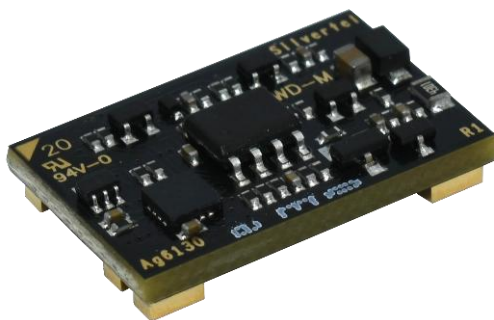




# Ag6130

## Single Channel Power Sourcing Equipment PoE Module



### Features

- Programmable output power limit up to 75W
- IEEE802.3 Compliant, for use with IEEE802.3at/af PoE devices.
- Single power rail feed
- Small SMT package size - 21mm x 14mm x 5mm
- Low cost
- Minimal (low cost) external components required
- Over-current and short circuit protection
- Output disable
- Supports reduced MPS power
- Industrial temperature range
- Silvertel "design-in" assistance
- Designed and manufactured in the UK

### Description

The Ag6130 is a single channel Power Sourcing Equipment (PSE) module designed for use in Power over Ethernet (PoE) applications with a wide range of power levels from 15.4W (IEEE802.3af), 25.5W (IEEE802.3at) up to 75W proprietary power levels.

The Ag6130 is aimed at a wide range of applications requiring PSE functionality such as CCTV DVR, home networking and industrial Ethernet.

Ag6130 is a self-contained module, requiring only a single supply voltage and just a few external components to provide simple and cost-effective Power Sourcing Equipment (PSE) application.

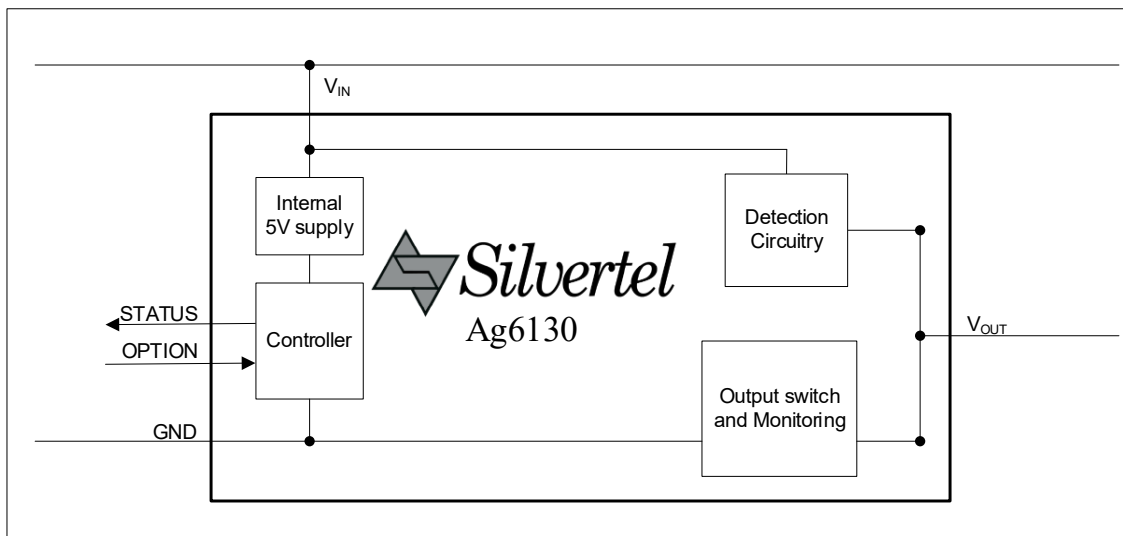
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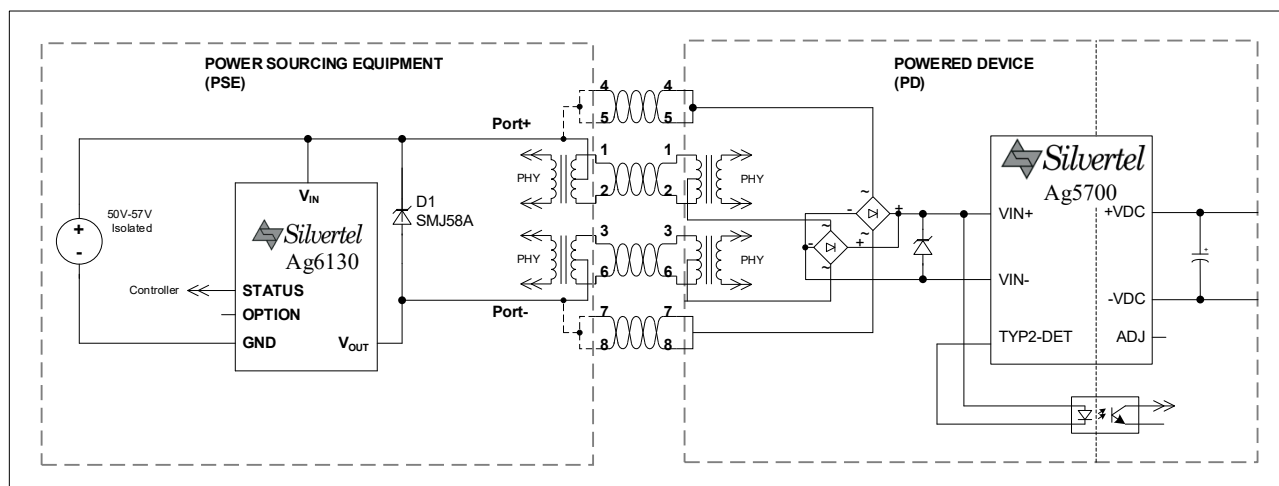
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## 1 Product Overview



**Figure 1: Block Diagram**



**Figure 2: Typical Connection Diagram**

## 1.1 Ag6130 Product Selector

| Part Number <sup>1</sup> | Output Power (W) | Marking <sup>2</sup> |
|--------------------------|------------------|----------------------|
| Ag6130                   | 15.4 - 75W       | abc                  |

**Table 1: Ordering Information**

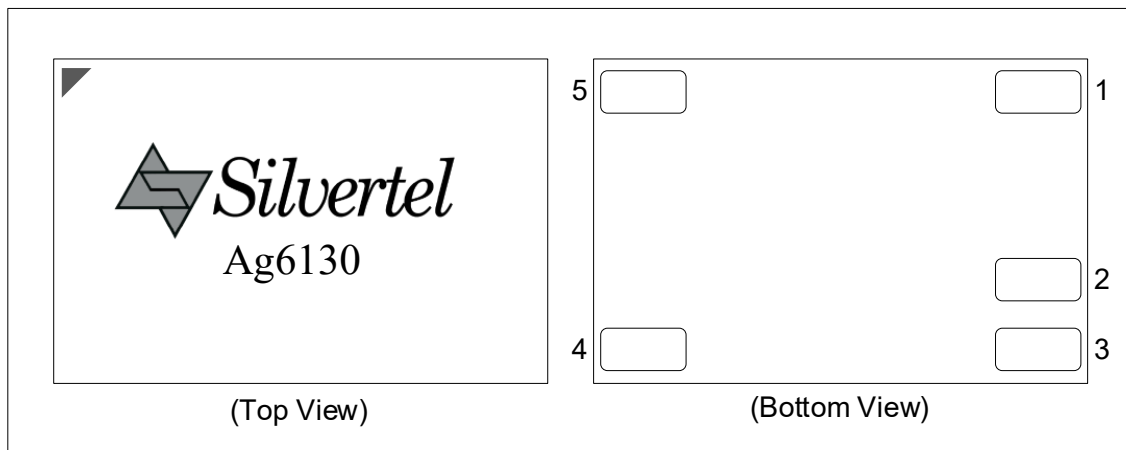
Note 1: Complies with the European Directive 2011/65/EU for the Restriction of use of certain Hazardous Substances (RoHS) including Directive 2015/863 published in 2015, amending Annex II of Directive 2011/65/EU. Moisture Sensitive Level 1 and HBM 1.

