ALL Power Labs
personal scale power

Introducing
the GEK Gasifier Systems

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I. Overview and Specifications

ALL Power Labs offers downdraft gasifier systems in various sizes: 10kW, 20kW, and 100kW. These kWe ratings reference the potential of electrical power capable in a gasifier/ICE/generator system at the gasifier's maximum gas flow capacity. The GEK PowerPallet integrates an internal combustion engine and a generator with automated controls with the ability to utilize the gas for other purposes, while the GEK Gasifier comes as an assemble-yourself kit that provides stand-alone wood gas for a variety of end uses. Below are the specifications of the systems provided by ALL Power Labs.

GEK Gasifier System Sizes provided by ALL Power Labs

	10kW GEK	*20kW GEK*	*100kW GEK*
electrical capacity range (kW)	2 - 10	4 - 20	20 - 100
gas flow range (m^2/hr)	5 -27	11 - 53	53 - 267
gas heat flow at max (BTU/hr)	168,993	331,727	8,355,765
biomass consumption rate (kg/day)	160 - 320	320 - 640	640 - 3200
gasifier system footprint (excluding hopper) (ft)	2 x 4	2 x 4	4 x 7

The GEK Systems are offered at various integration stages as well as at different kit levels to make the equipment accessible at various price points. The kit 'Levels' refer to the completeness of the offered product. The levels are as follows:

- Level I: free CAD files available online
- Level III: Weld-It-Yourself kit (mild steel only)
- Level IV: Assemble-It-Yourself kit (stainless steel only)
- Level V: Completely Assembled and Integrated

GEK Gasifier Models, Levels and Features Offered

Model	*Sizes (kW)*	*Levels Available*	*Included Features*
Basic GEK	10, 20	I, III, IV	Reactor, gas filter only. Gas drive system: ejector venturi
GEK TOTTI	10, 20, 100	III, IV	Basic GEK with Pyrocoil and Drying Bucket. Gas drive system: ejector venturi
GEK PowerPallet	10, 20	V	GEK TOTTI, PCU, logic and components for automation, engine and generator. Gas drive system: blowers. Integrated on a 4x4 pallet. Available in 120V/208/240V AC, 60/50Hz, and in single, split, or three phase configurations.
PowerTainer	100	IV, V	Pyrocoil, Drying Auger, PCU, logic and components for automation, open hopper with air lock, engine and generator. Integrated inside a shipping container

Biomass Requirements of the GEK Gasifier Systems

Most downdraft gasifier systems require specified feedstock characteristics and can be sensitive to feedstocks that lie outside of the required specifications for the given equipment. Across all of the GEK Models above, ALL Power Labs has implemented designs in both the reactor and the bulk handling systems that broaden the allowed feedstock characteristic requirements of typical systems of its size. Below are the suggested ranges for given feedstock characteristics to be used in the GEK systems.

