20V, 350mA, Rail-to-Rail Operational Amplifier

General Description

The RTQ9148 consists of a low power, high slew rate, single supply rail-to-rail input and output operational amplifier.

The RTQ9148 has a high slew rate (35V/µs), 350mA peak output current and offset voltage below 15mV. The RTQ9148 is ideal for Thin Film Transistor Liquid Crystal Displays (TFT-LCD).

The RTQ9148 is available in the WDFN-6L 3x3 package. The RTQ9148 are specified for operation over the full temperature range from –40°C to 105°C.

Ordering Information

RTQ9148□□-QT

Package Type
QW : WDFN-6L 3x3 (W-Type)
(Exposed Pad-Option 2)

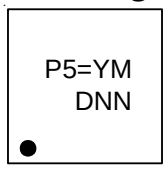
Lead Plating System
G : Green (Halogen Free and Pb Free)

Note :

Richtek products are :

- RoHS compliant and compatible with the current requirements of IPC/JEDEC J-STD-020.
- Suitable for use in SnPb or Pb-free soldering processes.

Marking Information



P5= : Product Code

YMDNN : Date Code

Features

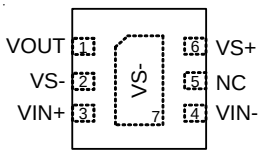
- **Rail-to-Rail Output Swing**
- **Supply Voltage : 6V to 20V**
- **Peak Output Current : 350mA**
- **High Slew Rate : 35V/µs**
- **Unity Gain Stable**
- **AEC-Q100 Grade 2 Certification**
- **RoHS Compliant and Halogen Free**

Applications

- TFT LCD Panels
- Notebook Computers
- Monitors
- LCD TVs

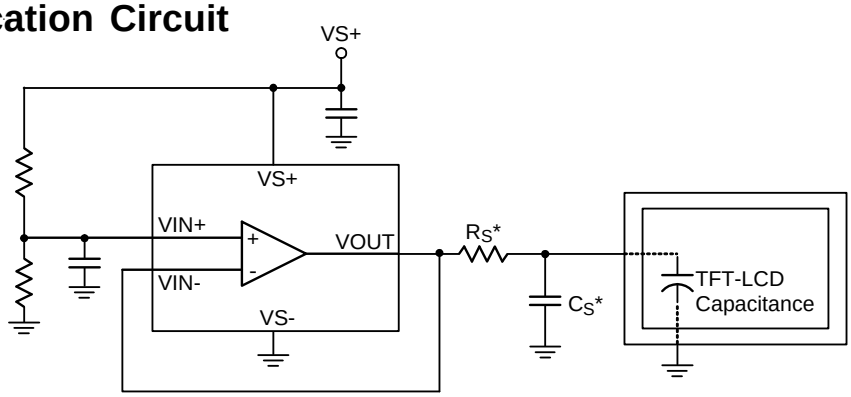
Pin Configuration

(TOP VIEW)



WDFN-6L 3x3

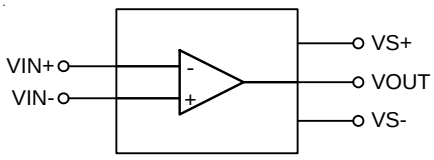
Typical Application Circuit



* : R_S and C_S may be needed for some applications.

Component	Recommend Value
R_S	5.1R, 10R
C_S	1μF, 2.2μF, 4.7μF, 10μF

Functional Block Diagram



Functional Pin Description

Pin No.	Pin Name	Pin Function
1	VOUT	Output.
2, 7 (Exposed Pad)	VS-	Negative supply input.
3	VIN+	Positive input.
4	VIN-	Negative input.
5	NC	No internal connection.
6	VS+	Positive supply input.

