

Write here,

CD writers aren't the luxury item they once were, and these days PC vendors include one in even an average machine. So if you haven't **joined the in-crowd yet secretly yearn to burn, check out our indispensable guide to 18 drives that will set you on fire.**

CD writers have come along way since the time when a unit would set you back up to £5,000 and blank discs were in the region of £100 a throw. You can now pick a drive up for as little as £150 inc VAT, putting them in the same price band as other removable storage devices which have much lower capacities.

CDs also have one major feature over all other removable storage media; no special equipment is required to read them. CD-ROM drives are in PCs everywhere and you'd get strange looks from the salesperson if you tried to purchase a machine without one. The only other storage medium that shares this universal acclaim is the floppy disk, but the fact that you can store over 450 times more data on a CD for little more on the price of a PC makes it a compelling solution.

The ability to use CD-RW discs was originally an extra feature, but is now becoming increasingly common. At first CD-RWs cost far more than CD-R discs, but this price gap is closing. Packet-writing software makes CD-RW a 'drag and drop' medium and removes the hassle of traditional authoring software. And since the majority of modern CD-ROM drives can read the discs, and native UDF (Universal Disk Format) support – which most packet-writing software can use – is included in Windows 2000, their use should become more prevalent.

If you've held off until now or were an early adopter and are looking to upgrade we've got 18 of the latest and greatest drives covering all bases: EIDE, SCSI and external. We've even got the first Sony FireWire drive, if you find the USB bus a little bit slow.

PHOTOGRAPH PATRICK LLEWELYN-DAVIES



right now...

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AOpen CRW 9624

EIDE



9624 is getting a bit long in the tooth now with a specification of six-speed CD-R, four-speed CD-RW and 24-speed CD-ROM performance. That said, the drive put in a decent performance and even beat the eight-speed Philips in the CD-R writing tests. CD-RW performance was commendable, but the CD-ROM read tests saw the AOpen consistently at the bottom of the graph, hindered by its 24-speed read specification.

AOPEN IS A COMPANY that produces almost every component that makes up a PC. Probably most recognisable for its array of motherboards, AOpen has also been producing optical drives for quite some time. Unfortunately, the CRW

Build quality was a little below par, with the drive casing appearing more flimsy than much of the competition. In fact the casing on our review model was a little loose on one side.

Nero Burning ROM software takes

care of CD writing, offering an easy to use interface. You also get an MP3 encoder and a copy of Norton Ghost for imaging your hard disk.

In its favour, the CRW 9624 is very cheap at £135 ex VAT. It's worth a look if you're on a tight budget, but we'd suggest saving a bit more and looking elsewhere.

DETAILS

★★★★

PRICE £158.62 (£135 ex VAT)**CONTACT** Dabs Direct 0800 138 5204www.aopen.nl**PROS** Relatively cheap**CONS** Low specification, poor build quality**OVERALL** Only worth a look if you're short of cash

Creative CD-Studio RW8432E

EIDE



eight-speed CD-R performance, compared to four-speed in the old drive. The four-speed CD-RW performance remains the same, but the CD-ROM speed increases from 24-speed to 32-speed. As a result performance is admirable, with only the 10-speed CD-R Sony proving to be significantly faster.

The drive is pretty solid and sports a single eject button and an indicator light on the front fascia, along with the headphone socket and volume wheel. At the rear you'll find connections for both analog and digital CD audio cables, although there's only an analog cable supplied. Also bundled is an EIDE cable and four screws to mount the drive in your PC.

THE ORIGINAL CREATIVE CD-RW Blaster CD-Studio received a *Recommended* award and a place in the PCW Best Buys. Now this updated package looks like it will follow in its ancestor's footsteps. This drive offers

Creative has given a lot of thought to this bundle, supplying comprehensive manuals for installing the drive and using the Nero Burning ROM and Prassi software. But where the CD-Studio really excels is in the media bundle. Inside the box is a single CD-RW disc as well as 10 CD-R discs.

DETAILS

★★★★★

PRICE £193.87 (£165 ex VAT)**CONTACT** Dabs Direct 0800 138 5204www.europe.creative.com**PROS** Solid performance and a great supporting package**CONS** None**OVERALL** A superb CD-RW package with everything you need

HP 9110i

EIDE



mainly down to the fact that EIDE cables are far cheaper than SCSI ones. The software package includes Easy CD Creator and DirectCD, both from Adaptec. Like the Creative drive, the HP also ships with a CD labeller.

The drive offers eight-speed CD-R writing, four-speed CD-RW writing and 32-speed CD-ROM reading. As far as performance goes, the HP lagged behind the Creative and Plextor eight-speed drives during the CD-R tests. CD-ROM read performance was impressive, as was CD-RW writing. The CD-RW format was a bit lacklustre however, with the HP turning in a time of over 26 minutes. The build quality is solid and the

HEWLETT-PACKARD'S 9110i comes with a similar bundle to its SCSI sibling. This includes a CD audio cable, single CD-R and CD-RW discs and fixing screws. Unlike the SCSI drive, this one comes with an interface cable, which is

fascia is laid out with two indicator lights, an eject button and a headphone jack and volume wheel.

On the whole the 9110i is a good bundle at an affordable price. Unfortunately, the CD-R writing and CD-RW formatting times let it down, making the Creative a better buy.

DETAILS

★★★★★

PRICE £178.60 (£152 ex VAT)**CONTACT** Dabs Direct 0800 138 5204www.hp.com/uk**PROS** Good price, decent bundle**CONS** Disappointing performance in some areas**OVERALL** A decent package, but the Creative bundle is a better bet

LG CED-8080B

EIDE



THE LG CED-8080B is an internal unit rated at the increasingly common standard of eight-speed CD-R, four-speed CD-RW and 32-speed CD-ROM.

The package includes not only a hefty multilingual manual on setting up

and using the drive itself, but also a volume on the burning and packet writing software that accompanies the drive. In the box you'll also find one CD-R and one CD-RW disc, plus EIDE and audio cables. LG has chosen Adaptec's Easy CD Creator and DirectCD combo (versions 3.5c and 2.5d respectively) for all your CD-RW needs. To top off the package, a floppy disk of MS-DOS CD-ROM extensions is also included, to provide access to the drive from DOS.

Performance, however, was erratic to say the least. It hovered near the top of the group for read speeds, but then plummeted to the bottom for CD-RW writing. CD-R performance saw it

placed around the middle with a CD-RW format taking 29 minutes 48 seconds.

The price of £199 inc VAT puts it in the same league as the Creative offering, which showed similar performance overall. However, the package that Creative has put forward makes the LG look a little lacking.

DETAILS

★★★★

PRICE £199 (£169.36 ex VAT)

CONTACT LG 01753 500 400

www.lge.co.kr

PROS Good documentation

CONS Not the best bundle for the price

OVERALL The specification of the drive is up to par, but when you look at the extras offered by other units the package just doesn't add up

Philips CDRW804K

EIDE



PHILIPS' EARLIER CD-RW drives looked great as external devices but were a little too grand for the standard beige box. The new CDRW800 Series is very stylish and the design should sit happily in all but the most boring of PCs.

The drive itself is an internal EIDE unit that can write CD-Rs at eight-speed, CD-RWs at four-speed and read CD-ROMs at 32-speed. For CD-R performance the Philips was adequate but was not the fastest of the eight-speed drives and was even beaten by the AOpen six-speed unit. The time taken to format a CD-RW was acceptable, although we have seen faster elsewhere in this test.

The bundled software is Adaptec's Easy CD Creator 4 standard edition with an accompanying update disc to version 4.02. For packet writing there's a copy of Adaptec DirectCD. Also in the pack is an EIDE cable and an audio lead to hook it up to your sound

card, plus a set of mounting screws. The multilingual manual describes the process of installing the drive, running through all the necessary steps. There's also one CD-R and one CD-RW disc in the box to get you started.

DETAILS

★★★★

PRICE £163.32 (£139 ex VAT)

CONTACT Dabs Direct 0800 138 5204

www.dabs.com

PROS Attractive styling without looking out of place. Good supporting software

CONS Not the fastest in the pack

OVERALL Philips has put together a stylish drive with great software for an extremely competitive price. It may not be the fastest, but it will do the job adequately

Plextor PlexWriter 8/4/32A

EIDE



PLEXTOR IS BEST known for its SCSI optical drives. This is borne out by the fact that the SCSI PlexWriter has walked away with the *Editor's Choice* award. This EIDE PlexWriter isn't quite as fast as the SCSI variant, boasting eight-speed

CD-R, four-speed CD-RW and 32-speed CD-ROM performance.

