


<b>ABB Oy</b> <b>MV Induction Machines</b>	Classifying code or document type			<b>PERFORMANCE DATA OF GENERATOR</b>	
	Department/Author PIC / Y. Tyllinen	Date of issue 2002-03-05	Lang. en		
Customer ref. Bonus 2.3 / 0.4 MW , 4/6-pole	Saving ident 8001749I.doc		Rev./Changed by I/zoku	Pages 1/24	

Driven Machine: Wind Turbine

Machine type code	AMA 500L4/6A BAXYH						
Machine type	Two speed, squirrel cage generator						
Mounting designation	IM 1001						
Protected by enclosure	IP 54						
Method of cooling	IC 611						
Insulation / Temperature rise	Class F / Class B						
Standards	IEC						
Ambient temperature, max.	50 °C						
Cooling air temperature, max.	40 °C						
Altitude, max.	1000 m.a.s.l.						
Duty type	S1	S1		S1			
Rated output	2300kW/2632kVA	400kW/464kVA		400kW/464kVA			
Connection of stator winding	Delta	Star		Star			
Voltage	690 V	690 V		690 V			
Frequency	50 Hz	50 Hz		50 Hz			
Speed	1512 rpm	1011 rpm		1011 rpm			
Current	2174 A	384 A		384 A			
Relat. Starting current	5,2	5,4		5,4			
Relat. Maximum torque	2,4	2,5		2,5			
No load current	584 A	111 A		111 A			
Rated torque	15080 Nm	4108 Nm		4108 Nm			
Load characteristics	Load %	Current A		Efficiency %	Power Factor		
	100	2174	384	96,3	92,2	0,887	0,872
	75	1661	296	96,4	92,7	0,870	0,852
	50	1180	213	95,8	92,3	0,811	0,786
	25	768	142	93,2	88,5	0,605	0,566
Direction of rotation	Uni-directional						
Overspeed	2200 rpm, 2 min						
Sound pressure level: (sinus supply, no load)	88 dB(A), tol. + 3 dB(A), 1 m						
Inertia rotor	61 kgm <sup>2</sup>						
Weight	6580 kg						
Bearings	Antifriction						

This performance data is final and the motor will be manufactured accordingly. All machine data is subject to tolerances in accordance with IEC.

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	<b>PERFORMANCE DATA OF GENERATOR</b>				
Department/Author PIC / Y. Tyllinen	Date of issue 2002-03-05	Lang. en	Rev. date 2004-07-13	Our ref. 7691HD299/298,8126HD2	
Customer ref. Bonus 2.3 / 0.4 MW , 4/6-pole			Saving ident 8001749I.doc	Rev./Changed by I/zoku	Pages 2/24

Machine type code: AMA 500L4/6A BAXYH

Nominal ratings	4-pole	
Output	2300 kW	
Voltage	690 V / D	
Frequency	50 Hz	
Speed	1512 rpm	
Current	2174 A	

Single phase equivalent circuit parameters in ohms and in p.u. , resistances at full load temperature

Stator resistance	$R_1$	0.0016		0,0087	
Stator leakage reactance	$X_{\sigma 1}$	0.0302		0,164	
Rotor resistance (running, start)	$R'_2$	0.0015	0.0028	0,0081	0,0152
Rotor leakage reactance (running, start)	$X'_{\sigma 2}$	0.0107	0.0086	0,0584	0,0469
Core loss resistance <sup>1)</sup>	$R_{Fe}$	30.0		163	
Magnetizing reactance <sup>1)</sup> (saturated, unsat)	$X_m$	0.64	0.94	3,49	5,13
Transient reactance	$X'$	0.0407		0,222	
Sub-transient reactance	$X''$	0.0386		0,210	

Approximated synchronous machine parameters: 2)

Synchronous reactance (saturated, unsat)	$X_d$	0.670	0.97	3,65	5,30
Negative phase sequence synchronous reactance	$X_-$	0.041		0,223	
Negative phase sequence synchronous resistance	$R_-$	0.003		0,016	
Positive phase sequence synchronous reactance	$X_+$	0.084		0,458	
Positive phase sequence synchronous resistance	$R_+$	0.161		0,878	
Zero phase sequence reactance <sup>2)</sup>	$X_0$	N.A.		-	
Zero phase sequence resistance <sup>2)</sup>	$R_0$	N.A.		-	
Direct axis transient open circuit time constant	$T'_{d0}$	1.519 s			
Subtransient open circuit time constant	$T''_{d0}$	0.013 s			
Direct axis transient short circuit time constant	$T'_d$	0.081 s			
Subtransient short circuit time constant	$T''_d$	0.012 s			
Armature time constant	$T_a$	0.042 s			
Locked rotor power factor		0.12			
Open circuit saturation curve points <sup>3)</sup>	$S(1.0)$	1.42			
Open circuit saturation curve points <sup>3)</sup>	$S(1.2)$	2.24			
Inertia constant of generator	$H$	0.294 kWs/kVA			

