

Features

- Integrated Transient Voltage Suppressor (TVS) in the Transceiver IC
- TVS Protection for Bus Terminals :
±15 kV IEC 61000-4-2, Contact Discharge
±18 kV IEC 61000-4-2, Air-Gap Discharge
±15 kV EIA/JEDEC Human Body Model
- HBM ±4kV ESD Protection for all pins
- MM ±400V ESD Protection for all pins
- Latchup immunity up to ±400mA for all pins.
- High CDM protection up to ±1kV for all pins.
- Meet the Requirements of the EIA/TIA-485 Standards with 5V Power Supply
- True Fail-Safe Receiver While Maintaining EIA/TIA-485 Compatibility
- Data Rate up to 10Mbps
- Hot-Swap Glitch free Protection on Control Inputs
- High driving ability of VOD2
- Up to 256 Transceivers on the Bus

Applications

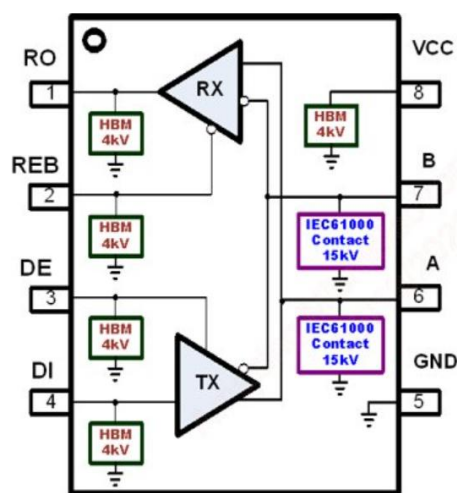
- Utility Meters
- Lighting Systems
- Industrial Control
- Security Systems
- Instrumentation
- Profibus Application

Description

The AZRS5054PA is a ±15kV IEC 61000-4-2 contact discharge protected half-duplex RS485 transceiver IC, which contains one transmitter and one receiver inside. This device is fully compliant with the EIA/TIA-485 standard with 5V power supply.

The AZRS5054PA features a fail-safe receiver, which guarantees the output of the receiver to be logic high when the differential inputs (bus pins, A and B) of the receiver are open, short or idle under abnormal operating conditions.

The AZRS5054PA features a hot-swap glitch-free design which guarantees outputs of the transmitter and the receiver in a high impedance state and even no short current event during the power up period. The AZRS5054PA has the thermal shutdown and the current limited function in the transmitter to protect the device from damage by system fault conditions during normal operating condition. The AZRS5054PA is designed 1/8 unit load with minimum 96kohm of input impedance, which can connect 256 devices on a bus at most. The AZRS5054PA is also a high reliable device with built-in system level ESD protected devices against high-energy noise transients without requiring any external components.



Functional Block of AZRS5054PA

| Part Number | Duplex | Tx/Rx | Supply (V) | Max Data Rate (Mbps) | Fail- safe | Rx Input Filtering | HBM on A,B | IEC 61000-4-2 Contact on A,B | Package Type |
|-------------|--------|-------|------------|----------------------|------------|--------------------|------------|------------------------------|--------------|
| AZRS5054PA | Half | 1/1 | 5 | 10 | Yes | Yes | ±15kV | ± 15kV | SO-8 |

ABSOLUTE MAXIMUM RATINGS

| PARAMETER | PARAMETER | RATING | UNITS |
|----------------------------|------------------|--------------------|-------|
| Power Supply Vcc | Vcc | -0.3 to 8.0 | V |
| Control Input Voltage | REB, DE | -0.3 to (Vcc+ 0.3) | V |
| Receiver Input Voltage | A, B | ±13 | V |
| Receiver Output Voltage | RO | -0.3 to (Vcc+ 0.3) | V |
| Transmitter Output Voltage | A, B | ±13 | V |
| Transmitter Input | DI | -0.3 to (Vcc+ 0.3) | V |
| Operating Temperature | T _{OP} | -40 to +85 | °C |
| Storage Temperature | T _{STO} | -65 to +150 | °C |

