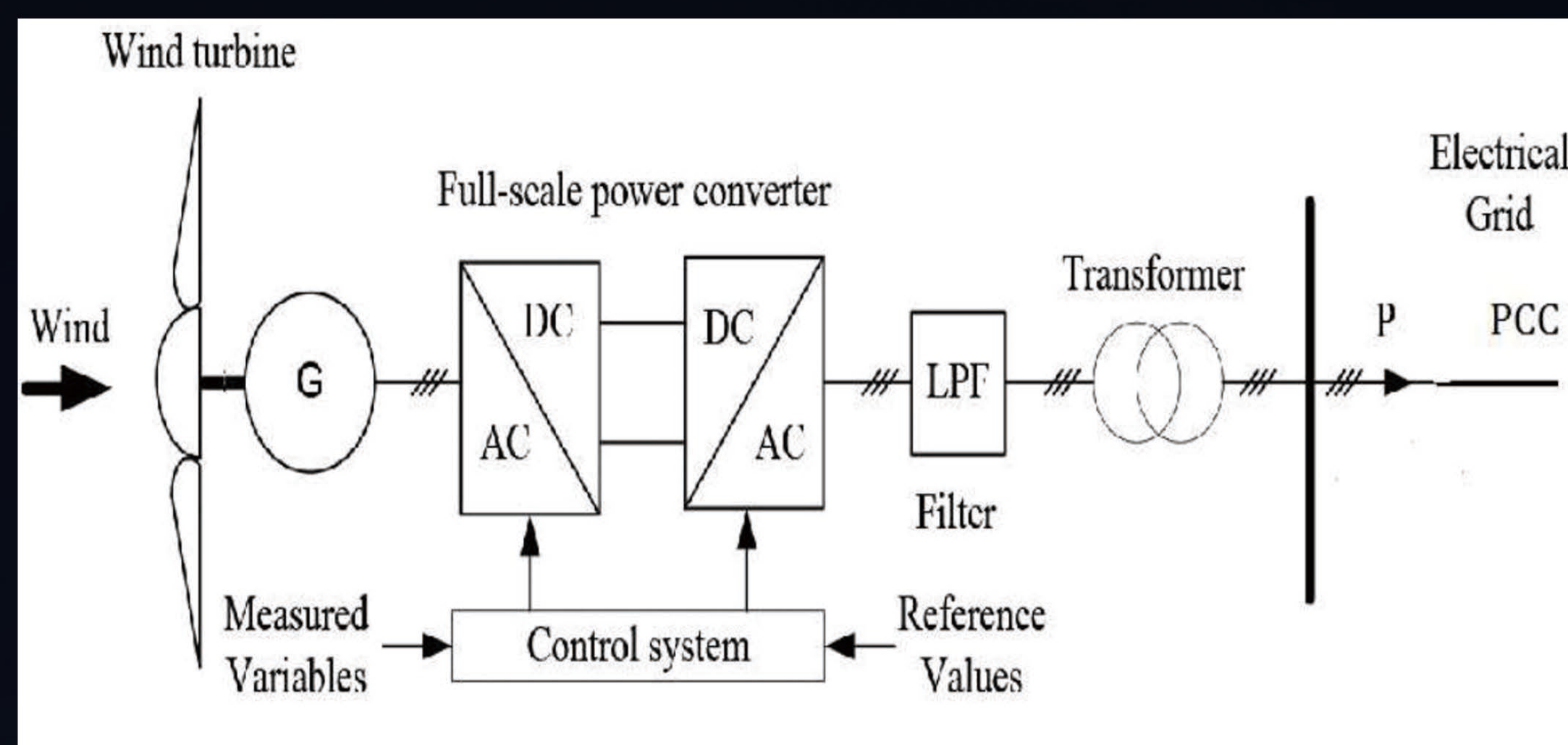


Voltage Source Converter Fault Protection

Problem

- ◆ DESIGN AND SIMULATE A TYPE 4 WIND TURBINE GENERATOR (WTG) SYSTEM THAT WE CAN USE TO DETERMINE AND LOCATE FAULTS BASED ON VARIOUS ELECTRICAL MEASUREMENTS.



