TS615

DUAL WIDE BAND OPERATIONAL AMPLIFIER WITH HIGH OUTPUT CURRENT

ADVANCE DATA

- **LOW NOISE :** 2.5nV/√Hz
- **HIGH OUTPUT CURRENT :** 310mA
- **VERY LOW HARMONIC AND INTERMODULATION DISTORTION :**
  HD2=-95dBc@100kHz, 4Vp on 25Ω load
  IM3=-99dBc@70&80kHz, 4Vp on 25Ω load
  (single ended)
- **HIGH SLEW RATE :** 490V/µs
- **-3dB BANDWIDTH :** 42MHz@gain=12dB on 25Ω load
- **20Vp-p DIFFERENTIAL OUTPUT DYNAMIC** on 50Ω load, 12V power supply
- **CURRENT FEEDBACK STRUCTURE**
- **5V to 12V POWER SUPPLY**
- **SPECIFIED FOR 10Ω and 25Ω LOAD** (single configuration)
- **POWER DOWN FUNCTION WITH A SHORT CIRCUITED OUTPUT to keep the matching with the line in sleep mode.**

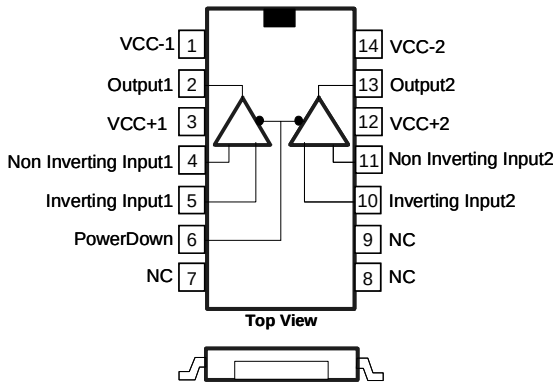
TSSOP14 &
TSSOP14 Exposed-Pad
(Plastic Micropackage)

ORDER CODE

Part Number	Temperature Range	Package	
		P	PW
TS615IPT	-40, +85°C	•	
TS615IPWT	-40, +85°C		•

P = Thin Shrink Small Outline Package (TSSOP) - only available in Tape & Reel (PT)
PW= Thin Shrink Small Outline Package (TSSOP Exposed-Pad) only available in Tape & Reel (PWT)

PIN CONNECTIONS (top view)



Cross Section View Showing Exposed-Pad
This pad can be connected to a (-Vcc) copper area on the PCB

DESCRIPTION

The TS615 is a dual operational amplifier featuring a high output current (310mA). These drivers can be configured differentially for driving signals in telecommunication systems using multiple carriers. The TS615 is ideally suited for xDSL (High Speed Asymmetrical Digital Subscriber Line) applications. This circuit is capable of driving a 10Ω or 25Ω load at ±2.5V, 5V, ±6V or +12V power supply. The TS615 will be able to reach a -3dB bandwidth of 42MHz on 25Ω load with a 12dB gain. This device is designed for the high slew rates to support low harmonic distortion and intermodulation. The TS615 is fitted out with Power Down function to decrease the consumption. During this sleep state the device displays a short circuit output in order to keep the impedance matching with the line. The TS615 is housed in TSSOP14 plastic package and TSSOP14 Exposed-Pad plastic package for a very low thermal resistance.

APPLICATION

- Line driver for xDSL.
- Multiple Video Line Driver

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage [1]	±7	V
V_{id}	Differential Input Voltage [2]	±2	V
V_{in}	Input Voltage Range [3]	±6	V
T_{oper}	Operating Free Air Temperature Range	-40 to + 85	°C
T_{std}	Storage Temperature	-65 to +150	°C
T_j	Maximum Junction Temperature	150	°C
R_{thjc}	Thermal Resistance Junction to Case	TBD	°C/W
R_{thja}	Thermal Resistance Junction to Ambient Area	40	°C/W
$P_{max.}$	Maximum Power Dissipation (@25°C)	3.1	W
	Output Short Circuit Duration	[4]	

1. All voltages values, except differential voltage are with respect to network terminal.
2. Differential voltages are non-inverting input terminal with respect to the inverting input terminal.
3. The magnitude of input and output voltages must never exceed V_{CC} +0.3V.
4. An output current limitation protects the circuit from transient currents. Short-circuits can cause excessive heating. Destructive dissipation can result from short circuit on amplifiers.

