AUTOMATIC VOLTAGE REGULATOR
R610
Instruction manual
TABLE OF CONTENT

AVR CARDS REFERENCE Page : 3

GENERAL DESCRIPTION : Page : 4

CARDS DESCRIPTION : Page : 11

BASIC OPTIONS : Page : 24

EXTENDED OPTIONS : Page : 30

START-UP : Page : 41

NOTE
THE ELECTRICAL CONNECTION DIAGRAM ARE ONLY GIVEN AS AN INDICATION. PLEASE REFER TO THE SPECIFIC DIAGRAMS OF YOUR ALTERNATOR

WARNING
TO PREVENT PERSONNAL INJURY OR EQUIPMENT DAMAGE, ONLY QUALIFIED TECHNICIANS/OPERATORS SHOULD INSTALL AND OPERATE THIS DEVICE

CAUTION
MEGGERS AND HIGH POTENTIAL TEST EQUIPMENT MUST NOT BE USED. INCORRECT USED OF SUCH EQUIPMENT COULD DAMAGE THE SEMICONDUCTORS CONTAINED IN THE AVR
### AVR MODEL R610 CARDS REFERENCE

<table>
<thead>
<tr>
<th>DESIGNATION</th>
<th>N° printed circuit board</th>
<th>N° complete card</th>
<th>N° instruction manual</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wired empty rack</td>
<td></td>
<td></td>
<td></td>
<td>SHUNT (+booster)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>PMG or AREP</td>
</tr>
<tr>
<td>Complete Generator 1-2F board</td>
<td>C51950230</td>
<td>NT1950230/a-03/96</td>
<td>100 / 120V - 50 / 60Hz</td>
<td></td>
</tr>
<tr>
<td>Complete Generator 1-2F board</td>
<td>C51950232</td>
<td>NT1950230/a-03/96</td>
<td>400 / 450V - 50 / 60Hz</td>
<td></td>
</tr>
<tr>
<td>Complete Generator 3F board</td>
<td>C51950233</td>
<td>NT1950233/a-03/96</td>
<td>Gen:110V; Mains:110V</td>
<td></td>
</tr>
<tr>
<td>Complete Generator 3F board</td>
<td>C51950234</td>
<td>NT1950234/a-03/96</td>
<td>Gen:400V; Mains:400V</td>
<td></td>
</tr>
<tr>
<td>Rack supply</td>
<td>CP1950040</td>
<td>C51950040</td>
<td>NT1950042/a-11/92</td>
<td></td>
</tr>
<tr>
<td>Sensing</td>
<td>CP1950050</td>
<td>C51950050</td>
<td>NT1950052/a-11/92</td>
<td></td>
</tr>
<tr>
<td>PID, limitation</td>
<td>CP1950060</td>
<td>C51950060</td>
<td>NT1950062/a-11/92</td>
<td></td>
</tr>
<tr>
<td>Driver</td>
<td>CP1950070</td>
<td>C51950070</td>
<td>NT1950072/b-11/93</td>
<td></td>
</tr>
<tr>
<td>CosØ, KVAR</td>
<td>CP1950080</td>
<td>C51950080</td>
<td>NT1950082/a-02/93</td>
<td></td>
</tr>
<tr>
<td>Limit Istator</td>
<td>CP1950090</td>
<td>C51950091</td>
<td>NT1950090/a-11/92</td>
<td></td>
</tr>
<tr>
<td>Manual mode 2</td>
<td>CP1950100</td>
<td>C51950102</td>
<td>NT1950100/a-02/93</td>
<td></td>
</tr>
<tr>
<td>Digital U / P.F potentiometer</td>
<td>CP1950110</td>
<td>C51950111</td>
<td>NT1950110/a-01/94</td>
<td></td>
</tr>
<tr>
<td>Mains P.F régulation</td>
<td>CP1950120</td>
<td>C51950121</td>
<td>NT1950120/a-04/94</td>
<td></td>
</tr>
<tr>
<td>Rotating diodes failure detector</td>
<td>CP1950130</td>
<td>C51950131</td>
<td>NT1950130/a-06/96</td>
<td>Available 09/96</td>
</tr>
</tbody>
</table>

- **= Necessary**
- **= Optionnal**

**NOTE:**
- 1F = Solo or parallel operation between machines (Voltage regulation + reactive load sharing (droop))
- 2F = 1F + parallel operation with the mains (P.F or KVAR regulation)
- 3F = 2F + automatic voltage matching between the generator and the mains. (For synchronizing)

**IMPORTANT:** The informations given on this sheet will be used to order spare parts. Take care of it.
1) APPLICATION
- The AVR model R600 can be used with brushless self-excited type generators, “SHUNT”, “SHUNT with BOOSTER” or “SHUNT with PMG” excitation. In case of “SHUNT with BOOSTER the booster current is totally monitored by the AVR.
- The AVR is able to ensure, depending of its constitution, solo operation, parallel operation between equivalent generators or parallel operation with the mains with cosØ or KVAR regulation.

2) DESCRIPTION
- The AVR model R610 is composed of electronic cards which are included in a half rack 19”.
- An empty slot located on the left of the rack allows future optional cards to be added without any internal wiring modification.
- The rear flat cable (BUS 64 points) is given more long as it can be connected to an optional interface terminal block which gives all the internal test points or in the future the possibility to connect another rack if the cards number will become too important.

3) INTERCONNECTIONS
- External interconnections are located on the top of the rack in form of two terminal blocks:
  - A power / voltage terminal block (16 terminals, two with fuses)
  - A command / control terminal block (24 terminals)
  - A conventional wiring connect this terminal blocks to the power block fitted on a heatsink and also to the "generator I/O" and "mains I/O" to give an interface with the flat cable BUS 64 points.
  - In the same manner a 8 points connector connects directly the driver card to the power block.

4) OPTIONAL CARDS
- Basically the AVR allows voltage regulation with reactive sharing when paralleling with other machines.

The following cards can be plugged into the AVR without internal wiring modification:
- CosØ / KVAR regulation (2F) (// with the mains)
- Voltage equalization with the mains (3F) (Synchro)

Only one is possible with the following cards
- Voltage and P.F digital potentiometers
- Manual operation
- Istator limitation
- Mains P.F or KVAR regulation from 4-20mA sensor

5) SPECIFICATIONS :
- Sensing voltage
  : 100/110Vac 50Hz
  : 120/130Vac 60Hz
  : 380/420Vac 50Hz
  : 430/450Vac 60Hz
- Power supply
  : Depend of generator(Adaptation by transformer).
  Maximum 180Vac 50/60Hz
  : PMG possible maximum 150Vac 3Ø 50/150Hz
- Field output
  : 8 Amperes nominal, 20Amp maximum during 10s on 6Ω minimum
- Accuracy
  : +/-1% of the means of the three phases on linear load and without droop
- Voltage setting range
  : +/-5% of the nominal voltage by means of external optionnal potentiometer .
- Droop setting range
  : - 7% of the nominal voltage at cosØ =0
- Under-frequency protection
  : Adjustable threshold and slope from V/Hz to 2V/Hz
- Field ceiling
  : 110% of If nominal permanently, unlocked in case of voltage decrease
- Protection
  : Heatsink overheating, exciter short-circuit
- Alarm output
  : Heatsink overheating, too much ceiling unlocked time
- Environnement
  : Maximum ambiant temperature -10°C to +50°C
  : Fitting in control panel without excessive vibrations

