



## IP3128XXX-25

### Single/Dual/Triple Output Series High Reliability DC-DC Converters

#### FEATURES

- 28V nominal input
- 25W output power with minimal derating
- High efficiency
- Inhibit
- Soft-start
- Short-circuit protection
- M class temperature range Tc –55°C to 105°C
- I class temperature range Tc –40°C to 85°C
- 1,500V<sub>DC</sub> input to output isolation

#### DESCRIPTION

The IP3128XXX-25 series is a family of high performance DC-DC power modules designed for aerospace, military and high-end industrial applications. These modules feature a fixed 400kHz switching frequency and deliver excellent reliability, low noise, and high power density. All models are optimized for a nominal 28 volt input within a voltage range of 16-40 volts. Single, dual and triple outputs of 5, 12, 15 volts are available. Typical applications do not require an external heat sink as long as the designer ensures that the case temp does not exceed -55°C to 105°C (M grade) or -40°C up to 85°C (I grade). All the modules are designed with LC network filters to minimize reflected input current ripple and output voltage ripple.

The modules include a soft-start, and short circuit protection circuitry to ensure critical module protections. The soft-start feature ensures that high inrush currents commonly seen during start-up are effectively controlled to prevent damage to the converter. The short circuit protection completely protects the modules against short-circuits of any duration by a shutting down and restores to normal when the overload is removed. The modules are potted with a thermally conductive compound and packaged in a metallic case to ensure the module's integrity under high stress environmental conditions.



<b>ABSOLUTE MAXIMUM RATINGS</b>	INPUT VOLTAGE:	16V <sub>DC</sub> – 40V <sub>DC</sub>	
	OUTPUT POWER:	25W	
	OPERATING TEMP (T <sub>c</sub> ):	–55°C to +105°C (M)	–40°C to +85°C (I)
	STORAGE TEMP:	–55°C to +125°C (M)	–40°C to +85°C (I)
	PIN SOLDER TEMP (10S):	300°C	

## ELECTRICAL CHARACTERISTICS – SINGLE OUTPUT

PARAMETER	CONDITIONS <sup>4</sup>	IP312805S-25			IP312812S-25			IP312815S-25			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE	V <sub>IN</sub> =28V <sub>DC</sub>	4.9	5.00	5.1	11.76	12.00	12.24	14.70	15.00	15.30	V <sub>DC</sub>
OUTPUT CURRENT	V <sub>IN</sub> = 16V <sub>DC</sub> 40V <sub>DC</sub>	0	–	5000	0	–	2000	0	–	1650	mA
OUTPUT POWER	V <sub>IN</sub> = 16V <sub>DC</sub> 40V <sub>DC</sub>	0	–	25	0	–	25	0	–	25	W
RIPPLE VOLTAGE <sup>1</sup>	V <sub>IN</sub> =28V <sub>DC</sub> FULL LOAD 20MHz	–	30	50	–	30	100	–	30	150	mV <sub>pp</sub>
LINE REGULATION	V <sub>IN</sub> = 16V <sub>DC</sub> 40V <sub>DC</sub> FULL LOAD	–	10	50	–	10	120	–	10	150	mV
LOAD REGULATION	V <sub>IN</sub> =28V <sub>DC</sub> NO LOAD TO FULL LOAD	–	10	50	–	10	120	–	10	150	mV
INPUT VOLTAGE	RANGE	16	28	40	16	28	40	16	28	40	V
	50V/100ms	0	–	50	0	–	50	0	–	50	
INPUT CURRENT	NO LOAD	–	10	30	–	10	30	–	10	30	mA
	INHIBITED	–	3	10	–	3	10	–	3	10	mA
REFLECTED RIPPLE CURRENT <sup>3</sup>	V <sub>IN</sub> =28V <sub>DC</sub> FULL LOAD, 20MHz	–	100	300	–	100	300	–	100	300	mApp
START UP INPUT VOLTAGE	FULL LOAD	–	15.5	–	–	15.5	–	–	15.5	–	V
EFFICIENCY	V <sub>IN</sub> =28V <sub>DC</sub> FULL LOAD	78	83	–	80	85	–	80	85	–	%
SHORT CIRCUIT MODE	INPUT CURRENT (AVERAGE)	–	–	80	–	–	80	–	–	80	mA
CAPACITY LOAD	MAXIMUM ADMISSIBLE	–	–	2000	–	–	470	–	–	470	μF
SWITCHING FREQUENCY	V <sub>IN</sub> = 16V <sub>DC</sub> 40V <sub>DC</sub>	–	400	–	–	400	–	–	400	–	kHz
STEP LOAD RESPONSE <sup>2</sup>	NORMAL INPUT 50%-100%-50% LOAD	–	±100	±250	–	±100	±250	–	±100	±250	mV
STEP LOAD RECOVERY <sup>2</sup>		–	200	300	–	200	300	–	200	300	μs
STEP LINE RESPONSE	16-40-16V <sub>DC</sub>	–	±50	±200	–	±100	±200	–	±100	±200	mV
STEP LINE RECOVERY		–	200	300	–	200	300	–	200	300	μs
START-UP	DELAY	–	10	30	–	10	30	–	10	30	ms
	FULL LOAD OVERSHOOT	–	0	50	–	0	50	–	0	50	mVpk
INSULATION RESISTANCE	≥100M @ 500 V <sub>DC</sub> (input-output, input-case, output-case)										
ELECTRIC STRENGTH	1500V <sub>DC</sub> , 1 min input to output										
INHIBIT	No connection or TTL high level, module operation										

