Vendor-Specific Model Library
PSS®E 34.8.2

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SIEMENS

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Chapter 1
General Electric Models

This chapter contains a collection of data sheets for the General Electric models contained in the PSS®E GEMDL.DLL dynamic model library.

1.1. Introduction to GE Models

The PSS®E dynamic simulation models for GE 1.5/3.6/2.5/4.0 MW wind turbines have been successfully used by numerous PSS®E users around the globe. This model was designed to simulate a wind turbine employing either a doubly fed induction generator with active control by means of a power converter in the 3-phase wound rotor winding (DFIG unit), or a synchronous generator decoupled from the grid by a full size power converter (FSC unit).

This set of manufacturer-specific wind models included in PSS®E allows simulation of DFIG and FSC units.

1.2. Modeling in Power Flow and Dynamic Simulation

A wind turbine in power flow is treated as a windmachine and specified on the existing generator record of the Power Flow Raw Data File. The user must consider all issues when modeling the equivalent of a wind farm, including but not limited to:

- Deciding howmany original units will be lumped into an equivalent machine in the power flow case. For n lumped machines, multiply the dispatch and MBASE of the original machine and the MVA of a step-up transformer by n. Implicit representation of step-up transformers is not allowed for wind generators.
- Providing an adequate equivalent of the collector/feeder systemup to the point of interconnection.

Note that in order to use the GE wind models described in this report, the generator has to be represented as a ‘Wind Machine’ in PSS®E power flow.

You must also select the appropriate reactive power control of the equivalent machine in power flow: whether it controls the terminal or remote bus voltage within its reactive capability, or a given power factor.

Remember that for power flow, the value of the machine source reactance (XSORCE) does not matter, but it might be important for dynamic simulation. GE indicates the source impedance providing the best compliance with test results should be 0.0+j0.8 pu.

For the FSC wind turbine (which is a full converter machine) units, the source reactance of the machine in power flow should be set to a large number (for instance 99999 pu).

This chapter contains a collection of data sheets for the General Electric Wind models contained in the PSS®E GEMDL.DLL dynamic model library.

Model	Description
GEWTGCU1	GE Wind Turbine Generator/Converter
GEWTECU1	GE Wind Turbine Electrical Control
GEWTPTU1	GE Wind Turbine Pitch Control
GEWTARU1	GE Wind Turbine Aerodynamic
GEWT2MU1	GE Wind Turbine Two Mass
GEWTGDU1	GE Wind Turbine Wind Gust and Ramp

1.3. GEWTGCU1

GE Wind Turbine Generator/Converter

CONs	Value	Description
J		P_{RATE}, rated power of the original unit, in MW
J+1		X_{EQ}, equivalent reactance for current injection, in pu on MBASE
J+2		V_{LVPL1}, LVPL voltage 1
J+3		V_{LVPL2},LVPL voltage 2
J+4		G_{LVPL}, LVPL gain
J+5		V_{HVRCR2}, HVRCR voltage 2
J+6		CUR_{HVRCR2}, max reactive current at V_{HVRCR2}
J+7		V_{LVACR1}, low voltage active current regulation logic, voltage 1
J+8		VLVACR2, LVACR logic, voltage 2
J+9		Rip_LVPL, rate of LVACR active current change
J+10		T_LVPL, voltage sensor for LVACR time constants
J+11		LVPL 1st voltage point
J+12		LVPL 1st power point
J+13		LVPL 2nd voltage point
J+14		LVPL 2nd power point
J+15		LVPL 3rd voltage point
J+16		LVPL 3rd power point
J+17		Impedance for changing IQCMD to voltage signal

ICONs	Value	Description
M		Number of original WTs lumped up to the model equivalent
M+1		Full converter flag • 0 : DFIG • 1 : FSC

STATEs	Description
K	Converter lag for Ipcmd
K+1	Converter lag for Eqcmd or Iqcmd
K+2	Voltage sensor for LVPL

VARs	Description
L	$V_{MACC,}$, Vterm magnitude on previous iteration
L+1	V_{AACC}, Vterm angle on previous iteration
L+2	deltaQ, overvoltage corr. factor

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 CON(J+17) /
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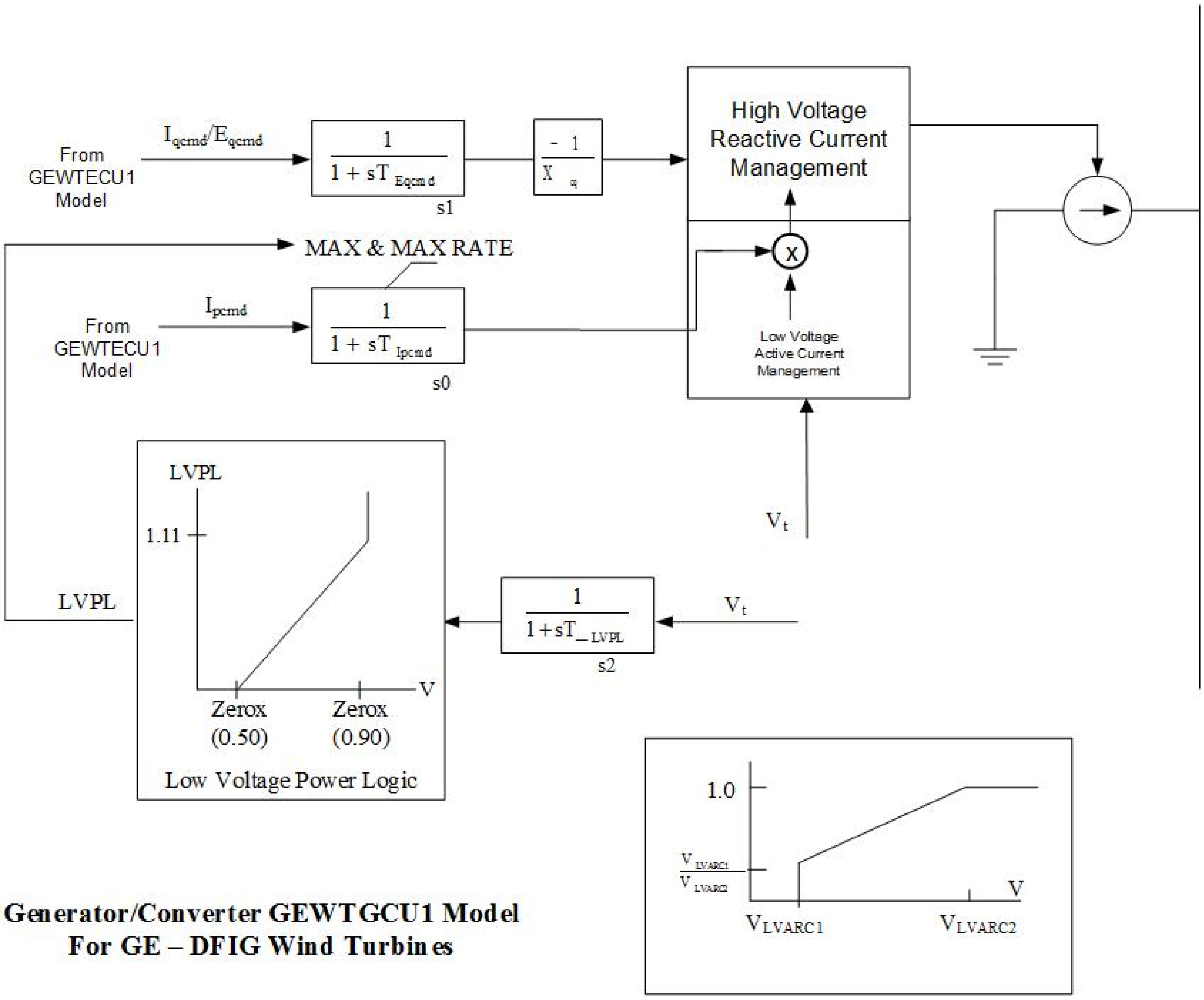
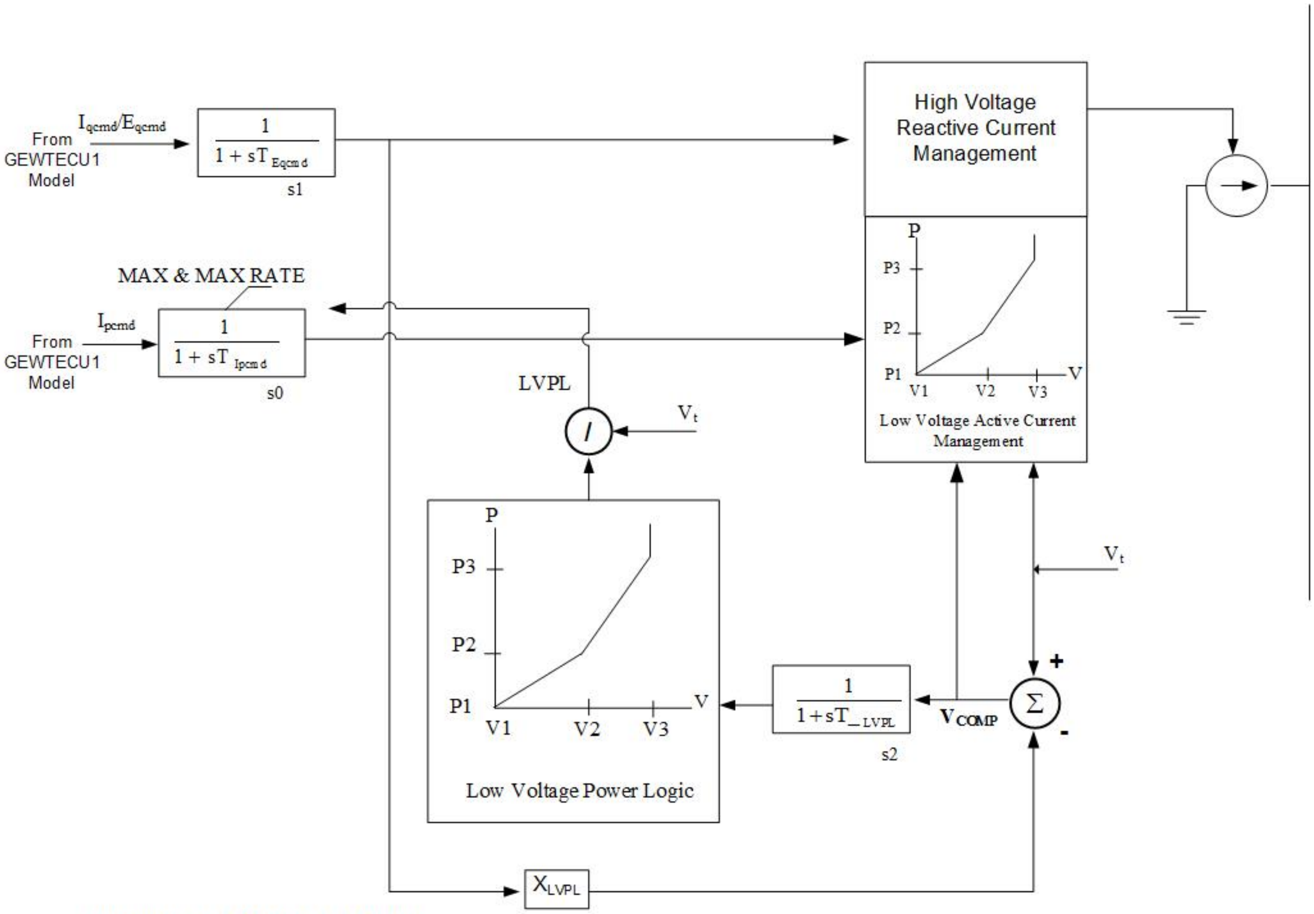


