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ELECTRIC LOCK

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Field of the Invention

5 The present invention relates to an electric lock. In particular, it relates to an electric lock that may be alternatively configured to require power to fail-safe lock or to require power to unlock fail-secure. Also, the present invention relates to an electric lock that may automatically adjust to be operated with a range of supply voltages.

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In reviewing the operation of our lock described in our New Zealand provisional patent specification 329491 additional advantages and benefits have become apparent and are referred to below. However, our specification 329491 is herein incorporated in its entirety where appropriate.

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Background Of The Invention

Many electric locks include a solenoid to actuate the bolt of the lock. These solenoids typically work against a biasing element, such as a spring, to return the bolt to its original position. These electric locks may generally be grouped as power-to-lock and power-to-unlock. Power-to-lock is where power supplied to a solenoid moves the bolt to place the lock in a locked configuration which, typically, involves the bolt of the lock extending into a recess in a door, or door frame, or the like. When power to this type of lock is cut, the biasing means returns the bolt to place the lock in an unlocked position, typically, out of the recess of the door, or door frame to allow the door to open. Alternatively, the lock may be power-to-unlock where the bolt is biased out from the lock and when powered, the solenoid moves the bolt into the lock.

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Suppliers of electric locks, locksmiths, or the like, are required to stock both of the above types of locks, which may be inconvenient or costly. It would be advantageous to stock one type of lock that may be swapped between power-to-lock and power-to-unlock configurations.

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Typically, electric locks are designed to be powered with a supply

current of a particular voltage. It would be advantageous for an electric lock to be compatible with a range of supply voltages.

One attempt to provide this facility is an add on module for electric
5 locks. These generally allow for user adjustments of its operation. However, an add on module may be less convenient to install and may not provide control that is optimised for a particular lock. Also it may not be adapted for feedback to be given from sensors in the lock to the controller of the add on module. This may necessitate the user spending time to set-up the
10 lock correctly and make difficult automatic adjustment of various settings related to supply voltages.

Furthermore, it may not receive feedback from the lock for whether a door is closed for example.

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It is also desirable that a lock be capable of being overridden either mechanically or electronically. In such cases, the override mechanism would act to lock or unlock the door independently of the function of the locks controlling module. It is also desirable that such override systems
20 incorporate some type of security mechanism.

Accordingly, it is an object of one embodiment of the present invention to provide an electric lock which is alternatively configurable to either require power for the lock to lock or require power for the lock to
25 unlock, or at least to provide the public with a useful choice.

It is another object of one embodiment of the present invention to provide an electric lock that may automatically adjust to any supply voltage within a range of supply voltages, or at least to provide the public with a
30 useful choice.

It is a further object of the present invention to provide an efficient electric lock including a controller as part of the lock and which is adapted for efficient control of the lock, or to at least provide the public with a useful
35 choice.

It is a further object of the present invention to provide an electronic lock which incorporates an override mechanism, preferably including security functionality or to at least provide the public with a useful choice.

5 **Summary Of The Invention**

According to one aspect of the present invention, there is provided an electric lock including:

- 10 - an electric actuator;
 - a controller;
 - a power receiver which, in use, receives a supply voltage for the electric lock,

15 wherein the controller is arranged suitably to receive the supply voltage from the power receiver, sense the level of the supply voltage, and supply a drive signal to the electric actuator, wherein the electric lock adapts the drive signal to the electric actuator dependent on the level of the supply voltage.

20 Preferably, the electric lock includes a housing which houses the electric actuator, controller and power receiver.

25 Preferably, the controller stores predetermined current criteria for current through the electric actuator.

 Preferably, the drive signal is adapted to satisfy the predetermined current criteria.

30 Preferably, the electric actuator is a solenoid actuator.

 Preferably, the drive signal includes a pulse width modulated signal.

35 Preferably, the drive signal includes an actuating phase which causes the solenoid to be actuated to a first configuration, and a holding phase which holds the solenoid in the first configuration.

 Preferably, the holding phase is initiated after a first delay starting at

the start of the actuating phase.

Preferably, during the actuating phase the drive signal consists of a continuous pulse.

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Preferably, the drive signal is pulse width modulated to provide a predetermined holding current through the solenoid.

