METHODS AND APPARATUS FOR ASSIGNING ELECTRODE POLARITY FOR A CONDUCTED ELECTRICAL WEAPON

FIELD OF INVENTION

[0001] Embodiments of the present invention relate to a conducted electrical weapon ("CEW") (e.g., electronic control device) that launches electrodes to provide a stimulus signal through a human or animal target to impede locomotion of the target.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

[0002] Embodiments of the present invention will be described with reference to the drawing, wherein like designations denote like elements, and:

[0003] FIG. 1 is a perspective view of a conducted electrical weapon ("CEW"), in accordance with various embodiments;

[0004] FIG. 2 is a schematic view of a CEW, in accordance with various embodiments;

[0005] FIG. 3 is a view of electrodes deployed from a CEW, in accordance with various embodiments;

[0006] FIG. 4 is a table of possible polarity assignments for the electrodes of FIG. 3, in accordance with various embodiments;

[0007] FIG. 5 is another table of possible polarity assignments for the electrodes of FIG. 3, in accordance with various embodiments;

[0008] FIG. 6 is a block diagram of an implementation of a CEW, in accordance with various embodiments;

[0009] FIG. 7 is an implementation of a selector circuit, in accordance with various embodiments;

[0010] FIGs. 8 – 10 are truth tables for the multiplexers of FIG. 7, in accordance with various embodiments;

[0011] FIG. 11 is a table of input and output values for delivering a stimulus signal using the selector circuit of FIG. 7, in accordance with various embodiments;

[0012] FIG. 12 is an implementation of a selector circuit, in accordance with various embodiments;

[0013] FIGs. 13 – 14 are truth tables for the relays of FIG. 12, in accordance with various

embodiments;

[0014] FIG. 15 is a diagram of input and output values for delivering a stimulus signal using the selector circuit of FIG. 12, in accordance with various embodiments;

[0015] FIG. 16 is a diagram of input and output values for delivering a test current using the selector circuit of FIG. 12, in accordance with various embodiments;

[0016] FIG. 17 is a diagram of input and output values for delivering a test voltage using the selector circuit of FIG. 12, in accordance with various embodiments;

[0017] FIG. 18 is a diagram of input and output values for delivering a test voltage using the selector circuit of FIG. 7, in accordance with various embodiments;

[0018] FIG. 19A is a view of electrodes deployed from a CEW, in accordance with various embodiments;

[0019] FIG. 19B is a table of example polarity assignments for the electrodes of FIG. 19A, in accordance with various embodiments;

[0020] FIG. 20A is a view of electrodes deployed from a CEW, in accordance with various embodiments; and

[0021] FIG. 20B is a table of example test measurements for the electrodes of FIG. 19A, in accordance with various embodiments.

DETAILED DESCRIPTION OF INVENTION

[0022] The detailed description of exemplary embodiments herein makes reference to the accompanying drawings, which show exemplary embodiments by way of illustration. While these embodiments are described in sufficient detail to enable those skilled in the art to practice the disclosures, it should be understood that other embodiments may be realized and that logical changes and adaptations in design and construction may be made in accordance with this disclosure and the teachings herein. Thus, the detailed description herein is presented for purposes of illustration only and not of limitation.

[0023] The scope of the disclosure is defined by the appended claims and their legal equivalents rather than by merely the examples described. For example, the steps recited in any of the method or process descriptions may be executed in any order and are not necessarily limited to the order presented. Furthermore, any reference to singular includes plural embodiments, and any reference to more than one component or step may include a singular embodiment or step. Also, any

reference to attached, fixed, coupled, connected, or the like may include permanent, removable, temporary, partial, full, and/or any other possible attachment option. Additionally, any reference to without contact (or similar phrases) may also include reduced contact or minimal contact. Surface shading lines may be used throughout the figures to denote different parts but not necessarily to denote the same or different materials.

[0024] Systems, methods, and apparatuses may be used to interfere with voluntary locomotion (e.g., walking, running, moving, etc.) of a target. For example, a CEW may be used to deliver a current (e.g., stimulus signal, pulses of current, pulses of charge, etc.) through tissue of a human or animal target. Although typically referred to as a conducted electrical weapon, as described herein a "CEW" may refer to a conducted electrical weapon, a conducted energy weapon, and/or any other similar device or apparatus configured to provide a stimulus signal through one or more deployed projectiles (e.g., electrodes).

[0025] A stimulus signal carries a charge into target tissue. The stimulus signal may interfere with voluntary locomotion of the target. The stimulus signal may cause pain. The pain may also function to encourage the target to stop moving. The stimulus signal may cause skeletal muscles of the target to become stiff (e.g., lock up, freeze, etc.). The stiffening of the muscles in response to a stimulus signal may be referred to as neuromuscular incapacitation ("NMI"). NMI disrupts voluntary control of the muscles of the target. The inability of the target to control its muscles interferes with locomotion of the target.

[0026] A stimulus signal may be delivered through the target via terminals coupled to the CEW. Delivery via terminals may be referred to as a local delivery (e.g., a local stun, a drive stun, etc.). During local delivery, the terminals are brought close to the target by positioning the CEW proximate to the target. The stimulus signal is delivered through the target's tissue via the terminals. To provide local delivery, the user of the CEW is generally within arm's reach of the target and brings the terminals of the CEW into contact with or proximate to the target.

[0027] A stimulus signal may be delivered through the target via one or more (typically at least two) wire-tethered electrodes. Delivery via wire-tethered electrodes may be referred to as a remote delivery (e.g., a remote stun). During a remote delivery, the CEW may be separated from the target up to the length (e.g., 15 feet, 20 feet, 30 feet, etc.) of the wire tether. The CEW launches the electrodes towards the target. As the electrodes travel toward the target, the respective wire tethers deploy behind the electrodes. The wire tether electrically couples the CEW to the electrode. The

electrode may electrically couple to the target thereby coupling the CEW to the target. In response to the electrodes connecting with, impacting on, or being positioned proximate to the target's tissue, the current may be provided through the target via the electrodes (e.g., a circuit is formed through the first tether and the first electrode, the target's tissue, and the second electrode and the second tether).

[0028] Terminals or electrodes that contact or are proximate to the target's tissue deliver the stimulus signal through the target. Contact of a terminal or electrode with the target's tissue establishes an electrical coupling (e.g., circuit) with the target's tissue. Electrodes may include a spear that may pierce the target's tissue to contact the target. A terminal or electrode that is proximate to the target's tissue may use ionization to establish an electrical coupling with the target's tissue. Ionization may also be referred to as arcing.

[0029] In use (e.g., during deployment), a terminal or electrode may be separated from the target's tissue by the target's clothing or a gap of air. In various embodiments, a signal generator of the CEW may provide the stimulus signal (e.g., current, pulses of current, etc.) at a high voltage (e.g., in the range of 40,000 to 100,000 volts) to ionize the air in the clothing or the air in the gap that separates the terminal or electrode from the target's tissue. Ionizing the air establishes a low impedance ionization path from the terminal or electrode to the target's tissue that may be used to deliver the stimulus signal into the target's tissue via the ionization path. The ionization path persists (e.g., remains in existence, lasts, etc.) as long as the current of a pulse of the stimulus signal is provided via the ionization path. When the current ceases or is reduced below a threshold (e.g., amperage, voltage), the ionization path collapses (e.g., ceases to exist) and the terminal or electrode is no longer electrically coupled to the target's tissue. Lacking the ionization path, the impedance between the terminal or electrode and target tissue is high. A high voltage in the range of about 50,000 volts can ionize air in a gap of up to about one inch.

[0030] A CEW may provide a stimulus signal as a series of current pulses. Each current pulse may include a high voltage portion (e.g., 40,000 – 100,000 volts) and a low voltage portion (e.g., 500 – 6,000 volts). The high voltage portion of a pulse of a stimulus signal may ionize air in a gap between an electrode or terminal and a target to electrically couple the electrode or terminal to the target. In response to the electrode or terminal being electrically coupled to the target, the low voltage portion of the pulse delivers an amount of charge into the target's tissue via the ionization path. In response to the electrode or terminal being electrically coupled to the target by contact

(e.g., touching, spear embedded into tissue, etc.), the high portion of the pulse and the low portion of the pulse both deliver charge to the target's tissue. Generally, the low voltage portion of the pulse delivers a majority of the charge of the pulse into the target's tissue. In various embodiments, the high voltage portion of a pulse of the stimulus signal may be referred to as the spark or ionization portion. The low voltage portion of a pulse may be referred to as the muscle portion.

[0031] In various embodiments, a signal generator of the CEW may provide the stimulus signal (e.g., current, pulses of current, etc.) at only a low voltage (e.g., less than 2,000 volts). The low voltage stimulus signal may not ionize the air in the clothing or the air in the gap that separates the terminal or electrode from the target's tissue. A CEW having a signal generator providing stimulus signals at only a low voltage (e.g., a low voltage signal generator) may require deployed electrodes to be electrically coupled to the target by contact (e.g., touching, spear embedded into tissue, etc.).

[0032] A CEW may include at least two terminals at the face of the CEW. A CEW may include two terminals for each bay that accepts a cartridge (e.g., cartridge). The terminals are spaced apart from each other. In response to the electrodes of the cartridge in the bay having not been deployed, the high voltage impressed across the terminals will result in ionization of the air between the terminals. The arc between the terminals may be visible to the naked eye. In response to a launched electrode not electrically coupling to a target, the current that would have been provided via the electrodes may arc across the face of the CEW via the terminals.

[0033] The likelihood that the stimulus signal will cause NMI increases when the electrodes that deliver the stimulus signal are spaced apart at least 6 inches (15.24 centimeters) so that the current from the stimulus signal flows through the at least 6 inches of the target's tissue. In various embodiments, the electrodes preferably should be spaced apart at least 12 inches (30.48 centimeters) on the target. Because the terminals on a CEW are typically less than 6 inches apart, a stimulus signal delivered through the target's tissue via terminals likely will not cause NMI, only pain.

[0034] A series of pulses may include two or more pulses separated in time. Each pulse delivers an amount of charge into the target's tissue. In response to the electrodes being appropriately spaced (as discussed above), the likelihood of inducing NMI increases as each pulse delivers an amount of charge in the range of 55 microcoulombs to 71 microcoulombs per pulse. The likelihood of inducing NMI increases when the rate of pulse delivery (e.g., rate, pulse rate, repetition rate, etc.) is between 11 pulses per second ("pps") and 50 pps. Pulses delivered at a higher rate may

provide less charge per pulse to induce NMI. Pulses that deliver more charge per pulse may be delivered at a lesser rate to induce NMI. In various embodiments, a CEW may be hand-held and use batteries to provide the pulses of the stimulus signal. In response to the amount of charge per pulse being high and the pulse rate being high, the CEW may use more energy than is needed to induce NMI. Using more energy than is needed depletes batteries more quickly.

[0035] Empirical testing has shown that the power of the battery may be conserved with a high likelihood of causing NMI in response to the pulse rate being less than 44 pps and the charge per a pulse being about 63 microcoulombs. Empirical testing has shown that a pulse rate of 22 pps and 63 microcoulombs per a pulse via a pair of electrodes will induce NMI when the electrode spacing is at least 12 inches (30.48 centimeters).

[0036] In various embodiments, a CEW may include a handle and one or more cartridges (e.g., deployment units). The handle may include one or more bays for receiving the cartridges. Each cartridge may be removably positioned in (e.g., inserted into, coupled to, etc.) a bay. Each cartridge may releasably electrically, electronically, and/or mechanically couple to a bay. A deployment of the CEW may launch one or more electrodes toward a target to remotely deliver the stimulus signal through the target.

[0037] In various embodiments, a cartridge may include two or more electrodes that are launched at the same time. In various embodiments, a cartridge may include two or more electrodes that may be launched individually at separate times. Launching the electrodes may be referred to as activating (e.g., firing) a cartridge. After use (e.g., activation, firing), a cartridge may be removed from the bay and replaced with an unused (e.g., not fired, not activated) cartridge to permit launch of additional electrodes.

[0038] In various embodiments, and with reference to FIGs. 1 and 2, a CEW 100 is disclosed. CEW 100 may be similar to, or have similar aspects and/or components with, any CEW discussed herein. CEW 100 may comprise a housing 110 and one or more cartridges 120 (e.g., deployment units). It should be understood by one skilled in the art that FIG. 2 is a schematic representation of CEW 100, and one or more of the components of CEW 100 may be located in any suitable position within, or external to, housing 110.

[0039] Housing 110 may be configured to house various components of CEW 100 that are configured to enable deployment of cartridges 120, provide an electrical current to cartridges 120, and otherwise aid in the operation of CEW 100, as discussed further herein. Although depicted as

a firearm in FIG. 1, housing 110 may comprise any suitable shape and/or size. Housing 110 may comprise a handle end opposite a deployment end. A deployment end may be configured, and sized and shaped, to receive one or more cartridges 120. A handle end may be sized and shaped to be held in a hand of a user. For example, a handle end may be shaped as a handle to enable hand-operation of CEW 100 by the user. In various embodiments, a handle end may also comprise contours shaped to fit the hand of a user, for example, an ergonomic grip. A handle end may include a surface coating, such as, for example, a non-slip surface, a grip pad, a rubber texture, and/or the like. As a further example, a handle end may be wrapped in leather, a colored print, and/or any other suitable material, as desired.

[0040] In various embodiments, housing 110 may comprise various mechanical, electronic, and/or electrical components configured to aid in performing the functions of CEW 100. For example, housing 110 may comprise one or more triggers 115, control interfaces, processing circuits 135, power supplies 140, and/or signal generators 145. Housing 110 may include a guard (e.g., trigger guard). A guard may define an opening formed in housing 110. A guard may be located on a center region of housing 110 (e.g., as depicted in FIG. 1), and/or in any other suitable location on housing 110. Trigger 115 may be disposed within a guard. A guard may be configured to protect trigger 115 from unintentional physical contact (e.g., an unintentional activation of trigger 115). A guard may surround trigger 115 within housing 110.

[0041] In various embodiments, trigger 115 be coupled to an outer surface of housing 110, and may be configured to move, slide, rotate, or otherwise become physically depressed or moved upon application of physical contact. For example, trigger 115 may be actuated by physical contact applied to trigger 115 from within a guard. Trigger 115 may comprise a mechanical or electromechanical switch, button, trigger, or the like. For example, trigger 115 may comprise a switch, a pushbutton, and/or any other suitable type of trigger. Trigger 115 may be mechanically and/or electronically coupled to processing circuit 135. In response to trigger 115 being activated (e.g., depressed, pushed, etc. by the user), processing circuit 135 may enable deployment of one or more cartridges 120 from CEW 100, as discussed further herein.

[0042] In various embodiments, power supply 140 may be configured to provide power to various components of CEW 100. For example, power supply 140 may provide energy for operating the electronic and/or electrical components (e.g., parts, subsystems, circuits, etc.) of CEW 100 and/or one or more cartridges 120. Power supply 140 may provide electrical power.

Providing electrical power may include providing a current at a voltage. Power supply 40 may be electrically coupled to processing circuit 135 and/or signal generator 145. In various embodiments, in response to a control interface comprising electronic properties and/or components, power supply 140 may be electrically coupled to the control interface. In various embodiments, in response to trigger 115 comprising electronic properties or components, power supply 140 may be electrically coupled to trigger 115. Power supply 140 may provide an electrical current at a voltage. Electrical power from power supply 140 may be provided as a direct current ("DC"). Electrical power from power supply 140 may be provided as an alternating current ("AC"). Power supply 140 may include a battery. The energy of power supply 140 may be renewable or exhaustible, and/or replaceable. For example, power supply 140 may comprise one or more rechargeable or disposable batteries. In various embodiments, the energy from power supply 140 may be converted from one form (e.g., electrical, magnetic, thermal) to another form to perform the functions of a system.

[0043] Power supply 140 may provide energy for performing the functions of CEW 100. For example, power supply 140 may provide the electrical current to signal generator 145 that is provided through a target to impede locomotion of the target (e.g., via cartridge 120). Power supply 140 may provide the energy for a stimulus signal. Power supply 140 may provide the energy for other signals, including an ignition signal, as discussed further herein.

[0044] In various embodiments, processing circuit 135 may comprise any circuitry, electrical components, electronic components, software, and/or the like configured to perform various operations and functions discussed herein. For example, processing circuit 135 may comprise a processing circuit, a processor, a digital signal processor, a microcontroller, a microprocessor, an application specific integrated circuit (ASIC), a programmable logic device, logic circuitry, state machines, MEMS devices, signal conditioning circuitry, communication circuitry, a computer, a computer-based system, a radio, a network appliance, a data bus, an address bus, and/or any combination thereof. In various embodiments, processing circuit 135 may include passive electronic devices (e.g., resistors, capacitors, inductors, etc.) and/or active electronic devices (e.g., op amps, comparators, analog-to-digital converters, digital-to-analog converters, programmable logic, SRCs, transistors, etc.). In various embodiments, processing circuit 135 may include data buses, output ports, input ports, timers, memory, arithmetic units, and/or the like.

[0045] In various embodiments, processing circuit 135 may include signal conditioning

circuity. Signal conditioning circuitry may include level shifters to change (e.g., increase, decrease) the magnitude of a voltage (e.g., of a signal) before receipt by processing circuit 135 or to shift the magnitude of a voltage provided by processing circuit 135.

[0046] In various embodiments, processing circuit 135 may be configured to control and/or coordinate operation of some or all aspects of CEW 100. For example, processing circuit 135 may include (or be in communication with) memory configured to store data, programs, and/or instructions. The memory may comprise a tangible non-transitory computer-readable memory. Instructions stored on the tangible non-transitory memory may allow processing circuit 135 to perform various operations, functions, and/or steps, as described herein.

[0047] In various embodiments, the memory may comprise any hardware, software, and/or database component capable of storing and maintaining data. For example, a memory unit may comprise a database, data structure, memory component, or the like. A memory unit may comprise any suitable non-transitory memory known in the art, such as, an internal memory (e.g., random access memory (RAM), read-only memory (ROM), solid state drive (SSD), etc.), removable memory (e.g., an SD card, an xD card, a CompactFlash card, etc.), or the like.

[0048] Processing circuit 135 may be configured to provide and/or receive electrical signals whether digital and/or analog in form. Processing circuit 135 may provide and/or receive digital information via a data bus using any protocol. Processing circuit 135 may receive information, manipulate the received information, and provide the manipulated information. Processing circuit 135 may store information and retrieve stored information. Information received, stored, and/or manipulated by processing circuit 135 may be used to perform a function, control a function, and/or to perform an operation or execute a stored program.

[0049] Processing circuit 135 may control the operation and/or function of other circuits and/or components of CEW 100. Processing circuit 135 may receive status information regarding the operation of other components, perform calculations with respect to the status information, and provide commands (e.g., instructions) to one or more other components. Processing circuit 135 may command another component to start operation, continue operation, alter operation, suspend operation, cease operation, or the like. Commands and/or status may be communicated between processing circuit 135 and other circuits and/or components via any type of bus (e.g., SPI bus) including any type of data/address bus.

