

■ 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

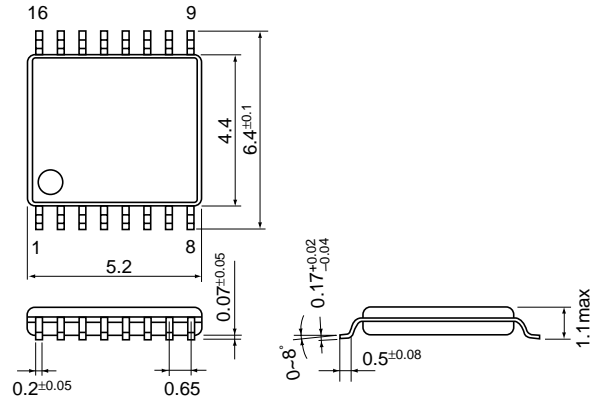
- Low input voltage: 2.5V to 6.5V
- 40V CDMOS Process:
 - Built-in 0.3Ω Nch-Power MOSFET(ch1, open drain)
- 3-channels PWM Control:
 - 2 boost circuits(ch1, ch2), 1 inverting circuit (ch3)
- Adjustable soft start time and maximum duty cycle
- Built-in timer latch for short circuit protection:
 - Delay 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

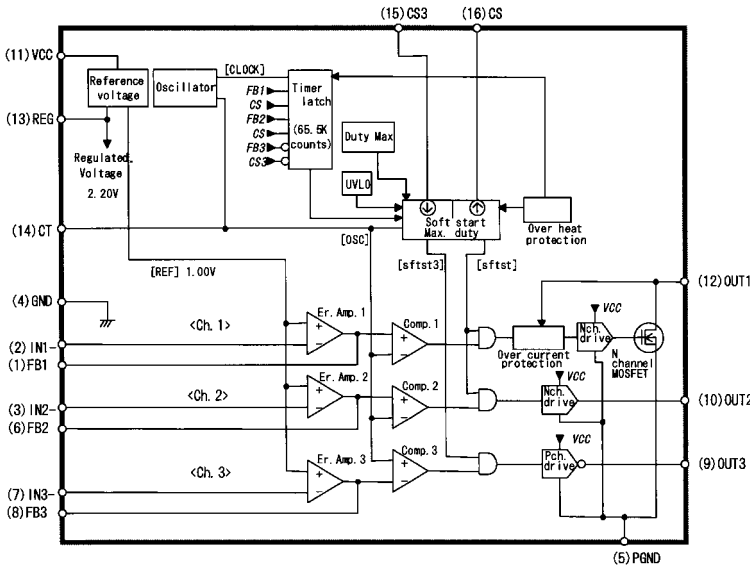
- Power supply for general equipment

■ 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 _{CC} | 6.5 | V |
| Output voltage at OUT1 pin | V _{OUT1} | 40 | V |
| Output current at OUT1 pin*1 | I _{OUT1} | 2.8 | A |
| Source peak current of OUT2 | I _{OUT2+} | -400 | mA |
| Sink peak current of OUT2 | I _{OUT2-} | 400 | mA |
| Source peak current of OUT3 | I _{OUT3+} | -400 | mA |
| Sink peak current of OUT3 | I _{OUT3-} | 400 | mA |
| Source average current of OUT2 | I _{OUT2+} | -50 | mA |
| Sink average current of OUT2 | I _{OUT2-} | 50 | mA |
| Source average current of OUT3 | I _{OUT3+} | -50 | mA |
| Sink average current of OUT3 | I _{OUT3-} | 50 | mA |
| Input voltage to err. amp. | V _{EI} | 5.0 | V |
| Total power dissipation*2 | P _d | 500 | mW |
| Ambient temperature | T _{OPR} | -25 to +95 | °C |
| Junction temperature | T _J | 125 | °C |
| Storage temperature | T _{STG} | -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 _{CC} | 2.5 | 5.8 | V |
| Output voltage of OUT1 | V _{OUT1} | 0 | 32 | V |
| Output current of OUT1 | I _{OUT1} | 0 | 1.8 | A |
| Oscillation frequency | f _{OSC} | 100 | 1000 | kHz |
| Ambient temperature | T _{OPR} | -20 | 85 | °C |

■ Electrical characteristics (V_{CC}=3.0V, Ta=25°C)

