MILLSWOOD engineering

ServoStation

DATASHEET

General Description

The ServoStation provides clean, efficient power for radio receivers and servos installed in radio-controlled and autonomous vehicles. The ServoStation includes all of the functionality of a conventional BEC (Battery Eliminator Circuit), plus a number of additional features.

The ServoStation has a high-efficiency switching regulator that generates 6 volts to power up to 8 analog or digital servos. This power supply can deliver 5 Amps continuously over the full industrial operating temperature range.

The ServoStation also has a low-noise linear regulator that generates 5 volts to power radio receivers and other low-power 5 volt devices. This regulator is rated at 1 Amp continuous.

The ServoStation includes 8 servo pulse amplifiers that boost the received PWM signals. These amplifiers have balanced push-pull output stages capable of sourcing and sinking up to 24mA each.

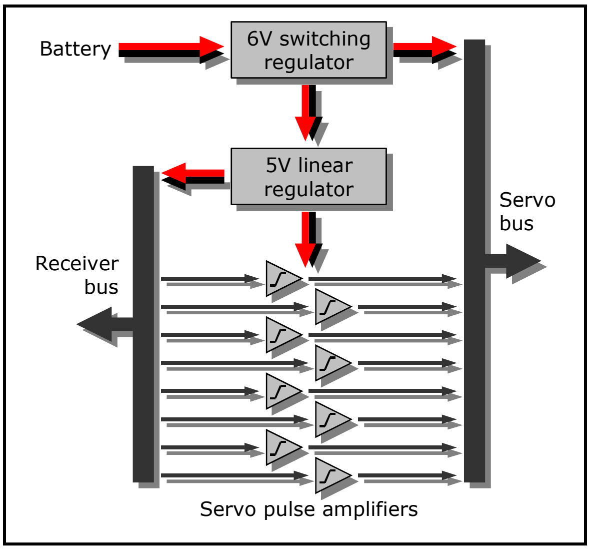

Fig. 1: ServoStation block diagram

Features

- High current servo power supply: 5 Amps continuous / 7.5 Amps peak
- Very high efficiency switching power supply: up to 95% at 5 Amps
- Ultra low-noise linear power supply: typically less than 20mV$_{p-p}$ ripple
- Novel architecture eliminates the 3 Amp connector limit
- Servo pulse amplifiers for maximum signal integrity in hostile environments
- Provides reverse polarity protection for radio receiver and servos
- Rated over full industrial temperature range: -40 to +85°C
- Full engineering specifications with extensive characterisation data
- Rugged aluminium enclosure
- Simple installation: replaces voltage regulator or BEC
- Compatible with standard RC receivers, analog and digital servos
- Flexible: can have a mix of 5 and 6 volt devices
- Graceful and predictable behaviour with a failing battery
- Shielded construction for low EMI

Innovations

Even though some BECs can produce more than 3 Amps, they cannot deliver this current to the receiver or servos because they use the industry standard connector, which is only rated to 3 Amps. The ServoStation eliminates this power supply bottleneck, whilst continuing to use the industry standard connector.

In a conventional RC system (shown in figure 2 below), power is distributed to the servos by the radio receiver, which is itself powered by a standard servo cable and connector.

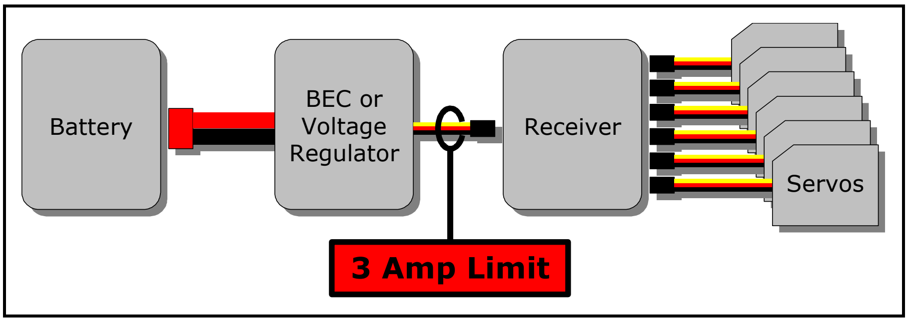

Fig. 2: Conventional supply path from battery to servos

Not only does this arrangement limit the current available to the servos to 3 Amps, it also places a heavy electrical burden on the radio receiver. The receiver must supply all of the servos' current demands, potentially degrading its noise performance and thus sensitivity.