6) SCHEMATICS AND DRAWINGS
- Following schematics give all the usual informations on the interconnexions between the terminal block, the I/O connectors and the power block.
**AVR MODEL R610**

<table>
<thead>
<tr>
<th>TERM N°</th>
<th>VOLTAGE / POWER TERMINAL BLOCK</th>
<th>0F</th>
<th>1F</th>
<th>2F</th>
<th>3F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Phase 1 (U) machine (measure)</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>2</td>
<td>Phase 2 (V) machine (measure)</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>3</td>
<td>Phase 3 (W) machine (measure)</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>4</td>
<td>+ field flashing or pre-excitation input (optional)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>5</td>
<td>- field output</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>6</td>
<td>+ booster input</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>7</td>
<td>- booster input</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>8</td>
<td>Paralleling CT phase 2 (V) S1</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>9</td>
<td>Paralleling CT phase 2 (V) S2</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>10</td>
<td>Phase 1 (U) mains (measure)</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>11</td>
<td>Phase 2 (V) mains (measure)</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>12</td>
<td>Phase 3 (W) mains (measure)</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>13</td>
<td>Power supply input (fused)</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>14</td>
<td>Power supply input</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>15</td>
<td>Power supply input (fused)</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>16</td>
<td>Power supply input (fused)</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>17</td>
<td>COMMAND / CONTROL TERMINAL BLOCK</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20.2</td>
<td>Potentiometer shield (2 terminals)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>21</td>
<td>External voltage potentiometer maximum CW</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>22</td>
<td>External voltage potentiometer (10KΩ-2W) (cursor)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>23</td>
<td>External voltage potentiometer (minimum CCW)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>24</td>
<td>External cosØ potentiometer maximum CW</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>25</td>
<td>External cosØ potentiometer (10KΩ-2W) (cursor)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>26</td>
<td>External cosØ potentiometer (minimum CCW)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>27</td>
<td>External KVAR potentiometer maximum CW</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>28</td>
<td>External KVAR potentiometer (10KΩ-2W) (cursor)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>29</td>
<td>External KVAR potentiometer (minimum CCW)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>30</td>
<td>cosØ regulation command input (/ terminal 31)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>31</td>
<td>Common</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>32</td>
<td>Voltage equalization command input (/ terminal 31)</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>33</td>
<td>Overheating or ceiling unlocked time alarm output (NO)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>34</td>
<td>Overheating or ceiling unlocked time alarm (common)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>35</td>
<td>Upper command voltage and P.F (/ terminal 37)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>36</td>
<td>Lower command voltage and P.F (/ terminal 37)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>37</td>
<td>Common</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>38</td>
<td>cosØ / KVAR selection command input (/ terminal 37)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>39</td>
<td>Field current measurement output (+Vdc / terminal 20)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>40</td>
<td>Reserve</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

**Legend:**
- **O** = Optional
- **N** = Necessary
- **Nothing** = Not applicable
- **O** = Optional
- **N** = Necessary
- **Nothing** = Not applicable
### AVR MODEL R610

### GENERAL DESCRIPTION

- The following tables give interconnections between each card and the 64 points flat cable.
- Grey cases give signals origine.
- Other cases where they go.
- On the left we have two numbers:
  - First the connector numbering
  - Second test block terminal number.
- On the right we have a recapitulative of all the informations which can be found on the test terminal block.

---

<table>
<thead>
<tr>
<th>PIN</th>
<th>PIN</th>
<th>PIN</th>
<th>PIN</th>
<th>PIN</th>
<th>PIN</th>
<th>PIN</th>
<th>PIN</th>
<th>PIN</th>
<th>PIN</th>
<th>PIN</th>
<th>PIN</th>
<th>PIN</th>
<th>PIN</th>
<th>PIN</th>
<th>PIN</th>
<th>PIN</th>
<th>PIN</th>
<th>PIN</th>
<th>PIN</th>
<th>PIN</th>
<th>PIN</th>
<th>PIN</th>
<th>PIN</th>
<th>PIN</th>
<th>PIN</th>
<th>PIN</th>
<th>PIN</th>
<th>PIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>1c</td>
<td>1a</td>
<td>2a</td>
<td>3a</td>
<td>4a</td>
<td>5c</td>
<td>6c</td>
<td>7c</td>
<td>8c</td>
<td>9c</td>
<td>10c</td>
<td>11c</td>
<td>12c</td>
<td>13c</td>
<td>14c</td>
<td>15c</td>
<td>16c</td>
<td>17c</td>
<td>18c</td>
<td>19c</td>
<td>20c</td>
<td>21c</td>
<td>22c</td>
<td>23c</td>
<td>24c</td>
<td>25c</td>
<td>26c</td>
<td>27c</td>
<td></td>
</tr>
<tr>
<td>2c</td>
<td>2a</td>
<td>4a</td>
<td>5a</td>
<td>6a</td>
<td>7c</td>
<td>8c</td>
<td>9c</td>
<td>10a</td>
<td>11a</td>
<td>12a</td>
<td>13a</td>
<td>14a</td>
<td>15a</td>
<td>16a</td>
<td>17a</td>
<td>18a</td>
<td>19a</td>
<td>20a</td>
<td>21a</td>
<td>22a</td>
<td>23a</td>
<td>24a</td>
<td>25a</td>
<td>26a</td>
<td>27a</td>
<td>28a</td>
<td>29a</td>
<td>30a</td>
</tr>
<tr>
<td>3c</td>
<td>3a</td>
<td>5a</td>
<td>6a</td>
<td>7a</td>
<td>8c</td>
<td>9c</td>
<td>10c</td>
<td>11c</td>
<td>12c</td>
<td>13c</td>
<td>14c</td>
<td>15c</td>
<td>16c</td>
<td>17c</td>
<td>18c</td>
<td>19c</td>
<td>20c</td>
<td>21c</td>
<td>22c</td>
<td>23c</td>
<td>24c</td>
<td>25c</td>
<td>26c</td>
<td>27c</td>
<td>28c</td>
<td>29c</td>
<td>30c</td>
<td>31c</td>
</tr>
<tr>
<td>4c</td>
<td>4a</td>
<td>6a</td>
<td>7a</td>
<td>8a</td>
<td>9a</td>
<td>10a</td>
<td>11a</td>
<td>12a</td>
<td>13a</td>
<td>14a</td>
<td>15a</td>
<td>16a</td>
<td>17a</td>
<td>18a</td>
<td>19a</td>
<td>20a</td>
<td>21a</td>
<td>22a</td>
<td>23a</td>
<td>24a</td>
<td>25a</td>
<td>26a</td>
<td>27a</td>
<td>28a</td>
<td>29a</td>
<td>30a</td>
<td>31a</td>
<td>32a</td>
</tr>
</tbody>
</table>

---

**Column Headers:**
- **test output**
- **Driver**
- **Manu mode**
- **Pot digital U**
- **CosØ,KVAR**
- **Sensing**
- **Manhains I/O**
- **Supply**
- **PID, limit**
- **Vac-puiss**

**Row Headers:**
- **+Vcc**
- **-Vcc**
- **+Vdc alim**
- **-Vdc alim**
- **Vac-dr1**
- **Vac-dr2**
- **Vac-dr3**
- **Vac-dm1**
- **Vac-dm2**
- **Vac-dm3**
- **V-10%**
- **Uregl**
- **Correct PID**
- **IsinØ**
- **Ures**
- **Uref**
- **Umanu**
- **Uexc**
- **Umanu**

