

Innovating Energy Technology

FUJI Power Semiconductors Power Supply Control ICs Selection Guide

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Green Mode PWM-ICs FA8A60N/70N/80N/90N Series

The AC/DC PWM Control IC FA8A60N/70N/80N/90N Series offer the best system for flyback circuits. With a rich variety of functions integrated in the small-sized package of SOP8, it makes excellent cost performance via a compact power supply design that leads to good energy saving at light loads.

1. Low standby power (Burst operation function)

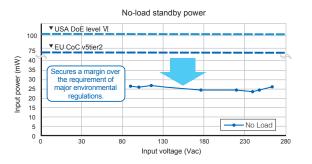
2. Switching frequency reduction adjustment is available

The frequency reduction starting point can be chosen from three patterns,

FB pin voltage and oscillation frequency

which makes it possible to improve efficiency for each power supply.

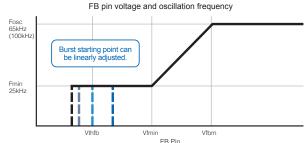
It achieves low standby power with its burst operation function. It is also capable of clearing the energy-saving standards for external power supplies such as DoE^{*1} and CoC^{*2} even securing some margin.



Fosc 65kHz (100kHz) Emin 25kHz Vthfb Vthfb Kmin FB Pin

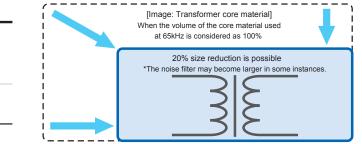
3. Burst starting point can be adjusted

The burst starting point can be continuously adjusted, which makes it easy to improve efficiency at light loads and implement measures for acoustic noise reduction.



In addition to the 65kHz type, a 100kHz type is also available. The high frequency has made it possible to reduce the size of the power supply transformer.

4. Reduced size of the power supply (100kHz type)



*1 DoE (United States Department of Energy): The energy-saving regulations in the United States that stand in for the Energy Star program promoted by the United States Department of Energy. *2 CoC (Code of Conduct): Abbreviation for the EU Code of Conduct. Tier 2 became effective in January 2016 as a replacement of the EuP directive. Applications (for flyback circuits) Office automation equipment, AC adapters, external power supplies, LCD TVs, etc.



Package: SOP-8

Product Line-up

	ounor =					
	500V	65kHz	FA8A60N	FA8A61N	FA8A70N	FA8A71N
Tuno	Starting circuit	100kHz	FA8A64N	FA8A65N	FA8A74N	FA8A75N
Туре	650V	65kHz	FA8A80N	FA8A81N	FA8A90N	FA8A91N
	Starting circuit	100kHz	FA8A84N	FA8A85N	FA8A94N	FA8A95N
Overlo	ad protecti	on (OLP)	Auto- Recovery	Latch	Auto- Recovery	Latch
	Delay time	Э	200ms	200ms	200ms	200ms
	Line comp	pensation	Built-in	Built-in	Built-in	Built-in
	Detection	level	1 Stage	1 Stage	1 Stage	1 Stage
X-Cap	discharge	function	No	ne	Buil	t-in
Freque	ency reduct	ion function		Selectable	(3 patterns)	
Burst o adjusti	peration p nent	oint		Linearly a	idjustable	
Power	-off mode			Bui	lt-in	
DSS (D	ynamic sel	lf supply)		Bui	lt-in	
Overvo	ltage prote	ction		25.5V	(latch)	
Over te	emperature	protection		140°C	(latch)	

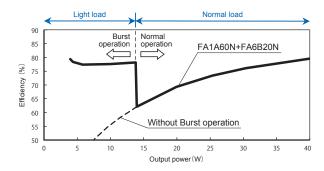
Critical mode PFC control IC and LLC current resonance control IC for high-efficiency power supplies

FA1A60N/FA6B20N

The critical mode PFC Control IC FA1A60N and LLC current resonance control IC FA6B20N provide an optimum system for LLC converters with an input of 75W or higher. The auto standby function enables the products to be applied not only to internal power supplies for LCD TVs, etc but also to adapters that do not have external standby signals.

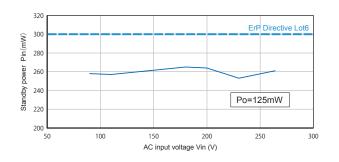
1. Improved efficiency at light load

Efficiency above 75% is achieved at 3% of rated power by providing burst control for both PFC control IC and LLC control IC at light load.



2. Low standby power

Standby power below 260mW is achieved without standby power supply when input is 230V AC and output power is 125mW. (ErP Directive Lot6*1: 0.3W or lower)



Application examples

LCD TVs, high power adapters, office automation (OA) equipment, communication power supplies and industrial power supplies



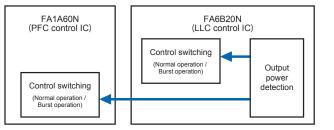


FA1A60N package :S0P-8

FA6B20N package :SOP-16 (N)

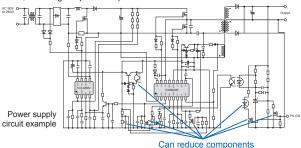
3. Auto standby function

Output power is detected by LLC control IC, and at light load condition, both PFC control IC andLLC control IC are switched from normal operation to burst operation.



