Introduction

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

1. Configuration (of parameters stored in the PMU's non-volatile memory),
2. Control (real-time control of the PMU's various features),
3. Monitoring (of measured voltages, currents, temperatures, etc), and
4. 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.

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/downloads.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.

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.

Configuration commands

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

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 (default: 12.0)

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 (default: 12.0)

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 (default: 06.0)

Set Vb=XX.X Where XX.X is the desired battery charging voltage in Volts
V_B may be set to any value from 16.8 to 25.2 inclusive (default: 21.0)

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 (default: 01.0).

Set Ps=XXX Sets which packets types are streamed. XXX is a decimal value ranging from 000 to 255 inclusive (i.e. one byte). 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

The default value for P_S is 255 (all packet types streamed).

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.

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 (default: 085). 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 avionics, servo or payload outputs (as long as at least one battery is connected).

Set S0=XXX Sets the power-up states of the PMU's various outputs. XXX is a decimal value ranging from 000 to 255 inclusive (i.e. one byte). Bits have the following significance:

Bit 0: Avionics and servo outputs (0=disabled, 1=enabled)
Bit 1: Payload output (0=disabled, 1=enabled)
Bit 2: Battery charger A (0=disabled, 1=enabled)
Bit 3: Battery charger B (0=disabled, 1=enabled)
Bit 5: Payload shedding (0=disabled, 1=enabled)
Bits 4, 6 and 7: Irrelevant

The default value for S_0 is 255 (all outputs and payload shedding enabled).

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 (default: 05.0).

Operational commands

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

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

The first packet returned shows the stored configuration settings and is 117 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	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.

Enable A+S Enables the avionics and servo outputs.

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

Enable Pay Enables the payload output.

Disable Pay Disables the payload output.

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.

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.

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.

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).
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).

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.

Packet type 0 (Voltage)

Va=XX.X V	Avionics output voltage
V28=XX.X V	28VDC output voltage
Vp=XX.X V	Payload output voltage
Vs=XX.X V	Servo output voltage
Vba=XX.X V	Battery A voltage
Vbb=XX.X V	Battery B voltage
Vg=XX.X V	Generator (BLDC motor) voltage***Note 1***

Packet type 1 (Current):

Ia=XX.X A	Avionics output current
I28=±XX.X A	28VDC output current***Note 2***
Ip=XX.X A	Payload output current
Is=XX.X A	Servo output current
Iba=±XX.X A	Battery A current***Note 3***
Ibb=±XX.X A	Battery B current***Note 3***

Packet type 2 (Battery status):

Eba=±XXXXX mAH	Battery A energy***Note 4***
Ebb=±XXXXX mAH	Battery B energy***Note 4***

Packet type 3 (Temperature):

T=±XXX C	Internal PMU temperature
Tba=±XXX C	Battery A temperature***Note 5***
Tbb=±XXX C	Battery B temperature***Note 5***
Tg=±XXX C	Generator (BLDC motor) temperature***Note 5***
Te=±XXX C	Engine starter (internal ESC module) temperature***Note 6***

Packet type 4 (Miscellaneous):

Sg=XXXXX RPM	Generator (BLDC motor) speed***Note 7***

Note 1: This is a DC value. Generator voltage is measured after the active rectification process.
Note 2: Positive current is defined as flowing out of the PMU.
Note 3: Positive current is defined as flowing out of the PMU, i.e. the battery is being charged.
Note 4: 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). Battery energy is a more faithful measure of the state of charge than battery voltage.
Note 5: Only valid if a suitable external temperature sensor is fitted.
Note 6: Only valid for units fitted with an internal engine starter.
Note 7: 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).

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 as shown below:

Packet type 0 (73 bytes including CR & LF)

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

Packet type 1 (66 bytes including CR & LF)

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

Packet type 2 (30 bytes including CR & LF)

E	b	a	=	+	0	0	0	0	0	m	A	H			E	b	b	=	+	0	0	0	0	0	m	A	H	CR	LF

Packet type 3 (51 bytes including CR & LF)

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

Packet type 4 (13 bytes including CR & LF)

S	g	=	0	9	5	4	0	R	P	M	CR	LF

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