ZTC 521 Hand Held DCC Railway Controller

With RealFeel™ Operations Manual

for Model Railways operating in
DCC Digital Mode.

Rev 3 Nov 2000

WARNING:
If you fail to read the installation instructions properly it is possible that you could accidentally damage your ZTC unit. Such damage is **NOT** covered by our guarantee. So to prevent avoidable and potentially expensive mistakes, please take the time to read these instructions before attempting to install your equipment

The ZTC System is only intended for controlling model railways by experienced modellers over the age of 14 .
It should only ever be operated by young persons under competent adult supervision.

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Foreword

Digital Control

ZTC Digital controllers operate model railways under the principles of DCC (digital command and control). They operate layouts which are permanently powered with an AC voltage applied throughout. Switched sections are not necessary.
Each loco or accessory (points and signals) is fitted with a small decoder which is identified by a number. The decoder rectifies the AC voltage on the track to a DC voltage which is used to power the motor. Control signals are sent along the track and are picked up by the appropriate decoder. These signals tell the decoder how to power the motor ie. speed and direction. Other more sophisticated control is also possible. Since each decoder recognises only the signals which are intended for it, it is therefore possible to run a number of locos on the same track operating independently.

The ZTC-521 hand controller can be operated as a DCC master unit (in conjunction with the ZTC-550 Power booster) or as a slave controller plugged into the desktop controller ZTC-511.

This manual is divided into three sections as follows:

Section 1 covers use of the unit on its own or as a DCC master, and gives connection details together with a brief description of how to control your locomotives.
This section also shows the command menus, and explains fully the function of more commonly used commands.

Section 2 covers use as a Slave controller with the ZTC-511 Master controller, another ZTC-521 or other units acting as a Master. It gives connection details together with a brief description of how to control your locomotives.
This section also shows the command menus, and explains fully the function of more commonly used commands.

Section 3 details common problems that may be encountered, and attempts to remedy them.

DO's	DONT's
Keep the unit dry	Drop it or dunk it
Unplug if not in use for an extended period	Place it on the track
Read this manual please!	Leave in a dusty place
Wipe the unit with a soft duster occasionally	Leave it in a damp place
Have fun with the worlds best model railway control system...	Expect the display to work if in a very cold room

Section 1 Solo/Master Controller

Turn to section 2 if you want to use the unit as a Slave Controller.

1.1 Connecting the ZTC-521 as a master controller

Important

Configure the unit as a DCC Solo by following the messages when you first switch on.
These messages will only appear once.

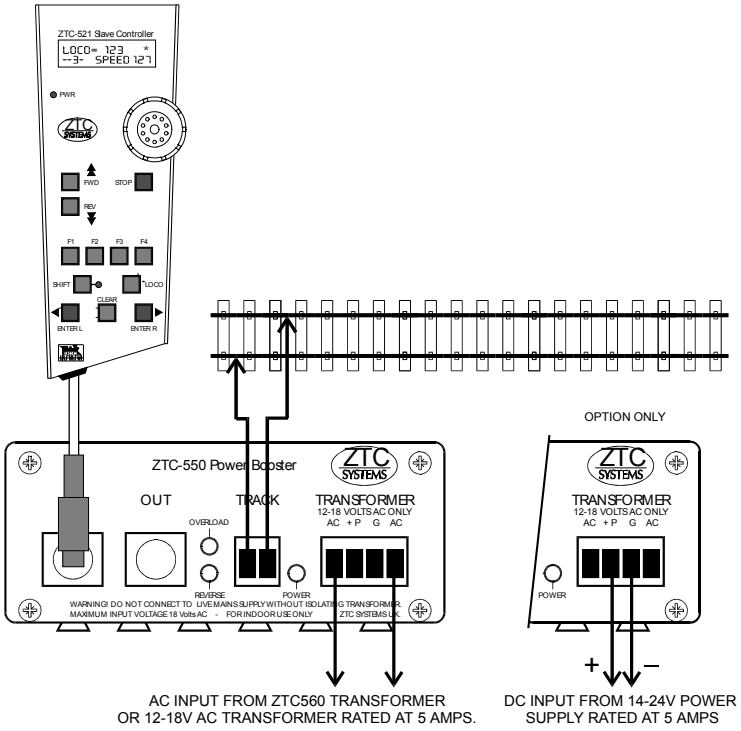


Fig.1 Connection Diagram

A mains transformer rated at 15V AC 5 Amps nominal is suggested for use with ZTC controllers. The ZTC-560 is recommended. Transformers with a lower current rating will reduce the number of locos and accessories that you can use.

For N gauge users a 12V AC transformer must be used. The ZTC-562 is recommended.

Wire all parts of your layout so that there are no isolated sections (the exception to this is reverse loop/triangle which is dealt with in the ZTC-550 Power Booster instruction manual). We suggest that you run a 2-core cable all around your layout, positioned under the baseboard and following the route of the track. 6 Amp cable is essential to maintain the track voltage and avoid overheating. Drop feeds from each rail at intervals of 1 Metre/3Ft. High frequency track cleaning equipment must not be used in combination.

Important before connecting your rails to the ZTC-550 Power Booster as shown in Fig.1 above, check that there are no shorts between the rails. To do this either connect a multimeter across the rails, or a battery and bulb wired in series. When you are sure that there are no shorts connect the track feed cable to the Power Booster.

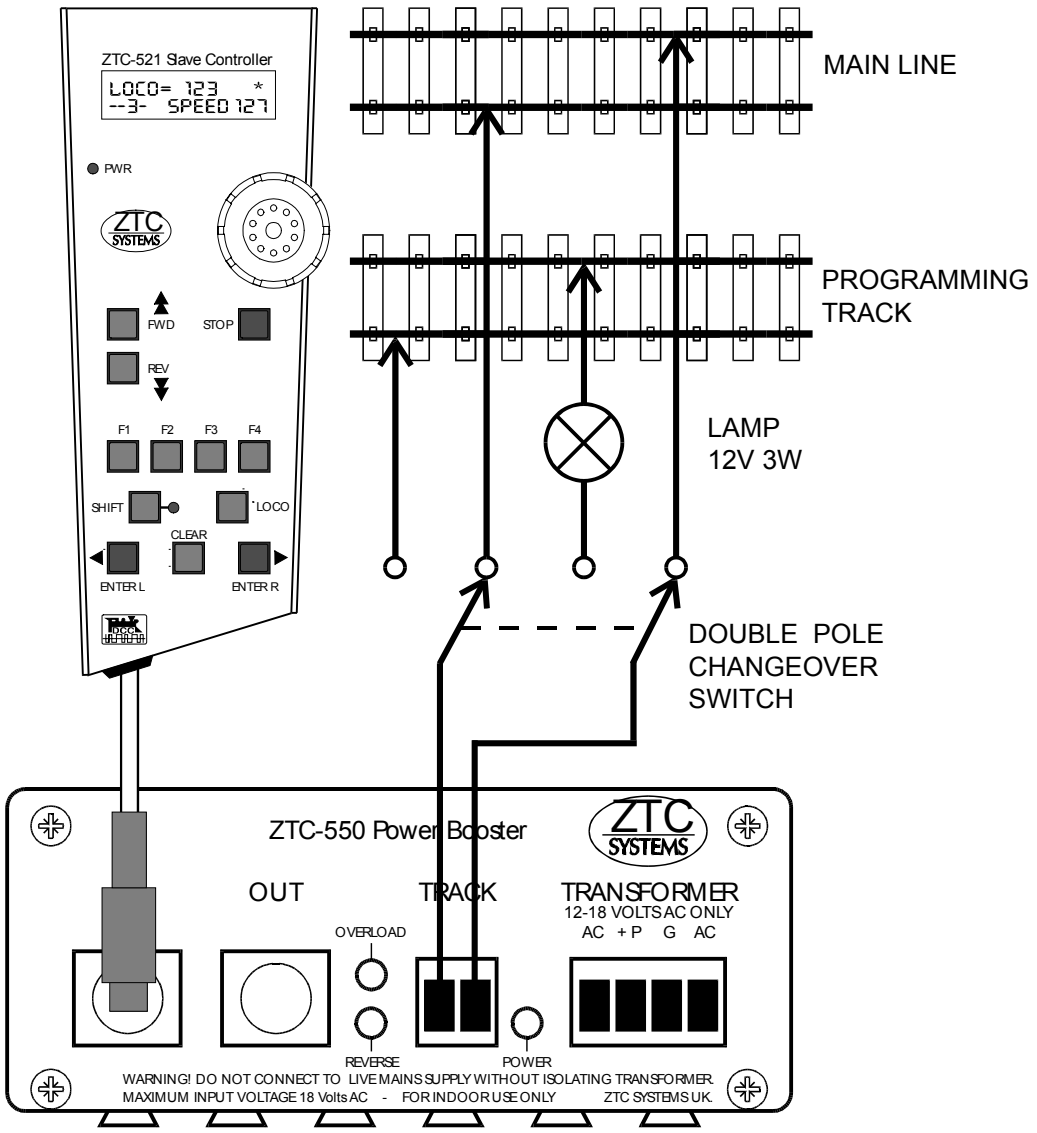


Fig.2 Adding a programming track

A Programming track will be required for setting up your locos. This should be operated via a double pole changeover switch as shown in Fig.2 above. Alternatively, the main track of your layout can be used for programming locos provided that you remove all other locos from the track.

