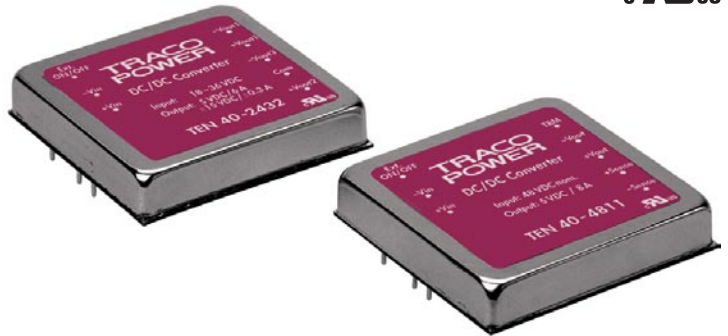


Features

- ◆ High power density: 40 W in a 51x51x10mm (2"x2"x0.4") package
- ◆ Wide 2:1 input voltage range
- ◆ Models with single-, dual- and triple output
- ◆ Models with 2 independently regulated 3.3 and 5.0 VDC outputs
- ◆ Extended operating temperature range: -40°C to +75°C
- ◆ Over temperature protection
- ◆ Under voltage lockout
- ◆ Remote On/Off
- ◆ Shielded metal case with insulated baseplate
- ◆ Optional heatsink
- ◆ Lead free design - RoHS compliant
- ◆ 3-years product warranty



The TEN 40 series is a family of high performance 40W dc-dc converter modules featuring 30 standard models with wide 2:1 input voltage ranges in a compact low profile case with industry-standard footprint. A very high efficiency allows an operating temperature range of -40°C to +75°C. Built-in filters for both input and output minimizes the need for external filtering. Further standard features include remote On/Off, output voltage trimming, over voltage protection, under voltage lockout and short circuit protection.

Typical applications for these products are battery operated equipment and distributed power architectures in communication and industrial electronics, everywhere where isolated, tightly regulated voltages are required and space is limited on the PCB.

Models

Order code	Input voltage range	Output 1	Output 2	Output 3	Efficiency typ..
TEN 40-1210	9 – 18 VDC (nominal 12 VDC)	3.3 VDC / 8.0 A			86 %
TEN 40-1211		5 VDC / 8.0 A			86 %
TEN 40-1212		12 VDC / 3.3 A			86 %
TEN 40-1220		*3.3 VDC / 8.0 A	*5 VDC / 8.0 A		85 %
TEN 40-1222		+12 VDC / 1.8 A	-12 VDC / 1.8 A		85 %
TEN 40-1223		+15 VDC / 1.4 A	-15 VDC / 1.4 A		85 %
TEN 40-1233		3.3 VDC / 6.0 A	+12 VDC / 0.4 A	-12 VDC / 0.4 A	84 %
TEN 40-1234		3.3 VDC / 6.0 A	+15 VDC / 0.3 A	-15 VDC / 0.3 A	84 %
TEN 40-1231		5 VDC / 6.0 A	+12 VDC / 0.4 A	-12 VDC / 0.4 A	86 %
TEN 40-1232		5 VDC / 6.0 A	+15 VDC / 0.3 A	-15 VDC / 0.3 A	86 %
TEN 40-2410	18 – 36 VDC (nominal 24 VDC)	3.3 VDC / 8.0 A			87 %
TEN 40-2411		5 VDC / 8.0 A			89 %
TEN 40-2412		12 VDC / 3.3 A			88 %
TEN 40-2420		*3.3 VDC / 8.0 A	*5 VDC / 8.0 A		86 %
TEN 40-2422		+12 VDC / 1.8 A	-12 VDC / 1.8 A		87 %
TEN 40-2423		+15 VDC / 1.4 A	-15 VDC / 1.4 A		87 %
TEN 40-2433		3.3 VDC / 6.0 A	+12 VDC / 0.4 A	-12 VDC / 0.4 A	85 %
TEN 40-2434		3.3 VDC / 6.0 A	+15 VDC / 0.3 A	-15 VDC / 0.3 A	85 %
TEN 40-2431		5 VDC / 6.0 A	+12 VDC / 0.4 A	-12 VDC / 0.4 A	87 %
TEN 40-2432		5 VDC / 6.0 A	+15 VDC / 0.3 A	-15 VDC / 0.3 A	87 %
TEN 40-4810	36 – 75 VDC (nominal 48 VDC)	3.3 VDC / 8.0 A			88 %
TEN 40-4811		5 VDC / 8.0 A			90 %
TEN 40-4812		12 VDC / 3.3 A			89 %
TEN 40-4820		*3.3 VDC / 8.0 A	*5 VDC / 8.0 A		88 %
TEN 40-4822		+12 VDC / 1.8 A	-12 VDC / 1.8 A		87 %
TEN 40-4823		+15 VDC / 1.4 A	-15 VDC / 1.4 A		87 %
TEN 40-4833		3.3 VDC / 6.0 A	+12 VDC / 0.4 A	-12 VDC / 0.4 A	86 %
TEN 40-4834		3.3 VDC / 6.0 A	+15 VDC / 0.3 A	-15 VDC / 0.3 A	86 %
TEN 40-4831		5 VDC / 6.0 A	+12 VDC / 0.4 A	-12 VDC / 0.4 A	88 %
TEN 40-4832		5 VDC / 6.0 A	+15 VDC / 0.3 A	-15 VDC / 0.3 A	88 %

* dynamic current allocation, max. 8A total output current for both outputs together

