GOSSEN METRAWATT

Safety through Competence

Power Supply in the Field of Hybrid Technology

Power Supplies

Contents

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No Power Without a Charged Battery

Ecological and cost-effective: The automotive industry is working harder and harder on solutions for sustainable mobility, and in doing so is banking above all on new drive concepts.
Presumably, conventional fuels like gasoline and diesel will soon be replaced by electrical energy.
The hybrid drive represents an alternative technology which makes it possible to protect the climate and reduce consumption.

As a rule, vehicles with hybrid drives are equipped with a gasoline or a diesel engine (internal combustion engine), a high torque electric motor and a battery (see figure 1). The use of this type of drive drastically reduces fuel consumption – by up to 50%. And emission reductions of a similar magnitude are not uncommon (internal combustion engine: approx, 200 grams per km, for hybrid vehicles: approx.100 grams per km).

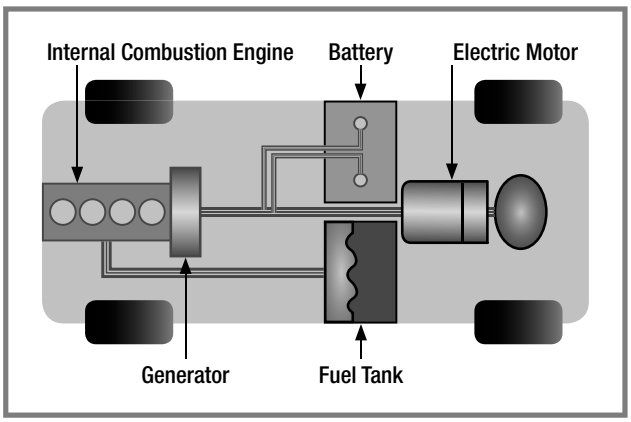


Figure 1: Components Included in a Serial Hybrid Vehicle

Ingenious Technology

When a hybrid vehicle is first started up, the electric motor is taken advantage of initially. After reaching a speed of 25 to 30 kilometers per hour, the internal combustion engine (diesel or gasoline) is started (figure 2: "Start ICE"). If the vehicle comes to a stop, for example to wait for a traffic light, the internal combustion engine is shut down and the electric motor is once again ready for operation. The electric motor is supplied with power from a battery to this end. The battery is charged each time the brakes are applied. As a result, less fuel is consumed thanks to the forward-looking system used by the hybrid engine.

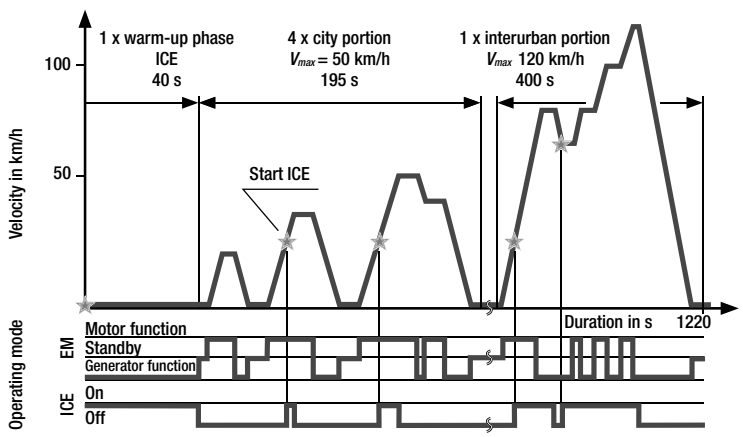


Figure 2: Representation of Signals for the Hybrid Drive Including Internal Combustion Engine (ICE) and Electric Motor (EM)

Great demands are placed upon the charging systems which have to continuously ensure that the battery is always ready for use. In order to assure suitable charging current for hybrid vehicle technology, GMC-I Messtechnik GmbH in Nürnberg has developed an ideally suited product with its high precision power supplies included in the SYSKON P4500 range.

Above all people who drive in the city or travel only short distances, as well as interurban drivers, profit the most from the advantages of a hybrid engine (see figure 2: "4 x city portion" or "1 x interurban portion"). Conversely, people who drive with a lead foot will not succeed in reducing fuel consumption. For drivers who rarely start up their engines as well, buying a hybrid vehicle will not necessarily affect their pocketbooks in a favorable fashion, because the purchase price of a hybrid vehicle is somewhat higher.
But automobiles with hybrid engines are recommended for everyone who takes CO_2 emissions and environmental consequences seriously. Economy and environmental friendliness enjoy top priority with this technology.