The ServoStation solves this problem by providing separate supply paths to the receiver and servos, as shown below:

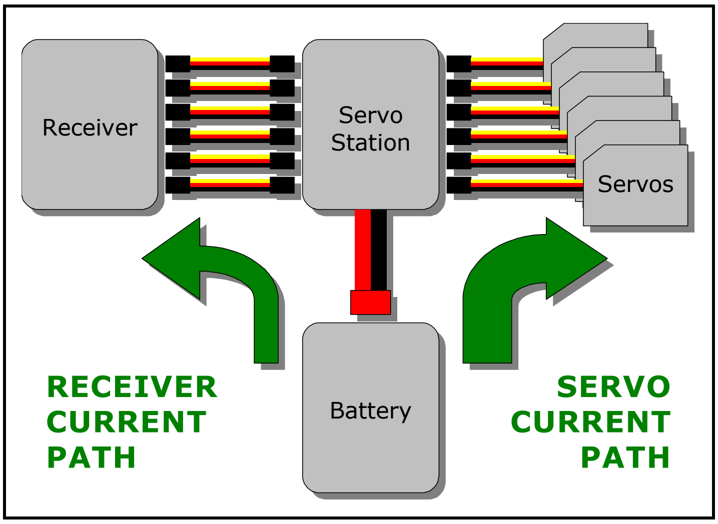

Fig. 3: A ServoStation provides separate supply paths to receiver and servos

A low-noise linear regulator provides 5 volts for the receiver, and a high-efficiency switching regulator provides 6 volts for the servos. The receiver no longer has to supply any current to the servos, and can get on with its job of receiving tiny signals in relative peace and quiet. The inclusion of 8 servo pulse amplifiers enhances the isolation between receiver and servos, and facilitates the use of long servo cables and/or multiple servos per channel.

ServoStation architecture also has reliability benefits. With a conventional BEC or voltage regulator, failure of the cable supplying the receiver results in total loss of vehicle control. This failure mode is eliminated with ServoStation architecture because each and every cable to the receiver carries a supply and ground connection.

