Introductory Note: *This document contains both descriptions and pictorial representations (graphs) of the charging algorithms used with the Deltran family of battery charger products. The contents of these descriptions and graphs are not intended to either make or imply any specific guarantee or warranty with respect to either the physical configuration or performance of any of the battery charger products listed herein. Battery charger designs are subject to change without notice.* ***It is the responsibility of the end user to determine whether a specific battery charger is appropriate for use in any application. This includes determining and resolving any compatibility issues that may exist between a specific battery charger and a specific battery, whether those issues arise as a result of fundamental characteristics of either item or from exposure due to the intended application.*** *To that end, it is recommended that the end user should contact technical representatives from the manufacturer of each product to assist in making that determination.*

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Battery Tender® Junior 6V0.750A:

Stage 1) Bulk Charge: Red Light On, Green Light Off, Constant Current = 0.750 Amp, Transition to Stage 2, Absorption Charge when battery voltage reaches 7.2 VDC.
Stage 2) Absorption Charge: Technically, there is no clearly defined Absorption phase because there is no constant voltage period before the float / maintenance phase. However in the region where the battery voltage increases above 7.0 VDC, the normal minimum absorption voltage for a GEL cell, one could argue that there that there is some absorption activity taking place in terms of the battery electro-chemical reaction to the higher voltage.
Stage 3) There is no Equalization Charge, Go directly to stage 4.
Stage 4) Float Charge: Red Light Off, Green Light On. Float Voltage = 6.6 VDC. If an external load is applied to the battery while the charger is in stage 4, Float Charge, and if the battery voltage drops below a range between 6.0 to 6.25 VDC, then the charge cycle restarts.

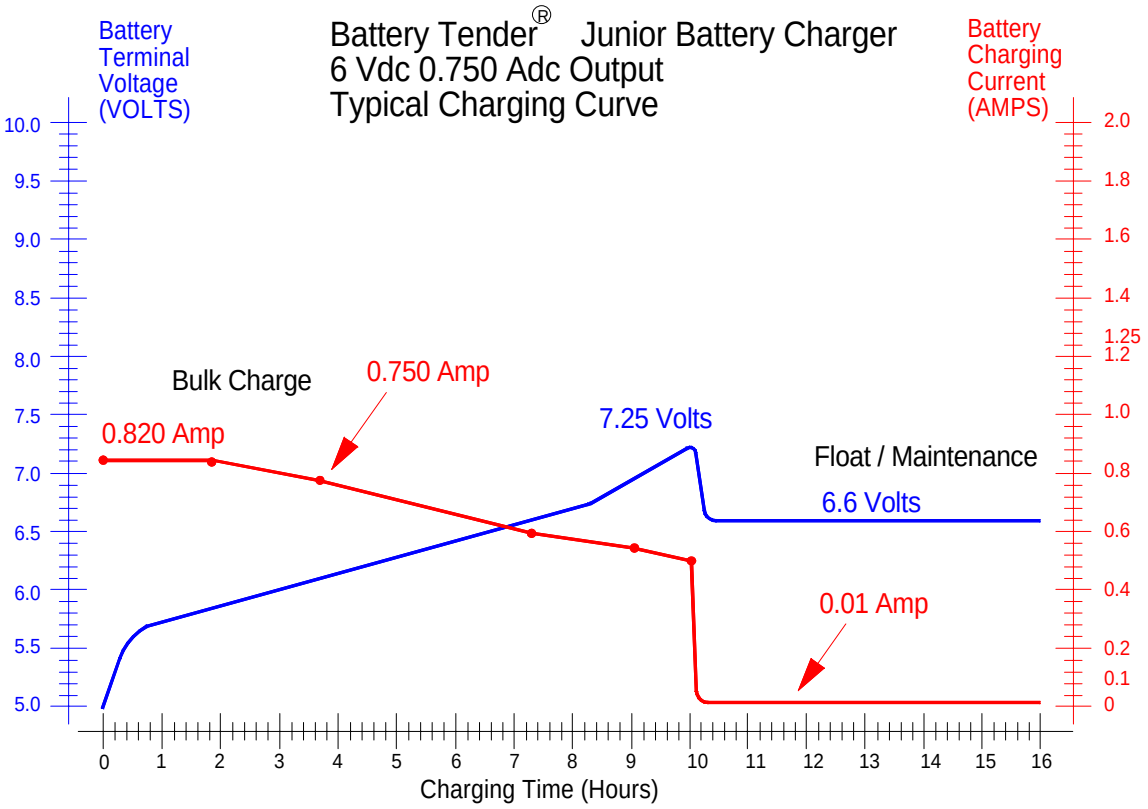

Figure 1 Charging Graph: Battery Tender® Junior 6V0.750A

Battery Tender® Junior 12V0.750A:

Stage 1) Bulk Charge: Red Light On, Green Light Off, Constant Current = 0.750 Amp, Transition to Stage 2, Absorption Charge when battery voltage reaches 14.4 VDC.
Stage 2) Absorption Charge: Technically, there is no clearly defined Absorption phase because there is no constant voltage period before the float / maintenance phase. However in the region where the battery voltage increases above 14.1 VDC, the normal minimum absorption voltage for a GEL cell, one could argue that there that there is some absorption activity taking place in terms of the battery electro-chemical reaction to the higher voltage.
Stage 3) There is no Equalization Charge, Go directly to stage 4.
Stage 4) Float Charge: Red Light Off, Green Light On. Float Voltage = 13.2 VDC. If an external load is applied to the battery while the charger is in stage 4, Float Charge, and if the battery voltage drops below a range between 12.0 to 12.5 VDC, then the charge cycle restarts.

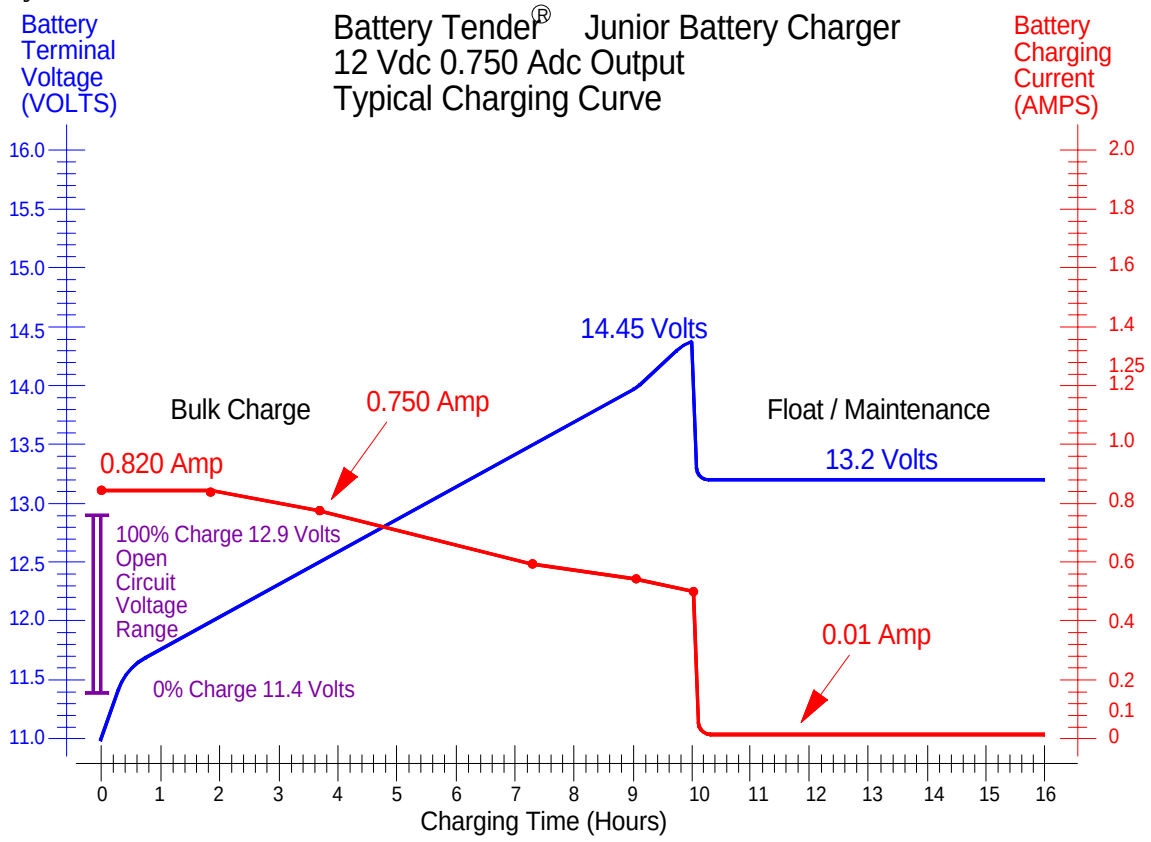

Figure 2 Charging Graph: Battery Tender® Junior 12V0.750A

Original Battery Tender® 12V1.25A:

Stage 1) Bulk Charge: Red Light On, Green Light Off, Constant Current = 1.25 Amps, Transition to Stage 2, Absorption Charge when battery voltage reaches 14.3 VDC.
Stage 2) Absorption Charge: Red Light On, Absorption Voltage = 14.3 VDC Transition to Float Charge when battery charging current drops below 0.5 amp.
Stage 3) There is no Equalization Charge, Go directly to stage 4.
Stage 4) Float Charge: Red Light Off, Green Light On. Float Voltage = 13.2 VDC. If an external load is applied to the battery while the charger is in stage 4, Float Charge, and if the battery voltage drops below a range between 12.0 to 12.5 VDC, then the charge cycle restarts.

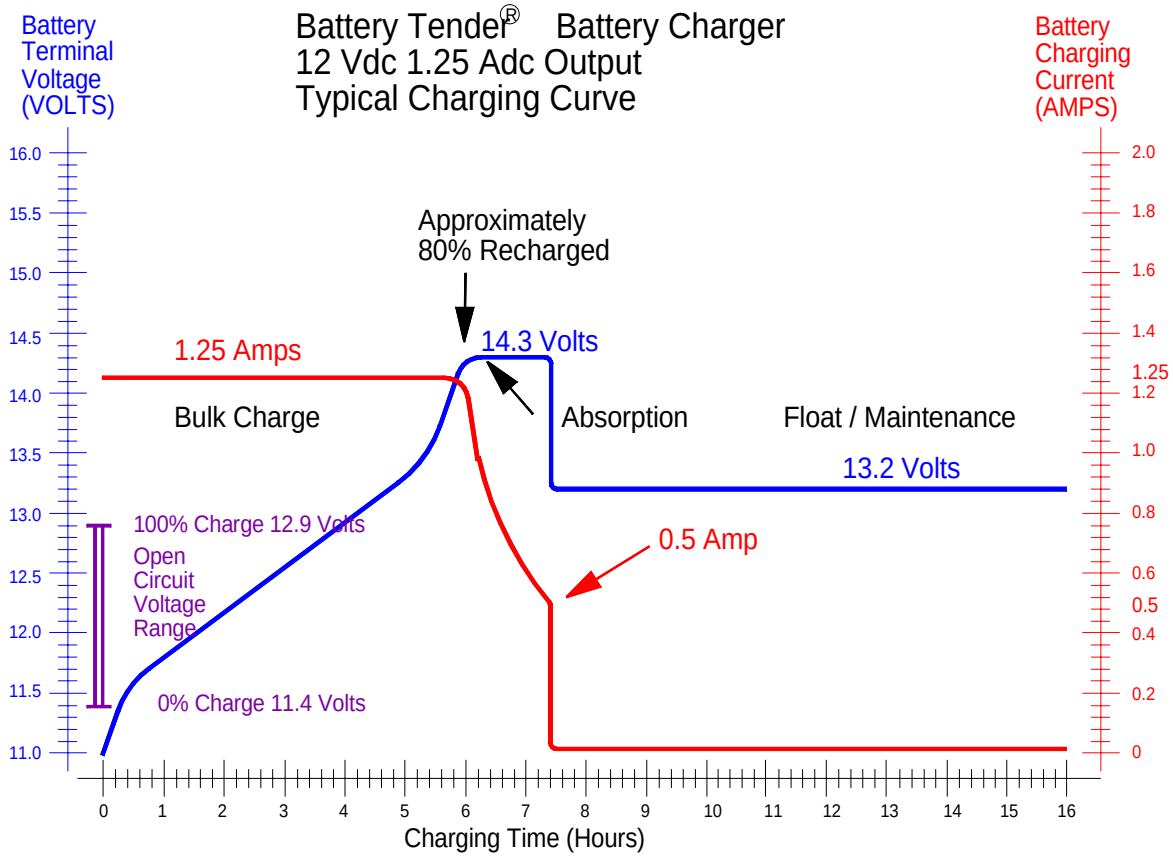

Figure 3 Charging Graph: Battery Tender® 12V1.25A

Battery Tender® Plus 6V1.25A:

Stage 1) Bulk Charge: Red Light On, Green Light Off, Constant Current = 1.25 Amps, Transition to Stage 2, Absorption Charge when battery voltage reaches 7.25 VDC.
Stage 2) Absorption Charge: Red Light On, Absorption Voltage = 7.25 VDC Transition to Float Charge when battery charging current drops below 0.1 amp or until 6 to 8 hours have elapses.
Stage 3) There is no Equalization Charge, Go directly to stage 4.
Stage 4) Float Charge: Red Light Off, Green Light On. Float Voltage = 6.6 VDC. If an external load is applied to the battery while the charger is in stage 4, Float Charge, and if the battery voltage drops below a range between 6.0 to 6.25 VDC, then the charge cycle restarts.

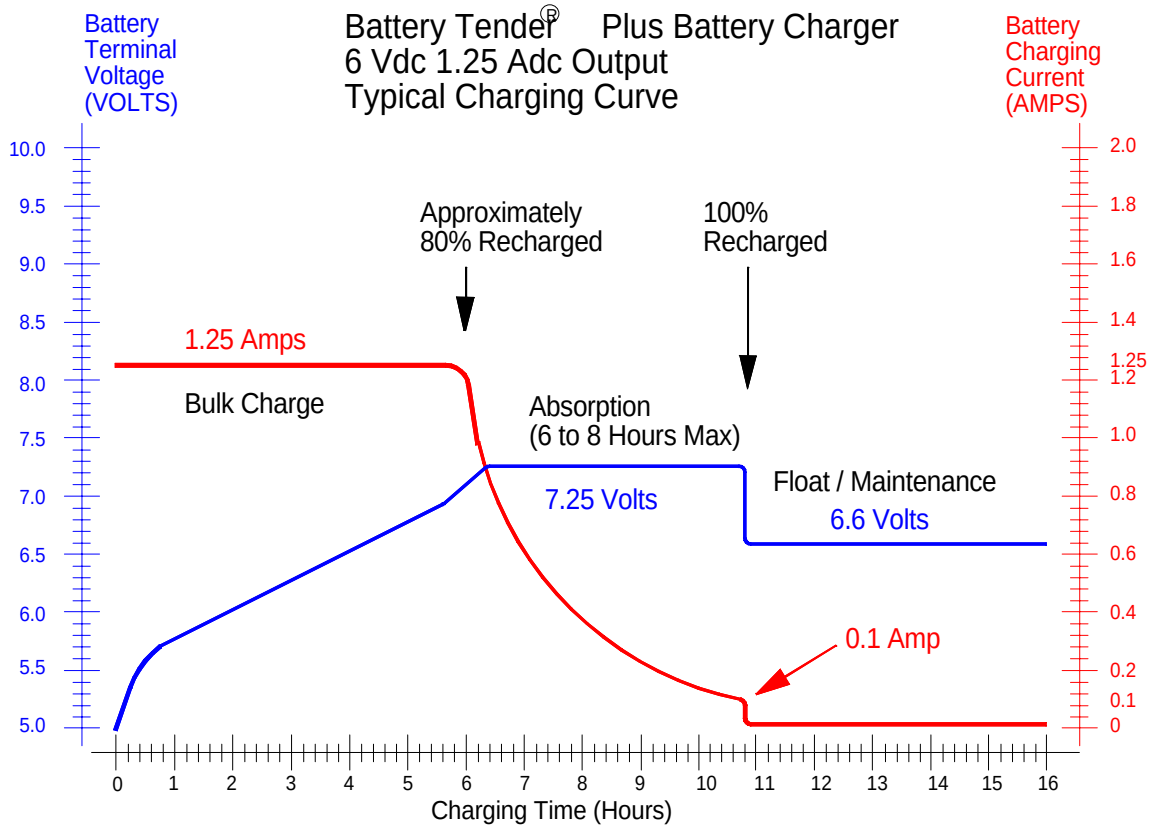

Figure 4 Charging Graph: Battery Tender® Plus 6V1.25A

Battery Tender® Plus 8V1.25A:

Stage 1) Bulk Charge: Red Light On, Green Light Off, Constant Current = 1.25 Amps, Transition to Stage 2, Absorption Charge when battery voltage reaches 9.65 VDC.
Stage 2) Absorption Charge: Red Light On, Absorption Voltage = 9.65 VDC Transition to Float Charge when battery charging current drops below 0.1 amp or until 6 to 8 hours have elapses.
Stage 3) There is no Equalization Charge, Go directly to stage 4.
Stage 4) Float Charge: Red Light Off, Green Light On. Float Voltage = 8.84 VDC. If an external load is applied to the battery while the charger is in stage 4, Float Charge, and if the battery voltage drops below a range between 8.0 to 8.25 VDC, then the charge cycle restarts.

