

## Features

- Current-controlled Output Current Source with 4 Input Channels
- Low-power Consumption
- Output Current up to 150 mA, Read Channel and Channel 2
- Output Current up to 200 mA, Channel 3 and Channel 4
- Total Output Current to 300 mA
- Rise Time 1.0 ns, Fall Time 1.1 ns
- On-chip RF Oscillator
- Control Frequency and Swings by Use of 2 External Resistors
- Oscillator Frequency Range from 200 MHz to 600 MHz
- Oscillator Swing to 100 mA
- Single 5 V Power Supply
- Common Enable/Disable Input
- TTL/CMOS Control Signals
- Small SSO16 Package

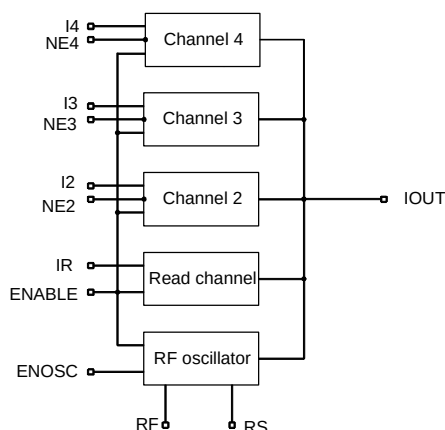
## Application

- DVD-RAM
- DVD-RW
- DVD+RW
- CD-RW
- Writable Optical Drives

## Description

The T0820 is a laser diode driver for the operation of a grounded laser diode for writable optical drives. It includes four channels for four different optical power levels which are controlled by a separate IC. The read channel generates a continuous output level whereas channels 2 to 4 are provided as write channels with very fast switching speeds. Write current pulses are enabled when a "low" signal is applied to the NE pins. All channels are summed together at the IOOUT pin. Read channel and channel 2 can contribute up to 150 mA and channels 3 and 4 up to 200 mA to the total output current of up to 300 mA. A total gain of 100 is provided between each reference current input and the selected output. Although the reference inputs are current inputs voltage control is possible by using external resistors. Frequency and swing can be set by two external resistors. Oscillation is enabled by a "high" at the ENOSC pin. Complete output current and oscillator switch-off is achieved by a 'low' at the ENABLE input.

**Figure 1.** Block Diagram



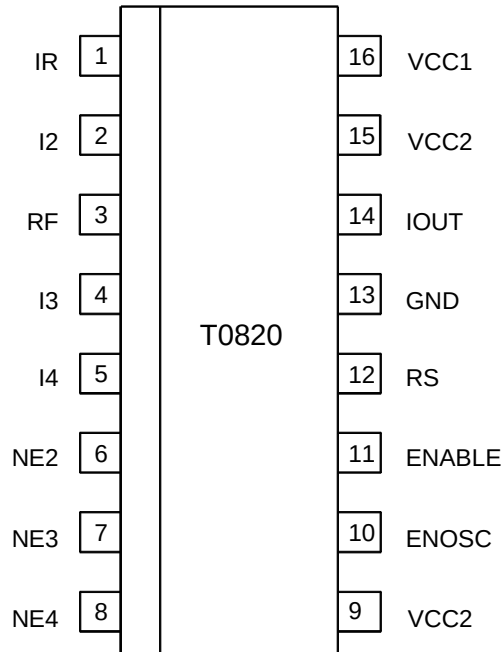
## 4-Channel Laser Driver with RF Oscillator

**T0820**



## Pin Configuration

**Figure 2.** Pinning SSO16



## Pin Description

| Pin | Symbol | Type    | Function                                           |
|-----|--------|---------|----------------------------------------------------|
| 1   | IR     | analog  | Input current, bias voltage approximately GND      |
| 2   | I2     | analog  | Input current, bias voltage approximately GND      |
| 3   | RF     | analog  | External resistor to GND sets oscillator frequency |
| 4   | I3     | analog  | Input current, bias voltage approximately GND      |
| 5   | I4     | analog  | Input current, bias voltage approximately GND      |
| 6   | NE2    | digital | Digital control of channel 2 (low active)          |
| 7   | NE3    | digital | Digital control of channel 3 (low active)          |
| 8   | NE4    | digital | Digital control of channel 4 (low active)          |
| 9   | VCC2   | supply  | +5 V power supply for IOOUT                        |
| 10  | ENOSC  | digital | Enables RF oscillator (high active)                |
| 11  | ENABLE | digital | Enables output current (high active)               |
| 12  | RS     | analog  | External resistor to GND sets oscillator swing     |
| 13  | GND    | supply  | Ground                                             |
| 14  | IOOUT  | analog  | Output current source for laser diode              |
| 15  | VCC2   | supply  | +5 V power supply for IOOUT                        |
| 16  | VCC1   | supply  | +5 V power supply for circuit                      |

