

Caterpillar Switchgear

Submittal

WICHITA WATER UTILITIES

MWTP Emergency Generators
448-2021-036463
Org # 54231508
OCA W8000

WICHITA, KANSAS

PROJECT #36019 / #301205

FOLEY
EQUIPMENT



Location: WP Hess Standby Power Generation Bldg
Plant equipment: 5494
Building: 7502-200
Rooms:
7502-200-01-101 Generator Bldg Electrical Room
7502-200-01-100 Generator Bldg Generator Gallery Room

Final Acceptance Date: 2021-01-09
City Project Engineer: Jeff Turhune
City Inspector: Roger Skilling
Contractor: Foley Equipment Co Inc
Contractor Manager: Charles Moffet
Subcontractor: Decker Electric
Project Engineer: Rick Whitehill, PE with PEC

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5494GEN1280001 GENERATOR SWITCHGEAR With DISCONNECT

Change Order #1
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PROJECT INTRODUCTION



Caterpillar Switchgear Aftermarket Warranty

CAT Switchgear warrants its aftermarket services and materials to be free of defects in material and workmanship for a period of (1) one year from the date of sale (material) and ninety (90) days from date of services (labor). This warranty applies to all aftermarket equipment and materials supplied by Caterpillar Switchgear. This warranty expressly excludes all materials and equipment supplied by others, whether new or existing, which are incorporated in Caterpillar Switchgear equipment, whether installed by Caterpillar Switchgear or not.

Caterpillar Switchgear reserves the right of final acceptance of any and all claims for warranty. The Customer is responsible for any and all charges related to a warranty claim should the claim be disallowed. Equipment will, at Caterpillar Switchgear's option, be replaced, or repaired FOB Caterpillar Switchgear's facility, freight prepaid, and in accordance with the following:

Caterpillar Switchgear requires all non-conforming goods be returned at Buyer's expense for evaluation, unless specifically stated otherwise in writing by Caterpillar Switchgear. Unless otherwise agreed in writing, Caterpillar Switchgear assumes no responsibility with respect to the suitability of the Customer's equipment or with respect to any latent defects in the same. This warranty does not cover damage to Customer's equipment, components or parts resulting in whole or in part from their deteriorated condition. This warranty does not cover failure or damage due to misuse, abuse or negligence. This warranty does not cover reimbursement for access, removal, installation, temporary power or any other expense, which may be incurred in connection with repair or replacement. The correction of any defects by repair or replacement by Caterpillar Switchgear shall constitute fulfillment of all obligations and liability of Caterpillar Switchgear to the purchaser under this warranty.

Warranty service is provided at no charge during normal business hours. Warranty service provided outside normal business hours is chargeable at published rates less the cost of normal business hours execution. Standby time is billable at published rates regardless of time of day. Warranty includes parts and labor for Caterpillar Switchgear material and equipment for the stated warranty period. A replacement part is warranted for the remainder of the warranty period and expressly does not extend the warranty period.

Caterpillar Switchgear is not responsible for failure of or damage to its equipment as a result of improper environment, storage, handling, installation, maintenance, operation, repair or adjustment; or as a result of acts of God, such as but not limited to lightning, fire, wind or flood. Further, any damage or subsequent failure as a result of operation of equipment above its rated capacity, or voltage for any reason, intentional or otherwise, is specifically excluded.

No other representations, guarantees or warranties, whether expressed or implied, are made by the seller and the foregoing Warranty is in Lieu of all other representations and warranties, whether expressed or implied, which are hereby expressly disclaimed and waived by Buyer, including any warranty of merchantability or of fitness for particular purpose.

Equipment / Component / Services Covered (specific) _____

Equipment Serial Number _____

Sales Order _____

Service Date (if applicable) _____

ENGINEERING DRAWINGS

INFORMATION DRAWING SET



CATERPILLAR

WICHITA WATER UTILITIES

WICHITA, KANSAS

5kV UTILITY / GENERATOR PARALLELING SWITCHGEAR

FOLEY EQUIPMENT SYSTEMS
CATERPILLAR PROJECT No. 36019 / 301205

TITLE: WICHITA WATER UTILITIES

TITLE SHEET

5KV UTILITY / GENERATOR PARALLELING SWITCHGEAR/BOARD

APPROVED BY *R Collins* ISCALE N.T.S. REV. 4.0

DATE APPROVED 02-28-2023

FILE NAME 36019-TS

DRAWN BY MCT

DATE CREATED 03-20-08

SHEET NUMBER

TS

DATE MODIFIED 09-09-08

AM

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| NO. | REVISION | DATE |
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| 2.0 | ISSUED FOR FIELD STARTUP | 06-19-09 |
| 2.1 | RE-ISSUED FOR FIELD STARTUP | 07-28-09 |
| 3.0 | ISSUED FOR AS BUILT | 04-20-11 |
| 4.0 | ISSUED FOR SUBMITTAL (301205) | 02-28-23 |
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| 1.1 | ISSUED FOR CUSTOMER WITNESS TEST | 06-15-09 |

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ABBREVIATION LEGEND

| ABBREVIATION | DESCRIPTION |
|--------------|-------------------------------------|
| 15/25 | SYNCHRONIZER with SYNC CHECK |
| 2 | TIMER |
| 25/25D | SYNC CHECK RELAY/DEAD BUS ONLY |
| 27/59 | UNDER/OVER VOLTAGE RELAY |
| 32 | REVERSE POWER RELAY |
| 32/62 | REVERSE POWER RELAY WITH TIMER |
| 3P | 3 POLE |
| 3w | 3 WIRE SYSTEM |
| 40 | LOSS OF EXCITATION RELAY |
| 40/62 | LOSS OF EXCITATION RELAY WITH TIMER |
| 46 | NEGATIVE SEQUENCE OVERCURRENT RELAY |
| 47 | UNDERVOLTAGE PHASE SEQUENCE RELAY |
| 4w | 4 WIRE SYSTEM |
| 50 | INSTANTANEOUS OVERCURRENT RELAY |
| 50/51 | INSTANTANEOUS TIME OVERCURRENT |
| 51 | TIME OVERCURRENT RELAY |
| 52 | CIRCUIT BREAKER |
| 59 | OVERVOLTAGE RELAY |
| 62 | TIME DELAY RELAY |
| 65 | GOVERNOR |
| 67 | DIRECTIONAL OVERCURRENT |
| 723 | WOODWARD DIGITAL GOVERNOR |
| 79 | RECONNECT TIME DELAY |
| 810/U | OVER/UNDER FREQUENCY RELAY |
| 86 | LOCKOUT RELAY |
| 87 | DIFFERENTIAL RELAY |
| 90 | REGULATING DEVICE |
| A | AMPERE |
| AC | ALTERNATING CURRENT |
| AF | AMPERAGE FRAME RATING |
| AI | ANALOG INPUT |
| AL | ALUMINUM |
| AM | AMPERE METER |
| AN | ANNUNCIATOR |
| AO | ANALOG OUTPUT |
| AP | AUTOMATION PROCESSOR |
| ARP | AMPERAGE RATING PLUG |
| AS | AMMETER SELECTOR |
| AT | AMPERAGE TRIP RATING |
| ATS | AUTOMATIC TRANSFER SWITCH |
| ATSR | ATS RUN REQUEST |
| ATSR | ATS RUN REQUEST RELAY |
| AUX | AUXILIARY |
| AVR | AUTOMATIC VOLTAGE REGULATOR |
| AWG | AMERICAN WIRE GAUGE |
| BATT | BATTERY |
| BCM | BATTERY CHARGER MALFUNCTION |
| BMS | BUILDING MANAGEMENT SYSTEM |
| CAP | SURGE CAPACITOR |
| CB | CIRCUIT BREAKER |
| CBCL | CIRCUIT BREAKER CLOSE |
| CBOC | CIRCUIT BREAKER OPEN |
| CBOS | CIRCUIT BREAKER CONTROL SWITCH |
| CCM | CATERPILLAR COMMUNICATIONS MODULE |
| CCW | COUNTER CLOCKWISE |
| CGR | BATTERY CHARGER |
| CI | CUSTOMER INTERFACE |
| CIM | CUSTOMER INTERFACE MODULE |
| CL | CLOSE LOCKOUT |
| CLO | CLOSED |
| COMS | COMMUNICATIONS |
| CPT | CONTROL POWER TRANSFORMER |
| CR | CONTROL RELAY |
| CS | CELL SWITCH |
| CT | CURRENT TRANSFORMER |
| CTB | CURRENT TEST BLOCK |
| CTL | CONTROL |
| CTS | CURRENT TEST SWITCH |
| CTSB | CT SHORTING BLOCK |
| CU | COPPER |
| CW | CLOCKWISE |
| D | DIODE |
| DC | DIRECT CURRENT |
| df/dt | RATE OF CHANGE OF FREQUENCY |
| DI | DIGITAL INPUT |
| DIST | DISTRIBUTION BLOCK |

| ABBREVIATION | DESCRIPTION |
|--------------|------------------------------------|
| D.O. | DRAWOUT |
| DO | DIGITAL OUTPUT |
| DRP | DROOP |
| DTI | DATA TABLE INTERFACE |
| E | ELECTRONIC |
| E.I. | ELECTRICAL INTERLOCK |
| E.O. | ELECTRICALLY OPERATED |
| EC | ENGINE CONTROL |
| ECP | ENGINE CRANKING PANEL |
| ECS | ENGINE CONTROL SWITCH |
| EI | ENGINE INTERFACE |
| ENG | ENGINE |
| EPB | EMERGENCY PANELBOARD |
| ERR | ENGINE RUN REQUEST |
| ES | ETHERNET SWITCH |
| FBP | FRONT BASE PLATE |
| FBO | FURNISHED BY OTHERS |
| FLA | FULL LOAD AMPS |
| FLD | FIELD |
| FLT | FAULT |
| FOR | FIBER OPTIC REPEATER |
| FM | FREQUENCY METER |
| F.M. | FIXED MOUNTED |
| FU | FUSE |
| GB | GENERATOR BYPASS |
| GEN | GENERATOR |
| GF | GROUND FAULT |
| GND | GROUND |
| GPS | GENERATOR PARALLELING SWITCHBOARD |
| HBR | HOT BUS RELAY |
| HET | HIGH ENGINE TEMP |
| HRN | HORN |
| Hz | FREQUENCY (HERTZ) |
| I | INSTANTANEOUS TRIP |
| IA | ISOLATOR AMPLIFIER |
| ILS | LOAD SHARING MODULE |
| INV | INVERTER |
| IO | I/O PLC |
| ITSM | INTEGRATED THERMO SENSING MODULE |
| k | 1000 (KILO) |
| kW | KILOWATT |
| kWh | KILOWATT HOUR |
| L | LONG TIME TRIP |
| LA | LIGHTNING ARRESTOR |
| LET | LOW ENGINE TEMP |
| LFL | LOW FUEL LEVEL |
| LOP | LOW OIL PRESSURE |
| LOR | LOCKOUT RELAY |
| LI | LONG AND INSTANTANEOUS TRIP |
| LIG | LI WITH GROUND FAULT TRIP |
| LS | LOAD SHED RELAY |
| LSI | LONG, SHORT AND INSTANTANEOUS TRIP |
| LSIA | LSI WITH GROUND FAULT ALARM |
| LSIG | LSI WITH GROUND FAULT TRIP |
| LT | LIGHT (for colors) |
| LWL | LOW WATER LEVEL |
| LYNX | ISO POWERLYNX MODULE |
| M | MOTOR |
| MAG | MAGNETIC |
| MALF | MALFUNCTION |
| M.O. | MANUALLY OPERATED |
| MCCB | MOLDED CASE CIRCUIT BREAKER |
| MCM | 1000 CIRCULAR MILS |
| M.I. | MECHANICAL INTERLOCK |
| MFR | MULTI FUNCTION RELAY |
| MISC | MISCELLANEOUS |
| MOC | MECHANISM OPERATED CELL SWITCH |
| MR | MULTI RATIO |
| MTR | METER (DEVICE) |
| MUF | MULTIPLE UTILITY FAILURE |
| N6 | #2-600MCM MECHANICAL LUG |
| N/A | NOT APPLICABLE |
| N/R | NOT REQUIRED |
| N.C. | NORMALLY CLOSED |
| SVM | SOURCE VOLTAGE METER |
| SFM | SOURCE FREQUENCY METER |
| NIA | NOT IN AUTOMATIC |

| ABBREVIATION | DESCRIPTION |
|--------------|--|
| NEU | NEUTRAL |
| NES | NON-ESSENTIAL LOAD SHED RELAY |
| NGR | NEUTRAL GROUND RESISTOR |
| N.O. | NORMALLY OPEN |
| OC | OVER CRANK |
| OIP | OPERATOR INTERFACE PANEL |
| OP | OPEN |
| OP CTR | OPERATION COUNTER |
| OS | OVER SPEED |
| PB | PUSHBUTTON |
| PC | PERSONAL COMPUTER |
| PF | POWER FACTOR |
| PHET | PRE HIGH ENGINE TEMP |
| PLC | PROGRAMMABLE LOGIC CONTROLLER |
| PLOP | PRE LOW OIL PRESSURE |
| POS | POSITION |
| POD | UPS CONTROL SWITCHBOARDS |
| POT | POTENTIOMETER |
| P.O.T.S. | PLAIN OLD TELEPHONE SERVICE |
| PRG | PROGRAMMING PORT |
| PT | POTENTIAL TRANSFORMER |
| REF | REFERENCE |
| RP | RATING PLUG |
| S | SHORT TIME TRIP |
| SA | SURGE ARRESTOR |
| SAR | SAFETIES ARMING RELAY |
| SB | STATION BATTERY |
| SC | SHUNT COIL |
| SCADA | SUPERVISORY CONTROL AND DATA ACQUISITION |
| SCT | SUMMING CURRENT TRANSFORMER |
| SECT | SECTION |
| SHLD | SHIELD/SHIELDED |
| SMP | SYNCH MODE PERMISSIVE |
| SMR | SYNCH MODE RUN |
| SMS | SYNCHRONIZING MODE SELECTOR |
| SPD | SPEED CONTROL |
| SR | SPRING RELEASE |
| SW | SELECTOR SWITCH |
| SS | SHIPPING SPLIT |
| SUF | SINGLE UTILITY FAILURE |
| T1 | #6-350MCM MECHANICAL LUG |
| TB | TERMINAL BLOCK |
| TBD | TO BE DETERMINED |
| TIO | TERMINAL I/O MODULE |
| TM | THERMAL MAGNETIC |
| TMR | TIMING RELAY |
| TOC | TRUCK OPERATED CELL SWITCH |
| TS | TOUCHSCREEN |
| TSP | TOUCHSCREEN PROCESSOR |
| TVSS | TRANSIENT VOLTAGE SURGE SUPPRESSOR |
| TWL | TEST WITH LOAD |
| UCLOS | UTILITY CLOSE LOCKOUT SWITCH |
| UPS | UNINTERRUPTABLE POWER SUPPLY |
| UVR | UNDER VOLTAGE RELEASE |
| VA | VOLT AMPERES |
| VAA | VOLT AMPERES APPARENT |
| VAR | VOLT AMPERES REACTIVE |
| VLT | VOLTAGE CONTROL |
| VM | VOLTMETER |
| VR | VOLTAGE REGULATOR |
| VT | VOLTAGE TRANSFORMER |
| VTS | VOLTAGE TEST SWITCH |
| W | WATT |
| WV | WATT/VAR |
| XDR | TRANSDUCER |
| a | NORMALLY OPEN CONTACT |
| b | NORMALLY CLOSED CONTACT |
| c | a AND b with COMMON |
| ba | NORMALLY OPEN BELL ALARM |
| mA | MILLIAMPERE |
| mV | MILLIVOLT |
| ∅A | A-PHASE |
| ∅B | B-PHASE |
| ∅C | C-PHASE |
| BMV | BUS VOLTAGE METER |
| BFM | BUS FREQUENCY METER |
| UVTD | UNDERVOLTAGE TIME DELAY |



CATERPILLAR

WICHITA WATER UTILITIES
DRAWING LEGEND

5KV UTILITY/GENERATOR PARALLELING SWITCHGEAR/BOARD

| | | | | | |
|---------------------------------|-----------------------------|----------------------------|-------------|-----------------|-------------|
| APPROVED BY <i>R Collins</i> | DATE APPROVED 02-28-2023 | SCALE N.T.S. | REV. 4.0 | DRAWN BY MCT | MODIFIED BY |
| DATE CREATED 03-20-08 | DATE MODIFIED | SHEET NUMBER G01 | | 1 of 31 | |
| FILE NAME 36019-G01 | | | | | |

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MV CIRCUIT BREAKER, LUGGING AND CONDUIT ENTRY SCHEDULE - (MSWG-0)

| DEVICE | LOCATION | MANUFACTURE TYPE | FRAME (A) | INTERRUPT CAP. (MVA) | TRIP FUNCTIONS | OPERATION | MOUNTING | CHARGE | SHUNT CLOSE | SHUNT TRIP | ACCESSORIES | | | | COMPRESSION LUGS | | | NAMEPLATE DESCRIPTION | CONDUIT ENTRY | | | |
|-----------|----------|-------------------------------|-----------------|----------------------|----------------|-----------|----------|---------|-------------|------------|-------------|----------|-----|-----|------------------|--------------|-------------|-----------------------|---------------|-------------------------|---|--|
| | | | | | | | | | | | AUXILIARY | KIRK KEY | MOC | TOC | LUGS PER PHASE | NEUTRAL LUGS | GROUND LUGS | | TOP | BOTTOM | | |
| 52M0 | 2A | CUTLER-HAMMER 50 VCP-W 350 | 3000 | 350 | N/A | E.O. | D.O. | 125V DC | 125V DC | 125V DC | 2 | | X | X | | | N/A | N/A | N/A | UTILITY #1 MAIN 52M0 | X | |
| LOAD LUGS | 3B | CUTLER HAMMER | 3000A LOAD LUGS | | | | | | | | | | | | 15-500 MCM | N/A | 15-500 MCM | LOAD LUGS | | X | | |

MV CIRCUIT BREAKER, LUGGING AND CONDUIT ENTRY SCHEDULE - (MSWG-1)

| DEVICE | LOCATION | MANUFACTURE TYPE | FRAME (A) | INTERRUPT CAP. (MVA) | TRIP FUNCTIONS | OPERATION | MOUNTING | CHARGE | SHUNT CLOSE | SHUNT TRIP | ACCESSORIES | | | | COMPRESSION LUGS | | | NAMEPLATE DESCRIPTION | CONDUIT ENTRY | | | |
|---------|----------|-------------------------------|-----------|----------------------|----------------|-----------|----------|---------|-------------|------------|-------------|----------|-----|-----|------------------|--------------|-------------|-----------------------|---------------|---------------------------|--|---|
| | | | | | | | | | | | AUXILIARY | KIRK KEY | MOC | TOC | LUGS PER PHASE | NEUTRAL LUGS | GROUND LUGS | | TOP | BOTTOM | | |
| 52T2 | 1A | CUTLER-HAMMER 50 VCP-W 350 | 3000 | 350 | N/A | E.O. | D.O. | 125V DC | 125V DC | 125V DC | 2 | | X | X | | | 15-500 MCM | N/A | 15-500 MCM | EMERGENCY TIE 52T2 | | X |
| 52D1 | 2A | CUTLER-HAMMER 50 VCP-W 350 | 1200 | 350 | N/A | E.O. | D.O. | 125V DC | 125V DC | 125V DC | 2 | | X | X | | | 1-500 MCM | N/A | 1-#3 AWG | DISTRIBUTION #1 52D1 | | X |
| 52LB/PG | 3B | CUTLER-HAMMER 50 VCP-W 350 | 1200 | 350 | N/A | E.O. | D.O. | 125V DC | 125V DC | 125V DC | 2 | | X | X | | | 1-500 MCM | N/A | 1-#3 AWG | LOAD BANK / PG 52LB/PG | | X |
| 52G4 | 4B | CUTLER-HAMMER 50 VCP-W 350 | 1200 | 350 | N/A | E.O. | D.O. | 125V DC | 125V DC | 125V DC | 2 | | X | X | | | 1-500 MCM | N/A | 1-#3 AWG | GENERATOR #4 52G4 | | X |
| 52G3 | 5B | CUTLER-HAMMER 50 VCP-W 350 | 1200 | 350 | N/A | E.O. | D.O. | 125V DC | 125V DC | 125V DC | 2 | | X | X | | | 1-500 MCM | N/A | 1-#3 AWG | GENERATOR #3 52G3 | | X |
| 52G2 | 6B | CUTLER-HAMMER 50 VCP-W 350 | 1200 | 350 | N/A | E.O. | D.O. | 125V DC | 125V DC | 125V DC | 2 | | X | X | | | 1-500 MCM | N/A | 1-#3 AWG | GENERATOR #2 52G2 | | X |
| 52G1 | 7B | CUTLER-HAMMER 50 VCP-W 350 | 1200 | 350 | N/A | E.O. | D.O. | 125V DC | 125V DC | 125V DC | 2 | | X | X | | | 1-500 MCM | N/A | 1-#3 AWG | GENERATOR #1 52G1 | | X |
| 52T1 | 8A | CUTLER-HAMMER 50 VCP-W 350 | 3000 | 350 | N/A | E.O. | D.O. | 125V DC | 125V DC | 125V DC | 2 | | X | X | | | N/A | N/A | N/A | EMERGENCY TIE 52T1 | | |
| 521E | 9B | CUTLER-HAMMER 50 VCP-W 350 | 1200 | 350 | N/A | E.O. | D.O. | 125V DC | 125V DC | 125V DC | 2 | | X | X | | | 1-500 MCM | N/A | 1-#3 MCM | DISTRIBUTION #2 521E | | X |
| 52M1 | 10A | CUTLER-HAMMER 50 VCP-W 350 | 3000 | 350 | N/A | E.O. | D.O. | 125V DC | 125V DC | 125V DC | 2 | | X | X | | | 15-500 MCM | N/A | 15-500 AWG | BUS TIE 52M1 | | X |
| 521A | 11A | CUTLER-HAMMER 50 VCP-W 350 | 2000 | 350 | N/A | E.O. | D.O. | 125V DC | 125V DC | 125V DC | 2 | | X | X | | | 3-500 MCM | N/A | 3-#4 AWG | DISTRIBUTION #3 521A | | X |
| 521B | 12A | CUTLER-HAMMER 50 VCP-W 350 | 2000 | 350 | N/A | E.O. | D.O. | 125V DC | 125V DC | 125V DC | 2 | | X | X | | | 3-500 MCM | N/A | 3-#4 AWG | DISTRIBUTION #4 521B | | X |
| 521C | 13A | CUTLER-HAMMER 50 VCP-W 350 | 2000 | 350 | N/A | E.O. | D.O. | 125V DC | 125V DC | 125V DC | 2 | | X | X | | | 3-500 MCM | N/A | 3-#4 AWG | DISTRIBUTION #5 521C | | X |
| 521D | 14A | CUTLER-HAMMER 50 VCP-W 350 | 2000 | 350 | N/A | E.O. | D.O. | 125V DC | 125V DC | 125V DC | 2 | | X | X | | | 3-500 MCM | N/A | 3-#4 AWG | DISTRIBUTION #6 521D | | X |

MV CIRCUIT BREAKER, LUGGING AND CONDUIT ENTRY SCHEDULE - (MSWG-2)

| DEVICE | LOCATION | MANUFACTURE TYPE | FRAME (A) | INTERRUPT CAP. (MVA) | TRIP FUNCTIONS | OPERATION | MOUNTING | CHARGE | SHUNT CLOSE | SHUNT TRIP | ACCESSORIES | | | | COMPRESSION LUGS | | | NAMEPLATE DESCRIPTION | CONDUIT ENTRY | | | |
|--------|----------|-------------------------------|-----------|----------------------|----------------|-----------|----------|---------|-------------|------------|-------------|----------|-----|-----|------------------|--------------|-------------|-----------------------|---------------|-------------------------|---|---|
| | | | | | | | | | | | AUXILIARY | KIRK KEY | MOC | TOC | LUGS PER PHASE | NEUTRAL LUGS | GROUND LUGS | | TOP | BOTTOM | | |
| 52M2 | 2A | CUTLER-HAMMER 50 VCP-W 350 | 3000 | 350 | N/A | E.O. | D.O. | 125V DC | 125V DC | 125V DC | 2 | | X | X | | | N/A | N/A | N/A | UTILITY #1 MAIN 52M2 | X | |
| 522A | 3A | CUTLER-HAMMER 50 VCP-W 350 | 2000 | 350 | N/A | E.O. | D.O. | 125V DC | 125V DC | 125V DC | 2 | | X | X | | | 3-500 MCM | N/A | 3-#4 MCM | DISTRIBUTION #4 522A | | X |
| 522B | 4A | CUTLER-HAMMER 50 VCP-W 350 | 2000 | 350 | N/A | E.O. | D.O. | 125V DC | 125V DC | 125V DC | 2 | | X | X | | | 3-500 MCM | N/A | 3-#4 AWG | DISTRIBUTION #3 522B | | X |
| 522C | 5A | CUTLER-HAMMER 50 VCP-W 350 | 2000 | 350 | N/A | E.O. | D.O. | 125V DC | 125V DC | 125V DC | 2 | | X | X | | | 3-500 MCM | N/A | 3-#4 AWG | DISTRIBUTION #2 522C | | X |
| 52T1 | 7A | CUTLER-HAMMER 50 VCP-W 350 | 3000 | 350 | N/A | E.O. | D.O. | 125V DC | 125V DC | 125V DC | 2 | | X | X | | | 15-500 MCM | N/A | 15-500 AWG | EMERGENCY TIE 52T1 | | X |
| 522D | 8A | CUTLER-HAMMER 50 VCP-W 350 | 2000 | 350 | N/A | E.O. | D.O. | 125V DC | 125V DC | 125V DC | 2 | | X | X | | | 3-500 MCM | N/A | 3-#4 AWG | DISTRIBUTION #1 522D | | X |

NOTE 1) CABLE SIZES AND QUANTITIES REQUIRED AT TIME OF RELEASE, OR ONLY STANDARD NEMA 2 HOLE PATTERN WILL BE SUPPLIED.

NOTE 2) CONDUIT ENTRY TO BE DETERMINED AT TIME OF RELEASE, OR ONLY BOTTOM ENTRY WILL BE SUPPLIED.



CATERPILLAR

**WICHITA WATER UTILITIES
CIRCUIT BREAKER SCHEDULE**

5KV UTILITY/GENERATOR PARALLELING SWITCHGEAR/BOARD

| | | | | |
|---------------------------------|--------------------------|-------------------|---------------------------|-------------------|
| APPROVED BY <i>R Collins</i> | SCALE N.T.S. | REV. 4.0 | DRAWN BY MCT | MODIFIED BY HC |
| DATE APPROVED 02-28-2023 | DATE CREATED 03-20-08 | SHEET NUMBER 2 | DATE MODIFIED 02-11-09 | of 31 |
| FILE NAME 36019-G02 | G02 | | | |

| NO. | REVISION | DATE |
|-----|----------------------------------|----------|
| 2.0 | ISSUED FOR FIELD STARTUP | 06-19-09 |
| 2.1 | RE-ISSUED FOR FIELD STARTUP | 07-28-09 |
| 3.0 | ISSUED FOR AS BUILT | 04-20-11 |
| 4.0 | ISSUED FOR SUBMITTAL (301205) | 02-28-23 |
| 0.6 | RE-ISSUED FOR SUBMITTAL | 01-23-09 |
| 0.7 | ISSUED FOR CUSTOMER RECORD | 02-12-09 |
| 1.0 | ISSUED FOR PRODUCTION | 03-10-09 |
| 1.1 | ISSUED FOR CUSTOMER WITNESS TEST | 06-15-09 |

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GENERAL NOTES
 POWER ENVELOPE: CUTLER-HAMMER
 SYSTEM VOLTAGE: 5kV CLASS, 4.16kV, 60Hz, 3 ϕ , 3-WIRE
 SYSTEM INTERRUPT RATING: 350MVA/ 49kA
 PHASE ROTATION: A-B-C
 SYSTEM AMPERAGE: 3000A
 BUS MATERIAL: SILVER PLATED COPPER
 MAIN BUS INSULATION: FLUIDIZED BED EPOXY
 BUS SUPPORT INSULATION: EPOXY
 ENCLOSURE: NEMA1 INDOOR
 FRONT ACCESSIBILITY: DOORS WITH 1/4 TURN KNOB
 REAR ACCESSIBILITY: COVERS
 UL LABEL: UL MV
 HANDLING: FORKLIFT
 COLOR: ANSI 61
 SEISMIC RATED: ZONE 4
 NAMEPLATES: WHITE PHENOLIC WITH BLACK LETTERING
 NAMEPLATES: ATTACHED WITH ADHESIVE

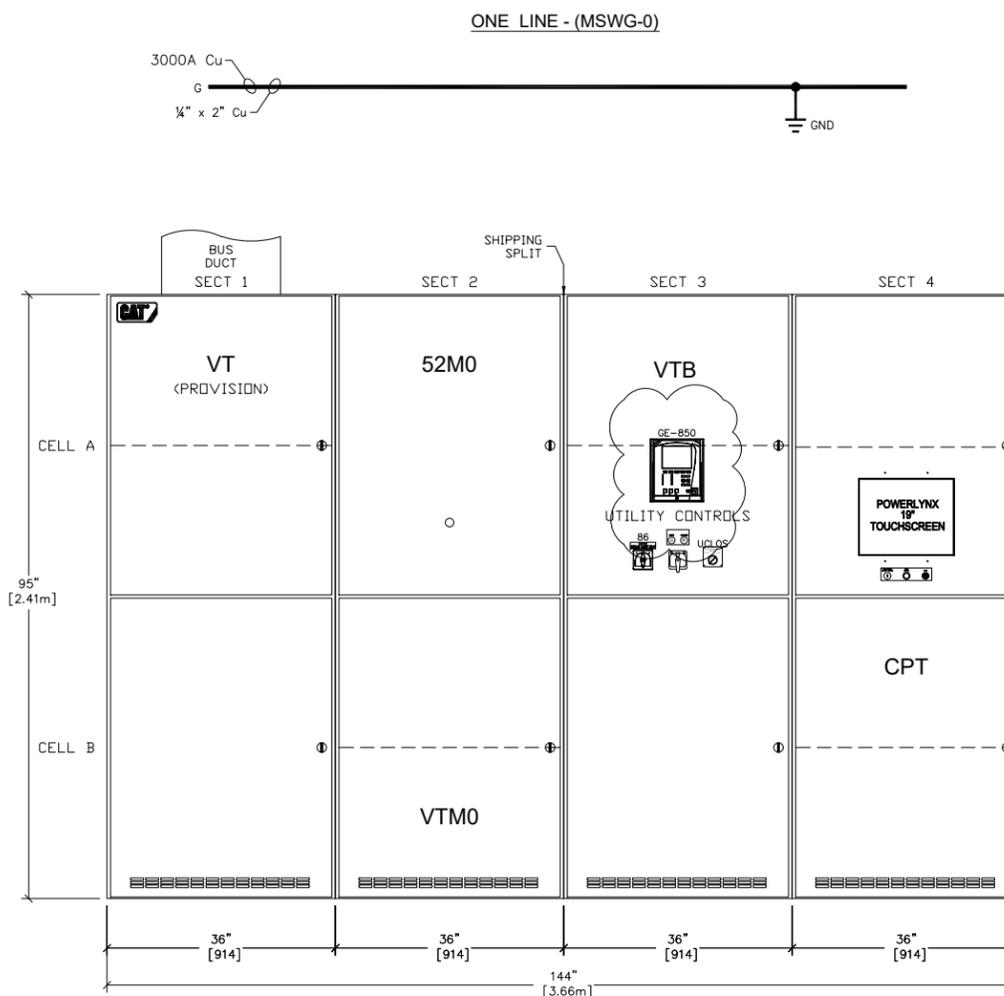
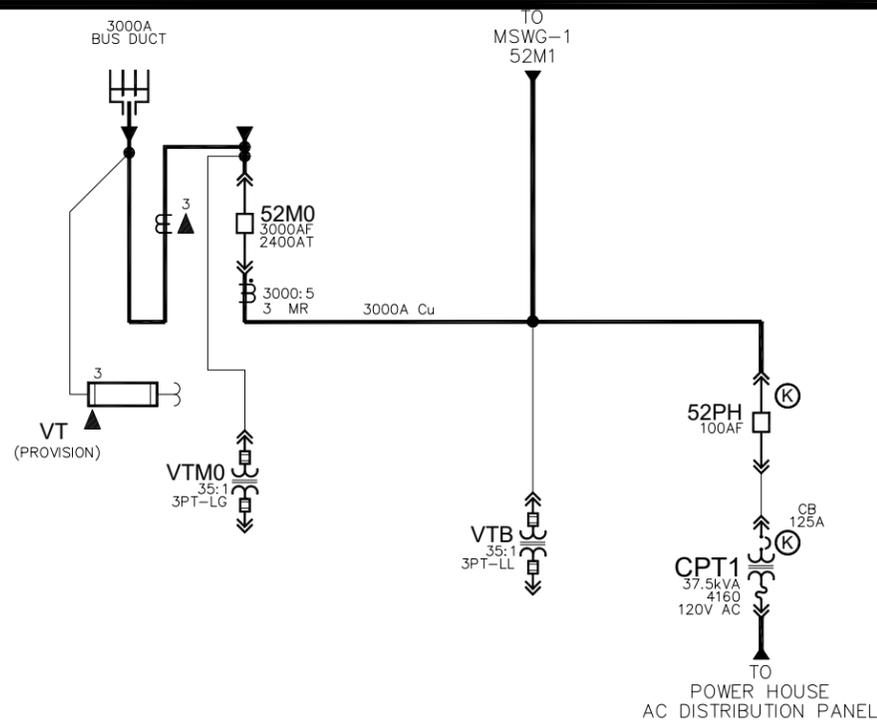
CIRCUIT BREAKERS SHIPPED SEPARATELY AT 350 LBS.

24V DC BATTERIES SHIPPED LOOSE FOR EXTERNAL MOUNTING.
 PROVIDED BATTERY RACK IS APPROXIMATELY 15 3/4" X 24".
 TYPICAL BATTERY SIZE IS TWO 12V 40Ah BATTERIES.

125V DC BATTERIES AND 125V DC CHARGER SHIPPED LOOSE
 FOR EXTERNAL MOUNTING.

ESTIMATED SHIPPING WEIGHTS:
 SECT 1 - 2,200 LBS.
 SECT 2 - 3,025 LBS.
 SECT 3 - 2,200 LBS.
 SECT 4 - 2,200 LBS.

DIMENSIONS: INCH
 * SUPPLIED BY OTHERS
 ▲ PROVIDED BY UTILITY



WICHITA WATER UTILITIES
 FRONT ELEVATION AND ONE-LINE (MSWG-0)
 5KV UTILITY / GENERATOR PARALLELING SWITCHGEAR/BOARD
 DRAWN BY: MCT
 DATE CREATED: 03-20-08
 SHEET NUMBER: 3 of 31
 REV. 4.0
 SCALE: N.T.S.
 APPROVED BY: R. Collins
 DATE APPROVED: 02-28-2023
 FILE NAME: 36019-G03

| NO. | REVISION | DATE |
|-----|----------------------------------|----------|
| 2.0 | ISSUED FOR FIELD STARTUP | 06-19-09 |
| 2.1 | RE-ISSUED FOR FIELD STARTUP | 07-28-09 |
| 3.0 | ISSUED FOR AS BUILT | 04-20-11 |
| 4.0 | ISSUED FOR SUBMITTAL (301205) | 02-28-23 |
| 0.6 | RE-ISSUED FOR SUBMITTAL | 01-23-09 |
| 0.7 | ISSUED FOR CUSTOMER RECORD | 02-12-09 |
| 1.0 | ISSUED FOR PRODUCTION | 03-10-09 |
| 1.1 | ISSUED FOR CUSTOMER WITNESS TEST | 06-15-09 |

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GENERAL NOTES
 POWER ENVELOPE: CUTLER-HAMMER
 SYSTEM VOLTAGE: 5kV CLASS, 4.16kV, 60Hz,
 3 ϕ , 3-WIRE
 SYSTEM INTERRUPT RATING: 350MVA/ 49KA
 PHASE ROTATION: A-B-C
 SYSTEM AMPERAGE: 3000A
 BUS MATERIAL: SILVER PLATED COPPER
 MAIN BUS INSULATION: FLUIDIZED BED EPOXY
 BUS SUPPORT INSULATION: EPOXY
 ENCLOSURE: NEMA1 INDOOR
 FRONT ACCESSIBILITY: DOORS WITH 1/4 TURN
 KNOB
 REAR ACCESSIBILITY: COVERS
 UL LABEL: UL MV
 HANDLING: FORKLIFT
 COLOR: ANSI 61
 SEISMIC RATED: ZONE 4
 NAMEPLATES: WHITE PHENOLIC WITH BLACK
 LETTERING
 NAMEPLATES: ATTACHED WITH ADHESIVE

CIRCUIT BREAKERS SHIPPED SEPARATELY AT
 350 LBS.

24V DC BATTERIES SHIPPED LOOSE FOR
 EXTERNAL MOUNTING. PROVIDED BATTERY
 RACK IS APPROXIMATELY 15 3/4" X 24".
 TYPICAL BATTERY SIZE IS TWO 12V 40Ah
 BATTERIES.

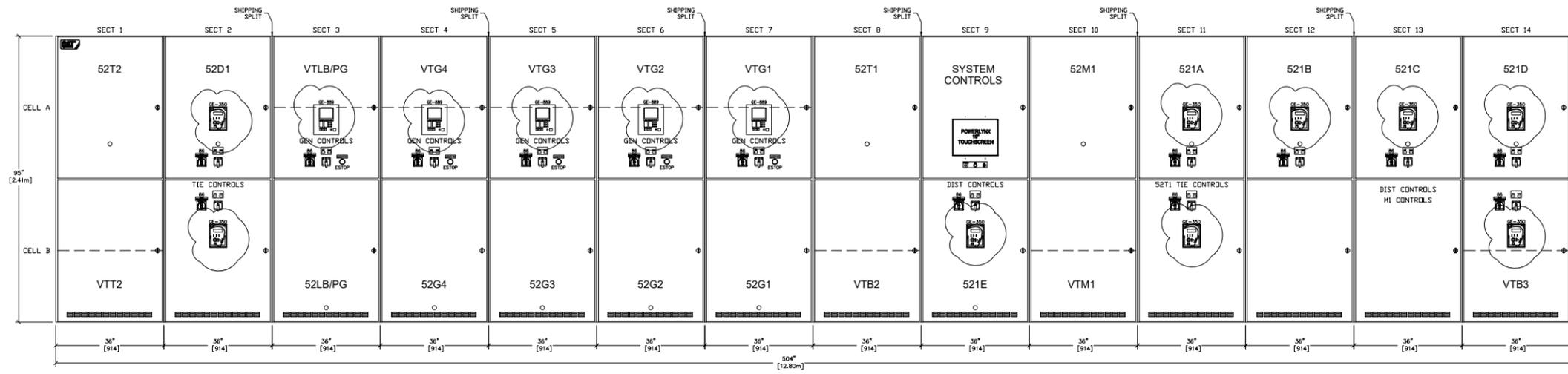
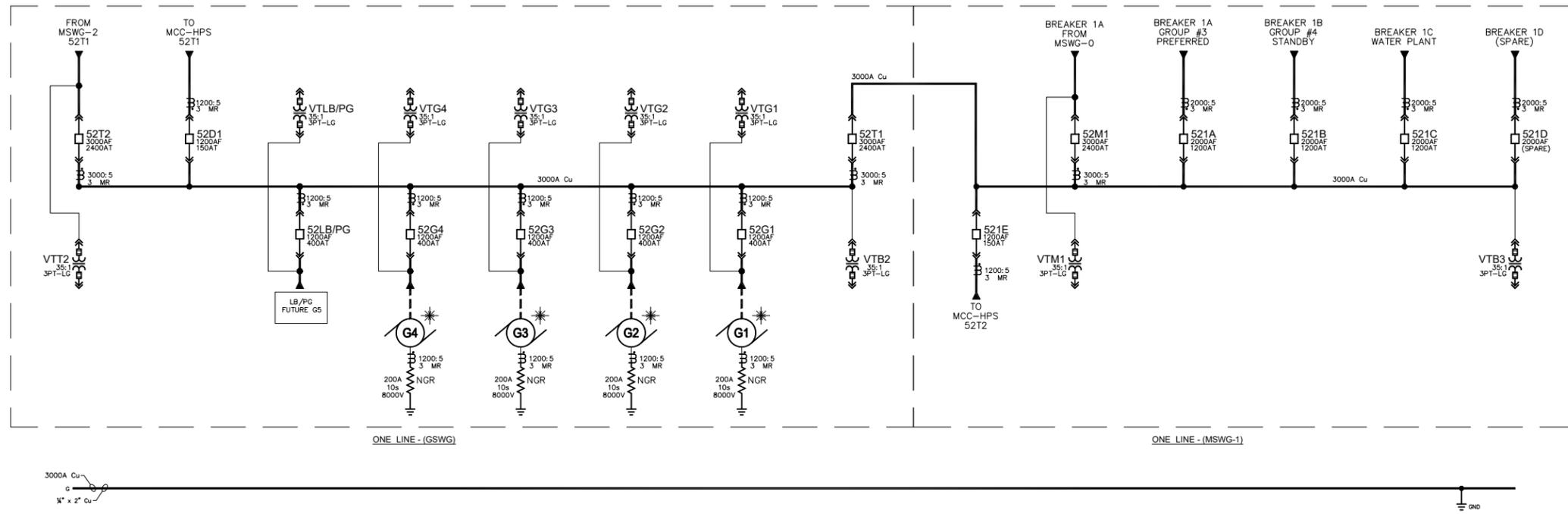
125V DC BATTERIES AND 125V DC CHARGER
 SHIPPED LOOSE FOR EXTERNAL MOUNTING.

ESTIMATED SHIPPING WEIGHTS:

- SECT 1 - 3,025 LBS.
- SECT 2 - 2,860 LBS.
- SECT 3 - 2,960 LBS.
- SECT 4 - 2,960 LBS.
- SECT 5 - 2,960 LBS.
- SECT 6 - 2,960 LBS.
- SECT 7 - 2,960 LBS.
- SECT 8 - 3,025 LBS.
- SECT 9 - 2,890 LBS.
- SECT 10 - 2,860 LBS.
- SECT 11 - 3,025 LBS.
- SECT 12 - 2,860 LBS.
- SECT 13 - 2,890 LBS.
- SECT 14 - 2,990 LBS.

DIMENSIONS: INCH
 [mm]

SUPPLIED BY OTHERS



FRONT ELEVATION - (GWSG/MSWG-1)



CATERPILLAR

WICHITA WATER UTILITIES
FRONT ELEVATION AND ONE-LINE (GWSG / MSWG-1)
5KV UTILITY / GENERATOR - PARALLELING SWITCHGEAR/BOARD

APPROVED BY: *R Collins*
 SCALE: N.T.S.
 REV: 4.0

DATE APPROVED: 02-28-2023
 DATE CREATED: 03-20-08
 DATE MODIFIED: 04-11-11

FILE NAME: 36019-G04
 SHEET NUMBER: 4 of 31

| NO. | REVISION | DATE |
|-----|----------------------------------|----------|
| 2.0 | ISSUED FOR FIELD STARTUP | 06-19-09 |
| 2.1 | RE-ISSUED FOR FIELD STARTUP | 07-28-09 |
| 3.0 | ISSUED FOR AS BUILT | 04-20-11 |
| 4.0 | ISSUED FOR SUBMITTAL (301205) | 02-28-23 |
| 0.6 | RE-ISSUED FOR SUBMITTAL | 01-23-09 |
| 0.7 | ISSUED FOR CUSTOMER RECORD | 02-12-09 |
| 1.0 | ISSUED FOR PRODUCTION | 03-10-09 |
| 1.1 | ISSUED FOR CUSTOMER WITNESS TEST | 06-15-09 |

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GENERAL NOTES
 POWER ENVELOPE: CUTLER-HAMMER
 SYSTEM VOLTAGE: 5kV CLASS, 4.16kV, 60Hz, 3 ϕ , 3-WIRE
 SYSTEM INTERRUPT RATING: 350MVA/ 49kA
 PHASE ROTATION: A-B-C
 SYSTEM AMPERAGE: 3000A
 BUS MATERIAL: SILVER PLATED COPPER
 MAIN BUS INSULATION: FLUIDIZED BED EPOXY
 BUS SUPPORT INSULATION: EPOXY
 ENCLOSURE: NEMA1 INDOOR
 FRONT ACCESSIBILITY: DOORS WITH 1/4 TURN KNOB
 REAR ACCESSIBILITY: COVERS
 UL LABEL: UL MV
 HANDLING: FORKLIFT
 COLOR: ANSI 61
 SEISMIC RATED: ZONE 4
 NAMEPLATES: WHITE PHENOLIC WITH BLACK LETTERING
 NAMEPLATES: ATTACHED WITH ADHESIVE

CIRCUIT BREAKERS SHIPPED SEPARATELY AT 350 LBS.

24V DC BATTERIES SHIPPED LOOSE FOR EXTERNAL MOUNTING.
 PROVIDED BATTERY RACK IS APPROXIMATELY 15 3/4" X 24".
 TYPICAL BATTERY SIZE IS TWO 12V 40Ah BATTERIES.

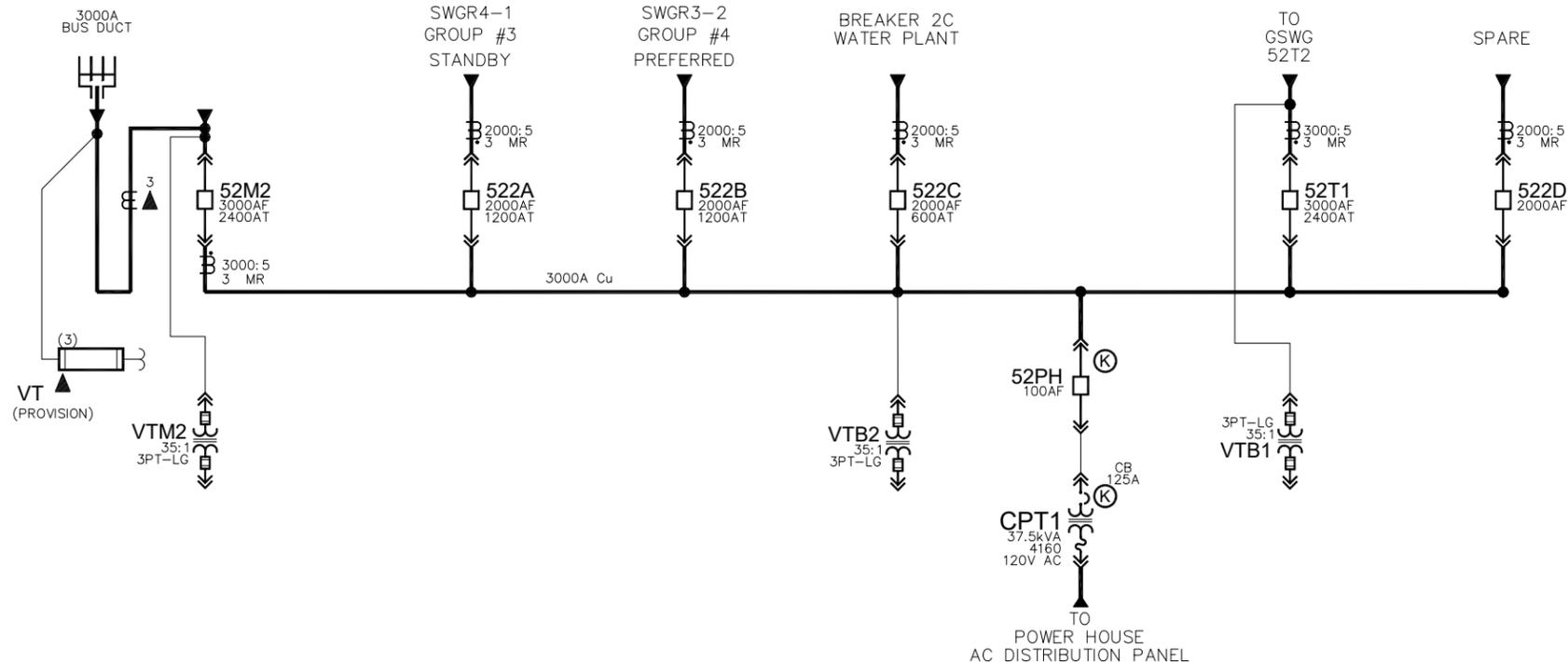
125V DC BATTERIES AND 125V DC CHARGER SHIPPED LOOSE
 FOR EXTERNAL MOUNTING.

ESTIMATED SHIPPING WEIGHTS:
 SECT 1 - 2,200 LBS.
 SECT 2 - 3,025 LBS.
 SECT 3 - 2,200 LBS.
 SECT 4 - 2,890 LBS.
 SECT 5 - 2,890 LBS.
 SECT 6 - 2,990 LBS.
 SECT 7 - 3,025 LBS.
 SECT 8 - 2,890 LBS..

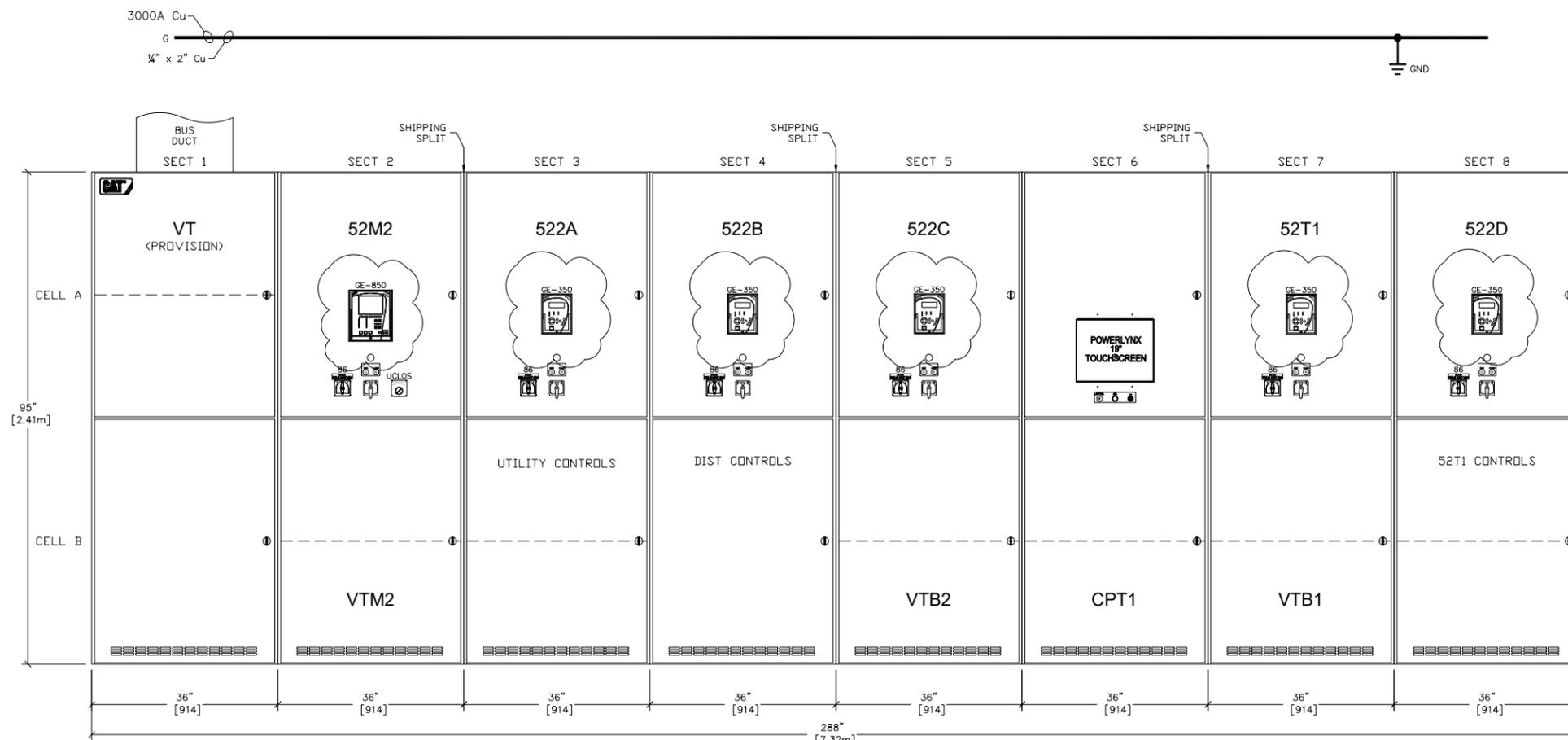
DIMENSIONS: INCH
 [mm]

☼ SUPPLIED BY OTHERS

▲ PROVIDED BY UTILITY



ONE LINE - (MSWG-2)



FRONT ELEVATION - (MSWG-2)



| | | | | | |
|--|--|--------------------------|--|------------------------|--|
| WICHITA WATER UTILITIES | | DRAWN BY MCT | | MODIFIED BY RBG | |
| FRONT ELEVATION AND ONE-LINE (MSWG-2) | | DATE CREATED 03-20-08 | | DATE MODIFIED 04-11-11 | |
| 5KV UTILITY/GENERATOR PARALLELING SWITCHGEAR/BOARD | | SCALE N.T.S. | | REV. 4.0 | |
| APPROVED BY R Collins | | DATE APPROVED 02-28-2023 | | FILE NAME 36019-G05 | |
| SHEET NUMBER 5 | | of 5 | | 31 | |

| NO. | REVISION | DATE |
|-----|----------------------------------|----------|
| 2.0 | ISSUED FOR FIELD STARTUP | 06-19-09 |
| 2.1 | RE-ISSUED FOR FIELD STARTUP | 07-28-09 |
| 3.0 | ISSUED FOR AS BUILT | 04-20-11 |
| 4.0 | ISSUED FOR SUBMITTAL (301205) | 02-28-23 |
| 0.6 | RE-ISSUED FOR SUBMITTAL | 01-23-09 |
| 0.7 | ISSUED FOR CUSTOMER RECORD | 02-12-09 |
| 1.0 | ISSUED FOR PRODUCTION | 03-10-09 |
| 1.1 | ISSUED FOR CUSTOMER WITNESS TEST | 06-15-09 |

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▲ PROVIDED BY UTILITY



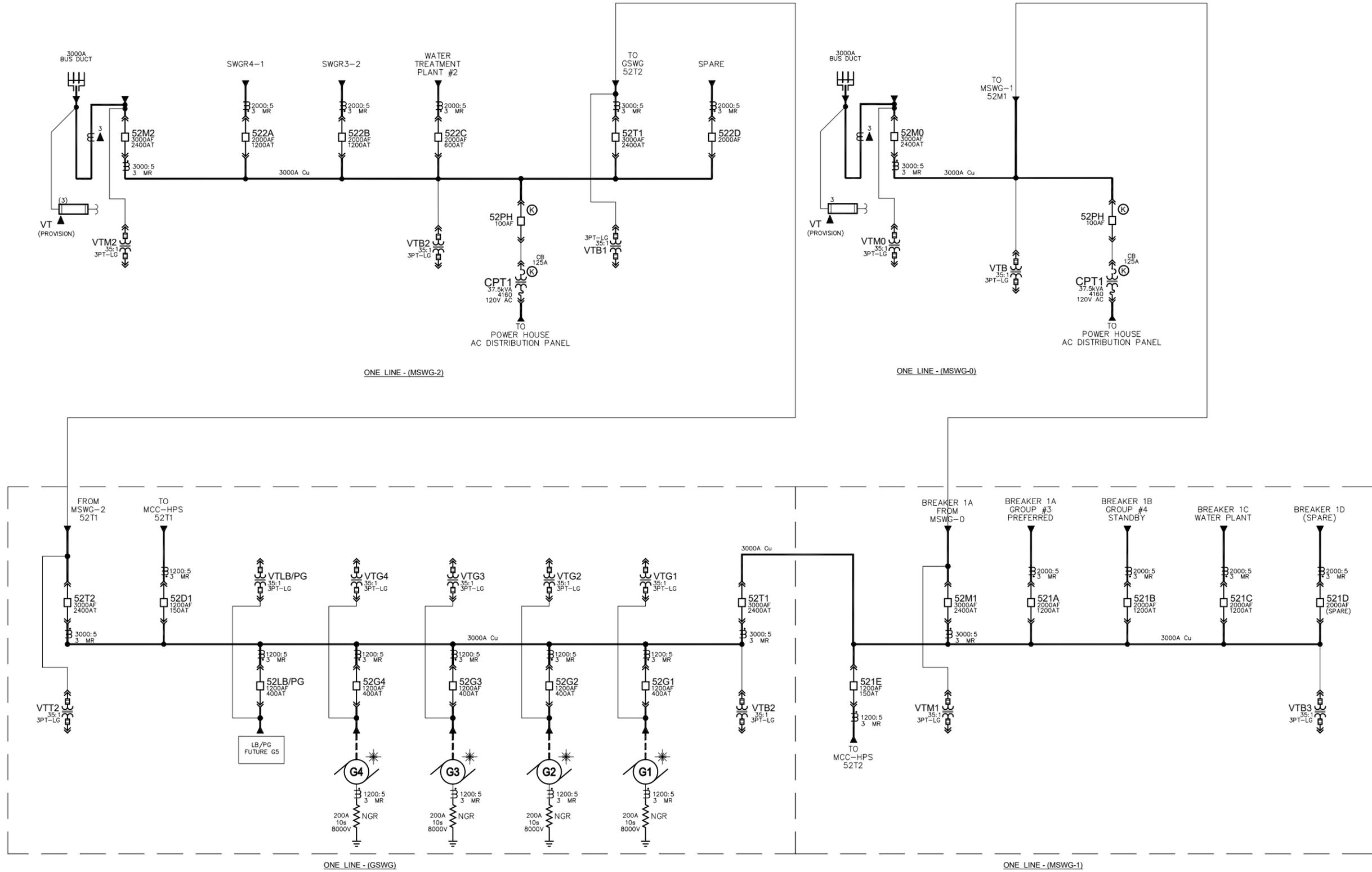
CATERPILLAR

WICHITA WATER UTILITIES
COMPLETE ONE - LINE
5KV UTILITY/GENERATOR PARALLELING SWITCHGEAR/BOARD

SCALE: N.T.S. REV. 4.0
 APPROVED BY: *R Collins*
 DATE APPROVED: 02-28-2023
 FILE NAME: 36019-G06

DRAWN BY: MCT MODIFIED BY: HC
 DATE CREATED: 03-20-08 DATE MODIFIED: 02-12-09
 SHEET NUMBER: 6 of 31

G06



| NO. | REVISION | DATE |
|-----|----------------------------------|----------|
| 2.0 | ISSUED FOR FIELD STARTUP | 06-19-09 |
| 2.1 | RE-ISSUED FOR FIELD STARTUP | 07-28-09 |
| 3.0 | ISSUED FOR AS BUILT | 04-20-11 |
| 4.0 | ISSUED FOR SUBMITTAL (301205) | 02-28-23 |
| 0.6 | RE-ISSUED FOR SUBMITTAL | 01-23-09 |
| 0.7 | ISSUED FOR CUSTOMER RECORD | 02-12-09 |
| 1.0 | ISSUED FOR PRODUCTION | 03-10-09 |
| 1.1 | ISSUED FOR CUSTOMER WITNESS TEST | 06-15-09 |

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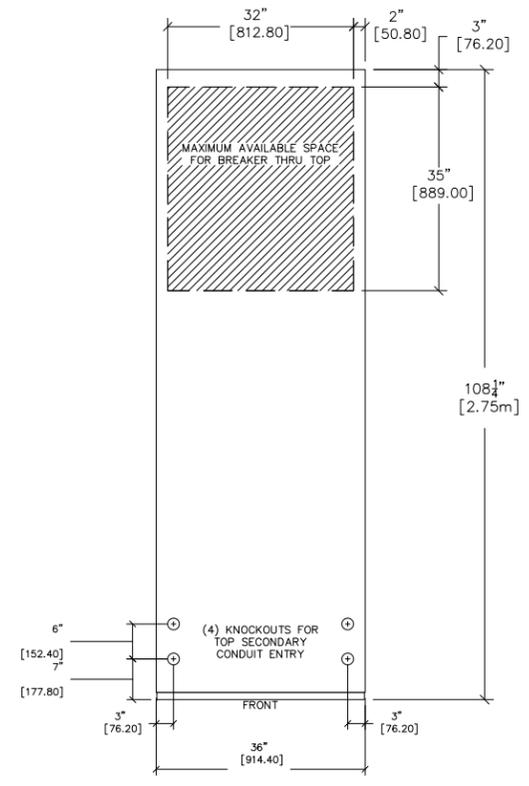
1. CUSTOMER'S GROUND PROVISIONS, PROVIDED AS SHOWN BY SYMBOL ON SHOP ORDER SECTIONAL SIDE VIEWS.

2. RECOMMENDED MINIMUM CLEARANCE TO REAR OF VAC-CLAD-W: 36 INCHES (914.4mm).

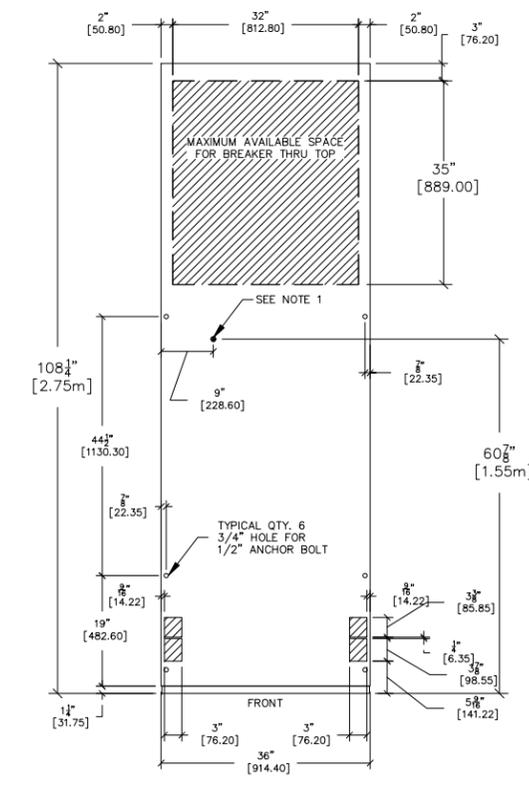
3. RECOMMENDED MINIMUM CLEARANCE TO LH AND RH SIDES OF VAC-CLAD-W: 32 INCHES (812.8mm).

