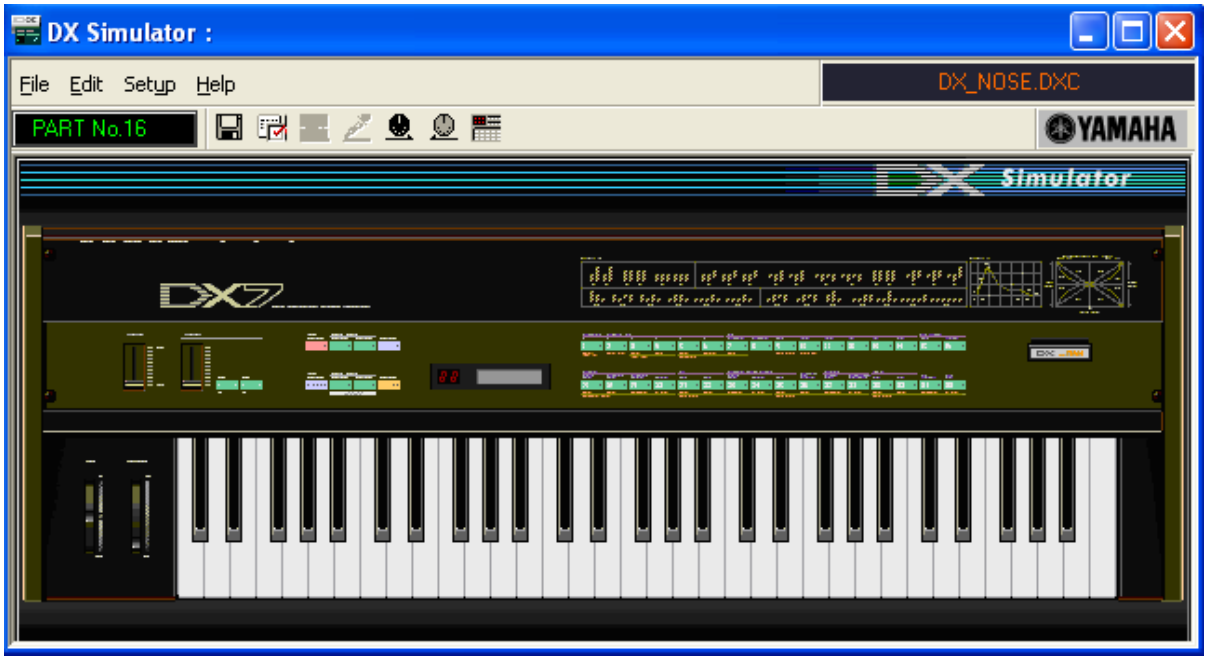
Motif ES & PLG150-DX

Power User Plus Pack:
DX_Nosebleed

64 DX Board Voices and 64 Motif ES Plug-in Voices using that data

PluginAllBulk file (NOSEBLEE.w2b): Load this file *through* the FILE Type that matches your PLG150-DX board. That is, PluginAllBulk1 if your PLG150-DX is in slot 1, PluginAllBulk2 if your PLG150-DX is in slot 2 and so on. These are PLG150-DX BOARD Voices for Board bank **035/000**
DX SIMULATOR file (DX_NOSE.dxc): Open with the DX Simulator program. Within the Simulator open "DX EDIT LIST" view. Provided for those curious to see how the Voices were made.
VOICE EDITOR for MOTIF ES file (Nose_s1.w2e); (Nose_s2.w2e); (Nose_s3.w2e): Open the file for your Slot (S1, S2 or S3) with the Voice Editor for Motif ES or load it directly to the Motif ES via the VOICE EDITOR File type. Open this file in the Editor to see how the Motif ES parameters were applied to the Board Voices to make the PLG User Voices.