Generator/Converter GEWTGCU1 Model For GE – DFIG Wind Turbines

Low Voltage Active Current Management



Converter GEWTGCU1 Model
For GE – FSC Wind Turbines

1.4. GEWTECU1

GE Wind Turbine Electrical Control

CONs	Value	Description
J		T_{FV}, filter time constant in voltage regulator (sec)
J+1		K_{PV}, proportional gain in Voltage regulator(pu)
J+2		K_{IV}, integrator gain in Voltage regulator (pu)
J+3		R_C, line drop compensation resistance (pu)
J+4		X_C, line drop compensation reactance (pu)
J+5		T_{FP}, filter time constant in Torque regulator (sec)
J+6		K_{PP}, proportional gain in Torque regulator(pu)
J+7		K_{IP}, integrator gain in Torque regulator (pu)
J+8		P_{MAX}, maximum limit in Torque regulator (pu)
J+9		P_{MIN}, minimum limit in Torque regulator (pu)
J+10		Q_{MAX}, maximum limit in Voltage regulator (pu)
J+11		Q_{MIN}, minimum limit in Voltage regulator (pu)
J+12		IP_{MAX}, maximum active current limit (pu)
J+13		T_{RV}, voltage sensor time constant (sec)
J+14		RP_{MAX}, maximum power order derivative (pu)
J+15		RP_{MIN}, minimum power order derivative (pu)
J+16		T_{POWER}, power reference filter time constant (sec)
J+17		KQ_I, Volt/MVAR gain
J+18		V_{MINCL}, minimum voltage limit
J+19		V_{MAXCL}, maximum voltage limit
J+20		KV_I, int. voltage/terminal voltage gain
J+21		XI_{MIN}, minimum limit
J+22		XI_{MAX}, maximum limit
J+23		T_V, lag in WindVar controller
J+24		T_P, Pelec filter in fast PF controller
J+25		F_N, a portion of on-line wind turbines
J+26		T_{PAV}, Pavail filter time constant (sec)
J+27		FR_A, frequency response curve
J+28		FR_B, frequency response curve
J+29		FR_C, frequency response curve
J+30		FR_D, frequency response curve
J+31		PFR_A, frequency response curve
J+32		PFR_B, frequency response curve
J+33		PFR_C, frequency response curve
J+34		PFR_D, frequency response curve
J+35		PFR_{MAX}, maximum Pavail
J+36		PFR_{MIN}, minimum Pavail

CONs	Value	Description
J+37		T_W, power command rate limit time constant (sec)
J+38		T_{LVPL}, LVPL sensor (sec)
J+39		V_{LVPL}, LVPL breakpoint
J+40		$SPDW_1$, initial arbitrary wind speed (m/sec)
J+41		$SPDW_{MAX}$, maximum wind speed (m/sec)
J+42		$SPDW_{MIN}$, minimum wind speed (m/sec)
J+43		SPD_{LOW}, low rotor speed to trip WTG
J+44		WTTHRES, high wind trip threshold
J+45		EBST, braking resistor energy threshold
J+46		KDBR, braking resistor controller gain
J+47		$PDBR_{MAX}$, breaking resistor power error maximum limit
J+48		$IMAX_{TD}$, converter current limit
J+49		IPHL, hard active current limit
J+50		IQHL, hard reactive current limit
J+51		T_{LPQD}, reactive droop time constant
J+52		K_{QD}, reactive droop gain
J+53		X_{QD}, reactive droop synthesizing impedance
J+54		K_{WI}, wind inertia gain
J+55		DB_{WI}, wind inertia deadband
J+56		TLP_{WI}, wind inertia filter time constant
J+57		TWO_{WI}, wind inertia washout time constant
J+58		URL_{WI}, wind inertia up rate ramp limit
J+59		DRL_{WI}, wind inertia down rate ramp limit
J+60		PMX_{WI}, wind inertia maximum additional power
J+61		PMN_{WI}, wind inertia minimum additional power
J+62		VER_{MX}, reactive power control maximum error signal
J+63		VER_{MN}, reactive power control minimum error signal
J+64		V_{FRZ}, reactive power control freeze voltage
J+65		QZP_{MX}, Qmax limit in zero power mode
J+66		QZP_{MN}, Qmin limit in zero power mode

ICONs	Value	Description
M		Remote bus number for voltage control
M+1		PFA_{FLG} • 1 - if fast PF control enabled
M+2		VAR_{FLG} • 1 - if Qord is provided by WindVar If VARFLG=PFAFLG=0 then Qordr is provided as a Qref=const
M+3		APC_{FLG}, active power control flag
M+4		PQ_{FLG}

ICONs	Value	Description
		• 0 - Q priority • 1 - P priority
M+5		Qdroop Branch "From Bus"[a]
M+6		Qdroop Branch "To Bus"[a]
M+7		Qdroop Branch "Id" (enter in single quotes)
M+8		WR_{FLG}, wind free enabling flag

[a]When zero, Q_{ELEC} is used as Q-droop input

STATEs	Description
K	Filter in Voltage regulator
K+1	Integrator in Voltage regulator
K+2	Filter in Torque regulator
K+3	Integrator in Torque regulator
K+4	Voltage sensor
K+5	Power reference filter
K+6	Mvar/Volt integrator
K+7	Volt/Mvar integrator
K+8	Lag of the WindVar controller
K+9	Input filter of PELEC for fast PF controller
K+10	Input filter for Pavail
K+11	Power response rate limit
K+12	LVPL limit
K+13	High wind speed trip integrator
K+14	Braking resistor integrator
K+15	Filter in Reactive Droop
K+16	Filter in WindInertia
K+17	Washout in WindInertia

VARs	Description
L	Remote bus reference voltage
L+1	Q reference if PFAFLG=0 and VARFLG=0
L+2	PF angle reference if PFAFLG = 1
L+3	Branch MW for Qdroop
L+4	Branch Mvar for Qdroop
L+5	Branch MVA for Qdroop
L+6	dpwi, WindInertia output
L+7	Auxiliary test signal
L+8	APC Freq Relay Timer
L+9	Available power from the wind, pu on machine base
L+10	Active power control output, pu on machine base
L+11	Rotor speed for available power

VARs	Description
L+12	Braking resistor power, pu on machine base
L+13	Signal added to WAUXSG
L+14	Real current command (WIPCMD), pu on machine base
L+15	Reactive current/voltage command (WIQCMD/WEQCMD), pu on machine base

