

18.2 WT2E1

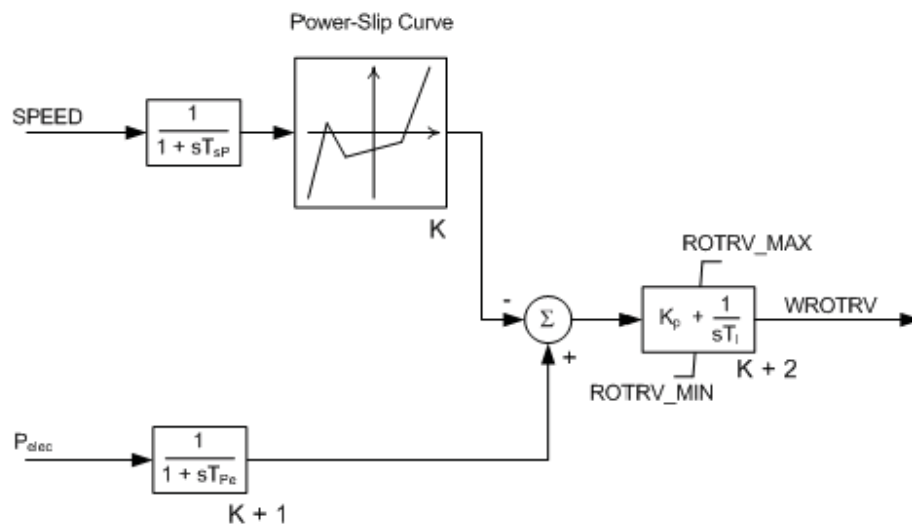
Rotor Resistance Control Model for the Type 2 Wind Generator

This model is located at system bus #_____ IBUS,
Machine identifier #_____ ID,
This model uses CONs starting with #_____ J,
and STATEs starting with #_____ K.

CONs	#	Value	Description
J			T_{SP} , rotor speed filter time constant, sec.
J+1			T_{pe} , power filter time constant, sec.
J+2			T_i , PI-controller integrator time constant, sec.
J+3			K_p , PI-controller proportional gain, pu
J+4			ROTRV_MAX, Output MAX limit
J+5			ROTRV_MIN, Output MIN limit

STATEs	#	Description
K		Rotor speed filter
K+1		Power filter
K+2		PI integrator

IBUS, 'WT2E1', ID, CON(J) to CON(J+5) /



18.3 WT3E1

Electrical Control for Type 3 Wind Generator (for WT3G1 and WT3G2)

This model is located at system bus # _____ IBUS
 Machine identifier # _____ ID
 This model uses CONs starting with # _____ J
 and STATES starting with # _____ K
 and VARs starting with # _____ L
 and ICONs starting with # _____ M

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			X_c , Line drop compensation reactance (pu)
J+4			T_{FP} , Filter time constant in torque regulator
J+5			K_{pp} , Proportional gain in torque regulator (pu)
J+6			K_{iP} , Integrator gain in torque regulator (pu)
J+7			P_{MX} , Max limit in torque regulator (pu)
J+8			P_{MN} , Min limit in torque regulator (pu)
J+9			Q_{MX} , Max limit in voltage regulator (pu)
J+10			Q_{MN} , Min limit in voltage regulator (pu)
J+11			IP_{MAX} , Max active current limit
J+12			T_{RV} , Voltage sensor time constant

CONs	#	Value	Description
J+13			RP_{MX} , Max power order derivative
J+14			RP_{MN} , Min power order derivative
J+15			T_{Power} , Power filter time constant
J+16			K_{qi} , MVAR/Voltage gain
J+17			V_{MINCL} , Min voltage limit
J+18			V_{MAXCL} , Max voltage limit
J+19			K_{qv} , Voltage/MVAR gain
J+20			XIQ_{min}
J+21			XIQ_{max}
J+22			T_v , Lag time constant in WindVar controller
J+23			T_p , P_{elec} filter in fast PF controller
J+24			F_n , A portion of online wind turbines
J+25			ωP_{min} , Shaft speed at P_{min} (pu)
J+26			ωP_{20} , Shaft speed at 20% rated power (pu)
J+27			ωP_{40} , Shaft speed at 40% rated power (pu)
J+28			ωP_{60} , Shaft speed at 60% rated power (pu)
J+29			P_{min} , Minimum power for operating at ωP_{100} speed (pu)
J+30			ωP_{100} , Shaft speed at 100% rated power (pu)

