

# Digital generator set 1302 control kit



## > Specification sheet

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### Description

The 1302 control is a microprocessor-based generator set monitoring, metering and control system.

The control provides a simple operator interface to the generator set, digital voltage regulation, digital engine speed governing, start/stop control, 12 V/24 V battery operation and generator set protective functions. The 1302 control also features support for full authority, electronically-controlled engines. The integration of all functions into a single control system provides enhanced reliability and performance compared to conventional generator set control systems.

The 1302 generator set control is designed for mounting directly on the generator set and is suitable for use on a wide range of generator sets in non-paralleling applications. It is compatible with reconnectable alternators up to 600 VAC line-to-line and can be configured for any frequency, voltage and power connection configuration from 120-600 VAC line-to-line, and is compatible with shunt and PMG excitation methods. It functions over a voltage range from 8 VDC to 30 VDC.

The control offers a wide range of standard and optional features so custom control configurations are not needed to meet application specifications.

Power for the control is derived from the generator set starting batteries.

### Features

#### **12 and 24 VDC battery operation.**

**Digital voltage regulation** - Full wave rectified single phase (line-to-line) sensing using shunt or PMG input power.

**Digital engine speed governing (optional)** - Provides isochronous frequency regulation.

**Full authority engine support** - Provides communication and control between the engine control module and the 1302 control.

**Generator set monitoring** - Monitors status of all critical engine and alternator functions. Configurable for single or three phase AC metering.

**Engine starting** - Includes relay drivers for starter, fuel shut off (FSO), glow plug/spark ignition power and switch B+ applications.

**Generator set protection** - Protects engine and alternator.

**Operator display panel** - Provides easy-to-use symbolic operator display of critical generator set parameters and operating history.

**Advanced serviceability** - Utilizing InPower™, a PC-based software service tool.

**Environmental protection** - The control system is designed for reliable operation in harsh environments. The core control board is an encapsulated module that is fully protected from the elements.

**Configurable inputs and outputs** - Four discrete inputs and two dry contact relay outputs.

**Certifications** - Suitable for use on generator sets that are designed, manufactured, tested and certified to relevant UL, NFPA, ISO, IEC, Mil Std. and CE standards.

**Warranty and service** - Backed by a comprehensive warranty and worldwide distributor service network.

## Control system

The standard control system includes a control board with an external control switch and status indicator. The control board includes all functions necessary to locally or remotely start and stop, regulate voltage and protect the generator set.

## Optional engine speed governing

The control is available with an optional governor power stage. This power stage amplifies control signals to directly drive an engine fuel control valve.



## Display panel

The display panel may be either locally or remotely mounted. The operator screens are made up of internationally accepted symbols so translations are not required. The display is composed of a backlit LCD display with a series of 6 generator set status LED lamps. The display is accompanied by six tactile-feel membrane switches that are used by the operator to navigate through control menus and to make control adjustments. It is configurable for units of measurement and has adjustable screen contrast and brightness.

The run/off/auto switch function is integrated into the display panel; therefore, an external switch is not required with the display panel option.

All data on the control can be viewed by scrolling through screens with the navigation keys.

The control displays the current active fault and a time-ordered history of the five previous faults.

**LED indicating lamps** - The display panel includes LED indicating lamps for the following functions:

- Not in auto
- Shutdown
- Warning
- Remote start
- Auto
- Run

**Operator adjustments** - The optional display panel includes provisions for many set up and adjustment functions via raise/lower switches.

**Generator set hardware data** - Access to the control and software part number, generator set rating in KVA and generator set model number is provided from the optional display panel or InPower.

**Data logs** - Engine run time, controller on time, number of runs and number of start attempts are available from the optional display panel.

**Fault history** - Provides a record of the most recent fault conditions with control hours time stamp. Up to 10 events are stored in the control non-volatile memory.

