PRODUCT REVIEW

HHB Compact Disc Recorder

Reviewed by Gary Galo

HHB CDR-800 Professional Compact Disc Recorder. HHB Communications USA, LLC, 1410 Centinela Ave., Los Angeles, CA 90025, (310) 319-1111, FAX (310) 319-1311, E-Mail sales@hhbusa.com; Website www.hhbusa.com.

HHB Communications is a British-based firm specializing in digital audio recording equipment and media for the professional audio industry. In addition to CD recorders, HHB manufactures portable DAT recorders, a line of vacuum-tube processors (including mike preamps, compressors, and parametric equalizers), and studio monitor loudspeakers (including nearfield monitors and powered subwoofers). HHB also distributes the Genex line of high bit rate, high sampling rate magneto-optical digital recorders. Their complete line of digital media includes professional-quality recordable compact discs (CD-R), ADAT tapes, MiniDiscs (MD), and rewriteable magneto-optical (MO) discs.

The CDR-800 Compact Disc recorder (*Photo 1*) has been on the market for over two years. At the time it was introduced, the CDR-800 represented a price breakthrough in professional CD recorders. The list price of $2200 has become irrelevant, since the unit now sells for around $1200 at most pro audio dealers.

PHOTO 2: Rear panel of the CDR–800. In addition to the RCA-type analog and digital inputs, balanced XLR analog inputs and an AES/EBU balanced digital input are also provided.

The CDR–800 looks suspiciously like the Pioneer PDR–05 and PDR–99 consumer CD recorders, which are essentially identical—the PDR–99 is marketed as part of Pioneer's Elite line, and features their glossy Urushi front panel and Rosewood side panels. While based on the consumer models, the CDR–800 is actually manufactured by Pioneer for the pro-audio user, and incorporates a number of features not found on the consumer units. The Pioneer consumer players have only unbalanced (RCA) analog inputs and outputs, along with S/PDIF and Toslink digital inputs and outputs. To these interfaces, the CDR–800 adds balanced XLR analog inputs, along with a balanced XLR AES/EBU digital input (*Photo 2*).

All analog and digital outputs on the CDR–800 remain unbalanced. This may appear odd at first, but most pro audio users are likely to use the CDR–800 with an external digital processor for playback, making balanced analog outputs unnecessary. One other important difference between the CDR–800 and its Pioneer counterparts concerns the types of recordable CDs you can use. The Pioneer consumer machines will only recognize consumer-type CD–R blanks. The CDR–800 will also work with computer-type CD blanks. The CDR–800 is also equipped with standard 19-inch rack mounts.

One important feature of the CDR–800 is Pioneer's Stable-Platter mechanism (*Photo 3*), which includes a full-size platter upon which the CD is placed upside down. There are a couple of advantages to this system. First, the disc is supported over its entire surface, minimizing vibration, which, in turn, should reduce clock jitter. This serves the same purpose as the disc dampers many of us have used, but Pioneer's solution is far more effective. Second, the laser now faces down, so it is far less likely to accumulate dust.

Operation

Operationally, the HHB CDR–800 is extremely well thought out, and is really not much more difficult to operate than an analog cassette deck. For the most

PHOTO 1: Front view of the HHB CDR–800 Professional Compact Disc Recorder and its remote control.

PHOTO 3: A close-up view of the Pioneer Stable-Platter mechanism used in the CDR–800. The CD must be inserted upside down, but this mechanism greatly reduces disc vibration and dust accumulation on the laser pickup.

part, the manual is clearly written, and includes numerous illustrations. Input and output connections are straightforward, but the rear panel also contains a couple of switches that you may need to reset. A three-position slide switch located between the balanced analog input connectors selects either the unbalanced RCA line inputs or the balanced XLR connectors at +4dBu or –8dBu levels.

A digital out switch mutes the digital outputs if only the analog outputs are used. You select digital copy permission/prohibition with a pair of DIP switches, which you can set to allow unlimited copies of your recording, one-time-only copying, or no copying at all. Since the CDR–800 is a professional product, it is not bound by the consumer Serial Copy Management System—the user controls the copy management.

