HV264

Quad High-Voltage Amplifier Array

Features

- Four Independent High-Voltage Amplifiers
- 215V Output Swing
- 9V/µs Typical Output Slew Rate
- 66.7V/V Fixed Gain
- High-Value Internal Feedback Resistors
- Very Low Operating Current

Applications

- Tunable Laser
- Microelectromechanical Systems (MEMS) Driver
- Test Equipment
- Piezoelectric Transducer Driver
- Braille Driver

General Description

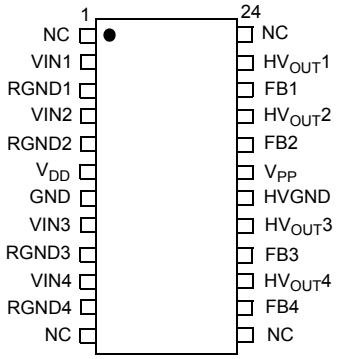
The HV264 is a quad high-voltage amplifier array integrated circuit. It operates on a 225V high-voltage supply and a 5V low-voltage supply. Each channel has its own input and output.

When both V_{OUT} and FB pins are connected together and RGND is set at 0V, a non-inverting amplifier is formed with a closed-loop gain of 66.7V/V. High-value internal feedback resistors are used to minimize power dissipation. The input voltage V_{IN} is designed for a range of 0.05V to 3.22V. The output can swing from 1V to V_{PP}–10V. A 3.22V input will cause the output to swing to 215V.

The HV264 is designed for maximum performance with minimal high-voltage current. The high-voltage current for each channel is less than 75 µA. The typical output slew rate performance is 9V/µs.

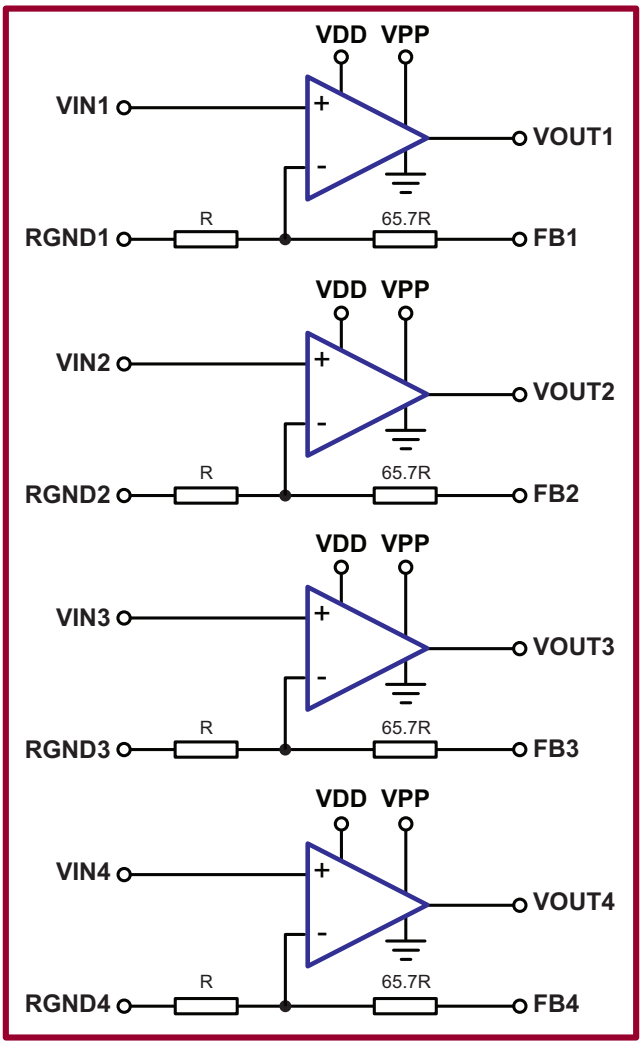
Package Type

24-lead TSSOP
(Top view)

