GROUND POWER UNIT GA140 TYPE

TECHNICAL DESCRIPTION

Guinault
AIRCRAFT GROUND ENERGY

PLUG & SAVE

INTRODUCTION

GUINAULT Company has been designing and manufacturing aircraft Ground Support Equipment (GSE) since 1949. Today, GUINAULT is an independent and privately owned company certified ISO9001/2015 which offers a very modern range of products dedicated to all type of aircraft.

Today, more than 20,000 GUINAULT GSE are in operation world-wide in more than 100 countries over the five continents. GUINAULT is the only company, **exclusively** focused on the design and manufacturing APU-OFF solutions, including GPU, ASU, ACU.

Specialization, and in-house expertise are key factors at GUINAULT to offer superior products, ensuring the highest reliability, the highest performance to really substitute to the APU on the ground:

➡ **400Hz alternator design, (manufactured by GUINAULT in France), digital electronics, power electronics, industrial refrigeration, thermodynamics are in house expertise.**

Thanks to its unique specialized experience in the APU-OFF solutions for decades, GUINAULT claims to be the partner of choice for the airlines, handlers and any third parties looking for savings and emission reductions trough the APU-OFF at the airport.

Because the return on investment for an APU-OFF solution (GPU, ASU, ACU) is impressive, because the reliability of the equipment generates valuable kerosene savings, because too many APUs are still running on the airports due to GSE quality/performances/reliability issues, GUINAULT pays a great attention to the quality of manufacturing, the selection of components, the tests, to ensure the highest performance and reliability. The digital technology is designed in house, to ensure the highest reliability in airport conditions, and to include dedicated service functions to the APU-OFF target.

For all these reasons, GUINAULT is a first choice GSE partner for providing power solutions to handlers, Airports, Airlines, Aircraft/helicopter OEM and Military Armed Forces.

A factory tour being be the best way to witness GUINAULT organization, strategy and expertise: feel free to come, and visit our factory, our design and testing facilities, and its 200 highly qualified and motivated employees.

GUINAULT S.A, Orléans (France)

WHY CHOOSING GUINAULT

Invest in quality to save over the entire life time of the equipment

High performances:

- Permanent current
- Peak current
- Voltage Transients
- Frequency Transients

Reliability and robustness:

- Deutz,
- GUINAULT Alternator and electrical regulation
- Full anti-corrosion protection: polyester canopy, plastic fuel tank and electro-galvanized steel chassis for long term utilization

Easy to Use:

- Excellent manoeuvrability due to reduced dimensions / weight and the leading front axle with ball bearing for low turning radius (= wheel base)
- Control panel with clear indication and robust switches
- Easy access for maintenance: Possibility to uncover entirely the device by swinging the canopy and opening the rear panel

Reducing of the Total Cost Ownership:

- Optimized fuel consumption due to the excellent efficiency of the alternator, the automatic stop after 20min if no load is provided, the low speed alternator 1714rpm option to save up to 15% fuel consumption and anti-towing security option to save fuel during no load time
- Low cost of spare parts due to the choice of standard components as much as possible

Multi-purpose:

- The GPU guarantees an adapted power supply for numerous types of aircrafts thanks to the high temporary overloads tolerated by the alternator and the Simultaneous Dual-Voltage operation possible for 400Hz and 28Vdc OUTPUTS

Complies with applicable standards in force:

- EN2282 / ISO6858 / EN12312-20 / SAE ARP 5015A / EN1915…
- Directives 2006/42/CE and 2004/108/CE and delivered with CE Certificate.

MAIN FEATURES

GA140

Engine type	Cylinders	Emission standard	Power (kW)	
Deutz TCD2013L06 2V	6	Stage 3A	174	
Deutz TCD6.1	6	Stage 5	167	

General data	**GA140**
Permanent Power at power factor = 0,8 (KVA)	140
Number of 400 Hz 115/200V Output	2
Dimension of output cables (115/200V-400Hz)	Length 10 meters, 4 x 70mm²
Battery System	24 Volts (2x12V/125 Ah in serial)
Fuel Tank	280 litres (autonomy from 8 hours up to 20 hours)
Weight	2500Kg