Typical Applications

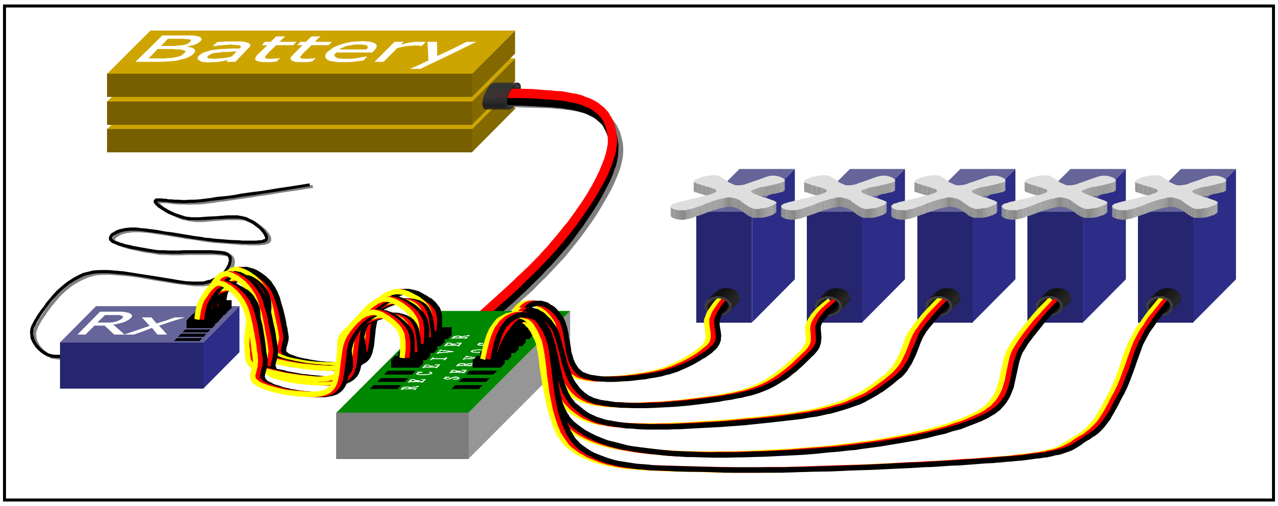

Fig. 4: A typical 5-channel setup for fuel powered vehicles

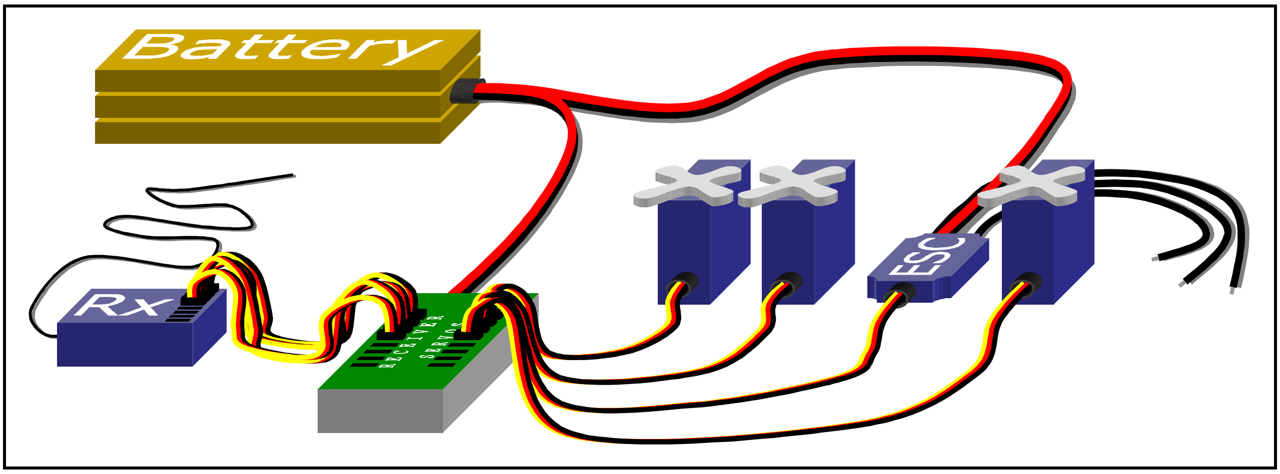

Fig. 5: A typical 4-channel setup for electric powered vehicles

Absolute Maximum Ratings*Note 1*

Symbol	Parameter	Min	Max	Unit
V_{BI}	Battery input voltage	-25	+25	V
V_{SI}, V_{SO}	Signal input & output voltages	-0.5	+7	V
V_{RPO}	Receiver power output voltage	-0.5	+7	V
V_{SPO}	Servo power output voltage	-0.3	+10	V
V_{ESD}	ESD rating as per Mil-Std-883C, method 3015, using the human body model*Note 2*	2		kV
T_{stg}	Storage temperature range	-40	+85	°C

Note 1: Absolute maximum ratings are those values beyond which damage to the product may occur. Functional operation under these conditions is not implied (or recommended).

Note 2: The human body model is a 100pF capacitor discharged through a 1.5kΩ resistor into each pin.

Recommended Operating Conditions

Symbol	Parameter	Min	Max	Unit
V_{BI}	Battery input voltage	+8	+22	V
T_{op}	Operating temperature range	-40	+85	°C
V_{air}	Air flow velocity	1.5		ms^{-1}

Electrical Characteristics

Test conditions are $+8<V_{BI}<+22V$, $-40<T_{op}<+85°C$, $V_{air}=1.5ms^{-1}$ unless stated otherwise.