Input selection is done with a momentary contact button on the front panel—you toggle through the various analog and digital inputs by repeatedly depressing the button. The CDR–800 has five modes of operation—three are automatic and two are manual. One of the most useful of the automatic modes is ID–SYNC for recording from DAT sources. This mode copies index numbers from your DAT and automatically turns them into track numbers on your CD–R.

The AES/EBU interface does not transmit DAT ID codes, so you must use the S/PDIF connection. To do so, simply load a blank disc and toggle the INPUT SELECTOR until the correct input appears—the display should recognize DAT as the source at this point. Now, cue up your DAT tape to a point about five seconds ahead of the first DAT index number you wish to record. Next, toggle the DIGITAL SYNCHRO button until ID–SYNC appears in the display. The CDR–800 will begin a short setup procedure, which takes a few seconds.

After this setup, ID–SYNC returns to the display, and SYNC flashes in red. You are now ready to begin recording. Simply press the play button on your DAT recorder—when the next index number appears, the CDR–800 automatically begins recording, making that index number track 1 on the CD. You don't even need to press RECORD on the CDR–800. Each subsequent DAT index number au-

TABLE 1: MANUFACTURER'S SPECIFICATIONS

Applicable discs: CD and CD-R
Frequency response: 2Hz–20kHz
Playback S/N: 110dB (EIAJ)
Playback dynamic range: 97dB (EIAJ)
Playback THD: 0.0027% (EIAJ)
Recording S/N (analog RCA input): 90dB
Recording dynamic range (analog RCA input): 90dB
Recording THD (analog RCA input): 0.005%
Recording S/N (S/PDIF digital input): 105dB
Recording dynamic range (S/PDIF digital input): 95dB
Recording THD (S/PDIF digital input): 0.003%
Wow and flutter: Less than measurable limit (±0.001% weighted peak) (EIAJ)
Analog input impedance: 10k
Analog XLR line input level: +4 or +8dBu, switchable
Analog RCA line input level: 500mV RMS
Analog output voltage: 2V RMS
Power supply: US model: 120V AC, 60Hz; European model: 220-230V AC, 50/60Hz
Power consumption: 21W
Weight: 6.2kg (13 lbs. 11 oz)
Dimensions: 482mm (W) × 294mm (D) × 134mm (H) (18 31/32″ × 11 9/16″ × 5 9/32″)

tomatically generates a track number on the CD. It makes sense to prepare a DAT master, including all of the index points you desire, before making a CD-R.

The CDR-800 will also copy other digital sources the same way, including MiniDisc, Digital Compact Cassette, and CD, using the AL-SYNC mode. There is also a 1-SYNC mode that allows automatic copying of 1 track from any of the above digital sources. After the one track of the original has been recorded, the recording process stops. You can add additional tracks to your recording, using this mode, until the CD-R is filled to capacity.

The CDR-800 also allows manual copying of analog or digital sources, one track at a time. During manual recording, the CDR-800's REC LEVEL and REC BALANCE function the same as on any other recording device. You can record an individual track, stop, and continue at a later time. If you manually record a single track, a process called "fixation" automatically takes place before and after the track is recording. During fixation, the lead-in and lead-out information for that track is written.

When you have finished recording a CD, you must perform a process called "finalization," which allows the CD-R to be played on any conventional CD player. During this process, the absolute lead-in and lead-out information for the entire disc, and the table of contents, are written to the CD, along with a code that prevents further recording on the disc. Once you have finished recording a disc, press the FINALIZE button. After a few seconds of setup, the display will indicate a time of 4:03 or 4:07, depending on the length of the recording. This is the amount of time it will take to finalize the disc.

Now, press the PAUSE button to begin the process. The time display begins counting down—when it reaches 0:00, the process is complete, and the CD-R may be played in any CD player. The CDR-800 has a SKIP-ID function that can be used during finalization. This function allows you to effectively eliminate any unwanted tracks on your CD after it has been recorded. Suitably equipped CD players will then ignore those tracks during playback.

