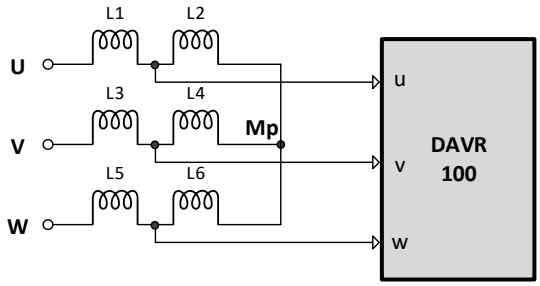
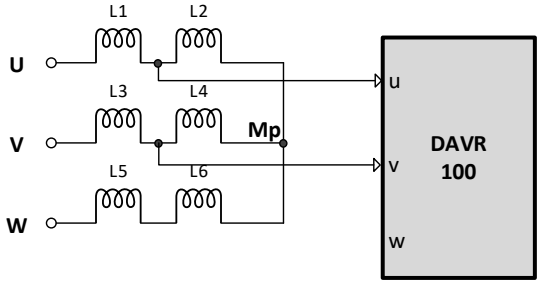
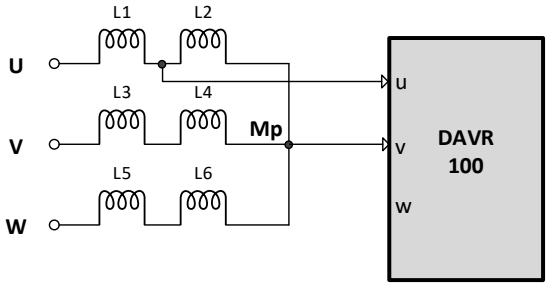
Digital Voltage Regulators

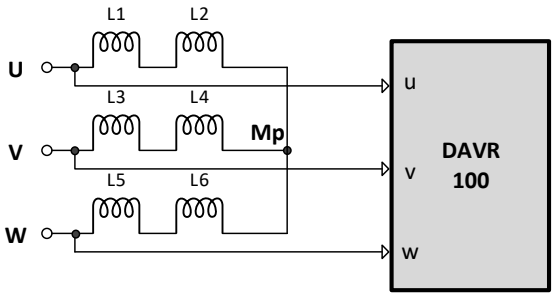
DAVR-100

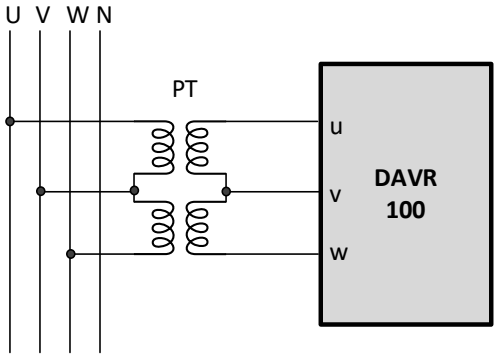
TECHNICAL SPECIFICATIONS &
APPLICATION WIRING DIAGRAMS (R6)

ENKO ELECTRONICS | Turkiye

TECHNICAL SPECIFICATIONS

OPERATING MODE:	DESCRIPTION:
AVR / FCR OPERATION MODES	DAVR100 can be set to operate as VOLTAGE REGULATOR or FIELD CURRENT REGULATOR depending on the set parameters.
GENERATOR VOLTAGE SENSING:	**DESCRIPTION:**
SENSE input voltage wiring configuration with 12-lead winding:	   2-phase or 3-phase connection, no neutral configuration (2W, 3W) 1-phase connection between phase and neutral Limited maximum sense voltage value: $480V_{AC}$

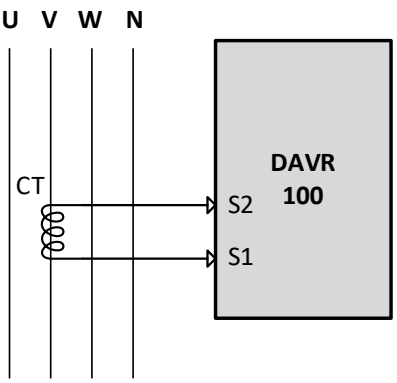
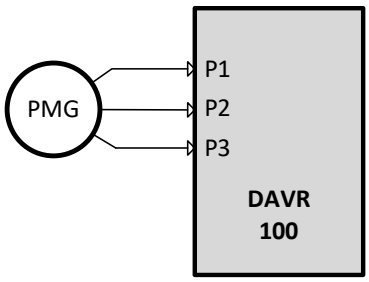
<table>
<tr><td>SENSE input voltage wiring with 6-lead winding:</td><td colspan="2"> 

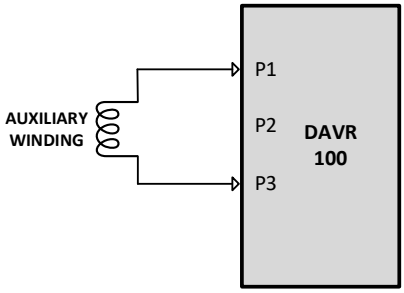
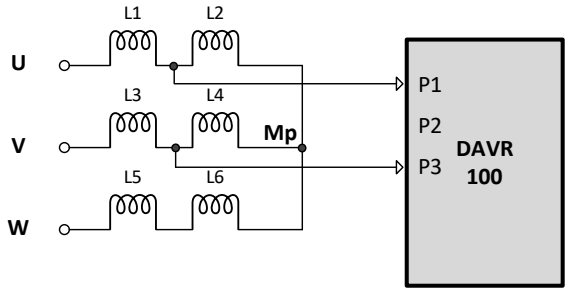
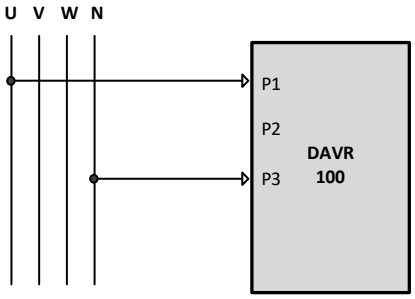
NOTE: U, V and W phase voltage selection should NOT exceed 480Vac nominal operating range.</td></tr>
<tr><td>Sense input voltage configuration with high-voltage input (V_{SENSE} > $480V_{AC}$</td><td colspan="2"> 