[0050] In various embodiments, processing circuit 135 may be mechanically and/or

electronically coupled to trigger 115. Processing circuit 135 may be configured to detect an activation, actuation, depression, input, etc. (collectively, an "activation event") of trigger 115. In response to detecting the activation event, processing circuit 135 may be configured to perform various operations and/or functions, as discussed further herein. Processing circuit 135 may also include a sensor (e.g., a trigger sensor) attached to trigger 115 and configured to detect an activation event of trigger 115. The sensor may comprise any suitable sensor, such as a mechanical and/or electronic sensor capable of detecting an activation event in trigger 115 and reporting the activation event to processing circuit 135.

[0051] In various embodiments, processing circuit 135 may be mechanically and/or electronically coupled to a control interface. Processing circuit 135 may be configured to detect an activation, actuation, depression, input, etc. (collectively, a "control event") of a control interface. In response to detecting the control event, processing circuit 135 may be configured to perform various operations and/or functions, as discussed further herein. Processing circuit 135 may also include a sensor (e.g., a control sensor) attached to a control interface and configured to detect a control event of the control interface. The sensor may comprise any suitable mechanical and/or electronic sensor capable of detecting a control event in the control interface and reporting the control event to processing circuit 135.

[0052] In various embodiments, processing circuit 135 may be electrically and/or electronically coupled to power supply 140. Processing circuit 35 may receive power from power supply 140. The power received from power supply 140 may be used by processing circuit 135 to receive signals, process signals, and transmit signals to various other components in CEW 100. Processing circuit 135 may use power from power supply 140 to detect an activation event of trigger 115, a control event of a control interface, or the like, and generate one or more control signals in response to the detected events. The control signal may be based on the control event and the activation event. The control signal may be an electrical signal.

[0053] In various embodiments, processing circuit 135 may be electrically and/or electronically coupled to signal generator 145. Processing circuit 135 may be configured to transmit or provide control signals to signal generator 145 in response to detecting an activation event of trigger 115. Multiple control signals may be provided from processing circuit 135 to signal generator 145 in series. In response to receiving the control signal, signal generator 145 may be configured to perform various functions and/or operations, as discussed further herein.

[0054] In various embodiments, signal generator 145 may be configured to receive one or more control signals from processing circuit 135. Signal generator 145 may provide an ignition signal to cartridge 120 based on the control signals. Signal generator 145 may be electrically and/or electronically coupled to processing circuit 135 and/or cartridge 120. Signal generator 145 may be electrically coupled to power supply 140. Signal generator 145 may use power received from power supply 140 to generate an ignition signal. For example, signal generator 145 may receive an electrical signal from power supply 140 that has first current and voltage values. Signal generator 145 may transform the electrical signal into an ignition signal having second current and voltage values. The transformed second current and/or the transformed second voltage values may be different from the first current and/or voltage values. The transformed second current and/or the transformed second voltage values may be the same as the first current and/or voltage values. Signal generator 145 may temporarily store power from power supply 140 and rely on the stored power entirely or in part to provide the ignition signal. Signal generator 145 may also rely on received power from power supply 140 entirely or in part to provide the ignition signal, without needing to temporarily store power.

[0055] Signal generator 145 may be controlled entirely or in part by processing circuit 135. In various embodiments, signal generator 145 and processing circuit 135 may be separate components (e.g., physically distinct and/or logically discrete). Signal generator 145 and processing circuit 135 may be a single component. For example, a control circuit within housing 110 may at least include signal generator 145 and processing circuit 135. The control circuit may also include other components and/or arrangements, including those that further integrate corresponding function of these elements into a single component or circuit, as well as those that further separate certain functions into separate components or circuits.

[0056] Signal generator 145 may be controlled by the control signals to generate an ignition signal having a predetermined current value or values. For example, signal generator 145 may include a current source. The control signal may be received by signal generator 145 to activate the current source at a current value of the current source. An additional control signal may be received to decrease a current of the current source. For example, signal generator 145 may include a pulse width modification circuit coupled between a current source and an output of the control circuit. A second control signal may be received by signal generator 145 to activate the pulse width modification circuit, thereby decreasing a non-zero period of a signal generated by the current

source and an overall current of an ignition signal subsequently output by the control circuit. The pulse width modification circuit may be separate from a circuit of the current source or, alternatively, integrated within a circuit of the current source. Various other forms of signal generators 145 may alternatively or additionally be employed, including those that apply a voltage over one or more different resistances to generate signals with different currents. In various embodiments, signal generator 145 may include a high-voltage module configured to deliver an electrical current having a high voltage. In various embodiments, signal generator 145 may include a low-voltage module configured to deliver an electrical current having a lower voltage, such as, for example, 2,000 volts.

[0057] Responsive to receipt of a signal indicating activation of trigger 115 (e.g., an activation event), a control circuit provides an ignition signal to cartridge 120. For example, signal generator 45 may provide an electrical signal as an ignition signal to cartridge 120 in response to receiving a control signal from processing circuit 135. In various embodiments, the ignition signal may be separate and distinct from a stimulus signal. For example, a stimulus signal in CEW 100 may be provided to a different circuit within cartridge 120, relative to a circuit to which an ignition signal is provided. Signal generator 145 may be configured to generate a stimulus signal. In various embodiments, a second, separate signal generator, component, or circuit (not shown) within housing 110 may be configured to generate the stimulus signal. Signal generator 145 may also provide a ground signal path for cartridge 120, thereby completing a circuit for an electrical signal provided to cartridge 120 by signal generator 145. The ground signal path may also be provided to cartridge 120 by other elements in housing 110, including power supply 140.

[0058] In various embodiments, a bay of housing 110 may be configured to receive one or more cartridges 120. For example, a bay of housing 110 may be configured to receive a single cartridge, two cartridges, three cartridges, nine cartridges, or any other number of cartridges.

[0059] A cartridge 120 may comprise one or more propulsion modules 125 and one or more electrodes E. For example, a cartridge 120 may comprise a single propulsion module 125 configured to deploy a single electrode E. As a further example, a cartridge 120 may comprise a single propulsion module 125 configured to deploy a plurality of electrodes E. As a further example, a cartridge 120 may comprise a plurality of propulsion modules 125 and a plurality of electrodes E, with each propulsion module 125 configured to deploy one or more electrodes E. In various embodiments, and as depicted in FIG. 2, cartridge 120 may comprise a first propulsion

module 125-1 configured to deploy a first electrode E0, a second propulsion module 125-2 configured to deploy a second electrode E1, a third propulsion module 125-3 configured to deploy a third electrode E2, and a fourth propulsion module 125-4 configured to deploy a fourth electrode E3. Each series of propulsion modules and electrodes may be contained in the same and/or separate cartridges.

[0060] In various embodiments, a propulsion module 125 may be coupled to, or in communication with one or more electrodes E in cartridge 120. In various embodiments, cartridge 120 may comprise a plurality of propulsion modules 125, with each propulsion module 125 coupled to, or in communication with, one or more electrodes E. A propulsion module 125 may comprise any device, propellant (e.g., air, gas, etc.), primer, or the like capable of providing a propulsion force in cartridge 120. The propulsion force may include an increase in pressure caused by rapidly expanding gas within an area or chamber. The propulsion force may be applied to one or more electrodes E in cartridge 120 to cause the deployment of the one or more electrodes E. A propulsion module 125 may provide the propulsion force in response to cartridge 120 receiving an ignition signal, as previously discussed.

[0061] In various embodiments, the propulsion force may be directly applied to one or more electrodes E. For example, a propulsion force from propulsion module 125-1 may be provided directly to first electrode E0. A propulsion module 125 may be in fluid communication with one or more electrodes E to provide the propulsion force. For example, a propulsion force from propulsion module 125-1 may travel within a housing or channel of cartridge 120 to first electrode E0. The propulsion force may travel via a manifold in cartridge 120.

[0062] In various embodiments, the propulsion force may be provided indirectly to one or more electrodes E. For example, the propulsion force may be provided to a secondary source of propellant within propulsion system 125. The propulsion force may launch the secondary source of propellant within propulsion system 125, causing the secondary source of propellant to release propellant. A force associated with the released propellant may in turn provide a force to one or more electrodes E. A force generated by a secondary source of propellant may cause the one or more electrodes E to be deployed from the cartridge 120 and CEW 100.

[0063] In various embodiments, each electrode E0, E1, E2, E3 may comprise any suitable type of projectile. For example, one or more electrodes E may be or include a projectile, an electrode (e.g., an electrode dart), or the like. An electrode may include a spear portion, designed to pierce

or attach proximate a tissue of a target in order to provide a conductive electrical path between the electrode and the tissue, as previously discussed herein.

[0064] A control interface of CEW 100 may comprise, or be similar to, any control interface disclosed herein. In various embodiments, a control interface may be configured to control selection of firing modes in CEW 100. Controlling selection of firing modes in CEW 100 may include disabling firing of CEW 100 (e.g., a safety mode, etc.), enabling firing of CEW 100 (e.g., an active mode, a firing mode, an escalation mode, etc.), controlling deployment of cartridges 120, and/or similar operations, as discussed further herein.

[0065] A control interface may be located in any suitable location on or in housing 110. For example, a control interface may be coupled to an outer surface of housing 110. A control interface may be coupled to an outer surface of housing 110 proximate trigger 115 and/or a guard of housing 110. A control interface may be electrically, mechanically, and/or electronically coupled to processing circuit 135. In various embodiments, in response to a control interface comprising electronic properties or components, the control interface may be electrically coupled to power supply 140. The control interface may receive power (e.g., electrical current) from power supply 40 to power the electronic properties or components.

[0066] A control interface may be electronically or mechanically coupled to trigger 115. For example, and as discussed further herein, a control interface may function as a safety mechanism. In response to the control interface being set to a "safety mode," CEW 100 may be unable to launch electrodes from cartridge 120. For example, the control interface may provide a signal (e.g., a control signal) to processing circuit 135 instructing processing circuit 135 to disable deployment of electrodes from cartridge 120. As a further example, the control interface may electronically or mechanically prohibit trigger 115 from activating (e.g., prevent or disable a user from depressing trigger 115; prevent trigger 115 from launching an electrode; etc.).

[0067] A control interface may comprise any suitable electronic or mechanical component capable of enabling selection of firing modes. For example, a control interface may comprise a fire mode selector switch, a safety switch, a safety catch, a rotating switch, a selection switch, a selective firing mechanism, and/or any other suitable mechanical control. As a further example, a control interface may comprise a slide, such as a handgun slide, a reciprocating slide, or the like. As a further example, a control interface may comprise a touch screen or similar electronic component.

[0068] The safety mode may be configured to prohibit deployment of an electrode from cartridge 120 in CEW 100. For example, in response to a user selecting the safety mode, the control interface may transmit a safety mode instruction to processing circuit 135. In response to receiving the safety mode instruction, processing circuit 135 may prohibit deployment of an electrode from cartridge 120. Processing circuit 135 may prohibit deployment until a further instruction is received from the control interface (e.g., a firing mode instruction). As previously discussed, a control interface may also, or alternatively, interact with trigger 115 to prevent activation of trigger 115. In various embodiments, the safety mode may also be configured to prohibit deployment of a stimulus signal from signal generator 145, such as, for example, a local delivery.

[0069] The firing mode may be configured to enable deployment of one or more electrodes from cartridge 120 in CEW 100. For example, and in accordance with various embodiments, in response to a user selecting the firing mode, a control interface may transmit a firing mode instruction to processing circuit 135. In response to receiving the firing mode instruction, processing circuit 135 may enable deployment of an electrode from cartridge 120. In that regard, in response to trigger 115 being activated, processing circuit 135 may cause the deployment of one or more electrodes. Processing circuit 135 may enable deployment until a further instruction is received from a control interface (e.g., a safety mode instruction). As a further example, and in accordance with various embodiments, in response to a user selecting the firing mode, the control interface may also mechanically (or electronically) interact with trigger 115 of CEW 100 to enable activation of trigger 115.

[0070] In various embodiments, a CEW may deliver a stimulus signal via a circuit that includes a signal generator positioned in the handle of the CEW. An interface (e.g., cartridge interface) on each cartridge inserted into the handle electrically couples to an interface (e.g., handle interface) in the handle. The signal generator couples to each cartridge, and thus to the electrodes, via the handle interface and the cartridge interface. A first filament couples to the interface of the cartridge and to a first electrode. A second filament couples to the interface of the cartridge and to a second electrode. The stimulus signal travels from the signal generator, through the first filament and the first electrode, through target tissue, and through the second electrode and second filament back to the signal generator.

[0071] In various embodiments, while providing the stimulus signal (e.g., one pulse of the stimulus signal), the signal generator provides the stimulus signal at a first voltage to the first

electrode, via the first filament, and at a second voltage to the second electrode via the second filament. The voltage difference across the first electrode and the second electrode applies a voltage potential across the target. The voltage potential across target tissue delivers charge into and through target tissue. The charge through target tissue impedes locomotion of the target.

[0072] The voltage potential applied across the first electrode and the second electrode may have the same polarity, but have different magnitudes. For example, +1,000 volts may be applied to the first electrode and +100 volts to the second electrode. In another example, -1,000 volts may be applied to the first electrode and -100 volts to the second electrode.

[0073] The voltage applied to the first electrode and the second electrode may have different polarities and/or different magnitudes. For example, +1,000 volts may be applied to the first electrode and -1,000 volts to the second electrode. In another example, +1,000 volts may be applied to the first electrode and -500 volts to the second electrode.

[0074] Herein, a common voltage (e.g., zero volts, ground) may be considered to have either a positive polarity or a negative polarity. For example, applying +1,000 volts to the first electrode and zero volts to the second electrode may be considered applying voltages at the same or different potentials.

[0075] In some CEWs, the polarity assigned to an electrode is predetermined and cannot be changed. In such CEWs, the polarity of an electrode is determined by the connection between the cartridge and the CEW and the connection cannot be modified.

[0076] In the present disclosure, electrode polarity may be assigned (e.g., changed, flipped, varied, etc.). Electrode polarity may be assigned prior to launching the electrodes. Electrode polarity may be assigned after launching the electrodes. Electrode polarity may be assigned at one moment in time and change at another moment in time (e.g., assigned a first polarity at a first time and a second polarity at a second time). For example, and in accordance with various embodiments, the polarity of the electrodes launched toward a target is assigned after launching the electrodes. In another implementation, the polarity of the electrodes is assigned after the electrodes are launched toward the target and tested for connectivity with the target. Testing may include applying a test voltage (e.g., high voltage, one pulse of stimulus signal) to all possible combinations of at least two electrodes launched toward the target. After determining which electrodes electrically couple to the target, a polarity may be assigned to two or more electrodes and the stimulus signal provide via the selected electrodes.

[0077] Polarity may be assigned when two or more electrodes are launched. When only two electrodes are launched, each launched electrode is assigned a polarity and must cooperate to provide the stimulus signal through the target.

[0078] Polarity may be assigned when three or more electrodes are launched. When three or more electrodes are launched, two electrodes may be selected to provide the stimulus signal through target tissue. Any two of the three or more launched electrodes may be selected. A polarity may be assigned to the two electrodes that cooperate to provide the stimulus signal. The polarities assigned to the two electrodes may change. A first polarity assignment (e.g., first electrode positive, second electrode negative) may be changed to a second polarity assignment (e.g., first electrode negative, second electrode positive).

[0079] A polarity may be assigned to three or more electrodes. The voltage potential of the stimulus signal may be applied over three or more electrodes. Three or more electrodes may be assigned a plurality of polarity assignments. For example, a first polarity assignment may assign a positive polarity to a first electrode and a negative polarity to the other electrodes. A second polarity assignment may assign a negative polarity to a first electrode and a positive polarity to the other electrodes. The stimulus signal may be provided concurrently through two or more electrodes in accordance with a given polarity assignment. Providing the stimulus signal through three or more electrodes, regardless of polarity assignments, decreases the current density of the current that flows through each circuit formed through target tissue by the three or more electrodes.

[0080] In an example of assigning polarity, referring to FIG. 3 and in accordance with various embodiments, four electrodes E0, E1, E2, and E3 have been launched from CEW 100 and electrically couple to a target 310. The CEW may assign any polarity (e.g., positive, negative) to any of the four electrodes. The CEW may also disconnect (e.g., tri-state) any electrode to break the circuit between the CEW and the target. For example, CEW 100 may assign a positive polarity to electrode E0, a negative polarity to electrode E1, and disconnect electrode E2 and electrode E3. A signal generator in the CEW provides each pulse of a stimulus signal to establish a voltage potential across electrodes E0 and E1. Because electrode E0 has been assigned a positive polarity, high positive voltage (VHP) is applied to electrode E0. High negative voltage (VHN) is applied to E1 because it has been assigned the negative polarity. The voltage potential between VHP and VHN delivers a pulse of current through the target to interfere with locomotion of the target. In an implementation, VHP is +2,500 volts and VHN is -2,500 volts there by providing a voltage

potential of 5,000 volts between VHP and VHN. The current induced by the voltage potential flows through target tissue between electrodes E0 and E1.

[0081] In another example of assigning polarity, and in accordance with various embodiments, electrode E3 is assigned a positive polarity, electrodes E0 and E2 are assigned a negative polarity, and electrode E1 is disconnected. In this example, the signal generator in the CEW applies VHP to electrode E3 and VHN to electrodes E0 and E2. The current induced by the voltage potential flows through target tissue through two circuits. One circuit is the circuit formed by electrodes E3 and E0. The other circuit is the circuit formed by electrodes E3 and E2. Because the current flows through two circuits, as to one circuit discussed above, the current density through each circuit is less than the current density through a single circuit. Reducing the current density may reduce the likelihood of causing NMI.

[0082] The ability to assign any polarity to any electrode increases the likelihood of being able to deliver the stimulus signal through a target. If the polarities of the electrodes are fixed (e.g., cannot be changed) and all darts of the same polarity miss the target, then no stimulus signal may be delivered to the target because no circuit may be formed. Being able to assign polarities means that a stimulus signal may be delivered through a target as long as any two electrodes electrically couple to the target. For example, a CEW may launch six electrodes and have four electrodes miss the target entirely. The stimulus signal may still be delivered to the target through the two electrodes that hit (e.g., electrically coupled with) the target because different polarities may be assigned to the two electrodes to enable formation of a circuit.

[0083] As discussed above, a CEW may test launched electrodes to determine whether they are electrically coupled to a target. Using the results of the testing, the CEW may select two or more electrodes to deliver the stimulus signal. In various embodiments, the connectivity of an electrode may be tested by observing a voltage at the target or a current that flows through the target via the electrodes under test.

[0084] In various embodiments, testing using a voltage includes at least three launched electrodes. A test voltage is applied across target tissue via two electrodes and the other electrodes are observing (e.g., tested, read) to see if they detect a voltage. For example, a voltage VHIGH may be applied to a first launched electrode and VLOW to a second launched electrode. The voltage potential between VHIGH and VLOW is dropped across target tissue. If the other electrodes are between or near the first and second electrodes, they may detect a voltage as it drops

across target tissue. The voltage that may be detected at the other electrodes may be said to be induced by VHIGH and VLOW.

