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Smoke Unit for Battery-powered Locomotives



This Smoke Generator will add realism to your Model by producing prototypical exhaust effects, but you will have to help it along to get the best from it.

For use ONLY with medium-density water-based Disco 'smoke' Fluid

Please do read and understand all sections of the manual before attempting installation and usage.

Above all, HAVE FUN with it!

If you have any questions or comments, we are only an email or 'phone call away, or visit www.magpiecd.com/smoke/faq

The Smoke unit consists of a container for the Smoke Fluid, which also houses the Fan, the replaceable Heater element, and the Control Electronics. Basic operation of the unit is controlled by a single push button, which needs to be mounted in a convenient position. An additional connection can be made to the Loco's motors, giving a more realistic operation. The unit can be used immediately 'out-of-the-box'; facilities are available to adjust various settings to customise the operation to your preferences. These procedures are described in detail later.

It is **imperative** that the Smoke unit is not operated with insufficient fluid! Doing so will damage the unit, and may cause further damage to your locomotive! The heater element has a power of up to 80 Watts, dependent on the smoke volume; the system must be treated with the necessary respect. Great care has been taken in the software design of the system to ensure that this eventuality will not happen.

Please read the **Smoke Fluid Consumption** section on Page 8.

What's in the Box

Smoke Unit
Connector & tail for Driver's Control
Driver's Push Button
Repeater LED
250 cc of Smoke Fluid
20 cc syringe
Fuseholder and 5 Amp Fuse.

What you will need to provide

Wire
15 mm diameter Plastic piping
15 mm end-feed copper fittings for bends
Suitable sealant / Epoxy Adhesive
A location for the Driver's control and repeater LED

Installation

1. Power Connections.

24V DC is connected to the two pluggable terminals on the Power Module (Fig 1), which is located at one end on the Unit. As the illustration shows, connect the **POSITIVE** to the UPPER TERMINAL, and **NEGATIVE** to the LOWER TERMINAL.

POLARITY IS VERY IMPORTANT!!

Reverse connection will damage the unit!

A 5 Amp fuse (supplied) must be incorporated into the Positive lead.

DO NOT use 12V or 36V!!!!

The Power connector is configured for SIDE entry; If it is more convenient for your particular installation, then it can be re-configured for END entry. You must remove and re-site the Black and Brown polarising clips to achieve this.

ENSURE THAT THE POSITIVE WIRE IS CONNECTED TO THE UPPER TERMINAL!

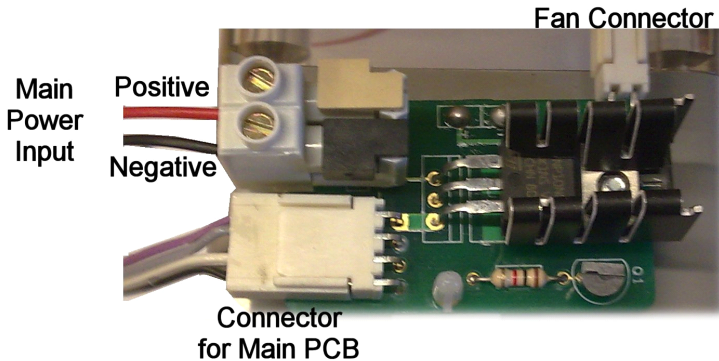


Fig 1. Power Module

Installation (cont)

2. Control Connections.

Refer to Fig 2 (below)

The Loco Speed sensing connector is shown in the top-left corner. If you want to have automatic speed sensing of the locomotive, connect these terminals to the motor-drive terminals of your Locomotive's Controller. Polarity is unimportant.

Drivers Control.

A connector is supplied which fits into the Driver's Control Connector (bottom-left in Fig 2). This connector has 3 wires coming from it (Blue, Red and Green). The Green and Blue wires are for driver's control push-button. A repeater LED can also be connected to this cable; the BLUE wire goes to the CATHODE (negative) of the LED, and the RED wire to the ANODE (positive). No resistor is required for the LED; it is already on the Board. NOTE: The LED's CATHODE is the SHORT leg!

