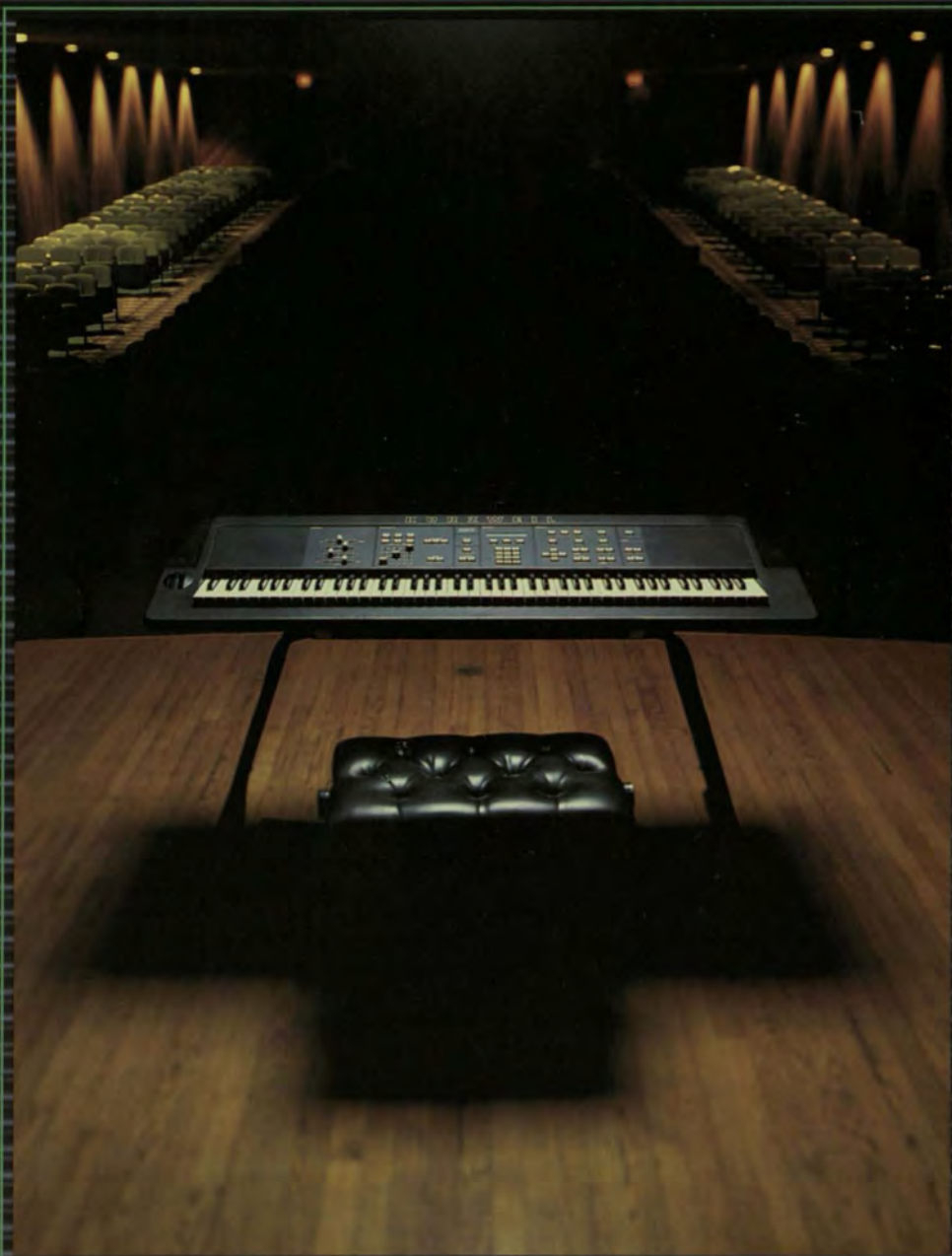


KURZWEIL™



THE KURZWEIL 250



FEELS LIKE A GRAND,
PLAYS LIKE A MILLION.

Introducing the Kurzweil 250.

Only you can do more for your music than the Kurzweil 250™ digital keyboard instrument. In one package, you get a piano-quality keyboard, over 100 factory-installed keyboard setups, a 12-track sequencer, and up to 45* of the best sounding "voices" going.

45 great ones for the road.

Want more backup for the road? The Kurzweil 250 is for you. What sets it apart from all others is the variety and quality of its sounds. In one package you can carry over 100 keyboard setups and up to 45 resident voices... all available at the touch of a button. Kurzweil's unique Contoured Sound Modeling™ technology has captured, with full digital quality, some of the

best studio-quality voices available including: Concert Grand Piano, Hammond B-3** Organ, Woodwinds, Brass, Human Choir, Percussion, Vibes, Electric Bass, Acoustic Guitar, Marimba, Chimes, Orchestral String Section, Slap Bass, Harp, Acoustic Bass.

So whether it's a piano or a bass, you get the real thing. In addition, the Kurzweil Sound Library Volumes offer an ever-growing collection of Kurzweil-quality voices and keyboard setups on Apple® Macintosh™ computer disks.

Variable sampling up to 50 kHz.

The Kurzweil 250 can also be ordered with an optional 50 kHz sampling system for adding your own sounds. This easy-to-use Sound Modeling Program™ samples and saves anything from a whisper to a cannon shot simply by plugging in a mic or patching in a line. Plus you get fourteen sampling rates (up to 50 kHz) and five sampling modes to choose from.

It really does feel like a grand piano.

It doesn't take long for an experienced musician to feel the difference between a classic instrument and an imitation. The Kurzweil 250 has an 88-note, wooden, velocity-sensitive keyboard that's weighted to respond like a grand piano... not a plastic lookalike. So it not only sounds like a quality instrument, it feels like one too.

Play it side by side, or over and under.

Mix and match the voices any way you want. Want guitar and percussion on the same note? It's easy. The Kurzweil 250 layers up to 6 different voices on a single key. Want bass on the bottom and flute on the top, piano and trumpet in the middle? No problem. You can split the keyboard into 88 separate sections... actually putting a different voice or combination on each key.

The next best thing to free studio time.

Playing the music is only part of the deal. The Kurzweil 250 also records on its built-in 12-track sequencer. After you've recorded your sequence, you can do almost anything with it:

- Edit single tracks
- Run continuous loops
- Switch instruments
- Edit single notes
- Chain sequences
- Match track volumes

After any change, play it back and check it out. Once you've gotten what you want, there's quantization to clean up slight timing errors. Then you can play with it, rehearse with it, or save it for use in your next performance. With the optional MacAttach™ Communications Package, you can even store and edit sequences and sampled sounds off-line on an Apple Macintosh computer.

Plug in to the rest of the world.

The Kurzweil 250 can interface with almost anything. Its extensive MIDI capabilities can run each track of the 12-track sequencer to one of 16 separate MIDI channels.

The Kurzweil 250 can also control or be a slave to any other MIDI receiving or sending device, including another Kurzweil 250.

You don't need a crane to lift it.

At 95 lbs, and under 5 feet long, you won't have to kill yourself to move a Kurzweil 250. Two people (or one weightlifter) can put a Kurzweil 250 into most cars, so you can use it for music, not exercise.

Trust your ears; come check it out.

Judge the Kurzweil 250 for yourself at a Kurzweil representative near you. We're confident your ears will tell you how good it is. For the name of your nearest Kurzweil representative, and information about the Kurzweil 250 demonstration cassette, write Kurzweil Music Systems, Inc., 411 Waverley Oaks Road, Waltham, MA 02154-8464. Or call toll-free (800) 447-2245. In Massachusetts, call (617) 893-5900.



THE KURZWEIL 250

Product Specifications

Keyboard:

Piano-type, wooden-key 88-note velocity-sensitive.

Pedal Pod:

Two piano-type pedals, power cord, fuse, power switch.

Dimensions:

Keyboard 57"(L) x 27"(W) x 9"(H); Pod 17³/₄"(L) x 11¹/₈"(W) x 4¹/₈"(H).

Weight:

Keyboard 95 lbs, Pod 22 lbs.

Power Consumption:

AC 110V, 50/60 Hz, 380W (220V version available).

Inputs:

Mic/Line input; Two 1/4" assignable volume-type pedal jacks; computer port.

Stereo Audio Output Levels:

Balanced XLR 600 ohm, 10V p-p nominal; Hi level, 1/4" 600 ohm, 10V p-p nominal; Low level, 1/4" 600 ohm, 1V p-p nominal; Headphone, stereo 1/4" 8-600 ohm.

Dynamic Range:

Over 100 dB.

Keyboard Setups:

Base unit contains 40 factory-installed keyboard setups, with up to 40 user-definable keyboard setups available.

Assignable Controls:

2 assignable levers, 3 assignable sliders, 2 assignable on/off foot switches (on pod), 2 assignable external pedal jacks.

Options

Sound Block A: Adds fifteen new resident voices plus 84 factory-defined keyboard setups.

Sound Modeling Program™: Variable sampling rate (5-50 kHz). Sampling time (10-100 seconds), depending upon sampling rate.

MacAttach™ Communications Package: Off-line storage and editing of sound files, keyboard and instrument setups, sequences.

The Sound Library Volumes: Collections of Kurzweil-quality sounds and keyboard setups on Macintosh disks.

*30 voices standard, 15 additional with optional Sound Block A.

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All specifications are subject to change without notification.



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USING

THE REAL THING

PROFESSIONALS AND THE KURZWEIL 250 by Freff

“My K250 . . . arrived sleek and sassy, has never broken down, and has sprouted new powers and abilities as fast as the harried programmers in Waltham could beat out the code.”

In 1983 I wrote an article for *Musician* magazine about digital samplers. It was virtually the first appearance of that topic in national print (proof of how fast things change), and in it I speculated wildly about a mysterious instrument called the Kurzweil 250. Nobody had seen or heard one yet, but the advance buzz indicated that the M.I. field was in for the biggest blast – or bust – of the decade.

They claimed that the K250 had nailed the piano.

Fighting words, those, to all true keyboard fans, especially those of us with an axe to grind from lugging Yamaha Electric Grands from gig to gig. Nailed the piano? The piano? The king of instruments, the very height of 19th-century musical technology . . . and these upstarts from the shadowy computer realm of Artificial Intelligence thought they could do as well with microchips and megabytes?

In 1983 I expressed grave doubts.



USERS

FINDING USES

Howard Kaufman (left) and Gunther Knaup

Today, in my current studio work, the K250 is the only piano I use.

Before the few remaining acoustic purists out there get too upset, let me stress that if you placed a K250 side-by-side with a Steinway or Yamaha or Bosendorfer, and sat in the room listening, you would favor the "real live" piano sound every time. But this would be an inherently unfair setup, because the K250 must be amplified. Take that one advantage away from the acoustic piano by doing your comparative listening over loudspeakers in another room, and the results can be highly embarrassing . . . to piano fanatics, anyway, who in the tests I've run quite often get the K250 and the acoustic grand mixed up.

The practical lesson here is not to trust our preconceptions.

Certainly a piano makes a better piano, live, than a K250 does. But a piano is not some sacred object, but a tool, and tools have purposes and appropriate applications. The right tool, at all times, is the one that best does the job. In a world where the vast majority of music is recorded, why unthinkingly favor an instrument that reached its evolutionary peak before Edison invented the cylinder phonograph?

Thankfully, the answer is moot. Hit records and sellout tours have a way of settling arguments real fast, and enough gold and platinum has been awarded by the RIAA in the last three years to drive home the point that — in good hands — the K250 Grand Piano is a contender.

Of course, if it were just a piano substitute I wouldn't be writing this. Digital samplers, synthesizers, sequencers, signal processors, master MIDI controllers . . . these have all become standard tools of the trade. The K250 offers the lot in one integrated, constantly improving package. It does so at a third the price of anything with even vaguely comparable expression, flexibility, and sound quality.

Looked at that way, the list price begins to look cheap . . . and not just to the Stevie Wonders of this world.

It doesn't matter what people who have already Made It buy, because they can afford anything. And everything. The people who really count are the ones in the trenches, the professionals facing hard decisions daily, the ones in the process of making it *right now*. If anyone has anything worth saying, it's them.



“But the biggest impact of the K250 is that our demos are more sophisticated than they used to be. They have to be, just to keep up.” Kaufman

Howard Kaufman is one-half of Kaufman & Knaup, a Manhattan-based team doing mostly post-production for advertising and commercials. He has had a K250 since April 1986. In addition to using his K250 for his normal studio work, he has used it to score children's films for Yellow Giraffe Productions and create backing tracks for live performances.

F: Let's start where it counts in this industry: money. What's a jingle cost you to make?

KAUFMAN: For a basic section, some horns, and some strings you would use 10 or 12 musicians at anywhere from \$100 to \$200 an hour. So right there, musician costs would be a minimum of \$1200 an hour and sometimes as much as \$2500. For a 30 second jingle. That's standard in New York.

F: That's for one day's work?

KAUFMAN: That's for one *hour*. Not only that, but you have to remember studio time. The agencies like to go to the big studios. They don't like going to holes in the wall. Add in studio time to the tune of \$200–\$250 and producing a jingle can sometimes cost you nearly three grand an hour.

F: With rates like that you could buy a full-blown K250 and a Macintosh in well under two days.

KAUFMAN: There's no doubt that anyone involved in professional production can save a

lot of money with the K250. You just have to learn enough about it to get the quality you need. For example, the resident sounds have gotten a lot better since the first set; blocks A, B, and C have more presence than the original voices. Using the originals you have to know where to add a little high-end EQ to the overall sound.

F: Any special favorites?

KAUFMAN: The piano has always been amazing in every way. And we really like the Rock Block for its drums. In fact, we've found great use for almost all the sounds — but since you're asking me for favorites, I'd say the electric bass, especially the bright bass and double basses, the harpsichord, the acoustic bass, and the solo strings and string sections. We use those all the time.