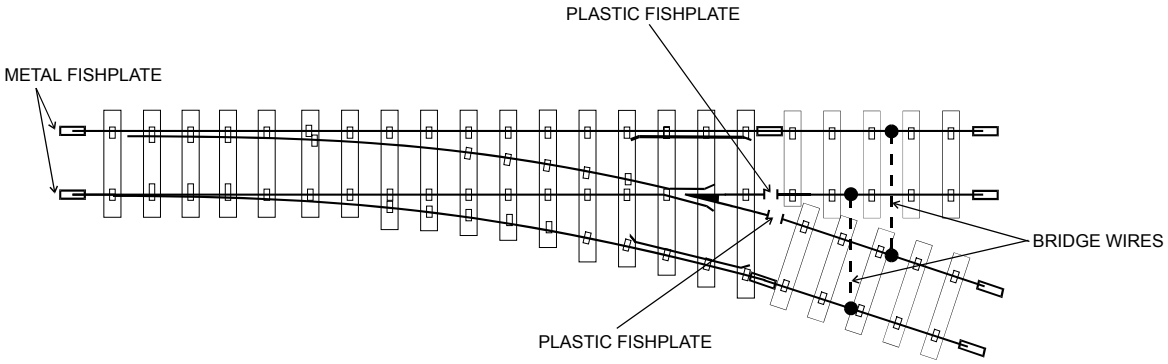


Fig.3 Bridging wires around a live frog

For points we recommend the live frog type. Here the rails into the frog must be insulated from the continuing rails with plastic fishplates as shown. The track power is fed from the toe. Both following rails are wired to be permanently live.

If using insulated frog points, bridge wires should also be fitted.

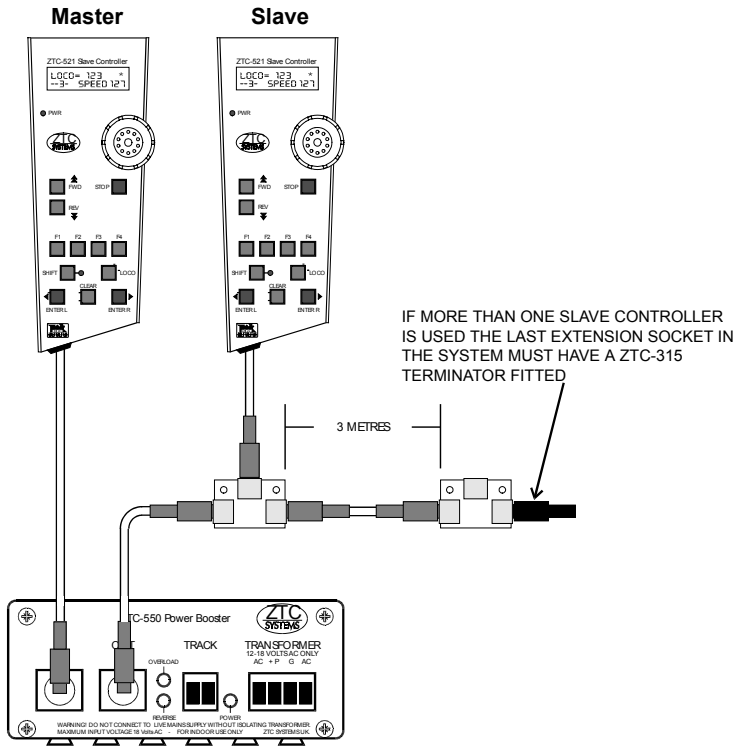


Fig.4 Connecting Slave controllers

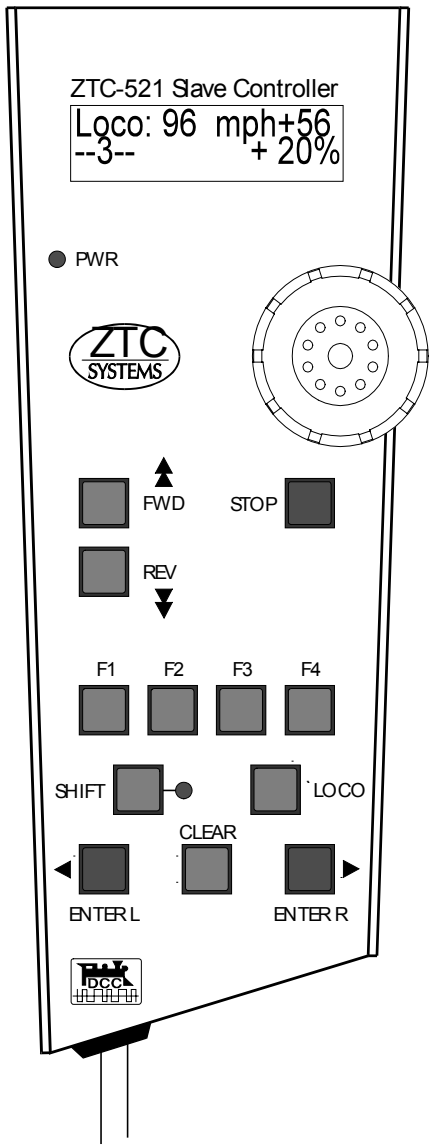
To add slave controllers to your system it must be configured as a DCC Master rather than a DCC Solo (see section 1.13.1).

Slave controllers (to a maximum of 30) may be added to your system via our interconnection system the ZTC-309. It consists of a three way socket board and a 3 metre extension cable. The socket board may be retained with suitable screws.

Slave controllers must not be connected directly to the Power Booster.

Daisy chaining sockets allows the user to either have multiple slave controllers, alternative connection points around the layout or a combination of both.

1.2 Key Functions



Thumbwheel Used to regulate speed
Used to scroll through menus
Used to select numbers and options

FWD/REV Used to regulate speed
Used to scroll through menus
Used to select numbers and options

LOCO Used in the selection of loco

STOP 1st press brings loco under control to a gradual halt
2nd press gives immediate Emergency stop
3rd press halts all locos
4th press switches off track power

CLEAR Clears keyed commands
Exits some commands
Restores track power after emergency stop

ENTER R Completes a command
Steps round loco roster
Operates a point right or a signal red

ENTER L Steps round loco roster
Operates a point left or a signal green

F1/F2/F3/F4 Switch auxiliary functions on and off
Give direct access to some menu items

SHIFT Used in combination with other keys to access higher functions
Press twice for access to command menus
Lamp on indicates shift mode
Flashing lamp indicates preset 'Learn Mode' or Point/Signal mode

PWR On indicates power on
Flashing indicates keyed error

Fig.5 Keypad layout

Note that the **FWD** and **REV** keys have the same function as the **Thumbwheel** when scrolling through menus, selecting numeric values or regulating loco speed. Therefore **Thumbwheel** may be substituted for **FWD** or **REV** for the remainder of this manual except where shown.

The **Thumbwheel** will increment numeric values or loco speed at the rate at which it is turned. To increment one digit at a time turn very slowly, to increment at a greater rate turn more quickly.

1.3 Controlling the first loco

ZTC Loco decoders are pre-programmed as *Loco: 3* therefore use this number when controlling your very first loco. Other manufacturers decoders may use a different value.
Later on you will learn how to alter a decoders address.
You may use a loco without a decoder fitted, in this case it must be selected as *Loco: 0* (except in Germany)
See also section 1.12 Loco 0

Connect the system as shown in Fig.1, then plug the transformer into a mains supply and switch on.
After a few startup messages the display will show *No Locos.*

- Press **LOCO** then using the **FWD** key (or turn the thumbwheel clockwise) select *Loco=4* and press **ENTER R**
- Wind the thumbwheel clockwise to increase the speed or anticlockwise to decrease the speed.
- When the display shows *Loco:3 Halted* press the **REV** key. The loco will now run in reverse.
- Wind the thumbwheel clockwise to increase the reverse speed or anticlockwise to decrease it.

