

## ■ Description

FA3629AV is a Power IC which includes DC-DC converter controller and Nch-power MOSFET. This IC can directly drive Nch/Pch MOSFET. This IC is suitable to reduce converter size because it has many functions in a small package TSSOP.

## ■ Features

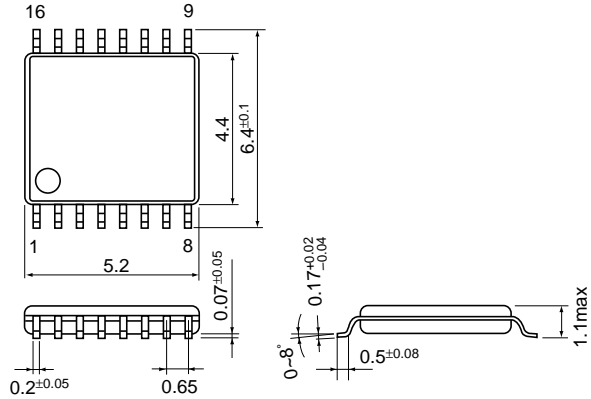
- Low input voltage: 2.5V to 6.5V
- 40V CDMOS Process:
  - Built-in 0.3Ω Nch-Power MOSFET(ch1, open drain)
- 3-channels PWM Control:
  - 2 boost circuits(ch1, ch2), 1 inverting circuit (ch3)
- Adjustable soft start time and maximum duty cycle
- Built-in timer latch for short circuit protection:
  - Delay time =  $2^{16}$  / (switching frequency)
- Built-in protection functions: Overcurrent limit for MOSFET, overheat protection, undervoltage lockout
- Wide range of operation frequency: 100kHz to 1MHz
- Package: TSSOP-16(Thin and small)

## ■ Applications

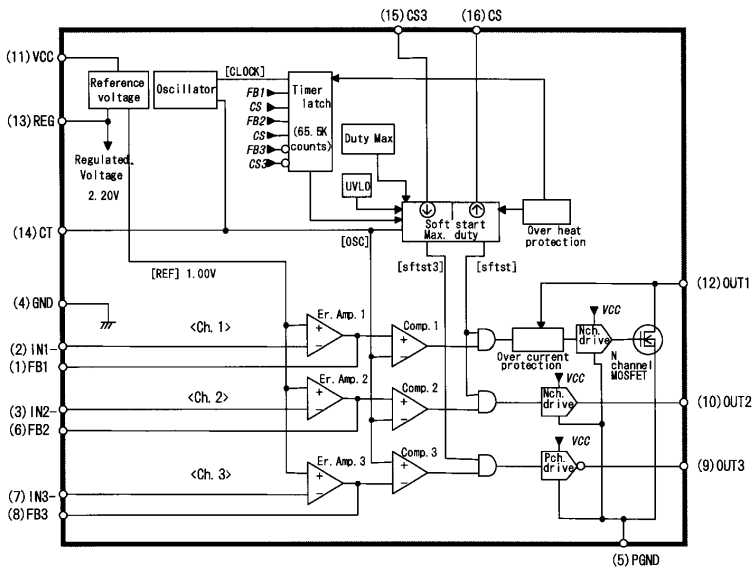
- Power supply for general equipment

## ■ Dimensions, mm

### ● TSSOP-16



## ■ Block diagram



Pin No.	Pin symbol	Description
1	FB1	Ch.1 output of error amplifier
2	IN1-	Ch.1 inverting input to error amplifier
3	IN2-	Ch. 2 inverting input to error amplifier
4	GND	Ground of control blocks
5	PGND	Ground of large power blocks
6	FB2	Ch. 2 output of error amplifier
7	IN3-	Ch. 3 inverting input to error amplifier
8	FB3	Ch. 3 output of error amplifier
9	OUT3	Ch. 3 output (for Pch-MOSFET)
10	OUT2	Ch. 2 output (for Nch-MOSFET)
11	VCC	Power supply
12	OUT1	Ch.1 drain output of internal Nch-MOSFET
13	REG	Regulated voltage output
14	CT	Oscillator timing capacitor
15	CS3	Soft start for Ch. 3
16	CS	Soft start for Ch.1 and Ch. 2

