AT&T Microelectronics

ATTL7542 Tip Ring Access Switch

Features

- Small size/surface-mount packaging
- Monolithic IC reliability
- Clean, bounce-free switching
- Low, matched ON-resistance
- Built-in current limiting, thermal shutdown, and SLIC protection
- Very low power consumption
- No EMI

Applications

- Central office
- DLC
- PBX

Description

The ATTL7542 Tip Ring Access Switch (TRAS) is a monolithic integrated circuit that contains six solid-state relay contacts designed to replace electromechanical relays (EMR) in central office and digital loop carrier analog line-card applications. Through application of appropriate control signals to two logic level inputs, the idle or talk state, power ring and line test access states are achievable via the TRAS IC. With the addition of a single 2 Form C EMR and associated controls (Figure 9), the ringing-generator test access states and battery-feed test access are realized.

The line break switch pair is a linear switch that has exceptionally low ON-resistance and an excellent ON-resistance matching characteristic. The ringing access switch has a breakdown voltage rating >450 V, which is sufficiently high enough to prevent breakdown (i.e., passing the transient on to the ringing generator) in the presence of a transient fault condition.

Incorporated into the TRAS is a foldover type SLIC protection circuit that limits the voltage seen by the battery feed and shunts currents to a ground device during a fault condition. Thus, the TRAS eliminates the need for a separate SLIC protection device.

To protect the TRAS from an overvoltage fault condition, use of a secondary protector is required. The secondary protector must limit the voltage applied to the TRAS to <250 V. Use of a foldback or crowbar type secondary protector is recommended. The line break switch pair and access switches (except those connected to the ringing generator) have a current-limit feature that will limit the current through the switch in the presence of a transient fault condition.

Also incorporated into the TRAS is a thermal shutdown circuit that will cause the chip to shutdown (all switches off) when excessive power dissipation, such as what is encountered in the presence of an extended power cross, causes the chip temperature to rise above a given threshold. With the proper design of SLIC circuitry, proper selection of secondary protector, and series resistors, the TRAS will meet appropriate regulatory agency requirements.

The TRAS requires 5 V, battery voltage, and ground to operate. The TRAS device is packaged in a 16-pin, plastic SOG package (ATTL7542AAE/BAE).

Pin Information

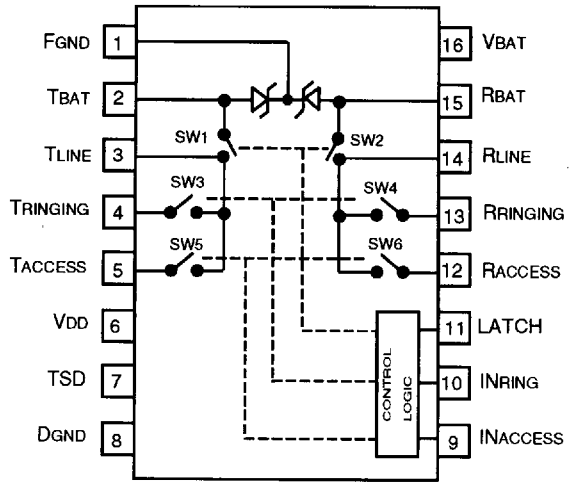


Figure 1. 16-Pin, Plastic SOG

Table 1. Pin Descriptions

Pin	Symbol	Description	Pin	Symbol	Description
1	FGnd	Fault ground.	16	VBAT	Battery voltage.
2	TBAT	Connect to TIP on SLIC side.	15	RBAT	Connect to RING on SLIC side.
3	TLINE	Connect to TIP on line side.	14	RLINE	Connect to RING on line side.
4	TRINGING	Connect to return ground for ringing generator.	13	RRINGING	Connect to ringing generator.
5	TACCESS	Test access.	12	RACCESS	Test access.
6	VDD	+5 V supply.	11	LATCH	Data input control, active-high, transparent low.
7	TSD	Temperature shutdown output flag will read +5 V when the device is in its operational mode and 0 V in the thermal shutdown mode. To disable the thermal shutdown mechanism, tie this pin to +5 V.	10	INRINGING	Logic level switch input control
8	DGnd	Digital ground.	9	INACCESS	Logic level switch input control.

