

# DC DC Converter Data Sheet Terms and Specifications

## Input Parameters

### Efficiency

Efficiency is defined as:

$$\text{Efficiency (\%)} = \frac{\text{Output Power}}{\text{Input Power}} \times 100$$

Efficiency is measured at full load and nominal line input.

### Fuse

This is a statement allowing the user to pick the proper fuse size. Input fusing should always be used. Fusing will limit the input power and reduce the risk of fire should a catastrophic failure happen either to the user's circuit or the power converter.

### Input Current

This is the typical input current that the converter will draw from the power source at nominal line voltage under full load and no load conditions.

### Maximum Input Overvoltage

This is the maximum voltage allowed at the converter's input terminals without damaging the converter. The specification is usually limited to 100 ms maximum duration and less than 0.05% duty cycle.

### Reflected Ripple

Due to the switching nature of a DC DC converter, noise is "kicked-back" into the input source. This noise is measured as a peak-to-peak current over a 0 to 20 MHz bandwidth. Usually the largest part of this current is at the fundamental switching frequency (or twice the switching frequency for push-pull designs).

### Switching Frequency

This is the fundamental frequency at which the DC DC converter operates. In push-pull designs, the noise is actually at twice the switching frequency due to the push-pull nature of the power stage.

### Turn-On Time

This is the time it takes for the output voltage to reach the specified accuracy when the outputs are fully loaded into resistive loads. The input voltage is increased from zero to the rated nominal in 2 ms and the settling time of the outputs is measured.

### Undervoltage Lockout

Some power converters have an undervoltage lockout circuit that shuts the converter off in the event of a low line voltage condition. The converter is usually placed in a low power condition to prevent excessive input current from the source. All CALEX power converters will survive a brownout condition without damage (the method of achieving this differs from series to series).

## Voltage Range

This is the minimum and maximum input voltage between which the converter will meet its specifications. The nominal value listed is the voltage used for all other tests unless otherwise specified.

## Output Parameters

### Cross Regulation

This is a reverse load regulation specification. The monitored output is held at a constant load while the other output(s) are changed. The amount of change in the monitored output is listed as a percentage of the nominal value. The specification applies to multiple output supplies only.

### Dynamic Response

When a load is applied, the output voltage momentarily exceeds its final value. This overshoot is the dynamic response. It is a measure of the converter's high frequency output impedance. This specification is generally more important than the settling time of the output, which is listed as the transient response time.

### Input Ripple Rejection

A modulating signal is injected into the converter operating at nominal line and full load. The signal is attenuated by the converter's feedback loop (loop gain) and propagates to the output. The ratio (in absolute terms) of the input to the output signal is expressed in dB and listed as the input ripple rejection. This is specified for a DC to 120 Hz input so that the effects of a full wave rectifier circuit can be evaluated. For example, if the Ripple Rejection of a converter is 60 dB (1000:1) and a 1 volt, 120 Hz signal is superimposed on the converter's input then the output will have a 1 mV, 120 Hz signal superimposed on it. This specification is sometimes referred to as "Audio Susceptibility."

### Line Regulation

When the input voltage is changed from rated maximum to rated minimum while the outputs are at full load, the output voltage will also change. Line regulation is the percent change in output voltage.

### Load Regulation

When the output load is changed from maximum rated current to minimum rated current, the output voltage changes. Load regulation is the percent change in output voltage. For multiple output supplies each output is measured, while all loads are varied.

### Long Term Stability

The long term stability is specified as the output voltage change per 1000 operating hours. This is not necessarily a cumulative process. The output voltage of most CALEX converters is based on metal film RN55 type resistors and a Bandgap reference. See the data sheet block diagram for more information.

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## Maximum Allowable Voltage Between Pins

On converters with remote sense and/or trim functions, the output voltage must not be allowed to exceed this value to prevent turn-on of the output overvoltage clamp.

## Noise

The output noise is specified at nominal line and full load. This specification is very difficult to measure correctly due to the measurement bandwidth (0-20 MHz). Short leads and proper grounding techniques must be used. The output noise is specified in mV peak-to-peak. The majority of the noise reading is due to the switching action of the converter and is at very high frequencies, whereas the peak-to-peak amplitude at the fundamental switching frequency is usually much less.

## Overvoltage Clamp

The converter will typically clamp the output voltage at this level during an output voltage transient (i.e. if the input pins are shorted to the output pins). The clamping device is a high peak power Zener Transient Suppressor and if overstressed, will usually fail in a shorted condition preventing damage to the user's circuitry.

## Rated Current

This is the rated load range for the output. Usually there is no minimum load required for proper operation, however, some converters do specify a minimum load. Operation below minimum load will not harm a CALEX converter in any way but load regulation may suffer. Operation above the maximum rated load is not recommended as it may degrade specifications or the converter's life. All CALEX DC DC converters are designed to be reliable in operation at the full rated load current provided that the case temperature does not exceed specifications.

## Short Circuit Protection

Most CALEX converters are designed to withstand a direct short on the output pins and to recover to normal operation when the short is removed. Under some conditions, the long term life of the converter will be degraded unless the short is removed within a certain amount of time. This specification lists the specific time and the protection technique used.