### ■ Absolute maximum ratings

Item	Symbol	Rating	Unit
Power supply voltage	V <sub>CC</sub>	6.5	V
Output voltage at OUT1 pin	V <sub>OUT1</sub>	40	V
Output current at OUT1 pin*1	I <sub>OUT1</sub>	2.8	A
Source peak current of OUT2	I <sub>OUT2+</sub>	-400	mA
Sink peak current of OUT2	I <sub>OUT2-</sub>	400	mA
Source peak current of OUT3	I <sub>OUT3+</sub>	-400	mA
Sink peak current of OUT3	I <sub>OUT3-</sub>	400	mA
Source average current of OUT2	I <sub>OUT2+</sub>	-50	mA
Sink average current of OUT2	I <sub>OUT2-</sub>	50	mA
Source average current of OUT3	I <sub>OUT3+</sub>	-50	mA
Sink average current of OUT3	I <sub>OUT3-</sub>	50	mA
Input voltage to err. amp.	V <sub>EI</sub>	5.0	V
Total power dissipation*2	P <sub>d</sub>	500	mW
Ambient temperature	T <sub>OPR</sub>	-25 to +95	°C
Junction temperature	T <sub>J</sub>	125	°C
Storage temperature	T <sub>STG</sub>	-40 to +125	°C

\*1 Output current is limited by the overcurrent protection

\*2 Ta < 25°C

### ■ Recommended operating conditions

Item	Symbol	Min.	Max.	Unit
Power supply voltage	V <sub>CC</sub>	2.5	5.8	V
Output voltage of OUT1	V <sub>OUT1</sub>	0	32	V
Output current of OUT1	I <sub>OUT1</sub>	0	1.8	A
Oscillation frequency	f <sub>OSC</sub>	100	1000	kHz
Ambient temperature	T <sub>OPR</sub>	-20	85	°C

### ■ Electrical characteristics (V<sub>CC</sub>=3.0V, Ta=25°C)

#### Reference voltage section

Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Reference voltage	V <sub>REF</sub>		0.98	1.00	1.02	V
Variation with supply voltage	V <sub>REF-LINE</sub>	V <sub>CC</sub> =2.5 to 5.8V		1	3	mV
Variation with temperature	V <sub>REF-TC1</sub>	Ta=-20 to +25°C		0.5	1.2	%
	V <sub>REF-TC2</sub>	Ta=+25 to +85°C		0.5	1.2	%

#### Regulated voltage for internal control blocks

Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Regulated voltage	V <sub>REG</sub>	C <sub>O</sub> =0.1μF	2.16	2.20	2.24	V
Variation with supply voltage	V <sub>REG-LINE</sub>	V <sub>CC</sub> =2.5 to 5.8V		3	8	mV
Variation with temperature	V <sub>REG-TC1</sub>	Ta=-20 to +25°C		0.5	1.5	%
	V <sub>REG-TC2</sub>	Ta=+25 to +85°C		0.7	1.5	%
Source current	I <sub>REG</sub>		-40		-15	mA

#### Oscillator section

Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Oscillation frequency	f <sub>OSC</sub>	C <sub>T</sub> =150pF	480	550	620	kHz
High level voltage	V <sub>OSCH</sub>	C <sub>T</sub> =150pF		1.38		V
Low level voltage	V <sub>OSCL</sub>	C <sub>T</sub> =150pF		0.78		V
Variation with supply voltage	f <sub>dv</sub>	V <sub>CC</sub> =2.5 to 5.8V		1	2	%
Variation with temperature	f <sub>dT1</sub>	Ta=-20 to +25°C		5	7	%
	f <sub>dT2</sub>	Ta=+25 to +85°C		5	7	%

**Soft-start and duty section**

Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Charge current of CS (Source)	I <sub>CS</sub>		-1.2	-1.0	-0.8	μA
Charge current of CS3 (Sink)	I <sub>CS3</sub>		0.8	1.0	1.2	μA
Max. duty cycle of OUT1 & OUT2	D <sub>max</sub>	f <sub>osc</sub> =500kHz	80	87	90	%
Max. duty cycle of OUT3	D <sub>max3</sub>	f <sub>osc</sub> =500kHz	80	86	90	%
Invalid TL threshold voltage of CS	V <sub>CSLO</sub>		0.42	0.52	0.62	V
Invalid TL threshold voltage of CS3	V <sub>CSHI</sub>		1.58	1.68	1.78	V