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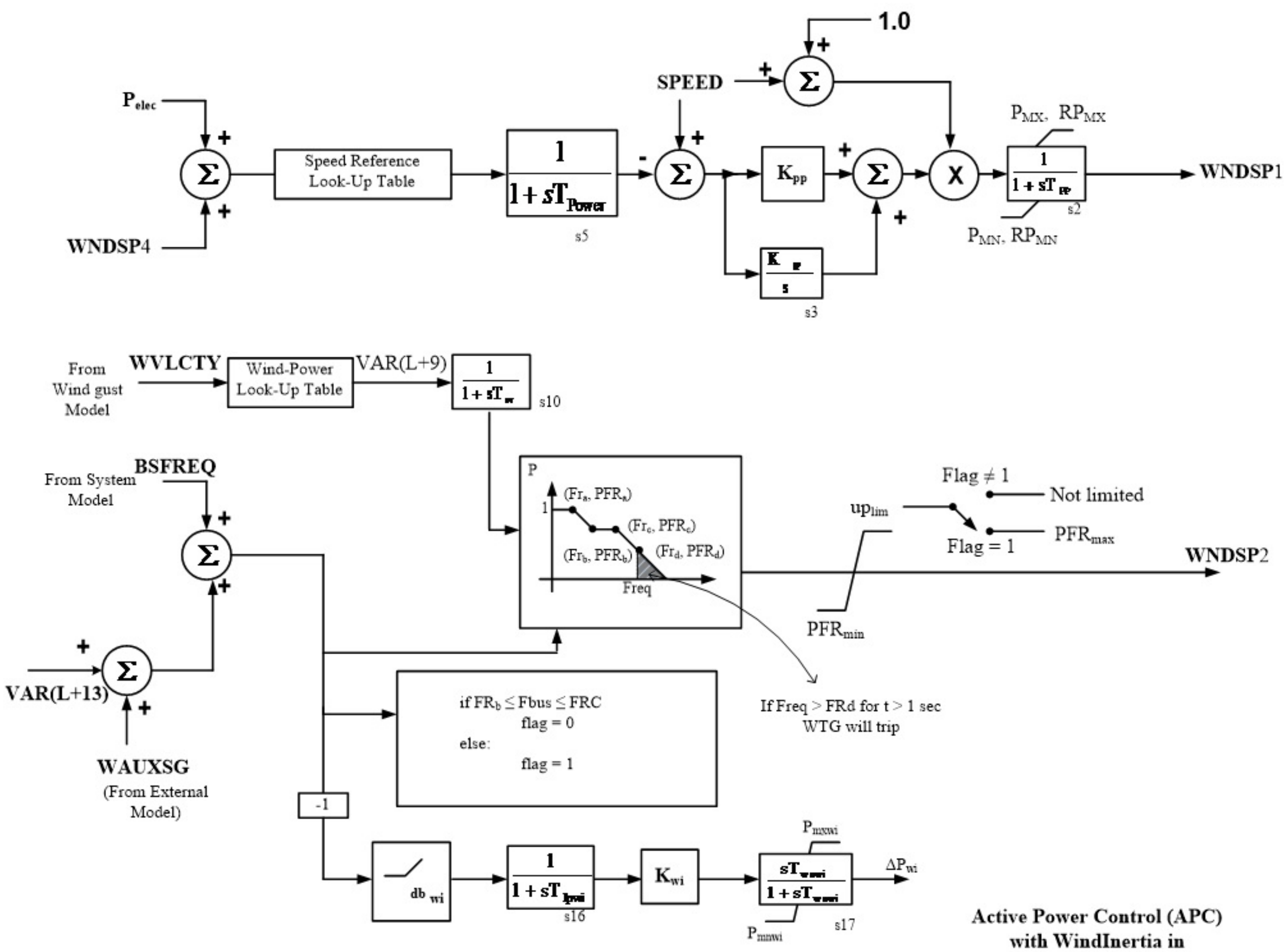
IBUS 'USRMDL' ID 'GEWTECU1' 102 0 9 67 18 16 ICON(M) to ICON(M+8) CON(J)
 to CON(J+66) /
```

Notes:

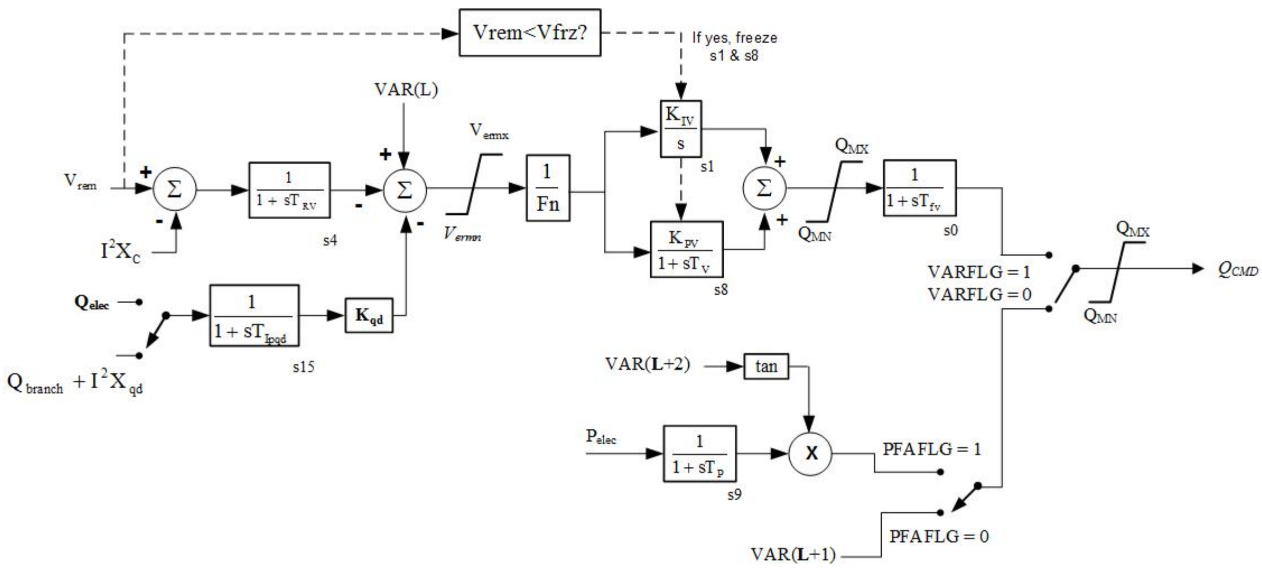
Weakening the torque control by setting Tfp=4 sec, Kpp=0.5, Kip=0.05 is recommended when the under-frequency events are simulated and the WindINERTIA feature is enabled.

There are four possible configurations:

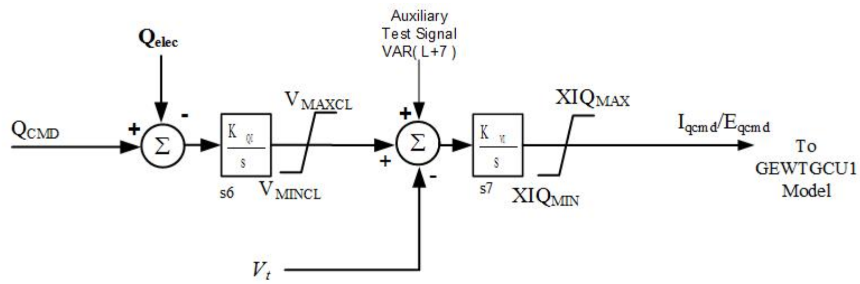
- Current North American configuration with WindVAR: VARFLG=1, PFAFLG=0, KQi small (for instance, KQi = 0.1)
- Current North American configuration without WindVAR: VARFLG=0, PFAFLG=0, KQi very small (for instance, KQi = 0.001)
- European (PFA control) with WindVAR: VARFLG=1, PFAFLG=0, KQi large (for instance, KQi = 0.5), KVi large
- European (PFA control) without WindVAR: VARFLG=0, PFAFLG=1, Specify desired PFA, KQi large (for instance, KQi = 0.5), KVi large

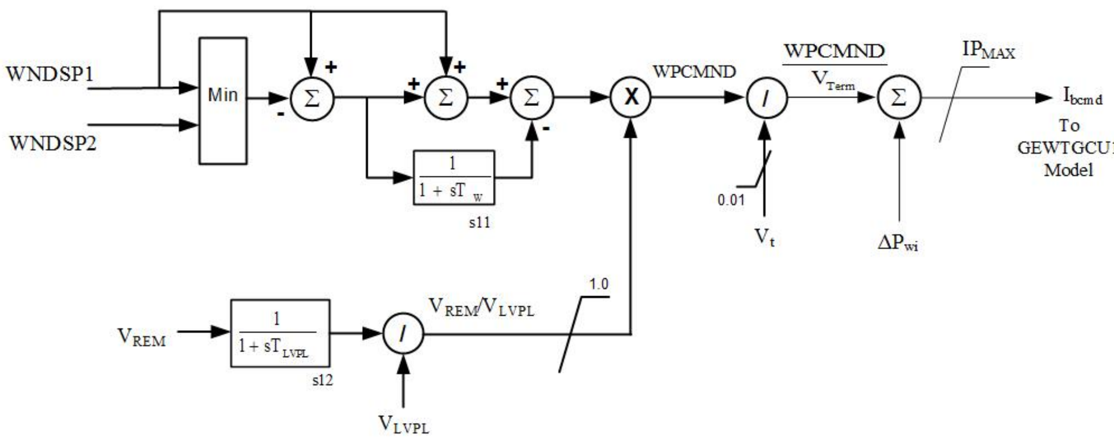


Active Power Control (APC) with WindInertia in Electrical Control GEWTECU1 Model

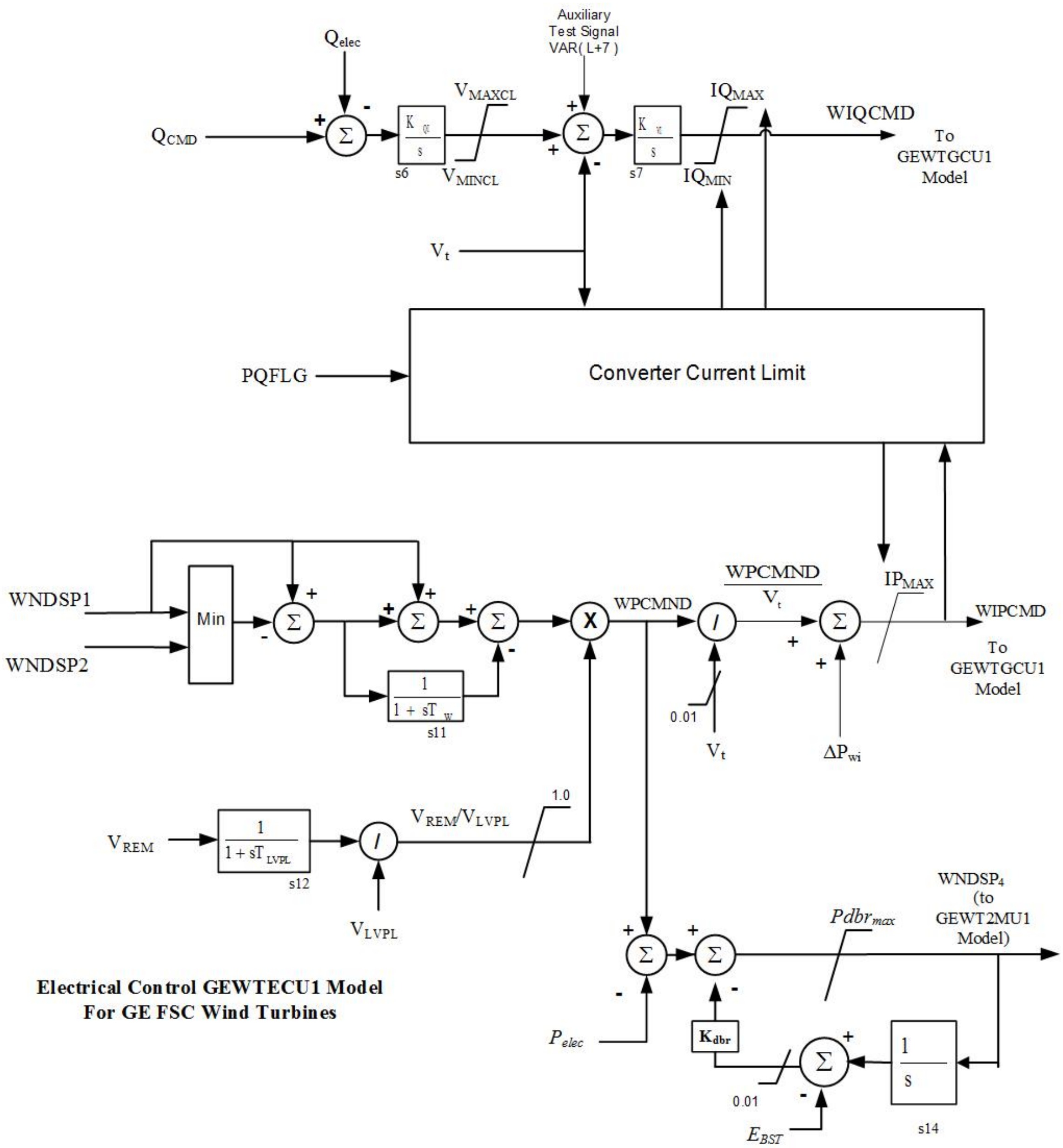


WindVAR Emulator in Electrical Control GEWTECU1 Model





Electrical Control GEWTECU1 Model For GE DFIG Wind Turbines



Electrical Control GEWTECU1 Model
For GE FSC Wind Turbines

1.5. GEWTPTU1

GE Wind Turbine Pitch Control

CONs	Value	Description
J		T_P, time constant of the output lag (sec)
J+1		K_{PPT}, proportional gain of PI regulator (pu)
J+2		K_{IPT}, tntegrator gain of PI regulator (pu)
J+3		K_{PC}, proportional gain of the compensator (pu)
J+4		K_{IC}, integrator gain of the compensator (pu)
J+5		θ_{MIN}, lower pitch angle limit (degrees)
J+6		θ_{MAX}, upper pitch angle limit (degrees)
J+7		$d\theta/dt_{MIN}$, lower pitch angle rate limit (degrees/sec)
J+8		$d\theta/dt_{MAX}$, upper pitch angle rate limit (degrees/sec)
J+9		P_{REF}, power reference

ICONs	Value	Description
M		For internal use (user to input 0)
M+1		For internal use (user to input 0)

STATEs	Description
K	Output Lag
K+1	Pitch Control
K+2	Pitch compensator

VARs	Description
L	Initial machine rotor speed (pu)
L+1	Initial pitch angle (degrees)
L+2	Power reference

```
IBUS 'USRMDL' ID 'GEWTPTU1' 104 0 2 10 3 3 0 0 CON(J) to CON(J+9) /
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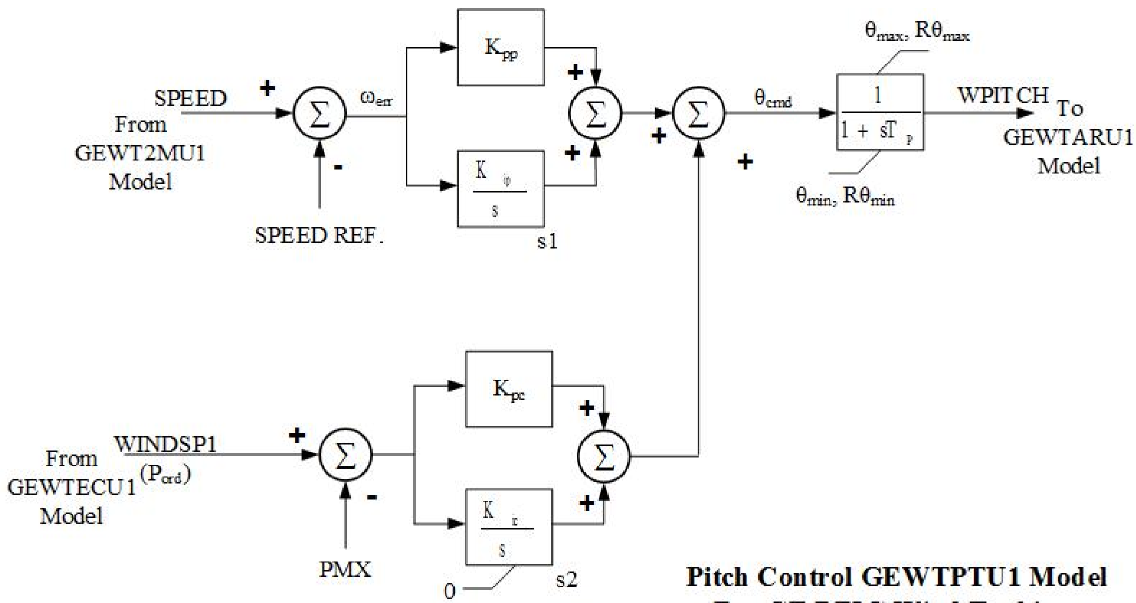

