XG XTRA

Vol. I • No. 5 • March, 1996

Presented by the YAMAHA® Corporation of America

Special NRPNs Issue!

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Spotlight On: XG NRPNs

Everything (and possibly more than) you ever wanted to know about the wonderful world of Non-Registered Parameter Numbers

If you're into tweaking sounds, you've probably already experimented with using MIDI System Exclusive ("sysex") messages to alter voice parameters. These allow you to "reach in" and remotely alter any editable parameter, but, more often than not, at the cost of a short but audible silence as the instrument's processor receives and responds to the incoming messages.

XG provides a much better way of doing this—and without any silences or glitches—through its extensive use of special MIDI control change messages called Non-Registered Parameter Numbers (NRPNs, for short). NRPNs—which use cc #99 to carry the MSB and cc #98 to carry the LSB—are potentially one of the most exciting areas of MIDI, because the MIDI spec gives manufacturers the latitude to implement them as they see fit. XG's use of NRPNs provide an excellent insight into true power—the power to produce music files that leap out of the speakers and (figuratively, anyway!) grab the listener by the throat. They're easy to use, have none of the shortcomings of sysex, and can really add that extra edge to your audio creations.

In this article, we'll take a close-up look at NRPNs and give you useful tips and techniques for applying them in your XG music files.

Although part of the original MIDI spec, NRPNs are a fairly new phenomenon in the world of sound cards and PC applications. This is because the GM standard does not require the use of NRPNs, so many GM-compatible instruments simply ignore them. The GS format (as described in Roland's GS Device Design Guidelines) does recommend the use of some NRPNs, but it does not include NRPN reception as a minimum requirement for GS-compatible instruments. Figure 1 on the next page lists the recommended GS NRPNs.

GS NRPNs

MSB	LSB	Description
01h	08h	Vibrato rate
01h	09h	Vibrato depth
01h	0Ah	Vibrato delay
01h	20h	Filter cutoff frequency
01h	21h	Filter resonance
01h	63h	Envelope attack rate
01h	64h	Envelope decay rate
01h	66h	Envelope release rate
18h	rr	Pitch coarse of specified drum sound
1Ah	rr	Level of specified drum sound
1Ch	rr	Panpot of specified drum sound
1Dh	rr	Reverb send level of specified drum sound
1Eh	rr	Chorus send level of specified drum sound

Note: rr = drum sound key number

Figure 1

In contrast, the XG format supports a more extensive list of NRPNs, as listed in figure 2 on the right.

XG NRPNs

MSB	LSB	Description
01h	08h	Vibrato rate
01h	09h	Vibrato depth
01h	0Ah	Vibrato delay
01h	20h	Filter cutoff frequency
01h	21h	Filter resonance
01h	63h	Envelope attack rate
01h	64h	Envelope decay rate
01h	66h	Envelope release rate
14h	rr	Filter cutoff frequency of specified drum sound
15h	rr	Filter resonance of specified drum sound
16h	rr	Envelope attack rate of specified drum sound
17h	rr	Envelope decay rate of specified drum sound
18h	rr	Pitch coarse of specified drum sound
19h	rr	Pitch fine of specified drum sound
1Ah	rr	Level of specified drum sound
1Ch	rr	Panpot of specified drum sound
1Dh	rr	Reverb send level of specified drum sound
1Eh	rr	Chorus send level of specified drum sound
1Fh	rr	Variation send level of specified drum sound

Note: rr = drum sound key number

Figure 2

Note that, in both sets, there are two basic categories: NRPNs that affect melody or SFX sounds (those with an MSB value of 01h), and NRPNs that affect individual drum sounds (those with an LSB value of rr, where rr = the drum sound key number). In the first category, the XG and GS NRPNs are identical (this was done purposely by the designers of XG for reasons of enhanced compatibility). However, XG adds many more drum sound NRPNs in order to give developers the ability to alter the filter cutoff frequency and resonance, envelope attack and decay rates, fine pitch, and Variation effect send level of individual drum sounds within a rhythm kit. Taken together, these NRPNs allow a much greater degree of customization over rhythm kits than is permitted by GS.