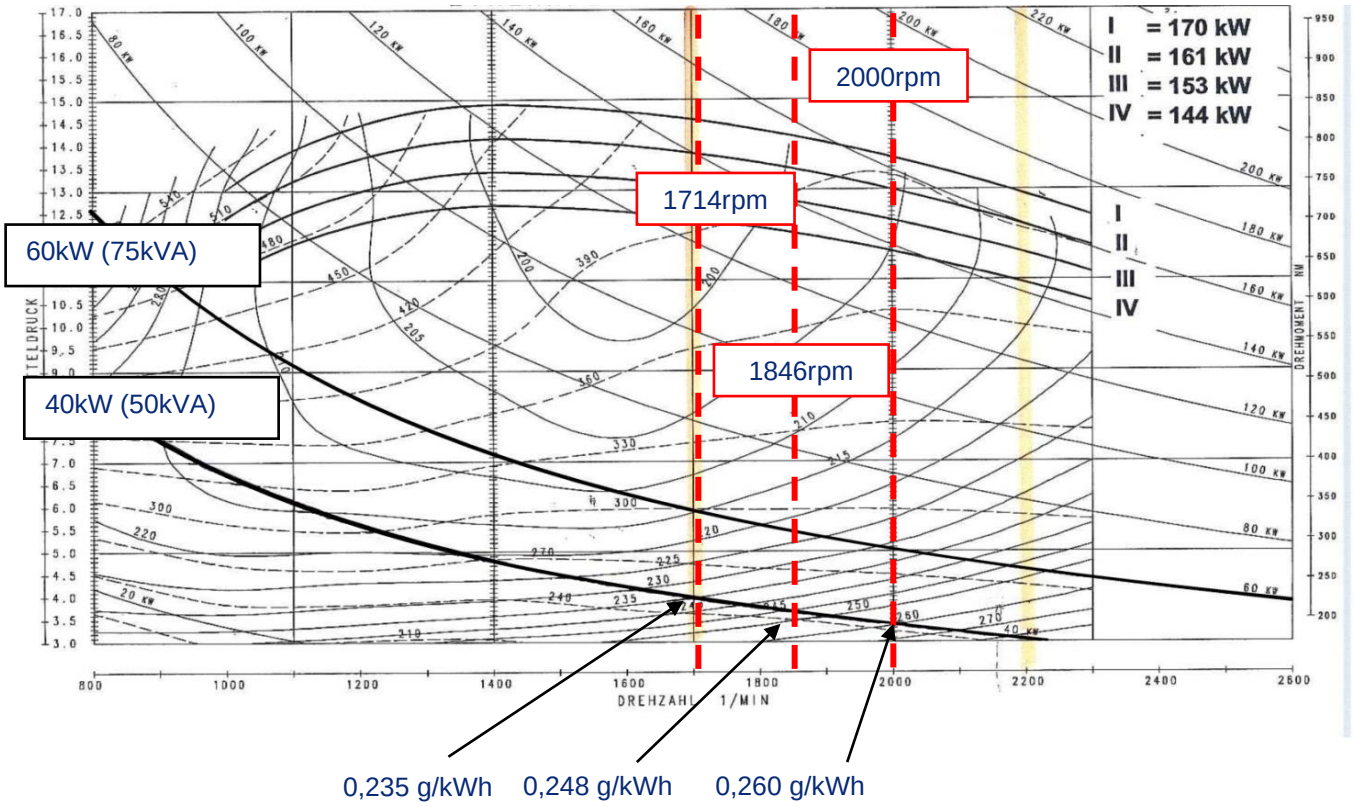
DESCRIPTION

1- TOTAL COST OF OWNERSHIP

1.1 SPECIFIC FUEL CONSUMPTION VS ENGINE SPEED

All GUINAULT units are equipped with engine running at 1714 RPM which offers better fuel efficiency.

Typical diesel engine fuel consumption - Extract from DEUTZ engine technical specification



1.2 SPECIFIC FUEL CONSUMPTION AT 40kW (50kVA)

1500 RPM: 227g/kW/h 1600 RPM: 231g/kW/h	**NON ACCEPTABLE TRANSIENT TIME**
1714 RPM: 235g/kW/h 1846 RPM: 248g/kW/h 2000 RPM: 260g/kW/h 2182 RPM: 280g/kW/h 2400 RPM: 300 g/kW/h	**ACCEPTABLE TRANSIENT TIME**

While decreasing the speed of the engine to save fuel, the inertia of the engine is also reduced and therefore the response time (transients). 1714 RPM is the best performance / fuel consumption compromise because the fuel economy delta is less interesting at lower stages below 1714 RPM whereas the transients are constantly deteriorating.

