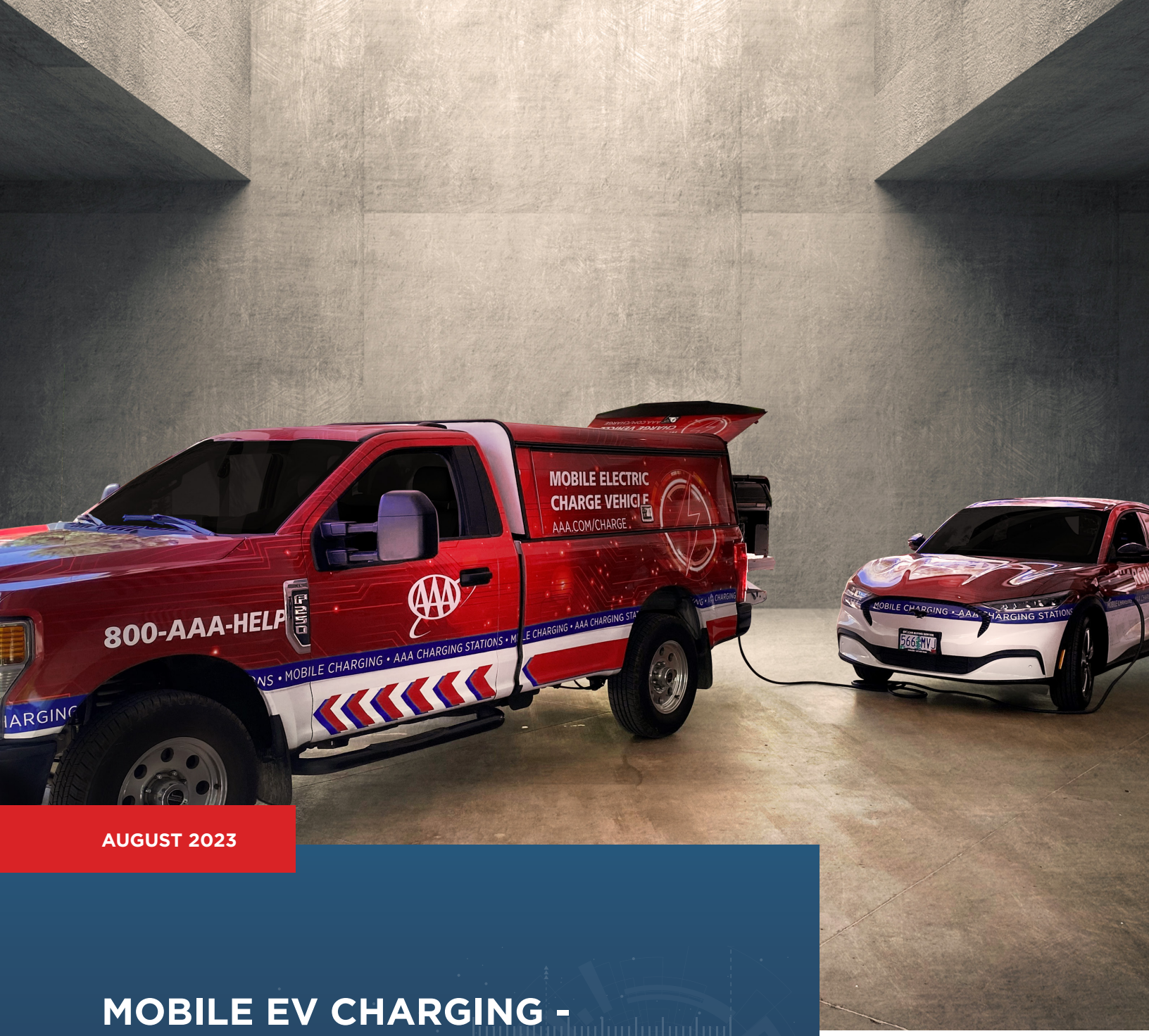

AUGUST 2023

MOBILE EV CHARGING - 2023 UPDATE

NewsRoom.AAA.com

ABSTRACT

AAA Roadside Service desires to provide the same level of support to all members, without regard to what they drive. Range anxiety is often a concern for those considering the purchase of a battery electric vehicle (BEV) powered by battery only, as opposed to a hybrid electric vehicle that has an internal combustion engine. Members and RAP Customers call AAA for assistance when they find themselves unexpectedly low or out of charge. Charging stations are not nearly as numerous or convenient as gas stations and the driving range of BEVs is typically much less than ICE vehicles. Arriving at a charging station to find it out of order can create significant problems for a BEV driver. As battery electric vehicles slowly gain market share and presence on U.S. roadways, more BEV drivers will experience an out-of-charge disruption in their trip. Similar to running out of gas, out-of-charge either requires a tow (a flatbed is required in almost all cases) or specialized equipment to accomplish a partial recharge of the electric vehicle's high voltage battery.

The goal of this research is to learn the capabilities and shortcomings of mobile EV charging equipment to assist AAA club and fleet managers to make good decisions about adding mobile EV charging capability to their roadside service offerings. AAA Automotive Engineering evaluated the Blink Mobile Charging Unit, Generation 1 in 2019. This research is a follow-up and evaluates the second generation of mobile EV charging equipment offered by Blink, Inc.

Research Questions/Key Findings:

This evaluation is limited to the Blink Mobile Charging Unit, Generation 2. All research questions and findings are applicable to the Blink Gen 2 unit and, where presented, comparable findings or specifications for the Blink Mobile Charging Unit, Generation 1.

