FDD03(U) SERIES

DC - DC CONVERTER
2 ~ 3W SINGLE & DUAL OUTPUT

FEATURES

- EFFICIENCY UP TO 79%
- 4:1 & 3:1 & 2:1 WIDE INPUT RANGE
- I/O ISOLATION
- SHORT CIRCUIT PROTECTION
- HIGH PERFORMANCE
- 3 YEARS WARRANTY

FDD03 - 05S4 x

BLANK : w/o SAFETY APPROVALS
U : SAFETY APPROVALS

C US
UL 60950-1

TÜV Rheinland Product Safety
BAUART GEPRÜFT
TYPE APPROVED
EN 60950-1

CE

MODEL LIST

MODEL NO.	INPUT VOLTAGE	INPUT CURRENT (typ.)	INPUT CURRENT (max.)	OUTPUT WATTAGE	OUTPUT VOLTAGE	OUTPUT CURRENT	EFF. (min.)	EFF. (typ.)	CAPACITOR LOAD (max.)
Single Output Models									
FDD03 - 05S(U)	20~60 VDC	70 mA	180 mA	2.5 WATTS	+ 5 VDC	500 mA	72%	74%	1000 μF
FDD03 - 12S(U)	20~60 VDC	80 mA	200 mA	3 WATTS	+ 12 VDC	250 mA	77%	79%	470 μF
FDD03 - 15S(U)	20~60 VDC	80 mA	200 mA	3 WATTS	+ 15 VDC	200 mA	77%	79%	330 μF
FDD03 - 05S1(U)	9~18 VDC	265 mA	340 mA	2 WATTS	+ 5 VDC	400 mA	63%	65%	1000 μF
FDD03 - 12S1(U)	9~18 VDC	310 mA	380 mA	2.4 WATTS	+ 12 VDC	200 mA	65%	67%	470 μF
FDD03 - 15S1(U)	9~18 VDC	285 mA	380 mA	2.4 WATTS	+ 15 VDC	160 mA	65%	67%	330 μF
FDD03 - 05S2(U)	18~36 VDC	155 mA	200 mA	2.5 WATTS	+ 5 VDC	500 mA	67%	69%	1000 μF
FDD03 - 12S2(U)	18~36 VDC	175 mA	230 mA	3 WATTS	+ 12 VDC	250 mA	70%	72%	470 μF
FDD03 - 15S2(U)	18~36 VDC	175 mA	230 mA	3 WATTS	+ 15 VDC	200 mA	70%	72%	330 μF
FDD03 - 05S3(U)	36~72 VDC	70 mA	100 mA	2.5 WATTS	+ 5 VDC	500 mA	72%	74%	1000 μF
FDD03 - 12S3(U)	36~72 VDC	80 mA	110 mA	3 WATTS	+ 12 VDC	250 mA	77%	79%	470 μF
FDD03 - 15S3(U)	36~72 VDC	80 mA	110 mA	3 WATTS	+ 15 VDC	200 mA	77%	79%	330 μF
FDD03 - 05S4(U)	9~36 VDC	155 mA	440 mA	2.5 WATTS	+ 5 VDC	500 mA	67%	69%	1000 μF
FDD03 - 12S4(U)	9~36 VDC	175 mA	510 mA	3 WATTS	+ 12 VDC	250 mA	70%	72%	470 μF
FDD03 - 15S4(U)	9~36 VDC	175 mA	510 mA	3 WATTS	+ 15 VDC	200 mA	70%	72%	330 μF
FDD03 - 05S5(U)	18~72 VDC	70 mA	200 mA	2.5 WATTS	+ 5 VDC	500 mA	72%	74%	1000 μF
FDD03 - 12S5(U)	18~72 VDC	80 mA	225 mA	3 WATTS	+ 12 VDC	250 mA	77%	79%	470 μF
FDD03 - 15S5(U)	18~72 VDC	80 mA	225 mA	3 WATTS	+ 15 VDC	200 mA	77%	79%	330 μF
Dual Output Models									
FDD03 - 05D(U)	20~60 VDC	70 mA	180 mA	2.5 WATTS	± 5 VDC	± 250 mA	73%	75%	± 100 μF
FDD03 - 12D(U)	20~60 VDC	80 mA	200 mA	3 WATTS	± 12 VDC	± 125 mA	75%	77%	± 47 μF
FDD03 - 15D(U)	20~60 VDC	80 mA	200 mA	3 WATTS	± 15 VDC	± 100 mA	75%	77%	± 22 μF
FDD03 - 05D1(U)	9~18 VDC	265 mA	340 mA	2 WATTS	± 5 VDC	± 200 mA	63%	65%	± 100 μF
FDD03 - 12D1(U)	9~18 VDC	310 mA	380 mA	2.4 WATTS	± 12 VDC	± 100 mA	65%	67%	± 47 μF
FDD03 - 15D1(U)	9~18 VDC	310 mA	380 mA	2.4 WATTS	± 15 VDC	± 80 mA	65%	67%	± 22 μF
FDD03 - 05D2(U)	18~36 VDC	155 mA	200 mA	2.5 WATTS	± 5 VDC	± 250 mA	66%	68%	± 100 μF
FDD03 - 12D2(U)	18~36 VDC	180 mA	230 mA	3 WATTS	± 12 VDC	± 125 mA	68%	70%	± 47 μF

