

Final Report
DVD Recorders Evaluation Standard Subcommittee,
Energy Efficiency Standards Subcommittee of
the Advisory Committee for Natural Resources and Energy

The “Final Report by the TV Sets and Video Cassette Recorders Evaluation Standard Subcommittee, Energy Efficiency Standards Subcommittee of the Advisory Committee on Natural Resources and Energy (June 13th, 2005)” presented the evaluation standard for DVD recorders. However, DVD recorders equipped with digital tuners accounted for only a small percentage in the market during the period of deliberation. The subcommittee consequently excluded such DVD recorder types from the scope of Top Runner Standards with an additional statement that, judging from the shipment condition, their evaluation shall begin when a sufficient number of the products enters the market.

In response to this statement and considering that DVD recorders with digital tuners are becoming the mainstream along with the nationwide commencement of digital terrestrial broadcasting in December 2006, the DVD Recorders Evaluation Standard Subcommittee had deliberations on the evaluation standard for the manufacturers and importers (hereinafter referred to as “manufacturers”) concerning the improvement of the performance of DVD recorders, and adopted the following final report to revise of the target scope.

1. Category to be Added to the Target Scope [See Attachment 1]

The current target scope for DVD recorders will be revised to include categories for those with digital tuners (hereinafter referred to as a “DTB [Digital Terrestrial Broadcasting]-capable DVD recorders”).

However, the additional target scope will exclude those for industrial use, those with game functions or server functions, those with neither VCR nor HDD, those having a digital tuner but equipped with VCR only, and those with a next generation recording device (Blue-ray disc recorder and HD DVD recorder).

2. Details of the Evaluation Standard for Manufacturers

(1) Target fiscal year [See Attachment 2]

Fiscal Year 2010

(2) Target standard value [See Attachments 3 and 4]

Concerning DTB-capable DVD recorders to be shipped by a manufacturer for the domestic market in the target fiscal year, for each category in the table below, the manufacturer has to make sure that the value obtained by weighting and averaging energy consumption efficiency (annual energy consumption) calculated according to (3) with the number of shipped units shall not go over the target standard value.

| Category | Integrated Recording Device | HDD Recording Capacity | Additional Function(s) | Target Standard Value (kWh/year) |
|----------|-----------------------------|-----------------------------------|---------------------------------------|----------------------------------|
| a | With HDD only | HDD capacity of below 500 GB | No additional function | 58.1 |
| b | | | With one additional function | 64.4 |
| c | | | With two or more additional functions | 71.2 |
| d | | HDD capacity of 500 GB or greater | No additional function | 65.3 |
| e | | | With one additional function | 71.7 |
| f | | | With two or more additional functions | 78.4 |
| g | With HDD and VCR | HDD capacity of below 500 GB | No additional function | 65.0 |
| h | | | With one additional function | 71.9 |
| i | | | With two or more additional functions | 79.3 |
| j | | HDD capacity of 500 GB or greater | No additional function | 72.9 |
| k | | | With one additional function | 79.8 |
| l | | | With two or more additional functions | 87.2 |

Note: "Additional function" refers to simultaneous dual program recording functions, iLink (digital video (DV) interface) and simultaneous encoding functions.

"iLink (DV interface)" is another term for IEEE 1394, which is one of the transmission methods for connecting a peripheral device(s) to personal computers or video devices. iLink is expected to be a promising standard for interfacing computers and video devices with peripheral devices. There is a move to utilize it for home LAN to interconnect home appliances.

"Simultaneous encoding function" refers to a feature which multiple encoders operate simultaneously.

(3) Measurement method of energy consumption efficiency [See Attachment 5]

Energy consumption efficiency shall be the value (kWh/year) calculated by the following equation.

$$E = [\{ P_{don} - (P_{don} - P_{doff}) \times 0.2 \} \times (t1 - t_{epg}) + P_{hrec} \times t2 + P_{hpl} \times t3 + P_{dvd} \times t4 + P_{epg} \times t_{epg}] / 1000$$

wherein,

- E : annual energy consumption (kWh)
- P_{don} : standby power during display state (W)
- P_{doff} : standby power during non-display state (W)
- P_{hrec} : operational power when HDD recording (W)
- P_{hpl} : operational power when HDD playing (W)
- P_{dvd} : operational power when DVD operating (W)
- P_{epg} : power consumption at EPG (electronic program guide) acquisition (W)
- t1 : annual standard standby time (7482.5) (h)
- t2 : annual standard HDD recording time (730) (h)
- t3 : annual standard HDD playing time (365) (h)
- t4 : annual standard DVD operating time (182.5) (h)
- t_{epg} : annual standard EPG acquiring time *varies depending on devices.

(4) Display items and others

(a) Display items shall be as follows.

- a) name and type
- b) category
- c) HDD memory capacity
- d) energy consumption efficiency (annual energy consumption)
- e) manufacturer's name

(b) Compliance items

- a) Energy consumption efficiency shall be indicated by 3 or greater significant figures in kWh/year. In this case, energy consumption efficiency shall be 105% or below of the displayed value.
- b) At consumers' selection, the display items shown in (a) shall be clearly displayed in prominent position of catalogs and instruction manuals which describe the products' performance. In this case, the item shown in d) of (a) shall be displayed in prominent fashion, such as underlined, in large size font, or color change.

3. Proposals for Energy-Saving

(1) Actions of users

- (a) Efforts shall be made to select DVD recorders with excellent energy consumption efficiency, by effectively using information such as “Energy-Saving Label”. When using DVD recorders, energy-saving effort shall also be made through appropriate and efficient usage.
- (2) Actions of retailers
- (a) Sales of DVD recorders with excellent energy consumption efficiency shall be promoted, and efforts shall be made to provide appropriate information, by use of “Energy-Saving Label”, etc., so that users are able to select such DVD recorders. Also, in utilizing Energy-Saving Label, it shall be displayed clearly so that users can understand it easily without misconception.
- (3) Actions of manufacturers
- (a) Technical development for energy-saving of DVD recorders shall be promoted, and efforts shall be made to develop products of excellent energy consumption efficiency.
 - (b) Aiming at the spread of DVD recorders with excellent energy consumption efficiency, "Energy-Saving Label" shall be swiftly introduced, and efforts shall be made to provide appropriate information so that users are able to select such DVD recorders. Also, in utilizing Energy-Saving Label, it shall be displayed clearly so that users can understand it easily without misconception.
 - (c) The next generation recording devices are excluded from the target scope this time due to their small market share and small numbers of introduced models. However, annual energy consumption and other information shall be displayed for the reason that, from now on, their shipment is expected to increase in the light of transition to Digital Terrestrial Broadcasting in FY 2011. When displaying the relevant information, it shall be done clearly so that users can understand it easily without misconception.
- (4) Actions of Government
- (a) Aiming at the spread of DVD recorders with excellent energy consumption efficiency, efforts shall be made to take necessary measures such as spread and enlightenment activities, so as to promote actions of users and manufacturers.
 - (b) Implementation of the display items by manufacturers shall be checked periodically and continuously. Also, appropriate law management shall be made so as for correct and easy-to-understand information provision for users concerning energy consumption efficiency.
 - (c) The energy-saving standard based on the Top Runner method is a very effective

means for energy-saving of products; therefore, effort shall be made to promote better understanding about the Top Runner method and to have it spread internationally by catching appropriate opportunities.

Scope of DVD Recorders
To Be Added to the Top Runner Standards

1. Current Target Scope

The following is the target scope of DVD recorders added to the designated machinery and equipment under the Energy Conservation Law in April 2006:

DVD recorders which operate on AC power line (rated frequency of 50Hz or 60Hz, and rated voltage of 100V).

However, the following types are excluded: those for industrial use having restrictions on specifications and those having an extremely small market share such as ones with neither VCR nor HDD, ones with game or server function, and one with digital tuners.

2. Categories Added to the Target Scope

In the final report of the “TV Sets and Video Cassette Recorders Evaluation Standard Subcommittee” held in 2005, it was decided for DVD recorders with digital tuners that “depending on future development, we shall conduct a necessary review when it is considered appropriate to include them in the scope.”

Consequently DVD recorders with digital tuners, which are now becoming the mainstream, are to be added to the target scope of the designated machinery and equipment.

However, next generation recording devices, Blue-ray disc recorders and HD DVD recorders, are excluded from the target scope for setting the target standard values, because of their small market share and model counts.

As for the following, they are also excluded from the target scope of the designated machinery and equipment.

- (1) DVD recorders for industrial use (Shipment volume in FY 2005: 53 thousand units)

They are the models for industrial purposes, such as ones for broadcasting or the similar ones with particular specification, whose video input/output form is RGB or component output, whose video input/output terminals are BNC

terminals, or whose external synchronization terminals are input/output terminals for synchronized signal, and so forth. They shall be excluded because of their limitations in specifications and the modest shipment volume.

(2) DVD recorders with extremely small market share

- Ones equipped with game function or server function
(Shipment volume in FY 2005: 0 thousand units)
- Ones with neither VCR nor HDD
(Shipment volume in FY 2005: 16 thousand units)
- Ones with digital tuners and having VCR only
(Shipment volume in FY 2005: 0 thousand units)

(Reference) Shipment volume in FY 2005 of other recording/playing devices:

- DVD players (2,789 thousand units)
- HDD recorders (----)

Target Fiscal Year, etc. for DVD Recorders

1. In general, a considerable improvement in energy consumption efficiency of DVD recorders is made when a model change takes place, and a typical development period of these new products is approximately 2 years. For this reason, consideration should be given so that manufacturers can take at least two opportunities of bringing out new models before a target fiscal year.

With the above in mind, the target fiscal year of DVD recorders equipped with digital tuner (hereinafter referred to as “DTB [Digital Terrestrial Broadcasting]-capable DVD recorders”) shall be set to FY 2010.

