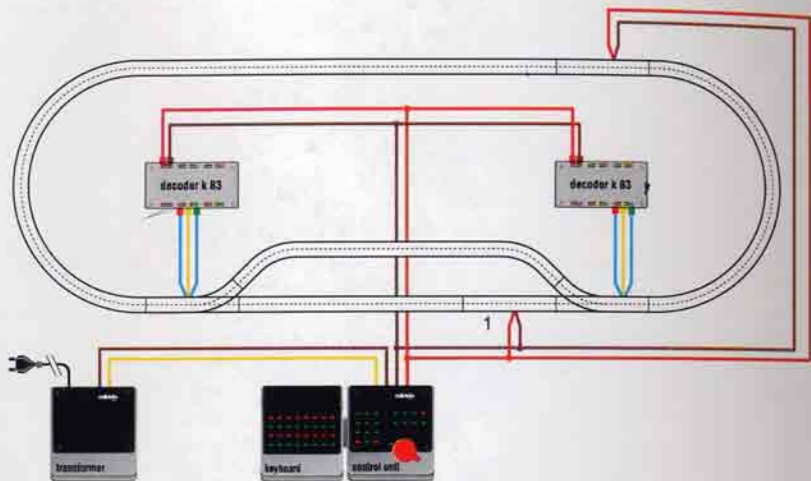


märklin
digital

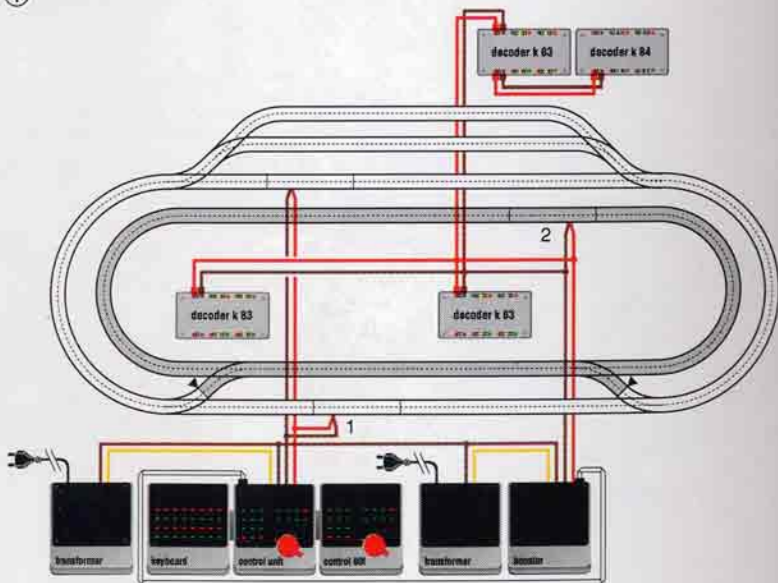


control unit

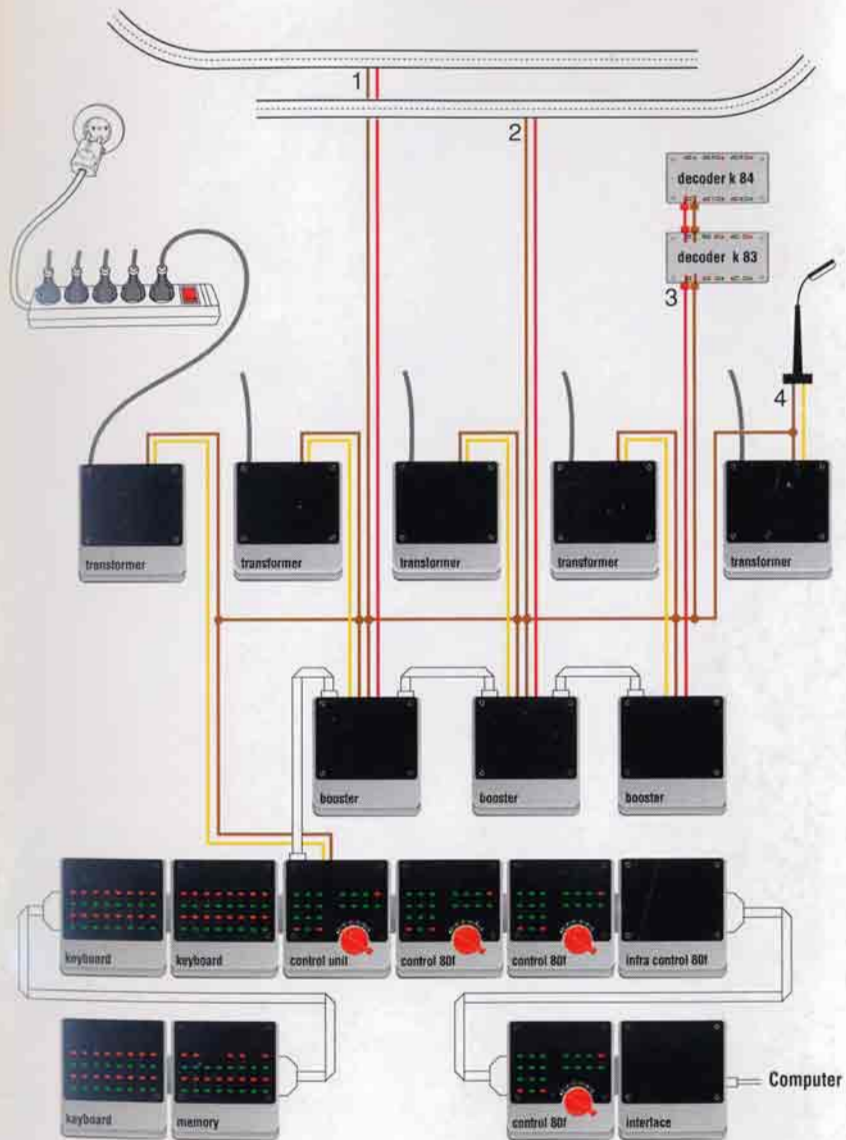
6021



①



②



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Explanation of the symbols used throughout this manual



Important.
Please comply under all circumstances.
Non-compliance may cause damage to the equipment.



Action.
You are expected to take action here.

- Observation.
Information concerning a result or the response of the equipment.

1. Basic information

Aim of this manual These instructions give a detailed explanation of how to use the CONTROL UNIT on model railroad layouts with Märklin H0 or Märklin 1 Gauge. It will also enable you to familiarize yourself with the extensive features offered by the digital model railway control system.

Until 1993 another multi-train control system was offered in the Märklin assortment for Märklin 1 Gauge. The Märklin 1 Gauge locomotives with a built-in digital decoder (6085 and variations specific locomotives) from this period cannot be controlled with the CONTROL UNIT. These types of locomotives can, however, be retrofitted with the current technology with no problem at all.

Brief introduction If you wish to move on to the more practical aspects as quickly as possible, you can leave out the following chapters and start Chapter 3.1.

1.1 Advantages of the Märklin Digital system

Step by step towards the Digital system The Digital system comprises a number of individual units. Items of digital equipment are available to suit every configuration of your model railway. This enables you to convert your existing layout into a Digital system step by step.

Operation of a model railway can be divided up according to two basic functions: "Digital locomotive operation" and "Digital accessory control".

"Digital locomotive operation" refers to the operation of trains and functional models, refer to Chapter 5.

"Digital accessory control" includes the switching of turnouts, signals and other "solenoid accessories", as well as lighting systems and motors, etc. Refer to Chapter 6.

These two concepts are mutually independent to a great extent which is reflected in the structure of this manual.

Advantages of the Digital system

Digital locomotive operation

- Up to 80 locomotives can be controlled independently in the same circuit.
- This enables realistic train operation even in difficult situations.
- Constant locomotive and car lighting without the need for additional circuitry.

Digital accessory control

- Requires less wiring than a conventional layout.
- The wiring does not require modification for changes in the operational sequence.
- Versatile range of possibilities for expansion incorporating auxiliary units:
 - Initiation and switching of entire "routes": MEMORY
 - Connection of a computer: INTERFACE

Refer to Chapter 6.6 for more detailed information.

1.2 How does the Märklin Digital system work?

Conventional layout	In a conventional layout, the value of the AC voltage in the track determines the speed of all locomotives on the track in question. A speed control knob on a conventional Märklin transformer is used to adjust the voltage.
Digital system	In a Digital system, the voltage in the track for running trains remains constant. This voltage is also used to transmit information in the Digital system. This information contains a "digital address" and commands for the respective "addressees" (for example the required speed for locomotives).
Digital address	To ensure that a locomotive is only capable of evaluating the commands which are intended for it, for example, each locomotive (and each solenoid accessory) is assigned a separate digital address. This digital address can be compared with a house number: the house number tells the postman which house the letters (his information) are for.
Decoder	The digital information is evaluated (decoded) by a digital decoder. Each decoder contains a set of "coding switches" which is used to set the digital address. The decoder only evaluates the items of information which are intended for the set address and forwards the commands to the locomotive or solenoid accessory.

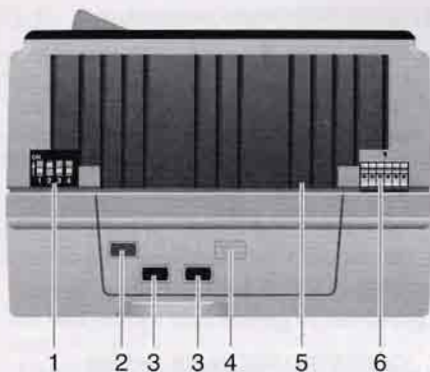
2. Getting to know the CONTROL UNIT

Function The CONTROL UNIT is the control center for the entire Digital system. It coordinates the information for all digital units, "injects" this information into the train control voltage and supplies power to the track. The CONTROL UNIT also contains a full-scale Digital locomotive controller.