◆ TYPE 4 WIND TURBINE SYSTEM

Project Background

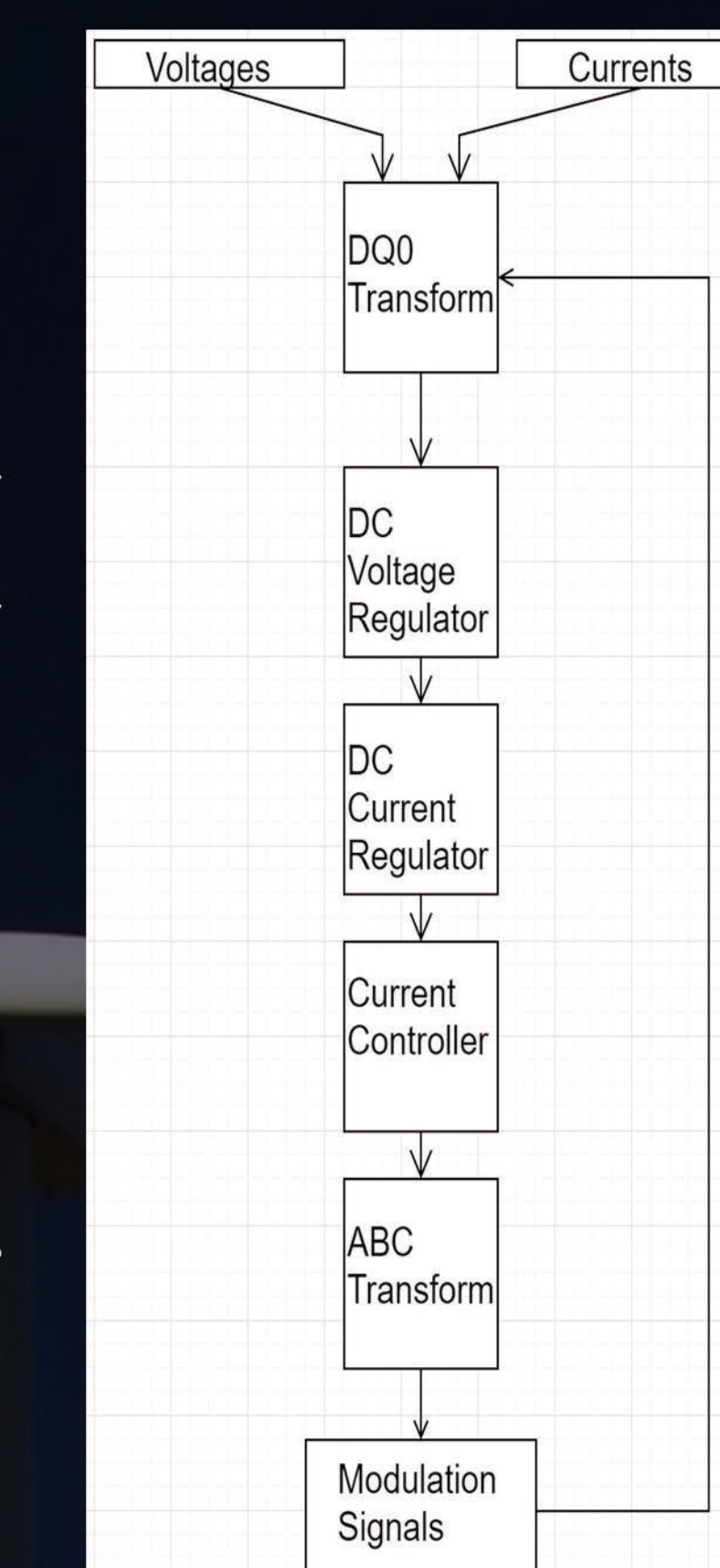
- ◆ TYPE 4 WTG SYSTEM IS A SQUIRREL-CAGE INDUCTION GENERATOR
- ◆ VOLTAGE SOURCE CONVERTER IS A AC/AC CONVERTER THAT ALLOWS US TO REGULATE THE CURRENT IN THE WTG
- ◆ NORMAL FAULT LOCATION METHODS RELY ON THE CURRENT TO DETERMINE THE FAULT LOCATION