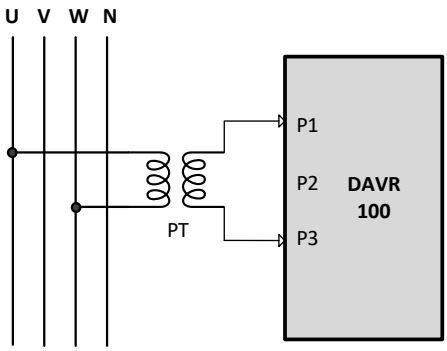
Transformer (PT) primary/secondary voltage ratio is S/W configurable</td></tr>
<tr><td>Voltage sensing type:</td><td>True-RMS voltage reading,
Phase-phase voltage sensing,
Average voltage sensing of three-phase input,</td><td>Voltage transformer must be used for sense inputs if phase-phase sense voltage exceeds 480Vac rms (max. limit)</td></tr>
<tr><td>Voltage sensing range:</td><td>100Vac – 276Vac (1-phase)
100Vac – 480Vac (2-phase and 3-phase)
Software configurable

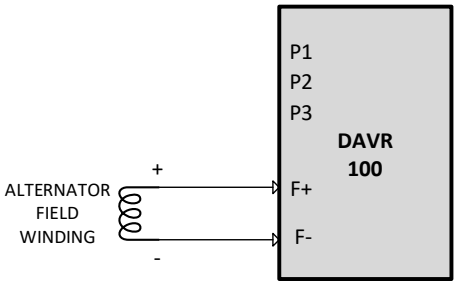
(Given sense voltage range values are referred to phase mid-point connection points)</td><td>25Hz to 75Hz operation</td></tr>
<tr><td>Voltage setting range:</td><td colspan="2">o Manual voltage setting of regulation level with on-board trimmer (±15% of S/W configured voltage setting value)
o Voltage setting via S/W using, PC configuration tool

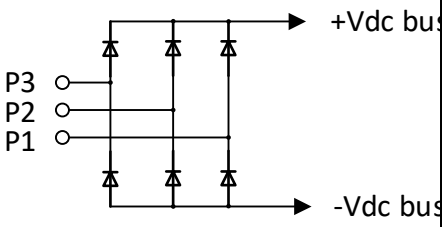
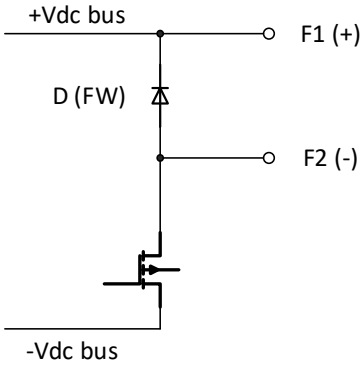
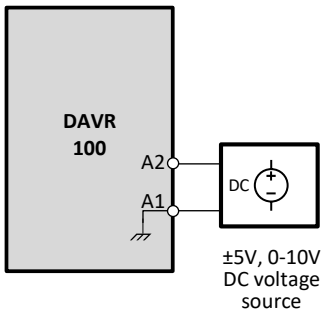
(Voltage setting of the AVR MUST match the wiring configuration of the alternator in the system)</td></tr>
</table>

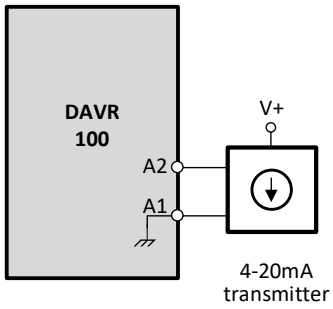
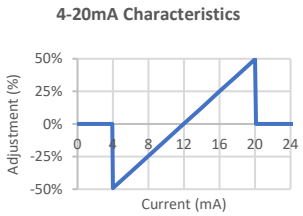
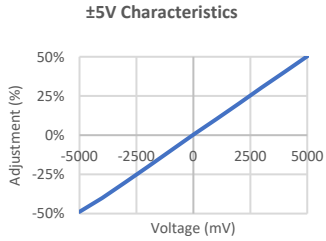
GENERATOR CURRENT SENSING:	DESCRIPTION:	
Current sense input connection:	 Current sense transformer connection on “V” phase line Current transformer conversion ratio is X/1A or X/5A (CT connection must be made according to IEC61000-6-4)	
CT ratio setting:	CT ratio setting via configuration S/W CT configuration: X / 1A or X/5A	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:	○ Quadrature droop for reactive load sharing (parallel operation), ○ Line droop compensation (+V/KVA), ○ Stator-load current monitoring, ○ Motor-start current limit according to set parameter value, *(If QUADRATURE DROOP function is selected, other functions cannot be selected)*	
CT load burden:	<1VA (over nominal operation range)	
POWER INPUT TO AVR:	**DESCRIPTION:**	
PMG CONNECTION:	 PMG type: 3-phase PM alternator Phase output voltage (L – L): 220Vac (170Vac – 300Vac) Power rating: Limited with maximum excitation output power, Operating frequency: 40Hz to 500Hz	

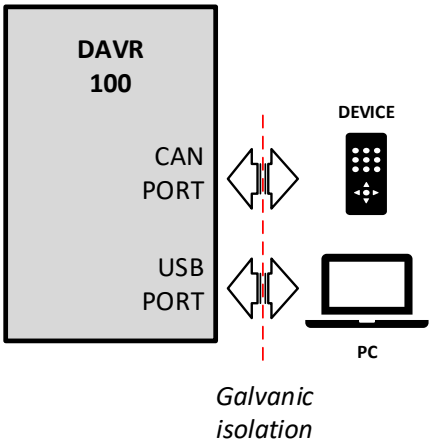
AVR POWER INPUT WITH AUXILIARY WINDING:	 AUXILIARY power winding voltage: Single phase,170Vac – 300Vac (maximum allowed voltage limit) Rated power is limited with the maximum specified excitation power, Frequency range: 40Hz to 75Hz
AVR POWER INPUT WITH TWO PHASE SHUNT CONNECTION:	 Two phase SHUNT connection across P1 and P3. (Voltage limit across terminals P1 and P3 is limited to 300Vac max)
AVR POWER INPUT WITH PHASE-NEUTRAL SHUNT CONNECTION	 SHUNT connection between phase and Neutral line. (300Vac maximum allowed voltage limit across terminals P1 and P3)