1. Does the Blink Gen 2 equipment successfully deliver a partial charge to battery electric vehicles in anticipated roadside service conditions?
    a) Yes – The Blink Mobile Charing Unit, Generation 2 successfully provided a partial charge to two BEVs. At 15 minutes charging time, displayed driving range increased an average of 5.7 miles. At 30 minutes charging time, displayed driving range increased an average of 13.7 miles (average of tests performed)
    b) In a direct comparison (same vehicle, same conditions), the Gen 1 unit provided 20 miles driving range in 30 minutes and the Gen 2 unit which provided 16 miles additional driving range.
2. Is the Blink Gen 2 mobile charging unit documented for electrical and worker safety according to equipment type and anticipated use?
    a) Yes – Blink Gen 2 has UL certification on the Simpson generator, and UL certification on the HQ 200 Blink charging unit.
3. Are there build quality concerns for the unit(s) evaluated?
    a) The Blink Gen 2 unit has the EVSE (charging unit) mounted in an orientation that blocks 120V outlets on the generator. This does not interfere with mobile EV charging, but limits additional uses[1] that the generator equipment might serve, including, but not limited to disaster recovery aid and power outages.
    b) The Blink Gen 2 unit is provided with wheels and a flip-up handle to enable easy movement of the unit. In practice, AAA service providers often securely mount the generator chassis to a

[1] The user manual, published by Blink, includes the following note (page 6 of 13): "The Generator is meant exclusively for EV Charging using Blink HQ 200 Smart. The use of the Generator for OTHER APPLICATIONS is NOT RECOMMENDED by Blink Charging. This can void Blink warranty on the Mobile charger product."

truck slide. In these instances, the mobile charging unit assembly is not intended for relocation after mounting in the service vehicle. Security (theft prevention) is a high priority for equipment used in roadside service operations.

Glossary

CCS1: Combined Charging System 1. This is the acronym for the SAE 1772 Dual charging connector that is used in U.S. markets (also Central America, Korea). The connector is a combination of the SAE J1772 AC Level 2 charging connector and two additional ports for high current and voltage direct current. Examples of electric vehicles using the CCS1 charging connection include the Chevrolet Bolt and BMW i3.

EVSE: electric vehicle service equipment. Commonly referred to as a “charging unit”.

Kilowatt and kilowatt-hour: Both are interrelated units of measurement, describing 1000 units of power measured in Watts. Kilowatt (kW) reflects rate of electricity usage, where kilowatt-hour (kWh) reflects the total amount or quantity of electricity used.

State of Charge (SOC)(%): An expression of the present battery capacity as a percentage of maximum capacity. When used to describe a battery electric vehicle’s traction battery, the common usage refers to the usable portion of the total battery pack capacity. For safety and battery longevity reasons, a lithium battery assembly, as is used in modern battery electric vehicles, is never totally discharged. Similarly, there is a safety margin that is not used at the top end of the battery capacity.

Figure 1: Charging connectors by region Image source: The Driven

CONTENTS

I. INTRODUCTION

Battery electric vehicles (BEVs) compromise 0.68% of the 284.2 million vehicles in operation in the United States[2]. AAA responded to 101,692 BEV events in 2022 or 5.25% of the total 1.9 million battery electric vehicles in operation on U.S. roadways. Only 2.1% of those roadside events were to assist a BEV that was out of charge.

Electric vehicle numbers are expected to grow significantly over the coming years – due to government incentives, upcoming mandates from cities and states regarding new internal combustion engine (ICE) vehicle sales, and as a direct consequence of the massive changes automakers have made in shifting product development and manufacturing from ICE to electric. AAA is working to proactively establish the capability of providing the same roadside service to all members regardless of the type vehicle they drive. Mobile electric vehicle charging equipment is intended to allow AAA to provide a partial electric charge to BEV drivers, enabling them to complete their trip or drive to a traditional fixed-installation charging station. Extended range electric vehicles (EREVs), such as the BMW i3 with an internal combustion range extender may also benefit from roadside charging with mobile EV service equipment.

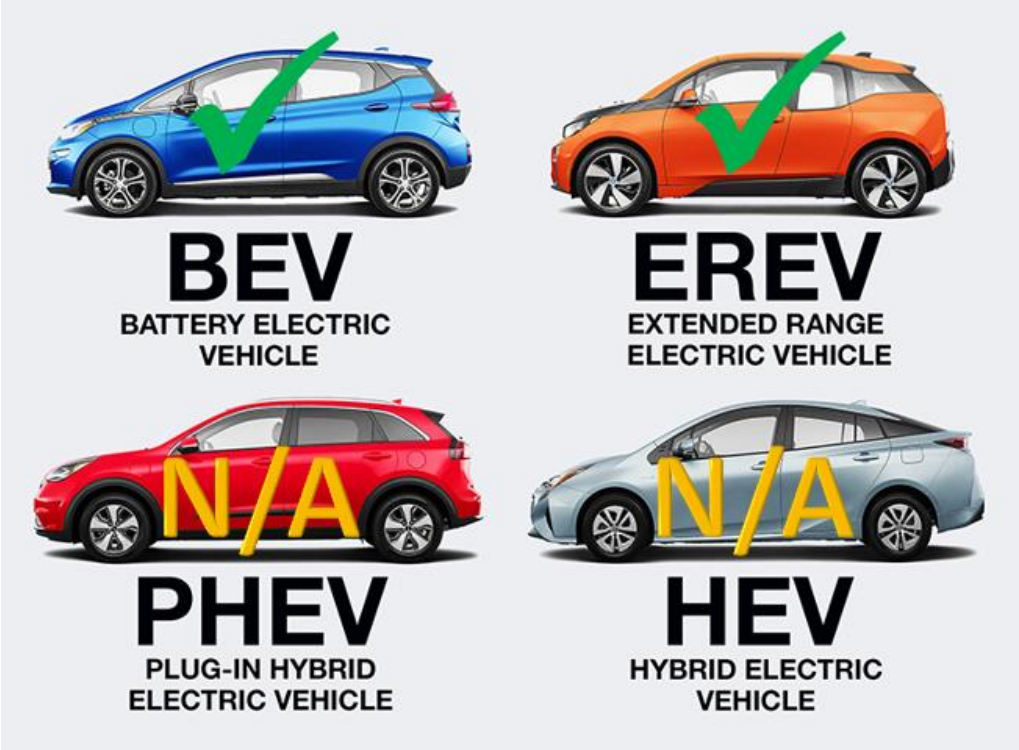

Figure 2: Different types of electrified propulsion showing relevance to mobile EV charging Image source: Current EV

[2] Data current through end of 2022.

