MANUAL

MODEL **1604/1608**
SWITCH MODE
BATTERY CHARGERS
for Lead-Acid Batteries

Before charging, read instructions carefully!

IMPORTANT SAFETY INSTRUCTIONS
SAVE THESE INSTRUCTIONS

Read the Operating Instructions carefully before using the Model 1604 or Model 1608 charger.

1. **WARNING** – Failure to install and operate the charger in accordance with these instructions may result in damage to the charger or injury to the operator.
2. **WARNING** – Never place the charger directly above or below the battery being charged. Gases or fluids from the battery will corrode and damage the charger. Locate the charger as far away from the battery as the output cable allows.
3. **WARNING** – Explosive gases may result from charging. Provide adequate ventilation during charging. Prevent flames or sparks.
4. **WARNING** – Do not attempt to open the charger. There is risk of electric shock even if the charger is unplugged. No user serviceable components inside.
5. **WARNING** – If safe operation of the charger can no longer be ensured, stop and secure it against operation.
6. **WARNING** – If the supply cord is damaged, it must be replaced by a qualified person in order to avoid hazard.
7. **WARNING** – Never charge a frozen battery.
8. **WARNING** – To reduce the risk of injury, charge only lead acid or gel cell type batteries. Do not attempt to charge any other type of chargeable or non-rechargeable battery; these batteries may burst, causing personal injury and damage.
9. **CAUTION** – It is recommended that you disconnect the AC power cord before connecting or disconnecting the charger to the battery.
10. **CAUTION** – Not intended for outdoor use.
11. **CAUTION** – Charger surface may be hot while plugged in and for a period of time thereafter. Handle unit by the cord to prevent scalding, or purchase optional handle kit P/N 17604348-3.
12. **CAUTION** – Units with fans must have at least 30mm of clearance on the vented ends of the charger. Do not restrict ventilation to the charger in any way. Failure to do so may result in degradation of charge performance.
13. **CAUTION** – If charger failure or malfunction may cause personal injury or material damage, use additional safety measures such as limit switches, guards, etc.
14. **CAUTION** – Failure to install and use the charger in accordance with these instructions may impair the protection provided by the charger and may void the manufacturers warranty.
15. **CAUTION** – Never plug a 120VAC only charger into a receptacle not rated for 120VAC nominal.
16. This charger was manufactured and tested according to the applicable technical standards referenced herein. It complies with safety regulations as shipped from the factory.
17. This charger may be mounted to a machine by temporary means, such as Velcro®. However, this unit was not designed to be permanently mounted to a machine.
18. Be sure to read and understand all of the battery manufacturer's instructions, such as removing or not removing cell caps or recommended rate of charging, prior to using this charger.
19. Use of an adapter is not allowed in Canada. If a grounded-type receptacle is not available, do not use this charger until a qualified electrician installs the proper outlet.
20. Extension cords used within the United States must be made of 18-3 cord with SP-2, SPE-2, SPT-2, SV, SVE, SVT, or SJT flexible jacket material, a minimum length of 6 feet and a maximum length of 10 feet.
21. Extension cords in locations other than the United States should use cord made of 18-3 or 1.5 mm, 3 wire, with an appropriate jacket material; in Canada use type SJ or equivalent. Consult a qualified electrician for details.
22. These chargers are suitable for use with rechargeable lead acid/gel cell batteries ONLY. 12VDC chargers are suitable for use with 12VDC, 6-cell batteries ONLY. 24VDC chargers are suitable for use with 24VDC, 12-cell batteries ONLY. 4 amp chargers are intended for use with 10-40Ah batteries; 8 amp chargers are intended for use with 26-80Ah batteries. 80% of these batteries' capacity will be restored within 8 hours of charging.

Warranty

Two Year Limited Warranty (see terms of sale for specifics).
All specifications subject to change without notice.