The eight-speed CD-R writing put the Plextor on a par with the Creative drive when burning CD-R media, with only the 10-speed Sony edging ahead. Performance when writing CD-RW media was also respectable, as was reading CD-ROM discs. However, where the Plextor really fell down was in the CD-RW format test. The PlexWriter took a whopping 52

minutes to format a disc, compared to under six minutes on the Sony drive.

The build quality is solid but the front fascia doesn't sport the same extensive array of options as the SCSI drive. What you do get is a headphone

socket and volume wheel along with an eject button and indicator light.

In the box you get EIDE and CD audio cables, as well as mounting screws and a manual eject pin. Software takes the form of WinOnCD and PacketCD.

On the whole this is a decent drive at a good price, but no-one wants to wait almost an hour for a CD-RW to format.

DETAILS

★★★★

PRICE £175.07 (£149 ex VAT)

CONTACT Dabs Direct 0800 138 5204

www.plextor.com

PROS Solid CD-R performance, good price

CONS CD-RW format takes an age

OVERALL If you don't need to format many CD-RWs, this drive is worth considering



Ricoh MP9060A

EIDE



THE RICOH MP9060A not only boasts six-speed CD-R, four-speed CD-RW and 24-speed CD-ROM performance, but four-speed DVD-ROM as well. This saves space by taking up one less drive bay and EIDE connector, but it does

mean that you can't do CD to CD copies directly (of material you own the copyright to, of course). There is also nothing stopping you from putting it in a system with a CD-ROM and having the best of both worlds.

To burn CDs there's a copy of Nero Burning ROM version 4.0 plus InCD version 1.3 for packet writing. Also in the box are a set of mounting screws, analog audio cable, a blank CD-R and a blank CD-RW disc. Unfortunately, no EIDE cable was supplied, so you'll need a spare connector if you want to play with it straight away. Paper documentation was sparse, to say the least – just a single 'Read me first!' sheet to guide you

through installation and an accompanying manual on CD-ROM.

Performance was adequate and the addition of DVD is a bonus, especially if you've been holding off buying one until now due to lack of space or free connectors.

DETAILS

★★★★★



PRICE £210.32 (£179 ex VAT)

CONTACT Dabs Direct 0800 138 5204

www.dabs.com

PROS CD-RW and DVD in one package

CONS Documentation was a little sparse

OVERALL If you know what you're doing and you want to save space and connectors, the Ricoh is a compelling solution that costs little more than some of the other plain drives

Sony CRX145E

EIDE



THIS IS THE FASTEST EIDE drive on test, with a CD-R write performance of 10-speed, along with four-speed CD-RW writing and 32-speed CD-ROM reading. The faster CD-R write speed was proved in the tests, with the Sony firmly

ahead of the competition. Also – like its SCSI sibling – the CRX145E managed a stunning time on the CD-RW format taking only five minutes 49 seconds compared to the next fastest time of 19 minutes five seconds.

The front fascia sports an eject button, indicator light and a headphone jack and volume wheel. Inside the box is a good bundle including an EIDE cable, analog CD audio cable and mounting screws. Media consists of single CD-R and CD-RW discs, but the software pack is quite generous. As well as WinOnCD for burning CD-R discs and PacketCD for dragging and dropping to CD-RW discs, you get Drive Image for imaging

your hard disk and DataKeeper for backing up files. Most of the CD writing software packages are fairly equal, so it's good to see some other useful applications supplied for added value.

On the whole the Sony is a very fast drive with a decent bundle. However, with a price of over £200 ex VAT performance will have to be paramount.

DETAILS

★★★★★

PRICE £239 (£203.40 ex VAT)

CONTACT Sony 01932 816 660

www.sony-cp.com/cd-rw

PROS Very fast, decent software bundle

CONS Very expensive

OVERALL The fastest EIDE drive on test, but the price is high

Teac CD-W54E

EIDE



TEAC USED TO be a major force in the CD-ROM drive department, but the hi-fi giant has been fairly quiet of late in the PC arena. Unfortunately the CD-W54E isn't likely to regain Teac's impressive reputation, sporting CD-R performance

of only four-speed, backed up with four-speed and 32-speed performance for CD-RW and CD-ROM respectively.

The slow CD-R performance was evident in the two writing tests, where the Teac languished at the bottom, taking over 15 minutes to burn each of the CDs. The CD-RW format was far better, with the Teac grabbing third place. The rest of the test results were middle of the pack, proving that it's only really the CD-R performance that lets this drive down.

The familiar headphone socket, volume wheel and eject button fascia layout is there. There are also two indicator lights, one of which illuminates

when a CD-ROM is accessed and the other when a disc is being written.

The box contains the Nero Burning ROM software, an EIDE cable, audio cable and fixing screws. There are also single CD-R and CD-RW discs.

Ultimately, the Teac represents old technology and the low price isn't consolation enough.

DETAILS

★★★

PRICE £149 (£126.81 ex VAT)

CONTACT Simply 0870 727 2190

www.teac.co.uk

PROS Cheap

CONS Poor CD-R performance

OVERALL A cheap drive, but you'll be waiting a long time for your CD-Rs

Toshiba SD-R1002

EIDE



Performance wise the SD-R1002 did not fare that well and it was noticeably slower than most of the competition when it came to CD-R performance and copying from CD to hard drive. CD-RW performance showed it to be as good as most of the pack, except when it came to CD-RW formatting – where it lagged with a noticeable 40 minutes and 16 seconds.

LIKE THE RICOH, the SD-R1002 also boasts DVD facilities on top of standard CD-RW capabilities, although the Toshiba is only a four-speed CD-R, with four-speed CD-RW, 24-speed CD-ROM and four-speed DVD-ROM.

On the software front Toshiba has opted for InstantCD Wizard 5, plus a bundled copy of WinDVD and MusicMatch. The pack includes two CD-Rs and one CD-RW, EIDE and audio cables, a pen, mounting screws and an eject tool. The manual is a full printed

multilingual tome covering all the necessary aspects, so installation and use shouldn't be a problem.

It's hard not to compare the Toshiba directly with the Ricoh, as both are combo drives and the Ricoh costs less and performed better overall.

DETAILS

★★★★

PRICE £254.98 (£217 ex VAT)**CONTACT** Toshiba 0800 169 4527www.toshiba.co.uk**PROS** DVD ability on top of CD-RW functionality**CONS** Not as good as the Ricoh package**OVERALL** The Toshiba drive is a good offering, but when put it up against the Ricoh it just can't compete

Iomega ZipCD 650 USB

EXTERNAL



measly, but given the constraints of USB bandwidth you'd be hard pressed to get more than that down the pipe.

In the box you'll find a copy of Adaptec Easy CD Creator version 3.5c and DirectCD for your PC needs. For those that want to use it with a Mac a copy of Adaptec Toast is also included.

Unfortunately the copy of Adobe Photoshop LE bundled with the internal drive has been dropped

IOmega WINS POINTS for being the only manufacturer not to just put an internal drive in a box. The ZipCD is rated as a four-speed CD-R, four-speed CD-RW and six-speed CD-ROM. The six-speed CD-ROM may seem a bit

from this kit, which is a shame. The ZipCD was not the nippiest of drives, but when it came down to CD-R burning there wasn't much in it. CD-RW formatting was acceptable, although it was a little slow copying to CD-RW.

Read speeds showed little to differentiate the USB drives, with the interface being the limiting factor.

If you like Iomega's styling, then the ZipCD should sit comfortably alongside your Zip and Jaz drives. Toast for the Mac is a bonus and in terms of speed the drive performed well.

DETAILS

★★★★

PRICE £207.96 (£176.99 ex VAT)**CONTACT** Simply 0870 727 2190www.simply.co.uk**PROS** Good styling**CONS** Not the fastest**OVERALL** Although not the fastest on test, the performance of the ZipCD was adequate. The design is stylish and the bundle is good

LaCie 4x4x24

EXTERNAL



CD-R, four-speed CD-RW and 24-speed CD-ROM, the LaCie sat near the bottom of the group in most of our tests, although it was generally within a minute of the competition as the results were quite close. CD-RW formatting took 40 minutes, which isn't very impressive but is nowhere near as bad as the Mitsumi, which took 95 minutes.

The LaCie supports both Mac and Windows, with copies of Adaptec's Easy CD Creator 4.01 and Toast 4.0.1.1 thrown in respectively. For packet writing there's a copy of DirectCD version 3.0 for Windows and version 1.0.5 for the Mac (although the CD did state that DirectCD was for SCSI devices only on the Mac).

LACIE'S EXTERNAL USB offering is the internal beige drive in a box design, which does somewhat negate the blue styling of the casing. The mains power adaptor is integrated into the main unit which is good. Rated at four-speed

To get you going there's one CD-R and one CD-RW in the box. The manual is comprehensive, although it does cover a number of other devices (magneto optical and hard drives) which could be confusing to the uninitiated. Overall, the LaCie was a fair offering, but it was pipped at the post by Iomega's drive.