**Timer latch section (TL)**

Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Threshold voltage of FB1 (Ch.1)	V <sub>TLTH1</sub>		1.58	1.68	1.78	V
Threshold voltage of FB2 (Ch. 2)	V <sub>TLTH2</sub>		1.58	1.68	1.78	V
Threshold voltage of FB3 (Ch. 3)	V <sub>TLTH3</sub>		0.42	0.52	0.62	V
Start up count	count		-	2 <sup>16</sup>	-	counts
Start up time	T <sub>TL</sub>	C <sub>T</sub> =150pF	105	119	137	ms

**Error amplifier section**

Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Input offset voltage	V <sub>IO</sub>				10	mV
Common mode input voltage range	V <sub>COM</sub>		0.2		1.5	V
DC open loop gain	A <sub>VO</sub>		70	75	80	dB
Unity gain band width	f <sub>T</sub>		1.0	1.7	2.0	MHz
Sink current (Ch.1)	I <sub>OL1</sub>	V <sub>FB1</sub> =0.5V	1.0	1.5	2.0	mA
Source current (Ch.1)	I <sub>OH1</sub>	V <sub>FB1</sub> =V <sub>REG</sub> -0.5V	-160	-120	-80	μA
Sink current (Ch. 2)	I <sub>OL2</sub>	V <sub>FB2</sub> =0.5V	0.5	0.7	0.9	mA
Source current (Ch. 2)	I <sub>OH2</sub>	V <sub>FB2</sub> =V <sub>REG</sub> -0.5V	-160	-120	-80	μA
Sink current (Ch. 3)	I <sub>OL3</sub>	V <sub>FB3</sub> =0.5V	1.0	1.5	2.0	mA
Source current (Ch. 3)	I <sub>OH3</sub>	V <sub>FB3</sub> =V <sub>REG</sub> -0.5V	-160	-120	-80	μA
Sink current variation with temperature	I <sub>OL-TC1</sub>	T <sub>a</sub> =-20 to +25°C			20	%
	I <sub>OL-TC2</sub>	T <sub>a</sub> =+25 to +85°C			20	%
Source current variation with temperature	I <sub>OH-TC1</sub>	T <sub>a</sub> =-20 to +25°C			20	%
	I <sub>OH-TC2</sub>	T <sub>a</sub> =+25 to +85°C			20	%

**Overcurrent protection section (OCP)**

Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Threshold current	I <sub>OC DTH</sub>	V <sub>CC</sub> =3.0V	1.4	1.8	2.0	A
		V <sub>CC</sub> =5.0V	1.8	2.0	2.2	A
Delay time	t <sub>OC D</sub>		100	200	400	ns

**Overheat protection section (OHP)**

Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Threshold temperature	T <sub>OH</sub>		125	135	145	°C

**Undervoltage lockout circuit section (UVLO)**

Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Threshold voltage of REG	V <sub>UVTH</sub>		1.95	2.05	2.15	V

**Output section (OUT1)**

Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
On resistance of MOSFET	R <sub>ON1</sub>	V <sub>CC</sub> =3.0V, I <sub>O1</sub> =200mA	0.25	0.275	0.3	Ω
Rise time of OUT1	t <sub>r</sub>	V <sub>CC</sub> =3.0V		25	35	ns
Fall time of OUT1	t <sub>f</sub>	V <sub>OUT1</sub> =10V, I <sub>O1</sub> =1.0A		25	35	ns

