after-sales service focusing on repair services for the “MELFA Series” of industrial robots from Mitsubishi Electric. The aim is to achieve stable operation of customer systems after purchase. However, needs for after-sales service are diversifying due to recent labor shortages, workstyle reform, and dissemination of the Internet of Things (IoT). In light of these conditions, we have developed new after-sales service products to meet customer needs.

1. Introduction

Needs for after-sales service of industrial robots are diverse and depend on factors like robot use methods and environments, maintenance costs, and approach to maintenance. There is also a need for more efficient service due to shorter working hours, driven by the labor shortages and workstyle reform of recent years.

To meet these needs for after-sales service of robots, we have developed a service that supports stable robot operation in all phases, including robot use, maintenance, and repair.

This paper describes features of the three sub-services making up this new “iQ Care MELFA Support” service: monitoring service, inspection service, and extended warranty service (Fig. 1).

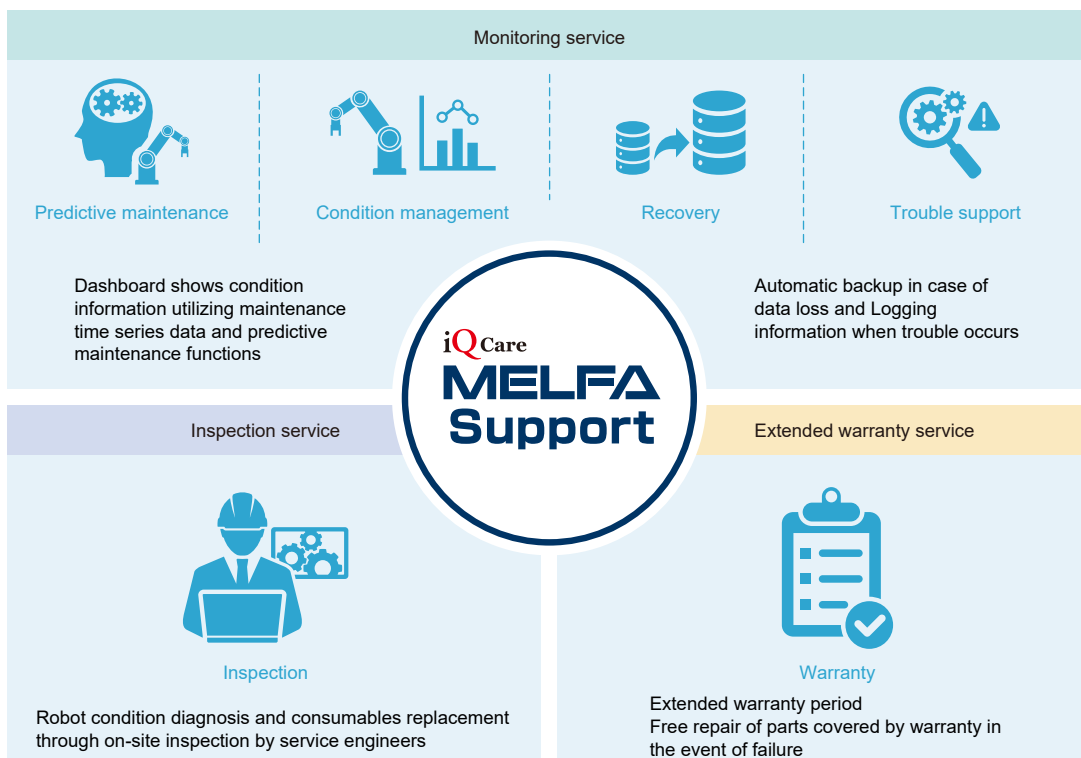


Fig. 1 iQ Care MELFA Support

2. iQ Care MELFA Support

iQ Care MELFA Support is an after-sales service product offering three services as a single package. These services can be used not only at startup when a system is first built, but also during actual system operation, and for malfunction repair and maintenance. The service is offered to customers who purchase new industrial robots from our company, and as an option to customers who have already adopted robot systems. Therefore, the service was developed to minimize the number of components, and enable operation without major changes in the existing system composition of the customer's operating environment.