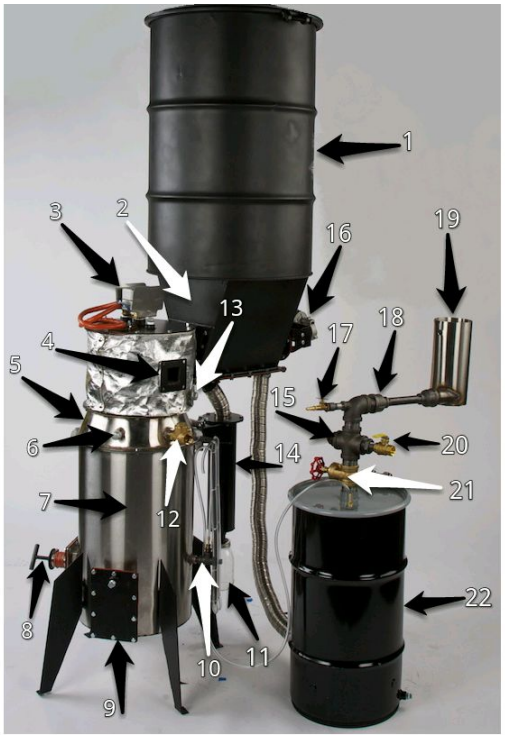
Biomass Requirements

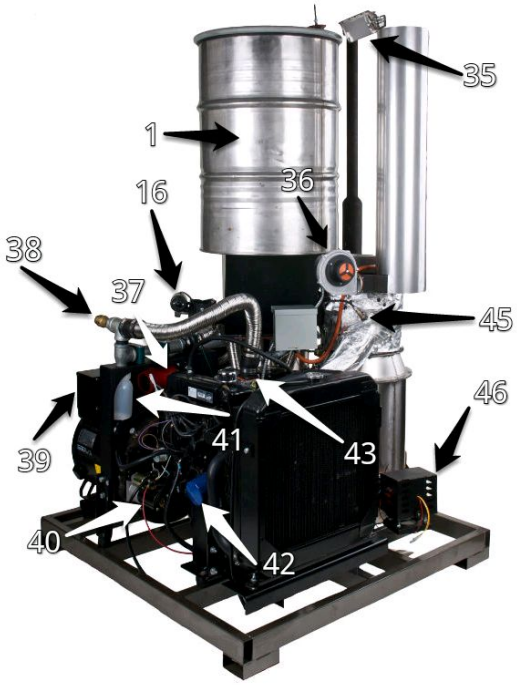
particle size (in)	.5 - 1.5
moisture content (% by dry weight)	<25
fixed to volatile ratio	>0.25
ash content (%)	>5

Please refer to the Feedstock Requirements and Preparation Guide for more information.

The GEK Systems are designed for raw biomass and organic-based feedstocks. Experimental feedstocks lying outside of the suggested ranges may require modification of the equipment and testing of the gas quality produced. For experimental and research, ALL Power Labs offers a **Research Experimenters Kit** with test and control equipment valuable for gas testing or further development off of the base systems. Contact sales@allpowerlabs.org for more information.

II. Identifying the GEK System Components





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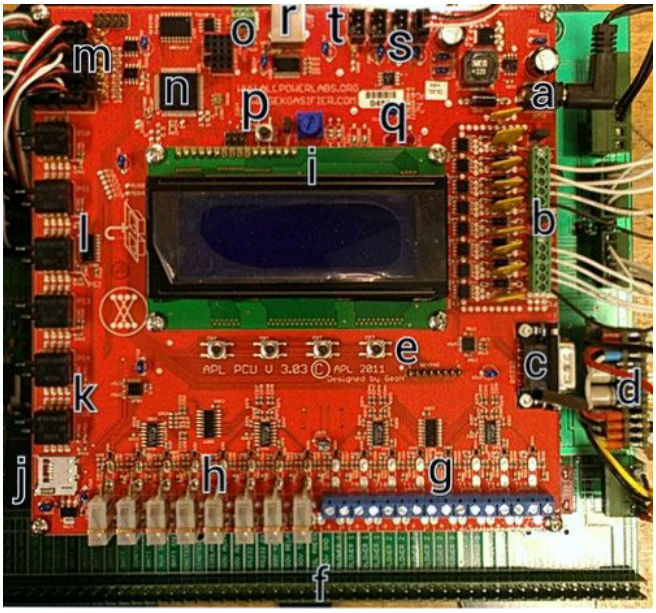
GEK System Components con't

1. Feedstock Hopper	26. Engine Radiator Coolant Port
2. Drying Bucket	27. Engine Alternator
3. Fuel Level Switch	28. 12V DC Car Battery (not included)
4. Pyrocoil Exhaust Port	29. Fuel Level Switch
5. Reactor	30. Pyrocoil and Exhaust Insulation Jacket
6. Auxiliary Port	31. Engine Exhaust
7. Gas Cowling	32. Engine Gas Valve
8. Manual Grate Shaker	33. Packed Bed Gas Filter Lid Access
9. Ash Port	34. Filter Condensate Drain Port
10. Dual Channel Manometer and Thermocouple Port	35. Automatic Flare Igniter
	36. Air Blower
11. Cyclone Condensate Jar	37. Air Filter
12. Air Inlet Check Valve	38. System Safety Relief Valve
13. Lighting Port	39. Generator and Electrical Connection Box
14. Cyclone	40. Engine Starter Motor
15. Gas Service Connection Port	41. Engine Condensate Trap
16. Biomass Feed Auger	42. Engine Oil Filter
17. Ejector Compressed Air Connection	43. Governor and Engine Throttle
18. Ejector Venturi Gas Drive	45. Oxygen Sensor
19. Swirl Burner	46. Automated Grate Shaker
20. Manual Air-Premix Valve	47. Feedstock Hopper View Port
21. Gas Shut-off Valve	48. Dual Gas Blower
22. Packed Bed Gas Filter	49. Pyrocoil Heat Exchanger
23. Hopper Barrel Puff Bung	50. Gas Line Access Port
24. Flare Stack	51. Process Control Unit (PCU) and Control Logic
25. Air Blower	52. Main Operation Panel