**Output section (OUT2, OUT3)**

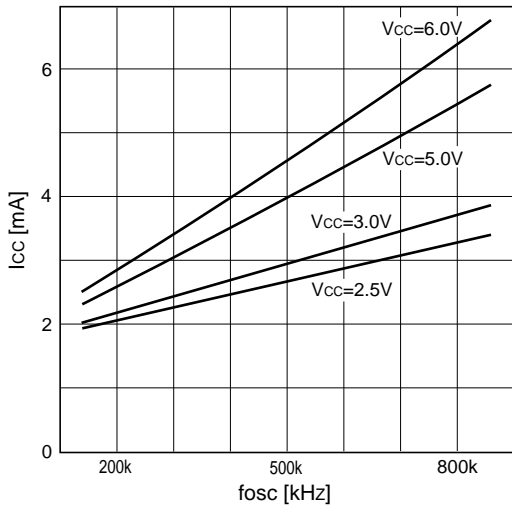
Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Rise time of OUT2	t <sub>r2</sub>	V <sub>CC</sub> =3V, C <sub>O2</sub> =1000pF	20	25	35	ns
Fall time of OUT2	t <sub>f2</sub>	(Between OUT2-GND)	20	25	35	ns
Rise time of OUT3	t <sub>r3</sub>	V <sub>CC</sub> =3V, C <sub>O3</sub> =1000pF	20	25	35	ns
Fall time of OUT3	t <sub>f3</sub>	(Between VCC-OUT3)	20	25	35	ns
High level on resistance of OUT2	R <sub>2AH</sub>	V <sub>CC</sub> =3V, I <sub>OUT2</sub> =-150mA	2.5	4.0	5.5	Ω
Low level on resistance of OUT2	R <sub>2AL</sub>	V <sub>CC</sub> =3V, I <sub>OUT2</sub> =150mA	2.5	4.0	5.5	Ω
High level on resistance of OUT3	R <sub>3AH</sub>	V <sub>CC</sub> =3V, I <sub>OUT3</sub> =-150mA	2.5	4.0	5.5	Ω
Low level on resistance of OUT3	R <sub>3AL</sub>	V <sub>CC</sub> =3V, I <sub>OUT3</sub> =150mA	2.5	4.0	5.5	Ω
High level on resistance of OUT2	R <sub>2AH</sub>	V <sub>CC</sub> =5V, I <sub>OUT2</sub> =-150mA	2.0	3.5	5.0	Ω
Low level on resistance of OUT2	R <sub>2AL</sub>	V <sub>CC</sub> =5V, I <sub>OUT2</sub> =150mA	2.0	3.5	5.0	Ω
High level on resistance of OUT3	R <sub>3AH</sub>	V <sub>CC</sub> =5V, I <sub>OUT3</sub> =-150mA	2.0	3.5	5.0	Ω
Low level on resistance of OUT3	R <sub>3AL</sub>	V <sub>CC</sub> =5V, I <sub>OUT3</sub> =150mA	2.0	3.5	5.0	Ω

**Overall device**

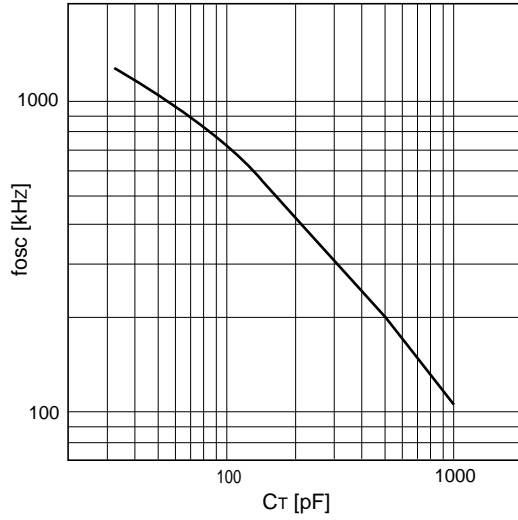
Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Operating current (Overall)	I <sub>CCA</sub>	D=50%, f <sub>osc</sub> =500kHz		3.0	3.8	mA
Operating current of control blocks	I <sub>CTRL</sub>			1.8		mA

■ Characteristic curves (Ta=25°C)