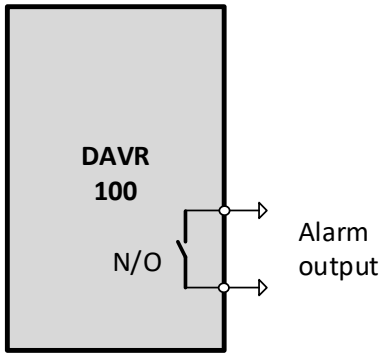
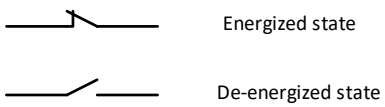
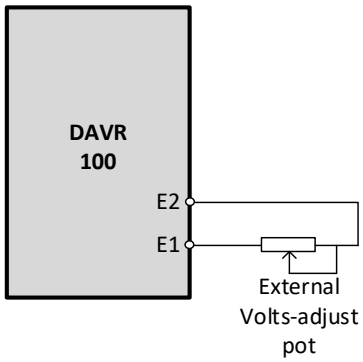
AVR POWER INPUT FROM HIGH POTENTIAL:	 PT must be used if AVR power is connected from high potential. Voltage across P1 and P3 is limited to 300Vac max. PT Burden power: 2500VA minimum.

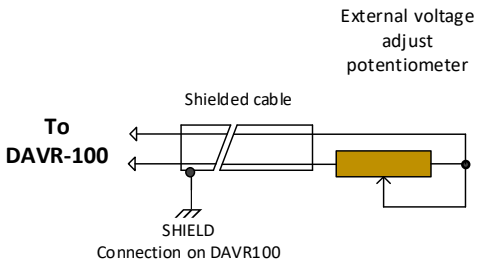
EXCITER DRIVE OUTPUT:	**DESCRIPTION:**	
FIELD WINDING configuration:	 Cable length between AVR and FIELD winding should NOT exceed 5 meters maximum length.	
EXCITATION voltage range:	Continuous drive: $140V_{DC}$ Overload status (20 sec): $220V_{DC}$ Overload status (10 sec): $300V_{DC}$	Power into the FIELD winding is limited with the available power across P1, P2 and P3 terminals of the AVR unit at any time. Excitation current is derated above 60°C by -5%/°C up to 70°C
EXCITATION current range:	Continuous drive: $7A_{DC}$ Overload status (20 sec): $10A_{DC}$ Overload status (10 sec): $15A_{DC}$ *(FIELD drive current is controlled according to I^2t thermal effect function and will be limited to this characteristic)*	

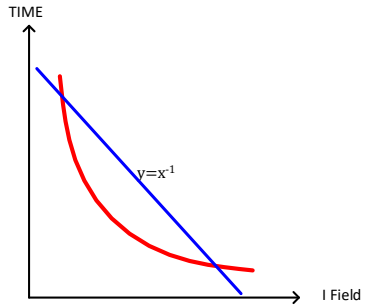
EXCITOR winding impedance:	Maximum: 50Ω Nominal: 15Ω Minimum: >5Ω (@ room temperature)	The wiring impedance from AVR to FIELD winding should NOT exceed 5% of FIELD winding nominal impedance at room temperature
AVR power input configuration:		For AUX and SHUNT connection, terminals P1 and P3 must be used
FIELD power drive configuration:		IGBT drive with PWM FW diode internal to AVR 7Adc continuous 10Adc for 20 sec 15Adc for 10 sec (given at max. operating temperature limit) Power is limited to 500W max @ 60°C continuous, (Derate at -5%/°C above +60°C)
ANALOGUE / SIGNAL INPUTS:	**DESCRIPTION:**	
ANALOG VOLTAGE SIGNAL INPUT (±5Vdc / 0-10Vdc):		Differential input: 0 – 10Vdc input ±5Vdc input (A1 terminal internally connected to GND) S/W configurable, no on-board trimmer Resolution: 1/1000 (non-isolated input)

ANALOG CURRENT SIGNAL INPUT (4-20mA):		4 -20mA current input connection (A1 connected to GND internally) Burden load: 100Ω <4mA corresponds to “low level input”, 12mA set as mid-point, S/W configurable. no on-board trimmer. Resolution: 1/1000 (Non-isolated input)
SIGNAL INPUT CHARACTERISTIC:		

COMMUNICATION PORT:	DESCRIPTION	
USB COMMUNICATION PORT (ISOLATED):		AVR configuration port for PC connection Power supply (internal & external) MODBUS protocol, On-board “Type-B” USB socket, Power and data galvanically isolated
CAN BUS COMMUNICATION PORT (ISOLATED)		DEVICE connection port for peripheral controllers. CAN OPEN architecture J1939 protocol Power and Data are galvanically isolated.

ALARM OUTPUT:	DESCRIPTION	
ALARM RELAY OUTPUT:		SPST relay output with “make” contact (N/O contacts during de-energized state) Relay is energized (contacts closed) during normal operation.
ALARM FUNCTIONS:	○ Threshold / Trigger status ○ Time Delay ○ Enable / Disable ○ Latched ○ Masked ○ Relay activation mode ○ TRIP activation	Any or a combination of alarm functions can be allocated for alarm state signal, using PC Tool Software suite.
CONTACT CAPACITY:		SPST configuration 30Vdc / 1A Hermetically sealed
EXTERNAL VOLTS ADJUST:	**DESCRIPTION**	
EXTERNAL VOLTAGE SETTING POT CONNECTION:		External voltage adjust pot connected to terminals E1 and E2 Adjustment range: ±15% of set voltage parameter (S/W configurable)

