1. GENERAL DESCRIPTION

This regulator is intended for a Prestolite alternator type AB210R. All the electronic circuitry is realised on a thick film tile with a PCB terminal board, which is all environmental protection by a flexible silicone encapsulant.

The electronic circuitry has the following features:

- It has twin high side switched power output stages with active flywheel diode suitable for driving highly inductive loads (field coils).
- A high & low side D+/L output stage for diagnostic.
- A W output driver stage for speed indication.
- A DFM low side output driver stage for state of field duty cycle.
- An external sense input feature for regulating voltage adjustment.
- With all outputs short-circuit protected.

The controller's functionality is implemented in software to give us the flexibility to tailor the regulator specification for the different types. The temperature of the electronics is accurately monitored for the purpose of thermal compensation of the regulating voltage.

2. BASIC FUNCTIONALITY

The regulator controls the current in the field (excitation) winding the alternator using Pulse Width Modulation (PWM). The duty cycle is continuously adjusted to maintain the output voltage at an approximately constant level, subject to the limitations of the alternator output and system installation. The field is switched in the positive side so that there is no voltage on the field winding when the machine is shut down.

The PWM stage runs at a fixed frequency with the required duty cycle derived from the sensed voltage at the machine positive. The control loop shall behave in a stable manner under extreme operating conditions and includes a "proportional" control band of defined width. Low frequency switching (lamp flicker) shall not occur even in the case of an open-circuit battery.

3. INTERFACE

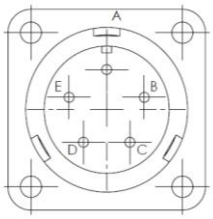
3.1 Five Pin Vehicle Interface

A five-pin bayonet lock MS-series military connector to MIL-C-5015, type 14S-5, is used to interface the control signals between the vehicle and alternator.

The fixed connector the regulator is equipped with male pins and has AB Connectors part no. ABB00T 14S-5PSN

The mating connector has AB Connectors part no. ABB06T 14S-5SSN

The layout of the pins on the regulator male connector is shown below.



CONNECTIONS

PIN A =W (AC) (OPTIONAL)
PIN B = L/D+ (RECOMMENDED)
PIN C = IGN (T15) (MANDATORY)
PIN D = S (OPTIONAL)
PIN E = DFM (OPTIONAL)

The signals supported are:

Pin	Designation	Description
A	W (AC)	AC output
B	D+/L	D+/Warning lamp output
C	Kl.15 (IGN)	Ignition enable/disable input
D	Kl.S	Remote sense/control input
E	DFM	Field duty cycle output

3.2 Interface Specification

Detailed descriptions of the hardware interfaces to the regulator tile are given in this section. The letter "U" is used to define the voltage on a particular pin, e.g. U_L = voltage on L terminal. Positive current refers to current being sourced from an output when in a high condition and negative current refers to sink current into an output in the low condition. Parameters are specified at 25°C unless otherwise stated.

3.3 Interface pins specification

3.3.1 Pin A - W (AC) Output

It is a requirement a frequency output corresponding to shaft speed and the regulator must processes the incoming phase waveform with no frequency translation.

The output has a source/sink output stage, making the need for an external pull-down resistor unnecessary when driving capacitive loads or long cable runs. When the machine is not generating sufficient phase amplitude, the output is in a low condition. When the regulator is shut down, the output is undefined.

An indefinite short-circuit to B- & B+, operating and non-operating is tolerated without sustaining damage.

The W output is disabled if the warning lamp is on (Kl.L=0V).

Frequency relationship:	1:1 (nalt = fin*10)
Signal form:	Squarewave with limited rise & fall times
Idle signal level:	V_W=0V
Commencement of O/P signal:	With phase signal & D+/L high
High condition current limit:	I_{Wh}=36mA max
Rated maximum current:	10mA
High condition voltage:	>U_B-3V @ I_W=10mA
Low condition current limit:	I_{Wl} =-36mA max
Low condition voltage:	<0.5V @ I_W =-2mA, <3V @ I_W =-10mA,

AC limits:	Within 2V of supply rails at 1000Hz with 220nF loading to 0V
Voltage rating of O/P:	Protected by 100R series resistor and 33V shunt Zener diode

3.3.2 Pin B - D+/L Function

For back-compatibility with traditional machines using an auxiliary rectifier (trio) for the field, the D+/L output is capable of sourcing and sinking current. Source current is up to 1A and the sink current is sufficient to drive a 4W lamp (large inrush current lasting circa 250ms) with inrush current limited by a resistor. This output is low when the machine is enabled but not cut-in or if a fault has been detected. It is high if the machine is enabled and generating. The output assumes a high impedance state if the machine is disabled via a low signal on Kl.15. The output stage is protected against an indefinite short-circuit to B+ with the output low and to B- with the output high (the two potentially damaging external fault conditions). The status of the output is determined by the machine status, including any possible fault conditions.