Given synchronous machine parameters are for transient simulation only. They shall not be used to calculate static operating points. ABB does not take any responsibility of the simulations made with these values.

Notes:

<sup>1)</sup> Core loss resistance and magnetizing reactance connected in parallel.

<sup>2)</sup> Zero phase sequence parameters are not applicable for windings with delta connection and for ungrounded windings with star connection. In these cases the given parameters are purely theoretical.

<sup>3)</sup> Saturation curve points:  $S\left(\frac{1.0}{1.2}\right) = \frac{I_{o,sat}}{I_{o,unsat}} @ (100\% \text{ or } 120\%) \times U_N$ .

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Machine type code: AMA 500L4/6A BAXYH

Nominal ratings	6-pole	
Output	400 kW	
Voltage	690 V / Y	
Frequency	50 Hz	
Speed	1011 rpm	
Current	384 A	

Single phase equivalent circuit parameters in ohms and in p.u. , resistances at full load temperature

Stator resistance	$R_1$	0.0415		0,040	
Stator leakage reactance	$X_{\sigma 1}$	0.1365		0,131	
Rotor resistance (running, start)	$R'_2$	0.0114	0.0236	0,0109	0,0227
Rotor leakage reactance (running, start)	$X'_{\sigma 2}$	0.0811	0.0636	0,782	0,613
Core loss resistance <sup>1)</sup>	$R_{Fe}$	179		172	
Magnetizing reactance <sup>1)</sup> (saturated, unsat)	$X_m$	3.46	3.89	3,33	3,75
Transient reactance	$X'$	0.216		0,208	
Sub-transient reactance	$X''$	0.199		0,191	

Approximated synchronous machine parameters: 2)

Synchronous reactance (saturated, unsat)	$X_d$	3.58	4,02	3,45	3,88
Negative phase sequence synchronous reactance	$X_-$	0.215		0,207	
Negative phase sequence synchronous resistance	$R_-$	0.052		0,050	
Positive phase sequence synchronous reactance	$X_+$	0.503		0,485	
Positive phase sequence synchronous resistance	$R_+$	0.90		0,867	
Zero phase sequence reactance <sup>2)</sup>	$X_0$	0.18		0,173	
Zero phase sequence resistance <sup>2)</sup>	$R_0$	0.052		0,050	
Direct axis transient open circuit time constant	$T'_{d0}$	1.007 s			
Subtransient open circuit time constant	$T''_{d0}$	0.0085 s			
Direct axis transient short circuit time constant	$T'_d$	0.057 s			
Subtransient short circuit time constant	$T''_d$	0.007 s			
Armature time constant	$T_a$	0.012			
Locked rotor power factor		0.30			
Open circuit saturation curve points <sup>3)</sup>	$S(1.0)$	1.023			
Open circuit saturation curve points <sup>3)</sup>	$S(1.2)$	1.024			
Inertia constant of generator	$H$	0.745 kW/s/kVA			

Given synchronous machine parameters are for transient simulation only. They shall not be used to calculate static operating points. ABB does not take any responsibility of the simulations made with these values.

Notes:

- <sup>1)</sup> Core loss resistance and magnetizing reactance connected in parallel.
- <sup>2)</sup> Zero phase sequence parameters are not applicable for windings with delta connection and for ungrounded windings with star connection. In these cases the given parameters are purely theoretical.

$$\supset \text{Saturation curve points: } S\left(\frac{1.0}{1.2}\right) = \frac{I_{o,sat}}{I_{o,unsat}} @ (100\% \text{ or } 120\%) \times U_N.$$

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Machine type code: AMA 500L4A BAXYH

Rated output	2300 kW	Power Factor	0.887
Voltage	690 V	Rated torque	15080 Nm
Frequency	50 Hz	Relat. starting current	5.2
Speed	1512 rpm	Relat. starting torque	
Current	2174 A	Relat. maximum torque	2.4