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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ZTC Controls Ltd.
24 Chilkwell St. Glastonbury.
Somerset BA6 8DB, England
Tel: 0870 241 8730 Fax: 01458 837831
E Mail: sales@ztccontrols.com
Web Site: www.ztccontrols.com

Introduction to the decoder and its features

With reference to the main picture and board description of Figure 1 the board consists of the following.

- **Main cable**. The signals from the DCC rail track and the signals that are output all come out on this cable apart from the Servo connector. Figure 1 details this cable and its signals.

- **Servo connector**. This only outputs Servo signals when the board has been programmed as a Servo Controller.

- **Switch.** This is used to manually switch the attached devices. Depending on which mode the decoder is in determines the nature of the manual output. For example by pressing the switch, if the decoder is in pulse mode then the unit will pulse in the opposite direction to last performed. Confirming status of decoder.
  The switch is also used to enter service mode whilst the device is connected to the main track. This enables programming of the CV values and thus configuration of the device.

As stated this decoder can control almost any point accessory device. It can be used for other control system such as lights, signals etc. It has circuitry enabling many modes of operation. These modes are categorised as follows.

1. Coil motor such as PECO, Hornby, Seep etc. This style of motor has two coils and either coil is pulsed to actuate the point in its respective direction.

2. Slow Action Point Motors such as Tortoise, Fulgarex, Lemaco etc. These devices are driven continuously therefore having a separate mode of control.

3. Servo control. Gives control of R/C servo units. These are fully programmable to allow adjustable end limits and the movement rate.

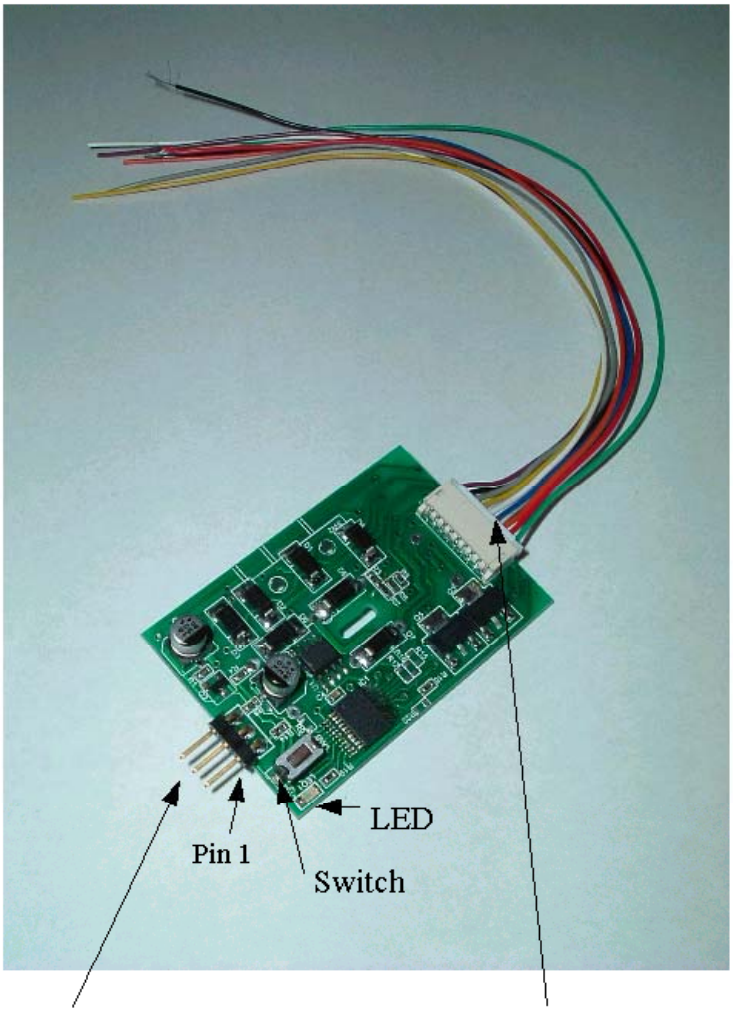
4. Flash mode. This enables fully programmable flashing outputs with independent configuration of the on and off times.

The ZTC 303 unit has the facility to be upgraded for future software enhancements.
The unit has been fully tested to work with all NMRA compatible systems.

Installation of the ZTC 303 Decoder

The Installation is very simple.
All that is required is for the Black and wires Red to be connected to the Track north and Track south and then the relevant connections to the chosen point motor.
See full diagram and chart below

FIGURE 1



Servo Output

Pin	Use
1	Servo signal
2	+5V
3	0V

Cable Colour	Use
Purple	Vs (20V – 40V)
Black	Tn (DCC Signal)
Grey	Coil - (One side of output)
Yellow	+5v (+5v reference)
White	Opto+ – future use
Blue	Opto- – future use
Orange	Coil 1- (Other side of output)
Red	Ts (DCC Signal)
Green	0V (0V reference)

Decoder Default Settings

When the unit is first connected to the track and has never been programmed before the following defaults will be set.