Absolute Maximum Ratings (Note 1)

- Supply Voltage, (VS+ to VS–) ---------- 24V
- VIN+, VIN– to VS– ---------- –0.3V to 24V
- VIN+ to VIN– ---------- ±5V
- Power Dissipation, P_D @ T_A = 25°C
  WDFN-6L 3x3 ---------- 2.22W
- Package Thermal Resistance (Note 2)
  WDFN-6L 3x3, θ_{JA} ---------- 45°C/W
  WDFN-6L 3x3, θ_{JC} ---------- 13.8°C/W
- Lead Temperature (Soldering, 10 sec.) ---------- 260°C
- Junction Temperature ---------- 150°C
- Storage Temperature Range ---------- –65°C to 150°C
- ESD Susceptibility (Note 3)
  HBM (Human Body Model) ---------- 2kV

Recommended Operating Conditions (Note 4)

- Supply Voltage, VS– = 0V, VS+ ---------- 6V to 20V
- Junction Temperature Range ---------- –40°C to 125°C
- Ambient Temperature Range ---------- –40°C to 105°C

Electrical Characteristics

(V_{S+} = 16V, V_{S-} = 0V, V_{IN+} = V_{OUT} = V_{S+} / 2, R_L = 10kΩ and C_L = 10pF, T_A = –40°C to 105°C, unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Input Characteristics						
Input Offset Voltage	V_{OS}	V_{CM} = V_{S+} / 2	--	2	25	mV
Input Bias Current	I_B	V_{CM} = V_{S+} / 2	--	--	1.5	μA
Load Regulation	ΔV_{LOAD}	I_L = 0 to –80mA	–0.5	--	0.5	mV/mA
		I_L = 0 to 80mA	–0.5	--	0.5	
Common Mode Input Range	CMIR		0.5	--	V_{S+} –0.5	V
Output Characteristics						
Output Swing Low	V_{OL}	I_L = –50mA	--	0.6	1.5	V
Output Swing High	V_{OH}	I_L = 50mA	V_{S+} –1.5	V_{S+} –0.3	--	V
Transient Peak Output Current	I_{PK}		190	355	520	mA
Power Supply						
Quiescent Current	I_{DD}	No load	--	4	--	mA
Dynamic Performance						
Slew Rate	SR	4V step, 20% to 80%, A_V = 1	--	35	--	V/μs

Note 1. Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions may affect device reliability.

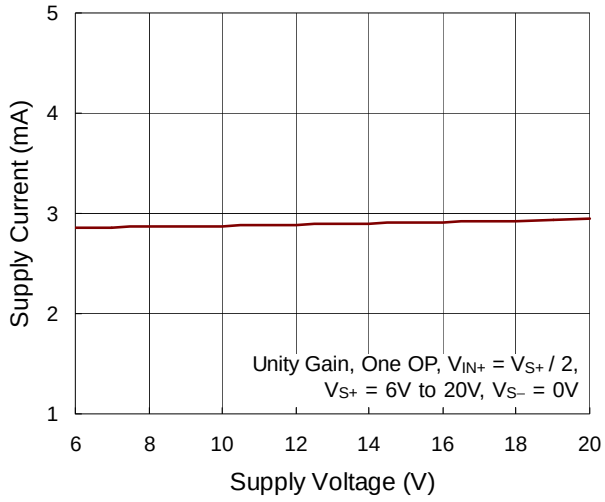
Note 2. θ_{JA} is measured under natural convection (still air) at T_A = 25°C with the component mounted on a high effective-thermal-conductivity four-layer test board on a JEDEC 51-7 thermal measurement standard. θ_{JC} is measured at the exposed pad of the package.

Note 3. Devices are ESD sensitive. Handling precaution is recommended.

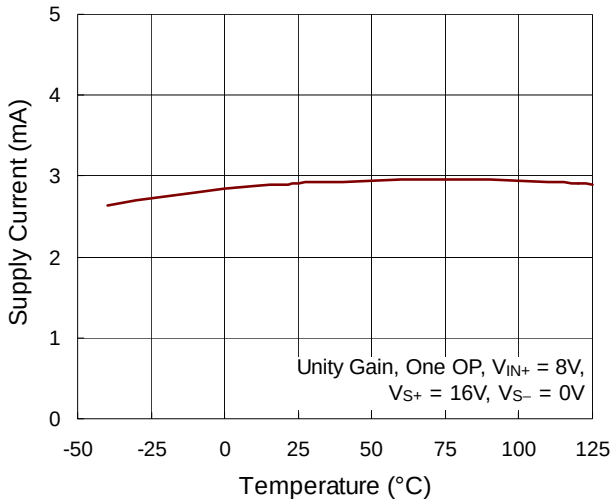
Note 4. The device is not guaranteed to function outside its operating conditions.