## Absolute Maximum Ratings

| Parameters                            | Symbol    | Value                                  | Unit |
|---------------------------------------|-----------|----------------------------------------|------|
| Supply voltage                        | $V_{CC}$  | -0.5 to +6.0                           | V    |
| Input voltage at IR, I2, I3, I4       | $V_{IN1}$ | -0.5 to +0.8                           | V    |
| Input voltage at NE2, NE3, NE4, ENOSC | $V_{IN2}$ | -0.5 to $V_{CC} + 0.5$                 | V    |
| Output voltage                        | $V_{OUT}$ | -0.5 to $V_{CC} - 1$                   | V    |
| Power dissipation                     | $P_{MAX}$ | 0.7 <sup>(1)</sup> to 1 <sup>(2)</sup> | W    |
| Junction temperature                  | $T_J$     | 150                                    | °C   |
| Storage temperature range             | $T_{stg}$ | -65 to +125                            | °C   |

Notes: 1.  $R_{thJA} \leq 115 \text{ k/W}$ ,  $T_{amb} = 70^\circ\text{C}$

2.  $R_{thJA} \leq 115 \text{ k/W}$ ,  $T_{amb} = 25^\circ\text{C}$

## Thermal Resistance

| Parameters       | Symbol     | Value              | Unit |
|------------------|------------|--------------------|------|
| Junction ambient | $R_{thJA}$ | 115 <sup>(1)</sup> | K/W  |

Note: 1. Measured with multi-layer test board (JEDEC standard)

## Operating Range

| Parameters                                           | Symbol                           | Value      | Unit |
|------------------------------------------------------|----------------------------------|------------|------|
| Supply voltage range                                 | VCC                              | 4.5 to 5.5 | V    |
| Input current                                        | $I_{IR}, I_{I2}, I_{I3}, I_{I4}$ | < 2        | mA   |
| External resistor to GND to set oscillator frequency | RF                               | > 3        | kΩ   |
| External resistor to GND to set oscillator swing     | RS                               | > 100      | Ω    |
| Operating temperature range                          | $T_{amb}$                        | 0 to +70   | °C   |

## Electrical Characteristics: General

$V_{CC} = 5\text{ V}$ ,  $T_{amb} = 25^{\circ}\text{C}$ , ENABLE = High, NE2 = NE3 = NE4 = High, ENOSC = Low, unless otherwise specified