MODEL LIST

MODEL NO.	INPUT VOLTAGE	INPUT CURRENT (typ.)	INPUT CURRENT (max.)	OUTPUT WATTAGE	OUTPUT VOLTAGE	OUTPUT CURRENT	EFF. (min.)	EFF. (typ.)	CAPACITOR LOAD (max.)
Dual Output Models									
FDD03 - 15D2(U)	18~36 VDC	180 mA	230 mA	3 WATTS	± 15 VDC	± 100 mA	68%	70%	± 22 μF
FDD03 - 05D3(U)	36~72 VDC	70 mA	100 mA	2.5 WATTS	± 5 VDC	± 250 mA	73%	75%	± 100 μF
FDD03 - 12D3(U)	36~72 VDC	80 mA	110 mA	3 WATTS	± 12 VDC	± 125 mA	75%	77%	± 47 μF
FDD03 - 15D3(U)	36~72 VDC	80 mA	110 mA	3 WATTS	± 15 VDC	± 100 mA	75%	77%	± 22 μF
FDD03 - 05D4(U)	9~36 VDC	155 mA	440 mA	2.5 WATTS	± 5 VDC	± 250 mA	66%	68%	± 100 μF
FDD03 - 12D4(U)	9~36 VDC	180 mA	510 mA	3 WATTS	± 12 VDC	± 125 mA	68%	70%	± 47 μF
FDD03 - 15D4(U)	9~36 VDC	180 mA	510 mA	3 WATTS	± 15 VDC	± 100 mA	68%	70%	± 22 μF
FDD03 - 05D5(U)	18~72 VDC	70 mA	200 mA	2.5 WATTS	± 5 VDC	± 250 mA	73%	75%	± 100 μF
FDD03 - 12D5(U)	18~72 VDC	80 mA	225 mA	3 WATTS	± 12 VDC	± 125 mA	75%	77%	± 47 μF
FDD03 - 15D5(U)	18~72 VDC	80 mA	225 mA	3 WATTS	± 15 VDC	± 100 mA	75%	77%	± 22 μF

SPECIFICATION

All Specifications Typical At Nominal Line, Full Load, 25°C Unless Otherwise Noticed

GENERAL

Characteristics	Conditions	min.	typ.	max.	unit
Switching frequency	Vi nom, Io nom	50			KHz
Isolation voltage	Input - Output	1,500			VDC
Isolation resistance	Input - Output, @ 500VDC	100			MΩ
Ambient temperature	Operating at Vi nom, Io nom	-40		+ 71	°C
Case temperature	Operating at Vi nom, Io nom			+ 90	°C
Derating	Vi nom	See derating curve			
Storage temperature	Non operational	-40		+100	°C
Relative humidity	Vi nom, Io nom	20		95	% RH
Temperature coefficient	Vi nom, Io min			± 0.02	% / °C
Dimension		L31.8 x W20.3 x H12.7			mm
MTBF	Bellcore issue 6@40°C, GB		1,640,000		Hours
Cooling	Free air convection				

INPUT SPECIFICATIONS

Characteristics	Conditions		min.	typ.	max.	unit
Input voltage range	Ta min …Ta max, Io nom	2 : 1	9	12	18	VDC
			18	24	36	VDC
			36	48	72	VDC
		3 : 1	20	48	60	VDC
		4 : 1	9	24	36	VDC
			18	48	72	VDC
No load input current	Vi nom, Io=0	12V			18	mA
		24V			15	mA
		48V			8	mA
Input voltage w/o damage	Io nom	12V			20	VDC
		24V			40	VDC
		48V			75	VDC
Startup voltage	Io nom	12V		7.2		VDC
		24V		7.2		VDC
		48V		16.1		VDC