[0085] For example, VHIGH may be 15 volts and VLOW 5 volts. If a voltage detected on any of the other electrodes is between VHIGH and VLOW, then that electrode is electrically coupled to the target. If an electrode is not coupled to the target, no voltage will be induced on that electrode and its voltage will be measured as zero volts.

[0086] In various embodiments, testing by observing a current uses two launched electrodes. A capacitor of the CEW is charged. The voltage across the capacitor is applied across the two launched electrodes. If the electrodes are electrically coupled to the target, the capacitor will discharge. If one of the selected electrodes is not coupled to the target, the capacitor does not discharge. All pairs of launched electrodes may be tested to determine which electrodes are electrically coupled to the target.

[0087] As shown in FIG. 3, CEW 100 has launched four electrodes, electrodes E0, E1, E2, and E3, toward target 100. Electrodes E0 – E3 may be any four of the possible electrodes deployable from a CEW (e.g., CEW 100, with brief reference to FIGs. 1 and FIG. 2). Any polarity may be assigned to electrodes E0 – E3, as discussed above. The connectivity of electrodes E0 – E3 to target 102 may be tested as discussed above. A stimulus signal may be provided by (e.g., via) any two or more electrodes of electrodes E0 – E3 to impede locomotion of target 310.

[0088] Although FIG. 3 shows only four electrodes and the examples and circuits discussed herein may show only four electrodes, the methods and circuits disclosed herein are suitable for any number of electrodes.

[0089] Table 400 in FIG. 4 identifies all possible electrode polarity assignments for electrodes E0 – E3 that are suitable for providing a stimulus signal to target 310. Table 400 assumes that the magnitude of the voltage with positive polarity are the same and the magnitude of the voltage with the negative polarity are the same. For example, each "+" mark in Table 400 represents +1000 volts and each "-" mark represents -1000 volts. In this example, a magnitude of the voltage with the positive polarity and a magnitude of the voltage with the negative polarity are the same, though in other examples, these magnitudes may be different. The cases where electrodes E0 – E3 are all assigned a positive polarity or all a negative polarity have been omitted because in those situations the magnitude and polarity of the voltages applied to all electrodes are the same. Lacking a voltage potential between at least two electrodes, no stimulus signal may be provided through the target.

[0090] Row 420 of table 400 shows the case in which electrode E3 is assigned a positive polarity and electrodes E0 – E2 are all assigned negative polarities. Assuming that electrodes E0 – E3 are all electrically coupled to target 310, the current of the stimulus signal provided by the signal generator of handle 110 will divide between the circuits formed by electrodes E3/E0, electrodes E3/E1 and electrodes E3/E2. The current will flow from electrode E3 and depending on the resistance of target 310, a first portion (e.g., of charge, current) will flow into electrode E0, a second portion into electrode E1, and a third portion into electrode E2. A similar division of the current of the stimulus signal into three branches will occur if the electrodes are assigned the polarities shown in rows 422, 426, 432, 434, 440, 444, and 446. Assigning the polarities shown in rows 424, 428, 430, 436, 438, and 442 to the launched electrodes results in the current of the stimulus signal branching to flow through two or more paths. In embodiments, a first electrode and a second electrode with an assigned positive polarity may each form a respective path for the stimulus signal to a third and a fourth electrode with an assigned negative polarity, resulting in four potential paths through which the stimulus signal may flow.

[0091] As discussed above, when a stimulus signal travels through target tissue via two or more paths (e.g., circuits) the current density of the stimulus signal in each path is less than if the current traveled through a single path. As the current density through a path decreases, the current through that path is less effective at halting locomotion. At some point, the current density through a path is too low to induce NMI.

[0092] Although Table 400 shows the possible polarity assignments for the launched electrodes of FIG. 3, these assignments may not be effective for impeding locomotion of a target because of the decrease in current density in the paths as discussed above.

[0093] Table 400 may be expanded to include polarity assignments for any number of launched electrodes. Testing electrodes for connectivity through target tissue may eliminate some rows and/or columns of Table 400 as possible assignments. For example, each of the electrodes E0-E3 may be launched, but testing the electrodes may indicate that electrode E0 is not coupled to the target, causing the combinations of possible polarity assignments associated with the column for electrode E0 and rows 432, 434 from being possible.

[0094] Branching of the stimulus signal through multiple paths may be eliminated by providing the stimulus signal through only two electrodes at a time while decoupling (e.g., disconnecting) the other electrodes from the signal generator.

[0095] Table 500 of FIG. 5 shows the polarity assignments for the electrodes E0 – E3 of FIG. 3 by pairs. The letter "Z" in Table 500 indicates high impedance. High impedance indicates that the corresponding electrode has been decoupled from the signal generator. An electrode that has been decoupled from the signal generator remains electrically coupled to the target, but no current flows through that electrode from the handle of the CEW, and no voltage is applied across that electrode from the handle of the CEW. From the perspective of the target, the electrode exhibits a high impedance. Even though the signal generator provides no current through or voltage across a decoupled electrode, a processing circuit of the CEW may observe (e.g., measure) the voltage on the electrode. Measurement of a voltage on a decoupled electrode was discussed above as a method for using a voltage to detect electrode connectivity to a target.

[0096] The plus (e.g., "+") and negative (e.g., "-") signs shown in Table 500 means that the respective electrode has been assigned a positive polarity or a negative polarity. The electrode assigned a positive potential is coupled to the positive voltage (e.g., VHP) of a stimulus signal and the electrode assigned to a negative potential is coupled to the negative voltage (e.g., VHN) of the stimulus signal. The voltage potential between the positive and negative electrodes causes the current of the stimulus signal to flow through target tissue. Because the current flows through a single path through target tissue the likelihood of inducing NMI increases.

[0097] For example, in row 520 of Table 500, electrode E0 is assigned a positive polarity (e.g., electrode E0 has a positive potential), electrode E1 is assigned a negative polarity (e.g., electrode E1 has a negative potential), and electrode E2 and electrode E3 are decoupled from the signal generator. When the signal generator applies (e.g., provides) the voltage potential of the stimulus signal across electrode E0 and electrode E1, a current flows through target tissue. The current provides a charge to target tissue that impedes target locomotion. Electrode E2 and electrode E3 do not carry any of the current of the stimulus signal. The signal generator does not apply (e.g., provide) a voltage potential across electrode E2 and electrode E3. In row 526 of Table 500, the current of the stimulus signal again flows through only electrode E0 and electrode E1, and not through electrode E2 and electrode E3; however, the polarity on electrode E0 and electrode E1 have been switched relative to the assignment indicated in row 520. The polarity is switched by applying (e.g., providing) VHN to electrode E0 and VHP to electrode E1 (e.g., electrode E1 has the positive potential and electrode E2 has the negative potential).

[0098] The rows of Table 500 show all of the possible ways to assign polarity to two electrodes

selected from electrodes E0 – E3 to deliver the stimulus signal through a target. Even though a CEW may be capable of assigning any electrode any polarity, the rows of Table 500 show a method for assigning polarity to two electrodes and decoupling all other electrodes to increase the effectiveness of the stimulus signal when delivered through target tissue.

[0099] Table 500 may be expanded to include polarity and decoupling assignments for any number of launched electrodes. Testing electrodes for connectivity through target tissue may eliminate some rows and/or columns of Table 500 as possible assignments.

[0100] In various embodiments, a selector circuit may be configured to selectively assign or provide an electrode to a potential (e.g., positive or negative). The selector circuit may couple or decouple an electrode to a potential. The selector circuit couples a voltage with a positive potential (e.g., VHP) to electrodes assigned a positive polarity and a voltage with a negative potential (e.g., VHN) to electrodes assigned a negative polarity. A selector circuit may couple voltage potentials to electrodes in accordance with Table 400 or Table 500. In various embodiments, a selector circuit couples two or more launched electrodes in accordance with Table 500.

[0101] In an implementation of a CEW, referring to FIG. 6, a selector circuit may couple one or more electrodes to one or more voltage potentials as discussed above. CEW 600 includes handle 610, and cartridges 630, 640, and 650. In various embodiments, CEW 600 may include a single cartridge, some of cartridges 630, 640, and 650, or more cartridges than cartridges 630, 640, and 650. A cartridge may have one or more electrodes. A cartridge includes a propellant (not shown) for launching the electrodes toward a target. The electrodes of a cartridge may be launched separately, as groups, or all together.

[0102] Handle 610 includes power supply 612, user interface 614, signal generator 616, selector circuit 618, processing circuit 622, and interface 624. Signal generator 616, selector circuit 618, and processing circuit 622 cooperate to provide a stimulus signal to cartridges 630, 640 and 650 via interface 624. Interfaces 638, 648, and 658 couples electrically and/or mechanically to interface 624 of handle 610. Interface 624 conducts (e.g., transmits) the stimulus signal generated by signal generator 616 to cartridges 630, 640, and 650. Cartridges 630, 640 and 650 receive the stimulus signal and other control signals (e.g., launch signal, data signal, etc.) via interface 624 and interfaces 638, 648, and 658 respectively. Interfaces 638, 648, and 658 provide the stimulus signal to the electrodes of cartridges 630, 640 and 650 that are selected by selector circuit 618.

[0103] Power supply 612 provides power to generate the stimulus signal, and to power handle 610 and cartridges 630, 640, and 650. Cartridges 630, 640, and 650 each include three electrodes. Cartridges 630, 640, and 650 each removably, mechanically couple to handle 610. Power supply 612 may perform the functions of a power supply, as discussed above.

[0104] CEW 600, handle 610, and cartridges 630, 640, and 650 perform the functions of a CEW, handle, and a cartridge as discussed above.

[0105] Cartridge 630 includes electrodes 632, 634, and 636, and interface 638. Cartridge 640 includes electrodes 642, 644, and 646. Cartridge 650 includes electrodes 652, 654, and 656. In various embodiments, a cartridge may further include a processing circuit (not shown). Interfaces 638, 648 and 658 interact with interface 624 of handle 610, as described above.

[0106] A signal generator provides a signal (e.g., stimulus signal) for interfering with locomotion (e.g., movement) of a human or animal target. A signal generator may provide the stimulus signal as a series of pulses of current. A signal generator may provide a pulse of current by providing a voltage potential that is applied across two or more electrodes, such as the voltage potential between VHP and VHN as discussed above. The voltage potential causes a current to flow between the two or more electrodes. If the electrodes are electrically coupled to target tissue, the current flows through target tissue thereby causing charge to flow through target tissue. The charge of the current may impede the locomotion of the target.

[0107] A signal generator may provide a stimulus signal as a series of current pulses for a period of time. A pulse of current may be provided at one or more magnitudes of voltage during the duration of the pulse. A series of pulses may be delivered at a pulse rate (e.g., 22 pps, 44 pps, etc.) for a period of time (e.g., 5 seconds, etc.). Each pulse of a stimulus signal may have a pulse width.

[0108] In various embodiments, the voltage potential of a stimulus pulse provided by a signal generator may be of sufficient magnitude to ionize air in one or more gaps in series with the signal generator and the target. Ionizing air in a gap establishes an ionization path to deliver the stimulus signal through the target.

[0109] A signal generator may receive electrical energy from a power supply. A signal generator may convert energy into a stimulus signal for ionizing gaps of air and/or interfering with locomotion of a target.

[0110] Signal generator 616 generates stimulus signals by generating high voltages VHP and VHN. VHP is a high voltage with a positive potential. In embodiments, VHP may lie in the range

of +500 to +5000 volts. VHN is a high voltage with a negative potential. In embodiments, VHN may lie in the range of -500 to -5000 volts. Signal generator 616 provides voltages VHP and VHN via output conductors (e.g., terminal, wire, metal trace, etc.) of signal generator 616. The output conductors of signal generator 616 couple to selector circuit 618.

[0111] In various embodiments, signal generator 616 may additionally provide other signals for testing the electrical coupling of an electrode to a target. Signal generator 616 may provide test signals VTP and VTN. Test signal VTP may have a positive polarity. Test signal VTN may have a negative polarity. Generally, the magnitude of VTP and VTN, when applied as a voltage potential across target tissue, is not sufficient to induce NMI. However, if the current is provided through target tissue then the electrodes electrically couple to target tissue. Signal generator 616 may provide one or more pulses at the voltage potentials VTP and VTN.

[0112] A selector circuit selectively couples signal generator 616 to one or more electrodes via interface 624 and interfaces 638, 648, and 658. A selector circuit selectively decouples one or more electrodes from signal generator 616. By selectively coupling or decoupling electrodes, a selector circuit selects two or more electrodes for providing a stimulus signal to a target. A selector circuit may also couple or decouple electrodes to test the electrical connectivity of an electrode to a target.

[0113] A selector circuit may cooperate with a processing circuit to determine whether a signal generator should be coupled to one or more electrodes. For example, the processing circuit may control the selector circuit to control coupling of the signal generator to one or more electrodes. A selector circuit may cooperate with a processing circuit to select electrodes for providing a stimulus signal. A selector circuit may include inputs for receiving signals from a signal generator. A selector circuit may include inputs for receiving signals from a processing circuit. A selector circuit may receive input signals (e.g., a voltage) from a signal generator and/or a processing circuit. A selector circuit may provide a signal received an input of the selector circuit to an output of the selector circuit.

[0114] A selector circuit may include any type of circuit suitable for switching high voltage signals and/or pulsed currents. A selector circuit may include high voltage multiplexers (e.g., multiplexors, MUX's, MPX's, etc.), demultiplexers (e.g., demultiplexors, DEMUX's, etc.), relays, semiconductor switches, and switches (e.g., double pole single throw ("DPST"), single pole double throw ("SPDT"), etc.).

[0115] In various embodiments, a selector circuit may be integrated into one or more of a processing circuit and/or a signal generator (e.g., a selector circuit, a processing circuit, and a signal generator comprise a single component, a selector circuit and a processing circuit comprise a single component, a selector circuit and a signal generator comprise a single components, etc.). In various embodiments, a selector circuit, a processing circuit, and/or a signal generator may be separate components (e.g., physically distinct and/or logically discrete).

[0116] In an implementation, selector circuit 618 electrically couples to signal generator 616, processing circuit 622, and interface 624. Selector circuit 618 receives stimulus signals VHP and VHN at its inputs. Selector circuit 618 selects (e.g., steers, provides, controls, etc.) stimulus signals VHP and VHN for provision on one or more outputs of selector circuit 618. The outputs of selector circuit 618 respectively couple to the electrodes of cartridges 630, 640, and 650 via interfaces 624, 638, 648, and 658. Providing a signal to an output of selector circuit 618 applies the signal to the electrode coupled to that output. Decoupling (e.g., disconnecting) an output of selector circuit 618 decouples the electrode coupled to that output from signal generator 616. Selector circuit 618 may choose to decouple one or more of electrodes 632 – 636, 642 – 646, and 652 – 656 from signal generator 616. As discussed above, a decoupled electrode presents a high impedance (e.g., Z) to target tissue.

[0117] Selector circuit 618 couples electrodes to signal generator 616 to provide a stimulus signal or a test signal through a target. A processing circuit, such as processing circuit 622, may determine which electrodes should be assigned a positive polarity, a negative polarity, or be decoupled. Selector circuit 618 implements the polarity and disconnect assignments determined by the processing circuit.

[0118] For example, when providing a stimulus signal through a target, selector circuit 618 couples VHP from signal generator 616 to the one or more electrodes that have been assigned a positive polarity. Selector circuit 618 couples VHN from signal generator 616 to the one or more electrodes that have been assigned a negative polarity. Because selector circuit 618 may provide VHP and VHN to any electrode, any number of electrodes may be assigned a positive polarity and any number of electrodes may be assigned a negative polarity. Further, selector circuit 618 may decouple any electrode from signal generator 616.

[0119] In various embodiments, selector circuit 618 may couple (e.g., connect) and/or decouple (e.g., disconnect) electrodes in accordance with patterns shown in Tables 400 and 500. For

example, referring to Table 500, assume that electrodes E0 – E3 have been launched and electrically couple to a target. Referring to row 532, selector circuit 618 connects (e.g., applies, provides, etc.) voltage VHN to electrode E0 because processing circuit 622 assigned electrode E0 a negative polarity. Selector circuit 618 connects (e.g., applies, provides, etc.) voltage VHP to electrode E2 because processing circuit 622 assigned electrode E2 a negative polarity. Selector circuit 618 decouples electrode E1 and electrode E3 from signal generator 616 because processing circuit 622 determines that the stimulus signal should be provided by only two electrodes. By coupling and decoupling electrodes as discussed above, selector circuit 618 steers the stimulus signal from signal generator 616 to the selected electrodes with the proper (e.g., assigned) polarity.

[0120] In various embodiments, selector circuit 618 may maintain the connections to the selected electrodes for delivery of all pulses of a stimulus signal. In other words, selector circuit 618 may provide all pulses of the stimulus signal via the same electrodes at a respective same polarity for each of the electrodes.

[0121] In various embodiments, selector circuit 618 may also respond to changes in electrode selection, electrode polarity, and electrode coupling for one or more pulses of a stimulus signal. In other words, for a first pulse of a stimulus signal, selector circuit 618 may assign voltages (e.g., VHP, VHN) to and decouple electrodes in accordance with row 522 of Table 500. Selector circuit 618 may operate in accordance with row 524 for a next pulse of the stimulus signal. Selector circuit 618 may operate in accordance with any row of Table 400 or Table 500 for any number of pulses of the stimulus signal.

[0122] A processing circuit may determine the electrodes for providing a stimulus signal or a test signal for each pulse of a stimulus signal or test signal. Selector circuit 618 operates in accordance with the assignments made by the processing circuit.

[0123] In various embodiments, electrode electrical connectivity with a target may be tested while providing a stimulus signals signal. The voltages VHP and VHN are formed by charging a first capacitor to the magnitude of voltage VHP (e.g., +2,500 volts) and a second capacitor to the magnitude of voltage VHN (e.g., -2,500 volts). When VHP and VHN are applied to electrodes, if the electrodes electrically couple to a target, the charge stored in the first capacitor and the second capacitor will discharge. The discharge of the first capacitor and the second capacitor demonstrates that the electrodes coupled to the first capacitor and the second capacitor formed a circuit through the target.

[0124] However, using voltages that have a lower magnitude for testing saves energy, so the voltages VHIGH and VLOW operate similarly to detect electrical connectivity. Analogous to VHP and VHN, a first capacitor and a second capacitor are charged to VHIGH (e.g., +100 volts) and VLOW (e.g., -100 volts), respectively, and coupled to electrodes. If the capacitors discharge, or discharge more than a threshold, the electrodes are identified as electrically coupling to the target. Further disclosure regarding VHIGH and VLOW, in accordance with various embodiments, is provided below.

[0125] As discussed above, selector circuit 618 receives signals from processing circuit 622. Processing circuit 622 may control, in whole or in part, the steering (e.g., application, provision, etc.) of signals from the inputs of selector circuit 618 to the outputs of selector circuit 618. Processing circuit 622 may determine, in whole or in part, whether one or more electrodes electrically couple to a target. Processing circuit 622 may determine, in whole or in part, whether two or more electrodes form a circuit through a target. Processing circuit 622 may keep a record of which electrodes are launched, which electrodes electrically couple to a target, which electrodes have been assigned which polarity, and/or any other information for selecting electrodes for providing a stimulus signal, assigning polarity, and/or providing the stimulus signal through a target.