High condition current limit:	I_{Lh} = 1.3A nominal
High condition voltage:	$>U_B$-0.75V (U_B-U_L<0.75V) @ I_L=1.0A
Low condition current limit:	I_{Ll} = 1A nominal
Low condition voltage:	<1V @ I_L=-0.5A

High condition current limit:	1.2A< I_{Lh} <2.2A
High condition voltage:	$>U_B$-0.5V (U_B-U_L<0.5V) @ I_L=1.0A
Low condition current limit:	0.45A nominal
Low condition voltage:	<2V @ I_L=-180mA
Voltage rating of low side switch:	80V, but protected by 11R series resistor and 56V shunt Zener diode
Voltage rating of high side switch:	100V

3.3.3 Pin C - Ignition (Kl.15) Enable Function

This input is used to enable/disable the regulator and has three states, high (=on) low (=off) and open circuit (=emergency). High and low thresholds respectively define the high and low input detection levels and are defined in software. If the input falls between these two levels then the open-circuit condition is assumed. Note that the pin floats at approximately 1.5V and sources current in off condition. A 10k pull-down resistor will ensure that Kl.15 is below the low condition threshold when open-circuit. However, in the application, careful attention should be paid to the ground point of the pull-down resistor which should be referenced to the machine 0V to guarantee correct operation.

High condition:	>14V+/-1V
Low condition:	<0.5V nominal
Open condition:	Neither of the above
Load current:	1.8mA @ Kl.15=24V nominal

3.3.4 Pin D - Remote Sensing Function

This is a general-purpose analogue input, which can be used for a variety of functions depending on the desired application. It may be used for controlling the regulator set point, depending on the internal software configuration and external input cct.

Connection to the S terminal is optional and the warning lamp is not illuminated if the terminal is left open. The active range of the S-input is 24V to 33V. The S-terminal input presents a resistive load to 0V of 98k with respect to the machine negative.

One option is to adjust the regulating voltage by connecting a resistor between machine B+ and the regulator sense adjust input. If linked directly to the machine B+ terminal the regulating voltage will go to Sense minimum voltage (SminV = Vreg – 2.23V)

The calculated resistance can be obtained by using the following formula and choosing the closest E24 resistor value:

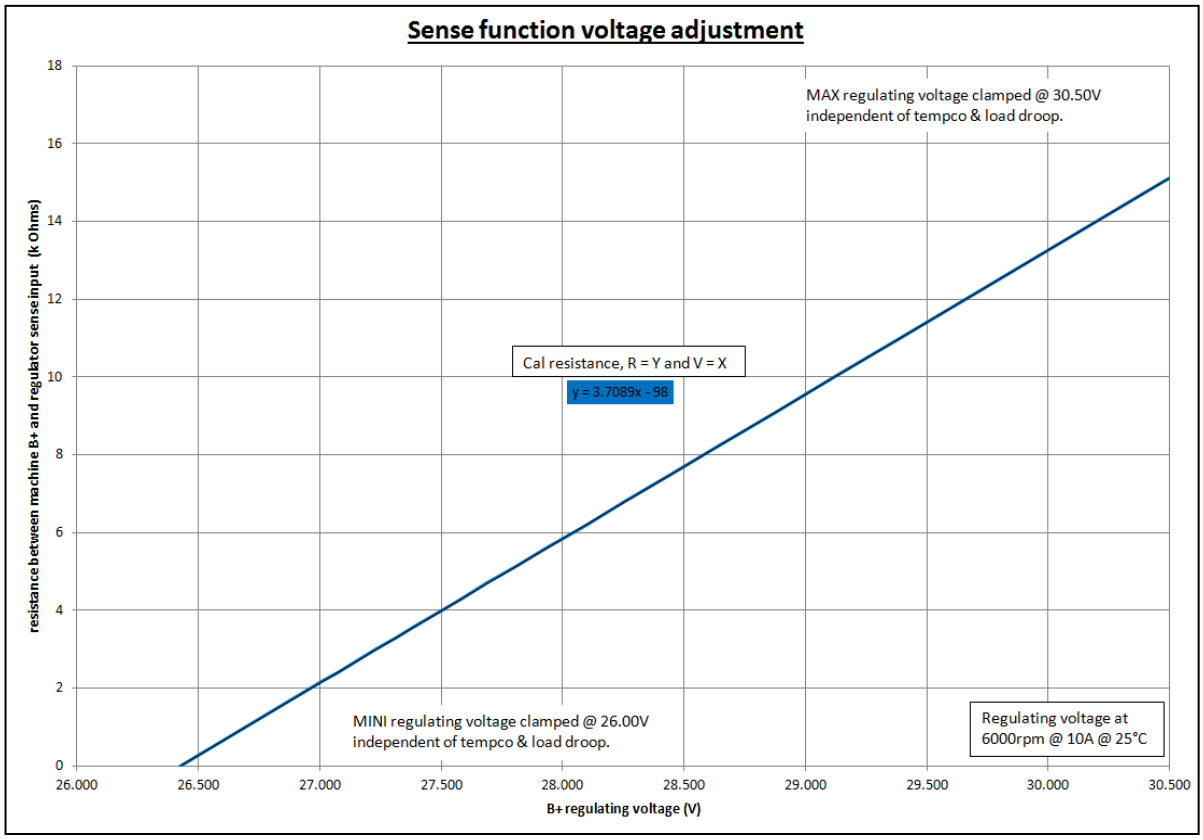
(Target Vreg – SminV) / (SminV / 98) = resistance in k Ohms

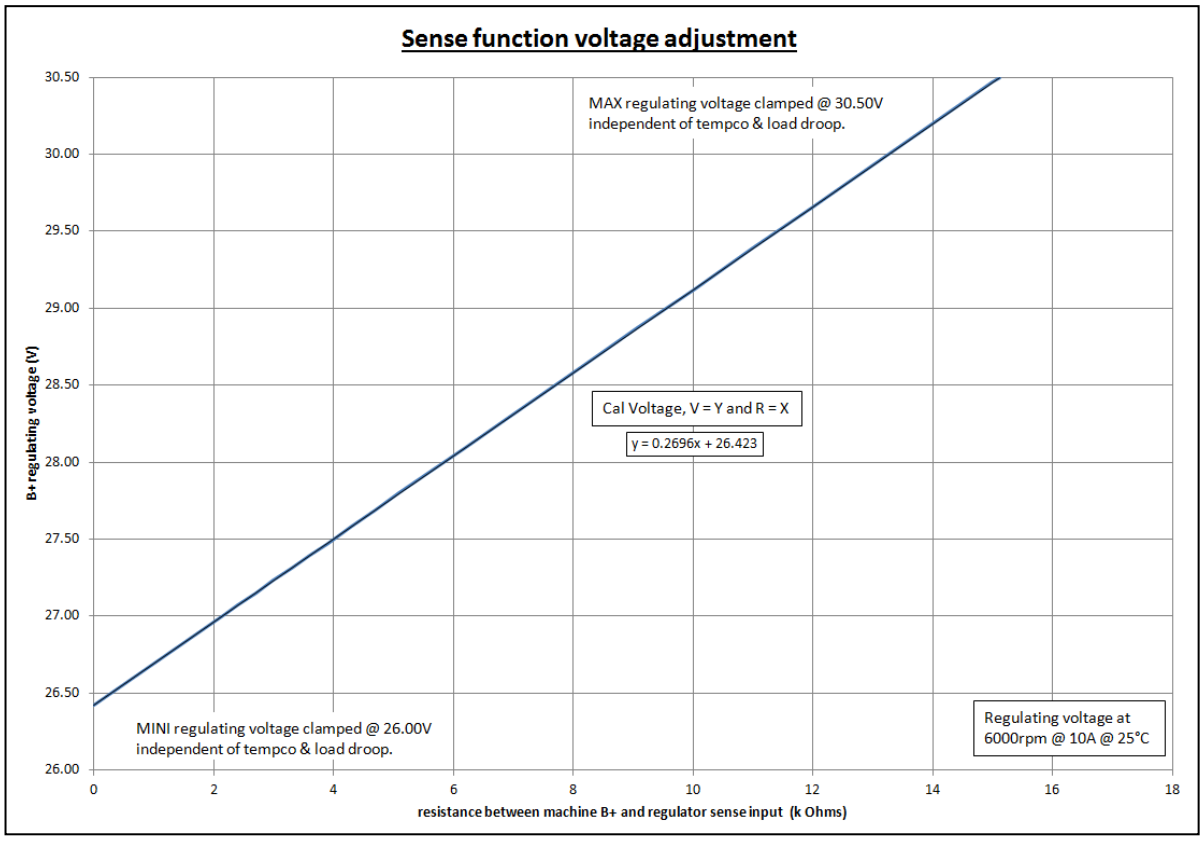
Example for a 1907802 regulator with a regulating voltage of 28.65V (with the sense adjust input open). These values are based on nominal voltages at 25°C and test conditions.