2. In addition, the improvement rate of energy consumption efficiency in the target fiscal year is expected to be approximately 20.5% based on the assumption that there will be no change in shipment volume and composition of each category from the current status (the result in 2006).

<Overview of Estimation >

- (1) Energy consumption efficiency estimated from the values of actual achievements of DTB-capable DVD recorders shipped in 2006: 85.9 kWh/year
- (2) Energy consumption efficiency estimated from the target standard values for DTB-capable DVD recorders to be shipped in the target fiscal year: 68.3 kWh/year
- (3) Improvement rate of energy consumption efficiency

$$\frac{(85.9 - 68.3)}{85.9} \times 100 = \text{Approximately } 20.5\%$$

Categories for DVD Recorders

1. Current DVD Recorder Categories

DVD recorders without digital tuners (non DTB-capable DVD recorders) are categorized as below based on the three parameters that will have impact on energy consumption efficiency (annual energy consumption) and the future development of energy-saving technologies. The standard is defined as a linear function with the storage capacity of hard disk drive (HDD) as a variable for each category (constant value for those having VCR only).

- (a) Categorization by the type of integrated recording device (HDD, VCR)
- (b) Categorization by the number of tuners and signal conversion functions
- (c) Categorization by the availability of digital network terminal

Table 1. Current Categories for Non DTB-capable DVD Recorders

| Recording Device | Tuner and Signal Conversion Function | Additional Terminal |
|--------------------|--------------------------------------|----------------------------------|
| Having HDD only | Basic specification | Without digital network terminal |
| | | With digital network terminal |
| | With multiple tuners | Without digital network terminal |
| | | With digital network terminal |
| | With multiple MPEG encoders | Without digital network terminal |
| | | With digital network terminal |
| Having VCR only | Basic specification | Without digital network terminal |
| | | With digital network terminal |
| | With multiple tuners | Without digital network terminal |
| | | With digital network terminal |
| Having HDD and VCR | Basic specification | Without digital network terminal |
| | | With digital network terminal |
| | With multiple tuners | Without digital network terminal |
| | | With digital network terminal |

| | | |
|--|-----------------------------|----------------------------------|
| | With multiple MPEG encoders | Without digital network terminal |
| | | With digital network terminal |

*Digital network terminal is referred to i) iLink, ii) USB, iii) LAN, or iv) HDMI.

2. New Categorization Method for DVD Recorders

(1) Basic Concept

Concerning DVD recorders with digital tuner (DTB-capable DVD recorders), for which the target standards are newly developed this time, they shall be categorized taking into consideration (a) the type of integrated recording device (HDD, VCR), (b) the recording capacity of HDD, (c) availability of simultaneous dual program recording function and (d) availability of iLink (DV interface), because these items will have impact on energy consumption efficiency and the future development of energy-saving technologies.

(2) Categories by the Type of Integrated Recording Device

Depending on the type of integrated recording device, DVD recorders can be either (a) those with HDD only, (b) those with VCR only, or (c) those with both HDD and VCR. Since the difference in the type of integrated recording device influences energy consumption efficiency and the future development of energy-saving technologies, DVD recorders are categorized as the above. However, since DTB-capable DVD recorders with VCR only are not and will not be shipped, this type is excluded from the revised categories.

(3) Categories by the Recording Capacity of HDD

Concerning currently shipped DTB-capable DVD recorders, taking 500 GB as a threshold, the number of HDDs is increased from one to two units. As a result, since the energy consumption efficiency is influenced by the storage capacity of HDD (approximately 8 kWh/year), DVD recorders are categorized by HDD storage capacity of either below 500GB or 500GB and over.

It should be noted that the standards, this time, are specified as fixed values in contrast to the current calculation formula for non DTB-capable DVD recorders with a variable of HDD's recording capacity. Consequently, an increase in the energy consumption due to growing recording capacity is expected to be limited.

(4) Categories by the Availability of Simultaneous Dual Program Recording Function

Currently shipped DTB-capable DVD recorders are equipped with multiple digital tuners, besides BS tuner, to support for digital terrestrial broadcasting; moreover, the availability of multiple tuners is already a standard specification. Since the difference in the number of tuners has little impact on energy consumption efficiency,

categorization by the number of tuners and signal conversion functions, which have been specified in the current standards, shall be terminated.

Meanwhile, some of the currently shipped DVD recorders are equipped with a simultaneous dual program recording function, which increases energy consumption efficiency (approximately 7 kWh/year). Accordingly, DTB-capable DVD recorders shall be categorized by the availability of simultaneous dual program recording function.

(5) Categories by the Availability of iLink (DV Interface)

While various digital network terminals have been developed as digitalization advances, non DTB-capable DVD recorders are currently categorized by the availability of digital network terminals (iLink [DV interface], USB, LAN and HDMI).

As digitization further advances, LAN and HDMI will become standard features for future DTB-capable DVD recorders, resulting in that the current categorization by the availability of digital network terminals will become obsolete. Considering market trends in future, however, the iLink (DV interface), which transmits digital signals of the information recorded on other recording devices (digital video camera, etc.) to a DVD recorder, gives an impact on energy consumption efficiency (approximately 7 kWh/year) and has stronger characteristics of being an additive function than other interfaces. As a result, DVD recorders shall be categorized by the availability of iLink.

- i) iLink: another name of “IEEE 1394” standard that is one of the transmission methods connecting PC and video equipment with peripheral devices. It is expected to be the standard for connecting PC and video equipment with peripheral devices. At the same time, there is a move to utilize it for LAN at home, which interconnects home appliances. Examples include an external output terminal of a digital video camera (commonly known as “DV interface”).
- ii) USB (Universal Serial Bus): it is one of the standards for data transmission channel, which connects PC, etc. with peripheral devices such as a keyboard, mouse, modem and joystick.
- iii) LAN (Local Area Network): A data transmitting network connection among computers, video equipment, printers, etc. placed in the same building through pair cables, co-axial cables, fiber-optical cables, etc. Although there are some variations depending on connection form and communication control method, Ethernet is the most prevalent standard.
- iv) HDMI (High-Definition Multimedia Interface): A new standard for digital video/audio input/output interface, mainly for home appliances and AV equipment. Since video/audio/control signals can be transmitted/received through one cable, it will allow controlling multiple AV devices with one remote-controller.

3. Establishment of Basic Category Proposal

Basic category proposal shall be set as follows.

Table 2. Categories of DTB-Capable DVD Recorders (Proposal)

| Tentative Category | Integrated Recording Device | HDD Recording Capacity | Availability of Simultaneous Dual Program Function | Availability of iLink | Production Quantity * (Composition Ratio) |
|--------------------|-----------------------------|---|--|-----------------------|---|
| A | With HDD only | HDD recording capacity of below 500 GB | Without simultaneous dual program function | Without iLink | 326,821 units (17.1%) |
| B | | | | With iLink | 8,562 units (0.4%) |
| C | | | With simultaneous dual program function | Without iLink | 530,319 units (27.7%) |
| D | | | | With iLink | 428,024 units (22.3%) |
| E | | HDD recording capacity of 500 GB or greater | Without simultaneous dual program function | Without iLink | – |
| F | | | | With iLink | – |
| G | | | With simultaneous dual program function | Without iLink | 96,800 units (5.1%) |
| H | | | | With iLink | 144,138 units (7.5%) |
| I | With HDD and VCR | HDD recording capacity of below 500 GB | Without simultaneous dual program function | Without iLink | 74,324 units (3.9%) |
| J | | | | With iLink | 90,944 units (4.7%) |
| K | | | With simultaneous dual program function | Without iLink | 22,493 units (1.2%) |
| L | | | | With iLink | 193,311 units (10.1%) |
| M | | HDD recording capacity of 500 GB or greater | Without simultaneous dual program function | Without iLink | – |
| N | | | | With iLink | – |
| O | | | With simultaneous dual program function | Without iLink | – |
| P | | | | With iLink | – |

* Production quantity in 2006 (Japan Electronics and Information Technology Industries Association)

Target Standard Values for DVD Recorders

1. Concept of Establishing Target Standard Values

(1) Basic Concept

We shall set target standard values based on the idea of Top Runner Method. The specific policies are as follows:

- (a) Target standard values shall be set for every category that has been appropriately defined.
- (b) As for the categories where future technological advances are expected to improve efficiency, the target standard values shall allow for the improvement as much as possible.
- (c) Target standard values shall not conflict among categories.

(2) Response to the Categories Having no Devices

We have determined that DVD recorders having digital tuners (hereinafter referred to as “DTB-capable DVD recorders”) shall be categorized by the type of integrated recording devices, HDD recording capacity, and the availabilities of simultaneous dual program recording function and/or iLink (DV interface). Some of the categories have no corresponding products at this time. Top Runner values for currently available DTB-capable DVD recorders are listed in Table 1.

For the categories that currently have no corresponding products, target standard values cannot be determined based on the actual measurements. However, as the transition to digital terrestrial broadcasting advances in the future, new models falling into these categories are expected to emerge. Therefore, we shall determine the Top Runner values for these categories by adding incremental values to those of the categories having corresponding devices. The incremental values are calculated and set for each of the following cases: having integrated VCR, having HDD recording capacity of 500 GB or greater, having simultaneous dual program recording function, and having iLink (DV interface).