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1 MODEL ENCODEMENT

Model[1]		Input Voltage [2]		Output Voltage [3]		Output Series [4]		Series Number [5]
1604CS	-	AVS	/	12	/	04	-	xxx
	-	AVS	/	24	/	04	-	xxx
1604FV	-	AVS	/	12	/	08	-	xxx
	-	AVS	/	24	/	08	-	xxx
1608FS	-	AVS	/	12	/	08	-	xxx
	-	AVS	/	24	/	08	-	xxx

1 1604CS: Convection cooled, sealed to IP-54
1604FV: Fan cooled, protected to IP-31
1608FS: Fan cooled, electronics sealed to IP-54, fan protected to IP-31

2 AVS: Auto Voltage Select, operates at 120VAC or 230VAC automatically

3 12: 12VDC
24: 24VDC

4 04: 4A
08: 8A

5 Series Number: Identifies charger features, consult Curtis

2

TECHNICAL SPECIFICATIONS

2.1 Electrical

	12V / 24V, 4A Chargers		12V, 8A Chargers		24V, 8A Chargers	
Nominal Operating Voltage	120VAC	230VAC	120VAC	230VAC	120VAC	230VAC
Input Voltage (VAC)	90 - 132	180 - 264	90 - 132	180 - 264	105 - 132	210 - 264
Operating Frequency (Hz)	47 - 63					
Input Current (A_{rms}, max.)						
12VDC nominal outputs	1.0 @ 90V/60Hz	0.5 @ 180V/50Hz	2.0 @ 90V/60Hz	1.0 @ 180V/50Hz	N/A	N/A
24VDC nominal outputs	2.0 @ 90V/60Hz	1.0 @ 180V/50Hz	N/A	N/A	4.0 @ 105V/60Hz	2.0 @ 210V/50Hz
Input Leakage (µA, max.)	<500 @ 120V/60Hz	<500 @ 230V/50Hz	<500 @ 120V/60Hz	<500 @ 230V/50Hz	<500 @ 120V/60Hz	<500 @ 230V/50Hz
Output Power (W, nom./max.)						
12VDC nominal outputs	48 / 67.5		96 / 125			
24VDC nominal outputs	96 / 135		192 / 240			
Output Current (A, max.)	4.0		8.0			
Output Voltage (VDC, nom./range)						
12VDC nominal outputs	12 / 6.0 - 15.0					
24VDC nominal outputs	24 / 12.0 - 30.0					

2.2 Mechanical

Case: Aluminum alloy, black finish

End caps: Polycarbonate, black

Dimensions (mm max.):
1604CS & 1604FV: 160 L x 96 W x 52 H
1608FS: 160 L x 140 W x 52 H

Weight (kg) 1604/1608: 1.0/1.5

2.3 Connections

AC Power Inlet: IEC 320/C14 Male on cable

DC Power: ITT Cannon XLR-3-12C Male Plug or equivalent on cable

Pin	Function
1	B+
2	B-
3	Motor Controller Charging Indicator

Programming Port: Molex 39-01-2040 with four female crimp terminals (Molex 39-00-0056). Use with Curtis Model 1311 Hand Held Programmer only.

Pin	Function
1	Rx
2	SEC_RTN
3	Tx
4	+12V

Output Adapters:

P/N 17604348-1 for use with Model 1288 Motor Controller

Pin	Function
1	Motor Controller Charging Indicator
2	B+
3	N/C
4	N/C
5	B-
6	N/C

P/N 17604348-2 for use as ISO-7176 compliant Off-board Charger

Pin	Function
1	B+
2	B-
3	B- (inhibit)

Charge Indicator: Low impedance capable of sinking 60 mA DC to B-.

Remote LED: Some models come with a wire harness for remote LED capability. Contact your local Curtis sales office for details.

2.4 Environmental

Operating Range:	-10°C to + 50°C
Storage Range:	-40°C to + 85°C
Humidity:	95% RH (non-condensing) at 35°C
Shock:	SAE J1378, 55g
Vibration:	5g rms, 5-500 Hz, 2 hours per axis
Protection:	1604CS: IP54
	1604FV: IP31 (horizontal mounting)
	1608FV: IP54 (Electronics) IP31 (Fan)