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
I_Q	Quiescent current	$T_{op}=+25°C$		25	30	mA
Servo power output						
V_{SPO}	Voltage		5.8	6.0	6.2	V
ΔV_{SPO}	Line regulation	$V_{BI}=+8V$ to $+22V$	unmeasurable*Note 1*			mV
ΔV_{SPO}	Load regulation	$I_{SPOT}=5mA$ to $5A$, $T_{op}=+25°C$		20	50	mV
I_{SPOT}	Total current capability*Note 2*		5.0			A
I_{SPOI}	Individual current capability*Note 3*		3.0			A
I_{SPOP}	Peak current capability	$V_{BI}>+10V$, 10 seconds/minute max, $T_{op}=+25°C$		7.5		A
$V_{SPORp-p}$	Peak-to-peak voltage ripple	Non-inductive load		30	100	mV
η	Switching power supply efficiency*Note 4*	$1A<I_{SPOT}<5A$, $T_{op}=+25°C$	90	95		%
f	Switching frequency		275	305	335	kHz
Receiver power output						
V_{RPO}	Voltage		4.8	5.0	5.2	V
ΔV_{RPO}	Line regulation	$V_{BI}=+8V$ to $+22V$	unmeasurable*Note 1*			mV
ΔV_{RPO}	Load regulation	$I_{RPO}=5mA$ to $1A$, $T_{op}=+25°C$		10	25	mV
I_{RPO}	Current capability		1.0			A
I_{RPOSC}	Short circuit current			1.8	2.2	A
$V_{RPORp-p}$	Peak-to-peak voltage ripple	Non-inductive load		15	50	mV
Servo pulse amplifiers						
I_{IL}	Input leakage current	$V_{SI}=0$ or $5.0V$			120	µA
V_{IL}	Input logic low		0		0.8	V
V_{IH}	Input logic high		2.0		5.0	V
V_{OL}	Output logic low	Sink current=50µA Sink current=24mA			0.1 0.5	V
V_{OH}	Output logic high	Source current=50µA Source current=24mA	4.7 4.0			V
t_P	Propagation delay	$C_L=50pF$	1.0		8.5	ns

Note 1: Change in output voltage is below noise floor.
Note 2: Current drawn by receiver subtracts from this value.
Note 3: Limited by connector current rating.
Note 4: Excludes cable losses.

Typical Performance Characteristics

Test conditions are T_{op}=+25°C, V_{air}=1.5ms^{-1} unless stated otherwise.

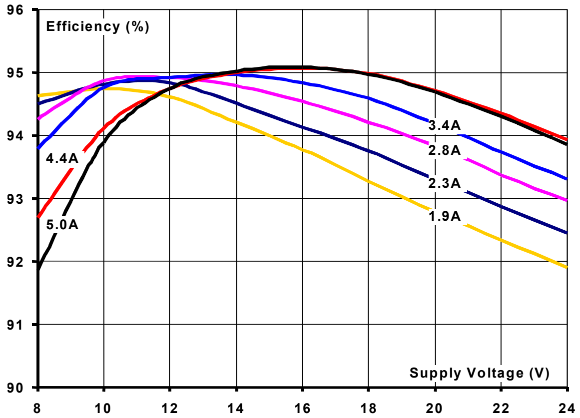

Fig. 6: Switching power supply efficiency versus supply voltage for various total output currents

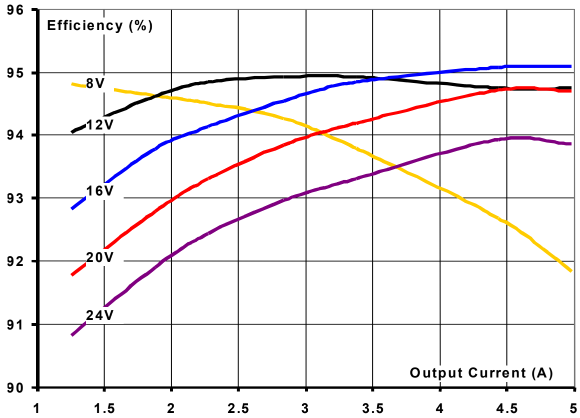

Fig. 7: Switching power supply efficiency versus total output current for various supply voltages

