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[1]ECD Delivered Energy Parameters	TASER® X26	ADVANCED TASER® M26
ECD power source	Two 3 V (volt) cells (Duracell® Ultra, CR123A)	8 - AA NiMH® cells (1.2 V per cell) or 8 - AA Alkaline cells (1.5 V per cell)
ECD energy per pulse into 400 Ω load	0.07 J (joules)	0.50 J
Delivered charge – net charge current	1.7 mA (milliampere) or 0.0017 A (amperes)	0.64 mA or 0.00064 A
ECD current - average over one second - average current is the flow of coulombs[2] - 1 mA = 0.001 A (ampere)	2.1 mA or 0.0021 A (average rectified current) 1.9 mA or 0.0019 A (current from main phase which is a better estimate of stimulation capacity)	3.6 mA or 0.0036 A (average rectified current) 1.7 mA or 0.0017 A (current from main phase, which is a better estimate of stimulation capacity)
Pulse Duration	100 µs (microseconds)	10 µs main phase 40 µs full waveform
ECD power output into 400 Ω load	1.33 W (watts)	7.39 W at 15 PPS (pulses per second [s])
Voltage - avg. over duration of full phase	400 V (volts)	320 V
Voltage - avg. over duration of main pulse	442 V	3,400 V
Voltage - peak (into 400 Ω [ohm] load)	1,200 V	5,000 V
Voltage - average over one second	0.84 V	1.44 V
Lots of Ways to Measure Electricity Analogy		
Evaluate Car Analogy	There are many ways to evaluate, or measure a car; a car is “hot” because it goes fast, quickly accelerates, gets 35 miles per gallon, has a tremendous stereo, looks fast, etc. Just as there are many ways to evaluate a car, there are also many ways to evaluate, or measure, electrical characteristics of a circuit, a device, or an output.	
Power Sources Demonstrations		
ECD Power Sources	The power sources for a TASER ECD range from a battery of two 3 V (camera type) cells for the TASER X26, to a battery of 8 AA (penlight) cells for the TASER M26. Thus, the ECD power sources are finite and very minimal and not capable of producing large discharges of energy.	

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Simultaneous ECD Discharge Analogy	
Water Analogy – Simultaneous ECD discharges	Two, or more, simultaneous ECDs discharges are not cumulative for numerous reasons (pulse duration, current paths of least resistance, pulse rates, pulse polarities, positioning of probes, etc.). One analogy is that if you take 2 glasses of water, each at 100 degrees Fahrenheit (F), and mix them together, the result is 1 glass of water at 100 degrees F, and not one glass of water at 200 degrees F.
Joule (Energy) Analogies	
Joule (J) comparison summary	• 1 J = 0.2388 calorie (small calorie) (small "c") (1,000 Cal = 1 kcal) (1 Cal = 4.2 J) • 1.33 J/s – (X26) energy delivered by X26 (0.07 j/pulse x 19 PPS = 1.33 J/s) (equals 1.33 W). • 4.2 J = 1 Cal • 7.5 J/s – (M26) energy delivered by M26 (at 15 PPS) (0.50 J/pulse x 15 PPS = 7.5 J/s). • 88.7724 J per drop of Pepsi® soft drink • 128.09 J/s energy expended by the average human body with moderate exercise in 1 s.
ECD storage capacitor maximum J (joules)	The ECD's energy storage capacitor has a maximum energy storage of 1.88 J (joules) (M26) and thus is not able to deliver large amounts of energy.
"joule" (J) analogies[3] - A joule is the International System unit of electrical, mechanical, and thermal energy.	1 joule = 1 newton-metre = 1 watt-second 1 joule in everyday life is approximately: • The energy required to lift a small apple one meter straight up • The energy released when that same apple falls one meter to the ground • The amount of energy, as heat, a quiet person produces every hundredth of a second • The energy required to heat one gram of dry, cool air by 1.39 degrees Celsius • One hundredth of energy a person can get by drinking a single drop of Pepsi® soft drink • 1 J = 0.00027778 watt-hours • 1 J = 0.2388 calorie (small calorie) (small "c") (1,000 Cal = 1 kcal) (1 Cal = 4.2 J) • 1 J = 0.7376 foot-pound force
J (joules) of energy expended per s (second) by an average 155-pound person with moderate exercise.	128.09 J per second – energy expended by the body[4] in 1 s.

