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New PoE Injector Products for Green Energy Performance

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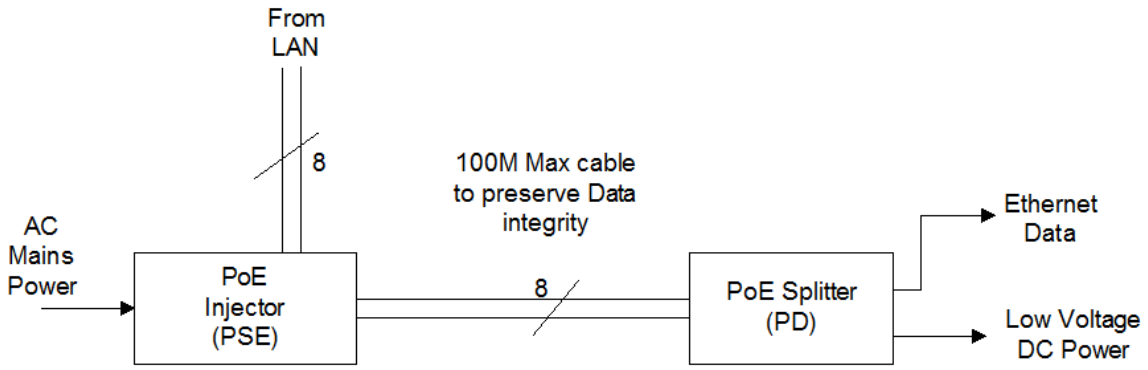
Power over Ethernet (PoE) as defined in the IEEE802.3 standard, has developed over the last 16 years into a mature technology capable of supplying up to 100W of remote DC power to Ethernet Appliances in locations where it is not practical to provide AC mains power, and an isolated AC/DC power supply for the Ethernet Appliance. New technological advances by Globtek now allow high Energy Efficiency performance from PoE networks, and compliance with the new US Department of Energy (DoE) Efficiency Level VI External Power Supply regulations.

Typical Implementation:

The diagram below shows a typical mid-span injection scheme for PoE. In the diagram the PoE Injector, also referred to as PSE, (for Power Supply Equipment as per the 802.3 standard lexicon) supplies the DC Power and injects it onto the ethernet cables. And the PoE Splitter, also referred to as PD, (for Powered Device, as per the 802.3 standard lexicon) receives the power and ethernet communications from the injector.



Power is transferred at between 40V and 57Vdc, which allows for maximum efficiency, without any safety hazard, since power less than 60Vdc and 100W power limiting, is defined as inherently safe in the National Electric Code (NEC), and is often referred to as an LPS (Limited Power Source) in the safety compliance community.

NOTE: In most cases, the PoE Splitter is combined with the final Ethernet appliance such as a security camera or a telephone, however in this paper the Splitter is theoretically considered separate from the Ethernet appliance.

Green Energy Performance PoE:

Although PoE technology can enable system cost efficiencies, by eliminating the need to provide power directly at the Ethernet appliance, the energy consumption of the PoE power distribution tends to be higher than other solutions. Energy consumption exists in the Injector, ethernet cabling voltage drop, and in the Splitter. Additionally when the PoE system is in an idle state, power loss through extended time exposure

Splitter. Additionally when the PoE system is in an idle state, power loss through extended time exposure also can be significant.

The US Department of Energy has issued energy performance regulations of External Power Supplies in EPS 2.0 Efficiency Level VI. PoE power adapters appear to fall within the categorization concepts detailed within the regulations. A basic problem for compliance with this regulation is meeting the 100mW maximum No Load power requirement, due to the continuous power consumed by the PoE Micro-Controller. Using a

proprietary (patent pending) method we have been able to meet this difficult 100mW No Load power requirement, as well as the Level VI Average Efficiency requirement, which varies as a function of the output power level.