[0126] In various embodiments, a polarity assignment may be assigned by a processing circuit. The processing circuit may perform one or more operations to assign a polarity assignment to one or more electrodes. Assigning the polarity assignment may include determining the polarity assignment and applying the polarity assignment to the one or more electrodes. Determining the polarity assignment may include generating information indicative of an assignment and/or writing information indicative of the assignment in a system memory associated with the processing circuit. For example, information corresponding to one or more tables disclosed herein may be written to a system memory by processing circuit 622. The information may be generated after one or more test results are determined (e.g., received, measured) by the processing circuit 622. Applying the polarity assignment may include reading information corresponding to the polarity assignment from system memory and/or generating one or more signals in accordance with the information to cause an electrode associated with the polarity assignment to be coupled to a conductor of a signal generator on which a stimulus signal of a polarity corresponding to the polarity assignment is provided. In embodiments, applying the information may include reading

the information from system memory and generating the one or more signals in accordance with the information.

[0127] In various embodiments, assigning a polarity assignment may include generating one or more select and/or enable signals by a processing circuit. For example, processing circuit 622 may determine a polarity assignment associated with a high polarity for electrode E0 and generate select and enable signals to couple electrode E0 to a conductor with signal VHN from signal generator 616. The signals may include an enable signal and/or a select signal for MUX's 718, 720, 730 or 732, and 740, with reference to FIG. 7. The assigning of the polarity assignment may include generating one or more select or enable signals to couple an electrode to a first conductor with first signal from a signal generator among a plurality of conductors from the signal generator, wherein the first electrode is configured to be coupled individually to each of the conductors upon generator of a respective set of signals from a processing circuit. Assigning the polarity may include altering one or more select or enable signals generated by a signal processor to couple or decouple an electrode to a signal generator conductor in accordance with the polarity assignment.

[0128] In various embodiments, a polarity assignment may be assigned in accordance with a test result. A polarity assignment of the one or more electrodes may not be assigned until after the test result is determined. The polarity assignment may be determined after the test result is determined by a processing circuit. The processing circuit may determine (e.g., apply, generate) the polarity assignment in accordance with the determined test result, thereby matching the polarity assignment to a corresponding number and selection of launched electrodes that are also determined to be coupled to a target.

[0129] In various embodiments, a processing circuit may assign a polarity of an electrode in accordance with a predetermined set of polarity assignments. For example, processing circuit 622 may be configured to assign one or more polarities in accordance with a number of launched electrodes. A first electrode may have a first assigned polarity in a first polarity assignment for a first number of launched electrodes and a second assigned polarity in a second polarity assignment for a second number of launched electrodes, the second number larger than the first number and the polarity assignment changed from the first polarity assignment to the second polarity assignment upon launch of the second number of launched electrodes. Another electrode, different from the first electrode, may change from an assigned second polarity to an assigned first polarity or remain assigned to the second assigned polarity upon launch of the second number of launched

electrodes. The other electrode may change or not change an assigned polarity in accordance with the first and second polarity assignments. In embodiments according to various aspects of the present disclosure, the polarity assignment may be determined independent of a test result, including without one or more test results being determined.

[0130] In various embodiments, one or more polarity assignments may be changed over time. For example, processing circuit 622 may be configured to assign different polarities to a same electrode. A first electrode may have a first polarity assignment at a first time and a second polarity assignment at a second time, the second time after the first time. The electrode may receive a stimulus signal with a same or a different magnitude between the first time and the second time, but with different polarities.

[0131] In various embodiments, a change in polarity assignment may be performed automatically. Processing circuit 622 may receive or detect one or more inputs and change one or more output signals in accordance with the received or detected input. For example, a polarity assignment for each electrode of a plurality of electrodes may be changed in accordance with one or more of a change in time and one or more test results. In embodiments, one or more first electrodes of a set of electrodes may be changed automatically, while one or more second electrodes of the set of electrodes may retain a same polarity assignment upon change of the polarity assignment of the one or more first electrodes. Automatically changing a polarity assignment may include automatically assigning a polarity assignment. In embodiments, automatically changing a polarity may include changing or assigning a polarity assignment independent of a manual input received by a respective CEW.

[0132] In various embodiments, a change in polarity assignment may be performed based on a previous polarity assignment. For example, it may be desired to change polarity assignment between each pulse of a stimulus signal. Changing polarity assignment between each pulse of the stimulus signal may provide health benefits to the human or animal target, while still inducing NMI. In various embodiments, changing polarity assignment based on a previous polarity assignment may include providing a positive potential to an electrode during a first polarity assignment, and a negative potential to the electrode during a second polarity assignment. The first polarity assignment may be performed prior to a first pulse of a stimulus signal. The second polarity assignment may be performed after the first pulse of the stimulus signal, such as before a second pulse of the stimulus, after a repeated pulse of the stimulus signal, or the like.

[0133] For example, a signal generator may provide a first pulse of a stimulus signal through a target via a first electrode and a second electrode coupled to the target. The first electrode may provide a positive potential of the first pulse and the second electrode may provide a negative potential of the first pulse. The signal generator may provide a second pulse of the stimulus signal through the target via the first electrode and a third electrode. The first electrode may provide the negative potential of the second pulse and the third electrode may provide the positive potential of the second pulse. In that regard, the first electrode may provide the stimulus signal during both the first pulse and the second pulse, but may provide different voltage potentials during each of the pulses.

[0134] In various embodiments, power supply 612 provides power for the operation of user interface 614, signal generator 616, selector circuit 618, processing circuit 622, and/or interface 624. Power supply 612 provides the energy to form a stimulus signal. Power supply 612 may provide power to cartridges 630, 640, and/or 650, so the cartridges may perform one or more functions.

[0135] User interface 614 may perform the functions of a trigger and/or a control interface, as discussed further herein. For example, processing circuit 622 may communicate with user interface 614 to display information to the user.

[0136] As a further example, processing circuit 622 cooperates with user interface 614 to launch electrodes from cartridges 630, 640, and 650 at a target. Processing circuit 622 may use information received from selector circuit 618 to determine the electrical connectivity of electrodes with a target. Processing circuit 622 may use information regarding electrode connectivity to control selector circuit 618. Processing circuit 622 may control selector circuit 618 to assign a positive polarity to one or more electrodes, assign a negative polarity to one or more electrodes, and/or decouple one or more electrodes from signal generator 616. Processing circuit 622 may control selector circuit 618 steer test voltages to one or electrodes.

[0137] Processing circuit 622 performs the functions of a processing circuit disclosed herein.

[0138] A cartridge may removably couple to a handle. For example, a cartridge may be inserted within a bay of the handle. A cartridge may include one or more electrodes. The cartridge may receive a stimulus signal from a signal generator. The cartridge may provide the stimulus signal to one or more electrodes. The cartridge may contain a propellant (e.g., pyrotechnic, compressed gas etc.). A processing circuit of a CEW may provide one or more launch signals to a cartridge to

activate the propellant to launch of one or more electrodes from a cartridge. A processing circuit may provide the one or more launch signals responsive to operation of a control (e.g., trigger) by a user of the CEW. Upon activation, the propellant propels the one or more electrodes toward a target. As the one or more electrodes fly toward the target, a respective filament deploys between the one or more electrodes and the cartridge to electrically couple the electrodes to the CEW. A filament may be stored in the body of the electrode. Movement of an electrode toward the target deploys the filament to bridge (e.g., span) the distance between the target and the CEW.

[0139] Cartridges 630, 640, and 650 perform the functions of a cartridge as disclosed herein.

[0140] Selector circuit 700, shown in FIG. 7, is an implementation of selector circuit 618, in accordance with various embodiments. Selector circuit 700 is implemented using one or more multiplexers (e.g., multiplexors, MUX's, MPX's, etc.). A multiplexer (e.g., multiplexor, MUX, MPX, etc.) may be implemented using any suitable technology. A multiplexer selects one or more inputs so that a signal on each selected input is presented on (e.g., steered to, provided to, etc.) one or more outputs. In various embodiments, a multiplexer may comprise a combinational logic circuit designed to switch one of a plurality of input lines to a single common output line by the application of a control signal. In various embodiments, a multiplexer may be digital or analog. A digital multiplexer may include digital circuits (such as high speed logic gates) used to switch digital or binary data. An analog multiplexer may include transistors, gates, relays, etc. configured to switch one of the voltage or current inputs through to a single output.

[0141] The symbols and truth tables for the MUX's used to implement selector circuit 700 are shown in FIGs. 8 – 10, in accordance with various embodiments.

[0142] In various embodiments, one or more of MUX 740, 742, 744, and 746 may include a 2-1 MUX, such as a MUX 800, with reference to FIG. 8. A 2-1 MUX may consist of two inputs, a select input and/or an enable input, and one output. The output is connected to either of the inputs based on the select input and/or the enable input. As shown in FIG. 8, MUX 800 may receive two inputs, two select signals (e.g., an input signal and an enable signal), and provide a single output. MUX 800 is selectively enabled or not enabled to provide or not provide any output in accordance with a first select signal of the two select signals (e.g., the enable signal). MUX 800 may provide an output corresponding to one of the inputs in accordance with a second select signal of the two select signals (e.g., the input signal) when an output is enabled to be provided.

[0143] In various embodiments, one or more of MUX 730 and 732 may include a 3-1 MUX,

such as a MUX 900, with reference to FIG. 9. A 3-1 MUX may consist of three inputs, two select inputs, and one output. The output is connected to one of the three inputs based on the select inputs. As shown in FIG. 9, MUX 900 may receive three inputs and provide an output corresponding to one of the inputs in accordance with a first select signal and a second select signal received by the MUX 900.

[0144] In various embodiments, one or more of MUX 718 and 720 may include a 4-1 MUX, such as a MUX 1000, with reference to FIG. 10. A 4-1 MUX may consist of four inputs, two select inputs, and one output. The output is connected to one of the four inputs based on the select inputs. As shown in FIG. 10, MUX 1000 may receive four inputs and provide an output corresponding to one of the inputs in accordance with a first select signal and a second select signal received by the MUX 1000.

[0145] Selector circuit 700 may use a combination of one or more MUX's to select between one or more input signals and output the selected signals to one or more electrodes. A MUX may be controlled by inputs, herein referred to as a select input, which select one or more inputs for steering to one or more outputs. A MUX may further be controlled by an enable signal that determines whether an output of the MUX is driven or decoupled so that it presents a high impedance.

[0146] In FIG. 7, selector circuit 700 is shown cooperating with signal generator 616, processing circuit 622, and interface 624 to provide signals to electrodes. Signal generator 616, processing circuit 622, and interface 624 perform the functions of a signal generator, a processing circuit, and an interface as discussed above.

[0147] Selector circuit 700 includes two 4-1 MUX's, two 3-1 MUX's, and four 2-1 MUX's, which cooperate to perform the functions of the selector circuit. The inputs of MUX's 718 and 720 are the inputs of selector circuit 700. The outputs of selector circuit 700 are the outputs of MUX's 740 – 746. The outputs of MUX's 740 – 746 provides signals to interface 624, which provides the signals to electrodes E0 – E3. Other inputs to selector circuit 700 include the select inputs and enable inputs to the MUX's. In this implementation, the select input and the enable input are driven by processing circuit 622.

[0148] Signal generator 616 provides signals VHP/VHN and signals VTP/VTN as inputs of selector circuit 700. As discussed above, stimulus signals VHP/VHN are provided to a target to interfere with the locomotion of the target. Testing signals VTP/VTN test whether one or more

launched electrodes has electrical connectivity with a target. Processing circuit 622 provides signals to one or more MUX's. Signals provided by processing circuit 622 drive MUX inputs (VHIGH, VLOW), select inputs, and enable inputs of one or more MUX's. Processing circuit 622 controls the select inputs and the enable inputs of the MUX's of selector circuit 700 to determine which input is steered to which output. Processing circuit 622 controls the select inputs and the enable inputs in accordance with assigning polarity and decoupling the electrodes. The polarities assigned by processing circuit 622 to the electrodes may be referred to as a polarity assignment. Decoupling one or more electrodes from signal generator 616 may be referred to as a decoupling assignment. Processing circuit 622 may change the polarity assignment and/or decoupling assignment from time to time, as discussed further herein.

[0149] In various embodiments, and with reference to FIG. 11, Table 1100 shows the relationship of the input signals, the select signals, and the enable signals to the output signals of selector circuit 700. Table 1100 shows how select signals and enable signals may steer a particular input signal to a specific electrode. In particular, Table 1100 shows how processing circuit 622 controls select inputs and enable inputs to steer stimulus signals VHP/VHN to the outputs of selector circuit 700 for delivery to a target via electrodes.

[0150] In various embodiments, and with reference to FIG. 18, Table 1800 shows how selector circuit 700 steers voltages VLOW/VHIGH and VTP/VTN to the electrodes to test connectivity.

[0151] Table 1100 includes columns 1102 – 1116 and rows 1130 – 1140. Table 1100 does not include all combinations of all input or output signals. Each column refers to a group of signals on select inputs, enable inputs, or outputs. For example, column 1102 shows the signals that drive the four select inputs for MUX's 718 and 720, column 1104 shows the output signals at outputs A and B of MUX's 718 and 720 respectively, column 1106 shows the signals that drive the four select inputs for MUX's 730 and 732, column 1108 shows the signals at outputs C and D of MUX's 730 and 732 respectively, and so forth. Outputs E0 – E3 drive or are decoupled from electrodes E0 – E3 respectively.

[0152] The symbol "X" as used in any table herein refers to the value of the input being irrelevant to the outcome. The symbol "Z" as used in any table herein refers to high impedance, as previously discussed herein. In selector circuit 700, the outputs that drive the electrodes may be decoupled from signal generator 616 by disabling MUX's 740, 742, 744, and/or 746. The numbers "1" and "0" as used in any table herein refer to a logic high value and a logic low value respectively.

The magnitude of voltage needed for a logic high value and a logic low value depends on the technology used to implement selector circuit 700, in accordance with various embodiments.

[0153] The rows of Table 1100 show some of the values of the signals at inputs and outputs of selector circuit 700. Row 1130 shows the inputs that result in electrode E0 being assigned VHN, electrode E1 being assigned VHP, and electrodes E2 – E3 being decoupled. Row 1130 shows how selector circuit 700 operates to implement the polarity assignment of row 526 of Table 500. In particular, electrode E0 is assigned a negative polarity, electrode E1 is assigned a positive polarity, and electrodes E2 and E3 are decoupled.

[0154] Column 1116 identifies the polarity assignment of either Table 400 or Table 500, with brief references to FIGs. 4 and 5, that corresponds to the polarities assigned by selector circuit 700 for the given input values. In particular, as discussed above, the input values shown in row 1130 when applied to selector circuit 700 provide output values to electrodes E0 – E3 that correspond to row 530 in Table 500. The input values shown in row 1132 correspond to row 434 in Table 400. In particular, electrodes E0 is assigned a positive polarity and electrodes E1, E2 and E3 are assigned a negative polarity.

[0155] As described above, the polarity assignments described in row 434 and implemented in row 1132 result in the current of the stimulus signal being divided (e.g., branching) through the various circuits formed between electrodes. One electrode (e.g., E0) applies a positive polarity (e.g., VHP) to the target, while other electrodes (e.g., E1, E2, E3) apply a negative polarity (e.g., VHN). The current provided via E1 divides through electrodes E1, E2 and E3, thereby decreasing the current density through any one circuit (e.g., E0-E1, E0-E2, E0-E3). The polarity assignment implemented in row 1132 may not be effective for impeding locomotion of the target because the current density through any one circuit may be too low to induce NMI.

[0156] However, rows 1130, 1134, 1138, and 1140 of Table 1100 describe input values to selector circuit 700 that conduct the stimulus signal through only two electrodes while disconnecting the other electrodes. So, the input signals for rows 1130, 1134, 1138, and 1140 are suitable for delivering a stimulus signal to a target which may likely induce NMI because the current of the stimulus signal flows through the target by way of only one circuit.

[0157] Selector circuit 1200, shown in FIG. 12 and in accordance with various embodiments, is another implementation of selector circuit 618. Selector circuit 1200 is implemented using relays and an H-bridge circuit. A relay may be implemented using any suitable technology. A

relay selects one or more inputs so that the signal on the selected inputs is presented on (e.g., steered to) one or more outputs. A relay may also be described as being similar to a switch. For example, a relay may be described as performing, for example, the functions of a single pole double throw ("SPDT") switch or, as another example, the functions of a double pole double throw ("DPDT") switch. Relays are particularly suitable for switching high voltages (e.g., 1000 – 10000 volts) such as the voltages of a stimulus signal.

[0158] The symbol and truth table for the relays used to implement selector circuit 1200 are shown in FIGs. 13 – 14. An H-bridge may be implemented using any suitable technology. An H-Bridge may be used to switch (e.g., flip) the signals at the output of the H-bridge. If the signals have different polarity, then an H-bridge may be used to switch the polarity of a voltage applied to a load. For example, H-bridge circuit 1210 includes inputs A and B, outputs HA and HB, and select SelH. When SelH is a logical 0, H-bridge 1210 passes input A to output HA and input B to output HB. When SelH is a logical 1, H-bridge 1210 passes input A to output HB and input B to HA.

[0159] Selector circuit 1200 may use a combination of one or more relays and H-bridges to select between one or more input signals and provide the selected signals to one or more electrodes. Selector circuit 1200 cooperates with signal generator 616, processing circuit 622, and interface 624 to provide signals to electrodes or to disconnect electrodes. Selector circuit 1200 includes four DPST relays, one H-Bridge, and four SPDT relays which cooperate to perform the functions of selector circuit 618 as described above. The outputs of relays 1260 – 1266 provides signals to interface 624, which provide the signals to electrodes.

[0160] The principles disclosed with respect to selector circuit 1200 may be extended to include any number of electrodes.

[0161] Signal generator 616 provides signals VHP/VHN and VTP/VTN as inputs to selector circuit 1200. As discussed above, stimulus signals VHP/VHN are provided to a target to interfere with the locomotion of the target. Testing signals VTP/VTN may be used to test whether one or more launched electrodes has electrical connectivity with the target and/or whether two or more electrodes may establish a circuit through a target.

[0162] Signals provided by processing circuit 622 may be applied to select inputs of one or more relays. Processing circuit 622 controls the select inputs of the relays to determine which inputs to selector circuit 1200 are steered to which output. Processing circuit 622 may further

provide input signals such as VLOW and VHIGH to relay 1240. As discussed above, signals VLOW/VHIGH are used to test the connectivity of launched electrodes to a target using a voltage, as opposed to the current used by VTN and VTP, to test for electrical connectivity.

[0163] Processing circuit 622 provides signals to one or more relays. Processing circuit 622, as discussed above, provides signals as logical 0s or 1s. A signal from processing circuit 622 may be level shifted to drive the input (e.g., input, select) of a relay.