DETAILS

★★★

PRICE £233.83 (£199 ex VAT)**CONTACT** Insight 0870 700 7350www.insight.com**PROS** Good software, Mac support**CONS** Not the cheapest on test**OVERALL** The LaCie was the most expensive USB device on test, but the performance did not live up to the asking price

Mitsumi CR 4804 TU

EXTERNAL



the flavour you have. However, the drive we received only seemed to offer support for Windows 98, not Macintosh which is a little silly. The drive itself is rated as a four-speed CD-R, four-speed CD-RW and eight-speed CD-ROM. There's a slight performance increase due to the eight-speed read, but there's only a noticeable difference on the large MPEG file copy.

One area that caused concern was formatting CD-RWs. Although this can often take a fair amount of time, 95 minutes is excessive and over twice as long as any other drive in the test.

To facilitate writing CD-Rs there's a copy of WinOnCD version 3.6 and on the CD-RW front you'll find PacketCD

ALTHOUGH AN ATTEMPT has been made to give the CR 4804 TU a bit of styling, it's still just an internal drive in a box. On the plus side it will look good alongside your iMac, with five different coloured sets of feet in the box to match

version 3.0. On the back of the unit there's an input for the supplied mains adaptor, USB connector plus two phono connectors for audio.

Instructions are basic, with the UK instructions unusually pushed to the rear of the multilingual manual.

DETAILS

★★

PRICE £175.07 (£149 ex VAT)**CONTACT** Dabs Direct 0800 138 5204www.dabs.com**PROS** Will look great next to an iMac but...**CONS** ...doesn't support Mac, excessive CD-RW formatting time**OVERALL** Although it was the cheapest USB drive on test, the time to format CD-RWs is unacceptable and makes it a false economy

Sony CRX120Ei-DV

EXTERNAL



comes to reading CD-ROMs, USB just can't keep up and once CD-R and CD-RW speeds rise it will soon become a bottleneck. The alternative to this is the snappily named IEEE 1394 interface better known as FireWire or i.LINK (by Sony). The CRX120Ei-DV is the first FireWire CD-RW device that we have seen so far and the results are impressive.

While speeds for both CD-R and CD-RWs were good, they were nothing to write home about. When it came to reading, however, the USB bandwidth bottleneck became clear, with this drive almost halving the time taken by the competition.

If you haven't got a FireWire card in

FOR THE CURRENT generation of drives, USB provides a compelling interface. It's 'hot-pluggable', comes as standard on most PCs, is far easier to configure than parallel-port devices and is well supported. However, when it

your PC, there is one in the box plus a copy of ULead VideoStudio and a connecting lead just in case you own a DV camcorder as well. WinOnCD version 3.7 has been chosen to do the burning honours, with PacketCD version 3.0 supplying the 'drag and drop' software.

DETAILS

★★★★

PRICE £349 (£297.02 ex VAT)**CONTACT** Sony 01932 816 660www.sony-cp.com/cd-rw**PROS** FireWire beats the USB bottleneck**CONS** Expensive**OVERALL** A FireWire card will cost about £100, so taking this into account it's good value. When more PCs come with FireWire as standard, the drive's price should drop further

Sony CRX120Eu-RP

EXTERNAL



speed CD-RW and 24-speed CD-ROM, due to the limits of the USB bus, the box, somewhat honestly, declares it as a six-speed CD-ROM.

The bundle includes WinOnCD version 3.6 for CD-Rs and PacketCD version 3.0 for CD-RW work. Added bonuses include a copy of PowerQuest's Drivelmage, Arcsoft Photobase, Steinberg Cubasis AV and Wavelab. A full complement of Mac software is also included, with Adaptec Toast doing the CD-R honours this time. In the box there's also one CD-R and one CD-RW disc, plus a labelling pen.

The mains adaptor is integrated into the main unit, which makes things tidy, and the USB lead is a fetching purple to

THE STYLING OF this unit is good, but on opening the front flap the illusion is shattered and you realise that the CRX120Eu-RP is just another internal drive in a box. Although the drive inside states it is a four-speed CD-R, four-

match the device. The performance of the drive was adequate, placing it in the middle of the field overall. A little slower in some areas, but nothing alarming. On the whole, Sony has put together a good package but it is a little pricey compared to the other external units in the test.

DETAILS

★★★★

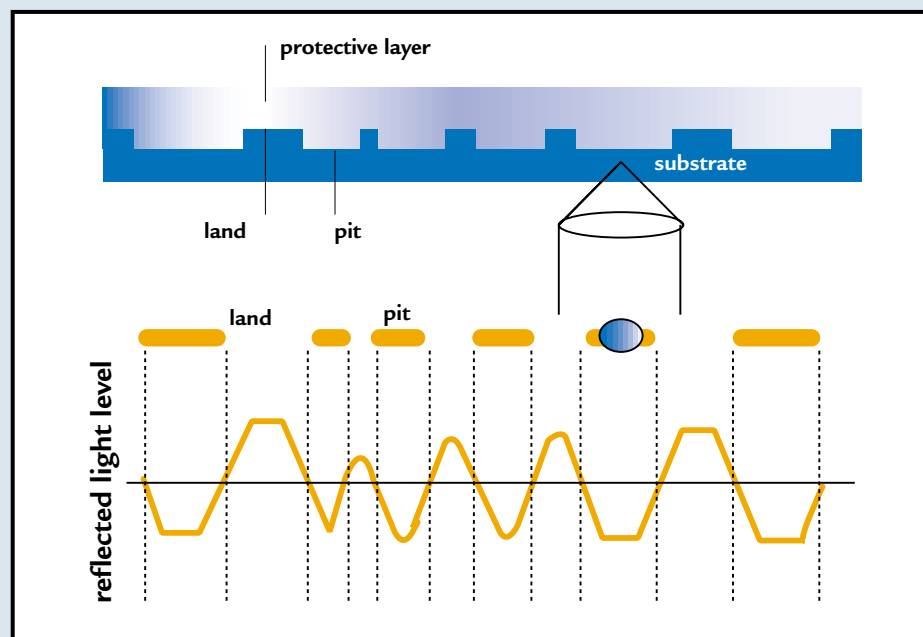
PRICE £222.07 (£189 ex VAT)**CONTACT** Dabs Direct 0800 138 5204www.sony-cp.com/cd-rw**PROS** Good software package, styling**CONS** A little on the expensive side**OVERALL** The styling may not appeal to everyone but the package is a good one. If you think it looks good and you'll use the extra software then this is a good buy

Everything you ever wanted to know about CDs

Since CDs were never designed to hold computer data, let alone be recordable, the fact that you can now use CD-Rs as an affordable backup and storage medium is quite a feat in itself. CD-Rs and CD-RWs are physically different to the audio CDs and CD-ROMs that you buy in the shops. However, when placed in a drive they appear the same to the unit. This fact, coupled with the ever decreasing cost, makes them a very attractive medium, since you'd be hard pushed to buy a computer without a CD-ROM nowadays. There's no need to install any software on the machine – it can simply read the disc.

To understand how CD-Rs (and CD-RWs) work we first need to look at how CDs function. The surface of a CD consists of a one spiral track, roughly 3.5 miles long, that runs from the center of the disc outwards (the opposite way to vinyl records) on top of a reflective material. Along the track are a series of variable length pits with a depth of 0.13micron; the area between the pits is referred to as the land. When a laser is focused on the disc, light that falls on the land bounces straight back whereas light that falls in a pit is scattered due to destructive interference (0.13micron is one quarter of the wavelength of the laser. When it bounces back it is half a wavelength out of sync with the beam and the two cancel each other out so no light is reflected back). While this is an over simplification of how data is encoded on CDs you can see how ones and zeros (binary data) can be stored on the disc due to the different intensity of the reflected light. During the production process, these pits are physically stamped into the surface of the CD.

CD-Rs work by emulating the physical land and pits on a CD. On a CD-R there is a layer of organic dye between the reflective surface and the laser, there is also a pre-groove spiral to guide the



recording laser along the correct path. The pits are created during the recording process by permanently altering the properties of the organic dye with the laser, so it diffuses the light and emulates the land-pit transitions that occur on a conventional CD. Since the dye is permanently changed by the recording laser, CD-R is referred to as a WORM (Write Once Read Many) format and cannot be changed once it has been recorded.

