

2021

# DAVR-40

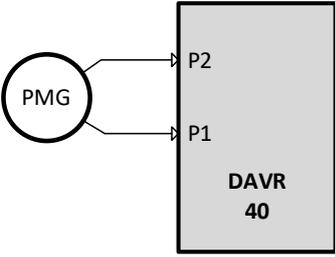
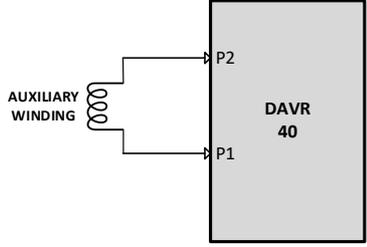
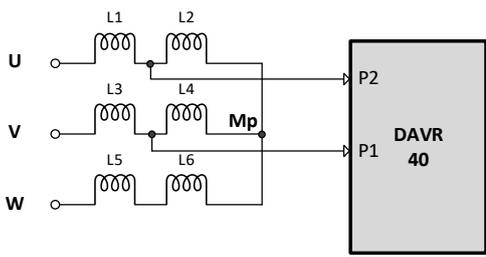
**TECHNICAL SPECIFICATIONS &  
APPLICATION WIRING DIAGRAMS**

ENKO ELECTRONICS | Turkey

## TECHNICAL SPECIFICATIONS

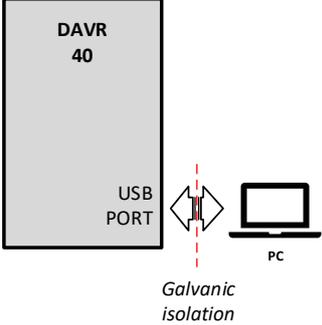
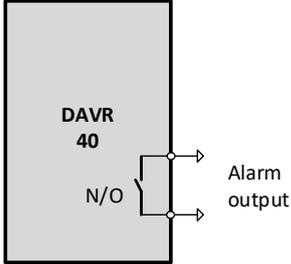
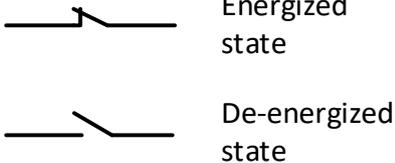
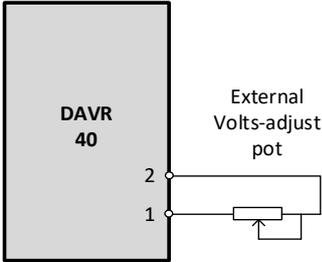
OPERATING MODE:	DESCRIPTION:
OPERATION MODE:	Operation only in AVR mode, which regulates the stator voltage based on the SENSE signal connection configuration.
GENERATOR VOLTAGE SENSING:	DESCRIPTION:
Sense input voltage wiring configuration:	<div style="text-align: center;"> </div> <p style="text-align: center;">2-phase connection, no neutral configuration (2W)            1-phase connection between phase and neutral            Limited maximum sense voltage value: 480V<sub>AC</sub></p>
Sense input voltage configuration with high-voltage input ( $V_{SENSE} > 480V_{AC}$ )	<div style="text-align: center;"> </div> <p style="text-align: center;">Transformer (PT) primary/secondary voltage ratio is S/W configurable</p>

Voltage sensing type:	True-RMS voltage reading, Phase-phase voltage sensing, Average voltage sensing of two-phase input,	Voltage transformer must be used for sense inputs if phase-phase sense voltage exceeds 480Vac rms (max. limit)
Voltage sensing range:	100Vac – 276Vac (Phase-Neutral) 100Vac – 480Vac (2-phase) Software configurable  <i>(Given sense voltage range values are referred to phase windings mid-point connection points)</i>	25Hz to 75Hz operation
Voltage setting range:	<ul style="list-style-type: none"> <li>○ Manual voltage setting of regulation level with on-board trimmer (<math>\pm 15\%</math> of S/W configured voltage setting value)</li> <li>○ Voltage setting via S/W using, PC configuration tool</li> </ul> <p>(Voltage setting of the AVR MUST match the wiring configuration of the alternator in the system)</p>	
<b>GENERATOR CURRENT SENSING:</b>	<b>DESCRIPTION:</b>	
Current sense input connection:	<p style="text-align: center;">U V W N</p> <p style="text-align: center;">CT</p> <p style="text-align: center;">DAVR 40</p> <p style="text-align: center;">S2</p> <p style="text-align: center;">S1</p>	
CT ratio setting:	CT ratio setting via configuration S/W CT configuration: X / 1A	Rated overload level: 200% continuous max. 300% for 120 seconds
Current sense error:	<1% of measured value, over full range	S1-S2 terminal inputs are galvanically isolated
Operation mode:	<ul style="list-style-type: none"> <li>○ Quadrature droop for reactive load sharing (parallel operation)</li> <li>○ Line droop compensation (+V/KVA)</li> <li>○ Stator-load current monitoring</li> <li>○ Motor-start current limit according to set parameter value</li> </ul> <p><i>(If QUADRATURE DROOP function is selected, other functions cannot be selected)</i></p>	
CT load burden:	<1VA (over nominal operation range)	

POWER INPUT TO AVR:	DESCRIPTION:
<p>PMG CONNECTION:</p>	 <p>PMG type: "SINGLE-PHASE" PM type alternator (50Hz/60Hz)            Phase output voltage (L – L): 170Vac – 300Vac</p> <p>Power rating: 3500VA max (for maximum filed power delivery)            Operating frequency: <b>40Hz to 75Hz</b></p>
<p>AVR POWER INPUT WITH AUXILIARY WINDING:</p>	 <p>AUXILIARY power winding voltage: Single phase, 170Vac – 300Vac (maximum allowed voltage limit)</p> <p>Rated power: 3500VA, connected across P1 and P2 terminals            Frequency range: 40Hz to 75Hz</p>
<p>AVR POWER INPUT WITH TWO PHASE SHUNT CONNECTION:</p>	 <p>Two phase SHUNT connection across P1 and P2. (Voltage limit across terminals P1 and P2 is limited to 300Vac max)</p>



