

# DL716 DIGITAL SCOPE

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*The newly developed digital scope DL716 features 16 channels and a maximum sampling rate of 10 MS/s. The DL716, which succeeds the DL708 (8 channels), further strengthens the DL700 Series. The electronic recording function has been enhanced to allow for the recording of 256 M Word to hard disk drive and fast replay of data. The Replay function allows swift detection of errors in recordings over a long time span and improvements in hardware and software have increased PC compatibility. We standardized all communications ports (SCSI/RS-232/GP-IB) and created PC software with DL main unit features like the Replay History function. This product supports waveform data from PCs in various formats including BMP, and CSV for spreadsheets. The amount of supported analog modules has been increased to seven and the addition of operation menus for all channels has increased flexibility.*

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## INTRODUCTION

There has been increasing demand, not only in the mechatronics field but also in the multimedia field, for a measuring instrument that can observe fast and slow waveforms as well as waveforms that require various signal conditioning (thermocouples or strains). Users from these fields who tend to use oscilloscopes, want in digital scopes the same operability as oscilloscopes. In response to these demands, in 1997 we introduced the DL708, an 8-channel digital scope, and have since developed the DL716, a 16-channel version, to enrich the lineup. Both of them were developed under the same basic concept of enhancing electronic recording. With the DL716, we redesigned the configuration, ASICs, and software, which allowed us to intensify the advanced acquisition functions through the addition of ultra-large memory and strengthening of PC compatibility. As for the display, the DL716 inherits the 10.4-inch color TFT LCD from previous models. Figure 1 shows an external view of the DL716.

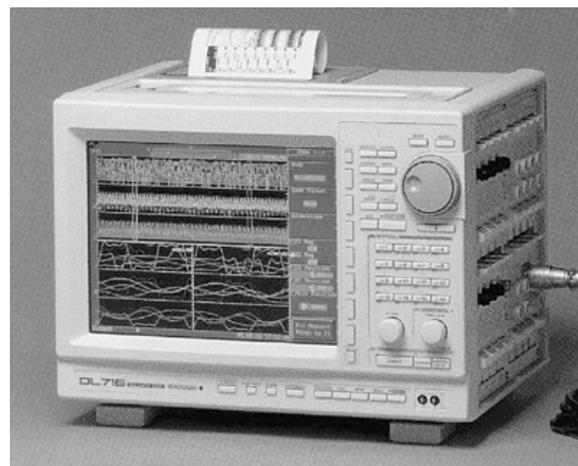
## FEATURES

The DL716 offers the following advantages:

### Data Acquisition

#### (1) Recording to Large Memory and Hard Disk Drive

The most distinguished feature is its ultra-large memory, which has a maximum capacity of 64 M words (for simultaneous recording on 4 channels). A maximum of 256 M words (for 1 channel recording) can be collected and recorded to the hard disk drive. Users can observe waveforms recorded to memory for 6.4 seconds at a rate of 10 MS/s, and to the hard disk drive for a maximum of 42.6 minutes at a rate of 100 kS/s. The use of memory with the DL716 enables



**Figure 1** DL716 Digital Scope

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measurement four times longer than that of the DL708 and its acquisition capabilities are unparalleled for this type of waveform measuring instrument.

(2) Replay

Since all of the acquired 256-M word data cannot be displayed on a single screen due to the display resolution, the DL716 incorporates the replay mode. This function displays a maximum of 1-M word (min. 1-k word) of waveform data on the screen, and the scrolling mode allows the user to smoothly replay the data after acquisition has ended as shown in Figure 2. The replay function allows users to detect problems quickly and the scrolling speed can be finely adjusted.

(3) All Channel View Menu

The DL716 is equipped with the All Channel View Menu shown in Figure 3. Users can set channels while confirming the settings of all channels on the screen. On the other hand, the DL716 continues to offer the operability of oscilloscopes, as users can set each channel while viewing waveforms. The DL716 allows users to select the mode of display they prefer. Also, this product has a Copy to Same Module function, which enables the copying of settings from one channel to other plug-in modules of the same type and thus eliminates the complexity of multi-channel setting.

(4) Time Trigger

The time trigger is activated automatically at a specified measurement start time and at specified intervals (in hours and minutes) thereafter. This is useful when continuously operated equipment needs to be monitored at a specified time. In combination with the History Memory function, it allows for the storing of up to 1000 waveform screens at specified intervals.