Design

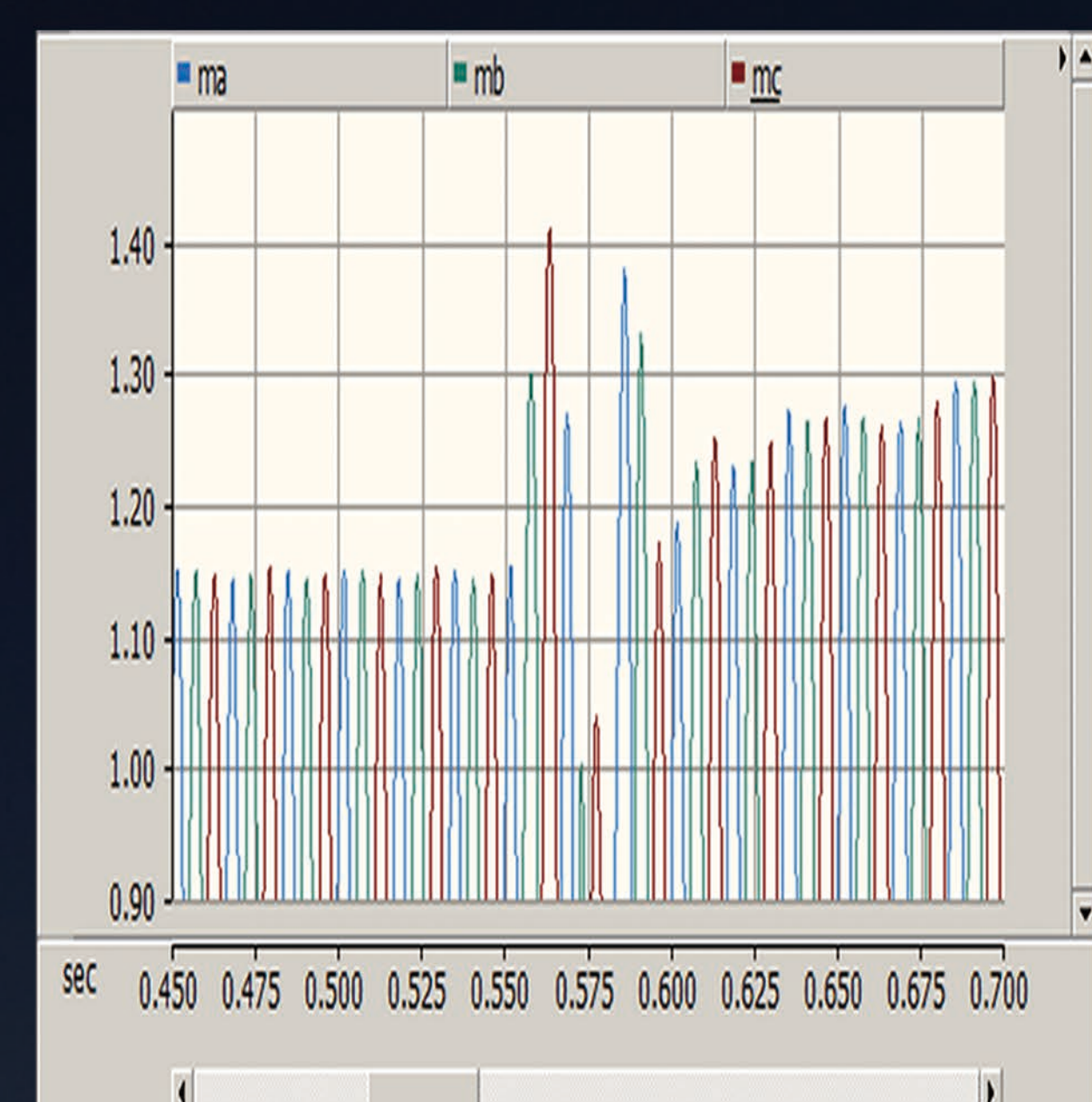
- ◆ WE IMPLEMENTED A TYPE 4 WTG IN PSCAD AND UTILIZED THE TERMINAL AND SOURCE VOLTAGE DEPRESSIONS AS INFORMATION TO DETERMINE A FAULT TYPE AND PHASE WHILE REGULATING THE SOURCE CURRENT TO THE GRID. WE MODULATED THE SIGNAL BY CONVERTING THE THREE-PHASE SYSTEM TO A TWO-AXIS SYSTEM (DQ0). TO PROPERLY DETERMINE THE FAULT, WE CREATED THIS SYSTEM IN BOTH THE STATIONARY AND THE SYNCHRONOUS REFERENCE FRAMES. MOVING TO THE STATIONARY REFERENCE FRAME WE USED THE CLARKE'S TRANSFORM AND A CONTROL DIAGRAM FOUND IN VOLTAGE-SOURCED CONVERTERS' TEXTBOOK. A SIMILAR PROCEDURE FOR THE SYNCHRONOUS FRAME WAS USED, EXCEPT WE USED PARK'S TRANSFORM. BY DOING THIS WE WERE ABLE TO SEE THE EFFECTS OF A FAULT IN THE SYSTEM AND DETERMINED THAT WE CAN USE SET POINTS ON TIME STAMPED PMU'S (PHASOR MEASUREMENT UNIT) TO LOCATE THE FAULT.

