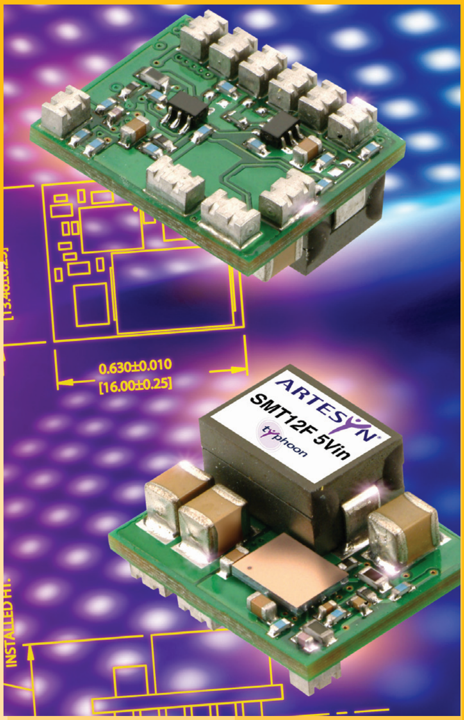
Caution Moisture-Sensitive

SMT12F 3.3V - 5Vin Single

Application Note 165



RoHS 2002/95/EC

ARTESYN®

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1. Introduction

There is an increasing demand for POL converters that maintain good regulation in the presence of very fast load transients (di/dt). This application note describes the features and functions of Artesyn Technologies' 5V, 12A series of non-isolated surface-mountable converter that is specifically designed to provide the designer with a modular solution for fast transient demands. POL converters that are not designed for this purpose leave no alternative to the customer other than to use excessive amounts of decoupling capacitance to try and supply these transients. These capacitors are expensive, take up a lot of room (quite often more than the POL converter), and can be unreliable. Our SMT12F range includes a number of specific features to overcome this issue and enables up to 300A/µs performance. See section 4.2.2 for more details regarding the transient performance capabilities of the SMT12F design.

The series has a 3V to 5.5VDC operating input voltage range and can operate over an ambient temperature range of -40ºC to +85ºC. The modules are fully protected against short-circuit and over-temperature conditions. Standard features include remote ON/OFF and remote sense.

Automated manufacturing methods, together with an extensive qualification program, ensure an extremely reliable design. These Point of Load modules are targeted at the fixed and mobile telecommunications, industrial electronics and distributed power markets.

Note: These devices have a moisture sensitivity level 3 rating in line with IPC/JEDEC J-STD-020C Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State surface mount devices.

2. Models

The SMT12F series comprises of 2 models, as listed in Table 1.

Model	Input Voltage	Output Voltage	Output Current
SMT12F-05W3V3J	3.0 - 5.5V	0.9 - 3.3V	12A

Table 1 - SMT12F Models

RoHS Compliance Ordering Information
The 'J' at the end of the part number indicates that the part is Pb-free (RoHS 6/6 compliant). TSE RoHS 5/6 (non Pb-free) compliant versions may be available on special request, please contact your local sales representative for details.

Note: The design is a buck converter for when Vin is 4.5V or lower, the maximum Vout is 2V.

V_{in}	V_{out}
4.5 - 5.5V	0.9 - 3.3V
< 4.5V	0.9 - 2.0V

Table 2 - Output Voltage Adjustment

2.1 Features

- High efficiency topology, typically 95% at 3.3Vout @ full load
- Wide ambient temperature range, -40°C to +85°C
- 0.9V to 3.3V output voltage adjustability
- No minimum load requirement
- Continuous short-circuit protection
- Over-temperature protection (OTP)
- Differential Remote Sense
- Output voltage adjust/trim
- Power Good
- Remote ON/OFF
- Separate digital inputs for +5% and -5% output voltage margining
- Available RoHS compliant

3. General Description

3.1 Electrical Description

The SMT12F design incorporates a proprietary control scheme that is specifically designed to offer an excellent transient response to step loads. This provides an extremely compact, fast, and accurate power delivery solution for low voltage applications that require fast transient responses to load steps of up to 300A/µs.

The POL topology is a non-isolated, three terminal buck converter. The output is adjustable over a range of 0.9V to 3.3V by means of an external resistor from trim pin to ground. The output voltage default is 3.3V, which can be trimmed down to any required setpoint within the range. See Section 9.1 for details.

The converter can be shut down via a remote ON/OFF input that is referenced to ground. This input is compatible with popular logic devices; an 'active Low' logic input is supplied as standard.

The converter is also protected against over-temperature conditions. If the converter is overloaded or the ambient temperature gets too high, the converter will shut down until the temperature falls below a minimum threshold. There is a thermal hysteresis of typically 105°C to 120°C PCB temperature, to protect the unit.

There is a requirement to place external capacitance on this design in order for it to meet the parameters as outlined in the datasheets. Please refer to Section 4.2 for specific details on what capacitance needs to be placed.

3.2 Physical Construction

The SMT12F is constructed using a multi-layer FR4 PCB. Heat dissipation of the power components is optimized, ensuring that control components are not thermally stressed.

The converter is an open-frame product and has no case or case pin. The open-frame design has several advantages over encapsulated closed devices. Among these advantages are:

- **Cost:** no potting compound, case or associated process costs involved.
- **Thermals:** the heat is removed from the heat generating components without heating more sensitive, less tolerant components.
- **Environmental:** some encapsulants are not kind to the environment and create problems in incinerators. Further more open-frame converters are more easily re-cycled.
- **Reliability:** open-frame modules are more reliable for a number of reasons, including improved thermal performance and reduced TCE stresses.

A separate paper discussing the benefits of open-frame DC/DC converters (Design Note 102) is available at www.artesyn.com

4. System Interface Information

4.1 Input Characteristics
The SMT12F series has an input voltage range of 3 to 5.5 volts. The wide input voltage range gives designers more flexibility in choosing a power source to operate the converter. When Vin is 4.5V or lower, the maximum Vout is 2.0V.