10 Preferably, the predetermined holding current is related to a spring constant of a given spring which is included in the electric actuator.

Preferably, the predetermined holding current is related to the inductance of the solenoid.

15 Preferably, the predetermined holding current is related to the heat dissipation and/or tolerance of the solenoid.

20 Preferably, the predetermined holding current is empirically determined as a minimum operational current required to hold the solenoid in the first configuration.

Preferably, the electric lock includes a strike sensor to sense whether the electric lock is aligned with a corresponding strike.

25 Preferably, the controller is adapted to receive information from the strike sensor.

30 Preferably, the electric lock is adapted to provide information relating to the relative alignment of the strike and lock and/or information relating to the configuration of the solenoid.

35 According to a further aspect of the present invention there is provided an electric solenoid lock for use with a strike substantially contained within a body, characterised in that the lock includes a controller which senses the level of a supply voltage and provides a drive signal to the solenoid, the characteristics of the drive signal being automatically adapted

in response to the level of the supply voltage.

Preferably, the characteristics of the drive signal are also automatically adapted such that the lock may consume a substantially
5 minimal level of power for any given supply voltage within the range of supply voltages.

Preferably, the drive signal is the pulsed signal having variable pulse widths and a voltage during pulses which is equal to the supply voltage,
10 wherein the adapted characteristic is the width of the pulses.

Preferably, the electric lock may be reconfigured from power-to-lock to power-to-unlock.

15 Preferably, the controller includes a switching means to allow an operator to reconfigure the operation of the controller from power-to-lock to power-to-unlock.

According to one aspect of the present invention, there is provided a
20 lock including:

a body;

a bolting means having a locking position and a non-locking position;

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an actuator to actuate the bolting means the actuator having first and second alternative configurations, wherein the actuator in the first configuration places the bolting means in the locking position when the actuator is operated and places the bolting means in the non-locking position otherwise, and wherein the actuator in the second
30 configuration places the bolting means in a non-locking position when the actuator is operated and in the locking position otherwise, and wherein the actuator may be reconfigured from one configuration to the other.

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Preferably, the actuator may include a reversible member arranged

such that reversing the orientation of the reversible member reconfigures the bolt actuator between alternative configurations.

5 Preferably, the reversible element may be mounted on a mounting pivot and is reversible by reversing its orientation on the pivot.

10 Preferably, the reversible element may also include an engageable portion and an actuation pivot these being arranged to substantially define an L-shape with the mounting pivot the corner of the L-shape.

15 Preferably, the actuator may include an electro-magnetic actuator.

20 Preferably, the electro-magnetic actuator may include a solenoid actuator including a solenoid rod.

25 Preferably, the solenoid rod may be connected to the second arm of the pivoting member by way of a connecting element which is pivotally connected to both the solenoid rod and the pivotal member, at the actuation pivot.

30 Preferably, the locking position of the bolting means may correspond to the bolting means protruding from the body of the lock.

35 Preferably, the engageable portion of the pivoting member may include a toggle.

Preferably, the bolting means may include a recess arranged suitably to cooperate with the toggle.

40 According to another aspect of the present invention, there is provided a lock including an electro-magnetic actuator, wherein the lock senses a supply voltage and adapts a drive signal to the electro-magnetic actuator dependent on the level of the supply voltage to operate the lock within a range of supply voltages.

45 Preferably, the lock is arranged to sense the supply voltage.

Preferably, the lock is arranged to periodically sense the supply

voltage.

Preferably, the electro-magnetic actuator includes a solenoid actuator.

5 Preferably, the lock is arranged able to compensate for different supply voltages, such compensation including providing a compensated pulse width modulated drive to the solenoid actuator.

Preferably, the lock includes a microcontroller.

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Preferably, the microcontroller serves to measure the supply voltage.

Preferably, the microcontroller also serves to control a power device to supply the compensated pulse width modulated drive.

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Preferably, the microcontroller also provides logic functions for sensing open/closed conditions of the door.

20 Preferably, the microcontroller also provides logic functions for delays for the timing of operations of the lock.

25 Preferably, the lock includes a programming jumper to allow the controller to be reconfigured between a first mode in which the solenoid is operated for the lock to provide locking and a second mode in which the lock provides locking unless the solenoid is operated.