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The Pepsi® Analogy	88.7724 J per drop of Pepsi®[5] soft drink
High Voltage Analogies (static electricity discharge and Van de Graff generator)	
Level IV Static Electricity Discharge Analogy	IEC (International Electrochemical Commission) has defined a “strong static electricity” shock as having electrical characteristics of 15,000 V (volts) and 30 A (amperes) peak.[6]
Van de Graff Generator Analogy	A Van de Graff generator has up to 25,000,000 V, while the peak delivered voltage from an ECD is from 1,200 V (X26) to 5,000 V (M26). 
Power Comparison Analogies	
Ground Fault Circuit Interrupter (GFCI) or Ground Fault Interrupter (GFI) Analogy	A standard GFCI/GFI in the bathrooms of tens of millions of U.S. homes has a cutout level of 6 mA (milliamperes), or 0.006 A (amperes). A TASER ECD delivers from 2.1 to 3.6 mA, or 0.0021 to 0.0036 A.
Hair Dryer Analogy	Many common hairdryers deliver from 1,500 to 1850 watts (W). An ECD delivers between 1.33 W (X26) and 7.39 W (at 15 PPS) (M26)
Horse Power Analogy	One horsepower equals 746 W. A TASER ECD delivers from 1.33 W to 7.39 W (at 15 PPS)

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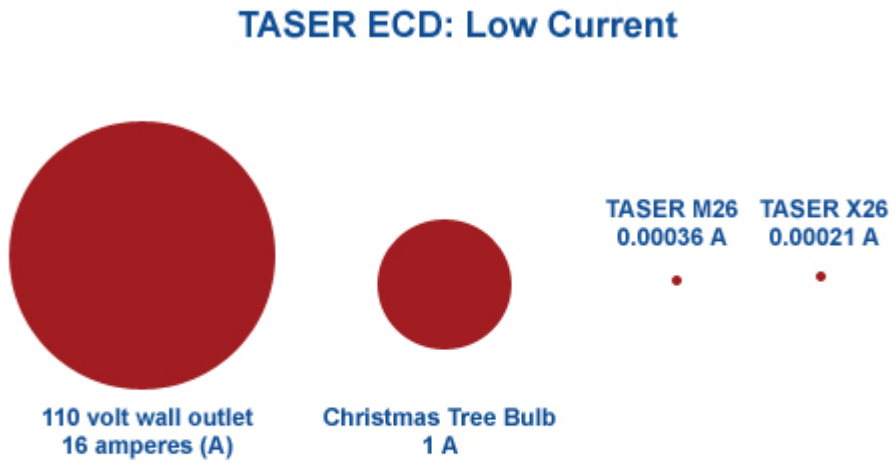
110 V AC (alternating current) and Christmas tree bulb current analogy	A 110 V wall outlet can have a continuous current of up to 16 A (amperes) (or more). It takes approximately 1 A to light a Christmas tree bulb. Compare to a TASER ECD that delivers an average rectified current of 0.0021 to 0.0036 A in short-duration pulses.	