POT VALUE:		Value: 1KΩ Power rating: 1W Single turn or multi-turn (POT connection cable MUST be shielded, and GROUNDED at AVR side only)
DETECTION:	Pot wiring open circuit detection Automatic pot connection detection	
VISUAL INDICATORS:	**DESCRIPTION**	
AVR NORMAL:	Normal operation with no active ALARM status,	GREEN (continuous)
ALARM CONDITION:	Active ALARM or TRIP state	RED (continuous)
USB:	Communication healthy, transmission active,	BLUE (flashing)
OVER-EXCITATION PROTECTION:	**DESCRIPTION**	
FIELD CURRENT MONITORING:	Current limit set point: $0 \leq I_F \leq 15A_{DC}$ Parameters are S/W configurable	Resolution: ±0.01 A_{DC}
TIME DELAY CONTROL:	Time delay set point: $0 \leq T_D \leq 10s$ for $I_F >= 15A_{DC}$ $0 \leq T_D \leq 120s$ for $7.0 > I_F > 11A_{DC}$ Parameters are S/W configurable	Resolution: ±0.1 sec

IDMT CONTROL:	Inverse current / time thermal effect function selection / activation I*t or I^2*t characteristic selection	
TRIP:	Alarm relay activation (latching / non-latching) LED indicator activation Parameters are S/W configurable, *(Over-excitation is calculated according to I^2t thermal effect function)*	
ROTOR DIODE FAILURE PROTECTION:	**DESCRIPTION**	
ROTOR DIODE MONITORING:	Alternator ROTOR DIODE rectifier block monitoring during operation	Mode: • Short/circuit • Open/circuit
TIME DELAY CONTROL:	Time delay setting range: $0 \leq T_D \leq 7200s$ Parameters are S/W configurable	Resolution: ±1.0 sec
TRIP:	Alarm relay 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: ±1.0 $V_{AC\ RMS}$ (% reduction of phase voltage referenced to effective voltage setpoint)
TIME DELAY CONTROL:	Time delay setting $0 \leq T_D \leq 25s$ Parameters are S/W configurable	Resolution: ±1.0 sec
TRIP:	Alarm relay activation (latching / non-latching) LED indicator activation Parameters are S/W configurable	

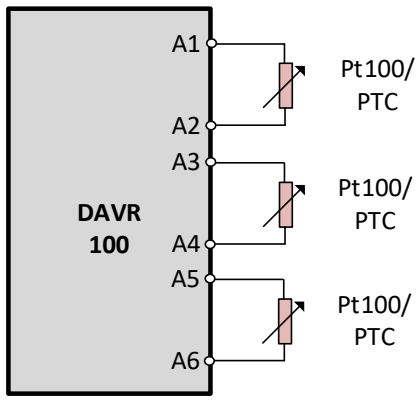
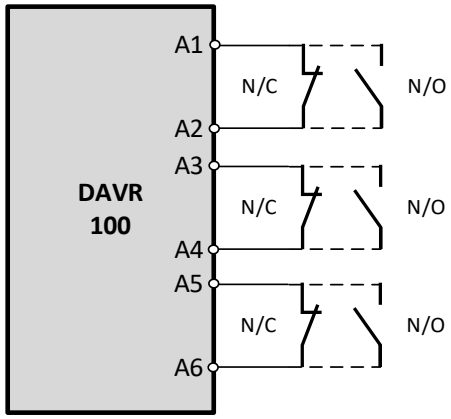
GENERATOR OVER-VOLTAGE PROTECTION:	DESCRIPTION	
OVER-VOLTAGE MONITORING:	Alternator phase-phase STATOR voltage monitoring, Over-voltage set point: 100% to 150%	Resolution: ±1.0% (% of effective stator voltage setpoint)
OVER-VOLTAGE TIME DELAY CONTROL:	Time delay set point, $0 \leq T_D \leq 15s$	Resolution: ±1.0ms
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: ±1.0% (% of effective stator voltage setpoint)
TIME DELAY CONTROL:	Time delay set point, $0 \leq T_D \leq 15s$	Resolution: ±1.0ms
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: ±1.0% of actual stator current value
TIME DELAY CONTROL:	Time delay set point: $0 \leq T_D \leq 120s$ (Allowed “over-current-time limits” are set according to alternator thermal specifications) Parameters are S/W configurable	Resolution: ±1.0 ms

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, $100\% \leq I_{CL} \leq 200\%$ CT ratio S/W configurable	Resolution: ±1.0% of actual stator current value
TIME DELAY CONTROL:	Time delay set point $0 \leq T_D \leq 60s$ Parameters are S/W configurable	Resolution: ±1.0 ms
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	

STATOR VOLTAGE UNBALANCE DETECTION:	DESCRIPTION	
UNBALANCE DETECTION:	3-phase STATOR voltage monitoring, (each phase voltage is monitored individually) $20 \leq V_{UNBALANCE} \leq 50\%$ Parameters are S/W configurable	Operates on "percent phase voltage deviation" with reference to 3-phase average voltage measurement value
TIME DELAY CONTROL:	Time delay set point: $0 \leq T_D \leq 120s$ Parameters are S/W configurable	Resolution: ±1.0 ms
TRIP:	Alarm relay activation (latching / non-latching) LED indicator activation Parameters are S/W configurable	
AUXILIARY INPUTS:	**DESCRIPTION**	
WINDING TEMPERATURE PROTECTION:	Monitoring of the heatsink temperature with on-board NTC sensor, $+40^oC \leq T_{HS} \leq 100^oC$	Resolution: ±1.0^{o}C *(On-board temperature sensors for internal board temperature management)*
AMBIENT TEMPERATURE SENSING:	On-board sensor for microcontroller ambient temperature sensing (temperature on the PCB) +10^{o}C to +100^{o}C	