Preferably, the end points of the range of voltages may be separated by at least five volts.

30 Preferably, the end points of the range of voltages may be separated by at least ten volts.

Preferably, the range of voltages includes 12 volts.

35 Preferably, the electric lock may operationally be supplied by any voltage within the range of about 8 volts to about 40 volts.

Preferably, the range is about 12 volts - 15% to about 24 volts + 15%.

5 In an alternative aspect, the lock may include an override mechanism adapted to mechanically and/or electronically override the operation of the controller.

10 Preferably, the override mechanism includes control means which intercepts movement of the bolt actuator to prevent, inhibit or control its movement.

15 Preferably the solenoid rod includes one of more engagement means, the engagement means oriented and adapted to engage with the control means.

20 Preferably the control means is connected to a chassis means, the movement of the chassis moving the control means in and out of an engagement position.

25 Preferably movement of the chassis is controlled by an override controller, the operation of said override controller physically moving the chassis and hence the control means into an engagement and disengagement position.

30 Preferably the override controller corresponds to a key and lock wherein the rotational movement of a lock barrel, when actuated by the key, is transmitted to the chassis by way of an arm connected to the barrel so that rotational movement of the key causes the control means to engage or disengage with the engagement means.

35 Preferably, the engagement means correspond to one or more pins protruding from the solenoid shaft substantially perpendicular to the direction of the shaft movement, wherein the engagement means are adapted to engage with the control means.

Preferably the control means includes at least one member or pin

adapted to extend from the chassis so as to engage with a corresponding engagement member wherein the resulting engagement action limits or inhibits the movement of the solenoid shaft.

5 According to an alternative embodiment, the lock may be adapted to auto-sense the supply voltage, the voltage being preferably between 8 and 40 volts.

10 According to one aspect of the present invention, there may be provided a lock substantially as herein described with reference to the accompanying drawings.

Other aspects of the present invention may become apparent to those skilled in the art from the following description.

15 **Brief Description Of The Drawings**

Figure 1: Shows a side view of an electric lock according to a preferred embodiment of the present invention.

20 **Figure 2:** Shows an end view of the assembled electric lock shown in Figure 1.

Figure 3: Shows an plan view of a faceplate of the electric lock shown in Figures 1 and 2.

25 **Figure 4:** Shows a plan view of a strike used in conjunction with the electric lock shown in Figures 1 and 2.

30 **Figure 5:** Shows a cut-away view of the electric lock of Figures 1 and 2 in a power-to-lock configuration with the bolt retracted.

35 **Figure 6:** Shows a cut-away view of the electric lock of Figures 1 and 2 in a power-to-lock configuration with the bolt extended.

Figure 7: Shows an actuation link of the lock of Figures 1 or 2 in a power-to-open configuration with the bolt retracted.

5 **Figure 8:** Shows a cut-away view of the electric lock of Figures 1 and 2 in a power-to-open configuration with the bolt extended.

10 **Figure 9:** Schematically shows the supply wiring of the electric lock of Figures 1 and 2.

Figure 10: Illustrates a perspective view of a lock incorporating a key override mechanism.

15 **Figure 11:** Illustrates a perspective view of a lock with key override with the bolt housing removed.

Figure 12: Illustrates a side view of the lock of figure 11 with the solenoid removed.

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Figure 13: Illustrates a top view of the lock shown in figure 12.

DETAILED DESCRIPTION OF THE DRAWINGS

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A preferred embodiment of the present invention is an electric lock that includes a solenoid to provide actuation for the bolt. Typically, this preferred embodiment is intended for use with doors where the lock is fitted into a door frame and a strikeplate is fitted into the door, or vice versa. With accessories, the lock can be installed surface mounted, and with further accessories, the lock can be installed surface mounted onto either a frameless glass door head, or onto a frameless glass door, or a combination of both.

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Figure 1 shows a side view of the electric lock 1 according to the preferred embodiment with the protective cover removed. The electric lock 1 may be described, in a modular fashion, to consist of a control module 3, an actuation module 4, an actuation link module 5, a bolt 6, a strikeplate 7

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(see figure 4), and a subminiature door position switch 40.