If you are new to the board see the PLG150-DX GETTING STARTED GUIDE downloadable from the Motifator.com website: http://files.keyfax.com/download/PLG150DX_Motif.pdf

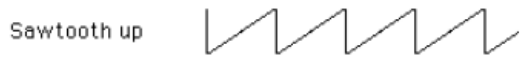


PLG150-DX Custom User Voice data

The DX synth engine is based on FM or Frequency Modulation (yes, the same FM that is used for radio – albeit that FM synthesis takes place mostly in the audible frequency band – below 20kHz). To gain an understanding of FM synthesis you have to appreciate waveforms and how waveform shapes are perceived by the human ear and brain. Analog synthesizers began by electronically creating 'geometric' waveforms, i.e., sine waves, square waves, pulse waves, sawtooth waves etc. These mathematically 'perfect' wave shapes do not, by themselves, sound like musical instruments that we know. But with the help of filters (to remove some harmonics) and envelopes to shape the sound, you could program some crude musical instrument emulations. Describing sound is always difficult it is always best to hear the examples. But if you know what a sine wave looks like (and you could not have gotten through school in America without studying sine waves in math class) you know that it is a smooth wavy line that starts at 0, and at 90 degrees reaches maximum returns to 0 at 180 degrees, then reaches the lowest point a 270 degrees before returning to 0 at 360 degrees and repeating. Getting that math class headache yet?

Too bad they didn't relate math to sound – it might have made class much more interesting and fun (at least for the future musicians, most of whom were sound asleep). Well, roughly speaking a **sine** wave is devoid of harmonics…er, harmonics are like the fingerprint of the sound. Your ear and brain use the harmonics of a sound to identify it. Harmonics explain how you can tell one person's speaking voice from another, how you can tell a trumpet playing A440 from a trombone playing A440 – the harmonic content is different. The instrument sounds with the least amount of harmonic content sound "flute-like" to our ears (a whistle has very few harmonics), while a **square** wave – odd harmonics only – sounds very much like a clarinet's tone.

Pulse waves, the narrower they are the more nasal they sound – oboe sounds are described as nasal and so are clavinet sounds. **Sawtooth** wave shapes give us a variety of sounds, both brass and strings.

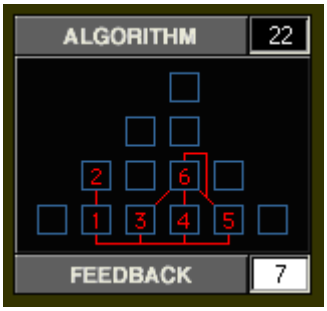


Selecting a waveform on an analog synth would get you in the ballpark. And from the rough descriptions I have given you here you could build instrument emulations. But FM synthesis, as introduced by the DX7, back in 1983 provided you with these things called "operators" that only output sine waves only. What to do? Many people stopped right there and never explored the vast sonic capability that lies within FM synthesis. To make a long complex story short, the operators were themselves complete little engines that could influence the harmonic content of each other. The output of one operator could be applied to the input of another to create a more complex wave shape. Like FM technology in radio broadcast (where it is in the Megahertz range - far beyond audible waveforms) there are Modulator and Carrier. In the DX the frequency modulation takes place at much lower frequencies (the range of human hearing – so a crystal set is not necessary to interpret the waveforms). The germ idea was born when Dr. John Chowning, CCRMA at Stanford University, was observing a violinist add vibrato to a string. The bow (horsehair) is dragged across the string (cat gut) causing the string to vibrate at a known frequency. At the same time the musician is applying a Low Frequency Oscillator (the left hand) varying the length of the vibrating string (lengthening and shorting the vibrating area alters the pitch) – what is called applying vibrato to the string. This LFO is applied at a rate of a few oscillations per second, while the bow is causing the string to oscillate at a much higher rate (perhaps 440 cycles per second = A440). Well, Dr. Chowning's idea had to do with "what if"…what if you sped the vibrato, the modulating frequency, up into the audible frequency range 20-20,000 cycles per second, what would that do to the overall response of the instrument? What influence would that have on the tone/timbre of the sound? That is how FM synthesis was born.[1] The answer was a whole new method of creating timbres was born.

To get into learning about FM synthesis it is a good method to start out recreating the geometric wave shapes we spoke of: sine, square, pulse, sawtooth. Then you can build on these familiar sounds and branch out. In FM the 'Carrier' is the signal that carries the sound you hear – it is analogous to the bowed violin string – its oscillation is audible. The 'Modulator' is the signal that is applied to the carrier to modify the sound – it is analogous to the vibrato applied by the musician's left hand. Although you hear its effect on the sound, you do not hear the modulator, directly. You hear its influence on the

[1] By the way he couldn't find a musician capable of this so he decided to do it electronically.

carrier. Therefore when you see a diagram of an FM algorithm, the carriers are always on the bottom row and the modulators are stacked above the carrier. Each carrier is audible directly, while each modulator influences the timbre of the operator beneath it. Stacks can become quite complex, but only those operators on the bottom of the algorithm chart are audible directly. You can stack modulator on top of modulator and get very complex tones – as you will hear from this set. Operators can even modulate themselves (called a feedback loop) and since output can be controlled by velocity and other controllers you have a degree of control over harmonic content that samples can't even dream about. So while samples offer a very accurate wave shape to start, your ability to manipulate on an organic level is nil. FM wave shapes are not as emulative of instruments to start but the behavior and degree of control over harmonic content is unprecedented.