Top panel of the CONTROL UNIT



Item	Meaning	Chapter
1	LED pilot light (red LED)	4.1
2	Buttons to control the functional models and auxiliary locomotive functions	5.5 5.3.3
3	"stop" and "go" buttons	5.4
4	Side plug connector to connect additional Digital locomotive controllers	3.2
5	Speed control knob	5.3
6	Buttons to enter the locomotive addresses or the addresses of functional decoders	5.3 5.5
7	Side plug connector to connect additional Digital accessory controllers	6.1, 6.6
8	Display of the current address	5.3

Rear panel of the
CONTROL UNIT

- 1 Coding switches
- 2 Red terminal ("B" = train control current):
for the red wire to the feeder track
- 3 Brown terminal ("0" = ground terminal):
for the brown wire to the TRANSFORMER and
for the brown wire to the feeder track
- 4 Yellow terminal ("L" = constant current):
for the yellow wire to the TRANSFORMER
- 5 Heat sink
- 6 Multi-pin connector for the cable to the BOOSTER: Chapter 8

Setting the coding switches

The coding switches on the back of the CONTROL UNIT are used to set it for different modes of operation.



UNIVERSAL switch settings

When switch 2 is set for ON, and switches 1, 3, and 4 are set for OFF, the earlier digital signal of the CENTRAL UNIT and the current digital signal of the CONTROL UNIT will be generated. All previous and current decoders will work with these switch settings. The direction of travel indicator will also be available with these settings.

Note: **With this combination of switch settings the CONTROL UNIT sends both data formats. This combination of switch settings is universally usable.**

CONTROL UNIT switch settings



When switches 1, 2, and 3 are set for ON and switch 4 remains at OFF, all of the additional features of the CONTROL UNIT not found on the CENTRAL UNIT are available for your use. With these settings all of the functions for multi-function decoders can be switched on and off. A direction of travel indicator is also available with these switch settings.

Important: **If you own a Märklin 7651 digital crane or an earlier function car (4999 vista dome car, 4998 dance car, or 2681 Kaiser Wilhelm train), they will not work with this group of coding switch settings. In this situation or in the event of malfunction of older decoders, you should change the coding switch settings to UNIVERSAL.**

CENTRAL UNIT switch settings



When all 4 switches are set to OFF, the Control Unit will produce the same data format as the older 6020 CENTRAL UNIT or the CENTRAL CONTROL that was formerly available in the 2601/2602, 2610/2612, and 2620/2622 starter sets.

Note: **The auxiliary functions for Märklin 1 locomotives and H0 locomotives with more than one controllable function cannot be switched on and off in this switch setting.**

3. Connecting Digital components

3.1 Connecting the CONTROL UNIT

Intended use

The CONTROL UNIT and the TRANSFORMER have been designed only for model railway operation in dry areas.

Correct household voltage?

Before connecting up components, check the following:

Does the voltage on the TRANSFORMER rating plate comply with the household voltage present at your wall outlets?

Transformer	6002
PRI	230V 50/60Hz
SEC	
O-L	16V- 52 VA



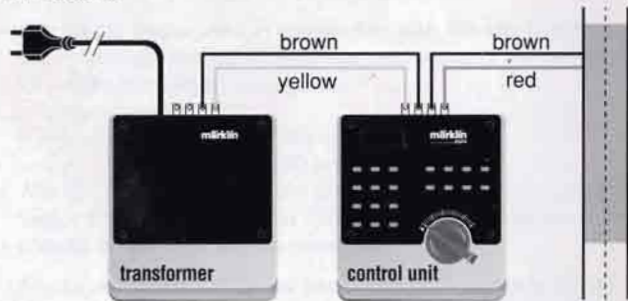
Always disconnect the TRANSFORMER from the household current before connecting or removing any Digital component.

(Unplug the transformer cord from the socket-outlet or turn off the switch on a multiple socket-outlet.)

Safety information

Observe all safety information in the TRANSFORMER instructions.

Connecting the CONTROL UNIT



Transformer	Voltage	Output power
6000	100 V	50 VA
6001	110 V	42 VA
6002	230 V	52 VA
6003	240 V	52 VA

Yellow and brown terminals: to the TRANSFORMER

Red and brown terminals: to the feeder track

Use model railway wire (flexible lead) in the same color as the terminals for easy coordination.

Also refer to Fig. ① on the folding page at the front of this manual.



Never connect the yellow TRANSFORMER terminal to the red CONTROL UNIT terminal.

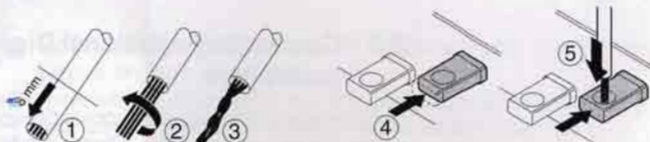
This may cause damage to the CONTROL UNIT when it is switched on.

Since Märklin 1 makes use of two-rail track, the red feeder wire is connected to one rail and the brown feeder wire to the other rail. We recommend the 5654 track feeder set for this. If you are using of the older Märklin 1 feeder tracks (example: 5992), the capacitor built into these tracks for preventing interference with radio or television reception must be removed.

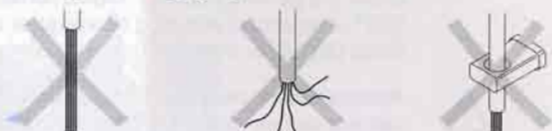
The choice of which rail to connect the red feeder wire to is entirely up to you. Just make sure that the red wire is always connected to the same rail for the entire layout (the same holds true for the brown wire).

On larger layouts additional feeder tracks should be installed every 2 to 3 meters (approx. 6 to 10 feet). By connecting feeder wires directly from the track power output on the Control Unit to these points, you will be assured of having sufficient power for distant points on the layout.

Preparing and connecting the wires



Bearing in mind:



Long tracks?

Several feeder tracks are required for longer track routes. To ensure reliable operation, a feeder track should be installed approx. every 2 m and connected to the red and brown terminals on the CONTROL UNIT (or BOOSTER).

A lot of trains?

Install additional BOOSTERS and TRANSFORMERS in the system to handle additional *power requirements* (also refer to Chapters 7 and 8).

Feeder tracks without capacitors

The feeder tracks used in conjunction with Märklin Digital must *not* contain capacitors. Always use feeder tracks without capacitors when building a new layout:

- M track: No. 5111
- K track: No. 2290 or standard K track with terminals 7500 and 7504

With C Track or Märklin 1 any piece of track can function as a feeder track. **The 74050 and 74045 feeder wire sets for C Track should on no account be used here.**

Removing capacitors

Any capacitors in the feeder tracks of existing layouts must be removed. To do this, cut through at least one of the capacitor connecting wires.

- M track: capacitor is mounted under the track road bed and *cannot be seen* from outside. Test whether a capacitor is present or not, refer to Chapter 9.9.
- K track: capacitor is visibly mounted next to the terminals.
- 1 Gauge track: The earlier 5990 and 5992 feeder tracks have an interference suppressor condenser under the feeder clips that must be removed.

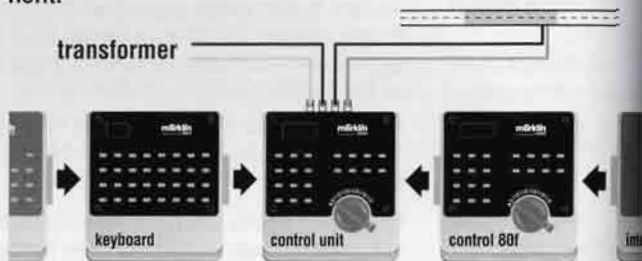
3.2 Connecting additional Digital locomotive controllers

Locomotive controllers and accessory controllers are combined under the general heading "Digital controllers". The CONTROL UNIT is equipped with plug connectors on either side for additional Digital controllers.



Always disconnect the TRANSFORMER from the household current before connecting or removing any Digital component.

Connecting additional Digital controllers



Digital locomotive controllers on the right

Additional Digital locomotive controllers must always be plugged into the connector on the *right-hand side* of the CONTROL UNIT. Digital locomotive controllers include: CONTROL 80 F, CONTROL 80, INFRA CONTROL and INTERFACE. The maximum possible configuration includes 9 additional locomotive controllers (including INTERFACE).

Digital accessory controllers on the left

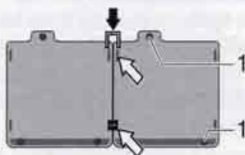
Additional Digital accessory controllers, on the other hand, must always be plugged into the connector on the *left-hand side* of the CONTROL UNIT. Digital accessory controllers include: KEYBOARD, SWITCHBOARD and MEMORY. The maximum possible configuration includes 16 KEYBOARDS/ SWITCHBOARDS and 4 MEMORIES.

Note

If the configuration of your layout includes a large number of Digital controllers, the CONTROL UNIT should be exclusively used to supply power to the controllers. In this case locomotives and solenoid accessories must receive their power from one or several BOOSTERS (cf. Chapter 7).

Securing plug-in connections

- Fit the plastic clips supplied with the components into the recesses on the bottom of the units.
- If necessary, also mount the components onto a baseplate with screws (using the holes provided for this, item 1).



Using interconnecting cables

Digital controllers may also be located a certain distance away from the CONTROL UNIT if interconnecting cables are used. This may be an advantage if, for example, a large layout is to be controlled from different stations.

Interconnecting wires between the Digital controllers:

ADAPTER 60 (No. 6039): 60 cm (23-1/2") long.

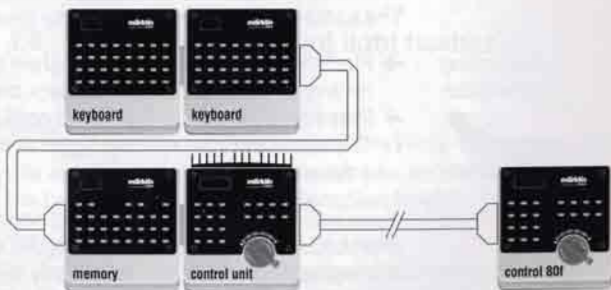
ADAPTER 180 (No. 6038): 180 cm (71") long.

The total length of all interconnecting wires should not exceed 6 m (20 feet).



The layout of the components shown below (locomotive controllers always on the right of the CONTROL UNIT and accessory controllers always on the left) must always be maintained, even if interconnecting cables are used. Non-compliance with this rule may cause damage to the incorrectly connected components.

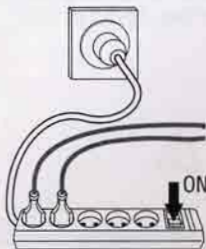
Correct use of interconnecting cables



4. Digital system operation

4.1 Switching on and off

Switching on



→ Connect the TRANSFORMER plug to the household current. If you are using more than one TRANSFORMER, plug them into a multiple socket-outlet.