NRPN Duplication with Control Change Messages

It's also important to note that the XG format improves on GS by supporting numerous additional control change messages. A number of these messages actually duplicate NRPN functionality, as shown in figure 3 below.

When creating XG music files, you'll generally find it more efficient to alter these parameters with control change messages rather than NRPNs, since fewer data bytes are required. However, in instances where you are porting over a previously created GS file for use with XG instruments, you can simply reuse your existing melody or SFX sound NRPN data (those with an MSB value of 01h), and the XG instrument will respond to them in exactly the same way as a GS instrument.

NRPN Name	Equivalent Control Change
Filter cutoff frequency	Brightness (cc #74)
Filter resonance	Harmonic Content (cc #71)
Envelope attack rate	Attack Time (cc #73)
Envelope release rate	Release Time (cc #72)

Figure 3

Using NPRNs

The reason that NRPNs provide a better method of editing sounds than using sysex is that standard real-time control change messages are used to select and alter parameters. This is a three-step process:

1. First, transmit control change #99 (carrying the NRPN MSB), followed by #98 (carrying the NRPN LSB) with the appropriate data values in order to select the NRPN you wish to access.

2. Next, the Data Entry MSB (cc #6) is used to enter the NRPN value, within a range of 0 to 127 (00h to 7Fh). In both XG and GS instruments, the Data Entry LSB (cc #38) is ignored for this purpose, but, for the sake of good programming practice, should be sent (with any data value), regardless.

3. Finally, send a "Null" message in order to "lock in"the changed data. This is accomplished by transmitting an NRPN MSB (cc #99) value of 127 (7Fh), followed by an NRPN LSB (cc #98) value of 127 (7Fh).

In order to avoid potential data overload, it is recommended that you leave minimum spacings of 5/480 clock ticks between each of the above messages.

Figure 4 on the next page shows how an NRPN might be used to change Vibrato rate in an XG-compatible instrument. As illustrated, simply transmit an NRPN MSB (cc #99), followed by an NRPN LSB (cc #98), and then a Data Entry MSB (cc #6) and LSB (cc #38). Conclude with an NRPN Null message in order to "lock in" the data change:

NRPN Selection

Here's a tip that can save you considerable time when programming NRPN changes in your XG music file: When making numerous NRPN changes to a melody or SFX voice, you don't have to retransmit MSB=01h between changes; simply changing the LSB to the appropriate value is all that is required to select a new NRPN. Similarly, when making numerous NRPN changes to one drum sound within a rhythm kit, you don't have to retransmit LSB = rr (drum instrument key number) between changes; simply changing the MSB to the appropriate value is all that is required to select a new NRPN.