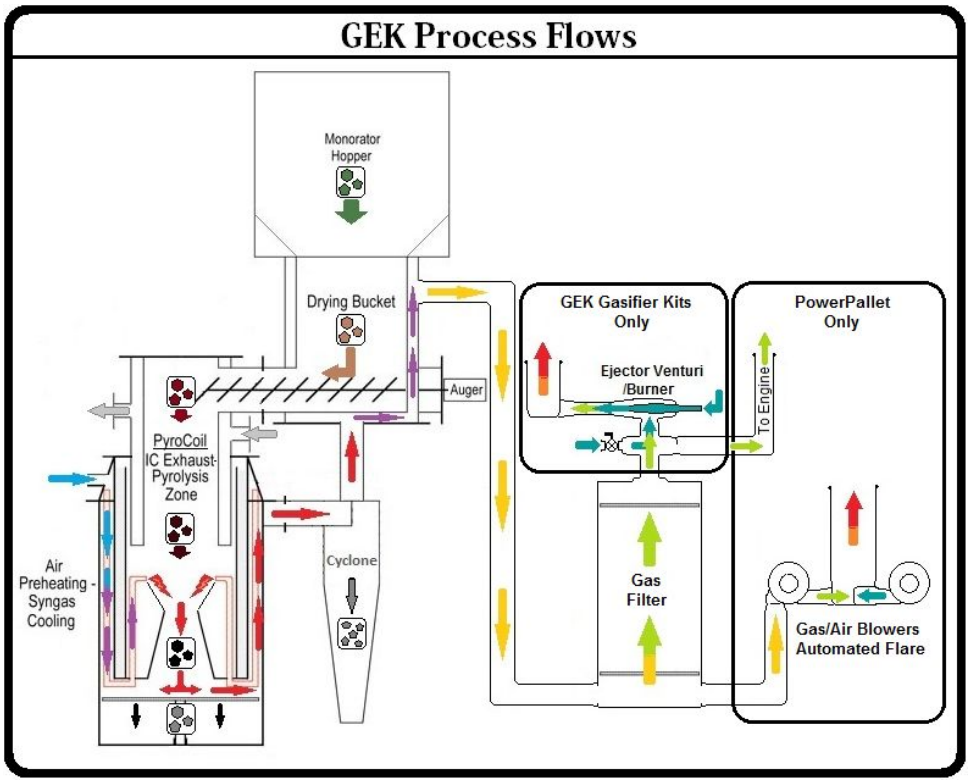
III. Identifying the PowerPallet Control Panel and PCU Components



53. Hour Meter 54. Oxygen Sensor Air/Fuel Ratio Dial 55. LCD Display 56. 4 Input Buttons 57. System Main Power 58. Engine Key Switch 59. Dual Gas Blower Adjustment Knob 60. Air Blower Adjustment Knob 61. PCU USB Connection Port 62. Warning Alarm	a. Power Input b. FETs c. RS232 Communication Port d. ATX Power Supply e. Input Buttons and Keypad Off-board Connection f. Relay Board I/O Connectors g. Thermocouple Screw Terminal Connectors h. Thermocouple Standard Connectors i. LCD Display and Contrast Knob j. Micro SD card	k. Low Range Pressure Sensors l. High Range Pressure Sensors m. Analog Inputs n. ATmel MicroProcessor o. CAN Bus Communication Port p. Reset Button q. Status LEDs r. USB Communication Port s. Servo Control Ports t. Timer

