## 17.2 WT1G1

**Direct Connected (Type 1) 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. |

| CONs | # | Value | Description |
|---|---|---|---|
| J | | | T open circuit transient time constant, sec. ( >0) |
| J+1 | | | T″, open circuit subtransient time constant,sec. (≥ 0); if T″ = 0, single cage |
| J+2 | | | X, synchronous reactance, pu |
| J+3 | | | X´, transient reactance, pu |
| J+4 | | | X″, subtransient reactance, pu (≥ 0); if X″ = 0, single cage |
| J+5 | | | Xl, leakage reactance, pu |
| J+6 | | | E1 |
| J+7 | | | S(E1) |
| J+8 | | | E2 |
| J+9 | | | S(E2) |

| STATEs | # | Description |
|---|---|---|
| K | | Eq´, transient flux q-component |
| K+1 | | Ed´, transient flux d-component |
| K+2 | | Eq″, subtransient flux q-component |
| K+3 | | Ed″, subtransient flux d-component |
| K+4 | | Internal |

| VARs | # | Description |
|---|---|---|
| L | | Admittance of initial condition MVAr difference |
| L+1 | | Machine Q |
| L+2 | | Telec |

IBUS, 'WT1G1', ID, CON(J) to CON(J+9) /

## 17.3 WT2G1

**Induction Generator with Controlled External Rotor Resistor (Type 2)**

| | | |
|---|---|---|
| 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. |

| CONs | # | Value | Description |
|---|---|---|---|
| J | | | XA, stator reactance, pu |
| J+1 | | | XM, magnetizing reactance, pu |
| J+2 | | | X1, rotor reactance, pu |
| J+3 | | | R_ROT_MACH, rotor resistance, pu |
| J+4 | | | R_ROT_MAX, a sum of R_ROT_MACH and total external resistance, pu |
| J+5 | | | E1, first saturation coordinate |
| J+6 | | | SE1, first saturation factor |
| J+7 | | | E2, second saturation coordinate |
| J+8 | | | SE2, second saturation factor |
| J+9 | | | POWER_REF_1, first of 5 coordinate pairs of the power-slip curve |
| J+10 | | | POWER_REF_2 |
| J+11 | | | POWER_REF_3 |
| J+12 | | | POWER_REF_4 |
| J+13 | | | POWER_REF_5 |
| J+14 | | | SLIP_1 |
| J+15 | | | SLIP_2 |
| J+16 | | | SLIP_3 |
| J+17 | | | SLIP_4 |
| J+18 | | | SLIP_5 |

| STATEs | # | Description |
|---|---|---|
| K | | Eq´, transient flux q-component |
| K+1 | | Ed´, transient flux d-component |
| K+2 | | Internal |

| VARs | # | Description |
|---|---|---|
| L | | Admittance of the hidden shunt |
| L+1 | | Machine Q |
| L+2 | | Telec |

IBUS, 'WT2G1', ID, CON(J) to CON(J+18) /

## 17.4 WT3G1

**Doubly-Fed Induction Generator (Type 3)**

| | | |
|---|---|---|
| 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 ICON | #_____ | M. |