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All Electricity is Not the Same (ball analogy)	
Ball Analogy	Just as all "balls" are not the same: a nerf ball, whiffle ball, beach ball, ping-pong ball, golf ball, racquet ball, tennis ball, dodge ball, softball, baseball, basketball, soccer ball, football, medicine ball, bowling ball, and wrecking ball are not the same, the same is true for electrical discharge or delivered energy. A lightning bolt or a high-current power line would be equivalent to a wrecking ball, and a handheld, battery-powered ECD would be approximately equivalent to a tennis ball.
Pulse Duration Analogies	
Duration of "on" time in one second visual stack of paper analogy (continuous AC (alternating current) vs. short-duration ECD pulse(s)	A 110 V AC (alternating current) electrical outlet delivers energy continuously for a full second of time. A pulse from a TASER X26 device only delivers energy for 100 µs. And, a pulse from an M26 device is only delivered for 40 µs full waveform, and 10 µs for the main phase.
TASER X26: 10,000 sheets of paper = 1 s 1 X26 (100 µs) pulse = 1 sheet of paper 19 X26 pulses/s = 19 sheets of paper	**TASER X26.** For the X26 – a 10,000-sheet stack of copy paper (about 4′ high) equals the "on" time for a 110 V AC current. One sheet from the top of the 10,000-sheet stack represents the "on" time for a single (100 µs) TASER X26 pulse. And 19 sheets of paper from the top of the 10,000-sheet stack represents the "on" time for the X26 for 1 second (s). Or, for the full 5 s X26 discharge (95 pulses), the stack of paper would be 50,000 sheets (representing 10,000 sheets/s for the full 5 s – about 20′ in height). Then, the total "on" time for the X26 for the 5 s cycle would be 95 sheets of paper from the stack of 50,000 sheets.
TASER M26: 25,000 sheets of paper = 1 s 1 M26 (40 µs) pulse = 1 sheet of paper 15 M26 pulses/s = 15 sheets of paper	**TASER M26.** Since the M26 has a 40 µs pulse, the stack of paper representing 1 s is 25,000 sheets. And, 1 sheet from the top equals the "on" time for one pulse. At 15 PPS, 15 sheets would be removed from the top of the 25,000 sheet stack.
Duration of "on" time – football field analogy • Football field (100 yards) = 1 s of time • X26 – move the ball 6.84″ in 1 s • M26 – move the ball 2.16″ in 1 s	**TASER X26.** A (U.S.) football field is 100 yards. If those 100 yards represent 1 second (s) of time, then, a single pulse from a TASER X26 (100 µs) would move the ball 0.36 inches toward the goal. And the X26 device's 19 PPS would move the ball 6.84 inches in one second. **TASER M26.** Because the M26 pulse is 40 µs one pulse would move the ball 0.144 inches toward the goal. And the M26 (at 15 PPS) would move the ball 2.16 inches in one second.

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Current Flow – path of least resistance analogy	
Baseball Diamond Current Flow Analogy	In a baseball game a batter hits a ball into right field. The batter then runs from base to base trying to reach home. The runner, for the most part, stays on a direct path (or path of least resistance) between the bases. The runner does not run off the bases into the stands. The person may run around a tag, but does not run up into the stands. Electricity flows between the 2 contacts, and it does not signifcantly flow away from the path of least resistance between the 2 contact points.
Medical Device Electrical Characteristics Analogies	
Pediatric Defibrillator Energy Analogy American Heart Association current Pediatric Advanced Life Support (PALS) Guidelines[7]	PALS guidelines call for 2–9 J/kg (joules/kilogram) for infants and children. Thus, for a 5 kg (11-pound) infant PALS states that 10–45 J have been found effective "with negligible adverse effects." Paddle Size: PALS advises to use the largest paddles that will fit the infant or child. These paddles are hundreds of times larger than a small TASER probe. Paddle Position: PALS states to place the paddles over the right side of the upper chest and the apex of the heart (to the left of the nipple over the left lower ribs or alternatively place one electrode on the front of the chest just to the left of the sternum and the other over the upper back below the scapula). These ideal positions are almost impossible for an ECD exposure.
Electrical Therapies: Automated External Defibrillators Analogy (AED)[8]	AED therapies have shown that 200 J or under is "relatively low energy" and "is safe." A TASER ECD delivers from 0.07 J/pulse to 0.50 J/pulse.
Electroconvulsive Therapy (ECT)[9] device Analogy • ECT delivers up to 1218 J in 30–60 s • ECT delivers 20.3 W • ECT pulses are 1 ms (millisecond) 183 times a TASER X26 over 5 s cycle	An ECT device is used to deliver an electrical shock to the brain to reset it as a therapy for severe refractory depression. The Somatics® ME 2316 delivers 20.3 W (watts) with 1 ms (millisecond) pulses for a 30–60 s (second) application. This gives a total of up to 1218 J (joules) of energy—directly to the head. This is 183 times more energy than delivered by the TASER X26 over a full 5-second application. The brain is primarily nerves, yet nerve damage is not found. In fact, therapeutic benefit is found even for epilepsy. A typical ECT unit delivers between 500 and 900 mA (milliamperes) of current directly to the head. This is hundreds of times the current from a TASER M26 or X26.

