

SCDIRM-1

Input Regulator Module (IRM) Series

DC-DC CONVERTERS

Features

- Voltage Range
 - V_{IN} : 28V_{DC} or 70V_{DC} or 100V_{DC}
 - V_{OUT} : 26V_{DC} to 48.00V_{DC}
- High Efficiency (>90%)
- Up to 100W output
- Provide Enable/Disable Control
- Adaptive Loop Feedback
- Zero Voltage Switching / Zero Current Switching (ZVS/ZCS) Boost-Buck Regulator
- Contains Built-in Protection Features
 - Input Over/Under-voltage Shutdown
 - Short Circuit Protection
- Package: Gull Winged Power Package
- MIL-PRF-38534 Class L Qualification Pending
- Temperature Range: -40°C to +85°C (Lead Temperature)
- Total Dose: 50 krad(Si)
- SEL Immune: >80 MeV-cm²/mg
- Power conversion applications for standard power systems
- Modularity for low NRE and flexibility
- Small size for centralized or distributed power conversion architectures

General Description

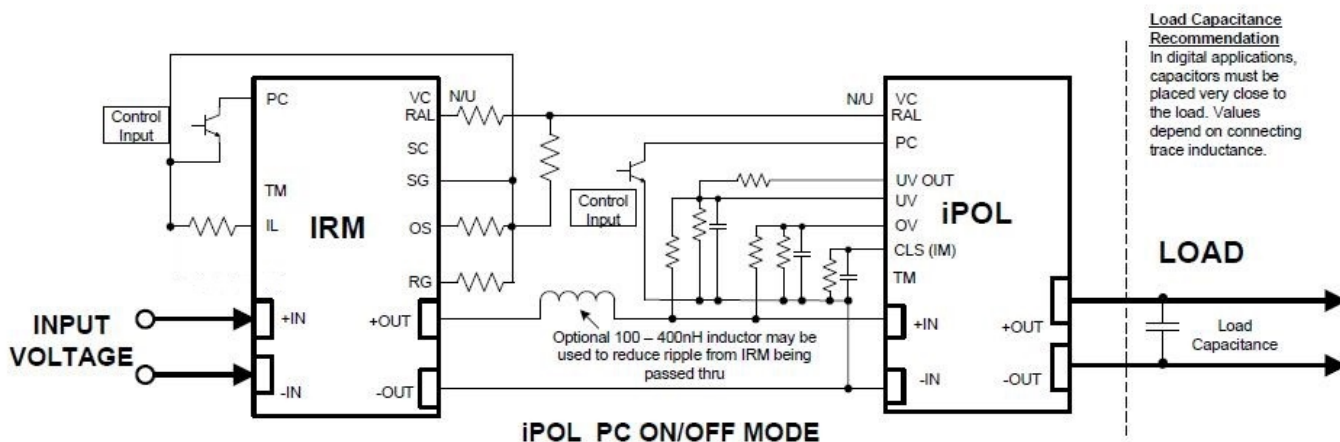
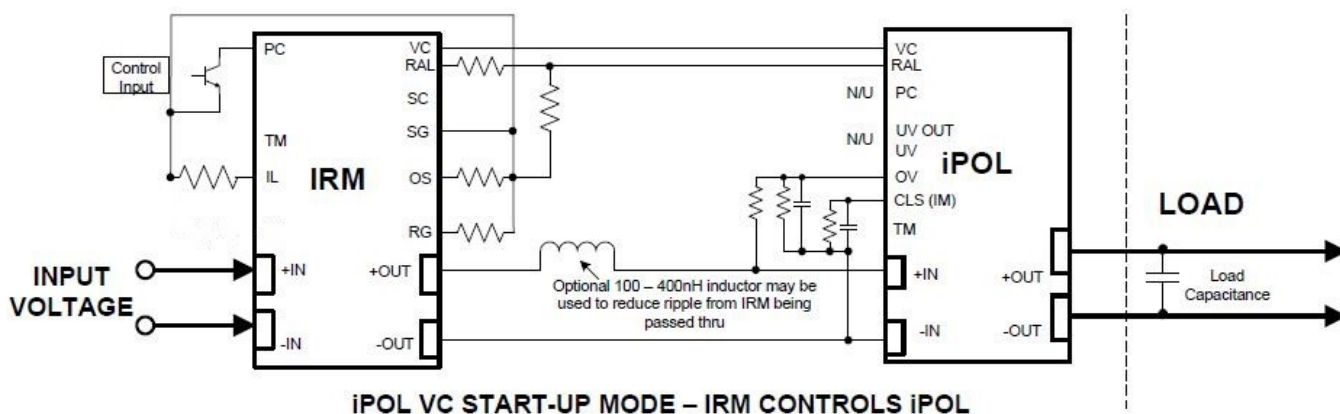
The CAES IRM Regulator is a very efficient non-isolated regulator capable of both boost and bucking a wide range input voltage and providing a regulated, adjustable output voltage.