The advantages of the hybrid engine for automotive applications can be summed up with the following three points:

1 Hybrid vehicles reduce fuel consumption.

- Automobiles with hybrid drive technology consume considerably less gasoline than conventional vehicles with internal combustion engines, and thus generate significantly less pollution: reduced fuel costs!
- Classification for the less expensive Euro 4 tax rating is no problem: less tax!
- Hybrid models with identical power ratings are capable of much faster acceleration than vehicles with gasoline or diesel engines thanks to their high-torque electric motors: important in critical situations!
- Hybrid vehicles make a considerable contribution to climate protection: environmental friendliness!

2 Hybrid vehicles are much quieter than conventional vehicles.

- Under normal driving conditions, the internal combustion engine is operated in the lower RPM range.
- With some hybrids only the electric motor runs at certain times, for example when the vehicle is first set into motion from a standstill and at low speeds. The vehicle is nearly inaudible at these times.
- The engine and the motor are shut down when the vehicle comes to a standstill. The noise level is greatly reduced.

3 Hybrid drives are less subject to wear.

- In interaction with the electric motor, the internal combustion engine is always operated within a favorable RPM range. The control electronics make it impossible to stall or overrev the internal combustion engine.
- The electric motor assures gentle start-ups. The internal combustion engine is run up to idling speed without compression or ignition when the vehicle is set into motion. Ignition does not occur until sufficient oil pressure is achieved and lubrication is assured.
- The electric motor is of simple design and is maintenance-free.
- Some hybrid cars work without a clutch or a conventional transmission.
- The regenerative brakes function in a contactless fashion. The hydraulic brakes do not come into play until considerable pressure is applied to the brake pedal, thus extending the service life of the brake linings.

As is also the case with electric vehicles, hybrid vehicles are equipped with various types of battery technology for battery voltage and charging current. The charging process must be monitored by the vehicle in order to prevent errors during charging, and at the same time to assure that the external charger is capable of charging all currently existing and possible future batteries.
All vehicles which will be connected to an external charging system must be equipped with a charging control module which can monitor and regulate the charging process.

Redundant Charging Systems

The task of the external charger is to supply the vehicle battery with direct voltage and regulated direct current. In addition to this, charging voltage (Uset) and charging current (Iset) characteristics must also be measured at the power supply. If, in addition to the external device, the vehicle's charging control module also performs these measurements, a fully redundant system can be set up in order to assure a highly reliable charging system. The following conditions must be fulfilled to this end:

- The charging parameters must be specified by the vehicle's charging control module and transferred to the external power supply for use as setpoints (Uset and Iset).
- Values measured during the charging process are transmitted from the power supply to the vehicle's charging control module.

Depending upon the application (electric motor performance), various setpoint values are possible for the charging process.
Output voltage and output current are frequently determined by the power supply in a controllable fashion. Output power within a range of 12 to 15 kW is typical (setpoint values for Uset of up to 400 V and for Iset of up to 100 A).
Safety is an extremely important aspect where charging currents of this magnitude are involved. The beginning of the charging process must be enabled by the external power supply, as well as by the vehicle's charging control module. It should be possible for the external power supply or the vehicle's charging control module to stop the charging process at any point in time. It's crucial to assure that the charging process is stopped immediately by the charger or the vehicle's charging control module in the event of an error or an interruption.

Power Supply Equipment from GMC-I Messtechnik

Modern power supplies are equipped with switching controller technology in order to reduce weight and size.
However, switching controllers require an appropriate filter with an output capacitor in the output circuit. The capacitor, whose rating may be several thousand µF depending upon power, directly determines dynamic performance. In addition to load current, adequately high charging current must also be permissible in order to achieve short rise times from lower to higher output voltages. Accordingly, this charging current influences dimensioning of the power component right on up to the power connection.

Rapid discharging must be assured in the other direction when reducing output voltage (fall time). Due to the fact that we cannot always assume that adequately high load current will be available, discharging must be accomplished by the power supply itself.
An accelerated discharging function can be achieved by means of an integrated dynamic load or current sink. This concept is taken advantage of by the SYSKON P series – an innovative DC power supply system manufactured by GMC-I Messtechnik GmbH.

Outstanding Performance in the Upper Limit Range

The measuring technology specialists at GMC-I have developed a new connection concept in order to assure a supply of suitable charging current in the field of hybrid vehicle technology. In addition to the fact that they're programmable, the high performance power supplies included in the SYSKON P4500 range (figure 3) demonstrate outstanding technical data where upper power limits are concerned (see table).

