Ordering number: EN 3222A

Monolithic Linear IC

SANYO No.3222A

# LA5601

## Low Dropout Regulator with Reset

## Overview

The LA5601 is a voltage regulator with a low-voltage detector and reset controller for use in microprocessor-based systems. It generates a reset signal for low power supply voltage. It also features a low 0.25V (typ.) dropout voltage for reduced power dissipation and power supply size. Applications include microprocessor-controlled consumer electronic equipment such as CD players,tuners and receivers, and preamplifiers.

## Functions

- Low dropout regulator with 250mA and 5.2V output
- Power supply reset generator function
- Supports on-off control of 5.2V using equipped enable pin (high active)
- Built-in Darlington driver (120mA)
- Built-in auxiliary regulator (5.2V, 250mA)

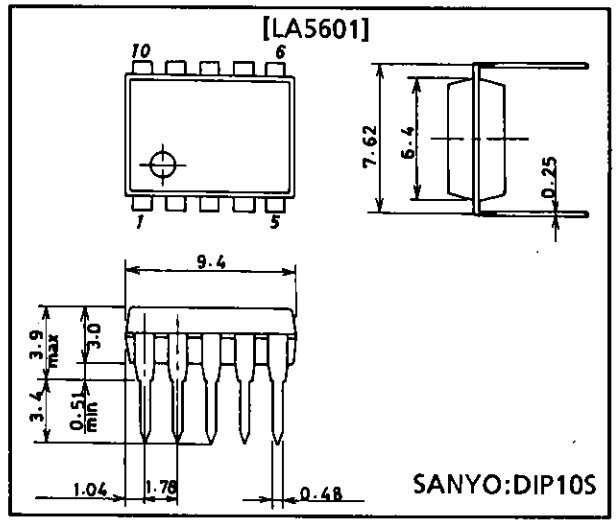
## Features

- Low minimum input -output voltage difference (0.3V typ.)
- Supports setting of reset output delay time using external capacitor
- Built-in fold-back current limiting circuit and excessive heat protection circuit.
- Reset output using active pull-up for simpler noise reduction and use with internal pull-down logic circuits
- Error amplifier noise filter pin
- Auxiliary regulator with reverse current protection

## Package Dimensions

unit:mm

3098-DIP10S




## Specifications

Maximum Ratings at Ta = 25°C

| | | | unit |
|---|---|---|---|
| Input Voltage | $V_{IN}$ max | 15 | V |
| Enable Pin Voltage | $V_{EN}$ max | $V_{IN}$ max | V |
| Reset Output Pin Voltage | $V_{\overline{RES}}$ max | 15 | V |
| Driver Output Voltage | $V_{OD}$ max | 15 | V |
| Driver Input Voltage | $V_{ID}$ max | 15 | V |
| Allowable Power Dissipation | Pd max | 1 | W |
| Operating Temperature | Topr | −30 to +80 | °C |
| Storage Temperature | Tstg | −55 to +150 | °C |

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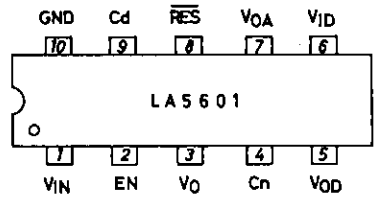
**Operating Conditions** at Ta = 25°C

| | | | | unit |
|---|---|---|---|---|
| Input Voltage | $V_{IN}$ | | 5.9 to 14 | V |
| Output Current | $I_{OUT}$ | | 0 to 250 | mA |
| 'H'-Level Reset Output Current | $I_{\overline{ORH}}$ | | 0 to 200 | μA |
| 'L'-Level Reset Output Current | $I_{\overline{ORL}}$ | | 0 to 2 | mA |
| Auxiliary Regulator Output Current | $I_{OA}$ | | 0 to 10 | mA |
| Driver Output Voltage | $V_{OD}$ max | | 14 | V |
| 'L'-Level Driver Output Current | $I_{ODL}$ max | | 120 | mA |
| 'H'-Level Driver Input Voltage | $V_{IDH}$ | $I_{ODL}$ = 120mA | 3 to 14 | V |
| 'L'-Level Driver Input Voltage | $V_{IDL}$ | $I_{ODL} \leqq 100\mu A$ | −0.3 to +0.3 | V |

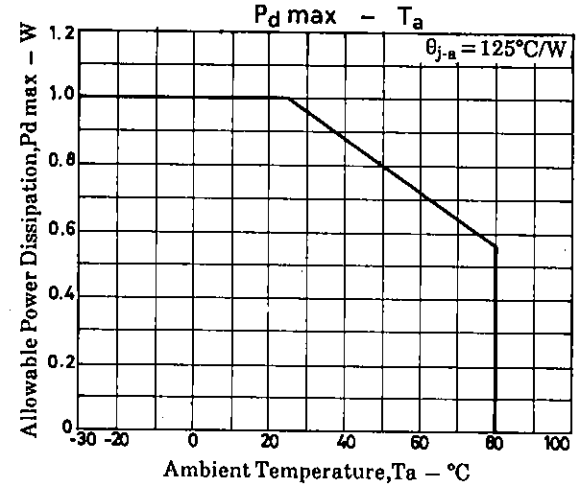
**Operating Characteristics** at Tj = 25°C, $V_{IN}$ = 6V, $I_{OUT}$ = 200mA, See specified Test Circuit.