With this service, various kinds of data are collected on a daily basis, such as operating information during system operation, and inspection information from maintenance or repair. This data increases in volume as the operating period grows longer. However, the CR800 robot controller used by the MELFA FR Series only has the minimal data storage area needed for operation, e.g., for the MELFA BASIC program for operating the robot, parameters for changing control settings, and alarm occurrence log data for a limited number of incidents. We have realized provision of services without reworking the customer's existing systems. This was achieved by using a special Secure Digital (SD) card that can be used for data storage as a key part, not just as a physical key for enabling the service.

The basic system configuration differs from the previous configuration of a robot arm (main unit), robot controller for controlling that arm, and engineering tools (RT ToolBox3) to support checking the robot state and doing programming. The adopted configuration is simple and involves merely inserting an SD card containing information for activating the service into the SD card slot that is standard equipment of the CR800 controller. The various types of information saved on the SD card are files of text data in Comma Separated Values (CSV) format, and this makes it easy to do secondary processing of data suited to the customer application. The system configuration is shown in Fig. 2.

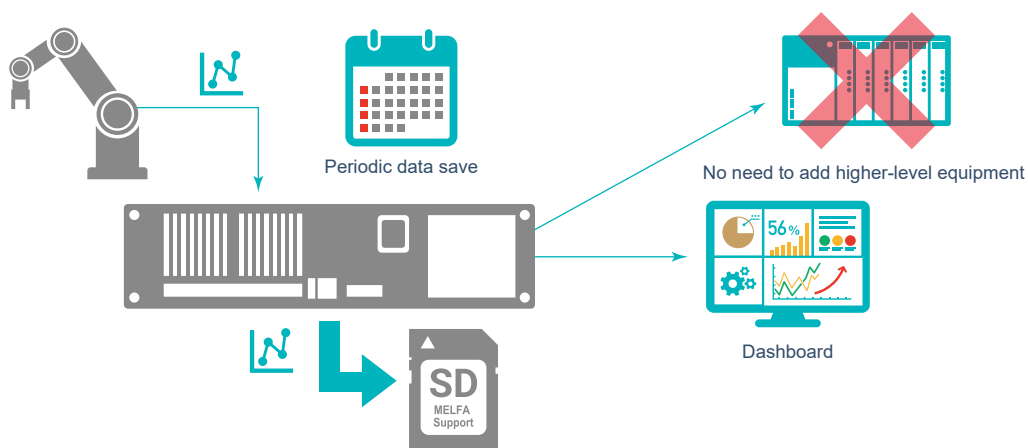


Fig. 2 System composition of iQ Care MELFA Support

3. Features of iQ Care MELFA Support

3.1 Monitoring service

The monitoring service provides a tabular dashboard display of various data from the robot that is necessary for stable operation, and thereby enables use of software for accessing and managing comprehensive maintenance information.

Digital management of operation/maintenance of FA devices is becoming increasingly sophisticated, in line with promotion of Digital Transformation (DX) in the manufacturing industry. As part of that trend, we have packaged multiple software functions together with the objective of digitally providing diverse operation data, covering both the existing customer segment currently using the robot system, and the new customer segment.

The basic function is “condition management.” This involves automatic tabulation of day-to-day robot operating information, monitoring of daily operation information and the status of robot components, conversion of these to time series files, and saving on an SD card. However, additional functions are also provided that are useful to customers from the perspective of after-sales service.

The purpose of the recovery function is to perform daily backup of robot settings and stored programs, and allow the user to fix mistaken changes in settings and mistakes in program editing due to mis-operation.

Robot data is automatically backed up at a frequency of once a day, by saving onto an SD card. The date when backup data was saved can be accessed from the calendar displayed in RT ToolBox3, and the robot settings or program can be restored to their state on a previous day by selecting any save date (Fig. 3).

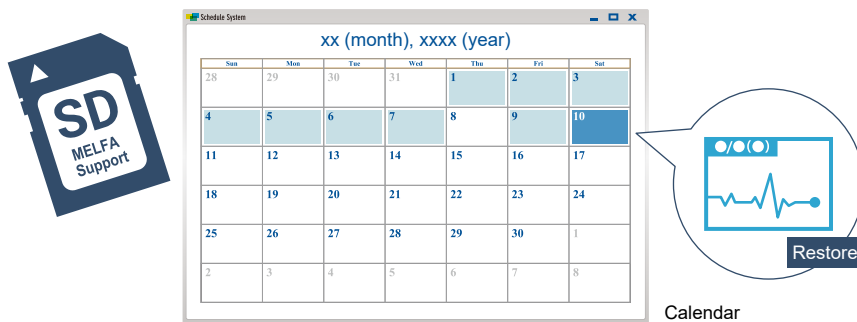


Fig. 3 Conceptual illustration of recovery function

The drive recorder function saves, as a log, servo data of the robot before and after a designated error, triggered by occurrence of that error at the robot being used (Fig. 4). When a problem occurs, this allows investigation of the cause of the error, including the state immediately before it occurred. This enables use as a cause analysis tool when a problem occurs that is very difficult to investigate.