1.4 Stopping the first loco

Use the thumbwheel to bring your loco to a halt.
In an emergency use the **STOP** key,

1st press brings loco under control to a gradual halt, **CLEAR** restores to previous speed.
2nd press gives immediate Emergency stop, **CLEAR** restores to halted.
3rd press halts all locos, **CLEAR** restores to halted.
4th press switches off track power, **CLEAR** restores to halted.

Important read the rest of this section at least, before you attempt to control other locos. If you experienced problems with the first loco then check your wiring, go over the text again and if necessary consult the fault finding section at the back of the manual.

1.5 Switched functions

Loco functions such as headlamps, rearlamps, carriage lighting etc can be switched on and off at will, even if the loco is stationary, provided that an appropriate decoder is fitted.

- Press **F1** or **F2** or **F3** etc once to turn the function on and again to switch it off.

display shows the state of functions (assuming that *Display optn* is set to 3 .... see section 1.13.2).

- Functions 5 and 6 are accessed by pressing the **SHIFT** key followed by **F1** for function 5 or **F2** for function 6.

Note that most ZTC decoders can switch 3 functions, the ZTC-205 decoder can switch 4.

For decoders operating in 14 step mode (see section 1.13.2) lamps are operated by pressing **SHIFT** followed by **F2** or **F4**. This function will be indicated by the first character on the display and will be an asterix for on and an underscore for off. * Lights on _ Lights off

1.6 Controlling more than one Loco (roster building)

In order to do this you must first have another loco setup with a different address. (see 1.13.3 PROGRAMMING MENU *Set New Address*)

Add another loco to your roster:

- Press **LOCO** then using the **FWD** key (or turn the thumbwheel clockwise) select *Loco = (No)* and press **ENTER R**
- Wind the thumbwheel clockwise to increase the speed or anticlockwise to decrease the speed

You now have control of the second loco. Use the **ENTER R** key to toggle between the locos.

The loco number displayed is the one under control, and *02/02* on the display indicates loco 2 of 2 on the roster.

Follow this procedure to add other locos to your roster up to a maximum of 16 at any one time.

For convenience the first four locos on the roster are assigned to keys **F1** to **F4** and may be accessed by pressing **LOCO** followed by **F1** or **F2** etc.

1.7 Deleting a loco from the roster

- First use the **ENTER R** key to gain control of the loco.
- Press **SHIFT SHIFT** and then select *LOCO SET MENU* with the **FWD** key and then **ENTER R**
- Select *Stop & Delete* with the **FWD** key and then **ENTER R**

The loco number will not now appear in the roster.

1.8 Adding Train Inertia

To simulate the weight of a loco it is possible to set the controller with an inertia factor. When this is done the loco will require you to crank up the regulator in order to get it in motion, and will take time to come to a halt with the regulator at zero power.
Five weight ranges are available: Light Medium Heavy V.Heavy Overweight

- First use the **ENTER R** key to gain control of the loco.
- Press **SHIFT** followed by **FWD** (not thumbwheel)
- Select a range with the **F1** **F2** **F3** or **F4** keys (these give direct access to the first four weight ranges).

- Use the **FWD** or **REV** keys (or thumbwheel) to fine tune the number top left on the display and press **ENTER R**

Setting inertia to zero cancels it.
To alter the setting or reset it to zero follow the procedure again.

Inertia set in this way is not saved when the controller is powered down. In order to retain inertia settings the decoder must be programmed with acceleration and deceleration factors (see 1.13.3 PROGRAMMING MENU Set CV Setup), or saved to the Saved Roster (see 1.10 How loco information is stored).

1.9 Double heading

Double heading means that two or more locos (max 7) are controlled simultaneously. Obviously their speeds may not be matched unless set up to do so, but they will travel in the same direction and accelerate and decelerate together. (Note: you cannot double head locos unless already on the roster).

- First add two locos to the roster in the normal way.
- Press **LOCO** then using the **FWD** key (or turn the thumbwheel clockwise) select Loco=(1st No)
- Again press **LOCO** then using the **FWD** key (or turn the thumbwheel) select Loco=(2nd No)
- Press **ENTER R** to complete the command.

The second loco entered will be shown as *DH:(2nd No)* to indicate that it is double headed.

- Wind the thumbwheel clockwise to increase the speed or anticlockwise to decrease the speed.

To escape double heading and restore individual locos to the roster:

- First select either double headed loco, press **LOCO** and **FWD**
- Press the **ENTER L** key.

Where more than two locos are double headed (multiple unit), individual locos can be removed by:

- Selecting the loco, press **LOCO** and then **FWD** followed by **ENTER L**

To break up a double headed group (2-7 locos) and restore individual locos to the roster:

- Press **SHIFT SHIFT** and then select *LOCO SET MENU* with the **FWD** key and then **ENTER R**
- Select *DoubleHead Break* with the **FWD** key and then **ENTER R**
- All double headed locos in the group will be listed, **ENTER R** will break up the group **ENTER L** will escape from the command leaving the group intact.

1.10 How loco information is stored - Rosters

Every time a loco number is entered into the controller it becomes part of an Active Roster (max 16 locos). Once entered it can be accessed by stepping through the roster with the **ENTER R** or **ENTER L** keys. When the system is powered down this roster is erased, however setting *Auto Startup* (see section 1.13.1) to *1* will regain control of the last loco used when the system is next powered up.

A more permanent Saved Roster is also available (max 16 locos). In this the loco numbers are stored together with inertia, scale speed, speed units and step mode settings (these are explained later in the manual). This type of roster is built by saving loco information to it before powering down:

Upon entering a loco, save it to the master roster by:

- Pressing **SHIFT** **SHIFT** and then selecting *LOCO SET MENU* with the **FWD** key and then **ENTER R**
- Select *Save currnt loco* with the **FWD** key and then **ENTER R**

When stepping through the active roster, saved locos are indicated with an asterix suffix.

Other locos can be added by following the same procedure.

Locos are deleted from saved roster by:

- Pressing **SHIFT** **SHIFT** and then selecting *LOCO SET MENU* with the **FWD** key and then **ENTER R**
- Select *Saved Loco List* with the **FWD** key and then **ENTER R**
- Select loco to be deleted with the **FWD** key, press **F1** followed by **ENTER R** to confirm.

On power up, the saved roster can be transferred to the active roster:

- Press **SHIFT** **SHIFT** and then select *LOCO SET MENU* with the **FWD** key and then **ENTER R**
- Select *Restore Roster* with the **FWD** key and then **ENTER R**

Setting *Auto Startup* (see section 1.12.1) to *2* will restore the entire saved roster automatically when the system is next powered up.

1.11 Point and Signals

Points and signals can be operated from the controller. They have their own type of decoder, the ZTC-304. Programming address codes is dealt with in the ZTC-304 instruction manual.

To operate a Point:

- Press **LOCO** followed by **SHIFT**
- Use the **FWD** or **REV** keys (or thumbwheel) to select the point number.
- Press **ENTER R** to operate the point right, or **ENTER L** to operate the point left.

Whilst the shift lamp flashes you may toggle the point left and right with the **ENTER L/R** keys.

- Press **CLEAR** to exit this command.

To operate a Signal:

- Press **SHIFT** followed by **LOCO**
- Use the **FWD** or **REV** keys (or thumbwheel) to select the Signal number.

- Press **ENTER R** to operate the signal red, or **ENTER L** to operate the signal green.

Whilst the shift lamp flashes you may toggle the signal green and red with the **ENTER L/R** keys.

- Press **CLEAR** to exit this command.

1.12 Loco 0

Most locos may be operated as Loco 0, however some are not suitable.

a) Portescap and Faulhaber and other coreless motors are not suitable.
b) N-Gauge locos must be operated with a 12V transformer. 15V is too high and will overheat the motor.
c) The loco must be checked for its suitability on the programming track as follows:

- Switch over to the programming track (a 12V 3W bulb must be connected as shown in Fig.2).
- Assign Loco 0 on the controller and make sure that it is shown as halted.
- Place the loco to be tested on the track at which point the lamp will light.
- If the lamp is very bright remove the loco immediately (the loco is drawing to much current and is not suitable)
- If the lamp glows dimly then operate the loco using the thumbwheel (a dim lamp indicates that the loco is drawing very little current) to check controllability.

A faint buzzing noise from the motor is normal.

1.13 Command menus

The ZTC-521 Hand controller commands are mainly accessed from the keypad and thumbwheel with either single or dual key operations. Some commands however, are accessed from menu items displayed on the LCD display. The menus are divided into four groups, each having a number of sub-items. When in a given menu the other three menus are accessed as sub-items. For ease of use, frequently used sub-items in each menu can be accessed with the four function keys **F1....F4**. Menu commands are activated by displaying them on screen and then pressing **ENTER R** on the keypad.