Input Specifications

Input current at no load	12 V models: 200 mA typ. 24 V models: 100 mA typ. 48 V models: 50 mA typ.
Input current at full load (nominal input 12/24/48 Vin)	3.3 V single output models: 2680 / 1325 / 655 mA typ. 5.0 / 12 V single output models: 4065 / 2000 / 1000 mA typ. 3.3 & 5 V dual output models: 3415 / 1685 / 825 mA typ. ± 12 / ± 15 V dual output models: 4400 / 2100 / 1050 mA typ. 3.3 V triple output models: 3000 / 1500 / 750 mA typ. 5.0 V triple output models: 4000 / 1990 / 980 mA typ.
Input voltage variation (dv/dt)	5 V/ms, max. (complies with ETS300 132 part 4.4)
Start-up voltage / under voltage lockout	12 Vin models: 9 VDC / 8 VDC (typ.) 24 Vin models: 17.8 VDC / 15.8 VDC (typ.) 48 Vin models: 36 VDC / 33 VDC (typ.)
Surge voltage (100 msec. max.)	12 / 24 / 48 Vin models: 25/50/100 V max.
Conducted noise (input)	EN 55022 level A, FCC part 15, level A with external capacitor (see note 1)
ESD (input)	EN 61000-4-2, perf. criteria B
Fast transient (input)	EN 61000-4-4, perf. criteria B
Surge (input)	EN 61000-4-5, perf. criteria B

Output Specifications

Voltage set accuracy	± 1 % (± 5 % for auxiliary outputs)
Output voltage adjustment	± 10 % (only for single output models and symmetric dual output models)
Regulation	– Input variation Vin min. to Vin max. single output models: 0.5 % max. dual output models: 1 % max. triple output models (main/auxiliary): 1 % max. / 5 % max. – Load variation 10 – 100 % single output models: 0.5 % max. dual output models: 1 % max. triple output models (main/auxiliary): 2 % max. / 5 % max. – Load cross variation 25 % / 100 % Dual output models: 5 % max. triple output models (main/auxiliary): 1 % max. / 5 % max.
Temperature coefficient	± 0.02 %/K max.
Ripple and noise (20 MHz Bandwidth)	3.3 V & 5 V outputs: 50 mVpk-pk max. dual outputs: 150 mVpk-pk max. all other outputs: 75 mVpk-pk max.
Start up time (nominal Vin and constant resistive load)	25 ms typ.
Transient response time (25% load change)	300 μ s typ.
Short circuit protection	indefinite (automatic recovery)
Over load protection	150 % of Iout max typ. foldback
Thermal shutdown	@ 115°C typ
Over voltage protection	3.3 V output: 3.9 V 5 V output: 6.2 V 12 V output: 15 V 15 V output: 18 V

All specifications valid at nominal input voltage, full load and +25°C after warm-up time unless otherwise stated.

Output Specifications

Minimum load (only for dual output models)	10% of rated max current (operation at lower load condition will not damage these converters, however, they may not meet all listed specifications)	
Capacitive load output models	3.3 V / 5 V / 12 V / 15 V:	21'000 / 13'600 / 2'360 / 1510 μ F max.
	dual output models (3.3 V / 5 V):	11'000 / 6'800 μ F max.
	dual output models ($\pm$ 12 V / $\pm$ 15 V):	1'200 / 750 μ F max. (on each output)
	3.3 V triple output models:	13'000 / 330 μ F max. (main-/output 2 & 3)

General Specifications

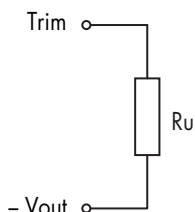
Temperature ranges	– Operating – Case temperature – Storage	–40°C to +75°C +100°C max. –55°C to +125°C
Derating		see graphs on page 3 to 5
Humidity (non condensing)		95 % rel H max.
Reliability, calculated MTTF (MIL-HDBK-217F, @ +25°C, ground benign)		>360'000 h
Isolation voltage (60 sec)	– Input / Output	1'500 VDC
Isolation resistance	– Input / Output	>1'000 M Ohm
Isolation capacity	– Input / Output	1000 pF max.
Remote On/Off	– On: – Off: – Off idle current:	3.5 ... 12 VDC or open circuit. 0 ... 1.2 VDC or short circuit pin 3 and pin 2 2.5 mA max.
Switching frequency (fixed)		300 kHz typ. (Pulse width modulation PWM)
Vibration		10–55 Hz, 10G, 30 minutes along X,Y,Z
Safety standards		UL 60950, EN 60950, IEC 60950 compliance up to 60 VDC input voltage (SELV limit)
Safety approvals	– UL/cUL	www.ul.com -> certifications -> File: E188913

Note 1:

In order to meet conducted emissions EN55022-A and EN55011-A a capacitor between +Vin and -Vin has to be installed. The capacitor should be capable to handle 1 A ripple current. A suggestion is KMF Series of Nippon chemi-con, 220 μ F/100V, ESR 90mOhm.

Output Voltage Adjustment

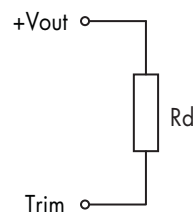
Trim up



R_u [kohm]*

output	3.3V	5V	12V	$\pm$ 12V	$\pm$ 15V
+5%	6.8	4.7	47	47	33
+10%	1.5	0.56	8.2	2.2	2.7

Trim down



R_d [kohm]*

output	3.3V	5V	12V	$\pm$ 12V	$\pm$ 15V
–5%	8.2	5.6	56	33	39
–10%	0.68	0.68	5.6	2.7	3.3

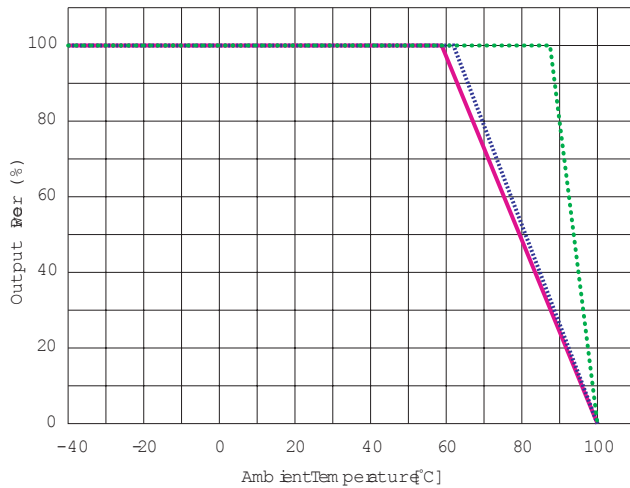
*approximate values

All specifications valid at nominal input voltage, full load and +25°C after warm-up time unless otherwise stated.