## Short Term Stability

With the converter fully warmed up at room temperature with constant line, load and temperature, the output will not vary by more than this amount.

## Temperature Coefficient

The converter is warmed up at 25°C ambient with full load and nominal line input. The converter is then cooled to the minimum listed operating temperature then heated to the maximum operating temperature. The output voltage deviation is calculated as the maximum deviation from +25°C to the minimum operating temperature or from +25°C to the maximum operating temperature and specified in PPM / °C ( 1 PPM/ °C = 0.0001 % / °C).

## Transient Response

This is the time it takes for the output voltage to settle to the specified accuracy after the given output load change. In multiple output converters, all other outputs are operated at full load during this test.

## Voltage Balance

The voltage balance is specified on dual converters. It is the difference in absolute terms between the positive output and the negative output expressed as a percentage. For example, if the positive output is at 15.000 Volts and the negative output is at -15.150 volts the balance would be 1.0 %.

## Voltage Range

This is the nominal output voltage and range for a nominal line input and full load condition. This might also be considered an initial accuracy specification of the output voltage.

## General Specifications

### Input to Output Capacitance

This is the isolation capacitance from the input pins to the output pins. This measurement is done with a 1 kHz, 1 VRMS capacitance bridge.

### Isolation

This parameter is measured by applying the listed isolation voltage from the input pins to the output pins. The maximum allowable leakage under this condition is specified. Input or output to case isolation is also measured in the same way.

### Logic Shutdown

The logic shutdown on CALEX converters is designed to be operated by pulling the ON/OFF pin low (minus input) to inhibit converter operation. If the ON/OFF function is not used, this pin may be left floating as it is internally pulled up. Open Output Voltage vs. Case Temperature

This is the normalized output voltage of the converter (normalized to zero at 25°C) versus case temperature. This is a typical curve of one unit. Other units may have changes in slope and the shape of the curve. Contact CALEX for more information on worst case shapes.

### Output Trim

Some CALEX converters have an output trim function so the output voltage can be changed from its factory setting. The output trim can be either a fixed resistor or a trimpot (see the specific data sheet). Any value from zero ohms to infinity may be used to trim the output voltage when fixed resistors are used. A 10K, 1 or 10 Turn trimpot is usually specified for continuous trimming. This pin may be safely left floating if it is not used.

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## Case Specifications

### Case

This is the CALEX case designation for that converter.

### Case Functional Range

The case functional range is the temperature range over which the converters will operate but won't necessarily meet all of the data sheet specifications.

### Case Operating Range

This is the temperature range at which the converter will operate with no derating. The case temperature is measured at the center of the top surface of the converter.

### Storage Temperature

The storage temperature is the safe storage temperature for the device. Long term exposure to these temperatures should not degrade the converter's performance.

### Thermal Impedance

This is the temperature rise of the case for each watt dissipated in the converter. The power dissipated is the difference between the input and output power.

### Thermal Shutdown

This is the case temperature above which the converter will shut down operation. Thermal shutdown halts the PWM operation placing the converter in a low current drain mode until the case temperature decreases.

### Unit Weight

This is the weight of the converter in ounces.  
1 ounce = 28.3 grams.

## Data Sheet Curves

### Efficiency vs. Line Input Voltage

This curve describes how the efficiency varies with input voltage. Usually one or more load values are plotted (i.e. 50% and 100% rated load). For multiple output converters, the load is the total load on all outputs, hence 100% rated load means all outputs are loaded to their 100% rating.

### Efficiency vs. Load

This curve illustrates how the efficiency varies with loading. For wide input range converters, a family of curves is usually shown relating to minimum, nominal and maximum input voltages. On multiple output converters, all loads are varied proportionally to each other for this curve.

### Idle Current vs. Line Input

This curve shows how the input current varies with line voltage when the converter ON/OFF pin is pulled to the OFF state.

### Input Current vs. Line Input

This curve illustrates how the input current varies with line input voltage. Usually a family of curves is shown depicting different output loading. The converter is loaded with resistive loads during this test so other types of loads may produce different curve shapes (especially at the transition from zero input to minimum rated input voltage). On multiple output converters, all outputs are loaded proportionally.

### Line to Output Transfer Function

Also commonly called Audio Susceptibility, this curve shows the line input to output transfer function of the converter. Also see the output parameter specification "Input Ripple Rejection."

### Output Impedance vs. Frequency

This curve shows how the output impedance of the converter varies with frequency. The curve is made with the converter fully loaded with a resistive load and at nominal line input.

### Output Regulation

On multiple output, cross regulated designs the output regulation is shown as a family of curves depicting the output voltage impact of one (or more) outputs on the others.

### Output Voltage vs. Case Temperature

This is the normalized output voltage of the converter (normalized to zero at 25°C) versus case temperature. This is a typical curve of one unit. Other units may have changes in slope and the shape of the curve. Contact CALEX for more information on worst case shapes.

### Power Derating

This curve shows the expected performance of the converter in a large ambient and an infinite heat sink condition. The curve, showing still air performance, assumes that the converter and its load will not increase the ambient temperature. If the converter and its load increase the ambient temperature, a thermal runaway condition can occur. This curve is for preliminary design information only. The specifications are guaranteed over the case temperature range since CALEX has no control over the application's ambient environment.