| [Main regulator : Output ON-state, $V_{EN}$ = 'H' or open] | | | min | typ | max | unit |
|---|---|---|---|---|---|---|
| Output Voltage | $V_O$ | | 5.0 | 5.2 | 5.4 | V |
| Dropout Voltage | $V_{DROP}$ | $I_{OUT}$ = 250mA | | 0.25 | 0.5 | V |
| Line Regulation | $\Delta V_{OLN}1$ | $5.5V \leqq V_{IN} \leqq 14V$ | | 30 | 80 | mV |
| | $\Delta V_{OLN}2$ | $6V \leqq V_{IN} \leqq 14V$ | | 20 | 40 | mV |
| Load Regulation | $\Delta V_{OLD}1$ | $5mA \leqq I_{OUT} \leqq 250mA$ | | 40 | 100 | mV |
| | $\Delta V_{OLD}2$ | $5mA \leqq I_{OUT} \leqq 100mA$ | | 14 | 50 | mV |
| Peak Output Current | $I_{OP}$ | | 250 | 500 | | mA |
| Output Short Current | $I_{OSC}$ | | | 80 | 300 | mA |
| **Current Drain** | $I_Q1$ | $I_{OUT}$ = 0 | | 2.2 | 6 | mA |
| | $I_Q2$ | | | 10 | 30 | mA |
| Output Noise Voltage | $V_{NO}$ | $10Hz \leqq f \leqq 100kHz$ | | 70 | | μVrms |
| Temperature Coefficient of Output Voltage | $\Delta V_O/\Delta Tj$ | Tj = 25 to 80°C | | −0.7 | | mV/°C |
| Ripple Rejection | Rrej | f = 120Hz, $7V \leqq V_{IN} \leqq 13V$ | | 74 | | dB |
| Output ON-State Control Voltage | $V_{ENH}$ | Main regulator, driver ON | 2.6 | | $V_{IN}$ | V |
| [Main regulator : Output OFF-state, $V_{EN}$ = 'L'] | | | | | | |
| 'L'-Level Output Voltage | $V_{O\,OFF}$ | $V_{EN}$ = 0 | | 50 | 200 | mV |
| Quiescent Current | $I_{Q\,OFF}$ | $V_{EN}$ = 0 | | 1.5 | 4 | mA |
| Output OFF-State Control Voltage | $V_{ENL}$ | Main regulator, driver OFF | | | 1.0 | V |
| [Reset circuit] | | | | | | |
| 'H'-Level Reset Output Voltage | $V_{\overline{ORH}}$ | $I_{\overline{ORH}}$ = 200μA | 4.97 | 5.17 | 5.37 | V |
| 'L'-Level Reset Output Voltage | $V_{\overline{ORL}}$ | $I_{\overline{ORL}}$ = 2mA, $V_{IN}$ = 3.7V | | 90 | 200 | mV |
| Reset Threshold Voltage | $V_{RT}$ | $I_{OUT}$ = 5mA | 3.7 | 3.9 | 4.1 | V |
| Reset Hysteresis Voltage | $V_{hys}$ | $I_{OUT}$ = 5mA | 50 | 150 | 300 | mV |
| Reset Output Delay Time | $t_d$ | $C_d$ = 0.1μF | 7.5 | 10 | 12.5 | mS |
| [Auxiliary regulator] | | | | | | |
| Output Voltage | $V_{OA}$ | $I_{OA}$ = 5mA | 3.2 | 3.4 | 3.6 | V |
| Line Regulation | $\Delta V_{OA\,LN}$ | $6V \leqq V_{IN} \leqq 14V$, $I_{OA}$ = 5mA | | 15 | 40 | mV |
| Load Regulation | $\Delta V_{OA\,LD}$ | $2mA \leqq I_{OA} \leqq 10mA$ | | 130 | 200 | mV |
| Output Short Current | $I_{OASC}$ | | 10 | 30 | | mA |
| Output Pin Leakage Current | $I_{OA\,LEAK}$ | $V_{IN}$ = 0, $V_{OA}$ = 6V | | | 2 | μA |
| [Darlington driver] | | | | | | |
| 'L'-Level Driver Output Voltage | $V_{ODL}1$ | $I_{ODL}$ = 80mA, $V_{ID}$ = 3V | | 1.1 | 1.6 | V |
| | $V_{ODL}2$ | $I_{ODL}$ = 120mA, $V_{ID}$ = 3V | | 1.2 | 1.8 | V |
| 'H'-Level Driver Input Current | $I_{IDH}$ | $I_{ODL}$ = 120mA, $V_{ID}$ = 3V | | 0.4 | 1 | mA |
| Output Pin Leakage Current | $I_{ODH}$ | $V_{IH}$ = 14V, $V_{OD}$ = 14V, $V_{ID}$ = 0.3V | | | 50 | μA |