The IRM can be used stand-alone as non-isolated voltage regulator with high efficiency and high power density, or it can be used in tandem with CAES' isolated Point Of Load (iPOL). In combination, IRMs and iPOLs form a complete DC-DC converter subsystem offering: high density and efficiency; low noise operation; architectural flexibility; extremely fast transient response; and elimination of bulk capacitance at the Point of Load.

SCDIRM-1

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DC-DC CONVERTERS



Load Capacitance Recommendation
In digital applications, capacitors must be placed very close to the load. Values depend on connecting trace inductance.

Figure 1: Typical Applications;
613xxx Modules Use VC Start-Up Mode;
612xxx Modules use either PC On/Off Mode or Self Start Mode (PC Pin Float, No connect VC Pin)

SCDIRM-1

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DC-DC CONVERTERS

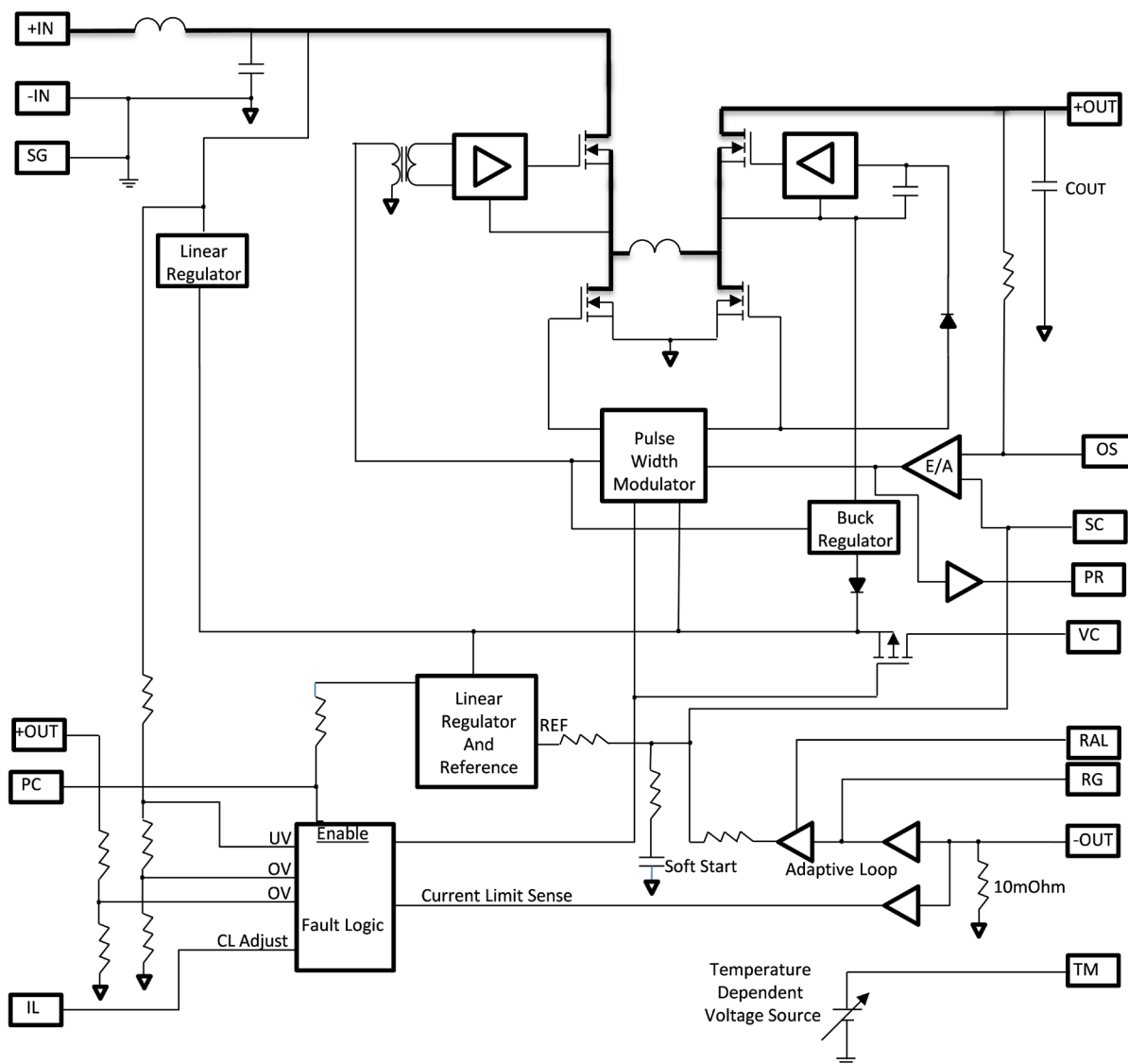


Figure 2: Detailed Block Diagram

Absolute Maximum Ratings

Parameter	Range	Units
Operating Case Temperature	-55 to +125	°C
Storage Case Temperature	-65 to +150	°C
Power Supply Voltages (V _{CC})	+7.0	V

Notice: Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress rating only; functional operation beyond the "Operation Conditions" is not recommended and extended exposure beyond the "Operation Conditions" may affect device reliability.

