

# REM4A Series ◊ Regulated DIP16 & SMD

## 4W ◊ Isolated Single & Dual Output ◊ 2:1 Input

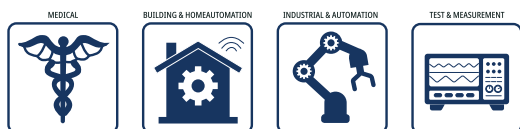
### FEATURES

- 2MOPP, 250VAC working voltage isolation
- Clearance and creepage distance  $\geq 8\text{mm}$
- Up to 5kVAC/1min reinforced insulation
- IEC/EN/UL 60601 and 62368-1 certified
- $-40^{\circ}\text{C}$  to  $+80^{\circ}\text{C}$  operation, no derating
- 2:1 wide input range
- Compact 24.3x14.4mm footprint
- 3 year warranty



Dimensions (LxWxH): 24.3 x 14.4 x 10.2mm (0.95 x 0.57 x 0.40 inch)  
7.0g (0.015 lbs)

### APPLICATIONS



### SAFETY & EMC



### DESCRIPTION

The REM4A series of medical grade regulated DC/DC converters feature reinforced 250VAC continuous working isolation with  $\geq 8\text{mm}$  creepage/clearance. The compact DIP16/SMD package offers industry standard pinouts with tightly regulated single/dual outputs and UVLO, SCP, and OVP. The operating ambient temperature range is from  $-40^{\circ}\text{C}$  to  $+80^{\circ}\text{C}$  without derating. The converters are UL marked and certified to IEC, EN, and ANSI/AAMI 60601 3rd Ed. Safety and 4th Ed. EMC medical standards as well as IEC, EN, UL 62368-1 industrial standards. The low  $2\mu\text{A}$  leakage current complies with medical applied part for B, BF, and CF rating limits as defined by IEC60601-1.

### SELECTION GUIDE

Part Number	Input Voltage	Output Voltage	Output Current	Efficiency	max. Capacitive
	Range [VDC]	nom. [VDC]	max. [mA]	typ. <sup>(1)</sup> [%]	Load <sup>(2)</sup> [ $\mu\text{F}$ ]
REM4A-0505S <sup>(3)</sup>	4.5-12	05	700	77	1470
REM4A-0509S <sup>(3)</sup>	4.5-12	09	389	78	680
REM4A-0512S <sup>(3)</sup>	4.5-12	12	292	82	470
REM4A-0515S <sup>(3)</sup>	4.5-12	15	234	82	330
REM4A-0524S <sup>(3)</sup>	4.5-12	24	146	82	170
REM4A-0512D <sup>(3)</sup>	4.5-12	$\pm 12$	$\pm 146$	82	$\pm 220$
REM4A-0515D <sup>(3)</sup>	4.5-12	$\pm 15$	$\pm 117$	81	$\pm 160$

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Part Number	Input Voltage Range [VDC]	Output Voltage nom. [VDC]	Output Current max. [mA]	Efficiency typ. <sup>(1)</sup> [%]	max. Capacitive Load <sup>(2)</sup> [µF]
REM4A-1205S <sup>(3)</sup>	9-18	05	700	79	1470
REM4A-1209S <sup>(3)</sup>	9-18	09	389	79	680
REM4A-1212S <sup>(3)</sup>	9-18	12	292	82	470
REM4A-1215S <sup>(3)</sup>	9-18	15	234	82	330
REM4A-1224S <sup>(3)</sup>	9-18	24	146	82	170
REM4A-1212D <sup>(3)</sup>	9-18	±12	±146	82	±220
REM4A-1215D <sup>(3)</sup>	9-18	±15	±117	82	±160
REM4A-2405S <sup>(3)</sup>	18-36	05	700	79	1470
REM4A-2409S <sup>(3)</sup>	18-36	09	389	80	680
REM4A-2412S <sup>(3)</sup>	18-36	12	292	83	470
REM4A-2415S <sup>(3)</sup>	18-36	15	234	83	330
REM4A-2424S <sup>(3)</sup>	18-36	24	146	82	170
REM4A-2412D <sup>(3)</sup>	18-36	±12	±146	82	±220
REM4A-2415D <sup>(3)</sup>	18-36	±15	±117	82	±160
REM4A-4805S <sup>(3)</sup>	36-75	05	700	79	1470
REM4A-4809S <sup>(3)</sup>	36-75	09	389	80	680
REM4A-4812S <sup>(3)</sup>	36-75	12	292	82	470
REM4A-4815S <sup>(3)</sup>	36-75	15	234	82	330
REM4A-4824S <sup>(3)</sup>	36-75	24	146	82	170
REM4A-4812D <sup>(3)</sup>	36-75	±12	±146	82	±220
REM4A-4815D <sup>(3)</sup>	36-75	±15	±117	82	±160