EXTERNAL TEMPERATURE SENSING & PROTECTION:		Monitoring of external temperature points +40°C ≤ T_{EXT} ≤ +300°C 3 independent RTD or Pt100 sensor inputs Parameters S/W configurable
TIME DELAY CONTROL:	Time delay control setting, 0 ≤ T_D ≤ 60 sec	Resolution: ±1.0 sec
TRIP:	Alarm relay activation (latching / non-latching) LED indicator activation Parameters are S/W configurable	
EXTERNAL DIGITAL INPUT:		Any of the AUXILIARY inputs can be configured as DIGITAL inputs. Functions can be allocated using PC Tool Software suit. (ONLY SUITABLE FOR DRY CONTACT CONNECTION)
VOLTAGE REGULATION:	**DESCRIPTION**	
VOLTAGE REGULATION:	3-phase RMS voltage regulation 2-phase RMS voltage regulation (Continuous average measurement)	Regulation: < ±0.25%
REGULATION CONDITIONS:	Prime mover speed change: <4% Cosϕ: >0.8 THD (3-phase average): <5%	
TEMPERATURE DRIFT:	ΔT < 40°C Unchanged load conditions	

SOURCES OF REGULATION SETPOINT:	• S/W voltage regulation set-point • On-board trimmer voltage setting • External pot voltage setting • AUX input-controlled voltage setting (control from an external device)	All regulation source selections are S/W configurable during AVR set-up
SOFT-START SEQUENCE CONTROL:	**DESCRIPTION**	
START TIME DELAY:	$0 \leq T_{DELAY} \leq 7200$ sec. Parameters S/W configurable	Time based start-delay in seconds
START FREQUENCY CONTROL:	$25Hz \leq F_{START} \leq 75Hz$ Parameters S/W configurable	Frequency based start-delay in Hz.
SOFT-START RAMP CONTROL:	$1 \leq T_{SOFTSTART} \leq 7200$ 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
STABILITY (PID) CONTROL:	**DESCRIPTION**	
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
FREQUENCY RESPONSE:	**DESCRIPTION**	
UFRO KNEE POINT CONTROL:	$40Hz \leq F_{UFRO} \leq 65Hz$ STATOR voltage roll-off point control Parameters S/W configurable	Resolution: 0.1 Hz increments
LAM FUNCTION DESCENDING_SLOPE CONTROL:	$0V/Hz \leq V_{COEFF.} \leq -80V/Hz$ Rate of volts control per Hz speed change Parameter S/W configurable	Resolution: -1.0 V/Hz increments

LAM FUNCTION ASCENDING-SLOPE CONTROL:	0V/sec. ≤ $V_{COEFF.}$ ≤ 500V/sec Rate of volts control per second time change, Parameter S/W configurable	Resolution: +1.0V/sec increments
LAM FUNCTION LOW PEDESTAL LIMIT VALUE:	0V < $V_{PEDESTAL}$ < 500V Low state pedestal voltage limit Parameter S/W configurable	Resolution: -1.0V
LAM FUNCTION DELAY TIME CONTROL:	0 sec ≤ $T_{COEFF.}$ ≤ 100 sec Delay time at low pedestal level, Parameter S/W configurable	Resolution: 0.1V/sec increments

QUADRATURE DROOP / LINE DROOP CONTROL:	**DESCRIPTION**	
REACTIVE DROOP COMPENSATION:	Manual DROOP control with on-board trimmer -5% ≤ DROOP ≤ +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, $-60^o \leq \rho \leq +60^o$ S/W configurable with automatic compensation	
LINE DROOP COMPENSATION:	Voltage line DROOP compensation -10% ≤ L_{DROOP} ≤ +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)	

DATA LOGGING:	DESCRIPTION	
ALARM LOG:	Last 100 alarms logged in memory, *(Time stamping with reference to alternator operating hours)*	FIFO register configuration (Logged data to be viewed via USB com port)
EVENT LOG:	Last 10 events logged with time stamping *(Time stamping with reference to alternator operating hours)*	
ENVIRONMENTAL LIMITS:	**DESCRIPTION**	
TEMPERATURE:	Operating temperature range:	-40°C to +70°C
	Excitation derating:	60°C < -5%/°C < 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
VIBRATION / SHOCK:	x, y, z axis	5g
	20Hz to 100Hz	1.2g
	53Hz to 500Hz	5g
MECHANICAL CONSTRUCTION:	**DESCRIPTION**	
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:	IP54
	Com ports:	IP00
MOUNTING:	Horizontal mounting Vertical mounting (no other mounting positions allowed)	Rigid mounting Mounting on AVMs
INDICATORS:	LED (8 LED indicators for alarm status)	Integrated in AVR body
DIMENSIONS:	200mm(W) x 150mm(D) x 55mm(H)	Most outer dimensions
WEIGHT:	450gr	

COMPLIANCE:	DESCRIPTION
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:

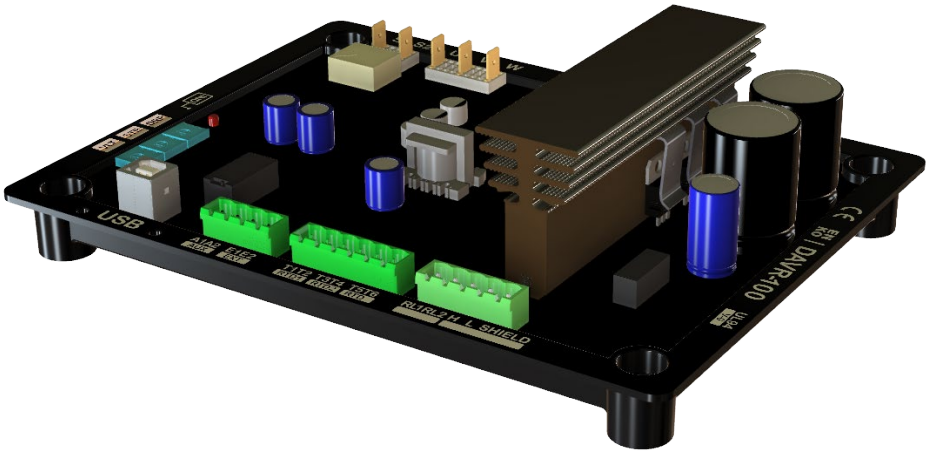


FIGURE 1: DAVR100 TRAY CONSTRUCTION

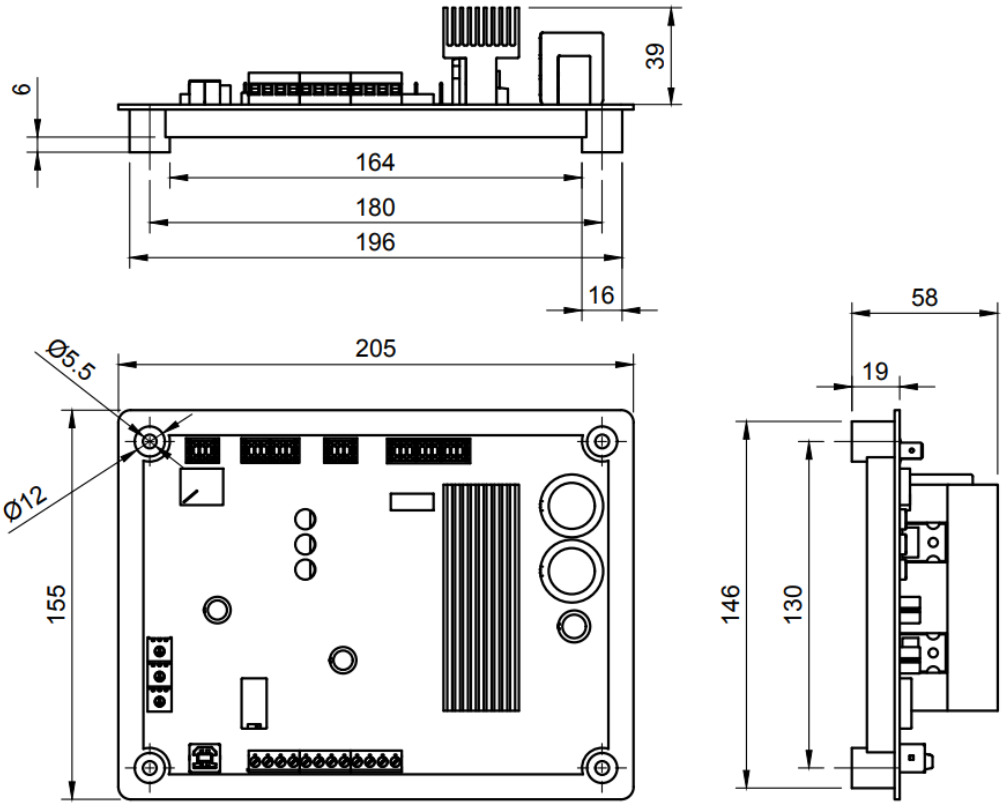


FIGURE 2: DAVR100 MECHANICAL DIMENSIONS (MM)

APPLICATION WIRING DIAGRAMS

SYNCHRONOUS ALTERNATOR WITH PMG

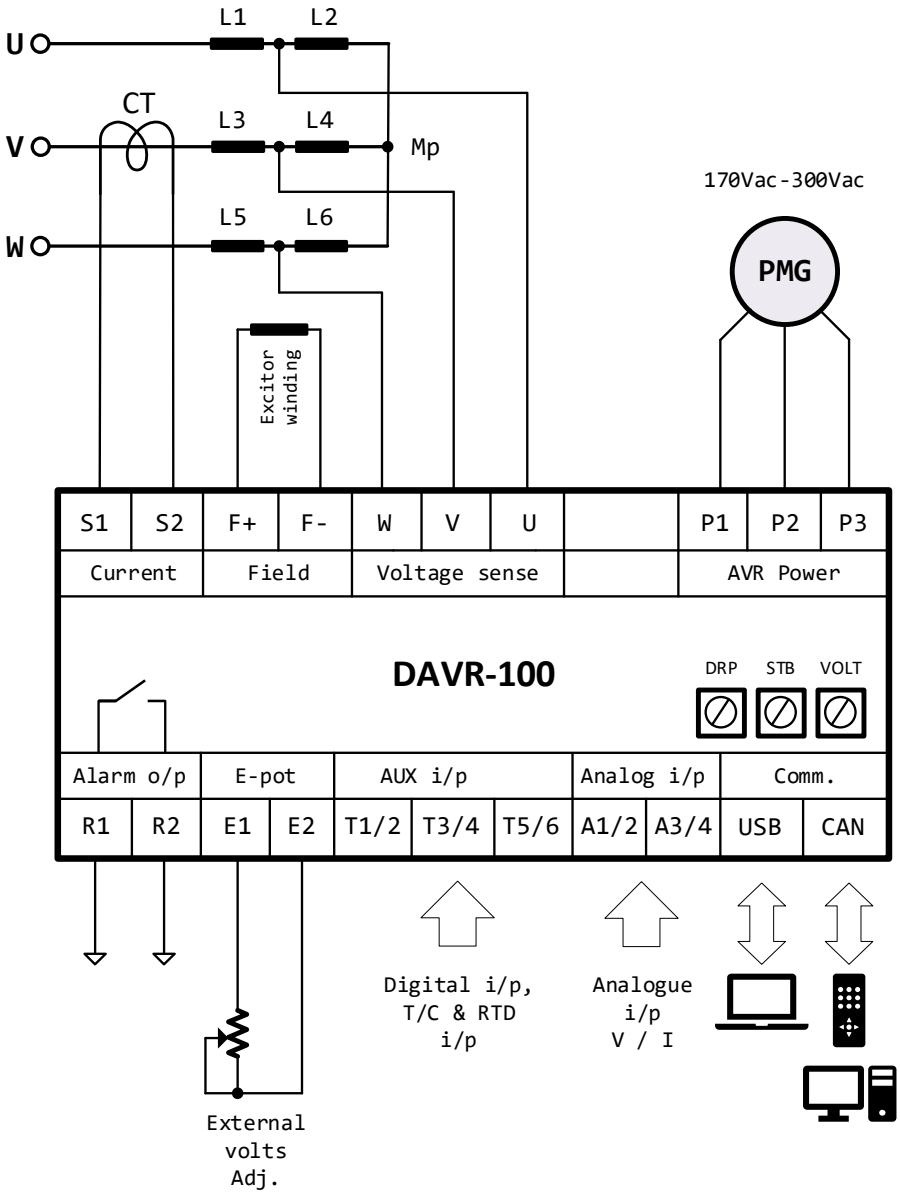


FIGURE 3: DAVR100 WIRING WITH PMG

NOTE:

Protection fuses are not used onboard AVR due to different regulations in different countries. Therefore, user appropriate protection fuses MUST be added in the AVR installation.

