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S90 and the Modular Synthesis Plug-in
System

PLG150-DX
Frequency Modulation Synthesis
Plug-in Board

A Getting Started Guide

PLG150-DX Advanced DX/TX Board

The **PLG150-DX** is a single part board. It has 912 preset voices and RAM for 64 user board voices. These 64 user board voices are created and/or loaded in with the computer software (called DX Simulator) and exist in a volatile RAM bank on the board. Think of the PLG150-DX as a separate synthesizer - in this case a DX7. In fact, Voice data can be loaded from any Yamaha 6-operator DX/TX series product. The DX is the same FM or Frequency Modulation synthesis found in the classic synthesizer. When you place the PLG150-DX board in the mothership you can address it via 'offsets' from the front panel and/or in detail with the Voice Editor software. You can load in custom Voice sets, you can make variations from the preset data and with the software, you can create your own sounds from scratch. The PLG150-DX has its own 16-notes of polyphony.

An important part of the concept to the plug-in boards is that although the PLG150-DX is an FM synth (Frequency Modulation), it does not have wheels, or knobs, or a screen, or keys, or effects...all of that must come from the host product, the S90. The DX board has some 912 preset sounds on it, but until you integrate them with the S90 parameters they are what we call a BOARD Voice. Once you have routed them through the S90 effects and assigned S90 controllers etc., they become what we call a PLUG-IN Voice. When the PLG150-DX is properly installed in a S90 and you power up, the S90 does a system check and scans the PLG board slots. When it finds a PLG150-DX board it will automatically load 64 finished PLUG-IN Voices (PLGPRE1). With each of the PLG150 series boards you will also find 64 blank PLUG-IN Voice locations for you to store your tweaks or customized versions of the sounds (PLGUSR).

You will find that you can use two editors when you have both a PLG150-DX and a S90. The **VOICE EDITOR for S90** will let you program USER Bank Voices for the S90. That is, AWM2 Normal User Voice, Drum User Kits and PLG150 Series User Plug-in Voices. Then why do you need the DX SIMULATOR program? Because it will let you edit the FM Voice Element itself. The S90 editor will let you integrate a finished DX Element with the S90. **The DX SIMULATOR** will let program the FM engine itself. Many parameters affecting the DX board are available from the S90 front panel and via the Voice Editor for S90, however, the fundamental and complete set of edit parameters are available **only** via the DX

SIMULATOR software. It would be impossible to include in the S90 architecture *all* of the parameters for each of the possible plug-in boards available. Each of the **PLG150 Series** boards is an entirely different technology: The DX is a Frequency Modulation (FM) synth equivalent to a DX7. AN is a physical model of an analog synthesizer. The VL is a physical model of an acoustic blown pipe/bowed string instrument and the DR, PC and PF are sample playback (like the S90). The parameters for these technologies are each whole synthesizers by themselves. You can create using FM synthesis building your own DX Elements. If you are just a tweaker - one who likes to fiddle with existing sounds - each board will give you plenty of data to work with and plenty of parameters to play with, as well. If, however, you do enjoy making sounds from scratch, you will love the way the S90-PLG150-computer system works. It will take some getting used to but is very powerful. Ultimately, you will be able to make custom sounds via the computer editor's graphic interface and save the data to SmartMedia card or a SCSI HD drive and restore them when you are at the gig (the computer remains safe at home where it belongs). You will not be editing from scratch while on stage. The idea is you put the voice in the S90 in a form that allows you to *perform* them via the available controllers.

The PLG150-DX will add its own 16-notes of polyphony to the modular system.