DC ELECTRICAL CHARACTERISTICS

(Vcc=5V ±5% with T_{AMB}= T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at Vcc=5V and T_{AMB}= 25 °C.)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|----------------------------------------------------|-------------------|------------------------------------------------|----------------------|------|-----|-------|
| Transmitter | | | | | | |
| Differential Transmitter Output | V _{OD1} | No load | | | Vcc | V |
| Differential Transmitter Output | V _{OD2} | Fig.1, R _L = 27 Ω | 2.3 | 3.0 | | V |
| Change in Magnitude of Differential Output Voltage | Δ V _{OD} | Fig.1, R _L = 27 Ω | | | 0.2 | V |
| Transmitter Common- Mode Output Voltage | V _{OC} | Fig.1, R _L = 27 Ω | | | 3 | V |
| Change in Magnitude of Common- Mode Voltage | Δ V _{OC} | Fig.1, R _L = 27 Ω | | | 0.2 | V |
| Input High Voltage | V _{IH} | DE, DI, REB | 2.0 | | | V |
| Input Low Voltage | V _{IL} | DE, DI, REB | | | 0.8 | V |
| Input Current | I _{IN1} | DE, DI, REB | | | ±2 | μA |
| Input Current for A and B | I _{IN2} | DE=0, Vcc=0V or 5.25V | V _{IN} =12V | | 125 | uA |
| | | | V _{IN} =-7V | -100 | | |
| Transmitter Short-Circuit Output Current | I _{OSD} | -7V ≤ V _{OUT} ≤ 12V, Vcc=5.0V | -250 | | 250 | mA |
| RECEIVER | | | | | | |
| Receiver Differential Threshold Voltage | V _{TH} | | -200 | | -50 | mV |
| Receiver Input Hysteresis | Δ V _{TH} | | | 20 | | mV |
| Receiver Output High Voltage | V _{OH} | I _O = -4mA, V _{ID} = 200mV | Vcc-0.6 | | | V |
| Receiver Output Low Voltage | V _{OL} | I _O = 4mA, V _{ID} = -200mV | | | 0.4 | V |
| Three- State Output Current at | I _{OZR} | REB=Vcc | | | ±1 | μA |

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNITS |
|---------------------------------------|-------------------|--------------------------------------------------------|---------------------|-----|-----|-----|-------|
| Receiver | | | | | | | |
| Receiver Input Resistance | R _{IN} | -7V ≤ V _{CM} ≤ +12V | | 96 | | | kΩ |
| Receiver Output Short-Circuit Current | I _{OSR} | Fig. 6, 0V ≤ V _{RO} ≤ V _{CC} | | | | ±95 | m A |
| SUPPLY CURRENT | | | | | | | |
| Supply Current | I _{CC} | No load, REB=GND, DI= V _{CC} or GND. | DE= V _{CC} | | 600 | 900 | μA |
| | | | DE= GND | | 600 | 900 | μA |
| Supply Current in Shutdown Mode | I _{SHDN} | REB= V _{CC} | DE= GND | | | 10 | μA |

SWITCHING CHARACTERISTICS

(Vcc=5V \pm 5% with T_{AMB}= T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at Vcc=5V and T_{AMB}= 25 °C.)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|--------------------------------------------------|----------------------|----------------------------------------------------------------------------------|-----|-----|------|-------|
| Transmitter Input to Output | t_{DPLH}, t_{DPHL} | Fig.2 and 7, $R_{DIFF}=54\Omega$, $C_{L1}=C_{L2}= 100pF$ | | | 50 | ns |
| Transmitter Output Skew $ t_{DPLH}-t_{DPHL} $ | t_{DSKEW} | Fig.2, Fig.7, $R_{DIFF}=54\Omega$, $C_{L1}=C_{L2}= 100pF$ | | 10 | | ns |
| Transmitter Rise or Fall Time | t_{DF}, t_{DR} | Fig.2, Fig.7, $R_{DIFF}=54\Omega$, $C_{L1}=C_{L2}= 100pF$ | | | 20 | ns |
| Data Rate | f_{Data} | | | | 10 | Mbps |
| Transmitter Enable to Output Low | t_{DZL} | Fig.4, Fig.8, $C_{DL}= 100pF$, S1 closed | | | 70 | ns |
| Transmitter Enable to Output High | t_{DZH} | Fig.4, Fig.8, $C_{DL}= 100pF$, S2 closed | | | 70 | ns |
| Transmitter Disable Time from Low | t_{DLZ} | Fig.4, Fig.8, $C_{DL}= 15pF$, S1 closed | | | 70 | ns |
| Transmitter Disable Time from High | t_{DHZ} | Fig.4, Fig.8, $C_{DL}= 15pF$, S2 closed | | | 70 | ns |
| Transmitter Enable from Shutdown to Output Low | $t_{DZL(SHDN)}$ | Fig.4, Fig.8, $C_{DL}= 50pF$, S1 closed | | | 1800 | ns |
| Transmitter Enable from Shutdown to Output High | $t_{DZH(SHDN)}$ | Fig.4, Fig.8, $C_{DL}= 50pF$, S2 closed | | | 1800 | ns |
| Time to shutdown | t_{SHDN} | | 50 | 800 | 1200 | ns |
| Receiver Input to Output | t_{RPLH}, t_{RPHL} | Fig.5, Fig.9, $ V_{ID} \geq 2.0V$; rise and fall time of $V_{ID} \leq 15ns$ | | 120 | 200 | ns |
| $ t_{RPLH}-t_{RPHL} $ Different Receiver Skew | t_{RSKD} | Fig.5, Fig.9, $ V_{ID} \geq 2.0V$; rise and fall time of $V_{ID} \leq 15ns$ | | 10 | | ns |

