Cat® Energy Control System 400



Image shown may not reflect actual configuration.

Cat® Energy Control System (ECS) 400

The Cat® ECS 400 integrates advanced site controls for both traditional and hybrid microgrid systems. The Cat ECS ensures precise management of generation assets with operational reliability and optimized cost effectiveness. The system features a user-friendly and intuitive 396 mm (15.6”) color touchscreen interface.

FEATURES

General Description

The Cat® ECS 400 is designed for large industrial/ commercial installations. The Cat ECS 400 integrates a variety of traditional and renewable energy sources within a microgrid by providing optimized monitoring and control for up to 32 Distributed Energy Resource (DER) assets.

Panel

- Rugged metal enclosure
- NEMA 1 wall mountable
- 396 mm (15.6”) industrial color touch-screen display
- Cat PLC-based electronic control module
- Ethernet router included
- Input/Output Ethernet module for interfacing with ATS and other relays
- Input Circuit Breaker Protection (Single phase 120/240 VAC 50/60 Hz)
- Best Battery Diode (BBD) for backup
- Cat PLE702 telematics device
- Router for Internet connection to telematics with Ethernet connection
- Operating temperature -20°C to 40°C (0 to 95% relative humidity)
- Voltage & lightning protection

User Interface

Provides graphical human machine interface (HMI) to all control elements to simplify operator interactions with DER assets. Includes system visualization and user interface for manual or automatic control of the DERs.

Distributed Energy Resources (DER) Dispatch

The DERs, including but not limited to generator sets, battery energy storage system (BESS) and other renewable sources are controlled from the Cat ECS 400 for:

- Energy contribution from each of the DERs to maximize penetration from renewable energy sources and system reliability. Priority for distributed resource use can be changed from the Cat ECS 400 user interface.
- Optimizing asset performance according to pre-programmed routines that can be adjusted via user-selectable criteria. The optimization routines can be based on several different parameters, such as minimizing fuel cost, optimizing engine operation, user configurable schedules for charging and discharging and grid export/import, charging batteries from PV only or maximizing system reliability.

Grid Import/Export Control

The Cat ECS 400 will regulate the amount of real and reactive power exported from DER's to the utility based on a programmable set point.

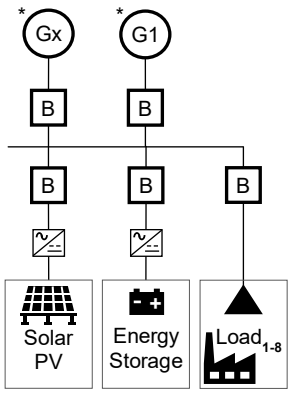
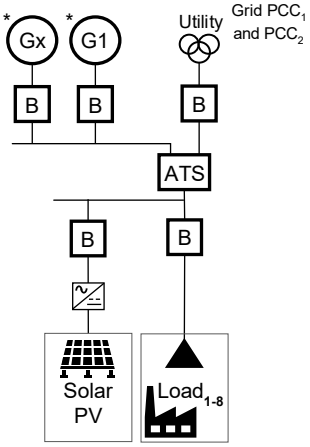
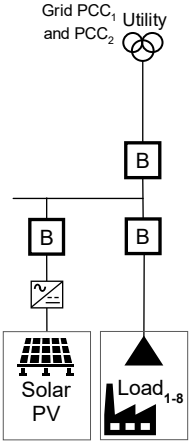
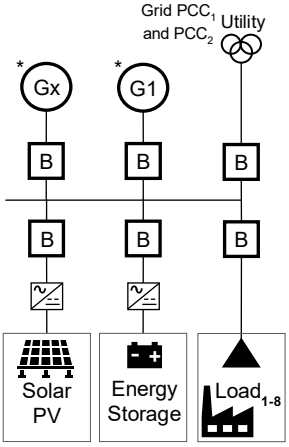
Cat Engineering Services Custom Solutions

The Cat ECS provides the option to have Cat Engineering Services customize solutions to meet large site requirements worldwide.

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Technical Specification

The Cat ECS 400 is used in a variety of microgrids where the Cat ECS 400 is configurable to meet applicable site-specific asset requirements. The following are four common examples, with more possible configurations available.