Pitch Control GEWTPTU1 Model
For GE DFIG Wind Turbines

1.6. GEWTARU1

GE Wind Turbine Aerodynamics

CONs	Value	Description
J		λ_{MAX}, maximum Lambda from Cp curves
J+1		λ_{MIN}, minimum Lambda from Cp curves
J+2		$PITCH_{MAX}$, upper limit of pitch angle
J+3		$PITCH_{MIN}$, lower limit of pitch angle
J+4		T_A, time constant of the conversion smoothing
J+5		ρ, air density (kg/m3)
J+6		RADIUS, blade radius (meters)
J+7		GB_{RATIO}, gear box ratio
J+*		SYNCHR, synchronous rpm

ICONs	Value	Description
M		For internal use (user to input 0)

STATEs	Description
K	Conversion smoothing lag

VARs	Description
L	K_ADJ from initialization
L+1	PITCH_INIT, Initial pitch angle
L+2	Lambda, current lambda
L+3	Cp, Current Cp

```
IBUS 'USRMDL' ID 'GEWTARU1' 105 0 1 9 1 4 0 CONs from (J) to (J+8) /
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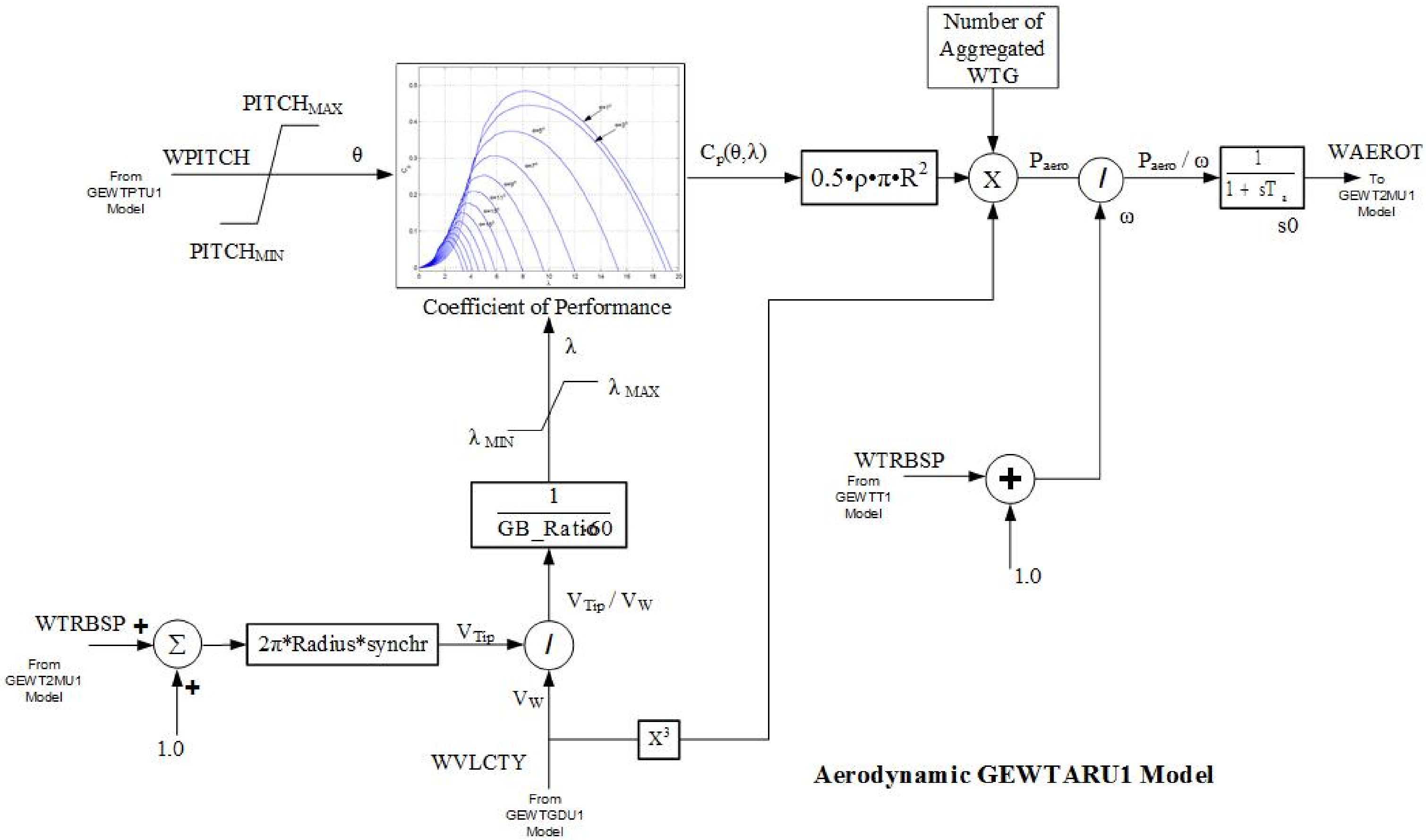

Aerodynamic GEWTARU1 Model

1.7. GEWT2MU1

GE Wind Turbine Two Mass Shaft

CONs	Value	Description
J		H, total inertia of the drive train (MW*sec/MVA)
J+1		DAMP, machine damping factor pu P/pu Speed
J+2		HT_{FRAC}, turbine inertia fraction (Hturb/H)
J+3		$FREQ_1$, first shaft torsional resonant frequency (Hz)
J+4		DSHAFT, shaft damping factor

ICONs	Value	Description
M		For internal use (user to input 0)

STATEs	Description
K	Shaft twist angle (radians)
K+1	Turbine rotor speed deviation (pu)
K+2	Generator speed deviation (pu)
K+3	Generator angle deviation (degrees)

VARs	Description
L	Paero on the rotor blade side (pu)
L+1	Initial rotor slip (pu)
L+2	Initial internal angle (degrees)
L+3	Cp, Current Cp

```
IBUS 'USRMDL' ID 'GEWT2MU1' 103 0 1 5 4 3 0 CON(J) to CON(J+4) /
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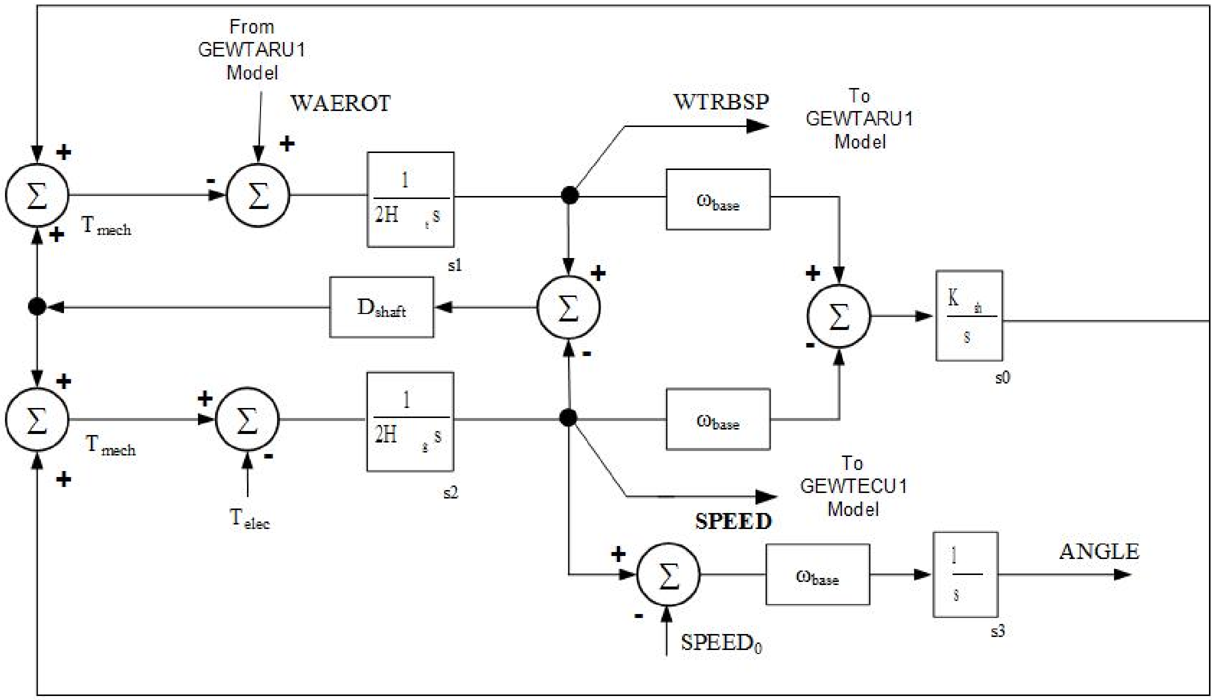


$H_t = H \times H_{tfrac}$

$H_g = H - H_t$

$$K_{shaft} = \frac{2H_t \times H_g \times (2\pi \times Freq1)^2}{H \times \omega_0}$$

Two-Mass Shaft GEWT2MU1 Model

1.8. GEWTGDU1

GE Wind Turbine Wind Gust and Ramp

CONs	Value	Description
J		T_{1G}, gust start time (sec)
J+1		T_G, gust duration (sec)
J+2		MAX_G, Gust peak over Vwb (m/sec)
J+3		$T1_R$, ramp start time (sec)
J+4		$T2_R$, ramp end time (sec)
J+5		MAX_R, ramp maximum over Vwb (m/sec)

ICONs	Value	Description
M		For internal use (user to input 0)

VARs	Description
L	VW, Effective wind speed
L+1	VW_G, gust component (m/sec)
L+2	VW_R, ramp component (m/sec)
L+3	VW_B, initial wind speed

```
IBUS 'USRMDL' ID 'GEWTGDU1' 106 0 1 6 0 4 0 CON(J) to CON(J+5) /
```

Chapter 2
Vestas Models

This chapter contains a collection of data sheets for the Vestas models contained in the PSS®E VSTMDL.DLL dynamic model library.

Users are advised to contact tolyp@vestas.com for any issues or questions regarding the model.

Model	Description
FCVWTU1	Full Converter Vestas Wind Turbine Model
VIECPCU1	Vestas Power Plant Controller Model
VIECPCU2	Vestas Power Plant Controller Model

2.1. FCVWTU1

Full Converter Vestas Wind Turbine Model

ICONs	Value	Description
M		Number of active power modules
M+1		FRT Qcontrol Flag: Enable = 1, Disable = 0
M+2		bus_from, bus for voltage measurement [a]
M+3		Internal icon (please enter 0)
M+4		Internal icon (please enter 0)
M+5		Internal icon (please enter 0)
M+6		Internal icon (please enter 0)
M+7		Internal icon (please enter 0)

[a]If bus_from set equal to zero or if the specified branch is not in the case the wind turbine output will be used.