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|----------------------------------------------|-----------------|------------------------------------------|-----|-----|------|-------|
| | | 15ns | | | | |
| Receiver Enable to Output Low | t_{RZL} | Fig.3, Fig.10, $C_{RL}=15pF$, S1 closed | | | 50 | ns |
| Receiver Enable to Output High | t_{RZH} | Fig.3, Fig.10, $C_{RL}=15pF$, S2 closed | | | 50 | ns |
| Receiver Disable Time from Low | t_{RLZ} | Fig.3, Fig.10, $C_{RL}=15pF$, S1 closed | | | 50 | ns |
| Receiver Disable Time from High | t_{RHZ} | Fig.3, Fig.10, $C_{RL}=15pF$, S2 closed | | | 50 | ns |
| Receiver Enable from Shutdown to Output Low | $t_{RZL(SHDN)}$ | Fig.3, Fig.10, $C_{RL}=15pF$, S1 closed | | | 1800 | ns |
| Receiver Enable from Shutdown to Output High | $t_{RZH(SHDN)}$ | Fig.3, Fig.10, $C_{RL}=15pF$, S2 closed | | | 1800 | ns |
| Time to shutdown | t_{SHDN} | | 50 | 400 | 700 | ns |

PIN FUNCTION DESCRIPTION

| Pin Number | Mnemonic | Function |
|------------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | RO | Receiver Output: When REB is low and if $(A - B) \geq -50mV$, RO is high; if $(A - B) \leq -200mV$, RO is low. |
| 2 | REB | Receiver Output Enable: REB is low to enable the Receiver; REB is high to disable the Receiver. |
| 3 | DE | Transmitter Output Enable: DE is high to enable the transmitter; DE is low to disable the transceiver. |
| 4 | DI | Transmitter Input: When DE is high, a low on DI forces A output low and B output high. Similarly, a high on DI forces A output high and B output low. |
| 5 | GND | Ground pin. Must be connected to 0V. |
| 6 | A | Non-inverting Receiver Input and Non-inverting Transmitter Output |
| 7 | B | Inverting Receiver Input and Inverting Transmitter Output |
| 8 | VCC | Power Supply Input 5V. Must adding a 100nF decoupling capacitor as close to the VCC pin as possible. |

FUNCTION TABLE

| TRANSMITTING | | | | |
|--------------|----|----|----------|---------|
| INPUTS | | | OUTPUTS | |
| REB | DE | DI | A | B |
| X | 1 | 0 | 0 | 1 |
| X | 1 | 1 | 1 | 0 |
| 0 | 0 | X | HIGH- Z | HIGH- Z |
| 1 | 0 | X | Shutdown | |

X= Don't care
HIGH- Z= High impedance

| RECEIVING | | | |
|-----------|----|---------------|----------|
| INPUTS | | | OUTPUTS |
| REB | DE | A - B | RO |
| 0 | 0 | $\geq -0.05V$ | 1 |
| 0 | 0 | $\leq -0.2V$ | 0 |
| 0 | 0 | Open/Shorted | 1 |
| 1 | 1 | X | HIGH- Z |
| 1 | 0 | X | Shutdown |

X= Don't care
HIGH- Z= High impedance



Detail Description

The AZRS5054PA is a half-duplex RS-485 transceiver IC with IEC61000-4-2 contact $\pm 15\text{kV}$ ESD protection for bus pins (A and B), which contains one transmitter and one receiver inside with 5V power supply. This device is fully compliant with the EIA/TIA-485 standard.

