

### General Description

The AOZ7645LQI-13 is a flyback receiver in primary side that targeted for power supply solution. It receives the ON time information signal from secondary side converter to drive integrated main MOSFET in primary side. The integrated high-voltage (HV) device provides fast start-up function.

The AOZ7645LQI-13 features include multiple protection functions such as  $V_{DD}$  under-voltage lockout, cycle-by-cycle current limit,  $V_{DD}$  over-voltage protection, secondary rectifier short-circuit protection, current sense pin open-circuit protection and internal over-temperature protection.

The AOZ7645LQI-13 is available in a 6mm×6mm QFN-17L package.

Function	Protection Behavior
Internal OTP	Auto recovery
HOCP	Auto recovery
Open CS Pin	Auto recovery
Open Pro Pin	Latch
VPRO OVP	Latch
VDD OVPLatch	Latch
Transmission Fail	Latch

### Features

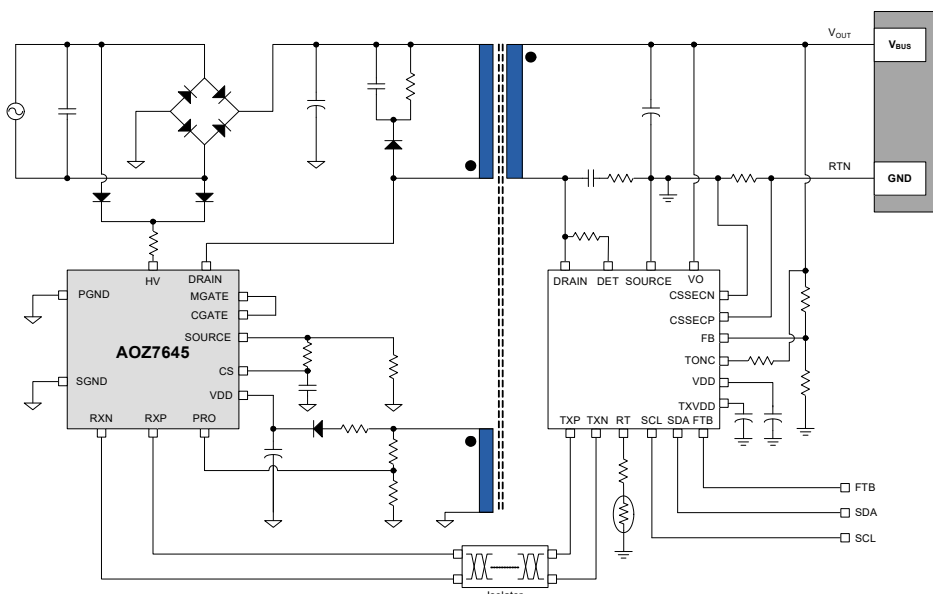
- Integrated HV start-up device
- Integrated with HV MOSFET
- 100kHz maximum start-up switching frequency
- $V_{DD}$  over-voltage protection
- Under-voltage lockout (6.7V/15.5V)
- Current sense leading edge blanking time
- Cycle by cycle current limit
- Secondary rectifier short-circuit protection
- CS pin open-circuit protection
- Internal over-temperature protection
- Thermally enhanced 17-pin 6x6 QFN

### Applications

- Smart charger
- Adapter
- TV and monitor applications
- Open frame power supply