Electrical Characteristics

T_A –40 °C to +85 °C, unless otherwise specified.

Minimum and maximum values are testing requirements. Typical values are characteristics of the device and are the result of engineering evaluations. Typical values are for information purposes only and are not part of the testing requirements.

Table 2. Power Supply Specifications

Parameter	Power Supply, V_{DD}	Power Supply, V_{BAT}
Nominal Voltage	+5 V	–48 V/–60 V*
Voltage Tolerance	±0.5 V	±20%

* Choice of SLIC protection circuit trigger voltage is determined by the maximum voltage of V_{BAT}. See SLIC Protection Circuit section for details.

Table 3. Break Switch, 1and 2

Parameter	Test Condition	Measure	Min	Typ	Max	Unit
Off-state Leakage Current	Vswitch (differential) = –320 V to Gnd Vswitch (differential) = –60 V to +260 V	Iswitch	—	—	1	µA
ON Resistance	Iswitch (on) = ±10 mA, ±40 mA	Δ Von	—	15 *	28	Ω
ON-resistance Match	Per ON-resistance Test Condition of SW3, SW4	Magnitude R_{ON} SW3—R_{ON} SW4	—	—	1	Ω
Current Limit	Vswitch (on) = ±10 V	Iswitch	80	—	220	mA
Isolation	Vswitch (both poles) = ±320 V Logic Inputs = GND	Iswitch	—	—	1	µA
dv/dt Sensitivity*	—	—	—	200	—	V/µs

* At 25 °C.

† Applied voltage is 100 Vpp square wave at 100 Hz.

Electrical Characteristics (continued)

Table 4. Ringing Return Switch 3

Parameter	Test Condition	Measure	Min	Typ	Max	Unit
Off-state Leakage Current	Vswitch (differential) = –320 V to Gnd Vswitch (differential) = –60 V to +260 V	Iswitch	—	—	1	µA
ON Resistance	Iswitch (on) = ±5 mA, ±10 mA	Δ Von	—	50*	100	Ω
Current Limit	Vswitch (on) = ±50 V	Iswitch	200	—	400	mA
Isolation	Vswitch = ±320 V Logic Inputs = GND	Iswitch	—	—	1	µA
dv/dt Sensitivity†	—	—	—	200	—	V/µs

* At 25 °C.

† Applied voltage is 100 Vpp square wave at 100 Hz.

Electrical Characteristics (continued)

Table 5. Ringing Switch 4

Parameter	Test Condition	Measure	Min	Typ	Max	Unit
Off-state Leakage Current	Vswitch (differential) = +260 V to −190 V Vswitch (differential) = −260 V to +190 V	Iswitch	—	—	1	µA
ON Resistance	Iswitch (on) = ±70 mA, ±80 mA	Δ Von	—	—	10	Ω
ON Voltage	Iswitch (on) = ±1 mA	Vos	—	—	3	V
ON Voltage (Vos)	Iswitch (on) = ±1 mA	Vos	—	—	3	V
Isolation	Vswitch = ±320 V Logic Inputs = GND	Iswitch	—	—	1	µA
Surge Current	—	—	—	—	2	A
Release Current	—	—	100	—	500	µA
dv/dt Sensitivity †	—	—	—	200	—	V/µs

* At 25 °C

† Applied voltage is 100 Vpp square wave at 100 Hz.

Table 6. Test Out Switch, 5 and 6

Parameter	Test Condition	Measure	Min	Typ	Max	Unit
Off-state Leakage Current	Vswitch (differential) = −320 V to GND Vswitch (differential) = −60 V to +260 V	Iswitch	—	—	1	µA
ON Resistance	Iswitch (on) = ±5 mA to 10 mA	Δ Von	—	30*	65	Ω
Current Limit	Vswitch (on) = ±50 V	Iswitch	100	—	220	mA
Isolation	Vswitch (both poles) = ±320 V Logic Inputs = GND	Iswitch	—	—	1	µA
dv/dt Sensitivity†	—	—	—	200	—	V/µs

* At 25 °C.