IV. Description of the GEK Gasifier Process Flows

The GEK Process starts with the introduction of feedstock into the hopper. After the hopper, the feedstock passes through an auger and enters the gasifier. The auger is controlled by a level switch incorporated into the reactor lid. The feedstock fills the GEK reactor and stages needed for passes through the stages of gasification: drying, pyrolyisis, combustion, and reduction. The hot gas exits the reactor and passes through a cyclone to separate char particulates. The GEK Gasifier systems are designed to utilize the heat from the gas produced to dry the incoming feedstock through the Drying Bucket. After the Drying Bucket, the gas passes through the gas filter and gas drive system. The GEK Gasifier systems have two main valves to switch between one of two operational modes: Flare or Engine Mode (or other gas utilization mode). For Engine Mode, the Pyrocoil heat exchanger, included in the TOTTI design, increases the efficiency of the reaction by supporting the heat needed for the pyrolysis zone by utilizing the waste heat from the exhaust of an engine or other process.



The GEK Gasifier Kits and the PowerPallet have different gas drive systems as shown in the GEK Process Flow diagram above. For the GEK Kits, the gas enters the gas filter, and passes through the ejector venturi gas drive system. Here the air is then mixed for the flare.
For the PowerPallet, the gas by-passes the filter on start-up and the blower system provides gas and air for the flare. After start-up, the flare is then shut off and the engine pulls gas through the gas filter.
The Basic GEK Kit does not include the Drying Bucket, Pyrocoil, or Auger shown in the diagram above. The Basic GEK Kit has a simple lid on top of the reactor and is to be filled manually. The Basic GEK Kits are offered as the most simple experimental development platform.

V. Description of GEK System Components

Feedstock Hopper

The feedstock hopper comes stock with the GEK Gasifier models. The GEK Gasifier kits and PowerPallet come with hopper volumes of 30 gallons (0.1 m^3) and 55 gallon (0.2 m^3), respectively. The hopper for the GEK Kit and PowerPallet systems are to be sealed to maintain the vacuum of the system. A puff lid safety release valve is included on the hopper lidMoisture from the drying process is collected by condensation in a monorator ring incorporated in the hopper design.

Drying Bucket

After the hopper, the feedstock then enters into the Drying Bucket which is a heat exchanger that heats up the incoming biomass with the hot exiting gases from the gasifier. The hot gases exit the reactor between 250-350C and enter into the cyclone then Drying Bucket across a series of baffles to heat the incoming biomass to about 100C. The baffles to knock particulates entrained in the gas stream. The L-shape form factor of the GEK TOTTI is intentional to separate the drying zone from the pyrolysis zone. This is advantageous because water competes with the heat needed to vaporize the tar from the feedstock. Water vapor will also decrease the solubility of the vaporizing tar in the pyrolysis zone. Another consequence of having water in the pyrolysis zone is the tenancy for tar and soot particles to agglomerate around droplets of water. This increases the droplet/particle size of the components that will then be partially oxidized in the combustion zone which decreases the efficiency of combustion and tar cracking. The efficiency of combustion and tar cracking increases when the fuel or tar particle/droplet size decreases.

Feedstock Auger and Fuel Level Switch

The feedstock auger comes stock with the GEK TOTTI and the PowerPallet and is controlled by a level switch that is located on top of the reactor lid. The fuel level switch is wired to a 12vDC circuit as normally closed (NC). For the PowerPallet, the PCU logic registers the current draw of the motor, switch state, and cycle frequency. The table below presents the logic for the possible auger states.

Biomass Auger State Table

Auger State	Possible Causes	Action
no current	auger is off	log state
low current for 1 minute	no feedstock transport (out of feedstock, bridging in hopper), broken motor, or broken auger indicator	Alarm sounds. If no operator intervention after 3 minutes, automatic shutdown of engine.
normal current	feedstock transport and normal auger operation	none
high current	motor working against bound feedstock/jammed auger	Reverse auger for 3 sec (configurable)or until reversing high current, then drive auger forward.