| No.      | Parameters                                     | Test Condition                                                                                                                | Pin       | Symbol      | Min. | Typ. | Max. | Unit          | Type* |
|----------|------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|-----------|-------------|------|------|------|---------------|-------|
| <b>1</b> | <b>Power supply</b>                            |                                                                                                                               |           |             |      |      |      |               |       |
| 1.1      | Supply current, power down                     | ENABLE = Low, NE2 = NE3 = NE4 = Low                                                                                           | 9, 15, 16 | $ICC_{PD2}$ |      | 0.3  |      | mA            | A     |
| 1.2      | Supply current, read mode, oscillator disabled | $I_{IR} = I_{I2} = I_{I3} = I_{I4} = 500\text{ }\mu\text{A}$                                                                  | 9, 15, 16 | $ICC_{R1}$  |      | 95   |      | mA            | A     |
| 1.3      | Supply current, read mode, oscillator enabled  | $I_{IR} = I_{I2} = I_{I3} = I_{I4} = 500\text{ }\mu\text{A}$ ,<br>ENOSC = High,<br>RS = 560 $\Omega$ ,<br>RF = 7.5 k $\Omega$ | 9, 15, 16 | $ICC_{R2}$  |      | 100  |      | mA            | A     |
| 1.4      | Supply current, write mode                     | $I_{IR} = I_{I2} = I_{I3} = I_{I4} = 500\text{ }\mu\text{A}$ , NE2 = NE3 = NE4 = Low                                          | 9, 15, 16 | $ICC_W$     |      | 230  |      | mA            | A     |
| 1.5      | Supply current, input off                      | $I_{IR} = I_{I2} = I_{I3} = I_{I4} = 0\text{ }\mu\text{A}$                                                                    | 9, 15, 16 | $ICC_{off}$ |      | 16   |      | mA            | A     |
| <b>2</b> | <b>Digital inputs</b>                          |                                                                                                                               |           |             |      |      |      |               |       |
| 2.1      | NE2/NE3/NE4 low voltage                        |                                                                                                                               | 6, 7, 8   | $VNE_{LO}$  |      |      | 1.3  | V             | A     |
| 2.2      | NE2/NE3/NE4 high voltage                       |                                                                                                                               | 6, 7, 8   | $VNE_{HI}$  | 2.0  |      |      | V             | A     |
| 2.3      | ENABLE low voltage                             |                                                                                                                               | 11        | $VEN_{LO}$  |      |      | 0.5  | V             | A     |
| 2.4      | ENABLE high voltage                            |                                                                                                                               | 11        | $VEN_{HI}$  | 3.0  |      |      | V             | A     |
| 2.5      | ENOSC low voltage                              |                                                                                                                               | 10        | $VEO_{LO}$  |      |      | 0.5  | V             | A     |
| 2.6      | ENOSC high voltage                             |                                                                                                                               | 10        | $VEO_{HI}$  | 3.0  |      |      | V             | A     |
| <b>3</b> | <b>Current at digital inputs</b>               |                                                                                                                               |           |             |      |      |      |               |       |
| 3.1      | NE2/NE3/NE4 low current                        | NE = 0 V                                                                                                                      | 6, 7, 8   | $INE_{LO}$  | -300 |      |      | $\mu\text{A}$ | A     |
| 3.2      | NE2/NE3/NE4 high current                       | NE = 5 V                                                                                                                      | 6, 7, 8   | $INE_{HI}$  |      |      | 800  | $\mu\text{A}$ | A     |
| 3.3      | ENABLE low current                             | ENABLE = 0 V                                                                                                                  | 11        | $IEN_{LO}$  | -150 |      |      | $\mu\text{A}$ | A     |
| 3.4      | ENABLE high current                            | ENABLE = 5 V                                                                                                                  | 11        | $IEN_{HI}$  |      |      | 100  | $\mu\text{A}$ | A     |
| 3.5      | ENOSC low current                              | ENOSC = 0 V                                                                                                                   | 10        | $IEO_{LO}$  | -100 |      |      | $\mu\text{A}$ | A     |
| 3.6      | ENOSC high current                             | ENOSC = 5 V                                                                                                                   | 10        | $IEO_{HI}$  |      |      | 800  | $\mu\text{A}$ | a     |

\* Type means: A: 100% tested B: 100% correlation tested C: Characterized on samples D: Design parameter

## Electrical Characteristics: Laser Amplifier

$V_{CC} = 5\text{ V}$ ,  $T_{amb} = 25^{\circ}\text{C}$ , ENABLE = High, unless otherwise specified