Note 2: The first letter, a, indicates the week as A-Z with uppercase being weeks 1-26, lower case weeks 27-52.

The second letter, b, indicates the year in uppercase A-Z starting from 2020.

The final letter, c, is a Silvertel reference.

## 1.2 Pin Description



**Figure 3: Ag6130 Package Format**

| Pin # | Name      | Description                                                                                                                 |
|-------|-----------|-----------------------------------------------------------------------------------------------------------------------------|
| 1     | $V_{IN}$  | <b>Main Power Supply.</b> This pin connects to an isolated supply and to the centre tap of one of the cable conductor pairs |
| 2     | OPTION    | <b>Option select pin.</b> A resistor should be fitted to select the power and class profile required. (see section 2.5)     |
| 3     | STATUS    | <b>Status Output.</b> This output shows the status of the Ag6130.                                                           |
| 4     | GND       | <b>Power Supply Return.</b> Return Path for the isolated power supply.                                                      |
| 5     | $V_{OUT}$ | <b>Port Output.</b> This pin monitors the line and enables power delivery to a valid Powered Device (PD)                    |

**Table 2 - Pin Descriptions**

## 2 Functional Description

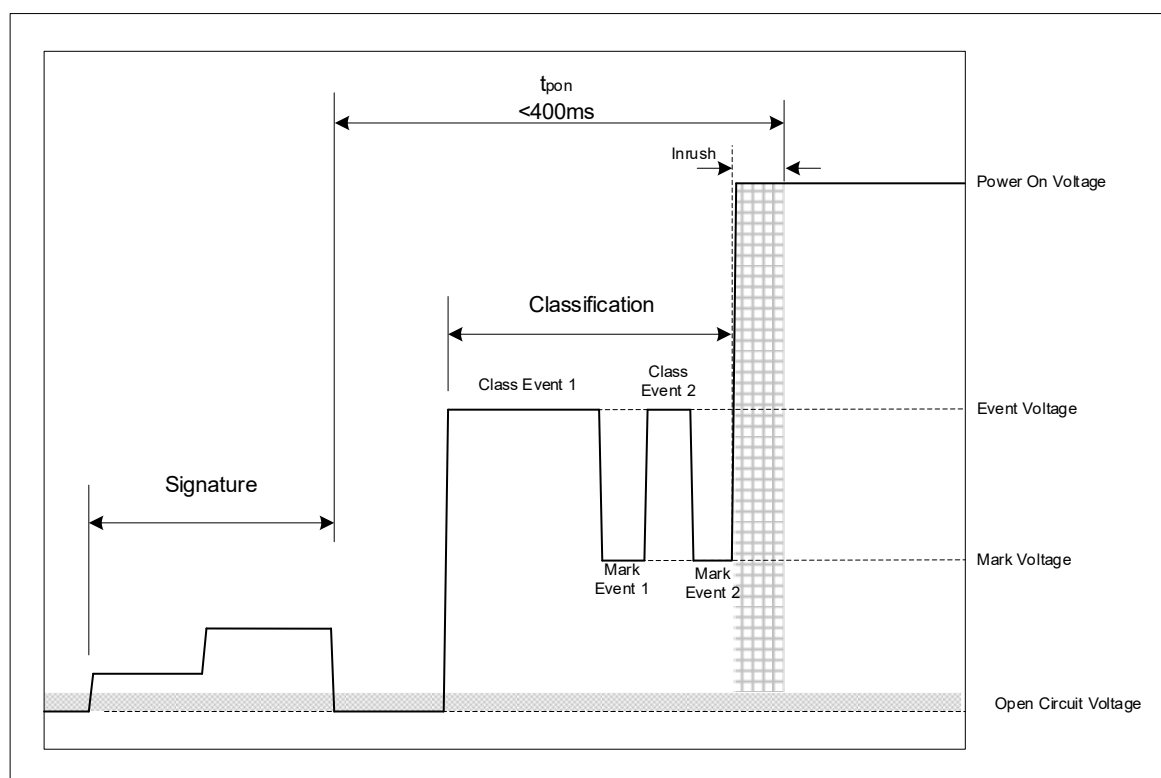
### 2.1 Detection Protocol

To prevent damage from occurring to non-PoE compatible devices that are connected to a PSE, the IEEE802.3 specification requires that the PSE only provides power after the detection of a PoE enabled device and remove power if it is detected that the device may have been disconnected.

To detect the presence of a PoE enabled device, the PSE should periodically check for a valid PoE signature. If a valid PoE signature is detected. The PSE will then proceed with the multistage classification waveform to determine the power level required from the connected device.

Prior to every detection check, the Ag6130 will confirm the option configuration selected, see section 2.5 Option Configuration for details.

If the Ag6130 detects an invalid response in either the signature or classification events the Ag6130 will abort the current identification protocol and flag 'Device Identification Error' before restarting the detection after a 2 second delay.



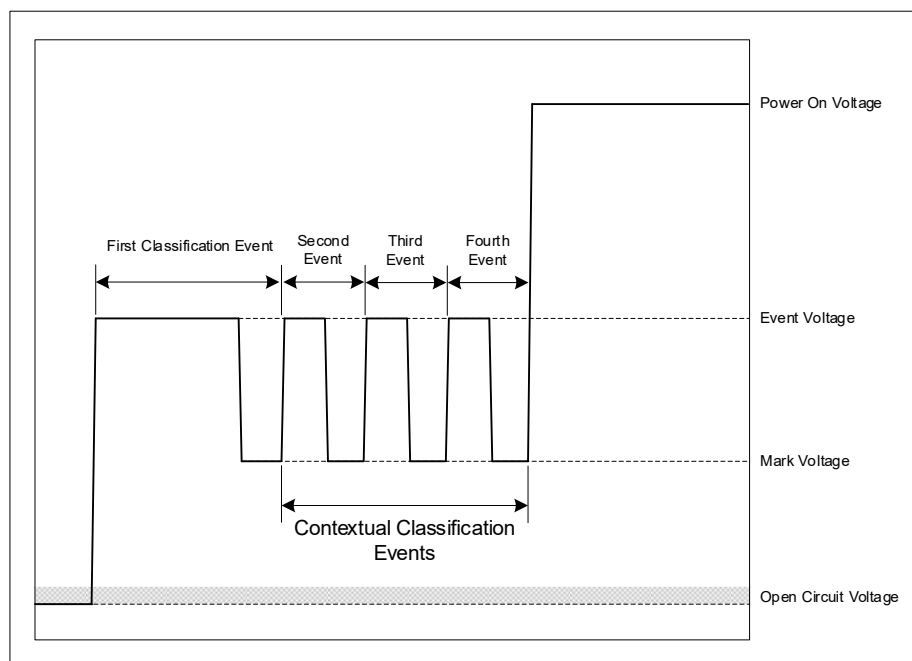
**Figure 4: Identification Profile**

#### 2.1.1 Signature Detection

An IEEE802.3 compliant PD should present a nominal 25kΩ signature resistance. This is detected by applying two voltages between 2.8V and 10V. If the Ag6130 does not see a valid signature then it will disconnect, wait approximately 2 seconds before trying again.