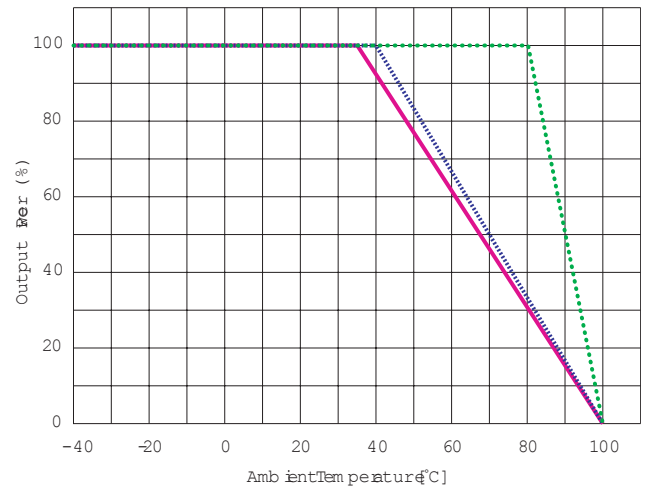
Power De-rating

- Natural convection without heat-sink
- Natural convection with heat-sink TEN-HS3
- 500 LFM with heat-sink TEN-HS3

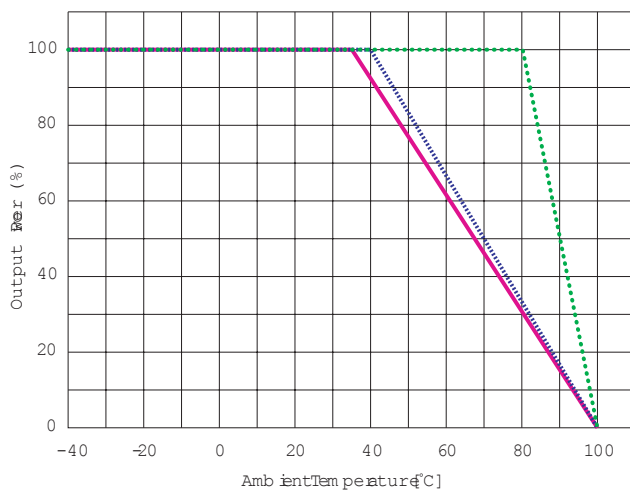
TEN 40-1210



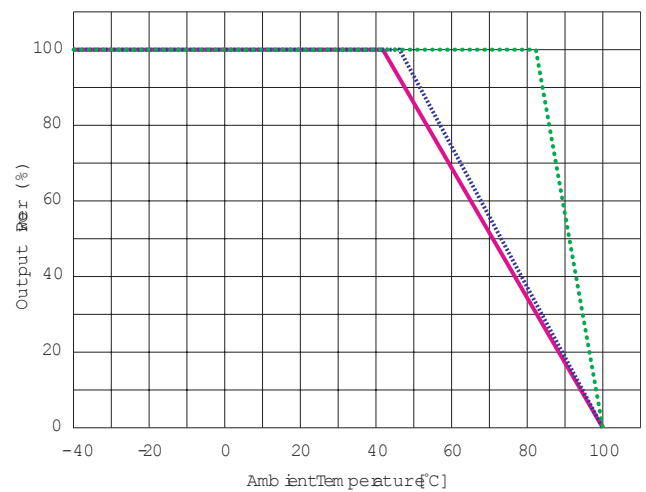
TEN 40-1211



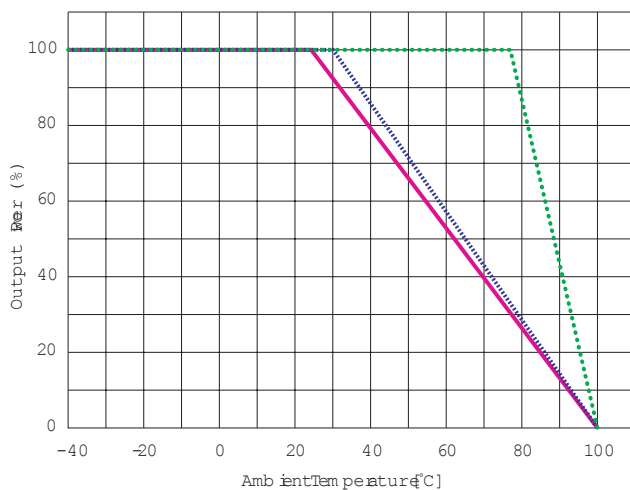
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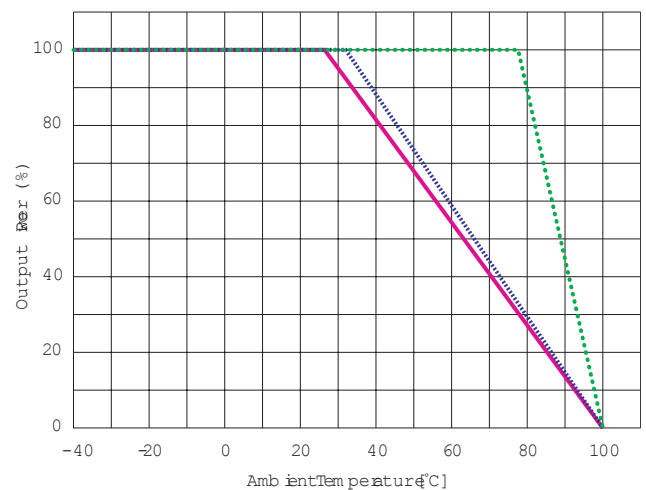
TEN 40-1220