## NOTES

1. Ripple voltage measured using tip and barrel measurement.
2. Step load measured using tip and barrel measurement.
3. Reflected ripple current guaranteed by design
4. 25°C T<sub>c</sub>, V<sub>in</sub>= 28V<sub>DC</sub>, 100% load, unless otherwise specified.

## ELECTRICAL CHARACTERISTICS – DUAL OUTPUT

PARAMETER	CONDITIONS <sup>4</sup>	IP312812D-25			IP312815D-25			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE	$V_{IN}=28V_{DC}$ $\pm V_o$	11.76	12.00	12.24	14.70	15.00	15.30	V
OUTPUT CURRENT	$V_{IN}=16V_{DC}$ 40V <sub>DC</sub> $\pm V_o$	0	–	1000	0	–	825	mA
OUTPUT POWER	$V_{IN}=16V_{DC}$ 40V <sub>DC</sub>	–	–	25	–	–	25	W
RIPPLE VOLTAGE <sup>1</sup>	$V_{IN}=28V_{DC}$ FULL LOAD 20MHz	–	30	100	–	30	150	mV <sub>pp</sub>
LINE REGULATION	$V_{IN}=16V_{DC}$ 40V <sub>DC</sub> FULL LOAD $+V_o$ $-V_o$	–	10	120	–	10	150	mV
LOAD REGULATION	$V_{IN}=28V_{DC}$ $+V_o$ $-V_o$	–	10	120	–	10	150	mV
CROSS LOAD REGULATION	U <sub>i</sub> NOMINAL	–	–	2	–	–	2	%
	+V <sub>out</sub> 75% LOAD							
	–V <sub>out</sub> FROM 25% TO FULL LOAD							
INPUT VOLTAGE	RANGE	16	28	40	16	28	40	V
	50V/100ms	0	–	50	0	–	50	
INPUT CURRENT	NO LOAD	–	20	30	–	20	30	mA
	INHIBITED	–	3	10	–	3	10	mA
REFLECTED RIPPLE CURRENT <sup>3</sup>	$V_{IN}=28V_{DC}$ FULL LOAD, 20MHz	–	100	300	–	100	300	mApp
START UP INPUT VOLTAGE	FULL LOAD	–	15.5	–	–	15.5	–	V
EFFICIENCY	$V_{IN}=28V_{DC}$ FULL LOAD	80	85	–	80	85	–	%
SHORT CIRCUIT MODE	INPUT CURRENT (AVERAGE)	–	–	80	–	–	80	mA
CAPACITY LOAD	MAXIMUM ADMISSIBLE	–	–	220	–	–	220	μF
SWITCHING FREQUENCY	$V_{IN}=16V_{DC}$ 40V <sub>DC</sub>	–	400	–	–	400	–	kHz
STEP LOAD RESPONSE <sup>2</sup>	NORMAL INPUT 50%-100%-50% LOAD	–	±100	±250	–	±100	±250	mV
STEP LOAD RECOVERY <sup>2</sup>		–	100	300	–	100	300	μs
STEP LINE RESPONSE	16-40-16V <sub>DC</sub>	–	±50	±200	–	±100	±200	mV
STEP LINE RECOVERY		–	200	300	–	200	300	μs
START-UP	DELAY	–	10	30	–	10	30	ms
	FULL LOAD OVERSHOOT	–	–	50	–	–	50	mVpk
INSULATION RESISTANCE	≥100M @ 500 V <sub>DC</sub> (input-output, input-case, output-case)							
ELECTRIC STRENGTH	1500V <sub>DC</sub> , 1 min input to output							
INHIBIT	No connection or TTL high level, module operation							

