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## Features

- Current-controlled Output Current Source, 3 Input Channels
- Low-power Consumption
- Output Current per Channel to 250 mA
- Total Output Current to 300 mA
- Rise Time 1.0 ns, Fall Time 1.1 ns
- On-chip RF Oscillator
- Control of Frequency and Swing by Use of 2 External Resistors
- Oscillator Frequency Range from 200 MHz to 500 MHz
- Oscillator Swing to 100 mA
- Single 5V Power Supply
- Common Enable, Disable Input
- TTL/CMOS Control Signals
- Small SSO16 Package and QFN16 Package

## Applications

- CD-RW Drives
- Writable Optical Drives

## 1. Description

The T0816 is a laser diode driver for the operation of a grounded laser diode for CD-RW drives. It includes three channels for three different optical power levels which are controlled by a separate IC. The read channel generates a continuous output level whereas channels 2 and 3 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. Each channel can contribute up to 250 mA to the total output current of up to 300 mA. A total gain of 100 (read channel), 250 (channel 2) and 150 (channel 3) are provided between each reference current input and the output. Although the reference inputs are current inputs voltage control is possible by using external resistors.

An on-chip RF oscillator is provided to reduce laser mode hopping noise during read mode. 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.



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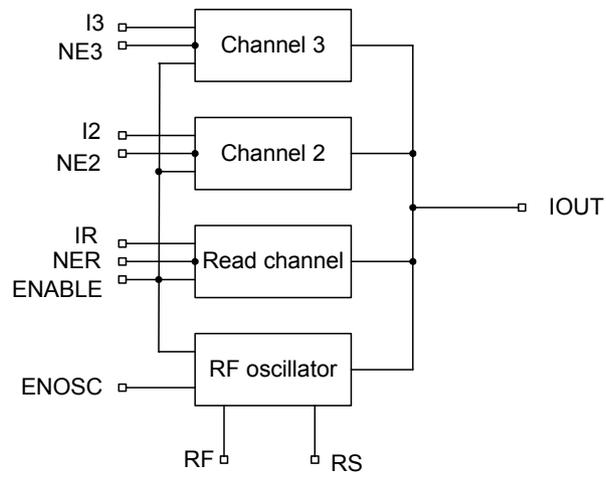
## 3-channel Laser Driver with RF Oscillator

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**T0816**



Figure 1-1. Block Diagram



## 2. Pin Configuration

Figure 2-1. Pinning SSO16

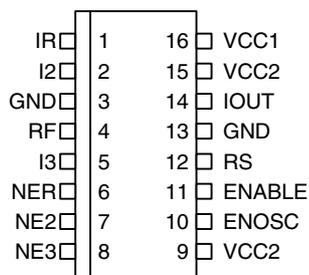
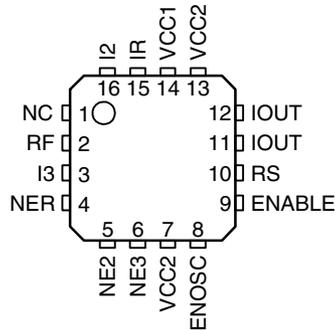


Table 2-1. Pin Description: SSOP16

Pin	Symbol	Type	Function
1	IR	Analog	Input current, bias voltage approximately GND
2	I2	Analog	Input current, bias voltage approximately GND
3	GND	Supply	Ground
4	RF	Analog	External resistor to GND sets oscillator frequency
5	I3	Analog	Input current, bias voltage approximately GND
6	NER	Digital	Digital control of read channel (low active)
7	NE2	Digital	Digital control of channel 2 (low active)
8	NE3	Digital	Digital control of channel 3 (low active)
9	VCC2	Supply	+5V 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	+5V power supply for IOOUT
16	VCC1	Supply	+5V power supply for circuit