Asset Type (1)	Site Power System Configuration - any combination up to thirty-two (32) assets			
	Off Grid *** (island)	Grid Connected		
		PV with Genset(s)	PV Only	PV/BESS with Genset(s)
Photovoltaic (PV) Inverter	•	•	•	•
Battery Energy Storage System (BESS) Inverter	•	–	–	•
Generator set (G)	•	•	–	•
Automatic Transfer Switch (ATS)	N/A	•	–	–
Power Meter at Grid PCC	N/A	•	•	•
Grid Connection Points of Common Coupling (PCC)	N/A	•	•	•
Diagrams	**Split bus can be customized through Engineering Services within microgrid**			
Typical Single Line Diagrams (SLD's) (2)				
Benefits	✓ PV can operate whenever Genset or grid forming BESS is online ✓ PV energy reduces fuel consumption during genset operation ✓ Any PV energy exceeding load can charge BESS ✓ BESS can provide reserve power, enabling shutdown of one or more generators, reducing fuel consumption ✓ BESS can be grid-forming, allowing all gensets to shut down for zero fuel consumption or "economy mode" operation. ✓ BESS in addition to other non-intermittent DERs can participate in "load smoothing" operation ✓ BESS supports genset response to block- loads, enabling gas genset island-mode ✓ Provides State of Charge (SoC) management for the BESS	✓ PV reduces grid import and may provide grid export ✓ Limits grid export to zero or user-set value with scheduler feature ✓ One or two grid Points of Common Coupling ✓ PV energy reduces fuel consumption during standby genset operation ✓ Power output from gensets can be combined ✓ ATS shown can be replaced by non-grid-paralleling switchgear island-mode	✓ PV reduces grid import and may provide grid export ✓ Limits grid import or export to zero or user-set value with scheduler feature ✓ One or two grid points of Common Coupling	✓ PV reduces grid import and may provide grid export ✓ Limits grid import or export to zero or user-set value with scheduler feature ✓ One or two grid Points of Common Coupling ✓ Limit SoC or charge/discharge of BESS using scheduler feature

• – Applicable
N/A – Not Applicable

(1) – Refer to Table (a) Connected Asset Compatibility for list of approved assets.
(2) – Detailed SLD's are available to meet application requirements. Contact your local Cat® dealer for more information.
* – Genset paralleling applications require paralleling controls (such as EMCP4.4 or Cat ECS 200).

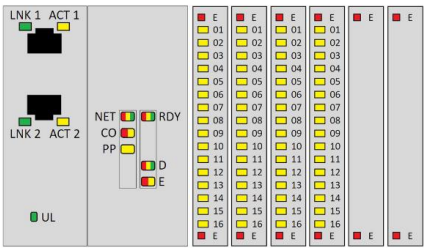
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Table (a) – Connected Assets Compatibility

Cat ECS 400 may be configured with up to 32 DER's. The table below includes a current list of compatible assets but can be customized by Engineering Services to support customer requirements.

Preconfigured Asset Compatibility [3]			
PV Inverters	SMA: Sunny Tri, Sunny Tri 2, Sunny Peak Yaskawa:XGI1000, XGI1500		
Energy Storage Inverter	BDP1000		
Genset Controls Exclusive Groups [4]	Paralleling	Group - A	Cat ECS 200 - Advanced Paralleling Control Data Link (APCDL)
		Group - B	GCCP 1.5
		Group - C	EMCP 4.4, Multi-gen data link (MGDL)
		Group - D	Other Genset Controls: ComAp: InteliGen NTC BaseBox (IG-NTC-BB) Deep Sea: DSE8600 DEIF: AGC 4, AGC 150 Woodward: easYgen-5003, easYgen-5010, 5100 and 5101
	Standby	Group - E	EMCP 4.3, 4.2B, 3.3, 3.2 (RS485 to Ethernet Protocol convertor – Standby Only), GCCP 1.1, GCCP 1.2
Power Meters/Utility Protection Devices	SEL735, PXM4K/6K/8K, PXM2000, ION7550/7650, ION 9000, PQM II, Bitronics Legacy, SEL751A, SEL751, AGC 4, AGC 150, Cat Remote Breaker Control		
Automatic Transfer Switch (ATS)	A single "ATS Run Signal" port is hardwired as a normally open, discrete DC input. When multiple ATS's are wired in parallel, the standard Cat ECS site control is unable to log which ATS sends the signal.		
Switchgear	Various switchgear via configurable protocol translator. Contact your local Cat dealer for more information.		