### NOTES

1. Ripple voltage measured using tip and barrel measurement.
2. Step load measured using tip and barrel measurement.
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4. 25°C T<sub>c</sub>, V<sub>in</sub>= 28V<sub>DC</sub>, 100% load, unless otherwise specified.

**ELECTRICAL CHARACTERISTICS – TRIPLE OUTPUT**

PARAMETER	CONDITIONS <sup>4</sup>	IP312812T-25			IP312815T-25			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE	V <sub>IN</sub> =28V <sub>DC</sub> Vo2, Vo3 Vo1	11.76 4.9	12.00 5.0	12.24 5.1	14.70 4.9	15.00 5.0	15.30 5.1	V
OUTPUT CURRENT	V <sub>IN</sub> =16V <sub>DC</sub> 40V <sub>DC</sub> Vo2, Vo3 Vo1	0 0	– –	500 2500	0 0	– –	400 2500	mA
OUTPUT POWER	V <sub>IN</sub> =16V <sub>DC</sub> 40V <sub>DC</sub>	–	–	25	–	–	25	W
RIPPLE VOLTAGE <sup>1</sup>	V <sub>IN</sub> =28V <sub>DC</sub> FULL LOAD 20MHz	–	30	100	–	30	150	mV <sub>pp</sub>
LINE REGULATION	V <sub>IN</sub> =16V <sub>DC</sub> 40V <sub>DC</sub> Vo2, Vo3 Vo1	– –	10 10	120 50	– –	10 10	150 50	mV
LOAD REGULATION	V <sub>IN</sub> =28V <sub>DC</sub> Vo2, Vo3 Vo1	– –	10 10	120 50	– –	10 10	150 50	mV
CROSS LOAD REGULATION	U <sub>i</sub> NOMINAL	–	–	2	–	–	2	%
	+V <sub>out</sub> 75% LOAD							
	–V <sub>out</sub> FROM 25% TO FULL LOAD							
INPUT VOLTAGE	RANGE	16	28	40	16	28	40	V
	50V/100ms	–	–	50	–	–	50	
INPUT CURRENT	NO LOAD	–	20	30	–	20	30	mA
	INHIBITED	–	10	20	–	10	20	mA
REFLECTED RIPPLE CURRENT <sup>3</sup>	V <sub>IN</sub> =28V <sub>DC</sub> FULL LOAD, 20MHz	–	100	300	–	100	300	mApp
START UP INPUT VOLTAGE	FULL LOAD	–	15.5	–	–	15.5	–	V
EFFICIENCY	V <sub>IN</sub> =28V <sub>DC</sub> FULL LOAD	78	82	–	78	82	–	%
SHORT CIRCUIT MODE	INPUT CURRENT (AVERAGE)	–	–	100	–	–	100	mA
CAPACITY LOAD	MAXIMUM ADMISSIBLE Vo1 Vo2, Vo3	–	–	2200	–	–	2200	μF
		–	–	100	–	–	100	
SWITCHING FREQUENCY	V <sub>IN</sub> =16V <sub>DC</sub> 40V <sub>DC</sub>	–	400	–	–	400	–	kHz
STEP LOAD RESPONSE <sup>2</sup>	NORMAL INPUT	–	±100	±250	–	±100	±250	mV
STEP LOAD RECOVERY <sup>2</sup>	50%-100%-50% LOAD	–	100	300	–	100	300	μs
STEP LINE RESPONSE	16-40-16V <sub>DC</sub>	–	±50	±200	–	±100	±200	mV
STEP LINE RECOVERY		–	200	300	–	200	300	μs
START-UP	DELAY	–	10	30	–	10	30	ms
	FULL LOAD OVERSHOOT	–	–	50	–	–	50	mVpk
INSULATION RESISTANCE	≥100M @ 500 V <sub>DC</sub> (input-output, input-case, output-case)							
ELECTRIC STRENGTH	1500V <sub>DC</sub> , 1 min input to output							
INHIBIT	No connection or TTL high level, module operation							

**NOTES**

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**APPLICATION NOTES**

**Output Short Circuit Protection (SCP)**

Internal short circuit protection circuitry protects the module against short circuits of any duration and restores the module to normal operation when the short circuit is removed. It operates in "hiccup" mode by testing periodically if an overload is applied.