**Figure 2-2.** Pinning QFN16



**Table 2-2.** Pin Description: QFN16

Pin	Symbol	Type	Function
1	NC	–	Not connected
2	RF	Analog	External resistor to GND sets frequency of oscillator A
3	I3	Analog	Input current, bias voltage approximately GND
4	NER	Digital	Digital control of R channel (low active)
5	NE2	Digital	Digital control of channel 2 (low active)
6	NE3	Digital	Digital control of channel 3 (low active)
7	VCC2	Supply	+5V power supply for IOU
8	ENOSC	Digital	Enables RF oscillator (high active)
9	ENABLE	Digital	Enables output current (high active)
10	RS	Analog	External resistor to GND sets oscillator swing
11,12	IOU	Analog	Output current source for laser diode
13	VCC2	Supply	+5V power supply for IOU
14	VCC1	Supply	+5V power supply for circuit
15	IR	Analog	Input current, bias voltage approximately GND
16	I2	Analog	Input current, bias voltage approximately GND
Paddle	GND	Supply	Ground

### 3. Absolute Maximum Ratings

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Parameters	Symbol	Value	Unit
Supply voltage	$V_{CC}$	-0.5 to +6.0	V
Input voltage at IR, I2, I3	$V_{IN1}$	-0.5 to +2.0	V
Input voltage at NER, NE2, NE3, 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.  $R_{thJA} \leq 115$  K/W,  $T_{amb} = 70^\circ\text{C}$

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

### 4. 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)

### 5. Operating Range

Parameters	Symbol	Value	Unit
Supply voltage range	$V_{CC}$	4.5 to 5.5	V
Input current	$I_{IR}$ $I_{I2}$ $I_{I3}$	< 2.5 < 1.0 < 1.7	mA
External resistor to GND to set oscillator frequency	RF	> 3	k $\Omega$
External resistor to GND to set oscillator swing	RS	> 1	k $\Omega$
Operating temperature range	$T_{amb}$	0 to +70	°C

## 6. Electrical Characteristics: General

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

No.	Parameters	Test Conditions	Pin <sup>(1)</sup>	Symbol	Min.	Typ.	Max.	Unit	Type*
<b>1</b>	<b>Power Supply</b>								
1.1	Supply current, power down	ENABLE = Low, NE2 = NE3 = Low	9; 15; 16	ICC <sub>PD2</sub>		0.3		mA	A
1.2	Supply current, read mode, oscillator disabled	I <sub>IR</sub> = 500 $\mu$ A, I <sub>I2</sub> = 200 $\mu$ A, I <sub>I3</sub> = 333 $\mu$ A	9; 15; 16	ICC <sub>R1</sub>		86		mA	A
1.3	Supply current, read mode, oscillator enabled	I <sub>IR</sub> = 500 $\mu$ A, I <sub>I2</sub> = 200 $\mu$ A, I <sub>I3</sub> = 333 $\mu$ A, ENOSC = High, RS = 7.5 k $\Omega$ , RF = 7.5 k $\Omega$	9; 15; 16	ICC <sub>R2</sub>		90		mA	A
1.4	Supply current, write mode	I <sub>IR</sub> = 500 $\mu$ A, I <sub>I2</sub> = 200 $\mu$ A, I <sub>I3</sub> = 333 $\mu$ A, NE2 = NE3 = Low	9; 15; 16	ICC <sub>W</sub>		175		mA	A
1.5	Supply current, input off	I <sub>IR</sub> = I <sub>I2</sub> = I <sub>I3</sub> = 0 $\mu$ A	9; 15; 16	ICC <sub>off</sub>		15		mA	A
<b>2</b>	<b>Digital Inputs</b>								
2.1	NER/NE2/NE3 low voltage		6, 7, 8	VNE <sub>LO</sub>			1.3	V	A
2.2	NER/NE2/NE3 high voltage		6, 7, 8	VNE <sub>HI</sub>	2.0			V	A
2.3	ENABLE low voltage		11	VEN <sub>LO</sub>			0.5	V	A
2.4	ENABLE high voltage		11	VEN <sub>HI</sub>	2.7			V	A
2.5	ENOSC low voltage		10	VEO <sub>LO</sub>			0.5	V	A
2.6	ENOSC high voltage		10	VEO <sub>HI</sub>	3.0			V	A
<b>3</b>	<b>Current at Digital Inputs</b>								
3.1	NER/NE2/NE3 low current	NE = 0V	6, 7, 8	INE <sub>LO</sub>	-300			$\mu$ A	A
3.2	NER/NE2/NE3 high current	NE = 5V	6, 7, 8	INE <sub>HI</sub>			800	$\mu$ A	A
3.3	ENABLE low current	ENABLE = 0V	11	IEN <sub>LO</sub>	-150			$\mu$ A	A
3.4	ENABLE high current	ENABLE = 5V	11	IEN <sub>HI</sub>			100	$\mu$ A	A
3.5	ENOSC low current	ENOSC = 0V	10	IEO <sub>LO</sub>	-100			$\mu$ A	A
3.6	ENOSC high current	ENOSC = 5V	10	IEO <sub>HI</sub>			800	$\mu$ A	A