Typical Operating Characteristics

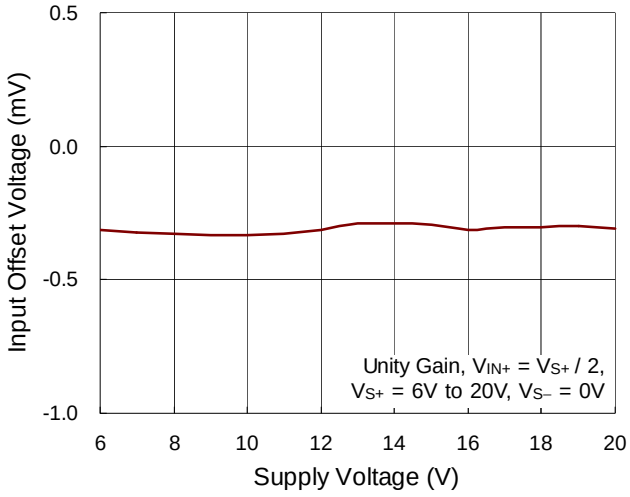
Supply Current / Amplifier vs. Supply Voltage



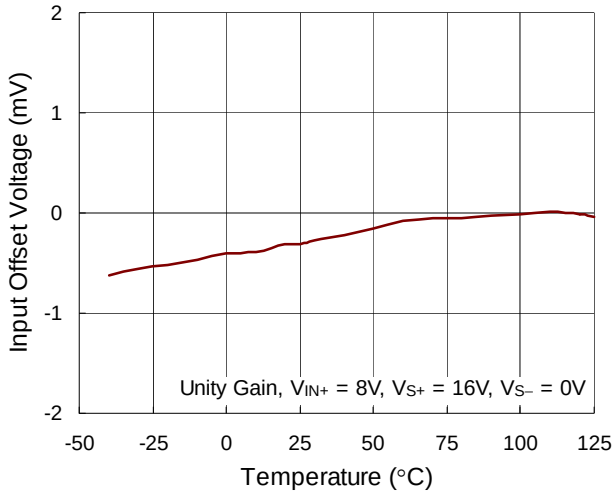
Supply Current / Amplifier vs. Temperature