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 filter
K+6		MVAR/Vref integrator
K+7		Verror/internal machine voltage integrator
K+8		Lag of the WindVar controller
K+9		Input filter of P_{elec} for PF fast controller

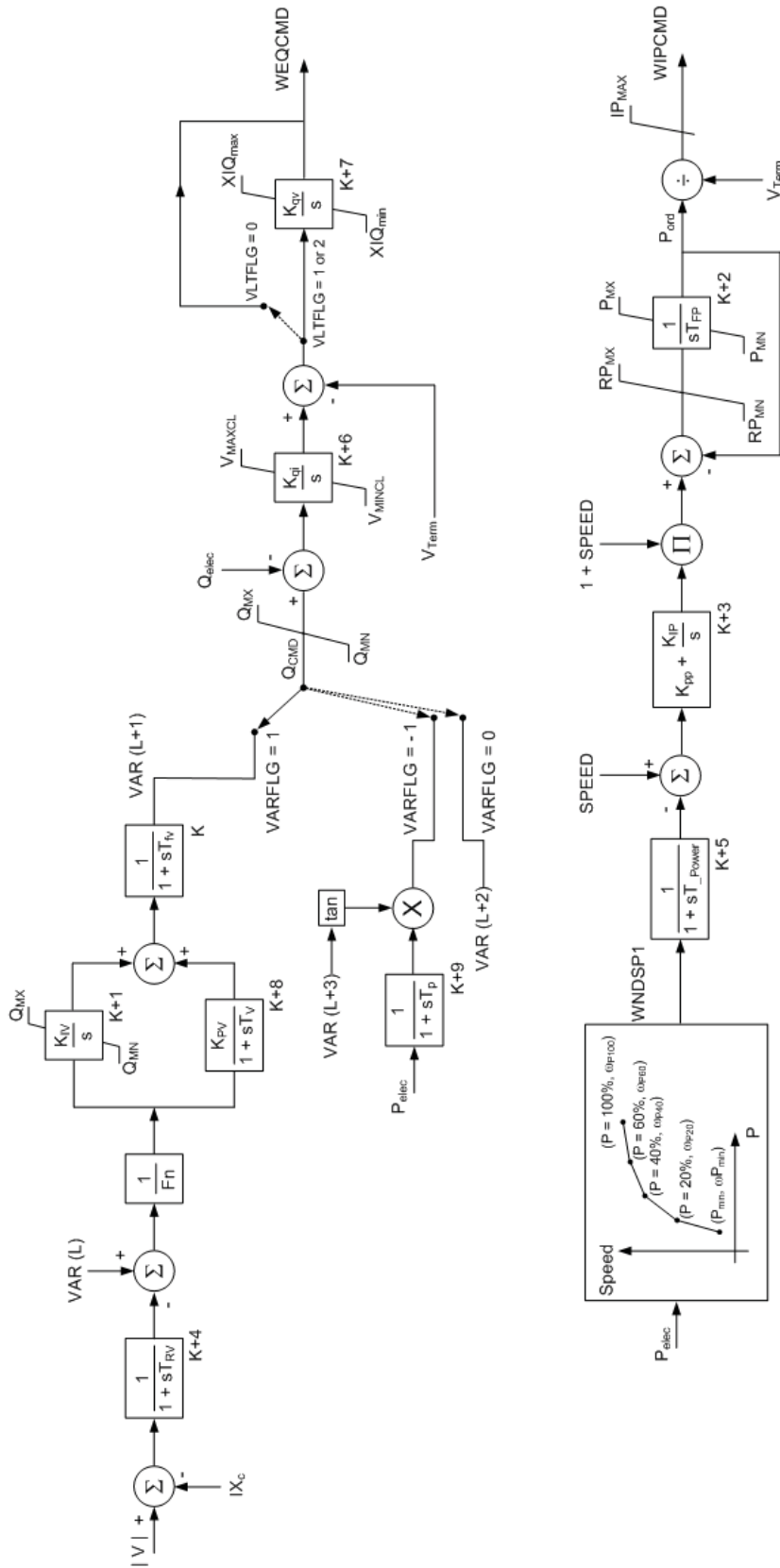
VARs	#	Description
L		Remote bus ref voltage