In the algorithm above operators 1, 3, 4 and 5 are Carriers (meaning you can hear their output) while operators 2 and 6 are Modulators (means their output is only heard by its affect on the Carriers to which they are connected. Without the Modulators each Carrier would sound only a 'sine wave'. Operator 6, above, is the feedback operator (where the signal can get very complex as it is fed back on itself – generating complex sidebands).

When you have a simple 2-operator FM stack, (like operator's 2 and 1 above) Modulator/Carrier, and the coarse tuning ratio of each is **1.00** and the output of the modulator is about at ¾ output (about 75), you will generate a fairly perfect sawtooth waveform, 1:1. If you increase the ratio of the modulator frequency so that it is 2:1 tuning ratio to the carrier you will generate a square wave. Any whole integer ratio 3:1, 4:1, 5:1 or greater will generate an ever-narrowing pulse wave. If the ratio is a non-whole integer relationship, you will generate what would be described as a 'bell tone'. That is the fundamentals of FM – of course, it can get very much more complex (FM is a ***real*** form a synthesis that can be studied at the college level), with nested feedback loops and interaction between operators. Filters were unnecessary in the original FM synthesizer since you were constructing the harmonic content more directly. To really get into FM you need to understand side-band frequencies and Bessel functions but most FM synthesis can be carried out on an intuitive basis once you understand the fundamentals.

If none of this interests you, it is okay. You can just enjoy the sounds. But without much exaggeration I can say that most of what is possible with DX-style FM has yet to be explored. And there are sounds that nothing but DX-style FM can do. Notice I didn't say it could do everything – but there are sounds that nothing else on the planet can do. It is estimated that there are some 10,000 useable FM sounds out there floating around. Some people insist they can "sample" it – you can't. Well, of course, you can, but what you miss is the interaction of the modulator and carrier within the sound. Each operator has its own *envelope*, its own response to velocity, etc. – this makes what happens within the FM voice a 'living' thing – it is more organic than can be captured in a simple sample of a waveform. Envelopes and output indexes can be influenced on a continuous basis, which in turn changes the timbre of the sound as you increase playing intensity – this is what cannot be sampled. The tremendous success of the DX7 'back-in-the-day' was not based on anything more than musicians thought that the sound was 'cool'. Most DX7 owners never programmed an FM Voice – the least pressed button in the world was the EDIT button on a DX7. It was way too complicated – but a good lesson was learned here – complexity comes in a paltry second to SOUND when musician's make up their mind they like something. (Well, duh, most sax players don't have a clue about how a saxophone makes sound and would be hard pressed to discuss Bernoulli's principle and the Graham Non-linear curve, and just what is hysteresis and the fricative value and what does it have to do with saxophone tone?) However, if you want to get involved with programming and tweaking FM – you will find your results their own reward. There is an excellent tutorial on-line at the Yamaha Digital Music World site – with a number of lessons taking you through the world of sine waves and operators – and the first 'synthesizers'.

Visit the **FM Tone Generator Seminar** at:
http://www.digitalmusicworld.com/html/hardware/SynthsTutorial.asp

The VOICES
Many of the sounds here are the full 16-note poly and some of the sounds are reduced to just 4-notes of polyphony, and some are mono. Depending on how you want to use the timbre you can change this. Listed below are the names of the Voices and the 4-note poly voices are identified. These take advantage of the UNISON POLY function (this parameter double-folds the sound for a thicker timbre). The UNISON POLY parameter was added to the FM structure when the DX7IIFD and the TX802 hit the market in late 1986. These parameters were not available on the original 1983 first generation of programmable 6-operator FM synths: DX7, DX5, DX1, TX7, TX816. If polyphony is an issue for you, navigate to the DX Simulator's "EDIT LIST" view - there you will find the UNISON Switch. Set this to OFF and you will have 16 note polyphony on the sound. For those of you wanting more polyphony for the FM sounds, you can add a second or third PLG150-DX board to your host and activate the POLY EXPAND function found in the Motif ES's UTILITY mode/ F6 PLUG/ SF1 Status. The UNISON POLY mode is about timbre – many of the sounds are musical effects and polyphony is not such a big issue.