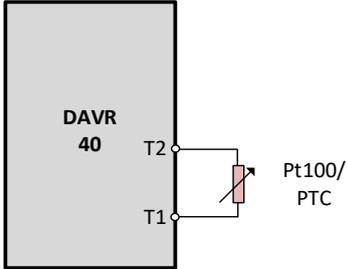
<p>FIELD WINDING IMPEDANCE:</p>	<p>Nominal: 15Ω Minimum: &gt;5Ω (@ room temperature)</p>	<p>Wiring impedance from AVR to FIELD winding should NOT exceed 5% of FIELD winding nominal impedance at room temperature</p>
<p>AVR POWER STAGE CONFIGURATION:</p>		<p>For AUX and SHUNT connection, terminals P1 and P2 must be used.</p> <p>SCR drive with PID control</p> <p>5Adc continuous 7Adc for 120 sec 10Adc for 10 sec</p> <p>(Given at max. operating temperature limit)</p>
<p><b>ANALOGUE INPUTS:</b></p>	<p><b>DESCRIPTION:</b></p>	
<p>DIFFERENTIAL ANALOG VOLTAGE SIGNAL INPUT (±5Vdc / 0-10Vdc):</p>	<p>(Only one analogue signal can be connected at any time)</p>	<p>0 – 10Vdc input</p> <p>±5Vdc input (configuration as -5Vdc/0V/+5Vdc with E2 terminal internally connected to GND)</p> <p>S/W configurable, no on-board trimmer</p> <p>Resolution: 1/1000 (non-isolated input)</p>
<p>DIFFERENTIAL ANALOG CURRENT SIGNAL INPUT (4-20mA):</p>	<p>(Only one analogue signal can be connected at any time)</p>	<p>4 -20mA current input connection (E2 connected to GND internally)</p> <p>Burden load: 100Ω &lt;4mA corresponds to “low level input” 12mA set as mid-point</p> <p>S/W configurable parameters, no on-board trimmer. Resolution: 1/1000 (Non-isolated input)</p>

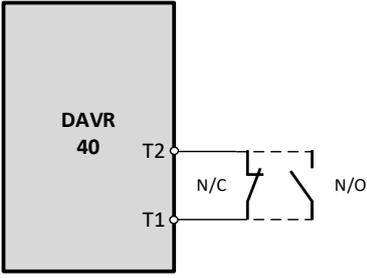
COMMUNICATION PORTS:	DESCRIPTION	
<p>USB COMMUNICATION PORT (ISOLATED):</p>		<p>Device configuration port for PC connection</p> <p>Power supply (internal &amp; external) MODBUS protocol Type-B socket on-board</p> <p>Power and data galvanically isolated</p>
ALARM OUTPUT:	DESCRIPTION	
<p>ALARM OUTPUT:</p>		<p>N/O Alarm contact output.</p> <p><i>(Contacts are closed/energized during normal operation)</i></p>
<p>CONTACT CAPACITY:</p>		<p>SPST Relay contact output 3.0 A<sub>AC</sub> (max) @ 230Vac 1.0 A<sub>DC</sub> (max) @ 24Vdc</p>
<p>ALARM FUNCTIONS LIST:</p>	<ul style="list-style-type: none"> <li>○ Threshold / trigger status</li> <li>○ Time delay</li> <li>○ Enable / Disable</li> <li>○ Latched</li> <li>○ Masked</li> <li>○ Relay activation</li> <li>○ Automatic fault reset</li> </ul>	<p>Each of the defined functions can be allocated to any alarm signal using PC Tool configuration software.</p>
EXTERNAL VOLTS ADJUST:	DESCRIPTION	
<p>EXTERNAL POT CONNECTION:</p>		<p>External voltage adjust pot connected to terminals 1 and 2</p> <p>Adjustment range: ±15% of set voltage parameter (S/W configurable)</p>



OVER-EXCITATION PROTECTION:	DESCRIPTION	
FIELD CURRENT MONITORING:	Current limit set point $0 \leq I_F \leq 10A_{DC}$  Parameters are S/W configurable	Resolution: $\pm 0.1 A_{DC}$
TIME DELAY CONTROL:	Time delay set point $0 \leq T_D \leq 10s$ for $I_F = 10A_{DC}$ $0 \leq T_D \leq 120s$ for $5A_{DC} < I_F < 7A_{DC}$ Parameters are S/W configurable  <i>(current / time thermal effect function calculation with <math>I^2t</math> characteristic)</i>	Resolution: $\pm 0.1$ sec
TRIP:	Alarm output activation (latching / non-latching) LED indicator activation Parameters are S/W configurable	
FIELD OVER-VOLTAGE PROTECTION:	DESCRIPTION	
FIELD VOLTAGE MONITORING:	Maximum field voltage limit setting $0 \leq V_F \leq 250V_{DC}$ Parameters are S/W configurable	Resolution: $\pm 1.0 V_{DC}$
TIME DELAY CONTROL:	Time delay set point $0 \leq T_D \leq 15s$ Parameters are S/W configurable	Resolution: $\pm 0.1$ sec
TRIP:	Alarm output activation (latching / non-latching) LED indicator activation Parameters are S/W configurable	
LOSS-OF-SENSING PROTECTION:	DESCRIPTION	
PHASE-PHASE VOLTAGE MONITORING:	Phase sense voltage detection $-50\% \leq V_{SETPOINT (EFF)} \leq 0\%$ Parameters are S/W configurable	Resolution: $\pm 1.0 V_{AC RMS}$ (% reduction of phase voltage, referenced to effective setpoint)
TIME DELAY CONTROL:	Time delay setting $0 \leq T_D \leq 25s$ Parameters are S/W configurable	Resolution: $\pm 1.0$ sec
TRIP:	Alarm relay activation (latching / non-latching) LED indicator activation Parameters are S/W configurable	

