Digital On-load Tap-Changer Voltage Controller
TAPCON® 250

Reinhausen Manufacturing Inc.
Humboldt, TN USA
Contents

• History of MR Automatic Voltage Regulation

• Foundation of Today’s TAPCON® series

• The latest TAPCON® Technology
  TAPCON® 250

• Control Methods for Transformers
  incl. samples
History

Generations up to TAPCON® 230

MK 10
1972

MK 20
1982

MK 30
1988

VC 100
1997

TAPCON® 230
2002
History  Generations up to TAPCON® 240

TAPCON® 240
2002

VC 100E
1998

MK 30E
1988

MK 20E
1983
Voltage Control

**TAPCON® 240**

**Voltage Control**

**TAPCON® 230**
TAPCON® 250

- The TAPCON® specifically for US end-users
- Interchangeable into today’s specific schemes
- Size allows easy retrofit solutions
Features

• Informative 128x128 dot graphic display
• LED’s and contacts for status and conditions
• simple and clear menus to navigate
• NORMSET for easy parameterization
• TAPCON®-trol System Visualization Software
Features

- Line Drop Compensation by
  R and X compensation
  Z compensation

- Several Paralleling Methods
  in one device without
  additional hardware
  circulating current
  Master - Follower

- Four different levels for
  voltage regulation
Features

• Reverse Power Operation

• Operations Counter

• Tap Position Knowledge by current loop method

• Tap Position Limits

• Tap Position Record
**Inputs**

- **Voltage Input**
  Measuring Potential Transformer 120VAC
  auxiliary Power Supply 12V DC

- **Current Input** 0.2 A

- **Four Programmable Command Inputs**
  Settable for Alternate Voltage Levels 2, 3, or 4, Auto Tapchange Inhibit, Parallel Group 1 or 2, Master/Follower, Quicktap, or Remote Voltage Level Activation

**Auto/Manual and Remote/Local Activation Inputs**

**Operation Count Input**
**Outputs**

- Isolated Form C Contacts Showing Modes or Status
  - MANUAL/AUTO
  - User programmable alarms
  - Status Alarm...

- Tap Position (analog)
Analog Interface

• Direct tap position knowledge

• Choice of tap position input:
  0 … 1 mA
  0 … 20 mA
  4 … 20 mA
  potentiometer

• Choice of tap position output:
  0 … 1 mA
  4 … 20 mA
Communications

- **Choice of communication ports:**
  - RS232, RS485,
  - fiber optical
  - RJ45 (modem or Ethernet)

- **Choice of communication protocols:**
  - DNP3.0
  - MODBUS ASCII & RTU
  - *on demand:*
    - e.g. IEC60870 –103,104

Communications Interface (CI)
TAPCON® 250

• MR has placed the TAPCON® series technology into this versatile package

• The adaptability to retrofit into existing installations with the leading edge technology
• Overview of different Control Schemes

• Circulating Current Analog Paralleling

• Circulating Current Digital Paralleling
**TAPCON® 250 Configurations**

**Single Installation**

**Analog Paralleling**
acc. to ANSI C57.12.10

**Digital Paralleling**
via CAN bus
Single Installation

• Standard installation for stand alone power transformers with on-load tap-changer

• Features
  Tap Position Detection
  Communications
  Adaptation to existing installations
  Four Programmable Inputs
  Visualization via TAPCON®trol System
  (included)
**Parallel Control**

*acc. ANSI C57.12.10 scheme*

Within the TAPCON®- family

- **TAPCON® 250**
- **TAPCON® 250**

(or other TAPCON®s)

Together with existing installations

- **TAPCON® 250**
- **e.g. Beckwith M 2001**

---

ANSI-scheme  
CAN-bus
Requirements

- Similar (practically identical Z%)
- Solid high-side bus (no separate sources)
- Comparable step voltages and ranges (but some differences may be tolerable)
- Provisions for LDC
- Same winding ratios
- Same MVA rating (ratio correcting CTs may be used)
TAPCON® 250 Circulating Current Analog Paralleling

Parallel Assistant XPA-I

- Easy adaption for paralleling via
  - CAN bus to Digital Voltage
  - Controllers of the TAPCON® family

- Simplified installations
  less wiring time and reduced failures

- Cost savings
Parallel Control with CAN bus

Digital Paralleling with TAPCON® 250 includes:

- easy parallel operation of up to 16 transformers
- Group Paralleling
- several paralleling methods
  - Circulating Current
  - Master - Follower
- simplified commissioning
- remarkable saving of costs
### Analog Limitations
- CT circuitry wired between transformers
- Similar (practically identical) Z%
- Solid high-side bus
- Comparable step voltages and ranges
- Provisions for LDC
- Same winding ratios
- Same MVA rating (ratio correcting CTs may be used)
- No visual indication of correct settings

### Digital Comparison
- No CT circuitry between transformers
- Z% can be different
- Separated high-side bus okay
- Different step voltages and tap ranges are okay
- LDC doesn’t require adjustment
- Different winding ratios okay
- Different MVA ratings okay (CT is sized according to rating)
- Controller guided commissioning
TAPCON® 250 Digital Paralleling

TAPCON® 250

... the Difference in Paralleling!

Traditional Analogue Scheme  TAPCON® 250 with CAN bus

Only one controller needs indication for two paralleled transformers
**Overview**

- Older analog methods required relay logic
- Master-Follower actually the most common method used in rest of world
- Only the master regulates
- All controllers need positive position knowledge
- Perfect and actually preferred for applications where each transformer naturally carries the load evenly on the same tap position.
  - Same Z%
  - Same Vector Groups
  - Same # of Taps
  - Same step voltage
fewer components.
fewer problems.
less work...

more benefits.
more reliability.
more cost savings...

... TAPCON® 250