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

Note2: Max Cap Load is tested at nominal input an full resistive load

### MODEL NUMBERING



Note3: without suffix = DIP16 type  
with suffix "/SMD"= for SMD package

### BASIC CHARACTERISTICS (measured @ T<sub>AMB</sub>= 25°C, nom. V<sub>IN</sub>, full load and after warm-up unless otherwise stated)

Parameter	Condition	Min.	Typ.	Max.
Internal Input Filter				capacitor
Input Voltage Range	nom. V <sub>IN</sub> = 5VDC	4.5VDC	5VDC	12VDC
	nom. V <sub>IN</sub> = 12VDC	9VDC	12VDC	18VDC
	nom. V <sub>IN</sub> = 24VDC	18VDC	24VDC	36VDC
	nom. V <sub>IN</sub> = 48VDC	36VDC	48VDC	75VDC
Input Surge Voltage	1 sec. max	nom. V <sub>IN</sub> = 5VDC		15VDC
		nom. V <sub>IN</sub> = 12VDC		25VDC
		nom. V <sub>IN</sub> = 24VDC		50VDC
		nom. V <sub>IN</sub> = 48VDC		100VDC

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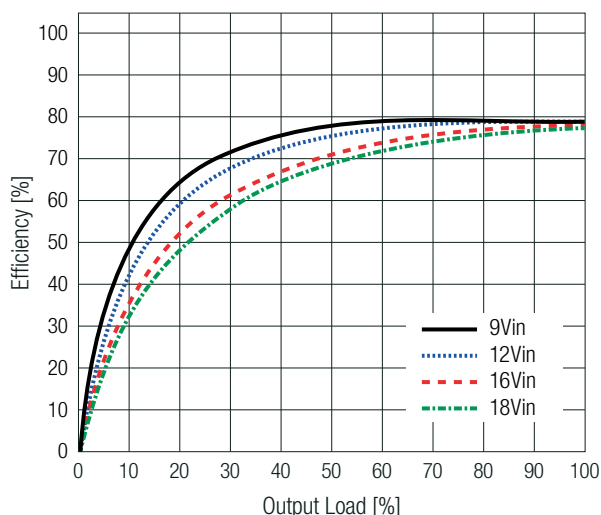
**BASIC CHARACTERISTICS** (measured @  $T_{AMB}=25^{\circ}C$ , nom.  $V_{IN}$ , full load and after warm-up unless otherwise stated)

Parameter	Condition		Min.	Typ.	Max.
Under Voltage Lockout (UVLO)	nom. $V_{IN}=5VDC$	DC-DC ON			4.5VDC
		DC-DC OFF	2VDC	3VDC	4VDC
	nom. $V_{IN}=12VDC$	DC-DC ON			9VDC
		DC-DC OFF	6VDC	7VDC	8VDC
	nom. $V_{IN}=24VDC$	DC-DC ON			18VDC
		DC-DC OFF	13VDC	15VDC	17VDC
nom. $V_{IN}=48VDC$	DC-DC ON			36VDC	
	DC-DC OFF	29VDC	32VDC	35VDC	
Start-up Time	power up / CTRL ON/OFF		10ms		20ms
ON/OFF CTRL <sup>(4)</sup>	DC-DC ON		open or high impedance		
	DC-DC OFF		2mA	3mA	4mA
Input Current of CTRL Pin	DC-DC OFF			2.5mA	
Internal Operating Frequency			100kHz		
Output Ripple and Noise	measured by 20MHz BW	$V_{OUT}=5, 12, 15, 24VDC$		50mVp-p	
		$V_{OUT}=48, \pm 12, \pm 15VDC$		75mVp-p	

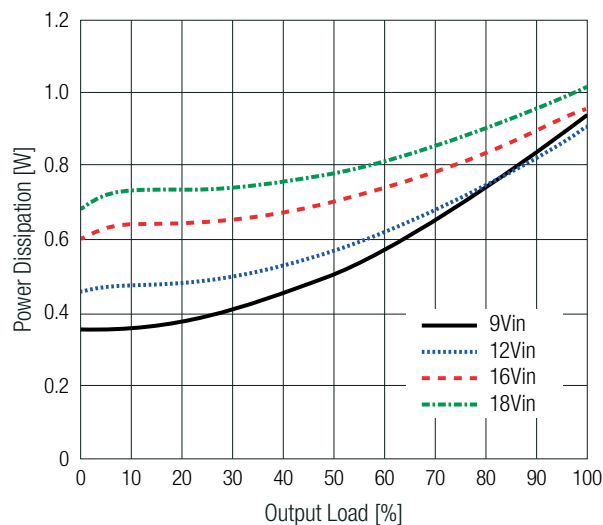
Note4: The pin voltage is referenced to -Vin pin and CTRL pin applied current