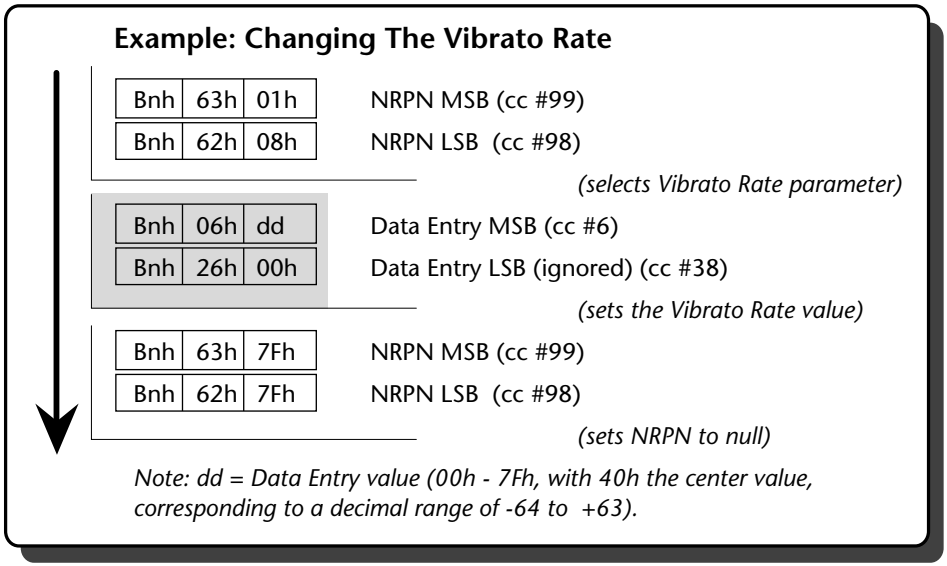


Figure 4

NRPN Data Entry

It's important to understand how NRPN data entry affects the selected parameter. For those parameters that provide a -64 to +63 range, a data entry value of 64 (40h) yields a parameter value of 00. If the voice has been programmed with the selected NRPN having a data value of 00 (as is often the case), then entering in data values greater than 64 results in a positive increase and entering in data values less than 64 results in a negative decrease. The actual degree of positive or negative change is not necessarily linear (as it is when using control change messages); it will instead depend upon the original parameter values used in the factory voicings. As with most parameter changes, it's always best to let your ears be your guide—after transmitting the appropriate NRPN MSB and LSB values, use a hardware or software controller set to transmit cc #6 and move it while playing the voice. When the voice parameter is altered to your aural satisfaction, the final data entry value is the one that should be pasted into your MIDI sequence.

For a parameter such as Drum instrument level (which provides a 00 to 127 range), entering a data entry value of 64 causes the level to jump to 64, despite its programmed value. For a parameter such as Drum instrument panpot (where the voice is often programmed with a value other than 00 [=Center panning]), again, entering in a data entry value of 64 causes the pan to jump to Center, not to its programmed value.

NPRN Null

In practice, you'll find that sending an MSB value of 7Fh alone is sufficient to accomplish the Null, but good programming practice suggests you get in the habit of sending both the MSB and LSB. If no Null message is sent, then any future Data Entry messages received by the instrument will be applied to the most recently selected NRPN. This could potentially have good application in the creation of interactive data where, for example, the user action of moving a joystick could, if translated to MIDI Data Entry messages, affect the accompanying music in real time as well as the onscreen graphics.

Parts vs. Voices

It's important to understand that changes made to melody or SFX sound NRPNs (that is, NRPN MSB = 01h) are applied to the part, not to the voice. In other words, when you call up a new melody or SFX voice within a part (by transmitting a program change message), that new voice will have the same NRPN changes as the original voice. This is the same way that GS treats melody or SFX sound NRPNs, so the feature has been duplicated by the XG format in order to provide compatability and make it possible to reuse GS NRPN data when porting over existing GS music files for XG usage. Handy tip: Create a short subsequence that calls up all XG NRPN parameters and sets them all with a data entry value of 40h; if you then want to reset NRPN data when calling up a new sound, simply paste this subsequence into the appropriate track just before the Bank Select MSB/LSB and program change messages.

In contrast to the way melody or SFX sound NRPNs work, XG NRPN changes applied to individual rhythm kit or SFX kit drum sounds (that is, NRPN LSB = rr, where rr = the drum sound key number) ARE reset when a new rhythm kit is called up via a program change message.

As a side note, control changes made to melody or SFX voices are also applied to the part, and not to the individual voice (that is, new voices "inherit" the previous control changes). Interestingly enough, this is also the case when applying control changes to rhythm or SFX kits; unlike NRPN changes, control changes do not reset when using a program change message to call up a different kit.

Drum Sound NRPNs

There are a number of unusual implementations in certain drum sound NRPNs worth noting. First, be aware that SFX kit voices in current XG instruments respond only to some, but not all drum sound NRPNs. Specifically, they respond to Pitch Coarse, Pitch Fine, Level, Panpot, Reverb Send Level, Chorus Send Level, and Variation Send Level. They do not respond to Filter Cutoff, Filter Resonance, Envelope Attack Rate, or Envelope Decay Rate, though, interestingly enough they do respond to the equivalent control change (#71 - 74) messages.