F: What about the sequencer? How does that fit into your work?

KAUFMAN: I use the internal sequencer, but not exactly like the company planned. See, for my main sequencer I use the Macintosh and Mark of the Unicorn's PERFORMER software. But since I don't have an interface that will sync the Mac to tape what I do is transfer songs track by track into the K250 sequencer, lock that to the tape with the K250's sync functions, and record from there. You know what I really like? The channel-stealing algorithm. We frequently have more than 12 tracks in our sequencer, often as many as 20, but we rarely run into difficulty getting them to play — apparently — simultaneously. The factory default on channel-stealing is just right. I played with changing some of the channel-steal settings, but I just can't cheat as much as with the default.

F: What kind of impact has it had on your work?

KAUFMAN: There's more of it, and it's different. A lot of our clients now are people who are saying, "Finally we can afford original music." They used to just go to a commercial music library, pay a fee, and be content with what they got. But now that they're aware that there are ways to do cost-effective original scoring they squeeze a little more money out and go that way.

Also there's a new thing happening at hotels, especially in the Borscht Belt, where the budgets are going down and the hotels can't afford Union musicians anymore. The singers from these places come to us with their repertoire, we create a recorded Kurz-

weil backing, and they use the tapes in their shows. The K250 is good for the natural, orchestral sound they're looking for.

But the biggest impact of the K250 is that our demos are more sophisticated than they used to be. They have to be, just to keep up. When I started in the jingle industry, back in 1977, it was common to submit a demo that was only guitar or piano and a voice. And the agencies would say, "Okay, this seems like the right direction, go do a real demo now." They'd give you \$500, you'd hire a rhythm section and one singer, and that would be the next stage. This went on and on before they'd make a final decision. But today everybody is submitting a virtually finished product. It got to the point that I was going up against guys with Synclaviers and big MIDI setups,

and piano-and-voice demos just wouldn't cut it. But with the K250 I can produce a finished demo in an hour or two that will stand up to anything those other guys can do.

F: So for you the K250 is actually a critical piece of your business plan?

KAUFMAN: Absolutely. It has also let me make the jump from producer-engineer to creator, which is an incredible change. Gunther and I have been enjoying working with it so much that we're having to admit to ourselves that we prefer the freedom of being able to do anything when we want, in any way we want, without having to rely on anybody else. Besides, it's a lot more fun to play the part yourself than to watch somebody else doing the overdub while you babysit the fader.



Brenda K. Martie

“The second day I had it [the K250], I broke even.” Surack

Chuck Surack is the owner of Sweetwater Productions, a multi-track studio in Fort Wayne, Indiana. He has had a K250 for almost two years and has created a library of samples for it that are offered to K250 users through the Sweetwater K250 sampling network.

SURACK: I sold the studio's Yamaha grand to get the K250, which was risky, but I was convinced by the advertising. All those different instrument sounds, for the same money? To me that made sense. Of course, every now and then the K250 is still a stumbling block for certain classical-type people, but if I can get them to close their eyes and listen, then they hear the truth: the K250 piano sounds better than what we were getting out of the Yamaha grand, partially because the folks at KMSI really did their homework and partially because we can record it direct, instead of having to mic. No more hearing people turning the pages of the

sheet music, or grunting into the mics! And it's a real pleasure to be able to track piano at the same time you track drums, without having to worry about acoustic baffling and sound leakage.

F: You bought it for more than just the piano, though?

SURACK: The other thing that convinced me was the way the company was committed to upgrades. These days everything is changing so fast that you buy a \$5000 synth, then six months later it's obsolete and you can't even get \$2000 for it. But the K250 just keeps on getting better: there's not a single board in mine that's original, and all of the upgrades have been fairly inexpensive. There were 40 resident sounds in my K250 when I bought it. Now I've got hundreds. It couldn't sample when I bought it. You just had to trust KMSI when they said it was coming and would be good. Well, it did and it was . . . and then they made it even better. The sampler, the sound blocks, the general improvements – they even improved the original bass sounds a while back – with all these moves they've met their commitment to their customers. It's the only instrument I've ever bought that is still worth what I put into it, and then some.

F: I understand from the grapevine that you've developed a pretty extensive library of K250 samples.

SURACK: I've also traded samples with owners from all over the country. Right now I've got maybe 200 disks of different sounds available. I do one-to-one swaps; otherwise it's \$5 a disk. I'm not doing it to make money, but to build my library and support the instrument.

F: You took a risk with your investment, but it seems to have paid off.

SURACK: The K250 has totally changed our studio. Two years ago we were really a public business. Bands came in, individuals came in, and we recorded them. But now that the K250 can sample and has gone beyond the original 40 sounds we're more of a production house. I've hired several staff keyboardists and we do total production of songs, jingles, gospel albums . . . often just using the K250 with the Macintosh and PERFORMER software to record complete tracks.

F: And the money angle?

SURACK: The second day I had it, I broke

even. I put a 40-piece string section on a project that couldn't possibly have had them otherwise, and I said that's it, I made the right choice. Since then . . . well, in the last 12 months the K250 has been worth at least \$175,000 in studio business alone. I have people who come here specifically for it, and for the skills of my technicians. These guys have learned how to get in and voice those instruments so they sound real. And since I spend several hours a day sampling and updating sounds, they have a wide range of voicings and colors to choose from. The thing is, with the K250 you can just sit down, hear a part, and play it immediately. In the past, if the orchestra was in and there was a problem with one of the written sections, too

Jeff Bova is a rising star among session keyboardists, with an enviable credit list ranging from top 40 albums to popular movie soundtracks. He has owned a K250 for almost two years.

F: How regularly do you use the K250 in sessions?

BOVA: Every day. I've got a full-blown unit with the Rock Block, which I've been using the drums from quite a bit. I've also been using the SOUND IDEAS SFX library on CD with it.

F: So you grab sounds off the library and –

BOVA: For Whoopi Goldberg's new movie, *Burglar*, I pulled all kinds of sound effects from the CD library, processed them through the K250, and flew them into the track. The rhythm section is all these "sneaking around" sounds – footsteps in the hallways, hacksaws, files, all turned into part of the groove . . . they were just harsh sound effects when taken individually, but sampled into the K250 and really played they became very musical.

F: The K250 is getting to be your main axe, then?

BOVA: Most of the time. It's certainly my primary MIDI controller once I've pre-programmed things, unless I have to use a breath controller or something else unique to some other instrument.

F: What prompted you to buy it over other samplers?

BOVA: Price and performance. I could have

bad. 20 orchestra people just can't change a part easily. But with the K250, you just write and learn and change parts as you fly.

F: What about charges that all this technology is putting musicians out of work?

SURACK: I think it puts mediocre musicians out of work. But great musicians? No way. Never will. I know for a fact that in the last 12 months I've hired more musicians than I ever did in years before, primarily because we're doing such good demos and things that it puts me in a whole different level of marketing. I have more products sell, I'm attracting bigger album budgets . . . and yeah, sure, they may want to use the K250 for half of it, but on the other half they'll want real musicians. It works out.

bought an Emulator II, but the kind of clients I work for expect sampling quality in the \$50,000 to \$100,000 class, the kind of thing you get out of Fairlights and Synclaviers. An Emulator II doesn't have it. The K250 does, for a lot less money. So it was really the best way I could go. Besides, it made it possible for me to have high-quality sampling without going into hock for the next five years.

F: You see it as a cost-effective piece of gear, then?

BOVA: Yeah. When I was with Herbie Hancock's Rockit Band we had two Fairlights with us on the road, and I was really getting accustomed to that machine, so you'd think that would be what I'd buy. But more than the difference in cost, the fact is there's just a lot of stuff in the K250 that outshines the Fairlight.

F: Like?

BOVA: Oh, the naturalness of its sound. Acoustic samples on a Fairlight or Synclavier tend to have a certain harshness. But with the anti-aliasing setup on the K250, and all its secret little sampling algorithms and all that, the instrument has a warm quality that really stands out. The MIDI implementation is also just great for me. I've got to do a lot of sequencing, and in the film work – especially in the film work, where people are constantly re-editing and shuffling scenes – having instant access to all the K250's different soundfiles is really the only way to work.

F: How have you used your K250 on albums?

Randy Marlowe



“... more than the difference in cost, the fact is there’s just a lot of stuff in the K250 that outshines the Fairlight.” BOVA

using the pitch bend lever. At other times, instead of running her voice through a DDL to thicken it up we’d sample it and use the K250 chorus and doubling to build a stereo image of her voice. Since we were detuning the samples, naturally the start and end times would constantly be different, so the vocal would start in one spot and then halfway through the phrase one of the lines would slant across itself and go back again. We just kept pushing to find something a little more unique. We even did some pre-echo.

F: Sampling her voice and flying it in ahead of the original take?

BOVA: That’s right. You hear the vocal line come in early, just like it was print-through on the tape, and then you hear the actual line.

F: Deliberate print-through is a new one on me.

BOVA: We did it on purpose, laid it right into the groove. It was a little unusual, but it worked, and they liked it.

F: You’re clearly not just a preset player.

BOVA: I always try to stretch, one way or the other. The people I work for expect something new every time, something that’s only going to be on their record, so you have to extend your tools every way you can. I could just play string parts or drum tracks for days,

but there’s nothing creative in that.

F: Are you still discovering things in the K250?

BOVA: The K250 is a deep instrument, literally. There’s a lot there, and I know that even though it has become the backbone of my setup I haven’t tapped it all yet. I want to dig deeper into the instrument editor, start playing games with new combinations and layers of samples, things like that. The QLS package will make loading sounds a lot quicker and easier; that’ll be a major step. Some kind of visual sample editor for the Mac would also be great, and I gather they are working on that. It will be wonderful, especially on a date, when I can jump right in and fine-tune my sustain loops and amplitude envelopes to meet specific needs.

F: In your business you have to maintain an arsenal of gear, and in turn that gear has to earn its keep. Is having the K250 crucial to you in terms of professional standing?

BOVA: I broke even on the K250 the first month. I got the Air Supply gig because they wanted the K250, I had it, and it was just right for their type of music. As for the rest . . . especially in corporate rock and roll, having the best equipment is a kind of status thing. It shows you are successful at what you do, and that you know enough about your business to own an instrument of quality. That’s the first thing people look for. I see very talented players who haven’t moved beyond a basic analog synth/DX7 kind of setup getting lost; clients just don’t think they’re making an effort to provide the best.

John Eric Alexander is the boss at John Eric Alexander Productions, Inc., one of the companies pioneering a new and very specific kind of original music: scores for movie trailers and commercials. He has had a K250 for 18 months.

ALEXANDER: Movie advertising is generally done months in advance of release, which means they don’t yet have a score. So I try to create music for the trailers that will be appropriate for the movie and conceptually similar to their plans for the final score. It’s pretty challenging. I did the theatrical trailer for *The Fly*, the trailer for *Night, Mother* . . . that one was interesting because it was a score

BOVA: Let’s see . . . Air Supply, Billy Joel’s *The Bridge* – lots of string parts on that one – Missing Persons, Cyndi Lauper’s *True Colors* . . . on the last track of Cyndi’s there is a tune I co-wrote, called “One Track Mind,” where we sampled Cyndi’s voice and used it for a backing keyboard part against the lead vocal. And I used the K250 electric bass all over the album, usually MIDIed up with the Super Jupiter or one of the DX7s. And on the Missing Persons album I got to play all kinds of wacked-out games with Dale Bozzio’s vocals. Some of it was in the nature of little repairs; in order to get through the sessions fast we just flew in the parts that were difficult for Dale to do. We’d sample a phrase and then pull it sharp or flat as needed by



Randy Matusow

for solo piano over strings that was just totally K250, and nobody ever suspected it for a minute. I also just did a little intro for *Jumpin' Jack Flash* using the drums and electric guitar from the Rock Block. The main music of the commercial was Keith Richard's remake of the title song, but they needed an intro and the Rock Block sounds fit right in. When I started this stuff I knew I needed to get into the thick of it with sampling. I just couldn't afford to hire a bunch of other musicians, so I started out with a Mirage and moved up to a K250 as soon as I could. I tell you, the day I switched over was just amazing. It was like going from a portastudio to an SSL board. And nowadays I'd say that the K250 covers just about 90% of everything I need, and I fill in the rest with a little DX7 and Oberheim Matrix-6.

F: You sound awfully pleased.

ALEXANDER: Oh, yes. Wouldn't be without it.

F: You mentioned the piano, strings, and Rock Block. Those are clearly favorites with a lot of players. What other sounds stand out for you?

ALEXANDER: The marimba is great. My wife is a percussionist and she gets very jealous because I'll use the K250 marimba rather than the real thing. It's an interesting battle, but I've finally gotten her used to coming in and triggering K250 percussion samples via an Octapad or a Simmons set. That way I can record rhythm lines with sequencers but still get a human feel, because she's actually playing them.

F: You didn't start out with a lot in the way of financial resources, so moving up to the K250 must have been quite a step.

“I did the theatrical trailer for ‘The Fly.’ ‘Night, Mother...’ was interesting because it was a score for solo piano over strings that was just totally K250, and nobody ever suspected it for a minute.”

Alexander

ALEXANDER: Yes, it was. But it was the right thing to do because it paid for itself in just a few weeks. At that time I was working a lot with Edd Kalehoff. He wasn't pleased with the string sounds in this Emulator II he'd rented, so before he finally bought his own K250 I was at his studio three or four times a week, bringing mine over just to lay down string sections. That saved him thousands of dollars on every job and paid off my K250 real quick. Ultimately, in my own work, I want to reach the point where I can hire real strings whenever I want them. No sampler or synth is ever going to match the real thing. But with these trailer jobs you might have to revise a track seven or eight times before everyone agrees on a final version, and if I had to pay Union rates to a string section on every pass I'd actually be losing money.