CD-RWs build on CD-R technology by adding the ability to change the properties of the recording layer more than once, allowing the disc to be written over and over again. On a CD-RW the recording layer is sandwiched between an upper and lower di-electric layer. The recording layer can exist in two states: a crystalline state with high reflectivity or an amorphous state with low reflectivity. CD-RWs start life in a crystalline state. The change occurs when the recording layer is heated to melting point and then left to cool. Rather than recrystallising, the layer settles in the amorphous state. To enable re-writability the layer can be recrystallised by heating it to a lower temperature,

therefore emulating the differing light intensities needed to read the disc. The disadvantage of CD-RWs is that their reflectivity is extremely low compared to stamped CDs. This means that not all CD-ROM drives will read them (although any produced in the last three years should be able to). It is highly unlikely that a CD-RW will be readable by an audio CD player for the above reason.

There are a number of different formats that are used to store data on CDs, but the main ones that you'll encounter are Red Book, used for audio CDs, Yellow Book, used for data CDs, and Orange Book Part III, used for CD-RWs.

Red Book CDs have the following basic format: a lead-in track, data area and lead-out track. These elements are described as a session. A session does not have to be written in one go and can be added to later, however such a session, described as open, will not be readable in a CD player. When you've finished adding data and you want to use the disc, the session must be closed. Closing a session involves writing a Table of Content (TOC) to the lead-in track, so the device can locate the data on the

disc, and writing the lead-out track.

Yellow Book CDs can have more than one session (Red Book CDs can as well, but an Audio CD player will only ever read the first session, so there is little point). CDs with more than one session are described as multi-session discs. To create a multi-session disc, when the last session on the disc is closed a link to the lead-in of the next session is created – so data in the next session can be accessed as well. This allows you to close the session, allowing the data to be read, but also allows you to add further data to the disc in the future.

CD-RWs can be written in the same way as CD-Rs (in sessions), although they are more commonly used with packet-writing software (like Adaptec's DirectCD). Packet writing removes the need to write data in sessions and allows the disc to be treated like a hard drive (ie 'drag and drop' operation which is seamless to the user). You can use packet-writing software with CD-Rs as well, but obviously they will fill up eventually. However, it is still necessary for the disc to be closed before it is ejected, otherwise the data will be unusable.

WILL HEAD

HP 9210i

SCSI



HEWLETT-PACKARD HAS been very successful in the CD-RW market. The competition is now much fiercer though, and HP's latest entry into the SCSI CD-RW market isn't quite as attractive as its previous models.

In HP's favour, this device is very solid and the build quality feels similar to the Plextor. However, its performance doesn't match the Plextor's. The 9210i writes CD-Rs at eight-speed, CD-RWs at four-speed and reads CD-ROMs at 32-speed. Although this makes it as fast as the Sony on paper, in reality that's not the case. The 9210i handled both the CD-R write tests almost two minutes slower than the Sony and the CD-RW format took over 26 minutes.

That said, the HP does have one aspect firmly in its favour and that's its price. With a street price of £150 ex VAT, the HP is £60 less than the Plextor and £40 less than the Sony.

The software bundle is made up of Adaptec Easy CD Creator and DirectCD. The fascia of the drive is adorned with a single eject button and two indicator lights, as well as a headphone jack with volume wheel.

The HP may not be the fastest drive available here, but £150 for a SCSI CD-RW represents excellent value.

DETAILS

★★★★

PRICE £176.25 (£150 ex VAT)**CONTACT** Dabs Direct 0800 138 5104www.hp.com/uk**PROS** Good value for money**CONS** Poor performance**OVERALL** If you're on a budget but want a SCSI drive, the HP is definitely worth a look

Plextor PlexWriter 12/4/32

SCSI



PLEXTOR HAS A long standing reputation for producing high-quality optical drives and the PlexWriter 12/4/24 is no exception.

As the name suggests, this drive will write CD-R discs at 12-speed, CD-RW

discs at four-speed and read CD-ROM discs at 32-speed.

The build quality is first rate and the whole unit has a reassuringly solid feel to it.

Adorning the fascia is a headphone socket with volume wheel as well as a stop/eject button and a play/skip button. The Disc and Read indicators are fairly self explanatory, while the L and H Write indicators determine what speed and media is being utilised.

L is lit during two-speed, four-speed or eight-speed writing, while H is illuminated when 12-speed writing is employed. Both indicators are illuminated when rewriting is used.

Performance is outstanding, with the

Plextor beating all the competition by a wide margin when it comes to CD-R writing. The format of the CD-RW disc took longer than expected, but the CD-RW write tests and the read tests were on a par with the other drives.

In the box you'll find WinOnCD, as well as Plextor's utility disc.

DETAILS

★★★★

PRICE £240.87 (£205 ex VAT)**CONTACT** Dabs Direct 0800 138 5204www.plextor.com**PROS** Fastest CD-R performance available, great build quality**CONS** Expensive**OVERALL** If you've chosen the SCSI route, it's worth spending a bit extra for the Plextor

Sony CRX140S-RP

SCSI



SONY'S ENTRY INTO the SCSI CD-RW market is rather understated, compared to its other expertly designed products. The drive fascia is somewhat barren compared to the Plextor, with an eject button, headphone socket and

wheel and a single indicator light.

The drive itself will write CD-Rs at eight-speed, CD-RWs at four-speed and read CD-ROMs at 32-speed. This is pretty much par for the course, although Sony's EIDE drive can write CD-Rs at 10-speed.

Performance was significantly slower on CD-R media than the 12-speed Plextor, which was no surprise. What was impressive, however, was that the CD-R performance was a lot better than the HP drive which also boasts eight-speed CD-R writing.

Where the Sony really shone, though, was in the CD-RW format. Here it beat the Plextor by almost nine minutes and beat the HP by over 20 minutes.

The software bundle is generous with WinOnCD taking care of burning and PacketCD handling drag and drop duties. You also get PowerQuest's Drive Image for imaging your hard disk and Data Keeper for backing up your files.

On the whole the Sony is a decent drive, but it's not quite up to the standard of the Plextor.

DETAILS

★★★★

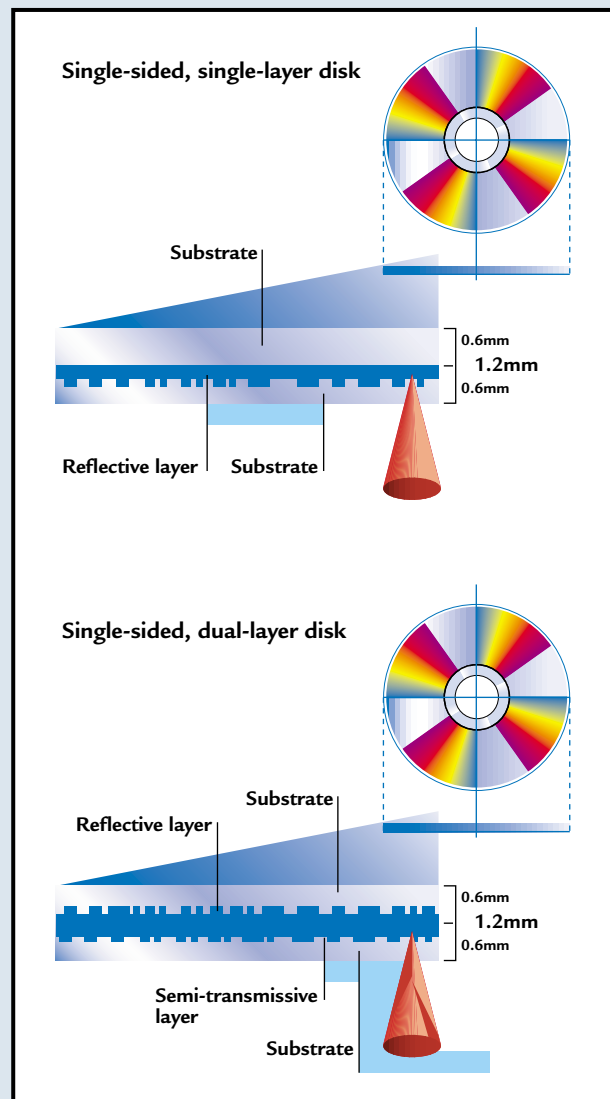
PRICE £222 (£189 ex VAT)**CONTACT** SMC 0800 597 5333www.sony.co.uk**PROS** Very fast CD-RW format**CONS** Almost as expensive as the faster Plextor**OVERALL** A good CD-RW package with fast eight-speed performance, but the price is high

DVD and the future of storage

When CD-ROM drives first launched, the thought of anything coming close to filling 640MB seemed ridiculous. It wasn't long, however, before we started to see software shipping on multiple CDs and it became clear that a solution had to be found. The natural progression of CD-ROM is DVD-ROM and you'd be hard pushed to find a new PC that doesn't ship with a DVD-ROM drive these days.