4. PRIMARY CONDUIT PROJECTION MUST NOT EXCEED 2 INCHES.

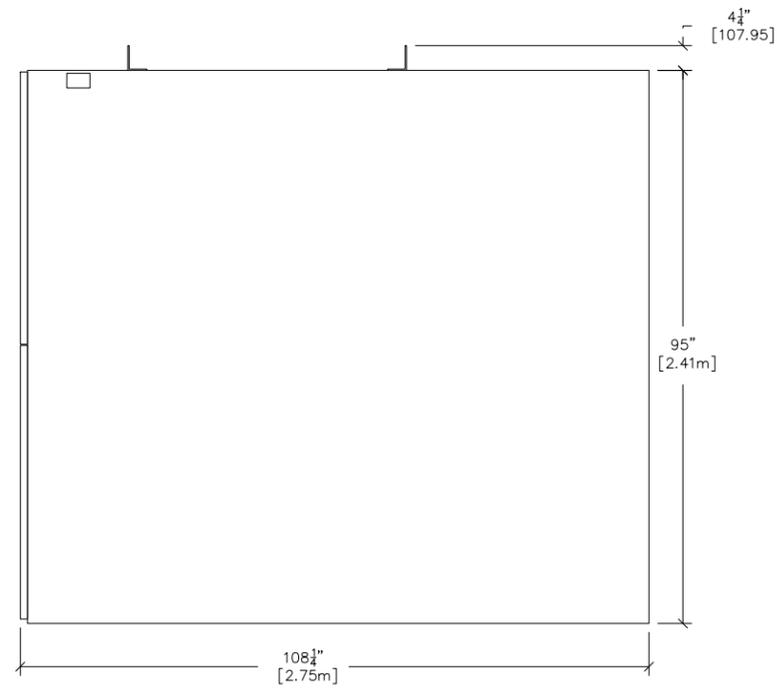
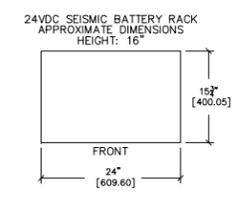
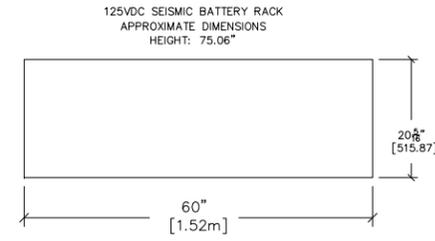
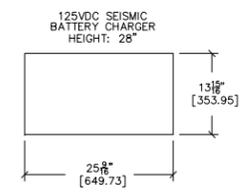
DIMENSIONS - $\frac{\text{INCHES}}{[\text{mm}]}$



TYPICAL FOR:
MSWG 0 - SECTs 1-4
MSWG 1 - SECTs 1-14
MSWG 2 - SECTs 1-8
TOP VIEW
TOP CONDUIT ENTRY



TYPICAL FOR:
MSWG 0 - SECTs 1-4
MSWG 1 - SECTs 1-14
MSWG 2 - SECTs 1-8
PLAN VIEW
BOTTOM CONDUIT ENTRY



TYPICAL FOR:
SECTs 1-4
SIDE VIEW



WICHITA WATER UTILITIES
PLAN AND SIDE VIEW

5KV UTILITY GENERATOR PARALLELING SWITCHGEAR/BOARD

| | | | | | | |
|------------------|-----------|--------------|----------|-------------|--------------|---------------|
| APPROVED BY | SCALE | REV. | DRAWN BY | MODIFIED BY | DATE CREATED | DATE MODIFIED |
| <i>R Collins</i> | N.T.S. | 4.0 | MCT | RBG | 03-20-08 | 01-21-09 |
| DATE APPROVED | FILE NAME | SHEET NUMBER | of | | | |
| 02-28-2023 | 36019-G07 | 7 | 31 | | | |

G07

| NO. | REVISION | DATE |
|-----|----------------------------------|----------|
| 2.0 | ISSUED FOR FIELD STARTUP | 06-19-09 |
| 2.1 | RE-ISSUED FOR FIELD STARTUP | 07-28-09 |
| 3.0 | ISSUED FOR AS BUILT | 04-20-11 |
| 4.0 | ISSUED FOR SUBMITTAL (301205) | 02-28-23 |
| 0.6 | RE-ISSUED FOR SUBMITTAL | 01-23-09 |
| 0.7 | ISSUED FOR CUSTOMER RECORD | 02-12-09 |
| 1.0 | ISSUED FOR PRODUCTION | 03-10-09 |
| 1.1 | ISSUED FOR CUSTOMER WITNESS TEST | 06-15-09 |

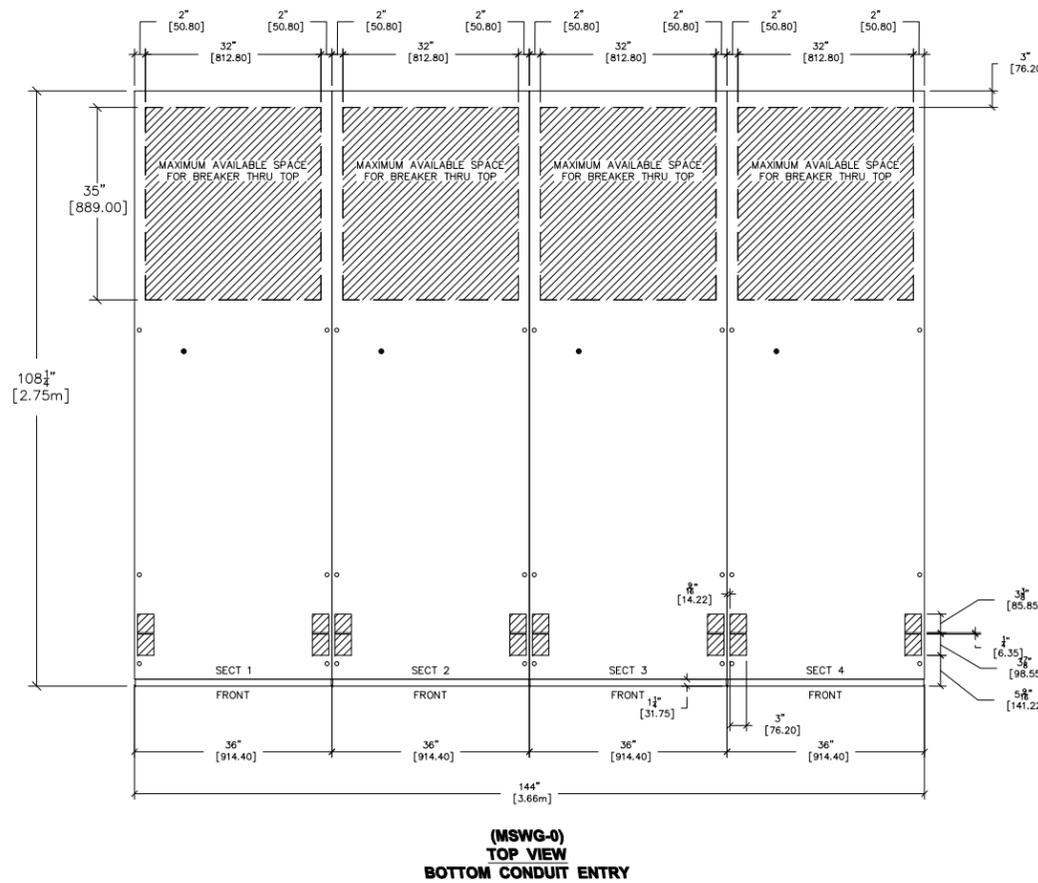
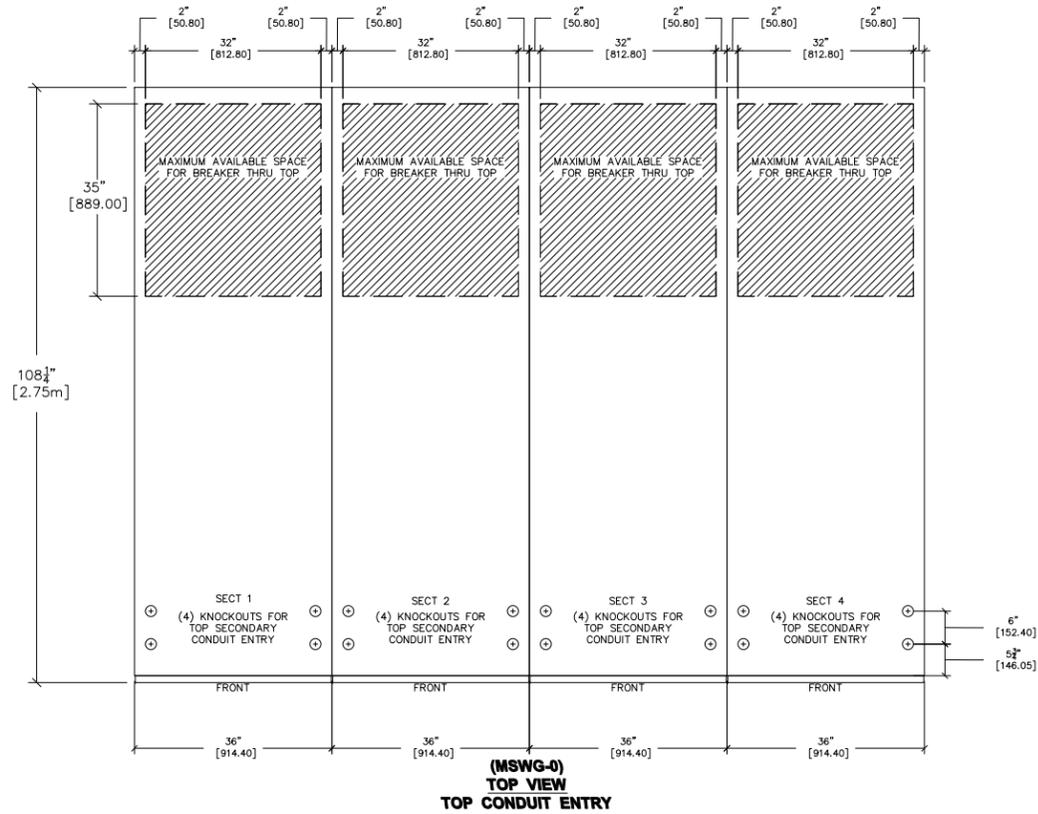
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36.00 INCHES (914.4mm) IS THE RECOMMENDED FRONT CLEARANCE FOR BREAKER REMOVAL WITH TOP-OF-SWITCHGEAR-MOUNTED BREAKER LIFTER. IF A PORTABLE BREAKER LIFTER IS TO BE USED, ALLOW AT LEAST 84.00 INCHES (2.13m) OF AISLE SPACE.

IF USING HINGED REAR DOORS ADD 1.25 INCHES (31.8mm).

STUB CONDUIT 2.00 INCHES (50.8mm) MAXIMUM IN POWER CABLE AREA, 1-INCH (25.4mm) MAXIMUM IN CONTROL CONDUIT AREA.

DIMENSIONS - INCHES [mm]



WICHITA WATER UTILITIES
FLOOR PLAN (MSWG-0)
5KV UTILITY / GENERATOR PARALLELING SWITCHGEAR/BOARD

| | | | | | | |
|------------------|-----------|--------------|----------|-------------|--------------|---------------|
| APPROVED BY | SCALE | REV. | DRAWN BY | MODIFIED BY | DATE CREATED | DATE MODIFIED |
| <i>R Collins</i> | N.T.S. | 4.0 | MCT | RBG | 03-20-08 | 01-21-09 |
| DATE APPROVED | FILE NAME | SHEET NUMBER | of | | | |
| 02-28-2023 | G08 | 8 | 31 | | | |

| NO. | REVISION | DATE |
|-----|----------------------------------|----------|
| 2.0 | ISSUED FOR FIELD STARTUP | 06-19-09 |
| 2.1 | RE-ISSUED FOR FIELD STARTUP | 07-28-09 |
| 3.0 | ISSUED FOR AS BUILT | 04-20-11 |
| 4.0 | ISSUED FOR SUBMITTAL (301205) | 02-28-23 |
| 0.6 | RE-ISSUED FOR SUBMITTAL | 01-23-09 |
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| 1.0 | ISSUED FOR PRODUCTION | 03-10-09 |
| 1.1 | ISSUED FOR CUSTOMER WITNESS TEST | 06-15-09 |

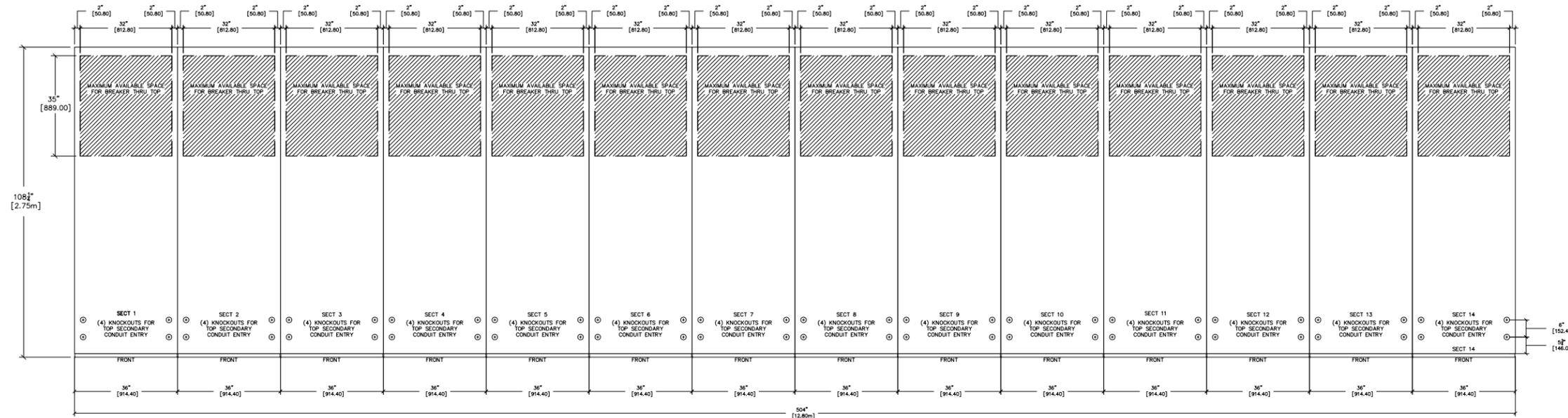
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36.00 INCHES (914.4mm) IS THE RECOMMENDED FRONT CLEARANCE FOR BREAKER REMOVAL WITH TOP-OF-SWITCHGEAR-MOUNTED BREAKER LIFTER. IF A PORTABLE BREAKER LIFTER IS TO BE USED, ALLOW AT LEAST 84.00 INCHES (2.13m) OF AISLE SPACE.

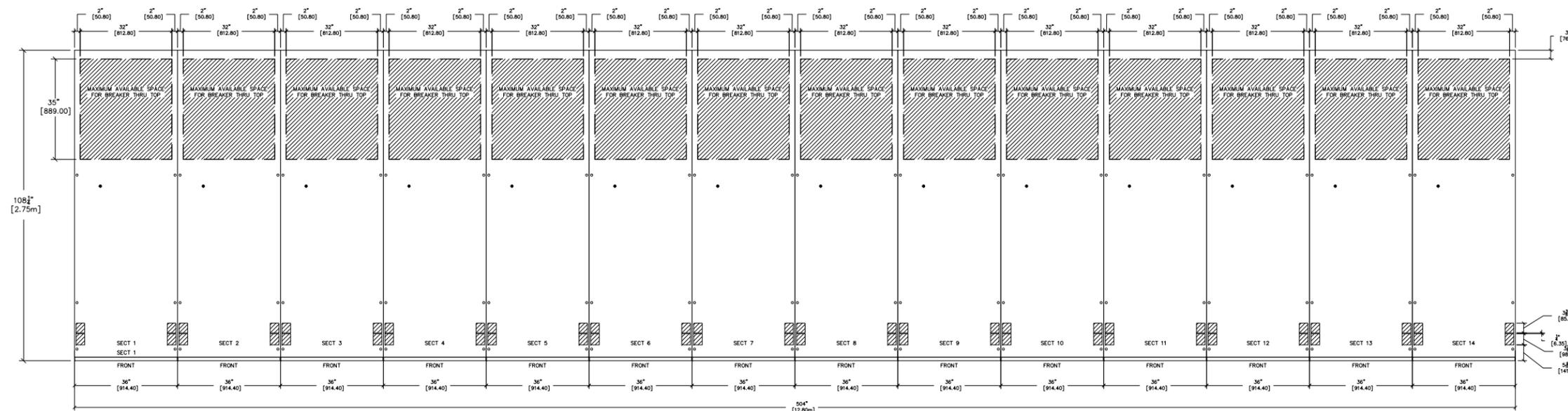
IF USING HINGED REAR DOORS ADD 1.25 INCHES (31.8mm).

STUB CONDUIT 2.00 INCHES (50.8mm) MAXIMUM IN POWER CABLE AREA, 1-INCH (25.4mm) MAXIMUM IN CONTROL CONDUIT AREA.

DIMENSIONS - INCHES [mm]



(GWSG / MSWG-1)
TOP VIEW
TOP CONDUIT ENTRY



(GWSG / MSWG-1)
TOP VIEW
BOTTOM CONDUIT ENTRY

WICHITA WATER UTILITIES
FLOOR PLAN (GWSG / MSWG-1)

5KV UTILITY/GENERATOR PARALLELING SWITCHGEAR/BOARD

SCALE: N.T.S.

REV. 4.0

APPROVED BY: *R Collins*

DATE APPROVED: 02-28-2023

FILE NAME: 36019-G09

G09

DRAWN BY: MCT
DATE CREATED: 03-20-08
SHEET NUMBER: 9

MODIFIED BY: RBG
DATE MODIFIED: 01-21-09
of 31

| NO. | REVISION | DATE |
|-----|----------------------------------|----------|
| 2.0 | ISSUED FOR FIELD STARTUP | 06-19-09 |
| 2.1 | RE-ISSUED FOR FIELD STARTUP | 07-28-09 |
| 3.0 | ISSUED FOR AS BUILT | 04-20-11 |
| 4.0 | ISSUED FOR SUBMITTAL (301205) | 02-28-23 |
| 0.6 | RE-ISSUED FOR SUBMITTAL | 01-23-09 |
| 0.7 | ISSUED FOR CUSTOMER RECORD | 02-12-09 |
| 1.0 | ISSUED FOR PRODUCTION | 03-10-09 |
| 1.1 | ISSUED FOR CUSTOMER WITNESS TEST | 06-15-09 |

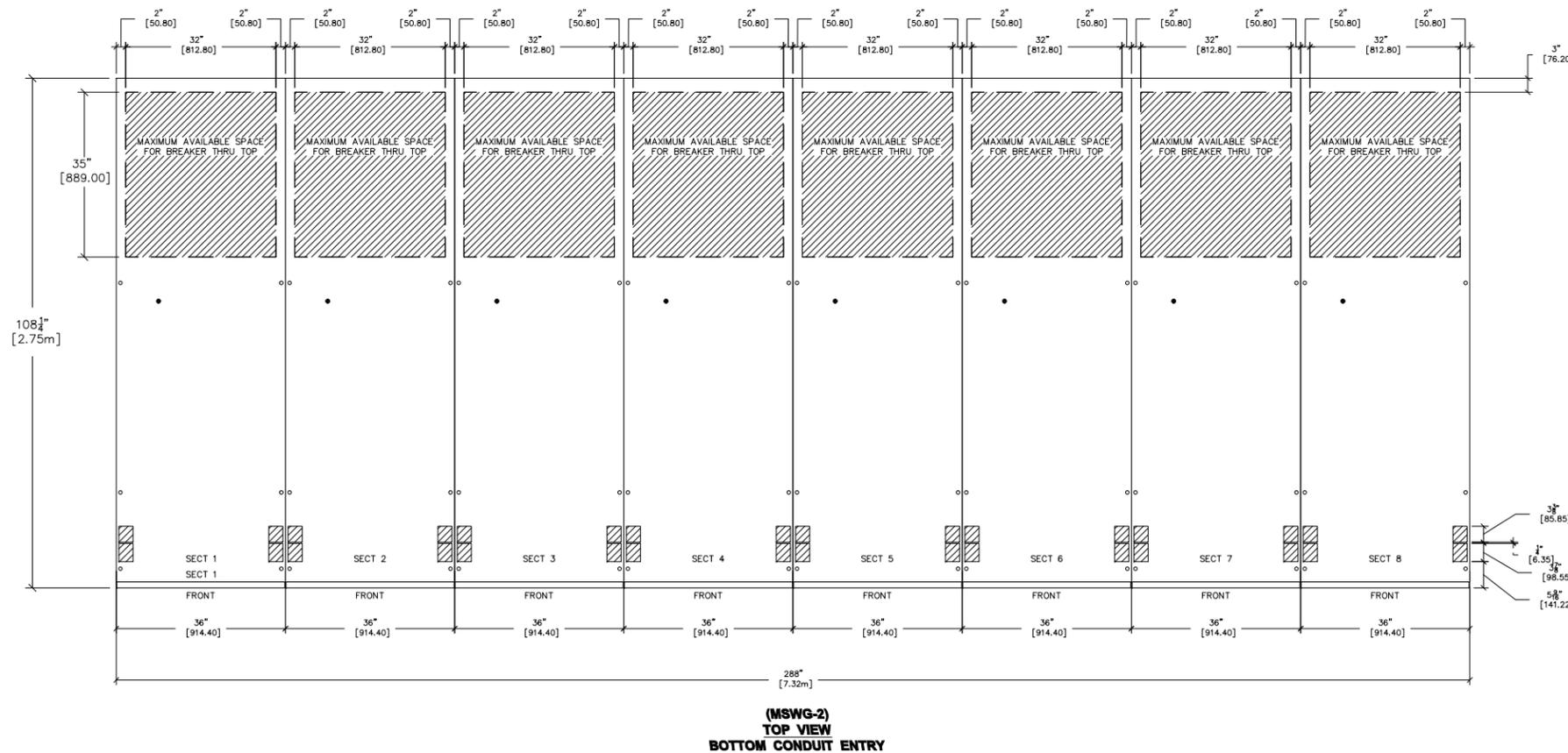
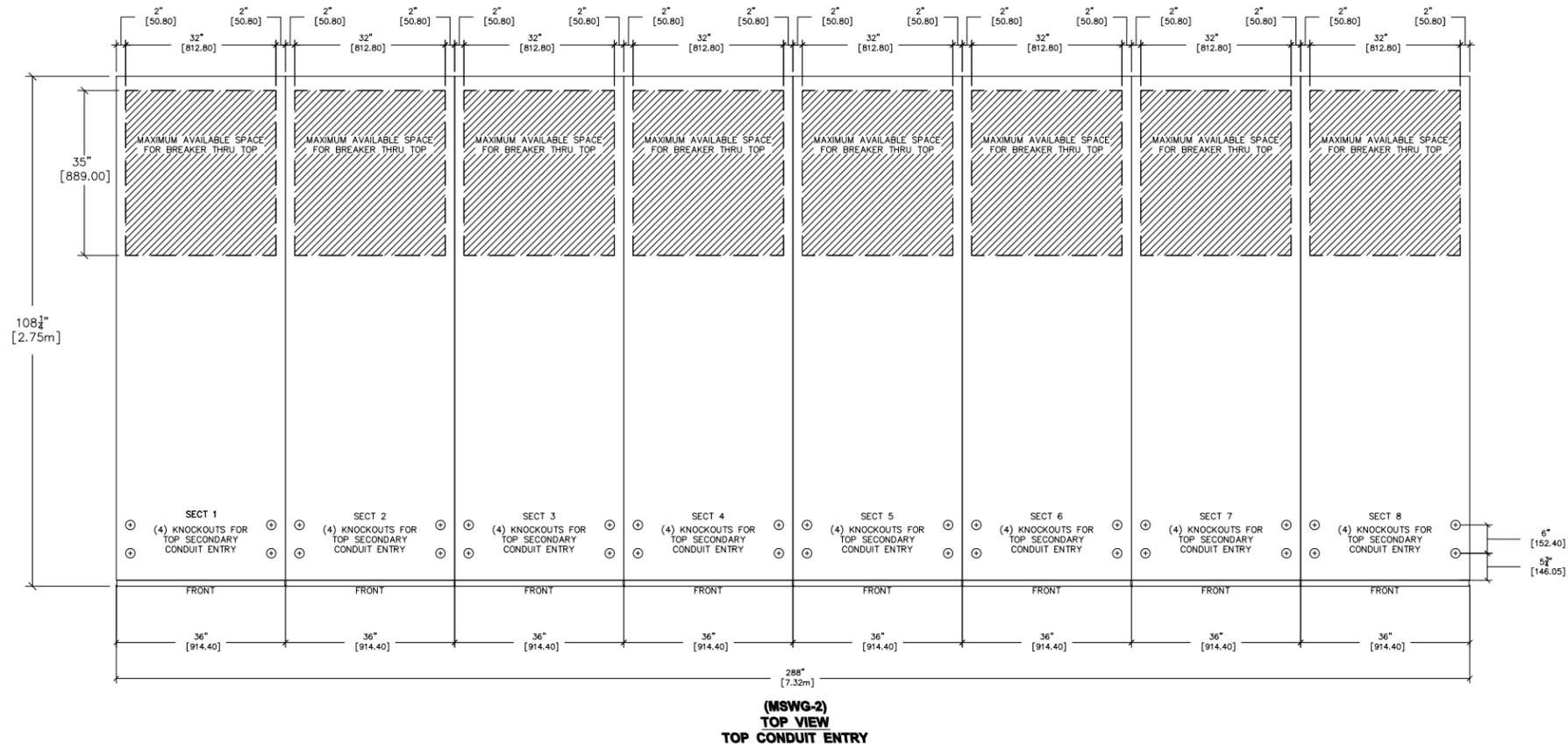
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36.00 INCHES (914.4mm) IS THE RECOMMENDED FRONT CLEARANCE FOR BREAKER REMOVAL WITH TOP-OF-SWITCHGEAR-MOUNTED BREAKER LIFTER. IF A PORTABLE BREAKER LIFTER IS TO BE USED, ALLOW AT LEAST 84.00 INCHES (2.13m) OF AISLE SPACE.

IF USING HINGED REAR DOORS ADD 1.25 INCHES (31.8mm).

STUB CONDUIT 2.00 INCHES (50.8mm) MAXIMUM IN POWER CABLE AREA, 1-INCH (25.4mm) MAXIMUM IN CONTROL CONDUIT AREA.

DIMENSIONS - INCHES [mm]



**WICHITA WATER UTILITIES
FLOOR PLAN (MSWG-2)
5KV UTILITY/GENERATOR PARALLELING SWITCHGEAR/BOARD**

| | | | | | | |
|------------------|-----------|--------------|----------|-------------|--------------|---------------|
| APPROVED BY | SCALE | REV. | DRAWN BY | MODIFIED BY | DATE CREATED | DATE MODIFIED |
| <i>R Collins</i> | N.T.S. | 4.0 | MCT | RBG | 03-20-08 | 01-21-09 |
| DATE APPROVED | FILE NAME | SHEET NUMBER | of | | | |
| 02-28-2023 | 36019-G10 | 10 | 31 | | | |

| NO. | REVISION | DATE |
|-----|----------------------------------|----------|
| 2.0 | ISSUED FOR FIELD STARTUP | 06-19-09 |
| 2.1 | RE-ISSUED FOR FIELD STARTUP | 07-28-09 |
| 3.0 | ISSUED FOR AS BUILT | 04-20-11 |
| 4.0 | ISSUED FOR SUBMITTAL (301205) | 02-28-23 |
| 0.6 | RE-ISSUED FOR SUBMITTAL | 01-23-09 |
| 0.7 | ISSUED FOR CUSTOMER RECORD | 02-12-09 |
| 1.0 | ISSUED FOR PRODUCTION | 03-10-09 |
| 1.1 | ISSUED FOR CUSTOMER WITNESS TEST | 06-15-09 |

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WICHITA WATER UTILITIES
3 - LINE DIAGRAM - (GWSG / MSWG-1)
5KV UTILITY / GENERATOR PARALLELING SWITCHGEAR/BOARD

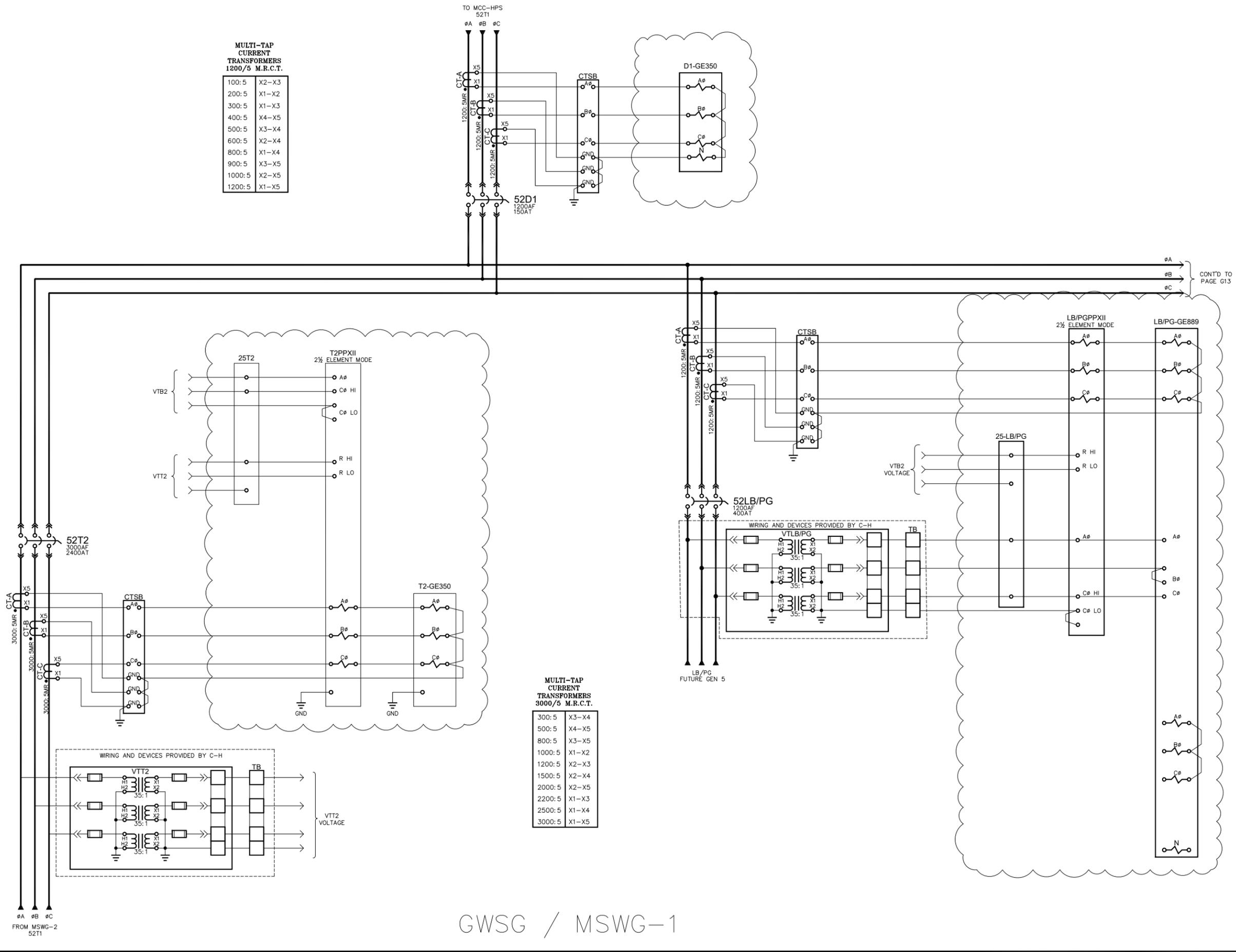
APPROVED BY: *R Collins*
 SCALE: N.T.S.
 REV. 4.0
 DATE APPROVED: 02-28-2023
 FILE NAME: 36019-G12

DRAWN BY: MCT
 MODIFIED BY: DSC
 DATE CREATED: 03-20-08
 DATE MODIFIED: 09-16-08
 SHEET NUMBER: 12 of 31

G12

| NO. | REVISION | DATE |
|-----|----------------------------------|----------|
| 2.0 | ISSUED FOR FIELD STARTUP | 06-19-09 |
| 2.1 | RE-ISSUED FOR FIELD STARTUP | 07-28-09 |
| 3.0 | ISSUED FOR AS BUILT | 04-20-11 |
| 4.0 | ISSUED FOR SUBMITTAL (301205) | 02-28-23 |
| 0.6 | RE-ISSUED FOR SUBMITTAL | 01-23-09 |
| 0.7 | ISSUED FOR CUSTOMER RECORD | 02-12-09 |
| 1.0 | ISSUED FOR PRODUCTION | 03-10-09 |
| 1.1 | ISSUED FOR CUSTOMER WITNESS TEST | 06-15-09 |

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GWSG / MSWG-1

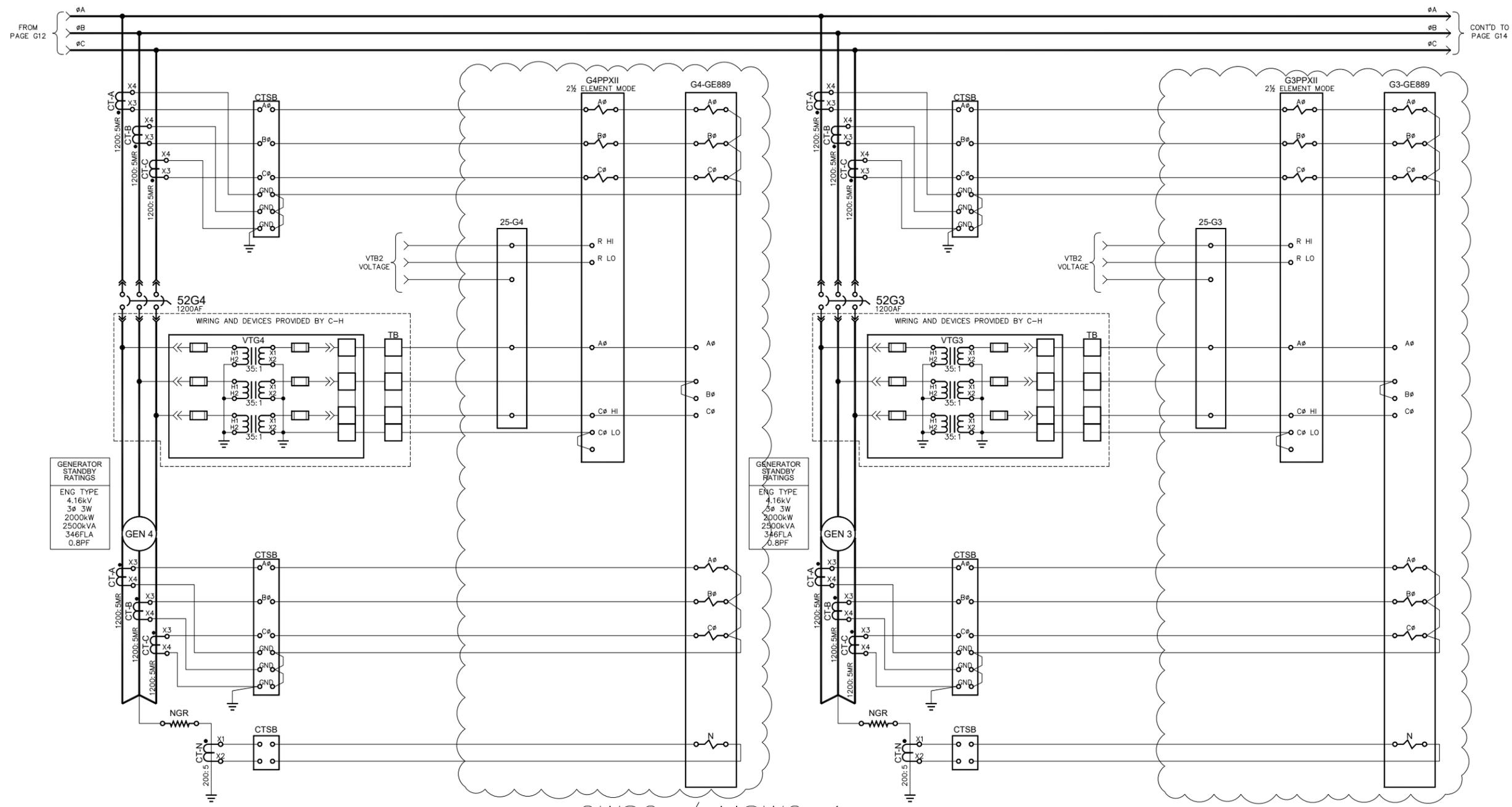
CONT'D TO PAGE G13



CATERPILLAR

MULTI-TAP CURRENT TRANSFORMERS 1200/5 M.R.C.T.

| | |
|--------|-------|
| 100:5 | X2-X3 |
| 200:5 | X1-X2 |
| 300:5 | X1-X3 |
| 400:5 | X4-X5 |
| 500:5 | X3-X4 |
| 600:5 | X2-X4 |
| 800:5 | X1-X4 |
| 900:5 | X3-X5 |
| 1000:5 | X2-X5 |
| 1200:5 | X1-X5 |



GENERATOR STANDBY RATINGS

| | |
|----------|--------|
| ENG TYPE | 4.16kV |
| 3ø 3W | 2000kW |
| 2500kVA | 346FLA |
| 0.8PF | |

GENERATOR STANDBY RATINGS

| | |
|----------|--------|
| ENG TYPE | 4.16kV |
| 3ø 3W | 2000kW |
| 2500kVA | 346FLA |
| 0.8PF | |

GWSG / MSWG-1

FROM PAGE G12

CONT'D TO PAGE G14

WICHITA WATER UTILITIES
3 - LINE DIAGRAM - (GWSG / MSWG-1)
5KV UTILITY/GENERATOR PARALLELING SWITCHGEAR/BOARD

| NO. | REVISION | DATE |
|-----|----------------------------------|----------|
| 2.0 | ISSUED FOR FIELD STARTUP | 06-19-09 |
| 2.1 | RE-ISSUED FOR FIELD STARTUP | 07-28-09 |
| 3.0 | ISSUED FOR AS BUILT | 04-20-11 |
| 4.0 | ISSUED FOR SUBMITTAL (301205) | 02-28-23 |
| 0.6 | RE-ISSUED FOR SUBMITTAL | 01-23-09 |
| 0.7 | ISSUED FOR CUSTOMER RECORD | 02-12-09 |
| 1.0 | ISSUED FOR PRODUCTION | 03-10-09 |
| 1.1 | ISSUED FOR CUSTOMER WITNESS TEST | 06-15-09 |

| | | | | | | |
|------------------|-----------|--------------|----------|-------------|--------------|---------------|
| APPROVED BY | SCALE | REV. | DRAWN BY | MODIFIED BY | DATE CREATED | DATE MODIFIED |
| <i>R Collins</i> | N.T.S. | 4-0 | MCT | RBG | 03-20-08 | 04-11-11 |
| DATE APPROVED | FILE NAME | SHEET NUMBER | of | | | |
| 02-28-2023 | 36019-G13 | 13 | 31 | | | |

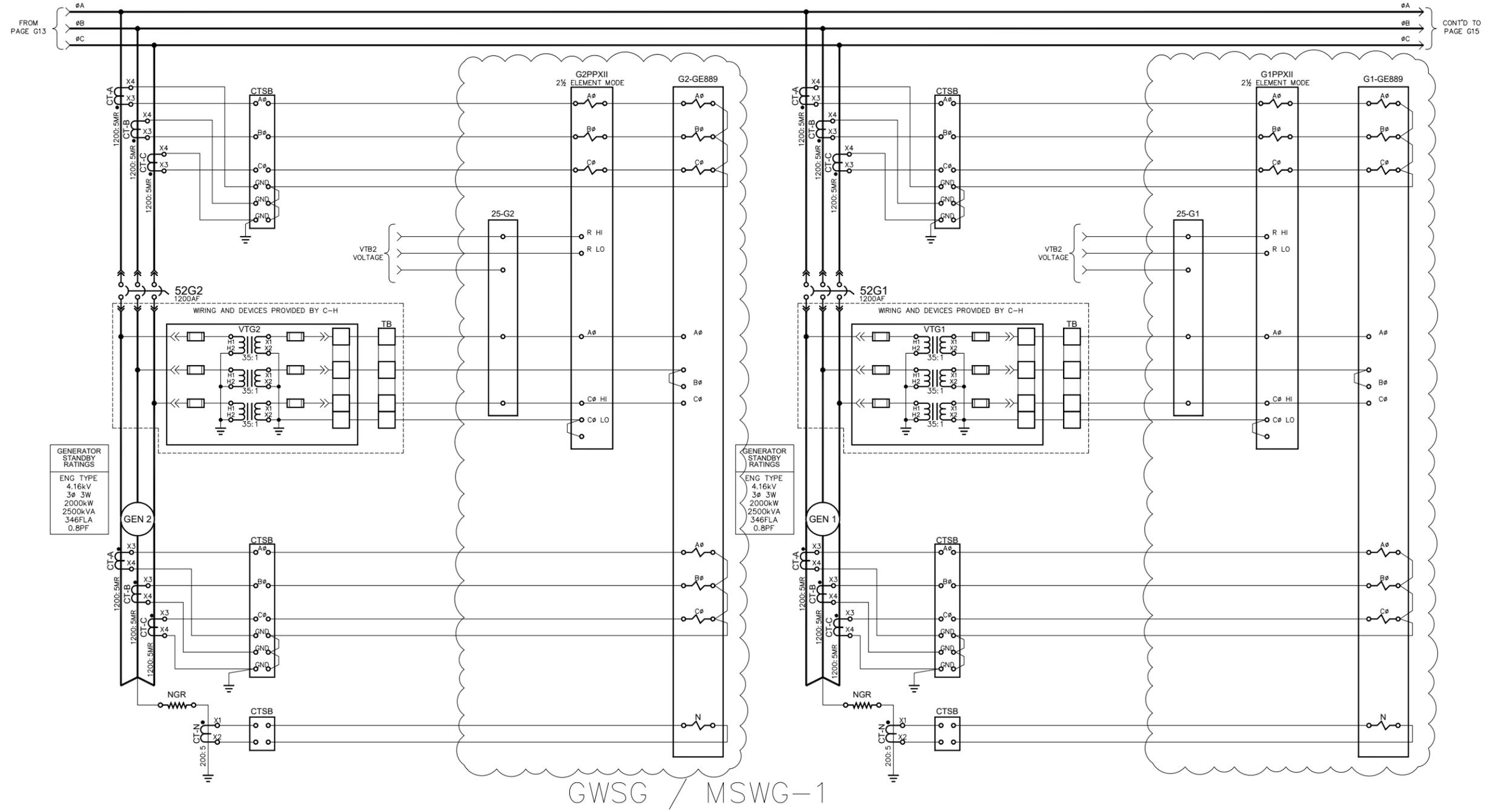
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MULTI-TAP CURRENT TRANSFORMERS 1200/5 M.R.C.T.

| | |
|--------|-------|
| 100:5 | X2-X3 |
| 200:5 | X1-X2 |
| 300:5 | X1-X3 |
| 400:5 | X4-X5 |
| 500:5 | X3-X4 |
| 600:5 | X2-X4 |
| 800:5 | X1-X4 |
| 900:5 | X3-X5 |
| 1000:5 | X2-X5 |
| 1200:5 | X1-X5 |



GENERATOR STANDBY RATINGS

| | |
|----------|--------|
| ENG TYPE | 4.16kV |
| 3ø SW | 2000kW |
| 2500kVA | 346FLA |
| 0.8PF | |

GENERATOR STANDBY RATINGS

| | |
|----------|--------|
| ENG TYPE | 4.16kV |
| 3ø SW | 2000kW |
| 2500kVA | 346FLA |
| 0.8PF | |

GWSG / MSWG-1

| | | | | | |
|-----|----------------------------------|----------|--|------|--|
| NO. | | REVISION | | DATE | |
| 2.0 | ISSUED FOR FIELD STARTUP | 06-19-09 | | | |
| 2.1 | RE-ISSUED FOR FIELD STARTUP | 07-28-09 | | | |
| 3.0 | ISSUED FOR AS BUILT | 04-20-11 | | | |
| 4.0 | ISSUED FOR SUBMITTAL (301205) | 02-28-23 | | | |
| 0.6 | RE-ISSUED FOR SUBMITTAL | 01-23-09 | | | |
| 0.7 | ISSUED FOR CUSTOMER RECORD | 02-12-09 | | | |
| 1.0 | ISSUED FOR PRODUCTION | 03-10-09 | | | |
| 1.1 | ISSUED FOR CUSTOMER WITNESS TEST | 06-15-09 | | | |

TITLE: WICHITA WATER UTILITIES
3 - LINE DIAGRAM - (GWSG / MSWG-1)
5KV UTILITY / GENERATOR PARALLELING SWITCHGEAR/BOARD

APPROVED BY: R Collins
SCALE: N.T.S.
REV.: 4.0
DRAWN BY: MCT
MODIFIED BY: RBG
DATE CREATED: 03-20-08
DATE MODIFIED: 04-11-11
SHEET NUMBER: 14
of 31
FILE NAME: 36019-G14
G14

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WICHITA WATER UTILITIES
3 - LINE DIAGRAM - (GWSG / MSWG-1)
5KV UTILITY / GENERATOR PARALLELING SWITCHGEARBOARD

| NO. | REVISION | DATE |
|-----|----------------------------------|----------|
| 2.0 | ISSUED FOR FIELD STARTUP | 06-19-09 |
| 2.1 | RE-ISSUED FOR FIELD STARTUP | 07-28-09 |
| 3.0 | ISSUED FOR AS BUILT | 04-20-11 |
| 4.0 | ISSUED FOR SUBMITTAL (301205) | 02-28-23 |
| 0.6 | RE-ISSUED FOR SUBMITTAL | 01-23-09 |
| 0.7 | ISSUED FOR CUSTOMER RECORD | 02-12-09 |
| 1.0 | ISSUED FOR PRODUCTION | 03-10-09 |
| 1.1 | ISSUED FOR CUSTOMER WITNESS TEST | 06-15-09 |

APPROVED BY: *R Collins*
 DATE APPROVED: 02-28-2023
 FILE NAME: 36019-G15

SCALE: N.T.S.
 REV: 4.0
 DRAWN BY: MCT
 MODIFIED BY: HC
 DATE CREATED: 03-20-08
 DATE MODIFIED: 02-11-09
 SHEET NUMBER: 15
 of 31

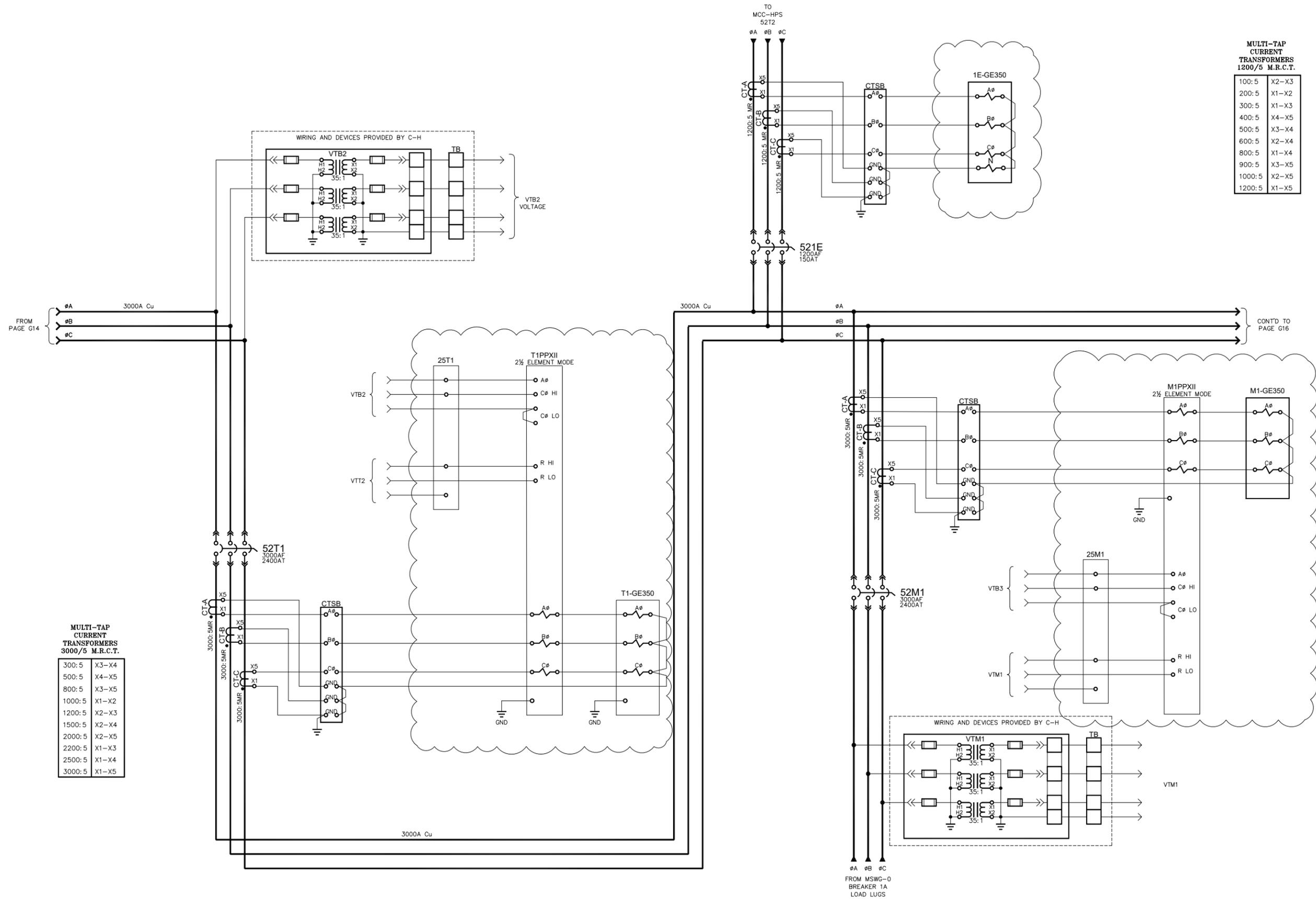
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MULTI-TAP CURRENT TRANSFORMERS 1200/5 M.R.C.T.

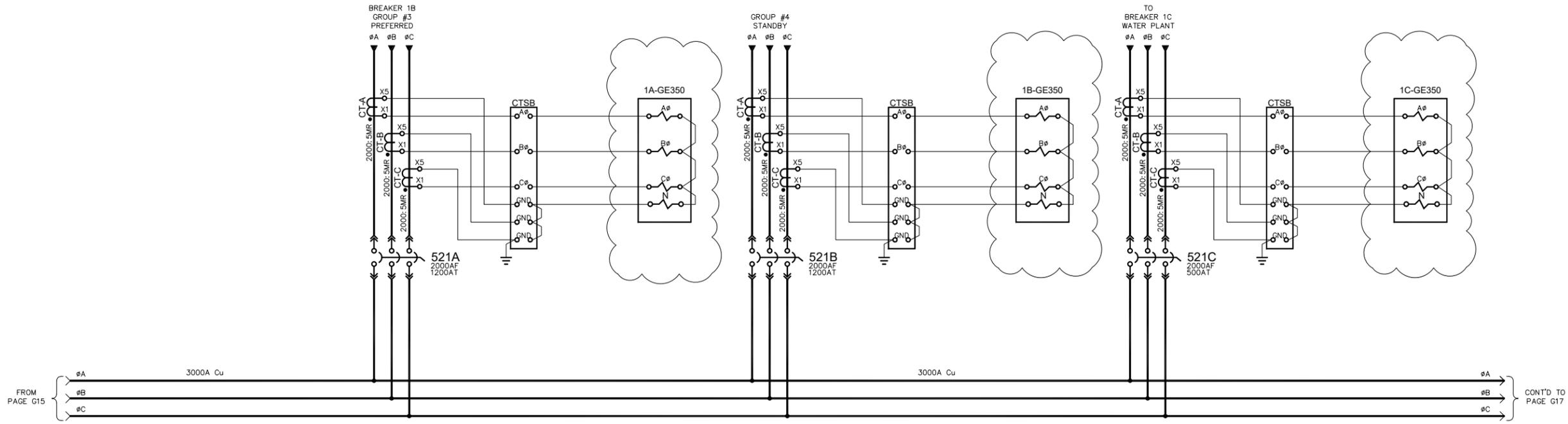
| | |
|--------|-------|
| 100:5 | X2-X3 |
| 200:5 | X1-X2 |
| 300:5 | X1-X3 |
| 400:5 | X4-X5 |
| 500:5 | X3-X4 |
| 600:5 | X2-X4 |
| 800:5 | X1-X4 |
| 900:5 | X3-X5 |
| 1000:5 | X2-X5 |
| 1200:5 | X1-X5 |

MULTI-TAP CURRENT TRANSFORMERS 3000/5 M.R.C.T.

| | |
|--------|-------|
| 300:5 | X3-X4 |
| 500:5 | X4-X5 |
| 800:5 | X3-X5 |
| 1000:5 | X1-X2 |
| 1200:5 | X2-X3 |
| 1500:5 | X2-X4 |
| 2000:5 | X2-X5 |
| 2200:5 | X1-X3 |
| 2500:5 | X1-X4 |
| 3000:5 | X1-X5 |



GWSG / MSWG-1



MULTI-TAP
CURRENT
TRANSFORMERS
2000/5 M.R.C.T.

| | |
|---------|-------|
| 300: 5 | X3-X4 |
| 400: 5 | X1-X2 |
| 500: 5 | X4-X5 |
| 800: 5 | X2-X3 |
| 1100: 5 | X2-X4 |
| 1200: 5 | X1-X3 |
| 1500: 5 | X1-X4 |
| 1600: 5 | X2-X5 |
| 2000: 5 | X1-X5 |

GWSG / MSWG-1



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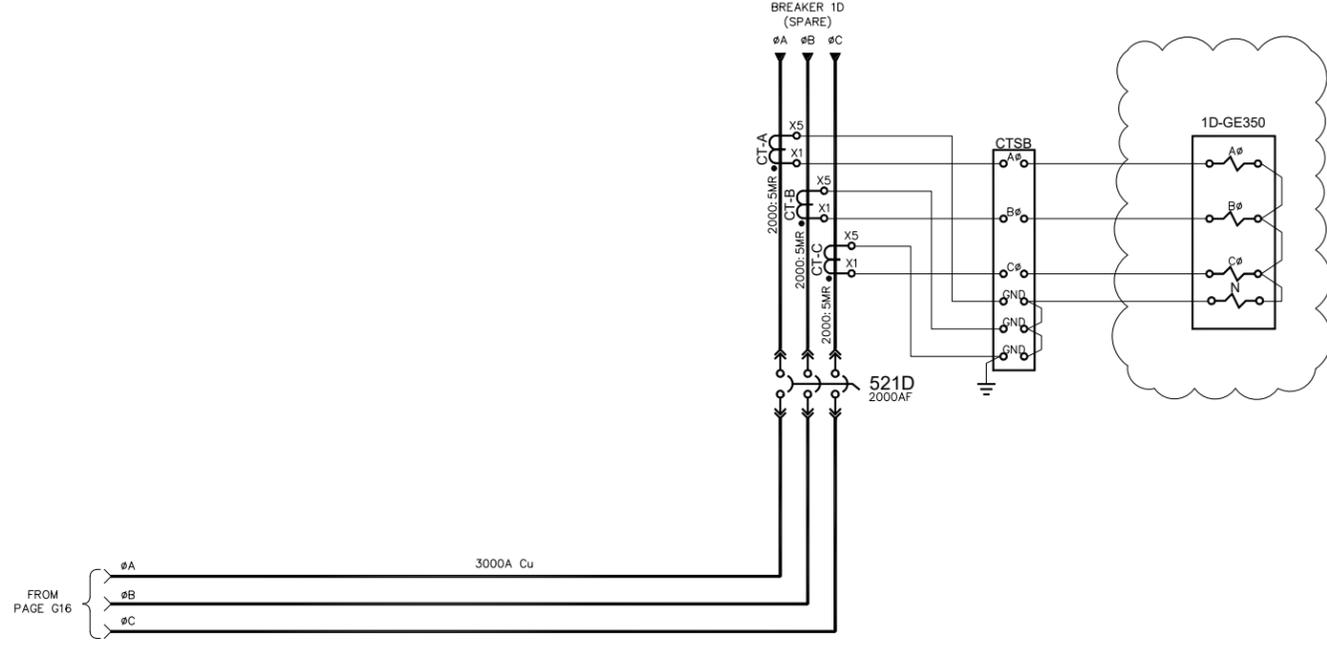
WICHITA WATER UTILITIES
3 - LINE DIAGRAM - (GWSG / MSWG-1)
5KV UTILITY / GENERATOR PARALLELING SWITCHGEAR/BOARD

APPROVED BY: *R Collins* SCALE: N.T.S. REV: 4.0
DATE APPROVED: 02-28-2023
FILE NAME: 36019-G16

DRAWN BY: MCT MODIFIED BY: HC
DATE CREATED: 03-20-08 DATE MODIFIED: 12-15-08
SHEET NUMBER: 16 of 31

| NO. | REVISION | DATE |
|-----|----------------------------------|----------|
| 2.0 | ISSUED FOR FIELD STARTUP | 06-19-09 |
| 2.1 | RE-ISSUED FOR FIELD STARTUP | 07-28-09 |
| 3.0 | ISSUED FOR AS BUILT | 04-20-11 |
| 4.0 | ISSUED FOR SUBMITTAL (301205) | 02-28-23 |
| 0.6 | RE-ISSUED FOR SUBMITTAL | 01-23-09 |
| 0.7 | ISSUED FOR CUSTOMER RECORD | 02-12-09 |
| 1.0 | ISSUED FOR PRODUCTION | 03-10-09 |
| 1.1 | ISSUED FOR CUSTOMER WITNESS TEST | 06-15-09 |

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MULTI-TAP
CURRENT
TRANSFORMERS
2000/5 M.R.C.T.

| | |
|---------|-------|
| 300: 5 | X3-X4 |
| 400: 5 | X1-X2 |
| 500: 5 | X4-X5 |
| 800: 5 | X2-X3 |
| 1100: 5 | X2-X4 |
| 1200: 5 | X1-X3 |
| 1500: 5 | X1-X4 |
| 1600: 5 | X2-X5 |
| 2000: 5 | X1-X5 |

GWSG / MSWG-1

| NO. | REVISION | DATE |
|-----|----------------------------------|----------|
| 2.0 | ISSUED FOR FIELD STARTUP | 06-19-09 |
| 2.1 | RE-ISSUED FOR FIELD STARTUP | 07-28-09 |
| 3.0 | ISSUED FOR AS-BUILT | 04-20-11 |
| 4.0 | ISSUED FOR SUBMITTAL (301205) | 02-28-23 |
| 0.6 | RE-ISSUED FOR SUBMITTAL | 01-23-09 |
| 0.7 | ISSUED FOR CUSTOMER RECORD | 02-12-09 |
| 1.0 | ISSUED FOR PRODUCTION | 03-10-09 |
| 1.1 | ISSUED FOR CUSTOMER WITNESS TEST | 06-15-09 |

| TITLE: | |
|---|---------------------------|
| WICHITA WATER UTILITIES 3 - LINE DIAGRAM - (GWSG / MSWG-1) 5KV UTILITY / GENERATOR PARALLELING SWITCHGEAR/BOARD | |
| APPROVED BY <i>R Collins</i> | DRAWN BY MCT |
| DATE APPROVED 02-28-2023 | DATE CREATED 03-20-08 |
| FILE NAME 36019-G17 | DATE MODIFIED 02-10-09 |
| | SHEET NUMBER 17 |
| | of 31 |



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**WICHITA WATER UTILITIES
3 - LINE DIAGRAM - (MSWG-2)**

5KV UTILITY / GENERATOR PARALLELING SWITCHGEAR/BOARD

APPROVED BY *R Collins*

DATE APPROVED 02-28-2023

FILE NAME 36019-G18

SCALE N.T.S.

REV. 4.0

G18

18 of 31

DRAWN BY MCT

MODIFIED BY HC

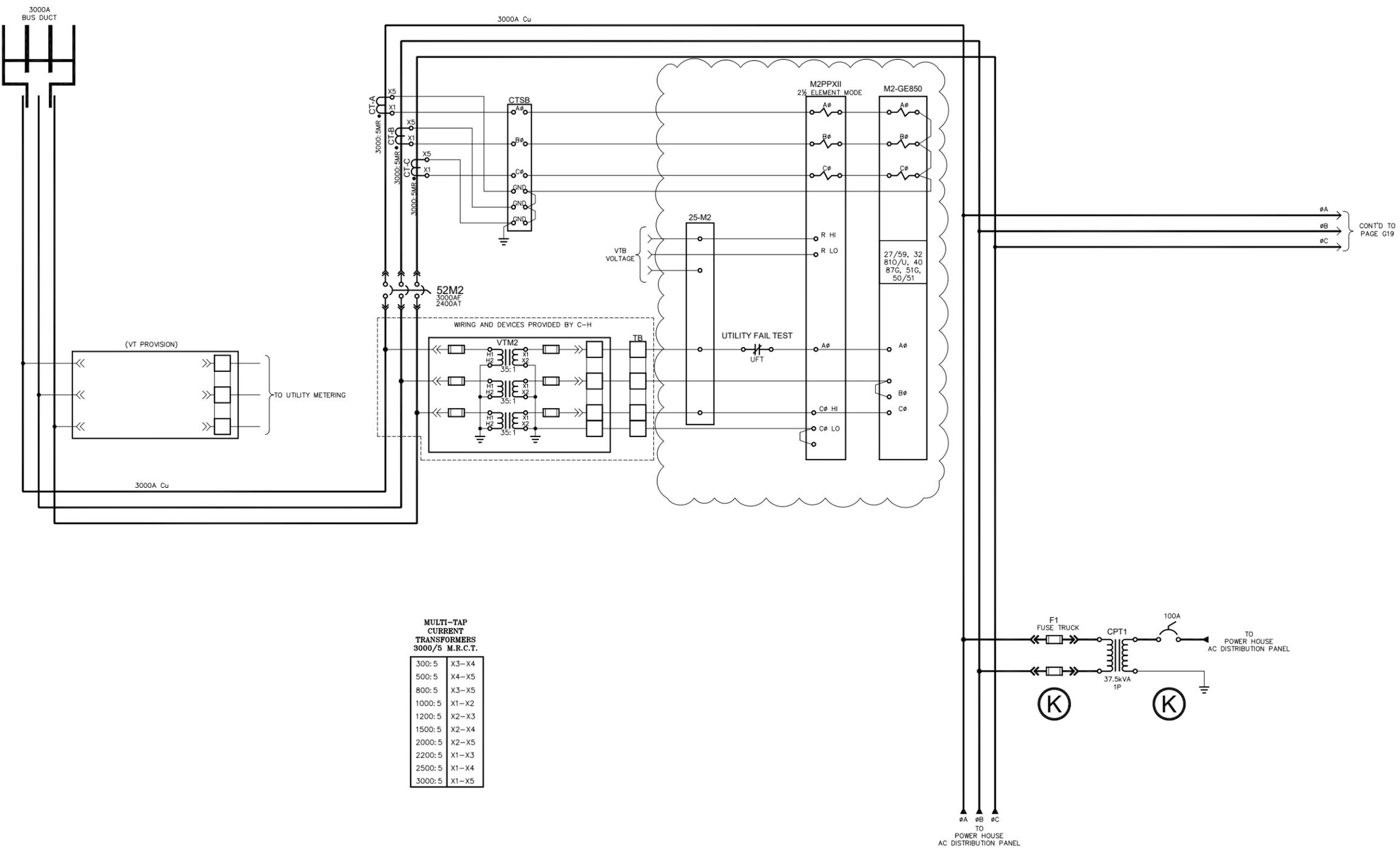
DATE CREATED 03-20-08

DATE MODIFIED 02-12-09

SHEET NUMBER 18

of 31

| NO. | REVISION | DATE |
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| 2.1 | RE-ISSUED FOR FIELD STARTUP | 07-28-09 |
| 3.0 | ISSUED FOR AS BUILT | 04-20-11 |
| 4.0 | ISSUED FOR SUBMITTAL (301205) | 02-28-23 |
| 0.6 | RE-ISSUED FOR SUBMITTAL | 01-23-09 |
| 0.7 | ISSUED FOR CUSTOMER RECORD | 02-12-09 |
| 1.0 | ISSUED FOR PRODUCTION | 03-10-09 |
| 1.1 | ISSUED FOR CUSTOMER WITNESS TEST | 06-15-09 |

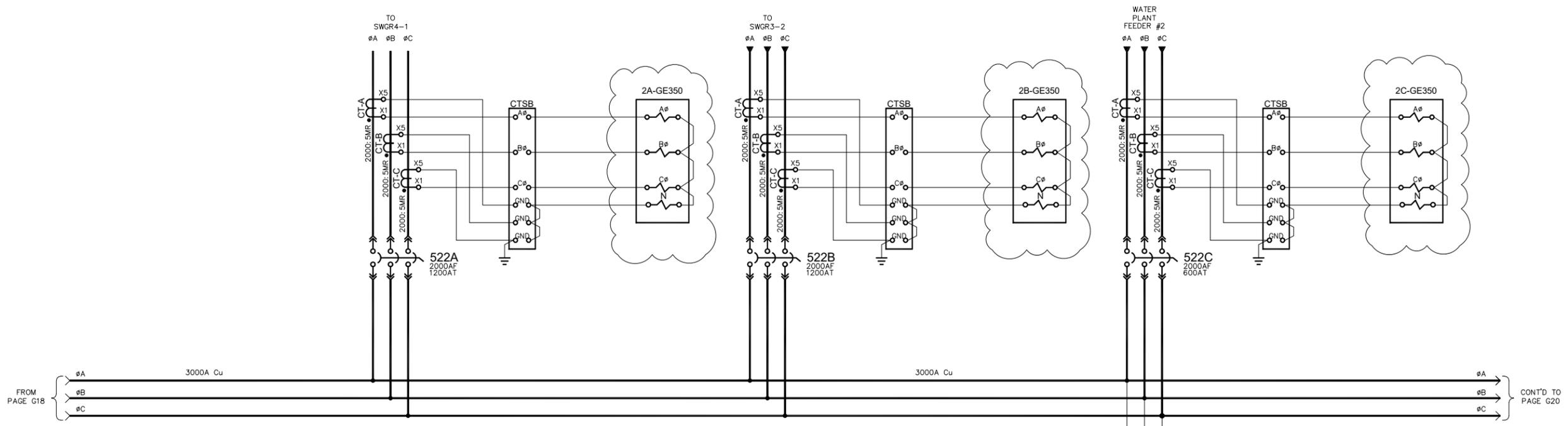


MULTI-TAP CURRENT TRANSFORMERS 3000/5 M.R.C.T.

| | |
|---------|-------|
| 300: 5 | X3-X4 |
| 500: 5 | X4-X5 |
| 800: 5 | X3-X5 |
| 1000: 5 | X1-X2 |
| 1200: 5 | X2-X3 |
| 1500: 5 | X2-X4 |
| 2000: 5 | X2-X5 |
| 2200: 5 | X1-X3 |
| 2500: 5 | X1-X4 |
| 3000: 5 | X1-X5 |

MSWG-2

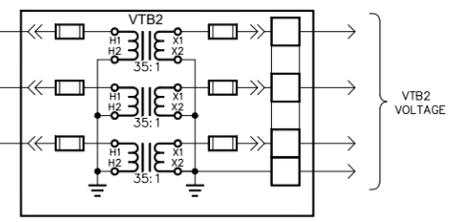
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CONT'D TO PAGE G20

MULTI-TAP CURRENT TRANSFORMERS 2000/5 M.R.C.T.

| | |
|--------|-------|
| 300:5 | X3-X4 |
| 400:5 | X1-X2 |
| 500:5 | X4-X5 |
| 800:5 | X2-X3 |
| 1100:5 | X2-X4 |
| 1200:5 | X1-X3 |
| 1500:5 | X1-X4 |
| 1600:5 | X2-X5 |
| 2000:5 | X1-X5 |



MSWG-2



CATERPILLAR

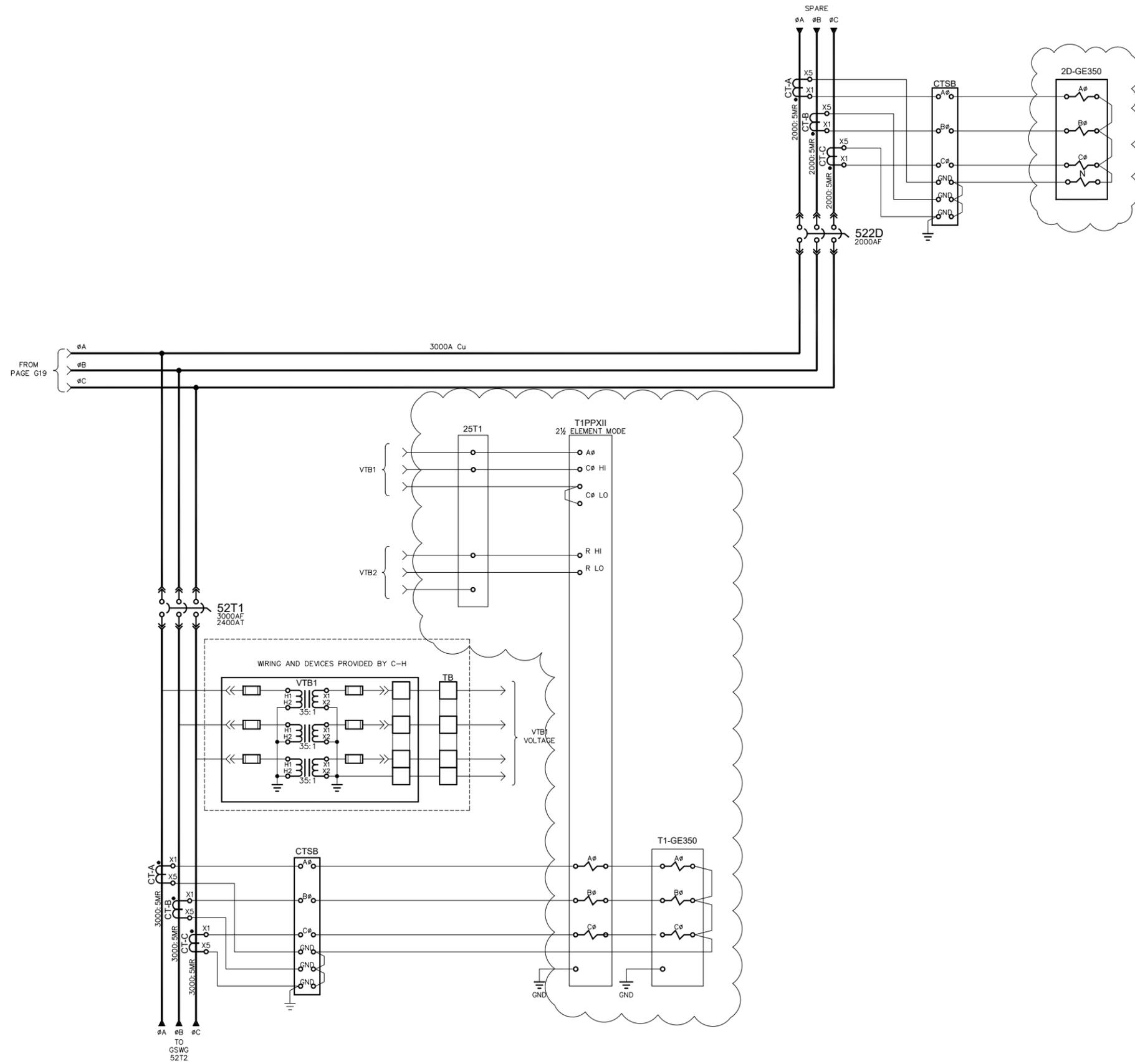
WICHITA WATER UTILITIES
3 - LINE DIAGRAM - (MSWG-2)

5KV UTILITY / GENERATOR PARALLELING SWITCHGEAR/BOARD

| | | | | |
|------------------|--------------|---------------|--------------|--------------|
| APPROVED BY | SCALE | REV. | DRAWN BY | MODIFIED BY |
| <i>R Collins</i> | N.T.S. | 4-0 | MCT | HC |
| DATE APPROVED | DATE CREATED | DATE MODIFIED | SHEET NUMBER | SHEET NUMBER |
| 02-28-2023 | 03-20-08 | 02-12-09 | 19 | 31 |
| FILE NAME | | | | |
| 36019-G19 | | | | |

| NO. | REVISION | DATE |
|-----|----------------------------------|----------|
| 2.0 | ISSUED FOR FIELD STARTUP | 06-19-09 |
| 2.1 | RE-ISSUED FOR FIELD STARTUP | 07-28-09 |
| 3.0 | ISSUED FOR AS BUILT | 04-20-11 |
| 4.0 | ISSUED FOR SUBMITTAL (301205) | 02-28-23 |
| 0.6 | RE-ISSUED FOR SUBMITTAL | 01-23-09 |
| 0.7 | ISSUED FOR CUSTOMER RECORD | 02-12-09 |
| 1.0 | ISSUED FOR PRODUCTION | 03-10-09 |
| 1.1 | ISSUED FOR CUSTOMER WITNESS TEST | 06-15-09 |