II. BACKGROUND

The Blink Mobile Charging Unit, Generation 1 was evaluated by AAA in 2019. The Blink Gen 1 unit provides an average driving range addition of 19.25 miles in 30 minutes. The unit, both generator and EVSE are properly certified for electrical and worker safety according to equipment type and anticipated use. As of July 2023, AAA roadside service providers have 23 Blink Mobile Charging, Generation 1, units deployed as shown in Figure 3.

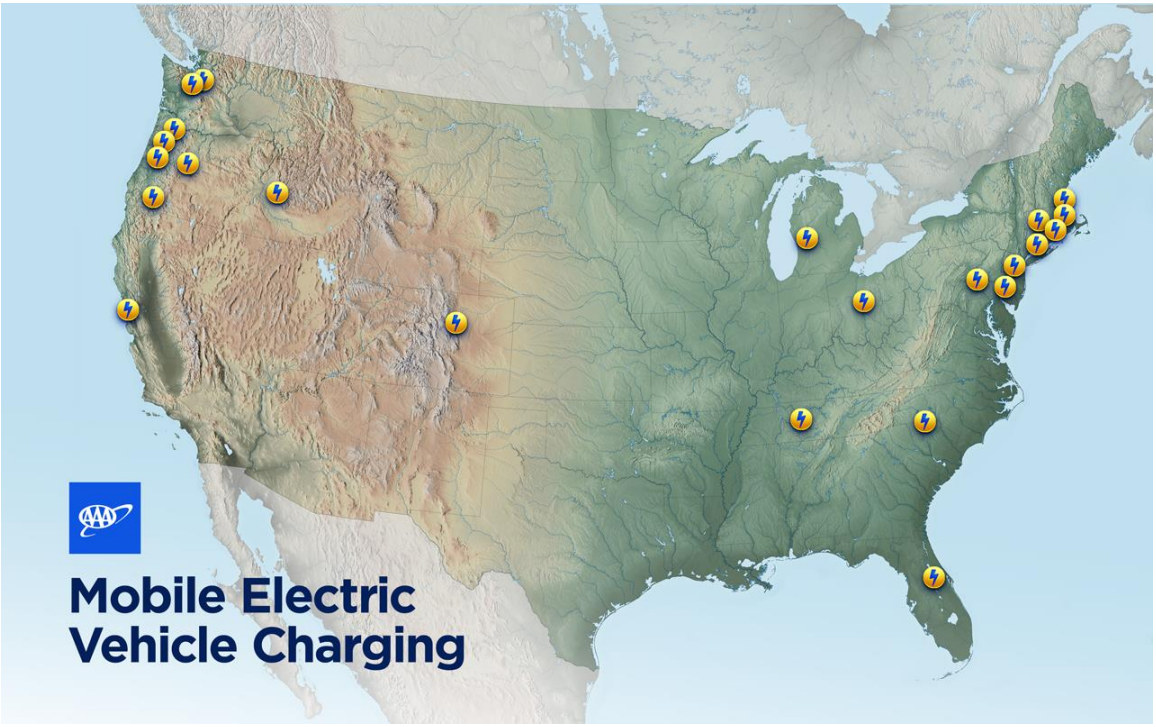

Figure 3: AAA Mobile EV Charging Deployment July 2023 Image source: AAA

A. Blink Mobile Charging Unit, Generation 1

The Blink Mobile Charging Unit, Generation 1 is a portable generator with commercial grade Blink IQ 200 Level 2 AC EVSE plugged into the generator's 240VAC outlet.

The generator is gasoline fueled and rated at 12,000 watts continuous output with a peak output (starting power) of 15,000 watts. Fuel requirements are minimum 85 octane regular and no more than 10% ethanol by volume; the fuel capacity as noted in the owner's manual is 10.9 gallons. A custom end panel and lifting eye are included for mounting the Blink charging unit and to assist in loading the unit, respectively. The generator section is EPA and CARB certified for use in California.

The generator produces substantial heat during operation and is labeled to recommend a 1.5 meter (5 foot) clearance on all sides during operation.

Figure 4: Blink Mobile Charger Image source: AAA

The charging unit, as configured, is rated for a maximum output of 40 amps. The 12 kW continuous output rating of the generator, with single-phase 240 VAC output and a power factor of 1 (estimated) is equivalent to a maximum generator sustained output of 50 amps. This results in a maximum sustained load rating of 80% for the generator when charging a vehicle at the 40 amp maximum configured output of the Blink IQ 200. The maximum calculated output of the generator/charging unit combination is 9.6 kW.

The Blink IQ 200 charger has 20mA ground fault protection per UL 2231 with an automatic reset feature. Ground monitor is per UL 2231. The instruction manual for the Blink IQ 200 charger lists over-voltage (OVP), under-voltage (UVP), over-current (OCP), over-temperature (OTP), and short-circuit protection. The ground terminal on the Blink electrical plug to the generator socket completes the EVSE ground path to the generator chassis. A ground lug is provided on the generator chassis for connection to the service vehicle body, thereby providing additional, necessary pathway for unit grounding. The charging cable length is 23 feet.

The Blink IQ 200 charger enclosure is rated NEMA 3R and is appropriate for outdoor use. It can be serviced by contacting Blink to dispatch a field technician or shipped the charger to one of Blink's U.S. service centers for service/repair. The generator can also be serviced at small engine repair shops.