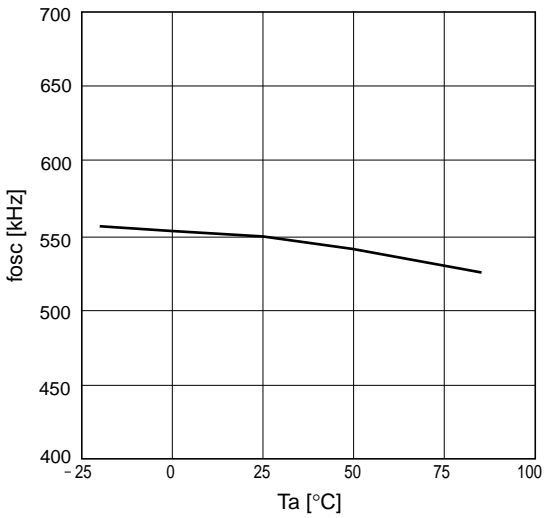
Supply current (I<sub>cc</sub>) vs oscillation frequency (f<sub>osc</sub>)



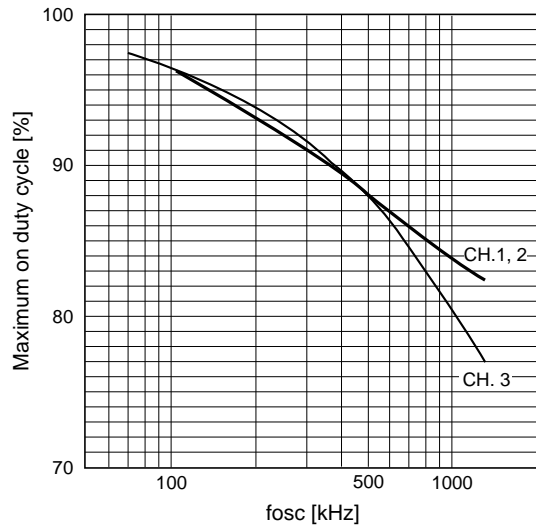
Oscillation frequency (f<sub>osc</sub>) vs. timing capacitor (C<sub>T</sub>)



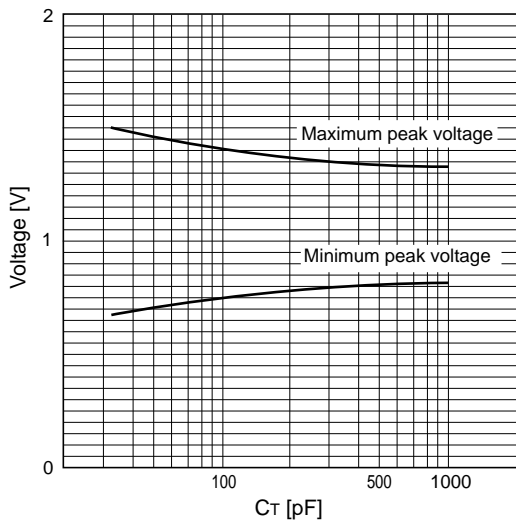
Oscillation frequency (f<sub>osc</sub>) vs. ambient temperature (Ta)



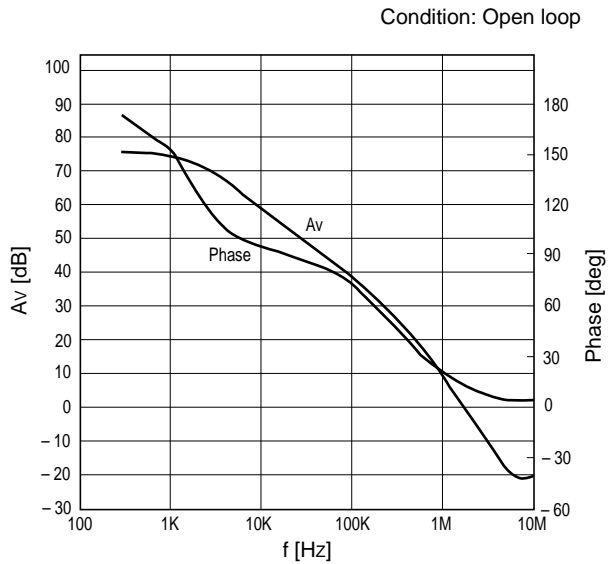
Max. on duty cycle vs. oscillation frequency (f<sub>osc</sub>)