10 forward/ reverse cycles	jammed auger	Alarm sounds.
20 forward/reverse cycles	jammed auger is non-fixable	Automatic engine shutdown.
auger on too long (low current for 4 minute and fuel switch state not changing)	no feedstock transport (out of feedstock, bridging in hopper)	Alarm sounds. If no operator intervention after 6 minutes, automatic shutdown of engine.

If the Fuel Switch changes state, this will reset the alarm and resume normal operation. Because of the variability of characteristics in various feedstocks, the difference between the high and low current thresholds is user configurable.

GEK Gasifier Reactor

- Air inlet

  At the air inlet a check valve allows air to enter the negative pressure system during normal operation, but does not allow expanding hot wood gas to escape through the inlet during shut down. The Air Inlet allows the air to pass through the Air Neck in which the air flow is divided among the 5 air lines for the 10kW and 20kW GEK reactor sizes. The air lines pass through the hot wood gas exiting the reactor to heat up the incoming air while cooling the wood gas.
- Air Nozzles

  The air nozzles experience the hottest temperatures in the reactor as they introduce the air into the combustion zone. The air nozzles are able to withstand these temperatures and do not need replacement very often, however, the reactor is designed to offer the replacement of air nozzles if needed. The air nozzles are to be oriented to point directly to the center of the reduction bell.
- Lighting Port

  This port allows the operator to light the reactor with a small propane torch at the combustion zone during start-up. This port is then closed with the 1/2 cap during operation. If needed, lighting fluid can be squirted into this port to help light the reactor.
- Reduction bell

  The reduction bell is the heart of the downdraft gasifier. The reduction bell controls the flow velocity and thus residence time of the gases passing through the combustion and reduction zone. Because the combustion reactions are many more times faster than the slower reduction reactions, the diameter of the top cone on the reduction bell is smaller and tapers down to a restriction to keep the combustion zone stable and preventing it from 'creeping'. The reduction reactions are slower endothermic reactions that proceed with the available heat from combustion. Here the char that has fallen into the bottom of

the cone from the pyrolysis zone, reduces the combustion products. The gasifier ends the reactions in a metastable state before the reaction reaches equilibrium to maximize CO and H_2 production. While the reduction bell can withstand many hours of normal operation, the reactor is designed to be able to replace the reduction bell if needed.

- Ash Grate and Grate Shaker

  The ash grate lies below the reduction bell to support the charcoal in the reduction zone but allow smaller char/ash to pass through toward the bottom of the gasifier. Smaller char granules increases the bulk density which decreases the void space in the bulk. Decrease in void space limits the gas flow through the media and creates resistance to flow in the system. The grate shaker controls monitor the pressure ratio across the reactor to shake the grate for a given shake time and interval. These settings can be configured through the PCU menu screens. The pressure ratio (P_ratio) is calculated as P_comb/P_react. The table below provides the conditions of the P_ratio value ranges.

Pressure Ratio Ranges and Conditions for Grate Shaker Control

Pressure Ratio (P_ratio); PCU LCD display [/100]	Condition
<20	bad, restricted gas flow due to packed reduction bell
~30	not good but workable, restricted gas flow due to packed reduction bell
30-60	good operating conditions
>60	bad, reduction bell not filled. Feedstock empty, bridging in reactor or bridging in hopper.

Increasing the amount of grate shaking can purge the bell too quickly and over fill the char/ash reservoir at the bottom. Once this reservoir is filled, the grate is no longer able to purge the small char particles, and the gasifier will have to be shut down and cleaned out. APL intends to release an ash take off system so that the char/ash can be purged without shutting the unit down which will increase the continual run time.

Cyclone

After the wood gas leaves the gasifier, it passes through a cyclone that separates the larger particulates that may have entrained in the gas stream. Condensate and particles fall through to the trap at the bottom of the cyclone. The cyclone jar should be emptied before operation if it reaches capacity. during operation of the GEK system by closing off the ball valve at the bottom and emptying the trap. This is included in all of the GEK models.

Packed Bed Gas Filter

The packed bed filter is16 gal (0.06 m^2) and is to be filled with charcoal between 1/16-1/4" particle size. While any charcoal can be used, the char that is purged from the gasifier can be collected and sifted to the required particle size and used in the filter. It is recommended to use the active char left over from the gasifier because the basic high temp char adsorbs the wood tars as most tar compounds are acidic. The 5 inch space below the filter media bottom grate is reserved for condensing in the filter and a bung is provided for draining the condensate.