SCDIRM-1

Input Regulator Module (IRM) Series

DC-DC CONVERTERS

PINLIST

PIN NO.	SIGNAL	PIN NO.	SIGNAL
1	-VOUT	40	SG
2	-VOUT	39	SC
3	-VOUT	38	RAL
4	-VOUT	37	IL
5	-VOUT	36	RG
6	-VOUT	35	OS
7	+VOUT	34	PR
8	+VOUT	33	PC ²
9	+VOUT	32	VC
10	+VOUT	31	TM
11	+VOUT	30	NOT USED ²
12	+VOUT	29	GND (-VIN)
13	+VOUT	28	GND (-VIN)
14	+VOUT	27	GND (-VIN)
15	+VOUT	26	GND (-VIN)
16	+VOUT	25	+VIN ¹
17	GND (-VIN)	24	+VIN
18	GND (-VIN)	23	+V N
19	GND (-VIN)	22	+VIN
20	GND (-VIN)	21	+VIN

Note 1: Pin 25 not populated for 621070 and 621100 Modules

Note 2: For 621028 Pin 30 provides low off state input current when grounded. Pin 33 must also be grounded to achieve this capability. (Sleep Mode Control)

SCDIRM-1

Input Regulator Module (IRM) Series

DC-DC CONVERTERS

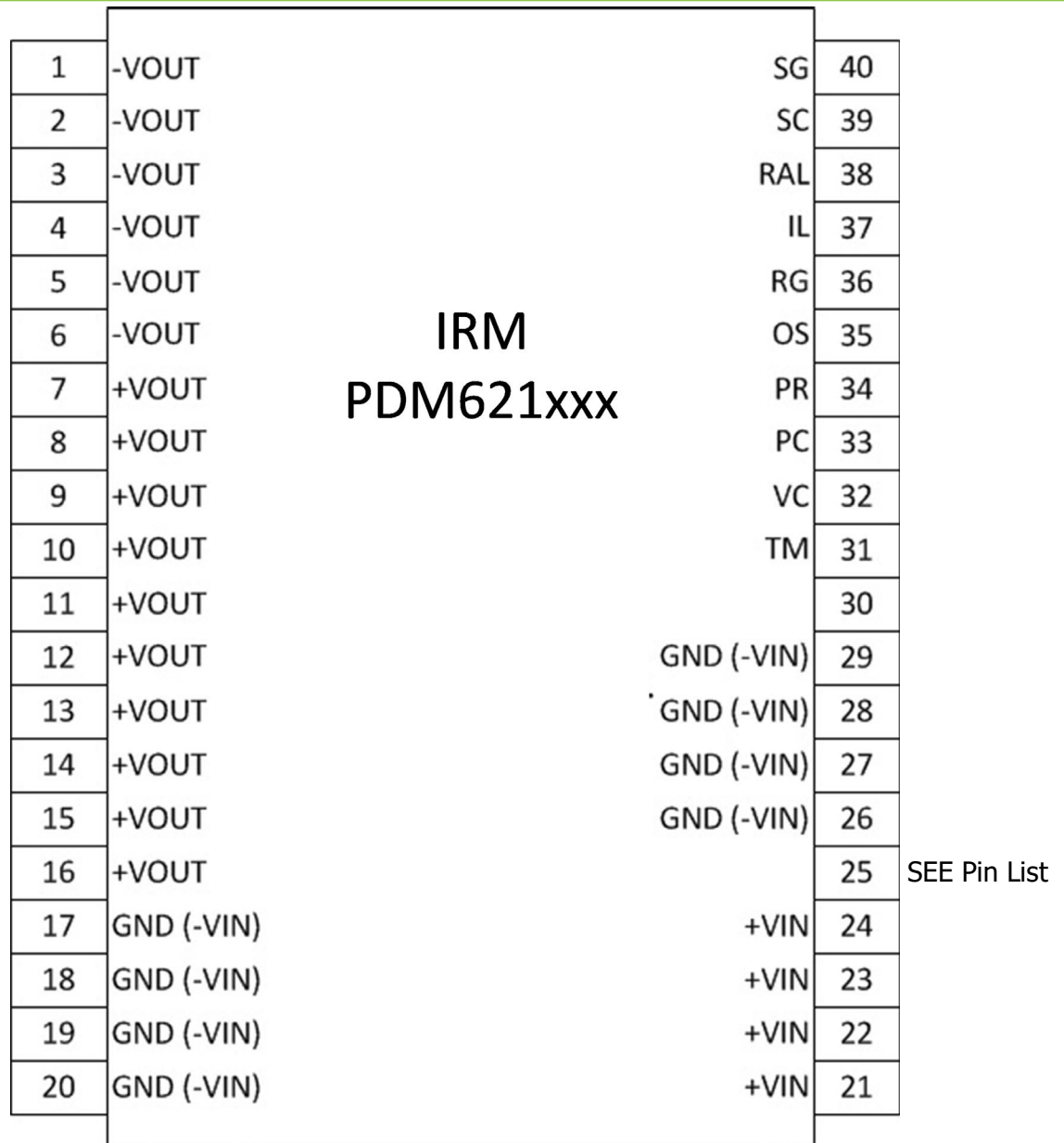


Figure 3: Package Pinout Diagram for 621xxx IRMs

SCDIRM-1

Input Regulator Module (IRM) Series

DC-DC CONVERTERS

FUNCTIONAL DESCRIPTION**+VIN / -VIN VOLTAGE**

The IRM's maximum input voltage should not be exceeded. IRMs have internal over / under-voltage lockout functions that prevent operation outside of the specified input range. IRMs will turn on when the input voltage rises above its under-voltage lockout. If the input voltage exceeds the overvoltage lockout, IRMs will shut down until the overvoltage fault clears. PC will switch Low indicating an out of bounds condition.

+VOUT / -VOUT FACTORIZED VOLTAGE OUTPUT

These pins provide the Factorized Bus voltage output. The -Out pin is connected internally to the -IN pin through a current sense resistor. The IRM has a maximum power and a maximum current rating and is protected if either rating is exceeded. Do not short -OUT to -IN.

PC - PRIMARY CONTROL

The IRM voltage output is enabled when the PC pin is open circuit (floating). To disable the IRM output voltage, the PC pin is pulled low. Open collector optocouplers, transistors, or relays can be used to control the PC pin. When using multiple IRMs in a high power array, the PC pins should be tied together to synchronize their turn on. During an abnormal condition the PC pin will pulse as the IRM initiates a restart cycle. This will continue until the abnormal condition is rectified. The PC should not be used as an auxiliary voltage supply, nor should it be switched at a rate greater than 1 Hz.