### REM4A-1205S

Efficiency vs. Load

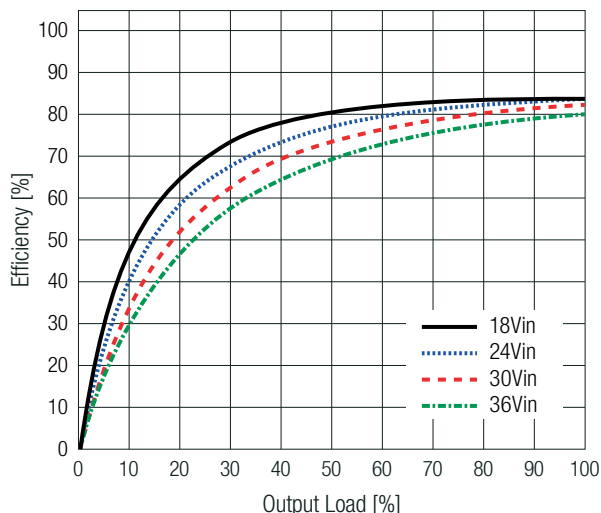


Power Dissipation vs Load

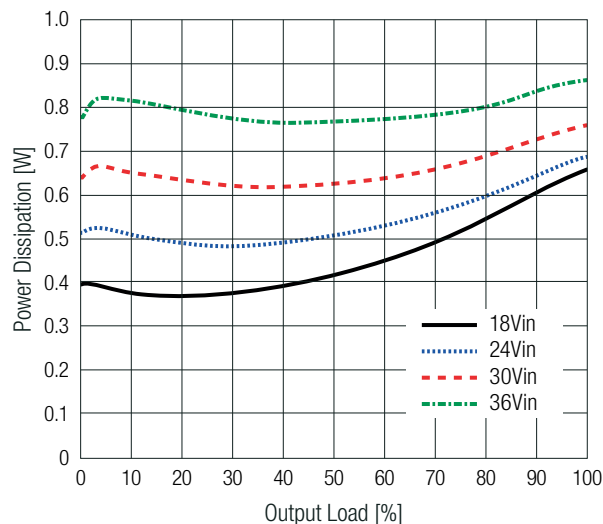


### REM4A-2412S

Efficiency vs. Load



Power Dissipation vs Load



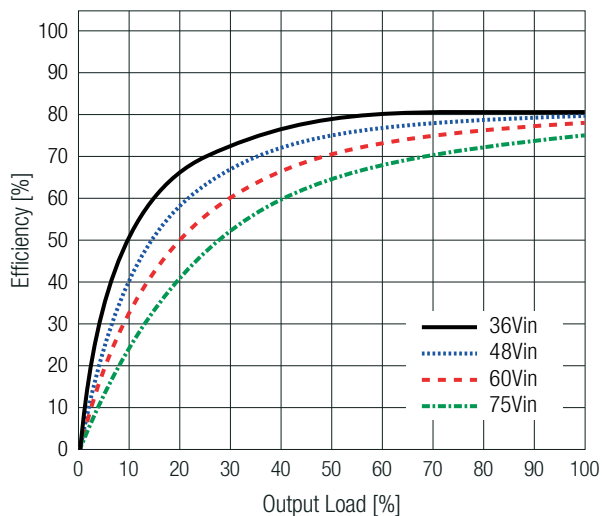
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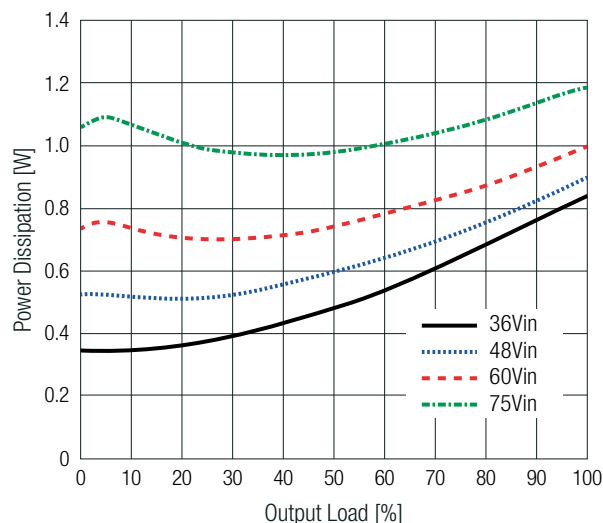
**BASIC CHARACTERISTICS** (measured @  $T_{AMB}=25^{\circ}C$ , nom.  $V_{IN}$ , full load and after warm-up unless otherwise stated)

