Timpdon Electronics

Technical Note - No. 10

UltraRad Controller Model *URC4*

Servo Calibration Procedure

Introduction

The ***UltraRad*** controller, Model ***URC4*** for live steam locomotives can control up to two standard Radio Control servos for regulator/reverser and steam whistle.

As all RC servos have different calibrations, and every locomotive requires a different set of servo settings for each function, it is necessary to provide a unique set of calibrations for each installation.

On the ***UltraRad*** system, servo calibrations are performed within the locomotive mounted controller, unlike a conventional RC system where adjustments are made using transmitter trim controls. In this way, a single transmitter can be used to control any locomotive without the need for any transmitter adjustments.

Each servo can be independently calibrated for end positions and, where appropriate, maximum rotation rates. Once calibrated, all settings are stored in non-volatile memory and retained even when power is removed from the ***URC4***.

Any or all calibration settings can be changed at any time,

Calibration is performed using an ***UltraRad*** Transmitter, Model ***UTX2*** or ***UTX3***, operating in a special calibration mode.

Once calibrated, the locomotive can be controlled using an ***UltraRad*** Transmitter, Model ***UTX1***, if desired.

URC4 Versions

The ***URC4*** has been supplied with two versions of control software, **Issue 1** and **Issue 2**.

The **Issue 1** version, supplied up to January 2011, has a total of **seven** settings which can be user calibrated.

The **Issue 2** version, supplied from February 2011, has **five** settings which can be user calibrated.

User calibration of the regulator rotation rate has been removed, and replaced by a single fixed calibration rate of approximately 0.7 seconds between minimum and maximum regulator positions.

This change has been made in response to user requests for a more rapid control response.

Please ensure that you use the calibration instructions applicable to your version. The issue number of the control software fitted to each ***URC4*** is printed on its label.

Issue 1 Software - Calibration Settings

A total of seven settings can be independently calibrated:

Regulator Servo

1 Regulator Stop Position
The regulator servo position when the reverser control is set to stop, or the speed setting control is set to minimum

2 Regulator Maximum Forward Position
The regulator servo position when the speed setting control is set to maximum, with the reverser set to forward

3 Regulator Maximum Reverse Position
The regulator servo position when the speed setting control is set to maximum, with the reverser set to reverse

Each regulator servo position can be set anywhere within the operating range of the servo.

After calibration, for transmitter speed control settings between minimum and maximum, the servo position will be set proportionately between the minimum and maximum positions.

4 Rotation Rate – Increasing Speed
The maximum rotation rate of the regulator servo for an increase in speed setting.

5 Rotation Rate – Decreasing Speed
The maximum rotation rate of the regulator servo for a decrease in speed setting.

Each setting is adjustable from 1 second to 8 seconds rotation period between the calibrated minimum and maximum settings

The rotation speed of the servo is limited only when the speed setting control is changed at a rate faster than the calibrated value. At lower rates, the servo position will directly follow the transmitter speed setting control.

Auxiliary 1 Servo

6 **Off Position**
The Auxiliary 1 servo position when the Aux 1 control switch is set to **Off**.

7 **On Position**
The Auxiliary 1 servo position when the Aux 1 control switch is set to **On**.

Both servo positions can be set anywhere within the operating range of the servo.

The rotation rate of the Auxiliary 1 servo is preset at 1 second rotation period between the calibrated on and off positions.

Note The ***UTX2*** and ***UTX3*** transmitters have a total of ten consecutive calibration steps, to accommodate the ***URC3*** controller. For the ***URC4***, Issue 1 controller, steps 8 to 10 are not used, and have no function.

Issue 1 Software - Calibration Procedure

All servo calibration is performed from the ***UTX2*** or ***UTX3*** transmitter, in calibration mode.

In this mode:

The **Tx** lamp is off
The **Cal** lamp flashes to show the current calibration step number [see below].
The **speed setting** [Calibrate]control sets the calibration value for the current step.
The **Aux 1 [Save]** switch saves the current programming value and then proceeds to the next step.
The **Aux 2 [Cancel]**switch cancels the current step, without changing the existing calibration value, and proceeds to the next step.
The **Reverser** switch has no function.

To enter calibration mode:

1 Ensure that the transmitter is on and locked to the receiver and controller to calibrated.
2 Make sure that both the **Aux 1** [**Save**] and **Aux 2** [**Cancel**] switches are off.
3 Press and hold the recessed **Cal** push button on the right side or rear of the transmitter for five seconds, using, for example, a pencil point, until the **Cal** lamp changes from flashing to fully on.
5 Then release the **Cal** push button.

Once the transmitter is in calibration mode, there is no exit until power is removed and re-applied.

On entry to calibration mode, the calibration sequence will always be set to **Step 1**. At all times, the current step will be shown by the flash sequence on the **Cal** lamp, as shown below.

For each step in turn, set the **speed control** to give the required servo setting for the current calibration step.

When satisfied, turn the **Save** [Aux 1] switch on and off once only. The **Cal** lamp will flash for one second while the save command is transmitted. The calibration setting will be saved within the ***URC4***, and the calibration procedure will then proceed to the next calibration step.

To proceed to the next calibration step without changing the existing calibration setting, turn the **Cancel** [Aux 2] switch on and off once only.

