DUPLEX

DUPLEX in a nutshell

Yesterday:

When no electronics were used, asynchronous generators were needed to produce so-called "clean" current, and synchronous generators to tackle the "hard starts".

Today:

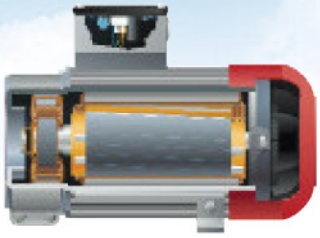
With Duplex technology, the electronic controller units are installed individually into each drive engine and react appropriately before the engine is overstrained. In this way, reserve output can be mobilized and the Duplex alternator powers even the heaviest inductive appliances and protects sensitive appliances from damage. This is how the Duplex system combines all the advantages of asynchronous and synchronous alternators, thereby ending the discussion as to which technology is best.

The fine difference:

Where conventional wear-prone carbon brushes were once used, the ENDRESS Duplex system uses an intelligent exciter machine. In connection with power electronics, it represents the pinnacle of new-generation technology.

Rotor head with wear prone carbon brush operation

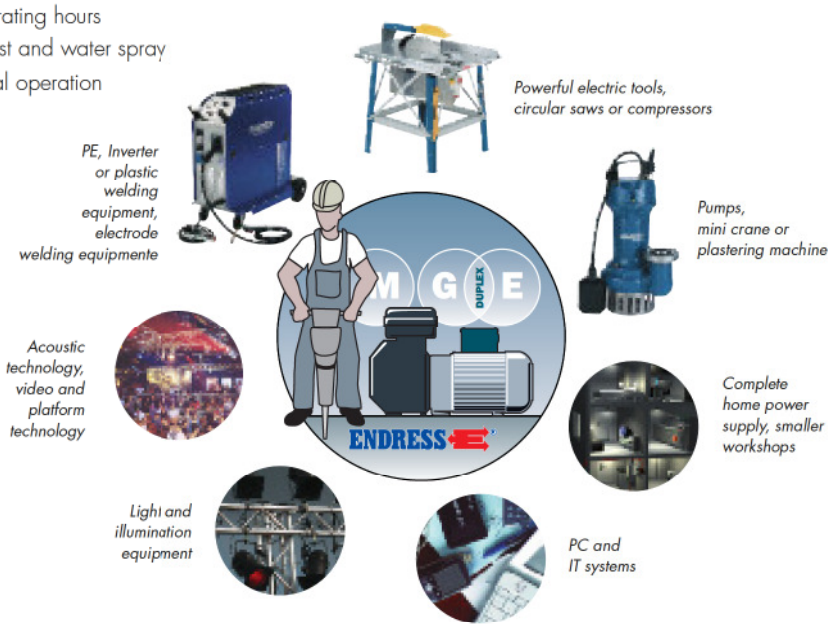
DUPLEX Rotor head loaded with an intelligent exciter machine



Advantages at a glance:

- Combines and strengthens the advantages of asynchronous and synchronous alternators
- WCT technology: W = wear-free C = contact-free T = trouble-free
- Simultaneous use by electronic and inductive appliances
- Brushless, electronically regulated synchronous alternator
- Brushless technology provides 20,000 operating hours
- Protection class IP 54 — protected from dust and water spray
- 200% suitable for unbalanced load in actual operation
- Voltage stability +/- 1% with 3~ alternators
- Up to 4 times the starting current
- 100% short-circuit-proof
- Distortion factor ≤ 5%

A generator for every use!



PE, Inverter or plastic welding equipment, electrode welding equipmente

Powerful electric tools, circular saws or compressors

Pumps, mini crane or plastering machine

Acoustic technology, video and platform technology

Complete home power supply, smaller workshops

Light and illumination equipment

PC and IT systems

All DUPLEX generators are built to IP 54 – for your safety

Greater safety with IP 54.
Why is IP 54 so important?

Generators of protection class IP 54 are protected from the smallest dust particles and water spray. This not only lengthens your generator's life, but most of all protects the people who work with it.