DVD offers far greater capacity than CD, with DVD-ROM discs storing between 4.7GB and 17GB. DVD differs from CD in many ways although it shares the 5in form factor. Unlike CD, DVD discs can store data on two sides by bonding two discs together, but most impressive is the fact that each side can have two layers. On a dual-layer disc the two layers are bonded using a photo-polymer resin, which is then cured under ultra-violet light. The resin then becomes clear, allowing the laser in the player to adjust its intensity to read through the top layer and access the second layer beneath it. Even without the bonded multi-layers, the data density on DVD discs is far higher than CD, producing 4.7GB of storage on a single-sided, single-layered disc. The reason for the increased data density is a reduction in the pit size (the pits are where the data is actually stored). On a CD the pit size is 0.83microns, compared to only 0.4microns on a DVD. Add to this the fact that the track spacing is only 0.74microns on DVD, compared with 1.6microns on CD and it's easy to see why so much more data can be squeezed onto a single DVD.

Because of the reduced pit size and track spacing, the laser used by CD drives is not accurate enough to read the data. Therefore a new laser was developed for the DVD standard, designed



DVD discs can store data on two layers, giving them more capacity

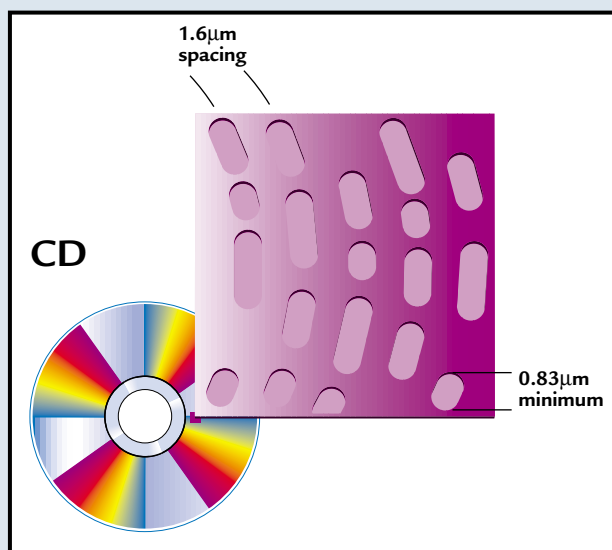
specifically to deal with the higher data density.

Of course DVD is more than just a ROM format for data distribution, it's also a writable format for data transport, backup or archive. DVD-RAM drives have been available for some time now and offer impressive capacity at a reasonable cost. DVD-RAM discs currently come in two flavours, single-sided 2.6GB discs and dual-sided 5.2GB discs. The most impressive aspect of the DVD-RAM format is the cost of the media, with a 5.2GB double-sided disc costing around £20. With this sort of value for money, DVD-RAM is ideal for storing or transporting

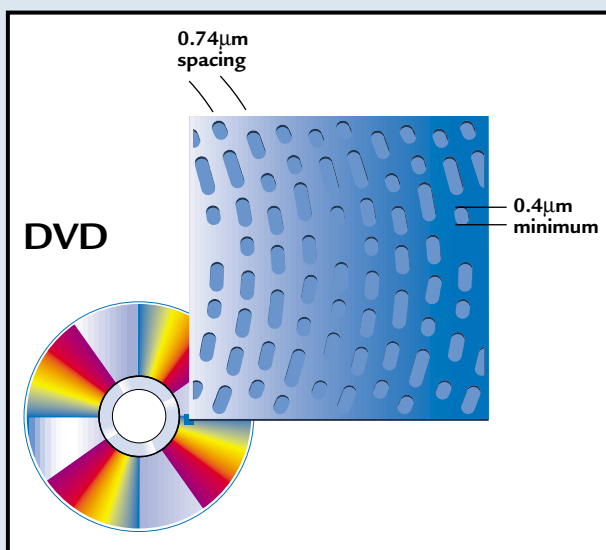
large amounts of data. However, DVD-RAM does have a couple of disadvantages as well. First is the fact that the media is stored inside a caddy, which adds a hurdle to the ideal situation of reading DVD-RAM discs in a DVD-ROM drive. The reason for the caddy is that DVD-RAM discs have a very low reflectivity compared to their ROM-based siblings. The result of this low reflectivity is that the slightest blemish or scratch on the disc could render it unreadable. The caddy therefore protects the delicate surface from the environment and ensures that the media has a long life.

The other disadvantage is the capacity. Of course, 2.6GB on one side of a disc is pretty impressive – but it's considerably lower than the 4.7GB that can be stored on a single-layer DVD-ROM disc. Because of this, DVD-RAM discs can't be used as a master for producing DVD-ROM discs. This is a problem that has almost been solved, though. The 4.7GB version of DVD-RAM is very close to completion and Panasonic should have a drive on the market by the time you read this. Not only will the 4.7GB version of DVD-RAM allow you to master DVD-ROM discs, it also means that a double-sided disc will store a massive 9.4GB of data. That's a very large amount for a removable storage device and will be ideal for video editors, who are always desperate for more storage space for large projects. Of course, there's no pricing for these high-capacity discs yet, but if the 5.2GB discs are anything to go by, you can expect them to be very affordable.

However, as with most things in the technology arena, the DVD standard is a bit more complicated than it first appears. A few years back a split began in the DVD Forum over the rewritable standard. Although the Forum had agreed on DVD-RAM being the rewritable format for DVD, Philips, Sony and HP decided that there was a better format available – DVD+RW. There were two main advantages to DVD+RW when information was first released to the press a couple of years ago. The first was that DVD+RW had a higher capacity than DVD-RAM at the time, 3GB per side as opposed to 2.6GB per side. However, this turned out to be something of a moot point, since the 3GB version of DVD+RW never saw the light of day. The second advantage, and one that is still being pushed hard, is that



CDs have 0.83micron pit size, with 1.6micron trackspacing



DVD's 0.4micron pits and 0.74micron trackspacing ups capacity

DVD+RW doesn't use a protective caddy. This means it can be placed in any DVD drive/player, which should also be able to read it.

The latest information on DVD+RW is that the 4.7GB per side variant is close to completion, but this of course offers no capacity advantage over DVD-RAM, which will reach this level first. However, it is the universal compatibility that's being touted hard in DVD+RW's favour. The idea is that a DVD+RW disc will be readable in any standard DVD-ROM drive, or even in a DVD-Video player.

Several demonstrations have been given of late, showing a DVD+RW disc playing in a multitude of DVD devices from various manufacturers. However, at the risk of sounding cynical, these demonstrations have done little to convince us of the reality and we're waiting patiently to test a DVD+RW device ourselves.

Unfortunately such drives

still don't exist, so the PCW jury is still out over the compatibility of DVD+RW. That said, looking at the specs of the DVD+RW discs, there's every chance that this compatibility could be a reality, especially since the reflectivity is identical to that of a dual-layered DVD-ROM disc. There also seems to be growing support for DVD+RW as a standard, with Thomson Multimedia and Ricoh both pushing the format at CeBIT this year.

Another member of the DVD family is the DVD-R drive. Like the CD-R drive, this can burn DVD discs permanently, but they can't be written to again. There were a couple of issues with DVD-R. First was the price, with initial drives costing well over £10,000. Second was the capacity, at 3.9GB DVD-R discs were not large enough to master DVD-ROM media from. That second problem has been recently overcome with the introduction of 4.7GB DVD-R media, but a

drive will still set you back around £4,000. It will be interesting to see whether DVD+RW manages to kill off DVD-R, since it is set to offer the same capacity and the same compatibility at a fraction of the price.

But wait, there's still another DVD format out there, DVD-RW. This is another rewritable format that is ratified by the DVD Forum. In direct competition to DVD+RW, DVD-RW has a capacity of 4.7GB and requires no disc caddy. DVD-RW is destined for consumer use and Pioneer has recently released the world's first consumer DVD video recorder. The DVR-1000 will record up to two hours of high-quality video on a single DVD-RW disc, but the user is also offered the option of selecting the quality level. If you're not that bothered about the quality of your recording, you can drop the level to increase the recording length. Using this manual setting, you can store up to six

hours of video on one disc. Although DVD-RW discs are not currently playable in DVD-ROM or video players, this is something that will be addressed with future hardware releases. So, eventually there should be nothing stopping you from recording something and then taking it round to a friend's house and watching it on their DVD-video player. However, before you get excited about recording all your favourite movies from Film Four, the DVR-1000 is fully equipped to recognise copy protection. So if digital broadcasters don't want you making digital copies, you won't be able to.

So, DVD is a medium with a multitude of uses and a multitude of formats. Regardless of all its problems, however, it's likely that DVD will become the standard for data, audio and video storage. Let's just hope it doesn't take the DVD Forum too long to get there.