In addition, in order to create the necessary power at very low speed, the torque of the engine must be increased (Power = Torque * Speed). Consequently, the engine pistons hit stronger and create more vibrations that may cause mechanical issues in the GPU on a long term basis.

1.3 FUEL SAVING CALCULATION AT 40kW (50kVA)

The GUINAULT alternator (28 poles) allows a significant reduction of the engine speed (1714 rpm) which means a reduction of noise frequency, an increase of the unit's lifetime and a reduction of the fuel consumption within the acceptable response time:

Formula:

2000 H (operating time per year) x (0,248 - 0,235) Kg/kWH (specific consumption difference, see diagram) x 40 kW (average needed power) / 0,85 (diesel density) = 1223 Liters / year savings.

Conclusion

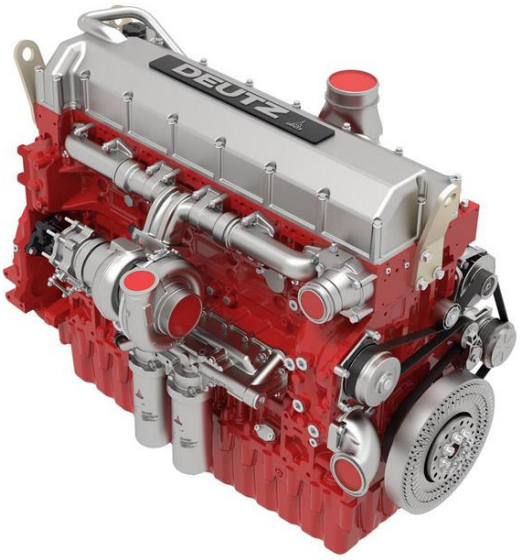
A rotation speed of 1714 RPM (instead of 1846 RPM) allows a saving of 1223 liters of fuel per year which means 12230 liters after 10 operating years.

This is the main technical evolution in the process of GPUs for aircrafts of the last 15 years.

GUINAULT low-RPM units (1714 RPM) ensure a fuel saving of about 12 230 € within 10 operating years (based on 1L=1€)

2- ENGINE

The unit is equipped with DEUTZ (see technical features across on page 2). The speed control is ensured by an electronic controller. Selected 6 cylinders on rated power of the unit. They comply with the respective emission standard (Stage 3A / Stage 5).



The swinging canopy allows a large access to the engine and generator for maintenance purpose.

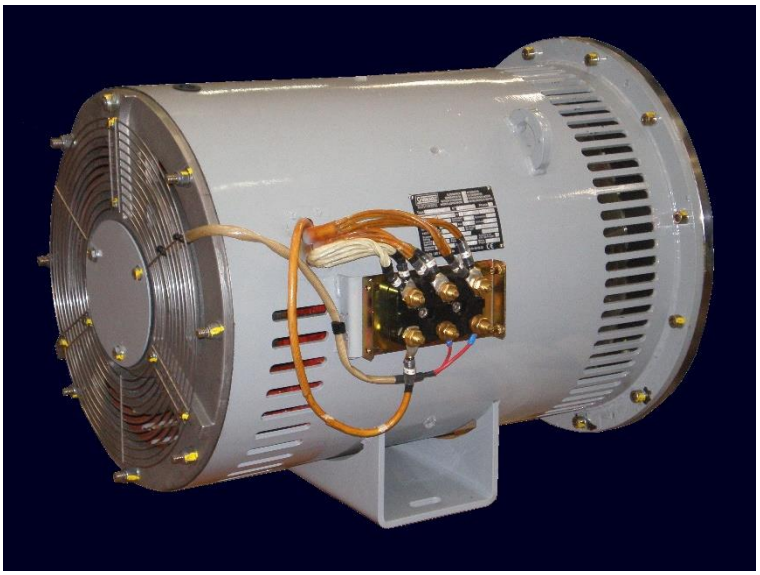
3- GENERATOR & ELECTRICAL OUTPUT

3.1 400Hz – 115/200V OUTPUT

The GUINAULT alternators are very compact and high efficient. The integral fan ensures a very good cooling in tropical or desert surroundings. (Technical data: see page 2)