(29.1V - 26.42) / (26.42 / 98) = 9k9 = 10k closest resistor value

Or you can use the table and charts below:

Vreg (V)	R S to B+ (k)		Vres (V)	R Power (mW)
26.424	0.003	Linked to B+	0.001	0.0002
27.016	2.2		0.593	0.1599
27.070	2.4		0.647	0.1745
27.151	2.7		0.728	0.1963
27.232	3		0.809	0.2181
27.313	3.3		0.890	0.2399
27.393	3.6		0.971	0.2617
27.474	3.9		1.052	0.2835
27.582	4.3		1.159	0.3126
27.690	4.7		1.267	0.3417
27.798	5.1		1.375	0.3707
27.933	5.6		1.510	0.4071
28.094	6.2		1.672	0.4507
28.256	6.8		1.833	0.4943
28.445	7.5		2.022	0.5452
28.634	8.2		2.211	0.5961
28.876	9.1		2.454	0.6615
29.119	10		2.696	0.7270
29.389	11		2.966	0.7996
29.658	12		3.235	0.8723
29.928	13		3.505	0.9450
30.467	15		4.044	1.0904
30.500	15.122	cal clamp	4.077	1.0993
30.500	18	clamped	4.077	0.9235


Sense function voltage adjustment
MAX regulating voltage clamped @ 30.50V
independent of tempco & load droop.
Cal resistance, R = Y and V = X
y = 3.7089x - 98
MINI regulating voltage clamped @ 26.00V
independent of tempco & load droop.
Regulating voltage at
6000rpm @ 10A @ 25°C
resistance between machine B+ and regulator sense input (k Ohms)
B+ regulating voltage (V)
18
16
14
12
10
8
6
4
2
0
26.000
26.500
27.000
27.500
28.000
28.500
29.000
29.500
30.000
30.500


Sense function voltage adjustment
MAX regulating voltage clamped @ 30.50V
independent of tempco & load droop.
Cal Voltage, V = Y and R = X
y = 0.2696x + 26.423
MINI regulating voltage clamped @ 26.00V
independent of tempco & load droop.
Regulating voltage at
6000rpm @ 10A @ 25°C
B+ regulating voltage (V)
resistance between machine B+ and regulator sense input (k Ohms)
30.50
30.00
29.50
29.00
28.50
28.00
27.50
27.00
26.50
26.00
0
2
4
6
8
10
12
14
16
18

3.3.5 Pin D - DFM Output Function

This signal comprises a current-limited PWM signal reflecting the field drive. This output provided by an active-low open-collector stage arranged to be ON when the field is ON. It is designed to drive a load resistor no lower than 2k4. The DFM stage is capable of withstanding an indefinite short to B+ in the full field condition. Overload protection is provided by limiting the short-circuit current to a low value. A flywheel diode is included between the low side driver and B+ to protect it against ESD transients. A low value resistor is wired between the driver stage and DFM pin.

Rated voltage of low side switch:	100V minimum
Series protection resistor:	22R +/-5%
Low condition current limit:	I_{DFMl} = -23mA +/-12mA @25°C
Low condition voltage:	0.85V +/-0.25V @ I_{DFM}=-10mA
Temperature coefficient of $I_{DFMl:}$	-40uA/°C max

When the regulator is shut down or the machine is not generating sufficient phase amplitude, the output is forced into a low condition.