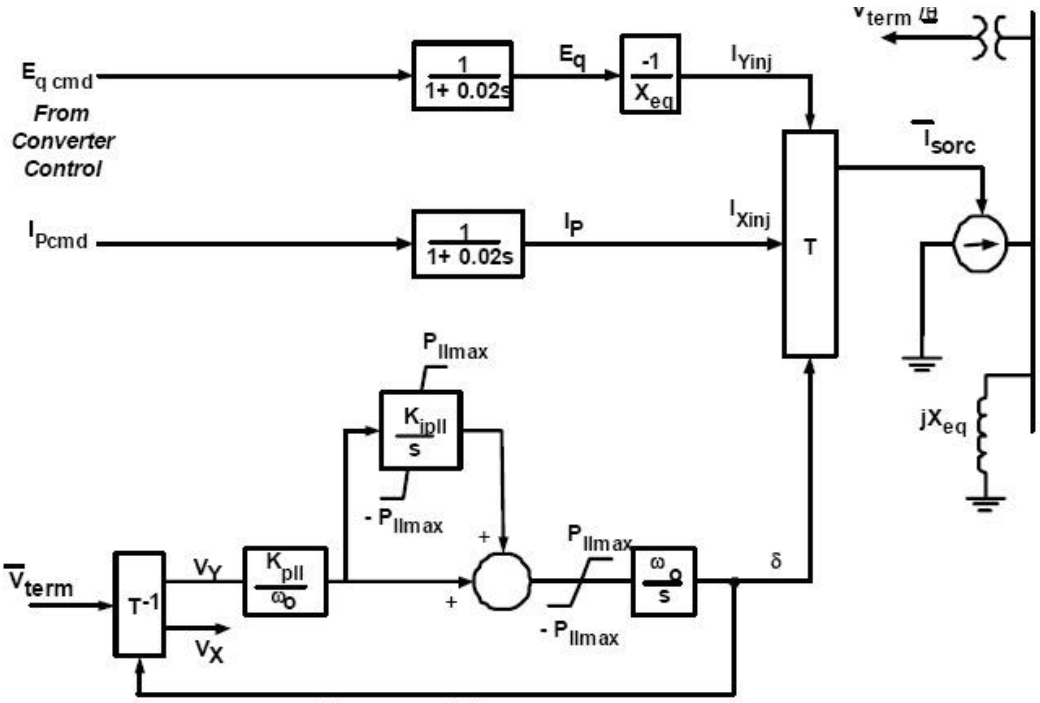
| CONs | # | Value | Description |
|---|---|---|---|
| J | | | $X_{eq}$, Equivalent reactance for current injection (pu) |
| J+1 | | | $K_{pll}$, PLL first integrator gain |
| J+2 | | | $K_{ipll}$, PLL second integrator gain |
| J+3 | | | $P_{llmax}$, PLL maximum limit |
| J+4 | | | Prated, Turbine MW rating |

| STATEs | # | Description |
|---|---|---|
| K | | Converter lag for Ipcmd |
| K+1 | | Converter lag for Eqcmd |
| K+2 | | PLL first integrator |
| K+3 | | PLL second integrator |

| VARs | # | Description |
|---|---|---|
| L | | $V_X$, Real component of Vterm in generator ref. frame |
| L+1 | | $V_Y$, Imaginary component of Vterm in generator ref. frame |
| L+2 | | $I_{xinj}$, Active component of the injected current |
| L+3 | | $I_{yinj}$, Reactive component of the injected current |

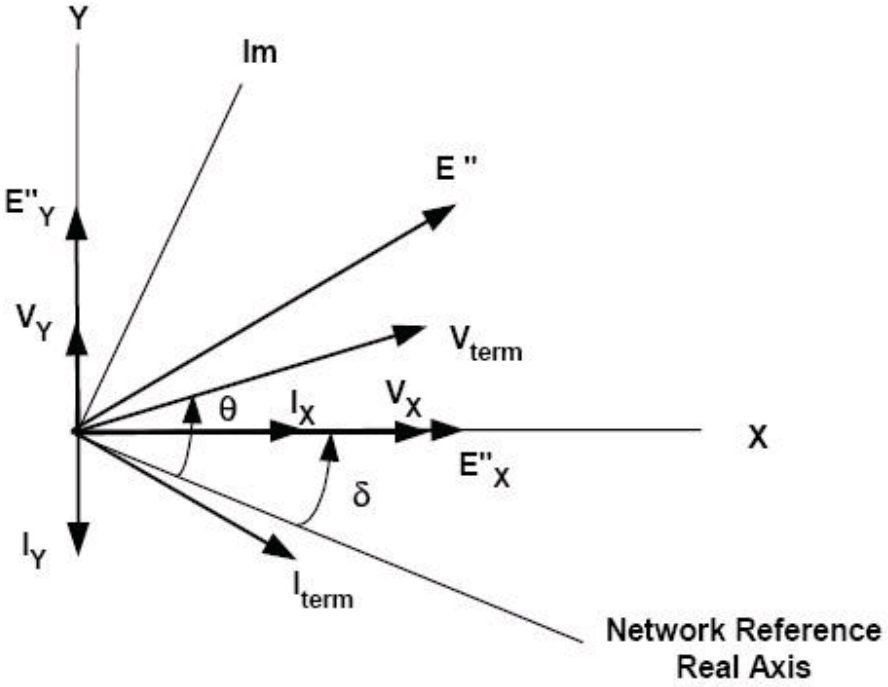
| ICON | # | Description |
|---|---|---|
| M | | Number of lumped wind turbines |

IBUS, 'WT3G1', ID, ICON(M), CON(J) to CON(J+4) /




Notes: 1. $\overline{V}_{term}$ and $\overline{I}_{sorc}$ are complex values on network reference frame.