4.1.1 Reflected Ripple Current
Because of the switching operation of the design, there is an AC current generated at the input of the unit. This is referred to as input reflected ripple current.

The typical ripple current for the SMT12F is typically 20mA rms at full load, with the output set to 3.3V.

4.1.2 Input Source Impedance and Input Capacitance
The SMT12F must be connected to a low AC source impedance. High source inductance can affect the loop stability. The unit does not require external input capacitance to operate. However in a test environment it may be necessary to include an external input capacitor to ensure the output source impedance of the bench power supply is less than that of the input impedance to the unit under test. Any input capacitance should be placed close to the converter-input pins to decouple distribution inductance. The external input capacitors must be chosen for suitable ripple current rating. Electrolytic capacitors should be avoided. Recommended input capacitors are ceramics such as 10µF 10V 1210 or similar.

4.2 Output Characteristics and Output Capacitance
The SMT12F has been designed for stable operation with a requirement for external capacitance at the output terminals. We recommend a minimum of 5 x 22µF low ESR ceramic caps. However, when powering loads with dynamic current requirements, improved voltage regulation can be obtained by inserting extra capacitors as close as possible to the load. The most effective technique is to locate low ESR ceramic capacitors (for example 22µF or greater GRM series from Murata or similar) as close to the load as possible. These ceramic capacitors will handle the short duration high frequency components of the dynamic current requirement.

It is equally important to use good design practices when configuring the DC distribution system. Low resistance and low inductance PCB layout traces should be utilized, particularly in the high current output section. Remember that the capacitance of the distribution system and the associated ESR are within the feedback loop of the power module. This can have an effect on the module's compensation capabilities and its resultant stability and dynamic response performance. With large values of capacitance, the stability criteria depend on the magnitude of the ESR with respect to the capacitance. As much of the capacitance as possible should be outside the remote sensing loop and close to the load.

Note that the maximum rated value of output capacitance for all models is 10,000µF. Contact your local Artesyn Technologies representative for further information if larger output capacitance values are required in the application.

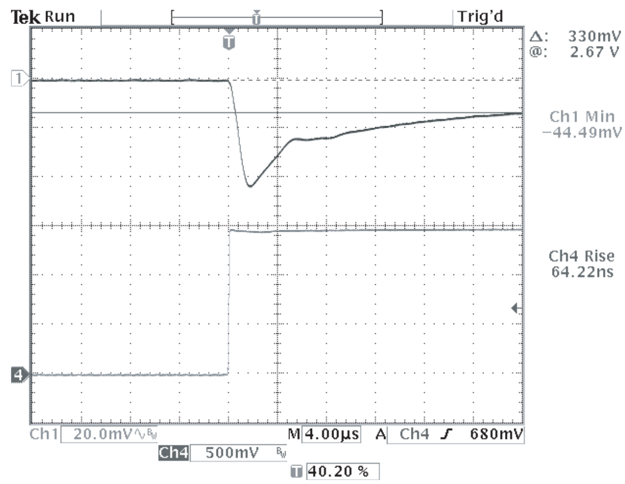
4.2.1 Converter Stability
The SMT12F series has been designed to meet minimum criteria of 45° at unity gain over line and load operating conditions. The topology of the design ensures it is unconditionally stable regardless of duty cycle.

4.2.2 Transient Response
Because of the difficulty for many electronic loads to generate high di/dt's an evaluation card has been specifically designed to demonstrate the fast transient response capability of the SMT12F. An external circuit allows the user to program the rate of change of current on the output of the unit under test. Two potentiometers on the evaluation board can be independently set to demonstrate the response (both sinking and sourcing) of the module for their particular load step requirements. Test cards are available on request, please contact your Artesyn Technologies representative for assistance.

The SMT12F has been specifically designed to provide the designer with a modular solution for fast transient demands. Step load di/dt's of up to 300A/µs can be accommodated by this design. Transient response plots are repeated in Figures 1 and 2.

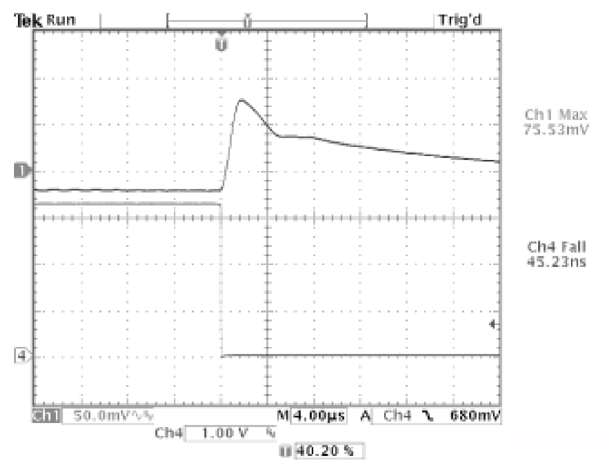
Figure 1 - Typical Transient Response (source)
6A load Step di/dt = 100A/µs
Channel 1: Deviation on unit = 3%, Settling Time = 12µs
Vin = 5V, Vout = 1.5V

Figure 2 - Typical Transient Response (sink)



12A load Step di/dt = 300A/µs-1
Channel 1: Deviation on unit = 2.3%, Settling Time = 16µs
Vin = 5V, Vout = 1.5V

The deviation and recovery time will be dependant on the load step



applied to the unit and the rate of change of that load step. A summary of the typical performance is included in table 2 below.