Table 1. Top Runner Values for DTB-Capable DVD Recorders

| Tentative Category | Integrated Recording Device | HDD Recording Capacity | Availability of Simultaneous Dual Program Function | Availability of iLink | Top Runner Value (kWh/year) |
|--------------------|-----------------------------|---|--|-----------------------|-----------------------------|
| A | With HDD only | HDD recording capacity of below 500 GB | Without simultaneous dual program function | Without iLink | 63.1 |
| B | | | | With iLink | 70.5 |
| C | | | With simultaneous dual program function | Without iLink | 70.0 |
| D | | | | With iLink | 78.5 |
| E | | HDD recording capacity of 500 GB or greater | Without simultaneous dual program function | Without iLink | — |
| F | | | | With iLink | — |
| G | | | With simultaneous dual program function | Without iLink | 110.5 |
| H | | | | With iLink | 86.4 |
| I | With HDD and VCR | HDD recording capacity of below 500 GB | Without simultaneous dual program function | Without iLink | 77.3 |
| J | | | | With iLink | 72.4 |
| K | | | With simultaneous dual program function | Without iLink | 98.1 |
| L | | | | With iLink | 91.6 |
| M | | HDD recording capacity of 500 GB or greater | Without simultaneous dual program function | Without iLink | — |
| N | | | | With iLink | — |
| O | | | With simultaneous dual program function | Without iLink | — |
| P | | | | With iLink | — |

(4) Room for Improvement in Energy Consumption Efficiency Driven by Future Technological Advances

Technological developments for DVD recorders are conducted mainly for better usability, and the engineering efforts to improve energy consumption efficiency greatly varies from one product to another, presumably leaving room for improvements in efficiency.

The significant difference in the engineering efforts to improve energy consumption efficiency among products can be seen in the Top Runner values of corresponding categories. Such differences are greater than technical differences expected from the type of integrated recording device, HDD storage capacity, etc. Therefore, considering the numbers of shipped models in the same category and the consistency of energy consumption efficiency between different categories, these technically expected differences are calculated for integrated recording devices, HDD storage capacity, etc. In addition, we assume that technological improvements in the future will provide improvements in energy consumption efficiency for each category to the same extent as that for the category where the efficiency improvement efforts are the most advanced at this time. Specifically, we decided to adopt differences of; 1.9 kWh/year for having an integrated VCR (difference between tentative categories B and J), 7.9 kWh/year for an increase in HDD recording capacity (difference between tentative categories D and H), 6.9 kWh/year for having simultaneous dual program recording function (difference between tentative categories A and C), and 7.4 kWh/year for the iLink (DV interface) (difference between tentative categories A and B).

After making these adjustments, target standard values improved by 8% from the originals are set for the product categories without VCR, which are thought to become the mainstream in the future. It is comprehensively taking account of the expectations for improvement in energy consumption efficiency due to power-saving features in standby and EPG retrieval and due to power-saving measures adopted in HDD and LSI/CPU at the time of developing new model lineup.

Table 2. Target Standard Values for DTB-Capable DVD Recorders

| Tentative Category | Integrated Recording Device | HDD Recording Capacity | Availability of Simultaneous Dual Program Function | Availability of iLink | Top Runner Value (kWh/year) | Improvement in Efficiency (%) | Target Standard Value (kWh/year) |
|--------------------|-----------------------------|---|--|-----------------------|-----------------------------|-------------------------------|----------------------------------|
| A | With HDD only | HDD recording capacity of below 500 GB | Without simultaneous dual program function | Without iLink | 63.1 | 8.0 | 58.1 |
| B | | | | With iLink | 70.5 | 8.0 | 64.9 |
| C | | | With simultaneous dual program function | Without iLink | 70.0 | 8.0 | 64.4 |
| D | | | | With iLink | 78.5 | 9.3 | 71.2 |
| E | | HDD recording capacity of 500 GB or greater | Without simultaneous dual program function | Without iLink | — | — | 65.3 |
| F | | | | With iLink | — | — | 72.1 |
| G | | | With simultaneous dual program function | Without iLink | 110.5 | 35.1 | 71.7 |
| H | | | | With iLink | 86.4 | 9.3 | 78.4 |
| I | With HDD and VCR | HDD recording capacity of below 500 GB | Without simultaneous dual program function | Without iLink | 77.3 | 15.9 | 65.0 |
| J | | | | With iLink | 72.4 | 0.0 | 72.4 |
| K | | | With simultaneous dual program function | Without iLink | 98.1 | 26.7 | 71.9 |
| L | | | | With iLink | 91.6 | 13.4 | 79.3 |
| M | | HDD recording capacity of 500 GB or greater | Without simultaneous dual program function | Without iLink | — | — | 72.9 |
| N | | | | With iLink | — | — | 80.3 |
| O | | | With simultaneous dual program function | Without iLink | — | — | 79.8 |
| P | | | | With iLink | — | — | 87.2 |

2. Specific Target Standard Values

Target standard values as calculated above indicate that the difference in the values between categories with simultaneous dual program recording function and with iLink (DV interface) is not more than 1%. These categories are consequently combined. Future market forces may create a new encoding function (for example, a signal conversion function for a mobile AV device, which is expected to have a circuit size [energy consumption efficiency] similar to that for DV signal conversion such as iLink [DV interface] because of the nature of the processing), which allows for simultaneous operation of multiple encoders (simultaneous encoding function). To reduce disincentives for new products with such function, and to encourage fair competition for such products under the Top Runner Program, simultaneous encoding function shall be defined as one of the additional functions. Consequently, simultaneous dual program recording function, iLink (DV interface) and simultaneous encoding function are the three additional functions, and DVD recorders shall be classified into three categories: (a) no additional function, (b) with one additional function, and (c) with two or more additional functions.

Target standard values according to the new categories are as follows.

Table 3. Target Standard Values for DTB-Capable DVD Recorders (Combined Categories)

| Category | Integrated Recording Device | HDD Recording Capacity | Additional Function(s) | Top Runner Value (kWh/year) | Improvement in Efficiency (%) | Target Standard Value (kWh/year) |
|----------|-----------------------------|---|---------------------------------------|-----------------------------|-------------------------------|----------------------------------|
| a | With HDD only | HDD recording capacity of below 500 GB | No additional function | 63.1 | 8.0 | 58.1 |
| b | | | With one additional function | 70.0 | 8.0 | 64.4 |
| c | | | With two or more additional functions | 78.5 | 9.3 | 71.2 |
| d | | HDD recording capacity of 500 GB or greater | No additional function | — | — | 65.3 |
| e | | | With one additional function | 110.5 | 35.1 | 71.7 |
| f | | | With two or more additional functions | 86.4 | 9.3 | 78.4 |
| g | With HDD and VCR | HDD recording capacity of below 500 GB | No additional function | 77.3 | 15.9 | 65.0 |
| h | | | With one additional function | 72.4 | 0.7 | 71.9 |
| i | | | With two or more additional functions | 91.6 | 13.4 | 79.3 |
| j | | HDD recording capacity of 500 GB or greater | No additional function | — | — | 72.9 |
| k | | | With one additional function | — | — | 79.8 |
| l | | | With two or more additional functions | — | — | 87.2 |

(Reference)

