DIETZ
MODELLBAHNTECHNIK

DECODER - EXTENSION INTERFACE

Serial User Standard Interface

Interface definition between decoders and external extension modules
(thereafter called “SUSI-modules”).

Interface Description:

Hardware:

The modules are connected with 4 wires:
- Ground
DATA
CLOCK
+ Rectified, Unregulated (Track) Power

The sequence of the wiring is (-, D, C, +) and is mandantory. The connection is established with a 4-pole socket JST SM04B-SRSS-TB (side entry) or JST BM04B-SRSS-TB (top entry) or compatible on both decoder and SUSI-module. Connection is established by cable with plug (JST 04SR-3S or SHR-04V-S-B) on both sides and pin 1 connected to pin 1 etc. Wires might be directly soldered to the PCB on the SUSI-module side. In exceptional cases (e.g. pre-equipped prototypes) the connection between the decoder and the SUSI module may be wired directly.

Cable colors
It is strongly recommended that the following color coding scheme is used:

Pin 1	Ground	black
Pin 2	Data	gray
Pin 3	Clock	blue
Pin 4	Power	red

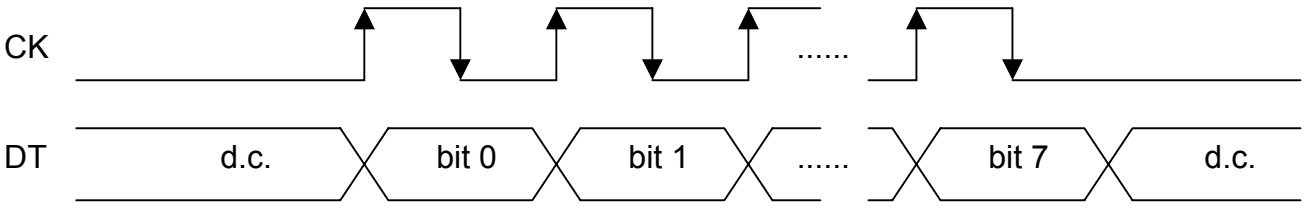
It is allowed to connect up to 3 SUSI-modules to the decoder.

The SUSI module connected to the decoder must include a reverse protection diode in its power supply.

The supply current of the external SUSI modules and their load may be drawn from the decoder and may not exceed the decoder-specified maximum output current. For plug JST-04SR-3 a maximum current of 700 mA per pin is specified, on plug JST SHR04V-B-S currents up to 1000mA are allowed. If higher load currents are needed they have to be externally powered (e.g. by an additional track bridge rectifier).

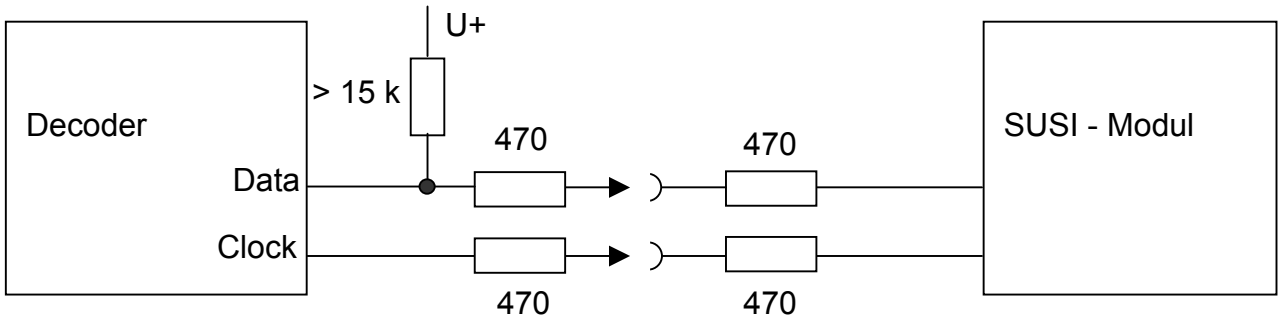
The data communication is a synchronous, unidirectional respective half-duplex connection and is similar to an SPI interface.

All SUSI packets are a multiple of 8-bits. The Clock is active high. Data is set on the positive edge and must be valid on the negative edge.

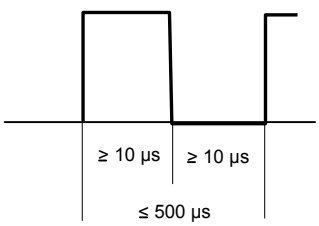


The clock and data lines include a series resistor of 470 ohms at the decoder and on the SUSI-module. The data line must have a pullup resistor to 5 V of ≥ 15kOhm directly on the decoder's sending device ("before" the 470R). Signal level is 5Volts.

The high and low period of the clock pulses may vary from 10 to 500µs.



The decoder always acts as master and supplies the clock pulses.
The first bit transferred is the LSB (bit 0).



The SUSI-module will acknowledge some instructions by pulling the data line to ground through its 470 ohm resistor.
This acknowledge has to occur within 19ms and is 1 to 2ms long.
The decoder should cancel the command after 20ms with the result being "not acknowledged". For commands giving an ACK see command table.