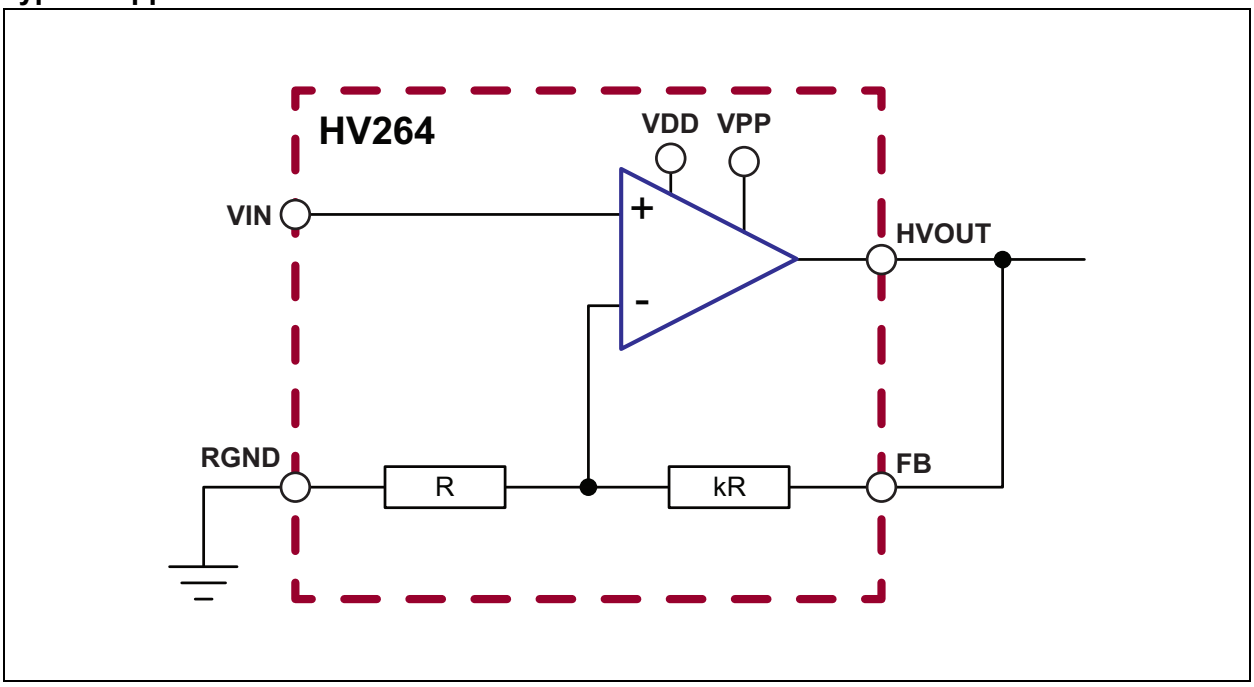


See Table 3-1 for pin information.

Functional Block Diagram



Typical Application Circuit



1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings†

High-Voltage Supply, V_{PP} 250V
Low-Voltage Supply, V_{DD} 6.5V
Output Voltage, HV_{OUT} ..... 0V to V_{PP}
Analog Input Signal, V_{IN} ..... 0V to V_{DD}
Maximum Junction Temperature, T_J ..... +150°C
Storage Temperature, T_S ..... –65°C to +150°C
ESD Rating (**Note 1**) ..... ESD Sensitive

† Notice: Stresses above 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 those or any other conditions above those indicated in the operational sections of this specification is not intended. Exposure to maximum rating conditions for extended periods may affect device reliability.

Note 1: Device is ESD sensitive. Handling precautions are recommended.

RECOMMENDED OPERATING CONDITIONS

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
High-Voltage Positive Supply	V_{PP}	50	—	225	V	
Low-Voltage Positive Supply	V_{DD}	4.5	5	5.5	V	
Input Ground Range	R_{GND}	0	0	V_{DD}	V	
V_{PP} Supply Current	I_{PP}	—	—	300	µA	V_{PP} = 200V, all inputs at 0V
V_{DD} Supply Current	I_{DD}	—	—	5	mA	V_{DD} = 5.5V
Operating Ambient Temperature	T_A	–40	—	+125	°C	
Operating Junction Temperature	T_J	–40	—	+125	°C	

DC ELECTRICAL CHARACTERISTICS

Electrical Specifications: Over operating conditions unless otherwise noted, T_J = +25°C.						
Parameter	**Sym.**	**Min.**	**Typ.**	**Max.**	**Unit**	**Conditions**
HV_{OUT} Voltage Swing	HV_{OUT}	1	—	V_{PP}–10	V	No load
HV_{OUT} Sink Current	I_{SINK}	3	—	—	mA	
HV_{OUT} Source Current	I_{SOURCE}	3	—	—	mA	
Input Voltage Range	V_{IN}	0	—	V_{DD}–1.5	V	
V_{IN} Input Current	I_{IN}	—	—	50	nA	
H_{VOUT} DC Offset	HV_{OS}	—	—	±1	V	V_{IN} = 0.2V