OUTPUT SPECIFICATIONS

Characteristics	Conditions		min.	typ.	max.	unit
Output voltage accuracy	Vi nom, Io nom				± 2	%
Minimum load	Vi nom	single output models	0			%
		dual output models (each output)	20			%

SPECIFICATION

All Specifications Typical At Nominal Line, Full Load, 25°C Unless Otherwise Noticed

OUTPUT SPECIFICATIONS

Characteristics	Conditions	min.	typ.	max.	unit
Line regulation	Io nom, Vi min ...Vi max			± 1	%
Load regulation	Vi nom, Io 0 ...Io nom, single output models			± 2	%
	Vi nom, Io min ...Io nom, dual output models			± 5	%
Cross regulation (Dual model)	Aymmetrical load 20% - 100% FL			± 10	%
Startup time	Vi nom, Io nom			30	ms
Transient recovery time	Vi nom, 1~0.5 Io nom			3	ms
Ripple & noise	Vi nom, Io nom, BW = 20MHz			300	mV
Efficiency	Vi nom, Io nom, Po / Pi	Up to 79%, See model list and efficiency curve			

CONTROL AND PROTECTION

Input reversed	External shunt diode, external fuse recommended (12Vin : 0.75A, 24Vin : 0.75A, 48Vin : 0.5A)
Output short circuit	Current limited (Auto-recovery)

APPROVALS AND STANDARD

cTUVus	UL 60950-1 Recognized
TUV	EN 60950-1
CE 1)	EN 61204-3, EN 55022 Class B, EN 61000-4-2, EN61000-4-3, EN61000-4-4, EN61000-4-6, EN 61000-4-8
Vibration	meet IEC 60068-2-6 (10-500 Hz, 2G, along X, Y, Z each Axis, 60 min for each Axis)

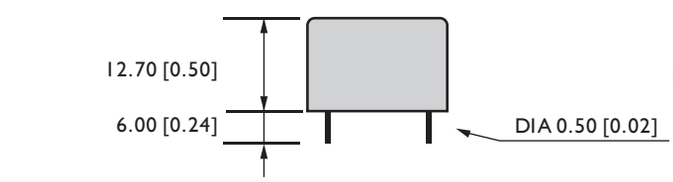
NOTE 1 : Pls refer to recommended circuit .

PHYSICAL CHARACTERISTICS

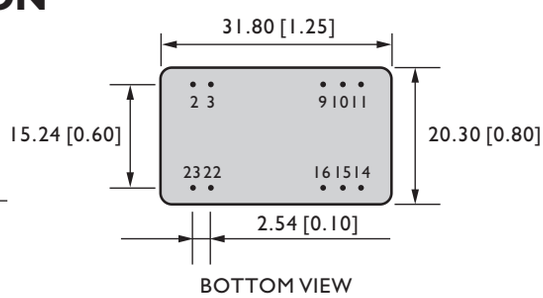
Case size	31.8 x 20.3 x 12.7 mm (1.25 x 0.8 x 0.5 inches)
Case material	Plastic
Weight	15 g
Potting material	Epoxy

MECHANISM & PIN CONFIGURATION

mm [inch]



GENERAL TOLERANCE	
0.00[0.00] - 30.00[1.18]	±0.30[0.01]
30.00[1.18] - 120.00[4.72]	±0.50[0.02]



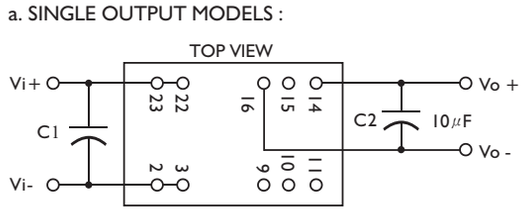
PIN ASSIGNMENT

GENERAL

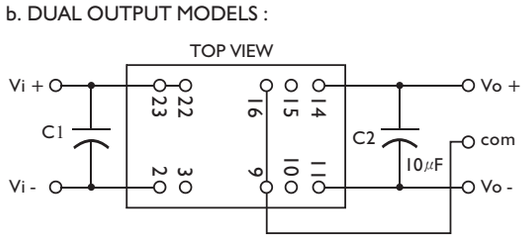
PIN NO.	2&3	9	10&15	11	14	16	22&23
SINGLE	Vi -	N. C.	N. C.	N. C.	Vo+	Vo -	Vi+
DUAL	Vi -	com	N. C.	Vo-	Vo+	com	Vi+