Reference voltage section

| Item | Symbol | Test condition | Min. | Typ. | Max. | Unit |
|-------------------------------|-----------------------|------------------------------|------|------|------|------|
| Reference voltage | V _{REF} | | 0.98 | 1.00 | 1.02 | V |
| Variation with supply voltage | V _{REF-LINE} | V _{CC} =2.5 to 5.8V | | 1 | 3 | mV |
| Variation with temperature | V _{REF-TC1} | Ta=-20 to +25°C | | 0.5 | 1.2 | % |
| | V _{REF-TC2} | 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 _{REG} | Co=0.1μF | 2.16 | 2.20 | 2.24 | V |
| Variation with supply voltage | V _{REG-LINE} | V _{CC} =2.5 to 5.8V | | 3 | 8 | mV |
| Variation with temperature | V _{REG-TC1} | Ta=-20 to +25°C | | 0.5 | 1.5 | % |
| | V _{REG-TC2} | Ta=+25 to +85°C | | 0.7 | 1.5 | % |
| Source current | I _{REG} | | -40 | | -15 | mA |

Oscillator section

| Item | Symbol | Test condition | Min. | Typ. | Max. | Unit |
|-------------------------------|-------------------|------------------------------|------|------|------|------|
| Oscillation frequency | f _{OSC} | C _T =150pF | 480 | 550 | 620 | kHz |
| High level voltage | V _{OSCH} | C _T =150pF | | 1.38 | | V |
| Low level voltage | V _{OSCL} | C _T =150pF | | 0.78 | | V |
| Variation with supply voltage | f _{dv} | V _{CC} =2.5 to 5.8V | | 1 | 2 | % |
| Variation with temperature | f _{dT1} | Ta=-20 to +25°C | | 5 | 7 | % |
| | f _{dT2} | 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 _{CS} | | -1.2 | -1.0 | -0.8 | μA |
| Charge current of CS3 (Sink) | I _{CS3} | | 0.8 | 1.0 | 1.2 | μA |
| Max. duty cycle of OUT1 & OUT2 | D _{max} | f _{OSC} =500kHz | 80 | 87 | 90 | % |
| Max. duty cycle of OUT3 | D _{max3} | f _{OSC} =500kHz | 80 | 86 | 90 | % |
| Invalid TL threshold voltage of CS | V _{CSLO} | | 0.42 | 0.52 | 0.62 | V |
| Invalid TL threshold voltage of CS3 | V _{CSHI} | | 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 _{TLTH1} | | 1.58 | 1.68 | 1.78 | V |
| Threshold voltage of FB2 (Ch. 2) | V _{TLTH2} | | 1.58 | 1.68 | 1.78 | V |
| Threshold voltage of FB3 (Ch. 3) | V _{TLTH3} | | 0.42 | 0.52 | 0.62 | V |
| Start up count | count | | - | 2 ¹⁶ | - | counts |
| Start up time | T _{TL} | C _T =150pF | 105 | 119 | 137 | ms |

Error amplifier section

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

Overcurrent protection section (OCP)

| Item | Symbol | Test condition | Min. | Typ. | Max. | Unit |
|-------------------|--------------------|-----------------------|------|------|------|------|
| Threshold current | I _{OCDTH} | V _{CC} =3.0V | 1.4 | 1.8 | 2.0 | A |
| | | V _{CC} =5.0V | 1.8 | 2.0 | 2.2 | A |
| Delay time | f _{OCD} | | 100 | 200 | 400 | ns |

Overheat protection section (OHP)

| Item | Symbol | Test condition | Min. | Typ. | Max. | Unit |
|-----------------------|-----------------|----------------|------|------|------|------|
| Threshold temperature | T _{OH} | | 125 | 135 | 145 | °C |

Undervoltage lockout circuit section (UVLO)

| Item | Symbol | Test condition | Min. | Typ. | Max. | Unit |
|--------------------------|-------------------|----------------|------|------|------|------|
| Threshold voltage of REG | V _{UVTH} | | 1.95 | 2.05 | 2.15 | V |