Second, when using the drum instrument Panpot (MSB = 1Ch), if you set the data value to 0, panning for that sound is random. Applied judiciously to selected sounds, this can be used effectively to spice up an otherwise less-than-enthralling drum track. This feature also enables random panning of an SFX voice (something which is not possible unless an SFX voice is played from within an SFX kit), which in gaming environments can be used to reinforce the user's sense that each time the game is played, he or she is hearing things differently.

Finally, note that the NRPN "Drum Envelope Decay Rate" (MSB = 17h) in fact affects both Decay 1 and Decay 2 times simultaneously. If the drum sound is programmed to ignore MIDI Note Offs, the end result to most people's ear is a seeming change in "release rate," since changing these two decay times at the same time in the same way has the sonic affect of altering the amount of time it takes the drum instrument sound to return to 0 after the Note On message is transmitted (that is, after the key is released). If the drum sound has been programmed to respond to MIDI Note Offs, it will instead utilize a fixed preset Release rate when a Note Off message is received. Individual drum sounds can be set to ignore or respond to MIDI Note Off messages with the use of the sysex string "F0h 43h 1nh 4Ch 3nh rr 09h dd F7h, where

n = device number, rr = drum sound note number and dd = 0 (for ignore Note Off) or 1 (for receive Note Off). See Table 3-9 in the XG Specifications for more information.

Examining NRPN Usage

There are a number of XG music files already in circulation that show how NRPNs can be used effectively to add animation and "life" to a piece of music. The creative use of NRPNs can be similar in many ways to having a skilled recording engineer set up a console during recording or mixing. For example, figure 5 on the right shows a screen dump of some of the data in the beginning of the drum track in the Pink Floyd-ish "Time" XG demo file.

Figure 5

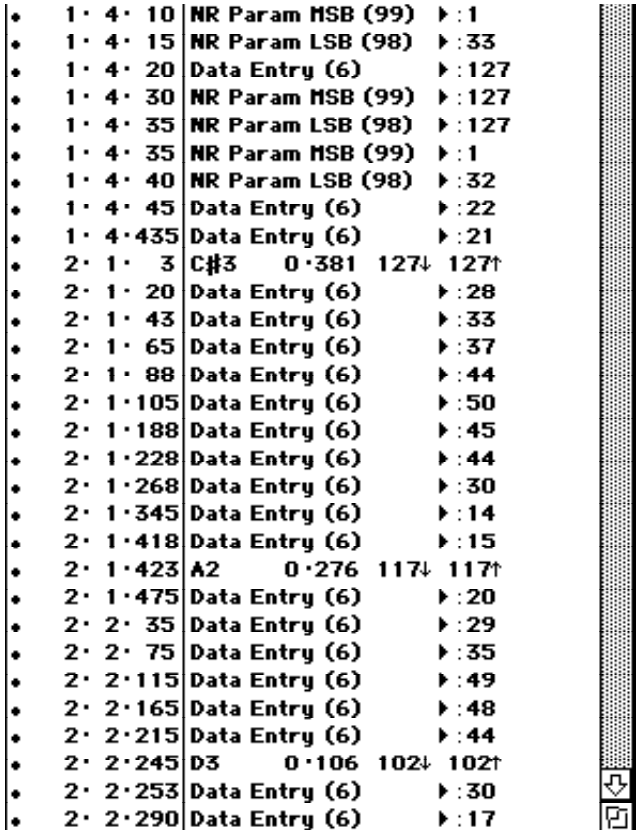
•	1· 3· 0	NR Param MSB (99)	:24
•	1· 3· 5	NR Param LSB (98)	:81
•	1· 3· 10	Data Entry (6)	:24
•	1· 3· 15	NR Param MSB (99)	:23
•	1· 3· 20	NR Param LSB (98)	:81
•	1· 3· 25	Data Entry (6)	:50
•	1· 3· 30	NR Param MSB (99)	:29
•	1· 3· 35	NR Param LSB (98)	:35
•	1· 3· 40	Data Entry (6)	:0
•	1· 3· 45	NR Param MSB (99)	:24
•	1· 3· 50	NR Param LSB (98)	:35
•	1· 3· 55	Data Entry (6)	:58
•	1· 3· 60	NR Param MSB (99)	:20
•	1· 3· 65	NR Param LSB (98)	:35
•	1· 3· 70	Data Entry (6)	:0
•	1· 3· 75	NR Param MSB (99)	:21
•	1· 3· 80	NR Param LSB (98)	:35
•	1· 3· 85	Data Entry (6)	:0
•	1· 3· 90	NR Param MSB (99)	:22
•	1· 3· 95	NR Param LSB (98)	:35
•	1· 3·100	Data Entry (6)	:14
•	1· 3·105	NR Param MSB (99)	:29
•	1· 3·110	NR Param LSB (98)	:33
•	1· 3·115	Data Entry (6)	:0
•	1· 3·120	NR Param MSB (99)	:23
•	1· 3·125	NR Param LSB (98)	:33
•	1· 3·130	Data Entry (6)	:82