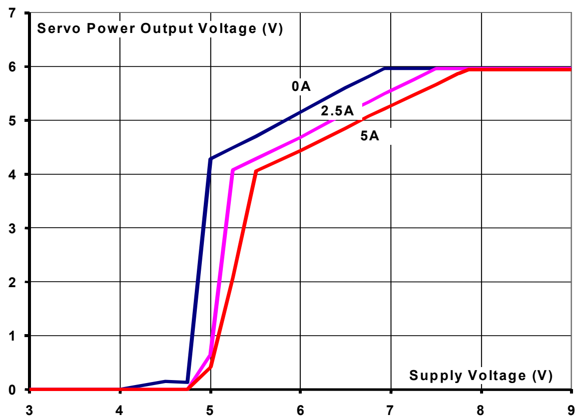

Fig. 8: Low voltage behaviour for various servo output currents

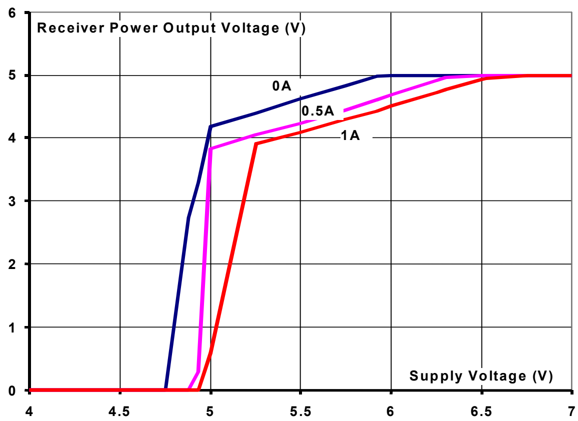

Fig. 9: Low voltage behaviour for various receiver output currents

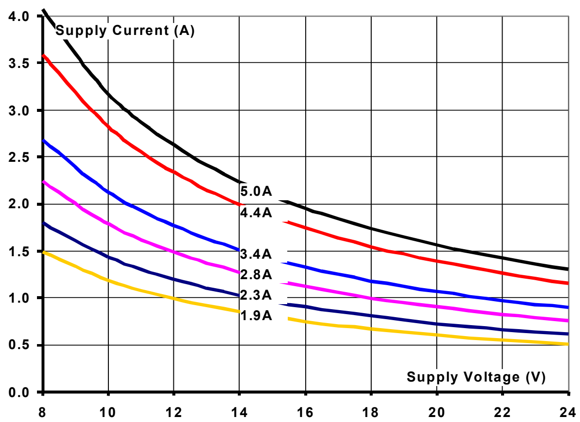

Fig. 10: Supply current versus supply voltage for various total output currents

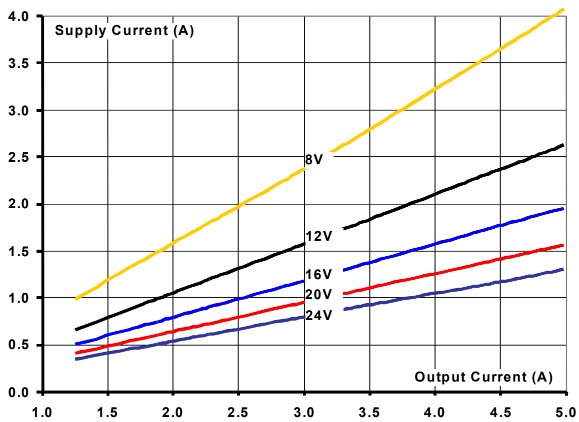

Fig. 11: Supply current versus total output current for various supply voltages

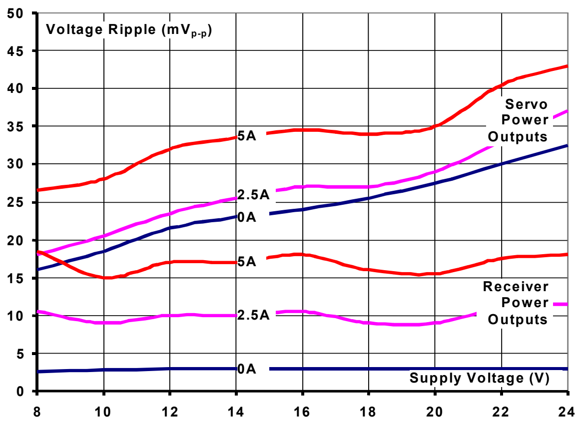

