

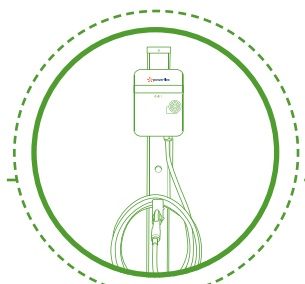


+ E-BOOK

Electric School Bus Charging: What to Know

Key Considerations When Choosing Chargers for Your Electric School Bus Fleet

10-Minute Read



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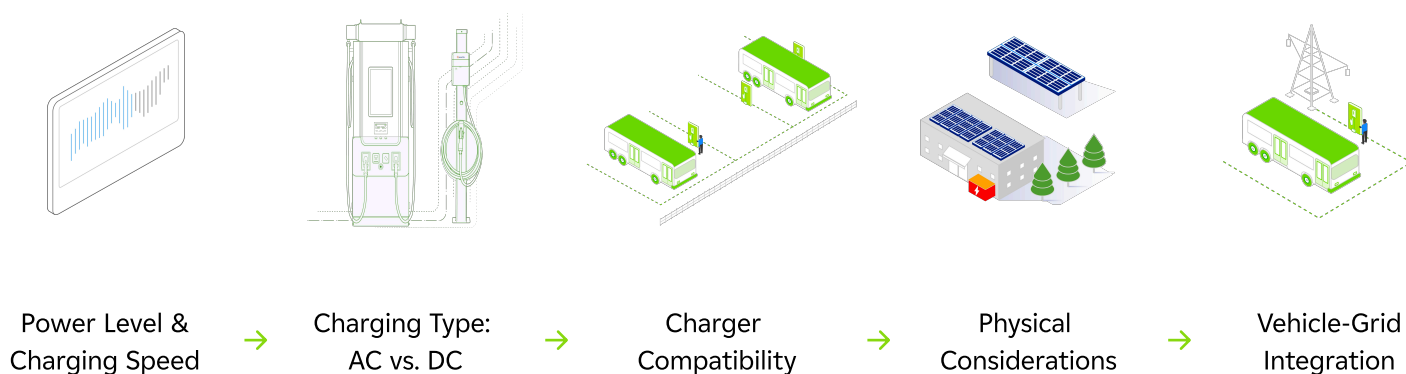
Electric school bus (ESB) fleets require carefully planned and reliable charging solutions to ensure smooth, cost-effective operations. As EV charging technology continues to evolve, there's a growing variety of makes, models, and types of chargers from which to choose. Making the right choice takes a deep understanding of ESBs, chargers, electrical infrastructure, fleet operations, and much more.

PowerFlex takes a hardware-agnostic stance on chargers for school bus fleets, meaning that we want to support customers in choosing the best available charger models for their specific use case, without playing favorites. As an industry leader in charge management, we have an unparalleled depth of experience and expertise.

The following guide summarizes how we advise our school bus fleet customers to think about charger selection. We've broken the considerations into five categories: charger speed, AC vs. DC, charger compatibility (with the vehicle and electrical service), physical considerations, and V2G capability. We have also provided a list of charger types that we currently recommend to school customers, grouped by power level.

Charger Selection Journey

Options narrow along each step of the journey.



Power Level & Charging Speed

The power output of any charging station is a key factor in determining how quickly it will charge a vehicle. A charger's power is measured in kilowatts (kW) and can range from about 5 kW to over 350 kW. Vehicle battery capacity, on the other hand, is measured in kilowatt-hours (kWh) and can range from roughly 80-300 kWh depending on the bus type and manufacturer.

Battery capacity could be thought of like the size of a diesel bus' fuel tank. The more powerful the charger, the faster it's able to fill the battery with energy. For example, if a school bus has a 100-kWh battery, a 50-kW charger will add 50 kWh, or 50% of the battery, in one hour. A 25-kW charger would take two hours to charge the same amount.