Standard Features

Applicable Codes and Standards	• UL 508A [5] • NEMA Type 1 • SunSpec Compliant
Standard Components	• Best Battery Diode (BBD) for backup power supply. • Managed switch that offers configurable site communication and enhanced security provision to assure network integrity. One ethernet (4-Wire) port connection for customer networking of DER's. • Telematics PLE702 (See LEHE22212) allows data logging of 300 channels for 1.5 days (requires subscription for visualization).
Input/Output Ethernet Modules	• Supports expanded Inputs/Outputs (IO) capability of the Cat ECS 400 control: - Analog & digital I/O - Temperature sensing (RTD) • Configure I/O for any event (read & write function) • Interface with a single ATS and other relays that allows load shed/load add with up to eight (8) load breakers. • Package mounted and/or ship loose options (See LEHE22466) Modbus Coupler Digital & Analog I/O 

[3] This list is updated frequently – other assets will be considered upon request. "Assets" are defined as system components that are controlled or monitored by the Cat ECS 400 to manage the power system.
[4] Genset asset compatibility is exclusive to a single controls group. Group D requires a single genset control platform.
[5] Note: Codes may not be available in all model configurations. Please consult your local Cat dealer for availability.

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Standard Features (*continued*)

Control Modes	**Auto** • Grid Connected Sub-modes (16) • Unplanned Islanding or Emergency standby - Closed transition (with soft unload) or Open transition • Planned Islanding or Intentional islanding • Load sense/load demand - Based on asset priority or engine-hour balancing - Automatically matches on-line asset capacity to the loads • Load shed/load add - Automatic or manual load shed up to eight (8) stages • Utility parallel, import power from grid - Minimum import kW setpoint is maintained • Utility parallel, export power to grid - Target export setpoint is maintained • Utility parallel, base load operations • Economy mode - All Gensets and non-renewable "fuel consuming" assets OFF • Reliability mode - At least one high priority "fuel consuming" asset ON • Scheduling - 5 schedules and 6 segments-BESS dispatch scheduling based on year, month, time, day and segment of day - 5 schedules and 6 segments -Import and export scheduling for active and reactive power based on time, day and segment of day • Load smoothing mode - Non-stable load dispatch using available assets for specified durations of time • 3 Flexible efficiency modes 1, 2 and 3 that may be set up based on asset group priorities • Pro-active add and drop - Ability to manually bring additional gensets online in anticipation of bringing on large loads. - Manually turning off gensets instead of waiting for LSLD drop when the customer knows large loads are being taken offline • Grid Reactive Control mode - There are 4 available reactive power control settings- Constant VAr, Constant PF, Volt-VAr curve, Watt-VAr curve • Off-Grid (Island) Sub-modes (7) • Economy mode - All Gensets and non-renewable "fuel consuming" assets OFF • Reliability mode - At least one high priority "fuel consuming" asset ON • Load smoothing mode - Non-stable load dispatch using available assets for specified durations of time • 3 Flexible efficiency modes 1, 2, and 3 that may be set up based on asset group priorities • Pro-active add and drop - Ability to manually bring additional gensets online in anticipation of bringing on large loads. - Manually turning off gensets instead of waiting for LSLD drop when the customer knows large loads are being taken offline
	Manual • Communications, power allocation test mode for site commissioning. Manually control assets and the microgrid system.
	Idle • Monitoring only - Cat ECS 400 relinquish control to another site controller.
	Off

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Options

Options are available to meet application requirements. Contact your local Cat dealer for more information.

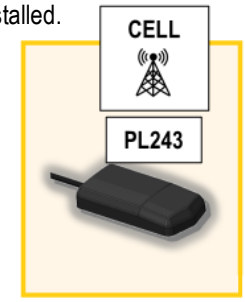
Telematics

Up to 800 channels of data storage every second for 1.5 days depending on the number of devices or equipment connected to PLE702 (See LEHE22212) with options for:

- Cellular (part no. 550-3269) or
- Satellite radio + cellular (part no. 545-3987)

(Requires subscription for visualization).

Cellular and satellite radio module and antenna available Cat dealer installed.

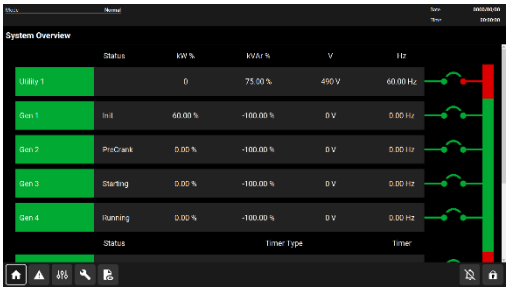




Cat Remote Breaker Control

The Cat ECS 400 utilizes an optional supplemental component for utility sensing breaker control.