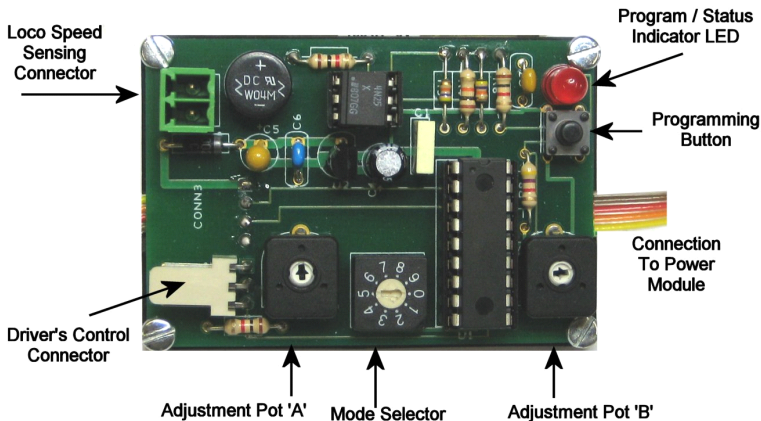


Fig 2. Control Board

Main Board Controls

The **Mode Selector** is a rotary switch with positions numbered 0 to 9. The number pointed to by the arrow indicates the current mode. The mode is changed by rotating the pointer with the aid of a small screwdriver in the slot.

Mode **0** is the running mode. Other modes are used to customise or program the unit, in conjunction with **Adjustment Pots A & B**, and also to indicate that you have refilled the unit. These operations are described later.

Installation (cont)

Physical Installation.

The unit should be located securely in the locomotive, such that it cannot move about, but can be easily lifted out for maintenance.

The exhaust stubs on the end of the unit are of 15 mm Plastic water pipe. Use similar piping together with 15 mm end-feed copper elbows and bends (easily obtained from any DIY / plumbing centre) to run to the exhaust outlets on the locomotive roof. Make sure that there are no traps in the plumbing; the 'smoke' can condense and lie in these traps, reducing the volume of smoke reaching the exhaust outlets. The joints should be sealed with Epoxy adhesive.

Using BOTH Smoke outputs.

The direction of rotation of the Fan causes the Smoke output to be concentrated on the Left-hand output stub. An elbow is fitted to the inside of the Right output stub, to divert some of the smoke to it. The exact position of this elbow will depend upon the 'resistance' of the exhaust plumbing, so needs to be established by trial and error. Once discovered, the elbow should be fixed in that position using a suitable adhesive.

Using only one output.

Use only the LEFT output stub; the Right Stub should be blanked off.

Things to be done before first use, and whenever the Element / Wick Assembly is replaced

Dismantle the unit (page 10)

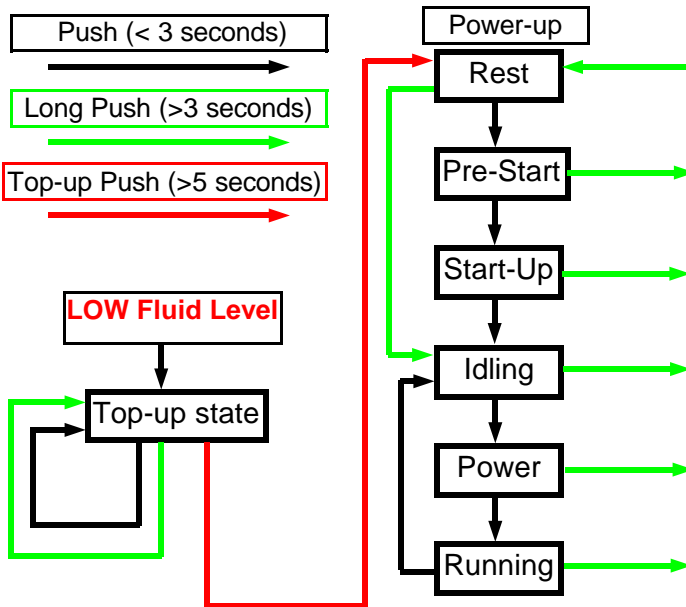
Ensure that the heater coils are wound evenly around the Wick, and that no coils are touching. Put the Element/Wick assembly in a small jar, and fill with sufficient fluid to completely cover it. Leave to soak for at least 24 hours.