The AZRS5054PA features the hot-swap glitch free design which guarantees the outputs of the transceiver in a high impedance state during the power-up period until the supply voltage has stabilized. The AZRS5054PA with whole chip ESD protected design for all of the I/O pins has robust ESD protection up to both HBM $\pm 4\text{kV}$ and MM $\pm 400\text{V}$. Moreover, the latchup immunity of the AZRS5054PA is up to $\pm 400\text{mA}$ for all of the pins. For IC self discharge issue, the CDM protection level of the AZRS5054PA is up to $\pm 1\text{kV}$.

Transmitter

The design of the transmitter is a non-inverted translator that converts the single-ended TTL input signal to differential EIA/TIA-485 signal level. The transmitter of the AZRS5054PA guarantees 10Mbps data rate communication. When the transmitter is active (DE= HIGH), the single-end TTL input signals of transmitter will be transported to differential output RS485 signals of the transmitter. Under the disable state (DE= LOW), the outputs of transmitter keep at high impedance state. The differential output voltage VA-VB(VOD2) of the AZRS5054PA is 3.0V with 54 ohm load under $V_{cc} = 5.0\text{V}$, $T = 25^\circ\text{C}$.

Receiver

The receiver of the AZRS5054PA converts the differential EIA/TIA-485 signals to single-end output TTL signal when receiver is in active state (REB=LOW), which incorporates input filtering in addition to input hysteresis. The input filtering

enhances the noise immunity under normal operating condition. When the receiver is disable (REB=HIGH), the output of the receiver keeps in high impedance state no matter what the input of the receiver is.

True Fail-Safe

In traditional design, the fail-safe function is implemented by two resistors on the PCB. One resistor is terminated pin A to VCC; the other is terminated pin B to GND to keep RO at high state when bus is idle, which is only the open fail-safe. The AZRS5054PA guarantees a receiver output high when the receiver inputs are short, open or idle, that is true fail-safe. The threshold voltage of receiver input is between -50mV and -200mV . If the differential input voltage (A - B) of receiver is greater than or equal to -50mV , receiver output (RO) is logic-high. If (A - B) is less than or equal to -200mV , RO is logic-low. In the case of a terminated bus with all transmitters disabled, the receiver's differential input voltage (A - B) is 0V, so the RO is logic-high at that time.

1/8 Unit Load

The AZRS5054PA transceiver has a $96\text{k}\Omega$ input impedance (1/8 unit load) of the receiver, allowing up to 256 or fewer devices to be connected in parallel on the RS485 bus.

Transmitter Output Protection

The AZRS5054PA has the current limitation function and the thermal shutdown protection in the transmitter. Firstly, the function of current limitation provides immediate protection against short circuits over the whole common-mode voltage range (-7V to $+12\text{V}$). Secondly, the function of thermal shutdown protection forces the transmitter outputs into a high impedance state if the die temperature becomes excessive.