2. In steady-state, $V_Y = 0$, $V_X = V_{term}$, and $\delta = \theta$.
3. $X_{eq}$ = Imaginary (ZSORCE)



## 17.5 WT3G2U

**Doubly-Fed Induction Generator (Type 3)**

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

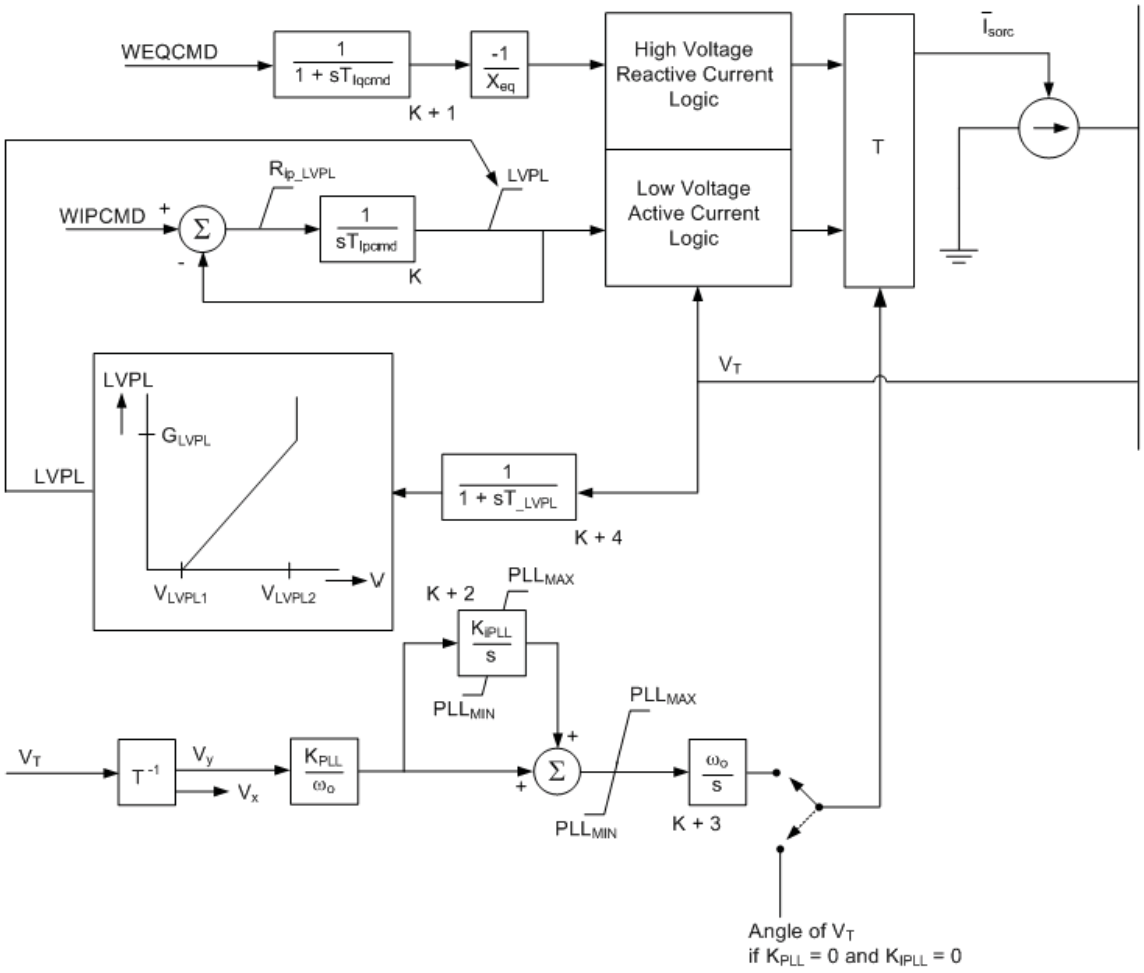
| CONs | # | Value | Description |
|---|---|---|---|
| J | | | Tiqcmd, Converter time constant for IQcmd |
| J+1 | | | Tipcmd, Converter time constant for IPcmd |
| J+2 | | | $K_{PLL}$, PLL gain |
| J+3 | | | $K_{IPLL}$, PLL integrator gain |
| J+4 | | | $PLL_{MAX}$, PLL max. limit |
| J+5 | | | Prated |
| J+6 | | | $V_{LVPL1}$, LVPL voltage 1 Low voltage power logic |
| J+7 | | | $V_{LVPL2}$, LVPL voltage 2 |
| J+8 | | | $G_{LVPL}$, LVPL gain |
| J+9 | | | $V_{HVRCR}$, High Voltage Reactive Current (HVRC) logic, pu voltage |
| J+10 | | | $CUR_{HVRCR}$, HVRC logic, current (pu) |
| J+11 | | | $R_{Ip\_LVPL}$, Rate of active current change |
| J+12 | | | $T_{\_LVPL}$, Voltage sensor for LVPL, second |

