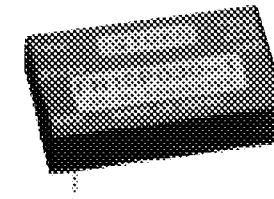
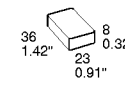
TOKO Switching Regulators FN-Family

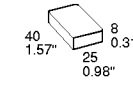
No input to output isolation
Single output of 5, 12 or 15 V DC/1.5...3 W
Dual output of ±12 or ±15 V DC/1.5...3 W
Input voltage from 2.7 up to 7 V DC

- High efficiency and low heat generation
- High reliability and long life
- Good output stability
- Silicon packed: high immunity against humidity
- No electrolytic capacitors used inside
- Choke coils for optimum EMI filtering (optional)
- Low profile (8 mm)





1.5 Watt



3 Watt

Summary

The FN family of switching regulators (DC-DC converters) offers low profile, high stability and high reliability. The regulators are suited to various applications in electronic systems, specifically control equipment, measuring instruments, telecommunications and general purpose, where high reliability is paramount. A full range of specifications and innovative optional chocke coils are available from Toko Components Division to suit a wide variety of technical needs.

Type Survey and Key Data

Table 1: Type survey

Output voltage $U_{o\,nom}$ [V]	Output current I_o [mA]	Rated output power $P_{o\,max}$ [W]	Input voltage range U_i [V]	Input voltage $U_{i\,nom}$ [V]	Efficiency η_{typ} [%]	Type designation
+5	3...300	1.5	2.7...4	3	79	FN05P015-0
	6...600	3.0				FN05P030-0
+12	2...125	1.5	2.7...7	5		FN12P015-1
	3...250	3.0				FN12P030-1
+15	2...100	1.5				FN15P015-1
	2...200	3.0				FN15P030-1
–5	3...300	1.5			71	FN05N015-1
	6...600	3.0			70	FN05N030-1
–12	2...125	1.5			71	FN12N015-1
	3...250	3.0			70	FN12N030-1
–15	2...100	1.5			71	FN15N015-1
	2...200	3.0			70	FN15N030-1
±12	±18...±62	1.5			71	FN12D015-1
	±37...±125	3.0			70	FN12D030-1
±15	±15...±50	1.5			71	FN15D015-1
	±30...±100	3.0			70	FN15D030-1

Table of Contents

Type Key and Product Marking

Type Key

Family ..... FN
Nominal output voltage in volt ..... 05…15
Output configuration: positive ..... P
negative ..... N
dual (±, common ground) ..... D
Nominal output power: 1.5 watts 015
3.0 watts 030
Version ..... -0…-1

Product Marking

Main face: Manufacturer, type designation, input and output pin designation, input and output voltage(s)

Electrical Input and Output Data

General Condition; T_A = 25 °C, see also *Derating Characteristics*.

Table 2a: Input and output data 1.5 W types with positive output

Characteristics		Conditions	FN 05P015-0 min	FN 05P015-0 typ	FN 05P015-0 max	FN 12P015-1 min	FN 12P015-1 typ	FN 12P015-1 max	FN 15P015-1 min	FN 15P015-1 typ	FN 15P015-1 max	Unit
Input												
U_i	Input voltage	$I_{o\,min}$…$I_{o\,max}$	2.7		4.0	2.7		7.0	2.7		7.0	V DC
Output												
U_o	Output voltage	$U_{i\,min}$…$U_{i\,max}$	4.75		5.25	11.40		12.60	14.25		15.75	V DC
I_o	Output current		3		300	2		125	2		100	mA
u_o	Output ripple and noise	$U_{i\,nom}$, with choke		120			120			120		mV_{pp}
$\Delta U_{o\,U}$	Static line regulation	$U_{i\,min}$…$U_{i\,max}$		±1.5			±1.5			±1.5		%
$\Delta U_{o\,I}$	Static load regulation	$U_{i\,nom}$, $I_{o\,min}$…$I_{o\,max}$		±1			±1			±1		
α_{Uo}	Temperature coefficient $\Delta U_o/\Delta T$			±1			±1			±1		

Table 2b: Input and output data 1.5 W types with negative output

Characteristics		Conditions	FN 05N015-1 min	FN 05N015-1 typ	FN 05N015-1 max	FN 12N015-1 min	FN 12N015-1 typ	FN 12N015-1 max	FN 15N015-1 min	FN 15N015-1 typ	FN 15N015-1 max	Unit
Input												
U_i	Input voltage	$I_{o\,min}$…$I_{o\,max}$	2.7		7.0	2.7		7.0	2.7		7.0	V DC
Output												
U_o	Output voltage	$U_{i\,min}$…$U_{i\,max}$	–4.75		–5.25	–11.40		–12.60	–14.25		–15.75	V DC
I_o	Output current		3		300	2		125	2		100	mA
u_o	Output ripple and noise	$U_{i\,nom}$, with choke		120			120			120		mV_{pp}
$\Delta U_{o\,U}$	Static line regulation	$U_{i\,min}$…$U_{i\,max}$		±1.5			±1.5			±1.5		%
$\Delta U_{o\,I}$	Static load regulation	$U_{i\,nom}$, $I_{o\,min}$…$I_{o\,max}$		±1			±1			±1		
α_{Uo}	Temperature coefficient $\Delta U_o/\Delta T$			±1			±1			±1		