Typically, the actuation module 4 receives an electric current to power a solenoid 9 to move in a given direction. Suitable alternatives to a solenoid known to those skilled in the art may be substituted. Some
5 examples of alternatives that may be suitable in various situations are DC motors and linear induction motors. Typically, the actuation module also includes a biasing element, such as a spring 10, to bias the rod of the solenoid 11 towards one end of its travel. As used herein, solenoid rod refers
10 to the central moving part of the solenoid and is preferably, but not exclusively, substantially rod shaped. Suitable alternatives to a spring 10 will be apparent to those skilled in the art. The bias may simply be supplied by gravity where the lock is suitably arranged. When the solenoid is powered, the solenoid rod 11 is moved into the solenoid compressing the spring 10.
15 When power is cut to the solenoid, the spring 10 moves the solenoid rod 11 out from the solenoid.

The electric lock 1 also includes an actuation link (12,13) which is actuated by the solenoid rod 11 and, in turn, actuates the bolt 6 to protrude
20 from or retract into the faceplate 8. The actuation link includes a connecting rod 12 which connects the solenoid rod 11 to a pivotal link 13 which includes a toggle 14. The pivot link 13 is pivotally mounted on the pivot 15. As shown in Figure 5, retraction of the solenoid rod 11 away from the pivot 15 causes the toggle 14 to move towards the faceplate 8. This in turn moves
25 the bolt 6 out from the faceplate 8. Typically, the strikeplate 7 is fitted into a door so that the bolt 6 protruding from the faceplate 8 engages the strike recess 18 to hold the electric lock 1 juxtaposed with the strikeplate to lock the door.

30 Figures 5 and 7 show the pivot link 13 in alternative orientations corresponding to the lock operating in alternative modes. Figure 5 shows the lock in a power-to-lock configuration the connecting rod 12 connected to the link member 13 at the connecting pivot 19. In this case, the connecting pivot 19 is positioned relatively near to the faceplate 8 so that when the solenoid
35 rod 11 is positioned near the pivot 15, the toggle 14 is relatively away from the faceplate 8. Therefore, the bolt 6 is retracted into the faceplate 8 and the

electric lock 1 does not lock. When the solenoid is powered, the solenoid rod 11 is drawn away from the pivot 15 and by means of the connecting rod 12, the pivoting link 13 is pivoted about the pivot 15 to move the toggle 14 towards the faceplate 8, thereby, protruding the bolt 6 out from the faceplate 8 so that the electric lock 1 locks. This is shown in figure 6.
5 When power is cut to the solenoid, the spring 10 reverses this action so that the electric lock 1 unlocks.

Figures 7 and 8 show the pivoting link 13 in the alternative orientation which corresponds to a power-to-open configuration or mode of the electric lock 1. When the electric lock 1 is not powered, the solenoid rod 11 is positioned relatively near to the pivot 15 (see figure 8). The length of the connecting rod 12 and the position of pivot 13 and 15 are chosen so that the solenoid rod 11 in this position moves the toggle 14 relatively towards the faceplate 8 (in a clockwise direction) so that the bolt 6 protrudes from the faceplate 8 so that the electric lock 1 is locked in the power off state. When the electric lock 1 is powered, the solenoid rod 11 is moved relatively away from the pivot 15 (to the left in figure 7) to retract the bolt 6 into the faceplate 8 so that the electric lock 1 is
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20 unlocked.

Figure 9 shows the wiring schematic of the electric lock 1. The bolt terminal block 20 includes a positive supply terminal 21, a negative supply terminal 22 and a control terminal 23 to power the electric lock 1, a positive voltage is supplied to the positive supply terminal 21 and also to the control terminal 23 to unlock the lock. Of course, this voltage need only be positive with respect to the voltage at the negative supply terminal 22. Typically, the positive supply terminal 21 will be kept at a positive voltage and the control terminal 23 will include a push button, switch, or any other connection/disconnection means known to those skilled in the art, between itself and the positive supply voltage. Therefore, the electric lock 1 will only be activated to power the solenoid to unlock when the button, switch, or the like 24 is closed. The bolt terminal block 20 also includes a function selection jumper 25 which must be switched when reconfiguring the electric lock 1 from power-to-lock to power-to-open configurations, and vice-versa.
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The preferred embodiment includes a single control module 3 for all

of the functions of the lock. These functions include: sensing whether the door is closed, controlling the solenoid, sensing the level (for potential difference) of the supply voltage, providing a drive signal for the solenoid 9, and adjusting the characteristics (such as the pulse width) of the drive signal.