[0164] In various embodiments, and with reference to FIG. 15, Table 1500 shows the relationship between input signals and select signals of selector circuit 1200 and the value of the resulting output signals. Table 1500 shows how select signals may be driven to steer (e.g., provide) a particular input signal to a specific electrode. In particular, Table 1500 shows how processing circuit 622 controls select inputs to steer stimulus signals VHP/VHN to the outputs of selector circuit 1200 for delivery to a target via electrodes.

[0165] Table 1500 does not show how test signals VTN and VTP or test signals VLOW and VHIGH are steered to the electrodes. Table 1600 and Table 1700, with brief reference to FIGs. 16 and 17, show how select selector circuit 1200 steers voltages VTP/VTN and VLOW/VHIGH to electrodes to test connectivity. The test signals are discussed in more detail below.

[0166] Table 1500 includes columns 1502 – 1516 and rows 1530 – 1540. Table 1500 does not include all combinations of input signals or output signals. Each column refers to a group of select inputs, enable inputs, and output signals. Column 1502 shows the signal that drives select input selAB and output signals at outputs O0 and O1, column 1504 shows the signal that drives the selH input and output signals at outputs HA and HB, column 1508 shows the signals that drives select inputs Sel01 and Sel23, and so forth. Outputs E0 – E3 drive or are decoupled from electrodes E0 – E3 respectively.

[0167] Nodes E0 – E3 may include a high impedance (e.g., > 1 megaohms, > 10 megaohms, > 100 megaohms) pull-down (not shown) so that electrodes that are not connected to a target are pulled to zero volts.

[0168] Input B on relays 1260 – 1266 is not connected to anything, so when the select signal (e.g., sel0, sel1, sel2, sel3) for one of relays 1260 – 1266 go to a logic 1, the output is not connected to input B and is thereby not connected to anything. When the sel0, sel1, sel2, or sel3 is driven by a logic 1 value, the output of that relay is in essence decoupled and presents a high impedance ("Z").

[0169] Table 1500 shows how stimulus signals VHP/VHN is steered from signal generator 616 to the electrodes and how electrodes may be decoupled from signal generator 616. Not all possible combinations of input and output values are shown in Table 1500. A few of the rows of Table 1500 are discussed to provide an understanding of the operation of selector circuit 1200. Row 1530 shows the inputs that result in electrode E0 being assigned VHN, electrode E1 being assigned VHP, and electrodes E2, E3 being decoupled. Row 1530 corresponds to assigning a negative polarity to electrode E0 and a positive polarity to electrode E1. Row 1530 shows how selector circuit 1200 operates to provide the polarity assignment of row 526 of Table 500.

[0170] Column 1516 of Table 1500 identifies the row in Table 500 that corresponds to the polarity assignment provided by selector circuit 1200 for the given input values. Selector circuit 1200 cannot provide the polarity assignments shown in Table 400. Selector circuit 1200 provides the stimulus signal via two electrodes at any one time and not through three or more electrodes.

[0171] The input values shown in row 1532 of Table 1500 assign a positive polarity to electrode E3, a negative polarity to electrode E0, and decouple electrodes E1 and E2. Row 1532 shows how selector circuit 1200 operates to provide the polarity assignment of row 538 of Table 500.

[0172] As discussed above, signals may be delivered to a target to test (e.g., determine) whether the electrodes electrically couple to the target and/or whether a pair of electrodes form a circuit through the target. After two or more electrodes have been launched toward a target, the electrodes may or may not form a circuit through a target. Electrodes that miss the target cannot form a circuit through the target. Electrodes that strike insulated material (e.g., non-conductive coat, rubberized raincoat, etc.) on the target cannot establish a circuit through the target.

[0173] After electrodes have been launched and have the opportunity to reach a target, selector circuits 700 and 1200 may steer test signals to the launched electrodes to test the electrical connectivity of the electrodes with the target and the ability of a pair of electrodes to provide a stimulus signal through target tissue.

[0174] Electrodes may be tested using one or more methods. For example, as described above, testing using a current may be performed by assigning the signals VTN and VTP to a pair of electrodes. If the signals VTN and VTP deliver a current through the target, that pair of electrodes are connected to and form a circuit through the target. All pairs of launched electrodes may be tested to determine which electrodes are electrically coupled to the target and which electrode pairs form a circuit through the target.

[0175] In various embodiments, and with reference to FIG. 16, Table 1600 shows how processing circuit 622 controls select inputs of selector circuit 1200 to steer test signals VTP/VTN to the electrodes to test connectivity. In particular, processing circuit 622 drives select input SelAB with a logical 1 so MUX 1230 steers test signals VTP/VTN from signal generator 616 to the outputs of MUX 1230. Processing circuit 622, drives the other inputs of selector circuit 1200 to steer signals VTP/VTN to the output of selector circuit 1200 and to the launched electrodes.

[0176] In various embodiments, selector circuit 1200 tests only two electrodes at a time using signals VTP/VTN. All other electrodes are disable and present a high impedance to the target. As discussed above, signals VTP/VTN are formed by signal generator 1216 by charging one capacitor to a negative voltage (e.g., VTN) and another capacitor to a positive voltage (e.g., VTP). Selector circuit 1200 electrically couples the negatively charged capacitor to a first electrode and the positively charged capacitor to a second electrode. If both of the first electrode and the second electrode are electrically coupled to the target, the capacitors will discharge at least partially. The capacitors may be observed (e.g., tested, monitored). If charge discharges from the capacitors through the selected electrodes, the pair of electrodes is considered to be coupled (e.g., connected) to and to form a circuit through the target. If no charge, or an amount less than a threshold, discharges from the capacitors through the selected electrodes, the pair of electrodes is not considered to be coupled to or through the target.

[0177] Processing circuit 622 may test and/or monitor the capacitors. Processing circuit 622 may keep a record (e.g., stored in memory) of those electrodes and/or electrode pairs that are electrically coupled to or for a circuit through the target. For example, processing circuit 622 may record that electrodes E1 and E3 electrically couple to the target and electrodes E2 and E0 do not electrically couple to the target. Processing circuit 622 may further record that the electrode E1 and E3 form a circuit through the target. Any two electrodes that electrically couple to a target form a circuit through the target.

[0178] The magnitude of voltages VTP may be in the range or 10 volts to 1000 volts. The magnitude of voltages VTP may be in the range or -10 volts to -1000 volts. As discussed above, stimulus signal VHP/VHN may be used to test the electrical connectivity of electrodes similarly to voltages VTP/VTN.

[0179] Table 1600 includes columns 1502 – 1516 as discussed above with respect to Table 1500 above. Rows 1630 – 1640 shows example input signal values and the resulting output signal

values. Not all possible combinations of input and output values are shown in Table 1600.

[0180] Electrode electrical connectivity with a target may also be tested by providing test signals VHIGH and VLOW to one of a pair of launched electrodes while observing the voltage induced on the other launched electrodes.

[0181] In various embodiments, Table 1700 of FIG. 17 shows how selector circuit 1200 steers test signals VHIGH and VLOW to the outputs of selector circuit 1200 to test electrode connectivity. Processing circuit 622 may provide (e.g., drive) the signals VLOW and VHIGH. Signals from processing circuit 622 may be level shifted to provide signals VLOW and VHIGH. Signals VLOW and VHIGH may be provided by a circuit that is separate from processing circuit 622.

[0182] Table 1700 includes columns 1502 – 1516 as discussed above with respect to Table 1500. Rows 1730 – 1740 shows input signal values and the respective output signal values. The rows of Table 1700 show the values at each input to selector circuit 1200 and the value of the resulting output for testing electrode connectivity using VLOW and VHIGH. Not all possible combinations of inputs are shown in Table 1700. Row 1730 shows the inputs that result in electrode E0 being assigned VHIGH, electrode E1 being assigned VLOW, and electrodes E2, E3 being decoupled so that selector circuit 1200 does not drive electrodes E2 and E3 with a signal.

[0183] Processing circuit 622 drives select input SelCD to a logical 1 in order to steer test signals VHIGH and VLOW to outputs D and C respectively and from there to two electrodes. All electrode pair combinations may be tested. Row 1730 shows how selector circuit 1200 operates to provide the polarity assignment of row 526 of Table 500.

[0184] After selector circuit 1200 has provided VLOW and VHIGH to two electrodes, processing circuit 622 may measure the voltage on the other, decoupled electrodes to determine electrical connectivity. Assume, referring to row 1730, that VHIGH is applied to electrode E0 and VLOW is applied to electrode E1. Assume also that electrode E2 is electrically coupled to the target, but that electrode E3 is not electrically coupled to the target. Note that sel2 and sel3 are driven by processing circuit 622 to a logical 1, which connects electrode E2 to open (e.g., floating) input s2 and electrode E3 to open input s3, thereby decoupling electrode E2 and E3 from signal generator 616 so as to present a high impedance to the target.

[0185] Because electrodes E0 – E2 electrically couple to target tissue, providing VLOW and VHIGH across electrodes E0 and E1 may induce a voltage on electrode E2. The tissue of a body

is similar to a resistive load. The voltage difference between VHIGH and VLOW is dropped across the target tissue between the electrodes E0 and E1. If electrode E2 is positioned in target tissue between or near electrodes E0 and E2, the voltage of target tissue at electrode E2 will lie somewhere between VHIGH and VLOW. The value of the voltage induced on electrode E2 may be read by processing circuit 622 at S2. Assume that VLOW is 10 volts and VHIGH is 100 volts. If processing circuit detects a voltage in that range of VLOW to VHIGH on electrode E2, say for example 35 volts, then processing circuit 622 knows that electrode E2 electrically couples to target tissue.

[0186] Processing circuit 622 will not detect a voltage at S3 because electrode E3 is not electrically coupled to target tissue. Processing circuit 622 will reads 0 volts on electrode E3. Because the voltage on electrode E3 is not in the range of VLOW to VHIGH, processing circuit 622 knows that electrode E3 does not electrically couples to target tissue.

[0187] Using a voltage to test connectivity may be used to test three or more launched electrodes. Two electrodes are used to apply the test voltage VLOW and VHIGH to target tissue and the remaining electrodes are tested to detect a voltage in the range of VLOW to VHIGH.

[0188] The test voltage VHIGH may be as high as 500 volts. The test voltage VLOW is generally non-zero, so that electrodes that do not electrically couple to the target may be detected by detecting a zero voltage on them. The electrodes that do not provide VHIGH and VLOW are coupled to a high impedance pull-down so that electrodes that do not electrically coupled to the target are pulled to zero volts. In another implementation VLOW = 1 volt and VHIGH = 10 volts.

[0189] In another implementation, the test voltage VHIGH is 12 volts and VLOW is one volt. Using a lower voltage (e.g., 1 – 20 volts) enables the test signal to be applied for a longer period of time (e.g., >100 ms) thereby providing more time for measuring the voltage induced in the other probes.

[0190] Processing circuit 622 may store the results of testing. For example, processing circuit 622 may store the results of testing in a memory. Processing circuit 622 may use test results, whether current or voltage tests results, to identify pairs of electrodes for providing the stimulus signal through the target. Processing circuit 622 may use the results of testing to drive the inputs of a selector circuit to provide a stimulus signal to a target. Processing circuit 622 may use the results of testing to select electrodes (e.g., an electrode pair) for providing a stimulus signal to a target.

[0191] Testing the connectivity of electrodes using a voltage may also be performed using the implementation of selector circuit 700. In various embodiments, Table 1800 of FIG. 18 shows how processing circuit 622 may control selector circuit 700 to steer test signals VHIGH/VLOW to test electrode connectivity. In particular, processing circuit 622 drives select inputs SelC1 and SelD1 to a logical 1 to steer signals VHIGH/VLOW to the outputs of selector circuit 700. As disclosed above, processing circuit 622 may provide the signals VLOW and VHIGH. Signals from processing circuit 622 may be level shifted to provide signals VLOW and VHIGH. Signals VLOW and VHIGH may be provided by a circuit that is separate from processing circuit 622.

[0192] Table 1800 includes columns 1102 – 1116 as discussed above with respect to Table 1100. Rows 1830 – 1826 show input signal values and the resulting output signal values. Not all combinations of inputs are shown in Table 1800. Rows 1830 – 1832 show how the voltages VHIGH and VLOW may be applied to electrodes to test electrode connectivity with voltage. Rows 1834 – 1836 show how test voltages VTP and VTN may be applied to electrodes to test electrode connectivity with a current.

[0193] Row 1830 shows the inputs values that result in electrode E0 being assigned VHIGH, electrode E3 being assigned VLOW, and nodes E1 – E2 being decoupled.

[0194] Assume that all electrodes E0 – E3 electrically couple to target tissue. As discussed above with respect to Table 1700, applying VHIGH to electrode E0 and VLOW to electrode E3 may induce a voltage on electrodes E1 – E2. Processing circuit 622 may detect a voltage on electrodes E1 – E2 by detecting the voltage at nodes s1 – s2 (e.g., outputs E1 – E2) in FIG. 7. The MUX's coupled to nodes s1 – s2 do not drive the nodes because they are disabled, so processing circuit 622 may detect the voltage induced on electrodes E1 – E2 by reading the voltage at nodes s1 – s2.

[0195] Nodes s0 – s3 may include a high impedance (e.g., > 1 megaohms, > 10 megaohms, > 100 megaohms) pull-down (not shown) so that electrodes that are not connected to a target are pulled to zero volts.

[0196] As discussed above, assume that VLOW is 10 volts and VHIGH is 100 volts. The tissue of a body is similar to a resistive load. The voltage difference between VHIGH and VLOW is dropped across the target tissue between the electrodes E0 and E3. If electrodes E1 – E2 are positioned in target tissue between or near electrodes E0 and E3, the voltage of target tissue at electrodes E1 – E2 will lie somewhere between VHIGH and VLOW. If the voltage detected at

nodes s1 – s2 lies in the range of VLOW to VHIGH, then the electrode coupled to that node, electrodes E1 – E2 respectively, is electrically coupled to target tissue. If processing circuit detects a voltage on nodes s1 – s2 that lies in the range of VLOW to VHIGH, then processing circuit 622 knows that that the corresponding electrode is electrically coupled to target tissue. If the voltage on node s1 or node s2 lies outside of the range of VLOW to VHIGH, most likely zero volts, then processing circuit 622 knows that the corresponding electrode is not electrically coupled to target tissue.

[0197] Any two electrodes may be assigned to provide the voltages VLOW and VHIGH respectively (e.g., refer to row 1832) and the other nodes may be tested for electrical connectivity to the target.

[0198] Processing circuit may also drive the inputs of selector circuit 700 to provide VTN and VTP to two electrodes to test the connectivity of the electrodes by discharge of capacitors as discussed above. Row 1834 of Table 1800 shows the input values for steering voltage VTP to electrode E2 and VTN to electrode E0 while row 1836 shows the input values for steering voltages VTP and VTN to electrodes E1 and E3 respectively.

[0199] Processing circuit 622 may store the results of testing with respect to selector circuit 700 (e.g., in a memory). Processing circuit 622 may use test results, whether a current test (e.g., VTP, VTN) or a voltage test (e.g., VHIGH, VLOW) to identify pairs of electrodes for providing the stimulus signal through the target.

[0200] Processing circuit 622 may use the results of testing to select electrodes for providing signals to target tissue. Processing circuit 622 may use the results of testing to determine a polarity assignment.

[0201] As an example, in accordance with various embodiments and with reference to FIG. 19A, a CEW 100 is depicted after deploying at least three electrodes (e.g., a first electrode E0, a second electrode E1, a third electrode E2) towards a target 5. As depicted, electrodes E0, E1, and E2 are all coupled to target 5. A pair of electrodes from electrodes E0, E1, E2 may be configured to provide a stimulus signal (e.g., via a signal generator of CEW 100) through target 5. Pairs of different electrodes from electrodes E0, E1, E2 may also be configured to provide alternating pulses of the stimulus signal through target 5. CEW 100 may alternate or change which electrode from a given pair of electrodes provides the negative potential and/or positive potential of a pulse of a stimulus signal.

[0202] For example, in accordance with various embodiments and with reference to FIGs. 19A and 19B, a Table 1900 depicts an exemplary provision of a negative potential ("-") and a positive potential ("+") during pulses of a stimulus signal. For example, CEW 100 may provide a first pulse (PULSE 1) of a stimulus signal through target 5 via first electrode E0 and second electrode E1. Third electrode E2 may be disconnected during the first pulse (e.g., decoupled from the signal generator so that third electrode E2 does not provide the first pulse of the stimulus signal through the target). During the first pulse, first electrode E0 may provide the negative potential of the first pulse and second electrode E1 may provide the positive potential of the first pulse.

[0203] CEW 100 may provide a second pulse (PULSE 2) of the stimulus signal through target 5 via second electrode E1 and third electrode E2. First electrode E0 may be disconnected during the second pulse (e.g., decoupled from the signal generator so that first electrode E0 does not provide the second pulse of the stimulus signal through the target). During the second pulse, second electrode E1 may provide the negative potential of the second pulse and third electrode E2 may provide the positive potential of the second pulse.

[0204] CEW 100 may provide a third pulse (PULSE 3) of the stimulus signal through target 5 via third electrode E2 and first electrode E0. Second electrode E1 may be disconnected during the third pulse (e.g., decoupled from the signal generator so that second electrode E2 does not provide the third pulse of the stimulus signal through the target). During the third pulse, third electrode E2 may provide the negative potential of the third pulse and first electrode E0 may provide the positive potential of the third pulse. In embodiments with additional electrodes coupled to target 5 (e.g., a fourth electrode), the third pulse may be provided via third electrode E2 and the fourth electrode. In that regard, during the third pulse, third electrode E2 may provide the negative potential of the third pulse and the fourth electrode may provide the positive potential of the third pulse, and first electrode E0 and second electrode E1 may be disconnected during the third pulse (e.g., decoupled from the signal generator so that first electrode E0 and second electrode E2 do not provide the third pulse of the stimulus signal through the target).

[0205] CEW 100 may continue to provide subsequent pulses (PULSE n) of the stimulus signal through target 5 via different pairs of electrodes accordingly.

[0206] In various embodiments, CEW 100 may provide repeated pulses of a stimulus signal without changing the accompanying potentials of one or more electrodes. For example, prior to providing the second pulse of the stimulus signal CEW 100 may provide a repeated pulse of the

stimulus signal through target 5 via first electrode E0 and second electrode E1. During the repeated pulse, first electrode E0 may still provide the negative potential of the repeated pulse and second electrode E1 may still provide the positive potential of the repeated pulse. In various embodiments, a repeated pulse may include a plurality of pulses of the stimulus signal.

[0207] In various embodiments, CEW 100 may determine a state of connection of one or more electrodes E0, E1, E2 before providing a pulse of the stimulus signal through an electrode E0, E1, E2. The state of connection may indicate whether an electrode E0, E1, E2 is electrically coupled to target 5. In response to the state of connection of an electrode being "not connected" (or a representation of not connected), CEW 100 may not provide the pulse of the stimulus signal through that electrode. In response to the state of connection of an electrode being "connected" (or a representation of connected), CEW 100 may select that electrode to provide the pulse of the stimulus signal.