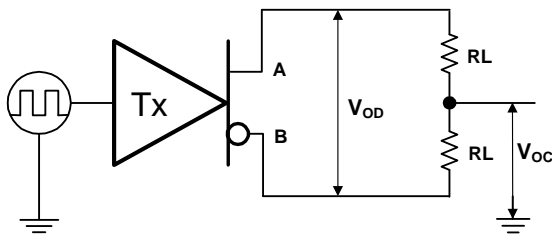


Fig.1 Transmitter DC test circuit

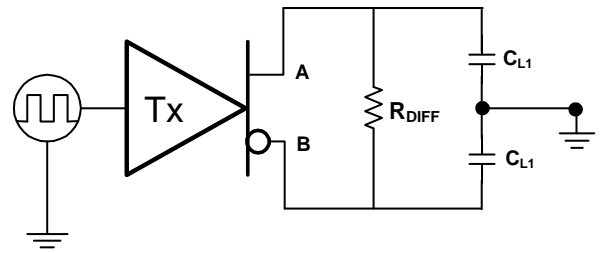


Fig.2 Transmitter timing test circuit

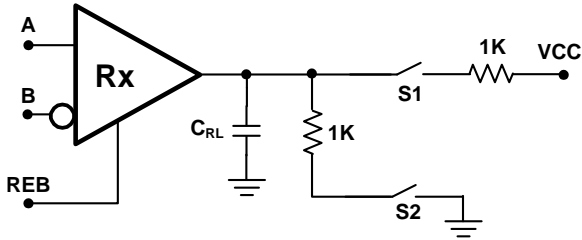


Fig.3 Receiver enable/disable timing test load

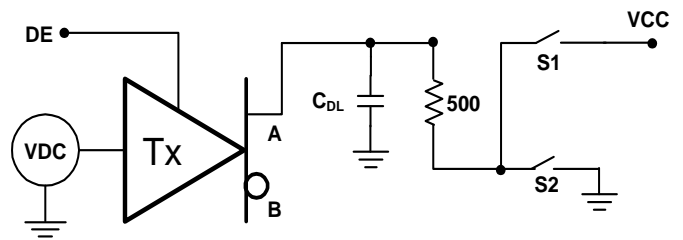


Fig.4 Transmitter enable/disable timing test load

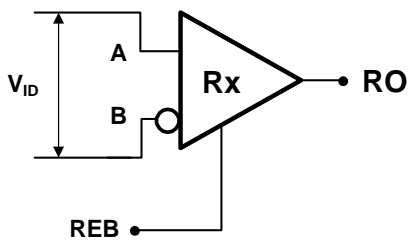


Fig.5 Receiver timing test circuit

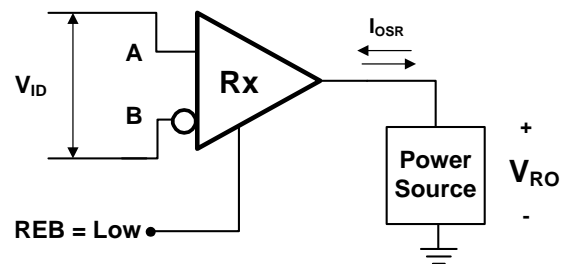


Fig.6 Receiver output short circuit

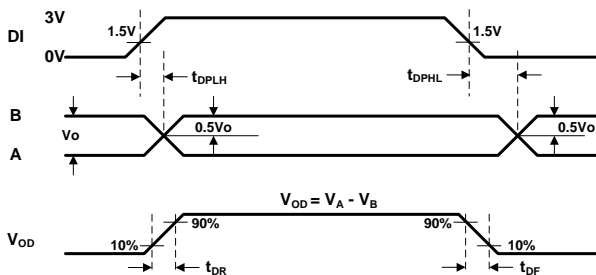


Fig.7 Transmitter Propagation Delays

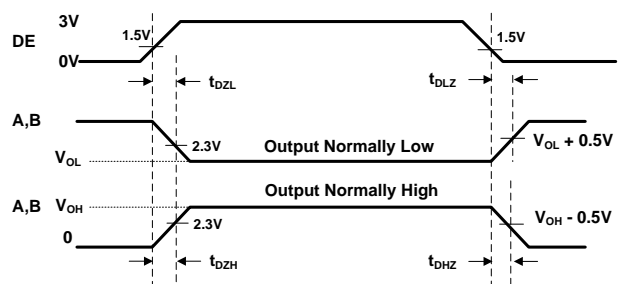


Fig.8 Transmitter Enable and Disable Times

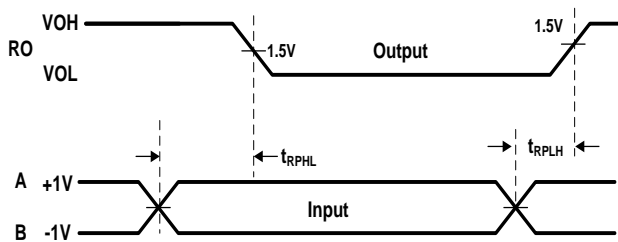


Fig.9 Receiver Propagation Delays

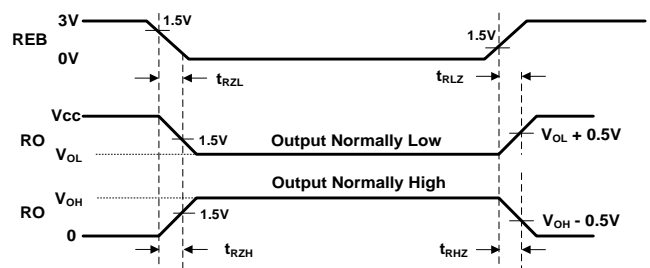
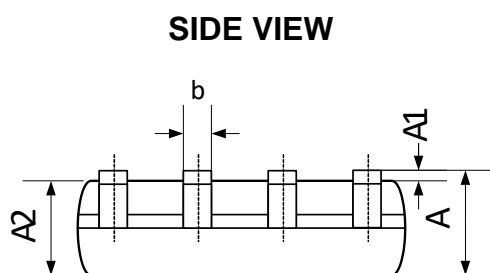
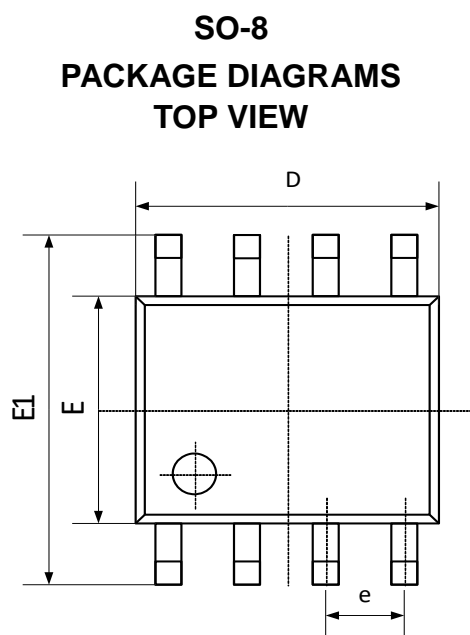
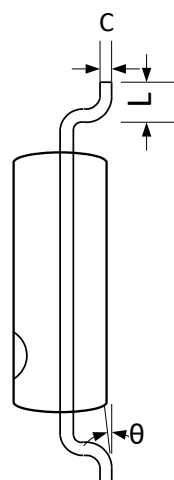


Fig.10 Receiver Enable and Disable Times

Mechanical Details



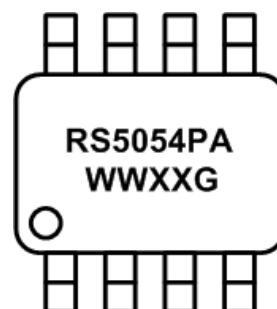
END VIEW



PACKAGE DIMENSIONS

| Symbol | Millimeters | | Inches | |
|--------|-------------|------|---------|-------|