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When the lock is to be activated, the control module 3 provides an initial drive signal pulse to the solenoid 4 to initially move the solenoid rod 11. This pulse may be at whatever voltage is supplied, providing that it is sufficient to move the solenoid rod 11. After the initial pulse and a given delay (such as 200 milliseconds), the control module supplies a holding drive signal to the solenoid 9. This holding drive signal is optimised for the particular lock. It is intended to be just sufficient to hold the solenoid rod 11 against the force of the spring 10. It is also intended to minimise power consumption of the lock. Factors to be considered in such an optimisation will depend on the characteristics of the particular lock and will be apparent to those skilled in the art. However, examples of such characteristics are: the inductance of the solenoid, the heat dissipation characteristics of the solenoid, and the spring constant of the spring 10.

20 The preferred embodiment supplies a holding drive signal which is pulsed and the width, or on-time, of the pulses is modulated. The inductive properties of the solenoid are used such that a suitable current is passed through the solenoid by the application low pulsed signal. The operation of the control module 3 then providing an optimised holding drive signal is intended to minimise power consumption of the electric lock 1, as well as other advantages apparent to those skilled in the art. As will be apparent to those skilled in the art, the pulse widths will vary with the level of the supply voltage. The control module 3 is also programmed so that the changing of a single switch 25 changes the electrical operation from power-to-lock to power-to-unlock. The technician also follows the mechanical procedure for changing the configuration or mode of the lock.

The suitable current may be experimentally or empirically determined before manufacture. This may establish a predetermined current (or set of currents) which are suitable to hold the solenoid rod 11 against the spring 10.

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These currents or parameters representative on them may then be stored in the controller module 3, in a memory associated with a microcontroller included in the control module 3. This control module 3 may then be programmed to calculate a pulse width modulation for the drive signal of the solenoid 9, where a holding action is required, that will satisfy the current criteria. This calculation requires the sampling, or measuring, of the supply voltage. The value obtained is, of course included, in the calculation. Any other parameters, such as the inductance of the solenoid, may be included in the calculation as determined by those skilled in the art.

The electric lock 1 may be supplied with voltages anywhere between 8 and 40 volts DC. Electric lock 1 automatically compensates for any changes in the voltage and adapts to the new voltage without any need for an operator to make any adjustments. A further embodiment includes the capability to auto-sense supply voltages. This voltage sensing functionality is achieved without operator adjustment. The implementation of such a voltage auto-sensing system would be known to one skilled in the art. The control module 3 includes a microcontroller which measures the supply voltage and provides a compensated pulse width modulated drive signal via a power device, also included in the control module 3 to the solenoid. This arrangement allows operation with a dynamically varying supply voltage. The microcontroller also carries out logic functions for the other automatic features of the lock. The activation link module 5 may include a reed switch (not shown) which indicates its alignment with a reed magnet 31 on the strikeplate. This arrangement allows the control module 3 to determine whether the door is in a closed position. This, in turn, allows delays relating to the door closing or opening to be built into the function of the electric lock 1. It also allows the control module 3 to save power by coordinating its operation with the opening and closing of the door. Typically, two delay facilities are incorporated. First, a delay of eight seconds, for example, may be applied after the electric lock 1 is signalled to unlock the door. This signal may be supplied by the push button 24, or the like being pressed. Of course, this signal may be provided by alternative means, such as a computer controlling the doors throughout a particular building, by a swipe card module, a key or

password module, or any other suitable means known to those skilled in the art. This delay allows that the door may be opened before the expiring of the delay after the signal to unlock has been given. This may be necessary or convenient where the signalling means is placed some distance from the door.

The lock also provides signals external to the lock to indicate whether the door is open or closed by means of the reed switch, and whether the solenoid is hard on, by means of a micro switch, 40. These signals may be received by a user or a building control system.

The preferred embodiment of the electric lock 1 allows that this delay may be adjusted during manufacture of the electric lock 1.