The CDR-800 is supplied with a remote control that duplicates the functions of the front-panel controls. You must use the remote to enter track numbers for CD playback—numeric buttons for track selection are not included on the main chassis of the CDR-800. Remote-control operation can be defeated with a DIP switch on the rear panel. The rear panel of the CDR-800 is also fitted with an 8-pin DIN Parallel Remote socket, which allows you to construct your own wired remote control, duplicating PLAY, PAUSE, RECORD, STOP, MANUAL TRACK NO., WRITE, and the two TRACK SEARCH BUTTONS. A connection diagram is included in the CDR-800 manual.

Circuitry and Construction

As *Photo 4* shows, the CDR-800 is packed with circuitry. There are no less than 13 PC boards in the CDR-800, varying in size from large servo and audio digital boards to several very small boards, including the headphone amp. Two power transformers are used, one for the audio and digital circuitry, and another dedicated to the servo. Like most products of Far East origin, the CDR-800 uses standard 3-terminal IC regulators for the power supplies. Several of these regulators are located on the two power-supply PC boards, but the analog/digital board and the servo board each house a pair of local IC regulators.

CD–R Basics

The physical structure of a CD–R disc is shown in *Fig. 1*. The recordable CD is molded with a continuous groove spiral from the inside to the outside of the disc's polycarbonate substrate. The "pregrooved" disc is necessary in order to provide the recorder with a physical reference. The groove also contains timing information that the recorder uses to keep the CD spinning at the correct speed at all points along the disc surface. After the polycarbonate substrate is molded, the disc is spin-coated with the recording layer, an organic dye such as cyanine, phthalocyanine, or azo.

The recording layer is then coated with a vacuum-deposited reflective layer, followed by a spin coat of protective lacquer. Most CD–R manufacturers add a label coating to further protect the disc from scratches. Special discs are available with a label area compatible with an inkjet printer specifically made for printing CD–R discs.

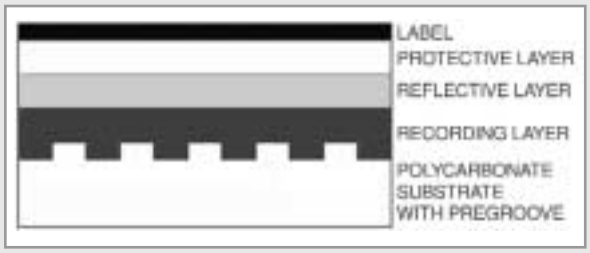

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FIGURE 1: Cut-away view of a CD–R recordable CD. The pregrooved polycarbonate substrate is coated with an organic dye recording layer and a reflective layer. During recording, the laser beam burns the organic dye, momentarily raising the temperature of the dye to over 300°F.

Inexpensive CD labeling systems are also available, from a variety of sources. Most of these allow you to print or write on a circular label with adhesive backing. These labeling systems carefully center the label on the CD in order to ensure smooth disc rotation. The adhesive backing on the CD labels is compatible with the materials from which the disc is manufactured, and should not impair the performance of the disc, or shorten its life. If you label CDs by hand, you should avoid solvent-based inks that could damage the disc. TDK makes a pen specifically for labeling CDs, which you can purchase from any pro audio dealer.

The recording laser beam is the same wavelength as that used for CD playback—780nm. The laser in the CD recorder literally burns the organic recording layer, momentarily raising the temperature of the recording layer at that spot to over 300°F. The width of a burned area, the equivalent of a pit on a prerecorded CD, is only 0.6 microns. The burning alters the optical characteristics of the organic dye, producing a different level of reflection from burned vs non-burned areas.

The most common organic dye found in CD–R disc is cyanine. Azo dye, originally developed for types of optical recording media, is also used for CD–R discs. Cyanine and azo-based discs are sensitive to ultraviolet light, as well as heat and humidity. As such, their archival life expectancy is only about ten years.

The recording surface of most CD–R discs is green, while some appear blue. This is due to the type of dye used and the color of the reflective layer. Silver and gold reflective layers yield a different color when they reflect light back through the organic dye.