| | min | max | min | max |
| A | 1.35 | 1.75 | 0.053 | 0.069 |
| A1 | 0.10 | 0.25 | 0.004 | 0.010 |
| A2 | 1.25 | 1.55 | 0.049 | 0.061 |
| b | 0.33 | 0.51 | 0.013 | 0.020 |
| C | 0.17 | 0.26 | 0.007 | 0.010 |
| D | 4.70 | 5.10 | 0.185 | 0.201 |
| E | 3.70 | 4.10 | 0.146 | 0.161 |
| E1 | 5.80 | 6.20 | 0.228 | 0.244 |
| e | 1.27 BSC | | 0.05BSC | |
| L | 0.40 | 1.27 | 0.016 | 0.050 |
| Θ | 0 | 8 | 0 | 8 |

MARKING CODE



RS5054PA= Device Code

WW = Date Code

XX = Control Code

G = Green Part Indication

| Part Number | Marking Code |
|----------------|-------------------|
| AZRS5054PA.RDG | RS5054PA WWXXG |

Ordering Information

| PN# | Material | Type | Reel size | MOQ | MOQ/interal box | MOQ/carton |
|----------------|----------|------|-----------|------------|------------------|-----------------------|
| AZRS5054PA.RDG | Green | T/R | 13 inch | 2,500/reel | 1 reel=2,500/box | 5 boxes=12,500/carton |

Revision History

| Revision | Modification Description |
|---------------------|--------------------------|
| Revision 2023/07/15 | Customized Release. |
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