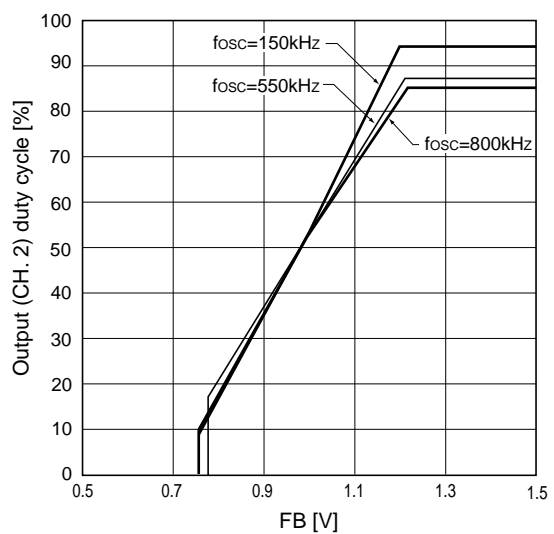
Oscillation peak voltage vs. timing capacitor (C<sub>T</sub>)



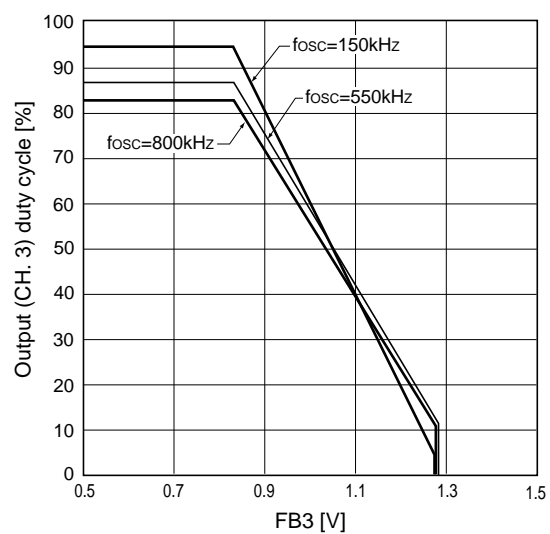
Error amplifier voltage gain (A<sub>v</sub>) /phase vs. frequency (f)



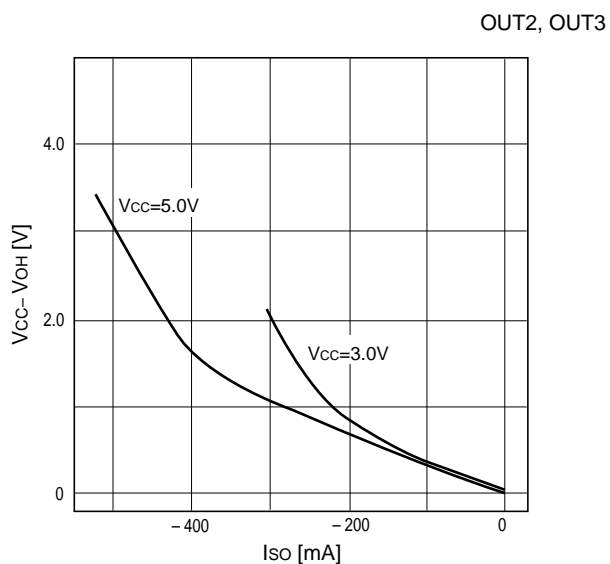
Output (Ch. 2) duty cycle vs FB terminal voltage (VFB)



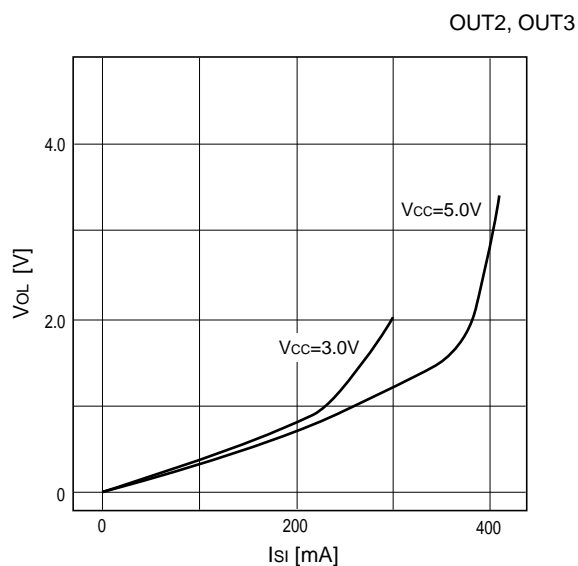
Output (Ch. 3) duty cycle vs. FB3 terminal voltage (VFB3)