F: Do you use the sequencer in the K250?

ALEXANDER: I do, to work things out initially. But I find that with only 12 channels in the instrument I run out of notes really quickly. You know — if you have a full six-note chord taking up half the channels already, and you try to put a string section on top, you just run out. So I use the onboard sequencer to work out ideas with just a few sounds, getting an idea of the shape of a piece and its proper tempo, then I use an MSQ-700 synced to a multi-track to do the final version.

F: What features do you get a kick out of?

ALEXANDER: I use timbre-shifting all the time; especially on the piano, just to brighten it up a little. And I love the chorus. It's just so beautiful and pure, because you're actually playing samples against samples instead of losing a few dB by electronically processing the audio after the fact. But the most fun I have is definitely sampling things. When I had my studio in my apartment I'd just wander around the rooms, sampling absolutely everything I could think of. It's amazing what happens when you hit a pot on the stove with a wooden spoon, then drop that sound down three or four octaves. Or cracking gum, that's a great sample, especially for percussion sequences. Blowing across a pop bottle isn't anything new, but sampled and processed it became the mainstay of a trailer I did for a Jane Fonda film called *The Morning After*. It was a mysterious sound when I was finished with it, and

nobody could figure out what it was. The initial blast of air had this real metallic ring to it, an edge, like Darth Vader breathing. I also collect voice samples. Everybody I know has lent me their voice for a few minutes; I record them saying different kinds of words, just to build up a selection of raw material to choose from. Everything's fair game, you know? For the new Harrison Ford movie, *The Mosquito Coast*, I used this silly little clay bird whistle that my mother brought back from a visit to Latvia, which is on the Baltic Sea, and from it I was able to create a kind of contemporary jungle music. Pushing it up high or low made for a really nice, creepy, jungly sound.

F: How did you feel about having to buy a computer in order to save your samples?

ALEXANDER: It didn't really bother me, because I also use the Mac for my bookkeeping and office work. It's an open-ended tool in its own right.

F: Have you dug into the instrument editor?

ALEXANDER: Yes. Definitely. Both for common things like reversing the cymbals, and more complicated jobs like tightening up the timpani preset so that the attack was a little crisper and the decay time shorter.

F: Is the K250 your master keyboard?

ALEXANDER: Yes, though I'll use the DX7 when I need a real fast solo line, because it's lighter and I'm not really a trained keyboardist. I'm actually a woodwind player; I was a concert clarinetist for a long time. But I recently got a MIDled Lyricon, and that opens up all kinds of possibilities, like playing one line on a real soprano sax, then doubling it with the K250 acoustic guitar *played via the Lyricon*. See, that way I don't have to transpose. I just tune the K250 so that my sax fingering and "K250 guitar" fingering are identical, and then for added effect I can use the Lyricon's breath sensitivity to control the pitch bend on the "guitar," giving it exactly the same inflections as the sax. It sounds just great, and I'm looking forward to pushing the technique. When I first tried the K250 and the Lyricon I was a little disappointed, because it seemed like I was having to blow my brains out to get any response. But I called Kurzweil and they told me exactly what I had to do to modify the velocity sensitivity on the instrument, and since then the combination has worked like a charm.

“... the K250's filtering seems to flavor the sound. Certain sounds just sound better on the K250.” Hammer

Chuck Hammer walks the line between two worlds: as sound effects designer and writer of commercial music at Sync Sound, his work can be heard all over network and cable television; as pioneer guitar synthesist, his recordings with Lou Reed and David Bowie, and solo album *Guitararchitecture* (on JEM), have carried the Hendrix banner into the 80's. He has owned a K250 for a little over a year.

F: You already had a Synclavier. Why buy the K250 as well?

HAMMER: The main interest I had was that it was multi-timbral. That was very important to me: separate sounds on separate MIDI channels that *worked*, because being able to hear more than one part at a time was essential for the projects I was doing. Even on the Synclavier you can't do that. It reads only one MIDI channel at a time. See, it considers itself the master. You can have different sounds on different MIDI channels, but only if you're using the Synclavier as the sequencer. I don't do that. I use PERFORMER, which happens to be a perfect match for the K250. Those two, together, are very fast. Certain clients come in, they have only two hours and need a mockup of something, and we can get it done. I had a guy who came in from Children's Television Workshop, with an Israeli video of some kind, and he wanted to imitate one of the styles of music that was happening in the hills. I tried a whole lot of stuff that I would never normally use and it came out fast and great. I love the K250 for that. Also for sampling. Although its sampling is not as precise as the Synclavier — there's no guesswork in the Synclavier in terms of length or cutting of samples — the K250's filtering seems to flavor the sound. Certain sounds just sound *better* on the K250. So a lot of the time I sample into the Synclavier, edit there,

then transfer the result to the K250. Certain sounds get fatter . . . they get very musical. The filters seem to be placed in a useful way. You know, there was a time when I was thinking I might sell the K250 and build up the Synclavier instead. The K250 had solved a problem: for the money, it gave me things I couldn't get on the Synclavier. And it certainly enabled me to *make* more money. And I was thinking maybe, since I now had the money, I ought to go ahead and build up the Synclavier so it can do things the K250 can't. But then I thought about . . . well, about things like how much RAM I would need to bring up the K250 Grand Piano on the Synclavier. Four or five megabytes for that alone, because the Synclavier doesn't have any filters in it. You really can't stretch a sample as wide without getting aliasing.

F: So in the end you're not willing to give up either?

HAMMER: Exactly. I'm thinking of the Synclavier more as a sound design tool now. Merging samples, cutting them, cataloguing them in a library . . . but to use them musically I'll dump them into the K250.

F: You've also got a SynthAxe now. Have you fooled around with different MIDI channels and K250 sounds for each string?

HAMMER: I haven't done much of that. There are still problems with the SynthAxe which keep me from using it too much. It's very fast. It's *too* fast. Delay doesn't enter into the problem, not like with pitch-to-voltage conversion systems, but now there are a whole new set of things to deal with. Very often you get notes you didn't ask for . . . or, rather, notes you didn't *realize* you were asking for.

F: It's too accurate for a human being.

HAMMER: Interesting way of putting it. I'd say it needs to be adapted. The software needs to be adjusted a little bit. That's coming.

F: So what work have you been doing with your K250?

HAMMER: I use samples for lots of sound effects. We do all the post-production on the *Pee-Wee Herman Show* here, working through Broadcast Arts. Pee-Wee is very silly, so there's a lot of drum hits, comical clarinet, chimes, doorbell things, that kind of stuff. There was a syndicated show called *Comedy Tonight* where we used the K250, among other things, as a laughtrack machine. There was an interesting job for WNET 13 and

Benny Goodman . . . see, a few months before Benny died he was honored at this awards show, and the jazz pianist playing with him fluffed a couple of notes. So they brought the videotape and sound recordings in here and WNET just went crazy over the K250's piano sound. We matched it up perfectly with the live piano and dropped in the corrections. Other things . . . I do a lot of stuff for SHOWTIME, the cable movie channel, with the K250. I did the entire music package for their sister channel, VIEWER'S CHOICE, with it. I'm doing a ballet for the Next Wave festival at the Brooklyn Academy of Music this season, and some of that is being done with it . . . it's a useful instrument. Speaking in guitarist terms, the K250 has its own sound, like a Martin does as opposed to a Guild. I hold on to it for that reason alone, because it has a unique way of coloring the sound that I like.

F: Between the K250, the Synclavier, and the SynthAxe you've invested a lot in your tools. How long did the K250 take to pay itself off?

HAMMER: It was a constant thing. It started making money for me right away, and it has continued fairly steadily, but I'd have to say that if you looked *strictly* at the K250 it took me about eight months to break even.

F: How does that fit with what you said earlier, about using earnings from the K250 to upgrade your Synclavier?

HAMMER: You really have to think about it in terms of the last six months. Spring was very good, summer was slow, and the fall has been great.

F: Business cycles?

HAMMER: Apparently, yeah. I don't think anyone in production does too much work in the summer, and then we seem to do nothing *but* work in spring and fall.

F: At least you get a little free time to work on your own music. Isn't it difficult, trying to combine such different career directions? Even a little damaging to one or the other?

HAMMER: I've been advised about that. Walking the line, though — that's a necessity. I made a very clear decision to take care of my art first, and that's why I went after Reed and Bowie, and made my *Guitararchitecture* record. But I also had to start thinking about bigger things. I've got great instruments, a great place to work . . . I'm doing just fine. So far straddling the fence may have damaged me a little bit, but not beyond repair.



CBS Associated Records

“NBC had been using some of my songs on their soap operas for years, but it was a tape I made with the K250 that got me the contract to do the new theme for ‘Search For Tomorrow,’ which led to the contract to do all the background music for the show.” Chinnock

Billy Chinnock juggles three careers, simultaneously writing television music, producing for CBS, and recording and performing as leader of the The Billy Chinnock Band. His latest album, *Learning To Survive In The Modern Age*, on CBS, is a showcase of what he's learned about his K250 in the last two years.

CHINNOCK: The K250 has become the heart of my entire music system. It's really made a lot of things happen. NBC had been using some of my songs on their soap operas for years, but it was a tape I made with the K250 that got me the contract to do the new theme for *Search For Tomorrow*, which led to



CBS Associated Press

the contract to do all the background music for the show. That job was fourteen separate pieces. I did the whole project, basically, on the K250, and 60% of the new theme was done that way. And I won an Emmy this year for my work on the show.

F: How did you go about putting the tracks together?

CHINNOCK: On the early projects for NBC I used the drums in the K250 exclusively, then sampled a little bit and did just about everything with only the K250 and its internal sequencer. I have a Trident board and a 16-track Otari recorder, so I'd throw a sync tone to tape and use the tape deck and the K250 in conjunction. It gave me fifteen tracks of Otari and twelve tracks of K250 to play with. As I worked with it, and got more involved, I realized the potential of the darned thing and started to perfect it. What I eventually did was that I grabbed a Linn 9000 and MIDI'd the Linn into the system. Today I run a tone from the Otari to the Linn, and from there I slave the K250. It's a faster way to get what I want, and besides, I needed to separate out the drums and use a dedicated device for them so I could have another sixteen channels of drums.

F: What then?

CHINNOCK: In the process of all this, my option was picked up by CBS for a new album. I worked for the first couple of weeks with a band, all of them terrific players from Nashville and New York, all rock 'n' roll . . . but it didn't have the right feel to me. So I

locked myself in the studio for three months, and using the K250 and the system I solo-recorded most of the entire album. The K250 is computer-based, you see, and it's a terrific machine. But you have to spend time with it. You can't let it scare you off.

F: What's the album like?

CHINNOCK: I'm from New Jersey, originally, and the album kind of feels like New Jersey rock 'n' roll colliding with the New Era. Most of the stuff on the record is just K250, maybe a little Linn, some guitar — I play guitar — and vocals, of course. But the essence of the album is K250. It would have been impossible to do without it. The system really got to the point where you couldn't tell whether it was the K250 bass with the thumb slaps, playing over the Linn, or a living, breathing musician.

F: Well it was a living, breathing musician. It was you.

CHINNOCK: Yes, but the music had the feel of a real ensemble. That's what I sought so hard to do with this record, to capture the best of both worlds.

F: What exactly is in your system, right now?

CHINNOCK: The Otari drives the Linn 9000, which drives (at various times) a K250, a K250 expander, a K150, and one old analog synth, an Oberheim OBXA.

F: That wasn't cheap to put together.

CHINNOCK: Here's what I feel. I think this technology is heralding a whole new era of music. And I think that I got my money's worth out of the K250 instantly, because of the stuff that I was able to do for NBC, and of course the new album for CBS. It's the equipment that has enabled all this other stuff to happen.

F: What features do you like best?

CHINNOCK: I love the dynamics of the keyboard. It takes a little bit of time to get used to, because the dynamics are so sensitive, and you have to learn to think more like the instrument sounds you're working with in order to put more heart into them, but having subtle dynamic changes gives a song a live feel. A real pulse. I also like the way that I can assign things to different MIDI channels and then, with my sequencer, just flip through instruments and pick and choose what I like. Not having to start and stop all the time really keeps the creative flow going. And I *love* the fact that you can have twelve

parts playing at the same time.

F: Don't you start losing music to the channel limitations, and automatic note-stealing?

CHINNOCK: A little bit. But I guarantee by the time you get to part number eight you're going to be dancing around your living room. The K250 is great for composition . . . and it's great for making records. I'm making master recordings in my own studio, masters for TV and records, straight from my Otari and system down to two-track digital on a Sony PCM F1. My biggest realization, after two or three weeks of recording, was that with the K250 you really have to drop the traditional approach of seeing, in your head, a drummer and a bassist and a guitarist standing there. Because the K250 will do so many things that all the different instruments take on new values and relationships. Parts that would normally be played by the drum can be played by multiple high hats and the piano. Where before you'd use your foot to hold down the bottom end, your bass to sit on top of that, and your high hat to keep time, now everything changes. On my new album there is a song called "Like A Hurricane," where we have eight different K250 parts all playing the same notes but with different timbres, and multiple drum parts likewise, and multiple bass parts . . . it forms something new. It's like a melodic clock. That's the best way I can say it. You no longer need the traditional drum patterns. You can create a composition where your rhythm section is also melodic, and vice-versa.

F: Tell me more about the record.

CHINNOCK: Well, the effect of all those parts playing tightly together in "Like a Hurricane" is just killer. And many times I found we used the K250 bass over a real player, because it sounded so good and was able to lock in so tightly with the time. Basically, the album couldn't have been done without the K250 and the K250 Expander. I suppose that for several hundreds of thousands of dollars I could have created a facsimile of this album. But it would definitely have been a facsimile, because the way this recording was done gave the album a character all its own. It sounds modern. Hard to put your finger on exactly why, but me, I believe it's just the essence of using all that amazing technology in the right way.