APPLICATION CIRCUIT

a. SINGLE OUTPUT MODELS :



b. DUAL OUTPUT MODELS :

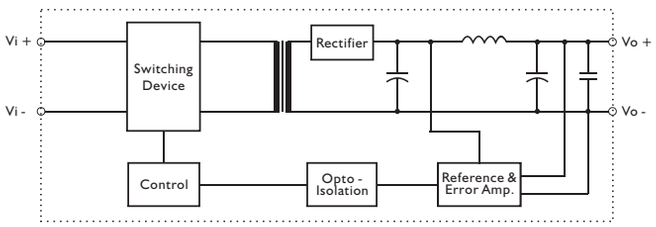


NOTE:

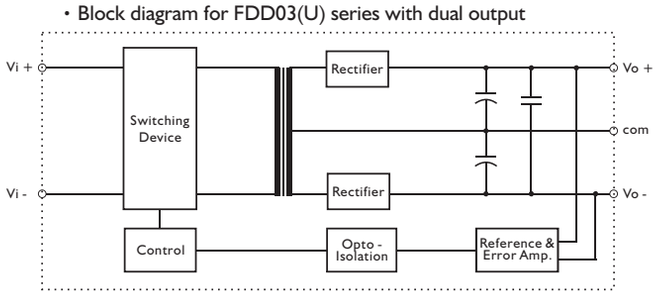
a.C1=4.7μF / 100V, C2=10μF
b.C1 MUST BE ADDED WHEN APPLICATION .
c.C2 OPTIONAL TO MINIMIZE THE R & N <100mV .
d.MAX. 80% LOAD WHEN INPUT VOLTAGE AT 9-11VDC FOR 9-36VDC INPUT MODELS & 18-21VDC FOR 18-72VDC INPUT MODELS .

CIRCUIT SCHEMATIC

• Block diagram for FDD03(U) series with single output



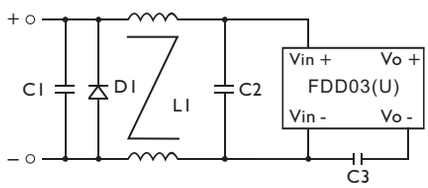
• Block diagram for FDD03(U) series with dual output



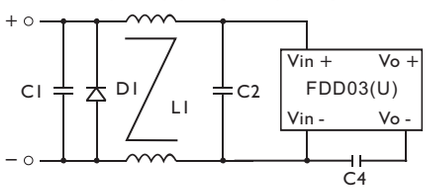
RECOMMENDED CIRCUIT

• Recommended filter for EN55022 Class B compliance

SINGLE OUTPUT MODELS



DUAL OUTPUT MODELS

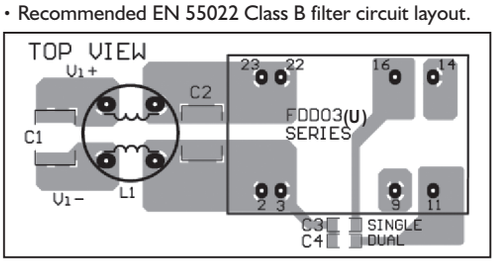


Note:D1 - Reverse Diode (1A/100V)

• The components used in the above figure, together with the manufacturer part numbers for these components, are as follows.

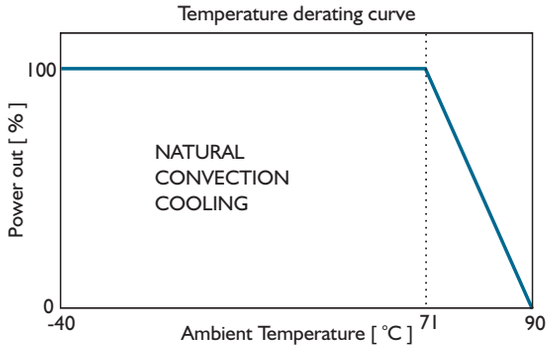
	C1	C2	C3	C4	L1
FDD03-XXSX(U)	6.8μF / 100V MLCC	4.7μF / 100V MLCC	InF/2KV MLCC		3mH Common Choke
FDD03-XXDX(U)	6.8μF / 100V MLCC	4.7μF / 100V MLCC		InF/2KV MLCC	3mH Common Choke

• Recommended EN 55022 Class B filter circuit layout.

