MILLSWOOD engineering

250W PMU V2

RS232 PROTOCOL

1 Introduction

The 250W PMU has both RS232 and CANbus interfaces that perform essentially the same functions, these being:

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

Once the PMU has been configured, there is no requirement to connect anything to either communications interface – the PMU 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 250W PMU's various features may be downloaded from www.millswoodeng.com.au/resources.html

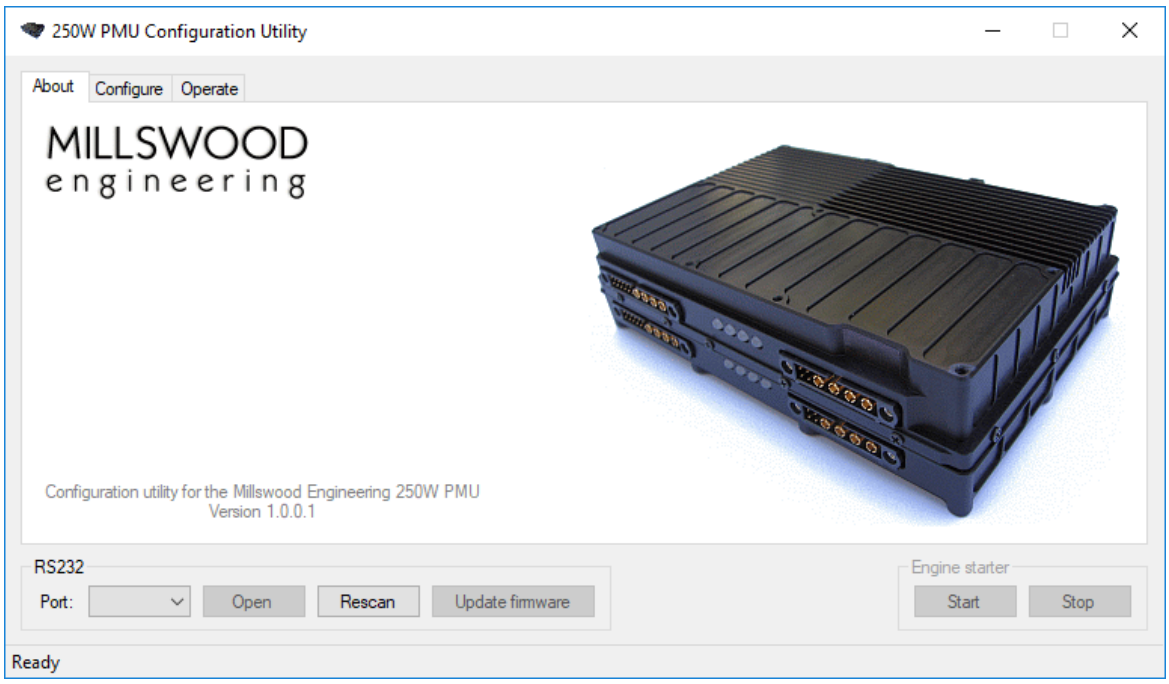

Figure 1 – 250W PMU Configuration Utility

Using the configuration utility relieves the user from the burden of writing software in order to configure and control the PMU. 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 PMU with other hardware and software.

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3 Contents

4 Commands

The PMU 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 configuration settings

Show Displays the PMU's configuration settings and enabled features.

The first packet returned shows the stored configuration settings and is 135 bytes long (including CR & LF), and is formatted as follows:

```
Configuration settings:  Va=12.0V   Vp=
15.0V   Vs=06.0V   Vb=21.2V   Pp=01.0S
Ps=255   T0=127   Tu=085C   S0=255   CT=0
5.0S   Cbrp=0   Ca=00001 CR LF
```

The second packet returned shows the enabled features and is 102 bytes long (including CR & LF), and is formatted as follows:

```
Enabled features: Avi: Enabled   Ser: E
nabled   Pay: Disabled   BCA: Enabled
BCB: Disabled   Gen: Enabled   CR LF
```

Avi = Avionics output
Ser = Servo output
Pay = Payload output
BCA = Battery charger A
BCB = Battery charger B
Gen = Electrical power generation

4.2 Configuration commands

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

4.2.1 Set Avionics voltage

Set Va=XX.X Where XX.X is the desired avionics output voltage in Volts.
V_A may be set to any value from 12.0 to 24.0 inclusive.

4.2.2 Set Payload voltage

Set Vp=XX.X Where XX.X is the desired payload output voltage in Volts.
V_P may be set to any value from 12.0 to 24.0 inclusive.

4.2.3 Set Servo voltage

Set Vs=XX.X Where XX.X is the desired servo output voltage in Volts.
V_S may be set to any value from 05.0 to 12.0 inclusive.

4.2.4 Set Battery voltage

Set Vb=XX.X Where XX.X is the desired battery charging voltage in Volts.
V_B may be set to any value from 20.0 to 25.2 inclusive.

4.2.5 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.
P_P may be set to any value from 00.1 to 25.5 inclusive.