CONs	Value	Description
J		WTG rated power (kW)
J+1		Nominal WTG LV terminal voltage (V)
J+2		Ramp Up limiter for active power (W/s)
J+3		Ramp Down limiter for active power (W/s)
J+4		Up limit for reactive power (Var)
J+5		Low limit for reactive power (Var)
J+6		Proportional gain of active power loop
J+7		Active power loop gain in regard to integrator component
J+8		Proportional gain of reactive power loop
J+9		Reactive power loop gain in regard to integrator component
J+10		Grid Side Filter Capacitance, (Farad)
J+11		Line Side Converter Rated Current per Module (A)
J+12		Internal used
J+13		Internal used
J+14		Limit for P during LVRT (pu)
J+15		Freq time constant(s)
J+16		Bandwidth of active power reference filter (Hz)
J+17		Bandwidth of reactive power reference filter (Hz)
J+18		Ramp up rate limiter for active power reference (kW/s)
J+19		Ramp down rate limiter for active power reference (kW/s)
J+20		Ramp up rate limiter for reactive power reference (Var/s)
J+21		Ramp down rate limiter for reactive power reference (Var/s)
J+22		Time constant for voltage measurement input (s)
J+23		Qcap_Max_VwtgLV_1 (Var)
J+24		Qcap_Max_VwtgLV_5 (Var)
J+25		Qcap_Max (Var)
J+26		Qind_Min (Var)

CONs	Value	Description
J+27		Qind_Min_VwtgLV_1 (Var)
J+28		Qind_Min_VwtgLV_5 (Var)
J+29		VwtgLV_1 (pu)
J+30		VwtgLV_2 (p.u)
J+31		VwtgLV_3 (pu)
J+32		VwtgLV_4 (pu)
J+33		VwtgLV_5 (pu)
J+34		PbwtgLV_1 (kW)
J+35		PbwtgLV_2 (kW)
J+36		PbwtgLV_3 (kW)
J+37		PbwtgLV_4 (kW)
J+38		PbwtgLV_5 (kW)
J+39		PewtgLV_1 (kW)
J+40		PewtgLV_2 (kW)
J+41		PewtgLV_3 (kW)
J+42		PewtgLV_4 (kW)
J+43		PewtgLV_5 (kW)
J+44		QcwtgLV_1 (kVar)
J+45		QcwtgLV_2 (kVar)
J+46		QcwtgLV_3 (kVar)
J+47		QcwtgLV_4 (kVar)
J+48		QcwtgLV_5 (kVar)
J+49		QdwtgLV_1 (kVar)
J+50		QdwtgLV_2 (kVar)
J+51		QdwtgLV_3 (kVar)
J+52		QdwtgLV_4 (kVar)
J+53		QdwtgLV_5 (kVar)
J+54		Tpfilt_PC (s)
J+55		PoRS_RateLimAvailPowO ffsetPU (pu)
J+56		PoRS_FRBRampDown Rate, (pu/s)
J+57		PoRS_RateLimPowRefPU sSlow, (pu/s)
J+58		PoRS_RateLimPowRefPU sNormalDown (pu/s)
J+59		PoRS_RateLimPowRefPU sNormalUp, (pu/s)
J+60		PcwtgLV_1 (kW)
J+61		PcwtgLV_2 (kW)
J+62		PcwtgLV_3 (kW)
J+63		PcwtgLV_4 (kW)
J+64		PcwtgLV_5 (kW)
J+65		PdwtgLV_1 (kW)
J+66		PdwtgLV_2 (kW)
J+67		PdwtgLV_3 (kW)

CONs	Value	Description
J+68		PdwtgLV_4 (kW)
J+69		PdwtgLV_5 (kW)
J+70		QfwtgLV_1 (kVar)
J+71		QfwtgLV_2 (kVar)
J+72		QfwtgLV_3 (kVar)
J+73		QfwtgLV_4 (kVar)
J+74		QfwtgLV_5 (kVar)
J+75		QgwtgLV_1 (kVar)
J+76		QgwtgLV_2 (kVar)
J+77		QgwtgLV_3 (kVar)
J+78		QgwtgLV_4 (kVar)
J+79		QgwtgLV_5 (kVar)
J+80		Slope of LVRT curve
J+81		Upper limit of reactive current (pu)
J+82		Lower limit of reactive current (pu)
J+83		Current Overload Factor (pu)
J+84		Ramp up rate for reactive current injection (pu/s)
J+85		Ramp down rate for reactive current injection (pu/s)
J+86		Slope limiter for active current injection (pu/s)
J+87		60 s moving average voltage filter constant
J+88		Up limit of 60s moving average filtered voltage (pu)
J+89		Low limit of 60s moving average filtered voltage (pu)
J+90		Slope of OV portion on LVRT curve
J+91		Asymmetrical reduction deadband (pu)
J+92		Asymmetrical reduction factor
J+93		Asymmetrical reduction limit (pu)
J+94		Reactive current offset (pu)
J+95		MV transformer compensation (pu)
J+96		Voltage negative sequence (pu)
J+97		LVRT entering threshold (pu)
J+98		LVRT leaving threshold (pu)
J+99		HVRT entering threshold (pu)
J+100		HVRT leaving threshold (pu)
J+101		PQ regain time (s)
J+102		U_HL_LIM
J+103		U_LL_LIM
J+104		ReactiveCurrentLimit Point1U (p.u)
J+105		ReactiveCurrentLimit Point2U (pu)
J+106		Reactive Current LimitP
J+107		ReactiveCurrentLimit Point5U (p.u)
J+108		ActiveCurrentLimit Zone3U2 (pu)

CONs	Value	Description
J+109		ActiveCurrentLimit Zone3U1 (pu)
J+110		ActiveCurrentLimit Zone2U2 (pu)
J+111		ActiveCurrentLimit Zone2U1 (pu)
J+112		ActiveCurrentLimit Zone3I (pu)
J+113		ActiveCurrentLimit Zone2I (pu)
J+114		ReactiveCurrentLimit Point1I (pu)
J+115		ReactiveCurrentLimit Point2I (pu)
J+116		ReactiveCurrentLimit Point5I, (p.u)
J+117		Qref Derate1 (pu)
J+118		Qref Derate2 (pu)
J+119		Qref Derate3 (pu)
J+120		Qref Derate4 (pu)
J+121		Delay_10ms
J+122		Bandwidth of low pass filter for active power (Hz)
J+123		Bandwidth of low pass filter for reactive power (Hz)
J+124		Time constant of low pass filter for voltage (s)

STATEs	Description
K	Integrator for active power control loop
K+1	Integrator for reactive power control loop
K+2	PLL PI control
K+3	PLL Angle
K+4	Frequency filter
K+5	P Filter
K+6	Q Filter
K+7	V filter
K+8	Pref filter
K+9	Integrator 2 for active power reference used in production controller (down)
K+10	Integrator 3 for active power reference used in production controller (up)
K+11	60 s moving average filterred voltage (p.u)
K+12	Voltage filter state 10ms moving average filter
K+13	Integrator for active power reference
K+14	Integrator for reactive power reference
K+15	Integrator for voltage measurement input

VARs	Description
L	Active power reference after PQ chart (pu)
L+1	Reactive power reference after PQ chart (pu)
L+2	Calculated FRT active current injection (pu)
L+3	Calculated FRT reactive current Injection (pu)
L+4	Active power reference after rate limiter (W)
L+5	Reactive power reference after saturation (Var)

VARs	Description
L+6	Filtered bus voltage angle
L+7	WTG active current injection (p.u)
L+8	WTG reactive current injection (p.u)
L+9	Real current injection
L+10	Reactive current injection
L+11	FRT status of WTG (0/1/2)
L+12	Loadflow Pgen
L+13	Active power reference after limiter (pu)
L+14	Available capacitive WTG reactive power (pu)
L+15	Available inductive WTG reactive power (pu)
L+16	Final P ref after PQ chart (pu)
L+17	Final Q ref after PQ chart (pu)
L+18	Active power reference after ramp rate limiter (kW)
L+19	Reactive power reference after ramp rate (Var)
L+20	rPref_lim_temp_kW
L+21	rVINP_PowUpInteg_kW
L+22	rVINP_PowDownInteg_kW
L+23	FRT reactive current injection (pu)
L+24	FRT active current injection (pu)
L+25	rFRT_Ireact_pu (pre-ramp rate)
L+26	Trigger for time counter during PQ regain after LVRT (s)
L+27	Trigger for time counter during PQ regain after HVRT (s)
L+28	Measurement filtered power
L+29	Filtered Q
L+30	Filtered V

```
IBUS  'USRMDL'  ID  'FCVWTU1'  101   1   8   125   16   31   ICON(M) to
 ICON(M+7)  CON(J) to CON(J+124) /
```

2.2. VIECPCU1

Vestas - IEC 61400-27 Power Plant Controller (PPC)

ICONs	Value	Description
M		mwpqmode, plant controller mode (Note 1) • 0: Q control • 1: Power Factor Control • 2: Reactive Power Control using voltage • 3: Voltage Control
M+1		bus_vmeas, bus for voltage measurement (Note 2)
M+2		bus_from, bus for voltage measurement (Note 3)
M+3		bus_to, to bus for power measurement
M+4		Branch ID of bus_from to bus_to branch (enter in single quotes)
M+5		Internal icon (please enter 0)
M+6		Internal icon (please enter 0)
M+7		Internal icon (please enter 0)
M+8		Internal icon (please enter 0)

CONs	Value	Description
J		T_{XFT}, (s) lead time constant in transfer block (Note 4)
J+1		T_{XFV}, (s) lag time constant in transfer block
J+2		dxrefmax, maximum change rate transfer block (pu/sec) (Note 5)
J+3		dxrefmin, minimum change rate transfer block (pu/sec)
J+4		Kwpqref, gain for plant reference Q
J+5		Kpwpx, Q/V PI controller proportional gain
J+6		Kiwpx, Q/V PI controller integral gain
J+7		Kiwpxmax, maximum value of PI integrator block output (pu)
J+8		Kiwpxmin, minimum value of PI integrator block output
J+9		SCR value at Point of Interconnection
J+10		Twppfiltq (s), time constant for plant P measurement
J+11		Twpufiltq (s), time constant for plant voltage measurement
J+12		Twpqfiltq (s), time constant for plant Q measurement
J+13		rwpdrop, resistive component of voltage drop impedance
J+14		xwpdrop, reactive component of voltage drop impedance
J+15		Tuqfilt (s), time constant for voltage error
J+16		vslopex1, First x point for Vslope control (pu) (Note 6)
J+17		vslopex2, Second x point for Vslope control (pu)
J+18		vslopex3, Third x point for Vslope control (pu)
J+19		vslopex4, Fourth x point for Vslope control (pu)

CONs	Value	Description
J+20		vslopey1, First y point for Vslope control (pu) (Note 7)
J+21		vslopey2, Second y point for Vslope control (pu)
J+22		vslopey3, Third y point for Vslope control (pu)
J+23		vslopey4, Fourth y point for Vslope control (pu)
J+24		vslope, Slope for voltage control
J+25		vmaxerrover, Maximum voltage error in Vslope control (pu) (Note 8)
J+26		vmaxerrunder, Minimum voltage error in Vslope control (pu)
J+27		basemult, Power base multiplier for Vslope control
J+28		Kwpqu, Voltage controller cross coupling gain (pu)
J+29		Vdb, voltage deadband for mwpqmode = 3 (twice the width of deadband)
J+30		uwpqdip, Voltage threshold for UVRT detection (pu) (Note 9)
J+31		uwpqdipR, LVRT exit level (pu)
J+32		FreezeTimeQ (s), Reactive power leave freeze delay
J+33		Tpft (s), lead time constant in P transfer block
J+34		Tpfv (s), lag time constant in P transfer block
J+35		prefmax, max value for P transfer block (pu) (Note 10)
J+36		prefmin, min value for P transfer block (pu)
J+37		dprefmax, max change rate P transfer block (pu/s) (Note 11)
J+38		dprefmin, min change rate P transfer block (pu/s)
J+39		Kwppref, Real power reference gain (pu)
J+40		Kpwpp, Real power controller proportional gain (pu)
J+41		Kiwpp, Real power controller integral gain (pu)
J+42		Kiwppmax, max value of P PI integrator (Note 12)
J+43		Kiwppmin, min value of P PI integrator (pu)
J+44		twppfiltp (s), Filter time constant for P measurement
J+45		twpffiltp (s), Filter time constant for frequency measurement
J+46		pbiasx1, First x point in power vs frequency table (Note 13)
J+47		pbiasx2, Second x point in power vs frequency table
J+48		pbiasx3, Third x point in power vs frequency table
J+49		pbiasx4, Fourth x point in power vs frequency table
J+50		pbiasy1, First y point in power vs frequency table
J+51		pbiasy2, Second y point in power vs frequency table
J+52		pbiasy3, Third y point in power vs frequency table
J+53		pbiasy4, Fourth y point in power vs frequency table
J+54		dpwprefmax, Maximum rate for WP power reference (Note 14)
J+55		dpwprefmin, Maximum rate for WP power reference (Note 15)
J+56		FreezeTimeP (s), Real power leave freeze delay