B. Blink Mobile Charging Unit, Generation 2

Blink introduced the new version in 2023. The generator is gasoline fueled and rated at 7,500 watts continuous output with a peak output (starting power) of 9,375 watts. Fuel requirements are minimum 85 octane regular and less than 10% ethanol by volume; the fuel capacity as noted in the owner's manual is 6.1 gallons. The generator section is EPA and CARB certified for use in California. The generator produces substantial heat during operation and is labeled to recommend a 1.5 meter (5 foot) clearance on all sides during operation.

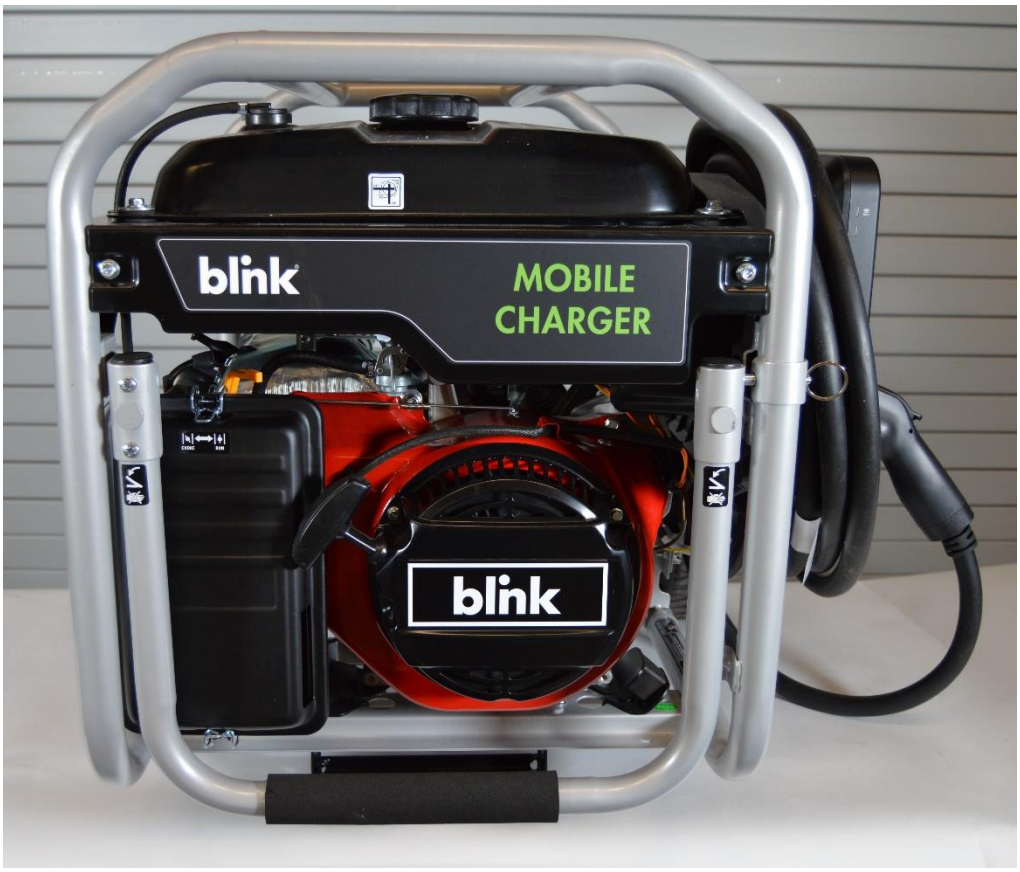

Figure 5: Blink Mobile Charging Unit, Generation 2 Image source: AAA

The charging unit, as configured, is rated for a maximum output of 32 amps. The 7.5 kW continuous output rating of the generator, with single-phase 240 VAC output and a power factor of 1 (estimated) is equivalent to a maximum generator sustained output of 31.25 amps. This results in a maximum sustained load rating of

100% for the generator when charging a vehicle at the maximum configured output of the Blink HQ 200. As a result, the maximum calculated output of the generator/charging unit combination is 7.5 kW.

The Blink HQ 200 charger has 20mA ground fault protection per UL 2231 with an automatic reset feature. Ground monitor is per UL 2231. The instruction manual for the Blink HQ 200 charger lists over-voltage (OVP), under-voltage (UVP), over-current (OCP), over-temperature (OTP), and short-circuit protection. The ground terminal on the Blink electrical plug to the generator socket completes the EVSE ground path to the generator chassis. A ground lug is provided on the generator chassis for connection to the service vehicle body, thereby providing additional, necessary pathway for unit grounding. The charging cable length is 23 feet.

The Blink HQ 200 charger enclosure is rated NEMA 3R and is appropriate for outdoor use. It can be serviced by contacting Blink to dispatch a field technician or shipped the charger to one of Blink's U.S. service centers for service/repair. The generator can also be serviced at small engine repair shops.

C. Specification Comparison

Blink Mobile Charging Unit		
	Generation 1	Generation 2
Electric Vehicle Service Equipment (EVSE)		
Model Designation	HQ 200	IQ 200
EVSE Classification	Residential	Commercial
Maximum Current	32 A	50 A
Enclosure Rating	NEMA 3R	
Charge Cable Length	23 ft (7.01 m)	
Charge Connector Type	SAE J1772	
Ground Fault Detection	CCID20, 20mA per UL 2231, Automatic and Manual Reset Feature	
Ground Monitor	Ground Monitor per UL 2231	
Safety Compliance	UL/ULC, CSA, NEC Article 625, RoHS	
Protection	Over-Voltage (OVP), Under-Voltage (UVP), Over-Current (OCP), Over-Temp (OTP), & Short-Circuit Protection	
EMC Compliance	FCC Part 15B	
Generator		
Manufacturer/Brand	Simpson	Champion
Model Designation	SPG7593E	10011
Voltage / Phase	120/240 V Single Phase	120/240 V Single Phase
Rated running power (kW)	7.5 kW	12 kW
Rated starting power (kW)	9.375	15
Fuel capacity (U.S. gallon)	6.1	10.9
Total Unit Specifications		
Weight	230 lbs	365 lbs.
Length	27"	39"
Width	21"	32"
Height	23"	34"

Figure 6: Blink Mobile Charging Unit, Generation 1 and 2 specifications Image source: AAA

Noise levels from both the Gen 1 and Gen 2 units were measured during charging sessions with the generators under consistent load. Summary results are provided in Figure 13 within Section VI.B.