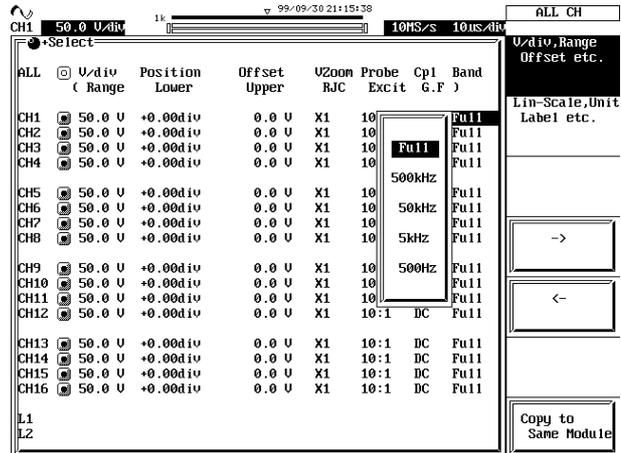


Figure 3 Simultaneous Channel Display

Plug-in Modules

(1) High-speed and High-resolution Modules (10 MS/s sampling, 12-bit resolution, and 850 V input)

To meet the increased demand for speed and resolution, we upgraded the resolution of high-speed modules (10 MS/s) from 10 to 12 bits. The DL700 series supports seven plug-in modules, including the high-speed isolation module, high-resolution module, temperature module, logic input module, and strain module.

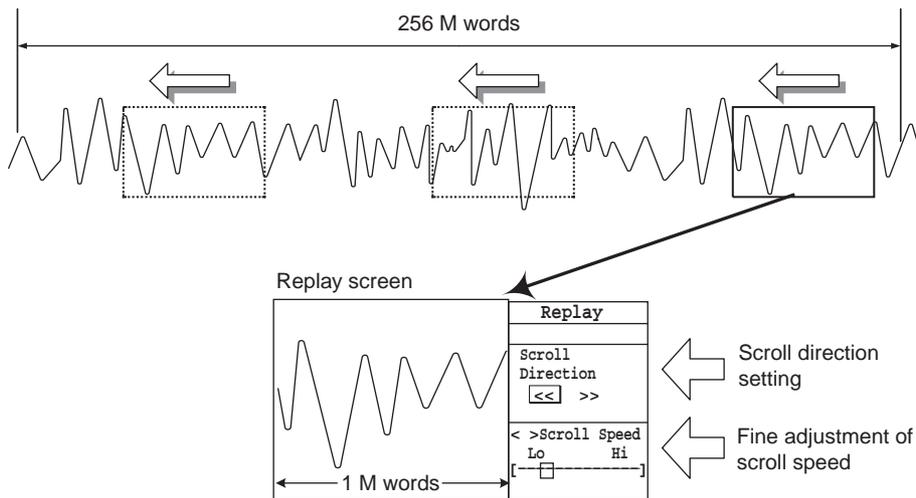
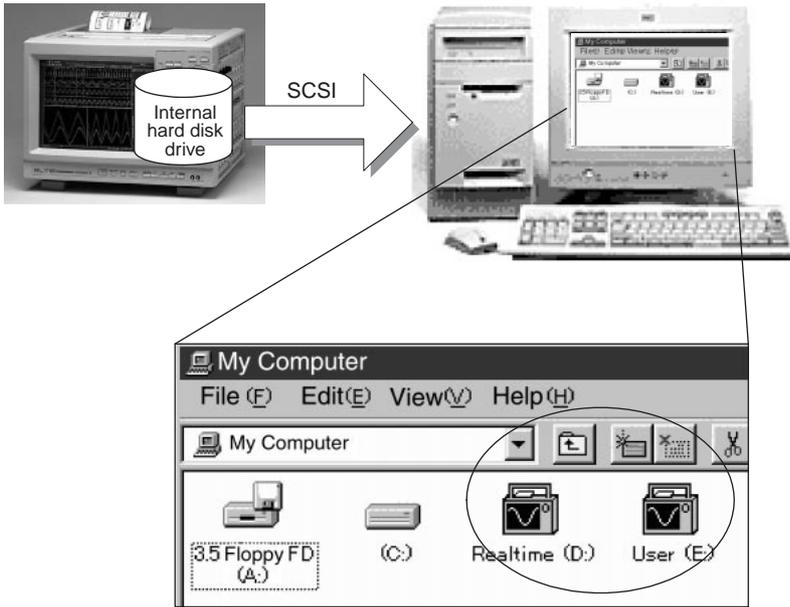


