CV	Description	Area	Value*
1	**Locomotive address**	DCC: 1 - 127 Motorola: 1 - 80	3
2	**Minimum speed** (the speed from 0 until the locomotive is running at speed step 1)	1 - 63	1
3	**Acceleration delay,** 1 means every 5 milliseconds the actual motor speed is increased by 1. If the maximum motor speed is 200 (CV 5 = 50 or CV 94 = 200), then the acceleration rate from 0 to maximum speed is 1 second	0-255	30
4	**Braking rate** (time factor like CV 3)	0-255	16
5	**Maximum speed** (must be greater than CV 2)	1 - 63	36
6	**Average speed** (must be greater than CV 2 and less than CV 5)	1 - 63	12
7	**Software version** (The processor can be updated)	-	differently
8	**Manufacturer identification** decoder reset, values like CV 59	different	162
17 18	**Long locomotive address** 17 = Byte should be lower-case: byte 18 = Byte should be lower-case: byte	1 - 9999 192 - 231 0 - 255	2000 199 208
29	**DCC standard configuration** Bit 0=0 Normal direction of travel Value 0 Bit 0=1 Opposite direction of travel 1 Bit 1=0 14 speed steps 0 Bit 1=1 28 speed steps 2* Bit 2=0 DCC-only mode 0 Bit 2=1 Automatic analog/digital recognition 4* Bit 3=0 RailCom® turned off 0 Bit 3=1 RailCom® turned on 8* Bit 4=0 Speed steps over CV 2, 5, and 6 0 Bit 4=1 Use the characteristic curve from CV 67 - 94 16 Bit 5=0 Short address (CV1) 0 Bit 5=1 Long address (CV 17/18) 32	0-63	14
30	Error codes for function outputs, motor, and temperature monitoring: 1 = function output fault, 2 = motor fault, 4 = overload protection	0-7	0
59	**Resetting to factory settings** (also possible via CV8) 1 = CV 0 - 256, as well as CV257 - 512 (RailCom® Bank 7) 2 = CV 257 - 512 (RailCom Plus® Banks 5 & 6) 3 = CV 257 - 512 (extended function mapping banks 1 & 2) 4 = CV 257 - 512 (PWM modulation function outputs banks 3 & 4)	0 - 4	0

* set ex works

Function assignments

F0	Light	F10	Cab light	F20	Window open/close
F1	Preheater	F11	Radio Chatter 1	F21	Volume regulator
F2	Heater	F12	Radio Chatter 2	F22	Mute
F3	Engine	F13	Radio Chatter 3		
F4	Whistle	F14	Station Announcement 1		
F5	Train lighting: Engine pulling	F15	Station Announcement 2		
F6	Train lighting: Engine pushing	F16	Clickety-Clack		
F7	Coupling	F17	Curve squeal		
F8	Switching gear	F18	Fuel pump		
F9	Driver's desk lighting	F19	Door open/close		

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#56491
PIKO multiprotocol SmartDecoder 4.1 PluX22
for Diesel locomotives D.141 FS H0

NOTE: Detailed information on the PIKO SmartDecoder 4.1 Sound is available as a PDF file on our Webshop on the page of the respective item number. The file contains a full description of all functions and operating possibilities for the new SmartDecoder 4.1 Sound.

Description
The PIKO SmartDecoder 4.1 Sound PluX22 is a powerful and compact multiprotocol decoder that can be used with standard DCC, Selectrix, and Motorola digital systems as well as in DC or AC analog mode. The sound decoder is RailCom® and RailCom Plus® capable as well as mfx®-capable for AC models that are factory-equipped with PIKO SmartDecoder 4.1 Sound. The innovative PIKO SmartDecoder 4.1 Sound automatically recognizes the layout operating mode and has a wide range of program options for its additional functions.