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MULTI-TAP CURRENT TRANSFORMERS 2000/5 M.R.C.T.

| | |
|---------|-------|
| 300: 5 | X3-X4 |
| 400: 5 | X1-X2 |
| 500: 5 | X4-X5 |
| 800: 5 | X2-X3 |
| 1100: 5 | X2-X4 |
| 1200: 5 | X1-X3 |
| 1500: 5 | X1-X4 |
| 1600: 5 | X2-X5 |
| 2000: 5 | X1-X5 |

MULTI-TAP CURRENT TRANSFORMERS 3000/5 M.R.C.T.

| | |
|---------|-------|
| 300: 5 | X3-X4 |
| 500: 5 | X4-X5 |
| 800: 5 | X3-X5 |
| 1000: 5 | X1-X2 |
| 1200: 5 | X2-X3 |
| 1500: 5 | X2-X4 |
| 2000: 5 | X2-X5 |
| 2200: 5 | X1-X3 |
| 2500: 5 | X1-X4 |
| 3000: 5 | X1-X5 |

MSWG-2



CATERPILLAR

WICHITA WATER UTILITIES
3 - LINE DIAGRAM - (MSWG-2)

5KV UTILITY / GENERATOR PARALLELING SWITCHGEAR/BOARD

| | |
|---------------|------------|
| APPROVED BY | R Collins |
| SCALE | N.T.S. |
| REV. | 4-0 |
| DRAWN BY | MCT |
| MODIFIED BY | HC |
| DATE APPROVED | 02-28-2023 |
| DATE CREATED | 03-20-08 |
| DATE MODIFIED | 12-15-08 |
| FILE NAME | 36019-G20 |
| SHEET NUMBER | 20 |
| of | 31 |

| NO. | REVISION | DATE |
|-----|----------------------------------|----------|
| 2.0 | ISSUED FOR FIELD STARTUP | 06-19-09 |
| 2.1 | RE-ISSUED FOR FIELD STARTUP | 07-28-09 |
| 3.0 | ISSUED FOR AS BUILT | 04-20-11 |
| 4.0 | ISSUED FOR SUBMITTAL (301205) | 02-28-23 |
| 0.6 | RE-ISSUED FOR SUBMITTAL | 01-23-09 |
| 0.7 | ISSUED FOR CUSTOMER RECORD | 02-12-09 |
| 1.0 | ISSUED FOR PRODUCTION | 03-10-09 |
| 1.1 | ISSUED FOR CUSTOMER WITNESS TEST | 06-15-09 |

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WICHITA WATER UTILITIES
 DC SCHEMATIC DIAGRAM
 5KV UTILITY / GENERATOR PARALLELING SWITCHGEAR/BOARD

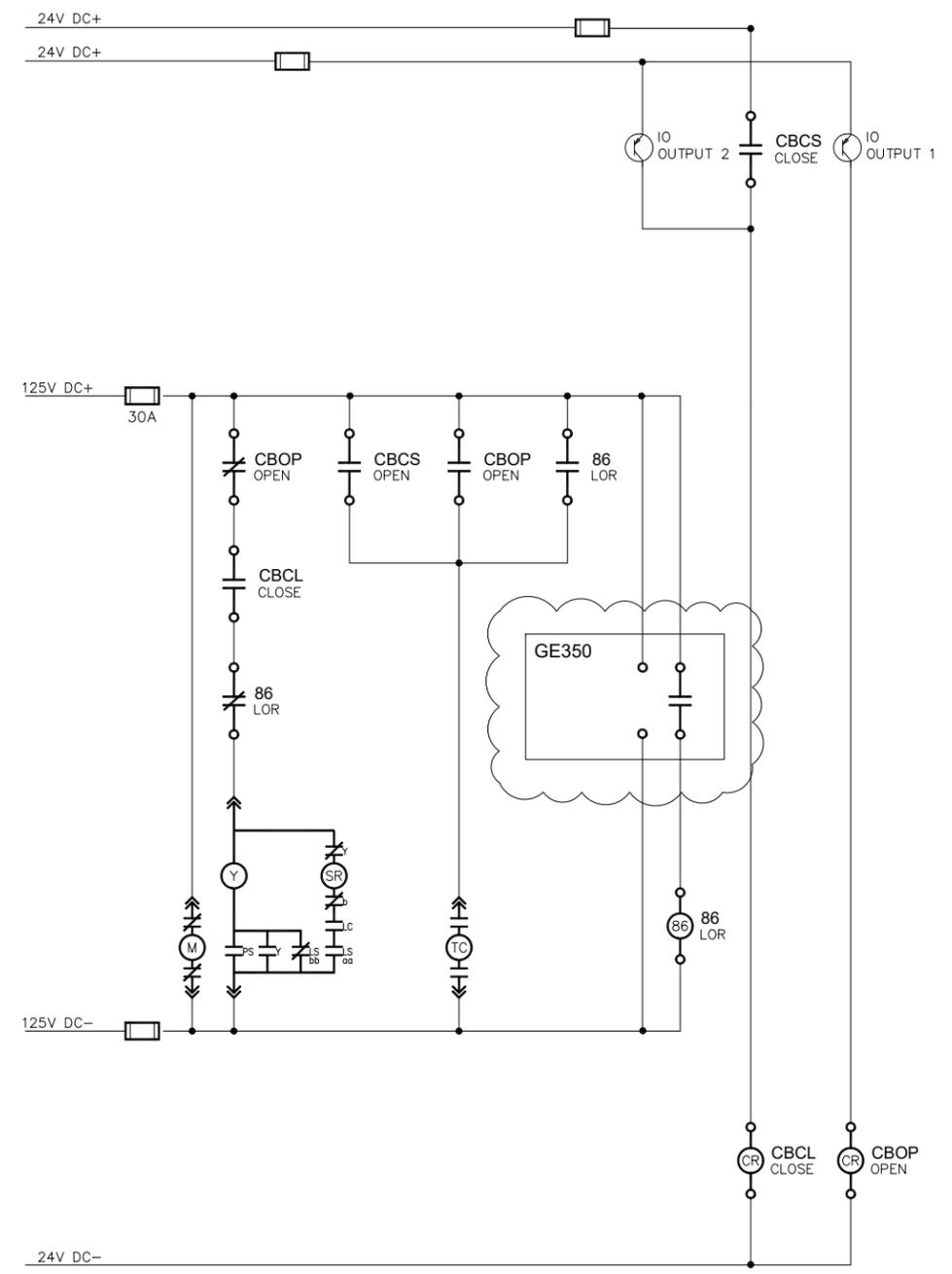
APPROVED BY: *R Collins*
 DATE APPROVED: 02-28-2023
 FILE NAME: 36019-G21

SCALE: N.T.S.
 REV: 4.0
 DRAWN BY: MCT
 DATE CREATED: 04-11-08
 SHEET NUMBER: 21 of 31

| NO. | REVISION | DATE |
|-----|----------------------------------|----------|
| 2.0 | ISSUED FOR FIELD STARTUP | 06-19-09 |
| 2.1 | RE-ISSUED FOR FIELD STARTUP | 07-28-09 |
| 3.0 | ISSUED FOR AS BUILT | 04-20-11 |
| 4.0 | ISSUED FOR SUBMITTAL (301205) | 02-28-23 |
| 0.6 | RE-ISSUED FOR SUBMITTAL | 01-23-09 |
| 0.7 | ISSUED FOR CUSTOMER RECORD | 02-12-09 |
| 1.0 | ISSUED FOR PRODUCTION | 03-10-09 |
| 1.1 | ISSUED FOR CUSTOMER WITNESS TEST | 06-15-09 |

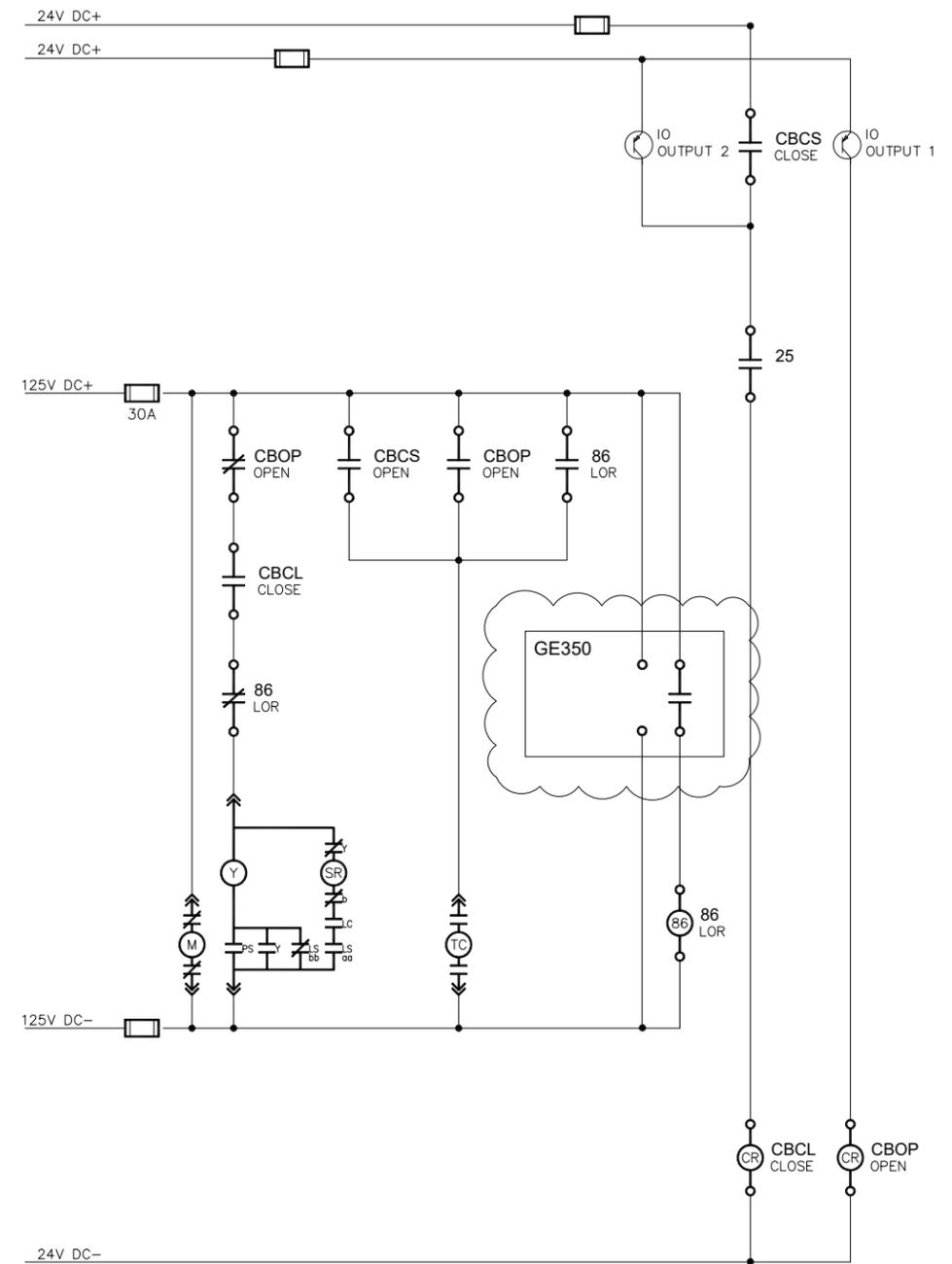
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SCHEMATIC DIAGRAM - DIST



SECT 4B, 5B, 6B, 8B (MSWG - 2)
 SECT 2B, 9D, 11B, 12B, 13B, 14B (GWSG / MSWG - 1)

SCHEMATIC DIAGRAM - TIE



SECT 7B (MSWG - 2)
 SECT 1B, 8B, 10B (GWSG / MSWG - 1)



CATERPILLAR

WICHITA WATER UTILITIES
DC SCHEMATIC DIAGRAM

5KV UTILITY / GENERATOR PARALLELING SWITCHGEAR/BOARD

APPROVED BY *R Collins* SCALE: N.T.S. REV: 4.0 DRAWN BY: MCT

DATE APPROVED: 02-28-2023 DATE CREATED: 04-11-08

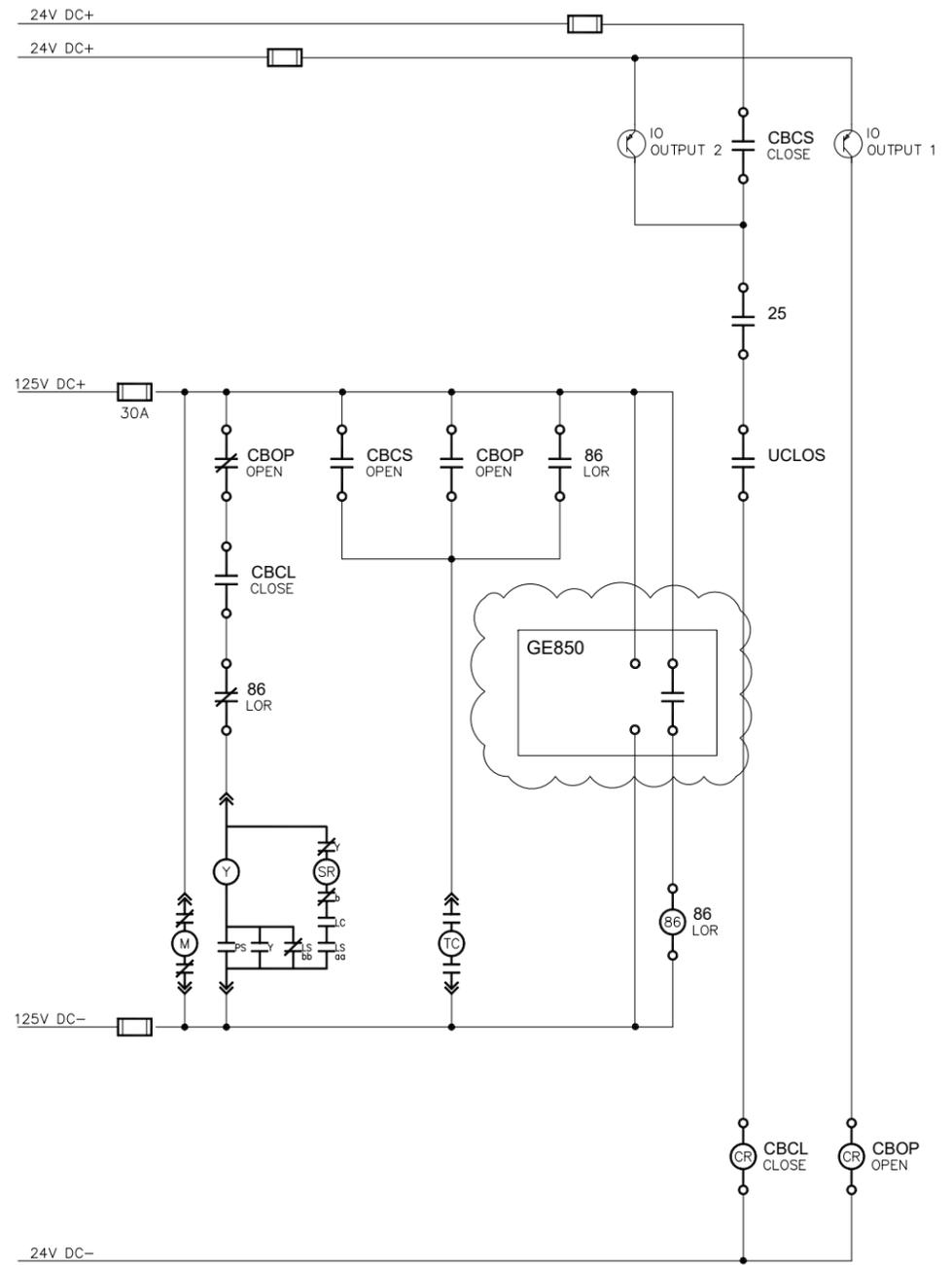
FILE NAME: 36019-G22 SHEET NUMBER: 22 of 31

G22

| NO. | REVISION | DATE |
|-----|----------------------------------|----------|
| 2.0 | ISSUED FOR FIELD STARTUP | 06-19-09 |
| 2.1 | RE-ISSUED FOR FIELD STARTUP | 07-28-09 |
| 3.0 | ISSUED FOR AS BUILT | 04-20-11 |
| 4.0 | ISSUED FOR SUBMITTAL (301205) | 02-28-23 |
| 0.6 | RE-ISSUED FOR SUBMITTAL | 01-23-09 |
| 0.7 | ISSUED FOR CUSTOMER RECORD | 02-12-09 |
| 1.0 | ISSUED FOR PRODUCTION | 03-10-09 |
| 1.1 | ISSUED FOR CUSTOMER WITNESS TEST | 06-15-09 |

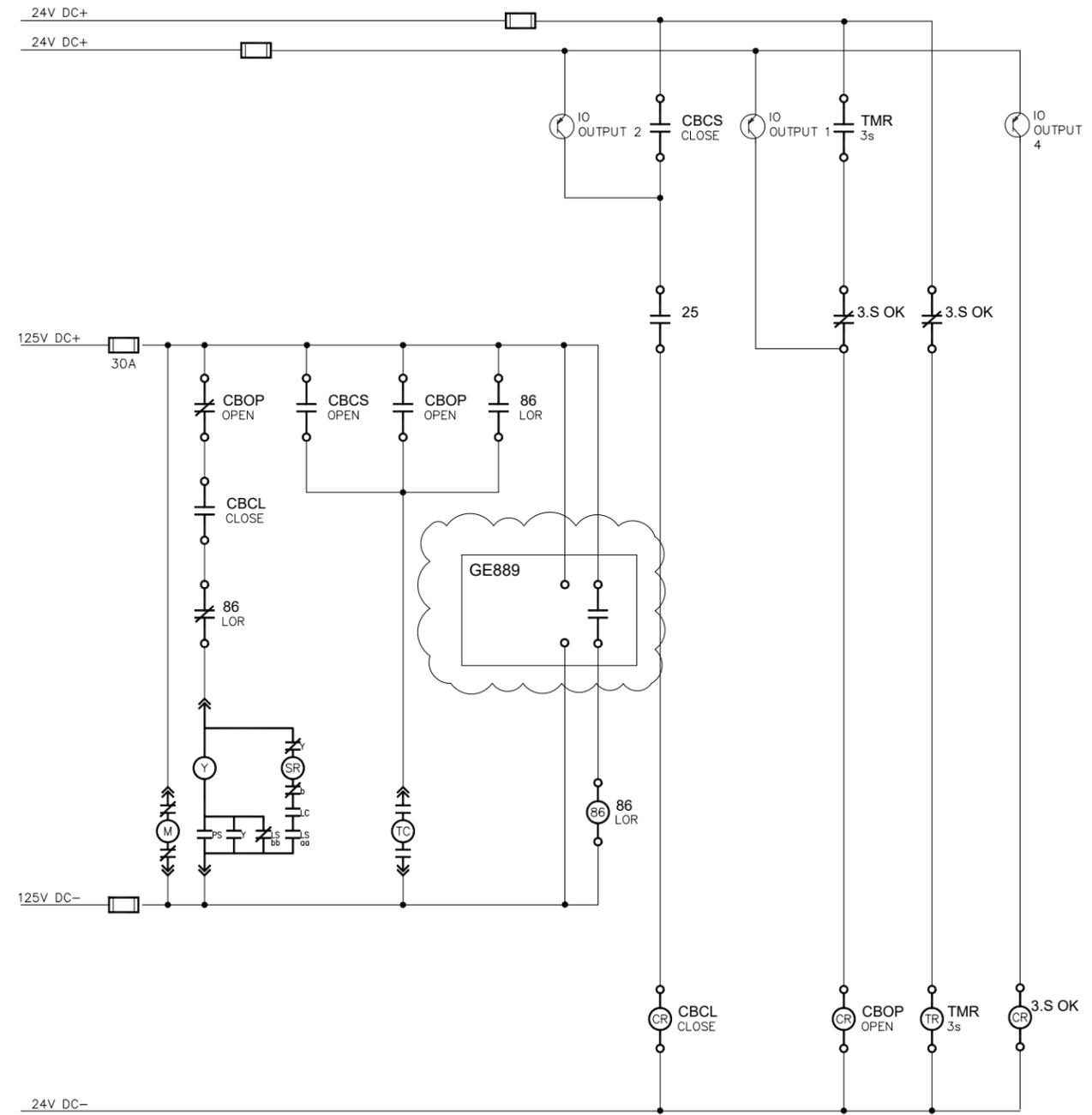
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SCHEMATIC DIAGRAM - UTILITY



SECT 2B (MSWG - 0)
SECT 2B (MSWG - 2)

SCHEMATIC DIAGRAM - GEN



SECT 4D, 5D, 6D, 7D (MSWG - 1)



CATERPILLAR

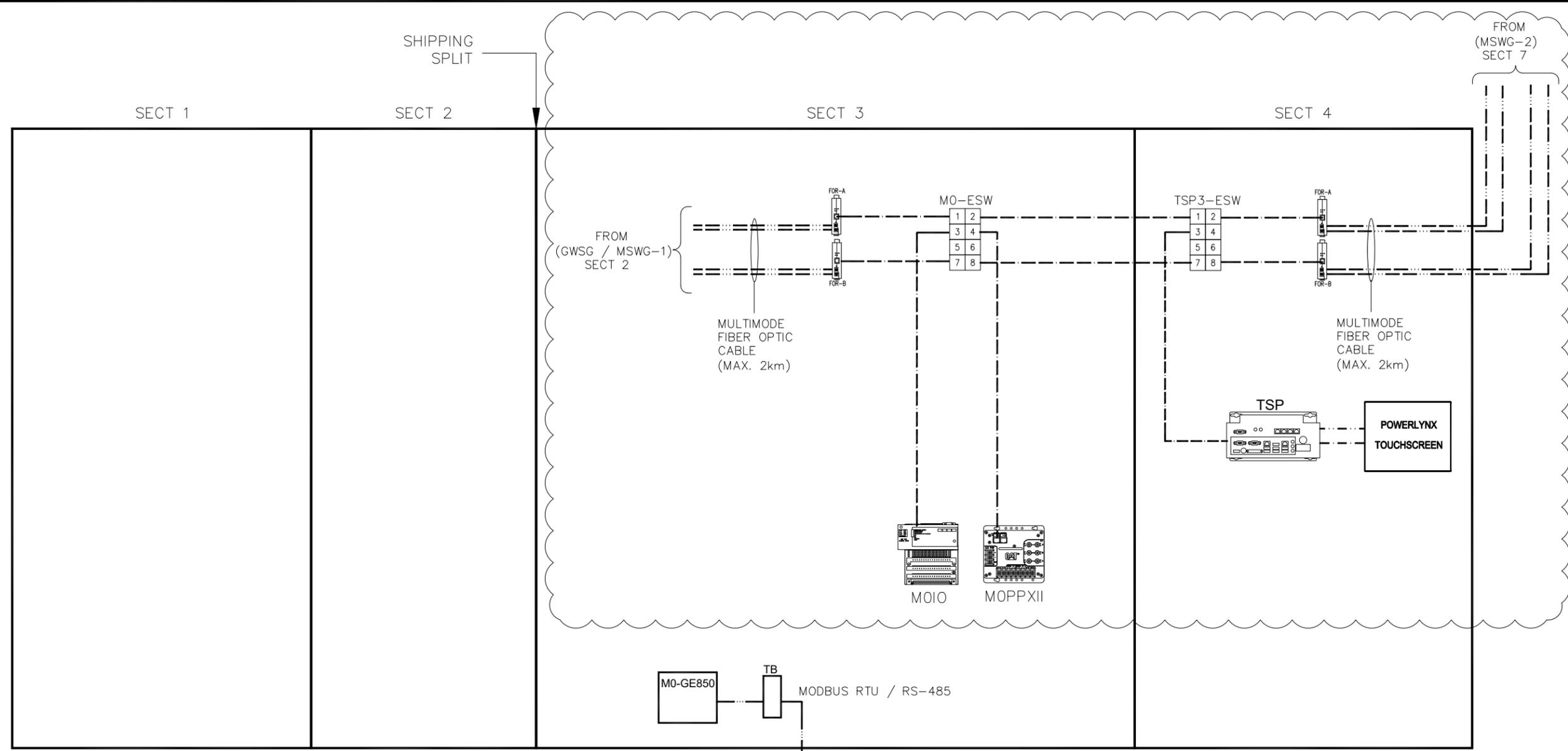
WICHITA WATER UTILITIES
AUTOMATION COMMUNICATIONS PLAN (MSWG-0)
5KV UTILITY / GENERATOR PARALLELING SWITCHGEAR/BOARD

APPROVED BY *R Collins* SCALE N.T.S. REV. 4-0
 DATE APPROVED 02-28-2026
 FILE NAME 36019-G23

DRAWN BY MCT
 DATE CREATED 04-11-08
 SHEET NUMBER 23 of 31

MODIFIED BY ASK
 DATE MODIFIED 03-09-09

| NO. | REVISION | DATE |
|-----|----------------------------------|----------|
| 2.0 | ISSUED FOR FIELD STARTUP | 06-19-09 |
| 2.1 | RE-ISSUED FOR FIELD STARTUP | 07-28-09 |
| 3.0 | ISSUED FOR AS BUILT | 04-20-11 |
| 4.0 | ISSUED FOR SUBMITTAL (301205) | 02-28-23 |
| 0.6 | RE-ISSUED FOR SUBMITTAL | 01-23-09 |
| 0.7 | ISSUED FOR CUSTOMER RECORD | 02-12-09 |
| 1.0 | ISSUED FOR PRODUCTION | 03-10-09 |
| 1.1 | ISSUED FOR CUSTOMER WITNESS TEST | 06-15-09 |



(MSWG-0)

TO
GWSG / MSWG-1
SECT 2

☼ SUPPLIED BY OTHERS

LINE LEGEND

| | |
|-------|---------------------|
| ----- | RS-232 |
| ----- | VIDEO CABLE |
| ----- | ETHERNET |
| ----- | MODBUS RTU / RS-485 |
| ===== | INCOM |
| ----- | DATA LINK |
| ----- | FIBER OPTIC CABLE |

DEVICE LEGEND

| | | | | | | | |
|--|----------------------|--|-------------------------------|--|-----------------------|--|------------------------|
| | FIBER OPTIC REPEATER | | TOUCH SCREEN PROCESSOR DYNICS | | 19 INCH TOUCHSCREEN | | BITRONICS PPXII |
| | REMOTE PC | | 8 PORT ETHERNET SWITCH | | POWERLYNX TOUCHSCREEN | | MOMENTUM M1E PROCESSOR |

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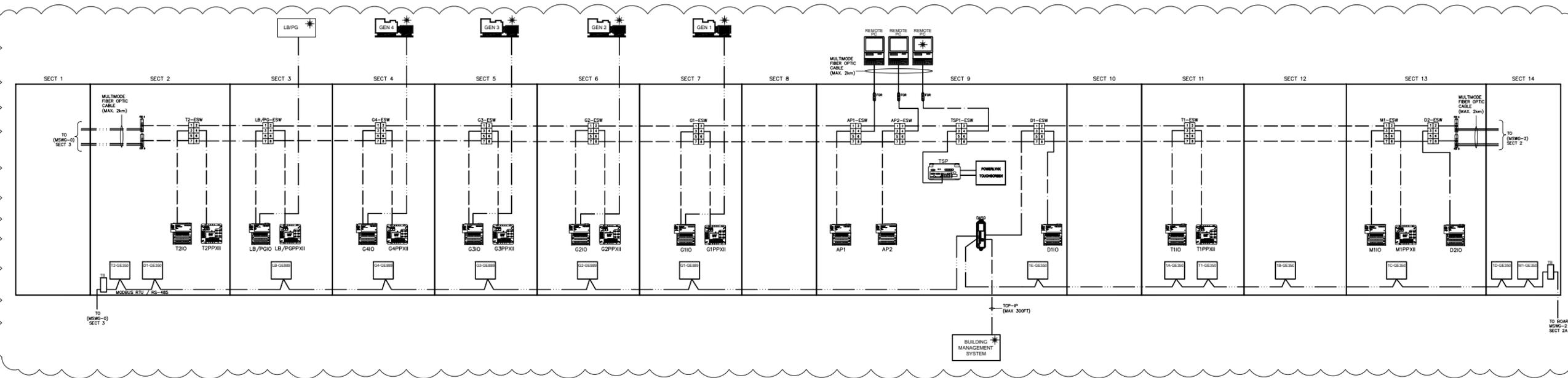
WICHITA WATER UTILITIES
AUTOMATION COMMUNICATIONS PLAN (GWSG / MSWG-1)
5KV UTILITY/GENERATOR PARALLELING SWITCHGEAR/BOARD

APPROVED BY: *R Collins*
 DATE APPROVED: 02-28-2023
 FILE NAME: 36019-G24

SCALE: N.T.S.
 REV: 4.0

DRAWN BY: MCT
 DATE CREATED: 04-11-08
 SHEET NUMBER: 24 of 31

DATE MODIFIED: 03-09-09



(GWSG / MSWG-1)

☼ SUPPLIED BY OTHERS

LINE LEGEND

| | |
|-------|---------------------|
| ----- | RS-232 |
| ----- | VIDEO CABLE |
| ----- | ETHERNET |
| ----- | MODBUS RTU / RS-485 |
| ===== | INCOM |
| ----- | DATA LINK |
| ----- | FIBER OPTIC CABLE |

DEVICE LEGEND

| | | | |
|----------------------|-------------------------------|------------------------|------------------------|
| FIBER OPTIC REPEATER | TOUCH SCREEN PROCESSOR DYNICS | 19 INCH TOUCHSCREEN | BITRONICS PPXII |
| REDLION DTI | REMOTE PC | 8 PORT ETHERNET SWITCH | MOMENTUM M1E PROCESSOR |
| | | POWERLYNX TOUCHSCREEN | |

| NO. | REVISION | DATE |
|-----|----------------------------------|----------|
| 2.0 | ISSUED FOR FIELD STARTUP | 06-19-09 |
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| 3.0 | ISSUED FOR AS BUILT | 04-20-11 |
| 4.0 | ISSUED FOR SUBMITTAL (301205) | 02-28-23 |
| 0.6 | RE-ISSUED FOR SUBMITTAL | 01-23-09 |
| 0.7 | ISSUED FOR CUSTOMER RECORD | 02-12-09 |
| 1.0 | ISSUED FOR PRODUCTION | 03-10-09 |
| 1.1 | ISSUED FOR CUSTOMER WITNESS TEST | 06-15-09 |

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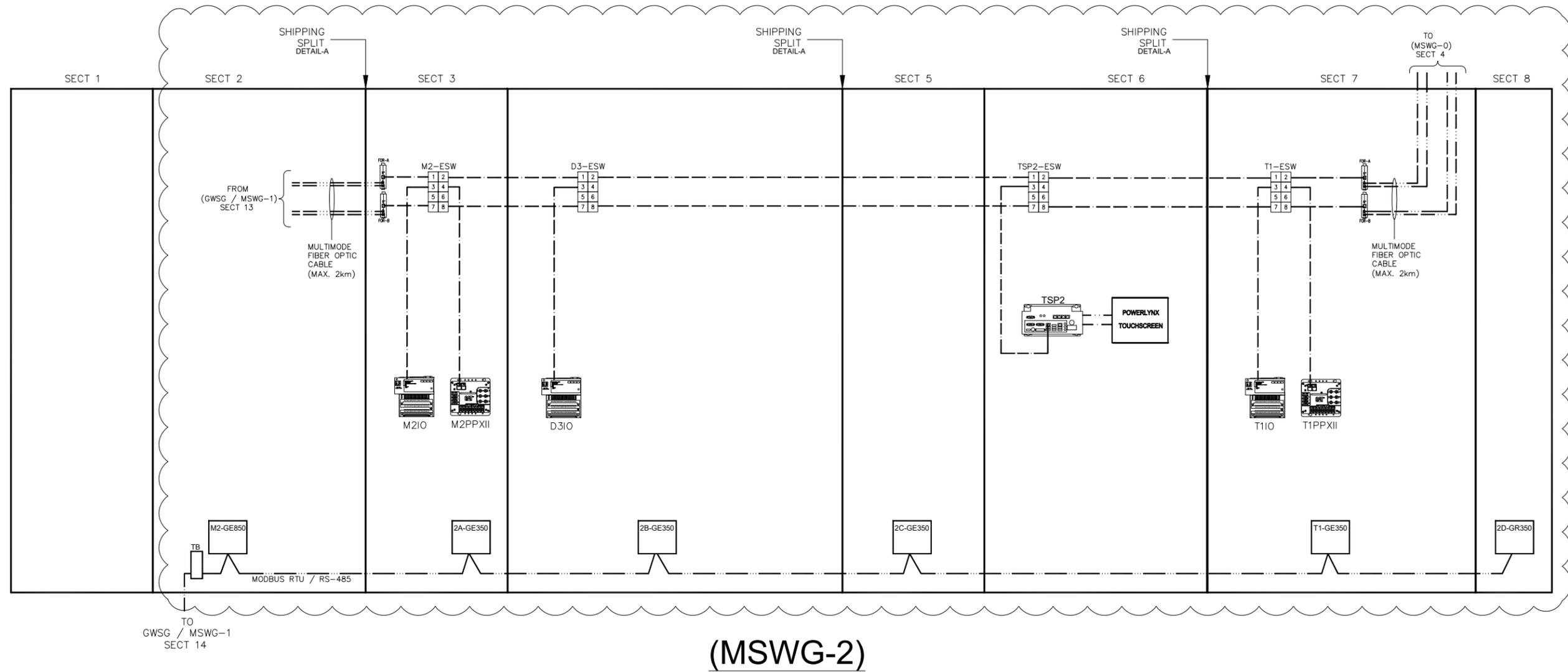
WICHITA WATER UTILITIES
AUTOMATION COMMUNICATIONS PLAN (MSWG-2)
5KV UTILITY GENERATOR PARALLELING SWITCHGEAR/BOARD

APPROVED BY: *R Collins*
 DATE APPROVED: 02-28-2023
 FILE NAME: 36019-G25

SCALE: N.T.S.
 REV: 4-0

DRAWN BY: MCT
 DATE CREATED: 04-11-08
 SHEET NUMBER: 25 of 31

MODIFIED BY: ASK
 DATE MODIFIED: 03-09-09



(MSWG-2)

☼ SUPPLIED BY OTHERS

LINE LEGEND

| | |
|---------|---------------------|
| --- | RS-232 |
| - - - - | VIDEO CABLE |
| --- | ETHERNET |
| --- | MODBUS RTU / RS-485 |
| ===== | INCOM |
| --- | DATA LINK |
| --- | FIBER OPTIC CABLE |

DEVICE LEGEND

| | | | |
|----------------------|-------------------------------|------------------------|------------------------|
| FIBER OPTIC REPEATER | TOUCH SCREEN PROCESSOR DYNICS | 19 INCH TOUCHSCREEN | BITRONICS PPXII |
| | REMOTE PC | 8 PORT ETHERNET SWITCH | MOMENTUM M1E PROCESSOR |
| | | POWERLYNX TOUCHSCREEN | |

| NO. | REVISION | DATE |
|-----|----------------------------------|----------|
| 2.0 | ISSUED FOR FIELD STARTUP | 06-19-09 |
| 2.1 | RE-ISSUED FOR FIELD STARTUP | 07-28-09 |
| 3.0 | ISSUED FOR AS BUILT | 04-20-11 |
| 4.0 | ISSUED FOR SUBMITTAL (301205) | 02-28-23 |
| 0.6 | RE-ISSUED FOR SUBMITTAL | 01-23-09 |
| 0.7 | ISSUED FOR CUSTOMER RECORD | 02-12-09 |
| 1.0 | ISSUED FOR PRODUCTION | 03-10-09 |
| 1.1 | ISSUED FOR CUSTOMER WITNESS TEST | 06-15-09 |

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WICHITA WATER UTILITIES
AUTOMATION COMMUNICATIONS PLAN
5KV UTILITY / GENERATOR PARALLELING SWITCHGEAR/BOARD

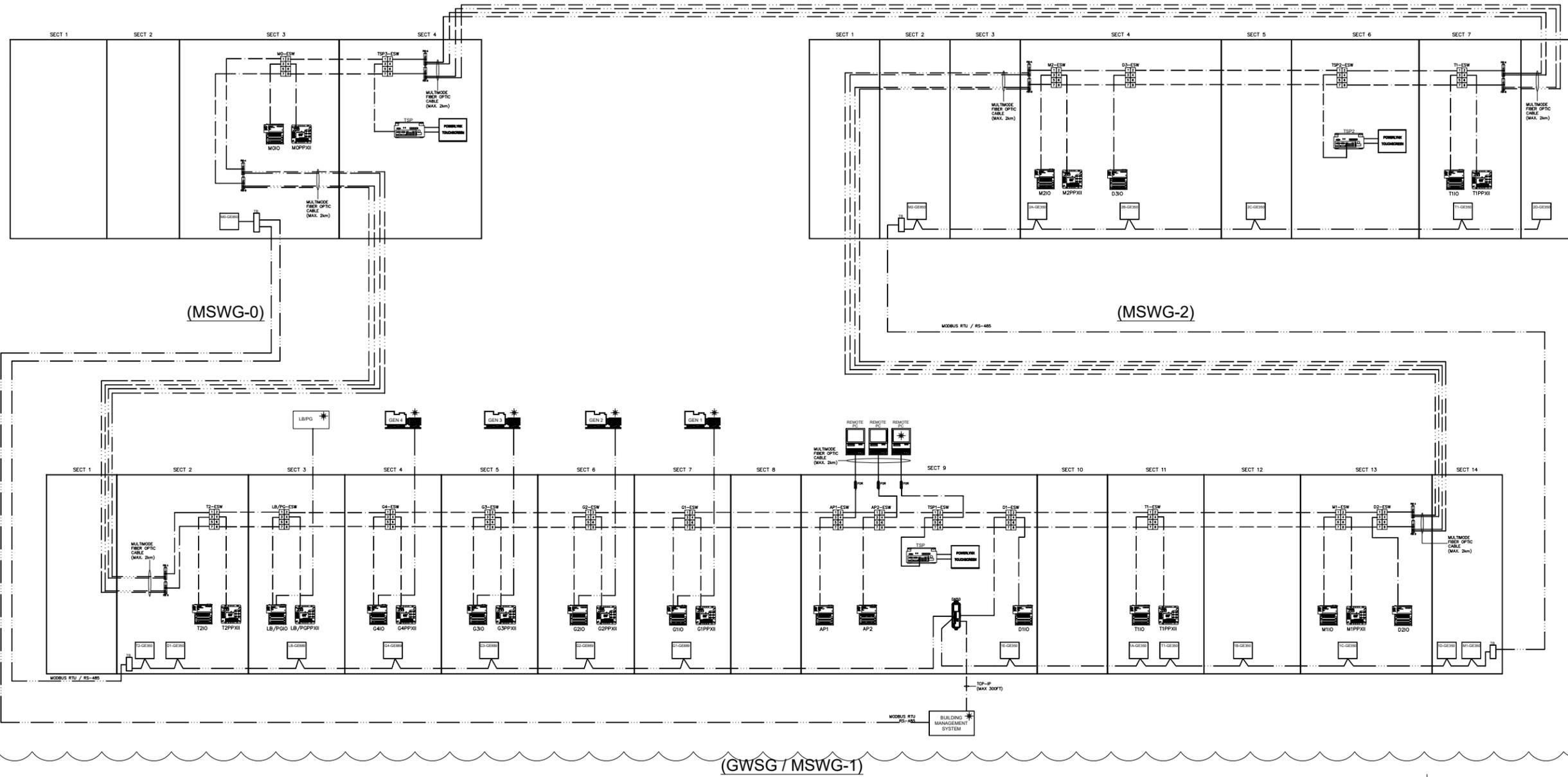
APPROVED BY: *R Collins*
 DATE APPROVED: 02-28-2023
 FILE NAME: 36019-G26

SCALE: N.T.S.
 REV: 4.0

DRAWN BY: MCT
 DATE CREATED: 04-11-08
 SHEET NUMBER: 26 of 31

MODIFIED BY: HC
 DATE MODIFIED: 02-11-09

| NO. | REVISION | DATE |
|-----|----------------------------------|----------|
| 2.0 | ISSUED FOR FIELD STARTUP | 06-19-09 |
| 2.1 | RE-ISSUED FOR FIELD STARTUP | 07-28-09 |
| 3.0 | ISSUED FOR AS BUILT | 04-20-11 |
| 4.0 | ISSUED FOR SUBMITTAL (301205) | 02-28-23 |
| 0.6 | RE-ISSUED FOR SUBMITTAL | 01-23-09 |
| 0.7 | ISSUED FOR CUSTOMER RECORD | 02-12-09 |
| 1.0 | ISSUED FOR PRODUCTION | 03-10-09 |
| 1.1 | ISSUED FOR CUSTOMER WITNESS TEST | 06-15-09 |



LINE LEGEND

| | |
|--|---------------------|
| | RS-232 |
| | VIDEO CABLE |
| | ETHERNET |
| | MODBUS RTU / RS-485 |
| | INCOM |
| | DATA LINK |
| | FIBER OPTIC CABLE |

DEVICE LEGEND

| | | | | | | | |
|--|----------------------|--|-------------------------------|--|------------------------|--|------------------------|
| | FIBER OPTIC REPEATER | | TOUCH SCREEN PROCESSOR DYNICS | | 19 INCH TOUCHSCREEN | | BITRONICS PPXII |
| | REDLION DTI | | REMOTE PC | | 8 PORT ETHERNET SWITCH | | MOMENTUM M1E PROCESSOR |

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CONTROL CIRCUIT CONDUIT SCHEDULE (SEE NOTE 1)

| CONDUIT | | | CONDUCTOR | | CONDUIT SIZE | CONDUIT TABLE |
|---------|----------------------------|---|--|---|--------------|------------------|
| NO. | FROM | TO | QTY-SIZE | FUNCTION | | |
| 1 | GEN 4 | SECT 4 (GWSG / MSWG-1) | 1 - 2 COND. #18 SHIELDED TWISTED PAIR, BELDEN 3073F OR EQUIVALENT | GEN 4 EMCP3.3 (DATA LINK) | NOTE 4 & 5 | TYPE D NOTE 6 |
| | | | 1 - 3 COND. #16 SHIELDED TWISTED TRIPLET, BELDEN 8618 OR EQUIVALENT | GEN 4 ADEM III (SPEED BRICK) (BUNDLE 5) | | |
| | | | 1 - 2 COND. #16 SHIELDED TWISTED PAIR, BELDEN 8719 OR EQUIVALENT | GEN 4 CDVR (ANALOG VOLTAGE CONTROL) | | |
| | | | 3 - #14 AWG | GEN 4 CDVR (MANUAL VOLTAGE CONTROL) | | |
| | | | 16 - #14 AWG | GEN 4 DISCRETE / LOCAL E-STOP | | |
| | | | 4 - 3 CONDUCTOR #16AWG SHIELDED TWISTED TRIPLET, BELDEN 8618 OR EQUIVALENT | RTD (BUNDLE 1-2-3-4) | | |
| 2 | GEN 4 NGR | SECT 4 (GWSG / MSWG-1) | 2 - #12 AWG | GEN 4 GROUND CT SIGNAL | NOTE 5 | TYPE C |
| | | | 3 - #14 AWG | GEN 4 CT SIGNALS FOR DIFFERENTIAL PROTECTION | | |
| | | | 16 - #14 AWG | BEST SOURCE BATTERY | | |
| | | | 4 - 3 CONDUCTOR #16AWG SHIELDED TWISTED TRIPLET, BELDEN 8618 OR EQUIVALENT | RTD (BUNDLE 1-2-3-4) | | |
| | | | 4 - #10 AWG | BEST SOURCE BATTERY | | |
| | | | 2 - #12 AWG | GEN 4 GROUND CT SIGNAL | | |
| 3 | GEN 4 | SECT 4 (GWSG / MSWG-1) | 6 - #10 AWG | GEN 4 CT SIGNALS FOR DIFFERENTIAL PROTECTION | NOTE 5 | TYPE C |
| | | | 1 - 2 COND. #18 SHIELDED TWISTED PAIR, BELDEN 3073F OR EQUIVALENT | GEN 3 EMCP3.3 (DATA LINK) | | |
| | | | 1 - 3 COND. #16 SHIELDED TWISTED TRIPLET, BELDEN 8618 OR EQUIVALENT | GEN 3 ADEM III (SPEED BRICK) | | |
| | | | 1 - 2 COND. #16 SHIELDED TWISTED PAIR, BELDEN 8719 OR EQUIVALENT | GEN 3 CDVR (ANALOG VOLTAGE CONTROL) | | |
| | | | 3 - #14 AWG | GEN 3 CDVR (MANUAL VOLTAGE CONTROL) | | |
| | | | 16 - #14 AWG | GEN 3 DISCRETE / LOCAL E-STOP | | |
| 4 | GEN 3 | SECT 5 (GWSG / MSWG-1) | 4 - 3 CONDUCTOR #16AWG SHIELDED TWISTED TRIPLET, BELDEN 8618 OR EQUIVALENT | RTD | NOTE 4 & 5 | TYPE A |
| | | | 4 - #10 AWG | BEST SOURCE BATTERY | | |
| | | | 2 - #12 AWG | GEN 3 GROUND CT SIGNAL | | |
| | | | 6 - #10 AWG | GEN 3 CT SIGNALS FOR DIFFERENTIAL PROTECTION | | |
| | | | 1 - 2 COND. #18 SHIELDED TWISTED PAIR, BELDEN 3073F OR EQUIVALENT | GEN 3 EMCP3.3 (DATA LINK) | | |
| | | | 1 - 3 COND. #16 SHIELDED TWISTED TRIPLET, BELDEN 8618 OR EQUIVALENT | GEN 3 ADEM III (SPEED BRICK) | | |
| 5 | GEN 3 NGR | SECT 5 (GWSG / MSWG-1) | 2 - #12 AWG | GEN 3 GROUND CT SIGNAL | NOTE 5 | TYPE C |
| | | | 6 - #10 AWG | GEN 3 CT SIGNALS FOR DIFFERENTIAL PROTECTION | | |
| | | | 1 - 2 COND. #18 SHIELDED TWISTED PAIR, BELDEN 3073F OR EQUIVALENT | GEN 2 EMCP3.3 (DATA LINK) | | |
| | | | 1 - 3 COND. #16 SHIELDED TWISTED TRIPLET, BELDEN 8618 OR EQUIVALENT | GEN 2 ADEM III (SPEED BRICK) | | |
| | | | 1 - 2 COND. #16 SHIELDED TWISTED PAIR, BELDEN 8719 OR EQUIVALENT | GEN 2 CDVR (ANALOG VOLTAGE CONTROL) | | |
| | | | 3 - #14 AWG | GEN 2 CDVR (MANUAL VOLTAGE CONTROL) | | |
| 6 | GEN 3 | SECT 5 (GWSG / MSWG-1) | 16 - #14 AWG | GEN 2 DISCRETE / LOCAL E-STOP | NOTE 4 & 5 | TYPE A |
| | | | 4 - 3 CONDUCTOR #16AWG SHIELDED TWISTED TRIPLET, BELDEN 8618 OR EQUIVALENT | RTD | | |
| | | | 4 - #10 AWG | BEST SOURCE BATTERY | | |
| | | | 2 - #12 AWG | GEN 2 GROUND CT SIGNAL | | |
| | | | 6 - #10 AWG | GEN 2 CT SIGNALS FOR DIFFERENTIAL PROTECTION | | |
| | | | 1 - 2 COND. #18 SHIELDED TWISTED PAIR, BELDEN 3073F OR EQUIVALENT | GEN 2 EMCP3.3 (DATA LINK) | | |
| 7 | GEN 2 | SECT 6 (GWSG / MSWG-1) | 1 - 3 COND. #16 SHIELDED TWISTED TRIPLET, BELDEN 8618 OR EQUIVALENT | GEN 2 ADEM III (SPEED BRICK) | NOTE 4 & 5 | TYPE D NOTE 6 |
| | | | 1 - 2 COND. #16 SHIELDED TWISTED PAIR, BELDEN 8719 OR EQUIVALENT | GEN 2 CDVR (ANALOG VOLTAGE CONTROL) | | |
| | | | 3 - #14 AWG | GEN 2 CDVR (MANUAL VOLTAGE CONTROL) | | |
| | | | 16 - #14 AWG | GEN 2 DISCRETE / LOCAL E-STOP | | |
| | | | 4 - 3 CONDUCTOR #16AWG SHIELDED TWISTED TRIPLET, BELDEN 8618 OR EQUIVALENT | RTD | | |
| | | | 4 - #10 AWG | BEST SOURCE BATTERY | | |
| 8 | GEN 2 NGR | SECT 6 (GWSG / MSWG-1) | 2 - #12 AWG | GEN 2 GROUND CT SIGNAL | NOTE 5 | TYPE C |
| | | | 6 - #10 AWG | GEN 2 CT SIGNALS FOR DIFFERENTIAL PROTECTION | | |
| | | | 1 - 2 COND. #18 SHIELDED TWISTED PAIR, BELDEN 3073F OR EQUIVALENT | GEN 1 EMCP3.3 (DATA LINK) | | |
| | | | 1 - 3 COND. #16 SHIELDED TWISTED TRIPLET, BELDEN 8618 OR EQUIVALENT | GEN 1 ADEM III (SPEED BRICK) | | |
| | | | 1 - 2 COND. #16 SHIELDED TWISTED PAIR, BELDEN 8719 OR EQUIVALENT | GEN 1 CDVR (ANALOG VOLTAGE CONTROL) | | |
| | | | 3 - #14 AWG | GEN 1 CDVR (MANUAL VOLTAGE CONTROL) | | |
| 9 | GEN 2 | SECT 6 (GWSG / MSWG-1) | 16 - #14 AWG | GEN 1 DISCRETE / LOCAL E-STOP | NOTE 4 & 5 | TYPE A |
| | | | 4 - 3 CONDUCTOR #16AWG SHIELDED TWISTED TRIPLET, BELDEN 8618 OR EQUIVALENT | RTD | | |
| | | | 4 - #10 AWG | BEST SOURCE BATTERY | | |
| | | | 2 - #12 AWG | GEN 1 GROUND CT SIGNAL | | |
| | | | 6 - #10 AWG | GEN 1 CT SIGNALS FOR DIFFERENTIAL PROTECTION | | |
| | | | 1 - 2 COND. #18 SHIELDED TWISTED PAIR, BELDEN 3073F OR EQUIVALENT | GEN 1 EMCP3.3 (DATA LINK) | | |
| 10 | GEN 1 | SECT 7 (GWSG / MSWG-1) | 1 - 3 COND. #16 SHIELDED TWISTED TRIPLET, BELDEN 8618 OR EQUIVALENT | GEN 1 ADEM III (SPEED BRICK) | NOTE 4 & 5 | TYPE D NOTE 6 |
| | | | 1 - 2 COND. #16 SHIELDED TWISTED PAIR, BELDEN 8719 OR EQUIVALENT | GEN 1 CDVR (ANALOG VOLTAGE CONTROL) | | |
| | | | 3 - #14 AWG | GEN 1 CDVR (MANUAL VOLTAGE CONTROL) | | |
| | | | 16 - #14 AWG | GEN 1 DISCRETE / LOCAL E-STOP | | |
| | | | 4 - 3 CONDUCTOR #16AWG SHIELDED TWISTED TRIPLET, BELDEN 8618 OR EQUIVALENT | RTD | | |
| | | | 4 - #10 AWG | BEST SOURCE BATTERY | | |
| 11 | GEN 1 NGR | SECT 7 (GWSG / MSWG-1) | 2 - #12 AWG | GEN 1 GROUND CT SIGNAL | NOTE 5 | TYPE C |
| | | | 6 - #10 AWG | GEN 1 CT SIGNALS FOR DIFFERENTIAL PROTECTION | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| 12 | GEN 1 | SECT 7 (GWSG / MSWG-1) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | NOTE 5 | TYPE C |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| 13 | EMERGENCY POWER PANEL | SECT 9 (GWSG / MSWG-1) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | NOTE 5 | TYPE C |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| 14 | EMERGENCY POWER PANEL | SECT 5 (GWSG / MSWG-1) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | NOTE 5 | TYPE C |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| 15 | EMERGENCY POWER PANEL | SECT 1 (GWSG / MSWG-1) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | NOTE 5 | TYPE C |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| 16 | EMERGENCY POWER PANEL | SECT 1 (MSSWG-0) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | NOTE 5 | TYPE C |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| 17 | EMERGENCY POWER PANEL | SECT 5 (MSSWG-2) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | NOTE 5 | TYPE C |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| 18 | EMERGENCY POWER PANEL | SECT 1 (MSSWG-2) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | NOTE 5 | TYPE C |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| 19 | EMERGENCY POWER PANEL | SECT 13 (GWSG / MSWG-1) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | NOTE 5 | TYPE C |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| | | | 120V AC FOR SPACE HEATERS (1Ø, 30A) | 120V AC FOR SPACE HEATERS (1Ø, 30A) | | |
| 20 | EMERGENCY POWER PANEL | 125V DC BATTERY CHARGER (GWSG / MSWG-1) | 3 - #10 AWG | 120V AC FOR 125V DC BATTERY CHARGER (1Ø, 30A) | NOTE 5 | TYPE C |
| | | | 2 - #10 AWG | 125V DC POWER | | |
| | | | 2 - #10 AWG | 125V DC POWER | | |
| | | | 2 - #14 AWG | 125V DC BATTERY CHARGER FAILURE | | |
| | | | 4 - #10 AWG | 24V DC POWER | | |
| | | | AS REQUIRED BY OPERATION | LOAD SHED | | |
| 21 | 125V DC BATTERY CHARGER | 125V DC BATTERIES (GWSG / MSWG-1) | 1 - CAT 5 ETHERNET CABLE | DATA TABLE INTERFACE | NOTE 5 | TYPE D |
| | | | 1 - FIBER OPTIC MULTIMODE CABLE, WITH ST-CONNECTORS | REMOTE COMMUNICATIONS | | |
| | | | 2 - #10 AWG | 125V DC POWER | | |
| | | | 2 - #10 AWG | 125V DC POWER | | |
| | | | 2 - #10 AWG | 125V DC BATTERY CHARGER FAILURE | | |
| | | | 2 - #14 AWG | 24V DC POWER | | |
| 22 | 125V DC BATTERIES | SECT 9 (GWSG / MSWG-1) | AS REQUIRED BY OPERATION | LOAD SHED | NOTE 5 | TBD |
| | | | 1 - CAT 5 ETHERNET CABLE | DATA TABLE INTERFACE | | |
| | | | 1 - FIBER OPTIC MULTIMODE CABLE, WITH ST-CONNECTORS | REMOTE COMMUNICATIONS | | |
| | | | 2 - #10 AWG | 125V DC POWER | | |
| | | | 2 - #10 AWG | 125V DC POWER | | |
| | | | 2 - #10 AWG | 125V DC BATTERY CHARGER FAILURE | | |
| 23 | 125V DC BATTERY CHARGER | SECT 9 (GWSG / MSWG-1) | AS REQUIRED BY OPERATION | LOAD SHED | NOTE 5 | TYPE A |
| | | | 1 - CAT 5 ETHERNET CABLE | DATA TABLE INTERFACE | | |
| | | | 1 - FIBER OPTIC MULTIMODE CABLE, WITH ST-CONNECTORS | REMOTE COMMUNICATIONS | | |
| | | | 2 - #10 AWG | 125V DC POWER | | |
| | | | 2 - #10 AWG | 125V DC POWER | | |
| | | | 2 - #10 AWG | 125V DC BATTERY CHARGER FAILURE | | |
| 24 | 24V DC STATION BATTERIES | SECT 9 (GWSG / MSWG-1) | AS REQUIRED BY OPERATION | LOAD SHED | NOTE 5 | TYPE A |
| | | | 1 - CAT 5 ETHERNET CABLE | DATA TABLE INTERFACE | | |
| | | | 1 - FIBER OPTIC MULTIMODE CABLE, WITH ST-CONNECTORS | REMOTE COMMUNICATIONS | | |
| | | | 2 - #10 AWG | 125V DC POWER | | |
| | | | 2 - #10 AWG | 125V DC POWER | | |
| | | | 2 - #10 AWG | 125V DC BATTERY CHARGER FAILURE | | |
| 25 | LOAD SHED | SECT 9 (GWSG / MSWG-1) | AS REQUIRED BY OPERATION | LOAD SHED | NOTE 5 | TBD |
| | | | 1 - CAT 5 ETHERNET CABLE | DATA TABLE INTERFACE | | |
| | | | 1 - FIBER OPTIC MULTIMODE CABLE, WITH ST-CONNECTORS | REMOTE COMMUNICATIONS | | |
| | | | 2 - #10 AWG | 125V DC POWER | | |
| | | | 2 - #10 AWG | 125V DC POWER | | |
| | | | 2 - #10 AWG | 125V DC BATTERY CHARGER FAILURE | | |
| 26 | BUILDING MANAGEMENT SYSTEM | SECT 9 (GWSG / MSWG-1) | AS REQUIRED BY OPERATION | LOAD SHED | NOTE 5 | TYPE D |
| | | | 1 - CAT 5 ETHERNET CABLE | DATA TABLE INTERFACE | | |
| | | | 1 - FIBER OPTIC MULTIMODE CABLE, WITH ST-CONNECTORS | REMOTE COMMUNICATIONS | | |
| | | | 2 - #10 AWG | 125V DC POWER | | |
| | | | 2 - #10 AWG | 125V DC POWER | | |
| | | | 2 - #10 AWG | 125V DC BATTERY CHARGER FAILURE | | |
| 27 | SECT 9 (GWSG / MSWG-1) | REMOTE PC | AS REQUIRED BY OPERATION | LOAD SHED | NOTE 5 | TYPE D |
| | | | 1 - CAT 5 ETHERNET CABLE | DATA TABLE INTERFACE | | |
| | | | 1 - FIBER OPTIC MULTIMODE CABLE, WITH ST-CONNECTORS | REMOTE COMMUNICATIONS | | |
| | | | 2 - #10 AWG | 125V DC POWER | | |
| | | | 2 - #10 AWG | 125V DC POWER | | |
| | | | 2 - #10 AWG | 125V DC BATTERY CHARGER FAILURE | | |

NOTES:

- ELECTRICAL CONTRACTOR RESPONSIBLE FOR ADHERENCE TO ALL APPLICABLE STANDARDS AND CODES.
- ELECTRICAL CONTRACTOR MAY MODIFY ROUTING AND COMBINE CONDUITS OF THE SAME TYPE.
- ELECTRICAL CONTRACTOR TO TERMINATE FIELD WIRING AT BOTH ENDS.
- CONDUIT TYPES A AND D MAY BE COMBINED.
- CONDUIT TO BE SIZED BY INSTALLER.

- SEPARATE METALLIC CONDUIT MUST BE USED FOR EACH WIRE TYPE (A, B, C, & D). WIRE TYPES A & D MAY BE COMBINED IN THE SAME METALLIC CONDUIT.
- SPARES TO BE LEFT 10' LONG, COILED AND TAPED IN BOTTOM OF ENCLOSURE.
- 4 POLE, 10A, 120V AC, FORM C DRY CONTACTS FOR LOAD SHED PURPOSES.
- ELECTRICAL CONTRACTOR TO PROVIDE 20% SPARES.
- ALL CONTROL WIRING TO BE STRANDED COPPER UNLESS SPECIFIED OTHERWISE.

CONDUIT TABLE

| | |
|---|-------------------|
| A | DC CONTROL <= 30V |
| B | DC CONTROL > 30V |
| C | AC CONTROL |
| D | SIGNAL LEVEL |
| E | FIBER OPTIC |



CATERPILLAR

**WICHITA WATER UTILITIES
CONTROL CONDUIT SCHEDULE**

5KV UTILITY/GENERATOR PARALLELING SWITCHGEARBOARD

APPROVED BY: *R Collins* DATE APPROVED: 02-28-2023
 DRAWN BY: MCT DATE CREATED: 04-14-08
 MODIFIED BY: RBG DATE MODIFIED: 03-11-11
 SCALE: N.T.S. REV. 4.0 SHEET NUMBER: 27 of 31
 FILE NAME: 36019-G27

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| 2.0 | ISSUED FOR FIELD STARTUP | 06-19-09 |
| 2.1 | RE-ISSUED FOR FIELD STARTUP | 07-28-09 |
| 3.0 | ISSUED FOR AS BUILT | 04-20-11 |
| 4.0 | ISSUED FOR SUBMITTAL (301205) | 02-28-23 |
| 0.6 | RE-ISSUED FOR SUBMITTAL | 01-23-09 |
| 0.7 | ISSUED FOR CUSTOMER RECORD | 02-12-09 |
| 1.0 | ISSUED FOR PRODUCTION | 03-10-09 |
| 1.1 | ISSUED FOR CUSTOMER WITNESS TEST | 06-15-09 |

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CONTROL CIRCUIT CONDUIT SCHEDULE (SEE NOTE 1)

| NO. | CONDUIT | | CONDUCTOR | FUNCTION | CONDUIT SIZE | CONDUIT TABLE |
|-----|--------------------------|----------------------------|---|---|--------------|---------------|
| | FROM | TO | | | | |
| 28 | EMERGENCY POWER PANEL | SECT 4 (MSWG-2) | 3 - #10 AWG 2 - #10 AWG | 120V AC FOR 24V DC BATTERY CHARGER (1Ø, 20A) 120V AC FOR SPACE HEATERS (1Ø, 30A) | NOTE 5 | TYPE C |
| 29 | EMERGENCY POWER PANEL | 125V DC BATTERY CHARGER | 3 - #10 AWG | 120V AC FOR 125V DC BATTERY CHARGER (1Ø, 30A) | NOTE 5 | TYPE C |
| 30 | 125V DC BATTERY CHARGER | 125V DC BATTERIES | 2 - #10 AWG | 125V DC POWER | NOTE 5 | TYPE B |
| 31 | 125V DC BATTERIES | SECT 4 (MSWG-2) | 2 - #10 AWG | 125V DC POWER | NOTE 5 | TYPE B |
| 32 | 125V DC BATTERY CHARGER | SECT 4 (MSWG-2) | 2 - #14 AWG | 125V DC BATTERY CHARGER FAILURE | NOTE 5 | TYPE A |
| 33 | 24V DC STATION BATTERIES | SECT 4 (MSWG-2) | 4 - #10 AWG | 24V DC POWER | NOTE 5 | TYPE A |
| 34 | EMERGENCY POWER PANEL | SECT 3 (MSWG-0) | 3 - #10 AWG 2 - #10 AWG | 120V AC FOR 24V DC BATTERY CHARGER (1Ø, 20A) 120V AC FOR SPACE HEATERS (1Ø, 30A) | NOTE 5 | TYPE C |
| 35 | EMERGENCY POWER PANEL | 125V DC BATTERY CHARGER | 3 - #10 AWG | 120V AC FOR 125V DC BATTERY CHARGER (1Ø, 60A) | NOTE 5 | TYPE C |
| 36 | 125V DC BATTERY CHARGER | 125V DC BATTERIES | 2 - #10 AWG | 125V DC POWER | NOTE 5 | TYPE B |
| 37 | 125V DC BATTERIES | SECT 3 (MSWG-0) | 2 - #10 AWG | 125V DC POWER | NOTE 5 | TYPE B |
| 38 | 125V DC BATTERY CHARGER | SECT 3 (MSWG-0) | 2 - #14 AWG | 125V DC BATTERY CHARGER FAILURE | NOTE 5 | TYPE A |
| 39 | 24V DC STATION BATTERIES | SECT 3 (MSWG-0) | 4 - #10 AWG | 24V DC POWER | NOTE 5 | TYPE A |
| 40 | FROM SECT 2 (MSWG-1) | TO SECT 3 (MSWG-0) | 2 - FIBER OPTIC MULTIMODE CABLE, WITH ST-CONNECTORS | FIBER OPTIC COMMUNICATIONS ETHERNET | NOTE 5 | TYPE E |
| 41 | FROM SECT 13 (MSWG-1) | TO SECT 3 (MSWG-2) | 2 - FIBER OPTIC MULTIMODE CABLE, WITH ST-CONNECTORS | FIBER OPTIC COMMUNICATIONS ETHERNET | NOTE 5 | TYPE E |
| 42 | SECT 9 (GWSG / MSWG-1) | REMOTE PC | 1 - FIBER OPTIC MULTIMODE CABLE, WITH ST-CONNECTORS | REMOTE COMMUNICATIONS | NOTE 5 | TYPE D |
| 43 | SECT 9 (GWSG / MSWG-1) | REMOTE PC | 1 - FIBER OPTIC MULTIMODE CABLE, WITH ST-CONNECTORS | REMOTE COMMUNICATIONS | NOTE 5 | TYPE D |
| 44 | SECT 9 (GWSG / MSWG-1) | TO SECT 4 (MSWG-0) | 1 - FIBER OPTIC MULTIMODE CABLE, WITH ST-CONNECTORS | FIBER OPTIC COMMUNICATIONS | NOTE 5 | TYPE D |
| 45 | SECT 9 (GWSG / MSWG-1) | TO SECT 3 (MSWG-2) | 1 - FIBER OPTIC MULTIMODE CABLE, WITH ST-CONNECTORS | FIBER OPTIC COMMUNICATIONS | NOTE 5 | TYPE D |
| 46 | SECT 9 (GWSG / MSWG-1) | TO SECT 3 (MSWG-0) | 2 - #14 AWG 1 - #8 AWG | HARDWIRED ERR 52M0 24VDC- COMMON GROUND | NOTE 5 | TYPE D |
| 47 | SECT 9 (GWSG / MSWG-1) | TO SECT 4 (MSWG-2) | 2 - #14 AWG 1 - #8 AWG | HARDWIRED ERR 52M2 24VDC- COMMON GROUND | NOTE 5 | TYPE D |
| 48 | SECT 3 (MSWG-0) | BUILDING MANAGEMENT SYSTEM | 1 - 2 COND #16 AWG SHIELDED TWISTED PAIR, BELDEN 8719 | CUSTOMER 485 COMMS CONNECT | NOTE 4 & 5 | TYPE D |
| 49 | SECT 3 (MSWG-0) | TO SECT 2 (GWSG) | 1 - 2 COND #16 AWG SHIELDED TWISTED PAIR, BELDEN 8719 | 485 COMMS BETWEEN (MSWG-0) AND (GWSG) | NOTE 4 & 5 | TYPE D |
| 50 | SECT 14 (GWSG) | TO SECT 2 (MSWG-2) | 1 - 2 COND #16 AWG SHIELDED TWISTED PAIR, BELDEN 8719 | 485 COMMS BETWEEN (GWSG) AND (MSWG-2) | NOTE 4 & 5 | TYPE D |
| 51 | FROM SECT 4 (MSWG-0) | TO SECT 7 (MSWG-2) | 1 - FIBER OPTIC MULTIMODE CABLE, WITH ST-CONNECTORS | FIBER OPTIC COMMUNICATIONS ETHERNET | NOTE 5 | TYPE E |
| 52 | FROM SECT 4 (MSWG-0) | TO SECT 7 (MSWG-2) | 1 - FIBER OPTIC MULTIMODE CABLE, WITH ST-CONNECTORS | FIBER OPTIC COMMUNICATIONS ETHERNET | NOTE 5 | TYPE E |



WICHITA WATER UTILITIES
CONTROL CONDUIT SCHEDULE

5KV UTILITY / GENERATOR PARALLELING SWITCHGEARBOARD

APPROVED BY: *R Collins* SCALE: N.T.S. REV: 4-0

DRAWN BY: MCT MODIFIED BY: RBG

DATE APPROVED: 02-28-2023 DATE CREATED: 04-14-08 DATE MODIFIED: 03-11-11

FILE NAME: 36019-G28 SHEET NUMBER: 28 of 31

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- NOTES:**
- 1) ELECTRICAL CONTRACTOR RESPONSIBLE FOR ADHERENCE TO ALL APPLICABLE STANDARDS AND CODES.
 - 2) ELECTRICAL CONTRACTOR MAY MODIFY ROUTING AND COMBINE CONDUITS OF THE SAME TYPE.
 - 3) ELECTRICAL CONTRACTOR TO TERMINATE FIELD WIRING AT BOTH ENDS.
 - 4) CONDUIT TYPES A AND D MAY BE COMBINED.
 - 5) CONDUIT TO BE SIZED BY INSTALLER.