PLANNED

UNOBSOLESCENCE

“Today’s K250 has the best sampler in the business, with 14 selectable sampling rates from 5 kHz to 50kHz, six sampling modes, adjustable triggering levels, crossfade looping, complete tuning and envelope control... and even with all that, the sampler is planned for eventual expansion and upgrade.” TMII

one of the few companies that has steadily delivered on its promises. Sometimes things have taken longer than announced, and sometimes the final product has had to go through a couple of generations before it matched the rest of the package for slickness, but these are minor inconveniences . . . especially in light of a little comparative history.

Most instruments quickly reach the end of their pre-ordained market life, get sold off in job lots, and are then replaced by newer, shinier boxes. Go look for a Prophet 5 or CS-80 or Emulator and see what you find. These instruments were designed, developed, distributed, and eventually dropped. Consider, even, the DX7. It’s the most popular synth in history, but the technology has been exploited to the point of market saturation and Yamaha’s exclusive patent on FM is running out. How long before the DX7, discontinued, litters the bargain shelves of America’s music stores? (Informed guess: more than six months, less than a year.)

The K250 flies in the face of this less than desirable tradition.

Here are just a few examples. Although the K250 looks much the same as when first shipped, it has gone through three major software and hardware revisions, with a fourth on the way. Back then it had one block of 40 resident setups. Today there are four more sound blocks – including that new studio standard, the Rock Block (Sound Block B) and the forthcoming Brass Block (Sound Block D) – which raises the number of onboard instruments to 96 and onboard setups to 341. The first version didn’t sample. Today’s has the best sampler in the business, with 14 selectable sampling rates from 5 kHz to 50kHz, six sampling modes, adjustable triggering levels, crossfade looping, complete tuning and envelope control . . . and even with all that, the sampler is planned for eventual expansion and upgrade.

The K250’s pattern of steady growth can be clearly seen in the history of the K250/Macintosh link. At first there was no link at all; not too bad, really, because there wasn’t yet any need for one. But then sampling became available. It required a Mac to store and load sounds, so Kurzweil released a simple program called MacAttach which handled the necessary communications. MacAttach was funky, and plain, and slow, but it did the job. Then came another version

of the program, with a better interface and improved features. And finally there was a whole new system called QLS – the Quick Load System – that nailed the link firmly into place in the form of a fast RS-422 connection capable of transferring data at a half million bits a second.

Right now there’s a ton of new stuff on the way, including:

SOUND BLOCK D (the Brass Block), which should do for brass freaks what the Rock Block did for drum mavens. Lyle Mays, Joe Ierardi, and Paul Heckert have designed 50 brass solo and section setups using new trumpets and trumpet mutes, brass stabs, tenor and growl tenor saxes, alto sax, trombones, and more.

Sound ram expansion for sampling. 100% compatible with the current software, this option will quadruple the available sample memory of the K250, allowing you to keep four banks of digitized sounds on-line and instantly available at all times. Key word: instantly. No disks to fool with and no loading delays to impede the flow of your creativity. The sound ram expansion option will give your K250 twice the memory of an Emulator II Plus (that’s four times the memory of an Emulator II), with all the additional benefits that come from an 18-bit data format and a variable sampling rate.

SD Convert, a nifty little program that allows your K250 to play sounds from Digidesign’s SOUND DESIGNER and SOFTSYNTH programs. The SOUND DESIGNER link radically expands the available sound library for the K250, making it possible to transfer sounds directly into the K250 from all major sampling keyboards, with no need of resampling, via the Macintosh. And as for SOFTSYNTH . . . well! Combining that program’s additive synthesis functions with the power of the K250’s instrument and setup editors makes for a digital synth package as formidable (or more) than anything else on the market today.

And finally, there is **V4**. The fourth K250 software/hardware revision, with radically enhanced sequencer features, new MIDI controller and mapping operations, and lots of other improvements to make it work better with third party sequencers and controllers.

I’m eagerly awaiting all four, and damned curious about what else Kurzweil Music Systems may have hidden has up its collective sleeve.

Sooner or later everything runs down. In the musical instrument world this general principle is made manifest in two forms, breakage and obsolescence. Virtually everything in my studio has either arrived defective (I had to put a cardboard shim inside my DX7 to stop its keyboard from rattling), or fritzed out when I really couldn’t afford the downtime (can anyone ever afford downtime?), or eventually been rendered a technological dinosaur (i.e. my Farfisa Combo Compact organ, the pride of 1966).

My K250, however, doesn’t play by those rules. It arrived sleek and sassy, has never broken down, and has sprouted new powers and abilities as fast as the harried programmers in Waltham Massachusetts could beat out the code.

If you’ve been around this field more than a month, I don’t have to tell you how unusual all that is.

Fact: in an industry increasingly plagued by vaporware, Kurzweil Music Systems is

CHANGES & CHOICE



Randy Matusew

What makes a superb musical instrument?

Though I was beating on toy drums and twanging rubber bands strung between drawer handles from early childhood, my first real instrument was a clarinet. It taught me two invaluable lessons: the very best thing an instrument can be is expressive, and the very worst is limiting. Because the clarinet excels at both these qualities, my musical life since escape from my high school's marching band has been a constant search for something . . . more. Something *considerably* more.

This hunger for more power, flexibility, and expression is a drive most musicians share. But it isn't new. It goes back as far as the first log drum, perhaps back even as far as the first voice. Who can be happy when every note written, sung, or played is achingly short of that perfect note which hangs, just out of reach, in the imagination?

. . . especially in these times, with the world changing faster than anyone dreamed possible.

“We need expression. We need power. We need instruments that will advance along with technology, instead of becoming obsolete.” Perfi

Now we have digital recording, digital sampling, digital synthesis, and digital reverb. We have MIDI. We have music software. We have digital audio encoders that cost less than a roundtrip flight from coast to coast and make bedroom demos sound better than the finest studio the Beatles ever worked in. We have, in short, a passable stand-in for magic. And reeling with the possibilities, always hungry for better, always discontent to stand in any one place for too long, we want more.

I've nothing against all this change. I'd no more turn back the clock and do without MIDI than I'd ask to live before the invention of painless dentistry. But I do worry about the pace of the passing parade. It is dizzying. It leaves musicians confused over their needs, priorities, and options . . . and it's likely to get worse, because the rate of change is speeding up instead of slowing down.

Today the music world belongs to those of us willing to pay attention not only to what we want (which is, of course, "more!"), but why we want it. It is not a time for short-term choices. We need expression. We need power. We need instruments that will advance along with technology, instead of becoming obsolete.

The lessons I learned from my clarinet still apply. And that's why I chose the K250. It is a superb musical instrument.

Our ROM wasn't built in a day.

Since its introduction, the Kurzweil 250™ has undergone an extraordinary evolution. And while it looks the same, technological enhancements and innovations have made the Kurzweil 250 considerably more powerful.

The Kurzweil 250 now offers up to 87 ROM-based resident sounds and 288 keyboard setups, all immediately accessible at the *touch of a button*. In combination with our high-fidelity sampling and extensive editing capabilities, the Kurzweil 250 has become the best composition and studio system available.

Let us bring you up to date...

Superior Sampling

The Kurzweil 250's Sound Modeling Program™ is an 18-bit floating point system. It's the industry's most accurate sampler.

The Sound Modeling Program provides 14 sampling rates from 5KHz to 50KHz (10 to 100 seconds of sampling time). With 6 sampling modes, 7 trigger levels, looping (with crossfade), reversing and trimming, and full control over envelopes and tuning, the Kurzweil 250 provides for any sampling need.

The Sound Modeling Program also makes the Kurzweil 250 a powerful multisampler, allowing you to arrange up to 63 samples per layer and 6 layers per keyboard setup. And all sampled sounds can be layered with Kurzweil resident sounds.

Introducing QLS™... the Quick Load System. QLS is our new RS-422 interface which allows the Kurzweil 250 to transfer 1/2 million bits/second to the Apple® Macintosh™ computer. QLS allows you to load a typical keyboard setup library in less than a second. You can load a typical 256K soundfile in 15 seconds from a Macintosh with a hard disk drive.



The Ultimate Compositional Tool

The Kurzweil 250 is a multi-timbral 12-voice polyphonic instrument with 88 touch-sensitive wooden keys. And it's the only sampling-based instrument with which you can really write music.



A Kurzweil 250 with Sound Blocks A, B and C has 87 instrument voices and 288 keyboard setups that are part of the system hardware (ROM chips). *No disks, no loading, no waiting*. All preset sounds, plus all sounds stored in sampling memory, may be used simultaneously in the on-board 12-track sequencer.

The Kurzweil 250 gives you maximum production efficiency—you have the ability to hear your work in progress with all discreet instrument voices audible at any point, allowing for immediate evaluation of composition.

Best Sounds. More Sounds.

The Kurzweil 250 now has 5 megasamples of resident sounds. The Base Sampler model Kurzweil 250 includes the enhanced Kurzweil Grand Piano, harpsichord, string section, acoustic bass and more. Sound Block A is renowned for its human choir, plus such sounds as woodwinds, vibes, and electric bass. Sound Block B ("Rock Block") has set a new standard for MIDI drums with ten new drum sets, along with a Mini-moog™, electric piano, electric guitar and more. Sound Block C ("Classical Block") includes such sounds as solo violin, solo cello, pizzicato strings, plucked harp and pipe organs. 87 resident sounds, 288 keyboard setups, all available at the touch of a button.



The Kurzweil 250.



KURZWEIL™

The Best Gets Better.

Kurzweil Music Systems, Inc.
411 Waverley Oaks Rd.
Waltham, MA 02154
(617) 893-5900

KURZWEIL**250****KURZWEIL 250 KEYBOARD SETUP LIST**

(Effective December 1986)

1. Kurzweil Grand Piano	154. Fluid Harpsichord	54. Shifting Choir	108. Steel Syndrome
2. Acoustic Bass/Piano	155. Bowed Harpsichord	55. Falling Choir	109. Lunar Landing
3. Slow Strings to Piano	156. Alien Harpsichord	56. Galactic Choir	110. Alien Harp
4. Bowed Strings Fast	157. Harpsichord & Piano	57. Harp/Cathedral Choir	111. Piano/Flute
5. Bowed Strings Slow	158. Harpsichord & Strings	58. Timpani/Choir	112. Piano & Flute
6. Slow to Fast Strings	159. Harpsichord & 8va	59. Timpani/Harp	113. Guitar & Flute
7. Acoustic Bass/Strings	160. Harpsichord in Space	60. Timp./Shim. Harps	114. Strings & Flute
8. Piano & Slow Strings	161. Sci-Fi Harpsichord	61. Chimes/Harps w/8va	115. Clar. & Strings & Flute
9. Acoustic Bass	162. Sine Wave	62. Harp/Chimes	116. Strings & Oboe
10. Bowed Acoustic Bass	163. Bright Sine Wave	63. Oboe	117. Slow Strings 2
11. Doubled Acoustic Bass	164. Endless Glissando	64. Dual Slow Oboes	118. Slow Strings Doubled
12. Fluid Acoustic Bass	165. Synth Sweep 1	65. Oboe Pipe Organ	119. Dual Bass/Organ 4
13. Infinite Acoustic Bass	166. Synth Sweep 2	66. Chimes	120. Dual Bass/Rock Piano
14. Electric Organ 1	167. Ping Pong Piano	67. Slow Chimes	121. Piano & Marimba
15. Electric Organ 2	168. Sine Drops	68. Digital Chimes	122. Piano & Vibes
16. Electric Organ 3	169. Sci-Fi Piano 1	69. Space Chimes	123. Rock & Roll Piano
17. Electric Organ 4	170. Sci-Fi Piano 2	70. Falling Chimes	124. Bowed Piano
18. Vibrato Organ 1	171. Piano Choir 1	71. Fluid Chimes	125. Cow Piano
19. Vibrato Organ 2	172. Piano Choir 2	72. Chimes & Vibes	126. Piano in 4ths
20. Drum Kit 1	173. Orchestra 1	73. Flute	127. Pianomento
21. Drum Kit 2	174. Orchestra 2	74. Flute w/Tremolo	128. Choir & Percussion
22. Drum Kit 1/2	175. Orchestra 3	75. Dual Attack Flute	129. Slow Strings & Choir
23. Mini Drum Kit	176. Klav Guitar	76. Woodwinds & Reeds 1	130. Tine Sine
24. Layered Drums	177. Bubbling Oil	77. Woodwinds & Reeds 2	131. Acoustic Bass/Vibes
25. Percussion Kit 1	178. Slow (Strings & Piano)	78. Flute & Choir	132. Bar. Horn Section
26. Percussion Kit 2	179. Bell & Strings	79. Flute & Marimba	133. Horn Section 2
27. Space Drums	180. Stereo Split Piano	80. Marimba	134. Cymbal Winds
28. Alien Percussion	181. Piano & Guitar	81. Bright Marimba	135. Drum Kit 3
29. Trumpet	182. Slow Strings & Guitar	82. Doubled Marimbas	
30. Quick Trumpet	183. Piano & Trumpet	83. Marimba & Congas	
31. Fluid Trumpet	184. Piano & Slow Harpsichord	85. Timpani/Flanged Timp.	
32. Trombone	185. Guitar & Baritone Horn	86. Conga/Conga Slap/Ring	
33. Trumpet & Trombone	186. Acoustic Bass/Organ 4	87. Vibes	
34. Horn Section	187. Slow Ballad Organ 1	88. Vibes w/Tremolo	
35. Fifth Horn Section	188. Slow Ballad Organ 2	89. Fluid Vibes	
36. Fifth Trumpets	189. Layered Organs	90. Stereo Panning Vibes	
37. Vibrato Trumpet	190. Dbl. Harpsichord & Strings	91. Digital Vibes	
38. Baritone Horn 1	191. Synth Gamelan	92. Vibes & Marimba	
39. Baritone Horn 2	192. Sinamento	93. 1000 Wild Marimbas	
40. Fluid Baritone Horn	193. Echo	94. Clarinet	
41. Timbre Shift Bar. Horn	194. Spaceleste	95. Clarinet w/Vibrato	
42. Baritone Horn Section	195. Pianorgan	96. Fluid Clarinets	
43. Baritone Horn & Trumpet	196. Noise	97. Ambient Clarinet	
44. Acoustic Guitar	197. "The Landing..."	98. Clarinet & Oboe	
45. Sustain Acoustic Guitar	198. Null Keyboard (MIDI)	99. Flute & Clarinet	
46. Fluid Acoustic Guitar		100. E.Bass/Slap Bass	
47. Doubled Acoustic Guitar		101. Doubled Elec. Bases	
48. Tripled Acoustic Guitar		102. Bright Bases	
49. Slow Acoustic Guitar		103. Dual Electric Bass	
150. Harpsichord	50. Choir	104. Electric Gliss Bass	
151. Quick Harpsichord	51. Doubled Choir	105. Flute Pipe Organ	
152. Bright Harpsichord	52. Cathedral Choir	106. Clarinet Pipe Organ	
153. Doubled Harpsichord	53. Synth Choir	107. 20th Century	