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

Note: 1. Related to SSO16 package.

## 7. Electrical Characteristics: Laser Amplifier

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

No.	Parameters	Test Conditions	Pin	Symbol	Min.	Typ.	Max.	Unit	Type*
<b>4</b>	<b>Output IOU</b>								
4.1	Total output current	Output is sourcing	14	$I_{OUT}$	300	350		mA	A
4.2	Output current per channel	Output is sourcing	14	$I_{OUTR}$	250			mA	A
4.5	$I_{OUT}$ series resistance	Total $R_{OUT}$ to $V_{CC}$ rail	14	$R_{OUT}$		6		$\Omega$	C
4.6	Best fit current gain $I_R$	Channel R <sup>(1)</sup>	14	GAINR	90	100	130	mA/mA	A
4.7	Best fit current gain $I_2$	Channel 2 <sup>(1)</sup>	14	GAIN2	225	250	325	mA/mA	A
4.8	Best fit current gain $I_3$	Channel 3 <sup>(1)</sup>	14	GAIN3	135	150	195	mA/mA	A
4.9	Best fit current offset	Any channel <sup>(1)</sup>	14	IOS	-8		+4	mA	A
4.10	Output current linearity	Any channel <sup>(1)</sup>	14	ILIN	-3		+3	%	A
4.11	$I_{IN}$ input impedance	$R_{IN,IR}$ is to GND	1	$R_{IN,IR}$	400	500	600	$\Omega$	A
4.12	$I_{IN}$ input impedance	$R_{IN,I2}$ is to GND	2	$R_{IN,I2}$	1000	1250	1500	$\Omega$	A
4.13	$I_{IN}$ input impedance	$R_{IN,I3}$ is to GND	5	$R_{IN,I3}$	600	750	900	$\Omega$	A
4.14	NE threshold	Temperature stabilized	6, 7, 8	VTH		1.68		V	B
4.15	Output off current 1	ENABLE = Low	14	IOFF <sub>1</sub>			1	mA	A
4.16	Output off current 2	NE2 = NE3 = High, $I_{IR} = 0$ , $I_{I2} = 200 \mu A$ , $I_{I3} = 333 \mu A$	14	IOFF <sub>2</sub>			1	mA	A
4.17	Output off current 3	NE2 = NE3 = Low, $I_{IR} = I_{I2} = I_{I3} = 0 \mu A$	14	IOFF <sub>3</sub>			5	mA	A
4.18	$I_{OUT}$ supply sensitivity, read mode	$I_{OUT} = 40$ mA, $V_{CC} = 5V \pm 10\%$ , read only	14	VSE <sub>R</sub>	-4		1	%/V	A
4.19	$I_{OUT}$ supply sensitivity, write mode	$I_{OUT} = 80$ mA, 40 mA read + 40 mA write, $V_{CC} = 5V \pm 10\%$	14	VSE <sub>W</sub>	-6		0	%/V	A
4.20	$I_{OUT}$ current output noise	$I_{OUT} = 40$ mA, ENOSC = Low	14	INO <sub>O</sub>		3		nA/ rt-Hz	C
4.21	$I_{OUT}$ temperature sensitivity, read mode	$I_{OUT} = 40$ mA, read only	14	TSE <sub>R</sub>		-400		ppm/ $^{\circ}C$	C
4.22	$I_{OUT}$ temperature sensitivity, write mode	$I_{OUT} = 80$ mA, 40 mA read + 40 mA write	14	TSE <sub>W</sub>		-400		ppm/ $^{\circ}C$	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.  $I_{OUT} = (I_{IN} \times GAIN) + I_{OS}$