OPERATING CONDITIONS

Symbol	Parameter	Value	Unit
V_{CC}	Power Supply Voltage	±2.5 to ±6	V
V_{icm}	Common Mode Input Voltage	V_{CC-}+1.5V V_{CC+}-1.5V	V

ELECTRICAL CHARACTERISTICS

V_{CC} = ±6Volts, R_{fb}=910Ω,T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
DC PERFORMANCE						
V_{io}	Input Offset Voltage	T_{amb}		1.25	6	mV
		$T_{min.} < T_{amb} < T_{max.}$			10	
ΔV_{io}	Differential Input Offset Voltage	T_{amb} = 25°C			6	mV
I_{ib+}	Positive Input Bias Current	T_{amb}		-1.65	-7.76	µA
		$T_{min.} < T_{amb} < T_{max.}$			-9	
I_{ib-}	Negative Input Bias Current	T_{amb}		3.4	7.23	µA
		$T_{min.} < T_{amb} < T_{max.}$			7.83	
Z_{IN+}	Input(+) Impedance			82		kΩ
Z_{IN-}	Input(-) Impedance			54		Ω
C_{IN+}	Input(+) Capacitance			1		pF
CMR	Common Mode Rejection Ratio	ΔV_{ic} = ±4.5V	58.5	63		dB
	20 log ($\Delta V_{ic}/\Delta V_{io}$)	$T_{min.} < T_{amb} < T_{max.}$	57.5			
SVR	Supply Voltage Rejection Ratio	ΔV_{cc}=±2.5V to ±6V	62.5	71		dB
	20 log ($\Delta V_{cc}/\Delta V_{io}$)	$T_{min.} < T_{amb} < T_{max.}$	61.7			
I_{CC}	Total Supply Current per Operator	No load		12.4		mA
DYNAMIC PERFORMANCE and OUTPUT CHARACTERISTIC						
R_{OL}	Open Loop Transimpedance	V_{out} = 7Vp-p , R_L = 25Ω	7.6	16.4		MΩ
		$T_{min.} < T_{amb.} < T_{max.}$	2			
BW	-3dB Bandwidth	Small Signal V_{out}<20mVp A_{VCL} = 12dB, R_L = 25Ω		42		MHz
	Full Power Bandwidth	Large Signal V_{out}=3Vp A_{VCL} = 12dB, R_L = 25Ω		26		
	Gain Flatness @ 0.1dB	Small Signal V_{out}<20mVp A_{VCL} = 12dB, R_L = 25Ω		7		MHz
Tr	Rise Time	V_{out} = 6Vp-p, A_{VCL} = 12dB, R_L = 25Ω		10.6		ns
Tf	Fall Time	V_{out} = 6Vp-p, A_{VCL} = 12dB, R_L = 25Ω		12.2		ns
Ts	Settling Time	V_{out} = 6Vp-p, A_{VCL} = 12dB, R_L = 25Ω		50		ns
SR	Slew Rate	V_{out} = 6Vp-p, A_{VCL} = 12dB, R_L = 25Ω	353	492		V/µs
V_{OH}	High Level Output Voltage	I_{out} = 220mA, R_L = 25Ω	5	5.29		V
V_{OL}	Low Level Output Voltage	I_{out} = 220mA, R_L = 25Ω		-5.64	-5	V
I_{out}	Output Sink Current	V_{out} = -5Vp		485		mA
		$T_{min.} < T_{amb} < T_{max.}$	294			
	Output Source Current	V_{out} = +5Vp		312		
		$T_{min.} < T_{amb} < T_{max.}$	262			

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
NOISE AND DISTORTION						
en	Equivalent Input Noise Voltage	F = 100kHz		2.5		nV/√Hz
in	Equivalent Input Noise Current (+)	F = 100kHz		TBD		pA/√Hz
	Equivalent Input Noise Current (-)	F = 100kHz		12.4		pA/√Hz
HD2	2nd Harmonic distortion (single ended)	V_{out} = 8Vp-p, A_{VCL} = 12dB				dBc
		F= 100kHz, R_L = 25Ω		-95		
		F= 1MHz, R_L = 25Ω		-73		
HD3	3rd Harmonic distortion (single ended)	V_{out} = 8Vp-p, A_{VCL} = 12dB				dBc
		F= 100kHz, R_L = 25Ω		-100		
		F= 1MHz, R_L = 25Ω		-81		
IM2	2nd Order Intermodulation Product (single ended)	F1= 70kHz, F2 = 80kHz V_{out} = 8Vp-p, A_{VCL} = 12dB R_L = 25Ω		-93		dBc
IM3	3rd Order Intermodulation Product (single ended)	F1 = 70kHz, F2 = 80kHz V_{out} = 8Vp-p, A_{VCL} = 12dB R_L = 25Ω		-99		dBc