### 2.1.2 Classification

On detection of a valid signature, the Ag6130 will then interrogate the PD to determine the requested Power Class. This is performed using multiple event process, with additional events added with the detection of higher power requests. For example, when connected to a device requesting class of 0,1,2 or 3, the Ag6130 will only output a single classification event prior to applying power, as detailed in Table 3 - PSE output Power. The number of Classification events can be used by the PD to determine if it is being supplied with enough power.



**Figure 5: IEEE802.3 Classification Timing**

The Ag6130 will respond to a single signature Class 5 or Class 6 in accordance with the IEEE802.3bt amendment, as a result there will be no compatibility issues with any single signature PD used in the Type 3 modes. As the Ag6130 only has a single output, it is not capable of detecting dual signature PD's or performing measurements of the current balance between the pairsets. For this reason this mode should only be used in proprietary applications where the connected devices and cabling can be controlled.

The Ag6130 supports the lower MPS requirement added in the IEEE802.3bt amendment, this is indicated to the PD by producing an elongated first class pulse.

## 2.2 Port Connections

The eight conductors of the ethernet link are divided into two pairsets. The two pairs terminating in pins 1,2,3 and 6, often called the 'Data Pairs', are grouped as a pairset. With the other conductors, often called the 'Spare Pairs', as the other pairset. In Gigabit Ethernet (GbE or 1000Base-T) both pairsets are used for data transmission

Power rails are applied to the ethernet link conductors via the centre tap of the data transformer, as shown in Figure 2: Typical Connection Diagram. This results in the power being applied in common to the data signals, preventing interference on the data transmission.

For applications up to Class 4 power levels, only one of the two pairsets should be used for power transmission. For applications above Class 4 power levels power should be applied to all eight conductors in the ethernet link.

The polarity of the power between the pairs of each pairset is not defined in the IEEE802.3 specification.

## 2.3 Classification Power Levels

The power levels of PoE are separated into several classes and types. The power levels contained in the first implementation of PoE to the IEEE802.3 specification, referred to as type 1 devices, are for applications ranging up to 13W. there are four classification levels for Type 1 devices, Classes 1 to 3 offer incremental power levels. Class 0 is the default for when the PD does not provide a classification power request, the PSE will revert to Class 3 power levels, even if it is capable of providing higher power levels.

Type 2 devices were added in the IEEE802.3at amendment, commonly known as PoE+, this added an additional classification power doubling the PSEs output power, allowing up to 25W applications.

The IEEE802.3bt amendment added two additional device types and four additional classification levels, all of these are commonly referred to as PoE++ devices. These power levels have the additional requirement of power being applied to all pairs in the cable to reduce transmission losses that could result in overheating of the transmission cable.

If a PD that requests a higher classification power than the PSE can provide, the PSE will provide the connected device with the highest output power it has available. For example, if a device the requests Class 8 is connected to the Ag6130 while it is in Type 2 mode, the Ag6130 will provide it Class 4 power levels of at least 30W. The PD is capable of detecting the PSE type during the detection protocol and should limit its power accordingly.

| PSE Type | Compatible Power Classes | PD Requested Class | Number of Class Events | Minimum PSE output power (W) | Guaranteed power available (W) |
|----------|--------------------------|--------------------|------------------------|------------------------------|--------------------------------|
| 1        | 0-3                      | 0                  | 1                      | 15.4                         | 12.95                          |
|          |                          | 1                  | 1                      | 4                            | 3.84                           |
|          |                          | 2                  | 1                      | 7                            | 6.49                           |
|          |                          | 3                  | 1                      | 15.4                         | 12.95                          |
| 2        | 0-4                      | 4                  | 2/3                    | 30                           | 25.5                           |
| 3        | 0-6                      | 5                  | 4                      | 45                           | 40                             |
|          |                          | 6                  | 4                      | 60                           | 51                             |
| 4        | 0-8                      | 7                  | 5                      | 75                           | 62                             |
|          |                          | 8                  | 5                      | 90                           | 71.3                           |

**Table 3 - PSE output Power**

## 2.4 Power Supply

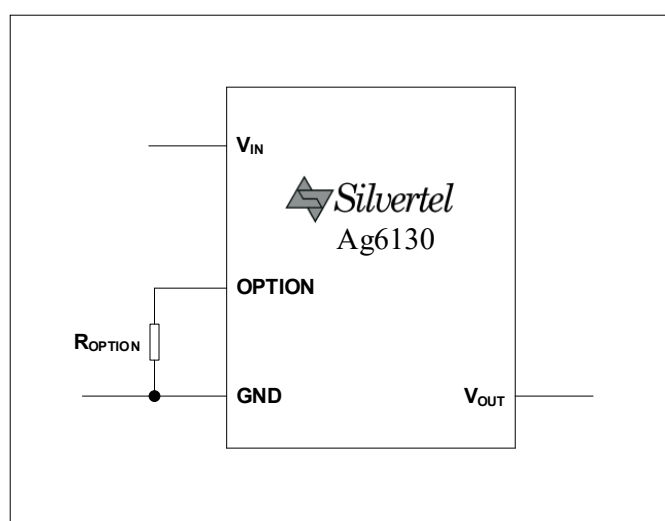
The Ag6130 requires only a single supply rail, in order to conform to the IEEE802.3 specification isolation requirements, this supply should be isolated from any accessible external conductors including mains ground.

If the power supply has a peak output of greater than 100W, we would recommend fitting a fuse to the positive output rail of the power supply.

## 2.5 Option Configuration

The Ag6130 can be configured to operate in different modes featuring different output power limits for use in a variety of applications, this is configured by connecting a resistance between the OPTION pin and GND, as shown in Figure 6.

If there is an open circuit on the OPTION pin, the Ag6130 will default to operation as an IEEE802.3 compliant Type 2 PSE, offering at least 30W to any device requesting class 4 or greater.



**Figure 6: OPTION pin connections**

For most applications, where the connected powered device is not known, it is recommended that the Ag6130 is used in either Type 1 or Type 2 mode. These two modes will be compatible with any IEEE802.3 compliant PD device connected to the port.

The other modes can be used in proprietary higher power applications where the possible connected powered devices are known and have been tested to be compatible in the chosen mode.

The selected mode is rechecked at the beginning of the detection protocol see section 2.7.2 for more details, this allows the output mode to be changed in the event that multiple Ag6130's are operating in the same application that has a power limit less than the sum of the maximum power of all the ports. For example, an application with two Ag6130 modules with a power budget of 60W, enough power to power a Class 4 device (PoE+) and a Class 3 device (PoE). When a Class 4 device is connected to one of the ports, an option resistor can be switched in on the second module to change the operating mode to Type 1.



| Mode                    | Option resistor<br>( $R_{OPTION}$ ) | Application<br>IEEE802.3<br>Compliance | Peak Output       |                  | Connected<br>pairsets*2 |
|-------------------------|-------------------------------------|----------------------------------------|-------------------|------------------|-------------------------|
|                         |                                     |                                        | Output<br>power*1 | Class<br>Request |                         |
| Type 2 (at)             | Open Circuit                        | Compliant                              | 36W               | 4                | Either                  |
| Port Disable            | 0Ω                                  | -                                      | -                 |                  | -                       |
| Type 1 (af)             | 43KΩ                                | Compliant                              | 20W               | 3                | Either                  |
| Proprietary high power  | 91KΩ                                | Proprietary                            | 75W               | 4                | Both                    |
| Type 3 (bt) - Class 5*3 | 180KΩ                               | Proprietary                            | 50W               | 5                | Either/Both             |
| Type 3 (bt) - Class 6*3 | 470KΩ                               | Proprietary                            | 75W               | 6                | Both                    |

Note 1: Dependent on Supply Voltage, See section 2.6 Power Dissipation for details.