### Alternator data

- Voltage (single or three phase line-to-line and line-to-neutral)
- Current (3-phase)
- KVA
- Frequency

### Engine data

- Starting battery voltage
- Engine speed
- Engine temperature
- Engine oil pressure

**Service adjustments** - The operator panel includes provisions for adjustment and calibration of generator set control functions. Adjustments are protected by a password. Functions include:

- Engine speed governor adjustments
- 12 VDC/24 VDC battery operations
- Voltage regulation adjustments
- Cycle cranking
- Configurable fault set up
- Configurable output set up
- Meter calibration
- Display language and units of measurement

### Other information

- Control not communicating
- Pop-up timers to indicate time remaining on time delays in the system

## Internal control functions

### Engine control

**12 VDC/24 VDC battery operations** - Will operate either on 12 VDC or 24 VDC batteries.

**Isochronous governing (optional)** - Controls engine speed within  $\pm 0.25\%$  for any steady state load from no load to full load. Frequency drift will not exceed  $\pm 0.5\%$  for a  $33\text{ }^{\circ}\text{C}$  ( $60\text{ }^{\circ}\text{F}$ ) change in ambient temperature over an 8 hour period.

### Temperature dependent governing dynamics

**(with governing option)** - Modifies the engine governing control parameters as a function of engine temperature. Allows engine to be more responsive when warm and more stable when operating at lower temperature levels.

**Remote start mode** - 1302 accepts a ground signal from remote devices to automatically start the generator set and immediately accelerate to rated speed and voltage. The remote start signal will also wake up the control from sleep mode. The control can incorporate a time delay start and stop.

**Remote and local emergency stop** - The control accepts a ground signal from an external remote emergency stop switch to cause the generator set to immediately shut down. The generator set is prevented from running or cranking with the switch engaged. The control also accepts a ground signal from an external local emergency stop switch. If in sleep mode, activation of either emergency stop switch will wake up the control.

**Sleep mode** - The control is configured to include a sleep mode. When the mode select switch is in the off position, the control will revert to a low-power-consumption mode until the run/off/auto control switch or any button on the optional display panel is operated. The control can be configured to go to sleep while in auto mode in order to conserve the generator starting batteries in applications that do not have battery chargers.

**Engine starting** - The control system supports automatic engine starting. Primary and backup start disconnects are achieved by one of three methods; magnetic pickup, battery charging alternator feedback, or main alternator output frequency. The control also supports programmable glow plug control. This feature can be disabled when not required.

**Cycle cranking** - Configurable for number of starting cycles (1 to 7) and duration of crank and rest periods. Control includes starter protection algorithms to prevent the operator from specifying a starting sequence that might be damaging.

**Time delay start and stop (cooldown)** - Configurable for time delay of 0-300 seconds prior to starting after receiving a remote start signal and for time delay of 0-600 seconds prior to shut down after signal to stop in normal operation modes. Default for both time delay periods is 0 seconds.

When paired with a full authority, electronically controlled engine, the 1302 can communicate with and control the generator set.

### Alternator control

The 1302 includes an integrated line-to-line sensing voltage regulation system that is compatible with shunt or PMG excitation systems. The voltage regulation system is full wave rectified and has an SCR output for good motor starting capability.

### Major system features include:

Digital output voltage regulation - 1302 will regulate output voltage to within  $\pm 1.0\%$  for any loads between no load and full load. Voltage drift will not exceed

$\pm 1.5\%$  for a 40 °C (104 °F) change in temperature in an 8 hour period. On engine starting, or sudden load acceptance, voltage is controlled to a maximum of 5% overshoot over nominal level.

The automatic voltage regulator feature can be disabled to allow the use of an external voltage regulator.

Torque-matched V/Hz overload control - The voltage roll-off set point and rate of decay (i.e., the slope of the V/Hz curve) is adjustable in the control.



### Protective functions

On operation of a protective function the display panel will indicate fault description and time of occurrence. The corresponding warning or shutdown LED will be illuminated. The service manual and InPower service tool provide service keys and procedures based on the fault codes provided.

### System protective functions

**Configurable alarm and status inputs** - 1302 will accept up to four alarm or status inputs (configurable contact closed to ground or open) to indicate customer-specified conditions. The control is programmable for warning, shutdown or status indication and for labeling the input.

**Emergency stop** - Annunciated whenever either emergency stop signal is received from external switch.

### Hydro mechanical full system engine protection

**Over speed shutdown** - Default setting is 115% of nominal.

**Low lube oil pressure warning/shutdown** - Level is preset (configurable with InPower) to match the capabilities of the engine used. Control includes time delays to prevent nuisance shutdown signals.