RIYAD EMERAN



The Panasonic LF-D101E DVD-RAM drive



Hitachi's DVD-RAM competitor



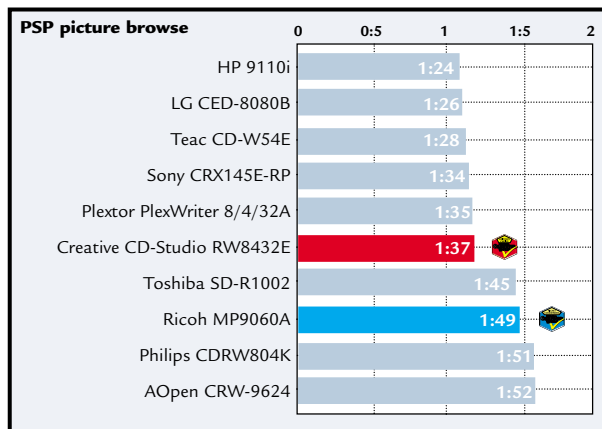
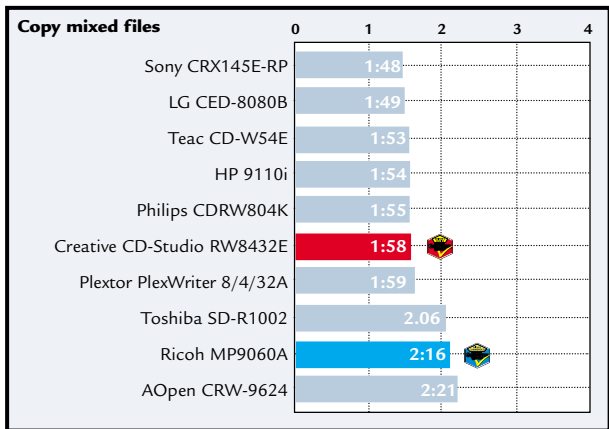
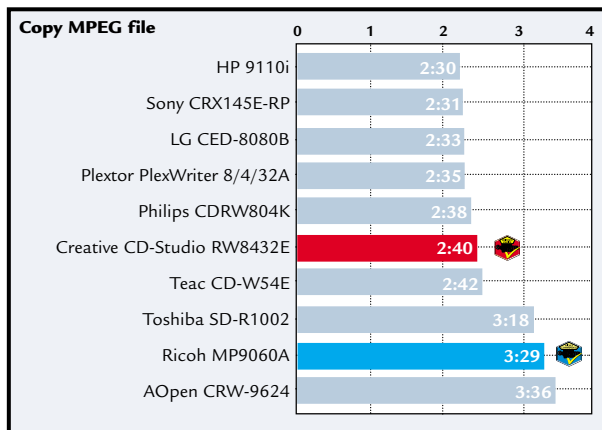
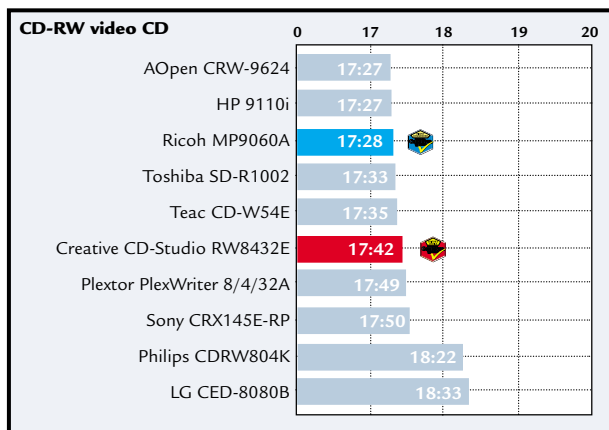
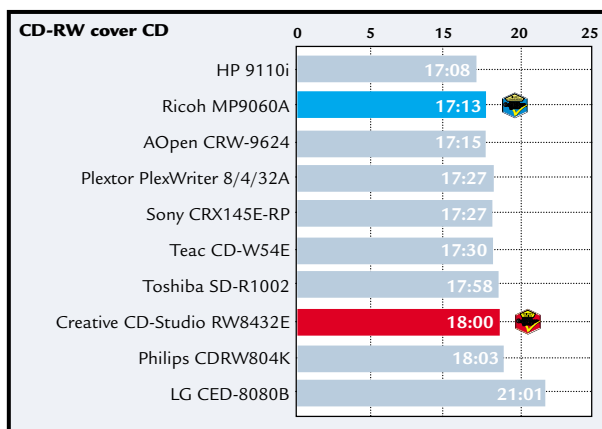
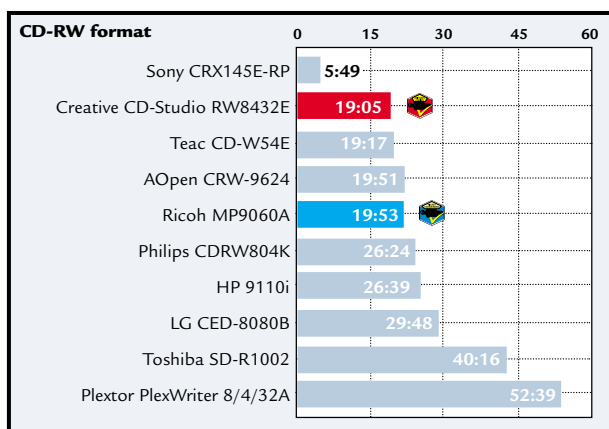
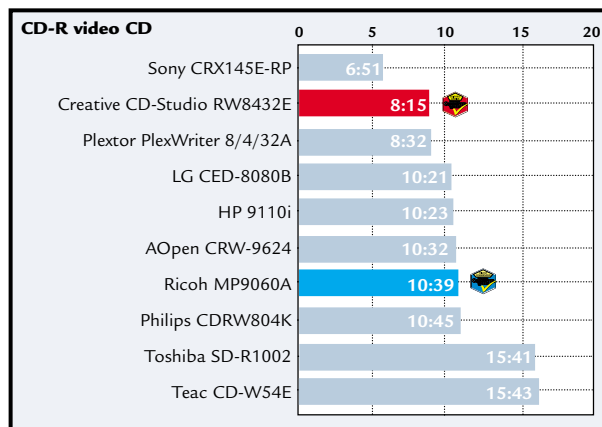
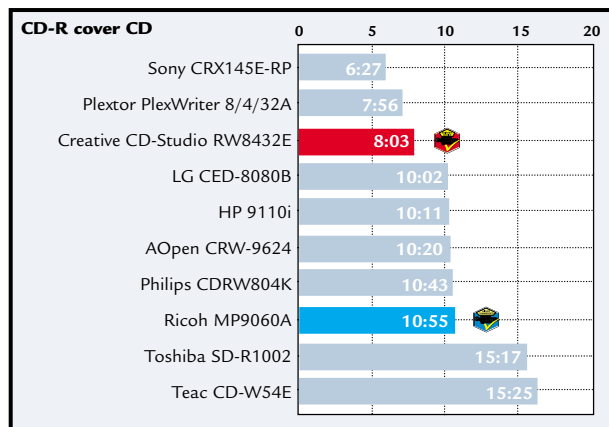
The DVR-5201 will burn DVD-R discs