Vout	Load Step	di/dt (A/µs)	Deviation (mV) Source	Recovery Time (µs)	Deviation (mV) Sink	Recovery Time (µs)
3.3	0 to 12A	300	103	12	75	16
3.3	0 to 12A	200	100	12	75	16
3.3	0 to 12A	100	100	12	75	16
3.3	0 to 12A	25	100	12	75	16
3.3	0 to 12A	10	90	12	70	16
2.5	0 to 10A	200	73	12	57	12
2.0	0 to 10A	150	58	10	45	10
1.8	0 to 8A	150	53	10	41	10
1.5	0 to 6A	100	44	12	32	10
1.5	0 to 6A	50	44	12	32	10
1.5	0 to 6A	10	42	12	28	10
1.2	0 to 4.8A	100	35	10	33	10
1.0	0 to 4A	100	30	10	25	10
0.9	0 to 3.6A	100	27	8	25	8

Table 2 - Typical Performance

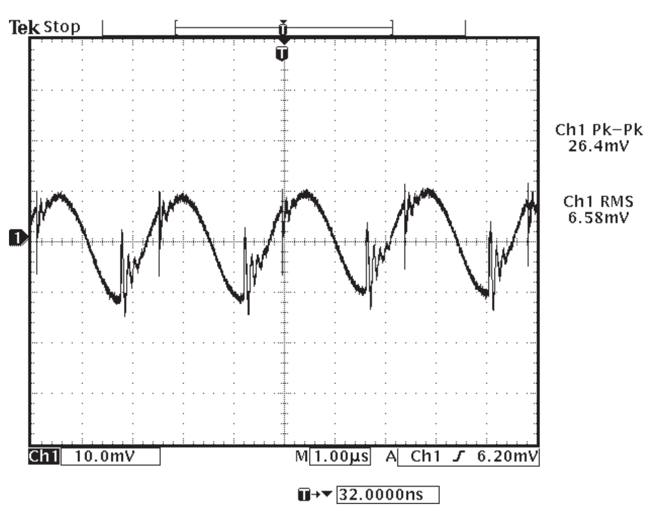
4.2.3 Ripple and Noise

A typical noise measurement is outlined in Figure 3. When measuring output ripple and noise, a 50½ coaxial cable with a 50½ termination resistor should be used to prevent impedance mismatch reflections disturbing the noise readings at higher frequencies.

Figure 3 - Ripple and Noise Measurement
Vin=5V, Vout=3.3V, Iout=12A

4.3 EMC

The SMT12F range has been designed to comply with the EMC requirements of EN61000. It has been tested and has passed radiated noise immunity (EN61000-4-3) and conducted noise immunity (EN61000-4-4)



both with normal performance.

5. Mechanical Information

5.1 Mechanical Outline Drawing

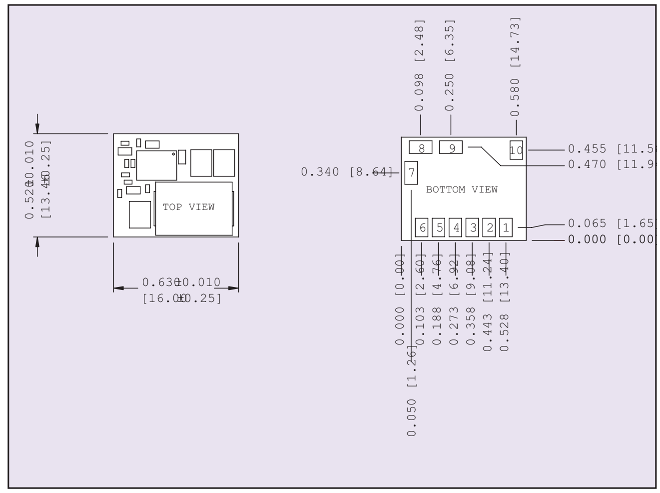


Figure 4 - Mechanical Outline

5.2 Pin-out Table

PIN CONNECTIONS	
PIN NUMBER	**FUNCTION**
1	Trim
2	Margin+
3	Remote ON/OFF
4	Margin-
5	$+V_{sense}$
6	$-V_{sense}$
7	$+V_{out}$
8	Ground
9	$+V_{in}$
10	Power Good

Table 3 - Pin Connections

5.3 Pin Description

5.3.1 Trim

A 1% 0.1W resistor must be directly connected between this pin and pin 8 (GND) to set the output voltage to a lower value than 3.3V. The temperature stability of the resistor should be 100 pm/°C or better. The set point range is from 3.3V to 0.9V. If left open circuit the output voltage will default to 3.3V. See Section 9.1 for further details.

5.3.2 Margin +

When this input is asserted to high, the output voltage is increased by 5%. This function is independent of trim and sense. See Section 9.5 for further details.

5.3.3 Remote ON/OFF

Applying a high level ground signal to this input disables the module's output and turns off the output voltage. When the Remote ON/OFF control is active, the input current drawn by the regulator is significantly reduced. If the Remote ON/OFF pin is left open-circuit, the module will produce an output whenever a valid input source is applied.

5.3.4 Margin-

When this input is asserted high, the output voltage is decreased by 5% from the nominal. This function is independent of trim and sense. See Section 9.5 for further details.

5.3.5 V_{sense+}

The sense input allows the regulation circuit to compensate for voltage drop between the module and the load. For optimal voltage accuracy

Vo Sense should be connected to Vout node of the bypass capacitor. It can also be left disconnected. See Section 9.3 for further details.

5.3.6 V_{sense-}
The Vsense should be connected to the ground of a bypass capacitor near the load or left open circuit. See Section 9.3 for further details.

5.3.7 V_{out}
The regulated positive power output with respect to the GND node.

5.3.8 GND
This is the common ground connection for the Vin and Vout power connections. It is also the 0VDC reference for the control inputs.

5.3.9 V_{in}
The positive input voltage power node to the module,which is referenced to common GND.

5.3.10 Power Good
This pin indicates the status of the output voltage. Power Good is driven low if output voltage deviates outside of specified limits.

5.4 Pin Composition
The specially designed surface mount links provide mechanical, electrical and thermal connection between the converter and application. They are constructed from a high conductivity alloy giving superior electrical and thermal connection. The geometry of the link ensures high shear strength when soldered, while meeting coplanarity specification of 100μm. The links are plated with a 90/10 tin/lead electroplate over a nickel barrier layer.