TEN 40-1222

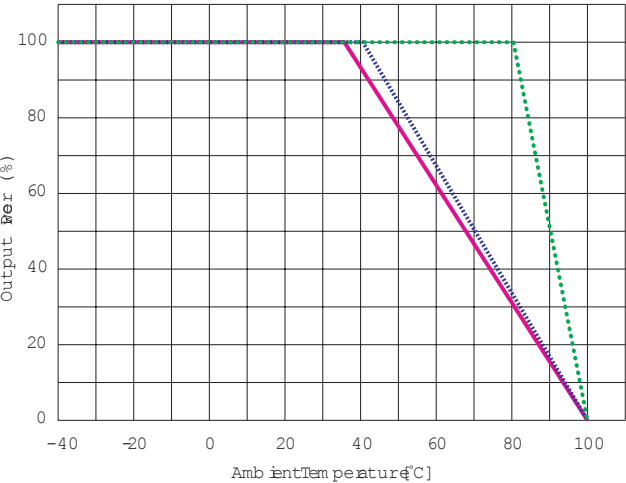


TEN 40-1223

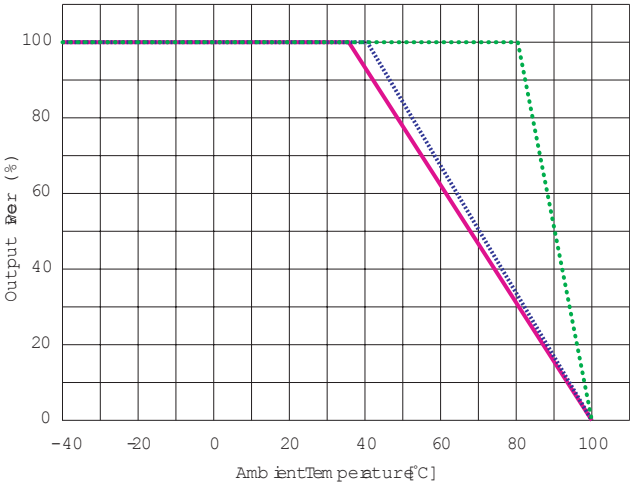


Power De-rating

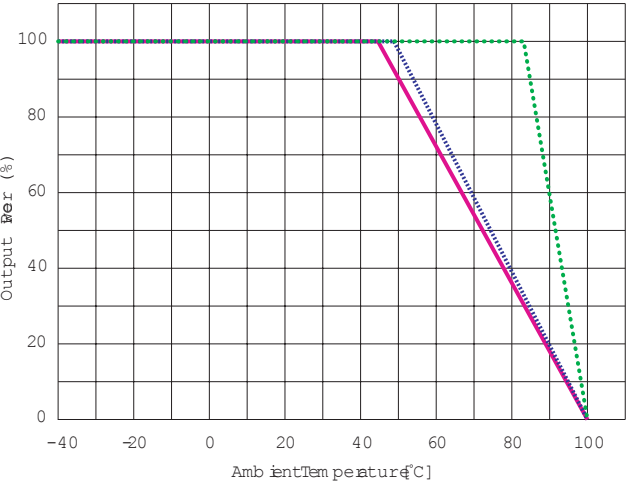
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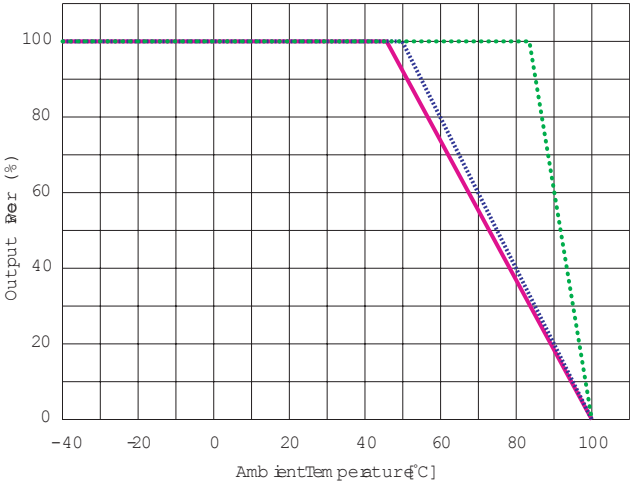
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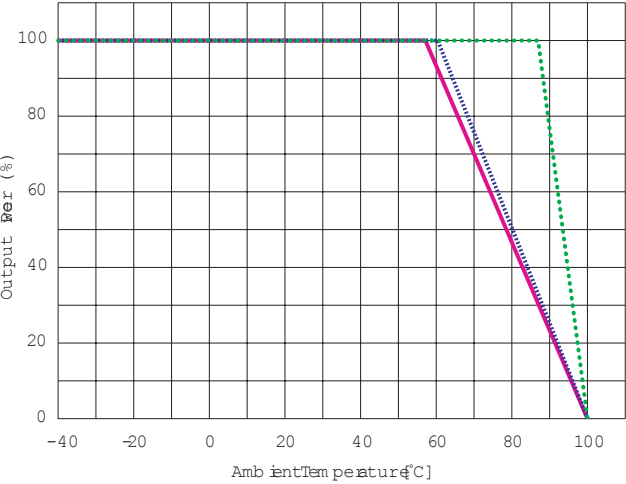
TEN 40-233