More recently, the Japanese firm Mitsui has developed a CD–R disc using phthalocyanine dye. These discs are gold in color, in part due to the gold reflective layer. The phthalocyanine discs are far less susceptible to the degrading effects of light, heat, and humidity, and are expected to have an archival life in excess of 100 years. Mitsui is manufacturing these gold discs for a number of other firms, including HHB, and they have licensed the technology to other manufacturers as well.

Care should be exercised in the handling and storage of all CD–R discs. Tests have shown that the green cyanine-based discs can be rendered unplayable if left exposed to bright sunlight for only a few days. Unless they are being recorded or played, all CD–R discs should be stored in their jewel cases at all times. The HHB CDR–800 recorder automatically adjusts the intensity of the laser beam to suit the specific type of dye found on the CD–R that has been inserted in the recorder.

All CD–R discs from reputable manufacturers are certified to meet "Orange Book" specifications. The Orange Book is a document produced by Sony and Philips describing the technical specifications for the compact disc format. Part II of the Orange Book describes the CD–R format. You can find a considerable amount of information on the CD–R format on the websites of Maxell (www.maxell.com) and HHB (www.hhbusa.com or www.hhb.co.uk).

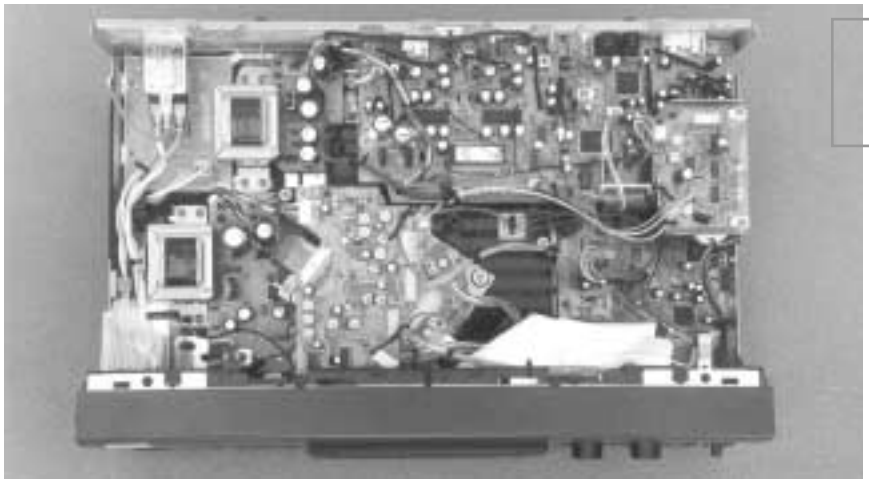

PHOTO 4: Inside view of the CDR–800. Two power transformers are used, and the solid copper chassis provides excellent shielding against EMI and RFI.

Balanced analog and AES/EBU digital signals enter the CDR–800 via the input PC board assembly. The balanced analog inputs are transformerless; the + and – legs of the balanced line are each fed to 5532 op amps operated noninverting as unity gain buffers. The outputs of these buffers are fed to the + and – inputs of a single 5532, converting the balanced signal to an unbalanced state.

The use of 5532 op amps is a real disappointment. I fail to understand why the Japanese audio industry continues to use these 20-plus-year-old devices when so many high-performance dual op amps are now available. A product as sophisticated as the CDR–800 clearly deserves better, but the Pioneer designers obviously continue to believe that high-performance op amps just don't make any difference.

The AES/EBU digital input also dispenses with the usual transformer-coupled input—the balanced to unbalanced conversion is accomplished with an SN75157P differential line receiver. The SN75157P is a dual device; only half of it is used.

The signals from the balanced input PC board are fed to the audio digital PC board assembly, which also houses all of the analog and digital unbalanced inputs. The unbalanced analog inputs for each channel are fed to NJM072 input signal op amps, manufactured by JRC. These are TL072-equivalents, another extremely dated device (data on JRC op amps can be found on their web site: www.njr.co.jp).