Because of how musical sounds and 'stuff'[2] are generated in the DX engine, the programmers would use a 2-operator stack (minimum) to generate a complex tone. This is why an item like the TX-Rack became so popular at over $4,000 – it could be expanded to house eight DX7 modules called TF1s – that's eight 6-operator engines. The TX816 original Voices sets, (and Yamaha only did one or two *official* Voice sets), had great detail. There was a Rhodes sound that had 24 different sound components, including the knock of the hammer, the tine, the tone bar, the 'fling' of the felt, etc. It was a real shame – but most recording studios owned TX816s and no one ever did any programming beyond stacking a sound eight times (which really only made it louder). Then they would compound their lunacy by detuning each module up or down a tuning increment – this 'bad' programming accounted for most of the DX Rhodes sounds you hear on records from the '80's – poorly utilized and was mainly responsible for the misconception that you had to layer sounds because FM was thin. Not necessarily so! What was done in the *original* TX816 programs was the additional TF1 modules were used for details (knocks, and noises…i.e., the "stuff"). Oh well. So many were sold that it was inevitable that it would be misunderstood.

If you add a second or third DX board and you turn the POLY EXPAND parameter to ON, the boards will combine and follow the board Voice selected by the lowest numbered slot. For example you place a DX board in slots 1 and 2, you will now have 32 notes of polyphony and you will use the PLG1 Voice mode button to select Voices. POLY EXPAND is just what it says – it allows you to expand the polyphony. If you want to layer sounds to get more complexity you would leave each 16-note engine as a separate synth and program them separately.

These sounds were derived from the Yamaha LoopFactory **DX200** and were reprogrammed for use in the Motif ES.

The LOAD:
As is the way with the Yamaha synth engine plug-in boards you have **two** files. One is the custom PLG150-DX Board Voices that will load into the board's own user RAM bank (035/000), and the second is the Motif ES level Plugin Voices that I created to show off these sounds. Remember the DX7 had no effects processor of its own (they didn't exist back in that day, circa 1983-88), so the Motif ES level PLUG-IN VOICES use the custom DX board data as the waveform but frame them with the powerful functions and effect processing of the Motif ES. Truly the best of both worlds – I have provided both the "PluginAllBulk" for the three possible slots (.w2b/.w3b) – load through the type for your board's slot; an additional file that can be opened in the **DX Simulator** for those interested in exploring deeper into FM programming (.dxc). This contains the same data but allows you to see the edit parameters – provided strictly for those that want to learn more about FM synthesis. Plus, of course, the Motif ES level Voice data in a VOICE EDITOR For MOTIF ES file (.w7e/.w8e) provided.

- Copy the .w2b/w3b bulk files to a SmartMedia card and if you are not running the VOICE EDTIOR, copy the .w7e/w8e files to the card as well;

Parameters you should know about:
Note Shift:
If you wish to note shift any of the PLUG-IN Voices, you will find the NOTE SHIFT parameter for a PLG150 sound by:
Press EDIT
Press Track 1 to select Element Edit
Press F1 OSC
Press SF5 OTHER

[2] "Stuff" is a word that was adopted by the early programmers of FM to describe a noise or artifact that accompanies the creation of a musical tone. It's the acoustic noise inside a Clavinet as the hammer releases, it's the quill falling back on a harpsichord, it's the finger noise on the acoustic guitar string, etc.

Overall Velocity Curve:
Because of the dynamic response of FM to velocity and the potential for overly bright sounds on extreme velocity, you may wish to tailor the velocity curve of the PLG150-DX to mimic the original DX7. To do this navigate to the PLUG-IN board parameters:
Press UTILITY
Press F6 PLUG
Press the SF "NATIVE" button that corresponds to the slot you have the PLG150-DX installed. Set the VelCurve to **DX7**.