5.5 PCB Layout Information
The PCB acts as a heat sink and draws heat from the unit via conduction through the pins and through radiation. The end user must ensure that other components and metal in the vicinity of the SMT12F meet the spacing requirements to which the system is approved. Low resistance and low inductance PCB layout traces should be used where possible, particularly when high currents are flowing (e.g. the output side). A low impedance track should connect input ground and output ground to maximize efficiency of the unit. See section 11.5 for the recommended land patterns.

6. Packaging Information

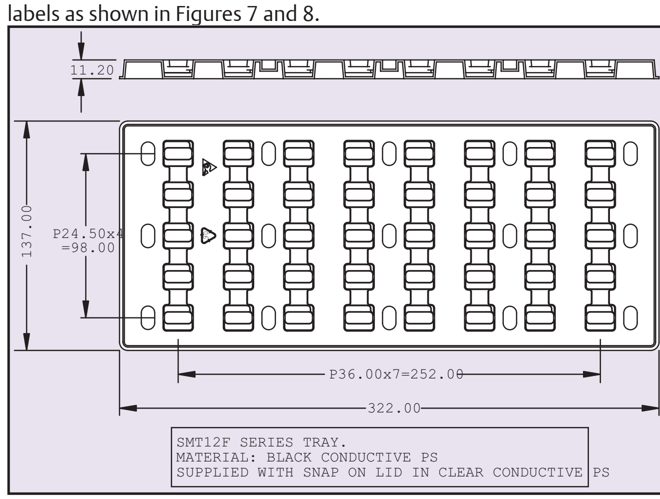
6.1 Packing
The SMT12F is available in trays of 40. Tray dimensions are shown in Figure 5.

Figure 5 - Tray

6.2 Labels and Part Numbering Sequence
All units in the series will be clearly marked to allow ease of identification for the end user. Figure 6 gives details of all the models.

Figure 6 - Part Numbering

6.3 MSL Classification Labels
Both the individual trays and inner box carry moisture identification labels as shown in Figures 7 and 8.



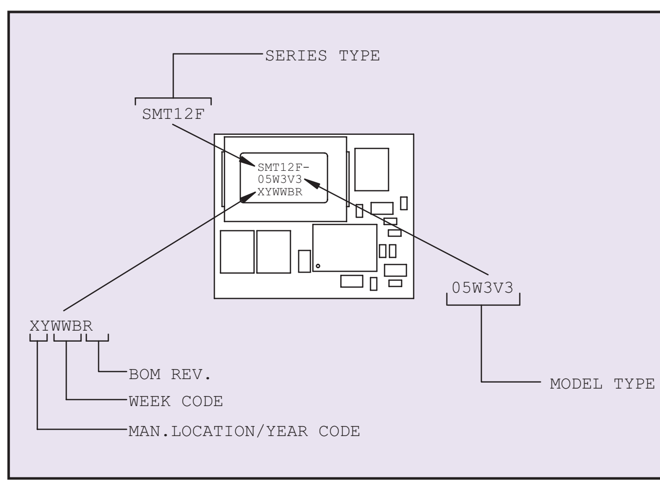
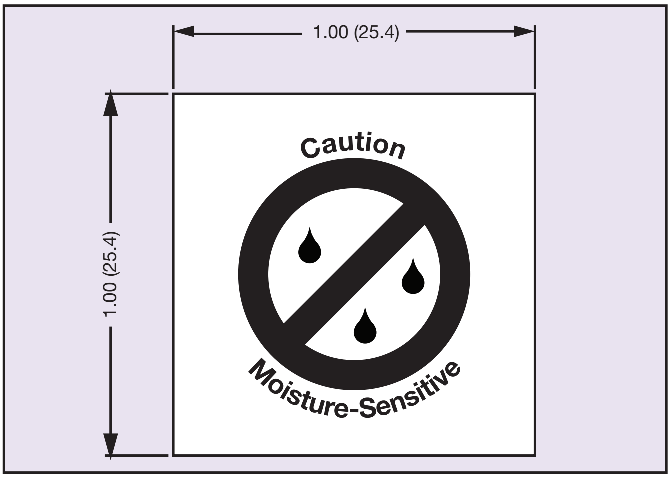


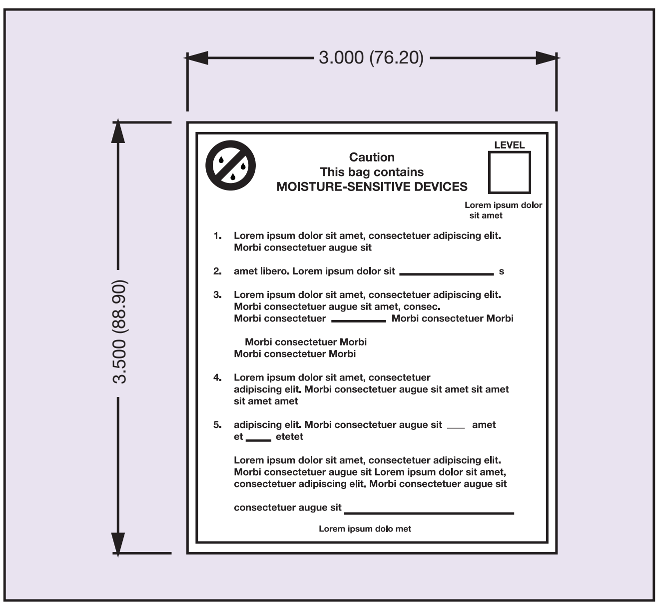
Figure 7 - Moisture Identification Label that goes on the Inner Box

Figure 8 - Caution Label that goes on the Moisture barrier bag for each tray

7. Safety Information



7.1 Safety Standards and Approvals
All models have full international safety approval including EN60950 and UL/cUL1950. Please refer to the datasheet for file numbers.