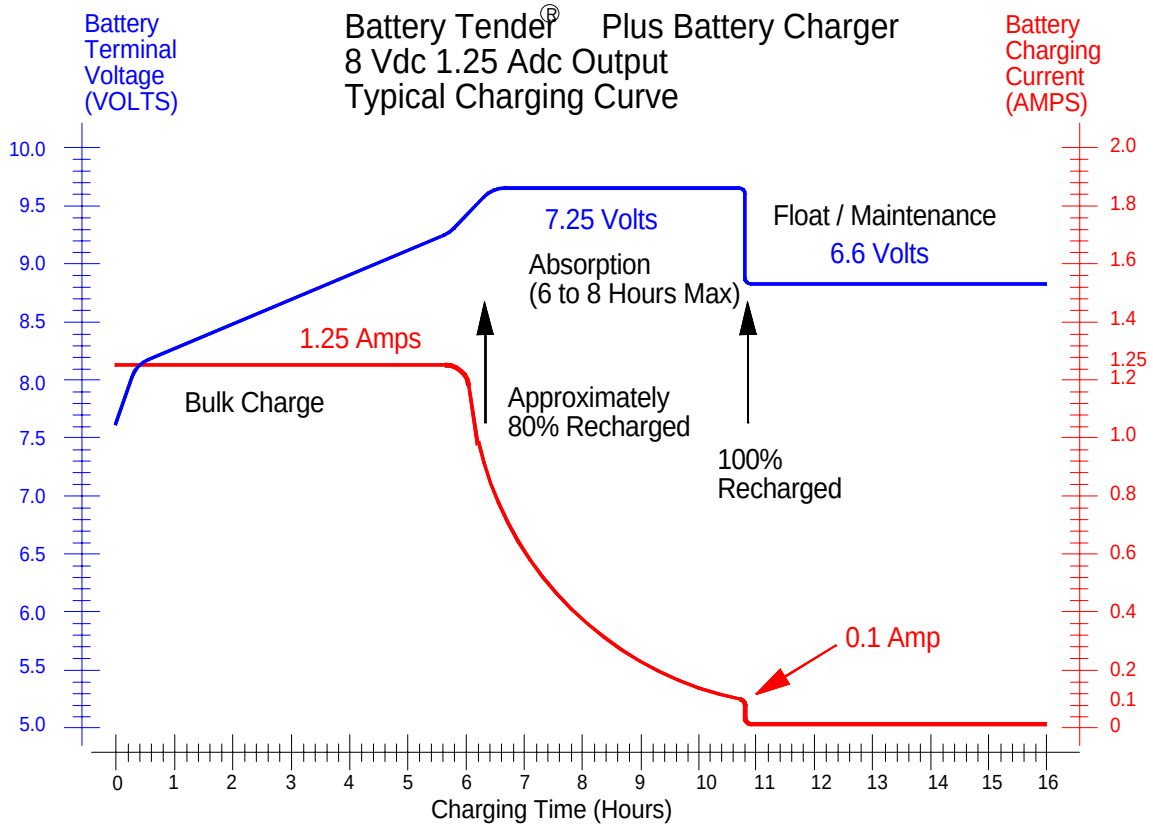

Figure 5 Charging Graph: Battery Tender® Plus 8V1.25A

Battery Tender® Plus 12V1.25A:

Stage 1) Bulk Charge: Red Light On, Green Light Off, Constant Current = 1.25 Amps, Transition to Stage 2, Absorption Charge when battery voltage reaches 14.4 VDC.
Stage 2) Absorption Charge: Red Light On, Absorption Voltage = 14.4 VDC Transition to Float Charge when battery charging current drops below 0.1 amp or until 6 to 8 hours have elapses.
Stage 3) There is no Equalization Charge, Go directly to stage 4.
Stage 4) Float Charge: Red Light Off, Green Light On. Float Voltage = 13.2 VDC. If an external load is applied to the battery while the charger is in stage 4, Float Charge, and if the battery voltage drops below a range between 12.0 to 12.5 VDC, then the charge cycle restarts.

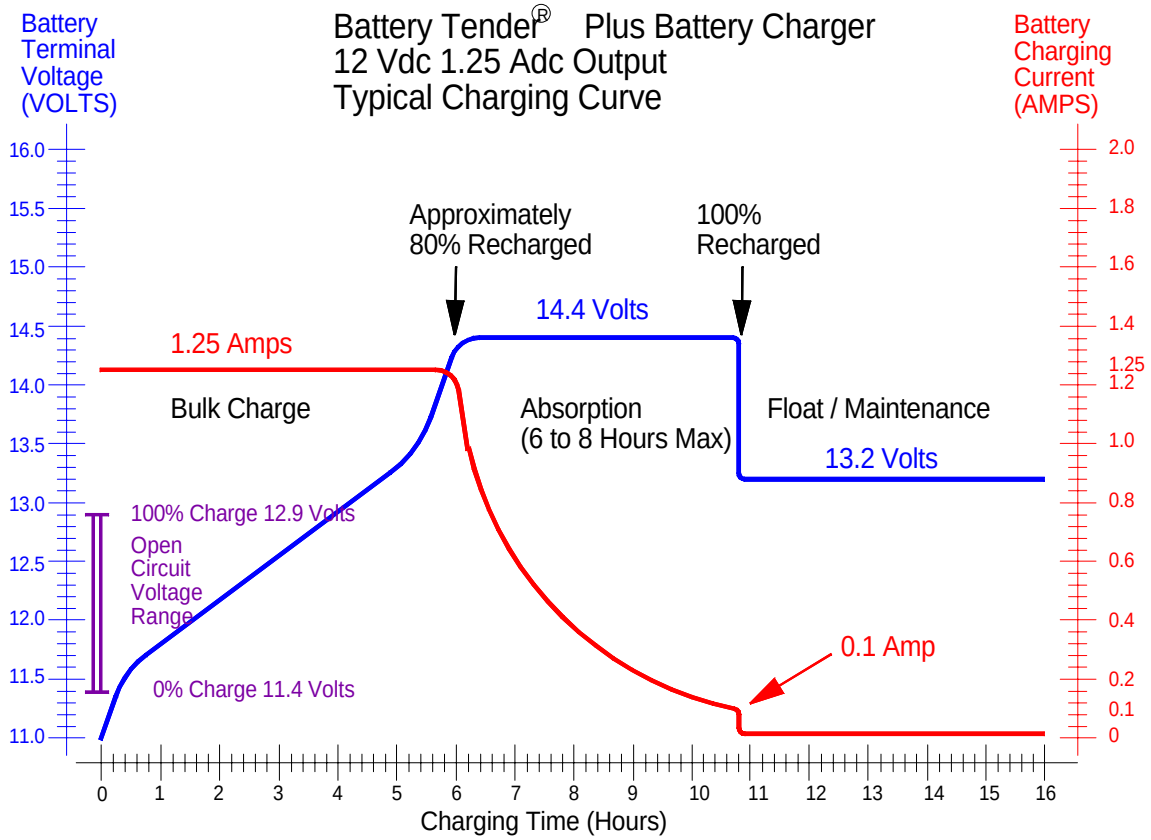

Figure 6 Charging Graph: Battery Tender® Plus 12V1.25A

This algorithm is also implemented in the new International Battery Tender®.

Battery Management Systems: Multiple Output Shop Chargers: 5 & 10 Bank "Gang Tenders": 12V2.0A:

Stage 1) Bulk Charge: Red Light On, Green Light Off, Constant Current = 2.0 Amps, Transition to Stage 2, Absorption Charge when battery voltage reaches 14.75 VDC.
Stage 2) Absorption Charge: Red Light On, Absorption Voltage = 14.75 VDC Transition to Float Charge when battery charging current drops below 0.1 amp or until 8 hours have elapses.
Stage 3) There is no Equalization Charge, Go directly to stage 4.
Stage 4) Float Charge: Red Light Off, Green Light On. Float Voltage = 13.5 VDC. If an external load is applied to the battery while the charger is in stage 4, Float Charge, and if the battery voltage drops below a range between 12.0 to 12.5 VDC, then the charge cycle restarts.

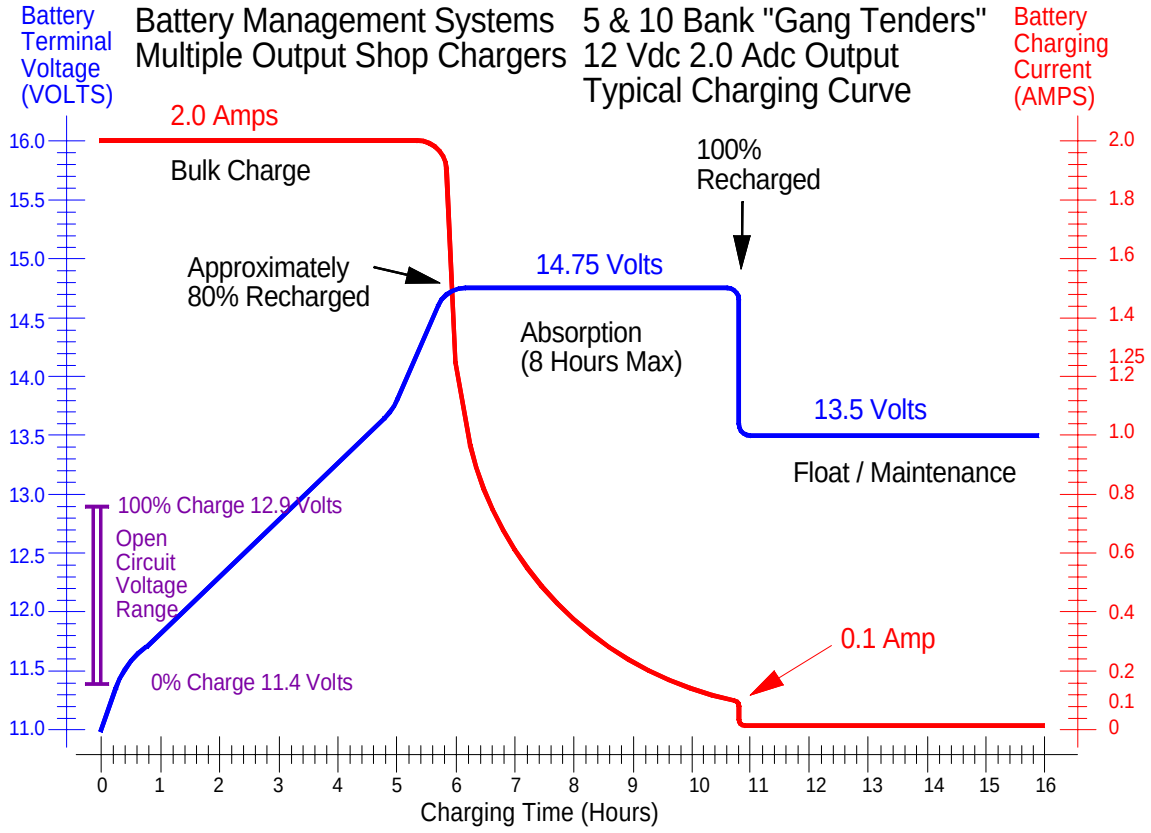

Figure 7 Charging Graph: 5 & 10 Bank BatMgmtSys 12V2.0A

Light Weight On-Board (Power Tender) 6V6A Models:

6V6A STANDARD:

Stage 1) Bulk Charge: Red Light On, Green Light Off, Constant Current = 5.5 Amps, Transition to Stage 2, Absorption Charge when battery voltage reaches 7.25 VDC.
Stage 2) Absorption Charge: Red Light On, Absorption Voltage = 7.25 VDC Transition to Float Charge when battery charging current drops below 3.0 amps.
Stage 3) There is no Equalization Charge, Go directly to stage 4.
Stage 4) Float Charge: Red Light Off, Green Light On. Float Voltage = 6.8 VDC. If an external load is applied to the battery while the charger is in stage 4, Float Charge, and if the battery voltage drops below a range between 12.0 to 12.5 VDC, then the charge cycle restarts.

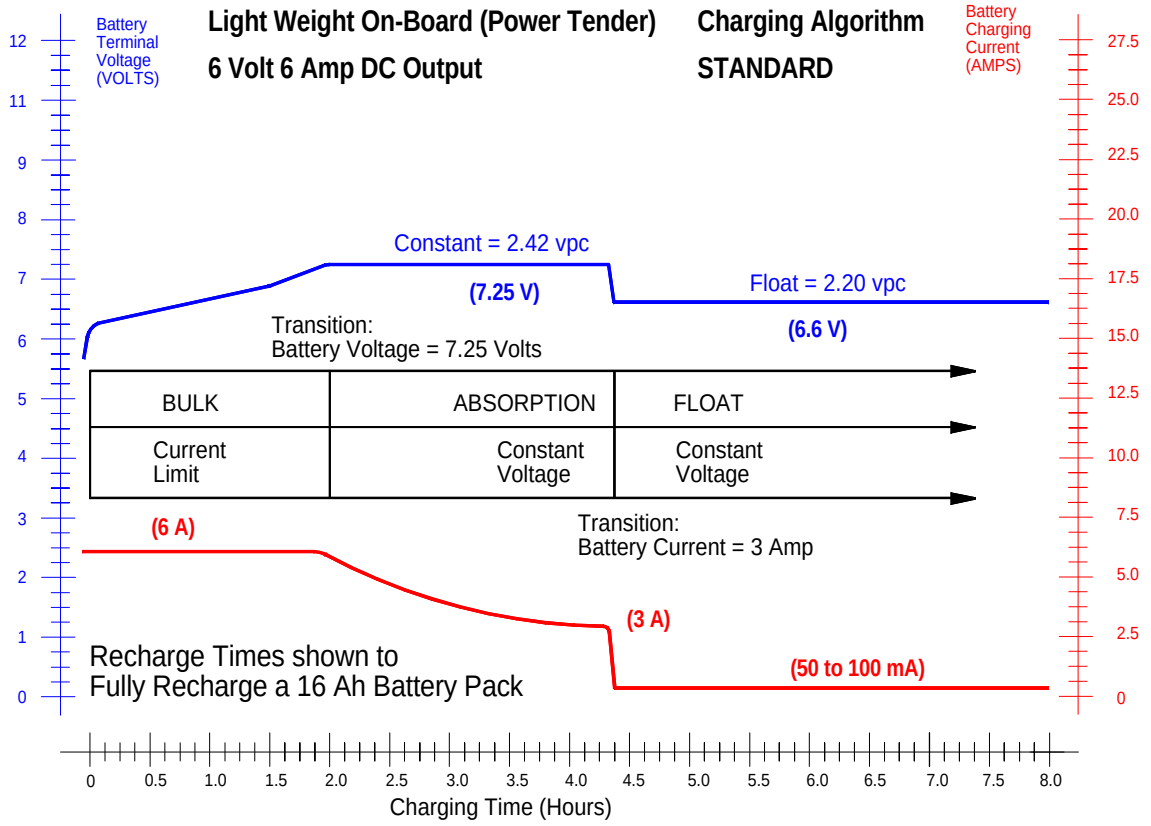

Figure 8 Charging Graph: LWOB Power Tender 6V6A STD

6V6A Sealed/VRLA/GRT/AGM (Hawker/Optima):

Stage 1) Bulk Charge: Red Light On, Green Light Off, Constant Current = 5.5 Amps, Transition to Stage 2, Absorption Charge when battery voltage reaches 7.45 VDC.
Stage 2) Absorption Charge: Red Light On, Absorption Voltage = 7.45 VDC Transition to Float Charge when battery charging current drops below 3.0 amps.
Stage 3) There is no Equalization Charge, Go directly to stage 4.
Stage 4) Float Charge: Red Light Off, Green Light On. Float Voltage = 6.8 VDC. If an external load is applied to the battery while the charger is in stage 4, Float Charge, and if the battery voltage drops below a range between 12.0 to 12.5 VDC, then the charge cycle restarts.