GENERATOR OVER-VOLTAGE PROTECTION:		DESCRIPTION
OVER-VOLTAGE MONITORING:	Alternator phase-phase STATOR voltage monitoring, Over-voltage set point: 100% to 150%	Resolution: $\pm 1.0\%$ (% of effective stator voltage setpoint)
OVER-VOLTAGE TIME DELAY CONTROL:	Time delay set point $0 \leq T_D \leq 20s$	Resolution: $\pm 1.0$ sec
TRIP:	Alarm relay activation (latching / non-latching) LED indicator activation Parameters are S/W configurable	
GENERATOR UNDER-VOLTAGE PROTECTION:		DESCRIPTION
UNDER-VOLTAGE MONITORING:	Alternator phase-phase STATOR voltage monitoring, Undervoltage set point: 50% to 100%	Resolution: $\pm 1.0\%$ (% of effective stator voltage setpoint)
TIME DELAY CONTROL:	Time delay set point $0 \leq T_D \leq 20s$	Resolution: $\pm 1.0$ sec
TRIP:	Alarm relay activation (latching / non-latching) LED indicator activation Parameters are S/W configurable	
STATOR CURRENT MONITORING:		DESCRIPTION
STATOR CURRENT MONITORING:	Alternator STATOR current monitoring, $100\% \leq I_{CL} \leq 300\%$ CT ratio S/W configurable	Resolution: $\pm 1.0\%$ of actual stator current value
TIME DELAY CONTROL:	Time delay set point $0 \leq T_D \leq 120s$ Parameters are S/W configurable (Function is based on alternator $I^2t$ thermal effect characteristic calculation)	Resolution: $\pm 1.0$ sec
CONDITIONS:	STATOR current limit protection can only be active, if generator is not in parallel operation (reactive droop control active)	
TRIP:	Alarm relay activation (latching / non-latching) LED indicator activation Parameters are S/W configurable	

START MOTOR FUNCTION & FAULT PROTECTION:	DESCRIPTION	
MOTOR CURRENT MONITORING:	Alternator STATOR current monitoring, 100% ≤ I <sub>CL</sub> ≤ 200% CT ratio S/W configurable	Resolution: ±1.0% of actual stator current value
TIME DELAY CONTROL:	Time delay set point 0 ≤ T <sub>D</sub> ≤ 60s Parameters are S/W configurable	Resolution: ±1.0 sec
CONDITIONS:	Motor start fault protection can only be active if “reactive droop compensation” is not selected.  During “Motor Start” function (if selected and activated), conflicting protection functions will be disabled automatically.	
TRIP:	Alarm relay activation (latching / non-latching) LED indicator activation  Trip function parameters are S/W configurable	
AUXILIARY INPUTS:	DESCRIPTION	
AMBIENT TEMPERATURE SENSING:	<b>On-board sensor</b> for microcontroller ambient temperature sensing (temperature on the PCB) +10°C to +100°C	Resolution: ±1.0°C
EXTERNAL TEMPERATURE SENSING & PROTECTION:	 <p>Monitoring of external temperature point +40°C ≤ T<sub>EXT</sub> ≤ +300°C 1 independent PTC or Pt100 sensor input, T1 – T2 input terminals  (Parameters S/W configurable)</p>	Resolution: ±1.0°C  (non-isolated input)

<p>EXTERNAL DIGITAL SIGNAL INPUT CONFIGURATION:</p>	 <p>N/O or N/C external DRY-CONTACT input for DIGITAL signal input detection (Parameter is S/W configurable)</p>	<p>T1/T2 temperature input can be configured as DIGITAL signal INPUT  (non-isolated input)</p>
<p>TIME DELAY CONTROL:</p>	<p>Time delay control setting, <math>0 \leq T_D \leq 30 \text{ sec}</math></p>	<p>Resolution: <math>\pm 1.0 \text{ sec}</math></p>
<p>TRIP:</p>	<p>Alarm relay activation (latching / non-latching) LED indicator activation Parameters are S/W configurable</p>	
<p><b>VOLTAGE REGULATION:</b></p>		<p><b>DESCRIPTION</b></p>
<p>VOLTAGE REGULATION:</p>	<p>2-phase RMS voltage regulation Phase-Neutral voltage regulation</p>	
<p>REGULATION CONDITIONS:</p>	<p>Prime mover speed change: &lt;4% Cosφ: &gt;0.8 THD (3-phase average): &lt;5%</p>	<p>Regulation: &lt; <math>\pm 0.25\%</math></p>
<p>TEMPERATURE DRIFT:</p>	<p><math>\Delta T &lt; 40^\circ\text{C}</math> Unchanged load conditions</p>	
<p>SOURCES OF REGULATION SETPOINT:</p>	<ul style="list-style-type: none"> <li>• S/W voltage regulation set-point</li> <li>• On-board trimmer voltage setting</li> <li>• External pot voltage setting</li> <li>• AUX input-controlled voltage setting (control from an external device)</li> </ul>	<p>All regulation source selections are S/W configurable during AVR set-up</p>
<p><b>SOFT-START SEQUENCE CONTROL:</b></p>		<p><b>DESCRIPTION</b></p>
<p>START TIME DELAY:</p>	<p><math>0 \leq T_{\text{DELAY}} \leq 7200 \text{ sec.}</math> Parameters S/W configurable</p>	<p>Time based start-delay in seconds Resolution: <math>\pm 1.0 \text{ sec}</math></p>
<p>START FREQUENCY CONTROL:</p>	<p><math>25\text{Hz} \leq F_{\text{START}} \leq 75\text{Hz}</math> Parameters S/W configurable</p>	<p>Frequency based start-delay in Hz. Resolution: <math>\pm 0.5\text{Hz}</math></p>

SOFT-START RAMP CONTROL:	$1 \leq T_{\text{SOFTSTART}} \leq 7200$ sec. Parameters S/W configurable	Soft-start ramp time in seconds
EXTERNAL START CONTROL:	Start function control with "External Start" input Parameters S/W configurable	Start signal from external input
DIGITAL START FUNCTION:	AVR function start from USB COM Bus	Start from PC Software Tool
<b>STABILITY (PID) CONTROL:</b>	<b>DESCRIPTION</b>	
PID PARAMETERS CONTROL:	$K_P / K_I / K_D$ PID parameters gain control S/W configurable parameters	Automatic setting of PID parameter gain constants
TRIMMER CONTROL:	Manual setting of $K_P / K_I$ constant	On-board trimmer controlled
<b>FREQUENCY RESPONSE:</b>	<b>DESCRIPTION</b>	
UFRO KNEE POINT CONTROL:	$40\text{Hz} \leq F_{\text{UFRO}} \leq 65\text{Hz}$ STATOR voltage roll-off point control Parameters S/W configurable	Resolution: 0.1 Hz increments
LAM FUNCTION SLOPE CONTROL:	$0\text{V/Hz} \leq V_{\text{COEFF.}} \leq 15\text{V/Hz}$ Coefficient of rate of volts control per Hz speed change Parameters S/W configurable	Resolution: 0.1 V/Hz increments
LAM FUNCTION DELAY TIME CONTROL:	$0\text{V/sec} \leq T_{\text{COEFF.}} \leq 100\text{V/sec}$ Coefficient of rate of volts control per time-second change Parameters S/W configurable	Resolution: 0.1V/sec increments
<b>QUADRATURE DROOP / LINE DROOP CONTROL:</b>	<b>DESCRIPTION</b>	
REACTIVE DROOP COMPENSATION:	Manual DROOP control with on-board trimmer $-5\% \leq \text{DROOP} \leq +5\%$ (Percent of the "droop" value set by S/W)	Set for parallel operation with automatic reactive load sharing
	Automatic DROOP control with S/W Initial set value: 5% (droop at full load) Droop control: >3% (stability limit) DROOP slope: -20% to +20% (S/W configurable)	