**SOUND BLOCK B
(optional)**

300. Rock Drums 1
301. Rock Drums 2
302. Rock Drums 3
303. Rock Drums 4
304. Rock Drums 5
305. Rock Drums 6
306. Rock Drums 7
307. Rock Drums 8
308. Rock Drums 9
309. Rock Drums 10
311. Synth 1
312. Slow Synth 1
313. Synth Long Decay
314. Velocity Filter
315. Solo Synth 5ths
316. Solo Synth 4ths
317. Slow Strings & Synth
318. Synth Beat
319. A. Guitar & Synth
320. Alien Synth
321. Slow Guitar

**SOUND BLOCK A
(optional)**

"&" = LAYER

"/" = SPLIT

"-." = DUAL AMPLITUDE

- 322. Guitopex
- 323. Harmonic Fade-In
- 324. Electric Piano
- 325. Filter E. Piano
- 326. E. Piano & Slow Strings
- 327. E. Piano Chorused
- 328. E. Piano 4ths
- 329. E. Piano Doubled
- 330. E. Piano Tripled
- 331. A. Bass/E. Piano
- 332. A. Guitar/E. Piano
- 333. E. Piano/A. Guitar
- 334. E. Piano & Kurz. Piano
- 335. Fluid E. Piano
- 336. Lead Guitar
- 337. Mutes - Lead Guitar
- 338. Lead Guitar - Harmonics
- 339. Harmonics - Lead
- 340. E. Guitar Doubled
- 341. E. Guitar Tripled
- 342. Powerchords 1
- 343. Powerchords 2
- 344. Powerchords 3
- 345. Fluid E. Guitar
- 346. E. Piano & Slow Choir
- 347. E. Piano/Trem. Flute
- 348. E. Piano/Harp up
- 349. E. Bass/E. Piano

**SOUND BLOCK C
(optional)**

- 400. Solo Violin
- 401. Solo Cello
- 402. S. Cello/S. Violin
- 403. S. Cello/S. Violin 2
- 404. S. Cello & S. Violin
- 405. Slow Solo Strings
- 406. Piano/Solo Violin
- 407. String Section 1
- 408. String Section 2
- 409. Pizzicato Strings
- 410. Pizz & Fast Strings
- 411. Plucked Harp
- 412. Harp & Pizz Strings
- 413. Harp & A. Guitar
- 414. Celeste
- 415. Hand Bells
- 416. Celeste & Hand Bells
- 417. A. Guitar/Solo Cello
- 418. Harp/Celeste
- 419. S. Strings Dbld 8va
- 420. Plucked Harp 5ths
- 421. Piano/Solo Cello
- 422. Solo Cello/Piano
- 423. Hawaiian Harp
- 424. Harp & Fast Strings
- 425. Piano & Harp
- 426. Piano & Pizz Strings
- 427. Harp/Solo Cello
- 428. Harp/Solo Violin
- 429. Bassoon
- 430. Bassoon w/Vibrato
- 431. Mello Bassoon
- 432. Bassoon (Tch Sens.)
- 433. Bassoon Dbld 8va
- 434. Bassoon & Fast Strings

- 435. Bassoon & Solo Cello
- 436. Bassoon/Solo Violin
- 437. Bassoon & Brass
- 438. Bassoon & Pizz Strings
- 439. Sawtooth Wave
- 440. Sawtooth (Tch. Sens.)
- 441. Lead Synth
- 442. Lead Synth 2 (5ths)
- 443. Electronic Piano 2
- 444. Cathedral Organ & Choir
- 445. Church Organ & Choir
- 446. Cathedral Organ 1
- 447. Cathedral Organ 2
- 448. Church Pipe Organ 1
- 449. Church Pipe Organ 2
- 450. Church Pipe Organ 3
- 451. Church Pipe Organ 4
- 452. Electric Pipe Organ 1
- 453. Electric Pipe Organ 2
- 454. Gospel Organ 1
- 455. Gospel Organ 2

**SOUND BLOCK D
(optional)**

- 600. Solo Trumpet
- 601. Trumpet Mutes
- 602. Solo Trombone
- 603. Dual Hardness Tenor Sax
- 604. Tenor Sax
- 605. Growl Sax
- 606. Soft Tenor Sax
- 607. Stabs (Falls)
- 608. Square Wave
- 609. Digital Wave Form 1
- 610. Mellow Trombone
- 611. Bass Trumpet
- 612. Trumpet & Mutes
- 613. Trumpet & Tenor Sax
- 614. Trumpet & Soft Tenor
- 615. Trumpet & Soft Tenor & Mutes
- 616. Trumpet & Dual Tenor
- 617. Trumpet & Mutes & Dual Tenor
- 618. Trumpet & Stabs
- 619. Trump & Stabs & Mute
- 620. Dual Tenor & Stabs
- 621. Dual Tenor & Trumpet & Stabs
- 622. Big Band 1
- 623. Big Band 2
- 624. Trumpet & Trombone & Strings
- 625. Trumpet w/Vibrato
- 626. Muted Trumpet w/Vibrato
- 627. Dual Tenor w/Vibrato
- 628. Trombone w/Vibrato
- 629. Acoustic Bass/Trumpet
- 630. Acoustic Bass/Muted Trumpet
- 631. Acous. Bass/Trombone
- 632. Acoustic Bass/Soft Tenor
- 633. Acous. Bass/Dual Tenor

- 634. Trumpet & Trombone
- 635. Trombone & Soft Tenor
- 636. Trombone & Dual Tenor
- 637. Trombone & Muted Trumpet
- 638. Trombone & Trumpet & Soft Tenor
- 639. Trombone & Trumpet & Mute
- 640. Dual Tenor & Soft Tenor
- 641. Trombone & 2 Saxes
- 642. Trio Section 1
- 643. Trio Section 2
- 644. Sfz Trombone Swells
- 645. Sfz Sax Swells
- 646. Sax Synth
- 647. Square Wave Synth 1
- 648. Square Wave Synth 2
- 649. Slow Square Synth
- 650. Touch Sens. Square Wave
- 651. Digital Electric Piano
- 652. Digital Klav 1

Total Instrument Voices: 96

Total Keyboard Setups: 341

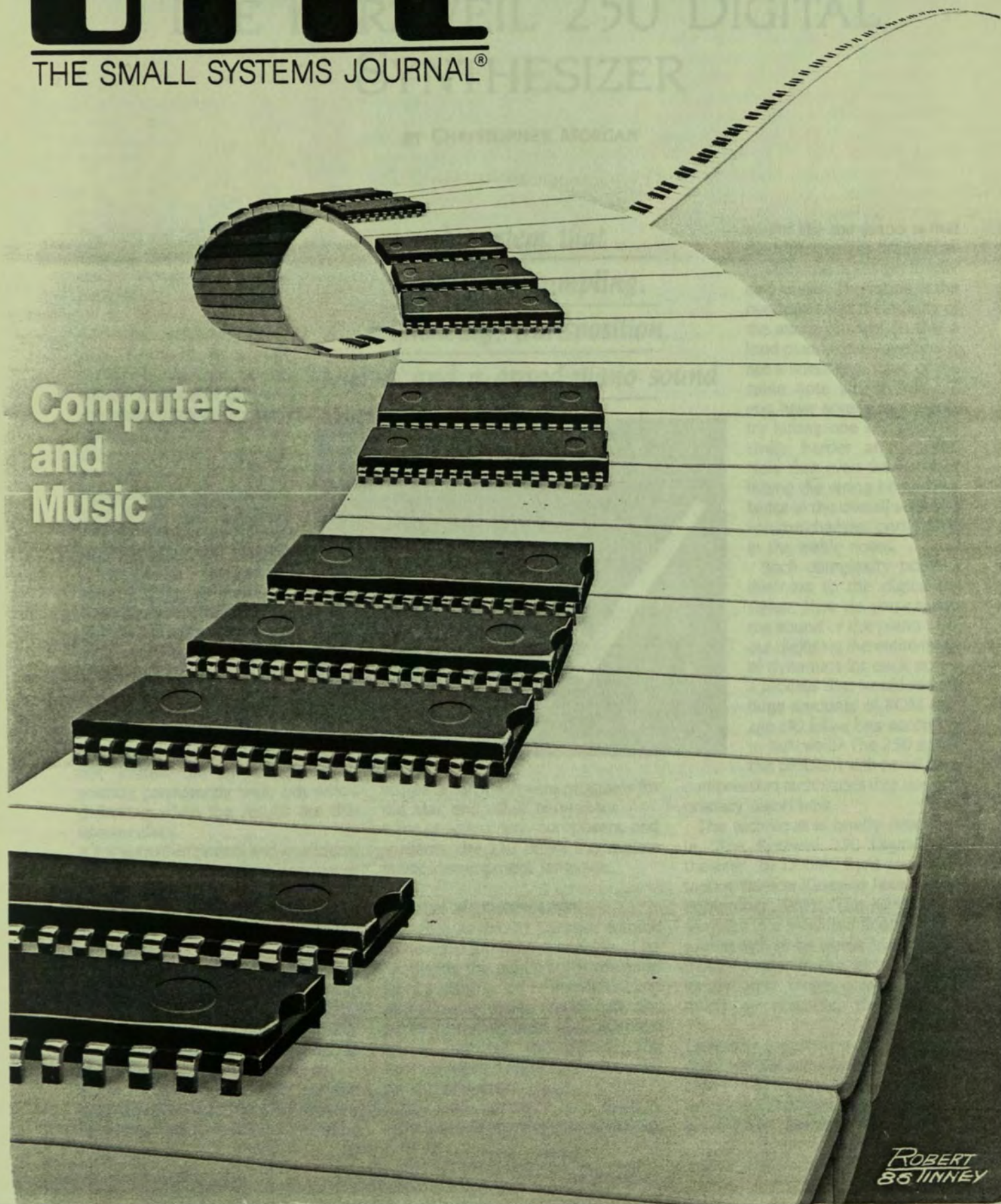
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Computers
and
Music



ROBERT
85 LINNEY



THE KURZWEIL 250 DIGITAL SYNTHESIZER

BY CHRISTOPHER MORGAN

The Kurzweil 250 Digital Synthesizer means many different things to different people.

- For the performing musician, the 250 is a fully equipped real-time performance instrument that lets you switch instantly from one voicing to another. No disk calls are involved, since the machine has no disk drives; digital samples come directly from RAM and 3.6 to 6 megabytes of ROM. The 250 also lets you store custom voicings on disk using an optional Macintosh interface.
- For hardware and digital-sound aficionados, the 250's state-of-the-art software and 68000-based hardware produce a fine imitation of a nine-foot concert grand—to say nothing of other instruments and effects. (It does not imitate all of these sounds consistently well, but who's quibbling when the results are this spectacular!)
- For sound engineers and musicians, the 250 has an excellent sequencer program for digital recording and mixing of tracks. You can easily record your own sounds and add them to the synthesizer.
- The Kurzweil 250 gives would-be musicians the chance to sound like virtuosos by using tricks like speeding up the music without raising its pitch, quantizing sequences of notes to clean up the rhythm, and so on.
- The 250 is a first-class MIDI machine that can drive or be driven by dozens of other MIDI devices, including

*A system that
offers users sampling,
sequencing, transposition,
MIDI, and a grand-piano sound*



scores of MIDI software programs for the Mac and other computers.

- For programmers, composers, and students, the 250 offers a complete music development language.

DESIGN METHODOLOGY

Designer Raymond Kurzweil wanted to develop a machine capable of reproducing the subtle tonal complexity of a piano or other instrument and also allowing you to create, edit, and perform new sounds with complete artistic freedom and control. The Kurzweil design team has succeeded on virtually every count.

The main problem with digitally sampling and reproducing a complex

sound like the piano is that the tone changes dramatically when the notes get louder and louder. The ratios of the overtones and the quality of the attack change, so that a loud piano-tone waveform is not a linear extension of the same note struck softly. If you have access to a piano, try hitting one key progressively harder and harder. Note that even the hammer hitting the string becomes a factor in the overall sound as volume changes, particularly in the treble notes.

Such complexity poses a dilemma to the digital designer: How do you capture the sound of the piano without digitizing the entire range of dynamics for each note—a process that would require huge amounts of ROM storage (30 billion bits according to Kurzweil)? The 250 solves this problem with novel data-

compression techniques that use proprietary algorithms.