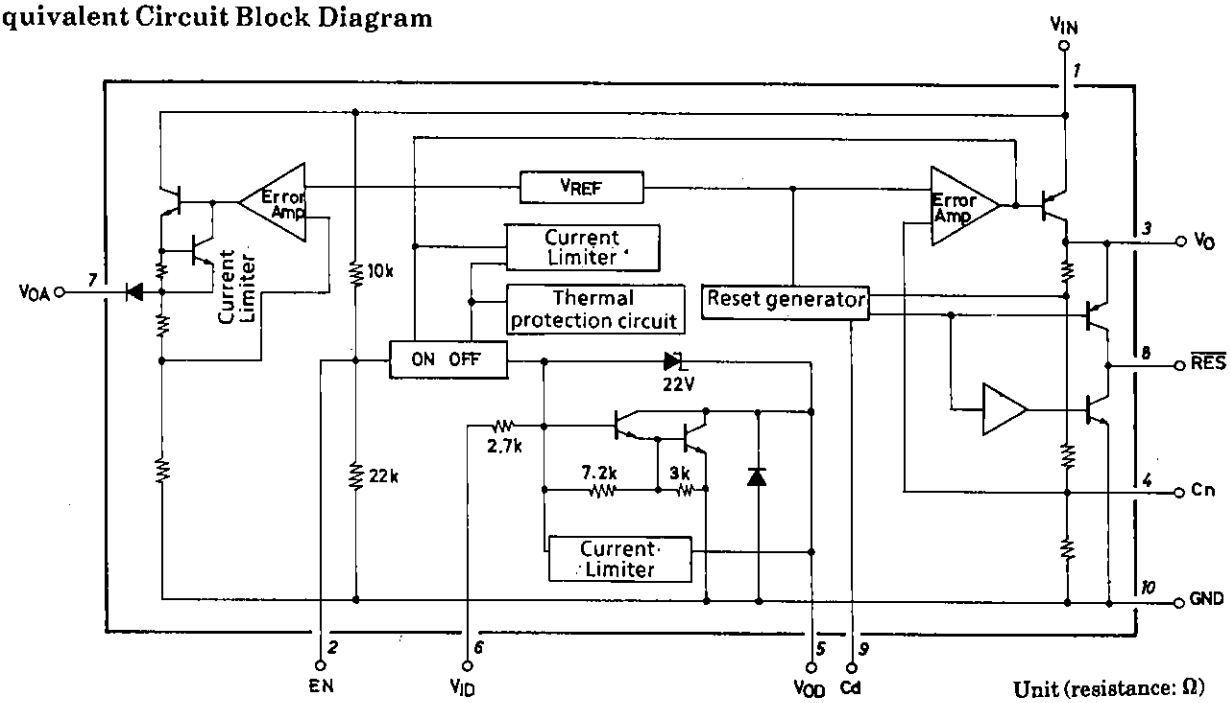
## Pin Assignment




Top view

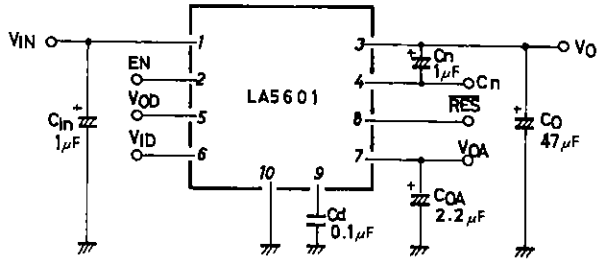



## Equivalent Circuit Block Diagram

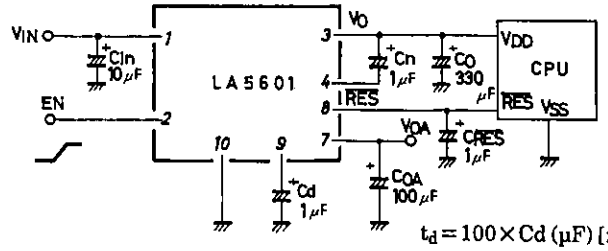



Unit (resistance: Ω)

## Specified Test Circuit




## Sample Application Circuit 1

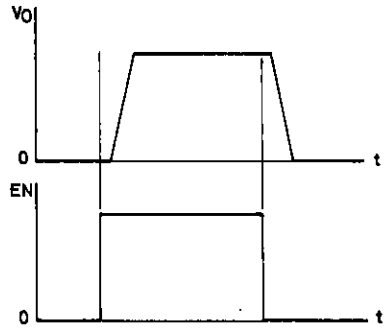



Note) 1. Capacitors $C_n$ and $C_{\overline{RES}}$ are only required if problems are experienced with noise from external sources.
2. If capacitor $C_n$ is present, ensure that $C_o$ is at least more than one-third of the value of $C_{in}$ in order to prevent output noise at power-down due to capacitor discharge timing.
3. The minimum recommended value of output capacitor $C_o$ is 47μF.
4. Use a low temperature coefficient capacitor for the delay time capacitor $C_d$.