Performances of the 115/200V - 400Hz output:

Nominal power:	140KVA
Overloads:	110 % of rated output for 10 min 125 % of rated output for 5 min
Rated Voltage:	115/200 V +/- 1%
Frequency:	400 Hz +/- 0.5%
Voltage regulation:	Electronic regulator GUINAULT type RS525
Output	115/200V-400Hz output, length 10 m, fitted with standard Stanag 3303 aircraft connector
Harmonics :	< 3%
Transient performances:	according to MIL STD 704F / EN2282 / ISO 6858 /SAE ARP 5015
Recovery time NO LOAD / FULL LOAD (Voltage)	80 ms



3.2 28,5VDC OUTPUT (OPTION)

A 28,5VDC output can be offered as an option.

The GUINAULT 28,5VDC Transformer Rectifier Unit (TRU) is equipped with 2 transformers (Start / Delta), 2 high efficiency cooling ventilators, and very robust rectifying diodes.

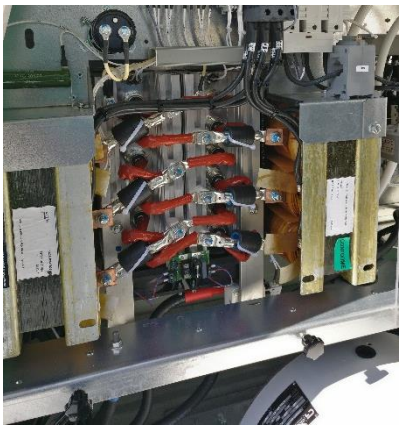
The Voltage / current are controlled by the GUINAULT RS525 voltage regulator, and monitored by the GUINAULT RS795 motherboard.

Performances of the 28,5VDC output :

Voltage	28,5 VDC
Current:	800 A permanent 1.500 A during 30 seconds 1.800 A during 3 seconds 2.400 A instantaneous peak
Voltage regulation:	Electronic regulator GUINAULT PCB type RS525
Output:	One 10 metres (*) long cable, complete with aircraft's connector compliant with STANAG * other cable length available upon request

The 28,5V output is equipped with a current limitation safety features adjusted at 1275A allowing the use on ATR aircrafts.

The design of GUINAULT GPU allows simultaneous us of 115/200V-400Hz and 28,5 VDC outputs.

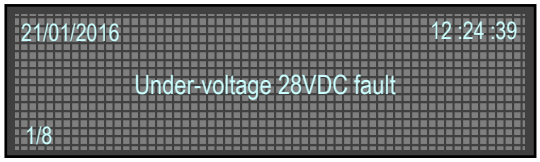


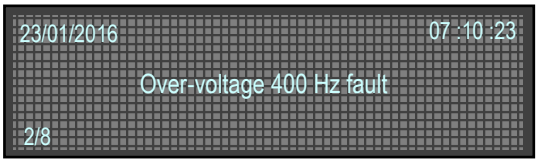
4- SAFETY FEATURES

The GUINAULT monitoring system protects the plane, the operator and the ground power unit against:

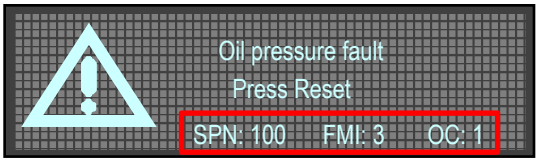
Engine Safeties	115V/400Hz Safeties	28,5Vdc Safeties
Low oil pressure High coolant temperature Clogged Air filter Battery charging fault Over speed	Over voltage Under voltage Over frequency Under frequency Overload	Over voltage Under voltage Overload

The faults display is done through the digital display on the control panel for easy understanding.





The digital display is also used as an interface to allow readings of specific warning and fault information detected by the engine controller (On Board Diagnostic using J1939 CAN bus protocol). Engine manufacturer software for engine diagnostic is therefore no longer necessary.



