+3 V/+5 V/±5 V, CMOS, 8-Channel Analog Multiplexer

Enhanced Product

ADG658-EP

FEATURES

- ±2 V to ±6 V dual supply
- 2 V to 12 V single supply
- <0.1 nA leakage currents (typical)
- 45 Ω typical on resistance over full signal range
- Rail-to-rail switching operation
- Single, 8 to 1 multiplexer
- 16-lead TSSOP package
- 0.01 µA typical supply current
- TTL/CMOS compatible inputs

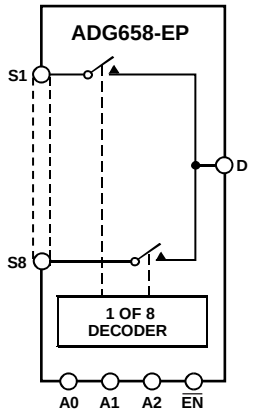
ENHANCED PRODUCT FEATURES

- Supports defense and aerospace applications (AQEC standard)
- Military temperature range: −55°C to +125°C
- Controlled manufacturing baseline
- One assembly/test site
- One fabrication site
- Enhanced product change notification
- Qualification data available on request

APPLICATIONS

- Automatic test equipment
- Data acquisition systems
- Battery-powered systems
- Communication systems
- Audio and video signal routing
- Relay replacement
- Sample-and-hold systems
- Industrial control systems

FUNCTIONAL BLOCK DIAGRAM



SWITCHES SHOWN FOR A LOGIC 1 INPUT.

Figure 1.

GENERAL DESCRIPTION

The ADG658-EP is a low voltage, CMOS analog multiplexer comprised of eight single channels. The ADG658-EP switches one of eight inputs (S1 to S8) to a common output, D, as determined by the 3-bit binary address lines A0, A1, and A2. An $\overline{EN}$ input enables or disables the device. When disabled, all channels are switched off.

The ADG658-EP is designed on an enhanced process that provides lower power dissipation yet gives high switching speeds. It can operate equally well as either a multiplexer or a demultiplexer, and has an input range that extends to the supplies. All channels exhibit break-before-make switching action, preventing momentary shorting when switching channels. All digital inputs have +0.8 V to +2.4 V logic thresholds, ensuring TTL/CMOS logic compatibility when using single +5 V or dual ±5 V supplies.

The ADG658-EP is available in a 16-lead TSSOP package.

Additional application and technical information can be found in the ADG658 data sheet.

PRODUCT HIGHLIGHTS

1. Single-supply and dual-supply operation. The ADG658-EP offers high performance and is fully specified and guaranteed with ±5 V, +5 V, and +3 V supply rails.
2. Military temperature range −55°C to +125°C.
3. Low supply current, typically 0.01 µA.
4. 16-lead TSSOP package.

Rev. 0

Document Feedback

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TABLE OF CONTENTS

REVISION HISTORY

8/2017—Revision 0: Initial Version

SPECIFICATIONS

DUAL SUPPLY

V_{DD} = 5 V ± 10%, V_{SS} = −5 V ± 10%, GND = 0 V, unless otherwise noted.

Table 1.