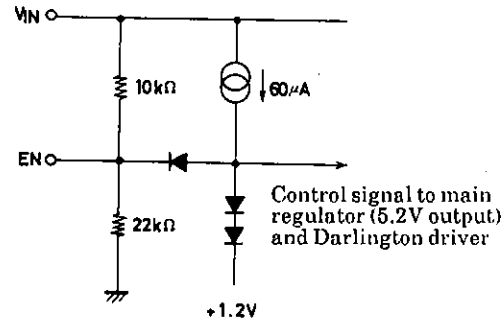
## Function Table

| $V_{EN}$ | $V_O$ | Driver |
|---|---|---|
| L | L | OFF |
| H | H | ON |

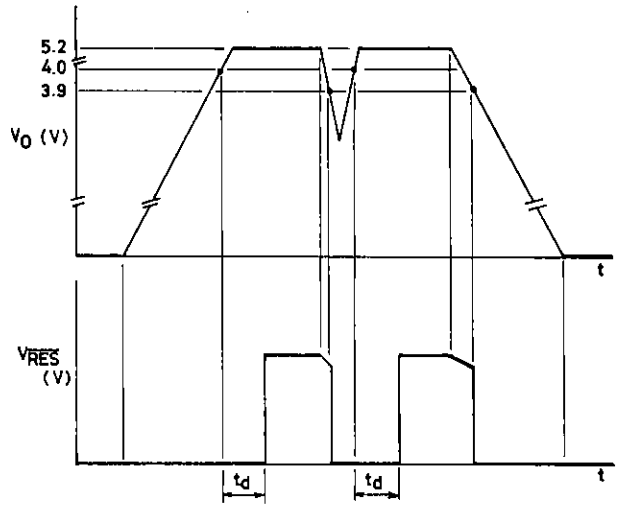
$V_{EN}$ = 'H' or open.



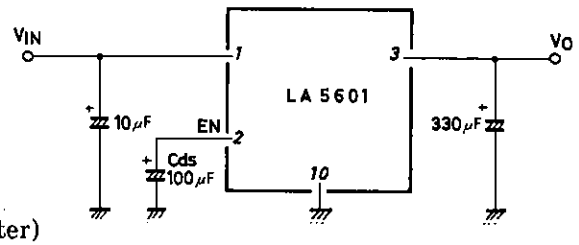

## Enable Circuit



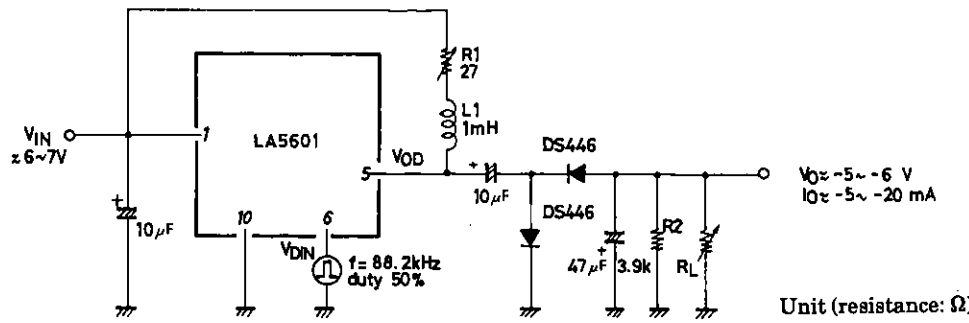

## Reset Operation




## Sample Application Circuit 2
(Delay start regulator)




## Sample Application Circuit 3
(Positive-to-negative DC converter)

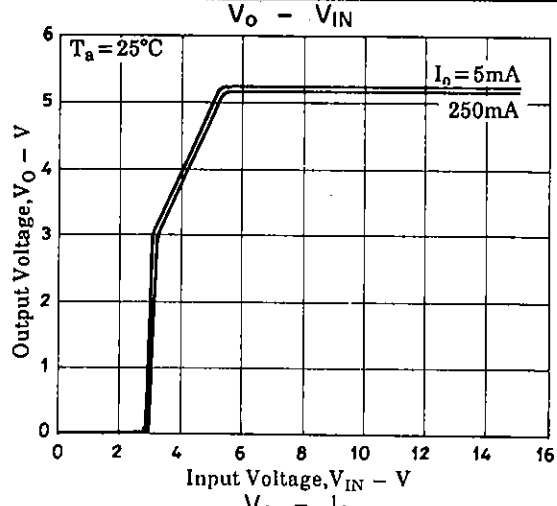



Note) 1. The output voltage can be fine-trimmed by adjusting R1. To protect the output transistor against over voltage, ensure that either R1 is non zero or use a low-Q coil for L1.

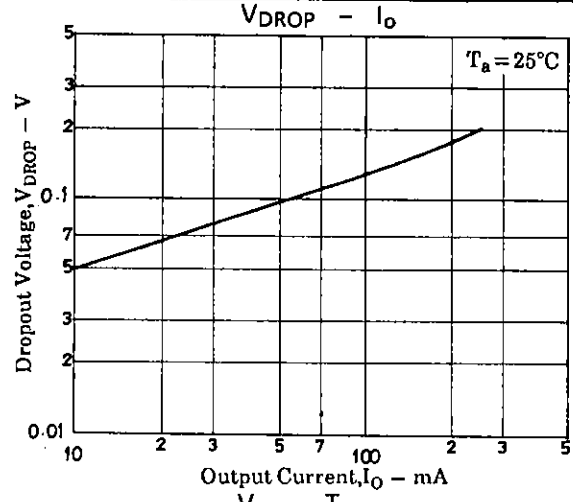
2. A load must always be present on power-up. To safeguard against excessive output voltages that occur when the circuit is powered up without a load, a dummy load resistor is recommended. This is shown on the circuit as R2.

3. Select $V_{IN}$, R1 and L1 so that $V_{OD}$<14V, and $I_{ODL}$<120mA. The component values shown require that $V_{IN}$ never exceeds 9V.