Output section (OUT1)

| Item | Symbol | Test condition | Min. | Typ. | Max. | Unit |
|-------------------------|-----------|-----------------------------|------|-------|------|----------|
| On resistance of MOSFET | R_{ON1} | $V_{CC}=3.0V, I_{O1}=200mA$ | 0.25 | 0.275 | 0.3 | Ω |
| Rise time of OUT1 | t_r | $V_{CC}=3.0V$ | | 25 | 35 | ns |
| Fall time of OUT1 | t_f | $V_{OUT1}=10V, I_{O1}=1.0A$ | | 25 | 35 | ns |

Output section (OUT2, OUT3)

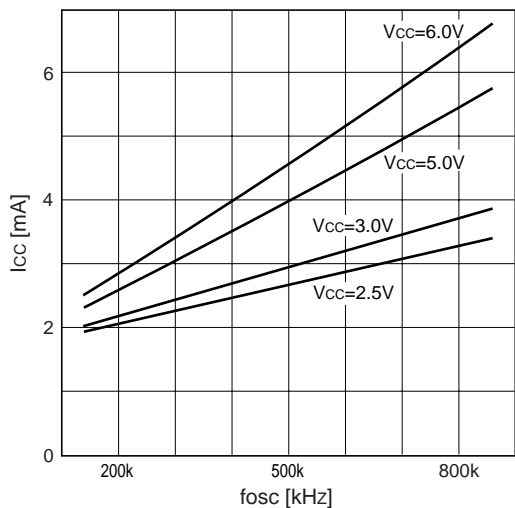
| Item | Symbol | Test condition | Min. | Typ. | Max. | Unit |
|----------------------------------|-----------|------------------------------|------|------|------|----------|
| Rise time of OUT2 | t_{r2} | $V_{CC}=3V, C_{O2}=1000pF$ | 20 | 25 | 35 | ns |
| Fall time of OUT2 | t_{f2} | (Between OUT2-GND) | 20 | 25 | 35 | ns |
| Rise time of OUT3 | t_{r3} | $V_{CC}=3V, C_{O3}=1000pF$ | 20 | 25 | 35 | ns |
| Fall time of OUT3 | t_{f3} | (Between VCC-OUT3) | 20 | 25 | 35 | ns |
| High level on resistance of OUT2 | R_{2AH} | $V_{CC}=3V, I_{OUT2}=-150mA$ | 2.5 | 4.0 | 5.5 | Ω |
| Low level on resistance of OUT2 | R_{2AL} | $V_{CC}=3V, I_{OUT2}=150mA$ | 2.5 | 4.0 | 5.5 | Ω |
| High level on resistance of OUT3 | R_{3AH} | $V_{CC}=3V, I_{OUT3}=-150mA$ | 2.5 | 4.0 | 5.5 | Ω |
| Low level on resistance of OUT3 | R_{3AL} | $V_{CC}=3V, I_{OUT3}=150mA$ | 2.5 | 4.0 | 5.5 | Ω |
| High level on resistance of OUT2 | R_{2AH} | $V_{CC}=5V, I_{OUT2}=-150mA$ | 2.0 | 3.5 | 5.0 | Ω |
| Low level on resistance of OUT2 | R_{2AL} | $V_{CC}=5V, I_{OUT2}=150mA$ | 2.0 | 3.5 | 5.0 | Ω |
| High level on resistance of OUT3 | R_{3AH} | $V_{CC}=5V, I_{OUT3}=-150mA$ | 2.0 | 3.5 | 5.0 | Ω |
| Low level on resistance of OUT3 | R_{3AL} | $V_{CC}=5V, I_{OUT3}=150mA$ | 2.0 | 3.5 | 5.0 | Ω |

Overall device

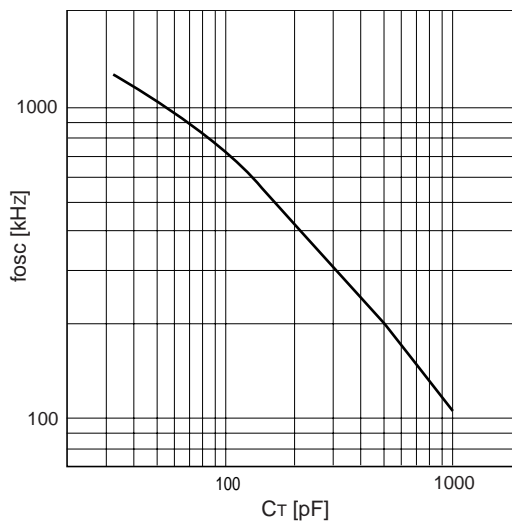
| Item | Symbol | Test condition | Min. | Typ. | Max. | Unit |
|-------------------------------------|------------|--------------------------|------|------|------|------|
| Operating current (Overall) | I_{CCA} | $D=50\%, f_{osc}=500kHz$ | | 3.0 | 3.8 | mA |
| Operating current of control blocks | I_{CTRL} | | | 1.8 | | mA |