[0208] As previously discussed herein, a signal generator, a selector circuit, and/or a processing circuit may be configured to control provision of the negative potential and the positive potential to electrodes during pulses of the stimulus signal. For example, a selector circuit may be configured to selectively provide the positive potential and the negative potential to the plurality of electrodes based on operation by the processing circuit. As a further example, a signal generator may comprise a first conductor and a second conductor. The first conductor may have a positive potential and the second conductor may have a negative potential. A selector circuit in electrical series between the signal generator and the electrodes E0, E1, E2 may be configured to selectively electrically couple any electrode from electrodes E0, E1, E2 to the first conductor or the second conductor of the signal generator. Selectively electrically coupling electrodes to the conductors may allow CEW 100 to change a polarity of an electrode during pulses of the stimulus signal.

[0209] A selector circuit may comprise one or more multiplexors, one or more relays, and/or one or more relays and an h-bridge. The one or more multiplexors, the one or more relays, and/or the one or more relays and the h-bridge may be configured to allow the selector circuit to selectively electrically couple the electrodes to the conductors, as discussed further herein.

[0210] In various embodiments, and as previously discussed herein, electrodes E0, E1, E2, etc. may be deployed from a single cartridge or one or more cartridges. For example, a housing of CEW 100 may define a bay. A plurality of cartridges may be insertable within the bay of the housing. Each cartridge of the plurality of cartridges may comprise one electrode from the

launched electrodes (e.g., a first cartridge comprises first electrode E0, a second cartridge comprises second electrode E1, etc.).

[0211] As another example, in accordance with various embodiments and with reference to FIG. 20A, a CEW 100 is depicted after deploying at least five electrodes (e.g., a first electrode E0, a second electrode E1, a third electrode E2, a fourth electrode E3, a fifth electrode E4) towards a target 5. As depicted, electrodes E0, E1, E2, E4 are coupled to target 5, and electrode E3 is not coupled to target 5 (e.g., a missed deployment). An electrode not coupled to a target is unable to provide a stimulus signal through the target. Testing electrical connectivity of launched electrodes may allow CEW 100 to determine a state of connection of each electrode and determine whether each electrode is able to provide a stimulus signal through the target. Testing electrical connectivity of launched electrodes may also allow CEW 100 to determine a relative distance between electrodes coupled to the target (e.g., dart spread, electrode spread, etc.). A greater distance between electrodes providing the stimulus signal may increase the likelihood of inducing NMI on the target.

[0212] CEW 100 (e.g., via a signal generator) may be configured to apply test signals on launched electrodes to test the electrical connectivity of the electrode. For example, CEW 100 may apply a first test signal (e.g., a first voltage) on a first electrode and a second test signal (e.g., a second voltage) on a second electrode. The first test signal may comprise a first voltage and the second test signal may comprise a second voltage different from the first voltage.

[0213] CEW 100 may detect a measurement voltage of each of the remaining electrodes to determine the state of connection of each of the remaining electrodes (wherein each of the remaining electrodes is not provided a test signal). The measurement voltage may inform the state of connection, as discussed further herein. For example, because each of the remaining electrodes coupled to the same target share electrical coupling with the first electrode (provided the first test signal) and/or the second electrode (provided the second test signal), the measurement voltage of a remaining electrode coupled to the target should be greater than 0 volts (e.g., a same voltage as the first test signal, a same voltage as the second test signal, a voltage between the first test signal and the second test signal, etc.). Because each of the remaining electrodes not coupled to the same target do not share electrical coupling with the first electrode (provided the first test signal) and the second electrode (provided the second test signal), the measurement voltage of a remaining electrode not coupled to the same target should be 0 volts (or close to 0 volts).

[0214] For example, a CEW may deploy at least three electrodes towards a target. The CEW may apply a first voltage to a first electrode of the at least three electrodes and a second voltage to a second electrode of the at least three electrodes. The first voltage may be greater than the second voltage. The CEW may detect (e.g., measure, receive, etc.) a measurement voltage at a remaining electrode from the at least three electrodes deployed towards the target.

[0215] The CEW may determine a state of connection based on the measurement voltage. For example, in response to the measurement voltage being 0 volts, the state of connection of the third electrode is "not connected" (or a representation of not connected) (e.g., the third electrode is not coupled to the target). In response to the measurement voltage being a value equal to the first voltage, equal to the second voltage, or between the first voltage and the second voltage, the state of connection of the third electrode is "connected" (or a representation of connected) (e.g., the third electrode is coupled to the target). In response to the measurement voltage being a value numerically closer to the first voltage than the second voltage, the third electrode may be coupled to the target at a location on the target closer to the first electrode than the second electrode (e.g., the first electrode is coupled at a first location, the second electrode is coupled at a second location, the third electrode is coupled at a third location, and the third location is closer to the first location than the second location). In response to the measurement voltage being a value numerically closer to the second voltage than the first voltage, the third electrode may be coupled to the target at a location on the target closer to the second electrode than the first electrode (e.g., the first electrode is coupled at a first location, the second electrode is coupled at a second location, the third electrode is coupled at a third location, and the third location is closer to the second location than the first location). In response to the measurement voltage being a value that is the same (or about the same) as the first voltage, the state of connection of the second electrode is "not connected" (or a representation of not connected) (e.g., the first electrode and the third electrode are coupled to the target, but the second electrode is not coupled to the target). In response to the measurement voltage being a value that is the same (or about the same) as the second voltage, the state of connection of the first electrode is "not connected" (or a representation of not connected) (e.g., the second electrode and the third electrode are coupled to the target, but the first electrode is not coupled to the target).

[0216] In various embodiments, a CEW may detect respective measurement voltages at multiple remaining electrodes at a same time. For example, the CEW may deploy at least four

electrodes towards a target. The CEW may apply a first voltage of a test signal to a first electrode of the at least four electrodes and a second voltage of a second test signal to a second electrode of the at least four electrodes. The first voltage may be greater than the second voltage. The first voltage may be applied across the different first and second electrodes at a same time. In accordance with the test signals, the CEW may concurrently detect a first measurement voltage at a third electrode from the at least four electrodes and a second measurement voltage at a fourth electrode from the at least four electrodes. Accordingly, a plurality of measurement voltages may be determined for a plurality of electrodes in accordance with a same one or more test signals (e.g., same test signal or pair of test signals, etc.).

[0217] The CEW may determine an electrode spread between electrodes based on the state of connection and/or the measurement voltage. For example, and as previously discussed, in response to the measurement voltage being a value numerically closer to the first voltage than the second voltage, the third electrode may be coupled to the target at a location on the target closer to the first electrode than the second electrode (e.g., the first electrode is coupled at a first location, the second electrode is coupled at a second location, the third electrode is coupled at a third location, and the third location is closer to the first location than the second location). Because the third electrode is closer to the first electrode than the second electrode, a relative electrode spread between the three electrodes can be determined (e.g., a first electrode spread between the first electrode and the second electrode is greater than a second electrode spread between the first electrode and the third electrode). As can be extrapolated by one skilled in the art, additional tests, measurement voltages, and states of connection may further determine and refine locations of the electrodes on the target, and the relative electrode spread between electrodes on the target.

[0218] As discussed, the first voltage and the second voltage applied as test signals may comprise different values. For example, the first voltage may be greater than the second voltage, or the second voltage may be greater than the first voltage. The first voltage and the second voltage may each comprise low voltages. The first voltage and the second voltage may each be less than 50 volts. For example, the first voltage (or the second voltage) may be less than 5 volts and the second voltage (or the first voltage) may be greater than 10 volts. In some embodiments, the first voltage (or the second voltage) may be 3 volts and the second voltage (or the first voltage) may be 12 volts. In embodiments, a voltage difference between the first voltage and the second voltage may be one or more of less than ten volts, less than twenty volts, less than thirty volts, less than

fifty volts, or less than one hundred volts. The voltage difference may comprise a difference of an absolute value of the first voltage and an absolute value of the second voltage.

[0219] In various embodiments, one or more measurement voltages and/or states of connection may be stored in memory of the CEW by a processing circuit. Storing the one or more measurement voltages and/or the states of connection in memory may allow CEW to further use the collected data for reporting, testing, or other processes or uses.

[0220] In accordance with various embodiments and with reference to FIGs. 20A and 20B, a Table 2000 depicts an exemplary application of a first test signal ("FIRST V") and a second test signal ("SECOND V") during a plurality of example tests. In Table 2000 use of the tilde identifier "~" may represent that the measurement voltage is close to, or closer to, a first test signal (e.g., ~FIRST V) than a second test signal, or that the measurement voltage is close to, or closer to, a second test signal (e.g., ~SECOND V) than a first test signal (wherein "closer to" as used in either context refers to a measured value being closer to a given value compared to a second value). In Table 2000 use of a bolded font may indicate the test signals applied during a given test (e.g., in TEST 1, FIRST V under electrode E0 and SECOND V under electrode E2 are bolded).

[0221] For example, CEW 100 may perform a first test (TEST 1) on the launched electrodes E0, E1, E2, E3, E4 by applying a first test signal (FIRST V) to first electrode E0 and a second test signal (SECOND V) to third electrode E2. During the first test, CEW 100 may detect a measurement voltage at second electrode E1, fourth electrode E3, and fifth electrode E4. As depicted in FIG. 20A, second electrode E01 is closer in location to first electrode E0 than to third electrode E2, so the detected measurement voltage should comprise a value closer to the first test signal than the second test signal (e.g., ~FIRST V); fourth electrode E3 is not coupled to target 5, so the detected measurement voltage is 0 volts (or close to 0 volts); and fifth electrode E4 is closer in location to third electrode E2 than to first electrode E0, so the detected measurement voltage should comprise a value closer to the second test signal than the first test signal (e.g., ~SECOND V).

[0222] The results (e.g., states of connection) of TEST 1 would indicate that electrodes E0, E1, E2, and E4 are electrically coupled to target 5, and fourth electrode E3 is not electrically coupled to target 5 (e.g., a state of connection of "not connected"). Further, CEW 100 may determine a relative electrode spread between the electrodes (e.g., electrode E0 has the greatest electrode spread with electrode E2 or E4, and electrode E2 has the greatest electrode spread with electrode

E0 or E1).

[0223] For example, CEW 100 may perform a second test (TEST 2) on the launched electrodes E0, E1, E2, E3, E4 by applying a first test signal (FIRST V) to second electrode E1 and a second test signal (SECOND V) to fifth electrode E4. During the second test, CEW 100 may detect a measurement voltage at first electrode E0, third electrode E2, and fourth electrode E3. As depicted in FIG. 20A, first electrode E0 is closer in location to second electrode E1 than to fifth electrode E4, so the detected measurement voltage should comprise a value closer to (or the same as) the first test signal than the second test signal (e.g., ~FIRST V); third electrode E2 is closer in location to fifth electrode E4 than to second electrode E1, so the detected measurement voltage should comprise a value closer to (or the same as) the second test signal than the first test signal (e.g., ~SECOND V); and fourth electrode E3 is not coupled to target 5, so the detected measurement voltage is 0 volts (or close to 0 volts).

[0224] The results (e.g., states of connection) of TEST 2 would indicate that electrodes E0, E1, E2, and E4 are electrically coupled to target 5, and fourth electrode E3 is not electrically coupled to target 5 (e.g., a state of connection of "not connected"). Further, CEW 100 may determine a relative electrode spread between the electrodes (e.g., electrode E1 has the greatest electrode spread with electrode E2 or E4, and electrode E4 has the greatest electrode spread with electrode E0 or E1).

[0225] For example, CEW 100 may perform a third test (TEST 3) on the launched electrodes E0, E1, E2, E3, E4 by applying a first test signal (FIRST V) to third electrode E2 and a second test signal (SECOND V) to fifth electrode E4. During the third test, CEW 100 may detect a measurement voltage at first electrode E0, second electrode E1, and fourth electrode E3. As depicted in FIG. 20A, first electrode E0 is closer in location to fifth electrode E4 than to third electrode E2, so the detected measurement voltage should comprise a value closer to (or the same as) the second test signal than the first test signal (e.g., ~SECOND V); second electrode E1 is closer in location to fifth electrode E4 than to third electrode E2, so the detected measurement voltage should comprise a value closer to (or the same as) the second test signal than the first test signal (e.g., ~SECOND V); and fourth electrode E3 is not coupled to target 5, so the detected measurement voltage is 0 volts (or close to 0 volts).

[0226] The results (e.g., states of connection) of TEST 3 would indicate that electrodes E0, E1, E2, and E4 are electrically coupled to target 5, and fourth electrode E3 is not electrically coupled

to target 5 (e.g., a state of connection of "not connected"). Further, CEW 100 may determine a relative electrode spread between the electrodes (e.g., electrode E2 has the greatest electrode spread with one of electrodes E0, E1, or E2).

[0227] For example, CEW 100 may perform a fourth test (TEST 4) on the launched electrodes E0, E1, E2, E3, E4 by applying a first test signal (FIRST V) to fourth electrode E3 and a second test signal (SECOND V) to second electrode E1. During the fourth test, CEW 100 may detect a measurement voltage at first electrode E0, third electrode E2, and fifth electrode E4. As depicted in FIG. 20A, first electrode E0 is electrically coupled to second electrode E1 (via target 5) and fourth electrode E3 is not coupled to target 5, so the detected measurement voltage should comprise a value that is the same (or close to the same) as the second test signal (e.g., SECOND V); third electrode E2 is electrically coupled to second electrode E1 (via target 5) and fourth electrode E3 is not coupled to target 5, so the detected measurement voltage should comprise a value that is the same (or close to the same) as the second test signal (e.g., SECOND V); and fifth electrode E4 is electrically coupled to second electrode E1 (via target 5) and fourth electrode E3 is not coupled to target 5, so the detected measurement voltage should comprise a value that is the same (or close to the same) as the second test signal (e.g., SECOND V).

[0228] The results (e.g., states of connection) of TEST 4 would indicate that electrodes E0, E1, E2, and E4 are electrically coupled to target 5, and fourth electrode E3 is not electrically coupled to target 5 (e.g., a state of connection of "not connected").

[0229] In various embodiments, a CEW may perform tests by applying test signals in any desired or structured order, and may perform as many tests as desired or necessary to test each launched electrode.

[0230] In various embodiments, a CEW may perform tests between pulses of a stimulus signal, between deployment of additional electrodes, and/or at any other time as desired. For example, a CEW may apply a first test signal and a second test signal to determine a first state of connection of launched electrodes (e.g., as previously discussed). After applying the first test signal and the second test signal, the CEW may provide a first pulse of a stimulus signal through a first pair of launched electrodes. The CEW may then apply a third test signal and a fourth test signal to determine a second state of connection of launched electrodes (e.g., as previously discussed). After applying the third test signal and the fourth test signal, the CEW may provide a second pulse of the stimulus signal through a second pair of launched electrodes. The second pair of launched

electrodes may be the same as the first pair of launched electrodes. The second pair of launched electrodes may be different from the first pair of launched electrodes (e.g., completely different, at least one electrode of the pair different, etc.). The first pair of launched electrodes may be based on the first state of connection (e.g., the first pair may include two electrodes coupled to the target, based on a determined electrode spread, etc.). The second pair of launched electrodes may be based on the second state of connection and/or the first state of connection (e.g., the first pair may include two electrodes coupled to the target, based on a determined electrode spread, etc.).

[0231] Embodiments according to various aspects of the present disclosure may include a conducted electrical weapon ("CEW") for providing a stimulus signal through a human or animal target for impeding locomotion of the target. The CEW may comprise at least three wire-tethered electrodes, the at least three electrodes configured to be launched toward the target to deliver the stimulus signal through the target. The CEW may further comprise a processing circuit configured to assign a first polarity assignment to a first electrode and a second electrode from the at least three electrodes. The CEW may further comprise a signal generator configured to provide the stimulus signal as a voltage potential across a first conductor and a second conductor of the signal generator, the first conductor having a positive polarity and the second conductor having a negative polarity. The CEW may further comprise a selector circuit electrically coupled to the first conductor and the second conductor and electrically coupled to the at least three electrodes via their respective wire-tethers wherein in accordance with the first polarity assignment, the selector circuit is configured to electrically couple the first electrode and second electrode to the first conductor and the second conductor respectively to deliver the stimulus signal through the target, whereby the first electrode is assigned the positive polarity and the second electrode is assigned the negative polarity. In embodiments, the processing circuit is configured to assign a second polarity assignment to the first electrode and the second electrode and responsive to the processing circuit assigning the second polarity assignment, the selector circuit is configured to electrically couple the first electrode and second electrode to the second conductor and the first conductor respectively whereby the first electrode is assigned the negative polarity and the second electrode is assigned the positive polarity. In embodiments, the selector circuit comprises a plurality of multiplexers; the processing circuit is configured to provide one or more select signals to the plurality of multiplexers; and in accordance with the one or more select signals, the selector circuit is configured to electrically couple the first electrode and the second electrode to the first conductor

and the second conductor respectively whereby the first electrode is assigned the positive polarity and the second electrode is assigned the negative polarity. In embodiments, the processing circuit is configured to change a value of the one or more select signals; and responsive to the change, the selector circuit is configured to electrically couple the first electrode and the second electrode to the second conductor and the first conductor respectively whereby the first electrode is assigned the negative polarity and the second electrode is assigned the positive polarity. In embodiments, the selector circuit comprises a plurality of relays; the processing circuit is configured to provide one or more select signals to the plurality of relays; and in accordance with the one or more select signals, the selector circuit is configured to electrically couple the first electrode and the second electrode to the first conductor and the second conductor respectively whereby the first electrode is assigned the positive polarity and the second electrode is assigned the negative polarity. In embodiments, the processing circuit is configured to change a value of the one or more select signals; and responsive to the change, the selector circuit is configured to electrically couple the first electrode and the second electrode to the second conductor and the first conductor respectively whereby the first electrode is assigned the negative polarity and the second electrode is assigned the positive polarity. In embodiments, the selector circuit comprises a plurality of relays and an h-bridge; the h-bridge is electrically coupled to the first conductor and the second conductor of the signal generator; the processing circuit is configured to provide a first select signal to the plurality of relays to select the first electrode and the second electrode; and the processing circuit is configured to provide a second select signal to the h-bridge to electrically couple the first electrode to the first conductor and the second electrode to the second conductor whereby the first electrode is assigned the positive polarity and the second electrode is assigned the negative polarity. In the above embodiment, the processing circuit may be configured to change a value of the second select signal to electrically couple the first electrode to the second conductor and the second electrode to the first conductor whereby the first electrode is assigned the negative polarity and the second electrode is assigned the positive polarity. In embodiments, the processing circuit is configured to select the first electrode and the second electrode from the at least three electrodes in accordance with testing an electrical connectivity of the at least three electrodes to the target. In embodiments, the processor circuit is configured to assign the first polarity assignment to a third electrode of the at least three electrodes and the selector circuit is configured to electrically couple the third electrode to one of the first conductor and the second conductor in accordance with the first polarity

assignment. In embodiments, the selector circuit is configured to concurrently electrically couple the first electrode and second electrodes to the first conductor and the second conductors to provide the stimulus signal in accordance with the first polarity assignment.