- The LED pilot lights in the top right-hand corners of the TRANSFORMER and CONTROL UNIT light up.
- The number 99 lights up briefly on the CONTROL UNIT and on all additional Digital locomotive controllers (automatic reset when switched on).
- The LEDs above buttons "L" and "F" light up.
- The CONTROL UNIT activates the power supply to the tracks: you may now start operations.

Switching off

→ Disconnect the TRANSFORMER from the household current.

Note

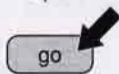
Once switched off, the LED pilot light on the CONTROL UNIT flashes until the voltage in the CONTROL UNIT has been discharged.

4.2 Overload cut-off

CONTROL UNIT
behavior

The CONTROL UNIT immediately shuts off the power supply to the track in the event of an overload or a short circuit. The LED pilot light on the CONTROL UNIT goes out. The power supply to the Digital controllers remains on, however, and the locomotive controllers retain the programmed locomotive addresses. The same result can be achieved by pressing the "stop" button.

Resuming
operation



- First eliminate the cause of the short circuit/overload (example: put a derailed train back on the track).
- Press the "go" button briefly (do not keep it pressed down).
- The trains will start running again at the previously set speed if the cause of the fault has been eliminated.

Note

If you keep the "go" button pressed down although there is still a short circuit in the system, the CONTROL UNIT makes several starting attempts before automatically triggering a reset.

4.3 Reset

- Function** Returns all Digital components to their original state when switched on. A reset erases any locomotive addresses and speeds entered into the locomotive controllers.
- Purpose**
- Restarting operation following a brief power failure (also refer to the following chapter).
 - Reading in new addresses programmed into the KEYBOARDS or other Digital components (refer to the respective operating instructions).

Initiation



- Press the "stop" and "go" buttons simultaneously.
- The number "99" lights up briefly on the CONTROL UNIT display and all locomotive controllers.



- Note** Disconnecting and reconnecting the TRANSFORMER plug to the household current only triggers a reset if you wait for at least 10 seconds before reconnecting. If this is not the case, only the CONTROL UNIT LED pilot light starts flashing. Trigger a reset by pressing the "stop" and "go" buttons.

4.4 CONTROL UNIT pilot light flashes – power failure

- System behavior** If
- all trains come to a halt and
 - the LED pilot light on the CONTROL UNIT starts flashing, during normal operation for no obvious reason, the power supply has been interrupted briefly.
- Remedy** Trigger a reset on the CONTROL UNIT:
- Press the "stop" and "go" buttons simultaneously.
 - The number "99" will be displayed briefly on the CONTROL UNIT and on all other locomotive controllers.
 - Restart all trains, refer to Section 5.4.

5. Digital locomotive operation

5.1 Basic equipment

The CONTROL UNIT is the central component of the Digital system and also contains a full-scale Digital locomotive controller. For Digital locomotive operation, you also require a Märklin TRANSFORMER for the power supply and at least one Digital locomotive.

Basic equipment for
"Digital locomotive
operation"



Digital locomotives

There are various types of Märklin Digital locomotives. The first two digits in the Märklin item number give information in this respect:

36..: Locomotives with standard digital decoders.

37..: Locomotives with the 6090 high-efficiency propulsion kit.

The top speed can be programmed in the decoders of these models (for example different top speed for a switching engine and an express train).

An adjustable acceleration and braking delay simulates the responses of a heavier train.

30.. to 35..: Locomotives for conventional systems.

Must be converted with a digital decoder.

38..: Locomotives for the two-rail Digital system.

Must be converted with a digital decoder for the three-rail Digital system.

Consult your Märklin dealer for advice and conversion.

Refer to the Märklin catalog for more detailed information.

Universal
locomotives,
MAXI
locomotives

H0 locomotives with a built-in DELTA module or MAXI locomotives can be operated on a digital layout with the addresses 02, 06, 08, 18, 20, 24, 26, 54, 56, 60, 62, 72, 74, 78 or 80. Please note the information on this in the locomotive instructions.

5.2 Programming the locomotive address

Coding switches in the locomotive decoder

Each Digital locomotive contains a locomotive decoder with a set of 8 coding switches (apart from a few exceptions). The housing of the locomotive must be removed to program the digital address (refer to the respective instructions for the locomotive).

The coding switches are used to enter an address of between 1 and 80. The following table shows the locomotive addresses and the associated switch settings. All switches indicated below must be set to ON. All other switches must be set to OFF.

Table of locomotive addresses

Address	Switch to ON	Address	Switch to ON	Address	Switch to ON
01	- 2 3 - 5 - 7 -	28	- 2 3 - 5 - - 8	55	- 2 3 - 5 - - -
02	- - 3 - 5 - 7 -	29	- - 3 - 5 - - 8	56	- - 3 - 5 - - -
03	1 - - 4 5 - 7 -	30	1 - - 4 5 - - 8	57	1 - - 4 5 - - -
04	- 2 - 4 5 - 7 -	31	- 2 - 4 5 - - 8	58	- 2 - 4 5 - - -
05	- - - 4 5 - 7 -	32	- - - 4 5 - - 8	59	- - - 4 5 - - -
06	1 - - - 5 - 7 -	33	1 - - - 5 - - 8	60	1 - - - 5 - - -
07	- 2 - - 5 - 7 -	34	- 2 - - 5 - - 8	61	- 2 - - 5 - - -
08	- - - - 5 - 7 -	35	- - - - 5 - - 8	62	- - - - 5 - - -
09	1 - 3 - - 6 7 -	36	1 - 3 - - 6 - 8	63	1 - 3 - - 6 - -
10	- 2 3 - - 6 7 -	37	- 2 3 - - 6 - 8	64	- 2 3 - - 6 - -
11	- - 3 - - 6 7 -	38	- - 3 - - 6 - 8	65	- - 3 - - 6 - -
12	1 - - 4 - 6 7 -	39	1 - - 4 - 6 - 8	66	1 - - 4 - 6 - -
13	- 2 - 4 - 6 7 -	40	- 2 - 4 - 6 - 8	67	- 2 - 4 - 6 - -
14	- - - 4 - 6 7 -	41	- - - 4 - 6 - 8	68	- - - 4 - 6 - -
15	1 - - - 6 7 -	42	1 - - - 6 - 8	69	1 - - - 6 - -
16	- 2 - - - 6 7 -	43	- 2 - - - 6 - 8	70	- 2 - - - 6 - -
17	- - - - - 6 7 -	44	- - - - - 6 - 8	71	- - - - - 6 - -
18	1 - 3 - - - 7 -	45	1 - 3 - - - 8	72	1 - 3 - - - -
19	- 2 3 - - - 7 -	46	- 2 3 - - - 8	73	- 2 3 - - - -
20	- - 3 - - - 7 -	47	- - 3 - - - 8	74	- - 3 - - - -
21	1 - - 4 - - 7 -	48	1 - - 4 - - 8	75	1 - - 4 - - -
22	- 2 - 4 - - 7 -	49	- 2 - 4 - - 8	76	- 2 - 4 - - -
23	- - - 4 - - 7 -	50	- - - 4 - - 8	77	- - - 4 - - -
24	1 - - - - 7 -	51	1 - - - - 8	78	1 - - - - -
25	- 2 - - - - 7 -	52	- 2 - - - - 8	79	- 2 - - - - -
26	- - - - - 7 -	53	- - - - - 8	80	1 - 3 - 5 - 7 -
27	1 - 3 - 5 - - 8	54	1 - 3 - 5 - - -		

8 coding switches



Please note that on 1 Gauge locomotives the "digital" mode of operation is specially set on the decoder. Additional information on this can be found in the locomotive instructions.

5.3 Controlling Digital locomotives from the locomotive controller

5.3.1 Addressing a locomotive

Prerequisite

The LED above the "L" on the locomotive controller is illuminated (the LED above the "F" button may also light up).

Enter the locomotive address

→ Enter the two digits for the address of the locomotive in question (between 01 and 80), for example "08".



Display starts flashing



- The address must light up continuously on the LED display.
- Control the speed of the train with the speed control knob.

If the displayed address starts flashing, the system is unable to control the locomotive.

- The programmed address was outside the range of 01 to 80
- the programmed address has already been selected by another locomotive controller (or the INTERFACE).

5.3.2 Reversing direction

→ Turn the speed control knob to the left, beyond the zero position, until you hear a gentle "click" in the locomotive controller (not in the locomotive).



With the CONTROL UNIT and UNIVERSAL modes of operation (=> Section 2) there is a direction of travel indicator to the right of the address display.

Arrow pointing up: forward direction

Arrow pointing down: reverse direction

This direction of travel indicator may not be activated with all versions of the decoders. If the direction of travel indicator does not agree with the locomotive's actual direction, remove the locomotive from the layout, reverse direction at the locomotive controller, and then set the locomotive back on the track. Now the direction of travel indicator will be the same as the locomotive's actual direction.

5.3.3 Addressing other locomotives from the same locomotive controller

Several locomotives can be controlled from one locomotive controller at the same time. For this:

- Enter the address for the 1st locomotive.
- Use the speed control knob to set the speed for the 1st locomotive.
- Enter the address for the 2nd locomotive.
(The 1st locomotive continues running in the previously set direction at the previously set speed.)
- Use the speed control knob to set the speed for the 2nd locomotive, etc.

5.3.4 Taking over a moving locomotive at a locomotive controller

- Enter the 1st digit of the address for the moving locomotive.
- Set the speed control knob to approximately the speed at which the locomotive is travelling. (The auxiliary function is automatically retained when the locomotive is taken over.)
- Enter the 2nd digit of the address: the locomotive can be controlled from the new locomotive controller as soon as the address lights up constantly on the display.

5.3.5 Operation with several locomotive controllers

A locomotive can only be addressed from one locomotive controller at any one time. If the same locomotive address is entered at another locomotive controller, the address will start flashing. The locomotive remains under the control of the first locomotive controller. This also applies to the INTERFACE (also refer to Chapter 5.8).

Releasing a locomotive

A locomotive can only be controlled from another locomotive controller after a different locomotive address has been entered into the first locomotive controller.

5.3.6 Activating Functions

Almost all digital locomotives have at least one controllable function. You must learn to distinguish between the auxiliary function and the other 4 controllable locomotive functions. The auxiliary function is turned on with the "function" button and turned off with the "off" button. The additional locomotive functions are switched on and off with the buttons "f1", "f2", "f3" and "f4".