### REM4A-4805S

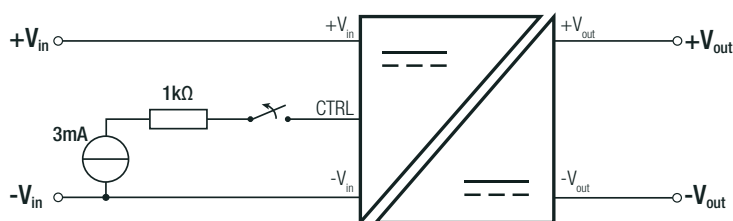
Efficiency vs. Load



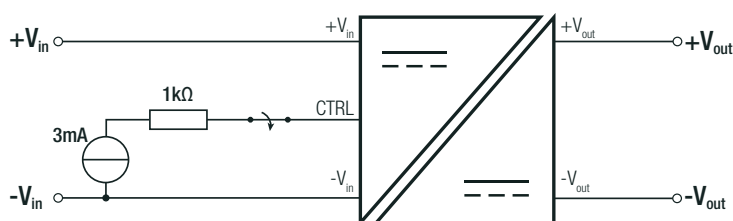
Power Dissipation vs. Load



### ON/OFF CTRL



**DC-DC ON:** Open or high impedance



**DC-DC OFF:** 2mA min. / 3mA typ. / 4mA max.

### REGULATIONS

Parameter	Condition	Value	
Output Accuracy		$\pm 1.0\%$ max.	
Line Regulation	low line to high line, full load	$\pm 0.2\%$ max.	
Load Regulation	0-100% load	single	$\pm 1.0\%$ max.
		dual	$\pm 1.0\%$ max.
	10-90% load	single	$\pm 0.5\%$ max.
		dual	$\pm 0.8\%$ max.
Cross Regulation	asymmetrical load 25% / full load	dual output only $\pm 5.0\%$ max.	
Transient Response	recovery time	500 $\mu$ s max.	

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### PROTECTIONS

Parameter	Condition		Value
Input Fuse <sup>(6)</sup>	external		refer to below table
Short Circuit Protection (SCP)			continuous, auto recovery
Over Voltage Protection (OVP)	clamping mode	$V_{OUT} = 5VDC$	6-8VDC
		$V_{OUT} = 9VDC$	10-14VDC
		$V_{OUT} = 12VDC$	13-19VDC
		$V_{OUT} = 15VDC$	16-22VDC
		$V_{OUT} = 24VDC$	25-35VDC
Isolation Voltage <sup>(7)</sup>	I/P to O/P, according to 60601-1, 62368-1	1 minute	5kVAC
Isolation Resistance	I/P to O/P, $V_{ISO} = 500VDC$		10GΩ min.
Isolation Capacitance	I/P to O/P		16pF typ. / 20pF max.
Insulation Grade			reinforced
Leakage Current	240VAC/60Hz		2μA max.
Means of Protection	250VAC working voltage		2MOPP
Medical Device Classification			built-in power supply
Internal Clearance and Creepage	I/P to O/P		≥8mm

Note7: For repeat Hi-Pot testing, reduce the time and/or the test voltage.

Note8: Refer to local safety regulations if input over-current protections is also required. Recommended fuse:

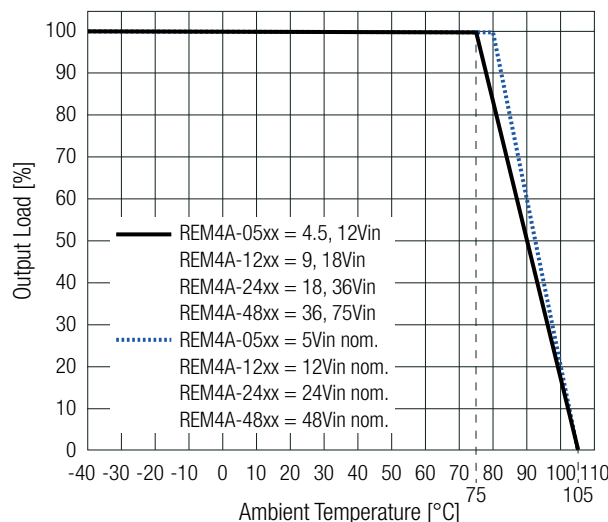
Modules	Fuse Rating [A]	Fuse Type
REM4A-05xx	1.6	slow blow
REM4A-12xx	0.8	
REM4A-24xx	0.5	
REM4A-48xx	0.315	