**Low coolant temperature warning** - Indicates that engine temperature may not be high enough for a 10-second start or proper load acceptance.

**High engine temperature warning/shutdown** - Level is preset (configurable with InPower) to match the capabilities of the engine used. Control includes time delays to prevent nuisance shutdown signals.

**Sensor failure indication** - Logic is provided on the base control to detect analog sensor or interconnecting wiring failures.

## Full authority electronic engine protection

Engine protection and fault announcement is handled inside the engine control module. The 1302 announces active faults from the engine control module via the CAN data link.

## General engine protection

**Low and high battery voltage warning** - Indicates status of battery charging system (failure) by continuously monitoring battery voltage.

**Weak battery warning** - The control system will test the battery each time the generator set is signaled to start and indicate a warning if the battery indicates impending failure.

**Fail to start (overcrank) shutdown.**

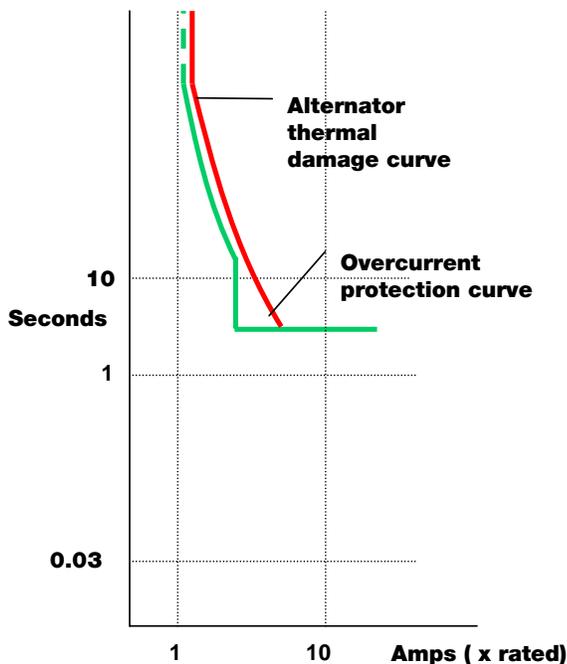
**Fail to crank shutdown** - Control has signaled starter to crank engine but engine does not rotate.

**Cranking lockout** - The control will not allow the starter to attempt to engage or to crank the engine when the engine is rotating.

## Alternator protection

**High/low AC voltage shutdown** - High default to 110% for 10 seconds, instantaneous 130%. Low default to 85% for 10 seconds.

**Overcurrent warning/shutdown** - Implementation of the thermal damage curve with instantaneous trip level calculated based on current transformer ratio and application power rating.



**Under/over frequency** - Under default to -6 Hz for 10 seconds. Over default +6 Hz for 10 seconds.

**Loss of sensing voltage shutdown.**

**Field overload shutdown** - uses field voltage to shutdown generator set when a field overload condition occurs.

## Environment

The control is designed for proper operation without recalibration in ambient temperatures from -40 °C to +70 °C (-40 °F to +158 °F) and for storage from -55 °C to +80 °C (-67 °F to +176 °F). Control will operate with humidity up to 95%, non-condensing.

The optional display panel is designed for proper operation in ambient temperatures from -20 °C to +70 °C (-4 °F to +158 °F) and for storage from -30 °C to +80 °C (-22 °F to +176 °F).

The control board is fully encapsulated to provide superior resistance to dust and moisture. The display panel has a single membrane surface, which is impervious to effects of dust, moisture, oil and exhaust fumes. This panel uses a sealed membrane to provide long reliable service life in harsh environments.

The control system is specifically designed and tested for resistance to RFI/EMI and to resist effects of vibration to provide a long reliable life when mounted on a generator set. The control includes transient voltage surge suppression to provide compliance to referenced standards.

## Control interface

### Input signals to the base control

**Remote start signal**

**Local and remote emergency stop**

**Configurable inputs** - Include (4) input signals from customer discrete devices that are configurable for warning, shutdown or status indication, as well as message displayed.