4. Reduced power supply components

Because the auto standby function is integrated, an external standby signal is unnecessary. This makes it possible to reduce the number of components by seven, including the photo coupler.



*1 The ErP Directive is also called the Eco Design Directive, the EU regulation that obligates environmentally conscious design

	ontents								
				Applicable circuit					
No.	Title		Page	Flyback	Forward	Full-bridge	Half-bridge Current Resonant	Boost	Buck
1	Product map		4						
2	AC/DC	Green Mode PWM-ICs (Current Mode)	6	✓					
3	Power Supply Control ICs	General PWM-ICs	8	✓	1			(√) *1	(✓) *1
4	0011101103	Green Mode Quasi-resonant ICs (Current Mode)	10	1					
5		Power Factor Correction ICs	12	1				1	
6		Current Resonant ICs	14				\checkmark		
7	Driver ICs		15			1	\checkmark		✓
8	Application circuit	examples	16						
9	Package outlines		18						

*1: Some products can be utilized depending on the applicable circuit

Type nomenclature

Example: FA8A00N

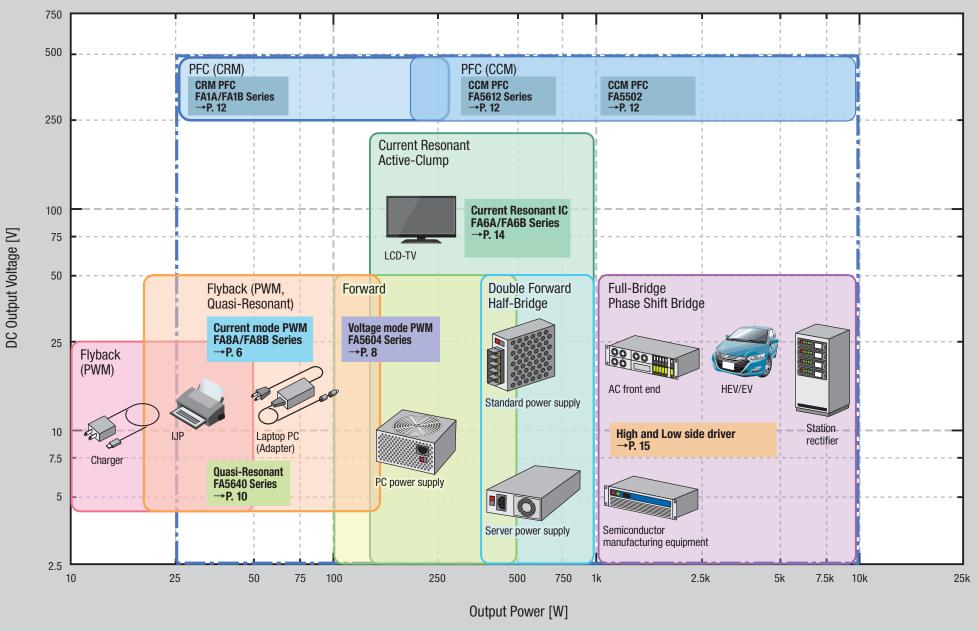
	F		Α		8	Α	00		Ν	
Со	mpany symbol	C	control system		Series	Generation	Number		Package code	
F	Fuji	A Analog		1	CRM PFC*	А	Two-digit integer	Ν	SOP	
				6	LLC	В				
				8	PWM	С				
		*CRM PFC: Critical Conduction Mo								

Example: FA5590N

	F		Α		55	90		Ν
Co	ompany symbol	C	ontrol system		Series	Number	Pac	ckage code
F	Fuji	A Analog		3X		Two-digit integer	M/N	SOP
				5X	AC/DC			
				13X				

Product Map

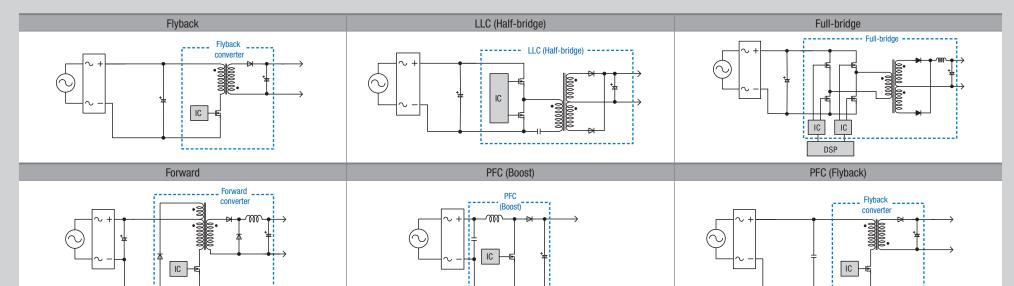
Application specific output power/output voltage and applicable ICs



Circuit type (AC/DC)

1......