TM

This function provides the internal temperature of the module at 10°C typical with respect to SG. This value is typically 2V at 27°C.

SG - SIGNAL GROUND

This pin provides a low inductance Kelvin connection to -VIN and should be used as reference for the OS, RG, SC, TM, RAL and IL pins.

RAL

Provides adaptive Temperature Compensation of the iPOL module. See application note ANPDM100 for details of how to connect this pin to a single iPOL in order to provide adaptive loop temperature compensation. This Pin is internally terminated with a 15.8K ohm resistor to SG.

RG - COMPENSATION DEVICE

Adaptive Loop control is configured by connecting an external resistor between the RG and SG pins. For no adaptive compensation connect RG directly to SG. See application note ANPDM100 for calculating the value of Rg.

IL - CURRENT LIMIT ADJUST

The IRM has a preset maximum current limit set point. The IL pin may be used to reduce the current limit set point to a lower value.

I Limit (Amps)	621028 ¹ R _{IL}	621070, 621100 ² R _{IL}
1.25	1.96K	3.57K
1.50	2.32K	4.32K
1.75	2.74K	5.36K
2.0	3.24K	6.65K
2.25	3.83K	8.66K
2.50	4.53K	11.5K
2.75	5.49K	16.5K
3.0	6.65K	26.1K
3.25	8.25K	54.9K
3.50	10.50K	--
3.75	14.30K	--
4.0	20.50K	--
4.25	35.70K	--
4.50	100.0K	--

Note 1: Accuracy ± 6% of full scale

Note 2: Accuracy of ± 9.2% of full scale

OS - OUTPUT SET (Ros)

The output voltage is set by connecting a resistor between OS and SG pins. Use the following equation for calculating the value of Ros.

$$OS\ RES = \left(\frac{102K}{VO - 1.093} \right) 1.093$$

VC – iPOL Start-Up

The IRM provides the VC pin as an output to provide start-up power to up to two iPOLs. The VC pin of the IRM should be connected to the VC pin of the iPOL. The iPOL output will rise by the proportionally with the IRM output. This Pin is internally terminated with a 1K ohm resistor to (-VIN). This pin should be left floating.

PR – Power Reference

The PR pin puts out a voltage that is proportional to the output power of the IRM. This pin is internally terminated with a 3.9K ohm resistor to SG. This pin should be left floating.

SC – IRM Reference

The SC pin is internally connected to the IRM control loop reference. This pin should be left floating.