Bank Select: From Voice mode press the PLG button that contains your PLG150-DX board, then use the **F2 Bank** option to select among the banks. If you have loaded the data properly you should see data in the Board bank (035/000) and in the PLG_USR bank. The first sound in both cases will be "Cp: Nosebleed". The 035/000 Board bank will be without the host's effects applied. The Voice in the PLG_USR bank will have effects.

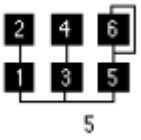
Poly/Mono Mode: You can change any of the sounds to mono mode either at the Element level (in the DX Simulator) or from the Plug-in Voice level. To do this at the Plug-in Voice level:
-Press EDIT
-Press COMMON to select overall parameters
-Press F1 General
-Press SF2 PlyMode (polyphony mode)

BOARD VOICES
Select Bank 035/000 to hear the raw PLG150-DX Board Voice Elements (without effects).

PLUG-IN VOICES
Select the PLG**x**USR bank to hear the completed Plugin Voices (where 'x' is the slot of your PLG150-DX) with effects.

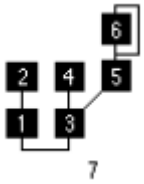
Nosebleed Voice Bank

1 Nosebleed: Algorithm 5 –



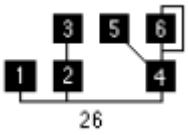
A favorite for sounds with complex attacks and very different sustains. This algorithm more than any other was a favorite for the classic electric piano sound of the original DX7. Each two-operator stack was responsible for a different part of the sound. Operators 1, 3 and 5 are sounding (carriers) and 2, 4 and 6 are modifiers (modulators). Here the complex tuning of a bell tone is emulated. This hard mallet sound is very characteristic of the FM – as one early reviewer of the DX7 said… it is very easy to make bell sounds with FM…well yes, any relationship other than whole integer ratios between operators will render a bell tone (that is physics). Note the tuning of the operators: 0.825, 4.11, 2.80, 4.00, 2.00 and 3.48. On the Motif ES parameter side, the INSERTION EFFECTS are the AUTO PAN and AMBIENCE. (Hint: to view the Motif ES level programming, press the INFORMATION button from the main Voice screen. Bypass the INSERTION EFFECT to hear the basic FM tone.

2 KlingKlang: Algorithm 7 –



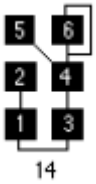
The name says it all here. This is another big bell tone with a fixed frequency component at operator 4, which contributes the knock or thump of the klanger at 371.5Hz.

3 Swimming: Algorithm 26 –



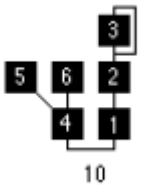
Musical Effect: Operators 1, 2 and 3 make up the cool bass tone, while 4, 5 and 6 are the piercing effect. This is one of those sounds you can use as a bass (if played with a good amount of velocity) or a sound effect (when played lightly).

4 Ethnectric: Algorithm 14



Two stacks 1-2, and the complex 3, 4, 5, 6 with Op4 modulated by both 5 and 6. This has a distinctive wooden tone with mallet. Bypass the Motif ES Effects to hear just the FM sound. The arpeggio and the Tempo Delays are added at the Motif ES level.

5 Percussive: Algorithm 10



…This sound is very similar to the Ethnectric sound but is much more 'synthy' sounding. They both are good sound sounds. The effects are again added at the Motif ES level (host).

Please explore the rest of these sounds and how they are made. Experiment…FM is a very powerful form of synthesis that has really no limits.

Here is a list of the FM Voices. They are 16-note poly (if you have a single PLG150-DX) unless otherwise noted. The UNISON POLY and UNSION MONO Voices use the DX7IIFD engines ability to fold over on itself for thicker richer sounds.