Big and bulky was yesterday – small and light are now

Size: tiny!
Output: huge!
The same pure power as a large unit!

Where heavy stationary units up to 15 kVA were once needed, now a 13 kVA Duplex generator does the job. A brushless Duplex alternator can withstand up to four times nominal current. First in its class – for better mobility.

Only DUPLEX generators give you the guarantee that no asymmetric loads can occur

Clean current
for sensitive appliances.
What is a clean current?

Electronic appliances, such as welding equipment, computers, TVs, stereos, heating systems or various electronic controls require constant power and a stable frequency. Our Duplex technology allows a voltage constant of up to +/- 1 % of nominal voltage (230 V), to protect your appliances.

ECOtronic

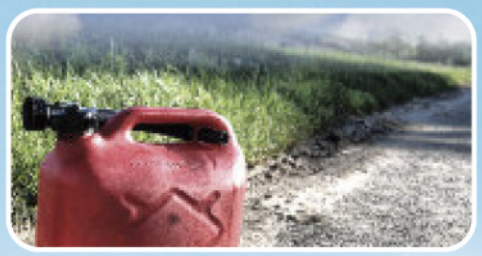
What is ECOtronic?

With a conventional petrol generator, power is created at the high speed of 3000 RPM. However, experience shows that a generator often runs without any load. From today's point of view, this leads to wasteful use, such as during work with electric tools on construction sites or in repair or emergency use. To meet the requirements, Endress has developed its own ECOtronic that is now standard in the DUPLEXplus Line.

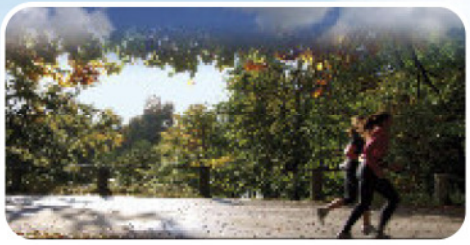
Here's how it works:

ECOtronic is an environmentally friendly alternative to conventioral power generation. During use, the ECOtronic system recognizes whether output is being used or not. If no power is drawn, it significantly lowers the RPM. This happens automatically and the generator runs quietly, saving fuel, but is always in readiness. Once power is needed again, such as when an electric tool is used, the ECOtronic makes the necessary power available – with no hesitation.

Quiet, at last!



Another fill-up already?



Take a deep breath...

Advantages at a glance:

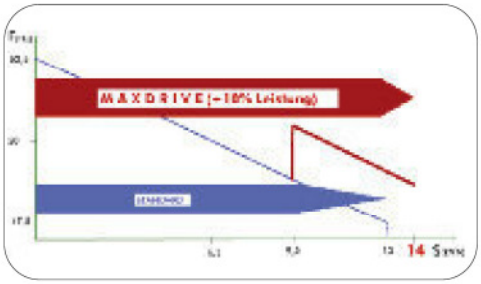
- Lower operating cost
- Reduced pollutant emissions
- Significantly reduced noise emission
- Fuel savings up to 30%
- Longer engine life

maxdrive

Endress new maxdrive power management module allows combustion engines to be used without performance loss.

Here's how it works:

During heavy loads, such as starting current or impact loads, the drive engine's centrifugal governor quickly reaches its limit. Before power drops, the maxdrive power management module supports the engine regulator. The throttle opens all the way and makes sure that the engine's entire output is available.



The advantages to you:

- Power increase of about 10%
- RPM remains stable under heavy load
- Constant frequency even in the upper RPM range

The new multifunctional E-MCS 4.0 control display

A system for optimum security and operator-friendliness in day-to-day use

The completely revised E-MCS 4.0 now provides even more information and the status of the unit than its predecessor model E-MCS 3.0. Thanks to its redesigned display, reading off data has become significantly easier since only information relevant to operation is visible. All other information such as warnings and connected systems remain hidden and are not displayed until they are activated. The new EMCS 4.0 is already designed for the new FireCAN standard so this system meets all the requirements of pioneering technology in the generator and vehicle sectors.