- 6) SEPARATE METALLIC CONDUIT MUST BE USED FOR EACH WIRE TYPE (A, B, C, & D). WIRE TYPES A & D MAY BE COMBINED IN THE SAME METALLIC CONDUIT.
- 7) SPARES TO BE LEFT 10' LONG, COILED AND TAPED IN BOTTOM OF ENCLOSURE.
- 8) 4 POLE, 10A, 120V AC, FORM C DRY CONTACTS FOR LOAD SHED PURPOSES.
- 9) ELECTRICAL CONTRACTOR TO PROVIDE 20% SPARES.
- 10) ALL CONTROL WIRING TO BE STRANDED COPPER UNLESS SPECIFIED OTHERWISE.

| | |
|---|-------------------|
| A | DC CONTROL <= 30V |
| B | DC CONTROL > 30V |
| C | AC CONTROL |
| D | SIGNAL LEVEL |
| E | FIBER OPTIC |

| NO. | REVISION | DATE |
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| 2.0 | ISSUED FOR FIELD STARTUP | 06-19-09 |
| 2.1 | RE-ISSUED FOR FIELD STARTUP | 07-28-09 |
| 3.0 | ISSUED FOR AS BUILT | 04-20-11 |
| 4.0 | ISSUED FOR SUBMITTAL (301205) | 02-28-23 |
| 0.6 | RE-ISSUED FOR SUBMITTAL | 01-23-09 |
| 0.7 | ISSUED FOR CUSTOMER RECORD | 02-12-09 |
| 1.0 | ISSUED FOR PRODUCTION | 03-10-09 |
| 1.1 | ISSUED FOR CUSTOMER WITNESS TEST | 06-15-09 |

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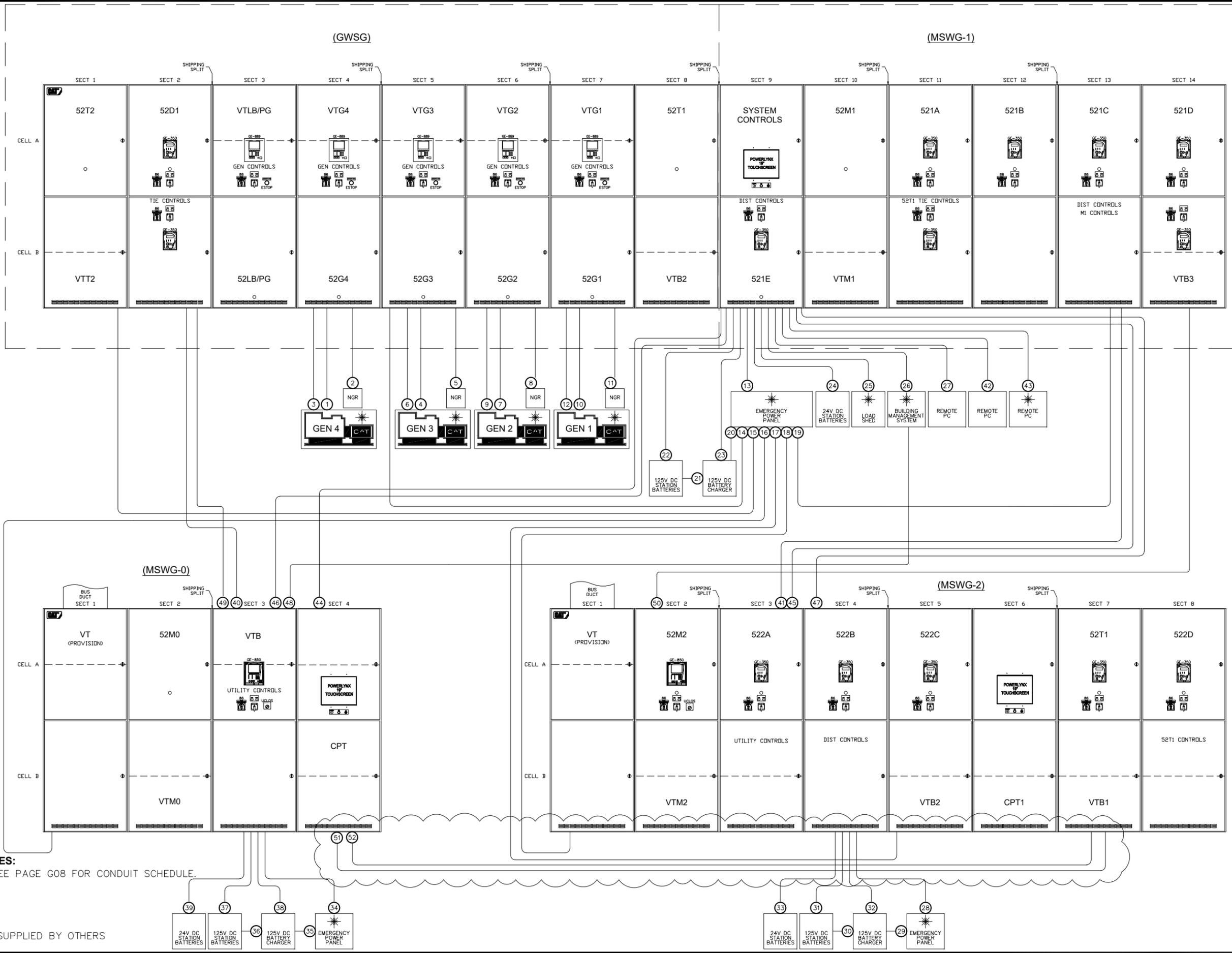
CATERPILLAR

**WICHITA WATER UTILITIES
CONTROL CONDUIT SCHEDULE**

5KV UTILITY/GENERATOR PARALLELING SWITCHGEAR/BOARD

| | | | | | | | |
|------------------|---------------|--------|------|--------------|--------------|-------------|---------------|
| APPROVED BY | DATE APPROVED | SCALE | REV. | DRAWN BY | DATE CREATED | MODIFIED BY | DATE MODIFIED |
| <i>R Collins</i> | 02-28-2023 | N.T.S. | 4-0 | MCT | 04-14-08 | RBG | 03-11-11 |
| FILE NAME | 36019-G29 | | | SHEET NUMBER | 29 | of 31 | |

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NOTES:
1) SEE PAGE G08 FOR CONDUIT SCHEDULE.

★ SUPPLIED BY OTHERS

| NO. | REVISION | DATE |
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| 2.0 | ISSUED FOR FIELD STARTUP | 06-19-09 |
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Functional Sequence of Operations

Automatic/Standby Mode

1. The utility main breakers 52M2 and 52M0 are closed serving utility power to each load bus.
2. The emergency tie breakers 52T1 and 52T2 in GWSG are normally open.
3. Breaker 52T1 in MSWG-2 and breaker 52M1 in MSWG-1 are normally closed.
4. The generator main breakers 52G1, 52G2, 52G3 and 52G4 are open.
5. Load Bank/Portable Generator breaker 52LB/PG is normally open.
6. The automation is standing by to act in response to a utility failure.
7. Distribution breakers 52D1, 521E, 521A, 521B, 521C, 522A, 522B, 522C, 522D are normally closed.
8. Distribution breakers 521D, 522D are normally opened as spares.

Emergency Mode

Dual Utility Failure

1. Utility protective relaying senses utility voltage or frequency out of tolerance at both utility sources.
2. Both utility main breakers 52M2 and 52M0 are opened.
3. A run request is sent to the generator plant. The Load shed system is initiated. The load breakers are opened.
4. The first generator up to voltage and frequency is closed to the generator bus.
5. The remaining generators are synchronized and paralleled to the bus as they come up to voltage and frequency.
6. Both emergency tie breakers 52T2 and 52T1 in GWSG are closed one after the other.
7. The system is now in Emergency Mode. Load is switched on by closing load breakers and the plant load is brought online based on generator system load capacity. Load capacity will be transmitted to the pump station SCADA system in pre-defined steps to allow the SCADA system to turn on loads based on available capacity.

Dual Utility Restoration and Exit from Emergency Mode (Closed Transition)

1. Utility protective relaying senses utility voltage and frequency within tolerance at both utility sources. Load is reduced to a pre-defined maximum level for closed transition return to the available utility source.
2. Following an adjustable time delay (which can be abbreviated by the operator) to assure that the utility power sources are stable, the generator plant is passively synchronized and paralleled to utility #1 source. Utility #1 main breaker 52M2 in MSWG-2 is closed.
3. The generator plant is soft ramp unloaded until the utility #1 source is nominally serving load bus #1.
4. The emergency tie breaker 52T2 in GWSG is opened.
5. The generator plant is passively synchronized and paralleled to utility #2 source. Utility #2 main breaker 52M0 in MSWG-0 is closed.
6. The generator plant is soft ramp unloaded until the utility #2 source is nominally serving load bus #2.
7. The emergency tie breaker 52T1 in GWSG is opened.
8. The generator breakers are opened.
9. The generators are allowed to run for their programmed cool down period.
10. The system is now back in Automatic/Standby Mode.
11. The generator control system now communicates to the pump station SCADA system that the system is in normal mode and the SCADA system will load the utility buses as normal.

Single Utility Failure

1. Utility protective relaying senses utility voltage or frequency out of tolerance at just one of the utility sources.
2. The associated utility main breaker 52M2 in MSWG-2 or 52M0 in MSWG-0 is opened.
3. A run request is sent to the generator plant.
4. The first generator up to voltage and frequency is closed to the generator bus.
5. The remaining generators are synchronized and paralleled to the bus as they come up to voltage and frequency.
6. The associated emergency tie breaker 52T1 or 52T2 in GWSG is closed.
7. One load bus is now in Emergency Mode while the other load bus remains in Automatic/Standby Mode.
8. The Generator System will communicate available load capacity in steps to the Pump Station SCADA for loading the generator bus.

Single Utility Restoration after a Dual Utility Failure (Closed Transition)

1. Utility protective relaying senses utility voltage and frequency within tolerance at just one of the utility sources. Load is reduced to a pre-defined maximum level for closed transition to the available utility source.
2. Following an adjustable time delay (which can be abbreviated by the operator) to assure that the utility power source is stable, the generator plant is passively synchronized and paralleled to the restored utility source by closing its utility main breaker 52M2 or 52M0.
3. The generator plant is soft ramp unloaded until the utility source is nominally serving its load bus.
4. The associated emergency tie breaker 52T1 or 52T2 is opened.
5. One load bus is now in Automatic/Standby Mode while the other load bus remains in Emergency Mode.
6. The Generator system will communicate available load capacity in steps to the Pump Station SCADA system for loading of the generator bus and communicate that the available utility bus is now in Normal Mode for loading of the utility source.

Single Utility Restoration after a Dual Utility Failure (Open Transition)

1. Utility protective relaying senses utility voltage and frequency within tolerance at just one of the utility sources.
2. Load is systematically shut down to via the plant control system for the bus that will be reconnected to the available Utility Source.
3. The associated emergency tie breaker 52T1 or 52T2 is opened.
4. The available Utility Breaker is Closed.
5. The preferred load breaker is now closed to restore power to the plant bus in the pump station.
6. One load bus is now in Automatic/Standby Mode while the other load bus remains in Emergency Mode.
7. The Hess Pump Station SCADA Control system will receive inputs from the Generator system indicating available capacity in pre-defined steps to allow the SCADA system to load or unload the generator system based on available capacity for the bus that is still on the generator system
8. The Generator control system communicates to the pump station SCADA system that one utility source is available for loading of the system on this bus for normal operation.

Transfer to Emergency Mode

Entry into Emergency Mode on Load Bus MSWG-2 or MSWG-0

1. The operator places the Utility Selector Switch for Transfer to Emergency Mode into the Utility #1 position or Utility #2 position.
2. The operator places the Master Mode Selector Switch into the Transfer to Emergency position.
3. A run request is sent to the generator plant.
4. The first generator up to voltage and frequency is closed to the generator bus.
5. The remaining generators are synchronized and paralleled to the bus as they come up to voltage and frequency.
6. The generators are allowed to run for a five-minute warm-up time (which can be abbreviated by the operator).
7. Load is reduced via the Hess Pump Station SCADA Control system to a pre-defined level for closed transition to the generator system.
8. After completion of the warm-up time, the generator plant is passively synchronized and paralleled to the utility #1 or #2 source by closing the associated emergency tie breaker.
9. The generator plant is soft ramp loaded until the generator plant is nominally serving load.
10. The associated utility main breaker is opened.
11. One load bus is now in Emergency Mode while the other load bus remains in Automatic/Standby Mode.
12. The plant loads are added to the bus dependant on the available generator capacity via the Hess Pump Station SCADA Control system after communication of the available capacity is transmitted.

Exit from Emergency Mode on Load Bus MSWG-2 or MSWG-0

1. The operator removes the Master Mode Selector Switch from Transfer to Emergency position and returns it to the Auto position.
2. Load is reduced via the Hess Pump Station SCADA Control system to a pre-defined level for closed transition.
3. Following an adjustable time delay (which can be abbreviated by the operator), the generator plant is passively synchronized and paralleled to the utility source by closing the associated utility main breaker.
4. The generator plant is soft ramp unloaded until the utility source is nominally serving the load.
5. The associated emergency tie breaker is opened.
6. The generator breakers are opened.
7. The generators are allowed to run for their programmed cool down period.
8. The system is now back in Automatic/Standby Mode.
9. The system communicates with the pump station SCADA control system to indicate that the utility bus is available for normal loading of the bus for normal operation of the system.

Entry into Emergency Mode on Load Bus MSWG-2 & MSWG-0

1. The operator places the Utility Selector Switch for Transfer to Emergency Mode into the "Both" position.
2. The operator places the Master Mode Selector Switch into the Transfer to Emergency position.
3. Load is reduced via the Hess Pump Station SCADA control system to a pre-defined level for closed transition.
4. A run request is sent to the generator plant.
5. The first generator up to voltage and frequency is closed to the generator bus.
6. The remaining generators are synchronized and paralleled to the bus as they come up to voltage and frequency.
7. The generators are allowed to run for a five-minute warm-up time (which can be abbreviated by the operator).
8. After completion of the warm-up time, the generator plant is passively synchronized and paralleled to the utility #1 source by closing the emergency tie breaker 52T2 in GWSG.
9. The generator plant is soft ramp loaded until the generator plant is nominally serving load bus MSWG-2.
10. The utility #1 main breaker 52M2 is opened.
11. The generator plant is passively synchronized and paralleled to the utility #2 source by closing the emergency tie breaker 52T1.
12. The generator plant is soft ramp loaded until the generator plant is nominally serving load bus MSWG-0.
13. The utility #2 main breaker 52M0 is opened.
14. The entire system is now in Emergency Mode.
15. The generator control system Communicates the available capacity to the pump station SCADA control system in steps for control of the loads on the system.

Exit from Emergency Mode on Load Bus MSWG-2 & MSWG-0

1. The operator removes the Master Mode Selector Switch from Transfer to Emergency position and returns it to the Auto position.
2. The generator control system communicates with the pump station SCADA system controller to reduce the load to a pre-defined level for closed transition.
3. Following an adjustable time delay (which can be abbreviated by the operator), the generator plant is passively synchronized and paralleled to the utility #1 source. Utility #1 main breaker 52M2 in MSWG-2 is closed.
4. The generator plant is soft ramp unloaded until the utility #1 source is nominally serving load bus MSWG-2.
5. The emergency tie breaker 52T2 in GWSG is opened.
6. The generator plant is passively synchronized and paralleled to the utility #2 source. Utility #2 main breaker 52T1 in GWSG is closed.
7. The generator plant is soft ramp unloaded until the utility #2 source is nominally serving load bus MSWG-0.
8. The emergency tie breaker 52T1 in GWSG is opened.
9. The generator breakers are opened.
10. The generators are allowed to run for their programmed cool down period.
11. The system is now back in Automatic/Standby Mode.
12. The generator control system communicates that the system is in normal condition and the pump station control system will now load the utility busses as required in normal operation.

No Load Test Mode

Entry

1. The No Load Test Switch is placed in the ON position.
2. All available generators are started.



CATERPILLAR

WICHITA WATER UTILITIES
SEQUENCE OF OPERATIONS

5KV UTILITY/GENERATOR PARALLELING SWITCHGEAR/BOARD

APPROVED BY *R Collins* SCALE N.T.S. REV. 4.0

DATE APPROVED 02-28-2023

FILE NAME 36019-G30

DATE CREATED 04-17-08

DATE MODIFIED 02-11-09

SHEET NUMBER 30 of 31

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| 2.1 | RE-ISSUED FOR FIELD STARTUP | 07-28-09 |
| 3.0 | ISSUED FOR AS BUILT | 04-20-11 |
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| 0.7 | ISSUED FOR CUSTOMER RECORD | 02-12-09 |
| 1.0 | ISSUED FOR PRODUCTION | 03-10-09 |
| 1.1 | ISSUED FOR CUSTOMER WITNESS TEST | 06-15-09 |

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3. The first generator up to voltage and frequency is closed to the bus.
4. The remaining generators are synchronized and paralleled to the bus as they come up to voltage and frequency.
5. The system is now in No Load Test Mode.

Exit

1. The No Load Test Switch is placed in the OFF position.
2. All generator breakers are opened.
3. The generators are allowed to run for their programmed cool down period.
4. The system is now back in Automatic/Standby Mode.

Utility Fail Test Mode

Entrance into Utility #1 Fail Test Mode

1. The Utility #1 Fail Test Switch is placed in the ON position.
2. Voltage sensing at the utility #1 protective relay is opened, which simulates a loss of utility #1.
3. The system enters into a Single Utility Failure as described in the "Emergency Mode" sequence above.

Exit from Utility #1 Fail Test Mode

1. The Utility #1 Fail Test Switch is placed in the OFF position.
2. Voltage sensing at the utility #1 protective relay is restored, which simulates the return of utility power.
3. The system exits from a Single Utility Failure as described in the "Emergency Mode" sequence above.

Entrance into Utility #2 Fail Test Mode

1. The Utility #2 Fail Test Switch is placed in the ON position.
2. Voltage sensing at the utility #2 protective relay is opened, which simulates a loss of utility #2.
3. The system enters into a Single Utility Failure as described in the "Emergency Mode" sequence above.

Exit from Utility #2 Fail Test Mode

1. The Utility #2 Fail Test Switch is placed in the OFF position.
2. Voltage sensing at the utility #2 protective relay is restored, which simulates the return of utility power.
3. The system exits from a Single Utility Failure as described in the "Emergency Mode" sequence above.

Entrance into Dual Utility Fail Test Mode

1. Both Utility Fail Test Switch's are placed in the ON position.
2. Voltage sensing at the utility #1 & #2 protective relays is opened, which simulates a loss of utility #1 & #2.
3. The system enters into a Dual Utility Failure as described in the "Emergency Mode" sequence above.

Exit from Dual Utility Fail Test Mode

1. Both Utility Fail Test Switch's are placed in the OFF position.
2. Voltage sensing at the utility #1 & #2 protective relays is restored, which simulates the return of utility power.
3. The system exits from a Dual Utility Failure as described in the "Emergency Mode" sequence above.

Load Shed Control

The System Controls shall include a Load Shed Control function to control the loads served by the generator plant. The Load Shed Control shall have one Essential Load Shed Priority Level for each generator in the system plus one Non-Essential Load Shed Priority Level (which is always shed in the Emergency Mode of operation).

The Load Shed Control shall control each of the distribution circuit breakers within the switchgear. Each electrically operated distribution circuit breaker shall be field selectable to be assigned to any of the available Load Shed Priority Levels. Additionally, Load Shed Control shall provide a 4 pole, 10A, 120VAC rated, form C set of contacts for each Load Shed Priority Level to allow for control of loads external to the switchgear.

The following controls shall be provided for each level:

- a. Shed Delay Timer, adjustable from 0 to 1024 seconds
- b. Add Delay Timer, adjustable from 0 to 1024 seconds
- c. Load Shed Override Selector (shed/auto/add)
- d. Status indicators to show whether the Priority Level is Added or Shed

The Load Shed Controls shall have:

- a. Load Shed Control Switch (On/Off)
- b. User-settable Load Shed % (as a function of on-line generator capacity)
- c. User-settable Load Add % (as a function of on-line generator capacity)
- d. User-settable Bus Under frequency Set point
- e. User-settable Bus Under frequency time delay
- f. Bus Under frequency Reset Pushbutton
- g. Bus Under frequency indicator

Conditional Load Shed: Upon entrance into Emergency Mode of operation, the Load Shed Control shall shed all Essential and Non-Essential loads. As generators come to the bus, Essential Priority Level loads shall be added conditionally based on the number of generators on line. When the first generator comes to the bus, Priority Level 1 loads shall be added; Second generator, priority 2, etc. After a time delay that allows all operational generators to come to the bus, Load Shed Mode shall shift to Load Sensitive Mode.

Load Sensitive Load Shed - After all generators have been given sufficient time to come to the bus, load shed shall shift to "Load Sensitive" mode. The system shall compare current generator on-line capacity (in kW) to current load requirements. If surplus capacity is greater than

the calculated Load Add setpoint, after the Load Add Time Delay the next Load Shed Priority will be added. This calculation will continue until all Sheddable Loads are added, or until surplus capacity is less than the calculated Load Add setpoint. If surplus capacity is less than the calculated Load Shed setpoint, after the Load Shed Time Delay the next Load Shed Priority will be shed. This calculation will continue until all Sheddable Loads are shed, or until surplus capacity is greater than the calculated Load Shed setpoint. The Load Shed Control, in its automatic shedding and adding of loads, shall not override any manual load shed/add operation.

Should the load bus frequency fall below the user selected bus underfrequency setpoint for a period longer than the bus underfrequency time delay, then all Priority Level loads shall be shed and load addition shall not resume until the operator has depressed the Bus Underfrequency Reset button. The bus underfrequency protection shall override any manual load add operation. Loads shall be added to the generator busses based on the available capacity kW. The Generator system shall interface with the Pump Station SCADA system controls for loading and unloading of the system based on this capacity. The steps for loading the system will be as follows:

- Step 1. Generator Facility Loads (House power #1 or House Power #2)
- Step 2. Hess Pump Station Facility House Loads (Via Breaker #1A and Breaker #1B) (Pump Station SCADA System will be set to keep Pumps off-line)
- Step 3. Water Plant House Loads (Via Breaker #1C)
- Step 4. Hess Pump Station First Pump
- Step 5. Hess Pump Station Second Pump
- Step 6. Hess Pump Station Third Pump
- Step 7. Water Treatment Facility (1/3 Capacity Production)
- Step 8. Water Treatment Facility (2/3 Capacity Production)
- Step 9. Water Treatment Facility (Full Capacity Production)
- Step 10. Hess Pump Station Fourth Pump
- Step 11. Load to be determined
- Step 12. Load to be determined
- Step 13. Load to be determined
- Step 14. Load to be determined
- Step 15. Load to be determined
- Step 16. Load to be determined
- Step 17. Load to be determined
- Step 18. Load to be determined
- Step 19. Load to be determined
- Step 20. Load to be determined

After each relay for step loading is closed the generator control system shall communicate with the Pump Station SCADA system so the SCADA system can add the preset load. The generator system shall wait for a period of time to allow the SCADA system to initiate the load and confirm that the load was either added or not. If no load was added the generator will initiate the next relay for addition of the next load in the list. The SCADA system will be evaluating the control of all pumps, pressures and operation of the Water Plant and the Hess Pump Station to adjust loading of the facilities based on the need for water in different areas. It may be necessary for the SCADA system to shutdown the water plant to initiate a pump or shut down pumps to initiate water plant operation at any time during the operation of the generator facility. The SCADA system will be required to calculate the loads added and subtracted from the system based on the available KW based on the relay closures that have been initiated by the generator facility to ensure the loading of the system stays within the available capacity depending on the number of generators in operation. In the event that the loading is such that a generator is cycled OFF due to low loading, the SCADA system shall communicate with the generator controller when loads are required that will exceed the 95% loading set point for automatic starting of the available generator to increase the available KW capacity by starting the OFF unit prior to starting the loads.

The SCADA system will be constantly communicating with the generator controller for available KW for modification of the SCADA controls for adding and shutting down loads within the water plant and the pump station.

Generator Demand Priority Control

The System Controls shall include a Generator Demand Priority Control function to automatically match the on-line generator capacity to the loads to avoid unnecessary operation of all the generators when the loads are low.

The following controls shall be provided for each generator:

- a. User-settable Generator Priority Selector
- b. Status indicator for the Generator Priority Selected
- c. Status indicator for generator On-line or Off-line

The Generator Demand Priority Control shall have the following controls:

- a. Generator Demand Priority Control Switch (On/Off)
- b. User-settable Generator Remove % (as a function of a single generator capacity)
- c. User-settable Generator Remove Delay
- d. User-settable Generator Add % (as a function of a single generator capacity)
- e. User-settable Generator Add Delay

Upon entrance into Emergency or Load Management modes, all generators shall be started and paralleled to the bus. After the Remove Time Delay, generators shall be removed from the bus as a function of the generator percentage loading by the user selected Generator Remove time delay. Generators shall be removed from the bus in descending priority. Should the generator percentage loading increase to the user selected Generator Add limits for the user selected Add Delay, the next generator will be started, synchronized and paralleled to the bus. Generators shall be added to the bus in ascending priority order. Should the generator plant ever reach 95% loading, the next priority generator shall be started and added to the bus with no time delay.

Gen Mode: 3. Performs generator duties as stated in sequence of operations.

Load Bank Mode: Will open on Emergency Mode described above.



**WICHITA WATER UTILITIES
SEQUENCE OF OPERATIONS**

| NO. | REVISION | DATE |
|-----|----------------------------------|----------|
| 2.0 | ISSUED FOR FIELD STARTUP | 06-19-09 |
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| 4.0 | ISSUED FOR SUBMITTAL (301205) | 02-28-23 |
| 0.6 | RE-ISSUED FOR SUBMITTAL | 01-23-09 |
| 0.7 | ISSUED FOR CUSTOMER RECORD | 02-12-09 |
| 1.0 | ISSUED FOR PRODUCTION | 03-10-09 |
| 1.1 | ISSUED FOR CUSTOMER WITNESS TEST | 06-15-09 |

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|---------------------------------|-----------------------------|--------------------|-----------------|--------------------------|-------------------|---------------------------|
| APPROVED BY <i>R Collins</i> | SCALE N.T.S. | REV. 4.0 | DRAWN BY MCT | DATE CREATED 04-17-08 | MODIFIED BY HC | DATE MODIFIED 02-11-09 |
| FILE NAME 36019-G31 | DATE APPROVED 02-28-2023 | SHEET NUMBER 31 | of 31 | | | |

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BILL OF MATERIALS

BILL OF MATERIALS

GENERATOR BOM

| PART NUMBER | DESCRIPTION | QTY: |
|------------------------|---|-------------|
| PLC-171CBU98091 | MODICON M1E PLC | 5 |
| PLC-170AMM11030 | MODICON 2AI 2AO 12DI 8DO 10-45 BASE | 5 |
| XDCR-MTWDN7CDM500RXB02 | BITRONICS POWERPLEX II TRANSDUCER | 5 |
| PRLY-256-PLDU-PQBX-C7 | CROMPTON CMI 25 SYNCHCHECK W/DB 120V 50/60HZ | 5 |
| PLC-2891031 | PHOENIX 8 PORT MANAGED SWITCH | 5 |

BILL OF MATERIALS

SYSTEM BOM

| PART NUMBER | DESCRIPTION | QTY: |
|----------------------|--|-------------|
| PLC-171CBU98091 | MODICON M1E PLC | 2 |
| PLC-170ADM85010 | MODICON 12VDC 16IN/16OUT BASE | 2 |
| COMP-TSP-E-02 | ENHANCED TOUCHSCREEN PROCESSOR (DYNICS) | 3 |
| PLC-DA50A0BNN0000020 | RED LION FLEX EDGE/DA50D | 1 |
| COMP-REMOTE-PC | DELL OPTIPLEX 3000 | 2 |
| COMP-REMOTE-MONITOR | DELL P2219H | 2 |
| TS-19WS-24VDC-ISO | ELO 19" WIDESCREEEN TOUCHSCREEN | 3 |
| PLC-2891031 | PHOENIX 8 PORT MANAGED SWITCH | 5 |
| 2891316 | PHOENIX MEDIA CONVERTER | 12 |

BILL OF MATERIALS

DISTRIBUTION BOM

| PART NUMBER | DESCRIPTION | QTY: |
|--------------------|-------------------------------|-------------|
| PLC-171CBU98091 | MODICON M1E PLC | 3 |
| PLC-170ADM85010 | MODICON 12VDC 16IN/16OUT BASE | 3 |
| PLC-2891031 | PHOENIX 8 PORT MANAGED SWITCH | 3 |

BILL OF MATERIALS

UTILITY BOM

| PART NUMBER | DESCRIPTION | QTY: |
|------------------------|---|-------------|
| PLC-171CBU98091 | MODICON M1E PLC | 2 |
| PLC-170ADM85010 | MODICON 12VDC 16IN/16OUT BASE | 2 |
| XDCR-MTWDN7CDM500RXB02 | BITRONICS POWERPLEX II TRANSDUCER | 2 |
| PRLY-256-PLDU-PQBX-C7 | CROMPTON CMI 25 SYNCHCHECK W/DB 120V 50/60HZ | 2 |
| PLC-2891031 | PHOENIX 8 PORT MANAGED SWITCH | 2 |

BILL OF MATERIALS

TIE BOM

| PART NUMBER | DESCRIPTION | QTY: |
|------------------------|---|-------------|
| PLC-171CBU98091 | MODICON M1E PLC | 4 |
| PLC-170ADM85010 | MODICON 12VDC 16IN/16OUT BASE | 4 |
| XDCR-MTWDN7CDM500RXB02 | BITRONICS POWERPLEX II TRANSDUCER | 4 |
| PRLY-256-PLDU-PQBX-C7 | CROMPTON CMI 25 SYNCHCHECK W/DB 120V 50/60HZ | 4 |
| PLC-2891031 | PHOENIX 8 PORT MANAGED SWITCH | 4 |

PROTECTIVE RELAY BOM

| PART NUMBER | DESCRIPTION | QTY: |
|---|-------------------------|-------------|
| 850-E-P5-NN-S5-H-N-N-A-L-A-M-A-S-F-C-SE-N-N-B-N-1 | GE 850 Protective Relay | 2 |
| 889-E-P5-P5-B5-H-S-S-A-L-A-M-A-P-F-A-SE-N-N-B-N-1 | GE 889 Protective Relay | 5 |
| 350-E-P5-G5-H-E-E-N-N-SN-D-N | GE 350 Protective Relay | 13 |

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Bitronics® PowerPlex II

The PowerPlex II (PPX II) is a new Automation Transducer built in the same package as the original PowerPlex, or with digital I/O added, in the M571 case. It is an Ethernet transducer with fast, 1-cycle updates that can be used in SCADA automation schemes and in synchronizing applications in conjunction with PLCs. It is an excellent choice as a replacement for the Bitronics M571 in non-recording applications. Two sets of three-phase voltages that allow direct connect for 600V ac systems are provided.

The PowerPlex II transducers are simple to set up and use, and provide the following features:

Communications

- No need for PC software – Ethernet service port provides access to web server in the instrument so meters can be interfaced with just a web browser for viewing and configuration
- Ethernet protocol support for DNP3, Modbus TCP, or IEC 61850
- Built-in Ethernet switch allows pass-through from one device to another
- An option for both standard secondary “optimal resolution” or primary units makes communications with SCADA/RTU more flexible
- Optional display port and IRIG-B port
- Optional configurable RS-232/RS-485 serial port

Measurements

- Full basic measurement set with demand and harmonic values plus phase angle, voltage differential and slip frequency used in synchronizing applications
- 0.2% revenue accuracy
- .001 Hz accuracy
- Updates every 1 cycle

Built for the Substation

- Wide-range universal power supply
- Rugged aluminum case
- Reduce inventory cost as one model covers all wiring options
- Easy to mount with compact transducer footprint

Applications

- Synchronizing, voltage control, power factor control, and load shedding
- Digital front-end to SCADA systems
- Intelligent Electronic Device (IED) interfacing to RTUs and PLCs
- Plant equipment, line, power & energy monitoring
- Breaker status, rack-in, rack-out in switchgear

Environmental

- Operating temperature range -40° to 70°C, storage temperature -40° to 85°C
- Humidity 0-95% non-condensing
- Surge withstand to ANSI/IEEE C37.90.1: 2002
- UL/CSA Recognized, File Number E164178, CE Marked



Specifications

Dimensions:

Standard chassis: 5.28" H x 5.60" W x 5.63" D – overall depth including handle is 5.75" D (134mm H x 142mm W x 143mm D – overall depth including handle is 146mm D).

Wide chassis (with I/O and serial port): 5.2" H x 8.5" W x 5.9" D (132mm H x 216mm W x 150mm D).

Weight:

Standard chassis: 2.3 lbs. (1.04 kg)

Wide chassis (with I/O and serial port): 3.5 lbs. (1.59 kg)

Power Supply: 12 – 40V dc nominal, intended to connect to 12 and 24V batteries or 48-250V dc/55-240V ac with built in monitoring

Current Inputs: 5A nominal to maximum of 10A (2x overload)

Voltage Inputs: 600V ac nominal, 45-65Hz

Outputs: Dual RJ45 10BaseT/100BaseTX ports (Ethernet switch) for service port functions, Modbus or DNP3 TCP/IP support; IEC 61850 support optional display and IRIG-B ports

Digital Inputs: Optional 4 or 8; High speed, suitable for 1ms SOE

- Nominal Input Range: 24V dc to 250V dc
- Threshold Voltage: 15V dc +/-1V or 80V dc +/-5V (at 25C)
- Input Resistance: 33kohm
- Input De-bounce Time: Selectable, from 1 ms to 2 s

Digital Outputs: Optional 4

- Tripping duty relay
- Resistive: 30A
- Continuous Carry: 5A
- Break Inductive @48V dc: 700mA
- Break Inductive @1.25V dc: 200mA
- Output Operate Time (time from command by Host, does not include protocol delays):
 - Assert (Close time with “N.O.” jumper): 8ms
 - Release (Open time with “N.O.” jumper): 3ms

Isolation: I/O Terminals to Case: 2000Vac, 1 min. I/O Terminals to Channel: 2000Vac, 1 min (channel 4 to other channels).

IP Address Identity Tool

The PPX II supports the Inverse Address Recognition Protocol (InARP), a software utility program that requests the IP address for a specific MAC address on an Ethernet network and can also scan for a range of MAC addresses and print the IP address for any devices which respond.

BITRONICS PART # MTWDN7CDM500RXB02

| Available Measurements | |
|---|--------|
| Available Measurements | PPX II |
| Amps A, B, C, Residual | x |
| Average 3-Phase Amps | x |
| Average 3-Phase Volts (1 & 2) | x |
| Average Volts AN, BN, CN, AB, BC, CA (Bus 1) | x |
| Average (Max.) Volts AN, BN, CN, AB, BC, CA (Bus 1) | x |
| Average (Min.) Volts AN, BN, CN, AB, BC, CA (Bus 1) | x |
| Average Watts A, B, C, Total | x |
| Average (Max.) Watts A, B, C, Total | x |
| Average (Min.) Watts A, B, C, Total | x |
| Average VARs A, B, C, Total | x |
| Average (Max.) VARs A, B, C, Total | x |
| Average (Min.) VARs A, B, C, Total | x |
| Average VAs A, B, C, Total | x |
| Average (Max.) VAs A, B, C, Total | x |
| Average (Min.) VAs A, B, C, Total | x |
| Class 0 Response Setup | x |
| CT Scale Factor | x |
| CT Scale Factor Divisor | x |
| Demand (Max.) Amps A, B, C, Residual | x |
| Demand (Max.) Fund. Amps A, B, C, Residual | x |
| Demand Amps A, B, C, Residual | x |
| Demand Fundamental Amps A, B, C, Residual | x |
| Displacement Power Factor A, B, C | x |
| Displacement Power Factor Total | x |
| Factory Version Hardware | x |
| Factory Version Software | x |
| Frequency (System) | x |
| Frequency Volts A, B, C (1 & 2) | x |
| Fund. Amps A, B, C, Residual | x |
| Fund. Volts AN, BN, CN, AB, BC, CA (1 & 2) | x |
| Health | x |
| Heartbeat | x |
| K-factor Amps A, B, C, Residual | x |
| Meter Type | x |
| Phase Angle Amps A, B, C | x |
| Phase Angle Volts A, B, C | x |
| Phase Angle Volts AB, BC, CA | x |
| Phase Angle Volts A 1-2, B 1-2, C 1-2 | x |

| Available Measurements | |
|--|---|
| Power Factor A, B, C, Total | x |
| Protocol Version | x |
| PT Scale Factor | x |
| PT Scale Factor Divisor | x |
| Slip Frequency Volts A 1-2, B 1-2, C 1-2 | x |
| Symmetrical Components Bus 1 & 2 Volts (Magnitude and Angle) | x |
| Symmetrical Components Current (Magnitude and Angle) | x |
| Tag Register | x |
| TDD Amps A, B, C, Residual | x |
| TDD Denominator A, B, C | x |
| THD Volts AN, BN, CN, AB, BC, CA | x |
| Unbalance Amps | x |
| Unbalance Volts (1 & 2) | x |
| Uncompensated VARs, Total | x |
| Uncompensated Watts, Total | x |
| VA-Hrs | x |
| VAR-Hrs Lag | x |
| VAR-Hrs Lead | x |
| VARs A, B, C, Total | x |
| VAs A, B, C, Total | x |
| Volts AN, BN, CN, AB, BC, CA (1 and 2) | x |
| Volts Aux1-Aux2 | x |
| Watt-Hrs Net | x |
| Watt-Hrs Normal | x |
| Watt-Hrs Reverse | x |
| Watts A, B, C, Total | x |



The PowerPlex II Tethered Display (PPXIITD) provides local or detached indication of measured values.



PowerPlex II with added I/O and serial port in M571 case.



novatechweb.com



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Functional TSP Spec (Enhanced)

Features

| CPU | |
|--|--|
| • Type | Intel CORE i series (or greater) |
| • Speed | 3 GHz (or greater) |
| • Cores | Quad Core (or greater) |
| • CPU on board Cache | 4MB to 8MB (or greater) |
| System Memory | |
| • Maximum | 8GB (or greater) |
| Storage Devices | |
| • SSD | 128GB SS Flash Drive (or greater) |
| Software Installed | |
| • Operating System | Win10 Pro (64 bit) Win7 Pro SP1 (32 or 64 bit) Win 10 IOT (Embedded) |
| Display interfaces (minimum) | |
| • HDMI | (1) HDMI |
| • DVI | (1) DVI |
| • VGA | (1) VGA |
| Resolution support (minimum) | |
| • Display | Must support: 1024×576, 1152×648, 1280×720, 1366×768, 1440×900, 1600×900, 1920×1080 (or greater) |
| I/O (type and qty.) | |
| • USB ports | (4) USB 3.0 (or greater) |
| • Ethernet Capability (ports/speed) | (2) RJ45 Gigabit Ethernet |
| • Com ports (type/qty) | 4 ports (2) RS232 (2) RS232/422/485 (or greater) |
| • PCIe slots (qty) | (1) PCIe slot (or greater) |
| Input power (volts and amps) | |
| • Power on button | Yes |
| • published | 24vdc nominal |
| Power consumption (amps/watts) | |
| • Power Consumed | No more than 90 Watts |
| Temperature | |
| • Operating | 0-50 deg C (or better) |

| | |
|------------------------------------|---------------------------------|
| • Operating (non-published) | ? |
| • storage | -20 to +70 Deg C |
| Relative Humidity (minimum) | |
| • Operating / Storage | 0-95% non-condensing |
| Vibration resistance | |
| • Operating | 1G from 57-2000Hz (or better) |
| • Non-Operating | 2.5G from 57-2000Hz (or better) |
| Shock resistance | |
| • Operating | 10G (or better) |
| • Non-Operating | 15G (or better) |
| Certifications | |
| • UL / cUL (Category / File #) | Yes |
| • CSA | Yes |
| • IEC / CE | Yes |
| • FCC | Yes |



250 Series DIN-rail and Wall Mounted Relays

Synchro-Check (paralleling)

The synchro-check relay can be used to assist in the semi-automatic paralleling of two ac power systems. The volt-free relay contacts change state when the voltage level, phase relationship and frequency are within the selected synchronising limits. Connecting two electrical systems that are not closely matched can cause expensive damage and disturbance to the electrical system. Using this relay will ensure that damage will not occur.

Operation

As part of a manual control system, the operator will make adjustments to the generator voltage (excitation) and frequency (engine speed) using a synchroscope or lamps and will then attempt to manually close the breaker. This synchro check protector will qualify that the two systems are closely matched before permitting the breaker to close. As part of an automatic synchronising arrangement, this relay can be used as an independent backup or checking device to ensure the two systems are suitably matched before the breaker can close.

Features

- Single-phase or three-phase, three or four-wire
- Live and dead bus versions
- Adjustable set point
- LED trip indication
- Volt free relay contacts

Benefits

- Monitors voltage phase displacement and frequency of 2 supplies
- Frequency matching
- Voltage matching
- Phase angle matching
- Synchronisation of Gen-Bus and Bus-Bus
- Monitors auto synchronising systems
- Assists in manual synchronisation

Applications

- Marine panels
- Switchgear
- Distribution systems
- Generator sets
- Co-generation
- Control panels

Model 256-PLD

This version operates in the same way as model 256-PLL but includes an additional dead bus detection function. If there is a requirement for a continuous supply or emergency power, then the generator can be connected without synchronising, thus ensuring continuity of supply. The absence of bus voltage will cause the relay to energise.

Product Codes

| Relay | Protection | ANSI no. | Cat. no. |
|----------------------------------|-------------------------------------|----------|----------|
| 1-phase, or 3-phase 3- or 4-wire | Phase angle and voltage Dead bus | 25 | 256-PLD |

Please specify system voltage, frequency and required options at time of ordering.

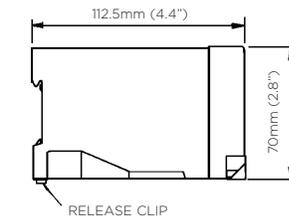
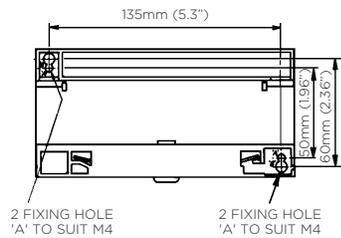
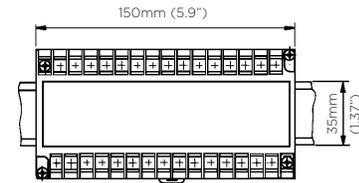
CROMPTON PART # 256-PLDU-PQBX-C7

Specification – Synchro-Check (parallelling)

| | |
|---------------------------|---|
| Nominal voltage | 100V, 110V, 120V, 208V, 220V, 230V, 240V, 277V, 380V, 400V, 415V, 440V or 480V |
| System frequency | 45, 50, 55, 60 or 65Hz |
| Burden | Bus: 2VA Generator: 4VA |
| Overload | -25 to +30% of the nominal voltage |
| Set point repeatability | >0.5% of full span |
| Differential (hysteresis) | Pre-set at 1%. Values 1 to 10% available on request |
| Trip level | 10 to 30% of the nominal voltage 6° to 20° electrical adjustment |
| Output relay | 1 pair NO (normally open), 1 pair NC (normally closed) 2 pair NO and 2 pair NC available on request |
| Relay contact rating | AC: 240V 5A non inductive DC: 24V 5A resistive |
| Relay mechanical life | 0.2 million operations at rated loads |
| Relay reset | Automatic |
| Operating temperature | 0°C to +60°C (0°C to +40°C for UL models) |
| Storage temperature | -20°C to +70°C |
| Temperature co-efficient | 0.05% per °C |
| Interference immunity | Electrical stress surge withstand and non-function to ANSI/IEEE C37 90a |
| Enclosure style | DIN-rail with wall mounting facility |
| Material | Flame retardant polycarbonate/ABS |
| Enclosure integrity | IP50 |
| Dimensions | 150mm (5.9") wide x 70mm (2.8") high x 112mm (4.4") deep |
| Weight | 1.0Kg approx. |

Dimensions

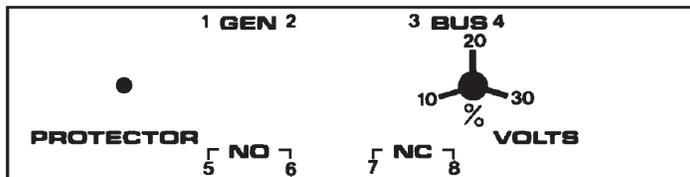
Model 256



Connections

256-PLD

| System | Generator Connections | Busbar Connections |
|----------------|-----------------------|--------------------|
| 3-phase 4-wire | 1 2 | 3 4 |
| 3-phase 3-wire | L1 N | L1 N |
| 1-phase 2-wire | L1 L2 | L1 L2 |
| | L1 N | L1 N |



Normally Open Contacts

Normally Closed Contacts



DELL Technologies

OPTIPLEX

3000 Tower, Small Form Factor and Micro

Business desktops with
essential performance
and smart design





OPTIPLEX 3000

Spec Sheet

Technology that revolves around you

Sustainably built business desktops with essential performance and manageability options to drive maximum value.

.....

Work confidently

OptiPlex is built secure with TPM 2.0, standard security lock slot, Padlock loop, Intrusion switch, SED hard drive, and secure accessories.

....

Power your success

Built with 12th gen Intel® Core™ processors up to 65W with new Hybrid Core technology (Celeron – i5 for tower and small form factor; Celeron – i7 for micro).

Ventilated front bezel

Optimizes air intake to keep your system cool and protected.

....

Wi-Fi 6E option

Future-proof your IT with the industry's fastest speeds.¹



....

Memory that offers more

Take on multi-tasking with up to 64 GB DDR4 memory and achieve more.

....

Native support for up to 4 displays

Without the need for additional graphics card.

....

Enhanced visual effects

Optional DisplayPort supports up to 8K resolution displays for better color grading and motion stabilization.



....

Most sustainable OptiPlex yet

With up to 60% recycled materials² including 1st ocean-bound plastics³. EPEAT Gold and ENERGY STAR qualified on select configurations.

....

Our greatest breadth of custom accessories

including all new micro mounts.



OPTIPLEX 3000

Spec Sheet

Sustainability on OptiPlex

OptiPlex is a leading platform for sustainable innovation and utilizes the most recycled content of all Dell PCs with up to 60% recycled plastic and closed-loop materials in its design.



Design

1st

OptiPlex was the first Dell product made with recycled materials in 2007.⁴

Sustainable Materials

60%

OptiPlex desktops contain up to 60% recycled and closed-loop materials.

Packaging Innovation

87%

87% of Dell's packaging is made from recycled or renewable materials.

OPTIPLEX HAS

100+

EPEAT registered products*



40+

TCO certified configurations



8.0

ENERGY STAR® throughout the portfolio



DELL PART # OPTIPLEX 3000

OPTIPLEX 3000

| FEATURE | TECHNICAL SPECIFICATION | TECHNICAL SPECIFICATION | TECHNICAL SPECIFICATION |
|---|---|---|---|
| MODEL NUMBER | OptiPlex 3000 Tower | 3000 Small Form Factor | 3000 Micro |
| PROCESSOR OPTIONS¹ | <p>Intel® Celeron® Gold G6900, 4MB cache, 2 cores, 4 threads, up to 3.40GHz, 46W</p> <p>Intel® Pentium® Gold G7400, 6MB cache, 2 cores, 4 threads, up to 3.70GHz, 46W</p> <p>12th Generation Intel® Core™ i3-12100, 12MB cache, 4 cores, 8 threads, 3.30GHz to 4.30GHz, 60W</p> <p>12th Generation Intel® Core™ i3-12300, 12MB cache, 4 cores, 8 threads, 3.50GHz to 4.40GHz, 60W</p> <p>12th Generation Intel® Core™ i5-12400, 18MB cache, 6 cores, 12 threads, 2.50GHz to 4.40GHz, 65W</p> <p>12th Generation Intel® Core™ i5-12500, 18MB cache, 6 cores, 12 threads, 3.00GHz to 4.60GHz, 65W</p> <p>12th Generation Intel® Core™ i5-12600, 18MB cache, 6 cores, 12 threads, 3.30GHz to 4.80GHz, 65W</p> | <p>Intel® Pentium® Gold G7400, 6MB cache, 2 cores, 4 threads, up to 3.70GHz, 46W</p> <p>Intel® Celeron® Gold G6900, 4MB cache, 2 cores, up to 3.40GHz, 46W</p> <p>12th Generation Intel® Core™ i3-12100, 12MB cache, 4 cores, 8 threads, 3.30GHz to 4.30GHz, 65W</p> <p>12th Generation Intel® Core™ i3-12300, 12MB cache, 4 cores, 8 threads, 3.50GHz to 4.40GHz, 65W</p> <p>12th Generation Intel® Core™ i5-12400, 18MB cache, 6 cores, 12 threads, 2.50GHz to 4.80GHz, 65W</p> <p>12th Generation Intel® Core™ i5-12500, 18MB cache, 6 cores, 12 threads, 3.00GHz to 4.60GHz, 65W</p> <p>12th Generation Intel® Core™ i5-12600, 18MB cache, 6 cores, 12 threads, 3.30GHz to 4.40GHz, 65W</p> | <p>Intel® Pentium® G7400T, 6MB, 2 core, 4 threads, up to 3.10GHz, 35W</p> <p>Intel® Celeron® G6900T, 4MB, 2 cores, 2 threads, up to 2.80GHz, 35W</p> <p>12th Generation Intel® Core™ i3-12100T, 12MB cache, 4 cores, 8 threads, 2.20GHz to 4.10GHz, 35W</p> <p>12th Generation Intel® Core™ i3-12300T, 12MB cache, 4 cores, 8 threads, 2.30GHz to 4.20GHz, 35W</p> <p>12th Generation Intel® Core™ i5-12400T, 18MB cache, 6 cores, 12 threads, 1.80GHz to 4.20GHz, 35W</p> <p>12th Generation Intel® Core™ i5-12500T, 18MB cache, 6 cores, 12 threads, 2.00GHz to 4.40GHz, 35W</p> <p>12th Generation Intel® Core™ i5-12600T, 18MB cache, 6 cores, 12 threads, 2.10GHz to 4.60GHz, 35W</p> <p>12th Generation Intel® Core™ i7-12700T, 25MB cache, 12 cores, 20 threads, 1.40GHz to 4.70GHz, 35W</p> |
| OPERATING SYSTEM² | <p>Windows 11 Home, 64-bit</p> <p>Windows 11 Pro, 64-bit</p> <p>Windows 11 Downgrade (Windows 10 image)</p> <p>Windows 11 Pro National Education, 64-bit</p> <p>Windows 11 CMIT Government Edition, 64-bit (China only)</p> <p>Kylin Linux® Desktop version 10.1 (China only)</p> <p>Ubuntu® Linux® 20.04 LTS, 64-bit</p> | <p>Windows 11 Pro, 64-bit</p> <p>Windows 11 Downgrade (Windows 10 image)</p> <p>Windows 11 Pro National Education, 64-bit</p> <p>Windows 11 CMIT Government Edition, 64-bit (China only)</p> <p>Kylin Linux® Desktop version 10.1 (China only)</p> <p>Ubuntu® Linux® 20.04 LTS, 64-bit</p> | <p>Windows 11 Home, 64-bit</p> <p>Windows 11 Pro, 64-bit</p> <p>Windows 11 Downgrade (Windows 10 image)</p> <p>Windows 11 Pro Education, 64-bit</p> <p>Windows 11 CMIT Government Edition, 64-bit (China only)</p> <p>Kylin Linux® Desktop version 10.1 (China only)</p> <p>Ubuntu® Linux® 20.04 LTS, 64-bit</p> |
| MEMORY OPTIONS^{3,4} | <p>4GB, 1 x 4GB, DDR4, 3200MHz, single-channel</p> <p>8GB, 1 x 8GB, DDR4, 3200MHz, single-channel</p> <p>8GB, 2 x 4GB, DDR4, 3200MHz, dual-channel</p> <p>16GB, 1 x 16GB, DDR4, 3200MHz, single-channel</p> <p>16GB, 2 x 8GB, DDR4, 3200MHz, dual-channel</p> <p>32GB, 1 x 32GB, DDR4, 3200MHz, single-channel</p> <p>32GB, 2 x 16GB, DDR4, 3200MHz, dual-channel</p> <p>64GB, 2 x 32GB, DDR4, 3200MHz, dual-channel</p> | <p>4GB, 1 x 4GB, DDR4, 3200MHz, single-channel</p> <p>8GB, 1 x 8GB, DDR4, 3200MHz, single-channel</p> <p>8GB, 2 x 4GB, DDR4, 3200MHz, dual-channel</p> <p>16GB, 1 x 16GB, DDR4, 3200MHz, single-channel</p> <p>16GB, 2 x 8GB, DDR4, 3200MHz, dual-channel</p> <p>32GB, 1 x 32GB, DDR4, 3200MHz, single-channel</p> <p>32GB, 2 x 16GB, DDR4, 3200MHz, dual-channel</p> <p>64GB, 2 x 32GB, DDR4, 3200MHz, dual-channel</p> | <p>4GB, 1 x 4GB, DDR4, 3200MHz, single-channel</p> <p>8GB, 1 x 8GB, DDR4, 3200MHz, single-channel</p> <p>8GB, 2 x 4GB, DDR4, 3200MHz, dual-channel</p> <p>16GB, 1 x 16GB, DDR4, 3200MHz, single-channel</p> <p>16GB, 2 x 8GB, DDR4, 3200MHz, dual-channel</p> <p>32GB, 1 x 32GB, DDR4, 3200MHz, single-channel</p> <p>32GB, 2 x 16GB, DDR4, 3200MHz, dual-channel</p> <p>64GB, 2 x 32GB, DDR4, 3200MHz, dual-channel</p> |
| PRIMARY HARD DISK DRIVES⁵ | <p>2.5-inch, 1TB, 5400RPM, SATA, HDD</p> <p>2.5-inch, 2TB, 5400RPM, SATA, HDD</p> <p>2.5-inch, 500GB, 7200RPM, SATA, HDD</p> <p>2.5-inch, 1TB, 7200RPM, SATA, HDD</p> <p>2.5-inch, 500GB, 7200RPM, SATA, HDD, Self-Encrypting, Opal 2.0, FIPS</p> <p>3.5-inch, 1TB, 7200RPM, SATA, HDD</p> <p>3.5-inch, 2TB, 7200RPM, SATA, HDD</p> <p>3.5-inch, 4TB, 5400RPM, SATA, HDD</p> <p>M.2 2230, 128GB, PCIe NVMe Gen3 x4, SSD, Class 35</p> <p>M.2 2230, 512GB, PCIe NVMe Gen3 x4, SSD, Class 35</p> <p>M.2 2230, 1TB, PCIe NVMe Gen3 x4, SSD, Class 35</p> <p>M.2 2230, 256GB, PCIe NVMe Gen3 x4, SSD, Class 35, Self-Encrypting, Opal 2.0, FIPS</p> <p>M.2 2280, 256GB, PCIe NVMe Gen3 x4, SSD, Class 40</p> <p>M.2 2280, 512GB, PCIe NVMe Gen3 x4, SSD, Class 40</p> <p>M.2 2280, 1TB, PCIe NVMe Gen3 x4, SSD, Class 40</p> <p>M.2 2280, 2TB, PCIe NVMe Gen3 x4, SSD, Class 40</p> <p>M.2 2280, 256GB, PCIe NVMe Gen3 x4, SSD, Class 40, Self-Encrypting, Opal 2.0, FIPS</p> <p>M.2 2280, 512GB, PCIe NVMe Gen3 x4, SSD, Class 40, Self-Encrypting, Opal 2.0, FIPS</p> <p>M.2 2280, 1TB, PCIe NVMe Gen3 x4, SSD, Class 40, Self-Encrypting, Opal 2.0, FIPS</p> <p>M.2 2230, 512GB, PCIe NVMe Gen4 x4, SSD, Class 35</p> <p>M.2 2280, 256GB, PCIe NVMe Gen4 x4, SSD, Class 35</p> <p>M.2 2280, 256GB, PCIe NVMe Gen4 x4, SSD, Class 40</p> <p>M.2 2280, 512GB, PCIe NVMe Gen4 x4, SSD, Class 40</p> | <p>3.5-inch, 4TB, 5400RPM, SATA, HDD</p> <p>3.5-inch, 1TB, 7200RPM, SATA, HDD</p> <p>3.5-inch, 2TB, 7200RPM, SATA, HDD</p> <p>2.5-inch, 500GB, 7200RPM, SATA, HDD, Self-Encrypting Opal 2.0, FIPS</p> <p>2.5-inch, 500GB, 7200RPM, SATA, HDD</p> <p>2.5-inch, 1TB, 7200RPM, SATA, HDD</p> <p>M.2 2230, 128GB, PCIe NVMe Gen3 x4, SSD, Class 35</p> <p>M.2 2230, 256GB, PCIe NVMe Gen3 x4, SSD, Class 35</p> <p>M.2 2230, 512GB, PCIe NVMe Gen3 x4, SSD, Class 35</p> <p>M.2 2230, 512GB, PCIe NVMe Gen4 x4, SSD, Class 35</p> <p>M.2 2230, 256GB, PCIe NVMe Gen3 x4, SSD, Class 35, Self-Encrypting Opal 2.0, FIPS</p> <p>M.2 2280, 256GB, PCIe NVMe Gen3 x4, SSD, Class 40</p> <p>M.2 2280, 512GB, PCIe NVMe Gen3 x4, SSD, Class 40</p> <p>M.2 2280, 1TB, PCIe NVMe Gen3 x4, SSD, Class 40</p> <p>M.2 2280, 2TB, PCIe NVMe Gen3 x4, SSD, Class 40</p> <p>M.2 2280, 256GB, PCIe NVMe Gen4 x4, SSD, Class 40</p> <p>M.2 2280, 512GB, PCIe NVMe Gen4 x4, SSD, Class 40</p> <p>M.2 2280, 256GB, PCIe NVMe Gen3 x4, SSD, Class 40, Self-Encrypting Opal 2.0, FIPS</p> <p>M.2 2280, 512GB, PCIe NVMe Gen3 x4, SSD, Class 40, Self-Encrypting Opal 2.0, FIPS</p> <p>M.2 2280, 1TB, PCIe NVMe Gen3 x4, SSD, Class 40, Self-Encrypting Opal 2.0, FIPS</p> | <p>2.5-inch, 1TB, 5400RPM, SATA, HDD</p> <p>2.5-inch, 2TB, 5400RPM, SATA, HDD</p> <p>2.5-inch, 500GB, 7200RPM, SATA, HDD</p> <p>2.5-inch, 1TB, 7200RPM, SATA, HDD</p> <p>2.5-inch, 500GB, 7200RPM, SATA, HDD, Self-Encrypting, Opal 2.0, FIPS</p> <p>M.2 2230, 256GB, PCIe NVMe Gen3 x4, SSD, Class 35</p> <p>M.2 2230, 512GB, PCIe NVMe Gen3 x4, SSD, Class 35</p> <p>M.2 2280, 512GB, PCIe NVMe Gen3 x4, SSD, Class 40</p> <p>M.2 2280, 2TB, PCIe NVMe Gen3 x4, SSD, Class 40</p> |
| GRAPHICS | <p>Intel® UHD Graphics 710</p> <p>Intel® UHD Graphics 730</p> <p>Intel® UHD Graphics 770</p> <p>AMD Radeon™ RX640, 4GB GDDR5 (optional)</p> <p>AMD Radeon™ 540, 1GB GDDR5 (optional)</p> <p>AMD Radeon™ 550, 2GB GDDR5 (optional)</p> | <p>Intel® UHD Graphics 710</p> <p>Intel® UHD Graphics 730</p> <p>Intel® UHD Graphics 770</p> <p>AMD Radeon™ RX 640, 4GB GDDR5 (optional)</p> <p>AMD Radeon™ 540, 1GB GDDR5 (optional)</p> <p>AMD Radeon™ 550, 2GB GDDR5 (optional)</p> | N/A |
| DISPLAY | Dell commercial displays including E series, Professional P series, UltraSharp, and collaboration monitors | Dell commercial displays including E series, Professional P series, UltraSharp, and Collaboration monitors | Dell commercial displays including E series, Professional P series, UltraSharp, and Collaboration monitors |
| CASE COLOUR | Dell Standard Black | Dell Standard Black | Dell Standard Black |

DELL PART # OPTIPLEX 3000

OPTIPLEX 3000

| FEATURE | TECHNICAL SPECIFICATION | TECHNICAL SPECIFICATION | TECHNICAL SPECIFICATION |
|--|--|--|--|
| MODEL NUMBER | OptiPlex 3000 Tower | 3000 Small Form Factor | 3000 Micro |
| PRODUCTIVITY SOFTWARE¹ | Microsoft Office 30-day trial Microsoft Office Home and Business 2019 Microsoft Office Professional 2019 Dell Hybrid Client 1.5 (optional) Intel Unite solution (optional) | Microsoft Office 30-day trial Microsoft Office Home and Business 2019 Microsoft Office Professional 2019 Dell Hybrid Client 1.5 (optional) Intel Unite solution (optional) | Microsoft Office 30-day trial Microsoft Office Home and Business 2019 Microsoft Office Professional 2019 Dell Hybrid Client 1.5 (optional) Intel Unite solution (optional) |
| SECURITY SOFTWARE | McAfee® Small Business Security 30-day free trial McAfee® Small Business Security 12-month subscription McAfee® Small Business Security 36-month subscription SafeGuard and Response, powered by VMware Carbon Black and Secureworks Next Generation Antivirus (NGAV) Endpoint Detection and Response (EDR) Threat Detection and Response (TDR) Managed Endpoint Detection and Response Incident Management Retainer Emergency Incident Response SafeData | McAfee® Small Business Security 30-day Free Trial McAfee® Small Business Security 12-month subscription McAfee® Small Business Security 36-month Subscription SafeGuard and Response, powered by VMware Carbon Black and Secureworks Next Generation Antivirus (NGAV) Endpoint Detection and Response (EDR) Threat Detection and Response (TDR) Managed Endpoint Detection and Response Incident Management Retainer Emergency Incident Response | McAfee® Small Business Security 30-day free trial McAfee® Small Business Security 12-month subscription McAfee® Small Business Security 36-month subscription Intel Guard Technologies & Secure Key: Software Guard (SGX), Boot Guard, BIOS Guard (Core CPU's only), OS Guard (Core CPU's only) and Secure Key (i5 or greater only) Intel Runtime BIOS Resilience (Copper Point) with attestation via Nifty Rock + Intel TXT Support of Absolute Persistent Module BIOS agent v2 OpenXT validation required SafeGuard and Response, powered by VMware Carbon Black and Secureworks Next Generation Antivirus (NGAV) Endpoint Detection and Response (EDR) Threat Detection and Response (TDR) Managed Endpoint Detection and Response Incident Management Retainer |
| WARRANTY³⁰ | 1-year basic warranty with hardware service on-site service after remote diagnosis 2-year basic warranty extension 3-year basic warranty extension 4-year basic warranty extension 5-year basic warranty extension 1-year ProSupport with Next Business Day on-site service 2-year ProSupport with Next Business Day on-site service 3-year ProSupport with Next Business Day on-site service 4-year ProSupport with Next Business Day on-site service 5-year ProSupport with Next Business Day on-site service 1-year ProSupport Plus for Client with Next Business Day on-site service 2-year ProSupport Plus for Client with Next Business Day on-site service 3-year ProSupport Plus for Client with Next Business Day on-site service 4-year ProSupport Plus for Client with Next Business Day on-site service 5-year ProSupport Plus for Client with Next Business Day on-site service | 1-year basic warranty with hardware service on-site service after remote diagnostics 2-year basic warranty extension 3-year basic warranty extension 4-year basic warranty extension 5-year basic warranty extension 1-year ProSupport with Next Business Day on-site service 2-year ProSupport with Next Business Day on-site service 3-year ProSupport with Next Business Day on-site service 4-year ProSupport with Next Business Day on-site service 5-year ProSupport with Next Business Day on-site service 1-year ProSupport Plus for Client with Next Business Day on-site service 2-year ProSupport Plus for Client with Next Business Day on-site service 3-year ProSupport Plus for Client with Next Business Day on-site service 4-year ProSupport Plus for Client with Next Business Day on-site service 5-year ProSupport Plus for Client with Next Business Day on-site service | 1-year Basic Warranty with Hardware Service on-site service after remote diagnosis 2-year Basic Warranty Extension 3-year Basic Warranty Extension 4-year Basic Warranty Extension 5-year Basic Warranty Extension 1-year ProSupport with Next Business Day on-site service 2-year ProSupport with Next Business Day on-site service 3-year ProSupport with Next Business Day on-site service 4-year ProSupport with Next Business Day on-site service 5-year ProSupport with Next Business Day on-site service 1-year ProSupport Plus for Client with Next Business Day on-site service 2-year ProSupport Plus for Client with Next Business Day on-site service 3-year ProSupport Plus for Client with Next Business Day on-site service 4-year ProSupport Plus for Client with Next Business Day on-site service 5-year ProSupport Plus for Client with Next Business Day on-site service |
| ACCIDENTAL DAMAGE SERVICES | 1-year Accidental Damage Service 2-year Accidental Damage Service 3-year Accidental Damage Service 4-year Accidental Damage Service 5-year Accidental Damage Service | 1-year Accidental Damage Service 2-year Accidental Damage Service 3-year Accidental Damage Service 4-year Accidental Damage Service 5-year Accidental Damage Service | 1-year Accidental Damage Service 2-year Accidental Damage Service 3-year Accidental Damage Service 4-year Accidental Damage Service 5-year Accidental Damage Service |
| KEYBOARD³ | N/A | N/A | N/A |
| PORTS | Front: (2) USB 2.0 ports (2) USB 3.2 Gen 1 ports Universal audio jack Rear: (2) USB 3.2 Gen 1 ports (2) USB 2.0 ports with Smart Power On RJ45 Ethernet port DisplayPort 1.4 port HDMI 1.4b port Optional video port (HDMI 2.0b/DisplayPort 1.4/VGA) Serial/PS2 port (optional) | Front: (2) USB 2.0 ports (2) USB 3.2 Gen 1 ports Universal audio jack Rear: (2) USB 3.2 Gen 1 ports (2) USB 2.0 ports with Smart Power On RJ45 Ethernet port DisplayPort 1.4 port HDMI 1.4b port Optional video port (HDMI 2.0b/DisplayPort 1.4/VGA) Serial port (optional) | Front: (2) USB 3.2 Gen 1 ports Universal audio jack Rear: (2) USB 3.2 Gen 1 ports USB 2.0 port with Smart Power On USB 2.0 port RJ45 Ethernet port 10/100/1000Mbps DisplayPort 1.4a (HBR2) HDMI port Power adapter port Optional port (HDMI) 2.0b/Displayport 1.4a (HBR3)/VGA/PS2/serial |
| OPTICAL DRIVE | 8x DVD-ROM (optional) 8x DVD+/-RW (optional) | 8x DVD RW, Slimline 9.5mm (optional) 8x DVD-ROM, Slimline 9.5mm (optional) | No optical drive |
| SLOTS | Kensington security-cable slot Padlock ring Full-height Gen 3 PCIe x16 slot (2) full-height Gen 3 PCIe x1 slots M.2 2230 slot for Wi-Fi and Bluetooth card M.2 2230/2280 slot for SSD (3) SATA 3.0 slots for 3.5-inch/2.5-inch HDD/SSD, and optical Drive | Kensington security-cable slot Padlock ring Half-height Gen 4 PCIe x 16 slot Half-height Gen 3 PCIe x1 slot M.2 2230 slot for WiFi and Bluetooth card M.2 2230/2280 slot for SSD (2) SATA 3.0 slots for 3.5/2.5-inch HDD, and slim optical drive | Kensington security-cable slot Padlock ring M.2 2230 slot for Wi-Fi and Bluetooth card M.2 2230/2280 slot for SSD Gen3 x4 SATA slot for 2.5-inch HDD |