1. Cp: Nosebleed Unison Poly 4
2. Cp: KlingKlang Unison Poly 4
3. Me: Swimming
4. Co: Ethnectric
5. Co; Percussive
6. Se: Skirmish
7. Se: Still DX Unison Poly 4
8. Me: Stomper Unison Poly 4
9. Se: Wreath AT Unison Poly 4
10. Ba: Subculture
11. Sc: Ni-Chi-B Unison Mono
12. Sc: KAGERO
13. Se: Warp
14. Se: Energie Unison Poly 4
15. Ld: Clokker Unison Poly 4
16. Se: GB Trance Unison Mono
17. Kb: Hypnotic
18. Sc: RaggaGab Unison Poly 4
19. Ld: Nose Dive
20. Se: Sink Unison Poly 4
21. Cp: Logi Drum
22. Me: Bombay Mono
23. Cp; Oaz Unison Poly 4
24. Kb: BrasilDr
25. Cp: Asiara
26. Sc: Acid Pulse
27. Sc: Elec Pulse
28. Cp: Dredzs Unison Mono
29. Me: Elec Rez Mono
30. Me: Night Lite
31. Ba: Orbo Fuzz Unison Poly 4
32. Se: Big Up Unison Poly 4
33. Ld: Drenched Mono
34. Se: TunaMooger Mono
35. Se: Digi Touch Mono
36. Me: Floaty Unison Poly 4
37. Sc: Cyanine
38. Cp: PingPong
39. Ba: Mini Jim
40. Ba: Distcore
41. Ld: Hardcore
42. Me: HouseParty
43. Sc: Ibiza
44. Me: Sand
45. Me: ChimeNoise
46. Kb: Deep Beat
47. Se: Full House
48. Kb: E-Salsa
49. Se: ScreamRibn
50. Se: FJA
51. Se: Minimal At
52. Sc: Voodoo Key
53. Ba: Oskylaytor
54. Se: Stupid
55. Ba: Solo Bass
56. Ld: Saw FB
57. Ld: Badass
58. Ld: Quid
59. Ld: Reeper
60. Ld: Scratches
61. Ld: Fuzz Line
62. Sc: House Dog
63. Pd: FreeGroove
64. Ld: Life Line Mono

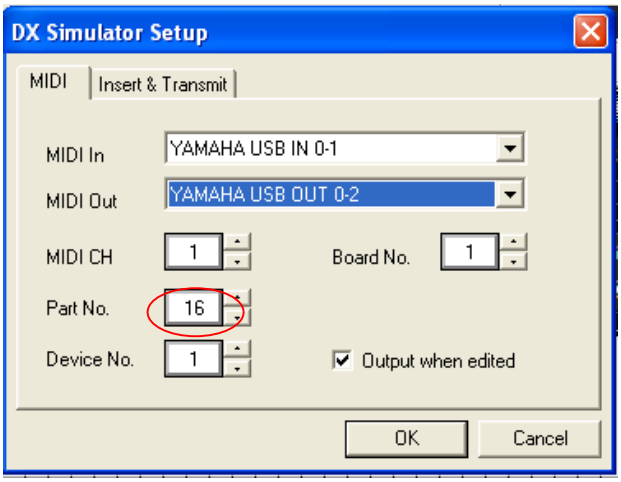
Using the PLG150-DX while in Multi Mode

The DX Simulator is the Voice Editor for the PLG150-DX. An important thing to realize is that the DX Board is designed to reside in a wide variety of Yamaha products (Motif, Motif Rack, S90, S80, CS6x, CS6R, MU-series, etc) – so although the "VOICE EDITOR for MOTIF ES" can edit PLG sounds at the Motif ES Voice level, the DX Simulator actually deals with Board Voice itself. The "VOICE EDITOR for MOTIF ES" is a Motif ES editor – it can edit a Motif ES Voice whether that Voice is pointing to a sampled waveform or an FM waveform. It applies Motif ES parameters to the waveform on the oscillator/wave screen.

- Press EDIT
- Press Track 1 to select Element edit
- Press F1 OSC
- Press SF1 WAVE