[1] This document, and the entirety of its contents, is for discussion and demonstration purposes only. All numbers, references, and values in this document are nominal. Actual measurements on particular products, references, and/or analogies may vary as a result of many factors including, but not limited to, factors outside TASER International, Inc.'s (TASER's) control. Please refer to TASER published product specifications, manuals and product literature for additional information including specified limits, test conditions, and allowed tolerances. For more information please see current TASER Web site (www.taser.com). TASER reserves the right to change or modify this document without notice. TASER is a registered trademark of TASER International, Inc.

[2] One C (coulomb) equals 6.24 quintillion (or 6.24 x 10^{18}) electrons.

[3] Joule (J), *The American Heritage Collegiate Dictionary (4th Edition)* defines a joule as "1. The International System unit of electrical, mechanical, and thermal energy. 2a. A unit of electrical energy equal to the work done when a current of one ampere is passed through a resistance of one ohm for one second. b. A unit of energy equal to the work done when a force of one newton acts through a distance of one meter." Merriam-Webster's Medical Dictionary (New Edition) defines a joule as "a unit of work or energy equal to the work done by a force of one newton acting through a distance of one meter."

One joule is the work done, or energy expended, by a force of one newton moving an object one meter along the direction of the force. This quantity is also denoted as a Newton-meter with the symbol N·m.

[4] Using an average person's weight (of 155 pounds), and the person is moderately active (multiply weight by 17 to get Kcal/day requirements) means that the person needs (155 x 17 =) 2,635 Kcal. 2,635 Kcal x 1,000 cal/Kcal = 2,635,000 cal. Then, 1 joule = 0.2388 cal. Thus, 1 cal = 4.2 J. Thus, 2,635,000 cal/day x 4.2 J/cal = 11,067,000 J/day. Now, 60 seconds x 60 minutes x 24 hours = 86,400 seconds per day. Thus, 11,067,000 J/day divided by 86,400 s/day = 128.09 J/s required by the body.

[5] A 12-ounce can of Pepsi® has 150 Kcal. Or, 150 Kcal x 1,000 cal/Kcal = 150,000 cal (in one 12-ounce can). Thus, 150,000 cal x 4.2 J/cal = 630,000 J (in one 12-ounce can). Now, 1 ounce = 29.57 milliliters (ml). And, there are 20 drops per ml. Thus, 12 ounces x 29.57 ml/ounce = 354.84 ml/12 ounces. And, 354.84 ml x 20 drops/ml = 7,096.8 drops per 12 ounces. Thus each drop of Pepsi is 630,000 J/7,096.8 drops = 88.7724 J/drop (of Pepsi).

[6] International Standard IEC-61000-4-2.

[7] Part 12: Pediatric Advanced Life Support, Circulation. 2005;112 [Suppl I]:IV-167-IV-187; published online before print November 28 2005, doi:10.1161/CIRCULATIONAHA.105.166573.

[8] Part 5: Electrical Therapies: Automated External Defibrillators, Defibrillation, Cardioversion, and Pacing, Circulation. 2005;112 [Suppl I]:IV-35-IV-46; published online before print November 28 2005, doi:10.1161/CIRCULATIONAHA.105.166554.

[9] Greenhalgh J, Knight C, Hind D, Beverley C, Walters S. Clinical and cost-effectiveness of electroconvulsive therapy for depressive illness, schizophrenia, catatonia and mania: systematic reviews and economic modeling studies. *Health Technol Assess* 2005;9:1-156, iii-iv. Krystal AD, Weiner RD. ECT seizure duration: reliability of manual and computer-automated determinations. *Convuls Ther* 1995;11:158-69. Nilsen SM, Willis KW, Pettinati HM. Initial Impression of Two New Brief-Pulse Electroconvulsive Therapy Machines. *Convuls Ther* 1986;2:43-54. Weinstein S. The anticonvulsant effect of electrical fields. Curr Neurol Neurosci Rep 2001;1:155-61.