- ◆ CONTROL DIAGRAM

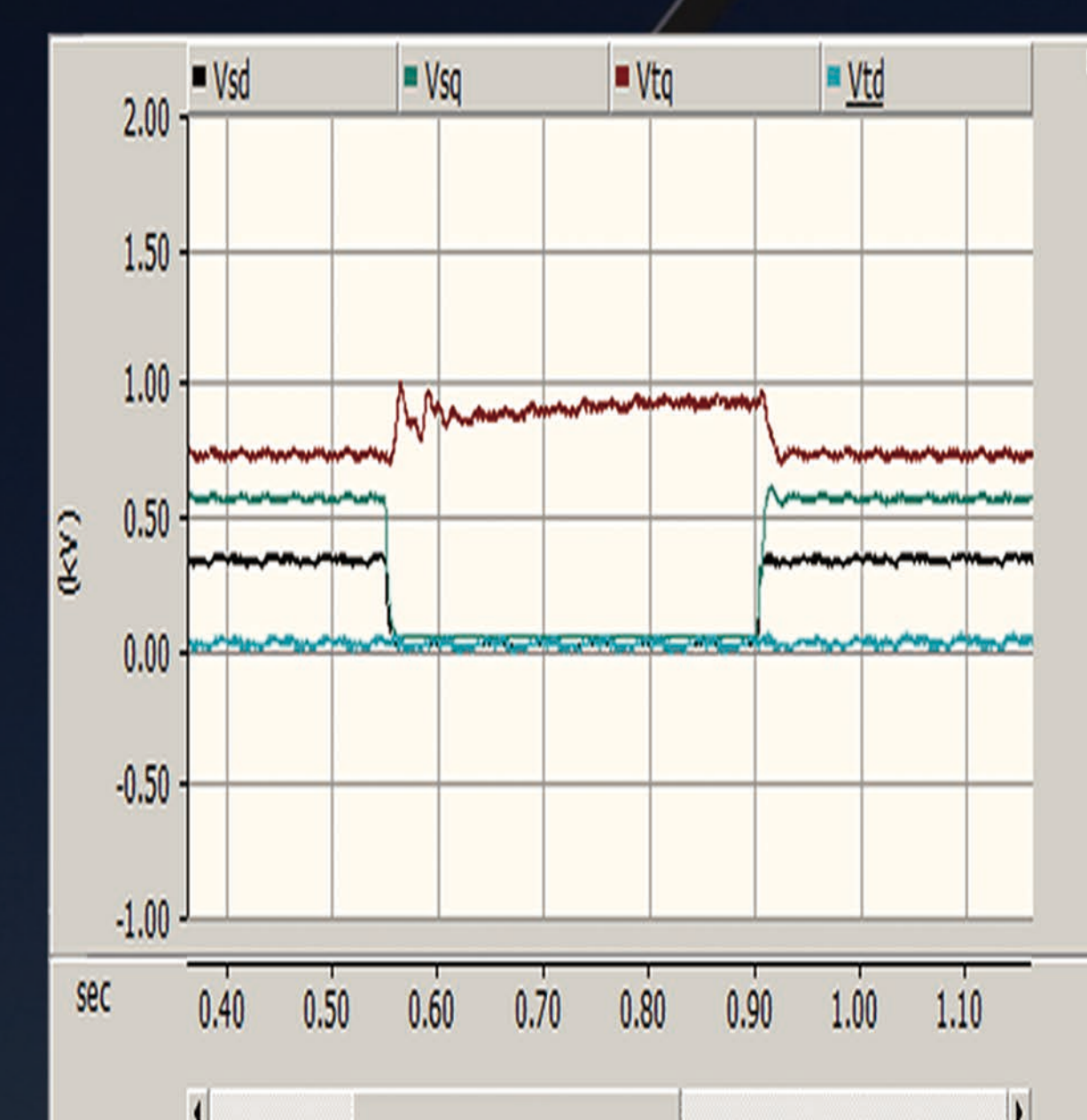


- ◆ DQ0 SYNCHRONOUS REFERENCE FRAME
- ◆ DC VOLTAGE REGULATION
- ◆ DC CURRENT REGULATION
- ◆ CURRENT REGULATION
- ◆ ABC MODULATION SIGNALS

