1 Introduction

The 1700W GCU has both RS232 and CANbus interfaces that perform essentially the same functions, these being:

- Configuration (of parameters stored in the GCU's non-volatile memory),
- Control (real-time control of the GCU's various features),
- Monitoring (of measured voltages, currents, temperatures, etc), and
- Updating the GCU's firmware.

Once the GCU has been configured, there is no requirement to connect anything to either communications interface – the GCU will operate quite normally with no communications at all.

The RS232 interface operates at 57600 baud, full-duplex, with 8 data bits and no parity (57600 8N1). The RS232 hardware layer is compliant with TIA/EIA-232-F and ITU V.28.

2 Software

A Windows application that provides easy access to most of the 1700W GCU's various features may be downloaded from www.millswoodeng.com.au/resources.html

Figure 1 – 1700W GCU Configuration Utility

Using the configuration utility relieves the user from the burden of writing software in order to configure and control the GCU. There is no need to read any more of this document if the configuration utility is used – the RS232 protocol is provided solely for the purpose of more tightly integrating the GCU with other hardware and software.

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3 Contents

4 Commands

The GCU supports a number of commands via its RS232 interface. The command processor is not case sensitive, but commands must be entered exactly as shown below, with the correct number of digits and no extraneous spaces. A carriage return or linefeed character is required to terminate each command. A confirmation string is issued if the command is successful.
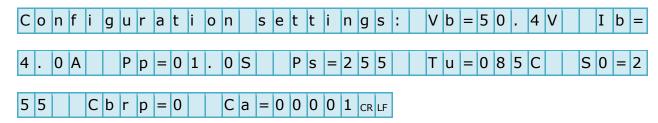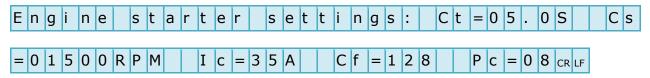
4.1 Status commands

4.1.1 Show settings

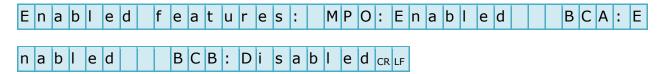**Show** Displays the GCU's settings and enabled features.

The first packet returned shows the stored configuration settings and is 96 bytes long (including CR & LF), and is formatted as follows:

| C | o | n | f | i | g | u | r | a | t | i | o | n | | s | e | t | t | i | n | g | s | : | | V | b | = | 5 | 0 | . | 4 | V | | | I | b | = |

| 4 | . | 0 | A | | | P | p | = | 0 | 1 | . | 0 | S | | | P | s | = | 2 | 5 | 5 | | | T | u | = | 0 | 8 | 5 | C | | | S | 0 | = | 2 |

| 5 | 5 | | | C | b | r | p | = | 0 | | | C | a | = | 0 | 0 | 0 | 0 | 1 | CR | LF |

The second packet returned shows the stored engine starter settings and is 71 bytes long (including CR & LF), and is formatted as follows:

| E | n | g | i | n | e | | s | t | a | r | t | e | r | | s | e | t | t | i | n | g | s | : | | C | t | = | 0 | 5 | . | 0 | S | | | C | s |

| = | 0 | 1 | 5 | 0 | 0 | R | P | M | | | I | c | = | 3 | 5 | A | | | C | f | = | 1 | 2 | 8 | | | P | c | = | 0 | 8 | CR | LF |

The third packet returned shows the enabled features and is 60 bytes long (including CR & LF), and is formatted as follows:

| E | n | a | b | l | e | d | | f | e | a | t | u | r | e | s | : | | M | P | O | : | E | n | a | b | l | e | d | | | B | C | A | : | E |

| n | a | b | l | e | d | | | B | C | B | : | D | i | s | a | b | l | e | d | CR | LF |

MPO = Main power output
BCA = Battery charger A
BCB = Battery charger B

4.2 Configuration settings

The following commands store configuration settings in non-volatile memory:

4.2.1 Set Battery charging voltage

Set Vb=XX.X Where XX.X is the nominal (fully charged) battery voltage in Volts. V_B may be set to any value from 40.0 to 55.0 inclusive.

4.2.2 Set Battery charging current

Set Ib=X.X Where X.X is the maximum battery charging current (for each battery) in Amps. I_B may be set to any value from 0.5 to 8.0 inclusive.

4.2.3   Set Packet period

Set Pp=XX.X   Sets the packet streaming period. XX.X is the desired interval of time between successive transmissions in seconds.
Pp may be set to any value from 00.1 to 25.5 inclusive.