■ Characteristic curves (Ta=25°C)

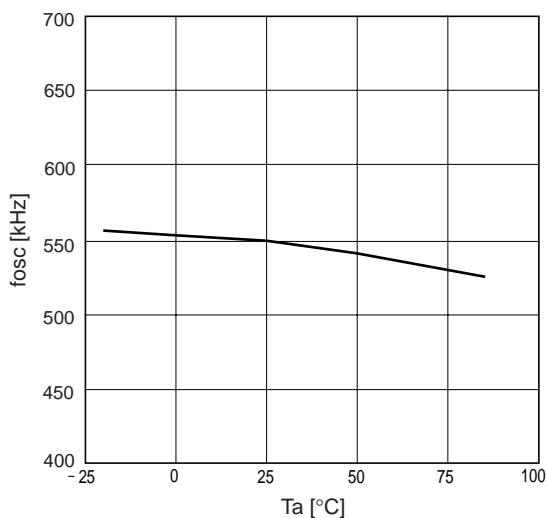
Supply current (I_{CC}) vs oscillation frequency (f_{osc})



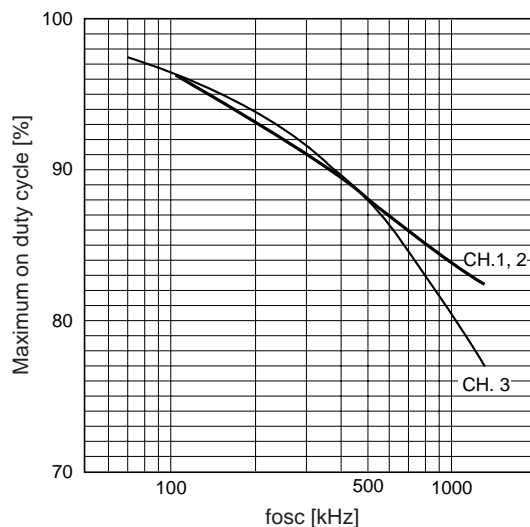
Oscillation frequency (f_{osc}) vs. timing capacitor (C_T)



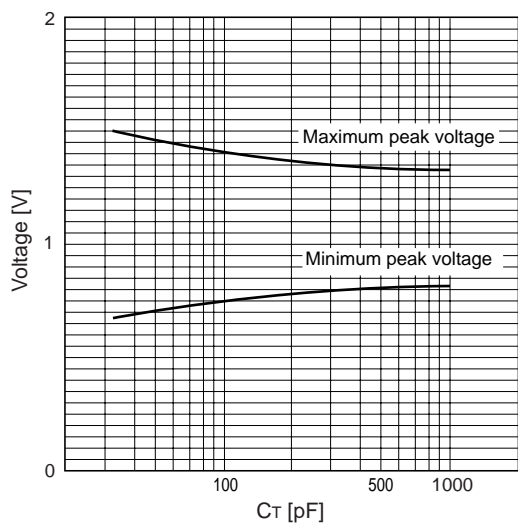
Oscillation frequency (f_{osc}) vs. ambient temperature (Ta)



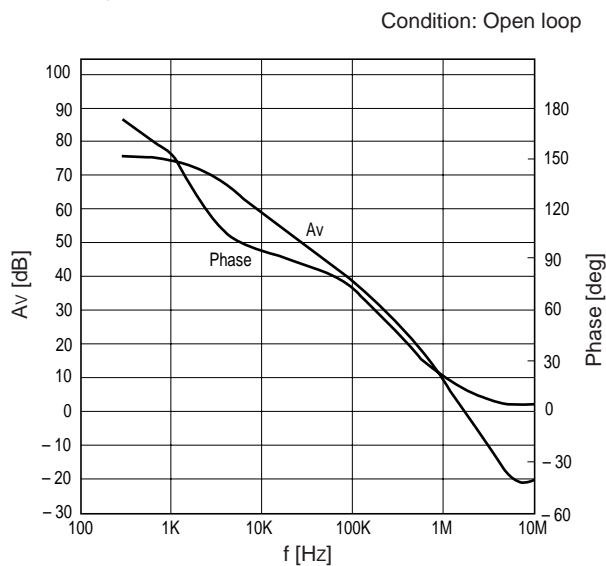
Max. on duty cycle vs. oscillation frequency (f_{osc})