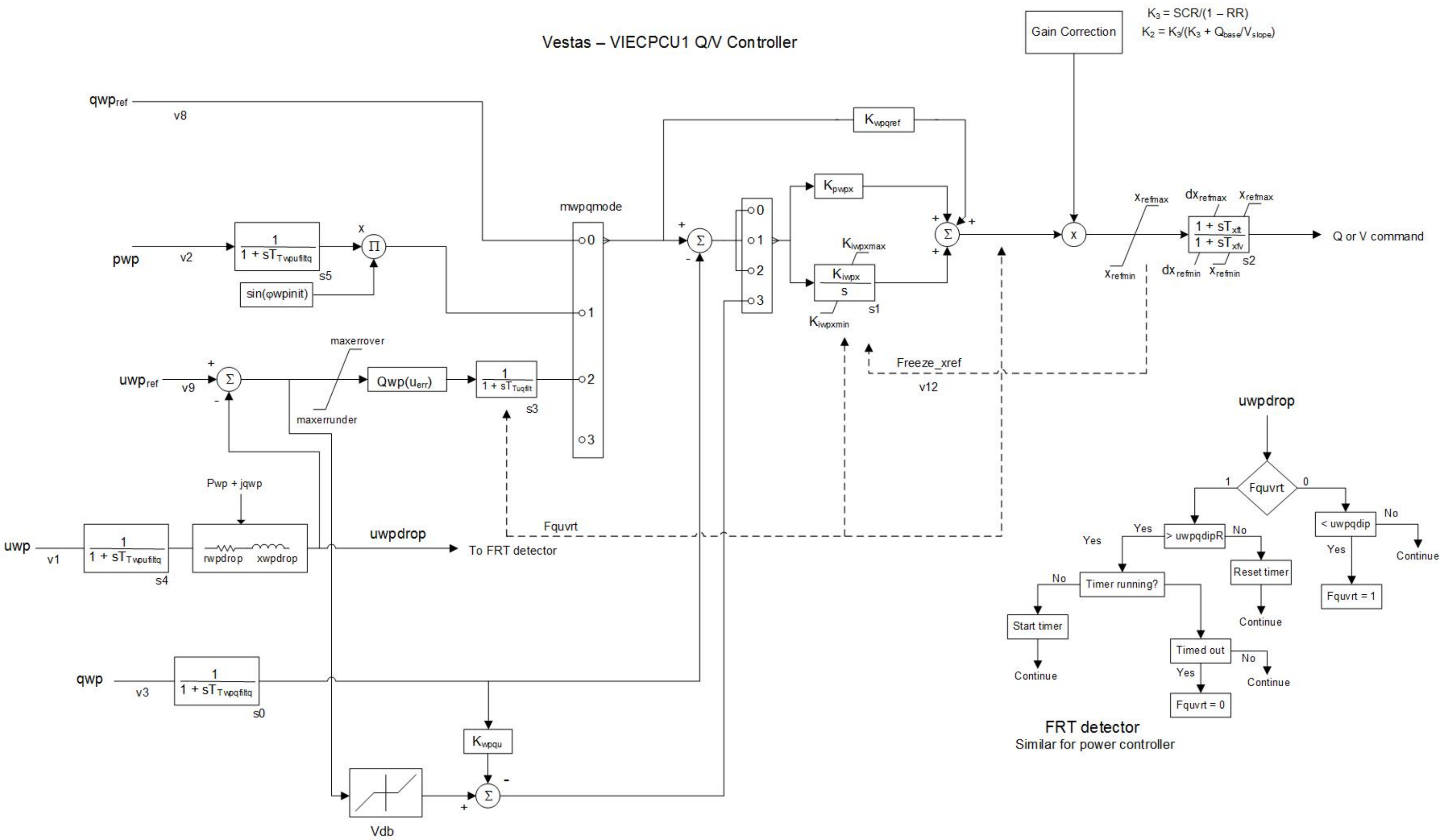
STATEs	Description
K	WT Q into controller filter block (s0)

STATEs	Description
K+1	Limited integrator in PI controller (s1)
K+2	Lead lag transfer function for Q/V output (s2)
K+3	error voltage filter block for mwpqmode = 2 (s3)
K+4	Voltage from reference bus filter block (s4)
K+5	WT P into controller filter block (s5)
K+6	WT P into filter block for P controller (s6)
K+7	Limited integrator in PI controller (s7)
K+8	Lead lag transfer function for P output (s8)
K+9	Frequency filter block in P controller (s9)

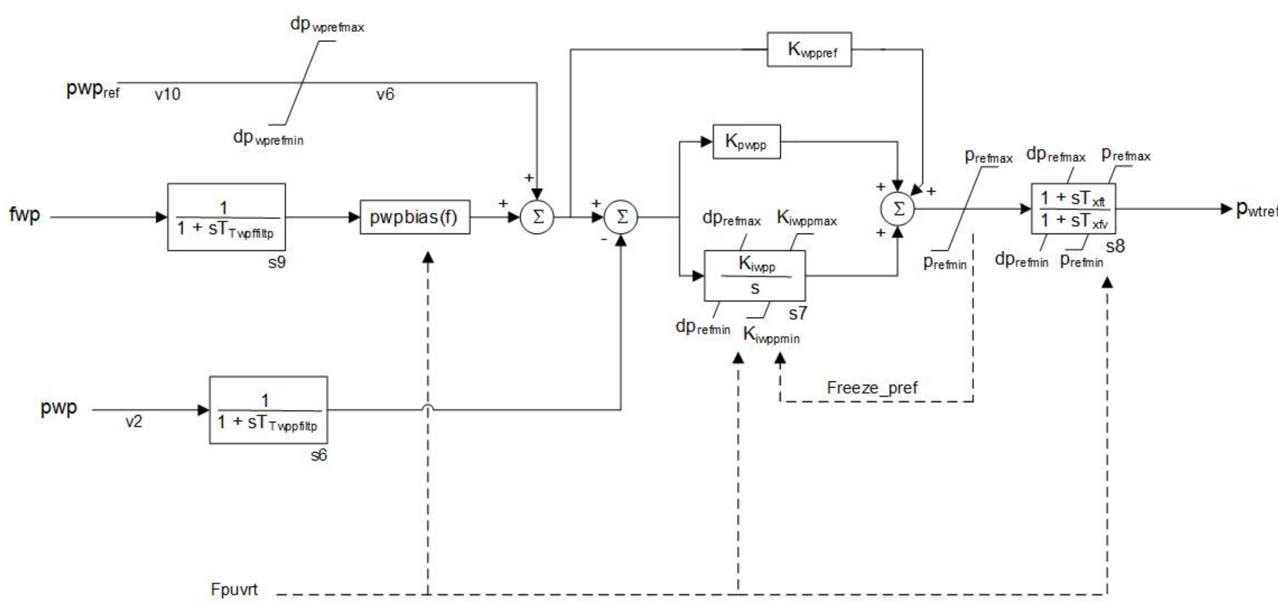
VARs	Description
L	Maximum Q available, pu on MBASE
L+1	uwp (pu), voltage at wind plant reference bus
L+2	pwp (pu on MBASE), real power in reference branch
L+3	qwp (pu on MBASE), reactive power in reference branch
L+4	Real power from wind turbine (pu on MBASE)
L+5	Reactive power from wind turbine (pu on MBASE)
L+6	Pwpref_ramp, reference Q after checking rate of change
L+7	Minimum Q available (pu on MBASE)
L+8	qwpref, controller reference reactive power (pu on MBASE)
L+9	uwpref (pu), controller reference voltage
L+10	pwpref, controller reference real power,(pu MBASE)
L+11	uwpdrop Voltage at reference point with drop
L+12	freeze_xref, freeze on integrator in Q cntl 0 or 1(freeze)
L+13	Voltage error before deadband and qwp(err) block (pu)
L+14	freeze_pref, freeze on integrator in P control 0 or 1(freeze)
L+15	tan(phiwpinit) from loadflow, Q/P, loadflow power factor
L+16	Voltage error after deadband (pu)
L+17	Gain correction
L+18	Used in Q freeze time calculation
L+19	Used in P freeze time calculation
L+20	Fquvrt, P undervoltage freeze state, 1 is freeze on
L+21	Fpuvrt, Q undervoltage freeze state, 1 is freeze on

```
IBUS  'USRMDL'  ID  'VIECPCU1'  107   0   9   57   10   22   ICON(M) to
 ICON(M+8)  CON(J) to CON(J+56) /
```

Vestas – VIECPCU1 Q/V Controller



Vestas - VIECPCU1 P Controller



Notes:

1. If mwpqmode not equal 0, 1, 2 or 3 it will be set to 0
2. If bus_vmeas is set equal to zero or to a bus number not in the case the voltage at the local bus will be used
3. If bus_from is set equal to zero or if the specified branch is not in the case the wind turbine output will be used
4. Time constants must be >= 0, or they will be set to zero
5. If dxrefmax is less than dxrefmin, the values will be interchanged
6. Used only with mwpqmode = 2; in which case the four vslopex values must be separated by at least 0.001 pu to prevent division by zero errors
7. Used only with mwpqmode = 2. The four y values must be monotonically increasing (or decreasing) except when vslopey2 is set equal to vslopey3 to create deadband
8. If maxerrover is less than minerrover, the values will be interchanged
9. If uwpqdip greater than uwpqdipR, the values will be interchanged
10. If prefmax is less than prefmin, the values will be interchanged
11. If dprefmax is less than dprefmin, the values will be interchanged
12. If Kiwppmax is less than Kiwppmin, the values will be interchanged
13. The four pbiasx values must be monotonically increasing and separated by at least 0.0001. The pbiasy values must be monotonically increasing (or decreasing) except when pbiasy2 is set equal to pbiasy3 to create deadband
14. dpwprefmax must be greater than 0.0. If not it will be set to 10.0
15. dpwprefmin must be less than 0.0. If not it will be set to -10.0

2.3. VIECPCU2

Vestas - IEC 61400-27 Power Plant Controller (PPC)

ICONs	Value	Description
M		mwpqmode, plant controller mode (Note 1) • 0: Q control • 1: Power Factor Control • 2: Reactive Power Control using voltage • 3: Voltage Control
M+1		bus_vmeas, bus for voltage measurement (Note 2)
M+2		bus_from, bus for voltage measurement (Note 3)
M+3		bus_to, to bus for power measurement
M+4		Branch ID of bus_from to bus_to branch (enter in single quotes)
M+5		Qcmd_optn_frz: Q command options in Q control freeze state • 1: Linear function of voltage error and active power • 2: Zero (unity power factor) • 3: Pre-freeze value
M+6		Internal icon (please enter 0)
M+7		Internal icon (please enter 0)
M+8		Internal icon (please enter 0)
M+9		Internal icon (please enter 0)