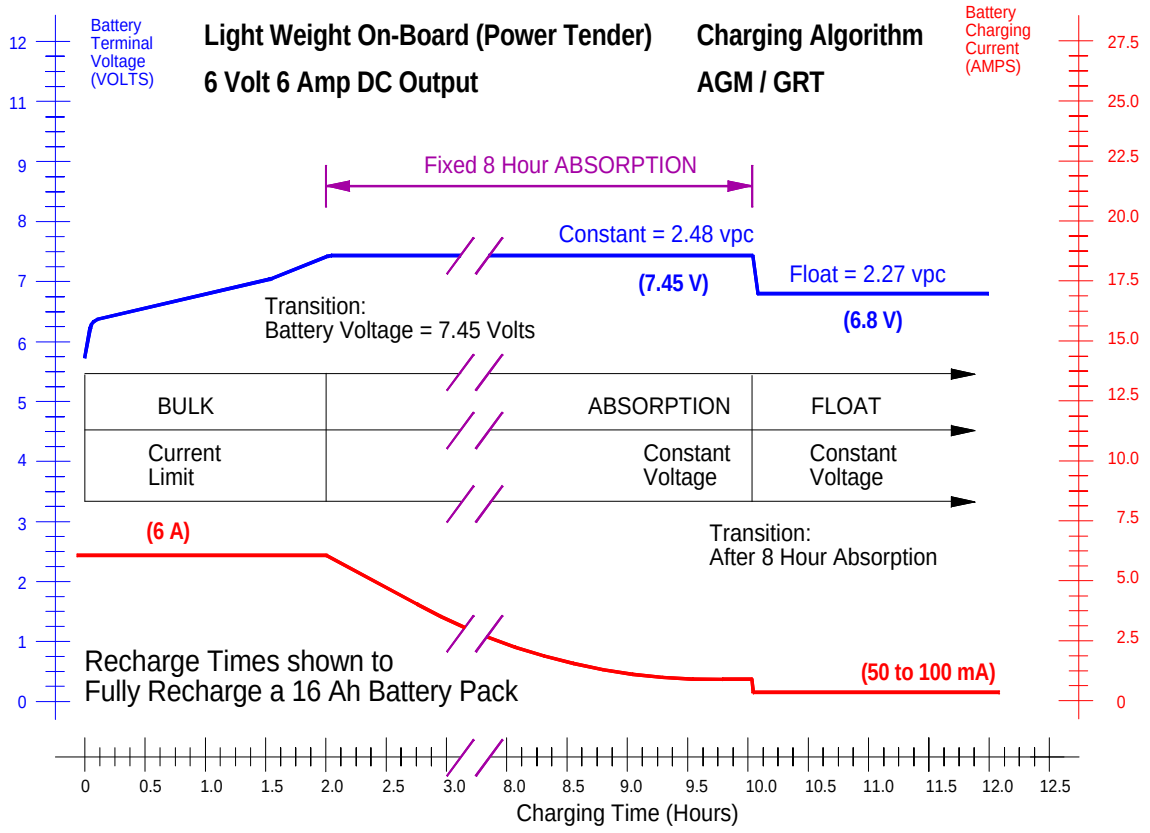

Figure 9 Charging Graph: LWOB Power Tender 6V6A AGM

Light Weight On-Board (Power Tender) 12V6A Models:

12V6A STANDARD:

Stage 1) Bulk Charge: Red Light On, Green Light Off, Constant Current = 5.5 Amps, Transition to Stage 2, Absorption Charge when battery voltage reaches 14.5 VDC.
Stage 2) Absorption Charge: Red Light On, Absorption Voltage = 14.5 VDC Transition to Float Charge when battery charging current drops below 3.0 amps.
Stage 3) There is no Equalization Charge, Go directly to stage 4.
Stage 4) Float Charge: Red Light Off, Green Light On. Float Voltage = 13.2 VDC. If an external load is applied to the battery while the charger is in stage 4, Float Charge, and if the battery voltage drops below a range between 12.0 to 12.5 VDC, then the charge cycle restarts.

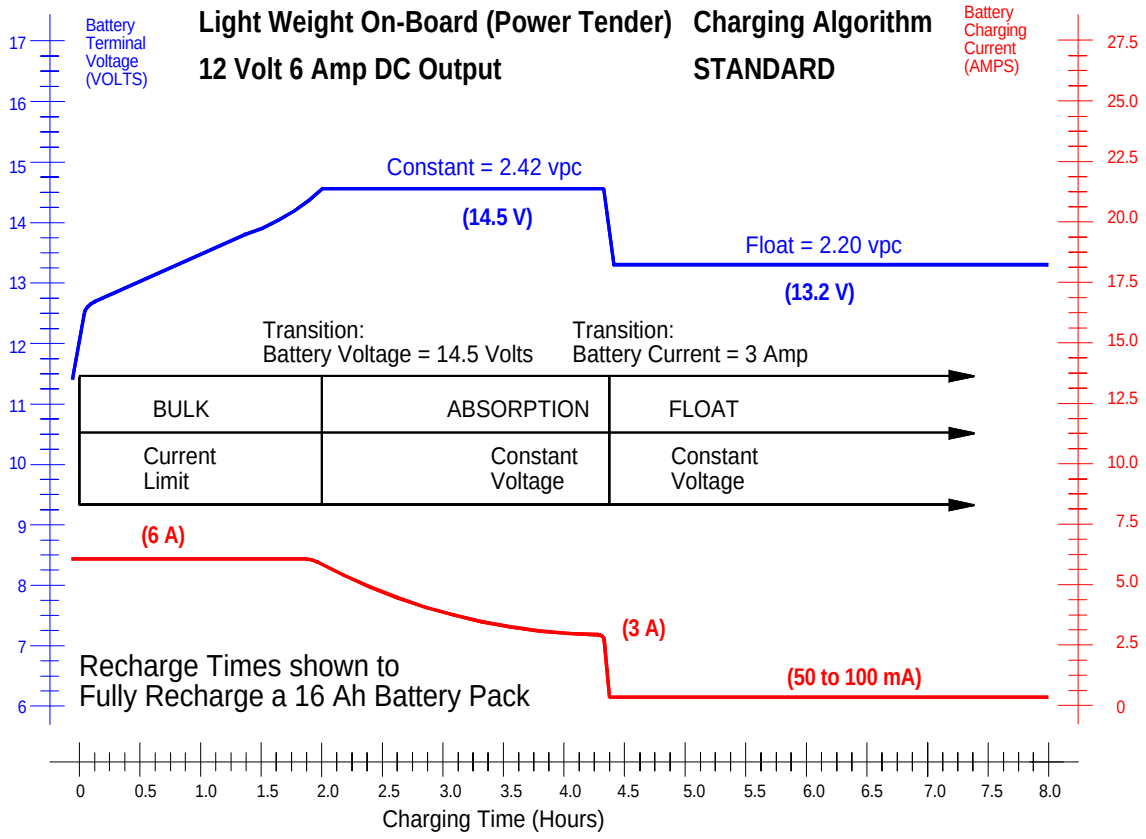

Figure 10 Charging Graph: LWOB Power Tender 12V6A STD

12V6A Sealed/VRLA/GRT/AGM (Hawker/Optima):

Stage 1) Bulk Charge: Red Light On, Constant Current = 5.5 Amps, Transition to Stage 2, Absorption when battery voltage reaches 14.9 VDC.
Stage 2) Absorption Charge: Red Light On, Green Light Flashing, Absorption Voltage = 14.9 VDC Transition to Float Charge 8 hours after entering stage 2.
Stage 3) There is no Equalization Charge, Go directly to stage 4.
Stage 4) Float Charge: Red Light Off, Green Light On. Float Voltage = 13.6 VDC. If an external load is applied to the battery while the charger is in stage 4, Float Charge, and if the battery voltage drops below a range between 12.0 to 12.5 VDC, then the charge cycle restarts.

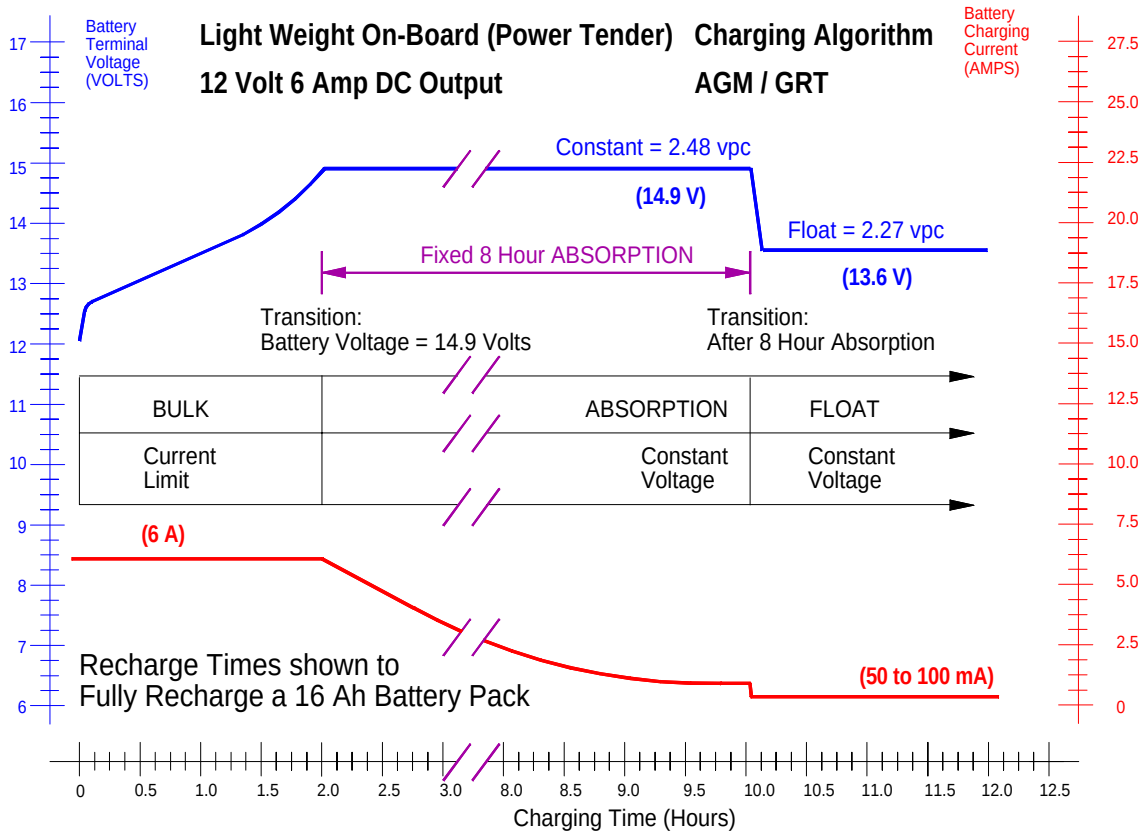

Figure 11 Charging Graph: LWOB Power Tender 12V6A AGM

12V6A GEL:

Stage 1) Bulk Charge: Red Light On, Green Light Off, Constant Current = 5.5 Amps, Transition to Stage 2, Absorption Charge when battery voltage reaches 14.1 VDC.
Stage 2) Absorption Charge: Red Light On, Absorption Voltage = 14.1 VDC Transition to Float Charge when battery charging current drops below 3.0 amps.
Stage 3) There is no Equalization Charge, Go directly to stage 4.
Stage 4) Float Charge: Red Light Off, Green Light On. Float Voltage = 13.2 VDC. If an external load is applied to the battery while the charger is in stage 4, Float Charge, and if the battery voltage drops below a range between 12.0 to 12.5 VDC, then the charge cycle restarts.

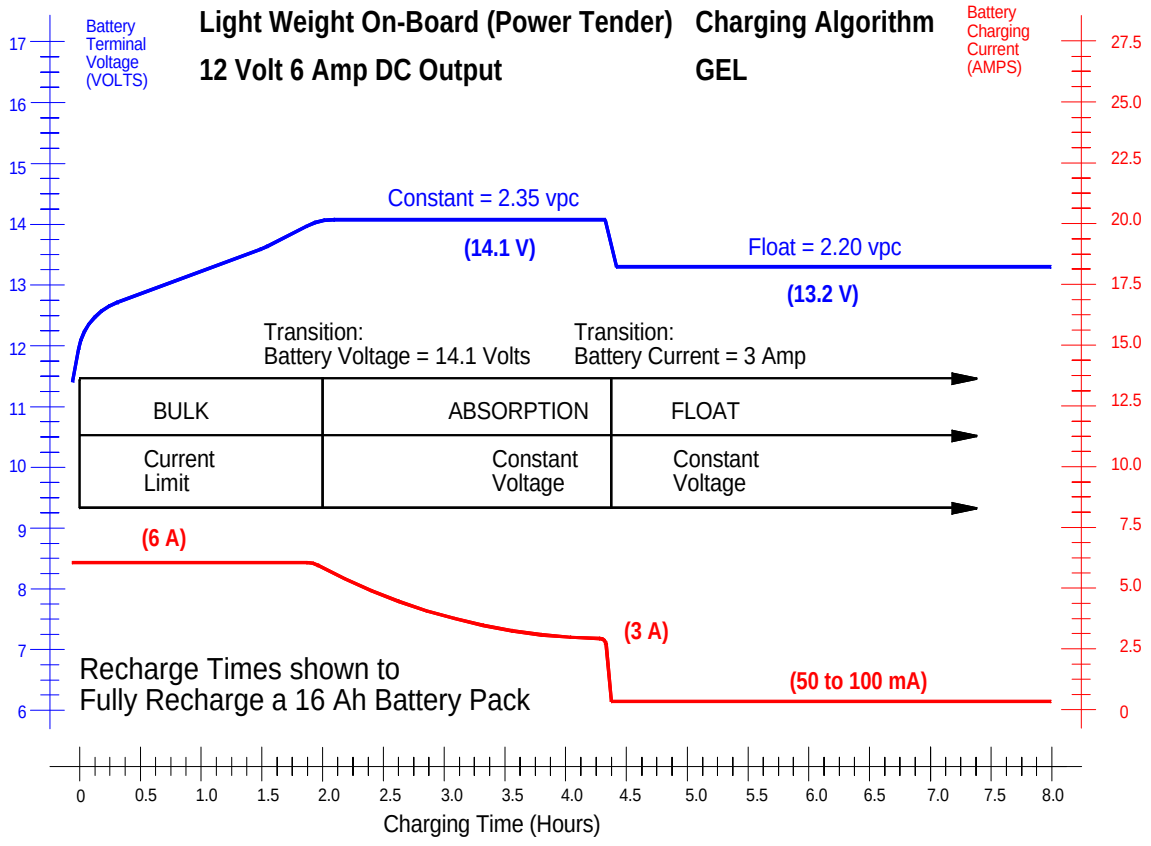

Figure 12 Charging Graph: LWOB Power Tender 12V6A GEL

Light Weight On-Board (Power Tender) 24V3A Models:

24V3A STANDARD:

Stage 1) Bulk Charge: Red Light On, Green Light Off, Constant Current = 3.0 Amps, Transition to Stage 2, Absorption Charge when battery voltage reaches 29.0 VDC.
Stage 2) Absorption Charge: Red Light On, Absorption Voltage = 29.0 VDC Transition to Float Charge when battery charging current drops below 1.0 amp.
Stage 3) There is no Equalization Charge, Go directly to stage 4.
Stage 4) Float Charge: Red Light Off, Green Light On. Float Voltage = 26.4 VDC. If an external load is applied to the battery while the charger is in stage 4, Float Charge, and if the battery voltage drops below a range between 24.0 to 25.0 VDC, then the charge cycle restarts.

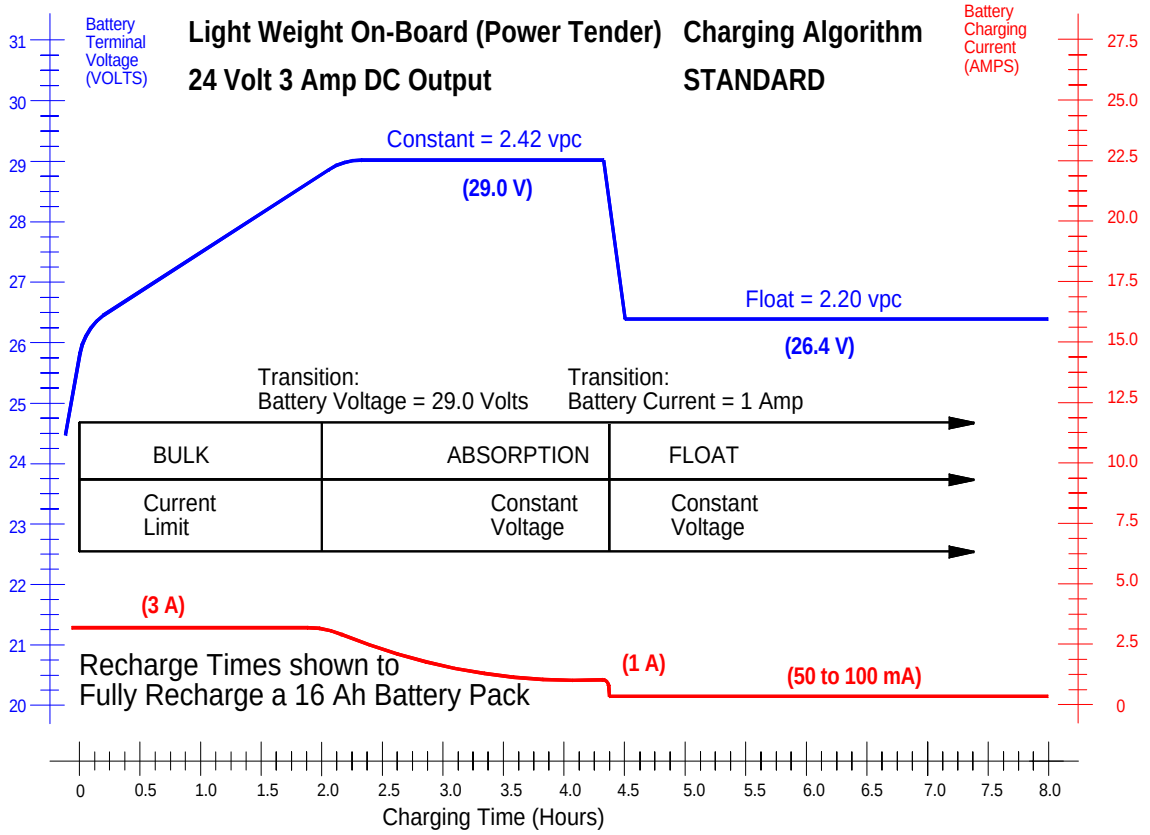

Figure 13 Charging Graph: LWOB Power Tender 24V3A STD

24V3A Sealed/VRLA/GRT/AGM (Hawker/Optima):

Stage 1) Bulk Charge: Red Light On, Constant Current = 3.0 Amps, Transition to Stage 2, Absorption when battery voltage reaches 29.8 VDC.
Stage 2) Absorption Charge: Red Light On, Green Light Flashing, Absorption Voltage = 29.8 VDC Transition to Float Charge 8 hours after entering stage 2.
Stage 3) There is no Equalization Charge, Go directly to stage 4.
Stage 4) Float Charge: Red Light Off, Green Light On. Float Voltage = 27.2 VDC. If an external load is applied to the battery while the charger is in stage 4, Float Charge, and if the battery voltage drops below a range between 12.0 to 12.5 VDC, then the charge cycle restarts.