A light sensor controls the LEDs on the basis of light incidence so that good visibility is guaranteed even in direct sunlight.

Displays in the relevant mode

- Voltage indicator of the individual phases 1-3
- Load of the individual phases 1-3
- Total load on the unit ***new***
- Fuel indicator – with warning when into reserve ***new***
- Frequency indicator
- Operating hours counter

Displays for warnings and connected systems

- Earth wire checking device
- Battery charge check/charging function (W)
- Insulation fault (W)
- Insulation fault - optional (A)
- ECOtronic active - optional ***new***
- Oil pressure (A)
- Motor temperature (W) ***new***
- Fuel temperature (W) ***new***
- Generator temperature (W) ***new***
- Ambient temperature (W) ***new***
- Emergency Off has been pressed

A = Shut-off, W = Warning

connected power with E-RMA

ENDRESS Remote Monitoring Application

The E-RMA system has been developed to secure your emergency electricity supply even over great distances. Wherever you are in the world, with the ENDRESS E-RMA system you always have sight of the most important data.

E-RMA
connected Power

E-RMA *LAN*

With the ENDRESS E-RMA LAN system you can integrate your permanently installed emergency electricity supply units into your building's computer network. After a few setup steps, you can access your unit from anywhere, including of course from your smartphone.

E-RMA *SIM*

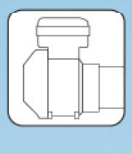
Even if you have no grid available, perhaps as a result of regional conditions, you do not have to go without remote monitoring and checking of your units. For this ENDRESS offers the solution via the mobile phone network with the E-RMA SIM. All that you need otherwise is a GSM card with a data tariff (not supplied). After a brief setup process you can check and control your emergency electricity supply from any location.

E-RMA *web application*

With the E-RMA system's web interface you can inspect the live data of your units at any time and take over control of them. It doesn't matter whether it's from your PC or your smartphone. The main components of the web application are:

- Control unit with remote start option
- List of alerts
- Detailed generator information
- Location

The generator drive engine



Types of drive

Petrol engines are used if the generator must be compact for mobile use and only average run times and variable operation are expected.

Diesel engines are heavier and more robust and are therefore better suited to long run times. The specific fuel consumption is lower with diesel engines.

When high speed and when low speed?

High speed:
3000 RPM petrol or diesel engines
Engines for daily operation: approx. 4 - 10 hours.
Life = service time: approx. 3,000 - 5,000 hours.
Applications: Construction sites, skilled trades, road-works.

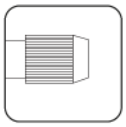
Low speed:
1500 RPM diesel engines
Engines for constant operation: 24 hours.
Life = service time: 10,000 - 20,000 hours.
Applications: Current and emergency power supply.

Starting systems

There are two basic types of starting systems:
1. Recoil starter for manual engine start with an automatic retracting cable.

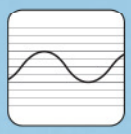
2. Electric start with an ignition switch (a battery must be available).

Synchronous or asynchronous: a system comparison



	Synchronous	*Asynchronous*
Application	All ohmic and inductive appliances	Only ohmic appliances without limitation Inductive appliances with significant limitations
Starting behaviour	Trouble-free starting, regardless of the appliance Compound-regulated generators with three times the starting current DUPLEX generators with four times the starting current	Problematic starting behaviour with hard-starting appliances; just for generators without start amplification. For alternators with start amplification a large generator dimensioning is needed
Load capacity	The alternator can handle a 100% load even with inductive appliances and can therefore be designed smaller	With inductive appliances, the alternator can only be loaded up to 1/3 (without start amplification), 2/3 (withstart amplification)
Regulation	Mechanical regulation IP 23. Electronic regulation IP 54	Usually unregulated, condenser
Protection class	Design-dependent internal cooling IP 23 Design-dependent cooling external IP 54	Design-dependent IP 54, external cooling
Protection measures	Safety-separated circuit for personal protection FI protection switch not necessary	Safety-separated circuit for personal protection FI protection switch not necessary

