Feature Article

50th Anniversary Product

Establishment of a “Common Analyzer” Concept in the MEXA-1170 Series

Hiroshi Nakamura

[The Development Team]

Back row from the left:
Akihiro Nishimoto, Koji Watanabe, Toshihiko Matano, Atsushi Tamura, Takekazu Sugihara

Front row from the left:
Hiroshi Nakamura, Masaru Miyai, Shigeru Nakatani, Yoshihisa Onda

At present, HORIBA’s engine exhaust gas analyzers comprise a wide variety of detectors, components, electrical process engineering, communication technology, and software engineering to meet various market demands. The concept of a “Common Analyzer” has been established to standardize these diverse technologies and engineering. This is so that we can: share development and service technology developed by HORIBA, reduce manpower for development and maintenance, reduce products & service parts costs, and control the mass production inventory. The common analyzer concept has been applied to the MEXA-1170 series to develop the MEXA-1170HNDIR, MEXA-1170HCLD, MEXA-1170NX, and MEXA-1170SX. The concept has enabled utilization of analysis technology, electrical process engineering, and software technology used in the MEXA-7000 (which is one of the main products of HORIBA engine measurement division). Not only this but also integration of the newly developed MEXA-1170 series analyzers to the MEXA-7000 became possible. In this paper, we will describe the “Common Analyzer” concept.

Introduction

Over the time of our involvement in emission measurement, we have developed analysis systems that correspond to diverse market needs. Figure 1 shows the current lineup of major analysis systems. Since each product has been developed based on the cost and the specification according to its application in the field, there are a wide range of technologies and engineering within these systems: detectors, components, electrical process engineering, communication technology, software engineering. For example, the detector within the analysis system shown in Figure 1 has more than 20 types of Non-Dispersive Infrared (NDIR) analyzers available, more than 20 types of Chemi-luminescence (CLD) analyzers, and the more than 30 types of Flame Ionization (FID) analyzers. All of them have been developed in accordance with a particular application.

The common analyzer concept is to standardize the technology and engineering used. With this concept, standardization of the developed technology and servicing technology has been realized. In addition, reduction of the manufacturing outlay for development and maintenance has now become possible, as well as product/service parts and inventory control in mass production.

To commence development of the new concept analyzer, we selected the MEXA-1170, a standalone analyzer targeted at users of mid-range systems in both price and specifications, as shown in the product lineup in Figure 1. We established the concept to share the major parts and electrical process engineering of MEXA-7000 series with the MEXA-1170HNDIR, the analyzer component of the OBS-1000 on-board emission measurement system, and the "Common Analyzer" concept including communication technology and software engineering of MEXA-7000 series with the MEXA-1170HCLD [1]-[3]. The following describes the standardization concept.

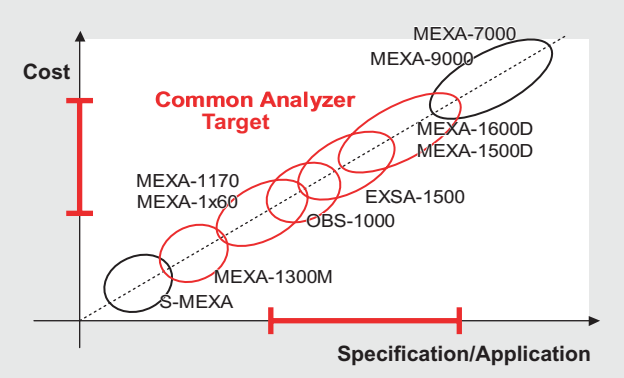

Figure 1 Lineup of Major Analysis Systems for Engine Emission Measurement

Engineering Standardization of Electrical Signal Processing and Communication Technology

To apply the detection, electrical processing, and software of the MEXA-7000 series, which is currently HORIBA's main product containing our traditional analysis technology expertise, to the "Common Analyzer" following three interfaces has been examined. The electrical signal processing interface with the MEXA-7000, the general purpose processing interface, and the user interface.