Circuit type	Product category	Page	Output power 10W	50W	100W	150W	200W	300W	500W	1kW -
	Green Mode PWM-ICs (Current Mode)	6								
Flyback	General PWM-ICs	8								
	Green Mode Quasi-resonant ICs (Current Mode)	10								
Forward	General PWM-ICs	8								
LLC (Half-bridge)	Current Resonant ICs	14								
Full-bridge	Driver ICs	15								
PFC (Boost)	Power Factor Correction ICs (Critical Conduction Mode)	12								
FT 6 (b003t)	Power Factor Correction ICs (Continuous Conduction Mode)	12								
PFC (Flyback)	Power Factor Correction ICs (FA1B00N, FA1A21N)	12								



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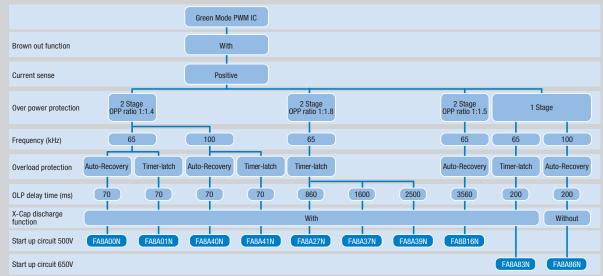
					Built-in	X-Cap						Protection mode			Power	Vcc threshol	ld voltage		
ation	Series	Type name	Control mode	Applied circuit	start up circuit	discharge function	Brown out function	Max Duty	Frequency fsw	Overcurrent detection	Over load	Over power	Overvoltage	Light-load switching	supply voltage Vcc	ON	OFF	Package	Rema
		FA8A00N									Auto-Recovery								
		FA8A01N							65kHz		Timer-latch								
		FA8A40N	-							-	Delay 70 ms Auto-Recovery	2 Stage (OPP ratio 1:1.4)*			12-24V				
	-	FA8A41N	-				1		100kHz		Timer-latch Delay 70 ms								
	FA8A00 Series (Basic functions	FA8A27N	-		✓ 500V	1	Fixed	83%		+ detection	Timer-latch Delay 860 ms		Latch Vcc	Linearly frequency - reduction +		13V	6.5V		
	version)	FA8A37N	-								Timer-latch Delay 1.6 s	2 Stage (OPP ratio 1:1.8)*	detection	Intermittent operation	10-28V				
		FA8A39N	-						65kHz		Timer-latch Delay 2.5 s								
		FA8A12N					_	-			Auto-Recovery	2 Stage (OPP ratio 1:1.4)*	-		12-24V				
ŀ		FA8A60N	-								Auto-Recovery	(0111114)							
		FA8A61N	-						65kHz		Timer-latch								
	-	FA8A64N	1			-				-	Auto-Recovery			Linearly frequency					
5	FA8A60 Series	FA8A65N			1				100kHz	+	Timer-latch		Latch	reduction + Intermittent operation					
	(Advanced functions version)	FA8A70N			500V		-	83%		detection	Auto-Recovery	1 Stage	Vcc detection	(Frequency	10-24V	12.5V	6.5V		
		FA8A71N							65kHz		Timer-latch		detection	reduction/burst point					
		FA8A74N									Auto-Recovery			adjustable)					
	-	FA8A75N	Current mode	Flyback					100kHz		Timer-latch							SOP-8	
		FA8A80N	mode								Auto-Recovery								
	-	FA8A81N				-	-		65kHz										
		FA8A83N				1	✓ Fixed	-	ΟΟΚΠΖ		Timer-latch		Latch Vcc						
	-	FA8A84N	-					-			Auto-Recovery		detection	Lincolu from one					
	FA8A80 Series	FA8A85N]			_	-		100kHz		Timer-latch			Linearly frequency reduction +					
	(Advanced functions, VH high withstand-	FA8A86N			✓ 650V		✓ Fixed	83%	TOORIL	+ detection	Auto-Recovery	1 Stage	-	Intermittent operation (Frequency	10-24V	12.5V	6.5V		
	voltage version)	FA8A87N									Timer-latch			reduction/burst point adjustable)					00
		FA8A90N	-						65kHz		Auto-Recovery		Latch						No co
	-	FA8A91N				1	-				Timer-latch		Vcc						
	-	FA8A94N	-							1	Auto-Recovery		detection						
	-	FA8A95N	-						100kHz		Timer-latch								
	FA8Bxx Series	FA8B16N	-		✓ 500V	1	✓ Fixed	83%	65kHz	+ detection	Auto-Recovery	2 Stage (OPP ratio 1:1.5)*	Latch Vcc detection	Linearly frequency reduction + Intermittent operation	12-24V	12.5V	8V		
1		FA5680N			1					_	Auto-Recovery		Latch	Linearly frequency					00 corre
	FA5680 Series	FA5681N			750V	-	-	85%	65kHz	detection	Timer-latch	1 Stage	Vcc detection	reduction + Intermittent operation	11-24V	18V	8V		exi

Green Mode PWM-ICs (Current Mode)