The proper current quality



230/400 V asynchronous alternator with condenser regulation	For appliances with low starting current, can't be overloaded
230 V synchronous alternator with condenser regulation	For appliances with starting current.not suitable for electronic appliances
230 V synchronous alternator with AVR regulation*	Stable output voltage for simple electronic power-consuming devices and power-consuming devices with low input current. Not suitable for power-consuming devices with very high input current!
400 V synchronous alternator with compound regulation**	For appliances with high starting current. Not suitable for electronic appliance. Never suitable for an unbalanced load***
230 V synchronous alternator with inverter regulation	Precise output voltage and frequency for sensitive appliances as well as for appliances with starting current for universal use
230/400 V DUPLEX alternator - electronic regulation	Precise output voltage and frequency for sensitive appliances as well as for appliances with high starting current for universal use/suitable for unbalanced load***

* AVR (Automatic Voltage Regulation) electronic voltage regulction
** Generator voltage is regulated by an additional magnetic field (compound transformer built into the stator).
*** An unbalanced load is understood as a non-uniform load in the individual phases of a three-phase alternator.

Current types

DC, AC, three-phase current
12 V DC
used for charging batteries.

230 V AC
Nearly all electric tools, lights and garden and construction machines can be run with it.

400 V three-phase
used at home for appliances like washing machines or cookers, and on construction sites for powerful devices like cranes, circular construction or table saws.

Key to abbreviations

V	= **volts**	**Voltage** (12/230/400)
Hz	= **hertz**	**Frequency** (50/60)
A	= **amperes**	**amperage**
W	= **watts** (x 1000 = **kW**)	**Active power**
VA	= **Volt Ampere** (x 1000 = **kVA**)	**Apparent output**
Cos φ	= normatively specified Power factor	**Power factor** (0,8-1)

Apparent output - data in **VA** or **kVA**
- is the output that the generator can produce.
Active power - data in **W** or **kW**
- the output that can be drawn from the alternator, depending on the alternator's power factor.
Reactive power
- the geometric difference between active and apparent power. This is important for covering the starting current.

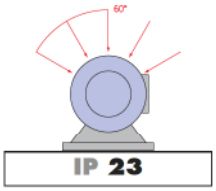
Electrical safety

All mobile generators conform to safety-separated circuit VDE 0100 part 410
No earthing is needed for this protection class. No dangerous touch current can occur if there is a fault to frame (connection between active lines and the appliance housing).

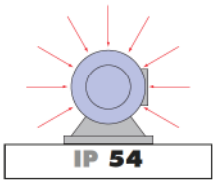
The RCD protection switch
The RCD protection switch provides further protection against dangerous shock current. It shuts off the power supply if there is fault current. This protection measure requires appropriate earthing in which the earthing spike is connected with an earthing cable to the generator's earthing screw for potential equalization.

Safety-separated circuit - Insulation monitoring with shut-off
The appliances turn themselves off automatically if the insulation resistance reaches a critical level. The insulation monitoring function is controlled from a test button. Costly earthing with an earthing spike and earthing cable are no longer necessary. This equipment provides a high level of safety, especially in underground construction such as work on gas and water mains (moist environments). It is even obligatory for pipeline construction according to DVGW GW 308.

IP = International Protection according to DIN 40050
The IP code consists of two digits that indicate the specific degree of protection. The first digit indicates the protection class for touch and foreign object protection, and the second indicates water and moisture protection.