---

**Notes:**
- NT1950255/a-03/96 f:6/8
- Page : 8/43
<table>
<thead>
<tr>
<th>PIN</th>
<th>PIN</th>
<th>Gen/Mains I/O</th>
<th>Supply</th>
<th>Sensing</th>
<th>PID, limit</th>
<th>CosØ, KVAR</th>
<th>Pot dig U</th>
<th>Manu mode</th>
<th>Driver puiss</th>
<th>test output</th>
</tr>
</thead>
<tbody>
<tr>
<td>17c</td>
<td>33</td>
<td>GND</td>
<td>GND</td>
<td>GND</td>
<td>GND</td>
<td>GND</td>
<td>GND</td>
<td>GND</td>
<td>GND</td>
<td>GND</td>
</tr>
<tr>
<td>17a</td>
<td>34</td>
<td>Mes lexc</td>
<td>Mes lexc</td>
<td>Mes lexc</td>
<td>Mes lexc</td>
<td>Mes lexc</td>
<td>Mes lexc</td>
<td>Mes lexc</td>
<td>Mes lexc</td>
<td>Mes lexc</td>
</tr>
<tr>
<td>18c</td>
<td>35</td>
<td>synchro</td>
<td>Perte synchro</td>
<td>Perte synchro</td>
<td>Perte synchro</td>
<td>Perte synchro</td>
<td>Perte synchro</td>
<td>Perte synchro</td>
<td>Perte synchro</td>
<td>Perte synchro</td>
</tr>
<tr>
<td>18a</td>
<td>36</td>
<td>I limit</td>
<td>I limit</td>
<td>I limit</td>
<td>I limit</td>
<td>I limit</td>
<td>I limit</td>
<td>I limit</td>
<td>I limit</td>
<td>I limit</td>
</tr>
<tr>
<td>19c</td>
<td>37</td>
<td>GND</td>
<td>GND</td>
<td>GND</td>
<td>GND</td>
<td>GND</td>
<td>GND</td>
<td>GND</td>
<td>GND</td>
<td>GND</td>
</tr>
<tr>
<td>19a</td>
<td>38</td>
<td>Fin rampe</td>
<td>Fin rampe</td>
<td>Fin rampe</td>
<td>Fin rampe</td>
<td>Fin rampe</td>
<td>Fin rampe</td>
<td>Fin rampe</td>
<td>Fin rampe</td>
<td>Fin rampe</td>
</tr>
<tr>
<td>20c</td>
<td>39</td>
<td>U cosØ</td>
<td>U cosØ</td>
<td>U cosØ</td>
<td>U cosØ</td>
<td>U cosØ</td>
<td>U cosØ</td>
<td>U cosØ</td>
<td>U cosØ</td>
<td>U cosØ</td>
</tr>
<tr>
<td>21c</td>
<td>41</td>
<td>U KVAR</td>
<td>U KVAR</td>
<td>U KVAR</td>
<td>U KVAR</td>
<td>U KVAR</td>
<td>U KVAR</td>
<td>U KVAR</td>
<td>U KVAR</td>
<td>U KVAR</td>
</tr>
<tr>
<td>21a</td>
<td>42</td>
<td>Pot tension</td>
<td>Pot tension</td>
<td>Pot tension</td>
<td>Pot tension</td>
<td>Pot tension</td>
<td>Pot tension</td>
<td>Pot tension</td>
<td>Pot tension</td>
<td>Pot tension</td>
</tr>
<tr>
<td>22c</td>
<td>43</td>
<td>U tension</td>
<td>U tension</td>
<td>U tension</td>
<td>U tension</td>
<td>U tension</td>
<td>U tension</td>
<td>U tension</td>
<td>U tension</td>
<td>U tension</td>
</tr>
<tr>
<td>22a</td>
<td>44</td>
<td>+lexc</td>
<td>+lexc</td>
<td>+lexc</td>
<td>+lexc</td>
<td>+lexc</td>
<td>+lexc</td>
<td>+lexc</td>
<td>+lexc</td>
<td>+lexc</td>
</tr>
<tr>
<td>23c</td>
<td>45</td>
<td>-lexc</td>
<td>-lexc</td>
<td>-lexc</td>
<td>-lexc</td>
<td>-lexc</td>
<td>-lexc</td>
<td>-lexc</td>
<td>-lexc</td>
<td>-lexc</td>
</tr>
<tr>
<td>23a</td>
<td>46</td>
<td>+Uauto</td>
<td>+Uauto</td>
<td>+Uauto</td>
<td>+Uauto</td>
<td>+Uauto</td>
<td>+Uauto</td>
<td>+Uauto</td>
<td>+Uauto</td>
<td>+Uauto</td>
</tr>
<tr>
<td>24c</td>
<td>47</td>
<td>-Uauto</td>
<td>-Uauto</td>
<td>-Uauto</td>
<td>-Uauto</td>
<td>-Uauto</td>
<td>-Uauto</td>
<td>-Uauto</td>
<td>-Uauto</td>
<td>-Uauto</td>
</tr>
<tr>
<td>24a</td>
<td>48</td>
<td>Cde reg cosØ</td>
<td>Cde reg cosØ</td>
<td>Cde reg cosØ</td>
<td>Cde reg cosØ</td>
<td>Cde reg cosØ</td>
<td>Cde reg cosØ</td>
<td>Cde reg cosØ</td>
<td>Cde reg cosØ</td>
<td>Cde reg cosØ</td>
</tr>
<tr>
<td>25c</td>
<td>49</td>
<td>Cde U=U</td>
<td>Cde U=U</td>
<td>Cde U=U</td>
<td>Cde U=U</td>
<td>Cde U=U</td>
<td>Cde U=U</td>
<td>Cde U=U</td>
<td>Cde U=U</td>
<td>Cde U=U</td>
</tr>
<tr>
<td>25a</td>
<td>50</td>
<td>cde auto/manu</td>
<td>cde auto/manu</td>
<td>cde auto/manu</td>
<td>cde auto/manu</td>
<td>cde auto/manu</td>
<td>cde auto/manu</td>
<td>cde auto/manu</td>
<td>cde auto/manu</td>
<td>cde auto/manu</td>
</tr>
<tr>
<td>26c</td>
<td>51</td>
<td>Défaut T°C</td>
<td>Défaut T°C</td>
<td>Défaut T°C</td>
<td>Défaut T°C</td>
<td>Défaut T°C</td>
<td>Défaut T°C</td>
<td>Défaut T°C</td>
<td>Défaut T°C</td>
<td>Défaut T°C</td>
</tr>
<tr>
<td>26a</td>
<td>52</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
</tr>
<tr>
<td>27c</td>
<td>53</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
</tr>
<tr>
<td>27a</td>
<td>54</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
</tr>
<tr>
<td>28c</td>
<td>55</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
</tr>
<tr>
<td>28a</td>
<td>56</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
</tr>
<tr>
<td>29c</td>
<td>57</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
</tr>
<tr>
<td>29a</td>
<td>58</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
</tr>
<tr>
<td>30c</td>
<td>59</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
</tr>
<tr>
<td>30a</td>
<td>60</td>
<td>Max pot</td>
<td>Max pot</td>
<td>Max pot</td>
<td>Max pot U/P,F</td>
<td>Max pot U/P,F</td>
<td>Max pot</td>
<td>Max pot</td>
<td>Max pot U/P,F</td>
<td>Max pot U/P,F</td>
</tr>
<tr>
<td>31c</td>
<td>61</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
<td>reserve</td>
</tr>
<tr>
<td>31a</td>
<td>62</td>
<td>Alarm</td>
<td>Alarm</td>
<td>Alarm</td>
<td>Alarm</td>
<td>Alarm</td>
<td>Alarm</td>
<td>Alarm</td>
<td>Alarm</td>
<td>Alarm</td>
</tr>
<tr>
<td>32c</td>
<td>63</td>
<td>-Vcc</td>
<td>-Vcc</td>
<td>-Vcc</td>
<td>-Vcc</td>
<td>-Vcc</td>
<td>-Vcc</td>
<td>-Vcc</td>
<td>-Vcc</td>
<td>-Vcc</td>
</tr>
<tr>
<td>32a</td>
<td>64</td>
<td>-Vcc</td>
<td>-Vcc</td>
<td>-Vcc</td>
<td>-Vcc</td>
<td>-Vcc</td>
<td>-Vcc</td>
<td>-Vcc</td>
<td>-Vcc</td>
<td>-Vcc</td>
</tr>
</tbody>
</table>
1) FUNCTIONAL

- This unit is mainly an interface between external signals and low power electronics.