Note 2: See section 2.2 Port Connections for details.

Note 3: Compatible with IEEE802.3bt single signature PDs

Table 4 – Option Select

2.5.1 Output Disable

In some applications it may be desirable to disable the port output. This can be implemented with a transistor in parallel with the option resistor, if fitted, to pull the OPTION pin to GND, as shown in Figure 7: Output Disable.

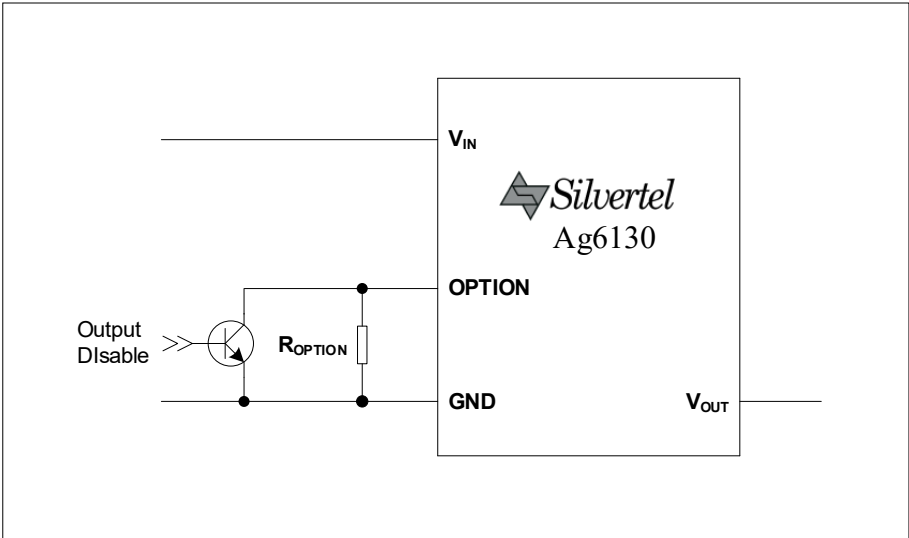
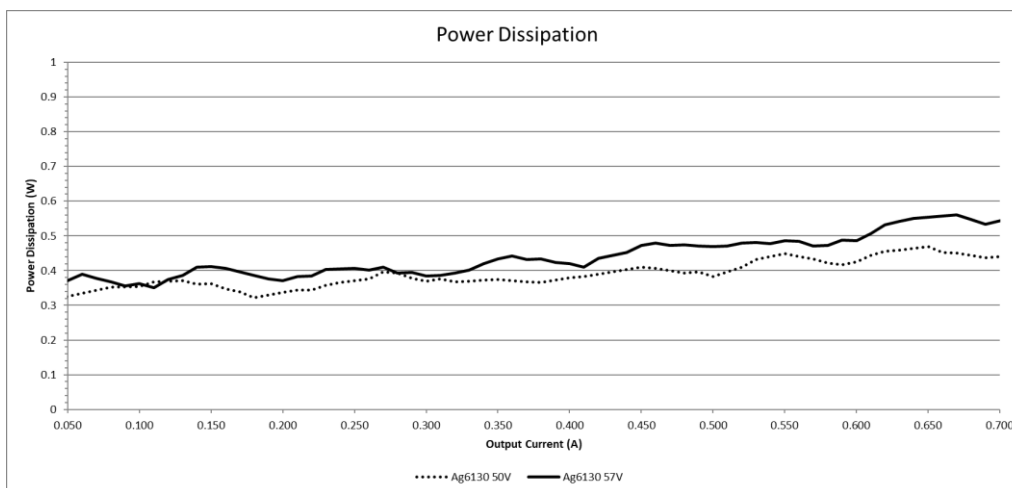


Figure 7: Output Disable

## 2.6 Power Dissipation

### 2.6.1 Power Dissipation

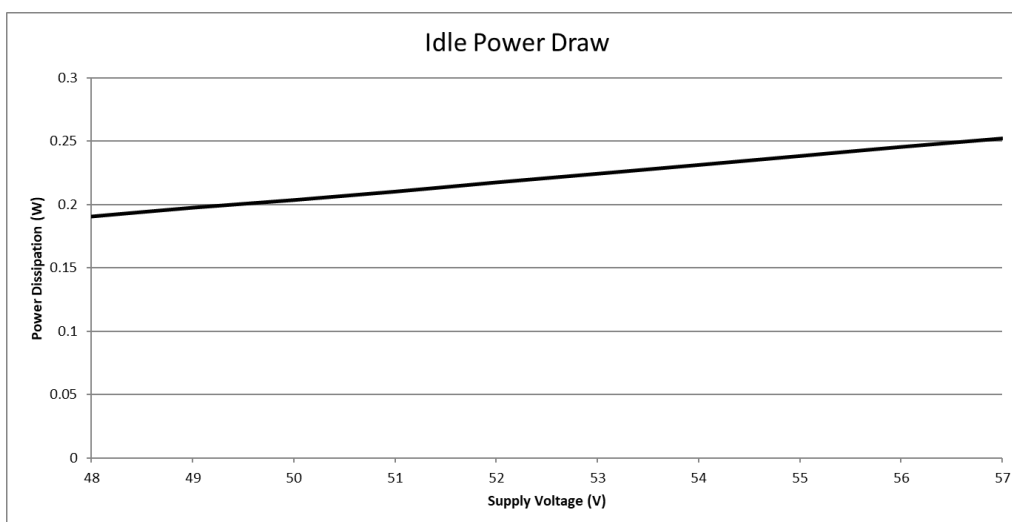
The Ag6130 dissipates very little power, in a Type 2 application drawing 30W will result in less than 500mW being dissipated in the Ag6130.



**Figure 8: Power Dissipation vs Output Current**

### 2.6.2 Idle power Dissipation

While the Ag6130 is not powering a device, whether due to no PoE device being detected or the Ag6130 being disabled, it will draw 0.20W - 0.25W depending on the supply voltage. In applications drawing the full 75W output of the Ag6130, the power dissipated across the module can increase up to 0.9W



**Figure 9: Idle Power Draw**

## **2.7 Output Power**

The maximum available power to a PD will be voltage dependent. Higher supply voltages will allow for more power to be available to the Powered Device. This is due to the IEEE802.3 specification requiring the transmission current to be the primary limiting criteria of power over ethernet.

### **2.7.1 Output Current Limits**

There are two over current mechanisms that the Ag6130 uses to determine whether to remove power to the device, Overload Current and Current Limiting.

#### **2.7.1.1 Overload Current**

The overload current allows the maximum cable current to be exceeded for brief periods of time, preventing temporary surges in power draw from triggering power removal due to overcurrent, such as an inrush due to the application waking from a low power mode or a peripheral device being connected

Exceeding the Overload Current Threshold,  $I_{OVL D}$ , for more than Overload Time Limit  $T_{OVL D}$  will result in power being removed from the line with the module flagging the Overload Current status. This is in accordance with upper and lower bound current templates detailed in the IEEE802.3 specification.

#### **2.7.1.2 Current Limiting**

In the event of a short circuit, or other fault event, the Ag6130 has a current limit where the output current will be capped at the Short Circuit Current Limit,  $I_{LIM}$ , for the Short Circuit Time Limit,  $T_{LIM}$ . If the current is still being limited at the end of this time period power will be removed from the line with the module flagging the Short Circuit status.

### **2.7.2 Maintain Power Signature (MPS)**

While the Ag6130 is supplying power to a connected device, it will continuously monitor the output current, not only to prevent over current, but to ensure that the device is still connected; this is referred to as the Maintain Power Signature (MPS).