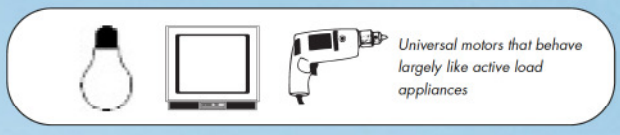
0 unprotected
1 Foreign objects > 50 mm
2 Foreign objects > 12 mm
3 Foreign objects > 2,5 mm
4 Foreign objects > 1,0 mm
5 dust protected



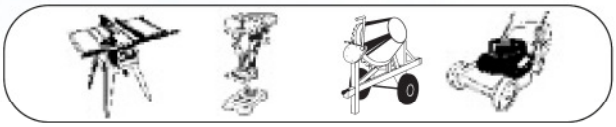
0 unprotected
1 Dripping water, vertical
2 Dripping water, diagonal to 15° from vertical
3 Sprayed water, diagonal to 60° from vertical
4 Splashed water, from all directions
5 Water jet, from all directions

Appliances in a nutshell

Ohmic appliances (active load appliances)
These are appliances that convert their power input completely into heat and light and therefore are unproblematic for any generator. The listed output power (watts) is always also the input power that is taken from thealternator. Such appliances include heating devices and hot plates.


Universal motors that behave largely like active load appliances

Inductive appliances
These are appliances that are driven by an electric motor. With these devices, friction losses and winding losses result in only about 70 % of the input power being available as output power. Additionally, when the motor is turned on, more power is needed. Depending on the type of device and the motor's quality, this can be 3 to 6 times the input power. Such appliances include compressors, table saws and high-pressure cleaners.



Capacitative appliances
These include critical appliances that, due to their charging function, can be powered safely by specially equipped Duplex or synchronous generators. They include flashers or discharge lamps.

The right generator for your application
For determining the right generator for your use, you will find the applications in each model's chart. On pages 38 and 39, you will find detailed selection assistance on appliances and the generators that go with them. The starting power of the Endress generators (3 to 4 times the continuous power value) and the corresponding appliance's starting current are already figured in.

That can be helpful!
To find out the appliance power, see the model plate or user manual. Consider reserve power in order to be equipped for future applications.
Recommendation: Stay 10% below continuous power. That preserves the environment and the generator.

Two important guidelines for generators

EU noise guideline 2000/14/EC

Purpose:
Standardization of existing noise protection regulations and limit values in the EU member states
Guideline 2000/14/EC specifies that the manufacturer is obligated to indicate the power unit's guaranteed noise value. The indication obligation includes the guaranteed value in dB, the LWA mark and a corresponding pictogram.

Measurement method and calculation
Sound values are measured according to a precisely specified testing procedure that must be followed by every manufacturer. There is only ***one*** obligatory, precise designation for the sound level: LWA sound power level. Always pay attention to the LWA value; all other values are chosen freely by the manufacturer.

Attention:
Many manufacturers advertise the so-called sound pressure level (LP), which is not represent data that conforms to the relevant standard. The LP value is freely determined by the manufacturer and is therefore not comparable! The LP value is calculated according to a formula that depends on a freely chosen distance from the power unit (see example).

Data in catalogue
ENDRESS provides two values.

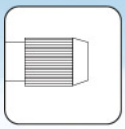
1. Sound power level (LWA)
confirmed on the device next to an obligatory designation per 2000/14/EC.
2. Sound pressure level (LPA)
at a distance of 7 metres, this value is calculated as follows: LWA 95 db(A) - 25 = Lp 70 db(A).

ENDRESS: 95 db(A) - 25 = 70 db(A) (distance 7m)
Competition: 95 db(A) - 28 = 67 db(A) (distance 10m)

Alternator output data

Motor: Engine output data are often given with the maximum output ***without load***, normally at 3600 RPM. However, in generators, only 3000 RPM are necessary. For the comparison to work, the output data must therefore always be taken at 3000 RPM.
All other comparisons are false!!

Therefore: **Trust only output data based on 3000 RPM.**



How much does an alternator really put out?
The total output depends on the efficiency level of the engine (max. 75% to 80%) and the alternator. To be on the safe side, you can use the following rule of thumb to estimate the output yourself:

1 HP engine output
Alternator output max. 0.65 kVA (65%)
1 kW engine output
Alternator output max. 0.85 kVA (85%)

Attention: Many competitors often give only the engine output. This is not the data for the generator out put!