7.2 Fuse Information
In order to comply with safety requirements the user must provide a fuse in the unearthed input line. This is to prevent earth being disconnected in the event of a failure. A 10A amp fast blow fuse should be used. Recommended fuse: Bussman ABC-V-10.

7.3 Safety Considerations
The converter must be installed as per guidelines outlined by the various safety agency approvals, if safety agency approval is required for the overall system.

8. Operating Information

8.1 Over-temperature Protection (OTP)
The SMT12F is equipped with non-latching over-temperature protection. A temperature sensor monitors the internal IC temperature. If the temperature exceeds a threshold of Tj 150°C (typical) the converter will shut down, disabling the output. When the case temperature has decreased by between 20°C and 30°C the converter will automatically restart.

The unit may experience over-temperature conditions during a persistent overload on the output. Overload conditions can be caused by external faults. OTP might also be entered due to a loss of control of the environmental conditions (e.g. an increase in the converter's ambient temperature due to a failing fan).

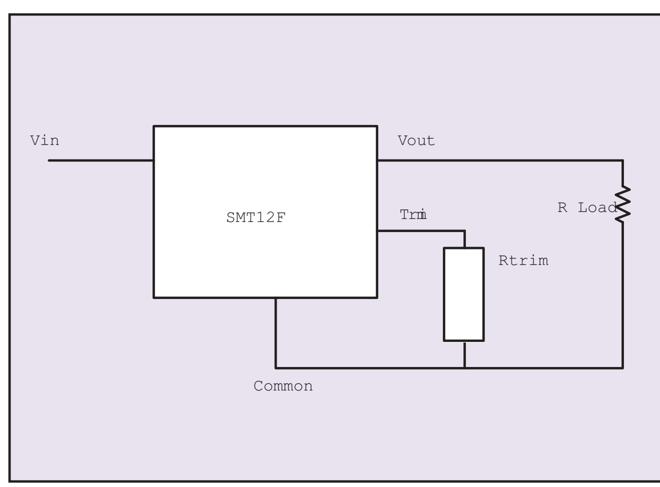
8.2 Short Circuit Protection
In the event of a short circuit the unit will enter a fault protection mode. Once the source of the short circuit has been removed the unit will auto-recover, and will remain undamaged while in a short circuit mode. This design is protected only against extreme short circuits. The unit is protected in an over-load condition by an over-temperature protection device. However we do not recommend operating this unit in a heavy over-load condition as it may reduce the lifetime of the converter.

9. Feature Set

9.1 Trimming the Output Voltage
The SMT12F-05W3V3J has a factory setpoint default of 3.3V. The setpoint can be set by the user, to any required voltage down to 0.9V. When trimmed down by the user, the unit can deliver an output load of up to 12Amps. This can be achieved placing an external resistor between Trim pin and Ground as demonstrated in Figure 9.

Figure 9 - Output Trim-up Resistor to Ground

Where Rtrim is the resistor placed between trim pin and ground, and Vout is the resultant output setpoint.



V_{OUT}	$R_{trim\ down}$ (K½)
0.9	41.60
1.0	48.25
1.2	63.40
1.5	92.70
1.8	133.8
2.0	171.9
2.5	352.6
3.3	Open

Table 4 - Trim Resistor Table (SMT12F-05W3V3J)

Above is a table of resistors that can be used to trim some standard voltage output setpoints.

Rtrim for the SMT12F-05W3V3J model can be calculated from the following formula:

Care needs to be taken when placing the external trim resistor. Poor grounding on the layout for this resistor may result in an increase of load regulation for the unit. The resistor should be placed directly between the trim pin and respective pin in use of the unit.

9.2 Remote ON/OFF

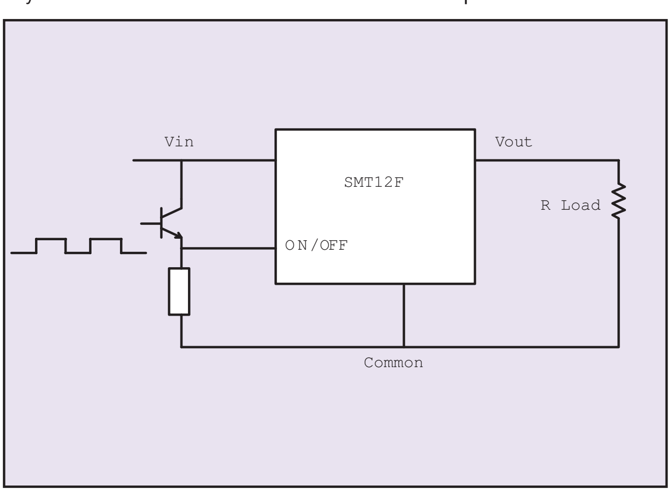
The remote ON/OFF input allows external circuitry to put the SMT12F converter into a low dissipation sleep mode. In this mode the input current is approximately 5mA for 5Vin. Active-low remote ON/OFF is available as standard. If the remote ON/OFF pin is low, or left floating, the unit will power up as normal. Pulling the pin high will turn off the unit.

$$R_{set} = \frac{110 \times V_{out}\ (Desired)}{3.28 - V_{out}\ (Desired)}\ k\Omega$$

This signal has TTL compatible threshold levels.

To simplify the design of the external control circuit, logic signal thresholds are specified over the full temperature range. The maximum remote ON/OFF input open circuit voltage, as well as the acceptable leakage currents, are specified in the short form datasheet. The remote ON/OFF input can be driven as described in Figure 10.