† Applied voltage is 100 Vpp square wave at 100 Hz.

Table 7. Additional Electrical Characteristics

Parameter	Test Condition	Measure	Min	Typ	Max	Unit
Digital Input Characteristics:						
Input Low Voltage	—	—	—	—	1.5	V
Input High Voltage	—	—	3.5	—	—	V
Input Leakage Current (High)	VDD = 5.5 V, VBAT = −58 V, Vlogicin = 5 V	Ilogicin	—	—	1	µA
Input Leakage Current (Low)	VDD = 5.5 V, VBAT = −58 V, Vlogicin = 0 V	Ilogicin	—	—	1	µA
Power Requirements:						
Power Dissipation	VDD = 5.5 V, VBAT = −58 V, Idle or Talk State	IDD, IBAT	—	15*	70	mW
VDD Current	VDD = 5.5 V, VBAT = −58 V, Idle or Talk State	IDD	—	0.25*	2	mA
VBAT Current	VDD = 5.5 V, VBAT = −58 V, Idle or Talk State	IBAT	—	0.25*	1	mA
Temperature Shutdown Requirements:†						
Shutdown Activation Temperature	—	—	110	125	150	°C
Shutdown Circuit Hysteresis	—	—	10	—	25	°C

* At 25 °C.

† Temperature shutdown flag (TSD) will be high during normal operation and low during temperature shutdown state.

Zero Cross Current Turn Off

The ring access switch (SW4) is designed to turn off on a zero current cross. This switch requires a current zero cross at the battery voltage to turn off. Switch 4 (SW4) will remain in the ON state (regardless of logic input) until a current zero cross. Therefore, to ensure proper operation, switch 4 should be connected to the ringing generator (via proper impedance).

SLIC Protection Circuit

The SLIC protection circuit, shown in Figure 3 as two zener diodes, is included in the ATTL7542 TRAS IC device to protect the battery feed from fault-induced overvoltage situations. With this feature, the only secondary protection required on the line card is the 210 V—250 V protector on the loop side of the solid-state relay. The battery feed is protected by a combination of the current limit in the SLIC break switches (SW3 and SW4) and the SLIC protection circuit.

In reality, this circuit consists of MOSFET transistors that are turned on when the voltage at the battery feed is more negative than the battery or more negative than an internal zener diode reference (clamp voltage). For positive fault conditions, the protection circuit will conduct when the battery feed exceeds one diode drop. The characteristics of the protection circuit are shown in Figures 4 and 5.

Two different clamp voltages are available for the ATTL7542 TRAS IC device. The first alpha character after the numerical device identifier designates the clamp voltage version. The A character designate is intended for a battery voltage of –48 V ± 20% and, the B character designate is intended for battery voltages of 60 V ± 20%. Tables 6 and 7 give the specifications for the leakage at the maximum battery voltage (58 V or –72 V), the voltage at which 1 mA is conducted, and the voltage at which the clamp circuit conducts the maximum dc current that can be carried by switches 1 or 2 (ILIMIT SW1, SW2).

The following information shown in Tables 8 and 9 is referenced in Figures 4 and 5.

Compilation of this data was over the full temperature range (–40 °C to +85 °C).

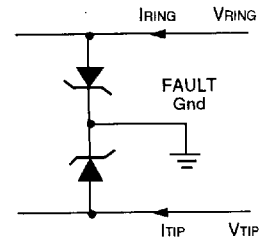


Figure 2. SLIC Protection Circuit

SLIC Protection Circuit (continued)

Table 8. SLIC Protection Circuitry Options (ATTL7542AAE)