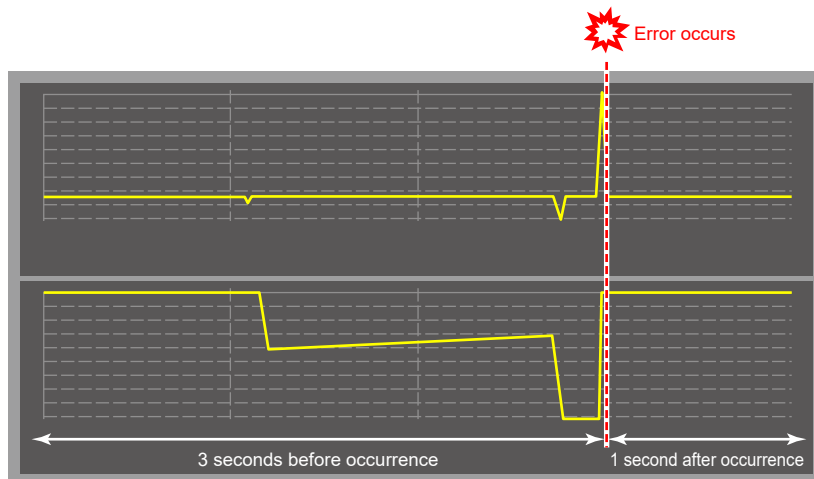


Fig. 4 Conceptual illustration of drive recorder

The predictive maintenance function enables reduction of downtime and projection of recommended times for maintenance through early detection of problems with robot components or signs of deterioration. This function enables use, within iQ Care MELFA Support, of AI functions that have earned a high reputation from the market as “MELFA Smart Plus”. To promote broader customer recognition of the predictive maintenance function, we have allowed it to be used for a limited time as part of iQ Care MELFA Support. The customer can continue using the function by entering into a continuation contract for each service of iQ Care MELFA Support, or purchasing MELFA Smart Plus.

Data produced by these functions is incorporated into files, and accumulated in the SD card. In RT ToolBox3, there is a tabular display of this data as a dashboard. This enables management of general maintenance information, and use of commercially-available tools such as Business Intelligence (BI) tools through secondary processing by the customer.

3.2 Inspection service

3.2.1 What is inspection service?

Inspection service is a service in which our service engineers visit the location where the industrial robots are installed, and carry out tasks such as diagnosing the conditions of the robots and replacing consumables.

Industrial robots are industrial equipment composed of many parts. Also required are periodic consumables such as backup batteries for the memory that stores the detector's locational information and lubricants (grease, etc.) associated with the operation of the drive units.

Therefore, maintenance based on periodic inspection is indispensable for stable operation of a robot. However, in analysis of market malfunctions, cases have been observed where periodic inspection was not done due to the trouble involved in maintenance, and as a result, sporadic malfunctions had an impact on production.

With this inspection service, our service engineers carry out periodic maintenance, and the customer's robots are kept in optimal condition, thereby ensuring stable robot operations.

3.2.2 Technical points for the inspection service

With previous inspection services, judgments were made based on the experience of the service engineer. For example, in judging backlash of a robot arm accompanying operation, the service engineer would set the robot to the servo lock state, and then check backlash based on his or her own "feel" to determine whether it was abnormal. This method allows judgment by service engineers with extensive experience, but cases arise where a decision is difficult for service engineers with little experience.

Therefore, inspection was switched to a method enabling quantitative judgment based on numerical values obtained using measuring instruments, etc.

Also, during inspection, the service engineer previously had the task of visually checking internal data accumulated in the robot controller (e.g., condition information) and transcribing it, etc. Therefore, with this inspection service, work time was shortened and transcription errors prevented by developing software for automatically converting internal data. The FR Series shown in Fig. 5 is an example of a robot covered by this service.