[0232] Embodiments according to various aspects of the present disclosure may include a method performed by a CEW selectively adjusting a signal applied to a same electrode. The method may comprise electrically coupling a first electrode of a plurality of electrodes to a first voltage provided by a signal generator; providing a first pulse of the signal via the plurality of electrodes in accordance with the first voltage; electrically coupling the first electrode to a second voltage provided by the signal generator; and providing a second pulse of the signal in accordance with the second voltage, wherein the first voltage is different from the second voltage. In embodiments, the first voltage may comprise a positive voltage and the second voltage may comprise negative voltage. In embodiments, the first pulse may comprise a pulse of a test signal and the second pulse may comprise a pulse of a stimulus signal. In embodiments, the second pulse may be provided in sequence after the second pulse. Coupling the first electrode to the first voltage may comprise coupling the first electrode to a first conductor of the signal generator and coupling the first electrode to the second voltage may comprise coupling the first electrode to a second conductor of the signal generator. Coupling the first electrode to the first voltage may comprise electrically coupling a third voltage to a second electrode of the plurality of electrodes. Providing the first pulse may comprise providing the first pulse in accordance with the first voltage and the third voltage. Coupling the first electrode to the second voltage may comprise coupling a fourth voltage to a third electrode of the plurality of electrodes. Providing the second pulse may comprise providing the second pulse in accordance with the second voltage and the fourth voltage. The third voltage may equal the second voltage. The fourth voltage may equal the first voltage. The second electrode may be same or different from the third electrode. The first voltage may be non-zero. The second voltage may be non-zero. The first voltage and the second may comprise a same polarity and different magnitudes. In embodiments, a magnitude of the second pulse may be higher than a magnitude of the first pulse.

[0233] Embodiments according to various aspects of the present disclosure may include a conducted electrical weapon ("CEW"). The CEW may be configured to provide a stimulus signal through a human or animal target, the stimulus signal for impeding locomotion of the target. The CEW may comprise a processing circuit, a signal generator, a selector circuit, and at least three

wire-tethered electrodes. The signal generator may provide the stimulus signal as a voltage potential across a first conductor and a second conductor of the signal generator, the first conductor having a positive polarity and the second conductor having a negative polarity. The selector circuit may be electrically coupled to the first conductor and the second conductor. The at least three electrodes may be configured to be launched toward the target to deliver the stimulus signal through the target, the at least three electrodes electrically coupled to the selector circuit via their respective wire-tethers. The processing circuit may select a first electrode and a second electrode from the at least three electrodes to deliver the stimulus signal through the target. The processing circuit may assign a first polarity assignment to the first electrode and the second electrode. In accordance with the first polarity assignment, the selector circuit electrically couples the first electrode and second electrode to the first conductor and the second conductor respectively whereby the first electrode is assigned the positive polarity and the second electrode is assigned the negative polarity. The signal generator is may be configured to provide the stimulus signal through the target via the first electrode and the second electrode.

[0234] In various implementations of the above embodiments, the processing circuit assigns a second polarity assignment to the first electrode and the second electrode; and responsive to the processing circuit assigning the second polarity assignment, the selector circuit electrically couples the first electrode and second electrode to the second conductor and the first conductor respectively whereby the first electrode is assigned the negative polarity and the second electrode is assigned the positive polarity. The selector circuit comprises a plurality of multiplexers; the processing circuit provides one or more select signals to the plurality of multiplexers; and in accordance with the one or more select signals, the selector circuit electrically couples the first electrode and the second electrode to the first conductor and the second conductor respectively whereby the first electrode is assigned the positive polarity and the second electrode is assigned the negative polarity. The processing circuit changes a value of the one or more select signals; and responsive to the change, the selector circuit electrically couples the first electrode and the second electrode to the second conductor and the first conductor respectively whereby the first electrode is assigned the negative polarity and the second electrode is assigned the positive polarity. The selector circuit comprises a plurality of relays; the processing circuit provides one or more select signals to the plurality of relays; and in accordance with the one or more select signals, the selector circuit electrically couples the first electrode and the second electrode to the first conductor and the second

conductor respectively whereby the first electrode is assigned the positive polarity and the second electrode is assigned the negative polarity. The processing circuit changes a value of the one or more select signals; and responsive to the change, the selector circuit electrically couples the first electrode and the second electrode to the second conductor and the first conductor respectively whereby the first electrode is assigned the negative polarity and the second electrode is assigned the positive polarity. The selector circuit comprises a plurality of relays and an h-bridge; the h-bridge electrically couples to the first conductor and the second conductor of the signal generator; the processing circuit provides a first select signal to the plurality of relays to select the first electrode and the second electrode; and the processing circuit provides a second select signal to the h-bridge to electrically couple the first electrode to the first conductor and the second electrode to the second conductor whereby the first electrode is assigned the positive polarity and the second electrode is assigned the negative polarity. The processing circuit changes a value of the second select signal to electrically couple the first electrode to the second conductor and the second electrode to the first conductor whereby the first electrode is assigned the negative polarity and the second electrode is assigned the positive polarity. The processing circuit selects the first electrode and the second electrode from the at least three electrodes in accordance with testing an electrical connectivity of the at least three electrodes to the target.

[0235] Embodiments according to various aspects of the present disclosure may include a method performed by a conducted electrical weapon ("CEW"). The CEW may be configured to provide a stimulus signal through a human or animal target, the stimulus signal for impeding locomotion of the target. The method may include the steps of: selecting a first electrode and a second electrode from a group of at least three wire-tethered electrodes, the at least three electrodes launched toward the target to deliver the stimulus signal through the target to impede locomotion of the target; assigning a first polarity assignment to the first electrode and the second electrode; responsive to the first polarity assignment, electrically coupling the first electrode and the second electrode to a first conductor and a second conductor respectively of a signal generator, the signal generator provides the stimulus signal as a voltage potential across the first conductor and the second conductor, the first conductor having the positive polarity and the second conductor having the negative polarity whereby the first electrode is assigned the positive polarity and the second electrode is assigned the negative polarity; and responsive to electrically coupling the first electrode and the second electrode to the first conductor and the second conductor, the signal

generator provides the stimulus signal through the target via the first electrode and the second electrode.

[0236] In various implementations of the above embodiments, the method may also comprise the step of assigning a second polarity assignment to the first electrode and the second electrode, wherein: responsive to the second polarity assignment: electrically coupling the first electrode to the second conductor whereby the first electrode is assigned the negative polarity; and electrically coupling the second electrode to the first conductor whereby the second electrode is assigned the positive polarity. The method may also comprise the step of assigning a second polarity assignment to the first electrode and the second electrode, wherein: responsive to the second polarity assignment: changing a value of a select signal to an h-bridge, the h-bridge electrically coupled to the first conductor and the second conductor; and responsive to changing the value, the h-bridge electrically couples the first electrode and the second electrode to the second conductor and the first conductor respectively whereby the first electrode is assigned the negative polarity and the second electrode is assigned the positive polarity. The step of selecting the first electrode and the second electrode may comprise: providing one or more select signals to a plurality of multiplexers; and an output of one multiplexer of the plurality electrically couples to a wire-tether of one electrode of the at least three wire-tethered electrodes respectively. The step of electrically coupling the first electrode and the second electrode to the first conductor and the second conductor may comprise providing one or more select signals to one or more multiplexers to electrically couple the first electrode to the first conductor and the second electrode to the second conductor whereby the first electrode is assigned the positive polarity and the second electrode is assigned the negative polarity. The step of electrically coupling the first electrode and the second electrode to the first conductor and the second conductor may comprise providing one or more select signals to one or more relays to electrically couple the first electrode to the second conductor and the second electrode to the first conductor whereby the first electrode is assigned the negative polarity and the second electrode is assigned the positive polarity.

[0237] Embodiments according to various aspects of the present disclosure may include a conducted electrical weapon ("CEW"). The CEW may be configured to provide a stimulus signal through a human or animal target, the stimulus signal for impeding locomotion of the target. The CEW may comprise a processing circuit, a signal generator, a selector circuit, at least two wire-tethered electrodes, and a computer-readable memory (e.g., a non-transitory, computer-readable

memory). The signal generator provides the stimulus signal as a voltage potential across a first conductor and a second conductor of the signal generator, the first conductor having a positive polarity and the second conductor having a negative polarity; The selector circuit electrically couples to the first conductor and the second conductor; The at least two electrodes are configured to be launched toward the target to deliver the stimulus signal through the target, the at least two electrodes electrically coupled to the selector circuit via their respective wire-tethers. The computer-readable medium comprises instructions embodied thereon, wherein the instructions, in response to execution by the processing circuit, cause the processing circuit to: select a first electrode and a second electrode from the at least two electrodes to deliver the stimulus signal through the target; assign a first polarity assignment to the first electrode and the second electrode; in accordance with the first polarity assignment, provide at least one select signal to the selector circuit, the at least one select signal electrically couples the first electrode and the second electrode to the first conductor and the second conductor respectively whereby the first electrode is assigned the positive polarity and the second electrode is assigned the negative polarity; and activate the signal generator to provide the stimulus signal through the target via the first electrode and the second electrode for impeding locomotion of the target.

[0238] In various implementations of the above embodiments, the processing circuit may further assign a second polarity assignment to the first electrode and the second electrode; and responsive to the second polarity, change a value of the at least one select signal to the selector circuit to electrically couple the first electrode and the second electrode to the second conductor and the first conductor respectively whereby the first electrode is assigned the negative polarity and the second electrode is assigned the positive polarity. The selector circuit may comprise at least one multiplexer; and the at least one select signal may drive a select input of the at least one multiplexer to electrically couple the first electrode and the second electrode to the first conductor and the second conductor in accordance with the first polarity assignment and the second polarity assignment. The selector circuit may comprise at least one relay; and the at least one select signal may drive a select input of the at least one relay to electrically couple the first electrode and the second electrode to the first conductor and the second conductor in accordance with the first polarity assignment and the second polarity assignment. The processing circuit may further test an electrical connectivity of the at least two electrodes; and assign at least one of the first polarity assignment and the second polarity assignment after testing the electrical connectivity of the at

least two electrodes.

[0239] Embodiments according to various aspects of the present disclosure may include a conducted electrical weapon. The conducted electrical weapon may comprise a signal generator, a plurality of electrodes, and a selector circuit. The signal generator may comprise a first conductor and a second conductor, wherein the signal generator is configured to provide a stimulus signal through the first conductor and the second conductor, and wherein the first conductor has a positive potential and the second conductor has a negative potential. The plurality of electrodes may be configured to deliver the stimulus signal through a target. The selector circuit may be in electrical series between the signal generator and the plurality of electrodes, wherein the selector circuit is configured to selectively electrically couple an electrode from the plurality of electrodes to the first conductor or the second conductor of the signal generator.

[0240] In various implementations of the above embodiments, the conducted electrical weapon may further comprise a processing circuit in communication with the selector circuit, wherein the processing circuit is configured to select a first electrode and a second electrode from the plurality of electrodes to deliver the stimulus signal through the target. The processing circuit may be configured to assign a first polarity assignment to the first electrode and the second electrode, and wherein in accordance with the first polarity assignment, the selector circuit electrically couples the first electrode to the first conductor and the second electrode to the second conductor. The processing circuit may be configured to assign a second polarity assignment to the first electrode and the second electrode, and wherein in accordance with the second polarity assignment, the selector circuit electrically couples the first electrode to the second conductor and the second electrode to the first conductor. The selector circuit may comprise a plurality of multiplexers, the processing circuit may provide one or more select signals to the plurality of multiplexers, and in accordance with the one or more select signals, the selector circuit may electrically couple the first electrode to the first conductor and the second electrode to the second conductor. The processing circuit may provide one or more second select signals to the plurality of multiplexers, the one or more second select signals may have a different value than the one or more select signals, and in accordance with the one or more second select signals, the selector circuit may electrically couple the first electrode to the second conductor and the second electrode to the first conductor. The processing circuit may provide the one or more select signals to the plurality of multiplexors prior to the signal generator providing a first pulse of the stimulus signal, and the processing circuit may

provide the one or more second select signals to the plurality of multiplexors prior to the signal generator providing a second pulse of the stimulus signal. The selector circuit may comprise a plurality of relays, the processing circuit may provide one or more select signals to the plurality of relays, and in accordance with the one or more select signals, the selector circuit may electrically couple the first electrode to the first conductor and the second electrode to the second conductor. The processing circuit may provide one or more second select signals to the plurality of relays, the one or more second select signals may have a different value than the one or more select signals, and in accordance with the one or more second select signals, the selector circuit may electrically couple the first electrode to the second conductor and the second electrode to the first conductor. The processing circuit may provide the one or more select signals to the plurality of relays prior to the signal generator providing a first pulse of the stimulus signal, and the processing circuit may provide the one or more second select signals to the plurality of relays prior to the signal generator providing a second pulse of the stimulus signal. The selector circuit may comprise a plurality of relays and an h-bridge, the h-bridge may electrically couple to the first conductor and the second conductor of the signal generator, the processing circuit may provide a first select signal to the plurality of relays to select the first electrode and the second electrode for providing the stimulus signal through the target, and the processing circuit may provide a second select signal to the h-bridge to electrically couple the first electrode to the first conductor and the second electrode to the second conductor. The processing circuit may provide a third select signal to the h-bridge, the third select signal may have a different value than the second select signal, and in accordance with the third select signal, the h-bridge may electrically couple the first electrode to the second conductor and the second electrode to the first conductor. The processing circuit may select the first electrode and the second electrode from the plurality of electrodes in accordance with testing an electrical connectivity of deployed electrodes from the plurality of electrodes to the target. The selector circuit may be integrated into the signal generator.

[0241] Embodiments according to various aspects of the present disclosure may include a method performed by a conducted electrical weapon ("CEW") for providing a stimulus signal through a target. The method may include steps comprising: selecting a first electrode and a second electrode from a group of a plurality of electrodes, the plurality of electrodes launched toward the target to deliver the stimulus signal through the target; electrically coupling the first electrode to a first conductor of a signal generator, wherein the first conductor has a positive polarity; electrically

coupling the second electrode to a second conductor of the signal generator, wherein the second conductor has a negative polarity, and wherein the signal generator provides the stimulus signal as a voltage potential across the first conductor and the second conductor; and providing, via the signal generator, the stimulus signal through the target via the first electrode and the second electrode.

[0242] In various implementations of the above embodiments, the method may include steps further comprising: electrically coupling the first electrode to the second conductor; electrically coupling the second electrode to the first conductor; and providing, via the signal generator, the stimulus signal through the target via the first electrode and the second electrode. Electrically coupling the first electrode to the first conductor and electrically coupling the second electrode to the second conductor may comprise: providing a first select signal to a selector circuit in communication with the signal generator, wherein based on the first select signal the selector circuit electrically couples the first electrode to the first conductor and the second electrode to the second conductor. The method may include steps further comprising: providing a second select signal to the selector circuit, wherein the second select signal is different from the first select signal; electrically coupling, via the selector circuit, the first electrode to the second conductor; and electrically coupling, via the selector circuit, the second electrode to the first conductor. Electrically coupling the first electrode to the first conductor and electrically coupling the second electrode to the second conductor may comprise: providing one or more select signals to one or more multiplexers to electrically couple the first electrode to the first conductor and the second electrode to the second conductor. Electrically coupling the first electrode to the first conductor and electrically coupling the second electrode to the second conductor may comprise: providing one or more select signals to one or more relays to electrically couple the first electrode to the first conductor and the second electrode to the second conductor.

[0243] Embodiments according to various aspects of the present disclosure may include a conducted electrical weapon. The conducted electrical weapon may comprise a processing circuit, a signal generator, a selector circuit, at least three electrodes, and a tangible, non-transitory memory. The signal generator may be configured to provide a stimulus signal as a voltage potential across a first conductor and a second conductor of the signal generator, the first conductor having a positive polarity and the second conductor having a negative polarity. The elector circuit may be electrically coupled to the first conductor and the second conductor of the stimulus generator. The

at least three electrodes may be electrically coupled to the selector circuit, wherein the at least three electrodes are configured to be launched toward a target to deliver the stimulus signal through the target. The tangible, non-transitory memory may be in electronic communication with the processing circuit. The tangible, non-transitory memory may have instructions stored thereon that, in response to execution by the processing circuit, cause the processing circuit to perform operations comprising: launching the at least three electrodes towards the target, selecting a first electrode and a second electrode from the at least three electrodes to deliver the stimulus signal through the target, providing a first select signal to the selector circuit, wherein based on the first select signal the selector circuit is configured to electrically couple the first electrode to the first conductor and the second electrode to the second conductor, and activating the signal generator to provide the stimulus signal through the target via the first electrode and the second electrode.

[0244] In various implementations of the above embodiments, the processing circuit may be configured to perform operations further comprising: providing a second select signal to the selector circuit, wherein based on the second select signal the selector circuit is configured to electrically couple the first electrode to the second conductor and the second electrode to the first conductor. The processing circuit may be configured to perform operations further comprising: selecting the first electrode and a third electrode from the at least three electrodes to deliver the stimulus signal through the target. The processing circuit may be configured to perform operations further comprising: providing a second select signal to the selector circuit, wherein based on the second select signal the selector circuit is configured to electrically couple the first electrode to the second conductor and the third electrode to the first conductor, and activating the signal generator to provide the stimulus signal through the target via the first electrode and the third electrode. The selector circuit may comprise a multiplexer, and the first select signal may drive a select input of the multiplexer to electrically couple the first electrode to the first conductor and the second electrode to the second conductor. The selector circuit may comprise a relay, and the first select signal may drive a select input of the relay to electrically couple the first electrode to the first conductor and the second electrode to the second conductor. The selector circuit may comprise a plurality of relays and an h-bridge, the h-bridge electrically may couple to the first conductor and the second conductor of the signal generator, and the first select signal may drive a select input of the h-bridge to electrically couple the first electrode to the first conductor and the second electrode to the second conductor. The processing circuit may be configured to perform operations further

comprising: testing an electrical connectivity of the at least three electrodes with the target, and selecting the first electrode and the second electrode to deliver the stimulus signal through the target based on testing the electrical connectivity.

[0245] Embodiments according to various aspects of the present disclosure may include a method. The method may comprise the steps of: providing, by a conducted electrical weapon, a first pulse of a stimulus signal through a target via a first electrode and a second electrode of at least three electrodes coupled to the target, wherein the first electrode provides a positive potential of the first pulse and the second electrode provides a negative potential of the first pulse; and providing, by the conducted electrical weapon, a second pulse of the stimulus signal through the target via the first electrode and a third electrode of the at least three electrodes, wherein the first electrode provides a negative potential of the second pulse and the third electrode provides a positive potential of the second pulse.