AC ELECTRICAL CHARACTERISTICS

Electrical Specifications: Over operating conditions unless otherwise noted, T_J = 25°C.						
Parameter	**Sym.**	**Min.**	**Typ.**	**Max.**	**Unit**	**Conditions**
HV_{OUT} Slew Rate–Rising Edge	SR	5	9	30	V/µs	V_{PP} = 200V, Load = 15 pF, measured between 10% to 90% of HV_{OUT}
HV_{OUT} Slew Rate–Falling Edge		—	9	—	V/µs	
Feedback Impedance, $R_f + R_i$	R_{FB}	3.5	5.3	—	MΩ	
Closed-Loop Gain	A_V	63.4	66.7	70	V/V	
HV_{OUT} –3 dB Channel Bandwidth	BW	25	—	—	kHz	V_{PP} = 200V, Load = 15 pF
HV_{OUT} Capacitive Load	C_{LOAD}	0	—	15	pF	
Output Referred Noise	V_N	—	—	10	mV_{RMS}	Measured at HV_{OUT}, 0 kHz to 1 kHz single pole, V_{IN} = 0.2V
V_{DD} Power Supply Rejection Ratio	PSRR1	55	—	—	dB	V_{DD} = 4.5V to 5.5V V_{PP} = 200V, V_{IN} = 0.1V
V_{PP} Power Supply Rejection Ratio	PSRR2	60	—	—	dB	V_{DD} = 5V, V_{PP} = 50V to 200V, V_{IN} = 0.1V
Crosstalk	Xtalk	—	—	–80	dB	Output referred

TEMPERATURE SPECIFICATIONS

Parameter	**Sym.**	**Min.**	**Typ.**	**Max.**	**Unit**	**Conditions**
Temperature Range						
Operating Ambient Temperature	T_A	–40	—	+125	°C	
Operating Junction Temperature	T_J	–40	—	+125	°C	
Storage Temperature	T_S	–65	—	+150	°C	
Package Thermal Resistance						
24-lead TSSOP	θ_{JA}	—	+72	—	°C/W	

2.0 TYPICAL PERFORMANCE CURVES

Note: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be outside the specified operating range (e.g. outside specified power supply range) and therefore outside the warranted range.

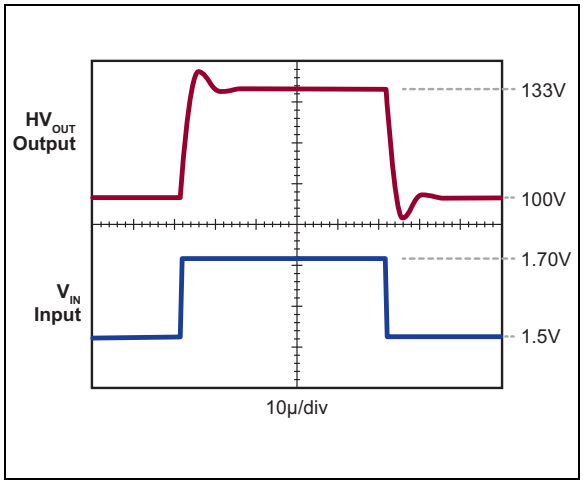


FIGURE 2-1: *Typical Small-Signal Pulse Response.*

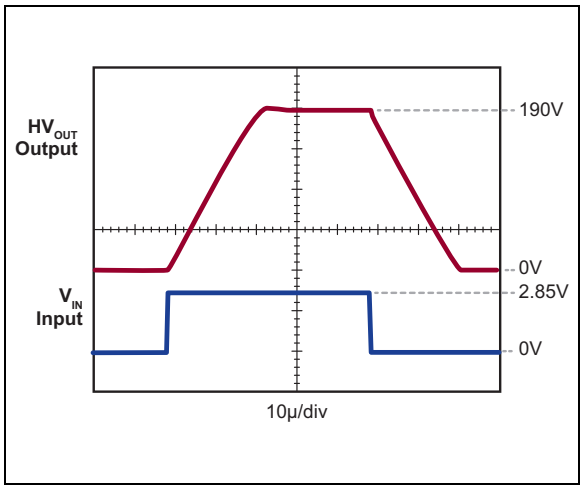


FIGURE 2-2: *Typical Large-Signal Pulse Response.*

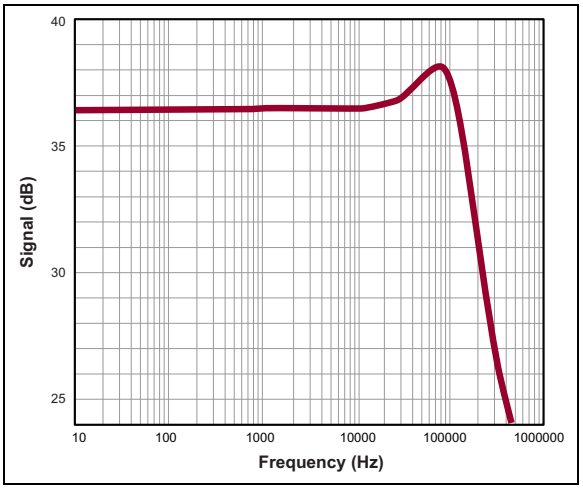


FIGURE 2-3: *Typical Bode Plot of Small-Signal Gain (V_{IN} = 0.2 V_{P-P}, V_{DC} = 1.5V, V_{DD} = 5V and V_{PP} = 200V).*