Auxiliary function



The auxiliary function varies according to the type of locomotive, example: headlights, TELEX coupler or smoke. Refer to the operating instructions for your locomotive for information concerning auxiliary function.

Continuous contact

To activate: press the "function" button.



To deactivate: press the "off" button.

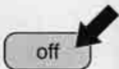


Momentary contact

To activate the auxiliary function briefly (example: for the TELEX coupler):

To activate: press the "off" button.

To deactivate: release the "off" button.



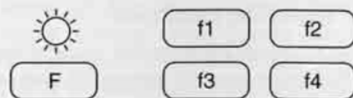
Locomotive functions:

Many Märklin models in the standard 1 Gauge program as well as several H0 locomotives have up to 4 other controllable locomotive functions.

Note: The locomotive functions can be turned on and off only when the CONTROL UNIT or UNIVERSAL modes of operation are turned on. (Sec. 2)

Since the 4 locomotive functions can also be used to turn working models on and off, it is possible on the CONTROL UNIT or a CONTROL 80f connected to the CONTROL UNIT to call up these functions simultaneously under an address different from that for the usual locomotive control (speed controller, auxiliary function). This is not necessary with the locomotive models, however. For that reason please make sure that the LEDs for the "L" and "F" buttons are on simultaneously (=> Sec. 5.5).

The buttons "f1", "f2", "f3", and "f4" are for turning the locomotive functions on and off.



Activating functions

Press one of buttons "f1" to "f4". The associated LED lights up when a function has been selected.

5.4 Suspending and resuming operation

Suspending operation



→ Press the "stop" button on the CONTROL UNIT or on one of the other Digital locomotive controllers.

- This interrupts the output voltage to the track and the LED pilot light on the CONTROL UNIT goes out.
- All trains come to a halt (without allowing for any braking delays that may have been programmed).
- The power supply to the Digital controllers is maintained. The direction, speed and auxiliary functions of all locomotives are stored in the memory.

stop

Resuming operation

→ Press the "go" button on the CONTROL UNIT:

- All locomotives start moving again at their previously set speeds.

go

Note

The speeds of one or more locomotives may be changed to avoid a collision, for example, while the "stop" command is in effect. To do this:

- Enter the address of the 1st locomotive, use the speed control knob to alter the speed.
- Enter the address of the 2nd locomotive, alter the speed, etc. The commands are only forwarded to the track when the "go" button has been pressed. It is therefore possible that the locomotives continue to travel for a few inches at their original speed before the new settings are adopted.

5.5 Controlling functional models

What are functional models?

Some Märklin models contain built-in function decoders. The 60960 function decoder can be used to convert model railroad cars into cars with working functions. A decoder of this type can be used to activate and deactivate various functions, example: motors, lighting etc. The vista dome car 4999 (no longer available) and the Digital slewing crane 7651 are examples of such functional models.

The 4998 and 4999 working cars, the 7651 digital rotary crane, and the 2681 Kaiser Wilhelm train can be operated only in the CENTRAL UNIT or UNIVERSAL operating modes. The 60960 function decoder can be operated only in the CONTROL UNIT or UNIVERSAL operating modes. Please note the references for the different modes of operation in Section 2.

Function decoder addresses Like the locomotive decoders, each function decoder is assigned a digital address. Please refer to the respective operating instructions for information concerning the programming of the function decoder in your functional model.

Selecting a function decoder For locomotive decoders with more than one controllable function, the address set on the decoder applies to both the locomotive and function areas. When installing a separate function decoder (example: 60960), you can give different addresses to the locomotive decoder in the locomotive and the function decoder in a car with working functions. Although the locomotive decoder and the function decoder can be operated at the same time, this allows the CONTROL UNIT to manage simultaneously a function decoder address different from that for the locomotive decoder.

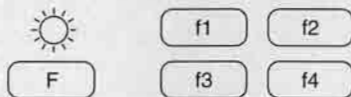
The two addresses are set equal when the CONTROL UNIT is switched on. This is indicated by the fact that the two LEDs above the "L" (locomotive decoder) and "F" (function decoder) light up together. When a locomotive address is entered, this is also the address of the function decoder.

Buttons for functional models



Buttons "F", "f1", "f2", "f3" and "f4" are used to control the function decoders.

(This is independent of the locomotive's auxiliary function controlled with the "function" and "off" buttons, refer to Chapter 5.3.3).



Activating functions Press one of buttons "f1" to "f4". The associated LED lights up when a function has been selected.

Independent selection of a function decoder address



→ Press the "F" button.

- You may continue to control the previously selected locomotive (speed and auxiliary function).

→ Enter the two-digit function decoder address.

Example:



→ Activate the required function.

Independent selection of a locomotive address



→ Press the "L" button.

- The previously selected function remains active.

→ Enter the new locomotive address.

Example:



→ Control the locomotive.

Setting locomotive and function decoder addresses equal



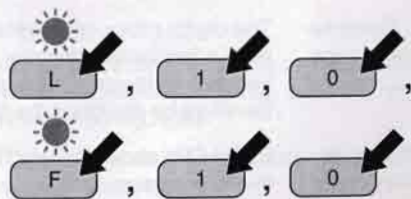
→ Press the "F" button.

→ Enter the function decoder address.

→ Press the "L" button.

→ Enter the same locomotive address.

Example:



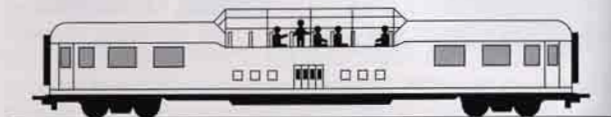
The two LEDs above the "L" and "F" buttons light up together. All subsequently entered addresses apply to both locomotive and function decoders.

Example
Vista dome car

The vista dome car has been programmed with function decoder address "10". If this car is part of a multiple-unit train, the most convenient solution is to assign the address "10" to the locomotive of this train as well (refer to Chapter 5.2 "Programming the locomotive address").

All you need to do now is to enter the address "10" to enable direct control of the train and the functions of the vista dome car.

Vista dome car



If the locomotive and function decoder addresses are different, you will have to program the addresses separately under "L" and "F" as described on the previous page. You will then be able to control the selected locomotive and activate/deactivate the functions of the selected function decoder.

The functions of the vista dome car can be controlled with buttons "f1" to "f4":

f1 on, f2 off: waiter moves forwards
 f1 off, f2 on: waiter moves backwards
 f1 on, f2 on: waiter stops moving
 f1 off, f2 off: waiter stops moving
 f3 on/off: table lighting on/off
 f4 on/off: interior lighting on/off

Example
Digital rotary crane

The digital rotary crane is a special functional model: it contains a locomotive decoder *and* a function decoder, both set to the same address (programmable). No other locomotive should therefore be assigned the same address.

Controlling the
rotary crane

Both LEDs above "L" and "F" **must** light up together to operate the rotary crane.
 (If not: refer to the section "Setting locomotive and function decoder addresses equal" on the previous page.)



- Enter the address for the rotary crane on the locomotive controller.
- Select one of the two motors with button "f1" or "f2",
- then use the speed control knob to control the speed and direction of travel for this motor.

f1 on, f2 off: to activate the rotary motor

f1 off, f2 on: to activate the lifting motor

f1 on, f2 on: both motors off

function/off: to activate/deactivate the electromagnet

5.6 Mixed operation with digital and analog components

Digital locomotive
on a conventional
layout

Digital locomotives may also be used on a conventional layout. The speed control knob of a conventional system is used to control the speed and direction. The auxiliary function cannot be switched, however.

Conventional loco-
motives on a
Digital layout

Conventional locomotives may only be used in a Digital system (without conversion) to a limited extent:

They travel at a constant speed and are not affected by the setting of the speed control knob on the Digital locomotive controller. They cannot change direction.

The locomotives may be brought to a halt on signal controlled blocks, however.

Conventional locomotives may be converted for Digital locomotive operation by your local Märklin dealer.

5.6.1 Mixed layouts

Conventional
subsections

The catenary or certain subsections of a model railway may still be operated in the conventional manner, while the rest of the layout has been converted to Digital.

On Märklin 1 Gauge layouts it is not possible to set up part of the layout for conventional operation.

Electric connection

The red "B" socket (train current) must never be connected to the yellow "L" socket (lighting current).

The ground wires from the conventional and Digital power supplies may be connected together.

Using rocker insulators



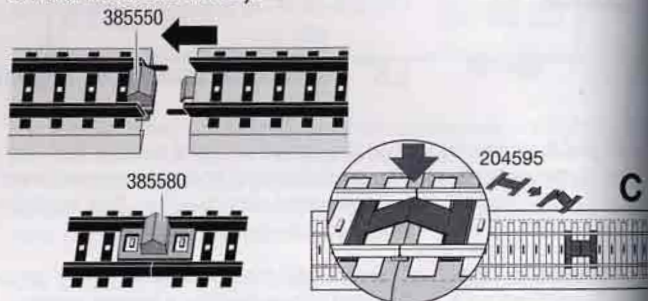
In addition to the usual insulation of the junction points (refer to Chapter 7.2), always fit "rocker insulators" across the third rail at all junctions between the two systems.

(M track: no. 38 5550, K track: no. 38 5580, C Track: no 204595, each comes in package with 5 pieces.)

If these are not installed, the pickup shoes may briefly connect the two circuits.

Locomotives or cars with several (electrically linked) pickup shoes should not cross these junctions.

Rocker insulators



5.6.2 Using conventional transformers

Power supply for lamps

Conventional transformers may still be used for the power supply of street lamps, house lighting, etc.

Power supply for the Digital system

A conventional Märklin transformer may also be used to power a CONTROL UNIT or a BOOSTER in principle.

The "yellow/brown" sockets are also used to connect it up. The available output power is much lower than that provided by the TRANSFORMER, however, which was specially developed for the Digital system. High power requirements of a Digital layout may cause the overheating protection of a conventional transformer to shut off the power.

5.7 Other literature

You will find more detailed information concerning these topics and electrical systems for model railways in a wide range of Märklin information pamphlets:

- Electrical manual H0
- "märklin TELEX"
- Club of North America Digital Newsletter
- Digital book

5.8 Upgrading options

One locomotive controller

A single locomotive controller can be used to program the speeds of several Digital locomotives *in succession*. Any locomotives which have not been selected continue to travel at the previously set speed.