- It is composed by:
  
  - The adaptation three phases transformer between generator input voltages (1F, 2F) and measurement circuits. For 2F a P.F / KVAR card must be fitted in the AVR
  
  - The burden resistor of parallel CT.
  
  - The adaptation transformer between input voltage and low power electronic supplies.

2) ADJUSTMENTS

- None

3) INPUT / OUTPUT

- See following table

<table>
<thead>
<tr>
<th>INPUT TERMINAL</th>
<th>Connector</th>
<th>Type</th>
<th>Interface</th>
<th>Connector</th>
<th>Connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6c</td>
<td>measure</td>
<td>transfo 3Ø TP3</td>
<td>1</td>
<td>7a</td>
</tr>
<tr>
<td>2</td>
<td>8c</td>
<td>measure</td>
<td>transfo 3Ø TP3</td>
<td>3</td>
<td>8c</td>
</tr>
<tr>
<td>3</td>
<td>10c</td>
<td>measure</td>
<td>transfo 3Ø 3</td>
<td>5</td>
<td>8a</td>
</tr>
<tr>
<td>9</td>
<td>5c</td>
<td>measure</td>
<td>resistance RTI</td>
<td>25</td>
<td>9a</td>
</tr>
<tr>
<td>10</td>
<td>7c</td>
<td>measure</td>
<td>GND</td>
<td>23</td>
<td>7c</td>
</tr>
<tr>
<td>20</td>
<td>7a</td>
<td>shield</td>
<td>GND</td>
<td>23</td>
<td>7c</td>
</tr>
<tr>
<td>21</td>
<td>1c</td>
<td>signal</td>
<td>resistance</td>
<td>19</td>
<td>11a</td>
</tr>
<tr>
<td>22</td>
<td>9a</td>
<td>signal</td>
<td>direct</td>
<td>26</td>
<td>21a</td>
</tr>
<tr>
<td>23</td>
<td>2c</td>
<td>signal</td>
<td>resistance</td>
<td>23</td>
<td>7c</td>
</tr>
<tr>
<td>24</td>
<td>2a</td>
<td>signal</td>
<td>resistance</td>
<td>15</td>
<td>1c</td>
</tr>
<tr>
<td>25</td>
<td>8a</td>
<td>signal</td>
<td>direct</td>
<td>24</td>
<td>20c</td>
</tr>
<tr>
<td>26</td>
<td>3c</td>
<td>signal</td>
<td>resistance</td>
<td>17</td>
<td>32a</td>
</tr>
<tr>
<td>27</td>
<td>3a</td>
<td>signal</td>
<td>resistance</td>
<td>15</td>
<td>1c</td>
</tr>
<tr>
<td>28</td>
<td>6a</td>
<td>signal</td>
<td>direct</td>
<td>22</td>
<td>21c</td>
</tr>
<tr>
<td>29</td>
<td>4c</td>
<td>signal</td>
<td>resistance</td>
<td>17</td>
<td>32a</td>
</tr>
<tr>
<td>30</td>
<td>11c</td>
<td>cmd input</td>
<td>relay</td>
<td>16</td>
<td>24a</td>
</tr>
<tr>
<td>31</td>
<td>1a</td>
<td>common</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>14a</td>
<td>cmd output</td>
<td>relay</td>
<td>8</td>
<td>31a</td>
</tr>
<tr>
<td>34</td>
<td>13a</td>
<td>cmd output</td>
<td>relay</td>
<td>1</td>
<td>31a</td>
</tr>
<tr>
<td>35</td>
<td>15c</td>
<td>cmd input</td>
<td>relay</td>
<td>12</td>
<td>23a</td>
</tr>
<tr>
<td>36</td>
<td>16a</td>
<td>cmd input</td>
<td>relay</td>
<td>10</td>
<td>24c</td>
</tr>
<tr>
<td>37</td>
<td>1a</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>10a</td>
<td>cmd input</td>
<td>relay</td>
<td>14</td>
<td>20a</td>
</tr>
<tr>
<td>39</td>
<td>4a</td>
<td>signal</td>
<td>resistance</td>
<td>21</td>
<td>17a</td>
</tr>
<tr>
<td>40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

VOLTAGE INPUTS:

<table>
<thead>
<tr>
<th>Reference</th>
<th>Generator sensing voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>C5 195 0230</td>
<td>100V to 120V 50/60Hz</td>
</tr>
<tr>
<td>C5 195 0232</td>
<td>400V to 450V 50/60Hz</td>
</tr>
</tbody>
</table>
R610 potentiometers position. For adjustments, refer to specific card technical manual
1) FUNCTIONAL
- This card, from not regulated symmetrical voltage, generates +15Vdc and -15Vdc voltages with 0V common to both named +Vcc for +15V and Vdd for -15V in the following.
- The non regulated voltages are first filtered (C01, C02), pre-regulated to 20dc with ballast stages Q01 et Q02 and finally decreased to15V by means of RG01 et RG02 regulators.
- Its permanent current capability is 0,5 Amp on both polarity.

2) ADJUSTMENTS
- None

3) INPUTS / OUTPUTS
- 2a, 2c : Input +30Vdc not regulated
- 3a,3c : Input -30Vdc not regulated
- 1a,1c : Output +15Vdc regulated (Vcc)
- 32a,32c : Output -15Vdc regulated (Vdd)
- 16a,17c : Common electronic ground
1) FUNCTIONAL

- This card elaborates from the three phases voltage image of the generator given by the "ALTERNATOR I/O" :
  - A rectified, calibrated, filtered voltage \( V_m \) proportional to the stator voltage of the generator. \( V_m \) could be affected by droop depending of adjustment.
  - A voltage function of the generator frequency, a part of which gives the reference set point named \( V_{ref} \).
  - \( V_{ref} \) is a constant above the underfrequency threshold set point (signaled by LED) and decreases below this threshold following a function depending of the position of the strap CV1:
    - In fixed V/Hz mode
    - In adjustable kVolt / Hz (see curve below)

2) ADJUSTMENTS

- P1 : Reactive droop adjust for parallel operation between equivalent machine.
- P2 : \( V_m \) adjust for nominal voltage. (9Vdc at Un)
- P3 : Underfrequency threshold adjust (normally \( F_n - 5\% \) signaled by LED).
- P4 : Underfrequency slope adjust ( \( k \) ) in kVolt / Hz mode
- P5 : Voltage set point \( V_{ref} \) for the nominal voltage (9Vdc at Un and \( F_n \))