2.5 Compliance

1604CS	1604FV	1608FS
UL 1012	UL 1012	UL1012
CAN/CSA-C22.2 No.107.2	CAN/CSA-C22.2 No.107.2	CAN/CSA-C22.2 No.107.2
EN60335-1	EN60335-1	EN60335-1
EN60335-2-29	EN60335-2-29	EN60335-2-29
EN55011	EN55011	EN55011
EN61000-3-3	EN61000-3-3	EN61000-3-3
EN61000-4-2	EN61000-4-2	EN61000-4-2
EN61000-4-3	EN61000-4-3	EN61000-4-3
EN61000-4-4	EN61000-4-4	EN61000-4-4
EN61000-4-5	EN61000-4-5	EN61000-4-5
EN61000-4-6	EN61000-4-6	EN61000-4-6
EN61000-4-8	EN61000-4-8	EN61000-4-8
EN61000-4-11	EN61000-4-11	EN61000-4-11
ENV 50204	ENV 50204	ENV 50204

2.6 Battery Types

All chargers are intended for use with lead acid or gel cell batteries only, for their respective voltages.

2.7 Charge Cycle Profile

Models 1604 and 1608 use a multi-stage charge cycle, dependent upon battery geometry, with software programmable set points.

1. Constant Current Mode: Output current is 4.0A max for the 4A models or 8.0A max for the 8A models. Current is held constant until the constant voltage is reached. Output current is reduced during the Constant Current Mode if the charger should begin to overheat.
2. Constant Voltage Mode: Output voltage shall be held at an average voltage of approximately 14.3V for 12V chargers or 28.6V for 24V chargers. The charger will hold the voltage to within 100mV of this value, reducing the current gradually until the charging ends. Charging ends when the current falls below 0.5A or the charger remains in Constant Voltage Mode for more than 4 hours. The charger will shut down and remain in standby.

3. Restart: If the battery self-discharges below 12.9V for 12V batteries or below 25.7V for 24V batteries while the charger is in standby, the charger cycles into a constant current of 1.0A (4A models)/2.0A (8A models) until the constant voltage setpoint is reached. The unit will regulate and terminate as in Constant Voltage Mode.

2.8 Indication Lights

The charger features built in diagnostics. Refer to the table below to interpret the flashing of the yellow and green indicator lights. Flashing of the yellow indicator means that the charging cycle has ended early and the battery may not be fully charged. Refer to the Troubleshooting section to correct these faults.

Flash Pattern	Indication
Yellow on	AC power present
Green on	Charge complete
Green blinking	Charging
Yellow & Green on simultaneously	Charger in standby mode
Yellow & Green blink simultaneously	No battery/reverse polarity
Yellow blinks 1X	Not reaching constant voltage setpoint
Yellow blinks 2X	Not reaching 24V within 2 hours
Yellow blinks 3X	Charge current/voltage does not normalize
Yellow blinks 4X	Battery voltage too high (over 32V)
Yellow blinks 5X	Charger over temperature

3 INSTALLATION

- Charger should be securely mounted on a flat surface.
- The power cord to the IEC 320/C14 connector should be of the appropriate gauge to carry a 10A current @ 120VAC, or a 5A current @ 230VAC for the cable's length, to meet the requirements of applicable electrical codes.
- A minimum of 30mm clearance should be provided at each end of the charger for vented models.
- The charger should not be installed in locations which restrict air flow.

4 OPERATION

4.1. Charging the Battery

Note: If a DC output adapter is used, connect the adapter to the charger output connector prior to supplying AC power to the charger.

4.1.1 Ensure that the charger is either unplugged from AC power or is in standby mode.

4.1.2 Connect the charger output connector to the vehicle/battery connector.

4.1.3 Plug the AC line cord into a nearby outlet. Turn on wall switch (if used). The yellow light will illuminate to indicate that AC power is present. After several seconds the green light will flash to indicate that charging is in process. If no lights are illuminated, or if the yellow light flashes, refer to the Troubleshooting section. Charge time may vary from less than 1 hour to 10 hours.

4.1.4 When charging is complete both the yellow and green lights will remain on and the charger will be in standby mode. The charger is now ready to be disconnected from AC power or from the battery. Note: if the charger is disconnected from the battery and connected to another battery with out removing AC power it resets itself over a three minute period. During this reset, the yellow light will flash briefly and the charger will return to standby mode prior to beginning a charge cycle.

4.2. Programming the Charger

The Model 1604 or 1608 charger has a number of parameters that can be programmed by the user, using a Curtis 1311 handheld programmer. These programming variables allow the charger's performance characteristics to fit the needs of the individual application. To use the 1311 refer to the 1311 instruction manual, Curtis P/N 53028.