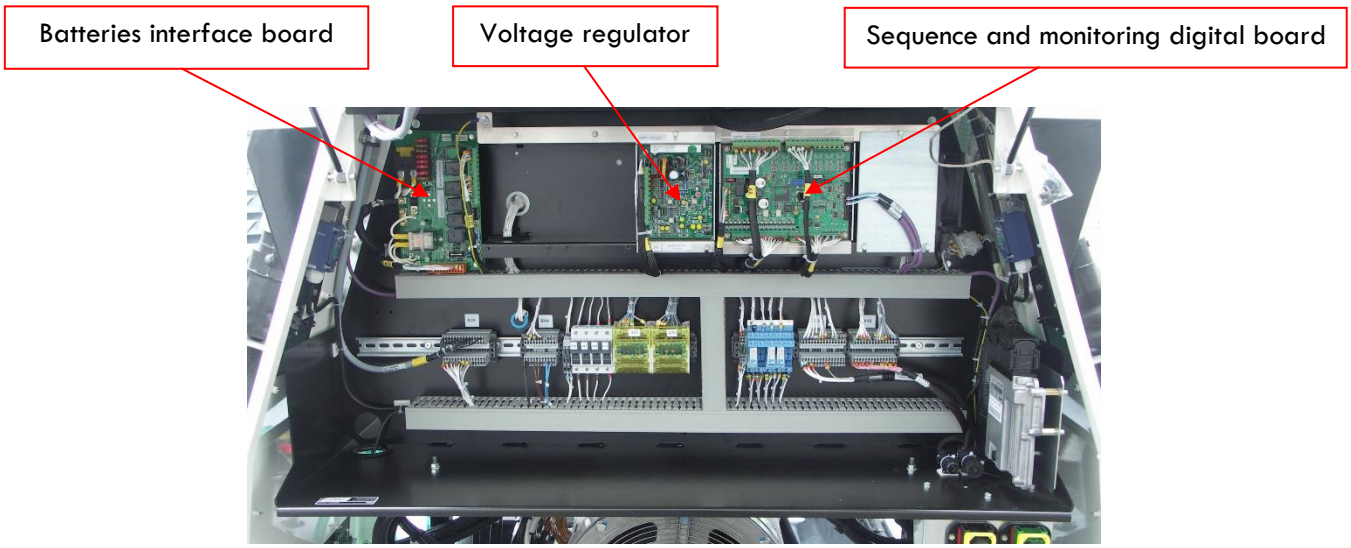
Engine diagnostic via J1939 CAN bus protocol

5- ELECTRICAL CABINET

A large and accessible Electrical Cabinet is located in the rear side of the unit. GUINAULT pays attention on the wiring labelling and the selection of components to ensure reliability, maintainability and reduced down-times.
The whole Electrical system is manufactured in one Location in France, ensuring a harmonious standard for labelling/wiring for the whole equipment manufactured by GUINAULT (GPU, ASU, ACU, Heater, Static Converters.)

The electrical cabinet gathers a set of homemade GUINAULT electronic boards:

- Batteries interface boards with protection relays and fuses
- voltage regulator with line drop compensation function
- Sequence and monitoring digital board to control accurately the whole functioning of the unit and ensure a complete monitoring of the electrical parameters (AC and DC outputs)



A rear access door allows complete and easy access to the electrical cabinet

6- CONTROL PANEL

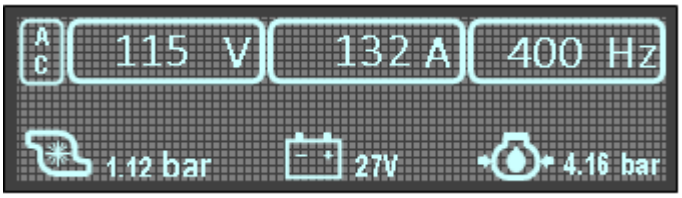
The GPU is equipped with a weatherproof digital control panel, easily accessible, with permanent indications in English or in local language upon request.

The control panel is fitted with robust and large push button, easy to operate in all weather conditions.