Apply	Condition	Figure	Measure			
			Parameter	Min	Max	Unit
$R_{BAT} = V_{BAT}$ $T_{BAT} = V_{BAT}$	$V_{BAT} = -58$ V	4	$I_{FAULTGROUND}$	—	1	µA
$I_{FAULTGROUND} = -1$ mA	$V_{BAT} = -58$ V	4	T_{BAT} R_{BAT}	$V_{BAT} + (-4$ V)	—	V
$I_{FAULTGROUND} = -I_{Limit}$ SW1, SW2	$V_{BAT} = -58$ V	4	T_{BAT} R_{BAT}	$V_{BAT} + (-14$ V)	—	V
$I_{FAULTGROUND} = +I_{Limit}$ SW1, SW2	$V_{BAT} = -58$ V	4	T_{BAT} R_{BAT}	—	3	V
$T_{BAT} = -60$ V (V1 Fig 5) $R_{BAT} = -60$ V (V1 Fig 5)	V_{BAT} = No Connection	5	$I_{FAULTGROUND}$	1	1	µA
$I_{FAULTGROUND} = -1$ mA	V_{BAT} = No Connection	5	T_{BAT} (V2 Fig 5) R_{BAT} (V2 Fig 5)	−70	—	V
$I_{FAULTGROUND} = +I_{Limit}$ SW1, SW2	V_{BAT} = No Connection	5	—	—	3	V

Table 9. SLIC Protection Circuitry Options (ATTL7542BAE)

Apply	Condition	Figure	Measure			
			Parameter	Min	Max	Unit
$R_{BAT} = V_{BAT}$ $T_{BAT} = V_{BAT}$	$V_{BAT} = -72$ V	4	$I_{FAULTGROUND}$	—	1	µA
$I_{FAULTGROUND} = -1$ mA	$V_{BAT} = -72$ V	4	T_{BAT} R_{BAT}	$V_{BAT} + (-4$ V)	—	V
$I_{FAULTGROUND} = -I_{Limit}$ SW1, SW2	$V_{BAT} = -72$ V	4	T_{BAT} R_{BAT}	$V_{BAT} + (-14$ V)	—	V
$I_{FAULTGROUND} = +I_{Limit}$ SW1, SW2	$V_{BAT} = -72$ V	4	T_{BAT} R_{BAT}	—	3	V
$T_{BAT} = -77$ V (V1 Fig 5) $R_{BAT} = -77$ V (V1 Fig 5)	V_{BAT} = No Connection	5	$I_{FAULTGROUND}$	1	1	µA
$I_{FAULTGROUND} = -1$ mA	V_{BAT} = No Connection	5	T_{BAT} (V2 Fig 5) R_{BAT} (V2 Fig 5)	−87	—	V
$I_{FAULTGROUND} = +I_{Limit}$ SW1, SW2	V_{BAT} = No Connection	5	—	—	3	V

Typical Performance Characteristics

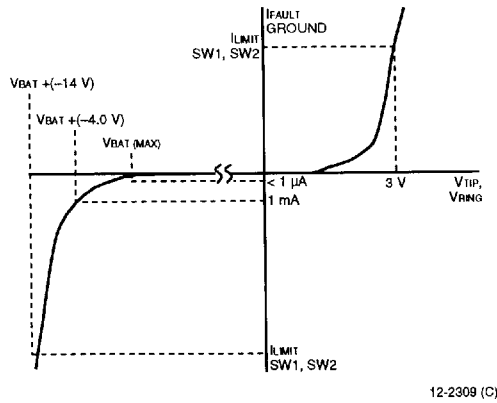


Figure 3. Characteristics of ATTL7542 (V_{BAT} Present)

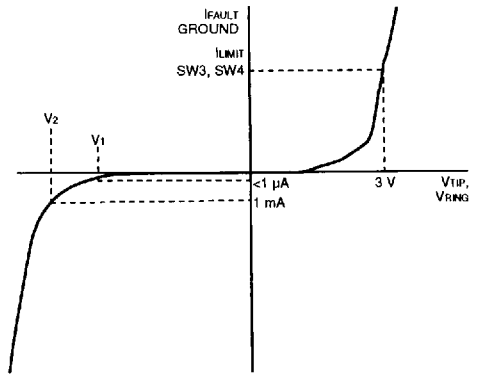


Figure 4. Characteristics of ATTL7542 (V_{BAT} Not Present)

