Features

Regulated Converter

- 2MOPP, 250VAC working voltage isolation
- Clearance and creepage distance >8mm
- Up to 10kVDC reinforced insulation
- IEC/EN/UL 60601 certified with CB Report (3rd Ed. Safety, 4th Ed. EMC)
- -40°C to +85°C operation, no derating
- 2:1 wide input range

RECOM
DC/DC Converter

REM3.5E

3.5 Watt 2:1 Input DIP24 Single & Dual Output

Description

The REM3.5E series of medical grade regulated DC/DC converters feature reinforced 250VAC continuous working isolation with >8mm creepage/clearance. The compact DIP24 package offers industry standard pinouts with tightly regulated single/dual outputs and UVLO, SCP, OCP and OVP. The operating ambient temperature range is from -40°C to +85°C without derating. The converters are UL marked and certified to CB, IEC, EN and ANSI/AAMI 60601 3rd. Ed. Safety and 4th Ed. EMC medical standards. The low 1µA leakage current makes them suitable for medical B, BF and CF applications.

Selection Guide

Part Number	nom. Input Voltage [VDC]	Output Voltage [VDC]	Output Current [mA]	Efficiency typ.(1) [%]	Max. Capacitive Load (2) [µF]
REM3.5E-xx05S/R(3)/A (4,5)	5 / 12 / 24 / 48	5	700	76 / 80 / 81 / 82	4700
REM3.5E-xx09S/R(3)/A (4,5)	5 / 12 / 24 / 48	9	388	80 / 81 / 82 / 82	3300
REM3.5E-xx12S/R(3)/A (4,5)	5 / 12 / 24 / 48	12	290	82 / 82 / 83 / 82	2200
REM3.5E-xx15S/R(3)/A (4,5)	5 / 12 / 24 / 48	15	233	83 / 82 / 84 / 83	2200
REM3.5E-xx24S/R(3)/A (4,5)	5 / 12 / 24 / 48	24	145	82 / 82 / 84 / 83	1000
REM3.5E-xx05D/R(3)/A (4,5)	5 / 12 / 24 / 48	±5	±350	76 / 80 / 81 / 82	±2200
REM3.5E-xx09D/R(3)/A (4,5)	5 / 12 / 24 / 48	±9	±194	80 / 81 / 82 / 82	±1600
REM3.5E-xx12D/R(3)/A (4,5)	5 / 12 / 24 / 48	±12	±145	82 / 82 / 83 / 82	±1000
REM3.5E-xx15D/R(3)/A (4,5)	5 / 12 / 24 / 48	±15	±117	83 / 82 / 84 / 83	±1000

Notes:

Note1: Efficiency is tested at nominal input and full load at +25°C ambient

Note2: Max Cap Load is tested at nominal input and full resisitive load

2MOPP
250VAC

CAN/CSA-C22.2 No. 60601-1:14
ANSI/AAMI ES60601-1
EN60601-1 pending
IEC60601-1 pending
IEC60601-1-2 pending
EN55032 pending

Model Numbering

REM3.5E- ___ ___ /R /A / ___ /

- Output Power
- nom. Input Voltage
- Output Voltage
- Single or Dual
- UVLO Option (5)
- CTRL Option (4)
- Pinning
- Isolation (3)

Notes:

Note3: add suffix „/R8“ for 8kVDC or „/R10“ for 10kVDC isolation

Note4: add suffix „/CTRL“ for fitted CTRL pin

Note5: add suffix „/X1“ for Under Voltage Lockout Option

Note6: *SMD versions available from Q2/2019*

Ordering Examples

REM3.5E-0505S/R8/A	= 5Vin, 5Vout, Single, 8kVDC Isolation and „A“ pinning, DIP24
REM3.5E-1205D/R10/A/ CTRL	= 12Vin, 5Vout, Dual, 10kVDC Isolation, „A“ pinning, with CTRL pin
REM3.5E-2405S/R8/A/X1	= 24Vin, 5Vout, Single, 8kVDC Isolation, „A“ pinning, DIP24 and with UVLO Option
REM3.5E-2405D/R10/A/CTRL/X1	= 24Vin, 5Vout, Dual, 10kVDC Isolation, „A“ pinning, DIP24, CTRL pin and UVLO Option