ENDRESS provides its output according to the European and national standards. We guarantee that our tested and approved measurement methods provide reliable and correct data on the output of our generators!

You can rely on this:
ENDRESS generators meet all required standards and guidelines.

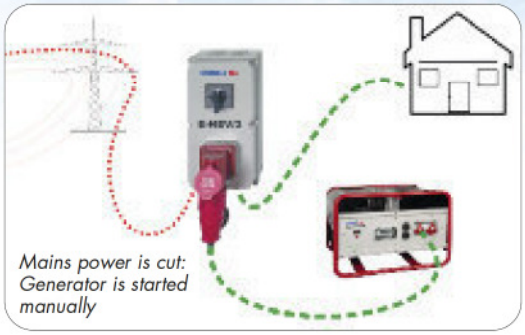
The standards that apply to generators
Noise guideline 2000/14/EC
Federal emission protection act (BImSchG)
DIN ISO 8528, DIN 6280.

There are several options for generating a simple but efficient emergency power supply. We would like to give you some practical advice and show you some ways in which you can safeguard your building against power cuts

Emergency power supply with *manual* load switching

In this version, if there is a power cut, a generator is connected to a supply distributor installed on the house and started manually.

- Inexpensive purchase price
- Simple installation by an electrician
- Emergency power mode is only guaranteed if the generator can be started when there is a power cut
- Security of supply not guaranteed



Mains power is cut: Generator is started manually

ENDRESS E-NEV supply distributor

- Manual load switching between public gird and generator
- Installation is done by an electrician between the public grid cable and distributor boxes, in the building (or on a special cable, for consumers entitled to emergency supply)
- Secure load switching is ensured by physical separation of the two networks

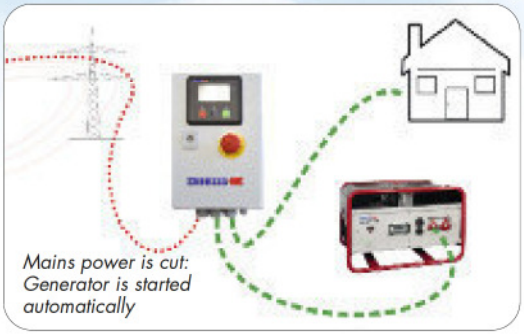
Available in two versions:

- **E-NEV/1** for 230 V supply at 16 A or 32 A
- **E-NEV/3** for 400 V supply at 16 A or 32 A

Emergency electricity supply with *automatic* load switching device

In this version an installed generator is automatically started and stopped in the event of a power cut. You do not have to be at home to protect your house from a power cut.

- Automatic start-stop operation in the event of a power cut
- Simple installation by an electrician
- Security of supply is guaranteed
- Purchase costs somewhat higher than with manual mode



Mains power is cut: Generator is started automatically

ENDRESS E-ATS automatic emergency electricity

- E-MCS 5.0 automatic control panel for monitoring the public grid and for controlling the connected generator
- Load switching contactors built into a robust metal housing, IP54
- Connector blocks for 400 V or 230 V domestic supply
- Charger for battery charging on the generator
- Hard-wired control cable to the generator, 7 m long
- Plug-and-Run connector for ENDRESS generator
- Choke control dependent on temperature

Double use with ENDRESS Plug-and-Run! Emergency electricity mode or portable generator – the choice is yours. The clever ENDRESS Plug-and-Run solution offers you unlimited options

Petrol, diesel or gas?

Which is suitable for emergency electricity supply?