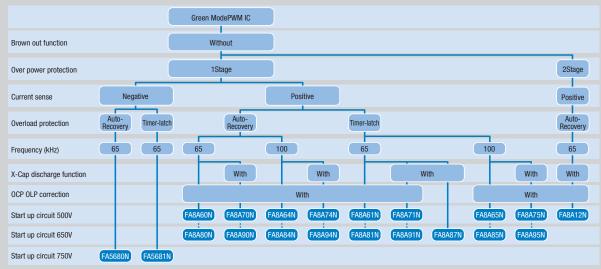
• Features

- With 500V/650V/750V withstand voltage start up circuit • Green mode functions (Intermittent Switching/Linearly reduced switching frequency)
- Protect functions (Over voltage/Brown out/2 stage Over power,etc.) Low EMI noise

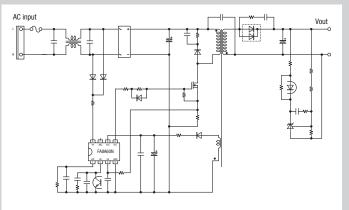
• Green mode PWM-ICs with Brown Out function



• Green mode PWM-ICs without Brown Out function



• Circuit example (Flyback) : FA8A60N



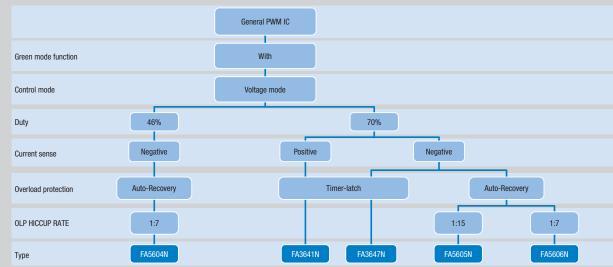
Genera	I PWM-ICs													
							Protectio	on mode		Power	Vcc thresh	old voltage		
Series	Type name	Control mode	Applied circuit	Max Duty	Frequency fsw	Overcurrent detection	Overload	Overvoltage	Light-load switch operation	supply voltage Vcc	ON	OFF	Package	Features
	FA13842N		Elybook	96%	External settings						16.5V			
FA1384× Series	FA13843N	- Current mode	Flyback	90%	10-500kHz	+ detection				10-25V	9.6V	9.0V		384 Series pin compatible, 5V reference voltage output, With
FA1304× Series	FA13844N		Forward	48%	External settings	+ delection	-	-	-	10-250	16.5V	9.00		error amplifier
	FA13845N		Forward	40%	5-250kHz						9.6V			
FA5504 Series	FA5504N		Forward	46%	External settings 10-500kHz	+ detection	Timer-latch	CS latch Vcc voltage detection	_	10-28V	16.5V	9.0V		With error amplifier 5V reference voltage output
	FA5510N		Forward	46%		. data atian		CS latch						
FA551× Series	FA5511N		Flyback	70%	External settings 10-500kHz	+ detection	Timer-latch	Vcc voltage	-	10-28V	16.5V	9.0V		5V reference voltage output
	FA5515N		Flyback	70%		- detection		detection						
	FA3641N				External settings	+ detection		CS latch	Frequency				SOP-8	5V reference voltage output
FA364× Series	FA3647N		Flyback	70%	30-500kHz	- detection	Timer-latch	Vcc voltage detection	reduction	10-28V	16.5V	9.0V		Frequency-reduction function added to FA5511/15
	FA5604N	Voltage mode	Forward	46%					Frequency reduction					
	FA5605N							CS latch	Start/stop FB voltage 1.8V/1.95V					
FA5604 Series	FA5606N		Flyback	70%	External settings 100-300kHz	- detection	Auto-Recovery	(External detection)	Frequency reduction Start/stop FB voltage 1.55V/1.65V	10-30V	17.5V	9.7V		Overload current drooping Frequency reduction
	FA5607N								-					

General PWM-ICs

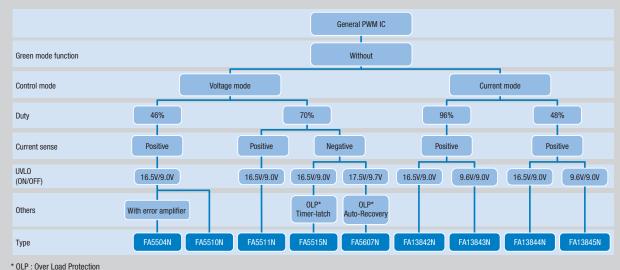
• Features

- Voltage mode control
- $\,\circ\,$ Operating frequency can be set externally
- $^\circ\,$ 5V reference voltage output

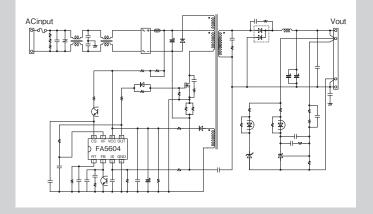
General PWM Control IC Series with Green Mode Function



