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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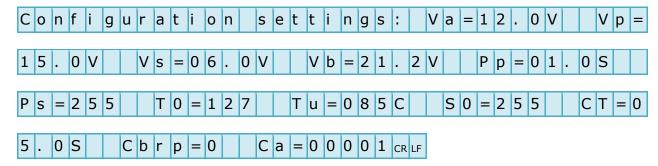This page intentionally left blank.

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.
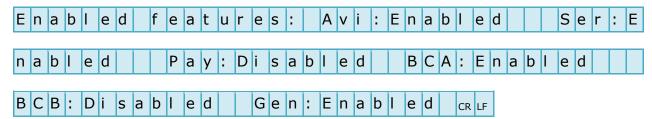
4.1   Status commands

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:

C	o	n	f	i	g	u	r	a	t	i	o	n		s	e	t	t	i	n	g	s	:		V	a	=	1	2	.	0	V			V	p	=

1	5	.	0	V			V	s	=	0	6	.	0	V			V	b	=	2	1	.	2	V			P	p	=	0	1	.	0	S		

P	s	=	2	5	5			T	0	=	1	2	7			T	u	=	0	8	5	C			S	0	=	2	5	5			C	T	=	0

5	.	0	S			C	b	r	p	=	0			C	a	=	0	0	0	0	1	CR	LF

The second packet returned shows the enabled features and is 102 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	:		A	v	i	:	E	n	a	b	l	e	d				S	e	r	:	E

n	a	b	l	e	d			P	a	y	:	D	i	s	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			G	e	n	:	E	n	a	b	l	e	d			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 Temperature offset calibration value

Set T0=XXX   Where XXX is the temperature offset calibration value.
T_0 may be set to any value from 000 to 255 inclusive. T_0 is set at the factory
and should not normally need changing.

4.2.8   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 PMU into thermal shutdown, and
setting T_U to 255 disables thermal shutdown. Note that thermal shutdown
DOES NOT affect the servo, payload or avionics outputs (as long as at least
one battery is connected); it does, however, mean that all battery charging
ceases and the 28VDC output will assume the highest battery voltage
available.

4.2.9   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 4: Battery disconnect detect (1 = enabled)
Bit 5: Payload shedding (1 = enabled)
Bit 6: Safe operating area management (1 = enabled)
Bit 7: Irrelevant

4.2.10   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.

4.2.11   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.

4.2.12   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).
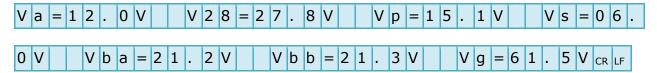
5   Monitoring

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 73 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	=	6	1	.	5	V	CR	LF

Va = Avionics output voltage
V28 = 28VDC output voltage
Vp = Payload output voltage
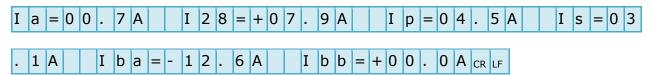*Vs = Servo output voltage*
Vba = Battery A voltage
Vbb = Battery B voltage
Vg = Generator (BLDC motor) voltage

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
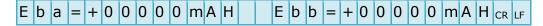*Is = Servo output current*
Iba = Battery A current
Ibb = Battery B current

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	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 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. 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 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 4: Electrical power generation flag (1 = enabled)
Bit 5: Thermal shutdown flag (1 = shutdown)
Bit 6: Safe operating area 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 1.0 -> 1.1

6.1.1 Commands
- Default Initial state updated (payload shedding is disabled by default).
- Minimum battery voltage changed from 16.8 to 20.0V.

6.1.2 Monitoring
- Packet type 4 – Miscellaneous updated to reflect firmware version 1.12 (flag registers added).

6.2 1.1 -> 1.2
- Document section numbering added.

6.3 1.2 -> 1.3
- This section renamed to Document version history.
- Document reformatted to suit printing and binding.

6.4 1.3 -> 1.4
- Changed description of Set Initial states and payload shedding command, but the command itself remains unchanged.

6.5 1.4 -> 1.5
- Set Initial states updated to reflect new feature added at firmware version 1.15 – Battery disconnect detect (bit 4).

6.6 1.5 -> 1.6
- Default values deleted.

6.7 1.6 -> 1.7
- Set Initial states updated to reflect new feature added at firmware version 1.16 – Safe operating area management (bit 6).
- Packet type 4 – Miscellaneous updated to reflect firmware version 1.16 (flag register R0 bit 6 changed from start button pressed to safe operating area shutdown flag).
- Packet type 4 – Miscellaneous updated to reflect firmware version 1.16 (flag register 2 added).

6.8 1.7 -> 1.8
- Added Set CAN Baudrate command. Only supported with firmware versions 1.17 and above.
- Added Set CAN address command. Only supported with firmware versions 1.17 and above.
- Show packet modified (18 bytes appended) to include CAN Baudrate and CAN address.