## 8. Electrical Characteristics: Laser Current Amplifier Outputs AC Performance

$V_{CC} = +5V$ ,  $I_{OUT} = 40\text{ mA DC}$  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>Output AC Performance</b>								
5.1	Write rise time	$I_{OUT} = 40\text{ mA (read) + 40 mA (10 to 90\%)}^{(1)}$	14	$t_{RISE}$		1.0	2.0	ns	C
5.2	Write fall time	$I_{OUT} = 40\text{ mA (read) + 40 mA (10 to 90\%)}^{(1)}$	14	$t_{FALL}$		1.1	2.0	ns	C
5.3	Output current overshoot	$I_{OUT} = 40\text{ mA (read) + 40 mA}^{(1)}$	14	OS		5		%	C
5.4	$I_{OUT}$ ON propagation delay	NE 50% High-Low to $I_{OUT}$ at 50% of final value	14	$t_{ON}$		2		ns	C
5.5	$I_{OUT}$ OFF propagation delay	NE 50% Low-High to $I_{OUT}$ at 50% of final value	14	$t_{OFF}$		2		ns	C
5.6	Disable time	ENABLE 50% High-Low to $I_{OUT}$ at 50% of final value	14	$t_{DIS}$		20		ns	C
5.7	Enable time	ENABLE 50% Low-High to $I_{OUT}$ at 50% of final value	14	$t_{EN}$		20		ns	C
5.8	Amplifier bandwidth	$I_{OUT} = 50\text{ mA}$ , all channels, $-3\text{ dB}$ value	14	$BW_{LCA}$		16		MHz	C
<b>6</b>	<b>Oscillator</b>								
6.1	Oscillator frequency	$R_F = 7.5\text{ k}\Omega$	14	$F_{OSC}$	270	300	330	MHz	A
6.2	Osc. temperature coefficient	$R_F = 7.5\text{ k}\Omega$	14	$TC_{OSC}$		-150		ppm/ $^\circ\text{C}$	C
6.3	Disable time oscillator	ENOSC 50% High-Low to $I_{OUT}$ at 50% of final value	14	$T_{DISO}$		4		ns	C
6.4	Enable time oscillator	ENOSC 50% Low-High to $I_{OUT}$ at 50% of final value	14	$T_{ENO}$		2		ns	C

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

Note: 1. Load resistor at  $I_{OUT}$  6.8  $\Omega$  measurement with 50- $\Omega$  oscilloscope and 39- $\Omega$  series resistor.

## 9. Characteristic Curves

Figure 9-1. Oscillator Frequency versus Resistor RF (RS = 7.5 kΩ)

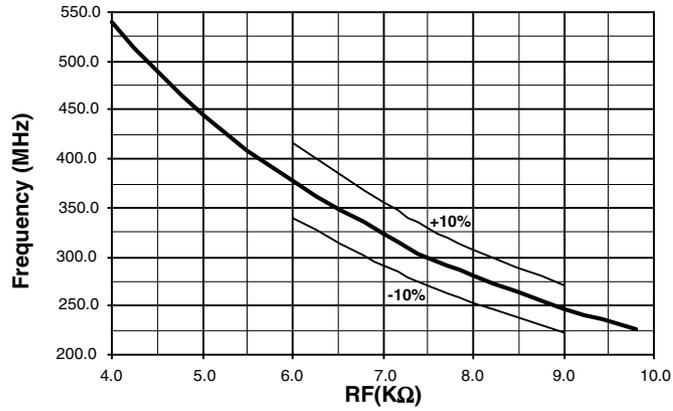


Figure 9-2. Oscillator Swing versus Resistor RS (RF = 7.5 kΩ)