**Normal Output**

All of the dual output modules can be configured to deliver outputs of 10v (+/-5v) 24v (+/- 12v) or 30v (+/-15v) by connecting the load across the (+) output and (-) output with one output grounded and leaving the common pin floating.

**Remote On/Off Function**

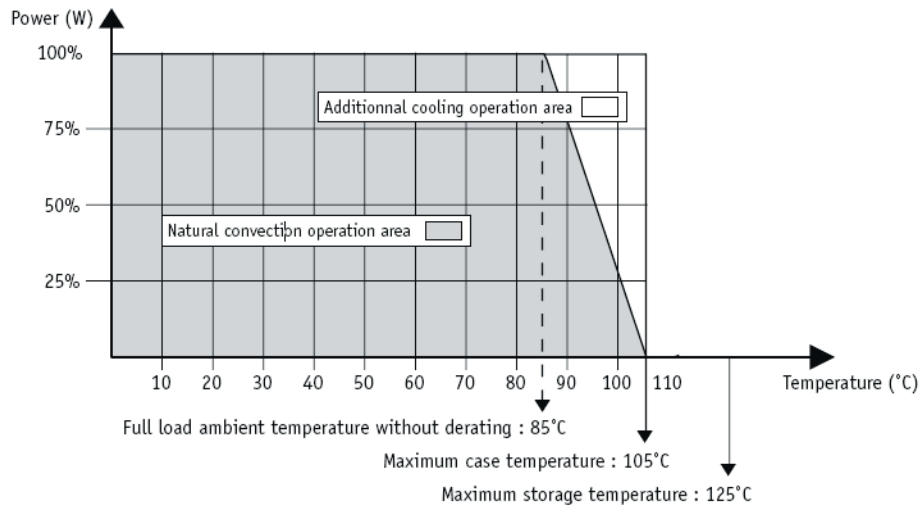
The control pin 4 (On/Off) can be used for applications requiring On/Off operation. A logic pulled low (<0.2V@1mA, referenced to Gi on pin 4) disables the converter. No connection or high impedance on pin 4 enables the converter. By releasing the On/Off function, the converter will restart.

**Ambient temperature & operating case temperature (M class)**

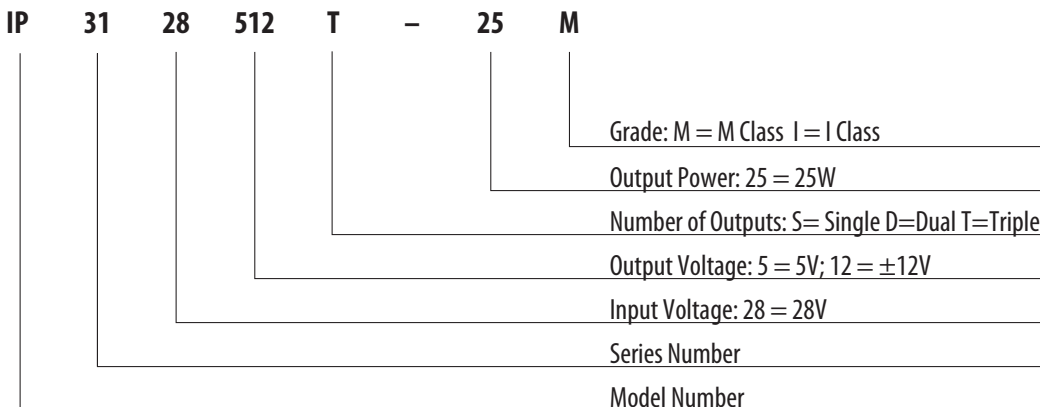
The IP3128XX-25 series operating case temperature should not exceed 105°C. The maximum ambient temperature admissible for the DC-DC converter corresponding to the maximum operating case temperature of 105°C depends on the ambient airflow, the mounting/orientation, the cooling features and the power dissipated.