4.2.6 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

4.2.7 Set Initial state

Set S0=XXX Sets the PMU's initial state. S_0 defines how the PMU'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: Avionics and servo outputs (1 = enabled)
Bit 1: Payload output (1 = enabled)
Bit 2: Battery charger A (1 = enabled)
Bit 3: Battery charger B (1 = enabled)
Bit 5: Payload shedding (1 = enabled)
Bits 4, 6 and 7: Irrelevant

4.2.8 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 00.0 to 25.5 inclusive. A value of 00.0 disables the timeout.

4.2.9 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.

4.2.10 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 Control commands

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

4.3.1 Avionics and servo outputs

Enable A+S Enables the avionics and servo outputs.

Disable A+S Disables the avionics and servo outputs. Use with extreme caution.

4.3.2 Payload output

Enable Pay Enables the payload output.

Disable Pay Disables the payload output.

4.3.3 Battery charger A

Enable BCA Enables battery charger A. Battery charging only occurs when electrical power generation is occurring or umbilical power is present.

Disable BCA Disables battery charger A.

4.3.4 Battery charger B

Enable BCB Enables battery charger B. Battery charging only occurs when electrical power generation is occurring or umbilical power is present.

Disable BCB Disables battery charger B.

4.3.5 Electrical power generation

Enable Gen Enables electrical power generation.

Disable Gen Disables electrical power generation. This removes the electromechanical load from the internal combustion engine; it **DOES NOT** affect the avionics, servo or payload outputs (as long as at least one battery is connected).

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

4.3.6 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).

4.3.7 Reset

Reset Restarts the PMU. 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 PMU 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 74 bytes (including CR & LF), and is formatted as follows:

V	a	=	1	2	.	0	V			V	2	8	=	2	7	.	8	V			V	p	=	1	5	.	1	V			V	s	=	0	6	.

0	V			V	b	a	=	2	1	.	2	V			V	b	b	=	2	1	.	3	V			V	g	=	1	2	1	.	5	V	CR	LF

Va = Avionics output voltage
V28 = 28VDC output voltage
Vp = Payload output voltage
Vs = Servo output voltage
Vba = Battery A voltage
Vbb = Battery B voltage
Vg = Generator (BLDC motor) 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 66 bytes (including CR & LF), and is formatted as follows:

I	a	=	0	0	.	7	A			I	2	8	=	+	0	7	.	9	A			I	p	=	0	4	.	5	A			I	s	=	0	3

.	1	A			I	b	a	=	-	1	2	.	6	A			I	b	b	=	+	0	0	.	0	A	CR	LF

Ia = Avionics output current
I28 = 28VDC output current
Ip = Payload output current
Is = Servo output current
Iba = Battery A current
Ibb = Battery B current

Positive current is defined as flowing out of the PMU. In the case of battery current this means that the battery is being charged.

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	m	A	H			E	b	b	=	+	0	0	0	0	0	m	A	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	2	8	C	CR	LF

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

For external temperature sensing the PMU will generally return a value of -128C if no temperature sensing device is present. The engine starter module temperature is no longer sensed and will always be reported as -128C.

5.5 Packet type 4 – Miscellaneous

Packet type 4 is 37 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	CR	LF

Sg = Generator (BLDC motor) speed

R0 = Flag register 0 – Bit 2: Battery A charge termination flag (1 = terminated)
Bit 3: Battery B charge termination flag (1 = terminated)
Bit 4: Electrical power generation flag (1 = enabled)
Bit 5: Thermal shutdown flag (1 = shutdown)
Bit 6: Overvoltage shutdown flag (1 = shutdown)
Bit 7: Payload shedding flag (1 = shed)

R1 = Flag register 1 – Bit 7: Engine starter module status flag (1 = ready)

R2 = Flag register 2 – Bit 0: Avionics and servo outputs (1 = enabled)
Bit 1: Payload output (1 = enabled)
Bit 2: Battery A charger (1 = enabled)
Bit 3: Battery B charger (1 = enabled)

Sg is only valid if Hall sensors are fitted to the BLDC motor and connected. The BLDC motor is presumed to have 4-poles (2 pole pairs).

6 Document version history

6.1 1.8 -> 2.0

6.1.1 Commands

- Set Initial states updated. Battery disconnect detect (bit 4) and Safe operating area management (bit 6) removed. These bits are now ignored by the firmware.
- Set Temperature offset calibration value removed. Calibration is no longer required.
- Set Temperature limit removed. The upper temperature limit is now fixed internally.
- Show configuration settings updated. In the first packet returned, T0 and Tu no longer contain meaningful values.

6.1.2 Monitoring

- Packet type 0 – Voltages updated. The Vg field contains an extra digit to accommodate voltages over 99.9V, and consequently the packet is 1 byte longer.
- Packet type 3 – Temperature updated. The engine starter module temperature is no longer sensed and will always be reported as -128C.
- Packet type 4 – Miscellaneous updated. Flag register 0 bits 2 and 3 now indicate battery charge termination, and bit 6 indicates overvoltage shutdown.