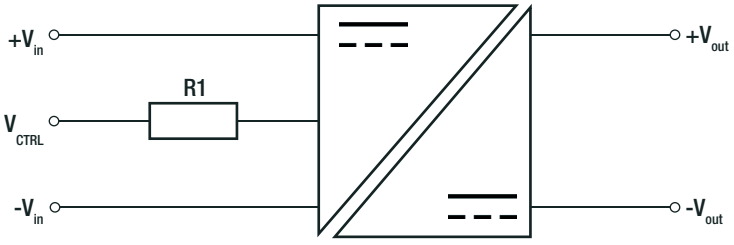
Specifications (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

BASIC CHARACTERISTICS					
Parameter	**Condition**		**Min.**	**Typ.**	**Max.**
Internal Input Filter					Pi-type
Input Voltage Range	nom. Vin = 5VDC nom. Vin = 12VDC nom. Vin = 24VDC nom. Vin = 48VDC		4.5VDC 9VDC 18VDC 36VDC	5VDC 12VDC 24VDC 48VDC	9VDC 18VDC 36VDC 75VDC
Under Voltage Lockout (UVLO) ("/X1" version)	nom. Vin= 5VDC	DC-DC ON DC-DC OFF		 3.9VDC	4.5VDC
	nom. Vin= 12VDC	DC-DC ON DC-DC OFF		 7.9VDC	9VDC
	nom. Vin= 24VDC	DC-DC ON DC-DC OFF		 16.7VDC	18VDC
	nom. Vin= 48VDC	DC-DC ON DC-DC OFF		 34.3VDC	36VDC
Input Current	nom. Vin = 5VDC nom. Vin = 12VDC nom. Vin = 24VDC nom. Vin = 48VDC			900mA 360mA 180mA 90mA	
Quiescent Current	nom. Vin = 5VDC nom. Vin = 12VDC nom. Vin = 24VDC nom. Vin = 48VDC				50mA 20mA 5mA 2.5mA
Minimum Load (8)				10%	
Start-up time				0.6ms	
Rise time				0.45ms	
Hold-up time				0.6ms	
ON/OFF CTRL	DC-DC ON DC-DC OFF				Open or 0VDC<V_{CTRL}<1.2VDC Short or 4.8VDC<V_{CTRL}<12VDC
Input Current of CTRL Pin	V_{CTRL}=5VDC			25mA	
Standby Current	DC-DC OFF				350µA
Intvernal Operating Frequency			120kHz		
Output Ripple and Noise (7)	20MHz BW				150mVp-p

Notes:

Note7: Measurements are made with a 0.1µF MLCC across output. (low ESR)

ON/OFF CTRL Option



R1
470Ω

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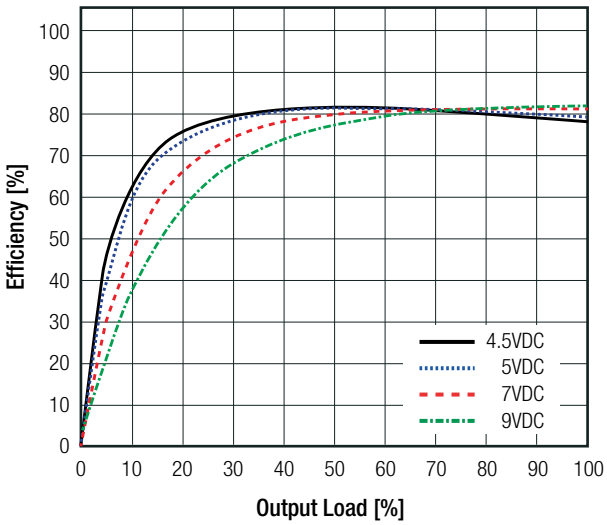
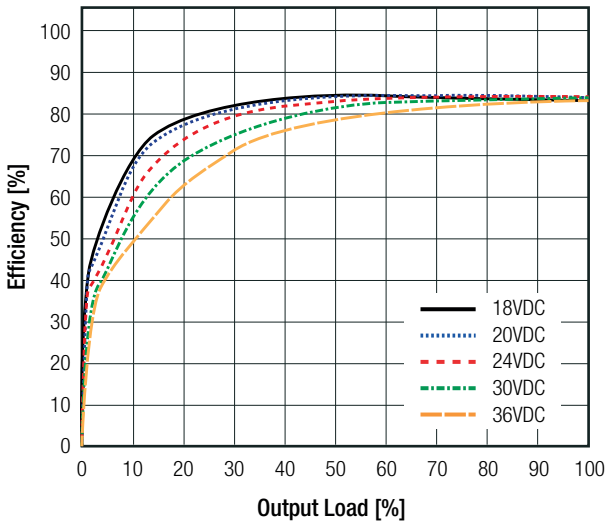
Specifications (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