### Typical Application



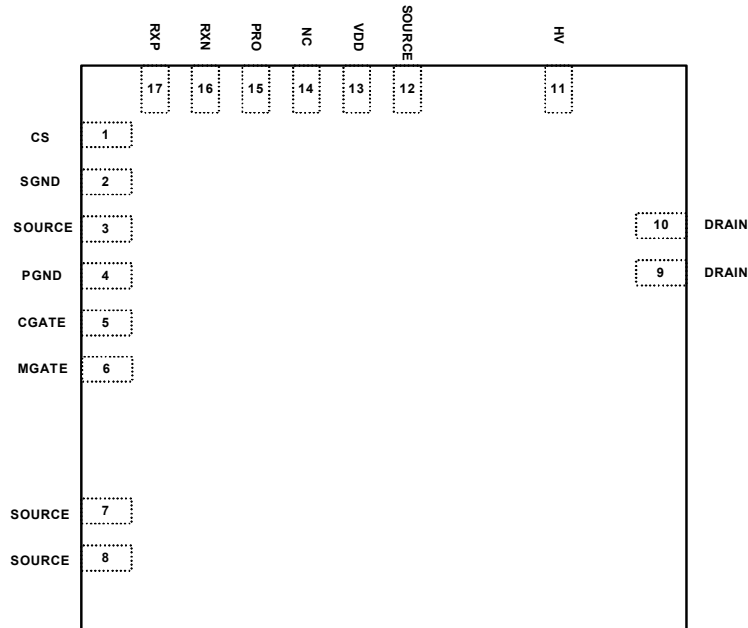
## Ordering Information

Part Number	Ambient Temperature Range	Package	Environmental
AOZ7645LQI-13	-40°C to +125°C	QFN 6x6A-17L	Green Product



AOS Green Products use reduced levels of Halogens, and are also RoHS compliant.

## Pin Configuration



**17-Pin 6mm x 6mm QFN  
(Top View)**

## Pin Description

Pin Number	Pin Name	Pin Function
1	CS	Current sense input pin.
2	SGND	Signal GND
3,7,8,12	SOURCE	Source of the MOSFET.
4	PGND	Power GND.
5	CGATE	The gate pin of controller.
6	MGATE	The gate pin of the integrated MOSFET
9,10	DRAIN	Drain of the integrated MOSFET.
11	HV	High voltage start-up current source.
13	VDD	The VDD is the bias-supply input pin to the controller.
14	NC	No connection.
15	PRO	Protection pin.
16	RXN	ON time information receiver pin.
17	RXP	ON time information receiver pin.

## Absolute Maximum Ratings

Exceeding the Absolute Maximum Ratings may damage the device.

Parameter	Rating
$V_{HV}$	-0.3V to 500V
$V_{DRAIN}$	-0.7V to 700V
$V_{DD}, V_{CGATE}$	-0.3V to 40V
$V_{CS}, V_{RXP}, V_{RXN}, V_{PRO}$	-0.3V to 7V
$V_{MGATE}$	-0.3V to 20V
Junction Temperature ( $T_J$ )	+150°C
Storage Temperature ( $T_S$ )	-65°C to +150°C
ESD HBM <sup>(1)</sup>	4kV
ESD CDM <sup>(1)</sup>	1kV

### Notes:

1. Devices are inherently ESD sensitive, handling precautions are required. Human body model rating: 1.5k $\Omega$  in series with 100pF.
2. 1x1inch, 2-layer PCB, follow JEDEC standard.

## Recommended Operating Conditions

The device is not guaranteed to operate beyond the Maximum Recommended Operating Conditions.

Parameter	Rating
Supply Voltage ( $V_{DD}$ )	8V to 33V
Ambient Temperature ( $T_A$ )	-40°C to +125°C
Package Thermal Resistance	25°C/W <sup>(2)</sup>