### Output signals from the control

**Configurable relay outputs** - Control includes (2) relay outputs rated at 2 amps. These outputs can be configured to activate on any control warning or shutdown fault, as well as ready-to-load, not-in-auto, common alarm, common warning and common shutdown.

**Ready to load (generator set running) signal** -

Operates when the generator set has reached 90% of rated speed and voltage and latches until generator set is switched to off or idle mode

### Communications connections

**Modbus® interface** - This RS-485 port allows the control to communicate with external devices like PLC on Modbus protocol.

**PC tool interface** - This RS-485 communication port allows the control to communicate with a personal computer running InPower.

Note - An RS-485 converter is required for communication between PC to control.

**Networking** - This RS-485 communication port allows connection from the control to the other Cummins Power Generation products

## Software

InPower (beyond 5.5 version) is a PC-based software service tool that is designed to directly communicate to the 1302 generator set control components to facilitate service and monitoring of these products.

## Certifications

The 1301 control meets or exceeds the requirements of the following codes and standards:

**NFPA 110:** For Level 1 or 2 systems.

**ISO 8528-4:** 1993 compliance, Controls and Switchgear.

**CE Mark:** The control system is suitable for use on generator sets to be CE Marked.

**EN 50081-1, 2:** Residential/Light Industrial Emissions or Industrial Emissions.

**EN 50082-1, 2:** Residential/Light Industrial or Industrial Susceptibility.

**ISO 7637-2, level 2:** DC Supply Surge Voltage Test.

**Mil Std 202C, Method 101 and ASTM B117:** Salt Fog Test.

**ISO9001:** These control systems and generator sets are designed and manufactured in ISO9001 certified facilities.

**UL 508:** Recognized or Listed and suitable for use on generator sets that are UL 2200 Listed.

## Warranty

All components and subsystems are covered by an express limited 90 day warranty. Other optional and extended factory warranties and local distributor maintenance agreements are available.

## Options and accessories

**1302 genset control kit (non electronic engine)** - Includes a 1302 control module, operator interface, oil pressure sender, coolant temperature sender and all required harnesses. Part number 0541-1414-01.

**1302 genset control kit (electronic engine)** - Includes a 1302 control module, operator interface and all required harnesses. Part number 0541-1414-02.

**Electronic governing power stage** - Includes an actuator driver power stage compatible with the 1302 control system. Part number 0541-1231. This kit is required for electronic governing. Care should be taken to ensure compatibility with fuel actuator.

**RS 232 to RS 485 converter kit** - Includes converter and harness. Part number 0541-1199.

**Remote annunciator kit** - Includes remote annunciator - see specification sheet S-1472, part number 0300-5929-02.

**Sales simulator** - Allows operation of the control system on a table top for sales demonstrations. Part number 0541-1371 includes 1302 control (specifically for use with simulator), display panel, mounting stand and harness. Part number 0300-5461 includes universal simulator.

**Current transformers** - Include 3 CTs for alternator current metering/protection, part number 0541-1263-01 through -09, depending on ratio.

The 1302 is compatible with standard 5 amp secondary CTs. The primary CT rating is sized to produce rated CT secondary current of 2.5 amps at rated genset load (at 0.8 pf). To select the proper CT ratio you must first calculate the lower and upper bound of the primary rating. Once this is done, you select a CT turns ratio within these bounds.

Part number	Turns ratio	(Primary / secondary)
	Tap 1 - 2	Tap 1 - 3
P/N 0541-1263-01	50 / 5	100 / 5
P/N 0541-1263-02	75 / 5	150 / 5
P/N 0541-1263-03	100 / 5	200 / 5
P/N 0541-1263-04	150 / 5	300 / 5
P/N 0541-1263-05	200 / 5	400 / 5
P/N 0541-1263-06	250 / 5	500 / 5
P/N 0541-1263-07	375 / 5	750 / 5
P/N 0541-1263-08	400 / 5	800 / 5
P/N 0541-1263-09	500 / 5	1000 / 5

The lower bound of the primary ratio is calculated by multiplying the maximum rated current by two (per phase).

$$\text{Min\_CT\_Ratio} = 2 * \text{Max\_Rated\_Current} : 5$$

eq. 3.1.1

The upper bound of the primary ratio is calculated by multiplying the maximum rated current by five (per phase).

$$\text{Max\_CT\_Ratio} = 5 * \text{Min\_Rated\_Current} : 5$$

eq. 3.1.2

Current is calculated by:

$$\text{Current} = \frac{\text{Power(VA)}}{\sqrt{3} * \text{Voltage}}$$

or

$$\text{Current} = \frac{\text{Power(W)}}{\sqrt{3} * \text{Power\_Factor} * \text{Voltage}}$$

In non-reconnectable genset applications the Max\_Rated\_Current and Min\_Rated\_Current will be the same. In reconnectable genset applications they will be different.