ELECTRICAL CHARACTERISTICS

V_{CC} = ±2.5Volts, R_{fb}=910Ω,T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
DC PERFORMANCE						
V_{io}	Input Offset Voltage	T_{amb}		0.23	6	mV
		$T_{min.} < T_{amb} < T_{max.}$			10	
ΔV_{io}	Differential Input Offset Voltage	T_{amb} = 25°C			6	mV
I_{ib+}	Positive Input Bias Current	T_{amb}		0.2	-2.1	µA
		$T_{min.} < T_{amb} < T_{max.}$			-3	
I_{ib-}	Negative Input Bias Current	T_{amb}		1.5	3.44	µA
		$T_{min.} < T_{amb} < T_{max.}$			3.6	
Z_{IN+}	Input(+) Impedance			71		kΩ
Z_{IN-}	Input(-) Impedance			62		Ω
C_{IN+}	Input(+) Capacitance			1.5		pF
CMR	Common Mode Rejection Ratio	ΔV_{ic} = ±1V	57	62		dB
	20 log ($\Delta V_{ic}/\Delta V_{io}$)	$T_{min.} < T_{amb.} < T_{max.}$	55			
SVR	Supply Voltage Rejection Ratio	ΔV_{cc}=±2V to ±2.5V	61.7	70		dB
	20 log ($\Delta V_{cc}/\Delta V_{io}$)	$T_{min.} < T_{amb.} < T_{max.}$	60			
I_{CC}	Total Supply Current per Operator	No load		10.3		mA
DYNAMIC PERFORMANCE and OUTPUT CHARACTERISTICS						
R_{OL}	Open Loop Transimpedance	V_{out} = 2Vp-p, R_L = 10Ω	2.6	5		MΩ
		$T_{min.} < T_{amb.} < T_{max.}$	0.7			
BW	-3dB Bandwidth	Small Signal V_{out}<20mVp A_{VCL} = 12dB, R_L = 10Ω		40		MHz
	Full Power Bandwidth	Large Signal V_{out} = 1.4Vp A_{VCL} = 12dB, R_L = 10Ω		20		
	Gain Flatness @ 0.1dB	Small Signal V_{out}<20mVp A_{VCL} = 12dB, R_L = 10Ω		5.7		MHz
Tr	Rise Time	V_{out} = 2.8Vp-p, A_{VCL} = 12dB R_L = 10Ω		11		ns
Tf	Fall Time	V_{out} = 2.8Vp-p, A_{VCL} = 12dB R_L = 10Ω		11.5		ns
Ts	Settling Time	V_{out} = 2.8Vp-p, A_{VCL} = 12dB R_L = 10Ω		39		ns
SR	Slew Rate	V_{out} = 2.8Vp-p, A_{VCL} = 12dB R_L = 10Ω	113	176		V/µs
V_{OH}	High Level Output Voltage	I_{out} = 200mA, R_L = 10Ω	1.7	1.86		V
V_{OL}	Low Level Output Voltage	I_{out} = 200mA, R_L = 10Ω		-2.16	-2	V
I_{out}	Output Sink Current	V_{out} = -1.5Vp	359	485		mA
		$T_{min.} < T_{amb} < T_{max.}$	297			
	Output Source Current	V_{out} = +1.5Vp	296	310		
		$T_{min.} < T_{amb} < T_{max.}$	268			

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
NOISE AND DISTORTION						
en	Equivalent Input Noise Voltage	F = 100kHz		2.5		nV/√Hz
in	Equivalent Input Noise Current (+)	F = 100kHz		TBD		pA/√Hz
	Equivalent Input Noise Current (-)	F = 100kHz		12.2		pA/√Hz
HD2	2nd Harmonic distortion (single ended)	V_{out} = 3Vp-p, A_{VCL} = 12dB				dBc
		F= 100kHz, R_L = 10Ω		-81		
		F= 1MHz, R_L = 10Ω		-62		
HD3	3rd Harmonic distortion (single ended)	V_{out} = 3Vp-p, A_{VCL} = 12dB				dBc
		F= 100kHz, R_L = 10Ω		-85		
		F= 1MHz, R_L = 10Ω		-63		
IM2	2nd Order Intermodulation Product (single ended)	F1= 70kHz, F2 = 80kHz V_{out} = 3Vp-p, A_{VCL} = 12dB R_L = 10Ω		-81		dBc
IM3	3rd Order Intermodulation Product (single ended)	F1 = 70kHz, F2 = 80kHz V_{out} = 3Vp-p, A_{VCL} = 12dB R_L = 10Ω		-86		dBc