These load regulated sound decoders operate on an 18.75 kHz frequency and are designed for standard DC motors as well as bell-shaped armature motors (i.e. Faulhaber, Maxon, Escap) that draw up to 1.2 A. Temporarily higher current levels up to 2 A are easily tolerated. The decoders are both RailCom® and RailCom Plus®-ready and recognize ABC automatic stop sections and ABC reduced speed sections. The motor voltage can be controlled either by a simple three-step motor speed curve, with minimum, midpoint and maximum voltage settings, or by a user-loadable speed curve, with 28 individually-set speed steps. The sound decoder provides two directional lighting outputs, as well as seven additional special funtion outputs. Slow-speed switching mode, with extended slow-speed range, along with three accelleration and braking rates, as well as the many vehicle sounds can be controlled via function keys.

Installing the PIKO SmartDecoder 4.1 Sound
Remove the jumper plug from your model's PluX22 interface. Insert the new sound decoder into the interface socket. Note that PIN 11 is missing on the new decoder. Please install the loudspeaker as shown in the graphic of the "Spare parts list". Check for crossed wires and short circuits before and after reinstalling the shell. Place the model on your programming track with programming mode activated on your DCC system. During programming or when reading the model's DCC address, a small amount of current will flow through the model, which does not affect the decoder; even in the event of a short circuit.

Special functions A1 to A7
The decoder's special function outputs A1 to A7 can only be activated if the desired functions are already connected to the model's PluX22 interface or if solder pads are available for the special function outputs on the main circuit board.

A short circuit in the motor, lighting, pick-up wiper, or wheelsets can destroy the decoder as well as the electronics of the model!

First-time use of the decoder (state of delivery)
Enter address 3 on your DCC control system. Depending on the data format used to address the sound decoder, the locomotive runs in DCC mode with 28 speed steps or in Motorola® mode. When using a RailCom Plus®-enabled DCC system or with an mfx®-capable DCC system (for this use decoder 56401), the decoder is detected automatically and can be operated immediately. If the decoder is used on a conventional analog layout, it can be controlled with a DC or AC power pack. The decoder will automatically detect the layout's operating mode.

NOTE: In DC mode, your vehicle is only switched on when the voltage is higher (speed controller continues to turn up). than you might have been used to with analogue vehicles. Please note that a trouble-free sound operation with electronic speed controllers (PWM operation), due to the large number of available on the market, often unstable systems cannot be guaranteed.

Function outputs in analog mode
It is possible to program the decoder so that function keys F0 - F12 (as they are assigned in the function mapping) can also be activated in analog mode. To do this, CVs 13 & 14 must first be programmed with a DCC central control unit. The corresponding values can be found in the CV table of the detailed operating instructions. The light function F0 and the traveling sound F3 are switched on at the factory.

Motorola®
The sound decoder has 3 Motorola® addresses to activate functions F1 - F12 on a Motorola®-format DCC system.

Configuration of CVs
In addition to the decoder address, the indexed CVs of a locomotive decoder are the most important CVs. These are the CVs 29, 50 and 51 in the PIKO SmartDecoder 4.1 Sound. As a rule, an indexed CV contains various basic settings of a decoder, such as reversing the direction of travel. CV calculation examples can be found in the detailed operating instructions.

RailCom®, RailCom Plus®
In the sound decoder, CV29 (RailCom®) can be turned on or off via bit 3. If RailCom Plus® is turned on, the decoder will be automatically recognized by a RailCom Plus®-enabled DCC control system (i.e. PIKO SmartControl) and a locomotive icon, decoder name, and its special function icons will appear on the control system's screen. With RailCom Plus® technology, no locomotive data has to be stored in the DCC central control unit and no locomotive addresses have to be programmed into the decoder.

mfx®
The PIKO SmartDecoder 4.1 Sound, factory-installed in PIKO AC models, is mfx®-capable. If your DCC control system uses the mfx® format, then the decoder is automatically recognized and is assigned its locomotive symbol, decoder address, and its maximum 20 special functions. With mfx® technology, no locomotive data has to be stored in the DCC central control unit and no locomotive addresses have to be programmed into the sound decoder.

Braking
The sound decoder understands the following braking methods:
Märklin® braking section (brakes with analog DC voltage)
DCC braking function
ABC (Automatic Brake Control) braking section
The sound decoder can stop the model with two adjustable braking distances that are accurate down to the centimeter. More information on "braking behavior" can be found in the detailed operating instructions for PIKO SmartDecoder 4.1 Sound.