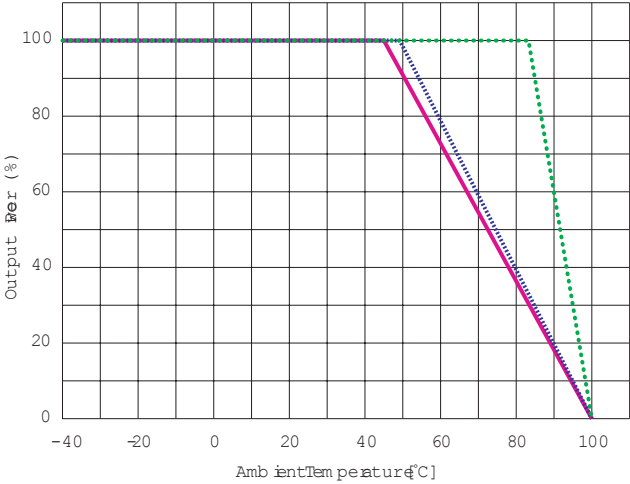
TEN 40-234



TEN 40-2410

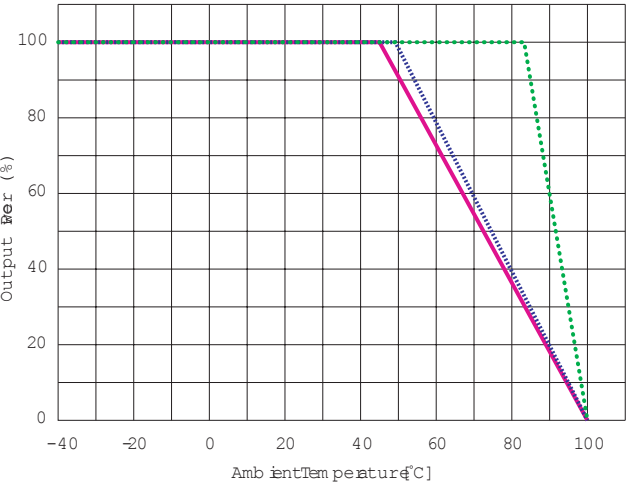


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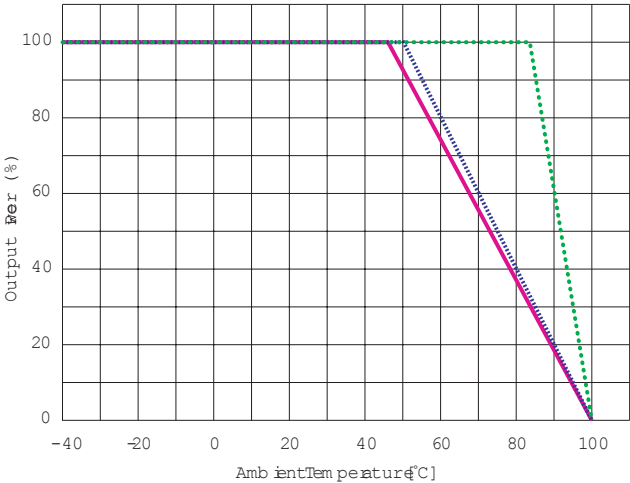


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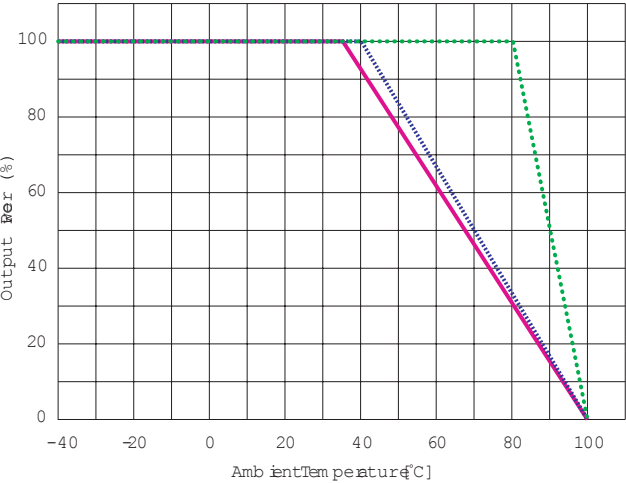
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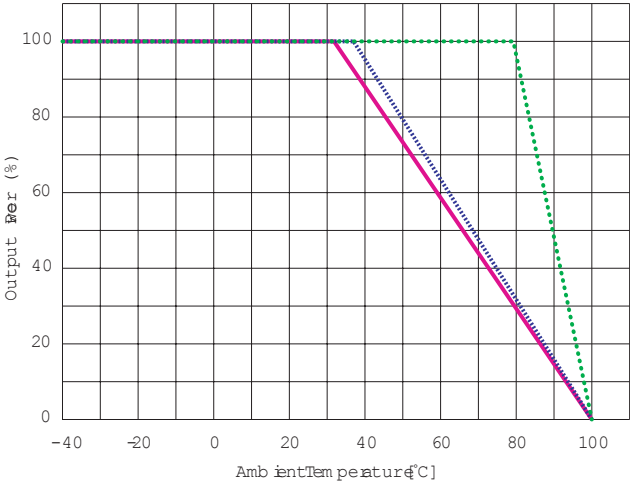
TEN 40-2420