PHASE COMPENSATION:	Control of PHASE OFFSET ANGLE, -60° ≤ ρ ≤ +60° S/W configurable with automatic compensation	
LINE DROOP COMPENSATION:	Voltage line DROOP compensation -10% ≤ L <sub>DROOP</sub> ≤ +10%  Compensation of line drop per KVA output	Compensation of the load line drop per KVA power output of the generator
CONDITION:	If LINE DROOP is selected, REACTIVE Droop compensation cannot be active. (Look at conditions of CT function selection list)	
<b>DATA LOGGING:</b>	<b>DESCRIPTION</b>	
ALARM LOG:	Last 50 alarms logged in memory, (Time stamp based on alternator operating hours)	FIFO register configuration (Logged data to be viewed via USB com port)
EVENT LOG:	Last 10 events logged with time stamping (Referenced to alternator operating hours)	
<b>ENVIRONMENTAL LIMITS:</b>	<b>DESCRIPTION</b>	
TEMPERATURE:	Operating temperature range:	-40°C to +70°C
	Storage temperature range:	-40°C to +85°C
HUMIDITY:	Operating humidity range Non-condensing:	30%RH to 95%RH
	Storage humidity range Non-condensing:	0%RH to 99%RH
VIBRATIO / SHOCK:	x, y, z axis	20g
	20Hz to 100Hz	1.2g
	53Hz to 500Hz	5g
<b>MECHANICAL CONSTRUCTION:</b>	<b>DESCRIPTION</b>	
ASSEMBLY:	Laid in PU encapsulation (UL compliant) Housed into a plastic tray (PA66GF20)	Solid assembly suitable for rigid mounting
HEATSINK:	Custom made aluminium heatsink (Horizontal or vertical mounting only)	No live parts exposed
TERMINALS:	Power terminals:	Fast-on terminals
	Signal terminals:	Spring mount terminals

IP PROTECTION:	Terminals	IP00
	Electronic assembly:	IP68
	Com ports:	IP00
MOUNTING:	Horizontal mounting Vertical mounting (no other mounting positions allowed)	Rigid mounting Mounting on AVMs
INDICATORS:	RGB LED (single LED configuration)	Integrated in AVR body
DIMENSIONS:	140mm(W) x 105mm(D) x 55mm(H)	Most outer dimensions
WEIGHT:	190gr	
<b>COMPLIANCE:</b>	<b>DESCRIPTION</b>	
EMISSIONS:	EN55011, Level B	
ELECTROSTATIC DISCHARGE:	IEC1000-4-2 / EN61000-4-2, Level B	
RADIATED IMMUNITY:	IEC1000-4-3 / EN61000-4-3, Level A	
ELECTRICAL FAST TRANSIENT:	IEC1000-4-4 / EN61000-4-4, Level B	
RADIO FREQUENCY (CONDUCTED):	IEC1000-4-6 / EN61000-4-6, Level A	
POWER FREQUENCY (MAGNETIC):	IEC1000-4-8 / EN61000-4-8, Level A	
DIELECTRIC STRENGTH:	IEC255	
SURGE IMMUNITY:	IEC1000-4-5 / EN61000-4-5, Level B	
VOLTAGE DIP, FLUCTUATION IMMUNITY:	IEC1000-4-11 / EN61000-4-11, Level C	
SAFETY, EMC:	UL508	
FLAMMABILITY:	UL94	
EARTHQUAKE:	EN60255-21-3	
SHOCK:	EN60255-21-2	
VIBRATION:	EN60068-6-2	

MECHANICAL DRAWINGS:

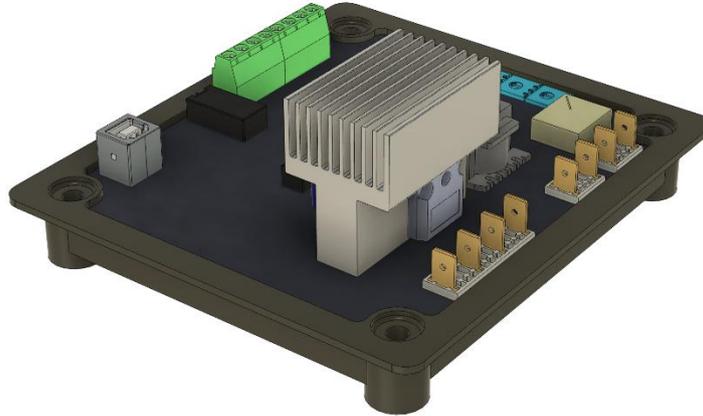


FIGURE 1: DAVR40 TRAY CONSTRUCTION

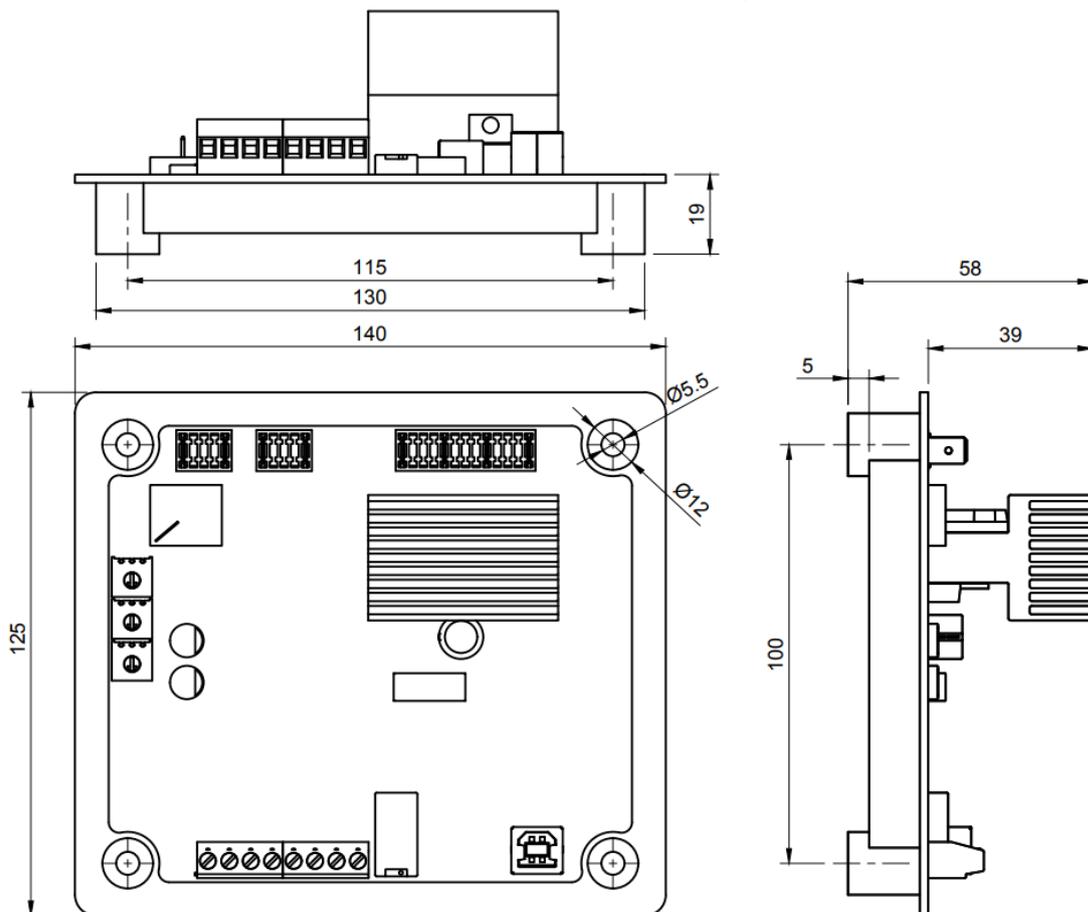


FIGURE 2: DAVR40 DIMENSIONS (MM)