### ENVIRONMENTAL

Parameter	Condition		Value
Operating Temperature Range	with derating and natural convection 0.1m/s	refer to „Derating Graph“	-40°C to +105°C
Maximum Case Temperature			+105°C
Temperature Coefficient			±0.02%/°C
Operating Altitude			5000m
Operating Humidity	non-condensing		5-95% RH max.
Pollution Degree			PD2
Shock, Thermal Shock, Vibration			MIL-STD-810F
MTBF	according to MIL-HDBK-217F, G.B.	$T_{AMB} = 25°C$	5041 x 10 <sup>3</sup> hours

#### Derating Graph

(@ Chamber and natural convection 0.1m/s)



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### SAFETY AND CERTIFICATION

Certificate Type (Safety)	Report Number	Standard
Audio/video, information and communication technology equipment. Safety requirements	T02-2402024	IEC62368-1:2018 3rd Edition
Audio/video, information and communication technology equipment. Safety requirements (LVD)		EN IEC 62368-1:2020+A11:2020
Audio/video, information and communication technology equipment-Part1: Safety requirements	pending	UL62368-1:2019 3rd Edition CAN/CSA-C22.2 No. 62368-1-19 3rd Edition
Medical electrical equipment Part 1: General requirements for basic safety and essential performance	E314885	ANSI/AAMI ES60601-1:2005+A2:2010/(R)2012 CAN/CSA-C22.2 No. 60601-1:14 3rd Ed.
Medical electrical equipment Part 1: General requirements for basic safety and essential performance	T02-2402025	IEC60601-1:2005+AM1:2012 3rd Edition
		EN60601-1:2006+A12:2014
RoHS2		RoHS 2011/65/EU + AM2015/863

EMC Compliance according to EN60601-1-2	Condition	Standard / Criterion
Medical electrical equipment Part 1-2: General requirements for basic safety and essential performance		EN60601-1-2:2015+A1:2020
Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement	with external filter	EN55011:2016+A11:2020, Class B
ESD Electrostatic discharge immunity test	Air: ±2, 4, 8, 15kV, Contact: ±2, 4, 8kV	IEC61000-4-2:2008 EN61000-4-2:2009
Radiated, radio-frequency, electromagnetic field immunity test	10V/m (80-2700MHz)	EN IEC 61000-4-3:2020
Fast Transient and Burst Immunity <sup>(9)</sup>	DC Power Port: ±2kV	IEC/EN61000-4-4:2012
Surge Immunity <sup>(9)</sup>	DC Power Port: ±0.5, 1kV	IEC/EN61000-4-5:2014+A1:2017
Immunity to conducted disturbances, induced by radio-frequency fields	3, 6V (0.15-80MHz) 6V (ISM bands) 6V (amateur radio bands)	IEC61000-4-6:2013 EN61000-4-6:2014+AC:2015
Power Magnetic Field Immunity	30A/m, 100A/m	IEC61000-4-8:2009 EN61000-4-8:2010
Testing and measurement techniques - Radiated fields in close proximity - Immunity test	30kHz, 8A/m 134.2kHz, 65A/m 13.56MHz, 7.5A/m	IEC61000-4-39

EMC Compliance according to EN55032/35	Condition	Standard / Criterion
Electromagnetic compatibility of multimedia equipment – Emission Requirements	with external filter	EN55032:2015+A11:2020, Class A, B
Electromagnetic compatibility of multimedia equipment – Immunity requirements		EN55035:2017+A11:2020
ESD Electrostatic discharge immunity test	Air: ±2, 4, 8, 15kV, Contact: ±2, 4, 6, 8kV	IEC61000-4-2:2008, Criteria A EN61000-4-2:2009, Criteria A
Radiated, radio-frequency, electromagnetic field immunity test	10V/m (80-1000MHz) 10V/m (1800, 2600, 3500, 5000MHz)	EN/IEC 61000-4-3:2020, Criteria A
Fast Transient and Burst Immunity <sup>(9)</sup>	DC Power Port: ±2kV	IEC/EN61000-4-4:2012, Criteria A
Surge Immunity <sup>(9)</sup>	DC Power Port: ±1kV	IEC/EN61000-4-5:2014+A1:2017, Criteria A
Immunity to conducted disturbances, induced by radio-frequency fields	3Vrms (0.15-10MHz) 3-1Vrms (10-30MHz) 1Vrms (30-80MHz)	IEC61000-4-6:2013, Criteria A EN61000-4-6:2014, Criteria A
Power Magnetic Field Immunity	50/60Hz, 100A/m, 50Hz, 1000A/m	IEC61000-4-8:2009, Criteria A EN61000-4-8:2010, Criteria A