Table 2c: Input and output data 1.5 W types with dual output

Characteristics		Conditions	FN 12D015-1 min	typ	max	FN 15D015-1 min	typ	max	Unit
Input									
U_i	Input voltage	$I_{o\,min}$...$I_{o\,max}$	2.7		7.0	2.7		7.0	V DC
Output									
U_o	Output voltage	$U_{i\,min}$...$U_{i\,max}$	±11.40		±12.60	±14.25		±15.75	V DC
I_o	Output current		±18		±62	±15		±50	mA
u_o	Output ripple and noise	$U_{i\,nom}$, with choke		120			120		mV_{pp}
$\Delta U_{o\,U}$	Static line regulation	$U_{i\,min}$...$U_{i\,max}$		±1.5			±1.5		%
$\Delta U_{o\,I}$	Static load regulation	$U_{i\,nom}$, $I_{o\,min}$...$I_{o\,max}$		±1			±1		
α_{Uo}	Temperature coefficient $\Delta U_o/\Delta T$			±1			±1		

Table 2d: Input and output data 3.0 W types with positive output

Characteristics		Conditions	FN 05N015-1 min	typ	max	FN 12N015-1 min	typ	max	FN 15N015-1 min	typ	max	Unit
Input												
U_i	Input voltage	$I_{o\,min}$...$I_{o\,max}$	2.7		4.0	2.7		7.0	2.7		7.0	V DC
Output												
U_o	Output voltage	$U_{i\,min}$...$U_{i\,max}$	4.75		5.25	11.40		12.60	14.25		15.75	V DC
I_o	Output current		6		600	3		250	2		200	mA
u_o	Output ripple and noise	$U_{i\,nom}$, with choke		120			120			120		mV_{pp}
$\Delta U_{o\,U}$	Static line regulation	$U_{i\,min}$...$U_{i\,max}$		±1.5			±1.5			±1.5		%
$\Delta U_{o\,I}$	Static load regulation	$U_{i\,nom}$, $I_{o\,min}$...$I_{o\,max}$		±1			±1			±1		
α_{Uo}	Temperature coefficient $\Delta U_o/\Delta T$			±1			±1			±1		

Table 2e: Input and output data 3.0 W types with negative output

Characteristics		Conditions	FN 05N015-1 min	typ	max	FN 12N015-1 min	typ	max	FN 15N015-1 min	typ	max	Unit
Input												
U_i	Input voltage	$I_{o\,min}$...$I_{o\,max}$	2.7		7.0	2.7		7.0	2.7		7.0	V DC
Output												
U_o	Output voltage	$U_{i\,min}$...$U_{i\,max}$	–4.75		–5.25	–11.40		–12.60	–14.25		–15.75	V DC
I_o	Output current		6		600	3		250	2		200	mA
u_o	Output ripple and noise	$U_{i\,nom}$, with choke		120			120			120		mV_{pp}
$\Delta U_{o\,U}$	Static line regulation	$U_{i\,min}$...$U_{i\,max}$		±1.5			±1.5			±1.5		%
$\Delta U_{o\,I}$	Static load regulation	$U_{i\,nom}$, $I_{o\,min}$...$I_{o\,max}$		±1			±1			±1		
α_{Uo}	Temperature coefficient $\Delta U_o/\Delta T$			±1			±1			±1		

Table 2f: Input and output data 3.0 W types with dual output

Characteristics		Conditions	FN 12D030-1 min	typ	max	FN 15D030-1 min	typ	max	Unit
Input									
U_i	Input voltage	$I_{o\,min}$...$I_{o\,max}$	2.7		7.0	2.7		7.0	V DC
Output									
U_o	Output voltage	$U_{i\,min}$...$U_{i\,max}$	±11.40		±12.60	±14.25		±15.75	V DC
I_o	Output current		±37		±125	±30		±100	mA
u_o	Output ripple and noise	$U_{i\,nom}$, with choke		120			120		mV_{pp}
$\Delta U_{o\,U}$	Static line regulation	$U_{i\,min}$...$U_{i\,max}$		±1.5			±1.5		%
$\Delta U_{o\,I}$	Static load regulation	$U_{i\,nom}$, $I_{o\,min}$...$I_{o\,max}$		±1			±1		
α_{Uo}	Temperature coefficient $\Delta U_o/\Delta T$			±1			±1		