3) INPUTS / OUTPUTS

- 7a, 8a, 8c : Voltage inputs image of the generator (3 x 21Vac between each and the GND)
- 9a : Current input image of the generator stator current (1Vac pour \( I_n \))
- 1a,1c : +15Vdc regulated (Vcc)
- 32a,32c : -15Vdc regulated (Vdd)
- 16a,17c : Common ground (GND or 0V)
- 11c : Voltage output image of the generator (\( V_m \)) 9Vdc at Un
- 11a : Voltage set point output (\( V_{ref} \)) 9Vdc at Un and \( F_n \)
**AVR MODEL R610**

**SENSING CARD**

---

Principle diagram

**SENSING card**

---

**OPTION**

- Mains voltage
- Volt match adjust
- **P1**

**SUPPLY**

- **O +15V**
- **O -15V**

**Détection Sensing**

- **Vref**
- **P5**
- **P7**
- **V m min**
- **KVAR**
- **P1**
- **P5**
- **Gain kvar**
- **P7**
- **P4**
- **Gain cosØ**
- **P7**
- **P1**
- **D**
- **Droop**
- **P5**
- **P1**
- **Under Frequency**
- **P7**
- **P1**
- **Statisme D**
- **P7**
- **Limitation excc min**
- **P1**
- **Ramp end**

---

NT1950052/a-03/96 f:2/2  
Page : 17/43
1) FUNCTIONAL
- This card, from Vm (machine voltage image), Vref (voltage set point) and complementary informations given in the following, elaborates the voltage command of the power driver card, which is the field current set point.
- Three operating modes are possible, depending of external informations:
  - Solo operation or parallel operation between equivalent machines (1 Fonction) (This is the normal mode)
  - Parallel operation with the mains with power factor (COSØ) or KVAR regulation (2 Fonction) (Only if COSØ / KVAR card is fitted)
  - Operation in voltage equalization mode between machine and mains before coupling (3 Fonction) (Only if "MAINS I / O" CARD is fitted)
1F : Machine image Vmis compared with the sum of Vref, Pext, etc voltages depending of used options and the resultant voltage (error voltage) feeds the PID.
2F : When cosØ cmd input is activated (+Vcc), the machine voltage Vm is compared to the voltage given from the cosØ/KVAR card and the result (error voltage) feeds the PID.
3F : When U/U cmd input is activated (+Vcc), the machine voltage Vm is compared to the voltage given from the "MAINS I / O" card and the result (error voltage) feeds the PID.

A compensation external input, given for specific applications is added to the error voltage and the resultant voltage is the real PID input. Each branch (P, I, D) of the PID, independently adjustable from the others, set the time constants of the AVR in regard to the generator. The integrator branch can be short-circuited, for example when starting-up.

These three outputs are added, limited to 10Vdc and then give the field current set voltage of the "automatic channel" which is the driver card input.

The minimum value of this signal can be limited to avoid total loss of excitation of the generator. In case of parallel operation with the mains (cosØ/KVAR card), this limitation is a function of the active power supply by the generator, this information is given by the COSØ / KVAR card.

A separate stage detects if the generator voltage is below an adjustable value to unlock the normal field ceiling voltage from 110% of nominal to 160% (adjustable).

2) ADJUSTMENTS
- P1 : Ceiling unlocked voltage threshold adjust (normally 90% Un).
- P2 : Proportionnal branch gain adjust (large signal)
- P3 : Proportionnal branch gain adjust
- P4 : Integrative branch time constant adjust
- P5 : Derivative branch gain adjust
- P6 : Derivative branch time constant adjust
- P7 : Minimum field limitation adjust
- P8 : Minimum field limitation, active power correction adjust

3) INPUTS / OUTPUTS
- 11a : Voltage reference set point input. Vref
- 13c : Added signal to voltage reference set point input (option)
- 22c : Added signal to voltage reference set point input (external voltage option)
- 21a : Added signal to voltage reference set point input (external potentiometer option)
- 13a : Added signal to voltage reference set point input (differential droop option; with cosØ/KVAR card)
- 19a : Integrator short-circuit command input
- 10a : Mains image voltage input (3F) (with "MAINS I / O" card only)
- 14c : CosØ error voltage input (2F) (with cosØ/KVAR card)
- 25c : Voltage equalization command input (3F) (with "MAINS I / O" card only)
- 24a : CosØ regulation command input (2F) (with cosØ/KVAR card)
- 1a,1c : +15Vdc regulated (Vcc)
- 32a,32c : -15Vdc regulated (Vdd)
- 16a,17c : Common electronic ground
- 14a : Minimum field limitation, active power correction input
- 15c : Field current voltage control output "AUTO" channel
1) FUNCTIONAL

This card controls from "AUTO" and "MANU" voltage reference and some additional informations detailed in the following, the exciter field current supply by the regulator and the booster (if used).

- Three operating modes are possible, depending on external informations:
  - Normal mode with 110% ceiling of If nominal.
  - Ceiling unlocked mode (160% minimum If field nominal) depending of the command input from the PID card with limited delay and alarm output in case of sustained undervoltage.
  - Maximum ceiling mode if the synchronisation voltage disappears (machine short-circuit) with limited (adjustable) field current.

- The "AUTO" or "MANU" reference voltage depending of the associated command input and also of the active limitations, is compared to the field current measurement and gives the error voltage which is after integration, compared to a sawtooth feed by the synchronisation voltage. The output of this stage is a variable duty cycle signal which controls the power transistors through isolating optocouplers.

- This card can be supplied in three manners:
  - From the general supply of the rack in normal operation
  - Through an isolated supply taken from the field voltage during start-up or generator short-circuit. (Rack supply not present)
  - Directly from the field voltage for power transistor command.

The permanent limitation (110% de If exc nominal) can be modified by the following conditions:

- Field ceiling unlocking on machine undervoltage condition. It increases from 110% (normal operation) to a minimum of 160% of the nominal field current during an adjustable time delay and then go back to 110%. An alarm is activated if this undervoltage is sustained afterward.
- Field ceiling unlocking on synchronisation voltage absence. It increases to the maximum given by the setting of P7.
- Field ceiling limitation caused by power heatsink overheating. On thermocontact action the ceiling is reduced to a value given by the setting of P8.

A separate circuit monitors the instantaneous current of the power transistor and reduces immediately the command signal if its value increases above a fixed value. (Exciter or wiring short-circuit protection).
1) FUNCTIONAL

This option allows the parallel operation coupling with the
mains with P.F or KVAR regulation (also called 2F)

This card elaborates from generator current and voltage
informations, the following signals:
- An image of the reactive current of the generator named (KVAR) used for KVAR regulation.
- An image of the phase shift between the voltage and the current of the generator named (Ø) used for cosØ (PF) regulation.
- An image of the active current of the generator named (KW) used for compensate the minimum Ifield limit of the PID card.
- The principle of measurement is to sample and hold the instantaneous value of the current when the instantaneous voltage reaches zero on positive slope.
- First the current image of the stator current is filtered and used directly for KVAR measure. Then it is derivated and used for KW measure. And then it is amplified to obtain square waves and integrated to give a sawtooth used to Ø measure.
- The voltage image is phase-shifted to compensate the phase shift of the current input filter and after amplification is fed to a monostable which gives the pulse signal (about 100µs) used by all the sample and hold circuits.
- KVAR and Ø values are compared with an internal and external (if used) setting and the difference is send to the PID card as an error signal. An external contact control an analog switch to select what information between KVAR and Ø will be regulated.
- Three informations (Ø, ΔØ, ΔKVAR) can be used as an alternative droop for solo operation.
- ΔØ gives no droop at cosØ=1 and the voltage decreases at lagging PF:
- ΔKVAR gives no droop at the KVAR value setting and the voltage decreases with more KVAR and increases if less.