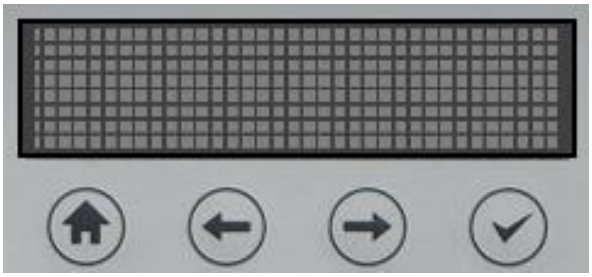
Control panel for D1 design

Control panel for D2 design

The digital display allows a quick check by the user of the good functioning of the unit, as well as an easy communication between the unit and the user.



Dedicated control arrows allow access and navigation through maintenance menu (protected by a password) for modifying specific parameters (115/200V-400Hz and 28VDC interlock, automatic shutdown timer, maintenance intervals warning, language setting, etc…)

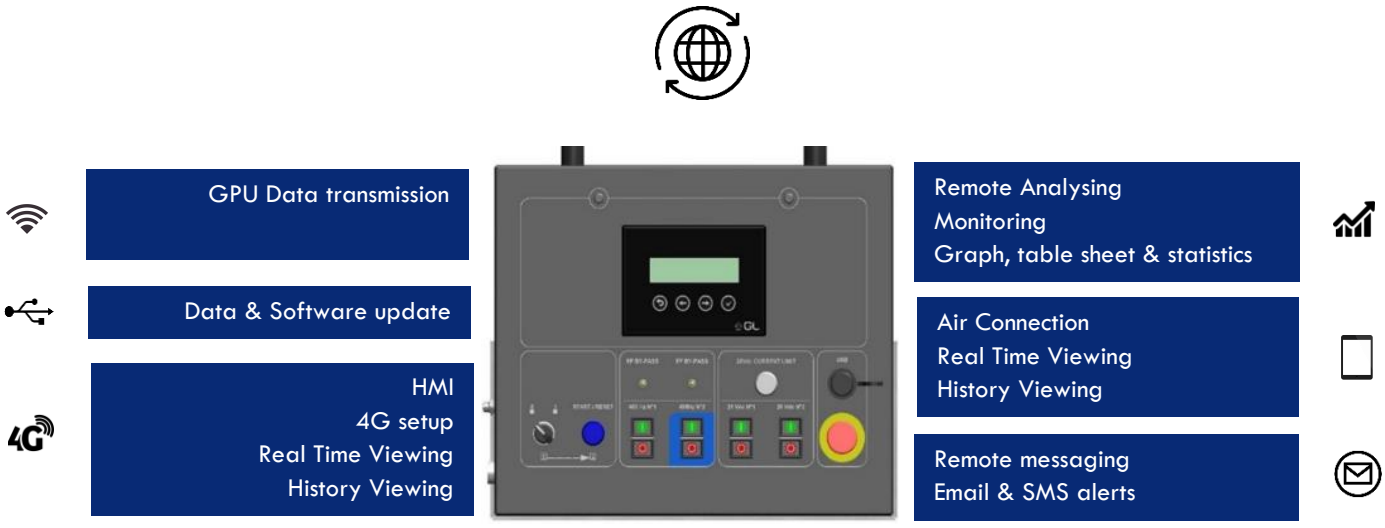


7- THE CONNECTED GPU : INTERNET OF THINGS

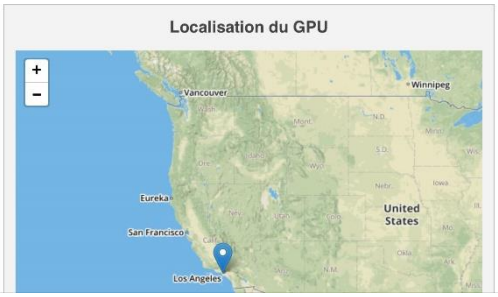
The unit is equipped with a unique GPS / WIFI /4G system which allows:

- Remote Information about location of the unit (3G or 4G)
- Real time monitoring of the parameters of the unit by connecting a smartphone or tablet using the WIFI connection
- Checking of all of the memorized faults, and status of the machine at the time of fault.
- Checking the past/actual operation of the unit
- & more ... (SMS in case of failure, summary of operation, web tracking...)