[0246] In various implementations of the above embodiments, the method may include steps further comprising providing, by the conducted electrical weapon, a third pulse of the stimulus signal through the target via the second electrode and the third electrode, wherein the third electrode provides a negative potential of the third pulse and the second electrode provides a positive potential of the third pulse. Providing the second pulse may comprise electrically decoupling, by the processing circuit, the first electrode from the signal generator. The method may include steps further comprising providing, by the conducted electrical weapon, a third pulse of the stimulus signal through the target via the third electrode and a fourth electrode of the at least three electrodes, wherein the third electrode provides a negative potential of the third pulse and the fourth electrode provides a positive potential of the third pulse. Providing the third pulse may comprise electrically decoupling, by the processing circuit, the first electrode and the second electrode from the signal generator. The method may include steps further comprising providing, by the conducted electrical weapon and prior to providing the second pulse of the stimulus signal, a repeated pulse of the stimulus signal through the target via the first electrode and the second electrode. The first electrode may provide a positive potential of the repeated pulse and the second electrode provides a negative potential of the repeated pulse. Providing the repeated pulse of the stimulus signal may comprise providing a plurality of pulses of the stimulus signal.

[0247] Embodiments according to various aspects of the present disclosure may include a conducted electrical weapon. The conducted electrical weapon may comprise a plurality of

electrodes, a signal generator, and a processing circuit. The plurality of electrodes may be configured to be deployed towards a target. The signal generator may be configured to provide a stimulus signal through the target via the plurality of electrodes. The processing circuit may be in communication with the signal generator. The processing circuit may be configured to perform operations comprising: deploying the plurality of electrodes towards the target; providing, via the signal generator, a first pulse of the stimulus signal through the target via a first electrode and a second electrode of the plurality of electrodes, wherein the first electrode provides a positive potential of the first pulse and the second electrode provides a negative potential of the first pulse; and providing, via the signal generator, a second pulse of the stimulus signal through the target via the first electrode and a third electrode of the plurality of electrodes, wherein the first electrode provides a negative potential of the second pulse and the third electrode provides a positive potential of the second pulse.

[0248] In various implementations of the above embodiments, the processing circuit may be configured to perform operations further comprising: providing, via the signal generator, a third pulse of the stimulus signal through the target via the second electrode and the third electrode, wherein the third electrode provides a negative potential of the third pulse and the second electrode provides a positive potential of the third pulse. The conducted electrical weapon may further comprise a selector circuit configured to selectively provide the positive potential and the negative potential to the plurality of electrodes. Providing the second pulse may comprise electrically decoupling, by the processing circuit, the first electrode from the signal generator. The conducted electrical weapon may further comprise a housing defining a bay; and a plurality of cartridges insertable within the bay of the housing, wherein each cartridge of the plurality of cartridges comprises one electrode from the plurality of electrodes.

[0249] Embodiments according to various aspects of the present disclosure may include a method. The method may include steps comprising: deploying, by a conducted electrical weapon, at least three electrodes towards a target; providing, by the conducted electrical weapon, a first pulse of a stimulus signal through the target via a first electrode and a second electrode of the at least three electrodes, wherein during the first pulse of the stimulus signal a first polarity of the first electrode is positive and a second polarity of the second electrode is negative; and providing, by the conducted electrical weapon, a second pulse of the stimulus signal through the target via the first electrode and a third electrode of the at least three electrodes, wherein during the second

pulse of the stimulus signal the first polarity of the first electrode is negative and a third polarity of the third electrode is positive.

[0250] In various implementations of the above embodiments, the method may include steps further comprising determining, by the conducted electrical weapon, whether each electrode from the at least three electrodes is coupled to the target, wherein the stimulus signal is provided through the target via a pair of electrodes from the at least three electrodes that are coupled to the target. Determining whether each electrode from the at least three electrodes is coupled to the target may occur prior to at least one of providing the first pulse of the stimulus signal through the target and providing the second pulse of the stimulus signal through the target. The method may include steps further comprising providing, by the conducted electrical weapon, a third pulse of the stimulus signal through the target via the second electrode and the third electrode, wherein during the third pulse of the stimulus signal the second polarity of the second electrode is positive and the third polarity of the third electrode is negative. The method may include steps further comprising providing, by the conducted electrical weapon, a third pulse of the stimulus signal through the target via the third electrode and a fourth electrode of the at least three electrodes, wherein during the third pulse of the stimulus signal the third polarity of the third electrode is negative and a fourth polarity of the fourth electrode is positive. The method may include steps further comprising deploying, by the conducted electrical weapon, a fourth electrode towards the target; and providing, by the conducted electrical weapon, a third pulse of the stimulus signal through the target via the third electrode and the fourth electrode, wherein during the third pulse of the stimulus signal the third polarity of the third electrode is negative and a fourth polarity of the fourth electrode is positive. The method may include steps further comprising determining, by the conducted electrical weapon and before providing the third pulse of the stimulus signal, whether the fourth electrode is coupled to the target.

[0251] Embodiments according to various aspects of the present disclosure may include a method. The method may include steps comprising: deploying, by a conducted electrical weapon, at least three electrodes towards a target; applying, by the conducted electrical weapon, a first voltage to a first electrode from the at least three electrodes; applying, by the conducted electrical weapon, a second voltage to a second electrode from the at least three electrodes, wherein the first voltage is different from the second voltage; and detecting, by the conducted electrical weapon, a measurement voltage at one or more electrodes from the at least three electrodes.

[0252] In various implementations of the above embodiments, the method may include steps further comprising determining, by the conducted electrical weapon, a state of connection of a third electrode from the at least three electrodes based on the measurement voltage. In response to the measurement voltage being 0 volts, the state of connection of the third electrode is not connected. In response to the measurement voltage being closer to the second voltage than the first voltage, the state of connection comprises the third electrode coupled to the target at a location closer to the second electrode than the first electrode. In response to the measurement voltage being the same as the first voltage, the state of connection comprises the second electrode not electrically coupled to the target. The method may comprise steps further comprising providing, by the conducted electrical weapon, a stimulus signal through a pair of electrodes from the at least three electrodes based on the state of connection. The first voltage and the second voltage may be each less than 50 volts. The second voltage may be greater than the first voltage. The first voltage may be less than 5 volts and the second voltage may be greater than 10 volts. The first voltage may be 3 volts and the second voltage may be 12 volts.

[0253] Embodiments according to various aspects of the present disclosure may include a conducted electrical weapon. The conducted electrical weapon may comprise a signal generator, at least three electrodes, and a processing circuit. The at least three electrodes may be electrically coupled to the signal generator, wherein the at least three electrodes are configured to be launched toward a target to electrically couple to the target. The processing circuit may be configured to perform operations comprising: deploying the at least three electrodes towards the target; applying, via the signal generator, a first voltage to a first electrode from the at least three electrodes; applying, via the signal generator, a second voltage to a second electrode from the at least three electrodes, wherein the first voltage is different from the second voltage; and detecting a measurement voltage at one or more electrodes from the at least three electrodes.

[0254] In various implementations of the above embodiments, the processing circuit may be configured to perform operations further comprising: determining a state of connection of the one or more electrodes from the at least three electrodes based on the measurement voltage. The processing circuit may be configured to perform operations further comprising: providing, via the signal generator, a stimulus signal through a pair of electrodes from the at least three electrodes that have the state of connection of connected. The conduced electrical weapon may further comprise a memory in electronic communication with the processing circuit, wherein in response

to determining the state of connection of the one or more electrodes the processing circuit is configured to perform operations comprising: storing, via the memory, the state of connection for each electrode of the one or more electrodes.

[0255] Embodiments according to various aspects of the present disclosure may include a method. The method may include steps comprising: deploying, by a conducted electrical weapon, at least three electrodes towards a target; applying, by the conducted electrical weapon, a first test signal to a first electrode from the at least three electrodes; applying, by the conducted electrical weapon, a second test signal to a second electrode from the at least three electrodes, wherein the first test signal comprises a first voltage and the second test signal comprises a second voltage; detecting, by the conducted electrical weapon, a measurement voltage at one or more electrodes from the at least three electrodes; and determining, by the conducted electrical weapon, a state of connection of each of the at least three electrodes based on the measurement voltage.

[0256] In various implementations of the above embodiments, the method may include steps further comprising providing, by the conducted electrical weapon, a stimulus signal through a pair of electrodes from the at least three electrodes based on the state of connection of each electrode. The method may include steps further comprising determining, by the conducted electrical weapon, an electrode spread between at least two electrodes from the at least three electrodes based on the state of connection of each electrode. The method may include steps further comprising: selecting, by the conducted electrical weapon, a pair of electrodes from the at least three electrodes based on the electrode spread; and providing, by the conducted electrical weapon, a stimulus signal through the pair of electrodes. The method may include steps further comprising: deploying, by the conducted electrical weapon, a fourth electrode towards the target; applying, by the conducted electrical weapon, a third test signal to an electrode from the at least three electrodes; applying, by the conducted electrical weapon, a fourth test signal to a second electrode from the at least three electrodes, wherein the third test signal comprises the first voltage and the fourth test signal comprises the second voltage; and detecting, by the conducted electrical weapon, a second measurement voltage at the one or more electrodes from the at least three electrodes and the fourth electrode. The method may include steps further comprising: providing, by the conducted electrical weapon and after applying the first test signal and the second test signal, a first pulse of a stimulus signal through a first pair of electrodes from the at least three electrodes; and providing, by the conducted electrical weapon and after applying the third test signal and the fourth test signal,

a second pulse of the stimulus signal through a second pair of electrodes from the at least three electrodes and the fourth electrode.

[0257] The foregoing description discusses implementations (e.g., embodiments), which may be changed or modified without departing from the scope of the present disclosure as defined in the claims. Examples listed in parentheses may be used in the alternative or in any practical combination. As used in the specification and claims, the words "comprising," "comprises," "including," "includes," "having," and "has" introduce an open-ended statement of component structures and/or functions. In the specification and claims, the words "a" and "an." are used as indefinite articles meaning "one or more." While for the sake of clarity of description, several specific embodiments have been described, the scope of the invention is intended to be measured by the claims as set forth below. In the claims, the term "provided" is used to definitively identify an object that not a claimed element but an object that performs the function of a workpiece. For example, in the claim "an apparatus for aiming a provided barrel, the apparatus comprising: a housing, the barrel positioned in the housing," the barrel is not a claimed element of the apparatus, but an object that cooperates with the "housing" of the "apparatus" by being positioned in the "housing."

[0258] The location indicators "herein," "hereunder," "above," "below," or other word that refer to a location, whether specific or general, in the specification shall be construed to refer to any location in the specification whether the location is before or after the location indicator.

CLAIMS

What is claimed is:

1. A conducted electrical weapon comprising:

a signal generator comprising a first conductor and a second conductor, wherein the signal generator is configured to provide a stimulus signal through the first conductor and the second conductor, and wherein the first conductor has a positive potential and the second conductor has a negative potential;

a plurality of electrodes configured to deliver the stimulus signal through a target; and

a selector circuit in electrical series between the signal generator and the plurality of electrodes, wherein the selector circuit is configured to selectively electrically couple an electrode from the plurality of electrodes to the first conductor or the second conductor of the signal generator.

2. The conducted electrical weapon of claim 1, further comprising a processing circuit in communication with the selector circuit, wherein the processing circuit is configured to select a first electrode and a second electrode from the plurality of electrodes to deliver the stimulus signal through the target.

3. The conducted electrical weapon of claim 2, wherein the processing circuit is configured to assign a first polarity assignment to the first electrode and the second electrode, and wherein in accordance with the first polarity assignment, the selector circuit electrically couples the first electrode to the first conductor and the second electrode to the second conductor.

4. The conducted electrical weapon of claim 3, wherein the processing circuit is configured to assign a second polarity assignment to the first electrode and the second electrode, and wherein in accordance with the second polarity assignment, the selector circuit electrically couples the first electrode to the second conductor and the second electrode to the first conductor.

5. The conducted electrical weapon of claim 2, wherein:

the selector circuit comprises a plurality of multiplexers,

the processing circuit provides one or more select signals to the plurality of multiplexers, and

in accordance with the one or more select signals, the selector circuit electrically couples the first electrode to the first conductor and the second electrode to the second conductor.

6. The conducted electrical weapon of claim 5, wherein:

the processing circuit provides one or more second select signals to the plurality of multiplexers,

the one or more second select signals have a different value than the one or more select signals, and

in accordance with the one or more second select signals, the selector circuit electrically couples the first electrode to the second conductor and the second electrode to the first conductor.

7. The conducted electrical weapon of claim 6, wherein:

the processing circuit provides the one or more select signals to the plurality of multiplexors prior to the signal generator providing a first pulse of the stimulus signal, and

the processing circuit provides the one or more second select signals to the plurality of multiplexors prior to the signal generator providing a second pulse of the stimulus signal.

8. The conducted electrical weapon of claim 2, wherein:

the selector circuit comprises a plurality of relays,

the processing circuit provides one or more select signals to the plurality of relays, and

in accordance with the one or more select signals, the selector circuit electrically couples the first electrode to the first conductor and the second electrode to the second conductor.

9. The conducted electrical weapon of claim 8, wherein:

the processing circuit provides one or more second select signals to the plurality of relays,

the one or more second select signals have a different value than the one or more select signals, and

in accordance with the one or more second select signals, the selector circuit electrically couples the first electrode to the second conductor and the second electrode to the first conductor.

10. The conducted electrical weapon of claim 9, wherein:

the processing circuit provides the one or more select signals to the plurality of relays prior to the signal generator providing a first pulse of the stimulus signal, and

the processing circuit provides the one or more second select signals to the plurality of relays prior to the signal generator providing a second pulse of the stimulus signal.

11. The conducted electrical weapon of claim 2, wherein:

the selector circuit comprises a plurality of relays and an h-bridge,

the h-bridge electrically couples to the first conductor and the second conductor of the signal generator,

the processing circuit provides a first select signal to the plurality of relays to select the first electrode and the second electrode for providing the stimulus signal through the target, and

the processing circuit provides a second select signal to the h-bridge to electrically couple the first electrode to the first conductor and the second electrode to the second conductor.

12. The conducted electrical weapon of claim 11, wherein:

the processing circuit provides a third select signal to the h-bridge,

the third select signal has a different value than the second select signal, and

in accordance with the third select signal, the h-bridge electrically couples the first electrode to the second conductor and the second electrode to the first conductor.

13. The conducted electrical weapon of claim 2, wherein the processing circuit selects the first electrode and the second electrode from the plurality of electrodes in accordance with testing an electrical connectivity of deployed electrodes from the plurality of electrodes to the target.

14. The conducted electrical weapon of claim 1, wherein the selector circuit is integrated into the signal generator.

15. A method performed by a conducted electrical weapon ("CEW") for providing a stimulus signal through a target, the method comprising:

selecting a first electrode and a second electrode from a group of a plurality of electrodes, the plurality of electrodes launched toward the target to deliver the stimulus signal through the target;

electrically coupling the first electrode to a first conductor of a signal generator, wherein the first conductor has a positive polarity;

electrically coupling the second electrode to a second conductor of the signal generator, wherein the second conductor has a negative polarity, and wherein the signal generator provides the stimulus signal as a voltage potential across the first conductor and the second conductor; and

providing, via the signal generator, the stimulus signal through the target via the first electrode and the second electrode.

16. The method of claim 15, further comprising:

electrically coupling the first electrode to the second conductor;

electrically coupling the second electrode to the first conductor; and

providing, via the signal generator, the stimulus signal through the target via the first electrode and the second electrode.

17. The method of claim 15, wherein electrically coupling the first electrode to the first conductor and electrically coupling the second electrode to the second conductor comprises:

providing a first select signal to a selector circuit in communication with the signal generator, wherein based on the first select signal the selector circuit electrically couples the first electrode to the first conductor and the second electrode to the second conductor.

18. The method of claim 17, further comprising:

providing a second select signal to the selector circuit, wherein the second select signal is different from the first select signal;

electrically coupling, via the selector circuit, the first electrode to the second conductor; and

electrically coupling, via the selector circuit, the second electrode to the first conductor.

19. The method of claim 15, wherein electrically coupling the first electrode to the first conductor and electrically coupling the second electrode to the second conductor comprises:

providing one or more select signals to one or more multiplexers to electrically couple the first electrode to the first conductor and the second electrode to the second conductor.

20. The method of claim 15, wherein electrically coupling the first electrode to the first conductor and electrically coupling the second electrode to the second conductor comprises:

providing one or more select signals to one or more relays to electrically couple the first electrode to the first conductor and the second electrode to the second conductor.

21. A conducted electrical weapon comprising:

a processing circuit;

a signal generator configured to provide a stimulus signal as a voltage potential across a first conductor and a second conductor of the signal generator, the first conductor having a positive polarity and the second conductor having a negative polarity;

a selector circuit electrically coupled to the first conductor and the second conductor of the stimulus generator;

at least three electrodes electrically coupled to the selector circuit, wherein the at least three electrodes are configured to be launched toward a target to deliver the stimulus signal through the target; and

a tangible, non-transitory memory in electronic communication with the processing circuit, the tangible, non-transitory memory having instructions stored thereon that, in response to execution by the processing circuit, cause the processing circuit to perform operations comprising:

launching the at least three electrodes towards the target,

selecting a first electrode and a second electrode from the at least three electrodes to deliver the stimulus signal through the target,

providing a first select signal to the selector circuit, wherein based on the first select signal the selector circuit is configured to electrically couple the first electrode to the first conductor and the second electrode to the second conductor, and

activating the signal generator to provide the stimulus signal through the target via the first electrode and the second electrode.

22. The conducted electrical weapon of claim 21, wherein the processing circuit is configured to perform operations further comprising:

providing a second select signal to the selector circuit, wherein based on the second select signal the selector circuit is configured to electrically couple the first electrode to the second conductor and the second electrode to the first conductor.

23. The conducted electrical weapon of claim 21, wherein the processing circuit is configured to perform operations further comprising:

selecting the first electrode and a third electrode from the at least three electrodes to deliver the stimulus signal through the target.

24. The conducted electrical weapon of claim 23, wherein the processing circuit is configured to perform operations further comprising:

providing a second select signal to the selector circuit, wherein based on the second select signal the selector circuit is configured to electrically couple the first electrode to the second conductor and the third electrode to the first conductor, and

activating the signal generator to provide the stimulus signal through the target via the first electrode and the third electrode.

25. The conducted electrical weapon of claim 21, wherein:

the selector circuit comprises a multiplexer, and

the first select signal drives a select input of the multiplexer to electrically couple the first electrode to the first conductor and the second electrode to the second conductor.

26. The conducted electrical weapon of claim 21, wherein:

the selector circuit comprises a relay, and

the first select signal drives a select input of the relay to electrically couple the first electrode to the first conductor and the second electrode to the second conductor.

27. The conducted electrical weapon of claim 21, wherein:

the selector circuit comprises a plurality of relays and an h-bridge,

the h-bridge electrically couples to the first conductor and the second conductor of the signal generator, and

the first select signal drives a select input of the h-bridge to electrically couple the first electrode to the first conductor and the second electrode to the second conductor.

28. The conducted electrical weapon of claim 21, wherein the processing circuit is configured to perform operations further comprising:

testing an electrical connectivity of the at least three electrodes with the target, and

selecting the first electrode and the second electrode to deliver the stimulus signal through the target based on testing the electrical connectivity.