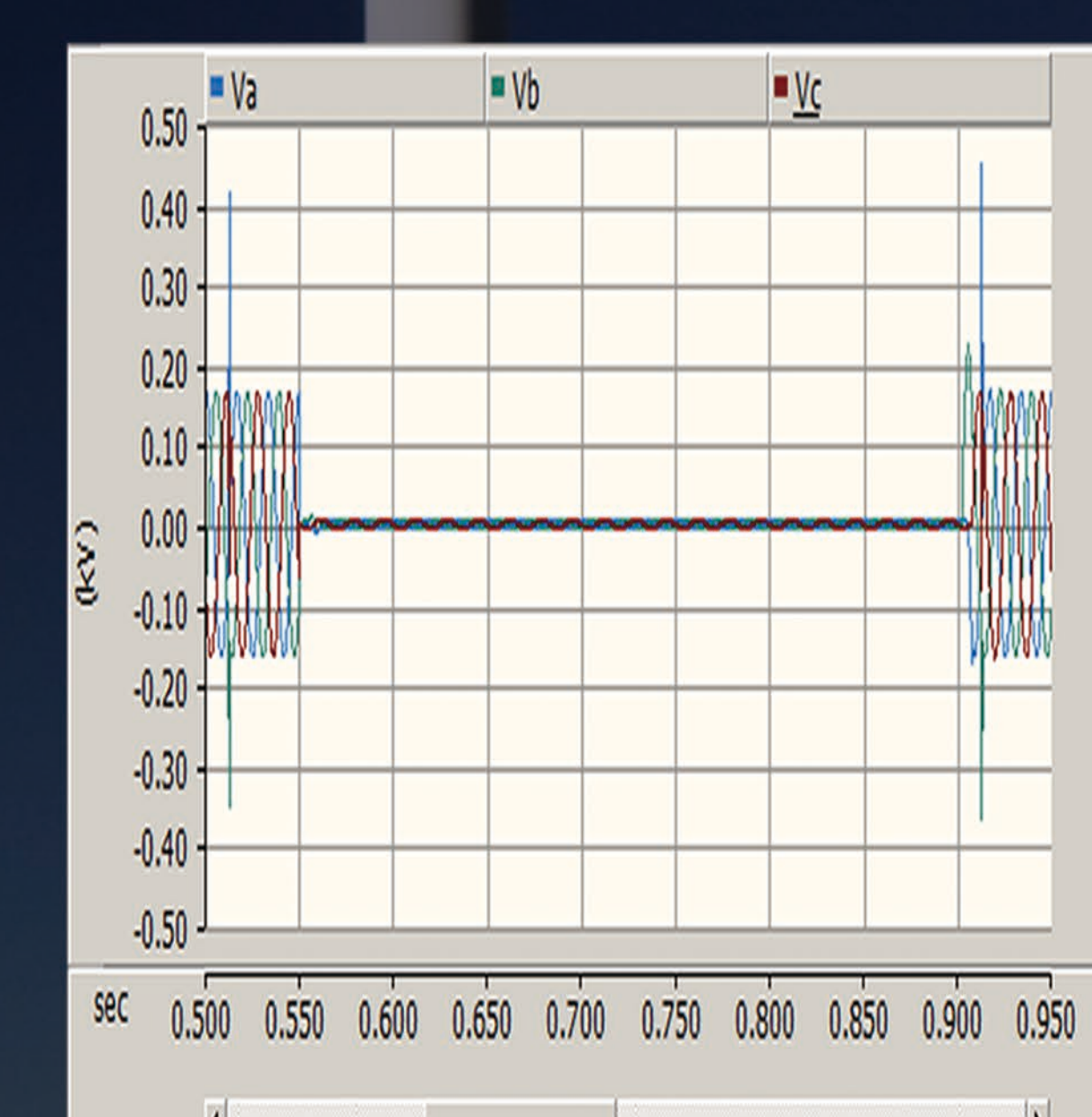
Results



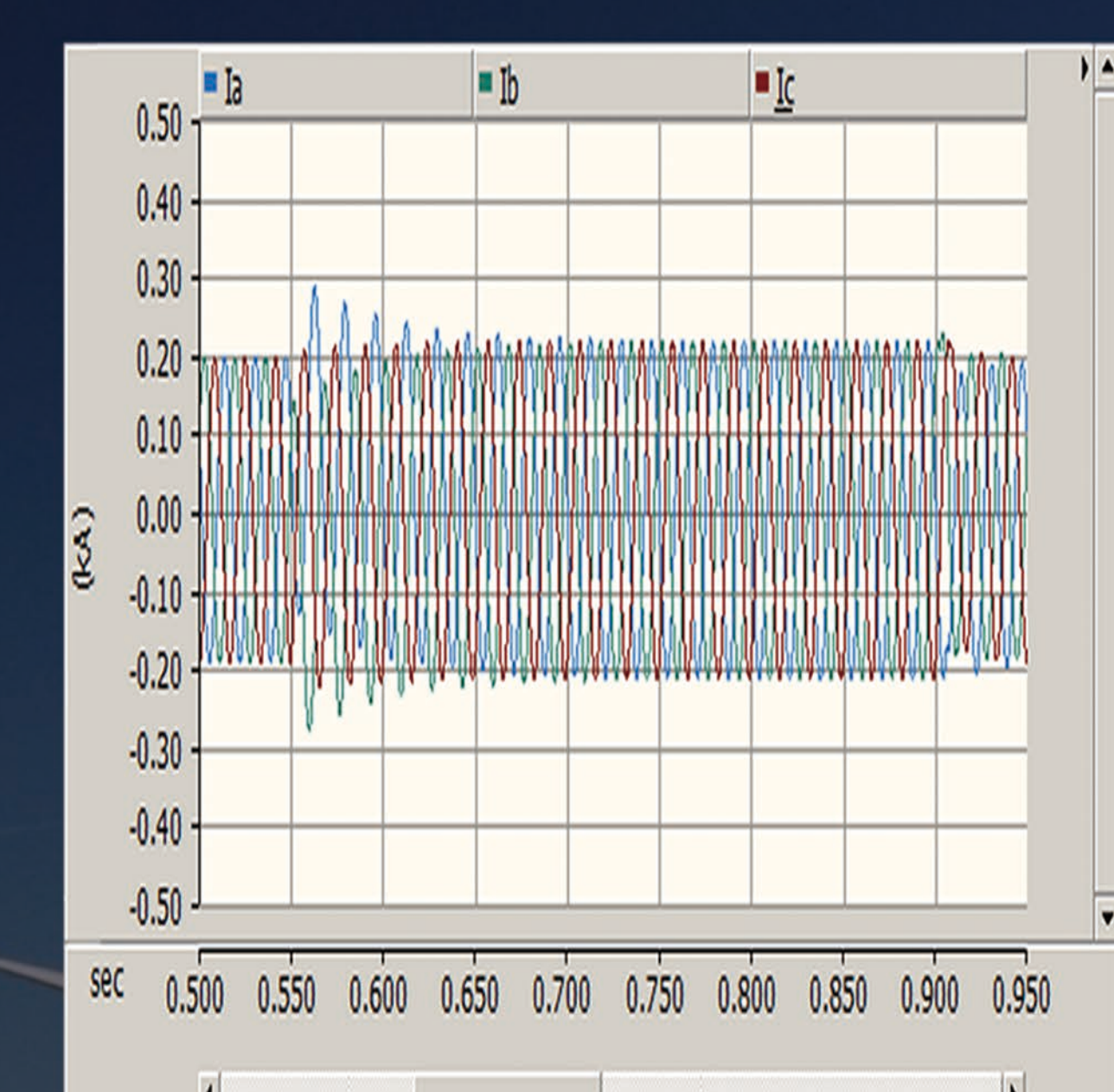
MODULATING SIGNAL



TERMINAL VOLTAGE



SOURCE VOLTAGE



SOURCE CURRENT

Next steps

- ◆ TIME STAMPED PMU MEASUREMENTS BETWEEN LINE TERMINALS.
- ◆ TEST ideas IN RTDS LAB.