As you can see, the first two bytes (at clocks 1/3/0 and 1/3/5—note the use of 5/480 gaps between all bytes, as recommended when programming NRPNs) select the Pitch Coarse parameter for the drum sound assigned to key #81 (A4). The next byte (at clock 1/3/10) is a Data Entry message that lowers the pitch of the selected drum sound to -40 (decimal); remember that, for parameters with a -64 to +63 range (such as Drum Pitch Coarse), a data entry value of 64 (40h) yields a parameter value of 00, so a lesser data entry value will have the effect of negatively decreasing pitch. The following set of three bytes (at clocks 1/3/15, 1/3/20, and 1/3/25) select the Envelope Decay Rate for the same drum sound and lower that sound's Decay 1 and Decay 2 rates (since the Data Entry value is less than 64). Each group of three bytes that follow select a different drum sound NRPN for individual drum sounds, effectively customizing the kit in ways that a recording engineer might do prior to recording or mixing (and even in ways—such as envelope settings—that the engineer could not). Note that there is no Null message used between each of these groups of three—it is not strictly necessary (and, in setup applications such as this, probably even a waste of MIDI bandwidth) to include Nulls after every NRPN data change. However, a Null message is used at the conclusion of the entire drum setup in order to ensure that Data Entry changes received by the XG instrument will not affect the last selected NRPN.

XG NRPNs can also be used for real-time change of musical parameters, similar to having a proficient musician use effects pedals onstage. An excellent example of this application is provided by the "Voodoo" XG demo file, in which multiple tracks drive the sound of a Hendrix-like electric guitar while NRPNs are used to first set filter resonance to maximum and then open and close the filter, simulating the sound of a Wah pedal. Figure 6 on the next page shows a screen dump of a portion of the data in track 2 of this file.

The first two bytes (at clocks 1/4/10 and 1/4/15) are used to select the Filter Resonance NRPN. The next byte (at clock 1/4/20) is a Data Entry message that sets the parameter to maximum (127), followed by two more bytes (at clocks 1/4/30 and 1/4/35) that set the Null message, locking in the data. The next two bytes (at clocks 1/4/35 and 1/4/40) select the Filter Cutoff Frequency NRPN, and all following Data Entry messages (which range over many bars) are used to alter this in real