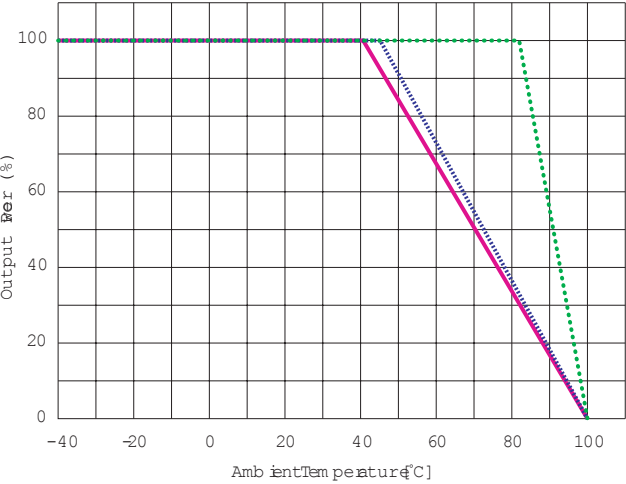
TEN 40-2422



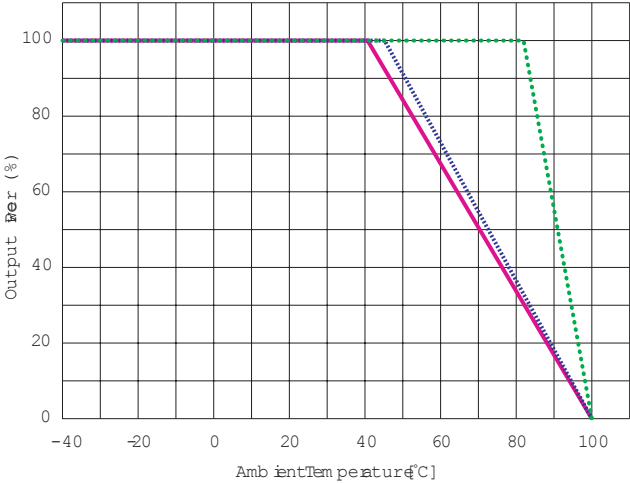
TEN 40-2423



TEN 40-2431

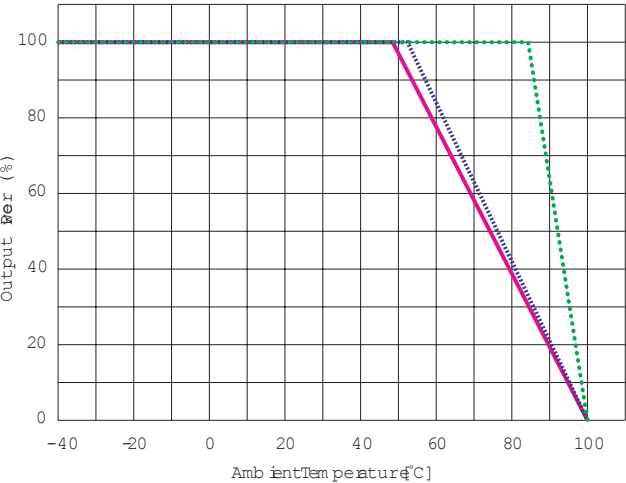


TEN 40-2432

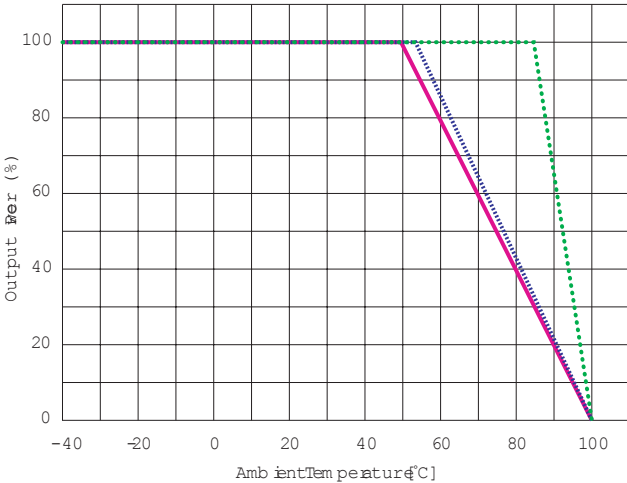


Power De-rating

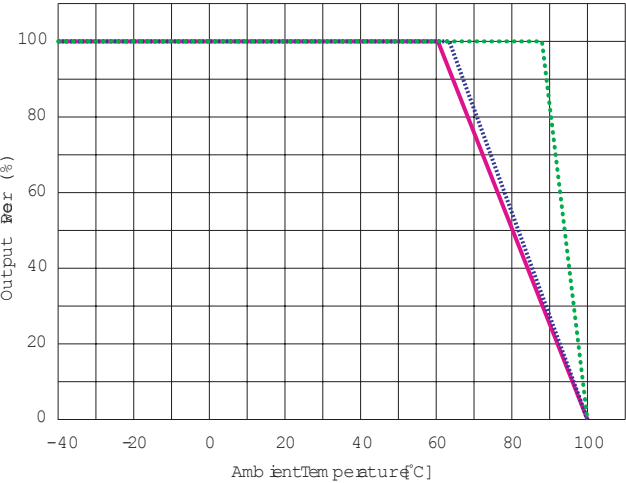
TEN 40-2433



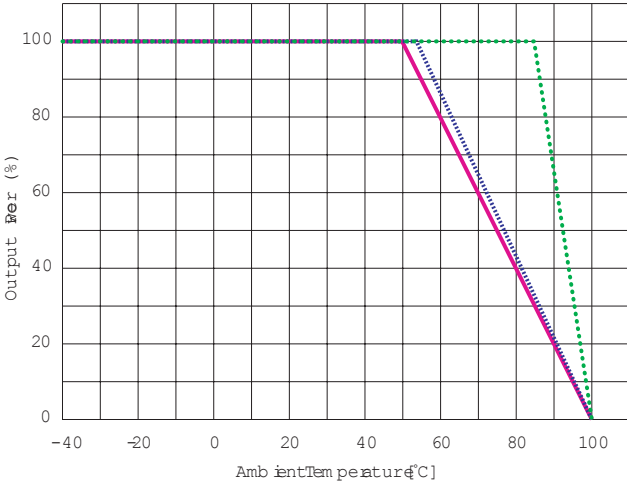
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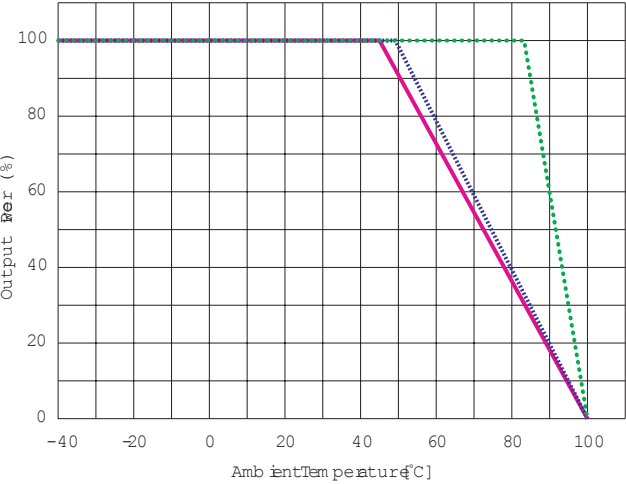
TEN 40-810