# APPLICATION WIRING DIAGRAMS

## SYNCHRONOUS ALTERNATOR WITH PMG

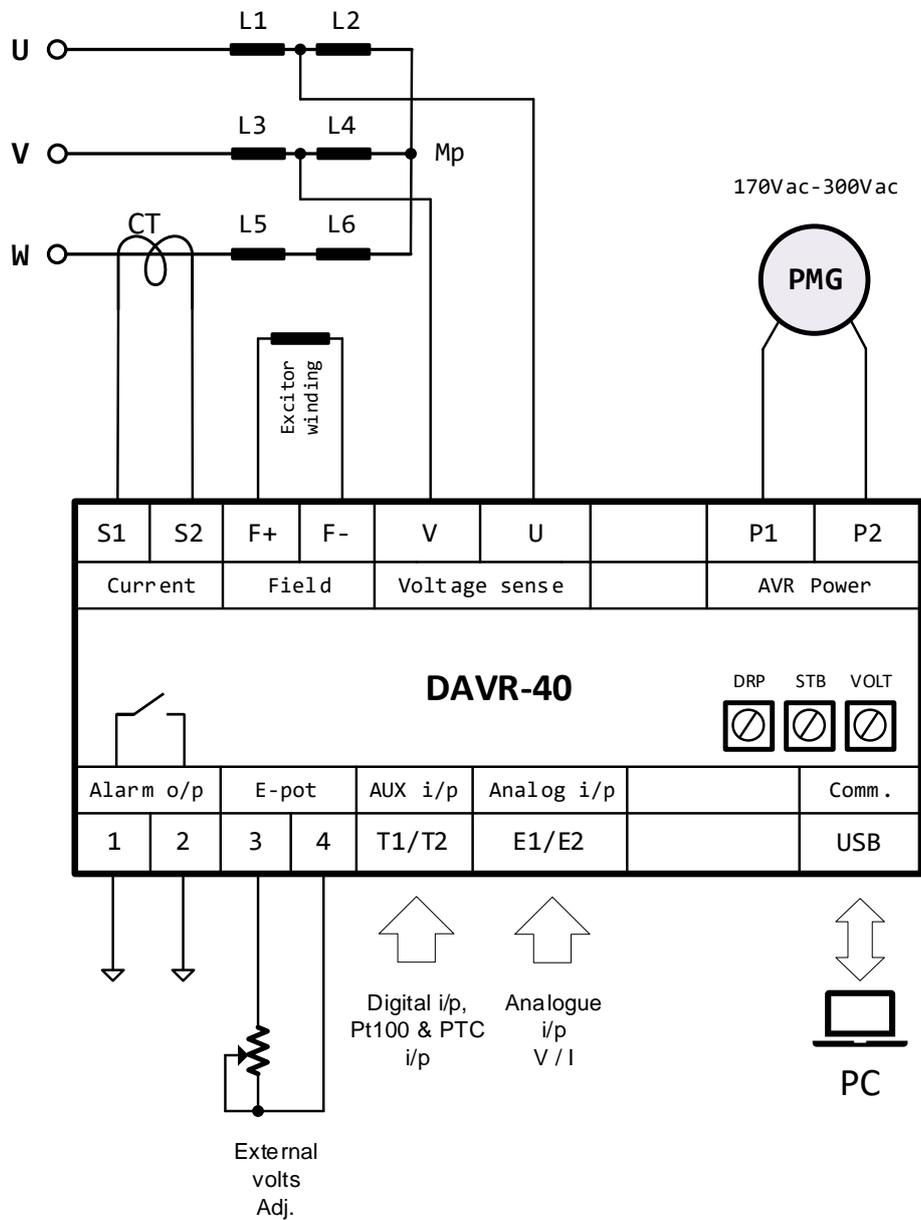


FIGURE 3: DAVR-40 WIRING WITH PMG

SYNCHRONOUS ALTERNATOR WITH AUX.  
WINDING

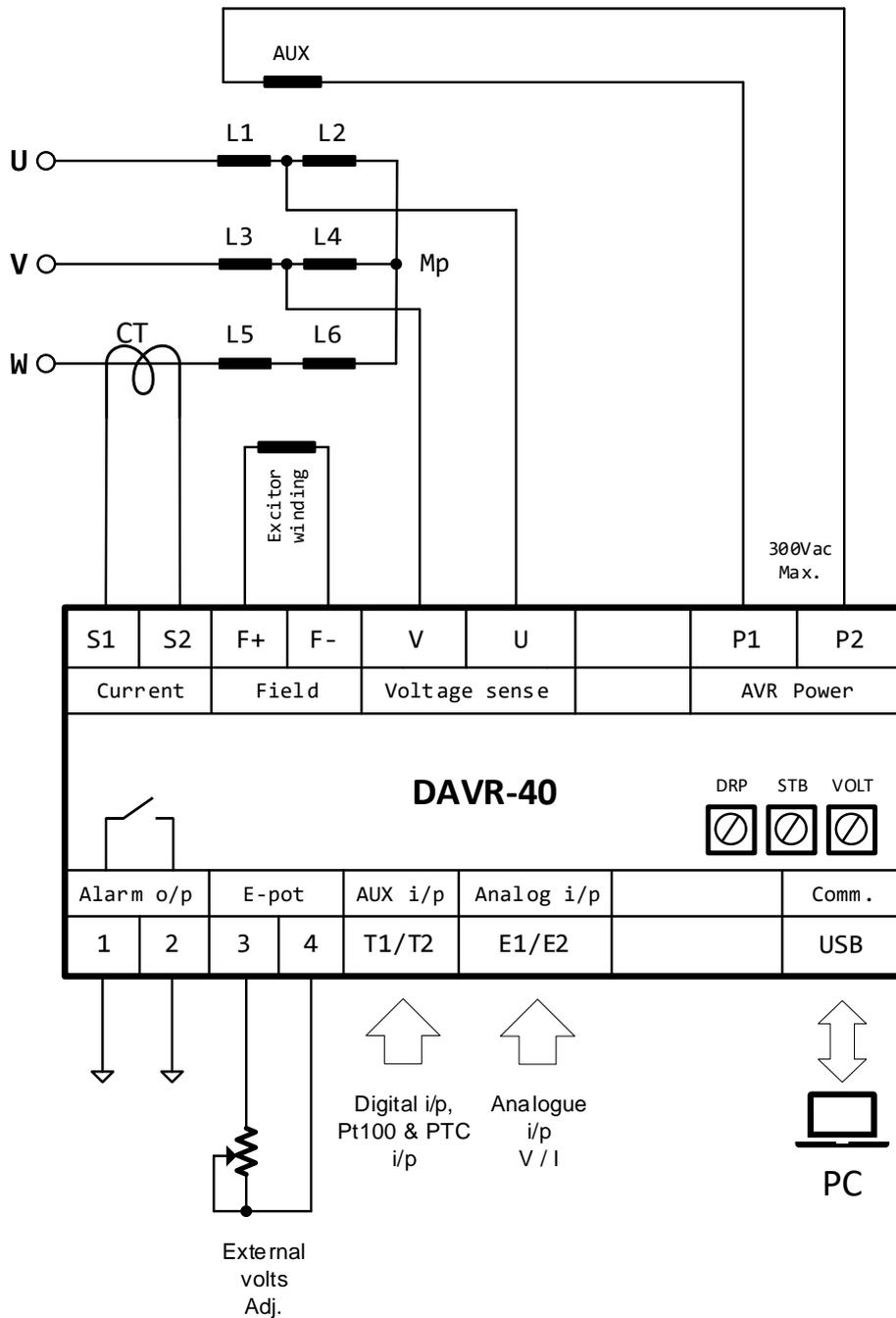


FIGURE 4: DAVR-40 WIRING WITH AUXILIARY WINDING

SYNCHRONOUS ALTERNATOR WITH SHUNT CONNECTION

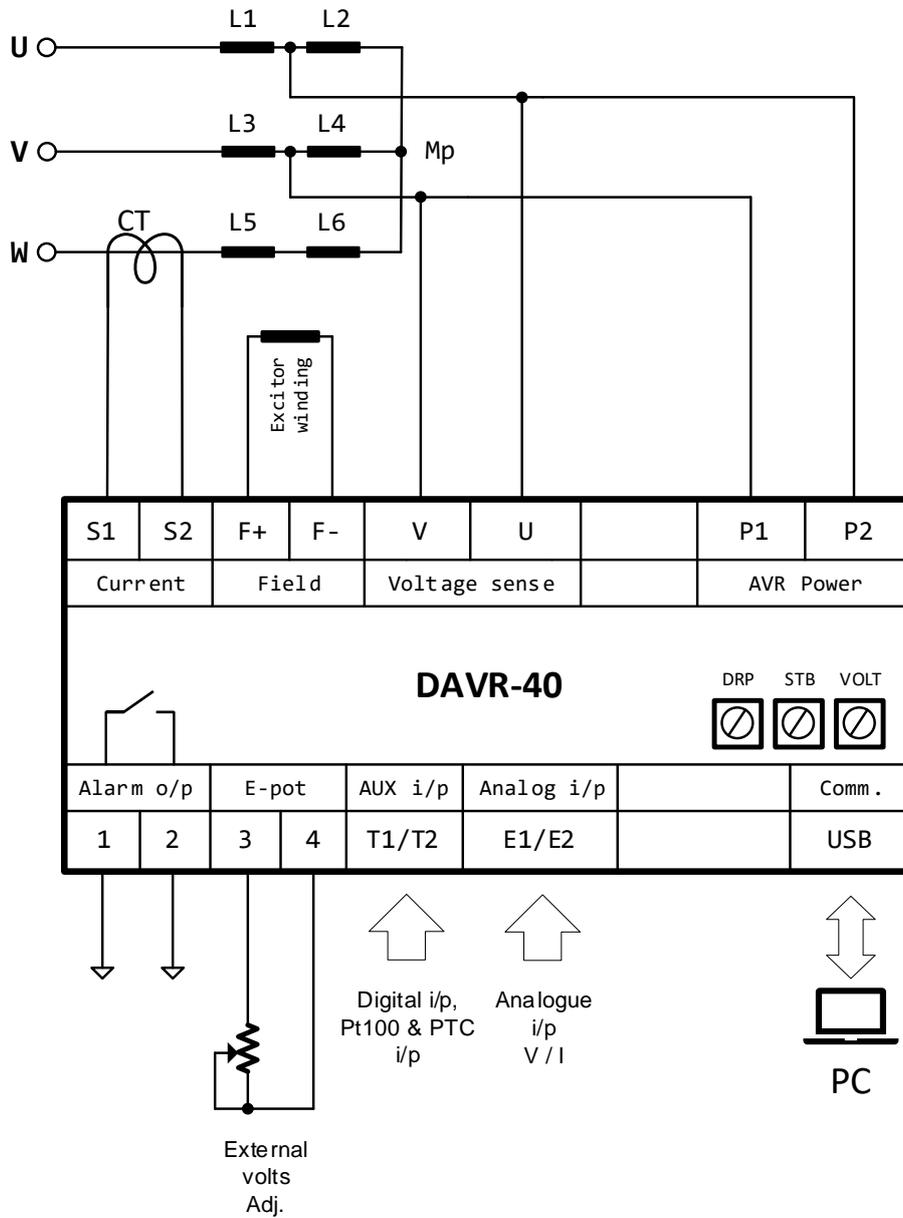