## Electrical Characteristics

$V_{DD}$ =15V,  $T_A$  = -25°C to 85°C, unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
MOSFET						
R <sub>DS(ON)</sub>	ON State Resistance	Static, I <sub>DRAIN</sub> = 1A, V <sub>DD</sub> = 10V, T <sub>J</sub> = 25°C		0.6	0.75	Ω
HV						
I <sub>HV</sub>	Supply Current from HV Pin	V <sub>HV</sub> = 100V, V <sub>DD</sub> = 0V, converter OFF		3.6	4.8	mA
I <sub>HV_LC</sub>	Leakage Current from HV Pin	V <sub>HV</sub> = 500V, V <sub>DD</sub> = 18V, converter ON		0.8		μA
VDD						
V <sub>DD_OVP</sub>	VDD Over-Voltage Protection Level		34	36	38.2	V
t <sub>D_OVP</sub>	VDD Over-Voltage Protection Debounce Time <sup>(1)</sup>			20		μs
V <sub>DD_ON</sub>	Turn-ON Threshold Voltage		14.0	15.5	17.0	V
V <sub>DD_UVLO</sub>	Turn-OFF and Under Voltage Lock Out		6.2	6.7	7.2	V
I <sub>DD_OP</sub>	Operation Current	V <sub>DD</sub> = 15V, converter ON, f <sub>S</sub> = 80kHz	0.6	1.2	1.8	mA
I <sub>DD_SKIP</sub>	Skip Mode Operation Current	V <sub>DD</sub> = 7V		500	550	μA
I <sub>DD_DIS</sub>	Disable Mode Operation Current	V <sub>DD</sub> = 15V, V <sub>DD_OVP</sub> is enabled or no GATE output		90	150	μA
Frequency						
f <sub>OSC</sub>	Start-up Operation Frequency	V <sub>PRO</sub> = 1V		100		kHz
f <sub>OSC1</sub>		V <sub>PRO</sub> = 0.5V		50		kHz
Protection Function						
V <sub>PRO_MIN</sub>	Min. Clamp Voltage	I <sub>PRO</sub> = -0.1mA	0.1	0.2	0.25	V
V <sub>DISH</sub>	Disable Voltage Level (High)		1.4	1.5	1.6	V
t <sub>DISHBN</sub>	Blanking Time		0.6	0.8	1	μs
t <sub>DISHDB</sub>	V <sub>DISH</sub> Debounce Cycles			4		Cycles
Gate Drive						
V <sub>G_CLAMP</sub>	GATE Clamping Voltage	V <sub>DD</sub> = 15V		12		V
t <sub>LEB</sub>	Leading Edge Blanking Time		300	350	420	ns
t <sub>PD</sub>	Propagation Delay Time			50	100	ns

**Electrical Characteristics (Continued)**
 $V_{DD}=15V$ ,  $T_A = -25^{\circ}C$  to  $85^{\circ}C$ , unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>Soft-start</b>						
$t_{SS\_OFF}$	Soft-Start Time for Shut Down			18	24	ms
$t_{SS\_CS}$	Soft-Start Time for Current Limit		5	7	9	ms
<b>Current LIMIT</b>						
$V_{CSL}$	General Continuous Operation Limited Current Sense Level	$I_{PRO} = 120\mu A$	285	300	315	mV
$V_{CSH}$	Fast Over Current Protection Limit			0.75		V
$t_{OCPH}$	Fast OCP for Auto Restart	$V_{CS} > 750mV$ and happening continuous		4		Cycles
<b>Receiver</b>						
$t_{RD}$	Delay Time for RX Rising Signal to GATE ON				100	ns
$t_{FD}$	Delay Time for RX Falling Signal to GATE OFF				100	ns
<b>Over temperature protection</b>						
$T_{SD}$	Thermal Shutdown	$T_J$ Rising		145		$^{\circ}C$
$T_{SDR}$	Thermal Shutdown Recovery Threshold	$T_J$ Falling		125		$^{\circ}C$

The block diagram illustrates the HV control logic. Key components and their interconnections include:

- Power Supplies:** HV, VDD, and SGND/PGND are shown at the top. VDD is connected to the BIAS, UVLO, and OVP Detection blocks. SGND and PGND are connected to the Driver Logic and the MOSFET gate.
- Control Logic:**
  - Reset and Shutdown Logic:** Receives inputs from the Latch Function, OVP Detection, and Fault signals. It outputs to the Driver Logic and the Latch Function.
  - Driver Logic:** Receives inputs from the Reset and Shutdown Logic, Current Limit, and Fault signals. It outputs to the MOSFET gate and the Fault signal.
  - Current Limit:** Receives input from the PRO Detection Circuit and outputs to the Driver Logic and the Fault signal.
  - PRO Detection Circuit:** Receives input from the HV line and outputs to the Current Limit and the Reset and Shutdown Logic.
  - OVP Detection:** Receives input from VDD and outputs to the Reset and Shutdown Logic.
  - UVLO:** Receives input from VDD and outputs to the Latch Function.
  - Latch Function:** Receives input from the UVLO and outputs to the Reset and Shutdown Logic.
  - Receiver:** Receives input from the RXN line and outputs to the Fault signal.
- MOSFET:** The MOSFET is connected to the HV line (Drain), the Driver Logic (Gate), and the Source. The Source is connected to the SGND/PGND line.