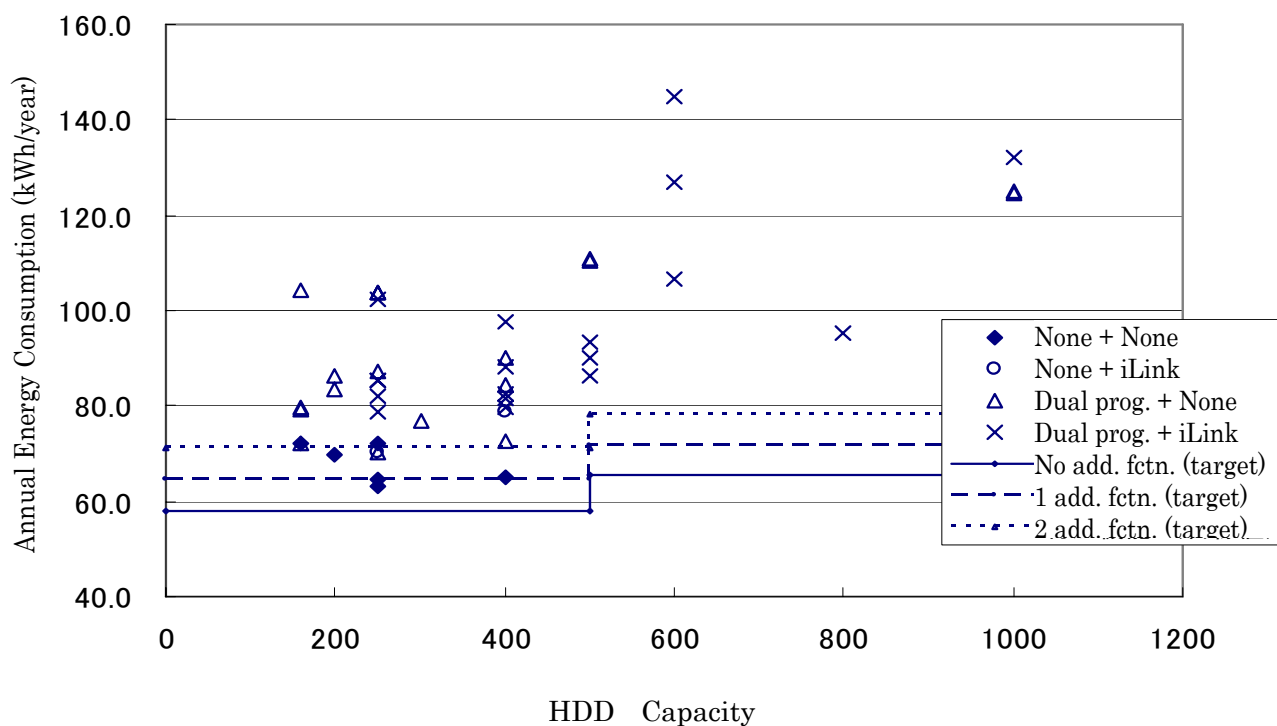


Figure 1. Target Standard Values for DTB-Capable Recorders with HDD only

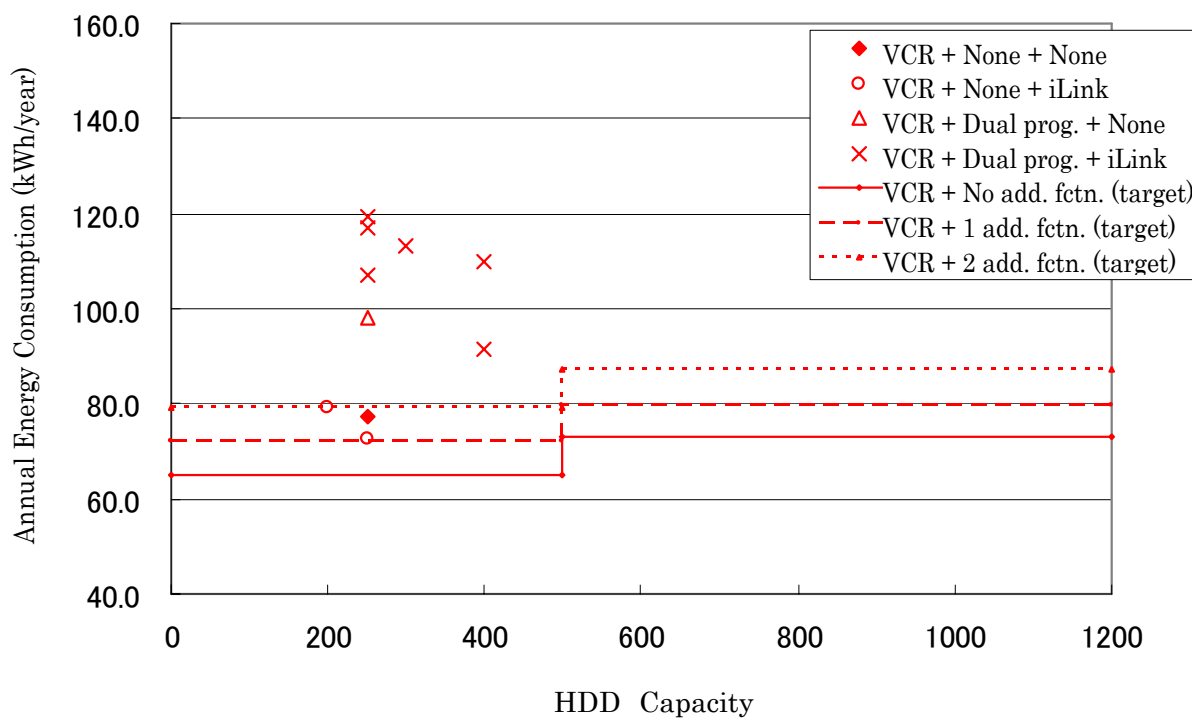


Figure 2. Target Standard Values for DTB-Capable DVD Recorders with HDD and VCR

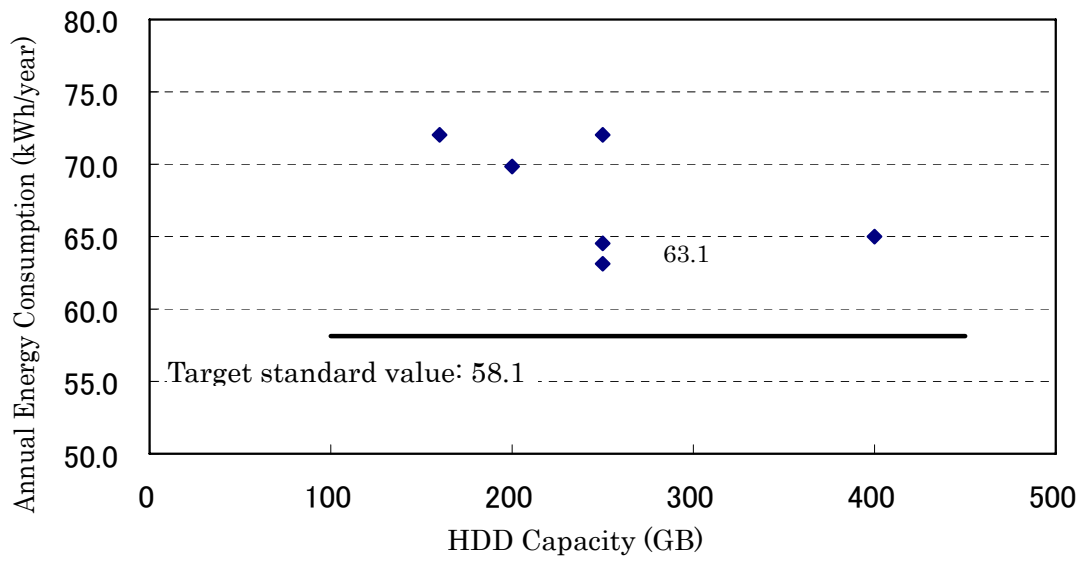


Figure 3. Top Runner Value and Target Standard Value of Category a

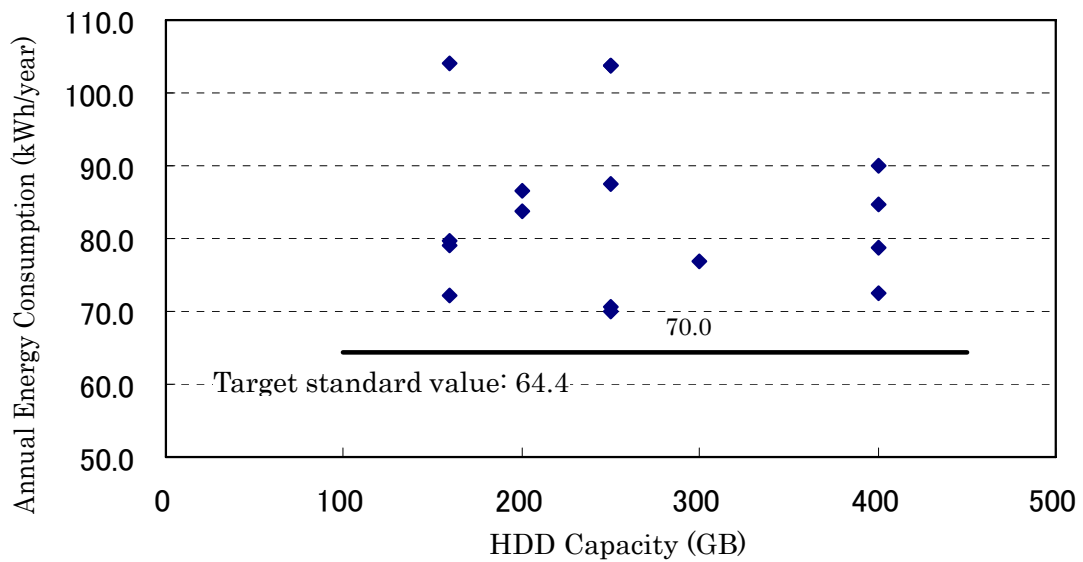


Figure 4. Top Runner Value and Target Standard Value of Category b

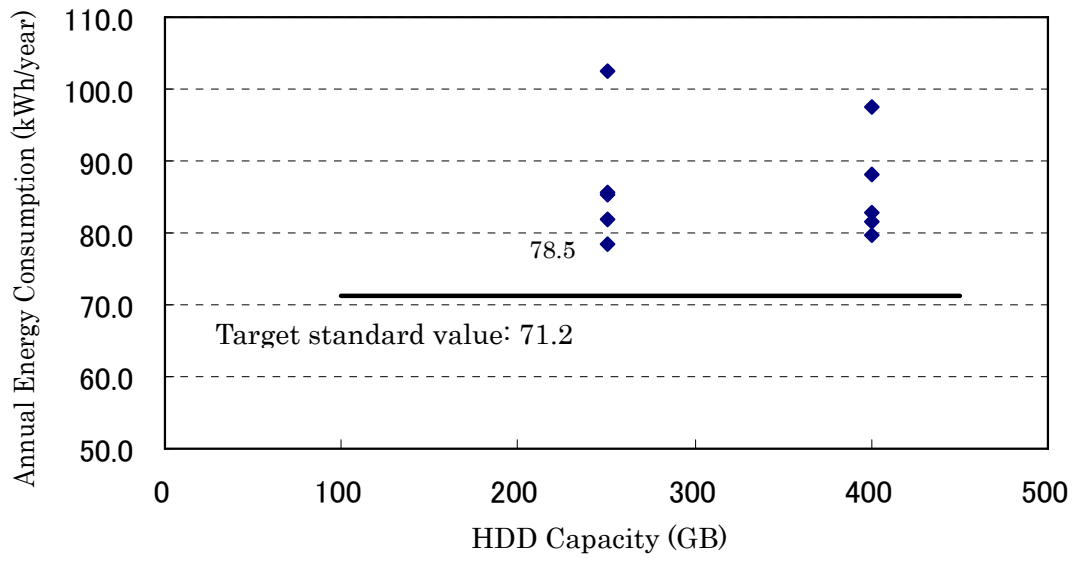


Figure 5. Top Runner Value and Target Standard Value for Category c

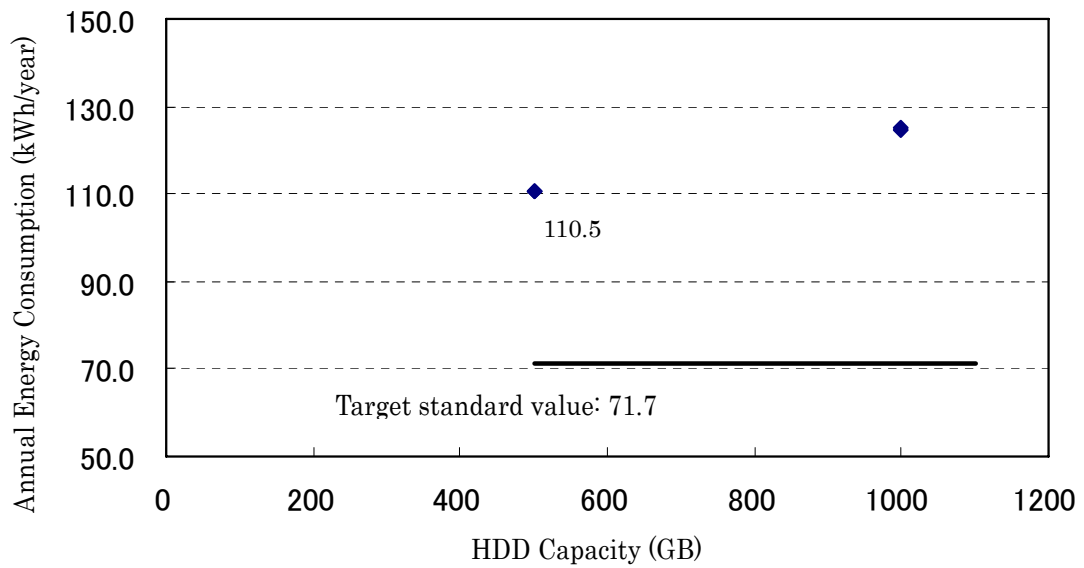


Figure 6. Top Runner Value and Target Standard Value for Category e

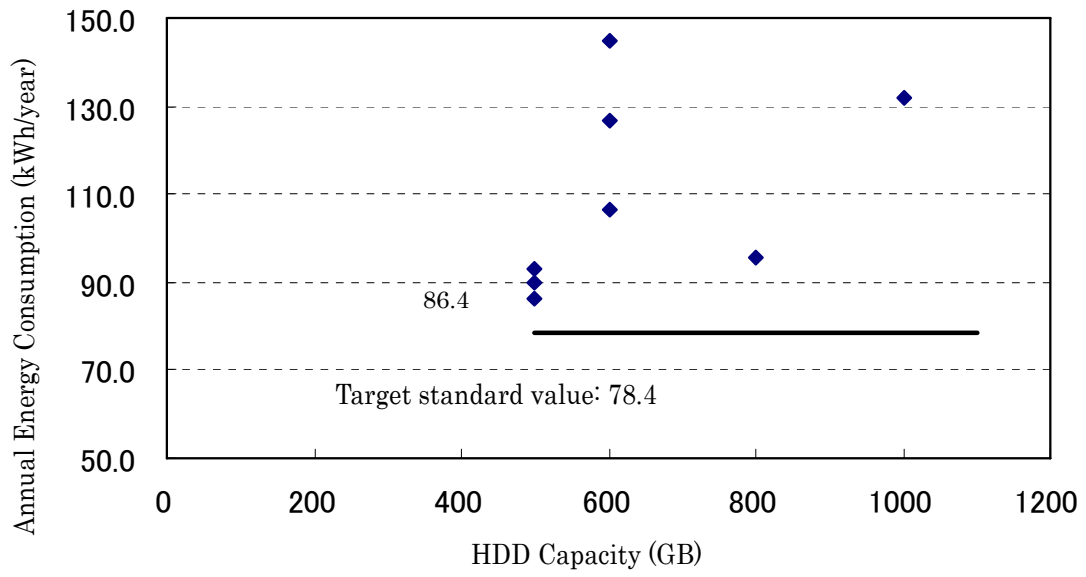


Figure 7. Top Runner Value and Target Standard Value for Category f