OPTIPLEX 3000

| FEATURE | TECHNICAL SPECIFICATION | TECHNICAL SPECIFICATION | TECHNICAL SPECIFICATION |
|---|---|---|---|
| MODEL NUMBER | OptiPlex 3000 Tower | 3000 Small Form Factor | 3000 Micro |
| DIMENSIONS | <p>US: Height: 12.77in. (324.30mm) Width: 6.06in. (154.00mm) Depth: 11.50in. (292.20mm) Weight (minimum): 11.41lbs. (5.17kg) Weight (maximum): 14.59lbs. (6.61kg)</p> <p>Rest of world: Height: 324.30mm (12.77in.) Width: 154.00mm (6.06in.) Depth: 292.20mm (11.50in.) Weight (minimum): 5.17kg (11.41lbs.) Weight (maximum): 6.61kg (14.59lbs.)</p> | <p>US: Height: 11.42in. (290.00mm) Width: 3.65in. (92.60mm) Depth: 11.53in. (292.80mm) Weight (minimum): 8.18lbs. (3.71kg) Weight (maximum): 11.09lbs. (5.03kg)</p> <p>Rest of world: Height: 290.00mm (11.42in.) Width: 3.65in. (92.60mm) Depth: 292.80mm (11.53in.) Weight (minimum): 3.71kg (8.18lbs.) Weight (maximum): 5.03kg (11.09lbs.)</p> | <p>US: Height: 7.16in. (182.00mm) Width: 1.42in. (36.00mm) Depth: 7.00in. (178.00mm) Weight: 1.43lbs. (0.65kg)</p> <p>Rest of world: Height: 182.00mm (7.16in.) Width: 36.00mm (1.42in.) Depth: 178.00mm (7.00in.) Weight: 0.65kg (1.43lbs.)</p> |
| CAMERA | No camera | No camera | No camera |
| AUDIO & SPEAKERS¹ | Realtek Audio Controller, ALC3246-CG | Realtek Audio Controller, ALC3246-CG | Realtek Audio Controller, ALC3246-CG Internal speakers (optional) |
| WIRELESS | Intel® AX211, 2x2, Wi-Fi 6E (WiFi 802.11ax), Bluetooth® 5.2 MediaTek® MT7921, 2x2, Wi-Fi 6 (WiFi 802.11ax), Bluetooth® 5.2 Intel® 9462, 1x1, Wi-Fi 5 (802.11ac), Bluetooth® 5.1 | Intel® AX211, 2x2, Wi-Fi 6E (WiFi 802.11ax), Bluetooth® 5.2 MediaTek® MT7921, 2x2, Wi-Fi 6 (WiFi 802.11ax), Bluetooth® 5.2 Intel® 9462, 1x1, Wi-Fi 5 (802.11ac), Bluetooth® 5.1 | Intel® AX211, 2x2, Wi-Fi 6E (WiFi 802.11ax), Bluetooth® 5.2 MediaTek® MT7921, 2x2, Wi-Fi 6 (WiFi 802.11ax), Bluetooth® 5.2 Intel® 9462, 1x1, Wi-Fi 5 (802.11ac), Bluetooth® 5.1 |
| BATTERY OPTIONS | No battery | No battery | No battery |
| POWER OPTIONS | 300W internal power supply unit (PSU), 92% Efficient, 80 Plus Platinum 240W internal power supply unit (PSU), 85% Efficient, 80 Plus Bronze 180W internal power supply unit (PSU), 85% Efficient, 80 Plus Bronze | 300W internal power supply unit (PSU), 92% Efficient, 80 Plus Platinum 180W internal power supply unit (PSU), 85% Efficient, 80 Plus Bronze | 90W AC adapter, 4.5mm barrel 65W AC adapter, 4.5mm barrel |
| REGULATORY^{1,2} | <p>Product Safety, EMC and Environmental Datasheets: https://www.dell.com/learn/us/en/uscorp1/product-info-datasheets-safety-emc-environmental</p> <p>Dell Regulatory Compliance Home Page: https://www.dell.com/learn/us/en/uscorp1/regulatory-compliance?s=corp</p> <p>Dell and the Environment: https://corporate.delltechnologies.com/en-us/social-impact/advancing-sustainability/sustainable-supply-chain/environment.htm</p> | <p>Product Safety, EMC and Environmental Datasheets: https://www.dell.com/learn/us/en/uscorp1/product-info-datasheets-safety-emc-environmental</p> <p>Dell Regulatory Compliance Home Page: https://www.dell.com/learn/us/en/uscorp1/regulatory-compliance?s=corp</p> <p>Dell and the Environment: https://corporate.delltechnologies.com/en-us/social-impact/advancing-sustainability/sustainable-supply-chain/environment.htm</p> | <p>Product Safety, EMC and Environmental Datasheets: https://www.dell.com/learn/us/en/uscorp1/product-info-datasheets-safety-emc-environmental</p> <p>Dell Regulatory Compliance Home Page: https://www.dell.com/learn/us/en/uscorp1/regulatory-compliance?s=corp</p> <p>Dell and the Environment: https://corporate.delltechnologies.com/en-us/social-impact/advancing-sustainability/sustainable-supply-chain/environment.htm</p> |
| CHIPSET | Intel® B660 | Intel® B660 | Intel® B660 |
| HARDWARE SECURITY | Kensington security-cable slot Padlock loop Chassis lock slot support Chassis intrusion switch Lockable cable covers SafeID including Trusted Platform Module (TPM) 2.0 Smart card keyboard (FIPS) Microsoft 10 Device Guard and Credential Guard (Enterprise SKU) Microsoft Windows BitLocker Local hard drive data wipe through BIOS (Secure Erase) Self-encrypting storage drives (Opal, FIPS) Trusted Platform Module TPM 2.0 China TPM Intel Secure Boot Intel Authenticate SafeBIOS: includes Dell Off-host BIOS Verification, BIOS Resilience, BIOS Recovery, and additional BIOS Controls | Kensington security-cable slot Padlock ring Chassis lock slot support Chassis intrusion switch Lockable cable covers SafeID including Trusted Platform Module (TPM) 2.0 Smart card keyboard (FIPS) Microsoft 10 Device Guard and Credential Guard (Enterprise SKU) Microsoft Windows BitLocker Local hard drive data wipe through BIOS (Secure Erase) Self-encrypting storage drives (Opal, FIPS) Trusted Platform Module TPM 2.0 China TPM Intel Secure Boot Intel Authenticate SafeBIOS: includes Dell Off-host BIOS Verification, BIOS Resilience, BIOS Recovery, and additional BIOS Controls | Kensington security-cable slot Padlock ring Chassis lock slot support Chassis intrusion switch Supply chain tamper alerts SafeID including Trusted Platform Module (TPM) 2.0 Smart card keyboard (FIPS) Microsoft 10 Device Guard and Credential Guard (Enterprise SKU) Microsoft Windows BitLocker Local hard drive data wipe through BIOS (Secure Erase) Self-encrypting storage drives (Opal, FIPS) Trusted Platform Module TPM 2.0 China TPM Intel Secure Boot Intel Authenticate |
| RECOMMENDED ACCESSORIES | <p>Mouse: Dell Pro Wireless Keyboard and Mouse - KM5221W</p> <p>Audio and Speakers : Dell Slim Soundbar - SB521A</p> <p>Audio Headsets : Dell Pro Stereo Headset - WH3022</p> | <p>Mouse: Dell Pro Wireless Keyboard and Mouse - KM5221W</p> <p>Audio and Speakers : Dell Slim Soundbar - SB521A</p> <p>Audio Headsets : Dell Pro Stereo Headset - WH3022</p> | <p>Keyboard and Mouse : Dell Pro Wireless Keyboard and Mouse - KM5221W</p> <p>Audio Headsets : Dell Pro Stereo Headset - WH3022</p> <p>Mounting Options : OptiPlex Micro and Thin Client Vertical Stand OptiPlex Micro and Thin Client and Under-the-Desk VESA mount Wall Mount OptiPlex Micro and Thin Client PSU Adapter Sleeve OptiPlex Micro and Thin Client Pro 2 E Series Monitor Mount OptiPlex Micro and Thin Client Dual VESA Mount OptiPlex Micro and Thin Client All-in-One Stand (MFS22)</p> |

OPTIPLEX 3000

| FEATURE | TECHNICAL SPECIFICATION | TECHNICAL SPECIFICATION | TECHNICAL SPECIFICATION |
|------------------------|--|--|---|
| MODEL NUMBER | OptiPlex 3000 Tower | 3000 Small Form Factor | 3000 Micro |
| SYSTEMS MANAGEMENT | Dell Client Command Suite for In-Band systems management | Dell Client Command Suite for In-Band systems management | Dell Client Command Suite for In-Band systems management |
| CONFIGURATION SERVICES | N/A | N/A | Factory image load BIOS customization Hardware customization Asset Tagging and Reporting |
| ADD-IN CARDS | N/A | N/A | N/A |

Product Disclosures: pages 2-4

* EPEAT registered where applicable. EPEAT registration varies by country. See www.epeat.net for registration status by country.

1 Available on Windows® 11.

2 Based on internal analysis, April 2021.

3 Based on internal analysis, April 2021, only applies to OptiPlex Micro.

4 Based on internal analysis, April 2021. 20% closed-loop recycled aluminum by weight in the 2TB 3.5" hard drive, optional on the OptiPlex 7090 Tower and 7090 Small Form Factor.

Product Disclosures: pages 5-8

1 Offering may vary by region. Some items may be available after product introduction. For complete details, refer to the Technical Guidebook published on www.dell.com/support.

2 System Memory and Graphics: Significant system memory may be used to support graphics, depending on system memory size and other factors.

3 4GB or Greater System Memory Capability: A 64-bit operating system is required to support 4GB or more of system memory.

4 Particular versions of Microsoft Windows may not support the full Bluetooth 4.2 functionality

5 Storage Option: GB means 1 billion bytes and TB equals 1 trillion bytes; actual capacity varies with preloaded material and operating environment and will be less.

6 TPM is available in selected regions.

7 Computrace: Not a Dell offer. Certain conditions apply. For full details, see terms and conditions at www.ijackforlaptops.com.

8 Please refer to www.epeat.net for specific country registration rating and participation.

9 Limited Hardware Warranty: For copy of Ltd Hardware Warranty, write Dell USA LP, Attn: Warranties, One Dell Way, Round Rock, TX 78682 or see www.dell.com/warranty.

10 on-site service after Remote Diagnosis: Remote Diagnosis is determination by online/phone technician of cause of issue; may involve customer access to inside of system and multiple or extended sessions. If issue is covered by Limited Hardware Warranty (www.dell.com/warranty) and not resolved remotely, technician and/or part will be dispatched, usually within 1 business day following completion of Remote Diagnosis. Availability varies. Other conditions apply.

11 Dell Services: Availability and terms of Dell Services vary by region. For more information, visit www.dell.com/servicedescriptions.

12 For complete listing of declarations and certifications, refer to the Dell Regulatory and Environmental Datasheet found in the Manuals section of Product Support information www.dell.com/support/home/us/en/19.



Transform how you work.

DELL 22 MONITOR | P2219H



OPTIMIZE YOUR WORKSPACE

Free up valuable desk space with this 21.5" FHD monitor featuring a small footprint and thin panel profile. Easily hide away cable clutter with the improved cable management design.



MAXIMIZE PRODUCTIVITY

The 3-sided ultrathin bezel delivers a seamless view across multiple monitors, while Easy Arrange in Dell Display Manager software helps you stay organized when multitasking.



WORK COMFORTABLY

Pivot, tilt, swivel and adjust the height of your monitor to your exact preference. Stay focused longer with a flicker-free screen and ComfortView that optimize eye comfort.



TRUSTED RELIABILITY

Dell monitors — World's number 1 monitor brand¹ Enjoy peace of mind with Dell Premium Panel Exchange, 3 year Advanced Exchange Service² and optional ProSupport.³

Maximize productivity

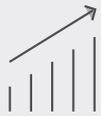


OPTIMIZED WORKSPACE

More room to work: Free up valuable desk space with a thin monitor profile and a small monitor base that's approximately 22% smaller than its predecessor.⁴

Clutter-free: Focus on your work while hiding away cable clutter with an improved cable management design.

Consistent and rich colors: A wide viewing angle enabled by In-Plane Switching technology lets you see vibrant colors—no matter where you sit.



MAXIMIZE PRODUCTIVITY

Expand your efficiency: The three-sided ultrathin bezel design lets you enjoy an uninterrupted view of your content across multiple monitors. And, with a Dell dual monitor set up, you can increase your productivity by up to 21%.⁵

More ways to multitask: Work conveniently across multiple screens and select from predefined templates with the Easy Arrange feature on Dell Display Manager software. Quickly tile and arrange your applications and get back to work faster with Auto-restore, a feature that remembers where you left off.



WORK COMFORTABLY

Adjust to your comfort: Pivot, tilt, swivel and adjust the height of your monitor for a comfortable setup all day long. Or choose from a variety of mounts and stands, including VESA, for even more flexibility.

Easy on the eyes: This TÜV⁶ Certified monitor has a flicker-free screen with ComfortView, a feature that reduces harmful blue light emissions. It's designed to optimize eye comfort even over extended viewing.



TRUSTED RELIABILITY

DELL MONITORS – WORLD'S NUMBER 1 MONITOR BRAND¹

Peace of mind: Dell Premium Panel Exchange allows a free panel replacement during the Limited Hardware Warranty⁷ period even if only one bright pixel is found.

Minimize downtime: Your monitor comes with a 3-year Advanced Exchange Service² so that if a replacement becomes necessary, it will be shipped to you the next business day during your 3-year Limited Hardware Warranty.⁷

Get a higher level of support: Upgrade to 24x7, in-region technical phone support from qualified engineers with Dell ProSupport option.³

Features & Technical Specifications

| | | |
|---|---|--|
| Monitor | Dell 22 Monitor - P2219H | What's in the box? Components <ul style="list-style-type: none"> • Monitor with stand Cables <ul style="list-style-type: none"> • DisplayPort cable • USB 3.0 upstream cable • Power cable Documentation <ul style="list-style-type: none"> • Quick Setup Guide • Safety and regulatory information |
| Diagonal Viewing Size | 54.61 cm (21.5 inches) | |
| Active Display Area | | |
| Width | 476.06 mm (18.74") | |
| Height | 267.79 mm (10.54") | |
| Maximum Preset Resolution | 1920 x 1080 at 60 Hz | |
| Aspect Ratio | 16:9 | |
| Pixel Pitch | 0.248 mm x 0.248 mm | |
| Pixel Per Inch (PPI) | 102 | |
| Brightness | 250 cd/m ² (typical) | |
| Color Support | Color Gamut (typical): 72% (CIE1931) ⁸ Color Depth: 16.7 Million colors | |
| Contrast Ratio | 1000: 1 (typical) | |
| Viewing Angle | 178°/178° | |
| Response Time | 8 ms (Normal); 5 ms (Fast) - (gray to gray) | |
| Panel Type | In-Plane Switching Technology | |
| Backlight Technology | LED Edgelight System | |
| ComfortView with Flicker-free screen | Yes | |
| Dell Display Manager Compatibility | Yes | |
| Remote Asset Management | Yes, via Dell Command Monitor | |
| Display Screen Coating | Antiglare with 3H hardness | |
| Connectivity | | |
| Connectors | 1 x DisplayPort version 1.2, 1 x HDMI port version 1.4, 1 x VGA port, 1 x USB 3.0 upstream port (bottom), 2 x USB 3.0 downstream ports (side), 2 x USB 2.0 downstream ports (bottom) | |
| Built-in Devices | USB 3.0 super-speed hub (with 1 x USB 3.0 upstream port), 2 x USB 3.0 downstream ports, 2 x USB 2.0 downstream ports | |
| Design Features | | |
| Adjustability | Height-adjustable stand (130 mm), Tilt (-5° to 21°) Swivel (-45° to 45°), Pivot (-90° to 90°) | |
| Security | Security lock slot (cable lock sold separately) | |
| Flat Panel Mount Interface | VESA (100 mm x 100 mm) | |
| Power | | |
| AC input voltage/frequency/current | 100 VAC to 240 VAC / 50 Hz or 60 Hz ± 3 Hz / 1.5 A (typical) | |
| Power Consumption (Operational) | 17W (typical) / 37W (maximum) ⁹ | |
| Power Consumption Stand by / Sleep | Less than 0.3W | |
| Dimensions (with stand) | | |
| Height (Compressed ~ Extended) | 353.4 mm ~ 472.0 mm; 13.91" ~ 18.58" | |
| Width | 487.3 mm (19.19") | |
| Depth | 166.0 mm (6.54") | |
| Weight | | |
| Weight (panel only - for VESA mount) | 2.75 kg (6.06 lb) | |
| Weight (with stand) | 4.72 kg (10.41 lb) | |
| Weight (with packaging) | 6.26 kg (13.80 lb) | |
| Standard Service Plan | Premium Panel Exchange, 3 Years Advanced Exchange Service ² & Limited Hardware Warranty ⁷ | |
| Optional Service Plan | Dell ProSupport ³ | |
| Environmental Compliance | ENERGY STAR [®] , EPEAT [®] registered where applicable ¹⁰ , RoHS Compliant, TCO-Certified Display, BFR/PVC free monitor (excluding external cables), Arsenic-Free glass and Mercury-Free for the panel only | |

Adjustability and connectivity

DELL 22 MONITOR | P2219H

Easily adjust the panel to your preferred viewing position.



Back view -
Cable management slot



Tilt and height adjustable



Pivot



Swivel

Connectivity



- A Power connector
- B HDMI port
- C Stand lock feature
- D DisplayPort
- E VGA connector
- F USB upstream port
- G USB downstream ports (x2)
- H USB downstream ports (x2)

RECOMMENDED ACCESSORIES



DELL DUAL MONITOR
STAND | MDS19

Enjoy toolless installation with Quick Release and the flexibility to pivot, tilt, swivel and adjust the height of each monitor independently. Features a small footprint and neat cable management.



DELL PRO STEREO
SOUNDBAR | AE515M

Optimize conference calls and multimedia streaming with exceptional audio clarity. Minimize background noise with the dual mic array and echo-cancelling feature.



DELL WIRELESS KEYBOARD
AND MOUSE | KM636

Elevated and spacious chiclet keys with muted typing sound. Pair up to 6 devices with Dell Universal Pairing.

1 Dell monitors are #1 Worldwide for 6 consecutive years (2013 to 2018)! Source: IDC Worldwide Quarterly PC Monitor Tracker, Q4 2018.
 2 Advanced Exchange: Dell will send you a replacement monitor the next business day in most cases, if deemed necessary after phone/online diagnosis. Shipping times may vary by location and for monitors 55" and above. Fee charged for failure to return defective unit. See dell.com/servicecontracts/global.
 3 Availability varies, please visit www.dell.com/support for details.
 4 Based on Dell internal analysis comparing the area of the monitor base in Dell P2219H versus P2217H.
 5 Source: Based on Principled Technologies Report commissioned by Dell, "Improve productivity with the new Dell P Series monitors in a dual-display configuration", November 2018, comparing Dell 24 USB-C Monitor - P2419H/HC and Dell 24 Monitor - P2414H/HC. Actual results will vary. Full report: https://www.principledtechnologies.com/Dell/P2419H_monitor_productivity_1118.pdf
 6 TÜV Certified (ID0000051369-Flicker Free / ID0000051370-Low Blue Light Content). For more details, visit www.tuv.com.
 7 For a copy of the Limited Hardware Warranty, write to Dell USA LP, Attn: Warranties, One Dell Way, Round Rock, TX 78682 or see dell.com/warranty.
 8 Color gamut (typical) is based on CIE1976 (82%) and CIE1931 (72%) test standards.
 9 Maximum power consumption with max luminance and contrast.
 10 EPEAT registered where applicable. EPEAT registration varies by country. See www.epeat.net for registration status by country.

Dell.com/monitors Product availability varies by country. Please contact your Dell representative for more information.

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- Pure glass touchscreens for optimal image quality
- Commercial durability
- 3 year warranty



2094L 19.5-inch LED Open-Frame Touchmonitor

The Elo 2094L 19.5" open-frame LCD touch display features a slim design and narrow outside dimensions due to the state-of-the-art energy-saving LED backlight, using less electricity to operate and generating less heat. Featuring a brilliant wide viewing angle panel, the 2094L instantly grabs and holds the users' attention for kiosks, casino and amusement, retail self-service, and industrial floor automation.

This compact touch display is "designed for touch" with proven Elo expertise and reliability built in. The 2094L provides stable "drift-free" operation with outstanding image clarity and light transmission—for accurate touch responses and vivid images. The touchscreen is sealed against dirt, dust and liquids, which simplifies integration into the final enclosure. Long-lasting product availability can be expected as the design and tooling is controlled by Elo specifications.

Available with a choice of industry-leading touch technologies, in single- or multi-touch technology, including

IntelliTouch® single-touch surface acoustic wave (SAW) touchscreen technology, and Elo's latest projected capacitive (PCAP) 2GS (two glass solution) multi-touch display with zero-bezel, offering both a ten touch "tablet like" interactive experience along with thru-glass functionality - both modes support single or dual latex gloves as well as cloth gloves.

At Elo, we design, build and are responsible for the complete solution with touch integrated from the start. We use our own touchscreens combined with our software and drivers, everything is designed to work together and tested as part of our life testing processes.

Worldwide agency approvals cover the whole display, which is developed, built, serviced and supported by a true single source supplier. The 2094L open-frame LCD touch display provides an economical solution for system integrators and VARs.



PRODUCT OVERVIEW

Benefits

- Choice of touch technology:
 - **Standard bezel:** IntelliTouch SAW
 - **Zero-bezel:** Projected capacitive
- LED backlighting allows for state-of-the-art slim design while reducing power consumption
- Mounting options include rack and front-mount
- Viewing angle of 178°(h) x 178° (v), for sharp colors and graphics in both portrait and landscape modes
- PCAP 2GS (two glass solution) offers pristine optical clarity and touch durability
- 10 touch projected capacitive (PCAP) with Thru-glass capabilities that passes UL-60950 & IK-07 Impact testing
- Display Port and VGA video interfaces

Application

- Casino and amusement games
- Retail self-service
- Kiosks
- Industrial Automation

About Elo

Elo founders pioneered the touchscreen over 40 years ago. Today, Elo Touch Solutions is a leading global supplier of touch-enabled technology, products and industry solutions. The Elo portfolio encompasses the broadest selection of OEM touchscreen components, touch displays, and all-in-one touchcomputers for the demanding requirements of diverse markets, including gaming machines, hospitality systems, industrial automation, interactive kiosks, healthcare, office equipment, point of sale terminals, retail displays, and transportation applications. The Elo touch experience has consistently stood for quality, reliability and innovation with over 20 million installations worldwide.

2094L 19.5-inch Open-Frame Touch Display

| Specifications | |
|------------------------------|--|
| Model | 2094L |
| Color | Black |
| Active Display Area | 434.9 x 238.7 mm / 17.12 x 9.40 inches |
| Diagonal | 19.5" |
| Aspect Ratio | 16:9 |
| Dimensions | Bezel: 476 x 280.1 x 43.4 mm / 18.74 x 11.03 x 1.71 inches; Zero-Bezel: 479.2 x 285 x 40.5 mm / 18.87 x 11.22 x 1.59 inches |
| Native Resolution | 1920x1080 at 50, 60Hz |
| Other Supported Resolutions | 640x480 at 60Hz; 720x400 at 70Hz; 800x500 at 60Hz; 800x600 at 56, 60Hz; 1024x768 at 60Hz; 1280 x 800 60 Hz; 1280x1024 at 60Hz; 1366x768 at 60Hz, 60Hz RB; 1440x900 at 60Hz, 60Hz RB; 1680x1050 at 60Hz, 60Hz RB |
| Colors | 16.7 million |
| Brightness (typical) | LCD Panel: 250 nits; IntelliTouch: 225 nits; Projected Capacitive (PCAP): 225 nits |
| Response (typical) | 20ms |
| Viewing Angle | Horizontal: 89°/178°; Vertical: 89°/178° |
| Contrast Ratio | 3000:1 |
| On-Screen Display | Accessible through switches on the unit's tethered OSD Control box. Controls: Menu, Up, Down, Select, Power Settings: Brightness, Contrast, Clock, Phase, H-position, V-position, Auto-Adjust, Aspect Ratio, Sharpness, Color Temperature, OSD Timeout, OSD Language, OSD H-Position, OSD V-Position, Recall Defaults, Video Priority, Information, Touch On Sleep Mode, Touch Through Languages: English, French, Italian, German, Spanish, Simplified Chinese, Traditional Chinese, Japanese Lockouts: OSD, Power |
| Input video format | Analog VGA and DisplayPort |
| Input video signal connector | Analog VGA on Female DB-15 connector DisplayPort V1.1a - Supports later versions of Display Port video input |
| Scanning frequency | Horizontal: 30 - 82 kHz; Vertical: 50 - 75 Hz |
| Power | Monitor Input Power Connector: Coaxial power jack (2.1mm pin outer diameter, 5.5mm barrel inner diameter) Monitor Input Power Signal Specifications: 12VDC +/- 5% Power Brick Input Connector: IEC 60320 C14 Power Brick Input voltage range: 100-240VAC, 50/60Hz |
| Power Consumption | ON (monitor + power brick): 20W SLEEP (monitor + power brick): 1.5W OFF (monitor + power brick): 0.5W |
| Temperature | Operating: 0 °C to 40 °C (32 °F to 104 °F); Storage: -20 °C to 60 °C (-4 °F to 140 °F) |
| Humidity | Operating: 20% to 80%; Storage: 10% to 95% |
| Weight | Unpackaged: 10.36 lb (4.7Kg); Packaged: 14.11 lb (6.4Kg) |
| Shipping Dimensions | 575 (L) x 376 (W) x 185 (H) mm / 22.64 (L) x 14.8 (W) x 7.28 (H) inches |
| Mounting Options | 100mm VESA mount; 2 Hole mounting interface on all four sides; Front mount with optional bezel kit (IT/AT/ST Models); Rack mount with optional kit (IT/AT/ST Models); Flush mount with included brackets (PCAP Models) |
| Warranty | 3 years standard |
| MTBF | 50,000 hours demonstrated |
| Agency Approvals | UL, FCC; RCM; cUL, IC; CCC; CE, TUV; VCCI; KCC; CoC; BSMI; CB; RoHS, China RoHS, WEEE, IMERC |
| What's in the Box | All displays include: VGA Cable, RJ45 OSD Remote, USB Touch Cable, User Manual CD, and Quick Install Guide; For Zero-Bezel Models: Flush Mount Brackets w/Screws; For Bezeled Models: "L" (Side Mount) Brackets w/Screws |

Ordering Information

| Model | Part Number | Part Description | Technology | Interface | Surface Treatment | Video Interface | Availability |
|-------|-------------|----------------------------|----------------------|-----------------|-------------------|-----------------|--------------|
| 2094L | E179257 | ET2094L-2UWA-0-MT-ZB-NPB-G | Projected Capacitive | USB | Clear | VGA & DP | Worldwide |
| | E197628 | ET2094L-8CWA-0-ST-NPB-G | IntelliTouch | Dual serial/USB | Clear | VGA & DP | Worldwide |

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GE
Grid Solutions

Multilin 350

Intuitive and Innovative Feeder Protection

The Multilin™ 350 is a member of the Multilin 3 Series protective relay platform and has been designed for the protection, control and management of feeders or related applications as a primary or backup protection device. This cost-effective protective device is used to perform advanced feeder protection, control and monitoring in a drawout or non-drawout design for low, medium and high voltage applications. The 350 also offers enhanced features such as metering, monitoring and diagnostics, preventative maintenance, advanced communications and security.

Key Benefits

- Cost-effective and flexible protection and control for utility and industrial applications
- Field-proven algorithms and reliable protection to avoid unwanted trips or under-protection
- Ease of use and standardization with one-step setup and universal CT inputs
- Environmental monitoring system to monitor operating conditions and plan preventative maintenance
- Advanced power system and switchgear diagnostics
- Flexible communications with multiple ports and protocols allowing seamless integration
- Integrated arc flash detection using light sensors supervised by over current to reduce incident energy and equipment damage
- Arc flash mitigation via zone inter-tripping, flex curves and multiple elements and setting groups
- Powerful security and hierarchical password control for centralized management
- Application flexibility with the use of programmable logic elements
- Drawout design simplifying, commissioning and maintenance, thereby increasing process uptime
- Increased network availability with zero failover time through IEC® 62439-3 PRP and HSR support
- Precise time synchronization through IEEE® 1588 (Precise Time Protocol (PTP)) support
- Robust design exceeding industry standards, with Automotive Grade components and advanced testing procedures such as accelerated life cycle testing
- Simplified migration of legacy MII Family relays to the 3 Series platform

Applications

- Primary protection and control for MV and HV utility and industrial overhead or cable feeder applications
- Protection for distribution transformers of various sizes and voltage levels
- Back-up protection for various HV application and capacitor bank protection
- Advanced control applications including Cold Load Pickup, multi-shot recloser and multiple settings groups
- Protection, control and monitoring of LV Incoming feeder providing flexible communications and eliminating the need for auxiliary equipment
- Protection against corrosion and humidity required for harsh environments



imagination at work



Protection and Control

- Comprehensive current, voltage and frequency protection functions
- Directional Power and Wattmetric Ground Fault
- Wide variety of protection curves
- Synchrocheck, CLP, 2nd Harmonic Blocking, Breaker Failure and Lockout functions
- Integrated arc flash protection

Metering and Monitoring

- Comprehensive metering
- Event Recorder: 256 events (1ms time stamping)
- Programmable oscillography and Fault Report
- Relay health diagnostics
- Breaker monitoring and CT/VT supervision
- Security and password control
- SNTP, IRIG-B or IEEE 1588 time synchronization

Communications

- Front USB and rear serial, Copper/Fiber Ethernet and dual port options for seamless redundancy (IEC 62439-3, PRP and HSR)
- Multiple communication protocols including IEC 61850, IEC 61850 GOOSE, Modbus® TCP/IP, Modbus RTU, DNP 3.0, IEC 60870-5-104, IEC 60870-5-103 and OPC-UA (IEC 62541)

EnerVista™ Software

- Simplified setup and configuration
- Strong document management system
- Full-featured monitoring and data recording
- Maintenance and troubleshooting tool
- Setting conversion tool for MII Family to 3 Series

Overview

The 350 relay is a member of the 3 Series family of Multilin relays. This protective device is used to perform primary or back-up circuit protection on medium or high voltage feeders or transformers and downstream protection for utility and industrial switchgear. The 350 can be used for a wide variety of protection applications in power systems such as HV/MV or MV/LV transformer protection or capacitor bank protection.

The basic protection provided by this relay includes multiple phase, ground, and neutral time and instantaneous overcurrent elements for coordination with upstream and downstream devices. Additionally, the device provides essential feeder control features such as cold load pickup blocking, 2nd harmonic blocking, breaker failure, synchrocheck and autoreclose.

The robust 350 streamlines user work flow processes and simplifies engineering tasks such as configuration, wiring, testing, commissioning and maintenance. This cost-effective relay also offers enhanced features such as diagnostics, preventative maintenance, arc flash mitigation and security.

Easy to Use

Drawout & Non-Drawout Construction

The 350 is offered in both a drawout and a non-drawout construction. In the drawout case design the 350 simplifies installation and improves site safety as the need to open switchgear doors or rewire the device after testing is eliminated. As communication cables remain connected to the chassis, even when the relay is withdrawn, communications connections are retained.

The 350 protection relay chassis used with a drawout relay is available separately, for use as a partial replacement or in test environments. The drawout relay with no chassis is also available to order as a spare unit.

Application Flexibility & Ease of Wiring

Removable terminals ease wiring and in-system testing or troubleshooting.

Available universal CT inputs along with a software-configurable input range (1A and/or 5A) helps to standardize the design and reduce the number of order codes. There is also no need to change the entire relay in case of a design change or future switchgear modifications.

Mixed inputs of 1A or 5A are advantageous for applications where the ground CT is different from the phase CTs.

Fast and Simple Configuration

With quick setup screens the 350 requires minimal configuration for standard feeder applications. Utilizing the powerful EnerVista 3 Series setup software, device configuration can be completed in one easy step.

Advanced Communications

Easy Integration Into New or Existing Infrastructure

With several Ethernet and serial port options, and a variety of protocols, the 350 provides advanced and flexible communication selections for new and existing energy management, SCADA and DCS systems. The 350 also provides industry-leading protocols such as PRP and HSR, when a failover time in communications is not tolerated.

350 Relay Features

✓ Easy to Configure - 1 Simple Step



✓ Advanced & Flexible Communication Options

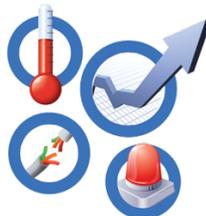


Non-drawout case design

✓ Easy to Use - Drawout Case

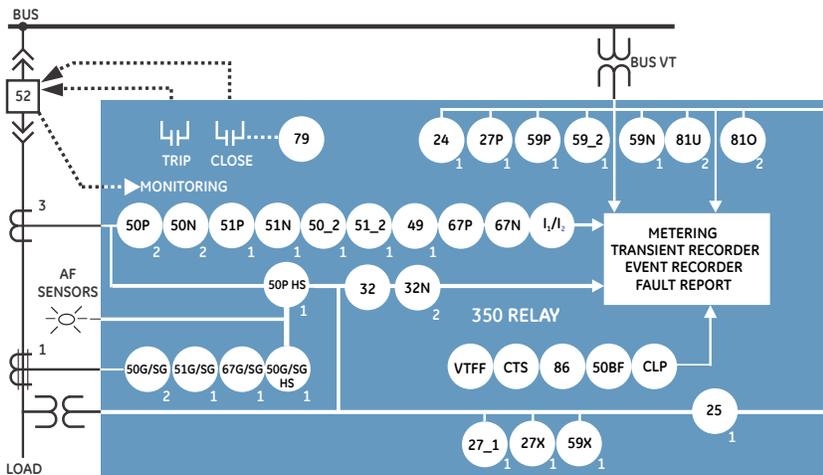


✓ Diagnostic Alarms



Drawout case design

Functional Block Diagram



ANSI® Device Numbers & Functions

| DEVICE NUMBER | 61850 LOGICAL NODE | DESCRIPTION |
|---------------|--------------------|--|
| 24 | PVPH | Volts per Hertz |
| 25 | RSYN | Synchrocheck |
| 27_1 | psseqPTUV | Positive Sequence Undervoltage |
| 27P | phsPTU | Phase Undervoltage |
| 27X | auxPTUV | Auxiliary Undervoltage |
| 32 | PDOP | Directional Power |
| 32N | ndPDOP | Wattmetric Ground Fault |
| I1/2 OR 46BC | | Broken Conductor |
| 49 | PTTR | Thermal Overload |
| 50_2 | ngseqPIOC | Negative Sequence Overcurrent |
| 50BF | RBRF | Breaker Failure |
| 50G/SG | gndPIOC/hsePIOC | Ground (or Sensitive Ground) Instantaneous Overcurrent |
| 50N | ndPIOC | Neutral Instantaneous Overcurrent |
| 50P | phsPIOC | Phase Instantaneous Overcurrent |
| 51_2 | ngseqPTOC | Negative Sequence Time Overcurrent |

| DEVICE NUMBER | 61850 LOGICAL NODE | DESCRIPTION |
|---------------|--------------------|--|
| 51G/SG | gndPTOC/hsePTOC | Ground (or Sensitive Ground) Time Overcurrent |
| 51N | ndPTOC | Neutral Time Overcurrent |
| 51P | phsPTOC | Phase Time Overcurrent |
| 59_2 | ngseqPTOV | Negative Sequence Overvoltage |
| 59N | ndPTOV | Neutral Overvoltage |
| 59P | phsPTOV | Phase Overvoltage |
| 59X | auxPTOV | Auxiliary Overvoltage |
| 60CTS | | CT Supervision |
| 67G/SG | gndRDIR | Ground (or Sensitive Ground) Directional Element |
| 67N | ndRDIR | Neutral Directional Element |
| 67P | phsRDIR | Phase Directional Element |
| 79 | RREC | Autoreclose |
| 81O | PTOF | Overfrequency |
| 81U | PTUF | Underfrequency |
| 86 | | Lockout |
| CLP | | Cold Load Pickup |
| VTF (60VTS) | | Voltage Fuse Failure |

Enhanced Diagnostics

Preventative Maintenance

The 350 allows users to track relay exposure to extreme environmental conditions by monitoring and alarming at high ambient temperatures. This data allows proactive scheduling of regular maintenance work and upgrade activities. The diagnostics data enables the user to understand degradation of electronics due to extreme conditions.

Switchgear Diagnostics

The current and voltage transformer monitoring feature allows users to easily locate and troubleshoot potential failures or mis-operations caused by CTs or VTs. Trip/Close Circuit Monitoring provides constant monitoring of the health of the control circuit.

Cost Effective

Robust Design and Reduced Life Cycle Cost

The 350 is subjected to Accelerated Life Testing (ALT) to validate accurate relay function under specified normal conditions. The device is further tested for durability through Highly Accelerated Life Testing (HALT) where it undergoes extreme operating conditions. The robust 350 design along with drawout construction ensures long term operation and reduces the total installation, maintenance and life cycle cost of the protection system, thereby reducing downtime and associated costs.

Fit-for-purpose Options

Several options for protection, control and communications are provided to match basic to high end application requirements.

The variety of order code selections satisfies the need for various applications from single-function Current or Voltage protection to multi-function including Power and Directional elements.

Protection

The 350 feeder protection system offers comprehensive fit-for-application protection with multiple elements.

Overcurrent

(51P/N/G/SG/_2, 50P/N/G/SG/_2)

The 350 provides three-phase TOC elements including Phase, Neutral, Ground (or Sensitive Ground) and Negative Sequence which enable coordination with upstream and downstream protection devices such as fuses and overload relays, to maximize fault selectivity and minimize interruptions and downtime.

Multiple time current curves are available including IAC, IEC, ANSI and IEEE curves. Additional user-programmable flex curves can be used to customize and meet specific coordination requirements. The TOC has both linear and instantaneous reset timing functions to coordinate with electro-mechanical relays.

The instantaneous TOC element provides fast clearance of high magnitude faults to prevent damage to the power infrastructure and the equipment connected to it.

The neutral overcurrent TOC element is derived as the residual sum of the three-phase CTs, eliminating the need for an additional ground sensor. The sensitive ground protection feature detects ground faults on high impedance grounded systems in order to limit damage to conductors and equipment. Special low ratio CT's are used for detecting low magnitude ground faults.

Directional Overcurrent (67P, 67N, 67G/SG)

Directional elements determine the phase current flow direction for steady state and fault conditions and can be used to control the operation of the phase overcurrent elements by sending directional bits to inputs of these elements.

The Ground and Neutral Directional element is used to discriminate between faults occurring in a forward or in a reverse direction, and it can be used either individually or with other overcurrent elements to define the trip direction.

The directional ground overcurrent element isolates faulted feeders in ring bus or parallel feeder arrangements. It also allows the detection of back feed fault current from feeders with motors.

Broken Conductor (I1/I2 OR 46BC)

The Broken Conductor detection function detects a line broken conductor condition or a single-pole breaker malfunction condition through checking the phase current input phasors and the I_2 / I_1 ratio.

Voltage and Frequency Protection (27P/X/_1, 59P/59X/N/_2, 81O/U)

Overvoltage and Undervoltage elements provide protection for voltage sensitive equipment as well as control for permissive functions and source transfer schemes.

Overfrequency and underfrequency elements improve network (grid) stability using voltage or frequency based load shedding techniques.

These elements also provide back up protection when protecting feeders and other frequency sensitive power equipment.

Thermal Overload (49)

The thermal overload protection function can be applied to prevent damage to the protected cables, dry transformers, capacitor banks, or even overhead lines. Loads exceeding the load ratings of the protected equipment can, over time, degrade the insulation, and may, in return, lead to short circuit conditions.

This protection feature is essential to ensure the longevity of electrical equipment; particularly important to prevent premature cable failures, expensive repair costs and system down time.

Directional Power (32)

Directional Power, with two independent elements, corresponds to three-phase directional power and is designed for applications requiring reverse power or low forward power.

Wattmetric Ground (32N)

The Wattmetric ground fault element detects feeder/line ground faults in solidly grounded, resistance grounded, ungrounded and resonance grounded networks.

It responds to power derived from zero-sequence voltage and current in a direction specified by the element characteristic angle.

Volts per Hertz (24)

The Volts per Hertz protection prevents damage to generators and transformers due to overexcitation that exceeds the equipment capacity which may lead to thermal overload.

Control

Synchronism Check

The Synchrocheck element monitors the connection of two parts of the circuit by the close of a breaker. This element verifies that voltages on both sides of the breaker are within the magnitude, angle and frequency limits set by the user before closing the breaker, in order to minimize internal damage that could occur due to the voltage difference.

Cold Load Pickup (CLP)

Cold Load Pickup allows automatic or manual blocking or raising of trip settings for a period after the breaker has been closed. This feature adapts the pickup of overcurrent elements to override the higher overload currents resulting from re-energization of the feeder after a certain period of time.

Second-Harmonic Blocking

The second-harmonic blocking element ensures that the protection function will not pick up in the event of transformer start-up, or when CTs are becoming saturated.

Breaker Failure

The Breaker Failure function is used to determine when a trip command sent to a breaker has not been executed within a selectable time delay. In the event of a breaker failure, the 350 will issue an additional signal to trip the breakers connected to the same busbar or to signal the trip of upstream breakers.

Autoreclose

Reclose can be initiated externally or from an overcurrent protection function. Up to four reclose operations are available, each with a programmable dead time. For each reclose shot, the relay can be programmed to block any overcurrent element.

VT and CT Supervision

The CT failure function is designed to detect problems with switchgear current transformers. Failure of a CT secondary wiring that is open (one phase or two phases), can lead to undesired operation by some of the enabled protection elements. VT fuse failure is used to detect various VT failure modes.

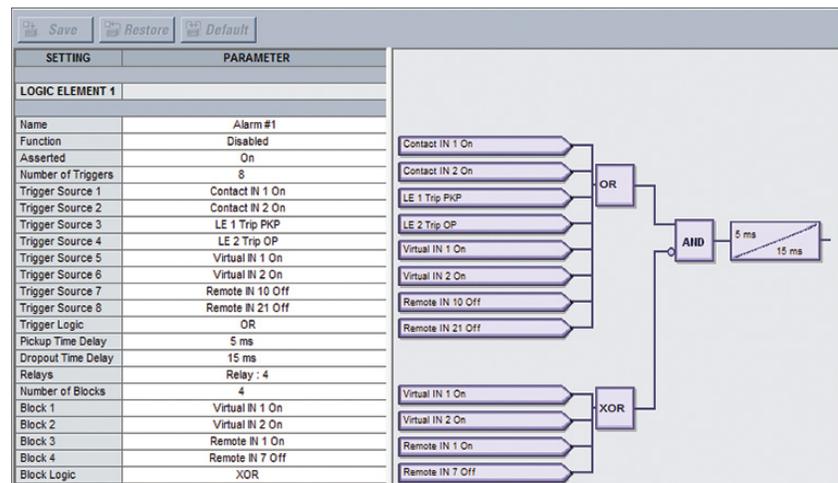
Lockout

The purpose of the Lockout function is to prevent unwanted closing of the breaker after being tripped by the operation of a protection element. A dedicated lockout function with ten individual inputs is available.

Integrated Arc Flash Protection

Traditional selectivity methods may not provide fast and accurate protection. Arc flash incident energy, which is a result of a fault, can endanger people and assets and impact power system reliability. The Multilin 350 supports an integrated arc flash module providing constant monitoring of an arc flash condition within the switchgear. The 350 is able to detect light and overcurrent using 4 arc sensors connected to the relay. In situations where an arc flash/fault does occur, the relay is able to quickly

Logic Designer



Sixteen logic elements available for applications such as manual control, interlocking and peer to peer tripping.

identify the fault and issue a trip command to the associated breaker(s) thereby reducing the total incident energy and minimizing resulting equipment damage.

Self-monitoring and diagnostics of the sensors ensures the health of the sensors as well as the full length optical fiber cables. Programmable LEDs on the front panel display of the 350 can be configured to indicate the health of the sensors and its connections to the relay.

the 350 supports both point and loop sensors which are suitable for a particular compartment or the entire busbar section of a MV or LV switchgear. Same input supports point and loop, and they are field interchangeable. Logic operands are available for arc flash elements.

Automation and Integration

Inputs and Outputs

The 350 features the following inputs and outputs for monitoring and control of typical feeder applications:

- 10 contact Inputs with programmable thresholds
- 2 Form A outputs for breaker trip and close with coil monitoring and 5 Form C output relays (3 Form C output relays in Arc Flash configuration)

IEC 61850 GOOSE

The 350 supports IEC 61850 which allows for digital communications to DCS, SCADA and higher level control systems. In addition, the 350 also supports IEC 61850 GOOSE communication, providing a means of sharing digital point state information between several 350 relays or other IEC 61850 compliant IEDs.

SECURITY/CHANGE HISTORY REPORT

Generated at: September 15 2010 16:56:05

| Device Summary | |
|-------------------|-------------------|
| Device Name: | 350 |
| Device Type: | SR 350 |
| Order Code: | 350-EPGGHSSNM2EDN |
| Firmware Version: | 1.20 |
| Serial Number: | BLOA10000019 |
| Communication: | COM 3, 115200 |

| Setting Changes History | | | | | | | | | |
|-------------------------|------------------------|------------------|--------------|------------------|-------------------------|-----------------|----------------|-----------------|---------------|
| Session# | Date of Change | Method of Change | # Of Changes | Password Entered | Changes by Whom IP /Mac | Event Type | Filename | Status | Firm. Version |
| 1 | 09/15/2010 04:40:11 PM | USB | 0 | Yes | 0:0:0:0 | Setpoint File | | Relay Not Ready | 120 |
| 2 | 09/15/2010 04:41:36 PM | Ethernet | 1 | Yes | 3:13:81:141 | Setpoint Change | 350_120.sr3:C: | Relay Not Ready | 120 |

| Setting Changes Detail History | | | | | |
|--------------------------------|------------------------|-----------|-----------|------------------------|----------------|
| Session# | Date Of Change | Old Value | New Value | Data Item | Modbus Address |
| 2 | 09/15/2010 04:41:36 PM | 1 | 1 | Config Revision Number | 0X1266 |
| 3 | 09/15/2010 04:44:48 PM | 1 | 1 | Config Revision Number | 0X1266 |
| 4 | 09/15/2010 04:46:20 PM | 50 | 5 | Ground CT Primary | 0X10e |

Trace any setting changes with security audit trail

Fast, reliable arc flash protection with light-based arc flash sensors integrated within the Multilin 3 Series of protection & control devices. With arc flash detection in as fast as 2m sec, the costs associated with equipment damage and unplanned downtime is significantly reduced.

MV Switchgear or Motor Control Center
Multilin 3 Series

Power System Troubleshooting

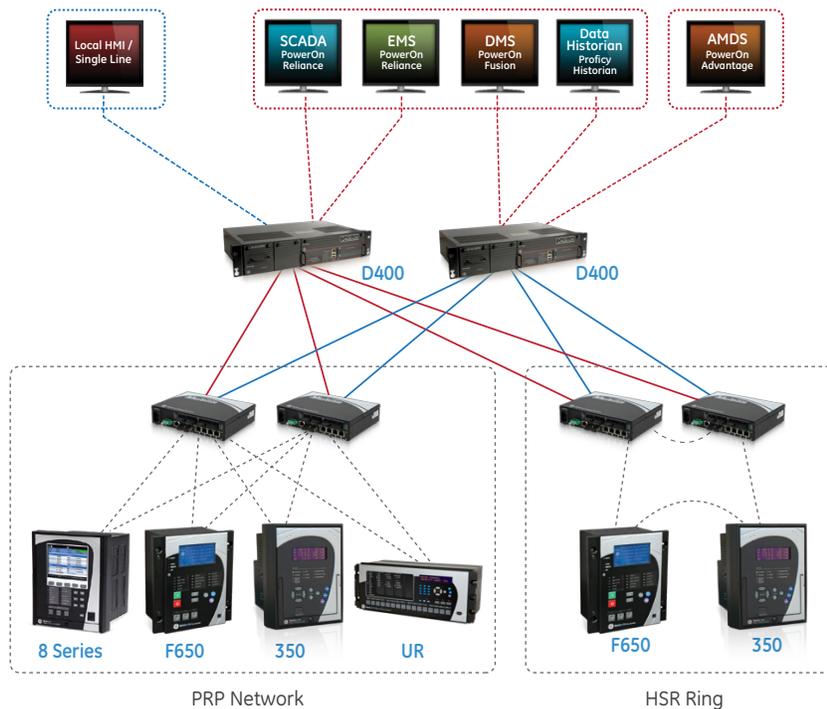
Analyze power system disturbances with transient fault recorder and event records

| Event | Select | Date | Time | Cause of Event |
|-------|-------------------------------------|-----------|--------------|---------------------------|
| 76 | <input type="checkbox"/> | 03/4/2009 | 15:02:55.561 | Reset |
| 75 | <input checked="" type="checkbox"/> | 03/4/2009 | 15:02:12.900 | Breaker Status Open |
| 74 | <input type="checkbox"/> | 03/4/2009 | 15:02:12.901 | Contact Input 1 Off |
| 73 | <input type="checkbox"/> | 03/4/2009 | 15:02:11.775 | Phase C TOC: Trip Operate |
| 72 | <input type="checkbox"/> | 03/4/2009 | 15:02:11.775 | Phase A TOC: Trip Operate |
| 71 | <input type="checkbox"/> | 03/4/2009 | 15:02:11.759 | Output Relay 3 |
| 70 | <input type="checkbox"/> | 03/4/2009 | 15:02:11.759 | Trip Coil |
| 69 | <input type="checkbox"/> | 03/4/2009 | 15:02:11.759 | Trip Lock Pickup |
| 68 | <input type="checkbox"/> | 03/4/2009 | 15:02:11.758 | Phase TOC: Trip Operate |
| 67 | <input type="checkbox"/> | 03/4/2009 | 15:02:11.758 | Phase B TOC: Trip Operate |

| Event Parameter | Value |
|-----------------|----------|
| Event Ia | 0° Lag |
| Event Ib | 120° Lag |
| Event Ic | 240° Lag |
| Event Ig | 0° Lag |
| Event Frequency | 59.99 Hz |
| Therm Cap PH A | 0.0% |
| Therm Cap PH B | 0.0% |
| Therm Cap PH C | 0.0% |

| PARAMETER | VALUE |
|-------------------------------|--------------------|
| Fault Report Order Code | 350-LPSGSHSMCVSEDN |
| Fault Report Feeder Name | Feeder Name |
| Fault Report Firmware Version | 2.20 |
| Fault Report Date | 06/30/2016 |
| Fault Report Time | 07:35:17 |
| Fault Report Fault Type | Phase IOC1 Trip OP |
| Active Setpoint Group | Group 1 |
| Fault Report Ia | 40.0 A |
| Fault Report Ib | 358° |
| Fault Report Ib Angle | 40.0 A |
| Fault Report Ic | 117° |
| Fault Report Ic Angle | 39.3 A |
| Fault Report Ig | 237° |
| Fault Report Ig Angle | 0.0 A |
| Fault Report In | 0° |
| Fault Report In Angle | 0° |
| Fault Report Va | 30 V |
| Fault Report Va Angle | 0° |
| Fault Report Vb | 30 V |
| Fault Report Vb Angle | 120° |
| Fault Report Vc | 30 V |
| Fault Report Vc Angle | 240° |
| Fault Report Vab | 52 V |

Example of Redundant HSR and PRP Architecture



Redundancy protocols (PRP and HSR) can be used for various networking architectures including combined PRP/HSR topologies.

- Eliminates the need for hardwiring contact inputs to contact outputs via communication messaging.
- Handles information exchange between devices as fast as 8 ms, depending on the architecture.
- Enables sequence coordination with upstream and downstream devices.
- If Breaker Open operation malfunctions, GOOSE messaging sends a signal to the upstream breaker to trip and clear the fault.

Logic Elements

The 350 relay has sixteen Logic Elements available for the user to build simple logic using the state of any programmed contact, virtual, or remote input, or the output operand of a protection or control element.

Use the logic element feature to assign up to eight triggering inputs in an "AND/OR/NOR/NAND/XOR/XNOR" gate for the logic element

operation, and up to four blocking inputs in an "AND/OR/NOR/NAND/XOR/XNOR" gate for defining the block signal. Trigger and block sources are grouped for ease of use. Pickup and dropout timers are available for delaying the operation and reset.

Virtual Inputs

Virtual inputs allow communication devices the ability to write digital commands to the 350 relay. These commands can include open/close the breaker, changing setting groups, or blocking any of the protection elements.

Multiple Settings Groups

Two separate settings groups are stored in nonvolatile memory, with only one group active at a given time. Switching between the two setting groups is done by means of a setting, a communications command, or contact input activation. The two settings groups allow users to quickly adapt settings to match

new power system conditions, or to maintain alternate profiles such as settings used during maintenance operations.

Metering, Monitoring and Diagnostics

Event Recording

Events consist of a broad range of change of state occurrences, including pickups, trips, contact operations, alarms and self test status. The 350 relay stores up to 256 events, time tagged to the nearest millisecond. This provides the information required to determine sequence of events, facilitating the diagnosis of relay operation. Event types are individually maskable in order to avoid generating undesired events, and include the metered values at the moment of the event.

Oscillography/ Transient Fault Recorder

The 350 captures current and voltage waveforms and digital channels at up to 32 samples per cycle (user-selectable). Multiple records can be stored in the relay at any given time with a maximum length of 192 cycles. Oscillography is triggered either by internal signals or an external contact.

Test Mode

The Test Mode for 3 Series relays consists of testing front panel LEDs, Inputs and Outputs. It can be used to test the SCADA system as well.

Trip/Close Coil Monitoring

The 350 can be used to monitor the integrity of both the breaker trip and closing coils and circuits. The supervision inputs monitor both the auxiliary voltage levels, while the outputs monitor the continuity of the trip and/or closing circuits, by applying a small current through the circuits.

Metering

Metered values include:

- Current: Ia, Ib, Ic, In, Ig, Isg
- Phase-to-phase and phase-to-ground voltages for bus and line: Van, Vbn, Vcn, Vab, Vbc, Vca and Frequency
- Demand (different types), Active and Reactive power (3-Phase)

Advanced Device Health Diagnostics

The 350 performs comprehensive device health diagnostic tests during startup and continuously

at runtime to test major functions and critical hardware. These diagnostic tests monitor for conditions that could impact system reliability. Device status is communicated via SCADA communications and the front panel display. This continuous monitoring and early detection of possible issues helps improve system availability by employing predictive maintenance.

Time Synchronization

The IEEE 1588 Precision Time Protocol (PTP) synchronizes the time between different nodes on an Ethernet network and is used when very precise time synchronization is required.

It is possible to synchronize distributed clocks with an accuracy of less than 1 microsecond via Ethernet networks. PTP enables clock redundancy and reduces wiring and testing. It can operate over a complete facility and has the ability to compensate for lead length.

IRIG-B is a standard time code format that allows time stamping of events to be synchronized among connected devices to within 1 millisecond. An IRIG-B input is provided in the 350 to allow time synchronization using a GPS clock over a wide area. The 350 IRIG-B supports both AM and DC time synchronization, with an auto detect feature that eliminates the need for configuration.

Temperature Monitoring

The 350 continually monitors ambient temperature around the relay and alarms when the device is exposed to extreme temperatures and undesirable conditions such as air-conditioning unit or station heater failures.

The EnerVista Viewpoint maintenance tool allows users to review and analyze the time period a 350 relay is exposed to certain temperature ranges.

Security

Password Control

The password system has been designed to facilitate a hierarchy for centralized management. With the implementation of the Password Security feature in the 350 relay, extra measures have been taken to ensure unauthorized changes are not made to the relay. When password security is enabled, changing of setpoints or issuing of commands requires passwords to be entered. Separate passwords are supported for remote and local operators, and separate access levels support changing of setpoints or sending commands.

Advanced Communications

The 350 incorporates the latest communication technologies, making it the easiest and the most flexible feeder protection relay for use and integration into new and existing infrastructures. The 350 relay provides the user with one front USB and one rear RS485 communication port. Also available with the 350 is a rear communication port with Ethernet Fiber and Copper. For configurations requiring PRP and HSR redundancy protocols, the 350 provides two rear Fiber ports. Through the use of these ports, continuous monitoring and control from a remote computer, SCADA system or PLC is possible.

The 350 provides optional Parallel Redundancy Protocol (PRP) and High Availability Seamless Ring (HSR) according to the IEC 62439-3 standard that defines two protocols to increase network availability by reducing failover time to zero. Both ports are capable of simultaneously supporting the following protocols: Modbus TCP/IP, IEC 61850, DNP3 or IEC 60870-5-104, IEEE 1588, SNTP and OPC-UA.

The basic concept of both protocols, PRP and HSR, is to send identical frames over different paths and discard one of the copies in reception, at best. If an error occurs or one of the paths goes down, the frame travelling through that path will not reach its destination, but its copy remains intact and will reach the desired destination. This technology ensures high reliability and availability of communication networks by providing redundancy and zero reconfiguration time in the event of a failure. Failsafe communications systems are crucial for industries and utilities with critical applications where no recovery time is tolerated.

Link Loss Alert (LLA) function detects any issue with one port and switch to the other one in case of failure.

The 350 supports popular industry-leading standard protocols enabling easy, direct integration into electrical SCADA and HMI systems. The protocols supported by the 350 include:

- IEC 61850
- IEC 61850 GOOSE
- DNP 3.0
- Modbus RTU
- Modbus TCP/IP
- IEC 60870-5-103
- IEC 60870-5-104
- PRP and HSR (IEC 62439-3)
- Link Loss Alert (LLA)
- OPC-UA
- IEEE 1588 for time synchronization

The 350 relay provides Precision Time Protocol (PTP) based on IEEE 1588 for precise time synchronization throughout a network. OPC-UA based on IEC 62541 is another feature that the 350 relay offers.

These protocols make it easy to connect to a utility or industrial automation system, eliminating the need for external protocol converter devices.

EnerVista Software

The EnerVista suite is an industry leading set of software programs that simplifies every aspect of using the 350 relay. The EnerVista suite provides all the tools to monitor the status of the protected asset, maintain the relay, and integrate the information measured into DCS or SCADA monitoring systems. Convenient COMTRADE and sequence of event viewers are an integral part of the 350 set up software and are included to ensure proper protection and system operation.

Simplified Feeder Setup

The 350 Feeder Protection System includes a simplified setup process. This simplified feeder setup consists of minimal settings and can be accessed through the relay front panel or via the EnerVista Setup software. Once the information is entered, the simplified setup will generate a settings file, and provide documentation indicating which settings are enabled along with an explanation of the parameters entered.

Viewpoint Monitoring

Viewpoint Monitoring is a simple to use and full featured monitoring and data recording software package for small systems. Viewpoint monitoring provides a complete HMI package with the following functionality:

- Plug and play device monitoring
- System single line monitoring and control
- Annunciator alarm screens
- Trending reports
- Automatic event retrieval
- Automatic waveform retrieval

Viewpoint Maintenance

Viewpoint Maintenance provides tools that will increase the security of the 3 Series. Viewpoint Maintenance will create reports on the operating status of the relay, and simplify the steps to troubleshoot protected motors.

The tools available in Viewpoint Maintenance include:

- Settings Security Audit Trail
- Device Health Report
- Comprehensive Fault Diagnostics

EnerVista Integrator

EnerVista Integrator is a toolkit that allows seamless integration of Multilin devices into new or existing automation systems.

Included in the EnerVista Integrator is:

- OPC/DDE Server
- Multilin Devices
- Automatic Event Retrieval
- Automatic Waveform Retrieval

Display

A 4-line liquid crystal display (LCD) allows visibility under varied lighting conditions. When the keypad and display are not being used, the metering summary page is displayed to show critical metered values.

LEDs

The 350 relay has 12 LEDs, including 8 optional programmable LEDs that provide status indication for various conditions of the relay and the system. The LED indications are color coded to indicate the type of event.

User Interface



SETPOINT GROUP 1, 2:
Trip, Alarm and Pickup indicators are continuously on for protection elements.

DISPLAY:
4-line text for easy viewing of key data and navigating through menu

LEDs:
10/12 LED indicators for quick diagnostics

KEYPAD:
10 button keypad for access to device interrogation, change of settings and control commands.

FRONT PORT:
Electrically isolated front USB communication port

INSTALLATION OPTIONS:
Drawout and non-drawout options available

Feeder protection settings in one easy step



Fast and accurate configuration in one simple screen.

| GROUPED ELEMENTS | OUTPUT RELAYS | | | | GROUP 1 | | | | GROUP 2 | | | | |
|-----------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|---------------|--------------------------|--------------------------|--------------------------|-------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| | R3 | R4 | R5 | R6 | R3 | R4 | R5 | R6 | R3 | R4 | R5 | R6 | |
| Phase TOC | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | Latched Alarm | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | Trip | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Phase IOC1 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | Alarm | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Latched Alarm | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Phase IOC2 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Ground TOC | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Alarm | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Ground IOC1 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Alarm | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Ground IOC2 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Ground Directional | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Neutral TOC | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Alarm | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Neutral IOC1 | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Latched Alarm | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Neutral IOC2 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Neutral Directional | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Negative Sequence IOC | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Phase UV | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Alarm | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Phase OV | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Neutral UV | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Negative Sequence OV | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Auxiliary UV | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Auxiliary OV | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Under-frequency 1 | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Alarm | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Under-frequency 2 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Over-frequency 1 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Over-frequency 2 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Cable Thermal Model | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Disabled | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

3 Series setup software protection summary for viewing a summary of Protection & Control configuration.

Retrofit Existing Multilin MII Family Devices

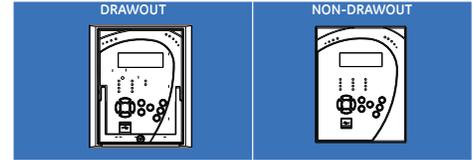
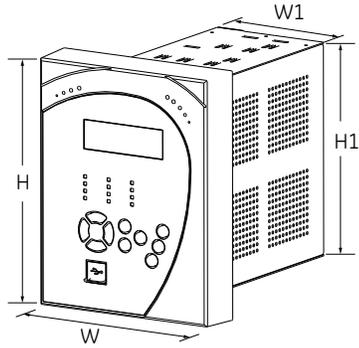
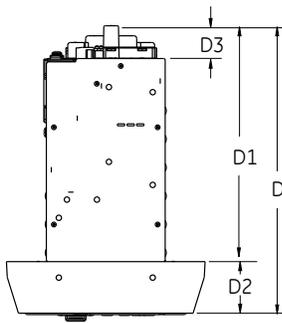
Traditionally, retrofitting or upgrading an existing relay has been a challenging and time consuming task often requiring re-engineering, panel modifications and re-wiring. Similar features and form factor of some models of MII family devices allow users to replace their existing relays with 3 Series relays with enhanced protection and control features and advanced communications. The [Multilin™ 3 Series Retrofit Instruction Manual](#) offers a solution to upgrade previously installed Multilin relays.

The SR3 Enervista Setup software allows users to create new setting files based on existing MIFII and MIVII setting files and can be uploaded to a 350 relay with a compatible model number. Retrofit is smooth and simplified with minor wiring or switchgear modifications.