## Typical Characteristics

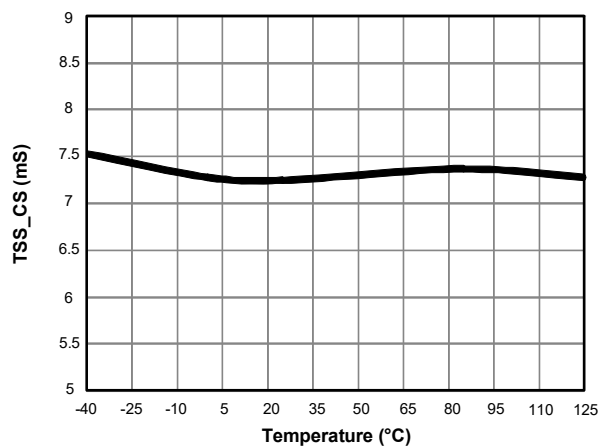


Figure 1. Soft Start Time for Current Limit vs. Temperature

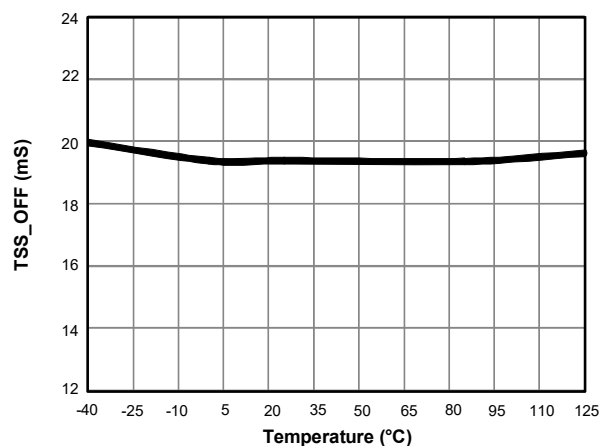


Figure 2. Soft Start Time for Shut Down vs. Temperature

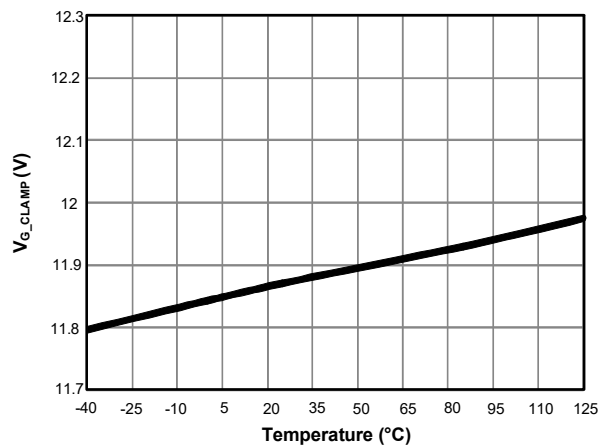


Figure 3. Gate Clamping Voltage vs. Temperature

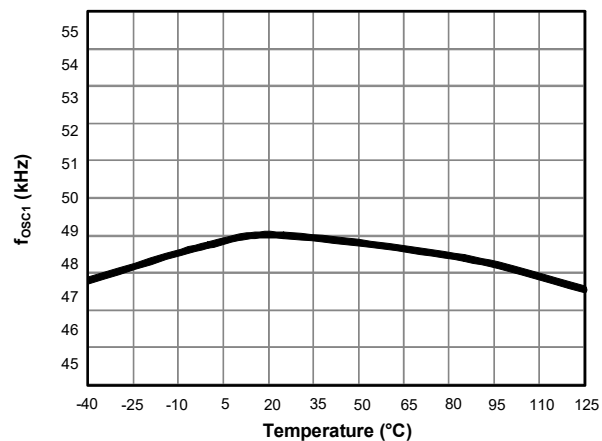


Figure 4. Minimum of the Start-up Operation Frequency vs. Temperature

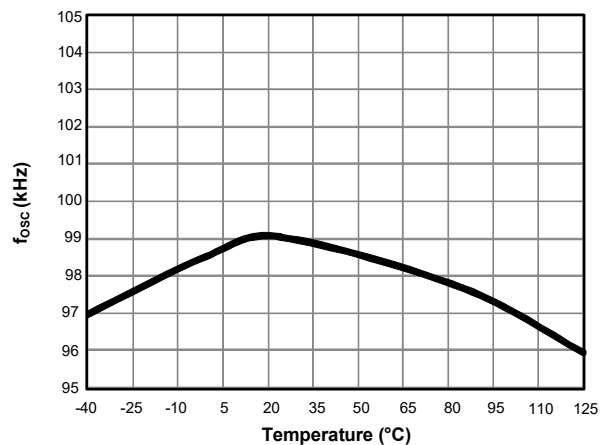


Figure 5. Maximum of the Start-up Operation Frequency vs. Temperature

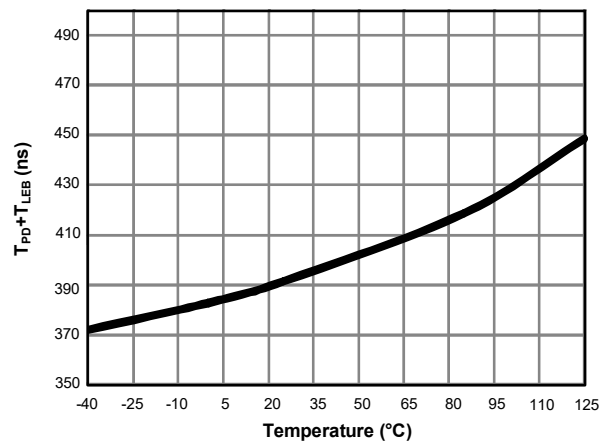