The technique is briefly described in "The Kurzweil 250 Digital Synthesizer" by Donald Byrd and Christopher Yavelow (*Computer Music Journal*, September 1985). "The K250 stores samples in a modified floating-point format with 18-bit words. In effect, the fractions contain the waveform with its dynamic range compressed as much as possible; most of the

(continued)

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AT A GLANCE

Name

Kurzweil 250 Digital Synthesizer

CompanyKurzweil Music Systems Inc.
411 Waverly Oaks Rd.
Waltham, MA 02154
(617) 893-5900**Size**Keyboard, 57 by 27 by 9 inches; pedal
pod, 17¼ by 11½ by 4½ inches**Components****Keyboard:** 88 notes, velocity-sensitive**Channels:** 12**Power:** AC 110 volts, 50/60 Hz, 380 watts
(220-volt option available)**MIDI (in, out, thru):** 16 channels, user-assignable; each sequencer track can be assigned to a separate MIDI channel; special MIDI mode slaves one Kurzweil 250 to another**Price**

Basic Kurzweil 250, \$12,970; sound-modeling program, \$1995; Sound Block Module A, \$1995; MacAttach software and interface, \$195; stand, \$195; plexiglass music rack, \$75

An expander system is also available and comprises a Kurzweil 250 without the keyboard unit. Three versions can be supplied: a basic system (\$9980); base system plus enhanced instrument voices (\$11,975); and a base system plus voices, sampling, sound modeling, and Macintosh software (\$13,970)

dynamic information is in the exponents. For typical musical sounds, the K250's separation of the original sound into compressed waveform and exponent uses the sample bits much more efficiently than would be possible through uniform compression systems such as those of dbx or similar companders."

Besides its data-compression capability, the 250 offers new levels of performance in sound quality, user sampling, sequencing, transposition, and MIDI utilization.

OVERALL DESIGN

The Kurzweil 250 is a true digital instrument. That is, it contains millions of digital samples of musical-instrument sounds (called "soundfiles" in Kurzweil nomenclature) stored in ROM. Pressing a musical key on the 250 causes the processor to extract digital samples from ROM. The samples are converted to analog signals in the channel board.

The basic instrument contains 40 soundfiles in ROM—including the grand piano. Also built into ROM is a series of factory-generated "instruments," Kurzweil's term for the effects (envelope, tremolo, vibrato, etc.) used to alter a soundfile that affects its sound.

To hear sound on the Kurzweil, you assign a keyboard setup to the physical keyboard. The keyboard setup contains one or more instruments, each of which is a modified soundfile. A keyboard setup can be simple (the grand-piano soundfile by itself, for instance), moderately complex (piano on the right side of the keyboard, string bass on the left), or quite complex (clarinet, oboe, stereo vibes, and bass on one layer, and organ on the other, with the restriction that the organ will sound only if you press the velocity-sensitive keys with sufficient force). It's easy to edit keyboard setups with the keyboard editor.

HARDWARE

The Kurzweil 250 Digital Synthesizer comes in a compact case that looks like an electric piano or an organ at first glance. It is quite a handful to transport and requires two people to lift it. Beneath the main unit is a

separate module, or pod, containing the power supply and two footpedals that normally control sustain and mute. The functions of these two pedals, like virtually every other knob and slider on the 250, are user-assignable. By isolating the power supply in the pod, the designers have helped to reduce possible hum in the system.

The action of the 88-note, velocity-sensitive wooden keyboard is strikingly similar to that of a grand piano. Directly above the keyboard is the control panel containing 38 buttons and sliders and, in the center, a 24-character-per-line, two-line LCD that serves as the main user interface. (A close-up of the 250's keyboard and control panel is shown in photo 4 of "Digital Music Synthesis" by Robert Moog on page 165 of this issue.) A standard calculator-style keypad is used to maneuver through command menus.

At the far left of the control panel are four sliders used to tune the instrument, to pan sounds between the two stereo output channels, and to adjust overall volume. To the right of these sliders is a group of six buttons and three more sliders used to control chorusing (a whole set of pseudo-reverberation and echo effects to enrich the sound of the synthesizer), to assign alphanumeric names to files and keyboards, and to adjust brightness, detuning, etc. Buttons in the center of the panel control transposition, the footpedals, and so on.

To the right are the controls for the sequencer, the sound-modeling program (digitizer), the various editors, the MIDI interface, and the interface to the optional Macintosh computer (via Kurzweil's MacAttach software). The interface is used to store custom soundfiles, keyboards, and keyboard setups on Macintosh disks, enabling you to build up a library of custom sounds and to trade sounds with other users via disk or modem.

There are three main microcomputer boards inside the Kurzweil 250: the central processor, the channel-group processor, and the channel board (see figure 1). The central processor is a Motorola 68000 running at 10 MHz. It has 128K bytes of ROM

(continued)

Pitches can be changed on each channel independent of the other channels.

and 128K bytes of battery-backed RAM for sequences, keyboard setups, instrument definitions, and general use. The system is extremely fast: Switching from one instrument sound to another is virtually instantaneous. By comparison, the MacAttach program plods along, taking from 2 to 4 minutes to load a custom soundfile.

The conversion to analog sound takes place in the channel board, which contains 12 channels, each with its own digital-to-analog converter, low-pass filter, and voltage-controlled amplifier. A mixer combines the 12 tracks down to 2 stereo outputs. For studio sound work, the Kurzweil offers balanced XLR inputs and outputs as well as unbalanced high- and low-level

connections. The Kurzweil 250 samples at a variable rate, meaning that pitches can be changed on each channel independent of the other channels.

The entire main chassis slides out of the unit at the rear for easy access. The engineers obviously put a lot of thought into the design of the boards and connectors. They are particularly easy to remove for servicing or upgrading.

To augment the sounds described for the basic 250, you can add the optional Sound Block A or B modules, which contain a set of 15 additional voices and 84 new factory-defined keyboard setups. The new keyboard setups also combine several of the new and old sounds. Further sound blocks are planned for the 250, including the recently introduced Sound Block C, which features several new pipe-organ sounds.

SOFTWARE

The possibilities for sound control on the Kurzweil 250 are virtually limitless. You control it by selecting commands from a large menu tree. The commands appear in the two-line LCD.

The simplest way to move around the menu is to use the four cursor-control arrows. Pressing the left and right arrows moves you back and forth within a given level of the tree; pressing the up and down arrows shifts you up and down the various levels of the tree.

You can also access any function directly by punching its code number into the numeric keypad or by using "shortcut" keys, a technique similar to that used in the Apple Macintosh when you want to avoid using the mouse to click on menu items. You can then access commands without having to step through the menus. However, you need to remember that certain Kurzweil keys get reassigned when you're using the various software editors.

KEYBOARD-SETUP AND INSTRUMENT EDITORS

The keyboard-setup editor lets you create your own keyboard setups out of combinations of instruments and soundfiles. Up to 40 such keyboards can be stored in the keyboard library, which is in battery-backed RAM, or on

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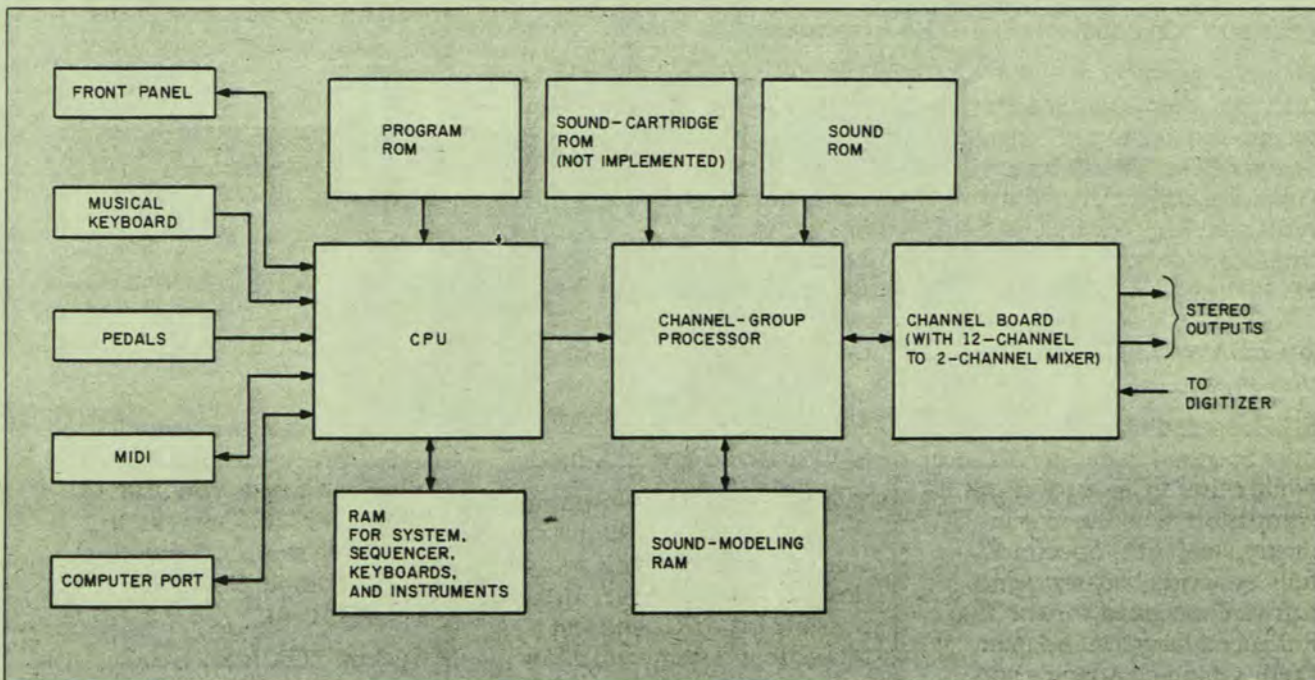


Figure 1. Block diagram of the Kurzweil 250 Digital Synthesizer, showing the three main microcomputer boards: the central processor, with its on-board Motorola 68000 microprocessor; the channel-group processor, used to extract and combine soundfiles; and the channel output board, which mixes as many as 12 channels of information into 2 and also serves as the input section for the digitizer.

a Macintosh disk using the MacAttach interface program.

The degree of freedom you have in creating keyboard setups is almost frightening. You can create your own sounds, musical or otherwise, and assign them to keyboards.

The instrument editor lets you control the chorusing, vibrato, tremolo, voicing, global parameters, and, via the envelope editor, the shape of the envelope waveform. The latter can consist of up to 255 separate segments, each of which can be a logarithmic-attack, exponential-growth, exponential-decay, or delay segment. Throughout, you have precise control of how quickly segments change in amplitude, what their absolute limits are, and so on.

GLOBAL PARAMETERS

There are 10 user-controllable functions that affect the Kurzweil 250 globally. They are sustain, brightness, keyboard dynamics, tremolo, vibrato, pitch-bend, channel stealing, maintenance, chorus, and transposition. Some are straightforward, such as tremolo and vibrato. Others, such as chorus, are complex and can have a profound effect on the 250's sound.

Chorusing, as defined on the 250, involves combining a sound with altered versions of itself that are delayed in time or changed in pitch or volume. Chorusing can create the impressive illusion that an entire group of instruments is being played instead of just one.

Chorusing should always be applied judiciously, since certain keyboard setups used in the chorus mode quickly use up the available 12 channels. At that point the software must "steal" channels by selectively silencing some of the notes currently being played in order to play the newly struck keys. You have control over what algorithm the software uses to choose the notes to be "abandoned." Channel stealing is helpful in some situations but cannot get around the absolute hardware limitations of the basic system. (Still, compared to the monophonic, or one-note-at-a-time, synthesizers of the 1960s, today's polyphonic synthesizers are a plea-

(continued)

sure.) One way to get around the limitation of 12 channels is to use the 250's MIDI capability to drive external slave synthesizers such as Kurzweil's expander (which is essentially another 250, but without the keyboard).

TRANSPOSITION

The 250's transposition feature is a particularly successful design. Let's

say you learned a piece of music in the key of C, but you need to accompany someone in the key of B-flat. Simply hit the transpose-down key twice, and the synthesizer will play in B-flat. There's no need to learn a new arrangement of the piece. Then if you hit two more keystrokes on the transpose-up key, you're back in the key of C. There are five modes of transposition: octave-pitch shift, chromatic-

pitch shift, octave transpose, chromatic transpose, and timbre shift.

SEQUENCER

The 250 comes with a sequencing program that lets you store note sequences in much the same way as you would with a tape recorder, although the process is entirely digital. The sequencer does not record actual tones. Instead, it records which keys are struck on the keyboard and how hard they are struck. It also preserves the effects associated with each voice being played. You can play a piece of music, then replay it to edit mistakes or change effects. The sequencer is extremely easy to use; it even lets you store a sequence on a Macintosh disk using the MacAttach interface program. You can control every parameter of a sequence with great precision.

With the 250 sequencer, you don't need a separate drum machine, since you can quickly create your own "loops." A loop is a sequence of music that repeats continuously. You create the first loop, then instruct the sequencer to play it over and over. Also, since the sequencer is recording keystroke events rather than actual musical pitches, you can speed up or slow down a sequence with a few keystrokes. This enables you to record difficult passages at a slow tempo and then speed them up to Vladimir Horowitz specifications. Another practical application is the so-called "time-compression/expansion" technique used to create commercials that are exactly one minute long. The sequencer lets you lengthen a piece of music that is, for example, 58 seconds long to exactly 60 seconds.

THE SOUND-MODELING PROGRAM

The sound-modeling program, or digitizer, lets you create your own soundfiles from tape recordings, records, or even a live microphone plugged into the 250. The user interface for the digitizer is cleverly designed and particularly easy to use. I found I could create an entirely new keyboard of sounds in just a few minutes. You can have someone speak or sing into a microphone, then digitize that voice into the 250 to

create an Uncle Harry voice, or whatever. The 250 automatically calculates the pitches of adjacent notes. The process is the culmination of the venerable practice of composing with "musique concrete," or modified sounds taken from nature.