4

Derating Characteristics

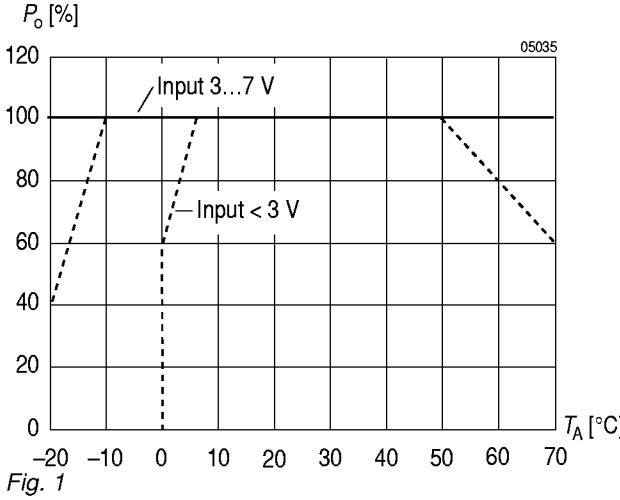


Fig. 1
Output power versus ambient temperature

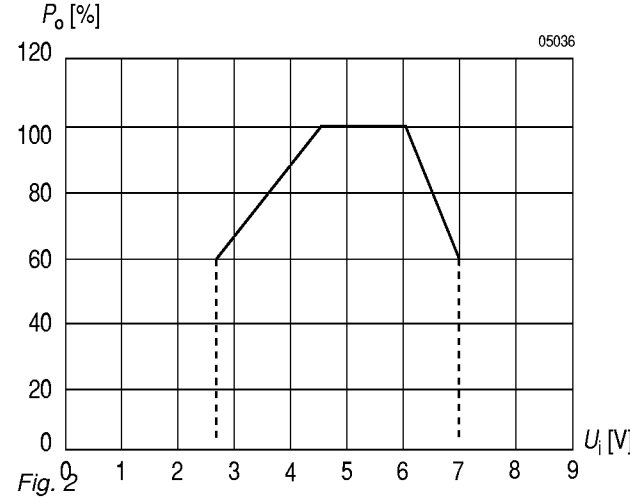


Fig. 2
Output power versus input voltage

Electromagnetic Compatibility (EMC)

Filtering Recommendations

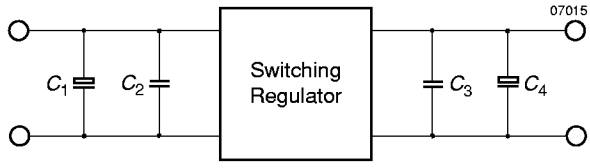


Fig. 3
External circuitry without chokes

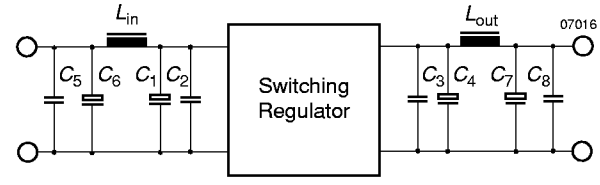


Fig. 4
External circuitry including chokes

Remarks:

Two different design-in circuits can be recommended:

a) circuit design by means of adding just input and output capacitors in order to reduce ripple and noise to a moderate value

b) circuit design by adding input and output π-filtering by means of capacitors and filtering chokes (in series connection) in order to achieve enhanced ripple and noise behaviour

Capacitors and chokes should be within 20 mm of regulator terminals;
C_2 and C_3: 0.047 µF ceramic capacitors
C_5 and C_8: 0.01 µF ceramic capacitors
C_6 = 82 µF
C_1, C_4 and C_7: see table below
L_{in} = 22 µH
L_{out} = 33 µH

Table 3a: External capacitors for 1.5 W types

U_i = 3 V C_1 [µF]	U_i = 5 V C_1 [µF]	Type	$I_{o\,max}$ [mA]	C_4 [µF]	C_7 [µF]
1000	470	FN 05P015-0	300	330	82
		FN 12P015-1	125	120	56
		FN 15P015-1	100	82	39
		FN 05N015-1	300	680	82
		FN 12N015-1	125	120	56
		FN 15N015-1	100	82	39
		FN 12D015-1	±62	2×120	2×56
		FN 15D015-1	±50	2×82	2×39

Table 3b: External capacitors for 3.0 W types

U_i = 3 V C_1 [µF]	U_i = 5 V C_1 [µF]	Type	$I_{o\,max}$ [mA]	C_4 [µF]	C_7 [µF]
2200	1000	FN 05P030-0	600	680	82
		FN 12P030-1	250	330	56
		FN 15P030-1	200	270	39
		FN 05N030-1	600	1000	82
		FN 12N030-1	250	330	56
		FN 15N030-1	200	270	39
		FN 12D030-1	±125	2×330	2×56
		FN 15D030-1	±100	2×180	2×39

Immunity to Environmental Conditions

Table 4: Temperature specifications

Temperature			Operating		Storage		
Characteristics		Conditions	min	max	min	max	Unit
T_A	Ambient temperature [1]	U_i = 3...7 V $I_{o\,min}$...$I_{o\,max}$	–10	50	–25	85	°C
r.H.	Relative humidity			95		95	%

[1] See also *Derating Characteristics*.