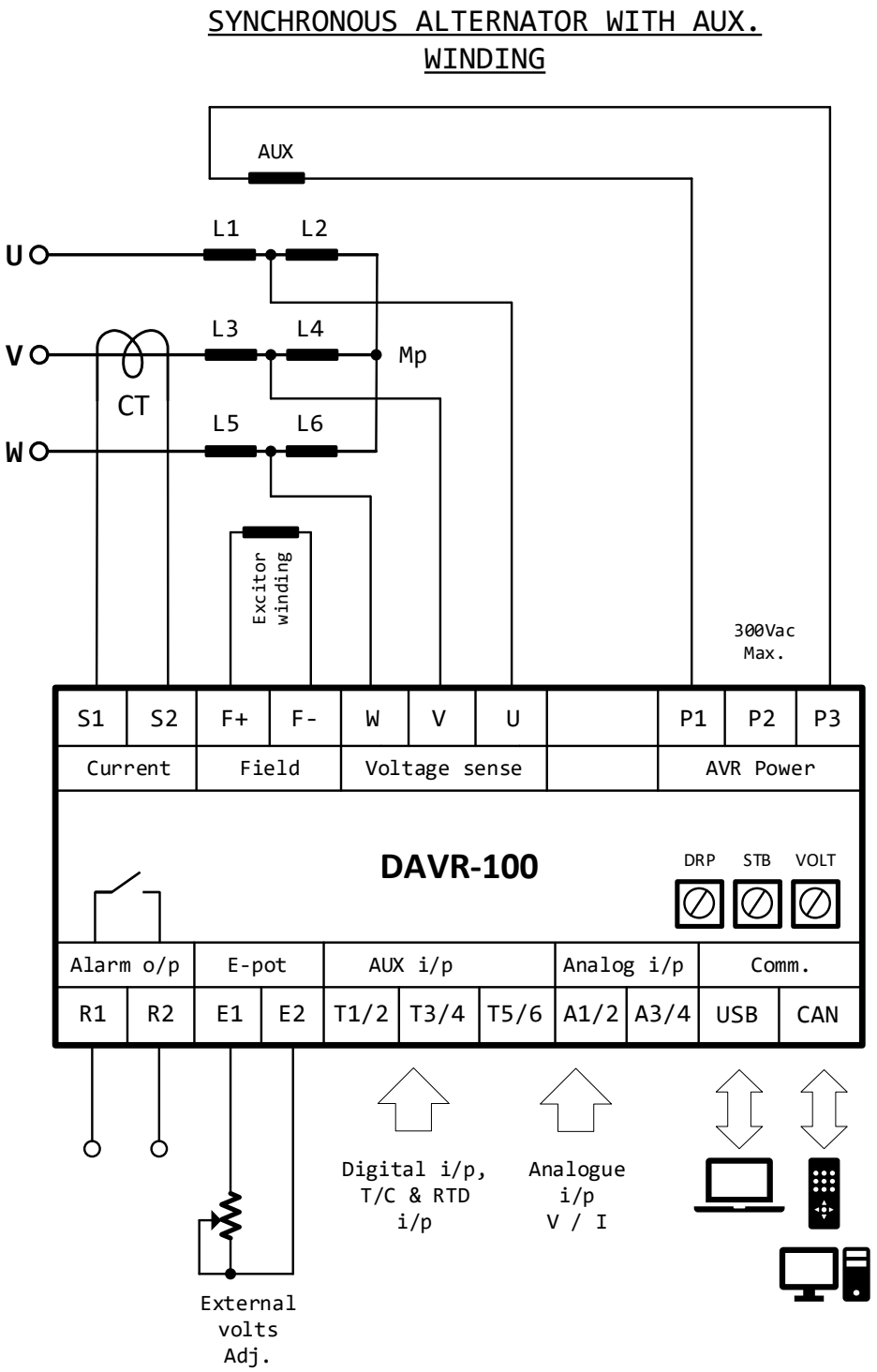


FIGURE 4: DAVR100 WIRING WITH AUXILIARY WINDING

NOTE:

Protection fuses are not used onboard AVR due to different regulations in different countries. Therefore, user appropriate protection fuses MUST be added in the AVR installation.