Summary: The PLG150-DX is part of a 'modular' system. It is analogous to adding a hardware synthesizer to your host product, the S90. The S90 will address certain performance-oriented parameters on the board via offset values. The Voices on the board are programmed via a computer Voice Editors (DX Simulator and the Voice Editor for S90) which can send Voice setups to the S90. The idea is to do "in depth" editing of the voice in the computer editor, then integrate with the controllers and effects of the S90 (Voice Editor for S90). The PLG150-DX board is like adding a separate component to your host product. As you will see there are some sounds that come directly from the board (Board Voices) and others that **you** will make that integrate the Board Voices with the host products routing, controllers and effects (called Plug-In Voices). Think of the Board Voices as the raw data you build the Plug-In Voices out of. When you install a PLG150-DX into the S90 you will be able to create 64 PLUG-IN USER (PLGUSR)

Voices using any of the board voice data **plus** you are given 64 all ready made Preset Plug-In (PLGPRE1) Voices that have been made using the S90 routing and effects. In a multi-timbral setup (MIXING) the S90 will have 16 AWM2 (Sample playback) sounds on Parts 1-16. You can replace or layer/split a PLG150 voice with an AWM2 Voice in one of the 16 Parts. Or if you are using the USB(MIDI) connection and an external sequencer you can address the S90 Internal sounds on one Port and the PLG150 boards on another Port. Please read this guide carefully – as the PLG150 boards are quite unique. Even if you have owned other manufacturer's products that take plug in boards, the Yamaha Modular Synthesis Plug-in System is a unique arrangement – these are not just new sounds, they are different technologies!

Checking Installation

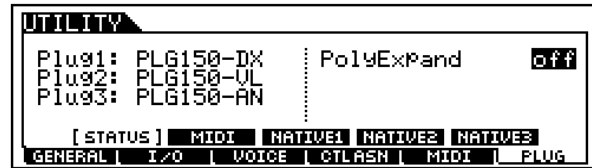
Check to make sure your board or boards are properly installed. The Orange connector is slot 1, the yellow connector is slot 2 and the Green connector is slot 3. A PLG150-series board can occupy any slot.¹ The boards should always be installed with the S90 off – the boot up routine will check the plug in slots and automatically load 64 Preset sounds for the detected board. (The VL board is the exception. It has actually 3 banks of 64 – one for Aftertouch, one for velocity play and one for breath control). Here's how to verify your board:

On the S90: Press [UTILITY]/[F6] PLG/ SF1 Status to check the status screen:

The "Expand" parameter will be active only when you have 2 or more PLG150 series boards of the **same** type installed and polyphony expansion is possible. A second PLG150-DX can give you a maximum of 32 notes of FM polyphony in Expand poly mode. A third PLG150 can give you 48 notes total. Because the System is **modular**, this polyphony **does not** take away from the 64-note polyphony of the mothership host (S30 / S80 / CS6x / CS6R / S906-7-8)- Nor does it contribute to a pool of notes – they are completely separate. You, of course, can use multiple boards as individuals, thus increasing how many Parts you for which you will have sounds available.

If you are getting any kind of crackling noise after installation please perform the HARD RESET: HOLD DOWN [REC]+[REMOTE] on power up. Select the [STORE] options to restore FACTORY SET.

¹ **HINT:** Find a consistent slot layout for your boards and stick with it. When making bulk files that reload your custom sounds, it matters which slot the board is found in.



Banks of sounds

Sixty-four Plug-in Voices are pre-loaded into the S90 when the PLG150-DX board is detected on power up – you can select between 'Banks' from the main [PLG] Voice screen by pressing [F2] Bank, then use [INC/YES] and [DEC/NO] buttons to change banks. There are two Plug IN Voice banks – one for the 64 pre-loaded sounds and one for you the user.

PLGPRE1 – a bank of 64 already made (preset) Plug In Voices loaded in at power up.



PLGUSR – 64 blank locations for your first creations integrated with the S90 controller / effect parameters.

Additionally, PLG150 series boards can have many 'raw' Board Voice banks on them

Play through the PLGPRE1 bank (Plug-in Voices). Press [PLG1], [PLG2] or [PLG3] (depending on which slot you have placed you're an board) and select sound A01, the sound called 'Kb: DX E.Piano'. There are 64 Plug-in Voices (A01-D16). The screen should read "Px—P:" in the upper left corner; where 'Px' is the Plug-in slot number and 'P' is for Preset, for example, a PLG150-DX in slot one would read "P1—P: 001 DX E.Piano"

What is a Plug-in Voice and what is a Board Voice?