| STATEs | # | Description |
|---|---|---|
| K | | Converter lag for Ipcmd |
| K+1 | | Converter lag for Iqcmd |
| K+2 | | PLL first integrator |
| K+3 | | PLL second integrator |
| K+4 | | Voltage sensor for LVPL |

| VAR | # | Description |
|---|---|---|
| L | | deltaQ, overvoltage correction factor |

| ICON | # | Description |
|---|---|---|
| M | | Number of lumped wind turbines |

IBUS, 'USRMDL', ID, 'WT3G2U', 1, 1, 1, 13, 5,1, ICON(M), CON(J) TO COM(J+12)



## 17.6 WT4G1

**Wind Generator Model with Power Converter (Type 4)**

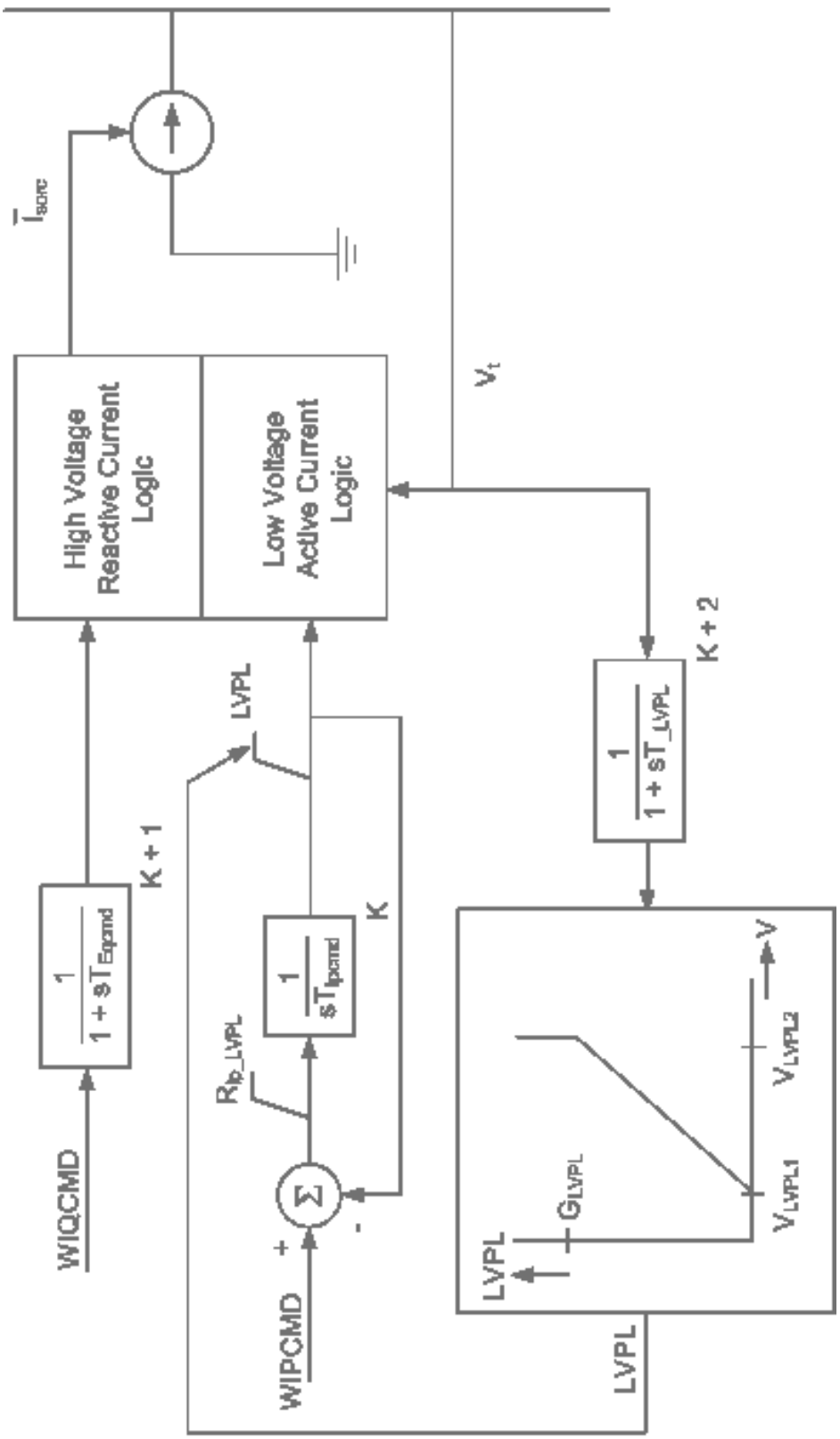
This model is located at system bus #_____ IBUS,
Machine identifier #_____ ID,
This model uses CONs starting with #_____ J,
and STATEs starting with #_____ K,
and VARs starting with #_____ L.