Figure 10 - Remote ON/OFF



9.3 Remote Sense

The remote sense compensation feature minimises the effect of resistance in the distribution system and facilitates accurate voltage regulation at the load terminals or another selected point. The remote sense line will carry very little current and hence does not require a large cross-sectional area. However, if the sense line is routed on a PCB, it should be located close to a ground plane in order to minimise any noise coupled onto the lines that might impair control loop stability. A small 100nF ceramic capacitor can be connected at the point of load to decouple any noise on the sense wires. The module will compensate for a maximum drop of 10% of the nominal output voltage. However, if the unit is already trimmed up, the available remote sense compensation range will be correspondingly reduced. Remember that when using remote sense compensation all the resistance, parasitic inductance and capacitance of the distribution system are incorporated into the feedback loop of the power module. This can have an effect on the module's compensation capabilities, affecting its stability and dynamic response.

9.4 Parallel and Series Operation

Because of the tight load regulation of this design, parallel operation of multiple converters is not recommended. If unavoidable, some de-coupling technique must be incorporated onto the user's design. It should be noted that this measure would adversely effect power conversion efficiency. However, a load sharing can be supplied as a standard modification if required. This version will allow the user to operate units in parallel for larger load requirements. Please contact your local Artesyn Technologies representative for details.

In some applications converters can be connected in series to obtain a higher output voltage. However this unit is not designed for such operation, not even with another SMT12F and in doing so may result in a catastrophic failure mode of the SMT12F. In such a case case, the load will pull current through the NMOS body diode of the low side switch. Pulling many amps of current through the body diodes, especially for extended periods of time, is obviously not recommended and might have a measurable impact on device reliability.

9.5 Margin Up and Down

The margin up and margin down pins support voltage margining of the module's voltage by a fixed percentage. When the margin+ pin is pulled high the nominal output voltage is increased by 5%. When the margin- pin is pulled high the nominal voltage is decreased by 5%. When both pins are pulled LOW, the module regulates to its nominal output voltage.

9.6 Power Good

This control signal indicates the status of the output voltage. When the voltage is within regulation this pin is HIGH. In the event of the output voltage going outside of regulation the output is driven LOW.

9.7 UVLO

An undervoltage lockout feature protects the regulator and its load when the supply voltage falls below 2.5 V. If this occurs the module is disabled. Normal operation is resumed if the supply voltage rises above 2.8 V.

10. Thermal Information

10.1 Thermal Reference Point

The electrical operating conditions determine how much power is dissipated within the converter. The following parameters further influence the thermal stresses experienced by the converter:

- Ambient temperature
- Air velocity
- Thermal efficiency of the end system application
- Parts mounted on system PCB that may block airflow
- Real airflow characteristics at the converter location

The maximum acceptable temperature measured at the thermal reference points is 100°C. A thermal reference point is shown in Figure 11.

Figure 11 - Thermal Reference Point Location

10.2 Thermal Derating Curves

Thermal characterisation data is presented here in Figures 12, 13, 14, 15, 16 and 17. These derating graphs show the load current versus the ambient air temperature and velocity, and the maximum safe operating area (SOA) for various line and output setpoint set-ups. The SOA was calculated by noting the case temperature of all components on the unit and applying our derating to each part. The air velocity is in the direction indicated by the arrow in Figure 11.

Figure 12 - Thermal Derating Curves (Vin = 5V , Vout = 3V3)

Figure 13 - Thermal Derating Curves (Vin = 5V0 , Vout = 2V5)

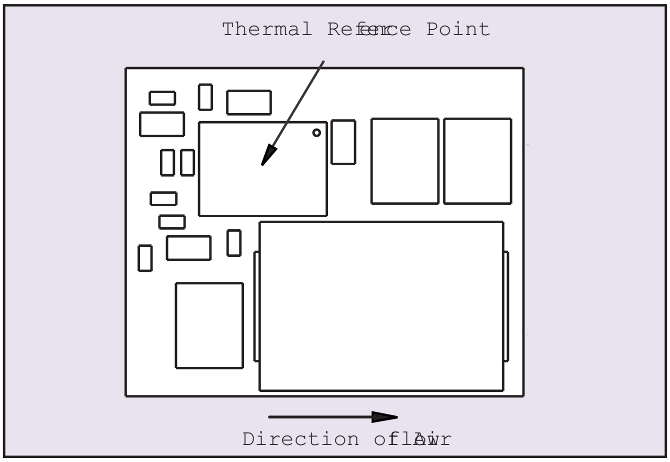


Figure 14 - Thermal Derating Curves (Vin = 5V0 , Vout = 2V0)

Figure 15 - Thermal Derating Curves (Vin = 5V0 , Vout = 1V5)

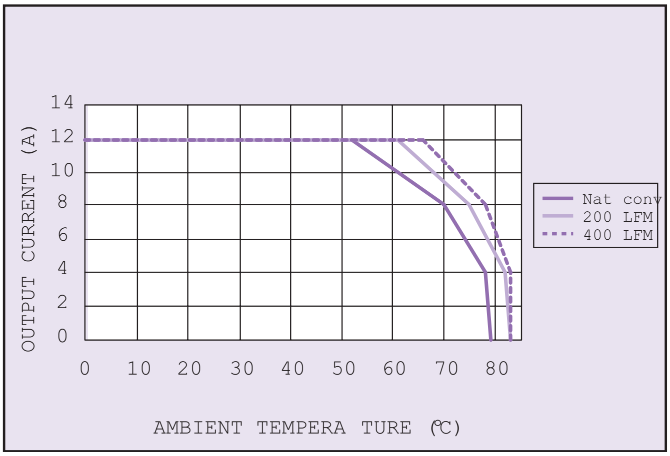


Figure 16 - Thermal Derating Curves (Vin = 3V3 , Vout = 2V5)