Table.1

SYSTEM MENU		Notes
None		
Control Status		Reports Master or Slave mode
Controls Test		
Slaves working?	**F4**	Reports identity of slaves connected
Set DCC Master		
Set Slave Mode		See section 2
Set Slave number		See section 2
Auto Startup		
Set hours		For clock display
Set minutes		For clock display
Stop/Start Clock		Toggles clock on or off
Time Scale		Sets rate at which clock runs on all controllers in system X1 to X15
PROGRAM MENU	**F3**	
PRESETS MENU	**F2**	
LOCO SET MENU	**F1**	

Highlighted sub-items are the more commonly used ones and are explained below.

To enter the menus press **SHIFT SHIFT** on the keypad, and use the **FWD/REV** keys to scroll through.

1.13.1 SYSTEM MENU

This menu contains commands which set up the system for your application.

Set DCC Master

Sets system for use as a DCC Master controller ie. a ZTC Starter set.

- Select item from menu and then press **ENTER R**

display returns to show last loco operated or *No Loco.*

Auto Startup

Sets system to restore locos when powering up.

- Select item from menu and then press **ENTER R**

options *1* *2* and *3* are given

- Use the **FWD** or **REV** keys to set the chosen value, and then **ENTER R**

display returns to show last loco operated or *No Loco.*

options are:
1 - Last loco restored after power down
2 - Saved roster restored after power down
3 - No locos restored after power down

Table.2

LOCO SET MENU		Notes
None		
Show loco roster	**F2**	Displays **active** roster
DEL.Saved Roster		Deletes **saved** roster
Saved Loco List	**F3**	Displays **saved** roster
Count actv locos		Count locos on **active** roster
Restore Roster		Restores **saved** roster
Save currnt loco	**F1**	Saves to **saved** roster
Stop & Delete		Deletes locos from **active** roster
Show loco info		Displays info about loco currently under control
DoubleHead Break		Breaks up double headed group and restores individual locos
Set Crane mode		For Roco crane only
Set 128 step mode		
Set 14 step mode		
Set 28 step mode		Default setting
Check Loco mode	**F4**	
Speed Scale		
Speed units		
Display optn.		
SYSTEM MENU		
PROGRAM MENU		
PRESETS MENU		

Highlighted sub-items are the more commonly used ones and are explained below.

To enter the menus press **SHIFT** **SHIFT** on the keypad, and use the **FWD/REV** keys to scroll through.

1.13.2 LOCO SET MENU

This menu contains commands which individualise your system, or display the status.

Display optn.

Sets the display to show either a clock, the loco weight or switched loco functions in the bottom left hand corner.

- Select item from menu and then press **ENTER R**
- Use the **FWD** or **REV** keys to enter the chosen display option, and then **ENTER R**

display returns to show last loco operated or *No Loco.*

Speed units

Sets the displayed speed to MPH, KPH or STEPS.

- Select item from menu and then press **ENTER R**
- Use the **FWD** or **REV** keys to enter the chosen speed option, and then **ENTER R**

display returns to show last loco operated or *No Loco.*

Speed Scale
Sets the maximum speed displayed when the regulator is wound up to 100% power.

- Select item from menu and then press **ENTER R**
- Use the **FWD** or **REV** keys to enter the chosen maximum speed, and then **ENTER R**

display returns to show last loco operated or *No Loco.*

Set 128 step mode
Sets the number of speed increments between 0% power and 100% power. 128 is the maximum and will give the smoothest operation. Some older non-ZTC decoders may not work in this mode.

1. Select item from menu and then press **ENTER R**

display returns to show last loco operated or *No Loco.*

Check Loco mode
Displays the current number of speed steps selected, 14, 28 or 128.

- Select item from menu and then press **ENTER R**

display shows current setting, then after a short period

display returns to show last loco operated or *No Loco.*

Show loco roster
Displays information about locos currently on the active roster.

- Select item from menu and then press **ENTER R**

display shows *Loco: 127 Master* or *Loco: 3 Free*

: Halted *: Step+4*

pressing the **ENTER R** key steps round the roster, and gives information about each loco.

Master means the loco currently under control, *Free* means loco is not under control but may be running.

- Press **CLEAR** to exit this command

display returns to show last loco operated or *No Loco.*

Stop & Delete
Deletes loco currently under control from active roster.

- Select item from menu and then press **ENTER R**

display shows *Halted* followed by *Deleted*

display returns to show last loco operated or *No Loco.*

Table.3

PROGRAM MENU		Notes
None		
Prog.Physical CV		Use in place of *Set New Address* for some older, non-ZTC decoders
Decoder All Reset	**F3**	Resets decoder to factory default settings
Accsry dec. set	**F4**	
Set CV Setup	**F2**	
Set New Address	**F1**	
SYSTEM MENU		
PRESETS MENU		
LOCO SET MENU		

Highlighted sub-items are the more commonly used ones and are explained below.

To enter the menus press **SHIFT** **SHIFT** on the keypad, and use the **FWD/REV** keys to scroll through.

1.13.3 PROGRAMMING MENU

This menu contains commands which individualise your loco or accessory.

Set New Address *(or Set Physical CV for older non-ZTC decoders)*
All ZTC decoders are programmed as loco 4 at the factory. Once fitted, they must be programmed to identify each loco with a different number. We usually recommend the last two digits of the cabside number.
Before any programming is done you must check that the loco is on the programming track (see Fig.2)

- Select item from menu and then press **ENTER R**
- Use the **FWD** or **REV** keys to enter the chosen Loco number, and then **ENTER R**
- Confirm that the programming track is switched on by pressing **ENTER R**

display shows *Programming* followed by *Pgm. Finished* (during this operation the loco may pulse a few times).

- Press **CLEAR** to exit this command.

display returns to show last loco operated or *No Loco.*

Decoder All reset
Resets a decoder to its factory settings in case you think that you have entered some CV's incorrectly.

- Select item from menu and then press **ENTER R**
- Confirm that the programming track is switched on by pressing **ENTER R**

display shows *Loco Decoder Reset* followed by >>>>> (during this operation the loco may pulse a few times).

Press **CLEAR** to exit this command

display returns to show last loco operated or *No Loco.*

Set CV Setup

CV's are configuration variables which customise your locos for both efficient running and realism. Every ZTC decoder can be programmed to achieve the best running possible. This is done by altering various CV's of which there are over a hundred, here we deal with only a few of the commonly used ones. The loco must be on the programming track

- Select item from menu and then press **ENTER R**
- Use the **FWD** or **REV** keys to access the appropriate CV, and then **ENTER R**
- Use the **FWD** or **REV** keys to set the chosen value, and then **ENTER R**
- Confirm that the programming track is switched on by pressing **ENTER R**

display shows *Programming* followed by *Pgm. Finished* (during this operation the loco may pulse a few times).

- Press **CLEAR** to exit this command.

display returns to show last loco operated or *No Loco.*

Commonly used CV's

CV number	What does it do?	Suggested setting
2 Start volts	sets the voltage at which the loco motor begins to move the loco	0 to 32
3 Loco accel	sets the rate at which a loco accelerates, simulating its scale weight	0 to 2
4 Loco decel	sets the rate at which a loco decelerates, simulating its scale weight	0 to 2
5 Loco max V	sets the max voltage that can be applied to a loco motor, and therefore its max speed	64 = 1/4 speed 128 = 1/2 speed 192 = 3/4 speed
29 Config reg	alters the direction of a loco if the decoder is wired in reverse	see decoder manual
For your use:		

More CV's are listed in the decoder installation manual.
A full listing is available on request.

Table.4

PRESETS MENU		Notes
None		
End New Preset	**F4**	
Preset status		Reports number of steps used in a preset
Delete last step	**F3**	
Start new preset	**F2**	
Delete Preset		Deletes selected preset
Recall Preset	**F1**	
Preset Step Time		
Delete all prset		
SYSTEM MENU		
PROGRAM MENU		
LOCO SET MENU		

Highlighted sub-items are the more commonly used ones and are explained below.

To enter the menus press **SHIFT SHIFT** on the keypad, and use the **FWD/REV** keys to scroll through.

1.13.4 PRESETS MENU

This menu contains commands which setup preset Point and Signal routes.

Start new preset

Defines a preset number and enters 'learn mode'.