- Utility Protection Functions – American National Standards Institute (ANSI)
  - Over / Under Voltage (59 / 27)
  - Over / Under Frequency (81O / U)
  - Rate of Change of Frequency (ROCOF) (81R)
  - Sync check (25)



Enclosure Options

- Security window
- Service Receptacle and Light Interior 120 VAC, 5A service receptacle and light.
- Uninterruptable Power Supply (UPS) with lithium iron phosphate (LFP) battery, when fully charged, provides backup for a minimum of 10 minutes with a DC load of 150 watts.

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Options (*continued*)

Cat Engineering Services

Global team delivering advanced solutions to meet customer specifications including:

- Custom Cat ECS control solutions
- Cat ECS hardware integrated with distribution switchgear
- Customer specified sequence of operations
- Test reports per Joint Commission on Accreditation of Healthcare Organizations (JCAHO)
- Integrated Automatic Transfer Switch (ATS) solutions including remote start signal integrity and report generation
- Expanded performance capability:
  - Multi-bus sites
  - Advanced utility protections
  - Greater than 8-stage Load Shed - Load Add (LS/LA) functionality
  - Redundant PLC configurations
  - Weather-rated packaging (IP54 / NEMA 3R or IP52 / NEMA 12).
  - Larger HMIs
  - Up to 250 Distributed Energy Resources (DER's)

Custom Cat ECS



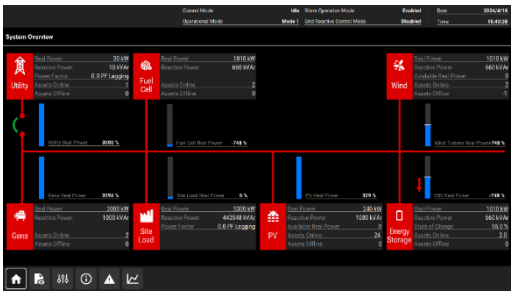
Integrated with Cat Switchgear



- Off Package HMI:

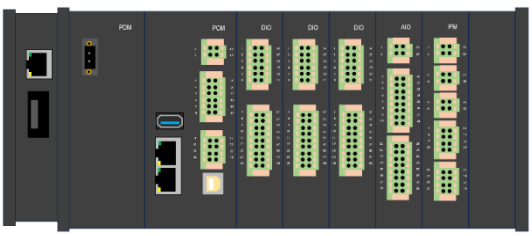
  The Cat ECS 400 supports a full function HMI display with the addition of an unmanaged Ethernet switch. The interactive 396 mm (15.6") color touchscreen graphical interface serves to display system alarm conditions, status indications and annunciation.

  (Ship loose HMI display without panel box).



- Advanced Hybrid Sites for > 32 DERs:

  Caterpillar developed code base is used to meet customers' energy outcomes in complex installations requiring up to 250 DERs.



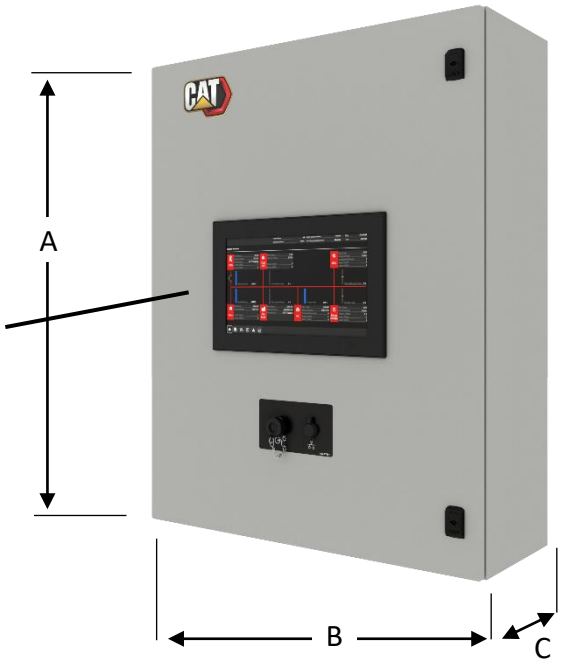
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Dimensions & Display



Image shown may not reflect actual configuration.



High-Resolution LCD	
Colors	16.7 million
Backlight	Thin-film-transistor (TFT)
Resolution 15”	1920 x 1080

Dimensions				
Control Box	A	B	C [7]	Weight
Units	mm (in)	mm (in)	mm (in)	kg (lbs)
Cat ECS 400	1007 (39.63)	800 (31.50)	309 (12.18)	75 (165)

[7] – Dimension including connectors on the door.

Worldwide Product Support
Cat dealers have over 1,800 dealer branch stores operating in 200 countries and offer extensive post-sale support including maintenance and repair agreements.

Materials and specifications are subject to change without notice.
The International System of Units (SI) is used in this publication.

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