- *For the GEK Kits,* on top of the filter media should be a fine filter such as fabric or fine mesh to prevent the filter media or fine particulates into the exiting gas stream. The final filter size will depend on what is needed for your end use gas requirements. The filter grate lays on top of the final fine filter to hold it in place and keep it from entraining in the gas stream.
- *For the PowerPallets,* two oiled fine foam filter disks are provided for use in the gas filter. One 65dpi and the other 45dpi are layered on the top of the filter media in this order. The filter disks can be cleaned with warm soapy water, dried and re-oiled for reuse.

Gas Drive System

The gas drive system is used to motivate the flow through the system during start-up. As flow increases, temperature increases. When the reactor temperatures reach the target minimum temperature of 750C, (>800C ideally), tar content in the gas stream may be low enough for use in engines. For full heat modes, gas drive systems that operate the system to flows that are within the bounds of the gasifiers temperature range for the given feedstock are preferred.

- *For the GEK Kits:* An ejector venturi gas drive system both creates suction on the system and mixes air in to the gas for the flare burner. The ejector venturi operates by providing compressed air at ~100psi for 6-8 CFM to the ejector nozzle. The ratio of motive compressed air and gas is only about 25% of the air/gas ratio needed for the flare. A manual air pre-mix valve is provided right before the ejector venturi that allows the air needed for the air/fuel ratio for the burner. While the ejector venturi can operate over a wide range of flow rates with no moving parts, this drive system has a higher power demand for a given flow and may not be appropriate for off grid applications for the system for this version release.
- *For the PowerPallets* Two squirrel cage blowers in series are controlled together with a single knob on the control panel and are used to draw a vacuum on the system. The dual blower design allows for the maximum volumetric flow rate of gas needed for start-up powered solely by the stand alone 12V DC system on-board. A third blower is used to introduce air into the flare burner. For the blower system, the gas bypasses the packed bed filter and goes straight to the flare. This prolongs the life of the packed bed filter as it filters the gas for use in the engine. The blowers are serviceable and can be taken apart and cleaned easily using isopropyl alcohol or the like. Complete combustion in the flare is ensured by adjusting the gas and air blowers to the right ratio to bring the combustion in the flare stack down to the bottom-most part of the flare stack. The blowers have a low power demand and are appropriate for start up for the stand alone off-grid systems but may only operate at the lower end of the gas flow capacity of the gasifier providing less heat than the gasifier is capable of in full heat mode.

Flare Stack and Igniter

For the PowerPallet, the igniter automatically turns on when P_react>0.5 WC and the engine is not running. When these conditions are true, the igniter relay turns on the igniter at the top of the flare stack to ensure that the flare lights and the gas (including CO) is not escaping from the system. The GEK Kits do not come with an igniter and it is required to light the flare manually. Lighting the flare with a hand-held propane torch is highly recommended.

Engine Gas Valve

The manual engine gas valve is installed with the PowerPallet that is opened for Engine Mode. For the GEK Kits, this valve is not included, but a port is available to connect an engine or other gas service.

Air-Mix Valve/Servo and Oxygen Sensor

For the Power Pallet, the air-mix servo acts as an automated wood gas carburetor to adjust to the correct air/gas ratio for the engine. The PCU receives the signal from the MTX Wideband Oxygen Sensor that is in the exhaust stream of the engine. With this signal, the PCU adjusts from the lean or rich mixture to the proper air to fuel ratio for the PowerPallet using PID controls. The GEK Kits come with a manual valve that can be adjusted to allow for the correct air/fuel ratio needed down stream, though an oxygen sensor is not included in the GEK Kits.

Engine

The PowerPallet and Powertainer combine the complete GEK Gasifier system with an engine and automated controls. The GEK Kits are provided as a stand alone gasifier for manual operation as a platform allowing for a variety of alternative development projects and custom controls.