SCDIRM-1

Input Regulator Module (IRM) Series

DC-DC CONVERTERS

ABSOLUTE MAXIMUM RATINGS^{1, 2}

Table 1: Absolute Maximum Ratings

SYMBOL	PARAMETER	MIN	MAX	UNITS
--	+V _{IN} to -V _{in} 621028	-1.0	60.0	V _{DC}
--	+V _{IN} to -V _{in} 621070	-1.0	125.0	V _{DC}
--	+V _{IN} to -V _{in} 621100	-1.0	125.0	V _{DC}
--	PC to -IN	-0.3	3.6	V _{DC}
--	IL to -IN	-0.3	3.6	V _{DC}
--	VC to -IN	-0.3	8.5	V _{DC}
--	+OUT to -OUT	-0.3	60	V _{DC}
--	SC to OUT	-0.3	3.3	V _{DC}
--	OS to -OUT	-0.3	3.3	V _{DC}
--	RG to -OUT	-0.3	3.3	V _{DC}
T _J	Junction Temperature	-40	+125	°C
θ _{JC}	Thermal resistance, junction-to-case	--	2.1	°C/W
T _{STG}	Storage Temperature	-55	+125	°C

NOTE:

- Stresses outside the listed absolute maximum ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions beyond limits indicated in the operational sections of this specification are not recommended. Exposure to absolute maximum rating conditions for extended periods may affect device reliability and performance.
- All voltages referenced to -IN

OPERATIONAL ENVIRONMENT⁽¹⁾

Table 2: Operational Environment

SYMBOL	PARAMETER	LIMIT	UNITS
TID	Total Ionizing Dose ⁽²⁾	50	krad(Si)
SEL	Single Event Latchup Immunity ⁽³⁾	>80	MeV-cm ² /mg

NOTE:

- For devices with procured with a total ionizing dose tolerance guarantee, post-irradiation performance is guaranteed at 25°C per MIL-STD-883 Method 1019, Condition A up to maximum TID level procured.
- Per MIL-STD-883, method 1019, condition A (*Optional: Per MIL-STD-883, method 1019.9, condition A, with extended room temperature anneal per section 3.11.2*)
- SEL is performed at component level at 125°C

RECOMMENDED OPERATING CONDITIONS⁽¹⁾

Table 3: Recommended Operating Conditions

SYMBOL	PARAMETER	MIN	MAX	UNITS
T _L ⁽²⁾	Case Operating Temperature Range	-40	+85	°C
V _{IN}	Positive Supply Voltage 621028	+22	+36	V _{DC}
V _{IN}	Positive Supply Voltage 621070	+65	+75	V _{DC}
V _{IN}	Positive Supply Voltage 621100	+95	+105	V _{DC}

NOTE:

- All voltages referenced to (-V_{IN})

SCDIRM-1

Input Regulator Module (IRM) Series

DC-DC CONVERTERS

DC ELECTRICAL CHARACTERISTICS⁽¹⁾

Table 4: DC Electrical Characteristics⁽²⁾

SYMBOL	PARAMETER	CONDITONS	MIN	TYP	MAX	UNITS
INPUT PARAMETERS						
dV_{IN} / dt	Input		--	--	1	V / us
V_{IN_UVTON}	Input under-voltage turn-on 621028		19.5	--	21.5	V_{DC}
	621070		53.0	--	65.0	V_{DC}
	621100		80.7	--	90.0	V_{DC}
V_{IN_UVTOFF}	Input under-voltage turn-off 621028		18.8	--	21.8	V_{DC}
	621070		54.0	--	64.0	V_{DC}
	621100		80.0	--	84.0	V_{DC}
V_{IN_OVTOFF}	Input Over-voltage turn-off 621028		38.0	--	45.0	V_{DC}
	621070		76.0	--	90.0	V_{DC}
	621100		111.0	--	116.0	V_{DC}
V_{IN_OVTON}	Input Over-voltage turn-on 621028		37.0	--	43.0	V_{DC}
	621070		71.5	--	86.0	V_{DC}
	621100		106.0	--	111.0	V_{DC}
I_{N_Q}	Input Quiescent Current	PC Low, SLEEP Open	--	13.0	18.0	mA
		PC Low, SLEEP Low (621028)	--	--	1.6	mA
I_{IN}	Input Current 621028	V_{IN} 28V, No Load	--	--	225	mA
		V_{IN} 70V, No Load	--	--	60.0	mA
		V_{IN} 100V, No Load	--	--	60.0	mA
I_{IN_RIP}	Input reflected ripple current 621028	V_{IN} 22V, 100W Load	--	360	--	mAp-p
		V_{IN} 70V, 75W Load	--	190	--	mAp-p
		V_{IN} 100V, 75W Load	--	130	--	mAp-p
V_{PC}	DC Voltage		--	--	3.9	V_{DC}
V_{PC_EN}	Module Enable Voltage		1.19	1.25	1.31	V_{DC}
	Disable Hysteresis		--	100	140	mV V_{DC}
SLEEP	SLEEP MODE Control					
	DC Voltage (621028)	SLEEP pin floating	--	14.0	20.0	V_{DC}
	DC Voltage (621070, 621100)	SLEEP pin floating	--	56	62	V_{DC}
	Source Current (621028, 621100)		--	--	1.0	mA
VOUT	Output Set Point Accuracy	Includes 0.1% tolerance of R_{OS} Resistor	--	--	1.0	%
VOUT_AL	Adaptive Loop Accuracy ⁽³⁾	From no load to full load including 0.1% tolerance of R_G Resistor	--	--	0.3	%

NOTE 1: All voltages referenced to (- V_{IN})

NOTE 2: Specifications apply over all line and load conditions over the temperature range of $-40^{\circ}C < T_J > 125^{\circ}C$ unless otherwise noted.