The standard MPS requirement is that the PSE cannot remove power from the device if there is a continuous current draw greater than 10mA for a period of at least 75ms, after which there can be a period of no current draw for up to 250ms.

The low power MPS that the Ag6130 supports requires 10mA to be drawn for only 6ms, after which there can be a period of 319ms with no current draw for the device to be determined as present.

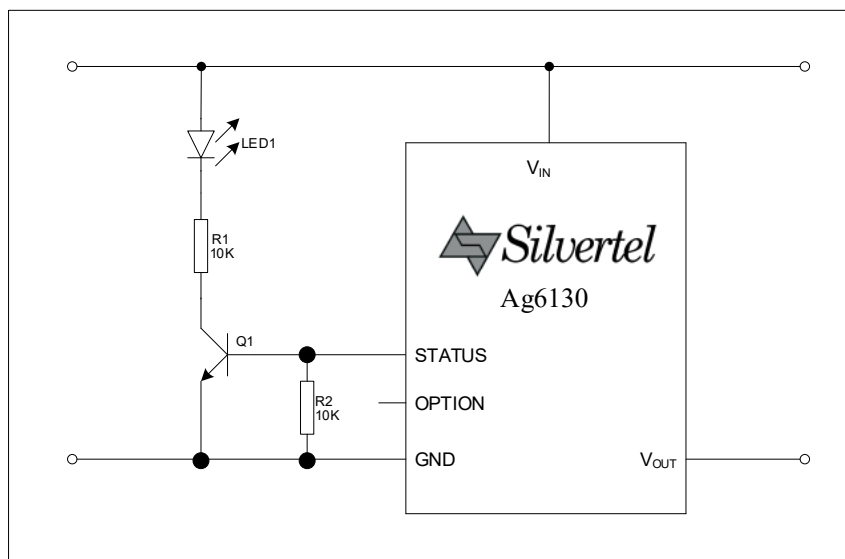
### **2.7.3 Under Voltage Lockout**

For operation in Type 1 mode for applications up to 15.4W, see section 2.5 Option Configuration for details, the supply voltage should be between 45V and 57V. For operation in all other modes the minimum supply voltage is 51V to comply with the permitted transmission voltages stated in the IEEE802.3 specification.

The Ag6130 will remove power from the port if the supply voltage drops below the undervoltage lockout threshold. The module's detection procedure will be suspended and flag as undervoltage as per section 2.8 Status Output until the supply voltage returns to a voltage exceeding the undervoltage lockout threshold hysteresis.

## 2.8 Status Output

The Ag6130 has a status output that can either be used to illuminate an LED or passed into a controller. The output of this pin is sourced through a 47kΩ current limiting resistor to prevent excessive power dissipation in the module. For illuminating an LED, the Status output should be used to drive the gate of a transistor as shown in Figure 10: STATUS Output Configuration

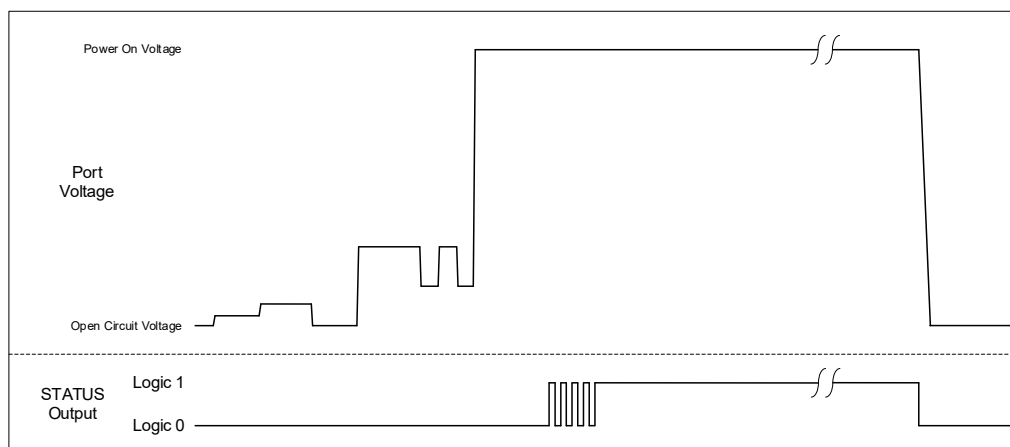


**Figure 10: STATUS Output Configuration**

The status output will default to logic 0. If an open circuit is detected on the output, the status output will remain at logic 0 with no pulses. If a non-PoE enabled device is connected to the port, depending on the configuration of the connected device, the status output may or may not provide a single flash every 2 seconds after each detection cycle.

### 2.8.1 Device Connection and Removal

After the successful detection and power up of a PoE Device, the status output will rise to logic 1, then begin a sequence of 100ms logic 0 pulses to indicate the requested power classification of the powered device, then remain at logic 1 while the device remains powered.



**Figure 11: STATUS Output at Port Connect and Disconnect**

2.8.2 Fault Condition

In the event of a fault the Ag6130 will output a sequence of Logic 1 pulses after power removal as per Table 5: Status Output, it will then repeat the sequence at the end of every detection cycle until the fault condition is no longer present. An example of the STATUS output during a persistent short circuit event occurring on the pairset can be seen in Figure 12: STATUS Output on Fault Condition

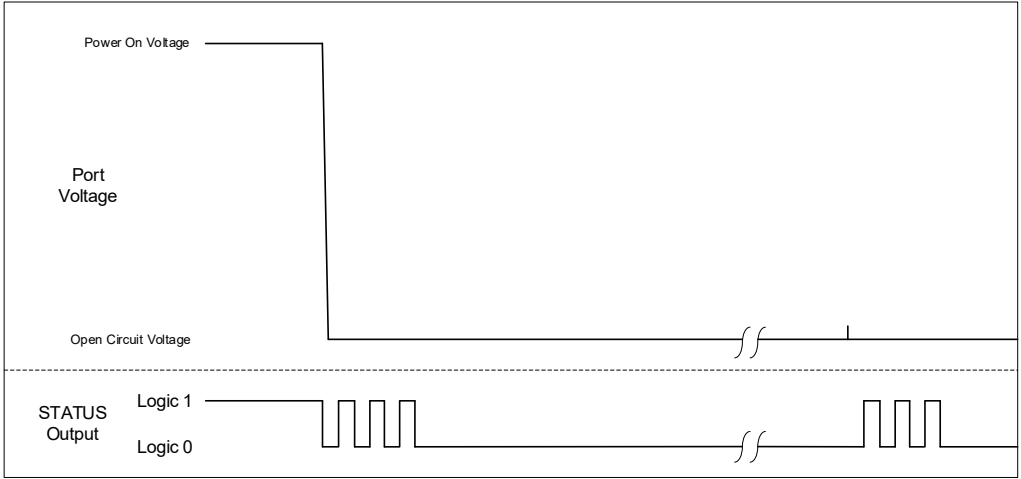


Figure 12: STATUS Output on Fault Condition

In addition to the STATUS output reporting when the output ports are connected or disconnected, the STATUS output also reports when a fault has been detected.

| Fault Condition             | Status Pulses (200ms)   |
|-----------------------------|-------------------------|
| Device Identification Error | 1 x Logic 1 Pulse       |
| Input Voltage < UVLO limit  | 2 x Logic 1 Pulses      |
| Short Circuit               | 3 x Logic 1 Pulses      |
| Overload Current            | 4 or 5 x Logic 1 Pulses |

Table 5: Status Output

### **3 Thermal Considerations**

The Ag6130 consumes very little power in normal operation, there are no specific requirements for thermal management.