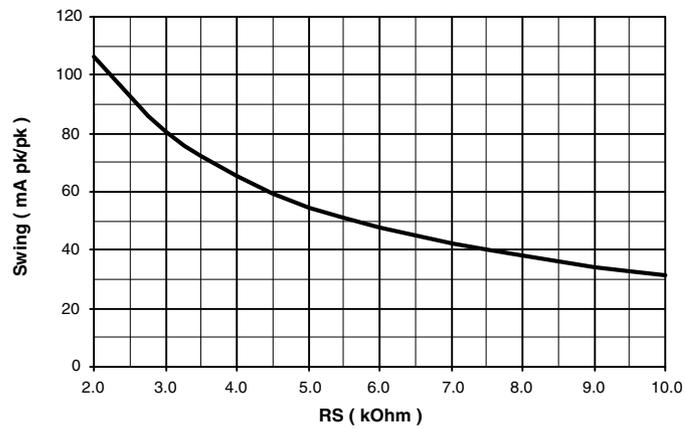
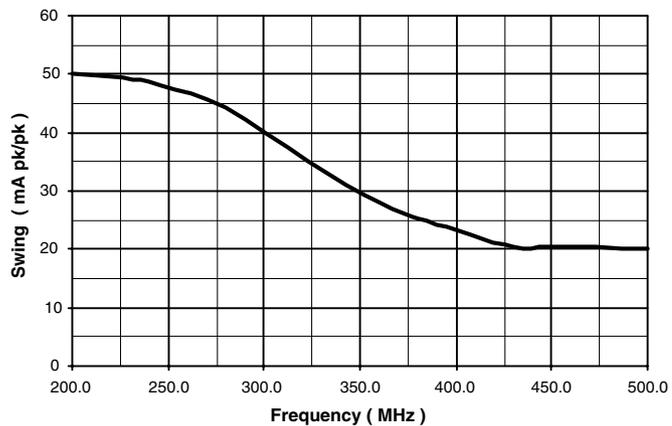
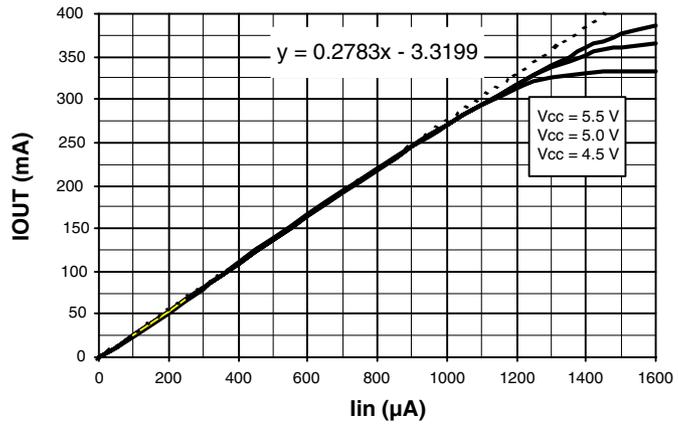