While programming can be performed when the charger is connected to the batteries or when charging, it is recommended that the charger be disconnected from power and from the batteries prior to commencing programming. Connecting the programmer to the charger while charging will result in the immediate termination of the charge cycle. The charger will remain in standby as long as the programmer is connected.

There are two Program menu options - Basic Settings and Top Off Settings.

There are four options under the Basic Settings. They are described in the following order. They are listed in the text by the names that appear on the programmer's Program Menu: (bold text indicates default settings)

- Constant Voltage
- Amp hour Capacity
- End of Charge Mode
- Fan Modulation

Constant Voltage (CV, see figures 1, 2, 3 and 4)

Constant voltage defines the battery voltage at which point the charger changes from constant current mode to constant voltage mode. Three Constant Voltage set-points are available:

Option	Setpoint (VDC) 12VDC charger	24VDC charger	Battery Chemistry
1	14.0	28.0	Gel
2	14.3	28.6	AGM, Gel, SLA, VRLA
3	14.6	29.2	special applications as required by the battery manufacturer

Amp hour Capacity

Amp hour Capacity is the storage capacity of the battery, as defined by the battery's manufacturer. Selecting the appropriate amp hour capacity determines the longest period of time the charger will charge before automatically shutting off. If the charger is still charging at this point, it provides an error code to the operator. Refer to Section 5, Troubleshooting, to correct this error. Three Amp hour Capacity setpoints are available:

Option	**Amp hour rating (4A / 8A charger)**	**Charge Cycle Timer** (t_c, see Fig. 1, 2, 3 and 4) **(hours)**
1	≤60 / ≤100	16
2	≤100 / ≤200	24
3	≤200 / ≤400	48

End of Charge Mode

End of Charge Mode defines how the charger terminates the charge cycle. There are three End of Charge Modes:

Option	**Mode**	**Notes**
1	End of Charge	Charge Profile: IVa
	(see Figure 1)	Charger goes into standby upon reaching End of Charge current. Charge will automatically restart if the standby voltage falls below 12.9V (12V charger) 25.7V (24V charger), and automatically self terminates. This compensates for battery self-discharge over long periods of time. This mode is recommended for daily use or for long term storage.
2	Equalize	Charge Profile: I_1VI_2a if previous mode was End of Charge $I_1V_1I_2V_2$ if previous mode was Float.
	(see Figure 2 and Figure 4)	After constant voltage terminates, charger adjusts its output current to 1.5A/3A (4A/8A charger). The current is held for either 3 hours or until the battery reaches 15.8V (12V charger) or 30.5V (24V charger). The Equalize cycle automatically reverts to the previous mode of charge termination after the completion of 1 cycle. Check the battery manufacturer's recommendation regarding the frequency at which batteries should be equalized.
3	Float	Charge Profile: IV_1V_2
	(see Figure 3)	After constant voltage terminates, the charger reduces the output current to 0.25A (24V charger), and cycles on and off automatically to maintain an average battery voltage of (float voltage, FV) 13.3V (12V charger) or 26.6VDC (24V charger). This will continue until AC power is recycled. This mode of charging is recommended for daily use or for short term storage conditions to maintain battery health.

Fan Modulation - Default setting: Off

Fan Modulation can be turned on or off. If fan modulation is set to Off, the fan runs at full speed whenever the charger is charging. This maximizes charger power output over all operating conditions. If fan modulation is set to On, the speed of the fan is proportional to the temperature of the charger. This mode of operation is quieter.

Top Off Settings - Default setting: Off

Charge profile with the Top Off settings enabled looks similar to the Equalize end of charge mode (End of charge option 2). The difference is that in the Top Off mode the following parameters can be adjusted:

- Top Off Time, ranging from 0 to 5 hours;
- Top Off Voltage, ranging from 28 to 32.4 Volts;
- Top Off Current, ranging from 0.5 to 4.5 Amperes.

The Top Off mode is enabled by setting the Top Off Time to a value higher than zero. The charger enters the Top Off mode at the end of the main charge cycle (after the constant voltage part) and sets the output current to the value defined by the Top Off Current setting. The Top-Off mode will finish when: (1) preset Top Off Time expires or (2) battery voltage reaches the Top Off Voltage setting, whichever happens first.