Figure 2 Replay Function



**Figure 4** Replay Function

**PC Compatibility**

(1) SCSI Interface (3.2-GB internal hard disk drive)

The DL716 comes standard with a SCSI interface, to improve PC compatibility. By allowing the internal hard disk drive to be directly connected to a personal computer, users running Windows 95/98<sup>22</sup> can read data on the internal hard disk drive using application software (see Figure 4). To be more precise,

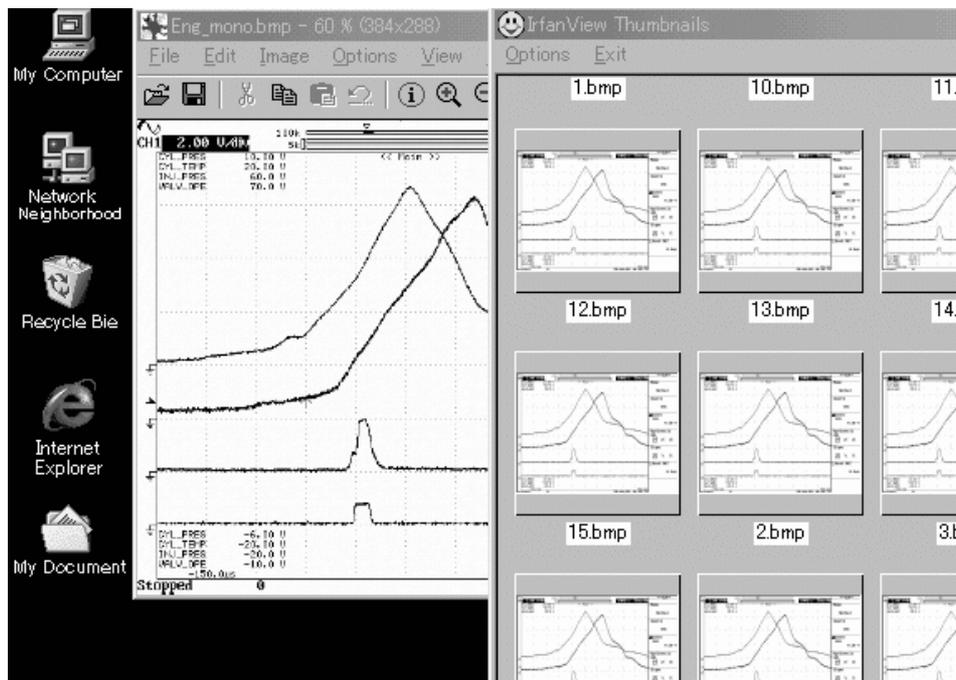
(2) Waveform Viewer on PC (Waveform Viewer for DL series)

We have provided software for displaying data of the DL series. An important feature of this software is that it allows for 256-M word waveform data to be processed on a personal computer. As personal computers are not equipped with compressor hardware, the DL716 transfers captured waveform