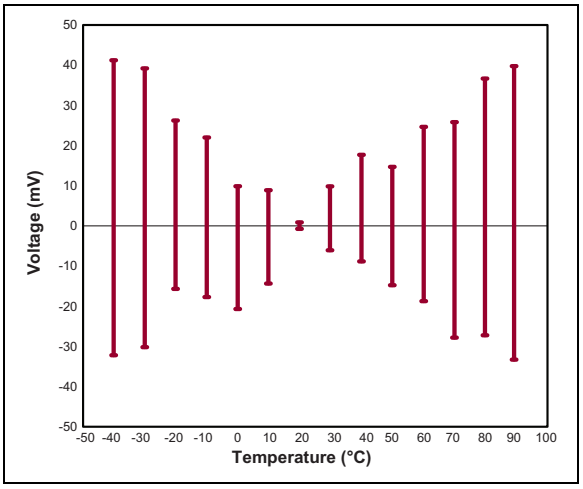


FIGURE 2-4: *Distribution of Typical HV_{OUT} Deviation over Temperature (V_{IN} = 0.1 V_{DC}, 1.6 V_{DC}, 3.3 V_{DC}, in Reference to +20°C).*

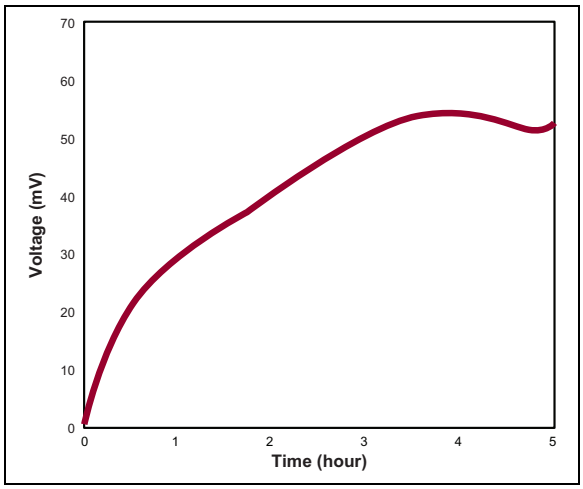


FIGURE 2-5: *Typical HV_{OUT} Drift Over Time (V_{PP} = 200V, V_{DD} = 5.5V, V_{IN} = 0.2V, Room Temperature and 50 pF Output Loading).*

3.0 PIN DESCRIPTION

The pin details are listed in Table 3-1. Refer to **Section "Package Type"** for the location of the pins.

TABLE 3-1: PIN FUNCTION TABLE

Pin Number	Pin Name	Description
1	NC	No connection
2	VIN1	Amplifier Input 1
3	RGND1	Resistor ground for Channel 1. Typically grounded. Can be connected to a voltage source to create a DC offset.
4	VIN2	Amplifier Input 2
5	RGND2	Resistor ground for Channel 2. Typically grounded. Can be connected to a voltage source to create a DC offset.
6	V_{DD}	Low-Voltage positive supply
7	GND	Device ground
8	VIN3	Amplifier Input 3
9	RGND3	Resistor ground for Channel 3. Typically grounded. Can be connected to a voltage source to create a DC offset.
10	VIN4	Amplifier Input 4
11	RGND4	Resistor ground for Channel 4. Typically grounded. Can be connected to a voltage source to create a DC offset.
12	NC	No connection
13	NC	No connection
14	FB4	Feedback Input 4
15	HVOUT4	Amplifier Output 4
16	FB3	Feedback Input 3
17	HVOUT3	Amplifier Output 3
18	HVGND	Device high-voltage supply ground
19	V_{PP}	High-Voltage positive supply
20	FB2	Feedback Input 2
21	HVOUT2	Amplifier Output 2
22	FB1	Feedback Input 1
23	HVOUT1	Amplifier Output 1
24	NC	No connection

4.0 FUNCTIONAL DESCRIPTION

4.1 Power-Up/Power-Down Sequence

The device can be damaged due to an improper power-up/power-down sequence. To avoid this, please follow the acceptable power-up and power-down sequences in Table 4-1 and Table 4-2 and add an external diode across V_{PP} and V_{DD} where the anode of the diode is connected to V_{DD} and the cathode of the diode is connected to V_{PP}. Any low-current high-voltage diode such as a 1N4004 will be adequate.