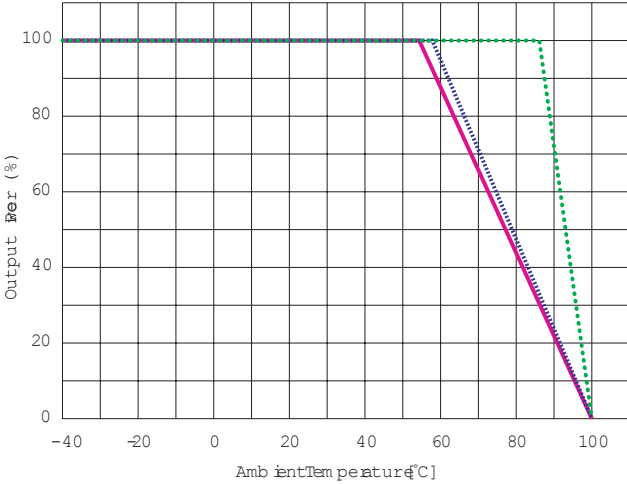
TEN 40-811



TEN 40-812

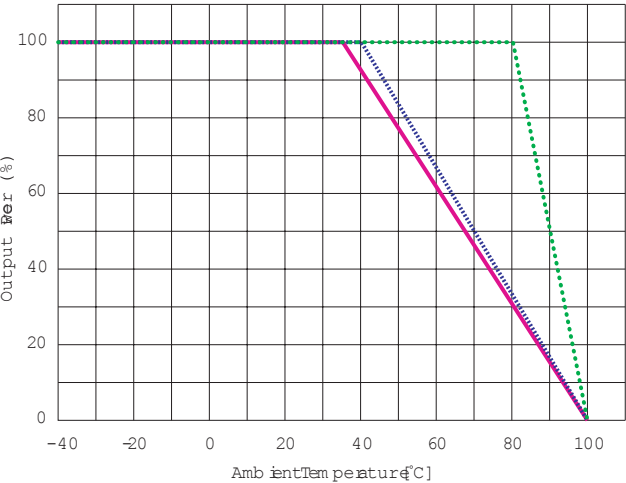


TEN 40-820

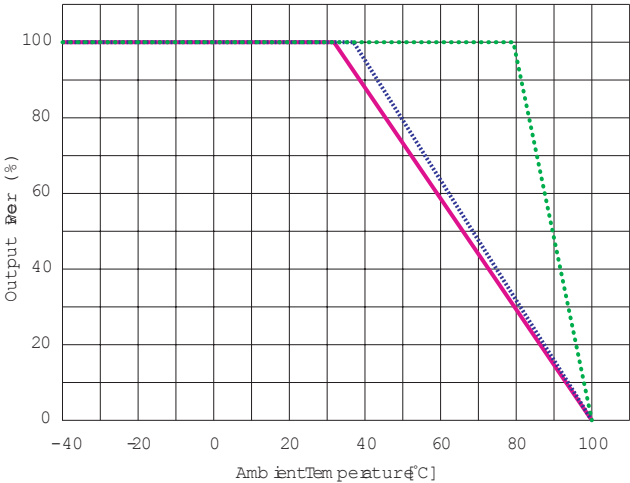


Power De-rating

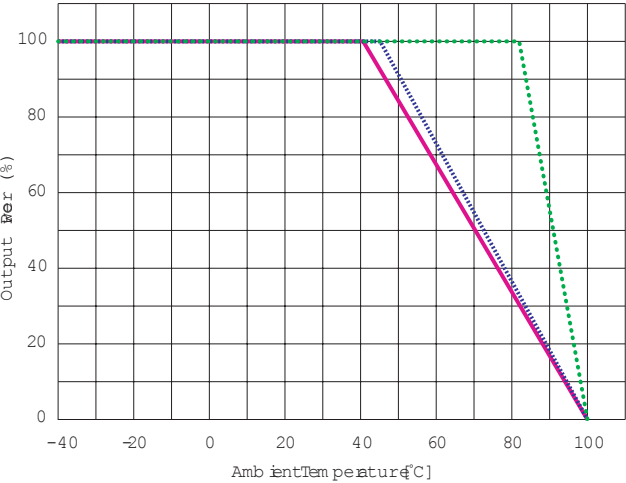
TEN 40-022



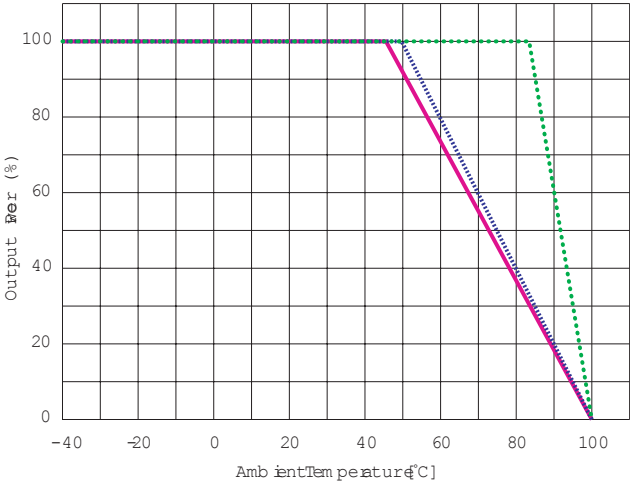
TEN 40-023



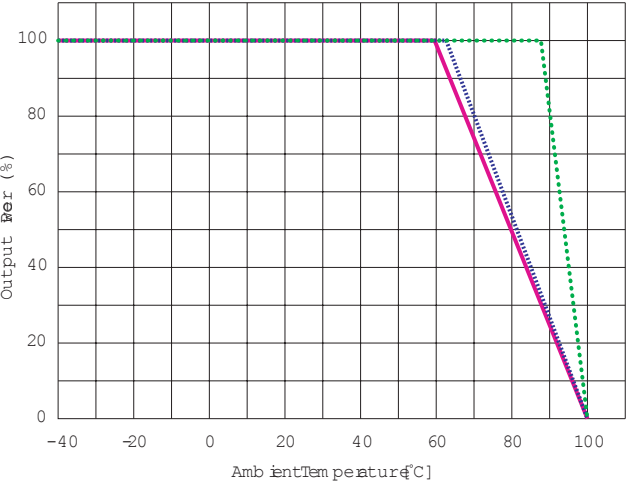
TEN 40-031



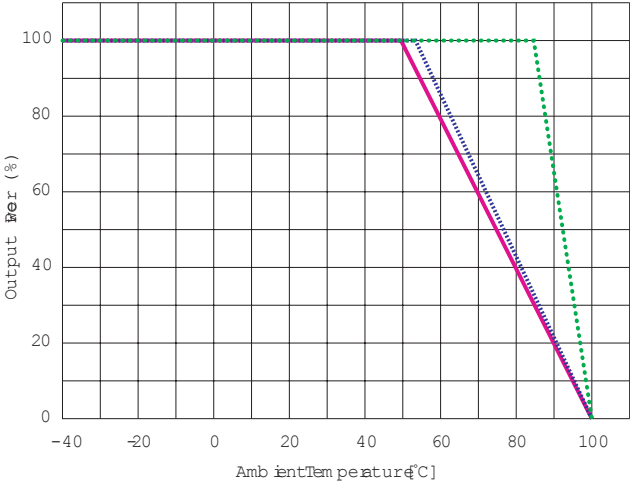
TEN 40-032



TEN 40-033



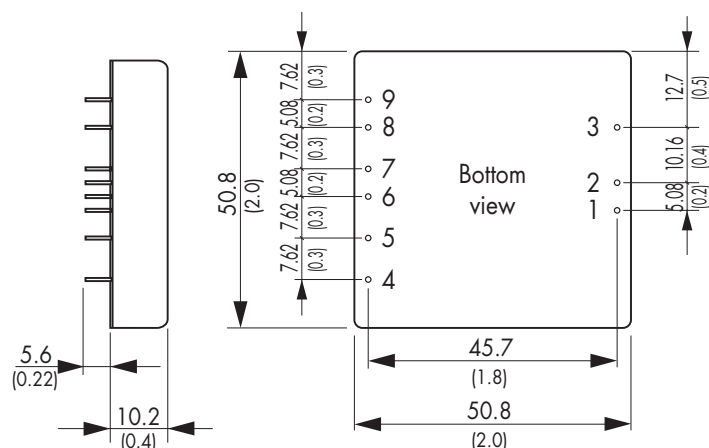
TEN 40-034



Physical Specifications

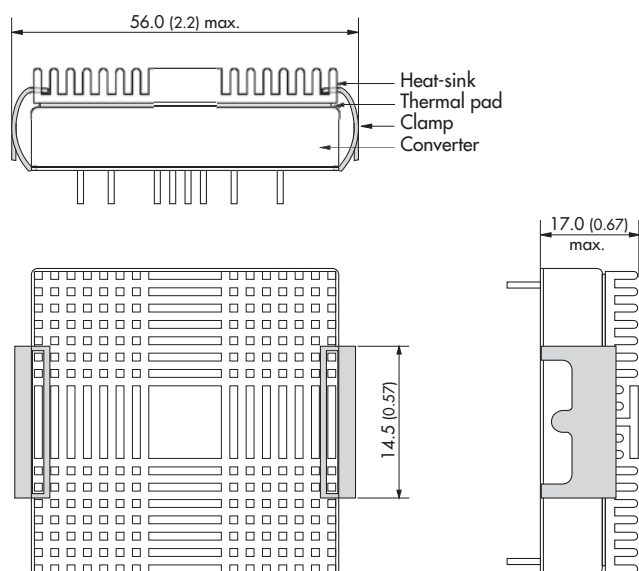
Casing material	copper, nickel plated
Baseplate material	none conductive FR4
Potting material	epoxy (UL 94V-0 -rated)
Weight	65 g (2.3 oz)
Soldering temperature	max. 265°C / 10 sec.

Outline Dimensions



Dimensions in [mm], () = Inch
Pin diameter: 1.0 ±0.05 (0.04 ±0.002)
Pin pitch tolerances: ±0.35 (±0.014)
Case tolerances: ±0.5 (±0.02)

Heat-sink TEN-HS3



Pin-Out				
Pin	Single	Dual symmetric	Dual asymmetric	Triple
1	+Vin (Vcc)	+Vin (Vcc)	+Vin (Vcc)	+Vin (Vcc)
2	-Vin (GND)	-Vin (GND)	-Vin (GND)	-Vin (GND)
3	Remote On/Off			
4	No con.	No pin	+ Vout 1	+ Vout 2
5	-Sense	+Vout	-Vout	Common 2/3
6	+Sense	Common	No con.	-Vout 3
7	+Vout	Common	No con.	+Vout 1
8	-Vout	-Vout	+Vout 2	-Vout 1
9	Trim	Trim	-Vout2	No con.

Order code: TEN-HS3

(cont.: heat-sink, thermal pad, 2 clamps)

Material: Aluminum

Finish: Anodic treatment (black)

Weight: 22 g (0.78oz) (without converter)

Note:

The product label on converter has to be removed before mounting the heat-sink.

For volume orders converters will be supplied with heat-sinks already mounted. Please contact factory for quotation.

Separate heat-sinks are only available for prototypes and small quantity orders.

Specifications can be changed any time without notice.