NOTE 3: Calculated not measured.

SCDIRM-1

Input Regulator Module (IRM) Series

DC-DC CONVERTERS

Table 6: DC Electrical Characteristics^(1,2)

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
OUTPUT PARAMETERS						
V _{OUT}	Output Voltage Range	V _{OUT} set by R _{OS}	--	--	--	--
		621028, 621100	26	--	48	V _{DC}
		621070	36	40	44	V _{DC}
P _{OUT}	Output Power	621028	--	--	100	W
		621070, 621100	--	--	75	W
I _{OUT}	Output Current	621028	--	--	3.85	A _{DC}
		621070, V _O = 40V	--	--	1.88	A _{DC}
		621100	--	--	2.9	A _{DC}
I _{OUT_CL}	DC Current Limit	621028	4.3	4.8	5.3	A _{DC}
		621070, V _O = 40V	2.1	2.34	2.58	A _{DC}
		621100	3.25	3.58	4.02	A _{DC}
V _{OUT-ST}	Output Voltage Stability	With 25ppm R _{OS} with mounting pin temperature of -40°C to 85°C	--	--	±1.5	%
ΔV _O / ΔV _I	Line Regulation	Low Line to High Line	--	0.1	0.2	%
ΔV _O / ΔI _L	Load Regulation	No Load to full load with mounting pin temperature of -40°C to 85°C	--	0.1	0.2	%
η	Efficiency 621028	V _{IN} = 28V / 26V _{OUT} Full Load V _{IN} = 28V / 40V _{OUT} Full Load	92 91.5	--	--	%
	Efficiency 621070	V _{IN} = 70V / 40V _{OUT} Full Load	91.8	--	--	%
	Efficiency 621100	V _{IN} = 100V / 26V _{OUT} Full Load V _{IN} = 100V / 48V _{OUT} Full Load V _{IN} = 100V / 40V _{OUT} 40W Load	88.25 90.0 85.6	--	--	%
V _{OUT - PP}	Output Ripple Voltage 621028	Full Load 100W	--	--	6	%
	621070	Full Load 75W	--	--	3.5	%
	621100	Full Load 75W	--	--	3.5	%
F _{SW}	Switching Frequency	621028	0.73	0.80	0.87	MHz
		621070	0.50	0.55	0.60	MHz
		621100	0.60	0.65	0.70	MHz
T _M	Temperature Monitor	27°C	--	2.0	--	V
	Gain		--	10	--	10mV/°C
T _{ON}	Output Turn-on					
	From application of power	PC Pin Floating	--	--	300	mSec
	From PC pin low to high	V _{IN} Pre-Applied	--	--	1200	μs
C _{LOAD}	Load Capacitance					
	1 iPOL Load	--	--	--	1.5	μF
	2 iPOL Loads	--	--	--	0.75	
	3 iPOL Loads	--	--	--	0.1	

NOTE:

1. All voltages referenced to (-V_{IN})
2. Specifications apply over all line and load conditions over the temperature range of -40°C < T_J > 125°C unless otherwise noted.