Knowing the typical schedules for school bus operations, and the amount of time vehicles are sitting idle at the bus yard (dwell time), helps narrow down the common range of charging power required to ensure smooth school bus operations to roughly 10-60 kW.

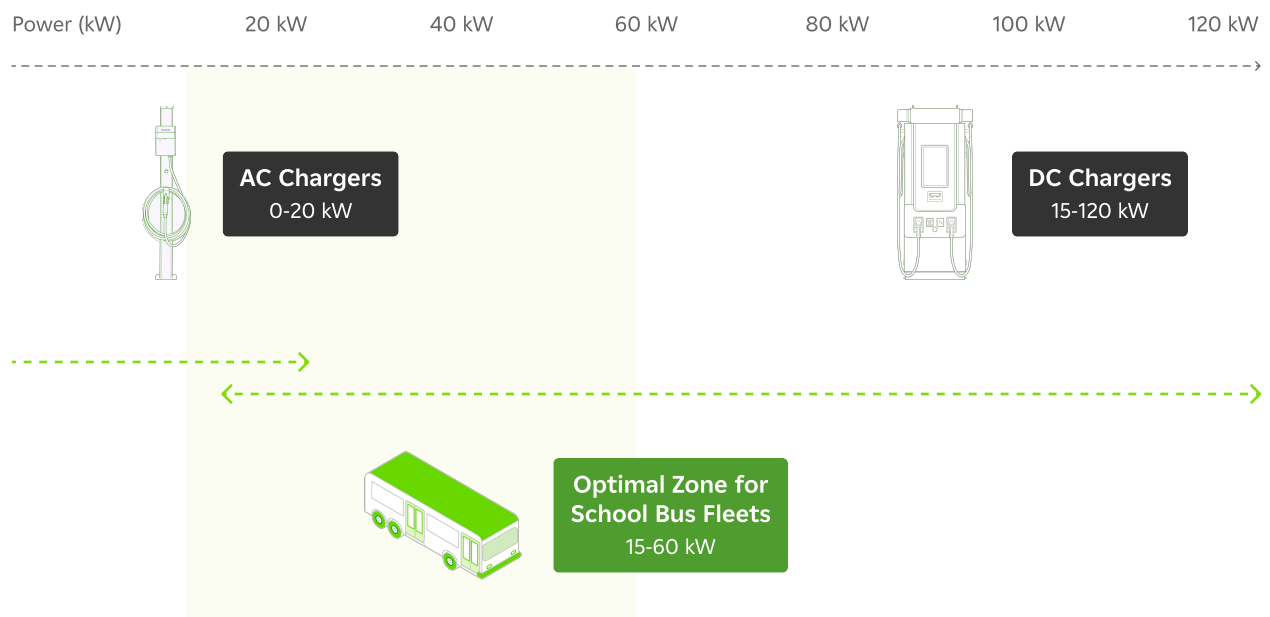
Depending on route length and bus type, some electric school buses may have enough range to complete their daily routes, morning and afternoon, without much need for midday charging. In this case, a lower-power AC charger in the 10-kW range would be a simple, low-cost solution. Buses that serve longer routes may require some midday charging to complete an afternoon trip, so a higher-powered AC charger or even DC charger may be a good fit. The maximum power of most AC chargers is 19.2 kW, and DC chargers start from around 20 kW. Finally, electric buses used for very long routes, midday routes, or field trips may require faster DC chargers to charge quickly as schedules dictate. For these use cases, 50-60-kW DC chargers could replenish a significant portion of the battery in just 2-3 hours. Charging any faster than this isn't usually required given typical school bus fleet operations. Most electric school buses can't accept a charge rate higher than 80-100 kW, so it's generally not worth it for school fleets to spend more for a higher-powered DC charger.



Charger Type: AC vs. DC

One basic way to categorize EV charging stations is whether they deliver AC (alternating current) or DC (direct current) power.