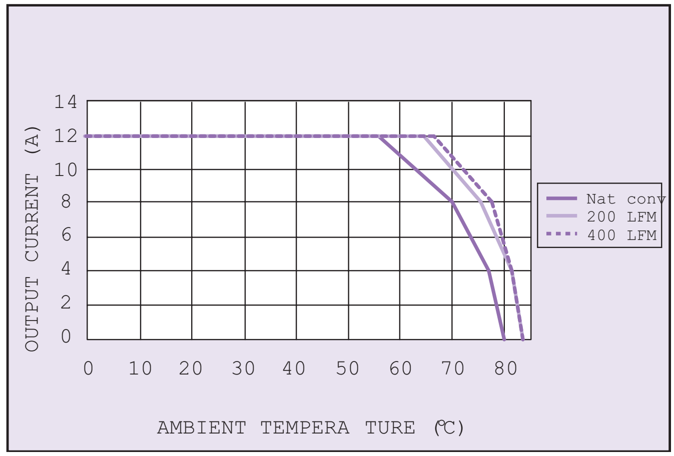
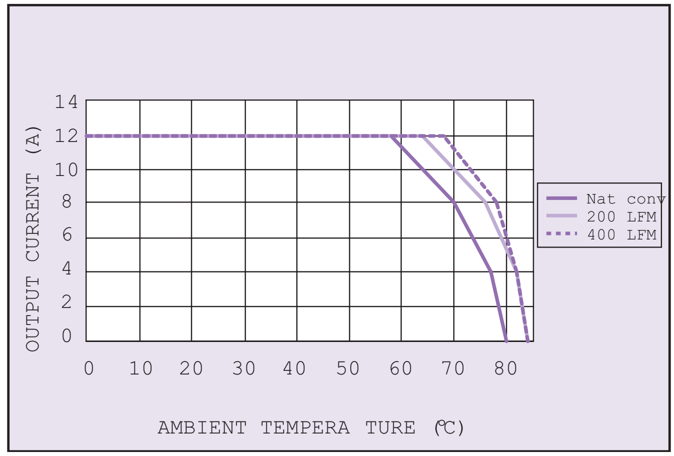
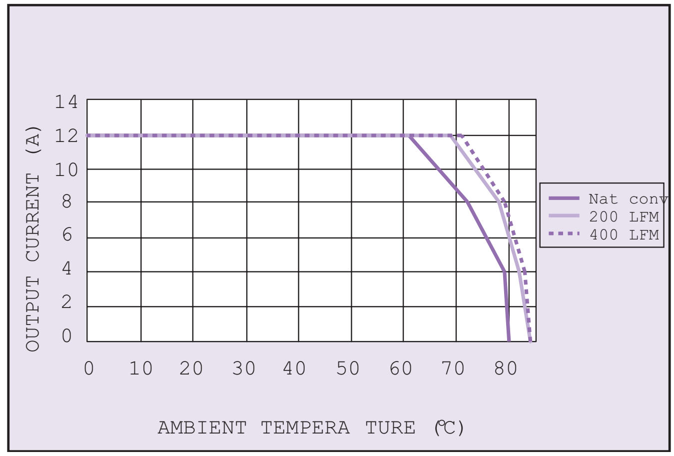


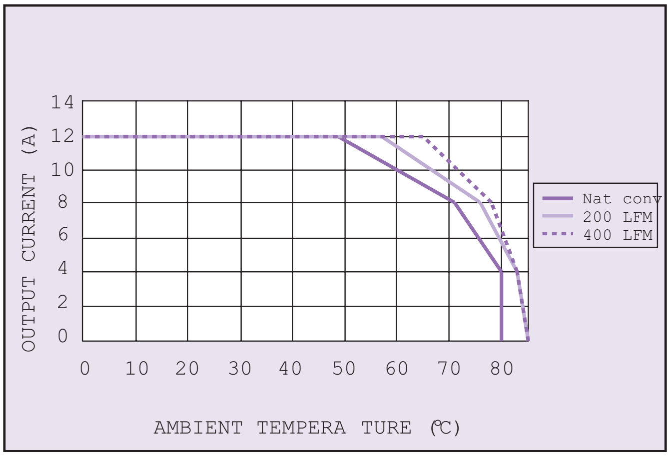
Figure 17 - Thermal Derating Curves (Vin = 3V3 , Vout = 1V5)



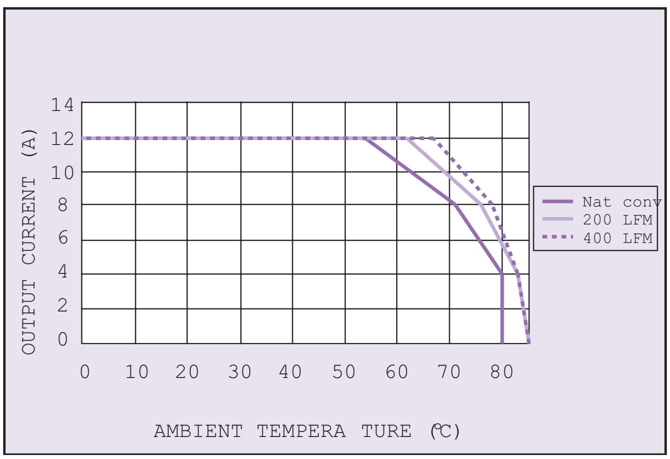


10.3 Thermal Test Set-up

All of the data was taken with the converter soldered to a test board, which closely represents a typical application. The test board is a 1.6mm, eight layer FR4 PCB with the inner layers consisting of 2oz power and ground planes. The top and bottom layers contain a minimal amount of metalization. A board to board spacing of 1 inch was used. The data represented by the 0 m/s curve indicates a natural convection condition i.e. no forced air. However, since the thermal performance is heavily dependent upon the final system application, the user needs to ensure the thermal reference point temperatures are kept within the



recommended temperature rating. It is recommended that the thermal reference point temperature be measured using either AWG #36 or #40



gauge thermocouples or an IR camera. In order to comply with stringent Artesyn derating criteria, the ambient temperature should never exceed 85°C. Please contact Artesyn Technologies for further support.