| CONs | # | Value | Description |
|---|---|---|---|
| J | | | $T_{IQCmd}$, Converter time constant for IQcmd |
| J+1 | | | $T_{IPCmd}$, Converter time constant for IPcmd |
| J+2 | | | $V_{LVPL1}$, LVPL voltage 1 (Low voltage power logic) |
| J+3 | | | $V_{LVPL2}$, LVPL voltage 2 |
| J+4 | | | $G_{LVPL}$, LVPL gain |
| J+5 | | | $V_{HVRCR}$, HVRCR voltage (High voltage reactive current limiter) |
| J+6 | | | $CUR_{HVRCR}$, HVRCR current (Max. reactive current at VHVRCR) |
| J+7 | | | $R_{Ip\_LVPL}$, Rate of LVACR active current change |
| J+8 | | | $T_{\_LVPL}$, Voltage sensor for LVACR time constant |

| STATEs | # | Description |
|---|---|---|
| K | | Converter lag for Ipcmd |
| K+1 | | Converter lag for Eqcmd |
| K+2 | | Voltage sensor for LVACR |

| VARs | # | Description |
|---|---|---|
| L through L+4 | | For internal use |
| L+1 | | VAACC, previous Vterm angle |
| L+2 | | deltaQ, overvoltage correction factor |

IBUS, 'WT4G1', ID, CON(J) to CON(J+8) /


$\bar{I}_{sorc}$
$V_t$
High Voltage Reactive Current Logic
Low Voltage Active Current Logic
K + 2
$\frac{1}{1 + sT_{LVPL}}$
LVPL
K + 1
$\frac{1}{1 + sT_{Epcmd}}$
K
$\frac{1}{sT_{Ipcmd}}$
$R_{lp\_LVPL}$
WIQCMD
WIPCMD
+
-
$\Sigma$
LVPL
$G_{LVPL}$
$V_{LVPL1}$
$V_{LVPL2}$
V
LVPL