The selection between these is made by mean of jumper (CAV) on the card. (internal)

2) ADJUSTMENTS

- P1 : KVAR internal setting.
- P2 : PF (cosØ) internal setting.
- P3 : Voltage phase shifter (internal)
- P4 : PF (cosØ) gain setting
- P5 : KVAR gain setting.
- P6 : Différential droop setting
- P7 : Pulse width setting (internal)
- Jumper CAV : Selection of droop type

No : Reactive droop adjusted by P1 (sensing card)
CAV1 : No droop for cosØ=1 and droop if lagging.
CAV2 : No droop for KVAR setting (P1), voltage decreases if more KVAR (lagging) and opposite if less.
CAV3 : No droop for PF setting (P2), voltage decreases if more lagging and opposite if less or leading.

Nota : If the droop is used from this card, potentiometer P1 of the sensing card must be set to zero.

3) INPUTS / OUTPUTS

Flat cable (BUS 64points)
- 8c : Generator voltage image input
- 9a : Generator current image input
- 20a : Command input "cosØ / KVAR" (0V = "cosØ")
- 21c : External KVAR setting input
- 20c : External cosØ setting input
- 1a,1c : +15Vdc supply (Vcc)
- 32a,32c : -15Vdc supply (Vdd)
- 16a,17c : Common electronic ground
- 14c : Error signal output to PID card
- 13a : Droop signal output to sensing card
- 14a : KW signal output to PID card
- 12a : KVAR signal output
- 10c : Ø signal output
AVR MODEL R610
COSØ - KVAR card

principle diagram
COSØ - KVAR card
1) FUNCTIONAL

This option allows the automatic matching of the mains and generator voltage during synchronizing (also called 3F).

- This unit is mainly an interface between external signals and low power electronics.

- It is composed by:
  - The adaptation three phases transformer between input voltages (generator (1F,2F) and mains (3Fonly) and measurement circuits.
  - The burden resistor of parallel CT.
  - The adaptation transformer between input voltage and low power electronic supplies.
  - The interface input relays between command / control terminals and internal circuits.
  - The interface between 64pts BUS and the analogic input / output terminals.

2) ADJUSTMENTS

- Voltage matching adjustment (P1) (3Fonly)

3) INPUT / OUTPUT

- See following table

<table>
<thead>
<tr>
<th>INPUT TERMINAL</th>
<th>Connector Type</th>
<th>I / O</th>
<th>Interface</th>
<th>Connector Type</th>
<th>Connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6c</td>
<td>measure</td>
<td>transfo 3Ø TP3</td>
<td>1</td>
<td>7a</td>
</tr>
<tr>
<td>1</td>
<td>6c</td>
<td>supply</td>
<td>transfo TP2</td>
<td>2</td>
<td>8c</td>
</tr>
<tr>
<td>2</td>
<td>8c</td>
<td>measure</td>
<td>transfo 3Ø TP3</td>
<td>3</td>
<td>8a</td>
</tr>
<tr>
<td>2</td>
<td>8c</td>
<td>supply</td>
<td>transfo TP1/2</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>10c</td>
<td>measure</td>
<td>transfo 3Ø 3</td>
<td>7</td>
<td>9a</td>
</tr>
<tr>
<td>3</td>
<td>10c</td>
<td>supply</td>
<td>transfo TP1</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>5c</td>
<td>measure</td>
<td>resistance RT1</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>7c</td>
<td>measure</td>
<td>GND</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>12c</td>
<td>measure</td>
<td>transfo 3Ø TP4</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>14c</td>
<td>measure</td>
<td>transfo 3Ø TP4</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>16c</td>
<td>measure</td>
<td>transfo 3Ø TP4</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>7a</td>
<td>shield</td>
<td>GND</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>1c</td>
<td>signal</td>
<td>resistance</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>9a</td>
<td>signal</td>
<td>direct</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>2c</td>
<td>signal</td>
<td>resistance</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>2a</td>
<td>signal</td>
<td>resistance</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>8a</td>
<td>signal</td>
<td>direct</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>3c</td>
<td>signal</td>
<td>resistance</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>3a</td>
<td>signal</td>
<td>resistance</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>6a</td>
<td>signal</td>
<td>direct</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>4c</td>
<td>signal</td>
<td>resistance</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>11c</td>
<td>cmd input</td>
<td>relay</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>1a</td>
<td></td>
<td></td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>13c</td>
<td>cmd input</td>
<td>relay</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>14a</td>
<td>cmd output</td>
<td>relay</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>13a</td>
<td>cmd output</td>
<td>relay</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>15c</td>
<td>cmd input</td>
<td>relay</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>16a</td>
<td>cmd input</td>
<td>relay</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>1a</td>
<td></td>
<td></td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>10a</td>
<td>cmd input</td>
<td>relay</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>4a</td>
<td>signal</td>
<td>resistance</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td></td>
<td></td>
<td></td>
<td>17</td>
<td></td>
</tr>
</tbody>
</table>

VOLTAGE INPUTS:

<table>
<thead>
<tr>
<th>Reference</th>
<th>Generator sensing voltage</th>
<th>Mains sensing voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>C5 195 0233</td>
<td>100V to 120V 50/60Hz</td>
<td>100V to 120V 50/60Hz</td>
</tr>
<tr>
<td>C5 195 0235</td>
<td>400V to 450V 50/60Hz</td>
<td>400V to 450V 50/60Hz</td>
</tr>
<tr>
<td>C5 195 0234</td>
<td>400V to 450V 50/60Hz</td>
<td>100V to 120V 50/60Hz</td>
</tr>
</tbody>
</table>
R610 potentiometers position. For adjustments, refer to specific card technical manual.
1) FUNCTIONAL

This card replace two conventional motorized potentiometers:
- One for the remote voltage setting.
- One for power factor or reactive current setting.
- Switch between the two modes is made by the external P.F regulation order (terminals 33,34) and switch between P.F and KVAR setting is made by the external order (terminals 48,53)
- Each last position is memorized when the control is switched or when the machine is stopped.

- Jumps (SW1 and SW2) allow the choice between unipolar or bipolar voltage output and the range is adjusted by means of potentiometers P02 and P03.
- Jumps SW3 and SW4 must be open for normal operation and are only used for special applications.
- Speed of all adjustments is controled by potentiometer P01.
- Two LED's (L1,L2) indicate the command orders + or - and four other LED's (L3,L4 and L5,L6) indicates the maximum and minimum position of voltage and P.F settings

-NOTE: When this card fitted, the internal voltage setting (P05 on sensing card) must be used to give the center position of the range (if bipolar range) or the minimum setting in case of unipolar range (idem for P.F and Kvar internal setting on P.F card). An external setting potentiometer must not be used, the settings are made only by mean of push-buttons on terminals 42,43,44.