Example of CT sizing (non-reconnectable):

A 250 kVA rated genset application at 240 V producing rated output current of 602 amps/phase. This would yield a Min\_CT\_Ratio of 1204:5 and a Max\_CT\_Ratio of 3010:5. Any CT with a ratio between these would be sufficient for this application.

Example of CT sizing (reconnectable):

A reconnectable generator capable of 208-240/416-480 V outputs with a 125 kVA 3 phase only rating.

We first need to find the current in each phase for each output voltage. This is done using the following formula:

eq. 3.1.3

Using this equation above, the current in each phase is computed and shown below.

Voltage (V)	Output current (A)
208	346.376
240	300.192
416	173.188
480	150.096

The next step is to use equations 3.1.1 and 3.1.2 to find the lower and upper bound for the CT ratios for each voltage configuration.

For the 208-240 voltage configuration:

$$Max\_CT\_Ratio = 5 * 300.192 = 1500.96$$

$$Min\_CT\_Ratio = 2 * 346.376 = 692.752$$

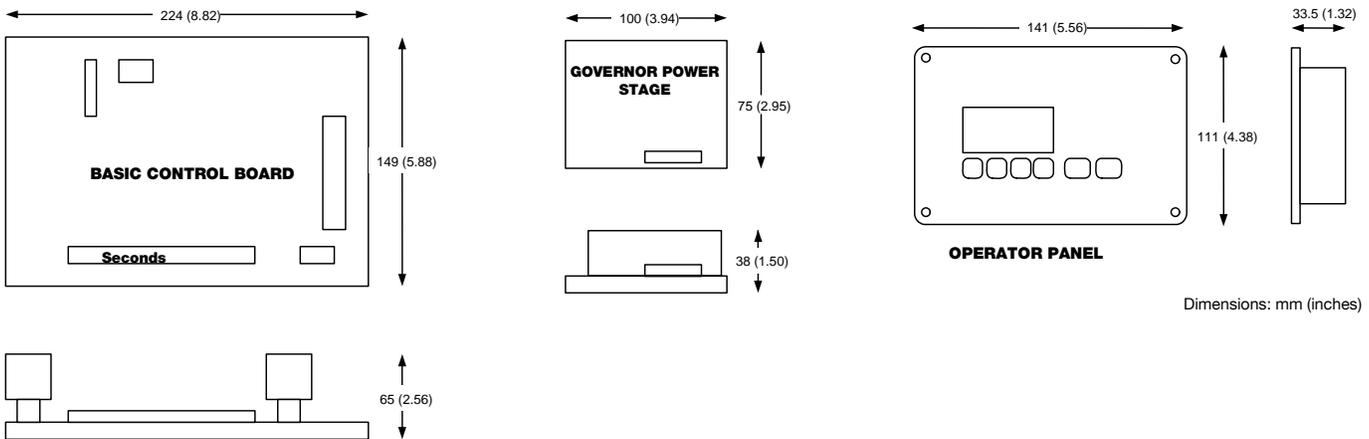
For the 416-480 voltage configuration:

$$Max\_CT\_Ratio = 5 * 150.096 = 754.8$$

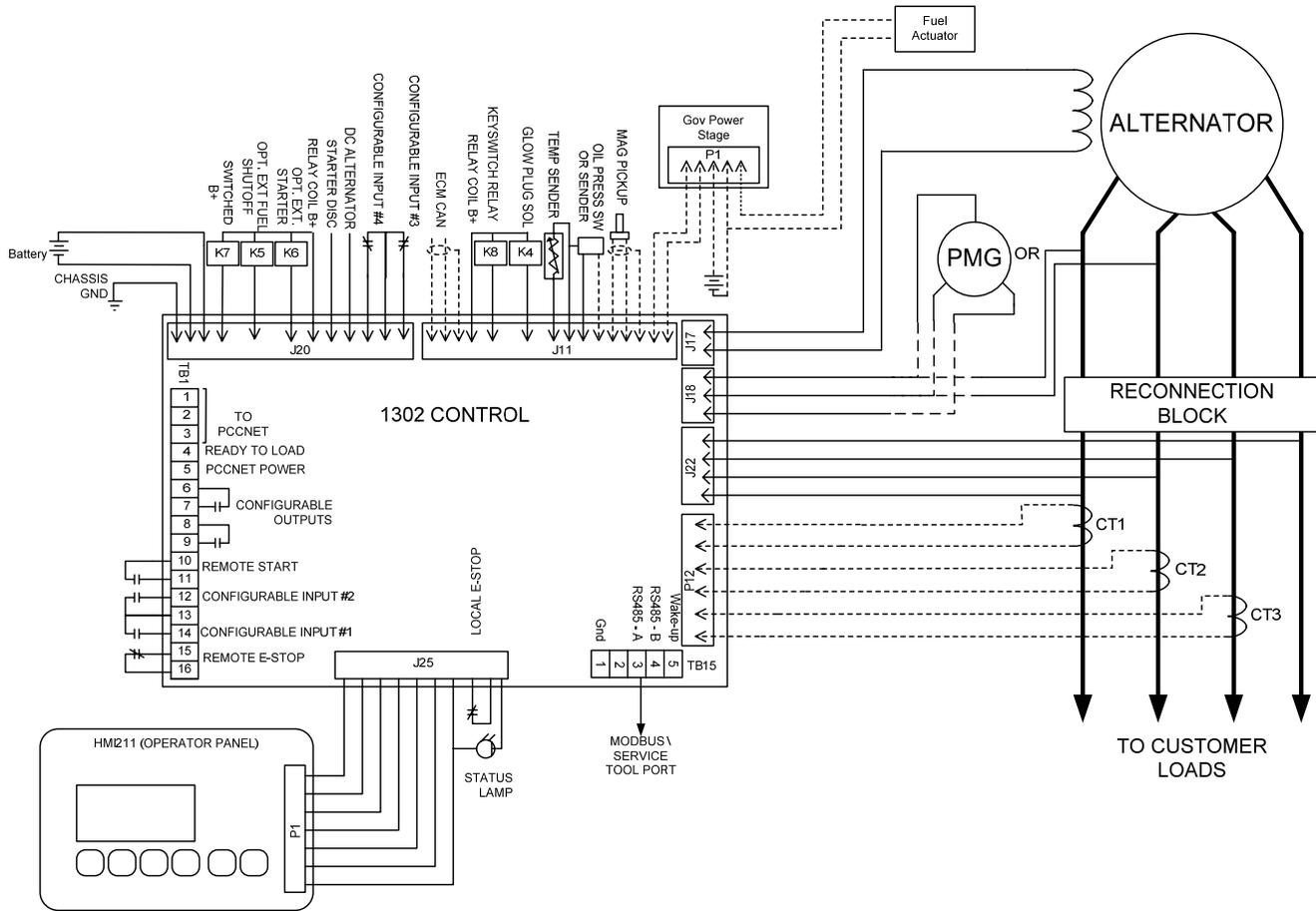
$$Min\_CT\_Ratio = 2 * 173.188 = 346.376$$

For three tap CTs it would be advisable to choose a CT with a 1500:5 ratio. For the 208-240 voltage configuration connect the CT leads to the 1<sup>st</sup> and 3<sup>rd</sup> CT connections, leaving the center tap un-connected. For the 416-480 voltage configuration it would be advisable to use the same 1500:5 ratio CT, but this time connect the CT leads to the 1<sup>st</sup> and 2<sup>nd</sup> (center-tap) connections on the CT. With this configuration one CT could be used for all voltage configurations.

**Mechanical drawings**



# Electrical interconnections



**See your distributor for more information**

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**Warning:** Back feed to a utility system can cause electrocution and/or property damage. Do not connect to any building electrical except through an approved device or after building main breaker is open.