Another delay may be applied after the door is closed and before the bolt is extended. This delay may, typically, be two seconds after the reed switch 30 detects that the electric lock 1 is in line with the strikeplate 7 provided that the reed contact is maintained in steady state for two seconds. This feature facilitates use of the preferred embodiment with double acting doors to prevent the bolt from being protruded before the door is correctly aligned and in a stable position. The preferred embodiment allows that this delay may be adjusted during manufacture.

To reconfigure the lock, it is only required that the pivoting link 13 is reversed on the pivot 15 and that the action jumper 25 is switched. The preferred embodiment is arranged so that reversal of the pivoting link 13 is a simple and quick operation. The pivoting link 13 is removed from the pivot and replaced with the faces parallel to the plane of the pivot 15 being reversed. -

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The preferred embodiment requires the following currents at the given supplied voltages, although it will be understood by those skilled in the art that other values may be applicable for alternative embodiments. For a 12 volt supply voltage, the initial required current is 1330mA and the current required to hold the bolt is 184mA. For a supply voltage of 18 volt, the initial required current is 1980mA and the current required to hold the bolt is

124mA. For a supply voltage of 24 volts, the initial required current is 2450mA and the current required to hold the bolt is 98mA.

5 The preferred embodiment of the electric lock might include a bolt position switch to indicate the position of the bolt, with respect to the rest of the electric lock 1.

Typically, the supply voltage required by the lock may range between 8 and 40 volts DC.

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A further exemplary embodiment is shown in figures 10 to 13. Referring to these figures, an electronic lock is shown incorporating a manual mechanical/electronic override system.

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According to the preferred embodiment, the override system comprises a mechanical lock 101. The lock has a barrel 110 (see figure 11) which rotates when the correct key is inserted into the slot 120 and rotated. This rotation action moves an arm 111 (see figure 12) in either a clockwise or anticlockwise manner. Referring to figure 11, when the key is rotated clockwise, the arm 111 engages with a plate 112 which causes chassis 104 to move in the direction indicated by A'. When rotated in the opposite direction B, the chassis withdraws (indicated by B'). The chassis (seen in more detail in figure 11) is constrained to move with a linear motion along the back face of the plate 8. The chassis is constructed so as to be located between the electronics and solenoid components and the plate 8.

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A control means 106 is mounted on a distal end of the chassis. Thus when the chassis moves in the direction A', the control means 106 moves to the left (see figure 12). The control means 106 includes upwardly extending pins or members 105. These are dimensioned and oriented to engage with the engagement means 100. The engagement means 100 extend outwardly from the solenoid shaft 11. Although the spring (or other biasing means has been omitted from figures 10 to 13 for clarity) it can be seen that the control means limits or inhibits the movement of the solenoid and by resisting the spring's expansion hence overrides normal operation of the bolt actuation system.

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Depending on the control mode of the lock (power-to-lock or power-to-unlock), rotating the key in the override mechanism (the key/lock combination) will linearly displace the control means into an engagement or disengagement position. Figure 12 illustrates the control means 106 engaging with the engagement means 100 by way of the pins 105. This action holds the solenoid shaft inside the coil and (in the mode shown) draws the bolt 6 into the door.

10 The mechanical override system may be supplemented with an electrical sensor which, in certain modes of operation, senses the override status of the mechanical override actuator. For example, in the power-to-lock mode, the key override may operate mechanically as an electrical function which activates a microswitch (not shown) which cuts off power thus allowing the
15 bolt to retract.

Other arrangements of chassis and control means are envisaged. The preferred embodiment includes a control means in the form of a yoke with the engagement means attached to the solenoid shaft being in the form of pins. However, other mechanical arrangements are feasible so long as the
20 movement of the bolt actuation system is inhibited as required. Similarly, the shape of the chassis may be varied depending on the particular dimensions and shape of the lock mechanism.

25 It has been found that providing the electronic lock including a possible override system as claimed herein in an integrated package is highly desirable and, generally, the only other component which is required is a power source and the striker plate. Aside from the advantageous aspects discussed above, this represents a significant improvement over prior art
30 multi-component electronic locking systems.