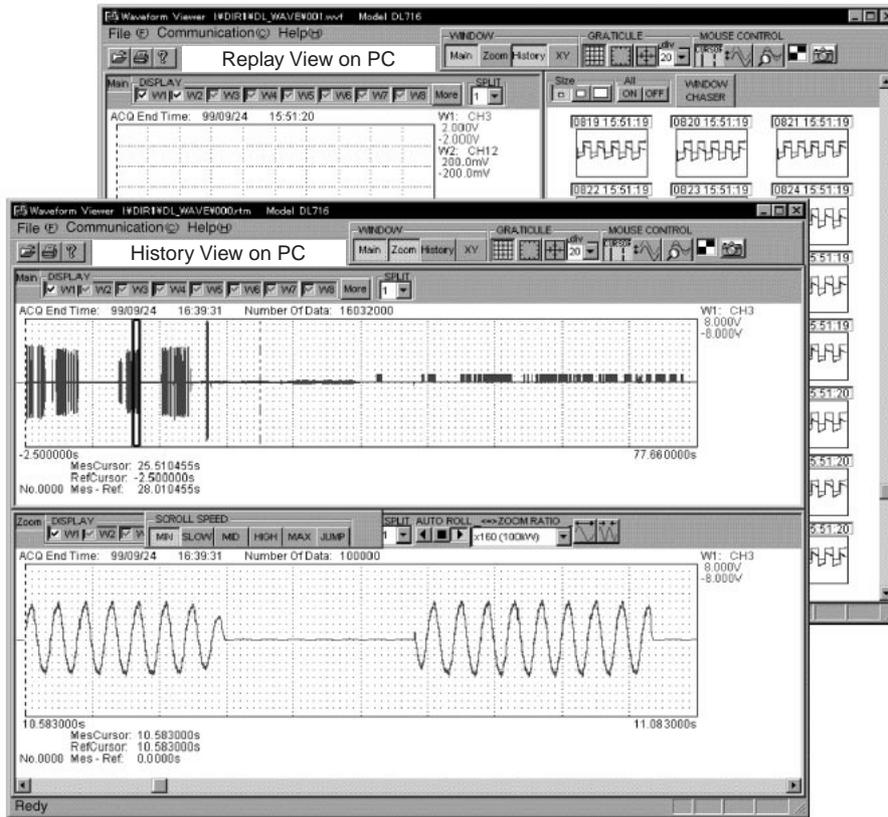
they can display waveforms directly on a personal computer or read the data using spreadsheet software without having to worry about transferring data after it has been captured. Data transfer is so fast that users are unaware that the process is taking place.

Data that can be read on a PC includes 1) bitmap image files of waveforms (BMP or TIFF, color or black-and-white), 2) measured raw data, and 3) automatically measured text data. Figure 5 shows an example of using bitmap image files on a personal computer. Waveform images that had to be printed out with conventional models can now be stored on a hard disk as bitmap data to be used on a personal computer later as necessary.

The DL716 also comes standard with a variety of other interfaces essential to interoperability with a personal computer (floppy disk drive, GP-IB, RS-232, VGA, GO-NOGO, and Centronics)



**Figure 5** Use of Waveform Images Stored on Internal Hard Disk Drive



**Figure 6** Replay and History Memory Functions on PC

data compressed in two steps to the personal computer to enable fast data display (see chapter 3). Waveform Viewer provides the Replay and History Memory functions of the DL716 on the personal computer (see Figure 6). Waveform Viewer also converts data to a format supported by spreadsheet software (CSV).

## SYSTEM CONFIGURATION

### Hardware

Figure 7 shows a block diagram of the DL716. The DL716 is basically the same as the DL708, but incorporates additional features such as ultra-large memory, 16-channel measurement, and two ASICs for support of the Replay function.

The ADP (Acquisition Data Processor with 80,000 logic gates) simultaneously processes input data from four channels; that is, it compresses data, performs computations, and detects trigger levels. Five ADPs are used in the DL716, four for 16-channel measurement and one for an extended logic circuit.

The ACL (Acquisition Control Logic with 50,000 logic gates) mainly controls acquisition sequences and addressing of waveforms stored to memory. The DL716 incorporates 64 units of high-speed commercial DRAM as waveform memory. Its

operating voltage is 3.3 V and capacity is 64 M bits (512 MB in total). DRAM needs periodical refreshing. The five stacks of FIFO (First-in First-out) provided for each channel and the writing speed of memory (12.5 MHz), 25% faster than the acquisition speed (10 MHz), makes it possible to maintain refreshing time.

Moreover, ADP's compression process works with DMA (Direct Memory Access) to make the system configuration simple.

### Principles of Replay Function

The replay must have the capability to scroll 256-M word data as smoothly as possible. This is nearly impossible using conventional methods because of the long compression time required for data. To overcome this problem, the hardware and software of the DL716 work together to compress captured waveform data in two steps (1/100 and 1/1000) (see Figure 8), and then the compressed data is stored along with the raw data to memory or the internal hard disk drive. When replaying the data, it reads the compressed data according to the zoom ratio. Quick scrolling allows for up to 1000x display of data.

Compressing the data not only contributes to increased replay speeds on the DL716, but also on the personal computer.