III. SELECTION OF TEST VEHICLES

A. Tesla Model 3 (2023 RWD)

Tesla vehicles currently account for 70% of the battery electric vehicles on the road in the United States. The Tesla Model 3 is the most popular Tesla model (by registration count). Hertz was reported in media to have contracted to purchase 100,000 Teslas. A report by Reuters in February 2023 stated Hertz' Tesla BEVs in the Americas (including Mexico and Canada) totaled 48,344 at the end of 2022. The Tesla count represented

approximately 11% of Hertz' vehicle count at that time. The prevalence of the Tesla Model 3 as a Hertz rental vehicle supports using it in AAA evaluation testing for Mobile EV charging equipment.

Figure 7: Tesla Model 3 Image source: Tesla

B. Polestar 2 (2023 Single Motor)

The Polestar 2[3] is similarly available for rental from Hertz. While the Polestar 2 is not yet a commonly purchased BEV, it represents an alternative to the Tesla Model 3 that will likely appeal to first time BEV buyers. Additionally, the Polestar 2 will be a prominent model within the Hertz BEV rental fleet and will likely represent a customer's first experience with a BEV. As such, the likelihood of an individual running out of charge could be higher relative to drivers with previous experience with BEVs. It is also important to note that this is the first evaluation by AAA using a Polestar vehicle.

[3] Polestar is Part of Volvo Cars, Polestar produces high performance electric vehicles.

Figure 8: Polestar 2 Image source: Polestar

IV. TEST EQUIPMENT AND RESOURCES

1. DUT (device under test): Blink Mobile EV Charging Units, Generation 2
2. Data logger (data acquisition unit – DAQ)
    a. DEWESoft Sirius® data acquisition system
    b. DEWESoft PowerSlice to provide measurement-independent power for high accuracy amperage measurement
    c. DEWESoft Krypton EtherCAT data acquisition module for thermocouple data
3. Thermocouples for temperature measurement.
    a. K-type thermocouples
4. Hioki CT6844-05 AC/DC Current Probe (500A)
    a. Hioki current transducer probes (2) for high accuracy current measurement and power analysis
    b. Externally powered and fully isolated ground
5. DEWESoft power supply for current transducer probes with shunt cables for connection to Sirius DAQ unit.
6. DEWESoft Power Analyzer software plug-in for DAQ
    a. Supports multiple calculations based on voltage and current, including harmonics and frequency.
7. Tesla J1772 to Tesla proprietary adapter
8. Break out box for data logging all connections of the J1772 charging connection

9. Sound level meter with NIST traceable calibration for measuring noise level

A. Data Recording and Calculations

Data logging was used to identify power quality issues that could create a safety issue or limit mobile EV charger performance and/or longevity. Temperature monitoring of mobile EV charging system components was performed to identify potential areas of concern with regard to safety and component durability. Sound level measurements were captured during active charging of the BEV.

Total energy transfer to the vehicle was recorded with high-accuracy inductive clamps and direct monitoring of voltage from the charging cable. Average voltage and current are calculated from data log files. Total energy transferred to the vehicle is calculated from Volts * Amps = Watts. Values are presented as kilowatts (1000 Watts)

V. METHODOLOGY

A. Safety and Compliance Documentation

The standard and certification list below is applicable to gasoline fueled generators and AC Level 2 EVSE. AAA Automotive engineering expects products to be certified/labeled as described below. The generator and EVSE are each appropriately certified (Figure 9). The combination of products does not require any additional certification.

- As per OSHA regulations, workplace equipment must be listed or labeled according to an appropriate safety standard.
    - The mark/label from a nationally recognized testing laboratory (NRTL) will meet the requirement for workplace safety.
- FCC Part 15 – Radio Frequency Devices
    - The unit must be FCC-EMC compliant. The Federal Communications Commission (FCC) is responsible for regulating electromagnetic compatibility in the United States. This may be a self-declaration or require a system level EMC test to show compliance.
- Commercial Electric Vehicle Service Equipment (EVSE)
    - UL 625 Standard for charging equipment used to charge PHEV and BEV vehicles. UL category code FFWA for supplying AC electricity to the vehicle, category code FFTG for supplying DC electricity to the vehicle.
    - UL 2594[4] Standard for Electric Vehicle Supply Equipment for AC Level 2 charging.
- Generator power supply
    - Proper documentation includes a valid workplace safety certification (OSHA compliant) and statement regarding necessity to ground the generator during operation.
    - Operating conditions, including temperature and weather resistance should be clearly stated in the operator's manual.
    - Maintenance schedule, if applicable, should be clearly stated in the operator's manual.
    - UL 2594 for charging station functionality assuming AC output Level 1 or Level 2.

[4] https://standardscatalog.ul.com/standards/en/standard_2594_2

	Blink
General	
Workplace Safety (OSHA listing/label)	Yes
FCC Part 15 - Radio Frequency devices	Yes
Commercial EV Service Equipment	
UL 625 Charging Equipment Supplying AC or DC	Yes
UL 2594 (AC Level 1 or 2 Charging)	Yes
Documentation for Operating Conditions	Yes
Documentation for Weather Resistance	Yes
Generator Power Supply	
Documentation for Operating Conditions	Yes
Documentation for Weather Resistance	Yes
Unit Grounding Requirements	Yes
Maintenance Schedule	Yes

Figure 9: Safety and Compliance Documentation: Summary Image source: AAA

Safety and compliance documentation status in the chart (Figure 9) is based on provision of the indicated documentation either by label on the device, or inclusion in operator's manual.