Fig. 12: Peak-to-peak voltage ripple versus supply voltage for various total output currents

Mechanical Data

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
L	Length	Excluding battery cable		89	90	mm
W	Width			43	44	mm
H	Height	Excluding bolt heads Including bolt heads		18.0 23.5	18.5 24.0	mm
M	Mass	Including battery cable		85		g

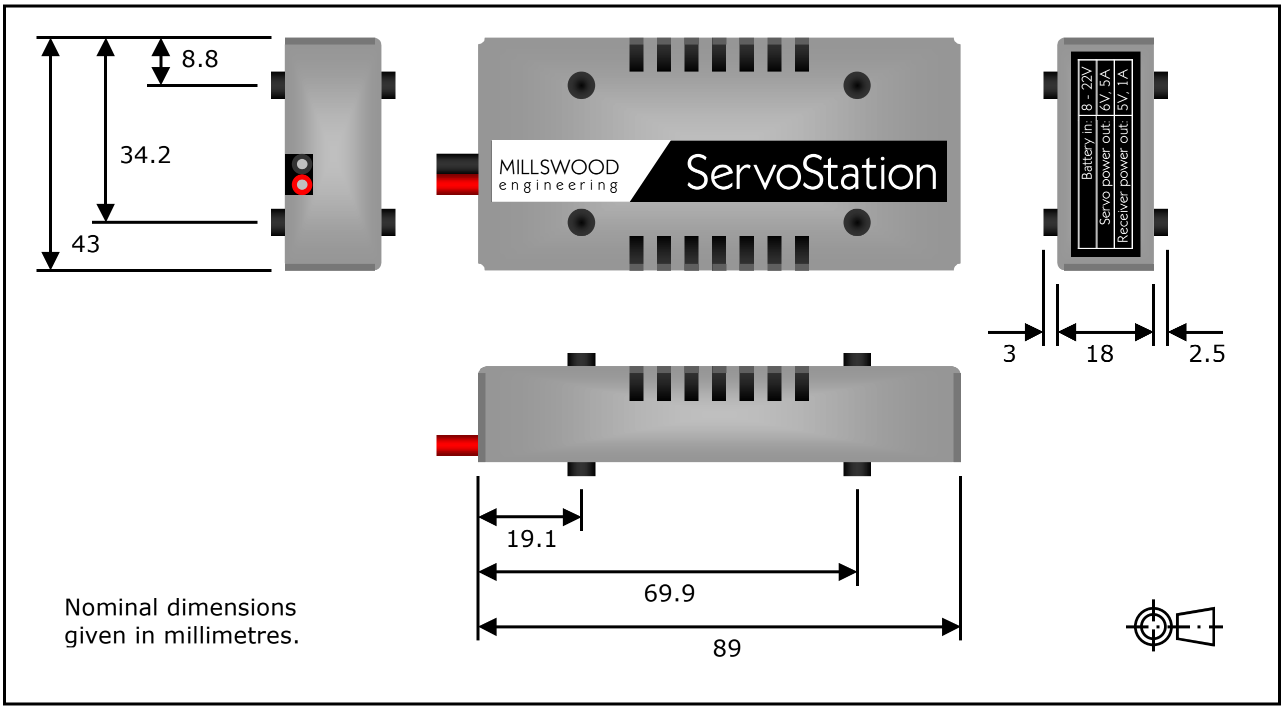

Fig. 13: Physical dimensions

Further Information

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