11. Use in a Manufacturing Environment

11.1 ESD Requirements

All units are manufactured in an ESD controlled environment and supplied in conductive packaging to prevent ESD damage occurring before or during shipping. It is essential that they are unpacked and handled using approved ESD control procedures. Failure to do so may affect the lifetime of the converter.

11.2 Soldering Requirements

The SMT12F is an open-frame power module manufactured with conventional surface mount technology using 62/36/02 with no-clean flux.

The SMT interconnect pins are a copper alloy with a solderable coating to prevent corrosion and ensure good solderability and shelf life. The coating is tin-lead with a nominal alloy composition of 90/10. This solder layer melts close to 183ºC. During soldering the lead temperatures must exceed this by approximately 30ºC to ensure a reliable solder joint.

Due to the fact that components with high thermal capacity such as the SMT12F may be slower to heat up than typical SMT parts, it may be necessary to customise the solder reflow profile. In doing this, customers need to be cognisant of the process limitations of other relevant components. The temperature of each SMT interconnect lead will vary during reflow due to differences in internal components, PCB lands and connecting paths. +Vout is a good choice for conservative temperature measurement, because it is typically connected to heavy copper paths. Figure 16 shows the recommended temperature of the +Vout pin during a typical reflow profile. The SMT12F is compatible with convection soldering using common solder alloys such as 63/37 and 62/36/02.

Figure 18 - Solder Reflow Profile per CECC 00802

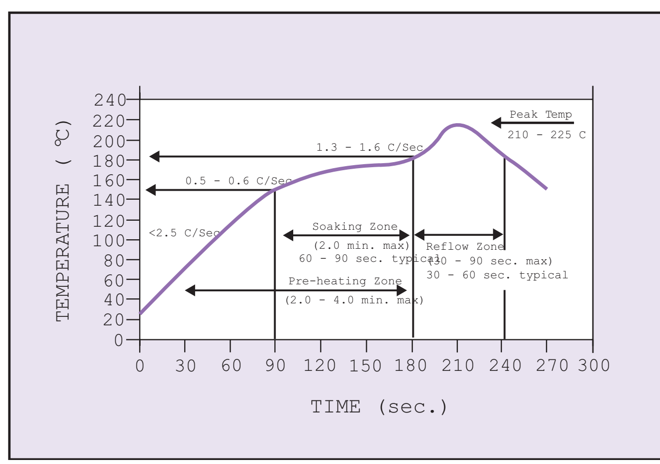
11.3 Coplanarity

The SMT12F has a maximum co-planarity as defined by JESD22B108 of better than 100μm (approximately 0.004”). Innovative design, interconnect technology, and specialised manufacturing processes ensure product integrity.

11.4 Paste Height/Coverage

Good quality solder joints have been demonstrated using a (0.006 inch) stencil.

11.5 Recommended Land Pattern



It is recommended that the customer use a solder mask defined land pattern similar to that shown in Figure 19.

Figure 19 - Recommended Land Pattern

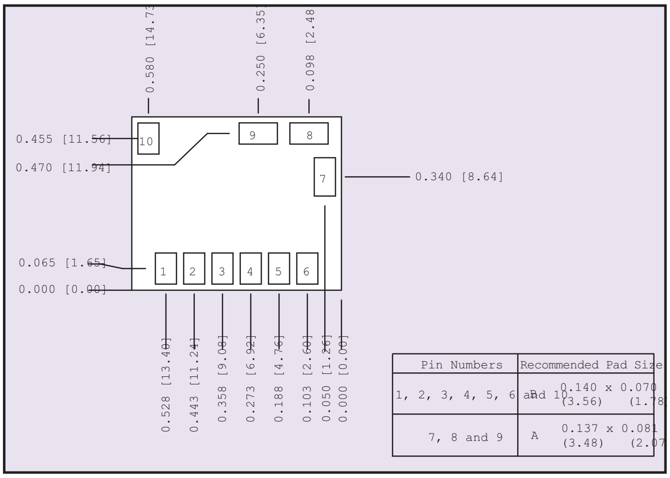
11.6 Pick and Place Information

The SMT12F is designed with certain features to ensure it is compatible with standard pick and place equipment.

- The low mass of typically 3 grams (0.105oz) is within the capability of standard pick and place equipment. The choice of nozzle size and style and placement speed may need to be optimized
- The inductor has a flat area of 59mm^2 (0.1in^2) that can be used as a pick-up area.

11.7 Water Washing

Where possible, a no-clean solder paste system should be used for solder attaching the SMT product onto application boards. The SMT is suitable for water washing applications, however, the user must ensure that the drying process is sufficient to remove all water from the con-



verter after washing - never power the converter unless it is fully dried. The user's process must clean the soldered assembly in accordance with ANSI/J-STD-001.

11.8 Inspection/Rework
Inspection and rework of the SMT12F is facilitated by the following:

- The pins of the SMT12F are positioned close to the edge of the unit to facilitate ease of visual inspection and touch-up.
- The unit is assembled with conventional solder and plating finish
- General SMT repair/rework guidelines apply to these units. In the unlikely event of a unit needing to be removed, this can easily be achieved by heating and removing one pin at a time using either hot air or a conductive iron, however care must be taken not to damage adjacent components. Surface mount units, which have been removed, are not suitable for re-use and should be replaced with a suitable new part. Normal warranty criteria will apply to the removed units.

A number of conventional techniques may be employed when replacing a unit in the application. A suitable volume of solder paste (as recommended above) is applied to the cleaned pads using either a precision dispenser or a suitable mini-stencil. Reflow is achieved using standard SMT rework techniques such as IR or techniques developed for BGA components.

11.9 Storage and MSL Packaging Requirements
These devices have a moisture sensitivity level 3 rating in line with IPC/JEDEC J-STD-020C Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State surface mount devices.

Product is packaged according to IPC/JEDEC J-STD-033A handling, packing, shipping and use of Moisture/Reflow Sensitive surface mount devices.

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