Function outputs
A comprehensive description of all options related to the function outputs can be found in the detailed operating instructions.

Simple and extended function mapping
With **simple function mapping**, adjustable functions like lighting, special function outputs, switching (shunting) mode, and acceleration and braking can be freely assigned to function keys F0 to F12 of the DCC central control unit. For more information, refer to the CV table at the end of this manual, as well as the detailed user guide.

Smoke generator control
A smoke generator can be connected to outputs A1 to A7 which are load-sensitive and react to the model's speed. For further information, please refer to the detailed operating instructions.

Electric coupler control
PIKO electric couplers are operated by tiny copper wire resistance wires which heat up when the decoder sends current through them. The heat causes the wires to expand, causing the coupler hook to move to the uncoupled position. The model can then back away from the car. The model's sound decoder can be programmed to automatically shut off current to the coupler mechanism after a certain time period, without need to press another key.

Switching (shunting) scenario, remote coupling/uncoupling
If your layout has remote electric uncouplers installed, you can program the locomotive decoder to perform a switching scenario like the following:
1) The locomotive runs in one direction for a certain distance.
2) The locomotive stops and reverses direction.
3) The locomotive uncouples and moves back from the uncoupled car for a certain distance.
4) The locomotive stops, and resumes switching..

For information on **extended function mapping**, refer to the detailed operating instructions.

Servo control
The sound decoder can control up to three servo motors via outputs A6, A7.

The use of a servo with the decoder requires electronics expertise.

Further information can be found in the detailed operating instructions.
Information on wiring servos to the function outputs can be found in the FAQ section of the PIKO Webshop by clicking on the link "Questions about the digital system." Scroll down to the "H0" category and click on the title "Servo connection to SUSI or solder pads at the PIKO SmartDecoder 4.1".

ATTENTION: Soldering on the decoder should only be carried out by experienced specialists with the appropriate tools. Decoders damaged by improper handling will not be covered by the warranty.

Sound settings
To change the overall volume of the PIKO SmartDecoder 4.1 Sound, first program the CV1021 = 2!
This will take you to the programming area for setting the total volume. You can now adjust the overall volume according to
If desired, set the CV900 in the value range from 0 - 255. Finally, program the CV1021 = 0 around the area of these sound settings again.
NOTE: In order to play a PIKO sound on the sound decoder, the test and programming device requires PIKO SmartProgrammer (#56415) and (optional) the PIKO SmartTester (#56416).
All further information about the sound section of the PIKO SmartDecoder 4.1 Sound as well as the available
For setting options, please refer to the detailed operating instructions.

Factory reset
CAUTION! When the decoder is reset, all factory settings are erased! Only perform a reset if it is absolutely necessary. If you nonetheless have to reset the decoder remember that functions programmed at the factory may no longer function and you must reprogram the individual Function Mapping (see FAQ)

To restore the decoder back to factory settings, use CV8 for DCC programming and CV59 in Motorola programming.

To avoid having to re-enter all programming after a reset, you can select beforehand which areas of the decoder programming should be reset to factory values.

To restore the basic functions of the decoder, enter a value of 1 in the Reset CV (8 or 59).

Information on extended reset can be found in the detailed operating instructions.

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RailComPlus® is a registered trademark of Lenz Elektronik GmbH, 35398 Gießen
Selectrix® is a registered trademark of Gebr. Märklin & Cie. GmbH, Göppingen

NOTE: This product is not a toy and is not suitable for children under the age of 14. Any liability for damage of any kind caused by improper use or failure to observe these instructions is excluded.

Service:
Internet: www.piko.de
E-Mail:info@piko.de
Hotline: Di + Do 16-18 Uhr

In the event of a defective decoder, please return the decoder module to PIKO along with proof of purchase, the decoder address, and a short description of the problem.

Warranty Statement
Each decoder module is fully tested before shipment. Nevertheless, should a malfunction occur within the 2-year warranty period, we will repair the module free of charge on presentation of the proof of purchase. This warranty is voided if the unit has been damaged by improper use. Please note that, according to the German Electromagnetic Compatibility Law (EMV-Gesetz), the decoder module may only be used inside models bearing the CE mark.