Figure 6. Minimum of the Turn-on Period vs. Temperature

## Typical Characteristics

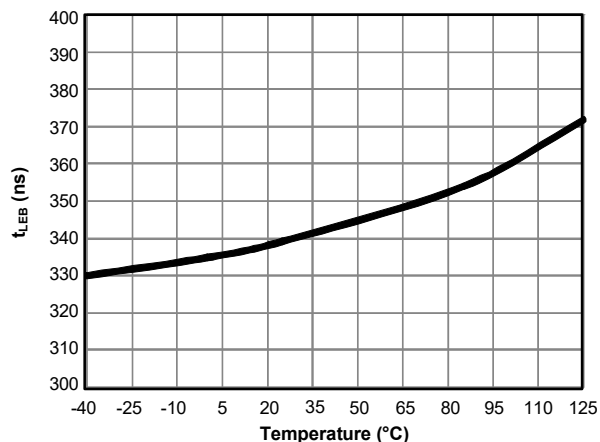


Figure 7. Leading Edge Blanking Time vs. Temperature

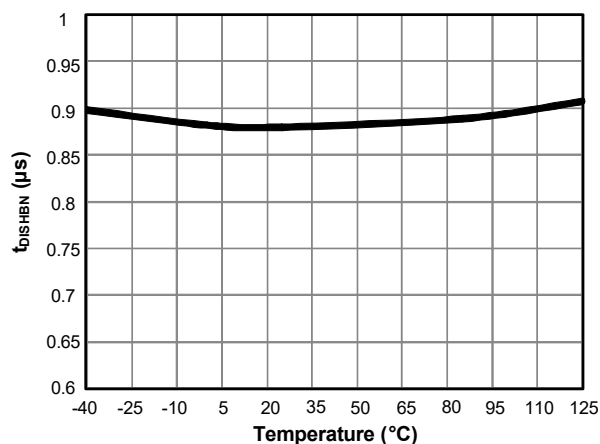


Figure 8. The Blanking Time of the Disable Voltage Level vs. Temperature

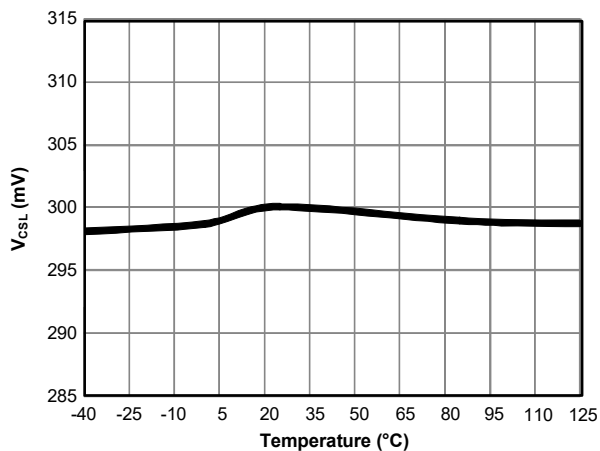


Figure 9. General Continuous Operation Current Sense Limit vs. Temperature

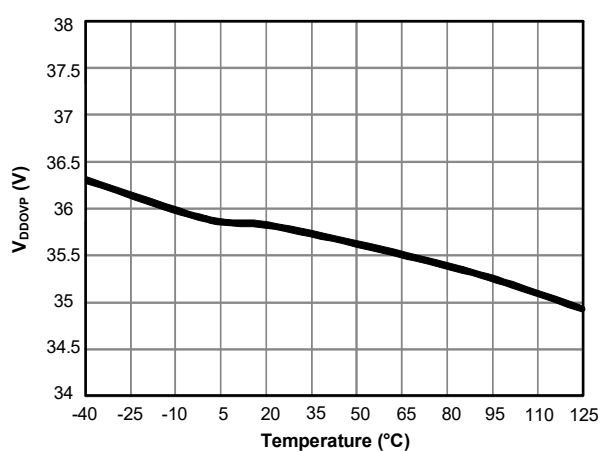


Figure 10. V<sub>DD</sub> Over-Voltage Protection Level vs. Temperature

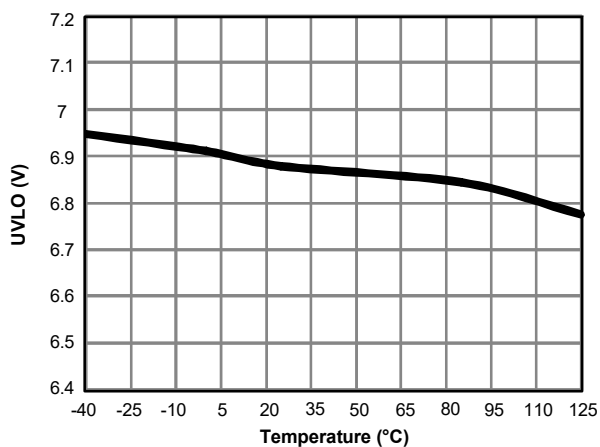