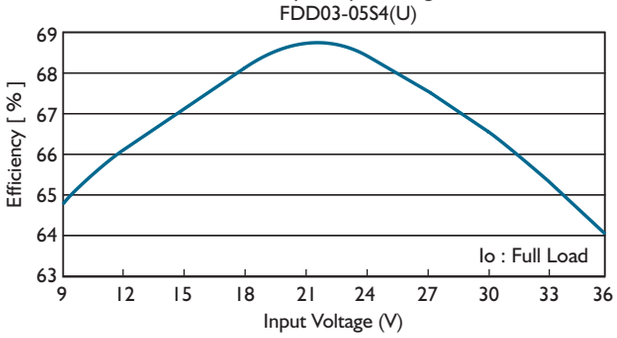


DERATING AND EFFICIENCY CURVE

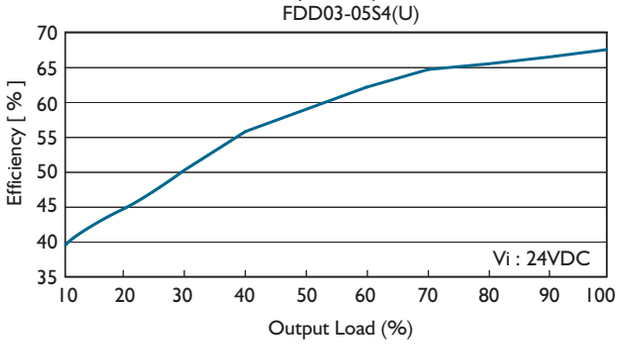
Temperature derating curve



Efficiency Vs Input Voltage
FDD03-05S4(U)



Efficiency Vs Output Load
FDD03-05S4(U)



FDD03A(U) SERIES

DC - DC CONVERTER

2.5 ~ 3W SINGLE & DUAL OUTPUT

FEATURES

- 4:1 WIDE INPUT RANGE
- DIP24 PACKAGE
- I/O, O/O ISOLATION
- SHORT CIRCUIT PROTECTION
- HIGH PERFORMANCE
- UL/cUL/TUV/CE
- 3 YEARS WARRANTY

FDD03 - 05S4A x

BLANK : w/o SAFETY APPROVALS
U : SAFETY APPROVALS

C US
UL 60950-1

TÜV Rheinland Product Safety | BAUART GEPRÜFT | TYPE APPROVED
EN 60950-1

CE

MODEL LIST

MODEL NO.	INPUT VOLTAGE	INPUT CURRENT (typ.)	INPUT CURRENT (max.)	OUTPUT WATTAGE	OUTPUT VOLTAGE	OUTPUT CURRENT	EFF. (min.)	EFF. (typ.)	CAPACITOR LOAD (max.)
Single Output Models									
FDD03 - 05S4A(U)	9~36 VDC	160 mA	440 mA	2.5 WATTS	+ 5 VDC	500 mA	65%	67%	1000 μF
FDD03 - 12S4A(U)	9~36 VDC	180 mA	530 mA	3 WATTS	+ 12 VDC	250 mA	68%	70%	470 μF
FDD03 - 15S4A(U)	9~36 VDC	180 mA	530 mA	3 WATTS	+ 15 VDC	200 mA	68%	70%	330 μF
FDD03 - 05S5A(U)	18~72 VDC	75 mA	205 mA	2.5 WATTS	+ 5 VDC	500 mA	70%	72%	1000μ F
FDD03 - 12S5A(U)	18~72 VDC	80 mA	235 mA	3 WATTS	+ 12 VDC	250 mA	75%	77%	470 μF
FDD03 - 15S5A(U)	18~72 VDC	80 mA	235 mA	3 WATTS	+ 15 VDC	200 mA	75%	77%	330 μF
Dual Output Models									
FDD03 - 05D4A(U)	9~36 VDC	155 mA	440 mA	2.5 WATTS	± 5 VDC	± 250 mA	66%	68%	±100 μF
FDD03 - 12D4A(U)	9~36 VDC	180 mA	530 mA	3 WATTS	± 12 VDC	± 125 mA	68%	70%	± 47 μF
FDD03 - 15D4A(U)	9~36 VDC	180 mA	530 mA	3 WATTS	± 15 VDC	± 100 mA	68%	70%	± 22 μF
FDD03 - 05D5A(U)	18~72 VDC	70 mA	205 mA	2.5 WATTS	± 5 VDC	± 250 mA	72%	74%	±100 μF
FDD03 - 12D5A(U)	18~72 VDC	80 mA	235 mA	3 WATTS	± 12 VDC	± 125 mA	75%	77%	± 47 μF
FDD03 - 15D5A(U)	18~72 VDC	80 mA	235 mA	3 WATTS	± 15 VDC	± 100 mA	75%	77%	± 22 μF
Double Output Models									
FDD03 - 0505D4A(U)	9~36 VDC	160 mA	440 mA	2.5 WATTS	5 / 5 VDC	250 / 250 mA	66%	68%	100 μF
FDD03 - 1212D4A(U)	9~36 VDC	180 mA	530 mA	3 WATTS	12 / 12 VDC	125 / 125 mA	68%	70%	47 μF
FDD03 - 1515D4A(U)	9~36 VDC	180 mA	530 mA	3 WATTS	15 / 15 VDC	100 / 100 mA	68%	70%	22 μF
FDD03 - 0505D5A(U)	18~72 VDC	70 mA	205 mA	2.5 WATTS	5 / 5 VDC	250 / 250 mA	72%	74%	100 μF
FDD03 - 1212D5A(U)	18~72 VDC	80 mA	235 mA	3 WATTS	12 / 12 VDC	125 / 125 mA	75%	77%	47 μF
FDD03 - 1515D5A(U)	18~72 VDC	80 mA	235 mA	3 WATTS	15 / 15 VDC	100 / 100 mA	75%	77%	22 μF