- Engines offered with the PowerPallets
  - 10kWPP- Kubota DG 9782: 3cyl natural gas engine.
  - 20kWPP- GM Vortec 3.0L 4cyl gasoline engine.
- Alternate power options include:
  - CHP applications are allowed through capturing the useful heat out of the radiator.
  - shaft power for vehicles or PTO applications.

Please see the engine manuals for more information.

Governor

The Woodward Governor controls the RPM with information from the MPU sensor on the engine for the PowerPallet. The governor configurations can be modified using the governor L-Series Configuration Tool program (Windows only). Within this program, the settings and control dynamics can be changed (Target RPM, over speed threshold, PID controls, droop, governor-to-governor networking for multiple systems, automatic shut down states, etc). Default configurations are set during testing before the shipment of each PowerPallet.
Please see the Woodward Governor manual for further information.

Generator

A Meccalte generator comes stock with the PowerPallet and Powertainer systems. The Meccalte generators may be configured to 120V/208/240V AC, 60/50Hz, and in single, split, or three phase configurations.
Please see the generator manuals for more information.

Pyrocoil

For the Power Pallet, the heat from the engine exhaust is utilized by passing through the Pyrocoil heat exchanger to provide heat to the pyrolysis zone thus increasing the efficiency of the gasifier. The Pyrocoil comes with the TOTTI GEK Kits in conjunction with the Auger/Drying Bucket system. For the GEK Kits, other waste heat streams may be utilized with the Pyrocoil.

CO Meter

CO meters are provided with all of the systems from ALL Power Labs as a safety precaution to alert the operator in the rare case of a CO leak.

Thermocouples

Two main thermocouples are provided with all of the GEK Systems. These act as the 'tachometer' for the GEK Gasifier. For the GEK Kits, a thermocouple reader is provided that gives the option for F or C readings. The PowerPallet temperatures are read by the PCU and are displayed on the LCD screen in Celsius. The two thermocouples are:

- Top of Reduction Bell temperature (T_tred), measures temperature of the combustion zone at 3/8ths inside the restriction of the Reduction Bell.
- Bottom of Reduction Bell temperature (T_bred), measures the temperature of the reduction zone at 1" inside the bottom opening of the Reduction Bell.

If more thermocouples are needed for your project, ALL Power Labs offers the Research Experimenters Kit that includes gas flow monitoring and control equipment, tar testing supplies, thermocouples (including a multi temperature probe with 6 different temperature detection points along a single probe) and more. For more information contact sales@allpowerlabs.org.

VI. Description of Control Panel and the PCU Components

Process Control Unit (PCU)
The PCU comes standard with the PowerPallet. ALL Power Labs also offers the PCU board separately in full or half fill configurations for alternative development projects. This section mainly describes the PCU as its integrated on the PowerPallet system.

- Power Input
  The power requirement for the PCU is 9-12 vDC, 1A.
- Field Effect Transistors (FETs)
  The 8 FETs control component relays. On/off switching for pumps, motors, solenoids, etc. For the PowerPallet systems, the FETs are wired to the components as follows:
  1. Feedstock Auger
  2. Grate Shaker
  3. Flare Igniter
  4. Engine Ignition Coil
  5. Engine Starter Motor
  6. Oxygen Sensor Power
  7. Warning Alarm
  8. Auxiliary (not in use)
- RS232 Communication Port
  This port allows communication with the PCU. The code on the PCU of the PowerPallet outputs all sensor data to the serial port. For more information see section *IV. Datalogging with the PCU.*
- Thermocouple Connectors
  Standard plug connections are offered on ports T0-T6 and screw terminal connections are available for T7-T14. For the PowerPallet, T0 is populated with T_tred thermocouple and T1 detects the temperature of T_bred.
- MicroSD card port
  Card not included. Currently no code has been written for the SD card that is on board the PCU. However, user code may be generated for datalogging, etc by interfacing via SPI.
- Differential Pressure Sensors
  Two ranges of pressure sensors are located on the PCU board, high range (P0-P3) +/- 28 WC and low range (P4 & P5) +/- 8 WC.
  On the PowerPallets, the dedicated pressure sensors are
  - P0-Combustion Pressure (P_comb), measures pressure at the top of the reactor.
  - P1-Reactor Pressure (P_react), measures the pressure after the reduction zone near the gas outlet.
  - P3-Filter Pressure (P_filt), measures the pressure at the outlet of the packed bed filter.