Parameter	+25°C	−55°C to +125°C	Unit	Test Conditions/Comments
ANALOG SWITCH				
Analog Signal Range		V_{SS} to V_{DD}	V	V_{DD} = +4.5 V, V_{SS} = −4.5 V
On Resistance, R_{ON}	45		Ω typ	Source voltage (V_S) = ±4.5 V, source current (I_S) = 1 mA
	75	100	Ω max	
On Resistance Match Between	1.3		Ω typ	
Channels, ΔR_{ON}	3	3.5	Ω max	V_S = 3.5 V, I_S = 1 mA
On Resistance Flatness, $R_{FLAT(ON)}$	10		Ω typ	V_{DD} = +5 V, V_{SS} = −5 V
	16	18	Ω max	V_S = ±3 V, I_S = 1 mA
LEAKAGE CURRENTS				V_{DD} = +5.5 V, V_{SS} = −5.5 V
Source Off Leakage, I_S (OFF)	±0.005		nA typ	Drain voltage (V_D) = ±4.5 V, V_S = ∓ 4.5 V
	±0.2	±5	nA max	
Drain Off Leakage, I_D (OFF)	±0.005		nA typ	V_D = ±4.5 V, V_S = ∓ 4.5 V
	±0.2	±5	nA max	
Channel On Leakage I_D, I_S (ON)	±0.005		nA typ	V_D = V_S = ±4.5 V
	±0.2	±5	nA max	
DIGITAL INPUTS				
Input High Voltage, V_{INH}		2.4	V min	
Input Low Voltage, V_{INL}		0.8	V max	
Input Current				
I_{INL} or I_{INH}	0.005		μA typ	Input voltage (V_{IN}) = V_{INL} or V_{INH}
		±1	μA max	
Digital Input Capacitance, C_{IN}	2		pF typ	
DYNAMIC CHARACTERISTICS[1]				
Transition Time, $t_{TRANSITION}$	80		ns typ	Load resistance (R_L) = 300 Ω, load capacitance (C_L) = 35 pF
	115	165	ns max	V_S = 3 V
$\overline{EN}$ On Time, t_{ON} ($\overline{EN}$)	80		ns typ	R_L = 300 Ω, C_L = 35 pF
	115	165	ns max	V_S = 3 V
$\overline{EN}$ Off Time, t_{OFF} ($\overline{EN}$)	30		ns typ	R_L = 300 Ω, C_L = 35 pF
	45	55	ns max	V_S = 3 V
Break-Before-Make Time Delay, t_{BBM}	50		ns typ	R_L = 300 Ω, C_L = 35 pF
		10	ns min	Source 1 voltage (V_{S1}) = 3 V, source 2 voltage (V_{S2}) = 3 V
Charge Injection	2		pC typ	V_S = 0 V, R_S = 0 Ω
	4		pC max	C_L = 1 nF
Off Isolation	−90		dB typ	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz
Total Harmonic Distortion Plus Noise, THD + N	0.025		% typ	R_L = 600 Ω, 2 V p-p, f = 20 Hz to 20 kHz
−3 dB Bandwidth	210		MHz typ	R_L = 50 Ω, C_L = 5 pF
Source Capacitance, C_S (OFF)	4		pF typ	f = 1 MHz
Drain Capacitance, C_D (OFF)	23		pF typ	f = 1 MHz
C_D, C_S (ON)	28		pF typ	f = 1 MHz
POWER REQUIREMENTS				V_{DD} = +5.5 V, V_{SS} = −5.5 V
Positive Power Supply Current, I_{DD}	0.01		μA typ	Digital inputs = 0 V or 5.5 V
		1	μA max	
Negative Power Supply Current, I_{SS}	0.01		μA typ	Digital inputs = 0 V or 5.5 V
		1	μA max	

[1] Guaranteed by design; not subject to production test.

5 V SINGLE SUPPLY

V_{DD} = 5 V ± 10%, V_{SS} = 0 V, GND = 0 V, unless otherwise noted.

Table 2.