2) ADJUSTMENTS

- P1 : Clock speed (total range time)
- P2 : Voltage range value
- P3 : P.F or KVAR range value
- SW1 : Voltage range polarity (0/+ or +/-)
- SW2 : P.F or KVAR range polarity (0/+ or +/-)

3) INPUTS / OUTPUTS

Flat cable (BUS 64points)

- 24c : Cmd lower
- 23a : Cmd upper
- 16c : If reference set point input
- 15c : If reference set point input "AUTO" channel
- 24a : External P.F regulation order
- 20a : External P.F or KVAR regulation order
- 13c : Voltage setting output to PID card
- 20c,21c : P.F or KVAR setting output to P.F card
- 30a : Maximum position of settings
- 1a,1c : +15Vdc regulated (Vcc)
- 32a,32c : -15Vdc regulated (Vdd)
- 16a,17c : Common ground (GND or 0V)
1) FUNCTIONAL

This card elaborates from internal setting (PO2) and external setting informations, the Ifield command signal given to "MANU" channel of the driver card.
- The Ifield output signal is limited or reduced if the generator voltage exceeds the limitation value sets by the potentiometer P01 (trip of the main breaker on load for example ).
- This case of operation is indicated by the LED "LIMIT" and the Ifield setting must be decreased to a point under control.
- On MANU operation, the difference between MANU output and AUTO channel output gives a compensation signal which is used to compensate the PID to have always the MANU and AUTO channels outputs identical. With this circuit a smooth switching between MANU to AUTO is possible and operation will go back to the AUTO channel own settings.
- The ceiling can be unlocked on this operation, that is why it can be necessary to wait some seconds after the switching to return on MANU operation.
- On AUTO operation, these two channels are also monitored and the difference is indicated by three LEDs.
  - HIGH says that MANU channel is higher than AUTO
  - LOW says that MANU channel is lower than AUTO
  - OK says that MANU and AUTO channels are identical and smooth AUTO ---> MANU switching is possible.

NOTE :
For the R610, the switching between AUTO <-> MANU is only possible by the switch command in front of the card, and the setting by the front potentiometer. It is not possible to use remote command or control.

2) ADJUSTMENTS

- P1 : Voltage limitation setting
- P2 : Internal Ifield value setting
- P3 : PID compensation gain setting
- P4 : Internal compensation setting

3) INPUTS / OUTPUTS

Flat cable (BUS 64points)
- 4c : 24Vac input image of the generator from "generator I/O" card
- 25a : "AUTO / MANU" command input (0V = "AUTO")
- 16c : If reference set point input
- 15c : If reference set point input "AUTO" channel
- 27c : External Ifield setting input
- 1a, 1c : +15Vdc regulated (Vcc)
- 32a, 32c : -15Vdc regulated (Vdd)
- 16a, 17c : Common ground (GND or 0V)
- 15a : If set point output "MANU" channel
- 12c : PID compensation output
- 9c : Ceiling locked output
MANUAL MODE 2 CARD MIMIC DIAGRAM

24Vac
\[ \uparrow \]
\[ 16, 17c \]
\[ 1c, 1a \]
\[ 32c, 32a \]
\[ 0V \]
\[ \text{AC / DC} \]
\[ \text{Filter} \]
\[ \text{PI amplifier} \]
\[ \text{Vintage limitation} \]
\[ \text{If field setting} \]
\[ S\text{ manu} \]
\[ \text{External If Control} \]
\[ \text{Limitation} \]
\[ + \]
\[ - \]
\[ \text{If setting too high} \]
\[ \text{If setting too low} \]
\[ \text{If setting OK} \]
\[ + \]
\[ - \]
\[ \text{Switch on front} \]
\[ \text{Gain} \]
\[ \text{Ceiling locked} \]
\[ \text{Cmd auto/manu} \]
\[ \text{PID Correct} \]
\[ \text{If field Cmd S auto} \]

MANUAL MODE
\[ A \Rightarrow M \]
\[ \text{LIMIT} \]
\[ \text{HAUT} \]
\[ \text{HIGH} \]
\[ \text{LOW} \]
\[ \text{BAS} \]
\[ \text{OK} \]

FRONT VIEW
Manual mode

NT1950102/b-10/94 f:2/3 Page : 34/43
1) DESCRIPTION

This card is used when the P.F or KVAR regulation is wanted not at the generator terminals but at the mains input. For this a P.F or KVAR sensor with 4-20mA output is necessary and it must be located at the place where the regulation must be made.

2) FUNCTIONAL

This card elaborates from setting informations and 4-20mA signal image of P.F (or KVAR) of the mains, the error-voltage dending to the PID of the PID card.
- The error signal have an adjustable gain and can be inversed depending of the 4-20mA sensor output.
- This kind of operation is indicated by the LED "L3" and by a contact (potential free) on the front connector.
- This operation is selected by mean of a contact on front connector and will be active on coupling when contact between terminals 33,34 of main terminals will be closed. If the contact on front connector remains open, the regulation (P.For KVAR) will be made at the generator output, if it is closed, this is the 4-20mA information wich is regulate function of the internal settings (P2 or channel 2 4-20mA) or/and external by the front connector.
- If during operation, the measuring 4-20mA signal desappears, control is automatically return to regulation on the generator output side and this failure is indicated by LED L1 ou L2 and by a contact on front connector.
- A second channel can be used as set point of the first channel or as a remote adjustment of voltage, P.F or KVAR on generator side. As on channel 1 if the 4-20mA desappears, output is inhibited and indicated by LED L2.
- A field current limitation is given, active when a contact (front connector) is closed and indicated by LED L4. The limtitatio is adjusted by P7 (Limit 2 set) and can be set between a maximum value preset by P7 on driver card and a minimum value preset by P8 on driver card.
- An signaling contact on the front connector gives (if they are used) the indication that one or more of the digital potentiometers are at maximum position.

3) ADJUSTMENTS

**Potentiometers**
- P1 : Channel 1 range adjustment
- P2 : Reference set point channel 1
- P3 : Gain channel 1
- P4 : Channel 2 range adjustment
- P5 : Reference set point channel 2
- P6 : Gain channel 2
- P7 : Limit 2 adjustment

**Jumpers**
- CV1 A : Channel 1 used
- CV1 B : Channel 1 not used
- CV2 A : Channel 1 used

4) INPUTS / OUTPUTS

**Flat cable (BUS 64points)**
- 12c : Error output to PID
- 21a : Output to voltage setting
- 20c : Output to generator P.F setting
- 21c : Output to generator KVAR setting
- 30a, c : Digital pot at maximum position
- 1a.1c : Supply +15Vdc regulated (Vcc)
- 32a,32c: Supply -15Vdc regulated (Vdd)
- 16a,17c: Common ground
- 23a : Cmd + U or + P.F
- 24c : Cmd - U or - P.F
- 14c : Output of generator side P.F card
- 24a : P.F regulation order
- 26c : Limitation 2 output to driver card

**Front connector (DB25 points)**
- 13 : + 4-20mA input channel 1
- 25 : 4-20mA output channel 1
- 20 : 12V to external setting potentiometer ch 1
- 12 : External setting potentiometer cursor ch 1
- 24 : Ground to external setting potentiometer
- 11 : + 4-20mA input channel 2
- 23 : 4-20mA output channel 2
- 20 : 12V to external setting potentiometer (ch 2)
- 10 : External setting potentiometer cursor ch 2
- 22 : Ground to external setting potentiometer
- 9 : 4-20mA failure (NO)
- 21 : 4-20mA failure (NF)
- 8 : 4-20mA failure (Commun)
- 3 : Digital pot at max position (NO)
- 15 : Digital pot at max position (NF)
- 2 : Digital pot at max position (Common)
- 7,19 : Contact regulation ch 1 active (mains P.F)
- 14,1 : Limitation 2 active

**LED**
- L1, L2 : 4-20mA failure channel 1 or 2
- L3 : Channel 1 active
- L4 : Ifield limitation 2 active
1) FUNCTIONAL
- A voltage, image of the stator current of the machine, fed from the “ALTERNATOR I / O” card is rectified, filtered and compared to a reference voltage. The error signal gives a voltage correction which is added to the main PID input to maintain the stator current equal to the adjusted value.
- The reference voltage is applied with an initial ramp adjustable from 0,5 to about 4s.
- A front LED signals stator current limitation operation.
- When this card is used for soft-start operation, the AVR power transformer must be fed from a separate source during the start operation and can be switched on the generator output when the voltage have reached the nominal value. The switching must be as fast as possible (by relay, not by manual switch).