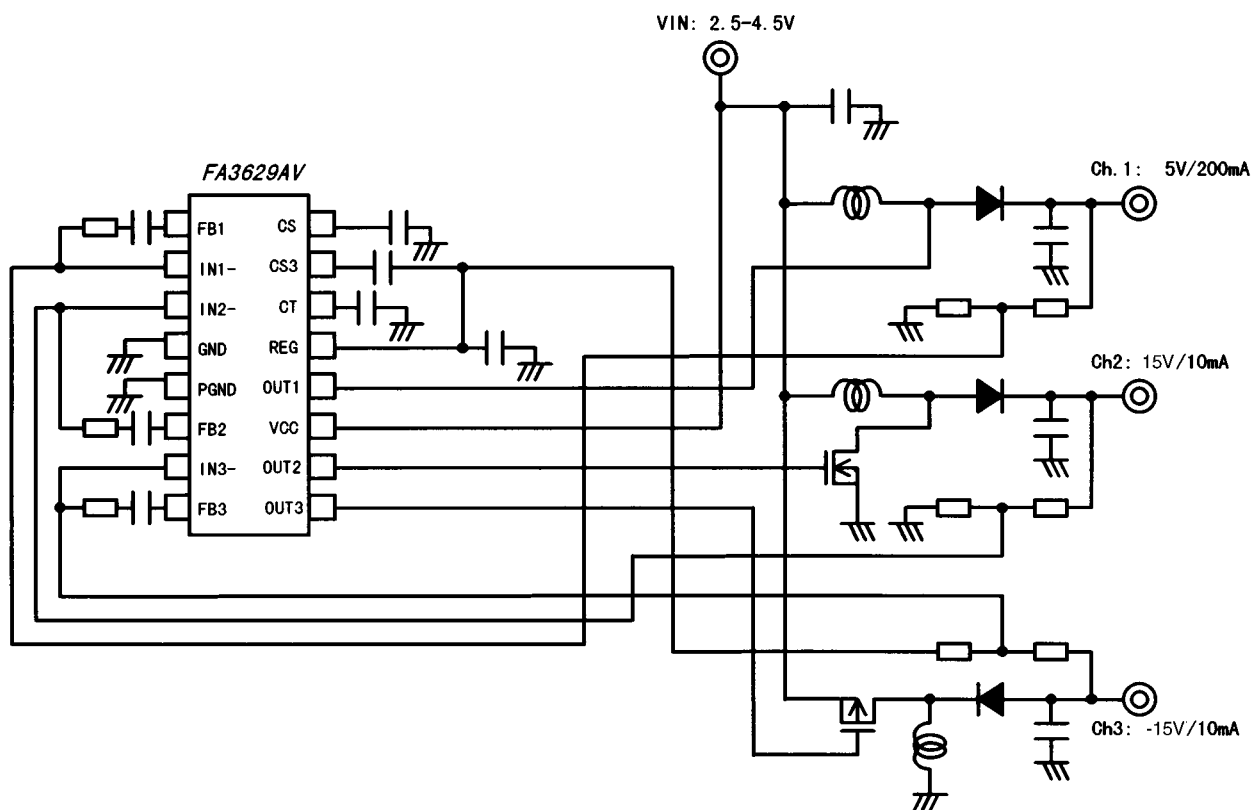
H-level output voltage (VoH) vs output source current (Iso)



L-level output voltage (VoL) vs. output sink current (Isi)



■ Application circuit



*Parts tolerances characteristics are not defined in the circuit design sample shown above. When designing an actual circuit for a product, you must determine parts tolerances and characteristics for safe and economical operation.*

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