Parameter	+25°C	−55°C to +125°C	Unit	Test Conditions/Comments
ANALOG SWITCH				
Analog Signal Range		0 to V_{DD}	V	V_{DD} = 4.5 V, V_{SS} = 0 V
On Resistance, R_{ON}	85		Ω typ	V_S = 0 V to 4.5 V, I_S = 1 mA
	150	200	Ω max	
On Resistance Match Between	4.5		Ω typ	V_S = 3.5 V, I_S = 1 mA
Channels, ΔR_{ON}	8	10	Ω max	
On Resistance Flatness, $R_{FLAT(ON)}$	13	16	Ω typ	V_{DD} = 5 V, V_{SS} = 0 V, V_S = 1.5 V to 4 V, I_S = 1 mA
LEAKAGE CURRENTS				V_{DD} = 5.5 V
Source Off Leakage, I_S (OFF)	±0.005		nA typ	V_S = 1 V/4.5 V, V_D = 4.5 V/1 V
	±0.2	±5	nA max	
Drain Off Leakage, I_D (OFF)	±0.005		nA typ	V_S = 1 V/4.5 V, V_D = 4.5 V/1 V
	±0.2	±5	nA max	
Channel On Leakage I_D, I_S (ON)	±0.005		nA typ	V_S = V_D = 1 V or 4.5 V
	±0.2	±5	nA max	
DIGITAL INPUTS				
Input High Voltage, V_{INH}		2.4	V min	
Input Low Voltage, V_{INL}		0.8	V max	
Input Current				
I_{INL} or I_{INH}	0.005		μA typ	V_{IN} = V_{INL} or V_{INH}
		±1	μA max	
Digital Input Capacitance, C_{IN}	2		pF typ	
DYNAMIC CHARACTERISTICS[1]				
Transition Time, $t_{TRANSITION}$	120		ns typ	R_L = 300 Ω, C_L = 35 pF
	200	300	ns max	V_S = 3 V
$\overline{EN}$ On Time, t_{ON} ($\overline{EN}$)	120		ns typ	R_L = 300 Ω, C_L = 35 pF
	190	280	ns max	V_S = 3 V
$\overline{EN}$ Off Time, t_{OFF} ($\overline{EN}$)	35		ns typ	R_L = 300 Ω, C_L = 35 pF
	50	70	ns max	V_S = 3 V
Break-Before-Make Time Delay, t_{BBM}	100		ns typ	R_L = 300 Ω, C_L = 35 pF
		10	ns min	V_{S1} = V_{S2} = 3 V
Charge Injection	0.5		pC typ	V_S = 2.5 V, R_S = 0 Ω, C_L = 1 nF
	1		pC max	
Off Isolation	−90		dB typ	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz
−3 dB Bandwidth	180		MHz typ	R_L = 50 Ω, C_L = 5 pF
Source Capacitance, C_S (OFF)	5		pF typ	f = 1 MHz
Drain Capacitance, C_D (OFF)	29		pF typ	f = 1 MHz
C_D, C_S (ON)	30		pF typ	f = 1 MHz
POWER REQUIREMENTS				V_{DD} = 5.5 V
Positive Power Supply Current, I_{DD}	0.01		μA typ	Digital inputs = 0 V or 5.5 V
		1	μA max	

[1] Guaranteed by design; not subject to production test.

2.7 V TO 3.6 V SINGLE SUPPLY

V_{DD} = 2.7 to 3.6 V, V_{SS} = 0 V, GND = 0 V, unless otherwise noted.

Table 3.

Parameter	+25°C	−55°C to +125°C	Unit	Test Conditions/Comments
ANALOG SWITCH				
Analog Signal Range		0 to V_{DD}	V	V_{DD} = 2.7 V, V_{SS} = 0 V
On Resistance, R_{ON}	185		Ω typ	V_S = 0 V to 2.7 V, I_S = 0.1 mA
	300	400	Ω max	
On Resistance Match Between	2		Ω typ	V_S = 1.5 V, I_S = 0.1 mA
Channels, ΔR_{ON}	4.5	7	Ω max	
LEAKAGE CURRENTS				V_{DD} = 3.3 V
Source Off Leakage, I_S (OFF)	±0.005		nA typ	V_S = 1 V/3 V, V_D = 3 V/1 V
	±0.2	±5	nA max	
Drain Off Leakage, I_D (OFF)	±0.005		nA typ	V_S = 1 V/3 V, V_D = 3 V/1 V
	±0.2	±5	nA max	
Channel On Leakage I_D, I_S (ON)	±0.005		nA typ	V_S = V_D = 1 V or 3 V
	±0.2	±5	nA max	
DIGITAL INPUTS				
Input High Voltage, V_{INH}		2.0	V min	
Input Low Voltage, V_{INL}		0.5	V max	
Input Current				
I_{INL} or I_{INH}	0.005		μA typ	V_{IN} = V_{INL} or V_{INH}
		±1	μA max	
Digital Input Capacitance, C_{IN}	2		pF typ	
DYNAMIC CHARACTERISTICS[1]				
Transition Time, $t_{TRANSITION}$	200		ns typ	R_L = 300 Ω, C_L = 35 pF
	370	490	ns max	V_S = 1.5 V
$\overline{EN}$ On Time, t_{ON} ($\overline{EN}$)	230		ns typ	R_L = 300 Ω, C_L = 35 pF
	370	490	ns max	V_S = 1.5 V
$\overline{EN}$ Off Time, t_{OFF} ($\overline{EN}$)	50		ns typ	R_L = 300 Ω, C_L = 35 pF
	80	110	ns max	V_S = 1.5 V
Break-Before-Make Time Delay, t_{BBM}	200		ns typ	R_L = 300 Ω, C_L = 35 pF
		10	ns min	V_{S1} = V_{S2} = 1.5 V
Charge Injection	1		pC typ	V_S = 1.5 V, R_S = 0 Ω, C_L = 1 nF
	2		pC max	
Off Isolation	−90		dB typ	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz
−3 dB Bandwidth	160		MHz typ	R_L = 50 Ω, C_L = 5 pF
Source Capacitance, C_S (OFF)	5		pF typ	f = 1 MHz
Drain Capacitance, C_D (OFF)	29		pF typ	f = 1 MHz
C_D, C_S (ON)	30		pF typ	f = 1 MHz
POWER REQUIREMENTS				V_{DD} = 3.6 V
Positive Power Supply Current, I_{DD}	0.01		μA typ	Digital inputs = 0 V or 3.6 V
		1	μA max	