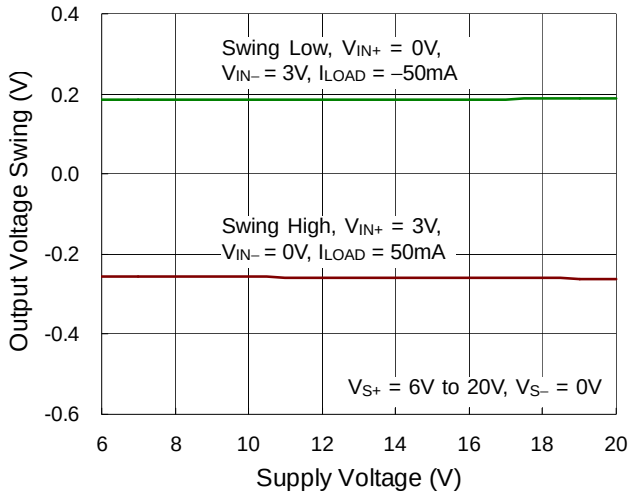
Input Offset Voltage vs. Supply Voltage



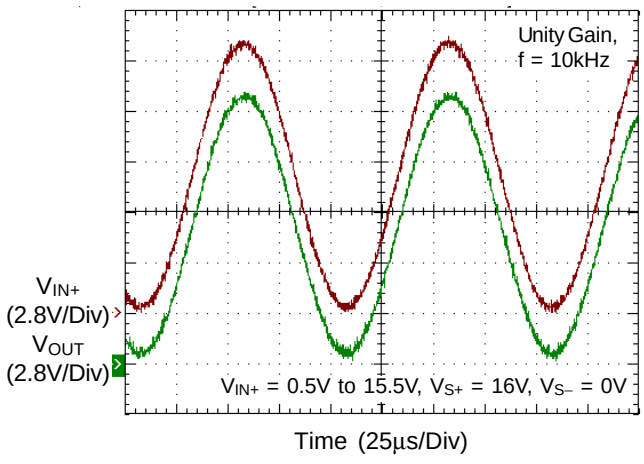
Input Offset Voltage vs. Temperature



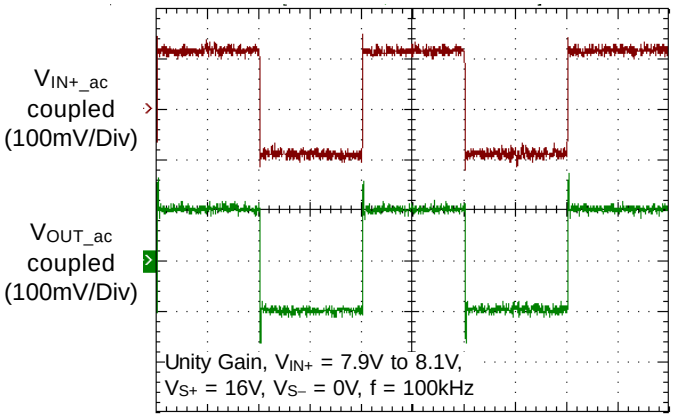
Output Voltage Swing vs. Supply Voltage



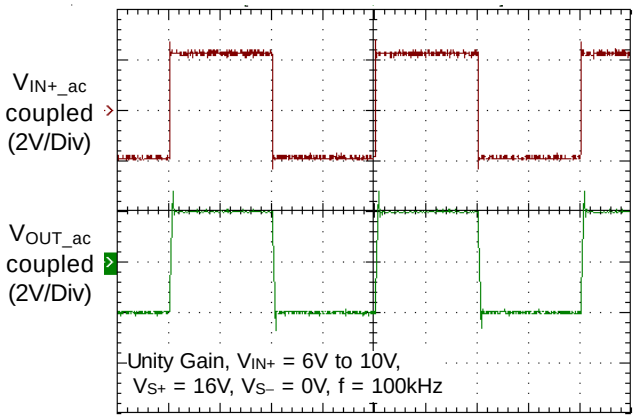
Rail to Rail



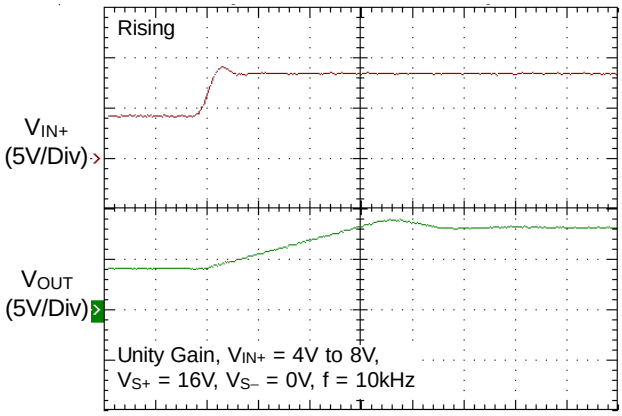
Small Signal Response



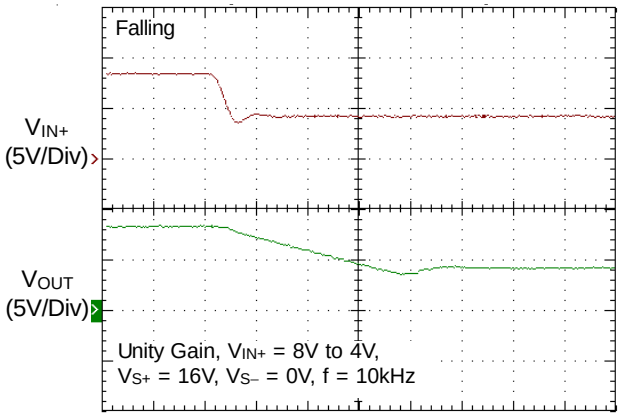
Large Signal Response



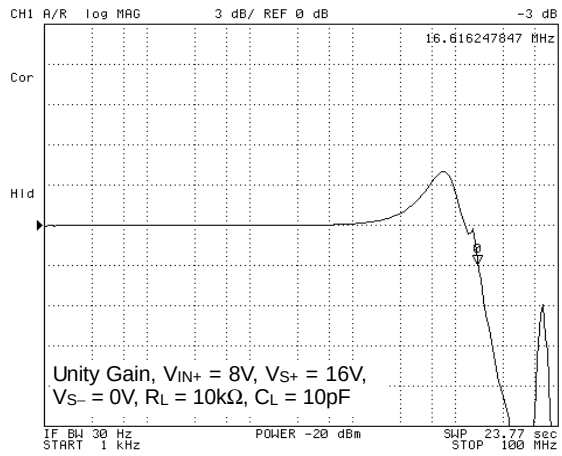
Slew Rate



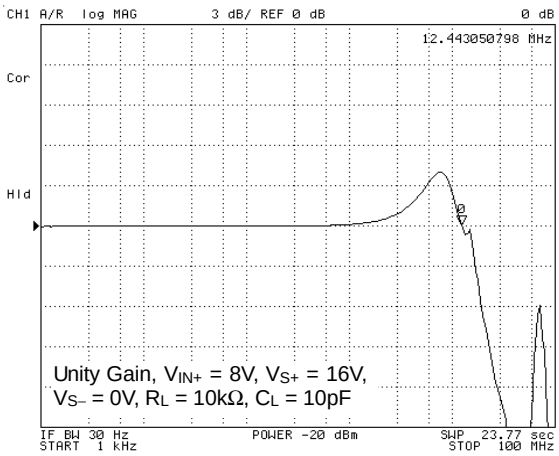
Slew Rate



–3dB Bandwidth



Gain Bandwidth Product



Applications Information

The RTQ9148 is a high performance operational amplifier capable of driving large loads for different applications. A high slew rates, rail-to-rail input and output capability, and low power consumption are the features which make the RTQ9148 ideal for LCD applications. The RTQ9148 also has wide bandwidth and phase margin to drive a load with 10kΩ resistance and 10pF capacitance.

Operating Voltage

The RTQ9148 total supply voltage range is guaranteed from 6V to 20V. The specifications are stable over both the full supply range and operating temperatures from –40°C to 85°C. The output swing of the RTQ9148 typically extends to within 1.5V of positive/negative supply rails with 50mA load current source/sink. Decreasing the load current will obtain an output swing even closer to the supply rails.

Short Circuit Condition

An internal short circuit protection is implemented to protect the device from output short circuit. The RTQ9148 limits the short circuit current to ±350mA if the output is directly shorted to positive/negative supply rails.