Several locomotive controllers

It is advisable to use several locomotive controllers if you wish to control a large number of locomotives *simultaneously*.

The locomotive controllers include: CONTROL 80, CONTROL 80 F, INFRA CONTROL and INTERFACE.

9 locomotive controllers may be connected up in any configuration in addition to the CONTROL UNIT.

All locomotive controllers must be connected to the right-hand side of the CONTROL UNIT (refer to Chapter 3.2).



Example using several locomotive controllers



5.8.1 Main features of additional locomotive controllers

Standard locomotive controllers

The functions of the CONTROL 80 F locomotive controller are exactly the same as the locomotive controller in the CONTROL UNIT.

With the CONTROL 80 locomotive controller offered previously in the Märklin assortment is not equipped with the buttons required to control the functional models.

"Mobile locomotive controller"

The INFRA CONTROL offered previously in the Märklin assortment offers similar facilities to the CONTROL 80 F. It is driven by a small infrared remote controller. This enables you to operate your model railway from any position in the room.

Computer connection

The INTERFACE can be used for fully automatic or semi-automatic computer control of the entire layout. Various standard programs are available for different computer systems, or you can write the programs to control the model railway yourself.

6. Digital accessory control

The general term "Digital accessory control" is used to describe the activation of solenoid accessories, for example turnouts, signals, uncoupler tracks etc., using the Digital accessory controllers.

6.1 Basic equipment

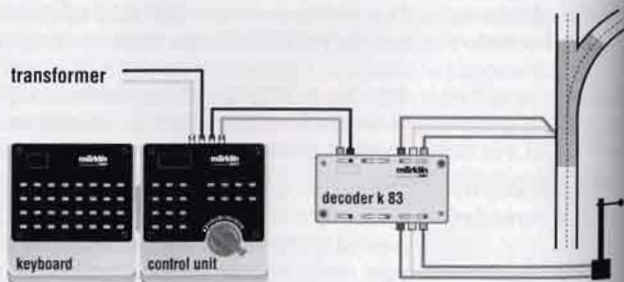
The CONTROL UNIT and the TRANSFORMER are always required for "Digital accessory control".

You will also require at least

- one KEYBOARD each capable of handling 16 solenoid accessories, or an INTERFACE;
- one solenoid accessory DECODER k 83 (or even k 84) for 4 turnouts/signals each or
- The k 73 turnout decoder or the installation decoder for C Track (74460) for installation into a solenoid accessory (retrofitting also possible). This does not require any extra wiring at all.

Note: The installation decoder can only be used in a layout with Digital locomotive operation, as they receive their information straight from the track.

*Basic equipment for
"Digital accessory
control"*



6.2 The KEYBOARD (Digital accessory controller)

Buttons The KEYBOARD contains 16 pairs of red and green buttons for the switching of solenoid accessories.
A switching command remains active as long as the button is pressed.

Light-emitting diodes (LEDs)

The positions of the solenoid accessory are indicated by 16 red LEDs. An LED lights up when the switching function of the associated *red* button is being executed. (The LEDs on the KEYBOARD also indicate execution of a switching command from the MEMORY or INTERFACE).

KEYBOARD



- 1 Multi-pin connector to the CONTROL UNIT
- 2 16 pairs of buttons
- 3 Plug connector for additional Digital accessory controllers
- 4 Label area to enter the programmed address
- 5 4 coding switches on the rear panel

Connecting the KEYBOARD

KEYBOARDS must always be connected to the left-hand side of the CONTROL UNIT.



Pay particular attention to this rule when adapter cables (item No. 6038, 6039) are used to connect KEYBOARDS, refer to Chapter 3.2.

Programming the KEYBOARD address The maximum Digital system configuration includes 16 KEYBOARDS. The 4 coding switches on the rear panel are used to program one of 16 addresses.

Table of KEYBOARD addresses

Keyboard-No.	Switch to ON	Keyboard-No.	Switch to ON
1	- - - -	9	- - - 4
2	1 - - -	10	1 - - 4
3	- 2 - -	11	- 2 - 4
4	1 2 - -	12	1 2 - 4
5	- - 3 -	13	- - 3 4
6	1 - 3 -	14	1 - 3 4
7	- 2 3 -	15	- 2 3 4
8	1 2 3 -	16	1 2 3 4

Example Programming the address for the 4th KEYBOARD:
 → Set switches 1 and 2 to ON, switches 3 and 4 to OFF.
 → Reset the CONTROL UNIT, refer to Chapter 4.3.

Coding switches



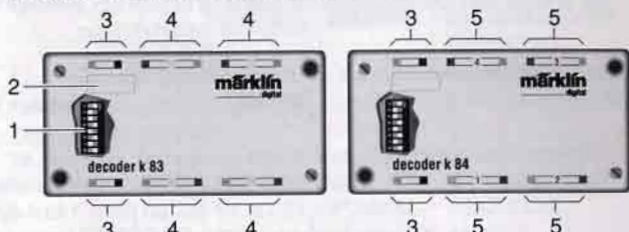
Attach address label Position the label with the programmed address on the label area in the top left-hand corner.

Note You may also program several KEYBOARDS under a single address, if you wish to control a large layout from several different stations.
 You should not, however, exceed the maximum number of 16 KEYBOARDS.

6.3 The k 73, k 83, k 84 decoders and the C Track installation decoders

The k 73, k 83 decoders and the C Track installation decoders (74460) are required to translate the switching commands from the digital accessory controllers (KEYBOARD, MEMORY or INTERFACE) for turnouts and signals. The k 84 DECODER is used for switching continuous currents (example: lighting circuits).

k 83 and k 84
DECODERS



- 1 8 coding switches inside the DECODER
- 2 Label area to make a note of the programmed address
- 3 "Red/brown" socket for connection to the CONTROL UNIT or BOOSTER
- 4 "Red/yellow/green" sockets (k 83) to connect the solenoid accessories
- 5 Sockets (k 84): continuous contact of the "red" or "green" socket to the "numbered" socket.

k 83 DECODER The k 83 DECODER (item No. 6083) handles all devices which require a short switching impulse, example: turnouts, signals, uncoupler tracks etc. It only supplies current as long as a button on the KEYBOARD is pressed (or for the duration of a switching command from a MEMORY or computer).

k 73 DECODER The k 73 built-in DECODER (item No. 6073) operates in the same way as a k 83 DECODER but has only one output. Your dealer can build a k 73 DECODER into a solenoid accessory of your choice that offers enough room for it. The solenoid accessory in question then no longer requires any additional wiring.

C Track installation decoder: The C Track installation decoder (74460) is a special version of the k 73 decoder for installation in standard, curved and double slip turnouts.

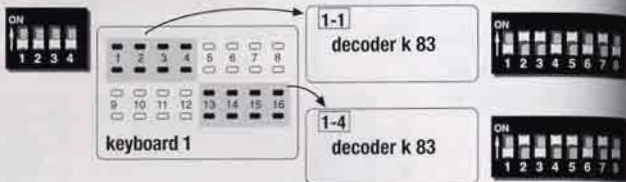
k 84 DECODER The k 84 DECODER (item No. 6084), on the other hand, is used to switch lighting systems or circuits on and off from a Digital accessory controller (continuous contact).

6.3.1 Programming DECODER address

Assignment of DECODERS to KEYBOARDS

k 83 and k 84 DECODERS each have 4 outputs, which are assigned to four successive pairs of buttons on a KEYBOARD. You therefore need 4 DECODERS if you wish to use all 16 pairs of buttons on a KEYBOARD.

Relationship between the KEYBOARD and DECODER addresses



Reprogramming DECODER address

On delivery, all DECODERS are programmed for decoder address "1 - 1", i.e. for button pairs 1 to 4 on the first KEYBOARD. If you wish to use the DECODER in conjunction with other buttons, the DECODER address must be reprogrammed with the 8 coding switches inside the DECODER:

Coding table

- Undo 2 screws in the housing and remove the cover.
- Set the coding switches according to the table on the folding page at the back of this manual. It is advisable to use a fine screwdriver or tweezers for this.





Note

- Enter the programmed DECODER address in the label area at the top left-hand corner of the housing right away. An incorrectly programmed DECODER address is a frequent cause of malfunctions.

Example

Programming the DECODER for buttons 13 to 16 on the first accessory controller:

Excerpt from the coding table

 Accessory controller	 -No. Button No.	 Decoder DEC. No.	 ON Coding switches to ON
1	13...16	1-4	- 2 - 4 5 - 7 -



- Set switches 2, 4, 5 and 7 to ON, switches 1, 3, 6 and 8 to OFF.

Connecting k 83/
k 84 DECODERS

Use the red and brown wires to connect the DECODER to the CONTROL UNIT or to a BOOSTER (refer to the color pictures on the folding pages).

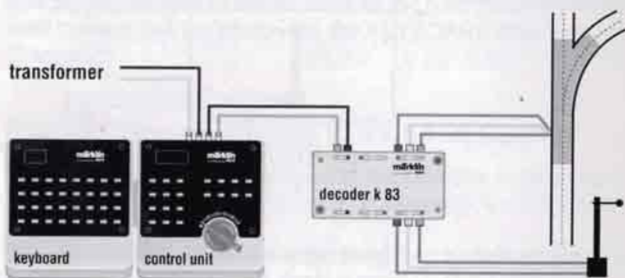
6.4 Connecting solenoid accessories to a k 83 DECODER

Standard
connection

Most solenoid accessories have a yellow wire (yellow connector) for the power supply and two blue wires (red and green plugs) to control the solenoids.

→ Plug the three plugs into the sockets of the corresponding colors on the k 83 DECODER.

Connecting
standard
solenoid accessories



Important

If a k 83 DECODER is used to switch solenoid accessories, their yellow wires must always be connected to the yellow socket on the k 83.

The yellow wire must **never** be connected to the TRANSFORMER (as is usual in conventional systems).

Note

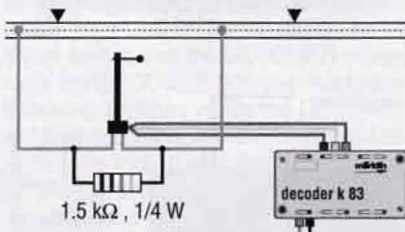
All solenoid accessories should be connected up according to the same color coding:

Red plug: red signal, turnout set for "branch"
Green plug: green signal, turnout set for "straight"

The correct method of connecting the most common solenoid accessories is shown in Fig. ④ on the folding pages at the back of this manual.