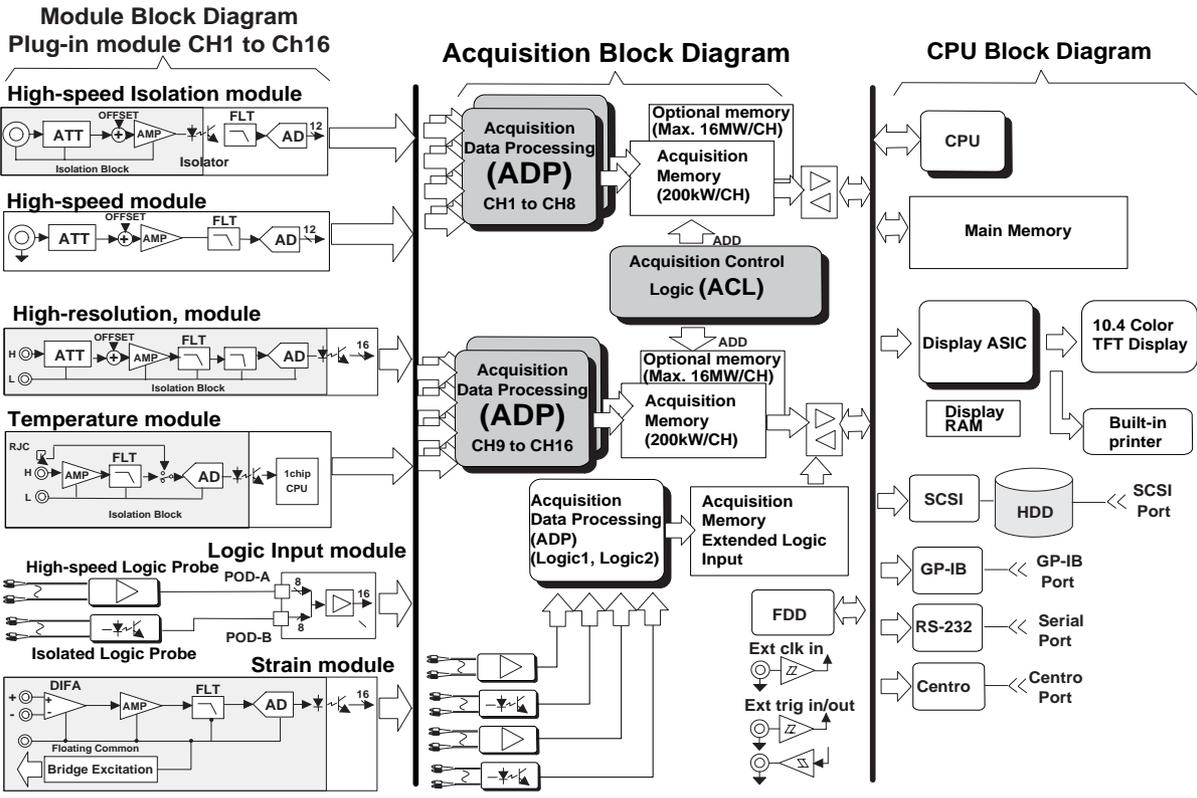


Figure 7 Block Diagram of the DL716

**APPLICATIONS**

This chapter gives examples of applications where the DL716 is suitable.

**MD Player**

MD (Mini Disk) players incorporate various mechanical and electrical components, and thus there are a wide variety of signals to be measured, such as servomechanism, sound, and digital data signals (see Figure 9). With the DL716, different servo signals or sound signals that require isolated measurement (more than 10

isolated analog channels), can be measured together with digital signals surrounding the micro computer (approximately 40 bits).

MD players are characterized by high-speed pre-read control to avoid skipping data and save power consumption. As shown in Figure 10, it pre-reads 40 seconds worth of sound data in a few seconds (read data is stored to DRAM for replay at normal speed). During the remaining time it turns off unneeded control circuits to save the battery (power consumption). Since all the