[1] Guaranteed by design; not subject to production test.

ABSOLUTE MAXIMUM RATINGS

T_A = 25°C, unless otherwise noted.

Table 4.

Parameter	Rating
V_{DD} to V_{SS}	13 V
V_{DD} to GND	−0.3 V to +13 V
V_{SS} to GND	+0.3 V to −6.5 V
Analog Inputs[1]	V_{SS} − 0.3 V to V_{DD} + 0.3 V
Digital Inputs[1]	GND − 0.3 V to V_{DD} + 0.3 V or 10 mA, whichever occurs first
Peak Current, Sx or D (Pulsed at 1 ms, 10% duty cycle max)	40 mA
Continuous Current, Sx or D	20 mA
Operating Temperature Range	−55°C to +125°C
Storage Temperature Range	−65°C to +150°C
Junction Temperature	150°C
θ_{JA} Thermal Impedance	
16-Lead TSSOP	150.4°C/W
Lead Temperature, Soldering	
Vapor Phase (60 sec)	215°C
Infrared (15 sec)	220°C
ESD (Human Body Model)	4.0 kV

[1] Overvoltages at Ax, $\overline{EN}$, Sx, or D are clamped by internal diodes. Current must be limited to the maximum ratings.

Stresses at or above those listed under Absolute Maximum Ratings may cause permanent damage to the product. This is a stress rating only; functional operation of the product at these or any other conditions above those indicated in the operational section of this specification is not implied. Operation beyond the maximum operating conditions for extended periods may affect product reliability.

ESD CAUTION

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

Table 5. Truth Table

A2	A1	A0	$\overline{EN}$	Switch Condition
X[1]	X[1]	X[1]	1	None
0	0	0	0	1
0	0	1	0	2
0	1	0	0	3
0	1	1	0	4
1	0	0	0	5
1	0	1	0	6
1	1	0	0	7
1	1	1	0	8

[1] X means don't care

PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

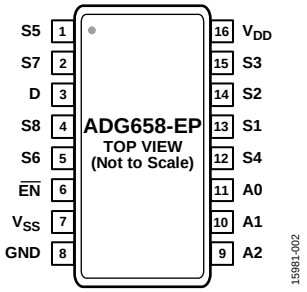


Figure 2. 16-Lead TSSOP Pin Configuration

Table 6. 16-Lead TSSOP Pin Function Descriptions

Pin No.	Mnemonic	Description
1, 2, 4, 5, 12, 13, 14, 15	S1 to S8	Source Terminals. Can be an input or output.
3	D	Drain Terminal. Can be an input or output.
6	$\overline{EN}$	Active Low Digital Input. When high, device is disabled and all switches are off. When low, Ax logic inputs determine on switch.
7	V_{SS}	Most Negative Power Supply Potential.
8	GND	Ground (0 V) Reference.
9, 10, 11	A0 to A2	Logic Control Inputs.
16	V_{DD}	Most Positive Power Supply Potential.