- Three-way turnouts Require two k 83 DECODER outputs.
- Uncoupler track Two uncoupler tracks may be switched with a pair of buttons on the KEYBOARD. The two yellow wires are connected together.
- Standard home signal Standard connection to the DECODER.
Connect a 1.5 kΩ, 1/4 watt resistor between the 2 third rail terminals. Two of these resistors (for 2 signals) are supplied with each k 83 DECODER.
This ensures that the locomotives always receive the digital information intended for them, even when signalled to stop.

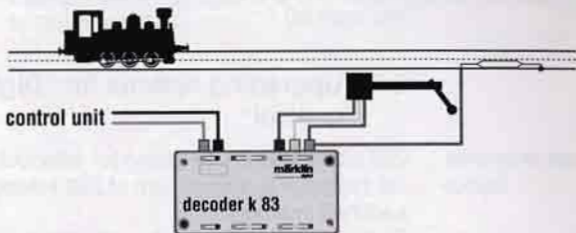
Installing a resistor



- Home signals
7041/7241 These signals indicate 3 positions:
Stop = Hp 0, Go = Hp 1 and Reduce speed = Hp 2.
They have 3 blue connecting wires and therefore occupy two DECODER outputs.
- Distant signals Distant signals may be connected to the same DECODER output as the home signal or to a separate output.

Tip Solenoid accessories may also be controlled directly by a track contact (circuit track, reed contact) in addition to the k 83 DECODER. This enables you to set up a simple train-controlled automatic circuit even if your Digital system is not equipped with a MEMORY.

Using contacts to control solenoid accessories



The signal changes to red as soon as the train passes over the reed contact, but the display on the KEYBOARD does not change.

6.5 Connecting circuits to a k 84 DECODER

The k 84 DECODER provides constant contacts at its outputs. Each of the four outputs comprises a relay with a changeover contact.

It is used to activate and deactivate lighting systems, motors or the power supply to individual track sections from a Digital accessory controller.



The "power source" is usually connected to a socket marked with a number. This socket is either connected to the socket marked green or to the socket marked red via the changeover contact.

Only one of the sockets is usually used to activate and deactivate a connected load (usually the green terminal).

Tip A signal controlled block in a hidden section of a layout may be equipped with universal relay 7245 or a k 84 DECODER (cf. track section "A" in Fig. ④ on the folding page at the back of this manual).

6.6 Upgrading options for "Digital accessory control"

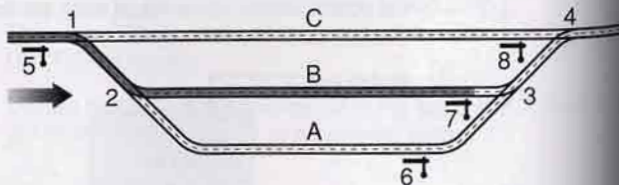
More extensive layout 256 addresses are available for solenoid accessories in the Digital system, i.e. a maximum of 256 solenoid accessories can be switched independently.

Each KEYBOARD has 16 pairs of buttons, so that a maximum of 16 KEYBOARDs can be used for 256 addresses.

Automatic operation Switching operations may also be initiated by the moving trains themselves, as long as circuit tracks or reed contacts are installed in the track at suitable positions. The contacts may also be connected to a set of turnouts or a signal for direct control of the solenoid accessories (cf. diagram on the previous page).

Using "routes" The MEMORY enables you to define a sequence of switching commands as a route and to activate this route later by pressing a single button.

*Example
Entry route*



Computer connection Used in conjunction with an INTERFACE and a suitable program, a computer offers a versatile means of

- controlling locomotives and functional models and
- switching turnouts and signals.

**Convenient auto-
matic operation**

The MEMORY and the INTERFACE are capable of evaluating the information from contact tracks, reed contacts and circuit tracks via the s 88 DECODER (track detection module) and controlling the train traffic accordingly.

You will find detailed examples of these features in the respective operating instructions and in other Märklin publications (refer to Chapter 5.7).

7. Layouts with high power requirements

If the power requirements of your layout exceed the capacity of one "supply unit" (TRANSFORMER and CONTROL UNIT), you will have to split the layout into several circuits. The additional circuits then receive their power supply via BOOSTERS. Each BOOSTER requires its own TRANSFORMER for a power supply.

7.1 Estimating your power requirements

You can estimate the power requirements for your layout yourself. (Note: 1 VA = 1 watt)

Power required by typical users	- H0 locomotive (1 motor) in motion	approx. 10 VA
	- Model railway light bulb	approx. 1.5 VA
	- Solenoid accessory when activated	approx. 5 - 10 VA
	- Digital controller on average	approx. 2 VA
	- Märklin 1 Gauge locomotive in motion (1 motor)	15 VA
	- Märklin 1 Gauge locomotive in motion (2 motors)	20-25 VA

Maximum output power The maximum output power provided by the CONTROL UNIT or a BOOSTER amounts to approx. 47 VA (for a transformer output power of 52 VA). This power is reduced accordingly if other loads are connected to the TRANSFORMER or if other controllers are connected to the CONTROL UNIT.

Example 3 trains are to travel on a medium-sized Digital layout at the same time, one of which has 4 lighted cars. The system comprises 1 CONTROL 80 F locomotive controller, 1 KEYBOARD and 1 MEMORY, i.e. 3 additional controllers. There are 16 lighted solenoid accessories. (Solenoid accessories without lighting need not be included in the calculation.)

Estimated power requirements:

3 locomotives	30 VA
4 lighted cars (= 8 light bulbs)	12 VA
3 additional controllers	6 VA
16 solenoid accessories with lights	24 VA
1 solenoid accessory during activation	10 VA

Total power 82 VA

The system certainly requires at least one BOOSTER with its own TRANSFORMER in addition to the CONTROL UNIT.

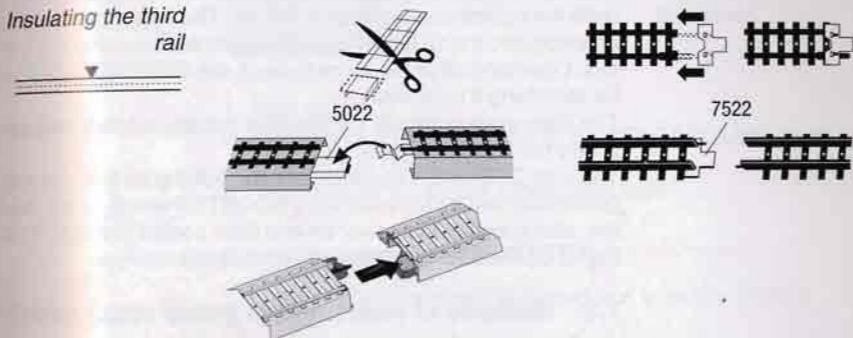
7.2 Splitting the circuits

The circuits must be divided up in such a way that the power requirement in any one power consumption area never exceeds 47 VA.



The third rails of each power consumption area must be carefully insulated from one another at all junction points. The ground wires, on the other hand, may be connected together.

Insulating the third rail



Märklin 1 Gauge track

On Märklin 1 Gauge track the rail connected to the red feeder wire is insulated with the 56091 plastic rail joiner.



Separate power for solenoid accessories

Wherever possible, no solenoid accessories should be connected to a power consumption area in which more than 3 trains are to run at the same time. A separate BOOSTER is required for approx. every 30 solenoid accessories with lighting (refer to Fig. ③ on the folding page at the front of this manual).

Many controllers

If your system contains more than approx. 15 Digital controllers, the CONTROL UNIT should no longer supply any power to the track. In this case, all train control circuits should receive their power supplies from BOOSTERS (refer to Fig. ③ on the folding page at the front of this manual).

- Tip** Divide a large layout into several smaller areas as you build it; each subarea must have at least one feeder track and isolated third rails.
The subareas may be connected to a single supply unit initially, it is then possible to convert the layout for connection of several BOOSTERS without disturbing the track.

Example

Example continued

In our previous example, the power requirement for the 3 trains (with the lighted cars) is approx. 42 VA. The controllers have to be connected to the CONTROL UNIT, which adds another 6 VA to this. Operating all of the trains through the CONTROL UNIT would be stretching it to its limits.
The track system should therefore be divided into two separate power consumption areas.
The k 83 DECODER and therefore the lighting for the solenoid accessories must be supplied via a BOOSTER which, in our example, also supplies the power for one train control circuit (refer to Fig. ② on the folding page at the front of this manual).

7.3 Methods of reducing the power requirements

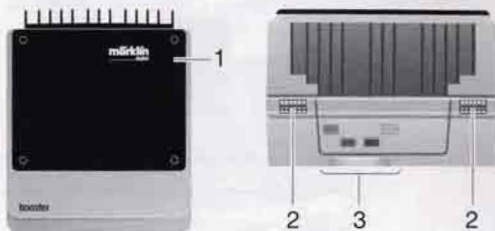
- Lighting** Lighting systems can often receive their power from a separate transformer (16 V AC):
- All lamps and motors connected via a k 84 DECODER.
 - All lighting systems which are completely independent of the Digital system, of course, such as street lamps, house lighting, etc.
 - Light signals frequently have a separate wire to supply power to the lamps, independent of the solenoid.
- Remove light bulbs** The light bulbs in hidden turnouts or signals can be removed.
- Connect light bulbs separately** Experienced do-it-yourself experts can also disconnect a light bulb from the solenoid inside a turnout and solder on a separate power wire for the light bulb. The lighting can then receive its power supply from a separate transformer.

8. The BOOSTER

Intended use

The BOOSTER and the TRANSFORMER have been designed only for model railway operation in dry areas.

*BOOSTER
top view and
rear panel*



- 1 LED pilot light
- 2 Multi-pin plug for connection to the CONTROL UNIT or another BOOSTER
- 3 Terminals for the power supply/track feed

8.1 Connecting a BOOSTER

Each BOOSTER must be connected to a separate TRANSFORMER.

Correct household voltage?

Before connecting up, check the following:
Does the voltage on the TRANSFORMER rating plate comply with the household voltage at your wall outlets?