The **Plug-in Voices** are found from the front panel of the host synth under the [PLG1], [PLG2] or [PLG3] buttons, when you have a PLG board properly installed. The host can store 64 Plug-in Voices per board (A01-D16). Synth data resident on the board, called the **Board Voices**, are the building blocks from which you create a Plug-in Voice. Instead of using ROM *samples* from the host, the PLG Voices point to data that is resident on the PLG board mounted in that slot. The Voice data contained on the PLG150-DX is not based on AWM2 sampled data like the internal voices. The

sounds of the DX board are generated using a synthesis method called "frequency modulation" (FM). Yamaha's FM uses a 6-operator arrangement to create sounds. Carriers and Modulators interact to allow for rich, dynamic synthesis. For an excellent background on FM synthesis please visit the Yamaha site. **Sixty-four** Plug-In Voices can be made available for instant recall from the 912 preset and 64 user Board Voices provided on the PLG150-DX. **Plug-In Voices are Board Voices that have been integrated into the host's setup and are stored in the [PLGx] bank.** The Modular Synthesis Plug-in System will let you create your own customized user controller sets to this technology. It is possible to customize the knobs, pedals, breath controller, wheels, aftertouch, etc., to help you with performing each sound.

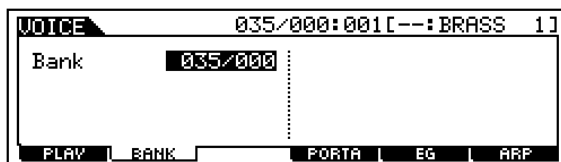
Board Voices

Let's look under the hood and see where these 64 sounds come from:

The PLG150-DX has several banks of sounds as follows: The numbers represent MSB/LSB for bank select – (MSB and LSB Bank Select numbers are used to facilitate remote changes from a device like a sequencer. More on that later).

Bank = 035/000 64 user RAM Board Voices
 Bank = 035/001 128 preset1 Board Voices
 Bank = 035/002 64 preset2 Board Voices
 Banks = *other* banks 067/000, 083/000, 083/064~083/080, 083/096~083/109, 099/000, and 099/064~099/080;

To listen to the preset1 and preset2 board Voices provided, from Voice mode:



- From the main Voice PLAY screen use [F2] to select the Bank page. Select the Board Voice bank you wish to explore: 035/001, 035/002, etc.
- Notice that banks will read P1-B, P2-B and P3-B. **P1-B** for slot 1, **P2-B** for slot 2 and **P3-B** for slot 3. The 'B' denotes a board voice not yet integrated with the S90 parameters (effects, etc.).

The banks of Board Voices are arranged according to their Bank Select (MSB/LSB) and

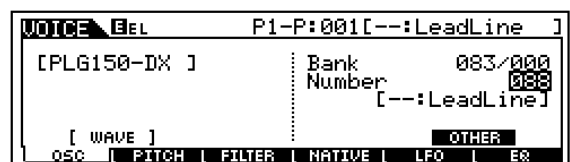
Program Change numbers. If this is your first experience using MIDI MSB/LSB bank select commands it may seem a bit confusing at first but you will get used to it. The two preset banks (named 035/001 and 035/002) contain 128 and 64 Voices respectively (A01-H16) and (A01-D16). The user RAM bank (035/000) is volatile – meaning Voices created here need to be backed up before powering down. When the unit is powered down these user bank voices will disappear. When you power up this bank reverts to 64 voices from the preset 2 bank.

- Banks are selected from the main PLAY screen via [F2] Bank.
- There are some 912 DX Board Voices spread out among the various banks. We will now learn how to turn one of these Board Voices into a S90 Plug-in Voice.

How to create a finished S90 Plug-in Voice from a PLG150-DX Board Voice.

Let's use "Leadline", a Board Voice synth sound, to learn something about how the DX synth works using on board (S90) parameters. Don't be afraid to explore when you are paging through the EDIT mode.