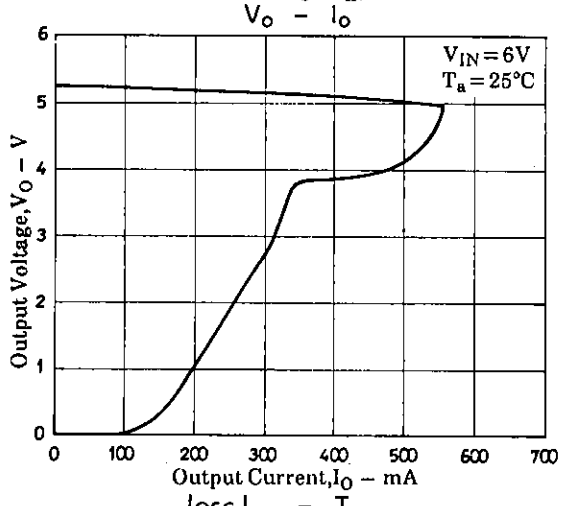
$V_O - V_{IN}$



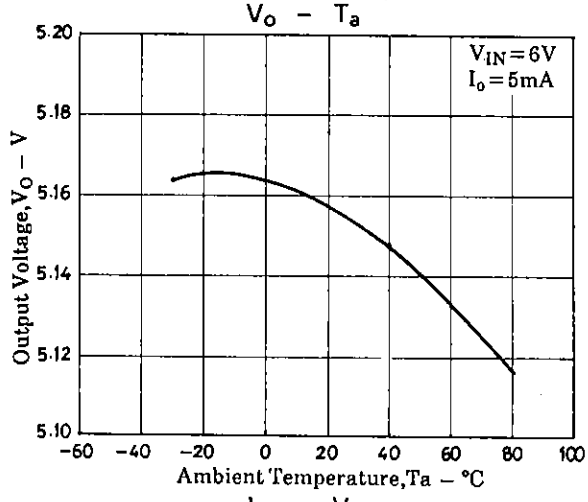

$V_{DROP} - I_O$



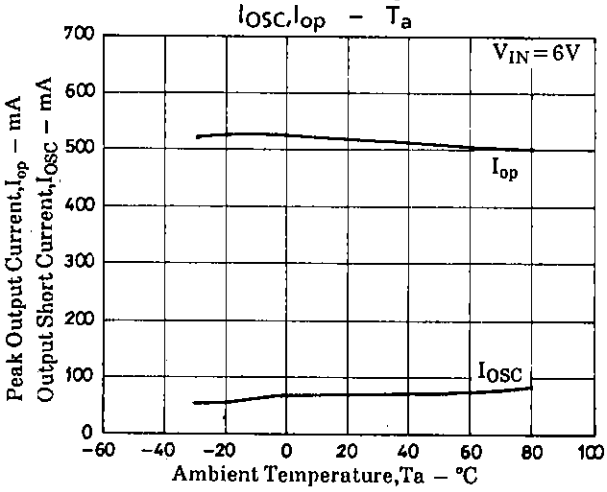

$V_O - I_O$



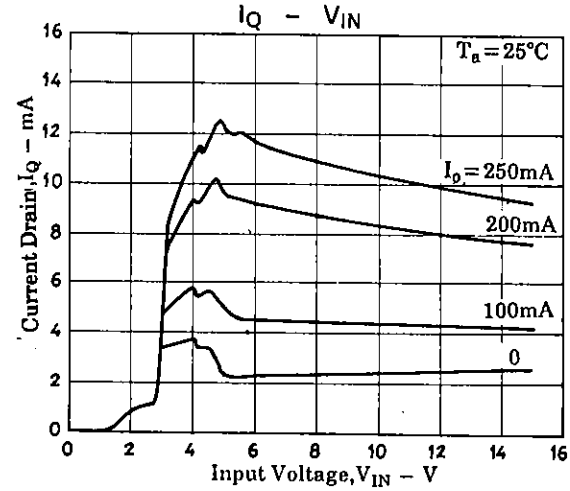

$V_O - T_a$



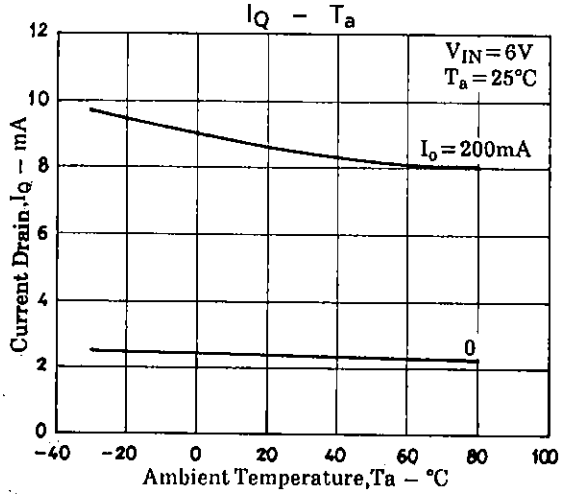

$I_{OSC}, I_{op} - T_a$



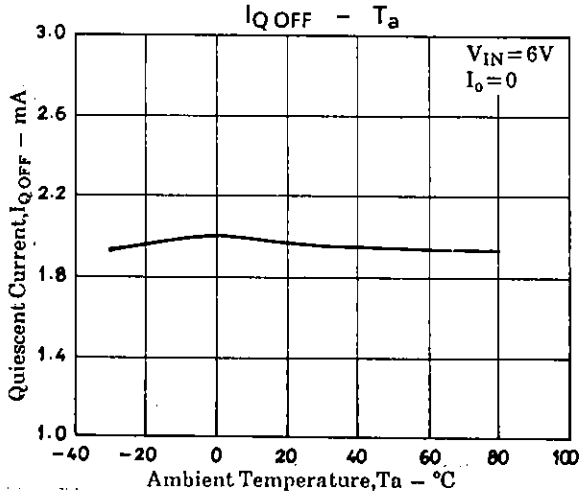

$I_Q - V_{IN}$