NOTE :
MAX. 80% LOAD WHEN INPUT VOLTAGE AT 9-11VDC FOR 9-36VDC INPUT MODELS &
18-21VDC FOR 18-72VDC INPUT MODELS.

SPECIFICATION

All Specifications Typical At Nominal Line, Full Load, 25°C Unless Otherwise Noticed

GENERAL

Characteristics	Conditions	min.	typ.	max.	unit
Switching frequency	Vi nom, Io nom	50			KHz
Isolation voltage	Input - Output	1,500			VDC
Isolation resistance	Input - Output, @ 500VDC	100			MΩ
Ambient temperature	Operating at Vi nom, Io nom	-40		+ 71	°C
Case temperature	Operating at Vi nom, Io nom			+90	°C
Derating	Vi nom	See derating curve			
Storage temperature	Non operational	-40		+100	°C
Relative humidity	Vi nom, Io nom	20		95	% RH
Temperature coefficient	Vi nom, Io min			± 0.02	% / °C
Dimension		L31.8 x W20.3 x H12.7			mm
MTBF	Bellcore issue 6@40°C, GB		1,640,000		Hours
Cooling	Free air convection				

INPUT SPECIFICATIONS

Characteristics	Conditions		min.	typ.	max.	unit
Input voltage range	Ta min ...Ta max, Io nom		9	24	36	VDC
			18	48	72	VDC
No load input current	Vi nom, Io=0	24V			15	mA
		48V			8	mA
Input voltage w/o damage	Io nom	24V			40	VDC
		48V			75	VDC
Startup voltage	Io nom	24V		7.2		VDC
		48V		16.1		VDC

OUTPUT SPECIFICATIONS

Characteristics	Conditions		min.	typ.	max.	unit
Output voltage accuracy	Vi nom, Io nom				± 2	%
Minimum load	Vi nom	single output models	0			%
		dual output models (each output)	20			%
Line regulation	Io nom, Vi min ...Vi max				± 1	%
Load regulation	Vi nom, Io 0 ...Io nom, single output models				± 2	%
	Vi nom, Io min ...Io nom, dual output models				± 5	%
Cross regulation (Dual model)	Aymmetrical load 20% - 100% FL				± 10	%
Startup time	Vi nom, Io nom				30	ms
Transient recovery time	Vi nom, 1~0.5 Io nom				3	ms
Ripple & noise	Vi nom, Io nom, BW = 20MHz				150	mV
Efficiency	Vi nom, Io nom, Po / Pi		Up to 77%, See model list and efficiency curve			

CONTROL AND PROTECTION

Remote ON / OFF	ON: opened or 5~10 VDC applied, reference to input GND OFF: -0.3~2 VDC applied, reference to input GND
Input reversed	External shunt diode, external fuse recommended (24Vin : 0.75A, 48Vin : 0.5A)
Output short circuit	Current limited (Auto-recovery)