The present invention allows that only one of power-to-lock or power-to-unlock configurations of the lock be held in stock and that the locks be reconfigured where necessary. This allows that less stock is held.
35 Of course, if one configuration of lock is predominantly required, the locks may be supplied in this configuration.

The present invention also provides an electric lock which may be supplied with a range of voltages and which can automatically sense the voltage so that human intervention is not required for the lock to compensate
5 for changes in supply voltage. This increases the versatility of the lock.

Where in the foregoing description, reference has been made to specific components or integers of the invention having known equivalents then such equivalents are herein incorporated as if individually set forth.
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Although this invention has been described by way of example and with reference to possible embodiments thereof, it is to be understood that modifications or improvements may be made thereto without departing from the scope of the appended claims.
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CLAIMS:

1. An electric lock including:
 - 5 - an electric actuator;
 - a controller;
 - a power receiver which, in use, receives a supply voltage for the electric lock,wherein the controller is arranged suitably to receive the supply
10 voltage from the power receiver, sense the level of the supply voltage, and supply a drive signal to the electric actuator, wherein the electric lock adapts the drive signal to the electric actuator dependent on the level of the supply voltage.
- 15 2. An electric lock as claimed in claim 1 including a housing which houses the electric actuator, controller and power receiver.
3. An electric lock as claimed in either claim 1 or 2 wherein the controller stores predetermined current criteria for current through the
20 electric actuator.
4. An electric lock as claimed in claim 3 wherein the drive signal is adapted to satisfy the predetermined current criteria.
- 25 5. An electric lock as claimed in any preceding claim wherein the electric actuator is a solenoid actuator.
6. An electric lock as claimed in any preceding claim wherein the drive
30 signal includes a pulse width modulated signal.
7. An electric lock as claimed in any preceding claim wherein the drive
 signal includes an actuating phase which causes the solenoid to be actuated to a first configuration, and a holding phase which holds the solenoid in the first configuration.
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8. An electric lock as claimed in claim 7 wherein the holding phase is initiated after a first delay starting at the start of the actuating phase.
9. An electric lock as claimed in claim 7 or claim 8 wherein during the

actuating phase the drive signal consists of a continuous pulse.

10. An electric lock as claimed in any preceding claim wherein the drive signal is pulse width modulated to provide a predetermined holding current through the solenoid.
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11. An electric lock as claimed in claim 10 wherein the predetermined holding current is related to a spring constant of a given spring which is included in the electric actuator.
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12. An electric lock as claimed in either claim 10 or claim 11 wherein the predetermined holding current is related to the inductance of the solenoid.
- 15 13. An electric lock as claimed in any one of claims 10 to 12 wherein the predetermined holding current is related to the heat dissipation and/or tolerance of the solenoid.
- 20 14. An electric lock as claimed in any one of claims 10 to 13 wherein the predetermined holding current is empirically determined as a minimum operational current required to hold the solenoid in the first configuration.
- 25 15. An electric lock as claimed in any preceding claim wherein the electric lock includes a strike sensor to sense whether the electric lock is aligned with a corresponding strike.
- 30 16. An electric lock as claimed in claim 15 wherein the controller is adapted to receive information from the strike sensor.
- 35 17. An electric lock as claimed in claim 15 or claim 16 wherein the electric lock is adapted to provide information relating to the relative alignment of the strike and lock and/or information relating to the configuration of the solenoid.
18. An electric solenoid lock for use with a strike substantially contained

within a body, wherein the lock includes a controller which senses the level of a supply voltage and provides a drive signal to the solenoid, the characteristics of the drive signal being automatically adapted in response to the level of the supply voltage.

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19. An electric lock as claimed in claim 18 wherein the characteristics of the drive signal are also automatically adapted such that the lock may consume a substantially minimal level of power for any given supply voltage within the range of supply voltages.

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20. An electric lock as claimed in either claim 18 or 19 wherein the drive signal is a pulsed signal having variable pulse widths and a voltage during pulses which is equal to the supply voltage, wherein the adapted characteristic is the width of the pulses.

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21. An electric lock as claimed in any one of claims 18 to 20 wherein the electric lock may be reconfigured from power-to-lock to power-to-unlock.