General PWM Control IC Series without Green Mode Function



• Circuit example (Forward) : FA5604N

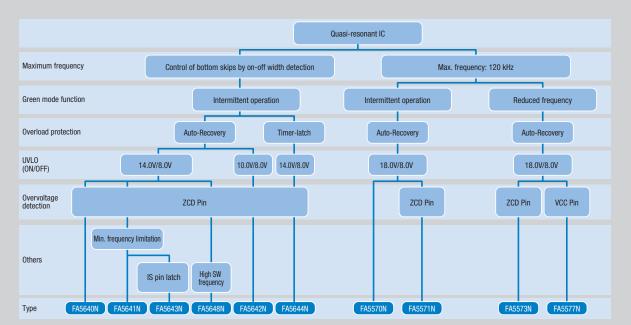


	Green Mo	de Quasi-reso	nant ICs	(Current	Mode)										
								Protecti	on mode		Power	Vcc thresh	iold voltage		
Generation	Series	Type name	Control mode	Applied circuit	Built-in start up circuit	Frequency fsw	Overcurrent detection	Overload	Overvoltage	Light-load switch operation	supply voltage Vcc	ON	OFF	Package	Features
		FA5640N				Bottom skip count						14V			-
5		FA5641N				control via self- excited on-off width	+ detection	Auto-Recovery				140			Minimum frequency (25kHz)
eratic	FA5640 Series	FA5642N			1	detection, estimated	+0.5V	Auto-necovery	Latch	Intermittent		10V			Vcc on-voltage (10V)
	FA5640 Series	FA5643N			500V	frequency switching from 1st to 2nd	(AC100V) +0.45V		ZCD voltage detection	operation	11-26V		8V		IS pin latch stop
4th		FA5644N				bottom	(AC230V)	Timer-latch				14V			Overload latch stop
		FA5648N	Current mode	Flyback		110kHz (FA5648 is 260 kHz)		Auto-Recovery						SOP-8	For High SW frequency
		FA5570N							-	Intermittent					Without overvoltage protection
ttion		FA5571N					+ detection +1.0V		Latch	operation					Queruslane 70D detection
generation	FA5571 Series	FA5573N			✓ 500V	Self-oscillation Maximum 120kHz	11.00	Auto-Recovery	ZCD voltage detection	Linearly	10-28V	18V	8V		Overvoltage ZCD detection
3rd ç		FA5577N					+ detection +0.5V		Latch Vcc voltage detection	frequency reduction					Overvoltage Vcc detection

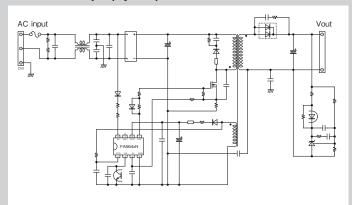
Green Mode Quasi-resonant ICs (Current Mode)

• Features

- ° Built-in 500V withstand voltage start up circuit
- Green mode functions (Intermittent Switching/Linearly reduced switching frequency)
- Protect functions (overvoltage/overload, etc.)



• Circuit example (Flyback) : FA5640N



Power Factor Correction ICs Critical Conduction mode PFC Control IC

						a	-	Protecti	on mode	- FB open/		Power	Vcc thresh	old voltage		
Series	Type name	Control mode	Applied circuit	OVP pin	Zero current detection	Overcurrent detection	Frequency fsw	Overload	Overvoltage	short circuit protection	Light-load switching	supply voltage Vcc	ON	OFF	Package	Features
	FA1A00N			1									9.6V			Light-load bottom skip function Output overvoltage double
	FA1A01N												12.4V	8.8V		protection
	FA1A10N			_							Frequency reduction		9.6V	0.01		Light-load bottom skip function
	FA1A11N				_					1	roduotion		12.4V			
	FA1A50N		PFC (Boost)		CS pin (Resistance)	- detection	Self-oscillation	Input current limitation (Auto-recovery)	Output current limitation				9.6V	8.8V		Light-load bottom skip function FA1A00N enhanced version
FA1Axx Series	FA1A60N			1				(Auto-recovery)	(Auto-recovery)		Frequency reduction +	10-26V	12.5V	7.5V		Light-load intermittent switching coordinated operation with FA6B19N/20N/22N
	FA1A61N	Voltage mode								(Open protection only)	Intermittent operation		12.5V	7.5V	SOP-8	Light-load intermittent operation coordinated operation with FA6B21N
	FA1A21N		PFC (Flyback)	_	ZCD pin (Winding)	+ detection	Self-oscillation	Input current limitation (Auto-recovery)	Auto-Recovery Vcc detection	-	Frequency reduction		17.3V	9.6V		For LED lighting Soft start function Overload protection
	FA5590N			_									9.6V			Max. frequency setting
FASSOO Ourise	FA5591N		PFC		IS pin		0-16	Input current	Output current		Max. frequency	10-26V	13.0V	0.01/		(100k~800kHz)
FA5590 Series	FA5696N		(Boost)	1	(Resistance)	– detection	Self-oscillation	limitation (Auto-recovery)	limitation (Auto-recovery)	1	limitation	10-260	9.6V	9.0V		Max. frequency setting Output overvoltage double protection
FA1Bxx Series	FA1B00N		PFC (Boost/ Flyback)	-	ZCD pin (Winding)	+ detection	Self-oscillation	Auto-Recovery	Output current limitation		Max. frequency limitation	10-24V	13.0V	9.0V		For LED lighting (PFC Flyback)