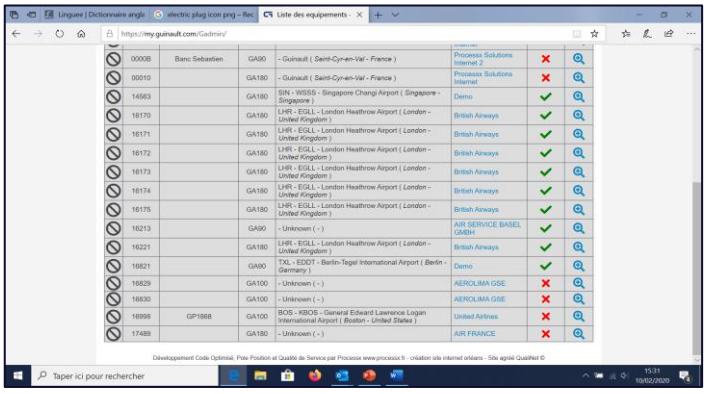
THE UNIQUE CONNECTED GPU IN OPERATION

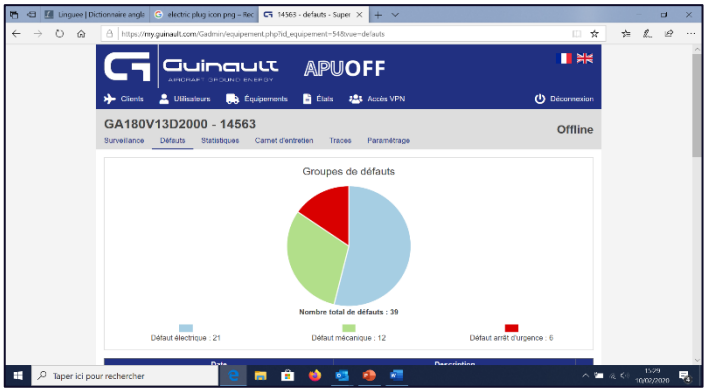


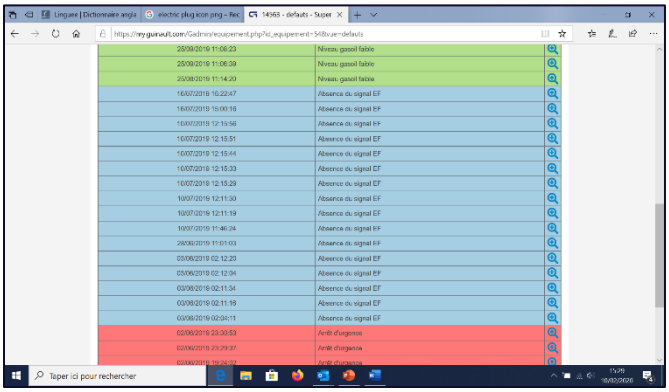
REAL TIME MONITORING



RUNNING DATA & FAULT HISTORY







REAL TIME REMOTE SUPPORT

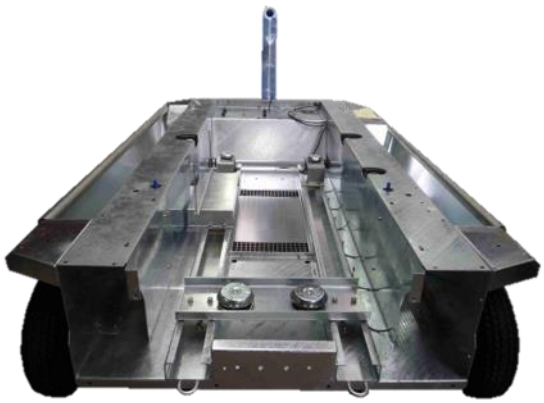
Upon your approval, our technical support team is able to connect to your machine for personal assistance.