LCD Panel Applications

The RTQ9148 is mainly designed for LCD V-com buffer. The operational amplifier has 350mA instantaneous source/sink peak current.

Thermal Considerations

The junction temperature should never exceed the absolute maximum junction temperature $T_{J(MAX)}$, listed under Absolute Maximum Ratings, to avoid permanent damage to the device. The maximum allowable power dissipation depends on the thermal resistance of the IC package, the PCB layout, the rate of surrounding airflow, and the difference between the junction and ambient temperatures. The maximum power dissipation can be calculated using the following formula :

$P_{D(MAX)} = (T_{J(MAX)} – T_A) / \theta_{JA}$

where $T_{J(MAX)}$ is the maximum junction temperature, T_A is the ambient temperature, and θ_{JA} is the junction-to-ambient thermal resistance.

For continuous operation, the maximum operating junction temperature indicated under Recommended Operating Conditions is 125°C. The junction-to-ambient thermal resistance, θ_{JA}, is highly package dependent. For WDFN-6L 3x3 package, the thermal resistance, θ_{JA}, is 45°C/W on a standard JEDEC 51-7 high effective-thermal-conductivity four-layer test board. The maximum power dissipation at T_A = 25°C can be calculated as below :

$P_{D(MAX)}$ = (125°C – 25°C) / (45°C/W) = 2.22W for a WDFN-6L 3x3 package

The maximum power dissipation depends on the operating ambient temperature for the fixed $T_{J(MAX)}$ and the thermal resistance, θ_{JA}. The derating curve in Figure 1 allows the designer to see the effect of rising ambient temperature on the maximum power dissipation.