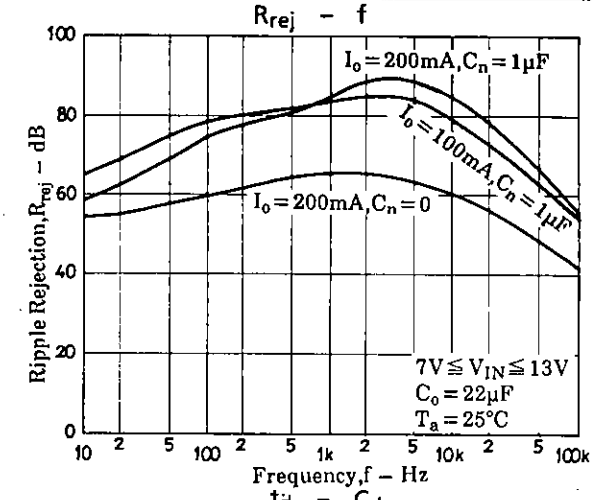

$I_Q - T_a$



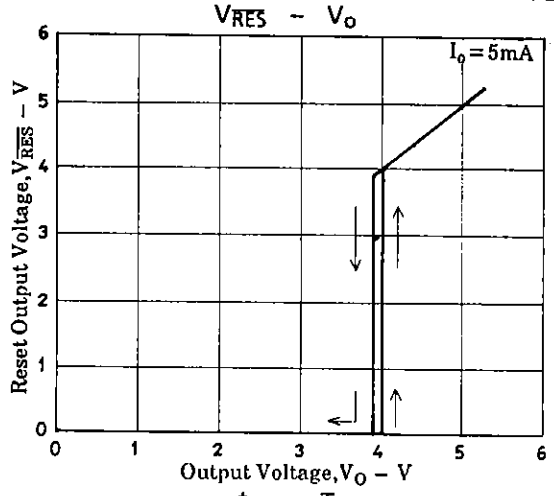

$I_{Q\,OFF} - T_a$



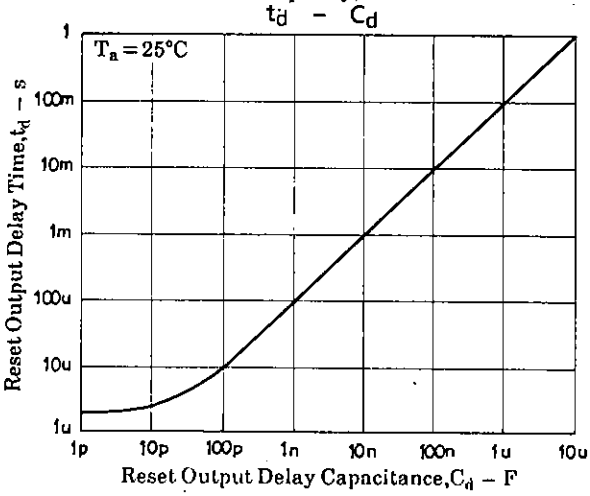
$R_{rej}$ – f



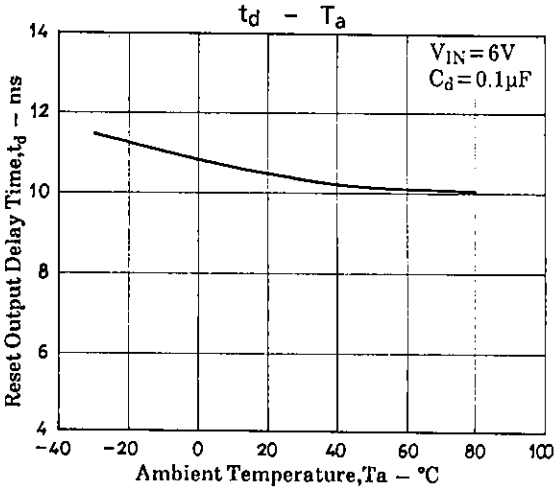

$V_{\overline{RES}}$ – $V_O$



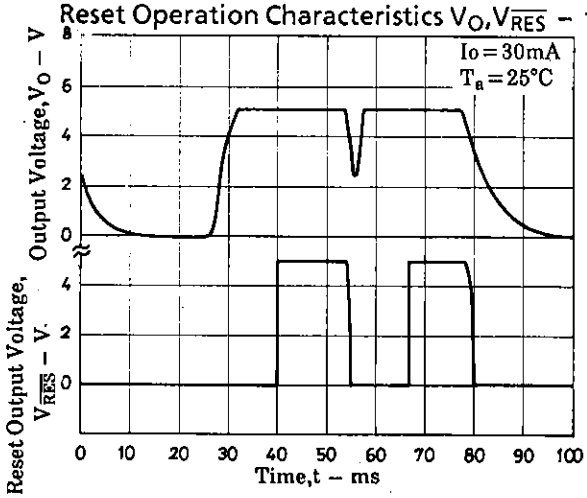

$t_d$ – $C_d$



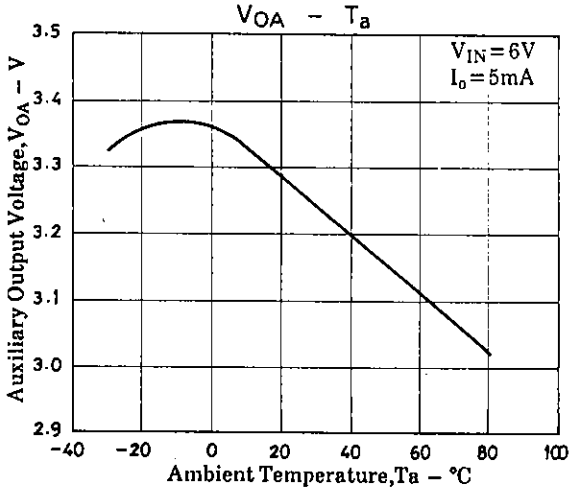

$t_d$ – $T_a$