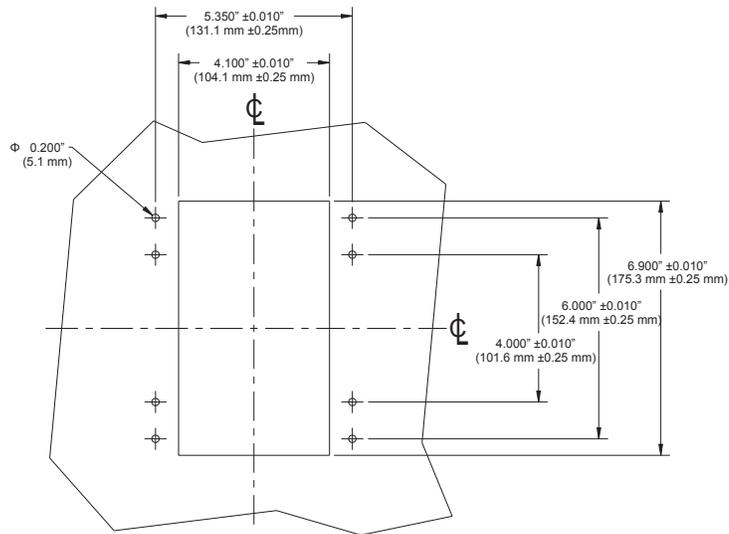
| SettingName | SettingValue | Original SettingName | Original SettingValue |
|------------------------------------|--------------|----------------------|-----------------------|
| File | | | |
| Relay Information | | | |
| Product Name | 350 | Product Name | MIF |
| Version | 220 | Version | 303 |
| Notes | | | |
| Rest Of the settings are defaulted | | | |
| Setpoints | | | |
| S1 Relay Setup | | | |
| Communications | | | |
| RS485 | | | |
| RS485 Comm Parity | None | | |
| Rear 485 Protocol | Modbus | | |
| Ethernet | | | |
| IP Settings | | | |
| Ethernet IP address | 0 | | |
| Ethernet subnet mask | 4294966272 | | |
| Ethernet gateway address | 0 | | |
| Transient Recorder | | | |
| Transient Buffer Setup | 1 x 192 | | |
| Trigger Mode | Overwrite | | |
| Trace Memory Trigger Position | 8 % | | |

Dimensions

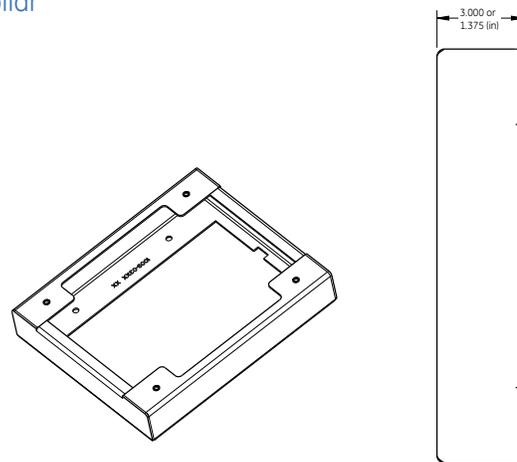


| | DRAWOUT | | NON-DRAWOUT | |
|----|---------|-------|-------------|-------|
| | in | mm | in | mm |
| H | 7.93 | 201.5 | 7.98 | 202.7 |
| W | 6.62 | 168.2 | 6.23 | 158.2 |
| D | 9.62 | 244.2 | 9.35 | 237.5 |
| W1 | 3.96 | 100.6 | 3.96 | 100.6 |
| D1 | 7.89 | 200.4 | 7.88 | 200.2 |
| D2 | 1.73 | 43.8 | 1.47 | 37.3 |
| D3 | 1.087 | 27.6 | 0.755 | 19.17 |
| H1 | 6.82 | 173.2 | 6.82 | 173.2 |

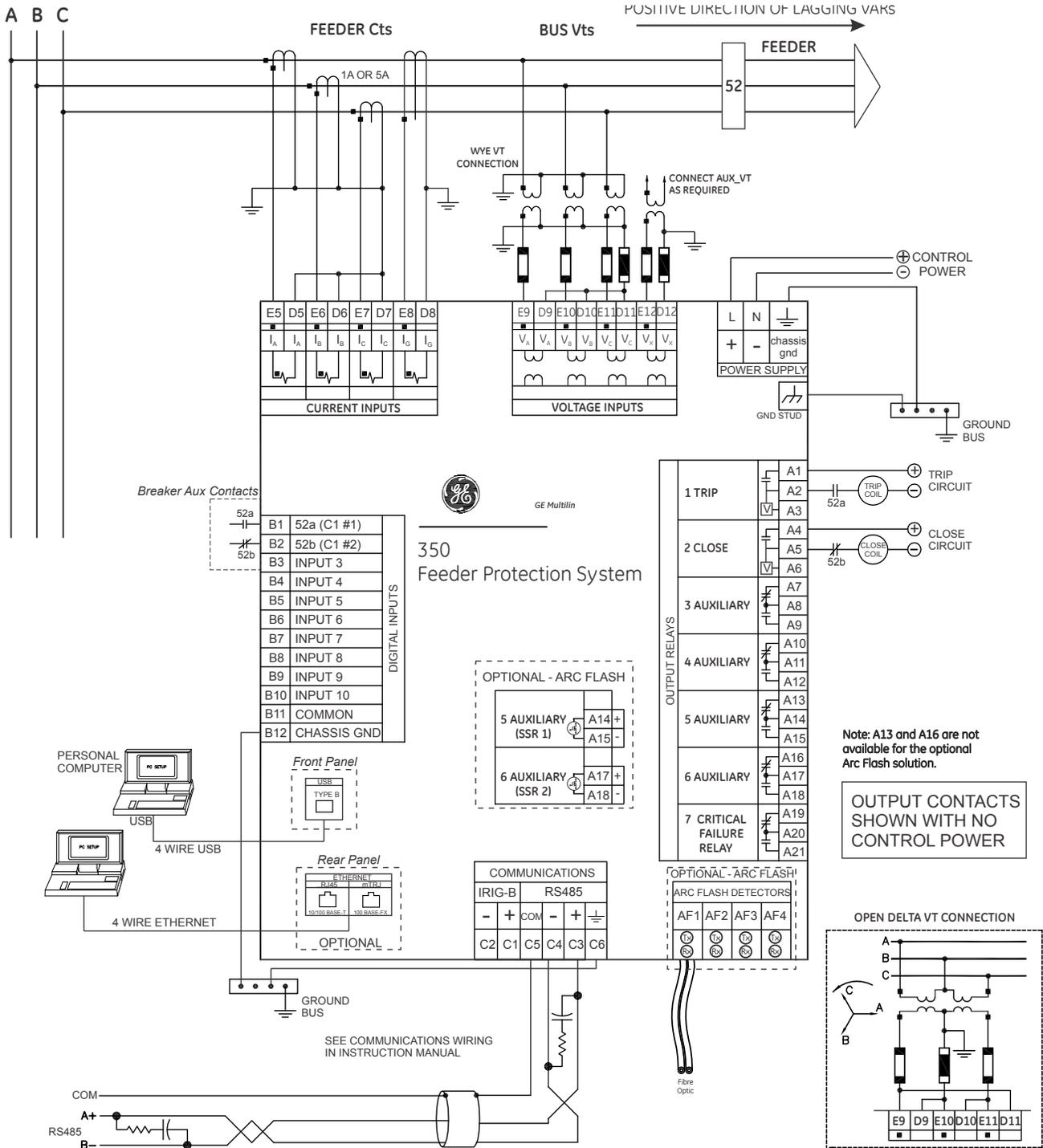
Mounting



3 Series Depth Reducing Collar



Typical Wiring Diagram - Drawout



Current Inputs does not exist in "V" option. Please refer to the manual for non-drawout wiring.

Technical Specifications

| PASSWORD SECURITY | |
|-------------------|--|
| Master Reset | 8 to 10 alpha-numeric characters |
| Settings Password | 3 to 10 alpha-numeric characters for local and remote access |
| Control Password | 3 to 10 alpha-numeric characters for local and remote access |

| PHASE/NEUTRAL/GROUND/NEGATIVE SEQUENCE TIME OVERCURRENT (51P/51N/51G/51.2) | |
|--|---|
| Pickup Level: | 0.05 to 20.00 x CT in steps of 0.01 x CT |
| Dropout Level: | 97% of Pickup @ I > 1 x CT Pickup - 0.02 x CT @ I < 1 x CT |
| Curve Shape: | ANSI Extremely/Very/Moderately/ Normally Inverse Definite Time (0.1 s base curve) IEC Curve A/B/C/Short IAC Extreme/Very/Inverse/Short User Curve, FlexCurve™ A/B (programmable curves) |
| Curve Multiplier: | 0.05 to 50.00 in steps of 0.01 |
| Reset Time: | Instantaneous, Linear |
| Time Delay Accuracy: | ±3% of expected inverse time or 1.5 cycle, whichever is greater, from pickup to operate |
| Level Accuracy: | per CT input |

| SENSITIVE GROUND TIME OVERCURRENT (51SG) | |
|--|---|
| Pickup Level: | 0.005 to 3.000 x CT in steps of 0.001 x CT |
| Dropout Level: | 97% of Pickup @ I > 0.1 x CT Pickup - 0.002 x CT @ I < 0.1 x CT |
| Curve Shape: | ANSI Extremely/Very/Moderately/ Normally Inverse Definite Time (0.1 s base curve) IEC Curve A/B/C/Short Inverse IAC Extreme/Very/Inverse/Short Inverse User Curve, FlexCurve™ A/B |
| Curve Multiplier: | 0.05 to 50.00 in steps of 0.01 |
| Reset Time: | Instantaneous, Linear |
| Time Delay Accuracy: | ±3% of expected inverse time or 1 cycle, whichever is greater, from pickup to operate |
| Level Accuracy: | per CT input |

| PHASE/NEUTRAL/GROUND/NEGATIVE SEQUENCE INSTANTANEOUS OVERCURRENT (50P/50N/50G/50.2) | |
|---|--|
| Pickup Level: | 0.05 to 20.00 x CT in steps of 0.01 x CT |
| Dropout Level: | 97% of Pickup @ I > 1 x CT Pickup - 0.02 x CT @ I < 1 x CT |
| Time delay: | 0.00 to 300.00 sec in steps of 0.01 |
| Operate Time: | <30 ms @ 60Hz (I > 2.0 x PKP, No time delay) <35 ms @ 50Hz (I > 2.0 x PKP, No time delay) |
| Time Delay Accuracy: | ±1% of 1 cycle, whichever is greater (Time Delay selected) |
| Level Accuracy: | per CT input |

| SENSITIVE GROUND INSTANTANEOUS OVERCURRENT (50SG) | |
|---|--|
| Pickup Level: | 0.005 to 3.000 x CT in steps of 0.001 x CT |
| Dropout Level: | 97% of Pickup @ I > 0.1 x CT Pickup - 0.002 x CT @ I < 0.1 x CT |
| Time delay: | 0.00 to 300.00 sec in steps of 0.01 |
| Operate Time: | <30 ms @ 60Hz (I > 2.0 x PKP, No time delay) <35 ms @ 50Hz (I > 2.0 x PKP, No time delay) |
| Time Delay Accuracy: | ±1% of 1 cycle, whichever is greater (Time Delay selected) |
| Level Accuracy: | per CT input |

| PHASE DIRECTIONAL (67P) | |
|-------------------------------|--|
| Directionality: | Co-existing forward and reverse |
| Operating: | Phase Current (Ia, Ib, Ic) |
| Polarizing Voltage: | Quadrature Voltage (ABC phase sequence: Vbc, Vca, Vab) (CBA phase sequence: Vcb, Vac, Vba) |
| Polarizing Voltage Threshold: | 0.05 to 1.25 x VT in steps of 0.01 |
| MTA: | From 0° to 359° in steps of 1° |
| Angle Accuracy: | ±4° |
| Operation Delay: | 20 to 30 ms |

| METERING SPECIFICATIONS | | | |
|----------------------------------|-------------------|--------------|-------------------|
| Parameter | Accuracy | Resolution | Range |
| 3-Phase Real Power (kW) | ±1% of full scale | 0.1 MW | ±100000.0 kW |
| 3-Phase Reactive Power (kvar) | ±1% of full scale | 0.1 Mvar | ±100000.0 kvar |
| 3-Phase Apparent Power (kVA) | ±1% of full scale | 0.1 MVA | 100000.0 kVA |
| 3-Phase Positive Watthour (MWh) | ±1% of full scale | ±0.001 MWh | 50000.0 MWh |
| 3-Phase Negative Watthour (MWh) | ±1% of full scale | ±0.001 MWh | 50000.0 MWh |
| 3-Phase Positive Varhour (Mvarh) | ±1% of full scale | ±0.001 Mvarh | 50000.0 Mvarh |
| 3-Phase Negative Varhour (Mvarh) | ±1% of full scale | ±0.001 Mvarh | 50000.0 Mvarh |
| Power Factor | ±0.05 | 0.01 | -0.99 to 1.00 |
| Frequency | ±0.05 Hz | 0.01 Hz | 40.00 to 70.00 Hz |

Note: Full scale for CT Input is 3 x CT. Negative values (-) represent lead and positive values (+) represent lag.
Voltage Parameters:
Wye VTs: AN, BN, CN, Negative Sequence, Zero Sequence and Auxiliary
Delta VTs: AB, BC, CA, Negative Sequence, Zero Sequence and Auxiliary

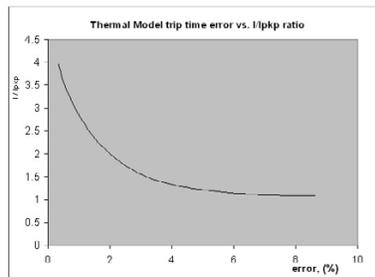
| ARC FLASH HS PHASE/GROUND INSTANTANEOUS OVERCURRENT HS 50P/50G | |
|--|--|
| Current: | Phasor Magnitude (special high speed algorithm) |
| Pickup Level: | 0.05 to 30.00 x CT in steps of 0.01 x CT (Ph/Gnd) 0.005 to 3.000 xCT in steps of 0.001 (SGnd) |
| Dropout Level: | 97% of Pickup |
| Level Accuracy: | For 0.05 to 0.2 x CT: ± 2% of reading or 1.5% of rated, whichever is greater For > 0.2 x CT: ± 5% of reading |
| Operate Time: | 5 ms at >6 x Pickup 4-8 ms at > (3-6) x Pickup |

| ARC FLASH SENSOR/FIBER | |
|---|-------------------------------------|
| Number of Point Sensors | 4 |
| Detection Acceptance Cone (Point Sensor): | minimum 180° spherical |
| Maximum Fiber Length (Point Sensor): | 35 m |
| Maximum Fiber Length (Loop Sensor): | 70 m |
| Fiber Size: | 1000 µm |
| Mode: | Multi-mode |
| Connector: | BROADCOM (c) Compact Versatile-Link |
| Fiber Type: | Plastic Optical Fiber |
| Bend Radius: | 35 mm minimum |

| GROUND DIRECTIONAL (67G) | |
|--------------------------|--|
| Directionality: | Co-existing forward and reverse |
| Operating: | Ground Current (Ig) |
| Polarizing Voltage: | - V, calculated using phase voltages (VTs must be connected in "Wye") - 3V, measured from Vaux input (3V, provided by an external open delta connection). |
| MTA: | From 0° to 359° in steps of 1° |
| Angle Accuracy: | ±4° |
| Operation Delay: | 20 to 30 ms |

| NEUTRAL DIRECTIONAL (67N) | |
|---------------------------|--|
| Directionality: | Co-existing forward and reverse |
| Polarizing: | Voltage, Current, Dual |
| Polarizing Voltage: | - V, calculated using phase voltages (VTs must be connected in "Wye") - 3V, measured by Vaux input (3V, provided by an external open delta connection). |
| Polarizing Current: | Ig |
| MTA: | From 0° to 359° in steps of 1° |
| Angle Accuracy: | ±4° |
| Operation Delay: | 20 to 30 ms |

| THERMAL OVERLOAD (49) | |
|-----------------------|--------------------------------|
| Current: | RMS current - max (Ia, Ib, Ic) |
| Pickup Accuracy: | per current inputs |
| Timing Accuracy: | See graph below |



The graph shows the trip time error with respect to the ratio of cable load and thermal model pickup setting. With a smaller I/lpk ratio, the time error tends to be higher, as accumulated through the logarithmic formula, the measurement error, and the time of measurement. For higher I/lpk ratios, the time to trip is substantially more accurate. Each point on the graph represents a trip time error, with the I/lpk ratio kept constant during the test.

| VOLTS PER HERTZ (24) | |
|----------------------|--|
| Inputs: | Van (Wye VTs), Vab (Delta VTs) |
| Pickup Level: | 0.80 to 4.00 x V/Hz in steps of 0.01 x V/Hz |
| Dropout Level: | 97% to 98% of pickup |
| Level Accuracy: | ± 0.02 x V/Hz or 2% of set value, whichever is greater |
| Time Curves: | Definite Time, Inverse A/B/C, FlexCurves A/B |
| TD Multiplier: | 0.00 to 600.00 s in steps of 0.01 s |
| Reset Delay: | 0.00 to 600.00 s in steps of 0.01 s |
| Time Accuracy: | ± 3% of operate time of ±15 cycles (whichever is greater) for values greater than 1.1 x pickup |

| PHASE/AUXILIARY/POSITIVE SEQUENCE UNDERVOLTAGE (27P, 27X, 27.1) | |
|---|--|
| Minimum Voltage: | Programmable from 0.00 to 1.25 x VT in steps of 0.01 |
| Pickup Level: | 0.00 to 1.25 x VT in steps of 0.01 |
| Dropout Level: | 102% of pickup |
| Curve: | Definite Time, Inverse Time |
| Time Delay: | 0.00 to 600.00 s in steps of 0.01 |
| Operate Time: | Time delay ±30 ms @ 60Hz (V < 0.85 x PKP) Time delay ±40 ms @ 50Hz (V < 0.85 x PKP) |
| Time Delay Accuracy: | ±3% of expected inverse time or 1 cycle, whichever is greater |
| Level Accuracy: | Per voltage input |

| PHASE/AUXILIARY/NEUTRAL/NEGATIVE SEQ OVERVOLTAGE (59P/59X/59N/59.2) | |
|---|--|
| Pickup Level: | 0.00 to 1.25 x VT in steps of 0.01 |
| Dropout Level: | 98% of pickup |
| Time Delay: | 0.00 to 600.00 s in steps of 0.01 |
| Operate Time: | Time delay ±35 ms @ 60Hz (V > 1.1 x PKP) Time delay ±40 ms @ 50Hz (V > 1.1 x PKP) |
| Time Delay Accuracy: | ±3% of expected inverse time or 1 cycle, whichever is greater |
| Level Accuracy: | Per voltage input |

| BROKEN CONDUCTOR (46BC) | |
|-------------------------------------|--|
| Minimum operating positive current: | 0.05 to 1.00 x CT in steps of 0.01 x CT |
| Maximum operating positive current: | 0.05 to 5.00 x CT in steps of 0.01 x CT |
| Pickup level: | 20.0% to 100.0% in steps of 0.1% |
| Dropout level: | 97% of pickup (pickup > 10) Pickup - 0.02 (pickup < 10) |
| Pickup time delay: | 0.000 to 65.535 s in steps of 0.001 s |
| Timer accuracy: | ± 3% of delay setting or ± ¼ cycle (whichever is greater) from pickup to operate |
| Operate time: | <30 ms at 60 Hz |

| WATTMETRIC GROUND FAULT (32N) | |
|-------------------------------|---|
| Measured power: | zero sequence |
| Number of elements: | 1 |
| Characteristic angle: | 0° to 359° in steps of 1° |
| Pickup threshold: | 0.001 to 1.200 pu in steps of 0.001 pu |
| Pickup level: | ± 2% or ± 0.03 pu, whichever is greater |
| Dropout Level: | 97% of pickup (pickup > 0.1) Pickup - 0.002 (pickup < 0.197) |
| Pickup delay: | Definite Time (0.00 to 600.0 s in steps of 0.1 s), Inverse Time, or Flexcurve 0.01 to 2.00 in steps of 0.01 |
| Inverse time multiplier: | 0.01 to 2.00 in steps of 0.01 |
| Curve timing accuracy: | ± 3.5% of operate time or ± ¼ cycle (whichever is greater) from pickup to operate |
| Operate time: | <30 ms at 60 Hz |

| DIRECTIONAL POWER (32) | |
|------------------------|--|
| Measured power: | 3-phase |
| Characteristic angle: | 0° to 359° in steps of 1° |
| Power pickup range: | -1.200 to 1.200 x Rated Power in steps of 0.001 |
| Pickup level accuracy: | 2.5% or 0.01 pu, whichever is greater |
| Hysteresis: | 2% of pickup |
| Pickup time delay: | 0.00 to 600.0 s in steps of 0.1 s |
| Operate time: | < 55 ms at 1.1 x pickup at 60 Hz < 65 ms at 1.1 x pickup at 50 Hz ± 3% of delay setting or ± ¼ cycle (whichever is greater) from pickup to operate |
| Timer accuracy: | ± 3% of delay setting or ± ¼ cycle (whichever is greater) from pickup to operate |

| UNDERFREQUENCY (81U) | |
|----------------------|--------------------------------------|
| Minimum Voltage: | 0.00 to 1.25 x VT in steps of 0.01 |
| Pickup Level: | 40.00 to 70.00 Hz in steps of 0.01 |
| Dropout Level: | Pickup +0.05 Hz |
| Time Delay: | 0.10 to 600.0 s in steps of 0.01 |
| Time Delay Accuracy: | 0 to 6 cycles (Time Delay selected) |
| Operate Time: | Typically 10 cycles @ 0.1Hz/s change |
| Level Accuracy: | ±0.03 Hz |

Technical Specifications

OVERFREQUENCY (810)

| | |
|-----------------|--------------------------------------|
| Minimum Voltage | 0.3 x VT |
| Pickup Level: | 40.00 to 70.00 Hz in steps of 0.01 |
| Dropout Level: | Pickup -0.05 Hz |
| Time Delay: | 0.10 to 600.0 s in steps of 0.01 |
| Time Delay | 0 to 6 cycles (Time Delay selected) |
| Accuracy: | |
| Operate Time: | Typically 10 cycles @ 0.1Hz/s change |
| Level Accuracy: | ±0.03 Hz |

FUSE FAIL (VTFF)

| | |
|------------------|---------------|
| Time Delay: | 1 s |
| Timing Accuracy: | ±0.5 s |
| Elements: | Trip or Alarm |

TRANSIENT RECORDER

| | |
|------------------|--|
| Buffer size: | 3 s |
| No. of buffers: | 1, 3, 6 |
| No. of channels: | 14 |
| Sampling rate: | 4, 8, 16, or 32 samples per cycle |
| Triggers: | Manual Command Contact Input Virtual Input Logic Element Element Pickup/Trip/Dropout/Alarm |
| Data: | AC input channels Contact input state Contact output state Virtual input state Logic element state |
| Data storage: | RAM - battery backed-up |

FAULT RECORDER

| | |
|-------------------|---|
| Number of records | 1 |
| Content: | Date and Time, first cause of fault, phases, Currents: Ia, Ib, Ic, Ig/lsg, In - magnitudes and angles/Voltages: Van, Vbn, Vcn, Vab, Vbc, Vca, Vaux - magnitudes and angles System frequency |

EVENT RECORDER

| | |
|-------------------|--|
| Number of events: | 256 |
| Header: | relay name, order code, firmware revision |
| Content: | event number, date of event, cause of event, per-phase current, ground current, sensitive ground current, neutral current, per-phase voltage (VTs connected in "Wye"), or phase-phase voltages (VTs connected in "Delta"), system frequency, power, power factor, thermal capacity |
| Data Storage: | Retained for 3 days |

CLOCK

| | |
|---------|---|
| Setup: | Date and time Daylight Saving Time |
| IRIG-B: | Auto-detect (DC shift or Amplitude Modulated) Amplitude modulated: 1 to 10 V pk-pk DC shift: 1 to 10 V DC Input impedance: 40kOhm ± 10% Accuracy with IRIG-B: ± 1 ms Accuracy without IRIG-B: ± 1 min / month |

LOGIC ELEMENTS

| | |
|------------------------------------|--|
| Number of logic elements: | 16 |
| Trigger source inputs per element: | 2 to 8 |
| Block inputs per element: | 2 to 4 |
| Supported operations: | AND, OR, NOR, NAND, XOR, XNOR, Pickup / Dropout timers |
| Pickup timer: | 0 to 60000 ms in steps of 1 ms |
| Dropout timer: | 0 to 60000 ms in steps of 1 ms |

BREAKER CONTROL

| | |
|------------|--|
| Operation: | Asserted Contact Input, Logic Element, Virtual Input, Manual Command |
| Function: | Opens / closes the feeder breaker |

SYNCHROCHECK (25)

| | |
|------------------------------------|--|
| Dead/Live levels for Line and Bus: | 0 to 1.25 x VT in steps of 0.01 |
| Maximum voltage difference: | 10 to 10000 V in steps of 1 V |
| Maximum angle difference: | 2° to 80° in steps of 1° |
| Maximum frequency slip | 0.01 to 5.00 Hz in steps of 0.01 Hz |
| Breaker Closing time | 0.01 to 1.00 s in steps of 0.01 s |
| Dead Source function: | None (DL-DB) Dead Line-Dead Bus (LL-DB) Live Line-Dead Bus (DL-LB) Dead Line-Live Bus (AL-DB) Any Line-Dead Bus (DL-AB) Dead Line-Any Bus (OL-OD) One Live-Other Dead (NBL) Not Both Live |

AUTORECLOSE (79)

| | |
|-------------------|---|
| Reclose attempts: | Up to 4 shots |
| Time Delay: | 0 to 3 cycles (AR Dead Time selected) |
| Accuracy: | |
| Elements: | Inputs, Outputs, Breaker Status (52 status) |

SYNCHROCHECK SUPERVISION

| | |
|------------|---------------------------|
| Operation: | Automatically |
| Function: | Close breaker supervision |

SECOND HARMONIC INHIBIT

| | |
|----------------------|---|
| Operating Parameter: | Current 2nd harmonic per phase or average |
| Pickup Level: | 0.1% to 40.0% in steps of 0.1 |
| Minimum Current: | 0.03 to 3.00 x CT in steps of 0.01 x CT |
| Time Delay: | 0.00 to 600.00 s in steps of 0.01 s |
| Time Delay | ±3% of expected time or 2 cycle, whichever is greater |
| Level Accuracy: | ±2% or ±10mA (whichever is greater) |

BREAKER FAILURE (50BF)

| | |
|-----------------|--|
| Pickup Level: | 0.05 to 20.00 x CT in steps of 0.01 x CT |
| Timer 1 Delay: | 0.03 to 1.00 s in steps of 0.01 s |
| Timer 2 Delay: | 0.00 to 1.00 s in steps of 0.01 s |
| Dropout Level: | 97 to 98% of pickup |
| Time Delay | 0 to 1 cycle (Timer 1, Timer 2) |
| Accuracy: | |
| Level Accuracy: | per CT input |
| Reset Time: | <14 ms typical at 2 x pickup at 60 Hz <16 ms typical at 2 x pickup at 50 Hz |

BREAKER TRIP COUNTER

| | |
|------------------------------|--------------------------|
| Trip Counter Limit (Pickup): | 1 to 10000 in steps of 1 |
|------------------------------|--------------------------|

CT FAILURE

| | |
|-----------------------------|---|
| Inputs: | Neutral Current IN, Neutral Current VN (from three-phase VTs) Ground Current Ig |
| Time Delay: | 0.00 to 60.00 s in steps of 0.01 s |
| 3I0 level accuracy: | per CT inputs |
| 3V0 level accuracy: | per VT inputs |
| GND current level accuracy: | see the specifications for phase and ground current inputs |
| Operate Time: | 30 ms at 60 Hz 35 ms at 50 Hz |

COLD LOAD PICKUP BLOCKING

| | |
|------------|--|
| Operation: | Automatically (current level), or by command (asserted input) |
| Function: | Block IOC functions, raise TOC pickup, for selected period of time |
| Time Delay | 0 to 1 cycle (block Time) |
| Accuracy: | ±50 ms (outage time ≤ 5 min) ±1 s (outage time > 5 min) |

AMBIENT TEMPERATURE

| | |
|--------------------------|----------------------------------|
| High Temperature Pickup: | 20°C to 80°C in steps of 1°C |
| Low Temperature Pickup: | -40°C to 20°C in steps of 1°C |
| Time Delay: | 1 to 60 min in steps of 1 min |
| Temperature Dropout: | Configurable 90 to 98% of pickup |
| Temperature Accuracy: | ±10°C |
| Timing Accuracy: | ±1 second |

BREAKER HEALTH

| | |
|-----------------|--|
| Timer Accuracy: | ± 3% of delay setting or ± 1 cycle (whichever is greater) from pickup to operate |
|-----------------|--|

DEMAND

| | |
|------------------------------|--|
| Measured Values: | Phase A/B/C present and maximum current, three-phase present and maximum real/reactive/apparent power |
| Measurement Type: | Thermal Exponential, 90% response time (programmed): 5, 10, 15, 20, 30 minutes Block Interval / Rolling Demand, time interval (programmed): 5, 10, 15, 20, 30 minutes |
| Current Pickup Level: | 10 to 10000 in steps of 1 A |
| Real Power Pickup Level: | 0.1 to 300000.0 in steps of 0.1 kW |
| Reactive Power Pickup Level: | 0.1 to 300000.0 in steps of 0.1 kVar |
| Apparent Power Pickup Level: | 0.1 to 300000.0 in steps of 0.1 kVA |
| Dropout Level: | 96-98% of Pickup level |
| Level Accuracy: | ± 2% (current demand only) |

CONTACT INPUTS

| | |
|--|--|
| Inputs: | 10 |
| Selectable thresholds: | 17, 33, 84, 166 VDC ±10% |
| Recognition time: | 1/2 cycle |
| Debounce time: | 1 to 64 ms, selectable, in steps of 1 ms |
| Maximum input voltage & continuous current draw: | 300 VDC, 2 mA, connected to Class 2 source |
| Type: | opto-isolated inputs |
| External switch: | wet contact |

PHASE & GROUND CURRENT INPUTS

| | |
|--------------------|--|
| CT Primary: | 1 to 6000 A |
| Range: | 0.02 to 20 x CT |
| Input type: | 1 A or 5 A (must be specified with order) |
| Nominal frequency: | 50/60 Hz |
| Burden: | <0.1 VA at rated load |
| Accuracy: | ±3% of reading from 0.2 to 20 x CT +/- 10 mA or ±20% of reading from 0.02 to 0.19 x CT, whichever is greater |
| CT withstand: | 1 second at 100 A (1 A option) 1 second at 400 A (5 A or universal CT option) 2 seconds at 40 x rated current continuous at 3 x rated current |

SENSITIVE GROUND CURRENT INPUT

| | |
|--------------------|--|
| CT Primary: | 1 to 600 A |
| Range: | 0.002 to 3 x CT |
| Input type: | 1 A or 5 A (must be specified with order) |
| Nominal frequency: | 50/60 Hz |
| Burden: | <0.1 VA at rated load |
| Accuracy: | ±3% of reading from 0.02 to 3 x CT +/- 10 mA or ±20% of reading from 0.02 to 0.19 x CT, whichever is greater |
| CT withstand: | 1 second at 100 A (1 A option) 1 second at 400 A (5 A or universal CT option) 2 seconds at 40 x rated current continuous at 3 x rated current |

PHASE/AUX VOLTAGE INPUTS

| | |
|--------------------|------------------------------|
| Source VT: | 0.15 to 550 kV / 50 to 220 V |
| VT secondary: | 50 to 240 V |
| VT ratio: | 1.0 to 5000 in steps of 0.1 |
| Nominal frequency: | 50/60 Hz |
| Relay burden: | <0.25 VA at 120 V |
| Accuracy: | ±1.0% of reading |
| Voltage withstand: | 260 VAC continuous |

RATINGS PER UL CERTIFICATION:

| | |
|-----------------------|----------------|
| Break (AC resistive): | 250 VAC / 10 A |
| Continuous Current: | 10 A |

FORM-A RELAYS

| | |
|----------------------------------|---|
| Configuration: | 2 (two) electromechanical |
| Contact material: | silver-alloy |
| Operate time: | <8 ms |
| Continuous current: | 10 A |
| Make and carry for 0.2s: | 30 A per ANSI C37.90 |
| Break (DC inductive, L/R=40 ms): | 24 V / 1 A 48 V / 0.5 A 125 V / 0.3 A 250 V / 0.2 A |
| Break (DC resistive): | 24 V / 10 A 48 V / 6 A 125 V / 0.5 A 250 V / 0.3 A |
| Break (AC inductive): | 720 VA @ 250 VAC Pilot duty A300 |
| Break (AC resistive): | 277 VAC / 10 A |

FORM-A VOLTAGE MONITOR

| | |
|---------------------|---------------|
| Applicable voltage: | 20 to 250 VDC |
| Trickle current: | 1 to 2.5 mA |

FORM-C RELAYS

| | |
|--------------------------------------|---|
| Configuration: | 3 (three) electromechanical |
| Flash option: | |
| Configuration, Non-Arc Flash option: | 5 (five) electromechanical |
| Contact material: | silver-alloy |
| Operate time: | <8 ms |
| Continuous current: | 10 A |
| Make and carry for 0.2s: | 30 A per ANSI C37.90 |
| Break (DC inductive, L/R=40 ms): | 24 V / 1 A 48 V / 0.5 A 125 V / 0.3 A 250 V / 0.2 A |
| Break (DC resistive): | 24 V / 10 A 48 V / 6 A 125 V / 0.5 A 250 V / 0.3 A |
| Break (AC inductive): | 720 VA @ 250 VAC Pilot duty A300 |
| Break (AC resistive): | 250 VAC / 10 A |

RELAYS RATINGS PER UL CERTIFICATION

| | |
|-----------------------|----------------|
| Break (AC resistive): | 250 VAC / 10 A |
| Continuous Current: | 10 A |

SOLID STATE CONTACT, ARC FLASH OPTION

| | |
|--------------------------------|-------------|
| Configuration: | 2 MOSFET |
| Operate time: | 60 µs |
| Continuous current: | 6 A |
| Make and carry for 1 s: | 10 A |
| Break (DC resistive): | 300 V / 6 A |
| Break (DC inductive L/R=40ms): | 300 V / 6 A |

SOLID STATE CONTACT RATINGS PER UL CERTIFICATION

| | |
|---------------------|--|
| Break: | 24 VDC, 1 A Pilot Duty 48 VDC, 0.5 A Pilot Duty 125 VDC, 0.3 A Pilot Duty 250 VDC, 0.2 A Pilot Duty |
| Continuous Current: | 6 A |

TRIP / CLOSE SEAL-IN

| | |
|------------------------|---------------------------------|
| Relay 1 trip seal-in: | 0.00 to 9.99 s in steps of 0.01 |
| Relay 2 close seal-in: | 0.00 to 9.99 s in steps of 0.01 |

HIGH RANGE POWER SUPPLY

| | |
|--------------------|---|
| Nominal: | 120 to 240 VAC 125 to 250 VDC |
| Range: | 60 to 300 VAC (50 and 60 Hz) 84 to 250 VDC |
| Ride-through time: | 35 ms |

LOW RANGE POWER SUPPLY

| | |
|----------|--------------|
| Nominal: | 24 to 48 VDC |
| Range: | 20 to 60 VDC |

Technical Specifications

| ALL RANGES | |
|--------------------|--|
| Voltage withstand: | 2 x highest nominal voltage for 10 ms |
| Power consumption: | 15 W nominal, 20 W maximum |
| Fuse rating: | 5A fuse; time lag, slow blow, 350V 4.5 O.D. X 14.5mm |

| SERIAL | |
|-------------------|--------------------------------------|
| RS485 port: | Opto-coupled |
| Baud rates: | up to 115 kbps |
| Response time: | 1 ms typical |
| Parity: | None, Odd, Even |
| Maximum Distance: | 1200 m (4000 feet) |
| Isolation: | 2 kv |
| Protocol: | Modbus RTU, DNP 3.0, IEC 60870-5-103 |

| ETHERNET (COPPER) | |
|-------------------|---|
| Modes: | 10/100 MB (auto-detect) |
| Connector: | RJ-45 |
| Protocol: | Modbus TCP/IP, DNP 3.0, IEC 60870-5-104, IEC 61850 GOOSE, IEC 61850, OPC-UA |

| ETHERNET (FIBER) | |
|------------------------------------|--|
| Fiber type: | 100 MB Multi-mode |
| Wavelength: | 1300 nm |
| Connector: | MTRJ |
| Transmit power: | -20 dBm |
| Receiver sensitivity: | -31 dBm |
| Power budget: | 9 dB |
| Maximum input power: | -11.8 dBm |
| Typical distance: | 2 km (1.25 miles) |
| Duplex: | half/full |
| Protocol: | Modbus TCP, DNP3.0, IEC 60870-5-104, IEC 61850 GOOSE, IEC 61850, OPC-UA, PRP, HSR, LLA |
| Maximum number of TCP/IP sessions: | 3 |

| USB | |
|-------------------------|------------------------|
| Standard specification: | Compliant with USB 2.0 |
| Data transfer rate: | 115 kbps |

| OPC-UA (OLE FOR PROCESS CONTROL - UNIFIED ARCHITECTURE) | |
|---|---|
| DA Server: | Transmission of real-time data to Clients |
| A&E Server: | Transmission of Event information to Clients. Acknowledge and confirmation permitted from Client side |

| CERTIFICATION | | |
|------------------|--|------------------------------------|
| | Applicable council directive | According to |
| CE compliace | Low voltage directive EMC Directive | 2014/35/EU 2014/30/EU UL 508 |
| North America | cULus | UL 1053 C22.2 No 14 |
| EAC | Machines and Equipment | TR CU 010/2011 |
| Lloyd's Register | Rules and Regulations for the Classifications of Ships | Marine Applications: ENV2, ENV3 |
| ISO | Manufactured under a registered quality program | ISO9001 |

| EAC | |
|---|--|
| The EAC Technical Regulations (TR) for Machines and Equipment apply to the Customs Union (CU) of the Russian Federation, Belarus and Kazakhstan | |
| Country of origin | Spain or Canada; see label on the unit |
| Date of manufacture | See label on the side of the unit |
| Declaration of Conformity and/or Certificate of Conformity | Available upon request |

| TEST | REFERENCE STADARD | TEST LEVEL |
|----------------------------------|---|---|
| Dielectric voltage withstand | | |
| high voltage power supply* | 60255-27 | 2200 VAC for one second |
| low voltage power supply* | 60255-27 | 550 VAC for one second |
| Impulse voltage withstand | EN60255-27 | 5kV |
| Damped Oscillatory Discharge | IEC 60255-26 / IEC61000-4-18 | 2.5kV CM, 1 kV DM |
| Electrostatic Discharge | IEC 60255-26 / IEC 61000-4-2 | 15 kV / 8 kV |
| RF immunity | IEC 60255-26 / IEC 61000-4-3 | 80 MHz- 1 GHz, 1.4 GHz-2.7GHz, 10 V/m |
| Fast Transient Disturbance | IEC 60255-26 / IEC 61000-4-4 | 2 or 4 kV |
| Surge Immunity | IEC 60255-26 / IEC 61000-4-5 | 0.5, 1 & 2 kV |
| Conducted RF Immunity | IEC 60255-26 / IEC 61000-4-6 | 150 kHz-80 MHz, 26-68 MHz, 10V/m |
| Voltage interruption & Ripple DC | IEC 60255-26 / IEC 61000-4-11 | 15% ripple, 200ms interrupts |
| Radiated & Conducted Emissions | CISPR11 / CISPR22 / IEC 60255-26: Section 7.1.2 & 7.1.3 | Class A |
| Sinusoidal Vibration | IEC 60255-21-1 | Class 1 |
| Shock & Bump | IEC 60255-21-2 | Class 1 |
| Seismic | IEC 60255-21-3 | Class 2 |
| Power magnetic Immunity | IEC 60255-26 / IEC 61000-4-8 | 1000 A/m, 100 A/m, 30A/m 300 A/m |
| Voltage Dip & interruption | IEC 60255-26 / IEC 61000-4-11 | 0, 40, 70, 80% dips, 250/300 cycle interrupts |
| Power frequency | IEC 60255-26 / IEC 61000-4-16 | Level 4 |
| Voltage Ripple | IEC 60255-26 / IEC 61000-4-17 | 15% ripple |
| Ingress Protection | IEC 60529 | IP54 front, IP10 Back |
| Environmental (Cold) | IEC 60068-2-1 | -40°C 16 hrs |
| Environmental (Dry heat) | IEC 60068-2-2 | 85°C 16hrs |
| Relative Humidity Cyclic | IEC 60068-2-30 | 6 day variant 2 |
| EFT | IEEE / ANSI C37.90.1 | 4kV, 2.5kHz |
| Damped Oscillatory RF Immunity | IEEE / ANSI C37.90.1 | 2.5kV, 1Mhz |
| ESD | IEEE / ANSI C37.90.3 | 35V/m (max field), 180 MHz-1 GHz with 1 kHz sine and 80% AM modulation) |
| Safety | UL 508 UL C22.2-14 UL 1053 | 8KV CD/ 15KV AD e83849 NKCR e83849 NKCR7 e83849 NKCR |

* Test level is based on basic insulation principle (Power supply I/P terminals tested to Chassis ground).

| DIMENSIONS | |
|------------|-----------------------------|
| Size: | Refer to Dimensions section |

| WEIGHT | |
|------------------|-------------------|
| NON-DRAWOUT UNIT | |
| Weight (net): | 2.9 kg (6.4 lbs) |
| Weight (gross): | 4.0 kg (8.6 lbs) |
| DRAWOUT UNIT | |
| Weight (net): | 3.9 kg (8.6 lbs) |
| Weight (gross): | 5.0 kg (11.0 lbs) |

| OPERATING ENVIRONMENT | |
|---|---|
| Ambient operating temperature: | -40°C to +60°C [-40°F to +140°F] |
| Ambient storage / shipping temperature: | -40°C to +85°C [-40°F to +185°F] |
| Humidity: | Operating up to 95% (non condensing) @ 55C (As per IEC 60068-2-30 Variant 2, 6days) |
| Altitude: | 2000m (max) |
| Pollution degree: | II |
| Overvoltage category: | III |
| Ingress Protection: | IP54 Front, IP10 back (IP20 cover is available for drawout version) |
| Noise: | 0 dB |

Ordering

| | 350 | - | * | * | * | * | * | * | * | * | * | * | * | * | * | Description |
|---------------------------------|-----|---|---|----|----|---|---|---|---|---|---|---|---|---|---|--|
| Interface | 350 | | | | | | | | | | | | | | | 350 Feeder Protection System |
| Language ^a | | | E | | | | | | | | | | | | | English without programmable LEDs |
| | | | L | | | | | | | | | | | | | English with programmable LEDs |
| Phase Currents ^b | | | | PX | | | | | | | | | | | | No CT |
| | | | | P0 | | | | | | | | | | | | 1 A or 5 A configurable phase current inputs |
| | | | | P1 | | | | | | | | | | | | 1 A 3-phase current inputs |
| | | | | P5 | | | | | | | | | | | | 5 A 3-phase current inputs |
| Ground Currents ^c | | | | | GX | | | | | | | | | | | No CT |
| | | | | | G0 | | | | | | | | | | | 1 A or 5 A configurable ground current inputs |
| | | | | | G1 | | | | | | | | | | | 1 A ground current input |
| | | | | | G5 | | | | | | | | | | | 5 A ground current input |
| | | | | | S0 | | | | | | | | | | | 1 A or 5A configurable sensitive ground current inputs |
| | | | | | S1 | | | | | | | | | | | 1 A sensitive ground current input |
| | | | | | S5 | | | | | | | | | | | 5 A sensitive ground current input |
| Power Supply | | | | | | L | | | | | | | | | | 24 to 48 V DC |
| | | | | | | H | | | | | | | | | | 125 to 250 V DC/120 to 240 V AC |
| Input/Output | | | | | | | E | | | | | | | | | 10 Inputs, 7 Outputs (2 Form A, 5 Form C) |
| | | | | | | | A | | | | | | | | | Arc Flash: 10 Inputs, 5 Outputs (2 Form A, 3 Form C), 2 SSRs, 4 Light Sensor Inputs |
| Current Protection ^d | | | | | | | | N | | | | | | | | None (voltage and frequency relay, requires a PX/GX configuration) |
| | | | | | | | | E | | | | | | | | Extended configuration: 49, 50P(2), 50G/SG(2), 50N(2), 51P(1), 51G/SG(1), 51N(1) |
| | | | | | | | | M | | | | | | | | Advanced configuration: Extended + 51_2 or 46(1), 50_2 (1) or 46(1), 11/12(46BC) |
| Control | | | | | | | | | N | | | | | | | CLP, Lockout (86) |
| | | | | | | | | | C | | | | | | | CLP, 50BF, Lockout (86), Autoreclose (79) |
| Other Options | | | | | | | | | | N | | | | | | No selection |
| | | | | | | | | | | V | | | | | | 27P(4), 27X(1), 27P_1(1), 59P(4), 59N(4), 59X(1), 59_2(2), 81O(4), 81U(4), 25(1), VTFF(1), 24(1), Voltage Metering (requires a PX/GX configuration) |
| | | | | | | | | | | D | | | | | | Neutral and Ground Directional Overcurrent Protection: 67N(1), 67G/SG(1), 60CTS |
| | | | | | | | | | | M | | | | | | Voltage, Power, and Energy Metering, 60CTS |
| | | | | | | | | | | R | | | | | | Phase, Neutral, and Ground Directional Overcurrent Protection: 67P(1), 67N(1), 67G/SG(1), 32N(2), VTFF + Voltage, Power, and Energy Metering, 60CTS |
| | | | | | | | | | | P | | | | | | Extended Protection: 27P(2), 27X(1), 27P_1 (1), 59P(2), 59N(1), 59X(1), 59_2(1), 81O(2), 81U(2), 67P(1), 67N(1), 67G/SG(1), VTFF(1), + Voltage, Power, and Energy Metering, 25(1), 60CTS |
| | | | | | | | | | | W | | | | | | Advanced Protection: Extended + 32(2) |
| Communications ^e | | | | | | | | | | | S | N | | | | Standard: Front USB, Rear RS485: Modbus RTU, DNP3.0, IEC60870-5-103 |
| | | | | | | | | | | | 1 | E | | | | Standard + Ethernet (Copper & Fiber - MTRJ), Modbus TCP/IP, DNP3.0, IEC 60870-5-104 |
| | | | | | | | | | | | 3 | E | | | | Standard + Ethernet (Copper & Fiber - MTRJ), Modbus TCP/IP, DNP3.0, IEC 60870-5-104, IEC 61850 |
| | | | | | | | | | | | 4 | E | | | | Standard + Ethernet (Copper & Fiber - MTRJ), Modbus TCP/IP, DNP3.0, IEC 60870-5-104, IEC 61850, OPC-UA |
| | | | | | | | | | | | 5 | E | | | | Standard + Ethernet (Dual Fiber - MTRJ), Modbus TCP/IP, DNP3.0, IEC 60870-5-104, IEC 61850, OPC-UA, PRP, HSR, 1588 |
| Case Design | | | | | | | | | | | | | D | | | Protection Relay with drawout design |
| | | | | | | | | | | | | | N | | | Protection Relay with non-drawout design |
| | | | | | | | | | | | | | X | | | Protection Relay (drawout design) with no chassis |
| Harsh Environment | | | | | | | | | | | | | | N | | None |
| | | | | | | | | | | | | | | H | | Harsh Environment Conformal Coating |

Ordering Notes:

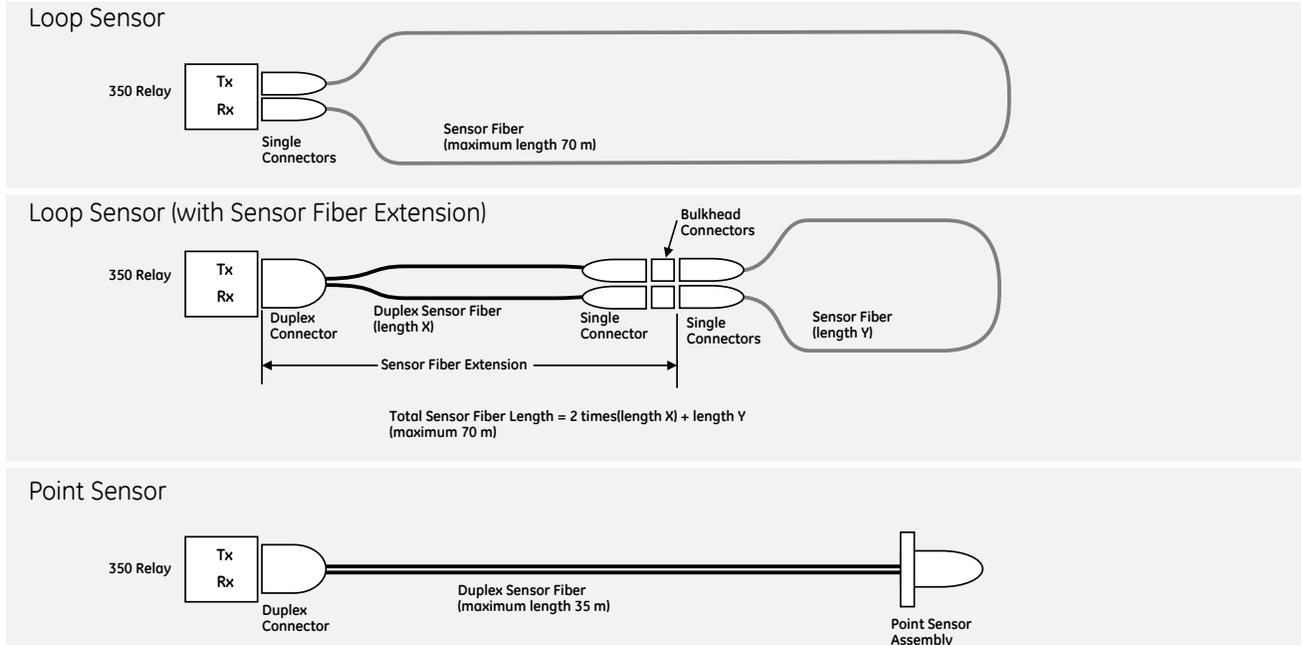
- ^a Phase current options "PX/P0" and Ground current options "GX/G0" are only available with the non-drawout Case Design "N".
- ^b Ground currents "G1/G5" and "S1/S5" must match the corresponding "P1/P5" Phase currents (i.e. 5A and 1A must not be mixed).
- Ground current "GX" must match the "PX" Phase current, and is only available with the non-drawout Case Design "N". Current protection "N", other options "V" and inputs/outputs "E"
- Ground current "G0/S0" must match the "P0" Phase current, and is only available with the non-drawout Case Design "N".
- ^c Current protection option "S" has been discontinued.
- ^d Communications option "4E" allows the selection of either IEC 61850 or OPC-UA; both cannot be used at the same time.
- ^e Communications option "5E" is only available with the drawout Case Design "D" or "X".
- ^f Arc Flash option "A" is only available with case design "N". Not available in PXGX configurations

Note: refer to the instruction manual for arc flash sensors and accessories.

| | CH | * | * | * | * | * | * | Description |
|------------------------------|----|----|----|---|---|---|---|--|
| Phase Currents | | P1 | | | | | | 1 A 3-phase CTs (Winding 1 - 1 A, Winding 2 - 1 A) |
| | | P5 | | | | | | 5 A 3-phase CTs (Winding 1 - 5 A, Winding 2 - 5 A) |
| Ground Currents ^a | | | G1 | | | | | 1 A standard ground CTs (Winding 1 - 1 A, Winding 2 - 1 A) |
| | | | G5 | | | | | 5 A standard ground CTs (Winding 1 - 5 A, Winding 2 - 5 A) |
| | | | S1 | | | | | 1 A sensitive ground CTs (Winding 1 - 1 A, Winding 2 - 1 A) |
| | | | S5 | | | | | 5 A sensitive ground CTs (Winding 1 - 5 A, Winding 2 - 5 A) |
| Other Options | | | | N | | | | No selection |
| | | | | D | | | | Neutral and Ground Directional Overcurrent Protection: 67N(1), 67G/SG(1), 60CTS |
| | | | | M | | | | Voltage, Power, and Energy Metering, 60CTS |
| | | | | R | | | | Phase, Neutral, and Ground Directional Overcurrent Protection: 67P(1), 67N(1), 67G/SG(1), 32N(2), VTFF + Voltage, Power, and Energy Metering, 60CTS |
| | | | | P | | | | Extended Protection: 27P(2), 27X(1), 27P_1 (1), 59P(2), 59N(1), 59X(1), 59_2(1), 81O(2), 81U(2), 67P(1), 67N(1), 67G/SG(1), VTFF(1), 25(1), 60CTS, Voltage, Power, and Energy Metering |
| | | | | W | | | | Advanced Protection: Extended + 32(2) |
| Communications ^b | | | | S | N | | | Standard: Front USB, Rear RS485: Modbus RTU, DNP3.0, IEC60870-5-103 |
| | | | | 1 | E | | | Standard + Ethernet (Copper & Fiber - MTRJ), Modbus TCP/IP, DNP3.0, IEC 60870-5-104 |
| | | | | 3 | E | | | Standard + Ethernet (Copper & Fiber - MTRJ), Modbus TCP/IP, DNP3.0, IEC 60870-5-104, IEC 61850 |
| | | | | 4 | E | | | Standard + Ethernet (Copper & Fiber - MTRJ), Modbus TCP/IP, DNP3.0, IEC 60870-5-104, IEC 61850, OPC-UA |
| | | | | 5 | E | | | Standard + Ethernet (Dual Fiber - MTRJ), Modbus TCP/IP, DNP3.0, IEC 60870-5-104, IEC 61850, OPC-UA, PRP, HSR, 1588 |
| Harsh Environment | | | | | | N | | None |
| | | | | | | H | | Harsh Environment Conformal Coating |

- ^a Ground current options "G1/G5" must match the corresponding "P1/P5" Phase currents
- ^b Communications option "4E" allows the selection of either IEC 61850 or OPC-UA; both cannot be used at the same time.

Loop Sensor



| AFC | - | * | * | Description |
|---------------------|---|----|---|--|
| AF System Component | E | | | Sensor Fiber Extension (black sensor fiber with two single bulkhead connectors, used with loop sensors) |
| | L | | | Loop Sensor with transparent sensor fiber |
| | P | | | Point Sensor with black sensor fiber |
| Sensor Fiber Length | | XX | | Sensor fiber length: 01 to 35 meters for Point Sensors and Extensions 01 to 70 meters for Loop Sensors |

Note: The length of the sensor fiber extension is duplex (double the path), and the total length of transparent fiber loop sensor and sensor fiber extension cannot exceed 70m; i.e. $xx + (2 \times yy) \leq 70$. For example, a loop sensor with a 25 meter transparent sensor fiber plus a sensor fiber extension of 10 meters would have a total of $2 \times 10m + 25m = 45m$ of single sensor fiber.

Related Products / Accessories

- | | |
|---|-----------------|
| • MultiSync 100 - GPS Clock | MultiSync100-P |
| • 350 Retrofit Kit For 735 | 1819-0103 |
| • 350 Retrofit Kit For IAC Relay | 1819-0102 |
| • 350 Retrofit Kit For MDP Relay | 1819-0101 |
| • 350 Retrofit Kit For S1/S2 Cut-Out | 1819-0100 |
| • SR3 Depth reducing collar - 1.375" | 18L0-0076 |
| • SR3 Depth reducing collar - 3.00" | 18L0-0075 |
| • SR3 IP20 Kit | 18L0-0080 |
| • SR3 Non-drawout Straight Terminal Block Kit | 3S-NDO-STCONKIT |
| • USB A-B configuration cable (6') | 0804-0458 |

Note: refer to the instruction manual for relay without chassis order codes.



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GE
Grid Solutions

Multilin 850

Innovative Feeder, Bay controller / One Box Solution for Industrial and Utility Applications

The Multilin™ 850 relay is a member of the Multilin 8 Series protective relay platform and has been designed for the management, protection and control of feeder applications. The Multilin 850 is used to provide primary (main) or backup protection for underground and overhead feeders for utility and industrial power networks.

With 12 Switchgear control elements, fully configurable Single Line Diagram on a large color graphical display, 36 alarm integrated annunciator panel and 20 push buttons makes this an ideal choice for Bay controller "One Box Solution for electrical systems."

Designed with advanced communications options and detailed asset monitoring capabilities, the Multilin 850 provides advanced functionality, including high-performance protection, extensive programmable logic and flexible configuration capabilities. With support for industry leading communications protocols and technologies, the 850 provides easy integration into new or existing SCADA or DCS for enhanced situational awareness.

Key Benefits

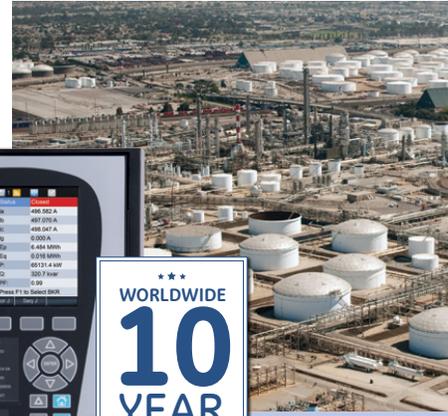
- One Box Solution with advanced logic and configuration flexibility to provide comprehensive primary or backup protection, control and monitoring of electrical power systems.
- User Configurable Single Line Diagram with color display for local control, system status, and metering.
- Advanced breaker diagnostics with high-end fault and disturbance recording
- Integrated arc flash detection using light sensors supervised by overcurrent to reduce incident energy and equipment damage
- High-end cyber security such as AAA, Radius, RBAC, and Syslog enabling NERC® CIP requirements
- Draw-out design simplifies testing, commissioning and maintenance, thereby increasing process uptime
- Optional Wi-Fi connectivity minimizes system configuration and provides safe relay programming and diagnostic retrieval
- Patented environmental monitoring, providing visibility to changes in environmental conditions that can affect relay life

Applications

- Wide range of feeder applications for utility, oil & gas, mining & metals, process industry, commercial, and waste water
- Comprehensive protection and management of incoming and outgoing feeders
- Fast protection pass enables use for load shedding schemes
- Advanced communications and flexlogic for reliable automatic bus transfer & auto-recloser schemes
- Bay controller for wide range of switchgear applications
- High speed fault detection for arc flash mitigation



imagination at work



Innovative Technology & Design

- Advanced feeder One Box Solution for protection, control monitoring and diagnostics of electrical systems
- Patented environmental monitoring and diagnostics
- Advanced, flexible and embedded communications: IEC@ 61850 Ed2,
- IEC 62439/PRP, Modbus® RTU & TCP/IP, DNP3.0, IEC 60870-5-104, IEC 60870-5-103
- Single setup and configuration across the platform
- Field swappable power supply
- Enhanced relay draw-out construction
- Elimination of electrolytic capacitors

Exceptional Quality & Reliability

- IPC A-610-E Class 3 manufacturing standards
- Highest reliability standards for electronics testing
- 100% Environmental Stress Screening and full functional testing
- Rated for IP54 (front) applications
- Standard Harsh Conformal Coating

Uncompromising Service & Support

- Covered under GE's 10 year warranty plan
- Designed, tested and assembled by GE

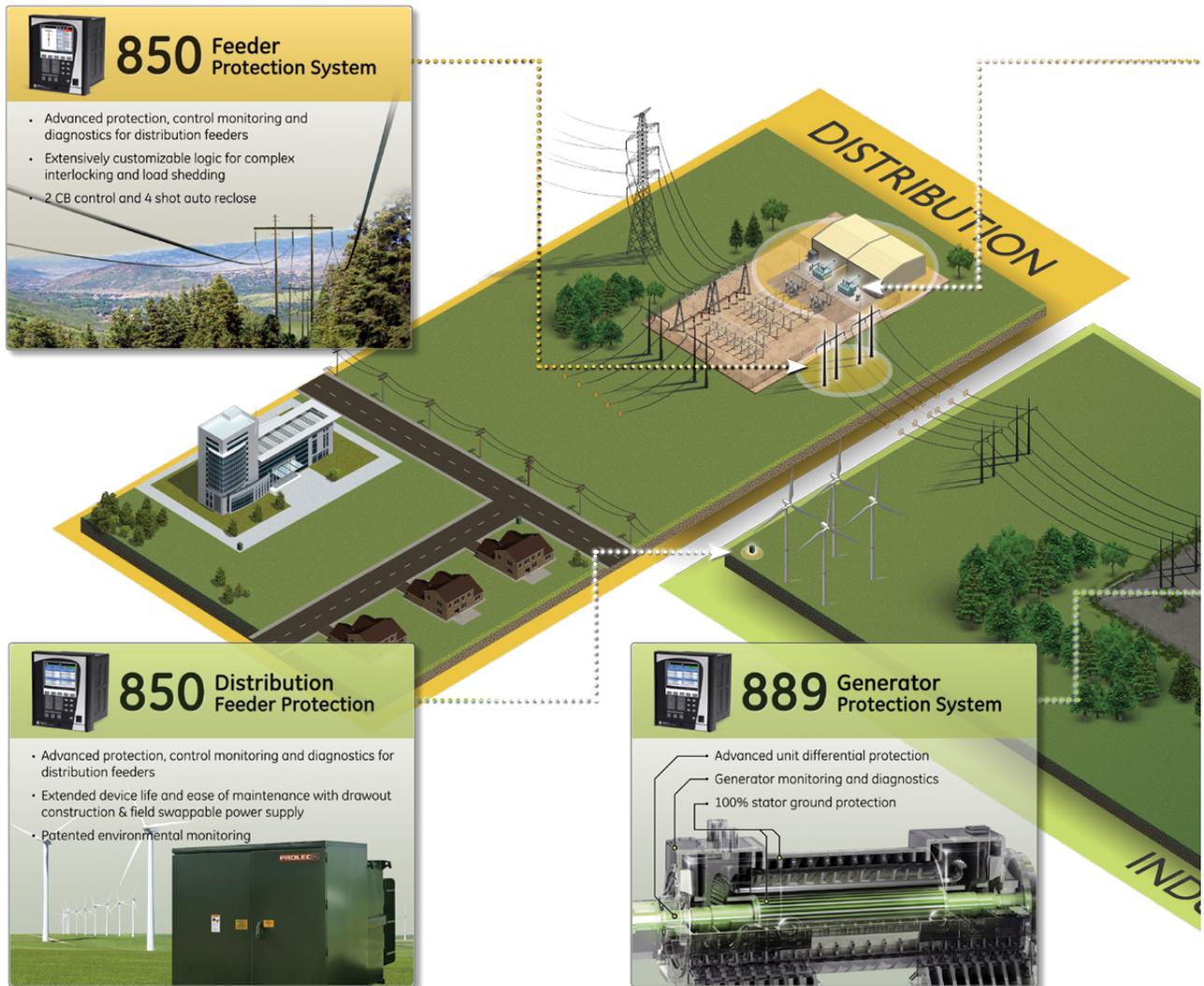
850 Feeder Protection System

Multilin 8 Series Platform Overview

From oil pumping and refining facilities, to open pit or underground mining and processing operations, to large or small utilities, customers demand solutions that ensure maximum process uptime, minimum operational and maintenance efforts, and have the durability to withstand harsh environmental conditions.

The Multilin 8 Series is GE's next-generation protection and control relay platform that provides comprehensive protection and asset monitoring for critical feeders, motors, generators, and transformers.

Multilin 8 Series Platform - Application Example



850 Feeder Protection System

The Multilin 8 Series is designed to solve challenges that customers face in running their day-to-day operations including maximizing system and process uptime, simplifying system integration and maintenance, and extending the life of critical assets. GE is raising the bar on system performance and reliability.

With advanced communications the Multilin 8 Series integrates easily and seamlessly into new or existing DCS/SCADA system, along with other Multilin protection devices, providing a comprehensive solution for the end-to-end electrical system within the operations.



850 Feeder Protection System

Exceptional Quality & Reliability

Industry-leading quality, reliability and design processes are at the core of GE's next generation protective relay platform. With significant investments in state-of-the-art type test facilities that simulate a complete range of operating environments and designed to the IPC A-610 Class 3 standard, adhering to the highest reliability standards and ensuring rugged performance, each device completes one hundred percent Electrical Stress Screening prior to shipping from GE's facility.

The Multilin 8 Series Protection Relays are manufactured in an ISO@ 9001:2008 certified manufacturing facility.

Pioneering Technology & Design

The Multilin 850 is part of the 8 Series platform that provides comprehensive, high performance protection, control, monitoring and diagnostics for critical assets in Industrial and utility environment.

Utilizing decades of experience, GE has implemented ease-of-use features, such as single screen set-ups delivering faster feeder configuration, configurable scheme logic that eliminates the need for complex end-user programming, driving quicker setup times, decreased implementation costs and reduced points of failure.

The Multilin 8 Series products have an integrated protection integrity engine that utilizes customized algorithms, providing advanced diagnostics to ensure asset protection is not compromised.

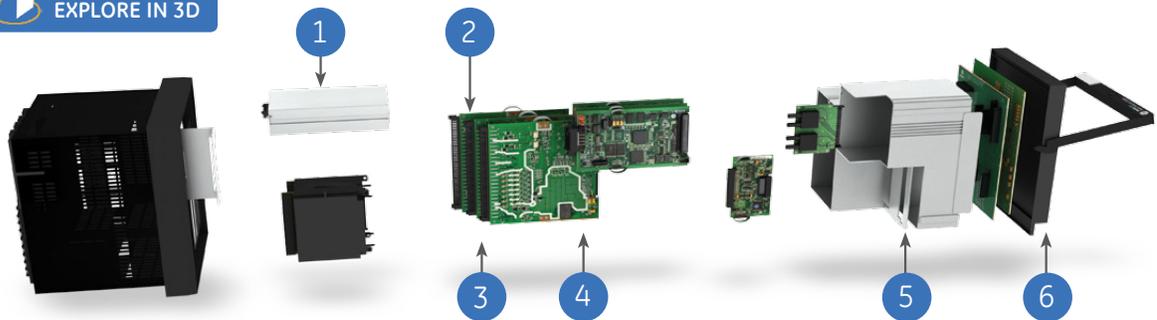
Maintaining and safeguarding the electrical supply of an operation is critical to ensuring maximum process availability and performance.

The 8 Series incorporates the latest cyber security features, including password complexity, RADIUS authentication, role-based access control (RBAC), customers to comply with NERC CIP and NISTIR 7628 requirements.

Understanding that customers need protection and control devices that must reliably operate in extremely harsh and challenging environments, GE delivers the Multilin 850 with harsh conformal coating on all printed circuit boards and a patented environmental awareness module that provides real-time detection of environmental factors that affect product life, as part of its standard offering, delivering higher reliability and extended relay life.

Uncompromised Service and Support

In addition to the superior technology and innovative design advancements that enable delivery of uncompromised performance and reliability, the Multilin 8 Series is also backed by GE's 10-year warranty plan.



- 1 Field Swappable Power Supply**
Extends the usable life of the protection relay and minimizes costly, time consuming replacement and re-configuration
- 2 Harsh Environment Conformal Coating**
Standard on all printed circuit boards delivering higher reliability and extended relay life
- 3 No Electrolytic Capacitors**
Increasing quality and reliability for continuous plant operations by removing high failure components (excluding low voltage power supply)
- 4 IPC A-610 Class 3 Manufacturing**
Drives to the highest level of reliability standards delivering rugged performance
- 5 Robust Extruded Aluminum Chassis**
Custom-designed extruded aluminum chassis delivering optimal operating performance with optimal heat dissipation
- 6 Draw-Out**
Providing simplified device fleet management

850 Feeder Protection System

Multilin 850 Overview

The Multilin 850 is an advanced feeder protection device designed for high performance, protection, control and monitoring of incoming and outgoing feeders.

With 21 digital inputs and 15 digital outputs in a compact box, the 850 provides a versatile and cost effective control, protection, measurement & monitoring solution. The Flexlements and Flexlogic enables users to customize various schemes to meet variety of applications.

For main-tie-main and main-standby configurations, the Multilin 850 delivers a more economical and reliable solution, enabling customers to reduce hardware requirements and simplify device integration, including safe and secure Wi-Fi communications for system configuration and diagnostics.

Bay Controller/One Box Solution

The 850 offers comprehensive switchgear control aided by a Single Line Diagram & breaker control. A total of 10 switchgear elements can be displayed and 8 elements controlled. The integrated solution for protection, control, monitoring and diagnostics eliminates the need for other external devices thus offering an integrated solution for switchgear systems. The device supports 6 user programmable pages.

Switchgear Control and Configurable SLD

The Multilin 850 provides a configurable dynamic SLD up to six (6) pages for comprehensive switchgear control of up to 3 breakers and 9 disconnect switches; including interlocks. Up to 15 digital and metering status elements

can be configured per SLD page. These can be configured to show breakers, switches, metering, and status items.

Individual SLD pages can be selected for the default home screen pages. Automatic cycling through these pages can also be achieved through default screen settings.

The provision of such powerful control and display capability within the relay ("One Box concept) eliminates the need for external controls, switches and annunciation on the panel reducing equipment and engineering cost.

Annunciator panel and virtual PBs

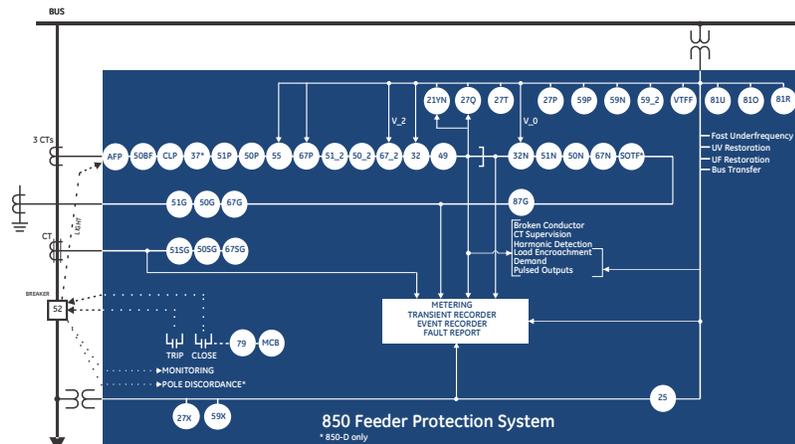
The Multilin 850 offers a configurable annunciator panel that can be constructed to show up to 36 alarms in either self-reset mode or latched mode per ISA 18.1 standard similar to a physical annunciator panel; eliminating the need for physical one. The alarms can be displayed on the front panel in a configurable grid layout of 2x2 or 3x3.