Re-assemble the unit. (Page 10).

Carry out the **Reset the Fluid Consumption Monitoring System** procedure (see page 12).

Basic Operating Overview

The smoke generator unit runs sequentially through a sequence of 'states'; using 3 different 'exhaust patterns', as shown in the diagram below. An Exhaust Pattern is a particular combination of Smoke Volume (0-100%) and a Fan Speed (0-100%).



When Power is applied to the unit, it will go to the 'Rest' state. Each push of the button will advance to the next state, following the path shown by the **BLACK** arrows.

Some states can be skipped, by pressing and holding the button for 3 seconds. (a **LONG** push).

The **GREEN** arrows indicate the route taken for a 'LONG' push.

You will see that when the unit is in the Rest state, a long push will go directly to Idling. When it is in any other state except Top-up, it will return directly to the Rest state.

The **RED** arrow shows the path taken after you have topped up the unit. Press and hold the button for at least 6 seconds (a **TOP-UP** push).

Some advances can be programmed to occur automatically. This features is described later.

Basic Operating Overview (continued)

State	Pattern	%Smoke	%Fan	LED Indication
Rest	OFF	0	0	'Blink' every 3 seconds
Pre-start	PRE-HEAT	100	0	'Flash' every second
Start-up	CLAG (Default)	100	80	'Flash' every second
Idling	IDLE (Default)	50	40	'Flash' every second
Power	CLAG (Default)	100	80	'Flash' every second
Running	OFF	0	0	'Blink' every second
Top-up	OFF	0	0	On permanently

The CLAG and IDLE patterns can be user-adjusted, if required.

The Status LED is always active in some way when power is ON, and helps to identify the current state. A 'Blink' is a very short pulse, whilst a 'Flash' is a longer pulse.

The length of a Flash is an indication of the how much power is being delivered to the heater, and therefore the volume of smoke that's being generated. For example, equal-length ON-OFF periods indicate 50% power.

If the LED is Permanently ON, this means that the unit needs to be topped-up with fluid (Top-up state).

If it's OFF, then the power to the unit is OFF!

A connection is available which allows a Repeater LED to be installed along with the push button, for the Driver's use. This is useful when the unit is installed in the Loco in such a position where the on-board LED can't be seen.

The Status LED and push button are also used to program the unit , if required. See later.

The Heater/ Wick Assembly

This is a replaceable assembly, which is responsible for producing the 'smoke'.

Smoke Fluid is drawn into the wick, and evaporated by the Heater which is wound around it. A few turns of the heater winding are always immersed in the smoke fluid; this helps to pre-heat the fluid, improving the flow into the wick.

Use only water-based medium-density 'Smoke' fluid designed for use at Discos.

DO NOT USE ANY OTHER FLUID!

Smoke Fluid Consumption.

At 100% smoke rate, fluid is consumed at a rate of approximately 2 cc per minute, and pro-rata for lower smoke rates.

The software in the unit monitors the consumption, based upon accumulated smoke rate (heater power) and time. When approximately 50 cc have been consumed, it will enter the Top-up state, with approximately 60 cc of fluid remaining. This is the LOW level. The Unit must NEVER be operated when the fluid is below this level.

When this level is reached, and the unit enters the Top-up state (with the LED permanently On), all operations are now disabled. When this happens, you must:

A) add 50 cc of fluid. You can use the syringe to do this down one of the exhaust outlets. If you have outlets that are of different lengths, use the shortest one. It is important that there are no traps in the 'plumbing', otherwise the intended amount may not reach the container. Do not overfill; doing so will 'swamp' the wick, and result in less smoke!