Figure 6



1· 4· 10	NR Param MSB (99)	▸:1	
1· 4· 15	NR Param LSB (98)	▸:33	
1· 4· 20	Data Entry (6)	▸:127	
1· 4· 30	NR Param MSB (99)	▸:127	
1· 4· 35	NR Param LSB (98)	▸:127	
1· 4· 35	NR Param MSB (99)	▸:1	
1· 4· 40	NR Param LSB (98)	▸:32	
1· 4· 45	Data Entry (6)	▸:22	
1· 4·435	Data Entry (6)	▸:21	
2· 1· 3	C#3	0·381	127↓ 127↑
2· 1· 20	Data Entry (6)	▸:28	
2· 1· 43	Data Entry (6)	▸:33	
2· 1· 65	Data Entry (6)	▸:37	
2· 1· 88	Data Entry (6)	▸:44	
2· 1·105	Data Entry (6)	▸:50	
2· 1·188	Data Entry (6)	▸:45	
2· 1·228	Data Entry (6)	▸:44	
2· 1·268	Data Entry (6)	▸:30	
2· 1·345	Data Entry (6)	▸:14	
2· 1·418	Data Entry (6)	▸:15	
2· 1·423	A2	0·276	117↓ 117↑
2· 1·475	Data Entry (6)	▸:20	
2· 2· 35	Data Entry (6)	▸:29	
2· 2· 75	Data Entry (6)	▸:35	
2· 2·115	Data Entry (6)	▸:49	
2· 2·165	Data Entry (6)	▸:48	
2· 2·215	Data Entry (6)	▸:44	
2· 2·245	D3	0·106	102↓ 102↑
2· 2·253	Data Entry (6)	▸:30	
2· 2·290	Data Entry (6)	▸:17	

time (these messages were originally played in by the creator of the file with the use of a MIDI footpedal). Similar manipulations of guitar sounds can be found in tracks 4 and 8 of this file.

Do yourself a favor and dig into the world of NRPNs the next time you're creating an XG music file—the potential rewards are well worth the relatively small amount of extra programming involved!

Coming in the next issue of XG Xtra!

The XG Disklavier - and more XG surprises!!

YAMAHA WAVEFORCE DB50XG SOUND DAUGHTERBOARD WINS INNOVATIONS '96 AWARD AT CONSUMER ELECTRONICS SHOW

The recently released Yamaha WaveForce DB50XG sound daughterboard has been recognized as "Outstanding Hardware for Multimedia" by the judging panel of the Innovations '96 Design and Engineering Awards, held at the Winter Consumer Electronics Show (CES), January 5-8, 1996. "Innovations" is endorsed by the Industrial Designers Society of America, and is the consumer electronics industry's foremost awards program for design and engineering.

Nominees are evaluated by a judging panel composed of consumer electronics industry trade press, engineers and industrial designers. Criteria used for evaluation include innovation, aesthetics, benefits to user and how the product improves the quality of life.

"We're honored that the WaveForce DB50XG has been given such recognition," said Henio Arcangeli, general manager, Consumer Products Division, Yamaha Corporation of America. "This designation, coupled with the Innovations '96 award for the PSR420 portable keyboard and the Innovations '95 award for the YST-SS1010 multimedia speaker system, reaffirms the Yamaha commitment to provide the latest in technology to consumers worldwide."

The WaveForce DB50XG, the first daughterboard designed to take advantage of the XG format, simply snaps onto any sound card with a WaveBlaster-compatible connector. While maintaining full compatibility with General MIDI music and game applications, the DB50XG goes far beyond the tonal and musical capabilities of existing computer sound upgrade devices. It offers 4 MB of ROM containing 676 wavetable voices and 21 drum kits, along with extensive DSP effect functions and 32-note polyphony—all at a suggested retail price of $249.

Voyetra Adds XG to Digital Orchestrator Plus

Voyetra Technologies, the Yonkers, New York-based company known worldwide for its multimedia products, has added support for XG in its new integrated Windows-based MIDI/digital audio sequencer—Digital Orchestrator Plus™. The software is currently bundled with the Yamaha WaveForce DB50XG daughterboard and WaveForce SW60XG sound upgrade card.

The result of combining XG with Digital Orchestrator Plus, which incorporates innovative digital audio editing and effects features, is sheer composing power. "XG allows composers the ability to duplicate performance nuances from one synthesizer to another," explains John Pavlik, a Voyetra senior software engineer. "You also have many more options with voices, effects and variations, all of which translate into greater control. The DB50XG and MU80 sound terrific with any GM or XG file."

For additional information about Digital Orchestrator Plus, contact Voyetra Technologies at 1-800-233-9377.

XG publications available from Yamaha

- An Introduction to XG
- XG Guidebook
- XG Music Production Recommendations
- XG Specifications
- XG Xtra #1
- XG Xtra #2
- XG Xtra #3
- XG Xtra #4

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