AC and DC chargers are also called Level 2 and DC Fast Chargers (DCFC), respectively. Our electrical grid uses AC power, while bus batteries accept DC power. This means that AC chargers are generally more affordable and simpler to install at a fleet depot or bus yard, but they charge at slower rates (19.2 kW max.) and require the vehicle itself to have an “onboard charger” to convert AC to DC power (see below for notes on charger/bus compatibility). DC chargers deliver DC power directly to the bus battery, allowing them to charge at significantly higher rates. This also means that DC chargers are generally more expensive and can be more complex to install, although the charge management system (CMS) can significantly reduce those challenges.



Based on our experience operating dozens of school bus charging sites and delivering hundreds of charging simulations, we have found that the sweet spot for school bus chargers is 19.2 kW AC and up to ~60-80 kW DC. Recently, many of our school bus sites have used “low-power” DC chargers between 20-30 kW per port.



Charger Compatibility

Another key consideration is selecting chargers that are compatible with onsite electrical infrastructure and the fleet's vehicles.

Vehicle Compatibility

As mentioned, because the electrical grid operates using AC power, and a vehicle's battery accepts DC power, there must be a conversion for the charger to deliver power to the vehicle. This conversion happens inside the unit for DC chargers and inside the vehicle's onboard charger for AC chargers.

Some electric school bus manufacturers include onboard chargers on all their buses, meaning they accept AC chargers. For other bus OEMs, including Blue Bird, it is an option with additional cost. Some manufacturers, notably Thomas Built, never include onboard chargers — meaning they can only charge using DC chargers. In addition, bus models often vary in the maximum power they are able to accept from chargers, thus limiting charger selection even more. See the tables on the next page for OEM-level data on the maximum vehicle acceptance rates for AC and DC charging.

Electrical Compatibility

For an EV charger to be electrically compatible, input voltage of the charger must match the voltage of the site's electrical service. In the United States, most residential and smaller commercial electrical services receive 240V power. Larger commercial and industrial buildings often have 480V electrical service. Unless a school facility or transportation yard has large machinery or other power-intensive equipment, many will have 240V service. All AC chargers have an input voltage of 240V, making them more affordable and simpler to install on existing electrical panels at most sites. With very few exceptions, DC chargers have an input voltage of 480V, which may require a transformer to increase voltage or new electrical service brought in from the local utility. Regardless of the voltage of the existing electrical service onsite, it is critical to check the specifications of a charger to determine if its input voltage is compatible with the electrical infrastructure that will be used to feed the charger.

Maximum vehicle acceptance rates for AC and DC charging

Check with OEM or bus dealers for latest specifications on updated bus models.

Type A

Bus OEM	BYD	GreenPower	Lion Electric	Micro Bird
Model	Type A	Nano Beast	LionA	Micro Bird G5
Max AC Charger	19.2 kW	19.2 kW	19.2 kW	13.2 kW
Max DC Charger	110 kW	65 kW	50 kW	50 kW

Type B

Bus OEM	Blue Bird	BYD	IC Bus	Lion Electric	Thomas Built
Model	Blue Bird Vision	Type C	CE Series	LionC	Saf-T-Liner C2 Jouley
Max AC Charger	19.2 kW (on request)	19.2 kW	19.2 kW	13.2 kW	Not accepted
Max DC Charger	80 kW	110 kW	125 kW	50 kW	90 kW