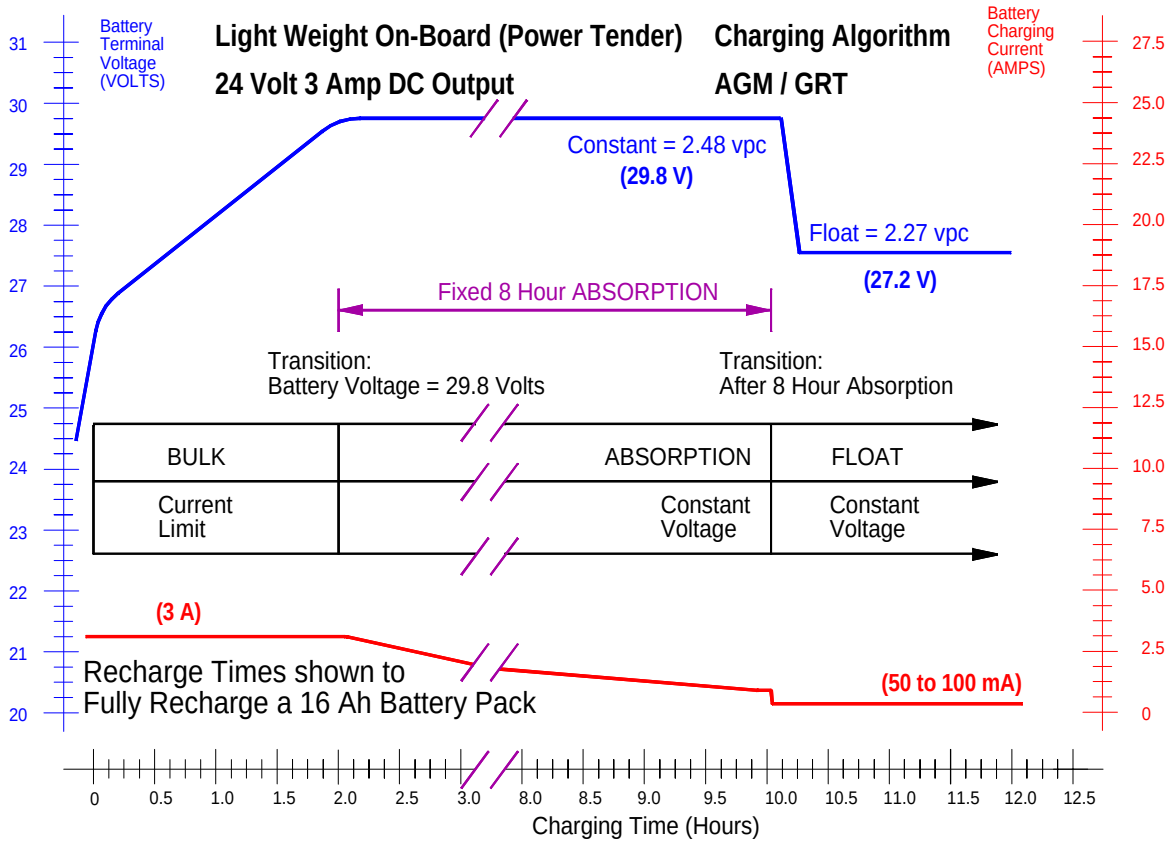

Figure 14 Charging Graph: LWOB Power Tender 24V3A AGM

High Frequency SuperSmart® (Golf Cart) 12V20A Models:

12V20A STANDARD:

Stage 1) Bulk Charge: Amber Light On, Constant Current = 20.0 Amps, Transition to Stage 2, Absorption Charge when battery voltage reaches 14.5 VDC.
Stage 2) Absorption Charge: Amber Light On, Absorption Voltage = 14.5 VDC Transition to Float Charge when battery charging current drops below 3.0 amps.
Stage 3) There is no Equalization Charge, Go directly to stage 4.
Stage 4) Float Charge: Amber Light Off, Green Light On. Float Voltage = 13.2 VDC. If an external load is applied to the battery while the charger is in stage 4, Float Charge, and if the battery voltage drops below a range between 12.0 to 12.5 VDC, then the charge cycle restarts.

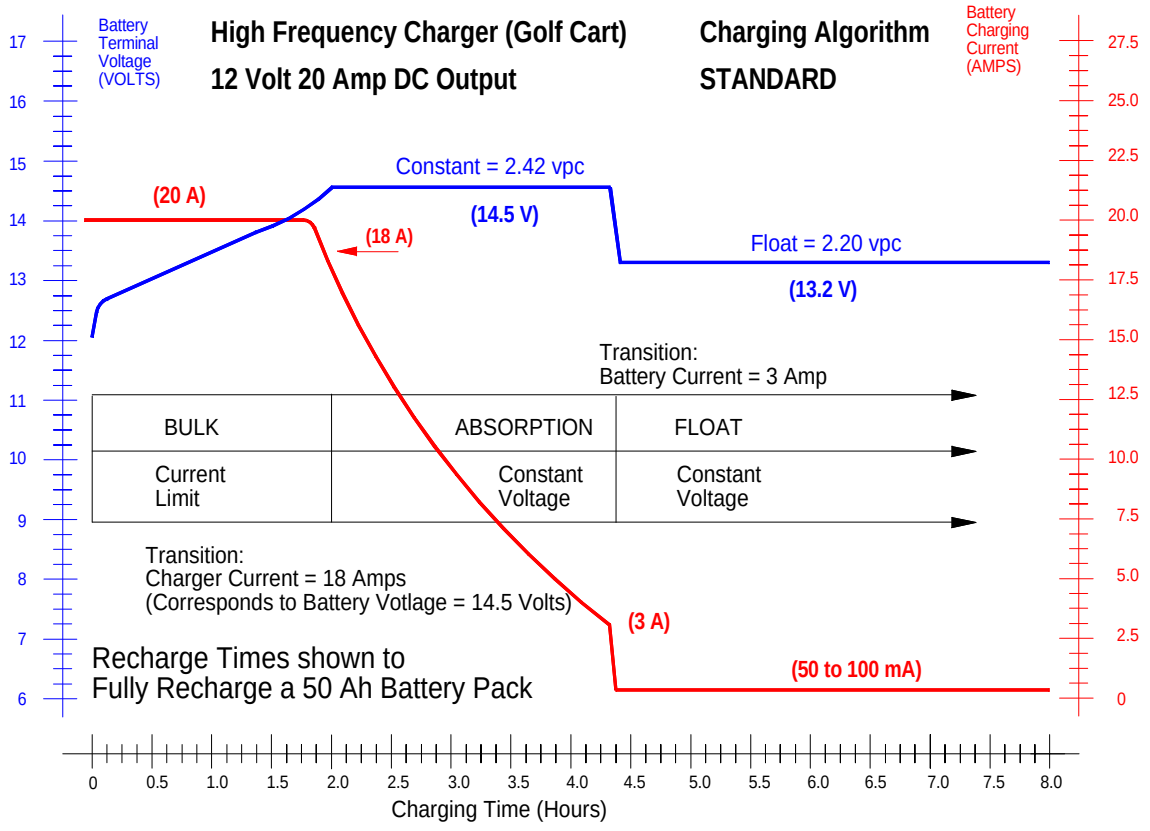

Figure 15 Charging Graph: HF SuperSmart® 12V20A STD

12V20A Sealed/VRLA/GRT/AGM (Hawker/Optima): Adaptive 4-Step:

Stage 1) Bulk Charge: Amber Light On, Constant Current = 20.0 Amps, Transition to Stage 2, Absorption when battery voltage reaches 14.9 VDC.
Stage 2) Absorption Charge: Amber Light On, Absorption Voltage = 14.9 VDC. Set Absorption Timer when charge current drops to 18 amps. This is approximately the same time that the voltage reaches 14.9 VDC. The Absorption Timer length is computed as a function of the time it takes to complete Bulk Charge. Absorption Charge Time = 1.5 x Bulk Charge Time. Transition to Equalization Charge when Absorption Timer resets.
Stage 3) Equalization Charge: Amber Light On, Equalization Voltage Limit = 15.6 VDC. Set Equalization Timer equal to 0.5 x Bulk Charge Time. Charge current is constant at 2 amps until the battery reaches the equalization voltage limit. Then the voltage is held constant at 15.6 VDC and the current gradually decreases. Transition to Float Charge when Equalization Timer resets.
Stage 4) Float Charge: Amber Light Off, Green Light On. Float Voltage = 13.6 VDC. If an external load is applied to the battery while the charger is in stage 4, Float Charge, and if the battery voltage drops below a range between 12.0 to 12.5 VDC, then the charge cycle restarts.

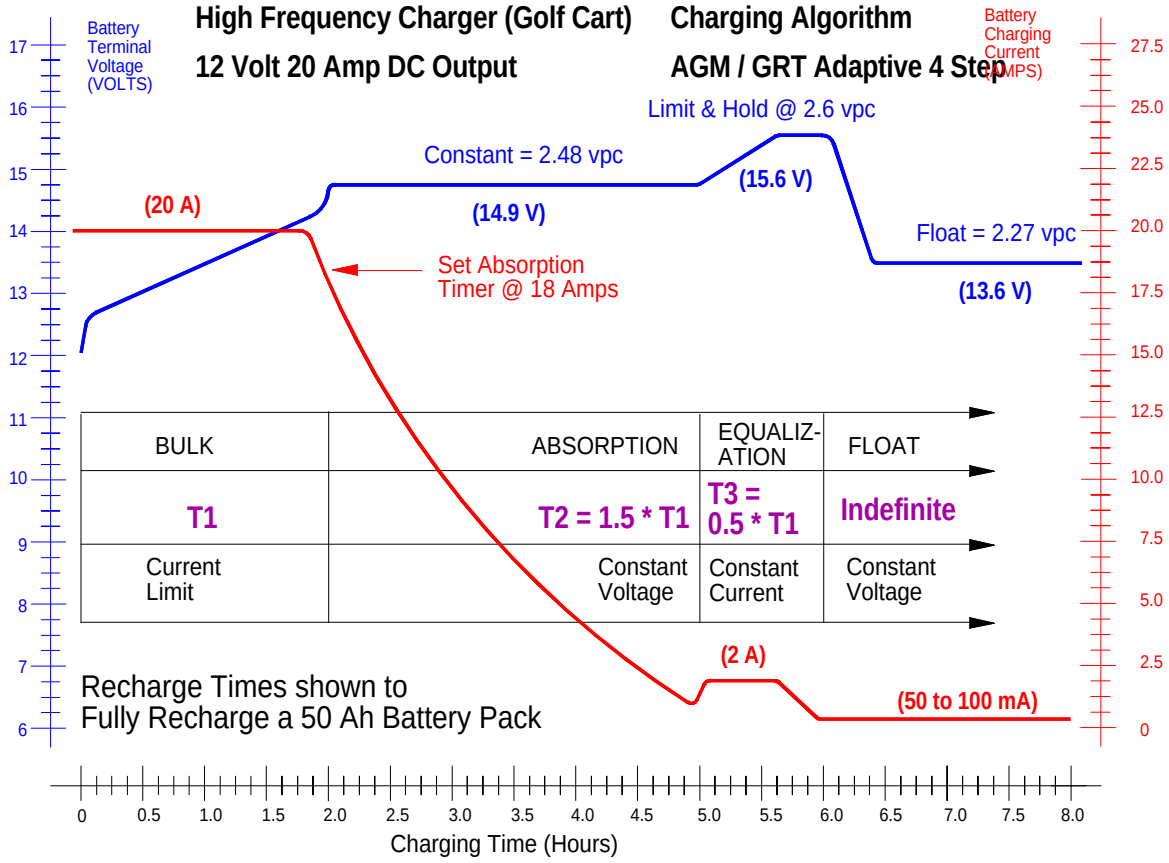

Figure 16 Charging Graph: HF SuperSmart® 12V20A AGM

12V20A Sealed/VRLA/GRT/AGM (Hawker/Optima): MONTHLY Charge Mode:

This charge mode is activated by holding in the pushbutton switch for 5 seconds at the beginning of the charge cycle.

Stage 1) Bulk Charge: Amber Light On, Constant Current = 20.0 Amps, Transition to Stage 2, Absorption when battery voltage reaches 14.9 VDC.

Stage 2) Absorption Charge: Amber Light On, Green Light Flashing, Absorption Voltage = 14.9 VDC Transition to Float Charge 16 hours after entering stage 2.

Stage 3) There is no Equalization Charge, Go directly to stage 4.

Stage 4) Float Charge: Amber Light Off, Green Light On. Float Voltage = 13.6 VDC. If an external load is applied to the battery while the charger is in stage 4, Float Charge, and if the battery voltage drops below a range between 12.0 to 12.5 VDC, then the charge cycle restarts.

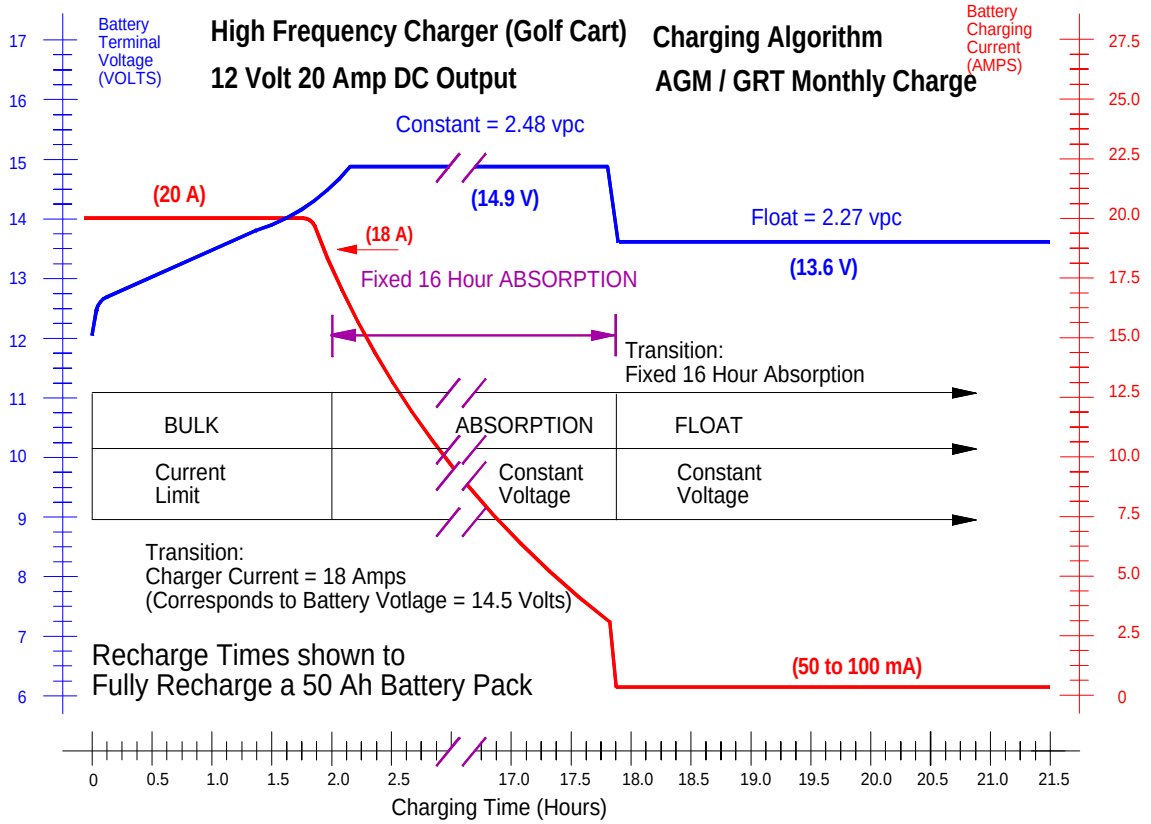

Figure 17 Charging Graph: HF SuperSmart® 12V20A AGM/Monthly

12V20A GEL:

Stage 1) Bulk Charge: Amber Light On, Constant Current = 20.0 Amps, Transition to Stage 2, Absorption Charge when battery voltage reaches 14.1 VDC.
Stage 2) Absorption Charge: Amber Light On, Absorption Voltage = 14.1 VDC Transition to Float Charge when battery charging current drops below 3.0 amps.
Stage 3) There is no Equalization Charge, Go directly to stage 4.
Stage 4) Float Charge: Amber Light Off, Green Light On. Float Voltage = 13.2 VDC. If an external load is applied to the battery while the charger is in stage 4, Float Charge, and if the battery voltage drops below a range between 24.0 to 25.0 VDC, then the charge cycle restarts.