Efficiency vs. Output Load

REM3.5E-0505S



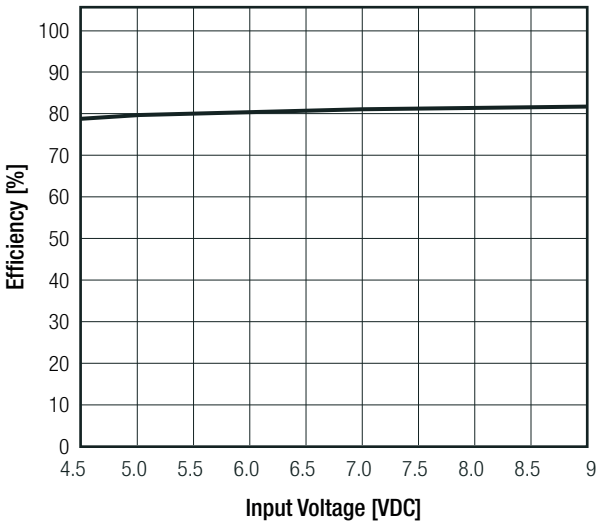
REM3.5E-2405S



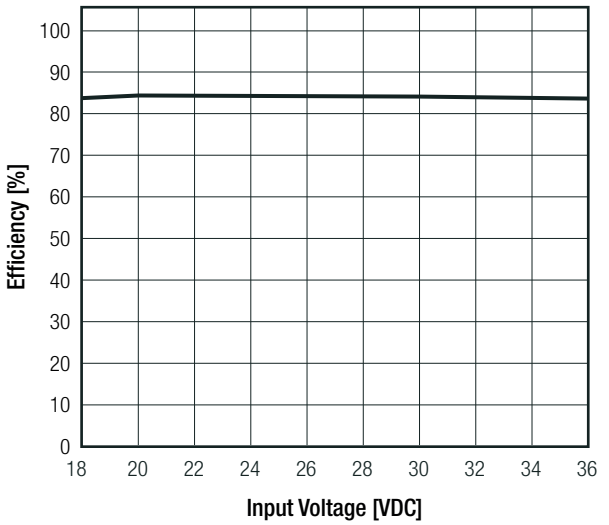
Efficiency vs. Input Voltage

(@ full Load)

REM3.5E-0505S



REM3.5E-2405S



REGULATIONS

Parameter	Condition	Value
Output Accuracy		±1.5% typ.
Line Regulation	low line to high line, full load	±0.3% max.
Load Regulation [8]	10% to 100% load	0.5% typ.
Cross Regulation	dual output only	±5.0% max.
Transient Response	25% load step change	5ms

Notes:

Note8: Operation below 10% load will not harm the converter, but specifications may not be met

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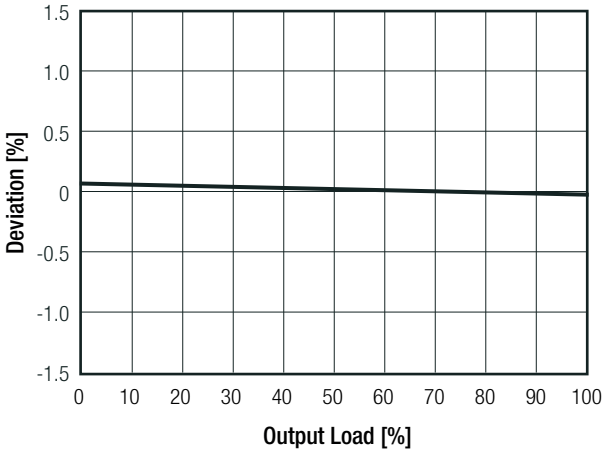
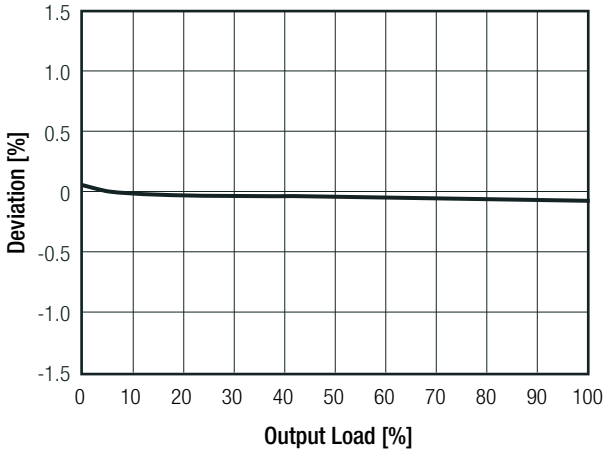
Specifications (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