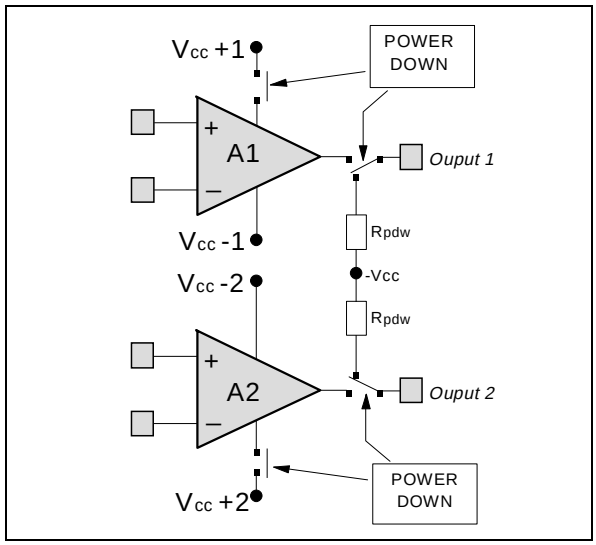
POWER DOWN MODE

V_{CC} = ±2.5Volts, 5Volts, ±6Volts or 12Volts, T_{amb} = 25°C

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{pdw}	Pin (6) Thershold Voltage for Power Down Mode				V
	Low Level	V_{CC}^-		V_{CC}^-+0.8	
	High Level	V_{CC}^-+2		V_{CC}^+	
Icc_{pdw}	Power Down Mode Total Current Consumption@ Vcc=5V			81	µA
	Power Down Mode Total Current Consumption@ Vcc=12V			180	µA
R_{pdw}	Power Down Mode Ouput Impedance @ Vcc=5V			13	Ω
	Power Down Mode Ouput Impedance @ Vcc=12V			6	Ω
C_{pdw}	Power Down Mode Output Capacitance		63		pF

POWER DOWN CONTROL	CIRCUIT STATUS
V_{pdw}=Low Level	Active
V_{pdw}=High Level	Standby