Continuous Conduction Mode PFC Control IC

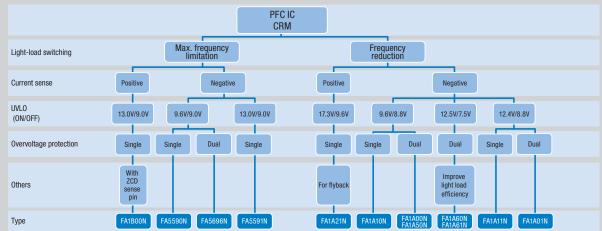
								Protecti	on mode	FB open/			Vcc thresh	old voltage		
Series	Type name	Control mode	Applied circuit	OVP pin	Max Duty	Overcurrent detection	Frequency fsw	Overload	Overvoltage	short circuit protection	Light-load switching	supply voltage Vcc	ON	OFF	Package	Features
FA5612 Series	FA5612N				94%	 detection -0.5V (AC100V) 	External selection (50-70 kHz scattered,	Input current limitation	Output current limitation	/	-	10-26V	9.6V	9.0V	SOP-8	Overcurrent detection level switching
FASO 12 Series	FA5613N	Average current	PFC (Boost)	_	94%	-0.4V (AC230V)	· · · · · · · · · · · · · · · · · · ·		(Auto-recovery)	v	-	10-200	13.0V	9.00	307-0	Fixed frequency, jitter switching
FA5502 Series	FA5502M			1	94%	- detection	External settings 15-150kHz	Input current limitation (Auto-recovery)	Output current limitation (Auto-recovery)	-	-	10-28V	16.5V	8.9V	SOP-16 (M)	ON/OFF pin Synchronous pin

Power Factor Correction ICs

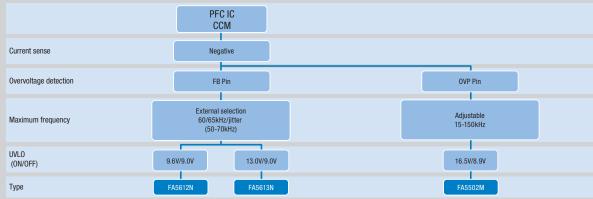
• Features

- $\,\circ\,$ Wide electric power range (From 25W to 10kW)
- $\,\circ\,$ Power factor ≥ 0.99
- Protect functions (FB pin open short/Over voltage, etc.)

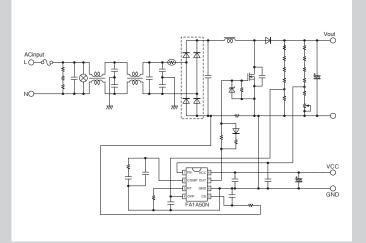
Critical Conduction mode PFC Control IC



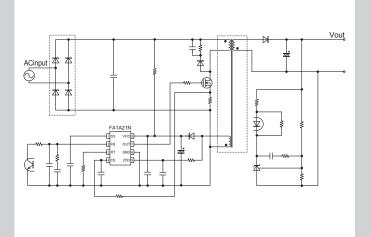
Continuous Conduction Mode PFC Control IC



• Circuit example (PFC boost) : FA1A50N



• Circuit example (PFC flyback) : FA1A21N



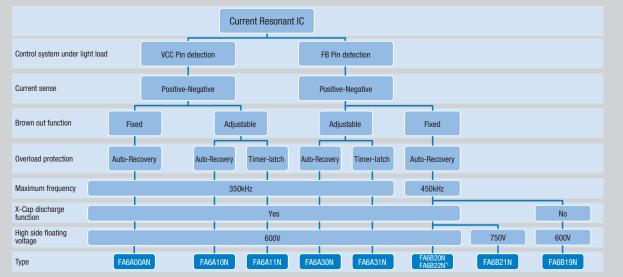
	Current F	Resonant	ICs																	
		-	Applied	Built-in	High side	X-Cap	Brown out	Low standby	-	Current	-		rotection mo	le	Light-load	Power supply	Vcc thresh	old voltage		
Generation	Series	Type name	circuit	start up circuit	floating voltage	discharge function	function	mode switching	Duty	sense	Frequency fsw	Overcurrent	Overload	Overvoltage		voltage Vcc	ON	OFF	Package	Features
ion		FA6B19N FA6B20N	_		600V	_		CA Pin detection												Auto standby function State setting function
3rd generation	FA6Bxx Series	FA6B21N		✓ 600V	750V	1	✓ Fixed	Auto switching/ external	50%	Positive- Negative	25-450kH	Auto-recovery	Auto-Recovery	Auto-Recovery	Burst operation FB pin control	14-29V	14.0V	9.0V		Transient response improvement Auto standby function
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		FA6B22N ^{*1}			600V			switching												B0 detection delay extension type Auto standby function
		FA6A00AN	Current resonant LLC (Half bridge)				✓ Fixed					Timer-latch	Auto-Recovery		Burst operation				SOP-16 (N)	Power good signal output State setting function Supports W/W voltage
generation		FA6A10N		,				External		Desitive		Auto-recovery	Auto-Recovery		Vcc pin control		12.0V			Brown out Detection level adjustment
2nd gene	FA6Axx Series	FA6A11N		600V	600V	1	1	switching STB pin	50%	Positive- Negative	38-350kHz	Timer-latch	Timer-latch	Timer-latch		14-27V		9.0V		State setting function Supports W/W voltage
21	_	FA6A30N					Adjustable					Auto-recovery	Auto-Recovery		Burst operation		13.0V			State setting function Brown out
		FA6A31N										Timer-latch	Timer-latch		FB pin control		13.00			Detection level adjustment Supports W/W voltage