Deviation vs. Load

REM3.5E-0505S



REM3.5E-2405S



PROTECTIONS

Parameter	Type			Value
Short Circuit Protection (SCP)	below 100mΩ			continuous, hiccup mode, automatic recovery
Isolation Voltage (9)	"/R8" suffix	I/P to O/P	tested for 1 second rated for 1 minute	8kVDC 4kVAC/60Hz
	"/R10" suffix	I/P to O/P	tested for 1 second rated for 1 minute	10kVDC 5kVAC/60Hz
Isolation Resistance				10GΩ min.
Isolation Capacitance				20pF typ.
Insulation Grade				reinforced
Leakage Current				0.8µA typ. / 1µA max.
Means of Protection	250VAC working voltage			2MOPP
Medical Device Classification				built-in power supply
Internal	clearance/creepage			>8mm
External	clearance/creepage			>8mm

Notes:

Note9: For repeat Hi-Pot testing, reduce the time and/or the test voltage

Note10: Refer to local safety regulations if input over-current protection is also required. Recommended fuse: slow blow type

ENVIRONMENTAL

Parameter	Condition		Value
Operating Temperature Range	full load @ natural convection 0.1m/s (see graph)		-40°C to +85°C
Maximum Case Temperature			+105°C
Temperature Coefficient			±0.02%/K typ. / ±0.05%/K max.
Thermal Impedance	0.1m/s, horizontal		20K/W
Operating Altitude			3000m
Operating Humidity	non-condensing		5% - 95% RH max.
Pollution Degree			PD2
MTBF	according to MIL-HDBK-217F, G.B.	+25°C +85°C	3600 x 10^3 hours 450 x 10^3 hours

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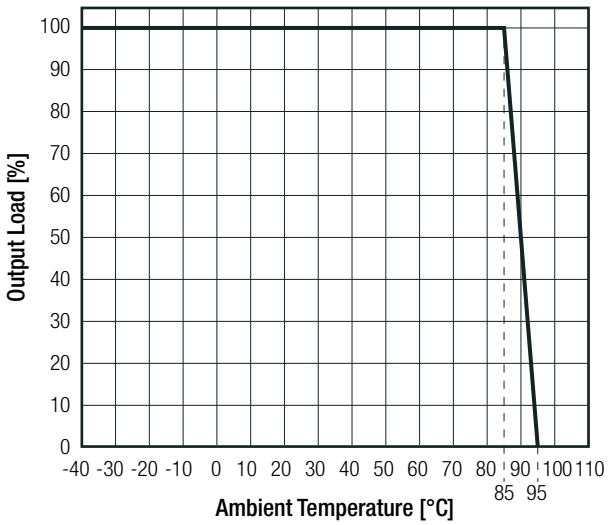
Specifications (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

Derating Graph

(@ Chamber and natural convection 0.1m/s)



SAFETY AND CERTIFICATIONS		
Certificate Type (Safety)	**Report / File Number**	**Standard**
Medical Electric Equipment, General Requirements for Safety and Essential Performance	E314885	CAN/CSA-C22.2 No. 60601-1:14, 3rd Edition: 2014 ANSI/AAMI ES60601-1:2012
Medical Electric Equipment, General Requirements for Safety and Essential Performance	pending	EN60601-1:2006 + A12:2014
Medical Electric Equipment, General Requirements for Safety and Essential Performance (CB Scheme)	pending	IEC60601-1:2005, 3rd Edition + AM1:2012
RoHS 2+		RoHS 2011/65/EU + AM2015/863