Figure 9-3. Oscillator Frequency Dependency of Swing



**Figure 9-4.** Transfer Characteristic of Channel 2  
(Gain = 278, Load Resistor at IO<sub>UT</sub> = 6.8Ω)



**Figure 9-5.** Voltage Compliance R (IO<sub>UT</sub> to V<sub>CC</sub>) = 5.9Ω

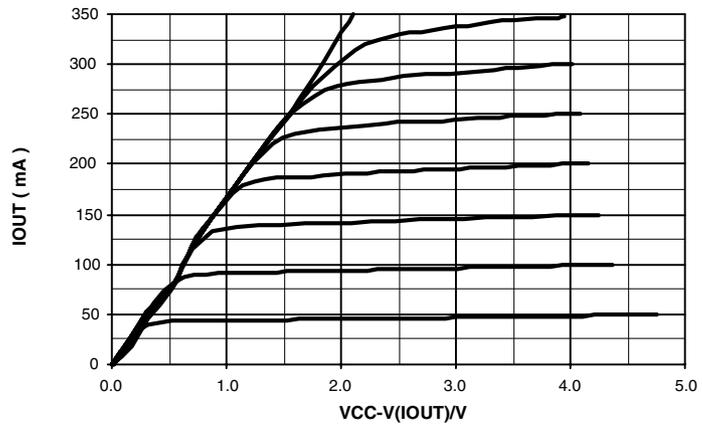


Figure 9-6. Step Response, Read Channel: 50 mA, Channel 2: 50 mApp

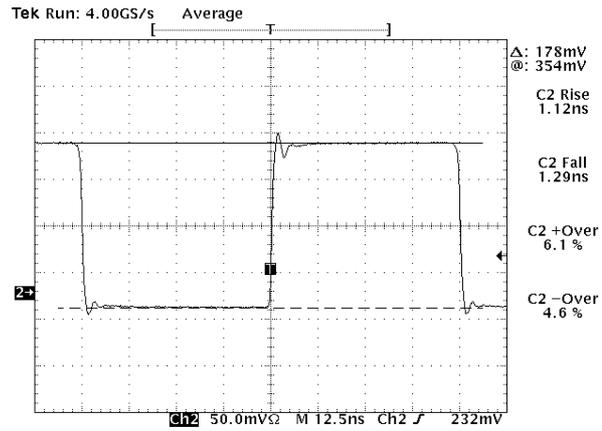
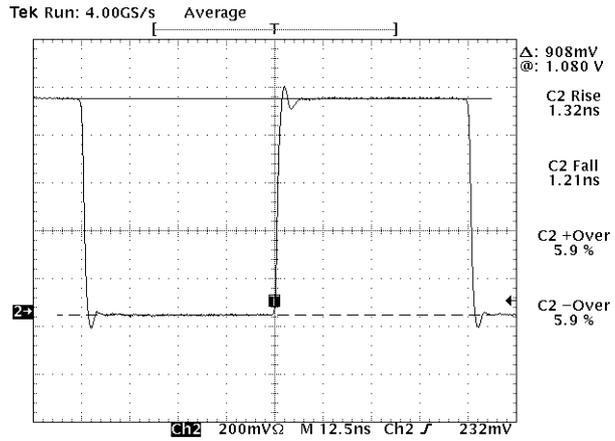
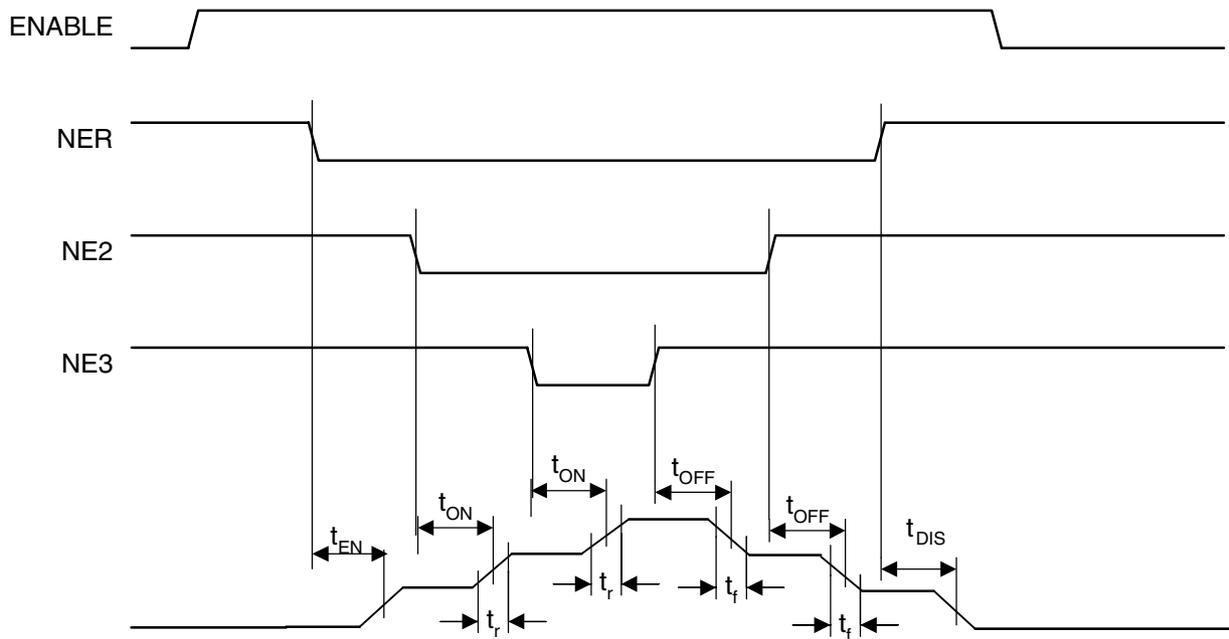