TABLE 4-1: ACCEPTABLE POWER-UP SEQUENCES

Option 1		Option 2	
Step	**Description**	**Step**	**Description**
1	V_{DD}	1	V_{DD}
2	V_{PP}	2	Inputs
3	Inputs	3	V_{PP}

TABLE 4-2: ACCEPTABLE POWER-DOWN SEQUENCES

Option 1		Option 2	
Step	**Description**	**Step**	**Description**
1	Inputs	1	V_{PP}
2	V_{PP}	2	Inputs
3	V_{DD}	3	V_{DD}

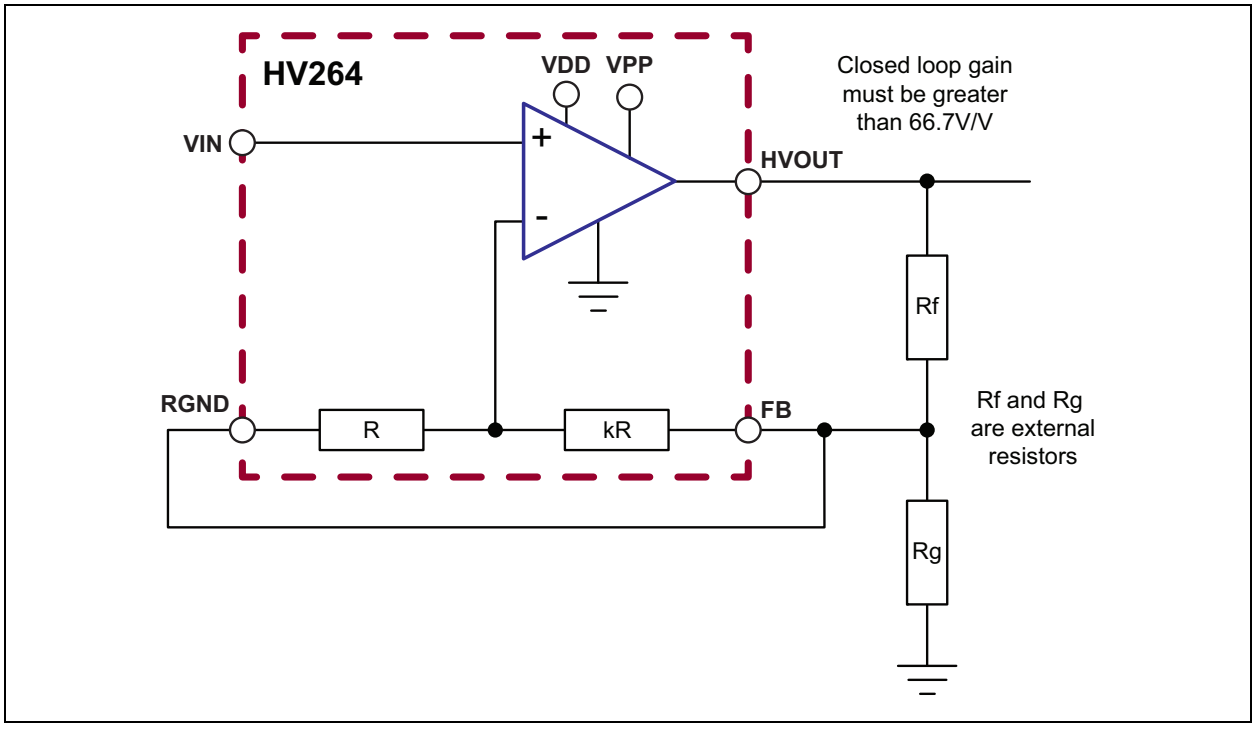
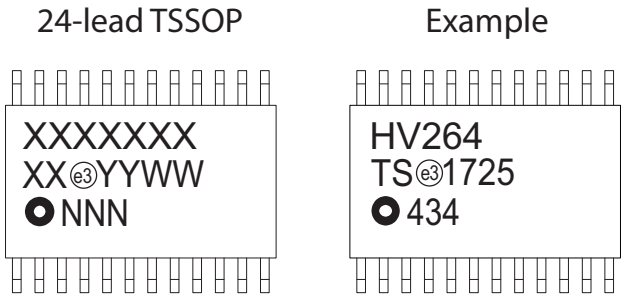