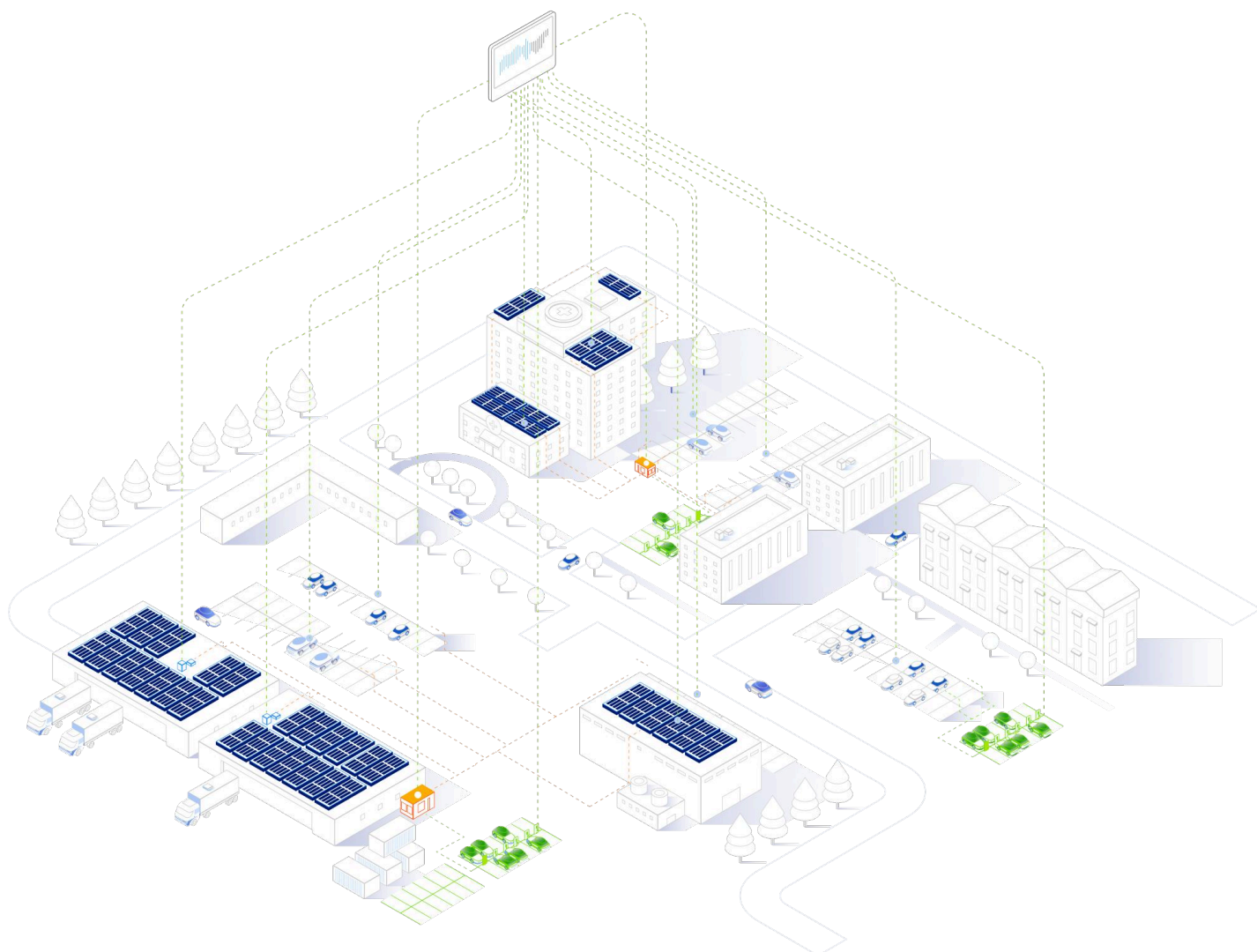
Type C

Bus OEM	Blue Bird	BYD	GreenPower	Lion Electric
Model	All American	Type D	BEAST	LionD
Max AC Charger	19.2 kW	19.2 kW	19.2 kW	19.2 kW
Max DC Charger	80 kW	110 kW	125 kW	50 kW



Charger/CMS Compatibility

Deploying a CMS like **ChargePilot® by PowerFlex** is the best way to ensure reliable and cost-effective fleet charging operations. One of the key requirements to consider is whether the charger uses Open Charge Point Protocol (OCPP) version 1.6J or later. This is the widely adopted communication standard that CMS software uses to communicate with and control charging stations. Another requirement to look for is whether the chargers have reliable means for connecting to a charge management software. This can be done via Wi-Fi or cellular signals, but a wired connection via ethernet cable is significantly more reliable, and requires charging stations to have an ethernet port on the unit itself. As the industry continues evolving, most chargers on the market today meet these requirements, but they continue to be important foundational requirements to understand.