EMC Compliance	**Condition**	**Standard / Criterion**
Medical electrical equipment Part 1-2: Electromagnetic disturbances – Requirements and tests	pending	IEC60601-1-2
Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement	with external filter	EN55032, Class A and B
ESD Electrostatic discharge immunity test	Air ±15kV, Contact ±8kV	EN61000-4-2, Criteria A
Radiated, radio-frequency, electromagnetic field immunity test	10V/m	EN61000-4-3, Criteria A
Fast Transient and Burst Immunity	DC Power Port: ±2kV	EN61000-4-4, Criteria A
Surge Immunity	DC Power Port: ±1kV	EN61000-4-5, Criteria A
Immunity to conducted disturbances, induced by radio-frequency fields	10Vr.m.s	EN61000-4-6, Criteria A

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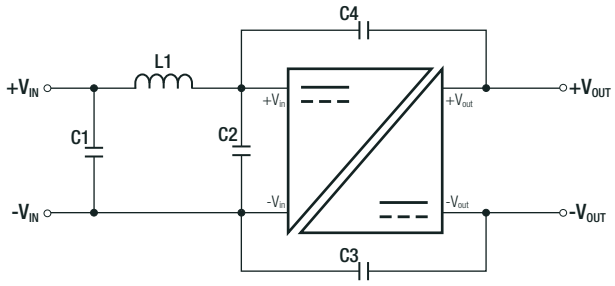
Specifications (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

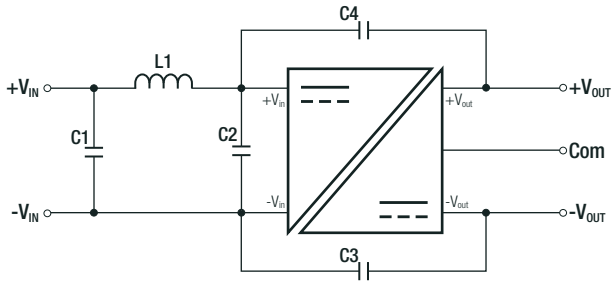
EMC Filtering Suggestions according to EN55032

Class A

Single output



Dual output

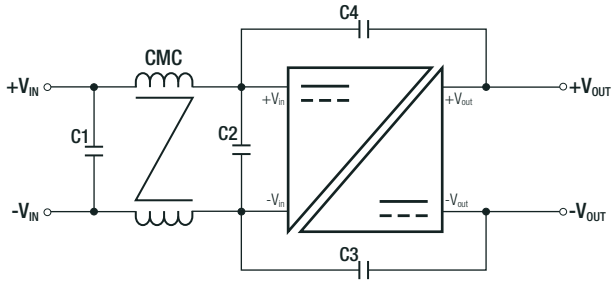


Component List Class A

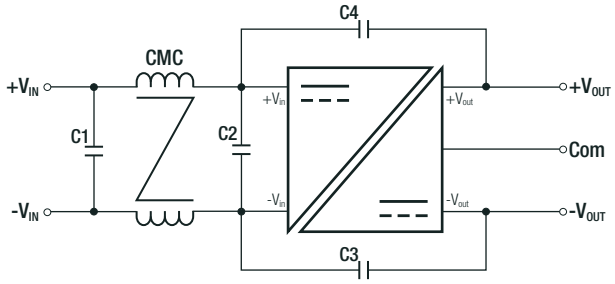
MODEL	C1	C2	C3	C4	L1
REM3.5E-05xxS/R/A and REM3.5E-12xxS/R/A	4.7µF/50V	N/A	100pF/12kV	N/A	3.3µH
REM3.5E-24xxS/R/A and REM3.5E-48xxS/R/A			150pF/12kV		
REM3.5E-05xxD/R/A and REM3.5E-12xxD/R/A	10µF/100V		100pF/12kV	100pF/12kV	
REM3.5E-24xxD/R/A and REM3.5E-48xxD/R/A			150pF/12kV	150pF/12kV	