- Select item from menu and then press **ENTER R**
- Use the **FWD** and **REV** keys to enter the chosen preset number (1 to 10), and then **ENTER R**
- Confirm with **ENTER R**
- Enter **SHIFT** followed by **LOCO** to enter a signal into the preset, or **LOCO** followed by **SHIFT** for a point.
- Use the **FWD** and **REV** keys to enter the chosen point/signal number, and then **ENTER R** or **ENTER L** display returns to show *SAVED Step = 01* and then prompts *Step = 01*
- Again use the **FWD** and **REV** keys to enter the chosen point/signal number, and then **ENTER R / L** display returns to show *SAVED Step = 02* and then prompts *Step = 02*

Continue adding points / signals (to a maximum of 90 steps).

Now end the preset as follows:

End New Preset

- Select item from menu and then press **ENTER R**

preset is saved.

Delete last step

Deletes a step during preset entry.

Whilst entering preset steps (above) you can delete a step if unwanted:

- Press **SHIFT SHIFT F3** and then **ENTER R**

continue to add steps as normal.

Preset Step Time

Sets the length of time between preset point or signal operations.

Whilst entering preset steps (above) you can add a time delay between steps:

- Press **SHIFT SHIFT**
- Select *Set preset time* and press **ENTER R**
- Use the **FWD** and **REV** keys to enter the chosen time in seconds, and then **ENTER R**
- Add the next step.

The delay time will be applied to subsequent steps unless you alter it now.

- Add the next step.

A default time of 2 seconds is applied to points included in preset routes.

Recall Preset

Runs a preset point/signal route.

- Select item from menu and then press **ENTER R**
- Use the **FWD** and **REV** keys to enter the chosen preset number, and then **ENTER R**

preset route runs, and display shows progress of steps.

1.13.5 FULL MENU REFERENCE TABLE

SYSTEM MENU		LOCO SET MENU		PROGRAM MENU		PRESETS MENU	
None		None		None		None	
Control Status		Show loco roster	**F2**	Prog.Physical CV		End New Preset	**F4**
Controls Test		DEL.Saved Roster		Decoder All Reset	**F3**	Preset status	
Slaves working?	**F4**	Saved Loco List	**F3**	Accsry dec. set	**F4**	Delete last step	**F3**
Set DCC Master		Count actv locos		Set CV Setup	**F2**	Start new preset	**F2**
Set Slave Mode		Restore Roster		Set New Address	**F1**	Delete Preset	
Set Slave number		Save currnt loco	**F1**	SYSTEM MENU		Recall preset	**F1**
Auto Startup		Stop & Delete		PRESETS MENU		PresetStepTime	
Set hours		Show loco info		LOCO SET MENU		Delete all prset	
Set minutes		DoubleHead Break				SYSTEM MENU	
Stop/Start Clock		Set Crane mode				PROGRAM MENU	
Time Scale		Set 128 step mode				LOCO SET MENU	
PROGRAM MENU	**F3**	Set 14 step mode					
PRESETS MENU	**F2**	Set 28 step mode					
LOCO SET MENU	**F1**	Check Loco mode	**F4**				
		Speed Scale					
		Speed units					
		Display optn					
		SYSTEM MENU					
		PROGRAM MENU					
		PRESETS MENU					

Section 2 Slave Controller

Turn to section 1 if you want to use the unit as a Master Controller.
A Slave remotely controls a Master.

2.1 Connecting the ZTC-521 as a slave controller

Important
Configure the unit as a Slave by following the messages when you first switch on.
These messages will only appear once.

To connect a slave controller to another ZTC-521 Handheld controller see Fig.4 in section 1

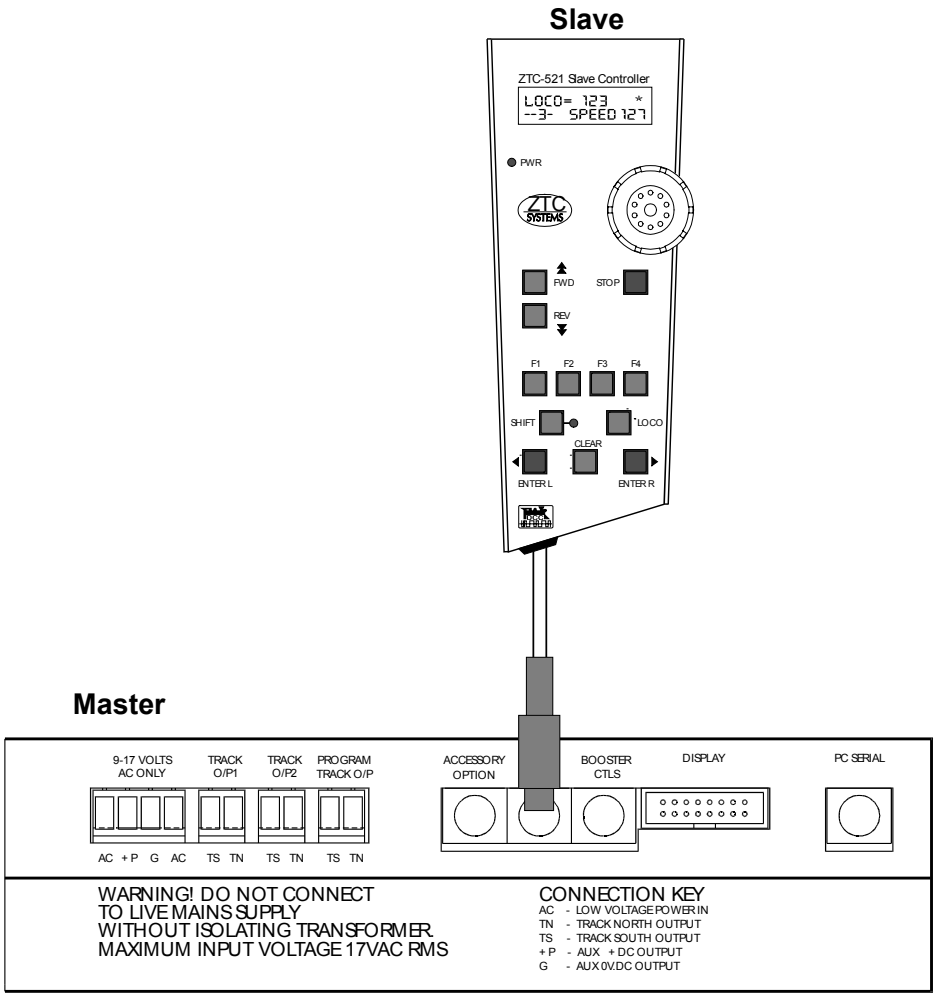


Fig.1 Connection Diagram

A mains transformer rated at 15V AC 5 Amps nominal is suggested for use with ZTC controllers. The ZTC-560 is recommended. Transformers with a lower current rating will reduce the number of locos and accessories that you can use.

For N gauge users a 12V AC transformer must be used. The ZTC-562 is recommended.