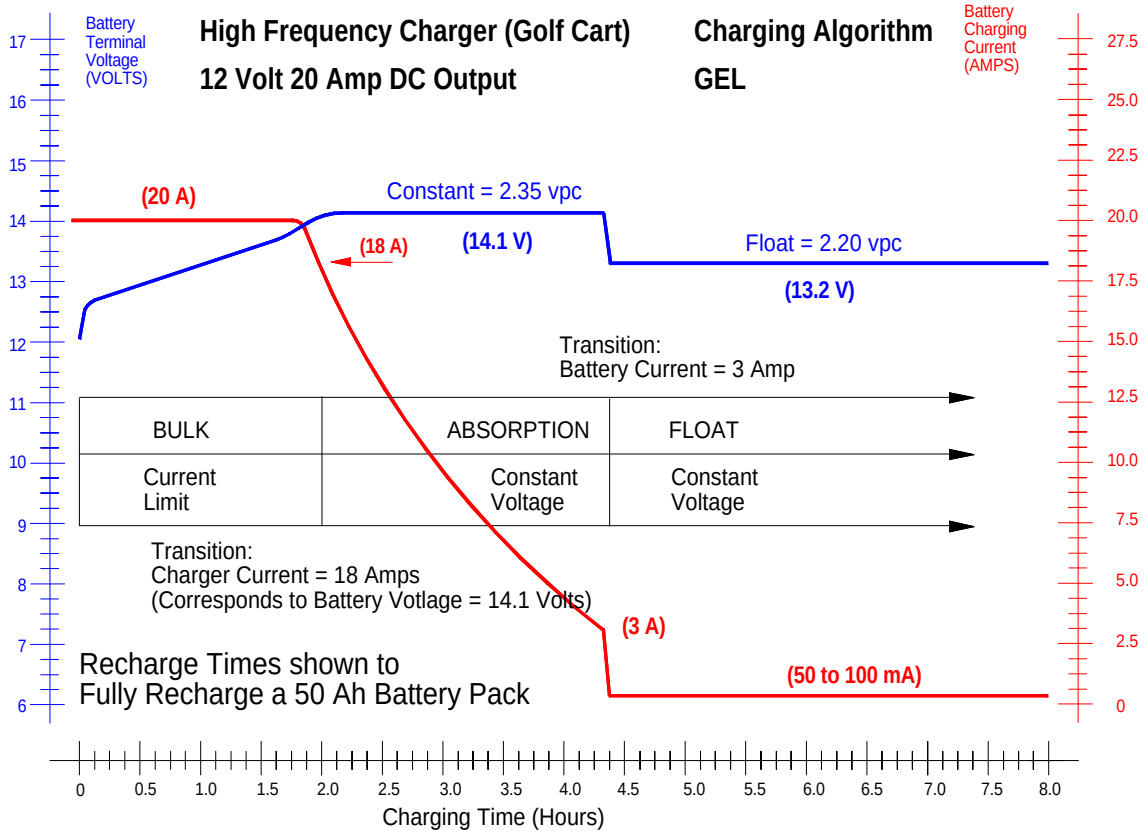

Figure 18 Charging Graph: HF SuperSmart® 12V20A GEL

High Frequency SuperSmart® (Golf Cart) 24V20A Models:

24V20A STANDARD:

Stage 1) Bulk Charge: Amber Light On, Constant Current = 20.0 Amps, Transition to Stage 2, Absorption Charge when battery voltage reaches 29.0 VDC.
Stage 2) Absorption Charge: Amber Light On, Absorption Voltage = 29.0 VDC Transition to Float Charge when battery charging current drops below 3.0 amps.
Stage 3) There is no Equalization Charge, Go directly to stage 4.
Stage 4) Float Charge: Amber Light Off, Green Light On. Float Voltage = 26.4 VDC. If an external load is applied to the battery while the charger is in stage 4, Float Charge, and if the battery voltage drops below a range between 24.0 to 25.0 VDC, then the charge cycle restarts.

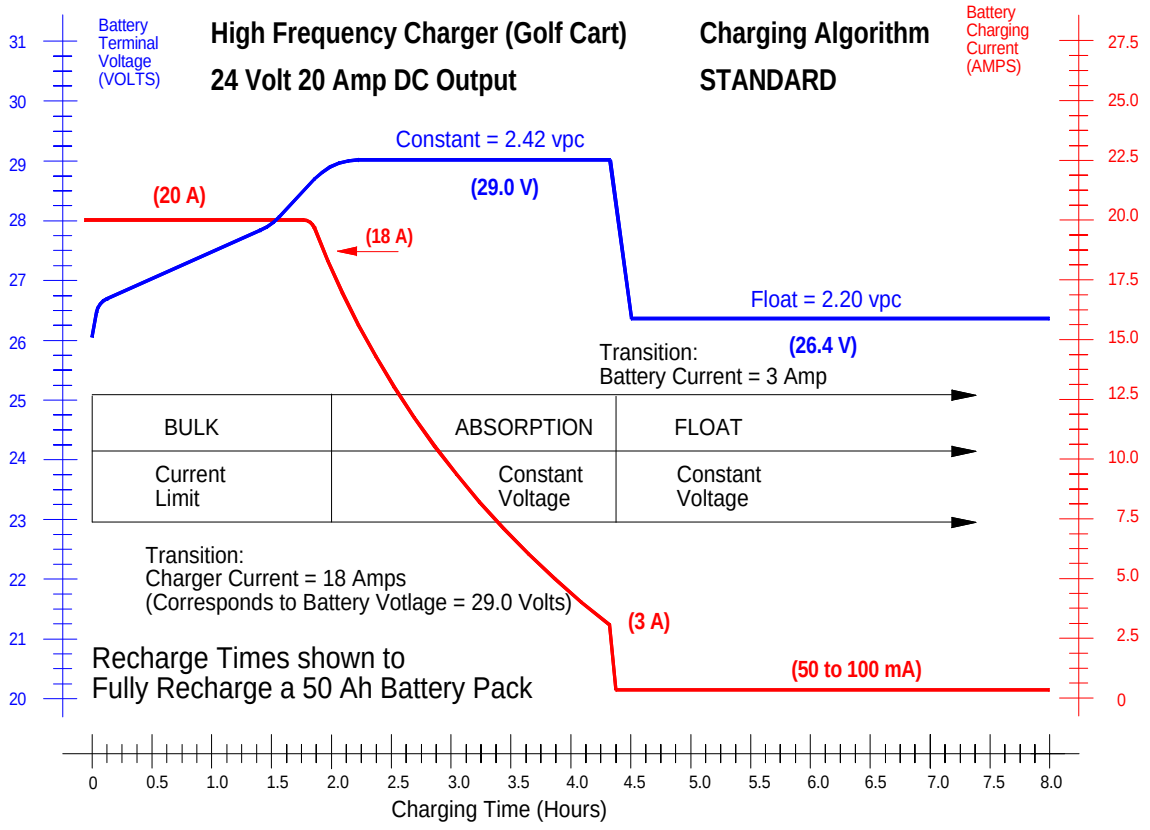

Figure 19 Charging Graph: HF SuperSmart® 24V20A STD

24V20A Sealed/VRLA/GRT/AGM (Hawker/Optima): Adaptive 4-Step:

Stage 1) Bulk Charge: Amber Light On, Constant Current = 20.0 Amps, Transition to Stage 2, Absorption when battery voltage reaches 29.8 VDC.
Stage 2) Absorption Charge: Amber Light On, Absorption Voltage = 29.8 VDC. Set Absorption Timer when charge current drops to 18 amps. This is approximately the same time that the voltage reaches 29.8 VDC. The Absorption Timer length is computed as a function of the time it takes to complete Bulk Charge. Absorption Charge Time = 1.5 x Bulk Charge Time. Transition to Equalization Charge when Absorption Timer resets.
Stage 3) Equalization Charge: Amber Light On, Equalization Voltage Limit = 31.2 VDC. Set Equalization Timer equal to 0.5 x Bulk Charge Time. Charge current is constant at 2 amps until the battery reaches the equalization voltage limit. Then the voltage is held constant at 31.2 VDC and the current gradually decreases. Transition to Float Charge when Equalization Timer resets.
Stage 4) Float Charge: Amber Light Off, Green Light On. Float Voltage = 27.2 VDC. If an external load is applied to the battery while the charger is in stage 4, Float Charge, and if the battery voltage drops below a range between 24.0 to 25.0 VDC, then the charge cycle restarts.

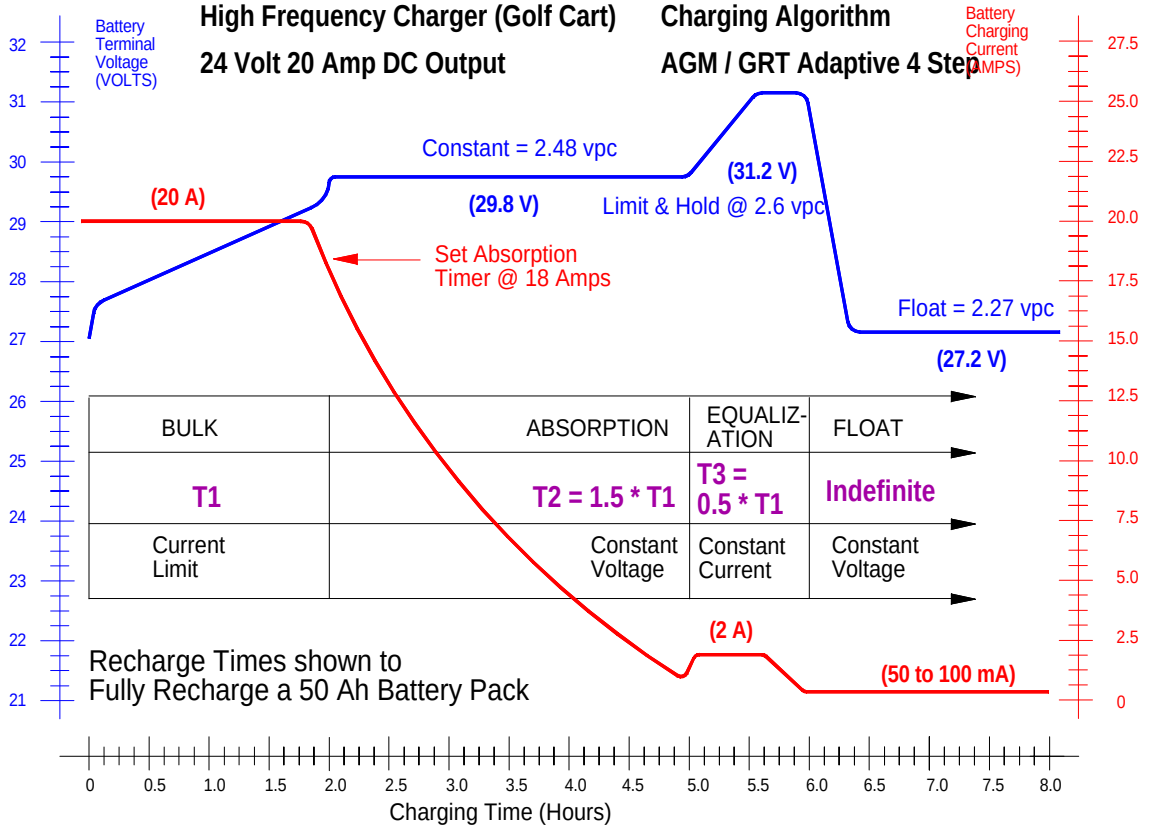

Figure 20 Charging Graph: HF SuperSmart® 24V20A AGM

24V20A Sealed/VRLA/GRT/AGM (Hawker/Optima): MONTHLY Charge Mode:

This charge mode is activated by holding in the pushbutton switch for 5 seconds at the beginning of the charge cycle.

Stage 1) Bulk Charge: Amber Light On, Constant Current = 20.0 Amps, Transition to Stage 2, Absorption when battery voltage reaches 29.8 VDC.

Stage 2) Absorption Charge: Amber Light On, Green Light Flashing, Absorption Voltage = 29.8 VDC Transition to Float Charge 16 hours after entering stage 2.

Stage 3) There is no Equalization Charge, Go directly to stage 4.

Stage 4) Float Charge: Amber Light Off, Green Light On. Float Voltage = 27.2 VDC. If an external load is applied to the battery while the charger is in stage 4, Float Charge, and if the battery voltage drops below a range between 24.0 to 25.0 VDC, then the charge cycle restarts.

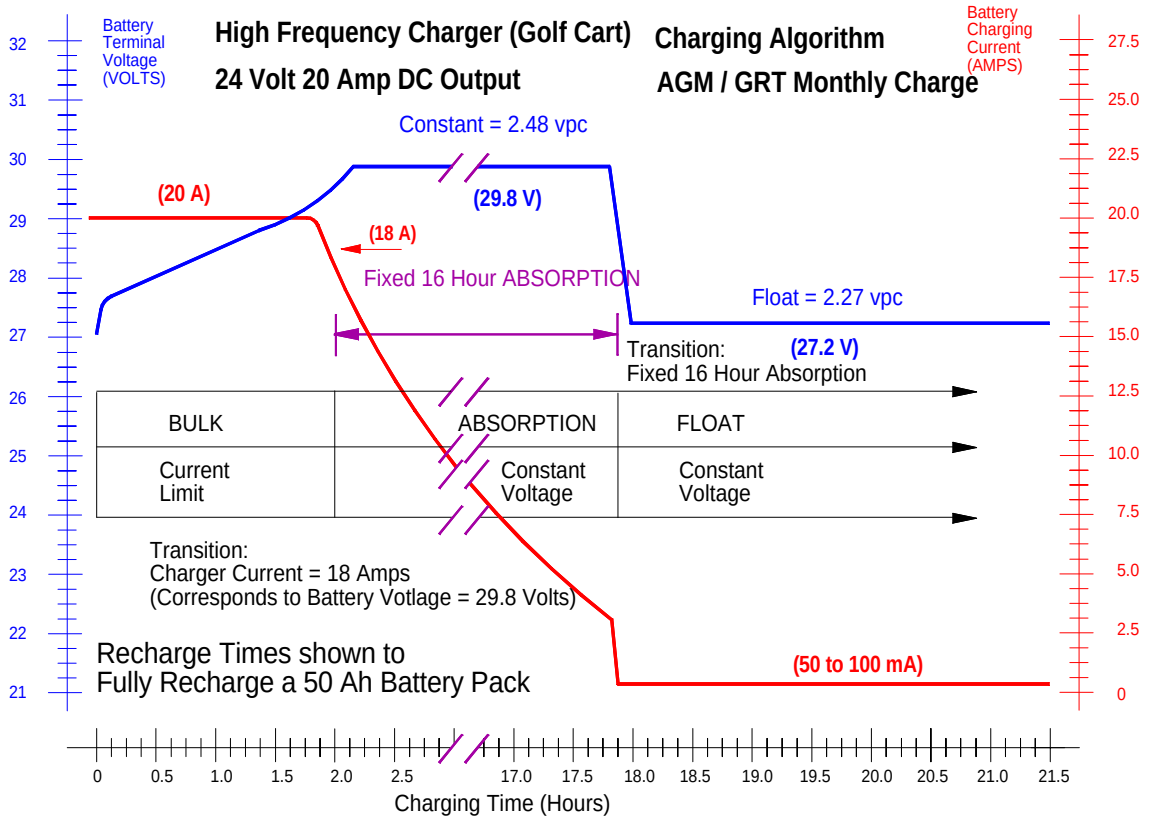

Figure 21 Charging Graph: HF SuperSmart® 24V20A AGM/Monthly

24V20A GEL:

Stage 1) Bulk Charge: Amber Light On, Constant Current = 20.0 Amps, Transition to Stage 2, Absorption Charge when battery voltage reaches 28.2 VDC.
Stage 2) Absorption Charge: Amber Light On, Absorption Voltage = 28.2 VDC Transition to Float Charge when battery charging current drops below 3.0 amps.
Stage 3) There is no Equalization Charge, Go directly to stage 4.
Stage 4) Float Charge: Amber Light Off, Green Light On. Float Voltage = 26.4 VDC. If an external load is applied to the battery while the charger is in stage 4, Float Charge, and if the battery voltage drops below a range between 24.0 to 25.0 VDC, then the charge cycle restarts.