Transformator	6002
PRI	230V 50/60Hz
SEC	
O-L	16V - 52 VA



Always disconnect the TRANSFORMER from the household current before connecting or removing any Digital component.

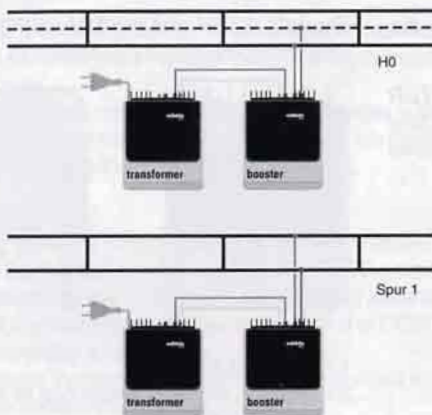
**Safety
information**

Observe all safety information in the TRANSFORMER instructions.

Always disconnect all transformers from the household current at the same time. Use a multiple socket-outlet with a built-in household current switch if possible.

Connecting the power supply

Yellow and brown terminals: to the TRANSFORMER
Red and brown terminals: to the feeder track/
k 83, k 84 DECODER.



Never connect the following together:

- the yellow TRANSFORMER terminal to the red terminal of the CONTROL UNIT or a BOOSTER;
- the yellow terminals on two TRANSFORMERS;
- the red terminal on the CONTROL UNIT to the red terminal on a BOOSTER;
- the red terminals on two BOOSTERS.

All brown ground wires, on the other hand, may be connected together.

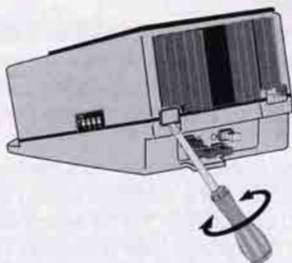
Control connections

There are two versions of the BOOSTER that can be used with the CONTROLL UNIT: The earlier 6015 BOOSTER and the current 6017 BOOSTER. The same connecting cable is included with both units, and it is connected to them differently according to the instructions included with each unit.

Important:

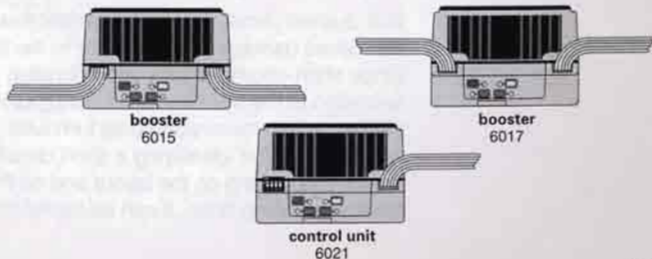
Before plugging the connection cable in, make sure which type of unit you have. If the connection cable is plugged in upside down, it may cause damage to the pins on the connection socket!

To prevent damage to them, the multi-pin sockets are protected by caps. The latter must be removed before connecting a cable to them.



The multi-pin socket on the left of a BOOSTER (when viewed from the back) is the input socket for the connecting cable. The socket on the right of the CONTROL UNIT or a BOOSTER (when viewed from the back) is the output socket for the connecting cable. The right output socket on the CONTROL UNIT is therefore connected with the cable to the left input socket on the first BOOSTER. The right output socket on the BOOSTER is then connected with a second cable to the left input socket on the second BOOSTER (etc.).

Depending on the type of unit, the connecting cable will point up or down where it is connected to a socket. On the CONTROL UNIT and the 6017 BOOSTER the cable must point up. On the 6015 BOOSTER the cable must point down. The connecting cable must never be plugged into the individual types of units the opposite of what has been described above!



8.2 Settings on the 6017 BOOSTER

Compared to the 6015 BOOSTER, the 6017 BOOSTER offers additional possible settings on the side.

The 6017 Booster has four coding switches on the right side of its housing. These switches are used to set the unit for different requirements and operating conditions. The settings for these switches should be changed only when the layout is turned off.

The Booster comes from the factory with all four switches turned off; this is the standard setting for normal locomotive operation in H0 and Märklin 1. The appropriate switch must be pushed up ("ON" setting) (see illustration 7) to turn on one of the functions described below.

Switch 1: Lowering the level of low voltage identification.

The output voltage for a Booster goes down when it has a high load. If the voltage goes below a particular value, the unit shuts off the layout due to an overload ("shutoff threshold"). The shutoff threshold must be lowered, if the track voltage has been reduced (with Switch 4). In addition, with a lower shutoff threshold higher outputs can be tapped in the short term (example: starting up several Märklin 1 locomotives in the area assigned to a *single* Booster), which can also lead to increased heat dissipated from the heat sink.

The shutoff threshold is lowered by setting Switch 1 to "ON".

Switch 2: Rise time for overload identification.

With a short circuit very high currents flow out to the layout which can cause damage to the track or to the locomotives and cars. Since short circuits of very short duration can also occur during operation of the system, which are unavoidable (such as a locomotive or train traversing some turnouts), the overload circuit waits briefly after identifying a short circuit before it shuts off the layout. Depending on the layout and on the type of locomotive operations being done, it can be useful to lengthen the rise time

for overload identification (Switch 1 "ON"). *The short time (Switch 2 shut off) should be selected if the longer rise time setting is not absolutely needed.*

Switch 3: Not used.

At present there is no function assigned to this switch.

Switch 4: Lowering the output voltage in the track.

This switch can be used to set a limit on the output voltage at a maximum of 16 volts (Switch 4 set to "ON"). This setting is useful when operating layouts in the smaller gauges where the motors for the locomotives and powered units are designed for 12 to 14 volts.

This setting should be selected only when the 6021 Control Unit is being used as a central unit and any other Boosters on the layout are also the type 6017. Switch 4 should be set to "ON" on all of these units to provide a uniform voltage supply on the layout.

The output voltage cannot be lowered if the Boosters are also being used to supply power and the digital signal to accessory decoders as well as locomotive operations. In this case it is recommended that one Booster be used to supply power and the digital signal only to the accessory decoders and that another Booster be used to supply power and digital signals to the locomotives.

8.3 BOOSTER operation

- Note Never use a BOOSTER without a CONTROL UNIT.
- LED Pilot light The status of the BOOSTER is indicated by a red LED in the top right-hand corner.
- Overload cut-off This switches the BOOSTER off automatically in the event of a short circuit or an overload in the circuit. The LED pilot light goes out. The CONTROL UNIT and any other BOOSTERS also switch off 1 - 2 seconds later. Careful monitoring of all pilot lights will therefore give you an idea of the circuit in which the overload or short circuit occurred. Refer to Chapter 9 for more information concerning troubleshooting.
- Eliminate the cause of the fault (put a derailed train back on the track).
 - Press the "go" button on the CONTROL UNIT briefly: normal operation should be resumed.

9. Troubleshooting

9.1 Problems affecting the system as a whole

Fault characteristics	Possible causes	Remedy
LED pilot light - on the CONTROL UNIT - on the TRANSFORMER remains off.	<ul style="list-style-type: none">• Transformer cord unplugged.• Thermostatic switch in the TRANSFORMER has cut off due to an overload.	<p>Plug in the transformer cord.</p> <p>Switches on again automatically after a delay of approx. 1 minute (watch the LED pilot light).</p>
LED pilot light - on the CONTROL UNIT remains off; - on the BOOSTERS remain off; - on all TRANSFORMERS light up.	<ul style="list-style-type: none">• The "stop" button has been pressed.• The CONTROL UNIT has switched off due to a <i>short circuit</i> in the circuit of a BOOSTER or of the CONTROL UNIT.• The CONTROL UNIT has cut off due to an <i>overload</i> in the power consumption area of a BOOSTER or in the CONTROL UNIT.	<p>Press the "go" button briefly – normal operation should be resumed.</p> <p>Locate and eliminate the short circuit (example: replace a derailed train). Press the "go" button briefly.</p> <p>Locate the faulty circuit:</p> <ul style="list-style-type: none">- Press the "go" button briefly: the LED pilot light on the faulty BOOSTER goes off a moment before the other LED pilot lights.- Disconnect the wire from the red terminal of the suspected BOOSTER; Press the "go" button briefly: if the LED pilot light of the CONTROL UNIT remains illuminated, the fault is located in the disconnected BOOSTER.- If this is not the case, keep disconnecting BOOSTERS until the faulty circuit has been located. If all BOOSTERS have been disconnected, the fault must be located in the CONTROL UNIT circuit. <p>- Estimate the power requirements for the individual power consumption areas (refer to Chapter 7.1). - Divide the overloaded power consumption area into subareas and use additional BOOSTER(s).</p>

Fault characteristics	Possible causes	Remedy
	<ul style="list-style-type: none"> • No electric connection between CONTROL UNIT/BOOSTER and the associated TRANSFORMER 	<ul style="list-style-type: none"> - Run fewer trains simultaneously or reduce the number of light bulbs (also refer to Chapter 7.3). Unplug the TRANSFORMER cord. - Check all terminals: Do the wire terminals make good contact? - Check the wires themselves.


9.2 Unusual CONTROL UNIT behavior

Fault characteristics	Possible causes	Remedy
CONTROL UNIT LED pilot light flashes and goes off.	<ul style="list-style-type: none"> • The TRANSFORMER for the CONTROL UNIT has been disconnected from the household current. • Permanent interruption in the power supply. 	Check the household power supply.
CONTROL UNIT LED pilot light suddenly starts flashing during operation.	<p>Brief interruption in the power supply due to</p> <ul style="list-style-type: none"> - power failure; - poor contact in the transformer cord; - intermittent contact in a wire connecting the TRANSFORMER to the CONTROL UNIT. 	<p>Initiate a reset:</p> <ul style="list-style-type: none"> Press the "stop" and "go" buttons simultaneously; start the locomotives again. - Plug the transformer cord in firmly or plug it into another socket-outlet. Initiate a reset. - Check that connecting wire makes good contact, initiate a reset.
The heat sink to the rear of the CONTROL UNIT heats up noticeably even when the trains are not moving.	Capacitor in the CONTROL UNIT feeder track.	Remove the capacitor; disconnect at least one of the capacitor's connecting wires. (Method for testing whether a capacitor is present, refer to Chapter 9.9).