Figure 11. Turn-OFF and Under Voltage Lock Out vs. Temperature

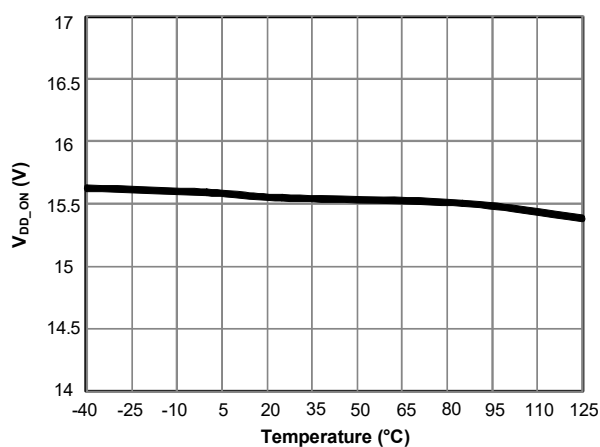


Figure 12. Turn-ON Threshold Voltage vs. Temperature

## Detailed Description

### HV Start-Up

There is a high-voltage (HV) device which is designed as a current source to charge the VDD capacitor during start-up. This current source will be turned off for reducing the power consumption after the AOZ7645LQI-13 is powered on. The HV pin should be connected to the input terminals through the rectifier diodes and a series resistor, the series resistor is recommended to be 10k $\Omega$ .