2) REGLAGES
- P1 : Stator current limit adjust. (about 2In to 4In)
- P2 : Ramp-up time adjust. (0,5 à 4s environ)
- P3 : Output signal gain

3) INPUTS /OUTPUTS
- 9a : Stator current image input (1Vac for In)
- 1a,1c : +15Vdc regulated (Vcc)
- 32a,32c : -15Vdc regulated (Vdd)
- 16a,17c : Common ground (GND or 0V)
- 12c : Voltage correction output to PID.
1) STARTING WITH MANUAL MODE CARD
- For initial start-up, the best is to use the manual mode for testing the sensing wires between the generator and the AVR.
- For this it is necessary to have a manual mode card plugged in the AVR. If not, see directly §2.
- Switch the manual card on ON (switch in front of card).
- Set the potentiometer P2 on manual card maximum CCW, start the prime mover up to the nominal speed.
- Turn slowly the potentiometer CW to obtain the nominal voltage.
- Check the presence and the value of the three phases at the AVR terminal block (terminals 1, 2, 3).
- Set the voltage to 5% above the nominal voltage.
- If yes, switch off the manual operation in the front of manual card.
- The voltage must reach the nominal value.
- Go to §3

2) STARTING WITHOUT MANUAL MODE CARD
- Start the prime mover up to the nominal speed.
- If the voltage does not appear, check wires between AVR and the generator field (terminals 5 and 6 of AVR), and the also the wires between AVR and power transformer (terminals 14, 15 (and 16 if used) of AVR. Check also the fuse inside the terminal 14,16 of AVR terminal block.
- If the voltage is too high, check that the sensing voltages at the terminals 1, 2, 3 of the AVR terminal block are present.
- Adjust the nominal voltage with Vref (P5) of the sensing card for the middle position of the external voltage potentiometer if used.

3) DE-ENERGIZING (optional)
- External contacts E01 and E02 must be used.
- E01 must be serie with terminal 14,15 of AVR (power input) and is opened for de-energizing.
- E02 must short-circuit the booster output (if used) (terminals 7 and 8 of AVR) and is closed for de-energizing.

4) ADJUSTMENTS
- Refer also to card descriptions.
- The AVR is normally preset in factory.
- The nominal voltage can be set by Vref (P5) on sensing card. Fine adjustment can be made by an external voltage potentiometer (10KΩ), (terminals 21, 22, 23).
- If an adjustment must be moved, note carefully the original setting for resetting in case of problems.
- If the strap V/Hz of sensing card is on kV/Hz position, the original setting is V/Hz and can be changed between V/Hz and 2V/Hz by potentiometer P4.
- The stability is adjusted with the machine in factory. If necessary, the response time can be changed by the setting of potentiometer P4 of PID card.
- Other settings are difficult to adjust without specific electronics equipments. It is better to not change them.

5) FIELD FLASHING
- Generally, field flashing is not necessary, but in some cases like long stop time or fault trip, it can be possible that the voltage does not appear naturally.
In this case, connect a 12Vdc to 24Vdc voltage source to the terminals 4 and 8 of AVR terminal block, + to 4 for a short time and remove it when the voltage increases.

6) PARALLEL OPERATION(1F)
- The generator voltages must be as equal as possible.
- Same for the droop. If it is not possible to measure it, set the potentiometers P1 of the sensing cards all in the same position. (middle set for example)
If the droop setting is made from cosØ/KVAR card (when used), see notice NT 1950080.
- The reactive currents (KVAR) must be shared, immediately after coupling. even the KW are not shared.
- If, immediately after coupling, the current increases abnormally, check if the parallel CT wires are not reversed. (9 et 10 of AVR terminal block)
- If the coupling is OK but if when the load increases, the cosØ or the current have an abnormal value, check that the sensing phases at the input of the AVR are right connected. (U, V, W respectively to the terminals 1, 2, 3 if clockwise rotation or W, V, U, if counter clockwise rotation)
7) PARALLEL WITH THE MAINS (2F)
- The generator and mains voltages must be as equal as possible. (see GENERATOR/ MAIN I/O card manual). The contact between terminals 30, 31 of AVR terminal block must be closed at the same time as the coupling and will remain closed as long as the generator is connected to the mains.

It will be open when parallel between generators.
- If, immediately after coupling, the current increases abnormally, check if the parallel CT wires are not reversed. (9 et 10 of AVR terminal block)
- If the coupling is OK but if when the load increases, the cosØ or the current have an abnormal value, check that the sensing phases at the input of the AVR are right connected. (U, V, W respectively to the terminals 1, 2, 3 if clockwise rotation or W, V, U, if counter clockwise rotation)
- The PF value is normally factory set to 0.9. It can be adjusted by mean of potentiometer P2 on cosØ/KVAR card or by mean of an external potentiometer (10KΩ-1W) connected to AVR terminal block (24,25,26)
- If the KVAR regulation is required terminals 37 and 38 must be short-circuited and the KVAR can be set by mean of potentiometer P1 on cosØ/KVAR card or by mean of an external potentiometer (10KΩ-1W) connected to AVR terminal block (27,28,29)
- For droop setting, see notice NT 1950080.

8) VOLTAGE EQUALISATION (3F)
- The following procedure must be made one time to take account of the mains transformer primary/secondary ratio.
- At no load and mains voltage present at terminals 11,12,13 of the AVR terminal block.
- Short circuit terminals 31,32 of the AVR terminal block
- Adjust P1 of MAIN I/O card to have generator and mains voltage as equal as possible.
- Remove the strap between terminals 31,32 of the AVR terminal block.
- The initial setting is made.

In normal operation the contact between terminals 31,32 of the AVR terminal block must be closed with synchronizer operation and can be opened after coupling.

9) MANUAL OPERATION (if used)
- If a manual mode card is used, it is possible to control directly the field current of the generator.
- In automatic mode, adjust the potentiometer P2 on manual mode card to have the LEDs "HIGHT" and "LOW" off and the LED OK lighting. At this time the manual setting is equal to the automatic channel control.
- Switch on front of manual card on position "ON" gives control to the manual channel and the field current is adjusted by potentiometer P2.

- This mode can be used when initial start-up of the generator, to make test after problems or when operating with the mains. It cannot be used when solo operation because it is not possible to follow the load variations.
- When coupling with the mains on load, if trip of the generator occurs, an overvoltage may occurs due to the fact that the field current setting is too high regarding the load of the generator. On this case, an internal circuit of the card decreases the field current to limit the overvoltage approximatively to 110% of nominal, the voltage in this case can be unstable but protect faster the equipments. LED "LIMIT" on front of the card will light. The setting of field current must be reset manually to the no load value and the LED "LIMIT" will switch off.