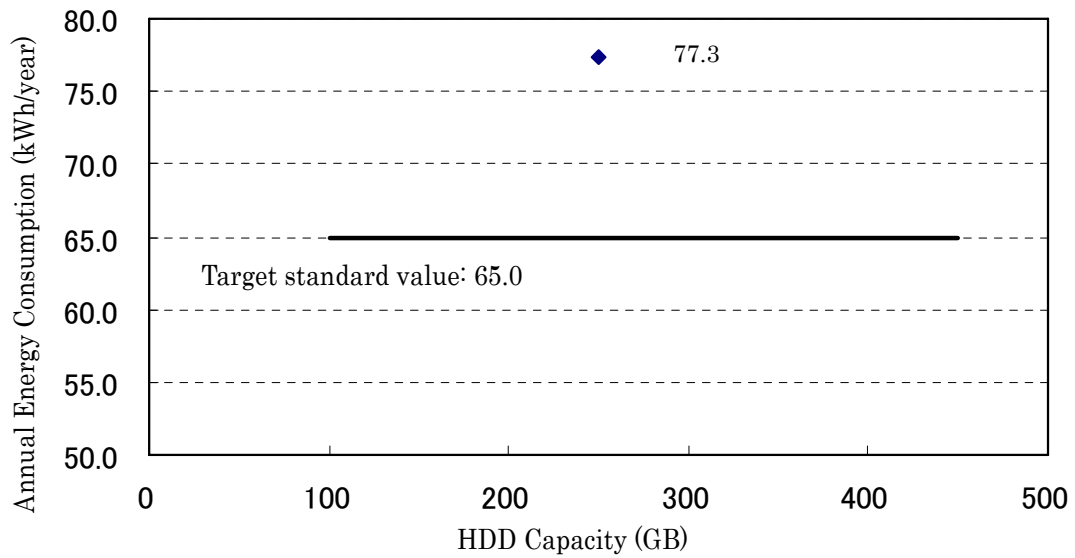


Figure 8. Top Runner Value and Target Standard Value for Category g

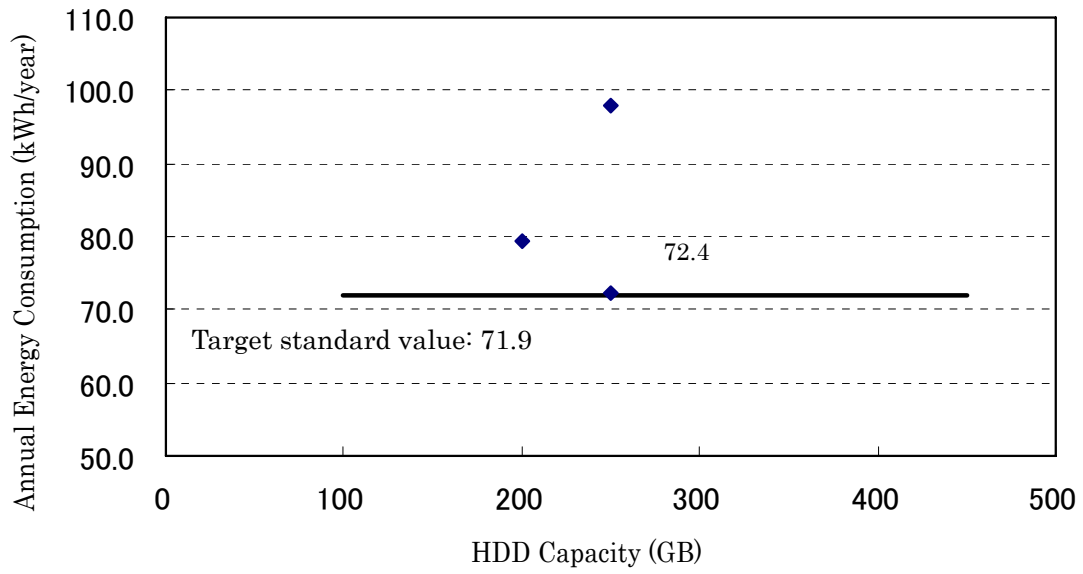


Figure 9. Top Runner Value and Target Standard Value for Category h

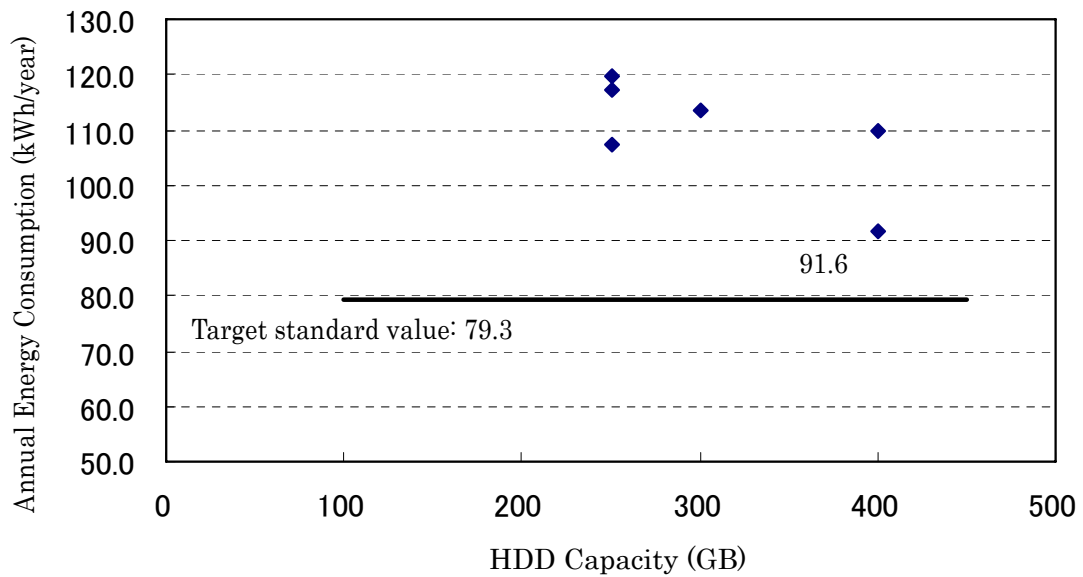


Figure 10. Top Runner Value and Target Standard Value for Category i

Energy Consumption Efficiency of DVD Recorders and Method of Measurement

1. Basic Concept

In April last year, when DVD recorders were designated as items of equipment covered by the Top Runner Standards, “annual energy consumption” was adopted as a realistic indicator of energy consumption efficiency. DVD recorders “having digital tuners,” which are newly added to the target products of Top Runner Standards, are thought to be used in the same manner as those which have been already designated.