B. Mobile Charging Unit Basic Functionality

The AC Level 2 mobile EV charger should compatible with all modern BEVs. Not every battery electric vehicle is capable of DC fast charging, but all modern BEVs can be charged via the J1772 Level 2 AC protocol. In the case of Tesla, an adapter is required. In the U.S. market, every Tesla vehicle is delivered with the adapter included in the vehicle's charging kit. AAA service providers that offer mobile EV charging typically purchase a J1772 to Tesla adapter to ensure it is available when needed (Figure 10). The J1772 to Tesla adapter is available from Tesla[5] for $50[6].

[5] https://shop.tesla.com/product/sae-j1772-charging-adapter
[6] Price from Tesla was $95 when first sourced in 2019.

Figure 10: J1772 to Tesla charging adapter Image source: Tesla

The generator of the Gen 2 unit uses regular gasoline with no more than 10% ethanol. Run time is estimated to be 5.5 hours in the generator operator's manual. In testing, the unit was used on three consecutive 45 minute charging sessions without refueling. The supplied wheel kit can be removed for semi-permanent mounting in a roadside service vehicle.

C. Charging Scenarios

Within this document, the following descriptions apply to "out of charge" and "low on charge" roadside service events:

Out of Charge service: The BEV has been operated until it will not drive any further. The situation is analogous to "run out of gas and engine will not restart."

Low on Charge service: The BEV owner/AAA member is aware they do not have sufficient range to complete their trip or make it to an accessible charging station. The BEV is not yet disabled, but requires additional range to drive to a charging station. This scenario is realistic for a BEV driver who arrives at a charging station to find it out of service, and the vehicle has insufficient charge to drive to the next nearest charging station.

Each BEV identified in Section IV was discharged and provided a partial re-charge using the Blink Mobile Charging Unit, generation 2 for each service type described above. Recharging was only conducted in the context of these "realistic" scenarios. Specifically, vehicles were not fully recharged and vehicles with over 25 miles of driving range were not considered to need roadside assistance for charging.

D. Test Setup

Each BEV started a test session with a minimum of 25 miles displayed driving range. The vehicle was operated on a combination of highway and city driving until driving range is in the single digits. Vehicle was then operated in a location where roadside service can be safely performed and is easily accessible by a service vehicle.

The BEV under test was driven until desired level of discharge is reached and parked/coasted to a safe location for service. Time of disablement is noted, and the roadside service event is targeted to start after 45

minutes to simulate AAA response time and allow for BEV battery pack temperature adjustments in a realistic manner.

The Blink Mobile Charging Unit, Generation 2 is transported to the BEV in a pickup truck to be realistic in terms of unit orientation (height from ground level). Data logging equipment and independent power supply is transported to the scene with the mobile charging equipment.

AAA previously used a Tesla Model 3 to evaluate mobile charging equipment. Characteristics of vehicle discharge, warnings to the driver, and the general speed of recharge based on power applied is known. One trial at a Low State of Charge was performed with the 2023 Tesla Model 3.

The Polestar 2 is a new vehicle to AAA Mobile EV Charging evaluations. The Polestar 2 was evaluated at both Low State of Charge and Out of Charge conditions.

VI. TEST RESULTS

A. Partial Vehicle Charging

The Blink Mobile Charging Unit, Generation 2, was evaluated using the two test vehicles with the BEVs in a state of needing to add range, and out of charge. Results for individual charging sessions are summarized in the chart below. Observations for each mobile charging unit follow the summary data chart.

Figure 11 details the vehicle status and displayed range values. Displayed range is what is shown on the instrument panel. Actual range is the difference in miles actually traveled relative to the displayed range.

Data log values for voltage and current are averaged for 15, 30, and 45 minutes during the charging sessions. Best practice is to turn off climate controls in the BEV.

Blink Mobile Charging Unit, Generation 2

	Vehicle Inverter Capacity	Level of Discharge	Start	15 Minutes		30 Minutes		45 Minutes		Data Log		Energy
			Displayed Range	kWh Charged	Displayed Range	kWh Charged	Displayed Range	kWh Charged	Displayed Range	Voltage (average)	Current (average)	Rate of charge kW/hour
Tesla Model 3 2023	11.5 kW	Add Range	5 mi	1.9	**12 mi**	3.7	**21 mi**	5.7	**29 mi**	243.60	31.34	7.6
Polestar 2 2023	11 kW	Out of charge	0 mi	1.8	**5 mi**	3.7	**10 mi**	5.6	**16 mi**	240.56	31.29	7.5
		Add Range	5 mi	1.8	**12 mi**	3.7	**20 mi**	5.3	**28 mi**	241.29	31.27	7.5
Polestar 2 with A/C on while charging			5 mi	1.8	**10 mi**	3.7	**16 mi**	5.3	**22 mi**	241.58	31.52	7.6

Figure 11: Blink Mobile Charging Unit, Generation 2 results from individual charging events Image source: AAA

The bottom two rows of figure 11 document the difference in results when leaving the air conditioning running vs. off (for the “Add Range” scenario). Ambient temperature was approximately 90°F during each of the charging events.

One test series with the Polestar 2 was conducted with the Gen 1 and Gen 2 chargers for directly comparable results as illustrated in Figure 12. The vehicle was driven to the Low on Charge state (5 miles

driving range remaining in both instances). The Gen 1 unit delivered approximately 20% more driving range in the same time as compared to the Gen 2 unit performance.

Polestar 2: Low on Charge			
Driving Range added for Charge Time in minutes			
Blink Gen 2		Blink Gen 1	
15 min	30 min	15 min	30 min
10	16	12	20

Figure 12: Charging results comparison: Blink Gen 1 and Gen 2 Image source: AAA

The power generation from the Gen 2 unit is more efficient than the Gen 1. The generator power capacity is reduced by 38% from Gen 1 to Gen 2, and the resulting (average) miles range added in 30 minutes is similarly reduced by 39%.