FIGURE 4-1: *Application Circuit with External Gain Setting Resistors.*

5.0 PACKAGE MARKING INFORMATION

5.1 Packaging Information

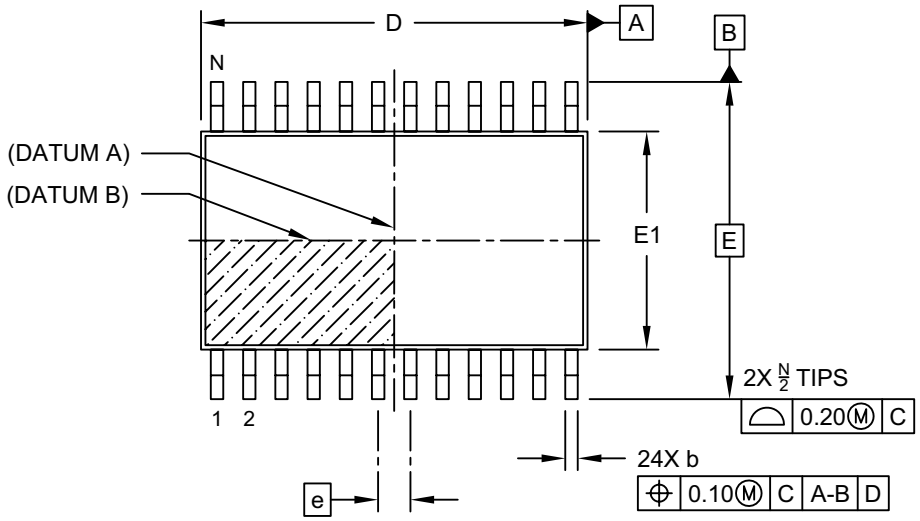


Legend:	XX...X	Product Code or Customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week '01')
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC® designator for Matte Tin (Sn)
	*	This package is Pb-free. The Pb-free JEDEC designator ((e3)) can be found on the outer packaging for this package.

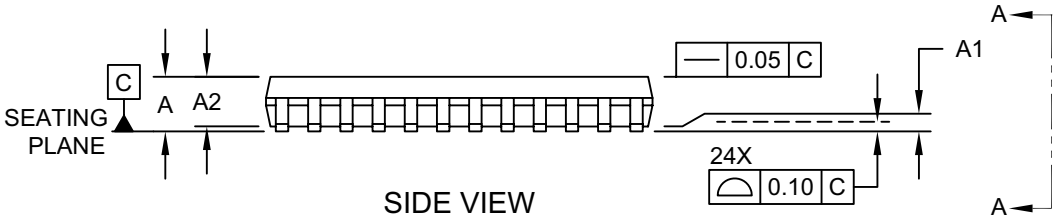
Note: In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for product code or customer-specific information. Package may or not include the corporate logo.

24-Lead Thin Shrink Small Outline Package (QE) - 4.40 mm Body [TSSOP]
Supertex Legacy & Micrel Legacy Package

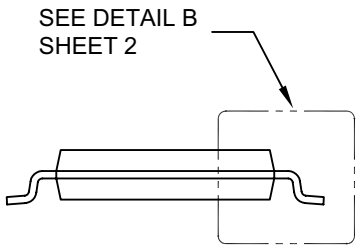
Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



TOP VIEW



SIDE VIEW

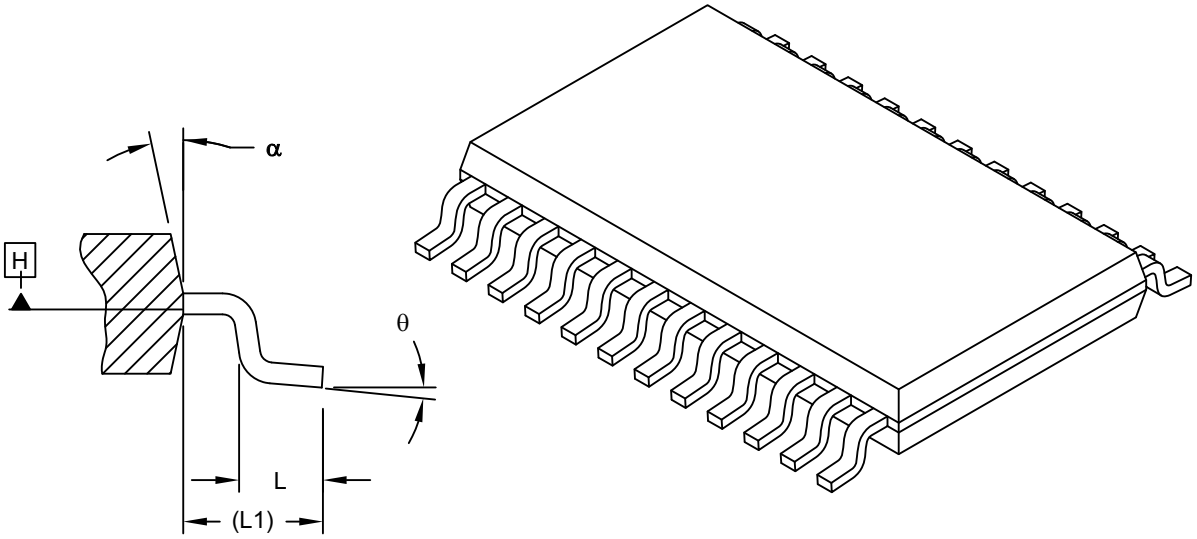


VIEW A-A

Microchip Technology Drawing C04-284A Sheet 1 of 2

24-Lead Thin Shrink Small Outline Package (QE) - 4.40 mm Body [TSSOP]
Supertex Legacy & Micrel Legacy Package