APPROVALS AND STANDARD

cTUVus	UL 60950-1 Recognized
TUV	EN 60950-1
CE 1)	EN 61204-3, EN 55022 Class B, EN 61000-4-2, EN61000-4-3, EN61000-4-4, EN61000-4-6, EN 61000-4-8
Vibration	meet IEC 60068-2-6 (10-500 Hz, 2G, along X, Y, Z each Axis, 60 min for each Axis)

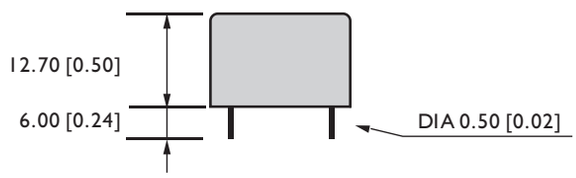
NOTE 1 : Pls refer to recommended circuit .

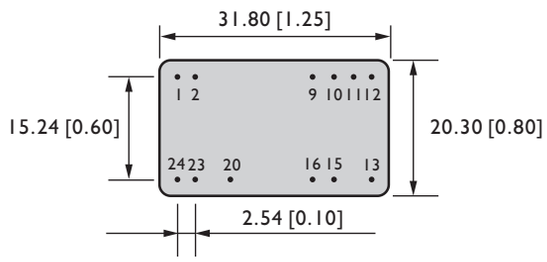
PHYSICAL CHARACTERISTICS

Case size	31.8 x 20.3 x 12.7 mm (1.25 x 0.8 x 0.5 inches)
Case material	Plastic
Weight	15 g
Potting material	Epoxy

MECHANISM & PIN CONFIGURATION

mm [inch]





GENERAL TOLERANCE	
0.00[0.00] - 30.00[1.18]	±0.30[0.01]
30.00[1.18] - 120.00[4.72]	±0.50[0.02]

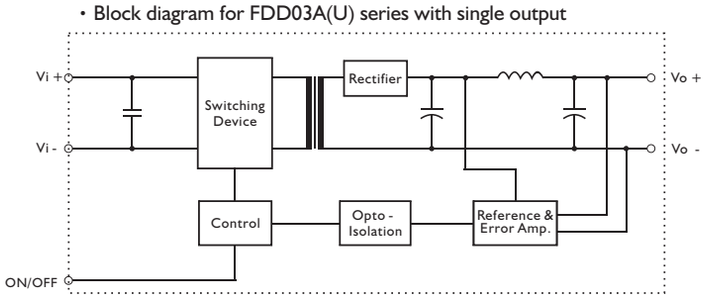
PIN ASSIGNMENT

GENERAL

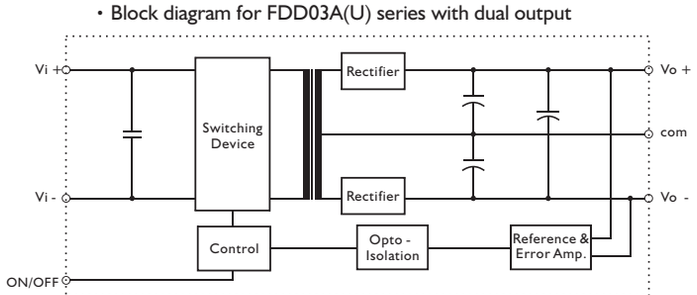
PIN NO.	1&2	9	10&11	12	13	15	16	20	23&24
SINGLE	Vi+	NO PIN	NO PIN	Vo -	Vo +	NO PIN	NO PIN	Remote ON/OFF	Vi -
DUAL	Vi+	NO PIN	com	NO PIN	Vo -	Vo+	NO PIN	Remote ON/OFF	Vi -
DOUBLE	Vi+	Vo1-	NO PIN	Vo1+	Vo2+	NO PIN	Vo2-	Remote ON/OFF	Vi -

CIRCUIT SCHEMATIC

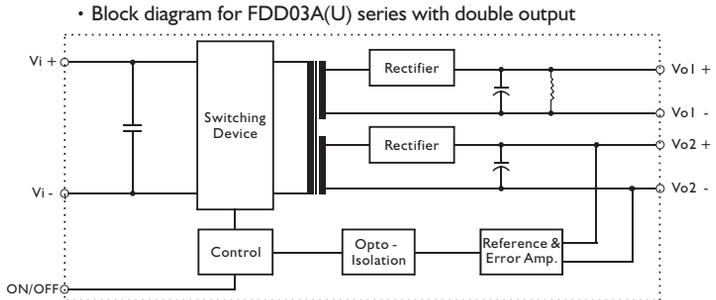
• Block diagram for FDD03A(U) series with single output