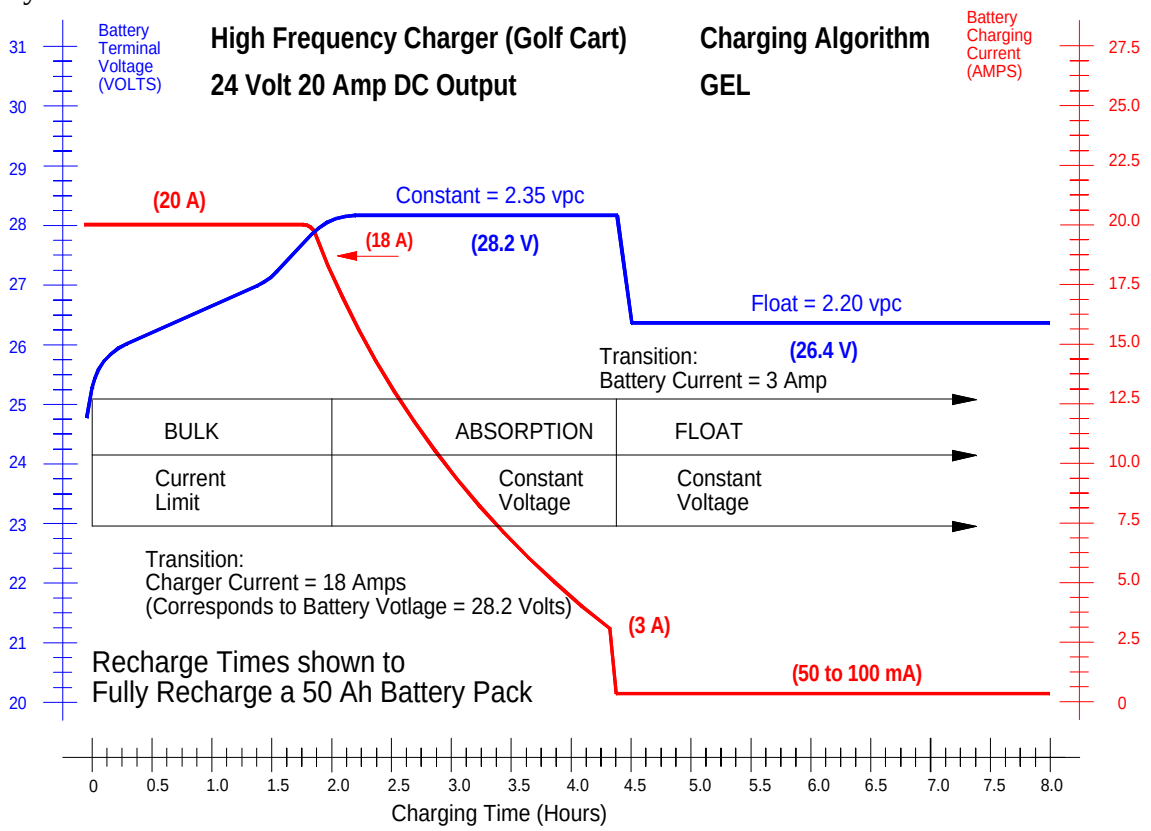

Figure 22 Charging Graph: HF SuperSmart® 24V20A GEL

High Frequency SuperSmart® (Golf Cart) 36V15A Models:

36V15A STANDARD:

Stage 1) Bulk Charge: Amber Light On, Constant Current = 15.0 Amps, Transition to Stage 2, Absorption Charge when battery voltage reaches 43.6 VDC.
Stage 2) Absorption Charge: Amber Light On, Absorption Voltage = 43.6 VDC Transition to Float Charge when battery charging current drops below 3.0 amps.
Stage 3) There is no Equalization Charge, Go directly to stage 4.
Stage 4) Float Charge: Amber Light Off, Green Light On. Float Voltage = 39.6 VDC. If an external load is applied to the battery while the charger is in stage 4, Float Charge, and if the battery voltage drops below a range between 36.0 to 37.0 VDC, then the charge cycle restarts.

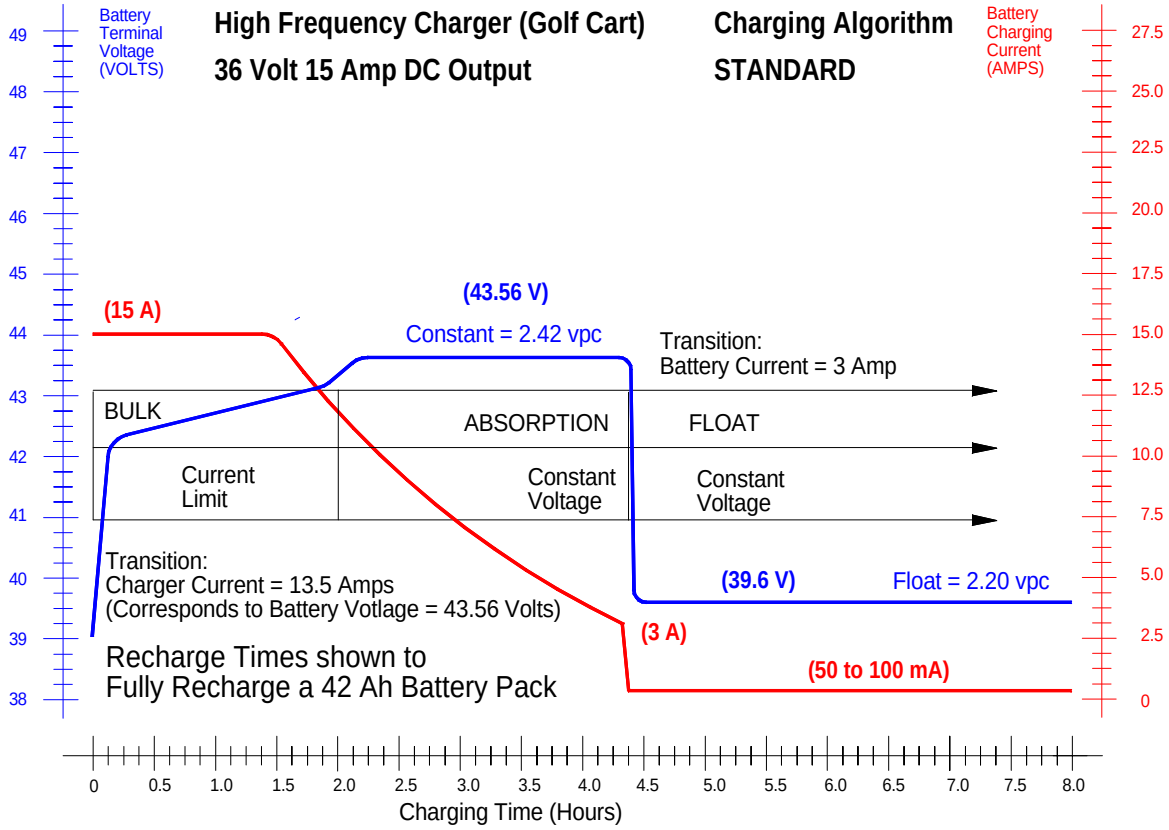

Figure 23 Charging Graph: HF SuperSmart® 36V15A STD

36V15A Sealed/VRLA/GRT/AGM (Hawker/Optima): Adaptive 4-Step:

Stage 1) Bulk Charge: Amber Light On, Constant Current = 15.0 Amps, Transition to Stage 2, Absorption when battery voltage reaches 44.6 VDC.

Stage 2) Absorption Charge: Amber Light On, Absorption Voltage = 44.6 VDC. Set Absorption Timer when charge current drops to 18 amps. This is approximately the same time that the voltage reaches 44.6 VDC. The Absorption Timer length is computed as a function of the time it takes to complete Bulk Charge. Absorption Charge Time = 1.5 x Bulk Charge Time. Transition to Equalization Charge when Absorption Timer resets.

Stage 3) Equalization Charge: Amber Light On, Equalization Voltage Limit = 46.8 VDC. Set Equalization Timer equal to 0.5 x Bulk Charge Time. Charge current is constant at 2 amps until the battery reaches the equalization voltage limit. Then the voltage is held constant at 46.8 VDC and the current gradually decreases. Transition to Float Charge when Equalization Timer resets.

Stage 4) Float Charge: Amber Light Off, Green Light On. Float Voltage = 40.9 VDC. If an external load is applied to the battery while the charger is in stage 4, Float Charge, and if the battery voltage drops below a range between 36.0 to 37.0 VDC, then the charge cycle restarts.

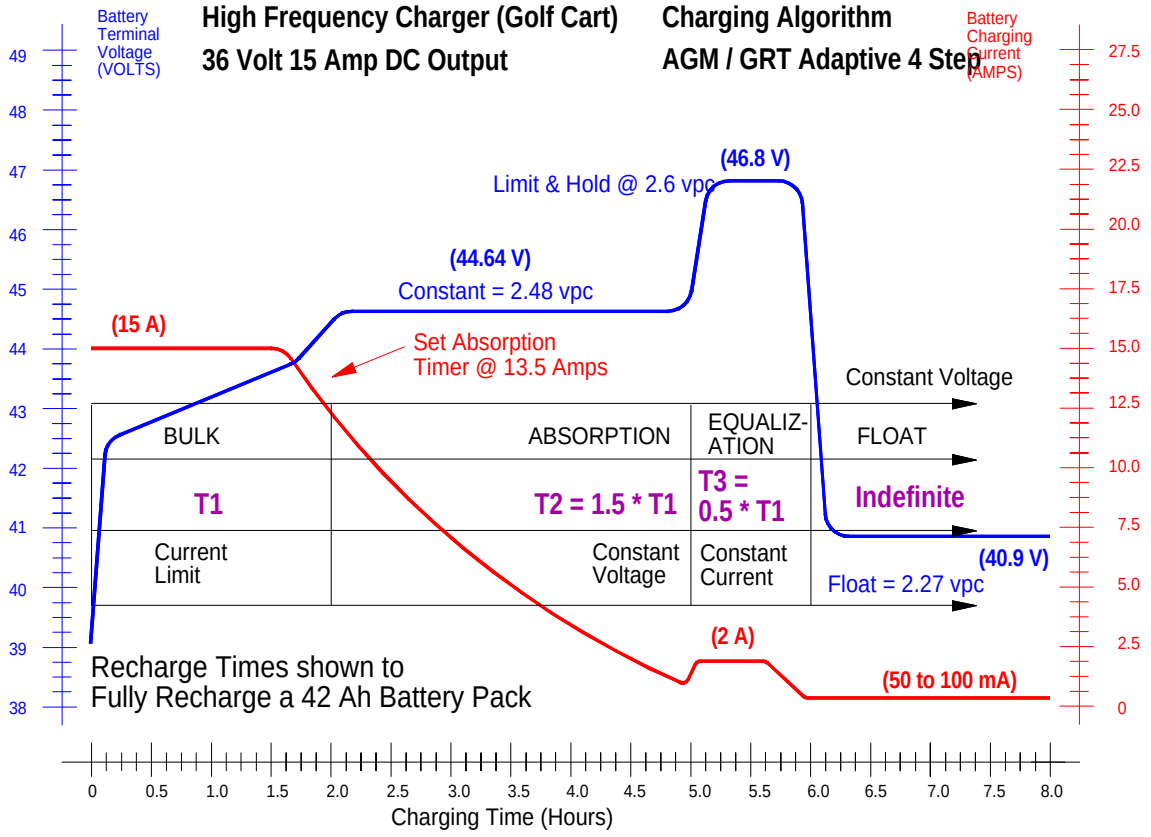

Figure 24 Charging Graph: HF SuperSmart® 36V15A AGM

36V15A Sealed/VRLA/GRT/AGM (Hawker/Optima): MONTHLY Charge Mode:

This charge mode is activated by holding in the pushbutton switch for 5 seconds at the beginning of the charge cycle.

Stage 1) Bulk Charge: Amber Light On, Constant Current = 15.0 Amps, Transition to Stage 2, Absorption when battery voltage reaches 44.6 VDC.

Stage 2) Absorption Charge: Amber Light On, Green Light Flashing, Absorption Voltage = 44.6 VDC Transition to Float Charge 16 hours after entering stage 2.

Stage 3) There is no Equalization Charge, Go directly to stage 4.

Stage 4) Float Charge: Amber Light Off, Green Light On. Float Voltage = 40.9 VDC. If an external load is applied to the battery while the charger is in stage 4, Float Charge, and if the battery voltage drops below a range between 36.0 to 37.0 VDC, then the charge cycle restarts.

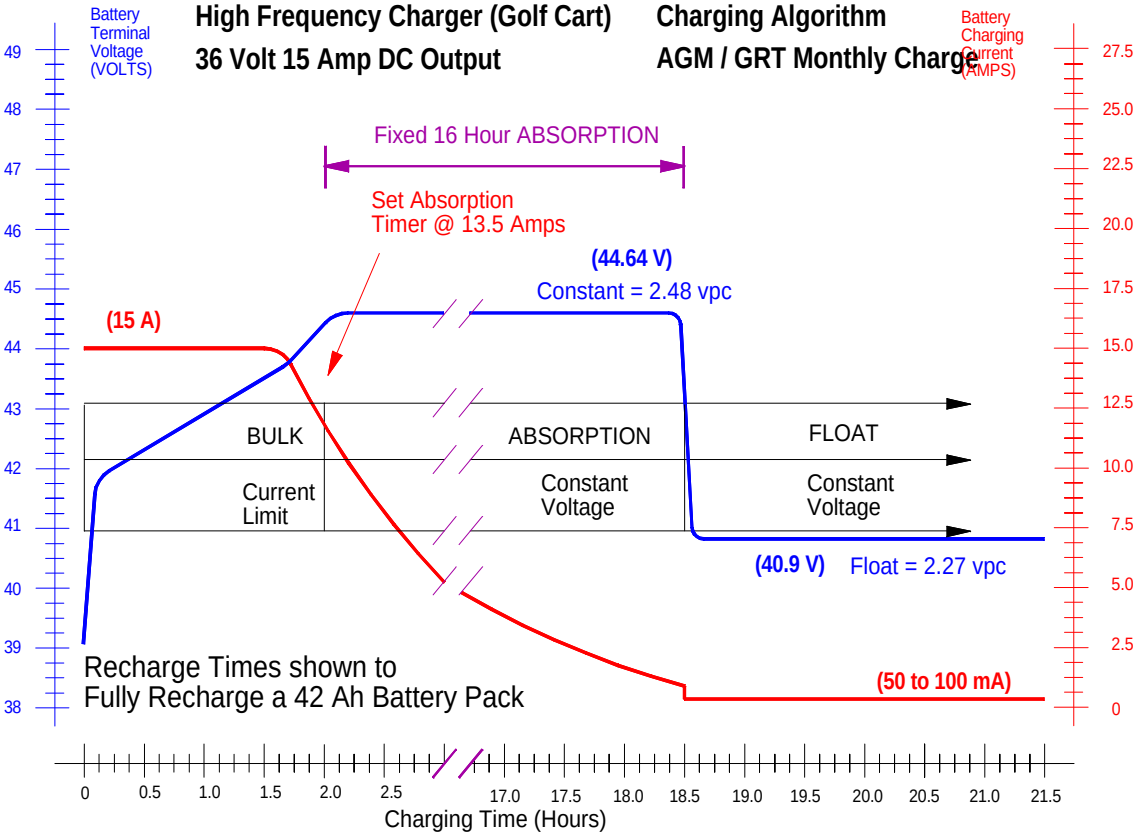

Figure 25 Charging Graph: HF SuperSmart® 36V15A AGM/Monthly

High Frequency SuperSmart® (Golf Cart) 48V10A Models:

48V10A STANDARD:

Stage 1) Bulk Charge: Amber Light On, Constant Current = 10.0 Amps, Transition to Stage 2, Absorption Charge when battery voltage reaches 58.1 VDC.
Stage 2) Absorption Charge: Amber Light On, Absorption Voltage = 58.1 VDC Transition to Float Charge when battery charging current drops below 3.0 amps.
Stage 3) There is no Equalization Charge, Go directly to stage 4.
Stage 4) Float Charge: Amber Light Off, Green Light On. Float Voltage = 52.8 VDC. If an external load is applied to the battery while the charger is in stage 4, Float Charge, and if the battery voltage drops below a range between 48.0 to 49.0 VDC, then the charge cycle restarts.

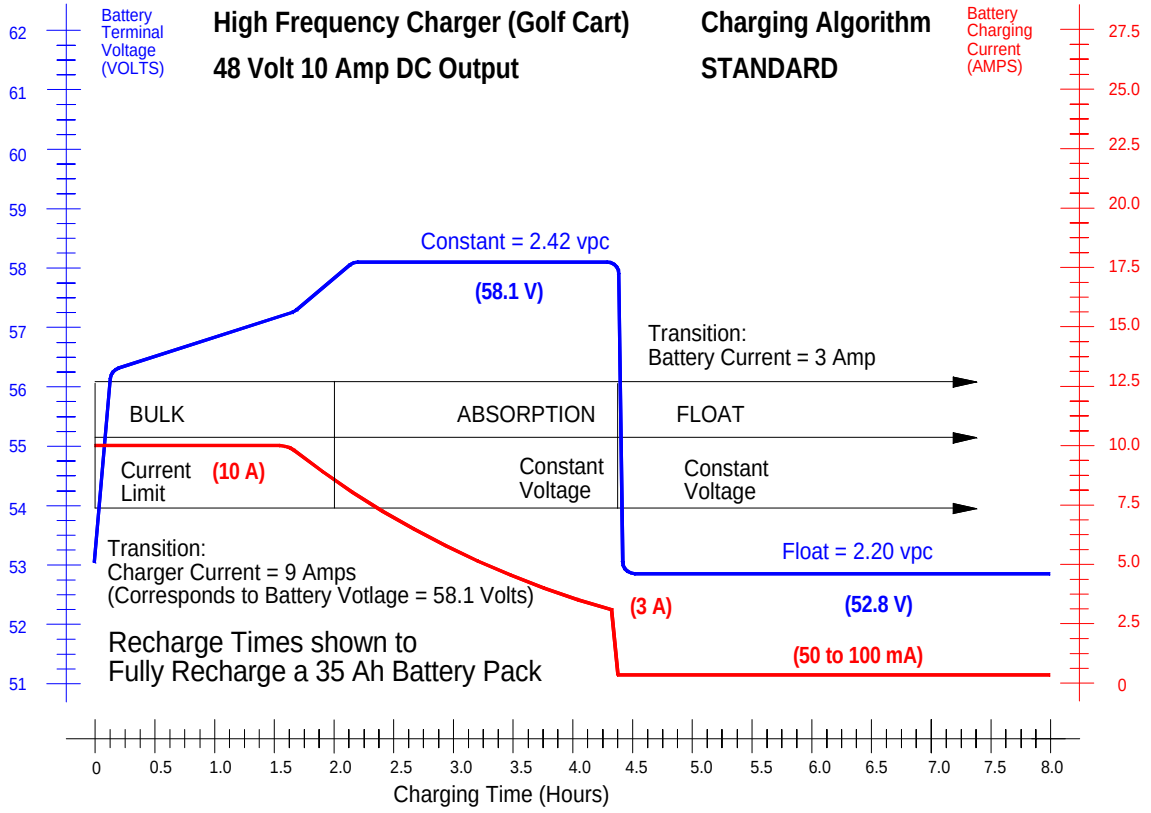

Figure 26 Charging Graph: HF SuperSmart® 48V10A STD

48V10A Sealed/VRLA/GRT/AGM (Hawker/Optima): Adaptive 4-Step:

Stage 1) Bulk Charge: Amber Light On, Constant Current = 10.0 Amps, Transition to Stage 2, Absorption when battery voltage reaches 59.5 VDC.