Petrol

Advantages:

- Low purchase price
- Small, light and portable generator because of the design of the motor

Disadvantages:

- In the event of a power cut, the local petrol station cannot supply any petrol either

Diesel

Advantages:

- Diesel fuel is somewhat cheaper to use

Disadvantages:

- Units are big and heavy because of the design of the motor
- Restricted portability
- High purchase price
- In the event of a power cut, the local petrol station cannot supply any diesel either

Gas

Advantages:

- Operation optionally with natural gas or LPG possible
- Combustion without any residues
- Very cheap to use
- No resin deposits in the carburettor with lengthy running times

Disadvantages:

- Restricted portability with the use of natural gas

Installation site of a generator

Even if it sounds tempting – a generator may not be operated within a closed building! The installation site must always be selected in such a way that sufficient cooling air is available and exhaust gases can escape to the outside air unhindered. Installation within buildings is permitted only in areas specially provided for the purpose. Please also ask your local chimney sweep about this. You should give your outdoor generator protection from the weather so as to prevent the penetration of moisture.

230 V or 400 V – which version is the right one for me?

If you urgently need a 400 V supply (e.g. stove connection, factory machinery etc.), 400 V supply is an important criterion for you. There are a few points to consider regarding supply. 400 V networks may only be supplied by a generator if they have phase compensation or phase control so as to prevent possible uneven load (overload in one phase). This could damage any connected power consuming devices e.g. televisions, computers. Our DUPLEX series generators are fitted with electronic phase control as standard, which makes supply to domestic networks possible. All ENDRESS generators may be used for 230 V supply.

You will find the right ENDRESS generator for you on the following pages

230 V supply
Automatic/Manual
Output range 1-10 kVA
Petrol Pages 17-32
Diesel Pages 33-39

400 V supply
Automatic/Manual
Output range 6-15 kVA
Petrol Pages 27-32
Diesel Pages 33-34

Complete GAS system
Automatic
230 V supply
Page 42

Stationary
electricity supply units
Output range 10-730 kVA
Pages 52-67

The ENDRESS generator profile

The latest technology and the best quality – guaranteed

- Handles for easier portability in day-to-day use
- Tank level indicator for safe operation
- Big tank for long running times

- 4-in-1 display for a better overview: V/Hz/hrs/Oil low
- ECOtronic saves operating costs
- maxdrive guarantees full motor performance

- Modern, quiet-running 4-stroke OHC and OHV motors can also be operated with E 10 fuel without modification
- Robust diesel motors with 3,000 rpm or 1,500 rpm

- All generators with low distortion device for clean voltage
- DUPLEX generators, IP 54, brushless, electronically regulated, conform to BGI 867 on unrestricted use in the open air
- Synchronous generators, IP 23 with high efficiency
- Compound regulated high-performance 400 V generators
- Quality earthed sockets

- Generator overload protection to protect the generator from damage
- Automatic shutoff when oil is low to protect the motor from damage
- Comprehensive range of special equipment and accessories
- ENDRESS generators meet all required standards and directives

Model designation at ENDRESS generators

ESE 1008 SDHS DC ES DI

- DI = Diesel engine
- ES = Electrical starting
- DC = direct current welding, AC = alternating current welding
- G = DUPLEX alternator, S = Synchronous alternator
- B = BRIGGS & STRATTON, H = HONDA, S = SUBARU, R = ROBIN, L = LOMBARDINI, H = HATZ, Y = YANMAR
- D = Three-phase current 400 V
- S = Welding alternator
- 04 = Series, frame device without large tank
- 06 = Series, frame device with large tank
- 08 = Series fully soundproof cover
- 10 = Performance class
- ESE = ENDRESS STROMERZEUGER

Application factor

●●● especially well suited

	Silent Line	Classic Power Line	Professional GT Line	Duplex^{plus} Line	Duplex^{Silent} Line	Duplex^{Silent} Line Diesel	Diesel Line
Electronic devices	●●●	●●	●	●●●	●●●	●●●	●
Electric tools	●●●	●●●	●●●	●●●	●●●	●●●	●●●
Gardening/construction equip.	●	●●	●●●	●●●	●●●	●●●	●●●
Inverter welding equipment		●	●●	●●●	●●●	●●●	●●
Emergency power supply	●●●	●	●	●●●	●●●	●●●	●
	Page 17	Page 19	Page 23	Page 27	Page 31	Page 33	Page 35