Software:

Because of the short distance between the decoder and the SUSI-module, no error detection/correction method is currently implemented. It is recommended not to exceed 20cm between the modules.

Upon power failure or reset, the decoder must send all relevant commands (VLOCO, VCPU, LLOCO, F0F4, F5F12) to the SUSI module(s) once if

- value is not 0

and

- command is implemented on the decoder

In the table below there is

M **Mandatory**; must be supported by the decoder and the SUSI module.

R **Recommended**; should be supported by the decoder and the SUSI module.

O **Optional;** may be supported by the decoder and SUSI module; it may ignore these instructions, but must not produce an error.

Commands:

Decoder sends	Remarks	Status
Function status F0 to F4 2 Byte [F0F4] [value] 0 1 1 0 0 0 0 0 0 0 0 F0 F4 F3 F2 F1 (96 dec) Has to be send on each DCC-command that has been valid for that decoder and refers to F0 to F4. Should also be send periodically (1-2 times per second) for refresh purpose.		M
Function status F5 to F12 2 Byte [F5F12] [value] 0 1 1 0 0 0 0 1 F12 F11 F10 F9 F8 F7 F6 F5 (97 dec) Has to be send on each DCC-command that has been valid for that decoder and refers to F5 to F12. Should also be send periodically (1-2 times per second) for refresh purpose.		M
Loco-speed (speed the loco is currently running) Value independently of actual speed step settings normalized to 0..127, where 127 is maximum. 2 Byte [VLOCO] [value] 0 0 1 0 0 1 0 0 DIRL l6 l5 l4 l3 l2 l1 l0 (36 dec) (DIRL 1 = forward) DIRL is the direction the loco is running, already corrected by CV29 direction setting and consist-direction setting. Has to be send 5 to 10 times per second.		M

Decoder sends	Remarks	Status
Control unit speed Value independently of actual speed step settings normalized to 0..127, where 127 is maximum. 2 Byte [VCPU] [value] 0 0 1 0 0 1 0 1 DIRC c6 c5 c4 c3 c2 c1 c0 (37 dec) (DIRC 1 = forward) DIRC is the direction the control unit is sending, but corrected by CV29 direction setting and consist-direction setting. Has to be send on each DCC-command that has been valid for that decoder and refers to control unit speed. Should also be send periodically (1-2 times per second) for refresh purpose.		M
„Load“ (actual motor-load) Can be load, motor voltage, motor current or Load correction factor. Value normalized to 0..127, where 0 is no load and 127 is maximum load. 2 Byte [LLOCO] [value] 0 0 1 0 0 1 1 0 0 p6 p5 p4 p3 p2 p1 p0 (38 dec) Has to be send 5 to 10 times per second.		R
No operation 2 Byte [NOP] [value] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 (0 dec)	Only necessary if clock can’t be stopped at transmitter	O
CV-Manipulation (equates DCC-command „direct CV addressing”) 3 Byte [MANCV&adrhi] [adrlo] [data] 0 1 1 1 C C A A A A A A A A A D D D D D D D D (112 to 127 dec) CC: 00 = undef. 01 = verify BYTE 10 = bit manipulation 11 = write Byte AAAAAAAAAA: range 896 – 1023 (CV’s 897 to 1024) D D D D D D D D if bit manipulation: 1 1 1 K D B B B K=0: verify bit K=1: write bit D: bit value to verify/write BBB bit # 0..7 to verify/write	This command corresponds exactly to the direct CV-adressing“ command. But on the SUSI-Interface only CV Addresses 897 to 1024 are allowed. All other CVs are not related to SUSI and must not be send on the interface. Decoder sends this command only if it has received it twice (DCC-requirement). For a SUSI-module it is therefore valid on the first reception of this command. This command is acknowledged by the SUSI-module with a ACK-Pulse on the data line if sucessful (write) or true (verify). On reception of a valid ACK on the SUSI-Interface the Decoder has to make the actual „DCC-acknowledge“ corresponding to its mode. The SUSI-module is not allowed to do e.g. the “increased current”- acknowledge.	M
Under evaluation 2 Byte (39 dec)		O

Commands 160 - 175 (dec.) are reserved for programming of the sound module memory (currently under evaluation).
All other commands not defined above are reserved.

CVs:

CVs 897 to 1024 have been assigned to the SUSI-interface.

As it is allowed to connect up to 3 SUSI-modules they have to be assigned to one of three CV-ranges before use. These three ranges are CV 900 to 939 (SUSI-I), CV 940 to 979 (SUSI-II) and CV 980 to 1019 (SUSI-III). Assignment is done via a „sub-address“ in CV 897 Bit 0 and 1.

Range I is selected by bit combination 01, range II with combination 10 and range III with combination 11. To avoid a possible deadlock of a SUSI-module bit combination 00 is also assigned to range I.

It is also allowed to select the SUSI-range by means of external hardware (like a DIP-switch) or having a fixed, dedicated range.