The DVR-1000 is a home DVD recorder

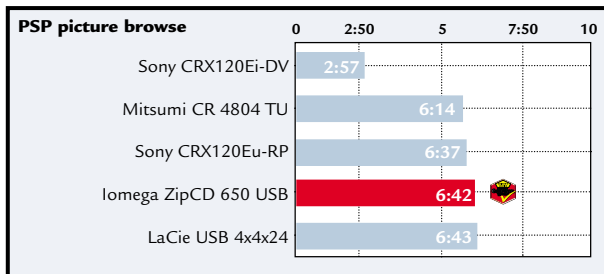
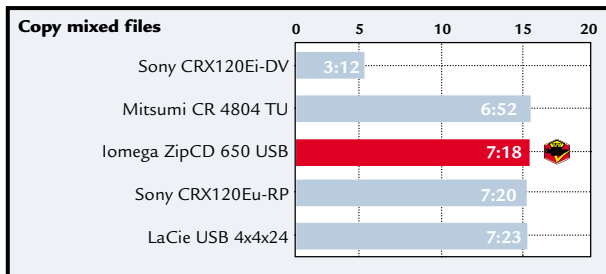
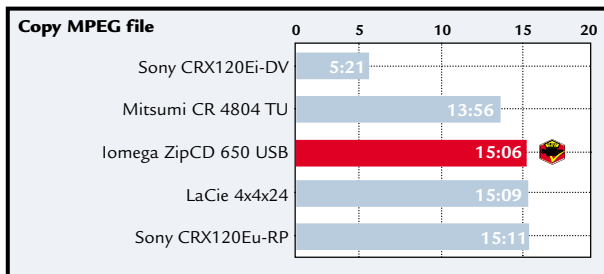
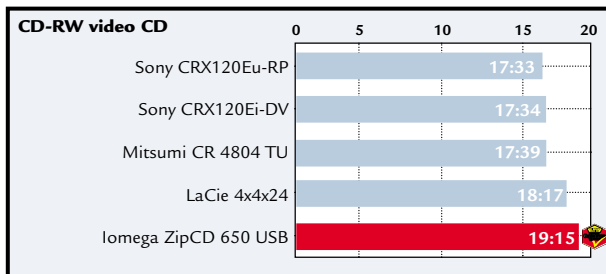
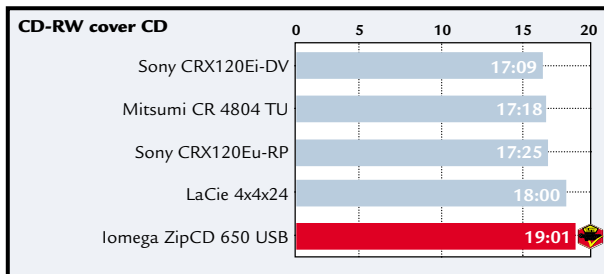
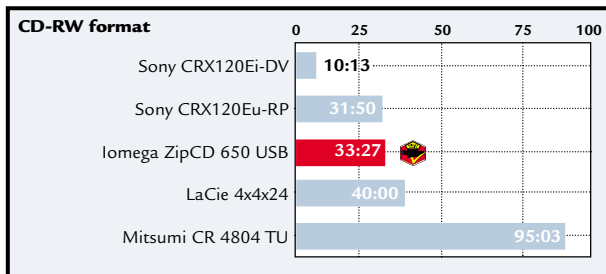
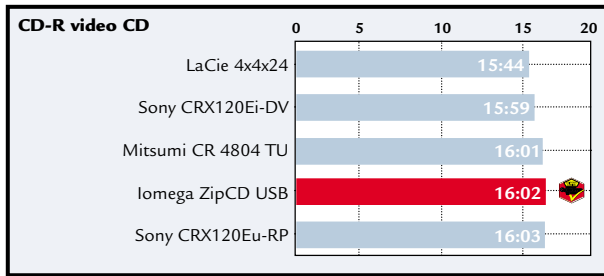
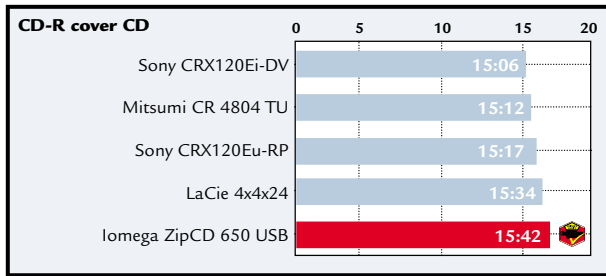
EIDE drive results

See overleaf for an explanation of how we did the tests



All scales in minutes and seconds. Shorter bars are better

External drive results



SCSI drive results

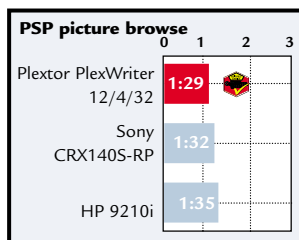
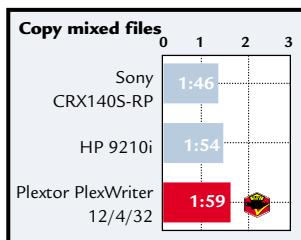
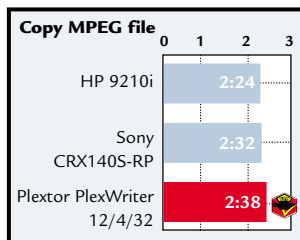
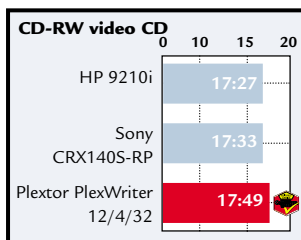
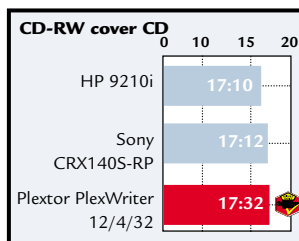
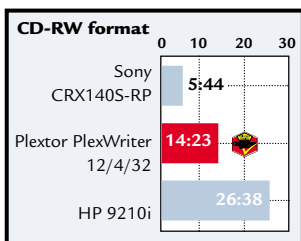
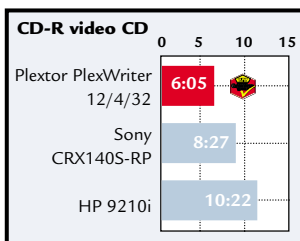
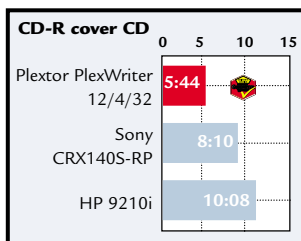


Table of features	EIDE							
	AOPEN	CREATIVE	HP	LG	PHILIPS	PLEXTOR	RICOH	SONY
MANUFACTURER	AOPEN	CREATIVE	HP	LG	PHILIPS	PLEXTOR	RICOH	SONY
MODEL NAME	CRW 9624	CD-RW CD-STUDIO RW8432E	9110i	CED- 8080B	CDRW 804K	PLEXWRITER 8/4/32A	MP9060A	CRX 145E-RP
Price (ex VAT)	£135	£165	£152	£169.36	£139	£149	£179	£203.40
Price (inc VAT)	£158.62	£193.87	£178.60	£199	£163.32	£175.07	£210.32	£239
Manufacturer URL	www.aopen.nl	www.europe.creative.com	www.hp.com/uk	www.lge.co.kr	www.philips.com	www.plextor.com	www.ricoh-europe.com	www.sony-cp.com/cd-rw
Supplier	Dabs Direct	Dabs Direct	Dabs Direct	LG	Dabs Direct	Dabs Direct	Dabs Direct	Sony
Supplier phone number	0800 135 5204	0800 135 5204	0800 135 5204	01753 500 400	0800 135 5204	0800 135 5204	0800 135 5204	01932 816 660
Supplier URL	www.dabs.com	www.dabs.com	www.dabs.com	www.lge.co.kr	www.dabs.com	www.dabs.com	www.dabs.com	www.sony-cp.com/cd-rw
HARDWARE SPECS								
Type	CD-RW	CD-RW	CD-RW	CD-RW	CD-RW	CD-RW	CD-RW + DVD	CD-RW
CD-R write speed	6	8	8	8	8	8	6	10
CD-RW write speed	4	4	4	4	4	4	4	4
CD read speed	24	32	32	32	32	32	24	32
Buffer size	2MB	2MB	Not supplied	2MB	2MB	4MB	2MB	4MB
Number of CD-Rs included	1	10	1	1	1	1	1	1
Number of CD-RWs included	1	1	1	1	1	1	1	1
Interface	EIDE	EIDE	EIDE	EIDE	EIDE	EIDE	EIDE	EIDE
External/internal	Internal	Internal	Internal	Internal	Internal	Internal	Internal	Internal
Front panel controls	Volume	Volume	Volume	Volume, Play/Forward	Volume	Volume	Volume	Volume
Front panel sockets	Headphone	Headphone	Headphone	Headphone	Headphone	Headphone	Headphone	Headphone
Analog audio out	✓	✓	✓	✓	✓	✓	✓	✓
Digital audio out	✓	✓	X	✓	X	X	✓	X
Cables supplied	Audio	EIDE	EIDE, Audio	EIDE, Audio	EIDE, Audio	EIDE, Audio	Audio	EIDE, Audio
SOFTWARE								
CD-R authoring software	Nero 4	Nero 4	Easy CD Creator 4	Easy CD Creator 3.5	Easy CD Creator 4	WinOn CD 3.6	Nero 4	WinOnCD 3.7
CD-RW Packet Software	InCD 1.3	abCD 1.3	DirectCD 3	DirectCD 2.5	DirectCD 3	PacketCD 3	InCD 1.3	PacketCD 3

How we did the tests



To test the performance of the drives we used a 733MHz Pentium III, equipped with 128MB of RAMBUS memory with a clean installation of Windows 98 SE. To ensure that we were testing the drives' ability to write, rather than the machine's ability to provide data, all the tests were performed from an 18GB IBM Ultra2 SCSI hard drive connected to an Adaptec 3950U2W card. We were interested in the package as a whole, rather than the raw performance of the drive, so all the devices were tested using

the supplied burning and packet writing software, as this is what the consumer will receive. After each drive had been tested the machine was restored to a clean installation of Windows 98 to ensure that previous software installations did not affect the results.