## **4 Protection**

### **4.1 Input Protection**

The Ag6130 has a built-in tranzorb diode across its input to protect the module from most transients from the power supply. If the application requires long cabling between the PSU output and the module, or is expected to be used in environments with increased transient intensity, we recommend additional protection is fitted to the input of the module.

If the power supply is capable of sourcing more than 100W, we recommend a 2A slow blow fuse to be fitted in line with the positive input rail.

### **4.2 Output Protection**

To protect the module from voltage transients coming from the RJ45 cable we would recommend fitting a SMAJ58 or higher on the Ag6130 output as shown in Figure 2: Typical Connection Diagram.

## 5 Solderability

The Ag6130 has been designed with a fully automated assembly process in mind and is lead-free (Pb-free) and RoHS compliant and fully compatible with a Pb-free automated assembly process. The Ag6130 can still be mounted manually using soldering iron or hot air.

There are no specific requirements regarding stencil thickness or solder paste classification type. Solder mask defined (SMD) pads are preferred over non-solder mask defined (NSMD) pads, the land pattern dimensions are given in Figure 14: Land Pattern.

Minimal thermal relief should be applied to the pads to allow for maximum thermal conductivity without hindering the reflow process, your Process Engineer should be able to provide suitable recommendations.

The Ag6130 requires no components of greater than Moisture Sensitivity level 1, as a result no special processes are required in the reflowing process of the Ag6130.

Note : Do not pass the Ag6130 through the reflow process mounted to the underside of the assembly due to the risk of components falling off the module.

### 5.1 Solder Profile

Below is a typical profile showing how the Ag6130 should be mounted, based on the J-STD-020 standard for Pb-Free applications. Exceeding these specifications may cause damage to the module. All production environments are different therefore please review these guidelines with your process engineer prior to use.

|               | Zone 1 | Zone 2 | Zone 3 | Zone 4 | Zone 5 | Units                  |
|---------------|--------|--------|--------|--------|--------|------------------------|
| Zone Duration | 42     | 42     | 42     | 42     | 42     | Seconds                |
| Top Heater    | 150    | 180    | 210    | 240    | 270    | °C                     |
| Bottom Heater | 150    | 180    | 210    | 240    | 270    | °C                     |
| Typical Slope | 2.1    | 1.2    | 1.1    | 0.9    | 0.8    | °C/Second              |
| Airflow rate  | 40     |        |        |        |        | M <sup>3</sup> /Minute |

**Table 6: Solder Profile**

|                                        | Min | Max | Units     |
|----------------------------------------|-----|-----|-----------|
| Soak Time (s)<br>150-180°C             | 30  | 90  | Seconds   |
| Time above (s)<br>≥217°C               | 30  | 90  | Seconds   |
| Time within 5°C of peak<br>Temperature |     | 30  | Seconds   |
| Target Peak Temperature (°C)           | 230 | 245 | °C        |
| ΔTemperature (°C/s)                    | -6  | 3   | °C/Second |

**Table 7: Solder Parameters**

## 6 Electrical Characteristics

### 6.1 Absolute Maximum Ratings<sup>1</sup>

|   | Parameter                  | Symbol   | Min  | Max  | Units |
|---|----------------------------|----------|------|------|-------|
| 1 | DC Supply Voltage          | $V_{DD}$ | -0.3 | 60   | V     |
| 2 | Storage Temperature        | $T_S$    | -40  | +100 | °C    |
| 3 | Moisture Sensitivity Level | MSL      | -    | 1    | -     |

Note 1 : Exceeding the above ratings may cause permanent damage to the product. Functional operation under these conditions is not implied. Maximum ratings assume free airflow.

### 6.2 Recommended Operating Conditions

|   | Parameter             | Symbol                     | Min | Typ | Max | Units      |
|---|-----------------------|----------------------------|-----|-----|-----|------------|
| 1 | Input Supply Voltage  | $V_{DD}$ (Type 1 mode)     | 45  |     | 57  | V          |
|   |                       | $V_{DD}$ (all other modes) | 51  |     | 57  | V          |
| 2 | Operating Temperature | $T_{OP}$                   | -40 | 25  | 85  | $T_a$ / °C |



### 6.3 Electrical Characteristics

|    | Parameter                           | Sym                                    | Power Level                 | Min  | Typ      | Max  | Units |
|----|-------------------------------------|----------------------------------------|-----------------------------|------|----------|------|-------|
| 1  | V <sub>DD</sub> Idle Supply Current | I <sub>DD</sub>                        |                             |      | 5.5      |      | mA    |
| 2  | Signature Detection Voltage         | V <sub>SIGL</sub><br>V <sub>SIGH</sub> |                             | 2.7  | 4.5<br>9 | 10.1 | V     |
| 3  | Valid Signature Range               | R <sub>SIGL</sub>                      |                             | 18   |          | 29   | kΩ    |
| 4  | Classification Event Voltage        | V <sub>CLASS</sub>                     |                             |      | 17       |      | V     |
| 5  | Classification Mark Voltage         | V <sub>MARK</sub>                      |                             |      | 8.3      |      | V     |
| 6  | Classification Threshold Current    | I <sub>CLASS</sub>                     | Class 0                     | 0    |          | 6.5  | mA    |
|    |                                     |                                        | Class 1                     | 6.5  |          | 14.7 |       |
|    |                                     |                                        | Class 2                     | 14.7 |          | 23.5 |       |
|    |                                     |                                        | Class 3                     | 23.5 |          | 33.6 |       |
|    |                                     |                                        | Class 4                     | 33.6 |          | 49   |       |
| 7  | Classification Current Limit        | I <sub>CLASSLIM</sub>                  |                             |      | 56       |      | mA    |
| 8  | Maintain Power Signature            | I <sub>MPS</sub>                       |                             | 5    | 7        | 10   | mA    |
| 9  | Overload Current Threshold          | I <sub>OVLD</sub>                      | Class 0 -3                  | 381  |          |      | mA    |
|    |                                     |                                        | Class 4                     | 649  |          |      |       |
|    |                                     |                                        | Class 5                     | 894  |          |      |       |
|    |                                     |                                        | Class 6 / Legacy High power | 1339 |          |      |       |
| 10 | Overload Time Limit                 | T <sub>OVLD</sub>                      |                             |      | 60       |      | ms    |
| 11 | Short Circuit Current Limit         | I <sub>LIM</sub>                       |                             |      | 1.4      |      | A     |
| 12 | Short Circuit Time Limit            | T <sub>LIM</sub>                       |                             |      | 3        |      | ms    |
| 13 | Under Voltage Lockout Threshold     | V <sub>UVLO</sub>                      | Type 1 Mode                 | 41   |          |      | V     |
|    |                                     |                                        | All other Modes             | 47   |          |      |       |
| 14 | UVLO Hysteresis                     | V <sub>UVLO-Hsy</sub>                  |                             |      | 1        |      | V     |
| 15 | STATUS Output                       | V <sub>OH</sub><br>V <sub>OL</sub>     |                             |      | 0.3      | 5    | V     |