9.3 Unusual BOOSTER behavior

Fault characteristics	Possible causes	Remedy
The LED pilot light on a BOOSTER lights up again after being switched off.	Normal reaction.	Wait until the LED goes off.
The LED pilot light on a BOOSTER flickers during operation.	The BOOSTER is being operated at its limits.	<ul style="list-style-type: none"> - Use additional BOOSTER. - Connect fewer loads to the affected circuit (refer to Chapters 7.1 and 7.2).
The heat sink to the rear of a BOOSTER heats up noticeably even when the trains are not moving.	Capacitor in the BOOSTER feeder track.	Remove the capacitor: disconnect at least one of the capacitor's connecting wires. (Method for testing whether a capacitor is present, refer to Chapter 9.9).

9.4 Unusual TRANSFORMER behavior

Fault characteristics	Possible causes	Remedy
The LED pilot light on a TRANSFORMER lights up even though the power cord for the TRANSFORMER in question was not plugged in.	The "L" or "B" terminals of two TRANSFORMERS are incorrectly connected together.	<p> Do not touch the unplugged power cord of the TRANSFORMER in question and disconnect all TRANSFORMERS from the household current IMMEDIATELY. You may otherwise receive an electric shock.</p> <p>Check the wiring: Only <i>one</i> TRANSFORMER may be connected to the yellow and brown terminals of <i>one</i> BOOSTER or the CONTROL UNIT at any one time. <i>Each</i> BOOSTER must receive its power supply from a <i>separate</i> TRANSFORMER.</p> <p>Recommendation: always make a point of disconnecting all TRANSFORMERS from the household current at the same time. (Use a multiple socket-outlet!).</p>

9.5 Unusual locomotive or accessory controller behavior

Fault characteristics	Possible causes	Remedy
<p>None of the LEDs on a locomotive or an accessory controller light up and there is no reaction to program inputs. The CONTROL UNIT pilot light lights up.</p>	<p>The side plug-in connectors do not make good contact.</p>	<p>Unplug the TRANSFORMER cord. Insert the side plug-in connector(s) into place in the adjacent unit. Secure the plug-in connections with the plastic clips supplied with the unit wherever possible (refer to Chapter 3.2).</p>
<p>Locomotive or accessory controller does not respond in the usual way.</p>	<ul style="list-style-type: none"> • The controller is connected via an adapter cable which has not been positioned correctly. • The adapter cable to the controller was plugged into the wrong side of the CONTROL UNIT. 	<p>Initiate a reset from the CONTROL UNIT: Press the "stop" and "go" buttons simultaneously.</p> <ul style="list-style-type: none"> - The total length of the adapter cable must not exceed 6 m (20 feet). - Do not coil the adapter cable. - Wherever possible avoid leading an adapter cable under a TRANSFORMER or BOOSTER. - Wherever possible, maintain 5 cm (2 inches) clearance between the adapter cable and other system wiring. <p>Connect the controller to the CONTROL UNIT directly as a test.</p> <p>Accessory controllers must always be connected to the left-hand side of the CONTROL UNIT (even if an adapter cable is used) and locomotive controllers to the right-hand side. Connect the controller to the CONTROL UNIT directly as a test. If the controller no longer works correctly, send it to your Märklin service center (not covered by the warranty).</p>

9.5 Unusual Behavior of Digital Locomotive Controllers

Fault characteristics	Possible causes	Remedy
<p>Locomotive does not react to entries made at the locomotive controller</p>	<ul style="list-style-type: none"> • One of the buttons F1, F2, F3 or F4 was pressed at the same time that a new speed was being set with the speed control knob. 	<p>Carry out a reset. (Press the "stop" and "go" buttons on the CONTROL UNIT at the same time). The speed control knob must not be adjusted at the same time that a function button (F1...F4) is being pressed on the CONTROL UNIT or a locomotive controller connected to it.</p>
<p>After the locomotive address is changed several times, one of the functions F1...F4 gives a false indication of its status (LED on instead of off, or off instead of on)</p>	<ul style="list-style-type: none"> • The function was carried out (example: F1) correctly but was not stored correctly in the locomotive controller. This can occur when the following sequence of entries is made: 1. Locomotive address 2. Function/off 3. One of the buttons F1...F4 	<p>If functions and the lights are to be turned on or off, then the following sequence should be followed: 1. Locomotive address 2. One of the buttons F1...F4 3. Any other button</p>
<p>After a command for a function model is entered, all of the control components cease to function</p>	<ul style="list-style-type: none"> • The address of a function model entered with the button F was the first address entered after the CONTROL UNIT was turned on. 	<p>Carry out a reset. (Press the "stop" and "go" buttons on the CONTROL UNIT at the same time). After the CONTROL UNIT is turned on, a locomotive address should be the first address entered. The second address can be a command for a function model (button F).</p>

9.6 Locomotives do not respond to control commands

Fault characteristics	Possible causes	Remedy
Entered digital address starts flashing	<ul style="list-style-type: none"> • Address is outside the permitted range. • The same address has also been selected from another locomotive controller. 	<p>Enter an address between 01 and 80.</p> <p>Enter a different address at the other locomotive controller. The address on the first locomotive controller lights up steadily and the locomotive can be controlled from this controller.</p>
Locomotive does not respond even though the entered address lights up constantly.	<ul style="list-style-type: none"> • The LED above "L" does not light up on the selected locomotive controller. • The locomotive has not been assigned the entered address. • The locomotive has stopped in front of a red signal (or a signal controlled block). • Electric locomotive has been programmed for catenary operation. • The locomotive is not making contact with the track. • The locomotive also does not move along a test track connected to a different circuit. 	<p>Press the "L" button; enter the locomotive address again.</p> <p>Check the address programmed inside the locomotive; program the correct address.</p> <p>Set the signal to "go".</p> <p>Set the locomotive to pickup shoe operation (refer to the operating instructions for the locomotive).</p> <p>Push the locomotive a few inches along the track by hand as a test.</p> <p>Check the brushes in the locomotive's motor (refer to the instructions for the locomotive).</p>

9.7 Problems with locomotive operation

Fault characteristics	Possible causes	Remedy
Trains lose speed considerably on ascending grades.	<p>Poor power supply to the ascending section.</p>	<p>Install an additional feeder track around the middle of the ascending section, connecting it to the red and brown terminals on the CONTROL UNIT or the respective BOOSTER.</p>
Trains always come to a halt in a specific track section.	<ul style="list-style-type: none"> • Poor rail contact. • The feeder track for a specific section is not receiving any power. • The section is located between 2 signal blocks. 	<p>Check the rail joiners and clips for the track in this section.</p> <ul style="list-style-type: none"> - Check the terminals at the respective supply unit (CONTROL UNIT or BOOSTER). - Check the wires for the feeder track. <p>Bridge the third rail in the track before and after the signal block with a length of wire.</p>
Problems using the Digital system in catenary mode.	<p>The catenary always provides a poorer contact than the pickup shoe.</p>	<p>Set electric locomotives to pickup shoe operation (refer to the operating instructions for the locomotives).</p>
Delayed locomotive response to changes in the speed set at the controller.	<ul style="list-style-type: none"> • A long acceleration and braking delay has been set for locomotives with the 6090 high-efficiency propulsion set. • The system is equipped with a number of MEMORYs and there is a high degree of automatic operation. 	<p>Reduce the delay setting (turn the respective potentiometer on the 6090 module to the left – refer to the instructions for the locomotive).</p> <p>Pauses can be programmed into the routes set by the MEMORY. This can be realized by entering the following command sequence: "input" - "A1" (designation of the route in question) - "extern" - "A3" (defines the brief pause) - "end". This sequence must be entered separately for each route.</p>

9.8 Solenoid accessories do not respond correctly

Fault characteristics	Possible causes	Remedy
<p>A single solenoid accessory does not respond when the respective button is pressed.</p>	<ul style="list-style-type: none"> • Solenoid accessory is not connected correctly or the terminal makes poor contact. • One of the DECODER's outputs is defective. • Solenoid accessory itself is defective. 	<p>Connect all three wires (including the yellow one) from the solenoid accessory to the color-coded sockets on a k 83 DECODER.</p> <p>Test the solenoid accessory by connecting it to another DECODER terminal (not forgetting to press different buttons on the KEYBOARD).</p> <p>Method of testing: disconnect the blue wires from the DECODER and hold them alternately against a single rail (ground); the solenoid accessory should switch in both directions alternately. If not: the solenoid accessory is defective.</p>
<p>A group of four solenoid accessories does not respond.</p>	<ul style="list-style-type: none"> • DECODER not connected correctly. • DECODER address not programmed correctly. 	<p>Check the red and brown DECODER wires.</p> <p>Program the correct address with the 8 coding switches inside the DECODER (refer to Chapter 6.3). Make a note of the programmed address in the label area.</p>
<p>None of the solenoid accessories connected to a KEYBOARD respond. Pressing a red button causes the associated LED to light up (and it goes off again when the green button is pressed).</p>	<ul style="list-style-type: none"> • Wrong KEYBOARD address programmed. • DECODER power supply not connected correctly. 	<p>Program the correct KEYBOARD address with the 4 coding switches on the rear panel of the KEYBOARD (refer to Chapter 6.2). Note: A change in the setting of the coding switches only becomes effective following a CONTROL UNIT reset.</p> <p>Check the red and brown wires for all DECODERs (particularly their connections to the CONTROL UNIT).</p>

Fault characteristics	Possible causes	Remedy
Lighting dims briefly when a solenoid accessory is activated.	CONTROL UNIT or BOOSTER is operating at its limits.	Use additional BOOSTERS; consider the possibility of using a separate BOOSTER just to handle the solenoid accessories.

9.9 Test to determine whether a capacitor is present in the feeder track

K track The interference-suppression capacitor on a K track is clearly visible next to the feeder track.

M track The interference-suppression capacitor on an M track, on the other hand, is mounted under the track itself and is therefore hidden from view when the layout has already been set up. The following test can be used in this case:

- Test**
- Disconnect all loads (locomotives, lighted cars etc.) from the entire power consumption area.
 - Connect a model railway light bulb between the red terminal on the CONTROL UNIT or BOOSTER and the red wire for the feeder track.
 - Switch the system on.
 - Enter any locomotive address into the locomotive controller.
 - If the light bulb lights up a bit this indicates that there is a capacitor in the tested circuit.
 - Remove the capacitor from the feeder track.
 - Repeat this procedure for all separate train control circuits (CONTROL UNIT and all BOOSTERS).