Mechanical Data

Dimensions in mm. Tolerances ±0.3 mm unless otherwise stated

European Projection

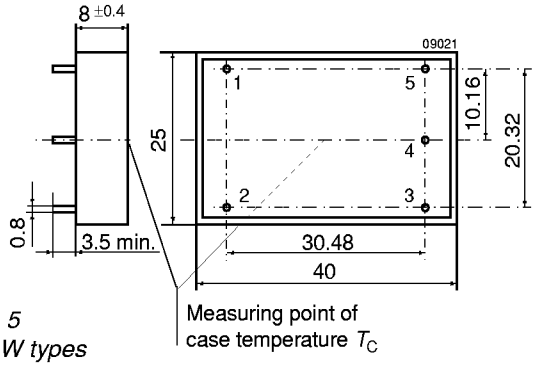


Fig. 5
3.0 W types

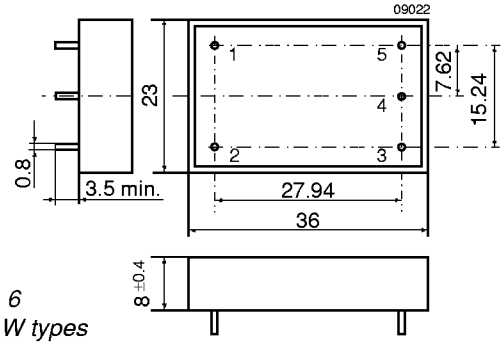


Fig. 6
1.5 W types

Safety and Installation Instructions

Installation Instruction

Installation of the switching regulators must strictly follow the national safety regulations in compliance with the enclosure, mounting, creepage, clearance, casualty, markings and segregation requirements of the end-use application.

Check for hazardous voltages before altering any connections.

The output circuit is not electrically separated from the input circuit.

The units should be connected to a secondary circuit.

Do not open the modules.

Ensure that a unit failure (e.g. by an internal short-circuit) does not result in a hazardous condition. See also *Safety of operator accessible output circuit.*

Soldering Directions

Best results can be achieved with a soldering temperature of 215°C for 10 s using a reflow soldering system after a pre-heating period of 80 s at 135°C. The switching regulators should not be exposed to the heat for more than 30 seconds. Solder temperatures exceeding 240°C may damage the devices.

Cleaning Agents

In order to avoid possible damage, any penetration of cleaning fluids is to be prevented, since the power supplies are not hermetically sealed.

Protection Degree

The protection degree of the switching regulators is IP 20.

Safety of operator accessible output circuit

If the output circuit of a switching regulator is operator-accessible, it shall be an SELV circuit according to IEC/EN 60950 related safety standards.

If the input circuit of a switching regulator is an SELV circuit and the output is protected against overvoltages higher than 60 V by external means, e.g. an overvoltage suppressor diode, its output circuit is considered to be an SELV circuit.

These statements are an interpretation of the IEC/EN 60950 safety standard with respect to the safety status of the output circuit. However, it is the sole responsibility of the installer or user to assure the compliance with the relevant and applicable safety regulations.

More information is given in *Technical Information: Safety & EMC*.

Table 5: Pin assignments

Type of regulator	P_o	Pin no. 1	Pin no. 2	Pin no. 3	Pin no. 4	Pin no. 5
FN 05P015-0, FN 12P015-1, FN 15P015-1	1.5 W	GND	Vi+	Vo+	GND	n.a.
FN 05N015-1, FN 12N015-1, FN 15N015-1		GND	Vi+	n.a.	GND	Vo-
FN 12D015-1, FN 12D015-1		GND	Vi+	Vo+	COMMON	Vo-
FN 05P030-0, FN 12P030-1, FN 15P030-1	3.0 W	GND	Vi+	Vo+	GND	n.a.
FN 05N030-1, FN 12N030-1, FN 15N030-1		GND	Vi+	n.a.	GND	Vo-
FN 12D030-1, FN 15D030-1		GND	Vi+	Vo+	COMMON	Vo-

n.a. → not assembled

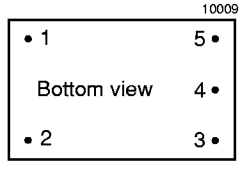


Fig. 7
Pinout