## 17.7 W4G2U

**Wind Generator Model with Power Converter (Type 4)**

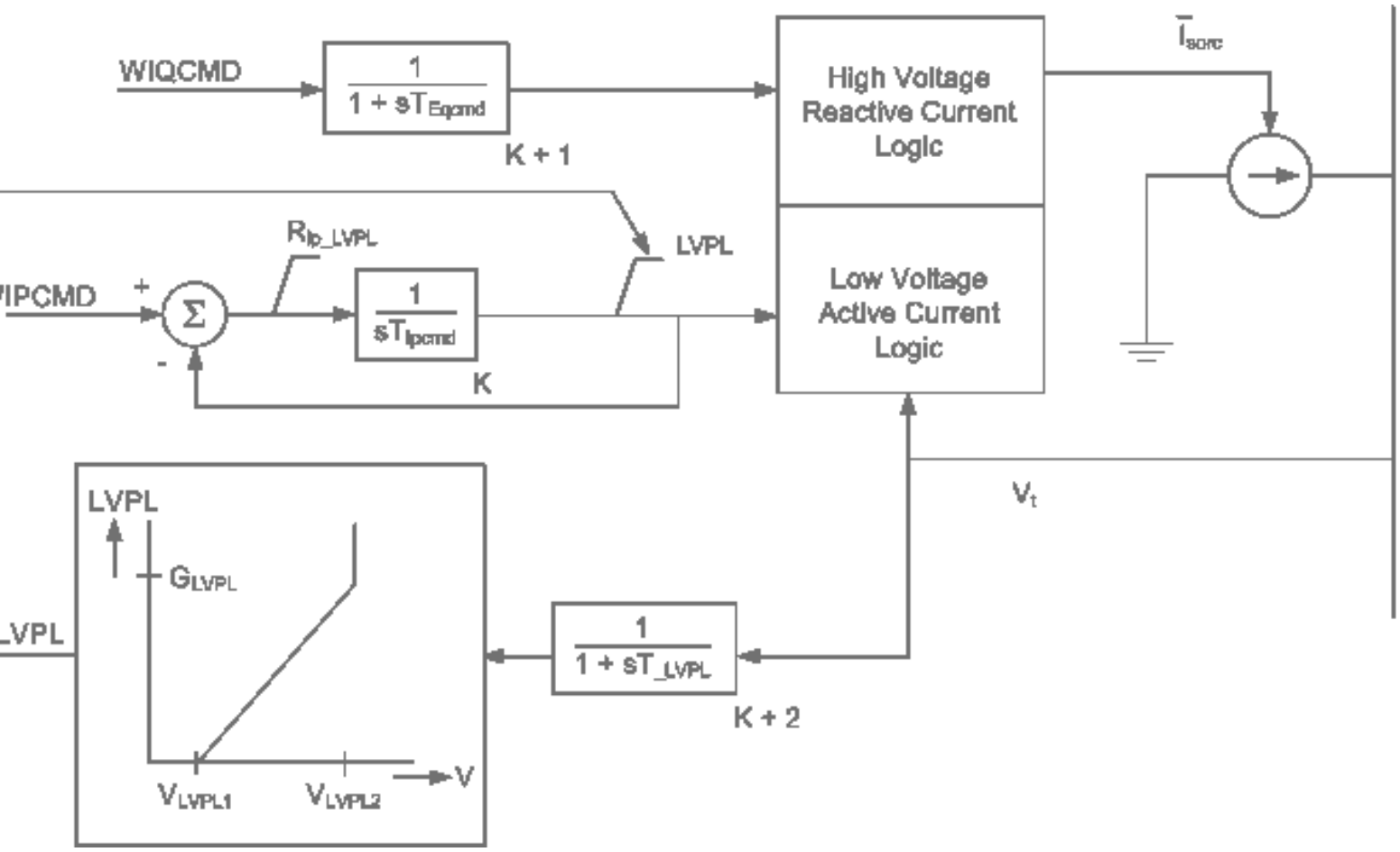
| | | |
|---|---|---|
| This model is located at system bus | #_____ | IBUS, |
| Machine identifier | #_____ | ID, |
| This model uses CONs starting with | #_____ | J, |
| and STATEs starting with | #_____ | K, |
| and VARs starting with | #_____ | L. |

| CONs | # | Value | Description |
|---|---|---|---|
| J | | | $T_{IQCmd}$, Converter time constant for IQcmd |
| J+1 | | | $T_{IPCmd}$, Converter time constant for IPcmd |
| J+2 | | | $V_{LVPL1}$, LVPL voltage 1 (Low voltage power logic) |
| J+3 | | | $V_{LVPL2}$, LVPL voltage 2 |
| J+4 | | | $G_{LVPL}$, LVPL gain |
| J+5 | | | $V_{HVRCR}$, HVRCR voltage (High voltage reactive current limiter) |
| J+6 | | | $CUR_{HVRCR}$, HVRCR current (Max. reactive current at VHVRCR) |
| J+7 | | | $R_{Ip\_LVPL}$, Rate of LVACR active current change |
| J+8 | | | $T_{\_LVPL}$, Voltage sensor for LVACR time constant |

| STATEs | # | Description |
|---|---|---|
| K | | Converter lag for Ipcmd |
| K+1 | | Converter lag for Eqcmd |
| K+2 | | Voltage sensor for LVACR |

| VARs | # | Description |
|---|---|---|
| L through L+4 | | For Internal Use |

IBUS, 'USRMDL', ID, 'W4G2U' 101 1 0 9 3 5 CON(J) to CON(J+8) /


WIQCMD
1 / (1 + sTEqcmd)
K + 1
High Voltage Reactive Current Logic
Low Voltage Active Current Logic
Isorc
RIp_LVPL
LVPL
IPCMD
+
-
Σ
1 / sTIpcmd
K
LVPL
GLVPL
LVPL
VLVPL1
VLVPL2
V
1 / (1 + sT_LVPL)
K + 2
Vt