Figure 3: Front and Rear Panels at the Syskon P4500 from GMC-I Messtechnik

Table: Technical Data for SYSKON P4500

Response times at idle / nominal load:	Uset = 0 V ➔ Uset (rise time) = 7 ms / 19 ms Uset = Uset ➔ 0 V (fall time) = 70 ms / 11 ms
Setting accuracy (18 to 28° C):	Voltage = 0.1%, current = 0.15%
Measuring accuracy (18 to 28° C):	Voltage = 0.1%, current = 0.8%, power = 1%
Efficiency at full load:	82 %

This top-of-the-line model from the SYSKON P range, which was introduced to the market in January 2009, allows for maximum power output of 4500 W in single mode operation with output parameters of Uset = 60 V and Iset = 75 A, or Uset = 25 V and Iset = 80 A (see figure 4).

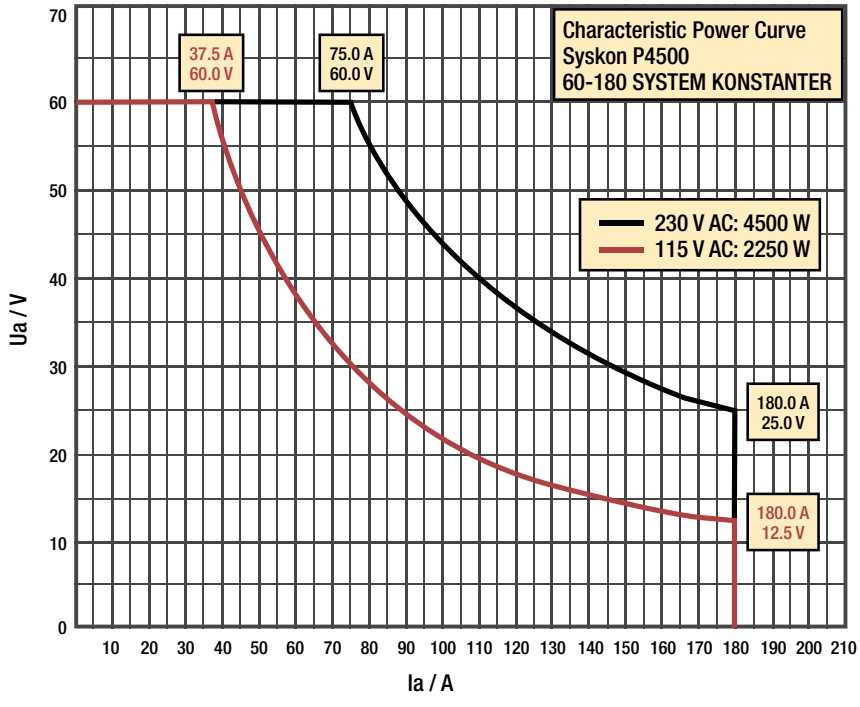


Figure 4: Syskon P4500 Output Power

The connection concept for the SYSKON K18000 (figure 5) is implemented by means of a master-slave setup consisting of four SYSKON P4500 devices connected in series via their analog interfaces located in the rear panel. This type of connection allows for output voltages of up to Uset = 240 V and output currents of up to Iset = 75 A. This corresponds to maximum output power of up to Pout = 18,000 W.