In addition, currently designated DVD recorders have been developed to achieve the target standards in the target fiscal year based on the established measurement method. If a different measurement method is introduced prior to the target fiscal year for DVD recorders used in the same manner, comparison by annual energy consumption becomes impractical; and the indicator cannot be a proper criterion for users to select products for purchase.

2. Details of Energy Consumption Efficiency and the Measurement Method

(1) Definition of Energy Consumption Efficiency

Energy consumption efficiency is defined as annual energy consumption being calculated according to the method described below, likewise specified in the “Evaluation Criteria for Manufacturers, etc. Regarding Improvement of the Performance of DVD Recorders” developed in April last year.

As described in 1., a measurement method shall be fundamentally the same as the current one, while taking into consideration the specific condition of products having digital tuners (the use of digital tuner when recording).

(2) Measurement Method of Energy Consumption Efficiency

The measurement method is as follows. The underlined parts are the changes from the current measurement method.

$$E = \{ \underline{P_{don}} - (P_{don} - P_{doff}) \times 0.2 \} \times (t1 - t_{epg}) + P_{hrec} \times t2 + P_{hpl} \times t3 + P_{dvd} \times t4 + P_{epg} \times t_{epg} / 1000$$

Wherein,

- E: annual energy consumption (kWh/year)
- P_{don} : standby power during display state (W)
- P_{doff} : standby power during non-display power (W)
- P_{hrec} : operational power when HDD recording (W)
- P_{hpl} : operational power when HDD playing (W)
- P_{dvd} : operational power when DVD operating (W)
- P_{epg} : power consumption at EPG (electronic program guide) acquisition (W)
- t1: annual standard standby time (7482.5) (h) (See Reference)
- t2: annual standard HDD recording time (730) (h)
- t3: annual standard HDD playing time (365) (h)
- t4: annual standard DVD operating time (182.5) (h)
- t_{epg} : annual standard EPG acquiring time (h) *varies depending on devices.

In the current measurement method, different methods are applied to DVD recorders with HDD and to those with VCR only. Since there is no DVD recorder having digital terrestrial tuner with VCR only, the measurement method shall be specified only for the DVD recorders with HDD.

(a) P_{don} : standby power during display state (W)

The standby power during display state shall be power consumption measured when a unit under test is turned off but able to be operated by a remote control (hereinafter referred to this state as “standby”).

(b) P_{doff} : standby power during non-display state (W)

The standby power during non-display state shall be standby power when the display device is turned OFF. If a unit cannot turn off its display function, it shall be standby power during display state.

(c) P_{hrec} : operational power when HDD recording (W)

The operational power when HDD recording shall be power consumption required to record received signals at UHF 27ch [in TS recording mode = (a mode in which broadcasted transport-stream signals are directly recorded) by a built-in tuner for digital terrestrial broadcasting.

(d) P_{hpl} : operational power when HDD playing (W)

The operational power when HDD playing shall be power consumption when playing video image in usual mode, which is recorded in (c) above.

(e) P_{dvd} : operational power when DVD operating (W)

The operational power when DVD operating shall be power consumption when playing DVD at the location from 24mm to 27.4mm in its radius.

(f) P_{epg} : power consumption at EPG acquisition (W)

The power consumption at EPG acquisition shall be operational power when acquiring EPG data for digital broadcasting.

(3) Conditions of Measurement

As noted in 1., measurement condition will be fundamentally the same as the current one. It shall be defined as follows, taking account of the particular conditions of DVD recorders with digital tuner.

(a) The acceptable variation of AC power supply shall be: voltage of $100(\text{V}) \pm 2 (\%)$, and frequency of $50 \text{ or } 60 (\text{Hz}) \pm 1 (\text{Hz})$.

(b) If a display unit (such as clock display) has a bright/dark switching function, it shall be set to a factory default. In addition, the clock shall be set to "10:00".

(c) Measurement shall take place only when power consumption of a unit under test reaches an adequately stable condition.

(d) A wattmeter to be used for measuring power consumption shall be capable of averaging measurements, shall be capable of measuring a waveform with the power peak factor up to 3, and shall be calibrated so that the accuracy falls within 1%.

(e) A unit under test shall be connected as follows, and no other connections must be made to the following items. In addition, if there are any other terminals available in the unit, they shall be unconnected.

i) To a television set

A video output terminal shall be D terminal (a video signal shall be a component signal).

An audio output terminal shall be RCA terminal (an audio signal shall be L and R signals).

In this case, a connecting terminal shall be connected to a terminal of 1 given system only, and any of the others shall be unconnected.

ii) To a RF signal generator

An RF antenna input terminal shall be one for a terrestrial digital tuner.

In this case, if a unit has multiple RF antenna input terminals, the connection shall be made to 1 given terminal only, and any of the others shall be unconnected.

- (f) EPG acquisition function shall be turned OFF (except when measuring P_{epg}). If the function cannot be turned OFF, measurement shall take place while the function is inactive.
- (g) Just clock function (automatic clock adjustment function) shall be turned OFF. If the function cannot be turned OFF, measurement shall take place while the function is inactive.
- (h) Other functions of the unit under test shall be set as follows.
 - i) BS antenna power supply setting: OFF
 - ii) BS antenna and terrestrial broadcasting antenna output setting: OFF
 - iii) Input switching: digital terrestrial tuner
 - iv) Channel setting: UHF 27ch
 - v) Timer record setting: unset
 - vi) Signal detecting automatic recording function: OFF
 - vii) HDD standby mode setting: factory default
 - viii) Digital network terminal: OFF
 - ix) Picture quality setting: factory default
 - x) Audio setting (input/output): factory default
 - xi) Setting other than the above: factory default
- (i) Measurement shall take place, while any recording/playing media (DVD, CD (compact disk), VCR tape, etc.) not to be used in the measurement are not inserted.

(4) RF antenna input signal

An input signal shall be digital terrestrial signal based on the following conditions:

Broadcast system: ISDB-T

Carrier frequency: $557+1/7$ MHz <UHF 27ch>

Video signal: color bar signals (75/0/75/0) of the JIS Standard (C6101-1)

Audio signal: 1 kHz MONO (modulation factor of PCM modulation shall be the maximum modulation minus 18 dB.)

High frequency wave input signal level: - 49 dBm

(Reference)

Concept of Setting DVD Recorder Operating Time Based on the Survey of Actual Status
of the Usage

(Excerpt from Final Report by TV sets and Video Cassette Recorders, etc.
Evaluation Standard Subcommittee)

Since DVD recorders are evaluated in terms of annual energy consumption including annual operational energy as well as annual standby energy, we need to set operating time for every action, such as recording/playing. In this section, we shall set the annual standard operating time based on the survey result of actual status of the usage.

1. DVD Recorders with HDD Only

(1) Survey result on actual status of the usage

- (a) HDD recording time: 1.88 hours/day
- (b) HDD playing time: 1.20 hours/day
- (c) DVD playing time: 0.33 hour/day
- (d) DVD recording time: 0.05 hour/day
- (e) Dubbing time (HDD ⇔ DVD): 0.2 hour/day

(2) The time listed in (1) above shall be rounded off in 0.5-hour unit

- i) HDD recording time: 2.0 hours/day
- ii) HDD playing time: 1.0 hour/day
- iii) DVD playing time: 0.5 hour/day
- iv) DVD recording time: 0 hour/day
- v) Dubbing time (HDD ⇔ DVD): 0 hour/day

DVD recorders with HDD only

| | Operating (Standby) Time per Day (A) | Annual Standard Operating (Standby) Time (A) × 365 days |
|--------------------|--|---|
| HDD recording time | 2.0 hours | 730 |
| HDD playing time | 1.0 hour | 365 |
| DVD operating time | 0.5 hour | 182.5 |
| Standby time | 20.5 hours | 7482.5 |

3. DVD Recorders with HDD and VCR

We could not obtain reliable data for those with HDD and VCR, because there are only a few users at present. However, taking into consideration that use of VCR is on a decline because of DVD and HDD functions and that use of VCR function is transient, it can be assumed that actual status of the usage of DVD recorders with HDD and VCR will not be significantly different from that of DVD recorders with HDD only. Accordingly, the same operating times as in 1. for DVD recorders with HDD only shall be also applied to DVD recorders with HDD and VCR.

DVD Recorders with HDD and VCR

| | Operating Time per Day (A) | Annual Standard Operating Time (A) × 365 days |
|--------------------|-------------------------------|--|
| HDD recording time | 2.0 hours | 730 |
| HDD playing Time | 1.0 hour | 365 |
| DVD operating time | 0.5 hour | 182.5 |
| Standby Time | 20.5 hours | 7482.5 |

DVD Recorders Evaluation Standard Subcommittee,
Energy Efficiency Evaluation Subcommittee of
the Advisory Committee for Natural Resources and Energy
Background of Holding

1st subcommittee meeting (January 30th, 2007)

- Opening of DVD Recorders Evaluation Standard Subcommittee
- Current status of DVD recorders
- Target scope of DVD recorders to which Top Runner Standards are added
- Energy consumption efficiency of DVD recorders and its measurement method

2nd subcommittee meeting (March 29th, 2007)

- Categorization of DVD recorders for setting target standards
- Target standards and Target fiscal year for DVD recorders

3rd subcommittee meeting (April 18th, 2007)

- Interim report

Interim report was open for public comments during the period from April 26, 2007 through May 28, 2007; however, no particular comment was received. Thus, it was adopted as the final report.