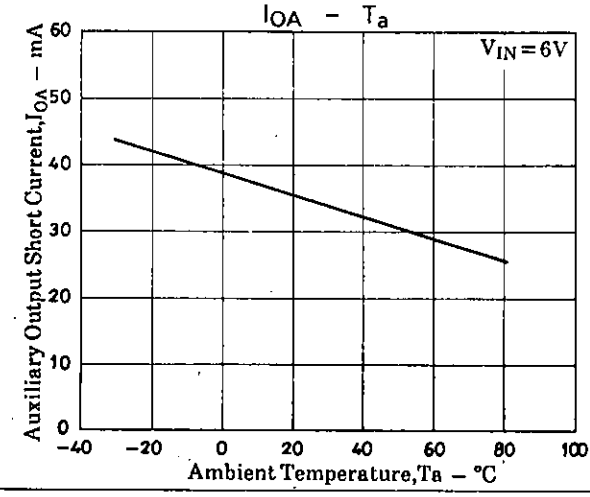

Reset Operation Characteristics $V_O$, $V_{\overline{RES}}$ – t



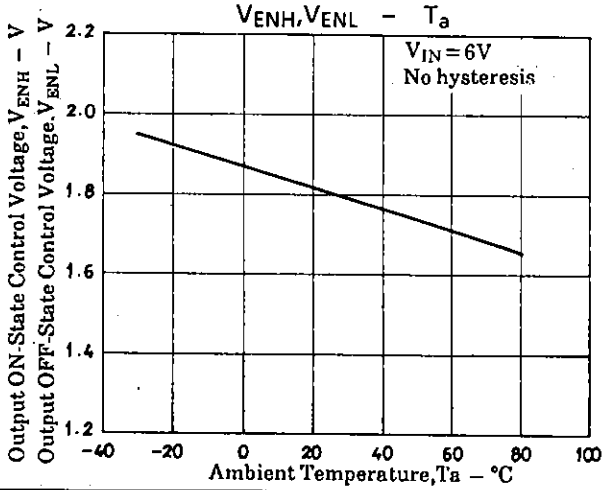

$V_{OA}$ – $T_a$



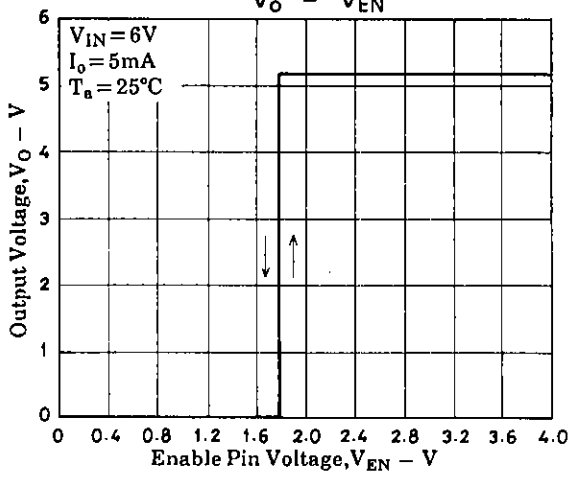

$I_{OA}$ – $T_a$



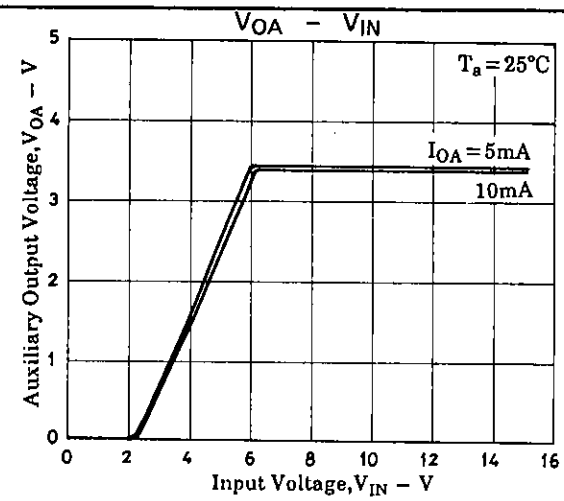

$V_{ENH}$, $V_{ENL}$ – $T_a$



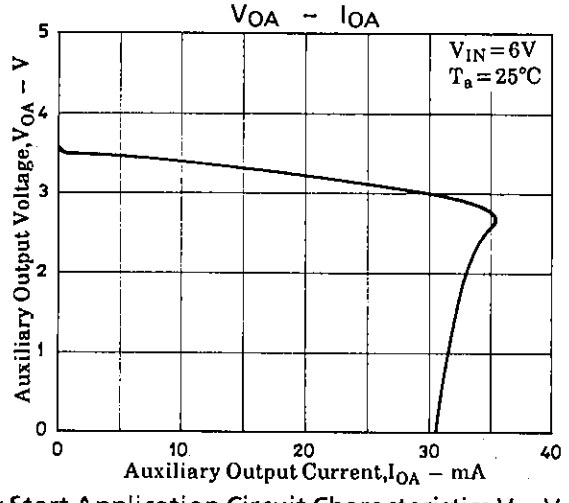
$V_O - V_{EN}$