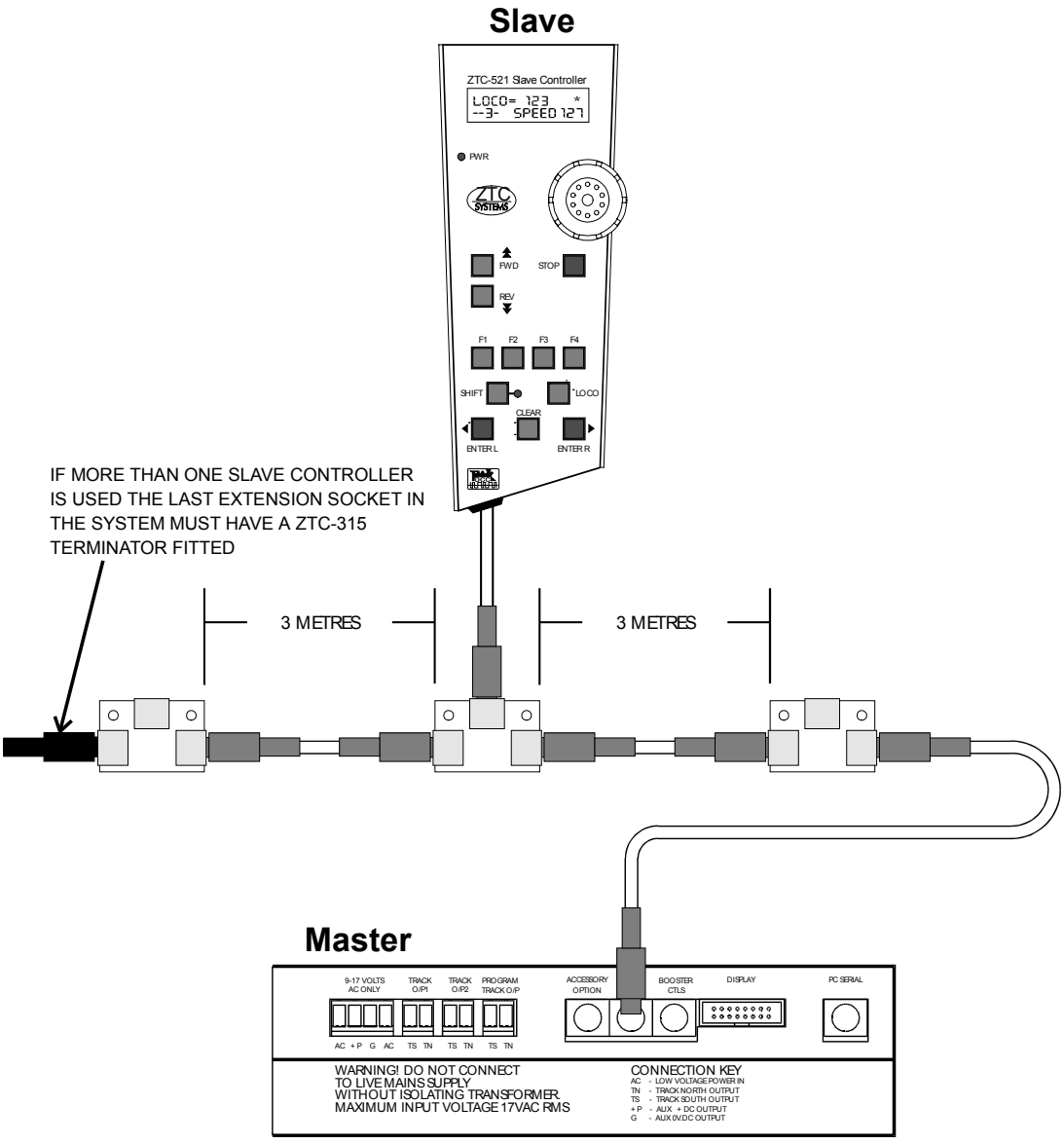
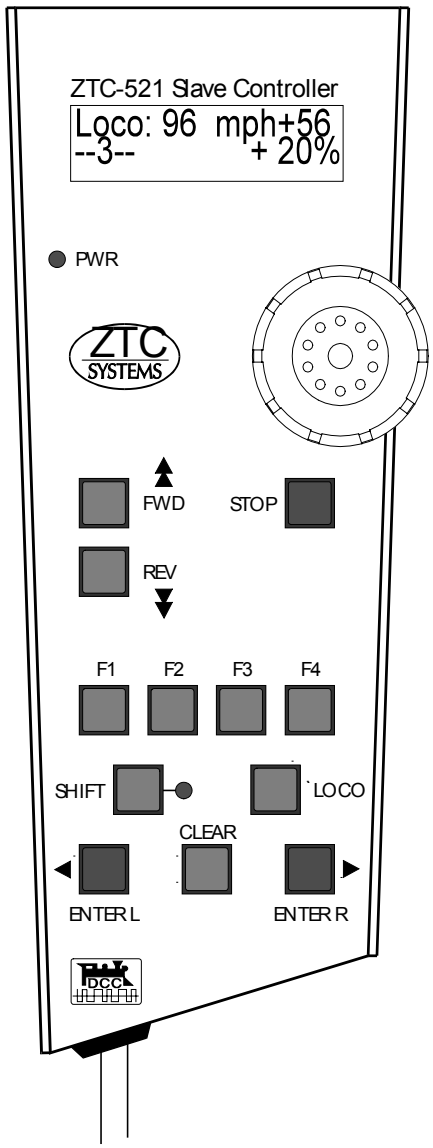


Fig.2 Connecting more than one slave unit

Other slave units may be used with the ZTC system up to maximum of 30. An interconnection system is available for this purpose. It consists of a three way socket board (ZTC 308) and a 3 metre extension cable (ZTC 309). The socket board may be retained with suitable screws.

Daisy chaining sockets allows the user to either have multiple slave controllers, connection points around the layout or a combination of both.

2.2 Key Functions



Thumbwheel Used to regulate speed
Used to scroll through menus
Used to select numbers and options

FWD/REV Used to regulate speed
Used to scroll through menus
Used to select numbers and options

LOCO Used in the selection of loco

STOP 1st press brings loco under control to a gradual halt
2nd press gives immediate Emergency stop
3rd press halts all locos
4th press switches off track power

CLEAR Clears keyed commands
Exits some commands
Restores track power after emergency stop

ENTER R Completes a command
Steps round loco roster
Operates a point right or a signal red

ENTER L Steps round loco roster
Operates a point left or a signal green

F1/F2/F3/F4 Switch auxiliary functions on and off
Give direct access to some menu items

SHIFT Used in combination with other keys to access higher functions
Press twice for access to command menus
Lamp on indicates shift mode
Flashing lamp indicates Point/Signal mode

PWR On indicates power on
Flashing indicates keyed error

Fig.3 Keypad layout

Note that the **FWD** and **REV** keys have the same function as the **Thumbwheel** when scrolling through menus, selecting numeric values or regulating loco speed. Therefore **Thumbwheel** may be substituted for **FWD** or **REV** for the remainder of this manual except where shown.

The **Thumbwheel** will increment numeric values or loco speed at the rate at which it is turned. To increment one digit at a time turn very slowly, to increment at a greater rate turn more quickly.

2.3 Controlling the first loco

ZTC Loco decoders are pre-programmed as *Loco: 3* therefore use this number when controlling your very first loco. Other manufacturers decoders may use a different value.

You may use a loco without a decoder fitted, in this case it must be selected as *Loco: 0* (except in Germany) See also section 2.13 Loco 0

Connect the system as shown in Fig.1, then plug the transformer into a mains supply and switch on. After a few startup messages the display will show *No Locos.*

- Press **LOCO** then using the **FWD** key (or turn the thumbwheel clockwise) select *Loco=3* and press **ENTER R**
- Wind the thumbwheel clockwise to increase the speed or anticlockwise to decrease the speed.
- When the display shows *Loco:3 Halted* press the **REV** key. The loco will now run in reverse.
- Wind the thumbwheel clockwise to increase the reverse speed or anticlockwise to decrease it.

2.4 Stopping the first loco

Use the thumbwheel to bring your loco to a halt.
In an emergency use the **STOP** key,

1st press brings loco under control to a gradual halt, **CLEAR** restores to previous speed.
2nd press gives immediate Emergency stop, **CLEAR** restores to halted.
3rd press halts all locos, **CLEAR** restores to halted.
4th press switches off track power, **CLEAR** restores to halted.

Important read the rest of this section at least, before you attempt to control other locos. If you experienced problems with the first loco then check your wiring, go over the text again and if necessary consult the fault finding section at the back of the manual.

2.5 Switched functions

Loco functions such as headlamps, rearlamps, carriage lighting etc can be switched on and off at will, even if the loco is stationary, provided that an appropriate decoder is fitted.

- Press **F1** or **F2** or **F3** etc once to turn the function on and again to switch it off.

display shows the state of functions (assuming that *Display optn* is set to 3 .... see section 2.14.2).

- Functions 5 and 6 are accessed by pressing the **SHIFT** key followed by **F1** for function 5 or **F2** for function 6.

Note that most ZTC decoders can switch 3 functions, the ZTC-205 decoder can switch 4.

For decoders operating in 14 step mode (see section 2.14.2) lamps are operated by pressing **SHIFT** followed by **F2** or **F4**. This function will be indicated by the first character on the display and will be an asterix for on and an underscore for off.

2.6 Controlling more than one Loco (roster building)

In order to do this you must first have another loco setup with a different address. (this can only be set on the master controller).

Add another loco to your roster:

- Press **LOCO** then using the **FWD** key (or turn the thumbwheel clockwise) select *Loco=(No)* and press **ENTER R**
- Wind the thumbwheel clockwise to increase the speed or anticlockwise to decrease the speed

You now have control of the second loco. Use the **ENTER R** key to toggle between the locos.

The loco number displayed is the one under control, and *02/02* on the display indicates loco 2 of 2 on the roster.

Follow this procedure to add other locos to your roster up to a maximum of 16 at any one time.

For convenience the first four locos on the roster are assigned to keys **F1** to **F4** and may be accessed by pressing **LOCO** followed by **F1** or **F2** etc.

Every time a loco is added, the roster on the master controller in the system is also updated. The master controller can not take control of the loco without stealing it (see 2.11 Stealing Locos)

2.7 Deleting a loco from the roster

- First use the **ENTER R** key to gain control of the loco.
- Press **SHIFT SHIFT** and then select *LOCO SET MENU* with the **FWD** key and then **ENTER R**
- Select *Stop & Delete* with the **FWD** key and then **ENTER R**

The loco number will not now appear in the roster.