VARs	#	Description
L+1		MVAR order from MVAR emulator
L+2		Q reference if PFAFLG=0 & VARFLG=0
L+3		PF angle reference if PFAFLG=1
L+4		Storage of MW for computation of compensated voltage
L+5		Storage of MVAR for computation of compensated voltage
L+6		Storage of MVA for computation of compensated voltage

ICONS	#	Description
M		Remote bus # for voltage control; 0 for local voltage control
M+1		VARFLG: 0 Constant Q control 1 Use Wind Plant reactive power control -1 Constant power factor control
M+2 ¹		VLTF LG: 0 Bypass terminal voltage control 1 Eqcmd limits are calculated as VTerm + XIQmin and VTerm + XIQmax, i.e., limits are functions of terminal voltage 2 Eqcmd limits are equal to XIQmin and XIQ max
M+3		From bus of the interconnection transformer
M+4		To bus of the interconnection transformer
M+5		Interconnection transformer ID

¹ WT3E1 model can be used with WT3G1 as well as WT3G2 models. When used with WT3G1 model, it is recommended that ICON(M+2) be set to 1; and when used with WT3G2 model, the ICON(M+2) be set to 2.

IBUS, 'WT3E1', ID, ICON(M) to ICON(M+5), CON(J) to CON(J+30) /



18.4 WT4E1

Electrical Control for Type 4 Wind Generator

This model is located at system bus #_____ IBUS,
 Machine identifier #_____ ID,
 This model uses CONs starting with #_____ J,
 and STATEs starting with #_____ K,
 and VARs starting with #_____ L,
 and ICONs starting with #_____ M.

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			K_{pp} , Proportional gain in Active Power regulator(pu)
J+4			K_{IP} , Integrator gain in Active Power regulator (pu)
J+5			K_f , Rate feedback gain (pu)
J+6			T_f , Rate feedback time constant (sec.)
J+7			Q_{MX} , Max limit in Voltage regulator (pu)
J+8			Q_{MN} , Min limit in Voltage regulator (pu)
J+9			IP_{max} , Max active current limit
J+10			T_{RV} , Voltage sensor time constant
J+11			dP_{MX} , Max limit in power PI controller (pu)
J+12			dP_{MN} , Min limit in power PI controller (pu)
J+13			T_{Power} , Power filter time constant
J+14			K_{QI} , MVAR/Voltage gain
J+15			V_{MINCL} , Min. voltage limit
J+16			V_{MAXCL} , Max. voltage limit
J+17			K_{VI} , Voltage/MVAR Gain
J+18			T_v , Lag time constant in WindVar controller
J+19			T_p , Pelec filter in fast PF controller
J+20			I_{maxTD} , Converter current limit
J+21			I_{phl} , Hard active current limit
J+22			I_{qhl} , Hard reactive current limit

STATes	#	Description
K		Filter in voltage regulator
K+1		Integrator in voltage regulator
K+2		Integrator in active power regulator
K+3		Active power regulator feedback
K+4		Voltage sensor
K+5		Power filter
K+6		MVAR/Vref integrator
K+7		Verror/Internal machine voltage integrator
K+8		Lag of the WindVar controller
K+9		Input filter of Pelec for PF fast controller

VARs	#	Description
L		Remote bus reference voltage
L+1		Q reference if PFAFLG=0 & VARFLG=0
L+2		PFangle reference if PFAFLG=1
L+3		Power reference