EMC Compliance according to EN61204-3	Condition	Standard / Criterion
Low voltage power supplies, d.c. output Part 3: Electromagnetic compatibility	with external filter	EN61204-3:2000, Class A, B
ESD Electrostatic discharge immunity test	Air: ±2, 4, 8, 15kV, Contact: ±2, 4, 6, 8kV	IEC61000-4-2:2008 EN61000-4-2:2009
Radiated, radio-frequency, electromagnetic field immunity test	10V/m (80-1000MHz)	EN IEC 61000-4-3:2020, Criteria A
Fast Transient and Burst Immunity <sup>(9)</sup>	DC Power Port: ±2kV,	IEC/EN61000-4-4:2012, Criteria A
Surge Immunity <sup>(9)</sup>	DC Power Port: ±1kV	IEC/EN61000-4-5:2014+A1:2017, Criteria A
Immunity to conducted disturbances, induced by radio-frequency fields	3Vrms (0.15-10MHz) 3-1Vrms (10-30MHz) 1Vrms (30-80MHz)	IEC61000-4-6:2013; EN61000-4-6:2014

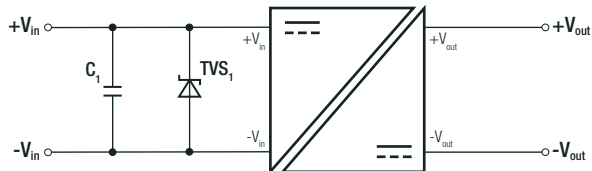
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**SAFETY AND CERTIFICATION**

### Fast Transient / Surge

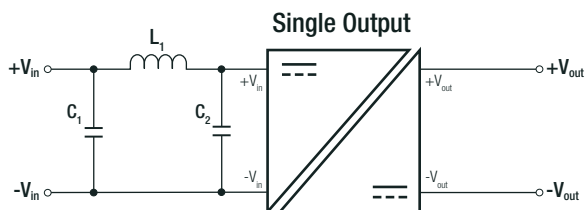
Note9: An external input filter capacitor is required if the module has to meet EN61000-4-4 and EN61000-4-5



### Component List

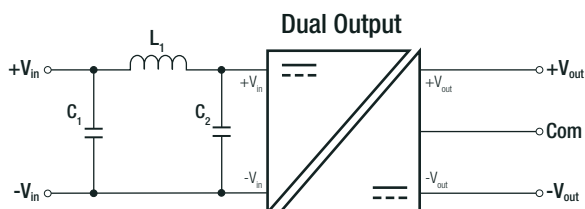
Model	C1	TVS
REM4A-05xx	1000 $\mu$ F/25V	18V/400W
REM4A-12xx	470 $\mu$ F/50V	N/A
REM4A-24xx	470 $\mu$ F/50V	N/A
REM4A-48xx	220 $\mu$ F/100V	N/A

### EMC Filtering Suggestions



### Component List Class A

Model	C1	L1	C2
REM4A-05xx	22 $\mu$ F	3.3 $\mu$ H	N/A
REM4A-12xx	10 $\mu$ F	10 $\mu$ H	N/A
REM4A-24xx	10 $\mu$ F	15 $\mu$ H	N/A
REM4A-48xx	2.2 $\mu$ F	68 $\mu$ H	N/A



### Component List Class B

Model	C1	L1	C2
REM4A-05xx	22 $\mu$ F	6.8 $\mu$ H	22 $\mu$ F
REM4A-12xx	10 $\mu$ F	10 $\mu$ H	10 $\mu$ F
REM4A-24xx	10 $\mu$ F	15 $\mu$ H	10 $\mu$ F
REM4A-48xx	2.2 $\mu$ F	68 $\mu$ H	2.2 $\mu$ F