B) Give a 'Top-up' push – ie a continuous push of > 5 seconds. The unit will now enter the 'rest' state. Normal operations are now enabled.

Experience has show that an average days' running can be done on 2 or 3 Top-ups. The unit will remember the last level if powered off, and back on.

The 'Top-up' procedure outlined above can be performed a maximum of 5 consecutive times. After this, the unit will remain permanently in the Top-up state; giving a Top-up push in this condition will lead to the LED flashing as a reminder. You must now carry out the **Reset the Fluid Consumption Monitoring System** procedure described on Page 12.

The **Reset the Fluid Consumption Monitoring System** procedure can be carried out at any convenient time, rather than wait to be forced to do it. It's probably a good idea to do so when the loco is back in the workshop at the end of a day's run.

Using the Smoke Unit when Driving

Starting the Unit.

Having applied power to the unit, it will be in the Rest state.

In conjunction with a Sound System:

Before 'starting' the engine, push the button to advance to the Pre-Start state. Here, the heater is run at full power, but no fan. This is used to accumulate smoke inside the unit, in readiness for Start-Up'.

Start the engine. When the engine 'catches', push the button to advance to the Start-Up state. Here, the CLAG pattern is run. The smoke that has accumulated in the unit is immediately ejected by the fan, followed by a steady stream of heavy exhaust. When your sound system reaches the engine idling sound, push the button to advance to the Idling state. This state produces an exhaust pattern that you would expect to see when a loco is idling.

NOTE: If desired, the advance from Start-Up to Idling can be made to occur automatically by following the programming procedure described later.

Without a Sound System

If you don't have a sound system, the unit can be made to skip the Pre-Start and Start states, advancing directly from the Rest state to the Idling state by means of a Long push.

Driving away

As you drive the loco away from rest, press the button to advance to the Power state, which uses the CLAG pattern. As the loco gathers speed, the exhaust can be turned off. Pressing the button advances to the Running state, using the OFF pattern (this will automatically occur after 10 seconds if you don't press the button). There is no need to have exhaust on the move, as the wind simply blows it away, so it's a waste of fluid. When you next slow down, prior to stopping, press the button to cycle back to the Idling state. Each subsequent push of the button will cycle around the Power, Running, and Idling states.

When Idling, the Smoke automatically cycles through 30 seconds ON, 15 OFF, whilst the Fan continues to run. This gives a realistic 'hunting' effect, and also reduces fluid consumption; using the default IDLE pattern allows approximately 2 hours of continuous Idling on one Top-up! It also helps to prolong the life of the Heater / Wick assembly.

NOTE: If desired, the 'Idling – Power – Running' sequences can be made to advance automatically, following the Loco's behaviour. You will need to connect the Loco Speed Sensing Connector to the Loco's motors, then follow the programming procedure described later.

Using the Smoke Unit when Driving (continued)

Push and hold the button for 3 seconds when in any state to put the unit back to the Rest state, ready for another engine start sequence, or when resting the locomotive.

Maintenance Procedures

Dismantling the unit:

1. Detach the 4-way ribbon cable from the lower-left connector of the power module, and the Fan cable from the top-right connector.
2. Remove the screw from each corner of the lid, remove the lid, then the heat-shield /deflector.
3. Remove the wick assembly by gripping the grey plastic connector and sliding it forward and out.

Re-assemble the Unit

1. Install the Wick by sliding it into the connector. Ensure that the dovetails in both connector halves are correctly engaged.
2. Replace the heat-shield/deflector, the Lid and the 4 screws.
3. Re-attach the 4-way ribbon cable, and the fan cable.

At the end of each running session

We recommend that at the end of each day's running, and in any case after 5 consecutive 'Top-up' pushes, that the unit should be drained, by removing it from the locomotive, and emptying through the exhaust stubs,

It must then be re-filled with 110 cc of fluid, (the drained fluid may be re-used) in preparation for the next session).

The '**Reset the Fluid Consumption Monitoring System**' procedure should be carried out after this.