FIGURE 5: DAVR-40 WIRING FOR SHUNT CONNECTION

SYNCHRONOUS ALTERNATOR WITH PHASE-NEUTRAL CONNECTION

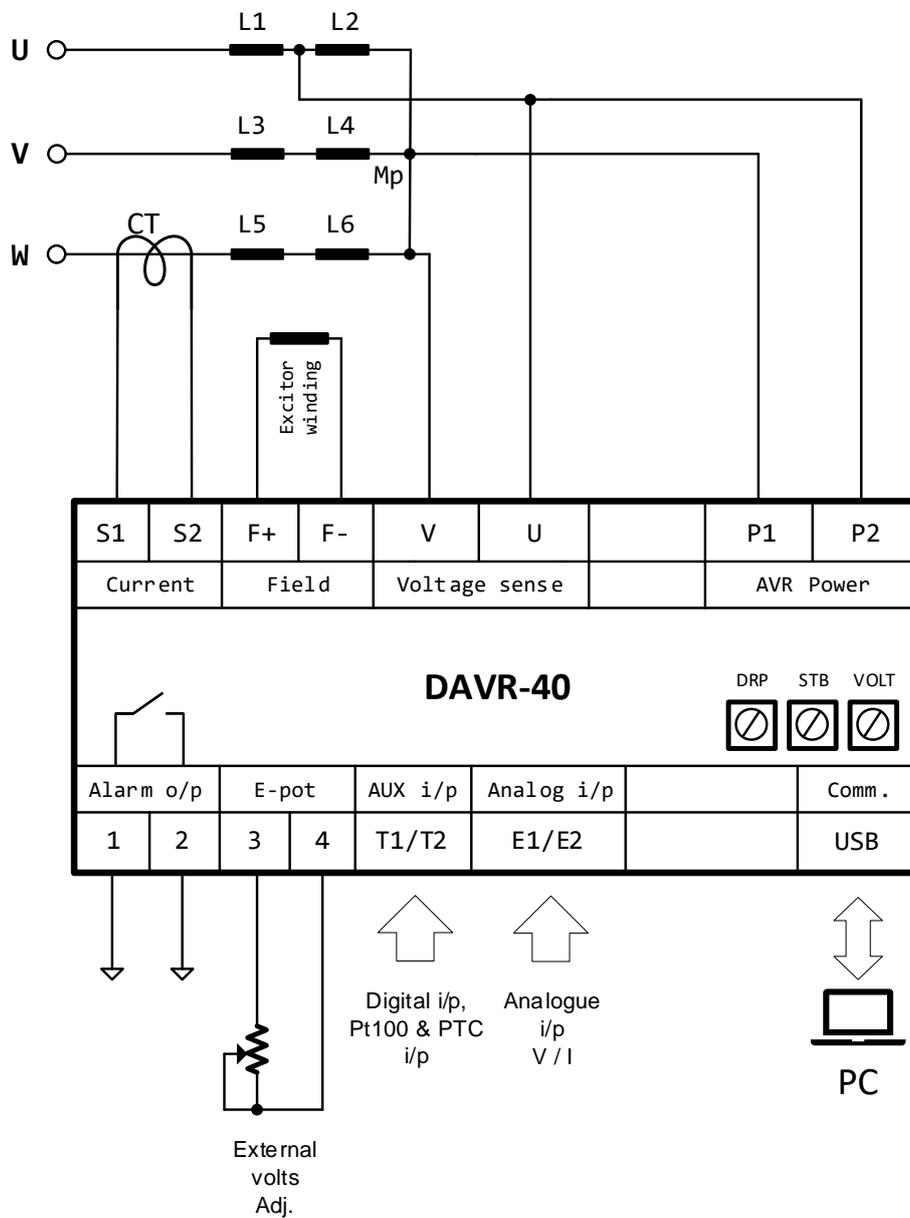


FIGURE 6: DAVR40 WITH PHASE-NEUTRAL SHUNT CONNECTION

SYNCHRONOUS ALTERNATOR SHUNT  
WIRING WITH HIGH POTENTIAL

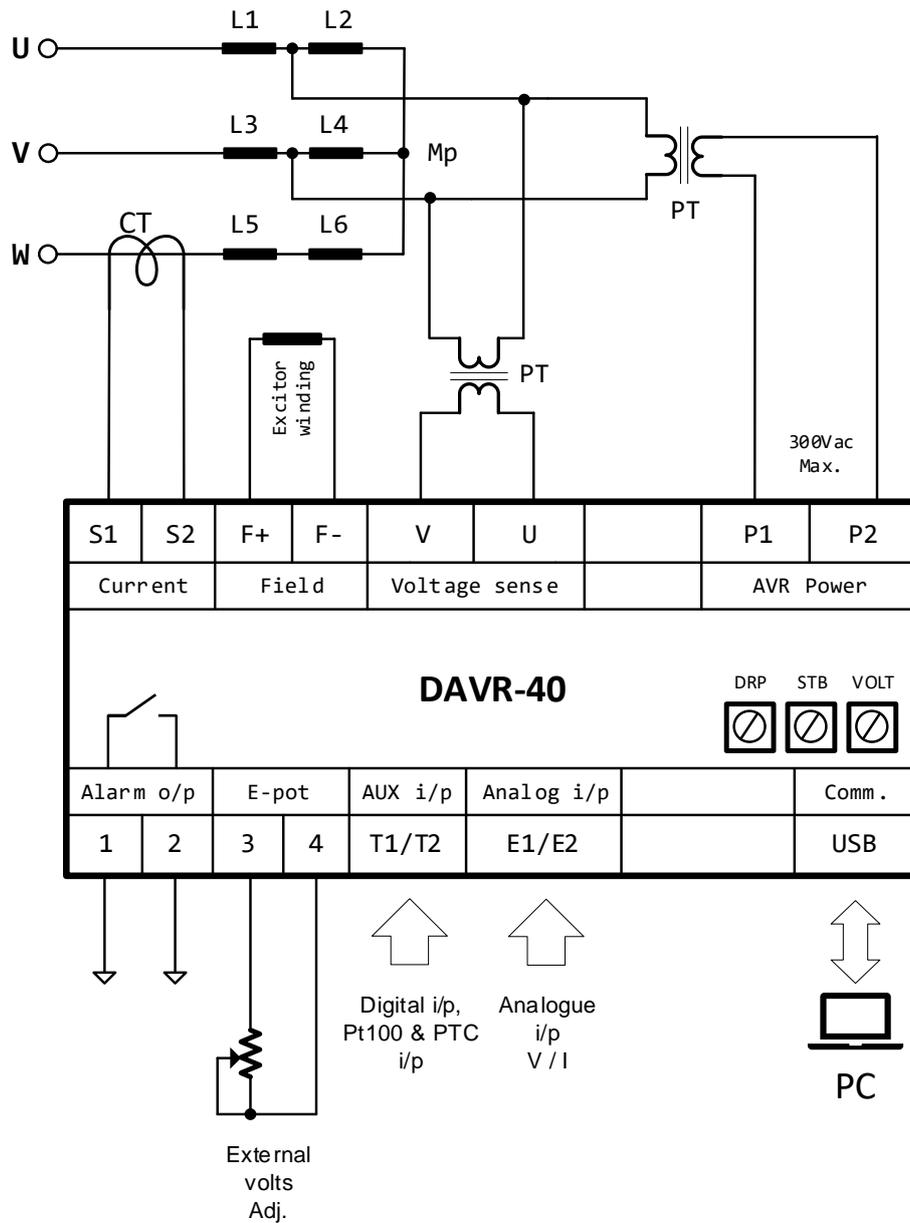
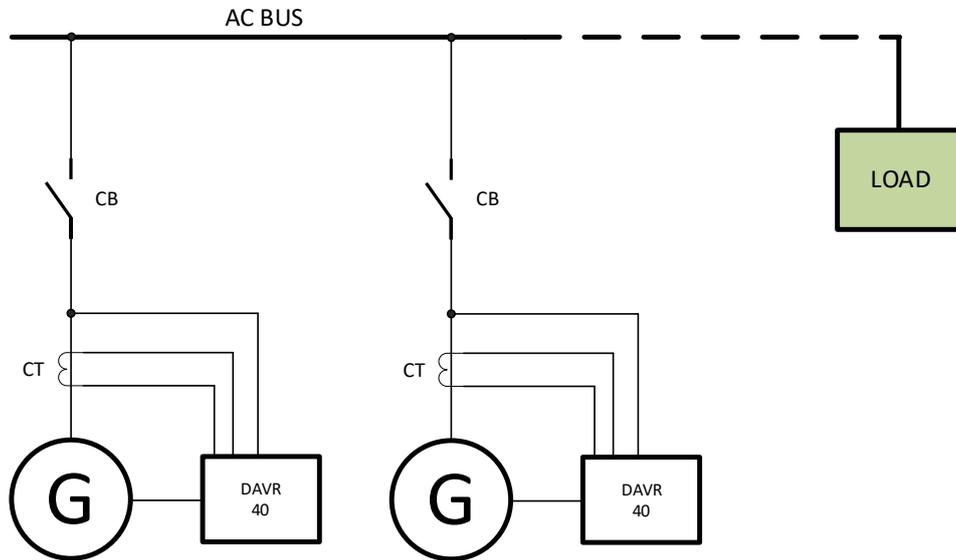