Decoder Address: 1
Mode: Pulse
Pulse Width: 200milliseconds

In this mode the decoder will switch point motors with a pulse of 200milliseconds. If configuration is required then the user will need to read the programming modes section
Mode Description

Programming your ZTC 303 Decoder

Pulse Motor operation.

This mode is the default mode of the decoder.

This mode consists of a programmable pulse output. When a switch command is received from the DCC control unit the decoder switches the appropriate output for the predefined time. The default value for this is 200milliseconds.

CV34 can be used to program this pulse width value. The user can program a value between 0 and 255 for this. Each increment in value increases the pulse time by 10milliseconds. For Example, 1 gives a pulse of 10milliseconds, 2 gives 20milliseconds, etc. This gives a maximum switching time of 2.55 seconds.

WARNING: IF A TOO LONG A PULSE DURATION IS SET THIS MAY CAUSE DAMAGE.

DUE TO THE HIGH CURRENT OF SOME POINT MOTORS IT IS ADVISED THAT THE POINT MOTOR SHOULD NOT BE SWITCHED REPETITIVLEY MORE THAN 5 TIMES IN ANY 10 SECOND PERIOD, OTHERWISE DAMAGE MAY OCCUR AND WARRANTY WILL BE VOID.

Continuous Mode Operation.

This mode provides a continuous or permanent on signal to the requested output. When first powered up it does not switch in either direction?

To place the decoder in this mode program CV33 with value 1.

PRESET → SIGNAL → *cv 33* → PRESET → *1* → ENTER R

When this is done a lock value is placed in CV35. This is to protect the unit from harm if it was connected to a point motor and is accidentally programmed into this mode. Using the decoder in continuous mode with a PECO Point motor for example will result in circuitry damage.

The decoder will not enter Continuous mode without programming the LOCK value into CV33 and you will not be able to instruct the decoder to output any signal without programming CV35 with the UNLOCK code.

To unlock the decoder outputs in continuous mode program CV35 with value 255.

PRESET → SIGNAL → *cv 35* → PRESET → *255* → ENTER R

No other value will unlock the outputs!

Servo Mode

The decoder's Servo connector provides the necessary signal to control a servo unit in either direction. The output is only enabled when the decoder is placed in Servo mode.

To place the decoder in this mode program CV33 with value 2.

PRESET → SIGNAL → *cv 33* → PRESET → *2* → ENTER R

The decoder has 3 other CV values to control the parameters of the servo output.

CV37 controls the negative limit for servo control. This is a value in degrees of rotation in the anticlockwise direction?

CV38 controls the positive limit for servo control. This is a value in degrees of rotation in the clockwise direction?

CV36 controls the speed of movement. Normal operation sees the degree movement increased by 0.5 degrees per 20milliseconds. The value programmed here will increase the time between 0.5 degree increments. Each value equals 20ms of time. So a value of 1 here will mean that 0.5degrees of rotation will be increased every 20milliseconds, 2 will give 0.5degrees rotation increase every 40 milliseconds and so on.

Flash Mode

This mode flashes the outputs. Alternatively

To place the decoder in this mode program CV33 with value 3

PRESET → **SIGNAL** → ***cv 33*** → **PRESET** → ***3*** → **ENTER R**

The rate at which it flashes is controlled by CV39 and CV40
The CV can be programmed with a value between 0 and 255. Each increment is equivalent to 100milliseconds of pulse width so 1 gives a flashing period of 100milliseconds ON, 100milliseconds OFF. 2 would give a flashing period of 200milliseconds ON, 200milliseconds OFF, etc.

Programming modes.

There are several modes of programming performed by command stations. These fall into two types, Operations mode and Service mode programming.

Operations mode programming. Operations mode is the normal operating state of the decoder whereby it receives DCC packets and acts upon them. Some command stations have the ability to perform Direct Mode programming whilst in Operations mode. For this reason this functionality has been provided with the decoder. See your control station manual on how to implement Direct Mode.

Service mode programming. Here the decoder is instructed to enter Service mode by holding the switch down on the decoder until the LED flashes. This indicates the unit is in Service mode and that it will only accept program instructions and will not act on normal operation mode instructions. Depending on which programming mode is being used depends on whether the switch is pressed whilst in service mode.

There are 4 modes of programming that a command station may be able to perform. These are

- Direct Mode
- Paged Mode
- Address only mode
- Physical Address mode.

Please read your command station manual to understand which programming mode you want to use.

When using Direct Mode and Paged Mode the user may stop holding the switch down when Service mode is entered. This tells the decoder to accept Direct or Paged Mode instructions.

If you wish to use Address only or Physical Address mode then you will need to hold the switch down throughout the whole of the programming required.