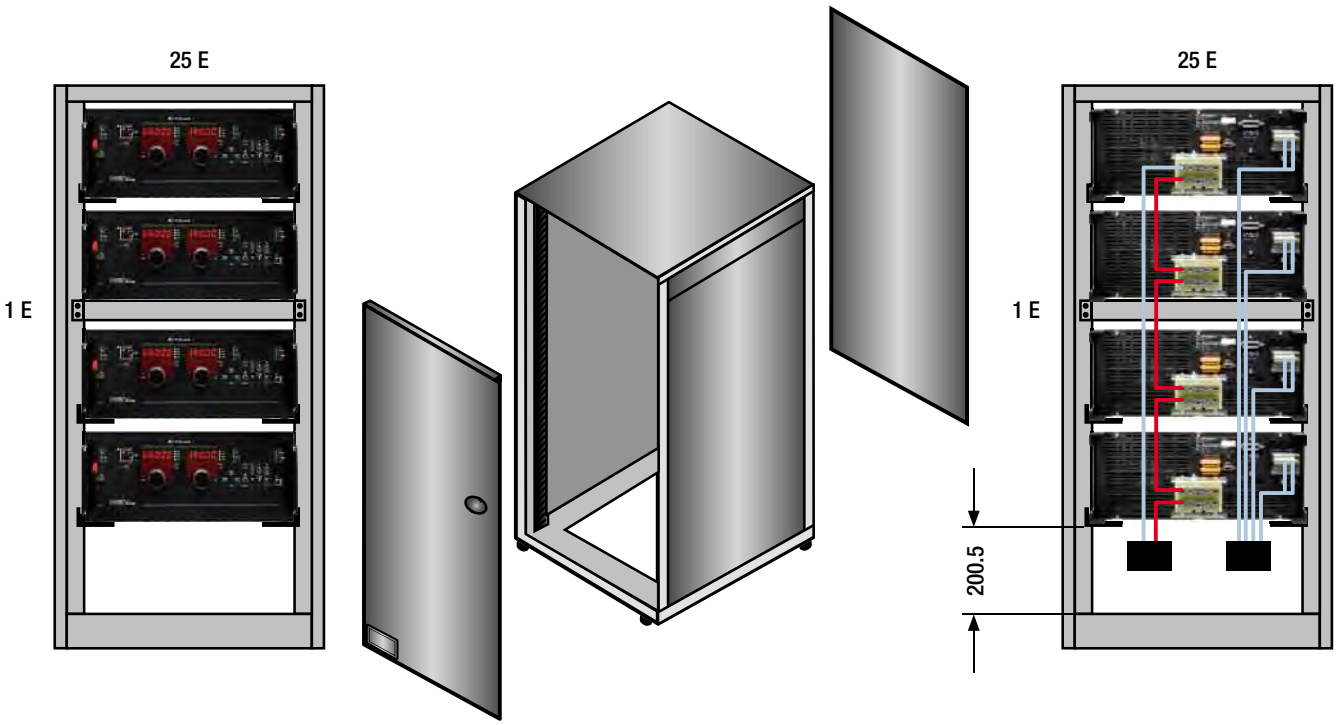


Figure 5: Innovative Connection Concept for the SYSKON K18000..

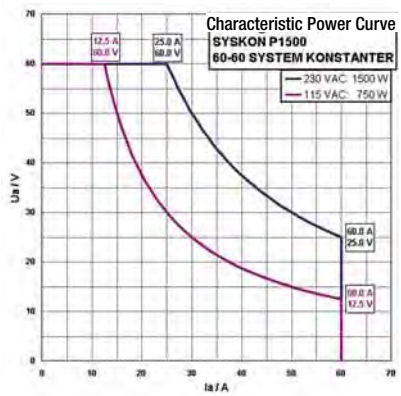
Soft Front-Panel

The SYSKON KONSTANTER includes convenient software as a standard feature for quick and easy operation of computer-controlled systems. Its central element is the soft front-panel (see figure 6), which can be connected via a USB port located on the front panel of the device.

Figure 6: The soft front-panel assures quick, easy operation.

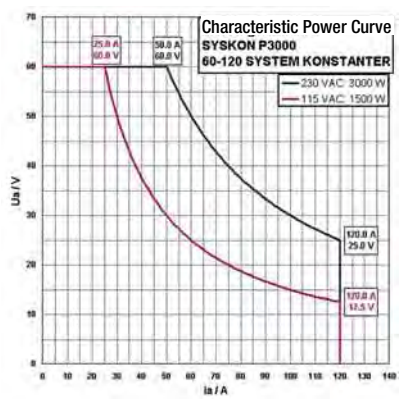
Further information and data regarding the SYSKON P KONSTANTER range is available from the GMC-I website at:

http://www.gossenmetrawatt.de/english/produkte/syskonp15004500.htm



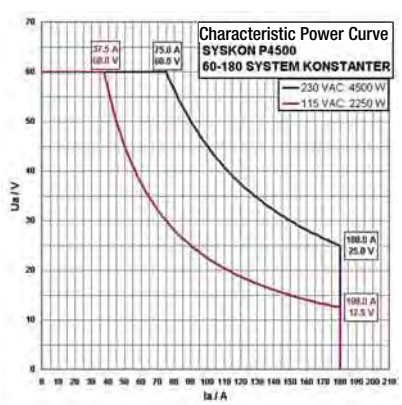
SYSKON | P1500

1500 W Output Power



SYSKON | P3000

3000 W Output Power



SYSKON | P4500

4500 W Output Power

SYSKON Transporter

Type		Article Number
1500 W	SYSKON P1500	K353A
3000 W	SYSKON P3000	K363A
4500 W	SYSKON P4500	K364A
IEEE 488 interface		K384A
Mains power cable, 3.5 m		K991B
SYSKON TRANSPORTER		Z116A

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