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



DETAIL B

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Leads	N		24	
Lead Pitch	e		0.65 BSC	
Overall Height	A	0.85	-	1.20
Standoff	A1	0.05	0.10	0.15
Molded Package Thickness	A2	0.80	1.00	1.15
Foot Length	L	0.45	0.60	0.75
Footprint	L1		1.00 REF	
Foot Angle	θ	0°	4°	8°
Overall Width	E		6.40 BSC	
Overall Length	D	7.70	7.80	7.90
Molded Package Width	E1	4.30	4.40	4.50
Lead Width	b	0.19	-	0.30
Mold Draft Angle Top	α		12° REF	

Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. Dimensioning and tolerancing per ASME Y14.5M

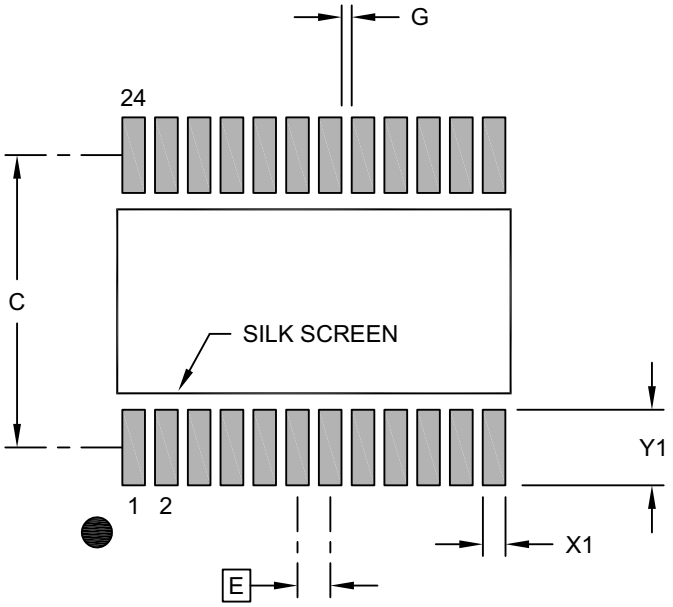
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

   REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-284A Sheet 2 of 2

24-Lead Thin Shrink Small Outline Package (QE) - 4.40 mm Body [TSSOP]
Supertex Legacy & Micrel Legacy Package

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



RECOMMENDED LAND PATTERN

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E		0.65 BSC	
Contact Pad Spacing	C		5.80	
Contact Pad Width (X24)	X1			0.45
Contact Pad Length (X24)	Y1			1.50
Contact Pad to Center Pad (X20)	G1	0.20		

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.
2. For best soldering results, thermal vias, if used, should be filled or tented to avoid solder loss during reflow process

Microchip Technology Drawing C04-2284A

NOTES:

APPENDIX A: REVISION HISTORY

Revision B (February 2019)

- Updated **Section "Features"**
- Updated **Section "General Description"**
- Updated **Section 1.0 "Electrical Characteristics"**
- Updated **Section 5.0 "Package Marking Information"**
- Minor typographical edits

Revision A (August 2017)

- Converted Supertex Doc# DSFP-HV264 to Microchip DS20005832B
- Changed the part marking format
- Made minor text changes throughout the document

NOTES:

PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, contact your local Microchip representative or sales office.

PART NO.	XX	-	X	-	X
Device	Package Options		Environmental		Media Type

Device:	HV264	=	Quad High-Voltage Amplifier Array
Package:	TS	=	24-lead TSSOP
Environmental:	G	=	Lead (Pb)-free/RoHS-compliant Package
Media Type:	(blank)	=	2500/Reel for a TS Package

Example:

a) HV264TS-G: Quad High-Voltage Amplifier Array, 24-lead TSSOP, 2500/Reel

NOTES:

Note the following details of the code protection feature on Microchip devices:

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as "unbreakable."

Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

Microchip received ISO/TS-16949:2009 certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona; Gresham, Oregon and design centers in California and India. The Company's quality system processes and procedures are for its PIC® MCUs and dsPIC® DSCs, KEELOQ® code hopping devices, Serial EEPROMs, microperipherals, nonvolatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001:2000 certified.