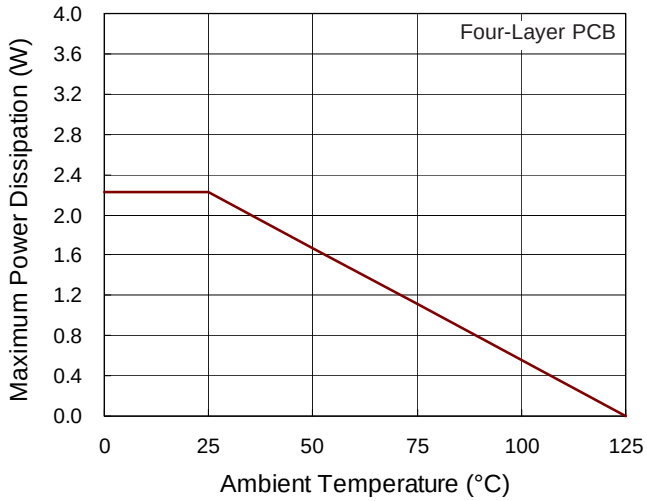


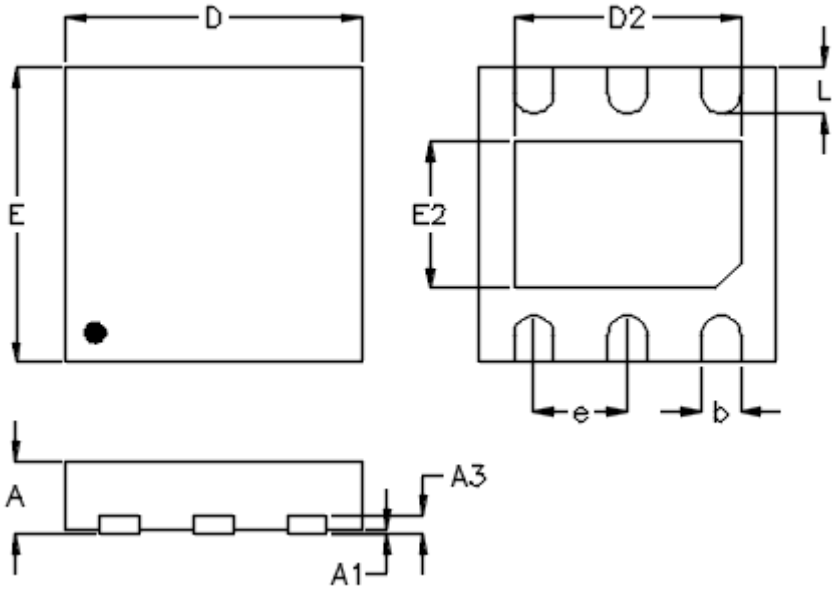
Figure 1. Derating Curve of Maximum Power Dissipation

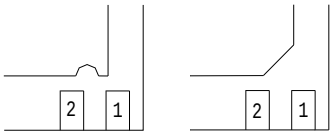
Layout Consideration

PCB layout is very important for designing power converter circuits. The following layout guidelines should be strictly followed for best performance of the RTQ9148.

- Place the power components as close to the IC as possible. The traces should be wide and short, especially for the high current loop.
- A series resistance may be needed at the output for some applications.
- Connect a 0.1µF capacitor from VIN+ to ground and place it as close to the IC as possible for better performance.
- The exposed pad of the chip should be connected to a large PCB plane for maximum thermal consideration.

Outline Dimension





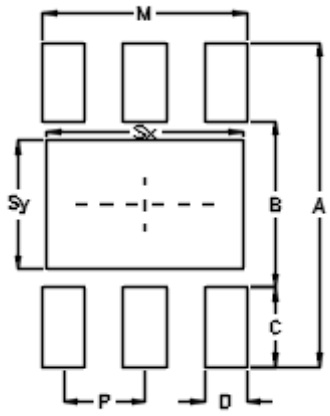
DETAIL A

Pin #1 ID and Tie Bar Mark Options

Note : The configuration of the Pin #1 identifier is optional, but must be located within the zone indicated.

Symbol		Dimensions In Millimeters		Dimensions In Inches	
		Min	Max	Min	Max
A		0.700	0.800	0.028	0.031
A1		0.000	0.050	0.000	0.002
A3		0.175	0.250	0.007	0.010
b		0.350	0.450	0.014	0.018
D		2.950	3.050	0.116	0.120
D2	Option1	2.250	2.350	0.089	0.093
	Option2	1.950	2.050	0.077	0.081
E		2.950	3.050	0.116	0.120
E2	Option1	1.450	1.550	0.057	0.061
	Option2	0.750	0.850	0.030	0.033
e		0.950		0.037	
L		0.425	0.525	0.017	0.021

W-Type 6L DFN 3x3 Package



Package		Number of Pin	Footprint Dimension (mm)								Tolerance
			P	A	B	C	D	Sx	Sy	M	
V/W/U/XDFN3x3-6	Option1	6	0.950	3.800	1.950	0.925	0.500	2.300	1.500	2.400	±0.050
	Option2							2.000	0.800		

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