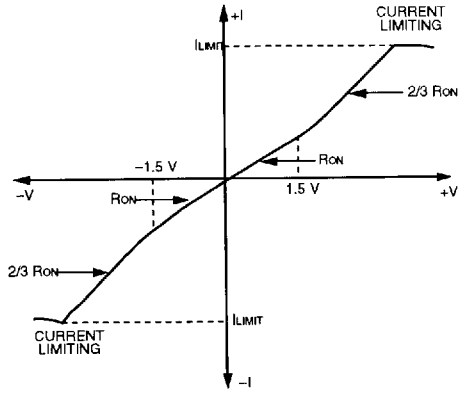


Figure 5. Switch 1—3, 5, 6

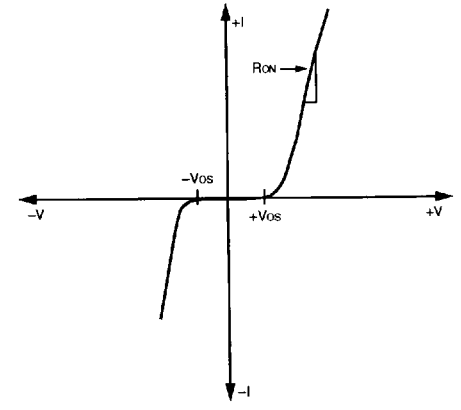


Figure 6. Switch 4

Application

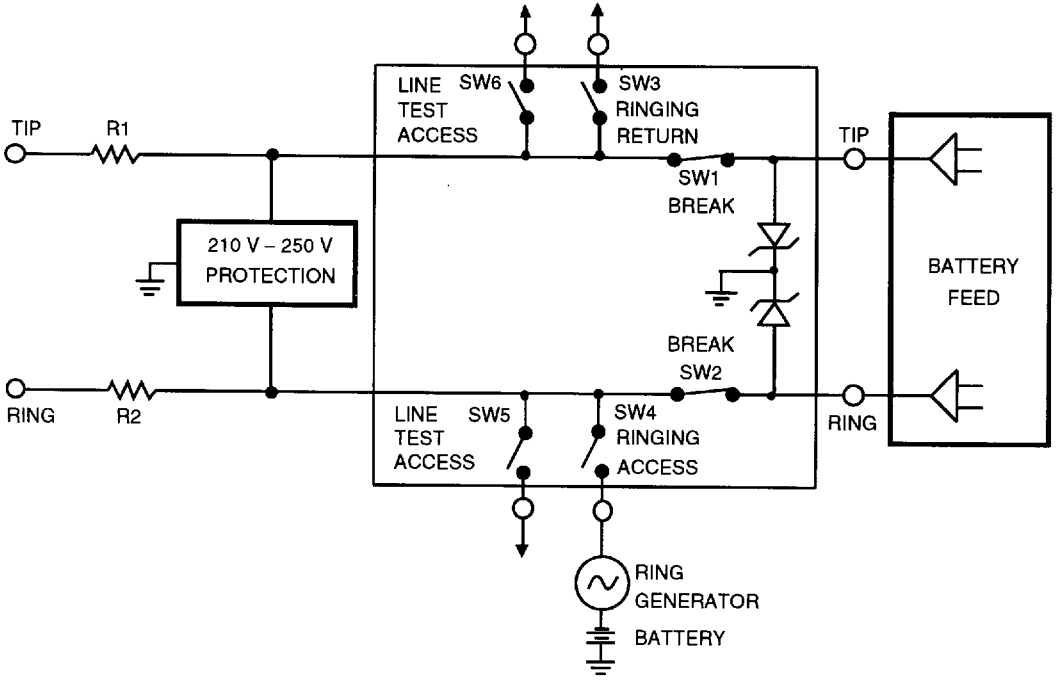


Figure 7. Typical TRAS Application, Idle or Talk State Shown

Table 10. Truth Table

Input		Switches			State Description
Ring	Access	SW 1/2	SW 3/4	SW 5/6	
Low	Low	Closed	Open	Open	Idle or talking state
Low	High	Open	Open	Closed	Line test state
High	Low	Open	Closed	Open	Power ringing state
High	High	Open	Open	Open	All off