**DIMENSION & PHYSICAL CHARACTERISTICS**

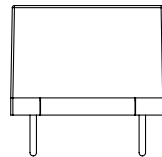
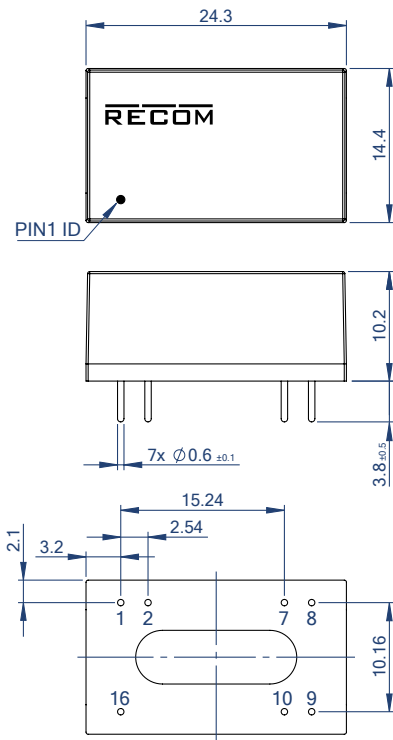
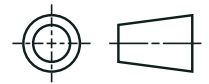
Parameter	Type	Value
Materials	case/ baseplate	non-conductive black plastic, (UL94 V-0)
	PCB	FR4, (UL94 V-1)
	potting	silicone, (UL94 V-0)
Dimension (LxWxH)		24.3 x 14.4 x 10.2mm 0.95 x 0.57 x 0.40inch
Weight		7g typ. 0.015lbs

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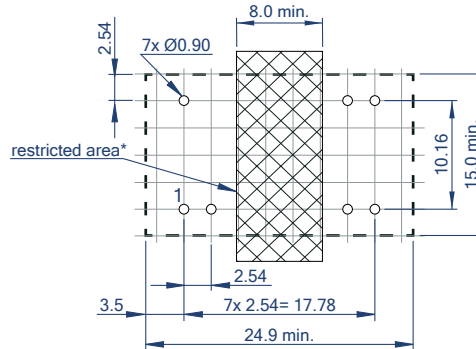
## 4W $\diamond$ Isolated Single & Dual Output $\diamond$ 2:1 Input

### DIMENSION & PHYSICAL CHARACTERISTICS

#### Dimension Drawing DIP16



#### Recommended Footprint Details (Top View)



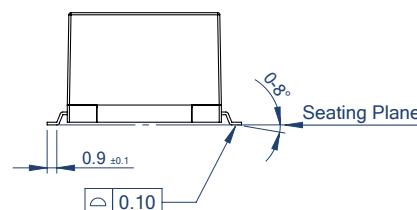
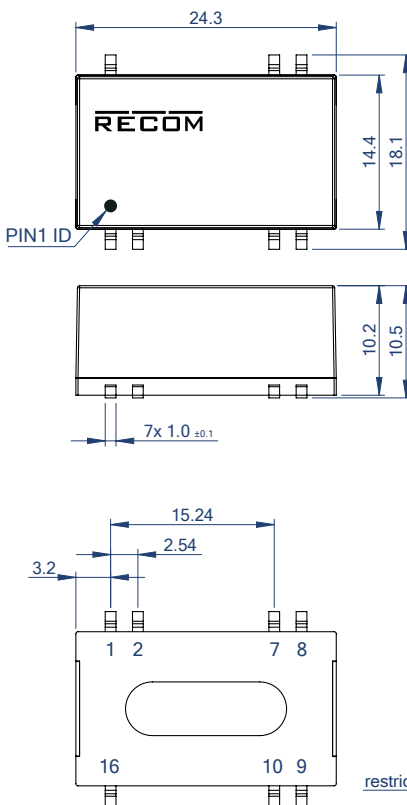
#### Pinning information

Pin #	Single	Dual
1	-Vin	-Vin
2	CTRL	CTRL
7	NC	NC
8	NC	Com
9	+Vout	+Vout
10	-Vout	-Vout
16	+Vin	+Vin

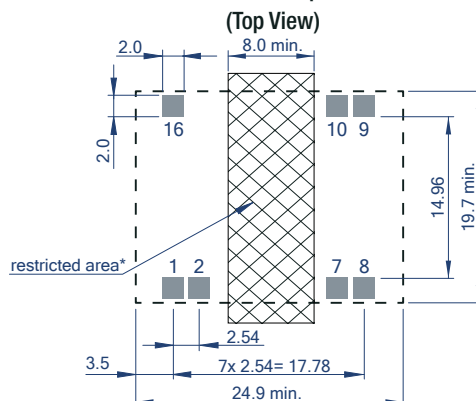
NC= not connected

\*There should be at least 8mm distance between primary and secondary circuit

#### Dimension Drawing SMD



#### Recommended Footprint Details



#### Pinning information

Pin #	Single	Dual
1	-Vin	-Vin
2	CTRL	CTRL
7	NC	NC
8	NC	Com
9	+Vout	+Vout
10	-Vout	-Vout
16	+Vin	+Vin