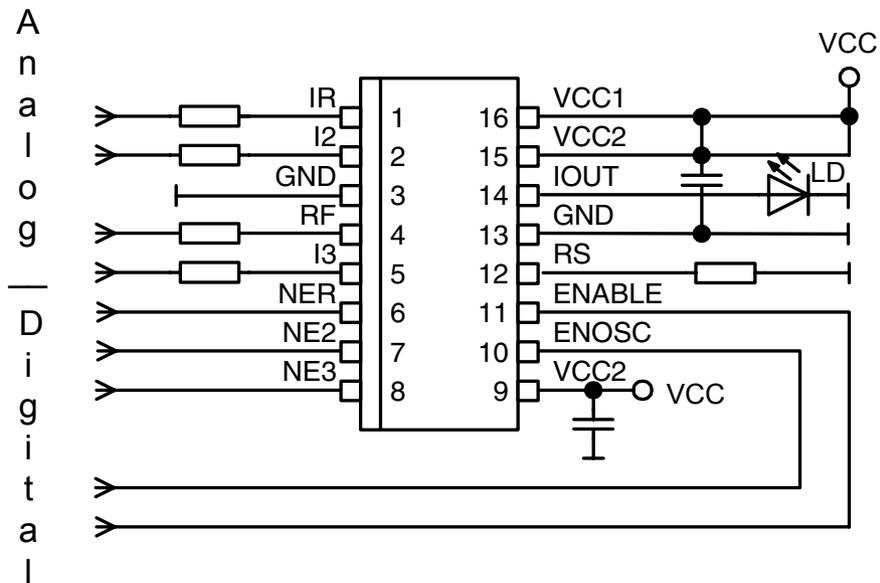
Figure 9-7. Step Response, Read Channel: 50 mA, Channel 2: 250 mApp