- From [VOICE] mode select the [PLG] bank that contains your PLG150-DX, [PLG1], [PLG2] or [PLG3]
- Press [JOB] and select the Initialize [F1] function. Initialize the current Voice position. Press [ENTER], then [INC/YES] to execute.
- Press [EDIT]
- **Select the OSC page – Touch track button [1] to select element level edits.**
- Press [F1] OSC / [SF1] Wave
- Using the data wheel select Bank 083/000; Select Program Number = 088[Leadline].



- Explore the Element parameter pages; Use the [F] keys to navigate the different screens.
- Use button [F4] to select the 'Native' (parameters) page. Native Parameters refers to parameters that address the data on the PLG150-DX board. You are **offsetting** data that originates on the board. Use the cursor arrows to navigate the pages. The concept of OFFSET is simple. If the originally programmed data for a parameter was set to 99, for

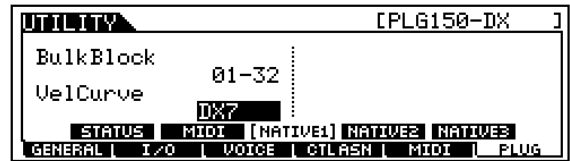
example, and you set that Native Parameter to a value of -25, then the parameter will be set to 74. You are simply adding or subtracting values from the preset data.

- Experiment with making edits – both on the Element level and the Common level. On the Element level check the [F] keys for parameters. You have a dedicated modeled Distortion and EQ. You can add S90 level parameters on the COMMON level. **Push the [COMMON] button to edit Common (S90) level parameters.** Practice navigating the edit area. Try adding some S90 EFFECTS. Press [F6] Effects/ [SF1] Connect.²
- There are the Dual Insertion Effects available on the Common level. INS1 has 25 effect algorithms and the INS2 has 104.
- Also available are the KNOB CONTROL FUNCTION parameters. You have the 4 knobs that can be selected:
 - Top row: knobs for Pan, Reverb, Chorus, Tempo (when appropriate)
 - Second row: Cutoff, Resonance, Attack and Release.
 - Third row: ASA (assignable knob A) is set to control envelope initial Decay and ASB (assignable knob B) is set to control envelope Sustain. AS1 and AS2 are assignable per Voice in the Voice Edit - Common level CONTROL SETS, [F4] CtlSet.
 - The bottom row: gain controls for 4-bands of EQ (storable per Voice)!
- When you press [STORE] your work will be saved to one of the 64 **PLGUSR** locations and become a proper Plug-In Voice. They will go to the “Px-U” PLGUSR bank- ‘Px’ for your Plug-in slot, ‘U’ is User. You have made a complete PLUG IN VOICE from Board Voice data.
- When you save your first data to the PLGUSR Bank your Voice will be there alone. Don’t panic if you press a program button and all the other places in that bank say “---:-----”. Simply press [F2] Bank and select a bank. When you attempt to store you are automatically taken to the USER bank, of course.
- When you save an ALL DATA file type the PLG bank Voice data will be saved to SmartMedia card. However, as we will see, if you have made any custom user Board Voices (those voices made from scratch via

² Element level (Program button [1]) and Common level ([COMMON] button) – are available. S90 effects are Common level.

the editor in bank 035/000) will need to be saved separately in a bulk type file (.w2b).

- **Native Parameters**



The BULK BLOCK can be set to receive/send 6-Operator DX Voice data in two sets of 32. You select either “01-32” or “33-64”. The VELOCITY CURVE of the PLG150-DX can be set to mimic the original DX7 curve (highly recommended).

Summary: We learned a few things. You may have noticed that changing certain S90 parameters make little or no difference in the sound on the PLG board. You may find some parameters make no difference when you move the knob – this can happen when the original Voice data does not use that parameter in the current configuration or it is already at maximum or minimum and you cannot offset it further. To fully view the entire list of parameters available you must open the DX Simulator software. The host product will give access to a smaller set (see below) of the full list (see editing software).