SCDIRM-1

Input Regulator Module (IRM) Series

DC-DC CONVERTERS

Figure 4: Typical Efficiency of 621028 vs. Output Power at 40V Out / 28V In

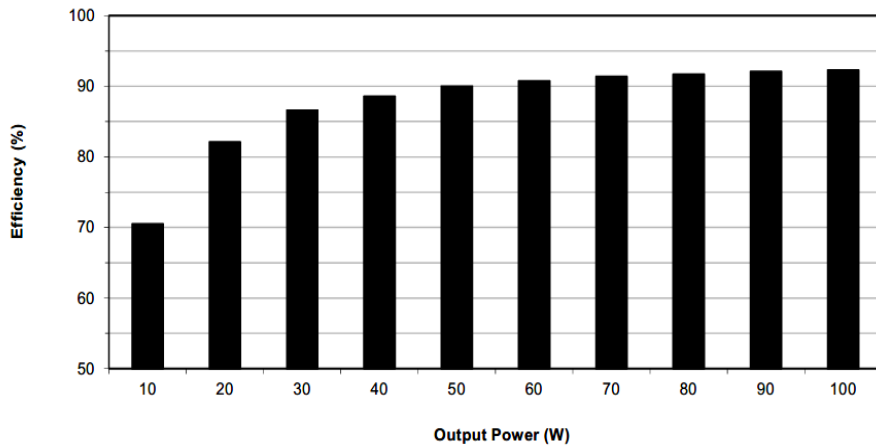


Figure 5: Typical Efficiency of 621070 vs. Output Power at 40V Out / 70V In

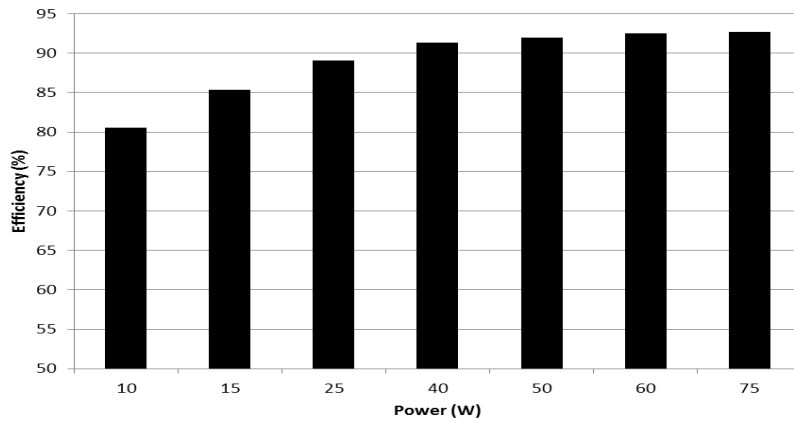
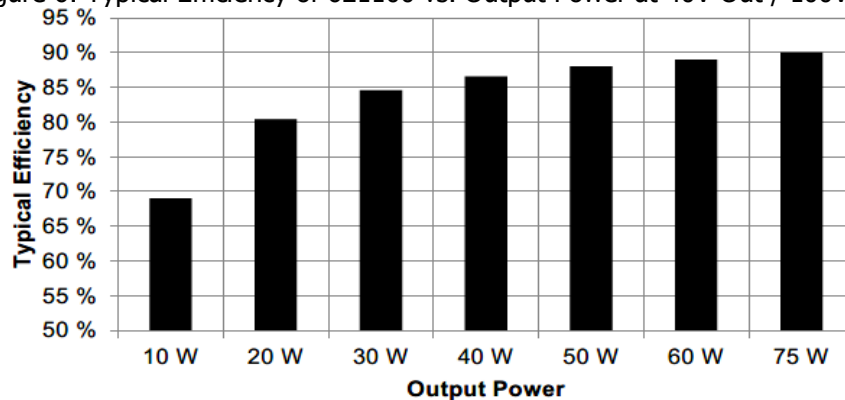


Figure 6: Typical Efficiency of 621100 vs. Output Power at 40V Out / 100V In

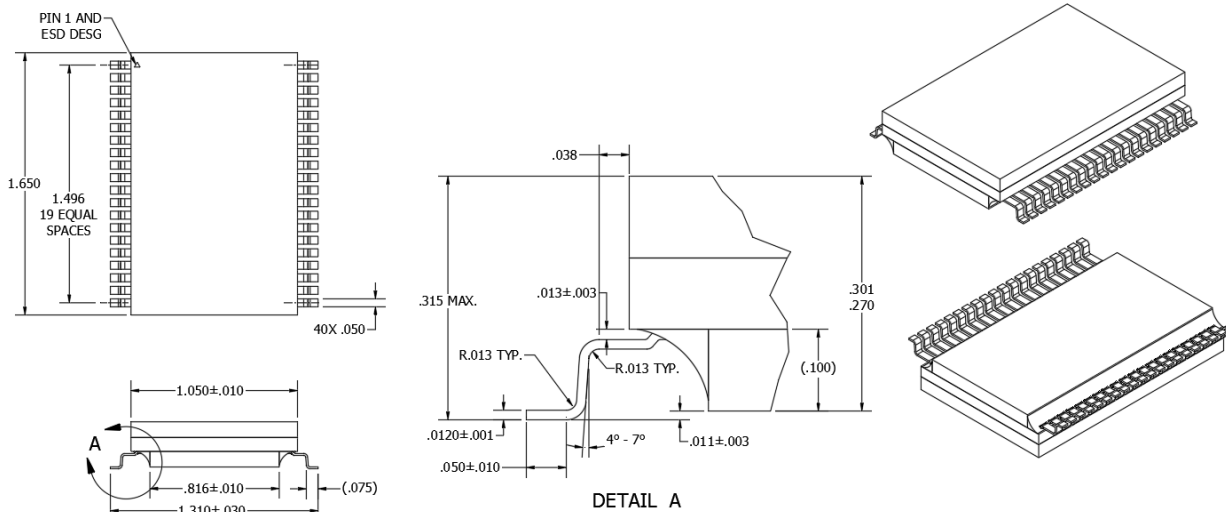


SCDIRM-1

Input Regulator Module (IRM) Series

DC-DC CONVERTERS

PACKAGE DRAWINGS



Dimensions in inches.
Tolerances ±.005 unless otherwise noted.