The PCB board that performs the main electrical signal processing of the MEXA-7000 analyzer series employs HORIBA's own bus (AZ bus). This is an interface between analyzer signals and main control unit (MCU), whose software calculates main process from analyzer signals to final output. These conditions caused difficulties when using the PCB board with other analysis systems. Therefore, we had to upgrade and assemble the analyzers of the MEXA-9000*1 (whose analyzer PCB has parallel, and GPIB interfaces) for the mid-range analysis system.

The "Common Analyzer" concept enabled us to utilize the MEXA-7000 analyzer by redesigning the MEXA-IFC-02 board. This board has signal processing, temperature control, and general-purpose interfaces as well as LAN, RS-232C, and analog outputs as standard specification. GPIB or a parallel interface is also available as option. At only half the size of the conventional MEXA-7000 interface board and being incorporated into the 19 inches analyzers. Therefore, MEXA IFC-02 can convert the limited interface (AZ-Bus) to general interface, and can install a software that calculates main process from analyzer signals to final output. Consequently the MEXA-IFC-02 board allows application of the "Common Analyzer" concept to numerous applications.

*1: MEXA series production preceded MEXA-7000 series.

Figure 2 shows the electrical block diagram of MEXA-1170 series.

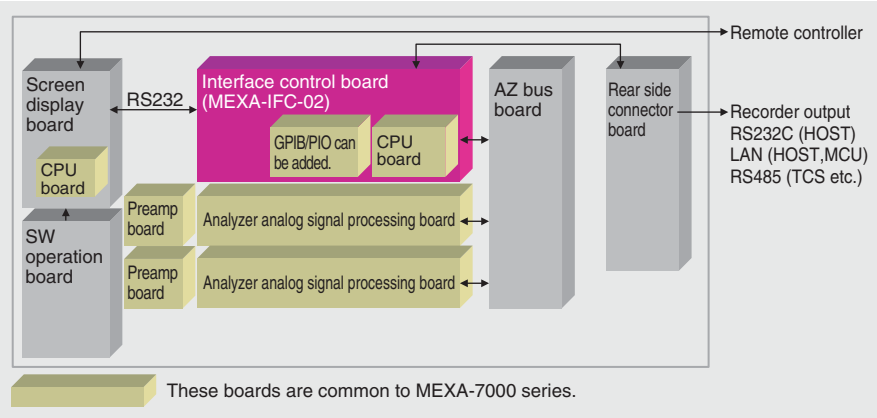

Figure 2 MEXA-1170 Series Electrical Block Diagram

Software Standardization

Firstly, MEXA-IFC-02 board was incorporated into the MEXA-1170HNDIR, which is the analyzer unit of the OBS-1000. By applying our know-how from work on the MEXA/CVS-7000 to the interface board (IFC) and the analyzer board, a more compact on-board type analysis unit was produced. For MEXA-1170HNDIR, we designed and produced exclusive new software.

Then the new concept has been employed to the software design too, by standardizing the software engineering. In addition to maximizing compatibility with the MEXA-7000 in hardware, software compatibility was also implemented. This allowed one piece of hardware to have two types of software functions: A mid-range analysis system or a MEXA-7000 analysis system.

Specific description is as follows: By selection via a hardware switch, the MEXA-1170 is recognized as one of the MEXA-7000 analyzer and can be controlled by the MEXA-7000MCU. This allows operation without any special functional limitations, and it functions as a complete standalone unit. For interoperation with both pieces of hardware, we have programmed the system so that each piece of hardware not only has two interfaces but is also able to read and write common data from each software program. In other words, various analyzers’ data such as calibration curve data created by the MEXA-7000MCU are available for the software of a single component analyzer, and the data created by the single component analyzer can then be reviewed by the MCU software.

As for the software’s internal system, we applied the calculation logic employed in the MEXA-7000MCU to enable higher performance when performing intensive calculations, Zero/Span calibration, and creation of calibration curves.