| No.  | Parameters                                    | Test Conditions                                                                                      | Pin           | Symbol       | Min. | Typ. | Max. | Unit                       | Type* |
|------|-----------------------------------------------|------------------------------------------------------------------------------------------------------|---------------|--------------|------|------|------|----------------------------|-------|
| 4    | <b>Laser Amplifier</b>                        |                                                                                                      |               |              |      |      |      |                            |       |
| 4.1  | Best fit current gain                         | Any channel <sup>(1)</sup>                                                                           | 14            | GAIN         | 90   | 105  | 130  | mA/mA                      | A     |
| 4.2  | Best fit current offset                       | Any channel <sup>(1)</sup>                                                                           | 14            | IOS          | -8   |      | +4   | mA                         | A     |
| 4.3  | Output current linearity                      | Any channel <sup>(1)</sup>                                                                           | 14            | ILIN         | -3   |      | +3   | %                          | A     |
| 4.4  | Input current range                           | Input is sinking                                                                                     | 1, 2,<br>4, 5 | IDAC         | 0    |      | 3    | mA                         | C     |
| 4.5  | Output current read channel                   | Output is sourcing                                                                                   | 14            | $I_{OUTR}$   | 150  |      |      | mA                         | A     |
| 4.6  | Output current channel 2                      | Output is sourcing                                                                                   | 14            | $I_{OUT2}$   | 150  |      |      | mA                         | A     |
| 4.7  | Output current channel 3                      | Output is sourcing                                                                                   | 14            | $I_{OUT3}$   | 200  |      |      | mA                         | A     |
| 4.8  | Output current channel 4                      | Output is sourcing                                                                                   | 14            | $I_{OUT4}$   | 200  |      |      | mA                         | A     |
| 4.9  | Output current read channel + channel 2       | Output is sourcing                                                                                   | 14            | $I_{OUTR,2}$ | 150  |      |      | mA                         | A     |
| 4.10 | Output current channel 3 + channel 4          | Output is sourcing                                                                                   | 14            | $I_{OUT3,4}$ | 200  |      |      | mA                         | A     |
| 4.11 | Total output current                          | Output is sourcing                                                                                   | 14            | $I_{OUT}$    | 300  |      |      | mA                         | A     |
| 4.12 | IOUT series resistor                          | $I_{OUT} = 250\text{ mA}$ total<br>$R_{OUT}$ to $V_{CC}$ -Rail                                       | 14            | $R_{OUT}$    |      | 8    |      | $\Omega$                   | C     |
| 4.13 | $I_{IN}$ input impedance                      | $R_{IN}$ is to GND                                                                                   | 1, 2,<br>4, 5 | $R_{IN}$     | 150  | 200  | 250  | $\Omega$                   | A     |
| 4.14 | NE threshold                                  | Temperature stabilized                                                                               | 6, 7, 8       | VTH          |      | 1.68 |      | V                          | B     |
| 4.15 | Output off current 1                          | ENABLE = Low                                                                                         |               | $IOFF_1$     |      |      | 1    | mA                         | A     |
| 4.16 | Output off current 2                          | NE2=NE3=NE4=High<br>$I_{IR}=0\text{ }\mu\text{A}$ ,<br>$I_{I2}=I_{I3}=I_{I4}=500\text{ }\mu\text{A}$ | 14            | $IOFF_2$     |      |      | 1    | mA                         | A     |
| 4.17 | Output off current 3                          | NE2=NE3=NE4=Low,<br>$I_{IR}=I_{I2}=I_{I3}=I_{I4}=0\text{ }\mu\text{A}$                               | 14            | $IOFF_3$     |      |      | 5    | mA                         | A     |
| 4.18 | $I_{OUT}$ supply sensitivity, read mode       | $I_{OUT} = 40\text{ mA}$ ,<br>$V_{CC} = 5\text{ V} \pm 10\%$ ,<br>read only                          | 14            | $VSE_R$      | -4   |      | -1   | %/V                        | A     |
| 4.19 | $I_{OUT}$ supply sensitivity, write mode      | $I_{OUT} = 80\text{ mA}$ , 40 mA read + 40 mA write,<br>$V_{CC}=5\text{V}\pm 10\%$                   | 14            | $VSE_W$      | -6   |      | 0    | %/V                        | A     |
| 4.20 | $I_{OUT}$ current output noise                | $I_{OUT} = 40\text{ mA}$ ,<br>ENOSC = Low                                                            | 14            | $INO_O$      |      | 3    |      | nA/<br>rt-Hz               | C     |
| 4.21 | $I_{OUT}$ temperature sensitivity, read mode  | $I_{OUT} = 40\text{ mA}$ , read only                                                                 | 14            | $TSE_R$      |      | -500 |      | ppm/<br>$^{\circ}\text{C}$ | C     |
| 4.22 | $I_{OUT}$ temperature sensitivity, write mode | $I_{OUT} = 80\text{ mA}$ , 40 mA read + 40 mA Write                                                  | 14            | $TSE_W$      |      | -600 |      | ppm/<br>$^{\circ}\text{C}$ | C     |

\* ) Type means: A =100% tested, B = 100% correlation tested, C = Characterized on samples, D = Design parameter

Note: 1. Linearity of the amplifier is calculated using a best fit method at three operating points of  $I_{OUT}$  at 20 mA, 40 mA, and 60 mA.  $I_{OUT} = (I_{IN} \times \text{GAIN}) + I_{OS}$

## Electrical Characteristics: Laser Current Amplifier Output AC Performance

$V_{CC} = +5\text{ V}$ ,  $I_{OUT} = 40\text{ mA}$  DC with 40 mA pulse,  $T_{amb} = 25^{\circ}\text{C}$ , unless otherwise specified