TYPICAL PERFORMANCE CHARACTERISTICS

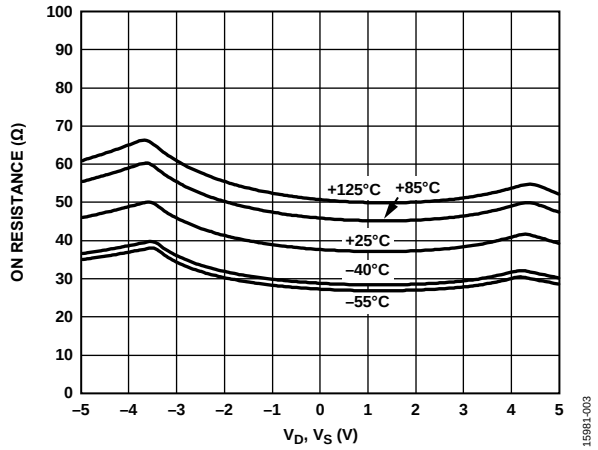


Figure 3. On Resistance vs. V_D (V_S) for Different Temperatures (Dual Supply)

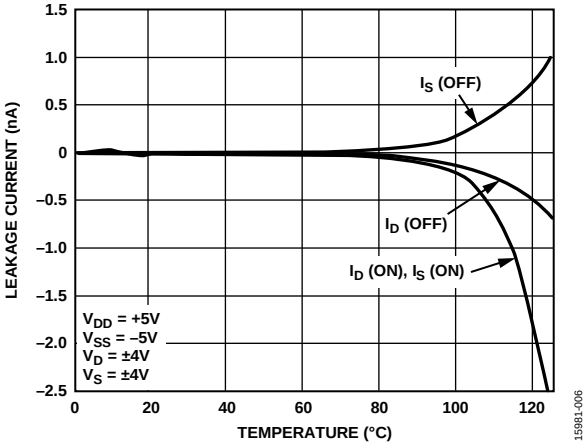


Figure 6. Leakage Current vs. Temperature (Dual Supply)

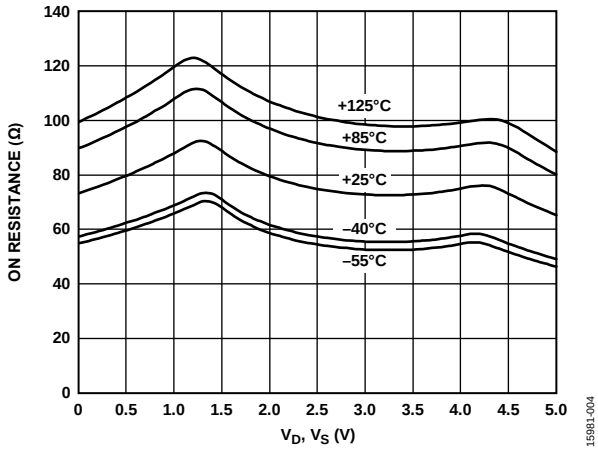


Figure 4. On Resistance vs. V_D (V_S) for Different Temperatures (Single Supply)

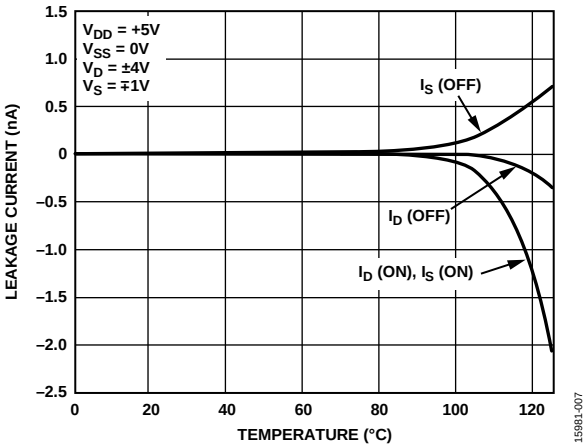


Figure 7. Leakage Current vs. Temperature (Single Supply)