The previous thermal calculation shows two areas of operation:

- A normal operation area in a free natural ambient convection (grey area in this following graph),
- An area with cooling features (air flow or heatsink) ensuring a maximum case temperature below the maximum operating case temperature of 105°C (white area in the following graph).



**ORDERING INFORMATION**



### ENVIRONMENTAL SCREENING

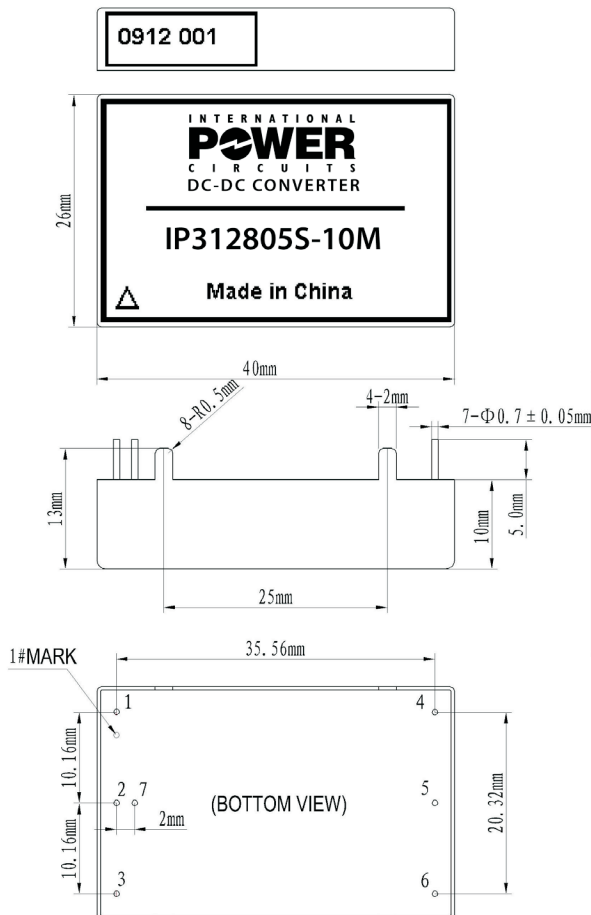
	NUMBER	TEST ITEM	METHOD	REQUEST	CONDITION
I	1	BURN-IN		100%	Tc = 85°C 48h
M	1	ENVIRONMENTAL STRESS SCREENING (ESS)	MIL-STD-2164	100%	-
	2	BURN-IN		100%	Tc = 105°C 168h

### QUALITY SYSTEM REQUIREMENTS

NUMBER	TEST ITEM	METHOD	REQUEST	CONDITION
3	ELECTRICAL TEST	MIL-STD-810	100%	-55°C, +105°C, 25°C
4	DEPRESSION (ALTITUDE)	MIL-STD-810	Sample	12k Pa (12000m)
5	TEMPERATURE SHOCK	MIL-STD-810	Sample	-55°C ~ 105°C 3 times
6	HUMIDITY	IEC68-2-30	Sample	40°C 93% RH 144 hours
7	VIBRATION	MIL-STD-810	Sample	0.04g <sup>2</sup> /Hz, 10-2000Hz
8	SHOCK	MIL-STD-810	Sample	50g, 11ms, 3 times
9	ACCELERATION	MIL-STD-810	Sample	50g, 5 min

### DIMENSIONS AND CONNECTIONS

Dimensions are given in mm. Tolerance : +/- 0.1 mm unless otherwise indicated.



PIN	PIN FUNCTIONS SINGLE	PIN FUNCTIONS DUAL	PIN FUNCTIONS TRIPLE
1	+INPUT (+Vin)	+INPUT (+Vin)	+INPUT (+Vin)
2	-INPUT (Gi)	-INPUT (Gi)	-INPUT (Gi)
3	NO CONNECTION	NO CONNECTION	NO CONNECTION
4	ON/OFF	ON/OFF	ON/OFF
5	NO CONNECTION	OUTPUT+ (+Vo)	OUTPUT2+ (+V2)
6	OUTPUT (Vo)	COMMON (CO)	OUTPUT1 (V1)
7	COMMON (CO)	OUTPUT- (-Vo)	COMMON (CO)
8	NO CONNECTION	NO CONNECTION	OUTPUT2- (-V2)

TOLERANCE: ± 0.1mm