| No.      | Parameters                                           | Test Conditions                                                    | Pin | Symbol     | Min. | Typ. | Max. | Unit                    | Type* |
|----------|------------------------------------------------------|--------------------------------------------------------------------|-----|------------|------|------|------|-------------------------|-------|
| <b>5</b> | <b>Laser Current Amplifier Output AC Performance</b> |                                                                    |     |            |      |      |      |                         |       |
| 5.1      | Write rise time                                      | $I_{OUT} = 40\text{ mA}$ (read) + 40 mA (10% - 90%) <sup>(1)</sup> | 14  | $t_{RISE}$ |      | 1.0  | 3.0  | ns                      | C     |
| 5.2      | Write fall time                                      | $I_{OUT} = 40\text{ mA}$ (read) + 40 mA (10% - 90%) <sup>(1)</sup> | 14  | $t_{FALL}$ |      | 1.1  | 3.0  | ns                      | C     |
| 5.3      | Output current overshoot                             | $I_{OUT} = 40\text{ mA}$ (read) + 40 mA <sup>(1)</sup>             | 14  | OS         |      | 5    |      | %                       | C     |
| 5.4      | $I_{OUT}$ ON prop delay                              | NE 50% High-Low to $I_{OUT}$ at 50% of final value                 | 14  | $t_{ON}$   |      | 2.0  |      | ns                      | C     |
| 5.5      | $I_{OUT}$ OFF prop delay                             | NE 50% Low-High to $I_{OUT}$ at 50% of final value                 | 14  | $t_{OFF}$  |      | 2.0  |      | ns                      | C     |
| 5.6      | Disable time                                         | ENABLE 50% High-Low to $I_{OUT}$ at 50% of final value             | 14  | $t_{DIS}$  |      | 10   |      | ns                      | C     |
| 5.7      | Enable time                                          | ENABLE 50% Low-High to $I_{OUT}$ at 50% of final value             | 14  | $t_{EN}$   |      | 50   |      | ns                      | C     |
| 5.10     | Amplifier bandwidth                                  | $I_{OUT} = 50\text{ mA}$ , all channels, -3 dB value               | 14  | $BW_{LCA}$ |      | 20   |      | MHz                     | C     |
| <b>6</b> | <b>Oscillator</b>                                    |                                                                    |     |            |      |      |      |                         |       |
| 6.1      | Oscillator frequency                                 | RF = 7.5 k $\Omega$<br>RS = 560 $\Omega$                           | 14  | $F_{OSC}$  | 255  | 300  | 350  | MHz                     | A     |
| 6.2      | Oscillator temperature coefficient                   | RF = 7.5 k $\Omega$<br>RS = 560 $\Omega$                           | 14  | $TC_{OSC}$ |      | -150 |      | ppm/ $^{\circ}\text{C}$ | C     |
| 6.3      | Disable time oscillator                              | ENOSC 50% Low-High to $I_{OUT}$ at 50% of final value              | 14  | $T_{DISO}$ |      | 4    |      | ns                      | C     |
| 6.4      | Enable time oscillator                               | ENOSC 50% High-Low to $I_{OUT}$ at 50% of final value              | 14  | $T_{ENO}$  |      | 2    |      | ns                      | C     |
| 6.5      | Oscillator swing                                     | RF = 7.5 k $\Omega$<br>RS = 560 $\Omega$                           | 14  | $S_{OSC}$  | 35   |      | 55   | mApp                    | A     |

\*) Type means: A = 100% tested, B = 100% correlation tested, C = Characterized on samples, D = Design parameter

Note: 1. Load resistor at  $I_{OUT}$  10  $\Omega$ , measurement with a 50- $\Omega$  oscilloscope and a 39- $\Omega$  series resistor

Application Information

Figure 3. Oscillator Frequency vs. Resistor RF (RS = 560 Ω)

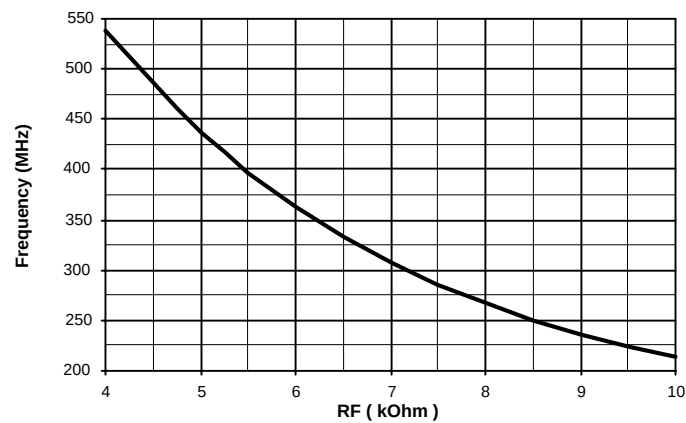


Figure 4. Oscillator Swing vs. Resistor RS (RF = 7.5 kΩ)