Note on displayed driving range

Understanding the displayed driving range near “empty” on BEVs is important for setting customer expectations at the roadside. The Polestar 2 used in this evaluation “ran out” of charge at the same time the driving range display went to zero (0) miles. For the Polestar, using EPA efficiency information, the vehicle will travel an average of 3.2 miles per kWh of electric energy. Put in one kWh and you will add approximately 3.2 miles of driving range.

For some BEVs, there may be a “reserve capacity” that has to be recharged prior to displaying positive driving range (miles). In a previous AAA test, a 2019 model Tesla 3 drove an additional 13 miles after the driving range display went to zero (0) miles. The 2019 Tesla is rated at 3.8 miles per kWh. The lowest usable capacity of the battery is not “linear” in comparing energy capacity to driving range. More energy will be added at the beginning of the charging session to “refill” the reserve capacity of the battery and continued charging will be more normal in terms of energy added equaling the expected increase in driving range.

B. Noise Level

Noise level was recorded during active charging with the generator under consistent load. The generator placement at the rear of a pickup truck is representative of actual roadside service conditions. Sound measurements were taken at a distance above ground equal to the height of the muffler assembly on the generator and are provided in Figures 13 and 14.

Noise Levels from Generator (dBA*)

Gen 2			Distance	Gen 1		
Orientation of Generator (exhaust to right)				Orientation of Generator (exhaust to rear)		
left	back	right		left	back	right
101.1	96.1	99.8	3 ft	106.6	109.0	110.4
81.6	86.1	82.7	12 ft	87.7	91.0	94.9
78.8	81.6	78.6	20 ft	82.3	82.5	85.7

**Noise levels are measured in decibels (dB); dB(A) is a weighted scale that corresponds to the hearing threshold of the human ear.*

Figure 13: Noise level comparison Gen 1 to Gen 2 Image source: AAA

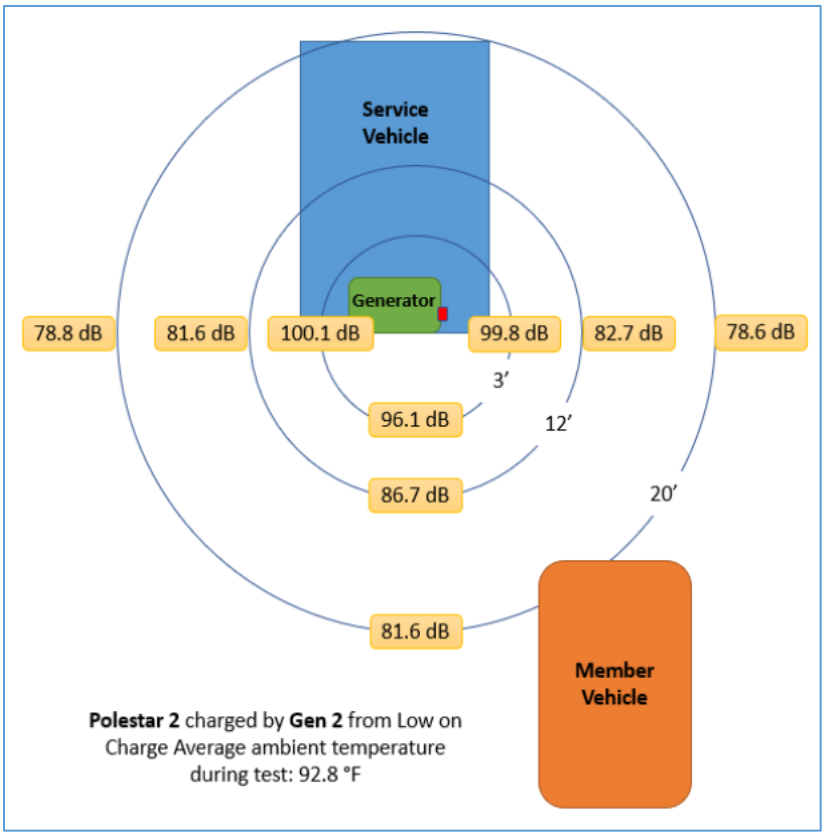

Figure 14: Noise levels Gen 2 showing orientation Image source: AAA

It should be noted that many smartwatches automatically display a notice of a loud environment to its user which is triggered at a specific decibel threshold specific to manufacturer and/or user settings. Depending on perceived risk tolerance of the Member, a notification of this nature could cause unease, concern, irritation, or a combination of various emotions.

Figure 15: Sample loud environment notification from Apple Watch Image source: Apple

In order to mitigate Member discomfort and possible socialization of a negative experience, it is recommended that ear protection be offered to the Member while the generator is in operation or that the member wait in the service vehicle.

C. Heat Output

Heat output from the generator was recorded in various locations during the BEV charging session with the generator under consistent load. Comparative temperature measurements between the Blink Gen 1 and Gen 2 mobile charging units are provided in Figure 16. Charging sessions were conducted on the same day, following test guidelines for the low on charge scenario, and under nearly identical weather conditions. Ambient temperature measured two feet from the charging port of the BEV is used as the comparative to calculate temperature increase from the generator. Figure 17 illustrates relative position of the service truck, generator, and locations where temperature measurements were collected while charging the Polestar 2 in a low charge condition with the Blink Mobile Charging Unit, Generation 2.