Power Rating Relationship between Injector (PSE) and Splitter(PD):

With the original introduction of the PoE standard in 2003 (IEEE 802.3-af), output power was limited to about 12W from the Splitter output. Later with the 2009 (IEEE-802.3-at) version of the standard doubled this allowable power level. Power requirements of the Injector, may basically be determined by analyzing the efficiency lost in the Splitter, and the voltage drop in the ethernet cabling. Typically the Splitter will have an efficiency of roughly 80%, and the voltage/power drop is typically in the range of 85% for a worst case (long length) ethernet cabling installation. Therefore, using these values, we can approximate the power requirement at the output of the Injector as follows:

12W x (1/80%) x (1/85%) = 17.65W

And if the Splitter output power requirement is 24W, the power at the injector will be 35.3W.

Globtek makes an 18W Injector and a 36W Injector, for adequate power for these two typical examples.

Additionally, Globtek has a 70W Injector using all 4 pairs (8 wires) of the ethernet cabling, for use with supplying DC power for Splitters supplying up to 50W of output power.

DC Voltage Drop in Ethernet Cable

Like all power transmission systems, there is expected voltage drop in the wires transferring power from the PoE Injector to the PoE Splitter. Therefore, it is wise to understand the maximum expected cable length for a specific installation. Bear in mind, that the 802.3 specification, has a limit of 100M specified, based upon the serial communication integrity. The feed voltage on a Globtek PoE Injector is 56Vdc typical , and the minimum voltage on a typical PoE Splitter is 40Vdc. Therefore voltage drop on the cable needs to be less than 16Vdc for effective power transfer.

Below is a table showing the typical DC voltage drop in an Ethernet cable for a long distance power transmission. Although 100M length is marked on the diagram, the voltage drop for shorter or longer length cables is directly proportional to the length of the cable, and so may be easily extrapolated from the following table data.

Voltage Drop in 100M (330 feet) of Cable @ 40C copper temperature using two twisted pairs of cable

	0.32A Current (2 pairs)	0.64A Current (2 pairs)	1.25A Current (4 pairs)
Cat 5 Cable #24 gauge	3.0V	6.0V	5.8V
Cat 6 Cable #23 gauge	2.4V	4.8V	4.7V

Note, if using all 4 pairs to transit power, the voltage drop will be 2X lower. Additionally, it may be seen that if the head voltage from the Injector is higher, then the cable loss is less, since then the voltage at the end of the cable will be greater, thus the splitter will draw less power.

Active and Passive Injectors

Although the IEEE 802.3 standard defined mainstream PoE product development, various methods to reduce the cost of PoE have been developed from various PoE equipment providers. One of the most

reduce the cost of PoE have been developed from various PoE equipment providers. One of the most prevalent non-802.3 compliant concepts is Passive PoE. PoE Devices which are fully compliant with the IEEE PoE standard are typically referred to as Active PoE devices. In order for power to be transferred using Active PoE technology, low level handshaking signals are communicated between the Injector and the Splitter. These signals have time, voltage, resistance and current requirements, and there is a sequence of operations required before the Injector and Splitter are in complete agreement that power can be transferred. After activation of power delivery between Injector and Splitter, handshaking signals cease,

and the same conductors used for the handshaking and now used for the power delivery using the Physical Link Layer. At higher power levels (above 50W) the Data Link Layer is fundamentally required to perform the handshaking function, the DLL communicates using standard USB digital communication serial protocol, same as any ethernet device would use.

The handshaking signals require digital micro-processing in order to function. This adds cost, complexity and power consumption to the PoE devices. By utilizing a Passive PoE strategy, the cost and efficiency may be increased in the PoE network. In massively deployed ethernet appliances such as remote security cameras, a low cost method of power delivery is an important design constraint. Additionally, as is often the case with ideal solutions, reducing waste, can in addition improve LCA (Life Cycle Analysis) green efficiency/performance.

Passive PoE Injectors, can power all types of Splitters regardless of type, or handshaking protocol.

Another area of positive benefit of Passive PoE is the many proprietary non-802.3 compliant splitters used in the 30W to 75W output power range. Many of these splitters are incompatible with injectors from other companies. By using a Passive injector for high power, these handshaking method incompatibilities are prevented. However, it is critical to point out that the use Passive PoE at highest power level permitted by the 802.3 standard (100W) can have associated with it some risk of overcurrent in the ethernet cabling system.