Stage 2) Absorption Charge: Amber Light On, Absorption Voltage = 59.5 VDC. Set Absorption Timer when charge current drops to 18 amps. This is approximately the same time that the voltage reaches 59.5 VDC. The Absorption Timer length is computed as a function of the time it takes to complete Bulk Charge. Absorption Charge Time = 1.5 x Bulk Charge Time. Transition to Equalization Charge when Absorption Timer resets.

Stage 3) Equalization Charge: Amber Light On, Equalization Voltage Limit = 62.4 VDC. Set Equalization Timer equal to 0.5 x Bulk Charge Time. Charge current is constant at 2 amps until the battery reaches the equalization voltage limit. Then the voltage is held constant at 62.4 VDC and the current gradually decreases. Transition to Float Charge when Equalization Timer resets.

Stage 4) Float Charge: Amber Light Off, Green Light On. Float Voltage = 54.5 VDC. If an external load is applied to the battery while the charger is in stage 4, Float Charge, and if the battery voltage drops below a range between 48.0 to 49.0 VDC, then the charge cycle restarts.

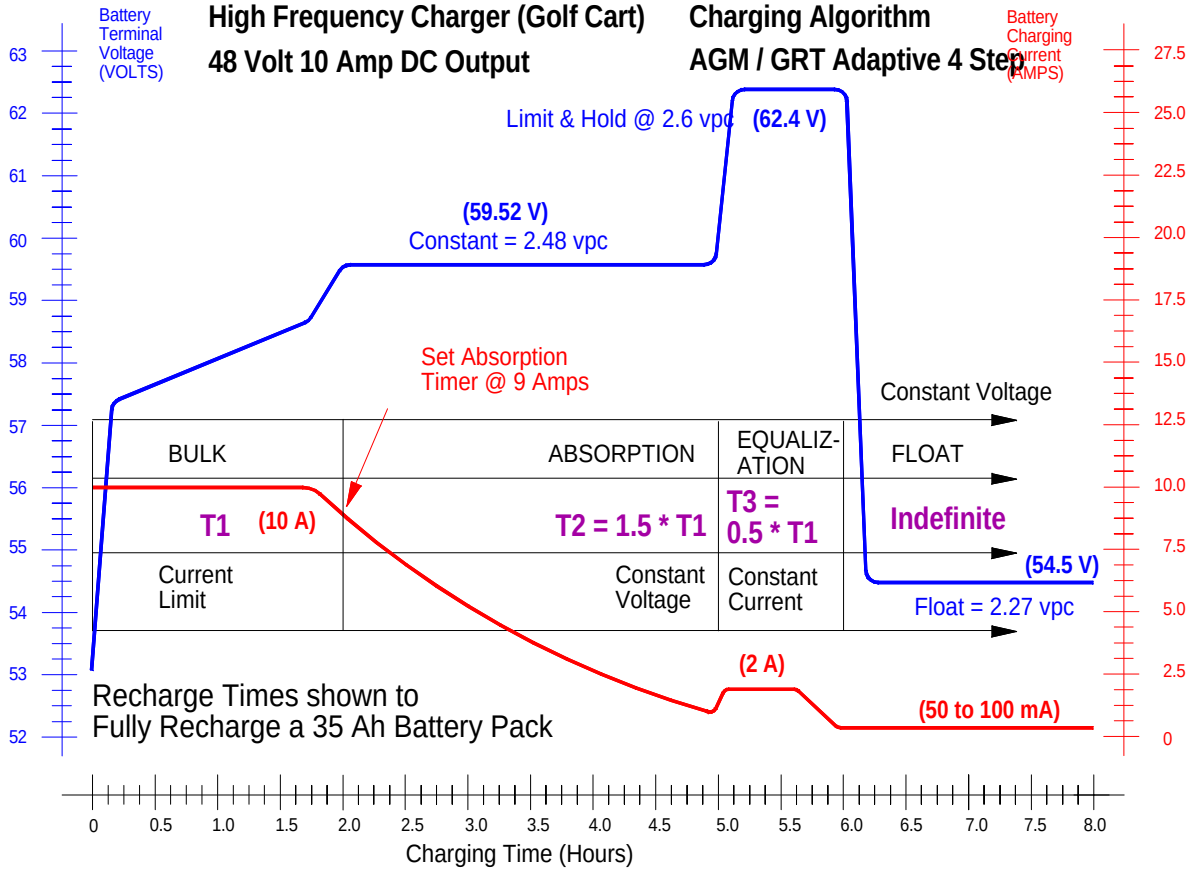

Figure 27 Charging Graph: HF SuperSmart® 48V10A AGM

48V10A Sealed/VRLA/GRT/AGM (Hawker/Optima): MONTHLY Charge Mode:

This charge mode is activated by holding in the pushbutton switch for 5 seconds at the beginning of the charge cycle.

Stage 1) Bulk Charge: Amber Light On, Constant Current = 10.0 Amps, Transition to Stage 2, Absorption when battery voltage reaches 59.5 VDC.

Stage 2) Absorption Charge: Amber Light On, Green Light Flashing, Absorption Voltage = 59.5 VDC Transition to Float Charge 16 hours after entering stage 2.

Stage 3) There is no Equalization Charge, Go directly to stage 4.

Stage 4) Float Charge: Amber Light Off, Green Light On. Float Voltage = 54.5 VDC. If an external load is applied to the battery while the charger is in stage 4, Float Charge, and if the battery voltage drops below a range between 48.0 to 49.0 VDC, then the charge cycle restarts.

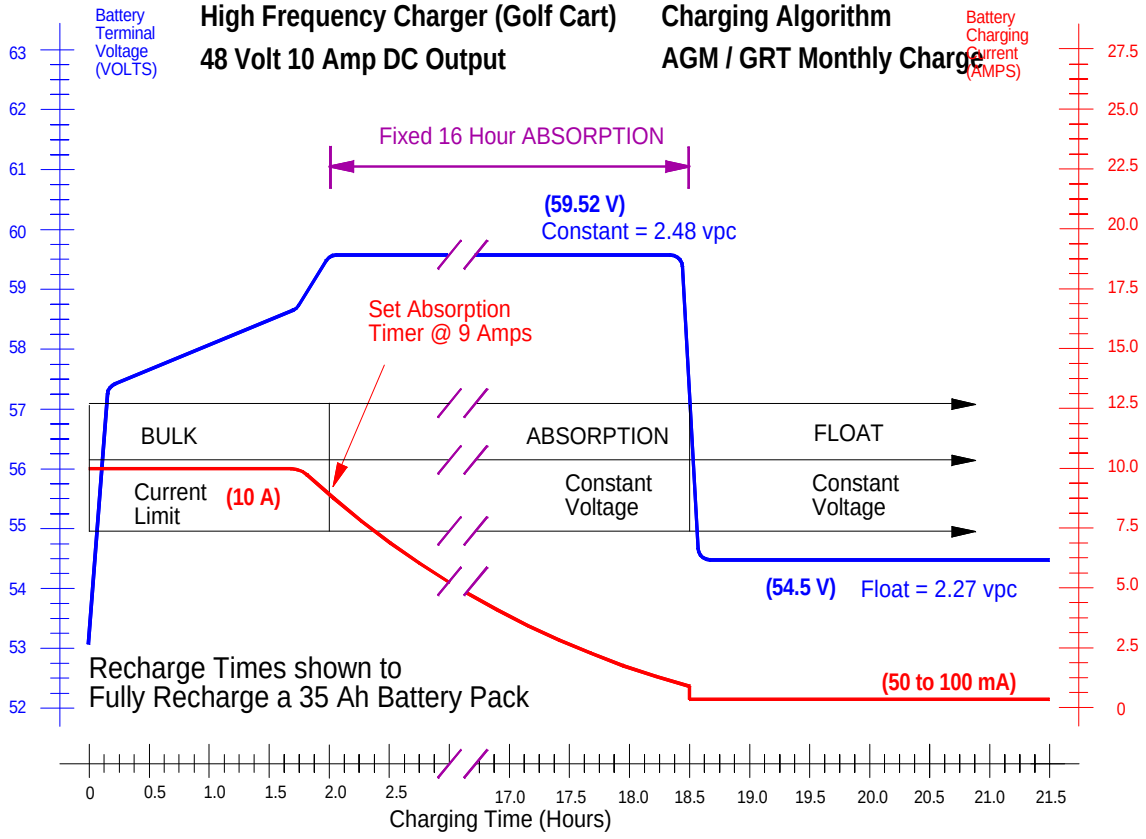

Figure 28 Charging Graph: HF SuperSmart® 48V10A AGM/Monthly

High Power Portable: DV Chargers: 12V10A Models:

12V10A DELCO:

Stage 1) Bulk Charge: Red Lights On, Constant Current = 10.0 Amps, Transition to Stage 2, Absorption Charge when battery voltage reaches 16.25 VDC.
Stage 2) Absorption & Equalization Charge: Red Lights On, the number of red lights will decrease as the charge current drops in 4 amp increments. Absorption Voltage = 16.25 VDC Transition to Float Charge after 2 hours has elapsed.
Stage 3) There is no separate Equalization Charge mode, since the absorption voltage is so high for Delco batteries it performs the equalization function also.
Stage 4) Float Charge: Red Lights Off, Green Light On and Flashing. Float Voltage = 13.4 VDC. If an external load is applied to the battery while the charger is in stage 4, Float Charge, and if the battery voltage drops below a range between 12.0 to 12.5 VDC, then the charge cycle restarts.

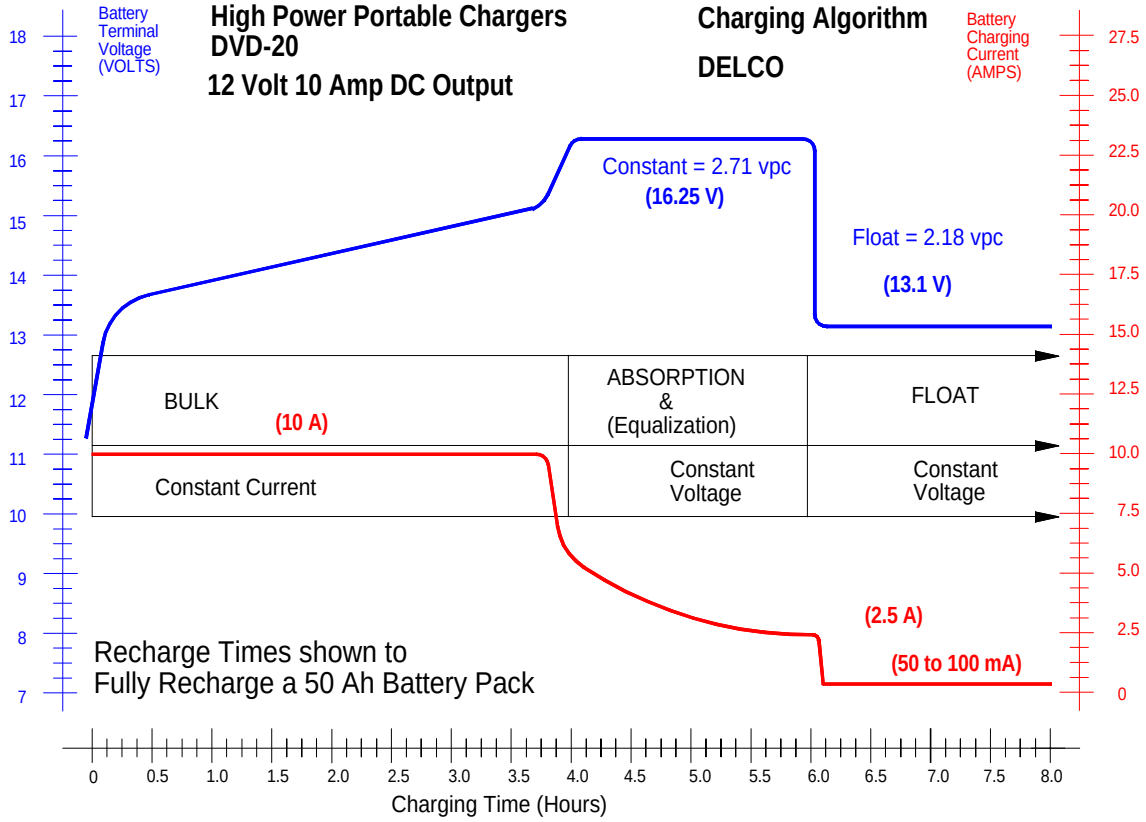

Figure 29 Chg Graph: DV High Pwr Portables: 12V10A DELCO

12V10A OTHER:

Stage 1) Bulk Charge: Red Lights On, Constant Current = 10.0 Amps, Transition to Stage 2, Absorption Charge when battery voltage reaches 14.55 VDC.
Stage 2) Absorption Charge: Red Lights On, the number of red lights will decrease as the charge current drops in 4 amp increments. Absorption Voltage = 14.55 VDC Transition to Equalization Charge when the charge current drops to 2.0 amps, typically 30 minutes or less.
Stage 3) Equalization Charge: Equalization Voltage depends on the battery's response to a constant = 2.0 amps. Typically, the battery voltage will rise to 16.25 to 16.5 VDC.
Stage 4) Float Charge: Red Lights Off, Green Light On and Flashing. Float Voltage = 13.1 VDC. If an external load is applied to the battery while the charger is in stage 4, Float Charge, and if the battery voltage drops below a range between 12.0 to 12.5 VDC, then the charge cycle restarts.

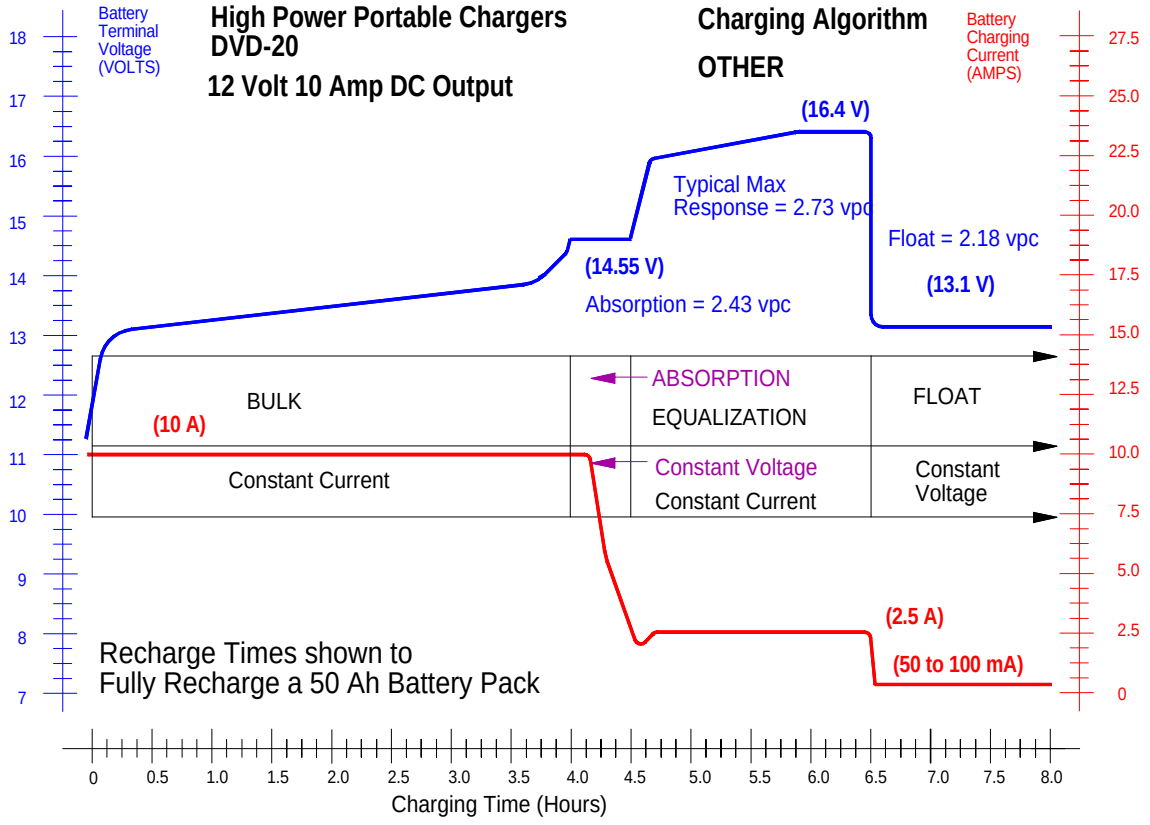

Figure 30 Chg Graph: DV High Pwr Portables: 12V10A OTHER

12V10A AGM (Hawker/Optima): Adaptive 4-Step:

Stage 1) Bulk Charge: Red Lights On, Constant Current = 10.0 Amps, Transition to Stage 2, Absorption when battery voltage reaches 14.9 VDC.
Stage 2) Absorption Charge: Red Lights On, Absorption Voltage = 14.9 VDC. Set Absorption Timer when charge current drops to 18 amps. This is approximately the same time that the voltage reaches 14.9 VDC. The Absorption Timer length is computed as a function of the time it takes to complete Bulk Charge. Absorption Charge Time = 1.5 x Bulk Charge Time. Transition to Equalization Charge when Absorption Timer resets.
Stage 3) Equalization Charge: Red Lights On, Equalization Voltage Limit = 15.6 VDC. Set Equalization Timer equal to 0.5 x Bulk Charge Time. Charge current is constant at 2 amps until the battery reaches the equalization voltage limit. Then the voltage is held constant at 15.6 VDC and the current gradually decreases. Transition to Float Charge when Equalization Timer resets.
Stage 4) Float Charge: Red Lights Off, Green Light Flashing. Float Voltage = 13.6 VDC. If an external load is applied to the battery while the charger is in stage 4, Float Charge, and if the battery voltage drops below a range between 12.0 to 12.5 VDC, then the charge cycle restarts.