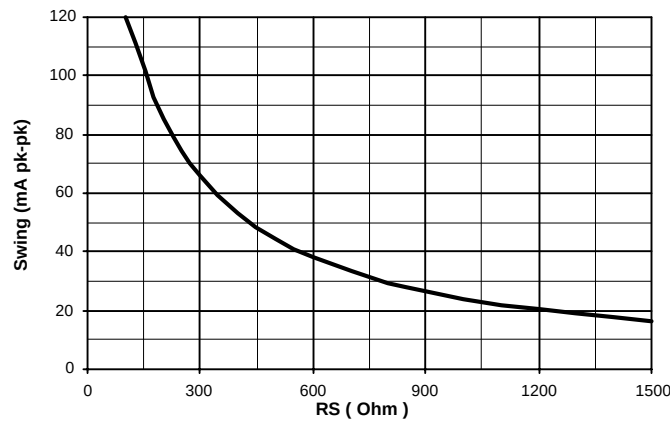
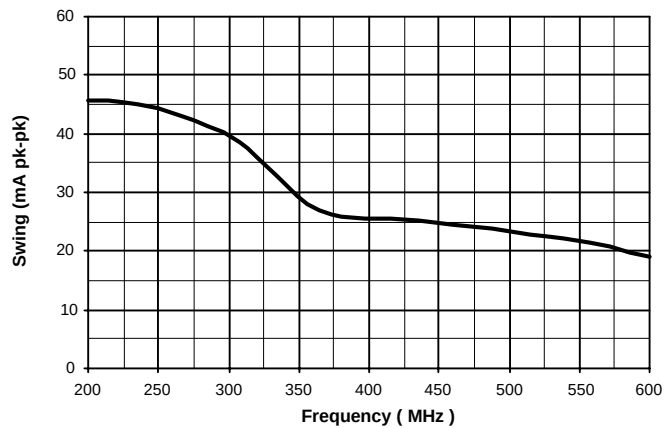
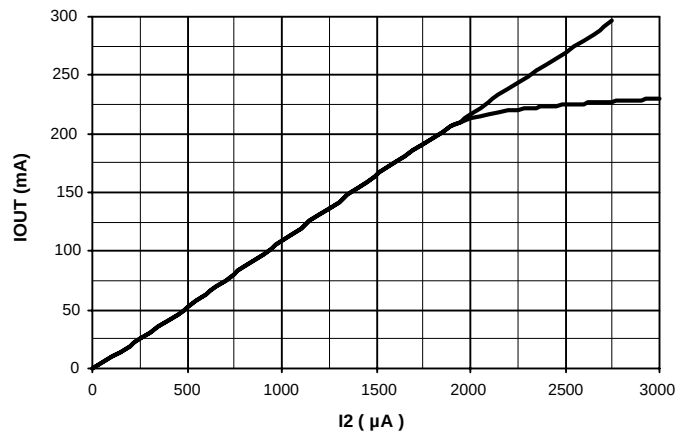


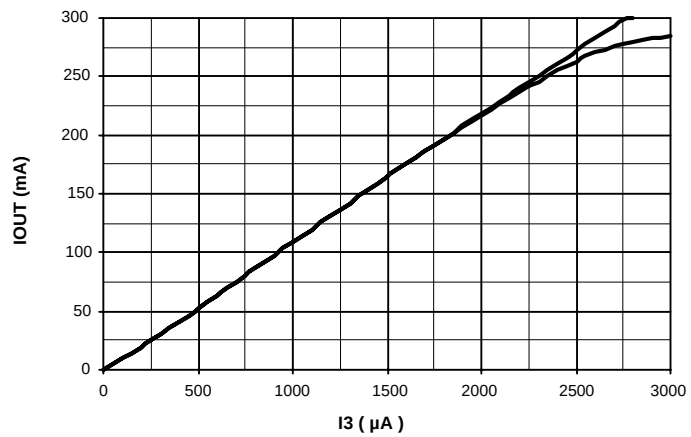
Figure 5. Oscillator Frequency Depending of Swing (RS = 560 Ω)



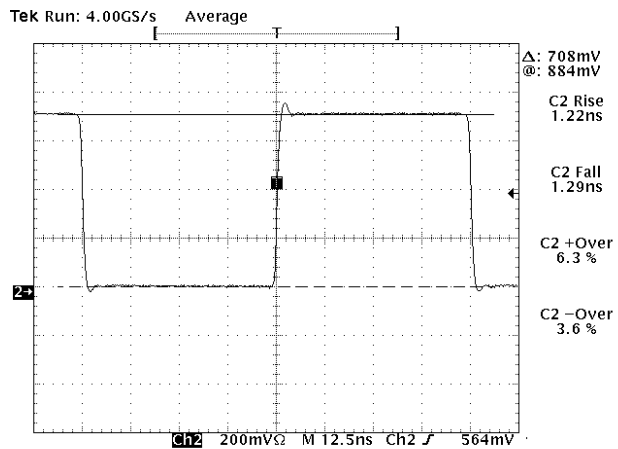
**Figure 6.** Transfer Characteristic of Channel 2 (gain = 112)