The 802.3 standard, requires that if high power is delivered from the injector, the 4 wire pair concept (using 8 wires), balance out the current load between each of the 4 pairs, to prevent ethernet cable heating issue, and mitigate safety risk. Additionally, each of the sets of 2 pairs is required to be protected by separate current limiter circuits in the Injector. The 802.3 current limiter circuit requirements, are fast current limiting at well-defined levels (as per the standard), which will essentially prevent any sort of risk in the ethernet cabling. Therefore if a passive PoE Injector is used, it is important that the output pairs have well controlled current limiting. Preferably, 2 sets of current limiting circuits for the 2 sets of pairs of conductors.

Versions of the 802.3 PoE Standard:

IEEE 802.3af-2003 is the original version of the ethernet standard which included PoE, this version limited available power to 15.4W at the input to the splitter, with an assumed output power from the splitter of approximately 12.5W. Note, Globtek makes an 18W rated injector for this output power application range.

In 2009 the PoE+ or PoE Plus standard was devised as a way of allowing more power transfer thru the ethernet cable. This version is titled IEEE 802.3at-2009, and devices compliant with this version of the standard may provide up to 25.5W at the input to the splitter, and an assumed output power of approximately 21W. However with the use of a higher power injector, such as a Globtek 36W model, it is possible for the splitter to provide 25W of output power, assuming a 0.85 efficiency factor for the CAT cable, and a 0.80 efficiency factor for the splitter power conversion.

Following the 2009 version of the standard, higher power delivery was being done by various Injector manufacturers using proprietary techniques, utilizing all 8 conductors of the cable. Eventually in 2012 there was an attempt to standardize the newer methods to allow up to 100W to be delivered form the injector, providing it could also comply with the LPS (Low Power Source) criteria in IEC 60950-1 and UL 1310.

In order to allow multi-port PoE enabled routers using end-point injection to have an accurate method to gauge the total power to be consumed by the various PoE devices, it was decided that the PoE standard would be modified to include digital serial communications of matrixes of information back and forth between the Injector and Splitter, to precisely define available power (from the injector) and required power (from the splitter). This serial communications is occurring on the Data Link Layer. The older, lower power

method used the Physical Layer, which was a far simpler and less precise method of handshaking between Injector and Splitter.

The 2012 version of the standard, (referred to as IEEE 802.3-2012) also formally defined the above method of supplying up to 100W of power to the splitter by utilizing all 8 wires for DC power delivery, while simultaneously using the same 8 wires for high speed Gigabit data communications. (Note the earlier versions of the 802.3 standard allowed only 4 of the 8 wires to be used for power transmission.)

Globtek PoE Product Offerings November, 2016:

All Injectors rated for 90-264Vac input, and have International Patent Pending Green Design, compliant to DoE Efficiency Level VI requirements for both No Load power consumption and 4 point Average Efficiency.

All products have a 90-264Vac input, and a 56Vdc nominal output voltage at the injector, there are 3 fundamental power classes/builds:

1) 18W Output GT-96180 series
2) 36W Output GT-96360 series
3) 70W Output GT-96700 series

The 18W and 36W use the same physical size plastic housings. Two mechanical format options exist:

a. Desktop configuration, with integral wall mounting tabs/wings
b. Direct Wall Plug-in, with modular/replaceable AC country plugs

The 70W plastic housing is larger, and is only available as a desktop configuration housing.

Desktop housing products have optional IEC320 inlet capability, as Class I or Class II.

IEC 320 inlet types: C6, C8, C14 (standard) and C18.

All models are available as either Active or Passive power delivery method.

The 18W series is also available with 18Vdc, 24Vdc, 36Vdc or 48Vdc Passive Configuration output, for dedicated short length cable powering of specialized devices using ethernet cabling.