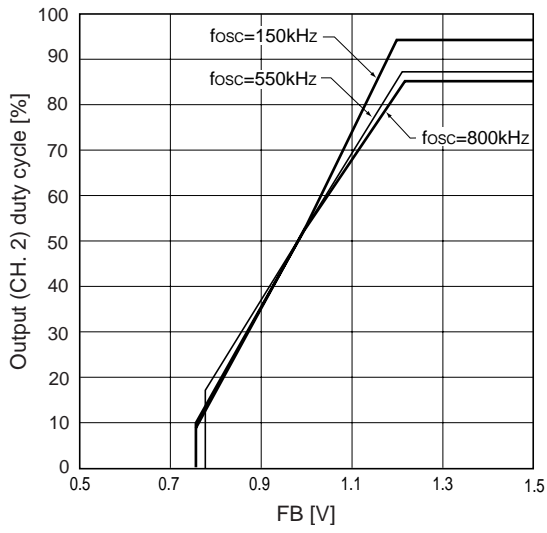
Oscillation peak voltage vs. timing capacitor (C_T)



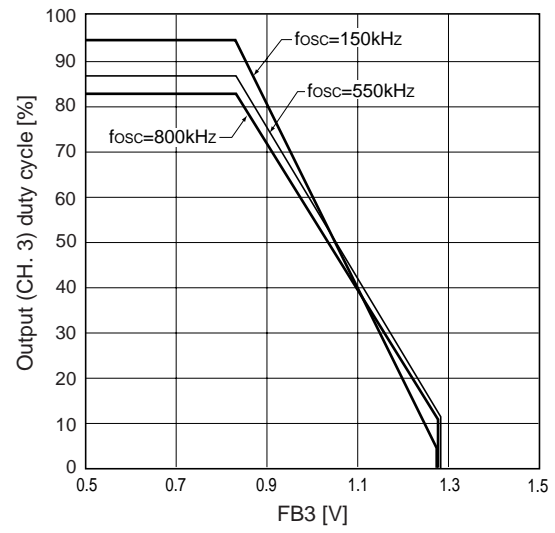
Error amplifier voltage gain (A_v) /phase vs. frequency (f)



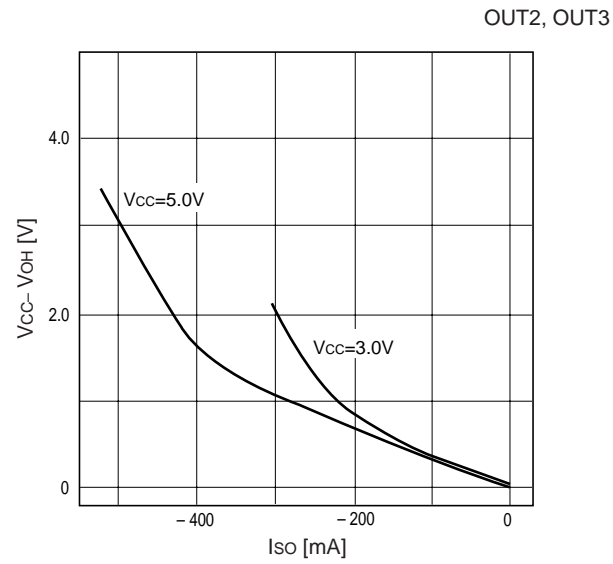
Output (Ch. 2) duty cycle vs FB terminal voltage (V_{FB})