DVD Recorders Evaluation Standard Subcommittee,
Energy Efficiency Evaluation Subcommittee of
the Advisory Committee for Natural Resources and Energy
List of Members

Chairman:

MITSUTOSHI HATORI, Professor in Department of Electrical, Electronic and Communication Engineering, Faculty of Science and Engineering, Chuo University

Members:

HITOSHI AIDA, Professor in Graduate School of Frontier Science, The University of Tokyo

HIROAKI IKEDA, Professor in Department of Urban Environment System, Faculty of Engineering, Chiba University

KENICHI ITO, Senior Manager, Japan Consumers' Association

KAZUO UENO, Vice Manager of Energy Technology Research Institute, National Institute of Advanced Industrial Science and Technology

AKIHIRO TSURUSAKI, Senior Researcher of Jyukankyo Research Institute Inc.

HIROYUKI TOKORO, Vice Chairman of AV Storage Network Program Committee, Japan Electronics and Information Technology Industries Association

TOSHIHISA MASUDA, General Manager of Technical Department, The Energy Conservation Center, Japan

TAEKO YUINE, Executive Managing Director of Nippon Association of Consumer Specialists

Current Status of DVD Recorders

Contents

1. Overview of Commercial Product Group of DVD Recorders, etc.
2. Commercial Product Trends of DVD Recorders, etc.
3. Domestic Shipment Trends – Growth of DVD Recorders
4. Import/Export Statistics of Recording/Playing Devices and Major Manufacturing & Sales Companies
5. Shipment Trends by Categories – Growth of Digital Tuner Models
6. Efforts for Reducing Energy Consumption

1. Overview of Commercial Products Group of DVD Recorders, etc.

◆ Overview of Commercial Product Group DVD Recorders, etc.

Notes

DVD=Digital Versatile Disc
 HDD=Hard Disc Drive
 VHS=Video Home System
 VCR=Video Cassette Recorder

Recording Media

(1) DVD

(2) HDD

(3) VHS Tape

(4) Next Generation Optical Disk

| Recording Media | Commercial Product Category by Combination of Recording Media | | Names in This Material | | Categories by Additional Functions | |
|-----------------|---|---|---------------------------------------|---|------------------------------------|------------------------|
| | Combination of Recording Media | Commercial Product Name | Collective Name | Individual Name | | |
| | (1) | Simple DVD Recorder | DVD Recorder | DVD Recorder having neither VCR nor HDD | | |
| | (1) + (2) | DVD Recorder with Built-In HDD | | DVD Recorders with HDD only | Game-capable DVD Recorder | |
| | | | | | Server-capable DVD Recorder | |
| | | | | | Other DVD Recorders with HDD only | With Analog Tuner only |
| | (1)+(2)+(3) | DVD Recorder with Built-In VCR & HDD | | DVD Recorder with HDD and VCR | With Analog Tuner only | With Digital Tuner |
| | (1)+(3) | DVD Recorder with Built-in VCR | | DVD Recorder with VCR only | With Analog Tuner only | |
| | (2) | Simple HDD Recorder | | HDD Recorder | Simple HDD Recorder | |
| | (2)+[(1)] | HDD Recorder with Built-in DVD Player | HDD Recorder with Built-in DVD Player | | | |
| | (2)+(3) | HDD Recorder with Built-in VCR | HDD Recorder with Built-in VCR | | | |
| | (4) | Blue Ray Disk Recorder HD DVD Recorder | Next Generation Optical Disk Recorder | | | |

- Currently applied home-use recording media include **DVD**, **HDD**, **VHS Tapes** and **Next Generation Optical Disks**.
- Depending on the combination of these media, various types of products are commercialized.
- In this material, those having recording devices for DVD, those having recording device for HDD without DVD recording function, and those having recording devices for a next generation optical disk system are designated as “**DVD recorders**,” “**HDD recorders**” and “**Next generation optical disk recorders**,” respectively.
- Within each commercial product category, the other kinds of categories with names shown in the above table are available, depending on the combination of recording media.
- In addition, sub-categories are created under the categories, such as “**Game-capable**,” “**Server-capable**,” “**With analog tuner only**,” and “**With digital tuner**.”

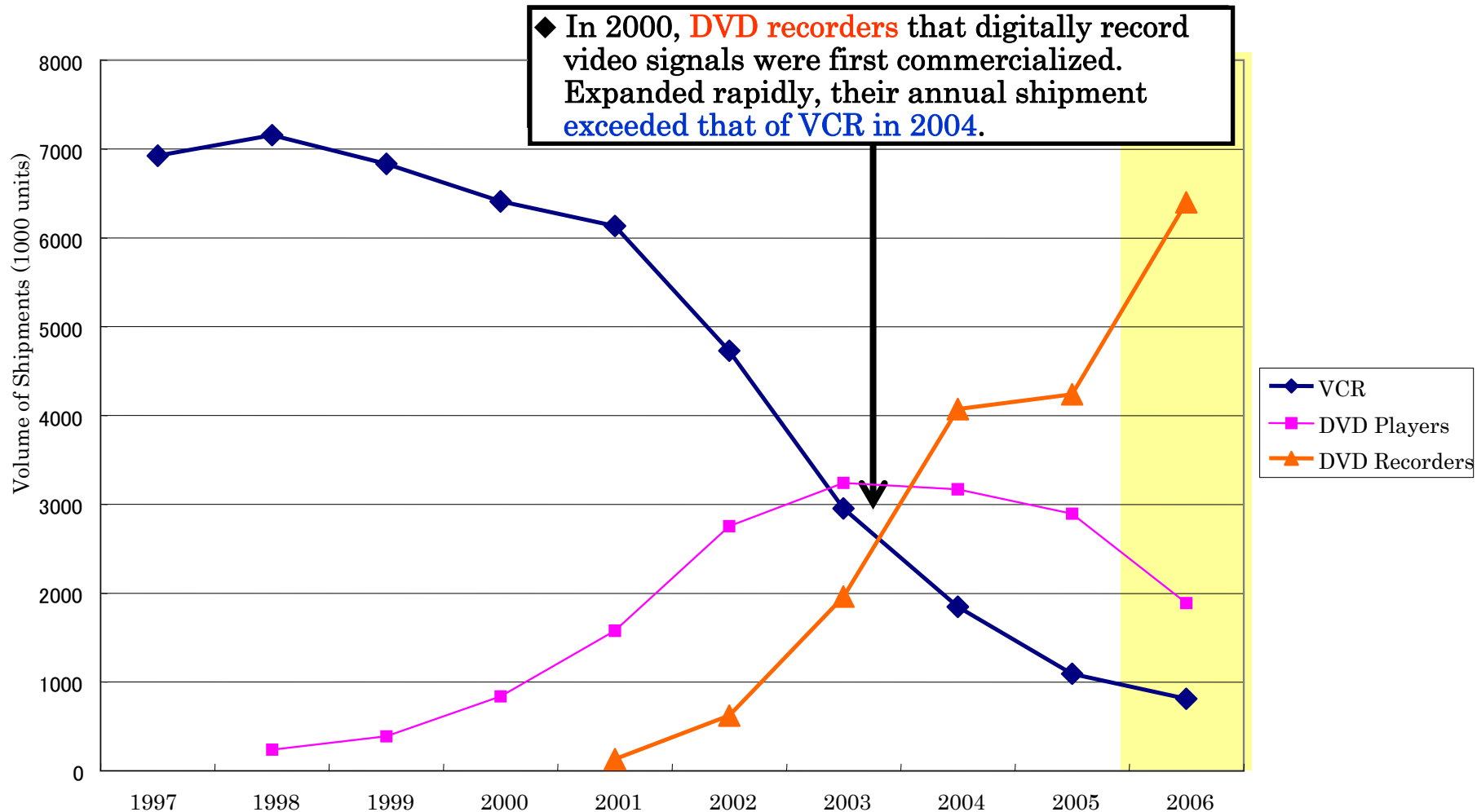
2. Commercial Products Trends of DVD Recorders, etc.

◆ Commercial Products Trends of DVD Recorders, etc.

- Commercial video imaging devices are largely categorized into:
 - (1) **Television receiver**: For watching video images,
 - (2) **Video recorder/player**: For recording and playing video images (VCR and DVD recorders),
 - (3) **Video camera device**: For filming video images
- Recently, technological advances have enabled video recorders/players to be easily usable:
 - (1) hard disk drives, which record magnetic changes on a magnetic disk in high density,
 - (2) optical disk drives, which utilize laser beams to write information on specially resined disks in high density (typical examples: compact disk (= CD), digital versatile disk (= DVD))
- With these technologies, video recorders/players storing video signals **on a recordable DVD or HDD in digital signal format** has become the mainstream, replacing VCRs.
- The main type is a **DVD Recorder with Built-in HDD**, which enables users to record, edit and temporarily store video signals on a relatively large capacity HDD, and which enables users to enjoy by playing desired parts only, by repeated playback, etc. Users can also enjoy the programs by dubbing them to a DVD (from HDD) for long-time storage (“record by HDD and store in DVD”).
- As for TV broadcasting, it has been decided to transition to **digital terrestrial broadcasting in 2011**.
- Responding to this move, DVD recorders are drastically shifting from conventional models with analogue tuners only to **DVD Recorders with Digital Tuners**.
- In addition, while current DVD recording function provides standard image quality only, **Next Generation Optical Disk Recorders**, which are capable of recording Hi-Vision signals, are emerging in the market resulting from the development of next generation optical disks (Blue-ray Disk and HD DVD), along with the availability of Hi-Vision programs by digital TV broadcasting and the market growth of flat-type Hi-Vision TVs.