Model	Type	Input Voltage	Watts	Vout	Efficiency	Technology
 GT-91080 Af type PoE Splitter	Desktop/External GT-91080, Af type PoE Splitter, Desktop/External, Power Over Ethernet Powered Device Converter (IEEE802.3af PoE PD) Power Supply AC Adaptor, , Input Rating: 36-60 VDC, , Output Rating: 12 Watts, 5-24V in 0.1V increments, Approvals:	36-60 VDC	12	5-24 V		Power Over Ethernet Powered Device Converter (IEEE802.3af PoE PD) Power Supply AC Adaptor
Request Info						
 GT-91087 POE PD Module DC/DC	PCB Mounted/DIP GT-91087, POE PD Module DC/DC, PCB Mounted/DIP, Power Over Ethernet Powered Device Converter (IEEE802.3af PoE PD) Power Supply AC Adaptor, , Input Rating: 36-60 VDC, , Output Rating: 15.4 Watts, 5-24V in 0.1V increments, Approvals:	36-60 VDC	15.4	5-24 V		Power Over Ethernet Powered Device Converter (IEEE802.3af PoE PD) Power Supply AC Adaptor

DC/DC

Request Info

Model	Type	Input Voltage	Watts	Vout	Efficiency	Technology
 GT-96180-WWVV-T3-PP PoE, Passive Power Injector Agency Documents Request Info	Desktop/External GT-96180-WWVV-T3-PP, PoE, Passive Power Injector, Desktop/External, Single Port Power Over Ethernet Midspan (IEEE802.3af PoE PSE), , Input Rating: 100-240V~, 50-60 Hz, IEC 60320/C14 AC Inlet Connector, Class I, Earth Ground, Output Rating: 18 Watts, 18-56V in 0.1V increments, Approvals: CB Patent US9838207B2 CE China RoHS Level VI PSE RoHS Ukraine VCCI WEEE Class I ETL S-Mark CB CB	100-240V~, 50-60 Hz	18	18-56 V	VI	Single Port Power Over Ethernet Midspan (IEEE802.3af PoE PSE)
 GT-96180-18VV-T2-PP PoE, Passive Power Injector Agency Documents Request Info	Desktop/External GT-96180-18VV-T2-PP, PoE, Passive Power Injector, Desktop/External, Single Port Power Over Ethernet Midspan (IEEE802.3af PoE PSE), , Input Rating: 100-240V~, 50-60 Hz, IEC 60320/C8 AC Inlet connector, Class II, Non-Earth Ground (aka "Figure-8"), Output Rating: 18 Watts, 18-56V in 0.1V increments, Approvals: CB EAC WEEE VCCI Ukraine China RoHS RoHS Level VI CE Double Insulation CB PSE ETL S-Mark CB	100-240V~, 50-60 Hz	18	18-56 V	VI	Single Port Power Over Ethernet Midspan (IEEE802.3af PoE PSE)
 GT-96180-1856-T3-AP PoE, Active Power Injector Agency Documents Request Info	Desktop/External GT-96180-1856-T3-AP, PoE, Active Power Injector, Desktop/External, Single Port Power Over Ethernet Midspan (IEEE802.3af PoE PSE), , Input Rating: 100-240V~, 50-60 Hz, IEC 60320/C14 AC Inlet Connector, Class I, Earth Ground, Output Rating: 18 Watts, 56V in 0.1V increments, Approvals: CB EAC Level VI ETL CB S-Mark WEEE VCCI RoHS PSE China RoHS CE CB	100-240V~, 50-60 Hz	18	54-56 V	VI	Single Port Power Over Ethernet Midspan (IEEE802.3af PoE PSE)