The Multilin 850 extends the local control functionalities with 20 virtual pushbuttons that can be assigned for various functions. Each programmable pushbutton has its own programmable LED which can be used to acknowledge the action taken by the tab pushbutton.

With a fast protection pass, running every 2 msec, the 850 relay provides faster response to current, voltage, power, and frequency protection elements; helping reduce stress on assets. The Multilin 850 supports the latest communication protocols, including DNP, ModBus, IEC 60870-5-103, IEC 62439/PRP and IEC 61850; facilitating easy integration into new or existing SCADA/DCS networks, integrates into new or existing networks.

Functional Block Diagram

| ANSI DEVICE | DESCRIPTION |
|-------------|--|
| 21 YN | YN Neutral Admittance |
| 25 | Syncheck |
| 27P | Phase Undervoltage |
| 27Q | UV Reactive Power |
| 27T | Timed Undervoltage Protection |
| 27X | Auxiliary Undervoltage |
| 32 | Directional Power |
| 32N | Wattmetric Ground Fault (Wattmetric zero sequence directional) |
| 37* | Undercurrent |
| 49 | Thermal Overload |
| 50BF | Breaker Failure |
| 50G | Ground Instantaneous Overcurrent |
| 50SG | Sensitive Ground Instantaneous Overcurrent |
| 50N | Neutral Instantaneous Overcurrent |
| 50P | Phase Instantaneous Overcurrent |
| 50_2 | Negative Sequence Instantaneous Overcurrent |
| 51G | Ground Time Overcurrent |
| 51SG | Sensitive Ground Time Overcurrent |
| 51N | Neutral Time Overcurrent |
| 51P | Phase Time Overcurrent |
| 51_2 | Negative Sequence Time Overcurrent |
| 52 | AC Circuit Breaker Pole Discordance |
| 55 | Power Factor |
| 59N | Neutral Overvoltage |
| 59P | Phase Overvoltage |
| 59X | Auxiliary Overvoltage |
| 59_2 | Negative Sequence Overvoltage |



| ANSI DEVICE | DESCRIPTION |
|-------------|---------------------------------------|
| 67G | Ground Directional Element |
| 67SG | Sensitive Ground Directional Element |
| 67N | Neutral Directional Element |
| 67P | Phase Directional Element |
| 67_2 | Negative Sequence Directional Element |
| 79 | Automatic Recloser |
| 81O | Overfrequency |
| 81U | Underfrequency |

| ANSI DEVICE | DESCRIPTION |
|-------------|----------------------------------|
| 81R | Frequency Rate of Change |
| 87G | Restricted Ground Fault (RGF) |
| AFP | Arc Flash Protection |
| CLP | Cold Load Pickup |
| 11/12 | Broken Conductor |
| MCB | Manual Close Blocking |
| SOTF* | Switch Onto Fault |
| VTF | Voltage Transformer Fuse Failure |

850 Feeder Protection System

Protection & Control

As part of the 8 Series family, the Multilin 850 provides superior protection and control. The 850 offers comprehensive protection and control solutions for incoming, outgoing bus-tie/bus-coupler feeders. It contains a full range of selectively enabled, self-contained protection and control elements.

The voltage and frequency protection functions detect abnormal system conditions, potentially hazardous to the system. Some of these conditions may consist of over and undervoltage, over and underfrequency, and phase reversal.

Fast Underfrequency

The 850 has an 8 stage Fast Underfrequency element that measures frequency by detecting the consecutive voltage zero crossings and measuring the time between them. The measured frequency has the range between 20 to 70 Hz. This is useful for performing fast load shedding when frequency variations from unbalance conditions arise due to:

- Inadequate load forecast or deficient generation capacity programming.
- Busbars, generator group or interconnection feeders trip.
- System splits into islands.

FlexCurves™

For applications that require greater flexibility, FlexCurves can be used to define custom curve shapes. These curves can be used to coordinate with other feeders to achieve fault selectivity.

RTD Protection

The Multilin 850 supports up to 13 programmable RTD inputs that can be configured for an Alarm or Trip.

The RTDs can be assigned to a group for monitoring ambient temperatures or any other desired temperature. The RTD voting option gives additional reliability to ignore any RTD failures.

Integrated Arc Flash Protection

The Multilin 8 Series supports an integrated arc flash module providing constant monitoring of an arc flash condition within the switchgear, motor control centers, or panelboards. With a 2ms protection pass, the 8 Series is able to detect light and overcurrent using 4 arc sensors connected to the 8 Series relay. In situations where an arc flash/fault does occur, the relay is able to quickly identify the fault and issue a trip command to the associated breaker thereby reducing the total incident energy and minimizing resulting equipment damage.

Self-monitoring and diagnostics of the sensors ensures the health of the sensors as well as the full length fiber cables. LEDs on the front panel display of the 850 can be configured to indicate the health of the sensors and its connections to the relay.



MV Switchgear or Motor Control Center

Multilin 8 Series

Fast, reliable arc flash protection with light-based arc flash sensors integrated within the Multilin 8 Series of protection & control devices. With arc flash detection in as fast as 2msec, the costs associated with equipment damage and unplanned downtime is significantly reduced.

Inputs and Outputs

The 850 provides a max of 21 Digital inputs and 15 Digital outputs with an option for 7 Analog Outputs (dc mA), 4 Analog Inputs (dc mA), 1 RTD input. The configurable analog inputs can be used to measure quantities fed to the relay from standard transducers. Each input can be individually set to measure 4-20 mA, 0-20 mA or 0-1 mA transducer signals.

The 850 can also be set to issue trip or alarm commands based on signal thresholds. The configurable analog outputs can be used to provide standard transducer signals to local monitoring equipment. The analog outputs can be configured to provide outputs based on measured analog values, or calculated quantities.

An optional general purpose transducer input allows a user-defined quantity to be monitored and used as part of the protection as defined by FlexLogic™.

Advanced Automation

The Multilin 850 incorporates advanced automation capabilities that exceeds what is found in most feeder protection relay. This reduces the need for additional programmable controllers or discrete control relays including programmable logic, communication, and SCADA devices. Advanced automation also enables seamless integration of the 850 into other protection or process systems (SCADA or DCS).

FlexElements™

FlexElement is a universal comparator, that can be used to monitor any (analog) actual value measured or calculated by the relay, or a net difference of any two analog (actual) values of the same type.

The element can be programmed to respond either to a signal level or to a rate-of-change (delta) over a pre-defined period of time.

This can be used to generate special protection or monitoring functions that can enable the user to flag user defined abnormality that gives better visibility to a certain condition.

FlexLogic™

FlexLogic is the powerful programming logic engine that provides the ability to create customized protection and control schemes, minimizing the need and associated costs of auxiliary components and wiring. Using FlexLogic, the 850 can be programmed to provide the required tripping logic along with custom scheme logic for feeder control interlocking schemes with adjacent protections (for example, preventing sympathetic tripping of healthy feeders), and dynamic setting group changes.

Monitoring & Diagnostics

The Multilin 850 includes high accuracy metering and recording for all AC signals. Voltage, current, and power metering are built into the relay as a standard feature. Current and voltage parameters are available as total RMS magnitude, and as fundamental frequency magnitude and angle.

Breaker Health Monitoring

The breaker is monitored by the relay not only for detection of breaker failure, but also for the overall “breaker health” which includes:

- Breaker close and breaker open times
- Trip circuit monitoring
- Spring charging time
- Per-phase arcing current
- Trip counters

All algorithms provide the user with the flexibility to set up initial breaker trip counter conditions and define the criteria for breaker wear throughout a number of set points.

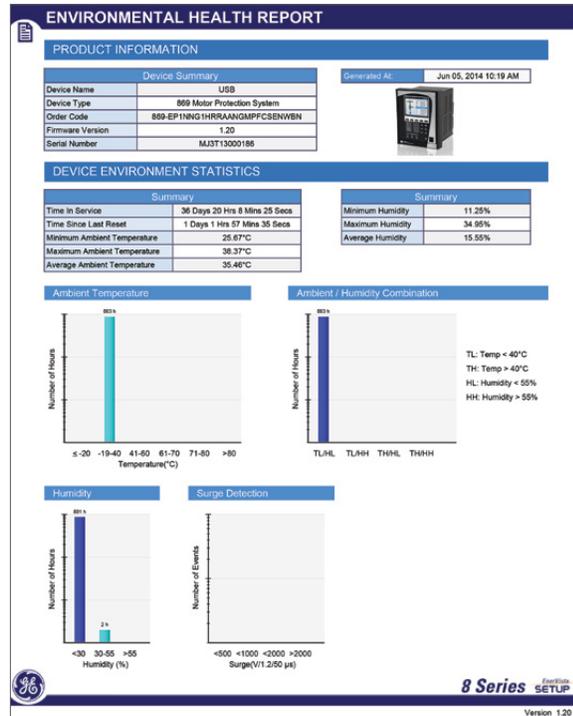
| SETTING | PARAMETER |
|-------------------------|-----------|
| Total Breaker Trips | 12 |
| Trips Since Last Reset | 9 |
| Alarm Counter | 4 |
| Last Trip Time | 2512 ms |
| Avg. of 5 Trip Time | 1842 ms |
| Avg. of Trip Time | 1856 ms |
| Last Close Time | 725 ms |
| Avg. of 5 Close Time | 948 ms |
| Avg. of Close Time | 1217 ms |
| Last PH A Arc Time | 0 ms |
| Avg. of 5 PH A Arc Time | 0 ms |

USB Records: Breakers

Multilin 8 Series Breaker Health Report available on display or via the setup software

Environmental Monitoring

The Multilin 8 Series implements a patented environmental monitoring system that measures and provides operating condition information. Reliable and secure operation of the 850 relay and other electronic devices in the vicinity may be affected by environmental factors. The 850 relay has been designed to meet or exceed all required industry standards, however some operating conditions may be beyond those standards and reduce total lifespan of the device.



Environmental health report is available via Multilin PC Software

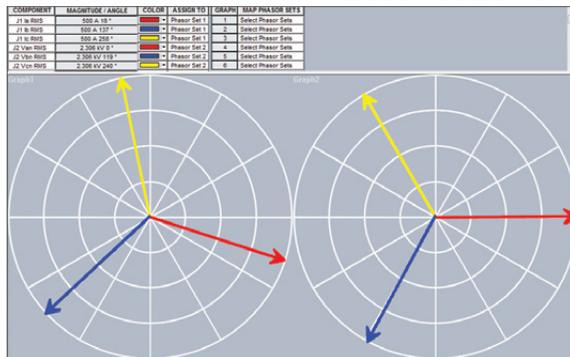
Typical environmental conditions that may affect electronic device reliability include voltage, current density, temperature, humidity, gas, dust, contamination, mechanical stress, shock, radiation, and intensity of electrical and magnetic fields. These environmental factors are different from natural weather conditions at particular installation conditions and are beneficial to monitor. The 8 Series built-in environmental awareness feature (patent “Systems and methods for predicting maintenance of intelligent electronic devices”) collects the histograms of each operating condition from the point the device is put into service. Monitored environmental conditions include temperature, humidity and transient voltage. The histogram of each environmental factor may be retrieved from the diagnostic page accessed through a PC running the EnerVista Multilin 8 Series Setup program

850 Feeder Protection System

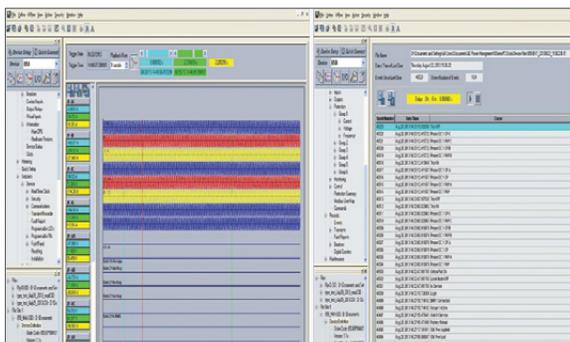
Metering

The Multilin 850 offers high accuracy power quality monitoring for fault and system disturbance analysis. The Multilin 8 Series delivers unmatched power system analytics through the following advanced features and monitoring and recording tools:

- Harmonics measurement up to 25th harmonic for both currents and voltages including THD.
- The length of the transient recorder record ranges from 31 cycles to 1549 cycles, depending on the user specified configuration. This gives the user ability to capture long disturbance records which is critical for some applications.
- 32 digital points and 16 analog values, assigned by the user, can be captured in the COMTRADE format by the transient recorder.
- Comprehensive data logger provides the recording of 16 analog values selected from any analog values calculated by the relay. Capture rates range from 16 ms, 20ms, 1 second, 30 seconds, 1 minute, 30 minutes, or 1 hour rate. This data capture flexibility allows the operator to measure power factor or reactive power flow (for example), for several hours or even days, enabling detailed analysis and corrective action to be taken, if required.
- Detailed Fault Report allows the user to identify the fault location, fault type and element(s) that triggered the 850 to trip. It carries other useful information, such as pre-fault and fault phasors, relay name and model, firmware revision and other details. The 850 stores fault reports for the last 16 events. 1024 Event Recorder chronologically lists all triggered elements with an accurate time stamp over a long period of time. The 850 stores the last 1024 events locally in the relay.



Multilin 850 Phasor viewer



The 850 monitoring system performance with oscillography and event records

Communications

The Multilin 8 Series provides advanced communications technologies for remote data and engineering access, making it easy and flexible to use and integrate into new and existing infrastructures. Direct support for fiber optic Ethernet provides high-bandwidth communications, allowing for low-latency controls and high-speed file transfers of relay fault and event record information. The 850 also supports two independent IP addresses, providing high flexibility for the most challenging of communication networks.

Providing several Ethernet and serial port options and supporting a wide range of industry standard protocols, the 8 Series enables easy, direct integration into DCS and SCADA systems. The 8 Series supports the following protocols:

- IEC 61850 (8 Clients, 4 Logical Devices, Tx & Rx expansion, Analog GOOSE), IEC 62439 / PRP
- DNP 3.0 serial, DNP 3.0 TCP/IP, IEC 60870-5-103, IEC 60870-5-104
- Modbus RTU, Modbus TCP/IP

The 850 has two interfaces as USB front port and Wi-Fi for ease of access to the relay.

Wi-Fi Connectivity:

- Simplify set-up and configuration
- Simplify diagnostic retrieval
- Eliminate personnel in front of switchgear
- WPA-2 security



Cyber Security

The 8 Series delivers a host of cyber security features that help operators to comply with NERC CIP guidelines and regulations.

AAA Server Support (Radius/LDAP)

Enables integration with centrally managed authentication and accounting of all user activities and uses modern industry best practices and standards that meet and exceed NERC CIP requirements for authentication and password management.

Role Based Access Control (RBAC)

Efficiently administrate users and roles within 8 Series. The new and advanced access functions allow users to configure up to three roles for up to eight configurable users with independent passwords. The standard "Remote Authentication Dial in User Service" (Radius) is used for authentication.

Event Recorder (Syslog for SEM)

Capture all cyber security related events within a SOE element (login, logout, invalid password attempts, remote/local access, user in session, settings change, FW update, etc.), and then serve and classify data by security level using standard Syslog data format. This will enable integration with established SEM (Security Event Management) systems.



Cyber Security with Radius Authentication

Software & Configuration

The EnerVista™ suite is an industry-leading set of software programs that simplifies every aspect of using the Multilin 850. EnerVista provides all the tools to monitor the status of the protected asset, maintain the device and integrate the information measured by the Multilin 8 Series, into SCADA or DCS process control systems. The ability to easily view sequence of events is an integral part of the setup software, as postmortem event analysis is critical to proper system management.

EnerVista Launchpad

EnerVista Launchpad is a powerful software package that provides users with all the setup and support tools needed for configuring and maintaining Multilin products. The setup tools within Launchpad allow for the configuration of devices in real-time, by communicating via serial, Ethernet or modem connections, or offline by creating device setting files to be sent to devices at a later time. Included in Launchpad is a document archiving and management system that ensures critical documentation is up-to-date and available when needed.

8 Series Setup Software

8 Series Setup Software is single setup and configuration across the platform and can reduce device setup and configuration time.

Simulation

The 8Series can simulate current and voltage inputs when this feature is enabled. Other test operations are also possible such as LED lamp test of each color and testing of output relays. The simulation feature is provided for testing the functionality of the relay in response to program conditions, without the need of external AC voltage and current inputs. First time users will find this to be a valuable training tool. System parameters such as currents and voltages, phase angles are entered as set points. When placed in simulation mode, the relay suspends reading actual AC inputs, generates samples to represent the programmed phasors, and loads these samples into the memory to be processed by the relay. Both normal and fault conditions can be simulated to exercise a variety of relay features.

1 Easy to Use - Draw-out case



2 Easy to Configure - 1 simple step



3 Detailed Diagnostics



850 Feeder Protection System

Simplified Setup and On-Going Maintenance

The robust 850 streamlines user workflow processes and simplifies engineering tasks, such as configuration, wiring, testing, commissioning, and maintenance. Building on the history of simplified setup and configuration, the 850 Feeder Protection Relay has implemented simplified setup screens to minimize relay setup time. In addition, for local programming, the 850 comes with a fully functional GCP, which allows users to locally monitor the asset.

Ease-of-Use

Continuing its legacy in providing easy-to-use protective relay solutions, the 850 is designed to minimize product and system configurability requirements, for quicker physical installations, easier and simplified setup and configuration.

Full Color Graphical HMI Front Display

A large, full color Graphic Control Panel (GCP) ensures clear representation of critical status and measurements. When the keypad and display are not being used, the GCP will automatically revert to screen saver mode, which will turn off the display until one of the local pushbuttons is pushed.

The 850 front panel provides 14 LED indicators and 3 LED pushbutton indicators. 10 LED's are user-programmable, while "In service" and "Pickup" LED's are non-programmable. "Trip" and "Alarm" LED's are not color programmable but can be assigned with selected operands.

The GCP can be used to view device and system status, alarms and event logs, and metering information. The GCP and navigation keys simplify relay configuration and setup, allowing users to make setting changes directly through the front panel. Up to six user-defined pages are available in the home menu.

LED Indicators for Quick Status Indication

The front panel includes user configurable LED's. Each LED can be completely configured and named based on the application and user requirements. The color of each indicator conveys its importance.

G = Green: General Condition

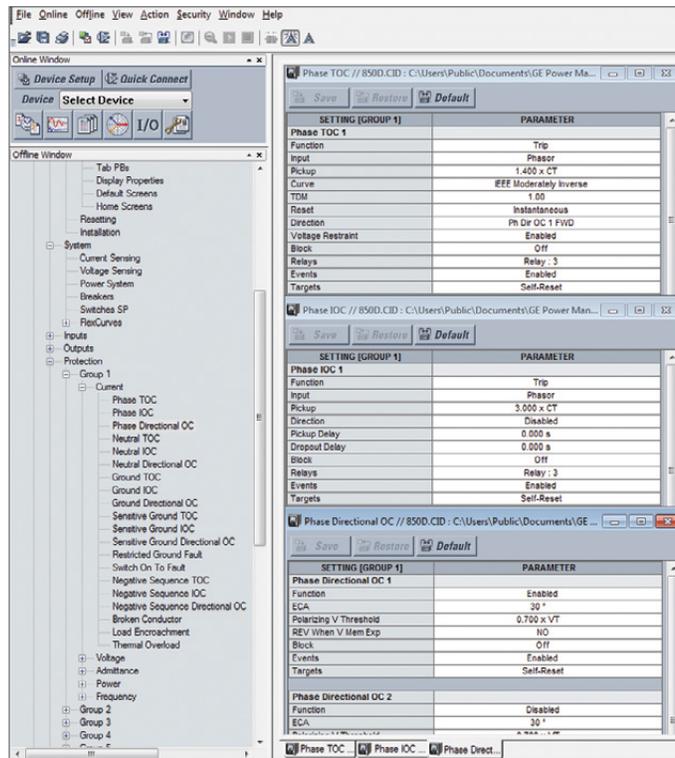
A = Amber: Alert Condition

R = Red: Serious Alarm or Important Status

User-programmable LED's can be turned on by a selection of FlexLogic operands representing protection, control or monitoring elements. Each LED can be configured to be self-reset or latched and labeled based on the application and user requirements. User-programmable LED's can be selected to be either Red, Green or Orange to give the distinctive indication of selected operations.

| GROUP 1 | | | | |
|---------------------------|--------------------------|-------------------------------------|-------------------------------------|--------------|
| PROTECTION ELEMENTS | R2 | R3 | R4 | FUNCTION |
| Phase TOC 1 | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Trip |
| Phase IOC 1 | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Trip |
| Phase Directional OC 1 | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Enabled |
| Neutral TOC 1 | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Trip |
| Neutral Directional OC 1 | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Enabled |
| Restricted Ground Fault 1 | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Trip |
| Switch On To Fault 1 | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Trip |
| Negative Sequence TOC 1 | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Trip |
| Neg Seq Directional OC 1 | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Enabled |
| Broken Conductor 1 | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Trip |
| Load Encroachment 1 | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Enabled |
| Phase UV 1 | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | Trip |
| Auxiliary UV 1 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Trip |
| Neutral Admittance 1 | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Trip |
| Fast Underfreq 1 | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | Trip |
| Fast Underfreq 2 | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | Trip |
| MONITORING ELEMENTS | R2 | R3 | R4 | FUNCTION |
| Trip Circuit Monitoring | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Configurable |
| Close Circuit Monitoring | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Configurable |
| Breaker 1 Arcing Current | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Configurable |
| Breaker Health | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Configurable |
| Harmonic Detection 1 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Configurable |
| Harmonic Detection 2 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Configurable |
| CONTROL ELEMENTS | R2 | R3 | R4 | FUNCTION |
| Pole Discordance 1 | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Configurable |
| Trip Bus 1 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Trip |
| UV Restoration 1 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Configurable |
| UF Restoration 1 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Configurable |
| CT Supervision 1 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Configurable |
| VT Fuse Failure 1 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Configurable |

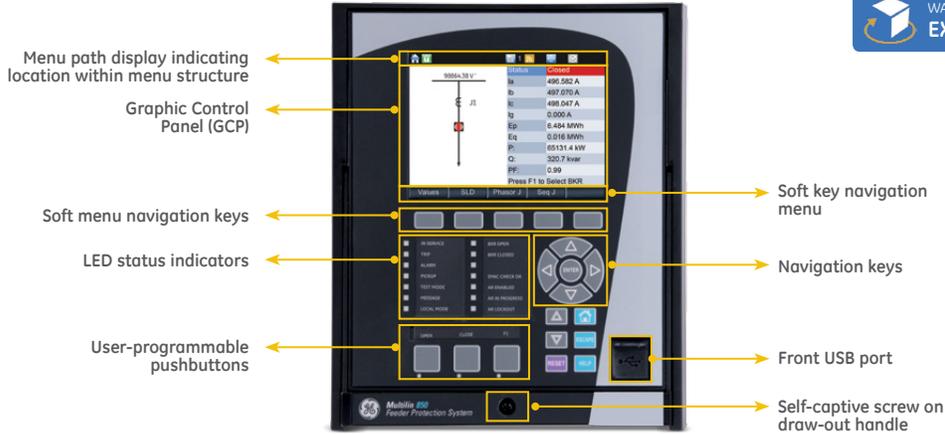
Multilin 850 Protection Summary



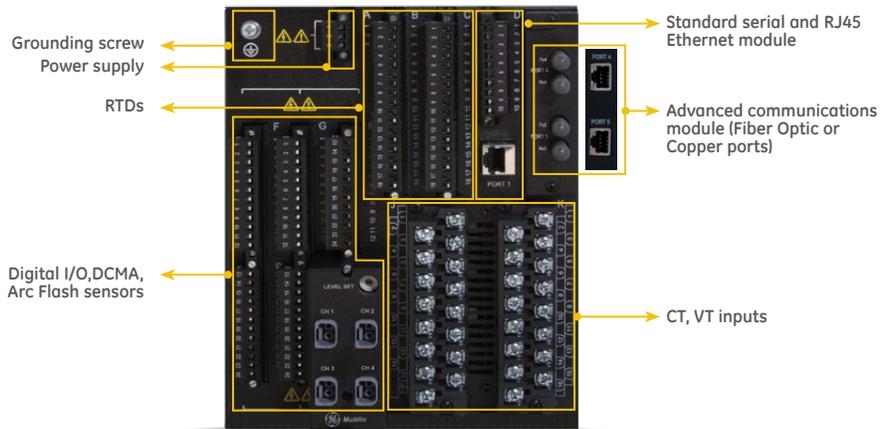
Multilin 850 Settings

850 Feeder Protection System

Front View



Rear View



Optional IP20 cover available

Dimensions & Mounting



Retrofit Existing Multilin SR Devices in Minutes

Traditionally, retrofitting or upgrading an existing relay has been a challenging and time consuming task often requiring re-engineering, panel modifications, and re-wiring. The Multilin 8 Series Retrofit Kit provides a quick, 3-step solution to upgrade previously installed Multilin SR 735 or 750/760 protection relays, reducing upgrade costs.

With the new 8 Series Retrofit Kit, users are able to install a new 850 Feeder Management System without modifying existing panel or switchgear cutouts, re-wiring, or need for drawing changes and re-engineering time and cost.

With this three-step process, operators are able to upgrade existing SR relays in as fast as 21 minutes, simplifying maintenance procedures and reducing system downtime. The Compatibility mode enables the user to change the Modbus actual value registers to emulate the SR 735 or 750/760 relay. This eliminates the downtime required to change the Modbus address in SCADA/DCS.

1



Update Settings File

EnerVista 8 Series Setup Software provides automated setting file conversion with graphical report to quickly and easily verify settings and identify any specific settings that may need attention.

2



Replace Relay

Simply remove the terminal blocks and then remove the SR chassis from the panel. No need to disconnect any of the field wiring.

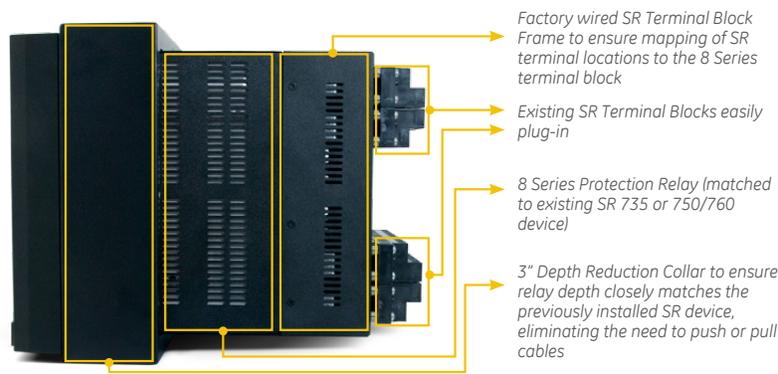
3



Plug & Play Reconnection

Insert the new 8 Series Retrofit chassis into the switchgear and simply plug-in the old terminal blocks - there is no need to make any cut-out modifications or push and pull cables.

The 8 Series Retrofit Kit comes factory assembled and tested as a complete unit with the 8 Series protection device and includes replacement hardware (terminal blocks and screws) if the existing hardware is significantly aged or damaged.



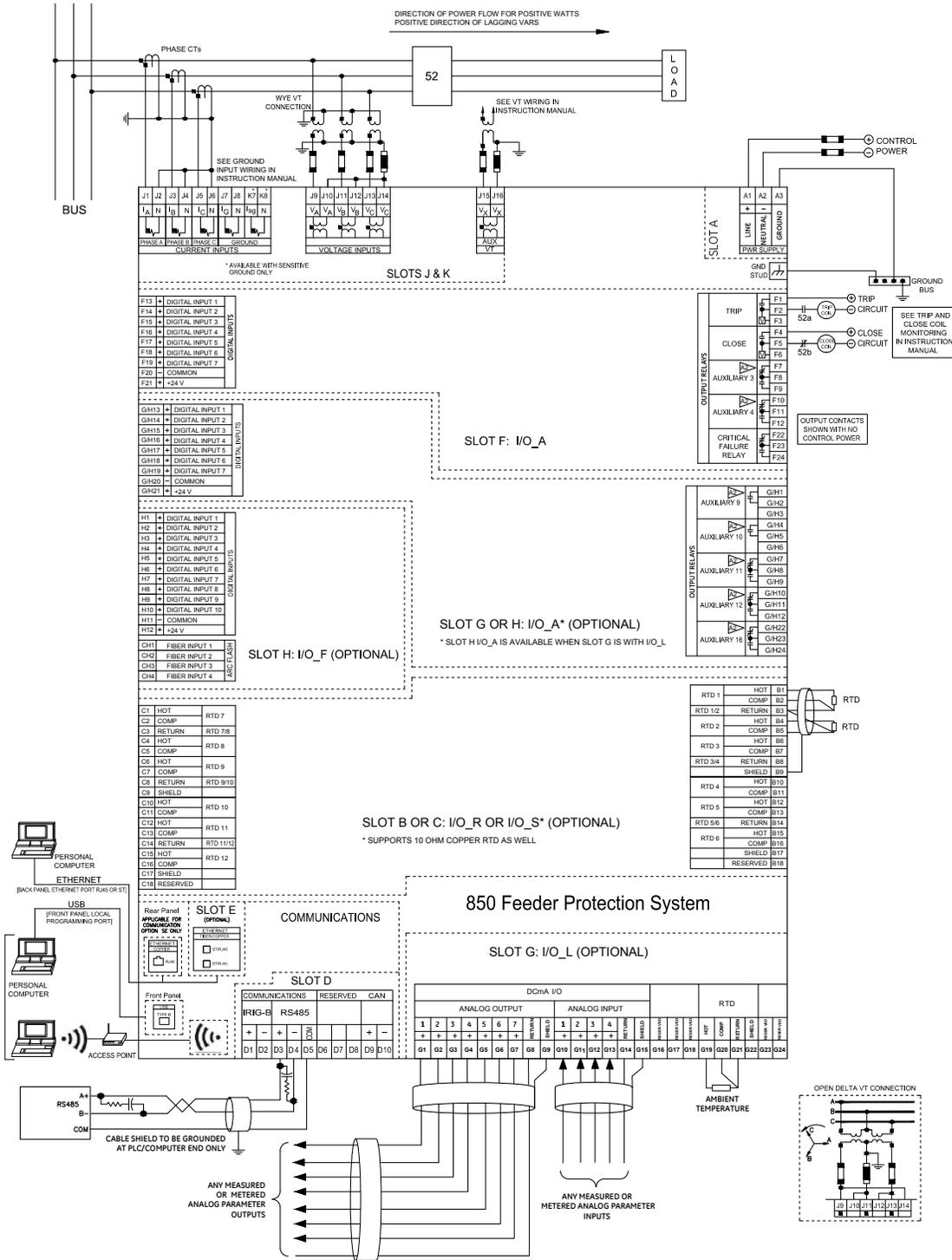
Explore in Detail

visit us online to explore the SR to 8 Series retrofit kit in detail using our interactive app. www.GEGridSolutions.com/8SeriesRetrofitKit



Multilin 8 Series Retrofit

Typical Wiring



Ordering

| 850 | * | ** | NN | * | * | * | * | A | * | * | * | * | * | * | * | * | * | * | N | Description |
|----------------------------------|-----|----|----|----|----|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--|
| Base unit | 850 | | | | | | | | | | | | | | | | | | | Feeder Protection Relay (Standard: English Language; High Voltage PS, Graphical Control Panel) |
| Application | | E | | | | | | | | | | | | | | | | | | Industrial |
| Phase Currents - Bank 1/2 | | D | | | | | | | | | | | | | | | | | | Distribution Feeder |
| Phase Currents - Bank 3 | | | P1 | | | | | | | | | | | | | | | | | 1A three phase current inputs (J1) with 4 voltage inputs (J2) |
| Ground Currents | | | PS | | | | | | | | | | | | | | | | | 5A three phase current inputs (J1) with 4 voltage inputs (J2) |
| Power Supply | | | | NN | | | | | | | | | | | | | | | | No phase current inputs |
| SLOT B - LV I/O | | | | | G1 | | | | | | | | | | | | | | | 1A ground input (NA for N1) |
| SLOT C - LV I/O | | | | | G5 | | | | | | | | | | | | | | | 5A ground input (NA for N1) |
| SLOT F - HV I/O | | | | | S1 | | | | | | | | | | | | | | | 1A ground + 1A sensitive ground input (NA if 2nd set of CT selected) |
| SLOT G - HV I/O | | | | | S5 | | | | | | | | | | | | | | | 5A ground + 5A sensitive ground input (NA if 2nd set of CT selected) |
| SLOT H - HV I/O | | | | | D1 | | | | | | | | | | | | | | | 1A ground + 1A polarizing current input (NA if 2nd set of CT selected) |
| Faceplate | | | | | D5 | | | | | | | | | | | | | | | 5A ground + 5A polarizing current input (NA if 2nd set of CT selected) |
| Current Protection | | | | | | H | | | | | | | | | | | | | | 110 - 250 V dc/110 - 230 Vac |
| Voltage Monitoring & Protection | | | | | | L | | | | | | | | | | | | | | 24 - 48 VDC |
| Control | | | | | | | N | | | | | | | | | | | | | None |
| Monitoring | | | | | | | R | | | | | | | | | | | | | 6 X RTDs (Pt100, Ni100, Ni120) |
| Communications | | | | | | | S | | | | | | | | | | | | | 6 X RTDs (Pt100, Ni100, Ni120, Cu10) |
| Advanced Communication Connector | | | | | | | | A | | | | | | | | | | | | None |
| Wireless Communication | | | | | | | | | N | | | | | | | | | | | 2 Form A (Vmon), 3 Form C, 7 Digital Inputs (Low / High voltage, Int/Ext supply) |
| Security | | | | | | | | | | A | | | | | | | | | | None |

Note: Harsh Environment Coating is a standard feature on all 8 series units.
 *HV I/O, Option A - Max 2 across slots F through H
 Arc Flash Detection (Option F): Includes 4 x Arc Flash sensors, each 18 feet long



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GEA-12739(LE)
 English
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GE
Grid Solutions

Multilin 889

Advanced Generator Protection and Management

The Multilin™ 889 Generator Protection System, a member of the Multilin 8 Series protection relay platform, has been designed for the protection, control, and management of generators and associated unit transformers in critical utility and industrial applications.

The 889 goes beyond asset protection providing power system engineers with the data, measurement accuracy, and visibility needed for comprehensive generator management. These advanced asset monitoring capabilities provides engineers with the ability to make informed, proactive decisions that enable planned maintenance activities reducing costs associated with pre- and post-fault analysis, equipment damage, and unplanned or extended downtime.

With a focus on connectivity and security, the 889 supports the latest in communications technologies and protocols including IEC 61850 Edition 2, OPC-UA, and IEC 62439/PRP, and provides advanced, industry standard, cybersecurity tools, ensuring simplified and secure device integration into new or existing SCADA or DCS systems.

Key Benefits

- Enhanced generator protection algorithms provide sub-cycle differential protection, ensuring faster fault clearing times for reduced generator damage
- Dedicated generator monitoring and control functions providing mission critical operational data to enable a pro-active maintenance approach
- Additional overall generator-transformer differential (870) providing additional back-up protection
- Advanced generator diagnosis, comprehensive asset monitoring and high-end fault and disturbance recording, simplifies pre- and post-fault analysis
- Industry standard cyber security tools such as AAA, Radius, RBAC and Syslog enabling NERC/CIP requirements
- Low insertion force, draw-out design simplifying testing, commissioning, and maintenance for increased process uptime
- Optional Wi-Fi connectivity minimizes system configuration and facilitates remote relay programming and diagnostic retrieval
- Patented environmental monitoring, providing visibility to changes in environmental conditions that can affect relay life

Applications

- Comprehensive protection from small to large generators
- Industrial or utility power generation
- Co-generation and renewable generation applications
- Unit Transformer Protection applications



imagination at work



Innovative Technology & Design

- Proven algorithms delivering sub-cycle and reliable differential protection
- Continuous monitoring and event driven diagnostics for a wide range of generator applications
- Patented environmental monitoring & diagnostics
- Advanced, flexible and embedded communications: IEC® 61850 Ed2, OPC-UA, IEC 62439/PRP, Modbus® RTU & TCP/IP, DNP3.0, IEC 60870-5-104
- Single setup and configuration across the platform
- Field swappable power supply
- Enhanced relay draw-out construction
- Elimination of electrolytic capacitors

Exceptional Quality & Reliability

- IPC A-610-E Class 3 manufacturing standards
- Highest reliability standards for electronics testing
- 100% Environmental Stress Screening and full functional testing
- Rated for IP54 (front) applications
- Standard Harsh Environment Conformal Coating

Uncompromising Service & Support

- Covered under GE's 10 year warranty plan
- Designed, tested and assembled by GE

889 Generator Protection System

Platform Overview

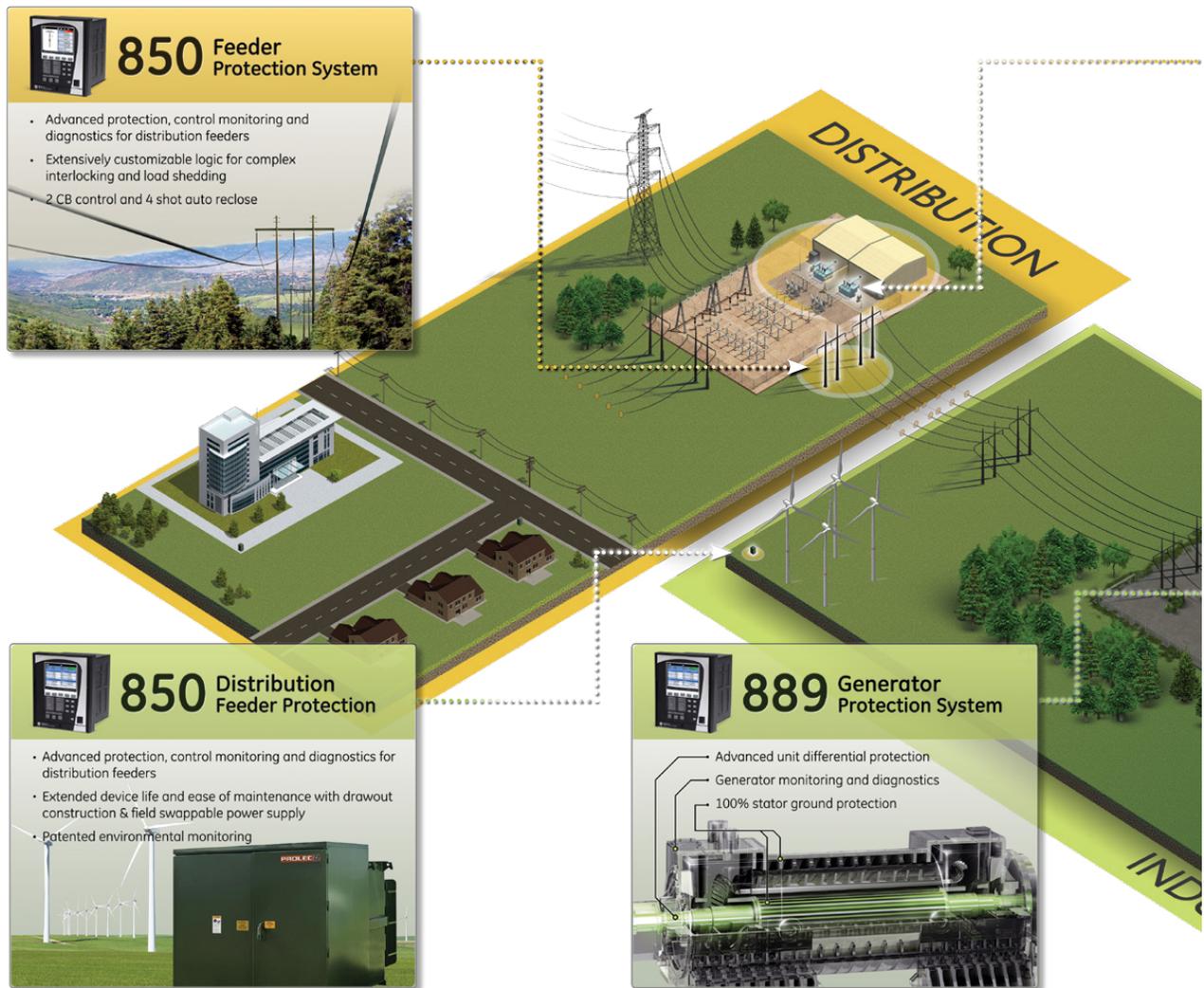
From oil pumping and refining facilities, to open pit or underground mining and processing operations, to large or small utilities, customers demand solutions that ensure maximum process uptime, minimum operational and maintenance efforts, and have the durability to withstand harsh environmental conditions.

The Multilin 8 Series is GE's next-generation protection and control relay platform that provides comprehensive protection and asset monitoring for critical feeders, motors, generators, and transformers.

The 8 Series is designed to solve challenges that customers face in running their day-to-day operations including maximizing system and process uptime, simplifying system integration and maintenance, and extending the life of critical assets.

With advanced communications the 8 Series integrates easily and seamlessly into new or existing DCS/SCADA system, along with other Multilin protection devices, providing a comprehensive solution for the end-to-end electrical system within the operations.

Multilin 8 Series Platform - Application Example



Exceptional Quality & Reliability

Industry-leading quality, reliability and design processes are at the core of GE's next generation protective relay platform. With significant investments in state-of-the-art type test facilities that simulate a complete range of operating environments and manufactured to the IPC A-610 Class 3 standard, adhering to the highest reliability standards and ensuring rugged performance, each device completes Environmental Stress Screening prior to shipping from GE's facility.

The Multilin 8 Series Protection Relays are manufactured in an ISO® 9001:2008 certified manufacturing facility.

Pioneering Technology & Design

The Multilin 889 is part of the 8 Series platform that provides comprehensive, high performance protection and control for critical assets in Industrial and utility environments.

Utilizing decades of experience in generator protection, GE has implemented ease-of-use features, such as single screen setup and condition-based health monitoring and diagnostics.

The Multilin 8 Series products have an integrated protection integrity engine that utilizes customized algorithms, providing advanced diagnostics to ensure asset protection is not compromised.

Maintaining and safeguarding the electrical supply of an operation is critical to ensuring maximum process availability and performance.

845 Transformer Protection System

Fault Analysis Tools

- Winding Hot Spots
- Internal Short Circuit
- High Oil Temperature

869 Motor Management System

- Stator Windings Overheating and Turn to Turn Fault Detection
- Broken Rotor Bar Protection
- Bearing Temperature Monitoring

Motor Health Report

850 Feeder Protection System

- Comprehensive voltage and current protection
- Advanced built-in main-tie-main schemes
- Redundant and reliable IEC 61850 communications

889 Generator Protection System

The 8 Series incorporates the latest cyber security features, including password complexity, RADIUS authentication and role-based access control (RBAC), enabling customers to comply with NERC CIP and NISTIR 7628 requirements.

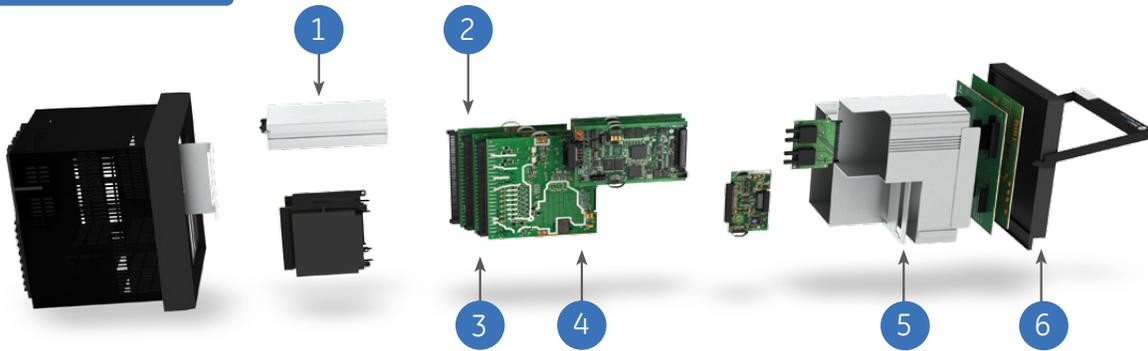
Understanding that customers need protection and control devices that must reliably operate in harsh and challenging environments, GE delivers the Multilin 8 Series with harsh conformal coating on all printed circuit boards and a patented environmental awareness module that provides real-time detection of environmental factors that affect product life, as part of its standard offering, delivering higher reliability and extended relay life.

Uncompromised Reliability & Service

In addition to the superior technology and innovative design advancements that enable delivery of uncompromised performance and reliability, the Multilin 8 Series is also backed by GE's 10 year warranty plan.

Protection & Control

The Multilin 8 Series provides comprehensive and field proven algorithms to ensure asset management and uninterrupted process and system availability. With a fast protection pass, the 8 Series relays provide fast operating current, voltage, power, and frequency protection elements. With highly configurable protection logic, system coordination with upstream and downstream disconnect devices is greatly simplified. Various forms of I/O are supported in the 8 Series to ensure protection, control, and management of critical substation and field assets.



- 1 Field Swappable Power Supply**
 Extends the usable life of the protection relay and minimizes costly, time consuming replacement and re-configuration.
- 2 Harsh Environment Conformal Coating**
 Standard on all printed circuit boards delivering higher reliability and extended relay life
- 3 No Electrolytic Capacitors**
 Increasing quality and reliability for continuous plant operations by removing high failure components (excluding low voltage power supply)

- 4 IPC A-610 Class 3 Manufacturing**
 Drives to the highest level of reliability standards delivering rugged performance
- 5 Robust Extruded Aluminum Chassis**
 Custom-designed extruded aluminum chassis delivering optimal thermal management to extend component life
- 6 Draw-Out**
 Providing simplified device fleet management

Generator Stator Differential

The 889 provides fault clearing operation at up to sub-cycle speed, by utilizing a high-speed dual slope differential protection for detecting and clearing of stator phase faults. Advanced CT saturation detection algorithms maintain immunity to saturation conditions that may be caused due to external disturbances. Through the use of a directional check, additional supervision is provided to ensure the fault is internal to the generator before triggering it to trip. This sub-cycle operation translates to less burning, and hence low carbon dissipation and thermal stress on insulation. This also enables root cause analysis during diagnosis/maintenance of the winding (sever longer duration faults burns-out all the evidence and make root cause analysis extremely difficult or sometimes impossible).

Overall Generator & Transformer Differential Protection

The 889 provides overall generator and transformer differential protection (87O). It covers the protection zones from the generator neutral to the Generator Step-Up (GSU) Transformer's High Voltage (HV) winding. For mid to large-size machines, the typical protection philosophy and architecture is to implement a dedicated transformer protection device along with a single function differential relay to provide the overall differential protection between the transformer and the generator. With support for 3 sets of phase CT inputs, the 889 can replace the single function device, providing the necessary overall differential protection with the added benefit of protection redundancy for both the Transformer and the Generator, when there is no tapping between the generator and GSU or unit transformer.

100% Stator Ground Fault Protection

The 889 provides 100% Stator Ground Fault Protection for High Resistance Grounded System (HRG), Low Resistance Grounded (LRG) or Hybrid Grounded Systems. For HRG systems the 889 employs a unique combination of Auxiliary Overvoltage and 3rd Harmonic Neutral Undervoltage protection elements to provide secure, reliable protection of the stator winding. With this function the 3rd harmonic neutral voltage variations do not need to be considered, simplifying the settings and configuration process.

For LRG systems with parallel machines, the 889 provides ground fault coordination ensuring only the faulted generator is islanded. In Hybrid Grounded Systems, the 889 provides fast, dynamic switching from low-z to high-z when an internal generator fault is detected, reducing potential damage to the generator and eliminating the need for additional protection devices.

Sensitive Directional Power

The 889 provides low forward power and reverse power elements to prevent generator motoring that can cause damage the prime mover. Independent settings for power pickup levels and operational delays are available for both alarming and tripping of each element.

The 889 directional power element responds to three-phase directional power and is designed for reverse power (32REV) and low forward power (32FWD) applications for interconnections involving co-generation.

Loss of Excitation

Supporting application flexibility, the 889 offers two methodologies to support loss of excitation detection. This can be done through an impedance-based approach or a Reactive Power approach. Unlike the Impedance based function, the Reactive Power Function settings do not need machine parameters for setting and can be used in cases where machine parameters are not available.

Out of Step Protection

The out-of-step element provides out of step (loss-of-synchronism or pole slip) tripping function for generators. The element is simplified using a single blinder operating characteristic with an offset mho supervisory. It is easy to apply based on IEEE/ANSI C37.102 guidelines, and IEEE PES PSRC tutorial on generator protection. The purpose of the supervisory mho is to prevent operation on stable swings that pass through both blinders and outside the mho characteristic. In addition, the out-of-step tripping feature allows "MHO EXIT" trip mode to reduce stresses on the circuit breaker.

Stator Thermal Protection

The 889 provides thermal overload protection as per IEC 60255-8 to prevent generator damage caused by generator overheating. The 889 can be configured to trip the generator offline when the generator's thermal limits are reached, or close an Alarm contact that signals operations personnel to take appropriate actions.

Overcurrent Elements

The 889 can be used to provide backup protection for transformer and adjacent power system equipment. Instantaneous overcurrent (IOC) elements can be used for fast clearing of severe internal and external (through) faults. Up to six time overcurrent protection (TOC) elements per winding allow to coordinate with the adjacent protection zones and act as backup protection.

- IOC protection functions are provided for phase, neutral & ground currents
- TOC protection functions are provided for phase, neutral and ground currents. A variety of standard time curves including IEEE, IEC, GE IAC, I2t, definite time are provided
- FlexCurves to coordinate with adjacent protections (including fuses) as well as transformer damage curves and thermal/damage curves for downstream equipment Directional protection functions are provided for phase, neutral and ground currents. The voltage memory function enables a more reliable relay operation, especially for faults close to the VTs.

Negative Sequence Overcurrent

For Delta/Wye impedance grounded transformers, overcurrent protection is particularly difficult to set. A negative sequence based overcurrent element provides the required sensitivity phase during faults.

Breaker Failure Protection

The breaker failure protection element monitors for timely operation of the connected breaker. If a trip command is not successful in operating the breaker and clearing the fault, the breaker failure element can be used to send trip signals to upstream breakers to clear the fault.

Undervoltage and Overvoltage Protection

The 889 provides phase Over and Under voltage functions and in addition also includes Neutral Overvoltage, Negative Sequence Overvoltage.

Over/Under Frequency Protection

The 889 calculates and maintains a running average of the system frequency and the frequency rate-of-change (df/dt). Two underfrequency and four rate-of-change elements are provided to implement traditional and advanced load shedding schemes. Additionally, an overfrequency element can be used to trigger a generator rampdown.

Synchronism Check

The 889 provides synchrocheck elements that monitor voltage difference, phase angle difference and slip frequency to ensure proper breaker closure for parallel operation.

889 Generator Protection System

Volts/Hz

To take care of over excitation that may result in saturation of the magnetic core or over heating due to stray flux.

In the 889, the per-unit volts-per-hertz (V/Hz) value is calculated using the maximum of the three-phase voltage inputs or the auxiliary voltage

User Definable Protection Functions

Eight user-definable protection functions (FlexElements) can be programmed to respond to quantities measured or computed by the relay (phase, ground and sequence current and voltage power, frequency, power factor, etc.) These elements respond to variations in its input signal. Applications could include: overvoltage, overpower, low power factor, temperature differential, and more.

CTs and VTs

Up to 12 analog current transformer (CT) and 8 voltage transformer (VT) signals can be configured to monitor power system equipment. Both 1A and 5A CTs are supported.

Digital I/O

Up to 14 contact inputs and 10 contact outputs are available and can be used to monitor and control a wide range of auxiliary equipment found within a substation or other protection applications.

RTD

8 Series devices support up to 13 programmable RTD inputs that can be configured for an Alarm or Trip. The RTDs can be assigned to a group for monitoring winding and ambient temperatures. The RTD voting option gives additional reliability to ignore any RTD failures.

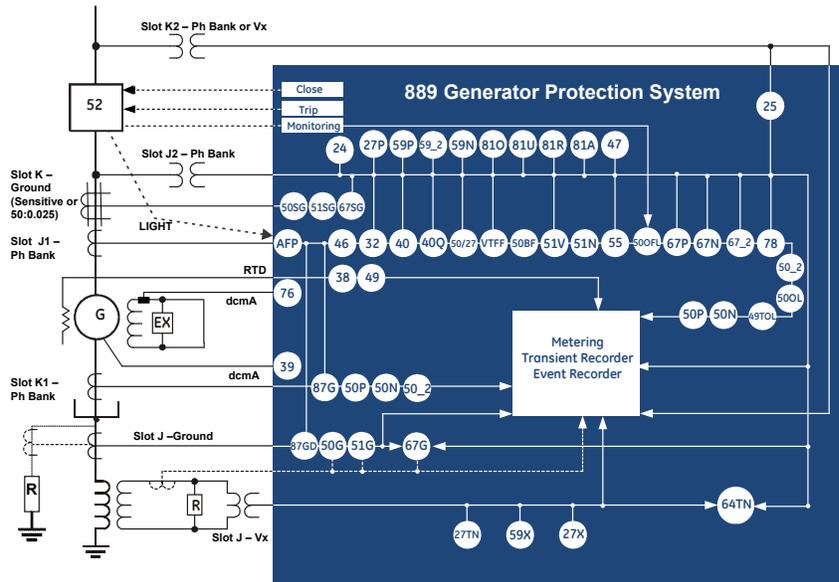
Analog Inputs, Analog Outputs

The 889 provides 7 Analog Outputs (dc mA), 4 Analog Inputs (dc mA), 1 RTD input. The configurable analog inputs can be used to measure quantities fed to the relay from standard transducers. Each input can be individually set to measure 4-20 mA, 0-20 mA or 0-1 mA transducer signals.

The 889 can also be set to issue trip or alarm commands based on signal thresholds. The configurable analog outputs can be used to provide standard transducer signals to local monitoring equipment. The analog outputs can be configured to provide outputs based on measured analog values, or calculated quantities. An optional general purpose transducer input allows a user-defined quantity to be monitored and used as part of the protection as defined by FlexLogic™.

Functional Block Diagram

| ANSI DEVICE | DESCRIPTION |
|-------------|--|
| 24 | Volts per Hertz |
| 25 | Synchrocheck |
| 27P | Phase Undervoltage |
| 27X | Auxiliary Undervoltage |
| 27TN | Third Harmonic Neutral Undervoltage |
| 32 | Directional Power |
| 38 | Bearing Overtemperature (RTD) |
| 39 | Bearing Vibration (dcmA) |
| 40 | Loss of Excitation |
| 40Q | Reactive Power |
| 46 | Generator Unbalance |
| 47 | Phase Reversal |
| 49 | Thermal (RTD) |
| 49TOL | Thermal Overload |
| 50/27 | Inadvertent Energization |
| 50BF | Breaker Failure |
| 50G | Ground Instantaneous Overcurrent |
| 50SG | Sensitive Ground Instantaneous Overcurrent |
| 50N | Neutral Instantaneous Overcurrent |
| 50P | Phase Instantaneous Overcurrent |
| 50_2 | Negative Sequence Instantaneous Overcurrent |
| 50OFL | Offline Overcurrent |
| 50OL | Overload |
| 51G | Ground Time Overcurrent |
| 51N | Neutral Time Overcurrent |
| 51SG | Sensitive Ground Time Overcurrent |
| 51V | Voltage Restrained Time Overcurrent |
| 55 | Power Factor |
| 59N | Neutral Overvoltage |
| 59P | Phase Overvoltage |
| 59X | Auxiliary Overvoltage |
| 59_2 | Negative Sequence Overvoltage |
| 64TN | 100% Stator Ground using 3rd Harmonic Voltage Differential |



----- Alternatives for connection

| ANSI DEVICE | DESCRIPTION |
|-------------|---------------------------------------|
| 67G | Ground Directional Element |
| 67N | Neutral Directional Element |
| 67P | Phase Directional Element |
| 67SG | Sensitive Ground Directional Element |
| 67_2 | Negative Sequence Directional Element |
| 76 | Excitation Current Protection (dcmA) |
| 78 | Out-of-step Protection |

| ANSI DEVICE | DESCRIPTION |
|-------------|------------------------------------|
| 81A | Frequency out-of-band |
| 81O | Overfrequency |
| 81U | Underfrequency |
| 81R | Frequency Rate of Change |
| 87G | Generator Stator Differential |
| 87O | Overall Unit (Gen-Xfrm) Protection |
| 87GD | Restricted Ground Fault (RGF) |
| AFP | Arc Flash Protection |
| VTFF | VT Fuse Failure |

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Switchgear Control and Configurable SLD

The Multilin 889 provides a configurable, dynamic Single Line Display (SLD), up to six (6) pages for comprehensive switchgear control. Up to 15 digital and metering status elements can be configured per SLD page. These pages can be configured to show breakers, switches, metering, and status elements or measurements. Individual SLD pages can be selected as the default home screen pages. Automatic cycling through these pages can also be achieved through default screen settings.

The provision of such powerful control and display capability within the relay ("One Box" concept) eliminates the need for external controls, switches and annunciation on the panel reducing equipment and engineering cost.

Annunciator panel and virtual PBs

The Multilin 889 offers a configurable annunciator panel that can be constructed to show up to 36 alarms in either self-reset mode or latched mode per ISA 18.1 standard similar to a physical annunciator panel - eliminating the need for physical one. The alarms can be displayed on the front panel in a configurable grid layout of 2x2 or 3x3.

The Multilin 889 extends local control functionality with 20 virtual pushbuttons that can be assigned for various functions. Each programmable pushbutton has its own programmable LED which can be used to acknowledge the action taken by the tab pushbutton.

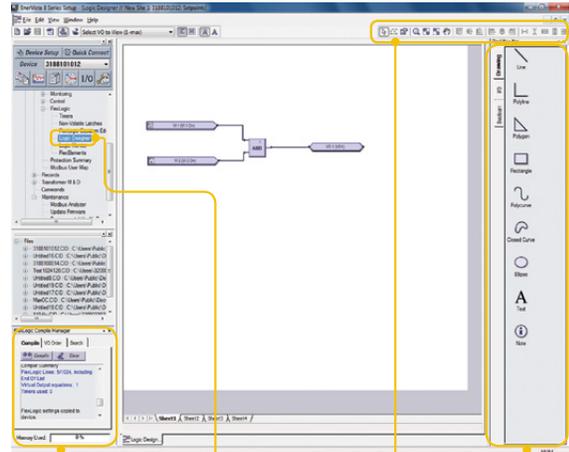
Integrated Arc Flash Protection

The Multilin 8 Series supports an integrated arc flash module providing constant monitoring of an arc flash condition within the switchgear, motor control centers, or panelboards. With a 2ms protection pass, the 8 Series is able to detect light and overcurrent using 4 arc sensors connected to the 8 Series relay. In situations where an arc flash/fault does occur, the relay is able to quickly identify the fault and issue a trip command to the associated breaker thereby reducing the total incident energy and minimizing resulting equipment damage.

Self-monitoring and diagnostics of the sensors ensures the health of the sensors as well as the full length fiber cables. LEDs on the front panel display of an 8 Series relay can be configured to indicate the health of the sensors and its connections to the relay.

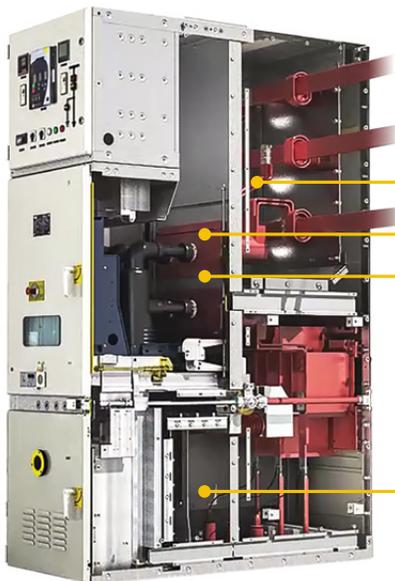
Advanced Automation

The Multilin 889 incorporates advanced automation capabilities that exceeds what is found in most generator protection relays. This reduces the need for additional programmable controllers or discrete control relays including programmable logic, communication, and SCADA devices. Advanced automation also facilitates the Multilin 889 to integrate seamlessly with other protection/process systems.



Single Click Device Communications Launch 'Logic Designer' Flex Tokens Tool Box 'Basic Actions' Tool Bar

EnerVista Logic Designer provides a graphical, simplified way to define and create operational and control logic



Multilin 8 Series

Fast, reliable arc flash protection with light-based arc flash sensors integrated within the Multilin 8 Series of protection & control devices. With arc flash detection in as fast as 2msec, the costs associated with equipment damage and unplanned downtime is significantly reduced.



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FlexLogic™

FlexLogic is the powerful programming logic engine that provides the ability to create customized protection and control schemes, minimizing the need and associated costs of auxiliary components and wiring. Using FlexLogic, the 889 can be programmed to provide the required tripping logic along with custom scheme logic for breaker control (including external inputs for interlocking), interlocking schemes with adjacent protections (for example, preventing sympathetic tripping of healthy feeders), and dynamic setting group changes.

Monitoring & Diagnostics

Multilin 8 Series devices include high accuracy metering and recording for all AC signals. Voltage, current, and power metering are built into the relay as a standard feature. Current and voltage parameters are available as total RMS magnitude, and as fundamental frequency magnitude and angle.

Advanced Asset Health Monitoring

Focused on delivering situational awareness and actionable information Multilin 8 Series devices go beyond protection and control providing power system operators and engineers with advanced asset monitoring and diagnostic tools to help extend the life of critical power system assets.

Digital Fault Records

Integrated digital fault records capture data required to analyze fault conditions and identify possible failure modes in order to take the necessary preventative and maintenance actions.

Asset Health Reports

Multilin 8 Series devices provide pre-formatted, easy to read, asset health reports in PDF format. These reports capture key operational data of the asset, providing clear indication of asset condition at an instant of time. This helps operators and asset managers analyze the risks associated with the asset as well as condition based maintenance planning.

| SETTING | PARAMETER |
|------------------------|-----------|
| Total Breaker Trips | 12 |
| Trips Since Last Reset | 9 |
| Alarm Counter | 4 |
| Last Trip Time | 2512 ms |
| Avg. of 5 Trip Time | 1842 ms |
| Avg. of Trip Time | 1856 ms |
| Last Close Time | 725 ms |
| Avg. of 5 Close Time | 948 ms |

Multilin 8 Series Breaker Health Report available on the display or via the setup software

Dedicated Generator System Monitoring & Control

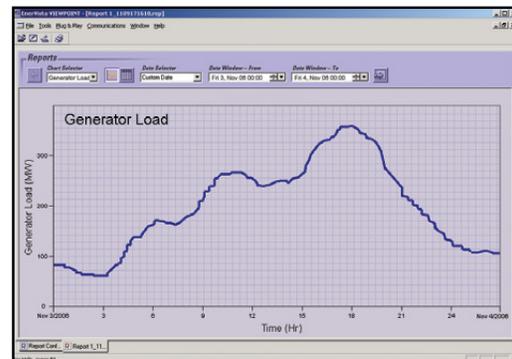
Turbine maintenance scheduling based on Frequency Out-of-band Accumulators (81A) along with other frequency elements which are useful for scheduling turbine maintenance. Distribution and industrial power system experience more variations in generation-load balances. This forces the turbine to function out-side the normal operating band.

- Generator Maintenance using Running hours
- Generator running hour accumulates duration of generator has been running since last maintenance
- Harmonic detection
- High speed harmonic detection function - allowing 2nd to 5th harmonic supervision for protection functions (i.e.: 87G blocking in-case of 2nd & 5th harmonic).

Advanced Generator Monitoring Diagnosis

- Bearing vibration (Analog Input)
- Excitation current (Analog Input)
- Any generator transducer (dcmA) input monitoring
- Breaker Health
- Data logger, Oscillography, Event Recorder.

The Multilin 889 offers a comprehensive generator health report that provides an easy-to-read snapshot of a generator's health and operating condition. Based on graphical representation and trend values of the generator historical data, the 889 enables operators and asset managers to identify process issues and maintenance requirements before damage occurs and costly repairs are required.



Log generator operating parameters to allow for analyzing generator loading and performance over weeks and months.

Over speed

Any of the input contacts can be used to read the pulses from the input source to determine the speed of the motor. The source of the pulses can be an inductive proximity probe or Hall Effect gear tooth sensor. Two modes of speed: under speed and over speed can be defined.

Breaker Health Monitoring

The breaker is monitored by the relay not only for detection of breaker failure, but also for the overall "breaker health" which includes:

- Breaker close and breaker open times
- Trip circuit monitoring
- Spring charging time
- Per-phase arcing current
- Trip counters

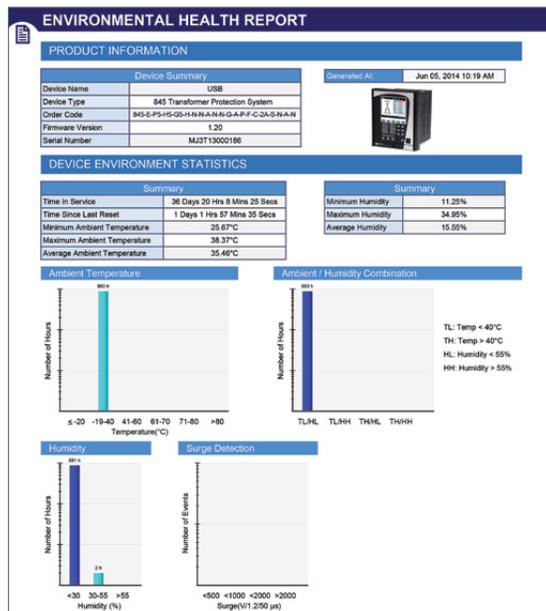
All algorithms provide the user with the flexibility to set up initial breaker trip counter conditions and define the criteria for breaker wear throughout a number of set points.

Environmental Monitoring

The Multilin 8 Series relay implements a patented environmental monitoring system that measures and provides operating condition information. Reliable and secure operation of the relay and other electronic devices in the vicinity may be affected by environmental factors. The 8 Series has been designed to meet or exceed required industry standards, however some operating conditions may be beyond those standards and reduce total lifespan of the device.

Typical environmental conditions that may affect electronic device reliability include voltage, current density, temperature, humidity, gas, dust, contamination, mechanical stress, shock, radiation, and intensity of electrical and magnetic fields. These environmental factors are different from natural weather conditions at particular installation conditions and are beneficial to monitor.

The 889 relay's built-in environmental awareness feature (patent "Systems and methods for predicting maintenance of intelligent electronic devices") collects the histograms of each operating condition from the point the device is put into service. Monitored environmental conditions include temperature, humidity and transient voltage. The histogram of each environmental factor may be retrieved from the diagnostic page accessed through a PC running the EnerVista Multilin 8 Series Setup program.