SYNCHRONOUS ALTERNATOR WITH SHUNT CONNECTION

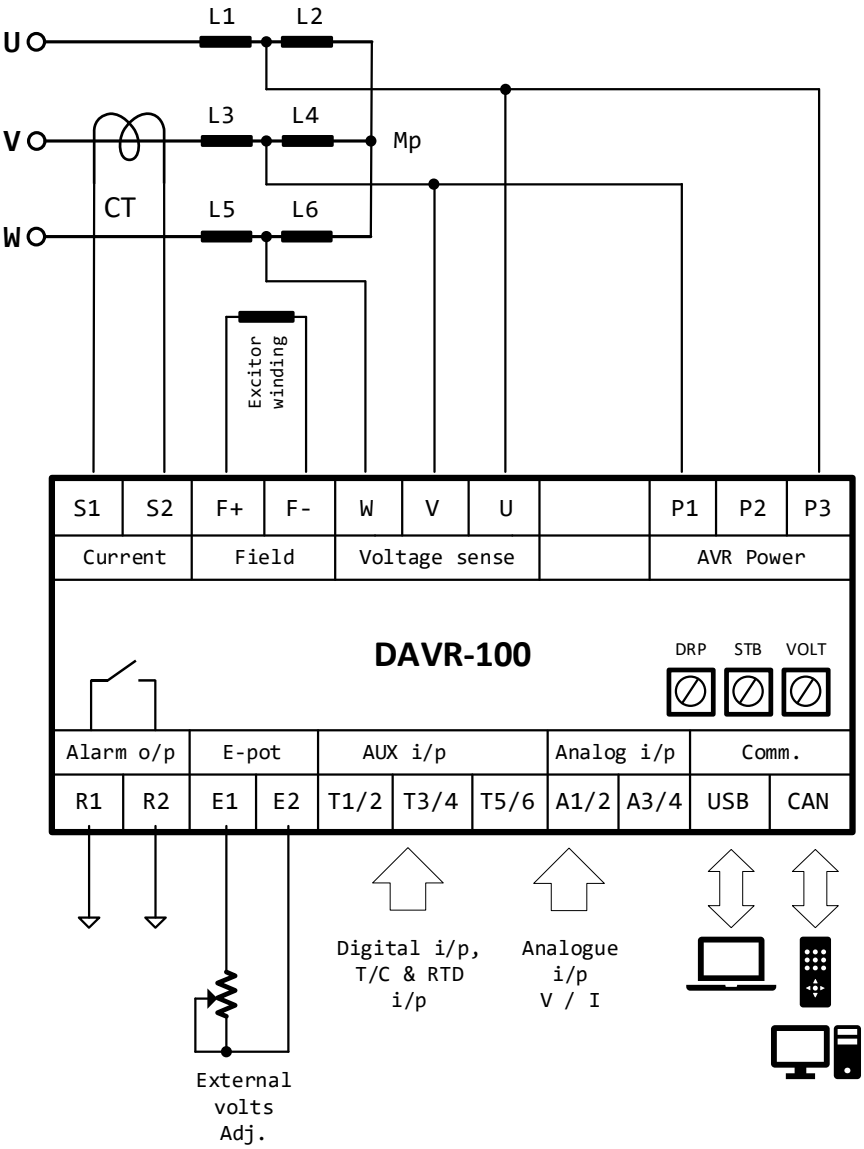


FIGURE 5: DAVR100 WIRING FOR SHUNT CONNECTION

NOTE:

Protection fuses are not used onboard AVR due to different regulations in different countries. Therefore, user appropriate protection fuses MUST be added in the AVR installation.

SYNCHRONOUS ALTERNATOR SHUNT
WIRING WITH HIGH POTENTIAL

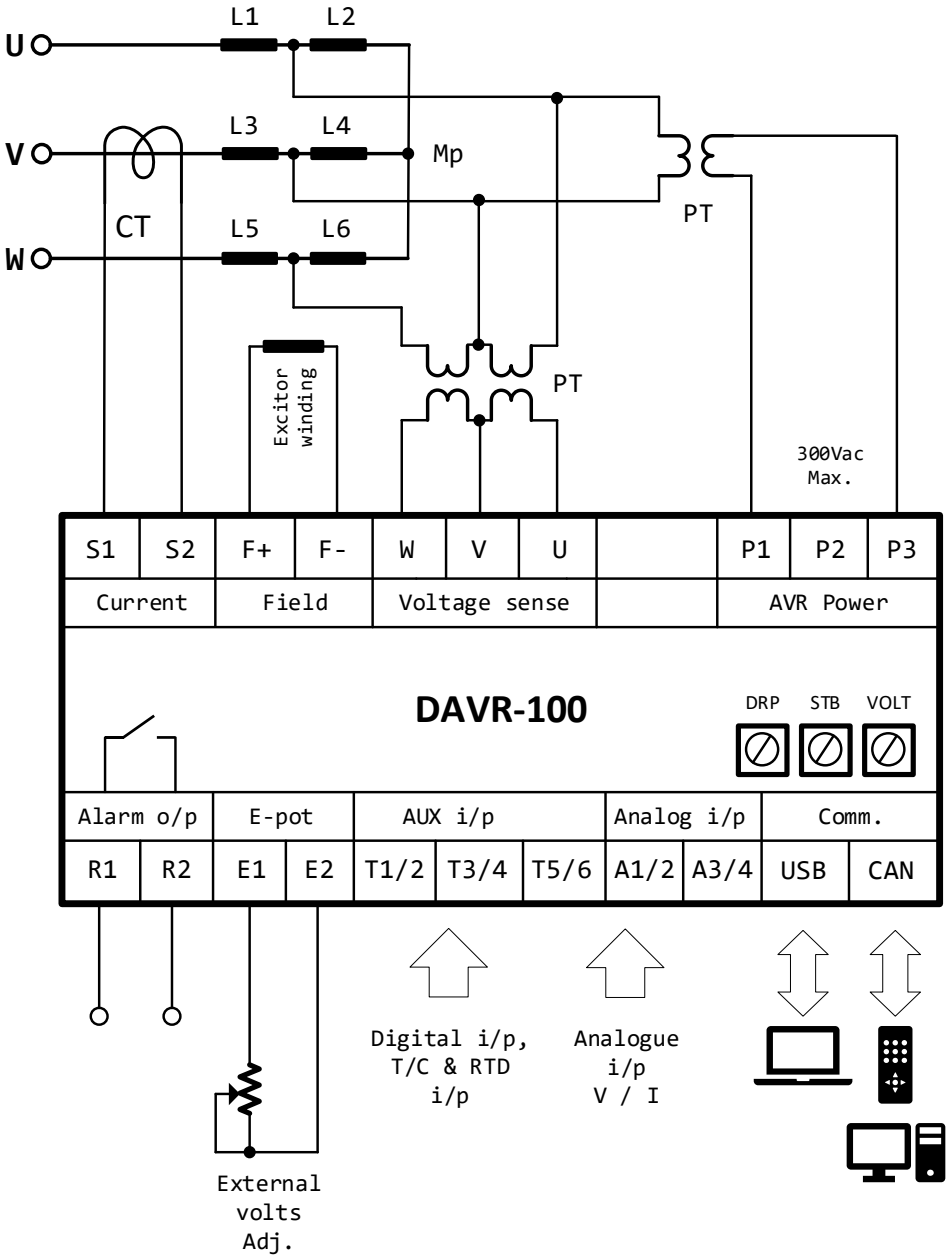


FIGURE 6: DAVR100 SHUNT WIRING WITH HIGH POTENTIAL INPUT

NOTE:

Protection fuses are not used onboard AVR due to different regulations in different countries. Therefore, user appropriate protection fuses MUST be added in the AVR installation.

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