#### • Features

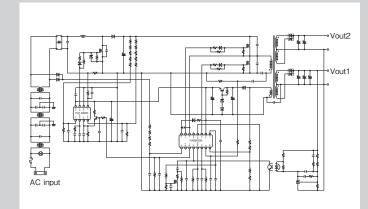
• Realize 1 convertor circuit structure at world wide input power • Built-in High side driver

• Preventing capacitive region operation • Protect functions (Over current/Over voltage/Over load/Over heat/Brown out)

• Green mode function (Intermittent switching)



#### • Circuit example (PFC + LLC) : FA1A60N, FA6B20N



*1: B0 detection delay time extension type

# Driver ICs

High and Low side driver ICs

	Type name	Number of input/ output pin supp		Absolute maximum ratings				Turn-on/off	Recommended	VCC, VBS threshold voltage			
Series			High side floating supply voltage	Output current	Power supply voltage	Maximum frequency	Input threshold voltage	propagation delay	power supply voltage VCC, VBS	ON	OFF	Package	Features
FA5650 Series	FA5650N	2	800V	-1.4/1.8A	30V	500kHz	Logic "1" 2.1V Logic "0" 1.1V	125ns	12-18V	8.9V	8.2V	SOP-8	High-side and low-side delay time difference 30ns (max), high-side dVs/dt withstand 50kV/µs, input 3.3V logic compatible

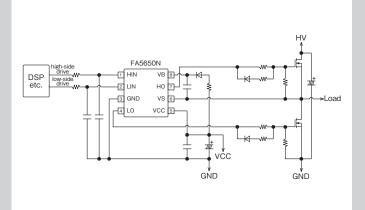
#### • Features

 $^{\circ}$  High negative transient voltage on VS pin

- $^{\circ}$  Wide range supply voltage up to 30V
- 3.3V logic compatible
- Built-in under voltage lockout
- $^\circ\,$  Allowable high slew rate of VS pin: dVs/dt up to 50kV/µs
- High speed response: Turn on/off delay time 125ns (Typ.)

	High and Low side driver IC
High side floating supply voltage	800V
Output current	-1.4A/1.8A
Turn-on/off propagation delay time	125ns
Package	SOP-8
Туре	FA5650N

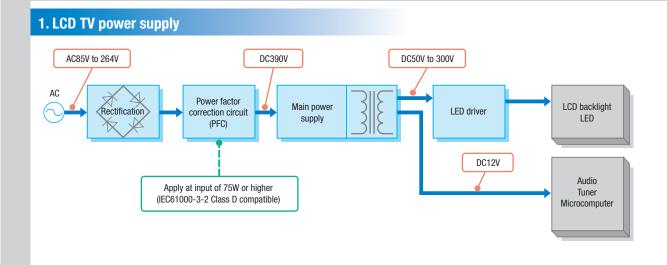
#### • Circuit example : FA5650N



#### • Pin Layout



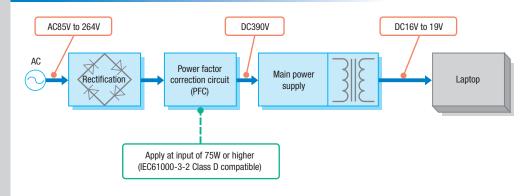
## Application circuit examples



#### Recommended IC

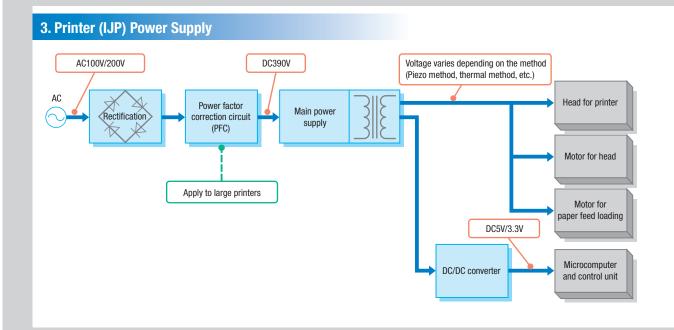
Circuit	Туре	Recommended IC	Page
Power factor	PFC (75W-200W)	FA1Axx Series	12
correction	PFC (more than 200W)	FA561x Series	12
	Quasi-resonant	FA564x Series	10
Main power	PWM	FA8A6x Series	6
supply		FA6Axx Series	14
	LLC	FA6Bxx Series	14