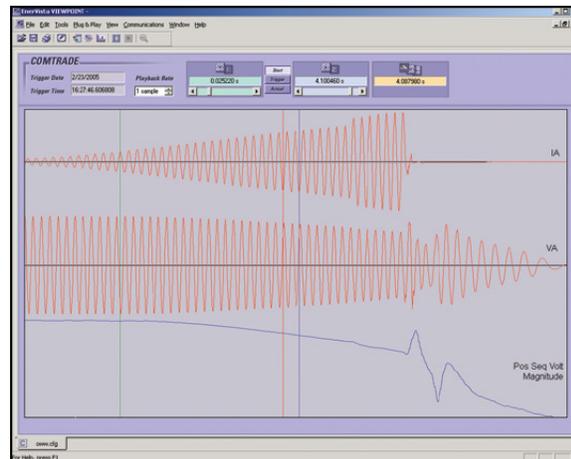


Environmental health report is available via Multilin PC Software

Metering

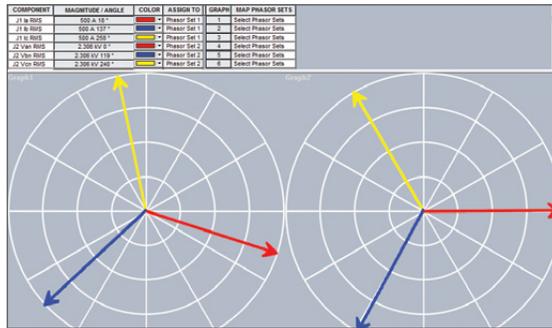
The Multilin 8 Series offers high accuracy power quality monitoring for fault and system disturbance analysis. The Multilin 8 Series delivers unmatched power system analytics through the following advanced features and monitoring and recording tools:

- Harmonics measurement up to 25th harmonic for both currents and voltages including THD.
- The length of the transient recorder record ranges from 31 cycles to 1549 cycles, depending on the user specified configuration. Giving the user the ability to capture long disturbance records which is critical for some applications.
- 32 digital points and 16 analog values, assigned by the user, can be captured in the COMTRADE format by the transient recorder.
- Comprehensive data logger provides the recording of 16 analog values selected from any analog values calculated by the relay. Capture rates range from 16 ms, 20ms, 1 second, 30 seconds, 1 minute, 30 minutes, or 1 hour rate. This data capture flexibility allows the operator to measure power factor or reactive power flow (for example), for several hours or even days, enabling detailed analysis and corrective action to be taken, if required.
- Detailed Fault Report allows the user to identify the fault location, fault type and element(s) that triggered the 889 to trip. It carries other useful information, such as pre-fault and fault phasors, relay name and model, firmware revision and other details. The 889 stores fault reports for the last 16 events.
- 1024 Event Recorder chronologically lists all triggered elements with an accurate time stamp over a long period of time. The 889 stores the last 1024 events locally in the relay.



Analyze generator faults using both analog and digital power system quantities that are measured and recorded up to a rate of 64 samples per cycle.

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8 Series Phasor Viewer

| Event Number | Date/Time | Cause |
|--------------|-----------------------------|----------------------------|
| 40 | Aug 3, 2006 06:35:12.919463 | GEN TRIP (V04) OFF |
| 39 | Aug 3, 2006 06:35:12.919463 | SIMUL TRIP INI I (VU1) LFF |
| 38 | Aug 3, 2006 06:35:12.919463 | STATOR DIFF DPO |
| 37 | Aug 3, 2006 06:35:12.866357 | PRIME MOV BKN (C03) ON |
| 36 | Aug 3, 2006 06:35:12.866357 | FILED BKR TRIP (C02) ON |
| 35 | Aug 3, 2006 06:35:12.866357 | GEN BKR TRIP (CU1) UN |
| 34 | Aug 3, 2006 06:35:12.864234 | PRIME MOV TRIP (V06) ON |
| 33 | Aug 3, 2006 06:35:12.864234 | FIELD TRIP (V05) ON |
| 32 | Aug 3, 2006 06:35:12.864234 | GEN TRIP (V04) ON |
| 31 | AUG 3, 2006 06:35:12.864234 | SIMUL TRIP INI I (VU1) UN |
| 30 | AUG 3, 2006 06:35:12.864234 | OSCILLOGRAPHY TRIG'D |
| 29 | AUG 3, 2006 06:35:12.864234 | STATOR DIFF OF |
| 28 | AUG 3, 2006 06:35:12.864234 | STATOR DIFF PKP |
| 27 | JULY 15, 2006 | PHASE TOCT DPO |

Record the operation of the internal 889 elements and external connected devices with 1ms time-stamped accuracy to identify the Sequence of Operation of station devices during generator faults and disturbances.

Communications

The Multilin 8 Series provides advanced communications technologies for remote data and engineering access, making it easy and flexible to use and integrate into new and existing infrastructures. Direct support for fiber optic Ethernet provides high-bandwidth communications, allowing for low-latency controls and high-speed file transfers of relay fault and event record information. The 8 Series also supports two independent IP addresses, providing high flexibility for the most challenging of communication networks.

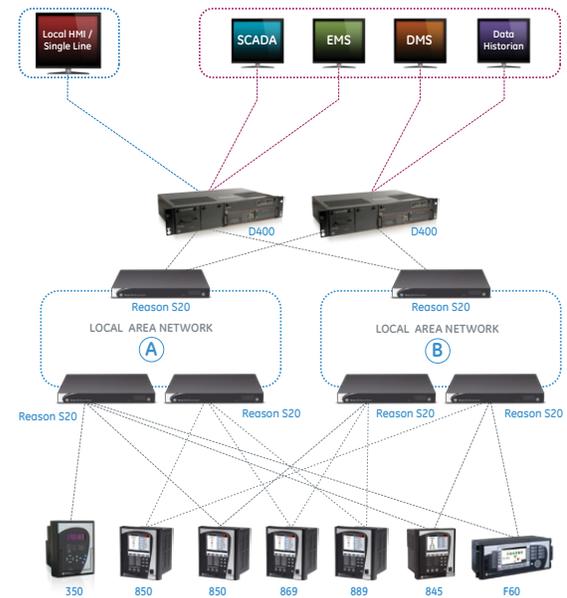
Providing several Ethernet and serial port options and supporting a wide range of industry standard protocols, the 8 Series enables easy, direct integration into DCS and SCADA systems. The 8 Series supports the following protocols:

- IEC 61850, IEC 62439 / PRP
- DNP 3.0 serial, DNP 3.0 TCP/IP, OPC-UA, IEC 60870-5-103, IEC 60870-5-104
- Modbus RTU, Modbus TCP/IP

The 8 Series has two interfaces a USB front port and optional Wi-Fi for ease of access to the relay.

Wi-Fi Connectivity:

- Simplify set-up and configuration
- Simplify diagnostic retrieval
- Eliminate personnel in front of switchgear
- WPA-2 security



Cyber Security

The 8 Series offers a comprehensive suite of industry standard cyber security tools, enabling operators to comply with NERC/CIP and international cyber security guidelines and regulations.

AAA Server Support (Radius/LDAP)

Enables integration with centrally managed authentication and accounting of all user activities and uses modern industry best practices and standards that meet and exceed NERC CIP requirements for authentication and password management.

Role Based Access Control (RBAC)

Efficiently administrate users and roles within the 8 Series. The new and advanced access functions allow users to configure up to three roles for up to eight configurable users with independent passwords. The standard "Remote Authentication Dial In User Service" (Radius) is used for authentication.

Event Recorder (Syslog for SEM)

Capture all cyber security related events within a SOE element (login, logout, invalid password attempts, remote/local access, user in session, settings change, FW update, etc), and then serve and classify data by security level using standard Syslog data format. This will enable integration with established SEM (Security Event Management) systems.



Cyber Security with Radius Authentication

Software & Configuration

The EnerVista™ suite is an industry-leading set of software programs that simplifies every aspect of using the 8 Series relays. EnerVista provides all the tools to monitor the status of the protected asset, maintain the device and integrate the information measured by the Multilin 8 Series, into SCADA or DCS process control systems. The ability to easily view sequence of events is an integral part of the setup software, as postmortem event analysis is critical to proper system management.

EnerVista Launchpad

EnerVista Launchpad is a powerful software package that provides users with all of the setup and support tools needed for configuring and maintaining Multilin products. The setup tools within Launchpad allow for the configuration of devices in real-time, by communicating via serial, Ethernet or modem connections, or offline by creating device setting files to be sent to devices at a later time. Included in Launchpad is a document archiving and management system that ensures critical documentation is up-to-date and available when needed.

8 Series Setup Software

8 Series Setup Software is single setup and configuration across the platform and can reduce device setup and configuration time.

Simplified Setup & On-Going Maintenance

The robust 8 Series streamlines user workflow processes and simplifies engineering tasks, such as configuration, wiring, testing, commissioning, and maintenance. Building on the history of simplified setup and configuration, each relay has implemented simplified setup screens to minimize relay setup time. In addition, for local programming, the relays come with a fully functional GCP, which allows users to locally monitor the connected asset.

Ease-of-Use

Continuing its legacy in providing easy-to-use protective relay solutions, the 8 Series is designed to minimize product and system configurability requirements, for quicker physical installations, easier and simplified setup and configuration.

Full Color Graphical HMI Front Display

A large, full color Graphic Control Panel (GCP) ensures clear representation of critical status and measurements. The GCP supports Single Line Diagram (Mimic) to represent the power system configuration of the asset being protected.

When the keypad and display are not being used, the GCP will automatically revert to screen saver mode, which will turn off the display until one of the local pushbuttons is pushed.

The GCP can be used to view device and system status, alarms and event logs, and metering information. The GCP and navigation keys simplify relay configuration and setup, allowing users to make setting changes directly through the front panel.

LED Indicators for Quick Status Indication

The front panel includes user configurable LED's. Each LED can be completely configured and named based on the application and user requirements. The color of each indicator conveys its importance.

G = Green: General Condition

A = Amber: Alert Condition

R = Red: Serious Alarm or Important Status

The 8 Series front panel provides 14 LED indicators and 3 LED pushbutton indicators. 10 LED's are user-programmable, while "In service" and "Pickup" LED's are non-programmable. "Trip" and "Alarm" LED's can be assigned with selected operands.

User-programmable LED's can be turned on by a selection of FlexLogic operands representing protection, control or monitoring elements. Each LED can be configured to be self-reset or latched and labeled based on the application and user requirements. User-programmable LED's can be selected to be either Red, Green or Amber to give the distinctive indication of selected operations.

Simulation - Simplifying Configuration Testing

The 8 Series now comes with a unique simulation tool that can be used to simulate Pre-fault, Fault, and Post-fault states. Functions can be tested without the need for external test equipment. The simulation tool can also test Digital Inputs and Outputs for changes of state and front display LEDs to ensure correct indication of operational conditions.

Employing this built-in tool operators are able to reduce the time and effort typically required to verify and analyze protection elements and I/Os under certain simulated conditions.

Retrofit Existing Multilin SR 489 Devices in Minutes

Traditionally, retrofitting or upgrading an existing relay has been a challenging and time consuming task often requiring re-engineering, panel modifications, and re-wiring. The Multilin 8 Series Retrofit Kit provides a quick, 3-step solution to upgrade previously installed Multilin SR 489 protection relays, reducing upgrade costs.

With the new 8 Series Retrofit Kit, users are able to install a new 889 Feeder Management System without modifying existing panel or switchgear cutouts, re-wiring, or need for drawing changes and re-engineering time and cost.

With this three-step process, operators are able to upgrade existing SR relays in as fast as 21 minutes, simplifying maintenance procedures and reducing system downtime.

1



Update Settings File

EnerVista 8 Series Setup Software provides automated setting file conversion with graphical report to quickly and easily verify settings and identify any specific settings that may need attention.

2



Replace Relay

Simply remove the upper, lower and low voltage terminal blocks and then remove the SR chassis from the panel. No need to disconnect any of the field wiring.

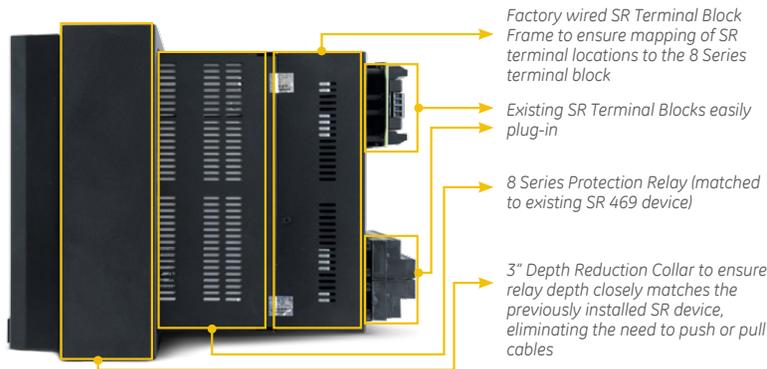
3



Plug & Play Reconnection

Insert the new 8 Series Retrofit chassis into the switchgear and simply plug-in the old terminal blocks - there is need to make any cut-out modifications or push and pull cables.

The 8 Series Retrofit Kit comes factory assembled and tested as a complete unit with the 8 Series protection device and includes replacement hardware (terminal blocks and screws) if the existing hardware is significantly aged or damaged.



Explore in Detail

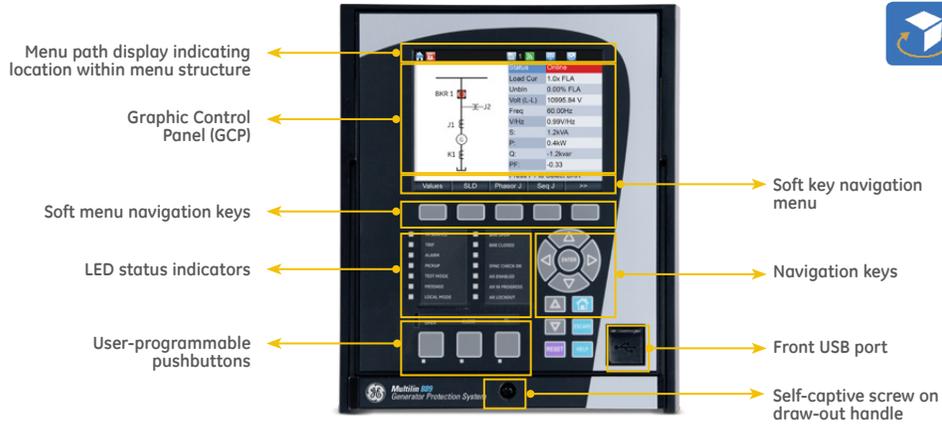
Visit us online to explore the SR to 8 Series retrofit kit in detail using our interactive app. www.GEGridSolutions.com/8SeriesRetrofitKit



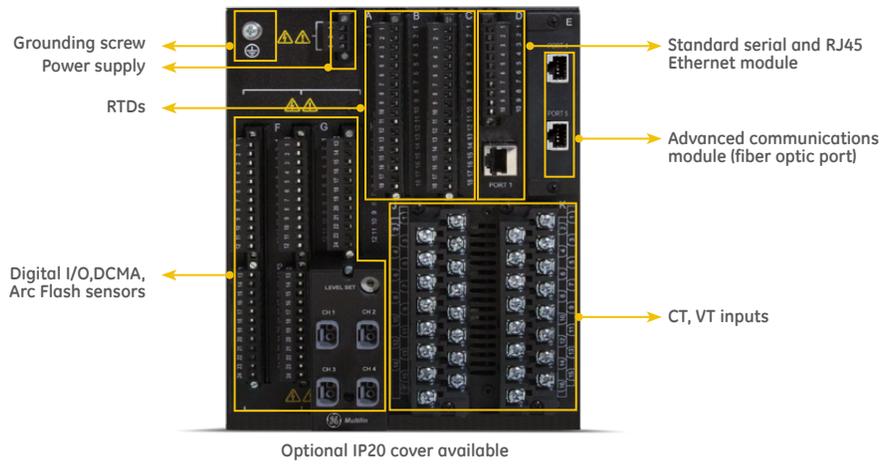
Multilin 8 Series Retrofit: Solutions Explorer Application

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Front View



Rear View

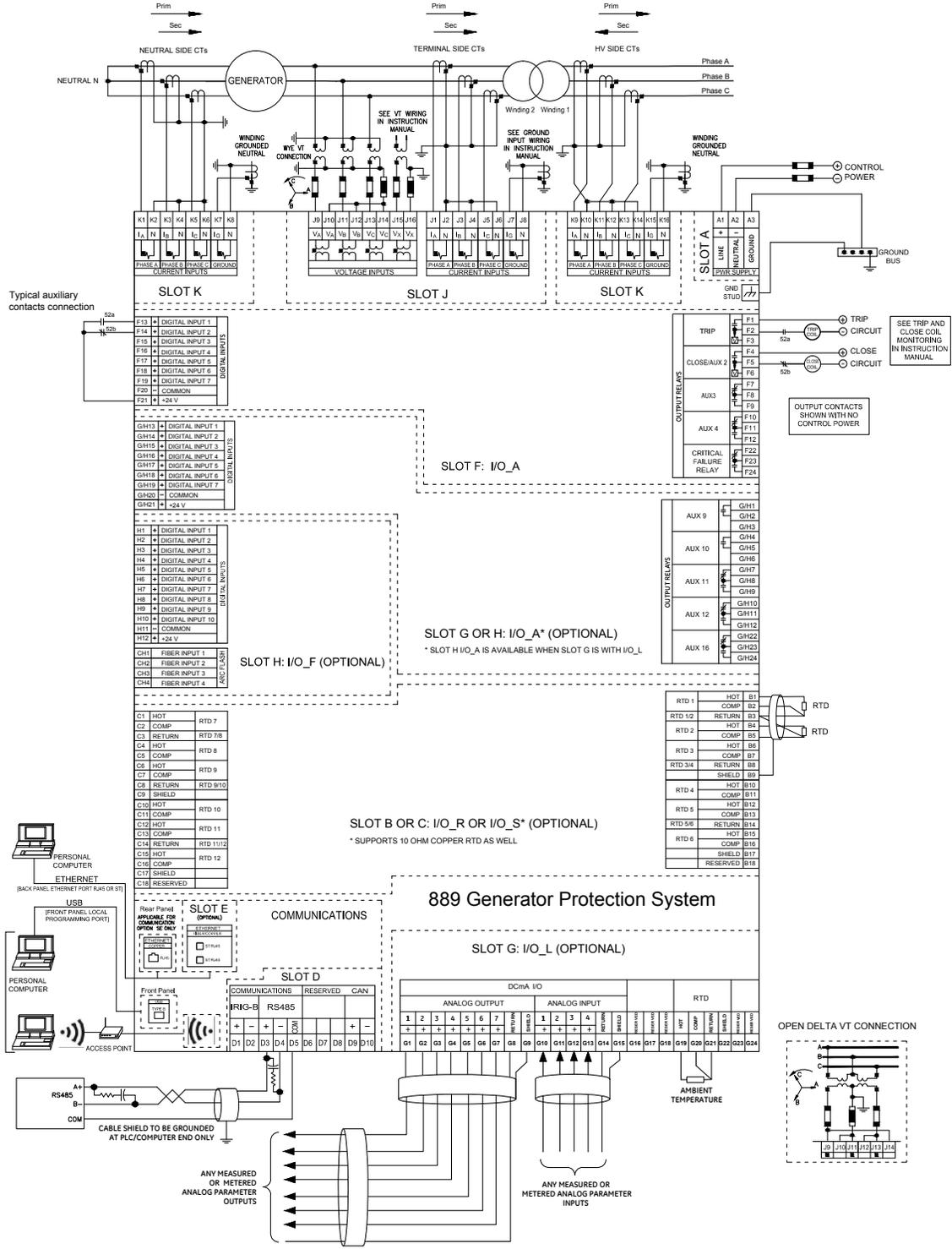


Dimensions & Mounting



889 Generator Protection System

Wiring Diagram



889 Generator Protection System

Ordering

| 889 | E | * | * | * | * | * | * | A | * | * | * | * | * | * | * | * | * | * | N | Description | |
|-----------------------------------|-----|----|----|----|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--|--------------------------------|
| Base Unit | 889 | | | | | | | | | | | | | | | | | | | Generator Protection Relay (Standard : English Language; High Voltage PS, Graphical Control Panel) | |
| Language | E | | | | | | | | | | | | | | | | | | | English | |
| Phase Currents - Slot J Bank 1 | | P1 | | | | | | | | | | | | | | | | | | 1A three-phase currents (J1) with voltage (J2) | |
| Phase Currents - Slot K Bank 1 | | P5 | | | | | | | | | | | | | | | | | | 5A three-phase currents (J1) with voltage (J2) | |
| | | | P1 | | | | | | | | | | | | | | | | | 1A three-phase currents (K1) with voltage (K2) | |
| | | | P5 | | | | | | | | | | | | | | | | | 5A three-phase currents (K1) with voltage (K2) | |
| | | | R1 | | | | | | | | | | | | | | | | | 1A three-phase inputs (K1), 1A three-phase inputs (K2) | |
| | | | R5 | | | | | | | | | | | | | | | | | 5A three-phase inputs (K1), 5A three-phase inputs (K2) | |
| Ground Currents | | | | G1 | | | | | | | | | | | | | | | | 1A ground current (qty 1 per phase current bank) | |
| | | | | G5 | | | | | | | | | | | | | | | | 5A ground current (qty 1 per phase current bank) | |
| | | | | S1 | | | | | | | | | | | | | | | | 1A ground (J1, K2)+ 1A sensitive ground input (K1) | |
| | | | | S5 | | | | | | | | | | | | | | | | 5A ground (J1, K2) + 5A sensitive ground input (K1) | |
| | | | | B1 | | | | | | | | | | | | | | | | 1A ground (J1, K2)+ 50.0.025 ground input (K1) | |
| | | | | B5 | | | | | | | | | | | | | | | | 5A ground (J1, K2)+ 50.0.025 ground input (K1) | |
| Power Supply | | | | | H | | | | | | | | | | | | | | | 110 - 250 V dc/110 - 230 Vac | |
| | | | | | L | | | | | | | | | | | | | | | 24 - 48 VDC | |
| Slot B - LV I/O | | | | | | N | | | | | | | | | | | | | | None | |
| | | | | | | R | | | | | | | | | | | | | | 6 x RTDs (Pt100, Ni100, Ni120) | |
| | | | | | | S | | | | | | | | | | | | | | 6 x RTDs (Pt100, Ni100, Ni120, Cu10) | |
| Slot C - LV I/O | | | | | | | N | | | | | | | | | | | | | None | |
| | | | | | | | R | | | | | | | | | | | | | 6 x RTDs (Pt100, Ni100, Ni120) | |
| | | | | | | | S | | | | | | | | | | | | | 6 x RTDs (Pt100, Ni100, Ni120, Cu10) | |
| Slot F - HV I/O* | | | | | | | | A | | | | | | | | | | | | 2 Form A (Vmon), 3 Form C, 7 Digital Inputs (Low / High voltage, Int/Ext supply) | |
| Slot G - HV I/O* | | | | | | | | | N | | | | | | | | | | | None | |
| | | | | | | | | | A | | | | | | | | | | | 2 Form A (Vmon), 3 Form C, 7 Digital Inputs (Low / High voltage, Int/Ext supply) | |
| | | | | | | | | | | L | | | | | | | | | | 7 DcmA O/P + 4 DcmA I/P + 1 RTD | |
| Slot H - HV I/O* | | | | | | | | | | | N | | | | | | | | | None | |
| | | | | | | | | | | | A | | | | | | | | | 2 Form A (Vmon), 3 Form C, 7 Digital Inputs (Low / High voltage, Int/Ext supply) | |
| | | | | | | | | | | | | F | | | | | | | | 10 Digital Inputs + 4 Arc flash inputs | |
| Faceplate | | | | | | | | | | | | | M | | | | | | | Basic: Membrane Keypad | |
| | | | | | | | | | | | | | G | | | | | | | Standard: Rugged Keypad | |
| Current Protection | | | | | | | | | | | | | | M | | | | | | Standard = 38(RTD), 39(AnIp), 46 (Gen. Unbl), 49 (RTD), 50/27, 50OFL, 50OL, 50P2/CTbank), 50N1/CTbank), 50G, 50SG, 50_2(1/CTbank), 51V, 51N, 51G, 51SG, 67N, 67G, 67SG, 76 (AnIp), 87G | |
| | | | | | | | | | | | | | | | A | | | | | Advanced = Standard + 67P, 67_2, 87GD (RGF/REF), 87O | |
| Voltage Monitoring & Protection | | | | | | | | | | | | | | | | S | | | | Standard=24, 25, 27TN, 27P, 27X, 32, 40Q, 40, 47, 59X, 81O, 81U | |
| | | | | | | | | | | | | | | | | | P | | | Advanced = Standard + 55, 59P, 59N, 59_2, 64TN (100% stator ground), 78, 81R | |
| Control | | | | | | | | | | | | | | | | | | F | | Standard = Setpoint Group Control, Virtual Inputs Control, Trip Bus, FlexLogic, VTF, 50BF, Sequential Shutdown, Field Breaker Discrepancy, Breaker Control | |
| | | | | | | | | | | | | | | | | | | | T | Advanced HMI = Standard + Tab PBs, Annunciator Panel, Configurable SLDs with Bay Control | |
| Monitoring | | | | | | | | | | | | | | | | | | | B | Basic = Breaker Coils and Arcing Monitoring, Demand, Digital Counters, Running hours | |
| | | | | | | | | | | | | | | | | | | | | Standard = Basic + Breaker Health Report, 49TOL (Thermal Overload) | |
| | | | | | | | | | | | | | | | | | | | | Advanced = Standard + 81A, Harmonic Detection | |
| Communications | | | | | | | | | | | | | | | | | | | | Standard = Front USB, 1 x Rear RS485 : Modbus RTU, DNP3.0, IEC60870-5-103 + 1 x Ethernet (Modbus TCP, DNP) | |
| | | | | | | | | | | | | | | | | | | | | Advanced = Front USB, 1 x Rear RS485 + 2 x Ethernet, MODBUS RTU / TCP, DNP3.0, IEC 60870-5-103/104, 1588, SNT, OPC UA | |
| | | | | | | | | | | | | | | | | | | | | Advanced + PRP | |
| | | | | | | | | | | | | | | | | | | | | Advanced + IEC 61850 | |
| | | | | | | | | | | | | | | | | | | | | Advanced + PRP + IEC 61850 | |
| | | | | | | | | | | | | | | | | | | | | Advanced + Extended IEC 61850 | |
| | | | | | | | | | | | | | | | | | | | | Advanced + PRP + Extended IEC 61850 | |
| Advanced Communications Connector | | | | | | | | | | | | | | | | | | | N | None | |
| | | | | | | | | | | | | | | | | | | | | S | ST, Multi-mode Fiber 1310nm |
| | | | | | | | | | | | | | | | | | | | | C | RJ45, Copper 10/100M |
| Wireless Communication | | | | | | | | | | | | | | | | | | | | N | None |
| | | | | | | | | | | | | | | | | | | | | W | WiFi 802.11 |
| Security | | | | | | | | | | | | | | | | | | | | B | Basic |
| | | | | | | | | | | | | | | | | | | | | A | Advanced - CyberSentry Level 1 |

Note: Harsh Environment Coating is a standard feature on all 8 series units.
 *HV I/O, Option A - Max 2 across slots F through H
 Arc Flash Detection (Option F): Includes 4 x Arc Flash sensors, each 18 feet long



Testing and Certification

| TEST | REFERENCE STANDARD | TEST LEVEL |
|------------------------------------|-------------------------------|--|
| Dielectric voltage withstand | EN60255-5/IEC 60255-27 | 2.3 kV |
| Impulse voltage withstand | EN60255-5/IEC 60255-27 | 5kV |
| Damped Oscillatory | IEC61000-4-18/IEC60255-22-1 | 2.5 kV CM, 1 kV DM |
| Electrostatic Discharge | EN61000-4-2/IEC60255-22-2 | Level 4 |
| RF Immunity | EN61000-4-3/IEC60255-22-3 | Level 3 |
| Fast Transient Disturbance | EN61000-4-4/IEC60255-22-4 | Class A and B |
| Surge Immunity | EN61000-4-5/IEC60255-22-5 | Level 3 & 4 |
| Conducted RF Immunity | EN61000-4-6/IEC60255-22-6 | Level 3 |
| Power Frequency Immunity | EN61000-4-7/IEC60255-22-7 | Class A & B |
| Voltage interruption and Ripple DC | IEC60255-11 | PQT levels based on IEC61000-4-29, IEC61000-4-11 and IEC61000-4-17 |
| Radiated & Conducted Emissions | CISPR11 /CISPR22/ IEC60255-25 | Class A |
| Sinusoidal Vibration | IEC60255-21-1 | Class 1 |
| Shock & Bump | IEC60255-21-2 | Class 1 |
| Seismic | IEC60255-21-3 | Class 2 |
| Power magnetic Immunity | IEC61000-4-8 | Class 5 |
| Pulse Magnetic Immunity | IEC61000-4-9 | Class 4 |
| Damped Magnetic Immunity | IEC61000-4-10 | Class 4 |
| Voltage Dip & interruption | IEC61000-4-11 | 0, 40, 70, 80% dips, 250/300 cycle interrupts |
| Conducted RF Immunity 0-150khz | IEC61000-4-16 | Level 4 |
| Ingress Protection | IEC60529 | IP54 front |
| Environmental (Cold) | IEC60068-2-1 | -40C 16 hrs |
| Environmental (Dry heat) | IEC60068-2-2 | 85C 16hrs |
| Relative Humidity Cyclic | IEC60068-2-30 | 6day variant 2 |
| EFT | IEEE/ANSI C37.90.1 | 4kV, 2.5 kHz |
| Damped Oscillatory | IEEE/ANSI C37.90.1 | 2.5kV, 1 MHz |
| RF Immunity | IEEE/ANSIC37.90.2 | 20V/m, 80 MHz to 1GHz |
| ESD | IEEE/ANSIC37.90.3 | 8kV CD/ 15 kV AD |
| Safety | UL508 | e57838 NKCR |
| | UL C22.2-14 | e57838 NKCR7 |

| APPROVALS | | |
|---------------|---|---|
| | APPLICABLE COUNCIL DIRECTIVE | ACCORDING TO |
| CE compliance | Low voltage directive | EN60255-5 / EN60255-27 |
| | EMC Directive | EN60255-26 / EN50263 EN61000-6-2 / EN61000-6-4 |
| | | |
| North America | cULus | UL508 UL1053 C22.2.No 14 |
| ISO | Manufactured under a registered quality program | ISO9001 |

| ENVIRONMENTAL | |
|------------------------------|--|
| Ambient temperatures: | |
| Storage/Shipping: | -40°C to 85°C |
| Operating: | -40°C to 60°C (continuous) |
| Humidity: | Operating up to 95% (non condensing) @ 55°C (As per IEC60068-2-30 Variant 2, 6days) |
| Altitude: | 2000m (max) |
| Pollution Degree: | II |
| Overvoltage Category: | III |
| Ingress Protection: | IP54 Front |

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GEA-12945A(E)
English
170828



Product data sheet Characteristics

170ADM85010 discrete I/O module Modicon Momentum - 16 I/O relay

Product availability : Stock - Normally stocked in distribution facility



Main

| | |
|---------------------------|---|
| Range of product | Modicon Momentum automation platform |
| Product or component type | Discrete relay I/O base DC |
| Group of channels | 1 group of 16 outputs 1 group of 16 inputs |
| Discrete input number | 16 IEC 1131-2 Type 3 |
| Discrete input logic | Positive |
| Discrete input voltage | 12 V DC 24 V DC 48 V DC |
| Discrete output number | 16 |
| Discrete output type | Solid state switch |
| Discrete output voltage | <= 60 V DC 12 V DC 24 V DC 48 V DC |
| Discrete output logic | Positive |
| Protective treatment | TC |

Complementary

| | |
|----------------------------|--|
| [Us] rated supply voltage | 12 V DC 24 V DC 48 V DC |
| Input voltage limits | 10...60 V |
| Voltage state 0 guaranteed | < 10 V 48 V < 2.5 V 12 V < 5 V 24 V |
| Voltage state 1 guaranteed | > 11 V 24 V > 30 V 48 V > 7.5 V 12 V |

Disclaimer: This documentation is not intended as a substitute for and is not to be used for determining suitability or reliability of these products for specific user applications.

| | |
|---|--|
| Current state 1 guaranteed | 2.3 mA 12 V 2.7 mA 24 V 2.9 mA 48 V |
| Discrete output current | 0.5 A per point 7 A 140 °F (60 °C) per module 8 A 122 °F (50 °C) per group |
| Leakage current | < 1 mA 60 V output circuit |
| Peak output current | 5 A |
| Voltage drop | < 1 V 0.5 A at state 1 output circuit |
| Fault type | Overload on output |
| Response time | < 0.1 ms from state 0 to state 1 on output < 0.1 ms from state 1 to state 0 on output 2.2 ms from state 0 to state 1 on input 3.3 ms from state 1 to state 0 on input |
| Isolation between group of I/O channels | 707 V DC |
| Isolation between channels and bus | 707 V DC |
| Power dissipation | 6.0 + (0.144 x number of input points) + (0.25 x number of output points) |
| Current consumption | 125 mA 48 V DC 250 mA 24 V DC 500 mA 12 V DC |
| Depth | 1.87 in (47.5 mm) |
| Height | 5.57 in (141.5 mm) |
| Width | 4.92 in (125 mm) |

Environment

| | |
|---------------------------------------|---|
| Product certifications | CSA UL FM Class 1 Division 2 |
| Resistance to electrostatic discharge | 4 kV contact IEC 801-2 8 kV on air IEC 801-2 |
| Resistance to electromagnetic fields | 9.14 V/yd (10 V/m) 80...1000 MHz IEC 801-3 |
| Ambient air temperature for operation | 32...140 °F (0...60 °C) |
| Ambient air temperature for storage | -40...185 °F (-40...85 °C) |
| Relative humidity | 95 % without condensation |
| Operating altitude | <= 16404.2 ft (5000 m) |

Ordering and shipping details

| | |
|-----------------------|---|
| Category | 18206 - MOMENTUM PROCESSORS,I/O BASES,CONN. |
| Discount Schedule | PC31 |
| GTIN | 00785901449584 |
| Nbr. of units in pkg. | 1 |
| Package weight(Lbs) | 1.02 |
| Returnability | Y |
| Country of origin | FR |

Offer Sustainability

| | |
|----------------------------------|--|
| Sustainable offer status | Green Premium product |
| RoHS (date code: YYWW) | Compliant - since 1350 - Schneider Electric declaration of conformity |
| REACH | Reference not containing SVHC above the threshold Reference not containing SVHC above the threshold |
| Product environmental profile | Available |
| Product end of life instructions | Available |

Contractual warranty

| | |
|-----------------|-----------|
| Warranty period | 18 months |
|-----------------|-----------|

Specifications

Overview

This section contains specifications for the 170AMM11030 Momentum I/O base.

General Specifications

The following table contains general specifications for the I/O base. Each discrete output is protected against short-circuiting and overload.

| External Power Requirement | |
|--|---|
| Normal Operating Voltage Range | 16 to 42 VDC |
| Absolute Minimum Voltage | 12 VDC |
| Absolute Maximum Voltage | 45 VDC |
| Electrical | |
| Module Current | 400 mA at 24 VDC |
| EMC for Industrial Environment | |
| Immunity | IEC 1131-2 Surge on auxiliary power supply 500 V |
| Emissions | EN 50081-2 |
| ENV 50140 | 10 V/M |
| Agency Approvals | UL, CSA, CE, FM Class 1, Div. 2 (pending) |
| Isolation | |
| Discrete I/O point to discrete I/O point | None |
| Field to ground | 500 VAC |
| Field to communication adapter | 500 VAC |
| Analog output channel to channel | 700 VDC |
| Environmental | |
| Storage Temperature | -40 to 85° C |
| Operating Temperature | 0 to 60° C |
| Humidity Operating | 95% RH @ 60° C |
| Humidity Non-Operating | 95% RH @ 60° C |
| Vibration Operating | 10 - 57 HZ 0.075 MMDA 57 - 150 HZ 1 G |
| Shock Non-Operating | 15 G, 11 MS, 3 shocks/axis |
| Free Fall (Unpackaged) | 0.1 meter |

Analog Inputs

The following table contains specifications for analog inputs.

| | |
|---|--|
| Number of Channels | 2 |
| Input Ranges | ± 10 VDC |
| Input Type | Single-ended |
| Resolution | 14 bit |
| Surge Tolerance | |
| Voltage Input | ± 30 VDC |
| Over-range Tolerance | 5% full scale |
| Protection | Polarity inversion |
| Common Mode Rejection | 250 VAC @ 47 to 63 HZ or 250 VDC channel to ground |
| Cross Talk Between Channels | ± lowest significant bit |
| Common Mode Rejection Ration @ DC | ± lowest significant bit |
| Common Mode Rejection Ration @ 50/60 | ± lowest significant bit |
| Maximum Input Signal | 15 VDC for voltage input |
| Filtering | Low pass with cutoff frequency 900 Hz |
| Conversion Times | 1.6 ms maximum for 2 input channels |
| Sampling Period | 3.2 ms per channel |
| Range | ± 10 VDC |
| Input Impedance | > 2.2 MOhm |
| Error @ 25°C | 0.2% for full scale |
| Error @ 60°C | 0.55% for full scale |
| Temperature Drift @ 60°C | 100ppm full scale /°C |

Analog Outputs

The following table contains specifications for analog outputs.

| | |
|---|---|
| Number of Channels | 2 |
| Output Ranges | ± 10 VDC |
| Resolution | 14 Bit |
| Conversion Times | 1.60 ms for all channels |
| Output Setting Time | 3.2 ms to 0.1% of final value |
| Accuracy | Max. error @ 25°C ± 0.4% for -10 to +10 VDC |
| Linearity | ± 1 LSB, Guaranteed Monotonic |
| Output Impedance | < 0.2 Ohms |
| Maximum Output Current | 5 mA |
| Maximum Temperature Drift @ 60°C | ± 100 ppm of full scale per °C |
| Data Format | Left justified |
| Crosstalk Between Channels | 80 dB |
| Load | > 2K Ohms @ ±10 VDC |
| Channel to Channel Isolation | 700 VDC |

Discrete Inputs

The following table contains specifications for discrete inputs.

| | |
|-----------------------------------|--|
| Operating Voltage | 16 to 42 VDC |
| Absolute Minimum Voltage | 12 VDC |
| Absolute Maximum Voltage | 45 VDC |
| Number of Points | 16 |
| Number of Groups | 1 |
| Points per Group | 16 |
| Type of Signal | True high (sourcing) |
| IEC 1131 I/O Type @ 24 VDC | 1+ |
| Minimum ON Voltage | > 11 VDC |
| Maximum OFF Voltage | < 5 VDC |
| Input Operating Current | 1.2 mA and lower, off 2.5 to 10 mA, on |
| Input Voltage | |
| Range | 16 to +42 VDC |
| Surge | 75 volt peak for 10 ms |
| Response Time | 6.2 ms OFF to ON @ 24 VDC 7.3 ms ON to OFF @ 24 VDC |

Discrete Outputs The following table contains specifications for discrete outputs.

| | |
|---------------------------------|--------------------------------------|
| Description | Solid state switch |
| Operating Voltage | 16 - 42 VDC |
| Absolute Minimum Voltage | 12 VDC |
| Absolute Maximum Voltage | 45 VDC |
| Maximum Voltage | 50 VDC for 1 ms |
| Number of Points | 8 |
| Number of Groups | 1 |
| Points per Group | 8 |
| Current Capacity | 250 mA per point 2 amps per module |
| Type of Signal | True high (sourcing) |
| Leakage Current | < 1 mA @ 42 VDC |
| Surge Current | 5 amps for 1 ms |
| On State Voltage Drop | < 1.0 VDC max at 0.25 amp current |
| Fault Sensing | Overload and short circuit |
| Fault Reporting | System bit |
| Response Time | 1.8 ms OFF to ON 1.8 ms ON to OFF |

| | |
|---|--|
|  | CAUTION |
| | <p>Discrete VDC outputs incorporate thermal shutdown and overload protection.</p> <p>The output current of a shorted output is limited to a nondestructive value. The short circuit heats the output driver, and the output will switch off. The output will switch on again if the driver leaves the over temperature condition and the user resets the output under program control. If the short circuit still exists after the output point is reset, the driver will reach the over temperature condition again and will switch off again.</p> <p>Failure to follow this precaution can result in injury or equipment damage.</p> |

Product data sheet Characteristics

171CBU98091

Unity M1E processor - RS232/485 - Ethernet -
USB - I/O bus - global data



Main

| | |
|----------------------------|--------------------------------------|
| Range of product | Modicon Momentum automation platform |
| Product or component type | Processor |
| Product compatibility | Modicon STB I/O |
| Integrated connection type | Ethernet USB port |

Complementary

| | |
|--------------------------------|---|
| Concept | Transparent Ready class B |
| Web services | Ethernet statistics Home pages CPU status Properties Bandwidth monitoring |
| Software designation | Unity Pro |
| Communication service | Modbus TCP I/O Scanner and Messaging Global Data, 2200 I/O message per second Modbus messaging 125 words, 200 I/O message per second |
| Processor name | Spear 320s |
| Word length | 32 bit |
| Supply voltage limits | 4.75...5.25 V |
| Clock frequency | 333 MHz |
| Topology | Star Modbus TCP Multidrop Modbus |
| Communication port protocol | Modbus TCP Ethernet 1 RJ45 10/100 Mbps twisted shielded pairs cable CAT 5E UTP Modbus RS485/RS232 1 RJ45 19200 bps 2-wire |
| Method of access | Master/Slave Client/Server |
| Control parameter | CRC-16 for Modbus CRC-32 for Modbus TCP/IP |
| Addressing | Unique IEEE global address Modbus TCP 1...247 Modbus |
| Fail state | Safe I/O mode |
| Memory description | Program memory LL984 3584 kB Program memory IEC 3584 kB |
| Register words | 26048 |
| I/O limit processor capacity | 2048 inputs/2048 outputs |
| Number of devices | 32 Modbus |
| Exact time for 1 K instruction | 83 ns |
| Local signalling | 1 LED green status of Ethernet network (ETH STS) 1 LED green data rate (ETH LINK) 1 LED green data rate (ETH 100) 1 LED yellow channel 0 operating (CH0) 1 LED red I/O module fault (I/O) 1 LED red processor or system fault (ERR) 1 LED green processor running (RUN) |
| Marking | CE |
| Current consumption | 500 mA at 5 V DC |

The information provided in this documentation contains general descriptions and/or technical characteristics of the performance of the products contained herein. This documentation is not intended as a substitute for and is not to be used for determining suitability or reliability of these products for specific user applications. It is the duty of any such user or integrator to perform the appropriate and complete risk analysis, evaluation and testing of the products with respect to the relevant specific application or use thereof. Neither Schneider Electric Industries SAS nor any of its affiliates or subsidiaries shall be responsible or liable for misuse of the information contained herein.

May 26, 2015

Schneider
Electric

1

| | |
|------------------|----------------------------|
| Module format | Standard |
| Product mounting | 35 mm symmetrical DIN rail |
| Height | 60.6 mm |
| Width | 144 mm |
| Depth | 53.47 mm |
| Product weight | 0.163 kg |

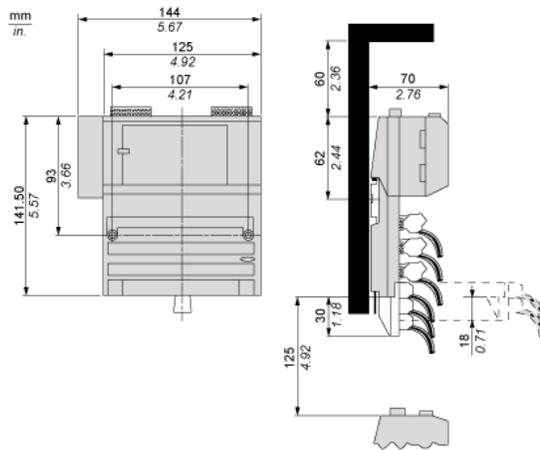
Environment

| | |
|---------------------------------------|---|
| Material | Lexan |
| Dielectric strength | 5000 V for 1 minute Ethernet 0 V not isolated RS485/RS232 |
| Product certifications | C-Tick FM |
| Standards | CSA C22.2 No 142 EN/IEC 61131-2 UL 508 |
| IP degree of protection | IP20 |
| Shock resistance | 15 gn during 11 ms sinusoidal vibrations |
| Resistance to electrostatic discharge | 8 kV on air conforming to EN/IEC 61000-4-2 6 kV contact conforming to IACS E10 6 kV contact conforming to EN/IEC 61131-2 zone B |
| Resistance to electromagnetic fields | 15 V/m 80...2700 MHz conforming to EN/IEC 61000-4-3 |
| Ambient air temperature for operation | 0...60 °C |
| Ambient air temperature for storage | -40...85 °C |
| Relative humidity | 5...96 % |
| Operating altitude | <= 2000 m |

Product data sheet Dimensions Drawings

171CBU98091

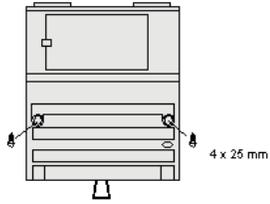
Processor and Option Adapter on a Typical Base



Product data sheet Mounting and Clearance

171CBU98091

Mounting on a Wall





Industrial Ethernet Switch - FL SWITCH 3008 - 2891031

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Managed Ethernet switch with eight RJ45 ports at 10/100 Mbps and operating temperature of -10°C ... +60°C

Product Description

FL SWITCH 3000 managed industrial Ethernet switches combine extensive network performance and security features with complete IEEE redundancy (STP/RSTP/MST) and 15 ms recovery time extended ring redundancy. Unique web customization provides a simplified user interface for today's applications and scalable functionality for future needs. A comprehensive mix of fiber optic and copper port connections meets a wide range of applications.

Product Features

- ✓ Unique cleanup function hides unused configuration pages, reducing complexity, maintenance and startup times
- ✓ Auto negotiation and autocrossing detection simplifies installation and setup
- ✓ Security options with cable locking
- ✓ Secure web-based and SNMP-based management
- ✓ Extensive web diagnostics with configurable LED and remote alarm contacts
- ✓ RJ45 ports support a transmission speed of 10/100 Mbps; fiber optic ports support 100 Mbps
- ✓ -40 to 75°C and -10 to 60°C ambient temperature versions



Ethernet

Key Commercial Data

| | |
|--------------------------------------|----------|
| Packing unit | 1 pc |
| Weight per Piece (excluding packing) | 1264.0 g |
| Custom tariff number | 85176200 |
| Country of origin | Taiwan |

Technical data

Dimensions

| | |
|--------|----------|
| Width | 54.4 mm |
| Height | 146.4 mm |
| Depth | 125 mm |



Industrial Ethernet Switch - FL SWITCH 3008 - 2891031

Technical data

Ambient conditions

| | |
|--|--|
| Degree of protection | IP20 |
| Ambient temperature (operation) | -10 °C ... 60 °C |
| Ambient temperature (storage/transport) | -20 °C ... 85 °C |
| Permissible humidity (operation) | 5 % ... 95 % (non-condensing) |
| Permissible humidity (storage/transport) | 5 % ... 95 % (non-condensing) |
| Air pressure (operation) | 57 kPa ... 108 kPa (up to 4850 m above mean sea level) |
| Air pressure (storage/transport) | 57 kPa ... 108 kPa (up to 4850 m above mean sea level) |
| Noise immunity | EN 61000-6-2:2005 |

Interfaces

| | |
|---------------------------|---------------------------------------|
| Interface 1 | Ethernet (RJ45) |
| No. of ports | 8 (RJ45 ports) |
| Connection method | RJ45 |
| Note on connection method | Auto negotiation and autocrossing |
| Transmission physics | Ethernet in RJ45 twisted pair |
| Transmission speed | 10/100 MBit/s (with auto negotiation) |
| Transmission length | 100 m |

Function

| | |
|----------------------------------|--|
| Basic functions | Managed switch |
| Status and diagnostic indicators | LEDs: U_{S1} , U_{S2} (redundant voltage supply), link and activity per port |
| Signal contact control voltage | 24 V DC |
| Signal contact control current | 1 A |

Network expansion parameters

| | |
|---|--|
| Cascading depth | Network, linear, and star structure: any |
| Maximum conductor length (twisted pair) | 100 m |

Supply voltage

| | |
|-----------------------------|--|
| Supply voltage | 24 V DC (redundant) |
| Residual ripple | 3.6 V _{PP} (within the permitted voltage range) |
| Supply voltage range | 12 V DC ... 48 V DC |
| Typical current consumption | 210 mA (at $U_S = 24$ V DC) |
| Inrush surge current | 8.6 A (2 ms) |

General

| | |
|------------------|----------------------------|
| Mounting type | NS 35 (IEC 60715) DIN rail |
| Type AX | Block design |
| Net weight | 940 g |
| Housing material | Aluminum |



Industrial Ethernet Switch - FL SWITCH 3008 - 2891031

Technical data

General

| | |
|----------------|--------------|
| Noise emission | EN 61000-6-4 |
|----------------|--------------|

Connection data

| | |
|---------------------------------------|---------------------------------------|
| Connection method | Pluggable COMBICON screw connections, |
| Conductor cross section solid min. | 0.2 mm ² |
| Conductor cross section solid max. | 2.5 mm ² |
| Conductor cross section flexible min. | 0.2 mm ² |
| Conductor cross section flexible max. | 2.5 mm ² |
| Conductor cross section AWG min. | 24 |
| Conductor cross section AWG max. | 12 |
| Stripping length | 7 mm |

Mechanical tests

| | |
|--------------|--|
| Type of test | Shock in acc. with EN 60068-2-27/IEC 60068-2-27 |
| Test result | 25g, 11 ms half-sine shock pulse |
| Type of test | Vibration resistance in acc. with EN 60068-2-6/IEC 60068-2-6 |
| Test result | 5g, 150 Hz, Criterion 3 |
| Type of test | Free fall in acc. with IEC 60068-2-32 |
| Test result | 1 m |

Conformity with EMC directives

| | |
|---------------------------------|--|
| Developed in acc. with standard | IEC 61000-6.2 |
| Test standard | IEC 61000-4-2 (ESD) |
| Test result | Criterion B |
| Test standard | IEC 61000-4-3 (immunity to radiated interference) |
| Test result | Criterion A |
| Test standard | IEC 61000-4-4 (burst) |
| Test result | Criterion A |
| Test standard | IEC 61000-4-5 (surge) |
| Test result | Criterion B |
| Test standard | IEC 61000-4-6 (immunity to conducted interference) |
| Test result | Criterion A |
| Test standard | IEC 61000-4-8 (immunity to magnetic fields) |
| Test result | Criterion A |
| Test standard | EN 55022 (emitted interference) |
| Test result | Class A |



Industrial Ethernet Switch - FL SWITCH 3008 - 2891031

Classifications

eCl@ss

| | |
|------------|----------|
| eCl@ss 4.0 | 27250501 |
| eCl@ss 4.1 | 27250501 |
| eCl@ss 5.0 | 19030117 |
| eCl@ss 5.1 | 19030117 |
| eCl@ss 6.0 | 19170106 |
| eCl@ss 7.0 | 19170106 |
| eCl@ss 8.0 | 19170106 |

ETIM

| | |
|----------|----------|
| ETIM 4.0 | EC000734 |
| ETIM 5.0 | EC000734 |

UNSPSC

| | |
|---------------|----------|
| UNSPSC 6.01 | 43172901 |
| UNSPSC 7.0901 | 43201404 |
| UNSPSC 11 | 43172015 |
| UNSPSC 12.01 | 43201410 |
| UNSPSC 13.2 | 43201410 |

Approvals

Approvals

Approvals

UL Listed / EAC / EAC / cUL Listed / cULus Listed

Ex Approvals

UL Listed / cUL Listed / cULus Listed

Approvals submitted

Approval details

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|---|
| UL Listed  |
|---|



Industrial Ethernet Switch - FL SWITCH 3008 - 2891031

Approvals

EAC

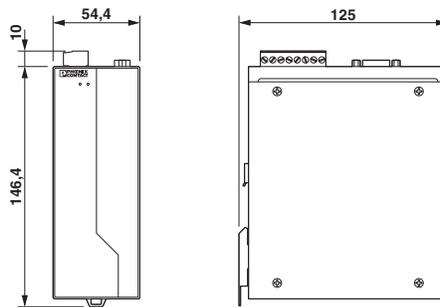
EAC

cUL Listed 

cULus Listed 

Drawings

Dimensional drawing





FO converters - FL MC 2000T ST - 2891316

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FO converter with ST fiber optic connection (1300 nm), for converting 100Base-TX to multi-mode fiberglass. Auto MDI(X) function and comprehensive link diagnostics. DIN rail mountable with wide operating temperature range.

Product Description

The FL MC 2000T media converter comes with one 10/100 Mbps twisted-pair RJ45 port and one 100 Mbps multimode fiber port with an ST connector



Key Commercial Data

| | |
|--------------------------------------|---|
| Packing unit | 1 pc |
| GTIN |  4 046356 869584 |
| GTIN | 4046356869584 |
| Weight per Piece (excluding packing) | 300.000 g |
| Custom tariff number | 85176200 |
| Country of origin | Taiwan |

Technical data

Note

| | |
|-------------------------|---|
| Utilization restriction | EMC: class A product, see manufacturer's declaration in the download area |
|-------------------------|---|

Dimensions

| | |
|--------|--------|
| Width | 28 mm |
| Height | 110 mm |
| Depth | 70 mm |

Ambient conditions

| | |
|---------------------------------|------------------|
| Ambient temperature (operation) | -40 °C ... 75 °C |
|---------------------------------|------------------|



FO converters - FL MC 2000T ST - 2891316

Technical data

Ambient conditions

| | |
|--|-------------------------------|
| Ambient temperature (storage/transport) | -40 °C ... 85 °C |
| Permissible humidity (operation) | 5 % ... 95 % (non-condensing) |
| Permissible humidity (storage/transport) | 5 % ... 95 % (non-condensing) |
| Altitude | 4850 m |
| Degree of protection | IP20 |

General

| | |
|--|--|
| Electrical isolation | VCC // FE // Ethernet |
| Latency | 865 ns (Pass-through mode) |
| Test voltage data interface/power supply | 1500 V AC (500 V AC, 1 minute) |
| Electromagnetic compatibility | Conformance with EMC Directive 2014/30/EU |
| Mounting position | On horizontal DIN rail NS 35 in acc. with EN 60715 |
| Mounting type | DIN rail mounting |
| Net weight | 310.3 g |
| Housing material | Aluminum |
| MTTF | 77.82 Years (MIL-HDBK-217F standard, temperature 25°C, operating cycle 100%) |
| Conformance | CE-compliant |
| UL, USA / Canada | Class I, Div. 2, Groups A, B, C, D |

Power supply

| | |
|-----------------------------|--|
| Nominal supply voltage | 24 V DC |
| Supply voltage range | 12 V DC ... 48 V DC |
| Typical current consumption | 110 mA (24 V DC) |
| Connection method | Plug-in screw terminal block (COMBICON), redundancy possible |

Interfaces

| | |
|---------------------------|---|
| Interface 1 | Ethernet interface, 10/100Base-T(X) in accordance with IEEE 802.3 |
| No. of ports | 1 |
| Connection method | RJ45 jack, shielded |
| Transmission medium | Copper |
| Transmission length | 100 m (twisted pair, shielded) |
| Auto-negotiation modes | Auto |
| Link through | Link fault pass through |
| MDI-/MDI-X switchover | Auto-MDI(X) |
| Signal LEDs | LNK/ACT, 100 |
| Serial transmission speed | 10/100 Mbps |

Optical interface FO

| | |
|------------|---------|
| Wavelength | 1310 nm |
|------------|---------|



FO converters - FL MC 2000T ST - 2891316

Technical data

Optical interface FO

| | |
|---|--|
| Transmission length incl. 3 dB system reserve | 8 km (fiberglass with F-G 62.5/125 0.7 dB/km F1000) |
| | 3.3 km (fiberglass with F-G 62.5/125 2.6 dB/km F600) |
| | 9.6 km (fiberglass with F-G 50/125 0.7 dB/km F1200) |
| | 5.3 km (fiberglass with F-G 50/125 1.6 dB/km F800) |
| Transmission medium | Multi-mode fiberglass |
| | GI-HCS fiber |
| Connection method | B-FOC (ST®) |

Digital outputs

| | |
|---------------------------|--------------|
| Output name | Relay output |
| Output description | Alarm output |
| Number of outputs | 1 |
| Contact type | N/C contact |
| Maximum switching voltage | 24 V DC |
| Max. switching current | 100 mA |

Standards and Regulations

| | |
|-------------------------------|--|
| Electromagnetic compatibility | Conformance with EMC Directive 2014/30/EU |
| Type of test | Vibration resistance in acc. with EN 60068-2-6/IEC 60068-2-6 |
| Test result | 5g, 150 Hz, Criterion 3 |
| Type of test | Shock in acc. with EN 60068-2-27/IEC 60068-2-27 |
| Test result | 30g, 11 ms half-sine shock pulse |
| Standards/regulations | EN 61000-4-2 |
| | EN 61000-4-3 |
| | EN 61000-4-4 |
| Comments | Criterion A |
| Standards/regulations | EN 61000-4-5 |
| | EN 55032 |
| | EN 61000-4-6 |
| Shock | 300 m/s ² , 11 ms (IEC 60068-2) |
| Conformance | CE-compliant |
| UL, USA / Canada | Class I, Div. 2, Groups A, B, C, D |

Environmental Product Compliance

| | |
|------------|---|
| REACH SVHC | Lead 7439-92-1 |
| China RoHS | Environmentally Friendly Use Period = 10; |
| | For details about hazardous substances go to tab "Downloads", Category "Manufacturer's declaration" |



FO converters - FL MC 2000T ST - 2891316

Classifications

eCl@ss

| | |
|---------------|----------|
| eCl@ss 10.0.1 | 19170132 |
| eCl@ss 11.0 | 19170411 |
| eCl@ss 4.0 | 27230200 |
| eCl@ss 4.1 | 27230200 |
| eCl@ss 5.0 | 27230200 |
| eCl@ss 5.1 | 27230200 |
| eCl@ss 6.0 | 19179200 |
| eCl@ss 7.0 | 19179290 |
| eCl@ss 9.0 | 19170114 |

ETIM

| | |
|----------|----------|
| ETIM 4.0 | EC001099 |
| ETIM 6.0 | EC001467 |
| ETIM 7.0 | EC001467 |

UNSPSC

| | |
|-------------|----------|
| UNSPSC 13.2 | 43222604 |
| UNSPSC 18.0 | 43223323 |
| UNSPSC 19.0 | 43223323 |
| UNSPSC 20.0 | 43223323 |
| UNSPSC 21.0 | 43223323 |

Approvals

Approvals

Approvals

UL Listed / cUL Listed / cULus Listed

Ex Approvals

UL Listed / cUL Listed / cULus Listed

Approval details

| | | | |
|-----------|--|---|---------------|
| UL Listed | | http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/index.htm | FILE E 140324 |
|-----------|--|---|---------------|



FO converters - FL MC 2000T ST - 2891316

Approvals

| | | | |
|------------|---|---|---------------|
| cUL Listed |  | http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/index.htm | FILE E 140324 |
|------------|---|---|---------------|

| | |
|--------------|---|
| cULus Listed |  |
|--------------|---|

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DA50A

1-Sled Scalable IIoT Gateway

▲ FLEXEDGE™ Intelligent Edge Automation Platform

CLOUD, EDGE, WIRED, OR WIRELESS, DESIGN YOUR IDEAL INDUSTRY 4.0 OR IIOT APPLICATION WITH EASE.

- ▲ Modular architecture allows for easy addition of communication capabilities including cellular, Wi-Fi, serial and USB
- ▲ Advanced networking support offers routing, NAT, firewall, and VPN support to ensure data security
- ▲ On-board I/O with configurable AI/DI and DO to monitor and control local sensors
- ▲ Field upgradeable software to enhance capability of gateway if application changes
- ▲ Supports up to 10 simultaneous protocol conversions between over 300 industrial drivers (optional)
- ▲ Real-time data logging to microSD card or via FTP (optional)
- ▲ Industrial construction for reliable operation
- ▲ Intuitive LED status ring



▲ Ordering Guide

MAIN UNIT

| PART NUMBER | DESCRIPTION | SW GROUP |
|------------------|--|----------|
| DA50A0BNN0000010 | FlexEdge 1-Sled Mixed Serial Networking Gateway | Group 1 |
| DA50A0BNN0000020 | FlexEdge 1-Sled Mixed Serial Protocol Gateway | Group 2 |
| DA50A0BNN0000030 | FlexEdge 1-Sled Mixed Serial Adv IIoT Gateway | Group 3 |
| DA50A0BNN0000040 | FlexEdge 1-Sled Mixed Serial Adv Automation Controller | Group 4 |

ACCESSORIES

| PART NUMBER | DESCRIPTION |
|------------------|--|
| DAS00CL9C4SAM000 | 4G LTE (CAT4) Cellular Sled for AMER (AT&T, Generic) |
| DAS00CL9C1SAZ000 | 4G LTE (CAT1) Cellular Sled for AUS (Telstra) |
| DAS00CL9C4SVZ000 | 4G LTE (CAT4) Cellular Sled for AMER (Verizon) |
| DAS00CL9C4SEU000 | 4G LTE (CAT4) Cellular Sled for EMEA, SAARC, APAC |
| DAS00WF10N0AM000 | 802.11n Wi-Fi Sled |
| DAS00PN40U400000 | 1 Port USB 2.0 Host Sled |
| DAS00PN2221IS000 | Dual RS232 Ports Sled (Isolated) |
| DAS00PN2442IS000 | Dual RS485 Ports Sled (Isolated) |
| DAS00PN2245IS000 | Mixed RS232/RS485 Ports Sled (Isolated) |

See software manual for details on sled operation.

DA50A Ordering Guide Cont. and Specifications

SOFTWARE GROUPS

| | GROUP 1 NETWORKING | GROUP 2 PROTOCOL | GROUP 3 ADV IIOT | GROUP 4 CONTROLLER |
|----------------------|-----------------------|---------------------|---------------------|-----------------------|
| CONFIGURATION | | | | |
| Web GUI | Y | Y | Y | Y |
| Crimson | Y | Y | Y | Y |
| NETWORKING | | | | |
| Firewall | Y | Y | Y | Y |
| RADIUS Auth. | Y | Y | Y | Y |
| Routing | Y | Y | Y | Y |
| NAT | Y | Y | Y | Y |
| IP Fallback | Y | Y | Y | Y |
| VPN Client/Server | Y | Y | Y | Y |
| AUTOMATION | | | | |
| 300+ Drivers | | Y | Y | Y |
| IIoT Connectors | | Y | Y | Y |
| OPC UA | | Y | Y | Y |
| SQL Sync | | | Y | Y |
| Data Logging | | | Y | Y |
| Virtual HMI | | | Y | Y |
| Advanced Web Server | | | Y | Y |
| IEC CONTROL | | | | |
| Crimson Control | | | | Y |

Specifications

Power Requirements

Supply Voltage: 12-24 VDC +/-15%, Class 2 source

| INPUT VOLTAGE | 12 V | 24 V |
|------------------------------------|-------|-------|
| Typ. Power DA50A Gateway Only | 2.5 W | 2.6 W |
| Max Power DA50A Gateway Only | 3.0 W | 3.1 W |
| Max Power DA50A Gateway, with Sled | 5.6 W | 5.7 W |

Battery

3 V Lithium coin cell.

Memory

On Board User Memory: 1 GB of non-volatile Flash memory.
Memory Card: microSD slot accepts Class 5 or better microSD cards up to 256 GB capacity. FAT32, industrial grade.

Communication Properties

USB Device Port: One (1) Isolated USB Type B Port Complies with USB Specification 2.0 (Full Speed)

Ethernet Ports: Two (2) 10BaseT / 100BaseTX RJ45 ports (1500 Vrms Network Isolation)

Serial Ports: Two Serial Ports with Individual Port Isolation

One (1) RS232 Serial RJ12 115200 Bps

One (1) RS485/RS422 Serial RJ45 115200 Bps

Digital Output (DOUT)

Configuration: Open Collector, reference to ground

Absolute Maximum IDC: 500 mADC (Vce = 750 mVDC)

Absolute Maximum VDC: 30 VDC (open circuit)

Absolute Minimum VDC: -0.4 VDC (open circuit)

Digital Input (DIN)

Configuration: Unisolated level detection, reference to ground

Active level: 2.5 VDC to 30 VDC

Inactive level: 0 VDC to 1.3 VDC

Absolute Minimum VDC: -0.3 VDC

Absolute Maximum VDC: 33 VDC

Leakage IDC at 5 VDC: 150 μ ADC

DA50A Specifications Cont. and Dimensions

Analog Input (Shared with Digital Input)

Configuration: Unisolated input, reference to ground
 Resolution: 4096 (ADC 12-bit)
 VDC per step: 9.483 mVDC (full scale level: 38.8 V)
 Accuracy: 2%
 Zero level: 0 VDC
 Absolute Minimum VDC: -0.3 VDC
 Absolute Maximum VDC: 33 VDC
 Leakage IDC at 5 VDC: 265.96 µADC typical

Emission CISPR 11 Class A
 IEC/EN 61010-1
 RoHS Compliant
 ATEX Approved
 Ⓜ II 3 G Ex ec IIC T4 Gc
 DEMKO 20 ATEX 2268X
 IECEx Approved
 IECEx UL 20.0007X
 UL Hazardous: File # E317425
 Rugged IP30 enclosure

Networking Capabilities

Tunneling: IPsec, GRE and Open VPN
 IP: NAT, port forwarding, dynamic DNS, DHCP Stateful inspection
 firewall, IP fallback and IP transparency
 Routing Protocols: VRRP Encapsulation Protocols

Connections

Wire Strip Length: 0.3" (7.5 mm)
 Wire Gauge Capacity: 12 to 24 AWG (3.31 to 0.20 mm²) copper
 wire only

Environmental

Operating Temperature: -40 to 75 °C
 Storage Temperature: -40 to 85 °C
 Operating and Storage Humidity: 0 to 85% max. RH
 noncondensing
 Vibration to IEC 60068-2-6: Operational 5-500 Hz, 2 g
 Shock to IEC 60068-2-27: Operational 15 g
 Altitude: Up to 2000 meters
 Installation Category II, Pollution Degree 2 as defined in IEC/EN
 60664-1.

Construction

Polycarbonate enclosure with IP30 rating.
 Weight: 13 oz (404.3 g)

Mounting

DIN Rail: Attaches to standard "T" profile DIN rail according to
 EN50022 - 35 x 7.5 and 35 x 15

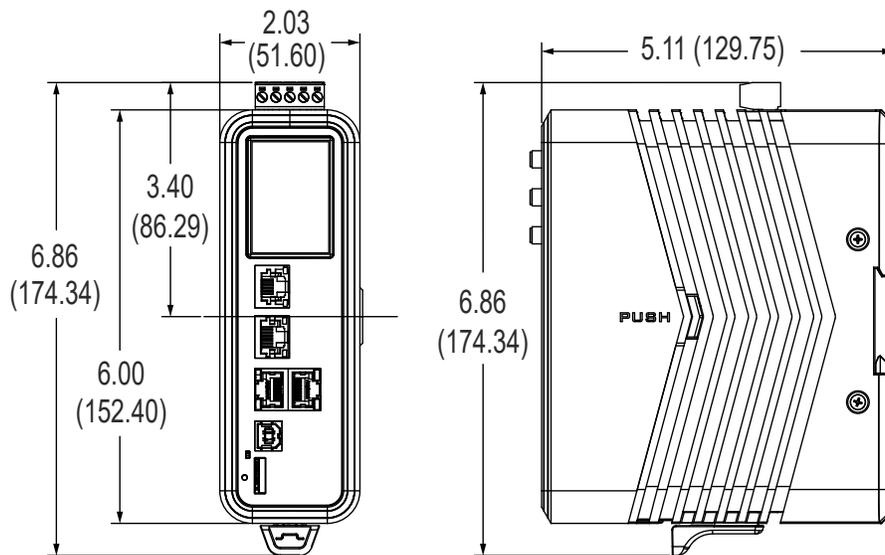
Certification & Compliance

CE Approved
 EN 61326-1 Immunity to Industrial Locations

Warranty

3 years on design and manufacturing defects.
 Specifications are subject to change.
 Visit www.redlion.net for more information.

Dimensions In inches (mm)





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Red Lion has been delivering innovative solutions to global markets since 1972 through communication, monitoring and control for industrial automation and networking - enabling companies worldwide to gain real-time data visibility that drives productivity. Red Lion is part of Spectris plc, the productivity enhancing instrumentation and controls company.

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