- Keypad
  Four buttons are available for user input.
- LCD screen and contrast knob
  The LCD screen allows adjustment of the contrast for better visibility.
- Analogue Inputs (from first colum top down to second column)
  1. Coolant Temperature
  2. Feedstock Auger Current
  3. Key Switch State
  4. Oxygen Sensor Signal
  5. Aux- Governor Signal (not in use)
  6. Throttle Position
  7. Engine Oil Pressure
  8. Fuel Switch State
- Microprocessor: Atmel ATmega 1280
- CANbus communication port
  Currently no code is included for the CANbus. However, user generated code could make use of this digital bus communication port.
- Reset Button
  Resets the PCU.
- Frequency Timer
  This port is typically used for hertz measurement from the generator.
- Status LEDs
  The power (PWR) LED comes on when power is applied to the PCU board. The diagnostic (DIAG) LED is prompted in the code to blink for each loop in the code logic.

For more information on the PCU, refer to the GCU Technical Manual, the Gasifier-Control-Unit page on the GEK Wiki website, and the PCU-Getting Started documentation.

Relay Board

The Relay Board manages the interface between the PCU and the wire harness of the PowerPallet and Powertainer models. The Relay Board does not come with the GEK Kits or the stand-alone PCU kit orders.

- PCU Power connection
  Provides clean 12 vDC power to the PCU from the ATX power supply.
- FET Outputs
  Interfaces the FET outputs from the PCU to the wiring harness.
- ATX Power Supply
  Power input from the on-board 12v battery supply to the ATX and clean power output from the ATX to power the PCU.
- ATX module

A current draw from the on-board 12 vDC battery supply would otherwise drop the instantaneous voltage available. To prevent this voltage drop from resetting the control board, the ATX provides clean reliable power to the PCU. A 10 amp input fuse is used for the ATX circuit.

- Governor RS232USB converter chip

  The RS232 chip on the Relay Board replaces the previous RS232 dongle that is used to communicate with the governor. The governor RS232 communication port passes through the Relay Board and provides a USB connection on the front of the main control panel. Connect a computer to the governor USB port on the main control panel to configure the settings through the governor program.

- Relay Bank (from left to right):
  1. Feedstock Auger Forward Relay (fuse: 15A)
  2. Feedstock Auger Reverse Relay (fuse: 15A)
  3. Grate Shaker Relay (fuse: 10A)
  4. Flare Igniter Relay (fuse: 10A)
  5. Aux Relay (not in use) (fuse: 10A)
  6. Engine Ignition Coil Relay (fuse: 10A)
  7. Engine Starter Relay (fuse: 10A)
  8. Oxygen Sensor Power Relay (fuse: 10A)
  9. Other component fuses:
     1. Main Power Fuse (25A)
     2. Air and Gas Blowers Fuse (10A)
- Input/Output catagories for Relay Board & # of connections (from left to right):
  1. Battery (2)
  2. Fuel Switch (4)
  3. GEK Harness (10)
  4. Governor Harness (12)
  5. Blowers (12)
  6. Key Switch/Panel Harness
- Analogue Inputs
- MTX Wideband Oxygen Sensor signal input/output
- Air Mixture (wood gas carburetor) Servo Control pass through
- JP1-Board Configuration Jumper
  - 1&2=20kWPP configuration
  - 2&3=10kWPP Configuration

For more information on the logic and controls of the PowerPallet please see "KS_PowerPallet v1.1 Controls."

VII. Datalogging with the PCU

The code running on the PCU provided with the PowerPallets outputs all the sensor data via the USB port at a baud rate of 115200. Use a terminal program such as PuTTy Tel (puttytel.exe) to access the serial port. When the board is powered, connect to the board via USB connection on your computer and datalog the values by the following:

Windows

1. Open puttytel
2. In the Datalogging tab, choose a location to save files (you can also save files with the date and time as part of the name)
3. Enter the correct COM# that the PCU registers under.

Mac

1. Open terminal
2. Use the following command:
3. screen -L /dev/tty.usbserial.
   This will also save the output to the user folder in a file named screenlog.0