CVs 897 to 899 are valid for all modules in all range settings (“common CVs”). Reading / writing of common CVs like the subadress in CV897 is useful only if a single module is attached to a decoder / programmer and shouldn’t be done during normal use as this will deliver garbled results.

CV Name	CV # Range I	CV # Range II	CV # Range III	Required	Read Only	Additional Comments
SUSI-range	897			**M**		optional range I, II or III
(reserved)	898 - 899					
manufacturer ID	900	940	980	**M**	Y	
version ID	901	941	981	**M**	Y	
module-type specific	902-939	942-979	982-1019			see recommendation
(reserved)	1020-1024					

CVs 898, 899 and 1020 to 1024 are reserved.

Currently there are 2 intended applications of a SUSI-module:

a). SOUND

b). external function outputs (output extentions)

Attached there are 2 proposals for CV usage.

CV Proposal for use in a SUSI-Soundmodule:

CV Name	CV#	Additional Comments
SNDvolume	902 / 942 / 982	Volume Range 0=minimum, 255=maximum
F0sound select	903 / 943 / 983	Sound # to play on Function 0 Value 0 is “no sound”
F1sound select	904 / 944 / 984	Sound # to play on Function 1
F2sound select	905 / 945 / 985	Sound # to play on Function 2
F3sound select	906 / 946 / 986	Sound # to play on Function 3
F4sound select	907 / 947 / 987	Sound # to play on Function 4
F5sound select	908 / 948 / 988	Sound # to play on Function 5
F6sound select	909 / 949 / 989	Sound # to play on Function 6
F7sound select	910 / 950 / 990	Sound # to play on Function 7
F8sound select	911 / 951 / 991	Sound # to play on Function 8
F9sound select	912 / 952 / 992	Sound # to play on Function 9
F10sound select	913 / 953 / 993	Sound # to play on Function 10
F11sound select	914 / 954 / 994	Sound # to play on Function 11
F12sound select	915 / 955 / 995	Sound # to play on Function 12
reserved	916 / 956 / 996	
…	…	
reserved	939 / 979 / 1019	

CV Proposal for use in a SUSI-Functionmodule:

CV Name Aux	CV#	Additional Comments
Output A mapping	902 / 942 / 982	AUX: Map function # to output A
Output B mapping	903 / 943 / 983	AUX: Map function # to output B
Output C mapping	904 / 944 / 984	AUX: Map function # to output C
Output D mapping	905 / 945 / 985	AUX: Map function # to output D
Output E mapping	906 / 946 / 986	AUX: Map function # to output E
Output F mapping	907 / 947 / 987	AUX: Map function # to output F
Output G mapping	908 / 948 / 988	AUX: Map function # to output G
Output H mapping	909 / 949 / 989	AUX: Map function # to output H
Output I mapping	910 / 950 / 990	AUX: Map function # to output I
Output J mapping	911 / 951 / 991	AUX: Map function # to output J
Output K mapping	912 / 952 / 992	AUX: Map function # to output K
Output L mapping	913 / 953 / 993	AUX: Map function # to output L
Output M mapping	914 / 954 / 994	AUX: Map function # to output M
Output N mapping	915 / 955 / 995	AUX: Map function # to output N
Output O mapping	916 / 956 / 996	AUX: Map function # to output O
Output P mapping	917 / 957 / 997	AUX: Map function # to output P
Output A features	918 / 958 / 998	AUX: Output features (timer etc.) output A
Output B features	919 / 959 / 999	AUX: Output features (timer etc.) output B
Output C features	920 / 960 / 1000	AUX: Output features (timer etc.) output C
Output D features	921 / 961 / 1001	AUX: Output features (timer etc.) output D
Output E features	922 / 962 / 1002	AUX: Output features (timer etc.) output E
Output F features	923 / 963 / 1003	AUX: Output features (timer etc.) output F
Output G features	924 / 964 / 1004	AUX: Output features (timer etc.) output G
Output H features	925 / 965 / 1005	AUX: Output features (timer etc.) output H
Output I features	926 / 966 / 1006	AUX: Output features (timer etc.) output I
Output J features	927 / 967 / 1007	AUX: Output features (timer etc.) output J
Output K features	928 / 968 / 1008	AUX: Output features (timer etc.) output K
Output L features	929 / 969 / 1009	AUX: Output features (timer etc.) output L
Output M features	930 / 970 / 1010	AUX: Output features (timer etc.) output M
Output N features	931 / 971 / 1011	AUX: Output features (timer etc.) output N
Output O features	932 / 972 / 1012	AUX: Output features (timer etc.) output O
Output P features	933 / 973 / 1013	AUX: Output features (timer etc.) output P
reserved	934 / 974 / 1014	
	…	
reserved	939 / 979 / 1019	

DIETZ MODELLBAHNTECHNIK
Hindenburgstraße 31
D-75339 Höfen
Germany
e-mail: info@d-i-e-t-z.de
www.d-i-e-t-z.de