CONs	Value	Description
J		T_{XFT}, (s) lead time constant in transfer block (Note 4)
J+1		T_{XFV}, (s) lag time constant in transfer block
J+2		dxrefmax, maximum change rate transfer block (pu/sec) (Note 5)
J+3		dxrefmin, minimum change rate transfer block (pu/sec)
J+4		Kwpqref, gain for plant reference Q
J+5		Kpwpx, Q/V PI controller proportional gain
J+6		Kiwpx, Q/V PI controller integral gain
J+7		Kiwpxmax, maximum value of PI integrator block output (pu)
J+8		Kiwpxmin, minimum value of PI integrator block output
J+9		SCR value at Point of Interconnection
J+10		Twppfiltq (s), time constant for plant P measurement
J+11		Twpufiltq (s), time constant for plant voltage measurement
J+12		Twpqfiltq (s), time constant for plant Q measurement
J+13		rwpdrop, resistive component of voltage drop impedance
J+14		xwpdrop, reactive component of voltage drop impedance
J+15		Tuqfilt (s), time constant for voltage error

CONs	Value	Description
J+16		vslopex1, First x point for Vslope control (pu) (Note 6)
J+17		vslopex2, Second x point for Vslope control (pu)
J+18		vslopex3, Third x point for Vslope control (pu)
J+19		vslopex4, Fourth x point for Vslope control (pu)
J+20		vslopey1, First y point for Vslope control (pu) (Note 7)
J+21		vslopey2, Second y point for Vslope control (pu)
J+22		vslopey3, Third y point for Vslope control (pu)
J+23		vslopey4, Fourth y point for Vslope control (pu)
J+24		vslope, Slope for voltage control
J+25		vmaxerrover, Maximum voltage error in Vslope control (pu) (Note 8)
J+26		vmaxerrunder, Minimum voltage error in Vslope control (pu)
J+27		basemult, Power base multiplier for Vslope control
J+28		Kwpqu, Voltage controller cross coupling gain (pu)
J+29		Vdb, voltage deadband for mwpqmode = 3 (twice the width of dead-band)
J+30		uwpqdip, Voltage threshold for UVRT detection (pu) (Note 9)
J+31		uwpqdipR, LVRT exit level (pu)
J+32		FreezeTimeQ (s), Reactive power leave freeze delay
J+33		Tpft (s), lead time constant in P transfer block
J+34		Tpfv (s), lag time constant in P transfer block
J+35		prefmax, max value for P transfer block (pu) (Note 10)
J+36		prefmin, min value for P transfer block (pu)
J+37		dprefmax, max change rate P transfer block (pu/s) (Note 11)
J+38		dprefmin, min change rate P transfer block (pu/s)
J+39		Kwppref, Real power reference gain (pu)
J+40		Kpwpp, Real power controller proportional gain (pu)
J+41		Kiwpp, Real power controller integral gain (pu)
J+42		Kiwppmax, max value of P PI integrator (Note 12)
J+43		Kiwppmin, min value of P PI integrator (pu)
J+44		twppfiltp (s), Filter time constant for P measurement
J+45		twpffiltp (s), Filter time constant for frequency measurement
J+46		pbiasx1, First x point in power vs frequency table (Note 13)
J+47		pbiasx2, Second x point in power vs frequency table
J+48		pbiasx3, Third x point in power vs frequency table
J+49		pbiasx4, Fourth x point in power vs frequency table
J+50		pbiasy1, First y point in power vs frequency table
J+51		pbiasy2, Second y point in power vs frequency table
J+52		pbiasy3, Third y point in power vs frequency table
J+53		pbiasy4, Fourth y point in power vs frequency table
J+54		dpwprefmax, Maximum rate for WP power reference (Note 14)
J+55		dpwprefmin, Maximum rate for WP power reference (Note 15)

CONs	Value	Description
J+56		FreezeTimeP (s), Real power leave freeze delay
J+57		db1 (pu), Voltage deadband in Qcmd freeze logics
J+58		Klvrt (pu), gain on real power, in Qcmd freeze logics
J+59		Klvrt_DV (pu), gain on voltage error, in Qcmd freeze logics
J+60		trackstp1, time step for tracking STATE(K+1) (Note 16)
J+61		trackstp3, time step for tracking STATE(K+3) (Note 16)

STATEs	Description
K	WT Q into controller filter block (s0)
K+1	Limited integrator in PI controller (s1)
K+2	Lead lag transfer function for Q/V output (s2)
K+3	error voltage filter block for mwpqmode = 2 (s3)
K+4	Voltage from reference bus filter block (s4)
K+5	WT P into controller filter block (s5)
K+6	WT P into filter block for P controller (s6)
K+7	Limited integrator in PI controller (s7)
K+8	Lead lag transfer function for P output (s8)
K+9	Frequency filter block in P controller (s9)

VARs	Description
L	Maximum Q available, pu on MBASE
L+1	uwp (pu), voltage at wind plant reference bus
L+2	pwp (pu on MBASE), real power in reference branch
L+3	qwp (pu on MBASE), reactive power in reference branch
L+4	Real power from wind turbine (pu on MBASE)
L+5	Reactive power from wind turbine (pu on MBASE)
L+6	Pwpref_ramp, reference Q after checking rate of change
L+7	Minimum Q available (pu on MBASE)
L+8	qwpref, controller reference reactive power (pu on MBASE)
L+9	uwpref (pu), controller reference voltage
L+10	pwpref, controller reference real power,(pu MBASE)
L+11	uwpdrop Voltage at reference point with drop
L+12	freeze_xref, freeze on integrator in Q cntl 0 or 1(freeze)
L+13	Voltage error before deadband and qwp(err) block (pu)
L+14	freeze_pref, freeze on integrator in P control 0 or 1(freeze)
L+15	Cos(phiwpinit) from load flow, load flow power factor
L+16	Voltage error after deadband (pu)
L+17	Gain correction
L+18	Used in Q freeze time calculation
L+19	Used in P freeze time calculation
L+20	Fquvrt, P undervoltage freeze state, 1 is freeze on

VARs	Description
L+21	Fpuvrt, Q undervoltage freeze state, 1 is freeze on
L+22	Input to Q controller transfer block after limit
L+23	Track STATE(K+1) time of latest step
L+24	Track STATE(K+1) latest step value
L+25	Track STATE(K+1) interim step value
L+26	Track STATE(K+1) interim step value
L+27	Track STATE(K+1) interim step value
L+28	Track STATE(K+1) oldest step value
L+29	Track STATE(K+3) time of latest step
L+30	Track STATE(K+3) latest step value
L+31	Track STATE(K+3) interim step value
L+32	Track STATE(K+3) interim step value
L+33	Track STATE(K+3) oldest step value
L+34	Track STATE(K+3) oldest step value

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ICON(M+9) CON(J) to CON(J+61) /
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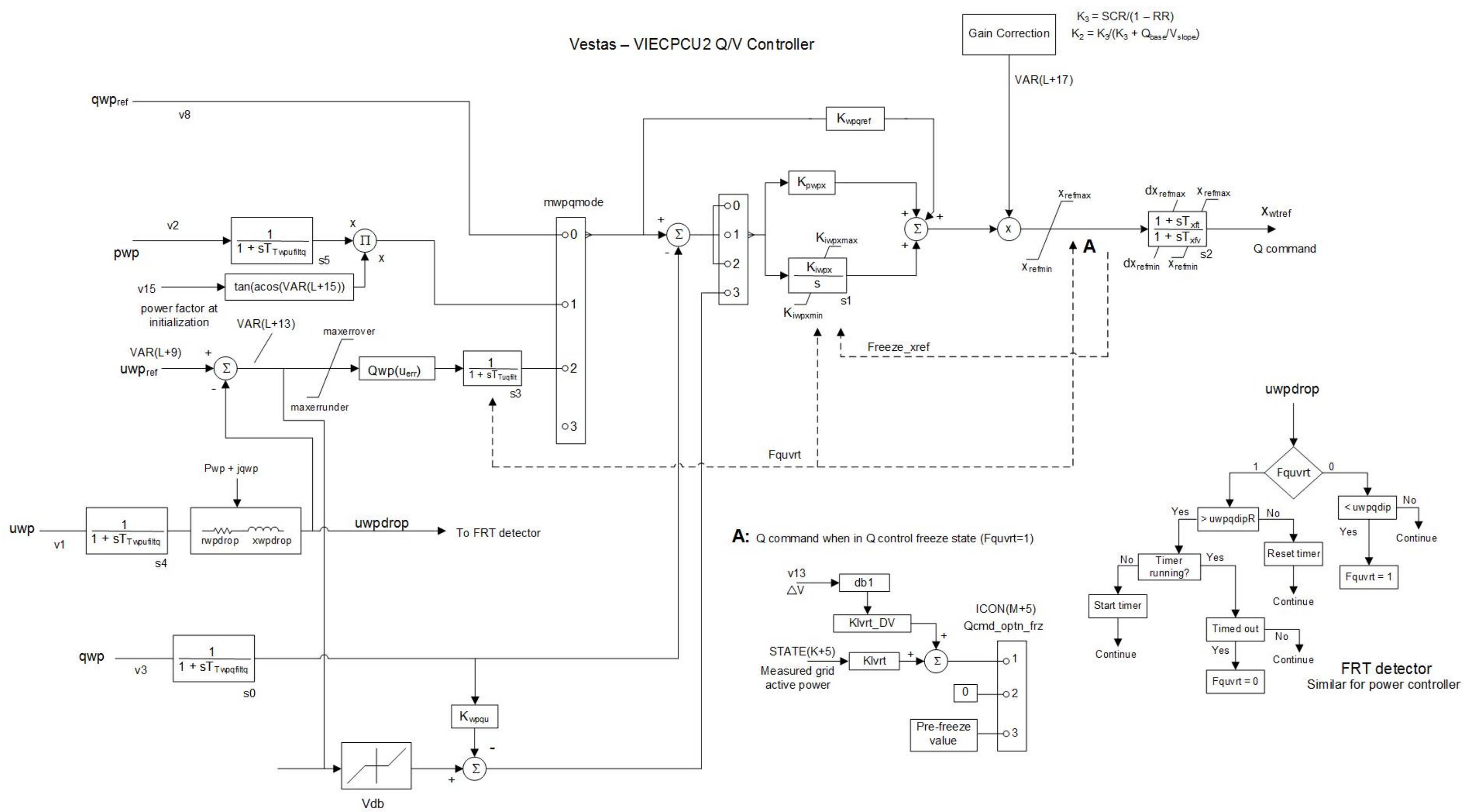

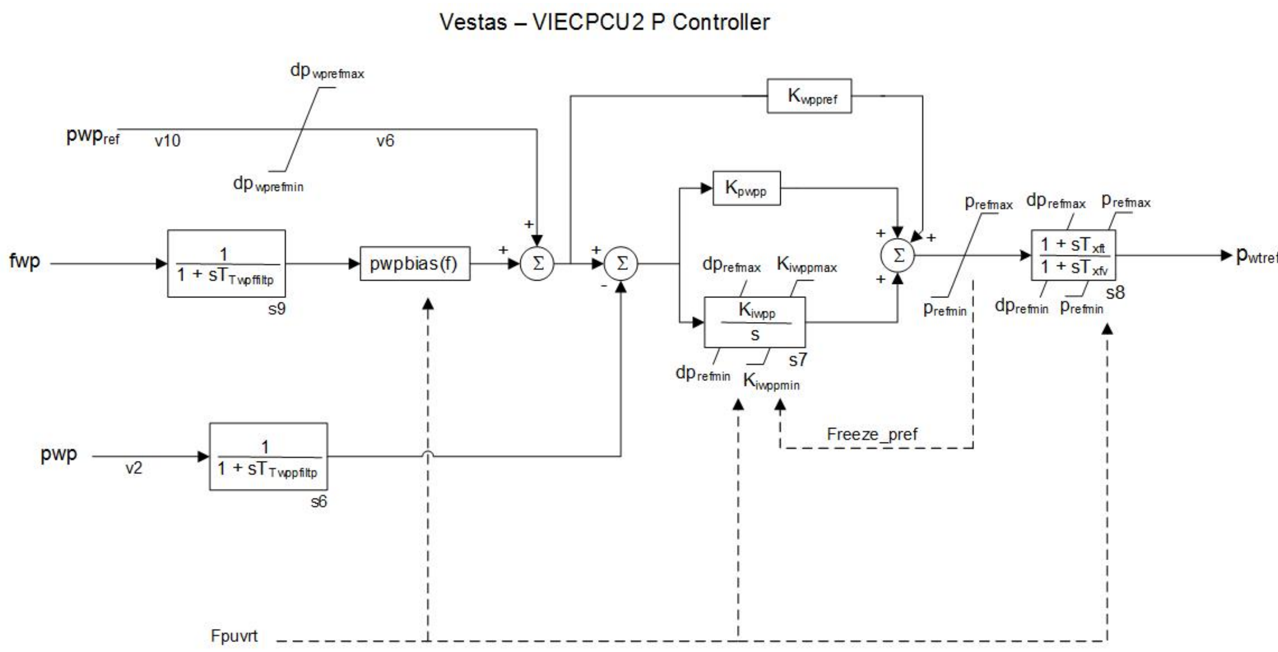

Notes:

1. If mwpqmode not equal 0, 1, 2 or 3 it will be set to 0
2. If bus_vmeas set equal to zero or to a bus number not in the case the voltage at the local bus will be used
3. If bus_from set equal to zero or if the specified branch is not in the case the wind turbine output will be used
4. Time constants must be >= 0, or will be set to zero
5. If dxrefmax is less than dxrefmin, the values will be interchanged
6. Used only with mwpqmode = 2; in which case the four vslopex values must be separated by at least 0.001 pu to prevent division by zero errors
7. Used only with mwpqmode = 2. The four y values must be monotonically increasing (or decreasing) except when vslopey2 is set equal to vslopey3 to create deadband
8. If maxerrover is less than minerrover, the values will be interchanged
9. If uwpqdip greater than uwpqdipR, the values will be interchanged
10. If prefmax is less than prefmin, the values will be interchanged
11. If dprefmax is less than dprefmin, the values will be interchanged
12. If Kiwppmax is less than Kiwppmin, the values will be interchanged
13. The four pbiasx values must be monotonically increasing and separated by at least 0.0001. The pbiasy values must be monotonically increasing (or decreasing) except when pbiasy2 is set equal to pbiasy3 to create deadband

14. dpwprefmax must be greater than 0.0. If not it will be set to 10.0
15. dpwprefmin must be less than 0.0. If not it will be set to -10.0
16. Users must enter a value >= 5*DELT. If entered value is greater than 5*DELT, the entered value will be used.

Chapter 3
AMSC Models

This chapter contains a collection of data sheets for the AMSC models contained in the PSS®E AMSCMDL.DLL dynamic model library.

Users are advised to contact NetworkPlanning@amsc.com for any issues or questions regarding the model.

Model	Description
CDVAR7U1	AMSC D-VAR Model

3.1. CDVAR7U1

AMSC D-VAR Model

ICONs	Value	Description
M		STATCOM Control Mode: • 0: Voltage control • 1: Power Factor Control • 2: Constant Susceptance Output • 3: Constant VAR Output
M+1		Reg Bus: Bus number for Regulation Voltage control
M+2		Bus_01 is bus number for D-VAR MV Bus
M+3		Trans_Bus: Bus number for Transient Voltage control
M+4		CT01_Frm-Bus: This is the From bus number for defining the CT01 flow. It is only needed if the Power Factor or Constant VAR regulation modes are desired. A value of '0' means to ignore CT inputs
M+5		CT01_To-Bus: This is the to bus number for defining the CT01 flow. It is only needed if the Power Factor or Constant VAR regulation modes are desired
M+6		CT01_CKT-ID: This is the circuit id to use for CT01. A value of -1 means to use the cumulative current flowing from the FROM bus to the TO bus. It is only needed if the Power Factor or Constant VAR regulation modes are desired.
M+7		TRSN_ONLY_FLAG: Default = 0
M+8		UK_DROOP : Droop based on measured Vars (add 0 or 1)
M+9		DRP_INCL_SVAR, 0 include SVAR (0 = Default, 1 = do not include)
M+10		Bus ID - Shunt01
M+11		Shunt01 ID (enter in single quotes)
M+12		Bus ID - Shunt02
M+13		Shunt02 ID (enter in single quotes)
M+14		Bus ID - Shunt03
M+15		Shunt03 ID (enter in single quotes)
M+16		Bus ID - Shunt04
M+17		Shunt04 ID (enter in single quotes)
M+18		Bus ID - Shunt05
M+19		Shunt05 ID (enter in single quotes)
M+20		Bus ID - Shunt06
M+21		Shunt06 ID (enter in single quotes)
M+22		Bus ID - Shunt07
M+23		Shunt07 ID (enter in single quotes)
M+24		Bus ID - Shunt08
M+25		Shunt08 ID (enter in single quotes)

ICONs	Value	Description
M+26		Bus ID - Shunt09
M+27		Shunt09 ID (enter in single quotes)
M+28		Bus ID - Shunt10
M+29		Shunt10 ID (enter in single quotes)
M+30		Bus ID - Shunt11
M+31		Shunt11 ID (enter in single quotes)
M+32		Bus ID - Shunt12
M+33		Shunt12 ID (enter in single quotes)

CONs	Value	Description
J		VREF: This is the D-VAR STATCOM’s regulation voltage target (puV). For a flat STRT, set to 0.0.
J+1		RG_BST_DRP : Droop for Boost Regulation Mode (puV/puA)
J+2		RG_BST_ON: Turn On Delta for Boost Regulation Mode (puV)
J+3		RG_BST_TRG: Target Delta for Boost Regulation Mode (puV)
J+4		RG_BCK_DRP : Droop for Buck Regulation Mode (puV)
J+5		RG_BCK_ON: Turn On Delta for Buck Regulation Mode (puV)
J+6		RG_BCK_TRG: Target Delta for Buck Regulation Mode (puV)
J+7		RG_KP : Proportional Gain
J+8		RG_KI : Integral Gain
J+9		SRATED: D-VAR STATCOM Rating (MVAr)
J+10		UK_DRP_MVAR : Range for applying Measured Droop (MVAR)
J+11		TRSN_BST_DRP : Droop for Boost Transient Mode (puV/puA)
J+12		TRSN_BST_ON: Turn On Delta for Boost Transient Mode (puV)
J+13		TRSN_BST_TRG: Target Delta for Boost Transient Mode (puV)
J+14		TRSN_BST_HLIM: Hard Limit for Boost Transient Mode (puV)
J+15		TRSN_BCK_DRP : Droop for Buck Transient Mode (puV/puA)
J+16		TRSN_BCK_ON: Turn On Delta for Buck Transient Mode (puV)
J+17		TRSN_BCK_TRG: Target Delta for Buck Transient Mode (puV)
J+18		TRSN_BCK_HLIM: Hard Limit for Buck Transient Mode (puV)
J+19		TRSN_KP : Proportional Gain for Transient Mode
J+20		TRSN_KI : Integral Gain for Transient Mode
J+21		KOL : Maximum D-VAR Overload Rating (puA)
J+22		TOVLD : Maximum Duration of Available Overload Continuous Rating (s)
J+23		TBACK: Time for ramping back maximum overload to continuous rating (s)
J+24		VINHIBIT: Minimum voltage for operation of D-VAR (puV)
J+25		PFREF : Power Factor Target
J+26		PF_KP : Proportional Gain for Power Factor
J+27		PF_KI : Gain for Power Factor
J+28		QREF: Constant MVAR target at measured point (MVar)

CONs	Value	Description
J+29		SUSP_OFFSET: Constant Susceptance Target (MVar)
J+30		HL_Droop, Droop value below Transient hard limits
J+31		Fast_Timeout: Transition time from Transient to regulation (s)
J+32		SUSP_RATE: Susceptance Slew Rate (puA/s)
J+33		MVAR_RATE: Constant MVAR Slew Rate (puA/s)
J+34		ShuntI1 (I1 < 0) (puA)
J+35		ShuntT1 (s)
J+36		ShuntI1 (I1 < I2 < 0) (puA)
J+37		ShuntT2 (s)
J+38		ShuntI3 (I3 > 0) (puA)
J+39		ShuntT3 (s)
J+40		ShuntI4 (I3 > I4 > 0) (puA)
J+41		Shunt T4 (s)
J+42		Shunt Switch Close-Delay (ms)
J+43		Shunt Switch Open-Delay (ms)
J+44		Shunt01 Rating (kVAr)
J+45		Shunt Discharge time (s) (For Capacitor Banks Only)
J+46		Shunt02 Rating (kVAr)
J+47		Shunt Discharge time (s) (For Capacitor Banks Only)
J+48		Shunt03 Rating (kVAr)
J+49		Shunt Discharge time (s) (For Capacitor Banks Only)
J+50		Shunt04 Rating (kVAr)
J+51		Shunt Discharge time (s) (For Capacitor Banks Only)
J+52		Shunt05 Rating (kVAr)
J+53		Shunt Discharge time (s) (For Capacitor Banks Only)
J+54		Shunt06 Rating (kVAr)
J+55		Shunt Discharge time (s) (For Capacitor Banks Only)
J+56		Shunt07 Rating (kVAr)
J+57		Shunt Discharge time (s) (For Capacitor Banks Only)
J+58		Shunt08 Rating (kVAr)
J+59		Shunt Discharge time (s) (For Capacitor Banks Only)
J+60		Shunt09 Rating (kVAr)
J+61		Shunt Discharge time (s) (For Capacitor Banks Only)
J+62		Shunt10 Rating (kVAr)
J+63		Shunt Discharge time (s) (For Capacitor Banks Only)
J+64		Shunt11 Rating (kVAr)
J+65		Shunt Discharge time (s) (For Capacitor Banks Only)
J+66		Shunt12 Rating (kVAr)
J+67		Shunt Discharge time (s) (For Capacitor Banks Only)
J+68		VC_LIMIT: Voltage Compliance Limit (puV)
J+69		VC_SLOPE: Voltage Compliance Slope (puA/puV)

STATEs	Description
K	STATCOM Main PI Controller Integrator (puA)

VARs	Description
L	AVR Mode – D-VAR Buck/Boost State
L+1	POUT Real power output of the D-VAR STATCOM (p.u. value on SBASE)
L+2	QOUT, Reactive power output of the D-VAR STATCOM (p.u. value on SBASE)
L+3	VAC_OWN, D-VAR STATCOM’s 480 bus voltage (puV)
L+4	VAC_CONTR, Control bus AC voltage (puV)
L+5	VAC_REGULATION, Regulation Control bus AC voltage (puV)
L+6	VAC_TRANSIENT, Transient Control Bus AC voltage (puV)
L+7	I_DVAR, per unit current on D-VAR STATCOM’s own MVA base (puA)
L+8	VREF_DVAR, Reference Voltage Active Target Before Droop (puV)
L+9	VAC, Measured Bus Voltage (puV)
L+10 to L +123	Internal Vars

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'FACTS Device Name'   'USRFCT'   'CDVAR7U1'   21   1   34   70   1   124
 ICON(M) to ICON(M+33)  CON(J) to CON(J+69) /
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Notes:

1. The Transient Voltage Control Bus (if unavailable) is set to be same as Regulation Voltage Control Bus and vice versa.

2. The DVAR MV Bus (if unavailable) is set to be same as Transient Voltage Control Bus.

3. Shunts 01 through 12 should be modeled as Fixed Shunts.