Figure 7: Package Drawing for 621028 Modules

Lead Material and Plating: Lead material is Copper, UNS No. C10100 IAW ASTM-B152/B512M. Temper is H02-Half Hard. Plating is Gold Plated, 5-10 micro-inches IAW MIL-DTL-45204, Type I, Grade A, Class 1, over Electrolytic Nickel plated 200-350 micro-inches in accordance with AMS-QQ-P290, Class 1, Grade G. Final finish is Sn60/Pb40.

SYM	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
L	Length	-	-	-	1.655 [42.037]	in [mm]
W	Width	-	-	-	1.060 [26.924]	in [mm]
H	Height	-	-	-	0.315 [8.001]	in [mm]
Wt	Weight	-	-	-	27	g
-	Soldering tip dwell time per single pin	Tip temperature 600°F Assembly pre-heated to 125°F	-	-	6	Sec

CONVERSION	
INCH	MM
0.001	0.025
0.003	0.076
0.005	0.127
0.010	0.254
0.011	0.279
0.012	0.305
0.013	0.330
0.030	0.762
0.038	0.965
0.050	1.270
0.075	1.905
0.100	2.540
0.270	6.858
0.301	7.645
0.315	8.001
0.816	20.726
1.050	26.670
1.310	33.274
1.496	37.998
1.650	41.910

SCDIRM-1

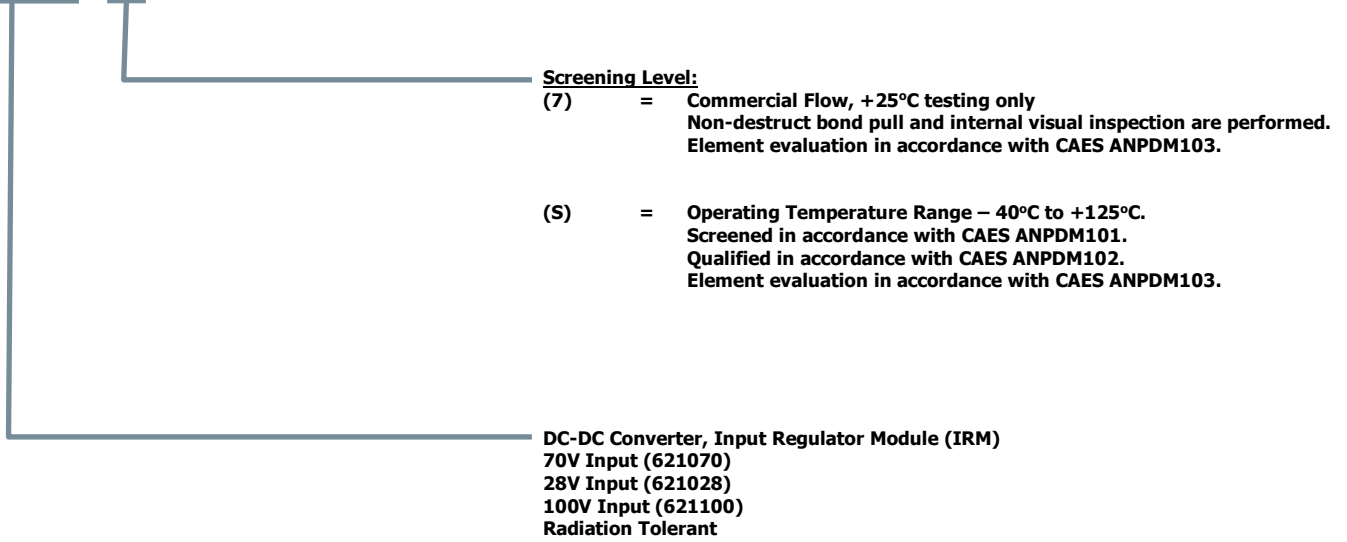
Input Regulator Module (IRM) Series

DC-DC CONVERTERS

Ordering Information

Generic Datasheet Part Numbering

PDM621xxx - *



Revision History

Date	Rev. #	Change Description	Initials
03/13/2017	A	INITIAL RELEASE	CL
03/12/2021	B	REVISED PER ECN 23557	CL

SCDIRM-1

Input Regulator Module (IRM) Series

DC-DC CONVERTERS

Datasheet Definitions

	DEFINITION
Advanced Datasheet	CAES reserves the right to make changes to any products and services described herein at any time without notice. The product is still in the development stage and the datasheet is subject to change . Specifications can be TBD and the part package and pinout are not final .
Preliminary Datasheet	CAES reserves the right to make changes to any products and services described herein at any time without notice. The product is in the characterization stage and prototypes are available.
Datasheet	Product is in production and any changes to the product and services described herein will follow a formal customer notification process for form, fit or function changes.

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