Physical Considerations

A transition to electric school buses will impact fleet operations in many ways, but one of the biggest changes is the equipment required to fuel vehicles will now be co-located alongside school buses, which requires careful planning to ensure the physical layout of bus depots can support efficient fleet operations.

All charging stations on the market have slightly different configurations, features, and accessories that can impact the way they fit into a charging depot and ease of use day to day. Understanding the variety of options on the market can make effective use of space at a bus depot, and even build in some degree of flexibility in terms of charging and fleet operations.

Multi-port Chargers

Many charging stations, including both AC and DC models, have multiple charging ports so they can serve more than one vehicle and more than one parking stall. Multi-port chargers can be more cost-effective in terms of dollars per charging port, and they can also be a way to maximize physical space at a bus depot. One common configuration is to install dual-port chargers that have two charging cables coming from each charging station. Another configuration, more common in higher-powered DC chargers, is to have a charger with one central power cabinet located a distance away from parking stalls that supplies power to two, three, or even more charging ports. One critical feature to understand about multi-port chargers is the distinction between sequential and simultaneous charging. Sequential charging means

that a charger can only deliver power to one charge port at a time. Even though multiple buses can be connected at the same time, they will need to take turns charging. Depending on the internal logic of the charger, the order in which vehicles charge is sometimes based on the order that they plugged in. The right CMS may be able to overrule the charger's sequential logic, but this varies. The alternative to sequential charging is simultaneous charging, whereby a multi-port charger can deliver different amounts of power to each charging port at the same time. Most chargers can simply divide the total power evenly across all charge ports in use, but a charge management system can dispatch the available power in other increments based on a fleet's operational needs.

Charger Configurations and Optional Accessories

Understanding the various configurations and accessories available with different chargers can also help plan for hardware selection, site design, and operational efficiency. Many chargers that are well suited for school fleets can be mounted on the wall and/or on pedestals.

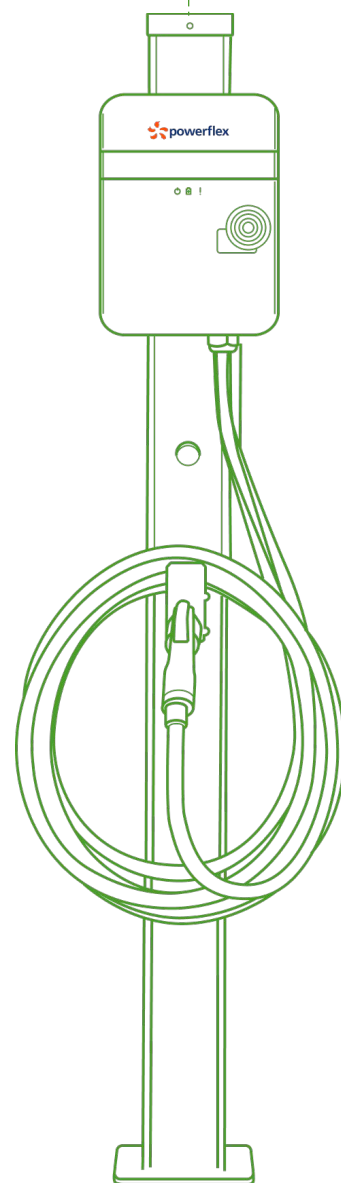
Depending on the physical layout of a bus depot, different options for mounting chargers can help maximize space and add flexibility to the fleet's charging operations. Another set of considerations and features that varies across brands and charger type is the length of the charging cable. In general, the maximum length for any EV charger cable is about 25 feet. A longer charging cable can add flexibility and versatility, especially since the location of the charge ports on school buses varies across bus OEMs. On the other hand, longer cables can be more cumbersome to handle. The importance of good cable management cannot be overstated, as cables require a level of care and attention to ensure they stay in working order.