Fig. 5 Example of applicable robot (FR Series)

Results of judgment of the robot state based on this change in the inspection method are presented to the customer through an inspection report, like that shown in Fig. 6. With this inspection service, the various inspection items are classified, and judgment values are established for each classification. This enables judgment at a glance of normal/abnormal status for each inspection item.

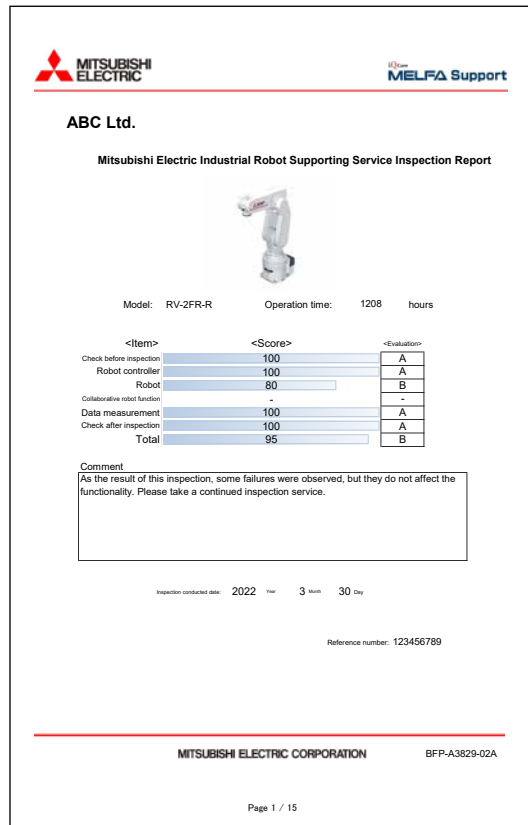


Fig. 6 iQ Care MELFA Support inspection report

3.3 Extended warranty service

3.3.1 What is extended warranty service?

Extended warranty service extends the warranty period associated with the product. Previously, the warranty for our company’s robots was only valid for one year after purchase of the product. The warranty provided repair at no charge for malfunctions during the warranty period. However, there were issues for end users such as prediction of maintenance costs after equipment adoption, and warranty expiration at the time of equipment delivery due to the startup period at the system integrator.

Extended warranty service solves these customer issues by further extending the one-year warranty period that comes with the product. Customers who have already purchased equipment are also eligible for extended warranty service, provided no problems are identified in the standardized, quantified inspection service described in section 3.2. This will allow us to support more customers. An overview of the service is shown in Fig. 7.

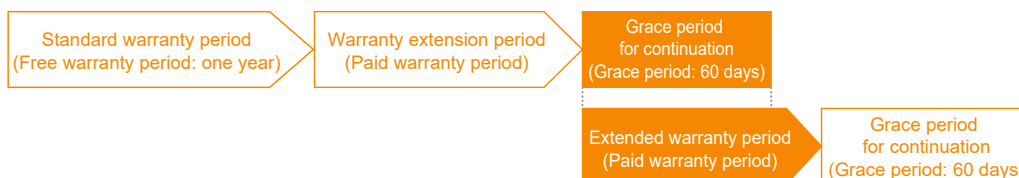


Fig. 7 Extended warranty service

3.3.2 Technical points for the extended warranty service

Because this service extends the warranty period, it is necessary to accurately ascertain the use period of the robot to which it is applied. It must also be ensured that information relating to the use period cannot be easily changed. With this service, information on the robot to which the service is applied, and the robot’s use time information, are managed as data that cannot be accessed by the user. This is done by using a special hidden information area on the SD card. Data in this area can only be accessed by special processing incorporated into the firmware of the CR800 controller, or applications created using the

Software Development Kit (SDK) provided by the SD card manufacturer. It cannot be changed with publicly available information. Also, if robot setting information is changed to an abnormal value relative to the use period information saved in this area, then processing is performed to disable the function and temporarily stop the service.

4. Conclusion

This paper has described the features of iQ Care MELFA Support. This support has been developed as an after-sales service product to promote stable operation of customer equipment in the industrial robot MELFA Series.

Going forward, market requirements will likely continue to diversify for robot products, for which there is a growing need for higher productivity and stable operation as production equipment. Therefore, we anticipate that requirements for after-sales service will also become more diverse, and we will continue to expand the content of the service in the future, developing service measures to address customer needs.