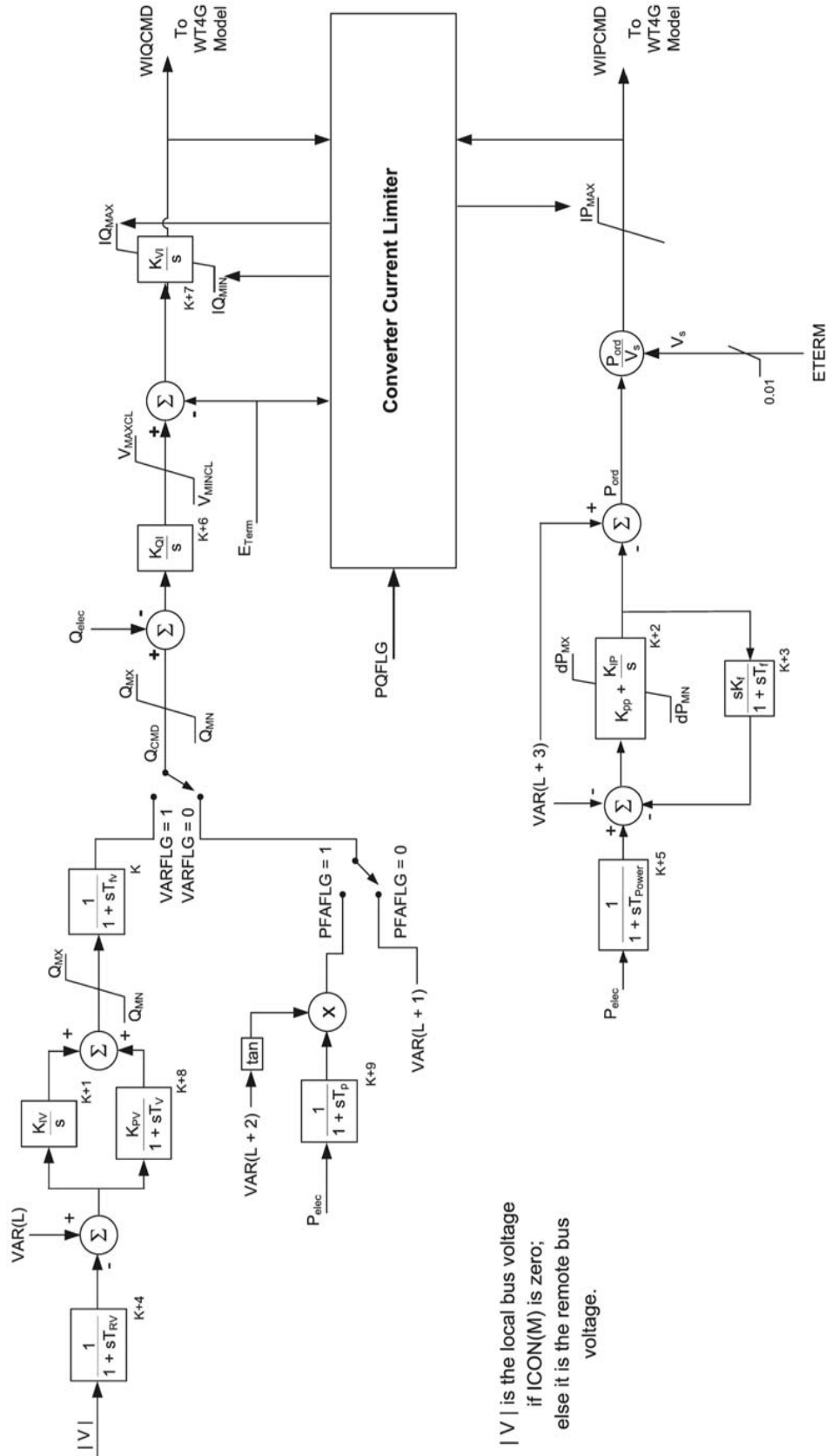
ICONS	#	Description
M		Remote bus # for voltage control; 0 for local control
M+1		PFAFLG: 1 if PF fast control enabled 0 if PF fast control disabled
M+2		VARFLG: 1 if Qord is provided by WindVar 0 if Qord is not provided by WindVar if VARFLG=PFAFLG=0 then Qord is provided as a Qref=const
M+3		PQFLAG, P/Q priority flag: 0 Q priority 1 P priority

IBUS, 'WT4E1', ID, ICON(M) to ICON(M+3), CON(J) to CON(J+22) /

Four possible configurations:

1. Current North American configuration with WindVAR:
varflg = 1; pfaflg = 0; Kqi small (0.1)
2. Current North American configuration without WindVAR:
varflg = 0; pfaflg = 0; Kqi = very small (or 0.).