**Figure 9-8.** Timing Diagram of IOUT



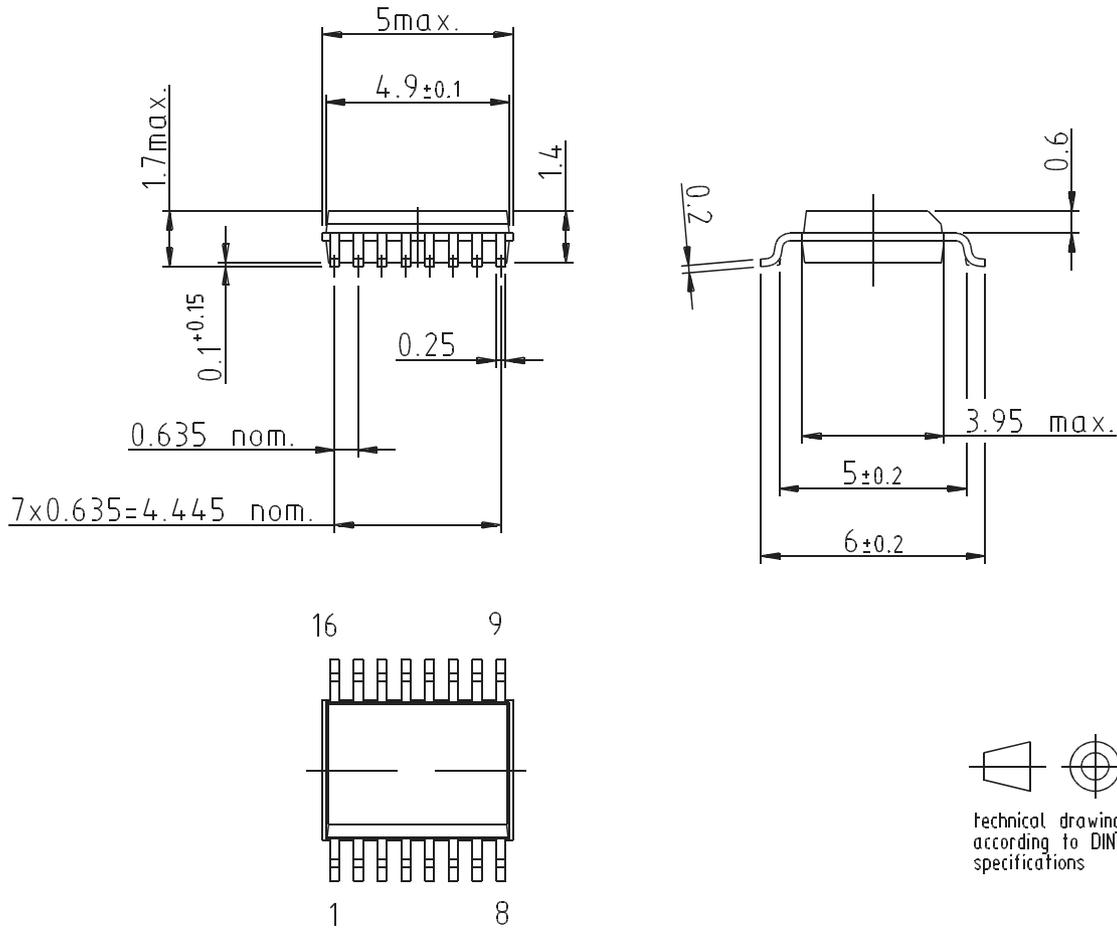
**Figure 9-9.** Application Circuit



### 10. Ordering Information

Extended Type Number	Package	Remarks
T0816-TCQ	SSO16	Taped and reeled
T0816M-TCQG	Pb-free SSO16	Taped and reeled
T0816-PEQG	Pb-free QFN16	Taped and reeled

### 11. Package Information

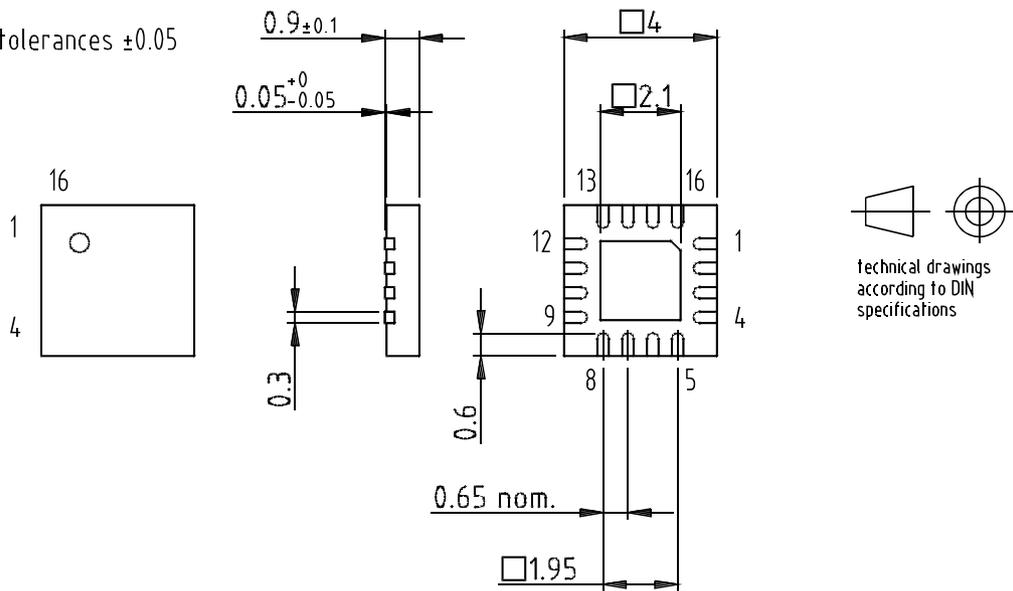


Drawing refers to following types: SS016  
 Package acc. JEDEC MO 137 AB

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

Package: QFN 16 - 4x4  
 Exposed pad 2.1x2.1  
 (acc. JEDEC OUTLINE No. MO-220)  
 Dimensions in mm

Not indicated tolerances  $\pm 0.05$



Drawing-No.: 6.543-5090.01-4  
 Issue: 2; 24.01.03



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Fax: (49) 71-31-67-2340

1150 East Cheyenne Mtn. Blvd.  
Colorado Springs, CO 80906, USA  
Tel: 1(719) 576-3300  
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