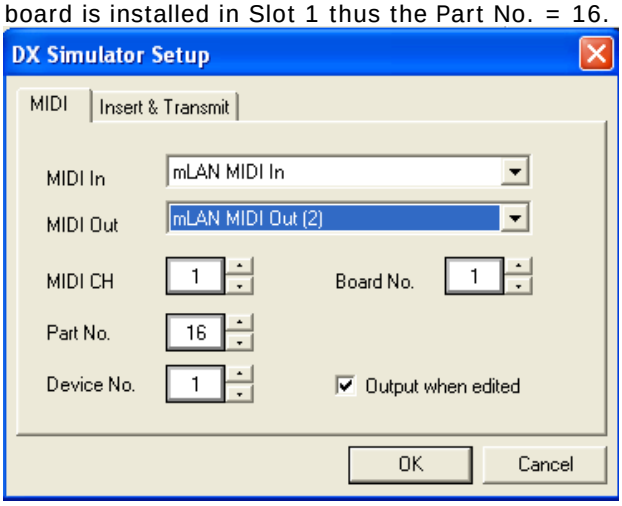
It is on that screen where the Motif ES Voice points to either a sampled wave (preset or user) or to a PLG150 Board waveform (preset or user). The DX SIMULATOR allows you to edit the User bank of the PLG150-DX Board. The DX Board has many preset banks and one User bank (035/000). The DX SIMULATOR is a specific editor for the 035/000 bank. And like most Voice editors it works while the host product is in Voice mode. But let's say you want to tweak a PLG150-DX sound while the Motif ES is in a multi-timbral setup. This is possible if you tell your computer where to find it. Here is what you need to know:

- If you are working with the PLG150-DX while in Voice mode, your MIDI interface will address the board as a part of the host product. So you would address it on the first port, **PORT 1**. It will not matter the PORT assignment of the PLG150 Boards – as long as you are in VOICE mode all Motif ES Voices are addressed on the internal Motif ES Port assignment, which is fixed at PORT 1.
- When addressing the Motif ES from an external MIDI sequencer (MIXING mode), it is common practice to set the PLG150 Boards on a separate Port from the host product. The Motif ES is fixed at Port 1 and often Port 2 is used to communicate with the PLG150 Boards (this allows them to be addressed on separate MIDI channels from the internal Parts thus breaking the 16 MIDI channel limit). This will be true whether you are using **USB-MIDI** or **mLAN-MIDI** as the interface for your sequencer.
- In order to address the Plugin Part while the Motif ES is in Song / Pattern MIXING mode, engineering has come up with a method to address the boards by slot and channel assignment. In the DX Simulator Setup you can select a parameter called the "Part No." (Part number). By setting the Part No. parameter and MIDI channel you will be able to address the PLG150-DX while the unit is in a multi-timbral setup – allowing you to tweak the sound in context of the music it will be used. The Part Number assignment is accomplished as follows:
    - Slot 1 = Part 16
    - Slot 2 = Part 15
    - Slot 3 = Part 14

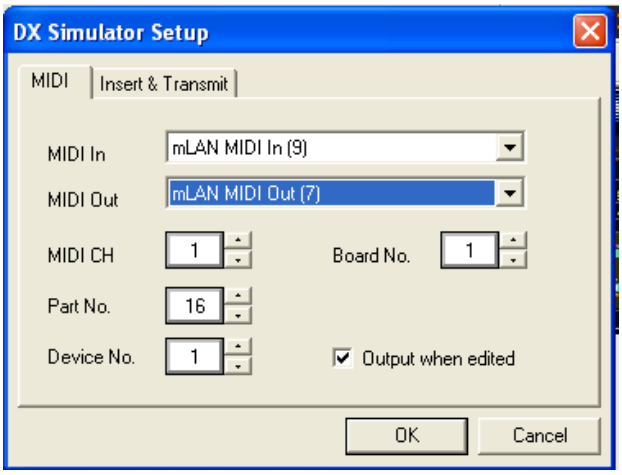


USB
Typical setting for when the using the Motif ES as the host and USB as the MIDI interface… MIDI IN is set to "Yamaha USB IN 0-1" – MIDI OUT is set to "Yamaha USB OUT 0-2" (the PLG150 boards are set to be communicated to via PORT 2 in the Motif ES. The PLG150-DX in this example is in Slot 1 (Part No. = 16), and is assigned MIDI channel 1.

MLAN16E: Below is a typical setup for a Motif ES containing an mLAN16E as the MIDI interface and the PLG150 boards on Port 2; the PLG150-DX board is installed in Slot 1 thus the Part No. = 16.



mLAN SYSTEM: Below is a typical setup for a large mLAN System where the 01X and Motif ES are both configured as MIDI interfaces (the 01X reserves the first 8 Ports into the computer and the Motif ES takes over at IN Port 9; the computer sends OUT to the 01X on five MIDI Ports (1-5) and Port 6 goes to the internal Motif ES/ while the second Motif ES Port, Port 7 goes to the PLG150 boards… Again the PLG150-DX is in Slot 1 (Part No. = 16), and the MIDI channel is channel 1.



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