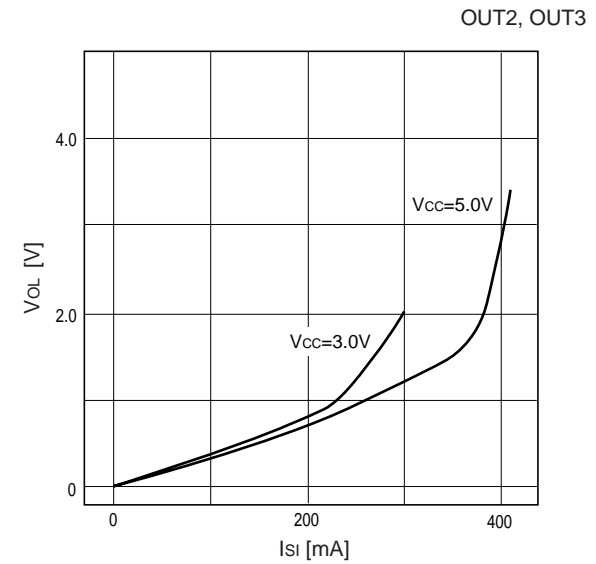
Output (Ch. 3) duty cycle vs. FB3 terminal voltage (V_{FB3})



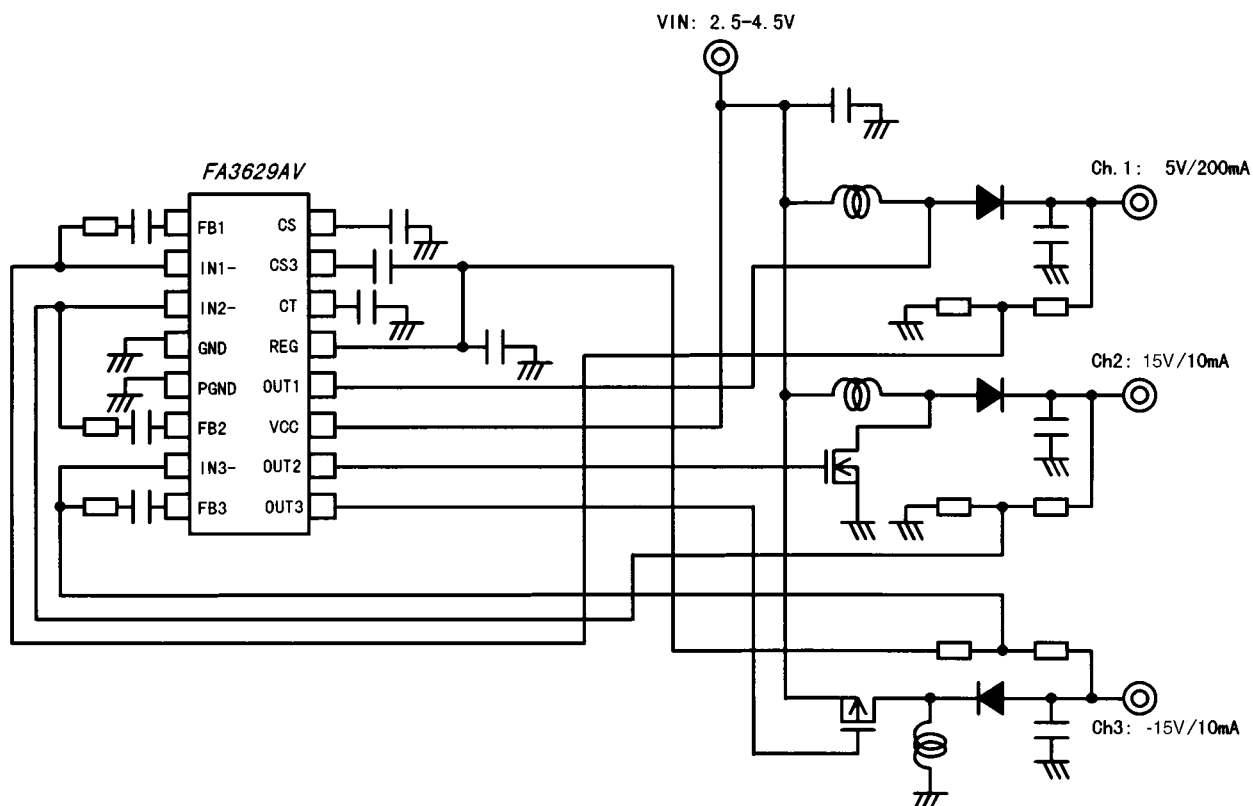
H-level output voltage (V_{OH}) vs output source current (I_{SO})



L-level output voltage (V_{OL}) vs. output sink current (I_{SI})



■ 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.