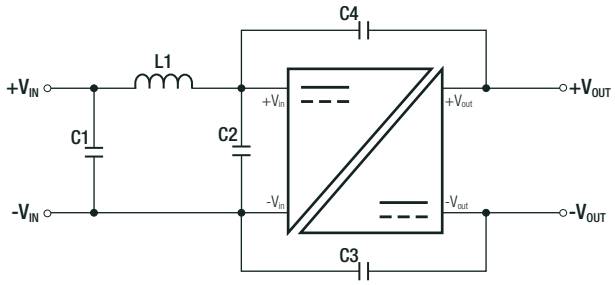
Class B

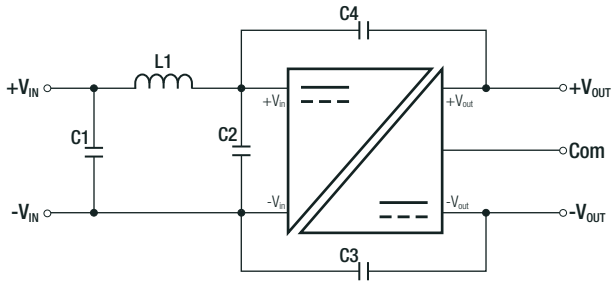
Single output



Dual output







Component List Class B

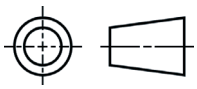
MODEL	C1	C2	C3	C4	L1	CMC
REM3.5E-05xxS/R/A	4.7µF/50V	N/A	100pF/12kV	N/A	N/A	0.2mH
REM3.5E-12xxS/R/A		4.7µF/50V	220pF/12kV		50µH	N/A
REM3.5E-24xxS/R/A	10µF/100V	10µF/100V	220pF/12kV			
REM3.5E-48xxS/R/A			330pF/12kV		N/A	1mH
REM3.5E-05xxD/R/A	4.7µF/50V	N/A	100pF/12kV	100pF/12kV		0.2mH
REM3.5E-12xxD/R/A		4.7µF/50V	220pF/12kV	220pF/12kV	50µH	N/A
REM3.5E-24xxD/R/A	10µF/100V	10µF/100V	220pF/12kV	220pF/12kV		
REM3.5E-48xxD/R/A			330pF/12kV	330pF/12kV	N/A	1mH

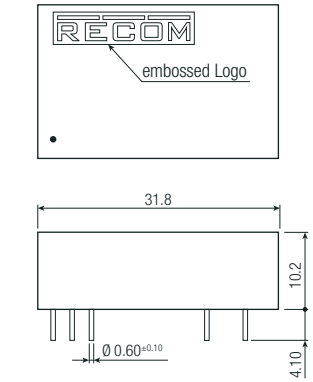
Specifications (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

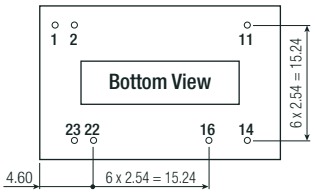
DIMENSION and PHYSICAL CHARACTERISTICS

Parameter	Type	Value
Material	baseplate case potting	non-conductive black plastic, (UL94 V-0) non-conductive black plastic, (UL94 V-0) silicone, (UL94 V-0)
Dimension (LxWxH)		31.8 x 20.3 x 10.2mm
Weight		14g typ.

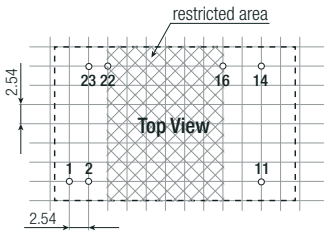
Dimension Drawing (mm)
“A” Pinning







Recommended Footprint Details



Pin Connections

Pin #	Single	Dual
1	CTRL (option)	CTRL (option)
2	-Vin	-Vin
11	NC	-Vout
14	+Vout	+Vout
16	-Vout	Com
22	+Vin	+Vin
23	+Vin	+Vin

Tolerance:
XX.X ± 0.5mm
XX.XX ± 0.25mm

PACKAGING INFORMATION

Parameter	Type	Value
Packaging Dimension (LxWxH)	tube	520.0 x 22.7 x 18.3mm
Packaging Quantity	tube	15pcs
Storage Temperature Range		-55°C to +125°C
Storage Humidity		95% RH max.

CODICO®

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