2.8 Adding Train Inertia

To simulate the weight of a loco it is possible to set the controller with an inertia factor. When this is done the loco will require you to crank up the regulator in order to get it in motion, and will take time to come to a halt with the regulator at zero power.
Five weight ranges are available: Light Medium Heavy V.Heavy Overweight

- First use the **ENTER R** key to gain control of the loco.
- Press **SHIFT** followed by **FWD** (not thumbwheel)

- Select a range with the **F1** **F2** **F3** or **F4** keys (these give direct access to the first four weight ranges).
- Use the **FWD** or **REV** keys (or thumbwheel) to fine tune the number top left on the display and press **ENTER R**

Setting inertia to zero cancels it.
To alter the setting or reset it to zero follow the procedure again.

Inertia set in this way is not saved when the controller is powered down. In order to retain inertia settings the decoder must be programmed with acceleration and deceleration factors (this can only be set on the master controller), or saved to the Saved Roster (see 2.10 How loco information is stored).

2.9 Double heading

Double heading means that two or more locos (max 7) are controlled simultaneously. Obviously their speeds may not be matched unless set up to do so, but they will travel in the same direction and accelerate and decelerate together. (Note: you cannot double head locos unless already on the roster).

- First add two locos to the roster in the normal way.
- Press **LOCO** then using the **FWD** key (or turn the thumbwheel clockwise) select Loco=(1st No)
- Again press **LOCO** then using the **FWD** key (or turn the thumbwheel clockwise) select Loco=(2nd No)
- Press **ENTER R** to complete the command.

The second loco entered will be shown as *DH: (2nd No)* to indicate that it is double headed.

- Wind the thumbwheel clockwise to increase the speed or anticlockwise to decrease the speed.

To escape double heading and restore individual locos to the roster:

- First select either double headed loco, press **LOCO** and **FWD**
- Press the **ENTER L** key.

Where more than two locos are double headed (multiple unit), individual locos can be removed by:

- Selecting the loco, press **LOCO** and then **FWD** followed by **ENTER L**

To break up a double headed group (2-7 locos) and restore individual locos to the roster:

- Press **SHIFT** **SHIFT** and then select *LOCO SET MENU* with the **FWD** key and then **ENTER R**
- Select *DoubleHead Break* with the **FWD** key and then **ENTER R**
- All double headed locos in the group will be listed, **ENTER R** will break up the group **ENTER L** will escape from the command leaving the group intact.

2.10 How loco information is stored - Rosters

Every time a loco number is entered into the controller it becomes part of an Active Roster (max 16 locos). Once entered it can be accessed by stepping through the roster with the **ENTER R** or **ENTER L** keys. When the system is powered down this roster is erased, however setting *Auto Startup* (see section 1.13.1) to *1* will regain control of the last loco used when the system is next powered up.

A more permanent Saved Roster is also available (max 16 locos). In this the loco numbers are stored together with inertia, scale speed, speed units and step mode settings (these are explained later in the manual). This type of roster is built by saving loco information to it before powering down:

Upon entering a loco, save it to the master roster by:

- Pressing **SHIFT SHIFT** and then selecting *LOCO SET MENU* with the **FWD** key and then **ENTER R**
- Select *Save currnt loco* with the **FWD** key and then **ENTER R**

When stepping through the active roster, saved locos are indicated with an asterix suffix.

Other locos can be added by following the same procedure.

Locos are deleted from saved roster by:

- Pressing **SHIFT SHIFT** and then selecting *LOCO SET MENU* with the **FWD** key and then **ENTER R**
- Select *Saved Loco List* with the **FWD** key and then **ENTER R**
- Select loco to be deleted with the **FWD** key, press **F1** followed by **ENTER R** to confirm.

On power up, the saved roster can be transferred to the active roster:

- Press **SHIFT SHIFT** and then select *LOCO SET MENU* with the **FWD** key and then **ENTER R**
- Select *Restore Roster* with the **FWD** key and then **ENTER R**

Setting *Auto Startup* (see section 1.13.1) to *2* will restore the entire saved roster automatically when the system is next powered up.

Rosters with Master / Slave combinations

Adding a loco to the active roster on any slave controller in the system will also update the active roster on the master controller in the system until it reaches it's maximum of 16. Thereafter no more locos can be added by slave controllers. Further locos can be added by the master controller but they will replace the 16th loco on the active roster whether it is under control or not.

A loco is available to either the master controller or the slave from which it was entered by using the **ENTER R** key to select it, provided that it is not currently under control. If the loco is under control it is available only by stealing it (see section 2.11).

2.11 Stealing/Releasing Locos

Locos under control can be requested or stolen from other users in the system.

Releasing

To request a loco under the control of another user:

- Press **LOCO** then using the **FWD** key (or thumbwheel) select *Loco=(No)* and press **ENTER R**

The controller on which it is being used will display:

Wanted - Slave 02 (the number is the slave requesting the loco and will only appear on master units)

- The current user releases the loco by pressing **LOCO** and **CLEAR** the display says *LocoX (No)* to indicate that the loco is released.
- The requesting user presses the **ENTER R** key to find the loco and thereby gains control.

Stealing

To steal a loco without requesting it first:

- Press **LOCO** then using the **FWD** key (or turn the thumbwheel clockwise) select *Loco=(No)* and press **ENTER L**

The loco will be added to the active roster and the controller from which it was stolen will display *Loco(No) Taken 1* (the number is the slave stealing the loco and will only appear on master units)

2.12 Point and Signals

Points and signals can be operated from the controller. They have their own type of decoder, the ZTC-304. Programming address codes is dealt with in the ZTC-304 instruction manual.

To operate a Point:

- Press **LOCO** followed by **SHIFT**
- Use the **FWD** or **REV** keys (or thumbwheel) to select the point number.
- Press **ENTER R** to operate the point right, or **ENTER L** to operate the point left.

Whilst the shift lamp flashes you may toggle the point left and right with the **ENTER L/R** keys.

- Press **CLEAR** to exit this command.

To operate a Signal:

- Press **SHIFT** followed by **LOCO**
- Use the **FWD** or **REV** keys (or thumbwheel) to select the Signal number.
- Press **ENTER R** to operate the signal red, or **ENTER L** to operate the signal green.

Whilst the shift lamp flashes you may toggle the signal green and red with the **ENTER L/R** keys.

- Press **CLEAR** to exit this command.

2.13 Loco 0

Most locos may be operated as Loco 0, however some are not suitable.

a) Portescap and Faulhaber and other coreless motors are not suitable.
b) N-Gauge locos must be operated with a 12V transformer. 15V is too high and will overheat the motor.
c) The loco must be checked for its suitability on the programming track as follows:

- Switch over to the programming track (a 12V 3W bulb must be connected as shown in section 1 Fig.2).
- Assign Loco 0 on the controller and make sure that it is shown as halted.
- Place the loco to be tested on the track at which point the lamp will light.
- If the lamp is very bright remove the loco immediately (the loco is drawing to much current and is not suitable)
- If the lamp glows dimly then operate the loco using the thumbwheel (a dim lamp indicates that the loco is drawing very little current) to check controllability.

A faint buzzing noise from the motor is normal.

2.14 Command menus

The ZTC-521 Hand controller commands are mainly accessed from the keypad and thumbwheel with either single or dual key operations. Some commands however, are accessed from menu items displayed on the LCD display. The menus are divided into four groups, each having a number of sub-items. When in a given menu the other three menus are accessed as sub-items. For ease of use, frequently used sub-items in each menu can be accessed with the four function keys **F1....F4**. Menu commands are activated by displaying them on screen and then pressing **ENTER R** on the keypad.

Table.1

SYSTEM MENU		Notes
None		
Control Status		Reports Master or Slave mode
Controls Test		
Set DCC Master		See section 1
Set Slave Mode		
Set Slave number	**F1**	
Auto Startup		See section 1.13.1
PROGRAM MENU	**F4**	
PRESETS MENU	**F3**	
LOCO SET MENU	**F2**	

Highlighted sub-items are the more commonly used ones and are explained below.

To enter the menus press **SHIFT** **SHIFT** on the keypad, and use the **FWD/REV** keys to scroll through.

2.14.1 SYSTEM MENU

This menu contains commands which set up the system for your application.

Set Slave Mode

Sets system for use as a Slave controller.

- Select item from menu and then press **ENTER R**

display returns to show last loco operated or *No Loco.*

Set Slave number

Assigns a number to each slave controller in the system.

- Select item from menu and then press **ENTER R**
- Use the **FWD** or **REV** keys to set the chosen value, and then **ENTER R**

display returns to show last loco operated or *No Loco.*

If the slave number selected is already in use, you are prompted to try again.