QUALITY MANAGEMENT SYSTEM
CERTIFIED BY DNV
═ ISO/TS 16949 ═

Trademarks

ISBN: 978-1-5224-4123-6

Worldwide Sales and Service

AMERICAS

Corporate Office
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200
Fax: 480-792-7277
Technical Support:
http://www.microchip.com/support
Web Address:
www.microchip.com

Atlanta
Duluth, GA
Tel: 678-957-9614
Fax: 678-957-1455

Austin, TX
Tel: 512-257-3370

Boston
Westborough, MA
Tel: 774-760-0087
Fax: 774-760-0088

Chicago
Itasca, IL
Tel: 630-285-0071
Fax: 630-285-0075

Dallas
Addison, TX
Tel: 972-818-7423
Fax: 972-818-2924

Detroit
Novi, MI
Tel: 248-848-4000

Houston, TX
Tel: 281-894-5983

Indianapolis
Noblesville, IN
Tel: 317-773-8323
Fax: 317-773-5453
Tel: 317-536-2380

Los Angeles
Mission Viejo, CA
Tel: 949-462-9523
Fax: 949-462-9608
Tel: 951-273-7800

Raleigh, NC
Tel: 919-844-7510

New York, NY
Tel: 631-435-6000

San Jose, CA
Tel: 408-735-9110
Tel: 408-436-4270

Canada - Toronto
Tel: 905-695-1980
Fax: 905-695-2078

ASIA/PACIFIC

Australia - Sydney
Tel: 61-2-9868-6733

China - Beijing
Tel: 86-10-8569-7000

China - Chengdu
Tel: 86-28-8665-5511

China - Chongqing
Tel: 86-23-8980-9588

China - Dongguan
Tel: 86-769-8702-9880

China - Guangzhou
Tel: 86-20-8755-8029

China - Hangzhou
Tel: 86-571-8792-8115

China - Hong Kong SAR
Tel: 852-2943-5100

China - Nanjing
Tel: 86-25-8473-2460

China - Qingdao
Tel: 86-532-8502-7355

China - Shanghai
Tel: 86-21-3326-8000

China - Shenyang
Tel: 86-24-2334-2829

China - Shenzhen
Tel: 86-755-8864-2200

China - Suzhou
Tel: 86-186-6233-1526

China - Wuhan
Tel: 86-27-5980-5300

China - Xian
Tel: 86-29-8833-7252

China - Xiamen
Tel: 86-592-2388138

China - Zhuhai
Tel: 86-756-3210040

ASIA/PACIFIC

India - Bangalore
Tel: 91-80-3090-4444

India - New Delhi
Tel: 91-11-4160-8631

India - Pune
Tel: 91-20-4121-0141

Japan - Osaka
Tel: 81-6-6152-7160

Japan - Tokyo
Tel: 81-3-6880- 3770

Korea - Daegu
Tel: 82-53-744-4301

Korea - Seoul
Tel: 82-2-554-7200

Malaysia - Kuala Lumpur
Tel: 60-3-7651-7906

Malaysia - Penang
Tel: 60-4-227-8870

Philippines - Manila
Tel: 63-2-634-9065

Singapore
Tel: 65-6334-8870

Taiwan - Hsin Chu
Tel: 886-3-577-8366

Taiwan - Kaohsiung
Tel: 886-7-213-7830

Taiwan - Taipei
Tel: 886-2-2508-8600

Thailand - Bangkok
Tel: 66-2-694-1351

Vietnam - Ho Chi Minh
Tel: 84-28-5448-2100

EUROPE

Austria - Wels
Tel: 43-7242-2244-39
Fax: 43-7242-2244-393

Denmark - Copenhagen
Tel: 45-4450-2828
Fax: 45-4485-2829

Finland - Espoo
Tel: 358-9-4520-820

France - Paris
Tel: 33-1-69-53-63-20
Fax: 33-1-69-30-90-79

Germany - Garching
Tel: 49-8931-9700

Germany - Haan
Tel: 49-2129-3766400

Germany - Heilbronn
Tel: 49-7131-67-3636

Germany - Karlsruhe
Tel: 49-721-625370

Germany - Munich
Tel: 49-89-627-144-0
Fax: 49-89-627-144-44

Germany - Rosenheim
Tel: 49-8031-354-560

Israel - Ra'anana
Tel: 972-9-744-7705

Italy - Milan
Tel: 39-0331-742611
Fax: 39-0331-466781

Italy - Padova
Tel: 39-049-7625286

Netherlands - Drunen
Tel: 31-416-690399
Fax: 31-416-690340

Norway - Trondheim
Tel: 47-7288-4388

Poland - Warsaw
Tel: 48-22-3325737

Romania - Bucharest
Tel: 40-21-407-87-50

Spain - Madrid
Tel: 34-91-708-08-90
Fax: 34-91-708-08-91

Sweden - Gothenberg
Tel: 46-31-704-60-40

Sweden - Stockholm
Tel: 46-8-5090-4654

UK - Wokingham
Tel: 44-118-921-5800
Fax: 44-118-921-5820