3. European (PFA control) with WindVAR:
varflg = 1; pfaflg = 0; Kqi large; Kvi larger
4. European (PFA control) without WindVAR:
varflg = 0; pfaflg = 1; hold desired PFA Kqi large ; Kvi larger



Electrical Control for Type 4 Wind Generator

18.5 W4E2U

Electrical Control for Type 4 Wind Generator

This model is located at system bus #_____ IBUS,
 Machine identifier #_____ ID,
 This model uses CONs starting with #_____ J,
 and STATEs starting with #_____ K,
 and VARs starting with #_____ L,
 and ICONs starting with #_____ M.

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			K_{pp} , Proportional gain in Active Power regulator(pu)
J+4			K_{iP} , Integrator gain in Active Power regulator (pu)
J+5			K_f , Rate feedback gain (pu)
J+6			T_f , Rate feedback time constant (sec.)
J+7			Q_{MX} , Max limit in Voltage regulator (pu)
J+8			Q_{MN} , Min limit in Voltage regulator (pu)
J+9			IP_{max} , Max active current limit
J+10			T_{RV} , Voltage sensor time constant
J+11			dP_{MX} , Max limit in power PI controller (pu)
J+12			dP_{MN} , Min limit in power PI controller (pu)
J+13			T_{Power} , Power filter time constant
J+14			K_{QI} , MVAR/Voltage gain
J+15			V_{MINCL} , Min. voltage limit
J+16			V_{MAXCL} , Max. voltage limit
J+17			K_{Vl} , Voltage/MVAR Gain
J+18			T_v , Lag time constant in WindVar controller
J+19			T_p , Pelec filter in fast PF controller
J+20			I_{maxTD} , Converter current limit
J+21			I_{phl} , Hard active current limit
J+22			I_{qhl} , Hard reactive current limit
J+23			T_{iqf} , I_{Qmax} filter time constant, sec.
J+24			FRT_Thres , Voltage Threshold for FRT activation (pu)

CONs	#	Value	Description
J+25			FRT_Hys, FRT De-activation Hysteresis (pu)
J+26			FRT_Droop, FRT Droop
J+27			FRT_Iq_Gain, FRT Iq Gain
J+28			Max_FRT_Iq, Max FRT Iq
J+29			IQMax_Fact1, Factor 1 to adjust IQMX (pu)
J+30			IQMax_Fact2, Factor 2 to adjust IQMX (pu)
J+31			DC_Link_Droop, Voltage Drop in DC-Link cables (pu)
J+32			VinvMax0, Maximum inverter no-load voltage (pu)
J+33			NBR_X, Network bridge reactor reactance

STATES	#	Description
K		Filter in voltage regulator
K+1		Integrator in voltage regulator
K+2		Integrator in active power regulator
K+3		Active power regulator feedback
K+4		Voltage sensor
K+5		Power filter
K+6		MVAR/Vref integrator
K+7		Verror/Internal machine voltage integrator
K+8		Lag of the WindVar controller
K+9		Input filter of Pelec for PF fast controller
K+10		IQmax filter

VARs	#	Description
L		Remote bus reference voltage
L+1		Q reference if PFAFLG=0 & VARFLG=0
L+2		PFangle reference if PFAFLG=1
L+3		Power reference