4.2.4   Set Packets streamed

Set Ps=XXX   Sets which packets types are streamed. XXX is a decimal value ranging from 000 to 255 inclusive. Bits have the following significance:

Bit 0: Set to stream packet type 0 (voltages)
Bit 1: Set to stream packet type 1 (currents)
Bit 2: Set to stream packet type 2 (battery statuses)
Bit 3: Set to stream packet type 3 (temperatures)
Bit 4: Set to stream packet type 4 (miscellaneous data)
Bits 5 to 7: Irrelevant

4.2.5   Set Temperature limit

Set Tu=XXX   Where XXX is the upper temperature limit in degrees Celsius.
T_U may be set to any value from 000 to 255 inclusive. There is approximately 10% hysteresis. Setting T_U to 0 forces the GCU into thermal shutdown, and setting T_U to 255 disables thermal shutdown. The main power output and both battery chargers are turned off during thermal shutdown.

4.2.6   Set Initial state

Set S0=XXX   Sets the GCU's initial state. S_0 defines how the GCU's outputs and features are configured immediately after power-up or reset. XXX is a decimal value ranging from 000 to 255 inclusive. Bits have the following significance:

Bit 0: Main power output (1 = enabled)
Bit 2: Battery charger A (1 = enabled)
Bit 3: Battery charger B (1 = enabled)
Bit 6: Keep fans on (1 = enabled)
Bits 1, 4, 5 and 7: Irrelevant

4.2.7   Set CAN Baudrate

Set Cbrp=X   Sets the CAN Baudrate according to the following formula:

$$Baudrate\ (kb/s) = \frac{1000}{X+1}$$

Values for X other than 0 (1Mb/s), 1 (500kb/s), 3 (250kb/s) and 7 (125kb/s) have not been tested.

4.2.8   Set CAN address

Set Ca=XXXXX   Sets the 16-bit CAN address. XXXXX may be set to any value from 00000 to 65535 inclusive. See the CAN protocol document for further information.

4.3 Engine starter settings

The following commands store engine starter settings in non-volatile memory:

4.3.1 Set Cranking timeout

Set Ct=XX.X Sets the maximum cranking time for the engine starter. XX.X is the time limit in seconds, and may be set to any value from 00.5 to 25.0 inclusive.

4.3.2 Set Cranking speed

Set Cs=XXX Sets the speed at which the engine is deemed to have started. XXX is the BLDC rotational speed in RPM x 100, and may be set to any value from 001 to 255 inclusive (corresponding to BLDC speeds of 100 to 25500 RPM).

4.3.3 Set Cranking current

Set Ic=XX Sets the current that will be drawn when starting the engine. XX is the current in Amps, and may be set to any value from 01 to 50 inclusive.

4.3.4 Set Cranking flags

Set Cf=XXX Sets flags that control the behaviour of the engine starter. XXX is a decimal value ranging from 000 to 255 inclusive. Bits have the following significance:

Bit 0: Direction of rotation
Bits 1 to 7: Irrelevant

4.3.5 Set Pole count

Set Pc=XX Sets the number of poles in the BLDC motor. This value is used to calculate the mechanical RPM of the BLDC motor from its electrical RPM, and may be set to any even number from 2 to 32 inclusive.

4.4 Control commands

The following commands perform actions (but do not store anything in non-volatile memory):

4.4.1 Main power output

Enable MPO Enables the main power output.

Disable MPO Disables the main power output.

4.4.2 Battery charger A

Enable BCA Enables battery charger A.

Disable BCA Disables battery charger A.

4.4.3 Battery charger B

Enable BCB Enables battery charger B.

Disable BCB Disables battery charger B.

An "Enabled features" packet is returned on receipt of a valid "Enable" or "Disable" command.

4.4.4 Engine starter module

Start Starts cranking the engine.

Stop Stops cranking the engine. This command is included for safety reasons only (the engine starter automatically disengages when it detects that the engine has started).

4.4.5 Reset

Reset Restarts the GCU. Outputs are set to their power-up states (as defined by the "Set S0" command), and the battery statuses Eba and Ebb are re-initialised to zero (see packet type 2 below).
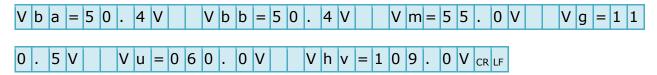
5 Monitoring

The GCU measures and reports a number of quantities via its RS232 interface. The measured data is formatted into a human-readable plain text packets that are streamed regularly at a user-defined rate (configured by the Set P_P command). Packet streams may be turned on and off individually using the Set P_S command.

Measurements are fixed width, i.e. leading zeros are always included. Measurements are separated from each other by pairs of spaces, and packets are terminated by both carriage returns and linefeeds.