“Common Analyzer” Example

MEXA-1170HCLD

The first analyzer which realizes the common analyzer concept is the MEXA-1170HCLD stand-alone type NO/NOx analyzer (Figure 3). The major components such as NO/NOx detectors, detector signal processing board, temperature control board, and system parts maintain high analysis accuracy and reliability by applying the basic designs of the MEXA-7000. This enabled development of a compact, low-price analyzer. This analyzer can be used not only as a standalone analyzer but also as one of the analyzer of a MEXA-7000 system.

Figure 3 External View of MEXA-1170HCLD

MEXA-1170NX

With the same concept, we developed the MEXA-1170NX ammonia analyzer (Figure 4) [4], which was not a part of the MEXA-7000. Oxidizing ammonia to NO has led to employment of CLD measurement technology. This analyzer can also be connected to the MEXA-7000. In this case, employing new measurement technology in a mid-range analysis system for the MEXA-7000 is the one of the great advantages of the common analyzer concept.

Figure 4 External View of MEXA-1170NX

MEXA-1170SX

The MEXA-1170SX (Figure 5), an analyzer to measure sulfur compounds in emission gas, is currently under development. The detection principle uses Ultra Violet Fluorescence (UVF) and uses addition of O_3 to reduce NO interference to the UVF. This analyzer also employs the "Common Analyzer" concept and is available either as a single device or as a part to be combined with the MEXA-7000.

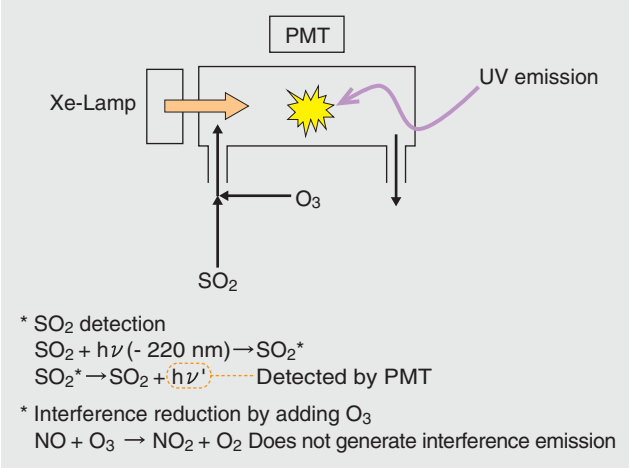

Figure 5 MEXA-1170SX Measurement Principle

Conclusion

From the point of view of engineers in the development division, establishing the concept of a "Common Analyzer" has generated an advantage of shortened development time. This has been through reducing the manufacturing outlay for future new product development and various established basic parts whose production is to be discontinued. We would like to apply this concept to other analysis systems so that the reduced outlay can be exploited for the next wave of technology, research and development.

Reference

[1] H. Nakamura, N. Kihara, M. Adachi, K. Ishida, Development of a Wet-Based NDIR and Its Application to On-Board Emission Measurement System, *SAE Paper* 2002-01-0612 (2002).

[2] H. Nakamura, N. Kihara, M. Adachi, S. Nakamura, K. Ishida, Development of hydrocarbon analyzer using heated-NDIR method and its application to on-board mass emission measurement systems, *JSAE Review*, **24**, 127-133 (2003).

[3] H. Nakamura, I. Asano, H. Ohashi, M. Adachi, Development of a new UVF Analyzer with O_3 injection for Measurement of SOx and TRS in Vehicle Emission, *SAE Fuel and Lubricants Paper* 2004-01-1959 (2004).

[4] S. Nakatani, T. Yoshimura, Y. Mori, N. Kihara, M. Adachi, Y. Goto, H. Suzuki, Development of a Real-time NH_3 Gas Analyzer Utilizing Chemiluminescence Detection for Vehicle Emission Measurement, *SAE Power train & Fluid System Conference*, 2004-01-2907 (2004).