### Soft Start

The AOZ7645LQI-13 has an internal soft start feature to limit inrush current and ensure the output voltage ramps up smoothly to the regulation voltage. If the AOZ7645LQI-13 never receives the ON time information from the secondary side converter, the AOZ7645LQI-13 will be shut down after 18ms ( $t_{SS\_OFF}$ ) from start-up.

### ON Time Receiver

The AOZ7645LQI-13 receives the ON time information from the secondary side converter through the RXP and RXN pins and send the ON time signal to the driver. The ON time width of the switching pulse varies according to the ON time signal.

### VDD Over-Voltage Protection

The output voltage can be sensed roughly from the VDD pin. When the VDD voltage exceeds the VDD OVP level ( $V_{DD\_OVP}$ ), the converter will be shut down after the VDD OVP debounce time ( $t_{D\_OVP}$ ) and then return to the start state.

### PRO Protection

The output voltage can be sensed indirectly by monitoring the auxiliary winding voltage. When the PRO voltage during turn-off period exceeds the PRO disable voltage level ( $V_{DISH}$ ), the converter will be shut down after the  $V_{DISH}$  debounce cycles ( $t_{DISHDB}$ ) and then return to the start state.

### Cycle-by-Cycle Current Limit

The AOZ7645LQI-13 detects the primary current through CS pin, and the CS peak voltage of each switching cycle is limited to  $V_{CSL}$ . The voltage across the current-sensing resistor  $R_{CS}$  is fed into the CS pin for current limit detection.

When the fault occurs due to transformer short circuit or secondary rectifier short circuit, and the

large current will flow through the main MOSFET at turn-on period, and this will cause damage on power components. In order to protect the system, Fast over current protection function is added. If the CS voltage reaches  $V_{CSH}$ , the converter will be shut down after four consecutive cycles and then return to the start state.

### CS Pin Open-Circuit Protection

The CS pin features open-loop protection to pass the CS pin single fault testing. When the CS pin is opened, the CS will be pulled high by internal circuit and CS pin voltage will higher than  $V_{CSH}$  and the converter will be shut down after four consecutive cycles and then return to the start state.

### Over-Temperature Protection

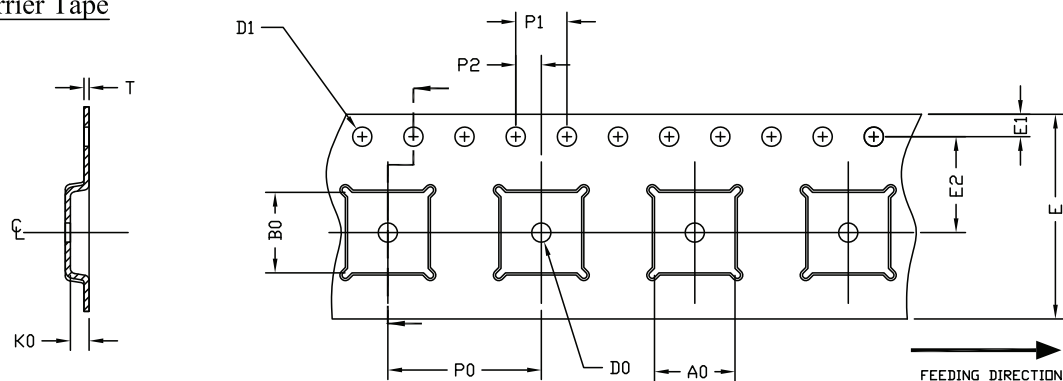
The AOZ7645LQI-13 provides an internal OTP protection function. If the junction temperature reaches the OTP threshold, the AOZ7645LQI-13 will stop switching until the junction temperature decreases below the OTP recovery temperature.