You can store user-created soundfiles on disk (through MacAttach) and modify them just like you can the factory-installed files, and you can combine them with the factory-installed files to create striking effects.

Several features are worth pointing out in the digitizer. One is the high fidelity that is possible with the highest sampling rate of 50 kHz. The other is the ease with which you can edit the sampled sound. Once sampled, a sound can be "trimmed" to remove unwanted material at the beginning or end of the sample.

You can trade soundfiles, instruments, and keyboard setups with other Kurzweil users via disk or modem. I belong to PAN (the Performing Artists' Network), a database bulletin board for electronic musicians and audio engineers. The Synthesizer and MIDI Development Network keeps several soundfiles in the library, which members can download. I recommend PAN to anyone seriously interested in computer music synthesis. For more information, call (215) 489-4640.

MIDI INTERFACE

MIDI is the ubiquitous communications scheme for digital music devices that has become a de facto standard in the music industry.

The Kurzweil 250 offers a particularly full implementation of the MIDI specification and allows the synthesizer to control or be controlled by a variety of other synthesizers, hardware devices, or computers. The 250 has MIDI-in, MIDI-out, and MIDI-thru jacks on the back panel.

DOCUMENTATION

Considering the complexity of the machine, the 250's documentation is surprisingly good, although there were gaps in the earlier versions—no comprehensive diagrams of the software command trees, for instance.

(continued)

The biggest bottleneck to using the 250 is the MacAttach program.

This situation has since been alleviated by the excellent diagrams in the Byrd and Yavelow paper, copies of which have been sent to all Kurzweil owners.

One drawback to the documentation is that it's hard to find things when you need them. However, those sections describing the sequencer and the sound-modeling programs are particularly well written.

NEW DEVELOPMENTS AND MISCELLANEOUS NOTES

The biggest bottleneck I found to using the 250 is the MacAttach program. At 56,700 bps, MacAttach version 2.0 (which I used for this review) is far too slow, taking from 2 to 4 minutes to load one custom soundfile. This would be prohibitively slow for the live performer. To compound things, MacAttach makes no use of the Macintosh's graphics, and its functions are restricted to loading files to and from the synthesizer's memory and making disk copies. However, this past winter the Kurzweil people told me that they plan to announce Fastlink, an interface card for the Kurzweil that will increase MacAttach data transmission tenfold, making it possible to load a file in 5 to 10 seconds instead of 2 to 4 minutes.

They are also optimizing the Kurzweil 250 for use with a Macintosh equipped with a hard disk drive, and in particular, to work more efficiently with sophisticated MIDI-based music software such as Mark of the Unicorn's Performer and Southworth's Total Music.

In response to criticism that the piano voice has some weaknesses (slight pitch aberrations, certain tubiness in the midrange, and slight discontinuities from one keyboard region to the next), the company has remasked the ROMs containing the piano voice (and several others). It is now much smoother and more ac-

curate. The new harpsichord voice is also excellent, as are several other new voices in the upgraded software. The approximate charge for retrofitting to the new voicings is \$2500.

Redoing the ROMs gave the designers the chance to convert from 256K-byte chips to 1-megabyte chips, freeing up several slots on the motherboard for more sound blocks. Announcements of new sound blocks should be forthcoming.

The currently available Sound Block B features 10 new rock-drum sounds, all recorded in New York with the help of such musicians as Phil Collins and the Thomson Twins. It also includes an electric piano, electric guitar, and other voices.

I have a library of about 20 custom sounds for the 250 that I obtained from the company and from users groups. Most of them are adequate; a few are standouts. It's great fun to create your own.

CONCLUSIONS

For a variety of reasons, I feel the Kurzweil 250 Digital Synthesizer is the most important advance in the art of computer music synthesis in the past 10 years. Other approaches may have their particular advantages, but nowhere else have I found a machine that can do all the things the 250 can do for the price.

The 250 is not cheap, but combined with a good analog or digital multi-track tape recorder, it's just about all you need to create a high-powered electronic music studio. The design innovations contained in the 250 will undoubtedly be copied by others, and it's only a matter of time before the Japanese begin to upgrade their designs. (Kurzweil is in fact working with a Japanese company to create a new, lower-priced design.) When the next wave of machines arrives, the state of the art will really take off. ■

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- Loy, Gareth, "Musicians Make a Standard: The Phenomenon of MIDI," *Computer Music Journal*, Winter 1986. (This article is the best treatment of MIDI I have seen to date.)

THE GOALS OF THE KURZWEIL 250

By Raymond Kurzweil

August, 1984

Two Worlds of Musical Instruments

In recent years, the world of musical instruments has been divided into two different and distinct approaches to creating music, each with its own strengths and weaknesses, and each with its own history. The world of acoustic instruments has provided rich complex timbres, but relatively limited ability for modification and control. The world of electronic instruments has provided a wide range of flexible methods to provide artistic control over sounds, through such techniques as sequencing, layering, splitting, timbre modulation and others, but traditionally has been unable to achieve the rich and musically satisfying timbres of "natural" acoustic instruments.

In understanding the goals of the Kurzweil 250, it would be worthwhile to touch on the history and capabilities of these two worlds.

The Acoustic World

The quintessential acoustic instrument, the piano, was an outgrowth of earlier keyboard instruments, primarily the harpsichord and clavichord, which are still manufactured although in relatively small numbers. The invention of the piano was an evolutionary process, but the primary piano action (and the piano's unique "touch sensitivity") was first perfected in 1709 by Bartolommeo Cristofori, who called the resulting instrument, a "gravicembalo con piano e forte" ("harpsichord with soft and loud").

The piano continued to evolve through the eighteenth century, achieving its "modern" form in the nineteenth century. Many consider it to be the most expressive acoustic instrument. It is also a cumbersome instrument with about 10,000 parts, most of which are moving.

The other acoustic instruments that make up the "modern" orchestra also evolved during the same period. The violin and other bowed string instruments, for example, achieved their height in the late seventeenth and early eighteenth century. Brass and woodwind instruments continued to evolve into the nineteenth century.

One acoustic instrument that was particularly significant in the subsequent emergence of electronic instruments is the organ. The first organs were pipe organs, the origins of which are buried in antiquity. The earliest surviving record is of an organ with multiple pipes and a crude keyboard for pitch control invented by a Greek engineer, Ctesibius, in Alexandria in the third century, B.C. The remains of an actual Ctesibius organ were found in 131 A.D. at Aquincum, near what is now Budapest, Hungary. The complete historical line of organ development is not clear, but grand pipe organs were in use by the ninth century in Christian churches.

Despite the fact that acoustic instruments represent a technology perfected in the nineteenth century and earlier, it is still the technology of choice for the great majority of musicians in the world today because of the musically satisfying, complex, time-evolving timbres it provides, and to some extent its "human engineering." There has been, however, increasing frustration with the limited tools available for sound modification and control. There are some techniques possible -- vibrato, pizzicato, various bowing methods and other techniques on a violin; portamento and pitch bend on a trombone; player piano mechanisms for a very limited sequencing function on a piano and others -- but the rather short list of such capabilities only highlights this limitation. Another fundamental limitation is the limited range and monophonicity of many acoustic instruments. You cannot, for example, play most Chopin preludes on a guitar or play any polyphonic music at all on wind instruments and only limited polyphony is possible on string instruments. Also of significance is that most musicians are unable to play most instruments; thus a keyboardist cannot create violin sounds and a guitarist cannot create piano sounds.

The Electronic World

The first "electronic" instruments were in fact electro-mechanical and were outgrowths of the organ. A major development occurred in 1934, when Laurens Hammond received a patent on his tone wheel organ, which synchronized different tone generators with alternating current frequency. Tone

coloration was controlled by the now famous drawbars, which are still in widespread use. The original commercial Hammond organ was introduced in 1939 at the Industrial Arts Exposition in New York and was favorably received. In promoting the new instrument, Hammond claimed that his "Model A," which sold for \$2,600, generated a sound that was equal in quality to a \$75,000 pipe organ. When challenged by the Federal Trade Commission to substantiate that claim, a "blind" test was set up to compare the model A to the Aeolian-Skinner Pipe Organ in the University of Chicago's Rockefeller Chapel. A panel of experts and students were essentially unable to tell the two instruments apart. Musical instruments that had to be plugged into the wall were then off and running.

Just as the electronic home organ was an outgrowth of the pipe organ, the modern synthesizer was an outgrowth of organ development. While the mechanical tone wheel approach developed for the Hammond Model A is still in use, it has largely been supplanted by entirely electronic methods. Early synthesizers were not considered musical instruments in their own right, but were rather complex experimental machines used primarily in the design of organs. The RCA Mark II, for example, initially developed by Dr. Harold Olsen and later redesigned by Columbia and Princeton Universities, was controlled by punched paper tape and was used for organ design as well as intense academic experimentation with new sounds.

The first practical synthesizer, which introduced the still popular voltage control method, was developed in 1964 by Robert Moog (and independently by Don Buchla), and went into production in 1966. Moog's synthesizer achieved widespread recognition in 1968 with the release of Walter Carlos' album *Switched on Bach*. The combination of Bach's intense and mathematically elegant harmonic progressions with the new and mysterious electronic sounds captured the public imagination, particularly in light of the Americans' then recent commitment to space travel and the attendant fascination with science.

While most synthesizers sold today still use the basic voltage controlled oscillator

technique, there has been a significant improvement in the ability to provide artistic control over the process. Microprocessors have largely replaced the cumbersome patch cord system allowing users to conveniently develop, store and recall patches. Polyphonicity, sound layering, sequencing and other techniques have provided musicians with unprecedented flexibility.

Synthesizers have been used in two different ways. First, they have provided a new palette of sounds that are quite different from acoustic sounds, which have been extensively and enthusiastically used in popular music and in some modern classical works as well. Second, they have been used to emulate acoustic instruments, such as flutes, strings, even piano. While commonly used in this second role, this application of synthesizers has not been fully satisfactory. Synthetic emulations have sounded noticeably different from their acoustic counterparts. It is simply not possible to capture a piano tone, with its complex spectral evolution and inharmonicity (overtones whose frequencies are not perfect multiples of the fundamental frequency), with a few simple oscillators. Even high end modern digital synthesizers with several dozen oscillators are unable to achieve a convincing replication. Beyond the complexity of a single piano tone (each one of which can have scores of constituent sounds), a piano is capable of creating thousands of different tones depending on which key is played and how hard the key is struck. This represents a complexity several orders of magnitude greater than is possible with even an advanced oscillator synthesizer.

In response to the desire of musicians to be able to more accurately capture acoustic sounds in an electronic instrument, another approach, called "sampling," was introduced with the development of the "Computer Musical Instrument" by Fairlight in 1978. Sampling involves storing digital recordings of musical sounds in a computer memory and then recalling them in response to the activation of music keys. Within the fidelity specifications of a particular sampling instrument, the recorded sounds do sound more realistic than those produced with oscillators. There are a number of significant limitations that have been associated with

conventional sampling as a technique, however. Because musical sound requires a very significant amount of computer memory for each second of sound stored, it is generally not possible to store the entire evolution of an instrument's sound. One approach that has been heavily used is to store only the attack portion and the initial part of the decay of a music tone, and then "looping" the last one or several waveforms. The difficulty with looping is that once the looping section begins, all inharmonicity is lost along with natural timbral evolution. The resulting sound after the attack is usually similar to an organ tone with a fixed fully harmonic spectrum.

Also because of memory limitations, it is not practical to store a sound for every key, so C# is created by playing the file for C at a slightly faster rate (a ratio of 2 to the 1/12 power, to be exact). This causes a slight change in the rate of evolution of the note as well as in the harmonic spectrum. While acceptable at one semitone from a "root" note, this effect becomes quite pronounced when the distance to the root becomes excessive causing an undesirable "munchkin" effect. Memory limitations have commonly prevented storing enough different sounds for different pitch ranges to prevent this munchkin effect. Traditional sampling approaches have also not been able to store different sounds for different loudness levels. It is, however, the case that a loud strike on a piano (and on other instruments) is not the same as a soft strike amplified. The entire spectral evolution changes along with the loudness. Capturing this effect of loudness on timbral evolution has also, therefore, not been achieved with the traditional sampling technique.

There are other difficulties as well. The traditional sampling approach generally models sound decay by using smaller and smaller samples. As the samples grow smaller, the signal to noise ratio also becomes smaller. The effect is often a growing hiss as a note decays.

One attempt that has been made to overcome some of these problems has been to extend the applicability of the available computer memory by compressing the sounds using "linear predictive coding" (LPC) speech synthesis chips. Since LPC coding requires

less memory per second, more seconds are available to model more of the evolution and to provide for more root notes. The result is that looping as such is not required and there is less munchkinization. This has been achieved, however, by reintroducing a technique of synthesis, which results in thinner, more synthetic sounding tones.

Thus while traditional sampling can provide some realistic tones, it has not in general been able to realistically capture timbral evolution, the effects of pitch and loudness on timbre, and an adequate signal to noise ratio through all portions of a note's envelope. To illustrate the difficulty of applying traditional sampling techniques to an instrument as complex as the piano, consider that each of the piano's 88 keys can create an average of approximately 50 distinct distinguishable timbres. Each of these 4,400 sounds lasts an average of about 10 seconds for a total of about 44,000 seconds. If these were recorded using standard digital audio disk techniques (44,100 16 bit samples), it would require about (44,000 x 44,100 x 16 or) 30 billion bits. With 256K bit memory chips, that would require over 100,000 memory chips for the piano alone!