Periodically

From time-to-time, the unit should be cleaned out, and the Wick should be examined.

Clean out the base and lid of the unit. Examine the wick; check that it is soft throughout its length. There will always be discolouration. If any part of it is starting to harden, it should be replaced with a new one.

If an unusually heavy amount of smoke starts to appear, this could be an indication that the wick is nearing the end of its life. This should be investigated immediately!

Customising the unit

The Mode Selector is a rotary switch with positions numbered 0 to 9. Mode 0 is the normal running mode. Mode 4 is a unique Mode that is used to reset the fluid level after emptying. Refer to the separate description.

Modes 5-9 are the 'customising' or 'adjustment' modes.

To enter an 'adjustment' mode, with the unit powered-up, turn the selector (using a small screwdriver) to the appropriate number. The Status LED will change to permanently ON. Push the button. The Status LED behaviour will change as described for the particular function.

Now refer to the particular Adjustment description.

NOTE: you cannot enter any adjustment mode if the Unit is in the Top-up state!

When satisfied with the setting for a particular adjustment, push the Button. The Status LED will change to steady ON. Rotate the Selector to position 0. The Led will show 'rest' status. The new settings have been stored. If you decide to abandon an adjustment, simply rotate the Selector to position 0 WITHOUT pushing the Button. As soon as you move the selector, the LED will change to steady ON. On reaching position 0, the LED will show 'rest' status.

Adjustment 5 – Automatic movement from Start-up to Idle

If you have a sound system, the advance from Start-up to Idle can be set to occur automatically, in synch with your sound. First, you need to time how long your sound system takes to move the sound from Engine start-up to Idle. To program this delay into your smoke unit, move the selector to position 5. Pot B is used to specify a delay from 0 seconds (Fully counter-clockwise, feature switched OFF) to about a minute (fully clockwise). Whilst in this function, The LED will indicate the delay time with a pattern of long/short blinks – each long blink indicates 10 seconds, and each short blink (if any) the units, eg a delay of 28 seconds is shown by 2 'long' blinks, then 8 'short' blinks.. Turn pot B until the LED pattern indicates the desired time delay. When satisfied, press the button.

Adjustment 6 – Adjust CLAG pattern.

This procedure uses Adjustment Pot A to adjust the Smoke output, and Adjustment Pot B to adjust the Fan speed, for the CLAG Exhaust pattern. On entry, the LED will flash according to smoke rate set by the position of pot A. Rotate the Adjustment Pots to achieve the desired effect – clockwise to INCREASE, counter-clockwise to DECREASE.

Adjustment 7 – Adjust IDLE pattern.

This procedure is identical to Operation 6; it is used to set the IDLE pattern.

Adjustment 8 – Set Loco Speed at which unit will automatically step from the Idling state to the Power state when moving from rest

On entry, the LED will be OFF. Move your loco speed control to the position where your loco is just moving. At this point, press the button. The LED will come ON, and the setting will be stored. If you press the button when the loco speed control is at Stopped, this turns automatic stepping OFF

Adjustment 9 – Restore Idle and Clag Exhaust patterns to Default Values (50/40 and 100/80) respectively.

On entry, the LED will be OFF. Press the button to Confirm. The LED will come ON, and the default settings will be restored.

Reset the Fluid Consumption Monitoring System – Mode 4

Whenever you drain the fluid out, and in any event after 5 Top-up pushes, you will need to re-synchronise the Unit's consumption monitoring system. To do this.

- 1. With Power to the unit OFF, (drain) then fill the unit with 110 cc of fluid.**
2. Move the Selector to position 4.
3. Apply Power to the Unit. The status LED will flicker continuously.
4. Push the Button. The Status LED will turn OFF.
5. Move the Selector to position 0. The unit will now be in the Top-up State, with the Status LED permanently ON.
6. Give a Top-up push and the unit will enter the Rest state (LED will Blink every 3 seconds). It is now ready for use, and a further 5 consecutive Top-ups are now enabled.

Document Revision

11 Oct 2009 Initial Release