Application

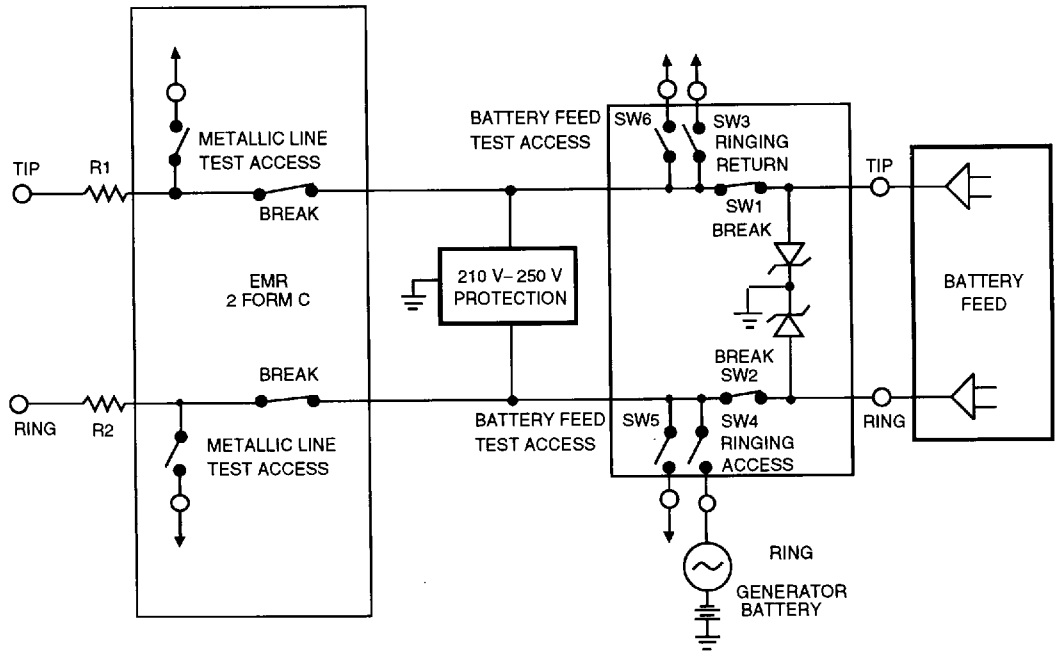


Figure 8. Typical TRAS Application with Metallic Test-in Access, Idle or Talk State Shown

Table 11. Truth Table

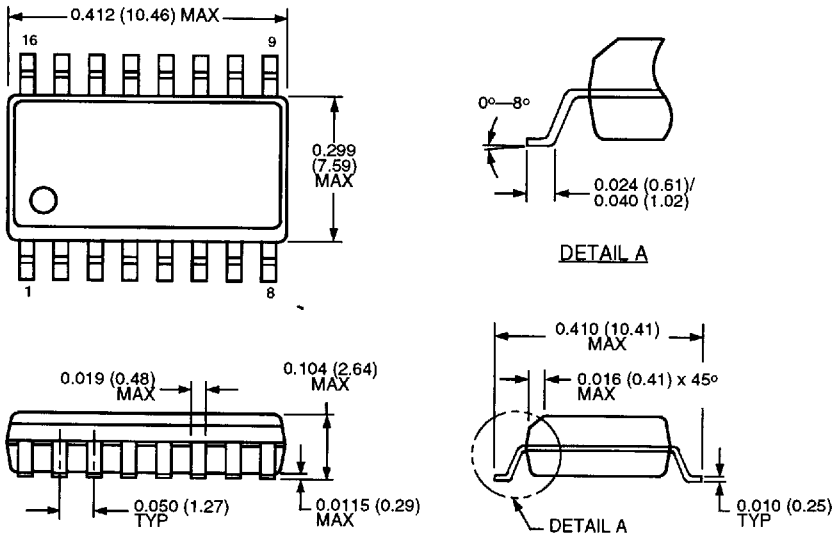
TRAS					EMR			State Description
Input		Switches			Input	Switches		
Ring	Access	SW 1/2	SW 3/4	SW 5/6	EMR	EMR Break	EMR Test-in	
Low	Low	Closed	Open	Open	Low	Closed	Open	Idle or talking state
Low	High	Open	Open	Closed	Low	Closed	Open	Line test state
Low	Low	Closed	Open	Open	High	Open	Closed	Battery feed test state
High	Low	Open	Closed	Open	Low	Closed	Open	Power ringing state
High	Low	Open	Closed	Open	High	Open	Closed	Ringing generator test state*
High	High	Open	Open	Open	Low	Closed	Open	All off

* Power ringing appears at test node.