I'm not familiar with the analog-to-digital converter chip—it bears the part number AK5340–VS. HHB claims it uses the latest 1-bit conversion system, which is completely free of zero-crossing distortion. The A/D chip design also eliminates nonlinear distortions within the passband, and does not require external adjustments.

Digital inputs are fed directly to the LC89585 EFM encoder chip. The CDR–800 also includes a built-in sampling-rate converter chip, which converts 32kHz or 48kHz inputs to the CD standard of 44.1kHz. The sampling-rate converter functions only when needed—inputs at the standard 44.1kHz frequency bypass the sampling-rate converter.

On the playback end, the SM5813AP digital filter feeds a pair of 1-bit Pioneer

PD2028B Pulseflow D/A converter chips, which are actually stereo devices, with left and right audio outputs. To improve low-level linearity, an entire chip is devoted to each channel, configured in a differential mode. The balanced outputs from the D/A chips are fed to the ±inputs of a 5532 op amp. The unbalanced output from the op amp is fed to a second 5532, which functions as an output buffer. The filter/DAC combination should provide resolution comparable to conventional 20-bit converters.

Deemphasis is accomplished in the analog domain, using a shunt filter located between the first and second 5532. The deemphasis network is activated with a single bipolar transistor. The CDR–800 does not apply emphasis to CD recordings. Only a handful of commercial CDs, mainly from Denon, are recorded with high-frequency emphasis, and modern high-resolution converters make it unnecessary. Overall, the construction of the CDR–800 is extremely impressive. This unit should stand up to demanding, day-in, day-out professional use.

Performance

In order to evaluate the accuracy of CD–R recordings, I made a demonstration disc cloned from a number of tracks on commercial CDs that I normally use for equipment evaluation. I made the test disc by connecting my CD transport, a modified Denon DCD–1015, to the S/PDIF input on the CDR–800. My DCD–1015 has a Canare 75Ω BNC output connector—the two units were connected with a DH Labs D–75 S/PDIF interconnect fitted with a Canare 75Ω BNC connector on one end, and a Canare 75Ω RCA connector on the other.

Every self-respecting, golden-eared audiophile will desire to know exactly how the CDR–800's copies compared to the original CDs. Unfortunately, the answer is not at all straightforward. I can't honestly state that the copies were indistinguishable from the originals. However, any differences I heard are no greater than those caused by substituting one high-quality digital interconnect for another. The differences were normally far less than those I associate with changing CD transports.

In my opinion, digital copies made on the CDR–800 are faithful reproductions of the original, and any observed differences may well be attributed to external factors. The performance of the CDR–800 will depend primarily on the quality of your source and the interconnect between your source and the HHB recorder.

The dated op amps mentioned previously undoubtedly limit the performance of the CDR–800 when used with its analog inputs and outputs. However, the excellent performance of the A/D and D/A converters used in this recorder make up, in part, for the performance of the op amps. I have no doubt that replacement of the op amps with the best dual devices currently available would significantly improve the analog performance of the CDR–800, allowing the excellent digital circuitry to perform to its potential.

Conclusions

The HHB CDR–800 is a remarkable product, and a real breakthrough in affordable professional CD recorders. Used with external digital sources, via its digital input, the CDR–800 will make compact discs that are virtual sonic clones of the original digital source. Recently, HHB introduced the CDR–850 rewritable Compact Disc Recorder (CD–RW), which is priced about $200 less than the CDR–800. Readers may wonder whether it renders the 800 obsolete. Not at all! The new CDR–850, also based on a consumer Pioneer product (the PD–R555RW), does not have the Stable Platter mechanism. For the ultimate in CD–R mechanical stability, the CDR–800 will continue to be the recorder of choice.

Home users in need of a CD recorder should not hesitate to purchase this pro product. Because of the Stable Platter mechanism, the CDR–800 will probably outperform your existing CD transport, so you may be able to dispense with your existing playback machine.

When the time came to purchase a CD recorder for use in my studio at the Crane School of Music at SUNY Potsdam, where I am employed as audio engineer, I chose the CDR–800. I could not give a more enthusiastic endorsement. ■