FIGURE 7: DAVR-40 SHUNT WIRING WITH HIGH POTENTIAL INPUT

**PARALLEL CONNECTION OF GENERATORS WITH DAVR-40**



**FIGURE 8: DAVR40 CONNECTION FOR PARALLEL GENERATOR OPERATION**

**DAVR-40 CONNECTION WITH SYNCHRONISATION  
AMF CONTROLLER**

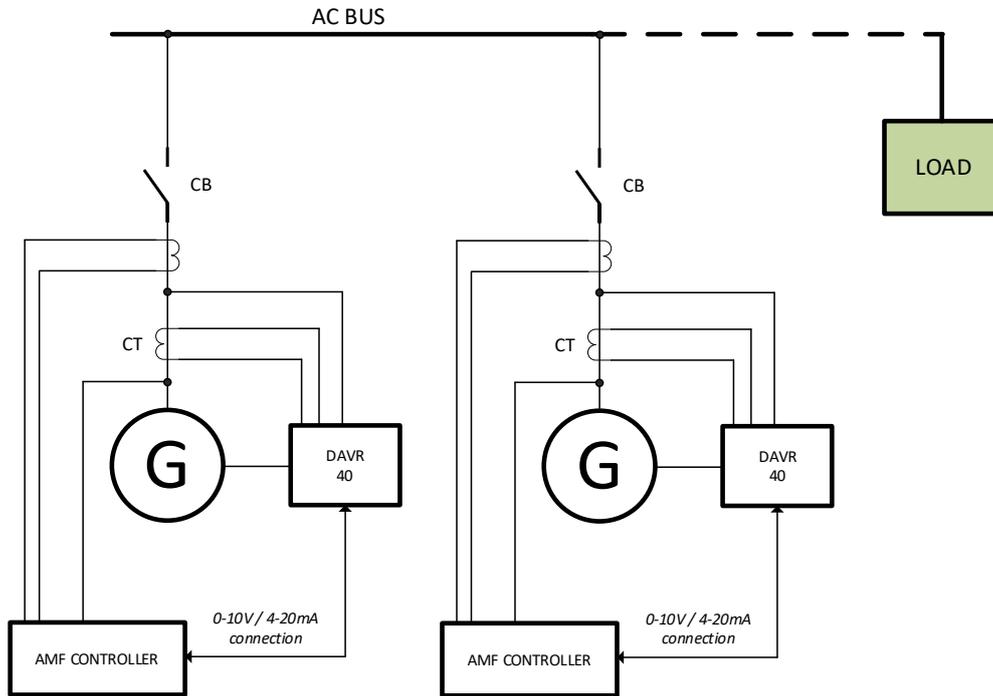


FIGURE 9: DAVR40 CONNECTION WITH AMF CONTROLLER

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