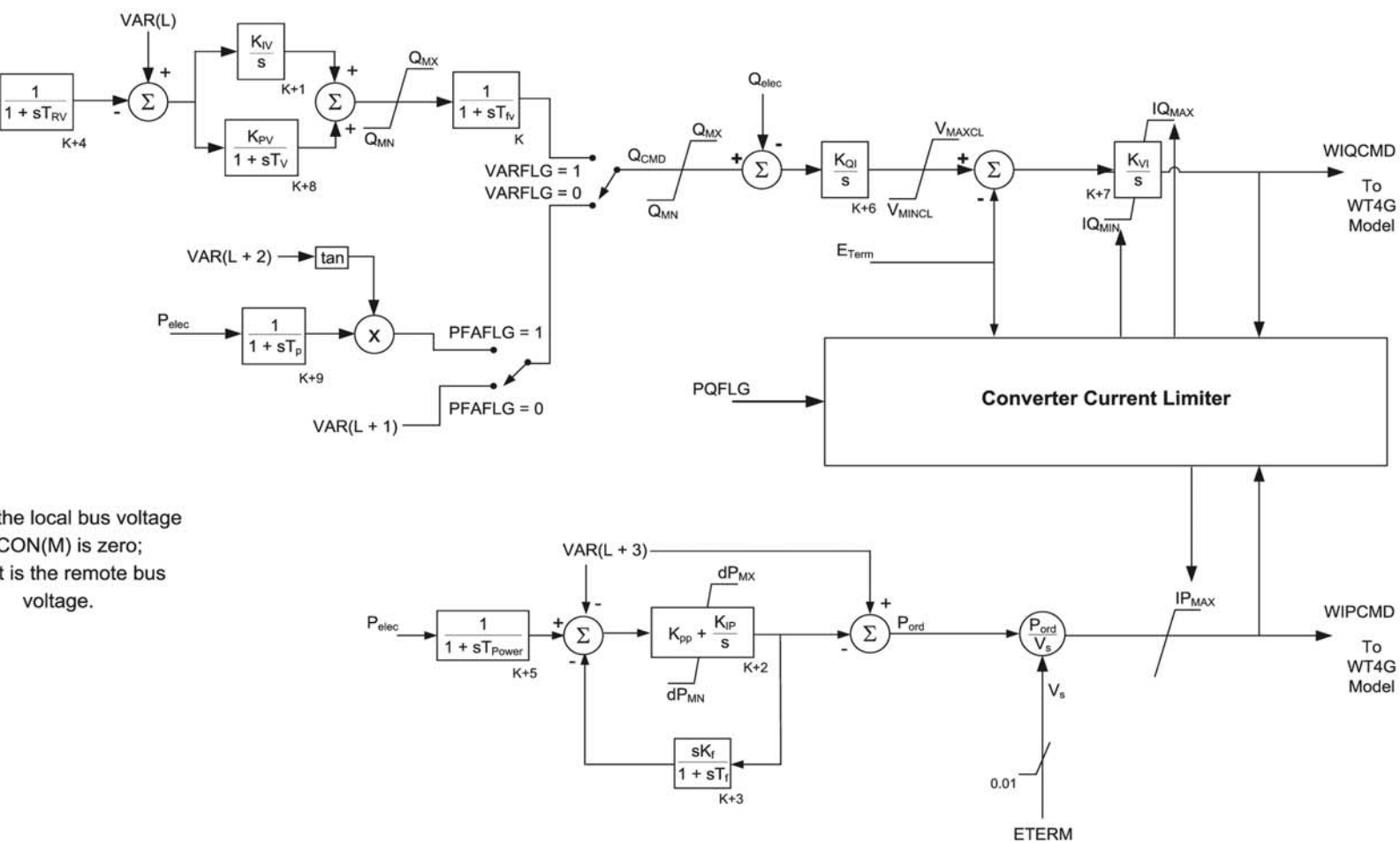
ICONS	#	Description
M		Remote bus # for voltage control; 0 for local control
M+1		PFAFLG: 1 if PF fast control enabled 0 if PF fast control disabled

ICONS	#	Description
M+2		VARFLG: 1 if Qord is provided by WindVar 0 if Qord is not provided by WindVar if VARFLG=PFAFLG=0 then Qord is provided as a Qref=const
M+3		PQFLAG, P/Q priority flag: 0 Q priority 1 P priority

IBUS, 'USRMDL', ID, 'W4E2U' 102 0 4 34 11 4 ICON(M) to ICON(M+3), CON(J) to CON(J+33) /

Four possible configurations:

1. Current North American configuration with WindVAR:
varflg = 1; pfaflg = 0; Kqi small (0.1)
2. Current North American configuration without WindVAR:
varflg = 0; pfaflg = 0; Kqi = very small (or 0.).
3. European (PFA control) with WindVAR:
varflg = 1; pfaflg = 0; Kqi large; Kvi larger
4. European (PFA control) without WindVAR:
varflg = 0; pfaflg = 1; hold desired PFA Kqi large ; Kvi larger



the local bus voltage
CON(M) is zero;
it is the remote bus
voltage.