In summary, electronic instruments have provided a wide palette of new sounds that have found their use in diverse forms of musical expression. Being in electronic form, they are easily manipulated with sound modification techniques, sequencers and a broad variety of other techniques. The goal of producing acoustic sounds and other sounds of acoustic complexity has not, however, been satisfactorily achieved with traditional synthesis and sampling techniques.

The Goal of the Kurzweil 250

The primary goal of the Kurzweil 250 is to bridge these two musical worlds, to provide the capabilities of both in a single instrument. For the acoustic world, the goal has been to recreate the rich complex time-varying timbres of the grand piano and other acoustic instruments, as well the effect of pitch and loudness on these timbres. For the electronic world, the goal has been to provide a state-of-the-art system for modification and control.

How well have these goals been achieved? We are certainly hesitant to claim perfection (otherwise how could we claim to provide "improvements" in the future?). The bottom line is that musicians will judge for themselves, regardless of what we say. We feel that we have come far closer to achieving these goals than has previously been achieved, but in the end we are most interested in musicians actually hearing the sound quality of the 250 and making up their own minds.

I will offer a few of my own observations. The most common reaction to a demonstration of the Kurzweil 250 appears to be one of "cognitive dissonance" -- listeners are surprised that such realistic acoustic sounds can be produced by a keyboardist. People frequently report closing their eyes and easily imagining a live combo, orchestra or soloist.

To demonstrate its confidence in the instrument, Kurzweil Music Systems performed an A-B comparison at the June, 1984, NAMM (National Association of Music Merchants) convention in Chicago, between a top of the line 9 foot concert grand piano and a Kurzweil 250, both played through the same very high quality \$40,000 sound system (this was, to my knowledge, the first time such an A-B comparison had ever been attempted). There was general agreement that it was not possible to tell the difference between the piano (which has long been considered the most difficult acoustic instrument to recreate electronically) and the 250 (and hence the company's motto that "you can't tell the difference").

In many ways, in combining capabilities from both worlds of musical instruments, the sum is greater than the parts, in that musical effects and expression can be achieved that were previously not possible, even if one worked with both acoustic and electronic instruments.

Now that a wide range of acoustic instrument timbres can be controlled from an electronic instrument, it is possible to apply the power of sound modification, layering, sequencing and other techniques to acoustic sounds. As a simple example, by just layering a piano and guitar together, one can easily play music that would be literally impossible to achieve with an ordinary piano and guitar.

As a more complicated example, by combining the splitting, layering and sequencing capabilities of the 250, one can experiment with complex orchestrations at one's leisure, modifying them as easily as one would modify a letter on a word processor.

Thus acoustic musicians are now able to take advantage of sound modification and event control techniques that have never been possible with acoustic instruments. Electronic musicians are now able to use powerful sound control techniques without sacrificing significant sound quality and complexity. Indeed the distinction between the acoustic and electronic worlds of music should become less relevant as musicians can now use whatever sounds and techniques are most appropriate for their musical intent.

Beyond capturing a wide range of expression and the timbral complexity of acoustic instruments and providing a state of the art system for modification and control, the Kurzweil 250 provides one other important musical capability, and that is the ability to create sounds that are entirely new yet have the same inherent complexity and richness of acoustic sounds. New "synthetic" sounds do not necessarily need to be thin. With the 250, a new world of sounds that have the same musical depth and complexity of evolution as acoustic sounds, yet have never been heard from an acoustic instrument, are now available.

The Kurzweil 250 is a new type of musical instrument and many of the persons who have been involved in its creation have expressed the feeling that the new things it allows a musician to do will probably end up being of greater importance than the 250's ability to play acoustic sounds. Piano sonatas were not created before there was a piano, and similarly we anticipate new forms of music developing for this new musical technology.

Let us examine separately each of the three areas of capability of the 250 -- recreation of acoustic sounds; sound modification and control; and new sound creation.

Acoustic Sounds on the Kurzweil 250

As noted above, a "brute force" sampling method of capturing all of the sound evolution and timbral variation of the piano would require something like 100,000 memory chips. As we have room for only a few dozen such chips, and those few dozen chips are intended to store not one but dozens of on-line instruments, it is obvious that we need a massive amount of information compression. As stated above, the goal of the technology in the 250, called "Contoured Sound Modeling," is to accomplish this compression without noticeable loss of accuracy, sound complexity, evolution, timbral variation and signal to noise ratio.

The technique works as follows. Kurzweil Music engineers record the actual instrument using high quality digital equipment. In recording the piano, for example, many different pitches as well as loudness levels are captured, as well as the time evolution of each tone. These recordings, which represent an enormous amount of information, are then fed into a computerized analysis system which generates a relatively compact computer model of the original instrument. These models can be said to be intelligent in that the maximum data compression possible is achieved. Instruments with a simpler sound structure produce simpler models which require less memory. The model for a more complex instrument like the piano requires more detail and thus takes more memory. The resulting models are stored in the read-only-memory of the 250 and despite the substantial data compression that is achieved nonetheless contain all of the information necessary to produce a convincing recreation of the original instrument analyzed. When the keyboardist plays the 250, the computers and specialized circuitry and software inside the 250 recreate in real-time the original complex time-varying waveforms.

A significant feature of the 250 is the ability to maintain the piano's distinctive inharmonicity during the decay portion of each note. The 250 maintains a high signal to noise ratio throughout all portions of each note; there is relatively little loss of SNR during note decay. Its dynamic range is

comparable to that of a grand piano -- well over 100 dB.

The same technique provides a similar degree of realism and accuracy on all acoustic instruments, including chorused instruments. We have successfully produced the sounds of an entire string section (with 30 string players ranging from violins to basses) and a choir of male and female voices. Since the Contoured Sound Modeling technique is sufficiently detailed to capture the complexities of acoustic instruments, it is also capable of capturing popular synthetic sounds.

The base instrument comes with the sounds of 30 resident instruments (of which the nine foot concert grand piano is one). This is expandable in a variety of ways. By adding permanently resident "sound blocks," the number of internally stored sounds can be expanded to approximately 60. These instrument sounds are accessible instantly. No "load" time is required to transfer them from a floppy disk or other medium. Another advantage of their being on-line is that they can be played simultaneously by splitting, layering and sequencing the keyboard. One can play up to a dozen instruments simultaneously and within a split second shift to another dozen, and so on. This is obviously not possible with instruments that permit only one or two sounds at a time to be loaded from a disk.

In addition to the permanently resident sound blocks, an expanding line of sound cartridges is available. These include a variety of synthesizer sounds, less popular acoustic sounds as well as sound effects.

Another important capability is user sampling. With the Kurzweil 250's sampling option, you can sample your own acoustic and electronic instruments, voices and sound effects. The instrument and sampling option will then compute an intelligent contoured sound model for each instrument, which users can store permanently on 3 inch hard shell diskettes.

Finally, as described below, all of the captured sounds in the 250, whether originally provided on sound blocks, cartridges or through user sampling, can be modified to produce a broad class of new sounds. These

can range from subtle alterations of envelope to dramatic changes in timbre.

Sound Modification and Control on the Kurzweil 250

The primary purpose of the Kurzweil 250, as expressed above, is to bridge the acoustic and electronic methods of musical expression. Having captured the intricacies of acoustic instruments, it was equally important to provide a powerful yet easy to use system for expressing these sounds with maximum flexibility.

The keyboard can be split as many times as desired, thus placing multiple instruments on the keyboard at the same time. Each section of the keyboard can also be layered, with up to six layers. Thus a single key can play up to six instruments at the same time. In addition, sounds can be doubled, echoed, flanged and chorused. This last feature automatically converts a solo instrument into an entire chorus of such instruments. Users have control over the balance of different instruments through the 250's stereo outputs.

Users also have control over a powerful 12 track sequencer. You can, for example, play a track on piano, play it back while recording a flute track, play back the piano and flute together while laying down a drum track, and so on up to 12 times. In addition to providing all of the professional features of a multi-track recorder, extensive editing features are also available. You can, for example, change instrument assignments or transpose key signatures without re-recording the sections being changed. Individual notes can be erased or changed, the tempo can be changed without changing pitch and vice versa. Other features include compatible external synchronization, rhythm requantization, virtual memory when the 250 is attached to an external personal computer, and many other features.

A wide range of sound modification features are provided. One can emulate the various playing techniques of acoustic instruments through the vibrato, tremolo, portamento, legato and pitch bend features. There are also synthesizer effect features, such as deep F.M., deep A.M., programmable envelope modifications, and various sound modulations. There are four types of

transpositions, including an interesting timbre shift. By using these features in various combinations, a wide range of dramatic and unique musical effects becomes possible.

To expand further the instrument's flexibility, there are a number of communication ports, all with support software, including MIDI (Musical Instrument Digital Interface), a high speed communications port for transferring information to and from a personal computer, synch in and synch out.

The MIDI port allows the 250 to control and to be controlled by other synthesizers. It also allows musicians who play instruments other than the keyboard to take advantage of the capabilities of the 250. For example, by plugging in a MIDI equipped electric guitar, one can play all of the sounds in the K250 (piano, human voice, drums, etc.) using a guitar and guitar playing technique. In addition, this technique allows a guitarist to take advantage of all of the splitting, layering, sequencing and sound modification techniques provided in the K250. By using one of the MIDI pitch trackers now coming on the market, one can play any acoustic instrument (including your own voice) and have those sounds "converted" into any of the K250 sounds. This is done by playing an ordinary instrument into a microphone or pick-up, having the pitch tracker extract the pitch and amplitude from this signal and then feeding the pitch tracker's MIDI commands into the MIDI port of the 250. You can thus play an ordinary violin using ordinary violin technique (or flute or voice or any other instrument) and have those sounds converted into any other sound, or choruses of sound.

The 250 can be connected by either its MIDI or its high speed port to a personal computer. Software is being developed to produce music notation from a recorded sequence. Other products that will be introduced by Kurzweil Music Systems will include computer assisted instruction and a programmable sound laboratory (described below).

There are two important interfaces between the musician and the 250 -- the music keyboard and the control panel. The value of

the 250's sound quality and its wide range of features would be diminished if these two primary interfaces failed to provide optimal sensitivity, responsiveness and ease of use. A great deal of effort, therefore, has gone into the design of these two systems.

With regard to the keyboard, our engineers developed special equipment to plot the mechanical displacement of an actual high quality piano action on a millisecond by millisecond basis to see exactly what happens during the strike of a piano key. An action of our own was then designed which, while a great deal simpler than the ninety moving parts that make up a grand piano action, nonetheless provides a distinctive snappy feel similar to "real" piano keys.

In addition, the 250's software provides a programmable "keyboard sensitivity adjustment," which can be set according to user taste. Many users also prefer to change this sensitivity adjustment for different instrument sounds.

The control panel was designed to be easily used by musicians, particularly those who do not happen to have an expertise in computer science. All terminology is musically oriented, and the two line display guides the user through all command sequences. The company worked with Bolt, Beranek and Newman, who are considered leading experts in the human factors field, as well as with a group of musicians, on the design of the panel and controls.

New Sounds on the Kurzweil 250

As was pointed out above, by combining the over two dozen techniques provided with the 250 for modifying any of the built-in sounds (or sampled sounds), it is possible to create a virtually unlimited array of new sounds. Some of these effects are subtle alterations of the original acoustic or synthetic sounds that were modified. Others are totally new sounds that are no longer identifiable as the original instrument, but that nonetheless retain the complexity and the musical richness of the original acoustic sounds.

Users are strongly encouraged to experiment on their own in the creation of such new sounds. One particularly powerful technique in this regard is sound layering.

Layering an instrument with itself using a significant pitch or timbre shift, or layering a variety of instruments all with significant pitch or timbre shifts, produces interesting and complex new sounds. Applying strange envelopes to natural instruments such as the piano or extreme settings of vibrato, tremolo, and flanging, combined with extensive sound layering, have also produced fascinating effects. Some results are more musically valuable than others, but many such experiments produce results that are interesting and sometimes very surprising.

To assist further in this process, a programmable sound laboratory is being developed which will provide users with the ability to analyze any stored or sampled sound into its constituent elements -- waveforms, spectra, envelopes -- and then use the results of these analyses to create exotic hybrid sounds. One could, for example, take the envelope of a bassoon, some of the harmonic content of a piano and human voice and combine them in a variety of ways to create complex tones that would sound quite different from any of the original instruments. The sound laboratory will provide a comprehensive package of sound analysis, graphical and mathematical manipulation tools and sound reconstruction techniques. The "new" instruments created with the sound laboratory can be saved on plastic diskettes and then loaded into the 250 to be played on its keyboard like any other set of instrument sounds.

It is the feeling of many of the persons who have been involved in the development of this instrument that the extensive abilities of the Kurzweil 250 to create complex new sounds may ultimately become of equal and perhaps of even greater significance than the ability to recreate acoustic instruments, particularly when creative musicians have the opportunity to extensively experiment with these capabilities.

Conclusion

There are many aspects to a musical keyboard instrument -- the sounds, the keyboard, the features, the controls, and the physical design, just to mention a few. All of these are important, and a critical component of the philosophy behind the 250 has been to

set a new standard of excellence in all of these areas. Achieving this goal has required an extremely talented design team in a variety of areas, including signal processing experts, computer scientists, circuit designers, human factors specialists, mechanical engineers, industrial designers, quality assurance and manufacturing experts and others. It has also required loving devotion, dedication, hard work and team spirit, all of which have been displayed in great abundance throughout the creation of the 250.

Perhaps the most exciting aspect of the 250 project is that now that the instrument has been created and is being distributed throughout the world in ever increasing numbers, the creativity that has been invested in the creation of the instrument is being melded with the creativity of the talented musicians who are using it. For all of us who have been involved in the development of the instrument, experiencing the musical expressiveness of its users is a source of continual excitement and delight.