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22. An electric lock as claimed in any one of claims 18 to 21 wherein the controller includes a switching means to allow an operator to reconfigure the operation of the controller from power-to-lock to power-to-unlock.

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23. A lock including an electro-magnetic actuator, wherein the lock senses a supply voltage and adapts a drive signal to the electro-magnetic actuator dependent on the level of the supply voltage to operate the lock within a range of supply voltages.

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24. A lock as claimed in claim 23 wherein the lock is arranged to periodically sense the supply voltage.

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25. A lock as claimed in either claim 23 or claim 24 wherein the electro-magnetic actuator includes a solenoid actuator including a solenoid rod.

26. A lock as claimed any of claims 23 to 25 wherein the lock includes a microcontroller.
27. A lock as claimed in claim 26 wherein the microcontroller serves to measure the supply voltage.
28. A lock as claimed in claim 27 wherein the microcontroller also serves to control a power device to supply a compensated pulse width modulated drive signal.
29. A lock as claimed in any of claims 26 to 28 wherein the microcontroller provides logic functions for sensing open/closed conditions of the door.
30. A lock as claimed in any of claims 26 to 29 wherein the microcontroller provides logic functions for delays for the timing of operations of the lock.
31. A lock as claimed in any of claims 23 to 30 wherein the lock includes a programming jumper to allow a controller to be reconfigured between a first mode in which the solenoid is operated for the lock to provide locking and a second mode in which the lock provides locking unless the solenoid is operated.
32. A lock as claimed in any of claims 23 to 31 wherein the end points of the range of voltages may be separated by at least five volts.
33. A lock as claimed in any of claims 23 to 31 wherein the end points of the range of voltages may be separated by at least ten volts.
34. A lock as claimed in any of claims 23 to 33 wherein the range of voltages includes 12 volts.
35. A lock as claimed in any of claims 23 to 34 wherein the electric lock may operationally be supplied by any voltage within the range of about 8 volts to about 40 volts.

36. A lock as claimed in any of claims 23 to 34 wherein the range is about 12 volts - 15% to about 24 volts + 15%.
- 5 37. A lock as claimed in any preceding claim including an override mechanism adapted to mechanically and/or electronically override the operation of a bolt controller.
- 10 38. A lock as claimed in claim 37 wherein the override mechanism includes control means which intercepts the movement of a bolt actuator to prevent, inhibit or control its movement.
- 15 39. A lock as claimed in claim 38 when dependent on claim 25, wherein the solenoid rod includes one or more engagement means, the engagement means oriented and adapted to engage with the control means, wherein the position of the control means inhibits the movement of the solenoid rod and hence the bolt actuator.
- 20 40. A lock as claimed in claim 39, wherein the control means is connected to a chassis, whereby movement of the chassis moves the control means in and out of an engagement position.
- 25 41. A lock as claimed in claim 40 wherein movement of the chassis is controlled by an override controller, the operation of said override controller being such as to physically move the chassis and hence the control means into and out of an engagement position.
- 30 42. A lock as claimed in claim 41 wherein the override controller corresponds to a key and lock wherein rotational movement of a lock barrel, when actuated by the key, is transmitted to the chassis by way of an arm connected to the barrel in such a way that rotational movement of the key causes the control means to engage or disengage with the engagement means.
- 35 43. A lock as claimed in any of claims 39 to 42 wherein the engagement means correspond to one or more pins protruding from the solenoid

shaft substantially perpendicular to the direction of the shafts movement.

- 5 44. A lock as claimed in any one of claims 40 to 42 wherein the control means corresponds to at least one pin adapted to extend from the chassis so as to engage with a corresponding engagement member wherein the resulting engagement action limits or inhibits the movement of the solenoid shaft.
- 10 45. A lock as claimed in any one of claims 37 to 44 wherein the override mechanism includes one or more sensors adapted to sense the operation and/or position of the override mechanism and, in response to same, electronically control the lock.
- 15 46. A lock as claimed in claim 45 wherein the sensor means corresponds to a microswitch adapted to sense the movement of an actuation controller.
- 20 47. A lock as claimed in any preceding claim adapted to automatically sense a supply voltage.
48. A lock as claimed in claim 47 adapted to operate at a supply voltage between substantially 8 and 40 volts.