Many chargers have optional cable management systems, such as cable retractors or holsters to safely stow the chargers when not in use, and to keep cables and the plugs off the ground. The added cost of these accessories is often well worth the investment to avoid excessive wear and tear on charging equipment that can lead to charging errors, damaged equipment, and reduced charger uptime.

Bidirectional/ V2G Chargers

School districts across the country continue to wonder if they should invest now in V2G-capable chargers as they begin adding electric buses to their fleets.

Connecting electric buses to the grid and monetizing their batteries is precisely the goal that PowerFlex is working toward. At the same time, there is a misconception that any school district in the country could simply purchase bidirectional chargers today and sell energy back to the grid tomorrow. The reality is that while these technologies exist today — and are rapidly improving and being deployed — many electric utilities aren't ready to offer programs that provide payment for electricity exported to the grid from buses to all customers. Before investing in V2G chargers, schools should consult their local utility to determine if they offer programs that will allow the district to earn enough money through participation to justify the higher equipment costs. PowerFlex also offers Vehicle-Grid Integration assessment services that provide an overview of V2G options for a school district given its location and model potential revenues. If V2G programs aren't available, another way to capture value and leverage school bus batteries in the near term would involve using unidirectional chargers, a CMS like **ChargePilot® by PowerFlex**, and participating in some of the existing utility programs for managed charging and demand response. By smart charging with an advanced CMS, you are setting yourself up to be ready for V2G as soon as it becomes commercially available.





Examples

Commonly Used Charger Powers & Example Models

Below, we've summarized the most common school bus charger types into four categories.

AC Wallbox (19.2 kW)

- Simple, low-cost chargers (under \$2,000)
- Flexible pedestal options for mounting two chargers side-by-side or back-to-back depending on site layout

DC Wallbox (20-25 kW)

- Simple, low-cost chargers (under \$2,000)
- Often offered in two models with different voltage input depending on existing site power (240V or 480V input)

30-50 kW Dual Port DC (wall-mounted or pedestal)

- Dual-port configuration means saving physical space and flexibility (e.g., 20 kW on two ports, or up to 40 kW on one if needed)
- Often have wall-mount or pedestal options

Multi-port DCFC

- Up to three high-powered ports with flexible physical configuration using power cabinet/dispensers
- Also see mobile DC units for bus garages or temporary solutions

Selecting the right charging solution for electric school bus fleets is paramount for ensuring smooth operations and maximizing benefits. **PowerFlex can help.**

Talk to an Expert Today →



About PowerFlex

PowerFlex is a clean technology solutions company making the transformation to carbon-free electrification and transportation possible. Our intelligent energy management platform PowerFlex X™ monitors, controls, and co-optimizes onsite assets like EV chargers, solar, energy storage, and microgrids — reducing overall energy costs through patented algorithms that maximize distributed energy resources.

PowerFlex is the largest installer of commercial solar in the United States, with over 500 megawatts (MW) of total solar capacity plus 50+ megawatt-hours (MWh) of battery energy storage. PowerFlex also manages more than 70,000 EV chargers nationwide, making it the largest hardware-agnostic EV charging provider in the U.S.

Through intelligent charging management and bidirectional vehicle-grid integration technology, PowerFlex enables electric vehicles to serve as flexible energy resources for transit agencies, school districts, and fleet operators.

PowerFlex is backed by EDF power solutions North America, Manulife Investments, and The Mobility House. Visit powerflex.com for more information and connect with us on [LinkedIn](#) and [YouTube](#).



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