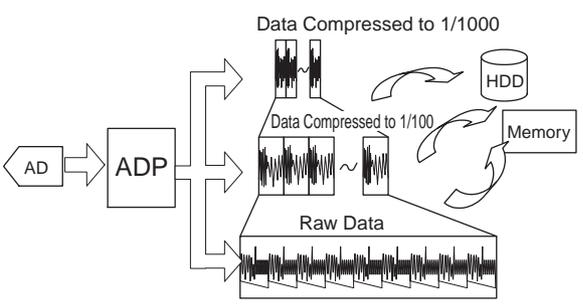


Figure 8 Data Compression in Replay Mode

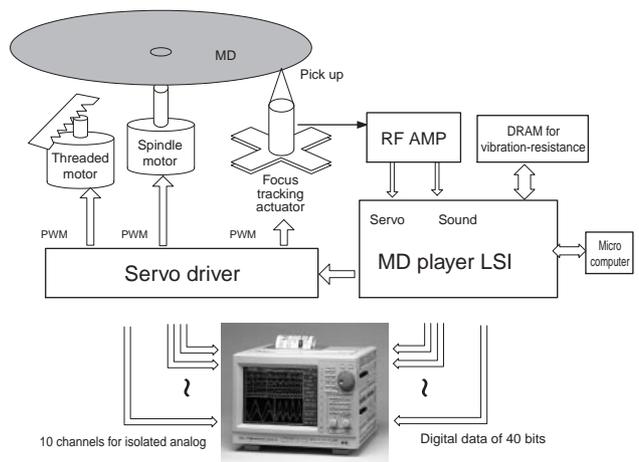
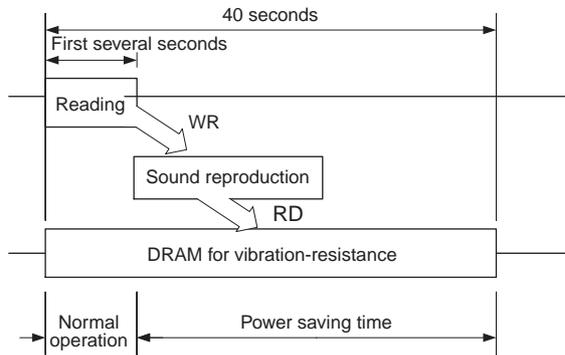


Figure 9 Application Example of MD Player

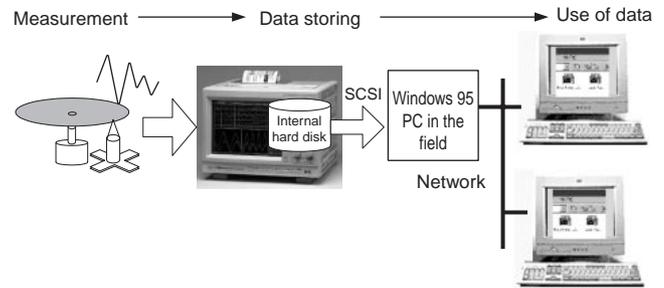


**Figure 10** MD's Vibration-resistant/Power-saving Mode

phenomena must be recorded over these 40 seconds, the DL716 is very effective because of its ultra-large memory. It can record 80 seconds of data through simultaneous sampling of 16 channels at a high-speed of 200 kS/s, and then store as much as 512 MB of the recorded data to the internal hard disk drive.

#### Sharing of Internal Hard Disk through Network

The internal hard disk of the DL716 can be shared with other personal computers through a network using the network file sharing functions of Windows 95/98<sup>\*2</sup> as shown in Figure 11. This enables users to share digital data (huge amounts of raw data or bitmap images of waveforms), captured in the field and stored to the internal hard disk drive, with personal computers in remote offices. Therefore, this new approach to measurement completely eliminates the need for recording data on paper in all stages, from the collection of data to its utilization.



**Figure 11** Sharing of Internal Hard Disk through Network

## CONCLUSION

As aforementioned, the DL716 allows multi-channel measurement and has enhanced digital recording capability. We believe that the DL716, as well as the DL708, will be very advantageous in a wide variety of measurement applications, from temperature to high frequency (MHz) signal measurement. We will further expand this series in line with changes in the field.



## REFERENCES

- (1) Kato S., Ito S., Takeshita Y., Mizusawa T., et al., "Digital Scope DL708E", Yokogawa Technical Report, No. 26, pp. 27-30 (1998).
- (2) Nagata, Y., "Power-saving Technology for MD Player", Electronic Engineering, Vol. 40, No. 4 pp. 30-34 (1998).

\*2 Windows 95/98/NT are registered trademarks of Microsoft Corporation.