8- CHASSIS AND CANOPY

8.1 EXTRA CHASSIS PROTECTION AND POLYMER FUEL TANK FOR HOT AND HUMID AREA

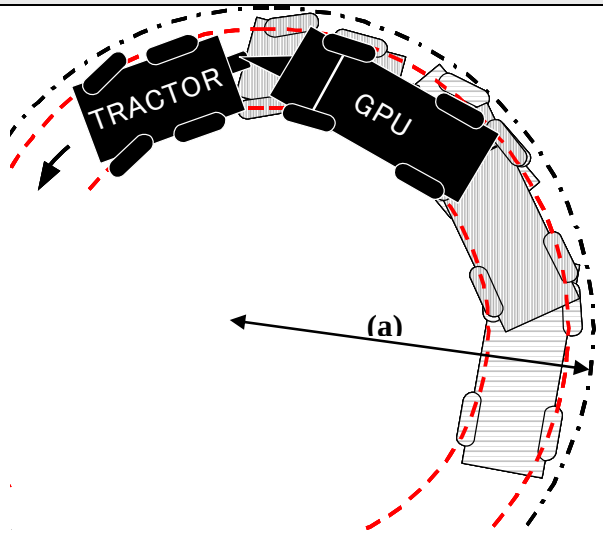
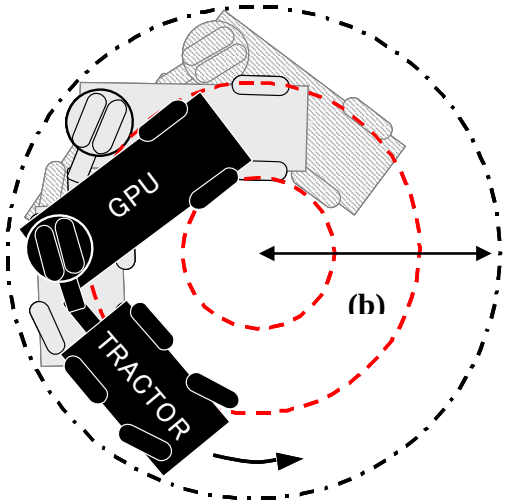
GUINAULT integrates on GPU an Extra-Anti-corrosion system dedicated to extreme weather condition area and/or fuel with high sulphide contain (>50ppm). It includes:

- Galvanization of the GPU chassis in order to avoid corrosion (treatment in the steel material for better efficiency (not only on surface))
- Fiberglass canopy with gel coat painting (no possible corrosion)
- Strong plastic Polymer fuel tank. High sulphur contained in fuel reacts with water to create sulphuric acid. The sulphuric acid corrodes the traditional steel fuel tank to create corrosion in fuel tank and in the fuel circuit (pump, filter…). The use of Polymer fuel tank allows to avoid the corrosion and increases significantly the fuel system life time.

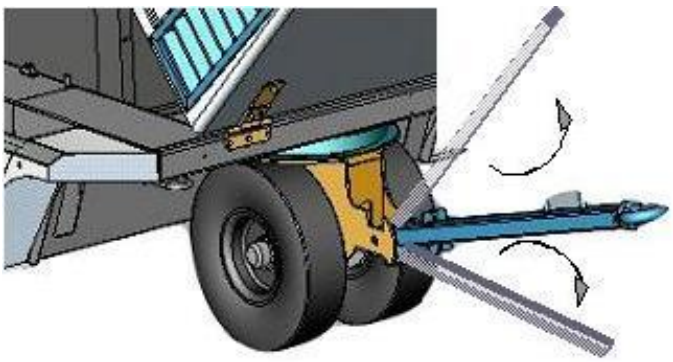


8.2 *HIGH MANOEUVRABILITY FRONT AXLE AND BRAKING SYSTEM*

The ground power unit steering is ensured by a steering turn table guaranteeing reliability, robustness and a great manoeuvrability (see schema below).

Traditionnal Trailer Mounted GPU	Guinault Trailer Mounted GPU
	
High Turning Radius (a) **(a) ≈ 5m >> Wheel Base**	**Short Turning Radius (b)** **(b) ≈ 3m ≈ GPU Wheel Base**

The braking is ensured by high and low positioning of the tow bar.



1. BRAKING POSITION

2. MOVING POSITION

3. BRAKING POSITION

8.3 CANOPY

The polyester canopy is designed to improve cooling of the unit by guiding the airflow efficiently through necessary components. It also significantly reduces the noise level.

Two Cable compartments are located on each side of the unit enabling a rapid and easy cable deposit. Those cable compartments are detachable from the main chassis allowing easy repairing or replacement.

Four red marker lights are fitted on the four upper corners of the canopy.

The access for maintenance and servicing is done by swinging the polyester canopy towards the front, allowing a total access to the diesel engine. The access to the control system part is done by opening a door at the rear of the unit.