**Figure 7.** Transfer Characteristic of Channel 3 and 4 (gain = 112)

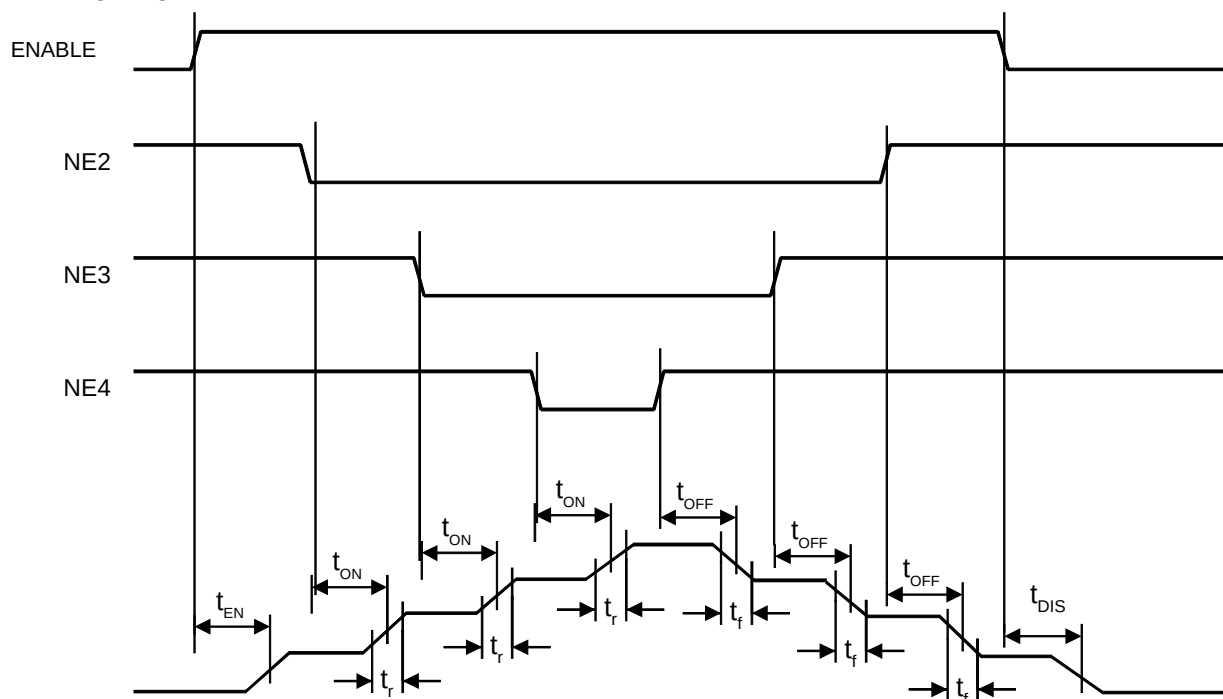


**Figure 8.** Step Response, Read Channel: 50 mA, Channel 3 = 200 mApp

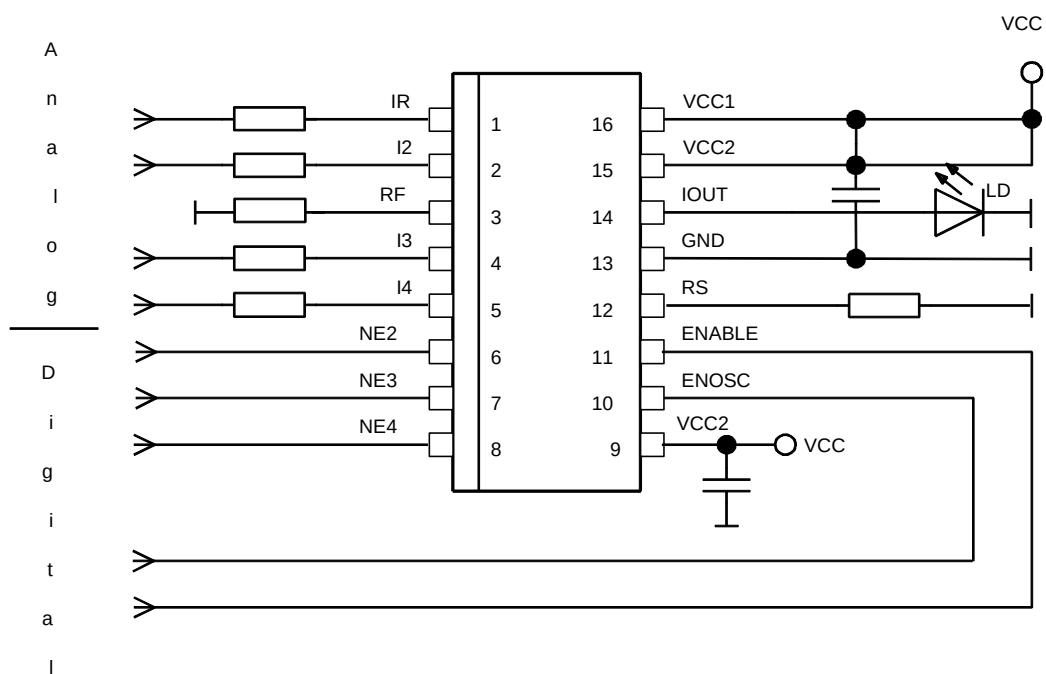




### Figure 9. Timing Diagram



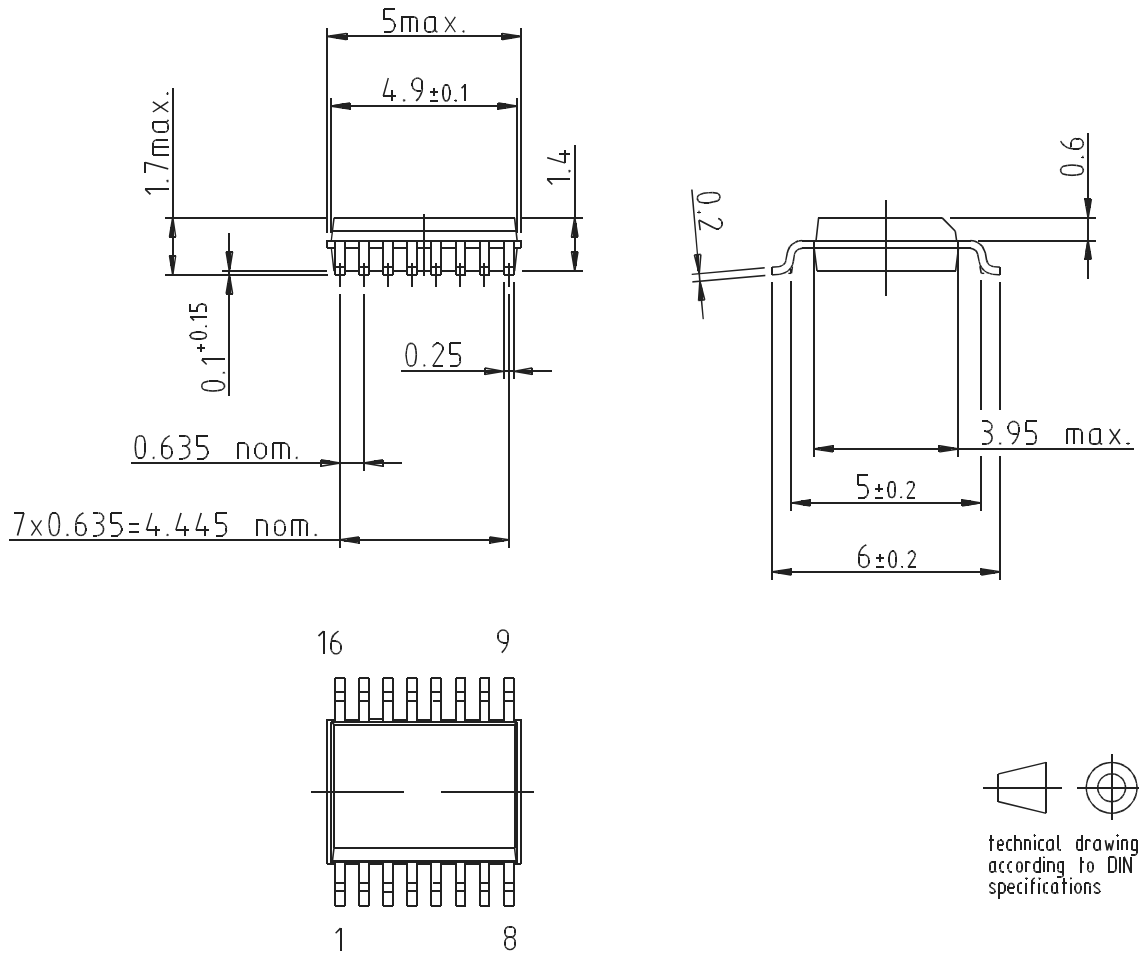
**Figure 10.** Typical Application Circuit



## Ordering Information

| Extended Type Number | Package | Remarks          |
|----------------------|---------|------------------|
| T0820-TCQ            | SS016   | Taped and reeled |

## Package Information



Drawing refers to following types: SS016  
Package acc. JEDEC MO 137 AB

Drawing-No.: 6.543-5060.01-4  
Issue: 2; 05.02.99



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