• Block diagram for FDD03A(U) series with dual output



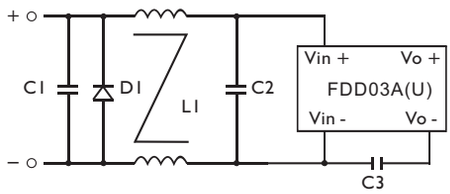
• Block diagram for FDD03A(U) series with double output



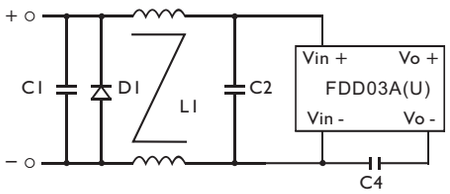
RECOMMENDED CIRCUIT

• Recommended filter for EN55022 Class B compliance

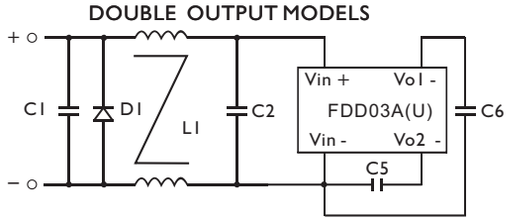
SINGLE OUTPUT MODELS



DUAL OUTPUT MODELS



DOUBLE OUTPUT MODELS

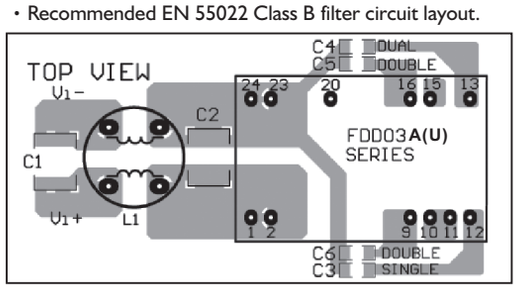


Note:D1 - Reverse Diode (1A / 100V)

• The commponents used in the above figure, together with the manufacturer part numbers for these components, are as follows.

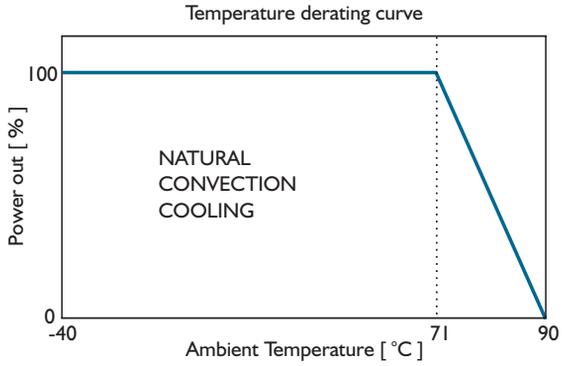
	C1	C2	C3	C4	C5	C6	L1
FDD03-XXSXA(U)	6.8μF/100V MLCC	4.7μF/100V MLCC	InF/2KV MLCC				3mH Common Choke
FDD03-XXDXA(U)	6.8μF/100V MLCC	4.7μF/100V MLCC		InF/2KV MLCC			3mH Common Choke
FDD03-XXXXDXA(U)	6.8μF/100V MLCC	4.7μF/100V MLCC			InF/2KV MLCC	InF/2KV MLCC	3mH Common Choke

• Recommended EN 55022 Class B filter circuit layout.

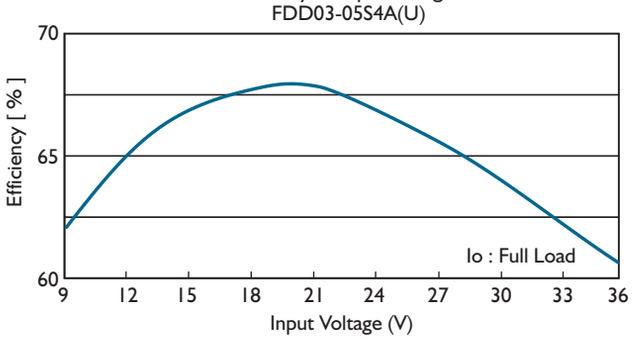


DERATING AND EFFICIENCY CURVE

Temperature derating curve



Efficiency Vs Input Voltage
FDD03-05S4A(U)



Efficiency Vs Output Load
FDD03-05S4A(U)