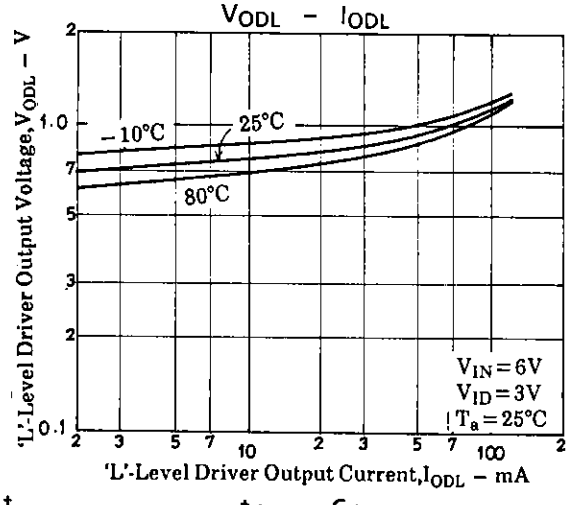

$V_{OA} - V_{IN}$



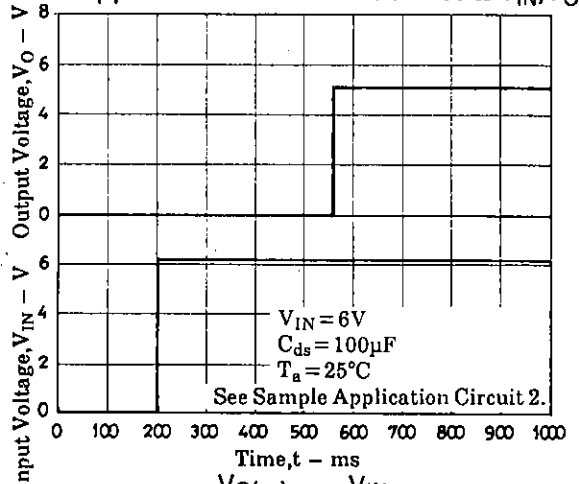

$V_{OA} - I_{OA}$



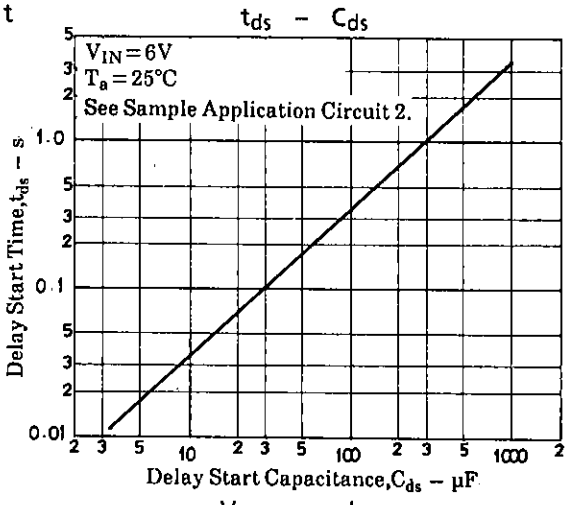

$V_{ODL} - I_{ODL}$



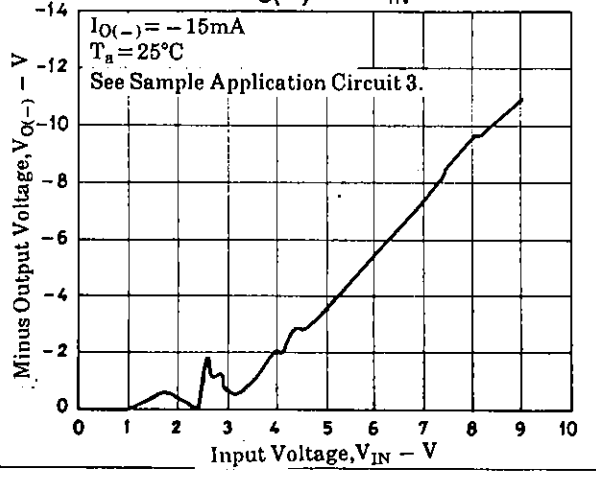

Delay Start Application Circuit Characteristics $V_{IN}, V_O - t$




$t_{ds} - C_{ds}$




$V_{O(-)} - V_{IN}$




$V_{O(-)} - I_{O(-)}$