5.1 Packet type 0 – Voltage

Packet type 0 is 66 bytes (including CR & LF), and is formatted as follows:

| V | b | a | = | 5 | 0 | . | 4 | V | | | V | b | b | = | 5 | 0 | . | 4 | V | | | V | m | = | 5 | 5 | . | 0 | V | | | V | g | = | 1 | 1 |

| 0 | . | 5 | V | | | V | u | = | 0 | 6 | 0 | . | 0 | V | | | V | h | v | = | 1 | 0 | 9 | . | 0 | V | CR | LF |

Vba = Battery A voltage
Vbb = Battery B voltage
Vm = Main power output voltage
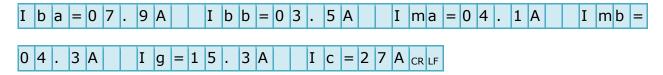*Vg = Generator (BLDC motor) voltage*
Vu = Umbilical input voltage
Vhv = Internal HV bus voltage

Vg is a DC value. Generator voltage is measured after the active rectification process.

5.2 Packet type 1 – Current

Packet type 1 is 62 bytes (including CR & LF), and is formatted as follows:

| I | b | a | = | 0 | 7 | . | 9 | A | | | I | b | b | = | 0 | 3 | . | 5 | A | | | I | m | a | = | 0 | 4 | . | 1 | A | | | I | m | b | = |

| 0 | 4 | . | 3 | A | | | I | g | = | 1 | 5 | . | 3 | A | | | I | c | = | 2 | 7 | A | CR | LF |

Iba = Battery A current
Ibb = Battery B current
Ima = Main power output current, A-side
Imb = Main power output current, B-side
Ig = Generator (BLDC motor) current
Ic = Cranking current

5.3 Packet type 2 – Battery status

Packet type 2 is 30 bytes (including CR & LF), and is formatted as follows:

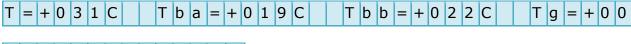| E | b | a | = | + | 0 | 0 | 0 | 0 | 0 | mA | H | | | E | b | b | = | + | 0 | 0 | 0 | 0 | 0 | mA | H | CR | LF |

Eba = Battery A energy
Ebb = Battery B energy

Eb is similar to a fuel gauge, except that it represents the change in energy stored (since power-up), rather than the total amount of energy stored. A positive value means that the battery has had a net gain in energy since power-up (i.e. it has been charged).

5.4   Packet type 3 – Temperature

Packet type 3 is 51 bytes (including CR & LF), and is formatted as follows:

| T | = | + | 0 | 3 | 1 | C | | | T | b | a | = | + | 0 | 1 | 9 | C | | | T | b | b | = | + | 0 | 2 | 2 | C | | | T | g | = | + | 0 | 0 |

| 1 | C | | | T | e | = | + | 1 | 0 | 0 | C | CR | LF |

T = Internal GCU temperature
Tba = Battery A temperature
Tbb = Battery B temperature
Tg = Generator (BLDC motor) temperature
Te = Engine starter module temperature

For external temperature sensing the GCU will generally return a value of -128C if no temperature sensing device is present. In the case of the engine starter module not being fitted the corresponding value is indeterminate.

5.5   Packet type 4 – Miscellaneous

Packet type 4 is 45 bytes (including CR & LF), and is formatted as follows:

| S | g | = | 0 | 9 | 5 | 4 | 0 | R | P | M | | | R | 0 | = | 0 | 0 | 0 | | | R | 1 | = | 0 | 0 | 0 | | | R | 2 | = | 0 | 0 | 0 | | |

| R | 3 | = | 0 | 0 | 0 | CR | LF |

Sg = Generator (BLDC motor) speed

R0 = Flag register 0 – Bit 5: Thermal shutdown flag (1 = shutdown)
*   Bit 6: Start button pressed flag (1 = pressed)*
*   Bit 7: Arm input active flag (1 = active)*

R2 = Flag register 2 – Bit 0: Main power output (1 = enabled)
*   Bit 2: Battery charger A (1 = enabled)*
*   Bit 3: Battery charger B (1 = enabled)*

R3 = Flag register 3 – Bit 7: Engine starter module status flag (1 = ready)

Sg is only valid if Hall sensors are fitted to the BLDC motor and connected, and the number of poles has been correctly specified.

6 Document version history

6.1   0.9 -> 1.0

- Initial release.

6.2   1.0 -> 1.1

- Updated product name from 1600W GCU to 1700W GCU.
- Set Initial states updated to allow configuration of battery chargers and main power output at power-up.
- Packet type 1 updated to allow for currents greater than 9.9 Amps.