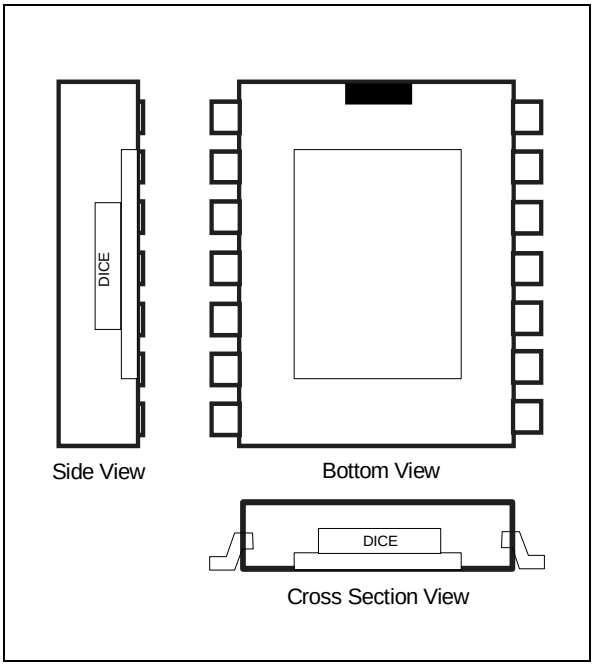
POWER DOWN MODE EQUIVALENT SHEMATIC



THERMAL INFORMATION

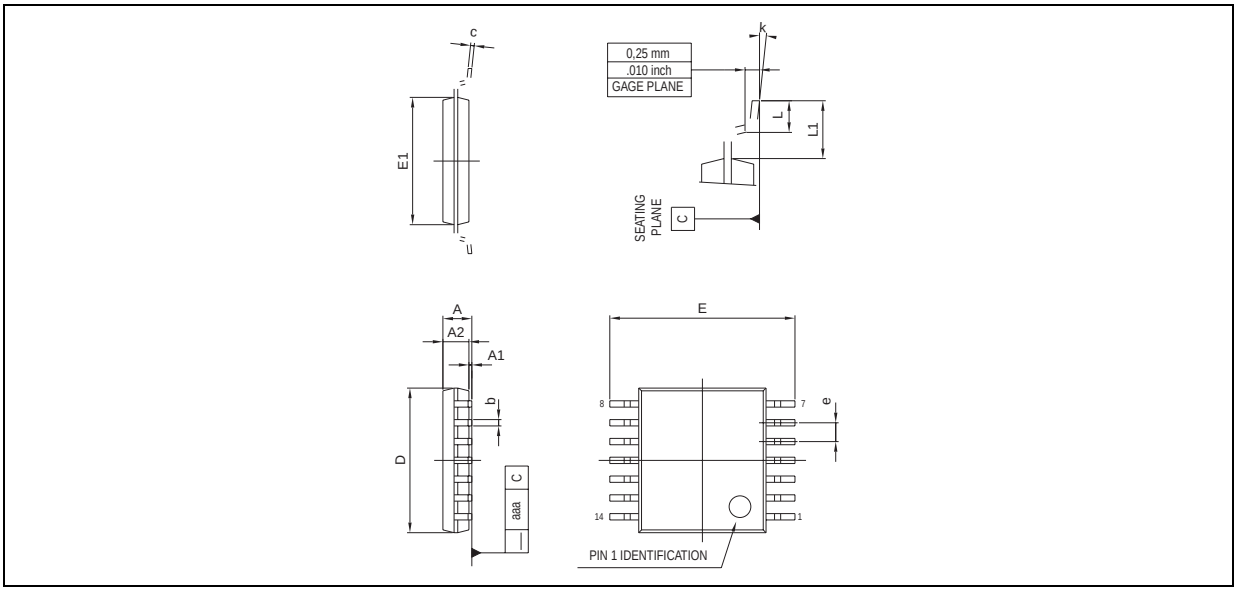
The TS615 is housed in an Exposed-Pad plastic package. As described on the figures below, this package uses a leadframe upon which the dice is mounted. This leadframe is exposed as a thermal pad on the underside of the package. The thermal contact is direct with the dice. This thermal path provide an excellent thermal performance.

The thermal pad is electrically isolated from all pins in the package. It can also be soldered to a copper area of the PCB underneath the package. Through these thermal paths within this copper area, heat can be conducted away from the package. In this case, the copper area must be connected to (-Vcc).



PACKAGE MECHANICAL DATA

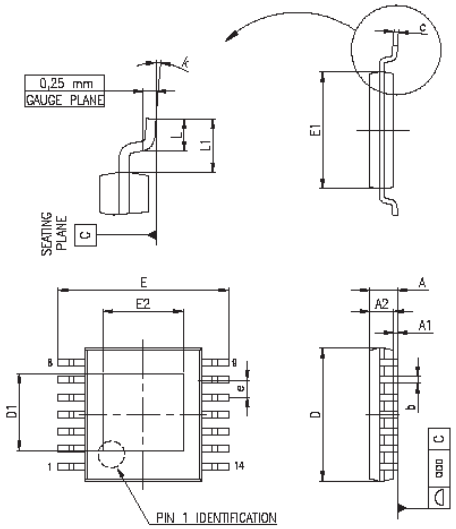
14 PINS - THIN SHRINK SMALL OUTLINE PACKAGE (TSSOP)



Dim.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.20			0.05
A1	0.05		0.15	0.01		0.006
A2	0.80	1.00	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.15
c	0.09		0.20	0.003		0.012
D	4.90	5.00	5.10	0.192	0.196	0.20
E		6.40			0.252	
E1	4.30	4.40	4.50	0.169	0.173	0.177
e		0.65			0.025	
k	0°		8°	0°		8°
l	0.50	0.60	0.75	0.09	0.0236	0.030

PACKAGE MECHANICAL DATA

14 PINS - THIN SHRINK SMALL OUTLINE PACKAGE (TSSOP Exposed-Pad)



Dim.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.200			0.047
A1			0.150			0.006
A2	0.800	1.000	1.050	0.031	0.039	0.041
b	0.190		0.300	0.007		0.012
c	0.090		0.200	0.004		0.008
D	4.900	5.000	5.100	0.193	0.197	0.201
D1	1.700			0.067		
E	6.200	6.400	6.600	0.244	0.252	0.260
E1	4.300	4.400	4.500	0.169	0.173	0.177
E2	1.500			0.059		
e		0.650			0.026	
L	0.450	0.600	0.750	0.018	0.024	0.030
L1		1.000			0.039	
k	0d		8d	0d		8d
aaa			0.100			0.004