3. Domestic Shipment Trends – Growth of DVD Recorders

Changes in Shipment: VCRs, DVD Players, DVD Recorders



Reference: Domestic Shipments Statistics of Consumer Electronic Equipment, JEITA
Values for 2006 are estimates.

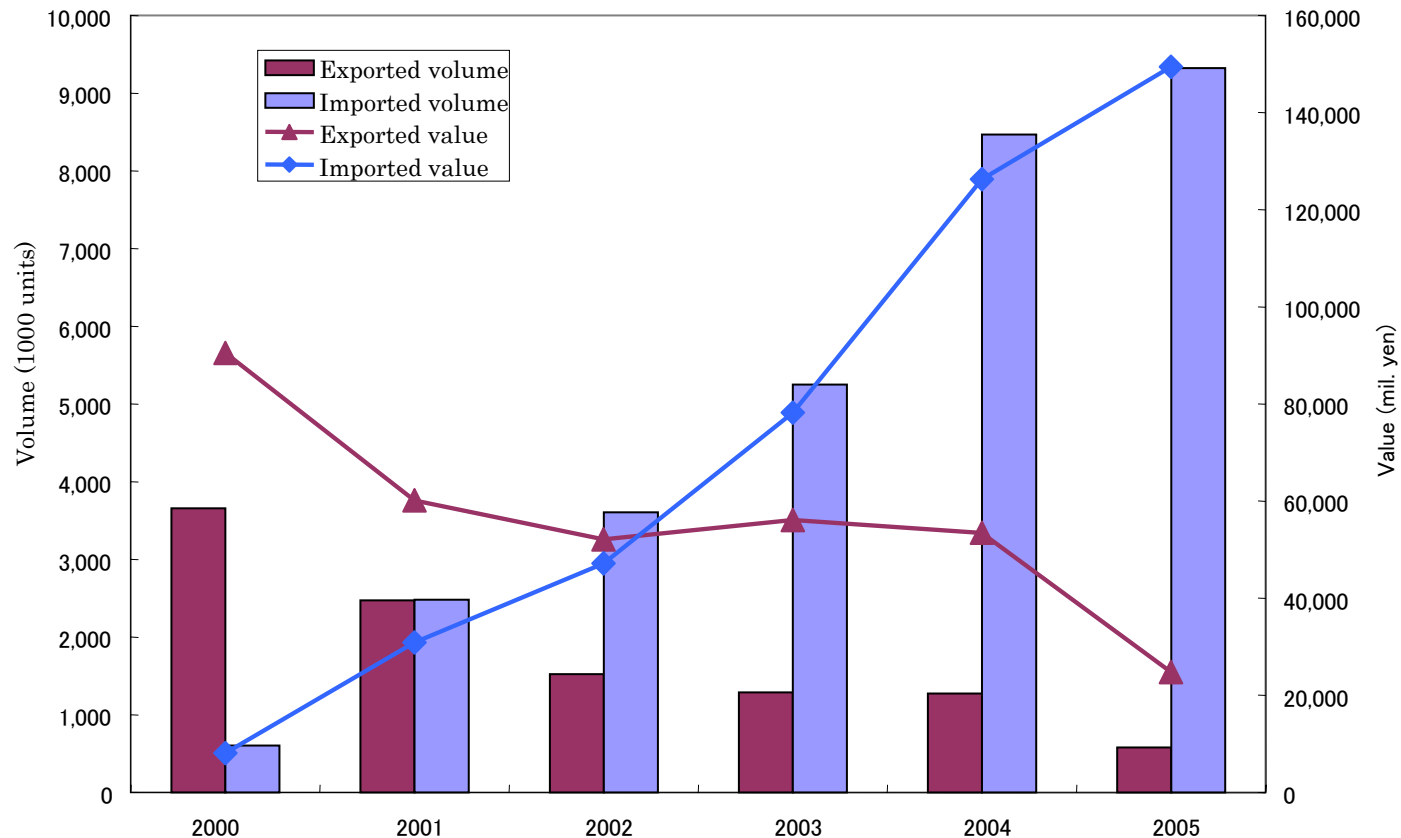
4. Import/Export Statistics of Recording/Playing Devices and Major Manufacturing & Sales Companies

◆ Import/Export Statistics of Recording/Playing Devices

- Mostly, they are manufactured in company-owned overseas plants and supplied as OEM/ODM from overseas EMS.

Reference: Trade Statistics by Ministry of Finance Japan

Import/Export Statistics of Recording/Playing Devices



◆ Major Domestic Manufacturing & Sales Companies

- Sanyo Electric, Sharp, Sony, Toshiba, Victor Company of Japan, Pioneer, Hitachi, Funai Electric, Matsushita Electric Industrial, Mitsubishi Electric, Samsung Japan, LG Electronics

5. Shipment Trends by Categories – Growth of Digital Tuner Models

◆ Shipment Trends by Categories

Note: Data for FY 06 is taken from April to December.
To clearly see the trends, the period of data in FY 05 has been matched

| Commercial Product Category by Combination of Recording Media | Name in This Material | | Categories by Additional Functions | Shipments Apr–Dec, FY 05 | | Shipments Apr–Dec, FY 06 | | |
|---|---------------------------------------|---|------------------------------------|--------------------------|-----------|--------------------------|-----------|-------|
| | Collective Name | Individual Name | | Volume (1000 units) | Ratio (%) | Volume (1000 units) | Ratio (%) | |
| Simple DVD Recorder | DVD Recorder | DVD Recorder having neither VCR nor HDD | | 16 | 0.5% | 0 | 0.0% | |
| DVD Recorder with Built-in HDD | | DVD Recorders With HDD only | Game-capable DVD Recorder | | 0 | 0.0% | 0 | 0.0% |
| | | | Server-capable DVD Recorder | | 0 | 0.0% | 0 | 0.0% |
| | | | Other DVD Recorders With HDD only | With Analog Tuner Only | | 965 | 32.9% | 302 |
| With Digital Tuner | | 641 | | 21.8% | 1,270 | 53.4% | | |
| DVD Recorder with Built-in VCR & HDD | | DVD Recorder with HDD and VCR | With Analog Tuner Only | | 894 | 30.5% | 296 | 12.4% |
| | | | With Digital Tuner | | 21 | 0.7% | 325 | 13.7% |
| DVD Recorder with Built-in VCR | | DVD Recorder with VCR only | With Analog Tuner Only | | 398 | 13.6% | 186 | 7.8% |
| | | | | | 0 | 0.0% | 0 | 0.0% |
| Simple HDD Recorder | | HDD Recorder | Simple HDD Recorder | | | | | |
| HDD Recorder with Built-in DVD Player | HDD Recorder with Built-in DVD Player | | — | | — | | | |
| HDD Recorder with Built-in VCR | HDD Recorder with Built-in VCR | | | | | | | |
| Blue Ray Disk Recorder HD DVD Recorder | Next Generation Optical Disk Recorder | | | — | | — | | |

- HDD integrated models account for the vast majority (92.2 % of total DVD recorder shipments in April–December, 2006).
- Shipment volume of the models without HDD is low (Simple DVD Recorders/ DVD Recorders with VHS).
- DVD recorders with built-in VHS and HDD are in decline but still have persistent demand because of self-owned and rental VHS software (7.8 % of total DVD recorder shipments in April–December, 2006)
- **As the transition to digital terrestrial broadcasting comes into clear view, models with digital tuners are rapidly increasing** (FY 2005 →2006: **22.5%→67.1%** of total DVD recorder shipments).
- However, there are **no models with VCR only and equipped with digital tuners**, which are unable to store Hi-Vision video images.
- Next generation optical disk recorders, which are capable of storing Hi-Vision video images on disk, have just emerged in the market.

6. Efforts for Reducing Energy Consumption

◆ Summary of Current Status

- Basic configuration of circuit blocks in digital tuner models is equivalent to that in current models equipped with analogue tuners only
 - It is assumable that the current concept for commercial product categories can be continued.
- But, Hi-Vision broadcasting requires:
 - a) Addition of a tuner for receiving digital broadcasting
 - b) HD corresponding platform and digital network terminals for wide band signal processingwhich will contribute to the increase of power consumption.
- In addition, it is thought that wider range products, which are those with various interactive functions and those with larger HDD capacity and functions to utilize it, will emerge from now on. That will become a factor to increase power consumption.

◆ Efforts for Energy Conservation

- To minimize the influence from these factors that increase power consumption, the following issues need to be addressed like the efforts previously made.
 - **Sort and Integration of Specifications of Mature Commercial Products**

When a new commercial product is launched, consumer reaction is sometimes unpredictable. As the products matures, it becomes clear whether the product specifications are acceptable or unacceptable for the consumers; then, commercial products' specifications are sorted, integrated or sometimes added.
 - **Elimination of Redundant Circuit by Mature Design**

When a new commercial product is launched, redundancy in circuits is likely to arise because of the unavailability of optimum parts and the attempt to avoid new-circuit related risks. As the design matures, it approaches the optimal by eliminating redundancy.
 - **Promotion of High Circuit Integration**

When a new commercial products is launched, an optimized LSI is often unavailable for the circuit. As the lifetime of the product becomes longer, optimal LSIs will be developed and higher circuit integration will advances.
 - **Power Reduction of HDD**

HDD power consumption will be reduced by optimizing the mechanism, reviewing the materials and optimizing the circuit..
 - **Power Reduction of CPU and LSI**

CPU and LSI power consumption will be reduced by optimizing CPU's operating speed, reviewing semiconductor processes and lowering the operating voltage.