7 Package

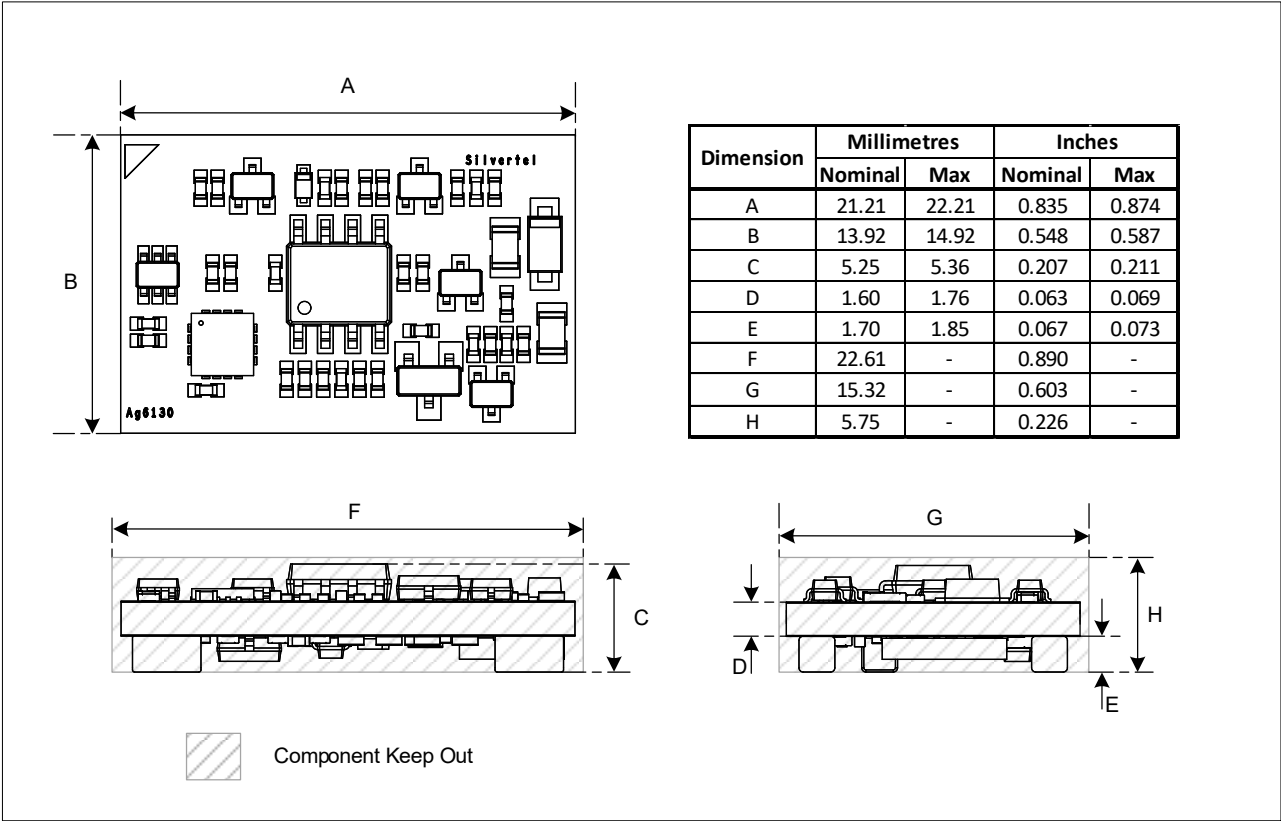


Figure 13: Package Dimensions

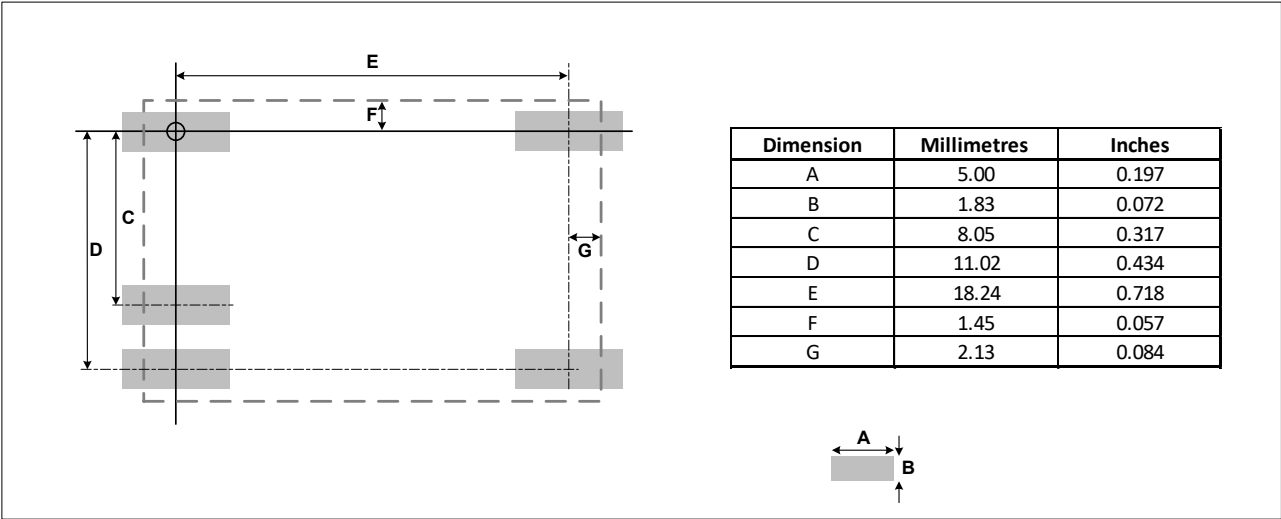
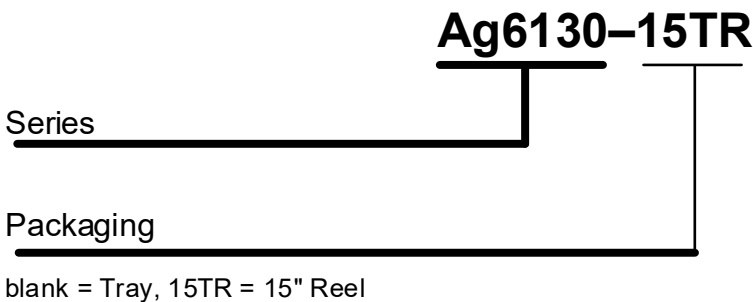