## Tape and Reel, QFN6x6A-17L, EP1\_S

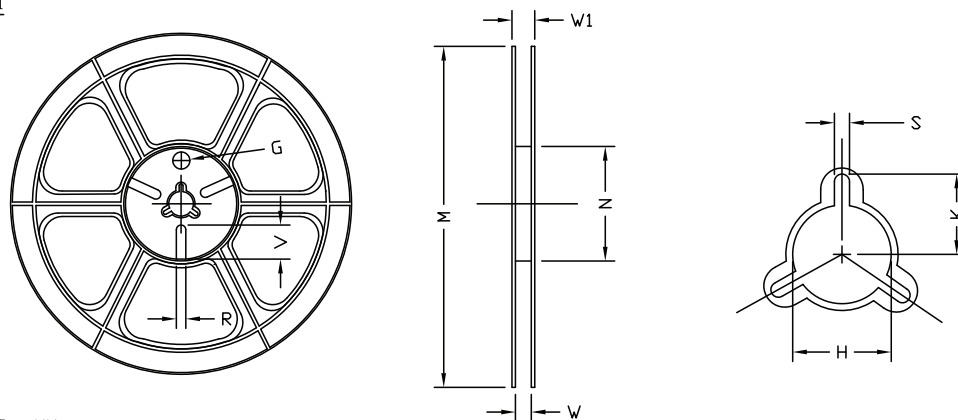
### Carrier Tape



UNIT: MM

PACKAGE	A0	B0	K0	D0	D1	E	E1	E2	P0	P1	P2	T
QFN6x6 (16 mm)	6.30 ±0.20	6.30 ±0.20	1.10 ±0.20	1.50 MIN.	1.50 +0.1 -0.0	16.0 ±0.3	1.75 ±0.10	7.5 ±0.1	12.00 ±0.20	4.00 ±0.20	2.00 ±0.10	0.30 ±0.05

### Reel

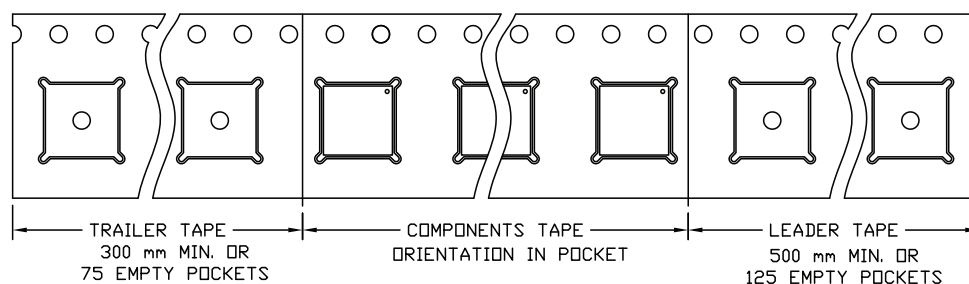


UNIT: MM

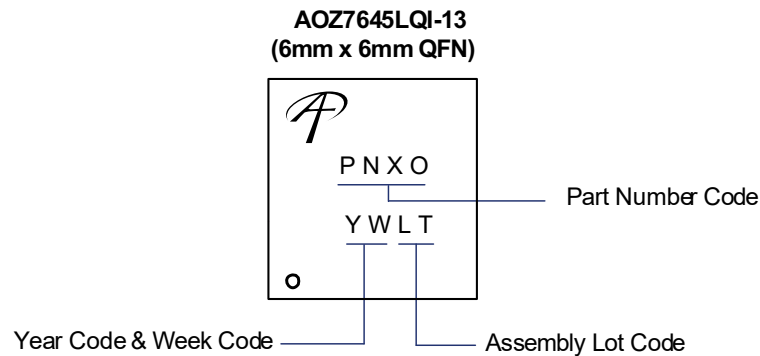
TAPE SIZE	REEL SIZE	M	N	W	W1	H	K	S	G	R	V
16 mm	ø330	ø330 MAX.	ø100 MIN.	16.4 +2.0 -0.0	22.4 MAX.	ø13.0 +0.5 -0.2	10.1 MIN.	1.5 MIN.	---	---	---

### Tape

Leader / Trailer  
& Orientation



## Part Marking



Part No.	Description	Code
AOZ7645LQI-13	Green Product	AYLD

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