Outline Drawings

Dimensions are in inches and (millimeters).

16-Pin, Plastic SOG



Packaging and Ordering Information

Throughout this section the following abbreviations are used:

DIP — Dual in-line package; SOG — Small-outline gull wing; SOJ — Small-outline J-lead; SONB — Small-outline narrow body; PLCC — Plastic leaded chip carrier.

Device Code	Package Type	Temperature
ATTL7551AP	44-Pin PLCC	–40 °C to +85 °C
ATTL7551AF	24-Pin DIP	–40 °C to +85 °C
ATTL7554AP	44-Pin PLCC	–40 °C to +85 °C
ATTL7556AAU	32-Pin PLCC	–40 °C to +85 °C
ATTL7557AAU		
ATTL7561AP	44-Pin PLCC	–40 °C to +85 °C
ATTL7564AP		
ATTL7581AC/BC	16-Pin DIP	–40 °C to +85 °C
ATTL7581AAE/BAE	16-Pin Plastic SOG	–40 °C to +85 °C
ATTL7582AE/BE	16-Pin Plastic DIP	–40 °C to +85 °C
ATTL7582AAE/BAE	16-Pin Plastic SOG	–40 °C to +85 °C
ATTL7583AF/BF	24-Pin Plastic DIP (600 mil)	–40 °C to +85 °C
ATTL7583ACG/BCG	24-Pin Plastic DIP (300 mil)	–40 °C to +85 °C
ATTL7583AAJ/BAJ	28-Pin Plastic SOG	–40 °C to +85 °C
ATTL7590AAF	14-Pin	–40 °C to +85 °C
ATTL7591AB	8-Pin, DIP	–40 °C to +85 °C
ATTL7591AS	8-Pin, SONB	–40 °C to +85 °C
LB1011AB	8-Pin, DIP	–20 °C to +70 °C
LB1013AD	18-Pin, DIP	–25 °C to +85 °C
LB1060AB	8-Pin, DIP	–40 °C to +65 °C
LB1201AB	8-Pin, DIP	–40 °C to +85 °C
LB1201AS	8-Pin, SONB	–40 °C to +85 °C
LB1208AAJ	28-pin SOG	–40 °C to +85 °C
LB1276AP	44-Pin PLCC	–40 °C to +85 °C
LB1276AF	24-Pin DIP	–40 °C to +85 °C
LB1356AF	24-Pin DIP	–40 °C to +85 °C
LH1263AR	20-Pin Plastic DIP	–40 °C to +85 °C
LH1571AB	8-pin Plastic DIP	–40 °C to +85 °C
LH1571AAC	8-pin SOG	–40 °C to +85 °C
T - 7503 - - - EL	20-Pin, SOJ	–40 °C to +85 °C
T - 7503 - - 1EC	20-Pin, SOJ	0 °C to 70 °C
T - 7504 - - - PL	28-Pin, DIP	–40 °C to +85 °C
T - 7504 - - - ML	28-Pin, PLCC	–40 °C to +85 °C
T - 5504 - - - PL	28-Pin, DIP	–40 °C to +85 °C
T - 5504 - - - ML	28-Pin, PLCC	–40 °C to +85 °C
T - 7513B - - EE	20-Pin, SOJ	–40 °C to +85 °C
T - 7513B - - PE	20-Pin, DIP	–40 °C to +85 °C
T - 7517A - - EE	16-Pin, DIP	–40 °C to +85 °C
T - 7517A - - PE	16-Pin, SOJ	–40 °C to +85 °C
T - 7548 - - - ME2	28-Pin, PLCC	0 °C to 85 °C
T - 7570 - - - ML2	28-Pin, PLCC	–40 °C to +85 °C