Table.2

LOCO SET MENU		Notes
None		
Show loco roster	**F2**	Displays **active** roster
DEL.Saved Roster		Deletes **saved** roster
Saved Loco List	**F3**	Displays **saved** roster
Count actv locos		Count locos on **active** roster
Restore Roster		Restores **saved** roster
Save currnt loco	**F1**	Saves to **saved** roster
Stop & Delete		Deletes locos from **active** roster
Show loco info		Displays info about loco currently under control
DoubleHead Break		Breaks up double headed group and restores individual locos
Set Crane mode		For Roco crane only
Set 128 step mode		
Set 14 step mode		
Set 28 step mode		Default setting
Check Loco mode	**F4**	
Speed Scale		
Speed units		
Display optn.		
SYSTEM MENU		
PROGRAM MENU		
PRESETS MENU		

Highlighted sub-items are the more commonly used ones and are explained below.

To enter the menus press **SHIFT** **SHIFT** on the keypad, and use the **FWD/REV** keys to scroll through.

2.14.2 LOCO SET MENU

This menu contains commands which individualise your system, or display the status.

Display optn.

Sets the display to show either a clock, the loco weight or switched loco functions in the bottom left hand corner.

- Select item from menu and then press **ENTER R**
- Use the **FWD** or **REV** keys to enter the chosen display option, and then **ENTER R**

display returns to show last loco operated or *No Loco.*

Speed units

Sets the displayed speed to MPH, KPH or STEPS.

- Select item from menu and then press **ENTER R**
- Use the **FWD** or **REV** keys to enter the chosen speed option, and then **ENTER R**

display returns to show last loco operated or *No Loco.*

Speed Scale
Sets the maximum speed displayed when the regulator is wound up to 100% power.

- Select item from menu and then press **ENTER R**
- Use the **FWD** or **REV** keys to enter the chosen maximum speed, and then **ENTER R**

display returns to show last loco operated or *No Loco.*

Set 128 step mode
Sets the number of speed increments between 0% power and 100% power. 128 is the maximum and will give the smoothest operation. Some older non-ZTC decoders may not work in this mode.

- Select item from menu and then press **ENTER R**

display returns to show last loco operated or *No Loco.*

Check Loco mode
Displays the current number of speed steps selected, 14, 28 or 128.

- Select item from menu and then press **ENTER R**

display shows current setting, then after a short period

display returns to show last loco operated or *No Loco.*

Show loco roster
Displays information about locos currently on the active roster.

- Select item from menu and then press **ENTER R**

display shows *Loco: 127 Master* or *Loco: 3 Free*

: Halted *: Step+4*

pressing the **ENTER R** key steps round the roster, and gives information about each loco.

Master means the loco currently under control, *Free* means loco is not under control but may be running.

- Press **CLEAR** to exit this command

display returns to show last loco operated or *No Loco.*

Stop & Delete
Deletes loco currently under control from active roster.

- Select item from menu and then press **ENTER R**

display shows *Halted* followed by *Deleted*

display returns to show last loco operated or *No Loco.*

Table.3

PROGRAM MENU		Notes
None		
SYSTEM MENU		
PRESETS MENU		
LOCO SET MENU		

Highlighted sub-items are the more commonly used ones and are explained below.

To enter the menus press **SHIFT SHIFT** on the keypad, and use the **FWD/REV** keys to scroll through.

2.14.3 PROGRAMMING MENU

This menu does not apply to slave operation. All decoder programming must be done by the master controller.

Table.4

PRESETS MENU		Notes
None		
End New Preset	**F4**	
Preset status		Reports number of steps used in a preset
Delete last step	**F3**	
Start new preset	**F2**	
Delete Preset		Deletes selected preset
Recall Preset	**F1**	
Preset Step Time		
Delete all prset		
SYSTEM MENU		
PROGRAM MENU		
LOCO SET MENU		

Highlighted sub-items are the more commonly used ones and are explained below.

To enter the menus press **SHIFT SHIFT** on the keypad, and use the **FWD/REV** keys to scroll through.

2.14.4 PRESETS MENU

This menu contains commands which setup preset Point and Signal routes.

Start new preset

Defines a preset number and enters 'learn mode'.

- Select item from menu and then press **ENTER R**
- Use the **FWD** and **REV** keys to enter the chosen preset number (1 to 10), and then **ENTER R**
- Confirm with **ENTER R**
- Enter **SHIFT** followed by **LOCO** to enter a signal into the preset, or **LOCO** followed by **SHIFT** for a point.
- Use the **FWD** and **REV** keys to enter the chosen point/signal number, and then **ENTER R** or **ENTER L** display returns to show *SAVED Step = 01* and then prompts *Step = 01*
- Again use the **FWD** and **REV** keys to enter the chosen point/signal number, and then **ENTER R / L** display returns to show *SAVED Step = 02* and then prompts *Step = 02*

Continue adding points / signals (to a maximum of 90 steps).

Now end the preset as follows:

End New Preset

- Select item from menu and then press **ENTER R**

preset is saved.

Delete last step

Deletes a step during preset entry.

Whilst entering preset steps (above) you can delete a step if unwanted:

- Press **SHIFT SHIFT F3** and then **ENTER R**

continue to add steps as normal.

Preset Step Time

Sets the length of time between preset point or signal operations.

Whilst entering preset steps (above) you can add a time delay between steps:

- Press **SHIFT SHIFT**
- Select *Set preset time* and press **ENTER R**
- Use the **FWD** and **REV** keys to enter the chosen time in seconds, and then **ENTER R**
- Add the next step.

The delay time will be applied to subsequent steps unless you alter it now.

- Add the next step.

A default time of 2 seconds is applied to points included in preset routes.

Recall Preset

Runs a preset point/signal route.

- Select item from menu and then press **ENTER R**
- Use the **FWD** and **REV** keys to enter the chosen preset number, and then **ENTER R**

preset route runs, and display shows progress of steps.

2.14.5 FULL MENU REFERENCE TABLE

SYSTEM MENU		LOCO SET MENU		PROGRAM MENU		PRESETS MENU	
None		None		None		None	
Control Status		Show loco roster	**F2**			End New Preset	**F4**
Controls Test		DEL.Saved Roster				Preset status	
		Saved Loco List	**F3**			Delete last step	**F3**
Set DCC Master		Count actv locos				Start new preset	**F2**
Set Slave Mode		Restore Roster				Delete Preset	
Set Slave number	**F1**	Save currnt loco	**F1**	SYSTEM MENU		Recall preset	**F1**
Auto Startup		Stop & Delete		PRESETS MENU		Preset Step Time	
		Show loco info		LOCO SET MENU		Delete all prset	
		Set Crane mode				SYSTEM MENU	
		Set 128 step mode				PROGRAM MENU	
		Set 14 step mode				LOCO SET MENU	
PROGRAM MENU	**F4**	Set 28 step mode					
PRESETS MENU	**F3**	Check Loco mode	**F4**				
LOCO SET MENU	**F2**	Speed Scale					
		Speed units					
		Display optn.					
		SYSTEM MENU					
		PROGRAM MENU					
		PRESETS MENU					

Section 3 Common Problems

It is assumed that loco decoders have been installed correctly and tested accordingly.

SYMPTOM	POSSIBLE CAUSES : REMEDY
Overload lamp on Power Booster illuminates	1. Track short circuit : Check wiring for crossed connections. Check insulation on points and reverse loops. Check for screwdrivers etc across track. Electrofrog point not correctly insulated.
Loco runs in opposite direction to that expected.	1. Direction incorrectly set at factory : Set CV29 to 3 2. Wires to loco motor reversed : Set CV29 to 3
Loco top speed is too fast.	1. Variation in loco motors : Set CV5, loco max voltage.
Too much movement of regulator required to start loco.	1. Variation in loco motors : Set CV2, loco start volts.
Loco speed excessive at low regulator setting.	1. Variation in loco motors : Set CV2, loco start volts.(try 0 to start with) Set CV5, loco max voltage. (try 255 to start) Set CV6, loco mid point. (try 0 to start with)
Poor running of individual loco.	1. Dirty track, wheels, pickups. 2. Pulse width modulation incorrect : Set CV9, PWM period. 3. Incorrect CV settings : Reset decoder to factory defaults.
Poor running, all locos.	1. Dirty track, wheels, pickups. 2. Insufficient power feeds to track : Add feeds every 1Metre/3Ft.
No response from loco during programming.	1. Programming track not switched on. 2. Check lamp is good by shorting tracks together momentarily. 3. Dirty track, wheels, pickups.