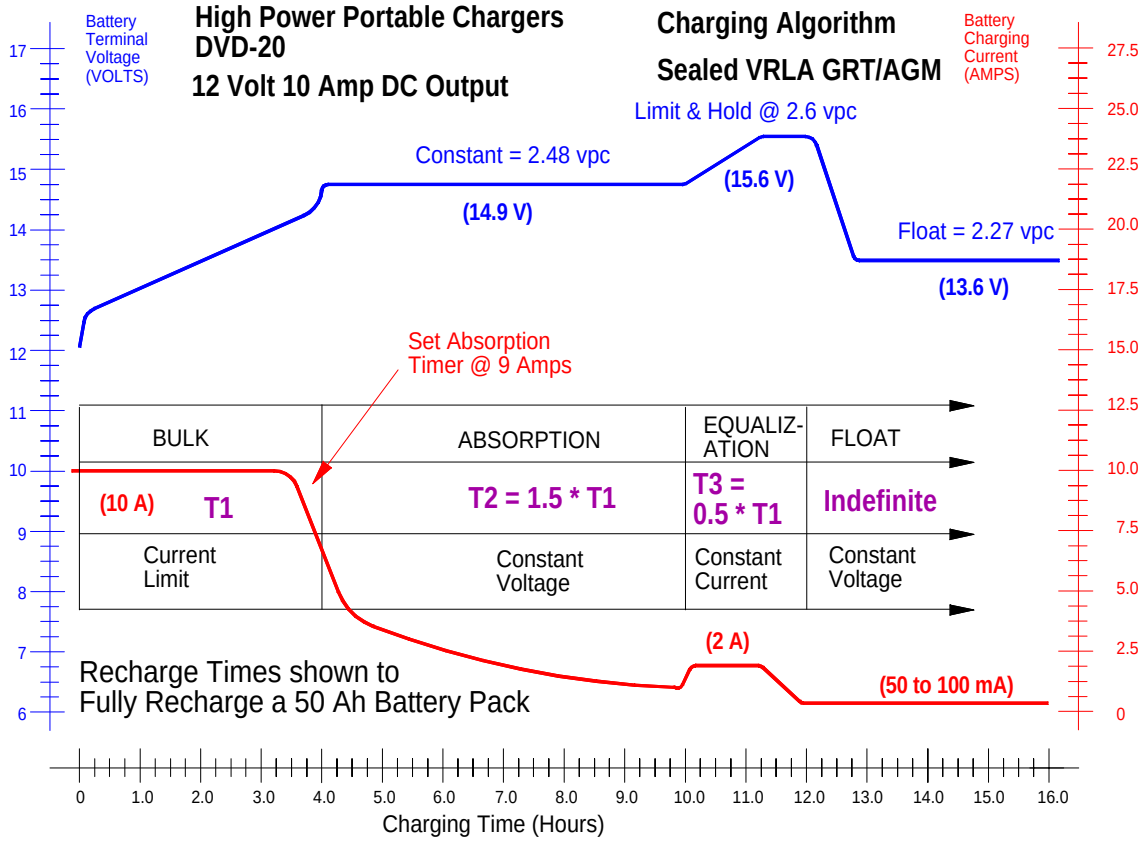

Figure 31 Chg Graph: DV High Pwr Portables: 12V10A GRT/AGM

High Power Portable: DV Chargers: 12V20A Models:

12V20A DELCO:

Stage 1) Bulk Charge: Red Lights On, Constant Current = 20.0 Amps, Transition to Stage 2, Absorption Charge when battery voltage reaches 16.25 VDC.
Stage 2) Absorption & Equalization Charge: Red Lights On, the number of red lights will decrease as the charge current drops in 4 amp increments. Absorption Voltage = 16.25 VDC Transition to Float Charge after 2 hours has elapsed.
Stage 3) There is no separate Equalization Charge mode, since the absorption voltage is so high for Delco batteries it performs the equalization function also.
Stage 4) Float Charge: Red Lights Off, Green Light On and Flashing. Float Voltage = 13.4 VDC. If an external load is applied to the battery while the charger is in stage 4, Float Charge, and if the battery voltage drops below a range between 12.0 to 12.5 VDC, then the charge cycle restarts.

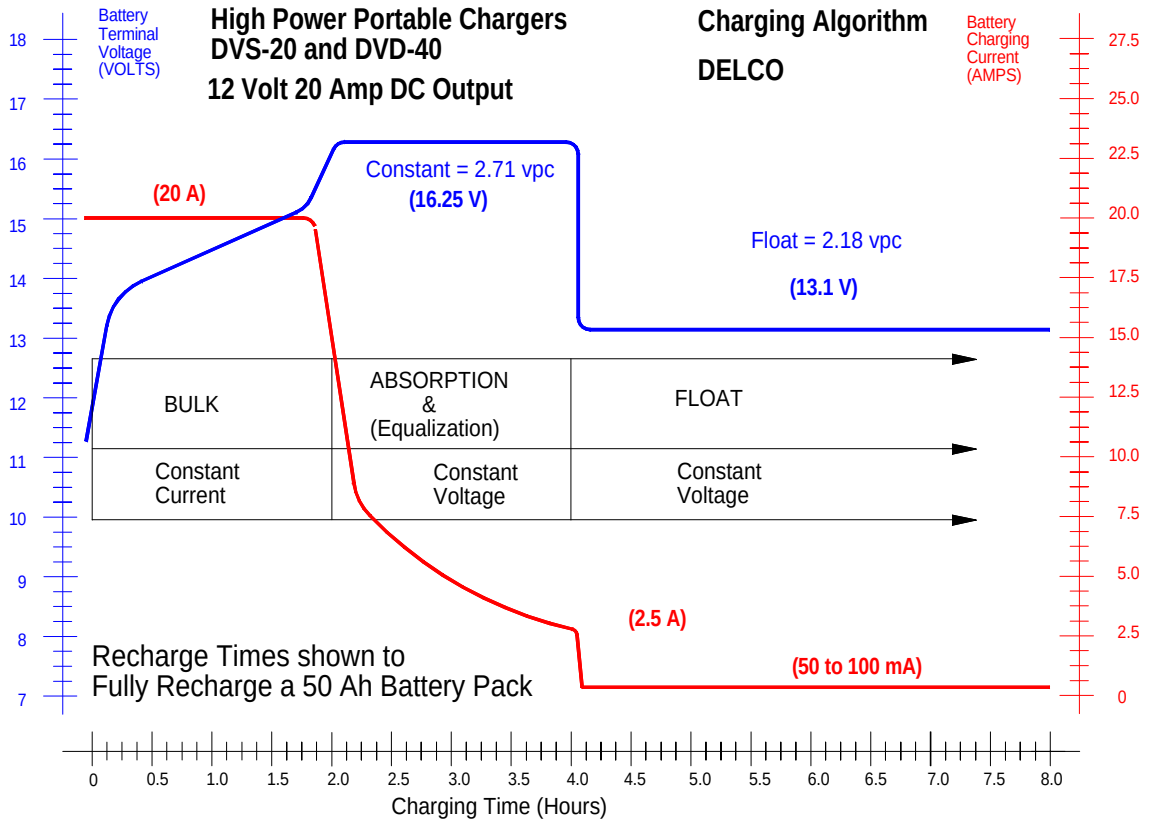

Figure 32 Chg Graph: DV High Pwr Portables: 12V20A DELCO

12V20A OTHER:

Stage 1) Bulk Charge: Red Lights On, Constant Current = 20.0 Amps, Transition to Stage 2, Absorption Charge when battery voltage reaches 14.55 VDC.
Stage 2) Absorption Charge: Red Lights On, the number of red lights will decrease as the charge current drops in 4 amp increments. Absorption Voltage = 14.55 VDC Transition to Equalization Charge when the charge current drops to 2.0 amps, typically 30 minutes or less.
Stage 3) Equalization Charge: Equalization Voltage depends on the battery's response to a constant = 2.0 amps. Typically, the battery voltage will rise to 16.25 to 16.5 VDC.
Stage 4) Float Charge: Red Lights Off, Green Light On and Flashing. Float Voltage = 13.1 VDC. If an external load is applied to the battery while the charger is in stage 4, Float Charge, and if the battery voltage drops below a range between 12.0 to 12.5 VDC, then the charge cycle restarts.

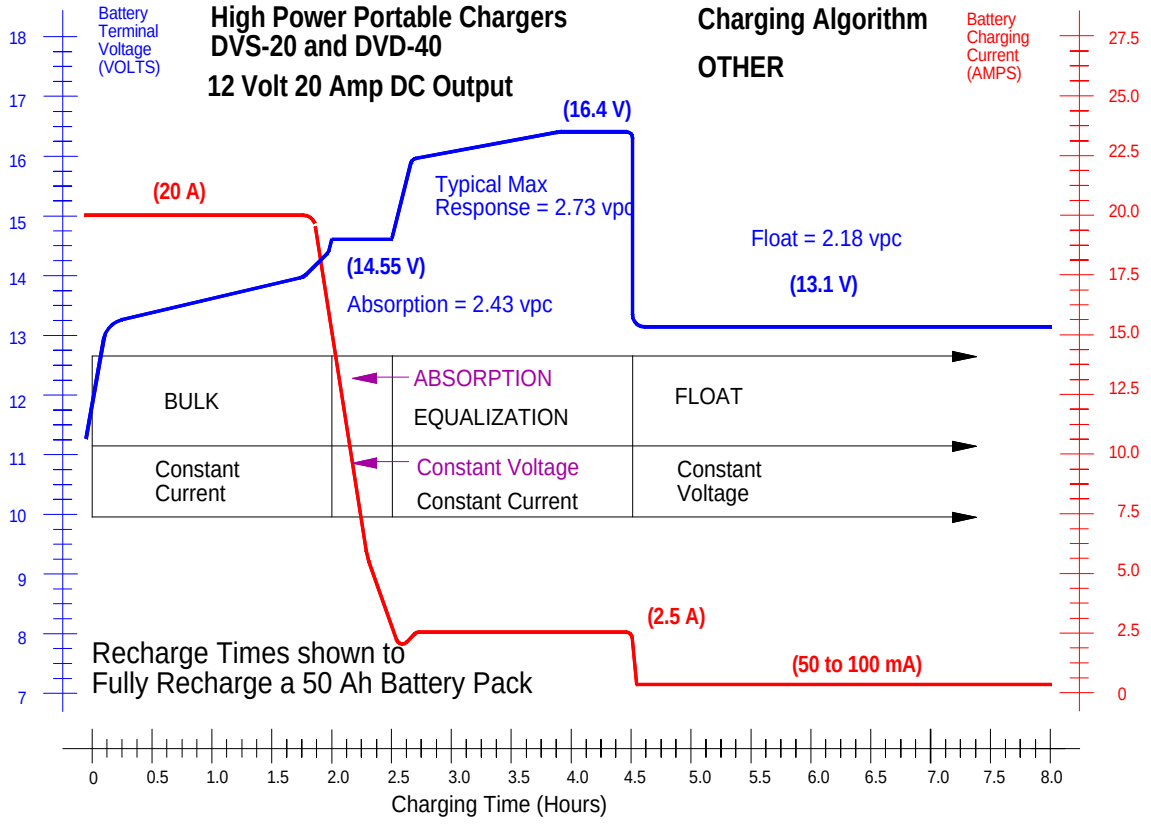

Figure 33 Chg Graph: DV High Pwr Portables: 12V20A OTHER

12V20A AGM (Hawker/Optima): Adaptive 4-Step:

Stage 1) Bulk Charge: Red Lights On, Constant Current = 20.0 Amps, Transition to Stage 2, Absorption when battery voltage reaches 14.9 VDC.
Stage 2) Absorption Charge: Red Lights On, Absorption Voltage = 14.9 VDC. Set Absorption Timer when charge current drops to 18 amps. This is approximately the same time that the voltage reaches 14.9 VDC. The Absorption Timer length is computed as a function of the time it takes to complete Bulk Charge. Absorption Charge Time = 1.5 x Bulk Charge Time. Transition to Equalization Charge when Absorption Timer resets.
Stage 3) Equalization Charge: Red Lights On, Equalization Voltage Limit = 15.6 VDC. Set Equalization Timer equal to 0.5 x Bulk Charge Time. Charge current is constant at 2 amps until the battery reaches the equalization voltage limit. Then the voltage is held constant at 15.6 VDC and the current gradually decreases. Transition to Float Charge when Equalization Timer resets.
Stage 4) Float Charge: Red Lights Off, Green Light Flashing. Float Voltage = 13.6 VDC. If an external load is applied to the battery while the charger is in stage 4, Float Charge, and if the battery voltage drops below a range between 12.0 to 12.5 VDC, then the charge cycle restarts.

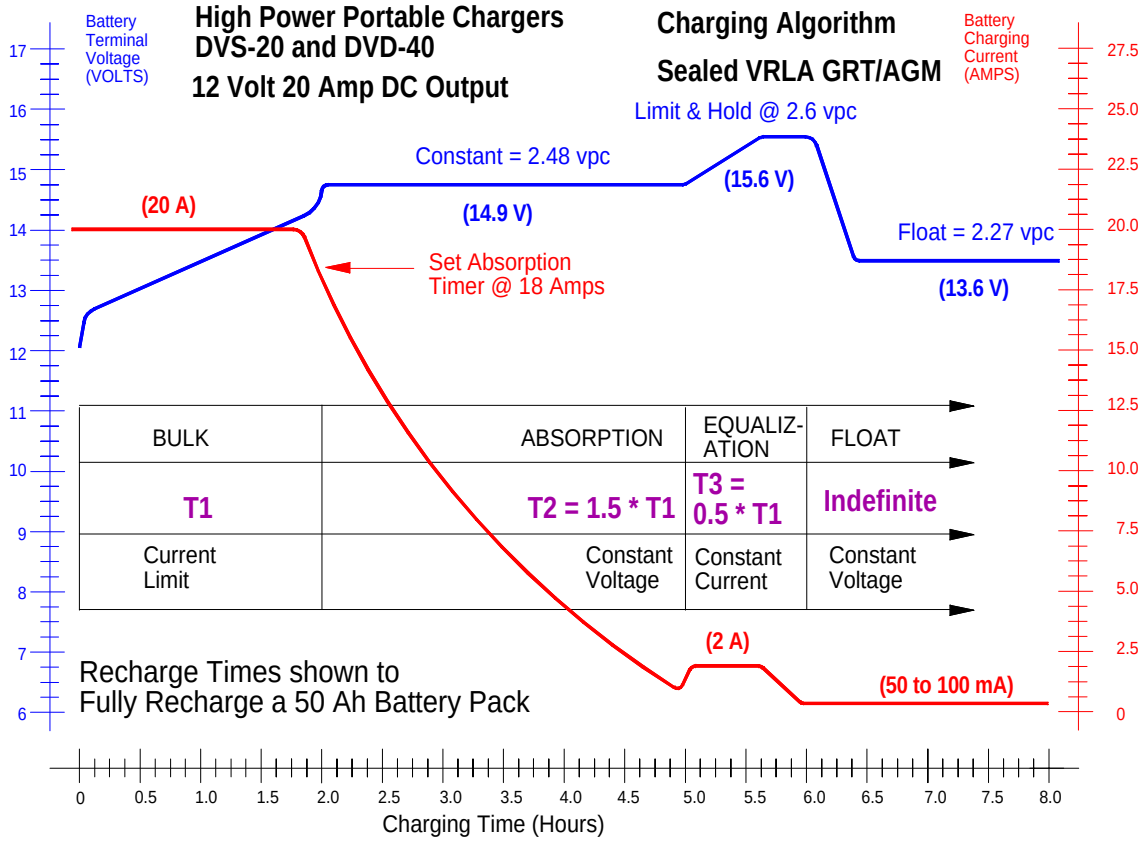

Figure 34 Chg Graph: DV High Pwr Portables: 12V20A GRT/AGM