Figure 14: Land Pattern

8 Ordering Code



9 Packaging

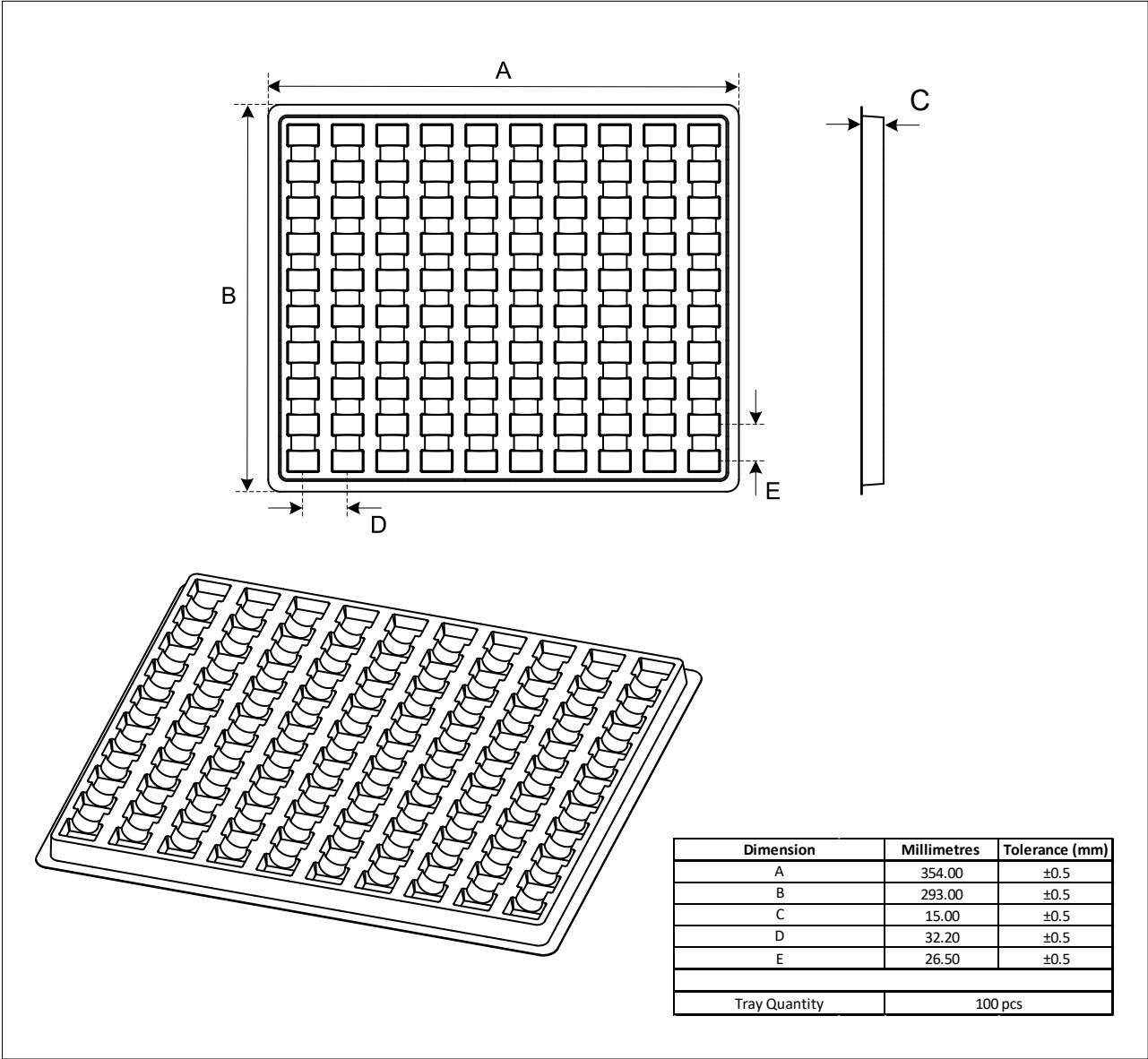


Figure 15: Tray Dimensions

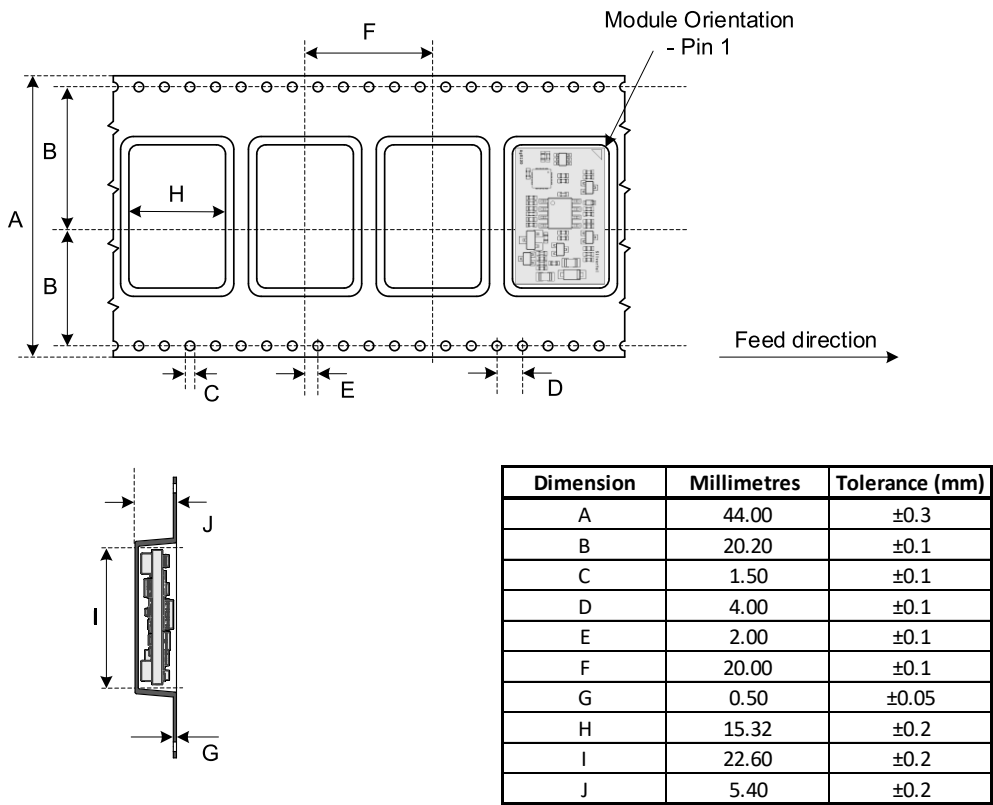
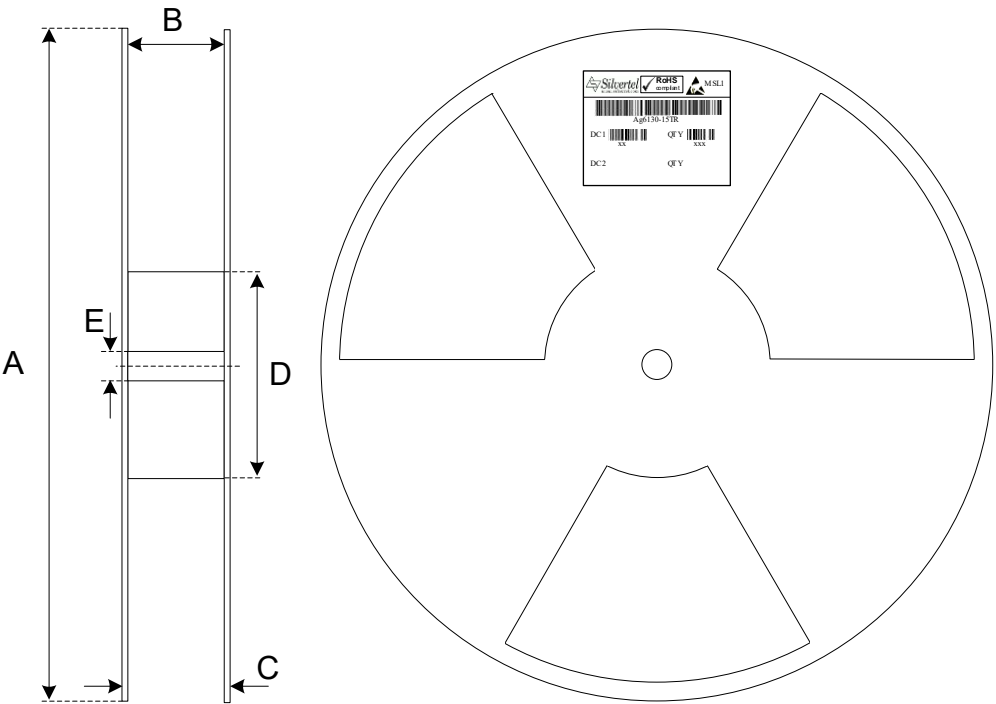


Figure 16: Tape Dimensions



| Dimension     | Millimetres | Tolerance (mm) |
|---------------|-------------|----------------|
| A             | 381.00      | ±0.5           |
| B             | 46.00       | ±0.5           |
| C             | 50.00       | ±0.5           |
| D             | 100.00      | ±0.5           |
| E             | 13.00       | ±0.5           |
|               |             |                |
| Reel Quantity | 500 pcs     |                |

Figure 17: Reel Dimensions

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