After Calibration **Step 10**, the sequence will restart at **Step 1**.

Calibration Steps

Step	Calibration	Flash Sequence
1	Regulator Stop Position	One – One
2	Regulator Maximum Forward Position	One – Two
3	Regulator Maximum Reverse Position	One – Three
4	Regulator Rotation Rate – Increasing Speed	One – Four
5	Regulator Rotation Rate – Decreasing Speed	Two – One
6	Auxiliary 1 Off Position	Two – Two
7	Auxiliary 1 On Position	Two – Three
8	[No Function]	Two – Four
9	[No Function]	Three – One
10	[No Function]	Three – Two

Issue 2 Software - Calibration Settings

A total of five settings can be independently calibrated:

Regulator Servo

1 Regulator Stop Position
The regulator servo position when the reverser control is set to stop, or the speed setting control is set to minimum

2 Regulator Maximum Forward Position
The regulator servo position when the speed setting control is set to maximum, with the reverser set to forward

3 Regulator Maximum Reverse Position
The regulator servo position when the speed setting control is set to maximum, with the reverser set to reverse

Each regulator servo position can be set anywhere within the operating range of the servo.

After calibration, for transmitter speed control settings between minimum and maximum, the servo position will be set proportionately between the minimum and maximum positions.

The rotation rate of the regulator servo is preset at 0.7 seconds rotation period between the calibrated on and off positions.

Auxiliary 1 Servo

4 **Off Position**
The Auxiliary 1 servo position when the Aux 1 control switch is set to **Off**.

5 **On Position**
The Auxiliary 1 servo position when the Aux 1 control switch is set to **On**.

Both servo positions can be set anywhere within the operating range of the servo.

The rotation rate of the Auxiliary 1 servo is preset at 0.7 seconds rotation period between the calibrated on and off positions.

Note The ***UTX2*** and ***UTX3*** transmitters have a total of ten consecutive calibration steps, to accommodate the ***URC3*** controller. For the ***URC4***, Issue 2 controller, steps 6 to 10 are not used, and have no function.

Issue 2 Software - Calibration Procedure

All servo calibration is performed from the ***UTX2*** or ***UTX3*** transmitter, in calibration mode.

In this mode:

The **Tx** lamp is off
The **Cal** lamp flashes to show the current calibration step number [see below].
The **speed setting** [Calibrate]control sets the calibration value for the current step.
The **Aux 1 [Save]** switch saves the current programming value and then proceeds to the next step.
The **Aux 2 [Cancel]**switch cancels the current step, without changing the existing calibration value, and proceeds to the next step.
The **Reverser** switch has no function.

To enter calibration mode:

1 Ensure that the transmitter is on and locked to the receiver and controller to calibrated.
2 Make sure that both the **Aux 1** [**Save**] and **Aux 2** [**Cancel**] switches are off.
3 Press and hold the recessed **Cal** push button on the right side or rear of the transmitter for five seconds, using, for example, a pencil point, until the **Cal** lamp changes from flashing to fully on.
5 Then release the **Cal** push button.

Once the transmitter is in calibration mode, there is no exit until power is removed and re-applied.

On entry to calibration mode, the calibration sequence will always be set to **Step 1**. At all times, the current step will be shown by the flash sequence on the **Cal** lamp, as shown below.

For each step in turn, set the **speed control** to give the required servo setting for the current calibration step.

When satisfied, turn the **Save** [Aux 1] switch on and off once only. The **Cal** lamp will flash for one second while the save command is transmitted. The calibration setting will be saved within the ***URC4***, and the calibration procedure will then proceed to the next calibration step.

To proceed to the next calibration step without changing the existing calibration setting, turn the **Cancel** [Aux 2] switch on and off once only.

After Calibration **Step 10**, the sequence will restart at **Step 1**.

Calibration Steps

Step	Calibration	Flash Sequence
1	Regulator Stop Position	One – One
2	Regulator Maximum Forward Position	One – Two
3	Regulator Maximum Reverse Position	One – Three
4	Auxiliary 1 Off Position	One – Four
5	Auxiliary 1 On Position	Two – One
6	[No Function]	Two – Two
7	[No Function]	Two – Three
8	[No Function]	Two – Four
9	[No Function]	Three – One
10	[No Function]	Three – Two

Restoring Normal Operation

To restore normal operation, turn off both the transmitter and controller, and then turn them on again. The normal operating mode will be restored, using the current calibration settings, which will be re-read from non-volatile memory.

This operation can be performed at any time during operation in calibration mode.

A Cautionary Note

When setting maximum and minimum servo calibrations, you must make sure that the positions selected are within the linear operating range of the servo. If the selected position is outside the operating range – i.e. the servo is against an end stop, the servo will never be able to achieve its selected position. The effect of this is twofold:

1. The servo will draw a very large current continuously as it attempts to reach a position which is not achievable. Under these conditions, we have measured servo currents of 1A, instead of the usual operating current, while moving, of less than 100 mA and a current, when stationary, of about 20 mA. Excessive servo currents will very quickly flatten your batteries.

2. If the servo draws a very high current continuously, it will very rapidly overheat and may be permanently damaged either from overheating, or from stripped gears due to excessive torque.