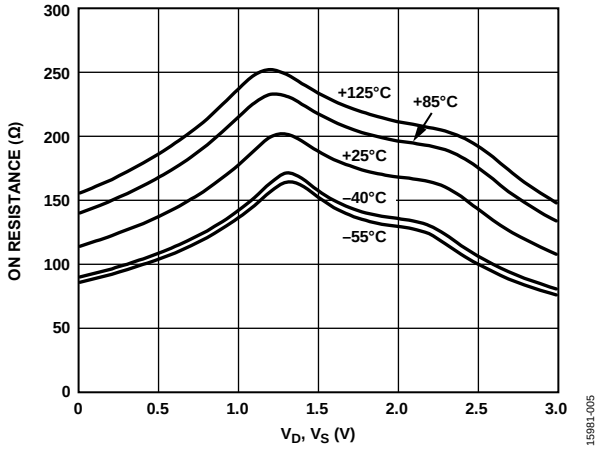


Figure 5. On Resistance vs. V_D (V_S) for Different Temperatures (Single Supply)

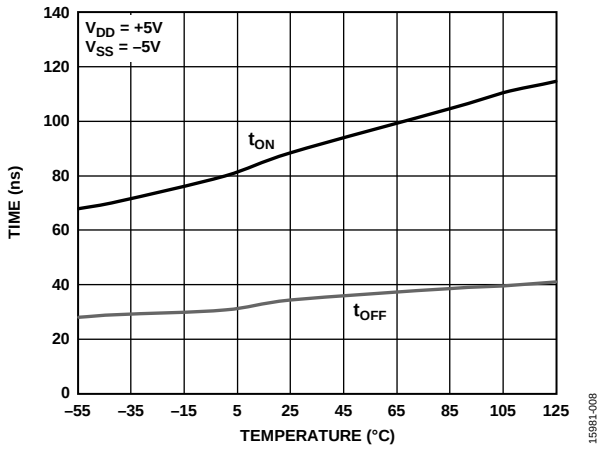


Figure 8. t_{ON}/t_{OFF} Time vs. Temperature (Dual Supply)

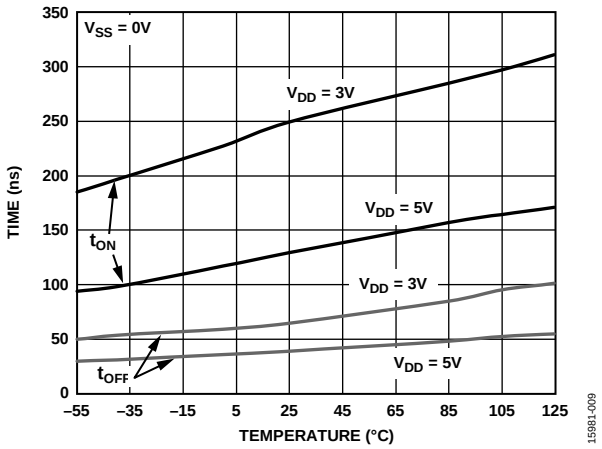
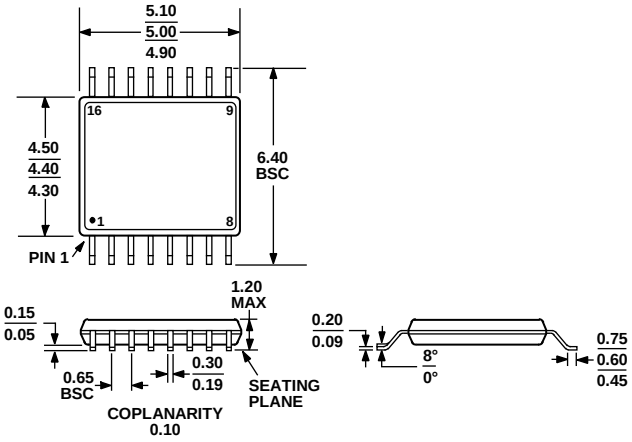


Figure 9. t_{ON}/t_{OFF} Time vs. Temperature (Single Supply)

OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MO-153-AB

Figure 10. 16-Lead Thin Shrink Small Outline Package [TSSOP]
(RU-16)
Dimensions shown in millimeters

ORDERING GUIDE

Model[1]	Temperature Range	Package Description	Package Option
ADG658TRUZ-EP	−55°C to +125°C	16-Lead Thin Shrink Small Outline Package [TSSOP]	RU-16
ADG658TRUZ-EP-RL7	−55°C to +125°C	16-Lead Thin Shrink Small Outline Package [TSSOP]	RU-16

[1] Z = RoHS Compliant Part.