For Direct Mode and Paged Mode the following table shows the Cv registers that are available to the user.

CV number	CV name	Description
1	AddressLSB	Holds the low order bits of the decoder address
7	SWVersion	Holds the software version number
8	ManID	Manufacturer ID – ZTC is decimal 132
9	AddressMSB	Holds the high order bits of the decoder address
33	Mode	Holds the decoder mode required
34	PulseModeOnTime	Time used for pulse mode x 10millisceconds
35	CMLock	Lock CV for continuous mode
36	ServoRate	Holds movement speed value for servo mode
37	ServoNegLimit	Holds degree limit in anticlockwise direction
38	ServoPosLimit	Holds degree limit in clockwise direction
39	FlashModeRateOn	For flash mode holds on time x100ms
40	FlashModeRateOff	For flash mode holds off time x100ms
41	ReverseDirection	Reverses the direction i.e. Left and right.

Programming with the ZTC 511 and ZTC 505 Controllers

Holding down the button on your ZTC 303 decoder for approximately 5 seconds until the LED flashes,
Then continue with the following keystrokes.

PRESET → **SIGNAL** → ***cv number*** → **PRESET** → ***new value*** → **ENTER R**

To leave programming mode simply turn the power off to the ZTC 303 or press the button on the ZTC 303 until the LED goes off.

Physical address mode.

Some more basic command stations only perform Physical Address mode. For compatibility with those the following solution has been provided to allow such command stations to program the decoder.

As defined by the NMRA standard, physical address mode consists of 8 addressable registers. Some of these registers have been labelled by the NMRA standards themselves and are only to be used for that specific purpose. Some have been left by the NMRA standard to be used by the Manufacturer as they see fit. The following table shows the table of registers as defined by the NMRA.

CV Address	Description
1	Lower address
2	Undefined
3	Undefined
4	Undefined
5	Undefined
6	Undefined
7	Version Number
8	Manufacturer ID

ZTC have CV 2 – 6 to fit the fully programmable features of the decoder in to. ZTC has achieved this through a special method. It maybe a little complex to follow but it is there to enable more basic controllers the full operation of this new decoder. This has led to the following scheme being used.

CV Address	Description	Actual CV address being programmed
1	Lower address	1
2	Mode	33
3	Mode specific	Depends on mode programmed
4	Mode specific	Depends on mode programmed
5	Mode specific	Depends on mode programmed
6	Reverse Direction	41
7	Version Number	7
8	Manufacturer ID	8

Register 2 is used to program the Mode of the decoder.
Register 6 is used to reverse the direction.
This can be used when the system has been implemented and it is then found out that the directions of the motor control need to be reversed.

Mode specific registers hold values that are different depending on which mode has been programmed.

When the decoder is in Mode Pulse the register tables takes the following form

Address	Description	Actual CV address being programmed
1	Lower address	1
2	Mode = PULSE	33
3	Pulse time x10milliseconds	34
4	Not used	No CV programmed
5	Not used	No CV programmed
6	Reverse Direction	41
7	Version Number	7
8	Manufacturer ID	8

When the mode is programmed to be 'Continuous' Mode then the table takes the following form.

Address	Description	Actual CV address being programmed
1	Lower address	1
2	Mode = CONTINUOUS	33
3	LOCK CV	35
4	Not used	No CV programmed
5	Not used	No CV programmed
6	Reverse Direction	41
7	Version Number	7
8	Manufacturer ID	8

When the mode is first programmed the decoder has automatically programmed the LOCK CV to the LOCKED value. This is a safety feature used to disable a potentially dangerous situation for the decoder.

When in pulse mode the decoder can drive high current motors for a small amount of time. If the mode was changed and the user did not realise then the circuitry would drive the high current motors continuously and this would then over heat the decoder.

So a LOCK CV has been used to ensure that if this mode is entered the user must also program this CV before any output will be generated.

When the mode is programmed to be 'Servo' mode the table takes the following form.

Address	Description	Actual CV address being programmed
1	Lower address	1
2	Mode = SERVO	33
3	Servo rate	36
4	Servo negative limit	37
5	Servo positive limit	38
6	Reverse Direction	41
7	Version Number	7
8	Manufacturer ID	8

When the mode is programmed to be 'Flash' mode the table takes the following form.

Address	Description	Actual CV address being programmed
1	Lower address	1
2	Mode = Flash	33
3	Flash on time x100milliseconds	39
4	Flash off time x100milliseconds	40
5	Not used	No CV programmed
6	Reverse Direction	41
7	Version Number	7
8	Manufacturer ID	8

Factory Resetting the decoder.

To reset the decoder to factory default you need to set CV 8 to a value of 8. To do this with the ZTC 511 or ZTC 505 controller proceed with the following steps

PRESET → **SIGNAL** → ***8*** → **PRESET** → ***8*** → **ENTER R** → **ENTER R**