Explanation: The Native Parameters are parameters that are native to the technology on the board in question. Each PLG150 series board represents an entirely different technology. These are available from the front panel of the S90 and for the DX board include:

- Carrier 1 level
- Carrier 2 level
- Carrier 3 level
- Carrier 4 level
- Carrier 5 level
- Carrier 6 level
- Modulator 1 level
- Modulator 2 level
- Modulator 3 level
- Modulator 4 level
- Modulator 5 level
- Modulator 6 level
- Feedback
- Portamento Mode
- Portamento Step
- Pitch Bend Step
- AC4 CC No. Assign
- AC4 Controller Parameter
- AC4 Controller Parameter Depth
- Receive DX System Exclusive
- Pitch Envelope

Edits can be made in the software on the ‘virtual’ front panel of our DX7 synthesizer.

Explore the DX Simulator software, with its original DX7 look – a nice touch of the 80's. You can view all parameters at once by clicking on an icon in the toolbar: DX EDIT LIST VIEW. You can even insert the system exclusive data for a voice into a sequence from the toolbar: INSERT DX BULK DUMP DATA. When an edit is completed you can store it in the software (click on the disk icon) and/or transfer it to the user RAM of the PLG150-DX as outlined above). From there we can use the RAM user **Board Voices** to make **S90 Plug-in Voices**. The difference between these *user* Board Voices and the *preset* Board Voices is that these user Board Voices must be reloaded each time you power up. Of course, this can be either from the computer editor or you can make an autoloader file that will automatically load your custom voice data on power up. This requires a SmartMedia card. You store the data as a 'PlugInBulkX' type file – check the S90 Owner's Manual for more details.

Theory of Operation:

You can edit the Voice in the computer software while playing it from the host edit buffer. You can (must) then bulk over a single sound or complete set to the RAM bank of the board and then create PLG Voices directed to one of 64 locations in the host's PLG bank. **You cannot store or load data to a PLG slot that does not contain the board with the correct technology.** You will see a "TYPE MISMATCH" error if such an attempt is made or the Voice will not sound. The PLG bank Voices can be backed up to an ALL DATA file save, if they contain only Preset Board Voices. If, however, your PLG Voices contain any user Board Voices (sounds bulked in with the editor) you will need to reload these voices to the board's user RAM in a separate operation (.w2b bulk file mentioned above). The PLG_Native parameters that you see in the screen of the S90 allow you to apply offsets to what has been programmed in the Editor. You can assign different parameter control to various physical controllers.

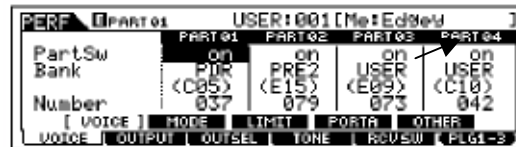
Note: It should be mentioned here that the host keyboard/module gives you options when it comes to how you are going to use the Plug-in sounds. For example, when you are performing live you will most likely want to have your favorite sounds stored as completed Plug-in Voices (complete with effects and controller routings). You can have instant access to 64 completely programmed Voices based on the data of the PLG150-DX. You may also find it convenient to set up a basic PLG Voice as a template with your favorite controller and effect settings. From there it is a simple matter to use to swap a Board Voice

element on the OSC Assign Element page – it will inherit the basic settings from the template. In this manner you can have access all 912 sounds without having to individually program effects and controllers for each one.

PLG Plug-in and Board Voices can also be used in complex split and layer arrangements via Performance mode. Performances can house single sounds or are complex combinations – even combining multiple technologies.

Push [F6] to see PLG.

Performances: When setting up Performance,



you can activate up to 4 Voices – In Performance Part edit you have a "PART Switch". This includes selecting one sound from your PLG150 series board (AN, DX, PF, and VL). Each 150 series slot, PLG1/PLG2/PLG3, can contribute **one** sound at a time. Alternatively, you can use the Performance mode Initialize JOB to create any combination of AWM2 Internal and PLG Voice slots. **Please note:** When you have multiple PLG150 Series (single part synthesizer) boards, each board must 'see' its own data through the proper slot. P1, P2 or P3 – attempting to recall voice data in a slot not containing the right board will cause a TYPE MISMATCH error or you will simply not hear your sound (even with the name showing). The board for the voice data must be in the S90 in order to play.

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

This is a great resource for additional background on Frequency Modulation (FM) synthesis.

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