At the end of the Top Off mode, the charger continues according to the End of Charge Mode settings - stands by and awaits for the restart voltage or continues the float mode.

To program the charger:

Curtis chargers do not use the 1311's Monitor, Faults, or Functions Menus. The Information and Programmer Setup Menus operate as describe in the 1311's instruction manual with the exception of the Serial Number submenu in the Information Menu – this field is filled with a default value of 12345678.

4.2.1. Disconnect the charger from the AC outlet and battery.

4.2.2. Attach the programmer to the 4-pin Molex connector on the charger (near the light indicators). Depending on the specific 1311 being used, a different connector cable may be required to connect to the charger. Contact a Curtis sales office for assistance.

4.2.3. Apply AC power to the charger. The yellow and green light indicators will alternately blink, indicating that the charger is in programming mode.

4.2.4. Configure the programmable parameters described above.

4.2.5. Once the programmable parameters have been defined, disconnect the 1311 programmer from the charger and follow the charger installation instructions.

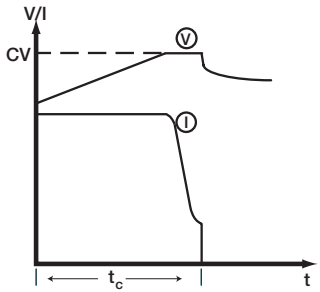

Figure 1. End of Charge Profile

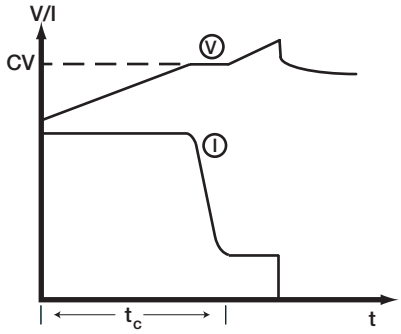

Figure 2. End of Charge Profile with Equalize

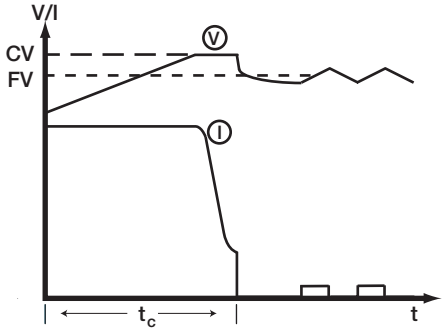

Figure 3. Float Profile

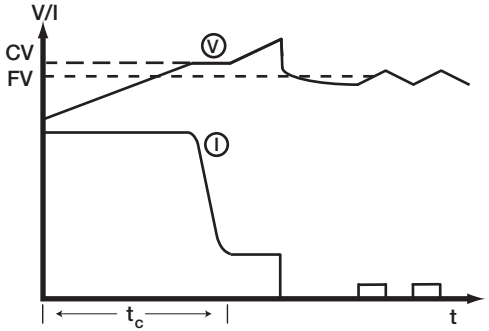

Figure 4. Float Profile with Equalize

5 TROUBLESHOOTING

Problem	Possible Causes & Solutions
Lights do not turn on.	No power. Plug the unit in. No power. If the outlet is damaged, try another outlet on another circuit.
Yellow light blinks 1x	Battery manufacturer's rated capacity may exceed charger's rating. Battery may be damaged or old.
Yellow light blinks 2x	Battery manufacturer's rated capacity may exceed charger's rating. Battery may be damaged or old.
Yellow light blinks 3x	Battery manufacturer's rated capacity may exceed charger's rating. Battery may be damaged or old. Unit may be damaged if operation does not resume after AC power is removed and reapplied.
Yellow light blinks 4x	Battery voltage exceeds charger specified operating range.
Yellow light blinks 5x	Charger overheated. Remove power, wait ten minutes and then reapply power.
Yellow & Green lights blink simultaneously	Battery may not be connected to the charger. Battery may be severely discharged (<6VDC). Battery connections may be reversed.
Yellow & Green lights alternately blink	Charger is in the program mode. Handheld programmer is connected to the charger. Disconnect the programmer from the charger.

6 MAINTENANCE

Cleaning:

Excess dirt or grime may be removed from the unit by wiping it with a cloth dampened with water.

CURTIS

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