NC= not connected

\*There should be at least 8mm distance between primary and secondary circuit

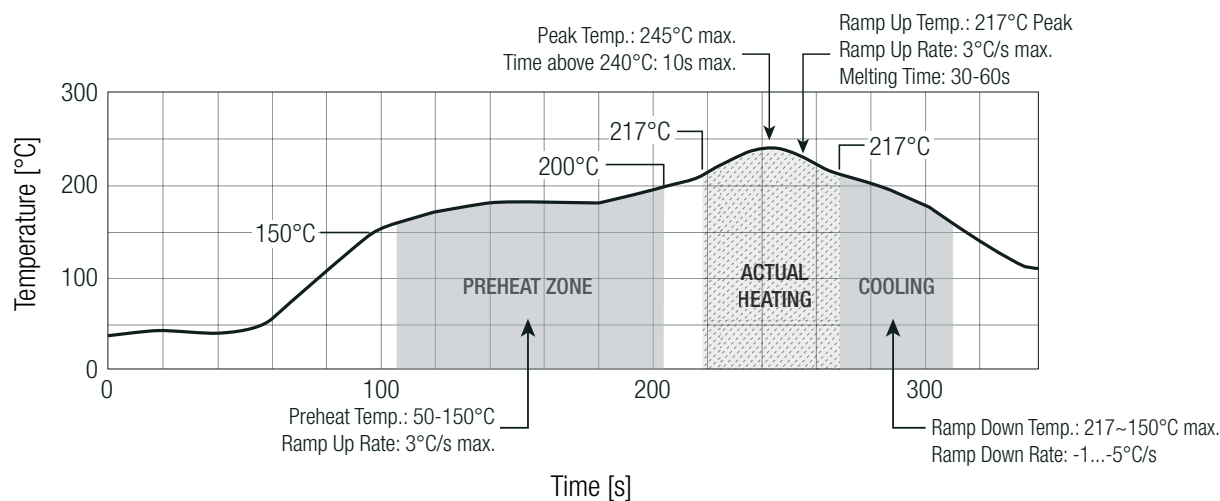
Tolerances:  
 x.x= ±0.5mm  
 x.xx= ±0.25mm



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**SOLDER PROFILE FOR SMD TYPE**



**PACKAGING INFORMATION**

Parameter	Type	Value
Packaging Dimension (LxWxH)	tube	290.0 x 17.35 x 25.6mm
Packaging Quantity		10pcs
Storage Temperature Range		-55°C to +125°C
Storage Humidity	non-condensing	5% - 95% RH max.
Moisture Sensitivity Level (MSL)	only for SMD type verification according to IPC J-STD-020E	IPC J-STD-033C, Level 2

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[R1M-1205S/SMD](#) [R1M-2415D/SMD](#) [R5M-2415D/SMD](#) [R2M-2415D/SMD](#) [R1M-2412S/SMD](#) [R3M-2412S/SMD](#) [R1M-2412D/SMD](#)  
[MGN1S1212MC-R7](#) [R3M-2412D/SMD](#) [UCC14141QDWRQ1](#) [MGN1S0512MC-R7](#) [R3M-2405S/SMD](#) [R5M-2415S/SMD](#)  
[MGN1D120603MC-R7](#) [MGN1S1208MC-R7](#) [R3M-1205S/SMD](#) [R2M-1205S/SMD](#) [R2M-2412S/SMD](#) [R5M-2405S/SMD](#) [R2M-2405S/SMD](#)  
[RSH2-2405S/H3](#) [MGN1S0508MC-R7](#) [UCC14130QDWRQ1](#) [PESE1-S3-S24-M](#) [MGN1D050603MC-R7](#) [R05C1TF05S-CT](#) [R2M-](#)  
[2412D/SMD](#) [R3M-2415D/SMD](#) [R3M-2415S/SMD](#) [R5M-2412D/SMD](#) [RA3-241503D/SMD](#) [R05C1TF05S-R](#) [R24C2T25-CT](#) [R24C2T25-R](#)  
[R24C2T25/R-CT](#) [R24C2T25/R-R](#) [R12C2T12/R-R](#) [R12C2T25/R-R](#) [R15C2T25/R-R](#) [R9C1T18/R-R](#) [R12C2T12/R-CT](#) [R12C2T25/R-CT](#)  
[R15C2T25/R-CT](#) [R9C1T18/R-CT](#) [REM2A-1212S/SMD](#) [REM2A-0505S/SMD](#) [REM2A-0512S/SMD](#) [REM2A-1205S/SMD](#) [REM2A-](#)  
[2405S/SMD](#) [REM4A-2405S/SMD](#)