For EIDE devices, the drive was configured as the master device with no others on the channel. SCSI drives were attached to the narrow channel on the Adaptec SCSI card. USB drives were connected to the onboard USB ports on the motherboard with no other

devices on the bus. To test the FireWire drive we used the supplied card, installed in a properly configured PCI slot.

We split the tests into three different areas: CD-R, CD-RW and CD-ROM performance.

CD-R performance

To test the unit's ability to write CD-R discs we used two sets of data, April's PCW cover CD and a VideoCD.

The cover CD, totalling around 500MB of files, represented a varied mix of file sizes and directory structures. The time taken from last button

EXTERNAL							SCSI		
TEAC	TOSHIBA	IOmega	LaCIE	MITSUMI	SONY	SONY	HP	PLEXTOR	SONY
CD-W54E	SD-R1002	ZIPCD 650 USB	4x4x24	CD 4804 TU	CRX120 E1-DV	CRX120 EU-RP	9210i	PLEXWRITER 12/4/32	CRX140S
£126.81	£217	£176.99	£199	£149	£297.02	£189	£150	£205	£189
£149	£254.98	£207.96	£233.83	£175.07	£349	£222.07	£176.25	£240.87	£222.08
www.teac.co.uk	www.toshiba.co.uk	www.iomega.com	www.lacie.com	www.mitsumi.com	www.sony-cp.com/cd-rw	www.sony-cp.com/cd-rw	www.hp.com/uk	www.plextor.com	www.sony-cp.com/cd-rw
Simply	Toshiba	Simply	Insight	Dabs Direct	Sony	Dabs Direct	Dabs Direct	Dabs Direct	SMC
0870 727 2190	0800 169 4527	0870 727 2190	0870 700 7350	0800 135 5204	01932 816 660	0800 135 5204	0800 135 5204	0800 135 5204	0800 597 5333
www.simply.co.uk	www.toshiba-europe.com/diskproducts	www.simply.co.uk	www.insight.com	www.dabs.com	www.sony-cp.com/cd-rw	www.dabs.com	www.dabs.com	www.dabs.com	www.smc-direct.com
CD-RW	CD-RW + DVD	CD-RW	CD-RW	CD-RW	CD-RW	CD-RW	CD-RW	CD-RW	CD-RW
4	4	4	4	4	4	4	8	12	8
4	4	4	4	4	4	4	4	4	4
32	24	6	24	8	24	6	32	32	32
2MB	Not supplied	Not supplied	2MB	2MB	2MB	2MB	Not supplied	4MB	4MB
1	2	2	1	1	1	2	1	1	1
1	1	0	1	1	1	2	1	1	1
EIDE	EIDE	USB	USB	USB	Firewire	USB	SCSI	SCSI	SCSI
Internal	Internal	External	External	External	External	External	Internal	Internal	Internal
Volume	Volume	Volume	Volume	Volume	Volume	Volume	Volume	Volume, Play/Forward	Volume
Headphone	Headphone	Headphone	Headphone	Headphone	Headphone	Headphone	Headphone	Headphone	Headphone
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
✓	✓	✗	✗	✗	✗	✗	✗	✗	✗
EIDE, Audio	EIDE, Audio	USB, Audio	USB, Audio	USB	FireWire	USB	Audio	Audio	Audio
Nero 4	Instant CD Wizard Gold 5	Easy CD Creator 3.5	Easy CD Creator 4	WinOnCD 3.6	WinOnCD 3.7	WinOnCD 3.6	Easy CD Creator 4	WinOnCD 3.7	WinOnCD 3.6
InCD 1.3	Instant CD Wizard Gold 5	DirectCD 2.5	DirectCD 3	PacketCD 3	PacketCD 3	PacketCD 3	DirectCD 3	PacketCD 3	PacketCD 3

press to the final disc creation was recorded. Validity tests were performed on each disc.

The VideoCD contained an MPEG file of around 500MB, plus a few sundry files. The VideoCD test examined the drive's sequential write capability for large file sizes, recording the time taken. Validity tests were executed on the resulting disc.

CD-RW performance

To conduct the CD-RW test the same data sources were used, although this time the

bundled packet-writing software was used. Since this software requires the disc to be formatted prior to use, we also recorded the time taken to do a full format on a blank disc.

Once the packet-writing software had been installed on the test machine, the cover CD content was copied from the SCSI drive to the disc using Windows Explorer. The time taken to copy was recorded and validity tests were done.

The VideoCD content was copied in the same way to a freshly formatted CD-RW

disc, with the time taken recorded.

CD-ROM performance

To test the drives' read speed, a different set of data was used. A mixed CD of office content including Word documents, Excel spreadsheets, Acrobat PDF files, HTML pages and small graphics files, totalling 200MB, were written to a test CD and the time taken to copy to the hard drive recorded. To test the sequential read of the drive, the MPEG file from

the VideoCD was used.

Finally, a 200MB set of TIFF graphics files were written to a CD and the browse function in Paint Shop Pro 6 was used.

Using Paint Shop Pro 6, the final test involved using the browse facility from the File menu. Once the CD containing the files had been selected from the directory tree, the time taken for the last preview to be drawn was recorded. Since a fresh install of Windows was used each time, no caching by Paint Shop Pro was present.



Editor's Choice

The CD-RW has become one of the most popular PC products of the moment, with PCs at almost every price point now shipping with them. The advantages are obvious, with the ability to back up and archive data and widespread compatibility. You can burn data onto a CD-R or CD-RW disc and be sure that almost any PC will be able to read it.

Obviously, the most popular devices are the EIDE variants, and this is borne out by the amount of EIDE drives available, compared to the SCSI and external models. That said, many PC users still opt for the high performance and flexibility of SCSI and are willing to pay the price premium associated with the interface.

The external drives have the

disadvantage of compromised performance due to the bandwidth of the USB bus, but they also have the added flexibility of being transportable devices. External units are also ideal for users who have both a desktop PC and a notebook, giving them the option of switching the drive between their computers.

As this test has shown, the main difference between the drives is the speed at which they burn CD-R media, with the fastest managing 12-speed and the slowest only running at four-speed. To a certain extent the speed of the burning process isn't an issue. You're unlikely to sit and wait for a CD to burn, you'll probably get on with something else or go and grab a cup of coffee. However, on those occasions when you are pushed for

time, that extra speed will seem more than worth while.

➤ Taking this into account, the first **Editor's Choice** award goes to the fastest drive on test, the Plextor PlexWriter 12/4/32. There were only three units in the SCSI section, but the Plextor won us over with its performance, build quality and front-panel features. Of course, you're paying a price premium for this quality, but most SCSI users are used to paying a bit more for peripherals and they'd rather buy the best than save a few pounds.

➤ The second **Editor's Choice** is in the external category and goes to the Iomega ZipCD 650 USB. Iomega has been producing high-quality removable media drives for a long time and we were quite surprised when it ventured into the already saturated CD-RW arena. That said, Iomega's experience has helped it produce a first-rate external unit compared to the other products on test, which were just standard internal drives in an external case. The ZipCD also ships with software for both PC and Mac, since the USB interface makes it applicable to both systems.

➤ The EIDE section was the most highly contested. Before we get to the winners, Sony deserves a mention for producing the fastest drive in this group, sporting 10-speed CD-R performance and lightning-fast CD-RW formatting speeds. Unfortunately, the cost was too high to warrant an award, but if you can afford it, it's an excellent drive.

The **Editor's Choice** award goes to the Creative CD-RW Blaster CD-Studio. Not only does it offer good performance from its eight-speed CD-R, four-speed CD-RW and 32-speed CD-ROM specs, but the whole package is first rate. Inside the retail box you get comprehensive documentation, all the necessary cabling, one CD-RW and 10 CD-R discs. Creative has put together a great bundle that's well worth the asking price.

Ricoh also walks away with a **Highly Commended** award for its MP9060A CD-RW/DVD-ROM combo drive. It may not match the standard of some of the dedicated CD-RW units, but its performance is acceptable and the price is very reasonable considering you're getting two drives in one.



The Plextor PlexWriter 12/4/32 won the SCSI crown with its CD-R writing speed



The external category was won by Iomega's ZipCD 650 USB, for Macs and PCs



Creative's EIDE CD-Studio RW8432E offers performance with an excellent bundle



Ricoh's MP9060A combines CD-RW with DVD and was runner up in the EIDE group