Heat Levels from Generator (°F)

Temperature Elevation from Ambient (°F)*

Blink Mobile Charging Unit, Generation 2 (ambient 92 °F)			Distance	Blink Mobile Charging Unit, Generation 1 (ambient 89 °F)		
Orientation of Generator (exhaust to right)				Orientation of Generator (exhaust to back)		
left	back	right		left	back	right
159 +66	182 +89	288 +195	1 ft	142.44 +53.02	328.45 +239.03	176.2 +86.78
149 +57	137 +45	267 +174	3 ft	130.7 +41.28	188.53 +99.11	155.35 +65.93
	102 +9		6 ft		126.31 +36.89	
	98 +5		12 ft		96.12 +6.70	

**Ambient temperature elevation is measured against temperature near the vehicle charging port at the same time as generator heat value.*

Figure 16: Noise level comparison Gen 1 to Gen 2 Image source: AAA

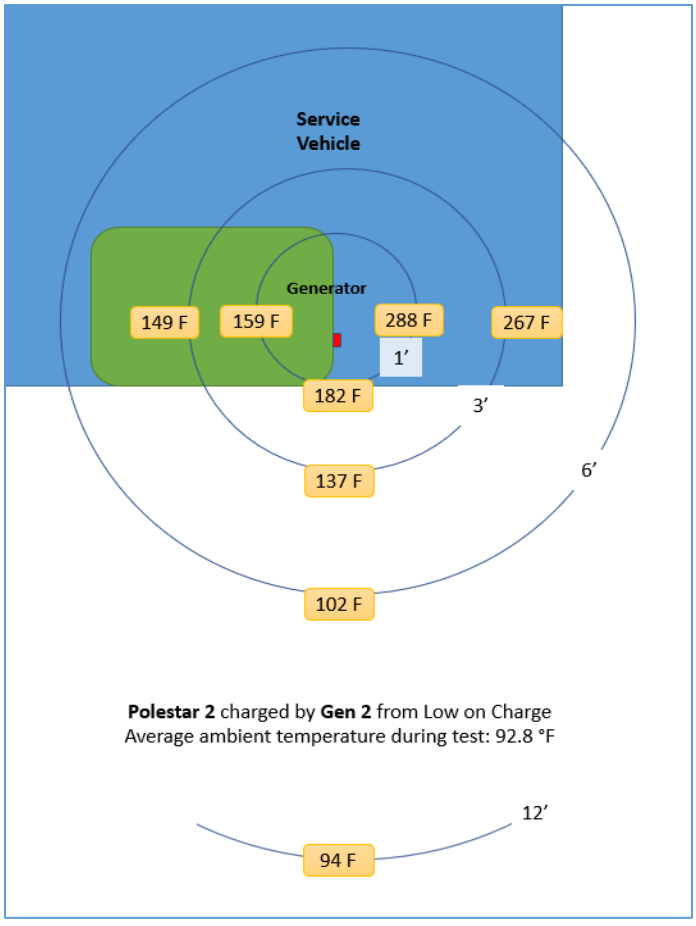

Figure 17: Heat output from Blink Mobile Charging Unit, Generation 2 Image source: AAA

VII. KEY FINDINGS

1. Does the Blink Gen 2 equipment successfully deliver a partial charge to battery electric vehicles in anticipated roadside service conditions?
    a) Yes – The Blink Mobile Charing Unit, Generation 2 successfully provided a partial charge to two BEVs. At 15 minutes charging time, displayed driving range increased an average of 5.7 miles. At 30 minutes charging time, displayed driving range increased an average of 13.7 miles
    b) In a direct comparison (same vehicle, same conditions), the Gen 1 unit provided 20 miles driving range in 30 minutes and the Gen 2 unit which provided 16 miles additional driving range.
2. Is the Blink Gen 2 mobile charging unit documented for electrical and worker safety according to equipment type and anticipated use?
    a) Yes – Blink Gen 2 has UL certification on the Simpson generator, and UL certification on the HQ 200 Blink charging unit.
3. Are there build quality concerns for the unit(s) evaluated?
    a) The Blink Gen 2 unit has the EVSE (charging unit) mounted in an orientation that blocks 120V outlets on the generator. This does not interfere with mobile EV charging, but limits additional uses[7] that the generator equipment might serve, including, but not limited to disaster recovery aid and power outages.
    b) The Blink Gen 2 unit is provided with wheels and a flip-up handle to enable easy movement of the unit. In practice, AAA service providers often securely mount the generator chassis to a truck slide. In these instances, the mobile charging unit assembly is not intended for relocation after mounting in the service vehicle. Security (theft prevention) is a high priority for equipment used in roadside service operations.

VIII. CONCLUSION

The Blink Mobile Charging Unit, Generation 2 was successful in delivering a partial charge to both battery electric vehicles tested. The amount of driving range delivered in 30 minutes varies by vehicle specification, the level of battery discharge, and other factors that include battery state of health and internal temperature. The energy delivered may not agree with the vehicle's driver information center "range" estimate. Consumer expectations must be carefully managed before committing to a roadside charging session. The Blink Mobile Charger added an average of 13.7 miles of driving range in 30 minutes. In a direct comparison test, the Gen 1 unit delivered 20 miles additional driving range in 30 minutes to a Polestar 2 that was in a low on charge condition (5 miles range displayed). The Gen 2 unit delivered 16 miles additional driving range to the same vehicle under similar conditions.

[7] The user manual, published by Blink, includes the following note (page 6 of 13): "The Generator is meant exclusively for EV Charging using Blink HQ 200 Smart. The use of the Generator for OTHER APPLICATIONS is NOT RECOMMENDED by Blink Charging. This can void Blink warranty on the Mobile charger product."

The Blink Mobile Charging Unit, Generation 2 was supplied to AAA for evaluation with adequate certification and safety documentation for use in the U.S. market. In addition, the generator section is CARB certified for use in California. Both the generator and charging unit portions of the assembly are rated for outdoor use over a wide temperature range.

Mounting of the charging unit must consider heat output from the generator exhaust. Noise levels from the generator can exceed 90 decibels and may trigger a “Loud Environment” warning from a Member’s smartwatch. Hearing protection is recommended for both roadside service operators and persons accompanying the vehicle receiving assistance.

AAA Clubs and fleet operators will need to evaluate the total time requirement to providing mobile charging and allow the member to complete their trip without the need to tow the stranded battery electric vehicle.