# 2. Laptop (AC Adapter) Power Supply



#### Recommended IC

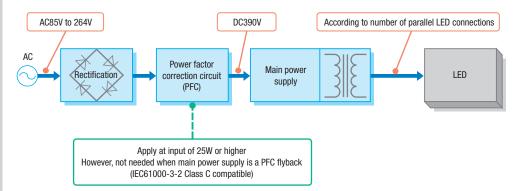
Circuit	Туре	Recommended IC	Page
Power factor	PFC (75W-200W)	FA1Axx Series	12
correction	PFC (more than 200W)	FA561x Series	12
	Quasi-resonant	FA564x Series	10
Main power supply	PWM	FA8A6x Series	6
ouppij	LLC	FA6Bxx Series	14



#### Recommended IC

Circuit	Туре	Recommended IC	Page
Power factor	PFC (75W-200W)	FA1Axx Series	12
correction	PFC (more than 200W)	FA561x Series	12
Main power	Quasi-resonant	FA564x Series	10
supply	PWM	FA8A6x Series	6

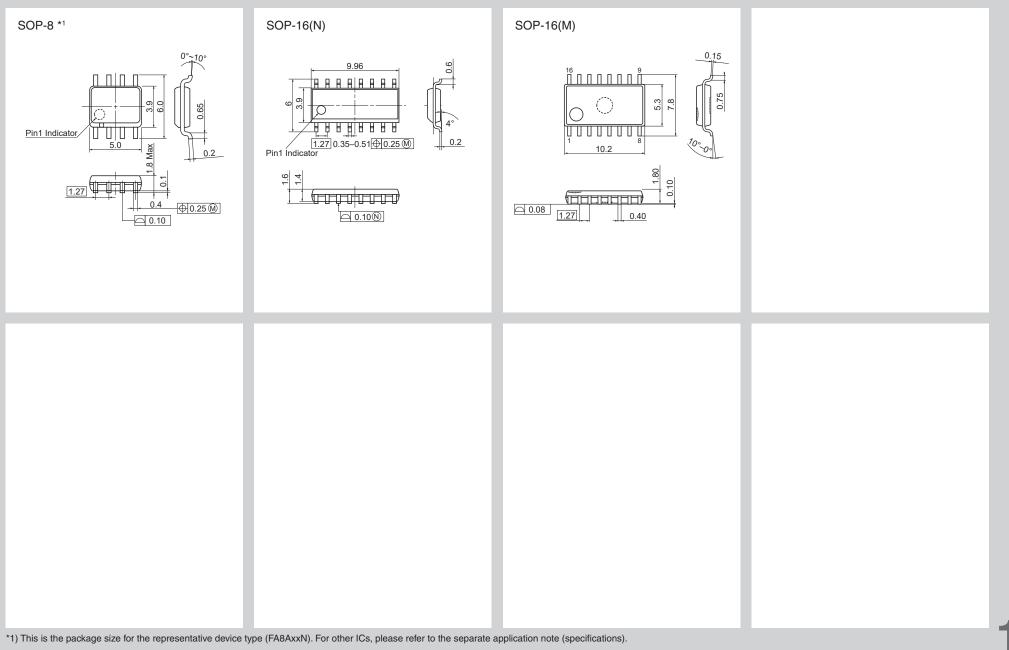
# 4. LED lighting Power Supply



#### Recommended IC

Circuit	Туре	Recommended IC	Page
		FA1Axx Series	12
Power factor correction	PFC (25W-200W) FA1B00N	FA1B00N	12
	PFC (more than 200W)	FA561x Series	12
	Quasi-resonant	FA564x Series	10
	PWM	FA8A6x Series	6
Main power supply	LLC	FA6Bxx Series	14
ouppiy		FA1A21N	12
	PFC Flyback	FA1B00N	12

# Package Outlines, mm



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#### Head Office:

Gate City Ohsaki, East Tower, 11-2 Osaki 1-chome, Shinagawa-ku, Tokyo 141-0032, Japan

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#### Fuji Electric Hong Kong Co., Ltd.

Unit 1601-03 & 05, 16/F., Tower II, Grand Century Place, No. 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong Tel: +852-2664-8699

**Fuji Electric Taiwan Co., Ltd.** 10F. No.168, Song Jiang Road, Taipei, Taiwan Tel: +886-2-2515-1820

#### Fuji Electric Asia Pacific Pte. Ltd.

151 Lorong Chuan, #03-01/01A New Tech Park, SINGAPORE 556741 Tel: +65-6533-0014

#### Fuji Electric India Private Ltd.

119(Part), 120, 120A, Electrical and Electronics Industrial Estate, Perungudi, Chennai - 600096, Tamil Nadu, India Tel: +91-44-40004200

#### Fuji Electric (China) Co., Ltd.

26F, Global Harbor Tower B, 1188 North KaiXuan Road, PuTuo District, Shanghai 200062, P.R.China Tel: +86-21-5496-1177

#### Fuji Electric Corp. of America

50 Northfield Avenue Edison, NJ 08837, USA Tel: +1-732-560-9410

Fuji Electric Europe GmbH

Goethering 58, 63067 Offenbach am Main, F.R. GERMANY Tel: +49-69-6690290