RoHS PSE China RoHS CE CB

Model	Type	Input Voltage	Watts	Vout	Efficiency	Technology
 GT-96180-1856-T2-AP PoE, Active Power Injector Agency Documents Request Info	Wall Plug-in+Desktop Combination GT-96180-1856-T2-AP, PoE, Active Power Injector, Wall Plug-in+Desktop Combination, Single Port Power Over Ethernet Midspan (IEEE802.3af PoE PSE), , Input Rating: 100-240V~, 50-60 Hz, IEC 60320/C8 AC Inlet connector, Class II, Non-Earth Ground (aka "Figure-8"), Output Rating: 18 Watts, 56V in 0.1V increments, Approvals: CB Patent US9838207B2 EAC WEEE VCCI Ukraine CE RoHS China RoHS Level VI Double Insulation CB PSE ETL S-Mark CB	100-240V~, 50-60 Hz	18	56 V	VI	Single Port Power Over Ethernet Midspan (IEEE802.3af PoE PSE)
 GT-96300-36VV-T3-PP PoE, Passive Power Injector Agency Documents Request Info	Desktop/External GT-96300-36VV-T3-PP, PoE, Passive Power Injector, Desktop/External, Single Port Passive Power Over Ethernet Midspan (Passive/Dumb PoE PSE) Power Supply AC Adaptor, , Input Rating: 100-240V~, 50-60 Hz, IEC 60320/C14 AC Inlet Connector, Class I, Earth Ground, Output Rating: 36 Watts, 18-56V in 0.1V increments, Approvals: CE CB PSE EAC Patent US9838207B2 CB China RoHS Class I Level VI RoHS Ukraine VCCI WEEE CB PSE	100-240V~, 50-60 Hz	36	18-56 V	VI	Single Port Passive Power Over Ethernet Midspan (Passive/Dumb PoE PSE) Power Supply AC Adaptor
 GT-96300-3656-T3-AP	Desktop/External GT-96300-3656-T3-AP, PoE, Active Power Injector, Desktop/External, Gigabit Power over Ethernet (IEEE802.3at PoE PSE) Power Supply AC Adaptor, , Input Rating: 100-240V~, 50-60 Hz, IEC 60320/C14 AC Inlet Connector, Class I, Earth Ground, Output Rating: 36	100-240V~, 50-60 Hz	36	56 V	VI	Gigabit Power over Ethernet (IEEE802.3at PoE PSE) Power Supply AC Adaptor

PoE, Active Power Injector
Agency Documents
Request Info

Ground, Output Rating: 30 Watts, 56V in 0.1V increments, Approvals: CB Patent US9838207B2 EAC PSE Level VI Ukraine CE CB WEEE VCCI China RoHS RoHS CB

Model	Type	Input Voltage	Watts	Vout	Efficiency	Technology
 GT-96300-3656-T2-AP (Desktop, non Hybrid) PoE, Active Power Injector Agency Documents Request Info	Desktop/External GT-96300-3656-T2-AP (Desktop, non Hybrid), PoE, Active Power Injector, Desktop/External, Gigabit Power over Ethernet (IEEE802.3at PoE PSE) Power Supply AC Adaptor, , Input Rating: 100-240V~, 50-60 Hz, IEC 60320/C8 AC Inlet connector, Class II, Non-Earth Ground (aka "Figure-8"), Output Rating: 36 Watts, 56V in 0.1V increments, Approvals: CB Patent US9838207B2 EAC PSE CE China RoHS RoHS Ukraine VCCI WEEE Double Insulation Level VI CB CB	100-240V~, 50-60 Hz	36	56 V VI		Gigabit Power over Ethernet (IEEE802.3at PoE PSE) Power Supply AC Adaptor
 GT-96600-7056-T3-AP ITE Power Supply Agency Documents Request Info	Desktop/External GT-96600-7056-T3-AP, ITE Power Supply, Desktop/External, Single Port Power Over Ethernet Midspan (IEEE802.3af PoE PSE), , Input Rating: 100-240V~, 50-60 Hz, IEC 60320/C14 AC Inlet Connector, Class I, Earth Ground, Output Rating: 70 Watts, 56V in 0.1V increments, Approvals: EAC CB S-Mark Level VI WEEE VCCI Patent US9838207B2 RoHS Class I China RoHS CE EAC Ukraine	100-240V~, 50-60 Hz	70	56 V VI		Single Port Power Over Ethernet Midspan (IEEE802.3af PoE PSE)

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